Site Preparation and Installation

August 1998
U.S. Manual PN: 10P56990201
A-4 Size Manual PN: 10P56990211
Please give us your feedback to help improve this manual.

1. Do you actually use this manual when you are:
   - configuring
   - making changes or enhancements
   - operating the system
   - troubleshooting
   - other ______________

<table>
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<th>Rarely</th>
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2. Does this manual answer your questions? ______ ______ ______ ______ ______

3. What could be changed in this manual to make it more useful?

Errors and Problems: Please note errors or problems in this manual, including chapter and page number, if applicable; or send a marked-up copy of the affected page(s).

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Fisher-Rosemount FAX #: (512) 834-7200  Thank you!
The Site Preparation and Installation Manual is intended to assist in the preliminary planning for a RS3 installation and to supply detailed information on hardware installation. Only equipment in current production for new orders is included. Information about earlier equipment can be found in previous versions of this document.

Details about equipment, such as size and general cabling, is at the front of each section.

**NOTE:** If any RS3 system, or any equipment therein, is used in a manner not specified by the manufacturer, the protection provided by the system and the equipment therein may be impaired.

**Changes for This Release**

The manual has been revised, reorganized, and extended to cover new equipment.

- Numerous corrections and minor revisions have been made throughout the manual.
- Information on the RS3 Millennium Package (RMP), the System Power Supply Unit, and the MPC5 Controller Processor with the 4 Meg NV Memory has been integrated into the manual. Information on the MAI16 along with the Loop Power Module has also been added.

**Revision Level for This Manual**

This manual should be used to plan hardware installation for all versions of the software.

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NOTE: The “x” in the part number is 0 for U.S. size (8-1/2 x 11 inch) or 1 for A-4 size manuals.
References to Other Manuals

References to other RS3 user manuals list the manual, chapter, and sometimes the section as shown below.

Sample Entries:
For ..., see CC: 3. For ..., see CC: 1-1.

Manual Title Chapter Manual Title Chapter-Section

Abbreviations of Manual Titles
- AL = Alarm Messages
- BA = ABC Batch
- CB = Control Block Configuration
- CC = Console Configuration
- DT = Disk and Tape Functions
- IO = I/O Block Configuration
- OP = Operator’s Guide
- OV = System Overview and Glossary
- PW = PeerWay Interfaces
- RB = Rosemount Basic Language
- RI = RNI Installation Guide
- RR = RNI Release Notes
- SP = Site Preparation and Installation
- SV = Service
Reference Documents

Prerequisite Documents

You should be familiar with the information in the following documents before using this manual:

System Overview Manual and Glossary 1984-2640-21x0

Related Documents

You may find the following documents helpful when using this manual:

ABC Batch Software Manual 1984-2654-21x0
Alarm Messages Manual 1984-2657-19x1
ABC Batch Quick Reference Guide 1984-2818-1103
Configuration Quick Reference Guide 1984-2812-0808
Console Configuration Manual 1984-2643-21x0
ControlBlock Configuration Manual 1984-2646-21x0
I/O Block Configuration Manual 1984-2645-21x0
Operator’s Guide 1984-2647-19x1
PeerWay Interfaces Manual 1984-2650-21x0
Rosemount Basic Language Manual 1984-2653-21x0
RNI Programmer’s Reference Manual 1984-3356-03x1
RNI Release Notes 10P574830x1
RNI Installation Guide 1984-3357-02x5
Service Manual, Volume 1 10P569802x1
Service Manual, Volume 2 10P569802x2
Service Quick Reference Guide 10P57000201
Software Discrepancies for Performance Series 1 10P56870304
Software Loading and Upgrade Procedure, Including Batch, Performance Series 1 10P56870206
Software Release Notes, Performance Series 1 10P56870106
User Manual Master Index 1984-2641-21x0

NOTE: The “x” in the part number is 0 for U.S. size (8-1/2 x 11 inch) and 1 to 9 for A-4 size manuals.
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Section 1: Environmental Considerations

The RS3 distributed control system (DCS) does not require a clean-room environment. However, equipment can be damaged if subjected to atmospheric contaminants that form acids upon condensation. Particulate material (dust) can short circuit electrical components, restrict cooling air flow by clogging filters, and damage mechanical components such as disk and tape drives and their magnetic media.

The RS3 distributed control system is designed for indoor use.

This section provides information you can use to understand, measure, and control your plant environment. A proper environment promotes reliable operation of your process control system, whereas a poor environment can greatly limit the reliable performance and overall service-life of the system.

The importance of considering the site environment cannot be understated. Whether installing a new system in a new plant, a new system in an existing plant, or expanding an existing system, environmental conditions must be considered, both in the immediate area and in surrounding areas.

For example, a system may be located in a geographic area where temperature and humidity are naturally high. Or, the process may add heat or humidity, contaminants in the form of dust such as fly-ash from a boiler, or corrosive vapors such as hydrogen sulfide (H₂S). Obviously, areas with these environment conditions can affect the operation of electronic equipment. Temperature, humidity, dust (including carbon), and corrosive vapors can cause gradual performance degradation, intermittent failures, and malfunctions.

To ensure maximum system efficiency and reliability, the environment in which the system is installed must not have a detrimental effect on system operation. Therefore, all environmental conditions must be accounted for in installation planning. Once the conditions are identified, environmental control equipment is designed to maintain proper environmental operating conditions within the range of the most limited instrument.

For example, Multipoint I/O equipment is designed to operate reliably in certain moderately corrosive environments. However, if a mainframe computer that normally has more stringent environmental control requirements is also installed in the area, then environmental control must be upgraded to protect the computer.
Therefore, installation planning requires both atmospheric environment identification and the best method to protect system equipment. Methods may have to encompass the total process area, the control room only, or even individual equipment enclosures. If, for example, I/O equipment and terminations will be located in a rack-room where the atmosphere will be hostile to them, the room atmosphere must be controlled. If the same instruments will be located on a plant floor with a hostile environment, protecting cabinets are required.

**Optimum Equipment Reliability**

For optimum equipment reliability and operation, environmental control systems must maintain the ambient temperature, relative humidity, and hourly variations of these, within normal operating limits.

When solid-state electronic equipment is operated within the specified temperature and humidity limits, normal reliability based on Mean Time Between Failure (MTBF) calculations can be expected. As equipment is operated in continuously higher temperatures, the failure rate increases. As a rule of thumb, the equipment failure rate can be expected to double for every 10°C temperature increase above reference limits that occurs in the environment where the equipment is located.

The equipment is designed to operate in the following environments (as defined by standards published in IEC 1010-1):

- System level overvoltage classification: Installation Category II
- Pollution degree 2
- Altitude limit 2000 meters (6560 feet)

Table 1.1.1 lists the temperature and humidity operating ranges for RS3 equipment.
### Table 1.1.1. RS3 Equipment Temperature and Humidity Operating Ranges

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Storage Environment</th>
<th>Operating Environment</th>
<th>Temperature</th>
<th>Humidity *</th>
<th>Temperature</th>
<th>Temperature Change</th>
<th>Humidity *</th>
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<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>Console Electronics</td>
<td>-40 to 70° C (-40 to 158° F)</td>
<td>5 to 95%</td>
<td>10 to 40° C (50 to 104° F)</td>
<td>1.0° C/min. (1.8° F/min.)</td>
<td>20 to 80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Cabinet Components</td>
<td>-40 to 70° C (-40 to 158° F)</td>
<td>5 to 95%</td>
<td>0 to 50° C (32 to 122° F)</td>
<td>0.5° C/min. (0.9° F/min.)</td>
<td>0 to 90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardened Command Console</td>
<td>-40 to 70° C (-40 to 158° F)</td>
<td>5 to 95%</td>
<td>10 to 52° C (50 to 125° F)</td>
<td>1.0° C/min. (1.8° F/min.)</td>
<td>0 to 90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multipoint I/O Components</td>
<td>-40 to 85° C (-40 to 185° F)</td>
<td>5 to 95%</td>
<td>-25 to 70° C (-13 to 158° F)</td>
<td>1.0° C/min. (1.8° F/min.)</td>
<td>5 to 90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Power Supply Units</td>
<td>-55 to 85° C (-67 to 185° F)</td>
<td>5 to 95%</td>
<td>0 to 70° C (32 to 158° F)</td>
<td>N/A</td>
<td>5 to 95%</td>
<td></td>
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* Noncondensing

### Controlling Relative Humidity

One item that requires special emphasis concerns control of relative humidity. When corrosive vapors are contained in the atmosphere, average relative humidity must be kept below 50% to prevent the possibility of condensation.

**CAUTION**

Preventing condensation is extremely important. Corrosive vapors dissolving in condensation turn into acids that begin to erode conductive lands, component leads, connector pins, and other metal on electronic equipment. The equipment can become damaged beyond repair.
Corrosive Environment Effects

Corrosive vapors are air-born contaminants, and as such, can significantly increase the rate of instrument failures. In severe cases, a corrosive environment can reduce an entire control system to a non-repairable state in less than one year. Perhaps more critically, such an environment can cause loss of accurate process control capability in less than thirty days.

The following tables classify corrosive environments in terms of copper reactivity rates in the presence of reactive sulfides, and also identify the contaminant levels that cause these reactivity rates. Table 1.1.2 shows these rates in angstroms of film formation on a copper sample after a 30-day exposure.

The Class G1 through GX ratings used in the tables are taken from Instrument Society of America (ISA) Standard S71.04, *Environmental Conditions for Process Measurement and Control Systems: Air-Born Contaminants*. The standard contains rating definitions and application information. We use this standard as a guide for product design and environmental measurement.

Information in Table 1.1.2 is based on copper reactivity in which the air-born contaminant is reactive sulfides. It is in Angstroms of film formation per 30 day exposure. The information does not take into account the synergistic effect of other contaminates such as chlorides. Usually when chlorides are added to sulfides, especially in the presence of high humidity, the combination causes copper reactivity to be worse than the actual visual indication.

<table>
<thead>
<tr>
<th>Mild Class G1</th>
<th>Moderate Class G2</th>
<th>Harsh Class G3</th>
<th>Special Class GX</th>
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<tbody>
<tr>
<td>Less than 300</td>
<td>Less than 1000</td>
<td>Less than 2000</td>
<td>Greater than 2000</td>
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Table 1.1.3 lists the gas concentration levels for reference purposes. They approximate the copper reactivity levels listed in Table 1.1.2 if the relative humidity is less than 50 percent. For a given gas concentration, the severity level increases by one level for each 10 percent increase in relative humidity above 50 percent, and also increases by at least one level for a relative humidity rate of change greater than 6 percent per hour.

Table 1.1.3. Classification of Chemically Active Contaminants in cm³/m³ (ppm)

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<tr>
<td>Sulphur Dioxide (SO₂)</td>
<td>≤0.01</td>
<td>≤0.1</td>
<td>≤0.3</td>
<td>&gt;0.3</td>
</tr>
<tr>
<td>Chlorine (Cl₂) (Relative Humidity @ 50%)</td>
<td>≤0.001</td>
<td>≤0.002</td>
<td>≤0.01</td>
<td>&gt;0.01</td>
</tr>
<tr>
<td>Hydrogen Fluoride (HF)</td>
<td>≤0.001</td>
<td>≤0.002</td>
<td>≤0.01</td>
<td>&gt;0.01</td>
</tr>
<tr>
<td>Ammonia (NH₃)</td>
<td>≤0.5</td>
<td>≤10</td>
<td>≤25</td>
<td>&gt;25</td>
</tr>
<tr>
<td>Nitrogen Oxides (NOₓ)</td>
<td>≤0.05</td>
<td>≤0.125</td>
<td>≤1.25</td>
<td>&gt;1.25</td>
</tr>
<tr>
<td>Ozone (O₃)</td>
<td>≤0.002</td>
<td>≤0.025</td>
<td>≤0.1</td>
<td>&gt;0.1</td>
</tr>
</tbody>
</table>
Use of Reactivity Coupons

To obtain a better indication of the combined effects of sulfides and chlorides, copper and silver reactivity is measured. The available reactivity coupons contain a copper and a silver strip to give an accurate indication of the potential for equipment corrosion at a plant site. The coupons should be placed in the areas of highest exposure, which is usually in the air stream cooling the equipment.

**CAUTION**

Damage by corrosive atmospheres occurs to most instrumentation systems during initial installation and during maintenance shut-downs. If the system is stored in a harsh environment or exposed when the environmental control system is not operational, damage will occur.

We recommend measuring the plant site environment with reactivity coupons and then properly preparing the site for adequate environment control before the instrument system is received. Such precaution can prevent early instrument failure.

A general idea of the environment at your plant site can be determined by observing exposed copper, such as power bus bars around switch gear and the trimmed ends of copper power wires. Table 1.1.4 provides guidelines for determining the harshness of the site environment.

**Table 1.1.4. Guidelines for Environmental Characterization by Visual Changes in Copper**

<table>
<thead>
<tr>
<th>Color of Exposed Copper</th>
<th>Corrosion Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>No visible change</td>
<td>Class G1 (Mild)</td>
</tr>
<tr>
<td>Light gold-brown in 4 to 6 months, gold-brown in 12 months,</td>
<td>Class G2 (Moderate)</td>
</tr>
<tr>
<td>or slow change over a longer period</td>
<td></td>
</tr>
<tr>
<td>Blue or black in any time period (1)</td>
<td>Class G3 (Harsh) or</td>
</tr>
<tr>
<td></td>
<td>Class GX (Special)</td>
</tr>
<tr>
<td>Flaking film in 3 to 6 months</td>
<td>Class G3 (Harsh)</td>
</tr>
</tbody>
</table>

(1) If copper turns black in about three weeks, the atmosphere is extremely harsh to electronic components. Users should attempt to lower the corrosive level or move the equipment to another location.
Humidity Effects on Reactivity Coupons

The presence or absence of free moisture may attenuate or accelerate copper or silver reactivity. For instance, when relative humidity is low, reactivity is slowed. Alternately, when relative humidity is high, reactivity speeds up. Both conditions can lead to misinterpretation of the atmosphere. The slow rate can provide a false sense that a minor problem exists; while a fast rate can do the opposite.

A way exists to minimize misinterpretation. By comparing the sulfide film formations on the silver and copper coupons, the attenuation or acceleration effects of humidity can be understood. Table 1.1.5 describes the meaning of the ratios between sulfide film formations on silver and copper coupons.

<table>
<thead>
<tr>
<th>Ratio of Silver Sulfide (Ag$_2$S) to Copper Sulfide (CuS)</th>
<th>Humidity Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag$_2$S $\geq$ 1.5 CuS</td>
<td>Indicates low relative humidity</td>
</tr>
<tr>
<td>Ag$_2$S $&gt;$ 0.5 $&lt;$ 1.5 CuS</td>
<td>Indicates humidity has little effect</td>
</tr>
<tr>
<td>Ag$_2$S $\leq$ 0.5 CuS</td>
<td>Indicates high relative humidity</td>
</tr>
</tbody>
</table>

When low relative humidity is indicated, very little moisture condensed onto the coupons either because the atmosphere inherently contained little moisture or the moisture was well controlled. The low humidity may have caused the copper sulfide film formation to have been attenuated. Additional testing of the environment is recommended.

When little humidly effects are indicated, relative humidity conditions present during the test period are considered not to have had any unusual effect on the copper sulfide film formation.

When high relative humidity is indicated, substantial moisture was condensing on the coupons. The humidity may have caused the copper sulfide film formation to accelerate. Consideration should be given to controlling the humidity in this environment.
Dusty Environment Effects

Air-born contaminates, such as uncontrolled dust, can significantly increase the rate of instrument failures. Dust can cause failure by insulating instruments from proper heat dissipation and by providing electrical short circuits through the dust buildup.

Normally, if instruments are installed in an atmosphere containing a particulate matter concentration of less than 0.1 milligrams of particulates per cubic meter of dry air, the effects of dust are minimized. Figure 1.1.1 portrays the size distribution of dust in a typical atmospheric sample.

Methods are available to reduce particulate size in the surrounding air and to minimize the effect of dust contamination. One of the most used methods is air-inlet filters sized to meet the particulate size requirement. Another often used method is maintaining positive pressure within instrument enclosures or even the entire equipment room. Of course, once the method is implemented, properly maintaining the dust control system by renewing filters periodically and keeping all dust control equipment operating properly is necessary.

Dust accumulating on electronic equipment can significantly affect its operation and reliability. For proper filter sizing, some idea of the sizes of dust normally found in an atmospheric sample is useful. The diagram in Figure 1.1.1 shows dust sizes, quantities, and percent by volume in a typical atmospheric sample. The diagram is reproduced courtesy of Snyder General Corporation, Dallas, TX 75204.

Air-born contaminants can greatly reduce the reliability and life electronic equipment. Figure 1.1.2 compares the relative size of common air-born contaminant and illustrates the effective ranges of popular filters per American Society of Heating, Refrigeration, and Air conditioning Engineers (A.S.H.R.A.E.) standards. The chart was provided for reproduction by Cambridge Filter Corporation, Syracuse, NY 13221-4906.
It should be pointed out that atmospheric dust varies considerably in particle size as well as constituents. In the above sample there were very few particles noted which were in excess of 30 microns in average diameter. With this as an upper limit, the particles were divided into six size ranges as indicated, with Column (2) indicating the average particle size for each group. For example the largest group consisted of those particles ranging between 30 and 10 microns — or an average of 20. In this particular size range it will be noted that the number of particles present is indicated as 1000, as shown in Column 3. This represents the proportionate quantities by count and indicates the relative number of particles in each size range based upon 1000 particles for the average 20 micron size.

Figure 1.1.1. Size Distribution of a Typical Atmospheric Dust Sample
Figure 1.1.2. Relative Size Chart of Common Air Contaminants
Shock and Vibration Effects

Mechanical influences consist of sinusoidal vibration and shock. Table 1.1.6 lists the design criteria for shock and vibration limitations. The limits noted in the table apply to infrequent happenings. Equipment continuously exposed to vibration or shock conditions may require additional mounting considerations.

Table 1.1.6. Shock and Vibration Limits for All Environmental Categories

<table>
<thead>
<tr>
<th>Condition</th>
<th>Operating Test Limits</th>
<th>Storage and Transportation Test Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>98 m/s² peak acceleration</td>
<td>Weight: 100 kg; Free Fall Height: 90 cm</td>
</tr>
<tr>
<td></td>
<td>1/2 sine wave application</td>
<td>200 kg; 50 cm</td>
</tr>
<tr>
<td></td>
<td>11 msec duration</td>
<td>300 kg; 45 cm</td>
</tr>
<tr>
<td>Shock</td>
<td>0.5 mm peak-to-peak displacement from 5 to 7.11 Hz; 1 m/s² peak acceleration from 7.11 to 150 Hz</td>
<td>3 mm peak-to-peak displacement from 3 to 9.19 Hz; 5 m/s² peak acceleration from 9.19 to 150 Hz</td>
</tr>
</tbody>
</table>

The operational vibration limit of the system is 30–60 cycles per second (cps) with an acceleration of 0.20 g (acceleration of gravity) peak (0.03” peak-to-peak). The static vibration limit is 3–100 cps with peak acceleration of 0.5 g.
Static and Electromagnetic Effects

If the system enclosure is properly grounded, static discharge during normal operations will not damage the equipment. Therefore, personnel operating the equipment do not need to take special precautions.

Standard electrostatic discharge (ESD) grounding precautions, such as use of a static control wrist strap, should be observed by anyone servicing the equipment or removing or installing circuit boards.

To limit the buildup of static charge on personnel, carpet in the vicinity of the equipment must be anti-static.

The use of portable two-way, hand-held radios and cellular telephones in process plants impose the need for greater protection of process control instrumentation from electromagnetic interference (EMI). This requirement extends to protection of software media including diskettes and magnetic tape.

Two EMI paths exist from a transmission source, such as a hand-held radio or a cellular telephone. One path is directly to the affected instrument from the radio antenna. The other path is indirectly by way of the normal signal and power lines connected to the affected instrument. In the latter case, the signal and power lines act like a receiving antenna. RS3 instruments are designed to resist interference by either path. But, like any instrumentation, maximum protection occurs when the instruments are properly installed. Installation instructions for individual pieces of RS3 equipment describe how to install equipment in a way that provides best immunity to all types of electromagnetic interference.

In most plant sites, maintenance personnel use hand-held radios for routine maintenance procedures. If the radios are used within one meter of process equipment cabinets or enclosure systems and the doors are open, the effect on the equipment is unpredictable. Additionally, the signal may be in a “Near Field” area (explained later), in which case the effect on instrumentation can also be unpredictable.
SAMA Standard PMC33.1, an EMI standard for process control equipment, provides testing specifications for “Far Field” signals. Such signals are defined as electromagnetic signals at a distance of one meter or greater from instrumentation being tested.

Measuring radio signal field strength around cabinets should be part of a checkout procedure before startup and periodically thereafter. However, in a near field area, radio signal field strength cannot be calculated or tested in a repeatable manner. No standards are presently available for Near Field testing.

Far Field signals consist of a radiation field and a remnant of an induction field from the radio antenna. At distances of greater than one meter from the antenna and in the frequency range of most hand-held radios, the induction field has negligible effects. Only the radiation field is of concern. However, in the near field area, both the radiation field and the induction field are important. At a distance equal to the wavelength divided by $2\pi$, or slightly less than $\lambda/6$, the two types of fields have equal intensity. Significant errors can occur if the measuring instruments are set up too close to the antenna, and the probability for adverse affects on process control equipment rapidly increases.

Some claims have been made that equipment will operate without negative effects when a hand-held radio is used in the area of non-protected units (i.e., open enclosure doors). Although no degradation may seem to occur initially, large Near Field signals can begin a circuit degradation that contributes to later failures. Until a repeatable testing standard is developed, no equipment design can be considered damage-resistant in Near Field signals, nor can the equipment operation be considered predictable.

RS3 instrumentation is tested for EMI resistance with cabinet and console doors closed and all equipment properly grounded electrically. Closed cabinet and console doors and proper equipment grounding provide maximum EMI protection. Test procedures are done in accordance with SAMA Standard PMC33.1. This equipment meets the conditions listed in Table 1.1.7.
### Table 1.1.7. Electromagnetic Field Limits

<table>
<thead>
<tr>
<th>Environmental Category</th>
<th>Reference Operating Limits</th>
<th>Normal Operating Limits</th>
<th>Operative Limits</th>
<th>Storage and Transportation Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A</td>
<td>100 mV/m 20 to 1000 MHz</td>
<td>0.5 V/m 20 to 1000 MHz</td>
<td>0.5 V/m 20 to 1000 MHz</td>
<td>No Limit</td>
</tr>
<tr>
<td>Category B</td>
<td>100 mV/m 20 to 1000 MHz</td>
<td>10 V/m 20 to 1000 MHz</td>
<td>30 V/m 20 to 1000 MHz</td>
<td>No Limit</td>
</tr>
<tr>
<td>Category C</td>
<td>100 mV/m 20 to 1000 MHz</td>
<td>10 V/m 20 to 1000 MHz</td>
<td>30 V/m 20 to 1000 MHz</td>
<td>No Limit</td>
</tr>
</tbody>
</table>

To provide maximum protection, run power and signal leads in rigid, metallic conduit that is solidly connected to a low-impedance ground. To prevent “signal-ground loops”, electrically ground the conduit at the power or signal source end only, and use non-conductive fittings to connect the conduit to system cabinets. Using low-pass capacitive filters on the signal wires connected to an instrument provides additional EMI protection. Such filters are usually feed-through devices connected in series with the instrumentation wires.

Minimizing radiation from an interference source minimizes EMI problems. Therefore, do not mount radio frequency device antennas in the vicinity of the instrumentation system. Also, avoid using radio communication while performing maintenance, especially any time that cabinet and console doors are open.
Controlling the Environment

Controlling the environment to required specifications pays large dividends in extended instrument life and overall system reliability. Depending on the severity of the environment and the system application, alternate methods for controlling the environment are available. The four main items that any method must control are temperature, humidity, dust, and corrosive vapors. Knowing the types of contaminants in the plant site atmosphere and knowing their normal sizes helps determine the protection system needed.

Often the best method to control an objectionable environment is to install all of the system instruments in an environmentally controlled room. This method may prove to be the most cost effective solution when flexibility of a plant application is not inhibited. A controlled room not only protects equipment but it protects plant personnel also.

In such a room, the heating, ventilating, and air conditioning (HVAC) system is designed to provide the specified control of temperature, humidity, dust, and corrosive vapors required. It is tailored to control the types of dust and corrosive gases on site, and it must maintain relative humidity under 50%. The system should have redundancy to maximize reliability.

Humidity control is the single most important factor affecting corrosion rates when corrosive vapors are present. Control must include both the average relative humidity and the rate of change per hour of the humidity. For example, maintaining relative humidity at 45 percent with changes of less than 6 percent per hour reduces a moderate (Class G2) environment to a mild (Class G1) one. In contrast, an 80 percent relative humidity causes a harsh (Class G3) environment when reactive chlorides are present at a concentration of 0.2 to 0.3 parts per billion.
Care must be given during room design to assure that a minimum positive pressure of 0.02 milli-bars (0.08 inches of water column) can be maintained. As a minimum, door air-lock systems are required.

Different types of construction produce different problems. For instance, cinder block walls are porous and allow outside contaminants to progress through the walls and eventually contaminate the room air. To inhibit contaminants, the walls must be sealed and painted with a water-proof paint, such as an epoxy-based or similar paint. This sealing, along with positive pressure inside the room, effectively controls contaminant ingress. Concrete floors present a major dust potential unless the floors are cleaned and sealed. The dust from the floors can clog air filters and may cause early instrument failure from excessive heat buildup.

All pipes, cables, and conduit passing through the walls, floors, and ceilings require sealing to maintain positive air pressure. Avoid use of porous materials, such as fiberglass batts, to seal the holes. Open pipes and conduit must be capped or plugged to prevent air passage. Additionally, cooking, eating, and smoking activities must be excluded from the room once the instrumentation system is installed.

“Blast-Proof” rooms require special construction and sealing techniques. Experts and contractors for this type of construction should be consulted.

For installations located on the plant floor or in remote areas, several methods are available to control the environment. If a small room cannot be built, then sealed cabinets or enclosure systems may be used. The same criteria for proper environmental control applies to cabinets and enclosure systems as it does for control rooms. As with control rooms, the amount and types of environmental control must be determined and then designed into the cabinet or enclosure system. For example, needed control might include temperature only, humidity and particulate filtration only, or perhaps particulate filtration only.
If temperature and humidity control is needed, it can be accomplished by using a small HVAC system that is mounted on the cabinet or enclosure system, or it can be a central unit feeding several cabinet or enclosure systems in various locations.

Another possibility is to use a purging system that supplies clean, cool, dry air or inert gas to pressurize a cabinet or enclosure system. As with HVAC systems, purging systems are designed for control of a specific environment.

Often, remote process areas are a type in which high temperature and high relative humidity occur, which also changes depending on the weather and time of year. In addition, dust contamination is high and high levels of corrosive gases are present. To overcome this environment, a clean air source is found, the size and type of enclosure (normally plastic or fiberglass in a corrosive environment) is determined, and the volume of air required to maintain an air pressure of 0.08 inches of water column is planned. A clean air source may be high quality instrument air or air from a locally placed chemical and particulate filtration system.

Additionally, the cleaning system required to purge the air after a cabinet or enclosure system door has been opened and then re-closed must be selected. And, finally, a location to keep the cabinet or enclosure system out of direct sunlight is selected.
A rough calculation can be made to determine the air flow in cubic feet per minute (CFM) required to maintain air pressure between 0.8 and 0.1 inches of water column. Calculation is made with the following formula:

\[ \text{Air Flow} = (C) \times (\text{width} \times \text{height} \times \text{depth of the room}) \]

“C” is a constant percentage of the area volumes needed to maintain the correct air pressure. Use Table 1.1.8 to determine the value of “C”.

<table>
<thead>
<tr>
<th>Enclosure Type</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMA 12 Enclosure</td>
<td>5 %</td>
</tr>
<tr>
<td>Blast-Proof Room</td>
<td>1.5 to 3.0 %</td>
</tr>
<tr>
<td>Sealed Concrete-Block-Wall Room</td>
<td>5 to 7 %</td>
</tr>
<tr>
<td>Typical Room Construction</td>
<td>10 to 12 %</td>
</tr>
<tr>
<td>Loose Room Construction</td>
<td>17 to 25 %</td>
</tr>
</tbody>
</table>
Maintaining the Environment

Maintenance of an environmental control system is equally as important as that of the process control system.

The importance of maintaining the environmental control system can not be overemphasized. Failure of the environmental system has a direct effect on the reliability of the process control system. Once corrosion begins on process control equipment, the damage caused by corrosion is normally not reversible.

The usual item not regularly maintained is air filters. Yet, clogged air filters directly contribute to early instrument failure by disrupting proper instrument cooling. Clogged or used up chemical filters allow corrosive contaminants to surround the instruments. Damaged air-lock seals and air-lock doors held open allow contaminants to enter protected rooms or enclosures.

Thus, scheduled preventive maintenance and periodic general inspection for damage becomes important to optimum control system reliability. Ongoing environmental system maintenance must be part of up-front system installation planning.
Section 2: 
Power Requirements

This section describes RS3 AC and DC power requirements and provides system-level recommendations and guidelines for AC and DC power installation. Specific instructions for wiring and grounding of individual products may be found in the appropriate product installation section. Proper wiring and grounding is of prime importance for operator safety, signal integrity, and electrical protection of the instrumentation system.

NOTE: Because of differing output voltages, AC/DC power supplies cannot be mixed on a DC bus with System Power Supply Units.

These recommendations and guidelines meet or exceed all applicable codes. All power and ground wiring practices must conform to locally applicable codes and regulations. The recommendations and wiring diagrams in this planning manual are, therefore, typical examples rather than specific requirements. Primary emphasis is on safety and proper equipment operation.

While these recommendations and guidelines attempt to cover most situations, there will no doubt be particular installations that may deviate from the norm. In these situations, contact your representative for assistance.

Plant distribution problems can be minimized by following these recommendations to the maximum extent possible.

- Provide a dedicated AC power/cabinet/DC ground connection (accessible for testing) for the instrumentation system.
- Connect consoles or computers and associated peripherals (which are connected together by non-isolated signal cables) to the same power distribution and ground system.
- Connect all cabinets within a grouping to one circuit breaker panel and utilize the same ground system.
- Earth ground connection must be in accordance with local, state, and federal codes. Insure the integrity of this connection.
- Provide a low impedance, high integrity ground path between all instrumentation and the RS3 ground connection.
- Limit the potential difference between the signal common and power supply common to a maximum of 200 millivolts DC at each device, with all units powered.
- Provide an intercabinet ground for all cabinets interconnected by non-isolated signals. Also provide an intercabinet ground for all cabinets sharing a backup power supply.
NOTE: Devices connected only by the PeerWay do not require connection to the same ground system. Systems so isolated may also have separate power sources.

Commercial AC power utilities normally provide power that meets the voltage and frequency requirements of the instrumentation system. However, plant distribution networks may drop 5 percent or more of the input AC power between the service entrance point to the plant and the final power connection to the various portions of the instrumentation system. Furthermore, starting transients from large motors and other loads connected to the distribution system can cause additional momentary line-voltage reductions as well as possible wave shape distortions.

System AC power problems are of two types:

- AC power quality
- Plant distribution system

Quality problems generally consist of loss of power, intermittent noise, low voltage, or transients and surges on power lines. To suppress electrical noise, a dedicated feeder between the main distribution panel and the instrumentation system branch panel is recommended. If low voltage from the commercial power source or objectionable transients and surges exists, or if noise is a problem even with a dedicated feeder, then a device (such as a noise filter or voltage regulating power source) that reduces input power noise may be required.

Devices that can be used include:

- Isolation transformer
- Noise filters
- Line conditioner
- Voltage regulating power source
- Motor-generator set
- Uninterruptible power supply (UPS)

NOTE: Do not use an isolation transformer, voltage regulating power source, or uninterruptible power supply with a ferroresonant transformer as its output device unless it is rated at least 3 kVA for each standard AC/DC power supply it powers. Use of a smaller ferroresonant transformer can result in oscillations.

If loss of power from a commercial power source is a problem, then a backup power source for critical portions of the control system is recommended.
The instrumentation system should have a separately derived AC power source that is isolated from all other loads; each building or site containing instrumentation should have a separate power device or backup power source. This is particularly important for the instrumentation system control center, which generally contains the consoles, controllers, and associated equipment. The power source should be supplied from the highest line voltage available from the commercial source, and only the instrumentation system equipment should be connected to the secondary.

The reason for using the highest voltage is to take advantage of the natural noise attenuation of the transformer when stepping down the voltage. The power source should have sufficient capacity to handle inrush overcurrents or surge currents (lasting about ten cycles), and still regulate its output voltage within the nominally rated voltage tolerances for the equipment. This tolerance is measured at the power input to the equipment when the equipment is energized.
Power Distribution Overview

The power distribution system consists of one or more of:

- AC Entrance Panel with AC/DC Power Supplies or System Power Supply Units
- Dual (A/B) DC Distribution Bus
- DC Distribution Card
- DC Distribution Cable

Figure 1.2.1 shows an overview of the system that includes an AC/DC power supply. The AC Panel is used to power peripheral devices such as CRTs and printers; and is also used to feed the cabinet fans and the AC/DC Power Supplies. The power supply feeds the DC bus. One DC Distribution Card feeds a ControlFile, and another feeds an Analog Card Cage.

Figure 1.2.2 shows an overview of the system that includes a System Power Supply Unit. System Power Supply Units do not require an AC Entrance Panel.

For details, see Chapter 5, System Cables and Power Distribution:
- SP:5-2-1 AC Distribution System
- SP:5-3-1 AC/DC Power Supplies
- SP:5-4-1 System Power Supply Units
- SP:5-5-1 DC Distribution System

**CAUTION**

Extra-Low Voltage (ELV) is no more than 30 volts rms, 42.4 volts peak, and 60 volts DC. Hazardous voltage is any voltage above ELV levels. The following rules must be observed when installing wiring for any hazardous voltage:

External terminal wiring must have double or reinforced insulation for the maximum supply voltage used. To ensure single fault protection, a locking lug must be used at the external terminals. The external terminals are suitable for use with up to 12 AWG wire.

Field I/O wiring shall not be connected directly to the mains supply without overcurrent protection. All AC mains supplies, including I/O wiring must be provided with an external switch and overcurrent protection devices, or a circuit breaker that can be manually operated as a switch. The external switch or circuit breaker must be installed near the equipment.
CAUTION

If the caution symbol shown on the left is present on the cabinet door (near the handle), then multiple mains supply circuits are located within the cabinet. Isolate all mains supplies prior to servicing.

Figure 1.2.1. Power Distribution Overview - RS3 with AC/DC Power Supply
Figure 1.2.2. Power Distribution Overview - RS3 with System Power Supply Unit
AC Power

AC power is required by the power supplies, cabinet fans, console CRTs, and printers. AC power is also required for distributed I/O cabinets, fans, and optional cooling units.

The RS3 distributed control system power requirements may vary with different OEM equipment. Check appropriate sections for ratings of these mains-powered components.

The required power falls within the following operating specifications:

**AC/DC Power Supplies**
- Voltage Range: 115 VAC (100 to 137 VAC)
  230 VAC (200 to 264 VAC)
- Frequency Range: 50 Hz (47.6 to 52.4 Hz)
  60 Hz (57.0 to 63.0 Hz)
- Harmonic Distortion: 5% maximum

**System Power Supply Units**
- Voltage Range: 85–264 VAC
- Frequency Range: 47–63 Hz

The AC/DC power supplies do not require line conditioning, such as isolation or regulation-type transformers, to reduce AC line noise or to regulate the incoming voltage. The AC distribution panel contains a capacitive filter for noise spikes. The transformers in the AC/DC power supplies are of a ferroresonant design that provides noise immunity, voltage regulation, and inherent current limiting. The AC distribution panel provides AC input filtering and regulation as well as adequate protection for the 30 VDC power under all but the most severe AC input conditions.

Line conditioning may be required to supply clean power to the console CRTs and printers. Conditioning may also be required for power supplies used with distributed I/O components.
AC Voltage Regulation

For input AC voltage variations within the nominal ranges, the system does not require additional input AC regulation. However, if the average AC input voltage is expected to be outside this range, you can use an automatic AC tap switching-type transformer.

NOTE: A small ferroresonant-type regulating transformer is not recommended as an AC signal conditioner because the AC/DC power supplies use this type of transformer. An small ferroresonant source transformer can produce an instability in the supply voltage to the system and may cause oscillations. A ferroresonant source transformer that is at least three times larger than the one in the power supply is acceptable. You can use ferroresonant transformers to regulate power to the console color monitors and printers.

AC Voltage Dropout - AC/DC Power Supplies

Internal batteries in the standard AC/DC power supplies protect the system from voltage loss during brief AC voltage dropouts for all parts of the system powered by the DC distribution system. The protection time depends on the number of supplies and the system DC load.

However, any part of the system that is not powered by the system DC bus loses power during AC power loss. This includes console CRTs, printers, system cabinet fans, self-powered transmitters, and any other AC powered devices. The remote power supplies typically used with distributed I/O cabinets do not have built-in battery backup, so some other protection from AC line dropout (such as a UPS) must be provided.

The AC/DC power supply is also available without batteries for installations with an uninterruptible power supply.

NOTE: System Power Supply Units do not have a battery backup.
AC Power Consumption

The AC load for each entrance panel can be determined by:

1. Finding the DC load on the bus.
2. Finding the number of AC/DC power supplies.
3. Calculating the AC load.

Finding the DC Load on a Bus

The DC load on a bus is computed by adding the loads of all devices attached to the bus. Table 1.2.1 gives the nominal current draw for 30 VDC and 24 VDC and local heat dissipation for equipment powered from the DC bus.

NOTE: All estimates assume a fully configured unit to allow for expansion.

<table>
<thead>
<tr>
<th>Component</th>
<th>Nominal Current at 30 VDC Amps</th>
<th>Nominal Current at 24 VDC Amps</th>
<th>Heat Output Watts (BTU/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consoles and PeerWay Interfaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multitube Command Console (MTCC) and System Manager Station</td>
<td>3.11</td>
<td>3.67</td>
<td>105.5 (360)</td>
</tr>
<tr>
<td>Command Console Electronics</td>
<td>3.76</td>
<td>4.70</td>
<td>113 (385)</td>
</tr>
<tr>
<td>Keyboard Interface, Operator Keyboard, Loop Call-up (DC current included in Command Console Electronics)</td>
<td>-</td>
<td>-</td>
<td>6 (20)</td>
</tr>
<tr>
<td>Supervisory Computer Interface (SCI)</td>
<td>1.7</td>
<td>2.12</td>
<td>54.4 (185)</td>
</tr>
<tr>
<td>Highway Interface Adapter (HIA)</td>
<td>1.7</td>
<td>2.12</td>
<td>54.4 (185)</td>
</tr>
<tr>
<td>PeerWay Extender (A B Pair)</td>
<td>.14</td>
<td>.18</td>
<td>12 (41)</td>
</tr>
<tr>
<td>PeerWay Tap (A B Pair)</td>
<td>-</td>
<td>-</td>
<td>16 (55)</td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Component</th>
<th>Nominal Current at 30 VDC Amps</th>
<th>Nominal Current at 24 VDC Amps</th>
<th>Heat Output Watts (BTU/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ControlFiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ControlFile (fully loaded)</td>
<td>10.10</td>
<td>12.63</td>
<td>305 (1040)</td>
</tr>
<tr>
<td>Analog FlexTerm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Connect Card III, V 1984–2543–xxxx or 10P5456xxxx (Draws negligible DC current)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transfer Card 1984–2494–xxxx</td>
<td>.09</td>
<td>.11</td>
<td>3 (10)</td>
</tr>
<tr>
<td>Output Bypass Card 1984–2551–xxxx</td>
<td>.11</td>
<td>.14</td>
<td>4 (12)</td>
</tr>
<tr>
<td>Field Interface Cards (FICs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4–20 mA 2 in/1 out 1984–2518–xxxx or 10P5444xxxx</td>
<td>.19</td>
<td>.24</td>
<td>5.8 (20)</td>
</tr>
<tr>
<td>4–20 mA 2 with Smart Daughterboard 1984–2519–xxxx</td>
<td>.22</td>
<td>.27</td>
<td>6.6 (23)</td>
</tr>
<tr>
<td>Pulse Input/Output 1984–2546–xxxx or 10P5447xxxx</td>
<td>.28</td>
<td>.35</td>
<td>7 (24)</td>
</tr>
<tr>
<td>Temperature Input 1984–2731–xxxx</td>
<td>.11</td>
<td>.14</td>
<td>4 (12)</td>
</tr>
<tr>
<td>Multiplexer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiplexer FlexTerm (With Power Supply and Communications Board)</td>
<td>.42</td>
<td>.52</td>
<td>13 (43)</td>
</tr>
<tr>
<td>Multiplexer Front End Module (FEM)</td>
<td>.03</td>
<td>.04</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Programmable Logic Controller/Rosemount Basic Language (PLC/RBL) FlexTerm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLC/RBL Interface Card 1984–2402–xxxx or 1984–2441–xxxx or 10P5485xxxx or 10P5488xxxx</td>
<td>.06</td>
<td>.07</td>
<td>1.8 (6)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RNI 10P5333xxxx</td>
<td>.71</td>
<td>.86</td>
<td>21 (72)</td>
</tr>
</tbody>
</table>
### Table 1.2.1. Equipment DC Power Consumption (continued)

<table>
<thead>
<tr>
<th>Component</th>
<th>Nominal Current at 30 VDC Amps</th>
<th>Nominal Current at 24 VDC Amps</th>
<th>Heat Output Watts (BTU/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multipoint I/O</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Discrete Termination Panel 1984–4127–xxxx or 10P5270xxxx with redundant FIMs</td>
<td>.12</td>
<td>.15</td>
<td>6 (20) note 1</td>
</tr>
<tr>
<td>MultiFIM Discrete Termination Panel 1984–4282–xxxx with 3 DIO FIMs 10P5352xxxx or 1984–4080–xxxx</td>
<td>.18</td>
<td>.22</td>
<td>11 (38) note 1</td>
</tr>
<tr>
<td>Isolated Discrete Termination Panel (A and B) 1984–4121–xxxx and 1984–4124–xxxx with redundant DIO FIMs 10P5352xxxx or 1984–4080–xxxx and 120 VAC or 24 VDC solid state relay modules</td>
<td>.13</td>
<td>.16</td>
<td>35 (119) note 1</td>
</tr>
<tr>
<td>High-Density Isolated Discrete Termination Panel 1984–4167–xxxx with DIO FIM 10P5352xxxx or 1984–4080–xxxx and 120 VAC or 24 VDC solid state relay modules</td>
<td>.07</td>
<td>.09</td>
<td>33 (113) note 2</td>
</tr>
<tr>
<td>High-Density Isolated Discrete Termination Panel 1984–4167–xxxx with DIO FIM 10P5352xxxx or 1984–4080–xxxx and 240 VAC solid state relay modules</td>
<td>.07</td>
<td>.09</td>
<td>48 (164) note 2</td>
</tr>
<tr>
<td>DIO IS Barrier Panel (A and B) with FIMs and barriers 10P5037xxxx and 10P5049xxxx</td>
<td>1.96</td>
<td>2.07</td>
<td>59 (201)</td>
</tr>
<tr>
<td>MAIO IS Barrier Panel with FIMs and barriers 10P5034xxxx</td>
<td>1.44</td>
<td>1.81</td>
<td>43 (147)</td>
</tr>
<tr>
<td>MAIO 16-point I/O Termination Panel with FIMs and Loop Power Modules 10P5477xxxx</td>
<td>.67</td>
<td>.82</td>
<td>22 (75)</td>
</tr>
<tr>
<td>MAI 32-point Input Termination Panel (10P5349xxxx) with FIM 10P53190004</td>
<td>.18</td>
<td>.21</td>
<td>9 (31)</td>
</tr>
</tbody>
</table>

(1) Heat output includes some field power.

(2) Heat output includes field side power dissipated in solid state relay modules. This figure assumes either all inputs or input-output mix, with output leads averaging 1 amp.
Finding the Number of Power Supplies Required

AC/DC Power Supplies

To determine the number of AC/DC power supplies needed to power the DC bus:

1. Add the DC current requirements of all equipment that will be fed from the DC bus.
2. Add an allowance for equipment expansion.
3. Multiply the total current draw by 0.06. This is an empirical number to handle both startup and maximum operating loads.
   
   \[
   \text{Power Supplies Needed} = 0.06 \times \text{(Total Current Draw)}
   \]
4. Round up the resulting number to the next higher number to find the number of power supplies needed.

Many sites add one extra supply as an on-line standby. This provides N+1 redundancy coverage should one supply fail.

The limit is six supplies on one bus. The power supply is rated for a maximum DC output of 22 amps. Normal design loads each supply at about 10 to 18 amps. The crest factor (peak current divided by average current) is approximately 1.3. The power factor is about .90 lagging.

System Power Supply Units

To determine the number of System Power Supply Units needed to power the DC bus:

1. Calculate the total DC amps that will be drawn.
2. Divide the total amps by 36 (this is 80% of the total output).
3. Round up to the next whole number.
4. Add one for redundancy.

The limit is four power supplies on one bus.
The AC Entrance Panel has three breakers (10-amp for 230 VAC and 15-amp for 115 VAC). Each power supply requires use of one breaker, and the cabinet fans normally require one breaker. Therefore, a system with two power supplies uses two breakers for the supplies and one for the fans, thus using the full capacity of one AC Entrance Panel. Breakers can be available for other uses if more than one panel is required.

**NOTE:** System Power Supply Units do not use AC entrance panels.
Determining the Total AC Load

The total AC load can be determined by adding the power requirements of system components and any other AC powered devices. Table 1.2.2 lists power consumption and heat output for equipment powered directly from an AC power source.

Table 1.2.2. Power Consumption for AC Powered Equipment

<table>
<thead>
<tr>
<th>Device</th>
<th>Total Current @ 115 VAC</th>
<th>Total Current @ 220 VAC</th>
<th>Heat Output Watts (BTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC/DC Power Supply</td>
<td>8</td>
<td>4</td>
<td>120 (410)</td>
</tr>
<tr>
<td>System Power Supply Unit</td>
<td>15</td>
<td>10</td>
<td>514 at full load (1754)</td>
</tr>
<tr>
<td>Multitube Command Console 21” CRT</td>
<td>3.0</td>
<td>1.8</td>
<td>150 (512)</td>
</tr>
<tr>
<td>Multitube Command Console 19” CRT</td>
<td>3.0</td>
<td>1.5</td>
<td>422 (1440)</td>
</tr>
<tr>
<td>Multitube Command Console 14” CRT</td>
<td>0.8</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Printer—Fujitsu DPL4600C</td>
<td>3.4</td>
<td>1.5</td>
<td>286 (975)</td>
</tr>
<tr>
<td>Printer—Fujitsu DL3800C</td>
<td>2.1</td>
<td>1.1</td>
<td>242 (825)</td>
</tr>
<tr>
<td>Hansman Cabinet Fan</td>
<td>1.0</td>
<td>0.5</td>
<td>100 (341)</td>
</tr>
<tr>
<td>Rittal Cabinet Fan (EBM Industries, Inc.)</td>
<td>1.2</td>
<td>1.0</td>
<td>138 (472)</td>
</tr>
</tbody>
</table>
Power Supply Redundancy

AC/DC Power Supplies

If your process requires a dual AC entrance, the dual AC Distribution Panel permits the entrance of two separate AC sources. The output side to the system is the same as with the single entrance panel.

If your process requires redundant power supplies, add one additional power supply to the number you calculate and you will have sufficient capacity to carry the system load if one power supply fails. Check to see if another AC Entrance Panel is necessary to feed this power supply.

If your process requires redundant DC distribution buses, use the calculated number of power supplies on each bus. This will power the two independent DC buses (A and B) and the system will survive the loss of either DC bus by drawing off the other bus.

A block diagram of the power distribution system is shown in Figure 1.2.3. The AC line input is brought to an AC Entrance Panel and then distributed to AC loads such as the AC/DC Power Supply. The AC/DC Power Supply produces 30 volt DC for distribution throughout the system. The DC Distribution Bus carries power within a system cabinet. A DC output card (not shown) provides a connection between the bus and a DC Distribution Cable to the device.
Power specifications for this power distribution system are:

- **Voltage Range:**
  - 115 VAC (100 to 137 VAC)
  - 230 VAC (200 to 264 VAC)

- **Frequency Range:**
  - 50 cycle (47.6 to 52.4 Hz)
  - 60 cycle (57.0 to 63.0 Hz)

- **Harmonic Distortion:**
  - 5% maximum

**NOTE:** This is a distributed power system. Therefore, the secondary power servicing the various parts of the building must be grounded to the building service entrance with an impedance of less than 1 ohm at 60 Hz. All electrical equipment cabinets must be grounded with no more than 1 ohm impedance at 60 Hz between the cabinet ground and the building service entrance ground.

Provision is made for redundancy at each level:

- You may use two independent AC power sources.
- You may use load-sharing redundant power supplies on a single DC distribution bus.
- You may use a dual redundant DC distribution system with two independent sets of power supplies on the standard dual DC power bus.
The standard AC/DC Power Supply has built-in battery backup to bridge short power outages. Other forms of uninterruptible power supply can be used to augment or replace the built-in battery backup. Power supplies without batteries are available for such installations.

There are several different ways in which system power can be installed. Figure 1.2.4 shows examples of single and redundant system AC power. With single-source AC power (no redundancy), if the AC power source fails, the system eventually fails. With redundant AC power, if one AC power source fails, the system relies on the second AC power source. The DC buses A and B are normally tied together.

**Figure 1.2.4. Examples of System AC Power Sources**
Figure 1.2.5 shows an additional power supply. The redundant DC power supplies share the load. If one DC power supply fails, the other DC supply assumes the load. Most sites install one more power supply than required to carry the load. If one fails, there is still enough capacity to run the system.

Standard AC/DC power supplies have built-in battery backup sufficient to bridge short power outages and provide time for a graceful shutdown for longer outages. Additional battery backup, in the form of an uninterruptible DC power supply, may be used. This backs up the DC powered portion of the system. Other means are required for AC powered equipment such as CRTs.

![Diagram of redundant AC power and load sharing DC power supplies](image-url)
Figure 1.2.6 shows the highest available level of power supply redundancy. DC bus A and DC bus B are individually fed from fully redundant sources. The power supply is now redundant from the AC power source to the system device.

Figure 1.2.6. Redundant AC Power, Load Sharing DC Power Supplies, and Redundant Power Buses
System Power Supply Units

The RS3 Millennium Package (RMP) has a redundant power supply without a battery backup. It must have a minimum of two System Power Supply modules.

**NOTE:** Because there is no battery backup, there must always be one extra power supply module than what is needed.

Non-redundant Bus Configuration

A standard, non-redundant, DC power distribution system consists of one or more System Power Supply Units feeding one or more DC Distribution Bus assemblies. Figure 1.2.7 shows a standard bus A/B operation.

A DC Distribution Bus should have no more than two System Power Supply Units (four DC outputs) wired to it, redundant power supply modules included.

**NOTE:** If a single System Power Supply Unit is used, the configuration should be the standard A/B distribution as shown in Figure 1.2.7.

![Figure 1.2.7. Standard DC Power Distribution for System Power Supply Units](image-url)
Redundant Bus Configuration

Figure 1.2.8 represents a redundant DC power distribution configuration consisting of one System Power Supply Unit feeding bus A and another System Power Supply Unit feeding bus B. Buses A and B are not connected.

Each bus (A and B) needs to have a separate redundant power supply module, so a total of two redundant power supply modules are needed for a redundant DC power distribution. (This would be a redundant bus/redundant power supply configuration, which meets the N+1 redundancy requirement.)

The redundant bus configuration must have the same number of power supply modules on each bus. Four power supply modules (two Power Supply Units) is the maximum allowed for both buses.

![Redundant Bus Configuration Diagram](attachment:Redundant_Bus_Configuration.png)

Figure 1.2.8. Redundant DC Power Distribution System for System Power Supply Units
Supplemental Power Systems

Individual installations may require that power to the system be maintained through an AC power loss. You can provide AC power backup with dual AC power sources, an uninterruptible power supply (UPS), a motor generator, or extended battery backup. You should locate supplemental power system equipment in a protected utility area.

Dual AC Power Sources

The dual AC Entrance Panel (used with AC/DC power supplies only) allows a primary and secondary AC input for two power sources. Upon the loss of the primary AC source, the secondary is automatically switched in through an internal switching mechanism. These two sources need not be in phase with each other. With standard AC/DC battery-backed up power supplies, a 500-millisecond lag during switchover does not affect system operation. Automatic switching back to the primary is provided as soon as primary (upper input connection) power returns. Alarm relay contacts are provided on the dual AC Entrance Panel to indicate the active input.

Uninterruptible Power Supplies (UPS)

AC/DC Power Supplies

You can use a commercially available uninterruptible power supply (UPS) as the primary source of system power (connected to the upper input of the dual AC distribution) with the utility power as the secondary source, or the UPS can be used as the backup to the utility power. The UPS system can also supply command console CRT power. However, because of efficiency and cost reasons, the UPS may not be the most reasonable way to back up system power.

The UPS must be able to support the AC/DC power supplies:

- Be suitable for operation with the ferroresonant regulating transformers in the RS3 AC/DC Power supplies.
- Have voltage and frequency within the AC/DC power supply limits.
- Have no more than 5% total harmonic distortion.
- Have Power Factor of approximately 0.90 leading.
  \[ \text{Power Factor} = \frac{\text{Average Power}}{\text{Apparent Power}} \]
- Handle Inrush current of 60 amps for <10 ms and surge current of 23 amps for <500 ms (per power supply at 115 VAC).
- Have a Crest Factor of approximately 1.29.
  \[
  (\text{Crest Factor}) = \frac{\text{Peak Current}}{\text{RMS Current}}
  \]

Figure 1.2.9 shows an example of a UPS used as a power backup for AC/DC power supplies. Utility power is used to provide primary power to the system. The power changeover can also be handled by a single external switching mechanism rather than by multiple AC distribution panels. If the UPS system is to be the primary source of power, the UPS system must be capable of handling all power requirements of the system with a 100% duty cycle.

**NOTE:** The UPS must supply an AC load of at least 1.5 times the system AC requirement.

![Diagram](image)

**Figure 1.2.9. Uninterruptible Power Supply (UPS) as Backup Power Source - AC/DC Power Supplies**
System Power Supply Units

You can use a commercially available UPS as the primary source of system power. The UPS system can also supply command console CRT power. However, the UPS may not be the most efficient or cost-effective way to back up system power.

The UPS must be able to support the System Power Supply Units:

- Having voltage and frequency within the System Power Supply limits.
- Handling inrush current of 50 amps for <10 ms and surge current of 23 amps for <500 ms (per power supply at 115 VAC).
- Supplying a crest factor of approximately 1.29
  \[(\text{Crest Factor}) = \frac{\text{Peak Current}}{\text{RMS Current}}\].

Figure 1.2.10 shows an example of a UPS used as a power backup for a System Power Supply Unit. Utility power provides primary power to the system. Power is routed through a 30 amp breaker, to the UPS and on to each power supply module. If the UPS system is the primary source of power, it must be capable of handling all power requirements of the system with a 100% duty cycle.

**NOTE:** The UPS must supply an AC load of at least 1.5 times the system AC requirement.

---

**Figure 1.2.10. Uninterruptible Power Supply (UPS) as Backup Power Source - System Power Supply Units**
Motor Generator - AC/DC Power Supplies

You can use a gasoline or diesel-powered AC generator as an economical means of providing backup power for an indefinite period of time. The generator must use a startup mechanism that provides power to the system before the internal AC/DC power supply batteries are drained. A properly maintained diesel generator with an automatic startup system can provide power within 10 to 30 seconds. Remember that the AC powered equipment (command console CRTs, printers, etc.) will be off during the period of time it takes to start the generator. Frequency of the incoming power should be kept within three cycles of the nominal 50 or 60 Hz. Figure 1.2.11 shows an example of a generator used as backup power for a system.

Figure 1.2.11. Diesel or Gasoline Powered AC Generator as Backup Power
Extended Battery Backup - AC/DC Power Supplies

A 24-volt battery backup system can provide an economical and efficient means of storing power. You can use a small 24 VDC to 120 or 220 VAC power inverter to back up CRTs, printers, and cabinet fans.

Full Battery Backup

Figure 1.2.12 shows an example of a battery backup system that provides full backup capability. This requires the use of both the A and B DC power bus in a redundant configuration. An isolation diode is not required in the secondary DC bus input line because diode isolation is present in each system DC power supply at all system components. The battery must float with reference to ground to allow the DC return to be connected to the grounding electrode. Each DC distribution system is sized to handle a maximum of 132 amps DC. Battery cables must be sized for minimum voltage drop.

You should use appropriate fusing along with a mechanism to disconnect the batteries when the battery voltage drops below 18 volts. Disconnecting the system power below 18 volts prevents the cards from trying to restart after a low voltage dropout and eliminates complete battery drain, which could damage the batteries.

Power for the system is supplied by the AC/DC power supplies, which run nominally at 30 volts. In the event of a power failure, the 24 volt batteries pick up the load immediately. You should choose battery capacity according to required backup time. You should size the battery charger to allow the batteries to charge in a reasonable amount of time. The battery charger and batteries must float with reference to ground to allow the ground connection to be made at the system return bus bar.

A DC to AC power inverter is used to convert the 24 volt battery power to 120 VAC for backup power to the color monitors, printer, and cabinet fans.

An AC/DC power supply without internal batteries is available for use in this type of installation.
*NOTE:* Battery negative lead should not be referenced to chassis ground.

**Figure 1.2.12. Full Battery Backup Power**
Partial Battery Backup

Figure 1.2.13 shows a battery backup system that provides a partial system backup. The battery backup system is powered from the battery charger while the batteries float with a nominal charge. The battery charger should be capable of simultaneously powering the system and charging the batteries with a ripple voltage of less than 0.5 volts. Battery capacity is sized to the backup time required. The battery charger and batteries must float with reference to ground to allow the ground connection to be made at the system return bus bar.

Appropriate fusing should be used along with a mechanism to disconnect the batteries when the battery voltage drops below 18 volts. Disconnecting the system power below 18 volts prevents the cards from trying to restart after a low voltage dropout and eliminates complete battery drain, which could damage the batteries.

No AC/DC power supply or AC distribution is required for this type of system power. A DC to AC power inverter is used to convert the 24 volt battery power to AC for power to the color monitors, printer, and cabinet fans.

Console CRT and Printer Backup

A small uninterruptible power supply, of the type used to back up personal computers, can be used to backup the console CRT and printers economically.
Millennium Cabinet and AC Wiring

On-site installation for the RS3 Millennium Package is limited to mains power supply module wiring and I/O module wiring. You will need to provide AC power to the Millennium cabinet from an external circuit breaker panel and wire the power leads to the AC input terminal blocks on the power supply housing.

Refer to “Installation” in Section 4 of Chapter 5 for detailed information about System Power Supply Unit connectivity.

Mains wiring should be supplied from a circuit breaker on a branch circuit panel. Use a 30 amp circuit breaker for circuits in the 120 volt range, and a 25 amp circuit breaker for circuits in the 240 volt range. The mains supply wiring should enter the cabinet through the bottom rear of the cabinet and be routed along the frame on the right side (as viewed from the rear) upward to the mains supply terminal block on the System Power Supply Unit housing. Use separate mains supply circuits to feed Power Supply 1 and Power Supply 2. Connect the line, neutral, and protective conductor to their respectively marked terminals.

The upper terminal block connects the mains supply to Power Supply 1 and the lower terminal block connects the mains supply circuit to Power Supply 2. Secure the mains wiring to the cabinet frame or mounting rails, using nylon cable ties or a similar method. (The method used must not permit cuts, abrasion, or excess stress on the wiring insulation.) Notice that each mains terminal block on the System Power Supply Unit housing also has an auxiliary output circuit for peripheral equipment. Each auxiliary circuit is over-current protected by a 15 amp circuit breaker.

Signal wiring is also routed through the bottom of the RMP cabinet, separate from the mains supply wiring. All signal wiring should be at non-hazardous voltage levels in the RMP cabinet. Data communication wiring from I/O devices to Remote Termination Panel II are routed up through plastic ducting located at approximately the horizontal center of the cabinet rear.

Route 26 VDC wiring outside the cabinet, down the cabinet side opposite that from the mains supply wiring; this should be the left side of the cabinet as viewed from the rear. Secure the DC wiring cable or harness to the vertical mounting rails or cabinet frame using nylon cable ties or a similar method. Ensure that the method used does not result in cuts, abrasion, or excess stress on the wiring insulation.
Route signal and 26 VDC wiring out of the cabinet in wireways separate from the mains supply wiring. Be sure that signal wiring also enters and exits the cabinet through a separate wireway from the 26 VDC, or use an approved partitioning method if within the same wireway as the 26 VDC wiring. Secure all wiring along its routing path. Keep any excess wiring at the bottom of the cabinet to a minimum, secured by a positive means such that the mains supply wiring remains segregated from the non-hazardous voltage level wiring, the 26 VDC wiring, and the signal wiring. Keep mains supply wiring separated from extra low-voltage wiring by a minimum of 208 mm (8 in.).

Alarm circuit wiring is the same as for the RS3 system cabinet (refer to “Alarm Wiring.” in Section 4 of Chapter 5)
Section 3: Grounding Recommendations

Safety to personnel is of primary importance in the installation of the RS3 distributed control system. The system is designed to adhere strictly to all National Electric Code (NEC), Canadian Standards Association (CSA), and other safety standards to ensure that no safety hazards exist in a properly installed system.

When installing the system, careful attention must be given to ensure that the equipment and all chassis components are correctly grounded; first, to ensure that no possibility exists for hazardous voltages that could injure personnel, and second, to minimize the effects of external voltage fluctuations on the system and its external components.

It is important that the AC supply connections to all system inputs comply with NEC Article 250 and all other local applicable codes. This applies not only for the permanent installation but also for temporary connections set up for system test and configuration.
Chassis Interconnections

All cabinet panels and doors are connected together using 4mm\(^2\) (12 AWG) green wire to assure complete chassis grounding of all components. Cabinet-to-cabinet connections are made using 25mm\(^2\) (3 AWG) wire. You may need to complete these connections upon arrival, when placing multiple cabinets in the final control installation.
Earth Ground Connection

The system must be connected to the plant or building grounding electrode system in two ways. First, an equipment grounding conductor must run with every AC circuit supplying power for the system. Second, a separate grounding electrode conductor must be installed from the nearest practical attachment point to the grounding electrode system to the system cabinet ground lug.

The plant or building grounding electrode system consists of underground water pipe, metal frame of the building, electrodes in concrete, a ground ring, and other made electrodes all connected together. The actual installation of the grounding electrode system is beyond the scope of this manual. A number of sources are available that cover earth grounding, its measurement, and how to maintain low resistance over time. It is important to realize that each individual installation varies according to temperature, time, current loading capacity, soil composition, moisture, and other factors. A high quality connection to earth helps to eliminate system problems from external noise sources and damage due to lightning.

Special consideration must be given to plant-wide grounding where there are multiple buildings or separate open-air process areas, particularly for protection against lightning transients. The plant grounding electrode system must provide low impedance ground interconnections from building to building throughout the area covered by instrument wiring and system communications wiring, except where fiber optic links are used. The primary goal of the grounding electrode system is potential equalization throughout the served area, with a secondary goal of connection to earth potential.

There is no need to create a special instrument ground for the system. It is generally better to create a single ground system of higher integrity for use by both instrumentation and electrical power distribution equipment. Noisy grounds seldom cause performance problems in RS3 process control system installations, and effective corrective action would usually involve increasing the integrity of the existing grounding electrode system.

The grounding electrode conductor resistance (the connection between the system cabinets and the grounding electrode system) must be less than 0.5 ohms. Wire size must be a minimum of 35mm² (2 AWG) copper wire or equivalent for lengths up to 61 meters (200 feet). More than 61 meters (200 feet) can be an excessive length. The grounding electrode conductor must take a path that is as short and direct as possible to the nearest connection point to the grounding electrode system, usually structural steel.
System Grounding

Figure 1.3.1 shows the system grounding method. The grounding electrode conductor must be a minimum of 35 mm$^2$ (2 AWG) wire.
Grounding Separate System Components

Separate system cabinet groups in a common area can be daisy chained together using a 35mm² (2 AWG) intercabinet grounding conductor, and connected to the grounding electrode system through a single grounding electrode conductor (Figure 1.3.2). Alternatively, each cabinet group may have its own grounding electrode conductor to the grounding electrode system. Multiple grounding electrode conductors can attach at the same point on the grounding electrode system, or to different points. If a daisy chain connection would result in a grounding connection more than 61 meters (200 feet), a direct connection to the grounding electrode system should be considered for the cabinet group at the end of the daisy chain.

If the DC bus goes between any two cabinet groups, those cabinet groups must be connected by a 35mm² (2 AWG) intercabinet grounding conductor. If console electronics are powered by a connection to a DC bus in another cabinet group, the cabinet groups must be connected with a ground wire at least as large as the DC supply wires. The same 35mm² 2 AWG wires that are used for other cabinet grounds is recommended.
Figure 1.3.2. Supplemental Grounding Electrode

- DC distribution
- DC grounding jumper
- AC service connection to building grounding electrode
- Additional connection to grounding electrode system
- Required when DC bus goes between cabinets
- Intercabinet grounding conductors
- Building grounding electrode system
- DC Bus

Additional connection to grounding electrode system required when DC bus goes between cabinets.
Other Grounding Considerations

Equipment that is connected only by the PeerWay can have individual grounds.

Remote Power Supplies

If an I/O cabinet, console, remote FlexTerm, or any other component is powered by a separate DC voltage source other than the system DC distribution system (which is referenced to chassis ground), you must connect the negative DC side of the power supply to the associated chassis ground potential.

However, if the external power supply is used as a secondary power source or as a backup (redundant supply) for the system DC distribution system, you need no additional ground connection.

Communication Lines

All system communication lines, such as PeerWay, ControlFile to FlexTerm, and printer connections, have optical isolation, which eliminates the need to ensure that the chassis at both ends of the communication wires are at the same voltage potential. Therefore, ground loop currents are not a problem.
Isolation Transformers

You can use an isolation transformer to provide power to the system for any of the following reasons:

- The incoming power is to be transformed to a lower voltage.
- There exists a voltage difference between the grounding electrode at the plant service entrance panel and the supplemental grounding electrode due to distance or earthing conditions.
- To allow connection of the system to an applicable ground in areas where ungrounded power systems are used (IT or TT systems).

You can add the isolation transformer between the AC power and the system to allow a new local connection to the grounding electrode system to eliminate the effects of ground currents between the system and the plant equipment, as shown in Figure 1.3.3.

Figure 1.3.3. Isolation Transformer
Intrinsic Safety Grounding

Figure 1.3.4 shows an example of a system ground that can be used for intrinsically safe barrier installation. System grounding and all hazardous area shields reference the potential at the barriers rather than the plant ground. Use of isolation transformers might be needed to allow changing of the ground reference to be closer to the system and barrier installation.

This is only an example. Rules governing the installation of components in and around a hazardous locations vary greatly because of local codes and the type of barriers used. Consult the barrier manufacturer for details of the specific barrier. Also consult National Electric Code Articles 500 to 504, and all other local applicable codes.

Figure 1.3.4. System Grounding with Intrinsically Safe Barrier Installation
Lightning Protection

The installation must protect instrumentation systems from lightning damage. A direct strike can disrupt critical processes, start fires, damage buildings and equipment, and injure personnel. Near strikes, too, can disrupt critical processes and damage electronic circuitry by inducing voltage in unprotected wiring. Therefore, adequate lightning protection is essential in a modern processing plant.

Two factors determine the level of protection required:

- Geographic location
- Process criticality

Lightning strikes occur more often in some areas than in others. Elevation, humidity, latitude, and normal weather patterns influence frequency in a particular geographic area.

The other factor in determining appropriate lightning protection is process criticality. The more critical a process, the more important lightning protection is, even though the system might be in an area of low lightning occurrence. If any strike or near strike, no matter how unlikely, could cause loss of control of a critical process, severe financial loss, major equipment damage, or danger to personnel, a complete lightning protection system is appropriate.

Lightning protection systems provide safe conduction paths to the ground. This minimizes equipment damage and personal injury. A complete lightning protection system includes:

- Lightning rods
- Conductor system
- Grounding system
- Lightning arrestors and surge protectors
Lightning rods (also referred to as air terminals) intercept lightning discharges above a building or facility. The conductor system is a safe discharge path from the lightning rods to the grounding system. The grounding system lets the lightning discharge or dissipate safely. Lightning arrestors and surge protectors protect power lines, data highway cables, instrumentation wiring, and other such equipment from induced voltages. Together, these elements minimize lightning discharge damage.

Although a lightning protection system intercepts, conducts and dissipates the main electrical discharge, it does not prevent possible secondary effects, such as spark-over in nearby large metal structures. To prevent secondary effects of lightning strikes, make sure that all adjacent metal structures interconnect with and tie to the main conductor system. This maintains the same electrical potential throughout all structures in the vicinity.

A lightning rod intercepts a discharge above a structure, and directs the discharge to a safe path. In particular, this minimizes the possibility of fire. Lightning rods should be on structures, and parts of structures, most likely to be struck. This means that chimneys, ventilators, towers, and other such higher parts of buildings should have lightning rods. The parts of flat-roofed building most likely to be struck are the roof edges. A large area such as a plant site needs a complete system of properly located lightning rods.

Once intercepted, a lightning discharge follows a low-impedance, metal path to the earth (path of least resistance). A conductor system consists of one or more such paths. Each path must be continuous from the lightning rod to the ground. Paths must not have any sharp bends or loops. This ensures that the system provides the most direct path to earth for lightning discharge. As illustrated in Figure 1.3.5, no bend should form an angle greater than 90 degrees, and no bend should have a radius less than 76 mm (3 in.). A non-ferrous metal such as copper or aluminum is the preferred material for the path, as it is not susceptible to the rust or corrosion of a ferrous metal.
The impedance of a conductor system is inversely proportional to the number of separate discharge paths. Therefore, increasing the number of paths decreases the impedance. In a multi-path conductor system, the paths (wires) should form a cage around the structure. The steel framework of a structure can substitute for separate conductors, but smooth connection straps must span any sharp bends or other hindrance. Figure 1.3.6 shows a typical protection system with a conductor, a grounded steel framework, and connection straps.
In metal structures, the conductor system can use the framing instead of separate conductor cables. In such cases, lightning rods should be electrically bonded to the top part of the framework, and ground terminals should be bonded to the bottom. Structures with electrically continuous metal exteriors might not require separate lightning rod and conductor systems, if the metal is at least 4.76 mm (0.188 in.) thick. The metal exterior itself can intercept lightning and conduct it to the ground.

Proper grounds are essential for effective lightning protection. Each ground connection, and each branch of each ground connection, should extend below and at least 600 mm (2 feet) away from a building’s foundation walls. This minimizes wall damage.
Lightning Arrestors and Surge Protectors

Lightning arrestors assist in the isolation of electrical (twinax) PeerWays, but strikes can still jump those systems. For the fullest protection, fiber optic links are recommended.

Lightning arrestors and surge protectors minimize current induced in wiring of an instrumentation system. This induction can occur in two ways:

- A lightning discharge passing through the conductor system generates a transient magnetic field, which induces current in nearby wiring.
- As the grounding system dissipates a discharge in the earth, a step difference in potential develops in the earth itself. This difference in potential induces current in underground instrumentation wiring.

Protection devices use three main types of circuits:

- Varistors
- Semiconductors (avalanche diodes)
- Gas discharge tubes

Varistors and semiconductors provide protection from lower current levels. Gas discharge tubes protect the system from high current and voltages levels. Most protection devices have a combination of these circuits.

When planning a protection system, carefully consider environmental conditions and plant requirements. To implement the system, follow these suggestions:

- Ground the building and plant site to a single ground system. If there is a remote or separated building at the plant site, isolate the signals, power, and communications systems of the remote building.
• Use overhead cables when possible. The air around overhead cables acts as an insulator, so such cables are less susceptible to lightning induced voltage than are underground cables. Also, because they are not buried, overhead cables are less susceptible to steep potential induction in the earth than are underground cables. Ground both types of cables, including their conduits, pipe racking, and cable trays.

• Use steel conduit, grounded at both ends, for system cables running between buildings.

• Install surge protectors on all cables running outside of buildings by:
  – Installing a protection device for power wiring at either the substation entrance (preferred), or at each piece of powered equipment.
  – Installing a protection device on each phone line coming into the building.
  – Installing a protection device on instrumentation wiring, if the structures are not all grounded to a plant-wide system, or else the equipment is not designed to handle an induced voltage surge.

**NOTE:** Connect a surge arrestor only to the shield of PeerWay cables. Do not connect an arrestor to the signal pair.

• When building a lightning protection system, use strong materials that resist rust and corrosion.

Building additions or structural repairs done without consideration for a lightning protection system can reduce the system’s effectiveness. Deterioration or mechanical damage to the system itself can reduce its effectiveness in similar ways.

To prevent a loss of protection, evaluate all proposed structural changes for effects on the protection system, and ensure that no structural repairs inhibit system protection. Inspect the structure annually for deterioration and mechanical damage. Thoroughly inspect and test the lightning protection system every five years.
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Section 1:
Moving and Unpacking the System

This section describes how to handle RS3 equipment.

RS3 equipment is packed for shipment using materials and methods chosen for optimum equipment protection and ease of handling.

WARNING
Equipment cabinets, especially single-bay cabinets, may be top-heavy. To prevent personal injury or equipment damage, use care when transporting and handling.
Storage

When the equipment is received, immediately move it indoors. Store the equipment in a location where it will not be exposed to extremes of temperature, humidity, vibration, or shock. The following guidelines should be followed for storing equipment at the customer site prior to installation:

- Temperature: -40 to 158° F (-40 to 70° C)
- Diskettes and tapes temperature: -40 to 114° F (-40 to 46° C)
- Humidity: 5% to 95%, non-condensing
- Non-corrosive atmosphere
- Cover equipment to protect from dust and water

**NOTE:** Do not remove the protective packing material until the equipment is in place and ready to be powered up. Exposure to excessive dust, moisture, or corrosive vapors may invalidate the equipment warranty.
Unpacking

Place equipment as close as possible to the storage area or final installation area before unpacking.

Inspect all containers, pallets, and equipment for visible damage before the delivery carrier leaves the site. The carrier and the customer are normally responsible for correcting shipping damage. The packing list, normally included inside crate #1, describes the hardware items shipped.

