PULSA Series®

DIAPHRAGM METERING PUMPS

PULSAR® MLC

INSTALLATION,
OPERATION &
MAINTENANCE
INSTRUCTION

BULLETIN No. PMP-MLC-IOM-99

PULSAFEEDER
A Unit of IDEX Corporation

Manufactures of Quality Pumps,
Controls and Systems

ENGINEERED PUMP OPERATIONS
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MLC™ FACTORY SERVICE POLICY

Your MLC is a state of the art microprocessor-based stroke length control device for use with *SERIES–M* Diaphragm Metering Pumps. It includes extensive on-board diagnostics. If you are experiencing a problem with your MLC, first review the diagnostic menu, then consult the trouble shooting guide. If the problem is not covered or cannot be solved, please contact your local PULSA Series Sales Organization or our Technical Service Department at (716) 292-8000 for further assistance. Do not open or tamper with your MLC enclosure as this will void the warranty.

Trained individuals are available to diagnose your problem and arrange a solution. Solutions may include purchasing a replacement unit or returning the MLC to the factory for inspection and repair. All returns require a Return Material Authorization (R.M.A.) number to be issued by Pulsafeeder. Replacements purchased under a possible warranty situation may be credited after an examination of the original MLC by Pulsafeeder personnel.

Certain components may be purchased for replacement. These include the manual over-ride knob, the keypad splash guard, and the fuses. Parts purchased to correct a warranty issue may be credited after examination of the original parts by Pulsafeeder personnel. Parts returned for warranty consideration that test satisfactorily, will be sent back to the originator freight collect.

Any field modifications will void the Pulsafeeder MLC warranty. Out-of-warranty repairs will be subject to Pulsafeeder's standard bench fees and testing costs associated with replacement components.

MLC MICROPROCESSOR-BASED CONTROLLER LIMITED WARRANTY

Pulsafeeder Inc. warrants the MLC, microprocessor-based controller against defects in materials or workmanship for a period of one year under normal use from date of shipment. The manufacturer's liability is limited to the repair or replacement of any failed component which is proven defective in material or workmanship upon manufacturer's examination. This warranty does not include removal or installation costs and in no event shall the manufacturer's liability exceed the selling price of such equipment.

This warranty does not extend to damage by corrosion, erosion, mishandling, any force of nature or any other conditions beyond the seller's reasonable control.

The manufacturer disclaims all liability for damage to its products through improper installation, maintenance, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise or any unauthorized repair. The manufacturer is not responsible for consequential or other damages, injuries or expenses incurred through the use of its products.

The above warranty is in lieu of any other guarantee, either expressed or implied. The manufacturer makes no warranty of fitness or merchantability. No agent of ours is authorized to make any warranty other than the above.

FCC WARNING

This equipment generates and uses radio frequency energy. If not installed and used properly, in strict accordance with the manufacturer’s instructions, it may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures necessary to correct the interference.

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Conventions

For the remainder of this bulletin, the following Conventions are in effect.

A WARNING DEFINES A CONDITION THAT COULD CAUSE DAMAGE TO BOTH THE EQUIPMENT AND THE PERSONNEL OPERATING IT. PAY CLOSE ATTENTION TO ANY WARNING.

Notes are general information meant to make operating the equipment easier.

Tips have been included within this bulletin to help the operator run the equipment in the most efficient manner possible. These "Tips" are drawn from the knowledge and experience of our staff engineers, and input from the field.

❖ **This is a procedure heading . A Procedure Heading indicates the starting point for a procedure within a specific section of this manual.**

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1. Introduction

The MLC is a microprocessor based stroke length control device for use with the *SERIES–M* diaphragm metering pump. It has been designed with many advanced features that allow the MLC to operate in a wide variety of industrial environments.

This instruction manual covers the MLC -- Digital Stroke Length Controller. All standard features are covered in this manual and most options have instructions where applicable.

1.1 DESCRIPTION

The MLC is an electromechanical servo controller dedicated to the *SERIES–M* diaphragm metering pump series. The unit is physically attached and integrated into the pump's design. It's purpose is to precisely adjust output flow of a process media by means of stroke length positioning

The MLC is designed for the international industrial market. The device is factory configured and calibrated for the attached pump. The man/machine interface is user friendly. Local setup and control is achieved through the nine button keypad and a back-lit two-line liquid crystal display. Basic operation is simple with dedicated function keys eliminating the need for a sophisticated menu system. The MLC responds immediately to user commands. Pump output is displayed as a percentage of stroke length position or in units of calibrated flow: GPH, LPH, CCH, GPM, LPM, CCM. In addition, the MLC display supports any one of four languages: English, French, German, or Spanish.

Analog signals and serial communications offer flexible remote control. They are fully isolated -- from each other as well as earth ground -- for improved protection and reliability. A Batch feature, with up to three independent programs, supplements the control features and allows for greater flow turndown.

The MLC is designed to simplify and automate the calibration of pump flow and analog signals. Flow calibration uses on-screen prompting, automated pump operation, and automatic curve fitting to eliminate stop-watches, calculators and human inaccuracies. Analog signal calibration is also accomplished by simple key-pad entry. It includes a real-time display of signal level. This eliminates the need for external meters.

The MLC readily accepts PULSAlarm® leak detection and drum level inputs. These may be configured to stop the pump and/or activate an alarm relay. Failures are time and date stamped into memory for later retrieval. Other diagnostics include analog signal failure and line power failure. These are time and date stamped as well and may be preset to control stroke position or motor status upon detection of a failure.

1.1.1 MLC STANDARD FEATURES

- Digital Stroke Length Control
- Keypad
- Back-lit 2 x 16 LCD Display
- Solid State PULSAR Motor Relay
- NEMA 4X Enclosure
- Manual Stroke Adjustment Over-ride
- 4-20mA Input and Output
- 10-Year Battery Backed Clock
- Solid State Alarm Relay
- Level Input for Drum or Remote Start/Stop
- PULSAlarm Leak Detection Interface
- Diagnostics

1.1.2 OPTIONS

- NEMA 7 Enclosure
- Operating Voltage/Frequency
- DC Motor Speed Control

Security password protection may be activated to prevent unwanted tampering. All settings and diagnostics have a battery back up for up to 10 years in the absence of power.

The MLC is available in any combination of 120/240 VAC, 50/60 Hz. Protection exists to prevent damage against over or under voltage conditions in the event the wrong line source is used.

2. SAFETY

The MLC is a sophisticated microprocessor based controller for use only with *PULSAR* diaphragm metering pumps. It yields tremendous control capacity -- electrical, mechanical and (in conjunction with the *PULSAR* pump) hydraulic in nature. Consider the following SAFETY issues and how they relate to you, your co-workers, and the process environment prior to the installation and operation of a MLC controlled *PULSAR* metering pump:

2.1 General Safety

The MLC was designed as a stroke length position actuator for operation solely with the PULSAR metering pump. Use for any other application is considered un-safe and voids all certification markings and warranties.

2.1.1 Explosive Atmosphere Safety

EXPLOSION HAZARD -- DO NOT PERFORM INSTALLATION/MAINTENANCE OF ANY KIND ON THIS DEVICE WHILE CIRCUIT IS LIVE AND/OR THE AREA IS KNOWN TO BE HAZARDOUS.

With the proper marking, this equipment is suitable for use in Class I, Division 2, Groups C & D; Zone 2, Groups IIA and IIB or non-hazardous locations only.

2.1.2 Electrical Safety

The MLC can be considered an industrial controller with an integrated single phase motor starter. Improper application and use can be hazardous.

The MLC's electrical installation must conform to all relevant electrical codes. Installation and electrical maintenance must be performed by a qualified electrician. Before installing or servicing this device, all power must be disconnected from the source at the main distribution panel.

The MLC emits electro-magnetic energy and generates radio frequency interference. Its use is restricted to industrial applications. You are responsible for shielding this energy /interference.

2.1.3 Mechanical Safety

When properly installed, the device has only one externally accessible moving part -- the hand adjustment knob. This component is under computer control and as such may actuate without warning. Care should be taken to keep loose clothing away from this component. Hands and fingers should be kept clear while the knob is turning under MLC control.

The MLC was designed to be service free. It contains no user-maintainable components. Removal of the entire MLC as an assembly from the pump is permissible. Never disassemble the MLC enclosure. Evidence of disassembly shall void the warranty.

2.1.4 Hydraulic Safety

Thoroughly review and adhere to the contents of the PULSAR Installation, Operation, Maintenance Instruction manual (Bulletin No. PMP-IOM-96) for hydraulic installation of your PULSAR metering pump. As a microprocessor controlled device, the MLC may activate the pump motor without warning -- generating hydraulic pressure and fluid flow. Care should be taken to protect both users and systems should the pump activate.

3. Equipment Inspection

Check all equipment for completeness against the order and for any evidence of shipping damage. Shortages or damage should be reported immediately to the carrier and your PULSAFEEDER representative.

4. Storage Instructions

The MLC can be successfully stored for extended periods. The key to this success is control of temperature and humidity.

4.1 Storage Length

4.1.1 Short Term (0 - 12 months)

The MLC should be stored in a temperature and humidity controlled environment. It is preferable to keep the temperature constant in the range of -18 to 40ø Celsius (0 to 104ø Fahrenheit). The relative humidity should be 0 to 90% non-condensing.

The adjustment knob should be rotated by hand one full revolution every six months.

If the MLC is installed on the pump, it should not be removed during this period - provided the above conditions can be applied to the pump as well. If the MLC is removed from the pump, it should be stored in the same pump mounted orientation. After removal of the MLC from the PULSAR metering pump, seal the eccentric box opening with a dust and moisture proof material. If the MLC was shipped in its own carton, it should be stored in that carton.

4.1.2 Long Term (12 months or more)

Storage of the MLC for periods of longer than twelve months is not recommended. If extended storage is unavoidable the MLC should be stored in accordance with those conditions stipulated for Short Term Storage. In addition, a porous bag of 85g (3 oz) silica gel or similar desiccant should be placed beneath the wiring access cover. The cover should be re-installed to seal the desiccant within the enclosure. The three conduit connections must be tightly capped.

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5. INSTALLATION

5.1 LOCATION

NOTE **Review the Safety section prior to installing the MLC. It contains information required to properly install and operate the MLC in an industrial environment.**

The site selected for the installation of your MLC is largely dependent on that of the PULSAR metering pump. Review the PULSAR Installation Operation Maintenance Instruction Manual (Bulletin No. PMP-IOM-96) provided with your PULSAR metering pump. It details system related issues that are important to proper operation of the PULSAR metering pump. Consider the following MLC related issues when selecting a site. The MLC should be mounted in an area where the operator has access to the front of the unit and a clear view of the display panel and keyboard. Avoid locations where the MLC would be subjected to extreme cold or heat. Note the warning statement on the next page. The installation of this device must comply with national, state and local codes.

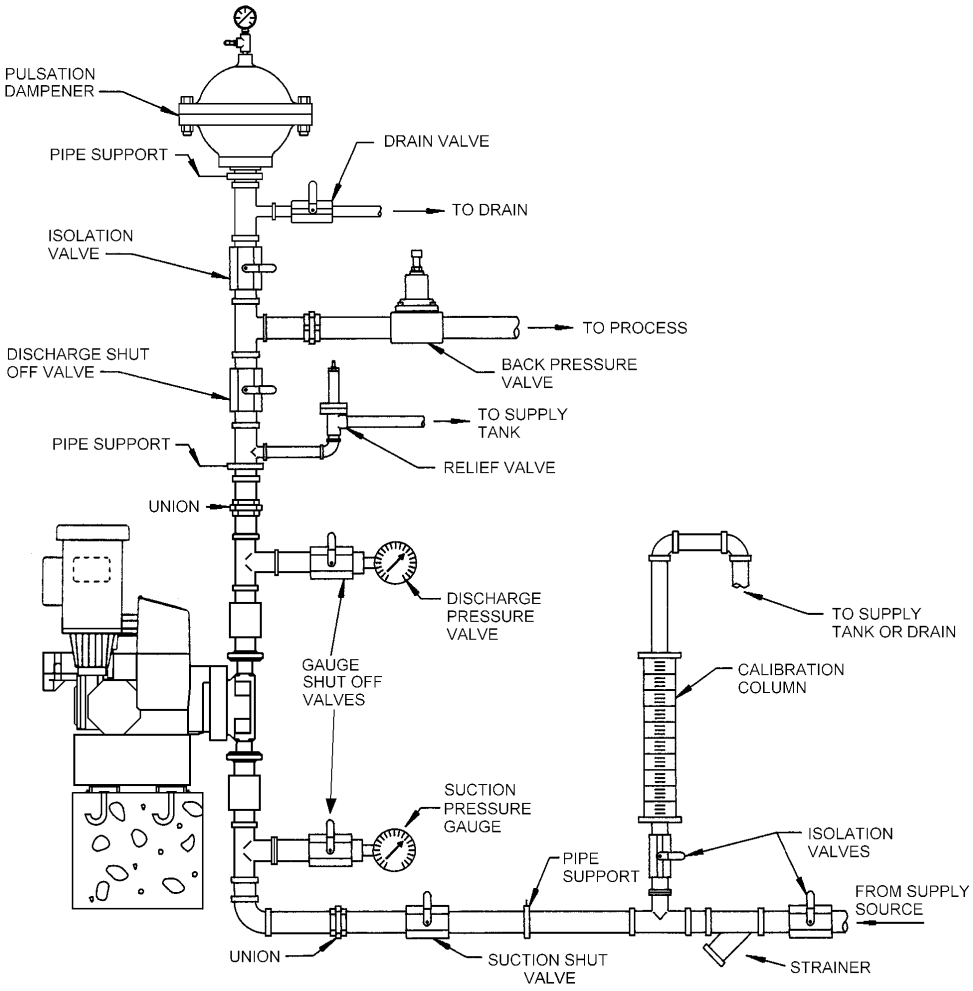

Figure 1 – Typical Installation.

AVOID LOCATIONS WHERE THE MLC WOULD BE SUBJECTED TO EXTREME COLD OR HEAT [LESS THAN -18º CELSIUS (0º FAHRENHEIT) OR GREATER THAN 40º CELSIUS (104º FAHRENHEIT)] OR DIRECT SUNLIGHT. FAILURE TO OBSERVE THIS WARNING COULD DAMAGE THE MLC AND VOID ITS WARRANTY.

5.2 INSTALLATION NOTES

1. The MLC is a microprocessor based controller that uses electro-static sensitive CMOS components. Do not make **ANY** electrical connections without adequately grounding the MLC and the worker to eliminate an electro-static charge between the two. A conductive wrist strap worn by the worker and attached to the MLC enclosure is adequate to satisfy this requirement.
2. Pump Flow Calibration is an important element of successful MLC operation. Permanent installation of a calibration column as depicted in *Figure 1* is strongly recommended.
3. Conduit connections can carry fluids and vapors into the MLC causing damage and void the warranty. Care should be taken when installing conduit to protect against fluid/vapor entry. If necessary, provide sealed entries or conduit drains near the point of entry.

5.3 ELECTRICAL WIRING

The MLC has many advanced features that may make wiring the unit appear complicated. Wiring is actually very simple -- a minimum of two high voltage connections are all that is required to take advantage of a majority of the MLC's features. It is highly recommended that you take a step-by-step approach to wiring and confirming proper MLC operation:

5.3.1 Getting Started

The field wiring of the MLC is accomplished through a rear access cover at the back of the unit -- near the PULSAR gearbox and motor. The access panel is opened by removing the 4 retaining screws (Phillips head screw driver required). Removal reveals the Field Wiring Board. Refer to *Figure 2.*

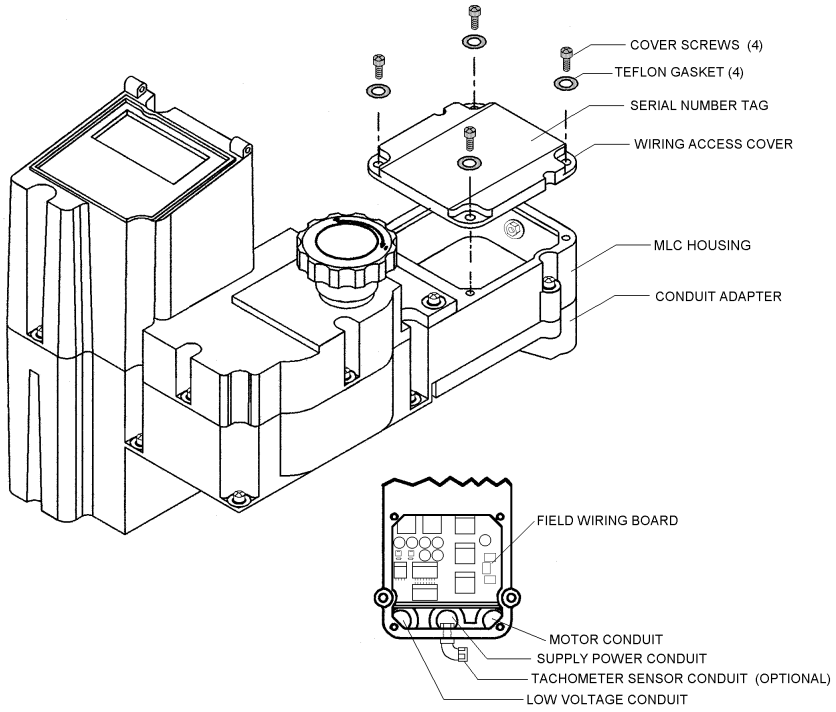

Figure 2 – Accessing the Field Wiring Board

TIP **The Field Wiring Access Cover has the Serial Number Tag on it. Keep the cover with the MLC it was removed from. The MLC is marked internally with the Serial Number. The internal marking will be used for warranty claims.**

The Field Wiring Board (refer to *Figure 2*) contains wiring blocks for making all of the electrical connections. It is mechanically attached to the Conduit Adapter. The adapter in conjunction with the Field Wiring Board form a modular connector or plug. This allows the MLC to be removed from the PULSAR unit without disturbing the electrical wiring and conduit connections.

WARNING **REMOVE THE CONDUIT ADAPTER AND FIELD WIRING BOARD FOR MLC REPAIR/REPLACEMENT PURPOSES ONLY. REFER TO *SECTION 13 - REPAIRS* FOR FURTHER INFORMATION.**

5.3.2 High Voltage Connections.

These connections will allow you to operate the MLC and attached PULSAR pump.

Go to Section 5.4 High Voltage Connections

4. Connect AC power to J1
5. Connect the PULSAR motor or Motor Starter relay to J3
6. Connect the external alarm if applicable, to J2, or go to step 2.
7. Power-up and test the MLC to confirm the connections and check for proper operation.
8. Power-down the MLC.

5.3.3 Low Voltage Input Connections

Go to Section 5.5 Low Voltage Input Connections

1. Decide which low voltage Inputs (e.g., 4-20mA in) will be used and make those connections.
2. Power-up and test the MLC to confirm the connections and check for proper operation.
3. Power-down the MLC.

5.3.4 Low Voltage Output Connections

1. Decide which low voltage Outputs (e.g., 4-20mA out) will be used and make those connections.
2. Conduct a final power-up and test the MLC to confirm the connections and check for proper operation.
3. Go to ***Section 6 - Start Up Instructions*** for information on performing the power-up tests.

5.3.5 Finding your way around the Field Wiring Board

The electrical connections are segregated on the Field Wiring Board. The High Voltage connections are on the right side while the low voltage connections are on the left. Refer to the Field Wiring Board map in *Figure 3* for specific connection and fuse locations.

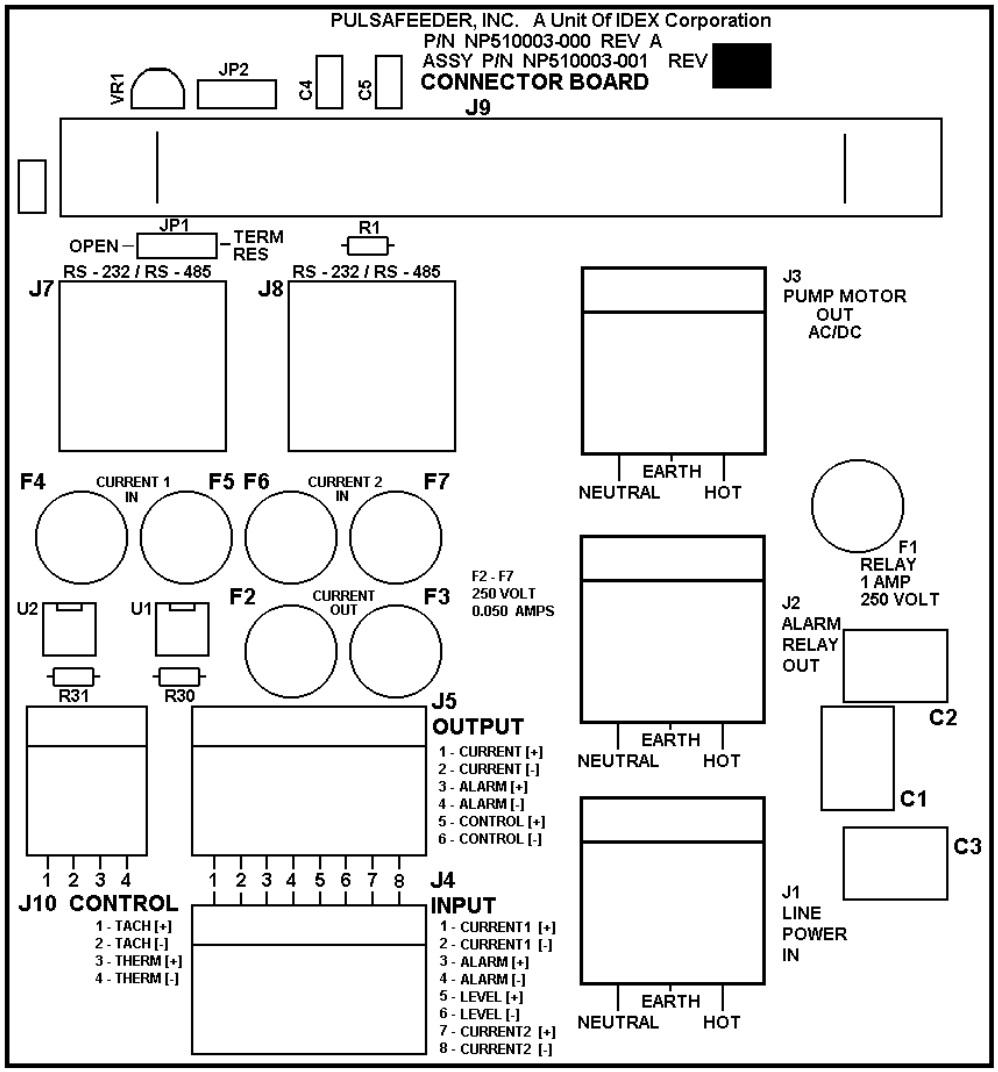

Figure 3 – Field Wiring Board Map.

5.4 HIGH VOLTAGE CONNECTIONS

There are only three high voltage connections to be made on the MLC: the supply power (J1), the PULSAR motor load (J3), and the Alarm Relay Load (J2). Only the supply power and PULSAR motor load connections are required. Refer to *Figure 4* for connection location.

