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INTRODUCTION

MANUAL CONVENTIONS

Important points

NOTE: Any additional information that may be useful follows the note marker.

CAUTION: Be careful, certain settings may cause problems.

WARNING: FOLLOW THE DIRECTIONS PRESCRIBED IN THE WARNING. SERIOUS PROBLEMS CAN OCCUR IF THE RECOMMENDATIONS ARE NOT FOLLOWED.

Buttons

Button graphics will be shown to the right of the corresponding information regarding the function for the button.

Screens

A graphic of this size and type will show the functions and/or information available in many of the different screens.

SAFETY

The Merrick MC³ Controller is used for the control of process weighing equipment. As such, it is normally responsible for the control of a process and is not intended as a motor control device. To insure personnel safety please read the following instructions and precautions carefully.

In General

Observe all standard precautions that pertain to moving machinery.

Observe all standard precautions that pertain to electrical drives and electrical controls.

Pay particular attentions to special notes and precautions that appear throughout this manual.

Please read and become familiar with this entire manual before attempting service or repair of the Merrick MC³ Controller. If you have any questions or problems, please call the Merrick Customer Support Department for assistance.

Electrical Precautions

Before undertaking work on the electrical system, the drives, or the Controller, from the main-disconnect switches and lock boxes insure power is disconnected. Work should never be performed on the Controller with power on the unit. It is recommended to disconnect the power from the controller before attempting any service procedure.
Verify that all grounds called for on the wiring diagrams are in place and are securely connected. Proper grounding not only helps insure your personal safety, but is also necessary for the proper operation of the controller.

If it is necessary to work in or near areas of live high voltage, always keep one hand clear of the machine, the cabinet, or any other conductors to avoid the possibility of electrical shock traveling across your chest. NEVER undertake any electrical work in areas with wet or flooded standing areas.

NEVER impair or disable the function of a fuse or a circuit breaker.

CAUTION: IF PERSONNEL ARE IN DOUBT ABOUT ANY PROCEDURE CONTACT THE MERRICK CUSTOMER SUPPORT DEPARTMENT.

SOLVING PROBLEMS

Several methods are available for assistance in solving problems. The application contains help buttons providing text explanations of the current selected function or parameter. Also included in this manual is a troubleshooting section to assist in solving technical problems (Diagnosing Problems section on page 91 or SOLVING PROBLEMS section on page 101).

Technical Support

Merrick provides customer technical and spare part support 24 hours a day, seven days a week. Our normal business hours are Monday through Friday 7:30 AM until 4:30 PM Central Standard Time. During normal hours call 1-888 MERRICK (637-7425) and ask for service. The call will be routed to the next available phone support technician.

After normal hours and on holidays and weekends, technical assistance is available by calling 1-888 MERRICK extension 7878. Follow the instructions and be sure to enter the area code and the phone extension where you can be reached. Someone will return your call as soon as possible.

When you call Merrick for Technical Support, please have your machine serial number or a controller serial number. This information will better help us to serve you.
SYSTEM CONCEPTS

The MC³ 20.20.EX is designed to be a complete belt feeder controller. It can control almost any conceivable belt weigher or feeder application from the very simple to the very complex. Examples are:

- Belt Scales (also known as Wild Flow Weighers). This is the simplest application of the MC³ 20.20, as it involves only the weighing of material as it is transported by the belt. There is no direct control of the feedrate of the material only an accounting for what passes by. Belts for these types of applications can range from only a few feet long to several hundred or thousand feet long.

- Basic Belt Feeder. This is the simplest of the control functions for the MC³ 20.20 and yet represents the core ability of the controller. In this application, the material is also weighed as it is transported, but is also controlled by means of adjusting the speed of the belt to achieve the desired rate (ie. the Setpoint). A typical PID (Proportional-Integral-Derivative) algorithm is used to continuously control the rate.

- A Batching Belt Feeder. This is the second most widely used application of the MC³ 20.20. In this application the feeder is not necessarily arranged to control the rate of the discharge, but rather the amount. In other words, it is designed to deliver accurate “batches” of material according to the Batch Setpoint. There are two modes of Batching available with this controller, “Empty Belt” and Stop Belt”. During Empty Belt batching the introduction of material to the Belt Feeder is started and stopped by means of the controller and a pre-feed device, and the belt will be empty before a batch starts and after it is complete. The pre-feed device can be as simple as a valve, or another feeding device such as a rotary feeder, screw feeder or even another belt feeder. Because the belt is empty at the beginning and end of the batch, it is possible to weigh exactly the amount of material discharged in each batch, and therefore this method is very accurate.

During Stop Belt batching, the belt is stopped at the completion of each batch, generally while material is still on the belt. The next batch can then be initiated very quickly and this is therefore the quicker of the two methods. Positional translation algorithms are used during this type of batching so that a very high degree of batch accuracy can still be maintained.

- Belt Feeder with Pre-Feeder. A pre-feeder can be used in conjunction with a belt feeder to help control the rate of discharge. There are several reasons why a pre-feeder might be beneficial. The material being controlled may be floodable, and require a device to keep it from flushing through the belt feeder in an un-controllable manner. Or, the material may be clumpy, fibrous, sticky or for some other reason difficult to shear and may have to be conditioned in some way before it can be weighed on the belt. Similarly to the Batching Belt Feeder above, the pre-feed device could be any feeding device such as a rotary feeder, screw feeder or even another belt feeder.

There are again two modes of operation with a pre-feeder, one where the pre-feeder controls the rate with feedback from the belt feeder, or one where the belt load is maintained by the pre-feeder, and rate is controlled in a second control loop by the belt feeder. The MC³ 20.20 handles both control loops automatically. An advantage of this second method is that by controlling the belt load and the discharge rate independently, frequently the overall turndown (operating range) of the belt feeder can be greatly extended.

- Belt Feeder with Instream Calibration. The purpose of Instream Calibration is to allow calibration of the Belt Feeder while in operation. It requires a bin arranged above the feeder, mounted on load cells and at least one controllable gate (valve) between bin and feeder.
The MC³ 20.20 controller utilizes a second PCAD (load cell analog to digital converter) board attached to load cells supporting an Instream bin. The controller can then compare the weight lost from the bin to an amount totalized by the Belt Feeder. The controller then displays the difference and allows the user to accept or reject the results. This is a very accurate means of calibrating the feeder, as it uses actual material conveyed as the test.

There are two Instream Calibration procedures available, Auto Cal and Instream Cal.

1. Auto Cal - This method is performed in the background every time the Instream Bin Gate is closed then opened. When the gate is initially closed, a settling time occurs. After the settling time expires the weight in the surge bin is noted. An amount of weight is allowed to flow from the surge bin through the feeder. When the gate is opened, the weight is immediately noted. The weight discharged in the hopper and the amount fed through the feeder is compared. A percentage of difference is calculated. All the operator has to do is to open the menu and verify that the change is acceptable.

2. Instream Cal - This method involves notification and feedback from an external control system. An operator starts the calibration procedure on the controller. This notifies an external controlling device that the controller is about to perform a calibration. This allows the controlling system to fill the surge bin to a predetermined level. When the weight in the surge bin exceeds the upper bin weight limit set in the controller an output is enabled notifying the control system to shut down the equipment feeding the surge bin. After a pre-feed time has expired, the controller turns on a close valve output used to shut the Instream Bin Gate. When the controller detects that the gate is closed, a settling time occurs. Then the weight is recorded and the feeder discharges material until a low bin weight is achieved. The controller compares the amount of material discharged in the surge bin with the amount fed through the feeder. This percentage is displayed for the operator to accept or reject.

Any or all of the above applications can be combined as needed. For example it is perfectly plausible to have a Batching Belt Feeder, with a Pre-feeder, and Instream Calibration.

In addition, the MC³ 20.20 has the ability to accept input from a variety of optional sensors, such as:

- **Belt Tracking Switches** – one or two stage (also sometimes known as belt runoff switches). These can be used to monitor the lateral position of the belt and warn the operator if the belt miss tracks (moves off center). As a second option a two-stage switch can be used to first warn the operator if the belt is slightly miss tracked, or take more serious action (i.e. stop the feeder) if the belt miss tracks even further.

- **Material on Belt Switch.** A variety of switches (tilt, capacitance, etc.) can be arranged to detect the loss of material on the belt, for example as a result of a pluggage before the feeder. Some programmable action can be taken as a result of loss of material, ie. warn the operator, or stop the feeder.

- **Discharge Pluggage Switch.** Similar to the Material on Belt Switch except this sensor is arranged to detect a pluggage after the feeder.

- **Second Encoder.** Typically the primary encoder is mounted to a driven pulley (ie. the Tail Pulley) because slip between the belt and pulley is negligible or non-existent. However, by means of a second encoder, typically mounted to the drive motor, the ratio of the motor speed and the belt speed can be monitored. Under normal circumstances, this ratio will be constant regardless of belt speed. If any discrepancy in this ratio occurs, it would be the result of slip of the belt on the Head Pulley. By means of programmable outputs, appropriate actions can be taken if this occurs.
- Infeed Valve Limit Switches. Can be used to monitor the position of the Infeed Gate Valve.
- Infeed Flow Monitor. An input from a flow monitor (ie. the Merrick Acoustic Flow Monitor) can be sued to indicate loss of material flow in the infeed ahead of the Belt Feeder.

This is not a complete list of all available inputs. If, after reading the appropriate sections of this Manual, you cannot find an input appropriate to your needs consult Merrick Customer Support for other possibilities.

Despite the many modes of operation and the variety of external sensors supported, the MC³ 20.20 remains very simple to configure and use. Those options that are not required can be rendered invisible if they are not selected. In this way the controller and its user interface need only be as complex as your application requires.

An illustration of the above concepts and some of the typical sensor arrangements can be seen below.

**HARDWARE OVERVIEW**

All MC³ controllers share the same basic hardware, including the components shown below.
Different enclosure packages are available, such as Panel mounted, Wall mounted, and Door mounted. Each is designed for a particular application, and different environments. See the separate Hardware documentation for more information.

The MC³ Controller has been designed to control many different types of feeding, weighing and metering equipment. This allows for easier maintenance and simplified training.

The Standard Merrick MC³ 20.20.EX Controller consists of an Enclosure, an LCD Display, Card Stack and a Power Supply.

SOFTWARE OVERVIEW

The software in each MC³ controller is unique to the purpose it is designed for. This Manual details information regarding the software application MC³ 20.20, intended for use on Belt Feeders and Weighers as previously explained. Each application is unique, but similar to the other applications in the MC³ family. By use of the graphical display and touch screen User Interface, only relevant information or options are displayed, making the controller easy to learn and to operate yet capable of controlling extremely complex operations.

Another feature of the MC³ family of controllers is the wide range of connectivity to industrial networks. Most networks can be supported, such as Allen-Bradley Device Net and Control Net, Profibus, Modbus RTU, Ethernet, etc. More options are continually being added so contact Merrick Customer Support if you have a special requirement.

Application Software

Application Software is written for each specific type of “job” that the controller is to perform. This software will allow you to turn on and off different modes of operation, which allows you to configure the software for your specific process.
**Batching in the MC³ 20.20.EX controller**

The batching feature in the MC³ controller allows predetermined amounts of material to be discharged from the feeder. This may be on a single batch basis with different amounts into vessels or part of a periodic cycle on a conveyor. To enable Batching, map the *Batching* logical input to Always ON.

There are two types of batching available in this controller. Empty Belt and Stop Belt. Empty Belt batching involves opening and closing an infeed valve or starting and stopping a pre-feeding device to control the batch weight. With Stop Belt batching the controller stops the belt of the feeder/scale with material left on the belt.

Another feature that is available is Auto-Batching. This allows automatic repetition of batches. For example, if series of batches is needed to fill buckets on a conveyor and the time between buckets is 30 seconds the controller can be set to run a batch every 30 seconds without having to request each batch in the series. The *Run Permission* input can be used to start and stop an Auto-batching sequence. To enable Auto-Batching, map the *Auto Batch* logical input to Always ON.

**Pre-Feeder Operation**

There are several reasons why a Prefeeder is needed to control the flow of material into a feeder. Certain materials are “floodable” and need to be kept from spilling out of the infeed of a feeder. The process does not have material collection point at the infeed of the feeder. In another case a process may call for an even distribution of material. These are just a few of the reasons a Prefeeder is used.

A Pre-Feeder can be used in these situations to assist in controlling material flow. The device may be another belt, a screw feeder, rotary valve or some other device that controls material flow into the feeder.

![Diagram](image)

There are 3 methods this controller uses to control the pre-feeding device, Pre-Feeder Analog Output (CAT - Current Adjust Type), PAT (Position Adjust Type) utilizing positional feedback and PAT with rail limit switches.
Pre-Feeder Analog Output (CAT)

This method of output uses an analog output to control the pre-feeding device. For instance if a volumetric screw feeder is being used, the controller can use the Pre-Feeder analog output to control the speed of the screw placing material on the belt.

PAT (Position Adjust Type) utilizing positional feedback

The controller uses the Analog Feedback to adjust the pre-feeding device to the percentage calculated for the Prefeeder output. The appropriate PAT output will stay on until the Analog Positional Feedback has reached the Prefeeder output value. For instance if the calculated position should be 60.5% and the Prefeeder Positional input indicates a position of 42% the controller will turn on the **PAT Adjust UP** logical output until the feedback reaches 60% (assuming 0.5% dead band).
PAT with limit switches only

This method turns on the appropriate PAT output for an amount of time (PAT On Time) to control the pre-feeding device. When there is no positional feedback available the controller must use limit switches that are attached to the device as rail (max/min) detectors. The controller uses these rail detectors to turn off the outputs associated with the limits when reached. They are also used to reset an internal position value the controller uses for relative position reference.

**CAUTION:** It is very important to set the PAT Stroke time to the proper value. The controller uses this information to keep relative positional information of the Prefeeder.

**Load Setpoint**

The controller can allow the load to vary from a low level (Min Load SP) to a high level (Max Load SP) to increase the effective operating range. Another words it can increase the “turn down” of the feeder. The controller clamps the load setpoint between the Max Load SP and Min Load SP. For constant loading the Max/Min Load SP may be set to the same Load desired.

If the load setpoint is less than 1% of the design load the controller will set the Prefeeder output to 100%.

**Load Method**

The Pre-feeder and Belt feeder are both controlled by the Setpoint. To make the belt load reach the load setpoint, the Prefeeder is nudged in steps. This method is useful only when the feedrate Setpoint is mostly constant. Tuning is critical.

**Setpoint method**

The Prefeeder is controlled by the Setpoint. The Belt feeder speed is controlled by the feedrate Setpoint divided by the load Setpoint. With a constant feedrate Setpoint, the belt speed will also be constant. Tuning is simple and non-critical.
Instream Calibration Procedures

The purpose of the Instream calibration process is to allow calibration of the Belt Feeder controller while in production, as opposed to the Material and Grab Sample calibration procedures that require that an amount of material be removed from the production stream and weighed using external means.

The 20.20.EX controller utilizes a second HPAD (PCAD) board attached to load cells supporting an Instream bin. The unit compares the weight lost from the bin to a totalizer in the controller. The controller then displays the results and allows the user to accept or reject the findings.

The Instream Calibration procedures use the base load units as the units for weight. For example, if the load units are kg/m then the bin weight units will be kg. The Instream bin should be free floating on the load cells to insure proper weighing.

There are two Instream Calibration procedures available, Auto Cal and Instream Cal.

3. Auto Cal - This method is performed in the background every time the Instream Bin Gate is closed then opened. When the gate is initially closed, a settling time occurs. After the settling time expires the weight in the surge bin is noted. An amount of weight is allowed to flow from the surge bin through the feeder. When the gate is opened, the weight is immediately noted. The weight discharged in the hopper and the amount fed through the feeder is compared. A percentage of difference is calculated. All the operator has to do is to open the menu and verify that the change is acceptable.

4. Instream Cal - This method involves notification and feedback from an external control system. An operator starts the calibration procedure on the controller. This notifies an external controlling device that the controller is about to perform a calibration. This allows the controlling system to fill the surge bin to a predetermined level. When the weight in the surge bin exceeds the upper bin weight limit set in the controller an output is enabled notifying the control system to shut down the equipment feeding the surge bin. After a pre-feed time has expired, the controller turns on a close valve output used to shut the Instream Bin Gate. When the controller detects that the gate is closed, a settling time occurs. Then the weight is recorded and the feeder discharges material until a low bin weight is achieved. The controller compares the amount of material discharged in the surge bin with the amount fed through the feeder. This percentage is displayed for the operator to accept or reject.

**CAUTION:** With both of the procedures, the weight in the hopper must be observed to insure that the level of material does not drop below a safe operating level. The Bin Weight in the Large Font Display (NuMerrick) screen or the “Low Bin Weight” logical output may be used to determine the proper value to open the gate before the safe low point has been reached.
Instream Calibration Parameters
These parameters are available only when the HPAD Operating Mode is set to Instream. In addition, this set Stability parameters are used only for the initial calibration of the Instream Bin. The Instream Setting parameters are used by the Auto cal and the Instream Cal procedures for calibrating the Feeder.

BIOS
The BIOS is the portion of the software that directly manipulates the hardware. It is the interface between the application and the hardware.

Register Database
The Register Database is a set of variables used in the software application. It is provided to allow structured access through Serial Communications to variables used in the MC³. A numeric listing of registers for each application is available from Merrick. Procedures for using Serial Communications to access the register list are also provided in the Merrick Serial Protocol Specification.

Digital I/O Mapping

1. Physical output map stores address of logic out assigned to it.
2. Logical Input map stores the address of the Physical In assigned to it.
3. Reversing and Force Properties are mapped to the Physical layer.
4. Remote Property is mapped to the Logical layer.
The MC³ allows configuration of the digital inputs and outputs to the system's requirements. By allowing mapping of the I/O, the MC³ gives a great degree of flexibility in design of the system.

I/O mapping requires a layered approach to the design process. In the MC³, there are two layers, one is a physical layer and the other is a logical layer. The physical layer is connected to the outside world, for example relays and switches. The MC³ actually acts upon data in the logical layer, such as determining if a user should be allowed access to the custom setup menus.

The physical input layer is mapped to the logical input layer. This allows a (one) physical input to control several logical inputs. For example, a physical input can control both accesses to the custom setup menus and to the ability to accept calibration changes. The logical output layer is mapped to the physical output layer. This allows use of several physical outputs mapped to one (1) logical output to control different processes. For example, a process may need to occur due to a high feedrate and an indication that the feedrate went high in the control room is required. The MC³ can map the High Feedrate logical output to two different physical outputs allowing the process to occur and giving an indication in the control room without using extra hardware.

The inverting function acts on the physical layer of the I/O. The MC³ gives the system designer the ability to adjust the type of logic for his system. For example, one (1) logical output controlling two (2) physical outputs with one (1) positive logic and one (1) negative logic.

The MC³ also allows forcing of the physical layer I/O ON or OFF. Forcing simulates the action of switches (inputs) or relays (outputs) for an easier way to troubleshoot the system. For example, by forcing on the weight simulators the entire process can be simulated for troubleshooting your system. Alternatively, if there is no longer an alarm indication on the system console, force the output on at the MC³ and detect where the problem is occurring.

**CAUTION:** This feature is a very powerful tool that should be used with extreme care. For most installations, the default settings should be used.
GETTING STARTED

INSTALLATION
Carefully unpack the controller and inspect it for obvious damage because of shipping or handling. If the unit appears to be damaged in any way, contact the Merrick Service Department for assistance.

Insure that the power is disconnected from the power supply. Make the wiring connections to the controller, following the instructions on the electrical connection diagram. In order to maintain the weatherproof integrity of the Wall Mount enclosure, liquid-tight conduit and conduit connectors must be used when running the wires. It is recommended to penetrate the enclosure from the bottom. This will insure a watertight environment for the electronics.

Verify all wiring connections before applying power to the controller.

NOTE: Before any deviation from the supplied wiring diagrams, Merrick must first be consulted to insure safe and proper operation of the controller. See Technical Support on page 2 for contacting the Merrick Customer Support Department.

STARTING THE CONTROLLER
Before initially using the controller, you should go through the following steps

Check all your wiring. At a minimum, the load cells and Power must be connected for the controller to operate. Normally, a connection diagram is supplied.

Apply power to the controller. During power up several start up operations are being performed. This sequence takes approximately twenty seconds. The start up screen counts down the time remaining during the start up sequence. Check for any error messages during the power-up sequence.

Check the Calibration settings. Normally, a specification sheet is supplied. Read more about how to set the “Calibration " on page 23.

Run a Speed Span procedure. Refer to “Speed Calibration “ on page 74 for more information.

Run a Zero procedure. See “Zeroing Procedure” on page 75.

Run a Material, Chain, Weight or an Electrical Calibration. See “Material Test” (page 76), "Chain Procedure” (page 77), “Weight Procedure” (page 78) or “Electronic Calibration” (page 80) for the method for performing the calibration procedures.

Set the Limit Switch values for the application. See “Limit Switch” on page 65.

Record all essential parameters for your reference. Use a copy of the specification sheet.

Change the Calibration, Diagnostic and Setup passwords to protect your settings.

PREFEEDER OPERATION
To enable the Pre-Feeder, turn on the _Prefeeder_ logical input.

The Main Feeder screen will display PF: (output percentage, PAT Up or PAT Down as indications of the state of the Prefeeder. Access to the Pre-Feeder parameters is available using the "Prefeeder: Params" button in the Settings Menu.
Upon initial power up of the controller, the logical output **PAT Adjust Down** will be turned on for a period time equaling the **PAT Stroke Tm** and the **Prefd Delay**.

If the controller is not running the feeder (Any state other than AUTO RUNNING), the **PAT Adjust Down** output is turned on until the PAT Closed logical input turns on.

If the Load Setpoint or the feedrate setpoint is zero the controller sets the pre-feeder output to 0.

When starting the feeder, the controller waits the Start Delay (page 51) before testing and then adjusting the Prefd Factor (page 52). After the startup time has expired the controller then will start the standard sampling rate.