Immediately report any shortage or damage found that will affect the progress of the installation.
Transporting Equipment

Before transporting the equipment, perform the following tasks:

- Make sure that no loose-shipped items are mounted on the equipment until it has been moved to the final installation area.
- Secure all cabinet doors so they cannot open.

Figure 2.1.1 shows handling methods for domestic shipments. Figure 2.1.2 shows handling methods for international shipments. The weights shown in the figures are approximations.

**WARNING**

Equipment cabinets, especially single-bay cabinets, may be top-heavy. To prevent personal injury or equipment damage, use care when transporting and handling.
Handling Method

Standard Equipment Cabinet
- Single: 272 Kg (600 lb)
- Double: 362–408 Kg (800–900 lb)
RS3 Millennium Cabinet
- 181–227 Kg (400–500 lb)

Hardened Command Console
- 453 Kg (1000 lb)

Multitube Command Console Tabletops
- 113–236 Kg (248–520 lb)

Multitube Command Console Tower
- Electronics Cabinet
- 82 Kg (180 lb)

Multitube Command Console Standard Electronics Cabinet
- 107–125 Kg (236–276 lb)

Multitube Command Console CRT
- 45 Kg (100 lb)

Accessories
- 22–45 Kg (50–100 lb)

AC/DC Power Supply
- 45 Kg (100 lb)

System Power Supply
- Housing: 7 Kg (15.5 lb)
- Module: 5 Kg (11.4 lb)

Figure 2.1.1. Equipment Packed for Domestic Shipment
Handling Method

NOTE: A hoist is required to stand the cabinet up.

Figure 2.1.2. Equipment Crated for International Shipment

RS3: System Cabinets
Moving and Unpacking the System
Cabinets Shipped Upright

☐ To transport and position cabinets that have been shipped upright:

1. Figure 2.1.3 shows how to transport equipment cabinets that are shipped secured to a pallet in an upright position.

![Diagram](image-url)

Figure 2.1.3. Transport of Cabinets that are Secured to a Pallet in an Upright Position
2. When the equipment has been moved as close as possible to the installation location, remove the bolts inside the cabinet that secure the cabinet base to the pallet, as shown in Figure 2.1.4.

![Figure 2.1.4. Cabinet-to-pallet Bolt Locations](image)

Remove Bolts

Remove Bolts and Bar

3. Once the cabinet is no longer secured to the pallet, it can be moved off the pallet. If the cabinet cannot be lifted with a hoist using the optional eye bolts, the following procedure may be used to remove the cabinet from the pallet (see Figure 2.1.5):

   a. Carefully slide one edge of the cabinet onto a wood block that is the thickness of the pallet.

   b. Tip the cabinet so that its weight is supported by the wood block and remove the pallet from under the cabinet. Let the cabinet edge rest on the ground while supporting the cabinet.

   c. Tip the cabinet in the opposite direction and remove the block.

   d. Maneuver the cabinet into its final position by hand.

![Figure 2.1.5. Removing Cabinet from Pallet Without a Hoist](image)
Cabinets Shipped Horizontally

Figure 2.1.6 shows how to transport equipment cabinets that are shipped in a horizontal position and are not secured to a pallet.

1. Dismantle crate.
2. Bring cabinet to upright position.
3. Transport.

OR

Figure 2.1.6. Transport of Cabinets That Are Shipped in a Horizontal Position
Section 2: The RS3 Millennium Package

The RS3 Millennium Package (RMP) is shipped pre-assembled with all components installed, including an RS3 System Power Supply Unit with two 1200-watt power supply modules. The System Power Supply Unit fits on standard 19-inch (483 mm) EIA rails in the top of the RMP cabinet and occupies three units of vertical rack space.

Figure 2.2.1 shows the placement of the components in the the RMP cabinet. The RMP is wired from the bottom only. Because of temperature requirements, the System Power Supply Unit housing is mounted at the top and the OI card cage is mounted at the bottom of the cabinet. Figure 2.2.2 shows front and rear views of the RMP.

Figure 2.2.1. RS3 Millennium Package Cabinet - Side View
Figure 2.2.2. RS3 Millennium Package Cabinet - Front and Rear Views
RMP Cabinet Dimensions

The cabinet for the RMP includes:
- Front and rear hand door swings
- Right and left access

Figure 2.2.3 shows the installation dimensions of the RMP cabinet.

Figure 2.2.3. RS3 Millennium Package Cabinet Dimensions
The handle for each door has a concealed lock mechanism with a sliding cover that can be used to label the cabinet. To open an unlocked door:

1. Slide the cover up to uncover the keyhole.
2. Press the keyhole button inward. The handle pops up.
3. Turn the handle.

To remove the locking side panels,

1. Insert the key into the lock mechanism. Turn the key.
2. Lift and pull out the side panel.

---

**RMP Installation and Maintenance**

If you need to install a System Power Supply Unit in an RMP cabinet, see the instructions in Chapter 5, Section 3. Maintenance for the System Power Supply Unit is also described in Chapter 5, Section 3.

Installation and maintenance for other components of the RMP are described in the appropriate sections of this manual and the RS3 Service Manuals.

---

**Grounding RMP Cabinets**

All metalwork within the cabinet must be grounded to the plated rail structure of the cabinet. This can be done by making bare metal to bare metal electrical contact, by use of a bonding cable, or by using self tapping screws in grounded metal. We recommend using more than one screw to ground two metalwork assemblies together. The cabinet rail structure must be connected to the building ground.
RMP Cabinet Fan Power

The RMP cabinet fan power is supplied by the DC bus of the System Power Supply. The part number for the cable that connects the power supply to the fan is 1984-4460-0001.

**NOTE:** The DC fan mounted in the RMP cabinet cannot use the RS3 AC/DC Power Supply; it will only work with a System Power Supply Unit.

Field Wire Entry into RMP System Cabinets

The RMP cabinet is available with cable entry openings in the bottom panel only (see Figure 2.2.1).

**NOTE:** Use separate wire channels for high-voltage (110/220 VAC) lines and low-voltage (4–20 mA) signal lines to maintain as much separation as possible between voltage and signal wiring. A minimum of 203 mm (8 in.) of separation is recommended.
Section 3:  
Series 2 System Cabinets  

RS3 components such as ControlFiles, FlexTerms, power supplies, and power distribution panels are housed in standard equipment cabinets. Each installation will have one or more standard equipment cabinets.

There are two cabinet series available:

- Series 1 (With round handles and round mounting holes in the internal rails)
- Series 2 (With rectangular handles and square holes in the mounting rails)

Series 1 cabinets are used for expansion of systems with Series 1 cabinets. Series 2 cabinets are shipped with new orders and for expansion of systems with Series 2 cabinets.

This section describes installation of Series 2 cabinets only.

Standard equipment cabinets are shipped as single-bay or double-bay units. If more than two cabinets are to be joined together, they must be assembled at the installation site.

- Cabinets with louvers and pagoda with fan will meet IP31 and NEMA 1 protection ratings.
- Sealed cabinets (no louvers, no pagoda top) will meet IP55 and NEMA 12 protection ratings.
Series 2 Cabinet Dimensions

Series 2 system cabinets are available with:

- Front and rear access
- Front access only
- Right or left hand door swings

Figure 2.3.1 shows the installation dimensions of the Series 2 system cabinet. A File Pocket can be mounted on the cabinet door as shown in Figure 2.3.2. Figure 2.3.3 shows the base mounting dimensions for single and multiple bay installations.

The handle has a concealed lock mechanism with a sliding cover that can be used to label the cabinet.

**NOTE:** To open an unlocked Series 2 cabinet:

1. Slide the cover up to uncover the keyhole.
2. Press the keyhole button inward. The handle pops up.
3. Turn the handle.
Notes:
1. Allow minimum of 1016 mm (40 in.) between door side of cabinet and any permanent wall for maintenance access

Figure 2.3.1. System Cabinet Dimensions
Figure 2.3.2. Door (Inside View)

Figure 2.3.3. System Cabinet Base Dimensions

Notes:

1 Foundation dimensions do not include side panels.
**Joining Series 2 Cabinets Together**

If Series 2 cabinets are to be joined, join them before they are secured to the floor. Cabinets to be joined to other cabinets do not have side panels on the mating sides.

Use the 1984–4237–0001 Cabinet Joiner Kit to secure cabinets to each other. The kit consists of six threaded bushings and twelve self-securing M6x12 cylinder-head screws. Figure 2.3.4 shows the joining positions. Install thin gasket tape from the cabinet accessory kit on the mating surfaces. Place a threaded bushing in each slot and use a screw at each end of the bushing. Tighten the screws gradually to bring the cabinets tightly together.

**NOTE:** Be sure to free any cables that are coiled in the cabinet before the cabinets are joined. Sometimes the cables are hard to reach after joining the cabinets.

![Figure 2.3.4. Joining Series 2 Cabinets Together](image)
Securing Series 2 System Cabinets to the Floor

Join system cabinets before securing them to the floor. Secure the cabinets to the floor through the four bolt holes shown in the base dimension drawing.

Vibration can damage electronic and mechanical assemblies. If a system is to be located near equipment that can cause vibration, cabinets should be isolated from the floor by installing a vibration-damping medium, such as neoprene.

Neoprene can be cut to size and installed as shown in Figure 2.3.5. Holes should be drilled in the mat to allow installation of the bolts. Nuts should be installed loosely to minimize transmission of vibration to the cabinet but still prevent the cabinet from tipping. The neoprene pad must be sized carefully to match the cabinet surface area and load factors. Neoprene is acceptable for high frequency, low amplitude vibration.

![Figure 2.3.5. Vibration Protection (Example)](image-url)
Grounding the Series 2 Cabinets

All metalwork within the cabinet must be grounded to the plated rail structure of the cabinet. This can be done by making bare metal to bare metal electrical contact, by use of a bonding cable, or by using self tapping screws in grounded metal. We recommend using more than one screw to ground two metalwork assemblies together. The cabinet rail structure must be connected to the building ground.

The first and last cabinets in a series have a ground block (55P0579x001) on the bottom rail of the cabinet.

Each cabinet that has a DC distribution bus installed is shipped with a 35 mm$^2$ (2 AWG) cable running from the DC neutral to the cabinet. This cable should remain installed.

When several cabinets are joined into a group, the ground jumpers (1984-4237-0039) must be connected in daisy-chain fashion between the cabinets as shown in Figure 2.3.6. The first or last cabinet of the group must be connected to the building ground by a 35 mm$^2$ (2 AWG) or larger conductor.

See the section on Grounding in Chapter 1 of this manual for more details.
Figure 2.3.6. Grounding a Group of Series 2 Cabinets
Series 2 Cabinet Fan Power

Power is provided to the fan assembly using a Cabinet Fan to AC Entrance Cable (1984-4290-xxxx), which routes between a set of AC Entrance Panel output terminals and the nearest cabinet fan, usually within the same cabinet. Adjacent cabinets within the same suite receive fan power using Cabinet Fan Jumper Cables (1984-4289-xxxx) to jumper fan to fan. These cables are a simple two-wire harness, with 1.5 mm² (16 AWG) insulated wires. Do not jumper more than 10 fans from one AC Entrance Panel output circuit.

Cabinetry is usually shipped with not more than two cabinets bolted together, or with all cabinets separated. Because the fan-to-fan jumper cables between cabinets would have to be disconnected prior to shipping, they are usually not installed at the factory. Thus, installation of these cables must be completed during final installation. If more equipment is to be installed in the cabinets at the end site, it is usually easiest to install cabling prior to installing rack mount equipment. Use caution when routing the Cabinet Fan to AC Entrance Cable and Cabinet Fan Jumper Cables, to prevent insulation damage. In most cases, the Cabinet Fan to AC Entrance Cable already will have been installed.

Route the wire harness along its entire path, but do not permanently secure it until a suitable routing path is determined. Avoid routing cables or harnesses near metalwork edges or corners where abrasion of the insulation might occur. The usual route for fan-to-fan jumper cable is directly from the fan to the side of the cabinet, where it would be secured to the cabinet frame. The cable or harness bend radius should not be less than about three times the largest diameter of the wire harness. From that point, route the harness around and inside the vertical mounting rails, to the front or rear of the cabinet frame, whichever is closest to the fan. Continue to route the harness along the cabinet frame until at the approximate horizontal center of the cabinet where the final run would leave the cabinet frame and route toward the fan connector mounted adjacent to the fan. If nonmetal flexible wire ducting is available, it may be used to enclose the harness.

Secure the wiring at about 150 mm (6 in.) intervals or less, where possible, along the cabinet frame, using nylon cable ties or some equivalent securing method. Thread one end of the cable tie through the hole in the cabinet frame. Wrap the tie around the cable and insert the cable tie straight end through the locking end. Pull the straight end snug, securing the wire harness against the cabinet frame. Use care not to over-tighten the cable ties. Over-tightening could cause damage to wire insulation. Remove the excess tail of the cable ties near the locking mechanism to avoid snagging other cables during routing.
After all fan cables are installed, ensure all mating connectors are connected near the fan. Connect the cable free end terminals to the respective RS3 AC Entrance Panel (10P5662000x) terminals L1, L2/N, and the Protective Conductor Terminal.

**NOTE:** Fan power is not to be routed between different cabinet suites.

Route and connect all wiring internal to the cabinet suite, and mount all equipment as described in the applicable section of this manual. Then, return to the section below and consider conducting the insulation tests prior to interconnecting cables and wire harnesses between different cabinet suites and consoles.

### Insulation Tests

Before attempting to conduct the tests described below, be sure you read all the information and fully understand it. If you have questions, consult the factory.

The isolation integrity between hazardous live circuits and operator accessible parts in systems or components of systems may need to be verified. Systems with a European Union CE Marking, certified by CSA to Canadian standards, or certified as NRTL to U.S. standards should be verified if devices and/or wiring for hazardous live circuits are installed in the cabinetry (other than mains supply wiring to the equipment) after the equipment has left the factory.

Upon completion of final assembly of a cabinet suite, dielectric strength tests (voltage withstanding tests or hipot tests) may be conducted to verify that the integrity of the hazardous live wiring insulation was maintained. Conduct these tests prior to connecting the mains supply wiring to the equipment.

Prior to conducting dielectric strength tests, ensure that all cables and wiring within the cabinet suite to be tested are disconnected from equipment in all other cabinet suites. Ensure the free ends of this wiring are secured, for safety purposes and to prevent erroneous test failure.

Then, turn on the RS3 AC Entrance Panel circuit breakers within the cabinet suite. Set up the test equipment and conduct dielectric strength tests described in the paragraphs below for each AC Entrance Panel installed within the cabinet suite. If there is more than one AC Entrance Panel within the suite, also test isolation between the different AC Entrance Panels’ mains input terminals. That is, test isolation between the mains input terminals of one AC Entrance Panel to the mains input terminals of the other AC Entrance Panel(s) within the same cabinet suite. The L1, L2/N terminals together are a good connection point for one lead of the hipot tester. Use the terminal set labeled “AC1” on dual input units.
Dielectric strength tests should be conducted by an experienced technician or engineer. Ensure that the area is secured for safety around the cabinet suite being tested, and that personnel cannot approach within a safe distance of the equipment under test, as prescribed in the site safety procedures and those of the hipot tester.

Read the hipot tester operating instructions before making any tester connections. Tests should be conducted between the mains supply terminals of the AC Entrance Panel, connected together to one lead of the tester, and the grounded chassis metalwork connected to the other lead of the tester. Conduct this test for each RS3 AC Entrance Panel installed in the cabinet suite.

Voltage withstanding test - test voltage and duration:

- For 120 VAC supplied systems, test at 820 V rms (or 1150 VDC) for 2 seconds.
- For 240 VAC supplied systems, test at 1350 V rms (or 1900 VDC) for 2 seconds.

Permit sufficient leakage current to prevent the tester from erroneous tripping. If the applied test voltage is AC, expect the leakage current to be higher than that of a DC test voltage. Follow the tester operating instructions to conduct the tests.

Hipot testing between different RS3 AC Entrance Panels is conducted between the mains supply terminals of each AC Entrance Panel to those terminals on the remaining AC Entrance Panels. Use the same test voltage and duration as listed above for the supply voltage from which the system will operate.
Field Wire Entry into Series 2 System Cabinets

Standard system cabinets are available with cable entry openings in both the top or the bottom panels.

**NOTE:** Use separate wire channels for high-voltage (110/220 VAC) lines and low-voltage (4–20 mA) signal lines to maintain as much separation as possible between voltage and signal wiring. A minimum of 203 mm (8 in.) of separation is recommended.
System cabinets must be sealed to maintain environmental integrity by preventing ingress of contaminants through cable ducts, trays, and trough/gutter-type wireway environments external to the location of the cabinetry.

The bottom of the cabinet can be sealed when only the top is used for cable entry. In this case, moving the bottom sliding gland plates together provides sufficient seal without extra gasketing. The cabinet top plate should be sealed around the wire entry point to prevent entry of contaminants.

Bottom cable entry can also be used by adjusting the bottom sliding gland plates and using some form of gasketing or sealing material to seal the open areas that remain after wiring entry is completed. Also, both top and bottom can be used simultaneously for wire and cable entry. Ensure proper sealing for both the top and bottom of the cabinet where cabling enters the equipment.

Note that the bottom of the cabinet contains six holes in the cabinet frame, two of which are used for bolting the cabinet to the shipping pallet. Once the cabinet is installed, use “cap stoppers” from the cabinet spares kit to plug all unused holes in the bottom of the cabinet frame.

System cabinets with top-mounted fan pagoda and louvered doors as the standard cooling method will have enclosure protection ratings of at least NEMA 1 and IP31, provided the sealing guidelines above are employed.

The AC entrance, power supply tray, and DC distribution bus typically are located as shown in Figure 2.3.7.
Figure 2.3.7. Power Component Location for Bottom Entry
Top Entry, Series 2 Cabinets

There is a flat gland plate at the top of the cabinet. Cut properly sized holes in this plate for the wire entry. The gland plates are fastened to the roof of the cabinet using M6 screws and paint cutting washers. There is a foam-in-place gasket on the top of the roof of the cabinet to provide a NEMA 12 type seal between the gland plate and cabinet.

The AC entrance, power supply tray, and DC distribution bus typically are located as shown in Figure 2.3.8.

![Diagram showing the location of AC entrance, power supply tray, and DC distribution bus.]

Figure 2.3.8. Power Component Location for Top Entry
RS3 components such as ControlFiles, FlexTerms, power supplies, and power distribution panels are housed in standard equipment cabinets. Each installation can contain one or more standard equipment cabinets.

There are two series available:

- Series 1 (With round handles and round mounting holes in the internal rails)
- Series 2 (With rectangular handles and square holes in the mounting rails)

Series 1 cabinets are used for expansion of systems with Series 1 cabinets. Series 2 cabinets are shipped with new orders and for expansion of systems with Series 2 cabinets.

This section describes installation of Series I cabinets only.

Standard equipment cabinets are shipped as single-bay or double-bay units. If more than two cabinets are to be joined, they must be assembled at the installation site.
Installing Vibration Protection for Series 1 Cabinets

Vibration can damage electronic and mechanical assemblies. If a system is to be located near equipment that can cause vibration, cabinets should be isolated from the floor by installing a vibration-damping medium, such as neoprene.

Neoprene can be cut to size and installed as shown in Figure 2.4.1. Holes should be drilled in the mat to allow installation of the bolts. Nuts should be installed loosely to minimize transmission of vibration to the cabinet but still prevent the cabinet from tipping. The neoprene pad must be sized carefully to match the cabinet surface area and load factors. Neoprene is acceptable for high frequency, low amplitude vibration.

Figure 2.4.1. Vibration Protection (Example)
Joining Series 1 Cabinets Together

If Series 1 cabinets are to be joined together, they should be joined before they are secured to the floor. Cabinets that are to be joined to other cabinets lack side panels on the mating sides.

**NOTE:** Be sure to free any cables that are coiled in the cabinet before the cabinets are joined. Sometimes the cables are hard to reach after joining the cabinets.

To secure cabinets to each other, bolt them together using the 1/4–20 cap screws, lock washers, and nuts provided. Bolt hole locations are indicated in Figure 2.4.2.

![Figure 2.4.2. Bolt Hole Locations for Securing Series 1 Cabinets Together](image)
Securing Series 1 Cabinets to the Floor

If Series 1 cabinets are to be joined together, they should be joined before they are secured to the floor.

Secure the cabinets to the floor through the four bolt holes, as shown in Figure 2.4.3. Remove the four lift eye bolts (if present) and seal their openings in the top of the cabinet to prevent entry of contaminants.

![Diagram of bolt hole locations for securing Series 1 cabinets to the floor]

Figure 2.4.3. Bolt Hole Locations for Securing Series 1 Cabinets to the Floor
You can connect the standard equipment cabinet air flow switch to an alarm to notify you when the fan is not operating.

Figure 2.4.4 shows the cabinet fan AC receptacle. Figure 2.4.5 shows an air flow switch alarm connected to a contact marshaling panel. Figure 2.4.6 shows an air flow switch alarm connected to a Contact FlexTerm. If all fans are ON, the contact will be open. If any fan is OFF, the contact will be closed.
Figure 2.4.5. Air Flow Switch Alarm to Contact Marshaling Panel

Figure 2.4.6. Air Flow Switch Alarm to Contact FlexTerm
Field Wire Entry into Series 1 System Cabinets

Standard system cabinets have cable entry openings in both the top and bottom panels.

**NOTE:** Use separate wire channels for high-voltage (110/220 VAC) lines and low-voltage (4–20 mA) signal lines to maintain as much separation as possible between voltage and signal wiring. A minimum of 8 inches (203 mm) of separation is recommended.

Bottom Entry

Figure 2.4.7 shows two possible ways of routing cabling for bottom entry into system cabinets. The bottom entry has a sliding panel for sizing the opening. A foam strip along the edge of the panel reduces entry of dust and other contaminants into the cabinet.
Figure 2.4.7. Methods of Bottom Cable Entry into System Cabinet
Figure 2.4.8 shows a possible way of routing cabling for top entry into system cabinets. The top entry has a sliding panel for sizing the opening. A foam strip along the edge of the panel reduces entry of dust and other contaminants into the cabinet.
Field Wire Routing to Card Cages

Figure 2.4.9 shows field wire routing to card cages inside standard system cabinets. This is a composite drawing and is not intended to show the actual configuration of a cabinet.

- For Multiplexer FlexTerms, route field wires through strain reliefs and leave sufficient length for removal of FEMs.
- Route field wires through wire channels and tiedowns.
- Route field wires down right side of cabinet using tiedowns and tiwraps.
- Route recorder wires down left side of cabinet using tiwraps and tiedowns.
- Route all wiring through bottom of cabinet.

Figure 2.4.9. Field Wire Routing to Card Cages (Bottom Entry Shown)
Field Wire Routing to Marshaling Panels

Figure 2.4.10 shows field wire routing to marshaling panels inside standard system cabinets. This is a composite drawing and is not intended to show the actual configuration of a cabinet.

Route field wires through tiewraps and tiedowns.

Route cables from marshaling panels to FlexTerms down left side of cabinet using tiewraps and tiedowns.

Route all wiring through bottom of cabinet.

Route field wires down right side of cabinet using tiedowns and tiewraps.

Figure 2.4.10. Field Wire Routing To Marshaling Panels (Bottom Entry Shown)
Section 5: Floor-Mounted I/O Cabinets

These I/O cabinet models are available:

- 2X5 - A cabinet that can contain two columns of five Multipoint I/O termination panels.
- 4X5 - A cabinet that can contain four columns of five Multipoint I/O termination panels.

**WARNING**

I/O cabinets can fall over if they are not supported at all times. Take care when removing the cabinet from the shipping pallet. Installed cabinets must be fastened to a wall or joined in a group back-to-back with other cabinets.

Properly sealed cabinets with louvered doors and top-mounted fan pagoda have protection ratings of at least NEMA 1 and IP31.

Sealed I/O cabinets, without door louvers and fan pagoda top, have protection ratings of NEMA 12 and IP55, provided the areas around cable entry and unused mounting holes in the frame are properly gasketed or sealed. Floor-mounted I/O cabinets are shipped from the factory with the cabinets bolted to shipping pallets. Once a cabinet is installed, unused mounting holes are to be plugged using “cap stoppers” provided in the cabinet spares kit. It is not necessary to place gasketing between the gland plates at the cabinet bottom to maintain those protection ratings if the wire entry is through the top only.

Mounting dimensions for the 2X5 cabinet are shown in Figure 2.5.1 and Figure 2.5.2.
Allow minimum of 1016 mm (40 in.) between door side of cabinet and any permanent wall for maintenance access.

Dimension of cabinet without side panels is 600 mm (23.6 in.).

Figure 2.5.1. 2X5 I/O Cabinet Dimensions
Notes:
1. Foundation dimensions do not include side panels.

Figure 2.5.2. 2X5 Cabinet Foundation Dimensions
Mounting dimensions for the 4X5 cabinet are shown in Figure 2.5.3 and Figure 2.5.4.

Notes:

1. Allow minimum of 1016 mm (40 in.) between door side of cabinet and any permanent wall for maintenance access.

2. Dimension of cabinet without side panels is 1200 mm (47.2 in.).

3. Dimension of cabinet without rear panel is 375.5 mm (14.75 in.).

Figure 2.5.3. 4X5 I/O Cabinet Dimensions
Single-Bay Foundation

Bottom Cable Entry Opening

4.0 (.55) Dia. Plinth Base Mounting Holes

37.5 (1.48)

62.5 (2.46)

350 (13.8)

275 (10.8)

1075 (42.3)

1200 (47.2)

400 (15.7)

Foundation dimensions do not include side panels.

Note:

Figure 2.5.4. 4X5 Cabinet Foundation Dimensions
Each cabinet comes with a mounting plate custom drilled for Multipoint I/O termination panels. Termination panels can be mounted directly against the mounting plate using M4 20 mm self-tapping screws (G53405-1001-4020). Alternately, standard DIN rails can be installed to mount termination panels equipped with the DIN foot. Either the asymmetrical 32 mm “G” (1984-4297-000x) or the symmetrical 35 x 7.5 mm “hat” (1984-4309-000x) rail as shown in Figure 2.5.5 can be used.

![Symmetrical Hat Rail and Asymmetrical G Rail](image)

**Figure 2.5.5. DIN Rails**
Joining 2X5 or 4X5 I/O Cabinets Together

If 2X5 or 4X5 I/O cabinets are to be joined together side-by-side, they should be joined before they are secured to the floor. Cabinets that are to be joined to other cabinets do not have side panels on the mating sides.

Use the 1984-4237-0001 Cabinet Joiner Kit to secure cabinets to each other side-by-side. The kit consists of six threaded bushings and twelve self-securing M6x12 cylinder-head screws. Figure 2.5.6 shows the joining positions. Install gasket tape from the cabinet accessory kit on one of the mating surfaces. Place a threaded bushing in each slot and use a screw at each end of the bushing. Tighten the screws gradually to bring the cabinets tightly together.

![Figure 2.5.6. Joining I/O Cabinets](image-url)
Installing Vibration Protection

Vibration can damage electronic and mechanical assemblies. If a system is to be located near equipment that can cause vibration, cabinets should be isolated from the floor by installing a vibration-damping medium, such as neoprene.

Neoprene can be cut to size and installed as shown in Figure 2.5.7. Holes should be drilled in the mat to allow installation of the bolts. Nuts should be installed loosely to minimize transmission of vibration to the cabinet but still prevent the cabinet from tipping. The neoprene pad must be sized carefully to match the cabinet surface area and load factors. Neoprene is acceptable for high frequency, low amplitude vibration.

Figure 2.5.7. Vibration Protection (Example)
Stabilizing 2X5 and 4X5 I/O Cabinets

2X5 and 4X5 cabinets are unstable. Depending on the weight distribution inside, they can tip over, even when joined side-to-side. To prevent tipping they must be securely fastened to a wall, to the floor, or be joined back-to-back.

Use the stabilizing bracket at the top rear of the cabinet to secure the cabinet to a wall. There are two 10 mm (0.4 in.) holes in the stabilizing bracket for this purpose.

The cabinets can be stabilized by joining them back-to-back. Bolt the two stabilizing brackets together. Join only like-sized cabinets together back-to-back.

The cabinets can be secured to the floor using the mounting holes in the cabinet base.

WARNING

I/O cabinets can fall over if they are not supported at all times. Take care when removing the cabinet from the shipping pallet. Installed cabinets must be fastened to a wall or joined in a group back-to-back with other cabinets.
Grounding the Cabinets

All metalwork within the cabinet must be grounded to the rail structure of the cabinet. This can be done by making bare metal to bare metal electrical contact, by use of a bonding cable, or by using self tapping screws in grounded metal. We recommend using more than one screw to ground two metalwork assemblies together. The cabinet rail structure must be connected to the building ground.

Use the ground block (55P0579x001) located on the center rail of the cabinet to connect to the building ground.

When several cabinets are joined into a group, the ground jumpers (1984–4237–0039) must be connected in daisy chain fashion between the cabinets as shown in Figure 2.5.8. The ground block of the first and last cabinet of the group must be connected to the building ground by a heavy conductor 35 mm² (2 AWG) or larger.

![Grounding a Group of 2X5 or 4X5 I/O Cabinets](image-url)

Figure 2.5.8. Grounding a Group of 2X5 or 4X5 I/O Cabinets
Wiring a 2X5 I/O Cabinet

Wires can enter the cabinet from the top or from the bottom. Figure 2.5.9 shows wiring in the 2X5 I/O cabinet. System wiring is run in the two 25X57 mm (1X2.25 in.) ducts (G60900-1022-0101) located in the frame of the cabinet. Field wiring is run in the 102X102 mm (4X4 in.) duct (G6090-4040-0101) located in the center of the cabinet.

Figure 2.5.9. Field and System Wiring in a 2X5 I/O Cabinet
Wiring a 4X5 I/O Cabinet

Wires can enter the cabinet from the top or bottom. System wiring for the outer columns of termination panels is run in two 25X57 mm (1X2.25 in.) ducts (G60900-1022-0101) located in the frame of the cabinet. System wiring for the inner termination panels is run in the central duct between the two columns.

Field wiring is run in the two 102X102 mm (4X4 in.) ducts (G6090-4040-0101) between column pairs.

Figure 2.5.10 shows the locations of the termination panels and wiring ducts on the mounting panel.
Installing Multipoint I/O Termination Panels

Figure 2.5.11 shows a typical Multipoint I/O termination panel installation.

![Diagram of a typical Multipoint I/O Termination Panel Installation]

Figure 2.5.11. Typical Multipoint I/O Termination Panel Installation
Installing a Remote Power Supply

Figure 2.5.12 shows a typical Remote I/O Power supply installation. See Section 6 for details of installing the supply.

Figure 2.5.12. Typical Installation in a 2X5 I/O Cabinet
Section 6:  
Wall-Mounted I/O Cabinets

The wall-mounted I/O cabinet is known as a 2X2 since it can hold two columns of two Multipoint I/O termination panels.

The wall-mounted cabinet will meet IP66 and NEMA 4.

WARNING

The cabinet can fall over if it is not supported at all times. Take care when removing the cabinet from the shipping pallet. Installed cabinets must be fastened to a wall.

The cabinet can be mounted flush with the wall by using the four 8 mm (0.3 in.) holes in the back of the cabinet.

The cabinet can be offset 40 mm (1.5 in.) from the wall by use of the optional 1984-4237-0024 wall-mounting brackets. These brackets extend 27 mm (1.1 in.) beyond the cabinet on each side.

Each cabinet comes with a mounting plate custom drilled for Multipoint I/O termination panels. Termination panels can be mounted directly against the mounting plate using M4 20 mm self-tapping screws (G53405-1001-4020). Alternately, standard DIN rails can be installed to mount termination panels equipped with the DIN foot. Either the asymmetrical 32 mm “G” (1984-4297-000x) or the symmetrical 35x7.5 mm “hat” (1984-4309-000x) rail shown in Figure 2.6.1 can be used.

Figure 2.6.1. DIN Rails

Figure 2.6.2 shows the dimensions of the 2X2 I/O cabinet.
Notes:

1. Allow minimum of 1016 mm (40 in.) between cabinet and any permanent wall for maintenance access.

2. Mounting plate has a custom hole pattern for mounting Distributed I/O components.

Figure 2.6.2. 2X2 Wall-Mounted I/O Cabinet Dimensions
Grounding the Cabinet

All metalwork within the cabinet must be grounded to the rail structure of the cabinet. This can be done by making bare metal to bare metal electrical contact, by use of a bonding cable, or by using self-tapping screws in grounded metal. We recommend using more than one screw to ground two metalwork assemblies together. The cabinet rail structure must be connected to the building ground.

There is a grounding lug (55P0579x001) near the bottom of the cabinet. Use this lug to connect the cabinet to the building ground.
Field Wiring

All wiring enters the cabinet from the bottom.

The 2X2 cabinet has all ducts for the system and field wiring fastened to the mounting panel, as shown in Figure 2.6.3. The outside 25X57 mm (1X2.25 in.) ducts (G60900-1022-0101) are for system wires. The inside 102X102 mm (4X4 in.) duct (G6090-4040-0101) is for field wires.

Figure 2.6.3. Field and System Wiring in a 2X2 I/O Cabinet
Figure 2.6.4 shows a typical Multipoint I/O termination panel installation.
A Remote I/O Power Supply can be mounted as shown in Figure 2.6.5. See Section 6 for information on installing the Remote I/O Power Supply.

Figure 2.6.5. Installing a Remote I/O Power Supply in a 2X2 I/O Cabinet
Section 7:
Remote I/O Power

The DIN rail mounted Remote I/O Power Supply can be used to supply DC power to Multipoint I/O termination panels. The supply is assembled as required from these components:

- AC Distribution Block (1984-4329-0001)
- Remote I/O Power Supply (10P57010001, 10P55030001 and 10P55030002)
- DC Distribution Block (1984-4329-000x)
- AC/DC Distribution Block (1984-4329-0004)
- DIN Rail, 396 mm (15.67 in.) long (1984-4309-0004)
- DC I/O Power Cable(s) (1984-4337-xxxx and 1984-4433-xxxx)
- Fuse Label (1984-4350-0001)
Remote I/O Power Supply Assembly

Figure 2.7.1 shows a typical assembly. This assembly uses the same space as a Multipoint I/O termination panel. It mounts on a 400 mm (15.75 in.) DIN rail and is 118 mm (4.6 in.) wide. Figure 2.7.2 shows a typical assembly.
Figure 2.7.2. Typical Remote I/O Power Supply Wiring
AC Distribution Block

The AC distribution Block (1984-4329-0001) provides two fused switched circuits to feed two AC devices, normally the power supply and the cabinet fan. The AC Distribution Block consists of grey blocks for the line and neutral connections and a yellow-green block for the ground. It requires approximately 30 mm (1.2 in.) of space on the DIN rail. Figure 2.7.3 shows the block. Figure 2.7.4 shows typical wiring.

The AC/DC Distribution Block (1984-4329-0004) provides ten DC circuits (numbered 1-10) with a 1.0 amp fuse for each circuit and two fused switched AC circuits to feed two AC devices. This block requires approximately 115 mm (3.5 in.) of space on the DIN rail.

The neutral terminals are connected by a built-in jumper. The line terminals are connected by an external jumper bar that must remain in place. The terminals will accept up to 4 mm² (10 AWG) solid or stranded wire.

NOTE: Always bring power into the side with the jumpers or one fuse will control both circuits.

The circuit is opened by removing the fuse module from the top of the block. Each module has a replaceable fuse and a fuse-blown indicator light.
Figure 2.7.3. AC Distribution Block
Figure 2.7.4. Typical AC Distribution Block Wiring
Remote I/O Power Supply

The Remote I/O Power Supply is available in the following models:

- 10P57010001 for 115–230 VAC and NRTL and CSA applications
- 10P55030001 for 115 VAC and CE applications
- 10P55030002 for 230 VAC and CE applications

10P57010001 DC output is 5.0 amp (maximum) at 24V. The supply is rated to deliver 120 watts.

10P5503000x DC output is 6.0 amp (maximum) at 24V. The supply is rated to deliver 150 watts.

The supply requires approximately 230 mm (9.1 in.) of space on the DIN rail. Figure 2.7.5 shows the supply.

![Diagram of Remote I/O Power Supply](image)
The DC Distribution Block provides for either one or ten individually
switched and fused DC circuits. The available assemblies are:

- 1984-4329-0002 for ten DC circuits with a 1.0-amp fuse for each
circuit. This block requires approximately 85 mm (2.3 in.) of
space on the DIN rail.

- 1984-4329-0003 for one DC circuit with a 3.0-amp fuse. This
block requires approximately 24 mm (0.9 in.) of space on the DIN
rail.

- 1984-4329-0004 (AC/DC Distribution Block) for ten DC
circuits with a 1.0 amp fuse for each circuit and two fused
switched AC circuits to feed two AC devices. This block requires
approximately 115 mm (3.5 in.) of space on the DIN rail.

Figure 2.7.6 shows the -0002 and -0003 blocks. The neutral terminals
of the ten circuit block are jumpered together by an internal jumper bar.
The VDC terminals are jumpered by an external jumper bar.
Figure 2.7.7 shows typical wiring.

**NOTE:** You must bring power to the side with the jumpers or one fuse
will control all circuits.

The terminals will accept up to 4 mm² (10 AWG) solid or stranded wire.
Always supply power to the center of the block on the side with the
jumpers.

The circuit is opened by removing the fuse module from the block.
Each module has a replaceable fuse and a fuse-blown indicator light.
AC distribution Block (1984-4329-0001) provides two fused switched
circuits to feed two AC devices, normally the power supply and the
cabinet fan. The AC Distribution Block consists of grey blocks for the
line and neutral connections and a yellow-green block for the ground. It
requires approximately 30 mm (1.2 in.)
Figure 2.7.6. DC Distribution Blocks
Figure 2.7.7. Typical DC Distribution Block Wiring
DC Power Cables

From one to ten DC power cables are supplied to connect the DC distribution block to the Multipoint I/O termination panel. The cables have stripped wire ends for connection to the power distribution termination block on the termination panel.

The cable for A bus use is 1984-4337-xxxx (Cable, Local DC Power supply, A Bus). For the B bus, use 1984-4433-xxxx (Cable, Local DC Power supply, B Bus).

The last four digits of the part number indicate the length.
- 0xxx is the length in meters
- 9xxx is the length in millimeters

The standard color code is used: orange for VDC and brown for return.

DIN Rail

The optional symmetrical DIN rail is 396 mm (15.67 in.) long. It can be mounted on the I/O cabinet mounting plate with the same holes and mounting screws used for a Multipoint I/O termination panel.

The DIN rail must be grounded to the cabinet ground. The mounting screws will normally provide an adequate ground connection.

Fuse Label

A label (1984-4350-000x) is provided to record the actual fuse sizes installed in the AC and DC distribution blocks. Install the label inside the I/O cabinet door or as close to the power supply as practical. Standard fuse sizes are listed on the label; be sure to record any changes from the standard. Figure 2.7.8 shows the label.
Power Distribution
Location: ________________

Unless otherwise noted, the following fuse sizes have been installed at the factory.

<table>
<thead>
<tr>
<th>Blocks of AC:</th>
<th>3 Amp/circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocks of 10 DC:</td>
<td>1 Amp/circuit</td>
</tr>
<tr>
<td>Block of 1 DC:</td>
<td>3 Amp/circuit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DC CKT #</th>
<th>Fuse Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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<td>3</td>
<td></td>
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<td>4</td>
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<td>5</td>
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</tr>
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<td>9</td>
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<td>10</td>
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</table>

<table>
<thead>
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<th>AC CKT #</th>
<th>Fuse Size</th>
</tr>
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<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2.7.8. Remote I/O Power Supply Fuse Label
Installing a Remote I/O Power Supply in an I/O Cabinet

The Remote I/O Power supply and distribution blocks can be mounted on existing DIN rail or on the optional rail. The optional DIN rail fits on the cabinet mounting panel. The supply assembly takes the same amount of space as a distributed I/O termination panel.

Figure 2.7.9 shows typical mounting for a 2X5 I/O cabinet, the 4X5 is similar. Figure 2.7.10 shows the assembly in a 2X2 I/O cabinet.

NOTE: The DIN rail must have an adequate ground connection to the cabinet chassis.
Figure 2.7.9. Installing a Remote I/O Power Supply in a 2X5 I/O Cabinet
Figure 2.7.10. Installing a Remote I/O Power Supply in a 2X2 I/O Cabinet
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<td>OI Card Cage Views</td>
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<td>Rear View of Card Cage</td>
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<td>Alarm Connectors</td>
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<td>Keyboard Cabling</td>
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<td>Keyboard/Video Interface Cabling</td>
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<td>3.6.1</td>
<td>Basic Process Network</td>
<td>3-6-3</td>
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<td>3.6.2</td>
<td>Expanded Process Network</td>
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<td>Connection to a Plant Network</td>
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<td>Network Management</td>
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<td>Elevated Operator Keyboard Dimensions in Millimeters (Inches)</td>
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<td>Operator Keyboard Dimensions in Millimeters (Inches)</td>
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<td>ROS Operator Keyboard Interface Card</td>
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<td>ROS Operator Keyboard Interface Connection</td>
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<th>Table</th>
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<td>OI Card Cage Connectors and Fuses</td>
<td>3-5-9</td>
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<td>CE-Compliant Cables</td>
<td>3-5-10</td>
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<td>3.6.1</td>
<td>Typical Power Consumption Examples</td>
<td>3-6-20</td>
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</tbody>
</table>
Section 1:
Series 2 Console Furniture

Series 2 furniture is modular, allowing the construction of single and multi-level tables as required. See the Design Considerations section for a listing of all available components. A typical installation is shown in Figure 3.1.1.

![Figure 3.1.1. Typical Installation](image)

**NOTE:** Rear access is required for any table where the Operator Interface (OI) Card Cage is installed.
Design Considerations

Series 2 tables are available in several configurations as shown below in Table 3.1.1. Tabletops are available in full depth (1200 mm [47.2 in.]) or half depth (600 mm [23.6 in.]) and three widths (600, 1200, 1800 mm [23.6, 47.2, 70.9 in.]). Half-depth tables are used to make multi-level assemblies. The rear tabletop can be at the -1 level (depressed 102 mm [4 in.]), 0 level (even with the front), or the +1 level (elevated 560 mm [22 in.]). You can have rear tables mounted at -1 and +1 or at 0 and +1. Corner assemblies allow 45° or 90° bends.

<table>
<thead>
<tr>
<th>Position</th>
<th>Depth</th>
<th>Width</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Level</td>
<td>1200 mm</td>
<td>600, 1200, 1800 mm, 45° Corner, 90° Corner</td>
<td>800 kg (1800 pounds)</td>
</tr>
<tr>
<td>Front facing, 0 Level</td>
<td>600 mm</td>
<td>600, 1200, 1800 mm, 45° Corner, 90° Corner</td>
<td>400 kg (900 pounds)</td>
</tr>
<tr>
<td>Rear facing, -1 Level</td>
<td>600 mm</td>
<td>600, 1200, 1800 mm, 45° Corner, 90° Corner</td>
<td>400 kg (900 pounds)</td>
</tr>
<tr>
<td>Rear facing, +1 Level</td>
<td>670 mm</td>
<td>600, 1200, 1800 mm, 45° Corner, 90° Corner</td>
<td>400 kg (900 pounds)</td>
</tr>
</tbody>
</table>

Capacity

The capacity includes equipment on the top of the table and the weight of suspended cabinets beneath the table.

**CAUTION**

Keep the center of gravity of heavy loads within 355 mm (14 in.) of the table centerline. This prevents tipping.
1200 mm Deep Tables

Full-depth tables mount only at the zero level. A +1 level rear-facing table can be used with a full-depth table. These tables have a rounded front edge. There is a cable tray along the centerline. Covered cable access holes are provided at the rear of the table. Figure 3.1.2 shows the table tops.

**NOTE:** Use of the 1200 mm deep table is recommended when access keys are used. Placing the Keyboard/Video Interface (KVI) on a -1 level table can make access to the key difficult.

![Figure 3.1.2. 1200 mm Deep Tables](image)

Zero Level Front-Facing Tables

These tables can be used with +1 and -1 level tables. The front edge is rounded. There is a cable tray on the rear underside. These tables are normally used as the operator’s work surface. Figure 3.1.3 shows the table tops.

![Figure 3.1.3. Zero Level Front-Facing Tables](image)
-1 Level Rear-Facing Tables

These tables can be used with 0 and +1 level tables. There is a cable tray on the rear front side. Covered cable access holes are provided. These tables are usually used to hold CRTs and KVI assemblies. Figure 3.1.4 shows these tabletops.

**NOTE:** Consider using the 1200 mm deep table when access keys are used. Placing the KVI on a -1 level table can make access to the key difficult. The -1 level table is preferred when the password keyboard is used.

![Figure 3.1.4. -1 Level Rear-Facing Tables](image1)

+1 Level Rear-Facing Tables

These tables can be used with 0 and -1 level tables. The +1 table is constructed of welded steel with integral cable ducts underneath. The front edge is rounded. The table is 670 mm (26.4 in.) deep. There are no cable access holes in the tabletop. These tables are usually used for double-stacking CRTs. Figure 3.1.5 shows the tables.

![Figure 3.1.5. +1 Level Rear-Facing Tables](image2)
Legs are available in two heights and eight configurations. The front view, Figure 3.1.6, shows all combinations.

<table>
<thead>
<tr>
<th>No.</th>
<th>Leg</th>
<th>No.</th>
<th>Leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+1 level table</td>
<td>7</td>
<td>Connecting, 1275 mm</td>
</tr>
<tr>
<td>2</td>
<td>0 level table</td>
<td>8</td>
<td>Right side connecting, 1275 mm</td>
</tr>
<tr>
<td>3</td>
<td>−1 level table</td>
<td>9</td>
<td>Right end, 750 mm</td>
</tr>
<tr>
<td>4</td>
<td>Left end, 750 mm (28.1 in.)</td>
<td>10</td>
<td>Left end, 1275 mm</td>
</tr>
<tr>
<td>5</td>
<td>Connecting, 750 mm</td>
<td>11</td>
<td>Right end, 1275 mm</td>
</tr>
<tr>
<td>6</td>
<td>Left side connecting, 1275 mm (50.2 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.1.6. Legs
The 750 mm (29.5 in.) legs support 0 and -1 level tables. The legs are available for left end, right end, and connecting positions. Legs are shipped with stop nuts at the 0 and -1 positions. Figure 3.1.7 shows details of the 750 mm leg.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>750 mm leg, outside view</td>
<td>8</td>
<td>Stopnut for -1 level tabletop</td>
</tr>
<tr>
<td>2</td>
<td>750 mm full panel</td>
<td>9</td>
<td>Stopnut for 0 level tabletop</td>
</tr>
<tr>
<td>3</td>
<td>750 mm leg, front view</td>
<td>10</td>
<td>0 level stopnut: 150 mm (5.9 in.)</td>
</tr>
<tr>
<td>4</td>
<td>750 mm leg, inside view</td>
<td>11</td>
<td>-1 level stopnut: 335 mm (13.2 in.)</td>
</tr>
<tr>
<td>5</td>
<td>Lower partial panel</td>
<td>12</td>
<td>Height of leg: 750 mm (29.5 in.)</td>
</tr>
<tr>
<td>6</td>
<td>Cable entry opening at front side of leg</td>
<td>13</td>
<td>Mounting holes: 660 mm (26.0 in.)</td>
</tr>
<tr>
<td>7</td>
<td>Fixed panel at rear side of leg</td>
<td>14</td>
<td>Width of foot: 720 mm (28.3 in.)</td>
</tr>
</tbody>
</table>

Figure 3.1.7. 750 mm Leg
The 1275 mm (50.2 in.) legs support 0, -1, and +1 level tables. The legs are available in right end, left end, connecting, right connecting, and left connecting configurations. Legs are shipped with stop nuts at the 0, -1, and +1 positions. Figure 3.1.8 shows details.

![Diagram of 1275 mm Leg](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1275 mm Leg, outside view</td>
<td>10</td>
<td>Stopnut for -1 level tabletop</td>
</tr>
<tr>
<td>2</td>
<td>Full panel</td>
<td>11</td>
<td>Stopnut for 0 level tabletop</td>
</tr>
<tr>
<td>3</td>
<td>1275 mm Leg, front view</td>
<td>12</td>
<td>Stopnut for +1 level tabletop</td>
</tr>
<tr>
<td>4</td>
<td>1275 mm Leg, inside view</td>
<td>13</td>
<td>0 level stopnut: 675 mm (26.6 in.)</td>
</tr>
<tr>
<td>5</td>
<td>Lower partial panel</td>
<td>14</td>
<td>+1 level stopnut: 150 mm (5.9 in.)</td>
</tr>
<tr>
<td>6</td>
<td>Cable entry opening at front side of leg</td>
<td>15</td>
<td>-1 level stopnut: 860 mm (33.9 in.)</td>
</tr>
<tr>
<td>7</td>
<td>Fixed panel at rear side of leg</td>
<td>16</td>
<td>Height of leg: 1275 mm (50.2 in.)</td>
</tr>
<tr>
<td>8</td>
<td>Upper partial panel</td>
<td>17</td>
<td>Mounting holes: 660 mm (26.0 in.)</td>
</tr>
<tr>
<td>9</td>
<td>Cable entry opening at center of leg</td>
<td>18</td>
<td>Width of foot: 720 mm (28.3 in.)</td>
</tr>
</tbody>
</table>

**Figure 3.1.8. 1275 mm Leg**
Assembly

The tables can be delivered partially set up or as a group of subassemblies. This manual covers assembly and adjustment of the tables.

☐ **Tools required:**
- Screwdriver, flat blade
- 4 and 5 mm hex wrenches
- Power wrench or screwdriver
- Strapping tape or masking tape

Recommended:
- Panel jack or other means of supporting and lowering tabletops
- Spirit level

Torque the setscrews to 7 N•m (63 in-lb). Torque screws in the composition tabletop material to no more than 5 N•m (45 in-lb) to avoid stripping the threads.

**NOTE:** It is sometimes easier to install the cable tray first and then put the tabletops on. This works well if there is no mechanical lift available to hold the tabletops during assembly.

☐ **General assembly instructions for tabletops with cable trays installed:**
1. Position the legs, making sure that the 0-level stop nuts and the lower cable openings are at the front.
2. Remove all caps and side panels. Use a screwdriver placed about 150 mm (6 in.) below the top of the panel to pry out the panel.
3. Assemble 4 square nuts and M8x10 screws. The square nut has one smooth side and one machined side. Be sure that the set screw enters the square nut from the machined side (with 4 small points at the corners).
4. Support the tabletop over the legs. Use of a jack or other device to support the tabletop is highly recommended.

**CAUTION**

Have two people lift the tabletops.

5. Insert a square nut into the two slots at each end of the table mounting brackets. Use tape to hold the nut in place.
6. Lower the table, inserting the mounting brackets into the leg channels. Remove the tape before it enters the leg channel.

7. Lower the table until the brackets are against the stop nuts.

8. Tighten the set screws into the 4 square nuts. Use a 4 mm hex wrench.

9. Leave the side panels and caps off until the table is leveled and the cables are installed.

General assembly instructions to install the cable tray and then the tabletop:

1. Remove the cable tray from the tabletop.

2. Remove all caps and side panels. Use a screwdriver placed about 150 mm (6 in.) below the top of the panel to pry out the panel.

3. Assemble 4 square nuts and M8x10 screws. The square nut has one smooth side and one machined side. Be sure that the set screw enters the square nut from the machined side (with 4 small points at the corners).

4. Insert a square nut into the two slots at each end of the table mounting brackets. Use tape to hold the nut in place.

5. Position the cable tray over the legs and insert the mounting brackets into the leg channels. Remove the tape before it enters the leg channel.

6. Lower the tray until the brackets are against the stop nuts.

7. Tighten the hex bolts into the 4 square nuts. Use a 4 mm hex wrench.

8. Position the tabletop on the cable tray. Screw the tabletop to the cable tray. Have someone hold it in position until several screws are installed.

9. Leave the side panels and caps off until the table is leveled and the cables are installed.
To assemble a zero-level (1200 mm deep) table:
1. Reposition the -1 level stop nuts to the 0 level position and follow the general instructions.

To assemble a (0, -1) level table:
1. Follow the general instructions. Install the -1 level table first.

To assemble a (0, +1, -1) level table:
1. Remove the +1 level stop nuts.
2. Follow the general instructions to install the 0 and -1 level tables.
3. Replace the +1 level stopnuts.
4. Follow the general instructions to install the +1 level table.

Fastening the Tables to the Floor (Optional)

The tables can be fastened to the floor by bolts and washers inserted in the holes in the feet.

To fasten the legs to the floor:
1. Remove the plastic caps on the bottoms of the legs. Use a screwdriver from the front bottom of the cap.
2. Mark the positions of the holes and install 8 mm (5/16 in.) threaded anchors in the floor.
3. Position the legs over the anchors.
4. Bolt the legs to the floor. Use 8 mm (5/16 in.) bolts and washers.
5. Replace the end caps.
Leveling the Table

Use a long spirit level to check the tabletops for level.

- **To level the table front to rear:**
  1. Loosen the 8 hex set screws at the bottom of the leg. Use a 4 mm hex wrench.
  2. Use a 5 mm hex wrench to adjust the leveling screws at the top of the leg. There is ±25 mm (±1 in.) adjustment available.
  3. Turn the low side screw clockwise or the high side screw counter-clockwise to adjust the tilt.
  4. Tighten the 8 hex set screws at the bottom of the leg.

- **To level the table left to right:**
  1. Loosen the 8 hex set screws at the bottom of each leg.
  2. Use a 5 mm hex wrench to adjust the leveling screws at the top of the legs.
  3. Turn both the low end screws clockwise or the high end screws counter-clockwise to adjust the tilt. Turn both screws the same amount.
  4. Tighten the hex set screws at the bottom of the legs.

Adjusting Table Height

- **To adjust table height:**
  1. Loosen the 8 hex set screws at the bottom of each leg.
  2. Use a 5 mm hex wrench to adjust the leveling screws at the top of the legs.
  3. Turn all screws clockwise to lower the tables or counter-clockwise to raise the tables. Turn all screws the same number of turns.
  4. Tighten the hex set screws at the bottom of the legs.
Electronics Cabinets

The OI Card Cage can be housed in:

- Standard System Cabinet
- Suspended Cabinet

Standard System Cabinet

The rail space required in a standard system cabinet depends on the number of tubes supported.

Suspended Cabinet

The console electronics (OI Card Cage, hard disk, and tape drive) can be installed in a Suspended Cabinet under the rear half of the table (-1 level or 0 level). The Suspended Cabinet (10P5264000x) mounts to a "V" bracket that is screwed to the underside of the -1 level table. Pre-drilled holes provide for mounting one cabinet for every 600 mm of table length. A 600 mm wide table can hold one cabinet, a 1800 mm table can hold three. Standard access to the tape drives and the electronics cards in the OI Card Cage is from the rear of the table. Front access is available on request. Figure 3.1.9 shows front and side views of three Suspended Cabinets installed on a 1800 mm wide table.

Figure 3.1.9. Suspended Cabinet
To install a Suspended Cabinet:

1. Mount the “V” Bracket on the underside of the -1 level table (rear half). Be sure that the open end of the “V” faces the rear of the table. Use the supplied M5.5 x 38 mm screws in the pre-drilled holes. Torque the screws in the tabletop to no more than 5 N•m (45 in-lb).

2. Open the rear door of the cabinet and leave it open when installing the cabinet. Remove the ground screw and washer from the weld nut on the upper right side of the cabinet.

   **CAUTION**

   Have two people lift the cabinet.

3. Slide the cabinet onto the “V” Bracket. Secure the cabinet with the supplied cap screw through the “V” Bracket.

4. Close the rear door. The fasteners pass through the cable tray.

5. Ground the cabinet to the cable tray with the ground screw and paint-cutting washer from step 2.

**Installing Power**

55P0547x001 AC power receptacle strips are installed on the face of the cable trays beneath the tables. The receptacles mount onto the cable trays with two M4.8 x 13 mm self-drilling screws and paint-cutting washers 1984-4327-0007.

1984-1657-000x AC power receptacles are installed on the underside of the table surface.

**Installing Cabling**

You can route cables from the floor to the underside of the tabletop by running them inside the side panel to the cable entry opening. The wire channel is approximately 180 x 7 mm (7 x 1 in.). The centerline of the inside channel is 14 mm (.55 in.) from the table edge. There is a wire channel on each side of the leg.

**Installing Other Equipment**

Position the KVIs, CRTs, keyboards, and other equipment on the tables. Use the built-in cable troughs, cable access holes, and space in the legs to route cables out of sight as much as possible.

**NOTE:** Use the tie points provided on the cable trays to securely tie down all cables.
**Operator Interface Card Cage Connections**

The Operator Interface (OI) Card Cages are typically located in a Suspended Cabinet. They can also be located in a nearby standard system cabinet. An OI Card Cage is included in the RS3 Millennium Package (RMP).

The OI (Operator Interface) Card Cage (10P52820001) is an enclosed, shielded redesign of the OIC Card Cage (1984-0660-000x). It is required for CE compliant installations but can be used in any installation.

The functions of the Alarm Output Panel and Alarm Output Board (1984-0744-000x) are included in the CE Card Cage Filterboard. The card cage can be powered from the standard system bus or from an optional remote power supply (10P54090003 or 0004 for CE compliance or 10P56450001 for NRTL/CSA compliance).

Figure 3.1.10 shows the dimensions of the CE OI Card Cage in mm (in.).

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front view, door closed</td>
<td>3</td>
<td>Rear view</td>
</tr>
<tr>
<td>2</td>
<td>Side view</td>
<td>4</td>
<td>Top view</td>
</tr>
</tbody>
</table>

Figure 3.1.10. OI Card Cage Views
The position of the cards is shown in Figure 3.1.11.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OI Card Cage, front view</td>
<td>5</td>
<td>PeerWay Interface</td>
</tr>
<tr>
<td>2</td>
<td>Power Switch</td>
<td>6</td>
<td>Printer Interface</td>
</tr>
<tr>
<td>3</td>
<td>Power Regulator</td>
<td>7</td>
<td>SCSI Card</td>
</tr>
<tr>
<td>4</td>
<td>Video Generator</td>
<td>8</td>
<td>OI Processor</td>
</tr>
</tbody>
</table>

Figure 3.1.11. Card Positions
Figure 3.1.12 shows the OI Card Cage connectors and fuses. Several connectors are used only when this cage replaces an earlier cage. Table 3.1.2 lists the OI Card Cage connectors and fuses.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS-422 Keyboard Interface cable connection (J086)</td>
<td>12</td>
<td>DC power A cable connection (J907)</td>
</tr>
<tr>
<td>2</td>
<td>SCSI cable (J088)</td>
<td>13</td>
<td>SCSI power cable connection (J933)</td>
</tr>
<tr>
<td>3</td>
<td>RS-232 printer cable connection (J085)</td>
<td>14</td>
<td>Power Switch cable connection (J906)</td>
</tr>
<tr>
<td>4</td>
<td>Process Alarm cable connection (TB2)</td>
<td>15</td>
<td>PeerWay A Drop Cable connection (J084)</td>
</tr>
<tr>
<td>5</td>
<td>Hardware Alarm cable connection (TB1)</td>
<td>16</td>
<td>Video BNC Output RED (J646)</td>
</tr>
<tr>
<td>6</td>
<td>Alarm Circuit fuses (F1, F2) 1.5 A max</td>
<td>17</td>
<td>Video Output cable connection to the BNC Breakout Panel (replacement use only) (J082)</td>
</tr>
<tr>
<td>7</td>
<td>Process Alarm Opto-2 (RL2)</td>
<td>18</td>
<td>Video BNC Output GRN (J647)</td>
</tr>
<tr>
<td>8</td>
<td>Hardware Alarm Opto-1 (RL1)</td>
<td>19</td>
<td>Video BNC Output BLU (J648)</td>
</tr>
<tr>
<td>9</td>
<td>Alarm Output cable connection to Alarm Output Panel (replacement use only) (J284)</td>
<td>20</td>
<td>PeerWay B Drop Cable connection (J083)</td>
</tr>
<tr>
<td>10</td>
<td>Keyboard/SCSI power cable connection (J920)</td>
<td>21</td>
<td>Fan cable connection (J919)</td>
</tr>
<tr>
<td>11</td>
<td>DC power B cable connection (optional) (J908)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Checklist for CE-Compliant Installations

These rules must be followed to ensure CE compliance:

1. Use cables listed in Table 3.1.3, as required.
2. The Keyboard/Video Interface-to-CRT coaxial cable (1984–1691–0003) is approximately 1 meter (39 in.) long. Do not use a longer cable between the KVI and the CRT.
3. Use Keyboard/Video Interface (KVI) 10P50840004 or 2004.
4. Use keyboards, trackball, printer, and CRT bearing the CE mark and install them in a control room environment.
5. Power the cage from a CE-approved power supply such as the system DC bus or a remote power supply (10P54090003 or 0004).

Table 3.1.3. CE-Compliant Cables

<table>
<thead>
<tr>
<th>Cable</th>
<th>P/N</th>
<th>Maximum Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>PeerWay Drop Cable</td>
<td>1984–0473–00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>DC Power Cable, bus to product</td>
<td>1984–0158–0xxx</td>
<td>61 meters (200 feet)</td>
</tr>
<tr>
<td>DC Power Cable, remote power supply to product</td>
<td>1984–1083–00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>DC Power Cable, local power supply to product</td>
<td>10P54100001</td>
<td>Standard</td>
</tr>
<tr>
<td>Fan Power Cable (for use with remote power supply)</td>
<td>1984–1605–0009</td>
<td>Standard</td>
</tr>
<tr>
<td>Fan Power “Y” Cable (for use with local power supply)</td>
<td>10P54190001</td>
<td>Standard</td>
</tr>
<tr>
<td>Power Cable, disk and tape drive</td>
<td>10P56840001</td>
<td>Standard</td>
</tr>
<tr>
<td>I/O Cable, disk and tape drive</td>
<td>1984–1895–9901</td>
<td>Standard</td>
</tr>
<tr>
<td>Keyboard/Video Interface (KVI) Power Cable</td>
<td>1984–1628–0xxx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>RGB Video Cable, coaxial, console to KVI</td>
<td>1984–1691–00xx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>RGB Video Cable, shielded, KVI to CRT</td>
<td>1984–1691–0003</td>
<td>1 meters (3 feet)</td>
</tr>
<tr>
<td>KVI Communication Cable, shielded, OI Card Cage to KVI</td>
<td>10P52890xxx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>Printer Communication Cable, shielded</td>
<td>10P530800xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>System Power Supply Unit DCD feeder cable</td>
<td>10P5827xxxx</td>
<td>3 meters (10 feet)</td>
</tr>
</tbody>
</table>
Mounting

The OI Card Cage mounts in a “7U” Mounting Bracket (10P52650001 or 0003) or a “13U” Mounting Bracket (10P52650002), which bolts to standard 483 mm (19 in.) rails. The “7U” holds one card cage with tape drive and disk and can be installed in a standard system cabinet or in a Suspended Cabinet (10P52640001). The “13U” holds two cages and peripherals in a stack. It can be installed only in a standard system cabinet.

1. Mount the CE OI Card Cage (10P52820001) in a properly grounded system cabinet or suspended cabinet. Use a “7U” (10P52650001 or 0003) or “13U” (10P52650002) Mounting Bracket.

2. Mount the OI Card Cage on the left with tape drive and hard disk on the right as viewed from the front. Mounting the tape drive or hard disk either above or below the OI Card Cage is not allowed.

3. Put the tape drive housing in electrical contact with the mounting bracket (10P53270001).

4. Insulate the hard disk housing from the mounting bracket (10P53270001).

5. Route the Small Computer System Interface (SCSI) data and power cables along the metal of the drive mounting bracket. Place the excess portion of the SCSI cable in the area between the card cage and the drive mount bracket to act as a service loop. Do not route other cables with the SCSI cables or near the drives. Figure 3.1.13 shows routing detail.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OI Card Cage (top view)</td>
<td>3</td>
<td>Disk and tape drives</td>
</tr>
<tr>
<td>2</td>
<td>SCSI cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.1.13. SCSI Cable Routing
6. Ground the KVI Enclosure (1984-1626-0004) and the KVI (10P50840004 or 2004) to the CRT protective ground point.

7. If a remote power supply is required, mount a remote power supply (10P54090003 or 0004 for CE compliance or 10P56450001 for CSA and NRTL compliance) onto the drive mounting bracket. The power supply slides into rails on the bracket and fastens in place with two screws as shown in Figure 3.1.14. A cooling fan assembly (1984-3282-0001) is required under the power supply. Route the AC power cord to the AC distribution receptacle provided. Securely tie wrap the cord to prevent movement or strain.

![Diagram of power supply mounting components]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mounting bracket</td>
<td>3</td>
<td>OI Card Cage (rear or cable end)</td>
</tr>
<tr>
<td>2</td>
<td>Power supply</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.1.14. Power Supply Mounting Components
System Cabling

Cable part numbers often use the last four digits to show cable length. This varies among cables; some are in inches, feet, decimeters, or meters; others use codes in place of a length. The variable is shown as xxxx.

Cabling for Power and PeerWay

The DC power can be supplied from the system bus in a system cabinet or from the optional remote power supply in a suspended cabinet. Figure 3.1.15 shows power and PeerWay cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J908 PWRB</td>
<td>1984-0158-1xxx (B Bus)</td>
<td>DC power B (optional)</td>
</tr>
<tr>
<td>2</td>
<td>J907 PWRA</td>
<td>1984-0158-0xxx (A Bus) 1984-0158-1xxx (B Bus)</td>
<td>DC Bus to System Device (A Bus)</td>
</tr>
<tr>
<td>3</td>
<td>J906 POWER SWITCH</td>
<td>10P53110001</td>
<td>Power switch and cable</td>
</tr>
<tr>
<td>4</td>
<td>J084 PEERWAY A</td>
<td>1984-0473-0xxx</td>
<td>PeerWay A Drop Cable</td>
</tr>
<tr>
<td>5</td>
<td>J083 PEERWAY B</td>
<td>1984-0473-0xxx</td>
<td>PeerWay B Drop Cable</td>
</tr>
<tr>
<td>6</td>
<td>J919 FAN</td>
<td>10P54190001 or 1984-1605-0009</td>
<td>“Y” cable, OI Card Cage to DC Fans, or single fan cable</td>
</tr>
</tbody>
</table>

Figure 3.1.15. Power and Peerway Cabling
Cabling for SCSI and Printer

Figure 3.1.16 shows SCSI and printer cable connections.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J933 SCSI POWER</td>
<td>10P56840001</td>
<td>Disk and Tape Drive Power (SCSI)</td>
</tr>
<tr>
<td>2</td>
<td>J085 RS-232</td>
<td>10P5308-xxxx</td>
<td>OI Card Cage to printer (RS-232)</td>
</tr>
<tr>
<td>3</td>
<td>J088 SCSI</td>
<td>1984–1895–9901 or –9909</td>
<td>Disk and tape communication cable (SCSI ribbon cable)  Use 1984–1895–0009 with disk-only console</td>
</tr>
</tbody>
</table>

Figure 3.1.16. SCSI and Printer Cable Connections
Optically isolated outputs are provided for Hardware and Process Alarms. TB1 and TB2 have normally open circuits that close when an associated alarm is active. A source of DC voltage between 5 and 40 volts is required. Maximum current is 1.0 amp. Use a diode across the load if the load is inductive (Figure 3.1.17).

Use connector J284 (labeled ALARM OUTPUT) to connect an external Alarm Output Panel (1984-1625-000x) and Alarm Output Board (1984-0744-000x). This is normally only for replacement installations. Figure 3.1.17 shows alarm connections.

![Diagram of alarm connections]

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J284 ALARM OUTPUT</td>
<td>1984-0744-000x Pigtail</td>
<td>Alarm output (used for replacements only)</td>
</tr>
<tr>
<td>2</td>
<td>TB1 HARDWARE ALARM</td>
<td>Customer supplied; connects to screw terminals on TB1</td>
<td>Normally open hardware alarm</td>
</tr>
<tr>
<td>3</td>
<td>TB2 PROCESS ALARM</td>
<td>Customer supplied; connects to screw terminals on TB2</td>
<td>Normally open process alarm</td>
</tr>
</tbody>
</table>

Figure 3.1.17. Alarm Connectors

**CAUTION**

Do not power the alarm circuit with AC. Use of AC and AC-rated optical isolators can result in problems that are very hard to locate.
Cabling from the OI Card Cage to the Keyboard/Video Interface

RGB Video Cable (1984–1691–0xxx) connects the RED–GRN–BLU (J646, J647, J648) connectors on the filterboard to the Keyboard/Video Interface Card. This cable can be up to 152 meters (500 feet) long.

Connector J082 (labeled VIDEO) is used to bring video signals to an external Alarm Output Panel (1984–1625–000x). This will normally be used only for replacement installations.

The KVI Power Cable (1984–1628–xxxx) goes from P979 of the 10P54180001 cable to J942 on the KVI.

Use the shielded Keyboard Interface Cable 10P52890xxx to connect J086 on the filterboard to J407 on the KVI Card.

Figure 3.1.18 shows keyboard cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P979</td>
<td>1984–1628–xxxx</td>
<td>KVI power to KVI Card</td>
</tr>
<tr>
<td></td>
<td>(on SCSI cable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>J646 RED</td>
<td>1984–1691–0xxx</td>
<td>RGB video cable to KVI Card</td>
</tr>
<tr>
<td></td>
<td>J647 GRN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>J648 BLU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>J086</td>
<td>10P52890xxx</td>
<td>Keyboard interface cable to KVI Card</td>
</tr>
<tr>
<td></td>
<td>RS-422</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.1.18. Keyboard Cabling
Cabling the Keyboard/Video Interface Card

Figure 3.1.19 shows keyboard/video interface cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KVI card 10P50840001 or -004</td>
<td>7</td>
<td>CRT AC power cord</td>
</tr>
<tr>
<td>2</td>
<td>KVI card DC power cable 1984–1628–0xxx to J942</td>
<td>8</td>
<td>Monitor-supplied (D-sub connector) RGB Video cable to J494 (if applicable, or use #9)</td>
</tr>
<tr>
<td>3</td>
<td>RS-422 keyboard communications cable 10P52890xxx to J407</td>
<td>9</td>
<td>RGB video CRT cable (BNC connector) 1984–1691–0003 to J495, J496, and J497</td>
</tr>
<tr>
<td>4</td>
<td>Ground wire to CRT ground point</td>
<td>10</td>
<td>Trackball and cable</td>
</tr>
<tr>
<td>5</td>
<td>RGB video input cable 1984–1691–0xxx to J491, J492, and J493</td>
<td>11</td>
<td>Operator keyboard and cable</td>
</tr>
<tr>
<td>6</td>
<td>CRT</td>
<td>12</td>
<td>Configuror’s keyboard and cable</td>
</tr>
</tbody>
</table>

D-sub = D-shell subminiature connector

Figure 3.1.19. Keyboard/Video Interface Cabling
Section 2: Series 1 Console Furniture

Series 1 Console Furniture provides table surfaces in a variety of shapes. Figure 3.2.1 shows a typical installation. This section gives the dimensions of Series 1 console components, tells how to assemble the console, and how to wire it.

Figure 3.2.1. Series 1 Console Furniture
Console Dimensions

Console furniture is made up of:

- Tabletop(s) and Legs
- Electronics Cabinet (optional)
- Turret-mounted CRT(s) (optional)

The tabletop holds:

- Keyboard(s)
- Free-standing CRT(s) (optional)
- Printer (optional)
Tabletops

Series 1 tables consist of one or more of the rectangular tabletops shown in Figure 3.2.2 and angled tops shown in Figure 3.2.3. The tabletops are a light gray in color. All table configurations contain the appropriate number of legs and modesty panels.

Figure 3.2.2. Rectangular Tabletop Dimensions in Millimeters (Inches)
Figure 3.2.3. Angle Tabletop Dimensions in Millimeters (Inches)
Electronics Cabinets

Multitube Command Console electronics can be housed in:

- Standard Electronics Cabinet
- Tower Electronics Cabinet
- Standard System Cabinet

The standard electronics cabinet or the tower electronics cabinet are often used as a leg to support the tabletop.

Standard Electronics Cabinet

The standard electronics cabinet can hold up to three Operator Interface (OI) Card Cages, and can support up to three CRTs.

Figure 3.2.4 shows the standard electronics cabinet dimensions.
The tower cabinet can hold one OI Card Cage, supporting one CRT. Figure 3.2.5 shows the tower electronics cabinet dimensions.

Figure 3.2.5. Tower Electronics Cabinet Dimensions in Millimeters (Inches)
Standard System Cabinet

The rail space required in a standard system cabinet depends on the number of tubes supported.

A single tube requires one OI Card Cage and takes 356 mm (14 in.) of rail space. The hard disk and tape drive are mounted beside the OI Card Cage.

A dual tube installation requires two OI Card Cages and takes 533 mm (21 in.) of rail space. The card cages are mounted side by side with the hard disks and tape drive that are mounted above the OI Card Cages.

A triple-tube installation requires three OI Card Cages and takes 762 mm (30 in.) of rail space. Two card cages are mounted side by side. The hard disks and tape drive are mounted beside the third card cage.
Console Installation

Series 1 tables are typically shipped already assembled. If the table is delivered unassembled, see the drawing provided with the table for assembly instructions.

**WARNING**

Series 1 tables can be very heavy and can be awkward to lift or move. Tables that use an electronics cabinet as a table leg and tables with a CRT mounted on the table can be especially heavy. Use care when lifting or moving tables to prevent personal injury or equipment damage.

Installation of the Multitube Command Console consists of adding connecting modesty panels (if required), securing tabletops to each other (if required), leveling the table surface, securing articulating CRTs to the CRT bases (if required), making electrical connections, installing labels in the console keyboards, and installing the printer. Figure 3.2.6 shows a typical installation.
Clamp two places between adjacent tables.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adjustable Levelers</td>
<td>3</td>
<td>Side Panels</td>
</tr>
<tr>
<td>2</td>
<td>Connecting Modesty Panel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.2.6. Series 1 Table

**Securing Tabletops to Each Other**

Secure table tops to each other using two clamps between each pair of tables, as shown in Figure 3.2.6.
Installing Connecting Modesty Panels

Some Series 1 tables are shipped with connecting modesty panels.

To install a connecting modesty panel:

1. Gain access to the interior of the table legs by removing each of the required side panels. First, lift the panel straight up. Then, pull the panel off.
2. Secure the connecting panel to the required legs with the screws provided.
3. Replace the side panels.

