MPplus™ Manual

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INTRODUCTION

OVERVIEW

The MPplus™ Volume Corrector / Pressure Recorder is a low-cost version of Eagle's family of products. It is an intelligent, compact, rugged, and reliable industrial microprocessor-controlled computer designed for measurement applications. It can execute multiple processes including tasks such as complex math functions, control algorithms, etc., without host intervention.

Flexibility, expandability, and reliability are the major factors in the MPplus™ design philosophy. It is a balanced system, featuring flexible memory, I/O, power, and communications schemes. A harsh environment tolerance is also one of the MPplus™ strengths. The operating temperature can range from -40°C to 70°C (-40°F to 158°F), and the MPPLUS™ is housed in a fiberglass NEMA 4X enclosure. This allows the unit to exist where the work must be done, eliminating costly signal conditioning or expensive long sensor runs.

The MPplus™, normally fed with a 5-15 VDC supply, employs a low-power CMOS design. An optional 120/240 VAC unit includes an uninterruptible power supply. Should it lose power, the unit will sense the failure, automatically switch to battery power, and continue to operate at full capacity. Other supply options include solar arrays and thermoelectric generators for sites without conventional power.

The optional operator interface is a single-line liquid crystal display. A scroll switch allows users to examine and/or change process data and diagnose problems at the remote site without a local host or terminal.

The MPplus™ can calculate natural gas corrected volumes using AGA-5, AGA-7, AGA-8, and NX-19 reports, and is fully compatible with Eagle Research's entire family of products. Eagle Research is committed to providing a complete solution for all gas flow, steam, and control applications.

RELIABILITY

The MPplus™ is ruggedly built to perform in a variety of industrial environments. Care is taken to maximize reliability by applying a urethane conformal coating to all circuit boards, utilizing a hermetically sealed display, and providing NEMA 4X packaging.

HAZARDOUS LOCATION CLASSIFICATIONS

The MPplus™ is designed for mounting in Class I, Division 2 hazardous area locations (refer to the NFPA Electrical Code Book). Approval for Class I, Div. 1 applications is pending.

FOUR-YEAR WARRANTY

Eagle Research Corporation warrants the products it manufactures to be totally free from any defects in materials and workmanship under normal operation and use. Eagle Research agrees to repair or replace any instrument that is defective due to faulty workmanship or material, if returned to our factory with shipping charges prepaid, within four years of original purchase.

RETURNS

When a faulty product cannot be repaired in the field, contact Eagle Research Corporation for an RMA number and for return information. Packaging and shipping criteria will be established at that time.

IMPORTANT REMOVE ANY REPLACEABLE BATTERY OR BATTERY PACK FROM ANY UNIT PRIOR TO ITS RETURN SHIPPING. DAMAGE CAUSED BY LOOSE BATTERIES WITHIN UNITS WILL NOT BE COVERED BY THE MANUFACTURER, AND MAY VOID ANY WARRANTY THE UNIT IS STILL UNDER.

ENCLOSURE SECURITY

Quick-release door latches that may be padlocked are standard features of the MPplus™ to prevent unwanted users from opening the enclosure. As an option, a magnetic door-ajar switch may be installed to initiate an alarm when the unit's door is opened.