The Prefeeder machine will operate in cooperation with the batching machine. If the Batch type is Stopped belt batching the controller will use the maneuvering machine to start and stop the belt. When Empty belt botching is enabled the controller will start and stop the Prefeeder determined by the batch setpoint.

The re-sampling of the load and adjustments are performed after the Prefd Delay (page 51) has expired and the Infeed LdCell (page 43) has been traversed. This allows the controller to test the adjustment made to the Pre-Feeder. The time it takes for the material to move from the Prefeeder to the infeed needs to be measured in seconds. The length from the Infeed to the Load cell is then measured and entered into the controller. The length is converted to pulses that the controller uses to adjust the amount of time it takes the material to move from the infeed to the load cell based on the belt speed. This means that the time for the controller to resample will vary based on the belt speed.

If the feedrate is above 1% of the design feedrate the controller calculates a factor based on the current Prefeeder output, feedrate and design feedrate. If the 0-Ld 1-SetP switch is set to Load the controller then will increment or decrement the new value and test to see if it is within allowed
limits. If setpoint is used the controller uses the new value and makes adjustments to the drive speed.

When ready the controller samples the load and makes adjustment to the pre-feed factor. If the load is found to be within the dead band area around the load setpoint the controller will not make a step change to the pre-feed factor. The controller will then adjust the Pre-feeder output based on the Feedrate Setpoint and the Pre-Feed Factor.

If PAT is used the controller looks to see if there is positional feedback available. This is accomplished by looking at the analog input mapping for Pre-Feeder Positional Feedback. If there is positional feedback the controller turns on the one of the PAT outputs to adjust to the Pre-feeder output value.

If the analog input mapping is set to Always Zero, the controller assumes there is no positional feedback and will perform adjustments based on the PAT Stroke Tm. The controller uses the PAT stroke time to determine where it is. The controller tests the PAT Full Open and PAT Closed inputs to turn off the output when the mechanical limit has been reached and resets an internal value.

When stopping the feeder with the Prefeeder enabled the controller waits in the STOPPING state until the Prefeeder has stopped (Prefeeder analog position < 0.05 or the PAT Closed logical input is turned on). The controller will then wait the Prefd Delay time before being allowed to start for.

**BATCH CONTROL**

**Empty Belt Batching**

When this method of batching is used, the controller assumes that the belt is at a speed and the controller has control of a Batch Control Device (BCD). When a Start Batch command is given, by touching the screen or by enabling the Start Batch input, the controller enables the "Open Gate" logical output. This output is used to open a gate or to start a pre-feed device. When the Batch setpoint plus the preact (normally a negative number) is reached, the output is turned off. This should close the infeed gate or stop the feeding device.

**Setting up the Controller for Empty Belt Batching**

1. The controller must be connected to a device that controls the flow of material onto the belt. This may be a valve, pre-feeder or even another belt. The logical output BCD On is used to start and stop the valve.

2. Set the Batch Type (page 49) to 0. This will setup the controller to use the Empty Belt Batching method.

3. Set the Prefd Delay (page 51) to the time needed for the material to move from the BCD to the belt at the feeder infeed. Measure and enter into the controller the length from the Infeed to the Load cell into the Infeed LdCell (page 43) parameter. Measure the length from the Load Cell to the Head Pulley and enter into the HdPly LdCell (page 43) parameter. This will insure that all material will be added to the batch.
4. The controller will adjust the **Curr Preact** (page 49) based on the amount of material from BCD to the load cell. Initially the Preact adjustment parameters, **Preact Limit**, **Pre Max Chang**, and **Preact Apply**, should be relatively wide. This will allow the controller to quickly move toward a good Preact value. After a couple of batches the Preact adjustment parameters should be tightened. This keeps the controller from making wild swings to the Preact based on disturbances that may occur.

**Stop Belt Batching**

This method will start and stop the belt to control batching. When a start batch request is given, the controller starts the belt and will run until the Batch setpoint plus the preact (normally a negative number) is reached. The controller then stops the belt.

**Setting up the Controller for Stop Belt Batching**

1. Set the Batch Type (page 49) to 1 for Stop Belt Batching.

2. Measure the length from the Load cell to the head pulley. Enter the value into the **HdPly LdCell** (page 43) in the Belt menu.

3. Adjust the number of Head Slots (page 42) in the Belt menu for a proper amount. Set the **B Slot Index** (page 50) to the same number as the number of Load Slots. This informs the controller to pick the load value from the slot that is currently falling off the belt.

4. Set the **Prefd Delay** (page 51) to the time needed for the material to drop from the batch controlling device to the belt at the feeder infeed. Measure and enter into the controller the length from the Infeed to the Load cell into the **Infeed LdCell** (page 43) parameter. Measure the length from the Load Cell to the Head Pulley and enter into the **HdPly LdCell** (page 43) parameter. This will insure that all material will be added to the batch.

5. The controller will adjust the **Curr Preact** (page 49) based on the amount of material from controlling device to the load cell. Initially the Preact adjustment parameters, **Preact Limit**, **Pre Max Chang**, and **Preact Apply**, should be relatively wide. This will allow the controller to quickly move toward a good Preact value. After a couple of batches the Preact adjustment parameters should be tightened. This keeps the controller from making wild swings to the Preact based on disturbances that may occur.
SYSTEM CONTROL

MAIN SCREENS

The button is used to change between the Feeder Screen, Trend Screen and a Numeric Display.

Feeder Screen

The first main screen in the 20.20.EX Controller is the Feeder Screen. This screen displays the current running statistics of the controller. It also allows you to enter into sub menus for setting the controller parameters, perform calibration and other functions. There is a text string available for you to enter text to assist in identifying the controller.

MERRICK

LOGO

This screen displays the address and phone number for Merrick. It also shows the revision for the software that is currently in operation. The build date is important when you need service on your controller.

INDICATORS

There are indicators that are used by the software to provide you with a visual indication of the current operating state of the feeder.

Ztrk

This indicates that the Zero Track function is currently running. See Zero Tracking Settings on page 40 for more information.
Auto
This condition indicates that the controller is running in feedrate control. This indicator will toggle between Auto and Manual based on the type of control desired. The indicator directly below the Auto indicator is the current feeder state. The states of Auto mode shown in the table below may be displayed. See Feeder Control on page 22 for more information.

<table>
<thead>
<tr>
<th>Restart</th>
<th>Running</th>
<th>Stopping</th>
<th>Stopped</th>
<th>Tripped</th>
<th>Blocked</th>
</tr>
</thead>
</table>

Manual
This condition indicates that the controller is running in manual speed control where the operator controls the speed of the belt by entering a percentage of speed desired. This indicator will toggle between Auto and Manual based on the type of control desired. The indicator directly below the Manual indicator is the current feeder state. The states of Manual mode shown in the table below may be displayed. See Feeder Control on page 22 for more information.

<table>
<thead>
<tr>
<th>Running</th>
<th>Stopped</th>
<th>Blocked</th>
</tr>
</thead>
</table>

Batch State Indicators
Below the Feeder State indicator is the Batch State indicator. The Batch states shown in the table below may be displayed. See Batch Control on page 22 for more information.

<table>
<thead>
<tr>
<th>Idle</th>
<th>Starting</th>
<th>Running</th>
<th>Finishing</th>
<th>Complete</th>
<th>Paused</th>
<th>Clearing</th>
<th>Waiting</th>
<th>AutoBatch</th>
</tr>
</thead>
</table>

PAT Direction Indicators
Below the Batch State indicator is the PAT direction indicator that is generated by the Prefeeder controller. See Prefeeder Operation on page 13 for more information.

<table>
<thead>
<tr>
<th>PAT Up</th>
<th>PAT Down</th>
</tr>
</thead>
</table>

Trend Screen
A Trend screen is available to show trend information for Belt Load, Feedrate and Speed. This screen also displays the current running statistics of the controller.

Numeric Display Screen
A Numeric screen is also available to display the current running status of the controller in a larger typeface for easier viewing from a distance. Pressing the buttons at the left of the screen will cycle through various parameters for display. You also have the option of locking the selections through Digital Inputs (page 56).
Numeric Display

There are several common elements to the screens that are described below.

Common Displays

- **Speed** - This is the current belt speed value in speed units. (SD: in the Feeder screen and Trend screen, SPEED in the Numeric Screen)

- **Feedrate** - This is the current Feedrate in feedrate units. (FR: in the Feeder screen and Trend screen, FEEDRATE in the Numeric Screen).

- **Belt Load** - This is the current belt load value in load units. (The belt load is located above the belt in the Feeder screen. LD: in the Trend screen. BELT LOAD on the Numeric Screen.)

- **Total** - This is the Master Total for the feeder. The Master Total may be reset from the Reset Total button in the Actions menu. See page 22 for instructions on the procedure to reset the Master Total. (GT: in the Feeder screen and Trend screen, TOTAL in the Numeric Screen)

- **Sub-Total** - This is the sub-total for the feeder. See page 22 for instructions on the procedure to reset the volumetric Total. (ST: in the Feeder screen and Trend screen, SUB TOTAL in the Numeric Screen)

- **Date** - The Date and Time is available on all of the main screens.

- **Time** - The Date and Time is available on all of the main screens.

- **Pulses** - This value is the number of pulses accumulated in the controller for Tacho 1. This value is available in the Numeric Display.

- **Setpoint** - This is the value of the current feedrate Setpoint in units that are based on the type of setpoint method selected. If the PID Controls logical input is disabled, this button will not be available.

  In the Feeder screen the method and value is displayed on the Setpoint selector button.

  - **MAN** displayed when manual speed control is selected.
  - **LOC** displayed when Local control is selected.
  - **ANA** displayed when the control mode is Remote Analog.
  - **RTO** displayed when the control mode is Remote Analog Ratio.
  - **SER** displayed when Remote Serial is selected.

  SP: is used in the Trend screen and SETPOINT is displayed in the Numeric Screen. The Setpoint method is not shown in either the Trend or Numeric screens.
Output - This is the current control output value in percent. (OP: in the Feeder screen, OUTPUT in the Numeric Screen, not available in the Trend screen) This display will be turned off on the Feeder screen when the PID Controls logical input is disabled.

Deviation - This is the setpoint deviation in percent. This value is available only in the Numeric Display. If the PID Controls logical input is disabled, this button will not be available.

Panel Meter - This selection displays the Analog Input Value. This value is displayed in the Numeric screen. See Analog Inputs on page 53 for more information.

Hours Ran - This is the number of hours that the Feeder has been running. This value is displayed in the Numeric screen. This value can be reset to zero. See Misc. Data section of the Diagnostic Display menu (page 98).

On Time - This is the amount of time, in hours, that power has been applied to the controller.

Pre-Feeder - This is the output sent to the Pre-Feeding device. This display will be turned off on the Feeder screen when the Prefeeder logical input is disabled.

Batch Total - This is the current or just completed batch total. If a batch is currently running this will display the current live batch amount.

Batch Setpoint - This is the current batch setpoint. The Batch machine sets this value at the start of the batch meaning any changes made during the batch will not occur until the start of the next batch.

Batch Preact - This value is the current preact used by the Batch machine when determining when to set the stop point.

Bin Weight - This displays the weight in the Instream Bin, when Instream calibration is enabled.

Blank Button - This button places a blank line onto the screen of the Numeric Display.
 WARNINGS

The Warning button is used to indicate a problem has occurred. Up to 16 Logical Inputs and Outputs may be selected to give you a warning indication. A Warning condition will not stop the feeder.

This button will remain displayed until the conditions that caused the Warning have been removed and the Warning acknowledged. To view the Warning screen, touch \[\text{\textbullet}\]. There is an active indicator to the left of the text (\(\text{\textbullet} = \text{ON} \quad \text{\textcircled{O}} = \text{OFF}\)). Any Warning that occurs will be saved until acknowledged by you and will be displayed with a \(\checkmark\) to the left of the active indicator. If there are no Warnings, this button will be hidden from the main screens. You may still access this screen from the action menu.

Use \(\uparrow\) and \(\downarrow\) to move the selection box to the Warning you want to acknowledge. \(\text{\textbullet}\) is used to acknowledge a Warning selected by the selection box. \(\text{\textcircled{O}}\text{\textcircled{O}}\text{\textcircled{O}}\text{\textcircled{O}}\) is used to acknowledge all Warnings. If the problem that caused an indication has not been corrected the Warning button will continue to be displayed on the main screens and the Warning will continue to be indicated on this screen.

FAULTS

The Fault button is used to indicate an error has occurred. A Fault condition will stop the feeder. The feeder will not restart until the Fault condition has been cleared. A Fault will also prevent the feeder from starting. Up to 16 Logical Inputs and Outputs may be selected to give you a Fault indication. Faults will cause the feeder to stop running.

This button will remain displayed until the conditions that caused the Fault have been removed and the Fault acknowledged. To view the Fault screen, touch \(\text{\textbullet}\). There is an active indicator to the left of the text (\(\text{\textbullet} = \text{ON} \quad \text{\textcircled{O}} = \text{OFF}\)). Any Fault that occurs will be saved until acknowledged by you and will be displayed with a \(\checkmark\) to the left of the active indicator. If there are no Faults, this
button will be hidden from the main screens. You may still access this screen from the action menu.

Use ▲ and ▼ to move the selection box to the Fault you want to acknowledge.  

is used to acknowledge a Fault selected by the selection box.  All is used to acknowledge all Faults. If the error that caused an indication has not been corrected the Fault button will continue to be displayed on the main screens and the Fault will continue to be indicated on this screen. The controller will display text indication the screen that it will return to.

WARNING: THE CONTROLLER WILL IMMEDIATELY START THE FEEDER AFTER THE FAULT CONDITION HAS BEEN CLEARED.

# ACTIONS MENU
This menu allows access to the calibration, total and subtotal reset and diagnostic menus.

## Feeder Control
This button will open the Feeder Control menu. See FEEDER CONTROL on page 26 for more information.

## Batch Control
This button will open the Batch Control menu. See Batch Control on page 32 for more information.

## Calibrate Menu
This button takes you to the Calibration menu. See Calibrating Your Controller (page 73) for further explanation of the Calibration menu.

## Reset G Total
When this button is selected you will be asked to enter the calibration password to confirm that you actually want to clear the Grand Total. Enter the password to clear the Total or touch the ESC button in the password screen to escape to the action screen without clearing the Master Total.

## Reset Sub-Total
When this button is touched you will clear the Sub-Total.

## Clean Screen
If the touch screen gets smeared or very dirty it may be necessary to clean the screen. This function gives you 60 seconds to clean the screen without affecting the controller.
**Diagnostic Display**

This selection takes you to the Diagnostic Display Menu. See Diagnostic Display (page 91) for more information. This menu is not password protected.

**Printer Menu**

This menu allows editing or printing one of the four available print strings and the Feeder Screen Display String. The print strings (1, 2, 3, and 4) are lines of characters that convey information to a printer for permanent record. The Feeder Screen Display (D) string allows placing custom text on the main screen for easier controller identification.

Touching one of these buttons will send the selected print string to the printer. The last selected line will be the line that is printed. For example, touching the button for line 1 for a test print, line 1 is the line printed when the external print command is triggered. This will be the string printed when an external print command is given. The <P at the end of line denotes the current selection.

One or more strings can be embedded into the printed line. For example, you have just edited line 1 and have embedded line 2 and 3 into line 1. When you send an external print command for line 1, lines 2 and 3 will be printed would be printed also. If the last line tested printed was line 3 then only line 3 would be printed.

**Edit Strings**

This selection allows editing of the strings. The string to edit is selected in the function.

**Line 1 – 4 / D**

This button cycles through the print line to Edit. This button toggles through the four available print strings and the Main Screen Text display.
**Character Scrolling**
This button scrolls through the selected print string. The Char # displays the current character in the line.

**Toggle Caps**
Toggles the current character between small and caps. If not a alpha character no changes will take place.

**Alpha Increment Decrement**
Increments or decrements Alpha Characters.

A B C D E F G H I J K L M N O P Q R S T U Y V W X Y Z

**Miscellaneous Character**
Cycles through the following characters.

Space “ # $ % & ” ( ) * +, - . / ; ; ; ; < = > ? @ [ \ ] ^ _ ` { | } ~

**Numeric Character**
Cycles through the numeric characters.

0 1 2 3 4 5 6 7 8 9

**Carriage Return Line Feed**
This button cycles between inserting a Carriage Return (13) or a Line Feed into the print string.

**Edit Value**
Opens a numeric entry screen to allow direct entry of numeric value into the print string. This allows entry of specific ASCII values that are not supported with a button. In addition, this menu allows:

Entry of a value for the print counter and the counter increment value.

Entry of a value for print lines to be printed at specific intervals (setting the timed print value to zero (0) turns off the timed print function).

**Extended Character**
Cycles through the following functions

<table>
<thead>
<tr>
<th>Char Val</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>ASCII CODE</td>
<td>DO NOT USE. Use to enter SCII values.</td>
</tr>
<tr>
<td>131</td>
<td>Total</td>
<td>Prints the total</td>
</tr>
<tr>
<td>132</td>
<td>Sub-total</td>
<td>Prints the subtotal</td>
</tr>
<tr>
<td>133</td>
<td>Date</td>
<td>Prints the MC³ date</td>
</tr>
<tr>
<td>134</td>
<td>Time</td>
<td>Prints the MC³ time</td>
</tr>
<tr>
<td>135</td>
<td>Clear Sub-total</td>
<td>Clears the Sub-total</td>
</tr>
<tr>
<td>136</td>
<td>Counter</td>
<td>Prints the value of the print counter</td>
</tr>
<tr>
<td>137</td>
<td>Increment counter</td>
<td>Increment the counter</td>
</tr>
<tr>
<td>138</td>
<td>Net Weight</td>
<td>Prints the current Net Weight</td>
</tr>
<tr>
<td>139</td>
<td>Feedrate</td>
<td>Prints the current feedrate</td>
</tr>
<tr>
<td>140</td>
<td>Setpoint</td>
<td>Prints the current setpoint</td>
</tr>
<tr>
<td>Char Val</td>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>141</td>
<td>Register value</td>
<td>Prints the value of a register</td>
</tr>
<tr>
<td>142</td>
<td>Weight unit</td>
<td>Prints the Weight units.</td>
</tr>
<tr>
<td>143</td>
<td>Feedrate unit</td>
<td>Prints the Feedrate units.</td>
</tr>
<tr>
<td>144</td>
<td>Total unit</td>
<td>Prints the Total units</td>
</tr>
<tr>
<td>145</td>
<td>Clear Line</td>
<td>Clear currently selected print string</td>
</tr>
<tr>
<td>146</td>
<td>Embed Line 1</td>
<td>Tells Print function to print line 1 when embedded in line 2, 3 or 4. Cannot be embedded in itself.</td>
</tr>
<tr>
<td>147</td>
<td>Embed Line 2</td>
<td>Tells Print function to print line 2 when embedded in line 1, 3 or 4</td>
</tr>
<tr>
<td>148</td>
<td>Embed Line 3</td>
<td>Tells Print function to print line 3 when embedded in line 1, 2 or 4.</td>
</tr>
<tr>
<td>149</td>
<td>Embed Line 4</td>
<td>Tells Print function to print line 4 when embedded in line 1, 2 or 3.</td>
</tr>
</tbody>
</table>
Feeder Control

There are two states of operation for the controller. These are \textit{AUTO} and \textit{MANUAL}. Various buttons used for control within these two states will appear and disappear based on the inputs, outputs, faults and warnings that the controller sees.

\textbf{AUTO}

There are six (6) states within the \textit{AUTO} mode of operation. These are \textit{RESTART, RUNNING, STOPPING, STOPPED, TRIPPED} and \textit{BLOCKED}.

\textbf{AUTO CONTROL MODE (SETPOINT)}

While in the \textit{AUTO} mode the controller runs in one of three possible control modes. These are LOCAL, REMOTE ANALOG and REMOTE SERIAL.
Local
When this mode is selected, the operator can enter a Feedrate setpoint. This setpoint is in engineering units for feedrate. This mode allows the operator-entered setpoint to be used by the controller in conjunction with the current feedrate to develop closed-loop control of the feeder.

Analog
This Setpoint mode allows the setpoint value to be input through the Analog Input in relation to the Maximum Feedrate. For example, if a 50% input signal is being read from the Analog Input, and the Maximum Feedrate Capacity is 40.00 lb/min, then the Setpoint will be 20.20 lb/min.

Ratio
This method scales the External Feedrate setpoint as a percentage of the incoming analog input signal. Scaling is the same as Remote Analog. This allows multiple feeders to be connected to a single signal with each feeder assigned a particular percentage of the signal as a setpoint.

For example, three feeders are to be used configured to provide material to a process using one analog input for control. Feeder number one provides 25%, feeder number 2 provides 35% and feeder number 3 will provide 40% of the material needed for the total process. When the setpoint changes for the process all three feeders will properly scale the outputs for the new setpoint.

Serial
This setpoint mode allows the MC³ Controller to receive a setpoint from a remote device through the serial port such as a computer or a PLC/SuperBridge Controller. This method requires that the remote device be connected to the controller via the RS-485 serial port.

NOTE: When the controller is to be used in SuperBridge or any other system, which transmits setpoint information using Serial Communications, the Remote Serial mode must be selected. The rules and format of the data exchange is described in a separate publication, Merrick Serial Protocol Specification.

Buttons
Start
You may be allowed to start RUNNING the feeder when all of the following conditions have been met.
1. There are no latched FAULTS
2. The current state is AUTO RESTART
3. The logical input Feeder Block is OFF.
4. The logical input Run Permission is ON
5. The logical input Belt Drv Overld and Belt Drv Fail is OFF.

Stop
This button will allow you to stop the feeder when RUNNING in the AUTO state of operation.

Manual
You may be allowed to go to the MANUAL state when the logical input Local Lockout is not on and the feeder is in one of the following AUTO states, RESTART, STOPPED or TRIPPED.

Numeric
This button is only available when the Local control mode is selected. This function will allow you to enter a setpoint value directly into the controller.
State Transitions

Restart
The following conditions will cause the controller to change from the Restart state to another state.