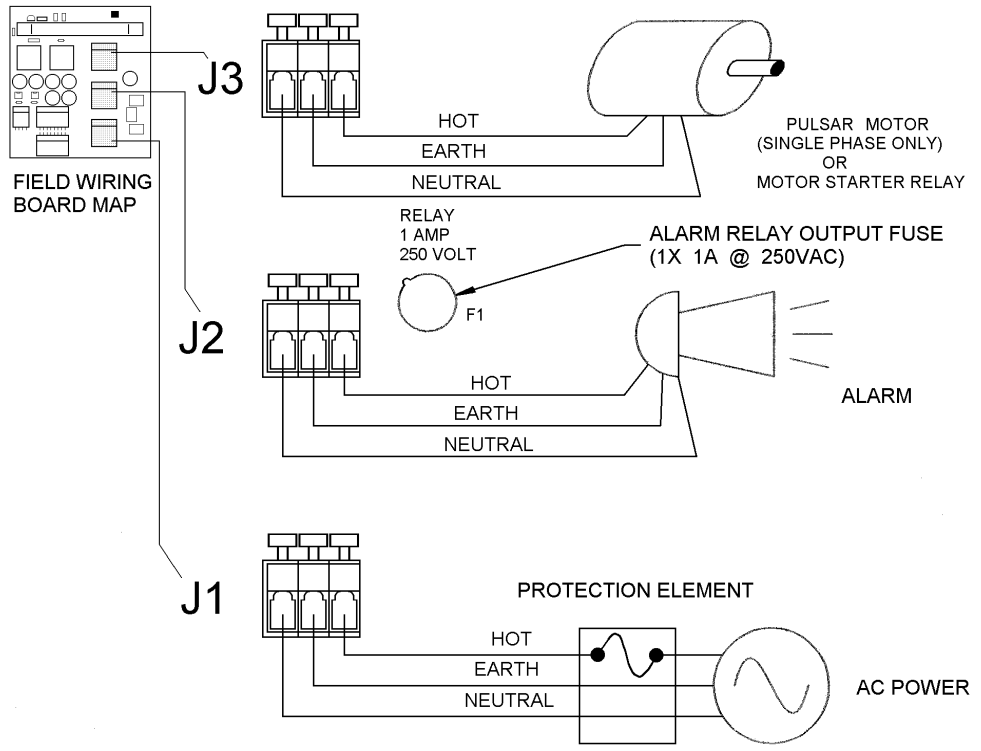

Figure 4 – High Voltage Connections

5.4.1 Supply Power

WARNING

THE MLC REQUIRES ONE CONNECTION TO AN EXTERNAL POWER SOURCE. IT USES THIS SAME CONNECTION TO POWER ITS OWN SUPPLY, THE SINGLE PHASE PUMP MOTOR (OR MOTOR STARTER RELAY) AND THE ALARM RELAY OUTPUT. YOU MUST TAKE THESE EXTERNAL LOADS INTO CONSIDERATION WHEN SIZING THE BRANCH CIRCUIT.

The MLC power supply and attached PULSAR motor do not have fuse protection. You are responsible for correctly sizing the protection element (i.e., fuse or circuit breaker at the distribution panel). Use the work sheet in *Table 2* for correctly sizing the branch protection element.

The MLC with an attached pump motor and alarm load, should be connected to its own branch circuit. Size the supply wire and protective element according to local code requirements. (Use 14 AWG (2.1mm^2), 105^{ø} C insulation wire or better.) Attach the supply to the J1 terminal block labeled 'LINE POWER IN.' Make 3 connections: Neutral, Earth (ground) and Hot as labeled.

115VAC +/- 10% 50/60Hz				230VAC +/- 10% 50/60Hz		
Device	Current Requirement (Amp)			Device	Current Requirement (Amp)	
MLC	1A	(1A Max.)		MLC	.5A	(.5A Max.)
Pump Motor*	+	(8A Max.)		Pump Motor*	+	(4A Max.)
Alarm Relay*	+	(1A Max.)		Alarm Relay*	+	(1A Max.)
Total **	=			Total **	=	

* In-rush current requirements should be considered. All values RMS.

** Calculation is for guideline purposes only. User must consult local electrical codes when sizing branch circuits. Protection must not exceed 10Amps RMS at 115VAC or 5.5Amps RMS at 230VAC.

Table 2 – Branch Circuit Protective Element Sizing Worksheet.

The operating voltage and frequency of the MLC are factory configured -- an internal motor and capacitor are sized according to voltage and frequency. If the power supplied to the unit does not match the factory configuration, the MLC will display an {OVER VOLTAGE} diagnostic message on power-up. This is possible because the microprocessor and display are powered by a switching power supply. It detects the incoming power and self-regulates its output. This power supply is protected by a 7.4 Joule surge suppression device. The microprocessor will not operate the internal synchronous motor, potentially causing damage, until the voltage problem is corrected.

HIGH VOLTAGE CIRCUITS (E.G., BRANCH) SHOULD BE RUN IN SEPARATE CONDUIT. DO NOT COMBINE HIGH VOLTAGE (I.E., GREATER THAN 100VAC) LINES AND LOW VOLTAGE (I.E., LESS THAN 28VDC) LINES IN A COMMON CONDUIT!

5.4.2 PULSAR Motor

Connect the pump motor to the J3 terminal block labeled 'PUMP MOTOR OUT AC/DC.' (Use 14 AWG (2.1mm^2), 105^{ø} C insulation wire size or larger.) The pump motor must be wired to operate at the MLC supply voltage (i.e., if the power supplied to J1 is 115VAC 60Hz, then the motor must operate on 115VAC at 60Hz).

THE MLC USES SOLID-STATE RELAYS FOR IT'S HIGH VOLTAGE OUTPUTS (I.E., MOTOR AND ALARM). IN THE 'OFF' STATE, THESE DEVICES TYPICALLY LEAK 20-30MA OF CURRENT AT THE SUPPLY VOLTAGE TO THE ATTACHED DEVICE (OR TERMINAL BLOCK)! THE SUPPLY POWER MUST BE DISCONNECTED AT THE MAIN BEFORE WORKING ON ELECTRICAL CONNECTIONS OR ANY MOVING PUMP COMPONENTS (E.G., MOTOR, GEAR TRAIN, ETC.).

WARNING

DOUBLE CHECK ALL CONNECTIONS TO CONFIRM GOOD ELECTRICAL CONTACT BETWEEN THE TERMINAL BLOCK CLAMP AND BARE WIRE. MAKE SURE THE CLAMP IS ON THE WIRE, NOT THE INSULATION. INSURE THAT BARE WIRE IS NOT FRAYED AND DOES NOT RISE ABOVE DIVIDERS.

If the PULSAR pump motor is controlled by a Variable Speed Drive (e.g., DC Drive), the Variable Speed Drive must be powered by the MLC. Wire the Variable Speed Drive to J3. Wire the PULSAR motor to the Variable Speed Drive in accordance with the Variable Speed Drive manufacturer's instructions. Refer to ***Section 8-Diagrams:*** *Installation / Component; Diagram 2* for recommended wiring.

If the PULSAR pump motor or Variable Speed Drive operates at a voltage different than that supplied to the MLC or is a three-phase motor, then a motor starter must be used. Wire the motor starter relay to J3. Wire the PULSAR motor or Variable Speed Drive to the motor starter in accordance with the starter manufacturer's instructions. Refer to ***Section 8-Diagrams:*** *Installation / Component; Diagram 2* for recommended wiring.

WARNING

DAMAGE MAY OCCUR TO THE MLC IF THE PULSAR PUMP MOTOR IS NOT WIRED AND COMMUNICATING WITH THE MLC.

5.4.3 Alarm Relay

The Alarm Relay is an output that is operator configured. Refer to ***Section 7 - General Operation*** for specific instructions on how to activate the Alarm Relay. The Alarm Relay Load must not exceed 1 Amp at rated voltage. Connect the Alarm load to the J2 terminal block labeled 'ALARM RELAY OUT'. Use 22 AWG (0.32 mm^2) wire size or larger. Make three connections: Neutral, Earth (ground) and Hot as labeled.

5.5 LOW VOLTAGE INPUT CONNECTIONS

There are two types of Low Voltage inputs: Current (e.g., 4-20mA) and Dry Contact. The Low Voltage Input connection block is labeled J4 'INPUT' (Refer to *Figure 5*). It contains three-pairs of inputs: Current, Alarm, and Level.

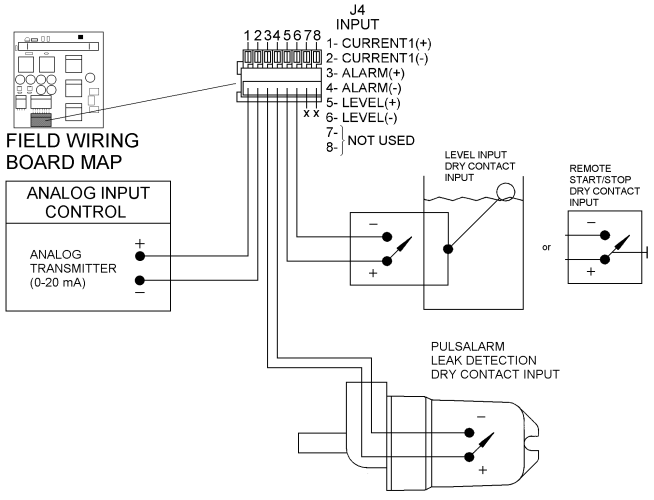

Figure 5 – Low Voltage Input

THE DRY CONTACT INPUTS ARE SELF-POWERED. SUPPLY ONLY A MECHANICAL SWITCH CLOSURE TO ACTIVATE. DO NOT ATTACH EXTERNALLY POWERED CIRCUITRY.

THE WIRE USED TO CONNECT LOW VOLTAGE INPUTS SHOULD BE RUN IN A CONDUIT SEPARATE FROM THE HIGH VOLTAGE POWER. DO NOT COMBINE HIGH VOLTAGE (I.E., GREATER THAN 100VAC) LINES AND LOW VOLTAGE (I.E., LESS THAN 28VDC) LINES IN A COMMON CONDUIT!

5.5.1 Analog Input

The Analog Input is used for remote control of the PULSAR flow. The input accepts current inputs anywhere in the range of 0 to 25mA (e.g., 4-20mA) provided the 'span,' (the difference between the High and Low value), is greater than 2mA. Voltage signals in the 0-5 volt range are accepted but displayed as current during Analog Input calibration.

Split-ranging, reverse acting, and ratio control are accomplished in the calibration routine in ***Section 7 - General Operation***. No hardware adjustments are required. The channel is surge protected and fused for over-current protection. The device is designed to avoid damage in the event high voltage is inadvertently applied.

Use 22-AWG (0.32 mm^2) wire or larger for hookup. Attach the analog signal generated by an external device (e.g., PLC) to the connection points labeled '1-CURRENT1(+)' and '2-CURRENT1(-)' on the J4 terminal block labeled 'INPUT' (refer to *Figure 5*). Attach the Positive lead to position 1 and the Negative lead to position 2. Position indicators are printed on the circuit board above the terminal. The MLC will provide approximately 200 ohms of resistance to a current loop. The Analog Input is isolated from all other inputs, outputs and earth ground. Follow the instructions in ***Section 7-General Operation*** for Analog Input software set-up.

5.5.2 Alarm Input

The Alarm Dry Contact Input is designed to operate with the PULSAlarm leak detection option. It is software configurable to generate an alarm, activate the alarm relay and/or shut down the PULSAR motor. The input is internally powered -- only a mechanical switch closure is required for activation. Use 22-AWG (0.32 mm^2) wire or larger. Attach one side of the switching device to the position labeled '3-ALARM(+)' and the other side to the position labeled '4-ALARM(-)' of connector J4-INPUT (refer to *Figure 5*). A resistance of 15K ohms or less is required across the two connections for proper detection. Follow the instructions in ***Section 7 - General Operation*** for Alarm Input (Leak Detection) software set-up.

5.5.3 Level Input

The Level Dry Contact Input is designed to operate in one of two modes:

Monitor a single-point drum level sensor and generate an alarm, activate the alarm relay and/or shut down the PULSAR motor.

or

Act as a remote on/off switch

The input is internally powered, only a mechanical switch closure is required for activation. Use 22-AWG (0.32 mm^2) wire or larger. Attach one side of the switching device to the position labeled '5-LEVEL(+)' and the other side to the position labeled '6-LEVEL(-) of connector J4-INPUT (refer to *Figure 5*). A resistance of 15K ohms or less across the two terminals is required for proper detection. Follow the instructions in ***Section 7 - General Operation*** for Drum Level Input software set-up.

5.5.4 Second Current Input

The Second Current Input, '7-Current2' and '8-Current2' is reserved for future use. Make no connection here.

5.6 Low Voltage Output Connections

There are two types of Low Voltage outputs: Analog (e.g., 4-20mA), and Transistor based Dry Contact. The Low Voltage Output connection block is labeled J5 'OUTPUT' (refer to *Figure 6*). It contains three-pairs of outputs: Current, Alarm and Motor Control Signal.

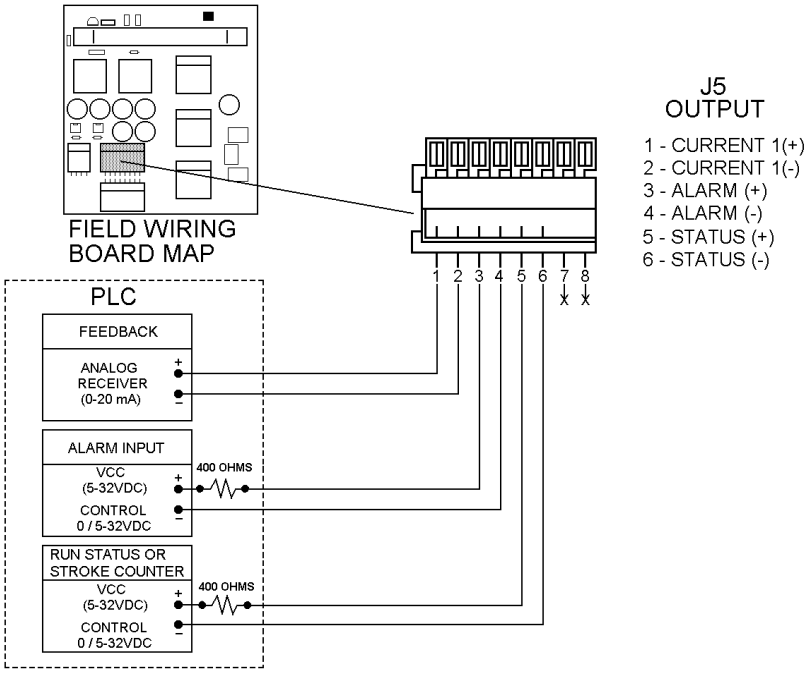

Figure 6 – Low Voltage Output

NOTE **The Transistor based Dry Contact output is optically isolated. It is not self-powered to achieve total isolation. The external device must supply and detect a return voltage level.**

WARNING **THE WIRE USED TO CONNECT LOW VOLTAGE INPUTS SHOULD BE RUN IN A CONDUIT SEPARATE FROM THE HIGH VOLTAGE LINE POWER. DO NOT COMBINE HIGH VOLTAGE (I.E., GREATER THAN 100VAC) LINES AND LOW VOLTAGE (I.E., LESS THAN 28VDC) LINES IN A COMMON CONDUIT!**

5.6.1 Current Output

The Current Output Channel follows the true stroke length position. It is calibrated to source current in the 0 to 20mA range (e.g., 4-20mA). The output can be calibrated for reverse acting, split ranging and ratio control. Refer to ***Section 7-General Operation****: Calibration* for further details.

The Current Output is used to control slave devices (e.g., MLC's, ELMA's, PULSAMATICs, etc.) or to fulfill closed loop system requirements. Attach the connection points labeled '1-CURRENT(+) and '2-CURRENT(-)' on connector J5-OUTPUT (see *Figure 6*) to the external device. Use 22-AWG (0.32 mm^2) wire or larger. Attach the Positive lead to position 1 and the Negative lead to position 2. The analog output will drive against a maximum load of approximately 700 ohms. Thus, a single MLC Analog Output could be used to drive two slave MLC's. They, in turn, could each drive two additional slaves. This is referred to as a fan-out of two. The Analog Output is isolated from all other inputs, outputs. and earth ground. Follow the instructions in ***Section 7 - General Operation:*** *Calibration, Analog Output*.

5.6.2 Alarm Dry Contact Output

The Alarm output is a solid state transistor closure. It indicates the present state of the alarm relay output. Logic HIGH indicates an ON condition while logic LOW indicates an OFF condition. It is commonly used to indicate an alarm status to external control equipment (i.e., PLC, PC or other Manual controllers). Refer to *Figure 6*.

TIP **VCC (+5VDC) and Ground are provided on terminals 7 and 8 of connector J5. A 250 ohm resistor from terminal '7-VCC' to terminal '3-ALARM(+)' will cause a +5VDC signal to appear between terminals '4-ALARM(-)' and '8-DCGND' when the alarm output is activated. This technique is only recommended if the input on the external device is isolated from all other inputs, outputs and grounds.**

An opto-coupler is used to achieve total isolation of this device. As such, the external control equipment must generate the supply on the positive output and detect the return of that signal when the output is activated by the MLC. In a typical application, use 22-AWG (0.32 mm^2) wire to attach the terminal labeled '3-ALARM(+)' -- the collector terminal -- to the external equipment's logic supply. Connect the terminal labeled '4-ALARM(-)' -- the emitter terminal -- to the positive input of the equipment. The negative input of the equipment should be connected to its isolated ground. A series resistance of 400 ohms is recommended -- especially when sinking current (e.g., a photo-diode of an opto-isolator). The Alarm output cannot be directly configured from the software. It follows the Alarm Relay output.

5.6.3 Run Status or Stroke Counter

The Status output can be configured through software to indicate that the pump motor is on or to generate a pulse with every pump stroke (for use with an external stroke counter). The factory default for this output is to indicate Pump Motor Status. The Stoke output is not in phase with the pump stroke but has a 50% duty cycle. (e.g., the output will be **ON** for half of the stroke and **OFF** for the other half.

An opto-coupler is used to achieve total isolation of this output. As such, the external control equipment must generate the supply on the positive output and detect the return of that signal from the MLC. In a typical application, use $0.32mm^2$ – $0.52mm^2$ (22-20 AWG) wire to attach the terminal labeled '5-STATUS(+)' – the collector terminal – to the external equipment's logic supply. Connect the terminal labeled '6-STATUS(-)' – the emitter terminal – to the positive input of the equipment. The negative input of the equipment should be connected to its isolated ground. A series resistance of 400 ohms is recommended – especially when sinking current (e.g., a photo-diode of an opto-isolator).

5.7 Tachometer Input

The Tachometer Sensor is connected to the Tachometer Input. It senses motor rotation. This input allows the MLC to control motor speed.

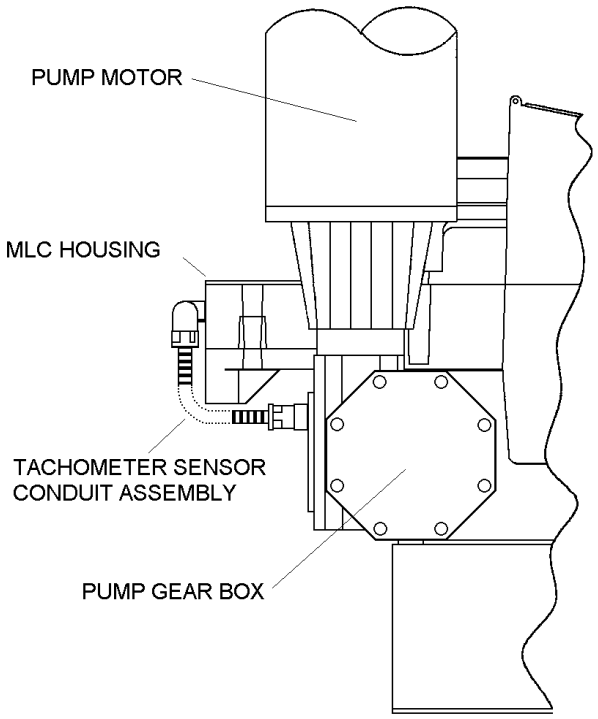

Figure 7 – Tachometer Sensor Conduit Assembly

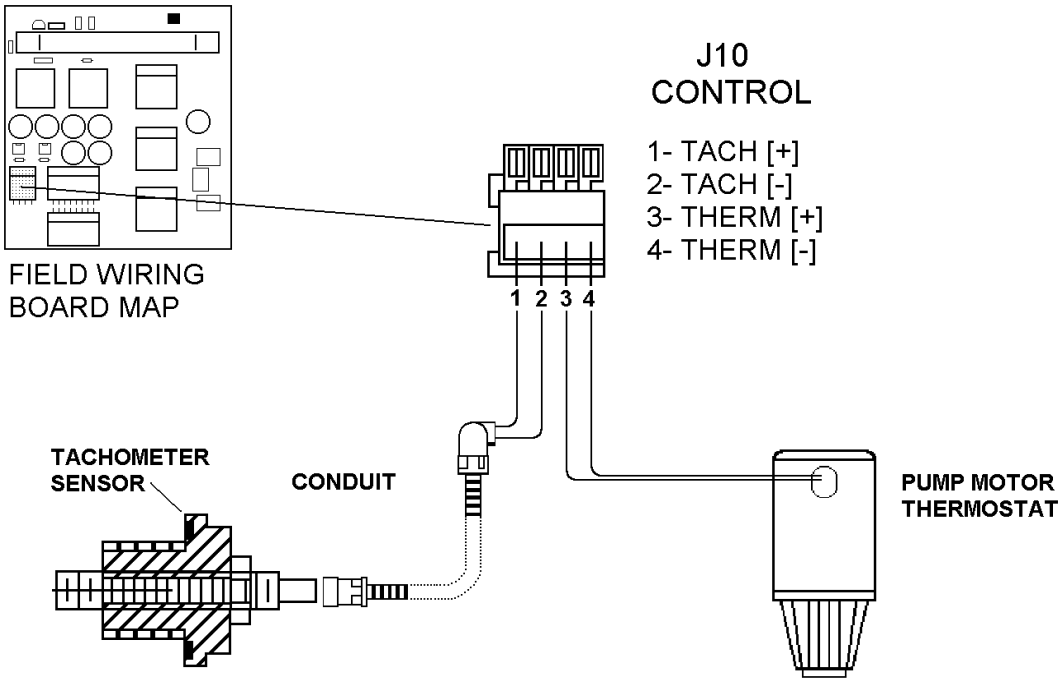

Figure 8 – Tachometer and Pump Motor Thermostat Connections

To connect the Tachometer Input, connect the wire labeled VDC (typically brown) to the connection point labeled 1–TACH [+] on connector J-10 CONTROL. Connect the wire labeled TACH (typically blue) to the connection point labeled 2–TACH [-] on connector J-10 CONTROL. Make these connections using the 22 AWG wire provided with the Tachometer Sensor (refer to *Figure 8*).

For additional information relating to the Tachometer Sensor, refer to ***Section 13–Repairs:*** *MLC Replacement*.

NOTE

The Tach input is designed for use with the supplied sensor only. Do not attempt to use any other device (e.g.: motor based tachometer outputs).

NOTE

It is permissible to run the pump motor thermostat in the same conduit as the pump motor. The signal is conditioned to prevent erroneous operation due to cross-talk.