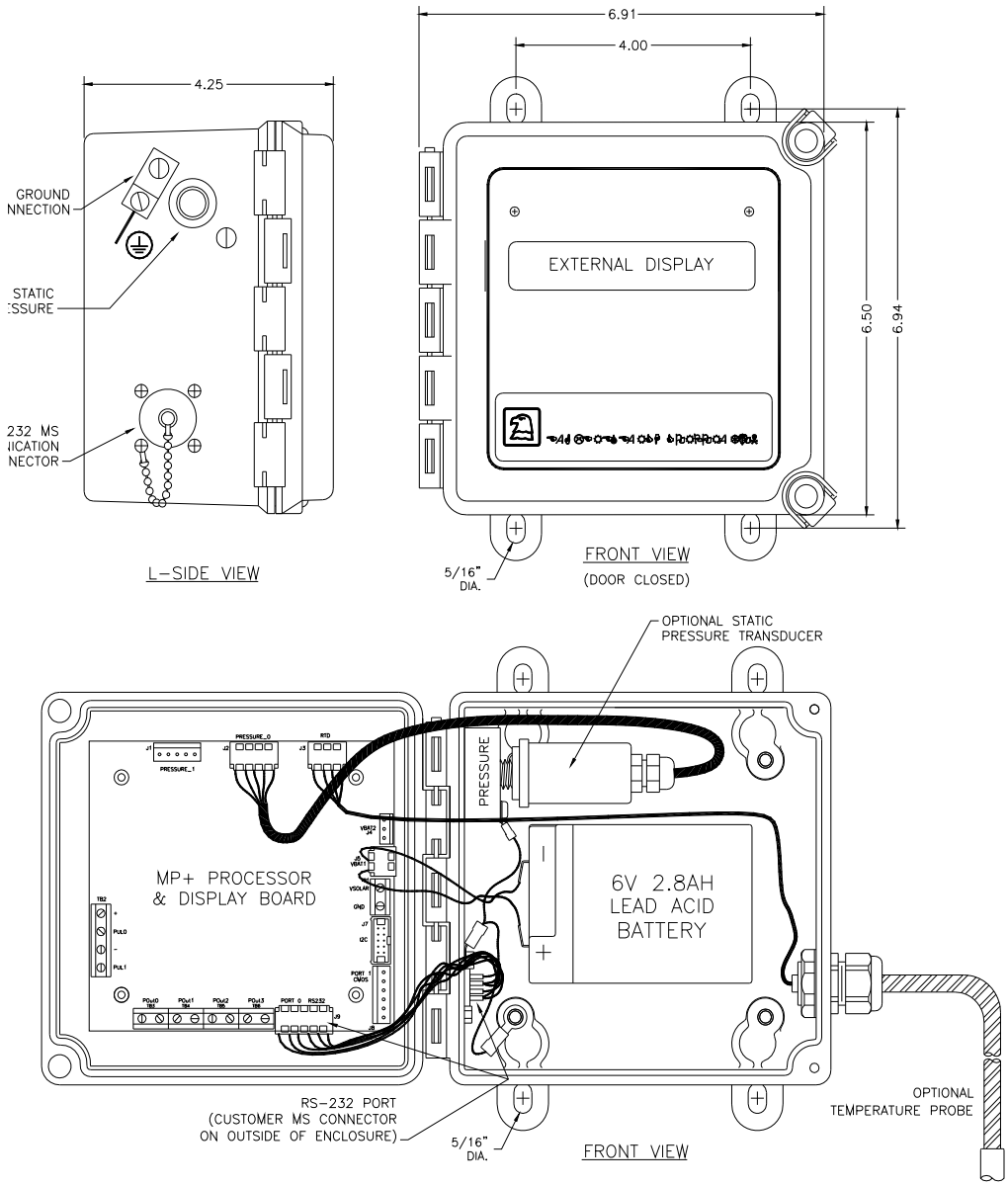


Figure 1 – The MPplus™

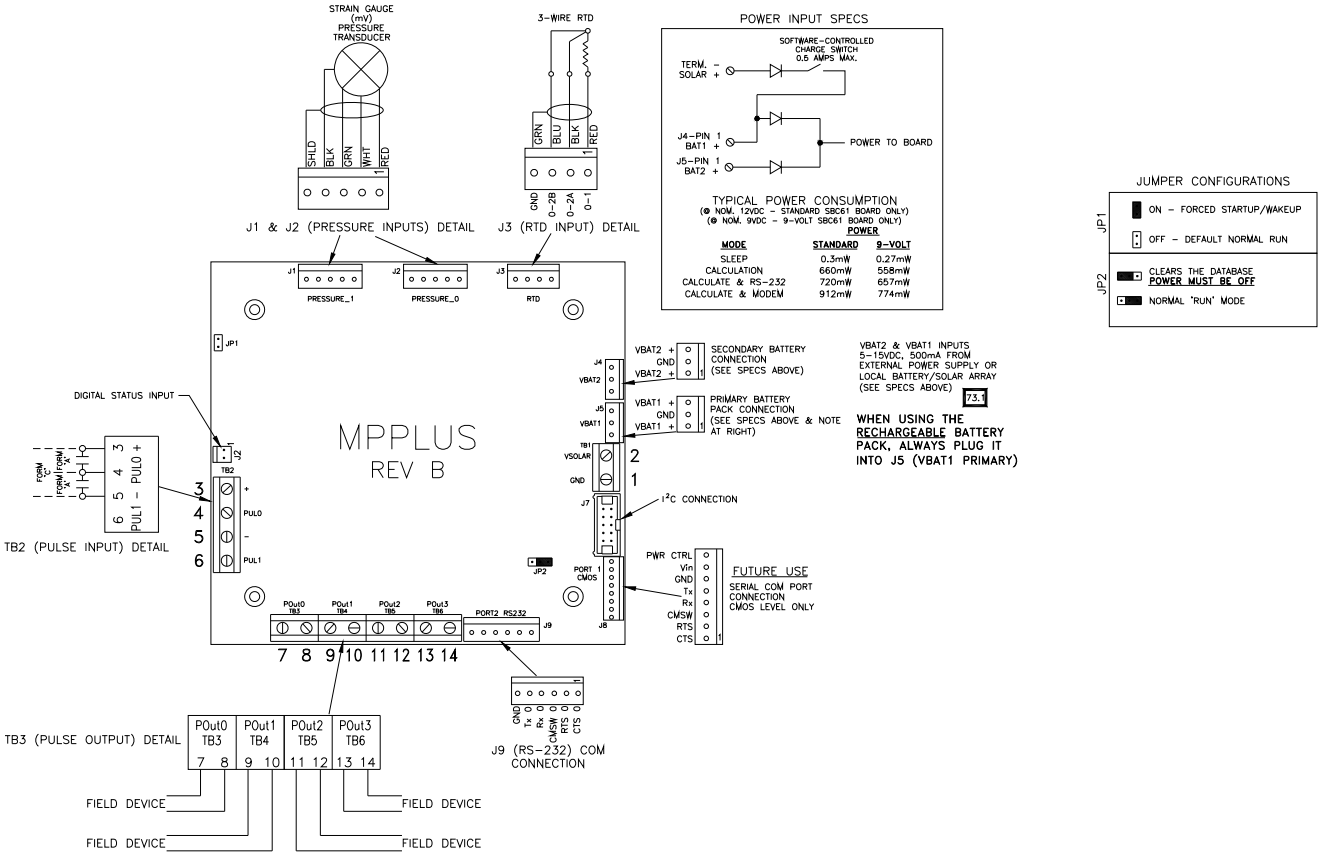


Figure 2 – Processor Board Detail

TECHNICAL SPECIFICATIONS

The table below lists the technical specifications for the MPplus™ Volume Corrector Units.

Features	Description
Input Power	5-15 VDC. Two battery inputs on MTA connectors. One solar power input on screw terminals.
Consumption	5 AH battery, 2-hr charging per day @ 50 mA charge rate. 1 mA average current. Less than 100 uA sleep current
Power Monitoring	Supply voltage monitoring through a/d with low supply voltage Interrupt
Backup Battery	3.6 VDC lithium backup battery: 10 years typical backup of database and time/date during normal use
Processor	Phillips P51XAS3 high performance 16-bit microcontroller running at 22.1184 MHz
Memory	512K x 8 remotely-programmable FLASH program memory 512K x 8 battery-backed RAM data memory
Real time Clock	Battery-backed, quartz crystal controlled; +/- 1 sec/day typical accuracy; programmable time scheduled interrupt capability
Internal Inputs	One ambient temperature input; one supply voltage input
Pulse Inputs	Two pulse inputs, software programmable for Form A or C; high or low speed. Each counter is a six-digit (0-999999) hardware counter with programmable interrupt support. Can be used for simple pulse accumulation, and for more complex applications such as card readers
Pulse Outputs	Four multi-purpose, memory-mapped, two-wire Output lines. (50 V max DC only).
Analog Inputs	Two precision strain gauge (mV) analog inputs thru MTA connectors for local pressure transducer, 12-bit resolution, analog sampling, software calibration. Each input has five MTA pins.
RTD Inputs	One 12-bit resolution RTD input thru an MTA connector; 3-wire lead compensated with ground shield connection; four-pin MTA
Communications	Two serial ports with RX, TX, RTS, CTS, and communication switch signals. Port 0 (RS-232 levels) typically connects to the MS connector to provide local communications via 6-pin MTA. Port 1 (CMOS levels – Future Use) for interfacing with modems, radios, etc. via 8-pin MTA. Configurable speed up to 115,200 baud.
Status LED	One software-controllable LED for various function indications
Expansion Capability	Additional connectors provide redundant termination points to allow for configuration flexibility. One 10-position connector allows for expansion over the I^2C communication bus. Optional isolated analog output modules and optional serial ports

TERMINAL SUMMARY

Feature	Terminal	Description	Customer Field Description
POWER INPUT	01	Power Input Ground	
	02	Solar Input (5-15 VDC)	
PULSE INPUTS	03	Pulse In 0 High+	
	04	Pulse In 0	
	05	Pulse In 0 Low-	
	06	Pulse In 1	
PULSE OUTPUTS	07	Pulse Out 0 N.O.	
	08	Pulse Out 0	
	09	Pulse Out 1 N.O.	
	10	Pulse Out 1	
	11	Pulse Out 2 N.O.	
	12	Pulse Out 2	
	13	Pulse Out 3 N.O.	
	14	Pulse Out 3	

MPPLUS™ SOFTWARE ADDRESSING

Description	Terminals	Software Address	Notes
Pulse Outputs			
Pulse Output #0	7 & 8	1.1	
Pulse Output #1	9 & 10	1.2	
Pulse Output #2	11& 12	1.3	
Pulse Output #3	13 & 14	1.4	
Power Input			Range 5 to 15 VDC Can be read in the Extended System process with address for line power and battery at location 117 and solar at location 122 in EEPROM editor
Battery #1	J5 (VBAT1)	73.1	
Battery #2	J4 (VBAT2)	73.1	
Solar	2	61.8	
Pulse Inputs		Form "A"	Form "C" High Speed
Pulse Input #0	3, 4, & 5	0	0.1 0.001
Pulse Input #1	6	1	1.1 1.001
Pressure Inputs			Precision strain gauge (mV) inputs. CANNOT be used for 4-20mA or 1-5V signal applications.
Pressure Input #0	J2	0	
Pressure Input #1	J1	1	
RS-232 Serial Ports			
Internal Port	J8	Port 1	CMOS levels **(Future Use)**
External Port	J9	Port 0	RS-232 levels
RTD Inputs			
RTD Input	J3	6	Range –40° to 160°F
Box Temperature	N/A	16	Range –67° to 257°F Can be read in the Extended System process

INSTALLATION

UNPACKING

1. Thoroughly examine the box to verify it was not damaged in shipping. If you find damage, immediately file a claim with the shipper, as the manufacturer cannot be held responsible for items damaged in transportation and accepted by the customer.

2. Carefully unpack the MPplus™ from the shipping container. Verify that the box contains every item listed on the shipping order.

!!! CAUTION !!!
This unit contains certain electronic components that are sensitive to electrostatic discharge (ESD); therefore, proper precautions should be taken during maintenance operations to avoid ESD. It is recommended that the operator first touch the MS connector (RS-232C port) on the left side of the unit to dissipate any accumulated static charge. Additional precautions may be taken in order to minimize the possibility of ESD, including the use of a grounding wrist or ankle strap.

If these precautions are not taken and the unit is subjected to severe ESD, it may revert to its default state. However, the unit will not exhibit any loss of data or degradation of performance.

3. Open the front door by releasing the quick release latches of the enclosure and swinging the door out.

4. Examine the label on the inside right wall of the enclosure. It indicates the configuration and serial number of the unit.

MOUNTING THE MPPLUS™

Note: For Positive Displacement (Index-Mounted) applications, see Appendix B.

The MPplus™ may be mounted directly on a wall or, optionally, on a pipe (see Fig. 3). Mounting feet are provided for wall mounting, and plates with U-bolts are provided for pole mounting. Two-inch rigid iron pipe or conduit is required for pipe mounting. It is recommended that the pipe be placed 18 to 24 inches into the ground in a 6-inch wide sackrete/concrete-filled hole. The length of the 2-inch mounting pipe or conduit will vary according to the site, but typical installations place the unit at about eye level for ease of operation.

