FISHER-ROSEMOUNT

RS3 ™

Digital Blending

Software Version 1, Release 2

November 1992
U.S. Manual PN: 1984-2658-0102
A-4 Size Manual PN: 1984-2658-0112

1984-2658-7x01
1984-2658-7x11

Printed in the U.S.A.

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Digital Blending

About This Manual

Changes for This Release

- The pagination and format of this book have changed in order to match the DOCVUE documentation library, a CD–ROM version of the RS3 manual set.

Revision Level for This Manual

For This Software Version:	Refer to This Document:		
	Title	**Date**	**Part Number**
1R2	Digital Blending	November 1992	1984-2658-01x2
1R1	Digital Blending	October 1993	1984-2658-01x2
##	Manual Title	Month Year	1984-xxx-xxxx

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.

Manual Title — Chapter

For ..., see CC: 1-1.

Manual Title — Chapter-Section

Abbreviations of Manual Titles

AL = Alarm Messages
BA = ABC Batch
CB = ControlBlock 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 Release Notes and Installation Guide
RP = RNI Programmer's Reference Manual
SP = Site Preparation and Installation
SR = System Resource Unit (SRU)
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	1984-2640-18x1
Software Release Notes, Version 18	1984-2818-01xx

Related Documents

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

ABC Batch Software Manual	1984-2654-18x1
Alarm Messages Manual	1984-2657-18x1
ABC Batch Quick Reference Guide	1984-2814-11xx
Configuration Quick Reference Guide	1984-2812-08xx
Console Configuration Manual	1984-2643-18x1
ControlBlock Configuration Manual	1984-2646-18x1
I/O Block Configuration Manual	1984-2645-18x1
Operator's Guide	1984-2647-18x1
PeerWay Interfaces Manual	1984-2650-18x1
Rosemount Basic Language Manual	1984-2653-18x1
RNI Programmer's Reference Manual	1984-3356-01x1
RNI Release Notes and Installation Guide	1984-3357-01x1
Service Manual, Volume 1	1984-2648-18x1
Service Manual, Volume 2	1984-2648-18x2
Site Preparation and Installation Manual	1984-2642-xxx1
Software Defects for Version 18	1984-2818-03xx
System Resource Unit (SRU) Manual	1984-2651-18x1
User Manual Master Index	1984-2641-18x1

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Section 1:
Introduction to Digital Blending

This section describes the digital inline blending process and provides an overview of the Fisher-Rosemount digital blending package along with applications for its use.

Introduction to Digital Inline Blending

Digital inline blending is a synchronized, accurate process for continuously standardizing or blending products by introducing multiple component streams into a common pipe or small vessel. This process is used to blend individual components to make a product such as ice cream, mayonnaise, and petroleum. Figure 1.1 shows a digital inline blender.

Digital inline blending is similar to batch blending in that ingredients and additives are metered together into a tank or pipe. However, it differs in that all of the ingredients are metered simultaneously by volume or weight, using digital technology to assure that the product batch is within specification at all times.

Continuous digital blending forces all metered components to respond to errors of ±1 pulse. A common demand for total product, ratioed for each component stream, synchronizes the overall blender. The demand for each stream is the integral of the demand rate, which is expressed as volume. Digital blending control algorithms compare the demand volume to the total measured volume for each component. The feedback algorithm operates on that error and continuously drives the volume error to zero.

The total demand rate can be paced back by one component stream. The total demand rate continues to decrease until the slowest component stream can keep up with the demand. This ensures that the total demand rate never exceeds the ability of the slowest component to deliver. During pacing, the feedback algorithm of the component stream continuously totals the difference between demand volume and measured volume and drives it to zero. The blending system algorithm optimizes and balances the blend of total product for component accuracy and rate of production.

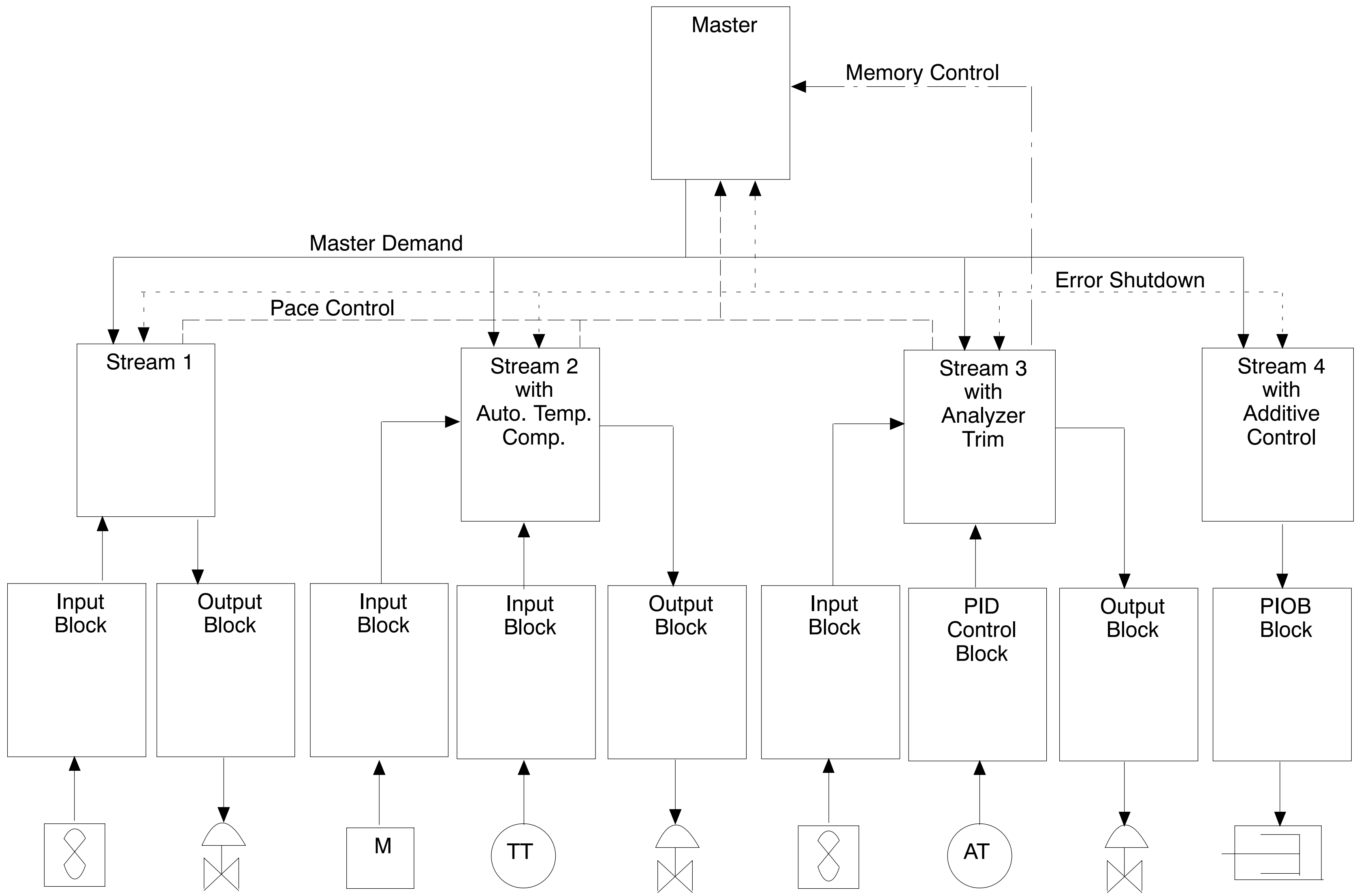

Figure 1.1. Digital Inline Blending

Overview of the Fisher-Rosemount Digital Blending Package

The Fisher-Rosemount Digital Blending package provides precise control of multiple components coming together into a single blended product. This solution gives you a way to produce a known product using a precise, ratioed, volume-to-volume, demand-to-measurement approach.

The Digital Blending package offers control for the following elements:

- A master that is responsible for starting, stopping, and managing the rate of production of the overall product.
- Component streams and additive streams that are arranged in various ways to provide several blending application solutions.

Digital Blending can be configured with up to 24 streams linked to one master. Multiple digital blending can be used within a single product as long as the configuration assures that the application is running at the speeds required to maintain accurate digital blending.

Figure 1.2 shows a digital blending example composed of a master with nine preconfigured discrete function ControlBlocks and up to 24 streams. This example allows for controller redundancy with a maximum of eight blend streams per controller.

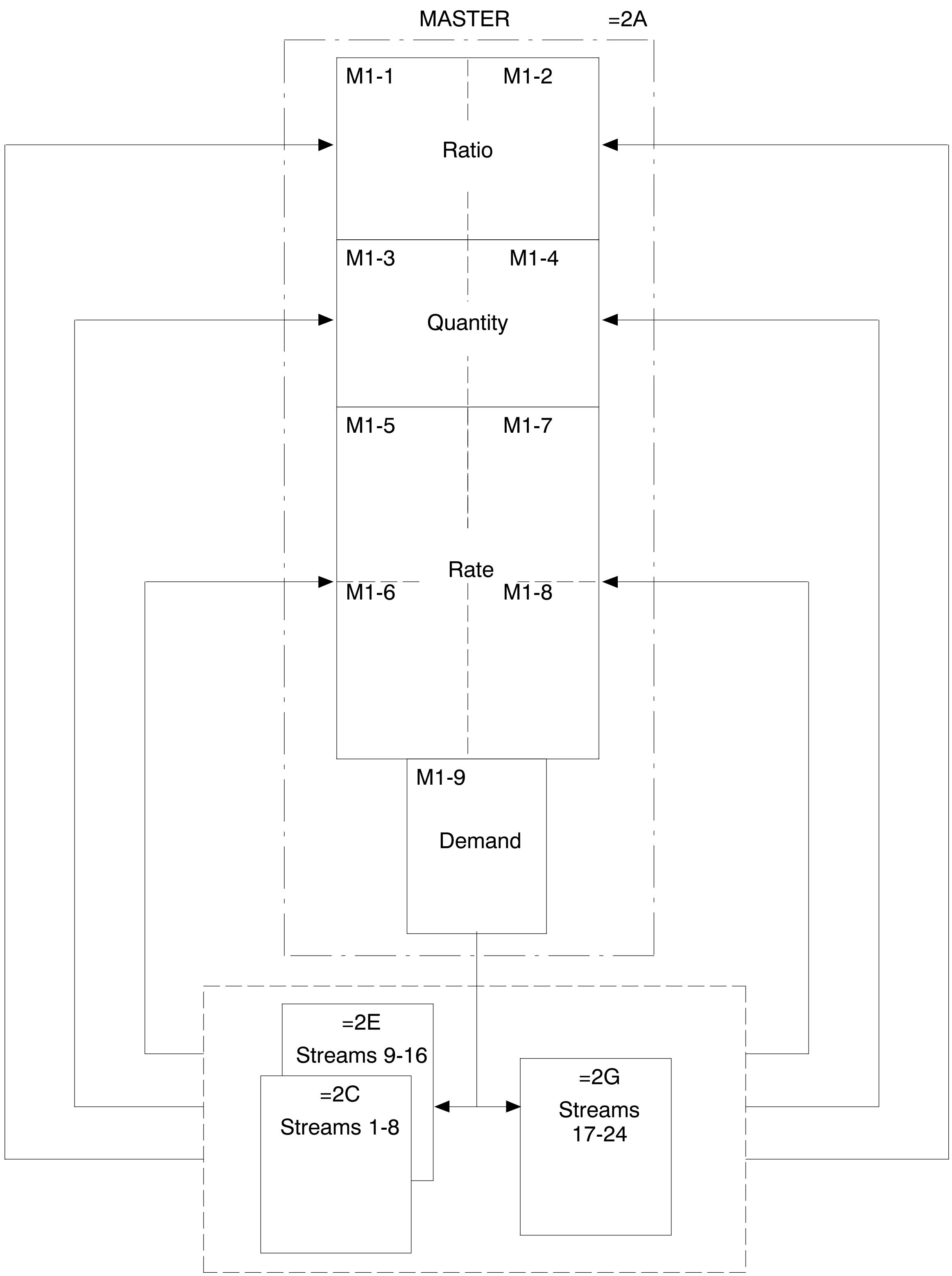

Figure 1.2. Fisher-Rosemount Digital Blending with 24 Streams

Digital Blending Applications

You can use the Fisher-Rosemount Digital Blending package for a variety of applications:

- Multi-stream digital inline blending
- Multi-stream batch blending
- Stream-to-stream blending
- Wild stream blending

Multi-stream Digital Inline Blending

Standard inline blending uses a master block to synchronize the overall blending of individual stream components. The example in Figure 1.3 shows a master controlling the process of 3 streams.

The master sends the demand for product rate as a common demand signal to all of the streams. Each stream controls the flow of a separate component of the blending application for the appropriate ratio or percentage of total blend in an accurate demanded component volume or weight to measured component volume or weight material balance manner.

A variety of flow meter types can be used for the inputs. The meters used should generate a stream of pulse outputs with as high a resolution as possible because the accuracy of the meters is reflected in the accuracy of the blend. The stream flow meters should be specifically selected according to the unique physical characteristics of each stream.

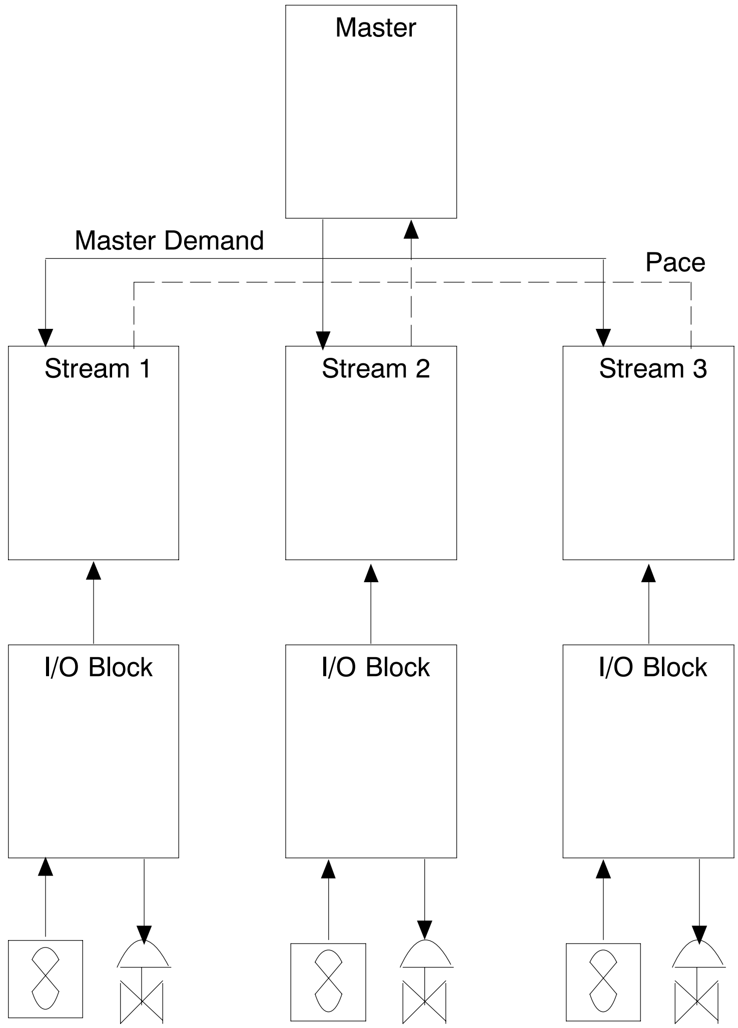

Figure 1.3. Multi-stream Digital Inline Blender

Multi-stream Batch Blending

Batch blending uses a master block to synchronize the overall blending of individual stream components. The example in Figure 1.4 shows a master controlling the process of 3 streams.

The master sends the demand for product rate as a common demand signal to all of the streams. Each stream controls the flow of a separate component of the blending application for the appropriate ratio or percentage of total blend in an accurate demanded component to volume or weight to measured component volume or weight material balance.

A variety of flow meter inputs can be used. The meters should generate a stream of pulse outputs. The overall blend accuracy is limited to the accuracy of the meters used. The flow meters should be specifically selected for the unique physical characteristics of each stream.

For batch blending, the addition of components is not time-critical; therefore, pace does not need to be enabled. Any stream that lags can catch up during or at the end of the blend.

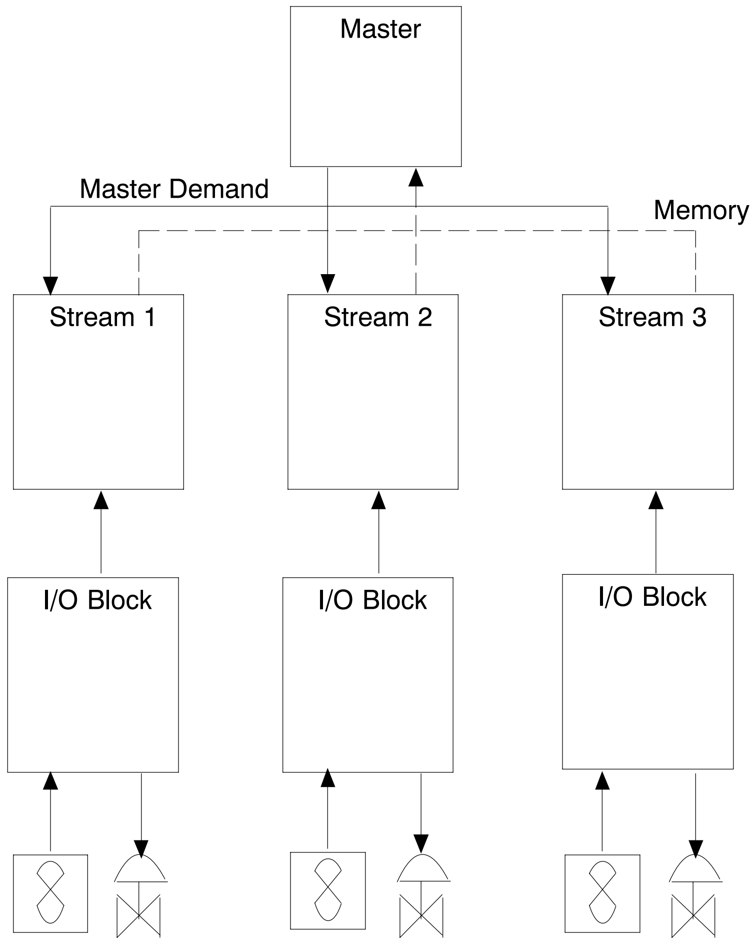

Figure 1.4. Multi-stream Batch Blender

Stream-to-Stream Blending

Stream-to-stream blending uses two streams to control their quantity with respect to one another. This is done by using the measured rate of one stream as the demand rate of another stream.

Figure 1.5 shows that stream 2 is used to maintain a ratio of stream 2 to stream 1. The demand rate of stream 2 is multiplied by a ratio or stream demand factor and then balanced against the flow meter of stream 2 to maintain a ratio of volume or weight of stream 2 to stream 1.

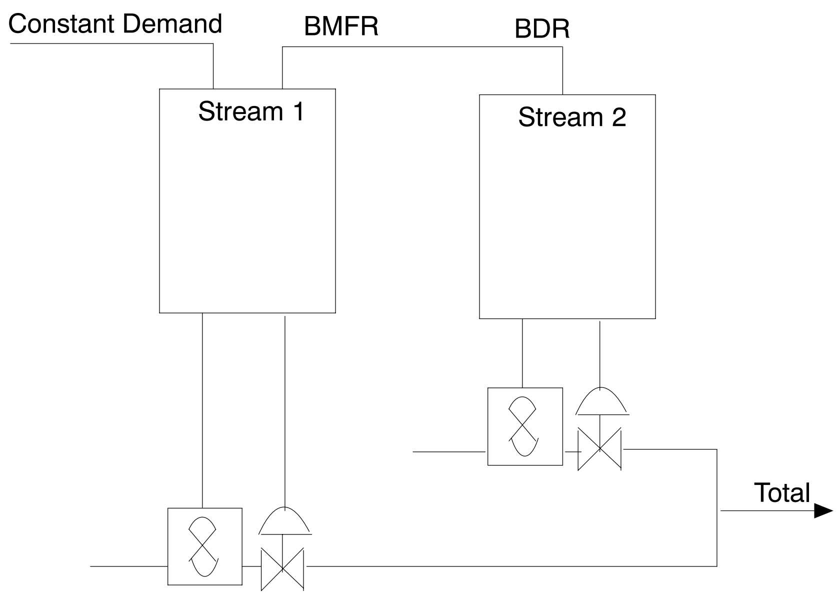

Figure 1.5. Stream-to-Stream Blending

Wild Stream Blending

Wild stream blending uses the measured total flow, which includes the wild stream, as the MDR rather than a master generated demand. The wild stream is always at the appropriate percent of blend, by definition, if the other components are at theirs.

In Figure 1.6, streams 2 and 3 are controlled streams that are controlling the accuracy of the total blend and are effectively slaved to the wild stream.

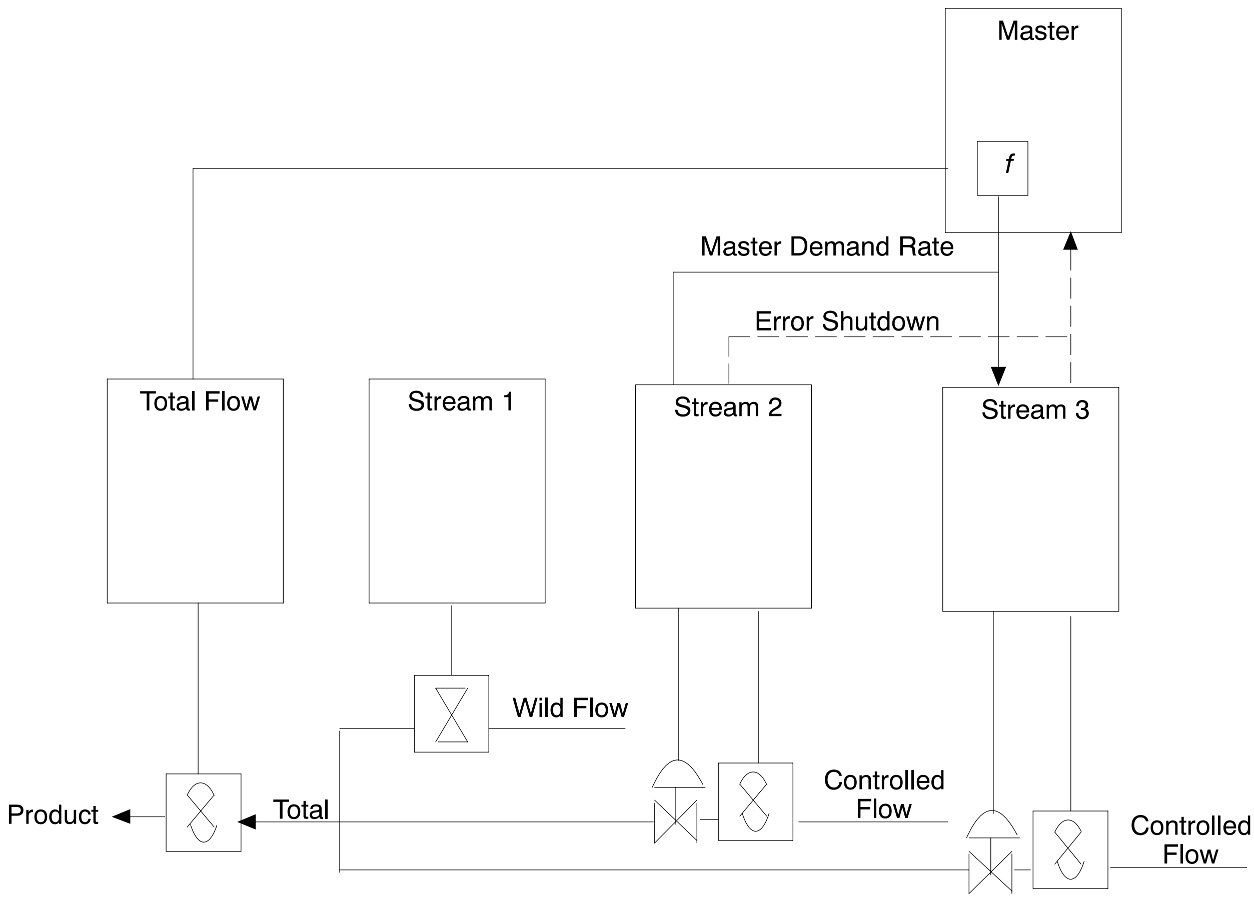

Figure 1.6. Wild Stream Blending

Section 2:
Digital Blending Theory of Operation

This section describes in detail the elements of the Fisher-Rosemount Digital Blending package.