- If there are any **FAULTS** the state will change to **TRIPPED**.
- If the logical input **Run Permission** goes away the state will change to **STOPPED**.
- If the START button is touched the state will change to **RUNNING**.
- You may go to the **MANUAL** mode if the MANUAL button is displayed.
- The **Spd Demand** output will be set to zero.

Running
The logical output **No Material** is only active in this state.

The following conditions will cause the controller to change from the Running state to another state.

- If there are any **FAULTS** the state will change to **TRIPPED**.
- If the logical input **Run Permission** goes away the state will change to **STOPPED**.
- You may stop the process by pressing the STOP button while **RUNNING**.
- This will cause the state to be changed to **RESTART**.

Stopping
The following conditions will cause the controller to change from the Stopping state to another state. This state is used when the Prefeeder logical input is turned on.

- If a **Fault** is present then the state will change to **TRIPPED** after the Isolation Valve is closed.
- If **Run Permission** is turned off the state will change to **STOPPED** after the Isolation Valve is closed.
- If the STOP button was pressed then the state will change to **RESTART**.

Stopped
The following conditions will cause the controller to change from the Stopped state to another state.

- If there are any **FAULTS** the state will change to **TRIPPED**.
- When the logical input **Run Permission** comes back the state will change to **RUNNING**.
- You may go to the **MANUAL** mode if the MANUAL button is displayed.
- The **Spd Demand** output will be set to zero.

Tripped
The following conditions will cause the controller to change from the Tripped state to another state.

- When the **FAULTS** are cleared the state will change to **RESTART**.
- You may go to the **MANUAL** mode if the MANUAL button is displayed.

Blocked
The following conditions will cause the controller to change from the Stopped state to another state.
• When the logical input Feeder Block goes away the state will change to **RESTART** if Run Permission is turned on.

• When the logical input Feeder Block goes away the state will change to **STOPPED** if Run Permission is turned off.

• If there are any **FAULTS** the state will change to **TRIPPED**.

• You may go to the **MANUAL** mode if the MANUAL button is displayed.

**MANUAL**

In this state there are two states, **RUNNING** and **STOPPED**.

**OUTPUT CONTROL**

The MANUAL mode allows you to directly control the speed of the belt motor on the feeder.

There are three buttons associated with the output speed. The **↑** and **↓** buttons are used to adjust the speed output of the controller. The **↑** increases and **↓** decreases the speed of the controller in 5% increments. The SPEED buttons allows you to directly enter the speed percentage.

**Speed**

This button is used to directly enter the output desired to the speed-controlling device from 0.0% to 100.0% of the maximum capacity of the speed-controlling device and drive motor on the feeder. The output may be voltage or current depending on jumper setting on the PCIO board.

**Buttons**

**Auto**

You may go to the **AUTO** mode when **STOPPED**.

**Start**

You may start the controller in MANUAL mode when the following conditions have been met:
1. There are no **FAULTS**.
2. The logical input **Feeder Block** is OFF.
3. The logical input **Belt Drv Overld** and **Belt Drv Fail** is OFF.
4. The **MANUAL** state is **STOPPED**.

**Stop**
This button will allow you to stop the feeder when **RUNNING** in the **MANUAL** mode of operation.

**Forward / Reverse**
This button will allow you to toggle the direction of belt movement while **STOPPED** in **MANUAL** state.

**NOTE:**
The button will display the current direction.

**Jog Forward**
The following conditions must be met before you will be allowed to jog the belt forward.

1. The **MANUAL** state is **STOPPED**.
2. The logical input **Feeder Block** is OFF.
3. The logical input **Belt Drv Overld** is OFF.
4. The belt is not running in reverse.
5. The logical input **Jog Permission** is on.

**Jog Reverse**
1. The **MANUAL** state is **STOPPED**.
2. The logical input **Feeder Block** is OFF.
3. The logical input **Belt Drv Overld** and **Belt Drv Fail** is OFF.
4. The logical input **Jog Permission** is ON.
5. The belt is not running forward.

**STATE TRANSITIONS**

**Stopped**
While in this state you may go to the **AUTO** mode or **RUNNING** by touching the START button.

**Running**
In this state you may only go to the **STOPPED** state by touching the STOP button.

**Blocked**
While in this state you may go to the **AUTO** mode. When the blocking condition is removed the state will change to **STOPPED**.

**Logical Outputs**

**Belt Forward**
This output will be enabled when the reverse delay time (the time allowed for the motor to stop before allowing a change of direction) has expired and one of the following occurs:

1. The controller is **RUNNING** in the **AUTO** mode.
2. The controller is **RUNNING** in the **MANUAL** mode and the **REVERSE** button is not toggled to **REVERSE**.

3. The controller is **STOPPED** in the **MANUAL** mode and the **JOG FORWARD** button is being pressed.

**Belt Reverse**

This output will turn on when the reverse delay time has expired and one of the following occurs:

1. The controller is **RUNNING** in the **MANUAL** mode and the **REVERSE** button is toggled to **REVERSE**.

2. The controller is **STOPPED** in the **MANUAL** mode and the **JOG REVERSE** button is being pressed.

**Belt Go**

This output is on when either the **Belt Forward** or the **Belt Reverse** logical outputs are enabled. When the Startup Delay (page 66) is set to a value greater than zero this output will turn on before the **Belt Forward** or the **Belt Reverse** logical outputs.
**BATCH CONTROL**

This is the current state of the Batching machine. The states are more fully explained in the Batch Sequence section found on page 34.

**Batch Errors**

There are currently three types of Batch errors, Batch Time Exceeded, Batch Out of Tolerance and Batch SP Out of Tolerance. If one or more of the errors occurs, the controller will turn on the Batch Error Logical output. The error is displayed on the Batch Control screen.

**Batch Time Exceeded**

The amount of time for the current batch has exceeded Max Batch Tm. The amount of time used by the current batch is available on the Batch Stats screen.

**Batch Out of Tolerance**

When the batch deviates from the setpoint by more than the B Deviation percentage the controller this error is generated.

**Batch SP Out of Tolerance**

This error occurs when the Batch setpoint is set to zero.

**Start Batch**

This button starts a new batch. Turning on the logical input Start Batch is the same as touching this button.

**Stop Batch**

This button will cause a currently running batch to pause. Touching this button is the same as turning on the Stop Batch logical input.

**Clear Batch**

This button will cause a current running batch to be aborted.

**Batch Setpoint**

There are two setpoint methods available by the Batch machine, Local and RM Serial.

**Local**

The Batch setpoint is entered into the controller directly using the numeric entry screen.
**Numeric**
This button displays a numeric entry screen to allow you to change the batch setpoint value.

**Serial**
The Batch setpoint is entered into the controller via serial communications.

**Sts (Stats)**
This option displays several batch statistics. The current state of the batch machine is displayed on the center of the top line.

If Auto-Batching is enabled the controller displays Auto-Batch on the second line. Also will display a count down time between batches in the place of the Batch State.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SetP</td>
<td>This is the setpoint for the current or just completed batch.</td>
</tr>
<tr>
<td>Curr</td>
<td>This is the live value for the current running batch or the value of the just completed batch if done.</td>
</tr>
<tr>
<td>Prev</td>
<td>This is the amount batched out in the previous batch.</td>
</tr>
<tr>
<td>High</td>
<td>This is the largest amount batched out since the last clearing of the statistics.</td>
</tr>
<tr>
<td>Low</td>
<td>This is the smallest batch total since the last clearing of the statistics.</td>
</tr>
</tbody>
</table>
| Ave       | This is the average Batch total based on the following formula. 
\[
(Ave \ \text{Batch} \ * \ \text{Batch counter}) + \ \text{Batch Total})/ 
(\text{Batch Counter} + 1)
\]
| Accu      | This is the accuracy of the batches based on the following formula. 
\[
(\text{Sum of All batches} / \ \text{Sum of all batch setpoints} * 100) - 100
\]
| Current Batch Time | This is the current amount of time expended for the batch. The units are in minutes. |
| Preact     | This is the current Preact used by the controller to adjust the stopping point. See the Preact parameter |
for a more detailed explanation.

<table>
<thead>
<tr>
<th>Prev (Preact)</th>
<th>This is the Preact used by the controller for the previous batch.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cntr</td>
<td>This is the number of batches that have been batched out by the controller since the statistics have been cleared.</td>
</tr>
</tbody>
</table>

**BATCH SEQUENCE**

**IDLE**

Either **Start Batch** Button or Logical Input will start a batch process.

**NOTE:** When **Auto Batch** input is enabled, the controller will automatically start a new batch after the **Auto Batch Timer** has expired.

The controller changes the Batch state to **INIT**.

**INIT**

This state is a transitory state and generally will not be seen on the display of the controller. During init the **Batch Running** output is enabled and the **Batch Complete** and **Batch Pause** outputs are turned OFF. The controller starts a timer that will display the overall batch time (in the Batch Stats menu). The controller also starts the Pre-Batch Settling Timer (**PreB Setl Tm**) that is used to allow the equipment to start-up before sampling the weight. The controller clears any previous Batch errors.

The controller grabs the setpoint that will be used for the current Batch. If the setpoint is change after this time the controller will not use the changed setpoint until the next batch. If the setpoint is incorrect during the current batch, use the Clear batch function to stop and reset the batch parameters before starting a new batch. Using the setpoint and the Batch Preact the controller sets a stop weight for the batch. This value is used in the running to stop the belt or close the gate at the proper time for accurate batch.

The controller changes the Batch state to **STARTING**.
STARTING

If the Batch type is *Stopped Belt Batching* the controller requests the Belt Maneuvering function to **START** the belt. (See Belt Maneuvering in another part of the manual.) If the Batch type is *Empty Belt Batching* the logical output **Open Gate** is enabled.

The controller will change states to **PAUSED** if the **Stop Batch** button or logical input has been detected. The state will change to **PAUSED** also upon loss of **Run Permission** or a **FAULT** has been detected or the **Feeder Block** logical input has been enabled. The controller will change state to **CLEAR** if the **Clear Batch** button or logical input has been detected.

The controller will change state to **RUNNING** after the Pre-Batch Settling Timer (**PreB Setl Tm**) has expired.

RUNNING

The controller continuously monitors the amount of material batched out. If the total time for the batch exceeds the Maximum Batch Time (**Max Batch Tm**) the controller sets the batch error for Exceeded Batch Time.

The controller will change states to **PAUSED** if the **Stop Batch** button or logical input has been detected. The state will change to **PAUSED** also upon loss of **Run Permission** or a **FAULT** has been detected or the **Feeder Block** logical input has been enabled. The controller will change state to **CLEAR** if the **Clear Batch** button or logical input has been detected.

When the weight reaches the stop weight the controller changes state to **FINISHING**.

FINISHING
If the batch type is **Stopped Belt Batching** the controller requests the Belt Maneuvering function to **STOP** the belt. If the Batch type is **Empty Belt Batching** the logical output **Open Gate** is turned off. The controller will wait a period of time (**Prefd Delay**) after issuing the stop command or turning off the **Open Gate** output for the material and equipment to slow down and stop. In addition if the batch type is **Empty Belt Batching** the controller will wait the number of encoder pulses calculated from the infeed to the head pulley.

The controller will change states to PAUSED if the **Stop Batch** button or logical input has been detected. The state will change to PAUSED also upon loss of **Run Permission** or a **FAULT** has been detected or the **Feeder Block** logical input has been enabled. The controller will change state to CLEAR if the **Clear Batch** button or logical input has been detected.

**CAUTION:** The controller assumes that after the Post Batch Settling Time has expired that the batch is complete. If there are mechanical problems that exist that allow material to continue to be fed, the controller may not include the weight in the batch amount.

The controller will change state to CLEANUP after the Post-Batch Settling Timer (**PostB Setl Tm**) has expired.

**CLEANUP**

This is a transitory state and the controller will not stay in this state for very long. During this state the controller tests to see if the current batch has exceeded the Batch Deviation Limit (**B Deviation**) and sets an error if outside of limit. The controller then adjusts the Batch Preact (**Curr Preact**) if needed. The controller then updates the batch statistics.

The controller then goes to the DONE state.

**DONE**

This is a transitory state and the controller will not stay in this state for very long. The controller gets the Total Batch Time. Then turns off the **Batch Running** output and turns on the **Batch Complete** output.

Control is then transferred to the IDLE state.

**PAUSED**

When entering the PAUSED state, the controller either turns off the **Open Gate** output or stops the belt depending on the batch method. The controller will turn off updating of the Preact if the current batch is resumed.

When the controller receives a **Start Batch** command from the touch pad or input the state changes to STARTING. If the controller receives a **Clear Batch** command the state changes to CLEAR.
CLEAR

The controller starts by clearing any batch errors, then insures the relevant outputs (Open Gate, Batch Running, Batch Complete) are turned off.

The controller then changes the state back to IDLE.
SETTING UP YOUR CONTROLLER

ENTERING NEW VALUES

Numeric Entry Screen

Most values are entered into the Controller via a numeric entry screen (see the above example). This screen shows the name of the parameter, the current value, units and the minimum and maximum allowed values for the parameter. If there are three or more related parameters, the controller displays three at a time otherwise the controller will only show one parameter. The active parameter is enclosed in a rectangle. This is the value that any button entry will act upon.

First find the value by using the or arrow buttons to scroll to the parameter to be changed. Then press the [CLR] button to clear the current value for a new entry.

Enter the new value for the selected parameter using the numeric buttons. The display will show the value area as they are entered.

If the value is correct press the [ENT] button to save this value. The controller tests the number to insure that it is a valid entry. If the number is within the minimum and maximum values a message will appear under the parameter list:

If the value is incorrect, there are two ways to correct the number. One is to press the [CLR] button and re-enter the value. You may also use the Back arrow button to move back to the incorrect digit. If the value is not within accepted limits, the following message will appear:

NOTE: The current engineering units will be shown for the parameter being displayed.
SETTINGS MENU

There are two screens in the Custom Setup menu. These functions allow you to customize the controller for a specific feeder and process.

Setup Menu

Units Select

To enter the Units Select Menu, press the button from the Setup Screen 1.

List of Unit Combinations

<table>
<thead>
<tr>
<th>Speed</th>
<th>Load</th>
<th>Total</th>
<th>Length</th>
<th>Feedrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft/min</td>
<td>lb/ft</td>
<td>Lb</td>
<td>ft</td>
<td>lb/min</td>
</tr>
<tr>
<td>ft/min</td>
<td>lb/ft</td>
<td>Lb</td>
<td>ft</td>
<td>lb/h</td>
</tr>
<tr>
<td>ft/min</td>
<td>lb/ft</td>
<td>TN</td>
<td>ft</td>
<td>lb/min</td>
</tr>
<tr>
<td>ft/min</td>
<td>lb/ft</td>
<td>TN</td>
<td>ft</td>
<td>lb/h</td>
</tr>
<tr>
<td>m/s</td>
<td>kg/m</td>
<td>Kg</td>
<td>m</td>
<td>kg/min</td>
</tr>
<tr>
<td>m/s</td>
<td>kg/m</td>
<td>Kg</td>
<td>m</td>
<td>kg/h</td>
</tr>
<tr>
<td>m/s</td>
<td>kg/m</td>
<td>T</td>
<td>m</td>
<td>kg/min</td>
</tr>
<tr>
<td>m/s</td>
<td>kg/m</td>
<td>T</td>
<td>m</td>
<td>kg/h</td>
</tr>
<tr>
<td>m/min</td>
<td>kg/m</td>
<td>Kg</td>
<td>m</td>
<td>kg/min</td>
</tr>
<tr>
<td>m/min</td>
<td>kg/m</td>
<td>T</td>
<td>m</td>
<td>kg/h</td>
</tr>
</tbody>
</table>

NOTE: When weight is displayed in the menu system, the units will follow the setting for load.
<table>
<thead>
<tr>
<th>Speed</th>
<th>Load</th>
<th>Total</th>
<th>Length</th>
<th>Feedrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>m/min</td>
<td>kg/m</td>
<td>T</td>
<td>m</td>
<td>kg/h</td>
</tr>
<tr>
<td>m/min</td>
<td>kg/m</td>
<td>T</td>
<td>m</td>
<td>t/h</td>
</tr>
</tbody>
</table>

**NOTE:** It may be necessary, after selecting the units, to update the decimal point selection values. Even if no changes to the decimal points are necessary, you should at least look at each decimal point option to insure the proper display of values.

**Decimal Points**
Internally the MC³ Controller uses floating-point numbers. Any changes to the decimal point setting affects only the display of the values, which will be rounded appropriately.

To enter the Decimal Points Menu, press the Decimal Points button while in the first Setup Screen menu. The display will be a Numeric Entry Screen. Use the directions on page 38 to change the value of the parameter.

**NOTE:** Note that the maximum number of decimal places is four and is used for display purposes only. The value entered is the value used for computations by the software.

**Design Capacities**
These parameters are use to set several internal scaling values in the controller.

**Design Load**
This parameter represents the largest amount of material that may be placed on the belt during normal operation.

**Design Feedrate**
This parameter represents the highest feedrate that can be obtained by the

**Design Speed**
This value represents the maximum speed of the belt as presented by the controller. Normally the actual maximum speed of the belt should be roughly 120% of this value. This is to allow overhead for the feeder to run faster during starvation conditions.

**Max Bin Weight**
This is the maximum amount of weight of material that the Instream bin may have in it. If there is no intention to use the Instream calibration procedure leave this at the default value.

**Zero Tracking Settings**
The Zero Tracking function is used to automatically zero the feeder when the belt is empty and running. The average belt load is measured for one belt revolution and is consequently deducted.
Wait Time
The “Time Delay” value is the delay time that the controller will wait after all conditions have been met before actually beginning a Zero Tracking sequence. This means that the belt must be empty and running for this amount of time before the sequence will begin. Limits are minimum of 0 and maximum of 3600.

Maximum Load (LOAD LIMIT)
This value is used to determine whether or not the belt is empty. For example, if this value is 2.00 lb/ft, then the belt would be considered empty if the load on the belt sequence drops below this value. If this value is exceeded anytime during the wait test, then the current Zero Track sequence is abandoned and the wait time is started for a new sequence. Limits are minimum of 0 and maximum equal to the Design Load.

Maximum Step Allowed (INCREMENT LIMIT)
This parameter is the maximum allowed change of the zero load. If the calculated correction is above this parameter then no change is made. Limits are minimum of 0 and maximum of 20% of the Design Load.

Maximum Zero Tracking (ABSOLUTE LIMIT)
The “Maximum Zero Tracking” parameter is the maximum allowed zero tracking load. If this value is reached then no change is made. The Logical Output “Zero Track Fail” will occur if the change is within the increment limit but outside the absolute limit. Limits are minimum of 0 and maximum of 10% of the Design Load.

Start Delay Time
This parameter is the hold off time at power up (coldstart) to keep controller from starting and running Zero Tracking on a cold belt.

Belt Length
The belt length variable represents the total length of the belt in the selected length units (feet or meters). Limits are minimum of 1 and maximum of 50,000.

Pulses / Rev
The Pulses / Rev represents the number of pulses from Tacho #1 that will be received by the controller for one full revolution of the feeder’s belt. Limits are minimum of 1 and maximum of 1,000,000. This value is normally set up by the Speed Calibration procedure (page 74).
# Proc Revs
The “Number of Procedure Revolutions” variable represents the number of belt revolutions to perform for calibration procedures with the exception of the Speed Calibration. Limits are minimum of 1 and maximum of 100.

# Speed Revs
This parameter is used to determine the number of revolutions to use for the Speed Calibration (page 74). Limits are minimum of 1 and maximum of 100.

Nominal Speed
This is the speed of the belt when no tacho is used on the belt pulleys and the belt will run at a constant speed. This is normally used for a belt scale application. Limits are minimum of 0 and maximum of the Design Speed.

Zero Slots
This parameter is used for belts or aprons where load presented varies for one revolution if the belt. For an apron feeder, set to the number of pans in the belt.

Rule of Thumb:
If using a feeder/scale with idlers use ½ the spacing of the idlers to determine the number of slots. For example, the idler spacing is 3 feet and the belt length is 100 feet. The number of slots would be 100 * (0.5 * 3) or 150 slots. Normally a long feeder.

If using a feeder/scale that does not have idlers, use ¼ of the weigh span to determine the number of slots. This assumes a relatively short feeder.

Head Slots
This parameter is the number of “containers” used to store the load value. The batcher allows you to sample the load at the end point of the belt.

The following “Rule of Thumb” should be used when setting the number of Load Slots. There are variables that may change the number or slots including the actual load, speed, number of pulses per belt rev, etc but generally these rules are acceptable.

If using a feeder/scale with idlers use ½ the spacing of the idlers to determine the number of slots. For example, the idler spacing is 3 feet and the length from the Load Cell to the Head Pulley is 10 feet. The number of slots would be 10 * (0.5 * 3) or 15 slots. Normally this setting is used for a long feeder.

If using a feeder/scale that does not have idlers, use ¼ of the weigh span to determine the number of slots. This assumes a relatively short feeder.
If Zero Memory is enabled use the following formula for determining the number of Head Slots.

\[
\text{Head Slots} = \frac{\text{HdPly LdCell Length}}{\text{Belt Length}} \times \text{Zero Slots}
\]

**HdPly LdCell**

This parameter is used to determine the number of pulses per load slot. When the number of pulses has accumulated, the controller places the current load into a slot. The batch machine then uses the values in the Load Slot array for the batch amount. The measurement for this parameter must be in the Belt Length units.

**Infeed LdCell**

This parameter is used to determine the number of pulses from the infeed to the load cell. When the number of pulses has accumulated, the controller places the current load into a slot. The batch machine then uses the values in the Load Slot array for the batch amount. The measurement for this parameter must be in the Belt Length units.

**Tacho Settings**

This set of parameters allows you to setup the Tacho interface. To select the type and direction of the Tacho, press the appropriate button and cycle through the possible choices. To edit the numeric parameters, use the directions found on page 38. The Type and Mode buttons will appear and disappear based on the function selected.

**Function**

This selects the encoder to use for speed detection.