5.8 Motor Thermostat

The motor thermostat has been supplied as an equipment safety measure. This allows the MLC pump motor to operate without the danger of overheating the motor windings.

In the event that the internal temperature of the motor exceeds the motor manufactures specification, the MLC can be configured to:

a) turn the motor off
b) sound an alarm
c) restart the motor when the temperature lowers to a safe level.

NOTE **For more information about the Motor Thermostat settings, refer to *Section 7, General Operation: Motor Thermostat Setup* .**

To connect the Motor Thermostat to the MLC, connect the two thermostat wires (typically these wires are a smaller gauge wire) coming from the pump motor to the connection point labeled '3–THERM [+]' and '4–THERM [-]' on connector J–10 CONTROL. Refer to *Figure 8*.

5.9 FUSE REPLACEMENT

Although Fuse replacement is not a part of normal installation, it is often likely that fuse failure will result from improper wiring. The MLC uses a total of 7 user replaceable fuses: 1 for the alarm relay output, 2 for each of the Current Input and Output Channels. Table 3 details fuse replacement information:

Table 3: Replacement Fuse Information

Designator	Function	Rating	Wickman P/N	Pulsafeeder P/N
F1	Alarm Relay	1A @ 250VAC	WK4048	NP5300026-000
F2-7	Current I/O	50mA @ 250VAC	WK3022	NP5300027-000

Figure 9 details the location of these fuses on the Field Wiring Board.

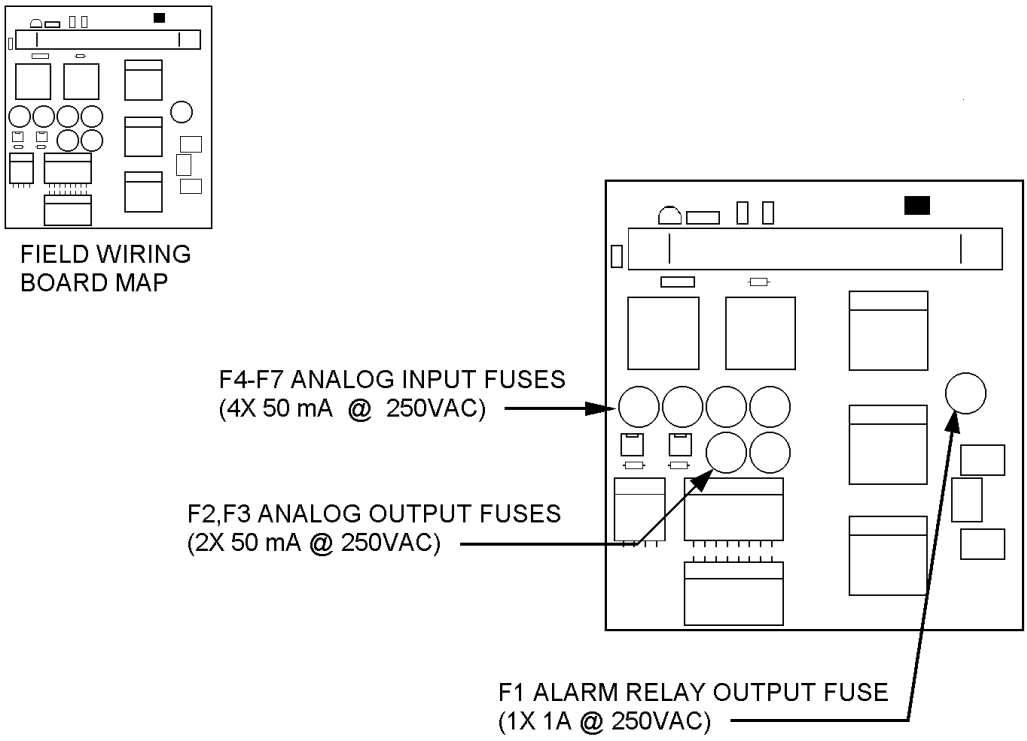

Figure 9 – Fuse Location.

The Internal MLC power supply is fused at 2 amps. This fuse is not user serviceable. The MLC Stroke Length Adjustment Shaft Synchronous Motor is inherently protected. It can operate continuously in a locked rotor state. The MLC also monitors this motor's duty cycle to maintain a 50% balance between ON and OFF times.

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6. Start Up Instructions

6.1 OVERVIEW

Once all electrical connections have been made, your MLC is ready for Start-up. The following 9 sections define the procedures required to complete a MLC Start Up.

WHEN POWER IS SUPPLIED TO THE UNIT, LINE VOLTAGE IS PRESENT ON THE FIELD WIRING BOARD LOCATED AT THE BACK OF THE UNIT EVEN WHEN THE MOTOR IS OFF.

DURING START-UP, IT IS NECESSARY TO START THE PUMP MOTOR. THIS WILL CAUSE FLUID TO DISCHARGE FROM THE PUMP. YOU ARE IS RESPONSIBLE FOR SAFELY DIVERTING FLOW FROM THE PUMP DURING START-UP AND CALIBRATION.

6.1.1 User Interface Familiarization

There are four key elements that will be useful in starting-up the MLC:

d) Display
e) Keypad
f) Manual Adjustment Knob
g) Pump Motor.

Refer to *Figure 10* on the next page to familiarize yourself with the location of these items before proceeding.

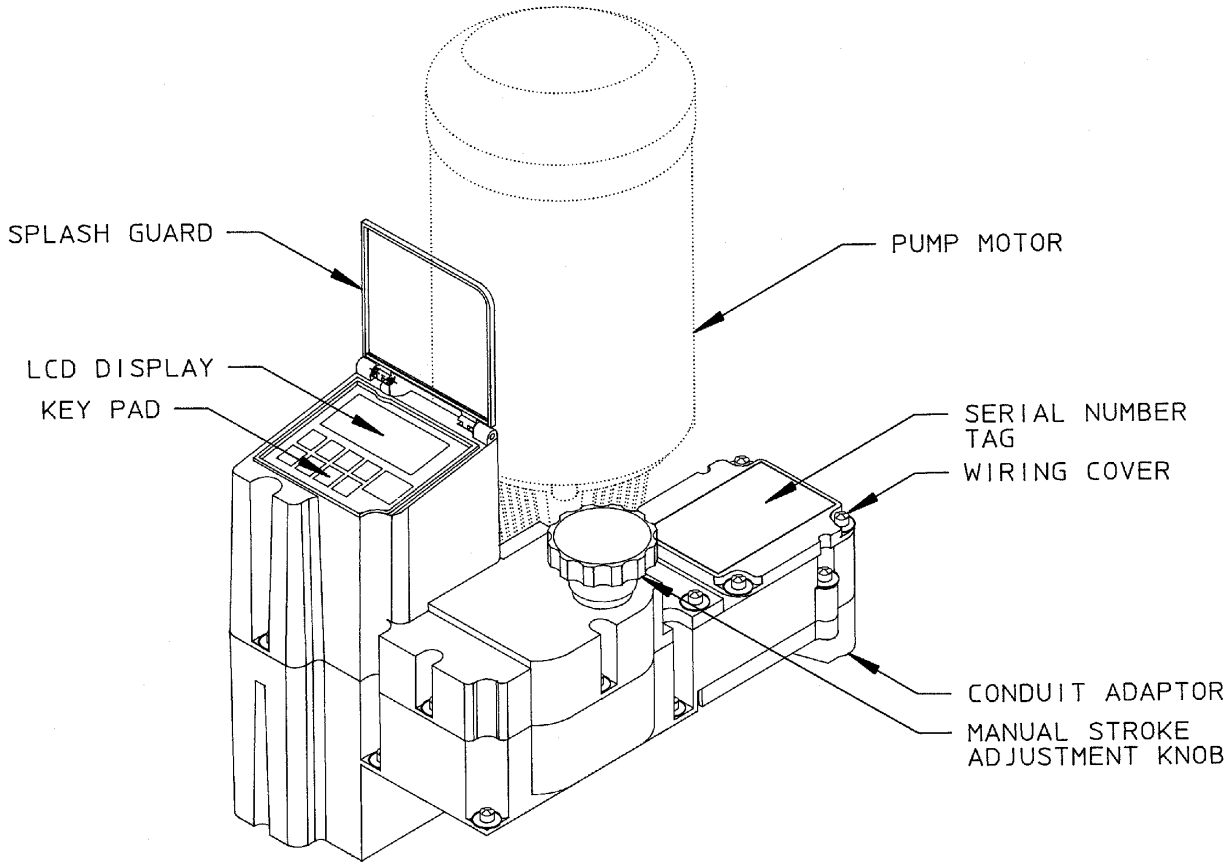

Figure 10 – Key MLC start-up elements.

6.1.1.1 Display:

This is a 2 line by 16 character alpha-numeric Liquid Crystal Display (LCD) located above the keypad. It is back-lit with a yellow-green light source for easy viewing in dark areas. Its contrast can be adjusted by using the keypad.

6.1.1.2 Keypad:

The Keypad is a sealed 9-button membrane style input device. It is easy to use and will guide you quickly to specific functions. Refer to *Figure 11* to familiarize yourself with the function of each key before starting.

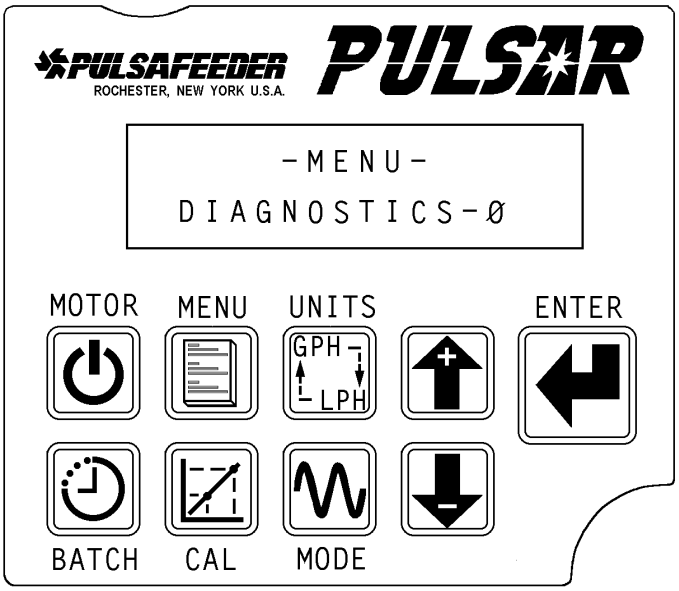

Figure 11 – Key Pad

MOTOR	Press this key to Start the PULSAR motor or place it in stand-by.
MENU	Press this key to access the Configuration Menu. Press the ARROW keys to scroll through the Configuration Menu Items. Press [**MENU**] a second time to exit the Configuration menu to the current operating status mode (e.g., MANUAL MODE).
UNITS	Press this key to cycle to the next unit type whenever a unit is displayed at the operating status mode (e.g., MANUAL MODE).
ARROWS	These keys are used to change values currently displayed on screen. Use the [**DOWN**] arrow to decrease the value and the [**UP**] arrow to increase it. Pressing both [**UP**] and [**DOWN**] arrows simultaneously performs special editing and by-pass functions. This is described further in ***Section 7 - General Operation***.
ENTER	Use this key to accept a flashing value or parameter and proceed to the next sub-menu screen.
BATCH	This key is used to activate the [**BATCH**] processing menu.
CAL	Press the [**CAL**] key to activate the Calibration menu for Flow and Analog Signals.
MODE	The [**MODE**] key is used to change the operating mode of the MLC. For example, press once to change from MANUAL to ANALOG. Press a second time to change from ANALOG to MANUAL.

6.1.1.3 Manual Adjustment Knob:

The manual adjustment knob is mechanically attached to the PULSAR stroke length adjustment mechanism. The MLC uses the shaft attached to this knob to make its automatic adjustments. Visually, the knob is a good indication of what the MLC is doing. For example, if the MLC is increasing the pump stroke length -- moving from 0 to 100% -- the knob will turn counter-clockwise until the desired position is achieved. Depending on the current operating mode, the MLC will respond differently to manual adjustments. In Manual Mode, turning the knob to a valid position (e.g., turning clockwise from 60% to 50%) will cause the display to update to the new value. If you try to force the adjustment above the 100% position or below the 0% position, the MLC will automatically react to correct the situation. If Batch Mode is active and a batch is running, the MLC will correct any attempts to manually change the stroke adjustment to something other than that specified by the batch. Likewise with Analog Signal Mode -- any attempts made to change the stroke setting to a value other than that specified by the signal will cause the MLC to make a correction. Finally, while performing a pump calibration, if you manually adjust the knob, the calibration session will be terminated. If the MLC is non-functional and an emergency arises, this knob can be used to adjust the flow output as long as the PULSAR motor is operating.

THE MANUAL ADJUSTMENT KNOB SHOULD NOT BE ADJUSTED WHILE POWER IS REMOVED FROM THE MLC. IF THE KNOB IS MOVED WHILE THE POWER TO THE MLC OR PUMP IS OUT, UPON RE-STARTING THE MLC WILL DETECT THE ADJUSTMENT AND PERFORM A ZERO CALIBRATION. (IF THE MOTOR IS NOT CONNECTED, DAMAGE COULD OCCUR TO THE MLC GEARING.)

WHEN THE MLC IS PERFORMING A ZERO CALIBRATION (THE DISPLAY WILL READ {CALIBRATING ZERO}), DO NOT TO TOUCH THE MANUAL ADJUSTMENT KNOB. DURING A ZERO CALIBRATION THE MLC IS SEARCHING FOR A HARD MECHANICAL STOP. ANY MANUAL INTERVENTION COULD CAUSE THE MLC TO INCORRECTLY DETECT THIS STOP. THIS WILL RESULT IN AN IMPROPER CALIBRATION.

You may notice that when adjusting from a lower to a higher value (e.g., 10% to 20%) the MLC appears to 'over-shoot' its destination and reverse direction for approximately 1/16 of a revolution. This behavior is normal. The MLC always approaches a new position from the same direction to eliminate backlash in the stroke adjustment mechanism.

6.1.2 Check Wiring and Close Access cover

Double check all of your electrical connections. Pay attention to polarity of all inputs and outputs -- both low and high voltage. Additionally, insure that all clamp style terminals are clamping onto the bare conductor, not on its insulation.

Replace the wiring access cover and its 4 retaining screws and Teflon gaskets.

NOTE **Use a screwdriver to hand tighten the retaining screws evenly. Failure to do so may cause the cover to leak and void the Warranty.**

6.1.3 Confirm Correct Incoming Power

Double check that the wiring access cover is on and tightened down. Whenever power is supplied to the MLC, the display's back-lighting will 'glow' with a yellow-green light. The presence of this back-lighting is an excellent indication that the MLC's incoming power has been wired successfully and voltage is present. Characters may or may not appear on the display. This is normal and will be covered in section 6.1.4.

WARNING **WITHOUT PRIOR OPERATING KNOWLEDGE, IT IS IMPOSSIBLE TO TELL IF THE PULSAR MOTOR WILL RUN WHEN POWER IS APPLIED TO THE MLC. YOU ARE RESPONSIBLE FOR TAKING THE NECESSARY STEPS TO ENSURE THAT ALL ASPECTS OF SAFETY HAVE BEEN CONSIDERED (E.G., ELECTRICAL, HYDRAULIC, ETC.). IF IN DOUBT, DISCONNECT THE MOTOR FROM J3 PRIOR TO APPLYING POWER.**

NOTE **The MLC detects any adjustments made to manual adjustment knob while its power is off. If it detects that the knob position has been changed, it will perform a zero calibration when the motor is started. This action is normal.**

Turn on power at the main. If the MLC's incoming power is connected correctly, the back-lighting on the MLC's display will illuminate (depending on lighting conditions, it may be necessary to shade the display to confirm illumination). If the display is not illuminating, first check the line voltage with a volt meter. If the voltage is not correct, return to ***Section 5 - Installation:*** *High Voltage Connections*. Otherwise, proceed with the next section.

6.1.4 Confirm Display and Keypad Functionality

NOTE **The example display messages are shown in English for demonstration purposes. If an alternate language has been set, the text is displayed as a translation of the English version.**

Now that you have confirmed that the MLC is receiving power, it is necessary to confirm that the display and keypad are functioning properly. On normal power-up, the {Self-Test} display is displayed for approximately 5 seconds. After that time, the display may appear with a message similar to any of those shown in *Figure 12*.

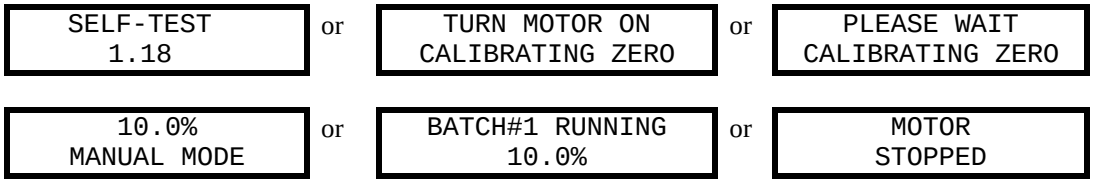

Figure 12 – Common Power-On Displays.

At this time, the actual message is not important, the characters should be visible and form a reasonable message.

If the display is blank (no-characters) then the display contrast must be adjusted. This can be accomplished by pressing and holding [**MENU**] while simultaneously pressing [**UP**]. This will darken the display. Be patient! You may have to hold both keys down for as long as 30 seconds before the characters will become visible. If the display is too dark, press [**MENU**] and [**DOWN**] simultaneously to decrease (lighten) the contrast. Once the contrast is properly adjusted, check the message displayed. If it does not look similar to one of those shown in *Figure 10*, proceed directly to sub-section 6.1.5 to perform a Factory Re-initialization on your MLC.

The keypad can be tested by depressing each key separately. Most, but not all keys will cause the text on the display to change. Do not be alarmed if a single key does not invoke a change to the display. This is normal. Different keys become active/inactive depending on the current operating mode. There are a number of functions that the MLC performs (e.g., zero calibration) where the keypad has no effect. In any case, if the stroke adjustment knob is not moving, at least one key on the key pad should cause the text on the display to change. Go to section 6.1.6. If this is not the case, refer to ***Section 11 - Trouble Shooting***.

6.1.5 Performing a Factory Re-initialization

NOTE **When Re-initializing your MLC, all of the system settings will be overwritten by original factory default settings. The controller must be re-configured to your specifications (e.g., re-calibrated).**

If your MLC appears to be functioning properly -- the display is similar to one of those shown in *Figure 12* -- go to section 6.1.6.

NOTE **A Factory Re-initialization restores all factory defaults to the MLC's memory, and typically is not required. It should be performed only if you have reason to believe that the internal MLC memory has become corrupted. A number of factors could cause this including: long-term storage, dis-regard of electrostatic precautions (refer to** *Section 2 - Safety***) during installation, improper wiring, voltage surges, etc. The condition usually manifests itself with inconsistent or erratic operation -- often associated with characters on the display. Depending on the state of your MLC, use one of the following procedures:**

❖ **Start-up Factory Re-initialization:**

Use this procedure when you cannot read the display, or if the MLC does not seem to be responding to your key presses:

1. Cycle power (turn it OFF then ON) to the unit.
2. Within the first 5 seconds of power on, simultaneously depress and hold the [**UNITS**], [**MODE**], and [**ENTER**] key's for approximately 1 second.
3. The display will continue to display the version number while the MLC's memory is restored. The display will then show {TURN MOTOR ON / CALIBRATING ZERO}. Return to section 6.1.4: Confirm the display and keypad are functioning properly.

❖ **Menu Factory Re-initialization:**

Use this procedure if the display and key pad appear to be functioning properly, but you suspect other problems with data corruption, erratic operation, etc. Perform the following steps:

1. Apply power to the unit. Wait for the {SELF-TEST} display to disappear. The unit should display a standard power on screen (refer to *Figure 12*). If {TURN MOTOR ON / CALIBRATING ZERO} is displayed, press [**MOTOR**] to allow the MLC to complete the Zero Calibration process.
2. Press [**MENU**]. The display will show the first menu item {DIAGNOSTICS}.
3. Press [**DOWN**]. The {FACTORY DEFAULTS} menu item should appear. If not, continue pressing [**DOWN**] until it does.
4. Press [**ENTER**]. The prompt {FACTORY RESET? / NO} is displayed.
5. Press [**UP**]. The prompt will read {FACTORY RESET? / YES}.
6. Press [**ENTER**] to accept the {YES} prompt. The prompt {ARE YOU SURE? / NO} is displayed.
7. Press [**UP**]. The prompt will read {ARE YOU SURE? / YES}.
8. Press [**ENTER**] to accept the {YES} prompt.
9. The display will read {PLEASE WAIT} for approximately 5 seconds while the MLC's memory is restored. The display should then display{TURN MOTOR ON / CALIBRATING ZERO}. Return to section 6.1.4. Confirm the display and keypad are functioning properly.

6.1.6 Test Pump Motor

NOTE **The Drum Level, PULSAlarm and Signal Loss inputs can be configured to shut the motor down if they are enabled. If this is the case, a message is displayed on the screen indicating the failure. You cannot re-start the motor until these inputs have been corrected or the {Motor Off} option has been disabled. Refer to *Section 7-General Operation* for further information on configuring these options.**

To test the PULSAR motor connection, press [**MOTOR**]. If the motor is running it should stop and the display should read {MOTOR STOPPED} or {TURN MOTOR ON / CALIBRATING ZERO} as in *Figure 13*.

MOTOR STOPPED	or	TURN MOTOR ON CALIBRATING ZERO

Figure 13 – Motor Stopped Display.

If the motor is stopped, press [**MOTOR**] to start it and set the unit in Operating Mode. The display should then read {MANUAL MODE} or {BATCH#X RUNNING} or {PLEASE WAIT / CALIBRATING ZERO} as in *Figure 14*.

10.0% MANUAL MODE	or	BATCH#1 RUNNING 10.0%	or	PLEASE WAIT CALIBRATING ZERO

Figure 14 – Operating Mode Display.

If the displays shown in *Figures 13* and *14* appear but the PULSAR motor does not start, return to ***Section 5-Installation:*** *High Voltage Connections* and check your wiring. If the wiring is correct, refer to ***Section 11 - Trouble Shooting***.

6.1.7 Set Time and Date

The clock on your MLC has been activated at the factory, but you must set it to the local time and date of the installation site.

Time and Date are set in the Configuration Menu. Below is an example that accepts some software default values:

1. From the Current Operating Mode Display, press [**MENU**]. The {–MENU– / DIAGNOSTICS-0} screen will display (follow along with *Figure 15*).
2. Press [**UP**]. The {–MENU– / SET TIME AND DATE} screen is displayed.
3. Press [**ENTER**]. The date and time screen is displayed.
4. Press [**ENTER**] to accept the 24 Hour time setting.
5. Press [**UP**] or [**DOWN**] to adjust the hour value displayed to the local time. Press [**ENTER**].
6. Press [**UP**] or [**DOWN**] to adjust the 10 minute value displayed to the local time. Press [**ENTER**].
7. Press [**UP**] or [**DOWN**] to adjust the 1 minute value displayed to the local time. Press [**ENTER**] twice (accept the default MM/DD/YY setting).
8. Press [**UP**] or [**DOWN**] to adjust the month value displayed to the current month. Press [**ENTER**].