The Fisher-Rosemount Digital Blending package consists of a master, component streams, and additive streams that are arranged in various ways to provide several blending application solutions.

The default node address for the digital blending application is node 2. The master resides on Controller Processor =2A. Streams 1-8 reside on Controller Processor =2C, streams 9-16 on Controller Processor , and streams 17-24 on Controller Processor =2G.

Master

The master is responsible for starting, stopping, and controlling the rate of production of the streams that are linked to it.

Figure 2.1 shows a master composed of nine preconfigured discrete function ControlBlocks that are grouped according to their functions:

- Ratio — ControlBlocks M1-1 and M1-2 sum the ratios of the enabled components to derive the total blend for the desired product.
- Quantity — ControlBlocks M1-3 and M1-4 sum the total measured quantity of the enabled components of the product being blended. These ControlBlocks also link the associated shutdowns and permissives for the associated component stream.
- Rate — ControlBlocks M1-5 through M1-8 sum the flow rates of the enabled components of the product being blended.
- Demand — ControlBlock M1-9 calculates the demand rate of the total production to which the ratios are applied for each component stream to be blended.

The default addresses of the preconfigured master ControlBlocks can be changed, but the address sequence must be maintained and all of the ControlBlocks must reside within the same ControlFile.

Master Ratio ControlBlocks M1-1 and M1-2

Master ControlBlocks M1-1 and M1-2 calculate the total of the ratios of the streams that contribute to the total blend ratio:

- M1-1 — Totalizes the ratios of streams 1 through 12.
- M1-2 — Totalizes the ratios of streams 13 through 24; adds the sum to the totalized value of ControlBlock M1-1; and checks the totalized ratio for equality to 100%.

Before totalizing the stream ratios, each stream ratio (BRO) is multiplied by the ControlBlock percent check (flag g).

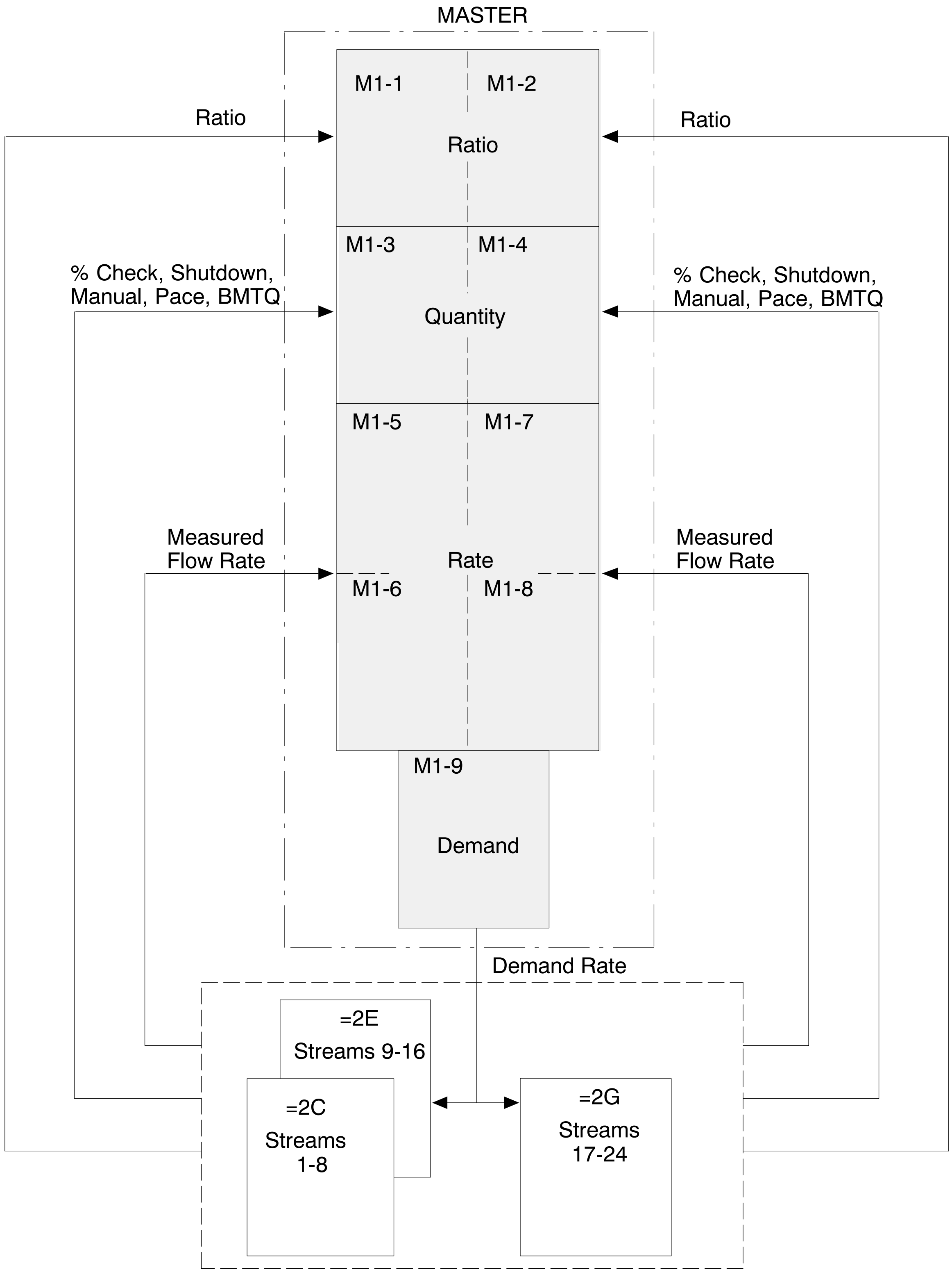

Figure 2.1. Master

Master Quantity ControlBlocks M1-3 and M1-4

Master ControlBlocks M1-3 and M1-4 act as or-gates for the following functions:

- % Check error — A signal sent by a stream to the master to indicate whether the stream ratio is equal to zero, Check is disabled, or that the block is not in Auto mode.
- +/– Shutdown — A signal sent by a stream to the master requesting that the master shutdown because the stream is outside the programmed tolerance for error (demand - measured value).
- Pace back control — A signal sent by a stream to the master to request that the master reduce the master demand rate (MDR) because that stream cannot keep up.
- BMTQ summation — If the master does not have a total product meter, then the master calculates its total blend by adding together the Block Measured Total Quantity (BMTQ) of all of the streams to which it is linked that have no percent-check error.

Master ControlBlocks M1-3 and M1-4 also sum the BMTQ for streams 1 through 24. Summation of stream quantities occurs only for those streams having no percent-check error.

- Master ControlBlock M1-3 performs the following functions:
  - Totalizes the metered totals and performs the above logic functionality for streams 1 through 12.
- Master ControlBlock M1-4 performs the following functions:
  - Totalizes the metered totals, performs the above logic functionality for streams 13 through 24, and adds the result of ControlBlock M1-3.

Master Rate ControlBlocks M1-5 Through M1-8

Master ControlBlocks M1-5 through M1-8 totalize the stream flow rates. The stream flow rates are referred to as the block measured flow rate (BMFR). The BMFR is measured in engineering units and includes the block measured flow span (BMFS).

- Master ControlBlock M1-5 totalizes the BMFR for streams 1 through 7.
- Master ControlBlock M1-6 totalizes the BMFR for streams 8 through 13 and then adds the result to ControlBlock M1-5.
- Master ControlBlock M1-7 totalizes the BMFR for streams 14 through 19 and then adds the result to ControlBlock M1-6.
- Master ControlBlock M1-8 totalizes the BMFR for streams 20 through 24 and then adds the result to ControlBlock M1-7.

In addition, Master ControlBlock M1-8 provides the master block links for the operator logical interface and other supervisory functions, such as start, stop, reset, and so forth, by performing the following functions:

- Generates the logical signals for master ControlBlock M1-9, such as master reset, blend active, ramp stop, and so forth.
- Generates the total summed flow rate and sends the result to ControlBlock M1-9.
- Passes a clamped setpoint for the master demand rate of blend setpoint (MRSP) to ControlBlock M1-9.

Master Demand ControlBlock M1-9

Master ControlBlock M1-9 performs the following functions:

- Generates the Master Demand Rate (MDR). The MDR is the rate of blend required of all streams for the total overall product rate.
- Generates the master demand quantity (MDQ). The MDQ is the quantity of the total flow required of all of the streams. This quantity is a total demand signal in units rather than units per time.
- Performs rampup and rampdown of the MDR.
- Calculates all of the master totals.
- Performs all of the master logical functions that are not peformed in master ControlBlock M1-8, such as pre-shutdown, end batch, rampup, rampdown, pace, pace limit stop, master batch done, and so forth.

Component Streams

A master can control up to 24 component streams. A component stream exists for each ingredient that is to be added to the digital blending application to make a product.

Figure 2.2 shows a stream algorithm composed of two preconfigured ControlBlocks:

- A discrete function ControlBlock that performs calculations for the blend stream.
- A PI function ControlBlock that controls the blend stream.

The default addresses of the preconfigured stream ControlBlocks can be changed. If the default addresses are changed, the address sequence must be maintained, especially with respect to the master addresses. The stream ControlBlocks must reside in Controller Processor cards within the same ControlFile. This Controller Processor card must be a different card than the card on which the master resides (except for systems with six or fewer component streams).

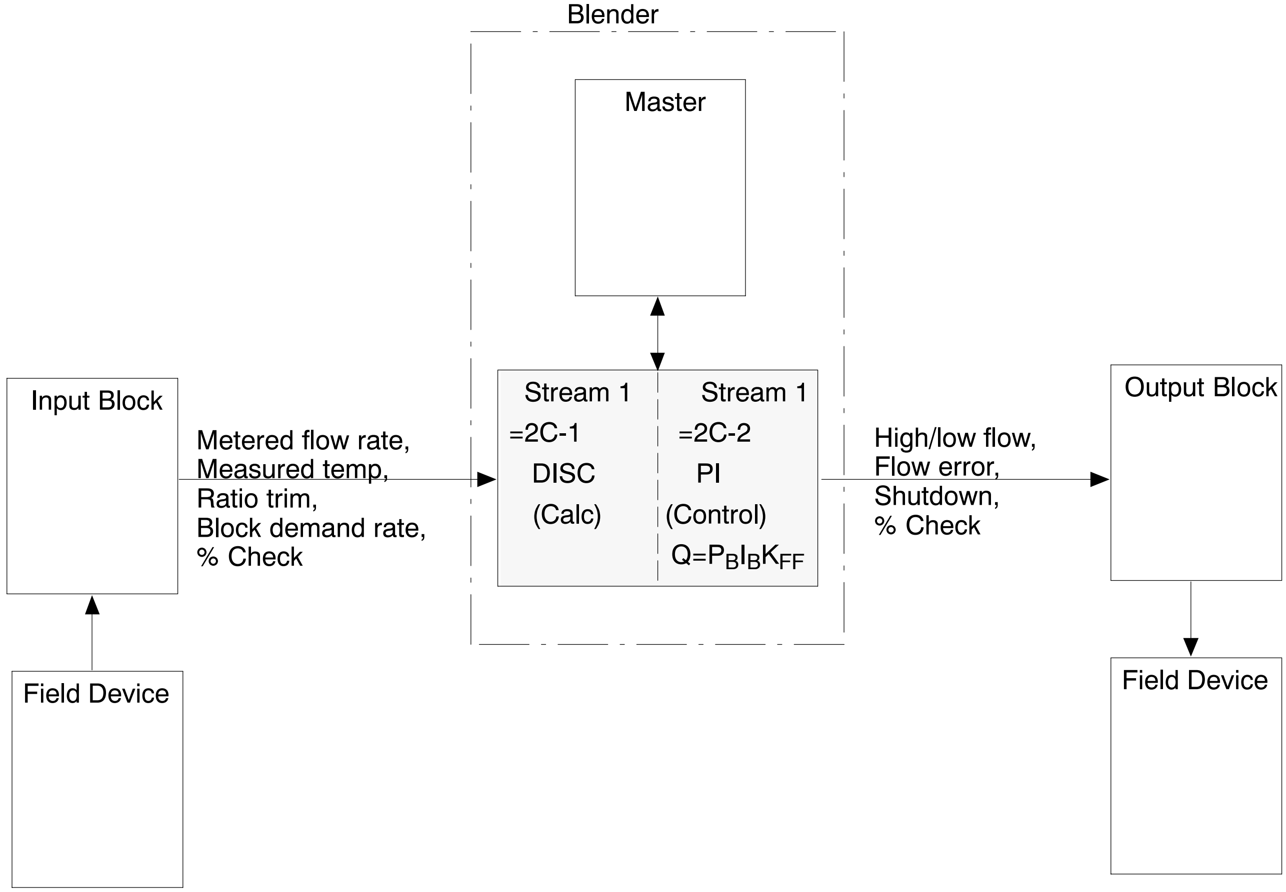

Figure 2.2. Component Stream

Component Stream Discrete ControlBlock

The calculation ControlBlock is a discrete function ControlBlock that links to the measurements, demand, and operator interface, and performs the following functions:

- Scales the signal and demand inputs.
- Selects the metered inputs, if two meters are used.
- Applies the operator-entered measurement compensation factor to the metered value and then sends the compensated measured flow rate to the component stream PI ControlBlock.
- Compensates the measurement for the coefficient of expansion, if automatic temperature compensation is enabled.
- Trims the operator-entered ratio to derive the compensated ratio, if feedback trim is enabled.
- Applies the ratio to the demand to develop the component stream demand rate and then sends that demand rate to the PI ControlBlock for the component stream.

On the display screens, the discrete function ControlBlock is referred to as B1-CALC (for stream 1 example).

Component Stream PI ControlBlock

The component stream ControlBlock is a PI block that uses the measured flow and the demand flow of the calculation ControlBlock along with information from the other block links to calculate the following values in order to control the blending action:

- Block measured total quantity
- Block demand total quantity
- Block error (demand quantity – measured quantity)
- ControlBlock algorithm
- Block pace back demand request
- Flow alarms
- Error alarms and shutdown
- Output to the manipulated variable

The block total can be cleared by preconfigured ControlBlock logic:

- Inventory clear — Clears the batch total and inventory total.
- Total clear — Clears the batch total.

The mode of the ControlBlock affects the operation of the block:

- Auto mode — The algorithms are executed automatically.
- Manual mode — The algorithms are executed automatically but allows the operator to enter the output manually. The blend stream PI must be in Auto mode to start the blend if the stream has its % Check enabled; however, once the blend has been started, the PI controller can be switched to Manual mode without automatically shutting down the blend system.

On the display screens, the PI function ControlBlock is referred to as B1-CTRL (for stream 1 example).

Component Stream Algorithm

The component stream algorithm manages and controls the continuous addition of the volume or mass of a component in exact, instantaneous proportions.

The stream algorithm provides for bumpless transfer.

- When switching a stream from Auto mode to Manual mode, the last block output value of the stream is held in Manual mode to allow the operator or external control scheme to manipulate the output value. While in Manual mode, the Block Error Total (BET) value is actively computed just as in Auto mode.
- When switching a stream from Manual mode to Auto mode, the output changes at the algorithm integral rate based on the accumulater BET. The stream must not be in Manual mode during shutdown.

If the calculated demand rate exceeds the maximum value that the PI ControlBlock can deliver, the ControlBlock will send a pace back alarm to the master.

Additive ControlBlock

The additive ControlBlock uses two discrete function ControlBlocks: ADD-CALC and ADD-CTRL. The ADD-CTRL block is linked to a pulse output PIOB with a Counter function.

The Block Demand rate (BDR) is applied to the ratio factor (BRO), which is entered by the operator to the additive calculation ControlBlock. This ratio factor is in units of delivery of the pulse block per normalized demand rate, such as 32 liters delivered per 100 gallons of product. The BDR is then integrated and scaled before being displayed as the block demand totalized quantity (BDTQ) and the block demand flow rate (BDFR). The demand rate is then applied to the alarm logic to develop the pace back alarm.

The pulse output value is summed in the ControlBlock algorithm where the values are totaled until a whole number is reached. At that time, the significant part of the number is sent to the PIOB where it is output to the hardware as a pulse train. The PIOB and additive discrete ControlBlocks are synchronized by their busy and load count flags. This pulse output value is displayed as a block total (BMTQ).

The block total can be cleared by preconfigured ControlBlock logic:

- Inventory clear — Clears the batch total and inventory total.
- Total clear — Clears the batch total.

The mode of the ControlBlock affects the operation of the block:

- Auto mode — The algorithms are executed automatically.
- Manual mode — The algorithms are executed automatically but allows the operator to enter the number of pulses to output. The additive stream ControlBlock must be in Auto mode to start the blend if the stream has % Check enabled; however, once the blend has been started, the ControlBlock can be switched to Manual mode without automatically shutting down the blend system.

Order of Execution within Digital Blending

The streams of a digital blending application must be carefully synchronized to assure a proper balance between the master demand and the measured totals of the streams. This requires that the master algorithm be executed once each Controller Processor evaluation cycle before the stream and additive algorithms. For this reason, the master and its associated component streams must be in the same ControlFile, contiguously loaded into Controller Processor cards, and executed at the same scan rate. A scan rate of .5 seconds is recommended.

A six-stream digital blending application is the recommended limit for configuration within one Controller Processor card. Typically, the master resides on one Controller Processor card, such as =2A, and then up to eight streams for the master reside on separate Controller Processor cards.

For example, for a 24-stream digital blending application to execute every half-second, the following configuration is suggested:

- Master residing on Controller Processor card =2A
- Streams 1 through 8 residing on Controller Processor card =2C
- Streams 9 through 16 residing on Controller Processor card =2E
- Streams 17 through 24 residing on =Controller Processor card =2G

The ControlFile scan time must be the same for all of the Controller Processors for a particular digital blending application.

Every evaluation cycle, the measured quantity, demand quantity, and error are calculated by the master. The master reset clears all of these values for the cycle.

How the Master Controls the Streams

The master coordinates and synchronizes the control of the streams for a total rate of product blending by defining the master demand rate and the master demand quantity for the streams.

The master sends the demand for product total as a master demand rate signal to all of the streams. Each stream controls the flow of a separate component of the blending application for the appropriate ratio or percentage of the total blend. An operator, supervisory computer, or batch program sets the individual ratio for each stream so that the master demand multiplied by the specific stream ratio gives the demand for ingredient quantity of that particular ingredient to the overall total product blend. Each stream balances the derived demand quantity to the measured quantity as metered by the field device linked to the component stream.

Figure 2.3 shows that streams can be configured for pace control or memory control.

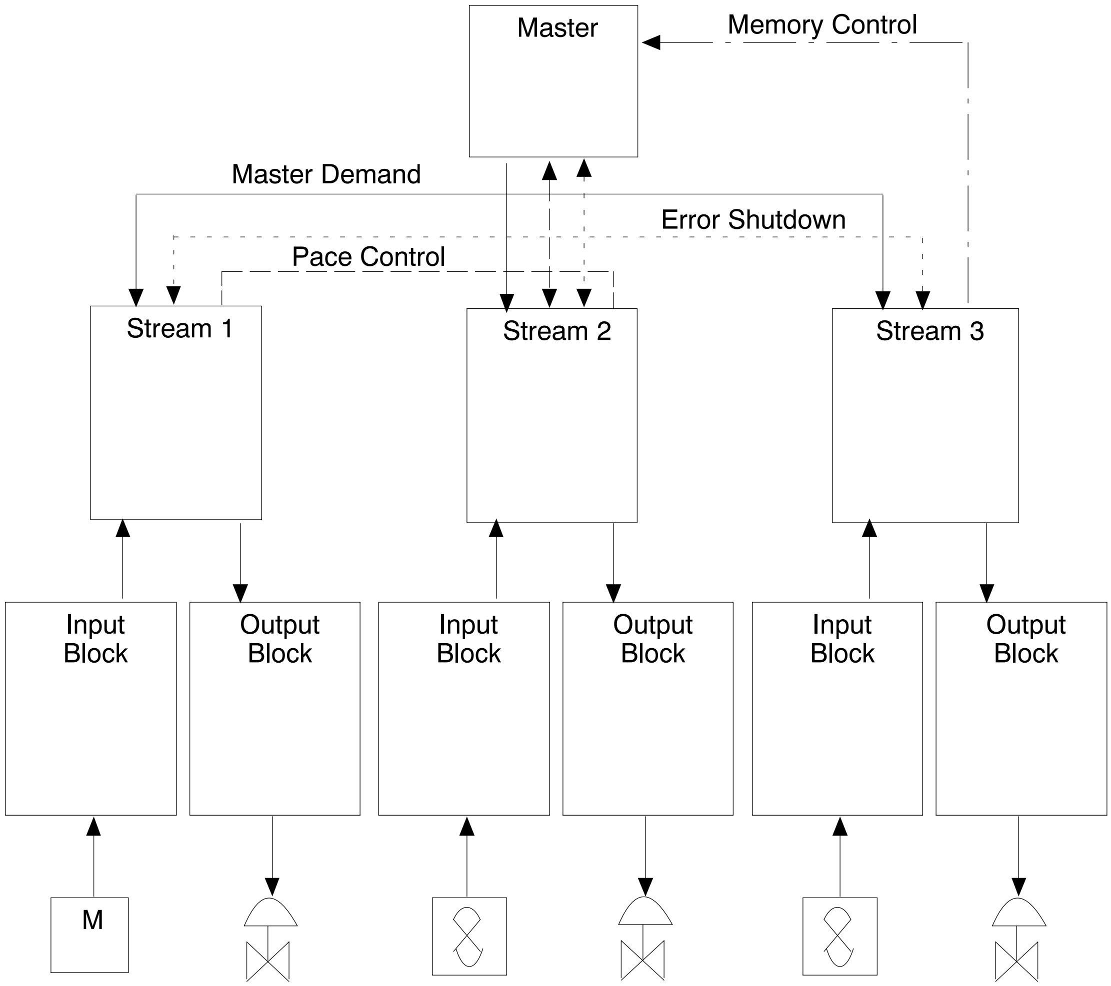

Figure 2.3. Digital Inline Blender Using Pace and Memory Control

Pace Control

The sample digital blending application in Figure 2.3 shows streams 1 and 2 using pace control. Pace control is used for critical streams that must be within product specification at all times and that cannot be allowed to correct for errors over time. The blending system algorithm continuously optimizes and balances the blend of total product for component accuracy and rate of production.

A stream under pace control adjusts the output to maintain the proper one-to-one relationship of demand quantity to measured quantity. If the output of a stream exceeds the pace limit maximum (normally 95-98% output), the stream applies a pace feedback signal to the master.

Upon receiving a pace feedback signal, the master slows down the overall master demand so that all of the streams are effectively paced back or slowed down evenly with respect to the total blend. The streams are paced back until the pace signal is no longer received or until the process reaches a minimum rate of blend and the application stops. This assures that the total demand rate never exceeds the ability of the slowest stream to deliver, resulting in a product that meets specification at all times.

If a meter or valve fails so that either the measurement exceeds or falls short of the master demand rate, the associated stream sends plus or minus shutdown alarms back to the master. When the master demand block senses a shutdown, the entire blend is shut down and all streams associated with the blend simultaneously bring their output to zero.

Memory Control

Memory control is used when the total component addition is critical, but the instantaneous product ratio is not important. For example, memory control might be used for streams such as color additives or other additives that are not critical to the process. The sample digital blending application in Figure 2.3 shows stream 3 using memory control.