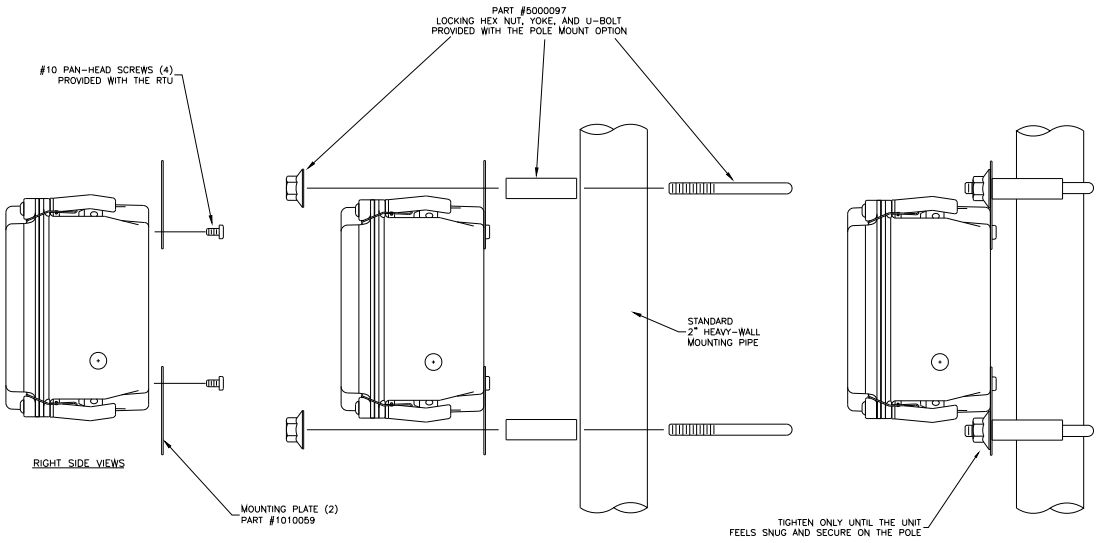


Figure 3 – Pole Mounting Detail

POWER FOR THE MPPLUS™

*(Refer to **Figure 2** on page 4 for processor board power connections.)*

POWER OPTIONS

The MPplus™ has several power options available: Internal Battery Power Only; Local or Remote Solar Power Array or Supply; or some combination of these. In addition to the primary operating power for the MPplus™, there is an onboard backup battery to maintain unit memory and clock.

ONBOARD BACKUP BATTERY

The onboard lithium backup battery in the MPplus™ maintains power for approximately ten years to the memory section and the real time clock of the processor board when primary operating power is not present. Operation and interactivity with the processor is not available when the backup battery alone is in use.

INTERNAL BATTERY POWER

Several internal battery packs are available for supplying primary power to the unit. The two basic kinds are **Alkaline** (non-rechargeable) and **Lead-Acid** (rechargeable).

Alkaline packs are typically used alone, without external power, and provide a one-time supply until drained of energy. Alkaline battery life is determined by a number of factors, such as frequency of calculations and communication, cabinet temperature, etc. Connections on the MPplus™ processor board are arranged such that, as one battery pack begins to lose power, a second pack may be connected before the first is removed, thus providing uninterrupted power.

WARNING (see Figure 2) Do not connect the alkaline battery packs to connector J4 or J5 when there is an external power supply in use. Damage may occur.

Lead-Acid batteries are rechargeable, and are typically used with a solar array or panel. With normal operating conditions, lead-acid batteries and their associated external supplies should provide long periods (up to 10 years) of unattended power to the unit. This would be more suitable for remote locations.

CAUTION (see Figure 2) Do Not connect the lead-acid battery packs to connector J4 as charging will not occur.

WIRING THE POWER INPUT

WARNING
The operating voltage range for the MPplus™ is 5-15 VDC. Do **NOT** exceed recommended input voltage of 15 VDC.

*(Refer to **Figure 2** on page 4 for processor board power connections.)*

If the unit is **internally battery powered only**, check the type of battery pack being used (it should be a non-rechargeable alkaline) and connect it as follows: Plug it into either J5 or J4 to power up the MPplus™. When it is time to replace the pack, a second pack may be plugged into the other connector before removing the first so power is not interrupted.

WARNING
Whenever external power is applied to the MPplus™, **NEVER** plug the non-rechargeable alkaline pack into J4 or J5, as damage to the unit may occur.

If the unit is **solar powered** with a local solar array feeding directly into it, follow this procedure. **First -** connect the internal lead-acid (rechargeable) battery pack to J5 (VBAT1). **Next** - connect the (+) lead of the solar array to terminal 2 (VSOLAR) and the (-) lead to terminal 1 (GND). Use the reverse procedure to power the unit down, disconnecting the solar array wires first. **Do not connect the internal lead-acid battery to J4, as charging will not occur**. **If for any reason an alkaline battery pack is used in this application, DO NOT connect the solar array as damage may occur.**

NOTE
Upon first powering up the MPplus™, the optional outside display will flash, indicating an alarm condition. In this case it means 'First Time Power', and is no cause for concern. To clear this alarm read the paragraph on 'Using the Scroll Switch' in the DISPLAY MODE section.

When the outside display option is present, you can now view selected parameter values using the scroll switch. The scroll switch is activated by the use of a magnet (one is shipped with units having this option).
The table below shows the terminal wiring for power input.

Power Input Description	MPplus™ Terminal Location
Power Input	**TB1**
GND (ground)	1
VSOLAR (solar power)	2 Screw Terminals
VBAT1 (MTA)	**J5** Primary Pin1 +; Pin2 Gnd
VBAT2 (MTA)	**J4** Secondary Pin1 +; Pin2 Gnd

INTERNAL CONNECTIONS

COMMUNICATIONS

To communicate with the MPplus™, the Site ID in the device must be the same as the Site ID entered in the software package. The Site ID is a unique identification number (1 to 65,535) that allows the software packages to communicate with the MPplus™. The default Site ID number is 1. Site ID Changer, available through Field Manager™, Talon™ Lite, or Talon SCE™, can be used to enter a number other than the default. Refer to the respective software User's Manual for additional information on these and other functions. The display and keypad can also be used to change the Site ID from its default value.

In its standard configuration, the MPplus™ is equipped with two communications ports – 0 and 1. Port #0 can be configured to allow local communication using RS-232C. Port #1 can be configured for CMOS and is for future communications use.

An optional RS-232C serial cable is required for local direct communications. Contact your factory representative for ordering information.

The tables below show the terminal wiring for the two communications ports.

PORT #0	MPplus™ Terminal / Pin Locations
RS-232C (CMSW pin grounded)	J9
CTS 0 (clear to send)	1
RTS 0 (request to send)	2
CMSW 0 (communications switch)	3 MTA pin numbers
Rx 0 (receive)	4
Tx 0 (transmit)	5
GND 0 (ground)	6

PORT #1	MPplus™ Terminal / Pin Locations
CMOS (CMSW pin open)	J8
CTS 1 (clear to send)	1
RTS 1 (request to send)	2
CMSW 1 (communications switch)	3
Rx 1 (receive)	4
Tx 1 (transmit)	5 MTA pin numbers
GND 1 (ground)	6
Vin	7
RS-232 Port 1 Ext. Power Control	8

WIRING THE PULSE INPUTS

The standard MPplus™ configuration includes two pulse inputs that are software programmable for Form A or C, and high speed or low speed. These inputs can be used for meter indexes, simple pulse counters, or in more demanding applications such as card readers. The table below shows the terminal wiring for the pulse inputs.

Pulse Input Description	MPplus™ Terminal Location
Pulse 0	**TB2**
+ 0	3
Pulse 0	4 Screw Terminals
- 0 (no connection for Form A)	5 (no connection on 5 for Form A)
Pulse 1	6

WIRING THE ANALOG INPUTS

The standard MPplus™ configuration includes two pressure strain gauge (mV) inputs and one RTD input with 3-wire lead compensation and ground shield connection. These are 12-bit resolution inputs with analog sampling capability. In addition, there is a box temperature and supply voltage input. All analog inputs can be software calibrated. The table below shows the terminal wiring for the analog inputs.

Analog Input Description	MPplus™ Terminal Location
Pressure 0	**J2**
Power 0	Pin 1
Analog Input 0	Pin 2
Analog Input 0	Pin 3 MTA pin numbers
Ground 0	Pin 4
Shield 0	Pin 5
Pressure 1	**J1**
Power 1	Pin 1
Analog Input 1	Pin 2
Analog Input 1	Pin 3 MTA pin numbers
Ground 1	Pin 4
Shield 1	Pin 5
RTD	**J3**
1-1	Pin 1
1-2A	Pin 2
1-2B	Pin 3 MTA pin numbers
Ground	Pin 4

Note: Inputs cannot be used for 4-20mA or 1-5V signals.