- **None** - There are no encoders connected to the feeder, use the value in Nominal Speed (page 42).

- **First** - Use the encoders connected to the first encoder’s connections on the LTI board.

- **Second** - Use the encoders connected to the second encoder’s connections on the LTI board.

- **Both** - Use both encoders, nominal ratio, allowed difference, minimum pulses for comparison. This method uses Tacho 1 for speed detection.

- **Auto Byp** - same as both with the addition of when the ratio between the two encoders exceeds the allowed difference, the speed will default to a speed that is factored to the current output. This method uses Tacho 1 for speed detection.
Analog – Uses an analog input for speed. It is normally scaled from 0 (4 mA) to Design Speed (20 mA).

Simulator - simulates a speed.

**Type**

A quadrature encoder allows the MC³ to determine when the belt is moving and will only generate a speed signal and totalize if the belt is moving in a forward direction. This is also useful for when a long belt is stopped and intermittent pulses are sent to the controller.

Optical - 5 Volt digital encoder, either signal channel or quadrature.

Mag/F-25 - Merrick F-25 Encoder or a 2 wire current loop magnetic style encoder.

Stepper - Brush-less pulse generator.

**Frequency** - Frequency type encoders.

**Mode**

Mode determines if direction detection is to be utilized. For direction detection, a quadrature encoder must be connected to the MC³, channel A and B. If only one tacho line is to be used, then the signal must be attached to the channel A input and the mode must be set to NO DIRECTION.

If direction detection is needed and you are not sure if your encoder is right hand or left hand, run the feeder and switch between right and left hand detection until a speed signal is present.

NO-DIRECTION - Direction of tacho is undetermined. The MC³ will use pulses from channel A only to determine the speed signal.

R-HAND - The MC³ will only generate a speed signal if a right-hand rotational direction is detected. The MC³ determines right hand rotation as channel A leading channel B (see diagram below.)

L-HAND - The MC³ will only generate a speed signal if a left-hand rotational direction is detected. The MC³ determines left hand rotation as channel B leading channel A (see diagram below.)
**Numeric Parameters**

*Nominal Ratio* - This value is the ratio between the two encoders. The ratio of Tacho 2 to Tacho 1 is used for comparison. For example, if Tacho 2 runs at 1000 pulses/rev and Tacho 1 runs at 100 pulses/rev the ratio would be 10.00. Limits are minimum of 0 and maximum of 10000.

*Allowed Difference (in %)* - This is the difference between the measured ratio and the Nominal Ratio between the two encoders. If the difference is larger than this percentage than the Logical output “Belt Slippage” will be enabled. Limits are minimum of 0 and maximum of 100.

*Minimum Number of Pulses* - This parameter is the minimum number of pulses to accumulate before the controller compares the pulses from two encoders. Limits are minimum of 0 and maximum of 1000000.

*Speed Factor* - Calculated output required by the belt speed-controlling device to obtain the design speed. This value is updated and maintained during normal feeder operation.

**Calibration Settings**

The following parameters are used during calibration.

**Grav Weigh Span**

The weigh span is the Gravimetric length of the weighbridge for determining load on the feeder. Performing a Weight Factor Procedure (page 79) will adjust this value. Limits are minimum of 0.1 and a maximum of 10000.

\[
\text{Weigh Span} = \frac{L_1 + L_2}{2} \quad \frac{L_3 + L_4 + L_5}{3}
\]
Calibration Weight
This is the weight you will be using when you are performing a Weight Procedure (page 78). Limits are minimum 0 to a maximum of the Design Load times the Weigh Span.

Chain Load
This is the load value of the test chain load to be used on the feeder during a Chain Procedure (page 77). Limits are minimum of 0 and a maximum of the Design Load. Performing a Chain Factor Procedure (page 78) will adjust this value.

E-Cal Liveload
This is the amount load cell output, in mV/V, for the belt load entered in the Design Load (see Design Capacities page 40). Limits are minimum of 0 and a maximum of 4.000 mV/V. Performing an E-Cal Factor Procedure (page 81) will adjust this value.

Zero Load Value
This value is the dead load value of the feeder. It includes the Weigh Idler/platform, unloaded belt, etc. This value is normally setup by the Zeroing Procedure (page 75).

Scale Factor
This is the scaling value for the controller. This value is normally set using one of the following procedures: Material Test (page 76), Chain Procedure (page 77), Weight Procedure (page 78), Electronic Calibration (page 80), or the Grab Sample Calibration (page 81).

Inferred Load
This value is the current Inferred Load value calculated by the controller based on the last belt revolution when conditions are appropriate for the calculation to occur. The Inferred Load value is used in ‘Auto Bypass’ mode when there is a Load Imbalance detected or if there are no load cells (Volumetric Feeders)

This value uses the Material On Belt logical input for enabling and disabling use of this value when in inferred mode.

Any of the following conditions will cause the calculation for a Inferred Load value to be aborted.

No calibration procedures are being performed.
A condition causing a bypass has not occurred. The conditions that will cause a bypass are:
  A/D Function is set to NONE.
  There is a Load Imbalance
  The HPAD is failing
  A/D function is set to Auto-Bypass and the logical output Load Imbalance is latched on as a Warning or a Fault.

If any of the following logical outputs are on:
  High Belt Load
  Low Belt Load
  Load Imbalance
  High Belt Speed
  Low Belt Speed
  Belt Slippage
  Load Cell Overload
  Load Cell Underload

\[
\text{Weigh Span} = \frac{L3 + L5}{2} + \frac{L4}{2}
\]
Dampening & Display

These parameters are used to dampen the values for the load, feedrate, speed, setpoint and to customize the display settings.

Invert Display
This button allows you to invert the pixel color of the display. An example is shown below.

Reverse Belt Direction
This allows the material falling from the belt to be oriented to the actual controller placement with respect to the feeder.

Display Numeric

Feedrate
The Feedrate dampening factor controls a feedrate low pass filter for the displayed feedrate and, if used, the corresponding analog output. It does not affect the internal feedrate value used by the PID controller. The purpose of this factor is to achieve a smooth and readable feedrate value.

Speed
The speed-dampening factor controls a sliding average filter that affects the internal and displayed belt speed value. Since the speed value is used for feedrate calculation, increased dampening will also affect the internal feedrate. Increasing this value normally requires a re-tuning of the PID controller parameters. Increase this parameter if the speed value appears to be noisy.

Setpoint
The speed-dampening factor controls a sliding average filter that affects the internal and displayed setpoint. Use this filter to eliminate noise on a remote analog setpoint (4..20 mA input).
Load Slots
There are two dampening functions for the belt load value. This parameter controls a sliding average filter that affects the internal and displayed belt load. Since the load value is used for feedrate calculation, increased dampening will also affect the internal feedrate. Increase this parameter if the load value appears to be noisy.

Load Damp
This is an alternative dampening function for the belt load value. This parameter controls a low pass filter that affects the internal and displayed belt load. Increase the Load Slots parameter first, if the load signal appears noisy, then this parameter.

Backlight Off Time
The backlight off time is used to turn off the backlight after a period of when no key press is detected. A value of 0 will turn off this feature.

**NOTE:** This feature requires the proper hardware upgrade to the controller. LTI and LCD boards must be of the appropriate type for this feature to work.

Graph Time
This parameter is the update time of the Graph Main Screen. With the default of 1 second per sample the controller can display approximately 2 ½ minutes of data. By changing the sample rate to 5 seconds, the controller can display approximately 12.5 minutes of data with a decrease of resolution.

**PID Settings & Output Dynamic Protection**

The MC³ Controller, when in control mode, uses a PID (Proportional (Gain), Integral, Derivative) control algorithm. To tune this algorithm to a particular feeder, changes can be made to these parameters.

When the MC³ is in control mode, it is the MC³’s job to maintain a setpoint. This is accomplished by minimizing the deviation between the setpoint and the actual feedrate. In the MC³, error is defined as \( \text{error} = \text{(feedrate)} - \text{(setpoint)} \). The PID algorithm uses this error term to adjust the speed of the feeder belt. For example: If the error is slightly positive (the feedrate is higher than the setpoint), the MC³ will slow down the belt speed.

The advantage of a PID algorithm is that it is an industry standard and many books and articles have been written on how to tune a PID controller. Several of these methods require little knowledge about the actual dynamics of the system to be tuned. If possible, Merrick will tune the PID controller before the feeder is shipped to you. Otherwise, we recommend you use whatever tuning method you are most familiar with.

**Gain**
This is the amount of gain associated with the PID algorithm. In the MC³, gain is expressed as a percentage. A purely proportional controller (with no integral and derivative action) would result in constant offset from the intended setpoint. Too much gain can cause the controller to go unstable.

**Integral**
Integral action tells the controller to accumulate (integrate) the error. The integral term is expressed in units of 1/sec. Since a purely proportional controller will result in a steady state offset from setpoint, the integral term eliminates this offset. As with gain, too much integral action can result in an unstable controller.

**Derivative**
Derivative action will add dampening to the controller. The derivative term is expressed in units of seconds. The derivative term inhibits rapid corrections to errors or setpoint changes, this has the effect of minimizing overshooting the setpoint.
There are also two other parameters that provide Output Dynamic Protection. The two parameters are available to limit the acceleration and deceleration of the belt. Their purpose is to eliminate damage to the motor drive circuit, motor, drive mechanism and belt. For some materials, it is also necessary to limit acceleration and deceleration of the belt to prevent material from bouncing around on the belt or falling off the belt. The parameters are expressed as percent per second.

**Start Speed Switch**
This determines whether the controller will perform a normal startup or will calculate the output needed to jump to the setpoint. 0 – Normal start, 1 – Jump to setpoint.

**Batch Settings**

- **Prefd Delay**: This is the amount of time (in seconds) that it takes the material to drop from the Pre-feeding or Batch controlling device to the belt at the infeed. This parameter is used by the controller for batching and by the Pre-feeder. (For more information regarding Pre-Feeder see the section “Pre-Feeder Instructions” in this manual.)

- **Max Batch Tm**: This is the maximum amount of time allowed for the batches.

- **Auto Batch Tm**: This is the amount of time between batches when using the Auto-Batch feature.

- **Curr Preact**: The Preact is an adjustment that is made to allow the controller to attain the setpoint for each batch. After each batch has occurred the Batch weight is compared with the setpoint and the controller will make a correction to this parameter. The controller uses this value to determine where to set the stop point for the batch state machine. This value is added with the batch weight.
settpoint to obtain the proper stopping point. This means the value normally would be a negative value.

**NOTE:** The controller will not make adjustments to the Preact if the current batch has been **PAUSED** for any reason.

**Preact Limit**
This is the largest value that the Preact is able to attain. The controller will stop adjusting the Preact when this value is exceeded. If a Preact value is entered or is calculated that is beyond this value the controller will change it to this value after the batch is complete. To keep the controller from changing to this value set the Preact Apply to 0. See the example below.

**Pre Max Chang**
This is the largest amount of change that can be made to the Preact each batch cycle. This is the maximum the Preact is allowed to change during each batch. If the change to the Preact is going to be greater than this value, the controller will only allow the Preact to change by this amount.

**Preact Apply %**
This is the percentage of the error to apply to the current Preact to correct for the difference between the amount batched and the batch setpoint. This amount is used in conjunction with the Preact Limit and Preact Max Change to adjust the Current Preact. To turn off the adjustment of the Preact, set this value to 0.

**An Example of the Preact Parameters**

- **Current Preact = -2.50 lbs**
- **Batch Setpoint = 100.00 lbs.**
- **Batched Weight = 102.00 lbs.**

This indicates that the controller would need to stop earlier to make the Batch setpoint. Hence the controller needs to increase (make more negative) the Preact in order to stop the batch at the proper time.

- **Error = -2.00 lbs.**
- **Preact Apply % = 50%**
- **Test Adjustment = -1.00 lb. (0.5 * 2.00)**

If the Preact Apply % had equaled 100%, the total error of -2.00 lbs would be applied to the Preact in the following tests.

- **Test Adjustment = -1.00 lb. (0.5 * 2.00)**
- **Pre Max Change = 1.00 lb**

The adjustment is at the Pre Max Change value. If the test adjustment had been -1.1 lbs then the controller would have limited the adjustment to -1.00 lb.

- **Test Adjustment = -3.50 lbs. (-1.00 test adjustment + -2.50 current Preact)**
- **Preact Limit = 3.00 lbs.**

In this scenario the controller will limit the Preact to the Preact Limit or 3.00 lbs.

**B Slot Index**
This is the point in the Head Slot array that the controller will pull off the stored belt load value and will use in the batch total. Normally you would want this value to be the same as the Head Slot. This places the point to get the load for the batch total at the moment the load is falling off of the belt.
**WARNING:** *This value should never be set to a value greater than the number Head Slots (Page 42) value is set at.*

**B Deviation**
This is the percentage of error allowed before the controller turns on the Batch Error output. The Batch error output will also turn on if the time for the current batch exceeds the Max Batch Time. The Batch error is displayed on the Batch Control display.

**Prefeeder Parameters**

**Max/Min Load SP**
The Pre-Feeder output or PAT digital outputs will try to control the pre-feeder to obtain the Belt Load within the range of these parameters. The Load setpoint will vary from the Min Load SP when the Feedrate setpoint is at low to the Max Load setpoint when the Feedrate setpoint is at the upper end of the range. These parameters are available to increase the “turn down” of the feeder. These values may be set to the same value for constant load operation.

**Dead Band**
The Dead Band is the area where the controller will not change or adjust the output when in Load Control mode of the Prefeeder. This parameter is also used by the PAT control to keep from constantly trying to turn the PAT outputs on and off to obtain the desired load. This is the percentage of the Design Load.

**Start Delay**
This is the amount of time to delay before starting to test the belt load and adjust the Pre-Feeder for desired Load Setpoint. This allows the system to stabilize before testing and adjusting.

**Prefd Delay**
This is the amount of time (in seconds) that it takes the material to drop from the Pre-feeding or Batch controlling device to the belt at the infeed. This parameter is used by the controller for batching and by the Pre-feeder.

**PAT Stroke Tm**
This is the amount of time it takes for a PAT device to go from full closed to full open. When there is no analog positional feedback it is very important for this value to be set as accurately as possible.
Prefd Factor
This value represents the characteristics of the Prefeeder with respect to the feeder. The controller will adjust this value under normal operation to control the Prefeeder. Normally this value should not be changed.

MaxFactorincr
This is the amount to increment or decrement the Prefeed Factor by when adjusting the prefeeding device. This only happens when the Load/Setpoint switch is set to Load (0). Increasing this value will make the Prefeeder more reactive.

AIN Lo Counts
This is the low reference point of raw analog input A/D counts. It is used to setup the analog input for Prefeeder positional feedback control. This value is normally set by the Analog Input Calibration function.

AIN Hi Counts
This is the high reference point of raw analog input A/D counts. It is used to setup the analog input for Prefeeder positional feedback control. This value is normally set by the Analog Input Calibration function.

AIN Zero Val
This value represents the closed condition of the Prefeeder Analog Feedback device. In nearly all circumstances this will be set to 0%.

AIN Full Val
This value represents full open of the pre-feeder feedback device. It should be set to 100% to represent that the pre-feeding device is fully open.

0-Ld 1-SetP
Load
The Pre-feeder and Belt feeder are both controlled by the Setpoint. To make the belt load reach the load setpoint, the Prefeeder is nudged in steps. This method is useful only when the feedrate Setpoint is mostly constant. Tuning is critical.

Setpoint
The Prefeeder is controlled by the Setpoint. The Belt feeder speed is controlled by the feedrate Setpoint divided by the load Setpoint. With a constant feedrate Setpoint, the belt speed will also be constant. Tuning is simple and non-critical.

Set Date and Time
For setting the date and time parameters, follow the direction given the Numeric Entry Screen section found on page 38.

INPUTS & OUTPUTS

```
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<thead>
<tr>
<th>Analog Inputs</th>
<th>Digital Inputs</th>
<th>Totalizer Settings</th>
<th>Curve Settings</th>
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<tbody>
<tr>
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<td>Digital Outputs</td>
<td>Limit Switches</td>
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<td>Sample Rate</td>
<td>Home Screen</td>
<td>Action Menu</td>
<td>Settings Menu</td>
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</tbody>
</table>
```

Inputs & Outputs
**Analog Inputs**

The analog inputs can be mapped to Analog Setpoint, Belt Speed, Panel Meter or Pre-Feeder functions. Two analog inputs are available when there are two PCIO boards installed into the controller. Once the inputs are mapped, you should adjust the high, low and scaling values. The Analog I/O Diagnostics (page 97) displays the active counts for the analog inputs and can be used to determine the high and low values.

**Analog Setpoint**
When you intend to use an analog signal for the setpoint, an Analog Input Source must be set for this input. The analog input selected is used for the setpoint when the Setpoint method is Remote Analog Input. There are also high and low limits (Setpoint page 65) that can be set to insure that the proper range is allowed.

**Belt Speed**
An external Analog style Speed signal can be used to determine the speed of the belt rather than an encoder. It will not be as accurate as an encoder will though.

**Panel Meter**
This selection is used to display an analog input for display purposes only. The value is scaled to a user-defined value. The value can be set in the numeric parameter selection (see below).

**Prefeeder**
This is used when there is Positional Feedback available from the Prefeeder. This input will be used only for the PAT (Position Adjust Type) utilizing positional feedback method (page 8). The numeric settings will be found in the Settings Menu under the Prefeeder Parameters section found on 51.

Analog Input Source Settings

- **Input 1** - The source used is analog input number 1 on PCIO board number 1.
- **Input 2** - The source used is analog input number 2, which is located on the PCIO board number 2.
- **Always Zero** - The value that is used for the function selected is always 0. When the Prefeeder input is set to this value, the Prefeeder will use the PAT with limit switches only setting (page 9).
- **Remote Input** - The value used is controlled through a register using the serial port.
- **Numeric**
Low Values
This value is the counts representing the zero level of the incoming signal. When the input signal is set to 4-20mA (2-10V) input then this value should be 200,000 counts. If the input is set to 0-20mA (0-10V) then the zero level should be close to 0 counts. Limits are minimum of 0 and a maximum of 1,040,000.

High Values
This value is the representation of the 100% value of the incoming signal. Normally this value will be 1,000,000 counts representing 100% (20mA or 10V) of the incoming signal. Limits are minimum of 1 and a maximum of 1,040,000.

Maximum Scale Values
This is the value representing the full-scale value used for scaling the input. This value should be associated with the analog input counts it is to represent

Minimum Scale Values
This is the value representing the zero value used for scaling the inputs.

Panel Meter Units
This unit will be displayed on the Large Display Screen.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Amps</td>
</tr>
<tr>
<td>1</td>
<td>Volts</td>
</tr>
<tr>
<td>2</td>
<td>Torque %</td>
</tr>
<tr>
<td>3</td>
<td>Temp °F</td>
</tr>
<tr>
<td>4</td>
<td>Temp °C</td>
</tr>
<tr>
<td>5</td>
<td>Incl °</td>
</tr>
<tr>
<td>6</td>
<td>Belt Spd</td>
</tr>
</tbody>
</table>

Analog Outputs
The purpose of this section is to configure the Analog Outputs. Each analog output may be 0-20mA (0-10V) or 4-20mA (2-10V). The type of output may be for Feeder Control, Feedrate or Belt Load, Speed or the current setpoint. To change the settings for any of the outputs, just press on the button to cycle through the choices for type and output rating.

Mode
Drive Output - The output is a percentage of the type selected.
Feedrate - The output is scaled to the design feedrate.

Belt Load - The output is scaled to the design belt load.

Belt Speed - The output is scaled to the design belt speed.

Setpoint - The output is the current setpoint scaled to the design feedrate.

Pre-Feeder -

Available - This mode makes the output available for use by an external source via the communications port.

**Type**

0-20mA (0-10V) - The mode selected is scaled between 0 and 20 mA (0 and-10V).

4-20mA (2-10V) - The mode selected is scaled between 4 and 20 mA (2 and 10V).

**Numeric Parameters**

**Zero Values** – The zero values are used to scale the zero point for each of the analog outputs. This allows you to scale the zero value to the desired mA or V required for your system.

For SCR Output, Manual setpoint and Prefeeder Output the value will be adjusted to the range selected. For Feedrate and Feedrate Setpoint outputs, the percentage will be scaled to the design feedrate. For Belt Load, the percentage will be scaled to the design belt load. For Belt Speed, the percentage will be scaled to the design belt speed.

![Graph](image)

**Full Values** – This allows you to adjust the scaling of the output to fit you system. For example if the 20 mA output causes the belt speed of the feeder to exceed your system requirements, you can adjust the SCR Out Full Value up to obtain the desired speed at 100% output.

For SCR Output, Manual setpoint and Prefeeder Output the value will be adjusted to the range selected. For Feedrate and Feedrate Setpoint outputs, the percentage will be scaled to the design feedrate. For Belt Load, the percentage will be scaled to the design belt load. For Belt Speed, the percentage will be scaled to the design belt speed.
Digital Inputs

This selection allows changing the mapping for the digital inputs. The Physical is mapped to the logical layer. This means that a (one) physical input may be mapped to several different logical inputs. For example the Physical Input "Rack 2 Input 1" may be mapped to the Logical Inputs "Calibr. Access" and "Advanced Set". This will allow calibration acceptance and custom setup access only if the input Rack 2 Input 1 is set appropriately.

Digital input screens

**SELECT COLUMN**
This button switches between the Logical and Physical sections allowing re-mapping of I/O points to occur.

**INVERT (button) / IV (display column)**
This button inverts the Physical I/O points. For example, if the physical input mapped to the Feeder Block logical input is ON and the invert option is on then the Feeder Block logical input would be off.

**FORCE (button) / FC (display column)**
This button toggles the Physical I/O point through ON (1), OFF (0) or None (X, normal state). The force selected will stay on until changed by this button. An indication that forces are in place is indicated on the Main Feeder Screen.

**ALARM (button) / WF (display column)**
This button cycles between Fault (F), Warning (W) and None (X). Faults will stop the feeder when in the AUTO state.