Leveling the Table Surface

Level the table surface using the adjustable levelers on the base of the legs. Figure 3.2.6 shows the location of the adjustable levelers.
Making Electrical Connections

The following procedures describe how to make electrical connections for the console. The exact locations of card cages, AC distribution boxes, cable troughs, CRTs, and so on differ with each installation. These instructions and associated figures are designed to provide general installation procedures.

Cables can be routed through table legs, cable troughs attached to the underside of tables, holes in tabletops, holes in CRT bases, cable socks, and other throughways, depending on the individual installation.

Cables should be marked at the connectors to identify which card cage and CRT (if applicable) they should be connected to.

Some installations might have different lengths of the same type of cable for a console, depending on the distance from the CRTs to the console card cages. Check to ensure that each CRT has the correct length of cables before installation.

Figure 3.2.7 shows a typical example of Keyboard/Video Interface (KVI) card, AC distribution box, CRT cable connections, and cable routing.
Figure 3.2.7. Keyboard/Video Interface Card, AC Distribution Box, and Monitor Cable Routing
AC Distribution Box Connections

An AC distribution box is typically mounted on the underside of a table to provide AC and grounding connections for one or more CRTs.

- **To make AC distribution box connections:**
  1. Connect the ground wire from the CRT base to the grounding screw on the AC distribution box. See Figure 3.2.7 for the location of the AC distribution box grounding screw.

**NOTE:** On the 55P0547x001 distribution box, use the mounting screw to bond to ground.

  2. Route the AC power wiring through a table leg or other means and connect to the AC distribution box.

**NOTE:** The 1984-1657-000x distribution box is permanently wired. The wiring must be installed with proper strain relief.

**NOTE:** On the 1984-1657-000x distribution box, the user-supplied AC power circuit must conform to local codes on wire size, routing, and protection. Conduit can be used if required by local ordinance. A size of 4 mm² (12 AWG) wire is recommended for power wiring. The maximum branch current rating is 15 amps. AC power wiring insulation must have a voltage rating that is double that of the supply voltage.

**NOTE:** The maximum branch current rating for the 55P0547x001 distribution box is 10 amps.
Non-EMC Operator Interface Card Cage Connections

Operator Interface (OI) Card Cage 1984-0660-000x is typically located in an Electronics Cabinet or on a Tower Electronics Cabinet. It can also be located in a nearby standard system cabinet.

Figure 3.2.8 shows a typical installation.
Figure 3.2.8. Typical Non-EMC Electronics Cabinet Wiring
To make OI Card Cage connections:

1. Connect the PeerWay cables to the PeerWay taps.

**NOTE:** If the PeerWay taps are mounted in the electronics cabinet, it is necessary to remove the top and left side panels of the electronics cabinet to gain access to the taps. Remove the four screws in each corner of the top panel and lift it off. Remove the two screws securing the side panel and lift it up and out. See Figure 3.2.9 for locations.

---

**Figure 3.2.9. Connecting Peerway Cables to Tap Boxes**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tap Boxes</td>
<td>5</td>
<td>Left Side Panel</td>
</tr>
<tr>
<td>2</td>
<td>PeerWay Cables</td>
<td>6</td>
<td>Top Panel</td>
</tr>
<tr>
<td>3</td>
<td>Screws (2 Places)</td>
<td>7</td>
<td>Screws (4 Places)</td>
</tr>
<tr>
<td>4</td>
<td>Drop Cables to Card Cage</td>
<td>8</td>
<td>Electronics Cabinet</td>
</tr>
</tbody>
</table>
2. Connect the PeerWay drop cables (1984-0473-xxxx) from the tap boxes to the card cage. The drop cables might have been installed at the factory. If the PeerWay tap boxes are remotely located, the drop cables must still be connected directly from the tap boxes to the card cage.

Console card cages are assigned numbers according to their location in the electronics cabinet. The card cage number is used to connect the video RGB cables and external alarms. Figure 3.2.10 shows the electronics cabinet numbering scheme.

The figure shows a typical electronics cabinet with three console card cages. It does not show all of the equipment that can reside in the cabinet. Wiring can be brought into the electronics cabinet through the top of either side, the bottom, or the rear of the cabinet.

3. Connect the RS-422 keyboard communication cable (1984-1627-xxxx) from the console Keyboard/Video Interface (KVI) Card to the console card cage at J086.
4. Connect the KVI card power cable (1984-1628-xxxx) from the console KVI Card to the console card cage at the connector (J920) directly below J907 and J908.

5. Connect the video RGB cables (1984-1691-xxxx) from the CRT to the alarm output board at P140, P141, and P142.

Information about installing external console alarms is given later in this section.

6. The 30 V DC switch box has cables (1984-0158-xxxx) coming out of it for each console card cage. Connect one of the cables to J907. If a dual DC distribution system is used, connect the second power cable to J908.

7. Connect the 30 VDC cable to the 30 VDC switch box. The other end of the cable will be connected to the DC distribution bus.

The console alarm output board can be used to trigger external alarm devices based on the occurrence of either hardware or process alarms. Two optically isolated circuits allow 5–40 VDC loads of up to 1 A. Figure 3.2.11 shows a general diagram for external alarm installation. See the Console Configuration Manual (CC) for details of alarm configuration.

CAUTION

Do not power the alarm circuit with AC. Use of AC and AC-rated optical isolators can result in problems that are very hard to locate.
A commutating diode must be added across the load when an inductive device is used.

Figure 3.2.11. Console Alarm Output Board External Alarm Installation
CE-Compliant Operator Interface Card Cage Connections

The Operator Interface (OI) Card Cages are typically located in a nearby standard system cabinet. An OI Card Cage is also included in the RS3 Millennium Package (RMP).

The OI Card Cage (10P52820001) is an enclosed, shielded redesign of the OI Card Cage (1984-0660-000x). It is required for CE-compliant installations but can be used in any installation.

The functions of the Alarm Output Panel and Alarm Output Board (1984-0744-000x) are included in the CE Card Cage Filterboard. The cage can be powered from the standard system bus or from an optional remote power supply (10P54090003 or 0004 for CE compliance or 10P56450003 for CSA and NRTL compliance).

Figure 3.2.12 shows the dimensions of the CE OI Card Cage in mm (in.).

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front view, door closed</td>
<td>3</td>
<td>Rear view</td>
</tr>
<tr>
<td>2</td>
<td>Side view</td>
<td>4</td>
<td>Top view</td>
</tr>
</tbody>
</table>

**Figure 3.2.12. OI Card Cage Views**
The position of the cards is shown in Figure 3.2.13.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OI Card Cage, front view</td>
<td>5</td>
<td>PeerWay Interface</td>
</tr>
<tr>
<td>2</td>
<td>Power Switch</td>
<td>6</td>
<td>Printer Interface</td>
</tr>
<tr>
<td>3</td>
<td>Power Regulator</td>
<td>7</td>
<td>SCSI Card</td>
</tr>
<tr>
<td>4</td>
<td>Video Generator</td>
<td>8</td>
<td>OI Processor</td>
</tr>
</tbody>
</table>

Figure 3.2.13. Card Positions
Figure 3.2.14 shows the OI Card Cage connectors and fuses. Several connectors are used only when this cage replaces an earlier cage. Table 3.2.1 lists the OI Card Cage connectors and fuses.

Figure 3.2.14. Rear View of Card Cage
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS-422 Keyboard Interface cable connection (J086)</td>
<td>12</td>
<td>DC power A cable connection (J907)</td>
</tr>
<tr>
<td>2</td>
<td>SCSI cable (J088)</td>
<td>13</td>
<td>SCSI power cable connection (J933)</td>
</tr>
<tr>
<td>3</td>
<td>RS-232 printer cable connection (J085)</td>
<td>14</td>
<td>Power Switch cable connection (J906)</td>
</tr>
<tr>
<td>4</td>
<td>Process Alarm cable connection (TB2)</td>
<td>15</td>
<td>PeerWay A Drop Cable connection (J084)</td>
</tr>
<tr>
<td>5</td>
<td>Hardware Alarm cable connection (TB1)</td>
<td>16</td>
<td>Video BNC Output RED (J646)</td>
</tr>
<tr>
<td>6</td>
<td>Alarm Circuit fuses (F1, F2) 1.5 A max</td>
<td>17</td>
<td>Video Output cable connection to the BNC Breakout Panel (replacement use only) (J082)</td>
</tr>
<tr>
<td>7</td>
<td>Process Alarm Opto--2 (RL2)</td>
<td>18</td>
<td>Video BNC Output GRN (J647)</td>
</tr>
<tr>
<td>8</td>
<td>Hardware Alarm Opto--1 (RL1)</td>
<td>19</td>
<td>Video BNC Output BLU (J648)</td>
</tr>
<tr>
<td>9</td>
<td>Alarm Output cable connection to Alarm Output Panel (replacement use only) (J284)</td>
<td>20</td>
<td>PeerWay B Drop Cable connection (J083)</td>
</tr>
<tr>
<td>10</td>
<td>Keyboard/SCSI power cable connection (J920)</td>
<td>21</td>
<td>Fan cable connection (J919)</td>
</tr>
<tr>
<td>11</td>
<td>DC power B cable connection (optional) (J908)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Checklist for CE-Compliant Installations

These rules must be followed to ensure CE compliance:

1. Use cables listed in Table 3.2.2, as required.
2. The Keyboard/Video Interface to CRT coaxial cable (1984–1691–0003) is approximately 1 meter (39 in.) long. Do not use a longer cable between the KVI and the CRT.
4. Use keyboards, trackball, printer, and CRT bearing the CE mark and install them in a control room environment.
5. Power the cage from a CE-approved power supply such as the system DC bus or a remote power supply (10P54090003 or 0004).

Table 3.2.2. CE-Compliant Cables

<table>
<thead>
<tr>
<th>Cable</th>
<th>P/N</th>
<th>Maximum Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>PeerWay Drop Cable</td>
<td>1984–0473–00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>DC Power Cable, bus to product</td>
<td>1984–0158–0xxx</td>
<td>61 meters (200 feet)</td>
</tr>
<tr>
<td>DC Power Cable, remote power supply to product</td>
<td>1984–1083–00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>DC Power Cable, local power supply to product</td>
<td>10P54100001</td>
<td>Standard</td>
</tr>
<tr>
<td>Fan Power Cable (for use with remote power supply)</td>
<td>1984–1605–0009</td>
<td>Standard</td>
</tr>
<tr>
<td>Fan Power “Y” Cable (for use with local power supply)</td>
<td>10P54190001</td>
<td>Standard</td>
</tr>
<tr>
<td>Power Cable, disk and tape drive</td>
<td>10P56840001</td>
<td>Standard</td>
</tr>
<tr>
<td>I/O Cable, disk and tape drive</td>
<td>1984–1895–9901</td>
<td>Standard</td>
</tr>
<tr>
<td>Keyboard/Video Interface (KVI) Power Cable</td>
<td>1984–1628–0xxx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>RGB Video Cable, coax, console to KVI</td>
<td>1984–1691–0xxx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>RGB Video Cable, shielded, KVI to CRT</td>
<td>1984–1691–0003</td>
<td>1 meters (3 feet)</td>
</tr>
<tr>
<td>KVI Communication Cable, shielded, OI Card Cage to KVI</td>
<td>10P52890xxx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>Printer Communication Cable, shielded</td>
<td>10P530800xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>System Power Supply Unit DCD feeder cable</td>
<td>10P5827xxxx</td>
<td>3 meters (10 feet)</td>
</tr>
</tbody>
</table>
Mounting

The OI Card Cage mounts in a “7U” Mounting Bracket (10P52650001) or a “13U” Mounting Bracket (10P52650002), which bolts to standard 483 mm (19 in.) rails. The “7U” holds one card cage with tape drive and disk and can be installed in a standard system cabinet. The “13U” holds two cages and peripherals in a stack. It can be installed only in a standard system cabinet.

1. Mount the CE OI Card Cage (10P52820001) in a properly grounded system cabinet. Use a “7U” (10P52650001) or “13U” (10P52650002) Mounting Bracket.

2. Mount the OI Card Cage on the left with tape drive and hard disk on the right as viewed from the front. Mounting the tape drive or hard disk either above or below the OI Card Cage is not allowed.

3. Put the tape drive housing in electrical contact with the mounting bracket (10P53270001).

4. Insulate the hard disk housing from the mounting bracket (10P53270001).

5. Route the Small Computer System Interface (SCSI) data and power cables along the metal of the drive mounting bracket. Place the excess portion of the SCSI cable in the area between the card cage and the drive mount bracket to act as a service loop. Do not route other cables with the SCSI cables or near the drives. Figure 3.2.15 shows routing detail.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OI Card Cage (top view)</td>
<td>3</td>
<td>Disk and tape drives</td>
</tr>
<tr>
<td>2</td>
<td>SCSI cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.2.15. SCSI Cable Routing
6. Ground the KVI Enclosure (1984-1626-0004) and the KVI (10P50840004 or -2004) to the CRT protective ground point.

7. If a remote power supply is required, mount a remote power supply (10P54090003 or 0004 for CE compliance or 10P56450003 for CSA and NRTL compliance) onto the drive mounting bracket. The power supply slides into rails on the bracket and fastens in place with two screws as shown in Figure 3.2.16. A cooling fan assembly (1984-3282-0001) is required under the power supply. Route the AC power cord to the desired AC receptacle. Securely tie wrap the cord to prevent movement or strain.

![Diagram of power supply mounting components]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mounting bracket</td>
<td>3</td>
<td>OI Card Cage (rear or cable end)</td>
</tr>
<tr>
<td>2</td>
<td>Power supply</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.2.16. Power Supply Mounting Components
System Cabling

Cable part numbers often use the last four digits to show cable length. This varies among cables; some are in inches, feet, decimeters, or meters; others use codes in place of a length. The variable is shown as xxxx.

Cabling for Power and PeerWay

The DC power can be supplied from the system bus in a system cabinet or from the optional remote power supply. Figure 3.2.17 shows power and PeerWay cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J908 PWRB</td>
<td>1984–0158–1xxx (B Bus)</td>
<td>DC power B (optional)</td>
</tr>
<tr>
<td>2</td>
<td>J907 PWRA</td>
<td>1984–0158–0xxx (A Bus)</td>
<td>DC bus to system device (A Bus)</td>
</tr>
<tr>
<td>3</td>
<td>J906 POWER SWITCH</td>
<td>10P53110001</td>
<td>Power switch and cable</td>
</tr>
<tr>
<td>4</td>
<td>J084 PEERWAY A</td>
<td>1984–0473–0xxx</td>
<td>PeerWay A Drop Cable</td>
</tr>
<tr>
<td>5</td>
<td>J083 PEERWAY B</td>
<td>1984–0473–0xxx</td>
<td>PeerWay B Drop Cable</td>
</tr>
<tr>
<td>6</td>
<td>J919 FAN</td>
<td>10P54190001 or 1984–1605–0009</td>
<td>“Y” cable, OI Card Cage to DC fans or single fan cable</td>
</tr>
</tbody>
</table>

Figure 3.2.17. Power and Peerway Cabling
Cabling for SCSI and Printer

Figure 3.2.18 shows SCSI and printer cable connections.

![Diagram showing cable connections](image_url)

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J933</td>
<td>10P56840001</td>
<td>Disk and Tape Drive Power (SCSI)</td>
</tr>
<tr>
<td></td>
<td>SCSI POWER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>J085</td>
<td>10P5308–xxxx</td>
<td>OI Card Cage to printer (RS-232)</td>
</tr>
<tr>
<td></td>
<td>RS-232</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>J088</td>
<td>1984–1895–9901 or –9909</td>
<td>Disk and tape communication cable (SCSI ribbon cable) Use 1984–1895–0009 with disk-only console</td>
</tr>
<tr>
<td></td>
<td>SCSI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.2.18. SCSI and Printer Cable Connections
Cabling for Alarms

Optically isolated outputs are provided for Hardware and Process Alarms. TB1 and TB2 have normally open circuits that close when an associated alarm is active. A source of DC voltage between 5 and 40 volts is required. Maximum current is 1.0 amp. Use a diode across the load if the load is inductive (Figure 3.2.19).

Use connector J284 (labeled ALARM OUTPUT) to connect an external Alarm Output Panel (1984-1625-000x) and Alarm Output Board (1984-0744-000x). This is normally only for replacement installations. Figure 3.2.19 shows alarm connections.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J284 ALARM OUTPUT</td>
<td>1984-0744-000x Pigtail</td>
<td>Alarm Output (used for replacements only)</td>
</tr>
<tr>
<td>2</td>
<td>TB1 HARDWARE ALARM</td>
<td>Customer supplied; connects to screw terminals on TB1</td>
<td>Normally open hardware alarm</td>
</tr>
<tr>
<td>3</td>
<td>TB2 PROCESS ALARM</td>
<td>Customer supplied; connects to screw terminals on TB2</td>
<td>Normally open process alarm</td>
</tr>
</tbody>
</table>

Figure 3.2.19. Alarm Connectors

**CAUTION**

Do not power the alarm circuit with AC. Use of AC and AC-rated optical isolators can result in problems that are very hard to locate.
Cabling from the OI Card Cage to the Keyboard/Video Interface

RGB Video Cable (1984–1691–0xxx) connects the RED–GRN–BLU (J646, J647, J648) connectors on the filterboard to the Keyboard/Video Interface Card. This cable can be up to 152 meters (500 feet) long.

Connector J082 (labeled VIDEO) is used to bring video signals to an external Alarm Output Panel (1984–1625–000x). This will normally be used only for replacement installations.

The KVI Power Cable (1984–1628–xxxx) goes from P979 of the 10P54180001 cable to J942 on the KVI.

Use the shielded Keyboard Interface Cable 10P52890xxx to connect J086 on the filterboard to J407 on the KVI Card.

Figure 3.2.20 shows keyboard cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P979 (on SCSI cable)</td>
<td>1984–1628–xxxx</td>
<td>KVI power to KVI Card</td>
</tr>
<tr>
<td>2</td>
<td>J646 RED J647 GRN J648 BLU</td>
<td>1984–1691–0xxx</td>
<td>RGB Video cable to KVI Card</td>
</tr>
<tr>
<td>3</td>
<td>J086 RS-422</td>
<td>10P52890xxx</td>
<td>Keyboard Interface cable to KVI Card</td>
</tr>
</tbody>
</table>

Figure 3.2.20. Keyboard Cabling
Cabling the Keyboard/Video Interface Card

Figure 3.2.21 shows keyboard/Video Interface cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KVI Card 10P50840001 or -004</td>
<td>7</td>
<td>CRT AC power cord</td>
</tr>
<tr>
<td>2</td>
<td>KVI Card DC power cable 1984–1628–0xxx to J942</td>
<td>8</td>
<td>Monitor-supplied (dsub connector) RGB Video cable to J494 (if applicable, or use #9)</td>
</tr>
<tr>
<td>3</td>
<td>RS-422 Keyboard Communications cable 10P52890xxx to J407</td>
<td>9</td>
<td>RGB Video CRT cable (BNC connector) 1984–1691–0003 to J495, J496, and J497</td>
</tr>
<tr>
<td>4</td>
<td>Ground wire to CRT ground point</td>
<td>10</td>
<td>Trackball and cable</td>
</tr>
<tr>
<td>5</td>
<td>RGB Video Input cable 1984–1691–0xxx to J491, J492, and J493</td>
<td>11</td>
<td>Operator Keyboard and cable</td>
</tr>
<tr>
<td>6</td>
<td>CRT</td>
<td>12</td>
<td>Configurator’s Keyboard and cable</td>
</tr>
</tbody>
</table>

Figure 3.2.21. Keyboard/Video Interface Cabling
Section 3: Keyboards, CRTs, and Printers

This section covers:

- Keyboards and Keyboard Interfaces
- CRTs
- Printers
Keyboards

The Multitube Command Console has a variety of keyboard options. Figure 3.3.1 shows the dimensions of the elevated operator keyboard with callup buttons.

Figure 3.3.1. Elevated Operator Keyboard Dimensions in Millimeters (Inches)
Figure 3.3.2 shows the dimensions of the operator keyboard with trackball. The optional Trackball can be mounted at the left or the right side.

Figure 3.3.2. Operator Keyboard Dimensions in Millimeters (Inches)

Figure 3.3.3 shows the dimensions of the trackball keyboard.

Figure 3.3.3. Trackball Keyboard Dimensions in Millimeters (Inches)
Figure 3.3.4 shows the dimensions of the configuration keyboard.

Figure 3.3.4. Configuration Keyboard Dimensions in Millimeters (Inches)
Installing the Keyboard Interface Card

The Keyboard Interface Card (KBI) provides the electronic interface between the Operator Interface Card Cage (OI Card Cage), the keyboard(s), and the CRT. It is housed in the monitor base of a CRT.

There are several variations available to support standard keyswitches, remote keyswitches, and the password security option.

- **To make electrical connections to the Keyboard Interface Card:**

  **CAUTION**

  The console Keyboard Interface Card contains electrostatic sensitive devices. Use a grounding wrist strap while installing cards.

  1. A portion of the connection cabling is typically routed through the legs of the table. To access the interior of the table legs, the table side panels must be removed. To remove a side panel, lift the panel up an inch or two, and then pull out.

  2. Remove the console Keyboard Interface Card from the monitor base by removing the two screws at the front of the console base and pulling out the assembly. Figure 3.3.5 shows the screw locations.

  ![Figure 3.3.5. Removing the Console Keyboard Interface Card](image-url)
3. Route the keyboard communications cable and the keyboard 30 VDC power cable through the table leg, cable trough, tabletop, and the base to the Keyboard Interface Card. The other ends of the cables will be connected to the console card cage.

4. Connect the keyboard communications cable to the Keyboard Interface Card at J407. The Keyboard Interface Card is shown in Figure 3.3.6.

![Keyboard Interface Card Connections](image)

**Figure 3.3.6. Keyboard Interface Card Connections**

5. Connect the keyboard 30 VDC power cable to the Keyboard Interface Card at J942.

6. Connect a ground wire from the ground stud on the Keyboard Interface Card to the ground stud on the CRT base. The ground stud on the CRT base is located just inside the rectangular opening at the rear of the base.

7. Connect a second ground wire to the ground stud on the CRT base. This ground wire will be connected to the AC distribution box later in this procedure.

8. Route the ground wire through the tabletop and cable sock.
9. Connect the longer video RGB cables from the Alarm Output Board to J491, J492, and J493. The video RGB cables \((1984-1691-xxxx)\) are three cables that are tie-wrapped together. Route one end of the cables through the table leg, cable trough, tabletop, CRT base, and cable sock. Then connect the cables to the RGB receptacles in the Keyboard Interface Card.

10. To install a free-standing (tabletop) CRT:
   
   a. The CRT power cord has different connectors on each end. Route the end that connects to the CRT (the rectangular plug) through the tabletop, CRT base, and cable sock. Plug the power cord into the CRT. Plug the other end of the cord into the AC distribution box.

   b. Connect the output RGB cable from the Keyboard Interface Card (J494) to the connector on the back of the CRT as shown in Figure 3.3.7.

   c. Verify that the CRT power switch is on.

![Figure 3.3.7. Free-Standing (tabletop) CRT Connections](image-url)
11. To install a Barco (or other large) Monitor:

a. The CRT power cord has different connectors on each end. Route the end that connects to the CRT (the rectangular plug) through the tabletop, CRT base, and cable sock. Plug the power cord into the CRT. Plug the other end of the cord into the AC distribution box.

b. The three short video RGB cables (1984-1691-xxxx) are tie-wrapped together. Connect the cables to the right-hand set of RGB receptacles in the back of the CRT as shown in Figure 3.3.8. The other end of the cables is connected to J495, J496, and J497 on the keyboard Interface Card.

c. Verify that the termination switches are on 75 ohm and the SYNC switch is on INT.
12. For a Remote Keyswitch application, connect the remote keyswitch cable (1984-3267-xxxx) to J415.

13. For a Dual keyswitch application, connect the dual keyswitch cable (1984-3223-xxxx) to J414.

14. Reinstall the console Keyboard Interface Card to the base with the two screws.

15. Connect the configuration, operator, and trackball keyboards (if available) to the base.
Installing Labels in the Keyboards

The console callup buttons keyboard and operator keyboard contain buttons that you can configure to perform certain functions.

To install labels in the callup buttons keyboard:

1. Prepare the label strips on a typewriter or with a pen.

2. Unplug the callup buttons keyboard from the keyboard interface connector. Turn the keyboard upside down and remove the four screws securing the base. See Figure 3.3.9 for screw locations. Remove the base from the keyboard.

3. Do not attempt to put new labels on top of existing labels. Remove any label strips that are being replaced. Remove the label strips from the label backing and insert the strips into the slots in the keyboard. Check the front of keyboard for proper placement of strips.

4. Secure the base to the keyboard with the four screws. Do not over-tighten screws — snug only. Plug the callup buttons keyboard into the keyboard interface connector.

Figure 3.3.9. Installing Labels in Callup Buttons Keyboard
To install labels in the operator keyboard:

1. Prepare the label strips on a typewriter or with a pen.

2. Unplug the operator keyboard from the keyboard interface connector. Turn the keyboard upside down and remove the six screws securing the base to the keyboard. See Figure 3.3.10 for screw locations. Remove the base from the keyboard.

3. Do not attempt to put new labels on top of existing labels. Remove any label strips that are being replaced.

4. Remove the label backing from the label strips and insert the strips into the slots in the keyboard. Check the front of keyboard for proper placement of strips.

5. Secure the base to the keyboard with the six screws. Do not over-tighten screws — snug only. Plug the operator keyboard into the keyboard interface connector.

Figure 3.3.10. Installing Labels in Operator Keyboard
CRTs

Multitube Command Console CRTs are available as:

- Free standing CRT
- Turret base CRT
- Articulating base CRT

Monitors are available in 14- to 21-inch models. Dimensions, specifications, setup, cabling, and controls are described in the user manual that accompanies the unit.

Turret-base CRTs are typically shipped secured to the tabletop. If the table is not supplied, then no monitor-securing hardware is shipped with the monitor. The user must provide the hardware necessary to fasten the articulating base or turret base to the user supplied table. Use care to insure stable mounting for the monitor.

Figure 3.3.11 shows the dimensions of a typical 15-inch free-standing CRT.

Figure 3.3.11. Free-standing CRT and Base Dimensions in Millimeters (Inches)
Figure 3.3.12 shows the dimensions of the turret-base CRT.

Figure 3.3.13 shows dimensions of the articulating-base CRT.

Figure 3.3.12. Turret-base CRT Dimensions in Millimeters (Inches)

Figure 3.3.13. Articulating-base CRT Dimensions in Millimeters (Inches)
Securing an Articulating-base CRT to the Base

Articulating-base CRTs are typically shipped with the base secured to the tabletop and the CRT packaged separately. The CRT must then be secured to the base during installation.

To secure an articulating-base CRT to the articulating base:

1. Remove the plastic feet from the monitor (if present) and discard.
2. Secure the monitor to the base using the four screws provided, as shown in Figure 3.3.14.

![Figure 3.3.14. Securing Articulating-base CRT to Base](image-url)
Figure 3.3.15 shows the dimensions of the Fujitsu printer model M3389 (DL3800). Figure 3.3.16 shows the printer stand.

**Figure 3.3.15. Fujitsu Printer Model M3389 (DL3800) Dimensions in Millimeters (Inches)**

**Figure 3.3.16. Printer Stand Dimensions in Millimeters (Inches)**
Installing a Printer

The RS-232 printer cable connects to the Printer Interface card in the console card cage. A source of AC power is required for the printer.

Printer options must be set for the printer to communicate with the RS3 control system. See the manufacturer’s user manual (packed with the printer), the Service Manual (SV: 3--5), or the Service Quick Reference Guide for the settings of your printer.

Installing a Modem Connection to a Printer

You can use a modem to print console information at a remote location. The modem connects to the console printer port. Figure 3.3.17 shows equipment for a modem connection to a printer.

To use a modem, you must make some settings:

- You must configure the Racal-Vadic modem communication options. Table 3.3.1 lists the recommended settings. For information about how to make the settings, see the modem manual.

- You must set DIP switches on the Multitech modem. Table 3.3.2 lists the recommended settings. For information about how to make the settings, see the modem manual.

- Jumpers HD1 through HD6 on the Printer Interface card must be set to the T position. For more information about the Printer Interface card jumpers, see the Service Manual (SV: 3--5) or the Service Quick Reference Guide.
Table 3.3.1. Racal-Vadic Communication Option Settings

<table>
<thead>
<tr>
<th>Option</th>
<th>Setting</th>
<th>Option</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Standard options</td>
<td>2 Disabled</td>
<td>12</td>
<td>not used</td>
</tr>
<tr>
<td>2 DSR control</td>
<td>2 DSR always on</td>
<td>13 Clock source</td>
<td>1 Internal</td>
</tr>
<tr>
<td>3 CXR control</td>
<td>1 CXR normal</td>
<td>14 Sync/async</td>
<td>1 Asynchronous</td>
</tr>
<tr>
<td>4 Auto answer</td>
<td>1 Enabled</td>
<td>15 Automatic Redial</td>
<td>1 No redial</td>
</tr>
<tr>
<td>5 Local copy</td>
<td>2 Disabled</td>
<td>16</td>
<td>not used</td>
</tr>
<tr>
<td>6 Dial mode</td>
<td>1 Automatic selection</td>
<td>17 Flow control</td>
<td>2 XON/XOFF</td>
</tr>
<tr>
<td>7 Blind dial</td>
<td>1 Disabled</td>
<td>18 Speed conversion</td>
<td>1 Disabled</td>
</tr>
<tr>
<td>8 Call progress</td>
<td>2 Disabled</td>
<td>19 Error control mode</td>
<td>3 Disabled</td>
</tr>
<tr>
<td>9 Response mode</td>
<td>1 Full words</td>
<td>20 Error control protocol</td>
<td>1 Originate side initiates</td>
</tr>
<tr>
<td>10 Character length</td>
<td>1 10 bits</td>
<td>21 CTS control</td>
<td>1 CTS follows RTS</td>
</tr>
<tr>
<td>11 Disconnect control</td>
<td>2 Disabled</td>
<td>22 DTR control</td>
<td>1 Terminal control</td>
</tr>
</tbody>
</table>
### Table 3.3.2. Multitech Modem DIP Switch Settings

<table>
<thead>
<tr>
<th>8-Position Switch</th>
<th>Setting</th>
<th>4-Position Switch</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Down</td>
<td>1</td>
<td>Up</td>
</tr>
<tr>
<td>2</td>
<td>Up</td>
<td>2</td>
<td>Up</td>
</tr>
<tr>
<td>3</td>
<td>Up</td>
<td>3</td>
<td>Down</td>
</tr>
<tr>
<td>4</td>
<td>Up</td>
<td>4</td>
<td>Down</td>
</tr>
<tr>
<td>5</td>
<td>Up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Down</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 4:
Hardened Command Console

The Hardened Command Console is used when environmental conditions are harsh. Figure 3.4.1 and Figure 3.4.2 show the mounting dimensions of the Hardened Command Console.

![Diagram of Hardened Command Console Dimensions]

Figure 3.4.1. Hardened Command Console Dimensions in Millimeters (Inches)
Installation of the Hardened Command Console consists of installing vibration protection (if desired), securing the console to the floor, making electrical connections, and installing labels in the keyboards.
Installing Vibration Protection

Vibration can damage electronic and mechanical assemblies. If a Hardened Command Console is to be located near equipment that can cause vibration, it should be isolated from the floor by installing a vibration-damping medium.

Figure 3.4.3 shows use of a neoprene pad. Neoprene is acceptable for high-frequency, low-amplitude vibration. Holes should be drilled in the pad to allow installation of the console mounting studs. Nuts should be installed loosely to minimize transmission of vibration to the console but still prevent the console from tipping. The neoprene pad must be sized carefully to match the console surface area and load factors.

![Figure 3.4.3. Vibration Protection Using Neoprene Pad](image-url)
Figure 3.4.4 shows use of a shell filled with resilient material to provide vibration protection. This type of installation is acceptable for low-frequency, high-amplitude vibration.

Figure 3.4.4. Vibration Protection Using Shell With Resilient Material
Securing the Console to the Floor

Secure the console to the floor using the four bolt holes in the console flange. Install the nuts loosely to minimize transmission of vibration to the cabinet but still prevent the cabinet from tipping. The two optional lift eye bolts can be removed and stored in the console.

Making Electrical Connections

Figure 3.4.5 shows the arrangement of the main electronic components in the Hardened Command Console cabinet. Procedures for making the electrical connections begin on the following page.
Figure 3.4.5. Hardened Command Console (Doors Open)

* The AC distribution box for the optional air conditioner must be supplied separately by the customer and must be on a different circuit than the circuit powering the CRT and card cage electronics.
To make electrical connections for the Hardened Command Console:

**NOTE:** The AC power wiring must conform to local codes on wire size, routing, and protection. Conduit and watertight connectors that meet NEMA 4 specifications must be used. 4 mm² (12 AWG) wire is recommended for AC power wiring.

1. Prepare a suitable watertight opening in the cabinet.
2. Route the AC power wiring through the watertight opening.
3. Connect the AC power wiring to the AC distribution box located in the lower right hand corner of cabinet. For the AC distribution box location, see Figure 3.4.5. For an illustration of the AC distribution box, see Figure 3.4.6.

![AC Distribution Box Diagram](image-url)
4. Plug the cooling unit, DC power supply, and monitor power cords into the AC distribution box.

5. A termination board for external alarm connections is located in the Hardened Command Console. If external alarm connections will be made, route the external alarm wires through the watertight opening in the cabinet to the alarm output board.

6. Route the PeerWay cables through the watertight opening to the PeerWay taps.

7. Connect the PeerWay drop cables (1984-0473-xxxx) to the PeerWay taps and to the card cage (see Figure 3.4.7).

8. Connect the 30 VDC cable(s) from the DC power supply to the card cage (see Figure 3.4.7).
(If remote power supply is used, negative side of power supply must be connected to chassis.)

Figure 3.4.7. Connecting PeerWay and Drop Cables
9. Connect the cooling unit according to the manufacturer’s instructions provided with the console.

10. Connect the configuration keyboard to the monitor base, as shown in Figure 3.4.8.

Figure 3.4.8. Configuration Keyboard
Installing Keyboard Labels

The Hardened Command Console callup buttons keyboard and operator keyboards contain buttons that you can configure to perform certain functions. The callup keyboard ships from the factory without labels in the keyboard. The operator keyboard ships with default label strips in the keyboard.

The console ships with blank callup keyboard label strips and blank operator keyboard label strips that you can fill out and install in the keyboards.

To install labels for the callup buttons keyboard and the operator keyboard:

1. Prepare the callup keyboard label strips and the operator keyboard label strips on a typewriter or with a pen.

2. Open the upper door of the Hardened Command Console.

3. Do not attempt to put new labels on top of existing labels. Remove any label strips that are being replaced.

4. Remove the new label strips from the label backing and insert them into the callup buttons and operator keyboards, as shown in Figure 3.4.9. Check the front of the keyboard for proper placement of strips.

5. Close the upper door to the Hardened Command Console.
Figure 3.4.9. Installing Labels in Callup Buttons Keyboard and Operator Keyboards
Section 5: System Manager Station

The System Manager Station (SMS) is a stand-alone, upright arrangement of the RS3 Operator Interface Console. Install it as close to the console configuration work surface as the length of the Operator keyboard cabling permits. The System Manager Station is CE-compliant when system-powered or powered with the 10P54090003 or 0004 power supply. The SMS is shown in Figure 3.5.1.

![System Manager Station](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWay Tap</td>
<td>4</td>
<td>Ventilation slots</td>
</tr>
<tr>
<td>2</td>
<td>Tape drive</td>
<td>5</td>
<td>Fan assembly</td>
</tr>
<tr>
<td>3</td>
<td>Disk drive</td>
<td>6</td>
<td>OI Card Cage (door closed)</td>
</tr>
</tbody>
</table>

Figure 3.5.1. System Manager Station: Front Door Removed
The System Manager Station cabinet can hold one Operator Interface (OI) card cage, supporting one CRT. Figure 3.5.2 shows the System Manager Station electronics cabinet dimensions.

![Diagram of System Manager Station Electronics Cabinet Dimensions](image)

**Figure 3.5.2. System Manager Station Electronics Cabinet Dimensions in Millimeters (Inches)**

Cooling the SMS requires consideration of space at the side for the ventilation slots at the base and top of the enclosure. Leave at least 5 cm (2 in.) of unobstructed space for airflow through the assembly.
Making Electrical Connections

The following procedures describe how to make electrical connections for the console. The exact locations of card cages, AC distribution boxes, cable troughs, CRTs, and so on differ with each installation. These instructions and associated figures are designed to provide general installation procedures.

Cables can be routed through table legs, cable troughs attached to the underside of tables, holes in tabletops, holes in CRT bases, cable socks, and other throughways, depending on the individual installation.

Cables should be marked at the connectors to identify which card cage and CRT (if applicable) they should be connected to.

Some installations might have different lengths of the same type of cable for a console, depending on the distance from the CRT to the console card cage. Check to ensure that the CRT has the correct cables before installation.

Figure 3.5.1 and Figure 3.5.3 show SMS components.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWay Tap</td>
<td>4</td>
<td>Keyboard/Video Interface (if internal mount)</td>
</tr>
<tr>
<td>2</td>
<td>Tape drive</td>
<td>5</td>
<td>Power supply (if present)</td>
</tr>
<tr>
<td>3</td>
<td>Disk drive</td>
<td>6</td>
<td>OI Card Cage (door closed)</td>
</tr>
</tbody>
</table>
Power Supply

Power options include direct power from the RS3 DC bus or a local AC/DC power supply option. The direct DC bus power input connection is the standard RS3 18 to 36 VDC A and or B power bus. The AC/DC power supply assembly is a 10P54090003 or 0004 for CE compliance or 10P56450001 for CSA and NRTL compliance.

If a local AC/DC power supply is used, it is mounted on the back of the disk drive mounting bracket using the power supply mounting bracket.

Grounding

Internal Power Supply

When an internal power supply is present, DC return and system chassis grounds must be bonded to the protective conductor terminal of the power supply.

If all grounding is through the power supply, the ground prong on the AC plug is the only necessary system ground.

The tabletop-mounted Keyboard/Video Interface (KVI) chassis connection must be grounded to the monitor safety ground using a 12 AWG (4 mm²) grounding wire.

Remote DC Power

When the DC supply is remote to the System Manager, ensure that the DC return is bonded to the protective conductor terminal at the power supply.

The SMS enclosure-mounted KVI chassis connection must be tied to the system chassis, which in turn must be grounded to the monitor safety ground using a 12 AWG (4 mm²) grounding wire.

The tabletop-mounted KVI chassis connection must be grounded to the monitor safety ground using a 12 AWG (4 mm²) grounding wire.
Tape Drive and Disk Drive

The tape drive and disk drive are mounted above the OI card cage.

This assembly allows service access to the drives and power supply. The drives are mounted on slot and tab brackets. These brackets can be pulled out by removing 2 mounting screws on the side of the panel. Lift and remove the mating tab from the slot in the U frame.

Keyboard/Video Interface (KVI)

The KVI can be mounted on a tabletop or in the SMS enclosure.

For tabletop mounting, use the CRT base KVI enclosure and install the KVI by tightening the faceplate screws and connecting a ground wire between the back of the circuit board and the ground stud on the enclosure.

When the KVI is mounted on the right side of the SMS chassis assembly, an access hole in the back allows access for keyboard cables and the operator key.

Connect the monitor to the internal KVI using coaxial cables 3.05 meters (10 feet) or less. Monitors with dsub connectors must be used with the tabletop-mounted KVI.
Operator Interface Card Cage Connections

The Operator Interface (OI) Card Cage (10P52820001) is the only card cage allowed for use in the System Manager Station.

The functions of the Alarm Output Panel and Alarm Output Board (1984-0744-000x) are included in the CE Card Cage Filterboard. The cage can be powered from the standard system bus or from an optional remote power supply (10P54090003 or 0004 for CE compliance or 10P56450001 for NRTL/CSA compliance).

Figure 3.5.4 shows the dimensions of the CE OI Card Cage in mm (in.).

![Diagram of OI Card Cage Views](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front view, door closed</td>
<td>3</td>
<td>Rear view</td>
</tr>
<tr>
<td>2</td>
<td>Side view</td>
<td>4</td>
<td>Top view</td>
</tr>
</tbody>
</table>

Figure 3.5.4. OI Card Cage Views
The position of the cards is shown in Figure 3.5.5.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OI Card Cage, front view</td>
<td>5</td>
<td>PeerWay Interface</td>
</tr>
<tr>
<td>2</td>
<td>Power Switch</td>
<td>6</td>
<td>Printer Interface</td>
</tr>
<tr>
<td>3</td>
<td>Power Regulator</td>
<td>7</td>
<td>SCSI Card</td>
</tr>
<tr>
<td>4</td>
<td>Video Generator</td>
<td>8</td>
<td>OI Processor</td>
</tr>
</tbody>
</table>

Figure 3.5.5. Card Positions
Figure 3.5.6 shows the OI Card Cage connectors and fuses. Several connectors are used only when this cage replaces an earlier cage. Table 3.5.1 lists the OI Card Cage connectors and fuses.

Figure 3.5.6. Rear View of Card Cage
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS-422 Keyboard Interface cable connection (J086)</td>
<td>12</td>
<td>DC power A cable connection (J907)</td>
</tr>
<tr>
<td>2</td>
<td>SCSI cable (J088)</td>
<td>13</td>
<td>SCSI power cable connection (J933)</td>
</tr>
<tr>
<td>3</td>
<td>RS-232 printer cable connection (J085)</td>
<td>14</td>
<td>Power Switch cable connection (J906)</td>
</tr>
<tr>
<td>4</td>
<td>Process Alarm cable connection (TB2)</td>
<td>15</td>
<td>PeerWay A Drop Cable connection (J084)</td>
</tr>
<tr>
<td>5</td>
<td>Hardware Alarm cable connection (TB1)</td>
<td>16</td>
<td>Video BNC Output RED (J646)</td>
</tr>
<tr>
<td>6</td>
<td>Alarm Circuit fuses (F1, F2) 1.5 A max</td>
<td>17</td>
<td>Video Output cable connection to the BNC Breakout Panel (replacement use only) (J082)</td>
</tr>
<tr>
<td>7</td>
<td>Process Alarm Opto-2 (RL2)</td>
<td>18</td>
<td>Video BNC Output GRN (J647)</td>
</tr>
<tr>
<td>8</td>
<td>Hardware Alarm Opto-1 (RL1)</td>
<td>19</td>
<td>Video BNC Output BLU (J648)</td>
</tr>
<tr>
<td>9</td>
<td>Alarm Output cable connection to Alarm Output Panel (replacement use only) (J284)</td>
<td>20</td>
<td>PeerWay B Drop Cable connection (J083)</td>
</tr>
<tr>
<td>10</td>
<td>Keyboard/SCSI power cable connection (J920)</td>
<td>21</td>
<td>Fan cable connection (J919)</td>
</tr>
<tr>
<td>11</td>
<td>DC power B cable connection (optional) (J908)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Checklist for CE-Compliant Installations

These rules must be followed to ensure CE compliance:

1. Use cables listed in Table 3.5.2, as required.

2. The KVI-to-CRT coaxial cable for a tabletop-mounted KVI (1984–1691–0003) is approximately 1 meter (39 inches) long. The KVI-to-CRT coaxial cable for an SMS enclosure-mounted KVI (1984–1691–0010) is approximately 3 meters (10 feet) long. Do not use a longer cable between the KVI and the CRT.


4. Use keyboards, trackball, printer, and CRT bearing the CE mark and install them in a control room environment.

5. Power the cage from a CE-approved power supply such as the system DC bus or a remote power supply (10P54090003 or 0004).

Table 3.5.2. CE-Compliant Cables

<table>
<thead>
<tr>
<th>Cable</th>
<th>P/N</th>
<th>Maximum Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>PeerWay Drop Cable</td>
<td>1984–0473–00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>DC Power Cable, bus to product</td>
<td>1984–0158–0xxx</td>
<td>61 meters (200 feet)</td>
</tr>
<tr>
<td>DC Power Cable, remote power supply to product</td>
<td>1984–1083–00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>DC Power Cable, local power supply to product</td>
<td>10P54100001</td>
<td>Standard</td>
</tr>
<tr>
<td>Fan Power Cable (for use with remote power supply)</td>
<td>1984–1605–0009</td>
<td>Standard</td>
</tr>
<tr>
<td>Fan Power “Y” Cable (for use with local power supply)</td>
<td>10P54190001</td>
<td>Standard</td>
</tr>
<tr>
<td>Power Cable, disk and tape drive</td>
<td>10P56840001</td>
<td>Standard</td>
</tr>
<tr>
<td>I/O Cable, disk and tape drive</td>
<td>1984–1895–9901</td>
<td>Standard</td>
</tr>
<tr>
<td>Keyboard/Video Interface (KVI) Power Cable</td>
<td>1984–1628–0xxx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>RGB Video Cable, coax, console to KVI (tabletop mount KVI)</td>
<td>1984–1691–00xx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>RGB Video Cable, shielded, KVI to CRT (tabletop mount KVI)</td>
<td>1984–1691–0003</td>
<td>1 meters (3 feet)</td>
</tr>
<tr>
<td>RGB Video Cable, shielded, KVI to CRT (internal mount KVI)</td>
<td>1984–1691–0010</td>
<td>3.05 meters (10 feet)</td>
</tr>
<tr>
<td>KVI Communication Cable, shielded, OI Card Cage to KVI</td>
<td>10P52890xxx</td>
<td>152.4 meters (500 feet)</td>
</tr>
<tr>
<td>Printer Communication Cable, shielded</td>
<td>10P5308000xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
</tbody>
</table>
System Cabling

Cable part numbers often use the last four digits to show cable length. This varies among cables; some are in inches, feet, decimeters, or meters; others use codes in place of a length. The variable is shown as xxxx.

Cabling for Power and PeerWay

The DC power can be supplied from the system bus in a system cabinet or from the power supply. Figure 3.5.7 shows power and PeerWay cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J908 PWRB</td>
<td>1984–0158–1xxx (Bus B)</td>
<td>DC power B (optional)</td>
</tr>
<tr>
<td>2</td>
<td>J907 PWRA</td>
<td>1984–0158–0xxx (Bus A) 1984–0158–1xxx (Bus B)</td>
<td>DC Bus to System Device (Bus A)</td>
</tr>
<tr>
<td>3</td>
<td>J906 POWER SWITCH</td>
<td>10P53110001</td>
<td>Power switch and cable</td>
</tr>
<tr>
<td>4</td>
<td>J084 PEERWAY A</td>
<td>1984–0473–0xxx</td>
<td>PeerWay A Drop Cable</td>
</tr>
<tr>
<td>5</td>
<td>J083 PEERWAY B</td>
<td>1984–0473–0xxx</td>
<td>PeerWay B Drop Cable</td>
</tr>
<tr>
<td>6</td>
<td>J019 FAN</td>
<td>10P54190001 or 1984–1605–0009</td>
<td>“Y” cable, OI Card Cage to DC Fans or single fan cable</td>
</tr>
</tbody>
</table>

Figure 3.5.7. Power and Peerway Cabling
PeerWay Extender Tap Usage

An SMS enclosure-mounted PeerWay Extender (PX) tap set should serve only the SMS node, although another node may be connected via PeerWay drop cables to the PX tap set. Do not connect a twin-axial PeerWay cable to the PX tap set. Otherwise, the PeerWay would be broken whenever the SMS is powered off.

When the PX tap set serves multiple nodes, the tap set must be mounted externally and provided with a backed-up power source. The SMS would then connect to the PX tap or a standard twin axial tap via a PeerWay drop cable.

Cabling for SCSI and Printer

Figure 3.5.8 shows SCSI and printer cable connections.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J933</td>
<td>10P56840001</td>
<td>Disk and tape drive power (SCSI)</td>
</tr>
<tr>
<td>2</td>
<td>J085</td>
<td>10P5308xxxx</td>
<td>OI Card Cage to printer (RS-232)</td>
</tr>
<tr>
<td>3</td>
<td>J088</td>
<td>1984–1895–9901</td>
<td>Disk and tape communication cable (SCSI ribbon cable)</td>
</tr>
</tbody>
</table>

Figure 3.5.8. SCSI and Printer Cable Connections
Cabling for Alarms

Optically isolated outputs are provided for Hardware and Process Alarms. TB1 and TB2 have normally-open circuits that close when an associated alarm is active. A source of DC voltage between 5 and 40 volts is required. Maximum current is 1.0 amp. Use a diode across the load if the load is inductive (Figure 3.5.9).

Figure 3.5.9 shows alarm connections.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TB1 HARDWARE ALARM</td>
<td>Customer supplied; connects to screw terminals on TB1</td>
<td>Normally open hardware alarm</td>
</tr>
<tr>
<td>2</td>
<td>TB2 PROCESS ALARM</td>
<td>Customer supplied; connects to screw terminals on TB2</td>
<td>Normally open process alarm</td>
</tr>
</tbody>
</table>

Figure 3.5.9. Alarm Connectors

CAUTION

Do not power the alarm circuit with AC. Use of AC and AC-rated optical isolators can result in problems that are very hard to locate.
Cabling from the OI Card Cage to the Keyboard/Video Interface

The Keyboard/Video Interface card may be installed in the SMS cabinet or in a KVI enclosure, at the CRT.

RGB Video Cable (1984–1691–0xxx) connects the RED–GRN–BLU (J646, J647, J648) connectors on the filterboard to the KVI Card. This cable can be up to 152 meters (500 feet) long (for a tabletop mounted KVI).

The KVI Power Cable (1984–1628–xxxx) goes from P979 of the 10P54180001 cable to J942 on the KVI.

Use the shielded Keyboard Interface Cable 10P52890xxx to connect J086 on the filterboard to J407 on the KVI Card.

Figure 3.5.10 shows keyboard cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P979 (on SCSI cable)</td>
<td>1984–1628–xxxx</td>
<td>KVI power to KVI Card</td>
</tr>
<tr>
<td>2</td>
<td>J646 RED J647 GRN J648 BLU</td>
<td>1984–1691–0xxx</td>
<td>RGB Video cable to KVI Card</td>
</tr>
<tr>
<td>3</td>
<td>J086 RS-422</td>
<td>10P52890xxx</td>
<td>Keyboard Interface cable to KVI Card</td>
</tr>
</tbody>
</table>

**Figure 3.5.10. Keyboard Cabling**
Cabling the Keyboard/Video Interface Card

Figure 3.5.11 shows keyboard/Video Interface cabling.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KVI Card 10P50840001 or -004</td>
<td>7</td>
<td>CRT AC power cord</td>
</tr>
<tr>
<td>2</td>
<td>KVI Card DC power cable 1984–1628–0xxx to J942</td>
<td>8</td>
<td>Monitor-supplied (dsub connector) RGB Video cable to J494 (if applicable, or use #9)</td>
</tr>
<tr>
<td>3</td>
<td>RS-422 Keyboard Communications cable 10P52890xxx to J407</td>
<td>9</td>
<td>RGB Video CRT cable (BNC connector) 1984–1691–0003 to J495, J496, and J497</td>
</tr>
<tr>
<td>4</td>
<td>Ground wire to CRT ground point</td>
<td>10</td>
<td>Trackball and cable</td>
</tr>
<tr>
<td>5</td>
<td>RGB Video Input cable 1984–1691–0xxx to J491, J492, and J493</td>
<td>11</td>
<td>Operator Keyboard and cable</td>
</tr>
<tr>
<td>6</td>
<td>CRT</td>
<td>12</td>
<td>Configurator’s Keyboard and cable</td>
</tr>
</tbody>
</table>

Figure 3.5.11. Keyboard/Video Interface Cabling
Section 6: RS3 Operator Station

You must complete these tasks to install the network. This section covers installation of:

- Ethernet equipment
- RS3 Network Interface (RNI)
- Workstation
- Operator Keyboard
- Router
- Uninterruptible Power Supply (UPS)
Planning a Process Network

The RS3 Operations Suite is a set of native 32-bit applications that run under the Windows NT™ operating system. The RS3 Operations Suite allows for the operation, observation, and control of an RS3 PeerWay system from a PC workstation on a process network.

A process network is an Ethernet network dedicated to process control traffic. It must always be isolated from other networks in the plant so that network traffic in other areas does not interfere with control and data traffic on the process network. A router must be used to isolate the process network from the plant network. The choice depends on the size, design, and use of the plant network.

The only equipment installed in the process network should be workstation(s), RNI(s), and a hub. The RNI provides the bridge between the RS3 PeerWay and the process network. The hub connects all equipment in the process network and supports connection to the plant network through a router. The workstations and hub should be connected to a reliable power supply, preferably an uninterruptible power supply (UPS).

The RS3 process network uses Category 5 10BaseT cables that can be up to 100 meters (328 feet) long. You should consider having the network installed by an organization skilled in the installation of Ethernet networks. Cabling problems are the most common forms of trouble with Ethernet installations. Experienced installers minimize these problems.

Each workstation must have a Hardware Keylock to authorize use of the software. At least one workstation on the process network should have:

- A tape drive for backup of all workstations on the process network.
- A printer. The printer should be configured as a shared printer so it can be used by any workstation on the process network.

**NOTE:** Alarm logging should be done on a printer attached to an RS3 PeerWay command console.

There is a one-to-one relationship between a workstation and RNI. Each workstation is set up to work with a particular RNI. The RNI should have no other responsibilities.
Basic Process Network

The simplest and most basic process network (Figure 3.6.1) consists of an RNI, a workstation, and a 10BaseT crossover cable (10P5562xxxx). The crossover cable has the transmit and receive connections reversed, similar to a “null modem” cable. This places the workstation on a dedicated Ethernet network, providing a stand-alone workstation with no communication to any other workstation except through the RS3 PeerWay. There is no communication path to a plant network.

To be able to back up the hard disk, the workstation must have a tape drive. A printer is optional.

![Figure 3.6.1. Basic Process Network](image-url)
Expanded Process Network

The next step up is to add a hub between the RNI and the workstation. The hub has multiple ports, so several RNIs and several workstations can be connected to the hub with 10BaseT Ethernet cable (10P5560xxxx). The hub is at the center of a star configuration with a cable running from it to each piece of equipment on the process network (Figure 3.6.2). There is no communication path to a plant network. There remains a one-to-one relationship between a workstation and the RNI assigned to it.

![Figure 3.6.2. Expanded Process Network](image)

Hubs are available in several sizes and can be stacked to provide a large number of ports. See the Service Manual for more information. We suggest use of the TP/8 8-port unmanaged hub for small process networks and the FMSII 12- or 24-port hubs for larger networks.

You can connect a printer to one of the workstations and configure it as a shared printer. Any workstation can then use the printer.

To be able to back up the hard disks of all workstations, at least one workstation must have a tape drive. The workstation with the tape drive becomes the backup server workstation. It must also have the appropriate backup software loaded.
Connection to a Plant Network

Connecting the process network to a plant network (Figure 3.6.3) requires special consideration. A router is required. The equipment required depends on the size, design, and usage of the plant network, so only general guidelines can be given here. Isolation is essential, so that a malfunctioning device somewhere in the plant does not affect the process network.

The system administrator of the plant network will specify the required equipment and might also specify the addresses to be used for the process network. A large plant network might be using network management software. If so, the system administrator may require a network management module in the process network hub.

Router

A plant network will have one or more routers to provide protected entry points for the process network. The router provides conversion between various types of Ethernet (10BaseT, 10Base2, etc.) and isolates traffic among networks. A router can be connected via the attachment unit interface (AUI) connector on the FMS II hubs or via the baby “N” connector (BNC) on the TP/8 hub. A transceiver module might be required to connect to the router.

Figure 3.6.3. Connection to a Plant Network
A large plant network may use network management software and Simple Network Management Protocol (SNMP) to monitor performance of the various networks (Figure 3.6.4). A network management module can be installed in any of the FMS II hubs.

Figure 3.6.4. Network Management
Process Network Addressing

Each node on a network has three addresses:

- Media Access Control (MAC) address (hardware address)
- Internet Protocol (IP) address (network address)
- Name

All three addresses point to the same item of hardware.

**MAC Address**

The MAC address is a unique number that is assigned by the device manufacturer. This address, like a serial number, belongs to the specific piece of hardware. It never changes. The address is normally written as 12 hex digits such as 08003E132409. Hyphens (–) or colons (:) may optionally be used to separate the bytes. This address is used by the Ethernet hardware to reach a specific node.

**IP Address**

The IP address is assigned by the system administrator at your site. An IP address is a 32-bit value assigned by the system administrator. It is normally written as a set of four decimal numbers separated by periods (w.x.y.z). The numbers are from 0 to 255 and represent the value of an octet or group of eight bits in the address. This address identifies the location of the node in the network. Much can be done with the IP address to isolate your process network from other networks in the plant.

**Name**

The name is assigned by the system administrator for human convenience. It is much easier to talk about a node as “RNI1” than it is to use the IP address or the MAC address. Software translates the name into the IP or MAC address as required.

The name can be up to 16 characters long. The only punctuation allowed is the underscore (_). In offices, it is common to give the nodes fanciful names such as “Gumby”, “Hotrod”, or “George”. In a plant, it is better to use functional names such as “RNI3”, “Console6”, or “Control2”. The name will be used in forming RS3 tag addresses.
Isolated Process Network

An isolated process network is not connected to a higher level network such as a plant network. The only requirement for IP addresses within an isolated network is that they all belong to the same subnetwork. All nodes on the network will then be able to talk with each other.

You should use IP addresses chosen from the public address set. You can use the class A public network 10.xxx.yyy.zzz, with a subnetmask of 255.0.0.0. All addresses on a subnet must have the same value (1 - 254) for xxx and yyy. The last octet (zzz) can be used to number nodes from 1 to 254. Each node must have a unique value for zzz. Values 0 and 255 are reserved.

If there is a possibility that you will make the connection in the future, you should use IP addresses specified by the plant network system administrator. If you connect to a plant network by a router, you can choose to renumber the nodes or to continue use of the current addresses.

Router-Connected Process Network

A process network that is connected to a plant network via a router can either use IP addresses as specified by the plant network or addresses from the public address set. Each node must have a unique name and IP address.

There is a security advantage in using public IP addresses. This makes it more difficult for a person somewhere on the Internet to gain access to the process network. The Internet routers do not pass messages addressed to the public IP address set.
Ethernet Equipment

Whenever possible, use personnel experienced in the installation of Ethernet cables and equipment.

A hub provides the common connection point for devices on the process network and a connection to the plant local area network (LAN). Fisher-Rosemount supports use of these hubs from the 3Com LinkBuilder series:

- TP/8 8-port Unmanaged TP Hub (10P55200001 - 115V)
- FMS II 12-Port TP Hub (10P55200002 - Autosensing power supply)
- FMS II 24-port TP Hub (10P55200003 - Autosensing power supply)

Install the hub as directed by the instructions included in the package. The hub requires:

- A source of AC power
- 10BaseT cables to the process network equipment

The hub should be plugged into a reliable power source, such as a UPS. The hub can be mounted inside a system cabinet. FMS II hubs require an additional power strip, which must be connected to the AC Entrance Panel.
Ethernet Cable

The RS3 process network uses 10BaseT cable. 10BaseT cable uses two pairs of 0.14 - 0.34 mm² (22 - 26 AWG) wires, one pair to transmit and one to receive data signals. The wires in each pair are twisted together along the length of the cable. This allows segment lengths of up to 100 meters (328 feet). There are two additional pairs of wires in the cable that can be used for telephone or other use. The cable has an eight-pin RJ-45 connector at each end.

- Use Category 5 cable in plenum grades
- Route the cables away from power lines or other sources of interference

NOTE: For CE-compliant applications, shielded 10BaseT cable is required.

Stranded-wire cable is suitable only for short runs where flexibility is required. Cable is available with color-coded jackets, with or without connectors.

Standard cable (for use with a hub) has the connection wired straight through. Crossed cable is available with the transmit and receive cables crossed over for “null modem” connections. Crossover cable is used only when a workstation is connected directly to an RNI without a hub.
Installing the RNI

The RS3 Network Interface (RNI) (10P53330001) is a node on the PeerWay and a host on the process network. It serves as a bridge between the networks. The RNI gets its boot code and PeerWay identity from its dedicated workstation.

Locate the RNI on the PeerWay system where you would locate a console. The RNI can be physically installed whenever convenient although it cannot boot up until the workstation BOOTP server is operating. The RNI sends a boot request on the Ethernet once a minute until a BOOTP server responds. The RNI will not affect the PeerWay until it is booted, because it gets the PeerWay software and PeerWay address in the boot code.

Install the RNI as directed in Chapter 8 of this manual.

The RNI requires:

- A source of DC power
- A pair of PeerWay drop cables to a PeerWay Tap Box set
- A 10BaseT cable to the hub or workstation
- A configured BOOTP server on the process network

The RNI can be installed in a system cabinet and be powered from the RS3 DC bus.

The write-on label (Figure 3.6.5) provides space to record the PeerWay Node address of the RNI, the Ethernet host name of the RNI, and which Ethernet port is in use. The MAC Address (machine address) will be filled out at the factory. This is the unique Ethernet address of the RNI.

<table>
<thead>
<tr>
<th>PEERWAY NODE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-NET HOST</td>
</tr>
<tr>
<td>MAC ADDRESS</td>
</tr>
<tr>
<td>E-NET 10 BASE T</td>
</tr>
<tr>
<td>E-NET 10 BASE 2</td>
</tr>
</tbody>
</table>

Figure 3.6.5. RNI Write-on Label
Installing the Workstation

The workstation consists of a computer, keyboard, mouse, CRT, and speakers. The workstation (10P5627xxxx - 166 MHz and 10P5693xxxx -200 MHz) can also have a tape drive, a printer, and an optional operator keyboard.

**The workstation personal computer is shipped with installation and service manuals provided by the PC manufacturer.**

The workstation requires:

- A source of AC power
- A 10BaseT cable to the process network hub/RNI
- A hardware keylock
- An appropriate computer operating environment
- Uninterruptible Power Supply (UPS)
  Two suitable uninterruptible power supplies are:
  - Liebert Power Sure PS600-60 (NRTL)
  - Liebert Power Sure PS600-50 (CE)

**CAUTION**

The computer has an operating temperature range of 10 to 35 degrees C. Operating the computer in temperatures above or below this range will cause damage to the computer. Install the computer in an environment that maintains temperatures within this range.

At least one workstation on the process network should have these peripheral devices:

- A tape drive for backup of all workstations on the process network
- A printer that can be used by any workstation on the process network

The optional tape drive is a 3200 MB Travan. Refer to the tape drive user’s manual.

The optional printer is a HP870Cxi Color Printer (10P55800004). This printer has an auto-sensing universal power supply for 100–240VAC, 50/60Hz. The software printer driver is the HP560 driver in Windows NT. The printer cable number is 10P55800003. Refer to the printer user’s manual.
To install a workstation:

1. Connect the workstation cables as directed by the installation document included in the computer box.

CAUTION

Check the voltage select switch on the computer to be sure that it matches the supply voltage. If it does not match, set the switch to match the supply voltage. Using the wrong setting will destroy the power supply.

2. Plug the keyboard cable into the keyboard jack.

3. Plug the mouse cable into the mouse jack.

4. Plug the CRT power cable into the CRT power jack.

5. Plug the CRT video cable into the video jack.

6. Connect the speaker to the speaker jack.

7. If applicable, connect the speaker power adapter to the same AC source as the computer. If you use a UPS, be sure to plug the power adapter into the UPS.

8. Attach the hardware keylock to the parallel port.

NOTE: Save the packing slip that comes with the hardware keylock. The codes on the slip will be required if the keylock is damaged.

9. Plug the computer into the AC source and turn the computer on. It should boot up to a RS3 Operations Suite View screen.
ROS CRTs

The color CRT monitors that can be used with the RS3 Operator Station include:

- 21-inch Hitachi HM-4721-D CRT
- 17-inch Iiyama Vision Master CRT

ROS CRT: Hitachi HM-4721-D

The Hitachi HM-4721-D CRT (12P0373x032) is a 21-inch color unit.

The unit runs on either 115 or 220 VAC, 50 or 60 Hz (100–120 / 200–240 VAC auto selecting).

Setup and controls are described in the user manual that accompanies the unit.

ROS CRT: ViewSonic P810

The ViewSonic P810 CRT (55P0675x012) is a 21-inch color unit.

The unit runs on either 115 or 220 VAC, 50 or 60 Hz (100–240 VAC auto selecting).

Setup and controls are described in the user manual that accompanies the unit.

ROS CRT: Iiyama Vision Master

The Iiyama Vision Master CRT (55P0144x022) is a 17-inch color unit.

The unit runs on either 115 or 220 VAC, 50 or 60 Hz (108–132 / 198–264 VAC auto selecting).

Setup and controls are described in the user manual that accompanies the unit.
The RS3 Operator Station (ROS) has a variety of keyboard options. Figure 3.6.6 shows the dimensions of the optional operator keyboard with a single option button panel. Up to three option button panels may be provided.

Figure 3.6.6. Elevated Operator Keyboard Dimensions in Millimeters (Inches)
Figure 3.6.7 shows the dimensions of the operator keyboard with trackball.

![Operator Keyboard Dimensions](image)

Figure 3.6.7. Operator Keyboard Dimensions in Millimeters (Inches)
CAUTION

Observe normal electrostatic discharge (ESD) precautions when handling the keyboard interface circuit board. Observe the safety precautions and instructions in your computer manual when installing the board in the computer.

To install the keyboard interface card:

1. Unpack the interface card. Make sure that the dip switches are set as shown in Figure 3.6.8.

2. Following the safety precautions and instructions in your PC user’s manual, remove the PC cover to gain access to the expansion card slots.

3. Select an open expansion card slot in your PC.

4. Remove the blank filler bracket at that slot and install the board by pressing it firmly into the slot connector. Check that the circuit board’s bracket is mated with the appropriate slot on the PC chassis, and install the bracket screw to hold the board in place.

5. Following the safety precautions and instructions in your PC user’s manual, reinstall the PC cover.

---

**Figure 3.6.8.** ROS Operator Keyboard Interface Card
Connecting the ROS Operator Keyboard

To connect the Operator Keyboard to the PC:

1. Connect the 9-pin D-sub connector end of interface cable 10P56700015 (Figure 3.6.9) to the keyboard interface card serial port on the back of the PC.

2. Using the 8-pin connector, connect the interface cable to the standard keyboard cable.

![Diagram of ROS Operator Keyboard Interface Connection]

Figure 3.6.9. ROS Operator Keyboard Interface Connection
Router

When connecting to a plant network, a router must be used to isolate your process network. Which to choose depends heavily on the nature of the plant network. Consult with your plant network administration or a knowledgeable networking service to select the proper connection mechanism for your installation.

Consult Fisher-Rosemount Systems for the recommended router.

**CAUTION**

The process network must be isolated from the plant network with a router. If it is not isolated, a misbehaving device on the plant network could cause loss of control on the process network.

Be sure to use the router’s controlled access list functionality to provide isolation from network traffic.
The workstation must be powered from an uninterruptible power supply (UPS). Two suitable systems are the Liebert Power Sure PS600--60 (55P0566x012 - NRTL) and the Liebert Power Sure PS600--50 (55P0567x012 - CE).

The UPS should be able to signal when primary power fails and when the battery is getting low. This signal is carried by cable to a dedicated serial port on a workstation computer. The NT operating system can be configured to warn users of power failure and to shut down the system when the UPS batteries are low. With the Liebert Power Sure PS600-60 (NRTL) or the Liebert Power Sure PS600-50, cable 10P56820001 (WIN-NEG-48A) is connected from COM2 on the PC to the communications port on the UPS.

The UPS should be sized to operate the equipment for at least five minutes to allow for an orderly shutdown. The minimum volt-ampere rating for a UPS on a single workstation is 600 VA. Table 3.6.1 lists typical power consumption examples.

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<td>17” CRT</td>
<td>130</td>
</tr>
<tr>
<td>21” CRT</td>
<td>250</td>
</tr>
<tr>
<td>Printer</td>
<td>12</td>
</tr>
<tr>
<td>TP/8 Hub</td>
<td>10</td>
</tr>
<tr>
<td>FMS II 12-Port Hub</td>
<td>28</td>
</tr>
<tr>
<td>FMS II 24-Port Hub</td>
<td>36</td>
</tr>
</tbody>
</table>
UPS Software Setup

Windows NT (under Control Panel) provides the UPS configuration software. In order to make changes to the UPS configuration you must be logged in as an NT Administrator.

**With the Liebert Power Sure PS600-60 (NRTL) or the Liebert Power Sure PS600-50, the following configuration should be set:**

- Select Uninterruptible Power Supply is installed on: COM2

Under UPS Configuration:

- Select Power failure signal (select Negative for UPS Interface Voltages).
- Select Low battery signal: at least 2 minutes (select Negative for UPS Interface Voltages).
- Select Remote UPS Shutdown (select Positive for UPS Interface Voltages).

Under UPS Service:

- Set Time between power failure and initial warning message to 0 seconds.
- Set Delay between warning messages to 30 seconds.
- Click on OK.
Chapter 4: ControlFiles

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  Connecting DC Power .............................................. 4-1-6
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Section 1: ControlFiles

This section describes installation and system cabling for the 10P52960001 ControlFile with built-in plenum and blower. The ControlFile mounts in a standard system cabinet and in the RS3 Millennium Package (RMP) where it takes 489 mm (19.25 in.) of rail space. The unit is 610 mm (24 in.) deep. Figure 4.1.1 shows a front view of the ControlFile.

![ControlFile Front View Diagram]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWay B Buffer</td>
<td>5</td>
<td>Coordinator Processor</td>
</tr>
<tr>
<td>2</td>
<td>PeerWay A Buffer</td>
<td>6</td>
<td>Optional Redundant Coordinator Processor</td>
</tr>
<tr>
<td>3</td>
<td>Power Regulator</td>
<td>7</td>
<td>Nonvolatile Memory</td>
</tr>
<tr>
<td>4</td>
<td>Optional Redundant Power Regulator</td>
<td>8</td>
<td>Controller Processors in slots A–H</td>
</tr>
</tbody>
</table>

Figure 4.1.1. ControlFile Front View
The ControlFile has a support section and a controller section. The support section holds two PeerWay Buffer Cards, one or two Power Regulator Cards, one or two Coordinator Processor Cards, and one Nonvolatile Memory Card. The controller section can hold up to eight Controller Processor Cards. ControlFiles are shipped with all cards installed and with the ControlFile address jumpers set to the address as ordered. Refer to the Service Manual, Chapter 4, for detailed information on the cards.

The ControlFile (10P52960001) is suitable for all installations, including those requiring CE compliance. This ControlFile cannot support the MultiLoop Controller Processor (MLC) (1984–1439–000x) or the Multi-Strategy Processor (1984–1249–000x), since the motherboard shield prohibits access to the bottom row of communication connectors which are needed by these processors for certain applications.
Mounting

The ControlFile card cage mounts on 483 mm (19 in.) rails in a standard system cabinet and the RS3 Millennium cabinet. Both front and rear access is required. The cabinet must be grounded.

**CAUTION**
The ControlFile Card Cage with cards installed is heavy. Take care when installing or removing the assembly. Two people should lift and install the assembly.

1. The ControlFile Card Cage assembly must be mounted to the plated (unpainted) rails of a 19-inch rack enclosure as shown in Figure 4.1.2.

2. Attach the slide rails (1984-1436-0004) to the four upright rails using the hardware provided with the slide rails.
   a. Mount the ControlFile Card Cage assembly to the front rails of the cabinet using four M5 screws (G12215-2005-0116) and M5 metal cage nuts (G53426-0501-0716).
   b. The ControlFile Card Cage assembly is provided with a safety ground wire for attachment to the cabinet rails. The ground wire is to be attached to any upright plated (unpainted) cabinet rail using an M6 screw (G12215-2006-0116) and M6 metal cage nut (G53426-0601-0716). The only restriction is that you must be able to pull the ControlFile card cage assembly out on the slide rails without straining the ground wire or cables.

3. The door to the ControlFile card cage must be latched and the captive screw securely tightened. The door should be opened only for maintenance operations.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cabinet rail</td>
<td>4</td>
<td>Captive screw on each card assembly</td>
</tr>
<tr>
<td>2</td>
<td>ControlFile</td>
<td>5</td>
<td>Slide rail screws fastened to rail (2 places)</td>
</tr>
<tr>
<td>3</td>
<td>M5 screws and metal cage nuts (4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4.1.2. ControlFile Mounting**
Connecting System Cables

The rear of the ControlFile provides connections for DC power, PeerWays A and B, and up to eight input/output devices. Figure 4.1.3 shows the cable connections.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B Bus Power Cable (Optional) J966 to the DC output card</td>
<td>5</td>
<td>Fan power jumper J967 to fan assembly</td>
</tr>
<tr>
<td>2</td>
<td>A Bus Power Cable J965 to the DC output card</td>
<td>6</td>
<td>Control Cables from Slots A–H (J532–J546) to Communication Termination Panel II</td>
</tr>
<tr>
<td>3</td>
<td>PeerWay Drop Cable J516 to PeerWay Tap Box A</td>
<td>7</td>
<td>Tie-wrap here to ensure strain relief</td>
</tr>
<tr>
<td>4</td>
<td>PeerWay Drop Cable J517 to PeerWay Tap Box B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.1.3. ControlFile Rear View
Connecting DC Power

**CAUTION**

Do not connect DC power to the ControlFile with the Power Regulator Card(s) installed. Arcing at the DC connector can result in equipment damage. Remove the Power Regulator Card(s), connect the DC power, and then install the cards according to the instructions given below.

The ControlFile is normally connected to DC distribution bus A by a 1984-0158-00xx power cable (Cable: DC Bus to System Device (Bus A)). Two wires in parallel are required to carry the current from the DC Distribution Card to the ControlFile. A 20 ampere fuse is required in the DC Distribution Card.

When redundant A and B buses are used, a second power cable is required (1984-0158-10xx, Cable: DC Bus to System Device (Bus B)) to connect to DC bus B.

**CAUTION**

Follow the procedure below when installing the Power Regulator Cards when DC power to the ControlFile is on. The input capacitors must be allowed to charge up before the power regulators turn on. Failure to do so can result in damage to the Power Regulator Card and to other cards in the ControlFile.