A stream under memory control adds material as fast as possible, making up for any component error with the master demand volume during the blend. This means that the stream makes up for the amount of additive into a stream as it can.

As with pace control, if the stream reaches a plus or minus error outside of the user-configured critical alarm limits, it causes the master to shut down.

Analyzer Trim Compensation for Ratio

Analyzer feedback trim can be used to compensate for the ratio term of a component or additive stream. The analyzer might be sensing color, viscosity, knock number, octane number, degree brix, percent sugar, and so forth.

Figure 2.4 shows digital blending with stream 2 using analyzer trim to compensate for ratio. When using trim, a feedback control loop corrects the ratio for a particular additive based on measured results. Feedback trim modifies the ratio before calculating the quantity demand of the stream.

For example, an operator might enter a 2% blend to color an additive brilliant blue. But a color analyzer might detect that the percentage must be 1.8% to provide the brilliant blue color. Therefore, the PID controller feeds back a signal to cause the algorithm within the memory controller to trim the ratio accordingly.

Feedback trim is an input value between 0 and 1:

- Feedback trim of 0 — Represents maximum negative trim.
- Feedback trim of .5 — Represents no trim.
- Feedback trim of 1 — Represents maximum positive trim.

Feedback trim is applied to the ControlBlock algorithm to trim the BRO or the remote set ratio of the PI ControlBlock. The feedback trim adjusts the ratio setting based on the feedback gain term of the component stream. The ratio is trimmed by a percentage of the algorithm:

- If the feedback trim is <.5, then the blend ratio is reduced proportionally to the gain.
- If the feedback trim is =.5, then no trim is entered.
- If the feedback trim is >.5, then the blend ratio is increased proportionally.

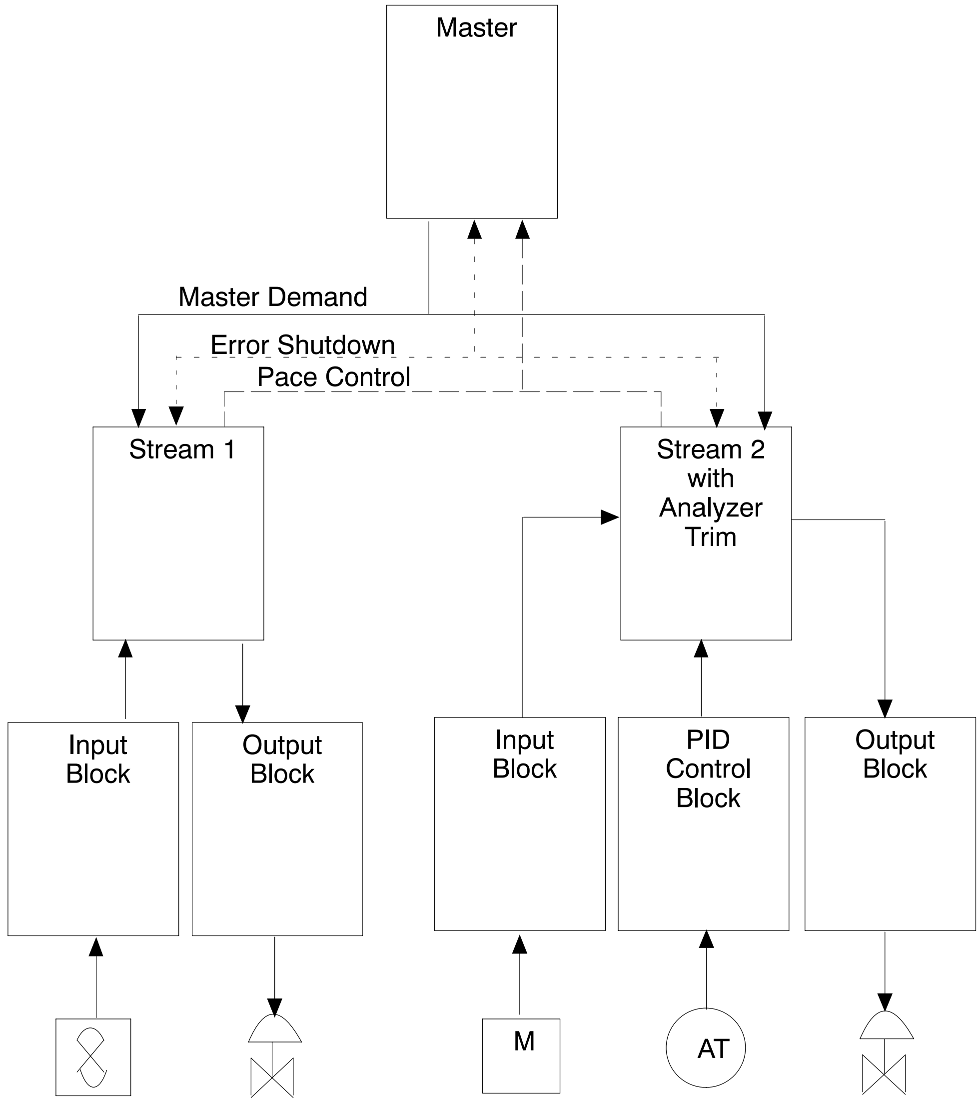

Figure 2.4. Digital Inline Blender Using Analyzer Trim Compensation

Compensation for Changes Due to Temperature

A stream that is being used for pace or memory control can be configured to provide automatic temperature compensation for volume expansion and density changes that are caused by temperature. Figure 2.5 shows a digital blending solution with stream 2 using automatic temperature compensation.

The temperature of the stream material is measured and is then used in the ControlBlock algorithm along with the database parameters for reference temperature and coefficient of expansion (in percent per degree) to compute a Block Compensation Factor (BCF) which the algorithm then uses to replace the operator-set compensation factor, that is, specific gravity for the stream. In this way, the temperature compensation compensates for the variations in temperature expansion. The BCF is calculated as follows:

1 – ((Measured temp – Reference temp) * Coefficient)

NOTE: See Section 4 “Automatic Temperature Compensation” for a definition of the coefficient term.

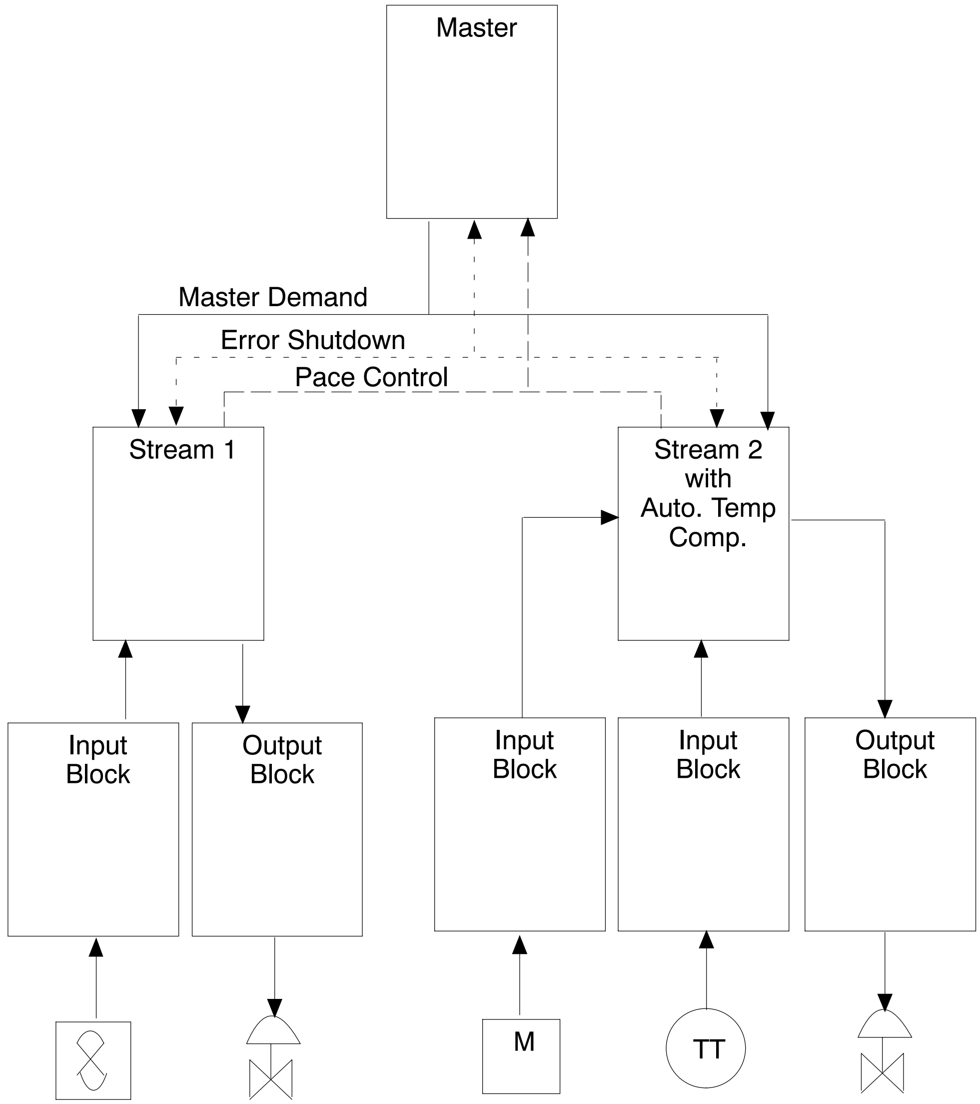

Figure 2.5. Digital Inline Blender Using Automatic Temperature Compensation

Additive Control

Figure 2.6 shows digital blending with stream 3 using additive control. Additive stream control drives manipulated variables that require pulses. If the demanded rate exceeds the database maximum rate available from the linked pulse output block, the additive block sends a pace-feedback alarm to the master.

The additive stream ControlBlock receives the master demand signal and applies the ratio multiplier factor, which is normally the stream ratio. The ratio multiplier factor can be a percentage as a standard stream or a volume per volume value (a volume per volume value requires special consideration).

For example, 100 gallons of additive per 1000 gallons of demand generates a normalized pulse output that represents a unit volume per pulse; i.e., if one pulse equals five gallons, then the block generates 20 pulses per 1000 gallons. This means that one pulse output from the stream demands a known volume of delivered component.

Additive control is typically used for a metering pump that delivers a unit of volume per stroke, which is represented by one output pulse. The block receives a demand input and develops a demand signal similar to a component stream demand quantity signal, but because it has no measurement, the stream does not balance against the measurement.

The demand signal is summed in a scaled totalizing algorithm function. This algorithm computes a number; when the number goes from a fraction to a whole number, the most significant digit is sent from the additive block to its linked PIOB. The fractional part of the number is saved and is added to the continuing input demand signal. The output pulse is then used by stream augers, dosing pumps, and other positive displacement final control elements to deliver a unit volume per pulse for that particular stream.

The pulse width is controlled by the time delay database variable. Output pulses are adjusted by a scaling factor for engineering units and totalized as inventory total and batch total for that specific stream. The pace alarm for this stream is generated as a high demand rate alarm. The pace signal is true whenever the block ratioed demand rate exceeds a preset data base value.

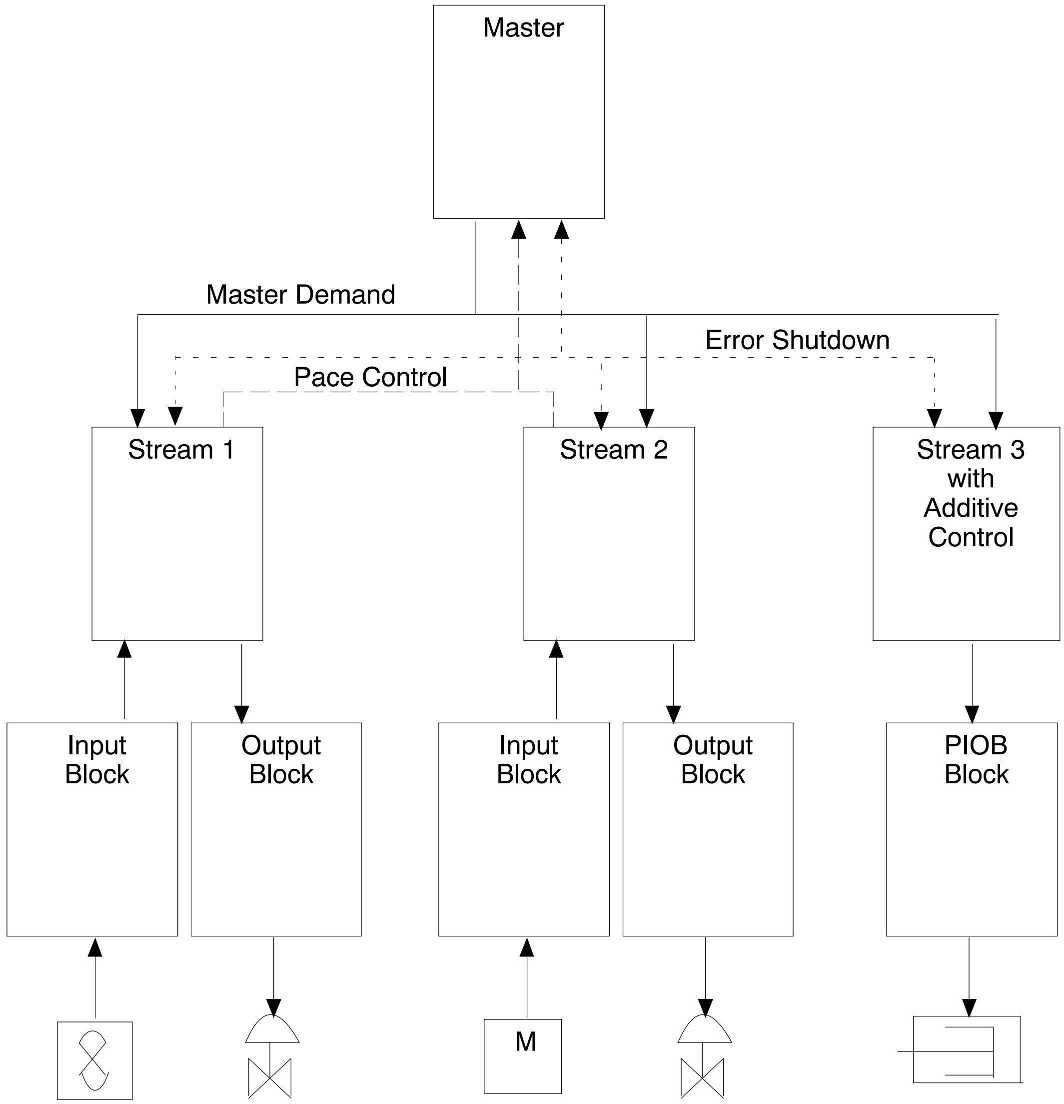

Figure 2.6. Digital Inline Blender Using Additive Control

Digital Blending Startup

A blender can be started using any of four means:

- A console on the PeerWay with the digital blending ControlFile
- A batch program
- A host computer
- A remote push button linked to the digital blending master via the discrete link of a block

Figure 2.7 shows that upon startup, the master increases the Master Demand Rate (MDR) of blend to a minimum level at T_0. The master then ramps the demand rate up to the operator set blend rate (MDSP) as shown between T_0 and T_1 in a predefined Ramp Up Time (RUT) at T_1. The master minimum rate assures that all of the valves and meters will start at a rate within their turn-down accuracy. The rampup allows all of the streams to provide a smooth start-up with product maintained accuracy while responding to the changing master demand from a zero flow rate to the total demand rate of blend.

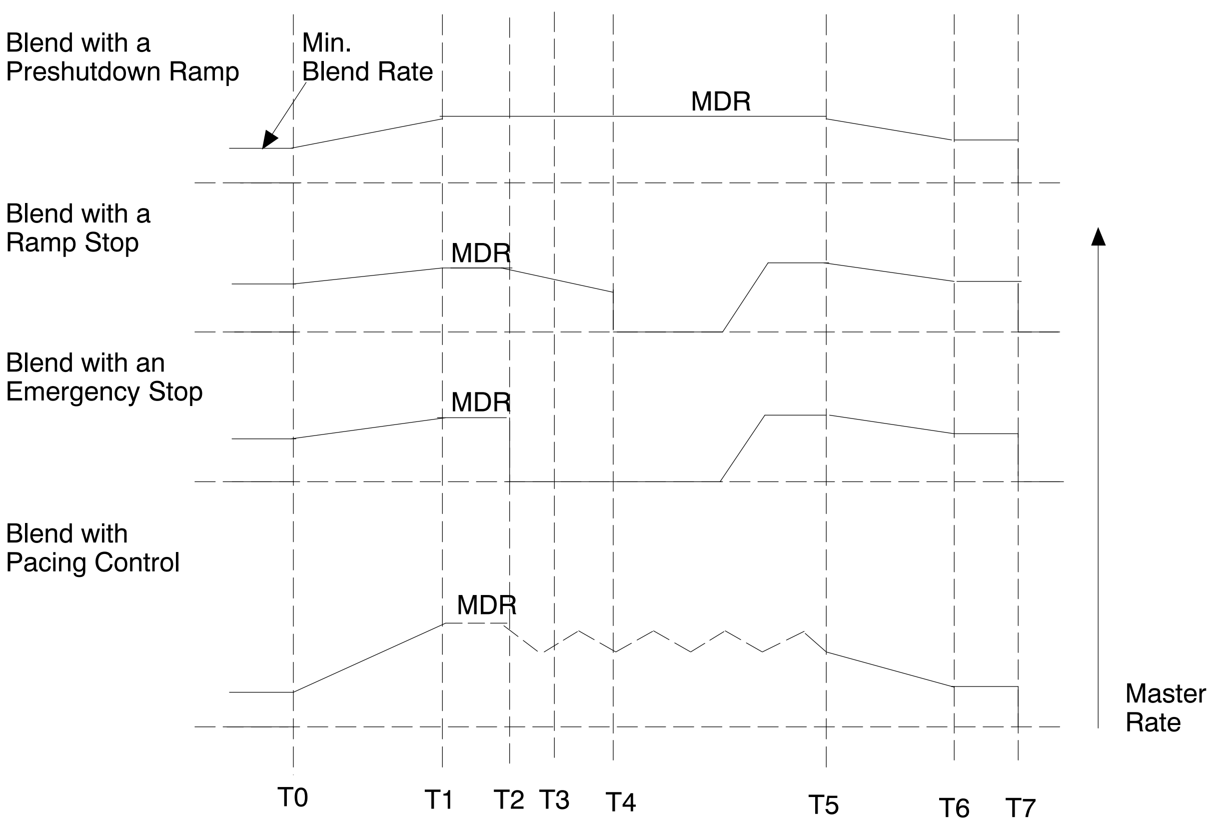

Figure 2.7. Digital Blending Startup and Shutdown

Digital Blending Shutdown

Figure 2.7 shows that the master continues to blend at the master demand rate until it receives a signal At this point, the process varies depending on the type of signal received:

- Preshutdown ramp signal
- Ramp stop signal
- Emergency stop signal
- Pace signal

Pre-shutdown Ramp Signal

In a normal blend situation, once a master demand total or measured total, depending on the operator entry, reaches the preshutdown setpoint as entered by the operator at T_5, the master ramps the master demand down to a hold value in the pre-database rampdown time (RDT) as shown between T_5 and T_6. The master holds the blend at this rate until the demand total or measure total equals the batch size set by the operator. When the batch is complete, the rate of blend is set to zero and the status of the blend active state goes to false as shown at T_7. The master output flags are then used by the streams to accomplish control on a stream-by-stream basis.

Ramp Stop Signal

In a ramp stop situation, the blend operation described earlier is interrupted by a ramp stop. When the master receives a ramp stop signal, it initiates a rampdown to the master hold (MDHLD) value in the RDT. The master then changes the master rate to zero and removes the active flag from its output to force all stream output valves to zero if applicable as shown at T_4.

Emergency Stop Signal

In an emergency stop situation, the blend operation described earlier is interrupted by an emergency stop alarm or an emergency shutdown. When the master receives an emergency stop signal, the master changes the master rate from its current point to zero and removes the active flag from its output. This signals all of the streams to force their output valves to zero if applicable as shown at T_2.

Pace Signal

If a pace signal is received from a stream during blending, the master demand ramps down the rate of blend by a percentage each evaluation cycle or as calculated based on the RDT. At T_2 this rampdown begins. The rampdown continues until the pace signal is removed by the stream, causing the master to ramp up the master demand; or the MDR goes to a minimum blend rate which causes the master to execute an emergency stop.

Other Functions Controlled by the Master

The master also controls the measured total blend method.

The master checks the database to determine whether the total measured product flow is computed or measured by means of an external meter.

- If the master is configured for a metered total and the metered input pulse block is linked to the master, then the metered input pulse is displayed to the operator as a flow rate and integrated for total measured flow.
- If the master block has been defined as a summed total, the block looks at its linkages to its component streams and through this linkage adds up the sum total of all of the independent measurement totalizers within the individual streams and uses this integrated total for the master overall product blend total.

Section 3:
Installing Digital Blending

This section describes how to install the digital blending package and provides procedures for the following tasks:

- Loading the digital blending software tape
- Loading and customizing the process graphics
- Loading the plant configuration
- Loading the console configuration

The digital blending application package requires the following minimum levels of hardware and software:

- MPCII CPIV hardware
- Version 15 Release 6 Rosemount System 3 software

Loading the Software Tape

The digital blending software is stored on a tape that is supplied by Fisher-Rosemount Systems, Inc. The software consists of the following files and folder:

- *n*-Stream (Plant Configuration file) — This file contains the default plant configuration information required for digital blending to function; *n* indicates the number of streams in your application.
- Process Graphics folder — This folder contains the default process graphic files that are used to operate the digital blending software.
- *n*Cons-10 (Console Configuration file) — This file contains the default console configuration parameters. You can also configure your own parameters; *n* indicates the number of streams in your application.

To use any of these files, you must load them from the software tape to the hard disk.

❑ **To load the tape into the tape drive:**

- Use the “Tape Load” operation, which is explained in Disk and Tape Procedure 1-7 in Appendix A.

Loading the Digital Blending Plant Configuration

You must load the digital blending plant configuration file from tape to disk and then to the controller processors which have been reserved for digital blending process control.

CAUTION

The digital blending package is preconfigured for Controller Processors =2A, =2C, =2E, and =2G; therefore, to use the preconfigured addresses and links you must load the digital blending plant configuration to address range =2. Your specific configuration should have been previously specified to your Fisher-Rosemount project manager.

The name of the plant configuration file is *n*-Stream, where *n* is 6, 8, 16, or 24 depending on the number of streams in your digital blending application.

❑ **To load the plant configuration:**

1. Copy the plant configuration file from tape by using the "Disk File Restore from Tape" operation (Disk and Tape Procedure 7-2 in Appendix A).
2. Load the plant configuration file to the Controller Processors (=2A, =2C, =2E, and =2G) by using the "Disk Load Controller" operation (Disk and Tape Procedure 3-5 in Appendix A).

   NOTE: If for some reason, you must load the plant configuration to another address, use the "Disk Load Transfer" operation (DT: 2-3).
3. Access the ControlFile Status screen (**CFS**), and make sure that the scan time is .5 for all Controller Processors (A, C, F, and G) used in the blending application.

NOTE: For a scan time other than .5, changes must be made to the digital blending algorithms.

Digital Blending Process Graphic

Two standard graphics are included with the digital blending package:

- The master graphic includes the Master Block parameters as well as the blend stream parameters for the total number of streams as shown in Figure 3.1.
- The detail graphic shown in Figure 3.2 contains up to eight B*x*-CTRL boxes; additional copies of this graphic are available for any additional streams.

The default digital blending process graphics folder contains the following graphics files depending on the size of your blending application:

- *n*MASTER — Provides an overview of information about the master and the component streams associated with that master.
- *n*STREAM#1 — Provides a summary of information about component streams 1 through 6 (6STREAM#1) or component streams 1 through 8 (8STREAM#1).
- *n*STREAM#2 — Provides a summary of information about component streams 9 through 16 (16 and 24 stream packages only).
- *n*STREAM#3 — Provides a summary of information about component streams 17 through 24 (24 stream package only).