List of Logical Inputs

<table>
<thead>
<tr>
<th>Logical Input</th>
<th>Description</th>
<th>Index</th>
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<table>
<thead>
<tr>
<th>Logical Input</th>
<th>Description</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>PID Controls</td>
<td>This input allows the controller to use the PID algorithm. If this is turned off the controller turns off functionality that uses Setpoint turning into a belt scale.</td>
<td>64</td>
</tr>
<tr>
<td>AutoStartFeeder</td>
<td>Allow Automatic starting of the feeder. <strong>WARNING:</strong> ENABLING THIS FEATURE ALLOWS THE CONTROLLER TO START THE FEEDER UPON COMPLETION OF THE 20 SECOND POWER UP TIMER WITHOUT ANY USER INPUT.</td>
<td>65</td>
</tr>
<tr>
<td>Zero Tracking</td>
<td>Enables the Zero Tracking feature. See Zero Tracking on page 40.</td>
<td>66</td>
</tr>
<tr>
<td>Belt Memory</td>
<td>This input turns the Zero Memory on. It is used to compensate for varying zero load along the belt. This is useful for spliced belts and apron feeders. See Zero Slots (page 42) for more information.</td>
<td>67</td>
</tr>
<tr>
<td>Batching</td>
<td>This input turns on Batching. The button will be displayed on the Main Feeder Screen. See Batch Control (page 32) for more information.</td>
<td>68</td>
</tr>
<tr>
<td>Auto Batch</td>
<td>This input enables the running a sequence of batches without using the Start Batch input for each batch. The interval between batches is set in the Auto Batch Tm (page 49) parameter.</td>
<td>69</td>
</tr>
<tr>
<td>Link Outp W/Cal</td>
<td>This input turns off the analog output for feedrate, Master Totalizer and EMT outputs while any calibration procedures are being performed.</td>
<td>70</td>
</tr>
<tr>
<td>Prefeeder</td>
<td>Enables the Prefeeder feature. See Prefeeder Operation on page 13 for more information.</td>
<td>71</td>
</tr>
<tr>
<td>Frc Comm Setpt</td>
<td>Force the controller to use the Serial feedrate setpoint when the controller is in communications with a serial device.</td>
<td>72</td>
</tr>
<tr>
<td>Belt Jogging</td>
<td>Enable jogging control in MANUAL mode. See MANUAL on page 29 for more information.</td>
<td>73</td>
</tr>
<tr>
<td>Belt Not Rvsble</td>
<td>The controls do not allow the belt to go in reverse. The associated controls for reversing will display from the MANUAL mode display.</td>
<td>74</td>
</tr>
<tr>
<td>Allow Cal Acpt</td>
<td>Allows calibration procedures to run to completion. You can still run calibration procedures, but you will not be able to accept the results.</td>
<td>75</td>
</tr>
<tr>
<td>EMT Enabled</td>
<td>When off, the pulses going to External Electromechanical Totalizer (EMT) are disabled.</td>
<td>76</td>
</tr>
<tr>
<td>Total Enabled</td>
<td>Enables the main Totalizer. When Off, the main total does not increment.</td>
<td>77</td>
</tr>
<tr>
<td>Sub-Total Enabl</td>
<td>Enables Sub Totalizer. When Off, the sub total does not increment.</td>
<td>78</td>
</tr>
<tr>
<td>Run Permission</td>
<td>This input is used to start and stop the feeder in continuous, automatic mode. The feeder will run when the input is on. If the Feedrate Setpoint Mode is set to &quot;Manual Speed&quot;, this input is ignored, and the feeder will run regardless of the state of the input.</td>
<td>79</td>
</tr>
<tr>
<td>Belt Running</td>
<td>Indicates to the MC³ that the belt is running. This input is normally connected to an auxiliary contact on the belt motor starter when the belt runs at a constant speed, and there are no encoders attached.</td>
<td>80</td>
</tr>
<tr>
<td>Logical Input</td>
<td>Description</td>
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</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Feeder Block</td>
<td>This input is used to unconditionally stop the feeder.</td>
<td>81</td>
</tr>
<tr>
<td>Bit Drive Fail</td>
<td>Input indicating that the Belt controlling device (VFD or SCR) has a failure condition.</td>
<td>82</td>
</tr>
<tr>
<td>Bit Drive Ovrd</td>
<td>Input indicating that an overload for the belt motor has tripped, or the speed controller is in an overload state.</td>
<td>83</td>
</tr>
<tr>
<td>Rem Print Cmd</td>
<td>Sends the selected print string to the printer serial port.</td>
<td>84</td>
</tr>
<tr>
<td>Reset Faults</td>
<td>Used to externally reset FAULTS.</td>
<td>85</td>
</tr>
<tr>
<td>Reset Warnings</td>
<td>Used to externally reset WARNINGS.</td>
<td>86</td>
</tr>
<tr>
<td>Belt Index</td>
<td>Input for the belt index, required when zero memory is used. Connected to a proximity switch, activated by one target on the belt.</td>
<td>87</td>
</tr>
<tr>
<td>Goto Volumetric</td>
<td>This input forces the controller to use the Inferred Load value for belt loading.</td>
<td>88</td>
</tr>
<tr>
<td>Force Min Setp</td>
<td>This input forces the feeder to feed at the Minimum Setpoint value set in the Setpoint (page 65) section of the Limit Switches menu.</td>
<td>89</td>
</tr>
<tr>
<td>Diverter Valve</td>
<td>Position of the grab sample diverter valve. When this input is ON the valve is open, diverting material out of the normal stream. See Grab Sample Calibration on page 81.</td>
<td>90</td>
</tr>
<tr>
<td>Vlv Not Closed</td>
<td>The valve attached to the infeed of the feeder is partially or fully open</td>
<td>91</td>
</tr>
<tr>
<td>Vlv Not Open</td>
<td>The valve attached to the infeed of the feeder is partially or fully closed</td>
<td>92</td>
</tr>
<tr>
<td>Mat on Belt</td>
<td>This is input turns on the inferred load value when the HPAD operating mode is set to 0 (none) or is set to 4 (Auto Bypass). See A/D Function on page 69 for more information.</td>
<td>93</td>
</tr>
<tr>
<td>Infeed Flow</td>
<td>Input used for monitoring an Infeed Flow detector. There is a delayed output associated with this input named No Infeed Flow.</td>
<td>94</td>
</tr>
<tr>
<td>Disch Pluggage</td>
<td>Input used for monitoring a discharge pluggage detector. There is a delayed output associated with this input named Disch Plugged.</td>
<td>95</td>
</tr>
<tr>
<td>Belt Offs Left</td>
<td>Input for the left side belt-tracking switch, first stage. Normally the alarming mode for this input should be set to WARNING to inform that the belt is mis-tracking.</td>
<td>96</td>
</tr>
<tr>
<td>Belt Offs Right</td>
<td>Input for the right side belt-tracking switch, first stage. Normally the alarming mode for this input should be set to WARNING to inform that the belt is mis-tracking.</td>
<td>97</td>
</tr>
<tr>
<td>Belt Err Left</td>
<td>Input for the left side belt-tracking switch, second stage. Normally the alarming mode for this input should be set to FAULT to shut down the feeder.</td>
<td>98</td>
</tr>
<tr>
<td>Belt Err Right</td>
<td>Input for the right side belt tracking switch, second stage. Normally the alarming mode for this input should be set to FAULT to shut down the feeder.</td>
<td>99</td>
</tr>
<tr>
<td>Spd Cal Pls Blk</td>
<td>This input blocks all incoming pulses from both tachs. It is used</td>
<td>100</td>
</tr>
<tr>
<td>Logical Input</td>
<td>Description</td>
<td>Index</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Start Batch</td>
<td>This input is used to start a batch.</td>
<td>101</td>
</tr>
<tr>
<td>Pause Batch</td>
<td>This input causes the controller to pause a batch. This is reflected on the feeder screen by displaying the Pause on the screen.</td>
<td>102</td>
</tr>
<tr>
<td>Clear Batch</td>
<td>This input will terminate a running batch and clear any associated values with the cleared batch.</td>
<td>103</td>
</tr>
<tr>
<td>Lock Num Displ</td>
<td>This input locks the Large Font (NuMerrick) buttons from being changed.</td>
<td>104</td>
</tr>
<tr>
<td>Lock SP Method</td>
<td>Locks Setpoint method to the current one selected. The buttons that change the setpoint method will disappear from the screen.</td>
<td>106</td>
</tr>
<tr>
<td>Ext Regs Access</td>
<td>Allows access to calibration constants in the register editor and via communications.</td>
<td>107</td>
</tr>
<tr>
<td>Regs Editor</td>
<td>Input permitting the user to access to the Register Editor (page 99).</td>
<td>108</td>
</tr>
<tr>
<td>Load Simulator</td>
<td>Turns on or off the belt load simulator.</td>
<td>109</td>
</tr>
<tr>
<td>Sim Load Up</td>
<td>This input is used to increase the simulated belt load. The simulated belt load increases until the design belt load is reached.</td>
<td>110</td>
</tr>
<tr>
<td>Sim Load Down</td>
<td>This input is used to decrease the simulated belt load. The simulated belt load will decrease until the zero load is reached.</td>
<td>111</td>
</tr>
<tr>
<td>InstrmGate Clsd</td>
<td>This input is used to notify the Instream Cal (page 84) that the Instream Bin Gate is Closed and to proceed with the calibration procedure.</td>
<td>112</td>
</tr>
<tr>
<td>Reset Sub-Total</td>
<td>Input used to reset the Sub total.</td>
<td>113</td>
</tr>
<tr>
<td>Clamp Setpoint</td>
<td>Switch used to clamp the feedrate setpoint between the limits set in the Setpoint (page 65) section of the Limit Switches menu.</td>
<td>114</td>
</tr>
<tr>
<td>PAT Full Open</td>
<td>Input indicating that the Prefeeder device is full open or at full capacity.</td>
<td>115</td>
</tr>
<tr>
<td>PAT Full Closed</td>
<td>Input indicating that the Prefeeder device is closed or off.</td>
<td>116</td>
</tr>
<tr>
<td>Available I/O 1/8</td>
<td>I/O points that may be used by an external communication device for control.</td>
<td>120/7</td>
</tr>
</tbody>
</table>

**List of Physical Inputs**

<table>
<thead>
<tr>
<th>Physical Inputs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always Off</td>
<td>The contact is always equal to 0 (open).</td>
</tr>
<tr>
<td>Always On</td>
<td>The contact is always equal to 1 (closed).</td>
</tr>
<tr>
<td>Keyboard A1 - H4</td>
<td>Keyboard Location Codes</td>
</tr>
<tr>
<td>Rack 1 INPUT 1 through 4</td>
<td>PCIO #1 1st bank. NOTE: Input 3 and 4 have a capability to “stretch” the ON time to accommodate fast acting switches such as proximity switches. Contact Merrick for details.</td>
</tr>
</tbody>
</table>
Physical Inputs | Description
--- | ---
Rack 2 INPUT 1 through 4 | PCIO #1 2nd bank.
Rack 3 INPUT 1 through 4 | PCIO #2 1st bank. Requires use of a second PCIO board.
Rack 4 INPUT 1 through 4 | PCIO #2 2nd bank. Requires use of a second PCIO board.
Accessory Inputs 1-4 | PCIO #2 2nd bank. Requires use of a second PCIO board.
External Inputs 1-16 | These represent “virtual” physical inputs. They are normally used by a communications device attached to a serial port to allow a logical input’s state to be changed.
External Outputs 1-16 | A device attached to a communications channel to display the state of an input normally uses these.
Stable Weight, Keyboard Locked | These inputs are used by the controller internally and should not be mapped.

Digital Outputs

This selection allows changing the mapping for the digital outputs. The Logical is mapped to the Physical layer. This means one (1) logical output may be mapped to several different physical outputs. For example the Logical Output “General Alarm” may be mapped to Rack 1 Output 4, Rack 2 Output 6 and Rack 4 Output 2 allowing different external processes to know that a problem has occurred with the controller.

Digital Outputs

<table>
<thead>
<tr>
<th>Digital Outputs</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Logical</td>
</tr>
<tr>
<td>Rack 1 Output 1</td>
<td>Fault</td>
</tr>
<tr>
<td>Rack 1 Output 2</td>
<td>Warning</td>
</tr>
<tr>
<td>Rack 1 Output 3</td>
<td>Ready</td>
</tr>
</tbody>
</table>

SELECT COLUMN
This button switches between the Logical and Physical sections allowing re-mapping of I/O points to occur.

INVERT (button) / IV (display column)
This button inverts the Physical I/O points. For example, if the physical input mapped to the Feeder Block logical input is ON and the invert option is on then the Feeder Block logical input would be off.

FORCE (button) / FC (display column)
This button toggles the Physical I/O point through ON (1), OFF (0) or None (X, normal state). The force selected will stay on until changed by this button. An indication that forces are in place is indicated on the Main Feeder Screen.

ALARMING (button) / WF (display column)
This button will run a menu that is used to adjust the Fault/Warning property of the Logical outputs more easily. The WF display cycles between Fault (F), Warning (W) and None (X) based on the current setting. Faults will stop the feeder when in the AUTO state.
### List of Logical Outputs

<table>
<thead>
<tr>
<th>Logical Output</th>
<th>Description</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unused</td>
<td>The physical output is not mapped to a valid logical output.</td>
<td>0</td>
</tr>
<tr>
<td>Fdr Drv Enable</td>
<td>Feeder running, Drive Out analog output is greater than 0%</td>
<td>1</td>
</tr>
<tr>
<td>Belt Forward</td>
<td>Run Belt Forward</td>
<td>2</td>
</tr>
<tr>
<td>Belt Reverse</td>
<td>Run Belt Reverse</td>
<td>3</td>
</tr>
<tr>
<td>Fault</td>
<td>This output indicates that a condition occurred that is serious enough to stop the feeder. This condition has no effect if the PID controls are off since the controller cannot stop the belt. Logical “or” of all outputs and inputs qualified for <strong>FAULT</strong>. <strong>NOTE:</strong> The controller will immediately start the feeder after a FAULT condition has been cleared.</td>
<td>4</td>
</tr>
<tr>
<td>Warning</td>
<td>A condition has occurred that needs attention but is not serious enough to stop the feeder. Logical “or” of all outputs and inputs qualified for <strong>WARNING</strong></td>
<td>5</td>
</tr>
<tr>
<td>Ready</td>
<td>Logical combination of: not Belt Drv Fail and not Belt Drv Overld and not Feeder Block and Feeder State AUTO.</td>
<td>6</td>
</tr>
<tr>
<td>Good Feedrate</td>
<td>Logical combination of: not High Belt Load and not Low Belt Load and not High Belt Speed and not Low Belt Speed and not High Deviation and not Low Deviation and not High Feedrate and not Low Feedrate and Feeding and Ready and not Warning and not Fault and not Contrlr Exhaust Controller State AUTO.</td>
<td>7</td>
</tr>
<tr>
<td>Belt At Index</td>
<td>Output indicating that the belt position is at the index (according to the Tacho Pulse count). Used for testing purposes, when no Belt Index Prox Switch is available.</td>
<td>8</td>
</tr>
<tr>
<td>Belt Index Lost</td>
<td>Output indicating that the Belt Index input has NOT activated despite the fact that the belt has traveled more than one belt</td>
<td>9</td>
</tr>
<tr>
<td>Logical Output</td>
<td>Description</td>
<td>Index</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>revolution, according to the Tacho Pulse count. Normally used to produce a warning that there is a problem with the Belt Index Prox Switch.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Batch Running</td>
<td>A Batch is in progress.</td>
<td>11</td>
</tr>
<tr>
<td>Batch Paused</td>
<td>The current batch has been stopped and may be restarted by the Start Batch command. The batch may be terminated by the Clear Batch command</td>
<td>12</td>
</tr>
<tr>
<td>Batch Complete</td>
<td>A batch has been completed</td>
<td>13</td>
</tr>
<tr>
<td>Batch Error</td>
<td>There is an error with the current or just completed batch.</td>
<td>14</td>
</tr>
<tr>
<td>PAT Adjust UP</td>
<td>Output used to adjust the Prefeeder to increase belt loading.</td>
<td>15</td>
</tr>
<tr>
<td>PAT Adjust DOWN</td>
<td>Output used to adjust the Prefeeder to decrease belt loading.</td>
<td>16</td>
</tr>
<tr>
<td>Hi Setpoint</td>
<td>Output indicating that the setpoint is above the High Feedrate Limit. The Setpoint will not be allowed to go above the High Setpoint Value and will be set to that value.</td>
<td>17</td>
</tr>
<tr>
<td>Lo Setpoint</td>
<td>Output indicating that the setpoint is below the “min_setpoint” limit. The setpoint will not be allowed to drop below the Low Setpoint Value.</td>
<td>18</td>
</tr>
<tr>
<td>Hi Feedrate</td>
<td>Output indicating that the feedrate has exceeded a set limit for a set time.</td>
<td>19</td>
</tr>
<tr>
<td>Lo Feedrate</td>
<td>Output indicating that the feedrate has been below a set limit for a set time.</td>
<td>20</td>
</tr>
<tr>
<td>Hi FR Deviation</td>
<td>Output indicating that the difference between the feedrate and the setpoint has lag set limits for a set time</td>
<td>21</td>
</tr>
<tr>
<td>Lo FR Deviation</td>
<td>Output indicating that the difference between the feedrate and the setpoint has lag set limits for a set time.</td>
<td>22</td>
</tr>
<tr>
<td>Hi Pnl Mtr Val</td>
<td>Output Indicating that the Analog Input mapped to the Panel Meter function has exceeded the limit switch value High Panel Meter.</td>
<td>23</td>
</tr>
<tr>
<td>Lo Pnl Mtr Val</td>
<td>Output Indicating that the Analog Input mapped to the Panel Meter function has dropped below the limit switch value Low Panel Meter.</td>
<td>24</td>
</tr>
<tr>
<td>Hi Output</td>
<td>Output indicating that the belt speed demand is above the limit set in the Limit Switch menu.</td>
<td>25</td>
</tr>
<tr>
<td>Lo Output</td>
<td>Output indicating that the belt speed demand lower the set limit.</td>
<td>26</td>
</tr>
<tr>
<td>HPAD Overload</td>
<td>Output indicating that at least one load cell input is overloaded high</td>
<td>27</td>
</tr>
<tr>
<td>HPAD Underload</td>
<td>Output indicating that at least one load cell input is overloaded low</td>
<td>28</td>
</tr>
<tr>
<td>Hi Belt Load</td>
<td>Output indicating that the belt load has exceeded a set limit for a set time.</td>
<td>29</td>
</tr>
<tr>
<td>Lo Belt Load</td>
<td>Output indicating that the belt load has been below a set limit for a set time.</td>
<td>30</td>
</tr>
<tr>
<td>Logical Output</td>
<td>Description</td>
<td>Index</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Inferred Load</td>
<td>A condition causing an Inferred Load has occurred.</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>The conditions that will cause an Inferred Load are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. A/D Function is set to NONE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. There is a Load Imbalance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. The HPAD is failing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. A/D function is set to Auto-Bypass and the logical output Load Imbalance is latched on as a Warning or a Fault.</td>
<td></td>
</tr>
<tr>
<td>Load Imbalance</td>
<td>Output indicating that the difference in belt load sensed on the left and right side exceeds a set limit. See Allowed Difference on page 70.</td>
<td>31</td>
</tr>
<tr>
<td>Hi Belt Speed</td>
<td>Output indicating that the belt speed has exceeded a set limit for a set time. See the Speed (page 65) section of the Limit Switches menu for more information.</td>
<td>32</td>
</tr>
<tr>
<td>Lo Belt Speed</td>
<td>Output indicating that the belt speed has been below a set limit for a set time. See the Speed (page 65) section of the Limit Switches menu for more information.</td>
<td>33</td>
</tr>
<tr>
<td>Inferred Speed</td>
<td>This output becomes active when:</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>1. The tacho function selected is NONE or SIMULATOR.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. The tacho function selected is AUTO-BYPASS and a Belt Slippage condition has been detected</td>
<td></td>
</tr>
<tr>
<td>No Speed</td>
<td>If PID Controls is turned off or PID controls is ON and the Belt GO output is ON, the controller will detect if there is no belt movement and set this output accordingly.</td>
<td>35</td>
</tr>
<tr>
<td>In Menu System</td>
<td>Output indicating that the user interface is not in one of its main screens</td>
<td>36</td>
</tr>
<tr>
<td>Cal in Progress</td>
<td>Output indicating a calibration procedure is in process</td>
<td>37</td>
</tr>
<tr>
<td>Manual Control</td>
<td>Controller in manual mode</td>
<td>38</td>
</tr>
<tr>
<td>Analog Setpoint</td>
<td>Analog / Analog ratio setpoint</td>
<td>39</td>
</tr>
<tr>
<td>Serial Setpoint</td>
<td>The controller is using serial communications to derive the setpoint.</td>
<td>40</td>
</tr>
<tr>
<td>BCD On</td>
<td>Batch Controlling Device. Output used by the controller to control a device used to feed material for Empty Belt Batching.</td>
<td>41</td>
</tr>
<tr>
<td>Stable Bin Wt</td>
<td>The weigh in the Instream Bin is stable</td>
<td>42</td>
</tr>
<tr>
<td>Cls Instrm Gate</td>
<td>Output used by the Instream Cal (page 84) to notify external devices controlling the flow of material to stop and close the infeed valve for calibration purposes.</td>
<td>43</td>
</tr>
<tr>
<td>BCal In Progres</td>
<td>The Instream Cal Procedure (page 84) is running</td>
<td>44</td>
</tr>
<tr>
<td>Fill Instrm Bin</td>
<td>Output used by the Instream Cal (page 84) to notify external devices controlling the flow of material to the Instream Bin to fill the bin with material.</td>
<td>45</td>
</tr>
<tr>
<td>Cal Instr Bin Wt</td>
<td>The weight level in Instream Bin has exceeded the Bin Hi Cal Wt level.</td>
<td>46</td>
</tr>
<tr>
<td>Z-Trk Out/Limit</td>
<td>The zero tracking load step change would take it out of the absolute limit. See Zero Tracking on page 40</td>
<td>47</td>
</tr>
<tr>
<td>Logical Output</td>
<td>Description</td>
<td>Index</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Ser Comm Lost</td>
<td>Output indicating that Scalenet serial communication has been initiated, and later timed out.</td>
<td>48</td>
</tr>
<tr>
<td>DF1 Comm Lost</td>
<td>Output indicating that DF1 serial communication has timed out.</td>
<td>49</td>
</tr>
<tr>
<td>Power Fail</td>
<td>Power was removed from the controller. This output only turns on when the controller is initialized during a power up sequence.</td>
<td>50</td>
</tr>
<tr>
<td>HPAD Failure</td>
<td>At least one of the HPAD boards fails to produce reliable data.</td>
<td>51</td>
</tr>
<tr>
<td>No Mat on Belt</td>
<td>Delayed output of loss of Mat on Belt logical input.</td>
<td>52</td>
</tr>
<tr>
<td>No Infeed Flow</td>
<td>Delayed output of loss of Infeed Flow logical input.</td>
<td>53</td>
</tr>
<tr>
<td>Dischrg Plugged</td>
<td>Delayed output of Disch Pluggage logical input.</td>
<td>54</td>
</tr>
<tr>
<td>Belt Slippage</td>
<td>Output indicating that the belt speed sensed by the two speed encoders is different by more than a the value set in Tacho (page 45).</td>
<td>55</td>
</tr>
<tr>
<td>Hi Instr Bin Wt</td>
<td>High Instream Bin weight. The value is set in the Instream Settings (page 71).</td>
<td>56</td>
</tr>
<tr>
<td>Lo Instr Bin Wt</td>
<td>Low Instream Bin weight. The value is set in the Instream Settings (page 71).</td>
<td>57</td>
</tr>
<tr>
<td>AuxIO Output 5-8</td>
<td>Output associated with the Available I/O that has the capability to be delayed on or off. These outputs may be used as an auxiliary timed output. Contact Merrick for more details.</td>
<td>58-61</td>
</tr>
<tr>
<td>Always ON</td>
<td>Output is always ON (closed).</td>
<td>62</td>
</tr>
<tr>
<td>Always OFF</td>
<td>Always turned off</td>
<td>63</td>
</tr>
</tbody>
</table>