1. Disable all cards in the ControlFile.
2. Slowly insert the Power Regulator Card into the card cage. The input capacitor edge connectors will make contact with the motherboard edge connectors first. Red LEDs will blink once.
3. When the LEDs are off, slowly push the card all the way in.
4. All yellow LEDs and the green LED should be ON. No red LED should be ON. If any red LED is ON, stop and troubleshoot the Power Regulator Card.
5. Repeat for the optional second card.
6. Leave all cards disabled until the installation is complete.
Connecting to the PeerWay

The ControlFile connects to The PeerWay Tap boxes with a pair of PeerWay Drop Cables (1984-0473-xxxx, Cable: Tap Box to Device, PeerWay Drop).

The cables are polarized so that incorrect connections cannot be made.

Connecting to an I/O Device

The ControlFile connects to:

- Analog Card Cage (Flexterm)
- Communication Termination Panel II
- Multiplexer FlexTerm (MUX) - (non-EMC)
- PLC or RBL FlexTerm - (EMC only via Comm Term Panel II)

See the section on the I/O device for installation instructions.

1. Shielded control cable 10P5651xxxx, maximum length: 60 meters (=200 feet) or control cable 1984-2783-xxxx is used to connect the ControlFile to other equipment. Tie-wrap to cable tie points on the back panel to ensure strain relief.
   
a. For EMC-compliant installations use shielded control cable 10P5651xxxx, maximum length: 60 meters (=200 feet) or 1984-2783-9045 control cable, which is approximately 1 meter (39 inches) long.
   
   Terminate 10P5651xxxx cable shield pigtail at ControlFile chassis screw for EMC-compliant installations.
   
   You may also use a Remote Communication Termination Panel II and shielded communication lines (1984-4188-xxxx), maximum length 1372 meters (=4500 feet), to connect equipment that the 1984-2783-9045 and 10P5651xxxx control cables cannot reach. The panel must be at Revision E/E or higher.
   
b. For all other installations (non-EMC) use a 10P5651xxxx, maximum length: 60 meters (=200 feet) or 1984-2783-0xxx, maximum length of 61 meters (200 feet). Use a Remote Communication Termination Panel II and Communication Lines for longer runs.

2. Keep I/O cables under 1370 meters (4500 feet). The total length from the back of the ControlFile to the farthest I/O device cannot exceed 1370 meters (=4500 feet).
Jumpers

There is one pair of jumpers located on the inside of the motherboard. Jumpers HAA and HAB define the PeerWay address of the ControlFile. These jumpers are factory set. You will rarely have to change them.

Do not change these jumpers with power applied to the ControlFile. You must remove the Power Regulator, Coordinator Processor, Memory, and at least Controller Processors A and B to gain access to the jumpers.

A jumper at the “H” position has the value marked on the board. Jumper 4 has the value 8 when set to “H”. A jumper at the “L” position has the value 0. The address is the sum of the jumper values plus 1. An example of address 29 is shown below. HAA and HAB must always be set to the same address.
RAM NV Memory Jumpers

RAM NV memory circuit cards are shipped with the memory backup batteries disabled. Reposition the battery jumpers if battery backup is desired. Figure 4.1.4 shows the location of the jumpers on the NV RAM card. Table 4.1.1 gives the battery jumper settings. All RAM NV memory jumpers, fuses, LEDs, and test points are covered in the Service Manual.

Figure 4.1.4. RAM NV Memory Fuse, Jumper, and Test Point Locations

Table 4.1.1. RAM NV Memory Battery Jumper Positions

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<tr>
<th>Jumper</th>
<th>Position</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD6</td>
<td>1–2</td>
<td>Battery 2 enabled</td>
</tr>
<tr>
<td></td>
<td>2–3</td>
<td>Battery 2 disabled</td>
</tr>
<tr>
<td>HD7</td>
<td>1–2</td>
<td>Battery 1 enabled</td>
</tr>
<tr>
<td></td>
<td>2–3</td>
<td>Battery 1 disabled</td>
</tr>
</tbody>
</table>
Installing Cards

Use these cards in the ControlFile:

- PeerWay Buffer 1984–1502–0001
- 5 VDC Only Power Regulator 1984–3505–0001
- Coordinator Processor CP-IV+ 1984–4164–0004
  or 10P50870004
- RAM NV Memory 1984–2347–0011 (1 meg),
  1984–2347–0021 (2 meg),
  or 1984–2347–0041 (4 meg)
- MPCII Controller Processor 10P50400006
- MPC5 Controller Processor 10P57520007

NOTE: You must tighten the captive screw on each card to ensure that the card is properly seated and grounded.

- To install cards in a non-powered ControlFile:
  1. If the ControlFile is not powered, you can install the cards in any order.
  2. Pull the Power Regulator Card(s) before applying power to the ControlFile. Follow the CAUTION note below when applying power.
  3. ENABLE the Coordinator Processor, the NV Memory, and then the primary and secondary Controller Processors.
  4. Latch the door closed and securely tighten the captive screw. The door should only be opened for maintenance.

- To install cards in a powered ControlFile:
  1. Install the PeerWay Buffer Cards. The LEDs will light.
  2. Install all cards EXCEPT the Power Regulator Card(s). Set all switches to DISABLE.
  3. Install the Power Regulator Card(s).

CAUTION

When inserting a Power Regulator Card into a powered ControlFile, push it part of the way and pause to allow the capacitors to charge. The LED will blink once. Then seat the card firmly. Failure to allow the capacitors to charge can result in burned edge connector contacts.

4. ENABLE the Coordinator Processor, the NV Memory, and then the primary and secondary Controller Processors.
5. Latch the door closed and securely tighten the captive screw. The door should only be opened for maintenance.
Checklist for EMC-Compliant Installation

Follow these rules to ensure EMC compliance:

1. Mount the ControlFile in a properly grounded system cabinet following the instructions under “Mounting.”
2. Attach the safety ground wire as directed under “Mounting.”
3. Use only the MPCII (10P50400006) or MPC5 (10P57520007) Controller Processors.
4. Securely tighten the captive screws on all the electrical assemblies, the door, and the PeerWay Drop Cables.
5. Attach cables following the instructions under “Connecting System Cables.”
6. Connect the ControlFile to I/O with one of the following:
   a. Shielded control cable 10P5651xxxx, maximum length: 60 meters (=200 feet) to Communications Termination Panel II (1984-4205-0001) <or> to Analog (Serial) I/O Communications Connect Card V.
      Terminate 10P5651xxxx cable shield by clamping the ferrule to the ControlFile metalwork strain relief.
   b. Control cable 1984-2783-9045 to Communications Termination Panel II.
7. Open the door only for maintenance operations.
# Chapter 5: System Cables and Power Distribution

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- Installing a Single-feed AC Entrance Panel
- Installing a Dual-feed AC Entrance Panel
- Checking AC Distribution

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- Installing an AC/DC Power Supply With Battery Backup
- AC/DC Power Supply (With Battery Backup) Alarm Contacts
- AC/DC Power Supply (With Battery Backup) LEDs and Controls
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  - 10P5409 Remote Power Supply Connector Pin-Out
  - 10P5409 Remote Power Supply LEDs
  - 10P5409 Remote Power Supply Checking and Adjusting Output
  - 10P5409 Remote Power Supply Specifications
  - 10P5756 for Operator Interface Applications
  - 10P5503 for I/O Applications
  - Checklist for EMC-Compliant Installation
  - 10P5503 Remote Power Supply Connector Pin-Out
  - 10P5503 Remote Power Supply LEDs
  - 10P5503 Remote Power Supply Checking and Adjusting Output
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Table 5.1.1 shows data on standard system cables. The cable’s outside diameter, the largest dimension of the connector, and the maximum allowable length are shown.

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<th>Cable</th>
<th>Part Number</th>
<th>Outside Dimension mm (in.)</th>
<th>Connector (maximum dimension) mm (in.)</th>
<th>Maximum Length m (ft)</th>
<th>CE Compliant Maximum Length m (ft)</th>
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<td>61 (200)</td>
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<td>69 (2.7)</td>
<td>15.2 (50)</td>
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CENELEC = European Electrotechnical Committee for Standardization  
CSA = Canadian Standards Association  
FEM = Front End Module  
HIA = Highway Interface Adapter  
KVI = Keyboard/Video Interface  
MIO = Multipoint Input/Output  
MUX = Multiplexer  
NEC = National Electric Code  
PLC = Programmable Logic Controller  
RBL = Rosemount Basic Language  
RGB = Red, Green, Blue  
RNI = RS3 Network Interface  
RTD = Resistance Temperature Detector  
SCI = Supervisory Computer Interface  

(continued on next page)
### Table 5.1.1. Standard System Cables (continued)

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<th>Cable</th>
<th>Part Number</th>
<th>Outside Dimension mm (in.)</th>
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<th>Maximum Length m (ft)</th>
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<td>Multipoint Analog I/O Termination Panel flying lead</td>
<td>10P5611xxxx</td>
<td>16.74 (.659)</td>
<td>96 (3.78)</td>
<td>60 (200)</td>
<td>60 (200)</td>
</tr>
<tr>
<td>Analog Card Cage-to-Marshaling Panel, Shielded</td>
<td>10P5552xxxx</td>
<td>15 (.59)</td>
<td>69 (2.7)</td>
<td>60 (200)</td>
<td>60 (200)</td>
</tr>
</tbody>
</table>

CENELEC = European Electrotechnical Committee for Standardization  
CSA = Canadian Standards Association  
FEM = Front End Module  
HIA = Highway Interface Adapter  
KVI = Keyboard/Video Interface  
MUX = Multipoint Input/Output  
NEC = National Electric Code  
PLC = Programmable Logic Controller  
RBL = Rosemount Basic Language  
RGB = Red, Green, Blue  
RNI = RS3 Network Interface  
RTD = Resistance Temperature Detector  
SCI = Supervisory Computer Interface  

(continued on next page)
<table>
<thead>
<tr>
<th>Cable</th>
<th>Part Number</th>
<th>Outside Dimension mm (in.)</th>
<th>Connector (maximum dimension) mm (in.)</th>
<th>Maximum Length m (ft)</th>
<th>CE Compliant Maximum Length m (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplexer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUX to Remote FEM</td>
<td>1984–0635–xxxx</td>
<td>5 (.206)</td>
<td>40 (1.57)</td>
<td>914 (3,000)</td>
<td>—</td>
</tr>
<tr>
<td>MUX to Remote CENELEC FEM</td>
<td>1984–0641–xxxx</td>
<td>5 (.206)</td>
<td>40 (1.57)</td>
<td>30.5 (100)</td>
<td>—</td>
</tr>
<tr>
<td>4–20mA FEM to Marshaling Panel</td>
<td>1984–0499–xxxx</td>
<td>13 (.5)</td>
<td>69 (2.7)</td>
<td>305 (1,000)</td>
<td>—</td>
</tr>
<tr>
<td>RTD or Voltage FEM to Marshaling Panel</td>
<td>1984–0500–xxxx</td>
<td>13 (.5)</td>
<td>69 (2.7)</td>
<td>305 (1,000)</td>
<td>—</td>
</tr>
<tr>
<td>MUX FlexTerm Assembly, 200 Points</td>
<td>1984–3062–00xx</td>
<td>6.5 (.25)</td>
<td>30.81 (1.213)</td>
<td>60.96 (200)</td>
<td>—</td>
</tr>
<tr>
<td>PeerWay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PeerWay Drop Cable</td>
<td>1984–0473–xxxx</td>
<td>11 (.43)</td>
<td>39 (1.52)</td>
<td>15.2 (50)</td>
<td>15.2 (50)</td>
</tr>
<tr>
<td>Twinax PeerWay – 100 Ohm</td>
<td>1984–0474–xxxx</td>
<td>8 (.33)</td>
<td>15 (.58)</td>
<td>610 (2,000)</td>
<td>610 (2000)</td>
</tr>
<tr>
<td>Twinax PeerWay – 124 Ohm</td>
<td>1984–0494–xxxx</td>
<td>11 (.44)</td>
<td>19 (.75)</td>
<td>1,006 (3,300)</td>
<td>1006 (3300)</td>
</tr>
<tr>
<td>Fiber Optic PeerWay (with repeaters)</td>
<td></td>
<td>Depends on application</td>
<td>Attached after cable is pulled</td>
<td>Depends on application 3,000 (10,000) absolute maximum</td>
<td>Depends on application 3,000 (10,000) absolute maximum</td>
</tr>
<tr>
<td>Optical Tap Box A to Electrical Tap Box A</td>
<td>1984–1195–xxxx</td>
<td>9 (.360)</td>
<td>69 (2.73)</td>
<td>30 (100)</td>
<td>—</td>
</tr>
<tr>
<td>Optical Tap Box B to Electrical Tap Box B</td>
<td>1984–1196–xxxx</td>
<td>9 (.360)</td>
<td>69 (2.73)</td>
<td>30 (100)</td>
<td>—</td>
</tr>
</tbody>
</table>

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(continued on next page)
<table>
<thead>
<tr>
<th>Cable</th>
<th>Part Number</th>
<th>Outside Dimension mm (in.)</th>
<th>Connector (maximum dimension) mm (in.)</th>
<th>Maximum Length m (ft)</th>
<th>CE Compliant Maximum Length m (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RNI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethernet cable</td>
<td>1984–4475–xxxx</td>
<td>10.80 (.425)</td>
<td>39.14 (1.541)</td>
<td>15.0 (49.21)</td>
<td>15.0 (49.21)</td>
</tr>
<tr>
<td><strong>Input/Output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Density Isolated Discrete Termination Panel, NEC/CSA</td>
<td>1984–4345–xxxx</td>
<td>19.30 (.760)</td>
<td>96 (3.78)</td>
<td>999 (3278)</td>
<td>999 (3278)</td>
</tr>
<tr>
<td><strong>SCI/HIA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCI-to-PC RS-232, Shielded</td>
<td>10P54340xxx</td>
<td>6.68 (.263)</td>
<td>53.04 (2.088)</td>
<td>15.2 (50)</td>
<td>15.2 (50)</td>
</tr>
<tr>
<td>X.25/SCI RS-422, Shielded</td>
<td>10P54390xxx</td>
<td>10.9 (.43)</td>
<td>39.14 (1.541)</td>
<td>15.2 (50)</td>
<td>15.2 (50)</td>
</tr>
<tr>
<td>HIA-to-Black Box RS-422, Shielded (CE compliant)</td>
<td>10P54400xxx</td>
<td>10.9 (.43)</td>
<td>39.14 (1.541)</td>
<td>15.2 (50)</td>
<td>15.2 (50)</td>
</tr>
<tr>
<td>HIA/Black Box (non CE compliant)</td>
<td>1984–2859–00xx</td>
<td>6.5 Z(.25)</td>
<td>63.50 (2.5)</td>
<td>60.96 (200)</td>
<td>60.96 (200)</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolated RS-422 Communications</td>
<td>1984–2629–xxxx</td>
<td>6.5 (.25)</td>
<td>63.50 (2.5)</td>
<td>60.96 (200)</td>
<td>—</td>
</tr>
<tr>
<td>Multi-FIM Discrete Termination Panel to Standard Remote Termination Panel (non-redundant)</td>
<td>1984–4299–xxxx</td>
<td>11.17 (.440)</td>
<td>96 (3.78)</td>
<td>999 (3278)</td>
<td>999 (3278)</td>
</tr>
<tr>
<td>Multi-FIM Discrete Termination Panel to Standard Remote Termination Panel (redundant)</td>
<td>1984–4319–xxxx</td>
<td>11.17 (.440)</td>
<td>96 (3.78)</td>
<td>999 (3278)</td>
<td>999 (3278)</td>
</tr>
</tbody>
</table>

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Section 2:
AC Distribution System

The RS3 distributed control system can be equipped with either a single-feed or a dual-feed AC distribution system.

NOTE: This is a distributed power system. Therefore, the secondary power servicing the various parts of the building must be grounded to the building service entrance with an impedance of less than 1 ohm at 60 Hz. In addition, all electrical equipment cabinets must be grounded with no more than 1 ohm impedance at 60 Hz between the cabinet ground and the building service entrance ground.
Installing a Single-feed AC Entrance Panel

The Single-feed AC Entrance Panel (10P5662000x) mounts in a system cabinet where it uses 89 mm (3.5 in.) of panel space. Figure 5.2.1 It includes an internal filter to reduce incoming AC line noise. Three output circuit breakers (10-amp for 230 VAC and 15-amp for 115 VAC) protect up to three AC/DC power supplies, AC cooling fans, or other AC loads. See Figure 5.2.1. There are two versions:

- 115 VAC 50/60 Hz (10P56620001)
- 230 VAC 50/60 Hz (10P56620006)

**CAUTION**

If the input current exceeds 20 amperes, use supply wire suitable for 115° C above ambient.

**WARNING**

For personal safety, use a circuit breaker lockout device to ensure that an opened breaker is not accidentally closed while you are working on the line.
To connect AC power to a single-feed AC distribution panel:

1. Remove the plastic guard covering the AC input terminal block.
2. Connect the AC entrance cable to the terminal block according to Table 5.2.1.

**NOTE:** Input wiring must be terminated with a locking lug.
3. Replace the plastic guard on the terminal block.

### Table 5.2.1. AC Input Wiring Connections

<table>
<thead>
<tr>
<th>AC Panel Terminal</th>
<th>115 VAC Wiring</th>
<th>230 VAC Wiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Hot</td>
<td>Line 1</td>
</tr>
<tr>
<td>L2/N</td>
<td>Neutral</td>
<td>Line 2</td>
</tr>
<tr>
<td>Ground</td>
<td>Ground (equipment protective conductor terminal)</td>
<td>Ground (equipment protective conductor terminal)</td>
</tr>
</tbody>
</table>
Installing a Dual-feed AC Entrance Panel

The Dual-Feed AC Entrance Panel (10P5662000x) mounts in a system cabinet where it uses 89 mm (3.5 in.) of panel space. It includes an internal filter to reduce incoming AC line noise. Three output circuit breakers (10-amp for 230 VAC and 15-amp for 115 VAC) protect up to three AC/DC power supplies, AC cooling fans, or other AC loads. Figure 5.2.2 shows a Dual-Feed AC Entrance Panel. There are two versions:

- 115 VAC 50/60 Hz (10P56620002)
- 230 VAC 50/60 Hz (10P56620005)

CAUTION

If the input current exceeds 20 amperes, use supply wire suitable for 115°C above ambient.

![Diagram of Dual-Feed AC Entrance Panel]

**Figure 5.2.2. Dual-Feed AC Entrance Panel**

The state of the Alarm Output is determined by which power input is being applied. The state of the Alarm Output under primary or secondary power is:

<table>
<thead>
<tr>
<th>Power</th>
<th>Normally Open Contacts</th>
<th>Normally Closed Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Closed</td>
<td>Open</td>
</tr>
<tr>
<td>Secondary</td>
<td>Open</td>
<td>Closed</td>
</tr>
</tbody>
</table>

WARNING

For personal safety, it is wise to use a circuit breaker lockout device to ensure that an opened breaker is not accidentally closed while you are working on the line.
The Dual-Feed AC Entrance Panel accepts AC from two independent sources. If the primary (upper) AC line drops out, the secondary (lower) AC line automatically switches in approximately 500 milliseconds. The 500 millisecond delay prevents arcing during switching if the two AC lines are out of phase. If primary AC power is restored, the relay switches back automatically from the secondary AC source to the primary AC source. Alarm output relay contacts indicate which AC line is being used.

**NOTE:** This provides a dual feed for the AC source. The remainder of the entrance equipment is common and could be a single point of failure.

The lamps labeled “OUTPUT” indicate AC out of each of the three circuit breakers. If fuse F1 or F2 is blown, the “INPUT” indicator lamp goes out, which indicates that power cannot be switched over from one AC line to the other.

**WARNING**

Dangerous AC voltage can be present even if the “AC IN” indicator is not lit. If the input fuse is blown, AC can still be present at the input terminal block.

- To connect AC power to a dual-feed AC distribution panel:
  1. Remove the plastic guard covering the AC input terminal block.
  2. Connect the primary and secondary AC input cables to the terminal block according to Table 5.2.2.

**NOTE:** Input wiring must be terminated with a locking lug.

![Warning Symbol]

### Table 5.2.2. AC Input Wiring Connections

<table>
<thead>
<tr>
<th>AC Panel Terminal</th>
<th>115 VAC Wiring</th>
<th>230 VAC Wiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Hot Line 1</td>
<td>Line 1</td>
</tr>
<tr>
<td>L2/N</td>
<td>Neutral Line 2</td>
<td></td>
</tr>
<tr>
<td>Ground</td>
<td>Ground (equipment protective conductor terminal)</td>
<td>Ground (equipment protective conductor terminal)</td>
</tr>
</tbody>
</table>

3. Replace the plastic guard on the terminal block.
4. An alarm output relay is provided with the dual AC feed system. The contacts are rated at 1 amp (30 volts). An external alarm can be connected to either the normally open (N.O.) or normally closed (N.C.) contacts by means of the terminal block located on the AC distribution panel. The alarm signals the loss of the primary AC input. The relay contacts are not powered.
To check out the AC distribution system:

1. Complete the mechanical and electrical installation.

CAUTION

Make sure that the consoles that are cabled to the DC power system are turned off. Make sure that all Field Interface Cards (FICs) are fully inserted into their respective slots.

2. Make sure that the AC INPUT (orange) lamps on the AC Distribution Panel are on. If the system has redundant AC power, both AC INPUT lamps must be on. See Figure 5.2.3.

3. Turn on all AC circuit breakers on the AC Distribution Panel(s) that have wiring attached.

4. Make sure that each AC output (orange) lamp goes on as each AC circuit breaker is turned on.

Figure 5.2.3. AC Distribution Panels
Section 3:
AC/DC Power Supplies

The AC/DC Power Supply converts AC power to 30 VDC for the DC bus. The supply mounts in a system cabinet on a mounting rack that holds two supplies side-by-side.

AC/DC Power Supplies are available for 115 volt or 220 volt service with or without built-in battery backup. Figure 5.3.1 shows the two supplies. Chapter 1, Section 2 covers design of the system and selection of the power supplies.

Figure 5.3.1. AC/DC Power Supplies

The supplies are designed to share the load automatically (up to a maximum of six supplies). The required number of supplies can be connected to the DC distribution bus. Many users add one additional supply as a backup. In normal operation, all supplies on the bus share the load. If one fails, the additional supply provides enough power to keep the system going. The A and B DC distribution buses are normally tied together if one set of power supplies is used.
For a fully redundant DC power supply system, a complete set of AC/DC power supplies is connected to each DC distribution bus (A and B). Each set of supplies should be fed from an independent AC source. The A and B sets will share the load, but both sets must be sized to support the entire system alone.

Installation of an AC/DC power supply consists of:

- Setting the Battery Charger Card jumpers (if battery backup is used)
- Rack mounting the power supply
- Connecting the supply to AC power
- Connecting the supply to the DC distribution system.
Rack Mounting the Power Supply

DC power supplies are mounted in standard equipment cabinets on a power supply shelf as shown in Figure 5.3.2.

Figure 5.3.2. Typical Power Supply Cabinet Mounting

WARNING

Each power supply unit weighs approximately 32 kg (70 lb). Have two people lift the unit into place to prevent injury or equipment damage.
The shelf (Figure 5.3.3) holds two supplies side-by-side. Secure the shelf to the cabinet uprights with the four bolts, lock washers, and nuts provided. Install the power supply and secure it with a retaining bracket.

**NOTE:** Set the jumpers of an AC/DC Power Supply with battery backup before mounting it in the cabinet.
Installing an AC/DC Power Supply With Battery Backup

The Battery Charger Card jumpers of the AC/DC Power Supply must be set before the power supply is installed.

**WARNING**

Do not attempt this on an installed power supply. Remove power from the supply and take the supply out of the rack.

- To access the Battery Charger Card:
  1. Remove the four screws securing the cover A and remove cover A as shown in Figure 5.3.4.
  2. Remove the single screw securing cover B and open cover B.
  3. Push the upper edge of the battery charger circuit card C toward the rear of the power supply just enough to free it from the standoff.
  4. Pull up the card slightly to free it from the card connector.
  5. Disconnect cable D from connector J193.
  6. Lift the card out of the power supply far enough to note the orientation of connectors J0 and J192 (E). On connector J0 the orange wire is nearest the large heat sink, and on connector J192 the yellow wire is nearest T1.
  7. Disconnect the cables.
  8. Separate the two cards (F).
  9. Position the jumpers as indicated in Table 5.3.1.

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Purpose</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1</td>
<td>Specifies alarm contact for power supply fault. (Factory set at 1–2)</td>
<td>1–2 normally open, 2–3 normally closed</td>
</tr>
<tr>
<td>HD2</td>
<td>Specifies alarm contact for battery fault. (Factory set at 1–2)</td>
<td>1–2 normally open, 2–3 normally closed</td>
</tr>
<tr>
<td>HD3</td>
<td>Provides support for battery backup. (Factory set at 1–2)</td>
<td>1–2 battery connected, 2–3 battery not connected</td>
</tr>
</tbody>
</table>

10. Replace the card in the power supply by performing the steps in Table 5.3.1 in reverse order.
Figure 5.3.4. Accessing the Battery Charger Card
AC/DC Power Supply (With Battery Backup) Alarm Contacts

The front panel provides two sets of terminals for battery fault and power supply fault alarm contacts. The cards are shipped with the contacts set to be normally open (N.O.). They can be changed to be normally closed (N.C.) by changing jumper positions on the Battery Charger Card. The appropriate contact will be closed (or opened) if the red BATT FAULT or PS FAULT LED is lighted. The supply will continue delivering power while the alarm condition is present. Figure 5.3.5 shows the alarm contacts.

The alarm contacts are rated for switching a resistive load:

- Maximum switching voltage: 100 VDC
- Maximum switching current: 250 mA
- Maximum current: 500 mA

![Figure 5.3.5. Power Supply (With Battery Backup) Alarm Contacts](image-url)
AC/DC Power Supply (With Battery Backup) LEDs and Controls

The AC/DC power supply has power indicators and controls on the front panel. Figure 5.3.6 shows the location of the LEDs and controls. Table 5.3.2 shows the significance of each.

**WARNING**

Under certain failure conditions 30 VDC can be present even though both LED indicators are off.

Check all AC/DC power supplies both for red LED fault indications and equal output current indication. All the supplies on the same DC distribution system should show approximately the same current flow indications within 3 to 6 amps (1 to 2 segments on the LED indicator). Check each DC distribution system individually.

![Power Supply Panel Features](image)

**Figure 5.3.6. Power Supply (With Battery Backup) Panel Features**
### Table 5.3.2. Power Supply (With Battery Backup) Indicators and Controls

<table>
<thead>
<tr>
<th>Item</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>BATT ON/OFF Toggle Switch</td>
<td>Removes the battery backup circuit from the system when in OFF position.</td>
</tr>
<tr>
<td>BATT TEST Pushbutton</td>
<td>The Battery Test Pushbutton is used to enable the 16-amp, 5-second battery test manually. If battery voltage falls below 20V during the test, the BATT FAULT LED lights and the battery alarm activates. <strong>NOTE:</strong> The battery cannot be tested until the system has been running for at least five minutes or until five minutes after the last battery test.</td>
</tr>
<tr>
<td>AC IN Indicator (Orange)</td>
<td>Indicates that AC input is present.</td>
</tr>
<tr>
<td>OUTPUT CURRENT LED (Bar Graph) (Red)</td>
<td>This is a series of LEDs indicating the relative current being delivered to the DC distribution system by the AC/DC power supply. It indicates the load share provided by the power supply with a readout in 3-amp intervals. Power supplies should be within 1 to 2 LEDs of the others on the same DC distribution system for proper load sharing.</td>
</tr>
<tr>
<td>PS FAULT LED (DS1) (Red)</td>
<td>The 30 VDC output has dropped below 26 volts. The power supply alarm is actuated when this LED is on.</td>
</tr>
<tr>
<td>PS NORM LED (DS2) (Green)</td>
<td>The DC output voltage and battery status (if the battery is used with the header jumper enabled) is in normal working condition.</td>
</tr>
<tr>
<td>BATT FAULT LED (DS3) (Red)</td>
<td>The battery has failed the periodic load test. Approximately once every 24 hours the unit automatically tests the batteries under a 16-amp load for five seconds. If battery voltage drops below 20 VDC (24 volts nominal), the BATT FAULT LED will light, the PS NORM LED will go out, and the battery fault alarm will activate. The battery fault alarm will also activate if the battery test fails.</td>
</tr>
</tbody>
</table>
Installing the AC/DC Power Supply (Without Battery Backup)

The power supply has no jumpers to set.

Alarm Contacts

The front panel provides a set of terminals for power supply fault alarm contacts (PS FAULT). These are normally closed (N.C.). The contact will be opened if the green PS NORM LED goes out. The supply continues to supply power when the alarm condition is active. The contacts are rated for switching a resistive load:

- 100 VDC
- 500 mA
- 10 Watts

**NOTE:** The PS FAULT contacts of the 10P5658000x power supply are normally closed (N.C.). The contacts of the 10P5664000x power supply (with battery backup) can be jumpered to be either normally closed (N.C.) or normally open (N.O.).

LEDs

The AC/DC power supply (without battery backup) has two indicators on the front to indicate status. Figure 5.3.7 shows the location of the lights. Table 5.3.3 shows the significance of each.

**WARNING**

Under certain failure conditions 30 VDC can be present even though both LED indicators are off.

Check all AC/DC power supplies both for green LED normal indications and equal output current. All the supplies on the same DC distribution system should supply approximately the same current within 3 to 6 amps. Check each DC distribution system individually.
Figure 5.3.7. Power Supply (Without Battery Backup) Panel Indicators

Table 5.3.3. Power Supply (Without Battery Backup) Indicators

<table>
<thead>
<tr>
<th>Item</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC IN (Orange)</td>
<td>Indicates that AC input is present.</td>
</tr>
<tr>
<td>POWER (Green)</td>
<td>Indicates that the DC output voltage is in normal working range. The power supply alarm is activated when this LED is off.</td>
</tr>
</tbody>
</table>
Measuring Output Current

Output current is measured by measuring the voltage drop across a .0033 ohm precision resistor that is in series with the output. Contacts TB2 1 and TB2 2 provide access to the resistor. A table is provided on the front panel to assist in converting the measured voltage drop to output current. Steps in the table correspond to LED segments on the 10P5658000x power supply.

The precise current output can be found by measuring the voltage across TB2 1 - 2 and then using Ohm’s Law:

\[ I = \frac{E}{R} \]

\[ = \frac{(Volts)}{(0.0033)} \]

\[ = 303 \times Volts \]

The current is thus 303 x Volts (as measured across TB2 - TB1).
**Connecting the AC/DC Power Supply to AC Power**

**WARNING**

Electrical shock hazard. Be sure that the AC distribution breakers and the battery switches are OFF before making any electrical connections.

- To connect a DC power supply to AC power:
  
  (Figure 5.3.8 shows the electrical connections)

  1. Turn off all battery switches and AC distribution breakers before making any electrical connections.
  
  2. Remove the clear plastic guard from the AC input terminal block. Connect the AC input wiring cable (10P5667xxxx) from the AC distribution system as shown. Replace the clear plastic guard.
  
  3. Connect the DC output cable (1984–0283–xxxx) connector to the PS OUTPUT jack. The connector is keyed to prevent improper insertion. The other end of the cable connects to a DC distribution bus.

---

**Figure 5.3.8. AC/DC Power Supply Electrical Connections and Panel Features**
Remote Power Supply

The remote power supply is available in these versions:

- For Operator Interface (OI) products:
  - 230 VAC input 10P54090003
  - 115 VAC input 10P54090004
  - 110–230 VAC input 10P57560001

- For Input/Output products:
  - 230 VAC input 10P55030001
  - 115 VAC input 10P55030002
  - 110–230 VAC input 10P57010001
10P5409 for Operator Interface Applications

This configuration supplies power to OI card cages located away from the main system DC bus. Figure 5.3.9 shows the unit.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front view</td>
<td>5</td>
<td>Top view</td>
</tr>
<tr>
<td>2</td>
<td>Green LED</td>
<td>6</td>
<td>Connector</td>
</tr>
<tr>
<td>3</td>
<td>Test socket for output voltage measurement</td>
<td>7</td>
<td>DC output cable (connector P981 goes to J907 PWRA on the OI Card Cage)</td>
</tr>
<tr>
<td>4</td>
<td>Potentiometer for output voltage adjustment</td>
<td>8</td>
<td>AC input:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.3.9. 10P5409 Power Supply

The power supply can be mounted in a Suspended Cabinet (“7U”), a “11U”, or a “13U” enclosure using the power supply mounting bracket (10P53760001), which is part of the assembly. The bracket attaches to the drive mounting bracket.

**NOTE:** A cooling fan assembly is required under the slot that holds the power supply.
10P5409 Remote Power Supply Connector Pin-Out

A connector is used to mount the cables on the power supply. The pin-out of the connector is shown in Table 5.3.4.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>DC + output</td>
</tr>
<tr>
<td>14</td>
<td>DC return</td>
</tr>
<tr>
<td>16</td>
<td>Jumper to pin 32 (connects DC return to AC safety ground)</td>
</tr>
<tr>
<td>28</td>
<td>L1 AC line 1</td>
</tr>
<tr>
<td>30</td>
<td>L2/N AC line 2 (230 V) or neutral (115 V)</td>
</tr>
<tr>
<td>32</td>
<td>AC safety ground</td>
</tr>
</tbody>
</table>

10P5409 Remote Power Supply LEDs

The power supply has one green LED that lights when the unit is operating normally.

10P5409 Remote Power Supply Checking and Adjusting Output

Adjustment should not be required. Attach a voltmeter to the test jack to monitor the output voltage. Adjust the voltage (± 1 Volt) with the adjustment potentiometer (∆U1).
Table 5.3.5 lists specifications for the remote power supply.

### Table 5.3.5. 10P5409 Remote Power Supply Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>-0001 230 VAC 1.5 Amp</td>
<td>Selected by factory-set internal jumper</td>
</tr>
<tr>
<td></td>
<td>-0002 115 VAC 3.0 Amp</td>
<td></td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>+15%, -20%</td>
<td></td>
</tr>
<tr>
<td>Input Frequency</td>
<td>45–440 Hz</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>24 VDC</td>
<td>Nominal</td>
</tr>
<tr>
<td>Output Adjustment Range</td>
<td>+1 V</td>
<td>Adjustment is by front-panel potentiometer.</td>
</tr>
<tr>
<td>Output Current</td>
<td>6 A</td>
<td>Maximum rated</td>
</tr>
<tr>
<td>Overload Protection</td>
<td></td>
<td>Continuous short-circuit proof backed by a thermal shutdown for overheating. Delivers rated current into a short circuit.</td>
</tr>
<tr>
<td>Internal Fuse</td>
<td>3.15 A, 250 V Wickman 19372K, Schurter Series MST 250, or equivalent</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>118 mm x 56 mm x 168.5 mm (4.6 in. x 2.2 in. x 6.6 in.)</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1 kg (.45 lb)</td>
<td></td>
</tr>
</tbody>
</table>
10P5756 for Operator Interface Applications

This configuration supplies power to OI card cages located away from the main system DC bus. Figure 5.3.10 shows the unit.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC output cable (connector P981 goes to J907 PWRA on the OI Card Cage)</td>
<td>2</td>
<td>AC input:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P850-1 (Black)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P850-2 (White)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P850-3 (Green)</td>
</tr>
</tbody>
</table>

Figure 5.3.10. 10P5756 Power Supply

The power supply can be mounted in a Suspended Cabinet (“7U”), a “11U”, or a “13U” enclosure using the power supply mounting bracket, which is part of the assembly. The bracket attaches to the drive mounting bracket.

**NOTE:** A cooling fan assembly is required under the slot that holds the power supply.
10P5503 for I/O Applications

This configuration supplies power to I/O panels located away from the main system DC bus. Figure 5.3.11 shows the unit.

![Diagram of 10P5503 Power Supply]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front view</td>
<td>5</td>
<td>Top view</td>
</tr>
<tr>
<td>2</td>
<td>Green LED</td>
<td>6</td>
<td>DC output: P837 (Orange) +24 V P838 (Brown) Return</td>
</tr>
<tr>
<td>3</td>
<td>Test socket for output voltage measurement</td>
<td>7</td>
<td>AC input: P834 (Black) L1 P835 (White) L2/N P836 (Green) Ground</td>
</tr>
<tr>
<td>4</td>
<td>Potentiometer for output voltage adjustment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.3.11. 10P5503 Power Supply

**NOTE:** A cooling fan assembly is required for the cabinet holding the power supply.
The power supply is normally mounted on a DIN rail and used with an AC and a DC distribution block as shown in Figure 5.3.12.

- AC Distribution Block 1984-4329-0001 (2 circuits)
- DC Distribution Block 1984-4329-0002 (10 circuits)
  1984-4329-0003 (1 circuit)
- Fuse Label 1984-4350-0001
- DIN Rail 1984-4309-0004

Figure 5.3.12. Typical Remote I/O Power Supply Assembly
The AC and DC distribution blocks have all like terminals jumpered together on the input side. Jumper the neutrals with an internal bar. The active terminals are jumpered with an external bridging jumper which must not be removed. The input side is marked with an “I”.

**CAUTION**

*Input power must be connected to the input side of the distribution block. All circuits will be controlled by a single fuse if this is not done.*

Distribution block fuses are mounted inside the black fuse module at the top of the block. Each fuse module has a bulb that lights if the fuse is blown. The fuse module also acts as a disconnect switch, remove the fuse module to open the circuit. The fuse is reached by prying the fuse module cover open. Table 5.3.6 shows the factory installed fuse values.

<table>
<thead>
<tr>
<th>Block</th>
<th>Wickman P/N</th>
<th>Littlefuse P/N</th>
<th>FRSI P/N</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Distribution</td>
<td>Series 19197</td>
<td>Series 235</td>
<td>G53394-3000-1</td>
<td>3.0 A, 250 V CSA approved</td>
</tr>
<tr>
<td>DC Distribution 10 Circuits</td>
<td>Series 19197</td>
<td>Series 235</td>
<td>G53394-1000-1</td>
<td>1.0 A, 250 V CSA approved</td>
</tr>
<tr>
<td>DC Distribution 1 Circuit</td>
<td>Series 19197</td>
<td>Series 235</td>
<td>G53394-3000-1</td>
<td>3.0 A, 250 V CSA approved</td>
</tr>
</tbody>
</table>

A label (1984-4350-000x) is provided to record the actual fuse sizes installed in the AC and DC distribution blocks. The label should be installed inside the I/O cabinet door or as close to the power supply as practical. Standard fuse sizes are listed on the label; be sure to record any changes from the standard.
Checklist for EMC-Compliant Installation

Follow these rules to ensure EMC compliance.

1. Use the cables and brackets provided with the unit.
2. Mount the unit as described.

10P5503 Remote Power Supply Connector Pin-Out

A connector is used to mount the cables on the power supply. The pin-out of the connector is shown in Table 5.3.7.

Table 5.3.7. 10P5503 Remote Power Supply Connector Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>DC + output</td>
</tr>
<tr>
<td>14</td>
<td>DC return</td>
</tr>
<tr>
<td>16</td>
<td>Jumper to pin 32 (connects DC return to AC safety ground)</td>
</tr>
<tr>
<td>28</td>
<td>L1 AC line 1</td>
</tr>
<tr>
<td>30</td>
<td>L2/N AC line 2 (230 V) or neutral (115 V)</td>
</tr>
<tr>
<td>32</td>
<td>AC safety ground</td>
</tr>
</tbody>
</table>

10P5503 Remote Power Supply LEDs

The power supply has one green LED that lights when the unit is operating normally.

10P5503 Remote Power Supply Checking and Adjusting Output

Adjustment should not be required. Attach a voltmeter to the test jack to monitor the output voltage. Adjust the voltage ($\pm$ 1 Volt) with the adjustment potentiometer ($\Delta$U1).
# 10P5503 Remote Power Supply Specifications

Table 5.3.8 lists specifications for the remote power supply.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>-0001 230 VAC 1.5 Amp</td>
<td>Selected by factory-set internal jumper</td>
</tr>
<tr>
<td></td>
<td>-0002 115 VAC 3.0 Amp</td>
<td></td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>+15%, -20%</td>
<td></td>
</tr>
<tr>
<td>Input Frequency</td>
<td>45--440 Hz</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>24 VDC</td>
<td>Nominal</td>
</tr>
<tr>
<td>Output Adjustment</td>
<td>+1 V</td>
<td>Adjustment is by front-panel potentiometer.</td>
</tr>
<tr>
<td>Overload Protection</td>
<td>Continuous short-circuit proof</td>
<td>Continuous short-circuit proof backed by a</td>
</tr>
<tr>
<td></td>
<td>Rear short-circuit proof backed by</td>
<td>thermal shutdown for overheating. Delivers</td>
</tr>
<tr>
<td></td>
<td>Thermal short-circuit proof</td>
<td>rated current into a short circuit.</td>
</tr>
<tr>
<td>Internal Fuse</td>
<td>3.15 A, 250 V Wickman 19372K,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schurter Series MST 250, or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>equivalent</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>118 mm x 56 mm x 168.5 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.6 in. x 2.2 in. x 6.6 in.)</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1 kg (.45 lb)</td>
<td></td>
</tr>
</tbody>
</table>
10P5701 for I/O Applications

This configuration supplies power to I/O panels located away from the main system DC bus. Figure 5.3.13 shows the unit.

![Diagram of 10P5409 Power Supply]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC output (Orange)</td>
<td>2</td>
<td>AC input: (Black) L1</td>
</tr>
<tr>
<td></td>
<td>(Brown) Return</td>
<td></td>
<td>(White) L2/N</td>
</tr>
<tr>
<td></td>
<td>+24 V</td>
<td></td>
<td>(Green) Ground</td>
</tr>
</tbody>
</table>

Figure 5.3.13. 10P5409 Power Supply

NOTE: A cooling fan assembly is required for the cabinet holding the power supply.
Section 4:
System Power Supply Units

The RS3 System Power Supply Unit is standard equipment in an RS3 Millennium Package (RMP). It is also standard equipment in most newer RS3 system cabinets. The RS3 System Power Supply Unit normally consists of two power supply modules (12P0238X012) and a housing (12P0236X012).

This section describes physical and electrical descriptions of the System Power Supply Unit, along with installation instructions and specifications.

**NOTE:** The 12P0238X012 power supplies cannot be mixed with 10P5658-XXXX, 1984-2298-XXXX, 1984-0298-XXXX, 10P5664-XXXX, or 1984-0390-XXXX AC/DC power supplies on the same DC bus.

Physical Description

The RS3 System Power Supply Unit is installed in an RS3 system cabinet or an RMP cabinet, providing regulated DC power for equipment installed in the cabinets.

The System Power Supply Unit does not require an AC entrance panel.

The System Power Supply Unit with two power supply modules has a 2400-watt capacity, with 74 amperes available, at 80% loading. A housing can contain either one or two 1200-watt power supply modules that provide DC power. If a housing contains only one power supply module, it should be installed in the right side of the housing (PS1 position).

The housing contains input and output connectors, alarm connectors, and circuit breakers for the auxiliary outputs. All connections are on the front of the housing. Rear and side access to the housing are not required.

Figure 5.4.1 shows a housing with two power supply modules installed.
Figure 5.4.1. System Power Supply Unit with Two Power Modules Installed
Figure 5.4.2 shows the System Power Supply Unit housing (12P0236X012). The housing mounts on standard 483 mm (19-in.) EIA rails in an RS3 system cabinet. Rack height is 133 mm (5.25 in.) with a depth of 343 mm (13.5 in.) from the mounting flange. The housing supports two power supply modules and contains separate DC output terminals for each power supply.

Figure 5.4.2. System Power Supply Unit with (Housing Only)

Figure 5.4.3 shows the DC output block on the housing. The housing contains separate DC output terminals for each power supply module. The figure also shows the alarm connections on the housing. The alarm connections do not require wire terminating lugs.

Figure 5.4.3. DC Output and Alarm Connections
Figure 5.4.4 shows the AC input connectors and the auxiliary AC output connectors and circuit breakers.

**CAUTION**

European installations require external switches or circuit breakers that break both the line and neutral connections of the AC inputs. (The circuit breakers provided for the auxiliary AC outputs are single-pole and break only the line side.)

The housing includes terminal blocks for two AC input sources. This enables each power supply in a housing to be connected to a separate AC source. The chassis of the power supply housing is internally bonded to the ground terminal of each AC input terminal block.

INPUT 1 is routed directly to PS1 (the power supply module on the right side of the housing), and is routed to AUXILIARY OUTPUT 1 through the AUX OUT 1 circuit breaker. INPUT 2 is routed directly to PS2 (the power supply module on the left side of the housing), and is routed to AUXILIARY OUTPUT 2 through the AUX OUT circuit breaker.

Separate 5-position terminal blocks are provided on the front of the housing to access the alarm relay contacts and interlock for each power supply.

Terminal blocks, circuit breakers, and all wiring connections are on the front of the housing. The housing does not require side or rear access.

---

**Figure 5.4.4. Input and Output Connectors and Auxiliary Output Circuit Breakers**
Power Supply Modules

Each power supply module (12P0238X012) has a brushless DC fan to provide cooling. Air flow is front to rear, and the rear of the power supply module and the housing are slotted to exhaust heat.

Figure 5.4.5 shows a front view of a power supply module and a detail view of the label. The upper right corner of the label shows the rated output wattage of the power supply module. The additional information on the label includes the part number and the serial number.

![Figure 5.4.5. Power Supply](image-url)
Electrical Description

Each power supply module converts AC line voltage to the DC voltage required by the equipment and field instruments. The power supply module output is rated at 1200 watts. The switching power supplies have universal AC inputs with power factor correction and can operate over an input range of 85–264 VAC, 47–63 Hz without reconfiguration. However, this supply voltage will be passed through auxiliary output, so AC voltage ranges for auxiliary devices (cabinet fans) must be properly defined. The power supply module outputs are provided with overvoltage, overcurrent, and short circuit protection.

A pair of isolated test jacks on the front of each power supply module enable monitoring of output current.

Each power supply module has two front-mounted LEDs:

- The amber LED indicates that the power supply module’s AC input is energized.
- The green LED indicates that the DC output voltage is within tolerances.

Each power supply module has an alarm relay that connects to a terminal block on the power supply housing. Alarm relays are energized during normal operation and de-energized if the DC output is out of tolerance or if the cooling fan fails. The alarm relay contacts are rated to 5 amperes at 250 VAC, or 5 amperes at 30 VDC, for a resistive load. A current-limited interlock loop (limited to 100 mA) is provided to allow connection of other external alarm circuits. See Alarm Wiring for more information.

The power supply housing includes separate AC input terminal blocks for each power supply module, enabling each power supply module in a housing to be connected to a separate AC source.

Inputs from each terminal block are routed through a single-pole, 15-ampere circuit breaker to an auxiliary AC output terminal block that can be used to power auxiliary equipment such as cabinet fans.

Individual power supply modules can be removed from the power supply housing and replaced without interrupting power to equipment that is redundantly powered.

You must power up multiple power supply modules connected to the same DC distribution bus consecutively, all within approximately 2–3 seconds. If too much time elapses between the power-up of the first and last power supply modules, one or more of the modules may go into over-current mode, until together they are able to supply the load.
Planning

The System Power Supply Unit housing fits on standard 483 mm (19 in.) EIA rails in front-access system cabinet assemblies and occupies three units of vertical rack space. Outline dimensions of the housing are shown in Figure 5.4.1.

This section provides information on using System Power Supply Units in a typical RS3 system cabinet installation.

System Cabinet and AC Wiring

You will need to provide AC power to RS3 system cabinets from an external circuit breaker panel, and wire the power leads to the AC input terminal blocks on the power supply housing. Use wire with insulation rated at least twice the working voltage of the circuit.

Fisher-Rosemount Systems recommends that each 1200-watt power supply module be powered from a 30-ampere circuit breaker. In no case should a power supply module be powered from a circuit breaker larger than 30 amperes.

Each power supply housing contains one or two power supply modules as shown in Figure 5.4.6. Terminal blocks are provided for two AC input sources. This enables each power supply module in the housing to be connected to a separate AC source. The chassis of the power supply housing is internally bonded to the ground terminal of each AC input terminal block.

Inputs from each terminal block are routed through a single-pole, 15-ampere circuit breaker to a terminal block for use by auxiliary equipment such as fans.

NOTE: The cabinet fans used with the RS3 System Power Supply Units are not autosensing. Depending on the AC input (110 VAC or 220 VAC), the correct fan must be specified according to the input voltage. AC power is supplied to the AC fan in the RS3 system cabinet from the auxiliary outputs on the RS3 System Power Supply Unit. (The system cabinet uses an AC fan but the RMP cabinet does not.)
System Cabinet DC Power Configurations

System Power Supply Units are intended to operate in an N+1 redundancy configuration. There should always be one extra power supply module connected to a DC bus to provide redundancy. Separate DC output terminals are provided for each power supply module on the front of the housing, as shown in Figure 5.4.6.

Standard RS3 system cabinets are available with cable entry openings in both the top and bottom panels. The System Power Supply Unit and DC Distribution Bus can be mounted as appropriate for bottom cable entry or top cable entry.

A typical system might have three cabinets, with three primary supplies and one redundant supply. The redundant supply is normally load sharing with the primary supplies. If a primary or redundant supply fails, there will be no power loss at the load. No. 8 AWG insulated wire, orange for 26V+ and brown for 26V-, is used to connect the System Power Supply Unit DC outputs to the DC Distribution Bus. Use either the 1-meter cable (10P58277001) or the 3-meter cable (10P58277003) to make this connection. Do not exceed $2.15 + 0.12 \text{ N}\cdot\text{m} (19+1 \text{ lbf}\cdot\text{in})$ torque on the DC output terminals of the System Power Supply Unit.

Use separate wire channels for high-voltage (110/220 VAC) lines and low-voltage (4–20 mA) signal lines to maintain as much separation as possible between voltage and signal wiring. A minimum of 203 mm (8 in.) is recommended.
Jumpers on the ControlFile Power Regulator and OI Power Regulator must be set for 24 VDC, as follows:

<table>
<thead>
<tr>
<th>Regulator</th>
<th>Header</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>OI Power Regulator</td>
<td>HD1</td>
<td>2-3</td>
</tr>
<tr>
<td>ControlFile Power Regulator</td>
<td>HD1</td>
<td>1-2</td>
</tr>
</tbody>
</table>

For more information about system cabinet configurations, dimensions, grounding, etc., refer to the RS3 SP and SV manuals.

The DC power distribution system consists of a DC Distribution Bus (installed in the system cabinet), DC Output card (attached to the DC Distribution Bus), and various cables.

Each DC Distribution Bus assembly within a system cabinet consists of three copper bus bars with a current-carrying capacity of 200 amperes. DC Distribution Bus assemblies can be daisy chained as required, using a Jumper Cable DC bus to DC bus (1984-0373-xxxx). Bus A is normally jumpered to bus B, giving a bus A/B.

A standard, non-redundant, DC power distribution system consists of one or more System Power Supply Units feeding one or more DC Distribution Bus assemblies. Figure 5.4.7 shows a standard bus A/B operation.

A DC Distribution Bus should have no more than two System Power Supply Units (four power supply modules) wired to it, redundant power supplies included. This applies to both redundant and non-redundant buses.

**NOTE:** If a single System Power Supply Unit is used, the configuration should be the standard A/B distribution as shown in Figure 5.4.7.
Figure 5.4.7. Standard DC Power Distribution for System Power Supply Units

Figure 5.4.8 represents a redundant DC power distribution configuration consisting of one System Power Supply Unit feeding bus A and another System Power Supply Unit feeding bus B. Buses A and B are not connected.

Figure 5.4.8. Redundant DC Power Distribution System for System Power Supply Units
Each bus (A and B) needs to have a separate redundant power supply module, so a total of two redundant power supply modules are needed for a redundant DC power distribution. (This would be a redundant bus/redundant power supply configuration, which meets the N+1 redundancy requirement.)

The redundant bus configuration must have the same number of power supply modules on each bus. Four power supply modules (two System Power Supply Units) is the maximum allowed for both buses.

**Alarm Wiring**

Figure 5.4.9 shows the alarm connections on the housing. The housing contains separate alarm connections for each power supply module. The alarm and interlock terminal blocks connect to alarm relay contacts and interlocks in the power supply modules. The alarm terminal blocks do not require wire terminating lugs.

![Figure 5.4.9. Alarm Connections](image)

To cause either power supply module relay to function as a combined alarms relay, connect any number of external alarm contacts that are closed during normal equipment operation in series and wire them across the interlock terminal connection of the power supply module. Refer to Figure 5.4.10 for an example.
If the interlock connections of an installed power supply module are not
connected to external alarm contacts, jumper the connections to enable
the power supply module alarm relay to operate properly.

To use only one combined alarm for a cabinet, wire the output alarm
contacts for one power supply module into the interlock circuit of the
other power supply module.

Alarm relay contacts are rated to 250 VAC. Use wiring with insulation
rated at least 300 Volts or twice the working voltage used for these
circuits, whichever is higher. Use 2.07 mm² (14 AWG) to 0.812 mm²
(18 AWG) wire for the connection.

Special Conditions

Ensure that all other devices are mounted above the Operator Interface
(OI) electronics to ensure compliance with temperature requirements.
The OI must be the lowest device mounted in a system cabinet.
Installation

The typical factory-prepared cabinet installation is shipped with the System Power Supply Unit mounted. However, this section provides installation procedures in the event you need to install a System Power Supply Unit.

Physical Installation

This subsection explains how to:

- Install a power supply housing in a cabinet
- Install a power supply module in a housing.

Installing a Housing in a Cabinet

Fisher-Rosemount Systems recommends that you install the housing first, without power supply modules; then install the power supply modules in the housing.

**NOTE:** The System Power Supply Unit can weigh as much as 13.29 kg (29.3 lb) if two power supply modules are installed.

The following procedure describes installation of a power supply housing in a system cabinet.

1. Place all external circuit breakers that control AC power inputs to the power supply housing in the OFF position.

   **CAUTION**
   The DC Distribution Bus and associated power cables may have DC power still applied if the load is backed up by a redundant power source located elsewhere. Personal injury and equipment damage can occur if a DC Distribution Bus or cable is accidentally shorted. Turn off any backup power sources.

2. Position the power supply housing on the EIA rails. Provide sufficient support to hold the housing in place until the flange-lock screws are installed and tightened.

3. Install the four M6 Phillips Screws with nylon splash (G12215-2006-0116) and M6 cage nuts (G53426-0601-0716) and tighten them until the housing is securely attached to the cabinet rails.
4. Connect DC output and alarm wiring as required for your installation.

5. Connect the AC inputs to the input terminal blocks on the right side of the housing front panel.

6. Install power supply modules in the housing (see *Installing a Power Supply in a Housing*, following).

7. After following appropriate procedures for energizing circuits, place all circuit breakers that control cabinet AC power in the ON position.

**NOTE:** Be sure to place the startup voltage jumpers on the OI and ControlFile power regulators in the 24 Volt position when using a System Power Supply Unit.

### Installing a Power Supply in a Housing

The following procedure describes installation of a power supply module in the housing.

1. Ensure that the AC power switch on the front of the power supply module is in the off (O) position and that the locking pawl is in the horizontal position.

2. Align the power supply module with the guide rails in the housing.

3. Slide the power supply module into the housing, making sure that the bottom right edge of the power supply module engages the plastic guide rail in the housing.

   **NOTE:** If you are installing only one power supply module in a housing, install it in the right side of the housing.

4. Continue inserting the power supply module until the locking pawl reaches the stop.

5. Using a screwdriver, slowly turn the locking screw counterclockwise one quarter turn while observing the pawl to ensure that it freely rotates 90 degrees to the vertical position and engages the slot in the bottom of the housing.

   If the pawl does not rotate to the vertical position, move the power supply module in or out of the housing slightly to align the pawl with the slot in the housing.

6. Turn the locking screw approximately 10 additional turns counterclockwise until it stops, to fully seat the blind-mate connector. The remaining turns draw the power supply module into the housing and seat the blind-mate electrical connector.

   **CAUTION**

   Do not apply power to the power supply module until the blind-mate connector is fully seated. Failure to fully seat the connector may result in damage to the power supply module and power supply housing.
Using the Auxiliary AC Outputs

The power supply housing includes two auxiliary AC outputs that are independent of the power supply modules. Figure 5.4.11 shows the layout of the AC input and auxiliary output terminal blocks and circuit breakers.

Figure 5.4.11. Input and Auxiliary Output Connectors and Auxiliary Output Circuit Breakers

Figure 5.4.12 shows a schematic diagram for one set of AC inputs and auxiliary AC outputs. Each housing has two identical circuits, one for each power supply module. Note that the circuit breakers on the housing control only the auxiliary AC outputs and do not control power to the power supply modules. Use wire with insulation rated for a minimum of twice the rated mains supply voltage that feeds the auxiliary circuit.
To Power Supply

Note: Each Housing Contains Two Circuits.

Auxiliary AC Circuit Breaker

15A

Terminal Block

\[
\begin{array}{c}
L \\
N \\
\hline
L \\
N \\
\hline
\end{array}
\]

AC Input

Auxiliary AC Output

Figure 5.4.12. Power Supply Housing AC Input and Auxiliary AC Output Schematic Diagram
Section 5:
DC Distribution System

This section describes installation of the DC power distribution system consisting of DC Distribution Bus (installed in the system cabinet), DC Output card (attached to the DC Distribution Bus), and various cables.

A standard, non-redundant, DC power distribution system consists of one or more AC/DC Power Supplies feeding one or more DC Distribution Bus assemblies as shown in Figure 5.5.1.

Each DC Distribution Bus assembly within a system cabinet consists of three copper bus bars with a current carrying capacity of 200 amps. DC Distribution Bus assemblies can be daisy chained as required using a Jumper Cable DC Bus to DC Bus (1984-0373-xxxx). Bus A is normally jumpered to the bus B, giving a bus A/B.

Figure 5.5.1. Standard DC Power Distribution System for AC/DC Power Supplies
A redundant DC power distribution system consists of one set of AC/DC Power Supplies feeding bus A and another set of AC/DC Power Supplies feeding the bus B as shown in Figure 5.5.2. Buses A and B are not connected.

Figure 5.5.2. Redundant DC Power Distribution System for AC/DC Power Supplies
DC Power Distribution Bus

The DC power distribution bus distributes power within the system cabinet. Figure 5.5.3 shows a functional diagram of the DC power distribution bus.

Each AC/DC Power Supply is connected to the DC Power Distribution Bus by an AC/DC Power Supply to DC Bus Cable (1984-0283-00xx).

**NOTE:** Each of the cables from the power supply to the bus should be the same length. This allows optimum use of the load sharing capability of the power supply.

The DC power distribution bus consists of heavy copper terminals mounted directly on three bus bars, bus A, bus B, and the return bus. bus A, bus B, and the return bus run parallel to each other in a plastic channel. Bus B is intended for use with an optional redundant DC distribution system. The return bus is used to connect the DC return system to the chassis with a large wire connected from the bus bar to the chassis ground lug. This is the only connection point of the DC return system to ground.

DC power distribution bus assemblies can be daisy chained using the DC Bus to DC Bus Jumper Cable (1984-0373-00xx) or 35 mm² (2 AWG) wire. The current limit is 180 amps.

Each DC power distribution bus assembly can hold up to six DC Output cards which are used to supply power to individual card cages and devices.
Figure 5.5.3. DC Power Distribution Bus
**DC Output Card**

Power for system devices is tapped from the bus bars by mounting DC Output cards (1984–1264–000x) on the bus bars as shown in Figure 5.5.4. Each DC Output card has a fuse and terminal for both bus A and bus B. A LED in parallel with each fuse lights to indicate a blown fuse. A fuse reference chart at the bottom of each output card indicates the proper size of fuse to be used in each position.

A standard DC distribution system has bus A and B jumpered together to give bus A/B. Devices can take power from either the bus A or the bus B portion of the DC Output card. Up to 12 devices can be connected to a single DC Distribution Bus in the standard configuration.

**NOTE:** The jumper between buses is normally connected at the far end of the bus.

A redundant DC distribution system has separate buses A and B. Up to six devices can be powered from a single DC Distribution Bus in the redundant configuration. Each device draws power from the bus A and the bus B portion of the DC Output card. The bus A and bus B fuses must be identical.
Figure 5.5.4. Standard (Non-redundant) DC Distribution Bus and DC Output Card
## DC Output Card Fuses

Table 5.5.1 shows the DC Output card fuses for various hardware devices.

<table>
<thead>
<tr>
<th>Device</th>
<th>FRSI Part No.</th>
<th>Bussman Part No.</th>
<th>Littelfuse Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multitube Command Console: 1 Tube</td>
<td>G09140-0047</td>
<td>AGC 15</td>
<td>311015</td>
<td>15A 32V Regular</td>
</tr>
<tr>
<td>Multitube Command Console: 2 Tubes</td>
<td>G09140-0061</td>
<td>ABC 20</td>
<td>314020</td>
<td>20A 250V Regular</td>
</tr>
<tr>
<td>Multitube Command Console: 3 Tubes</td>
<td>G09140-0061</td>
<td>ABC 20</td>
<td>314020</td>
<td>20A 250V Regular</td>
</tr>
<tr>
<td>ControlFile</td>
<td>G09140-0061</td>
<td>ABC 20</td>
<td>314020</td>
<td>20A 250V Regular</td>
</tr>
<tr>
<td>ControlFile Fan</td>
<td>G09140-0046</td>
<td>AGC 10</td>
<td>311015</td>
<td>10A 32V Regular</td>
</tr>
<tr>
<td>I/O Card Cage</td>
<td>G09140-0047</td>
<td>AGC 15</td>
<td>311015</td>
<td>15A 32V Regular</td>
</tr>
<tr>
<td>FlexTerm</td>
<td>G09140-0046</td>
<td>AGC 10</td>
<td>311010</td>
<td>10A 32V Regular</td>
</tr>
<tr>
<td>Highway Interface Adapter (HIA)</td>
<td>G09140-0047</td>
<td>AGC 15</td>
<td>311015</td>
<td>15A 32V Regular</td>
</tr>
<tr>
<td>RS3 Network Interface (RNI)</td>
<td>G09140-0046</td>
<td>AGC 10</td>
<td>311015</td>
<td>10A 32V Regular</td>
</tr>
<tr>
<td>Supervisory Computer Interface (SCI)</td>
<td>G09140-0047</td>
<td>AGC 15</td>
<td>311015</td>
<td>15A 32V Regular</td>
</tr>
</tbody>
</table>
DC Distribution Cabling

The DC power distribution system can be:

- Standard, with bus A jumpered to bus B.
- Redundant, with bus A and bus B independently powered.

Standard DC Distribution Cabling

The A/B Bus DC Power Distribution Cable (1984-0158-20xx) is used on the Analog Card Cage, the Analog, Contact, MUX, and PLC FlexTerms, and many other devices. This cable allows upgrade to redundant DC power without adding another cable.

When using the A/B Bus DC Power Distribution Cable with a standard DC power system, attach it to the DC Output card as shown in Figure 5.5.5. Connection can be made to either the bus A or bus B portion of the card. The other portion of the card can be used for another device.

NOTE: The Pxxx tags on the cable will not match the Jxxx tags on the DC Output card.

![Figure 5.5.5. Non-redundant DC Power Cable](image)
Redundant DC Distribution Cabling

When using the A/B Bus DC Power Distribution Cable (1984-0158-20xx) with a redundant DC power system, attach it to the DC Output card as shown in Figure 5.5.6. This applies to devices in which a single power cable can carry the load. This configuration provides full redundancy only if diode isolation is provided at the device.

**NOTE:** The fuses in the A and B bus sides of the output card must be identical.

The Pxxx tags on the cable will not all match the Jxxx tags on the DC Output card. See Table 5.5.2.

![Diagram of redundant DC power cable](image)

**Figure 5.5.6. Redundant DC Power Cable**

<table>
<thead>
<tr>
<th>Cable Plug</th>
<th>Jack</th>
</tr>
</thead>
<tbody>
<tr>
<td>P233/4</td>
<td>J234</td>
</tr>
<tr>
<td>P235/6</td>
<td>J236</td>
</tr>
<tr>
<td>P237/8</td>
<td>J237</td>
</tr>
<tr>
<td>P239/40</td>
<td>J240</td>
</tr>
</tbody>
</table>
Heavy Load Redundant DC Distribution Cabling

The standard A/B Bus DC Power Distribution Cable is not always adequate to carry the load. The A Bus DC Power Distribution Cable (1984-0158-00xx) and the B Bus DC Power Distribution Cable (1984-0158-10xx) are then used as dual power cables. Two conductors are provided for bus A and two for bus B. This is used to supply redundant power to the ControlFile and Multitube.

They are connected to the DC Output card as shown in Figure 5.5.7.

**NOTE:** The fuses in the A and B bus sides of the output card must be identical.

The Pxxx tags on the cable will match the Jxxx tags on the DC Output card.

![Diagram of Dual DC Power Cables]

**Figure 5.5.7. Dual DC Power Cables**

**CAUTION**

When connecting any device to a DC output card, make sure the fuse installed in that position has the proper rating for the device. Improper fusing can result in equipment damage.
Checking DC Distribution

- To check out the DC distribution system:
  1. Make sure that each AC/DC Power Supply (see Figure 5.5.8) has the following light indications:
     - PS NORM (green) LED on.
     - AC IN (orange) lamp on.

![Figure 5.5.8. AC/DC Power Supply](image)

2. If power supplies with battery backup are used, place the BATT ON/OFF switch on each power supply to the OFF position.

3. Measure the 30 VDC power distribution system voltage at all of the DC bus assemblies (see Figure 5.5.9). The voltage should be 28 to 34 VDC. If the system has redundant DC power, both the buses A and B must be measured.

![Figure 5.5.9. DC Bus and DC Output Cards](image)
4. Ensure that all installed Field Interface Cards (FIC) cards have one or more LEDs on. The LEDs can be green, yellow, or red. Some of the yellow LEDs can be blinking—this is normal.

5. If power supplies with battery backup are used, place the BATT switch on each power supply to ON. If the PS FAULT LED lights, wait for 1 hour. After the 1 hour wait, press and release the BATT TEST pushbutton. The PS FAULT LED should go out. If the PS FAULT LED does not go out, see the troubleshooting advice in the Service Manual (SV: 10).
Section 6:
Electrical (Twinax) PeerWay

This section describes installation of the electrical PeerWay including twinax PeerWay cables and PeerWay taps.

The PeerWay is fully redundant. Two sets of twinax PeerWay cables and PeerWay Tap Boxes are used to provide independent communication paths between the nodes. Figure 5.6.1 shows a PeerWay with two Tap Boxes and five nodes. Each node is attached to PeerWay A and PeerWay B through the Tap Box.

Figure 5.6.1. PeerWay Tap Box Connection

Up to 32 nodes can be attached to a PeerWay, but performance requirements and numbering rules often limit the effective number. Highway Interface Adaptors (HIA) can be used to connect multiple PeerWays. PeerWays connected by HIAs are electrically independent.
Twinax PeerWay Cable

Twinax PeerWay cable provides the communication connection between electrical PeerWay nodes. The twinax PeerWay transmits messages serially at a rate of one million bits per second. As many as 32 system devices such as ControlFiles and consoles can be connected to the twinax PeerWay.

Standard Twinax PeerWay cable (1984-0474-xxxx) has a characteristic impedance of 100 ohms and can be used for PeerWay runs of up to 600 meters (2000 feet) end to end. Long Twinax PeerWay cable (1984-0494-xxxx) has a characteristic impedance of 124 ohms and can be used for PeerWay runs of up to 1000 meters (3300 feet) end to end.

Standard Twinax PeerWay cable (G50194-0001) and Long Twinax PeerWay cable (G50194-0003) are available in bulk without connectors.

G50194-0003 cable is Intercomp 12402 in North America and Kerpen Kabel 07KS00175 in Europe. Both use G12885-0008 connectors. Belden 9860 cable, now G50194-0004, was used previously for long twinax PeerWay cable, and must use G12885-0006 connectors. These 124-ohm cables are all electrically compatible.

The two sides of the PeerWay must use the same type cable. Do not mix 100-ohm and 124-ohm cable in the same PeerWay.

Twinax PeerWay cables are used in pairs for PeerWay A and PeerWay B. In order to identify the cables, the A cable should be color coded green and the B cable should be color coded blue. The cable connectors can be marked with a felt-tip marker.

T-style connectors (G12885-0003) are used to connect the twinax cable to the bulkhead connector on the PeerWay tap. Straight connectors (G12885-0005) should be used when splicing two lengths of cable together. Avoid splices where possible.

NOTE: Connector bodies must not be grounded. Be sure that there is no contact between connector bodies and grounded metal. Grounding a connector body can result in a ground loop that is very hard to locate.
When pulling cables do not exceed the pulling strength and minimum bend radius listed in Table 5.6.1. Use pulling compound to lubricate the cable and reduce stress when pulling the cables through conduit.

Table 5.6.1. Twinax PeerWay Cable Specifications

<table>
<thead>
<tr>
<th>Twinax Cable</th>
<th>Maximum Safe Pull Strength Kg (lb)</th>
<th>Minimum Bend Radius mm (in.)</th>
<th>Maximum Length m (ft)</th>
<th>Nominal Temperature Range ° F (° C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-Ohm PeerWay Cable</td>
<td>49.4 (109)</td>
<td>127 (5)</td>
<td>600 (2000)</td>
<td>-40 to +176 (-40 to +80)</td>
</tr>
<tr>
<td>124-Ohm PeerWay Cable</td>
<td>77.1 (170)</td>
<td>171.5 (6.75)</td>
<td>1000 (3300)</td>
<td>-40 to +140 (-40 to +60)</td>
</tr>
</tbody>
</table>
Routing and Installing Twinax PeerWay Cables

PeerWay cables must run between PeerWay taps, as shown in Figure 5.6.2. Maximum cable length is defined as the length of the cable from a terminated tap on one end to the terminated tap on the other end.

Because of differences in routing, the cables for PeerWay A and PeerWay B need not be exactly the same length. The total length of PeerWay A and PeerWay B should not differ by more than 100 meters (≈ 330 feet). PeerWay A and PeerWay B must connect to paired tap boxes in the same order. Cable lengths between any two pairs of tap boxes should not differ in length by more than 100 meters (≈ 330 feet).

**CAUTION**

PeerWay taps A and B must not be connected to each other at any point. Make sure that PeerWay cable A is connected only to A taps and PeerWay cable B is connected only to B taps.

![Figure 5.6.2. PeerWay Routing](image-url)

PeerWay Drop Cables
15 meters (50 feet) Maximum

Termination
NOTE: Check local codes for restrictions on methods for routing and protecting PeerWay cables.

Twinaxial PeerWay cables should be run through electrical conduit, in a cable tray or some other type of cabling channel to protect the cables from mechanical damage. If the cables must be routed together, there is no risk of electrical interference between them. It is recommended, however, that each PeerWay cable be routed through separate cable paths to reduce the chances that both signal paths would be disrupted by one incident. Further protection can be afforded by separating the cable runs as far as possible; for example, on opposite sides of the building or with a structural barrier between them (walls, beams, etc.).

Do not remove the cable connectors when running the cables through electrical conduit. A 25 mm (1 in.) conduit will accommodate one PeerWay cable with the connectors attached. A 32 mm (1.25 in.) conduit will hold two PeerWay cables with the connectors attached. Running both cables through the same conduit is discouraged.

PeerWay cables must not be allowed to lie in water or in direct sunlight. Long-term exposure to water or sunlight can cause cable degradation. Prolonged degradation can cause PeerWay errors that are difficult to diagnose.

It is good practice to measure and record the actual length of the cable when it is installed. The data will be useful for future rerouting or additions.
Installing the Twinax PeerWay Tap Box Assembly

The Twinax PeerWay Tap Box Assembly (Figure 5.6.3) consists of a PeerWay A Tap Box (10P52760001), a PeerWay B Tap Box (10P52790001), and a mounting plate (1984-0484-0002). The assembly allows connection of up to four devices to the PeerWay.

**NOTE:** Refer to the *Service Manual (SV)* for Tap Boxes 1984-0488-0001 and 1984-0489-0001.

Each PeerWay Tap Box has four identical circuits that connect to four different nodes (system devices). The four circuits are isolated from each other so that if one node fails, other nodes will not be affected. There are four connections from the tap boxes to system device drop cables. The A tap box uses male connectors; the B tap box uses female connectors.

![Figure 5.6.3. Twinax PeerWay Tap Box Assembly](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWay Tap Box Assembly</td>
<td>5</td>
<td>PeerWay shield screw position: grounded</td>
</tr>
<tr>
<td>2</td>
<td>Tap Box A</td>
<td>6</td>
<td>PeerWay shield screw position: non-grounded</td>
</tr>
<tr>
<td>3</td>
<td>Tap Box B</td>
<td>7</td>
<td>PeerWay Drop Cable connectors</td>
</tr>
<tr>
<td>4</td>
<td>Twinax PeerWay connector</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.6.3. Twinax PeerWay Tap Box Assembly
Mounting Twinax PeerWay Tap Box Assembly

The PeerWay Tap Box set comes as an assembly consisting of a mounting plate with A and B PeerWay Tap Boxes. The assembly can be mounted in a standard 483 mm (19 in.) system cabinet or on a flat surface.

The tap box assembly must be grounded. Mounting the assembly in a properly grounded system cabinet grounds the boxes. If the assembly is mounted on a non-grounded surface, a ground wire must be run to the nearest system grounding point.

NOTE: Each tap box assembly must be grounded by having the metal case connected to ground. The twinax PeerWay shield must be connected to ground at only one tap box set. The shield is grounded by having the screw at the “GROUND” position.

Connecting Twinax PeerWay Cables to Tap Boxes

Twinax cables are attached to the top of the unit by a “T” connector (Figure 5.6.4). Use a terminator if this tap box is at the end of the twinax run.

For power, an onboard 5 volt regulator is provided for each of the four nodes, with unregulated 9 volts brought to each tap circuit from the originating node. Thus, each of the four taps receives power from the node to which it is cabled. The PeerWay Tap connects to a PeerWay Buffer Card (in a ControlFile) or a PeerWay Interface Card (in a console) through the PeerWay Drop Cable.

In a system with four nodes or less and in which a twinax is not needed for long communication distance, all connections can be made through a single PeerWay Tap with 100-ohm terminators installed on the twinax connectors.

CAUTION

The barrel of each twinax connector and terminator must be covered with an insulating sleeve to prevent inadvertent grounding of the twinax cable.
Figure 5.6.4 shows the cable connections to PeerWay Tap Boxes.