WIRING THE PULSE OUTPUTS

The MPplus™ comes standard with four multi-purpose, memory-mapped, digital Pulse Output lines. These outputs can be configured as simple discrete outputs or as precisely timed pulse outputs. (Solid-state 100mA max AC/DC)

Pulse Output Description	MPplus™ Terminal Location
Pulse Out 0 Normally Open 0 (NO0) Common 0 (Com0)	**TB3** 7 8 Screw Terminals
Pulse Out 1 Normally Open 1 (NO1) Common 1 (Com1)	**TB4** 9 10 Screw Terminals
Pulse Out 2 Normally Open 2 (NO2) Common 2 (Com2)	**TB5** 11 12 Screw Terminals
Pulse Out 3 Normally Open 3 (NO3) Common 3 (Com3)	**TB6** 13 14 Screw Terminals

GROUNDING

Because of the potential for equipment damage and injury to personnel, certain practices should, and often must, be observed when installing field computer systems. Of these practices, proper grounding is possibly the single most important. This section was included to point out general rules and practices, and ***NOT*** to supersede those defined in the **National Electrical Code** (NEC) published by the National Fire Protection Association (NFPA), nor the **Classification of Gas Utility Areas for Electrical Installations** booklet published by the American Gas Association (AGA). A sound understanding of Federal, State, and Local laws is fundamental to proper and legal installation work. Eagle Research Corporation makes no warranties or guarantees on the effectiveness or safety of any technique or suggestion here described.

All field computers, electronic utility interface, and gas meter equipment should be kept at the same ground potential so that unexpected voltages anywhere on the system are quickly shunted away to earth. This calls for a common ground rod (or "bed" of grounding materials) to which is securely tied all equipment chassis, metal cabinets, and intrinsic safety ground brackets. For equipment chassis and metal cabinets, a solid copper ground wire or ground strapping of an approved size and type is recommended to tie this equipment to the rod(s). For Intrinsic Safety systems it is recommended that two #12 AWG wires be run in parallel from individual ground terminals on each I.S. ground frame. Where more than one rod is used, as when some distance separates equipment, all rods should be bonded together with copper in an approved manner.

It should also be noted here that systems employing **Cathodic Protection** need to be approached differently when considering grounding measures. Eagle Research Corporation can help you define grounding procedures for any application.

References

- National Electrical Code
  - Article 250 - Grounding
  - Articles 500 & 501 - Hazardous (Classified) Locations
  - Article 504 - Intrinsically Safe Systems
- The IAEI Soares' Book on Grounding
- PolyPhaser Corporation's catalog of Lightning/EMP & Grounding Solutions
  www.polyphaser.com

OPERATING MODES

The MPplus™ operates in any of the following five standard modes:

- Sleep/Wake-up
- Display
- Alarm
- Configuration
- Calibration

To access any operating mode, press the keypad key that corresponds to the mode you want:

conf for configuration mode
alrm for alarm mode
cal for calibration mode
esc to return to a previous mode from any other mode

SLEEP/WAKE-UP MODE

In normal operation the MPplus™ maintains a powered down state (sleep mode) to conserve battery life. In this state the internal display is blank while the outside display shows the first label, **CV XXXXXXXX** for example, where **XXXXXXXX** is the most recent reading prior to the next wake-up interval. The unit executes processes depending upon the user's programmed wake-up interval. Shorter intervals result in more frequent data while longer intervals provide for longer battery life. The scheduled wake-ups result in immediate power-down after performing calculations.

In addition to the scheduled wake-ups for volumetric calculations, the MPPLUS™ can be brought up from its sleep mode by any of the following:

- Connecting a portable computer to the unit's serial communication port (MS connector)
- Pressing any key on the keypad
- Scrolling the external display with a magnet (see the section on DISPLAY MODE)
- Calling the unit via modem

Once the unit is awake, it will automatically power down one minute after the operator stops interacting with it. The MPPLUS™ can also be forced to enter the sleep mode by pressing the **ent** and **zero** keys simultaneously.

NOTE
The MPplus™ will not go to sleep if the RS-232C serial cable is connected. Battery life, in this case, may be drastically reduced.

Typically, the MPplus™ remains fully awake and does not enter the sleep mode if it is powered with an external power supply. In this case, the **Wake-up Interval** parameter is set to **0**.

DISPLAY MODE

In display mode, only limited parameters with assigned labels and function keys can be viewed. With the optional virtual keypad and display, the ▪ and ▪▪arrow keys will allow you to scroll through the display parameter list. You may use the **jump** key to directly view any of the assigned labels; press **jump** then enter the label number 1-64, followed by pressing **ent**. You can use the function keys (**F0 - F9**) to view previously assigned parameters. Talon™ Lite or Talon SCE™ software can be used to assign function keys and labels to any parameter. Also, the virtual keypad may be used to assign function keys.

Using the Scroll Switch

On units that feature the external display, a magnet may be used to easily access information without opening the door. Just below the display window, to the right, is a routed indention in the door. When the key chain magnet, supplied with these units, is held in the proximity of this 'dimple', the display will vary its information. Each subsequent pass of the magnet over this dimple will produce a new parameter display.

When in an alarm condition, the external display will be flashing. To clear alarms, hold the magnet against the dimple until flashing stops.

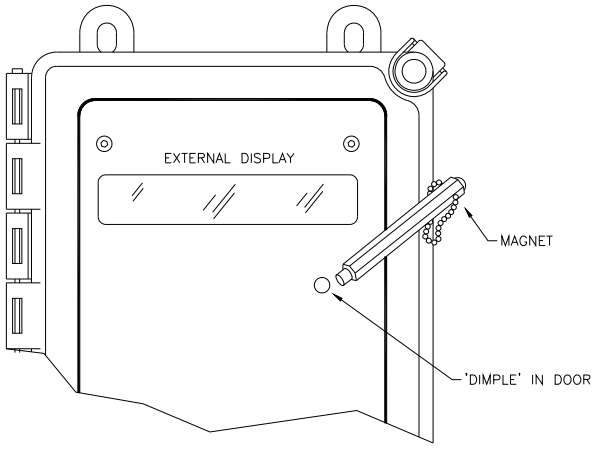


Figure 4 – Using the Scroll Switch Feature

ALARM MODE

The MPplus™ can be configured to activate an alarm when certain conditions are met or when user-defined limits are exceeded. Active alarm messages can be configured to show on the MPplus™ display. The unit can also automatically call a host computer running Field Manager™ and the Talon Software Suite to report the alarm. (see the section on SOFTWARE PACKAGES).

A history log is kept in the unit on each alarm condition, consisting of the following:

- Current value
- Type of alarm (high, low, etc.)
- Setpoint value (alarm limit)
- Time of alarm
- Date of alarm
- Time out of alarm
- Date out of alarm
- Extreme value alarm

The MPplus™ can be configured to monitor and alarm on any condition including, but not limited to, the following:

- First Time Power
- AC Power Failure
- Low Supply Volts
- High and Low Flow Rate
- High and Low Pressure
- High and Low Temperature
- Current Day Flow (Transportation Limit)
- Low Voltage Shutdown
- Box intrusion

NOTE
Additional hardware equipment and configuration may be required for some alarm monitoring applications.

Viewing and Clearing Alarms from the External Keypad or Virtual Keypad

(See the sections on ALARM MODE, & APPENDIX A: PARAMETER TABLES)

To enter alarm mode, press the **alrm** key on the optional keypad. In alarm mode you can view and acknowledge any alarm. If alarms are active, the unit will display the first alarm message. If there are more alarms, you can view them by pressing the ▪ key. Repeatedly pressing the ▪ key will cycle through the active alarm list.
Alarms can be locally acknowledged at the unit by pressing the **ent** key while a particular alarm message is displayed, or by polling with Talon™ Lite or Talon SCE™ software.

When in an alarm condition, the optional external display will be flashing. To clear alarms, hold the magnet against the dimple until flashing stops.

Unless the parameter's limits are violated again, the unit will not include acknowledged alarms in its list the next time the user enters alarm mode. To exit alarm mode without acknowledging the alarm, simply press the **esc** key.

First Time Power Alarm

First Time Power alarm is defined as the re-application of power after interruption of the power source. For example, whenever the battery is disconnected and then subsequently reconnected, the unit records the First Time Power event.