### List of Physical Outputs

<table>
<thead>
<tr>
<th>Physical Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack 1 Output 1 - 8</td>
<td>PCIO #1 1&lt;sup&gt;st&lt;/sup&gt; bank.</td>
</tr>
<tr>
<td>Rack 2 Output 1 - 8</td>
<td>PCIO #1 2&lt;sup&gt;nd&lt;/sup&gt; bank.</td>
</tr>
<tr>
<td>Rack 3 Output 1 - 8</td>
<td>PCIO #2 1&lt;sup&gt;st&lt;/sup&gt; bank. Requires use of a second PCIO board.</td>
</tr>
<tr>
<td>Rack 4 Output 1 - 8</td>
<td>PCIO #2 2&lt;sup&gt;nd&lt;/sup&gt; bank. Requires use of a second PCIO board.</td>
</tr>
<tr>
<td>External Outputs</td>
<td>These can be used by a serial communication device to show the mapped logical output.</td>
</tr>
<tr>
<td>Accessory Switches</td>
<td>USED INTERNALLY ONLY</td>
</tr>
</tbody>
</table>

### Totalizer Settings

#### Totalizer Cut-Off

When the belt load drops below this value, the totalizers will stop. The totalization is bi-directional, meaning that it is possible to subtract from the total. This is desirable if there is a large variation of zero load on the belt. The lower limit is -10% of the design load. Limits are -10% to 100% of the Design Load.
**Weight Per Pulse**
This is the value used to scale the EMT (External Mechanical Totalizer) output. If the Weight per Pulse is set to 1 then there is a pulse for every pound or kilogram that is totalized. If Weight per Pulse Value is set to 100.0, there must be 100.0 pounds or kilograms totalized before a pulse is sent to the external totalizer. Limits are minimum 1.0 and a maximum of 100,000.0.

**Pulse Length**
This value is the length in seconds for the pulse that is sent to the EMT. A mechanical totalizer will require a longer pulse than an electronic totalizer or pulses may be missed. The pulse output from the controller is buffered, in order to allow slow EMT’s to “catch up” and be accurate. The recommended value for a mechanical totalizer is 0.10, and 0.01 for an electronic totalizer. Limits are minimum of 0.01 and a maximum of 5.0. The duty cycle should be 50% at the full pulse rate.

**Limit Switches**

<table>
<thead>
<tr>
<th>Limit Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedrate</td>
</tr>
<tr>
<td>Load</td>
</tr>
<tr>
<td>Speed</td>
</tr>
<tr>
<td>Setpoint</td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td>Panel Meter</td>
</tr>
<tr>
<td>E In Weight</td>
</tr>
<tr>
<td>Return</td>
</tr>
</tbody>
</table>

There are several programmable limit indicators available in the MC³ Controller. They may be changed during the normal operation of the feeder as required. The Limit Switch Logical outputs will turn on after the associated delay time. For example, if the High Feedrate limit is set to 50 lb/min and the actual feedrate is 55 lb/min, it will take the High Feedrate delay time to expire before the associated logical output to turn on.

There are main screen indicators and logical outputs that are directly affected by the settings in this function.

**Feedrate**
This button allows you to set the upper and lower limits for the feedrate and feedrate deviations.

**Load**
This button allows you to set the upper and lower limits for the belt load.

**Speed**
This button allows you to set the upper and lower limits for the belt speed.

**Setpoint**
This button allows you to set the upper and lower limits for the setpoint.

**NOTE:** The setpoint will not be allowed to exceed the limits. If a setpoint is entered that is above or below these limits the setpoint will be clamped to the limit.

**Output**
This button sets the upper and lower limits for the controller output.

**Panel Meter**
This button sets the upper and lower limits for the Panel Meter monitor. This is an analog input that is available for monitoring another device such as the current used by a VFD.
Feeder Delays

**Material On Belt Delay**

This is the delay between the start of loss of the Mat on Belt logical input and the enabling of the No Mat on Belt logical output. The logical output No Mat on Belt can be set to stop the feeder when the alarm property is set to Fault.

**Discharge Pluggage Delay**

This is the delay between the start of the Disch Pluggage logical input and the enabling of the Dischrg Plugged logical output. The logical output Dischrg Plugged can be set to stop the feeder when the alarm property is set to Fault.

**Infeed Flow Monitor Delay**

This is the delay between the start of loss of the Infeed Flow logical input and the enabling of the No Infeed Flow logical output.

**Belt Reverse Delay**

This is the amount of time allowed for the belt to stop before running the belt in the opposite direction.

**Startup Delay**

This parameter allows the logical output Belt Motor to turn on before the Belt Forward or Belt Reverse outputs. This is to facilitate resetting of certain models of VFD's.

**No Speed Detection Delay**

This is the amount of time to delay before the NO SPEED logical output is enabled.

**Bin Weight**

This button displays a numeric menu allowing changes to be made to the Bin Weight limits.

**Sample Rate**

The sample rate is the rate at which the load cell signal is sampled. There are two modes of sample rates in the MC³ 20.20.EX Controller, Internal and External.

- **Internal Sample Rate Parameters**
  - The Sample Time is the rate at which samples are read from the Load Cell A/D converter. The range can be from 0.10 to 5.00 seconds.

- **External Sample Rate Parameters**
  - This sampling mode is used when the sampling rate needs to be in sync with external events to eliminate the effect of cyclic disturbing forces.
  - The Pulse Divisor parameter is the actual number of pulses on tacho input 1 required to generate a HPAD sample. For example, if this parameter is set to 10, it would take 10 pulses for a A/D reading to be generated. Limits are minimum of 1 and a maximum of 1000.
The **Min Sample Time** is the shortest sample time the A/D will sync to. The default value is 0.05 seconds, which allows 30 samples per second. Limits are minimum of 0.10 and a maximum of 5.0.

The **Max Sample Time** is the longest sample time the A/D will sync to. The default value is 5.00 seconds, which allows 1 samples every 5 seconds. Limits are minimum of 0.10 and a maximum of 5.0.

**NOTE:** If the incoming pulse period would generate a sample time that is higher or lower than the Max and Min sample times, the sample rate will default to the Max and Min sample times.

### Communications Settings

Serial Communications provides the means to exchange information between the MC³ Controller and another device. For example, data in the MC³ Controller can be exchanged with devices such as SuperBridge, for PLC connectivity. The rules and format of the data exchange is described in a separate publication, *Merrick Serial Protocol Specification*.

Communications port 1 is used for communication with another intelligent device such as SuperBridge, for PLC connectivity. Port 2 is used to send strings to a serial printer.

![Communications Settings Diagram]

Communications port 1 is used for communication with another intelligent device such as SuperBridge, for PLC connectivity. Port 2 is used to send strings to a serial printer.

**NOTE:** Failure to program communications correctly can result in the operational failure of serial communications.

For Baud Rate, Data Bits, Stop bits and Parity parameters, simply touching the button for the corresponding parameter will toggle through the list of available settings.

### Baud Rate

The Baud Rate is the speed at which data is transmitted across the serial communications lines. Available baud rates are:

<table>
<thead>
<tr>
<th>Baud Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
</tr>
<tr>
<td>600</td>
</tr>
<tr>
<td>1200</td>
</tr>
<tr>
<td>2400</td>
</tr>
<tr>
<td>4800</td>
</tr>
<tr>
<td>9600</td>
</tr>
<tr>
<td>19200</td>
</tr>
<tr>
<td>38400</td>
</tr>
</tbody>
</table>

### Data Bits

The number of data bits value indicates how many bits represent each character transmitted or received on the serial communications lines. The options available are 5, 6, 7 or 8. The recommended value is eight (8).

### Stop Bits

This value is used to number of stop bits added to the end of a character transmission unit and may be set to 1 or 2. The recommended value is one (1).

### Parity

Parity is a method of error checking during serial communications. Available selections:

<table>
<thead>
<tr>
<th>Parity</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
</tr>
<tr>
<td>ODD</td>
</tr>
<tr>
<td>EVEN</td>
</tr>
<tr>
<td>MARK</td>
</tr>
<tr>
<td>SPACE</td>
</tr>
</tbody>
</table>
Comm 1 Numeric

An ASCII Begin Code and End Code must be designated for each message sent to and from the serial port on the MC³ Controller. Since not all computers and protocols have the same Begin and End Codes, an operator may wish to change them in order to attempt to communicate with non-Merrick equipment. A specific controller number is used to identify each controller on the network.

NOTE: It is very important: Two (2) controllers on the same serial line do not have the same controller address! This would result in both responding to a message at the same time. The results would usually be unusable data.

Comp Start Code

This value is always sent at the beginning of a communications message. This default value is 10, for an ASCII representation of a Line Feed. To enter new values for this variable, use the arrow keys to select your choice. Limits are minimum of 1 and a maximum of 127.

Comp End Code

This value is always sent at the end of a communications message. This default value is 13, for an ASCII representation of a Carriage Return. Limits are minimum of 1 and a maximum of 127.

Controller Number

This number is used to identify the numeric address of the controller when utilizing serial communications on a multi-drop line. Controllers connected to the same communication line should not have the same controller number. Limits are minimum of 1 and a maximum of 64.

Communication Time-out

This parameter is the allowed limit of no communications activity on the serial port. If this value is exceeded, the logical output Comm Timeout will turn on. Limits are minimum of 0 (turns off alarm) and a maximum of 1,000,000.

Write Prot

The controller will not write a value to a register until the bit for the register in this word is set. See the Modbus protocol manual for the correct bit order.

Byte (Word) Order

The Byte (Word) order bit reverses the order of the two (2) words that contain the value information. This may be needed to allow the device requesting the data to receive the value in the format it needs to correctly process the data.

Int/Frac FP

The Integer/Fraction bits are used when the device using the data does not support floating-point numbers. The first word will carry the integer part and the second word carrying the fractional part, multiplied by 10000 (giving 4 implied decimal places). Setting this value to 0 uses IEEE floating point format (default).

Tag Reg 1-5

These values are the registers to be monitored by the Modbus ASCII communications.

Comm 2 Numeric

This button allows the operator access to the DF-1/DNI Menu containing the parameters required for correct DF-1 Communications. DF-1 is an Allen-Bradley industrial communications protocol, which is supported by the MC3 Controller.
**DF1 Time-out**  
This is the delay that will set the DF1 Timeout logical output when DF1 communications have not been detected.

**DF1 Uses BCC (error detection)**  
This sets the type of error correction for the DF1 protocol. Setting this to 0 will cause the controller to use the CRC error correction. Setting this to 1 will set the error correction to BCC.

**Write Protect**  
The write protection property should be set when a MC³ register is tagged for monitoring only. When the DNI writes to words which are write protected, the corresponding Tag n W value changes accordingly, but the corresponding MC³ register (Tag n R Value) is unaffected.

**Byte (Word) Order**  
The Byte (Word) Order Bit, when set, reverses the order of the two words that contains value information. To correctly transfer floating-point values to AB SLC5/03, 4/04 and 5/05 PLC's, these bits have to be set. Most other devices, including all AB PLC-5 models, have normal (IEEE) floating point representation.

**Int/Frac FP**  
The Integer/Fraction bits are used when the device using the data does not support floating-point numbers. The first word will carry the Integer part, and the second the fractional part, multiplied with 10000. (4 implied decimal places). Examples of such devices are AB Micrologix PLC's, MS Excel, and most expensive SCADA systems like Foxboro, ABB and Bailey.

**Tag Reg 1-5**  
These are the registers to be monitored by DF1 communications.

**NOTE:**  
Please consult Merrick’s Customer Service Department for any questions or comments regarding the available communication protocols.

**HPAD Settings**

**A/D Function**  
This value sets the operating mode for the A/D functions. There are five modes of operation.

- **None** - There are no load cells attached to the controller. This function uses the value Inferred Load (page 46) for the Load value. The load will be displayed when the Material On Belt logical input is turned on. If the Material On Belt Logical input is turned off the load will display 0.

- **First** - Use the Load Cell Connected to HPAD #1 for determining the active load. This mode is to be used when there is only one HPAD in to your controller. This is the default setting.

- **Second** - Use the load cell connected to HPAD #2 for determining the active load.
Both - Use the average counts from both HPAD’s when determining the load.

Auto Bypass - Use the average counts from both HPAD’s when determining the load. In the event one of the HPAD’s fails or the values differ more than the allowed difference, the controller will use the Inferred Load (page 46) value calculated for the load indication.

Instream – The counts from HPAD #1 for determining belt load of the feeder. The counts from the HPAD #2 will be used to determine the weight in the Instream Bin.

Standard Settings

Set Status AD1/2

This value is the hardware calibration setting and is preset at the factory. This value should not be changed.

WARNING: THIS NUMBER SHOULD NOT BE CHANGED FROM ITS SETTING OF 2. DO NOT CHANGE THIS NUMBER!

Allowed Difference

This parameter is the allowed difference in counts between two installed HPAD’s. If this value is exceeded the logical output Load Imbalance will activate.

Diff T Delay

This is the delay to expire from the time the controller detects a difference between the HPAD’s and the notification that an imbalance has occurred.

WARNING: THE FOLLOWING VALUES ARE SET AT THE FACTORY AND SHOULD NEVER BE CHANGED.

GAIN AD 1/2

This value is used by the HPAD Converter to control the Gain setting of the HPAD Converter. The amount of Gain depends on how much dead load and live load there will be on the scale. The actual Gain of the controller decreases as the HPAD Gain Value is increased. This value is normally set to 15.

CAL AD 1/2

This value is used by the HPAD Converter to control an amount of positive offset added to the load cell signal. It is used to simulate load on the load cell during an Electronic Calibration, and is normally zero. In the rare occasion of negative dead load, a positive value can be present. The actual offset signal that is added is 0.2 mV/V times the Cal Set number.

ZERO AD 1/2

This value is used by the HPAD Converter to control an amount of negative offset added to the load cell signal. It is used to electronically remove some of dead load from the load cell signal. This allows the HPAD to operate at a higher Gain and achieve better resolution when measuring the load cell signal. The actual offset signal is added is -0.2 mV/V times the Zero Set number.

Instream Cal Parameters

Bin Cal Wt

This parameter is the total amount of weight to use for the Instream Bin Weight Procedure. The Instream Calibration procedures use the base load units as the units for weight. For example, if the load units are lb/ft then the bin weight units will be lb. As much weight as possible should be used to minimize errors.
**Bin Scale Factor (Bin SclFactor)**

This number is the 'Internal Scale Factor". It is used to provide a numeric relation between the HPAD Counts (from the Load Cell signal) and the actual load in engineering units.

It is important to remember that modifying this value affects the feeder calibration directly. This value is the result of calculations completed during a Weigh Span Calibration Procedure. The Static Weight Procedure, the Material Test Procedure and the E-Cal Procedure are all Weigh Span Tests, which calculate a new Scale Factor.

**Bin Zero Wt**

This value is the result of calculations completed during the Instream Bin Zeroing Procedure. This is the amount of "dead weight" of the bin. The "dead weight" is the weight of all mechanisms and other components that are a part of the bin. This number is subtracted from the Gross Weight to arrive at the Weight of material in the hopper.

**Bin Ecal mV/V**

This parameter is used by the Instream Bin E-Cal Procedure to inject a simulated weight into the HPAD #2 to simulate a weight in the bin.

**NOTE:** Normally this value is set after a weight calibration has been performed, then by running the E-Cal Factor test.

**Stable Span**

The samples used when determining stability must be within this value of each for the number of samples requested during the allotted time. This is allowed span in engineering units when determining stability.

**Stable Samples**

This is the number of consecutive samples that must be within the stability span during the allowed time for the scale to be considered stable.

**Stable Time**

This is the amount of time allowed while scale stability is being determined.

**Allowed Cal %**

The controller will not allow an Instream calibration to be accepted if the error is greater than this value.

**Instream Settings**

**Bin Hi Cal Wt**

The Instream Calibration Procedure uses this value to determine when to shut off the equipment filling the Instream bin. When the weight as seen by the controller exceeds this amount, a logical output (Cal Hi Bin Wt) is enabled. When the weight drops below this value the output turns off.

**Bin High Wt**

This value represents the normal maximum amount of material in the Instream bin. When the weight as seen by the controller exceeds this amount, a logical output (Hi Bin Weight) is enabled. When the weight drops below this value the output turns off.

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**Bin Low Wt**

This value represents the normal minimum amount of material in the Instream bin. When the weight as seen by the controller drops below this amount, a logical output (Lo Bin Weight) is enabled. When the weight drops goes above this value the output turns off.

**Bin Settle Tm**

This timer is used to allow the material in the Instream Bin to settle or de-aerate after the Instream Gate has closed. The Auto and Instream Calibration procedures use this timer.

**Bin Prefd Tm**

This timer is used to allow the equipment filling the Instream Bin to stop before requesting to close the Instream Gate. The Instream Calibration procedure uses this timer.
CALIBRATING YOUR CONTROLLER

There are four categories of calibration procedures, intended for:

1. Correctly update the totalizers. This is performed by updating the scale factor. The scale factor is the relation between the raw counts from the HPADs and the belt load variable. If there are no load cells (ai_hpadnum is enumerated to “No Load Cells”) the inferred belt load is updated instead. The procedure available for this is Material Calibration. It is based on an amount of material, passing over the feeder, which is weighed elsewhere, on a reference scale. Normally, the Material Calibration Procedure is the most accurate way of calibrating a feeder. This is only true, however, if the feeder is properly zeroed at the time the Material Calibration takes place. It is also worth noting, that if there is an error in the calibration of the belt speed and belt travel, the scale factor is going to be updated to compensate for it, resulting in an accurate totalization and feedrate indication, but less accurate speed and belt load indication.

2. Correctly update Belt Speed and Belt Travel. This is accomplished by updating the number of tacho pulses for one belt revolution. If two encoders are used, the first (primary) tacho is used, and the pulse ratio between the two is calculated and stored. The procedure is called Belt Speed Calibration. At least one tacho must be used for this procedure. If ai_tachonum is enumerated to “No Tacho” or “Simulation”, this calibration can not be performed.

3. Correctly update the Belt Load. This is also accomplished by updating the scale factor. Three different methods are supported: Test Chain (with a known load in weight/length), Test Weights (with a known weight and a known weigh span), and electric (with a known live load signal from the load cells). All procedures assume a correctly calibrated belt speed and belt travel calibration, and also a properly zeroed scale. The chain load, weigh span and live load values can all be updated (factored) to accommodate consistency between different calibration procedures. Thus there are six procedures available, three calibration procedures and three factoring procedures.

4. Establishing the loading when there is no material on the belt. This is called zeroing. It is important to note that this traditionally was called “tare” or “tareing the scale”. This is no longer a usable name, since it is reserved for other purposes. When the Zero Memory logical input is turned on, the zeroing procedure also establishes a table of belt loads along the belt.

INITIAL CALIBRATION CHECKLIST

Before attempting to calibrate the feeder, insure that all values and parameters from the Specification Sheet have been entered into the controller correctly. Improper entry of some values in the controller can cause inaccurate calibration of the feeder. Below is a checklist with the order in which calibration tests should be accomplished. The first time a controller is installed all of the Calibration Routines listed below should be completed for proper operation. After the initial calibration is complete, it is normal to re-calibrate the feeder periodically by completing a Zeroing Procedure and then a Calibration Procedure.

The calibration strategy is depending of the means available to you, but some general guidelines are

Always start with a Belt Speed Calibration. As long as there is one functional tacho, and the belt length can be measured, this procedure is possible to execute.

Run the Zero Load procedure to establish the zero load. If possible, temporarily alter the belt tension and re-run the zero procedure, to check that the belt tension does not affect the zero load. If it does, the weigh span needs to be re-aligned.
Run a Material Calibration, if possible. Immediately after the Material Calibration, run a Chain Factor procedure (if a test chain is available), a Weight Factor procedure (if test weights are available) and an E-cal Factor procedure.