NOTE: *n* indicates the number of streams in your application.

The standard graphics supplied with the digital blending package are linked for node 2 with the control block layout as explained in Section 4. If your configuration is laid out differently, the graphics will need relinking.

To use the default graphics to control and operate the digital blending package, you must load the digital blending process graphics from tape to disk. Once loaded, your Fisher-Rosemount system engineer must customize the files to reflect your plant situation.

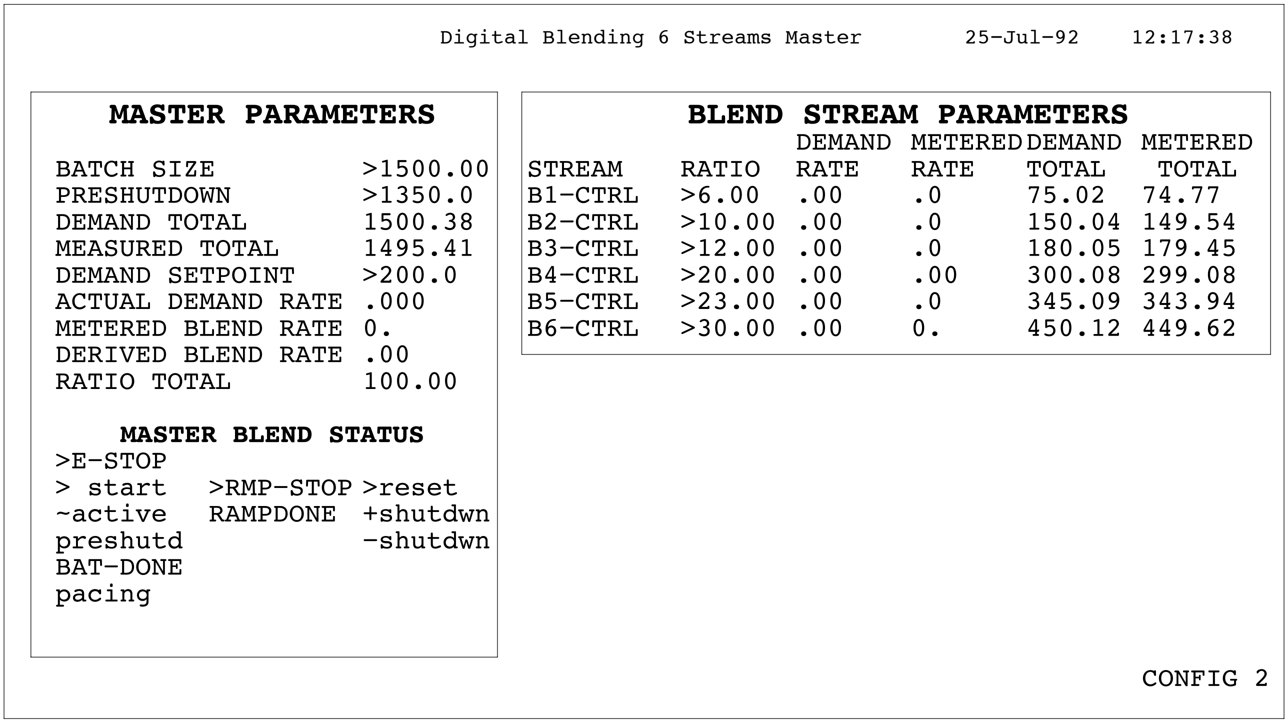

Figure 3.1. Digital Blending Master Graphic

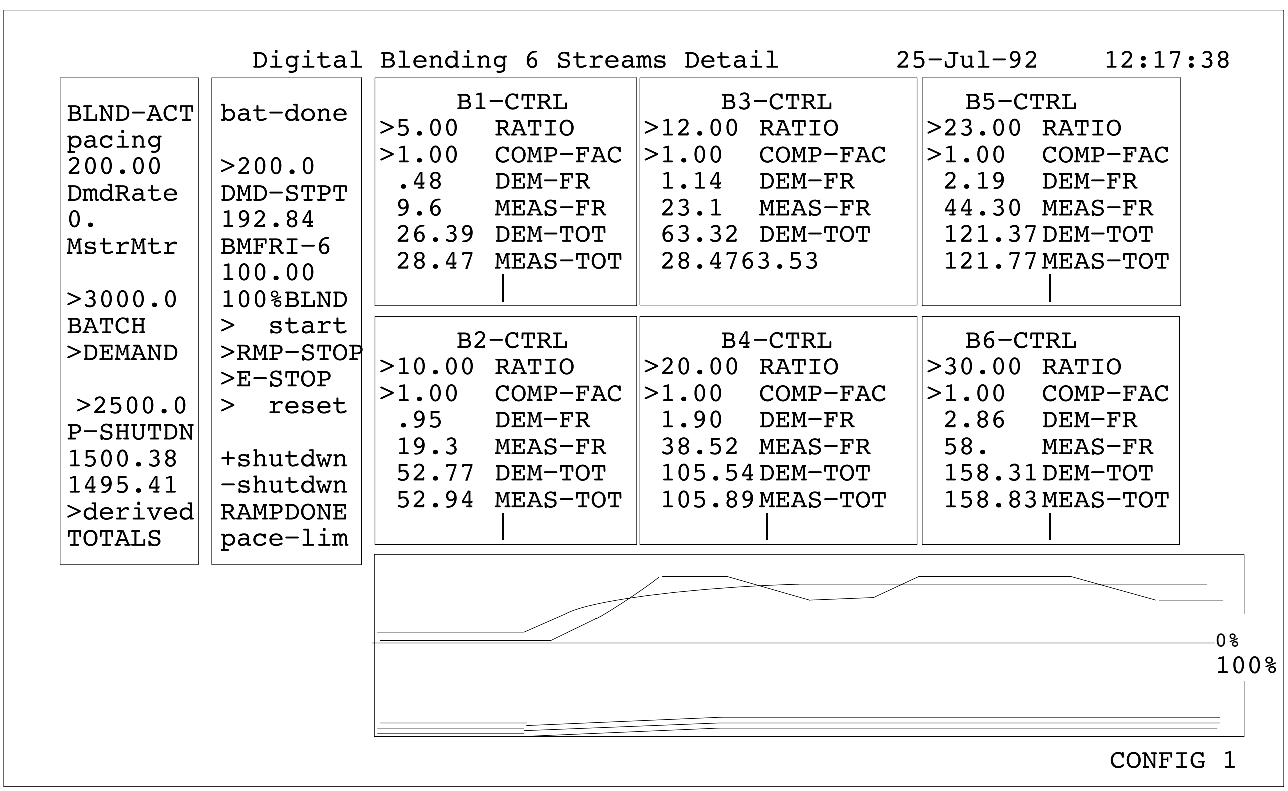

Figure 3.2. Digital Blending Detail Graphic

Loading the Digital Blending Process Graphics

The procedure for loading the process graphics differs depending on whether the console to which they are being loaded already contains a Process Graphics folder.

❑ **To load the default process graphics folder:**

- Load all of the files in the digital blending process graphics folder by using the “Restore Tape Files to Disk” operation (Disk and Tape Procedure 7-1 in Appendix A).

❑ **To load an individual default process graphics file:**

- Load individual files from the digital blending process graphics folder by using the “Disk File Restore from Tape” operation (Disk and Tape Procedure 7-2 in Appendix A).

Customizing the Digital Blending Process Graphics

If for some reason, you must load the plant configuration to an address other than node 2, you must update the links in the process graphics. With Version 17 software, you can use the Link Editor to update the graphics; otherwise, your Fisher-Rosemount system engineer must customize the default process graphic files to reflect your plant environment.

❑ **To update links in process graphics with Version 17 software:**

1. Call up the master graphic by typing

   PG:,nMASTER [ENTER]

   where *n* is the number of streams in your application.
2. Call up the link editor by typing

   LE
3. Cursor to the “Address Range” field; type =2a, and press [ENTER].
4. Cursor to the “New Address” field; type the address of your controller, and press [ENTER].
5. Cursor to the “Edit Mode” field; press [NEXT OPTION] until “Modify” appears.
6. Cursor to the “Press <ENTER> to Begin” field, and press [ENTER].

For additional information about using the Link Editor screen, see the *Software Release Notes for Version 17*.

Digital Blending Console Configuration

The digital blending console configuration file is *n*Cons10, where *n* is 6, 8, 16, or 24, depending on the number of streams in your digital blending application.

CAUTION

The default digital blending package is configured for a console on node 10. Your specific configuration should have been previously specified to your Fisher-Rosemount project manager.

You can load the entire console configuration in two basic steps; however, you can save most of your own current configuration by loading the following individual sections:

- Group displays: Group displays are predefined so that each display has two streams with a total of *n*/2 groups, where *n* equals the number of streams in your digital blending package. The default group displays start from Group 1 but can be configured as different groups if you have made previous assignments.
- Message pairs: User message pairs 1-45 are reserved for digital blending use and must be loaded from the console configuration file.
- Color configuration: The colors should be loaded from the console configuration file so that message pair and other colors match those described in this manual.
- Trend File Configuration: Trend file 6 is reserved for trending digital blending flow rates, etc. This configuration must be loaded separately.
- Plant Unit Configuration: The plant unit configuration should show plant unit 200 as having been selected.

❑ **To load the individual sections of the console configuration:**

1. Load the console configuration file from tape by using the “Disk File Restore from Tape” operation (Disk and Tape Procedure 7-2 in Appendix A).

2. Load the required console configuration types to node 10 by repeating the “Disk Load Console” operation until you have loaded the following “Config Types” (see step 6 in Disk and Tape Procedure 3-1 in Appendix A):

   a. Groups

      NOTE: You can skip this configuration type if you want to define your own groups as explained under the heading “Adding Group Displays.”

   b. Message Pairs (required)

   c. Color Configuration (required)

   d. Trend File Configuration (required)

   e. Plant Unit Configuration (required)

Loading the Entire Console Configuration

❑ **To load the entire console configuration:**

1. Load the console configuration file from tape by using the “Disk File Restore from Tape” operation (Disk and Tape Procedure 7-2 in Appendix A).
2. Load the console configuration file to Node 10 by performing the “Disk Load Console” operation twice (see Disk and Tape Procedure 3-1 in Appendix A):
    a. In Step 6, select the default condition “Most” in the “Config Types” field.
    b. See “Loading the Trend File Configuration” section.

Setting Up the Trend File Configuration

Trend file 6 is reserved for digital blending trending and the default trend file configuration provides the correct Trend File Setup; however, if for some reason, you must load the plant configuration to an address other than node 2, you must reconfigure the Trend File Setup.

❑ **To set up the trend file configuration:**

1. Call up the Trend File Setup screen by typing

   TFS

2. Cursor to the “Reset Trending (Press Enter)” field, and press [ENTER].
3. Cursor to file number 6, and press [SELECT].
4. If the digital blending tags do not appear on the Trend Configuration screen, reenter the appropriate addresses or the tag names according to the pattern shown in Table 3.1.
5. To enable trending, type

   ET

NOTE: Table 3.1 lists only the trend file tags for a 6-stream digital blending application; follow the same pattern to include tags for a larger package.

Table 3.1. Trend File Configuration

Tag	Descriptor	Tag	Descriptor
M1-8/J	MASTER PART #8	B3-CTRL/J	Stream 3Controllr
M1-8/K	MASTER PART #8	B4-CTRL/I	Stream 4Controllr
B1-CTRL/I	Stream 1Controllr	B4-CTRL/j	Stream 4Controllr
B1-CTRL/J	Stream 1Controllr	B5-CTRL/I	Stream 5Controllr
B2-CTRL/I	Stream 2Controllr	B5-CTRL/J	Stream 5Controllr
B2-CTRL/j	Stream 2Controllr	B6-CTRL/I	Stream 6Controllr
B3-CTRL/I	Stream 3Controllr	B6-CTRL/J	Stream 6Controllr

Defining the Group Displays

The default console configuration assigns numbers to the digital blending group displays and tags to those groups. Figure 3.3 shows Group 1: Digital Blending Strms 1&2. You can load the default group display configuration to the console, or you can add new groups to specific group display numbers without changing your existing configuration.

Table 3.2 lists the group names and tags used in the default group displays for a 6-stream application. You can follow a similiar pattern to define groups for 8, 16, and 24 stream packages.

❑ **To assign names and tags to group displays:**

1. Call up the Group Directory from the command line by typing

   GD: [ENTER]

2. Cursor to the appropriate group number; type the name of the group display, and press [ENTER].
3. Repeat Step 2 to define names for additional groups.
4. Call up the group display from the command line by typing

   G:*group#* [ENTER]

5. Cursor to each tag field; type the tag name for the appropriate controllers; and press [ENTER].
6. Repeat Steps 4 and 5 until you have defined all the necessary groups.
7. Save the new console configuration by using the “Disk Console Save” operation (Disk and Tape Procedure 4-1 in Appendix A.)

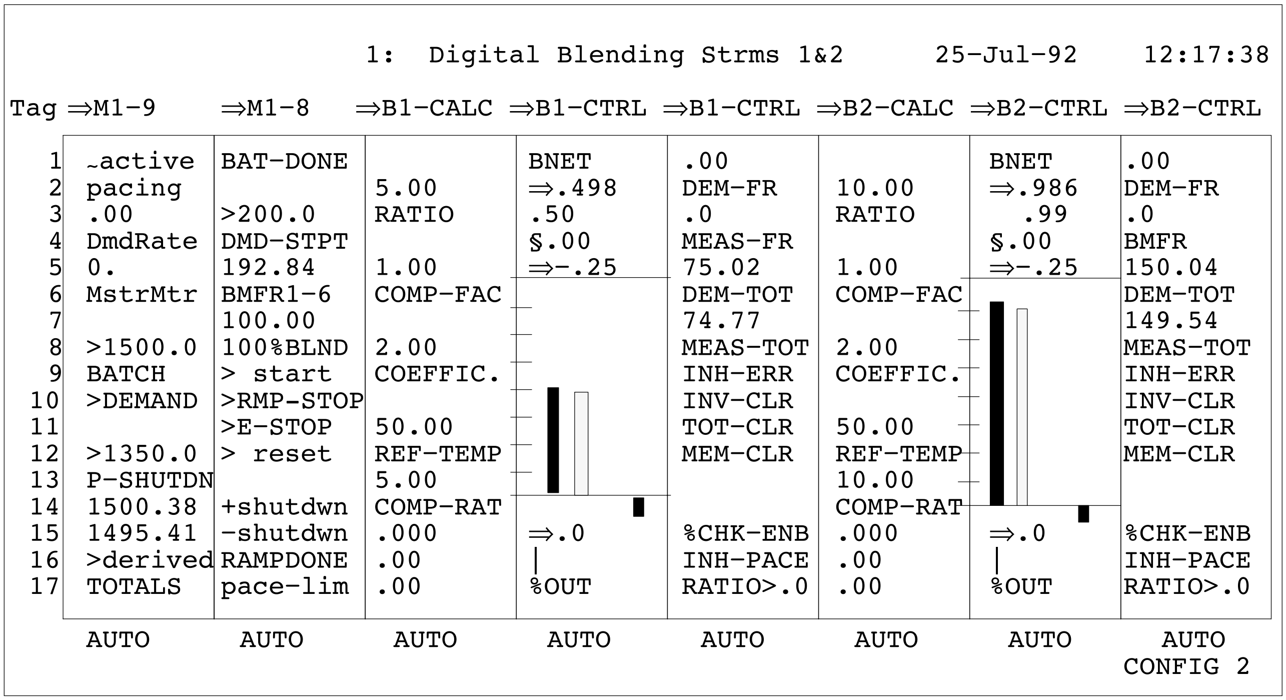

Figure 3.3. Digital Blending Group Display

Table 3.2. Digital Blending Group Displays

	Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
Group 1 Streams 1 & 2	M1-9	M1-8	B1-CALC	B1-CTRL	-B1-CTRL	B2-CALC	B2-CTRL	-B2-CTRL
Group 2 Streams 3 & 4	M1-9	M1-8	B3-CALC	B3-CTRL	-B3-CTRL	B4-CALC	B4-CTRL	-B4-CTRL
Group 3 Streams 5 & 6	M1-9	M1-8	B5-CALC	B5-CTRL	-B6-CTRL	B6-CALC	B6-CTRL	-B6-CTRL

NOTE: The “-” preceding the tag name for Tags 5 and 8 is a hyphen that specifies the discrete faceplate.

Creating the Callup Button Configuration

To make it easier to access the digital blending graphics, you can assign callup buttons to the graphics and group displays. Table 3.3 lists a sample configuration for a 6-stream application. For additional information about configuring callup buttons, see CC: 1-4.

❑ **To create the callup button configuration:**

1. Access the Callup Buttons screen by typing

   CCB

2. Cursor to the desired “Push Button” field, and type the appropriate command, similar to the ones shown in Table 3.3.

Table 3.3. Sample Callup Button Configuration

Push Button	Command	Comments
1	PG:,6MASTER*	Calls up the master graphic; from thisr graphic, you can use the [NEXT PAGE] and [PREV PAGE] keys to cycle through the stream detail graphics and back to the master.
2	PG:,6STREAM#1*	Calls up the first stream detail screen; for applications with *n*STREAM#2 and *n*STREAM#3, you can use the [NEXT PAGE] and [PREV PAGE] keys from *n*STREAM#1 to cycle through the additional stream detail graphics.
3	G:1*	Calls up the first group display (group 1); from this display, you can use the [NEXT PAGE] and [PREV PAGE] keys to cycle through the other groups.

Section 4:
Configuring the Digital Blending Database

This section contains information to help you configure your digital blending database. Appendix B contains worksheets that you should use to define the database entries.

Digital blending is the ability to blend several streams of additives into a single stream product, thus eliminating the need for mix tanks. The digital blending product is an integrator of flow with respect to scan time. All of the package adjustments to the individual streams are based on the volumetric flows of the individual and the master streams. Each stream consists of two ControlBlocks: the first is a calculation block and the second is a PI block for the control valve.

The following assumption is made:

- The ControlFiles used for digital blending have no other configuration except that pertinent to digital blending as loaded from the product tape.

Configuration

The digital blending packages are as follows

- 6 Streams
- 8 Streams
- 16 Streams
- 24 Streams

These packages are defined as one, two, three, and four card configurations, respectively. With the exception of the 6-stream package, the configuration is laid out as follows:

- Card 2A has nine master ControlBlocks: 2A-1 to 2A-9.
- Card 2C has eight (1-8) stream ControlBlock pairs: 2C-1 to 2C-16.
- Card 2E has eight (9-16) stream ControlBlock pairs: 2E-1 to 2E-16.
- Card 2G has eight (17-24) stream ControlBlock pairs: 2G-1 to 2G-16.

The 6-stream package is different in that the master and the six stream ControlBlocks are all on one controller card (2A). The number of master ControlBlocks is reduced, but they still occupy the same address range; the six stream controllers are addressed 2A-11 to 2A-22.

NOTE: This configuration permits you to set up redundant controller cards. If your system is not redundant and the controller cards are contiguous, you must do a “Disk Load Transfer” and then check the link addresses in the master blocks.

All of the stream configurations are set up for node 2; therefore, if you cannot use node 2, you may need to perform a “Disk Load Transfer” to fit your system configuration.

If your configuration does not use all of the available streams in a particular package, you can configure the addresses in the master blocks as *NONE. The space for the stream ControlBlocks should be left vacant, or the unused ControlBlocks should be copied in without configured I/O addresses. At a minimum, you should reserve this space in case you later want to expand up to the number of streams in the package that you purchased.

Each digital blending package also contains a console configuration and some graphics. If the configuration is loaded to a ControlFile other than Node 2, the graphics will need the links updated to the new addresses as explained in Section 3 of this manual.

Controller Loading

Table 4.1 provides a rough guide to controller loading for a digital blending installation.

Table 4.1. Guide to Controller Loading

Card	Idle Time*	Free Space*	Scan Time*
A Master	71%	86%	.50 sec
C, E & G (8 Streams each)	53%	71%	.50 sec
C, E & G (7 Streams each)	59%	75%	.50 sec
A (6-Stream pkg only)	52%	75%	.50 sec

* These percentages do not include I/O.

Sample Configuration

The examples in this section reference a configuration that uses the following flow meters:

- Stream 1 — 0 to 100 gallons/hour
- Stream 2 — 0 to 200 gallons/hour
- Stream 3 — 0 to 300 gallons/hour
- Stream 4 — 0 to 400 gallons/hour
- Stream 5 — 0 to 500 gallons/hour
- Stream 6 — 0 to 600 gallons/hour

Therefore,

$$\text{total range} = 100 + 200 + 300 + 400 + 500 + 600$$

$$= 2100 \text{ gallons/hour}$$

Master ControlBlock Configuration

The master ControlBlocks are responsible for starting, stopping, and controlling the rate of production of the streams that are linked to them. The following sections explain the configuration requirements for the master ControlBlocks.

Master Blocks 1, 2, 3, 4

M1-1 and **M1-2** sum the ratios of the streams.

M1-3 and **M1-4** sum the cumulated flows of the streams.

No configuration is required other than the removal of unused streams with *NONE as the block address in the continuous link pages when stream ControlBlocks are not loaded.

Master Blocks 5 and 6

M1-5 and **M1-6** sum the instantaneous stream flow rates for the 8, 16, and 24-stream packages. These blocks are not used in the 6-stream package.

M1-5 (8, 16, and 24-stream packages)

B	Engineering scale for input A	– Stream 1
D	Engineering scale for input C	– Stream 2
F	Engineering scale for input E	– Stream 3
H	Engineering scale for input G	– Stream 4
J	Engineering scale for input I	– Stream 5
L	Engineering scale for input K	– Stream 6
N	Engineering scale for input M	– Stream 7

M1-6* (8, 16, and 24-stream packages)

C	Engineering scale for input B	– Stream 8
E	Engineering scale for input D	– Stream 9
G	Engineering scale for input F	– Stream 10
I	Engineering scale for input H	– Stream 11
K	Engineering scale for input J	– Stream 12
M	Engineering scale for input L	– Stream 13

Master Block 7

M1-7 has one of the following configurations depending on the application size:

M1-7* (6 stream package)

B	Engineering scale for input A	– Stream 1
D	Engineering scale for input C	– Stream 2
F	Engineering scale for input E	– Stream 3
H	Engineering scale for input G	– Stream 4
J	Engineering scale for input I	– Stream 5
L	Engineering scale for input K	– Stream 6

* M1-7 for the 6-stream package is shown in the example in Figure 4.1.

M1-7 (16 and 24-stream packages)

C	Engineering scale for input B	– Stream 14
E	Engineering scale for input D	– Stream 15
G	Engineering scale for input F	– Stream 16
I	Engineering scale for input H	– Stream 17
K	Engineering scale for input J	– Stream 18
M	Engineering scale for input L	– Stream 19

```
                    CB CONTINUOUS LINKS           23-Jun-92     11:47:12
Tag   M1-7    Descriptor  MASTER PART #7
Addr =2A-07   Function  DISC Discrete Block

INPUT        SOURCE       Hold    Eng Zero     Eng Max      Value     Units

 A        >B1-CTRL/I     >no     >.00         >100.00      .00      >BMFR-1

 B        >100.00                >.00         >1.00        >.00     >BMFS-1

 C        >B2-CTRL/I     >no     >.00         >200.00      .00      >BMFR-2

 D        >200.00                >.00         >1.00        >.00     >BMFS-2

 E        >B3-CTRL/I     >no     >.00         >300.00      .00      >BMFR-3

 F        >300.00                >.00         >1.00        >.00     >BMFS-3

 G        >B4-CTRL/I     >no     >.00         >400.00      .00      >BMFR-4

              Q                  >.00         >1.00        >.00     >BMFR1-6

                                                     Block Mode> LOCAL
                                                                CONFIG 1
```

```
                CB CONTINUOUS LINKS           23-Jun-92     11:47:12
Tag   M1-7    Descriptor  MASTER PART #7
Addr =2A-07   Function  DISC Discrete Block

INPUT     SOURCE       Hold      Eng Zero     Eng Max   Value     Units

 H      >400.00              >.00            >1.00     >.00      >BMFS-4

 I      >B5-CTRL/I   >no     >.00            >500.00   .00       >BMFR-5

 J      >500.00              >.00            >1.00     >.00      >BMFS-5

 K      >B6-CTRL/I   >no     >.00            >600.00   .00       >BMFR-6

 L      >600.00              >.00            >1.00     >.00      >BMFS-6

 M      >*NONE               >.00            >1.       >0.       >

 N      >*NONE               >.00            >1.       >0.       >

 O      >*VALUE              >.00            >1.00     >.00      >TOTWORK

                                                  Block Mode> LOCAL
                                                             CONFIG 1
```

Figure 4.1. Continuous Links Screens-Master ControlBlock M1-7 (6-Stream Package)

Master Block 8

M1-8 has one of the following configurations depending on the application size:

M1-8* (6, 8, and 16-stream package)

H	Range for scaling the demand rate and the metered flow rate for trending; should be 1.5 or 2 times the maximum setpoint value as configured in register O of M1-8.
J	Master demand rate for trending; Eng Max should be the same as the value in register H.
K	Measured flow rate for trending; Eng Max should be the same as the value in register H.