Low Supply Volts Alarm

If the supply voltage to the unit falls below the Low Supply Volts Alarm Setpoint value, a **Low Supply Volts** alarm will be initiated. The alarm will remain active until the supply voltage is greater than the Low Supply Volts Alarm Reset parameter. The setpoints are user configurable with default values of 8.5 and 8.8 volts respectively for battery powered units.

High Flow Rate Alarm

If the flow rate should exceed the High Flow Rate Alarm Setpoint, a **High Flow Rate** alarm will be initiated. The alarm will remain active until the flow rate falls below the High Flow Rate Reset parameter value. The setpoints are user configurable with default values of 100000 and 99990 respectively.

Low Flow Rate Alarm

If the flow rate should fall below the Low Flow Rate Alarm Setpoint, a **Low Flow Rate** alarm will be initiated. The alarm will remain active until the flow rate rises above the Low Flow Rate Reset parameter value. The setpoints are user configurable with default values of -100 and -80 respectively.

High Pressure Alarm

If the gas pressure should exceed the High Pressure Alarm Setpoint, a **High Pressure** alarm will be initiated. The alarm will remain active until the pressure falls below the High Pressure Reset parameter value. The setpoints are user configurable with default values of 1500 and 1480 respectively.

Low Pressure Alarm

If the gas pressure should fall below the Low Pressure Alarm Setpoint, a **Low Pressure** alarm will be initiated. The alarm will remain active until the pressure rises above the Low Pressure Reset parameter value. The setpoints are user configurable with default values of -100 and -80 respectively.

High Temperature Alarm

If the gas flow temperature should exceed the High Temperature Alarm Setpoint, a **High Temperature** alarm will be initiated. The alarm will remain active until the temperature falls below the High Temperature Reset parameter value. The setpoints are user configurable with default values of 200 and 180 respectively.

Low Temperature Alarm

If the gas flow temperature should fall below the Low Temperature Alarm Setpoint, a **Low Temperature** alarm will be initiated. The alarm will remain active until the temperature rises above the Low Temperature Reset parameter value. The setpoints are user configurable with default values of -100 and -80 respectively.

Current Day Flow Alarm (Transportation Limit)

If the current day's total volume should exceed the Current Day High Volume Alarm Setpoint, a **Current Day Flow** alarm will be initiated. The alarm will remain active until the value for the current day volume is reset the next day at roll time. The setpoints are user configurable with default values of 100000 and 99990 respectively. For transport or interruptible customers, this parameter can be used to alarm when an account has exceeded a predetermined daily volume allocation.

Low Voltage Shutdown Alarm

If the supply voltage should fall to approximately 6.0 volts, an interrupt will be triggered and the unit will enter Low Voltage (Critical) Shutdown mode. **Low Batt** will be displayed on the display. This is an indication that the supply voltage is absolutely too low to operate the unit properly. The battery must be changed at this point or adequate supply voltage applied. In this mode, all operation ceased, and the unit operates in a protective mode. The on-board battery will continue to protect the unit's memory; therefore data prior to entering this mode will be maintained. The supply voltage is monitored constantly and the unit will reset itself should the supply voltage becomes greater than 6.0 volts. If the unit is left alone without applying adequate supply voltage, the battery will continue to drain and the outside display will eventually go blank.

When sufficient supply voltage is applied and the unit is powered up, a **Low Voltage Shutdown** alarm will be recorded.

Box Intrusion Alarm (Optional door ajar switch)

The **Box Intrusion** alarm is initiated when the door of the MPplus™ opens. When this occurs, a full wake-up is triggered and the unit executes its processes. The alarm is inactive when the door is closed.

CONFIGURATION MODE

Configuration mode allows you to set up the MPplus™ initial configuration, change any of the operating parameter values, and set alarm conditions and limits. Field Manager™ software, Talon™ Lite software, Talon SCE™ software, or the optional handheld keypad and display is required to perform configuration. See the online help files for operating instructions.

CAUTION
Care must be taken when editing parameters. Improper parameter editing may result in corruption of the database.

To enter configuration mode, press the **conf** key on the optional keypad. If the configuration mode is password protected, the MPPLUS™ will display **ENTER PASSWORD?** Only a valid password entry would then be given access to this mode. Configuration mode allows you to set up the unit's initial configuration, change any of the operating parameter values, set alarm conditions and limits, and assign function keys to various parameters. While in the configuration mode, the unit continues to operate normally. It continues to sample live pressure and temperature values, calculate corrected volume, and collect historical data.

Viewing Parameters

In configuration mode, any parameter value may be viewed. One method is to use the **Jump** key to directly view database items. Press **Jump** and then enter the address of the parameter **(PPSSII)** followed by pressing the **ent** key. The top line on the display is the address **XX-XX-XX** and the bottom line is the value. Function key assignments are still valid, so often-viewed parameters may be accessed in this manner. The right and left arrow keys **▪▪←→▪)** allow horizontal movement between processes, and the up and down arrow keys **▪▪▪▪▪▪▪** allow moving vertically within a process. Pressing **Jump** followed by the right arrow key **(→▪▪**will display the same item number in the next section. Likewise, pressing **Jump** followed by the up arrow key **(▪▪** will display the same item number in the previous section. Jumping to assigned labels is also supported as described in Display mode.

Editing Parameters

1. Enter configuration mode by pressing the **conf** key (use the password if required).
2. Display the desired parameter. Press the **jump** key, followed by the address of the parameter. The function keys can also be used to view assigned parameters.
3. With the desired parameter displayed, press the **edit** key. (The unit will display the current parameter value and prompt for a new value.) Use the keypad to enter the correct value and then press the **ent** key to execute the change. Pressing the **esc** key when the unit prompts for the new value will abort the change. Pressing the **ent** key if nothing has been typed, also leaves the parameter unchanged.

Assigning Function Keys

In configuration mode, any item can be assigned to a function key as follows:

1. Enter configuration mode by pressing the **conf** key (use the password, if required).
2. Display the desired parameter. Press & release the **jump** key, followed by the address of the parameter.
3. Assign a function key to the parameter. Press & release the **jump** key, then the **edit** key, and then the function key you wish to assign to the current item [**F0 - F9**].

Audit Trail

The MPplus™ maintains an electronic audit trail file that records all parameter changes and calibrations performed on the unit. Each entry is identified with the date and time the event occurred. The contents of this file cannot be changed, providing a secure, non-editable audit trail.

In the standard MPplus™ configuration, the audit trail is disabled. You can enable audit trail logging by editing address 010313 to **300** at the keypad or by using Talon™ Lite or Talon SCE™ software. The maximum memory allowed for audit trail is (300 records * 24 = 7,200).

NOTE
Once the audit trail is enabled (a value greater than "0"), the user cannot disable it without a full unit initialization. Reloading the database will not disable the audit trail.

Once enabled, the MPplus™ maintains the audit trail file with a maximum of 300 records. You can upload the information from the unit to a portable or host computer using Talon™ Lite or Talon SCE™ software. When the audit trail is full, **Audit Trail Full** will appear if editing is attempted and the unit will not allow any changes. The audit trail must first be uploaded and reset by Talon™ Lite or Talon SCE™ software.

Memory (History Logging)

The MPplus™ has a minimum of 512K x 8 Z-RAM for database, audit trail, and history logging, and 512K x 8 Flash memory allowing easy upgrade of run-time code. With the large memory capacity, a minimum of 32,000 historical inputs with time and date stamp can be stored. The non-editable history file provides the user with time related data logged in any variation of selectable intervals; minute, daily, weekly, and monthly. An event-driven history mode allows the logging of data when an event occurs (e.g. alarms). An experienced user with Talon SCE™ software can define the type of data and collection period. Since the history data elements are stored in a block of memory, the size has to be assigned at the time the history process is created in the unit; typically when the database is downloaded at the factory.

NOTE
The size of the history block cannot be changed once the history process has been created in the unit. A complete download would be required to reset the database and change the MPplus™ memory assignment.

The memory required to store an entire history process data block is [Max pointers * (Max Record +1) *4].

Data may be collected over the telephone lines via the optional modem, or on-site through the MS connector on the side of the enclosure. Talon Device Manager or Talon SCADA software is required for collection. The collected data can then be used for:

- Billing information
- Measurement reports for utility and customer management
- System analysis using flow rate and pressure
- Support for estimating gas volume consumption in cases of meter or instrument malfunction

Special Key Combinations

There are a number of special key combinations that allow the user to view system information and perform certain tasks very easily. These are listed in the table below.