9. Press [**UP**] or [**DOWN**] to adjust the day value displayed to the current day. Press [**ENTER**].
10. Press [**UP**] or [**DOWN**] to adjust the year value displayed to the current year. Press [**ENTER**] twice (accept the default Daylight Savings NO setting).
11. Press [**ENTER**]. The date and time information has now been set.

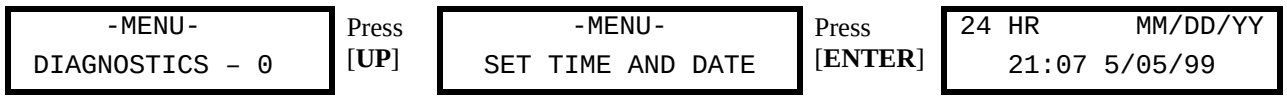

Figure 15 – Date and Time Menu.

Refer to ***Section 7 - General Operation:*** *Set Time and Date* for more detailed instructions on how to set the Time and Date information.

6.1.8 Flow Calibration (1-point).

Your MLC is factory calibrated at rated flow and pressure (1-point). Nevertheless, you should always perform a flow calibration with the PULSAR MLC installed in your system. The only item required to calibrate your MLC is a means to measure the output of the pump (i.e., calibration column, graduated cylinder, etc.). The following is a minimal procedure for performing a 1-point calibration.

1. Press [**MOTOR**] to start the motor (if the motor is not currently running).
2. Press [**UNITS**] repeatedly until a unit that is consistent with your flow measurement device (i.e., calibration column) appears. For example, if your column reads in Liters then set the display to LPM or LPH. Liters will be used in this example.
3. Press [**CAL**]. The {CALIBRATE / PUMP FLOW} screen will display.
4. Press [**ENTER**]. The {LAST FLOW CAL / 11:32 5/05/99} screen is displayed.
5. Press [**ENTER**]. The {FLOW CALIBRATION / 1-POINT} screen is displayed.
6. Press [**ENTER**]. The {CALIBRATE ZERO? / YES} screen is displayed.
7. Press [**ENTER**] to start the Zero Calibration procedure. The {PLEASE WAIT / CALIBRATING ZERO} screen is displayed. The MLC will test its encoder and adjust the stroke to the 0% position.
8. The {PLEASE WAIT / 14% 100%} screen is displayed. The MLC will adjust the stroke to the 100% position. The PULSAR motor will shut off.
9. The {ENTER TO START/ 1.3642 L} screen is displayed. The value '1.3642' represents the amount of fluid discharged in liters over 60 seconds the last time a calibration was performed at the 100% stroke setting. Record the fluid base reading from your calibration column.
10. Press [**ENTER**]. The PULSAR motor will start. A timer will display counting down from 60 seconds. After 60 seconds the motor will stop automatically.
11. The {ENTER VALUE 100% / 1.3642 L} screen will display. Read the measured volume displaced from the calibration column and enter the new value one position at a time using [**UP**] and [**DOWN**] to change an individual position. Press [**ENTER**] to move the cursor to the next position.
12. Pressing [**ENTER**] on the last position causes the {CONFIRM CHANGE? / YES} screen to be displayed. Press [**ENTER**] to accept. Your 1-point calibration is now complete.

Refer to ***Section7-General Operation***: *Calibration, Pump Flow* for more detailed instructions on how to perform MLC calibration.

6.1.9 Current Input Calibration.

If you are not using the 0-20mA input to the MLC for control, skip to section 6.1.10. To calibrate the Current Input you must first correctly wire an external signal source. Refer to ***Section 5-Installation****: Low Voltage Input Connections, Current Input*. To perform a calibration, the signal generating device (e.g., PLC) must be powered up and capable of altering its output from minimum to maximum signal. The following is a minimal procedure for calibrating the Analog Input.

1. Press [**CAL**]. The {CALIBRATE / PUMP FLOW} screen will display.
2. Press [**UP**]. The {CALIBRATE / ANALOG IN} screen is displayed.
3. Press [**ENTER**]. The {0% = 4.0mA / 100% = 20.0mA} screen is displayed. These values represent the previous calibration.
4. Press [**ENTER**]. The {INPUT ANALOG MIN / 0% = X.X mA} screen is displayed. Adjust your PLC to output a minimum signal (e.g., 4.0 mA). The MLC display will update as the incoming signal changes.
5. When the displayed value stabilizes, press [**ENTER**] to accept it. The {INPUT ANALOG MAX / 100% = XX mA} screen is displayed. Adjust your PLC to output a maximum signal (e.g., 20.0 mA). Again, the MLC will display will update with the changing signal.
6. When the displayed value stabilizes, press [**ENTER**] to accept it. The {INPUT RATIO / 100% = XX.XmA} screen is displayed.
7. Press [**ENTER**] to accept the 100% Ratio setting. The {CONFIRM CHANGE? / YES} screen is displayed.
8. Press [**ENTER**]. Analog input calibration is now complete.

Refer to ***Section 7-General Operation:*** *Calibration, Analog Input* for more detailed instructions on how to perform Analog Input calibration.

6.1.10 Wrapping up.

Congratulations! Your PULSAR MLC is now commissioned for manual use. Refer to ***Section 7 - General Operation*** for specific instructions on how to access your MLC's advanced features. Please don't be intimidated by your MLC, take time to explore and experiment with its features. Remember, you cannot configure the software in a way that would damage the MLC. Typically, whenever you are about to set a critical value (e.g., Calibrate Flow), you are always prompted to confirm your change before it takes effect. If you are ever dissatisfied with the configuration of your MLC, you can always return to the Factory Defaults by repeating section 6.1.5.

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7. General Operation

This section covers the General Operation of the MLC as it relates to software. It includes detailed instructions and example screens. Remember, the default values of the MLC have been factory set. You can over-ride these settings to tune the MLC to your particular needs.

NOTE **The MLC should be in MANUAL MODE for the following operations.**

7.1 General Operation Instructions

7.1.1 Pump Flow Calibration

Pulsafeeder recommends performing at minimum a 2-Point flow calibration on every PULSAR MLC installed. Maintenance re-calibration should be performed periodically -- at least every three to four months -- to account for component wear. Re-calibration of the pump is also recommended whenever wet-end components are replaced.

NOTE **The MLC does not automatically compensate for changing system conditions (e.g., discharge pressure, fluid viscosity, etc.). You should re-calibrate whenever the application conditions change.**

1. Press [**CAL**] to enter the Calibration Menu. If the screen {CALIBRATE / PUMP FLOW} is not displayed, press [**UP**] until it appears. Press [**ENTER**] to go to the calibrate pump flow sub-menu:

CALIBRATE PUMP FLOW	Press [**ENTER**]

2. The MLC displays the last time the pump was calibrated. This provides a key record for you. Press [**ENTER**] to continue with pump flow calibration.

LAST FLOW CAL 3:25 4/2/98	Press [**ENTER**]

3. The display shows {FLOW CALIBRATION / 1 POINT}. The '1 POINT' text will be flashing

FLOW CALIBRATION 1 POINT	Press [**UP**]

   Press [**UP**] to change flow calibration to 2 points, 3 points, 4 points or 5 points. The calibration points correspond to the following stroke length values:

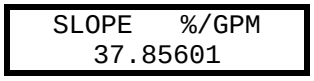
1 point	100%
2 points	10 and 100 %
3 points	10, 50 and 100%
4 points	10, 25, 50 and 100%
5 points	10, 25, 50, 75 and 100%

NOTE **A 1 point calibration should be avoided in applications where the displayed flow rate is critical. For discharge pressures less than 500 psi (34.5 Bar), a minimum 2 – point calibration is recommended. For discharge pressures above 500psi (34.5 Bar) a minimum 3 – point calibration is recommended.**

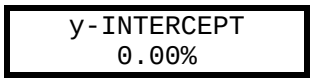
These percentage values correspond to the API standard. If you continue to press [**UP**] you will also see the following options: {CHANGE CONSTANTS} and {TUNE}. These options are for use after a multi-point calibration has been performed. They are explained in more detail in steps 4 and 5 below. For a standard multi-point calibration, set the number of calibration points to use and press [**ENTER**] to continue. Skip steps 4 and 5 below. Proceed to step 6.

NOTE **You can "skip" a calibration point by entering a flow value of 0.**

4. CHANGE CONSTANTS. Press [**UP**] until {CALIBRATION / CHANGE CONSTANTS} is displayed. This option is used to set the slope and y-intercept in the equation that describes the linear calibration curve: y = ax + b. Where 'a' is the slope and 'b' is the y-intercept. The input to this equation (i.e., x) is given in percent (%). The output (i.e., y) uses the currently displayed unit for flow. The units for the constants are given on screen. Values can be calculated from two or more flow readings and associated stroke settings. Press [**ENTER**] and the display prompts you to enter the slope value:



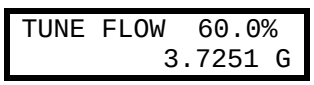
Use [**UP**] and [**DOWN**] to enter the calculated slope value in the displayed units (%/GPM in the example above). Press [**ENTER**]. The display prompts you to enter the y-intercept.



Use [**UP**] and [**DOWN**] to enter the calculated y-intercept value. Press [**ENTER**] to accept and continue through the calibration pump flow change constants sub-menu. The MLC will convert the constants to the other display units automatically. Proceed to step 9.

5. TUNE. In this sub-menu the flow curve can be shifted to 'tune' the flow to one given point. Before entering the TUNE sub-menu, you should measure the actual flow rate at a specific stroke setting. For example, the MLC is currently set at 60.0% stroke and it displays a calibrated flow rate of 3.725 GPH. An actual flow measurement is taken and found to be 3.500 GPH. The process is critical and cannot be shut down for a full calibration. Leaving the stroke setting at 60%, change the units to GPH.

   Press [**UP**] until {CALIBRATION / TUNE} is displayed. Press [**ENTER**] to accept and continue with the {CALIBRATE / TUNE} menu. The following screen is displayed:



NOTE **If the flow value is negative (e.g. – 000000) you cannot change the tune value.**

Using [**UP**] and [**DOWN**], set the value to 3.500. Press [**ENTER**]. The pump will now display the 3.500 value at the 60.0% stroke setting. Internally, the MLC has retained the slope calculated at the last calibration and has off-set the flow curve to satisfy the current reading requirement. Proceed to step 9.

6. The MLC will now prompt you to perform a Zero Calibration.

```
CALIBRATE ZERO?
      YES
```

To skip this operation, press [**UP**] and then press [**ENTER**] and skip to step 8. Otherwise press [**ENTER**].

7. The MLC will now perform a ZERO CALIBRATION. First, it will test its encoder's position by increasing the stroke adjustment mechanism 1%. Then the MLC will adjust in the opposite direction until it reaches the mechanical zero stop (0% stroke setting). This ensures that the positioning mechanism is working properly and calibrations will be accurate. The screen will display one of three messages:

```
PLEASE WAIT
CALIBRATING ZERO
```

– or –

```
TURN MOTOR ON
CALIBRATING ZERO
```

-or -

```
ENCODER ERROR 0
 PRESS ENTER
```

If you get the {TURN MOTOR ON...} screen, start the PULSAR motor by pressing [**MOTOR**]. If you get the {ENCODER ERROR...} screen, refer to ***Section 11-Trouble Shooting Guide***.

8. The MLC will drive to the 0.0% stroke length position. Once the zero calibration has been completed, the following screen is displayed:

```
   PLEASE WAIT
XX.X%       100%
```

Where XX.X% is the current stroke length adjustment setting and 100% is the stroke length destination. The MLC will adjust from the 0% to the 100% position.

9. Once the destination setting has been reached, the PULSAR motor will shut down and the display will show:

```
ENTER TO START
   2.6417 G
```

The display is showing the current stroke setting (e.g., 100%), and the amount of fluid discharged from the pump the last time this operation was performed (e.g., 2.6417 Gallons). This flow rate is based on 60 seconds of pump operation. Fill the calibration column in the system to the proper level to avoid running the pump dry during calibration.

10. When you are ready, press [**ENTER**], which will start the pump motor for a period of 60 seconds. The display will show a 60 second timer and its count down toward 0 seconds. During this time, the pump is operating at the first calibration stroke length setting.

```
TIMER:    60 SEC
   2.6417 G
```

11. At the end of 60 seconds, the pump motor will automatically turn off. The display will automatically change to prompt you to enter the new measured volume.

```
ENTER VALUE 100%
    2.6417 G
```

Read the new measured flow rate from the calibration column. Enter the new value one position at a time using [**UP**] and [**DOWN**]. Press [**ENTER**] to accept the setting and move the cursor to the next position. Continue to use the arrow keys and press [**ENTER**] on the last position to accept your setting.

If you would like to "skip" a calibration point, enter a value of 0.0000.

12. If a 2 through 5 point calibration was selected, the MLC will automatically proceed to the next stroke length setting and repeat steps 7 through 10 as described above. After the MLC has completed the above referenced process for all stroke length settings, it prompts you to accept the data collected in the above referenced steps:

```
CONFIRM CHANGE?
      YES
```

13. Press [**ENTER**] to accept the calibration. If you do not want to accept the new calibration curve, press [**UP**] to scroll to {NO} and press [**ENTER**]. The MLC will display a {PLEASE WAIT} message while it performs the Least Squares curve fit to the data points and calculates the new flow curve. Again, any point entered with a value of 0.0000 will be ignored by the curve fitting routine.

    The display is then returned to its original operating mode.

7.1.2 Analog Input Signal Calibration

The MLC will accept analog input signals of 0-20 mA, 4-20 mA, 1-5 mA, or 1-5 volts. The analog input signal should be calibrated to each system. To perform a calibration, the signal generating device (e.g., PLC) must be powered up, wired to the MLC and capable of altering its output from minimum to maximum signal.

The MLC should be in MANUAL MODE for the following operation.

You are calibrating the Analog Input Signal to the percentage of calibrated flow. The 0% and 100% values displayed in this section refer to a percentage of Flow not Stroke Position.

1. Press [**CAL**]. Press [**UP**] to scroll to {CALIBRATE / ANALOG IN}. Press [**ENTER**] to go to the calibrate analog input sub-menu.

```
CALIBRATE
ANALOG IN
```

2. The display shows the previous 0% and 100% flow analog signal values:

```
0%  =  4.0mA
100% =  19.8mA
```

If you would like to skip the calibration and change only the Signal Ratio, press both [UP] and [DOWN] simultaneously. Skip to step 5.

3. Press [**ENTER**]. The display prompts you to input the minimum analog signal value, 0% flow.

```
INPUT ANALOG MIN
 0% = XX.X mA
```

Send the low analog signal to the MLC (i.e., 0 mA, 1 mA, 4 mA or 1 volt) from the signal generating device (e.g., PLC). Refer to ***Section 5-Installation: Low Voltage Input*** and *Figure 5* for the wiring instructions. It is highly recommended that you use the actual signal the MLC will be receiving during calibration. The MLC will display its interpretation of the received signal. Do not be alarmed if the signal does not match the instrument. For example, your instrument is generating 4.0mA but the MLC display reads 3.6mA. It is only important that the MLC detects the full range of the instruments output. The MLC will digitally store this value as the 0% analog signal value. As the analog signal varies, the MLC will display the fluctuating values. Wait approximately 10 seconds until the value displayed stabilizes and press [**ENTER**] to accept it as the 0% flow analog signal value.

4. The display prompts you to input the maximum analog signal value, 100% flow. You send the analog signal to the MLC (i.e., 10 mA, 20 mA or 5 volts).

```
INPUT ANALOG MAX
 100% = XX.X mA
```

As the signal varies, the MLC will display the fluctuating values. Wait approximately 10 seconds until the value stabilizes and press [**ENTER**]. The MLC will digitally store this value as the 100% flow analog signal value.

If the range between the minimum and maximum analog signal values is less than 2 mA, the MLC will display the following:

```
RANGE TOO SMALL
  RE-ENTER
```

Press [**ENTER**] to return to step 3 to input the analog signal values again.

5. You are now ready to set the Signal Ratio. This option allows you to scale the Analog signal input to the pump output. Use this option only if you want to limit the range of operation of the pump (e.g., you want to limit the pump's output from 0 to 50% flow over the 4-20mA range). The display reads as follows:

```
INPUT RATIO
50% = 19.8mA
```

To use the ratio option, use [**UP**], [**DOWN**] and [**ENTER**] to set the ratio value. Press [**ENTER**] to accept the setting.

If you do not want to use the Input Ratio Option, enter a value of 100%.

6. The MLC prompts you to accept the analog signal calibration programmed in the above referenced steps.

```
CONFIRM CHANGE?
      YES
```

Press [**ENTER**] to accept. If you do not want to accept the new analog signal calibration, press [**UP**] to scroll to {NO} and press [**ENTER**].

The display will then return to its original operating mode.

7.1.3 Reverse Acting Analog Input Signal Calibration

To set up a reverse acting application, follow the above Analog Input Calibration procedure with the following changes to step 3 and 4:

1. In step 3, when the display requests the minimum analog signal value (0% flow), you should send the MLC the high analog signal value (i.e., 10 mA, 20 mA or 5 volts).

```
INPUT ANALOG MIN
  0% = XX mA
```

Send High (20mA) Signal

The MLC will digitally store this as the 0% flow analog input signal value. As the analog signal varies, the MLC will display the fluctuating values. Wait approximately 10 seconds for the signal to stabilize. Press [**ENTER**] to accept this as the 0% flow analog signal value.

2. In step 4, when the display requests the maximum analog signal value (100% flow), you send the MLC the low analog signal value (i.e., 0 mA, 1 mA, 4 mA or 1 volt).

```
INPUT ANALOG MAX
 100% = XX mA
```

Send Low (4mA) Signal

The MLC will digitally store this as the 100% analog input signal value. As the signal varies, the MLC will display the fluctuating values. Wait approximately 10 seconds for the signal to stabilize. Press [**ENTER**] to accept this signal as the 100% flow analog signal value.

You can confirm the reverse acting input signal calibration by re-entering the Analog Input Calibration menu. The first screen summarizes your calibration.

7.1.4 Analog Output Signal Calibration

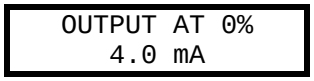
The MLC will generate an analog output signal proportional to the current stroke setting. The signal can be in the range of 0-20 mA, 4-20 mA, 1-5 mA, or 1-5 volts. It should be calibrated to the attached system.

NOTE **The value that the MLC displays is not precisely calibrated to its output. The value that is displayed (e.g., 4.0 mA) is for reference only. In most cases, the displayed value will not match the value read by attached equipment.**

NOTE **The Analog Output Signal is proportional to the stroke position mechanism, not the flow.**

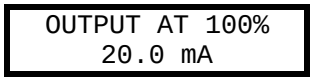
1. Press [**CAL**] to enter the {CALIBRATE} sub-menu. Press [**UP**] twice to scroll to the {ANALOG OUTPUT} selection:

2. Press [**ENTER**]. The screen that allows you to set the output at 0% is displayed.



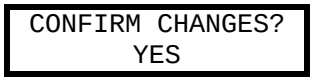
Using [**UP**] and [**DOWN**], set the value for the desired output. Note, the value that you set is for reference only. If you need a true 4.0 mA's at the remote equipment, you should read the actual value from the remote equipment and set the value here at whatever is required by that equipment. For example, say a remote PLC needs exactly 4.0mA's at 0% stroke. The PLC currently reads its input as 3.8mA and the MLC reads its output as 4.0mA. Increase the MLC output (e.g., 4.2) until the PLC reads correctly.

3. Once you have set the 0% stroke value press [**ENTER**] to accept it. The screen that allows you to set the output at 100% stroke is displayed.



As described in step 2, set the output using [**UP**] and [**DOWN**]. When you are satisfied with your settings press [**ENTER**] to accept it.

4. The MLC will prompt you to accept the analog output calibrated values.



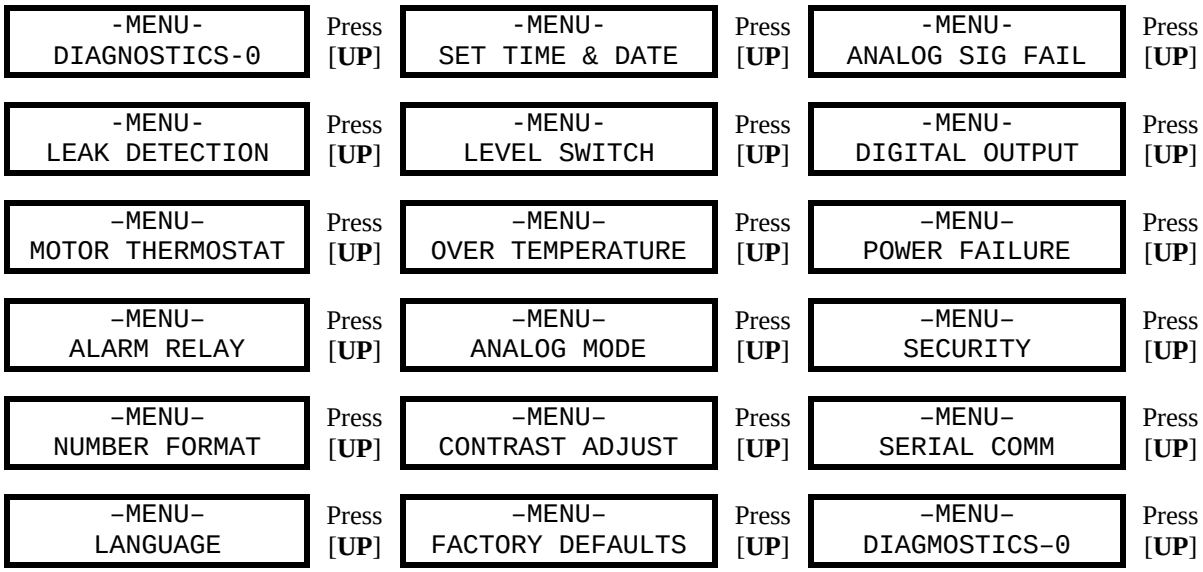
Press [**ENTER**] to accept the calibration. If you do not want to accept, press [**UP**] and then [**ENTER**].

The display will return to the last operating mode.

7.2 MENU

The default values and menus of the MLC Stroke Length Controller have been factory set, but you will want to configure the MLC to meet your specific application.

The [**MENU**] key activates the Configuration Sub-menu system. This consists of 17 different sub-menus as shown below. Use [**UP**] and [**DOWN**] to scroll through the sub-menus.



7.2.1 Alarm, and Error messages

When an error occurs, the MLC flashes Alarm and Error messages alternately with the standard display.

The following table gives an example of these messages and when you can expect them to be displayed.

Message	Displayed When:
ANALOG SIG FAIL	The Analog signal has fallen outside of its calibrated range or fallen rapidly (indicating an open circuit).
LEAK DETECTION	The PULSAlarm leak detection diaphragm has failed.*
LEVEL SWITCH	The Drum Level activated.*
POWER FAILURE	The input power to the MLC is interrupted while the pump motor is running.*
OVER TEMPERATURE	The internal temperature of the MLC has exceeded its operating limit.*
ALARM RELAY	If configured, this message is displayed when the alarm relay activates.
DUTY CYCLE	When displayed, indicates that the stroke adjustment motor has run continuously for more than 20 minutes.
POSITION ERROR	The MLC has attempted to move the Stroke adjustment for at least 10 minutes with no movement detected.
REMOTE ON/OFF	If configured, displays when the remote On/Off switch is in the Off position.
TERMINATED / PRESS ANY KEY	The Manual Control Knob moved during calibration.