Standard PeerWay Drop Cables (1984-0473-xxxx) are used to connect devices to the tap box. Tighten the connector captive screws at both ends of the cable run.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWay A Twinax connector and cable</td>
<td>4</td>
<td>PeerWay B Drop Cable to device</td>
</tr>
<tr>
<td>2</td>
<td>PeerWay B Twinax connector and cable</td>
<td>5</td>
<td>Device connected to the PeerWay</td>
</tr>
<tr>
<td>3</td>
<td>PeerWay A Drop Cable to device</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.6.4. PeerWay Tap Box Connection
Grounding Twinax PeerWay Shield

One tap box set (and only one tap box set) in each twinax PeerWay run must have the twinax shield connected to chassis ground. To make the connection at this tap box set, move the screw from the OPEN position to the GROUND position. The screws are located on the top of the tap boxes (Figure 5.6.3). Move the screws on both tap boxes. (Earlier tap boxes had an internal jumper for this purpose.)

Terminating Twinax PeerWay Cable

Terminators must be installed at each end of the PeerWay, as shown in Figure 5.6.5. The terminator eliminates reflections on the cable.

NOTE: There are different terminators for the 100-ohm and 124-ohm twinax PeerWays. Be sure to use the correct terminator.

- 100-ohm PeerWay: use terminator 1984-1065-0001
- 124-ohm PeerWay: use terminator 1984-1065-0002

Figure 5.6.5. PeerWay Taps at PeerWay Ends
Checklist for CE-Compliant Installation

Follow these rules for a CE-compliant installation.

1. Use only Tap Boxes 10P52760001 and 10P52790001 and mounting plate 1984-0484-0002, or a built-in tap box mounting plate in other CE-compliant RS3 components.

2. Keep the Tap Boxes on the metal mounting plate.

3. Mount the plate to grounded rails in a grounded system cabinet, a grounded metal surface, or run a ground wire from the plate to the nearest system ground point.

4. There must be an insulating sleeve over the metal barrel of all Twinax connectors and terminators. Connectors on factory-supplied cables will have the shield.

5. Use a terminator on any open twinax connector.
Installing Twinax Connectors

The connectors available for twinax PeerWay cable are listed in Table 5.6.2.

Table 5.6.2. Twinax Connectors

<table>
<thead>
<tr>
<th>Cable</th>
<th>Connector Type</th>
<th>Connector Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-Ohm Cable C50194--0001</td>
<td>Crimp Type</td>
<td>1167–0016–0001</td>
</tr>
<tr>
<td>100-Ohm Cable C50194--0001</td>
<td>Solder Type</td>
<td>G12885–0001</td>
</tr>
<tr>
<td>124-Ohm Cable C50194--0003</td>
<td>Solder Type</td>
<td>G12885–0008</td>
</tr>
<tr>
<td>124-Ohm Cable C50194--0004</td>
<td>Solder Type</td>
<td>G12885–0006</td>
</tr>
</tbody>
</table>

**NOTE:** An insulating sleeve should be placed over the metal barrel of the connector to prevent inadvertent grounding of the twinax shield.

Installation instructions for both types are given below.

- **To install a crimp-type twinaxial connector:**
  1. Strip the cable as shown in Figure 5.6.6.
  2. Refer to the crimping instructions (AS047401) shipped with the connector for installation instructions.

**NOTE:** A Connector Crimp Tool (1167–0016–0002) is required. A Crimp Tool Kit (1167–0016–0007) including a tool and 20 connectors is available.

---

**Figure 5.6.6. Crimp-Type Twinaxial Connector**
To install a solder-type twinaxial connector:

1. Place the wrench crimp nut onto the cable. Refer to step A of Figure 5.6.7.
2. Strip the cable as shown and bend the braid outward to allow free entry of the cone.
3. Push the cone under the braid until it is bottomed (step B).
4. Bend the long conductor outward and install the shield over the copper conductor.
5. Position the pin and solder in place.
6. Wrap the conductor between the shield ridges and the solder (step C). Do not allow the solder to extend above the ridges.
7. Bring the wrench crimp nut up onto the tapered portion of the cone (step D).
8. Assemble the connector body over the cable assembly and engage with the wrench crimp nut. Ensure that the cable and connector body are held stationary while tightening the nut.
9. Wrench tighten the nut to 40–50 in-lb torque.
Figure 5.6.7.  Solder-Type Twinaxial Connector
Section 7: Optical PeerWay

An optical PeerWay consists of the fiber optic cable, star coupler, optical tap box, electrical tap box, interface box, and optical repeater. An individual installation might not have all these components. Figure 5.7.1 shows an overview of one side of an optical PeerWay.

The optical PeerWay uses fiber optic cable and provides complete electrical isolation between system components. An optical PeerWay uses a passive star architecture with a star coupler feeding up to eight optical fiber runs. Each optical fiber run terminates at an optical tap box. The optical fiber run can include repeaters and/or attenuators to adjust signal strength.

Figure 5.7.1. Optical PeerWay (Side A or Side B)
Each side (A and B) of the optical PeerWay uses a dual fiber optic cable, one fiber for transmission and one for reception. The fiber optic cable carries messages serially at a rate of one million bits per second. A maximum of 32 system devices can be connected to an optical PeerWay. A Highway Interface Adaptor (HIA) can be used to connect two optical PeerWays or an optical and an electrical PeerWay.

Figure 5.7.2 shows maximum distances for an optical PeerWay. The optical PeerWay allows connection of devices up to 1 km (3300 feet) without a repeater. If an optical repeater is used on a fiber run of less than 1 km (3300 feet) in the direction of the optical tap box, an optical attenuator must be used to keep the photo energy in the receiver module within its dynamic range. A repeater/Attenuator or an inline fixed attenuator can be used.

An optical tap box can support up to four directly connected devices. Additional devices can be connected to the optical tap box by daisy chaining up to three electrical tap boxes using special opto/electrical cables. The maximum allowable distance of the chain is 30 meters (100 feet). Each electrical tap box can support up to four devices, which can be up to 23 meters (50 feet) from the tap box.
Figure 5.7.2. Optical PeerWay Maximum Distances
Two groups of equipment can be connected by optical PeerWay as shown in Figure 5.7.3. The optical PeerWay can be approximately 5 km (3 miles) long depending on the fiber chosen. A fixed optical attenuator will be required if the groups are close together. The electrical tap boxes can be spread over 30 meters (100 feet) and equipment can be up to 23 meters (50 feet) from the tap boxes.

**Figure 5.7.3. Direct Connection of Optical Tap Sets**

A standard two-fiber multimode 62.5/125 cable is used along with ST connectors. The transmitters operate at 850 nm, producing a red light that can be safely viewed. No special optical precautions are required.
Installing an Optical Tap Set

The Optical PeerWay Tap Set mounts in a system cabinet or on a wall. It requires 356 mm (14 in.) of space for mounting. It draws power from each of the devices connected by the PeerWay Drop Cables. The tap set consists of a mounting plate and two Optical Tap Boxes:

- PeerWay A  (1984-3211-0001)
- PeerWay B  (1984-3214-0001)

The Optical PeerWay Tap Set should always be used with a Fiber Optic Cable Tie Panel Assembly (1984-2231-0001) to dress securely and tie down the fiber optic cables. The cable tie assembly mounts at the top of the Optical PeerWay Tap. Figure 5.7.4 shows the Optical PeerWay Tap Set and the Fiber Optic Cable Tie Panel Assembly.
Figure 5.7.4. Optical PeerWay Tap and Cable Tie Panel Assembly
Connecting Cables to an Optical Tap Box

Figure 5.7.5 shows the fiber optic, opto/electric, and PeerWay drop cable connections to an optical tap box.

**NOTE:** The cable tie panel assembly is not shown, but must be used to secure the optical cables.

Use Opto/Electric Cable to daisy-chain from the Optical Tap Box to the Electrical Tap Box. Opto/Electric cable is also used to daisy-chain between Electrical Tap Boxes.

- Optical Tap Box “A” to Electrical Tap Box “A”: use Opto/Electric Cable 1984-1195-xxxx.
- Optical Tap Box “B” to Electrical Tap Box “B”: use Opto/Electric Cable 1984-1196-xxxx.

The Optical Tap Box can be in the middle of the daisy chain if desired. Both electrical connectors can be used at the same time.

Standard PeerWay drop cables are used to connect devices to the Optical Tap Box and to the Electrical Tap Box.
Figure 5.7.5. Cable Connection to Optical Tap Box
Installing an Electrical Tap Box

The Electrical Tap Box set mounts in a system cabinet or on a wall. The set requires 267 mm (10.5 in.) of rail space. It draws power from the devices connected by the PeerWay Drop Cables. The tap (Figure 5.7.6) consists of a mounting plate and two Electrical Tap Boxes:

- PeerWay A (1984-3211-0002)
- PeerWay B (1984-3214-0002)

Up to three Electrical Tap Boxes can be daisy chained to an Optical Tap Box using special Opto/Electrical cables. Devices are connected to the electrical tap box with normal PeerWay drop cables.

![Figure 5.7.6. PeerWay Electrical Tap Box Set](image_url)
Grounding Optical and Electrical Tap Box Groups

Each fiber optic tap box group must be grounded at one and only one tap box (optical or electrical). The selected tap set must have low resistance to earth ground (preferably less than one ohm). Both tap box A and tap box B must be grounded. As an example, Figure 5.7.7 shows a fiber optic PeerWay. All of the shaded tap boxes are grounded.

**NOTE:** A tap box group consists of the Optical Tap and any Electrical Taps connected to the Optical Tap. One tap of each group must be grounded.

![Diagram of Optical PeerWay Grounding](Figure 5.7.7. Example of Optical PeerWay Grounding)
To ground an optical or electrical tap box (see Figure 5.7.8):

1. Free fiber optic tap A by loosening the four captive screws that secure it to the mounting plate.

   **CAUTION**

   This procedure should be done before connecting the fiber optic cables to the tap boxes. However, if the fiber optic cables are attached to the tap, do not turn the tap over. Move the tap away from the mounting plate just enough to move or check the position of the jumper.

2. Turn the tap over to expose the circuit board.
3. Place the jumper in the GND (ground) position.
4. Reinstall the tap on the mounting plate.
5. Repeat the procedure for fiber optic tap B.
6. To prevent multiple grounds, remove and check the other taps in the tap box group to make sure that the jumpers are in the HOLD position.
CAUTION: Do not turn the tap box over if the fiber optic cables are attached.

NOTE: Set the jumpers in Tap A and Tap B the same way.

Figure 5.7.8. Grounding an Optical or Electrical Tap Box
Installing a Fixed Optical Attenuator

The Fixed Optical Attenuator (G52931-000x) is an inline component used to adjust signal levels in an optical PeerWay. It is most often used in optical PeerWays that have only two optical tap boxes and so do not require a star coupler. There are three models that give three levels of attenuation:

- \(-0001\) 5 dB
- \(-0002\) 10 dB
- \(-0003\) 15 dB
Installing an Optical Repeater/Attenuator

The Optical Repeater/Attenuator (1984–2350–100x) is used to adjust signal levels in an optical PeerWay. It is marked “FIBER OPTIC REPEATER” on the printed wiring board (PWA). Dash number 1001 is a repeater and 1002 is a repeater with a built-in attenuator. It is in a standard 20x20x10 cm (8x8x4 in.) electrical box that can be mounted on a wall or on a plate in a system cabinet. Figure 5.7.9 shows the mounting dimensions.

![Diagram of Optical Repeater/Attenuator Box Dimensions](image)

Figure 5.7.9. Fiber Optic Splice/Repeater/Attenuator Box Dimensions in Millimeters (Inches)
Figure 5.7.10 shows the jumper and LED locations on the card within the Optical Repeater/Attenuator box. Table 5.7.1 gives the jumper settings for normal and for test operation.

Table 5.7.1. Optical Repeater/Attenuator Jumper Settings

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Normal Position</th>
<th>Test Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1</td>
<td>1-2</td>
<td>2-3</td>
</tr>
<tr>
<td>HD2</td>
<td>1-2</td>
<td>2-3</td>
</tr>
</tbody>
</table>

LEDs

- DS1   Hardware Good
- DS2   Hardware Bad
- DS3   +30V Fuse Blown
- DS4   FO TX1 Failed *
- DS5   FO TX2 Failed *
- DS6   Data 1
- DS7   Data 2

* FO = Fiber Optic

Figure 5.7.10. Optical Repeater/Attenuator LED and Jumper Locations
Installing a Star Coupler

The Star Coupler (1984-1198-000x) provides optical connection for up to eight fiber optic cable pairs (transmit and receive). The coupler is a passive device that connects the optical fibers to provide circuit continuity. The Star Coupler mounts in a system cabinet or on a wall. It requires 89 mm (3.5 in.) of rail space. Two Star Couplers must be used, one for each PeerWay.

There is room within the Star Coupler to dress the fiber optic cables and tie them down. Avoid sharp bends in the cables. A 76 mm (3 in.) minimum bend radius is acceptable. Figure 5.7.11 shows the Star Coupler label and the eight fiber optic connectors.

---

**Figure 5.7.11. Star Coupler**
Section 8:
PeerWay Extender

The PeerWay Extender (PX) allows creation of a hybrid PeerWay with both twinax and fiber optic segments. The PX transfers information between the twinax and the fiber optic segments and acts as a regenerative repeater. It also provides two standard PeerWay drops, which directly connect to the twinax segment. The PX is designed to be fully compatible with both twinax PeerWay products and fiber optic PeerWay products.

NOTE: Use a pair of Highway Interface Adapters (HIA) to connect two PeerWays.

Figure 5.8.1 shows insertion of a fiber optic link in a twinax PeerWay. The PXs are shown at the physical end of the twinax segments. Actually they can be located anywhere along the twinax run. Several other hybrid PeerWays are shown later in this section.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Twinax PeerWay cable</td>
<td>6</td>
<td>DC power cable (18–36 VDC)</td>
</tr>
<tr>
<td>2</td>
<td>PeerWay Extender (PX)</td>
<td>7</td>
<td>Fiber Optic PeerWay cable</td>
</tr>
<tr>
<td>3</td>
<td>DC power cable (18–36 VDC)</td>
<td>8</td>
<td>PeerWay Drop Cables to devices</td>
</tr>
<tr>
<td>4</td>
<td>PeerWay Extender (PX)</td>
<td>9</td>
<td>PeerWay Drop Cables to devices</td>
</tr>
<tr>
<td>5</td>
<td>Twinax PeerWay cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.8.1. PeerWay Extender Example
A PeerWay Extender Tap Box Assembly consists of a PeerWay A PX (10P50930001), a PeerWay B PX (10P50960001), and a mounting plate. Use of a Fiber Optic Cable Tie Assembly (1984–2231–0001) is recommended. A typical unit is shown in Figure 5.8.2.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mounting Plate</td>
<td>3</td>
<td>PX for PeerWay B</td>
</tr>
<tr>
<td>2</td>
<td>PX for PeerWay A</td>
<td>4</td>
<td>Fiber Optic Cable Tie Assembly</td>
</tr>
</tbody>
</table>

Figure 5.8.2. PeerWay Extender Tap Box Assembly
Figure 5.8.3 shows the parts of a PeerWay Extender.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Twinax PeerWay Connector</td>
<td>7</td>
<td>Label showing effect of Normal/Test switches</td>
</tr>
<tr>
<td>2</td>
<td>Normal/Test switches (S1 and S2)</td>
<td>8</td>
<td>DC power connector</td>
</tr>
<tr>
<td>3</td>
<td>LEDs</td>
<td>9</td>
<td>PeerWay Drop 1 connector</td>
</tr>
<tr>
<td>4</td>
<td>Fiber Optic output power switch (S3)</td>
<td>10</td>
<td>PeerWay Drop 2 connector</td>
</tr>
<tr>
<td>5</td>
<td>Tap Box grounding screw position</td>
<td>11</td>
<td>Fiber Optic receiver</td>
</tr>
<tr>
<td>6</td>
<td>Tap Box non-grounded screw position</td>
<td>12</td>
<td>Fiber Optic transmitter</td>
</tr>
</tbody>
</table>

Figure 5.8.3. PeerWay Extender
Checklist for CE Compliant Installation

These rules must be followed to ensure CE compliance:


2. Properly ground the PX mounting plate. Installation in a grounded System Cabinet will provide an adequate ground.

3. If you install the PX assembly on a non-conducting surface, you must run a grounding wire from the mounting plate to the nearest available system ground point.

4. There must be an insulating sleeve over the metal barrels of all Twinax connectors and terminators. Connectors on factory supplied cables will have the shield. Heat-shrinkable tubing is adequate.

5. You must power the PX from a CE-approved source of DC.
Mounting

The PeerWay Extender comes as an assembly consisting of a mounting plate with A and B PeerWay Extender Tap Boxes. The assembly can be mounted in a standard 483 mm (19 in.) system cabinet or on a flat surface. You must provide strain relief for the fiber optic cables and the DC power cable. Use of the Fiber Optic Cable Tie Assembly (1984-2231-0001) is recommended.

The tap box assembly must be grounded. Mounting the assembly in a properly grounded system cabinet grounds the boxes. If the assembly is mounted on a non-conducting surface, a ground wire must be run to the nearest system grounding point.

**NOTE:** Each tap box assembly must be grounded by having the metal case connected to ground. The twinax PeerWay shield must be connected to ground at only one tap box set. The shield is grounded by having the screw at the “GROUND” position on a PX or new standard tap box, or by setting the “SHIELD” jumper to “GND” on an original standard tap box.
System Cabling

The PeerWay Extender is cabled as shown in Figure 5.8.4. Table 5.8.1 identifies the parts.

Figure 5.8.4. PeerWay Extender Cabling
Table 5.8.1. PeerWay Extender Cabling Callouts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWay A Twinax connector and cable</td>
<td>6</td>
<td>PeerWay B fiber optic cables and connectors</td>
</tr>
<tr>
<td>2</td>
<td>PeerWay B Twinax connector and cable</td>
<td>7</td>
<td>PeerWay A Drop Cable to device</td>
</tr>
<tr>
<td>3</td>
<td>DC power cable for PX A</td>
<td>8</td>
<td>PeerWay B Drop Cable to device</td>
</tr>
<tr>
<td>4</td>
<td>DC power cable for PX B</td>
<td>9</td>
<td>Device connected to the PeerWay</td>
</tr>
<tr>
<td>5</td>
<td>PeerWay A fiber optic cables and connectors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Twinax cables are attached to the top of the unit by a “T” connector. Use a terminator if this tap box is at the end of the twinax run. If there are no twinax cables attached, you must put a terminator on the single twinax connector at the top of the unit. Use only one terminator.

**CAUTION**

The barrel of each twinax connector and terminator must be covered with an insulating sleeve to prevent inadvertent grounding of the twinax cable to the mounting plate.

Fiber optic cables require strain relief near the connector. It is customary to leave about 3 meters (10 feet) of cable to allow replacement of the connector. Use of the Fiber Optic Cable Tie Assembly (1984–2231–0001) is recommended.

A standard DC Bus to System Device cable (1984–0158–xxxx) can be used to connect system DC power to the tap box. Any other reliable source of DC in the range of 18 to 36 V can be used. A Mate N Lock® connector (G11262–1004) is used.

**CAUTION**

The PX must be supplied with a reliable source of DC power. If the PX loses power, the PeerWay is broken into separate twinax segments at that point.

Standard PeerWay Drop Cables (1984–0473–xxxx) are used to connect devices to the tap box. Tighten the connector captive screws at both ends of the cable run.

**NOTE:** The PX can be powered through the Drop Cables but this should be done only if turning the devices off will not break the PeerWay by removing power from the PX.

**CAUTION**

A RS3 Network Interface (RNI) cannot power a PX via the drop cables.
There are three LEDs. Table 5.8.2 lists and describes the LEDs.

<table>
<thead>
<tr>
<th>LED</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATUS (Yellow)</td>
<td>The PX is running and has adequate power applied.</td>
</tr>
<tr>
<td>XMT (Yellow)</td>
<td>Fiber Optic Transmit - ON (flickering) when messages are being transmitted on the fiber optic channel. ON continuously indicates a stuck transmitter or transmitter in test mode.</td>
</tr>
<tr>
<td>RECV (Yellow)</td>
<td>Fiber Optic Receive - ON (flickering) when messages are being received on the fiber optic channel. ON continuously indicates a stuck transmitter at the other end of the fiber or transmitter in test mode.</td>
</tr>
</tbody>
</table>
Grounding the Twinax PeerWay

One tap box set (and only one tap box set) in each twinax PeerWay segment must have the twinax shield connected to chassis ground. To make the connection at the PX tap box set, move the screw from the OPEN position to the GROUND position. Move the screws on both tap boxes A and B.

A zero length twinax segment (a PX with no twinax attached) must have the screw set at GROUND on both A and B tap boxes.
Switches

There are two sets of switches: S1 and S2 control the Normal/Test mode of operation; S3 controls the output power of the fiber optic transmitter. The switches are reached through holes in the faceplate.

Fiber Optic Power Switch

Switch S3 controls the power output of the fiber optic transmitter. At the HIGH POWER setting full transmitter power is output. At the LOW POWER setting the output is about 7 to 10 dB lower. This is used in place of an external attenuator. Table 5.8.3 shows the effects of switch S3 settings.

<table>
<thead>
<tr>
<th>S3 Position</th>
<th>Effect</th>
</tr>
</thead>
</table>
| HIGH POWER  | Full power Mode  
(Use with star or greater than 1 km fibre optic cable) |
| LOW POWER   | Reduced power mode  
(most common application) |
Normal/Test Switches

The PeerWay Extender has three operating modes: normal, disabled, and test. The modes are controlled by switches S1 and S2. You must force PeerWay traffic to the other PeerWay before using either disable or test mode.

**Normal Mode:** When S1 and S2 are both thrown to the right, normal operation results.

**Disabled Mode:** When S1 and S2 differ, the twinax to fiber optic connection is turned off.

**Test Mode:** When S1 and S2 are both thrown to the left, the fiber optic transmitter sends a 50 percent duty cycle signal on the fiber. The Receive LED on all tap boxes connected to this fiber should be ON. This verifies that both transmitter and receiver are functioning within specification. Table 5.8.4 shows the effects of switch S1 and S2 settings.

### Table 5.8.4. Switch S1 and S2 Settings

<table>
<thead>
<tr>
<th>S1 Position</th>
<th>S2 Position</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>Right</td>
<td>Normal Mode</td>
</tr>
<tr>
<td>Right</td>
<td>Left</td>
<td>Disabled</td>
</tr>
<tr>
<td>Left</td>
<td>Right</td>
<td>Disabled</td>
</tr>
<tr>
<td>Left</td>
<td>Left</td>
<td>Fiber Optic Transmitter Test Mode</td>
</tr>
</tbody>
</table>
PeerWay Configurations

The PeerWay Extender (PX) allows creation of a large number of new PeerWay configurations.

Fiber Optic Link in a Twinax PeerWay

Figure 5.8.5 shows an example of a fiber optic link in a twinax PeerWay.

![Figure 5.8.5. Fiber Optic Link in a Twinax PeerWay](image)

Hybrid Fiber Optic and Twinax PeerWay

Figure 5.8.6 shows an example of a hybrid fiber optic link and twinax PeerWay.

![Figure 5.8.6. Hybrid Fiber Optic and Twinax PeerWay](image)
Twinax Segment Added to a Fiber Optic PeerWay

Figure 5.8.7 shows an example of a twinax segment added to a fiber optic PeerWay.

Figure 5.8.7. Twinax Segment Added to a Fiber Optic PeerWay
Figure 5.8.8 shows an example of a fiber optic "star."

Figure 5.8.8. Fiber Optic "Star"
Hybrid PeerWay Design Guidelines

A hybrid PeerWay consists of both twinax and fiber optical segments. The twinax segments must meet the design guidelines for twinax PeerWays, the fiber optic segments must meet those for fiber optic PeerWays, and the entire hybrid PeerWay must meet the hybrid PeerWay guidelines.

A PeerWay can have a maximum of 32 nodes. Performance factors often limit the practical number to something less than that.

Twinax Segment Design Guidelines

The hybrid PeerWay can have several twinax segments. Each twinax segment is governed by these design guidelines:

**Length:** The length of a twinax segment is limited by the type of cable used. There can be an additional limit due to Slot Width considerations which are discussed later. Table 5.8.5 shows cable length limits.

<table>
<thead>
<tr>
<th>Cable</th>
<th>Part Number</th>
<th>Maximum Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (100 ohm)</td>
<td>1984-0474-xxxx</td>
<td>600 meters (2000 feet)</td>
</tr>
<tr>
<td>Long (124 ohm)</td>
<td>1984-0494-xxxx</td>
<td>1 kilometer (3300 feet)</td>
</tr>
</tbody>
</table>

**Termination:** Each twinax segment must be properly terminated at both ends. Use a “T” connector with a terminator appropriate to the twinax cable. For Standard PeerWay cable (100 ohm), use Terminator 1984-1065-0001. For Long PeerWay cable (124 ohm), use 1984-1065-0002.

**NOTE:** A PX with no twinax cable attached (zero length twinax segment) must have a terminator on the twinax connector.
Grounding: One, and only one, tap box set in each twinax segment MUST have the twinax shield grounded. On an original Twinax Tap box set, an Optical Tap Box Set, or an Electrical Tap box set, move jumper HD2 to GND. On a PX or new standard Tap Box set, move the grounding screw from the OPEN to the GROUND side. Set both the A and B tap box jumpers at the same tap box set. Be sure that the tap box metal is grounded.

NOTE: A PX with no twinax cable attached (zero length twinax segment) must have the twinax shield grounded.

Fiber Optic Segment Design Guidelines

The hybrid PeerWay can have several fiber optic segments. Each segment is governed by the design guidelines given below. The guidelines are stated for 62.5/125 μm cable with 4 dB/km attenuation. Use of other cable requires recomputation.

- Use the low-power setting for most fiber optic cable runs.
- Use the high-power setting if the PX drives a star.
- Use the high-power setting for cable runs over 1 km.
- Calculate the flux budget only for runs over 1 km or those with many splices.
- Slot width, not transmitter power, is likely to be the limiting factor for cable length.

Length: The point-to-point maximum cable length is 3 km. This assumes use of 2 connectors and no splices. When a Star Coupler is used, the limit is 1 km between nodes. The nodes can be a PX or an Optical Tap Box. Slot Width requirements can further limit the maximum cable length.

Segments: Slot Width considerations limit the number of fiber optic segments that can be used. No message should travel through more than four PXs.

Flux Budget: There must be enough signal to ensure reliable operation. The flux budget calculation starts with the transmitter power, subtracts all losses, and must result in a number greater than the receiver sensitivity but less than the receiver overload value. Fiber optic transmitters lose output power with age. To ensure proper operation over time, a safety factor of 3 dB is added to all calculations.

The flux budget equation is:

\[
\text{Reserve Power} = \text{Received Power} - \text{Receiver Sensitivity}
\]

\[
\text{Received Power} = \text{Transmitter Power} - \text{Losses}
\]

\[
\text{Losses} = \text{Cable} + \text{Connectors} + \text{Star} + 3
\]
Example 1. A point-to-point connection with 3 km of cable and two connectors:

\[
\text{Losses} = (3\text{ km} \times 4\text{ dB/km}) + (2 \times 1\text{ dB}) + 0 + 3 = 17\text{ dB}
\]

\[
\text{Received Power} = -7.6\text{ dBm} - 17\text{ dB} = -24.6\text{ dBm}
\]

\[
\text{Reserve Power} = -24.6 - (-31.7) = +7.1\text{ dBm}
\]

The Reserve Power (+6.6 dBm) is positive and the Received Power (-25.1 dBm) is less than the maximum so the flux budget is OK.

Example 2. A Fiber Optic Star with a maximum of 1 km optical cable between tap boxes and 4 connectors:

\[
\text{Losses} = (1\text{ km} \times 4\text{ dB/km}) + (4 \times 1) + 13 + 3 = 24\text{ dB}
\]

\[
\text{Received Power} = -7.6\text{ dBm} - 24 = -31.6\text{ dBm}
\]

\[
\text{Reserve Power} = -31.6\text{ dBm} - (-31.7\text{ dBm}) = +0.1\text{ dBm}
\]

The Reserve Power and Received Power are within limits.

**Hybrid PeerWay Design Guidelines**

A Hybrid PeerWay is one with both twinax and fiber optic segments. Each segment must meet the appropriate design guidelines. The entire hybrid PeerWay must meet the guidelines below.

**PX Limit:** A signal must not go through more than four PX taps.

**Slot Width:** Slot Width is an RS3 parameter which allows for the transmit time of PeerWay messages down the twinax or fiber optic cable. It sets the amount of dead time between messages. The Slot Width minimum is 20, the default value is 30. The higher the Slot Width, the greater amount of dead time between messages. The Slot Width upper limit is 200. This number determines the absolute maximum PeerWay length possible. However, setting the Slot Width to 200 may cause an unacceptable decrease in PeerWay performance.

A very heavily loaded PeerWay will pass about 500 messages a second with a Slot Width of 30. Increasing the Slot Width to 200 (which increases the dead time between messages) will cut capacity to about 125 messages per second. This may not be enough bandwidth for effective control, especially during plant upset conditions. Slot Width should be kept as small as possible. A system with Slot Width near 200 should have only a few nodes on it. Consult the factory for guidance whenever the Slot Width is 100 or greater. Consider using a pair of Highway Interface Adapters (HIAs) to break a very long PeerWay into two shorter PeerWays.
The propagation delay for the equipment normally used is shown in Table 5.8.6.

**Table 5.8.6. Cable Propagation Delay**

<table>
<thead>
<tr>
<th>Cable/Device</th>
<th>FRSI P/N</th>
<th>Propagation Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twinax - 100 ohm</td>
<td>1984--0474--xxxx</td>
<td>.00506 μs/meter (.00155 μs/feet)</td>
</tr>
<tr>
<td>Twinax - 124 ohm</td>
<td>1984--0494--xxxx</td>
<td>.00427 μs/meter (.00131 μs/feet)</td>
</tr>
<tr>
<td>FO Cable 62.5/125 μm</td>
<td>G51769--xxxx</td>
<td>.00496 μs/meter (.00152 μs/feet)</td>
</tr>
<tr>
<td>PX Tap Box</td>
<td>10P50930001</td>
<td>1.5 μsecond</td>
</tr>
<tr>
<td></td>
<td>10P50960001</td>
<td></td>
</tr>
</tbody>
</table>

The formula for Slot Width is:

\[
\text{Slot Width} = 2 \times \{ 2 \times (\text{Longest twinax delay}) \\
+ 2 \times (\text{Longest fiber optic delay}) \\
+ 2 \times 1.5 \times (\text{Max number of PXs between nodes}) \\
+ 6.4 \}
\]

All values are in μseconds. Any fractional result for Slot Width should be rounded up to the next integer. The units for Slot Width are 0.5 μseconds. A Slot Width of 30 represents an allowed delay of 15 μseconds per PeerWay message. The 6.4 μsecond constant is the time required for each node to synchronize a PeerWay message.

**Example 1.** Twinax PeerWay with 1 km of 124 ohm cable (Figure 5.8.9):

\[
\text{Slot Width} = 2 \times \{ 2 \times (1000 \text{ m} \times .00427 \text{ μs/m}) + 6.4} \}
\]

\[
= 29.88
\]

\[
\equiv 30
\]

![Figure 5.8.9. Twinax PeerWay: Propagation Delay Example](image-url)
**Example 2.** Three twinax segments connected by two fiber optic segments (Figure 5.8.10):

![Diagram of three twinax segments connected by two fiber optic segments](image)

**Figure 5.8.10. Three Twinax PeerWay Segments: Propagation Delay Example**

The total twinax delay is:

\[
twinax \text{ delay} = (1000 \text{ m} + 1000 \text{ m} + 550 \text{ m}) \times 0.00427 \text{ m/sec/m} = 10.89 \text{ m/sec}
\]

\[
fiber \text{ optic delay} = (3000 \text{ m} + 3000 \text{ m}) \times 0.00496 \text{ m/sec/m} = 29.76 \text{ m/sec}
\]

\[
FX \text{ delay} = 4 \times 1.5 \text{ m/sec} = 6 \text{ m/sec}
\]

\[
Slot \text{ Width} = 2 \times [2 \times 10.89 + 2 \times 29.76 + 2 \times 6 + 6.4]
\]

\[
= 199.4
\]

\[
\approx 200
\]

This PeerWay is physically as long as possible since it requires a Slot Width of 200. Such a PeerWay will have significantly lower capacity. Highway Interface Adapters (HIAs) should be used to break a very long PeerWay into shorter segments.

**Node Count:** Bandwidth of the PeerWay is the parameter limiting performance. More nodes need more bandwidth to send messages. Increasing the Slot Width decreases the available message bandwidth. As a general guideline, use the relationship:

\[
Number \text{ of nodes} = 32 - \left(\frac{Slot \text{ Width} - 30}{7}\right)
\]

If the Slot Width is 100, there should be no more than

\[
32 - \left(\frac{100 - 30}{7}\right) = \frac{32-10}{7} = 22 \text{ nodes}
\]

**Node Numbering:** It is a good idea to avoid using adjacent node numbers (4,5 or 1,32). When possible, use only the even numbers.
## Specifications

Table 5.8.7 lists PeerWay Extender specifications.

### Table 5.8.7. Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fiber Optic Transmitter</strong></td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td>Edge emitting diode 830 nm (red)</td>
</tr>
<tr>
<td>Power (into 62.5 μm cable)</td>
<td>High Power: -7.6 dBm (min.)</td>
</tr>
<tr>
<td></td>
<td>Low Power: 7 to 10 dB less</td>
</tr>
<tr>
<td>Connector</td>
<td>ST</td>
</tr>
<tr>
<td><strong>Fiber Optic Receiver</strong></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (62.5 μm cable)</td>
<td>-31.7 dBm (min.)</td>
</tr>
<tr>
<td>Allowed power</td>
<td>-15 dBm (max)</td>
</tr>
<tr>
<td>Connector</td>
<td>ST</td>
</tr>
<tr>
<td><strong>Optical Flux Budget</strong></td>
<td></td>
</tr>
<tr>
<td>For 62.5/125 μm cable</td>
<td>24.1 dBm (High power setting)</td>
</tr>
<tr>
<td></td>
<td>Approximately 14 dBm (low power setting)</td>
</tr>
<tr>
<td><strong>Loss in a Star</strong></td>
<td>9 dB</td>
</tr>
<tr>
<td></td>
<td>Each output line will be 9 dB less than the input line.</td>
</tr>
<tr>
<td><strong>Connector loss</strong></td>
<td>1.25 dB</td>
</tr>
<tr>
<td></td>
<td>ST style connector</td>
</tr>
<tr>
<td><strong>Cable loss</strong></td>
<td>4 dB/km</td>
</tr>
<tr>
<td></td>
<td>62.5/125 μm cable</td>
</tr>
<tr>
<td><strong>Aging allowance</strong></td>
<td>3 dB</td>
</tr>
<tr>
<td></td>
<td>This allows for degradation of components.</td>
</tr>
<tr>
<td><strong>Jitter</strong></td>
<td>6.25% (max)</td>
</tr>
<tr>
<td><strong>Current Draw</strong></td>
<td>95 mA @ 30 VDC (max)</td>
</tr>
<tr>
<td><strong>Internal Power Consumption</strong></td>
<td>8 Watts (max) with 2 drops active</td>
</tr>
</tbody>
</table>
Section 9:  
Field Communications

Field communication wiring is used to:

- Connect Multipoint I/O panels to a ControlFile
- Connect a card cage to a ControlFile when the distance between them exceeds 95 meters (311 feet)

This section covers:

- Connecting Multipoint I/O to a ControlFile
- Connecting a distant card cage to a ControlFile
- Communications cables
- Communications Connect Card V
- Remote Communications Terminal Panel II
- Fiber Optic I/O Converter

Maximum length is 1500 meters (≈5000 feet) using the standard shielded, twisted pair cable.

Shielded, twisted pair wires are normally used, but a fiber optic link is available for special applications. The fiber optic link can be used for:

- Long distances
- Electrical isolation between buildings
- Lightning protection

A fiber optic link requires the use of a Fiber Optic I/O Converter at both ends of the link.

**NOTE:** Use odd-numbered communications lines to connect devices. Reserve the even-numbered lines for redundancy. A redundant connection requires an odd-numbered line (n) for the primary and the next even-numbered line (n+1) for the secondary device.
Connecting Multipoint I/O to a ControlFile

Multipoint I/O can be connected to a ControlFile in two ways:

- Using a Remote Communications Termination Panel
- Using an Analog Card Cage and a Communications Connect Card

Figure 5.9.1 shows the Remote Communications Termination Panel II used to connect Multipoint I/O Termination Panels to a ControlFile.

Figure 5.9.2 shows the Communications Connect Card in an Analog Card Cage used to connect Multipoint I/O Termination Panels to a ControlFile.
Figure 5.9.1. Remote Communications Termination Panel II Used With Multipoint I/O
Figure 5.9.2. Communications Connect Card Used With Multipoint I/O
Connecting a Distant Card Cage to a ControlFile

The Controller to FlexTerm cable (10P5331xxxx), used to connect a card cage to a ControlFile, is supplied in lengths up to 15 meters (50 feet). Connecting equipment beyond that distance requires using communications lines and termination panels.

Figure 5.9.3 shows the use of the Remote Communications Termination Panel II to connect a remotely located card cage to a ControlFile. One communications line is required for each active slot in the remote Analog Card Cage.

Figure 5.9.3. Connecting a Distant Card Cage Using a Remote Communications Termination Panel II
Field Interface Module (FIM) Communication Cables (1984–4188–xxxx) come in even meter lengths from 1 to 6 meters (3 to 20 feet), 8 meters (26 feet), and 10 meters (32 feet). The cable is supplied with a connector on one end and bare wires on the other. Longer lengths can be specially ordered. The maximum length is 1500 meters (≈5000 feet).

A three-position connector (plug) (G53373–0103) is used.

The user typically provides the multi-pair cable used to connect a distant card cage to a ControlFile. Table 5.9.1 lists recommended cables for various applications. The cable you use must have the following characteristics:

- Individually shielded, twisted pairs with PVC insulation
- 2.5 – .34 mm² (14 – 22 AWG) conductor
- 1.5 – .25 mm² (16 – 24 AWG) drain wire for foil shield

The shields of individual twisted pair cable are landed at both ends on the terminals, which reference system ground. The overall shield that covers all shielded pairs must be grounded at the ControlFile end only.

Communication lines must be run in a conduit or tray. This conduit may be shared with other signal cables such as PeerWay, 4–20 mA lines, or other low voltage signal cables. The communication lines must not be within 30 cm (12 in.) of any AC or high voltage lines.

**NOTE:** The transient suppression networks are sufficient for cables within a building. For runs between buildings, provide lightning arrestors where the cable enters the building. Use of metal conduit or a copper ground wire is recommended. A fiber optic link can be used for runs between buildings or where lightning transients are a problem.
## Table 5.9.1. Recommended Communication Cables

<table>
<thead>
<tr>
<th>Use</th>
<th>Cable</th>
</tr>
</thead>
</table>
| Normal            | Belden type 8774  
                  | Alpha type 6014  
                  | American type A24509  
                  | These cables have nine polypropylene insulated pairs with individual foil shields and an overall PVC jacket. The ninth pair can be used as an overall drain wire connected to the “Overall Shield” terminal block at the ControlFile end of the cable only. The maximum length for these cables is 1500 meters (≈5000 feet). |
| CSA approval      | Belden type 9332  
                  | Alpha type 6059  
                  | American type A36609  
                  | The maximum length for these cables is 1006 meters (≈3300 feet). |
| Noisy environment | Alpha type 5620B2008  
                  | American type A29008  
                  | The maximum length for these cables is 1006 meters (≈3300 feet). |
Installing a Communications Connect Card V

The Communications Connect Card V (10P54560001) is marked “COMMUNICATIONS CONNECT V” on the printed wiring assembly (PWA). It is a standard part of the Analog Card Cage as shown in Figure 5.9.4. It provides a physical connection to the Controller Processor card and to the next Analog Card Cage (if more than one card cage is used). This cabling is connected and the card jumpers are set when the Analog Card Cage is installed.

The Communications Connect card also provides transient voltage protection for up to eight communications lines running from Field Interface Modules (FIMs) or Field Interface Cards (FICs) to the Controller Processor card. Each communications line has a transient suppression diode between the signal lines and communications ground. A transient suppression network ties communications ground to chassis ground.

Figure 5.9.5 shows the card. Up to eight shielded, twisted pair communication lines may be connected to TB-1 through TB-8. The communication line connectors (G53373-0103) are removable plugs identical to the connectors used in the Multipoint I/O termination panels. Connect the shield (or drain) to “S”, the black wire to “-”, and the red wire to “+”.

Table 5.9.2, Table 5.9.3, and Table 5.9.4 show the jumper settings.
Terminals for Communication Lines 1 – 8
(Each of these connections has +, -, shield)

Connector for Controller 1
Connector for Controller 2

HD1, HD2
Card Cage Address

HD4
Controller Processor
Redundancy

HD5
Card Cage Location

Figure 5.9.5. Communications Connect Card V

Table 5.9.2. Cage Address Jumper Positions

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Card Cage Address A</th>
<th>Card Cage Address B</th>
<th>Card Cage Address C</th>
<th>Card Cage Address D</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1</td>
<td>1-2 (ZERO)</td>
<td>2-3 (ONE)</td>
<td>1-2 (ZERO)</td>
<td>2-3 (ONE)</td>
</tr>
<tr>
<td>HD2</td>
<td>1-2 (ZERO)</td>
<td>1-2 (ZERO)</td>
<td>2-3 (ONE)</td>
<td>2-3 (ONE)</td>
</tr>
</tbody>
</table>

Table 5.9.3. Controller Redundancy Jumper Positions

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Controller Not Redundant</th>
<th>Controller Redundant</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD4 A</td>
<td>1-2 (NORMAL)</td>
<td>2-3 (REDUNDANT)</td>
</tr>
<tr>
<td>HD4 B</td>
<td>1-2 (NORMAL)</td>
<td>2-3 (REDUNDANT)</td>
</tr>
</tbody>
</table>

Table 5.9.4. Location Jumper Positions

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Card Cage in Control File Area</th>
<th>Card Cage in Remote Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD5</td>
<td>2-3 CONTROL FILE AREA</td>
<td>1-2 REMOTE I/O</td>
</tr>
</tbody>
</table>
Installing Remote Communications Termination Panel II

The Remote Communications Termination Panel II (1984–4205–000x) is marked “COMM TERM PNL II” on the PWA. It is mounted on a DIN rail and measures 77 x 200 mm (3 x 7.8 in.). It has plastic loops at each corner of the panel for attaching strain relief ties. It requires no connection to the power distribution system but does require a good connection to ground. Figure 5.9.6 shows a Remote Communications Termination Panel II.

Figure 5.9.6. Remote Communications Termination Panel II

The Remote Communications Termination Panel provides termination and transient suppression for up to eight communication lines between a Controller Processor and a Multipoint termination panel, an analog card cage, or a FlexTerm for long distance applications.

With Multipoint I/O, only one Remote Communications Termination Panel is required. The Multipoint I/O termination panel has adequate termination for the other end of the communication lines.
To connect a distant card cage, a Remote Communications Termination Panel must be installed at each end of the communication link. Mount the panel in the same cabinet or set of cabinets as the Control File or remote I/O to which it is attached.

Each panel has two connectors for a pair of redundant Controller Processors, or for daisy chain cabling to a local card cage or FlexTerm.

Communication line connectors (G53373–0103) are removable plugs identical to the connectors used in the Multipoint I/O termination panels. Connect the shield (drain) to “S,” the black wire to “-” and the red wire to “+”.

The panel features two transient suppression diodes for each communications line to protect the Controller Processor.

**NOTE:** The panel is shipped with a ground wire attached to TB9. It must be connected to chassis ground for proper operation of transient protection. The other terminal of TB9 can be used to ground the communications cable overall (external) shield. Ground the overall shield only at the Control File end of the run.

### CE Compliant Installation

Follow these steps to ensure CE compliance:

1. Use panels with minimum revision E/E or higher.
2. Use Control Cable 1984–2783–9045, which is approximately 1 meter (39 in.).
3. Fasten the panel ground wire to the nearest grounded rail. Use an M6 screw and cage nut.
4. Set jumper HD1 to “CONT FILE AREA.”
5. Use FIM Communication Cable (1984–4188–xxxx) or equivalent. Acceptable single twisted pair cables are Belden 9462 and Carol C0720. Acceptable cables with nine twisted pairs and an overall shield are Belden 8774, Alpha 6014, and American A24509.

**CAUTION**

The green chassis ground wire must be connected to a good ground to maintain system transient immunity.
Mounting

The Communications Terminal Panel II is mounted on a DIN rail (see Figure 5.9.7), two panels can be mounted on a 483 mm (19 in.) rail. The panel is approximately 77 x 200 mm (3 x 7.8 in.). There are plastic loops at each corner of the panel for attaching strain relief ties.

![Figure 5.9.7. Communications Terminal Panel II DIN Rail Mounting](image)

**NOTE:** The chassis ground wire (green) must be connected to a good ground (such as grounded cabinet rails) to maintain system transient immunity. Terminal TB9 may be used to ground a communication line overall cable shield (if any is present).
System Cabling

The Communications Termination Panel II has two connectors for control cables to a Control File or to a local card cage or FlexTerm. One control cable is always used; the second is normally used for installations with redundant Controller Processors.

Eight terminals (TB1–TB8) are provided to connect individually shielded twisted-pair communication lines. The communication line used establishes the slot address of the device connected to the line. The individual shields must be terminated at both ends of the cable. A mating connector (50P05890103 or G53373-0103) is used on the communication line. Connect the shield (or drain) of each twisted pair to “S”, the black wire to “−”, and the red wire to “+”.

**NOTE:** If the communication lines are gathered into a shielded cable, the overall cable shield must be grounded to terminal TB9 **only** at the Control File end of the cable run.

Use FIM Communication Cable (1984-4188-xxxx) or equivalent cable with specifications:

- Individually shielded 0.34 mm² (22 AWG) twisted pairs with PVC insulation
- 100 percent shield coverage
- Drain wire 0.34 mm² (22 AWG) with foil shield

The maximum length for the I/O cable from the Control File to the device is 1370 meters (≈ 4500 feet).
Single Panel Installation

A single panel (see Figure 5.9.8) is used when the remote device(s) accept a communications line. The panel supports eight communications lines. The maximum cable length from the ControlFile to the device is 1370 meters (≈ 4500 feet).

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ControlFile</td>
<td>4</td>
<td>Communication cables</td>
</tr>
<tr>
<td>2</td>
<td>Control cable</td>
<td>5</td>
<td>Remote devices attached to communications lines (maximum four per line)</td>
</tr>
<tr>
<td>3</td>
<td>Communications Termination Panel II (with HD1 set to &quot;CONT FILE&quot;)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.9.8. Single Communications Termination Panel II Installation
Dual Panel Installation

Two panels (see Figure 5.9.9) can be used to effectively increase the length of the control cable from the ControlFile to the device. The maximum cable length from the ControlFile to the device is 1370 meters (≈ 4500 feet). Eight communications lines are required between the panels.

**NOTE:** This configuration is not allowed for CE compliant installations.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ControlFile</td>
<td>5</td>
<td>Communications Termination Panel II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(with HD1 set to “REMOTE I/O”)</td>
</tr>
<tr>
<td>2</td>
<td>Control cable</td>
<td>6</td>
<td>Control cable</td>
</tr>
<tr>
<td>3</td>
<td>Communications Termination Panel II (with HD1 set to “CONT FILE”)</td>
<td>7</td>
<td>Remote device</td>
</tr>
<tr>
<td>4</td>
<td>Bundled communications cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 5.9.9. Dual Communications Termination Panel II Installation**
Jumpers on each panel specify the location of the panel and whether normal or redundant Controller Processor operation is being used (see Table 5.9.5).

Table 5.9.5. Communications Termination Panel II Jumpers

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Position</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1</td>
<td>REMOTE I/O (1-2)</td>
<td>Used when the panel is at the remote end of the communication line; at the card cage or FlexTerm.</td>
</tr>
<tr>
<td></td>
<td>CONT FILE (2-3)</td>
<td>Used when the panel is at the ControlFile (source) end of the communication line.</td>
</tr>
<tr>
<td>HD2A</td>
<td>NORMAL (1-2)</td>
<td>Normal operation. One cable is used from the ControlFile to the panel. The panel is connected to one Controller Processor.</td>
</tr>
<tr>
<td>HD2B</td>
<td>REDUNDANT (2-3)</td>
<td>Redundant operation. Two cables are used between the ControlFile and the panel. The panel is connected to two Controller Processors.</td>
</tr>
</tbody>
</table>
Fiber Optic I/O Converter

The Fiber Optic I/O Converter (1984–3278–000x) allows you to insert a fiber optic link in a twisted pair communications line between a controller and an I/O device. Two converters are required, one to convert from the RS-485 electrical format to fiber optic format and another to convert back to electrical signaling.

**NOTE:** Revision Level C/D and higher includes the ground wire and DIN clip.

The converter is mounted on a DIN rail and measures 77 x 200 mm (3 x 7.8 in.). Two converters can be mounted side-by-side on a single 483 mm (19 in.) piece of DIN rail. The converter requires DC power and a good connection to ground.

Figure 5.9.10 shows front and top views of the converter.
Figure 5.9.11 shows mounting on a DIN rail.

**NOTE:** Only one fiber optic link may be used in a communication line run.

The total length of the twisted pair communication line at either end of the fiber optic link cannot exceed 75 meters (246 feet). The length of the optical fiber run depends on losses in the cable, splices, and connectors.
Figure 5.9.12 shows a typical installation.

Figure 5.9.12. Fiber Optic Link in a Communications Line
Fiber Optic I/O Converter Power Wiring

The converter uses about 1.2 watts of DC power. It draws 48 mA at 24 VDC.

CAUTION

Connect the panel to a good earth ground. It is mounted to the DIN rail by nonconducting plastic feet. Use one of the ground terminals on the power strip.

The power plug (J980) is a four-position locking connector and is compatible with the 30V bus cable used in other parts of the system. It provides for 30V A and B connections allowing redundant power connections. Figure 5.9.13 shows this usage.

NOTE: Use either the power plug or the power strip. Do not use both.

Figure 5.9.13. Power and Ground Wiring: Using Power Plug
The power strip (TB3) is a screw-down terminal block. Two inputs for 30V A and B allow easy daisy chaining of power. Maximum current through these terminal blocks is 7 amps. Figure 5.9.14 shows this.

![Diagram of TB3 Power Strip]

**NOTE:** Maximum current (A + B) = 7 amps

Figure 5.9.14. Power and Ground Wiring: Using the Power Strip

**Fiber Optic I/O Converter Communication Wiring**

See “Communication Cables” (page 5-9-6) for information about the communication cables used. Connect the communications line to TB1. Use TB2 for daisy chaining of the communications line to other devices. The communication line at either end of the fiber optic link must not exceed 75 meters (246 feet) in length.

The communication line connectors (G53373-0103) are removable three-position plugs. Connect the shield (or drain) to “S”, the black wire to “-”, and the red wire to “+” as shown in Figure 5.9.15.

![Diagram of Communication Line Connector Wiring]

Figure 5.9.15. Communication Line Connector Wiring
Fiber Optic I/O Converter Optical Cables

The same fiber optic cable and connectors are used for fiber optic link or fiber optic PeerWay. Table 5.9.6 shows component specifications. See page SP:5-10-1 for details about installing and testing fiber optic cable.

Table 5.9.6. Fiber Optic I/O Converter Specifications

<table>
<thead>
<tr>
<th>Device</th>
<th>Output Power</th>
<th>Sensitivity</th>
<th>Attenuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber Optic I/O Converter</td>
<td>-16 dbm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmitter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber Optic I/O Converter</td>
<td>-24 dbm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST Connector</td>
<td>.8 db (Typical)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Splice</td>
<td>.6 db (Typical)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable (62.5/125 μm)</td>
<td>4 db/km (Typical)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following is an example, using 62.5/125 μm cable: The loss budget from the transmit module to the receive module is 8 dbm (the difference between transmitter power and receiver sensitivity). We lose 1.6 dbm for the two ST connectors required, which leaves 6.4 dbm. The cable loss is 4 db/km, so we have $6.4 \div 4 = 1.6$. This allows for a maximum cable run of 1.6 km ($\approx 1$ mile). Any splices or additional connectors required will reduce the maximum cable run.
Section 10: Fiber Optic Cable

Each fiber optic cable has two separate fibers. One fiber is used to transmit data and one fiber is used to receive data. Fiber optic PeerWay cables are used in pairs, called A and B. The A cable should be color coded green and the B cable should be color coded blue. The cable connectors can be marked with a felt-tip marker. Corresponding A and B tap boxes are marked with green and blue labels.

The fiber optic cable is terminated with ST connectors that have less than 0.7 dB loss per connector.

- PeerWay cables A and B should follow separate routes in separate conduits throughout the plant. This reduces the probability of both PeerWays being damaged from a single mishap or failure.

- Each fiber optic cable, which includes one transmit and one receive fiber, should have its own dedicated 19 mm (3/4 in.) minimum conduit. For protection of the fiber optic cable, conduit must be used over the entire length of the PeerWay. Consult with us for assistance on special applications that require the fiber to be buried.

- The conduit used can be a plastic inner liner that is pulled inside larger steel conduits or wiring trays along with electrical signal or voltage cable. The plastic inner liner provides segregation. The inner liner should be placed first and then the fiber cable should be installed.

- Do not pull fiber optic cable through conduit with connectors installed.

- The safe minimum bend radius of fiber optic cable is typically ten times the outer diameter. Running the fiber optic cable in 19 mm (3/4 in.) conduit, which has a standard minimum bend radius of 152 mm (6 in.), will meet the minimum requirements. When coiling the fiber optic cable, the minimum bend radius must be strictly adhered to. As a conservative guideline, a 76 mm (3 in.) minimum bend radius is acceptable. Fiber optic cables must never be sharply kinked.
If cable is to be pulled through more than four 90 degree bends, intermediate pull points are necessary.

Maximum pull strengths are specified for each type of fiber optic cable (for specifications, see manufacturer’s documentation). Strict adherence to these limits is mandatory. Fiber optic cable should be pulled using a smooth, steady motion. Never tug on a fiber optic cable.

Avoid using petroleum based lubricants on fiber optic cable. Use lubricants approved for use with Polyvinyl Chloride (PVC) building cables, such as neutral soft soap, talc powder, soapstone, or equivalents.

Wire mesh pulling grips of an appropriate size can be used. Consult the manufacturer’s specifications for appropriate sizes.

When securing cables, use flat lacing tape or cable ties. Do not tighten them so much that they impress the cable jacket.

Fiber optic cable should never be strung through ring supports or allowed to sag between horizontal supports.

To prevent entangling the fiber, do not include a pull line for future use.

Fiber optic cable must never be pulled around sharp corners. Sharp corners usually lead to violating the minimum bend radius and damaging the internal fibers.

When pulling fiber optic cable to the connection point, leave a minimum of 1.5 meters (5 feet) of extra cable to allow room for cable termination. During the cable termination process, the cable must have sufficient length to be brought to a comfortable working position in order to prepare and install the connectors.

Label each fiber optic cable as either PeerWay A or PeerWay B. Indicate the destination of each cable end.
Installing Fiber Optic Connectors

There are two common methods of terminating fiber optic cable:

- By connector
- By pigtail

A connector is installed directly on the end of the cable. There are many varieties available, but all require a fair amount of labor and skill to install.

A pigtail is a short length of cable with a factory-installed connector. The pigtail is spliced onto the end of the fiber optic cable. Making the splice is quick and fairly easy.

A connector requires more time and labor to install but gives a lower loss termination. A splice is quicker to make but involves both the loss due to the connector and the loss due to the splice.
Testing the Optical PeerWay

After the PeerWay components are installed, check and record the system performance for future reference.

It is important to realize that the optical transmitters have a rated output intensity and the receivers have a specified range of sensitivity. To ensure proper and efficient operation of the system, a loss budget must be met. The sum of all losses must be less than the sensitivity of the receiver.

A fiber optic power meter is required to test the optical PeerWay system. The power meter should meet the following specifications:

- Be capable of accepting ST style connector
- Calibration wavelength 850 nm (nanometer)
- Sensitivity range +3 to -60 dbm
- Accuracy ±5 % or better

The following meters meet these specifications:

- Photodyne 11XE or 18XT
- Fotec M202 or M212A.

Many other meters are available that meet the specifications. No optical power source is necessary for checkout other than the optical transmitter modules on the optical tap boxes.

The specifications are shown in Table 5.10.1.
### Table 5.10.1. Optical PeerWay Component Specifications

<table>
<thead>
<tr>
<th>Device</th>
<th>Output Power Level</th>
<th>Sensitivity</th>
<th>Attenuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Tap Box Transmitter</td>
<td>-7.6 dbm minimum</td>
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<tr>
<td>Optical Tap Box Receiver</td>
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<td>-3.7 dbm</td>
<td></td>
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<tr>
<td>Star Coupler</td>
<td></td>
<td></td>
<td>10.5 to 13 dbm</td>
</tr>
<tr>
<td>Repeater/Attenuator Transmitter</td>
<td>-7.6 dbm minimum</td>
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<tr>
<td>Repeater/Attenuator Receiver</td>
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<td>-3.7 dbm</td>
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<tr>
<td>Fixed Optical Attenuator</td>
<td></td>
<td>-0001 5 dbm</td>
<td>-0002 10 dbm</td>
</tr>
<tr>
<td>ST Connector</td>
<td></td>
<td>.8 dbm</td>
<td></td>
</tr>
<tr>
<td>Splice</td>
<td></td>
<td>.2 dbm</td>
<td></td>
</tr>
</tbody>
</table>

The loss budget from any transmit module to any receive module on the PeerWay must be no more than 24.1 dbm.
Loss Calculations

The following information can be used to determine the optical signal losses expected on the optical PeerWay.

- To calculate the loss in a line:
  1. Add 0.8 dbm for each connector pair in the loop.
  2. Add 0.2 dbm for each splice in the loop, both transmit and receive.
  3. Calculate the loss for the length of line in the loop (both transmit and receive) and add in the loss for the star coupler. Subtract this loss calculation from the transmitter power reading to get the power available at the receiver. This loss can be measured and verified for each optical loop.
  4. Add an additional 3 dbm overall loss when performing initial loss measurements and calculations to allow for degradation of the transmitter modules due to aging and the effects of environmental fluctuations on the fiber cables.
Establishing the Attenuation of a Test Cable

You must use a test cable when making measurements in the optical PeerWay to protect the fiber optic pigtails attached to the transmitter and receiver modules. If the test equipment is connected directly to the module pigtails, the potential of irreparable damage to the modules is very high. It is, however, necessary to connect the test meter directly to the pigtail in order to establish the known attenuation of the test cable. The test cable is a short length of fiber, 1.5 to 2.1 meters (5 to 7 feet) long, and is terminated on both ends.

To determine the loss of a test cable:

1. Remove the transmitter module pigtail from the bulkhead connector on any tap box or repeater. Being extremely careful to prevent stress on the pigtail fiber, connect the pigtail to the power meter. Place the transmitter in the test mode, and read the output of the transmitter. Record the value.

2. Reconnect the pigtail to the bulkhead connector and attach the test cable to the transmit connector.

3. Connect the other end of the test cable to the power meter and measure the output. Subtract the reading of step 1 from this reading. The result is the attenuation of the test cable.

4. Place the transmitter module back in the normal mode and connect any cables removed.
Optical Transmitter and Receiver Testing

This procedure is intended to test all optical transmitters and receivers connected directly to the star coupler. If any loops have optical repeaters, the loops on the tap box side of the repeater are tested independently from the loops on the star coupler side. Complete Table 5.10.2 and Table 5.10.3 in the test procedures when you install and check out the fiber optic PeerWay. The information can be helpful when you are troubleshooting problems later. It might also allow the detection of potential problems.

NOTE: When power measurements are referred to, they are given in absolute terms. For example, -35 dbm is less than -33 dbm. Conversely, -16 dbm is greater than -18 dbm.

- To test all optical transmitters and receivers connected directly to the star coupler:
  1. From any console, configure the Peerway Overview screen to include all nodes assigned on the PeerWay. The node numbers should be entered in tap box groupings as they are installed in the plant. This aids in future troubleshooting and problem isolation.
  2. Table 5.10.2 is a matrix that allows the power measurements to be recorded for all eight legs in a star coupler. Indicate in the table the destination location and the destination device type for all star legs.
  3. On the Peerway Overview screen enter a “Force Margin” field of 1000. This forces all communications to PeerWay B and allows complete testing of PeerWay A.
  4. Disconnect the receive cables at all the optical tap boxes and optical repeaters connected to the star coupler on PeerWay A. Cover the connector tips with the rubber boots provided with the connectors. During the remainder of the testing procedure, remove the rubber boot only when connecting the optical power meter. Always replace the boot as soon as the optical power meter is disconnected. This prevents damage to the connector and keeps the tip free from contaminants.
5. Remove the four captive screws that secure the first PeerWay A optical tap box and gently tilt the box forward to gain access to the internal jumpers. Move HD-2 to the TEST position. For a repeater, place the appropriate jumper in the TEST position. HD-1 is for the #1 side and HD-2 is for the #2 side. This cycles the optical transmitter on for 6 seconds and off for 6 seconds.

6. Disconnect the transmit cable from the optical tap box used in step 5. Connect the power meter to the transmit connector by using a short test cable with a known attenuation (see the “Establishing the Known Attenuation of a Test Cable” heading in this section). Measure the output of the transmitter and subtract the loss on the test cable. Remember, the transmitter only stays on for 6 seconds at a time. The reading should be between -3 and -7.6 dbm. If it is not, replace the optical tap box and retest. Record the net power reading on Table 5.10.2. Reconnect the transmit cable to the tap box.

7. Remove the rubber boot from the receive cable and connect the power meter. The reading must be between -18 and -31.7 dbm. If it is not, see the “Troubleshooting” heading in this section. Enter the power reading in Table 5.10.2. Remove the power meter and replace the rubber boot.

8. Repeat step 7 on the remaining optical tap boxes and repeaters. Record the value from each node in Table 5.10.2.

9. Move the jumpers placed in the test position in step 5 back to the Normal position.

10. Repeat steps 4 through 9 for all remaining optical tap boxes and repeaters on PeerWay A. When you are done, Table 5.10.2 should show the effective received power reading of each receive line from each transmitter on PeerWay A.

11. Reconnect all the receive cables removed in step 4.

12. Set the “Force Margin” field on the Peerway Overview screen to NONE.

13. When the Peerway Overview screen settles, and shows no errors and a margin of about 500, enter a “Force Margin” field value of 0. This forces all PeerWay communications onto PeerWay A, allowing PeerWay B to be tested.

14. Repeat steps 4 through 12 on PeerWay B.
Repeater Testing

You test repeaters by measuring the power at the receiving ends of the optical tap box and the repeater with the transmitters in the test mode. It is important to know that the receiving end at the repeater is actually coming from the transmitter in the optical tap box.

- **To test a repeater:**

  1. On the Peerway Overview screen enter a “Force Margin” field of 1000. This forces all communications to PeerWay B and allows complete testing of PeerWay A. Disconnect the receive cables at the optical tap box connected to the repeater being tested on PeerWay A. Cover the connector tips with the rubber boots provided with the connectors. During the remainder of the testing procedure, remove the rubber boot only when connecting the optical power meter. Always replace the boot as soon as the optical power meter is disconnected. This prevents damage to the connector and keeps the tip free from contaminants.

  2. At the PeerWay A repeater, disconnect the transmit and receive cables coming from the star coupler. Place protective rubber boots over the ends of the connectors. This isolates the repeater side of the PeerWay.

  3. Remove the receive cable coming from the PeerWay A optical tap box from its connector inside the repeater. Place a protective rubber foot over the end of the connector.

  4. Connect the power meter to the connector that the cable was removed from in step 3 by using a short test cable with a known attenuation (see the “Establishing the Known Attenuation of a Test Cable” heading of this section).

  5. Place the repeater in the TEST mode by moving the appropriate jumper to the TEST position. HD-1 is for the #1 side and HD-2 is for the #2 side. This cycles the transmitter module on for 6 seconds and off for 6 seconds.
6. Measure the output of the transmitter and subtract the loss of the test cable. Remember, the transmitter only stays on for 6 seconds at a time. The reading should be between -3 dbm and -7.6 dbm. If it is not, replace the repeater and retest. Record the net power reading in Table 5.10.3.

7. Disconnect the power meter and reconnect the cable that was removed in step 3.

8. At the PeerWay A optical tap box, remove the receive cable and connect it to the power meter.

9. Measure the signal coming from the repeater. It should be between -18 dbm and -31.7 dbm. If the measurement is more than -18 dbm, the signal is too strong and an attenuator must be installed in line with the receive cable. If the signal is less than -31.7 dbm and the measurement in step 6 was good, there is too much loss in the cable (for more information, see the “Troubleshooting” heading of this section). Record the measurement in Table 5.10.3.

10. Disconnect the power meter and reconnect the cable to the optical tap box.

11. Place the repeater in the normal mode by placing the jumper that was moved in step 5 in the Normal position.

12. Remove the four captive screws securing the PeerWay A optical tap box and gently tilt the box forward to gain access to the internal jumpers. Move HD-2 to TEST position.

13. Remove the transmit cable from the optical tap box and place a protective rubber boot over the tip of the connector.

14. Connect the power meter to the transmit connector on the optical tap box using a short test cable with a known attenuation.

15. Measure the output of the transmitter and subtract the loss of the test cable. Remember, the transmitter only stays on for 6 seconds at a time. The reading should be between -3 dbm and -7.6 dbm. If it is not, replace the optical tap box and retest. Record the net power reading in Table 5.10.3.

16. Disconnect the power meter and reconnect the transmit cable to the optical tap box.

17. At the PeerWay A repeater, remove the transmit cable coming from the optical tap box.
18. Measure the signal coming from the optical tap box. It should be between -18 dbm and -31.7 dbm. If the measurement is more than -18 dbm the signal is too strong and an attenuator must be installed in the line with the receive cable. If the signal is less than -31.7 dbm and the measurement in step 15 was good, there is too much loss in the cable, the connectors, or the splices. For more information, see the “Troubleshooting” heading in this section. Record the measurement in Table 5.10.3.

19. Disconnect the power meter and reconnect the transmit cable to the repeater.

20. Reconnect the transmit and receiver cables removed in step 2.

21. Check the Peerway Overview screen and ensure that the PeerWay is running with no errors and has a margin of about 500. Enter a “Force Margin” field value of 0.

22. Repeat steps 2 through 21 on the PeerWay B repeater.
Optical PeerWay troubleshooting is more a technique than a process. The basic goal of the PeerWay cable is to carry photo energy from the transmitting point to the receiving point with enough energy left over for the receiver. Every element introduced into the optical path, such as splices, connectors, attenuators, star couplers, and the length of the fibers, reduces the amount of photo energy left for the receiver. The general process is to start from the transmitter and ensure that the output is within acceptable limits (between $-18$ and $-31.7$ dbm). From the transmitter, work toward the receiver, taking measurements at each point along the way. If at any point a reading is not within the acceptable limits, take steps to remove the source of the problem. Possible causes include:

- Improperly installed or dirty terminations
- Bends less than the minimum radius
- Cable lengths that exceed specifications
- A faulty star coupler, tap box, or repeater

As long as there is at least $-31.7$ dbm left at the receiver, the system should work. If it does not, the problem could be the receiver itself.
### Table 5.10.2. Optical PeerWay Power Measurements

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Table 5.10.3. Optical PeerWay Repeater Power Measurements

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# Chapter 6: Analog Card Cages

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</tr>
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</table>
SP: vi
Section 1:
Analog Card Cage

The Analog Card Cage (1984-2526-0002) mounts in a standard system cabinet, where it requires 178 mm (7 in.) of vertical space. It is also known as the Analog FlexTerm. Figure 6.1.1 shows the unit.

![Diagram of Analog Card Cage](image)

**Figure 6.1.1. Analog Card Cage (Front)**

The Analog Card Cage can hold up to eight Field Interface Cards (FIC). The card cage has no field wire termination capability. Field wiring is landed on a marshaling panel and then connected to the card cage via cable.

The Communications Connect Card provides eight twisted pair communications lines for connection of Multipoint I/O termination panels or a remote Analog Card Cage.

Space at the right of the Analog Card Cage provides a vertical wiring channel with anchors for attaching plastic wraps. Cabling can also be routed from side panels.
Connecting to the ControlFile: Direct Connect

The Analog Card Cage can be connected directly to a ControlFile with **shielded** control communications cable 10P5590xxxx. The **shielded** control cable can be up to 60 meters (≈200 feet) long for EMC-compliant (CE) installations. The Control Cable is landed on one connector of the Communications Connect Card as shown in Figure 6.1.2. Terminate the cable shield pigtail at the ControlFile chassis screw (just above the connector).

The Analog Card Cage can be connected directly to a ControlFile with control cable (1984–2783–xxxx), which can be up to 61 meters (200 feet) long for non-EMC installations.

The second connector allows daisy chaining of up to four Analog Card Cages. Use the appropriate (CE or non-CE) control communications cable option to connect additional card cages. For EMC-compliant (CE) daisy chain installations, use shielded control communications cable 10P5590xxxx or 1984–2783–9015 or −9045.

When redundant Controller Processors are used, two Control Cables are required to connect the primary and secondary Controller Processors to the two connectors of the Communications Connect Card.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cable Shield Pigtail (with 10P5590xxxx)</td>
<td>5</td>
<td>Communication Connect Card V</td>
</tr>
<tr>
<td>2</td>
<td>ControlFile</td>
<td>6</td>
<td>Daisy chain: Control Communications Cable</td>
</tr>
<tr>
<td>3</td>
<td>Control Communications Shielded Cable 10P5590xxxx (60 meters (=200 feet) maximum)</td>
<td>7</td>
<td>Analog Card Cages</td>
</tr>
<tr>
<td>4</td>
<td>Control Communications Standard Cable 1984–2783 xxxx (61 meters maximum for non-EMC)</td>
<td>8</td>
<td>Dashed line is second cable for optional redundant controller</td>
</tr>
</tbody>
</table>

**Figure 6.1.2. Directly Connecting an Analog Card Cage to a ControlFile**
Connecting to the ControlFile: Via Comm Term Panel II

The Analog Card Cage can be connected to the ControlFile with a Communications Termination Panel II and individual twisted pair communications lines as shown in Figure 6.1.3.

The ControlFile can be connected to a Communications Termination Panel II with shielded control communications cable 10P5590xxxx, which can be up to 60 meters (≈200 feet) long. Terminate the cable shield pigtail at the ControlFile chassis screw (just above the connector) for EMC-compliant (CE) installations.

The ControlFile can be connected to a Communications Termination Panel II with control cable (1984-2783-xxxx). The control cable can be up to 61 meters (200 feet) long for standard installations. **EMC-compliant installations restrict this cable length to 1 meter (1984-2783-9045).**

With this method, individually shielded twisted-pair wires are run from each Communication Termination Panel II slot to the pluggable terminal blocks on the edge of the Communication Connect Card V. Use eight Communication Cables: 1984-4188-xxxx or a customer-supplied equivalent. Maximum length is 1372 meters (≈4500 feet).

Use the appropriate (CE or non-CE) control communications cable option to daisy chain up to four Analog Card Cages. For EMC-compliant (CE) daisy chain installations, use shielded control communications cable 10P5590xxxx or 1984-2783-9015 or -9045. To daisy chain over longer distances, connect additional shielded twisted-pair wires (cable 1984-4188-xxxx) to the pluggable terminal blocks on the Communications Connect Card.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cable Shield Pigtail (with 10P5590xxxx)</td>
<td>4</td>
<td>Communication Terminal Panel II</td>
</tr>
<tr>
<td>2</td>
<td>Control Communications <strong>Shielded</strong> Cable 10P5590xxxx (60 meters maximum)</td>
<td>5</td>
<td>Eight Communication Cables 1984–4188–xxxx (or equivalent)</td>
</tr>
<tr>
<td>3</td>
<td>Control Communications Standard Cable, 1984–2783 xxxx (1984–2783–9045 for EMC)</td>
<td>6</td>
<td>Communications Connect Card</td>
</tr>
</tbody>
</table>

*Figure 6.1.3. Connecting an Analog Card Cage to a ControlFile with Comm Term Panel II*
Connecting to DC Power

Use either of the two power connectors to connect DC power. Use cable: DC Bus to System Device (A/B bus) (1984-0158-20xx). Refer to Figure 6.1.4.

Figure 6.1.4. Connecting an Analog Card Cage to DC Power

EMC systems require the DC cable supplying system power to the analog card cage to have a ferrite cable clamp (Figure 6.1.5) attached within 100 mm of the connector.

Figure 6.1.5. Ferrite Cable Clamp
Connecting to the Analog Marshaling Panel

The Analog Card Cage is cabled to an Analog Marshaling Panel as shown in Figure 6.1.6. Field wiring to the marshaling panel is discussed in detail latter in this section.

Standard (non-CE) Installation

Use an Analog Marshaling Panel (1984-2512-000x), an Analog Marshaling Panel II (1984-2415-0001), or a European Marshaling Panel (10P54590001) or (10P54620001).

Use an analog card cage to marshaling panel cable (1984-0498-xxxx), which can be up to 60 meters (≈200 feet) long.

CE Installation

Use Analog Marshaling Panel II (1984-2415-0001) or a European Marshaling Panel (10P54590001) or (10P54620001).

Use the analog card cage to marshaling panel shielded cable (10P55520xxx), which can be up to 60 meters (≈200 feet) long.
Connecting to Multipoint I/O

The Communications Connect Card provides eight communications lines that can be used to connect Multipoint I/O termination panels or a remotely located Analog Card Cage.

Figure 6.1.7 shows an Analog Card Cage wired to a ControlFile Controller Processor and connected to an Analog Marshaling Panel. The cage is also daisy chained to another Analog Card Cage, which is then connected to a Multipoint I/O termination panel via the Communications Connect Card and a communications line.

Figure 6.1.7. Typical Analog Card Cage Wiring
A label on the front of the Analog Cage records the hardware address. Figure 6.1.8 shows the Analog Card Cage label. Write the hardware address in the blanks provided. The address includes the Control File Node (numeric), the Controller slot (A–H), and the FlexTerm or Card Cage (A–D). Use the box beside each point number to record a tag or label. Locations for Output Bypass or Transfer cards and the Comm Connect are shown on the label.