* M1-8 for the 6-stream package is shown in the example in Figure 4.2.

M1-8 (24-stream only)

C	Engineering scale for input B –	Stream 20
E	Engineering scale for input D –	Stream 21
G	Engineering scale for input F –	Stream 22
I	Engineering scale for input H –	Stream 23
K	Engineering scale for input J –	Stream 24
N	Operator-enterable setpoint for the demand flow rate.	
O	Operator/supervisor entry for maximum setpoint value.	

Eng. Max for registers J and K should be same as the value entered in register H.

```
                              CB CONTINUOUS LINKS      23-Jun-92   11:47:12
Tag   M1-8     Descriptor  MASTER PART #8
Addr =2A-08    Function  DISC Discrete Block

INPUT     SOURCE    Hold      Eng Zero    Eng Max     Value     Units

 H      >600.00               >.0         >1.         500.      >RateSclr

 I      >M1-9/K     >no       *>.00       >1.00       61.25     >DmdRate

 J      >*VALUE               >.0         >600.00     61.2      >DmdRate2

 K      >*VALUE               >.0         >600.00     40.1      >MeasRte2

 L      >*VALUE               >.00        >1.00       >.00      >TOTWORK

 M      >M1-2       >no       *>.00       >1.00       100.00    >TBRO

 N      >*ENTRY               >0.         >1.0        >200.0    >DMD-STPT

 O      >200.                 >0.         >1.         200.      >MRMAX

                                                       Block Mode> AUTO
                                                                CONFIG 1
```

Figure 4.2. Continuous Links Screen–Master ControlBlock M1-8 (6-Stream Package)

TREND Block

A TREND block, used only in the 24-stream package, is configured as follows (see Figure 4.3):

A Range for scaling the demand rate and the metered flow rate for trending; should be 1.5 to 2 times the maximum setpoint value as configured in register O of M1-8.

B Master demand rate for trending; Eng Max should be the same as the value in register A.

C Measured flow rate for trending; Eng Max should be the same as the value in register A.

Eng. Max for registers B and C should be same as the value entered in register A.

```
                           CB CONTINUOUS LINKS      23-Jun-92     11:47:12
Tag   TREND Descriptor  Master and Measured Dmds
Addr =2A-10 Function  DISC Discrete Block

INPUT     SOURCE      Hold      Eng Zero      Eng Max     Value  Units

 A        >600.00               >.0           >1.0        >.0    >RateSclr

 B        >*VALUE               >.00          >600.00     >.00   >DmdRate2

 C        >*VALUE               >.00          >600.00     >.00   >MeasRte2

 D        >M1-9/K     >no       *>.00         >1.00       >.00   >DmdRate

 E        >M1-8       >no       *>.00         >1.00       >.00   >BMFR1-24

 F        >

 G        >

            Q                   >.00          >100.00     >.00

                                                     Block Mode> LOCAL
                                                                 CONFIG 1
```

Figure 4.3. Continuous Links Screen–24-Stream TREND Block

Master Block 9

M1-9 has operator options and manipulates the demand rate before passing a demand rate to the stream calculation blocks. Figure 4.4 shows the Continuous Links screens for the M1-9 block in a 6-stream package.

The Configuror registers are as follows:

- F Master meter (if it exists) flow transmitter input
- G Master meter (if it exists) flow range. See register F.
- J Calculated flow range: the sum of the flow ranges in ControlBlocks M1-5 to M1-8. (Figure 4.4 shows 2100 gallons, as the sum of flow ranges from M1-7 in the 6-stream package.)
- L Ramp up time
- M Ramp down time

  NOTE: L and M are the times that it should take to ramp up/down the demand rate to the specified setpoint/minimum flow rates. These values must have the same units of time as the flow rate; that is, if the demand flow rate is in gallons/hour, then L and M should be specified as hours. For example, 5 minutes = .0833 hours as shown in Figure 4.4.
- O Scan time adjustment for the flow rate time units; O is calculated from the time base units for the flow rate and the scan time of the controller (see ControlFile Status screen – **CFS**); for example, if the scan time is 0.5 seconds and the flow rate is measured in gallons/hour, then

$$O = \frac{\text{Rate–time units in seconds}}{\text{Controller scan time}} = \frac{3600}{0.5} = 7200$$

- Q — Demand rate, which is calculated and requires an Eng Max value
- @j — Toggles between master meter (if it exists) and calculated flow from streams; if there is no master meter transmitter, then @j should be configured as *OFF and removed from the faceplate.

The following operator-enterable variables for M1-9 define the flow recipe/scheme:

- B — Batch size (in the same volume units as the flow meters)
- C — Pre-shutdown volume; value at which the system starts to ramp down the demand rate; the example in Figure 4.4 shows 800 gallons.
- N — Minimum flow rate, which should be taken from the smallest stream flow for which that stream's meter can accurately measure. For example, if the minimum turn-down flow of a meter is 20 gal/hr and that stream's component is 20% of the product, then:

$$N = \frac{20}{.2} = 100.00$$

CB CONTINUOUS LINKS 23-JuL-92 11:47:12
Tag M1-9 Descriptor
Addr =2A-09 Function DISC Discrete Block

INPUT	SOURCE	Hold	Eng Zero	Eng Max	Value	Units
A	>M1-8/N	>no	>.0	>1.0	200.0	>SETPOINT
B	>*ENTRY		>.0	>1.0	>1000.0	>BATCH
C	>*ENTRY		>.0	>1.0	>800.0	>P-SHUTDN
D	>M1-2	>no	>.00	>1.00	100.00	>RATIOTOT
E	>M1-4	>no	>.0	>1.0	1000.5	>TOT-MEAS
F	>*ENTRY		>0.	>0.	>0.	>MstrMtr
G	>*ENTRY		>.00	>1.00	0.00	>MMFS
	Q		>.00	>2100.00	.00	>DEMAND%

Block Mode> AUTO
CONFIG 1

CB CONTINUOUS LINKS 23-JuL-92 11:47:12
Tag M1-9 Descriptor
Addr =2A-09 Function DISC Discrete Block

INPUT	SOURCE	Hold	Eng Zero	Eng Max	Value	Units
H	>*VALUE		>.00	>1.00	>1000.50	>TOTALS
I	>*VALUE		>.00	>1.00	>1000.39	>DEMD-TOT
J	>2100.00		>.00	>1.00	2100.00	>MDFS
K	>*VALUE		>.00	>1.00	>0.00	>DemandRate
L	>.0833		>.0000	>1.0000	.0833	>RUT
M	>.0833		>.0000	>1.0000	.0833	>RDT
N	>100.0		>.0	>1.0	100.0	>MDHR
O	>7200.00		>.000000	>1.000	7200.00	>MDTU

Block Mode> AUTO
CONFIG 1

Figure 4.4. Continuous Links Screens–Master ControlBlock M1-9 (6-Stream Package)

Calculation Block: Bx-CALC

The calculation block (Bx-CALC) is common to a valved stream and a metering pump stream. This block is always the first of a stream pair. Bx-CTRL receives the demand flow from the master block and calculates the stream flow from that master flow. This block has Auto lock equal to Yes with the following inputs as shown in Figure 4.5:

H Block demand conversion factor; this is calculated by dividing the O-register Eng Max by the D-register Eng Max. For example, if the master demand has a flow scale of 0 to 2100 units/hour and the stream meter has a flow range of 0 to 200 units/hour, then

K Operator input for this stream's percentage of the product

$$H = \frac{2100}{200} = 10.5$$

O Link from the master block (M1-9) demand flow

Analyzer Controller

If an analyzer controller is used for this stream, the operator percentage can be adjusted with the following configuration:

L Link from the analyzer controller block output
NOTE: L should be .5 when the additive is to specification; if this occurs at some other value, step j will need to be modifed.

M Gain for the analyzer trim; if M=1.0, then the analyzer could zero the operator value.

@c Operator switch to enable analyzer controller compensation; if there is no analyzer, then @c should be configured as *OFF for safety reasons and removed from the faceplate.

```
                              CB CONTINUOUS LINKS       23-Jul-92   11:47:12
Tag   B2-CALC    Descriptor  Stream 2Calcultn
Addr =2A-13      Function  DISC Discrete Block

INPUT    SOURCE       Hold   Eng Zero      Eng Max     Value    Units

 A     >METER-2       >no    >.0           >200.00     40.1     >meter 2

 B     >*ENTRY               >.00          >100.00     >.00     >Meter#2

 C     >25.00                >.00          >100.00     25.00    >BMSEL

 D     >*VALUE               >.00>1.00     >200.00     >40.1    >MEAS-FR

 E     >50.00                >-30.         >170.00     50.00    >REF-TEMP

 F     >0.10                 >.00          >1.00       0.10     >COEFFIC.

 G     >TT2001               >-30.         >170.00     >.00     >BMT

            Q                >.00          >100.00     40.00    >DEM-FR

                                                  Block Mode> AUTO
                                                              CONFIG 1
```

```
                              CB CONTINUOUS LINKS       23-JuL-92     11:47:12
Tag   B2-CALC  Descriptor  Stream 2Calcultn
Addr =2A-13    Function  DISC Discrete Block

INPUT    SOURCE       Hold      Eng Zero    Eng Max     Value    Units

 H     >10.50                   >.00        >1.00       >10.50   >BDCF

 I     >*VALUE                  D>.00       >200.0      >40.0    >MEAS-FR

 J     >*ENTRY                  >.00        >1.00       >1.00    >COMP-FAC

 K     >*ENTRY                  >.00        >1.00       >20.00   >RATIO

 L     >*ENTRY                  >.00        >100.00     >.00     >BFB

 M     >.50                     >.00        >1.00       .50      >BFG

 N     >*VALUE                  >.00        >1.00       >20.00   >COMP-RAT

 O     >M1-9          >no       >.00        >2100.00    200.00   >DEMAND

                                                        Block Mode> AUTO
                                                                 CONFIG 1
```

Figure 4.5. Continuous Links Screens—B2-CALC (6-Stream Package)

Dual Flow Meter Installation

In a dual meter situation, the calculation block automatically selects between two meters.

NOTE: *The following configuration is not in the metering pump (pulsed) stream calculation block.*

A	Low-range meter input or the single meter input address
B	High-range meter input address
C	Cross-over value from meter A to B
D	Selected meter
@a	Enables flow meter switching; if there is only a single meter, then @a should be configured as *OFF on the Continuous Links screen and Q and D should then have the same range as A. See Figure 4.6 where the Stream 2 meter is 0 to 200 gallons/hour.

The downward change is at C – (C*.05) to prevent continuous switching when the flow rate is approximately equal to C. Registers A, B, C, and D should have the same ranges; since this is unlikely, B, C, D, and Q should have the same range (as derived from B).

Example:

- A range = 0 to 150 gals/hr
- B range = 100 to 350 gals/hr
- C and D should be ranged as 0 to 350 and in step a
  - The OFF statement equation is:

$$D = \frac{A*150}{350}$$

  - The ON statement equation is:

$$D = \frac{(B*250) - 100}{350}$$

In general terms, the equation is:

$$X = \frac{(A * \text{range of } A) + \text{Eng zero of } A - \text{Eng zero of } X}{\text{range of } X}$$

Automatic Temperature Compensation

The following configuration modifies the measured volume of an additive in one scan by varying temperature from a reference temperature. This calculation is in step b.

- E — Reference temperature; must have the same Eng Zero and Eng Max values as G.
- F — Based on the coefficient of expansion of the additive and on the instrument range of G; for example, as shown in Figure 4.6, if the transmitter is ranged −30 to 170 and the coefficient of expansion is .0005, then

  $$F = (.0005 * 200) = .10$$

- G — Input for the temperature transmitter
- J — Operator-enterable compensation/consistency factor (typically equal to1 if there is no automatic temperature compensation). If there is to be no operator adjustment, then J should be hard coded as 1 on the Continuous Links screen and removed from the faceplate.
- @b — Operator switch to enable automatic temperature compensation; if there is no compensation, then @b should be configured as *OFF for safety reasons and removed from the faceplate.

Registers A, D, and Q have the same Eng Max value.

```
                              CB CONTINUOUS LINKS     23-Jul-92     11:47:12
Tag   B2-CALC  Descriptor  Stream 2Calcultn
Addr =2A-13    Function  DISC Discrete Block

INPUT     SOURCE       Hold      Eng Zero       Eng Max      Value  Units

 A      >METER-2       >no       >.0            >200.0       40.1   >meter 2

 B      >*ENTRY                  >.00           >100.00      >.00   >Meter#2

 C      >*ENTRY                  >.00           >100.00      >25.00 >BMSEL

 D      >*VALUE                  >.00>1.00      >200.00      >40.1  >MEAS-FR

 E      >50.00                   >-30.          >170.00      50.00  >REF-TEMP

 F      >0.10                    >.00           >1.00        0.10   >COEFFIC.

 G      >TT2001                  >-30.          >170.00      >.00   >BMT

             Q                   >.00           >200.00      40.00  >DEM-FR

                                                     Block Mode> AUTO
                                                              CONFIG 1
```

Based on the coefficient of expansion of the additive and on the instrument range of G.

Figure 4.6. Continuous Links Screen–B2-CALC

PI Controller: Bx-CTRL

The Bx-CTRL ControlBlock for each stream has the following inputs as shown on the Continuous Links screens in Figure 4.7:

RS	Factor for converting the demand units to meter units; if the units of measurement are the same, then RS = 1.0.
I	Measured flow rate
K	Upper travel limit of the valve (0-100% open), or the valve position for maximum flow; that is, moving the valve beyond this value will not increase the flow rate.
L	Error between the demand and measured flow rate accumulators; the units are the same as those of the stream meter.
M	Full scale value of the demand rate; see Eng Max of B2-CALC register O.
N	Stream meter range; see Eng Max of B2-CALC register D.
O	Scan time adjustment for the flow rate time units; same as M1-9/O.

On the Continuous Diagram screens for I and L, you need to configure all four alarms for each stream: Hi Crit, Hi Adv, Lo Adv and Lo Crit.

NOTE: If this block is used for very small dosing rates, then the totalized flow and flow rate do not need to be linked to the master blocks, because the error is very small when not including these. See master blocks M1-5 (to M1-7) and M1-3 (to M1-4) and registers Bx-CTRL/H and Bx-CTRL/I of the affected stream controllers.

CB CONTINUOUS LINKS 23–Jul–92 11:47:12
Tag B2–CTRL Descriptor Stream 2
Addr =2A–14 Function PI

INPUT	SOURCE	Hold	Eng Zero	Eng Max	Value	Units
PV	>*VALUE		>.000	>1.000	>.500	>BNET
LS	>.50		>.00	>1.00	.50	>K
RS	>1.00		>.00	>1.00	1.00	>ConvFact
FF	>B2–CALC/J	>no	*>.0>1.00	>1.00	1.00	>COMP–FAC
E	>*VALUE		>,000	>1.000	>.333	>BDQ
F	>*VALUE		>.00	>1.00	>1669.80	>DEM–TOT
G	>*VALUE		>.000	>1.000	>.333	>BMQ
	Q		>.00	>100.00	19.97	>%OUT

Block Mode> AUTO
CONFIG 1

CB CONTINUOUS LINKS 23–JuL–92 11:47:12
Tag B2–CTRL Descriptor Stream 2
Addr =2A–14 Function PI

INPUT	SOURCE	Hold	Eng Zero	Eng Max	Value	Units
H	>*VALUE		>.00	>1.00	>1671.48	>MEAS–TOT
I	>B2–CALC/I	>no	*>.0	>200.0	40.0	>MEAS–FR
J	>B2–CALC	>no	*>.00	>200.00	40.00	>DEM–FR
K	>75.00		>.00	>100.00	75.00	>BOPL
L	>*VALUE		>.00	>1.00	>–.01	>BET
M	>200.00		>.00	>1.00	200.00	>BDFS
N	>200.00		>.00	>1.00	200.00	>BMFS
O	>7200.00		>.000	>1.00	7200.00	>MDTU

Block Mode> AUTO
CONFIG 1

Figure 4.7. Continuous Links Screens—B2-CTRL (6-Stream Package)

Pulse Block Controller: ADD-CTRL

The ADD-CTRL ControlBlock has the following inputs:

- J Flow from the additive calculation block. (See the section titled "Calculation Block: Bx-CALC.")
- B Volumetric unit per pump pulse
- C Time-base conversion; this is the same value that is used in the Master block M9/O, that is:

$$C = \frac{\text{Rate time units seconds}}{\text{Controller scan time}}$$

- D Conversion for demand units to pump volumetric units (register B); this is a units factor for converting the demand rate to pump volume units; the demand rate is specified by the operator in Master block M9/B; for example, if the master rate is specified in barrels per hour and the metering pump volume (B) is specified in liters, the following formula is used to calculate D:

  barrels (petroleum) = 42 US gals
  US gallons = 3.7854 liters
  D = 42x3.7854 = 158.9868

On the Continuous Diagram screens for J and A, you need to configure alarms as follows:

- J Hi Adv flow rate alarm
- A Hi Crit, Hi Adv, Lo Adv, and Lo Crit for shutdown alarms

You also need to make the following links to master blocks:

- H Flow rate to be linked to either M1-5, M1-6, M1-7, or M1-8.
- L Accumulated flow to either M1-3 or M1-4.

I/O Block Configuration

Input and output blocks must be configured for each component stream that is used in the blend. It is assumed that pulse I/O FIC cards will be used for this application.

The following I/O blocks need to be configured:

- PIOB for each flow meter input
  Point Type = Pulse Input
  Function Type = Frequency
- PIOB for each small dosage additive stream:
  Point Type = Pulse Output
  Function Type = Count
- PIOB* for each component stream PID output:
  Point Type = mA Output
  Output Type = Analog

  * The third point on the pulse FIC card can be used for this purpose.

For details about configuring PIOB I/O blocks, see IO: 3.

PIOB Pulse Input Example

Figure 4.8 shows an example of the flow-meter input for a two-meter stream; this block is configured as a contact input and powered by the Rosemount System 3 with the following parameters:

- Turbine meter range = 0 to 200 gal/min
- K = 180 pulses per gallon
- Turn-down ratio = 10

therefore,

$$\text{Maximum Frequency} = \frac{200 * 180}{60} = 600 \text{ Hz}$$

```
                         I/O BLOCK CONFIGURATION        25-Jun-92    10:42:34
Address    =10AD10AA101     Device Type  PIOB

Block Tag >METER-2       Block Type >PIOB        Mode      >AUTO

Point Type >Pulse Input                            Auto Lock >no

                                                   Block Output  .00
Type >Contact                                        Freq (Hz) : 0.

Debounce >5ms
 ----------------------------------------------------------------------
|                        Function Type >Frequency                      |
|                                                                      |
|                 Range Zero (Hz) >0.     Eng Zero >0                  |
|                                                                      |
|                 Range Max  (Hz) >600.   Eng Max  >200.               |
|                                                                      |
|                 Low Cutoff (Hz) >1.     Eng Units >gpm               |
 ----------------------------------------------------------------------

Hardware Alarm Code 0    Plant Unit>0        Alarm Priority >0
                                                                CONFIG 1
```

Figure 4.8. Configuring a Flow-Meter Input PIOB

PIOB mA Output Example

Figure 4.9 shows an example of the configuration for an analog output to drive the stream control valve.

NOTE: This configuration uses the third channel of the pulse FIC card.

```
                          I/O BLOCK CONFIGURATION     12-Jan-90    16:01:49
Address   =1AA103            Device Type  PIOB

Block Tag >Valve2           Block Type >PIOB             Mode   >AUTO

Point Type >mA Output       Source Link >B2-CTRL         Auto Lock >no
                            Source Value     0.
Output Type >Analog                                      Block Output 0.
                            Comm Fail >Zero Output     Current (mA) 0.










Hardware Alarm Code  19    Plant Unit >0      Alarm Priority >0

                                                                CONFIG 1
```

Figure 4.9. Configuring a Control-Valve Output PIOB

Section 5:
Digital Blending Operating Instructions

This section contains information about setting initial values and starting and monitoring the blend.

Setting Initial Values

In order for digital blending to be operational, you need to set the following values for each blend stream block:

- Ratio
- Compensation factor
- Percent checking enabled, if desired
- Pacing enabled, if desired

Setting Ratio and Compensation Factors

The ratio determines the percentage of product for each stream. Percentages are entered as follows: 5% for example, is entered as 5.0.

The compensation factor should be set to 1 if automatic temperature compensation is not required; otherwise, this is the actual compensation factor.

From the Stream Detail Graphic (see Figure 5.1), follow these steps for each Bx-CTRL box:

1. Cursor to the first item in the box and enter the ratio for this stream.
2. Cursor to the second item in the box, and enter “1” as the compensation factor.

NOTE: You can enter the stream ratios from the “Blend Stream Parameters” section of the master graphic or from the Bx-CALC faceplates on the group displays. The compensation factor is also accessible from the Bx-CALC faceplate.

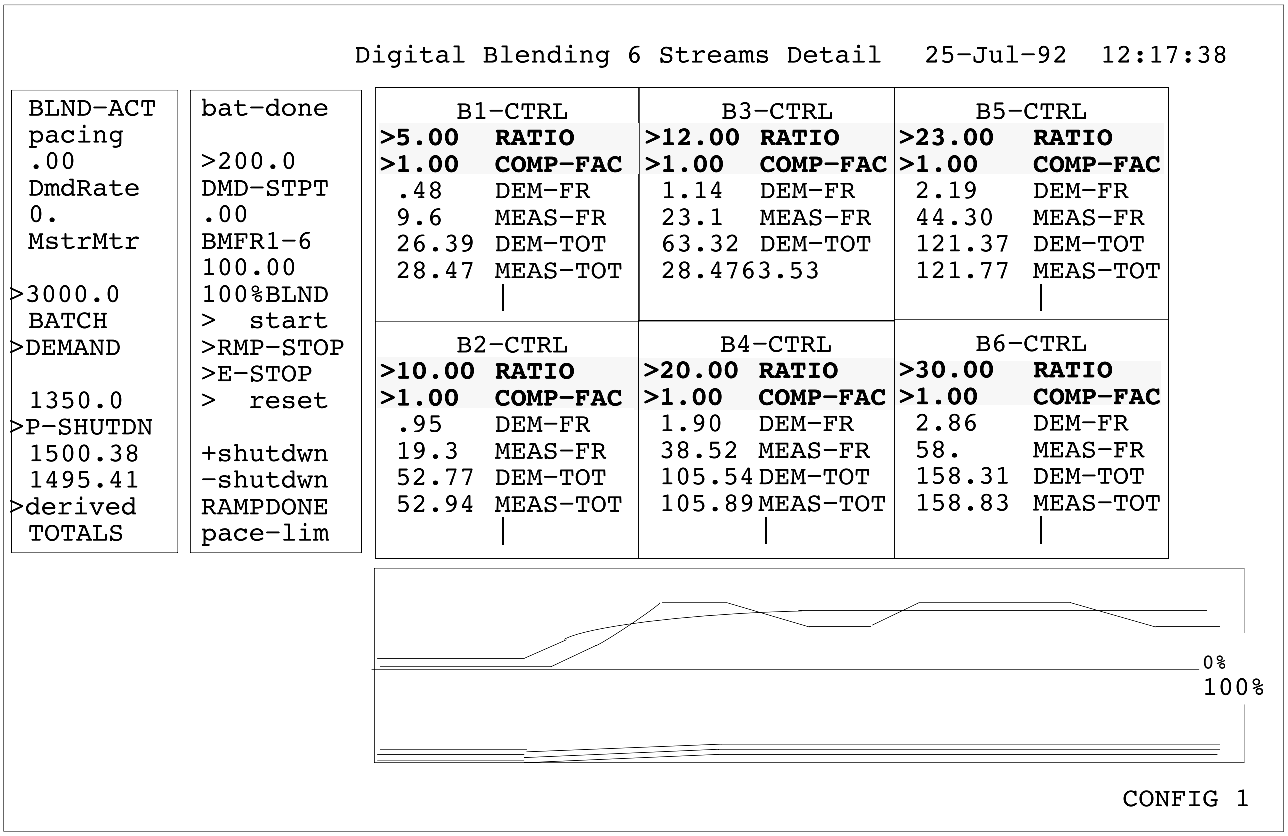

Figure 5.1. Setting Ratio and Compensation Factors

Checking Stream ControlBlocks

The Bx-CTRL faceplates contain fields that specify how the stream is to operate:

- Line 15 specifies whether or not a percentage check is enabled. If %CHK-ENB appears for a block, the system calculates the total percentage and allows you to ensure that the blend is configured to 100% and that the flow rate for this stream is included in the master total.