Key Combination	Description
+ / - and **zero**	System Passwords
• and **cal**	System information (ROM version, unit S/N, calculated Checksum)
→ and **edit**	Toggles keypad beeper on and off

CALIBRATION MODE

Main calibration should be done using the software wizard built into the software provided with the unit. Instructions are included in the software. The following procedure is designed for use with a local external keypad or with Virtual Keypad.

Calibration mode allows the user to calibrate the analog inputs such as static pressure and temperature. While operating in the calibration mode the MPplus™ continues to periodically update volume. The analog input value used for calculations is the value measured when calibration mode was initially entered. Once in calibration mode, the user can perform the following operations:

- Calibrate **zero** only
- Calibrate both **zero** and **span**

Of course, the option to change the calibration reference points is available at all times. Several other features make the software calibration routine attractive and more intuitive. In the MPplus™, unit calibration is software based; there is no need for laborious operator adjustments. Software calibration does away with the need for repetitive potentiometer adjustments, thereby simplifying field calibration procedures.

Calibrating Static Pressure and Temperature Transmitters

1. View the value of the transmitter to be calibrated on the display. The function keys can be used for quick access.
2. Press the blue **cal** key. Enter your password at the optional **PASSWORD?** prompt, if required.
3. The unit will enter calibration mode. The display will alternate between **CALIBRATING** and the parameter label; **PRESSURE #1** for example.
4. Apply the zero reference to the transmitter and wait for the reading to stabilize.
5. Press the blue **zero** key. The display now shows the following:

   ZERO> XX.XX
   NEW?>

   Where **XX.XX** represents the unit's default zero value. If the current zero reference matches the unit's default, simply press the **ent** key to collect the new point. Otherwise, key in the value of the current reference before pressing the **ent** key. The unit should display **Calculating . . .** briefly, and then display the new point. Pressing the **esc** key instead of the **ent** key at this point aborts the operation and returns you to the calibration prompt.

6. Apply the span (full-scale) reference to the transmitter and wait for the reading to stabilize.

7. Press the blue **span** key. The unit now shows:

   SPAN> XX.XX
   NEW?>

   As with the zero point, if the external reference matches the default span value, simply press the **ent** key. Otherwise, key in the current value of the external reference, then press **ent**. After the **ent** key is pressed, the display reading should immediately adjust to reflect the new calibration point. Pressing the **esc** key instead of **ent** at this point aborts the operation and returns the operator to the calibration prompt.

8. Steps 4 through 7 are required only once. They may be repeated as often as necessary while in calibration, but only the most recent point will be saved on completion of calibration.

9. To permanently store the results of the calibration press the **ent** key, and the unit will prompt, **Enter to accept Calibration**. Simply press the **ent** key again to save the calibration. Press the **esc** key to abort the calibration. (Note: Pressing **esc** repeatedly from anywhere within the calibration procedure will back the operator out of calibration mode).

Calibrating the Optional Analog Output Board

Several features make the Analog Output software calibration routine attractive and more intuitive. In the MPplus™, unit calibration can be software based; there is no need for laborious operator adjustments. Software calibration does away with the need for repetitive potentiometer adjustments, thereby simplifying field calibration procedures. The keypad/display or Talon Device Manager software is necessary to perform software calibration.

NOTE
Pressing **esc** repeatedly from anywhere within the calibration procedure will back the operator out of calibration mode.

1. Display the Analog Output parameter on the display.

2. Press **cal**. Enter your password at the optional **PASSWORD?** prompt, if required.

3. The unit will enter calibration mode and the display will show the current value and mA representation of the analog output signal. For example,

   Eng: 48.000
   mA: 11.680

   Where **48.000** is the analog output reading representing **11.680** mA. The top line (**Eng**) will alternate between four different readouts: **48.000, UP/DN TO CHANGE, CALIBRATING**, and the parameter label, while the bottom line will always show the mA value.

4. Connect a milliamp meter in series with the loop to measure the current. The field instrument that the loop is driving can also be used to read the output, if desired.

5. Pressing ▪▪will increment the output current to represent 0%, 25%, 50%, 75%, & 100% of the analog output parameter to check the calibration. Pressing ▪▪will decrement the output current. Therefore, 0% = 4mA, 25% = 8mA, 50% = 12mA, 75% = 16mA, & 100% = 20mA.

6. If adjustments are needed, press **zero**. The display now shows:

zero: x.xxx
04.000 +y.yyy mA

Where **x.xxx** represents the default zero value (low scale) and **y.yyy** is the adjustment made to 4mA for the analog output signal. The adjustment can be either positive or negative shown by **+** or **-** respectively. The top line (zero) will alternate between: **x.xxx** and **UP/DN TO ADJUST**. This is the zero-adjusted value to calibrate the analog output to 4mA.

7. Press ▪ or ▪ to increase or decrease the output until the meter reads 4mA or the current zero reference matches the field equipment. Press **ent** to collect the new point.

8. Press **span**. The display shows:

span: x.xxx
20.000 +y.yyy mA

Where **x.xxx** represents the default span value (full scale) and **y.yyy** is the adjustment made to 20mA for the analog output signal. The adjustment can be either positive or negative shown by **+** or **-** respectively. The top line (span) will alternate between: **x.xxx** and **UP/DN TO ADJUST**. This is the span-adjusted value to calibrate the analog output to 20mA.

9. Press ▪ or ▪ to increase or decrease the output until the meter reads 20mA or the current span reference matches the field equipment. Press **ent** to collect the new point.

10. Steps 5 - 9 are required only once. They may be repeated as often as necessary while in calibration, but only the most recent point will be saved on completion of calibration.

11. To permanently store the results of the calibration press **ent**, and the unit will prompt **Enter to accept Calibration**. Simply press **ent** again to save the calibration. Press **esc** to abort the calibration.

MAINTENANCE

As with any device based on solid-state electronics, maintenance of the MPplus™ should be minimal. However, there are certain guidelines that, if followed, will minimize device failure and increase the product's service life.

Enclosure Maintenance

Enclosure maintenance is a program of routine inspections to ensure the integrity of the door's seal and the various ports in the box's exterior. Excess moisture can ruin a field computer if allowed to accumulate within the enclosure. Although the circuit boards themselves are conformally coated to protect against humidity, the wiring interconnections and various exposed metal surfaces are susceptible to corrosion in extreme cases of interior humidity. Here are some checks you should periodically make of the enclosure:

1. Ensure that the mounting arrangement for the unit is secure and provides a stable platform for termination of the pressure tubing, conduits, etc.

2. Verify the integrity of the enclosure lid seal. Check the lid gasket for deterioration, chemical damage, tears, or compression.

3. Check for damaged cord grips and a missing or damaged MS connector (RS-232 port) cap.

4. Examine the RS-232C port itself. Ensure that the port's mounting screws are secure and provide firm support when attaching a serial cable.

Changing the Optional Internal Battery

IMPORTANT IN THE EVENT A UNIT MUST BE RETURNED TO THE FACTORY FOR ANY REASON, REMOVE ANY REPLACEABLE BATTERY OR BATTERY PACK PRIOR TO ITS RETURN SHIPPING. DAMAGE CAUSED BY LOOSE BATTERIES WITHIN UNITS WILL NOT BE COVERED BY THE MANUFACTURER, AND MAY VOID ANY WARRANTY THE UNIT IS STILL UNDER.

(See the section on POWER FOR THE MPplus™)

A: Disposable (Non-Rechargeable) Battery Packs

The disposable (alkaline) battery packs are used in cases where there is no external power source, such as a solar array. These packs, under normal operating conditions, will eventually drop below the voltage level needed to maintain unit power. Their lifespan is determined by dozens of variables specific to each unit, and therefore difficult to predict.

To replace the disposable battery pack in the unit:

1. Open the front door by releasing the upper and lower quick-release latches on the device enclosure and swinging the door out.
2. Connect the new battery to the unused connector J4 'VBAT2' or J5 'VBAT1' (see Fig. 2).
3. Disconnect the old battery from the other connector in the unit. Power, in this case, is never removed from the unit, and no current data is lost due to temporary power down.
4. Remove the old battery from its mounting in the enclosure by ripping it off of its dual lock mount, and press the new pack firmly into place.
5. Press any key to wake-up the unit and verify that it is fully operational.
6. Properly dispose of the spent battery pack.