![Analog Card Cage Address Label Image]

**Figure 6.1.8. Analog Card Cage Address Label**
Checklist for EMC-Compliant Installation

Follow these rules to ensure EMC compliance:

1. Connect the card cage to the ControlFile with one of the following:
   a. Shielded control cable 10P5590xxxx, maximum length: 60 meters ($\approx$ 200 feet)
   b. Eight shielded communication lines (1984--4188--xxxx), maximum length 1372 meters ($\approx$ 4500 feet), to Communications Termination Panel II 1984--4205--0001, and then to the ControlFile with Control cable 1984--2783--9045 or the shielded control cable 10P5590xxxx, maximum length: 60 meters ($\approx$ 200 feet)

Connect the card cage to another card cage with one of the following:
   c. Shielded control cable 10P5590xxxx, maximum length: 60 meters ($\approx$ 200 feet)
   d. Control cable 1984--2783--9045 or 1984--2783--9015.

2. Connect the card cage to field devices following these rules:
   a. Cabling from the termination panel to the analog card cage must be shielded, with the shield terminated through the drain wire to an analog card cage mounting screw.
   b. Field wiring: Use individually shielded twisted pairs having 100% shield coverage and a drain wire. Typical examples:
      - Single twisted pair – Belden 9462, Carol C0720
      - Nine twisted pairs – Belden 8774, Alpha 6014, American A24509
   c. Maintain a continuity of shields between the wiring from the field device and the wiring to the analog card cage. Do not break the shield continuity through a termination panel.
   d. The maximum length of cable in which the shield does not encase the twisted pair is 0.5 m. Wire gauge is not restricted, and can be suited to the application.
Use these cards in the card cage:

   e. Analog FIC (4–20 mA) (10P54440002)
   f. Smart Transmitter Daughterboard (also called the HART Option Board) (10P54500005) installed on Analog FIC (4–20 mA)
   g. Communications Connect Card V (10P54560001)
   i. Pulse I/O FIC (10P54470002)

3. Use these components:

   a. Serial I/O Analog Marshaling Panel II (1984–2415–0001) or European Marshaling Panel (10P54590001) or (10P54620001)
   b. Shielded cable (10P55520xxx) between the card cage and the marshaling panel
   c. Ferrite cable clamp (55P0426X002) installed on the DC cable supplying system power to the Serial I/O card cage

4. DO NOT USE:

   a. Pulse I/O FIC (1984–2546–000x)
   e. Smart Transmitter Daughterboard (1984–2483–xxxx)
Fuses

Table 6.1.1 lists Analog FIC fuse data.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Littelfuse Part No.</th>
<th>Schurter Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>G50382-0021</td>
<td>273002</td>
<td>MSF 034.4224</td>
<td>2 A 125 V Plug-In</td>
</tr>
<tr>
<td>F11</td>
<td>G50382-0011</td>
<td>273.250</td>
<td>MSF 034.4213</td>
<td>1/4 A 125 V Plug-In</td>
</tr>
</tbody>
</table>

Table 6.1.2 lists Analog Transfer Card fuse data.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Littelfuse Part No.</th>
<th>Schurter Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>G50382-0014</td>
<td>273.500</td>
<td>MSF 034.4216</td>
<td>1/2 A 125 V Plug-In</td>
</tr>
</tbody>
</table>

Table 6.1.3 lists Output Bypass Card fuse data.

<table>
<thead>
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<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Bussman Part No.</th>
<th>Littelfuse Part No.</th>
<th>Schurter Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>G09140-0030</td>
<td>AGC 2</td>
<td>312002</td>
<td>- -</td>
<td>2 A 250 V Quick Acting</td>
</tr>
<tr>
<td>F2</td>
<td>G50382-0009</td>
<td>- -</td>
<td>273.125</td>
<td>MSF 034.4210</td>
<td>1/8 A 125 V Plug-In</td>
</tr>
</tbody>
</table>

Table 6.1.4 lists Pulse I/O Field Interface Card fuse data.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Littelfuse Part No.</th>
<th>Schurter Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>G50382-0021</td>
<td>273002</td>
<td>MSF 034.4224</td>
<td>2.0 A 125 V Plug-In</td>
</tr>
<tr>
<td>F11</td>
<td>G50382-0011</td>
<td>273.250</td>
<td>MSF 034.4213</td>
<td>1/4 A 125 V Plug-In</td>
</tr>
</tbody>
</table>
This section describes installation and field wiring to the:

- Standard Analog Marshaling Panel: 1984-2415-0001
- European Analog Marshaling Panel: 10P54590001 (no fuses) and 10P54620001 (with fuses)
- Cold Junction Compensator (1984-2616-0001)
- Marshaling Panel Auxiliary Terminal Block (1984-1543-000x)

Figure 6.1.9 shows Analog Marshaling Panel 1984-2415-0001.
Figure 6.1.10 shows European Analog Marshaling Panel 10P54620001 (with fuses). Table 6.1.5 shows fuse data for European Analog Marshaling Panel 10P54620001.

![European Analog Marshaling Panel 10P54620001](image)

Table 6.1.5. European Analog Marshaling Panel 10P54620001 Fuses

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 to F24</td>
<td>G53394-0250-0005</td>
<td>0.25 A 125 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 127-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fast Acting 5 x 20 mm</td>
</tr>
</tbody>
</table>
Mounting Analog Marshaling Panel

The standard Analog Marshaling Panel (1984–2415–0001) mounts in a standard system cabinet where it takes 179 mm (7 in.) of rail space. It requires no DC system power. Figure 6.1.11 shows the mounting dimensions.

European Analog Marshaling Panels (10P54590001 and 10P54620001) include universal DIN rail snap-in fittings.

Figure 6.1.12 shows the mounting dimensions.
The panel is cabled to the Analog Card Cage as shown in Figure 6.1.13. All eight Field Interface Cards (FIC) are connected to the panel.

The Field Interface cards (FIC) that can be used are:
- Analog FIC (4–20 mA)
- Analog FIC with Smart Transmitter Daughterboard
- Pulse I/O FIC
- RTD/TC TEMP FIC

Each FIC can control three points on the panel (except the RTD/TC TEMP FIC, which has two inputs). See the Service Manual (SV: 5–1) or the Service Quick Reference Guide for more information on these cards.


Use an analog card cage to marshaling panel cable (1984–0498–xxxx), which can be up to 60 meters (≈200 feet) long, or use shielded cable (10P55520xxx), which can be up to 60 meters (≈200 feet) long. If shielded cable is used, terminate the shield as with CE installation.

For a CE compliant installation, use Analog Marshaling Panel II (1984–2415–0001) or a European Marshaling Panel (10P54590001 or 10P54620001). Use the analog card cage to marshaling panel shielded cable (10P55520xxx), which can be up to 60 meters (≈200 feet).

Cabling from the termination panel to the analog card cage must be shielded, with the shield terminated through the drain wire to an analog card cage back panel mounting screw.
Cold Junction Compensator

Use a Cold Junction Compensator (1984-2616-000x) with thermocouples. Its label shows the connections to use for various applications. It mounts firmly against the metal in the center of the marshaling panel to sense the ambient temperature at the marshaling panel.

Marshaling Panel Auxiliary Terminal Block

The Marshaling Panel Auxiliary Terminal Block (1984-1543-000x) provides a method to connect external components into the control loop. Figure 6.1.14 shows the Marshaling Panel Auxiliary Terminal Block. Figure 6.1.15 shows the block wiring diagram.

The terminal block can be mounted to either the upper or lower row of terminals on the marshaling panel. The block is marked with normal and inverted letters; use the set that is right side up for your connections.

If a Cold Junction Compensator is in place, remove the screw at the bottom of the block to make clearance for the cold junction compensator plate.

The Auxiliary Terminal Block has six field device or component termination points and an A and B connection point for the marshaling panel. The termination points are connected in pairs. The Auxiliary Terminal block is CSA approved for 300V and accepts 2.5 mm² (14 AWG) wire.

See the Service Manual (SV: 5-1) for field wiring examples using the terminal block.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clamp Screws (6 total)</td>
<td>3</td>
<td>Analog Marshaling Panel Terminal</td>
</tr>
<tr>
<td>2</td>
<td>Field device or component termination panel (6 total)</td>
<td>4</td>
<td>Support Standoff</td>
</tr>
</tbody>
</table>

**Figure 6.1.14. Marshaling Panel Auxiliary Terminal Block**

**Figure 6.1.15. Auxiliary Terminal Block Wiring Diagram**

**NOTE:** Observe the “A” and “B” terminal labels when connecting components.
Field Wiring to an Analog Marshaling Panel

Field wiring can be brought to an Analog Marshaling Panel as shown in Figure 6.1.16. Devices that can be served include:

- 4-20 mA Input and Output
- Temperature Input
- Pulse Input and Output

**CAUTION**

Always check field wiring for fault conditions or inappropriate signals that could damage field interface cards (FICs) or system wiring before making final connections.

**NOTE:** A field device used with an isolated FIC can be grounded and have a maximum of 150 volts DC common mode between either field terminal and the system ground (chassis).

CE compliant field wiring uses individually shielded twisted pairs having 100% shield coverage and a drain wire. Typical examples are:

- Single twisted pair – Belden 9462, Carol C0720
- Nine twisted pairs – Belden 8774, Alpha 6014, American A24509

Maintain continuity of shields between the wiring from the field device and the wiring to the analog card cage. Do not break the shield continuity through a termination panel.

The maximum length of cable in which the shield does not encase the twisted pair is 0.5 meter. Wire gauge is not restricted, and can be suited to the application.
Figure 6.1.17 shows CE field wiring to a standard (1984-2415-0001) Marshaling Panel.

Figure 6.1.17. CE Field Wiring Standard Marshaling Panel (1984-2415-0001)
Figure 6.1.18 shows CE field wiring to a European (10P54590001 or 10P54620001) Marshaling Panel. The European Marshaling Panel is DIN mounted with one row of pluggable screw terminals.

Jumper the headers to “External Power.” Do not use the terminals to bring loop power onto the board.

A screw terminal detail is shown below. Terminals labeled “11A” “11B” and “SHD” correspond to Analog Card Cage addresses 101A and 101B, and to the field wiring shield, respectively.

![Diagram of CE field wiring](image)

**Figure 6.1.18. CE Field Wiring European Marshaling Panel (10P54590001 / 10P54620001)**
Table 6.1.6 shows the devices that can be connected to an Analog Marshaling Panel. The letters refer to diagrams in Figure 6.1.19 to Figure 6.1.23. Device types include:

<table>
<thead>
<tr>
<th>Letter in Figure</th>
<th>Input or Output</th>
<th>2-wire or 4-wire Transmitter</th>
<th>With or w/o Positive Barriers</th>
<th>With or w/o Other Instruments</th>
<th>Power Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>system</td>
</tr>
<tr>
<td>B</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>separate</td>
</tr>
<tr>
<td>C</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>system</td>
</tr>
<tr>
<td>D</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>separate</td>
</tr>
<tr>
<td>E</td>
<td>input</td>
<td>2-wire</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>separate</td>
</tr>
<tr>
<td>F</td>
<td>input</td>
<td>2-wire</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>separate</td>
</tr>
<tr>
<td>G</td>
<td>input</td>
<td>2-wire</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>system</td>
</tr>
<tr>
<td>H</td>
<td>input</td>
<td>2-wire</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>system</td>
</tr>
<tr>
<td>I</td>
<td>input</td>
<td>4-wire</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>self</td>
</tr>
<tr>
<td>J</td>
<td>input</td>
<td>4-wire</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>self</td>
</tr>
<tr>
<td>K</td>
<td>output</td>
<td>------</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>system</td>
</tr>
<tr>
<td>L</td>
<td>output</td>
<td>------</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>system</td>
</tr>
<tr>
<td>M</td>
<td>output</td>
<td>------</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>system</td>
</tr>
<tr>
<td>N</td>
<td>output</td>
<td>------</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>system</td>
</tr>
<tr>
<td>O</td>
<td>output</td>
<td>------</td>
<td>with barriers</td>
<td>with other inst.</td>
<td>system</td>
</tr>
<tr>
<td>P</td>
<td>output</td>
<td>------</td>
<td>with barriers</td>
<td>with other inst.</td>
<td>system</td>
</tr>
</tbody>
</table>
Figure 6.1.19. 4-20 mA Inputs Without Barriers

- input
- 2-wire
- w/o barriers
- w/o other instruments
- system powered

This line may be grounded

- input
- 2-wire
- w/o barriers
- w/o other instruments
- separate power supply

This line may be grounded
Figure 6.1.20. 4-20 mA Inputs With Barriers

**FIC loop power jumper in “SELF” position**
- input
- 2-wire
- with barriers
- w/o other instruments
- separate power supply

**CAUTION:** This connection may not provide enough loop voltage. Take special care in selecting components.
Figure 6.1.21. 4-20 mA 4-Wire Inputs
Figure 6.1.22. 4–20 mA Outputs

- output
- with barriers
- w/o other instruments
- system-powered
This line may be grounded

Figure 6.1.23. 4-20 mA Outputs
Temperature Input Devices

Temperature input devices can be terminated at analog marshaling panels as shown in Figure 6.1.24 and Figure 6.1.25.

Figure 6.1.24. RTD Device Termination
Figure 6.1.25. Thermocouple, Cold Junction Compensator, Millivolt Input, and Resistance Input Terminations
Pulse I/O Devices

Termination of pulse I/O devices is shown in Figure 6.1.26.

Figure 6.1.26. Pulse I/O Terminations
I/O Electronics Redundancy

Figure 6.1.27 shows one-to-one redundancy for the electronics serving a single I/O point. The single transmitter is served by two FICs, a primary in an odd-numbered and a backup in the next higher-numbered slot. External wiring is required only for one-to-one redundancy, and must be accompanied by appropriate FIC jumper placement and RIOB configuration.

(One-to-three and one-to-seven redundancy uses Analog Transfer cards instead of external wiring.)

![Diagram of 1/1 Redundancy Termination]

Figure 6.1.27. 1/1 Redundancy Termination
Figure 6.1.28 shows field wire routing to marshaling panels inside standard system cabinets. This is a composite drawing and is not intended to show the actual configuration of a cabinet.

Route field wires through tiewraps and tiedowns.

Route cables from marshaling panels to FlexTerms down left side of cabinet using tiewraps and tiedowns.

Route all wiring through bottom of cabinet.

Route field wires down right side of cabinet using tiedowns and tiewraps.

Figure 6.1.28. Field Wire Routing To Marshaling Panels (Bottom Entry Shown)
Section 2:
MUX Hardware

This section describes field wiring to the Multiplexer FlexTerm and Multiplexer Marshaling Panel:

- Multiplexer (MUX) FlexTerm (1984-0620-000x)
- 4-20 mA (Current) MUX Marshaling Panel (1984-2458-000x)
- Voltage MUX Marshaling Panel (1984-2457-000x)
- Resistance Temperature Detector (RTD) MUX Marshaling Panel (1984-2456-000x)

The MUX FlexTerm shown in Figure 6.2.1 mounts in a system cabinet and requires standard system DC power. It takes 312 mm (12.25 in.) of rail space. It contains a DC power supply, a communication card, and Front End Modules (FEMs).

![Figure 6.2.1. Multiplexer (MUX) FlexTerm](image-url)
Up to five FEMs can be installed for a total of 100 input points. Signals from the FEMs are fed to the Communication card, which takes 7 seconds to scan all 100 points. The individual readings are sent to a Controller Processor in the ControlFile through an isolated RS-422 communications cable (Cable: ControlFile to MUX FlexTerm) (1984–2629–xxxx) as shown in Figure 6.2.2. The cable is available in lengths up to 15 meters (50 feet).

You may connect marshaling panels to the Multiplexer FlexTerm to facilitate field terminations.

The type of FEM installed controls the type of field input that can be used. The Multiplexer FlexTerm can support these FEMs:

- Thermocouple and Millivolt input
- Current input (4 – 20 mA)
- RTD input
- Universal input
An MPC II or MPC5 Controller Processor can control two MUX FlexTerms by use of the “Y” cable “MUX Cable Assembly, 200 Points” (1984–3062–00xx). Points in the first MUX FlexTerm have addresses 001 to 100. Those in the second MUX FlexTerm have addresses 101 to 200. Plug P106 defines the first FlexTerm, plug P107 is used on the second.

The MPC II must be loaded with the MPC2+ image and have the MPC II Image functionality jumpers set to MUX+. The MPC5 must be loaded with the MPC5 image jumpers set to MUX5. In both cases, this allows the use of up to 200 points. Figure 6.2.3 shows this configuration.

![Diagram of Two MUX FlexTerms Connected to a Controller Card](image)

**Figure 6.2.3. Two MUX FlexTerms Connected to a Controller Card**
To install a FEM in the MUX FlexTerm:

**CAUTION**

TURN OFF MUX power when FEMs are removed or inserted. The securing bar must be firmly in place to ensure that all FEM contacts are engaged.

- Install the securing bar with a washer under the head of the screw to the FlexTerm and a washer between the securing bar and the FEM as shown in Figure 6.2.4.

![Figure 6.2.4. Securing a FEM in the MUX](image)
Field Wiring to a Multiplexer FlexTerm

Field wiring can be brought into Front End Modules (FEMs) in a Multiplexer (MUX) FlexTerm (1984-0620-000x). Figure 6.2.5 shows wire routing in a Multiplexer FlexTerm. The cover must be installed on the Front End Module for proper operation. FEM terminals accept .128 to 2.5 mm² (26 to 14 AWG) solid or stranded wire.

Figure 6.2.5. Wire Routing in a Multiplexer FlexTerm
The following FEMs can be used in the Multiplexer FlexTerm:

- 1984-0607-0001 Solid state, low voltage, thermocouple
- 1984-0607-0002 Solid state, Cenelec approved
- 1984-0607-0003 Solid state, RTD
- 1984-0607-0004 Reed, 4-20 mA
- 1984-0607-0005 RTD, low voltage, Cenelec approved
- 1984-0607-0007 Reed, high/low voltage, thermocouple
- 1984-0607-0009 Reed, RTD

**CAUTION**

When connecting wires to the FEM, shut off power at the FlexTerm and pull the affected FEM free of the card connector. Then wire to the FEM.

Figure 6.2.6 shows the terminal labeling for RTD-type FEMs: 1984-0607-0003, -0005, and -0009.

Figure 6.2.6. Labeling for RTD-type FEMs (1984-0607-0003, -0005, -0009)
Figure 6.2.7 shows the terminal labeling for non-RTD type FEMs: 1984-0607-0001, -0002, -0004, and -0007.

Figure 6.2.7. Labeling for Non-RTD type FEMs (1984-0607-0001, -0002, -0004, -0007)
MUX Marshaling Panels

There are three MUX Marshaling Panels available to connect field wiring to the MUX FlexTerm:

- Voltage MUX Marshaling Panel (1984–2457–000x)
- Current MUX Marshaling Panel (1984–2458–000x)
- RTD MUX Marshaling Panel (1984–2456–000x)

Voltage MUX Marshaling Panel

The Voltage MUX Marshaling Panel (1984–2457–000x) mounts in a system cabinet where it takes 179 mm (7 in.) of panel space. It requires no system DC power. It is marked “ANALOG MARSHALLING PANEL” on the printed wiring assembly (PWA) and “VOLTAGE MUX MARSHALLING PANEL” on the label at the top. It accepts field inputs for voltage input Front End Modules. Each Voltage MUX Marshaling Panel has a total of 20 I/O points. Table 6.2.1 lists the Voltage MUX Marshaling Panel specifications.

See the Service Manual (SV: 5) for field wiring details.

Table 6.2.1. Voltage MUX Marshaling Panel Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>CSA: 150 V rms</td>
</tr>
<tr>
<td></td>
<td>With a locally coated connector: 250 V rms</td>
</tr>
<tr>
<td>Wire gauge</td>
<td>.5 to 4 mm² (20–12 AWG) solid, stranded, lugged</td>
</tr>
<tr>
<td>Temperature</td>
<td>Maximum: 105° C</td>
</tr>
<tr>
<td>Connection to FlexTerm</td>
<td>50 conductor cable terminated to connector on FlexTerm motherboard.</td>
</tr>
</tbody>
</table>
Field Wiring to a Voltage MUX Marshaling Panel

Field wiring can be brought to a voltage MUX marshaling panel (1984-2457-000x). Figure 6.2.8 shows the voltage MUX marshaling panel along with field wiring terminations.

The cable (RTD or Voltage FEM to Marshaling Panel) (1984-0500-xxxx) connects the marshaling panel and the FlexTerm. The system typically ships with the 1984-0500-xxxx cable wires already connected to the FlexTerm. If the wires are to be connected by the user, see the Service Manual (SV: 5) for details.

Figure 6.2.8. Voltage MUX Marshaling Panel (1984-2457-000x)
Current MUX Marshaling Panel

The Current MUX Marshaling Panel (1984–2458–000x) mounts in a system cabinet where it takes 179 mm (7 in.) of panel space. It requires no system DC power. It is marked “MUX MARSH PANEL” on the PWA and “4–20 MUX MARSHALLING PANEL” on the label. It is designed to terminate 4–20 mA signals for MUX inputs. The panel accepts field inputs for three types of Front End Modules:

- 4–20 mA FEM with a self-powered transmitter
- 4–20 mA FEM with system bus power
- 4–20 mA FEM with remote power at the Marshaling panel.

The 4–20 mA Marshaling Panel has 20 inputs per panel and 60 terminals for field termination.

Table 6.2.2 lists the panel specifications.

See the Service Manual (SV: 5) for field wiring details.

### Table 6.2.2. 4–20 mA MUX Marshaling Panel Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC power isolation and fusing</td>
<td>1984–1321 fuse module with isolating diodes</td>
</tr>
<tr>
<td>Per point fusing</td>
<td>1/4 A</td>
</tr>
<tr>
<td>Temperature range</td>
<td>0–70°C</td>
</tr>
<tr>
<td>Maximum voltage</td>
<td>Transmitter powered: 250 V rms</td>
</tr>
<tr>
<td></td>
<td>150 V rms CSA</td>
</tr>
<tr>
<td></td>
<td>System and remote powered: 150 V rms</td>
</tr>
<tr>
<td>Wire gauges</td>
<td>0.5 to 4 mm² (20–12 AWG) solid, stranded, lugged</td>
</tr>
<tr>
<td>Connection to FEM</td>
<td>50 conductor cable terminated directly to FEM terminals.</td>
</tr>
</tbody>
</table>
Field Wiring to a Current (4–20 mA) MUX Marshaling Panel

Field wiring can be brought to a 4–20 mA MUX marshaling panel (1984-2458-000x). Figure 6.2.9 shows the 4–20 mA MUX marshaling panel along with field wiring terminations.

The cable (4–20 mA FEM to Marshaling Panel) (1984–0499–xxxx) connects the marshaling panel and the FlexTerm. The system typically ships with the cable already connected to the FlexTerm. If the wires are to be connected by the user, see the Service Manual (SV: 5–1) for details.
Figure 6.2.9. 4-20 mA MUX Marshaling Panel (1984-2458-000x)
The RTD MUX Marshalling Panel (1984-2456-000x) mounts in a system cabinet where it takes 89 mm (3.5 in.) of space. It requires no system DC power. It is marked “MULTI STRATEGY MARSHALLING PANEL” on the PWA and “RTD MUX MARSHALLING PANEL” on the label. It accepts field inputs for RTD Front End Modules. Each RTD MUX Marshaling Panel has a total of 10 I/O points. Table 6.2.3 lists the panel specifications.

See the Service Manual (SV: 5–1) for field wiring details.

### Table 6.2.3. RTD MUX Marshaling Panel Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>CSA: 150 V RMS</td>
</tr>
<tr>
<td></td>
<td>With a locally coated connector: 250V RMS</td>
</tr>
<tr>
<td>Wire gauge</td>
<td>0.5 to 4 mm² (20–12 AWG)</td>
</tr>
<tr>
<td></td>
<td>Solid, stranded, lugged</td>
</tr>
<tr>
<td>Temperature</td>
<td>Maximum: 105°C</td>
</tr>
<tr>
<td>Connection to FlexTerm</td>
<td>50 conductor cable terminated to connector on FlexTerm motherboard.</td>
</tr>
</tbody>
</table>

### Field Wiring to an RTD MUX Marshaling Panel

Field wiring can be brought to an RTD MUX Marshaling Panel.

A cable (RTD or Voltage FEM to Marshaling Panel) (1984-0500-xxxx) connects the marshaling panel and the FlexTerm. The system typically ships with the cable wires already connected to the FlexTerm. If the wires are to be connected by the user, see the Service Manual (SV: 5–1) for details.

Figure 6.2.10 shows the RTD MUX marshaling panel along with field wiring terminations.
NOTE:
For 3-wire terminations on the marshaling panel, the associated V+ and I+ pins on the FEM must be jumpered. Leave all existing wires on FEM.

Figure 6.2.10. RTD MUX Marshaling Panel (1984-2456-000x)
Section 3: Contact I/O

The MultiPurpose Controller (MPC) Contact I/O uses:

- MPC Processor Card in a ControlFile
- Contact Card Cage (Contact FlexTerm) with up to eight Contact Field Interface Cards (FICs)
- Field wiring landed on up to two Local Termination Boards, two Contact Marshaling Panels, or one of each
- Optical Isolator Modules to interface field signals with control signals

The Contact FlexTerm is cabled to a ControlFile as shown in Figure 6.3.1. An MPC Processor Card can control up to 96 input/output points on two interconnected Contact Card Cages.

Figure 6.3.1. Contact Flexterm Cable Connections to ControlFile
Each Contact Card Cage can hold eight Contact Field Interface cards to control 48 points. The field wiring can be landed on a Local Termination Board or a Contact Marshaling Panel.

A Local Termination Board can hold 24 Optical Isolator Modules and has field wiring terminals for 24 points. The Local Termination Board mounts directly on the Contact Card Cage.

A Contact Marshaling Panel can hold 24 Optical Isolator Modules and has field wiring terminals for 24 points. The Contact Marshaling Panel is connected to the Contact Card Cage by cable. The Contact Marshaling Panel mounts in a system cabinet.

The Contact Card Cage can hold two Local Termination Boards: connect to two Contact Marshaling Panels, or use one of each. Figure 6.3.2 shows use of one of each.

Figure 6.3.2. Contact Flexterm Field Wiring Connections
Installing a Contact Card Cage

The Contact Card Cage (1984–2576–000x) mounts in a system cabinet, where it takes 312 mm (12.25 in.) of rail space. It requires standard system DC power, and is cabled to a ControlFile MPC Controller card. It is marked “MPC CONTACT FLEXTERM MOTHERBOARD” on the printed wiring assembly (PWA).

Figure 6.3.3 shows a Contact Card Cage. The two 40 position connectors at the top are used to connect to the Controller Processor and to an optional redundant Controller Processor. If only one Controller Processor is used, the other connector can be used to “daisy chain” to another Contact Card Cage or to an Analog Card Cage. The 40-position connector at the bottom is not used.

The Contact Card Cage has connectors for two Field Termination Boards and connectors for two remote Contact Marshaling Panels. You can install one Field Termination Board and one Contact Marshaling Panel if required.

Cage address jumpers select either Cage A or Cage B corresponding to the MPC point addressing scheme. Controller redundancy jumpers are used to specify normal or redundant connection to the ControlFile.

A fuse card protects the Contact Card Cage from overloads.
Figure 6.3.3. Contact Card Cage
Contact Card Cage FIC Addressing

Figure 6.3.4 shows the addressing scheme for Contact Card Cage field interface cards (FICs). The first slot FIC addresses points 101 through 106; the second slot FIC addresses points 201 through 206.

The left hand Local Termination Board and the left hand Contact Marshaling Panel connector address points 101 through 406 (covered by the upper set of FICs).

The right hand Local Termination Board and the right hand Contact Marshaling Panel connector address points 501 through 806 (covered by the lower set of FICs).

Figure 6.3.4. FIC Addressing in a Contact Card Cage
Contact Card Cage Jumpers

The Contact Card Cage motherboard has address and redundancy jumpers.

The address jumpers (HD3A-HD3H) set the Contact Card Cage address as Card Cage A or Card Cage B. All eight jumpers must be in the same position. Write an “X” in the appropriate box of the cage address label to record the cage address.

The redundancy jumpers indicate whether or not redundant Controller Processors are connected to the Contact Card Cage in the ControlFile.

Figure 6.3.5 shows the jumper locations on the motherboard. Table 6.3.1 shows the jumper positions.

![Diagram of Contact Card Cage Jumpers]

Figure 6.3.5. Contact Card Cage Jumpers
### Table 6.3.1. Contact Card Cage Jumper Positions

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Position</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1, HD2</td>
<td>NORMAL</td>
<td>One Controller Processor is used. (Normal case)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NOTE:</strong> Both jumpers must be in the same position.</td>
</tr>
<tr>
<td>HD1, HD2</td>
<td>REDUNDANT</td>
<td>Redundant Controller Processors are used.</td>
</tr>
<tr>
<td>HD3A to HD3H</td>
<td>Cage A</td>
<td>The Contact Card Cage is Card Cage A.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NOTE:</strong> The eight sets of jumpers correspond to the eight contact FICs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All eight jumpers must be in the same position.</td>
</tr>
<tr>
<td>HD3A to HD3H</td>
<td>Cage B</td>
<td>The Contact Card Cage is Card Cage B.</td>
</tr>
</tbody>
</table>
Installing Contact FICs

The Contact Field Interface Card (1984-1460-0003) interfaces with the Controller Processor to turn optical isolation input/output modules on and off. The card is marked “CONTACT I/O” on the PWA.

Each Contact Field Interface card can control six modules in any combination of input or output, AC or DC. The card plugs into a slot on the Contact Card Cage.

Contact FIC Jumpers

Jumper HD1 must be set before the card is installed. This setting controls the action of the card on communication failure (either hold the previous condition or set the output to OFF). Figure 6.3.6 shows the jumper location. Table 6.3.2 gives jumper values.

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Position</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1</td>
<td>HOLD</td>
<td>Hold output value on communications failure</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Drive output to zero on communications failure</td>
</tr>
</tbody>
</table>

Figure 6.3.6. Contact FIC 1984-1460-000x Fuse and Jumper Locations

Table 6.3.2. Contact Field Interface Card Jumper Positions
Installing a Local Termination Board

The Local Termination Board (1984–1288–000x) is marked “CONTACT FIELD TERMINATION” on the PWA. The Local Termination Board plugs directly into the connectors of a Contact Card Cage. It accommodates 24 field I/O terminations. The Local Termination Board provides optical isolation and fusing for each I/O point. Optical isolation modules are installed only in active points.

The Local Termination Board is limited to 1 amp maximum output current for the optical isolation modules. The fuses on the Local Termination Board are in line with the field wiring. Figure 6.3.7 shows the Local Termination Board.

**NOTE:** When installing a Local Termination Board, be very careful to insert both connectors in the receiving slots on the Contact Card Cage.

![Figure 6.3.7. Local Termination Board](image)
Local Termination Board Field Wiring

The Local Termination Board must have an optical isolation module for each active input or output point. Different optical isolation modules are required for different types of inputs and outputs. The maximum current allowed is 1 amp.

**NOTE:** The field wiring terminals on the left terminal board have the positive (+) terminal on the top. The field wiring terminals on the right terminal board have the negative (−) terminal on the top.

**WARNING**
There must be no power on the input wiring while connecting it to the Contact Card Cage. Serious injury and equipment damage can result.

**CAUTION**
Two different phases of AC power must not be connected to the same Local Termination Board. Damage to the optical Isolation modules can result.

See the *Service Manual* (SV: 5–2) for details of field wiring.

Local Termination Board Fuses

The Local Termination Board provides a fuse in line with the field wiring of each point. Figure 6.3.7 shows the fuse locations. Table 6.3.3 gives fuse data.

**NOTE:** The factory installs 1.5 amp fuses. Size the fuses should to match the load and the optical isolation module used.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Bussman Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| F1 to F24 | G09140–0029 | MDQ 1-1/2 | 1.5 A 250 V Slow Blow  
**NOTE:** Other fuses can be used to match the applied load.

Optical Isolator Modules

See page 6-3-15 for a list of available Optical Isolator Modules.
Installing a Contact Marshaling Panel

The Contact Marshaling Panel (1984–2459–000x) mounts in a system cabinet with a cable to a Contact Card Cage. The panel requires 267 mm (10.5 in.) of rail space. It is marked “CONTACT MARSHALING PANEL” on the PWA. Figure 6.3.8 shows the Contact Marshaling Panel. Figure 6.3.9 shows the dimensions of the panel.

**Figure 6.3.8. Contact Marshaling Panel**

**CAUTION**

DO NOT connect 2 different phases of AC power to the same Contact Marshaling Panel. Damage to the optical isolator modules and/or the panel can result.
The Contact Marshaling Panel provides field wiring termination strips, optical isolators, fuses, and address labels for field wiring. Optical isolator modules of up to 3 ampere capacity can be used with the Contact Marshaling Panel. Different optical isolator modules are required for different types of inputs and outputs.

Each group of 6 points is connected to a single contact FIC card, as indicated by the highlighting in Figure 6.3.8. Each group of 6 points can be system powered from the appropriate terminal strip at the right side, as shown in the figure.

Figure 6.3.9. Contact Marshaling Panel Mounting Dimensions

All mounting holes are 7 mm (0.28 in.) in diameter.
Table 6.3.4 lists the Contact Marshaling Panel specifications.

<table>
<thead>
<tr>
<th>Term</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Ratings/Temperature</td>
<td><strong>DC Output:</strong> 2.3 amps at 25°C</td>
</tr>
<tr>
<td></td>
<td>1.8 amps at 40°C</td>
</tr>
<tr>
<td></td>
<td>1.0 amps at 60°C</td>
</tr>
<tr>
<td></td>
<td><strong>AC Output:</strong> 3.0 amps at 25°C</td>
</tr>
<tr>
<td></td>
<td>2.3 amps at 40°C</td>
</tr>
<tr>
<td></td>
<td>1.2 amps at 60°C</td>
</tr>
<tr>
<td>Voltage</td>
<td>Maximum: 300 V rms</td>
</tr>
<tr>
<td>Fusing</td>
<td>4 amp slow blow per Optical Isolator Module</td>
</tr>
<tr>
<td>Cabling</td>
<td>50 conductor round cable</td>
</tr>
<tr>
<td>Maximum distance</td>
<td>Card Cage or FlexTerm to Marshaling Panel: 229 meters (750 feet)</td>
</tr>
<tr>
<td>Connection to Card Cage or FlexTerm</td>
<td>50 conductor cable terminated to connector on motherboard.</td>
</tr>
<tr>
<td>Wire gauge</td>
<td>0.34–2.5 mm² (14–22 AWG) solid or stranded</td>
</tr>
</tbody>
</table>
Contact Marshaling Panel Field Wiring

The Contact Marshaling Panel accommodates 24 field I/O terminations, with four contacts available at each point as shown in Figure 6.3.8. The (+) and the (−) connections are used for devices powered in the field. A jumper is required from Vx to + to provide system power to the point. The fuse is in series with the Vx power supply to the point.

See the Service Manual (SV: 5-2) for field wiring details.

**WARNING**

TURN OFF POWER on the contact wiring while connecting the Contact Marshaling Panel to the Contact Card Cage. Serious personal injury and equipment damage can result.

Contact Marshaling Panel Fuses

Contact Marshaling Panel fuses are in line between the terminal block and the individual point (V1, 2, 3, or 4), not in the field wiring. Table 6.3.5 gives fuse data.

The factory installs fuses sized for the maximum allowable load on the output Optical Isolator Module. A smaller fuse can be used if a smaller load is applied or if the point is an input.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Bussman Part No.</th>
<th>Littelfuse Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 to F24</td>
<td>G09140-0038</td>
<td>MDL 4</td>
<td>313004</td>
<td>4 A 250 V Slow Blow</td>
</tr>
</tbody>
</table>

**NOTE:** Use smaller fuses if smaller loads are applied.
Optical Isolator Modules

Optical Isolator Modules (G12243-00xx) are solid-state, optically isolated relays that define each contact point as an input or an output. Each module has a fuse in series with the field pair. The modules are used in Local Termination Boards and Contact Marshaling Panels. Table 6.3.6 lists the available modules.

**NOTE:** Care must be taken to make sure the proper type of module is installed because input and output modules are mechanically interchangeable.

### Table 6.3.6. Optical Isolator Modules

<table>
<thead>
<tr>
<th>Part Number C12243-</th>
<th>Model</th>
<th>Function</th>
<th>Output Contact*</th>
<th>Voltage</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0005</td>
<td>IAC5A</td>
<td>Input</td>
<td>None</td>
<td>180–280 VAC/DC</td>
<td>Yellow</td>
</tr>
<tr>
<td>-0006</td>
<td>IDC5</td>
<td>Input</td>
<td>None</td>
<td>10–32 VDC</td>
<td>White</td>
</tr>
<tr>
<td>-0007</td>
<td>IDC5B/ IDC5F</td>
<td>Input</td>
<td>None</td>
<td>4–16 VDC</td>
<td>White</td>
</tr>
<tr>
<td>-0008</td>
<td>IAC5</td>
<td>Input</td>
<td>None</td>
<td>90–140 VAC/DC</td>
<td>Yellow</td>
</tr>
<tr>
<td>-0009</td>
<td>ODC5</td>
<td>Output</td>
<td>N.O.</td>
<td>5–60 VDC</td>
<td>Red</td>
</tr>
<tr>
<td>-0010</td>
<td>ODC5A</td>
<td>Output</td>
<td>N.O.</td>
<td>5–200 VDC</td>
<td>Red</td>
</tr>
<tr>
<td>-0011</td>
<td>OAC5A5</td>
<td>Output</td>
<td>N.C.</td>
<td>24–280 VAC</td>
<td>Black</td>
</tr>
<tr>
<td>-0012</td>
<td>OAC5</td>
<td>Output</td>
<td>N.O.</td>
<td>12–140 VAC</td>
<td>Black</td>
</tr>
<tr>
<td>-0013</td>
<td>OAC5–A/OAC5–1</td>
<td>Output</td>
<td>N.O.</td>
<td>24–280 VAC</td>
<td>Black</td>
</tr>
</tbody>
</table>

* All output modules, except OAC5A5, have normally open (N.O.) outputs. The output contact is open when the block output is false.

**NOTE:** AC inputs are yellow, outputs are black. DC inputs are white, outputs are red.
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Multipoint I/O

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<td>7-5-21</td>
</tr>
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<td>7.5.7 MTL Analog Input and Output Isolators</td>
<td>7-5-22</td>
</tr>
</tbody>
</table>
Section 1: Multipoint I/O Installation and System Wiring

Multipoint I/O (MIO) is a family of I/O products that allow distribution of the I/O electronics and marshaling panels close to the I/O devices controlled. The devices share a common packaging format and system cable connection method. Multipoint I/O is used to read and control analog and discrete (contact) I/O points. A Multipoint I/O Termination Panel provides connection of field wiring to/from I/O devices, one or two Field Interface Modules (FIM), optional Loop Power Module (LPM), and communication with the Controller Processor in a ControlFile.

NOTE: All FIMs and LPMs have keyed connectors to prevent incorrect insertion into their respective termination panel receptacles. After proper insertion, tighten the screw at each end of the FIM or LPM to secure the module in place.

Most Multipoint I/O termination panels provide the option of online FIM replacement or redundant FIM operation. For online replacement operation, a single FIM is installed and a single communication line is used. If this FIM fails, a replacement may be inserted in the empty socket. The replacement will take over for the failed FIM. Redundant operation requires two installed FIMs and two communication lines. Both FIMs operate continuously, with one as primary and the other as secondary. If the primary FIM fails, the secondary FIM takes over immediately.

A Communication Connect Card III, Communication Termination Panel II, or Remote Communication Termination Panel provides up to eight communications lines between a MultiPurpose Controller (MPC) in a ControlFile and the MIO termination panels. Up to four MIO termination panels can be connected to each communication line, with each MIO panel having a separate address. Configuration space and processor time will limit the amount of hardware that can be connected and serviced.

A pair of Fiber Optic I/O Converters can be used to insert a fiber optic link in the communication line.

Additional information on installation of Multipoint I/O termination panels can be found on:

- Page 2-5-1 for installation in floor mounted I/O cabinets.
- Page 2-6-1 for installation in wall mounted I/O cabinets.
- Page 2-7-1 for installation of a Remote I/O Power supply.
Multipoint I/O termination panels can be connected directly to a Control File by using a Communications Termination Panel II (1984–4205–000x) or a Remote Communications Termination Panel (1984–2552–000x). Figure 7.1.1 shows a typical installation.

Figure 7.1.1. Multipoint I/O Using the Communication Termination Panel II
Multipoint I/O termination panels can be connected to an Analog Card Cage using a Communications Connect Card III (1984-2543-000x). Figure 7.1.2 shows a typical installation.

Figure 7.1.2. Multipoint I/O Using the Analog Card Cage and Communication Connect Card III
Multipoint I/O Termination Panel Addressing

Figure 7.1.3 shows how I/O addresses are formed. The standard RS3 address format has been generalized to make the new hardware configuration fit logically within the familiar RS3 address structure.

The Control File Node Address specifies which Control File is used.

The Controller Slot Address specifies which controller is used.

The “Cage Address” specifies which termination panel on the communication line is used.

The communication line or “Card Cage Slot” specifies which communication line is used.

The Point Address specifies which I/O point is used.

Figure 7.1.3. Multipoint I/O Termination Panel Addressing

Multipoint I/O Termination Panel Address Jumpers

The termination panel address or “card cage address” is specified by a jumper that is set to address A, B, C, or D. The isolated Discrete Termination Panel pair has an address jumper on each of the two panels. Both must be set to the same address. The MultiFIM discrete Termination Panel has separate address jumpers for each FIM.
Multipoint I/O Scanning Rates

The rate at which I/O points are scanned depends on the highest card cage address served by the communication line.

- The maximum panel scanning rate of 32 per second is achieved when only address “A” is used on the communication line; the scanning pattern is “A A A A”.
- Using address “B” halves the rate for all points to 16 scans per second; the scanning pattern is “A B A B”.
- Using address “C” gives 16 scans per second to A and 8 each to B and C; the scanning pattern is “A B A C”.
- Using address “D”, gives 8 scans per second to all; the scanning pattern is “A B C D”.

The Multipoint Discrete I/O (MDIO) I/O point update rate is equal to the panel scan rate.

The Multipoint Analog I/O (MAIO) I/O point update rate is one-fourth the panel scan rate. Four messages are needed to update the points, so the analog I/O point update rate is the panel scan rate divided by 4. Thus a MAIO panel addressed as “A”, with a panel scan rate of 32 scans per second, gives 8 I/O point scans per second or a scan time of .125 second. The minimum useable controller scan time is .25 second. Table 7.1.1 shows the scan rates and minimum controller scan time for various cage addresses.

NOTE: The controller scan time (.25, .50, .125 second), selected from the Control File Status screen, must always be greater than the I/O point scan time. The controller scan time applies to all card cages served by the controller, so the scan time of the slowest cage must be used.

Table 7.1.1. I/O Point and Minimum Controller Scan Rates

<table>
<thead>
<tr>
<th>Highest Card Cage Address</th>
<th>Cage Scan Pattern</th>
<th>Cage Scan Rate (Scans Per Second)</th>
<th>Minimum Controller Scan Time (Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AAAA</td>
<td>32</td>
<td>0.125</td>
</tr>
<tr>
<td>B</td>
<td>ABAB</td>
<td>16</td>
<td>0.125</td>
</tr>
<tr>
<td>C</td>
<td>ABAC</td>
<td>A: 16, B, C: 8</td>
<td>0.25, 1.0</td>
</tr>
<tr>
<td>D</td>
<td>ABCD</td>
<td>8</td>
<td>0.25, 1.0</td>
</tr>
</tbody>
</table>
Multipoint I/O FIM Redundancy and Online Replacement

Most Multipoint I/O termination panels support FIM redundancy and FIM online replacement.

Multipoint I/O FIM Online Replacement

Online replacement operation is provided when one FIM and one communication line is used. The FIM can be installed in either the “A” or the “B” socket. The other socket is available for an online replacement. The redundancy jumper(s) must be set to normal to allow online replacement operation.

If the FIM fails in any way, a good FIM can be plugged into the empty socket. The failed FIM red LED will be ON. The new FIM will take over from the installed FIM in a few seconds. The failed FIM can be removed for repair as soon as the new FIM green LED is ON and the yellow “Comm Active” LED flashes.

**NOTE:** The new FIM may be left in service in that socket; the failed FIM should be removed. The empty socket will provide for another online replacement. Do not leave two FIMs plugged into the panel.

Multipoint I/O FIM Redundancy

Full FIM redundancy is provided when two FIMs are used. Two communication lines are required, one for an odd numbered slot and one for the next even numbered slot. The primary FIM is in the “FIM A” socket and the redundant FIM is in the “FIM B” socket. The redundancy jumper(s) must be at redundant to allow redundant operation. A Redundant I/O Block must be configured to control operations.

The odd numbered slot address must be wired to FIM A, the “primary” FIM. The even numbered slot must be wired to FIM B, the “secondary” FIM.
Primary (A) FIM Failure: If the primary FIM fails, the secondary FIM will take over and assume the duties of the primary. The failed FIM red LED will be ON and the green LED will flash. The failed FIM should be removed and replaced. As soon as the new FIM A powers up, it will assume the duties of the primary FIM and FIM B will return to secondary operation.

Secondary (B) FIM Failure: If the secondary FIM B fails, the primary FIM A will continue to operate. The failed FIM red LED will be ON and the green LED will flash. The failed FIM B should be removed and replaced. As soon as the new FIM B powers up, it will resume the duties of secondary FIM.
Multipoint I/O Termination Panel Installation

The termination panel must be mounted with the long dimension vertical as shown in Figure 7.1.4. The panel can be installed in a rack, on DIN rails, or against a flat surface. Ambient air temperature specifications refer to the temperature of the air at the bottom of each terminal panel.

Wire tie-wrap anchor points are provided on the label bracket at each end of the panel.

Figure 7.1.4. Multipoint I/O Panel Dimensions

Multipoint I/O Termination Panel Grounding

The termination panel must be connected to cabinet ground. If the panel is mounted on a grounded DIN rail or mounted against a grounded metal panel it will be adequately grounded. Otherwise you must connect a ground wire to one of the ground terminals of the power strip.
Multipoint I/O Termination Panel FIM Power Wiring

Removing power from a termination panel stops processing for all points served by the panel.

Terminal panel (FIM) power is supplied either from the RS3 system DC power supply bus or from a local DC source. Provision is made for optional A and B redundant DC supplies.

There are two approved ways to supply FIM power. Option 1 uses the standard RS3 4-pin power jack and a standard RS3 DC power cable as shown in Figure 7.1.5.

![Power Wiring Diagram](Figure 7.1.5. Multipoint I/O Termination Panel Power Wiring: Option 1)
Option 2 is more suitable if FIM power is supplied by a local source or if additional panels are to be fed from the same source. Figure 7.1.6 shows option 2.

![Diagram of Multipoint I/O Termination Panel Power Wiring: Option 2]

**NOTE:** Maximum current \((A + B)\) 7 amps

Figure 7.1.6. Multipoint I/O Termination Panel Power Wiring: Option 2

**CAUTION**

Do not use both the power jack and the power strip at the same time. This may result in damage to the panel.
Multipoint I/O Termination Panel Communication Wiring

Port A and Port B provide for connecting two independent communication lines. The communication line used determines the panel slot address. One line is used for single FIM (online replacement) applications. An odd-even pair is used for redundant FIM applications.

Each terminal is labeled +, -, and S for the plus and minus signal wires and the shield. The terminals will accommodate one wire of 0.34 to 4 mm² (22 to 12 AWG) size or two wires in the range 0.34 to 0.75 mm² (22 to 18 AWG). This allows communication wires to be daisy chained to other panels as required.

Shield grounding is supplied within the termination panel. An internal spark gap transient suppressor is supplied on the communication lines and within the FIM. A low impedance connection between the panel and local ground is required for proper protection. No further transient suppression should be required.
Multipoint I/O Termination Panel Communication Wiring: Online Replacement

The communication line can be connected to Port A or Port B. The other port can be used to daisy chain the communication line to another panel.

**NOTE:** It is good practice to use an odd numbered line and to reserve the next even numbered line for eventual redundant operation.

The redundancy jumpers connect the communication lines to allow online replacement operation with a single line. These jumpers must be at normal for online replacement operation.

Figure 7.1.7 shows communication wiring for the single FIM (online replacement) application.

![Communication Wiring Diagram](image)

**NOTE:** Redundancy jumpers must be on normal.

**Figure 7.1.7. Multipoint I/O Termination Panel Communication Wiring: Online Replacement**
Multipoint I/O Termination Panel Communication Wiring: Redundancy

Use of redundant FIMs requires two independent communication lines as shown in Figure 7.1.8. The odd numbered line must be wired to Port A, for FIM A (the “primary” FIM). The even numbered line must be wired to Port B for FIM B (the “secondary” FIM).

The redundancy jumpers must be at redundant to allow use of the two independent communication lines.

NOTE: Redundancy jumpers must be on redundant

Figure 7.1.8. Multipoint I/O Termination Panel Communication Wiring: Redundant Operation
Section 2:  
Multipoint Discrete I/O (MDIO)

This section describes installing the:

- Direct Discrete Termination Panel II (10P52700001)
- Multi-FIM Discrete Termination Panel (1984-4282-000x)
- Isolated Discrete Termination Panel set (1984-4121-000x and 1984-4124-000x)
- High Density Isolated Discrete Termination Panel (1984-4167-000x)

Multipoint Discrete I/O is used to read and control discrete (contact) I/O points. It allows location of the I/O electronics Field Interface Module (FIM) at the field wiring termination panel. The discrete termination panels can be mounted where the user desires (within communication wiring length limits).
The Direct Discrete Termination Panel II (10P52700001) is marked “DIRECT DISCRETE TERMINATION PANEL II” on the printed wiring assembly (PWA). The panel is CE approved for EMC emissions and susceptibility.

**FIMs**

The panel can be used with either a high or a low-side switching FIM. The high-side switch FIM (MDIOH) breaks the high (supply) side of the circuit for outputs. This FIM should be used for all new installations. The low-side switch FIM (MDIOL) breaks the low (return) side. This FIM is used primarily for installations that are backward compatible with the earlier MDIO FIM (1984-4080-0001). The termination panel can be keyed so only the proper type FIM can be installed.

**Keying**

The FIM and panel are keyed to prevent installation of the wrong type of FIM. Keying plugs are moveable so the panel can be field-converted from MDIOL to MDIOH and back.

**I/O Points**

The panel supports 16 input/output points (1–16) and 16 input-only points (17–32).

- All points share a common return bus which is floating relative to the panel chassis ground.
- Points 1–16 can be configured as inputs or as outputs.
- Points 17–32 can only be configured as inputs.
- Point 1 must be configured (either as input or output) and the transition voltage must be specified. The transition voltage applies to all 32 points. See the I/O Block Configuration Manual (IO: 10).

**Loop Power**

An independent source of loop power is required unless all points are field-powered inputs.

- Each group of 8 points can have an independent source of loop power but all sources must share the common return bus. The panel is normally shipped with all voltage terminals (V1–V4) and their returns (N1–N4) jumpered together.
- Field-powered inputs must have their returns connected to the loop power return.

Figure 7.2.1 shows the Direct Discrete Termination Panel II.
Field Wiring

Loop Power
The panel supports 32 I/O points in four groups of eight points. Each has a group supply bus (V). All groups share a common return bus (N). The supplies (V1–V4) are isolated so that each group may be powered independently (as long as the returns can be common). The terminals will accommodate wire sized 4 to 0.34 mm² (12 to 22 AWG).

The panel is normally shipped with all supply (V1–V4) terminals jumpered together. Jumpers are also installed on all return (N1–N4) terminals (N) to carry excess current between the terminals. The jumpers on the return terminals (N) should not be removed.

NOTE: The loop power return bus is isolated from chassis ground. You can supply a connection to the chassis ground terminal of TBA if it is required for your installation.

Field Terminals
A pictorial representation of points 9–16 is shown in Figure 7.2.2. Note that the group supply line terminates at each end of the group. This makes it easy to daisy chain groups together.

Output points and contact-closure input points are wired between the upper (odd) terminal and the corresponding lower (even) terminal. Field-powered input points are wired between the lower (even) terminal and the common return bus.

![Figure 7.2.2. Direct Discrete Termination Panel II Field Wiring Terminals](image)

Strain Relief
For strain relief, route the field wires through the fingers of the wire manager assemblies (1984-4152-0003). To ease the task of routing wires, the top pair of wire manager assemblies are factory-mounted and the remaining assemblies are shipped loose. As you progress through the wiring, mount the assemblies using the 1/4-inch fasteners provided.
Labels

A replaceable label (1984–4195–0001), Figure 7.2.3, is provided on the panel label holder assembly. The label provides space at the end to record the ControlFile Node address (1–32), Controller Slot Address (A–H), Termination Panel FIM address (A–D), and Communication Line (1–8). There is provision for recording both the primary and redundant communication line number. The body of the label provides for recording the group supply sources (V1–V4) and each point’s field connection (1–32).

The underside of the label holder carries a label that shows a schematic of the field wiring terminations and provides space for recording fuse values.

![Figure 7.2.3. Label, Direct Discrete Termination Panel II Field Wiring](image-url)
Keying

Panels and FIMs are keyed to prevent insertion of the wrong FIM type. The FIM has a pair of keying pins that fit into matching holes in the panel. The panel is set up by inserting plugs into the unused holes at each end of the FIM. Figure 7.2.4 shows a panel set up for a MDIOH FIM. Two spare plugs are provided with each panel.

![Figure 7.2.4. Keying the Panel](image)

- **To remove a plug:**
  1. Insert a screwdriver under the lip of the plug. The small access hole at the edge of the plug can be used to get the screwdriver under the plug.
  2. Pry the plug up until you can grip it with your fingers and pull it out.

- **To insert a plug:**
  1. Press the plug into the hole until it clicks in place. Be sure to use the marked hole rather than the nearby access hole.
  2. Repeat for the other end of the FIM.
Jumpers

There are three sets of jumpers on the panel. HD17 specifies the panel (FIM) address. HD18 jumpers must be positioned correctly to support normal (one-FIM) operation with online replacement, or optional redundant (two-FIM) operation. Jumpers HD1–HD16 change connections for points as shown on the following pages.

Table 7.2.1 shows jumper values.

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Value</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1–HD16</td>
<td></td>
<td>MDIOL: Input or Output Point MDIOH: Input Point</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Right</td>
<td>MDIOH: Output Point</td>
</tr>
<tr>
<td>HD17</td>
<td>A</td>
<td>Use Card Cage Address A</td>
</tr>
<tr>
<td>(One jumper)</td>
<td>B</td>
<td>Use Card Cage Address B</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Use Card Cage Address C</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>Use Card Cage Address D</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>Not used</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Not used</td>
</tr>
<tr>
<td>HD18</td>
<td>NORM</td>
<td>Normal single-FIM operation</td>
</tr>
<tr>
<td>(Two jumpers)</td>
<td>REDUN</td>
<td>Redundant operation with two FIMs</td>
</tr>
</tbody>
</table>
MDIOH High-Side Switch

Put the jumper at the left for inputs and at the right for outputs as shown in Figure 7.2.5.

**Contact Closure Input Point**

**NOTE:** Input only points 17–32 are wired the same way for contact closure type inputs.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V+ (Loop power supply)</td>
</tr>
<tr>
<td>2</td>
<td>Field terminal block (Odd number, upper row)</td>
</tr>
<tr>
<td>3</td>
<td>Input contact</td>
</tr>
<tr>
<td>4</td>
<td>Field terminal block (Next even number, lower row)</td>
</tr>
<tr>
<td>5</td>
<td>FIM input</td>
</tr>
</tbody>
</table>

**Field-powered Input Point**

**NOTE:** Input only points 17–32 are wired the same way for externally sourced inputs.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIM input</td>
</tr>
<tr>
<td>2</td>
<td>Field terminal block (Even number, lower row)</td>
</tr>
<tr>
<td>3</td>
<td>Voltage source (+)</td>
</tr>
<tr>
<td>4</td>
<td>Voltage source return (–) (Connected to any point on the common return bus)</td>
</tr>
</tbody>
</table>

**Output Point**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIM output (Switched V+)</td>
</tr>
<tr>
<td>2</td>
<td>Field terminal block (Odd number, upper row)</td>
</tr>
<tr>
<td>3</td>
<td>Load</td>
</tr>
<tr>
<td>4</td>
<td>Field terminal block (Next even number, lower row)</td>
</tr>
<tr>
<td>5</td>
<td>V– (Common return)</td>
</tr>
</tbody>
</table>

Figure 7.2.5. MDIOH High-Side Switch Jumpers
MDIOL Low-Side Switch

Put the jumper at the left for all points as shown in Figure 7.2.6.

**Contact Closure input Point**

![Diagram of the contact closure input point](image)

**Voltage Input Point**

![Diagram of the voltage input point](image)

**Output Point**

![Diagram of the output point](image)

**NOTE:** Input only points 17–32 are wired the same way for contact closure type inputs.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V+ (Loop power supply)</td>
</tr>
<tr>
<td>2</td>
<td>Field terminal block (Odd number, upper row)</td>
</tr>
<tr>
<td>3</td>
<td>Input contact</td>
</tr>
<tr>
<td>4</td>
<td>Field terminal block (Next even number, lower row)</td>
</tr>
<tr>
<td>5</td>
<td>FIM input</td>
</tr>
</tbody>
</table>

**NOTE:** Input only points 17–32 are wired the same way for externally sourced inputs.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIM input</td>
</tr>
<tr>
<td>2</td>
<td>Field terminal block (Next even number, lower row)</td>
</tr>
<tr>
<td>3</td>
<td>Voltage source (+)</td>
</tr>
<tr>
<td>4</td>
<td>Voltage source return (-) (Connected to any point on the common return bus)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V+ (Loop power supply)</td>
</tr>
<tr>
<td>2</td>
<td>Field terminal block (Odd number, upper row)</td>
</tr>
<tr>
<td>3</td>
<td>Load</td>
</tr>
<tr>
<td>4</td>
<td>Field terminal block (Next even number, lower row)</td>
</tr>
<tr>
<td>5</td>
<td>FIM output signal (V- switched return)</td>
</tr>
</tbody>
</table>

**Figure 7.2.6. MDIOL Low-Side Switch Jumpers**
Fuses

There are 32 fuses protecting signal circuits powered through this panel. The factory installs 1 amp fuses in all positions. Other fuses appropriate for the load protected can be installed but must not exceed a 1.0 amp rating (IEC) or 1.6 amp rating (UL/CSA). (Characteristics: 250 V, quick acting, 5x20 mm, ceramic.) If other fuses are installed, the fuse rating should be marked on the point's data label. Table 7.2.2 shows fuse data.

For externally powered inputs, a fuse with the same maximum rating or equivalent current limiting must be provided where the circuit receives its power.

Table 7.2.2. Direct Discrete Termination Panel Fuses

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Littelfuse Part No.</th>
<th>Wickmann Part No.</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 to F32</td>
<td>G53394-1000-0005</td>
<td>216 001</td>
<td>19 194 1 A</td>
<td>1 A 250 V (IEC) Quick acting 5x20 mm Ceramic</td>
</tr>
</tbody>
</table>
Multi-FIM Discrete Termination Panel

The Multi-FIM Discrete Termination Panel (1984-4282-000x) holds three Discrete FIMs and provides marshaling panel connections for three sets of 32 I/O points. It is marked “MULTI-FIM TERMINATION PANEL” on the PWA.

The panel can be used in three ways:

1. Three independent (non-redundant) FIMs
2. FIM A and FIM B as a redundant pair and FIM C as a stand-alone (non-redundant) FIM. FIM A is primary, FIM B secondary.
3. FIM A and FIM B as an online replacement pair and FIM C as a stand-alone (non-redundant) FIM. One FIM is required in either the A or the B position. The other position is then available for an online replacement. One FIM is installed in the C position.

CAUTION

You should provide overcurrent protection or current limiting for field wires. Neither the termination panel nor the FIM provides this protection. The current should be limited to 1.6 amp per point. A 1.6 amp (1.0 amp IEC) fuse can be used.
Field Wiring

The Multi-FIM Discrete Termination Panel can be connected to up to six Standard Remote Termination Panels by marshaling panel cables. Use cable 1984-4299-xxxx for single FIM applications and cable 1984-4319-xxxx for redundant FIM applications. Figure 7.2.7 shows connections for an application using FIMs A and B as a redundant pair and FIM C as a single FIM.

Field wiring is landed on a Standard Remote Termination Panel. Wiring methods are identical to those used for the Direct Discrete Termination Panel. See the Service Manual (SV) writeup on that panel for details.

FIM C Points 1–16
(Input and Output)

FIM C Points 17–32
(Input Only)

Redundant FIM A/B Points
1–16
(Input and Output)

Redundant FIM A/B Points
17–32
(Input Only)

Figure 7.2.7. Field Wiring to a Multi-FIM Discrete Termination Panel

Strain Relief

For strain relief, route the field wires through the fingers of the wire manager assemblies (1984-4152-0003). To ease the task of routing wires, the top pair of wire manager assemblies are factory-mounted and the remaining assemblies are shipped loose. As you progress through the wiring, mount the assemblies using the 1/4-inch fasteners provided.
Communication Wiring

One communication line is connected to a communication port for each FIM. Port A (J581) supports FIM A, Port B (J582) supports FIM B, and Port C (J583) supports FIM C. The communication line used determines the panel slot address. Connector J587 is reserved for future use.

When redundant operation of FIMs A and B is required, FIM A (primary) must have an odd-numbered communication line and FIM B (secondary) must have the next higher even numbered line.

When online replacement operation of FIMs A and B is required, one communication line is connected to Port A or Port B. Jumper HD12 must be ON to connect Port A and Port B.

In either case, a communication line is connected to Port C for FIM C.

Label

Label holders are provided to record the address of FIMs A, B, and C. Write the FIM address on the label next to the FIM.
Jumpers

Jumpers HD1, HD2, and HD3 specify the termination panel address (A, B, C, or D) for FIMs A, B, and C. The address should be set to A when possible to get the highest scan rate. The factory sets each FIM for address A. Only one jumper is allowed in positions A–D. There is also a jumper in position F, which is reserved for a future application.

Jumpers HD4 through HD8 control redundancy or online replacement operation of FIMs A and B. They can be “parked” at 1–2 for normal operation or moved to 2–3 for redundant FIM operation.

Jumpers HD9, HD10, and HD11 provide a return path for the loop or supply power for intrinsically safe barriers. Only two configurations are allowed; any other configuration can cause damage to the FIM.

**WARNING**

*Remove power from the panel before moving jumpers on HD9, 10, or 11. The FIM can be damaged if 1--8 is ON when any of the other positions are ON.*

For normal loop operation, install the three jumpers in positions 2–7, 3–6, and 4–5 (1–8 is open). For intrinsically safe barriers, only 1–8 is installed. The other two jumpers can be parked by placing them horizontally across the other pins as shown on the PWA.

Jumper HD12 allows connection of communication ports A and B to support online replacement of FIMs A and B. For normal operation, all jumpers are removed from HD12. For online replacement of FIMs A and B, jumpers are placed on 1–12, 3–10, and 5–6.

Table 7.2.3 shows jumper values.
### Table 7.2.3. Multi-FIM Discrete Termination Panel Jumpers

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Value</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1, 2, 3</td>
<td></td>
<td>FIM address A (factory setting)</td>
</tr>
<tr>
<td></td>
<td>A ON</td>
<td>NOTE: Only one jumper is allowed in positions A–D</td>
</tr>
<tr>
<td></td>
<td>B ON</td>
<td>FIM address B</td>
</tr>
<tr>
<td></td>
<td>C ON</td>
<td>FIM address C</td>
</tr>
<tr>
<td></td>
<td>D ON</td>
<td>FIM address D</td>
</tr>
<tr>
<td></td>
<td>E OFF</td>
<td>Not used</td>
</tr>
<tr>
<td></td>
<td>F ON</td>
<td>Factory setting, do not move</td>
</tr>
<tr>
<td>HD4–8</td>
<td>1–2</td>
<td>Normal individual FIM operation</td>
</tr>
<tr>
<td></td>
<td>2–3</td>
<td>Redundant operation of FIMs A and B</td>
</tr>
<tr>
<td>HD9, 10, 11</td>
<td></td>
<td>Normal loop operation</td>
</tr>
<tr>
<td></td>
<td>1–8 OFF</td>
<td>Used with Intrinsically Safe barriers</td>
</tr>
<tr>
<td></td>
<td>2–7 ON</td>
<td>CAUTION</td>
</tr>
<tr>
<td></td>
<td>3–6 ON</td>
<td>Remove power from the panel before moving</td>
</tr>
<tr>
<td></td>
<td>4–5 ON</td>
<td>jumpers on HD9, 10, or 11. The FIM can be</td>
</tr>
<tr>
<td></td>
<td>1–8 ON</td>
<td>damaged if 1–8 is ON when any of the other</td>
</tr>
<tr>
<td></td>
<td>2–7 OFF</td>
<td>positions are ON.</td>
</tr>
<tr>
<td></td>
<td>3–6 OFF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4–5 OFF</td>
<td></td>
</tr>
<tr>
<td>HD12</td>
<td>OFF</td>
<td>Communication Ports A and B are independent</td>
</tr>
<tr>
<td></td>
<td>No jumpers</td>
<td>(Normal case) (stand-alone or redundant operation of FIMs A and B)</td>
</tr>
<tr>
<td></td>
<td>1–12 ON</td>
<td>Communication Ports A and B are connected</td>
</tr>
<tr>
<td></td>
<td>3–10 ON</td>
<td>(for online replacement operation of FIMs A and B)</td>
</tr>
<tr>
<td></td>
<td>5–6 ON</td>
<td></td>
</tr>
</tbody>
</table>
**Isolated Discrete Termination Panel**

The Isolated Discrete Termination Panel set consists of two panels connected by a short cable. The pair supports 32 discrete I/O points. The “A” panel supports 16 input/output points (1-16). The “B” panel supports 16 input-only points (17-32). Solid state relay modules are used for input and output control. The panels are CE approved when used with the MDIOL FIM.

The “A” panel (1984–4121–000x) is marked “ISOLATED DISCRETE TERMINATION PANEL A” on the PWA.

The “B” panel (1984–4124–000x) is marked “ISOLATED DISCRETE TERMINATION PANEL B” on the PWA.

The panels use the MDIOL Low-side switching Field Interface Module (FIM) (10P53520006) which is CE approved. The termination panel is keyed so only a low-side switching FIM can be installed.

An “A” panel can be used alone if no more than 16 points are required and the online replacement or redundant FIM feature are not required.

The “B” panel must always be used in conjunction with an “A” panel because there is no provision for connecting a communication line to the “B” panel.

The panels are normally connected by a (1984–4186–00xx) flat cable. The panels can also be mounted side by side using a round cable no more than 152 cm (5 feet) long. Cable 1984–0498–0005 can be used.

Each panel has a socket for one MDIOL FIM. Either socket can be used for a single FIM. The socket on the other panel is then available for an online replacement if needed.

For redundant operation, the primary FIM is inserted in the “FIM A” socket (“A” panel) and the redundant FIM is inserted in the “FIM B” socket (“B” panel).

Figure 7.2.8 shows the Isolated Discrete Termination Panels.
NOTE: SSR = Solid State Relay

Figure 7.2.8. Isolated Discrete Termination Panels
Field Wiring

Each panel supports 16 points in four groups of four points. Each group has a group supply line and a group return line. The groups may be entirely isolated so that each group may be used as desired. The terminals will accommodate one wire sized 4 to 0.34 mm² (12 to 22 AWG).

A pictorial representation and a circuit diagram of a typical group is shown in Figure 7.2.9. The group supplies and returns are on the four-position terminal blocks (TB 2, 4, 6 on panel A; TB 9, 11, 13 on panel B). Note that the group supply and group return lines terminate at the ends of the group. This makes it easy to daisy chain groups together.

Field wiring goes to the 16-position terminal blocks:
- Group supply and fuse (1, 5, 9, 13)
- Solid-State Relay + (3, 7, 11, 15)
- Solid-State Relay - (2, 6, 10, 14)
- Group return (4, 8, 12, 16)

The panels are shipped with all of the group supplies (1–2) jumpered together and the group returns (3–4) jumpered together. The A panel is shipped with all SSR “+” terminals jumpered to the group supply (1–3, 5–7, 9–11, 13–15) to make the SSRs available as output devices. The B panel is shipped with all SSR “–” terminals jumpered to the group return (2–4, 6–8, 10–12, 14–16) to make the SSRs available as input devices.

Strain Relief

For strain relief, route the field wires through the fingers of the wire manager assemblies (1984-4152-0003). To ease the task of routing wires, the top pair of wire manager assemblies are factory-mounted and the remaining assemblies are shipped loose. As you progress through the wiring, mount the assemblies using the 1/4-inch fasteners provided.
LVD Wiring Guidelines

The MDIO Isolated Discrete Termination Panels A and B (part numbers 01984-4121-0002 and 01984-4124-0002) are designed to provide a certain level of isolation between field and system, between other points on the same individual term panels and between field points of the two term panels. The following is a guideline for using these termination panels in compliance with the Low Voltage Directive (LVD).

Separated Extra-Low Voltage (SELV) is no more than 30 volts rms, 42.4 volts peak and 60 volts DC. Hazardous voltage is any voltage above SELV levels.

Use the following of rules to guide the installation of the MDIO Isolated Termination Panels A and B to ensure that termination panel installation and application result in safe operation.

These rules apply to Term Panel A and Term Panel B independently of each other. When considering these rules, remember that different types of voltages will result in different relationships to each other. That is, AC versus DC, opposite polarities of DC, and different phases of AC.

Field I/O Hazardous Voltage Applications

The applications at hazardous voltages described below are commonly for AC circuits. However, they also include DC circuits of hazardous levels.

**Application with Hazardous Voltage 150 to 300 Volts**

Applications where any field I/O termination point is a hazardous voltage above 150 volts but not more than 300 volts:

You may:

- Mix only hazardous voltage I/O circuits in this range if they are all AC or all DC voltages and the same phase or polarity, respectively.

You must not:

- Mix any SELV I/O circuit on the same term panel that has hazardous voltage I/O circuits above 150 volts.
Applications where any field I/O termination point is a hazardous voltage of 150 volts or less:

You may:

- Mix SELV I/O circuits with hazardous voltage I/O circuits where the numerical sum of the highest SELV voltage (AC or DC) and highest hazardous voltage (AC or DC) does not exceed 150 volts ($V_{\text{rms}} + V_{\text{DC}} \leq 150 \text{ V}$).
- Mix hazardous AC voltage I/O circuits of different phases, including 180° (split phase).
- Mix hazardous DC voltage I/O circuits of opposite polarities.
- Mix hazardous AC and DC voltage I/O circuits, provided the sum of the worst case potential difference between the two voltages is less than 300 volts.

You must not:

- Connect SELV I/O circuits to the same term panel that has hazardous voltage I/O circuits connected if the numerical sum of the highest SELV (AC or DC) and highest hazardous voltages (AC or DC) is greater than 150 volts, regardless of phase or polarity.

Field I/O Voltage Applications with SELV Only

Applications where all field I/O circuits are SELV levels:

You may:

- Mix any variety of SELV I/O circuits using separate power feed for each point.
- Mix SELV I/O circuits in four groups of 4 points each, with each group having a common power feed.

Maximum Current

NOTE: Loop power feed terminals (TB2, TB4, and TB6 on Term Panel A and TB9, TB11, and TB13 on Term Panel B) are used to feed the bus that provides the fused power available on each group of 4 point sets.

1. Maximum current through any single I/O point set:
   - 3.0 amps at 25°C ambient temperature.
   - 2.0 amps at 40°C ambient temperature.
   - 1.2 amps at 70°C ambient temperature.
2. 20 amps is the maximum current permitted through a single power Loop Power feed terminal.

3. Current limit through any group of 4 I/O points is 10 amps when using a common loop power feed terminal.
   
   - If 2 groups of 4 I/O points use the same power feed, the loop power feed terminal should be between the two groups sharing the feed. This permits 10 amps to each group to the left and to the right of the feed point.
   
   - If 3 groups of 4 I/O points use the same power feed, the total current feeding the adjacent groups to the left or to the right of the loop power feed terminal shall not exceed 10 amps in each direction.
   
   - If all I/O termination points are sharing a common loop power feed terminal, the field power must be supplied to the center-most loop power feed terminal set. The total current to the left and to the right of the feed terminal shall not exceed 10 amps for either direction.

4. Field I/O points are rated for 3 amperes or less, depending on the solid state relay used.

Termination Panel to Termination Panel Field I/O Points

Termination Panel A and Termination Panel B are treated independently from each other in the rules listed above. Therefore, where Termination Panel A and Termination Panel B are both used as a set, one of the termination panels may contain SELV field I/O circuits while the other contains only hazardous voltage field I/O circuits up to 300 volts.

I/O Wiring for All Isolated Discrete Termination Panels

Field wiring used for field I/O circuits of hazardous voltage must have a minimum insulation rating twice that of the working voltage of the circuit.

Extended Ambient Temperature Environments

Contact the Fisher-Rosemount Systems factory for assistance with thermal loading requirements when installing the Isolated Discrete Termination Panels A and B and High Density Isolated Discrete Termination Panels in I/O cabinets with extended ambient temperatures.
Figure 7.2.9. Field Wiring Terminals
Input Points

Input points are available on both panels as shown in Figure 7.2.10. The input Solid-State Relay acts as a sensor.

Contact-Closure Input Point

Field-Powered Input Point

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuse and group supply (terminals 1, 5, 9, 13)</td>
<td>4</td>
<td>Group return (terminals 4, 8, 12, 16)</td>
</tr>
<tr>
<td>2</td>
<td>Solid-State Relay – (terminals 2, 6, 10, 14)</td>
<td>5</td>
<td>Input contact closure</td>
</tr>
<tr>
<td>3</td>
<td>Solid-State Relay + (terminals 3, 7, 11, 15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuse and group supply (unused)</td>
<td>4</td>
<td>Group return (unused)</td>
</tr>
<tr>
<td>2</td>
<td>Solid-State Relay – (terminals 2, 6, 10, 14)</td>
<td>5</td>
<td>Input contact closure including power source</td>
</tr>
<tr>
<td>3</td>
<td>Solid-State Relay + (terminals 3, 7, 11, 15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7.2.10. Input Point Wiring
Output Points

Output points are available only on panel A. They can be system or field powered as shown in Figure 7.2.11. The output Solid-State Relay acts as a switch.