NOTE: This calculated total percentage is shown on line 7 of the M1-8 faceplate.

- Line 16 specifies whether the controller is under pace or memory control:

  — INH_PACE indicates that the controller uses Memory control. This method should be used when the total component addition is critical, but the instantaneous product ratio is not important.

  — PACE_ENB indicates that the controller uses Pace control. This method is used for critical streams that must be within product specification at all times and that cannot be allowed to correct for errors over time.

- Each block that is to be used (Bx-CTRL *and* Bx-CALC) should be in AUTO mode.

❑ **To check the operation settings of the stream ControlBlocks from a group display:**

1. For each Bx-CTRL block with a percentage entered, check line 15 on the faceplate to see if %CHK-ENB is visible; if not, and if it is necessary to include this stream's flow in the master flow rate, place the cursor over INH-%CHK, and press [ENTER]. See Figure 5.2.
2. To set each Bx-CTRL block to the appropriate control type, cursor to line 16, and press [ENTER] until the appropriate type appears: INH_PACE for memory control or PACE_ENB for pace control.
3. Check the mode field for each block to be used (Bx-CALC and Bx-CTRL), and if that field at the bottom of the faceplate does not show AUTO, press [AUTO] on the keypad.
4. Check block M1-8 to ensure that line 7 is 100.00 and that line 8 shows 100%BLND. This ensures that all the streams that are to be activated do total 100%. If line 7 does not show 100%, make sure that the individual stream percentages are entered correctly, that the %CHK-ENB is visible for each block, and that all blocks are in auto mode.

NOTE: To access group displays for additional blocks, press [NEXT PAGE].

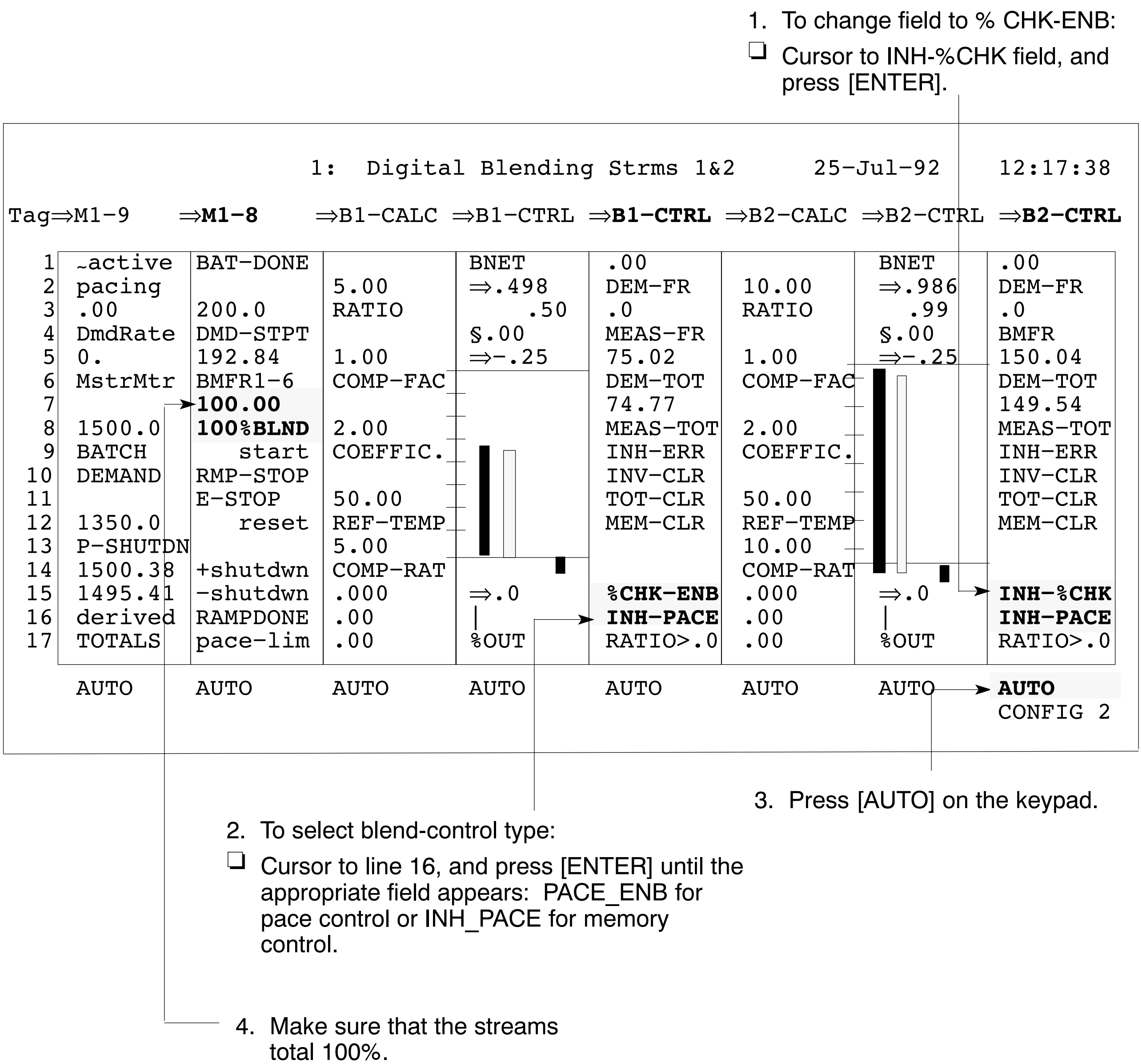

Figure 5.2. Checking Stream ControlBlocks

Setting the M1-9 Block

Master Control Block M1-9 allows you to enter the total amount of product to be produced, the amount at which to begin the rampdown, and the accumulator to be used. See Figure 5.3.

❑ **To define values in the M1-9 block from any digital blending group display:**

1. On line 7, enter the total amount of product to be produced.
2. On line 10, press [ENTER] to toggle between >DEMAND and MEASURED; this field indicates which accumulator to use to determine the total batch that is compared with the total amount of product as shown on line 8.
3. On line 11, enter the amount at which digital blending should start to ramp down before reaching the amount shown on line 8.
4. On line 16, press [ENTER] to toggle between showing the accumulation as a MSTR-MTR (master meter) or as derived (measured by the summation of the individual stream meters).

NOTE: You can also set these values for the M1-9 block from the detail graphic.

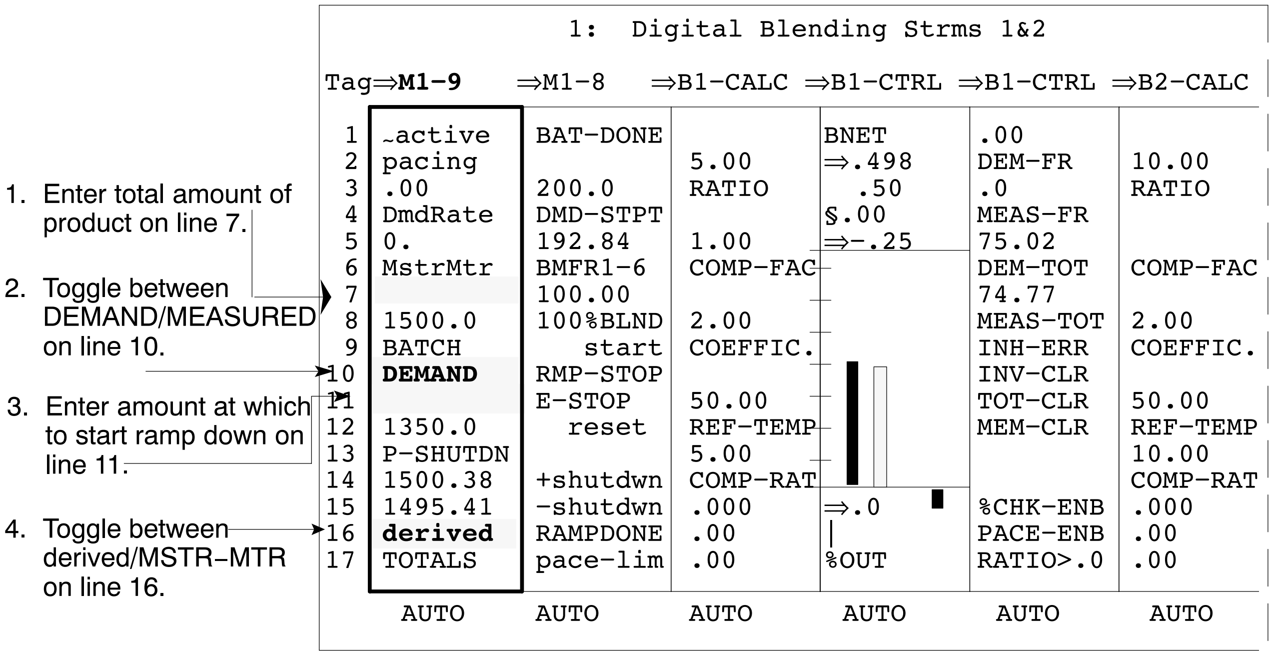

Figure 5.3. Setting M1–9 Block Values

Setting the M1-8 Block

The M1-8 block allows you to define the flow rate and to clear any accumulators as shown in Figure 5.4.

❑ **To define values in the M1-8 block from any digital blending group display:**

1. On line 2, enter the flow rate at which the batch is to be made.
2. To clear any previous accumulations, cursor to line 12 (reset), and press [ENTER].

NOTE: You can also set these values for the M1-8 block from the detail graphic.

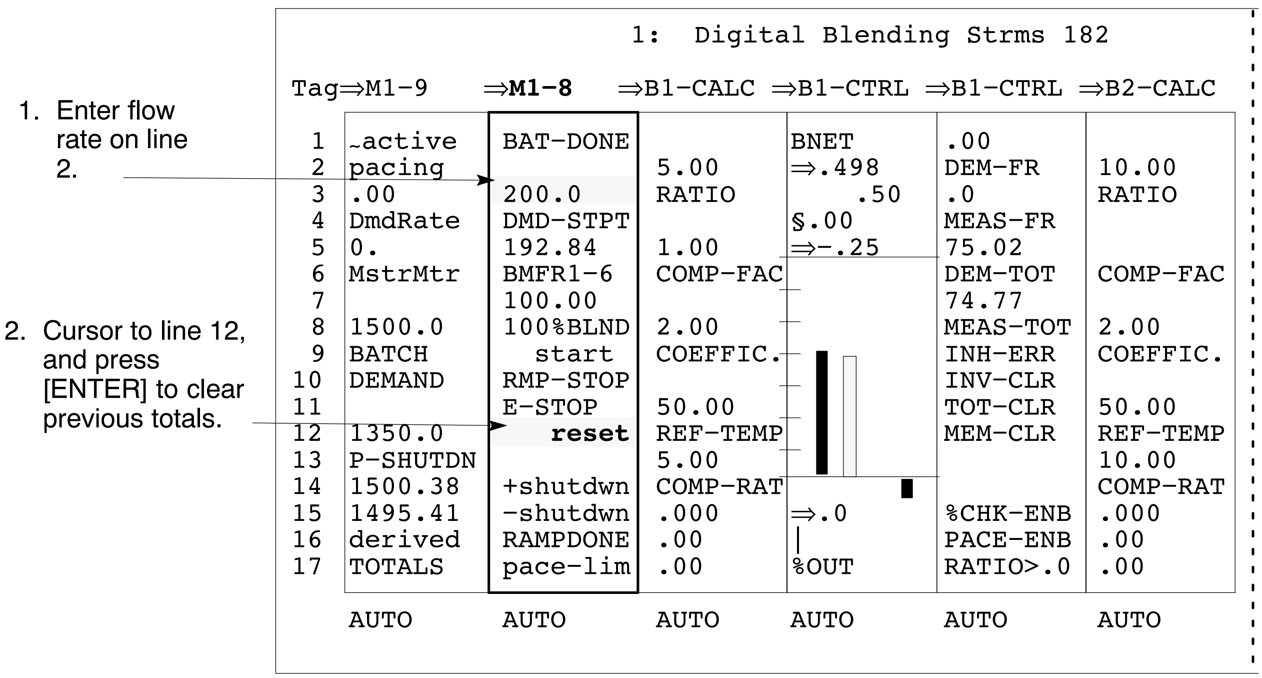

Figure 5.4. Setting M1-8 Block Values

Starting the Blend

You can start the blend process from the master or detail graphics or from any digital blending group display. Figure 5.5 shows how to start the blend from a group display.

❑ **To start the blend:**

1. Access any digital blending display showing the M1-8 discrete faceplate.
2. Cursor to line 9 (start), and press [ENTER].

1: Digital Blending Strms 182 25-Jul-92

12:17:38

Tag	⇒M1-9	⇒**M1-8**	⇒B1-CALC	⇒B1-CTRL	⇒B1-CTRL	⇒B2-CALC	⇒B2-CTRL	⇒B2-CTRL
1	˷active	BAT-DONE		BNET	.00		BNET	.00
2	pacing		5.00	⇒.498	DEM-FR	10.00	⇒.986	DEM-FR
3	.00	200.0	RATIO	.50	.0	RATIO	.99	.0
4	DmdRate	DMD-STPT		§.00	MEAS-FR		§.00	BMFR
5	0.	192.84	1.00	⇒-.25	75.02	1.00	⇒-.25	150.04
6	MstrMtr	BMFR1-6	COMP-FAC		DEM-TOT	COMP-FAC		DEM-TOT
7		100.00			74.77			149.54
8	1500.0	100%BLND	2.00		MEAS-TOT	2.00		MEAS-TOT
9	BATCH	**start**	COEFFIC.		INH-ERR	COEFFIC.		INH-ERR
10	DEMAND	RMP-STOP			INV-CLR			INV-CLR
11		E-STOP	50.00		TOT-CLR	50.00		TOT-CLR
12	1350.0	reset	REF-TEMP		MEM-CLR	REF-TEMP		MEM-CLR
13	P-SHUTDN		5.00			10.00		
14	1500.38	+shutdwn	COMP-RAT			COMP-RAT		
15	1495.41	-shutdwn	.000	⇒.0	%CHK-ENB	.000	⇒.0	%CHK-ENB
16	derived	RAMPDONE	.00	|	PACE-ENB	.00	|	PACE-ENB
17	TOTALS	pace-lim	.00	%OUT	RATIO>.0	.00	%OUT	RATIO>.0
	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO	MANUAL	MANUAL CONFIG 2

❑ Cursor to line 9, and press [ENTER] to start blend.

Figure 5.5. Starting the Blend

Monitoring the Blend

The following faceplates allow you to monitor the digital blending process:

- M1-8 and M1-9 are available on any of the detail graphics or on any of the group displays.
- Bx-CALC and Bx-CTRL values can be viewed on the master or detail graphics but are controlled only from the group displays.

Using the Master Graphic

The master graphic provides an overview of the master parameters as well as information about the component streams. Table 5.1 and Figure 5.6 explain the fields in the Master Blend Status section.

Table 5.1. Master Blend Status Fields

TRUE (ON)	FALSE (OFF)	Explanation
E-STOP (green)	E-STOP (red)	Momentary ON that allows you to stop the blend in an emergency condition.
START	start	Momentary ON that allows you to start the blend.
BLND-ACT	~active	Indicates whether or not the blend is active.
PRESHUTD	preshutd	Indicates whether or not the blend is in a pre-shutdown state.
BAT-DONE	bat-done	Indicates whether or not the batch is done.
PACING	pacing	Indicates whether or not pacing is active.
RMP-STOP (green)	RMP-STOP (yellow)	Momentary ON that allows you to ramp down the blend rate to stop blending.
RAMPDONE	RAMPING	Indicates whether or not ramping is active
RESET	reset	Momentary ON that allows you to reset the accumulators.
+SHUTDWN	+shutdwn	Indicates a stream-to-master shutdown signal when a stream is exceeding its demand rate.
–SHUTDWN	–shutdwn	Indicates a stream-to-master shutdown signal when a stream cannot keep up with its demand rate.

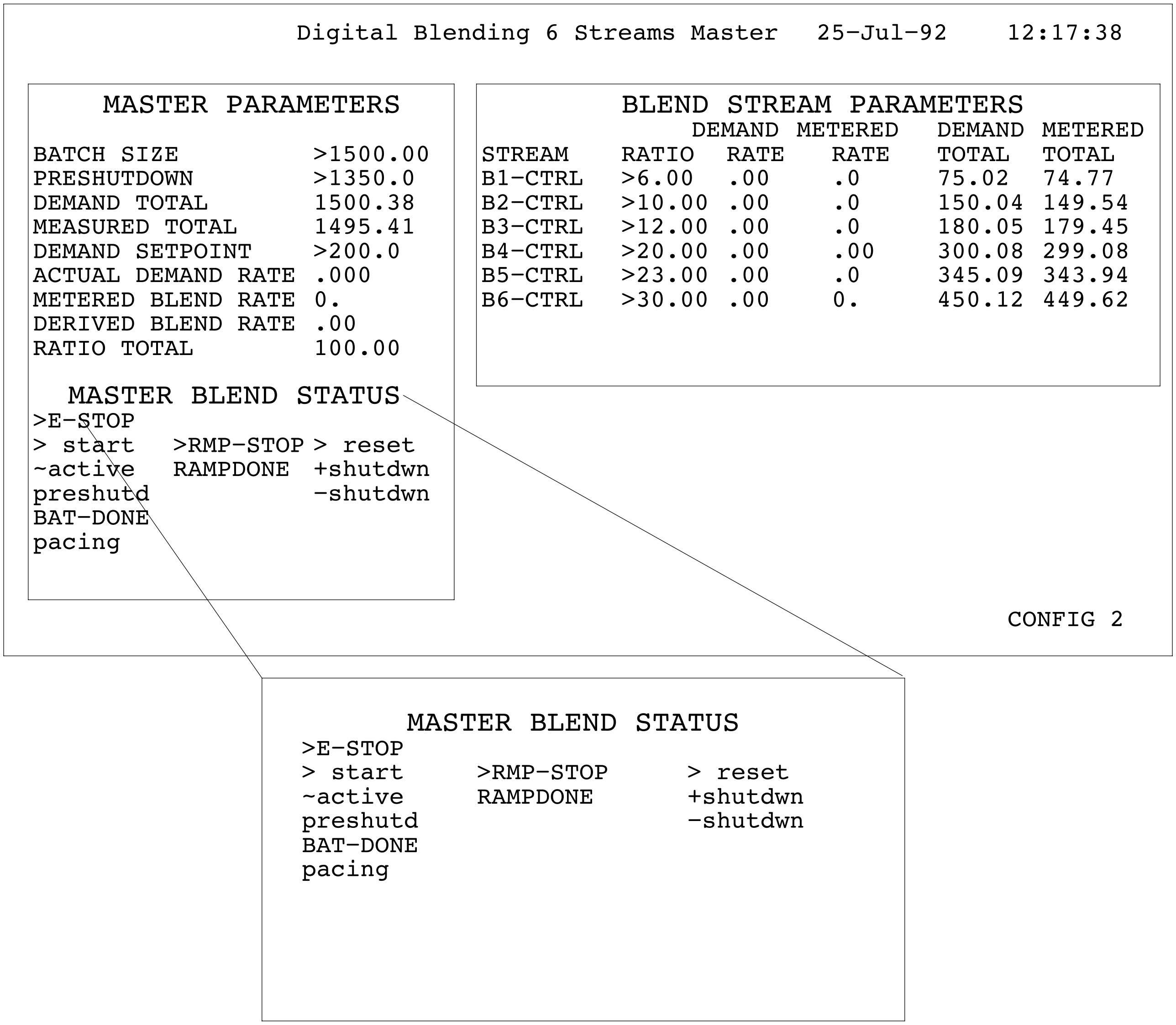

Figure 5.6. Using the Digital Blending Master Graphic

Using the M1-9 Discrete Faceplate

The discrete faceplate for the M1-9 Master Block appears on the stream detail graphic as well as on each group display. Table 5.2 and Figure 5.7 explain the fields on this faceplate.