If a Material Calibration procedure cannot be run, use the Chain Calibration procedure, if possible. Immediately after the Chain Calibration, run a Weight Factor procedure (if test weights are available) and an E-cal Factor procedure.

If a Material Calibration or Chain Calibration procedure cannot be run, use the Weight Calibration procedure, if possible. Immediately after the Weight Calibration, run an E-cal Factor procedure.

If a Material Calibration, Chain Calibration or Weight Calibration procedure cannot be run, use the Electrical Calibration (E-cal) procedure.

**CALIBRATION MENU**

To enter the Calibration Menu, press the **Cal** button while in the Action Menu.

The display will show the password entry screen. A four digit numeric password must be entered at this time. The default (unmodified) value of the Calibrate Password is 1234. While entering the password an asterisk (*) will appear for each digit entered. If the correct password has not been entered you will be prompted again for the Calibration Password. If the correct password has been entered the Calibration menu will be displayed.

You may run any of the calibration procedures at any time, but if the calibration access logical input is off you will not be able to accept and change any results.

**SPEED CALIBRATION**

This procedure is used to set the pulses per revolution of the feeder belt for accurate indication of speed. If there are two encoders attached to the feeder, this procedure will also set the ratio between the two encoders.

The first screen to appear will show you the current setting of Pulses / Rev (page 41) and the # Speed Revs (page 42). See Belt on page 41 for information regarding changing those parameters. If two encoders are configured the ratio of tacho 2 to tacho 1 is also displayed.

A logical input, **Spd Pulse Block**, is available for use to start and stop the pulses from the encoder. You can map the input to an unused physical input, connect a switch to the input and use the switch to start and stop the encoder pulses to the controller. If no method is available to start and stop the encoder pulses, the start and stop button can be used.

You should mark an index on the belt and on the feeder. This will make it easier to count the number of belt revolutions needed for accurate results. When performing the test insure that you are able to see the belt and index for proper counting of belt revolutions.
If your feeder has a Feeder Connection Board turn off the Tacho Pulses switch. Press to start the test. Turn on the tacho pulses switch. Keep track of the number of revolutions of the belt. As the test progresses, you will see the tacho counts accumulate on the screen.

When the number of revolutions is completed, turn off the Tacho Pulses switch and then press the button to acknowledge the end of the test.

If the values are correct press to accept or to reject the results.

Before proceeding with other calibration procedures or normal operation verify that pulses are turned back on to the controller.

**ZEROING PROCEDURE**

The purpose of the Zeroing Procedure is to zero the average belt load value when the belt is running empty. This procedure will measure the average load over the length of the belt and adjust the zero load value accordingly. The Zeroing Procedure is accomplished by the controller recording weight readings while the feeder is running empty. For a correct Zero Load value to be computed the belt should be empty during the test. The controller will record load readings for a set amount of belt revolutions. The number of belt revolutions for the test is determined by the parameter “# Proc Revs” (page 42). After the correct number of belt revolutions is reached, the
controller will display a difference value computed for the change in the new zero load value. The operator will then have the option of accepting or rejecting the new zero load value.

If you do not wish to run the Zeroing Procedure, press the CANCEL button to return to the Calibration Menu. However, if you are ready to begin the Zeroing Procedure press START. The display will show the percent of the test completed.

After the test is 100 percent complete the display will show the difference between the current and new Zero Load values.

At this point the change in the zero load value as a percent of design load will be shown in the display. If you wish to accept the new zero load value press ACCEPT. Otherwise, press CANCEL to abort the results of the test. Pressing either button will return you to the calibration menu:

**MATERIAL TEST**

The Material Test allows you to enter the actual value that passed over the feeder to compare with the value that the controller totaled. The Total or Sub-Total display can be used to calculate the desired percentage of change for the Material Test. The MC³ displays the Sub-Total as a suggestion in the Scale Totalized value. First the desired totalizer is reset to zero. Then a known amount of material is fed across the feeder. The feeder will totalize this material.
The actual weight of the material fed through the feeder is entered into the controller through the Actual Total entry screen. When both values are correct you must touch the Accept button to continue.

The error between the weighed and totalized amount is calculated automatically by the controller and will be displayed to you as a percentage. The controller will adjust its Scale Factor relative to the error entered.

**MC³ Totalized**

The MC³ Controller will suggest the current Sub Total. You may change or update the value.

**Actual Total**

This is the amount of material that the MC³ Controller actually fed. This value should be accurate and verified by an external source.

Use Entering New Values on page 38 for instructions on entering values.

After entering the values press the **ACCEPT** button.

The difference in percentage will be displayed.

If OK press the **ACCEPT** to accept changes.

**CHAIN PROCEDURE**

A chain that produces a known load value is placed on the feeder. The controller will record load readings for a set amount of belt revolutions and compare this to the calibration Chain Load (page 46) value. The number of belt revolutions for the test is determined by the parameter "# Proc Revs" (page 42). After the correct number of belt revolutions is reached, the controller will display a difference value computed for the change in the new scale factor value. The operator will then have the option of accepting or rejecting the new value.

**NOTE:** After running a Chain Factor, the Chain Test uses the Factored Chain value.

The belt must be running for this test. The display will show:
If your chain has been installed and you are ready to begin the Chain Procedure press the START button. The display will show the percentage of test completed:

After the test is complete the display will show:

If the test is not accurate or if you do not wish to complete the Chain Procedure for any reason, press the CANCEL button to return to the Calibration Menu.

If you wish to accept the new values press ACCEPT. Otherwise, press CANCEL to abort the results of the test.

**CHAIN FACTOR PROCEDURE**

This procedure will store an adjusted chain value using the current internal Scale Factor as guidelines. This should only be run after an accurate Material Calibration procedure has been performed.

The Feeder must be running to perform this procedure. Also a Grav Weigh Span value (page 45) must be entered. To run a Chain Factor Procedure, select this option from the Calibration menu. From this point on the procedure is just like the Chain Procedure. See page 77 for a description of the Chain Procedure. After the procedure is complete, a new chain load value will be stored. The calibration of the feeder is not affected in this test.

**WEIGHT PROCEDURE**

This test is normally used where there is no access to or is very difficult to apply a test chain to the feeder. A calibration weight is placed on the feeder, usually by hanging off the weigh
suspension The number of belt revolutions for the test is determined by the parameter "# Proc Revs" (page 42). After the correct number of belt revolutions is reached, the controller will display a difference value computed for the change in the new scale factor value. The operator will then have the option of accepting or rejecting the new value. Using the weight value entered in Calibration Weight (page 46), the controller computes the difference between what was totalized and what was calculated. This error is used to adjust the internal Scale Factor.

To begin the Weight Procedure press the button. The display will show:

If your calibration weights have been installed and you are ready to begin the procedure press the button. The display will show the percentage of test completed:

After the test is complete the display will show:

If the value is not accurate or if you do not wish to complete the procedure for any reason, press the button to return to the Calibration Menu.

If you wish to accept the new values press . Otherwise, press to abort the results of the test.

**WEIGHT FACTOR PROCEDURE**

This test will calculate a new Weigh Span using static weights. This should only be run after an accurate Material Test procedure (page 76) or a Chain Procedure (page 77) has been performed.

To run a Weight Factor Procedure, select this option from the Calibration menu. From this point on the procedure is just like the Weight Procedure. After the procedure is complete the difference
will be applied to the Gravimetric weigh span. This procedure does not change the calibration of the feeder.

**ELECTRONIC CALIBRATION**

The Electronic (E-Cal) Procedure is provided as a third method used to accurately calculate the internal Scale Factor of the Feeder. The E-Cal Procedure is used when it is not convenient to run a Material, Weight or a Chain Procedures on the feeder. The E-Cal Procedure is made possible by the ability of the MC³ HPAD Board to simulate a load on the load cell. The key to the accuracy of the E-Cal test is the E-Cal Live Load mV/V value entered in the Setup Menu. If this value has been correctly entered, then the E-Cal Test can be very accurate. Requirements for performing an E-Cal Test are as follows.

If the calculated Live Load has changed from the specification sheet, “Load Cell Live Load” in section “Machine Data”, use the following formula to calculate the E-Cal Live Load mV/V:

\[
\text{ECal Load mV/V} = \frac{\text{Design Live Load} \times \text{mV/V rating of Load Cell} \times \text{Weigh Span}}{\text{Capacity of Load Cell}}
\]

**NOTE:** See Design Capacities on page 40 for more information on the Design Load. See Grav Weigh Span on page 45 for more information regarding the Weigh Span value.

To start the test, press the **ECAL** button from the Calibration menu.

If the E-Cal Load mV/V is not accurate or if you do not wish to complete the E-Cal Procedure for any reason, press the **CANCEL** button to return to the Calibration menu. If you are ready to execute the E-Cal Procedure, press the **START** button.

During the test, the percentage completed will be displayed on the controller.
After the test is complete the display will show the error percentage.

At this point the proposed change in the internal Scale Factor as a percent of design load will be shown. If you wish to accept the new value press **ACCEPT** button, otherwise, press **CANCEL** to abort the test.

**E-CAL FACTOR PROCEDURE**

This test will store an adjusted E-Cal value using the internal scale factor as a guideline. This should only be run after an accurate Material, Chain or Weight procedure has been accomplished.

To run a E-Cal Factor Procedure, select this option from the Calibration menu. From this point on the test is just like the E-Cal Procedure. See page 80 for a description of the E-Cal Procedure. The E-Cal value will be adjusted accordingly. No change is made to the internal Scale Factor. The calibration of the feeder is not affected in this test.

**GRAB SAMPLE CALIBRATION**

Use this method only as a last resort. It sets the Load Scale Factor, while the feeder is running, using a diverter valve in the material flow, and a separate totalizer for the grab sample. A limit switch on the diverter valve must be connected to the logical input Diverter Valve. After opening and closing the diverter valve, and then weighing the diverted sample, enter the GRAB SAMPLE screen.

Enter the weight of the diverted material by touching the Sample Weight button, then touch **ACCEPT**.
You will be presented with the difference, new and old scale factor, and have the option to accept or cancel the procedure.

**ANALOG INPUT SETUP**

This procedure allows you to setup your analog inputs.

**Analog Input Setup**

Press the number of the input to calibrate.

Touch the number of the analog input to calibrate or touch the analog in alarms button to edit the analog input alarm values.

**Analog Input Setup**

<table>
<thead>
<tr>
<th>Live</th>
<th>Current</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>201102</td>
<td>201354</td>
<td>No Value</td>
</tr>
<tr>
<td>Hi</td>
<td>1001944</td>
<td>No Value</td>
</tr>
</tbody>
</table>

Adjust the input for a zero level. The live counts will vary accordingly. When zero is reached touch the snap zero button. The live value will snap to the new value column.

Adjust the input for full-scale level. The live counts should follow the input. When the full level has been reached touch the Snap full button. The live value will snap to the new Hi column.

**Analog Input Setup**

<table>
<thead>
<tr>
<th>Live</th>
<th>Current</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lo</td>
<td>201354</td>
<td>201128</td>
</tr>
<tr>
<td>Hi</td>
<td>1001944</td>
<td>1001593</td>
</tr>
</tbody>
</table>

If the values you selected are correct for your application, touch the accept button. The controller will move the values from the New column to the Current column and start using the new values.
INSTREAM CALIBRATION PROCEDURES

The following instructions explain the use of the Instream Calibration procedures. For an explanation refer to Instream Calibration Procedures (page 10).

**Auto Cal**

This procedure runs anytime the InstrmGate Clsd logical input is turned on and the Instream Cal procedure is not in progress.

The procedure.

1. Turn on the InstrmGate Clsd logical input. Usually this will be by a contact (i.e. Limit switch) indicating that the gate has been closed. Opening and closing of the gate is by other means.

2. The controller then waits the Bin Settle Tm (see Instream Settings menu) for the material to settle from being in-flight.

3. After the settling time has expired, the controller acquires the current bin weight and resets an internal totalizer.

4. During this time the weight in the bin must be observed to insure that the level of material does not drop below a safe operating level. The Bin Weight in the Large Font Display (NuMerrick) screen or the Lo Instr Bin Wt logical output may be used to determine the proper value to open the gate.

5. When the gate re-opens, the controller reads the bin weight and performs several calculations to obtain the values of changes that can be made.

To verify and accept the calibration values, touch the Accept button in the menu.

Touch Accept to install changes or Cancel to reject changes.
Instream Cal

This procedure uses several logical inputs and output to control and sense external control equipment. Also several numeric parameters are used to determine calibration events.

Parameters used are: **Bin Hi Cal Wt**, **Bin Low Wt**, **Bin Settle Tm** and **Bin Prefd Tm**.

Logical Input used is: **InstrmGate Clsd**.

Logical Outputs used are: **Cal In Progress**, **BCal In Progress**, **Fill Instrm Bin**, **Lo Instr Bin Wt**, and **Cls Instrm Vlv**.

To start the Instream calibration procedure touch the button.

Touch the button to begin the procedure.

The logical outputs **BCal In Progress** and **Fill Instrm Bin** are enabled. The **Fill Instrm Bin** is used to inform that the equipment attached to the infeed of the bin to fill the bin to the **Bin Hi Cal Wt** (Cal Wt:).

The controller will test the weight in the bin (Bin Wt:) until the **Bin Hi Cal Wt** (Cal Wt:) has been reached. The controller displays the **Bin Hi Cal Wt** (Cal Wt:) and the live bin weight (Bin Wt:) for convenience.
When the **Bin Hi Cal Wt** (Cal Wt:) has been reached the controller turns off the **Fill Instrm Bin** output. The controller then takes a time mark and will wait until the **Bin Prefd Tm** to allow the bin filling equipment to slow down and stop. This delay time is displayed as a count down timer on the controller screen.

When the **Bin Prefd Tm** expires the controller turns on the **Cls Instrm Gate** then waits until the logical input **InstrmGate Clsd** is turned on.
When the **InstrmGate Clsd** has been enabled, the controller takes another time mark and will wait until the **Bin Settle Tm** expires. This timer is used to allow the material in the bin to settle from being in flight. This time is displayed as a count down timer on the controller screen. Also the live bin weight (Bin Wt:) is displayed. The controller keeps the **Cls Instrm Gate** turned on.

When the **Bin Settle Tm** expires, the controller samples the weight in the hopper and checks the weight in the bin. The controller keeps the **Cls Instrm Gate** turned on.
When the weight in the bin drop below the **Bin Low Wt** (Low Wt:) value the controller then turns off the **Cls Instrm Gate** output. The controller will then display the results screen.

Touch **Accept** to install changes or **Cancel** to reject changes.

**Instream Bin Zeroing Procedure**

The purpose of the Instream Bin Zeroing Procedure is to zero the weight value when the hopper is empty. This procedure will measure the weight and adjust the zero weight value accordingly. For a correct Zero weight value to be computed the Instream Bin must be empty during the test. The controller will record weight readings, looking for a number of stable samples within the stable time.

To begin the Zeroing Procedure touch **Start**.
The display will show the elapsed time of the test and an indication on the stability of the scale.

To return to the calibration menu touch.

After the test is complete the display will show the difference between the current and new Zero Load values. At this point, the change in the zero weight value as a percent of design weight will be shown in the display. To accept the new zero weight value, touch the button. Otherwise, touch to abort the results of the test. Touching either button will return the screen to the calibration menu.

**Instream Bin Weight Procedure**

The Static Weight Calibration procedure is used to calibrate (span) the scale to show a correct weight. A Zeroing Procedure must always precede this procedure. To run this procedure, calibration weights that represent at least 10% of the overweight limit of the scale are required. The Instream Bin must not contain any material.

To begin the Weight Procedure, touch the button. Verify that the test weight is on the feeder and the amount agrees with the Calibration Weight displayed on the controller.

If the weight has been installed and the operator is ready to begin the procedure, touch
The display will show the elapsed time of the test and an indication on the stability of the scale.

To return to the calibration menu touch \[\text{Cancel}\].

After the number of stable samples has been achieved, the controller will display a difference value computed for the change in the new scale factor value. If the new values are correct, touch \[\text{Accept}\]. Otherwise, touch \[\text{Cancel}\] to abort the results of the test.

**Instream Bin ECal Procedure**

The Electronic (E-Cal) Procedure is provided as a method used to calculate the internal Scale Factor of the Feeder. The E-Cal Procedure is used when it is not convenient to run a Weight procedure. The E-Cal Procedure is made possible by the ability of the MC³ HPAD Board to simulate a load on the load cell. The key to the accuracy of the E-Cal test is the E-Cal Live Load mV/V value entered in the Setup Menu. If this value has been correctly entered, then the E-Cal Test can be very accurate. Requirements for performing an E-Cal Test are as follows.

If the calculated Live Load has changed from the specification sheet, "Load Cell Live Load" in section "Machine Data", use the following formula to calculate the E-Cal Live Load mV/V:

\[
\text{ECal Load mV/V} = \frac{\text{Design Weight} \times \text{mV/V rating of Load Cell}}{\text{Load Cell Capacity}}
\]

The Instream Bin must be empty when performing this procedure.

To start the test, touch \[\text{Start}\] from the Calibration menu.
If the E-Cal Load, mV/V is not accurate or to stop the E-Cal Procedure for any reason, touch Cancel to return to the calibration menu or touch Start to proceed.

After the test is complete, the display will show the error percentage. At this point, the proposed change to the internal Scale Factor, as a percent of design load, will be shown. To accept the new value, touch Accept, otherwise, touch Cancel to abort the test.

**Instream Bin ECal Factor Procedure**

This test will store an adjusted E-Cal value using the internal scale factor as a guideline. This procedure should only be run after an accurate material or weight procedure has been accomplished. The Instream Bin must be empty when performing this procedure.

To run an E-Cal Factor Procedure, select this option from the Calibration menu. From this point on the test is just like the E-Cal Procedure. The E-Cal value will be adjusted accordingly. This does not make changes to the internal Scale Factor. The calibration of the feeder is not affected in this test.
DIAGNOSING PROBLEMS

DIAGNOSTIC DISPLAY

The Diagnostic Menus for the MC³ Controller is provided to allow access to additional displays and values. It is not necessary to access this menu under normal operating conditions. It is provided as a troubleshooting tool and should be accessed only by knowledgeable personnel. The Diagnostic Setting Menu has its own password.

```
<table>
<thead>
<tr>
<th>HPAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
```

### Diagnostic Settings

This selection takes you to the Diagnostic menu. See Diagnostic Settings (page 99) for further explanation on the Diagnostic menu system. This menu is password protected.

### Faults

This selection allows you to view the status of the Logical I/O selected as Faults (page 21) at any time.

### Warning

This selection allows you to view the status of the Logical I/O selected as Warnings (page 21) at any time.

### HPAD Diagnostics

- **Cnts**
  This display is the raw, digital representation of the total belt load as it is received directly from the HPAD. It is the same as HPAD #1 if one HPAD is used. It is the average of HPAD #1 and HPAD #2 if two HPAD's are used. When the A/D Function (page 69) is set to Both or Auto Bypass the controller will display the value for the second HPAD in a separate box.

- **Avgd Cnts**
  When the A/D Function (page 69) is set to Both or Auto Bypass the controller will display the averaged counts in a separate box.
mV/V
The Live Load mV/V is the relative output signal of the load cell, representing the live load on the belt. When the A/D Function (page 69) is set to Both or Auto Bypass the controller will display the value for the second HPAD in a separate box.

LL
When the A/D Function (page 69) is set to Both or Auto Bypass the controller will display the combined mV/V value for both HPAD’s in a separate box.

Ld
This value is the current belt load in engineering units.

Z Ld
This is the amount of “dead” load of the feeder. This number is used to subtract the portion of the dead load that is not subtracted by the HPAD Zero set mechanism (see below). It is important to remember that modifying this value affects the zero calibration directly.

An example for which it might be necessary to change this value directly, would be to return a scale to a known Zero Value after the system has been reset or damaged in some way. After a good Zero Calibration has been accomplished, it is a good idea to record this number for future reference. When the A/D Function (page 69) is set to Both or Auto Bypass the controller will display the value for the second HPAD in a separate box.

The display also shows when the last Zero calibration occurred.

Scale Factor
This number is the ‘Internal Scale Factor”. It is used to provide a relation between the HPAD Counts (from the Load Cell signal) and the actual load in engineering units.

It is important to remember that modifying this value affects the feeder calibration directly. An example for which it might be necessary to change this value directly, would be to return a scale to a known calibration after the system has been reset or damaged in some way. After a good calibration has been accomplished, it is a good idea to record this number for future reference.

The date of the last calibration affecting the scale factor is also displayed.

Settings
CAL, ZERO, GAIN, SET STAT. A thorough discussion of the meanings of these setting is discussed in HPAD Settings on page 69.

Mix/Max Counts
The controller will also display the minimum and maximum counts (with the date and time) that have occurred since the last time the button has been pressed.

Communication Diagnostics
When you are using ScaleNet on Comm 1 for communications, this screen is useful for troubleshooting.
ScaleNet Diagnostic

Rx Buff  The first 28 characters in the receiver buffer; start character and controller number stripped out.

TX Buffer  The first 28 characters in the transmitter buffer; start character and controller number stripped out.

**NOTE:** Not all characters can be displayed so some may appear as spaces. When a long telegram is followed by a short, you will see the tail of the long, following the short.