**System-Powered Output Point**

![System-Powered Output Point Diagram]

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuse and group supply (terminals 1, 5, 9, 13)</td>
<td>4</td>
<td>Group return (terminals 4, 8, 12, 16)</td>
</tr>
<tr>
<td>2</td>
<td>Solid-State Relay - (terminals 2, 6, 10, 14)</td>
<td>5</td>
<td>Output load</td>
</tr>
<tr>
<td>3</td>
<td>Solid-State Relay + (terminals 3, 7, 11, 15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Field-Powered Output Point**

![Field-Powered Output Point Diagram]

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuse and group supply (unused)</td>
<td>4</td>
<td>Group return (unused)</td>
</tr>
<tr>
<td>2</td>
<td>Solid-State Relay - (terminals 2, 6, 10, 14)</td>
<td>5</td>
<td>Output load including power source</td>
</tr>
<tr>
<td>3</td>
<td>Solid-State Relay + (terminals 3, 7, 11, 15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7.2.11. Output Point Wiring
A replaceable label is provided on each Isolated Termination Panel assembly (1984-4195-0002 for panel “A”, 1984-4195-0003 for panel “B”). Figure 7.2.12 shows the panel “A” label. The label provides space at the end to record the panel Control File Node address (1-32), Controller Slot Address (A-H), Termination Panel (Card Cage) address (A-D), and Communication Line (1-8). There is provision for recording both the Primary and Redundant communication line addresses. The body of the label provides for recording the group supply sources (V1-V4) and each point’s field connection (1-16, or 17-32). The underside of the label holder carries a schematic of the field wiring terminations.

![Figure 7.2.12. Label, Isolated Discrete Termination Field Wiring Panel A](image-url)
Solid State Relays

Solid State Relays, also called Optical Isolator Modules, (55P0427xxxx or G12243–00xx) are solid-state, optically isolated relays that define each contact point as an input or an output. Care must be taken to make sure the proper type of module is installed because input and output modules are mechanically interchangeable. Table 7.2.4 shows a list of available modules.

Table 7.2.4. Solid state Relays

<table>
<thead>
<tr>
<th>Part Number 55P–0427-</th>
<th>Model</th>
<th>Function</th>
<th>Output Contact*</th>
<th>Voltage</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>–0005</td>
<td>IAC5A</td>
<td>AC Input</td>
<td>None</td>
<td>180–280 VAC/DC</td>
<td>Yellow</td>
</tr>
<tr>
<td>–0006</td>
<td>IDC5</td>
<td>DC Input</td>
<td>None</td>
<td>10–32 VDC</td>
<td>White</td>
</tr>
<tr>
<td>–0008</td>
<td>IAC5</td>
<td>AC Input</td>
<td>None</td>
<td>90–140 VAC/DC</td>
<td>Yellow</td>
</tr>
<tr>
<td>–0009</td>
<td>ODC5</td>
<td>DC Output</td>
<td>N.O.</td>
<td>5–60 VDC</td>
<td>Red</td>
</tr>
<tr>
<td>–0010</td>
<td>ODC5A</td>
<td>DC Output</td>
<td>N.O.</td>
<td>5–200 VDC</td>
<td>Red</td>
</tr>
<tr>
<td>–0011</td>
<td>OAC5A5</td>
<td>AC Output</td>
<td>N.C.</td>
<td>24–280 VAC</td>
<td>Black</td>
</tr>
<tr>
<td>–0013</td>
<td>OAC5-A</td>
<td>AC Output</td>
<td>N.O.</td>
<td>24–280 VAC</td>
<td>Black</td>
</tr>
<tr>
<td>–0014</td>
<td>IDC5G</td>
<td>DC Input</td>
<td>None</td>
<td>35–60 VAC/DC</td>
<td>White</td>
</tr>
</tbody>
</table>

* Normally open (N.O.) contacts are open when the block output is FALSE (or 1). Normally closed (N.C.) contacts are closed when the block output is FALSE (or 0).
Jumper HD1 specifies the card cage address (A-D) of the termination panel. The slot address is specified by the communication line. The factory sets HD1 for card cage A.

Positions E and F specify the communication rate used. Position F specifies the standard RS3 rate of 10.4 kb. This jumper should not be moved.

**NOTE:** Both jumpers on HD1 must be set the same on panels “A” and “B”.

Jumper HD2 on panel “A” specifies normal or redundant operation of both the “A” and “B” panels. Both jumpers at HD2 must be removed to allow FIM redundancy. Table 7.2.5 shows jumper values.

**Table 7.2.5. Isolated Discrete Termination Panel Jumpers**

<table>
<thead>
<tr>
<th>HD1 (Panels “A” &amp; “B”)</th>
<th>A</th>
<th>Card cage A (factory setting)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Card cage B</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Card cage C</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>Card cage D</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>Not used</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Factory setting, do not move</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HD2 (Panel “A” only)</th>
<th>Both Jumpers ON</th>
<th>Normal single FIM operation with online replacement capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Both Jumpers OFF</td>
<td>Redundant FIM operation</td>
</tr>
</tbody>
</table>
Fuses

There are 16 fuses on each panel to protect the field circuits. The factory installs 3.15 amp fuses (IEC) in all positions. Other fuses appropriate for the load protected can be installed but must not exceed a 4 amp UL/CSA rating. If other fuses are installed, the fuse rating should be marked on the point's data label. Table 7.2.6 shows fuse data.

Table 7.2.6. Isolated Discrete Termination Panel Fuses

<table>
<thead>
<tr>
<th>Fuse</th>
<th>FRSI Part No.</th>
<th>Littelfuse Part No.</th>
<th>Wickmann Series</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 to F32</td>
<td>G5394–3150–0005</td>
<td>216 3.15</td>
<td>19 194</td>
<td>3.15 A 250 V (IEC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.15 A</td>
<td>Quick acting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5x20 mm Ceramic</td>
<td></td>
</tr>
</tbody>
</table>
High Density Isolated Discrete Termination Panel

The High Density Isolated Discrete Termination Panel (1984-4167-000x) services 32 discrete I/O points: 16 input/output points (1-16) and 16 input-only points (17-32). Miniature solid state relay modules are used for input and output control. The panel is CE approved when MDIOL FIMs are used.

The panel is marked “HIGH DENSITY ISOLATED DISCRETE TERMINATION PANEL” on the PWA.

The panel has a socket for one MDIOL FIM (10P53520006). Online replacement and redundant FIM operation is not supported by this panel. There are no fuses supplied for the field wiring.

Figure 7.2.13 shows the High Density Isolated Discrete Termination Panel.

CAUTION

Solid state relays or modules may be hot. Avoid touching these surfaces with bare skin.
Figure 7.2.13. High Density Isolated Discrete Termination Panel
Field Wiring

Field wiring is landed on a Standard Remote Termination Panel, which is connected to the termination panel with a marshaling panel cable. Figure 7.2.14 shows the cabling. Connector #1 (J559) supports input/output points 1–16. Connector #2 (J560) supports input points 17–32. Use Marshaling Panel Cable 1984–4298–xxxx for standard applications and 1984–4345–xxxx for NEC/CSA applications.

The marshaling panel cable pin-out is shown in Table 7.2.7. Field wiring is connected the same way as for the Isolated Discrete Termination Panel.

![Figure 7.2.14. Field Wiring to a Multi-FIM Discrete Termination Panel](image)

**Strain Relief**

For strain relief, route the field wires through the fingers of the wire manager assemblies (1984-4152-0003). To ease the task of routing wires, the top pair of wire manager assemblies are factory-mounted and the remaining assemblies are shipped loose. As you progress through the wiring, mount the assemblies using the 1/4-inch fasteners provided.
<table>
<thead>
<tr>
<th>Point</th>
<th>Signal Pin</th>
<th>Return Pin</th>
<th>Point</th>
<th>Signal Pin</th>
<th>Return Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/17</td>
<td>D2</td>
<td>Z2</td>
<td>9/25</td>
<td>D18</td>
<td>Z18</td>
</tr>
<tr>
<td>2/18</td>
<td>D4</td>
<td>Z4</td>
<td>10/26</td>
<td>D20</td>
<td>Z20</td>
</tr>
<tr>
<td>3/19</td>
<td>D6</td>
<td>Z6</td>
<td>11/27</td>
<td>D22</td>
<td>Z22</td>
</tr>
<tr>
<td>4/20</td>
<td>D8</td>
<td>Z8</td>
<td>12/28</td>
<td>D24</td>
<td>Z24</td>
</tr>
<tr>
<td>5/21</td>
<td>D10</td>
<td>Z10</td>
<td>13/29</td>
<td>D26</td>
<td>Z26</td>
</tr>
<tr>
<td>6/22</td>
<td>D12</td>
<td>Z12</td>
<td>14/30</td>
<td>D28</td>
<td>Z28</td>
</tr>
<tr>
<td>7/23</td>
<td>D14</td>
<td>Z14</td>
<td>15/31</td>
<td>D30</td>
<td>Z30</td>
</tr>
<tr>
<td>8/24</td>
<td>D16</td>
<td>Z16</td>
<td>16/32</td>
<td>D32</td>
<td>Z32</td>
</tr>
</tbody>
</table>
LVD Wiring Guidelines

The following is a set of rules that guide the installation of the High Density Isolated Discrete Termination Panel with Standard Remote Termination Panels. The purpose is to ensure that installation and application of these devices result in safe operation.

The rules below apply to the High Density Isolated Termination Panel; two groups of points of 16 points each (1-16 and 17-32) independently of each other, just as Isolated Discrete Termination Panel A is considered independently from Isolated Discrete Termination Panel B in a previous section. Each group of 16 points employs a Standard Remote Termination Panel to terminate the field wiring. A multiconductor cable with DIN connector on each end is used to connect the Standard Remote Termination panel to a DIN connector on the High Density Isolated Discrete Termination Panel. Two such connections provide connectivity for all 32 Discrete I/O points.

Separated Extra-Low Voltage (SELV) is no more than 30 volts rms, 42.4 volts peak and 60 volts DC. Hazardous voltage is any voltage above SELV levels.

Also, when considering these rules, remember that different types of voltages result in different relationships to each other. That is, AC versus DC, opposite polarities of DC, and different phases of AC.

Field I/O Hazardous Voltage Applications

The applications at hazardous voltages described below are commonly for AC circuits. However, some applications may include DC circuits of hazardous levels. Therefore, both have been included.

Applications with hazardous voltage 150 to 300 volts

Applications where any field I/O termination point within a group of 16 points (1-16 or 17-32) is a hazardous voltage above 150 volts, but not more than 300 volts:

You may mix hazardous voltage I/O circuits in this voltage range if they are all AC or all DC voltages and the same phase or polarity, respectively, within that group of 16 points.

You must not mix any SELV I/O circuit in the same group of 16 points (1-16 or 17-32) with hazardous voltage I/O circuits where the numerical sum of the SELV level and hazardous voltage is greater than 150 volts, regardless of phase or polarity.
Applications where any field I/O termination point within the same group of 16 points (1–16 or 17–32) has a hazardous voltage of 150 volts or less:

**You may:**

- Mix SELV I/O circuits with hazardous voltage I/O circuits, within that group of 16 points, where the numerical sum of the highest SELV level (AC or DC) and highest hazardous voltage (AC or DC) does not exceed 150 volts. \((V_{rms} + V_{DC} (150 \text{ volts})\).
- Mix hazardous AC voltage I/O circuits of different phases, including 180°.
- Mix hazardous DC voltage I/O circuits of opposite polarities.
- Mix hazardous AC and DC voltage I/O circuits, provided the sum of the worst case potential difference between the two voltages is less than 300 volts.

**You must not** connect SELV I/O circuits within the same group of 16 points where hazardous voltage I/O circuits are also connected if the numerical sum of the highest SELV (AC or DC) and highest hazardous voltage (AC or DC) is greater than 150 volts, regardless of phase or polarity.

**Field I/O Voltage Applications with SELV Only**

Where all field I/O circuits are SELV levels in a group of 16 points (1–16 or 17–32):

**You may:**

- Mix any variety of SELV I/O circuits within that group of 16 points.
- Mix any variety of SELV I/O circuits on all 32 points.

**Maximum Current**

The maximum current for any field I/O point on the termination panel (points 1–32) is 1 ampere or less at 50°C term panel ambient temperature depending upon the type of circuit and solid state relay used. Input Modules are limited to less by their internal resistance.

- All points that use Output Modules, except 240 VAC, are limited to 1 amp.
- Points for 240 VAC Output Modules are limited to 0.5 amp.
Group-to-Group Field I/O Points

One group of 16 field I/O points (1–16 or 17–32) may contain SELV levels while the other group of 16 field I/O points contains only hazardous voltages up to 300 volts.

Each of the two group of 16 field I/O points (1–16 and 17–32) may contain only hazardous voltages up to 300 volts, as described in “A.” above. Because the two groups are independent up to 300 volts:

- Both groups may contain hazardous AC field I/O circuits up to 300 volts in each group with the circuits of one group being of a different phase from the circuits of the other group.
- Both groups may contain hazardous DC field I/O circuits up to 300 volts in each group with the circuits of one group being of opposite polarity from the circuits of the other group.
- One group may contain all DC voltages up to 300 volts while the other group contains all AC voltages up to 300 volts.

Field Wiring for High Density Termination Panels

The field I/O wiring terminates at a Standard Remote Termination Panel that can terminate up to 16 field I/O points (1–16 or 17–32). Two Standard Remote Termination Panels, one for each group of 16 field I/O points (1–16 and 17–32), are required to connect all 32 field I/O points of the High Density Isolated Discrete Termination Panel.

The user shall supply overcurrent protection in-line for each field I/O point at a location prior to connection of field I/O wiring to the Standard Remote Termination Panel. Overcurrent protection consists of a fuse and fuse holder approved for the application. To maintain proper protection, the fuse is to have a current rating of not more than 3.15 amps @ 250 volts IEC, or not more than 4 amps @ 250 volts CSA or UL, as applicable. The fuse holder is to have a minimum rating the same as that of the fuse.

Thermal Considerations

240 VAC Solid State Relays, also called Optical Isolator Modules, should only be used if every other module is installed on the High Density Isolated Termination Panel. This is needed to avoid exceeding the thermal specifications of the module.
I/O Wiring for All Isolated Discrete Termination Panels

Field wiring used for field I/O circuits of hazardous voltage is to have a minimum insulation rating twice that of the working voltage of the circuit.

Extended Ambient Temperature Environments

Contact the Fisher-Rosemount Systems factory for assistance with thermal loading requirements when installing the Isolated Discrete Termination Panels A and B, and High Density Isolated Discrete Termination Panels in I/O cabinets with extended ambient temperatures.

Label

Write the FIM address on the label and insert it in the label holder.
Jumpers

Jumper HD1 specifies the termination panel address (A–D) of the panel. The slot address is specified by the communication line. The factory sets HD1 for address A.

Positions E and F specify the communication rate used. Position F specifies the standard RS3 rate of 10.4 kb. This jumper should not be moved.

Only two jumpers can be in place on HD1, one for the panel address and one in position F.

Position 2–3 is ON. Position 1–2 is reserved for future use. Table 7.2.8 shows jumper values.

Table 7.2.8. High Density Isolated Discrete Termination Panel Address Jumpers

<table>
<thead>
<tr>
<th>Position</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Termination panel address is A (factory setting) (2–3 is ON)</td>
</tr>
<tr>
<td>B</td>
<td>Termination panel address is B</td>
</tr>
<tr>
<td>C</td>
<td>Termination panel address is C</td>
</tr>
<tr>
<td>D</td>
<td>Termination panel address is D</td>
</tr>
<tr>
<td>E</td>
<td>Not used</td>
</tr>
<tr>
<td>F</td>
<td>Factory setting, do not move</td>
</tr>
</tbody>
</table>
Solid State Relays

Miniature solid state relays, also called Optical Isolator Modules, (G60350-xxxx) are solid-state, optically isolated relays that define each contact point as an input or an output. See Table 7.2.9 for a listing of the available units.

**NOTE:** Care must be taken to make sure that the proper type of module is installed because input and output modules are mechanically interchangeable.

**CAUTION**

The solid state relays can be hot enough to cause serious burns.

<table>
<thead>
<tr>
<th>Part Number G60350-</th>
<th>Model</th>
<th>Function</th>
<th>Output Contact</th>
<th>Voltage</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>70M-IAC5-A</td>
<td>AC Input</td>
<td>None</td>
<td>180–280 VAC</td>
<td>Yellow</td>
</tr>
<tr>
<td>0002</td>
<td>70M-IDC5</td>
<td>DC Input</td>
<td>None</td>
<td>10–32 VDC</td>
<td>White</td>
</tr>
<tr>
<td>0003</td>
<td>70M-IAC5</td>
<td>AC Input</td>
<td>None</td>
<td>90–140 VAC</td>
<td>Yellow</td>
</tr>
<tr>
<td>0004</td>
<td>70M-ODC5</td>
<td>DC output</td>
<td>NO</td>
<td>5–60 VDC</td>
<td>Red</td>
</tr>
<tr>
<td>0007</td>
<td>70M-OAC5-A</td>
<td>AC output</td>
<td>NO</td>
<td>24–280 VAC</td>
<td>Black</td>
</tr>
</tbody>
</table>
Section 3: Multipoint Analog I/O (MAIO)

This section describes installing the:

- MAIO16 Termination Panels
  - 4–20 mA 10P54770001 (field wires landed on panel)
  - 4–20 mA 10P54770002 (field wires landed on an MIO marshaling panel)
  - Loop Power Module (LPM) 1984–4398–0001 or 10P57070001

- MAIO16 FIMs
  - 4–20 mA Input 10P54040004 or 10P57700005
  - 4–20 mA Output 10P54080004

- MAI32 Termination Panels
  - 4–20 mA 10P53490001 (field wires landed on panel)
  - 4–20 mA 10P53490002 (field wires landed on an MIO marshaling panel)

- MAI32 FIM
  - 4–20 mA (32 Input Points) 10P53190004

The MAIO16 panel can serve 16 input points or 16 output points depending on the FIM used. The MAI32 panel serves 32 input points.

Multipoint Analog I/O is used to read and control analog I/O points (4–20 mA). It allows location of the I/O electronics Field Interface Module (FIM) at the field wiring termination panel. The termination panel can be mounted where the user desires (within communication wiring length limits).
MAIO16 Termination Panel

MAIO16 Termination Panel:

This section covers installation of the:

- MAIO16 4–20 mA Termination Panel:
  - with field terminals: 10P54770001
  - with field terminals and marshaling panel connector: 10P54770002
- Loop Power Module (LPM): 1984-4398-0001 or 10P57070001
- MAIO16 Field Interface Module (FIM):
  - 4–20 mA Input 16 Point: 10P54040004 or 10P57700005
  - 4–20 mA Output 16 Point: 10P54080004

The panel is CE approved.

Figure 7.3.1 shows the panel. Table 7.3.1 lists the figure callouts.

I/O Points

The panel supports 16 analog input points or 16 analog output points. Field wiring is landed directly on the -0001 panel using terminal blocks TB1 through TB16. A multi-conductor cable and a remote marshaling panel is used with the -0002 panel to land the field wiring at a remote location.

A three-position terminal (+, -, and S) is used to connect field wiring to the panel. All of the field wire shields are connected together within the panel. TB18 provides a way to connect all field wire shields to the panel chassis ground or to leave them floating.

Loop Power

A locally grounded source of loop power is required unless all points on the panel are self-powered inputs. Loop power can be supplied by a Loop Power Module (LPM) or from an external DC source with nominal voltage from 24 to 28V. At no time may the loop power voltage exceed 29 VDC. A second LPM can be used to provide backup to the first LPM. If the LPM is used with redundant FIMs, two LPMs are required.

Labels

A replaceable label (1984-4195-0010) is provided on top of the termination panel label holder assembly. The label provides space at the end to record the ControlFile Node address, Controller Slot Address, Termination Panel (FIM) address (A–D), and Communication Line. There is provision for recording both the primary and redundant communication line addresses. The body of the label provides for recording each point’s field connection (1–16) and the source of external loop power (V+, V−).

Keying

The termination panel is keyed to prevent installation of any other type of FIM. The keying does not prevent installing an input FIM when an output FIM is desired. An alarm will be generated if an Analog Input Block (AIB) finds an output FIM or an Analog Output Block (AOB) finds an input FIM.
Figure 7.3.1. MAIO16 Termination Panel
Table 7.3.1. MAIO16 Termination Panel Components

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TBA Power Strip: For panel DC supply using stranded wire. Allows daisy chaining of DC power and access to panel chassis ground.</td>
<td>10</td>
<td>FIM A (J593): Input or Output FIM.</td>
</tr>
<tr>
<td>2</td>
<td>Power Jack (J974): For panel DC supply using a 1984-0158-xxxx cable.</td>
<td>11</td>
<td>FIM B (J594): Optional redundant Input or Output FIM.</td>
</tr>
<tr>
<td>3</td>
<td>TB18: Connects all field wiring shields (SH) to chassis ground (CH) when jumpered.</td>
<td>12</td>
<td>LPM 2 (J596): Optional second Loop Power Module.</td>
</tr>
<tr>
<td>4</td>
<td>TB17: External loop power terminal. V+ is loop power pos. V- is loop power neg.</td>
<td>13</td>
<td>Port C (J598): Not used.</td>
</tr>
<tr>
<td>5</td>
<td>TB1–TB16: Field wiring terminals for points 1–16 (+, −, shield).</td>
<td>14</td>
<td>Port A (J599): Odd-numbered communication line for FIM A.</td>
</tr>
<tr>
<td>6</td>
<td>Marshaling panel connector (J597): Installed on –0002 panel only.</td>
<td>15</td>
<td>HD18–HD19: FIM redundancy jumpers.</td>
</tr>
<tr>
<td>7</td>
<td>HD1–HD16: Point Type jumpers. Control the supply of loop power to each field point.</td>
<td>16</td>
<td>Port B (J600): Even-numbered communication line for redundant FIM B.</td>
</tr>
<tr>
<td>8</td>
<td>LPM 1 (J595): Loop Power Module.</td>
<td>17</td>
<td>Loop power supply jumpers TB19, TB20, TB21 and TB22. Jumper at TB21 shown in “holder” position. Jumper at TB22 shown in the “fully installed” position. <strong>CAUTION: SEE Loop Power SECTION FOR INFORMATION ON PROPER PLACEMENT OF JUMPERS FOR ALL LOOP POWER OPTIONS.</strong></td>
</tr>
</tbody>
</table>
MAIO Termination Panel Installation

See 7-1-1, *Multipoint I/O Installation and System Wiring*, for installation, panel addressing, power wiring, communication wiring, redundancy, and online replacement information.

**CAUTION**

Operation of the panel depends on the type of FIM (input or output) installed. Be careful to install the correct type FIM and be sure that both FIMs of a redundant pair are of the correct type.

Loop Power

Loop Power can be supplied in any one of three ways:

1. **Loop Power Module(s)**

   This option is used when the FIM and loop power are supplied by the RS3 system DC bus or any DC supply unsuitable for direct loop power.

   In this case, loop power is derived from system power applied at TBA Power Strip through single or redundant Loop Power Module(s). A second LPM can be used to provide backup to the first LPM.

   When using one or two LPMs, remove all four jumpers at TB19 through TB22. Also install a short wire jumper from the V-terminal of TB17 to the SH terminal of TB18 to provide a loop power ground reference, or leave a four tab jumper connecting the V-terminal of TB17 with the CH and SH terminals of TB18.

2. **Combined FIM power and loop power**

   This option is used when a DC power supply such as the Remote I/O Power Supply is located with the MAIO termination panel. A single supply or redundant pair of supplies powers both FIMs and loops.

   In this case, loop power comes directly from a suitable power supply (+24 to +28 VDC nominal) connected at TBA Power Strip through loop power jumpers TB19-TB22.

   For this option, all four jumpers at TB19 through TB22 must be in the “fully installed” position with both tabs of the jumper installed in the terminal block. The loop power supply must be ground referenced at its negative side. At no time may the loop power supply voltage exceed 29 VDC.
3. External Loop Power

This option requires separate power wiring for FIM power and loop power. There is no provision for redundant loop supplies on the termination panel.

In this case a suitable power supply (+24 to +28 VDC nominal) is connected at external loop power terminal TB17.

For this option, all four jumpers at TB19 through TB22 must be in the “holder” position with only one tab of the jumper installed in the terminal block. This prevents inappropriate installation of an LPM later. The loop power supply must be ground referenced at its negative side. At no time may the loop power supply voltage exceed 29 VDC.

Loop power options 2 and 3 above require a ground referenced external supply. This ground reference must be at or near the termination panels. For supplies rated or fused at more than 7 Amps, the ground reference must be external to any termination panel and TB17 V- terminal should not be jumpered to TB18 CH. Move the 4-tab jumper at TB17 and TB18, if installed, to the position where tabs are in TB18 only and one un-installed tab is on each side of TB18. Smaller supplies, including the Remote I/O Power Supply, should be ground referenced at the termination panel by installing a wire jumper from TB17 V- to TB18 SH, or leaving the 4-tab jumper connecting TB17 V- to TB18 SH and TB18 CH.

A jumper (HD1–HD16) controls application of loop power to each point. A second LPM can be installed to provide loop power redundancy. Using the LPM with redundant FIMs requires use of redundant LPMs as well. Figure 7.3.2 shows the LPM.

NOTE: If all input points are self-powered, there is no need for an LPM or an external loop power supply. A local loop ground reference is still required at the V- terminal of TB17. In this case, place jumpers and the V- connection of TB17 as described in case 1 above for using an LPM.

![Fisher-Rosemount Loop Power Module](image)

**Figure 7.3.2. Loop Power Module**

The LPM draws power from the termination panel where it is installed. It accepts redundant A and B supply voltages. Two LPMs can be used on a termination panel to provide redundant operation when one will supply the loop power if the other fails. They operate in a “hot standby” mode and do not significantly share the load.

The LPM produces up to 380 mA of DC current at 25.0 to 25.5 VDC. It is not adjustable.
Field Wiring

Caution

Both signal wires of all input points must be constrained to operate within the common mode range +29 to -2 VDC or erroneous results will be reported.

The condition in the CAUTION is automatically met for all system powered inputs with an appropriate source of loop power. The ground reference is the V- terminal of TB17.

A self-powered input with a remote ground reference can operate with a ground differential of up to +/- 2 VDC. A self-powered input with no other ground reference must be ground referenced at its point type jumper HD1 to HD16.

Wire Landing

Field wiring is landed at terminal blocks TB1–TB16 on the -0001 MAIO16 termination panel. A Remote Marshaling Panel and cable are used with the -0002 MAIO16 panel. The I/O Point Type jumpers (HD1–HD16) are used with both panels. Field wiring is landed as shown in Figure 7.3.3.

Figure 7.3.3. MAIO16 Field Wiring
The pin-out specification for the marshaling panel cable is shown in Table 7.3.2.

### Table 7.3.2. Marshaling Cable Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D2</td>
<td>1+</td>
<td>10</td>
<td>D20</td>
<td>10+</td>
<td>33</td>
<td>Z2</td>
<td>1-</td>
<td>42</td>
<td>Z20</td>
<td>10-</td>
</tr>
<tr>
<td>2</td>
<td>D4</td>
<td>2+</td>
<td>11</td>
<td>D22</td>
<td>11+</td>
<td>34</td>
<td>Z4</td>
<td>2-</td>
<td>43</td>
<td>Z22</td>
<td>11-</td>
</tr>
<tr>
<td>3</td>
<td>D6</td>
<td>3+</td>
<td>12</td>
<td>D24</td>
<td>12+</td>
<td>35</td>
<td>Z6</td>
<td>3-</td>
<td>44</td>
<td>Z24</td>
<td>12-</td>
</tr>
<tr>
<td>4</td>
<td>D8</td>
<td>4+</td>
<td>13</td>
<td>D26</td>
<td>13+</td>
<td>36</td>
<td>Z8</td>
<td>4-</td>
<td>45</td>
<td>Z26</td>
<td>13-</td>
</tr>
<tr>
<td>5</td>
<td>D10</td>
<td>5+</td>
<td>14</td>
<td>D28</td>
<td>14+</td>
<td>37</td>
<td>Z10</td>
<td>5-</td>
<td>46</td>
<td>Z28</td>
<td>14-</td>
</tr>
<tr>
<td>6</td>
<td>D12</td>
<td>6+</td>
<td>15</td>
<td>D30</td>
<td>15+</td>
<td>38</td>
<td>Z12</td>
<td>6-</td>
<td>47</td>
<td>Z30</td>
<td>15-</td>
</tr>
<tr>
<td>7</td>
<td>D14</td>
<td>7+</td>
<td>16</td>
<td>D32</td>
<td>16+</td>
<td>39</td>
<td>Z14</td>
<td>7-</td>
<td>48</td>
<td>Z32</td>
<td>16-</td>
</tr>
<tr>
<td>8</td>
<td>D16</td>
<td>8+</td>
<td>17</td>
<td>B2-B30</td>
<td>Open</td>
<td>40</td>
<td>Z16</td>
<td>8-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>D18</td>
<td>9+</td>
<td>18</td>
<td>B32</td>
<td>Shield</td>
<td>41</td>
<td>Z18</td>
<td>9-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Shield Grounding
All field wire shield terminals are connected together and to TB18 SH at the termination panel. As shipped from the factory, TB18 SH and TB18 CH are tied together and newer panels also connect this to TB17 V-. This grounds shields and loop power negative to chassis. In a few cases where chassis ground is very noisy, the shields may need to be tied to a quieter ground. TB18 SH may be connected to this ground. If so, TB17 V- should also be connected to the quieter ground.

### Strain Relief
For strain relief, route the field wires through the fingers of the wire manager assemblies (1984-4152-0003). To ease the task of routing wires, the top pair of wire manager assemblies are factory-mounted and the remaining assemblies are shipped loose. As you progress through the wiring, mount the assemblies using the 1/4-inch fasteners provided.
I/O Point Type

The ganged Point Type jumpers (HD1–HD16) are set to define each point. Each jumper can be set fully to the left, centered, or fully to the right. A point can be defined as:

- Output
- System-powered input
- Self-powered input (with external ground reference)
- Self-powered input (with ground reference at termination panel).

Figure 7.3.4 shows the field I/O point circuit. A three-position ganged jumper is used to connect all but two of the pins. The jumper can be at one of three positions: full left, centered, or full right.

![Figure 7.3.4. Field I/O Point Circuit](image-url)
Output Point

One of the three sources of loop power (described earlier) is required for output points. The Output FIM distributes the power to each point. All returns are connected to the loop power return. All Point Type jumpers (HD1–HD16) must be set to the full left position as shown in Figure 7.3.5.

![Diagram of MAIO16 Output Point]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Output constant-current driver in FIM</td>
<td>3</td>
<td>Field wiring terminal block</td>
</tr>
<tr>
<td>2</td>
<td>Jumper at full left position</td>
<td>4</td>
<td>Valve or I/P</td>
</tr>
</tbody>
</table>

Figure 7.3.5. MAIO16 Output Point
System-Powered Input Point

A system-powered input point requires one of the three sources of loop power (described earlier). The Point Type jumper (HD1–HD16) must be set in the center as shown in Figure 7.3.6.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input sense resistor in FIM</td>
<td>3</td>
<td>Field wiring terminal block</td>
</tr>
<tr>
<td>2</td>
<td>Jumper centered</td>
<td>4</td>
<td>Transmitter</td>
</tr>
</tbody>
</table>

Figure 7.3.6. MAIO16 System-Powered Input Point
A self-powered input point obtains its loop power from the transmitter or other device. The point can be isolated from the other points by placing the Point Type jumper (HD1--HD16) in the full left position as shown in Figure 7.3.7. This should be done only when the loop is ground referenced elsewhere in the loop, such as at the transmitter. Both the negative and positive sides of the loop must remain within the +29 VDC to −2 VDC range, relative to loop power negative TB17 V−.

**CAUTION**

The V− terminal of TB17 must be tied to a suitable ground if Loop Power Modules are used.

![Diagram](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input sense resistor in FIM</td>
<td>3</td>
<td>Field wiring terminal block</td>
</tr>
<tr>
<td>2</td>
<td>Jumper at full left position</td>
<td>4</td>
<td>Transmitter</td>
</tr>
</tbody>
</table>

**Figure 7.3.7. MAIO16 Self-Powered Input Point with External Ground Reference**

This configuration is useful when an additional device is placed in the loop between the − terminal and ground, or when a loop is referenced to a positive supply, or when the loop is ground referenced at a remote transmitter and there is some ground differential between the remote ground and local ground. The differential must be less than 2 VDC.
A self-powered input point obtains its loop power from the transmitter or other device. The point can be referenced to the loop power return by placing the Point Type jumper (HD1-HD16) in the full right position as shown in Figure 7.3.8. This jumper position should be used when there is no other ground reference in a loop, such as when the loop is powered by a floating supply at the field device.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input sense resistor in FIM</td>
<td>3</td>
<td>Field wiring terminal block</td>
</tr>
<tr>
<td>2</td>
<td>Jumper at full right position</td>
<td>4</td>
<td>Transmitter</td>
</tr>
</tbody>
</table>

Figure 7.3.8. MAIO16 Self-Powered Input Point with Ground Reference at Termination Panel
Connecting Field Devices

Table 7.3.3 shows the 4–20 mA devices that can be connected to a Multipoint Analog Termination Panel. The letters refer to diagrams in Figure 7.3.9 to Figure 7.3.13.

CAUTION

To prevent equipment damage that could affect all points on the FIM, check field wiring for appropriate voltage before connecting it to the panel.
Table 7.3.3. Device Types

<table>
<thead>
<tr>
<th>Letter in Figure</th>
<th>Input or Output</th>
<th>2-wire or 4-wire Transmitter</th>
<th>With or w/o Positive Barriers</th>
<th>With or w/o Other Instruments</th>
<th>Power Supply</th>
<th>Using Input or Output FIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>system</td>
<td>Input</td>
</tr>
<tr>
<td>B</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>separate</td>
<td>Input</td>
</tr>
<tr>
<td>C</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>system</td>
<td>Input</td>
</tr>
<tr>
<td>D</td>
<td>input</td>
<td>2-wire</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>separate</td>
<td>Input</td>
</tr>
<tr>
<td>E</td>
<td>input</td>
<td>2-wire</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>separate</td>
<td>Input</td>
</tr>
<tr>
<td>F</td>
<td>input</td>
<td>2-wire</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>separate</td>
<td>Input</td>
</tr>
<tr>
<td>G</td>
<td>input</td>
<td>2-wire</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>system</td>
<td>Input</td>
</tr>
<tr>
<td>H</td>
<td>Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>input</td>
<td>4-wire</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>self</td>
<td>Input</td>
</tr>
<tr>
<td>J</td>
<td>input</td>
<td>4-wire</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>self</td>
<td>Input</td>
</tr>
<tr>
<td>K</td>
<td>Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>output</td>
<td>--------</td>
<td>w/o barriers</td>
<td>w/o other inst.</td>
<td>system</td>
<td>Output</td>
</tr>
<tr>
<td>N</td>
<td>output</td>
<td>--------</td>
<td>w/o barriers</td>
<td>with other inst.</td>
<td>system</td>
<td>Output</td>
</tr>
<tr>
<td>O</td>
<td>output</td>
<td>--------</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>system</td>
<td>Output</td>
</tr>
<tr>
<td>P</td>
<td>output</td>
<td>--------</td>
<td>with barriers</td>
<td>w/o other inst.</td>
<td>system</td>
<td>Output</td>
</tr>
<tr>
<td>Q</td>
<td>output</td>
<td>--------</td>
<td>with barriers</td>
<td>with other inst.</td>
<td>system</td>
<td>Output</td>
</tr>
<tr>
<td>R</td>
<td>Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Figure 7.3.9. 4-20 mA Inputs Without Barriers**

- input
- 2-wire
- w/o barriers
- w/o other instruments
- system powered

- input
- 2-wire
- w/o barriers
- w/o other instruments
- separate power supply

- input
- 2-wire
- w/o barriers
- w/o other instruments
- separate power supply

- input
- 2-wire
- w/o barriers
- w/o other instruments
- system powered

- input
- 2-wire
- w/o barriers
- w/o other instruments
- separate power supply
Figure 7.3.10. 4-20 mA Inputs With Barriers

- input
- 2-wire
- with barriers
- w/o other instruments
- separate power supply

NOTE: Be sure that the loop power source supplies adequate voltage for two barriers.
- input
- 2-wire
- with barriers
- w/o other instruments
- separate power supply

Not Applicable to MAIO
Figure 7.3.11. 4-20 mA 4-Wire Inputs

- input
- 4-wire
- w/o barriers
- w/o other instruments
- self-powered

Not applicable to MAIO

RS3: Multipoint I/O

Multipoint Analog I/O (MAIO)
Figure 7.3.12. 4-20 mA Outputs
Figure 7.3.13. 4-20 mA Outputs

- output
- with barriers
- with other instruments
- system-powered

Not applicable to MAIO
A replaceable label (1984-4195-0010), is provided on top of the termination panel label holder assembly. The label provides space at the end to record the Control File Node address (1-32), Controller Slot Address (A-H), Termination Panel (FIM) address (A-D), and Communication Line (1-8). There is provision for recording both the primary and redundant communication line addresses. The body of the label provides for recording each point’s field connection (1-16) and the source of external loop power (V+, V-).

The underside of the label holder shows jumper settings, communication line connections, and power connections.

Figure 7.3.14 shows the labels.
Jumpers

Table 7.3.4 shows jumper values. Jumpers HD1 through HD16 control the supply of loop power to each I/O point. Jumper HD17 controls the card cage address of the termination panel. Legal addresses are A, B, C, or D. Jumpers HD18 and HD19 control single FIM or redundant FIM operation. Terminal block TB18 provides for grounding all field wiring shields to chassis ground when TB18 SH is jumpered to CH. The panel ships with this jumper in place. When using Loop Power Modules, a short jumper wire must be installed from the V– terminal of TB17 to the SH terminal of TB18, in addition to the SH to CH jumper, or a 4-tab jumper may be used to connect all three terminals.
<table>
<thead>
<tr>
<th>Jumper</th>
<th>Value</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD1–HD16</td>
<td>Full left</td>
<td>Self-Powered Input Point with external ground reference or Output Point</td>
</tr>
<tr>
<td></td>
<td>Centered</td>
<td>System-Powered Input Point</td>
</tr>
<tr>
<td></td>
<td>Full right</td>
<td>Self-Powered Input Point with ground reference at Termination Panel</td>
</tr>
<tr>
<td>HD17</td>
<td>A at 1–2</td>
<td>Cage address A (Factory setting)</td>
</tr>
<tr>
<td></td>
<td>B at 1–2</td>
<td>Cage address B</td>
</tr>
<tr>
<td></td>
<td>C at 1–2</td>
<td>Cage address C</td>
</tr>
<tr>
<td></td>
<td>D at 1–2</td>
<td>Cage address D</td>
</tr>
<tr>
<td>HD18</td>
<td>Both at “N” (1–2)</td>
<td>Normal single FIM operation</td>
</tr>
<tr>
<td>HD19</td>
<td>Both at “R” (2–3)</td>
<td>Redundant FIM operation Requires two FIMs and two communication lines</td>
</tr>
<tr>
<td>TB17</td>
<td>V–, SH and CH jumpered (4-tab jumper installed)</td>
<td>Loop power negative and field wiring shields connected to chassis ground. Use with LPMs. (New factory setting.)</td>
</tr>
<tr>
<td>TB18</td>
<td>SH to CH jumpered (4-tab jumper straddling TB18 or 2 tab jumper installed)</td>
<td>Field wire shields connected to chassis ground. Use with locally grounded source of loop power. (Old factory setting with 2 tab jumper.)</td>
</tr>
<tr>
<td></td>
<td>SH to CH open (Jumper removed)</td>
<td>Allows connecting shield to a different ground reference than chassis.</td>
</tr>
<tr>
<td>TB19</td>
<td>Jumpers fully installed, absent, or in “holder for loop position”.</td>
<td>Fully installed: Power at TBA used for loop power. Holder position: Loop power connected at TB17 Absent: LPMs used for loop power</td>
</tr>
</tbody>
</table>
# LEDs

The MAIO16 FIM has 6 LEDs as shown in Table 7.3.5.

## Table 7.3.5. MAIO16 FIM LEDs

<table>
<thead>
<tr>
<th>LED</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>On: FIM Good Flashing: FIM Inactive (Green)</td>
<td>ON steady when the FIM is in normal operation. Flashing when the FIM is disconnected from the field.</td>
</tr>
<tr>
<td>FIM Failure (Red)</td>
<td>ON when FIM considers itself failed. Flashing when the FIM is not communicating with the Controller.</td>
</tr>
<tr>
<td>Port A Active (Yellow)</td>
<td>Flashes when communication Port A is active.</td>
</tr>
<tr>
<td>Port B Active (Yellow)</td>
<td>For factory use only.</td>
</tr>
<tr>
<td>Status 1 (Yellow)</td>
<td>Flashes steadily while the FIM operates.</td>
</tr>
<tr>
<td>Status 2 (Yellow)</td>
<td>Flashes a diagnostic code if the FIM is disabled and the red LED is ON.</td>
</tr>
</tbody>
</table>

When the FIM boots up, the red LED goes ON, the green LED blinks briefly and then goes ON, the red LED goes off, and the yellow “Port A” LED begins to flash rapidly as the FIM communicates with the Controller Processor. The yellow “Status 1” LED flashes regularly while the FIM is in normal operation. The green LED blinks if there is no I/O block for any point configured in the Controller Processor or if the FIM is disconnected from the field due to redundancy operation, on-line replacement operation, or communication failure.

If the FIM does not boot up with the green LED ON or flashing, check the “Status 2” LED. If it flashes five times, pauses, and flashes five times, check to see that the address jumpers are set correctly. If it is flashing any other number, replace the FIM. Please record the number and send it along when the FIM is returned for repair or replacement.
The LPM has 2 LEDs as shown in Table 7.3.6

Table 7.3.6. LPM LEDs

<table>
<thead>
<tr>
<th>LED</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOOD (Green)</td>
<td>LPM functioning normally.</td>
</tr>
<tr>
<td>BAD (Red)</td>
<td>LPM out of specification or failed.</td>
</tr>
<tr>
<td>None Lit</td>
<td>LPM out of specification, failed, or no input power.</td>
</tr>
</tbody>
</table>
MAI32 Termination Panel

This section covers installation of the:

- MAI32 4–20 mA Termination Panel
  with field terminals
  10P53490001
  with field terminals and
  marshaling panel connector
  10P53490002
- MAI32 Field Interface Module (FIM) 10P53190004

MAI32 is used to read up to 32 4–20 mA analog input points. The FIM is located on the field wiring termination panel. The MAI32 termination panel can be remotely mounted within communication wiring length limits.

**Input Points**

The panel supports 32 analog input points using two termination panel addresses. The first address supports the Left Group of points (L1–L16), the second address supports the Right Group of points (R1–R16). An Analog Input Block (AIB) or a Smart Transmitter Input Block (SIB) must be configured for each address. HART variables can be addressed by configuring a Value Input Block (VIB).

**Field Wiring**

Wires can either be landed directly on the panel or at a remote location using multi-conductor cables and remote marshaling panels.

Terminal blocks TB1–TB4 are used to connect field wiring to the panel. All of the field wire shields are connected together within the panel. TB21 provides a way to connect all field wire shields to the panel chassis ground, tie them to an external ground, or leave them floating.

Connectors J701 and J702 are used when a remote marshaling panel is desired. A combination of remote landing and local landing of field wires can be used.

**Loop Power**

A source of loop power is required unless all points on the panel are self-powered inputs. Loop power is supplied by an external DC source (23 to 29 VDC) connected to TB23.

**Labels**

A replaceable label (1984–4195–0011) is provided on top of the termination panel label holder assembly. The label provides space at the end to record the ControlFile node address, the Controller slot address, the two termination panel (FIM) addresses, and the Communication Line number. The body of the label provides for recording each point's field connection and the source of external loop power (V+, V–).

The underside of the label shows examples of field wiring.
The FIM and panel are keyed to prevent insertion of an incorrect FIM.

The Field I/O Status Screen (previously the FIC Status Screen) shows the type of device connected to each controller. The MAI32 FIM will have two entries, one for each cage address used. The type code is “MAI32-x” where the “x” shows the card cage of the OTHER set of 16 points. Thus if the panel is addressed as A and C, the first entry will show “MAI32-C” and the second will show “MAI32-A”.
Figure 7.3.15. MAI32 Termination Panel
### Table 7.3.7. MAI32 Termination Panel Components

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HD33: Panel (Card Cage) address jumpers.</td>
<td>14</td>
<td>Port B (J705): To daisy-chain the communication line to another panel.</td>
</tr>
<tr>
<td>2</td>
<td>HD34: Loop power detect jumpers.</td>
<td>15</td>
<td>Port C (J704): Not used.</td>
</tr>
<tr>
<td>3</td>
<td>HDL1–HDL8: Point Type jumpers for Left Points 1–8.</td>
<td>16</td>
<td>TBA Power Strip: For panel DC supply using stranded wire. Allows daisy chaining of DC power and access to panel chassis ground.</td>
</tr>
<tr>
<td>5</td>
<td>HDL9–HDL16: Point Type jumpers for Left Points 9–16.</td>
<td>18</td>
<td>TB23: External loop power terminal.</td>
</tr>
<tr>
<td>6</td>
<td>FL9–FL16: Fuses for Left Points 9–16.</td>
<td>19</td>
<td>TB21: Connects all field wiring shields to chassis ground when jumpered.</td>
</tr>
<tr>
<td>7</td>
<td>MAI32 Input FIM.</td>
<td>20</td>
<td>Shield Terminals (TB6–20): For field wiring shields.</td>
</tr>
<tr>
<td>8</td>
<td>HDR1–HDR8: Point Type jumpers for Right Points 1–8.</td>
<td>21</td>
<td>TB4: Field wiring terminals for Right Points 9–16.</td>
</tr>
<tr>
<td>9</td>
<td>FR1–FR8: Fuses for Right Points 1–8.</td>
<td>22</td>
<td>Marshaling panel connector (J702) serves Left Points 1–16.</td>
</tr>
<tr>
<td>12</td>
<td>FIM LEDs.</td>
<td>25</td>
<td>Marshaling panel connector (J701) serves Right Points 1–16.</td>
</tr>
</tbody>
</table>
System Wiring

The MAI32 termination panel is connected to a controller in a ControlFile via a single communication line as shown in Figure 7.3.16.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWay</td>
<td>5</td>
<td>Controller in the ControlFile</td>
</tr>
<tr>
<td>2</td>
<td>ControlFile</td>
<td>6</td>
<td>Communication Line (shielded twisted pair)</td>
</tr>
<tr>
<td>3</td>
<td>Control Cable (1984–2783–xxxx)</td>
<td>7</td>
<td>MAI32 Termination Panel</td>
</tr>
<tr>
<td>4</td>
<td>Communication Termination Panel II</td>
<td>8</td>
<td>Field wiring (typically shielded twisted pair)</td>
</tr>
</tbody>
</table>

Figure 7.3.16. MAI32 System Wiring
SP: 7-3-32

Addressing
The MAI32 panel requires two Card Cage addresses which are set by jumper HD33. The alphabetically lowest jumper at 1-2 specifies the cage address for the Left Group of points (L1–L16). The next jumper at 1-2 specifies the address for the Right Group of points (R1–R16). The parity (P) jumper must be at 1–2 to establish the correct address parity.

Use cage addresses A and B for the fastest scanning time. See chapter 7 for more information on scanning rates. Two addresses must be set.

Power
DC power for the panel can be supplied from the standard RS3 DC bus or from another DC source. When you use the power jack (J983), use a 1984–0158–xxxx cable with a 2 Amp fuse in the DC Output Card. When you use the TBA Power Strip, connect the wires to terminals “A” and “Rtn”. Do not use both the Power Jack and the Power Strip at the same time. The panel supports use of redundant (A/B) DC supplies.

Grounding
The panel is grounded by being fastened to a grounded surface or a grounded DIN rail. In other cases, attach a ground wire to one of the ground terminals on the TBA.

Communications
The single MAI32 FIM requires one communication line connected to Port A. Port B can be used to daisy chain the communication line to another destination. Port C is not used.

Loop Power
A source of loop power is required unless all points are self-powered inputs. The external source of loop power must be attached to TB23. The source must be in the range 23 to 29 VDC. The current draw will be under 700 mA.

CAUTION
Do not use the same source to power the panel and to supply loop power. This bypasses power isolation and can result in field wiring faults propagating to the power source.
Field Wiring

Wire Landing
Field wiring can be landed directly at terminal blocks on the panel. TB1 and TB2 serve the Left Group of points. TB3 and TB4 serve the Right Group. A Remote Marshaling Panel and cable can be used to land field wires at a remote location. Connector J701 serves the Left Group of points. Connector J702 serves the Right Group of points. Wiring can be mixed with some points landing directly on the panel and others landing at the remote marshaling panel. Field wiring is landed as shown in Figure 7.3.17.

Shield Grounding
Field wire shields can be landed at the SHIELD terminals (TB6, 8, 10, 12, 14, 16, 18, 20). All field wire shields are connected together within the termination panel. Jumpering Terminal Block TB21 lets you connect all of the shields to the panel chassis ground. If TB21 is open, the shields are connected together but are floating relative to the panel ground. TB21 can also be used to connect the shields to an external ground.

Strain Relief
For strain relief, route the field wires through the fingers of the wire manager assemblies (1984-4152-0003). To ease the task of routing wires, the top pair of wire manager assemblies are factory-mounted and the remaining assemblies are shipped loose. As you progress through the wiring, mount the assemblies using the 1/4-inch fasteners provided.

I/O Point Type
The Point Type jumpers (HDL1-HDL16, HDR1-HDR16) are set to define each point. Each jumper can be set fully to the left or fully to the right. A point can be defined as:

- System-powered input Jumper fully left
- Self-powered input Jumper fully right

**NOTE:** The negative (return) sides of all self-powered transmitters are connected to the negative (return) side of the Loop Power source.
Each input point is individually fused. Do not use a fuse larger than 1/10 Amp 250 V.

A system-powered input point requires a source of loop power at TB23. The Point Type jumper must be set fully to the left as shown in Figure 7.3.18.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System-powered input point</td>
</tr>
<tr>
<td>2</td>
<td>Input sense resistor</td>
</tr>
<tr>
<td>3</td>
<td>Point Type Jumper set fully to the left for system-powered input point</td>
</tr>
<tr>
<td>4</td>
<td>Fuse F1-F32</td>
</tr>
<tr>
<td>5</td>
<td>Field wiring terminal block: +, -</td>
</tr>
<tr>
<td>6</td>
<td>System-Powered transmitter</td>
</tr>
</tbody>
</table>

Figure 7.3.18. System-Powered Input Point
A self-powered input point requires no source of loop power. The return sides of all points are connected to the Loop Power return. The Point Type jumper must be set in the full right position as shown in Figure 7.3.19.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Self-powered input point</td>
</tr>
<tr>
<td>2</td>
<td>Input sense resistor</td>
</tr>
<tr>
<td>3</td>
<td>Point Type Jumper set fully to the right for self-powered input point</td>
</tr>
<tr>
<td>4</td>
<td>Fuse</td>
</tr>
<tr>
<td>5</td>
<td>Field wiring terminal block: +, -</td>
</tr>
<tr>
<td>6</td>
<td>Self-powered transmitter</td>
</tr>
</tbody>
</table>

Figure 7.3.19. Self-Powered Input Point
The pin-out specification for the marshaling panel cable is shown in Table 7.3.8.

Table 7.3.8. MAI32 Marshaling Panel Cable Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
<th>Pin</th>
<th>DIN#</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D2</td>
<td>IN1+</td>
<td>10</td>
<td>D20</td>
<td>IN10+</td>
<td>33</td>
<td>Z2</td>
<td>IN1-</td>
<td>42</td>
<td>Z20</td>
<td>IN10-</td>
</tr>
<tr>
<td>2</td>
<td>D4</td>
<td>IN2+</td>
<td>11</td>
<td>D22</td>
<td>IN11+</td>
<td>34</td>
<td>Z4</td>
<td>IN2-</td>
<td>43</td>
<td>Z22</td>
<td>IN11-</td>
</tr>
<tr>
<td>3</td>
<td>D6</td>
<td>IN3+</td>
<td>12</td>
<td>D24</td>
<td>IN12+</td>
<td>35</td>
<td>Z6</td>
<td>IN3-</td>
<td>44</td>
<td>Z24</td>
<td>IN12-</td>
</tr>
<tr>
<td>4</td>
<td>D8</td>
<td>IN4+</td>
<td>13</td>
<td>D26</td>
<td>IN13+</td>
<td>36</td>
<td>Z8</td>
<td>IN4-</td>
<td>45</td>
<td>Z26</td>
<td>IN13-</td>
</tr>
<tr>
<td>5</td>
<td>D10</td>
<td>IN5+</td>
<td>14</td>
<td>D28</td>
<td>IN14+</td>
<td>37</td>
<td>Z10</td>
<td>IN5-</td>
<td>46</td>
<td>Z28</td>
<td>IN14-</td>
</tr>
<tr>
<td>6</td>
<td>D12</td>
<td>IN6+</td>
<td>15</td>
<td>D30</td>
<td>IN15+</td>
<td>38</td>
<td>Z12</td>
<td>IN6-</td>
<td>47</td>
<td>Z30</td>
<td>IN15-</td>
</tr>
<tr>
<td>7</td>
<td>D14</td>
<td>IN7+</td>
<td>16</td>
<td>D32</td>
<td>IN16+</td>
<td>39</td>
<td>Z14</td>
<td>IN7-</td>
<td>48</td>
<td>Z32</td>
<td>IN16-</td>
</tr>
<tr>
<td>8</td>
<td>D16</td>
<td>IN8+</td>
<td>17-31</td>
<td>B2-B30</td>
<td>Open</td>
<td>40</td>
<td>Z16</td>
<td>IN8-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>D18</td>
<td>IN9+</td>
<td>32</td>
<td>B32</td>
<td>Shield</td>
<td>41</td>
<td>Z18</td>
<td>IN9-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LEDs

The MAI32 FIM has 6 LEDs as shown in Table 7.3.9.

Table 7.3.9. MAI32 FIM LEDs

<table>
<thead>
<tr>
<th>LED</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>On: FIM Good Flashing: FIM Inactive (Green)</td>
<td>ON steady when the FIM is in normal operation. Flashing when the FIM is disconnected from the field.</td>
</tr>
<tr>
<td>FIM Failure (Red)</td>
<td>ON when FIM considers itself failed. Flashing when the FIM is not communicating with the Controller.</td>
</tr>
<tr>
<td>Port A Active (Yellow)</td>
<td>Flashes when communication Port A is active.</td>
</tr>
<tr>
<td>Port B Active (Yellow)</td>
<td>For factory use only.</td>
</tr>
<tr>
<td>Status 1 (Yellow)</td>
<td>Flashes steadily while the FIM operates.</td>
</tr>
<tr>
<td>Status 2 (Yellow)</td>
<td>Flashes a diagnostic code (see Table 7.3.10) if the FIM is disabled and the red LED is ON.</td>
</tr>
</tbody>
</table>

When the FIM boots up, the red LED goes ON, the green LED blinks briefly and then goes ON, the red LED goes off, and the yellow “Port A” LED begins to flash rapidly as the FIM communicates with the Controller Processor. The green LED blinks if there is no I/O block configured in the Controller Processor.

Table 7.3.10. MAIO Input “Status 2” LED Diagnostic Codes

<table>
<thead>
<tr>
<th>LED Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RAM failure.</td>
</tr>
<tr>
<td>2</td>
<td>Voltage failure, one or more internal voltages are out of tolerance.</td>
</tr>
<tr>
<td>3</td>
<td>Not assigned.</td>
</tr>
<tr>
<td>4</td>
<td>ADC failure.</td>
</tr>
<tr>
<td>5</td>
<td>Address jumpers on the Termination Panel are not set to A, B, C, or D.</td>
</tr>
<tr>
<td>6</td>
<td>Write or erase failure in FLASH.</td>
</tr>
<tr>
<td>7</td>
<td>Verification failure in BOOT or APP code.</td>
</tr>
<tr>
<td>8</td>
<td>Not assigned.</td>
</tr>
<tr>
<td>9</td>
<td>Not assigned.</td>
</tr>
<tr>
<td>10</td>
<td>Point diagnostic failure.</td>
</tr>
<tr>
<td>11</td>
<td>Not assigned.</td>
</tr>
</tbody>
</table>
Jumpers

All panel jumpers must be set for correct operation as shown in Table 7.3.11.

NOTE: Three jumpers are required for the ADDRESS (HD33).

- The alphabetically lowest jumper at 1–2 specifies the cage address for the Left Group of points (L01–L16).
- The next jumper at 1–2 specifies the address for the Right Group of points (R01–R16).
- The third jumper (P) must be at 1–2 to establish correct address parity.

Table 7.3.11. MAI32 Termination Panel Jumpers

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Position</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDL01–HDL16 HDR01–HDR16</td>
<td>Full left</td>
<td>System-powered input point</td>
</tr>
<tr>
<td>HD33 ADDRESS</td>
<td>One jumper A–C at 1–2</td>
<td>Cage address for Left Group of points L01–L16 (A is recommended)</td>
</tr>
<tr>
<td></td>
<td>One jumper B–D at 1–2</td>
<td>Cage address for Right Group of points R01–R16 (B is recommended)</td>
</tr>
<tr>
<td></td>
<td>P at 1–2</td>
<td>Required for correct parity</td>
</tr>
<tr>
<td>HD34 LOOP PWR DETECT</td>
<td>ENABLE</td>
<td>Enables detection of loop power loss</td>
</tr>
<tr>
<td></td>
<td>DISABLE</td>
<td>Disables detection of loop power loss</td>
</tr>
<tr>
<td>TB21 Shield Grounding</td>
<td>SH and CH connected</td>
<td>All field wiring shields are connected to panel chassis ground</td>
</tr>
<tr>
<td></td>
<td>SH and CH open</td>
<td>All field wiring shields are connected together and are floating with respect to panel chassis ground</td>
</tr>
<tr>
<td></td>
<td>SH connected to external ground</td>
<td>All field wiring shields are connected together and are connected to the external ground point</td>
</tr>
</tbody>
</table>

SH = Shield
CH = Chassis
Field wiring can be landed directly on most Multipoint Discrete I/O (MDIO) termination panels or can be connected closer to the field devices by use of a Multipoint I/O (MIO) marshaling panel.

These panels are available:

- Standard Remote Termination Panel
Standard Remote Termination Panel

Figure 7.4.1 shows the Standard Remote Termination Panel (1984–4344–000x) used to connect unshielded field wiring to a MDIO termination panel. It is marked “STANDARD REMOTE TERMINATION PANEL” on the printed wiring assembly (PWA). The panel can handle currents up to 1 amp per point. No fuses are supplied for the field wiring.

The panel snaps onto a standard DIN rail.

The label holder provides a place to record the address of the points served by the panel. The panel is shipped with two sets of point labels so the user may indicate the use of points 1-16 or 17-32.
The termination panel can be connected to a discrete I/O termination panel with a Marshaling Panel Cable as shown in Table 7.4.1.

Table 7.4.1. Standard Remote Termination Panel, Marshaling Panel Cable

<table>
<thead>
<tr>
<th>Application</th>
<th>Use Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-FIM Termination Panel</td>
<td>1984–4299–xxxx</td>
</tr>
<tr>
<td>Multi-FIM Termination Panel, Redundant FIMs</td>
<td>1984–4319–xxxx</td>
</tr>
<tr>
<td>High Density Isolated Discrete Termination Panel</td>
<td>1984–4298–xxxx</td>
</tr>
<tr>
<td>High Density Isolated Discrete Termination Panel, NEC/CSA</td>
<td>1984–4345–xxxx</td>
</tr>
</tbody>
</table>
Section 5: Intrinsic Safety (IS)

Operating electrical equipment in hazardous (classified) locations where flammable gases, flammable liquids, or other combustible materials exist requires special handling. One approach is to use equipment that is intrinsically safe, that is, equipment where the energy supplied to the hazardous area is not enough to ignite the materials present.

Figure 7.5.1 shows the concept. The normal RS3 equipment is located in the Safe (non-hazardous) Area. The device being controlled is located in the Hazardous Area. An Intrinsically Safe Barrier, located in the Safe Area, is used to isolate the Hazardous Area by limiting the energy that can be sent into the area.

RS3 systems are designed for connection to IS products specified by Fisher-Rosemount Systems, Inc. (FRSI). RS3 supports IS applications with both MTL® Discrete and Analog IS Termination Panels if proper installation practices are followed. Refer to RS3 Control Drawing for Intrinsically Safe Associated Apparatus and Field Wiring as Used in RS3 Equipment, 10P57190001, for complete recommendations and requirements.

Standards for hazardous wiring practices include current versions of:

- Europe
  - EN50014, Electrical Apparatus for Potentially Explosive Atmospheres: General Requirements
  - EN50020, Electrical Apparatus for Potentially Explosive Atmospheres: Intrinsic Safety “I”
- Canada
  - C22.1, Canadian Electrical Code Part 1
United States

- ANSI/ISA RP12.6, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations
- NFPA 70, National Electrical Code

The rules and guidelines below apply to IS-associated RS3 equipment and in some nations or localities, may be required by law. Where local law or practices require deviation from these rules and guidelines, the deviations must be reviewed by FRSI prior to implementation.

- IS wiring and non-IS wiring cannot share the same cabinet cable entry locations. In addition, IS wiring must meet one or more of the following criteria:
  - Installed in a wireway separate from all non-IS wiring
  - Positively segregated from any non-IS wiring within an enclosure or cable tray by means of a grounded metal partition or an insulating partition in a wireway
  - Spaced at least 50 mm from any non-IS wiring and tied down. The non-IS wiring must also be secured to prevent it from violating the 50 mm spacing requirement.

- Care must be taken in terminal layout and wiring methods to prevent contact of IS and non-IS circuits. Some layouts will not provide adequate separation if a wire becomes disconnected (for example, when terminals are arranged one above the other). In these cases, additional precautions such as tie-downs are necessary.

- Wiring to an IS device must be installed following the instructions provided with each IS product. MTL provides these instructions with their isolators.

- Wire routing requirements within RS3 equipment enclosures are provided in control drawing 10P57190001. This drawing is included with all shipments of the MTL IS Analog Termination Panels and MTL IS Discrete Termination Panels.

Figure 7.5.2 shows Panel A (10P5037000x). Figure 7.5.3 shows Panel B (10P5049000x).
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Isolator 16 - Serves input points 31 and 32</td>
<td>9</td>
<td>Power Strip (TBD) for panel DC supply using stranded wire (Allows daisy chaining of DC power and access to panel chassis ground)</td>
</tr>
<tr>
<td>2</td>
<td>HD18 – Common Line Fault Detect Jumper</td>
<td>10</td>
<td>Port B (TBB) – Even-numbered communication line for redundant FIM B</td>
</tr>
<tr>
<td>3</td>
<td>Silk-screen label showing relationship of Isolators and I/O points</td>
<td>11</td>
<td>Port A (TBA) – Odd-numbered communication line for FIM A</td>
</tr>
<tr>
<td>4</td>
<td>Isolator 1 - Serves input points 1 and 2 or output point 1</td>
<td>12</td>
<td>HD1-HD16 – Individual point Input/Output and Line Fault Detect selection jumpers</td>
</tr>
<tr>
<td>5</td>
<td>Fuse Blown LED</td>
<td>13</td>
<td>FIM A (required)</td>
</tr>
<tr>
<td>6</td>
<td>Fuse – 3.15 Amp, 250 V, IEC</td>
<td>14</td>
<td>HD17 – Panel (Card Cage) address (A, B, C, or D)</td>
</tr>
<tr>
<td>7</td>
<td>Power Jack (J636) for panel DC supply using a 1984-0158-xxxx cable</td>
<td>15</td>
<td>Mounting holes (2) for wire Tagging Kit</td>
</tr>
<tr>
<td>8</td>
<td>HD20-HD21 – FIM redundancy jumpers</td>
<td>16</td>
<td>Connector (J635) for ribbon cable to Panel B</td>
</tr>
</tbody>
</table>

Figure 7.5.2. MTL Discrete IS Termination Panel A
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuse Blown LED</td>
<td>7</td>
<td>HD17-HD32 – Jumpers that enable/disable Common Line Fault Detect for the corresponding isolator</td>
</tr>
<tr>
<td>2</td>
<td>Fuse – 3.15 Amp, 250 V, IEC</td>
<td>8</td>
<td>FIM B (optional) for redundancy</td>
</tr>
<tr>
<td>3</td>
<td>Isolator 24 – Serves output point 16</td>
<td>9</td>
<td>Mounting holes (2) for wire Tagging Kit</td>
</tr>
<tr>
<td>4</td>
<td>Silk-screen label showing relationship of Isolators and I/O points</td>
<td>10</td>
<td>Power Jack (J982) for panel DC supply using a 1984–0158–xxxx cable</td>
</tr>
<tr>
<td>5</td>
<td>Isolator 17 – Serves output point 2</td>
<td>11</td>
<td>HD1 – Panel (Card Cage) address (A, B, C, or D)</td>
</tr>
<tr>
<td>6</td>
<td>Connector (J638) for ribbon cable to Panel A</td>
<td>12</td>
<td>Power Strip (TBD) for panel DC supply using stranded wire (Allows daisy chaining of DC power and access to panel chassis ground)</td>
</tr>
</tbody>
</table>

Figure 7.5.3. MTL Discrete IS Termination Panel B
MTL IS Termination Panel for Discrete Applications

The MTL discrete IS panel is implemented as a set:

- MDIO MTL IS Termination Panel A (10P5037000x)
- MDIO MTL IS Termination Panel B (10P5049000x)

The panels are marked “MDIO-MTL © I.S. ISOLATOR BARRIERS TERMINATION PANEL A” and “MDIO-MTL © I.S. ISOLATOR BARRIERS TERMINATION PANEL B” on the Printed Wiring Assembly (PWA).

Panel A holds 16 isolators that can serve up to 32 input points (1–32), or up to 8 odd-numbered output points (1–15) and 16 inputs, or any other combination of inputs and outputs (up to 8 outputs). Panel B can hold 8 isolators. These are used to serve the 8 even-numbered output points (2–16). Panel B is required only when there are more output points than can be served with Panel A or when FIM redundancy is required.

NOTE: The Multipoint Discrete I/O Field Interface Module (MDIO FIM) supports 16 input/output points (1–16) and 16 input-only points (17–32). The 8 odd-numbered output points (1–15) are mapped to Panel A; the 8 even-numbered points (2–16) are mapped to Panel B.

MTL provides a number of galvanic isolator barriers to meet different signal requirements. Hazardous-side field wiring is brought to a connector at the top of the isolator.

NOTE: MTL refers to their galvanic isolator barriers as “isolators.”

Technical documentation and Application Notes available from MTL include:

- Intrinsic Safety - Principles and Practice PS007
- User’s Guide to Intrinsic Safety AN9003A
- MTL4000 Series Isolating Interface Units Instruction Manual
- Control drawing for each isolator Various MTL drawing numbers
An optional Wire Tagging Kit (10P50510001 for Panel A and 10P50510002 for Panel B) provides a place to record the field wire assignment for each isolator. The label is carried by a bridge over the isolators.

Figure 7.5.4 shows how the MDIO MTL IS Termination Panel is attached to an RS3 Control File.

Figure 7.5.4. Discrete I/O with MDIO MTL IS Termination Panel A and Panel B

FIM redundancy requires use of Panel A, Panel B, two identical FIMs, two communication lines, and a Redundant I/O Block (RIOB).
Mapping I/O points to MTL Discrete Isolators

Table 7.5.1 and Table 7.5.2 show the mapping of I/O points to isolators on the MTL discrete panels.

**Table 7.5.1. Mapping of I/O Points to MTL Discrete Panel A Isolators**

<table>
<thead>
<tr>
<th>Isolator Position</th>
<th>Input Point</th>
<th>Output Point</th>
<th>Isolator Position</th>
<th>Input Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1–2</td>
<td>1</td>
<td>9</td>
<td>17–18</td>
</tr>
<tr>
<td>2</td>
<td>3–4</td>
<td>3</td>
<td>10</td>
<td>19–20</td>
</tr>
<tr>
<td>3</td>
<td>5–6</td>
<td>5</td>
<td>11</td>
<td>21–22</td>
</tr>
<tr>
<td>4</td>
<td>7–8</td>
<td>7</td>
<td>12</td>
<td>23–24</td>
</tr>
<tr>
<td>5</td>
<td>9–10</td>
<td>9</td>
<td>13</td>
<td>25–26</td>
</tr>
<tr>
<td>6</td>
<td>11–12</td>
<td>11</td>
<td>14</td>
<td>27–28</td>
</tr>
<tr>
<td>7</td>
<td>13–14</td>
<td>13</td>
<td>15</td>
<td>29–30</td>
</tr>
<tr>
<td>8</td>
<td>15–16</td>
<td>15</td>
<td>16</td>
<td>31–32</td>
</tr>
</tbody>
</table>

**Table 7.5.2. Mapping of I/O Points to MTL Discrete Panel B Isolators**

<table>
<thead>
<tr>
<th>Isolator Position</th>
<th>Output Point</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>2</td>
<td>Isolator positions 17–24 serve even-numbered output points</td>
</tr>
<tr>
<td>18</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>25–32</td>
<td></td>
<td>Positions 25–32 are currently not used</td>
</tr>
</tbody>
</table>
DC Power

The MTL discrete isolators will function over the voltage range 20.7 to 36 VDC. The standard RS3 DC bus can range from 18 to 36 VDC.

CAUTION

The MTL discrete isolators can be operated from the standard RS3 DC bus but you must be aware that the isolators will stop operating at low voltage before the system stops.

NOTE: Both discrete Panel A and Panel B require DC power connections.

Communication Wiring

A single communication line is connected to Port A for normal single-FIM operation. Two lines, connected to Port A and Port B, are required for redundant FIM operation.

Field Wiring

Hazardous-side field wiring is brought to a connector at the top of each MTL isolator. The hazardous-side wiring must follow local standards for intrinsic safety.
Line Fault Detection (LFD)

Line Fault Detection (LFD) is available as an option on some isolators. Dual-channel inputs and all outputs can provide for the use of common LFD. Some single-channel inputs can provide individual-point LFD. The common LFD signal is returned on input point 32.

NOTE: You can use a mixture of common and individual LFD.

- **To use common LFD:**
  1. Set the common LFD jumper (HD18 on Panel A) to “ENABLE”. common LFD is then enabled for both Panel A and Panel B.
  2. For Panel A, set the appropriate jumper (HD1–HD16) for each isolator as shown on the panel label or in Figure 7.5.5 or Figure 7.5.6.
  3. For Panel B, set the common LFD jumper for the isolator (HD17–HD24) to “ENABLE”.
  4. Configure input point 32 to receive the common LFD signal.

NOTE: The common LFD signal is delivered on input point 32. No isolator is required to receive this signal. When common LFD is used, you cannot install an isolator in position 16 of Panel A.

- **To use individual LFD:**
  1. Use an isolator with LFD in any position of Panel A.
  2. Set the appropriate jumper (HD1–HD16) as shown on the panel label or in Figure 7.5.5.

NOTE: Do not use LFD on MTL 4016.
MTL Discrete Isolators

Input isolators can be used only on Panel A.

- Dual-channel input isolators connect to both the odd- and the even-numbered point served by the isolator position. Dual-channel isolators with LFD may use common LFD.

**NOTE:** Do not use LFD on MTL 4016.

- Single-channel input isolators connect to the odd-numbered point and supply the LFD signal on the even-numbered point. Therefore the corresponding even-numbered point on Panel B cannot be used.

Output isolators can be used on either Panel A or Panel B. All output isolators are single channel.

- Output isolators connect to the odd-numbered point when used on Panel A and to the even-numbered point when used on Panel B.
- Output isolators with LFD may use common LFD.
- An output isolator on Panel A can serve the odd point and another output isolator on Panel B can serve the adjacent even point.

**NOTE:** Isolator position 16 (Panel A) cannot be used when common LFD is enabled.

Table 7.5.3 lists the MTL discrete isolators available for use with RS3. See the MTL product catalog for details.
### Table 7.5.3. MTL Discrete IS Isolators

<table>
<thead>
<tr>
<th>MTL P/N</th>
<th>Name</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTL4016</td>
<td>Two-Channel Switch/Proximity Detector Interface, With Line Fault Detection</td>
<td>Dual-channel input – Use PH-REV to have field agree with the distributed control system (DCS). Do not use LFD.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Input Isolators</strong></td>
<td></td>
</tr>
<tr>
<td>MTL4021</td>
<td>Solenoid/Alarm Driver</td>
<td>Single-channel output – Serves an odd-numbered point on Panel A or an even-numbered point on Panel B</td>
</tr>
<tr>
<td>MTL4023</td>
<td>Solenoid/Alarm Driver, With Line Fault Detection</td>
<td>Single-channel output – Serves an odd-numbered point on Panel A or an even-numbered point on Panel B – Common LFD is available</td>
</tr>
<tr>
<td>MTL4025</td>
<td>Solenoid/Alarm Driver, Low Current Output</td>
<td>Single-channel output – Serves an odd-numbered point on Panel A or an even-numbered point on Panel B</td>
</tr>
<tr>
<td></td>
<td><strong>Output Isolators</strong></td>
<td></td>
</tr>
</tbody>
</table>
Panel A Jumpers

**FIM Address:** FIM address jumpers (HD17) are set as for any other MIO panel. One jumper is set at 1-2 to specify address A-D. The jumper at “F” must be at 1-2.

**FIM Redundancy:** The FIM redundancy jumpers (HD20 and HD21) are set to “N” for normal single-FIM operation and to “R” for redundant FIM operation.

**Line Fault Detection:** The common LFD jumper (HD18) must be set to “ENABLE” if any isolator on either panel uses common LFD. Otherwise, set it to “DISABLE”.

**NOTE:** The common LFD signal is available on input point 32. An isolator serving point 32 is NOT required. An isolator cannot be installed in position 16.

Figure 7.5.5 shows the settings for the per-isolator jumpers (HD1 to HD16) when the point pair is used for input.

**HD1 TO 16 JUMPER SETTINGS FOR INPUT(S)**

<table>
<thead>
<tr>
<th>Position</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **INPUT(S) WITH COMMON LFD, ALSO ENABLE HD18**
- **INPUT(S) WITH INDIVIDUAL LFD**
- **INPUT(S) WITH NO LFD**

*Figure 7.5.5. Line Fault Detection Jumper Settings for Input Points*

Figure 7.5.6 shows the settings for the per-isolator jumpers (HD1 to HD8) when the point pair is used for output.