Table 5.2. M1-9 Discrete Faceplate

Line Number	Explanation
1	BLND-ACT indicates that the blend is in progress; ~active indicates that the blending process is inactive.
2	PACING indicates that pacing is active; pacing indicates pacing that is inactive.
3	Current master demand rate (Input K)
4	Label for line 3
5	Input from master meter flow transmitter if it exists (Input F)
6	Label for line 5
7	Input line for total batch size
8	Current total batch size (Input B)
9	Label for line 8
10	DEMAND indicates that the batch totalizer is based on demand rate; MEASURED indicates that the totalizer is based on the actual flow-rate measurement.
11	Input line for pre-shutdown volume
12	Current pre-shutdown volume (Input C)
13	Label for line 12
14	Master demand total (Input I)
15	Master measured total (Input H)
16	MSTR-MTR indicates that the master block totalizing is on the master meter; derived indicates that totalizing is based on the sum of the stream flows.
17	Label for lines 14 and 15

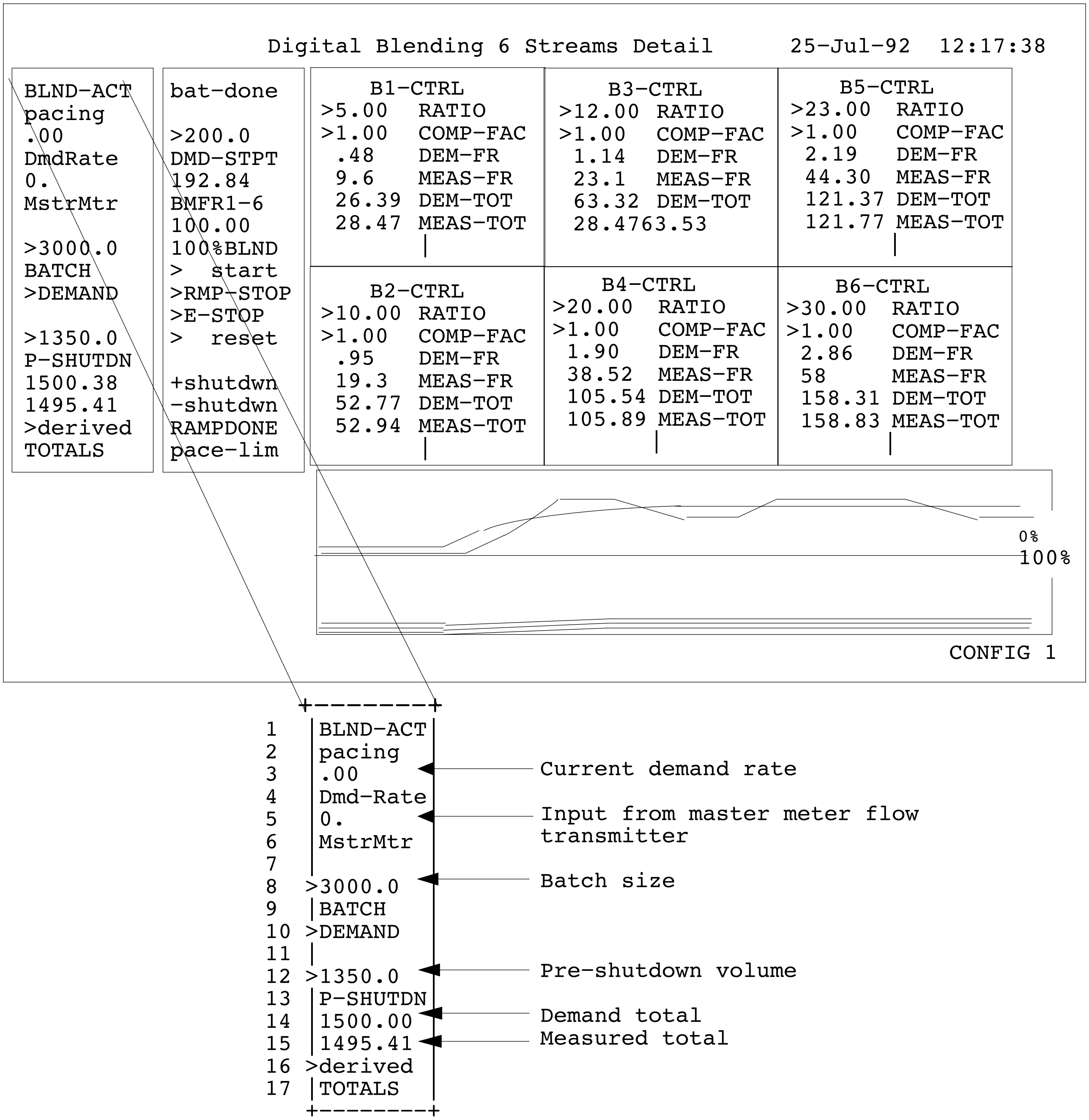

Figure 5.7. M1-9 Discrete Faceplate

Using the M1-8 Discrete Faceplate

The discrete faceplate for the M1-8 master block appears on the stream detail graphic as well as on each group display. Table 5.3 and Figure 5.8 explain the fields on this faceplate.

Table 5.3. M1-8 Discrete Faceplate

Line Number	Explanation
1	BAT-DONE indicates that the batch has finished; bat-done indicates that the blend is not in a finished state.
2	Input line for the master demand flow rate
3	Current value of the master demand flow rate (Input N)
4	Label for line 3
5	Actual master flow rate (Q)
6	Label for Line 5; in the example in Figure 5.8, BMFR1-6 indicates that the total measured flow rate comes from streams 1 to 6.
7	Sum of active stream ratios (Input M)
8	100% BLD indicates that the blend total equals 100%; ~100%BLND indicates the blend total on line 7 is not at 100%.
9	Momentary ON that allows you to start the blend.
10	Momentary ON that allows you to ramp down the master blend rate to stop.
11	Momentary ON that allows you to stop the blend in an emergency condition with no ramping down of the demand rate.
12	Momentary ON that allows you to reset the accumulators
13	– – – –
14	+SHUTDWN indicates that the master received a shutdown signal from a stream that was exceeding its demand; +shutdwn indicates that this signal is false.
15	–SHUTDWN indicates that the master received a shutdown signal from a stream that cannot keep up with its demand; –shutdwn indicates that this signal is false.
16	RAMPDONE indicates that the ramping is finished; RAMPING indicates that the process is still ramping the master demand rate.
17	PACE-LIM indicates that pacing is active; pace-lim indicates no pacing.

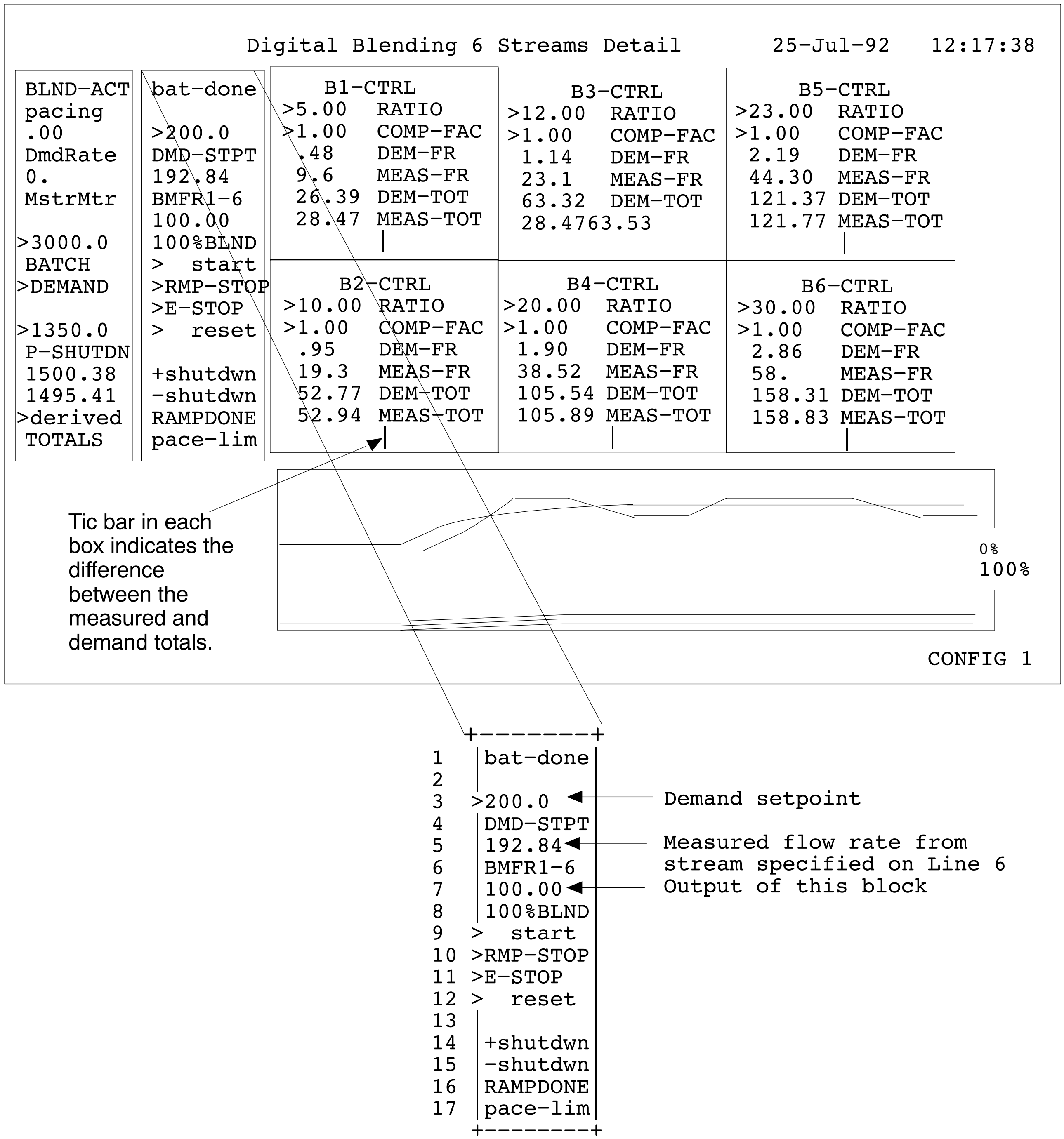

Figure 5.8. M1-8 Discrete Faceplate

Using the Bx-CALC Discrete Faceplate

The discrete faceplates for the Bx-CALC blocks appear on the group displays. Table 5.4 and Figure 5.9 explain the fields on this faceplate.

Table 5.4. Bx-CALC Discrete Faceplate

Line Number	Explanation
1	Input line for the percentage of the master demand that is defined for this stream
2	Current percentage of the master demand to be applied to this stream (Input K)
3	Label for line 2
4	Input line for the compensation factor
5	Current compensation/consistency factor (Input J)
6	Label for line 5
7	Input line for the coefficient
8	Current coefficent for this stream (Input F)
9	Label for line 8
10	Input line for the reference temperature
11	Current reference temperature (Input E)
12	Label for line 11
13	Current compensation ratio (Input N)
14	Label for line 13
15	Master demand rate
16	Measured flow of this stream
17	Demand rate for this stream

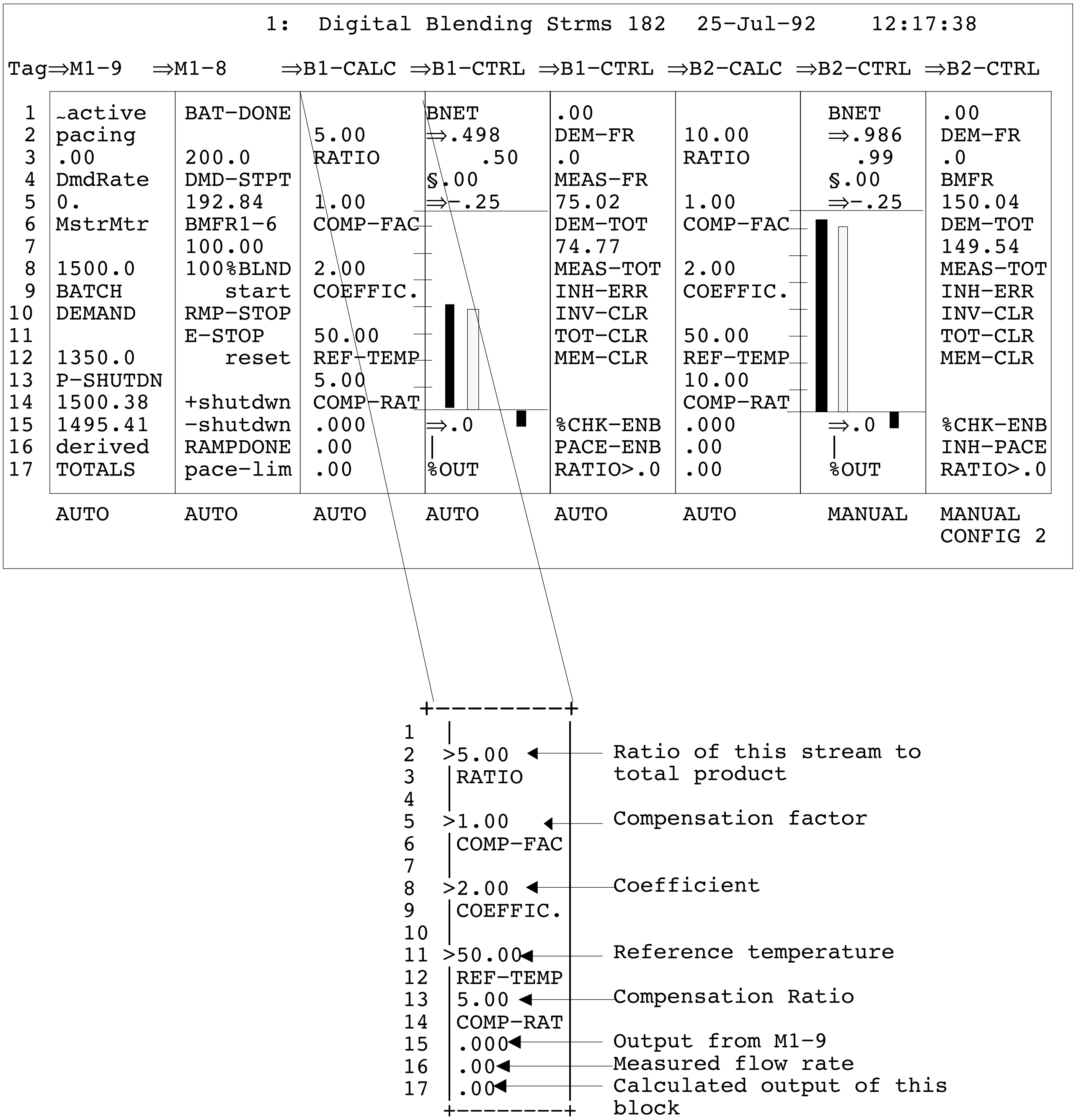

Figure 5.9. Bx-CALC Discrete Faceplate

Using the Bx-CTRL Discrete Faceplate

The discrete faceplates for the Bx-CTRL blocks appear on the group displays. Table 5.5 and Figure 5.10 explain the fields on this faceplate.

Table 5.5. Bx-CTRL Discrete Faceplate

Line Number	Explanation
1	Demand flow rate for this stream (Input J)
2	Label for line 1
3	Measured flow rate for this stream (Input I)
4	Label for line 3
5	Demand total for this stream (Input F)
6	Label for line 5
7	Measured total for this stream (Input H)
8	Label for line 7
9	Momentary ON that prevents a stream alarm from shutting down the blend; INH-ERR in red indicates a true condition; INH-ERR in green permits activation of shut-down alarms.
10	Momentary ON that allows the measured and demand totals for a stream to be cleared; INV-CLR in red indicates a true condition; INV-CLR in green is false.
11	Momentary ON that allows the measured and demand totals to be cleared; TOT-CLR in red indicates a true condition; INV-CLR in green is false.
12	Momentary ON that resets the stream controller; MEM-CLR in red indicates a true condition; MEM-CLR in green is false.
13	– – –
14	– – –
15	%CHK-ENB indicates that the system will check the total percentages of all streams; INH-%CHK is false, indicating that percentage checking is not enabled.
16	PACE-ENB indicates that pacing is enabled; INH-PACE indicates the process is running in memory mode.
17	RATIO=.0 indicates that % checking is enabled but no percentage has been entered; Ratio > .0 indicates that percentages have been entered.

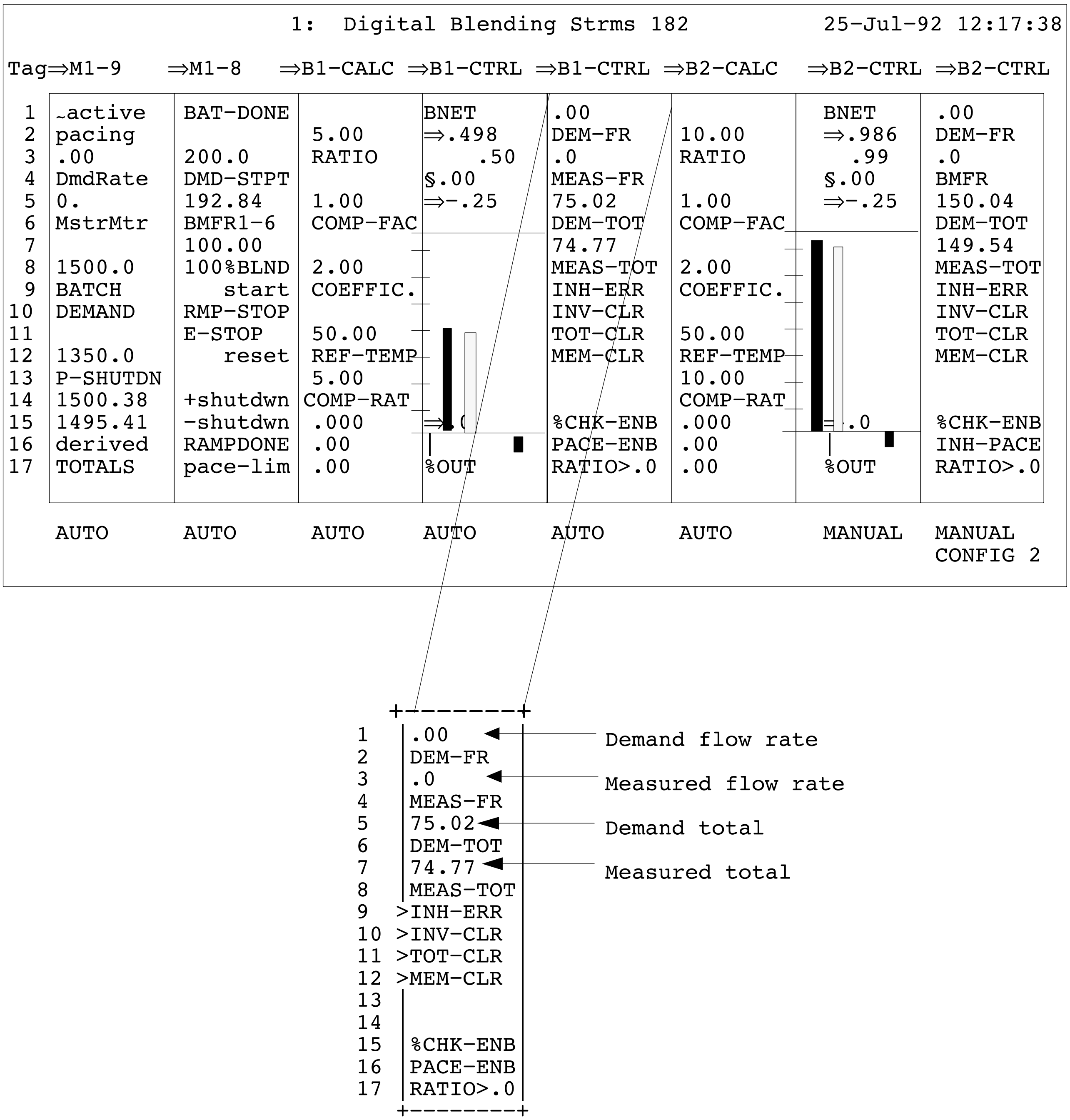

Figure 5.10. Bx-CTRL Discrete Faceplate

Using the Bx-CTRL Continuous Faceplate

The continuous faceplates for the Bx-CTRL block appear on the group displays. Figure 5.11 explains the fields on this faceplate.

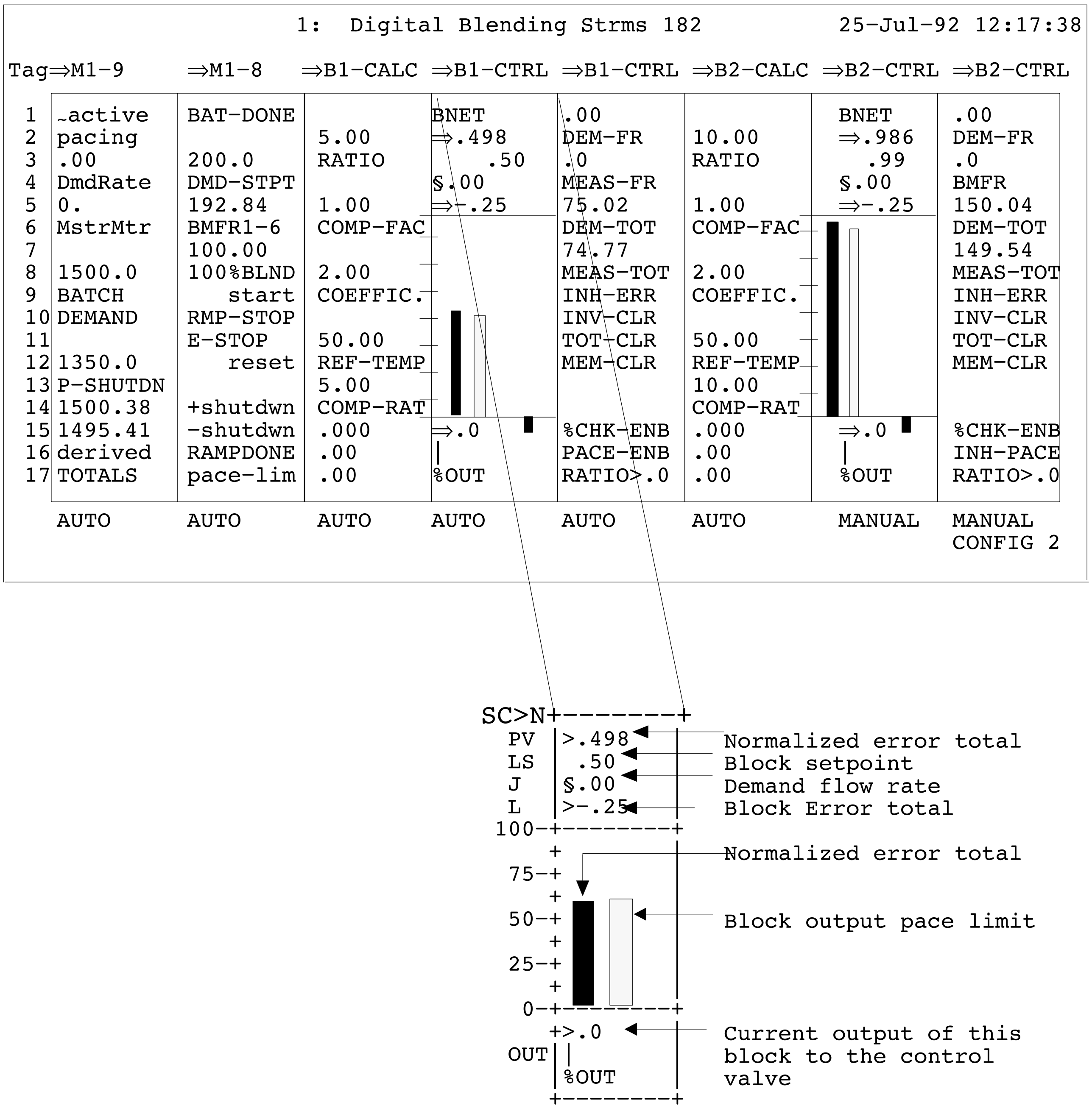

Figure 5.11. Bx-CTRL Continuous Faceplate

Appendix A:
Disk and Tape Procedures

This section contains the disk and tape procedures needed to load the Digital Blending software.

Table A.1. Disk and Tape Procedure1-7: Tape Load

Step	Operation	Description
1	Action:	For vertical tape drives: • Insert the tape cartridge into the tape drive as shown in Figure 1–9, with the metal plate of the cartridge on the left side and the notches located near the top. • Slide the tape drive button down. For horizontal tape drives: • Insert the tape cartridge into the tape drive as shown in Figure 1–9, with the metal plate of the cartridge on the bottom and the notches located on the left side. • Slide the tape drive button to the right.
2	Action:	Call up the Disk Directory PeerWay screen by typing: **DDP** [ENTER] The Disk Directory PeerWay screen appears.
3	Action: Response: Comments:	Cursor to the name or location of the tape to be loaded, and press [ENTER]. The Disk Activity screen appears. The tape is listed as Unloaded in the “Drive” field.
4	Action: Response:	Cursor to the “Operation” field on the Disk Activity screen. Press the [NEXT OPTION] key repeatedly until the following message appears above the “Operation” field: Tape Load Press [ENTER]. The “Tape Load” message appears in the “Operation” field:
5	Action: Response: Comments:	Cursor to the “Press <ENTER> to Begin” field, and press [ENTER]. The tape drive light comes on and remains on until the Tape Unload procedure is completed. While the operation is in progress, this field reads Tape Operation in Progress The operation is complete when the “Press <ENTER> to Begin” field reappears. The operation takes up to 9 minutes to complete.
6		**CAUTION** **Do not remove the tape until the operation is completed. The tape drive light remains on while the tape is being initialized or loaded. To prevent damaging the tape, never remove a tape while the tape drive light is on.**

* For additional information, see DT: 2-1.