**ERR**  Errors and statistics counters

<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Receive Errors Counter</td>
</tr>
<tr>
<td>B</td>
<td>Status Errors Counter. A status error is a UART error condition, such as parity or overrun error.</td>
</tr>
<tr>
<td>C</td>
<td>Input Buffer Overrun Errors Counter. Too many characters have been received without an End character</td>
</tr>
<tr>
<td>D</td>
<td>Bad Message Counter. The MC³ does not understand the incoming telegram.</td>
</tr>
<tr>
<td>E</td>
<td>Communication Interrupts Counter. Increments for every character transmitted or received.</td>
</tr>
<tr>
<td>F</td>
<td>UART Status Register</td>
</tr>
</tbody>
</table>

**States, IIR**  IIR, UART Interrupt Identification Register

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Modem status changed</td>
</tr>
<tr>
<td>1</td>
<td>No interrupt pending</td>
</tr>
<tr>
<td>2</td>
<td>Transmitter buffer empty</td>
</tr>
<tr>
<td>3</td>
<td>No interrupt pending</td>
</tr>
<tr>
<td>4</td>
<td>Receiver buffer full</td>
</tr>
<tr>
<td>5</td>
<td>No interrupt pending</td>
</tr>
<tr>
<td>6</td>
<td>Receiver buffer full and receive character error</td>
</tr>
<tr>
<td>7</td>
<td>No interrupt pending</td>
</tr>
</tbody>
</table>

**States, LSR**  UART Line Status Register, bit encoded

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 7</td>
<td>Not used.</td>
</tr>
</tbody>
</table>
| Bit 6 | Transmitter Empty  
1 - No byte in transmitter hold or transmitter shift register  
0 - One byte in transmitter hold or transmitter shift register |
| Bit 5 | Transmitter Buffer Empty  
1 - no byte in Transmitter Hold Register  
0 - one byte in Transmitter Hold Register |
<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 4</td>
<td>Break.</td>
</tr>
<tr>
<td></td>
<td>1 – Break Detected</td>
</tr>
<tr>
<td></td>
<td>0 - No Break Detected</td>
</tr>
<tr>
<td>Bit 3</td>
<td>Framing Error</td>
</tr>
<tr>
<td></td>
<td>1 – Framing Error Detected</td>
</tr>
<tr>
<td></td>
<td>0 - No Framing Error Detected</td>
</tr>
<tr>
<td>Bit 2</td>
<td>Parity Error</td>
</tr>
<tr>
<td></td>
<td>1 – Parity Error Detected</td>
</tr>
<tr>
<td></td>
<td>0 - No Parity Error Detected</td>
</tr>
<tr>
<td>Bit 1</td>
<td>Overrun Error</td>
</tr>
<tr>
<td></td>
<td>1 – Overrun Error Detected</td>
</tr>
<tr>
<td></td>
<td>0 - No overrun error Detected</td>
</tr>
<tr>
<td>Bit 0</td>
<td>Receive Data Ready</td>
</tr>
<tr>
<td></td>
<td>1 - Received data in receiver buffer register</td>
</tr>
<tr>
<td></td>
<td>0 - No Received Data</td>
</tr>
</tbody>
</table>

**States, RX**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Waiting for start char</td>
</tr>
<tr>
<td>1</td>
<td>Waiting for controller address</td>
</tr>
<tr>
<td>2</td>
<td>Addressed, Buffering chars</td>
</tr>
<tr>
<td>3</td>
<td>Message received, not processed yet</td>
</tr>
</tbody>
</table>

**States, TX**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Transmitter passive</td>
</tr>
<tr>
<td>1</td>
<td>Transmitter active</td>
</tr>
<tr>
<td>2</td>
<td>The last byte of the telegram is being transmitted</td>
</tr>
</tbody>
</table>
## Error Counters

Communications status and statistics can be inspected in the MC³. The following table explains the counters.

<table>
<thead>
<tr>
<th>Label</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>rxlen</td>
<td>Length, in bytes, of the last incoming telegram</td>
</tr>
<tr>
<td>lalen</td>
<td>Length, in bytes, of the last outgoing telegram</td>
</tr>
<tr>
<td>cCRC</td>
<td>CRC16 value calculated out of the incoming telegram. Hex.</td>
</tr>
<tr>
<td>tCRC</td>
<td>CRC16 value received in the incoming telegram. Hex. Should be the same as cCRC</td>
</tr>
<tr>
<td>mxtim</td>
<td>Communications timeout in 100 ms ticks - &quot;Comm Timeout&quot; in the Com/Num menu</td>
</tr>
<tr>
<td>unita</td>
<td>&quot;Slave address&quot; for this controller number. &quot;Controller Number&quot; in Com/Num menu</td>
</tr>
<tr>
<td>ints</td>
<td>Comm events counter. Counts all incoming and outgoing bytes</td>
</tr>
<tr>
<td>rxchs</td>
<td>Received bytes counter.</td>
</tr>
<tr>
<td>txchs</td>
<td>Transmitted bytes counter</td>
</tr>
<tr>
<td>rtgms</td>
<td>Received, complete telegrams to this node counter</td>
</tr>
<tr>
<td>ttgms</td>
<td>Transmitted telegrams from this node</td>
</tr>
<tr>
<td>rENQs</td>
<td>Received ENQ counter. Retransmission requests (Not used in Modbus.)</td>
</tr>
<tr>
<td>tENQs</td>
<td>Transmitted ENQ counter. Retransmission requests (Not used in Modbus).</td>
</tr>
<tr>
<td>rNAKs</td>
<td>Received NAK counter. Telegrams to this node with badly formatted data, requesting non-existing registers or writing to write-protected registers (Not used in Modbus).</td>
</tr>
<tr>
<td>tNAKs</td>
<td>Transmitted NAK counter. Telegrams to this node with badly formatted data, requesting non-existing registers or writing to write-protected registers</td>
</tr>
<tr>
<td>rACKs</td>
<td>Received ACK counter (Not used in Modbus).</td>
</tr>
<tr>
<td>tACKs</td>
<td>Transmitted ACK counter (Not used in Modbus).</td>
</tr>
<tr>
<td>NotMe</td>
<td>Received telegrams intended for other nodes counter</td>
</tr>
<tr>
<td>rxe</td>
<td>Received telegrams in error counter</td>
</tr>
<tr>
<td>rxuae</td>
<td>Received bytes with UART errors counter</td>
</tr>
<tr>
<td>rxlua</td>
<td>Last encountered UART error. See note 1.</td>
</tr>
<tr>
<td>rxces</td>
<td>Received telegrams with CRC16 error counter</td>
</tr>
<tr>
<td>rxfme</td>
<td>Received telegrams with format error counter</td>
</tr>
<tr>
<td>rxfm</td>
<td>Last format error encountered. See note 2.</td>
</tr>
<tr>
<td>rxcme</td>
<td>Non-supported command received counter</td>
</tr>
<tr>
<td>timee</td>
<td>Comm timeouts counter</td>
</tr>
<tr>
<td>addr</td>
<td>First register in received command. Should toggle between 16 and 44</td>
</tr>
<tr>
<td>size</td>
<td>Number of registers in received command. Should toggle between 8 and 4</td>
</tr>
<tr>
<td>cmd</td>
<td>Modbus command received. Should toggle between 3 and 16</td>
</tr>
<tr>
<td>subf</td>
<td>Subfunction in diagnostics command. Not supported yet</td>
</tr>
<tr>
<td>retST</td>
<td>Return status of an received command causing a NAK</td>
</tr>
<tr>
<td>Label</td>
<td>Meaning</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>RX</td>
<td>Received telegram. Bytes in HEX format</td>
</tr>
<tr>
<td>TX</td>
<td>Transmitted telegram from this node. Bytes in hex format.</td>
</tr>
</tbody>
</table>


**Note 2** Format errors have a decimal numerical value:
1. Unsupported Modbus command.
2. Read Holding Register telegram not 6 bytes long.
3. Trying to read from non-existing registers.
4. Read Diagnostic telegram not 8 bytes long.
5. Unsupported sub function in Read Diagnostics telegram.
6. Trying to write to non-existing registers.
7. Byte count field disagrees with length field in Preset Multiple Registers command.
8. Telegram length disagrees with length field in Preset Multiple Registers command.
9. Trying to write to read-only registers.
10. Unknown Modbus command.
11. MC³ Receiver buffer overrun - more than 255 bytes in telegram.
12. Linefeed not following Carriage Return in Modbus ASCII telegram.
13. Bytes received after complete telegram, before telegram interpretation (too fast).
15. Should never happen… Transmitter buffer overrun.

**Data Table**

<table>
<thead>
<tr>
<th>Str/DNI</th>
<th>1000</th>
<th>Ctrl/DNI</th>
<th>0000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Est.xlsx</td>
<td>0000</td>
<td>Est.xlsx</td>
<td>0000</td>
</tr>
<tr>
<td>Warning</td>
<td>0000</td>
<td>Feed SP</td>
<td>1.000000e+00</td>
</tr>
<tr>
<td>Faults</td>
<td>0000</td>
<td>Sec SP</td>
<td>1.000000e+00</td>
</tr>
<tr>
<td>Tst R U</td>
<td>0.000000e+00</td>
<td>Tst R U</td>
<td>0.000000e+00</td>
</tr>
<tr>
<td>Tst R V</td>
<td>0.000000e+00</td>
<td>Tst R V</td>
<td>0.000000e+00</td>
</tr>
<tr>
<td>Tst R W</td>
<td>0.000000e+00</td>
<td>Tst R W</td>
<td>0.000000e+00</td>
</tr>
<tr>
<td>Tst S U</td>
<td>0.000000e+00</td>
<td>Tst S U</td>
<td>0.000000e+00</td>
</tr>
<tr>
<td>Tst S V</td>
<td>0.000000e+00</td>
<td>Tst S V</td>
<td>0.000000e+00</td>
</tr>
<tr>
<td>Tst S W</td>
<td>0.000000e+00</td>
<td>Tst S W</td>
<td>0.000000e+00</td>
</tr>
</tbody>
</table>

The data table exposed to communications can be inspected in the MC³. Note that the values are only updated on valid DF1 or Modbus telegrams. If no telegrams have been received, most values are zero. The layout follows the MC³ data map exactly. The 'e' format of the floating points can help troubleshooting FP transfers. You are reading from the first six rows to the left, and writing to the first 3 rows on the right. If you succeed with the integrity bit, you should see the Sts/DNI and Ctl/DNI toggle between XX00 and XX80.
Analog I/O Diagnostics

This diagnostic screen displays the current function and type for each of the Analog outputs. The “Actual” column in the output section displays the current value of function selected for the particular output. The “EST-mA” column displays the estimated milliamp value for the output. See Analog Outputs on page 54 for more information.

In the Input section the current analog counts, the percentage of the allowed range and the value based on the full scale value for the particular input are displayed. See Analog Inputs (page 53) for more information.

Digital I/O Diagnostics

The button between the up and down arrows toggles between Digital Outputs and Inputs. The up and down arrow buttons are used to page the digital I/O points. Also is available for displaying the complete logical and physical list without the current mapping.

ST - Current status of I/O point.

IV Invert the I/O point.

I The I/O point is inverted.

WF Fault or Warning

F The I/O point is qualified as a Fault.

W The I/O point is qualified as a Warning.
<table>
<thead>
<tr>
<th>FC</th>
<th>Force the I/O point ON, OFF or Normal Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The I/O point is forced off..</td>
</tr>
<tr>
<td>1</td>
<td>The I/O point is forced on..</td>
</tr>
</tbody>
</table>

**Register Monitor**

<table>
<thead>
<tr>
<th>Register</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0250</td>
<td>0.0</td>
</tr>
<tr>
<td>R0261</td>
<td>0.0</td>
</tr>
<tr>
<td>R0172</td>
<td>7.11</td>
</tr>
<tr>
<td>R0621</td>
<td>0.0</td>
</tr>
<tr>
<td>R0673</td>
<td>0.00</td>
</tr>
<tr>
<td>R0480</td>
<td>0.0</td>
</tr>
<tr>
<td>R0232</td>
<td>45.000</td>
</tr>
<tr>
<td>R0247</td>
<td>0.00</td>
</tr>
</tbody>
</table>

This screen is used to monitor the values of specific registers. The display includes the register number, the value and the register name.

To setup the register pointers you must have access to the Register Editor and a register list. Determine the number of the register 'ai_regptr0'. Enter this value into the register number field (R[ ]) in the register editor. Tab to the register value entry field. Clear and enter the number of the register you wish to view in the monitor. You may enter up to eight different registers for viewing with the register monitor.

**Misc. Data**

This screen displays various operating data including the start and current times the number of hours that the controller has been running, NMI Counts and other data.

**Calib Display**

This screen displays the current and previous 3 calibrations affecting the Zero Load and Scale Factor values that have been performed. The date and time stamp is also displayed.
DIAGNOSTIC SETTINGS

This menu will allow you to change the password and directly edit registers if allowed.

**Password Settings**

This option is used to select the passwords that allow specific users access to the Calibration, Setup and Diagnostic screens. The password is a four digit numeric value.

<table>
<thead>
<tr>
<th>Menu</th>
<th>Default Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration</td>
<td>1234</td>
</tr>
<tr>
<td>Set-Up</td>
<td>5678</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>1030</td>
</tr>
<tr>
<td>Setpoint</td>
<td>0</td>
</tr>
</tbody>
</table>

This software incorporates a failsafe method of gaining access to this menu in case of lost passwords. It is called the challenge response system. On the Diagnostic screen a string is displayed called challenge. Phone this number into Merrick service and a response will be given to allow entry to the diagnostic settings menu to observe or change the password.

**Register Editor**

Access to the Register Editor menu is only allowed if the logic input Register Access is enabled. If the logical input is off the button for the Register Editor button will not appear on the diagnostic screen.

Use of the register editor is simple. The '>' symbol is used to denote the active line. The top line displays the current register number. The second line displays the register name and the value that the register contains.

Register editor screen

**NOTE:** Before entering new values into the controller, clear the previous value by touching this button.

The tab button is used to switch between the Register Number line and the Register Name/Value line.

The left arrow is used a backspace key in the register editor.
The up and down arrow buttons are used to scroll up and down through the register list. This works when either the register number or register name is the current selection.

**Quick Setup**

This button will setup reasonable values for the following parameters. It will appear when the Register Access logical input is enabled.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Load</td>
<td>40</td>
</tr>
<tr>
<td>Inferred Load</td>
<td>46</td>
</tr>
<tr>
<td>Zero Slots</td>
<td>42</td>
</tr>
<tr>
<td>Totalizer Cut-Off</td>
<td>64</td>
</tr>
<tr>
<td>Decimal Points</td>
<td>40</td>
</tr>
<tr>
<td>Nominal Speed</td>
<td>42</td>
</tr>
<tr>
<td>AIN Full Val</td>
<td>52</td>
</tr>
<tr>
<td>Maximum Scale Values</td>
<td>54</td>
</tr>
<tr>
<td>Max/Min Load SP</td>
<td>51</td>
</tr>
<tr>
<td>Infeed LdCell</td>
<td>43</td>
</tr>
<tr>
<td>Feedrate Limit Switches</td>
<td>65</td>
</tr>
<tr>
<td>Load Limit Switches</td>
<td>65</td>
</tr>
<tr>
<td>Speed Limit Switches</td>
<td>65</td>
</tr>
<tr>
<td>Setpoint Limit Switches</td>
<td>65</td>
</tr>
<tr>
<td>Zero Tracking</td>
<td>40</td>
</tr>
<tr>
<td>Instream Cal Parameters</td>
<td>70</td>
</tr>
<tr>
<td>Instream Settings</td>
<td>71</td>
</tr>
</tbody>
</table>
SOLVING PROBLEMS

If the following procedures do not assist in solving the problem, see Technical Support on page 2 on obtaining factory support for the controller.

SYMPTOMS

Unit does not power up.

WARNING: ONLY QUALIFIED SERVICE TECHNICIANS SHOULD WORK ON THE CONTROLLER. WHEN WORKING WITH LIVE VOLTAGES INSURE ALL SAFETY PRECAUTIONS ARE TAKEN.

Check wiring harnesses, Power running to the controller.

Verify that the fuses are good. There are two (2) fuses in the controller. One (1) is in the power receptacle and one (1) is on the power supply board.

Using a voltmeter, verify that 110V is present at the power supply.

Verify that the +5 volt and ±12 volts at the power supply are good.

Controller Fails to Boot Up.

If the message "Bad Register Checksum", touch OK to Continue" appears during boot-up, hit OK and the controller should continue to initialize. After the controller has initialized, check all settings carefully before operating the Feeder.

By touching the upper left and right corners of the touch screen simultaneously during initialization, a screen will be displayed requesting "Reset the Registers to Reasonable Values?"

This will set the feeder to the factory defaults that will be different from the actual setup. Re-enter all of the operating parameters and re-calibrate the feeder before normal operation can resume.

WARNING: MAKE SURE THAT YOU CHECK ALL SETTINGS CAREFULLY BEFORE STARTING THE FEEDER. OTHERWISE, THE FEEDER COULD OPERATE IN AN UNSAFE MODE.

LCD Display too dark or too light

The contrast of the LCD display is affected by large temperature changes. It may need to adjust it. The contrast adjustment (R3) is located inside the controller on the backside of the display assembly in the upper right hand corner.

The LCD backlight may be burnt-out and need to be replaced. This can be verified by removing the top of the controller and looking at the display assembly. With power applied, there should be a light seen from the backlight coming from the bottom of the assembly.

No Weight, or Bad Weight Reading

Check all wiring connections.

Has the scale been properly calibrated? If not, see Calibrating Your Controller (page 58) for proper setup procedures.

Inoperative HPAD, Counts = 0 or 16,777,215. If there isn't any response and the system is using 5 wire Load cell connections insure that the sense signal lines are connected to the excitation voltage.

Check and insure the correct number of HPAD's installed is entered in HPAD Settings.

Check that a positive millivolt input between 0.01 an 30.0 mV exists on the terminals four (4) and five (5) on the HPAD Board. If it does not exist, the load cell may be damaged or incorrectly connected.
After correcting the problem, cycle the power to the controller.

**No analog Input**

Check all wiring; make sure that the polarity is correct.

If at all possible, place a current meter in series with the current loop and verify that current is present and the polarity is correct.

Check that a positive millivolt input between 0.01 an 1.0 mV exists on the terminals five (5) and six (6) on the HPAD Board. If it does not exist, the signal source may be damaged or incorrectly connected.

After correcting the problem, cycle the power to the controller.

**External Totalizer problems**

1. Check and verify all wiring and connections are correct.
2. If the system is using a DC EMT, check the polarity of the connection between the EMT and the controller are correct.
3. Check the "External Mechanical" on page 49 and verify that the Divide Value and Pulse Length values are correct for the installation.

**No Serial Communications**

Check all cables and wire harness.

Check the serial port settings in Communications on page 53 (baud rate, data bit, stop bits, parity.)

**Hang Message Appears**

The hang screen message will appear if an error occurs within the control software that could effect the safe operation of the system. If the hang screen appears, write down the exact error that is displayed on the screen and call customer support at Merrick Industries. Several types of errors may cause the controller to reset or reboot. If this occurs, verify all parameters.

**HARDWARE CALIBRATION AND TESTING**

The MC³ was calibrated and tested at the factory before it was shipped. The following procedures can effect the accuracy of the controller and should only be performed with extreme caution.

**WARNING:** Always disconnect the MC³ from the feeder before attempting to test or calibrate hardware. Failure to do so could damage the feeder or cause personal injury.

**Analog Outputs**

Attach a milliamp meter to the analog output to be adjusted.

In the Analog Output setup menu, select 'Feeder Control' and '0-20mA' for the output that is being calibrated.

In the setpoint menu, select 'Manual Spd'. Set the controller output to 0%.

If, calibrating analog output 1, adjust the 'A01 Z' pot (R68) until the meter reads 0.0 mA. If, calibrating analog output 2, adjust the 'A02 Z' pot (R66) until the meter read 0.0 mA.

In the setpoint menu, set the controller output to 100%.

If, calibrating analog output 1, adjust the 'A01 S' pot (R67) until the meter reads 20.0 mA. If, calibrating analog output 2, adjust the 'A02 S' pot (R65) until the meter read 20.0 mA.
Set the controller output to 50% and verify that 10 mA is read on the meter.

Potentiometers used for adjusting analog input and outputs

**Analog Inputs**

Typically, a current source is not available, so the easiest way to adjust the analog input is to feed the analog outputs back into the analog input. This is accomplished by using jumpers from the analog output to the analog input. To calibrate the Analog Input using the 20.20.EX application, access to the register editor, is required. The following procedure assumes using analog output 1.

Insert a jumper wire from analog output 1 to the analog input. Insure the polarity is correct (positive to positive, negative to negative).

In the analog output menu, set analog output 1 to 'Drive out', '0-20mA'.

In the maneuvering menu, select Manual mode. Set the output to 0%.

Go to the register editor and select the al_aninst1 register (this is register 385 for version 0.3A).

Adjust 'AIN Z' (R64) until the register just reads 0 (the best way to do this is approach zero from the positive side).

In the setpoint menu, set the output to 100%

Adjust 'AIN S' (R63) until the register reads 1,000,000 counts.

In the setpoint menu, set the output to 50%

Verify that the register reads 500,000 counts.

**HPAD**

To calibrate the HPAD requires a precision load-cell simulator and therefore can not be calibrated in the field. However, to gain confidence that the HPAD is working correctly, use the following procedure.

Create a dummy load cell by shorting the Excite + to Sense + (pins 2 & 3), shorting the input signal (pins 4 & 5), short Excite - to Sense - (pins 6 & 7).

Attach the dummy load and turn on the controller (this is important that the dummy load cell be attached when the power is first turned on.)

In the diagnostic menu, select the HPAD settings menu. Set the CAL setting to 3.

Go to the HPAD diagnostic menu and the HPAD1 counts should be around 200,000.

Return to the HPAD settings menu and return the CAL setting to 0.
SIMULATOR

A weight simulator is available for demonstration purposes and if necessary to assist in troubleshooting problems. To invoke the simulator, map the 'Weight Simulator' logical input to the physical input 'always on' in the Digital Input setup menu (See the section on I/O mapping). To disable the simulator, map the 'Weight Simulator' logical input to the physical input 'always off' in the Digital Input setup menu. If there are no load cells connected for simulation, you may simulate weight by setting the A/D Function (see page 69) to 0. Insure that when you are ready to run the feeder, you set the simulator settings off.

WARNING: MAKE SURE THE SIMULATOR FUNCTIONS ARE TURNED OFF BEFORE ATTEMPTING TO OPERATE A FEEDER.