**HD1 TO 8 JUMPER SETTINGS FOR OUTPUT(S)**

<table>
<thead>
<tr>
<th>Position</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **OUTPUT(S) WITH COMMON LFD, ALSO ENABLE HD18**
- **OUTPUT(S) WITH INDIVIDUAL LFD**
- **OUTPUT(S) WITH NO LFD**

*Figure 7.5.6. Line Fault Detection Jumper Settings for Output Points*
Panel B Jumpers

**FIM Address:** The Address jumpers (HD1) must be set to the same address as used on Panel A.

**Line Fault Detect:** The per-isolator common LFD jumpers (HD17 to HD24) are set to “ENABLE” if the isolator supports common line fault detection. All other jumpers are set to “DISABLE”.

**NOTE:** The Common Line Fault Detect jumper (HD18) on Panel A must be set to “ENABLE” for any of the per-isolator common LFD jumpers on Panel B to be effective.

Fuses

Each panel has a fuse and a “Fuse Blown” LED. The maximum allowed fuse size is 3.15 amp, 250 volt IEC.

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<thead>
<tr>
<th>Table 7.5.4. MTL Discrete IS Termination Panel Fuses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRSI P/N</strong></td>
</tr>
<tr>
<td>C53394–3150–0005</td>
</tr>
</tbody>
</table>

Labels

Descriptive labels on the discrete panels show the relationship between isolator positions and I/O points.

Each panel has a place to record the address of the primary FIM.

An optional label holder spans the length of the panel and provides a place to record the field wiring connection to each isolator. The part number is 10P5051000x.
Mounting

MTL Discrete IS Termination Panels are the same size as other MIO panels.

NOTE: To comply with CSA, NRTL, or CE standards, MTL panels must be mounted in an enclosure that meets the requirements of the corresponding standard.

Mounting in a System Cabinet: The MTL DIO Mounting Bracket (10P57830001) can be used to mount two MTL panels side-by-side with the safe area wire channel between them. A wiring duct, either labeled or blue in color, should be specified. If the discrete Panel A and Panel B are mounted side-by-side, the connecting cable should be routed behind the mounting bracket. This can only be done on the ends, because the cable is two feet long.

Figure 7.5.7 shows system cabinet mounting of the MTL discrete panel. Dimensions shown below are given as mm (in.).

![Diagram of MTL Discrete IS Panel Rack Mounting]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MDIO Field Interface Module</td>
<td>5</td>
<td>Cabinet Rail</td>
</tr>
<tr>
<td>2</td>
<td>MTL Isolator</td>
<td>6</td>
<td>DIO Mounting Bracket</td>
</tr>
<tr>
<td>3</td>
<td>Label Holder</td>
<td>7</td>
<td>IS Wire Duct</td>
</tr>
<tr>
<td>4</td>
<td>Hazardous Area Wiring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7.5.7. MTL Discrete IS Panel Rack Mounting
Mounting in an I/O Cabinet or on a Panel:
MTL discrete IS panels can be mounted in I/O cabinets or on panels as shown in Figure 7.5.8. The I/O cabinet panel is pre-drilled to fit. Other panels must be drilled and tapped as shown in Figure 7.5.10. Table 7.5.5 shows recommended hole sizes for various panel thicknesses.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MDIO Field Interface Module</td>
<td>4</td>
<td>IS Wire Duct</td>
</tr>
<tr>
<td>2</td>
<td>MTL Isolator</td>
<td>5</td>
<td>MAIO Field Interface Module</td>
</tr>
<tr>
<td>3</td>
<td>Label Holder</td>
<td>6</td>
<td>Mounting Panel</td>
</tr>
</tbody>
</table>

Figure 7.5.8. MTL IS Panel I/O Cabinet Mounting
Panels are normally mounted in pairs with the field wiring terminals facing each other. This allows routing field wiring in the central channel and system wiring on the sides as shown in Figure 7.5.9.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Panel B</td>
<td>4</td>
<td>DC power to panels A and B</td>
</tr>
<tr>
<td>2</td>
<td>Panel A</td>
<td>5</td>
<td>Communication line to panel A</td>
</tr>
<tr>
<td>3</td>
<td>IS field wiring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7.5.9. Panel Mounting Example
Figure 7.5.10 shows the location of MTL discrete IS panel mounting holes. Dimensions shown below are given as mm (in.). Table 7.5.5 specifies the size of the mounting holes based on the thickness of the panel.

![Top View](image1)

![Side View](image2)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Panel mounting hole</td>
<td>2</td>
<td>DIN rail mounting holes</td>
</tr>
</tbody>
</table>

Table 7.5.5. Mounting Hole Sizes

<table>
<thead>
<tr>
<th>Panel Thickness (mm)</th>
<th>Hole size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3.61</td>
</tr>
<tr>
<td>3</td>
<td>3.66</td>
</tr>
<tr>
<td>4</td>
<td>3.70</td>
</tr>
</tbody>
</table>
MTL IS Termination Panel for Analog Applications

The MTL Analog IS Termination Panel (10P50340001) is shown in Figure 7.5.11. It is marked “MAIO-MTL® TERMINATION PANEL” on the printed wiring assembly. The panel holds 16 isolators and can handle either 16 input points or 16 output points depending on the FIM installed.

Two FIMs are available:

- **MAI16**  4–20 mA Input  10P54040004 or 10P57700005
- **MAO16**  4–20 mA Output  10P54080004

The MAI16 serves 16 input points; the MAO16 serves 16 output points.

MTL provides a number of galvanic isolator barriers to meet different signal requirements. Hazardous-side field wiring is brought to a connector at the top of the isolator.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HD3 Panel (Card Cage) address (A, B, C, or D)</td>
<td>7</td>
<td>Power Strip (TBD) for panel DC supply using stranded wire (Allows daisy chaining of DC power and access to panel chassis ground)</td>
</tr>
<tr>
<td>2</td>
<td>Socket for optional redundant FIM B</td>
<td>8</td>
<td>Fuse Blown LED</td>
</tr>
<tr>
<td>3</td>
<td>FIM A (required)</td>
<td>9</td>
<td>Fuse – 3.15 Amp, 250 V, IEC</td>
</tr>
<tr>
<td>4</td>
<td>Port B (TBB) – Even-numbered communication line for redundant FIM B</td>
<td>10</td>
<td>Isolator and point 16</td>
</tr>
<tr>
<td>5</td>
<td>Jumpers HD1–HD2 for FIM redundancy</td>
<td>11</td>
<td>Isolator and point 16</td>
</tr>
<tr>
<td>6</td>
<td>Port A (TBA) – Odd-numbered communication line for FIM A</td>
<td>12</td>
<td>Address label – Write the address of the primary FIM here</td>
</tr>
</tbody>
</table>

An optional label holder spans the length of the panel and provides a place to record the field wiring connection to each isolator.

**Figure 7.5.11. MTL Analog IS Termination Panel**
The MTL Analog IS Termination Panel is connected to an MPC II Controller in a Control File via a communication line as shown in Figure 7.5.12.

<table>
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<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control File</td>
<td>5</td>
<td>Communication Line (shielded twisted pair) (two lines are required for FIM redundancy)</td>
</tr>
<tr>
<td>2</td>
<td>Controller in the Control File</td>
<td>6</td>
<td>DC power for MTL Analog IS Termination Panel</td>
</tr>
<tr>
<td>3</td>
<td>Control Cable (1984-2783-xxxx non-EMC) (10P5651xxxx EMC)</td>
<td>7</td>
<td>MTL Analog IS Termination Panel</td>
</tr>
<tr>
<td>4</td>
<td>Communication Termination Panel II</td>
<td>8</td>
<td>IS field wiring (connects to top of isolators)</td>
</tr>
</tbody>
</table>

Figure 7.5.12. Analog I/O with MTL IS Termination Panel
DC Power

The MAIO FIM allows loop power between the FIM and the isolator in the range 22 to 36 VDC. A Remote I/O Power Supply (1984–4302–0000x) can be used to supply 27 ± 1 VDC. The panel can use a redundant (A/B) DC supply.

Grounding

Grounding is accomplished by mounting the panel to a metal part that is grounded. The metal tab on the termination panel must be used to connect grounds. When the panel is mounted on a nonconducting wall, a ground wire must be run to the ground terminal of the power strip.

Communication Wiring

A single FIM requires one communication line attached to Port A. Redundant FIMs require two communication lines: an odd-numbered line to Port A and the next even-numbered line to Port B. Use shielded twisted pair wires such as 1984–4188–xxxx.

Field Wiring

IS field wiring is landed at terminals on top of the isolators. Hazardous-side wire routing must follow local standards for intrinsic safety.

Labels

The panel has a place to record the address of the primary FIM.

Fuses

The panel has a fuse and a “Fuse Blown” LED. The maximum fuse size allowed is 3.15 amp, 250 volt IEC.

Table 7.5.6. MTL Analog IS Termination Panel Fuses

<table>
<thead>
<tr>
<th>FRSI P/N</th>
<th>Wickman P/N</th>
<th>Littelfuse P/N</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>C53394–3150–0005</td>
<td>19 194 3.15 A</td>
<td>216 3.15</td>
<td>3.15 Amp 5x20 mm Ceramic 250 V IEC</td>
</tr>
</tbody>
</table>
MTL Analog Isolators

The MTL analog IS isolators that work with RS3 are listed below. See the MTL catalog for details.

Table 7.5.7. MTL Analog Input and Output Isolators

<table>
<thead>
<tr>
<th>MTL P/N</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTL4041B</td>
<td>Repeater power supply, 4/20 mA, for 2 or 3-wire transmitters (smart devices)</td>
<td>Single-channel input – Works with 2 or 3-wire 4/20 mA transmitters and smart transmitters</td>
</tr>
<tr>
<td>MTL4041P</td>
<td>High-power repeater power supply, 4/20 mA, for 2 or 3-wire transmitters</td>
<td>Single-channel input – Works with 2- or 3-wire 4/20 mA transmitters and smart transmitters</td>
</tr>
</tbody>
</table>

Output Isolators

<table>
<thead>
<tr>
<th>MTL4045B</th>
<th>Isolating driver, 4/20 mA, for I/P converters</th>
<th>Single-channel output – Works with 4/20 mA current/pressure (I/P) converters</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTL4046P</td>
<td>High-power isolating driver, for HART valve positioners</td>
<td>Single-channel output – Works with 4/20 mA devices and HART valve positioners</td>
</tr>
</tbody>
</table>

HART = Highway Addressable Remote Transducer

Jumpers

**FIM Address:** The panel (card cage) address is set by jumper HD3. Only one jumper is allowed at the 1–2 position to specify the address as A, B, C, or D.

**FIM Redundancy:** The redundancy jumpers (HD1–HD2) must be at “N” for single-FIM operation and at “R” for redundant FIM operation.
Mounting

The panel can be mounted:
- in a System Cabinet (19-inch rack)
- in an I/O Termination Cabinet
- on a flat panel (non-HART)
- on DIN rails (non-HART)

**NOTE:** To comply with CSA, NRTL, or CE standards, MTL panels must be mounted in an enclosure that meets the requirements of the corresponding standard.

Two panels fit side-by-side on a DIO Mounting Bracket (10P57830001) in a System Cabinet (see Figure 7.5.7). I/O Termination Cabinets are available in 2x2, 2x4 and 2x5 sizes to hold two columns of panels with 2, 4, or 5 panels per column. The rear wall of the I/O cabinet is drilled to fit the panels. Dimensions shown below are given as mm (in.).

![Diagram of panel mounting instructions]

**NOTE:** This panel is wider than the standard MIO panel.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Panel or Wall Mounting Holes (4) - Use M4x20 (8-32 x 3/4) Screws</td>
</tr>
<tr>
<td>2</td>
<td>DIN Rail Mounting Holes (2)</td>
</tr>
</tbody>
</table>

**Figure 7.5.13. MTL Analog Panel Mounting Instructions**
Panels are normally mounted in pairs with the field wiring terminals facing each other. This allows routing field wiring in the central channel and system wiring on the sides as shown in Figure 7.5.14.

Figure 7.5.14. Analog Panel Wiring Illustration
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PeerWay Interface Devices

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<td>8-1-9</td>
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<tr>
<td>8.1.3</td>
<td>Board 1 Jumper Settings</td>
<td>8-1-10</td>
</tr>
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<td>Board 2 LEDs</td>
<td>8-1-15</td>
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<td>8.2.1</td>
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<td>8-2-5</td>
</tr>
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<td>8.2.2</td>
<td>RS-232C Signals and Connector Pin Assignments</td>
<td>8-2-5</td>
</tr>
<tr>
<td>8.2.3</td>
<td>Definition of Some RS-422 Terms</td>
<td>8-2-7</td>
</tr>
<tr>
<td>8.2.4</td>
<td>RS-422 Pins and Signals</td>
<td>8-2-7</td>
</tr>
<tr>
<td>8.2.5</td>
<td>X.25 Parameters</td>
<td>8-2-10</td>
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<td>8.2.6</td>
<td>CE-Compliant Cable Specifications</td>
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<td>8.2.7</td>
<td>X.25 Clocking Parameters</td>
<td>8-2-13</td>
</tr>
<tr>
<td>8.2.8</td>
<td>EIA Options</td>
<td>8-2-14</td>
</tr>
<tr>
<td>8.3.1</td>
<td>HIA/Black Box Cable Assembly Pin Assignments</td>
<td>8-3-5</td>
</tr>
<tr>
<td>8.3.2</td>
<td>CE Compliant Cable Specifications</td>
<td>8-3-7</td>
</tr>
<tr>
<td>8.5.1</td>
<td>RNI LEDs</td>
<td>8-5-6</td>
</tr>
</tbody>
</table>
Section 1: VAX/PeerWay Interface

The Virtual Address Extension (VAX) QBUS® Interface is a link between an RS3 and a Digital VAX® computer system. The VAX QBUS Interface resides as a node on the PeerWay and connects to the VAX QBUS.

There are two QBUS to PeerWay Interface (QBI) kits for different types of VAX.

- QBI Hardware Kit, MicroVAX II (1984–2350–0001)
- QBI Hardware Kit, MicroVAX 3xxx and 4xxx Series (1984–2647–0001)

The VAX 3xxx/4xxx kit works with systems with BA213 or BA215 cabinets, such as the 3300, 3400, 35xx, 36xx, 3800, 3900, and the VAX 4000.

The kits share the PeerWay Interface board and one short cable. They differ in the marshaling panel and the long cable.

See details for Host Mode in the PeerWay Interfaces Manual (PW) for information on configuration.

Figure 8.1.1 shows the VAX QBUS Interface installed in a MicroVAX II cabinet.
Figure 8.1.1. VAX QBUS Interface Installation
QBI Hardware Kit for the MicroVAX II

The kit for the MicroVAX II consists of:

- Cable, QBUS Board 1 to Board 2 (1984–2504–9002)
- Cable, QBUS Boards to Marshaling Panel (MP) (1984–2335–9901)
MicroVAX II - PeerWay Marshaling Panel

The MicroVAX/PeerWay Interface Marshaling Panel (1984–2533–000x) is shown in Figure 8.1.2. One end of the QBUS Board to MP-MicroVax II cable (1984–2535–9901) is connected to the connector behind the Marshaling Panel, shown in the side view of Figure 8.1.2. The Marshaling Panel is installed in a blank panel on the back of the MicroVAX. The special PeerWay Drop cables (1984–2628–1006 and 1984–2628–2006) are connected to the front of the Marshaling Panel.

Figure 8.1.2. MicroVAX/PeerWay Interface Marshaling Panel
QBI Hardware Kit for the VAX 3xxx and VAX 4xxx

The kit for the MicroVAX 3xxx or VAX 4xxx consists of:

- Cover Plate, DEC (1984-2624-0001)
- QBUS Board 1 (CPU Card) (1984-3261-0002)
- QBUS Board 2 (PeerWay Interface Card) (1984-2510-0001)
- Cable, QBUS Board 1 to Board 2 (1984-2504-9002)
- Cable, QBUS Boards to Marshaling Panel (MP) (1984-2335-9901)
VAX 3xxx/VAX 4xxx - PeerWay Marshaling Panel

The MicroVAX/PeerWay Interface Marshaling Panel (1984-2622-0001) and Cover Plate (1984-2624-0001) are shown in Figure 8.1.3. One end of the QBUS Board to MP-MicroVax II cable (1984-2335-9901) is attached to the connector behind the Marshaling Panel. The Marshaling Panel is installed in the cover plate and then in the back of the MicroVAX. Special PeerWay Drop cables (1984-2628-1006 and 1984-2628-2006) are connected to the front of the Marshaling Panel.

![Marshaling Panel Diagram](image-url)

Figure 8.1.3. VAX 3000 - PeerWay Marshaling Panel
VAX QBUS Interface Marshaling Panel LEDs

LEDs show activity of the interface and indicate board faults. Figure 8.1.2 and Figure 8.1.3 show the LEDs. Table 8.1.1 gives the meanings of the LEDs.

If B1 or B2 is ON, the corresponding card is bad.

B1 and B2 alternate ON and OFF after the Interface is powered up but not yet booted.

Both B1 and B2 will be ON while the diagnostics are running. If they stay ON, both cards can be bad.

Table 8.1.1. MicroVAX/Peerway Interface Marshalling Panel LEDs

<table>
<thead>
<tr>
<th>LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 (RED)</td>
<td>Shows the condition of the CPU card. (Board 1)</td>
</tr>
<tr>
<td>B2 (RED)</td>
<td>Shows the condition of the PeerWay Interface card. (Board 2)</td>
</tr>
<tr>
<td>TXA (YELLOW)</td>
<td>Shows transmission of data to PeerWay A.  Blinks when data is sent.</td>
</tr>
<tr>
<td>TXB (YELLOW)</td>
<td>Shows transmission of data to PeerWay B.  Blinks when data is sent.</td>
</tr>
<tr>
<td>RXA (YELLOW)</td>
<td>Shows reception of data from PeerWay A.  Blinks when data is received.</td>
</tr>
<tr>
<td>RXB (YELLOW)</td>
<td>Shows reception of data from PeerWay B.  Blinks when data is received.</td>
</tr>
</tbody>
</table>
VAX QBUS Interface Circuit Cards

The VAX QBUS Interface contains two circuit cards:

- QBUS Board 1 (CPU card) (1984–3261–0002)
- QBUS Board 2 (PeerWay Interface) (1984–2510–000x)

The circuit cards must be located in the VAX QBUS after the CPU and memory cards and before any disk and tape controller cards. Two complete quad slots must be reserved for the VAX QBUS Interface circuit cards. No gaps can exist between cards in the VAX. If, by moving the disk and tape controller cards or some other cards, a dual slot gap exists, you must put a Digital Equipment Corporation Grant Continuity Card (model M9047) into the empty dual slot.

Figure 8.1.4 shows proper installation. Board 1 should be in the right quad slot. Board 2 should be in the left quad slot. The long cable that is attached to the Marshaling Panel must be connected to the bottom connector of Board 2. The short cable (1984–2504–9002) must be connected from Board 1 to Board 2.

The VAX must be able to supply enough power to the circuit cards. The requirements for each card are listed in Table 8.1.2.

**NOTE:** Be certain that the circuit boards are properly seated in the VAX. Improper seating can result in operating problems that are difficult to trace.
Figure 8.1.4. Circuit Card Installation

Table 8.1.2. Circuit Card Power Requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Board 1 (CPU Card) 1984-3261-000x</th>
<th>Board 2 (PeerWay Interface Card) 1984-2510-000x</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 VDC current</td>
<td>4 A</td>
<td>1.5 A</td>
</tr>
<tr>
<td>12 VDC current</td>
<td>--</td>
<td>700 mA</td>
</tr>
<tr>
<td>Total Watts</td>
<td>20 W</td>
<td>15.9 W</td>
</tr>
<tr>
<td>AC bus loads</td>
<td>1 AC load</td>
<td>0 AC load</td>
</tr>
<tr>
<td>DC bus loads</td>
<td>1 DC load</td>
<td>0 DC load</td>
</tr>
</tbody>
</table>
VAX QBUS Interface Board 1 (CPU Card) Jumpers

Board 1 contains the VAX QBUS Interface memory identification jumpers and the DEC I/O space code jumpers. Figure 8.1.5 shows the locations of these jumpers, Table 8.1.3 shows settings.

![Diagram of Board 1 Jumper Locations]

**Figure 8.1.5. Board 1 Jumper Locations**

**Table 8.1.3. Board 1 Jumper Settings**

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD2</td>
<td>2–3</td>
<td>Factory setting, do not move.</td>
</tr>
<tr>
<td>HD4–HD8</td>
<td>See text for data</td>
<td>I/O Space Code, determines the base address used.</td>
</tr>
<tr>
<td>HD13–HD18</td>
<td>See text for data</td>
<td>Memory Identification, first or second memory window.</td>
</tr>
<tr>
<td>HD29–HD30</td>
<td></td>
<td>Not used.</td>
</tr>
</tbody>
</table>

**Memory Identification Jumpers:** A VAX can hold up to two VAX QBUS Interfaces. Each VAX QBUS Interface is assigned a memory window by the memory identification jumpers. The two valid jumper positions, are shown in Figure 8.1.6. Either jumper position can be used. Note the jumper position because it must be entered into the VAX.
Figure 8.1.6. Board 1 Memory Identification Jumper Positions

Jumper positions to use the first memory window.

Jumper positions to use the second memory window.
**I/O space code jumpers:** The I/O space code jumpers determine the base address used by the VAX QBUS Interface. The jumpers are originally set for a base address of 766020 octal. If the VAX QBUS Interface needs a base address other than 766020 octal, set these jumpers for the required base address. Figure 8.1.7 details the I/O space code jumper settings.

---

**Figure 8.1.7. Board 1 I/O Space Code Jumper Positions**

- Base address 7 6 6 0 2 0
  - This digit is determined by jumpers HD6, HD7, and HD8. HD6 is the least significant digit and HD8 is the most significant digit.
  - This digit is determined by jumpers HD4 and HD5. HD5 is the most significant digit.

- Never use the 1-2 jumper position.
  - The 3-4 jumper position represents a 0 value.
  - The 2-3 jumper position represents a 1 value.

- These are the jumper positions of the board as shipped and represents 766020 octal.
  - HD4, HD5, HD6, HD7, HD8

- These jumper positions represent 766540 octal.
  - HD4 is in the 0 value position and HD5 is in the 1 value position; they represent a value of 4 octal.
  - HD6 and HD8 are in the 1 value position and HD7 is in the 0 value position; they represent a value of 5 octal.
VAX QBUS Interface Board 2 (PeerWay Interface Card) Jumpers

Board 2 (PeerWay Interface) contains the PeerWay node address jumpers. These jumpers are positioned to provide the PeerWay address of this node. Figure 8.1.8 shows the location of these jumpers. Figure 8.1.9 shows how these jumpers are positioned to indicate the PeerWay node address.

Figure 8.1.8. Board 2 Jumper Locations
Figure 8.1.9. PeerWay Node Address Jumper Values
VAX QBUS Interface Board 2 (PeerWay Interface Card) LEDs

Board 2 (PeerWay Interface) has LED indicators, as shown in Figure 8.1.10 and described in Table 8.1.4.

<table>
<thead>
<tr>
<th>Mode</th>
<th>LED Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power on, but not yet booted; board reset</td>
<td>The bottom two LEDs alternate on and off and the bottom yellow LED is steady on.</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>The bottom red LED is steady on. The yellow LEDs blink as diagnostics are run.</td>
</tr>
<tr>
<td>Running</td>
<td>The green LED is steady on. The yellow LEDs blink as indicated above.</td>
</tr>
</tbody>
</table>

Figure 8.1.10. Board 2 LED Indicators

Table 8.1.4. Board 2 LEDs
Section 2:
Supervisory Computer Interface (SCI)

The Supervisory Computer Interface (SCI) provides an interface between the RS3 and host computer systems. The SCI resides as a node on the PeerWay. The SCI can be connected to the supervisory computer by:

- RS-232C Asynchronous Communication Protocol
- RS-422 Asynchronous Communication Protocol
- RS-422 X.25 Communication Protocol

The SCI consists of:

- OI Card Cage
- OI Power Regulator
- OI PeerWay Interface
- OI NV Memory
- OI Processor

See the PeerWay Interfaces Manual (PW) for information on SCI configuration.

Set jumpers on OI NV Memory to match the communications protocol in use. See detail on the appropriate OI NV Memory card in the Service Manual (SV) or the Service Quick Reference Guide (SQ) for jumper setting information.
Figure 8.2.1 shows the SCI and components.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power Switch and Cable</td>
<td>4</td>
<td>OI Processor</td>
</tr>
<tr>
<td>2</td>
<td>OI Power Regulator</td>
<td>5</td>
<td>OI NV Memory Board</td>
</tr>
<tr>
<td>3</td>
<td>OI PeerWay Interface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 8.2.1. Supervisory Computer Interface (Front)**
Figure 8.2.2 shows SCI connections.

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J938 PWRB</td>
<td>1984–0158–1xxx (B Bus)</td>
<td>DC power B (optional)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(optional)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>J937 PWRA</td>
<td>1984–0158–0xxx (A Bus)</td>
<td>DC Bus to System Device (A Bus)</td>
</tr>
<tr>
<td>3</td>
<td>J936 POWER</td>
<td>10P53110001</td>
<td>Power switch and cable</td>
</tr>
<tr>
<td></td>
<td>SWITCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>J084 PEERWAY A</td>
<td>1984–0473–0xxx</td>
<td>PeerWay A Drop Cable</td>
</tr>
<tr>
<td>5</td>
<td>J083 PEERWAY B</td>
<td>1984–0473–0xxx</td>
<td>PeerWay B Drop Cable</td>
</tr>
<tr>
<td>6</td>
<td>J939 FAN</td>
<td>1984–5311–0001</td>
<td>Cable, OI Card Cage to DC Fan</td>
</tr>
</tbody>
</table>

Figure 8.2.2. SCI Cabling Connections (Rear View)
RS-232C Asynchronous Communications Protocol

The RS-232C port connects the SCI to a remote host computer when using RS-232C asynchronous or RS-422/X.25 protocols. The SCI can appear as either a terminal or a modem on the RS-232C port.

An RS-232C cable (10P54340xxx) is used to connect the SCI to a remote host computer. Figure 8.2.3 shows possible connections using the RS-232C port.

Figure 8.2.3. Possible SCI/Host Computer Communication Configurations: RS-232C Port
Table 8.2.1 defines some RS-232C terms. Table 8.2.2 shows the RS-232C connector pin assignments.

### Table 8.2.1. Definition of Some RS-232C Terms

<table>
<thead>
<tr>
<th>Signal</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXD</td>
<td>Data Transmit</td>
</tr>
<tr>
<td>RXD</td>
<td>Data Receive</td>
</tr>
<tr>
<td>RTS</td>
<td>Ready to Send</td>
</tr>
<tr>
<td>CTS</td>
<td>Clear to Send</td>
</tr>
<tr>
<td>DSR</td>
<td>Data Set Ready</td>
</tr>
<tr>
<td>DCD</td>
<td>Data Carrier Detect</td>
</tr>
<tr>
<td>DTR</td>
<td>Data Terminal Ready</td>
</tr>
</tbody>
</table>

### Table 8.2.2. RS-232C Signals and Connector Pin Assignments

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>--</td>
<td>14</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>TXD Data transmit</td>
<td>15</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>RXD Data receive</td>
<td>16</td>
<td>--</td>
</tr>
<tr>
<td>4</td>
<td>RTS Ready to send</td>
<td>17</td>
<td>--</td>
</tr>
<tr>
<td>5</td>
<td>CTS Clear to send</td>
<td>18</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>DSR Data set ready</td>
<td>19</td>
<td>--</td>
</tr>
<tr>
<td>7</td>
<td>Signal ground</td>
<td>20</td>
<td>DTR Data terminal ready</td>
</tr>
<tr>
<td>8</td>
<td>DCD Data carrier detect</td>
<td>21</td>
<td>--</td>
</tr>
<tr>
<td>9</td>
<td>--</td>
<td>22</td>
<td>--</td>
</tr>
<tr>
<td>10</td>
<td>--</td>
<td>23</td>
<td>--</td>
</tr>
<tr>
<td>11</td>
<td>--</td>
<td>24</td>
<td>--</td>
</tr>
<tr>
<td>12</td>
<td>--</td>
<td>25</td>
<td>--</td>
</tr>
<tr>
<td>13</td>
<td>--</td>
<td></td>
<td>--</td>
</tr>
</tbody>
</table>
Figure 8.2.4 shows the female plug for the SCI and details pin functions when the SCI appears as a terminal.

Figure 8.2.4. Standard RS-232C Cable Connector with SCI as a Terminal

Figure 8.2.5 shows the female plug for the SCI and the pin functions when the SCI is jumpered to appear as a modem.

Figure 8.2.5. Standard RS-232C Cable Connector with SCI as a Modem
The RS-422 port on the SCI connects the SCI to the supervisory computer with asynchronous or X.25 protocols. The SCI can be connected to the supervisory computer or modem by an RS-422 cable using a nonstandard connector on the SCI end (AMP HDC-20, P/N 205422-1 or equivalent).

The SCI cannot be jumpered to look like a modem or terminal when using the RS-422 port. Cables from the RS-422 port to the host or modem must provide the electrical configuration.

Table 8.2.3 defines some RS-422 terms. Table 8.2.4 shows RS-422 pin assignments.

### Table 8.2.3. Definition of Some RS-422 Terms

<table>
<thead>
<tr>
<th>Signal</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXD</td>
<td>Data Transmit</td>
</tr>
<tr>
<td>RXD</td>
<td>Data Receive</td>
</tr>
<tr>
<td>RTS</td>
<td>Ready-To-Send</td>
</tr>
<tr>
<td>CTS</td>
<td>Clear-To-Send</td>
</tr>
<tr>
<td>RXC</td>
<td>Receive Data Clock</td>
</tr>
<tr>
<td>TXC</td>
<td>Transmit Data Clock</td>
</tr>
</tbody>
</table>

### Table 8.2.4. RS-422 Pins and Signals

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>--</td>
<td>9</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>--</td>
<td>10</td>
<td>TXC+ (X.25 only)</td>
</tr>
<tr>
<td>3</td>
<td>CTS+ Clear to send</td>
<td>11</td>
<td>TXC- (X.25 only)</td>
</tr>
<tr>
<td>4</td>
<td>CTS- Clear to send</td>
<td>12</td>
<td>RXC+ (X.25 only)</td>
</tr>
<tr>
<td>5</td>
<td>RXD+ Data receive</td>
<td>13</td>
<td>RXC- (X.25 only)</td>
</tr>
<tr>
<td>6</td>
<td>RXD- Data receive</td>
<td>14</td>
<td>RTS+ Ready to send</td>
</tr>
<tr>
<td>7</td>
<td>TXD+ Data transmit</td>
<td>15</td>
<td>RTS- Ready to send</td>
</tr>
<tr>
<td>8</td>
<td>TXD- Data transmit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RS-422 Asynchronous Protocol Cabling

Figure 8.2.6 shows the male plug to be connected to the SCI and indicates the pin functions for RS-422 asynchronous protocol.

Send data to host \{ TXD - \ TXD + \}

Receive data from host \{ RXD - \ RXD + \}

When asserted by host SCI transmit is enabled \{ CTS - \ CTS + \}

Asserted by the SCI when it is ready to talk to the Host.

Figure 8.2.6. RS-422 Cable Connector: Asynchronous Protocol
RS-422 X.25 Protocol

For the X.25 protocol, the SCI is configured both logically and electrically. The SCI logical configuration is its function in exchanging data packets. Logically, the SCI can be the data circuit-terminating equipment (DCE) or the data terminal equipment (DTE).

The electrical configuration of the SCI refers to whether it functions as a modem or terminal. Electrically, the SCI functions as a modem if it is directly connected to the host and as a terminal if it is connected to a modem.

Figure 8.2.7 shows various RS-422 X.25 protocol connections.
The X.25 parameters shown in Table 8.2.5 can be configured as directed by the installation instructions provided by the vendor of the host computer.

**Table 8.2.5. X.25 Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>The maximum number of unacknowledged packets at both the link and network layers (1 to 7).</td>
</tr>
<tr>
<td>T1</td>
<td>The link level transmission timeout (10 to 10,000 milliseconds).</td>
</tr>
<tr>
<td>N1</td>
<td>The maximum network layer packet size (16 to 1024 bytes).</td>
</tr>
<tr>
<td>N2</td>
<td>The maximum number of link level retries (1 to 100 attempts).</td>
</tr>
<tr>
<td>T3</td>
<td>The link level idle transmit timeout (0 to 5000 seconds). If zero is selected, the link layer never times out.</td>
</tr>
</tbody>
</table>
RS-422 X.25 Cabling

For X.25 protocol, the cabling from the SCI to the modem or host determines whether the SCI is electrically configured as a modem or terminal. An SCI that implements X.25 protocol is shipped with a custom cable that electrically configures the SCI as a modem. In X.25 protocol, this cable connects the SCI directly to the host, as in Figure 8.2.8. The cable and RS-422 connectors carry the RS-422 electrical interface. If you want to configure the SCI electrically as a terminal, you must design a cable that performs that task.

The clock jumpers on the OI NV Memory must be set for internal clocks if the SCI is configured as a modem, or for external clocks if the SCI is configured as a terminal.

![Figure 8.2.8. RS-422 Cable Connector: X.25 Protocol](image)
Checklist for CE-Compliant Installation

Follow these rules to ensure CE compliance:

1. Use cables specified in Table 8.2.6 as needed.
2. Install the card cage and mounting bracket in a grounded system cabinet.
3. Power the cage from a CE-approved power supply.
4. Use a CE-approved modem when a modem is required.

Table 8.2.6. CE-Compliant Cable Specifications

<table>
<thead>
<tr>
<th>Cable</th>
<th>Part Number</th>
<th>Maximum Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>PeerWay Drop Cable</td>
<td>1984-0473-00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>DC Power Cable, Bus To Product</td>
<td>1984-0158-0xxx</td>
<td>61 meters (200 feet)</td>
</tr>
<tr>
<td>DC Power Cable, Power Supply to Product</td>
<td>1984-1083-00xx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>Fan Power Cable</td>
<td>1984-1605-9009</td>
<td>Standard</td>
</tr>
<tr>
<td>Cable, HIA to HIA</td>
<td>1984-2171-0004</td>
<td>1.2 meters (4 feet)</td>
</tr>
<tr>
<td>Shielded RS-232 cable assembly, SCI to PC</td>
<td>10P54340xxx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>Shielded RS-422 cable assembly, X.25/SCI</td>
<td>10P54390xxx</td>
<td>15.2 meters (50 feet)</td>
</tr>
<tr>
<td>Shielded RS-422 cable assembly, HIA to Black Box®</td>
<td>10P54400xxx</td>
<td>15.2 meters (50 feet)</td>
</tr>
</tbody>
</table>
The clock lines of the RS-422 port (TXC and RXC) are for X.25 protocol only. TXC gives the transmit data clock signal and RXC the receive data clock signal. The direction of the clock lines is determined by the synchronous clock jumper settings on the NV Memory. If the SCI is electrically configured as a modem, the jumpers are set for internal clock and the clock lines are driven by the SCI at the configured internal baud rate. In an SCI electrically configured as a terminal, jumpers are set for external clock and clock lines supply clock signals to the SCI.

A synchronous clock can be supplied internally at 300, 1200, 1800, 2400, 3600, 4800, 9600, 19.2K, 38.4K and many higher rates. The SCI accepts any external clock in the range 300 to 200K baud. At baud rates above 38.4K, multiple flags may be needed between packets to assure 500 microseconds between messages.

**NOTE:** The NV Memory jumpers must match values entered on the SCI Configuration screen.

Table 8.2.7 shows the X.25 clocking parameters.

<table>
<thead>
<tr>
<th>Electrical Configuration of the SCI</th>
<th>Nonvolatile Memory Jumper Configuration</th>
<th>Source of Clock Signals</th>
<th>Direction of Clock Lines (TXC and RXC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modem</td>
<td>Internal Clock</td>
<td>SCI</td>
<td>Output</td>
</tr>
<tr>
<td>Terminal</td>
<td>External Clock</td>
<td>Modem</td>
<td>Input</td>
</tr>
</tbody>
</table>
EIA Options

Select the EIA options on the SCI Configuration screen for asynchronous protocol using the RS-232C or RS-422 ports. The present implementation of X.25 protocol does not provide EIA options.

The EIA options available are: CTS, MODEM and NONE.

The CTS option is a hardware means of flow control. Flow control can also be enabled in software by selecting XON and XOFF control on the SCI Configuration screen. When the host sends XOFF, the SCI stops sending messages until it sees XON. XON and XOFF control is not implemented for X.25.

The EIA options are described in Table 8.2.8.

Table 8.2.8. EIA Options

<table>
<thead>
<tr>
<th>EIA Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTS</td>
<td>SCI configured as a modem: When DTR (pin 20) is asserted by the host, the SCI can transmit.</td>
</tr>
<tr>
<td></td>
<td>SCI configured as a terminal: When DCD (pin 8) is asserted by the host, the SCI can transmit.</td>
</tr>
<tr>
<td>MODEM</td>
<td>SCI configured as a terminal: The SCI monitors the modem Carrier Detect (CD) signal to determine when the host has called in. When DTR (pin 20) is asserted by the SCI, the modem answers the phone and establishes the carrier. When DTR is dropped by the SCI, the modem hangs up the line. Unless dropped to hang up the line, this pin remains asserted once software initialization is complete. DCD (pin 8) is asserted by the modem to inform the SCI that the data carrier is detected.</td>
</tr>
<tr>
<td>NONE</td>
<td>No EIA option is selected.</td>
</tr>
</tbody>
</table>
Section 3: Highway Interface Adapter (HIA)

The Highway Interface Adapter (HIA) connects two PeerWays. It resides as a node on one PeerWay and communicates with another HIA that is a node on the other PeerWay.

The HIA pair is connected to provide PeerWay-to-PeerWay communications:
- Directly, for adjacent PeerWays
- By modem, for geographically separated PeerWays

The HIA consists of:
- OI Card Cage
- OI Power Regulator
- OI PeerWay Interface
- OI NV Memory
- OI Processor

Figure 8.3.1 shows two HIAs and their components. See the PeerWay Interfaces Manual (PW: 4) for configuring HIA software.

Figure 8.3.1. HIA Pair (Front)
HIA Direct Connection of PeerWays

Two HIAs providing a direct PeerWay-to-PeerWay connection are typically contained in a shelf assembly side-by-side with an HIA Link Cable joining the RS-422 connectors.

Figure 8.3.2 shows the rear view of two directly connected HIAs.

![Diagram of HIA direct connection](image_url)

<table>
<thead>
<tr>
<th>No.</th>
<th>Connector</th>
<th>Cable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J938 PWRB</td>
<td>1984–0158–1xxx (Bus B) (optional)</td>
<td>DC power B (optional)</td>
</tr>
<tr>
<td>2</td>
<td>J937 PWRA</td>
<td>1984–0158–0xxx (Bus A)</td>
<td>DC Bus to System Device (Bus A)</td>
</tr>
<tr>
<td>3</td>
<td>J936 POWER SWITCH</td>
<td>10P53110001</td>
<td>Power switch and cable</td>
</tr>
<tr>
<td>4</td>
<td>J084 PEERWAY A</td>
<td>1984–0473–0xxx</td>
<td>PeerWay A Drop Cable</td>
</tr>
<tr>
<td>5</td>
<td>J083 PEERWAY B</td>
<td>1984–0473–0xxx</td>
<td>PeerWay B Drop Cable</td>
</tr>
<tr>
<td>6</td>
<td>J939 FAN</td>
<td>1984–5311–0001</td>
<td>Cable, OI Card Cage to DC Fan</td>
</tr>
<tr>
<td>7</td>
<td>RS-422 (J086) to RS-422 (J086)</td>
<td>1984–2171–0004</td>
<td>The cable is 1.2 meters (4 feet) long.</td>
</tr>
</tbody>
</table>

Figure 8.3.2. HIA Cabling (Rear View)
FRSI recommends configuring PeerWays connected by HIAs to provide alternate communication paths if communications fail. Figure 8.3.3 shows four PeerWays connected by HIAs. Dual HIAs can be used as shown at the right side of the figure. If communications fail between a pair of HIAs, data can still be routed to the proper destination.

Figure 8.3.3. PeerWays Connected by HIAs
HIA Connection of PeerWays Using Modems

Distant PeerWays can be connected by use of HIAs, Converters, Modems, and a communication line as shown in Figure 8.3.4. This is referred to as "HIA Modem".

The HIA modem group at each end of the communication line consists of:

- HIA
- Black Box® Data Converter (Customer furnished)
- HIA/Black Box® Cable Assembly (1984–2859–00xx)
- Synchronous Modem (Customer furnished).

The Data Converter is a Black Box® IC454–187 (or equal) that converts between RS-422 and RS-232 formats. Set the Data Converter to modem operation on the HIA side and to terminal operation on the modem side.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cable 10P54400xxx from RS-422 (J086) to Black Box®</td>
<td>The cable length (xxx) is in decimeters. Maximum is 15.2 meters (50 feet)</td>
</tr>
<tr>
<td>2</td>
<td>Black Box® Data Converter</td>
<td>Model IC454–187 (or equivalent)</td>
</tr>
<tr>
<td>3</td>
<td>RS-232C data cable</td>
<td>Must be a shielded cable</td>
</tr>
<tr>
<td>4</td>
<td>Modem</td>
<td>Must be CE approved</td>
</tr>
<tr>
<td>5</td>
<td>Communications line</td>
<td>Runs to a matching set connected to the other PeerWay</td>
</tr>
</tbody>
</table>

Figure 8.3.4. HIA Modem Connection of PeerWays
An HIA/Black Box® Cable Assembly (1984–2859–xxxx) is required between the HIA and the Data Converter. The cable connects the 15-pin RS-422 connector on the HIA to the 37-pin RS-449 connector on the Data Converter. Table 8.3.1 shows the cable pin assignments.

The modems must be set to agree with the rest of the equipment.

The OINV Memory card jumpers and the Configure HIA screen must be set to agree with the particular connections used.

Table 8.3.1. HIA/Black Box Cable Assembly Pin Assignments

<table>
<thead>
<tr>
<th>Twisted Pair</th>
<th>Signal</th>
<th>Wire Color</th>
<th>RS-422 Connector (HIA)</th>
<th>RS-449 Connector (Black Box)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RXD –, RXD +</td>
<td>Black, Red</td>
<td>6, 5</td>
<td>6, 24</td>
</tr>
<tr>
<td>2</td>
<td>RTS –, RTS +</td>
<td>Black, White</td>
<td>15, 14</td>
<td>7, 25</td>
</tr>
<tr>
<td>3</td>
<td>TXC –, TXC +</td>
<td>Black, Green</td>
<td>11, 10</td>
<td>5, 23</td>
</tr>
<tr>
<td>4</td>
<td>RXC –, RXC +</td>
<td>Black, Blue</td>
<td>13, 12</td>
<td>8, 26</td>
</tr>
<tr>
<td>5</td>
<td>TXD –, TXD +</td>
<td>Black, Yellow</td>
<td>8, 7</td>
<td>4, 22</td>
</tr>
<tr>
<td>6</td>
<td>CTS –, CTS +</td>
<td>Black, Brown</td>
<td>4, 3</td>
<td>9, 27</td>
</tr>
<tr>
<td>Pairs 1–6</td>
<td>Ground</td>
<td>Drain Wires</td>
<td>2</td>
<td>19, 20, 37</td>
</tr>
<tr>
<td></td>
<td>Jumper Wire</td>
<td>White (.25 mm², 24 Ga.)</td>
<td>7 TO 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jumper Wire</td>
<td>White (.25 mm², 24 Ga.)</td>
<td>25 TO 30</td>
<td></td>
</tr>
</tbody>
</table>
OI NV Memory Jumpering for the HIA

The RS-422 Terminal/Modem jumpers on the OI NV Memory Card determine the source of the HIA clock synchronization. OI NV Memory Card section in the Service Manual shows jumper locations and settings (SV: 3–6).

NOTE: The Configure HIA screen of each HIA must agree with the jumper settings on that HIA.

OI NV Memory Jumper Setting for HIA Direct Connection

One HIA in the pair must be jumpered as a modem (internal clocking).

The other HIA must be jumpered as a terminal (external clocking).

The HIA jumpered as a modem (internal clocking) is the source of the clock synchronization signal.

OI NV Memory Jumpering for HIA Connection Using Modems

Each HIA must be jumpered as a terminal (external clocking).
Checklist for CE Compliant Installation

Follow these rules to ensure CE compliance:

1. Use cables specified in Table 8.3.2 as needed.
2. Install the card cage and mounting bracket in a grounded system cabinet.
3. Power the cage from a CE approved power supply.
4. Use a CE approved modem when a modem is required.

<table>
<thead>
<tr>
<th>Table 8.3.2. CE Compliant Cable Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
</tr>
<tr>
<td>PeerWay Drop Cable</td>
</tr>
<tr>
<td>DC Power Cable, Bus To Product</td>
</tr>
<tr>
<td>DC Power Cable, Power Supply to Product</td>
</tr>
<tr>
<td>Fan Power Cable</td>
</tr>
<tr>
<td>Cable, HIA to HIA</td>
</tr>
<tr>
<td>Shielded RS-232 cable assembly, SCI to PC</td>
</tr>
<tr>
<td>Shielded RS-422 cable assembly, X.25/SCI</td>
</tr>
<tr>
<td>Shielded RS-422 cable assembly, HIA to Black Box</td>
</tr>
</tbody>
</table>
Configure HIA Screen

An HIA is configured with the Configure HIA screen (see Figure 8.3.5), which displays the information necessary for HIA operation. Configure each HIA on the PeerWay to which it is connected.

<table>
<thead>
<tr>
<th>Node number</th>
<th>Other node</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;10</td>
<td>64</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PeerWay number</th>
<th>Other PeerWay</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>=&gt;2</td>
</tr>
</tbody>
</table>

Node 10 Configuration Information

Program version: 11.xx  Boot version: x.xx

Distance penalty: 24  Baud rate: 614400

Clock src: CLK_INT  Link passing time: 1.0 s

Slot width: 30  Time correction: 0.00 sec/day

Pass time: yes

Volume, Filename for Program: xxx,xxxx

Volume, Filename for Config: xxx,xxxx

operation: Save HIA configuration to config file

Press <ENTER> to Begin

Figure 8.3.5. Configure HIA Screen

The “Baud rate” field entry must match the baud rate used. For direct connection this is 614400 baud. The modem connection baud rate is determined by the modems or the converters used.

The “Clock src” field entry on the Configure HIA screen must match the clock jumper position for each HIA used. Only “CLK_EXT” and “CLK_INT” are allowed.

Pressing [PAGE AHEAD] from the Configure HIA screen calls up the HIA Status screen. The HIA Status screen contains communications diagnostic information.
See the *PeerWay Interfaces Manual* (PW) for a complete description of the screens and for more information on HIA configuration.

An HIA pair can support up to 40 links over the HIA connection. The number of available links can be viewed on the PeerWay Node screen for the HIA.

**NOTE:** The Configure HIA screen of each HIA must agree with the jumper settings on that HIA.
Section 4:  Diogenes Interface

The Diogenes Interface connects an RS3 and a Rosemount Diogenes® control system. The Diogenes Interface resides as a node on the PeerWay and connects to the Diogenes via a TI Communications Card.

The Diogenes Interface consists of:

- OI Card Cage
- OI Power Regulator
- OI PeerWay Interface
- OI NV Memory
- OI Processor Card
- Diogenes TI Communications Card (7900-0408-0001)
- Diogenes Communications Connection Box (Optional)
- Diogenes Cables

The Operator Interface (OI) Nonvolatile (NV) Memory card must have the terminal/modem jumpers in the terminal position. See the Service Manual (SV: 3-6) for the location and setting of the jumpers.

Diogenes Interface Software must be loaded into the OI Processor card and the PeerWay Interface NV Memory card.
Figure 8.4.1 shows the Diogenes Interface and its components.

![Diagram of Diogenes Interface (Front)]

Figure 8.4.2 shows the connections on the OI Card Cage backside.

![Diagram of Diogenes Interface (Back)]
Figure 8.4.3 shows two methods of connecting the systems.

Direct RS-232 connection
- Max 50 Feet
- Cable 7900-0355-0005, -0006, -0007, or -0008

Current loop RS-232 connection
- Max 1 km
- Max 50 Feet
- Cable 7900-0166-000x
- Communication Converter Box
- Cable 7900-0164-000x

Figure 8.4.3. Diogenes/RS3 Connections
The Diogenes Interface requires a TI Communications card (7900-0408-0001) in one Console or SCI interface slot in the Diogenes Card Cage. Refer to the Diogenes User’s Manual for information about installing TI Comm Cards in the TI 960B.

Figure 8.4.4 shows the TI Comm Card jumper positions for an RS-232 connection and for a current loop connection.
Diogenes Communication Convertor Box

The Diogenes Communication Converter Box is only used for the current loop connection.

The Converter Box must be jumpered for a Diogenes/RS3 current loop connection. To access the jumpers, unplug the Communication Converter Box, remove the four cover screws, and take off the cover. Figure 8.4.5 shows the required jumper positions.

Figure 8.4.5. Diogenes Communication Converter Box Jumpering (Current Loop Connection)
Section 5:
RS3 Network Interface (RNI)

The RS3™ Network Interface (RNI) (10P53330001) provides a connection between the PeerWay and an Ethernet Local Area Network. It is a node on the PeerWay and a host on the Ethernet. Software in the RNI provides a connection between PeerWay messages and Ethernet messages. Figure 8.5.1 shows the RNI in the 19-inch mounting bracket (10P53900001).

![Figure 8.5.1. RNI and Mounting Bracket](image)

Figure 8.5.2 shows the front of the RNI.

![RNI Front Panel Diagram](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ethernet 10BaseT connector</td>
<td>6</td>
<td>LEDs</td>
</tr>
<tr>
<td>2</td>
<td>PeerWay B drop cable</td>
<td>7</td>
<td>Console/Serial connector for terminal communicating with the RNI</td>
</tr>
<tr>
<td>3</td>
<td>PeerWay A drop cable</td>
<td>8</td>
<td>Reset switch</td>
</tr>
<tr>
<td>4</td>
<td>Write-on label</td>
<td>9</td>
<td>DC power connector</td>
</tr>
<tr>
<td>5</td>
<td>Ethernet 10Base2 connector</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 8.5.2. RNI Front Panel**

The write-on label, shown in Figure 8.5.3, provides space to record the PeerWay Node address, the Ethernet host name, and which Ethernet port is in use. The MAC Address (machine address) will be filled out at the factory. This is the unique Ethernet address of the RNI.

<table>
<thead>
<tr>
<th>PEERWAY NODE NUMBER</th>
<th>E-NET HOST</th>
<th>MAC ADDRESS</th>
<th>E-NET 10 BASE T</th>
<th>E-NET 10 BASE 2</th>
</tr>
</thead>
</table>

**Figure 8.5.3. RNI Label**
Checklist for CE Compatible Installations

These rules must be followed to ensure CE compliance:

1. Mount the RNI in the RNI Rack Mount Bracket (10P53900001).
2. Mount the RNI bracket in a properly grounded system cabinet.
3. Install the ferrite clamp next to the connector on the Ethernet cable.
4. Use a EMC-approved source of DC power.
5. Connect the PeerWay Drop Cables to a CE-approved PeerWay Tap.
Connecting System Cables

The RNI connects to both an RS3 PeerWay and to an Ethernet Local Area Network as shown in Figure 8.5.4.

![Diagram of system connections]

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PeerWays A and B</td>
<td>5</td>
<td>DC power cable</td>
</tr>
<tr>
<td>2</td>
<td>PeerWay Tap Boxes A and B</td>
<td>6</td>
<td>10BaseT or 10Base2 Ethernet connector</td>
</tr>
<tr>
<td>3</td>
<td>PeerWay Drop Cables A and B</td>
<td>7</td>
<td>Ethernet</td>
</tr>
<tr>
<td>4</td>
<td>RNI</td>
<td>8</td>
<td>Computers on Ethernet</td>
</tr>
</tbody>
</table>

Figure 8.5.4. System Connections to the RNI

**DC Power:** Use a 1984–0158–00xx cable for A bus power, or a 1984–0158–20xx cable for A/B power. Use a 10-amp fuse in the DC Distribution Card. There is no power switch on the RNI.

**PeerWay:** The RNI is connected to the PeerWay by a set of standard PeerWay Drop Cables (1984–0473–xxxx).

**CAUTION**

The RNI cannot supply adequate current to power an Optical Tap Box or a PeerWay Extender (PX). It can power a twinax Tap Box.
**Ethernet:** The RNI connects to the Ethernet by a 10baseT twisted pair or 10Base2 coaxial cable. Use of other Ethernet media requires an external converter. The ferrite clamp (55P-0426-x001) must be fastened next to the connector on the Ethernet cable for CE compliant installation.

**NOTE:** The RNI is normally shipped jumpered for use with 10BaseT twisted pair wiring.

**Serial Port Cable:** A cable (10P55180007) is supplied to connect your ASCII terminal to the Console/Serial connector. The cable has a RJ-11 connector on each end. Two adaptors are provided: a RJ-11 to 9-pin Dsub (10P55130001) and a RJ-11 to 25-pin Dsub (10P55130002). The adaptor fastens to the serial port of your PC and then allows the cable to connect to the RNI. This cable is used in the startup procedure and for servicing the RNI. Use a terminal emulator program in your PC to communicate with the RNI over the serial port. Set it for RS-232 communication using 9600 baud, 8 bits, no parity, and no handshaking.

**Label:** Write the PeerWay Node Number and the Ethernet device name on the label.
The history ofasync in asynchronous computing evolved over several decades. Initially, the concept of asynchronous programming was inspired by the early work on nondeterministic systems and the study of concurrency and parallelism. Over the years, the field has seen significant advancements and contributions from various researchers and practitioners. In recent years, the rise of cloud computing has further propelled the development of asynchronous programming, with technologies like AWS Lambda and Google Cloud Functions paving the way for more efficient and scalable implementations.

Asynchronous programming has found applications in a wide range of domains, from web development to machine learning. Its ability to handle long-running tasks without blocking the main thread allows for more responsive and efficient systems. Moreover, the integration of asynchronous programming with modern infrastructure, such as serverless architectures, has opened up new possibilities for developing scalable and resilient applications.

In summary, the historical development of asynchronous programming has been a fascinating journey, marked by innovative ideas, practical implementations, and significant impacts on various fields. With ongoing advancements and the continued evolution of computing technologies, asynchronous programming is poised to play an increasingly important role in shaping the future of software development.
Jumpers

Internal jumper HD1 selects Ethernet format as either 10BaseT or 10Base2. Figure 8.5.5 shows the location of the jumper. The default type is 10BaseT. The selected Ethernet type is marked on the label. You can change to 10Base2 by opening the case and moving the jumper. Be sure to change the marking on the label.

![Figure 8.5.5. RNI Ethernet Jumper Location](image)

Configuring the RNI

The Ethernet network administrator will register the machine number (MAC address) of the RNI and assign it a name in the network. The PeerWay configuror will assign a PeerWay Node Number to the RNI. This must be entered in the RNI configuration file on the host computer. The RNI reads this file at boot time and thus determines the PeerWay Node Number to use. The name and Node Number should be written on the RNI label.
Appendixes

Appendix A: IEC and ISO Symbols ........................................ A-1
Appendix B: Acronyms and Abbreviations .............................. B-1
## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1</td>
<td>A-1</td>
</tr>
</tbody>
</table>

- **Table A.1**: IEC and ISO Symbols
Appendix A:  
IEC and ISO Symbols

Table A.1 describes the International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO) symbols used in this manual.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Publication</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>──────</td>
<td>IEC 417, No. 5031</td>
<td>Direct current</td>
</tr>
<tr>
<td>☯</td>
<td>IEC 417, No. 5032</td>
<td>Alternating current</td>
</tr>
<tr>
<td>┏┓</td>
<td>IEC 417, No. 5033</td>
<td>Both direct and alternating current</td>
</tr>
<tr>
<td>┌┐</td>
<td>IEC 417, No. 5017</td>
<td>Earth Ground TERMINAL</td>
</tr>
<tr>
<td>┌┐</td>
<td>IEC 417, No. 5019</td>
<td>Protective Conductor TERMINAL</td>
</tr>
<tr>
<td>┌┐</td>
<td>IEC 417, No. 5020</td>
<td>Frame or Chassis TERMINAL</td>
</tr>
<tr>
<td>▲▼</td>
<td>IEC 417, No. 5021</td>
<td>Equipotentiality</td>
</tr>
<tr>
<td>─</td>
<td>IEC 417, No. 5007</td>
<td>On (Supply)</td>
</tr>
<tr>
<td>─</td>
<td>IEC 417, No. 5008</td>
<td>Off (Supply)</td>
</tr>
<tr>
<td>─</td>
<td>IEC 417, No. 5172</td>
<td>Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION</td>
</tr>
<tr>
<td>▶</td>
<td>ISO 3864, No. B.3.6</td>
<td>Caution: Risk of electric shock</td>
</tr>
<tr>
<td>▶</td>
<td>ISO 3864, No. B.3.1</td>
<td>Caution: Refer to accompanying documents</td>
</tr>
<tr>
<td>▶</td>
<td>IEC 417, No. 5041</td>
<td>Caution: Hot surface</td>
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<tr>
<td>λ</td>
<td>IEC 27-1, No. 101a</td>
<td>Power Factor</td>
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</table>
## Appendix B: Acronyms and Abbreviations

### A

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Ampere</td>
</tr>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>A/D</td>
<td>Analog to Digital</td>
</tr>
<tr>
<td>ADLC</td>
<td>Advanced Data Link Controller</td>
</tr>
<tr>
<td>AIB</td>
<td>Analog Input Block</td>
</tr>
<tr>
<td>AIO</td>
<td>Analog Input/Output</td>
</tr>
<tr>
<td>AIO-R</td>
<td>Redundant Analog Input/Output</td>
</tr>
<tr>
<td>AIO-RS</td>
<td>Redundant Analog Input/Output with Smart Daughterboard</td>
</tr>
<tr>
<td>Amp</td>
<td>Ampere</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>AOB</td>
<td>Analog Output Block</td>
</tr>
<tr>
<td>ARB</td>
<td>Arbitration</td>
</tr>
<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
</tr>
<tr>
<td>A.S.H.R.A.E.</td>
<td>American Society of Heating, Refrigeration, and Air Conditioning Engineers</td>
</tr>
<tr>
<td>ASIC</td>
<td>Application Specific Integrated Circuit</td>
</tr>
<tr>
<td>ASYNC</td>
<td>Asynchronous</td>
</tr>
<tr>
<td>AUI</td>
<td>Attachment Unit Interface</td>
</tr>
<tr>
<td>AWG</td>
<td>American Wire Gauge</td>
</tr>
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</table>

### B

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BCC</td>
<td>Basic Command Console</td>
</tr>
<tr>
<td>BCD</td>
<td>Binary-Coded Decimal</td>
</tr>
<tr>
<td>BMI</td>
<td>Buffered Motherboard Interface</td>
</tr>
<tr>
<td>BNC</td>
<td>Baby “N” Connector</td>
</tr>
<tr>
<td>BRAM</td>
<td>Battery Backed Random Access Memory</td>
</tr>
<tr>
<td>BTU</td>
<td>British Thermal Unit</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Celcius</td>
</tr>
<tr>
<td>CC</td>
<td>Command Console; Contact Controller</td>
</tr>
<tr>
<td>CE</td>
<td>Conformité Européenne (Marking that indicates compliance to all applicable European directives)</td>
</tr>
<tr>
<td>CENELEC</td>
<td>European Committee for Electrotechnical Standardization</td>
</tr>
<tr>
<td>CFM</td>
<td>Cubic Feet per Minute</td>
</tr>
<tr>
<td>CFS</td>
<td>Control File Status (an RS3 command line entry)</td>
</tr>
<tr>
<td>CH</td>
<td>Chassis</td>
</tr>
<tr>
<td>CIB</td>
<td>Contact Input Block</td>
</tr>
<tr>
<td>CIO</td>
<td>Contact Input/Output</td>
</tr>
<tr>
<td>CJC</td>
<td>Cold-Junction Compensator</td>
</tr>
<tr>
<td>cm</td>
<td>Centimeter(s)</td>
</tr>
<tr>
<td>cm³</td>
<td>Cubic Centimeters</td>
</tr>
<tr>
<td>CMOS</td>
<td>Complementary Metal-Oxide Semiconductor</td>
</tr>
<tr>
<td>COB</td>
<td>Contact Output Block</td>
</tr>
<tr>
<td>Com.</td>
<td>Common</td>
</tr>
<tr>
<td>CP</td>
<td>Coordinator Processor</td>
</tr>
<tr>
<td>cpi</td>
<td>Characters Per Inch</td>
</tr>
<tr>
<td>CPLST</td>
<td>Coordinator Processor Line Status</td>
</tr>
<tr>
<td>cps</td>
<td>Characters Per Second</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>CRC</td>
<td>Cyclical Redundancy Check</td>
</tr>
<tr>
<td>CRT</td>
<td>Cathode-Ray Tube</td>
</tr>
<tr>
<td>CSA</td>
<td>Canadian Standards Association (Canadian Approval)</td>
</tr>
<tr>
<td>CTS</td>
<td>Clear to Send</td>
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<table>
<thead>
<tr>
<th><strong>D</strong></th>
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<tbody>
<tr>
<td>D/A</td>
<td>Digital to Analog</td>
</tr>
<tr>
<td>DAC</td>
<td>Digital-to-Analog Converter</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel</td>
</tr>
<tr>
<td>dBm</td>
<td>Decibels above (or below) 1 Milliwatt</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>DCD</td>
<td>Data Carrier Detect</td>
</tr>
<tr>
<td>DCE</td>
<td>Data Circuit-Terminating Equipment</td>
</tr>
<tr>
<td>DCS</td>
<td>Distributed Control System</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
</tr>
<tr>
<td>DDP</td>
<td>Disk Directory PeerWay</td>
</tr>
<tr>
<td>DEC</td>
<td>Digital Equipment Corporation</td>
</tr>
<tr>
<td>DIB</td>
<td>Discrete Input Block</td>
</tr>
<tr>
<td>DIN</td>
<td>Deutsche Industrie Normenausschuss (a German national standards organization)</td>
</tr>
<tr>
<td>DIO</td>
<td>Discrete Input/Output</td>
</tr>
<tr>
<td>DIP</td>
<td>Dual Inline Package</td>
</tr>
<tr>
<td>DMA</td>
<td>Direct Memory Access</td>
</tr>
<tr>
<td>DMAC</td>
<td>Direct Memory Access Controller</td>
</tr>
<tr>
<td>DNB</td>
<td>Data Terminal Not Busy</td>
</tr>
<tr>
<td>DOB</td>
<td>Discrete Output Block</td>
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<tr>
<td>DRAM</td>
<td>Dynamic Random Access Memory</td>
</tr>
<tr>
<td>DS</td>
<td>Disk Shutdown (an RS3 command line entry)</td>
</tr>
<tr>
<td>DSR</td>
<td>Data Set Ready</td>
</tr>
<tr>
<td>DTE</td>
<td>Data Terminal Equipment</td>
</tr>
<tr>
<td>DTACK</td>
<td>Data Transfer Acknowledge</td>
</tr>
<tr>
<td>DTR</td>
<td>Data Terminal Ready</td>
</tr>
<tr>
<td>DUART</td>
<td>Dual Universal Asynchronous Receiver/Transmitter</td>
</tr>
<tr>
<td>DVM</td>
<td>Digital Voltage Meter</td>
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<tr>
<td>ECC</td>
<td>Enhanced Command Console</td>
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<tr>
<td>EDAC</td>
<td>Error Detection and Correction</td>
</tr>
<tr>
<td>EEPROM</td>
<td>Electrically Erasable Programmable Read-Only Memory</td>
</tr>
<tr>
<td>EEROM</td>
<td>Electrically Erasable Read-Only Memory</td>
</tr>
<tr>
<td>EIA</td>
<td>Electronic Industries Association</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic Compatability</td>
</tr>
<tr>
<td>EMI</td>
<td>Electromagnetic Interface</td>
</tr>
<tr>
<td>EN</td>
<td>European Norm</td>
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<tr>
<td>EPROM</td>
<td>Erasable Programmable Read-Only Memory</td>
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<tr>
<td>ESD</td>
<td>Electrostatic Discharge</td>
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<tr>
<td>ETS</td>
<td>Electrical Tap Set</td>
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<tr>
<td>F</td>
<td>Fahrenheit</td>
</tr>
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<td>FEM</td>
<td>Front End Module</td>
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<td>Acronym</td>
<td>Definition</td>
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<td>---------</td>
<td>------------</td>
</tr>
<tr>
<td>FET</td>
<td>Field Effect Transistor</td>
</tr>
<tr>
<td>FIC</td>
<td>Field Interface Card</td>
</tr>
<tr>
<td>FIM</td>
<td>Field Interface Module</td>
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<tr>
<td>FMS</td>
<td>Flexible Media Stack</td>
</tr>
<tr>
<td>FO</td>
<td>Fiber Optic</td>
</tr>
<tr>
<td>FRSI</td>
<td>Fisher-Rosemount Systems, Inc.</td>
</tr>
<tr>
<td>FSA</td>
<td>Formatter/Sense Amplifier</td>
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<tr>
<td>ft</td>
<td>Feet</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>G</td>
<td>Acceleration of gravity at Earth’s surface</td>
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<tr>
<td>GAK</td>
<td>Gate Array Logic</td>
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<tr>
<td>GND</td>
<td>Ground</td>
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<tr>
<td>H</td>
<td>Highway Addressable Remote Transducer</td>
</tr>
<tr>
<td>HART®</td>
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<tr>
<td>HCC</td>
<td>Hardened Command Console</td>
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<tr>
<td>HIA</td>
<td>Highway Interface Adapter</td>
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<tr>
<td>HOB</td>
<td>HART Output Block</td>
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<tr>
<td>hr</td>
<td>Hour</td>
</tr>
<tr>
<td>HVAC</td>
<td>Heating, Ventilation, and Air Conditioning</td>
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<tr>
<td>Hz</td>
<td>Hertz</td>
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<table>
<thead>
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<th>Acronym</th>
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<tr>
<td>ID</td>
<td>Identification</td>
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<tr>
<td>i.e.</td>
<td>Id Est (that is)</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
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<tr>
<td>I/F</td>
<td>Interface</td>
</tr>
<tr>
<td>IGND</td>
<td>Isolated Ground</td>
</tr>
<tr>
<td>in.</td>
<td>Inch(es)</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>IP</td>
<td>International Protection</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>I/P</td>
<td>Current to Pressure</td>
</tr>
<tr>
<td>IS</td>
<td>Intrinsic Safety</td>
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<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>ISA</td>
<td>Instrument Society of America</td>
</tr>
<tr>
<td>ISO</td>
<td>Isolated</td>
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<tr>
<td>IT</td>
<td>Isolation Transformer</td>
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<th>Definition</th>
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<tbody>
<tr>
<td>Kb</td>
<td>Kilobit (1024 bits)</td>
</tr>
<tr>
<td>KB</td>
<td>Kilobyte (1024 bytes)</td>
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<tr>
<td>KBI</td>
<td>Keyboard Interface Card</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>kHz</td>
<td>Kilohertz</td>
</tr>
<tr>
<td>km</td>
<td>Kilometer</td>
</tr>
<tr>
<td>KMD</td>
<td>Kill Memory Dump</td>
</tr>
<tr>
<td>kVa</td>
<td>Kilovolt-ampere</td>
</tr>
<tr>
<td>KVI</td>
<td>Keyboard/Video Interface</td>
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<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>lb</td>
<td>Pound(s)</td>
</tr>
<tr>
<td>lbf</td>
<td>Pounds of Force</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
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<tr>
<td>LFD</td>
<td>Line Fault Detection</td>
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<tr>
<td>LLB</td>
<td>Local Loop Back</td>
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<tr>
<td>lpi</td>
<td>Lines Per Inch</td>
</tr>
<tr>
<td>LPM</td>
<td>Loop Power Module</td>
</tr>
<tr>
<td>LVD</td>
<td>Low Voltage Directive</td>
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<th>Definition</th>
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<tbody>
<tr>
<td>m</td>
<td>Meter(s)</td>
</tr>
<tr>
<td>m³</td>
<td>Cubic Meters</td>
</tr>
<tr>
<td>mA</td>
<td>Milliampere</td>
</tr>
<tr>
<td>MAC</td>
<td>Media Access Control</td>
</tr>
<tr>
<td>MAIO</td>
<td>Multipoint Analog Input/Output</td>
</tr>
<tr>
<td>MB</td>
<td>Megabyte</td>
</tr>
<tr>
<td>MBM</td>
<td>Magnetic Bubble Memory</td>
</tr>
<tr>
<td>MC</td>
<td>MiniConsole</td>
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</table>
MDIO  Multipoint Discrete Input/Output
MDIOH Multipoint Discrete Input/Output - High-Side Switch FIM
MDIOL Multipoint Discrete Input/Output - Low-Side Switch FIM
MEG  Megabyte
MHz  Megahertz
MIB  Multiplexer Input Block
MIO  Multipoint Input/Output
mm  Millimeter
MLC  MultiLoop Card
MMI  Main Memory Interface
MOS  Metal-Oxide Semiconductor
MP  Marshaling Panel
MPC  MultiPurpose Controller
ms  Millisecond
MTBF  Mean Time Between Failure(s)
MTCC  Multitube Command Console
MTL  Measurement Technologies Limited
MTO  Master Terminal Operator
MUX  Multiplexer
mV  Millivolt(s)
mV/m  Millivolt(s) per meter

N

N/A  Not Applicable
NBS  National Bureau of Standards (American) - This organization is now known as the National Institute of Science and Technology.
N.C.  Normally Closed
NEC  National Electrical Code
NEMA  National Electrical Manufacturers Association
NFPA  National Fire Protection Association
nm  Nanometer(s)
N·m  Newton Meter(s)
No.  Number
N.O.  Normally Open
NRTL  Nationally Recognized Testing Laboratory (American)
NRTL/C  Nationally Recognized Testing Laboratory/Canada (meets American and Canadian standards)
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>NRZ</td>
<td>Non-Return to Zero</td>
</tr>
<tr>
<td>NV</td>
<td>Nonvolatile</td>
</tr>
<tr>
<td>NVRAM</td>
<td>Nonvolatile Random Access Memory</td>
</tr>
<tr>
<td>OBC</td>
<td>Output Bypass Card</td>
</tr>
<tr>
<td>OBU</td>
<td>Output Bypass Unit</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<tr>
<td>OI</td>
<td>Operator Interface</td>
</tr>
<tr>
<td>OSC</td>
<td>Oscillator</td>
</tr>
<tr>
<td>OTS</td>
<td>Optical Tap Set</td>
</tr>
<tr>
<td>PAL</td>
<td>Programmable Array Logic</td>
</tr>
<tr>
<td>PIOB</td>
<td>Pulse Input/Output Block</td>
</tr>
<tr>
<td>PIT</td>
<td>Parallel Interface Timer</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
</tr>
<tr>
<td>PLCB</td>
<td>Programmable Logic Controller Block</td>
</tr>
<tr>
<td>PLD</td>
<td>Programmable Logic Device</td>
</tr>
<tr>
<td>P/N</td>
<td>Part Number</td>
</tr>
<tr>
<td>ppm</td>
<td>Parts Per Million</td>
</tr>
<tr>
<td>psi</td>
<td>Pounds per Square Inch</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>PWA</td>
<td>Printed Wiring Assembly</td>
</tr>
<tr>
<td>PWB</td>
<td>Printed Wiring Board</td>
</tr>
<tr>
<td>PX</td>
<td>PeerWay Extender</td>
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<tr>
<td>QBI</td>
<td>QBUS to PeerWay Interface</td>
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<tr>
<td>RAM</td>
<td>Random Access Memory</td>
</tr>
<tr>
<td>RBL</td>
<td>Rosemount Basic Language</td>
</tr>
<tr>
<td>RBLC</td>
<td>Rosemount Basic Language Controller</td>
</tr>
<tr>
<td>RCVR</td>
<td>Receiver</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>---------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>RF</td>
<td>Radio Frequency</td>
</tr>
<tr>
<td>RFI</td>
<td>Rosemount Factory Interface</td>
</tr>
<tr>
<td>RGB</td>
<td>Red-Green-Blue</td>
</tr>
<tr>
<td>RGRANT</td>
<td>Redundancy Grant</td>
</tr>
<tr>
<td>RIOB</td>
<td>Redundant Input/Output Block</td>
</tr>
<tr>
<td>RMON</td>
<td>Remote Monitoring</td>
</tr>
<tr>
<td>RMP</td>
<td>RS3 Millennium Package</td>
</tr>
<tr>
<td>rms</td>
<td>Root Mean Square</td>
</tr>
<tr>
<td>RNI</td>
<td>RS3 Network Interface</td>
</tr>
<tr>
<td>ROM</td>
<td>Read Only Memory</td>
</tr>
<tr>
<td>ROS</td>
<td>RS3 Operator Station</td>
</tr>
<tr>
<td>RREQ</td>
<td>Redundancy Request</td>
</tr>
<tr>
<td>RSEL</td>
<td>Redundancy Select</td>
</tr>
<tr>
<td>RTC</td>
<td>Real Time Clock</td>
</tr>
<tr>
<td>RTD</td>
<td>Resistance Temperature Detector</td>
</tr>
<tr>
<td>RTN</td>
<td>Return</td>
</tr>
<tr>
<td>RTS</td>
<td>Ready to Send</td>
</tr>
<tr>
<td>RX</td>
<td>Receive</td>
</tr>
<tr>
<td>RXC</td>
<td>Receive Clock</td>
</tr>
<tr>
<td>RXD</td>
<td>Data Receive</td>
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**S**

<table>
<thead>
<tr>
<th>Acronym</th>
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<tr>
<td>SAMA</td>
<td>Scientific Apparatus Makers Association</td>
</tr>
<tr>
<td>SCI</td>
<td>Supervisory Computer Interface</td>
</tr>
<tr>
<td>SCR</td>
<td>Silicon-Controlled Rectifier</td>
</tr>
<tr>
<td>SCSI</td>
<td>Small Computer System Interface</td>
</tr>
<tr>
<td>SEL</td>
<td>Selector</td>
</tr>
<tr>
<td>SELV</td>
<td>Separated Extra-Low Voltage</td>
</tr>
<tr>
<td>SH</td>
<td>Shield</td>
</tr>
<tr>
<td>SIB</td>
<td>Smart Transmitter Input Block</td>
</tr>
<tr>
<td>SMS</td>
<td>System Manager Station</td>
</tr>
<tr>
<td>SNMP</td>
<td>Simple Network Management Protocol</td>
</tr>
<tr>
<td>SRAM</td>
<td>Static Random Access Memory</td>
</tr>
<tr>
<td>SRU</td>
<td>System Resource Unit</td>
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