Table A.2. Disk and Tape Procedure 3-1: Disk Load Console

Step	Operation	Description
1	Action: Response:	**WARNING** **The Disk Console Load operation may change console displays.** Call up the Disk Directory PeerWay screen by typing: **DDP** [ENTER] he Disk Directory PeerWay screen appears.
2	Action: Response:	Cursor to the disk volume name or location containing the console configuration, and press [SELECT]. The Disk Directory screen appears.
3	Action: Response:	Cursor to the Console Configuration folder name, and press [SELECT]. The Console Config Directory screen appears.
4	Action: Response:	Cursor to the name of the file to be loaded, and press [ENTER]. The Disk Activity screen appears.
5	Action: Response:	Cursor to the “Operation” field on the Disk Activity screen. Press the [NEXT OPTION] key repeatedly until the following message appears above the “Operation” field Disk Load Console Press [ENTER]. The “Disk Load Console” message appears in the “Operation” field.

* For additional information, see DT: 2-3.

(continued on next page)

Table A.2. Disk and Tape Procedure 3-1: Disk Load Console

Step	Operation	Description
6	Action: Response: Comments:	Cursor to the “Config Types” field. Press the [NEXT OPTION] button repeatedly until the desired configuration option appears above the “Config Types” field. Press [ENTER]. The desired configuration appears in the “Config Types” field. **NOTE:** “Most” is the default condition and can be used if the entire configuration is to be loaded. The alarm/event configuration and the trend file configuration must be individually restored by using the [NEXT OPTION] button to select the restore operation on the particular file Disk Activity screen.Choose from these options to select the configuration types to be loaded: • MOST (except Alarm/Event Cnfg and Trend File Cnfg) • Groups • Overview Configuration • Loop Callup Keys • Unit Configuration • Console Configuration • Graphics Character Set • Message Pairs • Loop Tuning Configuration • PeerWay Overview • Display Button Configuration • Plant Status • Plant Unit Configuration • Alarm/Event Configuration • Area Name Configuration • Color Configuration • Material History Configuration • Trend File Configuration • Find/Filter/Format/Sort Configuration • Trend Group Configuration • Batch Configuration
7	Action: Response: Comments:	Cursor to the “Press <ENTER> to Begin” field, and press [ENTER]. While the operation is in progress this field reads: Disk Operation in Progress The operation is complete when the “Press <ENTER> to Begin” field reappears.

* For additional information, see DT: 2-3.

Table A.3. Disk and Tape Procedure 3-5: Disk Load Controller

Step	Operation	Description
1	Action: Response:	**WARNING** **The Disk Load Controller activity may affect the plant control scheme.** Call up the Disk Directory PeerWay screen by typing: **DDP** [ENTER] The Disk Directory PeerWay screen appears.
2	Action: Response:	Cursor to the disk volume name or location containing the plant configuration, and press [SELECT]. The Disk Directory screen appears.
3	Action: Response:	Cursor to the Plant Configuration folder name, and press [SELECT]. The Plant Config Directory screen appears.
4	Action: Response:	Cursor to the name of the file containing the data to be loaded, and press [ENTER]. The Disk Activity screen appears.
5	Action: Response:	Cursor to the “Operation” field on the Disk Activity screen. Press the [NEXT OPTION] key repeatedly until the following message appears above the “Operation” field: Disk Load Cont Press [ENTER]. The “Disk Load Cont” message appears in the “Operation” field.
6	Action: Response: Comments:	Cursor to the “Address Range” field. Enter the address range of the node(s) to which the configuration is to be loaded. For example, 1,16 specifies that the configuration is loaded into nodes 1 through 16. Press [ENTER]. The node address range appears in the “Address Range” field. **NOTE:** The default range is 1 through 32 (all addresses on the PeerWay). If you need to change the node range to a value higher than 32, you must first change the name in the “Source File” field and then a prompt will appear in the “Node Range” field.
7	Action: Response: Comments:	Cursor to the “Press <ENTER> to Begin” field and press [ENTER]. While the operation is in progress this field reads: Operation in Progress The operation is complete when the “Press <ENTER> to begin” field reappears. The operation may take several minutes to complete, depending on the amount of data to be loaded.

* For additional information, see DT: 2-3.

Table A.4. Disk and Tape Procedure 4-1: Disk Console Save

Step	Operation	Description
1	Action: Response:	Call up the Disk Directory PeerWay screen by typing: **DDP** [ENTER] The Disk Directory PeerWay screen appears.
2	Action: Response:	Cursor to the disk volume name or location containing the console configuration, and press [SELECT]. The Disk Directory screen appears.
3	Action: Response:	Cursor to the Console Configuration folder name, and press [SELECT]. The Console Config Directory screen appears.
4	Action: Response:	Cursor to the name of the file to which the configuration is to be saved (or if saving to a new file, highlight any file name), and press [ENTER]. The Disk Activity screen appears.
5	Action: Response:	Cursor to the “Operation” field on the Disk Activity screen. Press the [NEXT OPTION] button repeatedly until the following message appears above the “Operation” field: Disk Console Save Press [ENTER]. The “Disk Console Save” message appears in the “Operation” field.
6	Action: Response:	To save the configuration to a new file, cursor to the “Source File” field. Type the name of the new file to which the data is to be saved, and press [ENTER]. The new name replaces the existing file name in the “Source File” field.

* For additional information, see DT: 2-4.

Table A.5. Disk and Tape Procedure 7-1: Restore Tape Files to Disk

Step	Operation	Description
1	Action:	See the Tape Load operation (Procedure 1–7) to load the tape containing the folder or hard disk files to be restored.
2	Action: Response:	Call up the Disk Directory PeerWay screen by typing: **DDP** [ENTER] The Disk Directory PeerWay screen appears.
3	Action: Response:	Cursor to the name of the tape or location containing the files, and press [ENTER]. The Disk Activity screen appears.
4	Action: Response: Comments:	Cursor to the “Operation” field on the Disk Activity screen. Press the [NEXT OPTION] key repeatedly until the following message appears above the “Operation” field: Restore Tape Files to Disk Press [ENTER]. The “Restore Tape Files to Disk” message appears in the “Operation” field. **NOTE:** If a file of the same name and folder type already exists on the disk, the file is not replaced by the file on the tape.
5	Action: Response: Comments:	Cursor to the “Folder Type” field. Press the [NEXT OPTION] key repeatedly until the name of the folder type to be restored appears above the “Folder Type” field. Press [ENTER]. The folder or name(s) to be restored appears in the Folder Type field. **NOTE:** “All” is the default condition.The Folder Type options are:AllReport ConfigurationRBL FilesPlant ConfigurationReportsLog FilesPlant ProgramProcess GraphicsBatch TasksTrend DataProcess SymbolsSRU ConfigurationConsole Program FilePeerway I/F ConfigurationSRU DataConsole ConfigurationPeerway I/F ProgramABC Data
6	Action: Response:	Cursor to the “Destination Disk” field. Enter the disk name (or node number:drive number) to which the files or folder are to be restored, and press [ENTER]. The destination disk name appears in the “Destination Disk” field.
7	Action: Response: Comments:	Cursor to the “Press <ENTER> to Begin” field, and press [ENTER]. While the operation is in progress this field reads: Tape Operation in Progress The operation is complete when the “Press <ENTER> to Begin” field reappears. The operation takes several minutes to complete.

* For additional information, see DT: 2-7.

Table A.6. Disk and Tape Procedure 7-2: Disk File Restore from Tape

Step	Operation	Description
1	Action:	See the Tape Load operation (Procedure 1–7) to load the tape containing the file(s) to be restored.
2	Action:	If the file(s) are being restored to a floppy disk, insert the floppy disk to which the file(s) is to be restored, and latch the door of the disk drive.
3	Action: Response:	Call up the Disk Directory PeerWay screen by typing: **DDP** [ENTER] The Disk Directory PeerWay screen appears.
4	Action: Response:	Cursor to the tape name or location containing the disk file, and press [SELECT]. The Tape Directory screen appears.
5	Action: Response:	Cursor to the name of the file to be restored, and press [ENTER]. The Disk Activity screen appears.
6	Action: Response:	Cursor to the “Operation” field on the DISK ACTIVITY screen. Press the [NEXT OPTION] key repeatedly until the following message appears above the “Operation” field: Disk File Restore from Tape Press [ENTER]. The “Disk File Restore from Tape” message appears in the “Operation” field.
7	Action: Response:	Cursor to the “Destination Disk” field. Enter the disk name (or node number:drive number) to which the file is to be restored, and press [ENTER]. The destination disk name appears in the “Destination Disk” field.
8	Action: Response:	Cursor to the “Destination File” field. Enter the file name to which the file is to be restored, and press [ENTER]. The destination file name appears in the “Destination File” field.
9	Action: Response: Comments:	Cursor to the “Press <ENTER> to Begin” field, and press [ENTER]. While the operation is in progress this field reads: Disk Operation in Progress The operation is complete when the “Press <ENTER> to Begin” field reappears. The operation takes several minutes to complete.

* For additional information, see DT: 2-7.

Appendix B:
Configuration Worksheet

This section contains worksheets for use in configuring a Digital Blending package.

NOTE: The worksheets in Tables B-5, B-6, and B-7 are to be used for multiple streams even though only one worksheet of each type is provided here; therefore, you should make the required number of copies of all worksheets in this section before you start defining your configuration.

Table B.1. Master Blocks, 24-Stream Package

Block	Input	Stream	Range	Comments
M1-5	B	1		All ranges must have same units. See “Master Blocks 5 and 6” section.
	D	2		
	F	3		
	H	4		
	J	5		
	L	6		
	N	7		
				=Summation of ranges
M1-6	C	8		See “Master Blocks 5 and 6” section.
	E	9		
	G	10		
	I	11		
	K	12		
	M	13		
				=Summation of ranges
M1-7	C	14		See “Master Block 7” section.
	E	15		
	G	16		
	I	17		
	K	18		
	M	19		
				=Summation of ranges

Table B.1. Master Blocks, 24-Stream Package(continued)

Block	Input	Stream	Range	Comments
M1-8	C	20		See “Master Block 8” section.
	E	21		
	G	22		
	I	23		
	K	24		
				=Summation of ranges
	O	Max. Setpoint		
M1-9	F	Meter		See “Master Block 9” section.
	G	Meter Range		
	J			Summation of stream meters
	L	Time		Ramp up. See “Master Block 9.”
	M	Time		Ramp down. See “Master Block 9.”
	N	Flow Rate		Hold/min flow rate
	O	Time Conv.		7200=hrs, 120=mins, 2 =secs Scan time=.5 seconds
Trend	A	RateSclr		Should be 1.5 to 2.5 times the maximum setpoint value (M1-8/O); this value should then be used as the Eng Max of B & C.

Table B.2. Master Blocks, 16-Stream Package

Block	Input	Stream	Range	Comments
M1-5	B	1		All ranges must have same units. See “Master Blocks 5 and 6” section.
	D	2		
	F	3		
	H	4		
	J	5		
	L	6		
	N	7		
				=Summation of ranges
M1-6	C	8		See “Master Blocks 5 and 6” section.
	E	9		
	G	10		
	I	11		
	K	12		
	M	13		
				=Summation of ranges
M1-8	C	14		See “Master Block 8” section.
	E	15		
	G	16		
				=Summation of ranges
	H	RateSclr		Should be 1.5 to 2.5 times the maximum setpoint value (M1-8/O); this value should then be used as the Eng Max for links J & K.
	O	Max. Setpoint		

Table B.2. Master Blocks, 16-Stream Package(continued)

Block	Input	Stream	Range	Comments
M1-9	F	Meter		See “Master Block 9” section.
	G	Meter Range		
	J			Summation of stream meters
	L	Time		Ramp up. See “Master Block 9.”
	M	Time		Ramp down. See “Master Block 9.”
	N	Flow Rate		Hold/min flow rate
	O	Time Conv.		7200=hrs, 120=mins, 2 =secs Scan time=.5 seconds

Table B.3. Master Blocks, 8-Stream Package

Block	Input	Stream	Range	Comments
M1-5	B	1		All ranges must have same units. See “Master Blocks 5 and 6” section.
	D	2		
	F	3		
	H	4		
	J	5		
	L	6		
	N	7		
				=Summation of ranges
M1-6	C	8		See “Master Blocks 5 and 6” section.
	E	9		
	G	10		
	I	11		
	K	12		
	M	13		
				=Summation of ranges
M1-8	C	14		See “Master Block 8” section.
	E	15		
	G	16		
	I	Spare		
	K	Spare		
				=Summation of ranges
	H	RateSclr		Should be 1.5 to 2.5 times the maximum setpoint value (M1-8/O); this value should then be used as the Eng Max for links J & K.
	O	Max. Setpoint		

Table B.3. Master Blocks, 8-Stream Package(continued)

Block	Input	Stream	Range	Comments
M1-9	F	Meter		See “Master Block 9” section.
	G	Meter Range		
	J			Summation of stream meters
	L	Time		Ramp up. See “Master Block 9.”
	M	Time		Ramp down. See “Master Block 9.”
	N	Flow Rate		Hold/min flow rate
	O	Time Conv.		7200=hrs, 120=mins, 2 =secs Scan time=.5 seconds

Table B.4. Master Blocks, 6-Stream Package

Block	Input	Stream	Range	Comments
M1-7	B	1		All ranges must have same units. See “Master Block 7” section.
	D	2		
	F	3		
	H	4		
	J	5		
	L	6		
				=Summation of ranges
M1-8	C	Spare		See “Master Block 8” section.
	E	Spare		
	G	Spare		
	I	Spare		
	K	Spare		
		Spare		=Summation of ranges
	H	RateSclr		Should be 1.5 to 2.5 times the maximum setpoint value (M1-8/O); this value should then be used as the Eng Max for links J & K.
	O	Max. Setpoint		
M1-9	F	Meter		See “Master Block 9” section.
	G	Meter Range		
	J			Summation of stream meters
	L	Time		Ramp up. See “Master Block 9.”
	M	Time		Ramp down. See “Master Block 9.”
	N	Flow Rate		Hold/min flow rate
	O	Time Conv.		7200=hrs, 120=mins, 2 =secs Scan time=.5 seconds

Table B.5. Stream Configuration Sheet: Bx-CALC*

Tag Number: ____________________________

Input	Description	Range	Comments
A	Meter #1	**Range** **Units**	See "Dual Flow Meter Installation" section.
B	Meter #2	**Range** **Units**	
C	Crossover Value		
E	Reference Temperature		See "Automatic Temperature Compensation" section.
F	Coefficient of Expansion		
G	Temp Tx	**Range** **Units**	
J	Operator Input		Used in place of temperature compensation. See "Automatic Temperature Compensation" section.
K	Operator Input		Stream's percentage of product.
L	Analyser Controller		See "Analyser Controller" section.
M	Operator Input	**Analyser gain**	See "Analyser Controller" section.

* Use one worksheet for each blend stream.

Table B.6. Stream Configuration Sheet: Bx-CALC*

Tag Number: ______________________________

Input	Description	Range	Comments
RS	Conversion Factor		See “PI Controller (Bx–CTRL)” section.
K	Valve Pace Limit		Max valve position; initiates pacing.
M	Crossover Value Demand Rate Scale		See MI–9/J Units:
N	Flow Meter Range		See Bx–CALC/D Units:
O	Time/Scan Conversion		7200=hrs, 120=mins, 2 =secs Scan time .5 seconds
Alarm Limits			
I	Hi Adv Lo Adv	Hi Crit Lo Crit	Flow rate alarms
L	Hi Adv Lo Adv	Hi Crit Lo Crit	Deviation of measured from demand accumulated flow.

* Use one worksheet for each blend stream,

Table B.7. Stream Configuration Sheet: ADD-CTRL

Input	Description	Range	Comments
D	Conversion Factor		See “PI Controller (Bx–CTRL)” section.
B	Flow Meter Range		Volume of one stroke Units:
C	Time/Scan Conversion		7200=hrs, 120=mins, 2 =secs Scan time=.5 seconds
Alarm Limits			
J	Hi Adv Lo Adv	Hi Crit Lo Crit	Flow rate alarms; high alarm starts pace back.
A	Hi Adv Lo Adv	Hi Crit Lo Crit	Deviation of measured from demand accumulated flow.

* Use one worksheet for each pulse additive stream.

Appendix C:
List of Acronyms

A

ATC — **Automatic Temperature Compensation**

B

BAO — **Block Automatic Output**
Output of the stream as calculated by the PI stream algorithm. If the controller processor is in Auto, the value is copied to the manual output.

BCE — **Block ATC Coefficient of Expansion**
Coefficient of expansion in percentage/°F or percentage/°C that is applied to the automatic temperature compensation algorithm when ATC is active.

BCF — **Block Compensation Factor**
Factor used to multiply the measured input in order to calculate the totalized measurement and the measured flow rate. Depending on the application this factor might be percent nonfat, percent butterfat, specific gravity, percent brix, or another type of unit.

BCR — **Block Compensated Ratio**

BDCF — **Block Demand Conversion Factor**

BDFR — **Block Demand Flow Rate**
Additive demand rate

BDFS — **Block Demand Flow Span**
Factor that represents the full scale flow rate of the demand signal for this block and the block scan time.

BDQ — **Block Demand Quantity**

BDR — **Block Demand Rate**
Demand rate to the stream algorithm for the application.

BDTQ	**Block Demand Totalized Quantity** Integrated total of demand pulses calculated by the algorithm.
BDTU	**Block Demand Time Units** Time-base conversion factor
BEGU	**Block Engineering Units**
BET	**Block Error Total**
BFB	**Block Feedback Trim** A value between 0 and 100 percent or between 0 and 1 that compensates for the pecentage of an additive by adjusting the *BRO* to derive the *BCR* used by a stream. It allows for an analyzer trimmed ratio value for an analytically measured or inferred value of an additive.
BFG	**Block Feedback Gain**
BHEA	**Block Hystorisis Error Alarms**
BHFA	**Block Hystorisis Flow Alarms**
BHSD	**Block Hystorisis Error Shutdowns**
BMFHA	**Block Measured Flow High Alarm** Value, in engineering units, at which the stream generates the high flow alarm flag if the value of measured quantity flow rate exceeds the alarm setting. Configured as an advisory high alarm for continuous input register L of the PI ControlBlock for a stream.
BMFLA	**Block Measured Flow Low Alarm** Value, in engineering units, at which the stream generates the low flow alarm flag if the flow rate is less than the measured output. Configured as an advisory low alarm for continuous input register L of the PI ControlBlock for a stream.
BMFR	**Block Measured Flow Rate** Measured flow rate, in engineering units, of a specific stream. Linked to the master and included in the master calculated total blend flow rate.
BMFS	**Block Measured Flow Span** Full scale flow rate of a stream used by the master to scale the *BMFR* of a specific stream.

BMIP	**Block Metered Input Pulses or Pulse Counter**
BMK	**Block Meter K Factor**
BMO	**Block Manual Output**
BMR	**Block Measured Rate**
BMQ	**Block Measured Quantity**
BMSEL	**Block Meter Select**
BMT	**Block Temperature Compensator Measured Temperature** Value input to the ATC algorithm for automatic temperature compensation.
BMTIQ	**Block Measured Totalized Inventory Quantity**
BMTQ	**Block Measured Total Quantity** Measured total quantity of a specific stream. Linked to the master and included in the master calculated total blend.
BMTU	**Block Measurement Time Units**
BNA	**Block Negative Error Alarm** Value, in engineering units, that sets the minus error flag when the accumulated error between demand and measurement is negative. Configured as an advisory low alarm for continuous input register L of the PI ControlBlock for a stream.
BNET	**Block Normalized Error Total**
BNF	**Block Normalization Factor** Factor applied to the demand signal so that the demand quantity is in the same engineering units as the measurement.
BNSD	**Block Negative Error Shutdown** Value, in engineering units, that sets the minus error flag when the accumulated error between demand and measurement is negative. Configured as an advisory low alarm for continuous input register L of the PI ControlBlock for a stream.

BO — **Block Output to Manipulated Variable**

BOMAX — **Block Output Maximum Clamp**

BOMIN — **Block Output Minimum Clamp**

BOPL — **Block Output Pace Limit**
Percentage value that the output variable is checked against to generate the pace back output flag. This output limit can be a constant, a pointer, or a calculated variable.

BPA — **Block Positive Error Alarm**
Value, in engineering units, that sets the plus alarm error flag when the accumulated error between demand and measurement is positive. Configured as an advisory high alarm on continuous input register L of the PI ControlBlock.

BPSD — **Block Positive Error Shutdown**
Value, in engineering units, that sets the plus shutdown flag when the accumulated error between demand and measurement is positive. Configured as a critical high alarm on continuous input register L of the PI ControlBlock.

BRO — **Block Operator-Entered Ratio Factor**
Operator-entered factor, between 0 and 100 percent, that is used by the algorithm to compute the quantity demand for the stream. This factor is linked to the master so that it is included in the master total ratio.

BST — **Block Sample Time in Seconds**

M

MCFR — **Master Calculated Flow Rate**

MDFS — **Master Demand Full Scale**
Range in engineering units of the measured flow of the total blend *MMFS*.

MDHR — **Master Demand Hold Rate**
Percent of the demand rate at which the digital blending stops the rampdown at the end of the blend time or between the time preactivation was reached and the total blend quantity was achieved.

MDQ	**Master Demand Quantity**
MDR	**Master Demand Rate** Rate of blend demanded by the master of all component streams for the total overall product rate.
MDTQ	**Master Demand Totalized Quantity** Total demand quantity, in engineering units, calculated by the master when the master blend is active. This is a free-running total and is cleared to 0 at the reset time either by the operator or by a supervisory program. This demand total is used by the master alarm logic to generate the rampdown signal at the preset time and to generate the end batch signal.
MDTU	**Master Demand Time Units** Manually-calculated demand rate in scans/second units (with the units in seconds). Entered during configuration.
MEGU	**Master Engineering Units**
MMCF	**Master Measured Compensation Factor**
MMFLA	**Master Measured Flow High Alarm Setpoint**
MMFR	**Master Measured Flow Rate** Totalization of all of the BMFRs that are a part of the total blend.
MMFS	**Master Measured Flow Scale** Full scale flow range of the digital blending total meter.
MMIP	**Master Metered Input Pulses** Used for the measured total of the master when an external meter is used for the blend total.
MMK	**Master Measured Meter K**
MMQ	**Master Measured Quantity**
MMR	**Master Measured Rate**
MMTIQ	**Master Measured Totalized Inventory** A free-running totalizer that is not reset by the reset pulse of the master. Available to the operator as a block variable for display purposes, or to be read or cleared by other supervisory batch programs.

MMTQ — **Master Measured Totalized Quantity**
Integrated total quantity of either the calculated total flow or the metered total flow, depending on whether the total meter is enabled. This total can be reset at the master demand reset time by the master demand logic input by either the operator or batch programs.

MMTU — **Master Measured Time Units**

MRMAX — **Master Rate Max**

MRSP — **Master Rate Setpoint**
Rate of total blend at which the master operates when the blend is activated and the ramp function is not active.

MST — **Master Scan Time**

N

NBMFR — **Normalized Block Metered Flow Rate**
Calculation of the measured flow rate in engineering units.

P

PBCR — **Pulse Block Compensated Ratio**

PBDR — **Pulse Block Demand Rate**

PBDTU — **Pulse Block Demand Time Units**

PBK — **Pulse Block K Factor in EGU/pulse**

PBNF — **Pulse Block Totalized Quantity**

PBOP — **Pulse Block Output Pulses**

PBP — **Pulse Block Pulse**

PBPA — **Pulse Block Pulse Accumulator**

PBST — **Pulse Block Scan Time**

PVSD — **Pre-shutdown Valve**
Number of engineering units prior to batch completion at which digital blending initiates the rampdown function. Can be a constant, a pointer, or a variable.

R

RDT — **Rampdown Time**
Number of block scans, in seconds, that it takes the master to ramp the demand rate from the demand at the time of the rampdown stop or when the preset time was reached.

RTC — **Reference Temperature for ATC**

RUT — **Rampup Time**
Number of block scans, in seconds, that it takes the master to ramp the demand rate from 0 to the operator-entered value or to the remote set rate of blend.

T

TBRO — **Total Block Ratio**

TOTBS — **Total Batch Size Setpoint**
Target quantity, in engineering units, at which the normal blend is stopped and the end blend batch size flag is set to on.

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