* Refer to the next Section (Diagnostics) for information on each of these messages.

7.2.2 Diagnostics

The MLC is supplied with a complete diagnostic menu. It will alert you if something has failed, the time and date of the failure, and prompt you to clear the failure.

❖ **Diagnostics procedure**

1. Press [**MENU**]. In a normal condition, the display reads {–MENU– / DIAGNOSTICS-0}.

```
-MENU-
DIAGNOSTICS-0
```

NOTE **If a diagnostic failure was detected, the "DIAGNOSTICS - #" would appear. The '#' indicates the number of failures that has occurred.**

2. Press [**ENTER**] and the first diagnostic sub-menu is displayed. If the incoming power supply to the MLC is interrupted while the PULSAR motor is running, a failure will be detected and logged.

```
DIAG MENU 1/11
POWER IN: OK
```
-or-
```
DIAG MENU 1/11
POWER IN: FAIL
```

3. Use [**UP**] to scroll to the next sub-menu. If the analog signal fails, a failure will be detected and logged. An analog input failure is detected if one of the following conditions occur. First, the signal falls outside of the calibrated range by 0.3mA (if the MLC is calibrated with a range of 4-20mA and the signal falls to 3.6mA then a failure will be logged). Second, if the analog signal falls below 0.3mA and is changing at a rate of 2.2mA per second or more a failure will be logged. This second condition is primarily for the situation where the input is calibrated for 0 to 20 mA's.

```
DIAG MENU 2/11
ANALOG IN: OK
```
-or-
```
DIAG MENU 2/11
ANALOG IN: FAIL
```

4. Use [**UP**] to scroll to the next sub-menu. Digital communications are not available in this version.

```
DIAG MENU 3/11
DIGITAL: OK
```

5. Use [**UP**] to scroll to the next sub-menu. If a PULSAlarm leak detection diaphragm rupture is detected, the MLC will show a failure in this diagnostic sub-menu.

```
DIAG MENU 4/11
LEAK DET.: OK
```
-or-
```
DIAG MENU 4/11
LEAK DET.: FAIL
```

6. Use [**UP**] to scroll to the next sub-menu. If the drum level dry contact is activated, the MLC will show a failure in this diagnostic sub-menu.

DIAG MENU 5/11 LEVEL SW.: OK	-or-	DIAG MENU 5/11 LEVEL SW.: FAIL

7. Use [**UP**] to scroll to the next sub-menu. The pump motor temperature is monitored by a thermostat embedded in the motor windings. If the temperature exceeds the manufacturers recommended operating temperature, the MLC will show a warning in this diagnostic sub-menu.

DIAG MENU 6/11 MOTOR TEMP: OK	-or-	DIAG MENU 6/11 MOTOR TEMP: FAIL

8. Use [**UP**] to scroll to the next sub-menu. The MLC is equipped with a thermistor to monitor internal enclosure temperatures. If the temperature exceeds 70°C (158°F), the MLC will show a warning in this diagnostic sub-menu.

DIAG MENU 7/11 DRIVE TEMP: OK	-or-	DIAG MENU 7/11 DRIVE TEMP: FAIL

The flashing alarm message is reset when the temperature falls below 65°C (149°F) or the MLC power is cycled.

9. Use [**UP**] to scroll to the next sub-menu. The MLC is equipped with a clock that is backed by a 10-year lithium battery. If the battery life fails, the MLC will show a failure in this diagnostic sub-menu. The error is automatically cleared when the new battery is installed and powered.

If the battery fails, the MLC will continue to operate off the external power supply. However, the clock and battery backed RAM will not function if the power supply is interrupted.

DIAG MENU 8/11 BATTERY: OK	-or-	DIAG MENU 8/11 BATTERY: FAIL

10. Use [**UP**] to scroll to the next sub-menu. If the RAM, EEPROM or internal synchronous MLC motor fail, the MLC would show the failure, flashing, in this diagnostic sub-menu. The error is automatically cleared when the new component is replaced and power is applied.

DIAG MENU 9/11 CIRCUIT: OK	-or-	DIAG MENU 9/11 CIRCUIT: FAIL

If a failure occurs, you can access a sub-menu from the above screen by pressing [**ENTER**]. The lower level menus show more descriptive circuit information.

The MLC performs a Self-test at power-up. The values in the circuit menus shown below are updated at that time.

Use [**UP**] to scroll between sub-menus.

CIRCUIT FAILURE RAM: OK	-or-	CIRCUIT FAILURE RAM: FAIL
CIRCUIT FAILURE EEPROM: OK	-or-	CIRCUIT FAILURE EEPROM: FAIL
CIRCUIT FAILURE MOTOR: OK	-or-	CIRCUIT FAILURE MOTOR: FAIL

11. The total pump operating time is displayed in this diagnostic sub-menu. You can reset the time by pressing [**ENTER**] and answering YES to the {RESET RUN TIME? / YES} and {ARE YOU SURE? / YES} prompts.

DIAG MENU 10/11 RUN XXX HRS	Press [**ENTER**]	RESET RUN TIME? NO

12. Use [**UP**] to scroll to the next sub-menu. The number of strokes made by the controller since the last time the count was reset is displayed here. You can reset the stroke count by pressing [**ENTER**] and answering YES to the {RESET COUNT? / YES} and {ARE YOU SURE? / YES} prompts

DIAG MENU 11/11 STROKES: XX	Press [**ENTER**]	RESET COUNT? YES

13. Press [**ENTER**] on any of the diagnostic screens depicted in step 2 through 12 above to display the time and date of the failure occurred or more descriptive information.

DIAG MENU 1/11 POWER IN: FAIL	Press [**ENTER**]	POWER FAILURE 13:27 4/2/96

14. Press [**ENTER**] again, and you are prompted to clear the failure. Depending upon the type of failure diagnosed, you may want to take other steps before clearing the failure and restarting the pump. If so, press [**ENTER**] to keep the error date and time stamp. Otherwise, use [**UP**] to scroll to {YES} and press [**ENTER**]. The MLC will return to a normal condition.

POWER FAILURE CLEAR? NO

If more than one failure occurred, repeat steps 3 and 4 above for each sub-menu indicating a failure.

7.2.3 Set Time and Date

The clock/calendar is essential to the proper operation of the batch system and proper error time stamping. The clock should be set during installation. It can be configured to operate without any additional maintenance in most time zones.

NOTE **If the Date is set out of range (e.g., you try to set a date of 6/31/99), you cannot exit the field until it is set correctly.**

NOTE **The year representation is limited to 2 digits. Values of 90 to 99 refer to the century '19' (e.g., 90 = 1990, 99 = 1999). Values of 00 to 89 refer to the century '20' (e.g., 00 = 2000, 89 = 2089).**

1. Press [**MENU**], then [**UP**] once to display {–MENU– / SET TIME & DATE}.

```
     -MENU-
SET TIME & DATE
```

   Press [**ENTER**] to access the Set Time & Date sub-menu.

2. Flashing in the upper left hand corner of the display should be "24 HR", which denotes a 24 hour clock. By pressing [**UP**], you can change this to a 12 hour ("12 HR") clock with a.m. or p.m.

NOTE **The 12 hour clock selection will add an 'a' or 'p' after the time.**

   Press [**ENTER**] to accept the desired configuration.

```
12 HR   MM/DD/YY
2:31a    4/27/98
```

3. The time will now be flashing with the cursor located under the hour position. Use [**UP**] and [**DOWN**] to adjust the time to your local standard time.

NOTE **The cursor located under the digit in the time, represents the character being changed (flashing).**

   Once the hour is set, press [**ENTER**] and the digit will stop flashing and the cursor will move to the first digit in the minute setting. Continue to use [**UP**] and [**DOWN**] in conjunction with [**ENTER**] to set the correct time and a.m. (A) or p.m. (P).

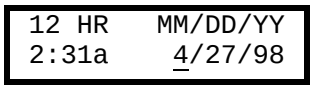
```
12 HR   MM/DD/YY
2:31a    4/27/98
```

4. The date format will now be flashing on the display. The date can be expressed in one of three formats:

Month, Day, Year	MM/DD/YY
Day, Month, Year	DD/MM/YY
Year, Month, Day	YY/MM/DD

   Use [**UP**] and [**DOWN**] to scroll through the above referenced formats. When the format you desire is displayed, press [**ENTER**] to accept this format and continue.

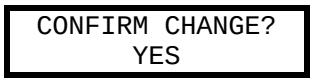
5. The date is now flashing on the display. Use [**UP**] and [**DOWN**] to change this to the current date. Press [**ENTER**] to accept this value and the cursor moves to the next date position. Continue to use [**UP**] and [**DOWN**]. Press [**ENTER**] on the year field to accept your setting.



6. The MLC prompts you to change the time and date for {DAYLIGHT SAVINGS / NO}. Use [**UP**] to scroll to {AUTOCHANGE}. The auto-change option complies with daylight savings time changes as mandated by United States legislation. Press [**ENTER**] to accept the correct configuration based on the location of the MLC.

7. If "AUTO CHANGE" was accepted in the previous step, the MLC prompts you for the current day of the week. Press [**UP**] to scroll through the days of the week. Press [**ENTER**] to accept the current day of the week.

8. The MLC prompts you to accept the date programmed in the above referenced steps, {CONFIRM CHANGE? / YES}. Press [**ENTER**] to accept. If you do not want to accept the new inputs, press [**UP**] to scroll to {NO} and press [**ENTER**].



9. The display will return to the main {- MENU -/ SET TIME & DATE} screen.

7.2.4 Analog Signal Failure Set Up

This sub-menu allows you to set up the MLC response if the analog signal fails. You can program the MLC to have one of the following responses:

- Freeze at the last analog input signal,
- Go to a default signal,
- Shut the motor off.

An analog input failure is detected if one of the following conditions occur. First, the signal falls outside of the calibrated range by 0.3mA. For example, if the MLC is calibrated with a range of 4-20mA and the signal falls to 3.6mA then a failure will be logged. Second, if the analog signal falls below 0.3mA and is changing at a rate of 8.8mA per second or more a failure will be logged. This second condition is primarily for the situation where the input is calibrated for 0 to 20 mA's.

❖ **Setting up the MLC response**

1. Press [**MENU**] and press [**UP**] two (2) times. The display will read {–MENU– / ANALOG SIG FAIL}.

-MENU-
ANALOG SIG FAIL

Press [**ENTER**] to continue to the Analog Signal Fail sub-menu.

The first entry in the Analog Signal Failure menu determines how the MLC recovers from a failed analog input. You can select from two {RESTORE TO:} modes: Analog or Manual. If {ANALOG MODE} is selected, the MLC will resume automatically following the 4-20mA input after the signal is restored. If {MANUAL MODE} is selected, the MLC will enter the manual mode as soon as the signal loss is detected. It will remain in Manual Mode until it is changed manually (press [**MODE**] on the front panel). The benefit of using {RESTORE TO: / ANALOG MODE} is that it's totally automatic. If so programmed, the MLC can shut itself down, wait for a signal to return, and then start itself back up.

Press [**ENTER**] to accept the factory default of {RESTORE TO: / ANALOG MODE} or press [**UP**] and then press [**ENTER**] to select the {RESTORE TO: / MANUAL MODE}.

RESTORE TO:
ANALOG MODE

Press [**UP**]

RESTORE TO:
MANUAL MODE

2. The menu for having the MLC freeze at the last signal is displayed.

ANALOG SIG FAIL
FREEZE @LAST SIG

To accept this action, press [**ENTER**]. Go to step 3.

If you desire a different action, press [**UP**].

a) The menu for having the MLC shut the motor off is displayed.

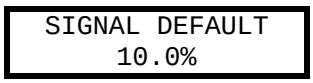
To accept this action, press [**ENTER**]. Go to step 3.

If you desire a different action, press [**UP**].

b) The menu for having the MLC go to a default signal (e.g.: 10%) is displayed.

To accept this action, press [**ENTER**].

c) The next display prompts for the percent of flow to be the default setting. Enter the value using [**UP**] or [**DOWN**].



To accept this value, press [**ENTER**].

3. The {ERROR MESSAGE / ENABLED} screen is displayed.

To accept this value, press [**ENTER**] and the {–MENU– / ANALOG SIG FAIL} screen is displayed.

If you desire a different action, press either [**UP**] or [**DOWN**] to display the {ERROR MESSAGE / DISABLED} screen.

To accept this value, press [**ENTER**] and the {–MENU– / ANALOG SIG FAIL} screen is displayed.

NOTE **The error will still be logged with the time and date, but the flashing error message on the screen is suppressed. This is for applications that intentionally interrupt the analog signal in the normal course of operations, stopping and re-starting the pump.**

7.2.5 Leak Detection Failure Set Up

This sub-menu allows you to configure the MLC to interact with a PULSAlarm Leak Detection Diaphragm. You can modify the way the MLC responds to a diaphragm rupture. The following responses are available:

- Shut the motor off,
- Trigger an alarm relay,
- Shut the motor off and trigger an alarm relay.

NOTE **The leak sensor must be a dry contacting type.**

NOTE **If you select the 'motor off' option, the motor will have to be manually re-started if a Leak Failure is detected (i.e., press [**MOTOR**] to start the pump motor).**

Refer to ***Section 5-Installation:*** *Low Voltage Inputs* for wiring information.

Leak Detection Failure Set Up Procedure

1. Press [**MENU**] to enter the {–MENU–} sub-system. Press [**UP**] three (3) times until {– MENU – / LEAK DETECTION} appears. Press [**ENTER**] to continue to program the Leak Detection options.
2. The Leak Detection Input can be configured as {INACTIVE}, if the pump is not supplied with a PULSAlarm Leak Detection Diaphragm. Press [**ENTER**] to return to the screen {– MENU – / LEAK DETECTION}.

3. Press [**UP**] to scroll to the next sub-menu. The Leak Detection Input relay can be configured as {NORMALLY OPEN}.

or press [**UP**] to configure the relay as {NORMALLY CLOSED}.

Press [**ENTER**] to accept the desired configuration.

4. The display prompts you to configure the motor state (ON/OFF) should a diaphragm rupture occurs (i.e., a leak is detected).

If you do not want the pump's motor to turn off when a leak is detected, press [**ENTER**] to accept the default value. If you want the motor to shut off if a leak is detected, press [**UP**] to scroll to {YES} and press [**ENTER**].

5. The display prompts if the alarm relay should be triggered.

```
LEAK DETECTION
ALARM RELAY? NO
```

If you do not want the Alarm Relay activated when a leak is detected, press [**ENTER**] to accept the default of {NO}. If you want the alarm relay to be active if a leak is detected, press [**UP**] to scroll to {YES} and press [**ENTER**]. The display returns to the {MENU / LEAK DETECTION} screen.

7.2.6 Level / Start – Stop Set Up

This sub-menu allows you to configure the MLC to interact with a level input. You can program the MLC to have one of the following responses:

- Shut the motor off.
- Trigger the alarm relay.
- Shut the motor off and trigger the alarm relay.
- Shut the motor OFF when the level input is in one state (e.g. CLOSED) and turn the motor ON when the level input is in the other state (e.g. OPEN).

NOTE **The level sensor must be a dry contacting type.**

NOTE **If you select the 'motor off' option, the motor will have to be manually re-started if a Level Failure is detected (i.e., press [**MOTOR**] to start the pump motor).**

Refer to ***Section 5-Installation:*** *Low Voltage Input Connections*.

❖ **Level/Start-Stop Set Up Procedure**

1. Press [**MENU**] to enter the { – MENU – } sub-system. Press [**UP**] four (4) times until the { – MENU –- / LEVEL SWITCH} screen is displayed.

```
-MENU-
LEVEL SWITCH
```

Press [**ENTER**] to continue to program the Level Switch sub-menu.

2. The level input can be configured as {INACTIVE}, if the system will not use a level sensor.

```
LEVEL SWITCH
  INACTIVE
```

Pressing [**ENTER**] when {LEVEL SWITCH / INACTIVE} is displayed will cause the screen to return to the { – MENU – / LEVEL SWITCH} screen. Go to step 13.

3. Press [**UP**] to scroll to the next option {LEVEL SWITCH / ACTIVE}.

LEVEL SWITCH ACTIVE

4. Press [**ENTER**] when {LEVEL SWITCH / ACTIVE} is displayed and the {LEVEL SWITCH / DRUM LEVEL} screen is displayed.

LEVEL SWITCH DRUM LEVEL

If {LEVEL SWITCH / DRUM LEVEL} is selected, go to step 7.

5. Pressing [**UP**] when {LEVEL SWITCH / DRUM LEVEL} is displayed will display the {LEVEL SWITCH / START/STOP} screen.

LEVEL SWITCH START/STOP

6. Pressing [**ENTER**} from {LEVEL SWITCH / START/STOP} screen allows the LEVEL SWITCH input to be used as a remote motor On/Off switch.

The {START/STOP} feature uses the default setting of {MOTOR OFF? YES} and {ALARM RELAY? NO}. These settings cannot be modified.

7. Pressing [**ENTER**] from either the {LEVEL SWITCH / DRUM LEVEL} screen or {LEVEL SWITCH / START/STOP} screen will open the {LEVEL SWITCH / NORMALLY CLOSED} screen.

LEVEL SWITCH NORMALLY CLOSED

8. Press [**ENTER**} to configure the switching device as {NORMALLY CLOSED}, or press [**UP**] and then press [**ENTER**] to configure the switching device as {NORMALLY OPEN}.

LEVEL SWITCH NORMALLY OPEN

When either {LEVEL SWITCH / NORMALLY CLOSED} or {LEVEL SWITCH / NORMALLY OPEN} option has been set from the {LEVEL SWITCH / START/STOP} screen you are returned to the {– MENU – / LEVEL SWITCH} screen. Skip to step 13.

9. The display prompts for the motor status when the Level Input trips:

LEVEL SWITCH MOTOR OFF? YES

Press [**ENTER**] if you want the PULSAR motor to turn off when the input is sensed. Go to step 11.

10. If you want the PULSAR motor to shut off if a low level is sensed, press [**UP**] to scroll to {NO}. Press [**ENTER**].

```
LEVEL SWITCH
MOTOR OFF?   NO
```

11. The display prompts you for the alarm relay status should the Level Input trigger the alarm relay.

```
LEVEL SWITCH
ALARM RELAY? YES
```

Press [**ENTER**] if you want the Alarm Relay to activate with the Level Input. Go to step 13

12. If you do not want the Alarm Relay to activate with the Level Switch Input, press [**UP**] to scroll to {NO}.

```
LEVEL SWITCH
ALARM RELAY? NO
```

Press [**ENTER**] to accept the setting.

13. The display returns to the {– MENU – / LEVEL SWITCH} screen.

7.2.7 Digital Output Set Up

This sub-menu allows you to determine if the Digital Output is to be used as a counter for pump strokes, or as a remote motor on/off indication.

NOTE **A tachometer input is required for the stroke counting option, and is not available on the MLC.**

For example: If the Digital Output is set up as {RUN/STOP STATUS}, and {DIGITAL OUTPUT / NORMALLY OPEN} it will activate when the motor is on and deactivate when the motor is off.

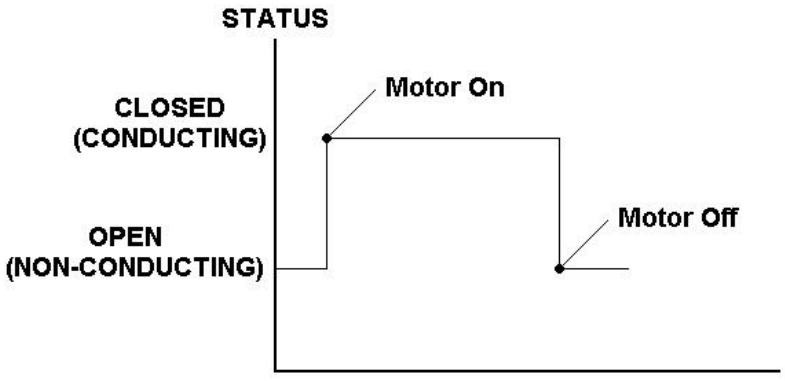


Figure 16 – Run/Stop Status

If the Digital Output is set up as {PUMP STROKE}, it will activate for 50% of each stroke and deactivate for 50% of each stroke.

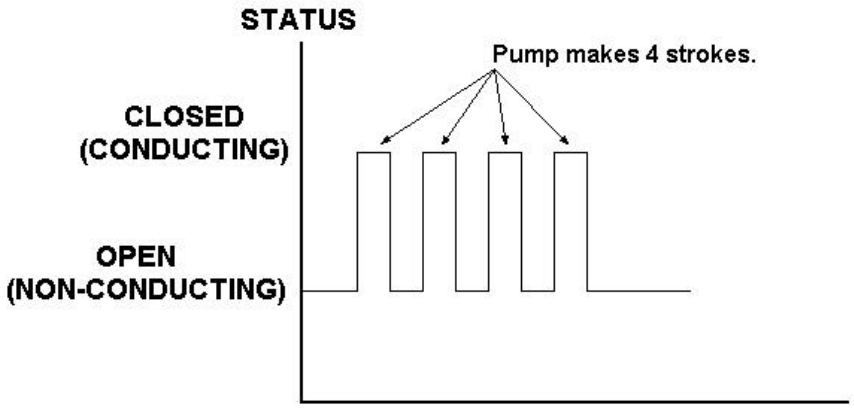


Figure 17 – Pump Stroke Status

❖ **Digital Output Set Up Procedure**

1. Press [**MENU**] once and then press [**UP**] eight (8) times until the display reads {–MENU– / DIGITAL OUTPUT}.

–MENU–
DIGITAL OUTPUT

2. Press [**ENTER**] to continue to program the Digital Output sub-menu. The {DIGITAL OUTPUT / RUN/STOP STATUS} screen is displayed.

DIGITAL OUTPUT
RUN/STOP STATUS

   To use the DIGITAL OUTPUT function as a remote On/Off indication, press [**ENTER**]. Skip to step 4.

3. Press [**UP**] and the {DIGITAL OUTPUT / PUMP STROKE} screen is displayed.

DIGITAL OUTPUT
PUMP STROKE

   To use the DIGITAL OUTPUT to indicate pump strokes, press [**ENTER**]. Go to step 6.

4. The {DIGITAL OUTPUT / NORMALLY OPEN} screen is displayed.
   In this mode, the output is open (non-conducting) when the motor is off.

DIGITAL OUTPUT
NORMALLY OPEN

   The output is closed (conducting) when the motor is on.
   Configure the output as {NORMALLY OPEN} by pressing [**ENTER**]. Go to step 6.

5. Press [**UP**] to open the {DIGITAL OUTPUT / NORMALLY CLOSED} screen.
   In this mode, the output is open (non-conducting) when the motor is on.

```
DIGITAL OUTPUT
NORMALLY CLOSED
```

   The output is closed (conducting) when the motor is off.
   Press [**ENTER**] to configure the output as {NORMALLY OPEN}.
6. The {–MENU– / DIGITAL OUTPUT} screen is displayed.

7.2.8 Motor Thermostat Set Up

This sub-menu allows you to configure the MLC to interact with the pump motor thermostat.