B: Rechargeable Battery Packs (charged by local solar array)

CAUTION
The rechargeable battery pack must ONLY be plugged into battery connector J5 'VBAT1'. The local solar array provides charging current ONLY to connector J5. Do Not plug rechargeable packs into J4 'VBAT2' as charging

The rechargeable battery pack, under normal operating conditions, should provide as many as 10 years of productive service before needing to be replaced. When it becomes apparent that the rechargeable pack cannot maintain its charge during the hours without sunlight, replacement is in order.

To replace the rechargeable battery pack in the unit:

1. Open the front door by releasing the upper and lower quick-release latches on the device enclosure and swinging the door out.
2. Disconnect the old battery from the J5 'VBAT1' connector in the unit. This will result in a momentary power-down of the unit that will interrupt any measurements being recorded at the time. No historical records or configuration settings will be lost, though.
3. Remove the old battery from its mounting in the enclosure by ripping it off its dual lock mounting, and press the new pack firmly back into place.
4. Connect the new, fully charged battery to the J5 'VBAT1' connector in the unit. **DO NOT CONNECT TO J4 (VBAT2).**
5. Press any key to wake-up the unit and verify that it is fully operational. A **'first time power'** alarm will have been initiated. See the section on ALARM MODE.

CALIBRATION

Calibration is a crucial element of any program of scheduled maintenance. However, because of the MPplus™ design, software calibration does away with the need for laborious adjustments, thereby simplifying field calibration. See the section on CALIBRATION MODE.

SOFTWARE PACKAGES

FIELD MANAGER™, TALON™ LITE, AND TALON SCE™

The Talon™ software system provides application solutions for Natural Gas, Water/Waster Water, Environmental Protection, Steam, and Electrical applications. Industrial/Commercial Measurement, Pressure/Temperature Monitoring, Supervisory Control, and Odorization are a few of the systems that utilize the software.

Whether your concern is natural gas distribution, gas pipeline transmission or production, Talon gives you the ability to create a powerful system that meets your specific needs. Its flexible design provides the option to purchase only the modules you need, and the ability to expand your system with additional features by adding new modules in the future.

Eagle Research Corporation designed the Talon™ family specifically to meet your needs, providing software modules for both central office and field operations. A separate manual on the Talon™ Suite of Software is available. Contact your sales representative.

APPENDIX A: PARAMETER TABLES

Each unit built is loaded with a variety of parameters, detailing the way the unit is designed to address a customer's needs. These parameters are defined in Tables, like the example below, and cover such options as Single & Dual Positive Displacement Metering, Single & Dual Orifice Metering, Single & Dual Pressure Monitoring, etc.

The parameter table shown here is **typical** of those associated with each unit manufactured, **and may not accurately represent the configuration at your site.** For further information on the specific configuration for your unit(s), contact your factory representative.

TABLE A-1: PROCESS LISTING for Single Positive Displacement Metering

ID	Name	Type
1	System	Extended System
2	Analog Inputs	Extended Analog
3	Press Profile	Ext. 3D Profile
4	Counter Inputs	Counter
5	AGA-7 Meter Run	Turbine (AGA-7)
6	Avg Daily Press	Sum/Avg
7	Avg Daily Temp	Sum/Avg
8	Avg Hourly Press	Sum/Avg
9	Avg Hourly Temp	Sum/Avg
10	Min/Max Press	Min/Max
11	Min/Max Flow	Min/Max
12	Alarm Detector 1	Alarm
13	Alarm Detector 2	Alarm
14	Alarm Detector 3	Alarm
15	Alarm Detector 4	Alarm
16	Alarm Histories	History8
17	Daily Histories	History8
18	Hourly Histories	History8
19	Alarm Dialer	Auto Dialer
20	UnCorr Meter	Turbine (AGA-7)
21	Press Only Meter	Turbine (AGA-7)
22	Analog Output #1	Analog Output
23	Analog Output #2	Analog Output

APPENDIX B: POSITIVE DISPLACEMENT APPLICATIONS

(see the section on GROUNDING)

INTRODUCTION

The MPplus™ may be adapted to calculate flow based on pulses received from the optional index assembly installed on a meter drive. The index assembly may be mounted directly to the unit, or may be located on the meter drive and wired over to the MPplus™. Magnetically operated reed switches inside the index assembly send electronic pulses as the drive turns. These pulses represent uncorrected meter volume to the MPplus™. With the integral static pressure transmitter(s) and temperature probe(s), accurate flow calculations may be obtained.

To eliminate false counts that can result from reed switch "bounce", the MPplus™ uses a set/reset, dual-reed switch configuration. An input pulse is generated only when the opening and closing of the first switch is followed by the opening and closing of the second switch.

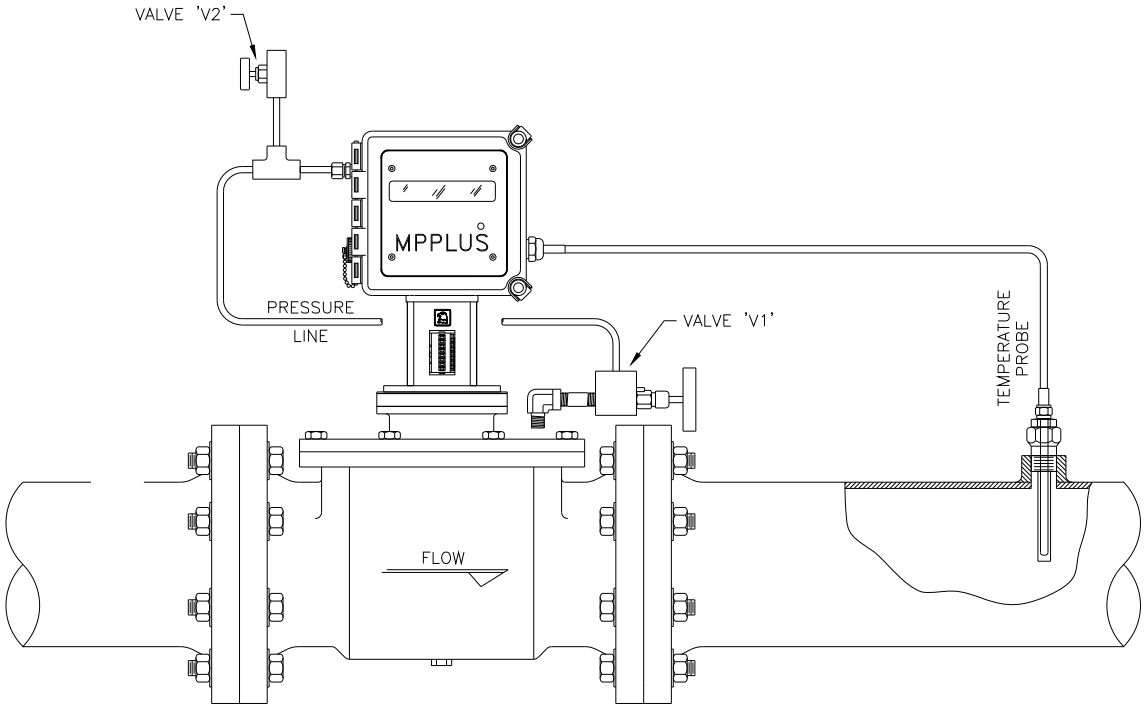


Figure 5 - Typical Positive Displacement Application for Gas

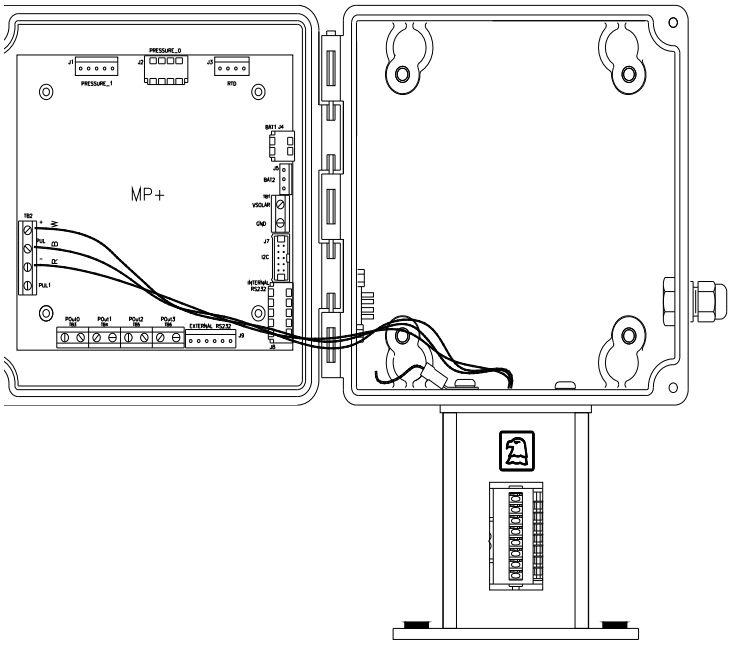


Figure 6 - Index Assembly Wiring

INDEX ASSEMBLY WIRING

The index assembly will typically wire into terminal block TB2, as shown in Figure 9.