For equipment safety, the MLC can be programmed to have one of the following responses if the Motor Thermostat activates:

- Shut the motor off.
- Trigger the alarm relay.
- Shut the motor off and trigger the alarm relay.
- Shut the motor off, trigger the alarm relay, and then restart the motor when the Motor Thermostat resets.
- Shut the motor off and then restart the motor when the Motor Thermostat resets. (No alarm)
- Ignore the thermostat input. (not recommended)

❖ **Motor Thermostat Set Up Procedure**

1. Press [**MENU**] once and then press [**UP**] nine (9) times until the display reads {–MENU– / MOTOR THERMOSTAT}.

```
     –MENU–
MOTOR THERMOSTAT
```

2. Press [**ENTER**] and the {MOTOR THERMOSTAT / NORMALLY CLOSED} screen is displayed.

```
MOTOR THERMOSTAT
NORMALLY CLOSED
```

Press [**ENTER**] to accept the {NORMALLY CLOSED} configuration. Go to step 4.

or

Press [**UP**] and the {MOTOR THERMOSTAT / INACTIVE} screen is displayed.

```
MOTOR THERMOSTAT
    INACTIVE
```

If the {MOTOR THERMOSTAT} is to be configured as {INACTIVE}, press [**ENTER**] and you are returned to the {–MENU– / MOTOR THERMOSTAT} screen.

IF YOU SET {MOTOR THERMOSTAT} TO {INACTIVE} IT IS POSSIBLE FOR THE MOTOR WINDINGS TO OVERHEAT LEADING TO PREMATURE MOTOR FAILURE AND POSSIBLE HAZARDOUS CONDITIONS (E.G., FIRE).

3. Pressing [**UP**] from the {MOTOR THERMOSTAT / INACTIVE} screen will display the {MOTOR THERMOSTAT / NORMALLY OPEN} screen.

```
MOTOR THERMOSTAT
 NORMALLY OPEN
```

Press [**UP**] to select between {NORMALLY CLOSED} or {NORMALLY OPEN}. Press [**ENTER**] to accept your setting.

4. The {MOTOR THERMOSTAT / MOTOR OFF? YES} screen is displayed.

```
MOTOR THERMOSTAT
MOTOR OFF?  YES
```

Press [**UP**] to select between {YES} or {NO}.

If you want the motor to turn off when the thermostat activates, (recommended), set {MOTOR OFF?} to {YES}.

Press [**ENTER**] to accept the desired configuration.

IF YOU SET {MOTOR OFF?} TO {NO} IT IS POSSIBLE FOR THE MOTOR WINDINGS TO OVERHEAT LEADING TO PREMATURE MOTOR FAILURE AND POSSIBLE HAZARDOUS CONDITIONS (E.G., FIRE).

5. The {MOTOR THERMOSTAT / ALARM RELAY? YES} screen is displayed.

```
MOTOR THERMOSTAT
ALARM RELAY?  YES
```

Press [**UP**] to select between {YES} and {NO}.

```
MOTOR THERMOSTAT
ALARM RELAY?  NO
```

Press [**ENTER**] to accept the desired configuration.

6. If {MOTOR THERMOSTAT / MOTOR OFF? YES} is selected in step 4, the {RESTORE TO: / MOTOR ON} screen is displayed.

If you want the MLC to turn the motor back on when the thermostat deactivates, set {RESTORE TO:} to {MOTOR ON}. Press [**UP**] to select between {MOTOR ON} and {MOTOR OFF}. Press [**ENTER**] to accept your setting.

7. The display will return to the {–MENU– / MOTOR THERMOSTAT} screen.

7.2.9 Over Temperature Set Up

This sub-menu allows you to disable the warning message when the MLC's internal temperature approaches it's operating limit of 70°C / 158°F. The error condition will not reset until the temperature drops below 65°C / 149°F. The difference between the trip and release point is 5°C / 9°F.

❖ **Over Temperature Set Up Procedure**

1. Press [**MENU**] once and then [**UP**] five (5) times until the display reads {– MENU – / OVER TEMPERATURE}.

Press [**ENTER**] to go to the Over Temperature sub-menu.

2. The {OVER TEMPERATURE / ENABLED} (system default) screen is displayed.

3. Press [**ENTER**} to accept the {ENABLED} setting and you are returned to the {– MENU – / OVER TEMPERATURE} screen.

   or

   Press [**UP**] to display the {OVER TEMPERATURE / DISABLED} screen.

Press [**ENTER**} to accept the {DISABLED} setting. The display will return to the {– MENU – / OVER TEMPERATURE} screen.

```
– MENU –
OVER TEMPERATURE
```

7.2.10 Power Failure Set Up

This sub-menu allows you to configure the way the MLC reacts when power is restored after a power outage. During the power up stage, the MLC can either:

- Return to settings that were active when the pump lost power.
- Shut the motor off.

NOTE **A power outage is defined as the loss of power whenever the MLC is not in the {MOTOR OFF} state.**

❖ **Power Failure Set Up Procedure**

1. Press [**MENU**] once and then [**UP**] six (6) times until the display reads {– MENU – / POWER FAILURE}.

```
-MENU-
POWER FAILURE
```

   Press [**ENTER**] to go the power failure response sub-menu.

2. The display prompts you for the Power-up status. To shut the motor off when the power is returned to the unit (after a power failure), select the {MOTOR OFF} option.

```
DURING POWER UP
  MOTOR OFF
```

   Press [**ENTER**] to accept. Skip to step 4.

3. If you want to return to the prior settings, press [**UP**] and scroll to {DURING POWER UP / PRIOR SETTINGS}.

```
DURING POWER UP
 PRIOR SETTINGS
```

   Press [**ENTER**] to accept.

4. The display will return to the {– MENU – / POWER FAILURE} screen.

7.2.11 Alarm Relay

This sub-menu sets up the alarm relay output as normally open or normally closed.

❖ **Alarm Relay Set Up Procedure**

1. Press [**MENU**]. Press [**UP**] seven (7) times until the {–MENU– / ALARM RELAY} appears. Press [**ENTER**] to continue to program the Alarm Relay sub-menu.

2. The alarm relay can be configured as {NORMALLY OPEN}. With this setting the relay will CLOSE when the alarm output is activated.

If you would rather have the relay OPEN when the output is activated, press [**UP**] to change the configuration to {NORMALLY CLOSED}.

When you have finished making your selection, press [**ENTER**] to accept.

3. The display returns to the {–MENU– / ALARM RELAY}.

7.2.12 Analog Mode

Use the Analog Mode setting to activate or de-activate the analog mode. If deactivated, the [**MODE**] key will be ignored. If you are not using the analog input (i.e., you have made no connections to J4-1 and J4-2) but have the Analog Mode set to ACTIVE then any time you mistakenly press [**MODE**], by default the MLC will generate an {ANALOG SIGNAL FAILURE} alarm. De-activating Analog Mode prevents this.

If Analog Mode is active, there are two additional parameters that can be configured. You can set the number of samples to be averaged (within a valid range of 1 to 100 samples). You can set the interval, in number of samples, that the MLC should adjust the stroke setting to the specified average (within a valid range of 1 to 100 samples). The MLC samples the Analog Input every .25 seconds. The default values for the number of samples and interval are 10 and 20 respectively. Therefore, the MLC will average the last 10 samples and make an adjustment every 2.5 seconds (10*.25=2.5). Here are some general guidelines to assist you when adjusting these values:

- Increase the {SAMPLE SIZE} value to reduce the effect of line noise on the Analog Input.
- Decrease the {SAMPLE SIZE} value to increase sensitivity to changes in the Analog Input.
- Increase the {UPDATE EVERY / XX SAMPLES} value if the MLC is constantly adjusting the stroke setting (often resulting in a {DUTY CYCLE} alarm).
- Decrease the {UPDATE EVERY / XX SAMPLES} value to increase tracking response.

NOTE **In most situations, the default values will be adequate.**

Analog Mode Set Up Procedure

1. Press [**MENU**]. Press [**UP**] eight (8) times until the screen {–MENU– / ANALOG MODE} is displayed. Press [**ENTER**] to continue to program the Analog Mode sub-menu.
2. The Analog Mode can be configured as {INACTIVE} if you are not using the Analog Input. Pressing [**ENTER**] when {INACTIVE} is displayed will cause the screen to return to the {–MENU– / ANALOG MODE} status.

ANALOG MODE
INACTIVE

3. If you want the analog mode to be active and {INACTIVE} is displayed, press [**UP**] to change the display to {ACTIVE}. Press [**ENTER**].
4. The { SAMPLE SIZE / XX }window is displayed. Use [**UP**] and [**DOWN**] to set the number of samples taken from the 4-20mA input to average. The MLC will adjust its output in accordance with the average of the number of samples you set here. You may enter a value in the range of 1 to 100 samples. Press [ENTER] to accept the entry.

Increase the number of samples to smooth out a noisy input. Decrease the number of samples to cause the MLC to track more closely a rapidly changing signal.

SAMPLE SIZE
XXX

5. The {UPDATE EVERY / XX SAMPLES} screen is displayed. Use [**UP**] and [**DOWN**] to set how often the MLC will adjust to the current average value. The default value (2) causes the MLC to adjust every 20 samples or every 5 seconds (20 * .25 = 5). You may enter a value in the range of 1 to 100.

To closely follow a rapidly changing signal, decrease the update value. To adjust less frequently (e.g.: filter a noisy signal) increase the update value.

UPDATE EVERY
XXX SAMPLES

6. Press [**ENTER**] to accept and return to the {–MENU– / ANALOG MODE} screen.

7.2.13 Security

The MLC has three modes of security:

- None (OFF)
- Tamper Proof
- Calibration

With Tamper Proof security active, the MLC will lockout all of the front panel keys with the exception of [**MOTOR**]. To use any key you must first enter a four digit Personal Identification Number (PIN). Successful entry of a PIN allows you to access all MLC functions without PIN re-entry. With Calibration security set, the MLC will lockout only [**CAL**]. To use [**CAL**] you must first enter your PIN. Successful entry of a PIN allows you to access the {CALIBRATE} menu.

The security mode re-sets after 5-minutes of keypad in-activity.

Security Set Up Procedure

1. Press [**MENU**]. Press [**UP**] nine (9) times until the screen {–MENU– / SECURITY} is displayed. Press [**ENTER**] to continue to program the Security sub-menu.

```
-MENU-
SECURITY
```

2. The type of security available appears flashing on the display. If no password security protection is desired, press [**ENTER**] and go to step 8.

```
SECURITY TYPE
OFF
```

3. Press [**UP**] and the {TAMPER PROOF} option is displayed. If complete tamper proof security of all settings is required, press [**ENTER**] and go to step 5.

```
SECURITY TYPE
TAMPER PROOF
```

4. Press [**UP**] and the {CAL SETTINGS} option is displayed. If security protection of only the calibration settings is desired, press [**ENTER**].

```
SECURITY TYPE
CAL SETTINGS
```

5. The display prompts you to enter a four digit pin number. A line under the first digit indicates the character to be changed. Use [**UP**] and [**DOWN**] to scroll through the numbers 0-9. Press [**ENTER**] to accept the desired number. The line then moves to beneath the second digit. Continue to use [**UP**], [**DOWN**] and [**ENTER**] to set the four digit password.

NOTE **The values you enter are visible to both yourself and anyone else who may be watching you. Safe guard the security of your password.**

```
NEW PIN #
0000
```

6. After the four digit PIN has been entered, the display prompts you to confirm the new number:

```
CONFIRM CHANGE?
YES
```

Press [**ENTER**] to accept the pin number and go to step 8.

7. If the pin number is not correct, press [**UP**] to change the display to:

CONFIRM CHANGE?
NO

Press [**ENTER**] to reject the pin number and go to step 5

8. The menu display returns to {–MENU– / SECURITY} screen.

7.2.14 Number Format

The position of the comma and decimal point can be interchanged in the number format menu. You can also change the number of significant decimal places.

NOTE **You should recalibrate pump flow whenever you change the decimal position value.**

Number Format Set Up Procedure

1. Press [**MENU**] and [**UP**] ten (10) times until the display reads {-MENU- / NUMBER FORMAT}. Press [**ENTER**] to continue into the number format sub-menu.
2. The display shows the English numerical format of 9,999.99. Press [**UP**] to change to the European format of 9.999,99.

eg.: 9,999.99 Decimal or Comma	Press [**UP**]	eg.: 9.999,99 Decimal or Comma

Press [**ENTER**] to accept the displayed format.

3. The decimal position screen is displayed. Use [**DOWN**] to move the decimal position one place to the left. For example, the screen displays 9.999, pressing [**DOWN**] causes the display to change to 0.9999. When the decimal position satisfies your needs, press [**ENTER**] to accept.

eg.: 9.999 DECIMAL POSITION	Press [**DOWN**]	eg.: 0.9999 DECIMAL POSITION

4. The display returns to {–MENU– / DECIMAL FORMAT} screen.

7.2.15 Contrast Adjust

The MLC contrast can be adjusted to a desired setting.

Contrast Adjustment Procedure

1. Press [**MENU**]. Press [**UP**] eleven (11) times until the display reads {–MENU– / CONTRAST ADJUST}. Press [**ENTER**] to continue in the contrast adjust sub-menu.

2. Use [**UP**] to darken the characters on the display. Use [**DOWN**] to lighten the characters.

NOTE **By going too far in either direction the screen can be extremely difficult to read. Press the opposite arrow to correct the display.**

3. Press [**ENTER**] to accept the desired contrast setting.
4. The display returns to {–MENU– / CONTRAST ADJUST} screen.

TIP **You can adjust the contrast at any time by pressing [MENU] and [UP] or [DOWN] simultaneously.**

7.2.16 Serial Communications

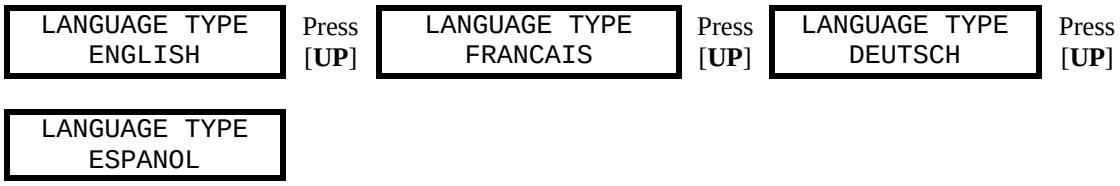
At this time, the Serial Communications feature is non-functional.

7.2.17 Language

The MLC menus can be displayed in English, Spanish, French or German.

❖ **Language Set Up Procedure**

1. Press [**MENU**]. Press [**UP**] thirteen (13) times until {–MENU– / LANGUAGE} appears. Press [**ENTER**] to continue through the language sub-menu.
2. The language type appears on the display. Press [**UP**] to scroll through the available languages.



When the correct language is displayed, press [**ENTER**] to activate.

NOTE **Once a selection is made, all text will be displayed in the selected language.**

3. The display returns to {–MENU– / LANGUAGE}.

7.2.18 Factory Default Settings

All of the MLC settings can be returned to factory defaults.

❖ **Procedure for resetting the factory defaults**

1. Press [**MENU**] and [**UP**] fourteen (14) times until the {–MENU– / FACTORY DEFAULTS} appears. Press [**ENTER**] to continue through the factory defaults sub-menu.
2. The display prompts you to not reset all the settings to the factory defaults.

```
FACTORY RESET?
NO
```

   If this is not desired, press [**ENTER**] to abort back to the {–MENU– / FACTORY DEFAULTS} screen. Otherwise, proceed with the next step.
3. If the MLC should be reset to all factory defaults, use [**UP**] to scroll the value to {YES}.

```
FACTORY RESET?
YES
```

   Press [**ENTER**] to accept.
4. The display double checks your action.

NOTE **Re-setting Factory Defaults will destroy any user calibration information.**

```
ARE YOU SURE?
NO
```

   Use [**UP**] to change the value to {YES}. Press [**ENTER**] to accept the value. The MLC will display the {PLEASE WAIT} screen while factory default values are restored. The MLC will then perform a {ZERO CALIBRATION}.
5. The MLC returns to the {–MENU– / FACTORY DEFAULTS} screen.

7.3 Units

By pressing [**UNITS**], the calibrated flow display will scroll through GPH, LPH, CCH, GPM, LPM, CCM, or % stroke length setting. The MLC will automatically convert the flow rate, based on the calibrated flow, to any of the above referenced units.

7.4 Varying the Flow Rate - Manually

The operator has two options for varying the flow rate:

Keypad – Increase flow rate by pressing [**UP**]. Decrease flow rate by pressing [**DOWN**].

Manual Adjustment Knob – The large black hand-wheel can be turned to increase or decrease the flow rate. The MLC will display the corresponding value of the manual hand-wheel stroke adjustment.

The Manual Control Knob should be used only in an emergency to adjust flow rate. (e.g.: the Keypad has failed)

Do not adjust the MLC's hand-wheel while the power is off. This will cause the MLC to lose its zero point and force a {ZERO CALIBRATION} at startup.

7.5 Mode

Pressing [**MODE**], switches the MLC operating modes. When ANALOG MODE is set to ACTIVE, pressing [**MODE**] will switch between {MANUAL MODE} and {ANALOG MODE}. In essence, this key acts like a local auto/manual switch.

7.6 Batch

The MLC is capable of controlling up to three (3) different batch programs. The batches operate in two modes: One Time Only and Repeating.

7.6.1 One Time Only

The One Time Only batch will start at a user specified time and run for a user specified duration. Refer to *Figure 18.*

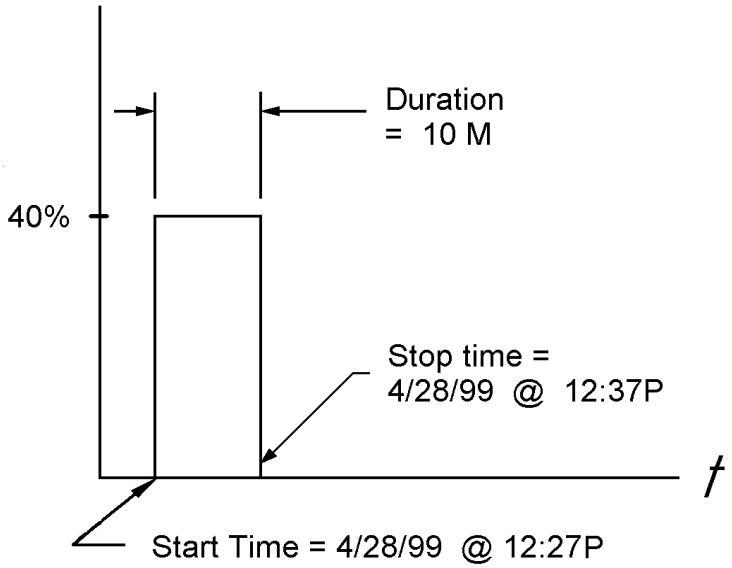


Figure 18 – One Time Only Batch.

7.6.2 Repeating

A Repeating Batch will start at a specified time and run for a specified duration. It will stop for a specified period of time and then repeat the run time. This will continue indefinitely. Refer to *Figure 19*.

NOTE **Any of the three batches can be specified as one time only or repeating.**

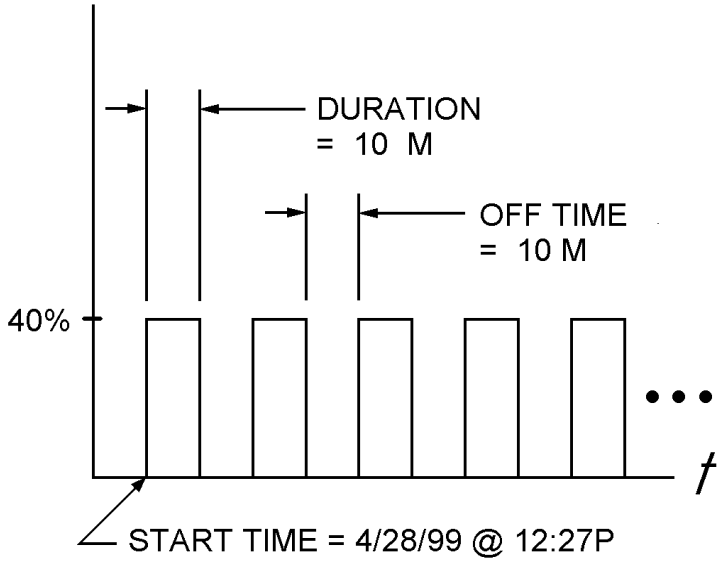


Figure 19 – Repeating Batch.

7.6.3 Overlapped

The batches can also be overlapped. Refer to *Figure 20* below.

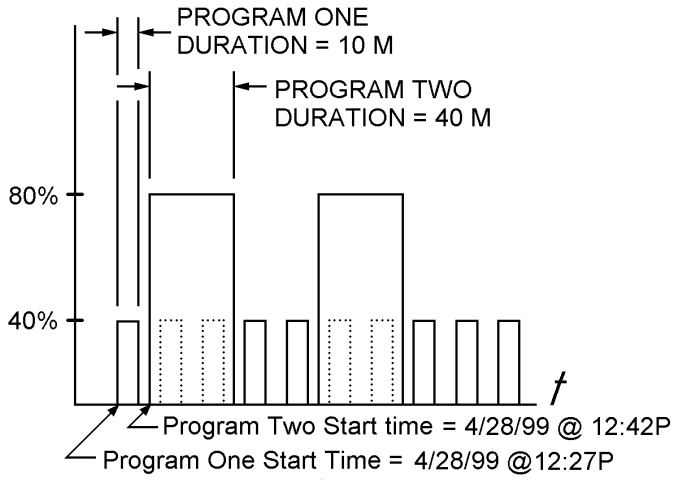


Figure 20 – Overlapping Batch.

NOTE **When the batches are overlapped, the flow rates are NOT additive. The highest of the two or three flow rates is used.**

The MLC can make a 1% per second adjustment of pump stroke length. Remember that when a batch starts, the MLC will require some amount of time to achieve the new stroke setting. The adjustment time is taken as a portion of the batch running time. This will cause the output of the pump to be skewed.

Batching system Set Up procedure:

1. Press [BATCH], to enter the batch set-up menu.
2. The display will come up as {BATCHES / ACTIVE} or {BATCHES / INACTIVE}. Press [**UP**] to change the batch system to {ACTIVE}.

Setting the batch system to ACTIVE will cause any pre-configured batches that are scheduled to start at this time, to start immediately.

BATCHES ACTIVE	Press [**UP**]	BATCHES INACTIVE	Press [**UP**]

Press [**ENTER**] to continue on to the batch sub-menu.

3. The display shows {EDIT / BATCH #1}. Press [**UP**] to {EDIT / BATCH #2} and [**UP**] again to {EDIT / BATCH #3}.

EDIT BATCH #1	Press [**UP**]	EDIT BATCH #2	Press [**UP**]	EDIT BATCH #3

The MLC is supplied with three programmable batches. Press [**ENTER**] to select the desired batch to edit.

4. The display shows {BATCH #1 RATE / 92.5%} (the value and unit of flow will depend on previous programming). The {RATE} text will be flashing. You can press [**UP**] or [**DOWN**] to view/change the other menu items related to this batch (e.g., RATE / DURATION / TYPE / START, etc.). Pressing [**ENTER**] causes the {RATE} value to stop flashing and allows you to program the batch flow rate. Use [**UP**] and/or [**DOWN**] to set the value.

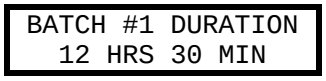
If a value has been set previously it will be used as a starting point for the new setting.

You can change the display units at any time by pressing [UNITS].

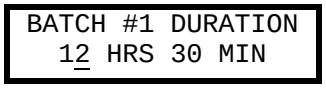
BATCH #1 RATE 92.5%

Press [**ENTER**] to accept your setting.

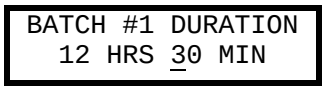
5. The display shows {BATCH #1 DURATION / XX HRS, XX MIN} with the word DURATION flashing. Press [**ENTER**] to set the duration (i.e., pump on time) of the batch.



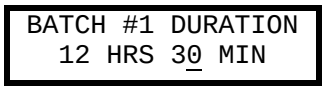
6. The hours value should now be flashing on the display. A line (cursor) under the second digit indicates the field to be changed. Use [**UP**] and [**DOWN**] to scroll through the numbers 0-99. Press [**ENTER**] to accept the desired hour setting.



7. The cursor then moves to minutes field. Use the [**UP**] and [**DOWN**] keys to scroll through the numbers 0-5. Set the first digit of the minute value one position at a time. Press [**ENTER**] to accept the desired first digit of the minute setting



8. The cursor then moves to the second digit of the minutes field. Use [**UP**] and [**DOWN**] to scroll through the numbers 0-9. Set the second digit of the minute value one position at a time. Press [**ENTER**] to accept the desired second digit of the minute setting, accept the batch duration, and exit the Batch Duration screen.



9. The display shows {BATCH #1 TYPE / ONE TIME ONLY}. Press [**ENTER**] to program the type of batch.

10. You can select two types of batches: either a one time only batch or a repeating batch. A one time only batch executes the batch only once. A repeating batch repeats an on/off cycle indefinitely. Press [**UP**] to scroll between the different batch types.

Press [**ENTER**] to select the type of batch desired. If you select {ONE TIME ONLY} skip the next step.

11. If a Repeating batch is selected, the display prompts you to enter the off duration time of the batch.

```
BATCH #1 OFF TIME
  10 HRS 23 MIN
```

Press [**UP**] and [**DOWN**] to program the time the batch should be off. Press [**ENTER**] to accept the time setting.

12. The display shows {BATCH #1 START TIME / XX:XX XX/XX/XX}. Press [**ENTER**] to edit the batch start time. Use [**UP**] and [**DOWN**] to set the time and date value one character at a time. Press [**ENTER**] to accept your setting.

```
  BATCH #1 START
8:01a     2/03/96
```

13. The display shows {CONFIRM BATCH? / YES}. Press [**ENTER**] to confirm the batch or press [**UP**] to scroll to the {NO} value and then press [**ENTER**] to disregard the batch.

```
BATCH #1 CONFIRM?
       YES
```

14. The display changes to let you know the batch is now pending and displays the time and date the batch will begin.

```
BATCH #1 PENDING
  8:01a 6/10/98
```

15. When the clock reaches the start time and date for the batch, the display automatically changes to indicate that the batch is running. The pump will then operate at the specified rate, for the specified time.

You can press [UNITS] to change the displayed units while the batch is running.

```
BATCH #1 RUNNING
      92.5%
```

While a batch is running you can display the time left in HH:MM:SS format by pressing either [**UP**] or [**DOWN**].

```
 BATCH #1 RUNNING
REMAIN   11:59:58
```

16. When the batch has operated for the specified time period, it will automatically shut off the pump's motor.

17. If this a One Time Only batch, the display will show the batch completed message and the operating mode will be set to manual.

```
BATCH #1 COMPLETED
  PRESS ANY KEY
```

Press any key to clear the display.

```
   300,000 CCH
   MANUAL MODE
```

18. If this was a repeating batch, the display will return to {BATCH #N PENDING / HH:MM DD/MM/YY} and the MLC will wait until its internal Time/Date clock matches the displayed time and date. At that time, the batch will recycle.

```
 BATCH #1 PENDING
 6:54a     6/11/98
```

7.6.3.1 Inactivating Batches

If the batch operation is not required to operate over a certain period of time, for instance the weekend, batches should be inactivated.

❖ **Batch Inactivation**

1. Press [**BATCH**]. The screen will show the batch status: {BATCHES / ACTIVE}. Press [**UP**] to change the display to {BATCH / INACTIVE}. Press [**ENTER**] to accept and inactivate the batches.

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8. DIAGRAMS: INSTALLATION / COMPONENT

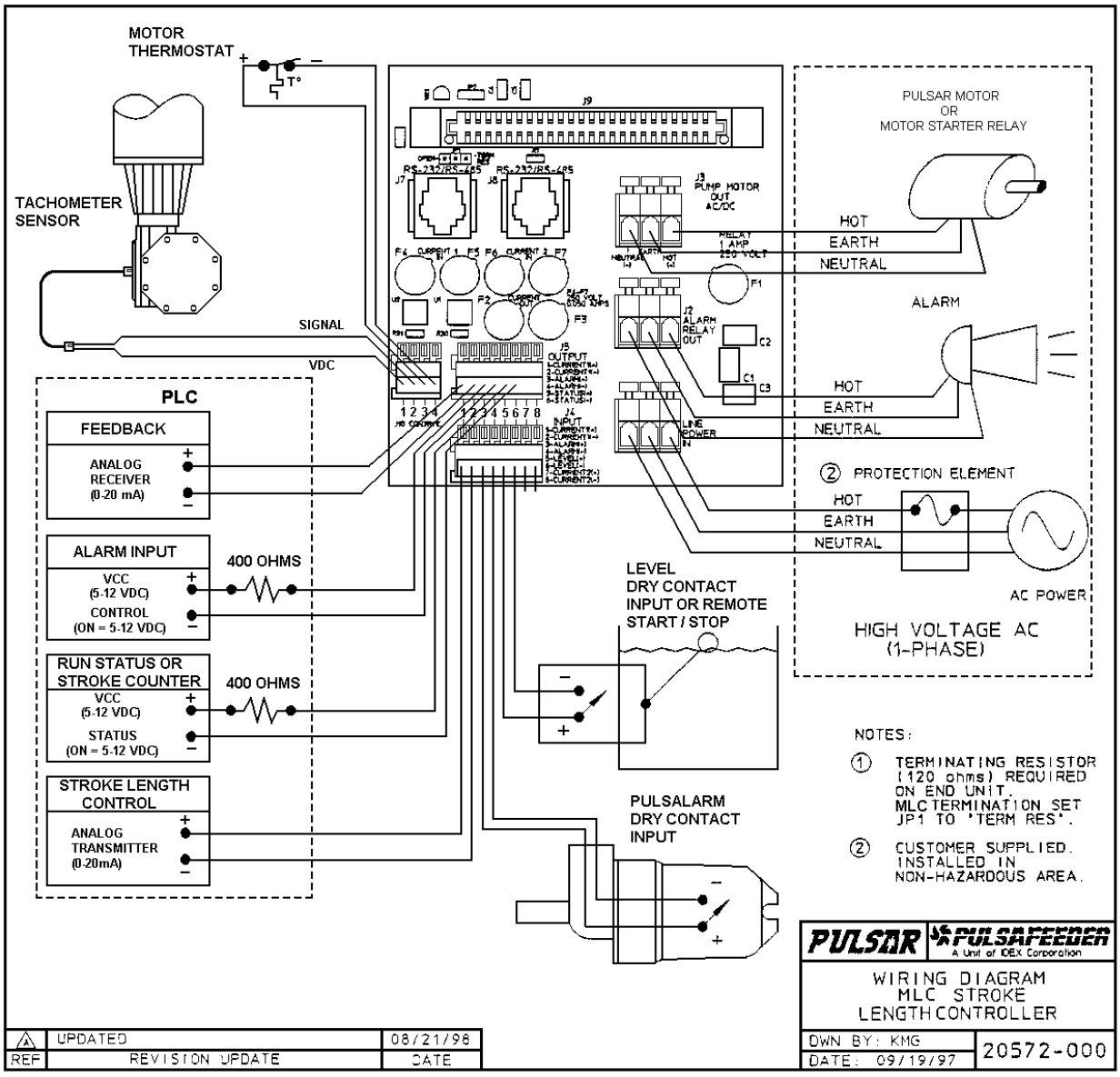

DIAGRAM 1 – MLC Wiring Diagram (19565-000)

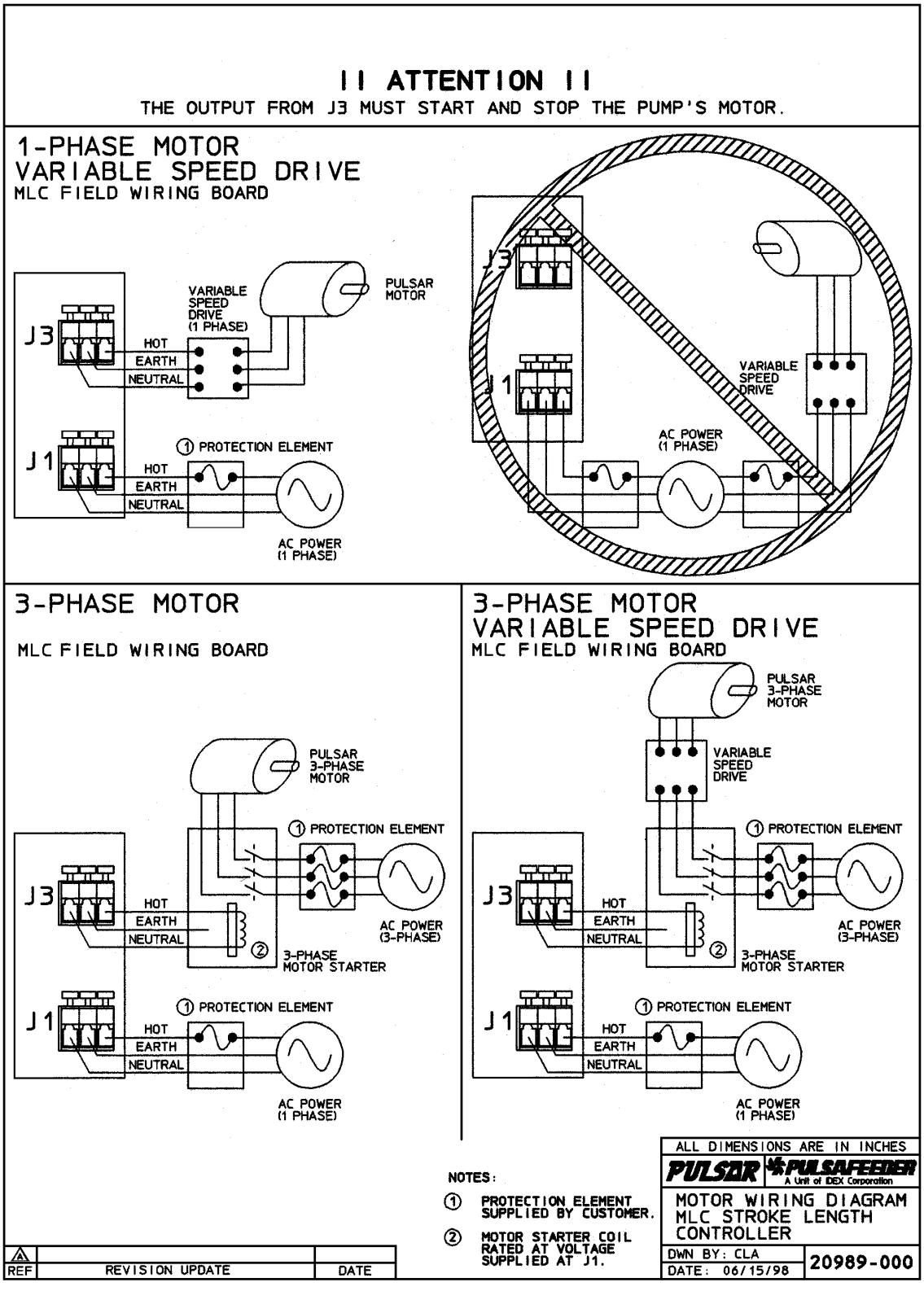

DIAGRAM 2. MLC Motor Wiring Diagram (20989-000).

9. SPECIFICATIONS

Turndown Ratio 10:1

Accuracy ..... No added inaccuracy to pump flow.

Resolution ..... 0.1%; four digits on units of flow.

Response ..... 1% per second

Temperature ..... Operation: 18ø C to 40ø C (0ø F to 104ø F)
Storage: 18ø C to 60ø C (0ø F to 160ø F)

High Voltage Inputs

Line Power (J1) ..... Factory Configured:
115 VAC +/- 10%, 60 Hz, 10 Amp max.
115 VAC +/- 10%, 50 Hz, 10 Amp max.
230 VAC +/- 10%, 60 Hz, 5 Amp max.
230 VAC +/- 10%, 50 Hz, 5 Amp max.

High Voltage Outputs

Alarm Relay (J2) ..... 1 Amp at rated Line Voltage (Fused)

Pump Motor (J3) ..... 8 Amps at 115 VAC
4 Amps at 230 VAC
Must be rated at line Voltage

Low Voltage Inputs

Analog Input (J4-1, J4-2)

Range ..... 0 to 25mA / 0 to 5volts
Minimum Span 2mA / 0.4 volts
Fuse 50mA
Input Impedance 200ohms
Surge Protection 7.4 Joules
Isolation ..... 500volts from all other I/O and ground
Sample Rate .... 0.25 Seconds
Modes ..... Split Ranging / Reverse Acting / Ratio

PULSAlarm (J4-3, J4-4)

Type ..... Dry Contact (Do not apply powered signal)
Modes ..... Normally Open / Normally Closed

Digital (J4-5, J4-6)

Type ..... Dry Contact (Do not apply powered signal)
Isolation:..... Not isolated from PULSAlarm or motor thermostat. 500 volts from all other inputs, outputs and ground.
Modes ..... Normally Open / Normally Closed

Low Voltage Outputs

Analog Output

Range / Load ... 0 to 20mA / 700ohms Max.
Minimum Span 2mA
Fuse 50m
Surge Protection 7.4 Joules
Isolation ..... 500volts from all other I/O and ground
Modes ..... Split Ranging / Reverse Acting

Alarm Status (J5-3, J5-4)

Type ..... Dry Contact (Transistor Type)
VCE(SAT) 0.3volts
Max Forward Current 50mA
On-State Resistance 100ohm
Isolation ..... 5000volts from all I/O and ground

Digital Output (J5-5, J5-6)

Type ..... Dry Contact (Transistor Type)
VCE(SAT) 0.3volts
Max Forward Current 50mA
On-State Resistance 100ohm
Isolation ..... 5000volts from all I/O and ground

Non-Incendive (with appropriate markings only)

UL/CSA ..... Class I, Division 2, Groups C & D
IEC ..... Zone 2, Groups IIA and IIB.

Control Inputs

Tachometer Sensor (J10-1, J10-2)

Range: ..... 0-5VDC Analog
For use with supplied Analog Proximity sensor only.

Motor Thermostat (J10-3, J10-4)

Type ..... Dry Contact (Optical)
Isolation ..... Not isolated from PULSAlarm or Digital Input. 500 volts from any other inputs, outputs and ground.
Modes..... Normally Open, Normally Closed (Default)

10. FACTORY DEFAULT VALUES

CALIBRATION	
Pump Flow	1-Point Calibration on PULSAR at Rated Flow and Pressure.
Analog Input	4.0 - 20.0mA
Analog Output	4.0 - 20.0mA
Ratio	100%
ANALOG INPUT	Enabled
Failure Mode	Freeze at last signal / Restore to Analog Mode
Sample Average	20 Samples
Sample Update	20 Samples (5.0 Seconds)
LEAK DETECTION	
Failure Mode	Inactive
LEVEL SWITCH	
Failure Mode	Inactive
OVER TEMPERATURE	
Failure Mode	Enabled
POWER FAILURE	
Failure Mode	Motor Off
ALARM RELAY	
Relay Output	Normally Open
SECURITY	OFF
NUMBER FORMAT	
Separators	X , XXX . XX (Comma / Decimal)
Position	PULSAR dependent (e.g., 9.999, 0.9999, etc.)
CONTRAST	Restored to initial factory setting.
SERIAL COMM	
Net Address	Disabled
LANGUAGE	English
UNITS	Percent (%)
BATCH	Inactive
Batch #n Rate	0%
Batch #n Duration	0 H 00 M
Batch #n Type	One Time Only
Batch #n Start	Current Date and Time for first setting

DATE/TIME

Date Format	MM/DD/YY
Time Format	24:00
Daylight Savings	No
MODE	Manual – Motor Off
FLOW RATE	0%
ALARMS	Cleared

11. TROUBLE SHOOTING GUIDE

11.1 System Diagnostics

Your MLC contains extensive diagnostics that allow it to determine the source of common problems. If your MLC is not operating properly, your first course of action should be to review the {DIAGNOSTICS} sub-menu in the {CONFIGURE} menu. To access this menu from the standard operating mode follow this procedure (provided your user interface – keypad and display – is functioning):

1. Press [**MOTOR**] repeatedly until the display reads {MOTOR OFF}.
2. Cycle power to the MLC (turn the main OFF then ON). This will cause the self-test routine to re-execute.
3. Press [**MENU**]. The screen { - MENU - / DIAGNOSTICS-1} is displayed. The value, in this case '1' indicates how many failures were detected.
4. Press [**ENTER**] to enter the Diagnostics Menu. The screen {DIAG MENU 1/8 / POWER IN: OK} is displayed.
5. Repeatedly press [**UP**] to cycle through all eight Diagnostic screens.
6. If a screen displays a FAIL message, press [**ENTER**] to display the time and date the failure occurred. Press [**ENTER**] again to display the clear screen. Press [**UP**] and then [**ENTER**] to clear the message.

Make a note of any failures reported in the Diagnostics Menu. Using this information, proceed with the troubleshooting instructions below:

Other actions may be necessary to bring the process back to normal conditions before clearing a failure.

MENU (DIAGNOSTICS)		
Symptom	Probable Cause	Possible Solution
DIAG 1/11 POWER IN: FAIL	The power to the MLC failed while the pump motor was running	Place MLC in {MOTOR OFF} operating mode before disconnecting power. See POWER trouble shooting.
DIAG 2/11 ANALOG IN: FAIL	The Analog Input signal fell outside of the calibrated range, or fell to 0 within .25 seconds (i.e., the signal was changing by more than 8.8mA per second and was less than .3mA).	Place MLC in {MANUAL MODE} before the signal loss occurs. Re-calibrate Analog Input. Condition Analog Input Signal. See ANALOG INPUT trouble shooting.
DIAG 3/11 DIGITAL: FAIL	The MLC could not communicate with the master (slave-to mode only).	Review ***Section 7- General Operation :*** *Serial Communications*. See SERIAL COMMUNICATIONS trouble shooting
DIAG 4/11 LEAK DET: FAIL	The Leak Detection Switch closure activated according to its configuration.	Review ***Section 7- General Operation***: *Leak Detection Failure Set-up*. See LEAK DETECTION trouble shooting.
DIAG 5/11 LEVEL SW: FAIL	The Drum Level Switch closure activated according to its configuration.	Review ***Section 7- General Operation*** *Drum Level Failure Set-up*. See LEVEL trouble shooting.

MENU (DIAGNOSTICS) [cont]		
Symptom	**Probable Cause**	**Possible Solution**
DIAG 7/11 DRIVE TEMP: FAIL	The MLC internal temperature has exceeded the units rating of 160° F (40°C)	Re-locate the MLC to a environment with lower ambient temperatures. See ***Section 9-Specifications***.
DIAG 8/11 BATTERY: FAIL	The MLC clock is backed by a Lithium Battery with a 10 year life.	The life expectancy is over. Contact Technical Services.
DIAG 9/11 CIRCUIT: FAIL *RAM*	The Random Access Memory (RAM) on the mother board cannot be reliably read and/or written to.	Cycle Power on unit to double check error. Contact Technical Services.
DIAG 9/11 CIRCUIT: FAIL *EEPROM*	The Electronically Erasable Read Only Memory (EEPROM) on the mother board cannot be reliably read and/or written to.	Cycle Power on unit to double check error. Contact Technical Services.
DIAG 9/11 CIRCUIT: FAIL *MOTOR*	The MLC's internal motor failed to respond when given a command to do so.	Cycle Power on unit to double check error. Review MANUAL KNOB / MLC INTERNAL DRIVE MOTOR trouble shooting. Contact Technical Services.
	The MLC's internal motor has achieved its Duty Cycle limit: 50% on over a 20 minute interval.	Cycle Power to clear. Reduce motor run time by changing batch or conditioning analog input.

DISPLAY		
Symptom	**Probable Cause**	**Possible Solution**
No Display Back-lighting	No power supplied.	Check power source.
	Supply power wired incorrectly.	Check wiring.
	Supply power outside of specification.	Check voltage/frequency against specification.
	Low voltage I/O wired incorrectly.	Check wiring.
	Display ribbon cable loose.	Contact Technical Support.
	Low voltage power supply failed.	Contact Technical Support.
No Text on Display	Contrast out of adjustment.	Adjust with [**MENU**] [**UP**] or [**MENU**] [**DOWN**]
	Software did not initiate properly.	Cycle power.
	Memory corrupted.	Cycle power. Perform Factory Re-Initialize.
	Environment exceeds 40øC (104øF).	Relocate to another area.

POWER		
Symptom	**Probable Cause**	**Possible Solution**
No power Indicators	No power supplied.	Check power source.
	Supply power wired incorrectly.	Check wiring.
	Supply power outside of specification.	Check voltage/frequency against specification.
	Low voltage I/O wired incorrectly.	Check wiring.
	Low voltage power supply failed.	Contact Technical Support.

PULSAR MOTOR (1-Phase)		
Symptom	**Probable Cause**	**Possible Solution**
Motor will not start.	No power supplied.	Check power source to MLC/Starter.
	Motor/Starter wired incorrectly.	Check wiring.
	Supply power outside of specification.	Check voltage/frequency against spec.
	Motor key not pressed.	Press motor key to start motor.
	Software did not initiate properly.	Cycle power.
	Leak or Drum input set with option MOTOR OFF? set to YES.	Correct Leak or Drum condition. Set MOTOR OFF? to NO.
	PULSAR mechanicals locked.	Check PULSAR, reference IOM.
	Solid-State relay failed.	Contact Technical Support.
Motor will not stop.	Motor/Starter wired incorrectly.	Check wiring.
	Software did not init properly.	Cycle power.
	Motor key not pressed.	Press motor key to stop motor.
	Solid-State relay failed.	Contact Technical Support.

ALARM RELAY		
Symptom	**Probable Cause**	**Possible Solution**
Alarm Relay will not Activate	Relay wired incorrectly.	Check wiring.
	Relay fuse blown.	Replace with 1A@250VAC fuse.
	Software not configured properly.	Refer to ***Section7-General Operation****: Menu Alarm Relay*.