The pulse input is software selectable for Form-C (3-wire, Low Speed), Form-A (2-wire, Low Speed) or Form-A (2-wire, High Speed) configuration. Talon™ Lite or Talon SCE™ software can be used to configure the pulse input.

MOUNTING THE MPPLUS™ ON THE METER

The index assembly permits installation of the MPplus™ on a wide variety of meters. In general, the front of the MPplus™ should face the front of the meter. In certain applications, the MPplus™ can be installed 180° from the standard position by removing all four (4) screws that attach the index base plate to the index housing. Replace the screws after you have repositioned the unit.

A reversible counter assembly permits the index to be used on either clockwise (CW) or counterclockwise (CCW) rotating meters. Perform the following checks before installing the unit:

1. Check the meter drive rotation by looking down on the meter-driving dog. Note whether it rotates clockwise (CW) or counterclockwise (CCW).

2. The standard index is setup for clockwise (CW) meter drives. The rotation of the unit can be changed for counterclockwise (CCW) meter drives. See Fig. 7 - Reversing the Index Rotation.

3. Determine the desired reading for the mechanical index and mask the index assembly. See Table C-1, and Fig. 8 - Counter Masking, on the following pages.

4. Align the index base plate holes with the corresponding holes in the top of the meter. Secure the unit by bolting it to the meter. Ensure that the drive dog and index wriggler are correctly aligned and not binding.

5. Plug all unused holes in the index base plate with the rubber plugs provided.

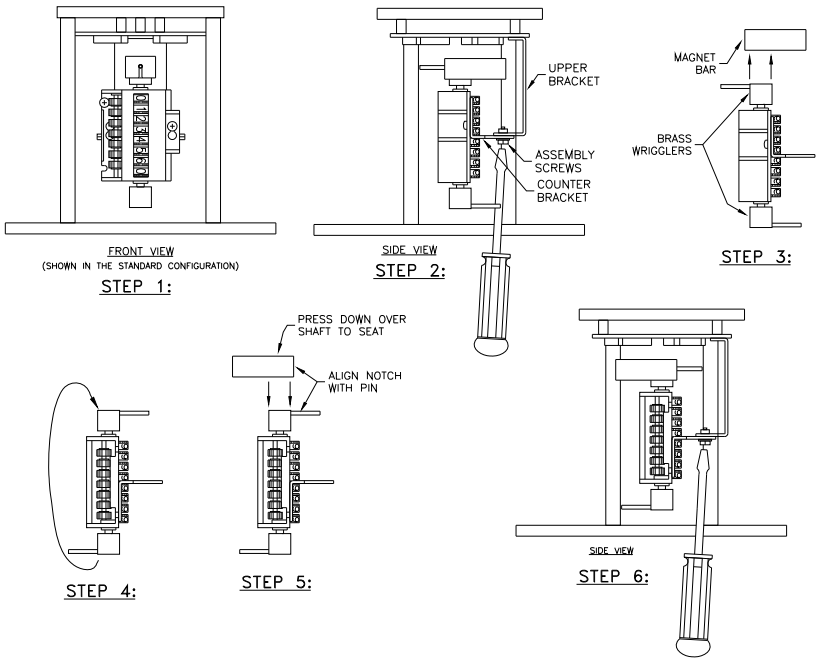


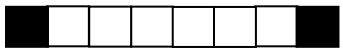
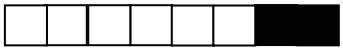
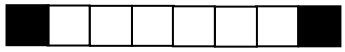
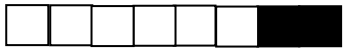
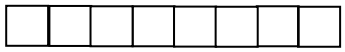
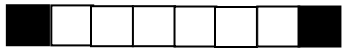
Figure 7 – Reversing the Index Rotation

REVERSING THE INDEX ROTATION

The default configuration of the counter is as shown in Step 1 of Fig 7; with the most significant digit at the top, and the least at the bottom. This would be used on meters having clockwise (CW) rotation. For meters having counterclockwise rotation, the counter assembly must be reversed as follows:

1. The unit is shown in its standard configuration – set up for a clockwise rotating meter.
2. Remove the two-hex/slotted screws holding the counter bracket to the upper bracket, and remove the counter assembly.
3. Remove the magnet bar from the counter by gently pulling it away from the brass wriggler. Be careful not to flex the pliable bar assembly or plastic counter body more than necessary.
4. Flip the entire counter assembly end for end.
5. Press the magnet bar firmly onto the opposite brass wriggler, aligning its notch with the wriggler's roll pin. As before, take care not to stress the bar or counter any more than necessary. Make sure the magnet bar is firmly and squarely seated on the wriggler body.
6. Reinstall the counter assembly into the index housing in the reverse order it was removed. Being careful not to twist the upper bracket, snug down the two assembly screws. Make sure the counter turns freely before mounting onto the meter.

TABLE B-1: 8-DIGIT COUNTER MASKING

Drive (Ft^3/Rev)	Index Reading Multiplier	Counter Masking
10	DCF	
	CCF	
	MCF	
100	CCF	
	MCF	
1,000	CCF	
	MCF	

Index Reading Multiplier:
DCF = Reading times ten feet CCF = reading times one hundred feet MCF = reading times one thousand feet

Counter Masking

In the configuration shown in Figure 8, the index counter is positioned so the digits read from top to bottom (clockwise meter rotation as viewed from top). In this case, the desired mask can be used to hide those digits not needed from either end of the readout. Refer also to Table B-1.

1. Wipe any accumulated dust from the face of the counter with alcohol and allow it to dry.

2. Peel the backing from the chosen mask and apply. Note that the mask and the counter face both have a wider area above the readout, and a narrower one below.

3. Peel the backing from the cubic feet or meters per **revolution** label and place in the wide area above the readout.

4. Peel the backing from the cubic foot **resolution** label and place in the narrow area below the readout.

Note: In cases where the counter is reversed (for meters having counterclockwise rotation), the entire procedure is flipped 180°.

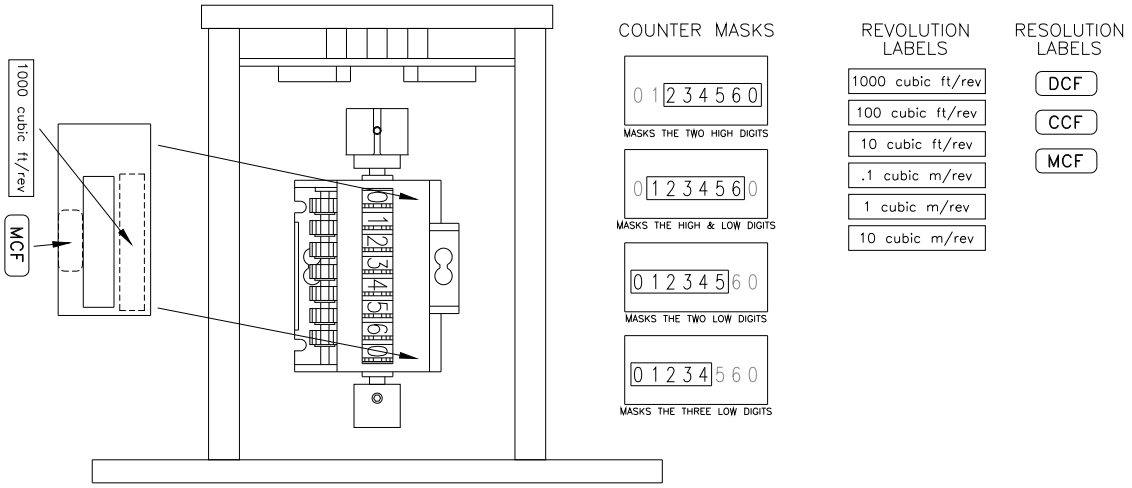


Figure 8 – Counter Masking Kit Application