ANALOG INPUT		
Symptom	**Probable Cause**	**Possible Solution**
Not Responding to Analog (mA) Input	Input wired incorrectly.	Check wiring.
	Input wired to second channel.	Move wires from positions 7 & 8 on J4 to 1 & 2.
	Input fuse(s) blown.	Replace F4 & F5 w/ 50mA@250VAC.
	Not in Analog Operation Mode.	Press [MODE].
	Input not calibrated properly.	Review ***Section7-General Operation***: *Calibration.*
Signal Failure Message Displayed with no signal loss	Break in wiring.	Check wiring.
	Input outside of specification.	Boost/Condition Signal.
	Process fluctuates too rapidly: < .3mA and changing by more than 8.8mA/s	Condition Signal. Change Failure Mode. Re-calibrate.
Low Analog Input point (e.g., 4.0mA) does not equate to 0% unit reading	Mis-Calibrated.	Re-Calibrate.
	0% calibration value mis-interpreted.	The "0% = 4.0mA" calibration screen refers to 0% flow. Not 0% stroke.

PULSAlarm		
Symptom	**Probable Cause**	**Possible Solution**
Not Responding to PULSAlarm Input	Input wired incorrectly.	Check wiring.
	Input not configured properly.	Review ***Section7-General Operation*** *Menu, Leak Detection Failure Set-up.*
	Powered contact used.	Remove and replace with dry contact. If no change, contact Technical Support.

LEVEL		
Symptom	**Probable Cause**	**Possible Solution**
Not Responding to Level Input	Input wired incorrectly.	Check wiring.
	Input not configured properly.	Review ***Section 7-General Operation****: Menu, Drum Level Set-up*.
	Powered contact used.	Remove and replace with dry contact. If no change, contact Technical Support.

ANALOG OUTPUT		
Symptom	**Probable Cause**	**Possible Solution**
No Analog (mA) Signal Present.	Output wired incorrectly.	Check wiring.
	Output fuse(s) blown.	Replace F2 & F3 w/ 50mA@250VAC.
Not tracking	Output not calibrated properly.	Review ***Section7-General Operation***: *Calibration*.

ALARM RELAY OUTPUT		
Symptom	**Probable Cause**	**Possible Solution**
No Output	Output wired incorrectly.	Check wiring.
	External Device not powering output.	Refer to wiring diagram. External device must supply voltage to dry contact.
	Alarm Options not set.	Review ***Section7-General Operation***: *Leak Detection/Drum Level Set-up/Alarm Relay*.

MANUAL ADJUSTMENT KNOB / MLC INTERNAL DRIVE MOTOR		
Symptom	**Probable Cause**	**Possible Solution**
Knob will not turn under MLC control or by hand.	PULSAR Stroke Adjustment jammed on mechanical stop at 0%.	Remove MLC. Turn shaft counter-clockwise with crescent wrench on flats to free. Re-install MLC. Re-calibrate flow.
	PULSAR Stroke Adjustment jammed on mechanical stop at > 100%.	Remove MLC. Turn shaft clockwise with crescent wrench on flats to free. Re-install MLC. Re-calibrate flow.
	MLC gearing worn.	Contact Technical Support.
Knob will not turn under MLC control. Display shows {DUTY CYCLE}.	Internal MLC Synchronous motor has achieved its duty cycle limit of 50% ON time (based on a 20 minute interval). Rapidly cycling batches and wildly swinging analog inputs will cause this motor to run continuously.	Eliminate batches that are cycling too rapidly (e.g., changing stroke from 0 to 100% one minute and 100 to 0% the next - the internal drive motor runs all the time). Condition analog input signal. Cycle Power. Wait for 5 minute 'cool-down' period. See 'POWER' section.
Knob turns at power-up.	Normal Zero Calibration. Display should read {PLEASE WAIT / ZERO CALIBRATE}.	Do not turn knob by hand while MLC's power is off.

MANUAL ADJUSTMENT KNOB / MLC INTERNAL DRIVE MOTOR (cont)		
Symptom	**Probable Cause**	**Possible Solution**
Knob will not turn under MLC control. Display shows {POSITION ERROR}. The MLC has attempted to move the stroke adjustment for at least 10 minutes with no movement determined.	Motor Starter wired incorrectly.	Motor starter must be wired through MLC
	The Stroke Position encoder is bad.	Cycle power and attempt re-calibration. If Encoder diagnostics appears, contact Technical Services.
	The Stroke Position gear train has failed.	Cycle power. Use [UP] and/or [DOWN] to set stroke to 50% while MLC stroke motor is running. Adjust knob by hand. Feel for smooth operation and 'Catching'. Contact Technical Services.
	The Stroke adjustment is jammed.	Rotate adjustment in the direction opposite to the current position (i.e. at 100% rotate clockwise, at 0% rotate counter clockwise).

KEYPAD		
Symptom	**Probable Cause**	**Possible Solution**
Display does not respond to keypad entry.	Software did not initiate properly.	Cycle power.
	Memory Corrupted.	Cycle power. Perform Factory Re-Initialize.
	Keypad connector loose.	Contact Technical Support.

BATCH OPERATION		
Symptom	**Probable Cause**	**Possible Solution**
Activated batch appears to be running through batches rapidly.	Batch Activated with Old Start Date. For example, today is 4/28/1998. You have a repeating batch programmed to start on 4/29/1998). The display will show the 'run-through' of all batches between the start day/time and today.	Change Batch start-time to or future date/time.
Repeating Batch will not start.	Batch duration is set to 0 hours and 0 minutes.	Duration must be greater than 0 minutes for batch to activate.

CALIBRATION		
Symptom	**Probable Cause**	**Possible Solution**
Message: {Terminated / Press any key} appears during Calibration.	Manual Knob adjusted while Calibration session was active.	Do not touch the Manual adjustment knob while a Calibration session is active.

UNITS		
Symptom	**Probable Cause**	**Possible Solution**
Units do not increment with change in %.	Unit not properly calibrated. Calibration beyond display resolution.	Re-calibrate to value within display range. Change number format to give additional precision.
Displayed units read { -####.##}	High pressure pump. Calibrated zero flow correlates to a stroke setting above zero (negative flow).	Display is normal. Increase the stroke setting until the unit reads properly. Re-calibrate.

MISCELLANEOUS		
Symptom	**Probable Cause**	**Possible Solution**
Voltage failure message displayed	Incoming Power un-reliable	MLC should have separate branch circuit taken from main. Re-wire. Consider surge-suppression.
	MLC factory configured for operating voltage other than input.	MLC must run under Factory configured operating voltage. Locate source of correct voltage and re-wire.
Power failure message displayed.	PULSAR motor running at time of power loss.	Turn PULSAR motor off before powering MLC down.

ENCODER ERROR		
Symptom	**Probable Cause**	**Possible Solution**
Message: {ENCODER ERROR / PRESS ENTER} displays during zero calibration.	Encoder defective.	Contact Technical Services.
Message: {POSITION ERROR / PRESS ENTER}	No movement of the encoder during the previous ON period.	Attempt to free gear train by moving the Manual Control Knob. Contact technical services

Refer to next section - Encoder Diagnostics

11.1.1 ENCODER DIAGNOSTICS

Whenever the MLC is re-calibrated it first performs a Zero Calibration. The first portion of the {CALIBRATING ZERO} routine is an encoder test. The MLC will increase the stroke adjustment 1%, while monitoring the encoder output. It will then reverse direction and drive the mechanism to the 0% position. During the 1% increase, the MLC reads the encoder output and compares it to the expected value. If, at any time during this process the MLC detects an error it will display:

```
ENCODER ERROR ##
  PRESS ENTER
```

A numerical value between 0 and 15 will display (instead of '##' in the example). Pressing and releasing [UP] will increase the stroke setting one encoder pulse. A new value will display. The value should increase by one count. Repeating the press and release [**UP**] step should cause the value to increase by one count with each cycle: : 0-1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-0-1-2-3-4, etc. Like wise, pressing [**DOWN**] will reduce the value by one count.

ENCODER ERROR		
Symptom	**Probable Cause**	**Possible Solution**
Numbers decrease sequentially with [UP]	Encoder wiring.	Cycle power and re-test. Contact Technical Services.
Numbers are not sequential	Encoder optical alignment.	Replace encoder. Contact Technical Services.

While the {ENCODER ERROR ##} screen is displayed you can access a further diagnostic by pressing [**UP**] and [**DOWN**] simultaneously. This will cause a bit level diagnostic to display:

```
EXPECTED 1101
ACTUAL   1101
```

Again use individual [**UP**] and [**DOWN**] keystrokes to change the value. The expected value should match the actual value. If they do not, try cycling power to re-test. If the failure re-occurs, contact Technical Support.

Press [**ENTER**] to exit the diagnostic display. The MLC will then repeat the test. There is no way to bypass the Encoder Test in the {CALIBRATING ZERO} process.

When the synchronous motor Duty Cycle protection is enabled, if there has been no movement of the Encoder in the previous ON period, the pump motor is shut off and the following error message is displayed.

```
POSITION ERROR
  PRESS ENTER
```

Press [**ENTER**] and the following screen is displayed:

```
ENCODER ERROR ##
  PRESS ENTER
```

Press [**ENTER**] and the following screen is displayed:

```
  TURN MOTOR ON
CALIBRATING ZERO
```

Press [**MOTOR**] and the MLC retries a Zero Calibration. If successful the MLC is returned to its normal operating condition. If unsuccessful, the {ENCODER ERROR ## / PRESS ENTER} screen is displayed. Contact Technical Support.

11.1.2 Tachometer Troubleshooting

The MLC utilizes the Tachometer sensor installed in the gear box to determine motor speed. This sensor detects the passage of 24 gear teeth per motor shaft revolution. If this device is not working properly, the MLC will malfunction. This typically results in the display of the {TACHOMETER / FAILURE} or {OVER SPEED / SHUT-DOWN} message. If your MLC displays either of these messages, use the following procedure to trouble shoot the device:

Required Tools:

- Phillips head screw driver
- Adjustable Wrench
- Multi-meter

1. Turn off and lock out the power to the MLC at the main panel.
2. Remove the Wiring Access cover (refer to Figure 2: Accessing the Field Wiring Board).
3. Disconnect the motor power from J3 on the Field Wiring Board (refer to Figure 4 – High Voltage Connections).
4. Assure that the pump will not discharge fluid and will not be subject to back pressure. Take all necessary precautions.

   To complete this procedure, you will have to manually rotate the PULSAR drive motor. If the motor type is TEFC, you can push against the fan blades through the shroud to do this. If the motor type is TENV, you must remove the protective cap from the end of the motor to access the motor shaft.
5. Turn on the power to the MLC at the main panel.
6. Check the supply voltage to the Tachometer.
   a) Set your multi-meter to read DC voltage in the range of 0-10VDC.
   b) Connect the positive lead of the multi-meter to J10-1 (TACH[+]).
   c) Connect the negative lead of the multi-meter to J5-8 (unlabeled, it is actually DC ground).
   d) You should read a value of 5.0VDC +/-0.5VDC. If this value is not displayed, stop your test. — **Do not proceed -- Contact Technical Services** —

7. Check the output from the Tachometer.
   a) Set your multi-meter to read DC voltage in the range of 0-5VDC.
   b) Connect the positive lead of your multi-meter to J10-2 (TACH[-])
   c) Connect the negative lead to J5-8 (unlabeled, it is actually DC ground).
   d) Slowly rotate the pump motor observing the high and low multi-meter readings.

      When the Tachometer is working properly this output will be transition from a value below 0.35VDC when a gear tooth is near the end of the sensor to a value above 1.8VDC when it is away from it.
   e) If these readings are obtained skip to step 17.
8. If these voltage readings are not obtained, adjust the sensor as follows.
9. Remove the conduit from the sensor housing by removing the 'C' clip and threading the plastic coupling off of the sensor.

   The tachometer cord will prevent you from removing the conduit completely. See *Figure 8: Tachometer and Pump Motor Thermostat Connections*.
10. Remove the lock nut from the sensor housing and carefully rotate the sensor body clockwise until the sensor bottoms against the gear, then rotate the sensor body counter clockwise 1/2 turn.
11. Slowly rotate the pump motor till the minimum multi-meter reading is obtained. If the meter does not exhibit any voltage change either the sensor or the interface circuitry is defective.
    — **Do not proceed -- Contact Technical Services** —
12. Slowly rotate the sensor body counter-clockwise a few degrees at a time until the minimum multi-meter reading is obtained. If this reading is above 0.35 volts either the sensor or the interface circuitry is defective. — **Do not proceed -- Contact Technical Services** —.
13. Slowly rotate the sensor body clockwise a few degrees at a time until the multi-meter reading rises slightly (0.01 to 0.05 volts above the minimum obtained above).
14. Replace and tighten the lock nut, while maintaining the voltage reading above by holding the sensor cable to prevent the sensor from rotating.
15. Slowly rotate the pump motor observing the high and low multi-meter readings. The output should now transition from a value below 0.35VDC when a gear tooth is near the end of the sensor to a value above 1.8VDC when it is away from it. If the meter reads a low value above 0.35 VDC or a high value below 1.8 VDC either the sensor or the interface circuitry is defective. — **Do not proceed -- Contact Technical Services** —.
16. The multi-meter is reading a value that changes between below 0.35VDC and above 1.8VDC as you rotate the motor. If you have already made adjustments to the Tachometer position at this point you may want to skip to step 20 and test your adjustments.
17. The Tachometer or Target gear may be damaged. Rotate the pump motor 360 degrees and count the number of transitions from high (>1.8VDC) to low (<0.35VDC) that you observe on your multi-meter.
18. If you do not count exactly 24 high interspersed with 24 low levels, the Tachometer target gear is damaged. — **Do not proceed -- Contact Technical Services** —
19. Test your settings. Turn off and lock-out the power to the MLC at the main panel.
20. Reconnect all conduit fittings to the Tachometer if removed in a previous step.
21. Connect the motor power to J3 on the Field Wiring Board (see *Figure 4: High Voltage Connections*).
22. Replace the Wiring Access cover (see *Figure 2: Accessing the Field Wiring Board*).

23. Turn ON the power to the MLC at the main panel.
24. Press [MOTOR] to start the motor.
25. Observe the display and operation of the motor. If the problem persists, contact Technical Services.

12. CONVERSION (MANUAL to MLC)

Your PULSAR can be easily converted from a Manual Stroke Adjustment Mechanism to the MLC. The MLC effectively replaces the Manual Cover Assembly. Use the following procedure for conversion:

1. While running the pump motor, adjust the stroke setting to approximately 50%.
2. Disconnect the power supply going to the PULSAR drive motor.
3. Remove the six Phillips Head screws that hold the Manual Cover Assembly to the Eccentric Box (refer to – *Figure 21*).

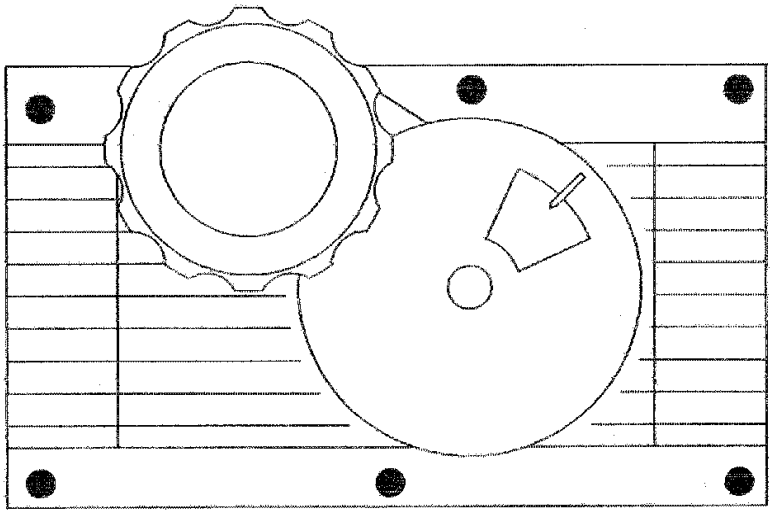

Figure 21 – Manual Cover Assembly

4. Remove the Manual Cover vertically from the Eccentric Box.
5. Visually inspect the Cam Pocket cover.

   If the Cam Pocket cover is constructed out of plastic, refer to and perform the procedure defined in Bulletin No. **PMP-MLC-FCM-98** Cam Pocket Cover Replacement.

   If the Cam Pocket cover is constructed out of metal continue to step 6.
6. Note the position of the adjustment shaft 'flats'. They mate with a slot in the MLC output shaft. Familiarize yourself with these mating components prior to installation (Refer to *Figure 22*).

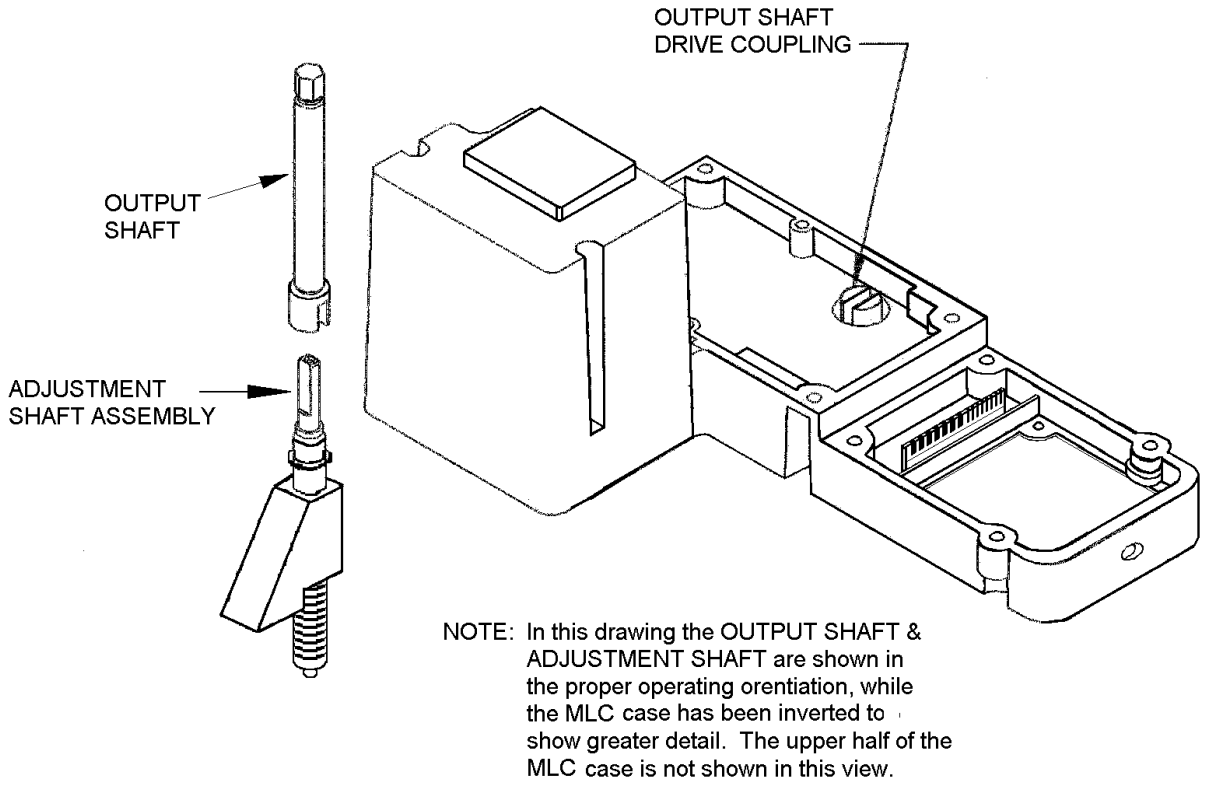

Figure 22 – MLC/Eccentric mating components

7. Locate the face on the bottom of the MLC that mates with the face of the lip of the eccentric box. The MLC is oriented such that the control pad and display sit to the left of the pump's reagent head (as viewed standing in front of the reagent head looking at the motor). The conduit connections and access panel (with Serial Tag) reside at the rear of the pump near the gear box.
8. Orient the MLC properly at a comfortable height above the pump and align the slot in the MLC coupling with the 'flats' on the adjustment shaft by turning the black hand knob on the MLC. Do not turn the adjustment shaft!
9. Lower the MLC onto the eccentric box. It may be necessary to tip the MLC slightly towards the motor to clear the motor adapter. With the MLC approximately 25mm (1 inch) above the eccentric box, make a fine adjustment to align the slot in the MLC coupling with the adjustment shaft 'flats'. Once aligned, lower the MLC to mate with the eccentric box. Do not force the cover! When the coupling is properly aligned, the MLC will seat properly under its own weight.
10. Install the 4 MLC mounting screws and washers provided.
11. Remove the 4 wiring access panel screws.
12. Follow the instructions in ***Section 5-Installation: Electrical Wiring*** of this manual for electrical connections.
13. Perform the steps detailed in ***Section 6-Start Up Instructions***.
14. Review ***Section 7 - General Operation*** for detailed information on configuring your MLC and its advanced features.

13. REPAIRS

The MLC contains no user-serviceable components within its main enclosure. In the un-likely event that your MLC needs to be repaired, PULSAFEEDER has implemented a replacement program. Contact PULSAFEEDER Customer Service at (716) 292-8000 to enter a replacement order. The representative will ask for the following information:

- Model Number
- Serial Number
- Nature of problem
- Ship-To Address
- Billing-Address
- Purchase Order Number

Within 24-hours a MLC will be shipped to you in a returnable container. Remove the replacement MLC from the packaging and swap it with the MLC needing repair. Return the MLC in the same packaging within **30 days**. Make sure that there are no components missing from the returned unit -- you will be charged accordingly. Upon receipt of the unit at PULSAFEEDER, an evaluation will be made within **14 days**. The unit returned will be refurbished for use in the replacement program.

The MLC has been designed to allow you to replace a defective unit without disturbing the wiring and conduit. The replacement unit will be shipped with the conduit adapter and attached field wiring board (refer to *Figure 2*). It is left to your discretion as to whether or not these components are used for the replacement. (Typically, these are left attached to the wire/conduit and form a 'plug' for the replacement unit.) When the original unit is returned to PULSAFEEDER , which ever conduit adapter that is **not used** ("new or "original") must be attached to the original unit.

13.1 EMERGENCY MANUAL PULSAR OPERATION

If your MLC is not functioning, you can operate your PULSAR manually without removing the MLC. Follow this procedure:

1. Disconnect the power to the MLC at the main.
2. Remove wires to J1 LINE POWER and J3 PUMP MOTOR. Use wire nuts or other code approved connectors to attach the LINE HOT to the MOTOR HOT, the LINE EARTH to the MOTOR EARTH, and the LINE NEUTRAL to the MOTOR NEUTRAL.
3. Re-connect the MLC power at the main.

THE PULSAR MOTOR WILL START IMMEDIATELY! TAKE ALL NECESSARY SAFETY PRECAUTIONS.

4. Rotate the manual adjustment knob on the MLC clockwise to zero the pump. It will be difficult to rotate as you are back-driving the MLC motor. Be careful! Do not force the knob. Try turning it in both directions to get a feel for the back-drive torque. As you approach zero the knocking will diminish.
5. Once you have found zero, mark the knob and cover with a piece of tape to use as a reference.
6. You can set the stroke adjustment to a specific value by calculating the number of knob turns. To do this, divide the desired setting (%) by a factor of 4(%/rotation). For example, say your

desired setting was 67%. You would divide 67 by 4 which equals 16.75. So you would turn the knob 16 and 3/4 revolutions from the zero position.

13.2 MLC REPLACEMENT

❖ **The following procedure assumes that you have received your replacement MLC and are ready to perform the replacement.**

1. If possible, activate the PULSAR motor and adjust the stroke setting in the range of 10 to 90%.

   Avoid 0 and 100% stroke settings on the PULSAR when replacing a MLC. If necessary, use the Manual Adjustment knob. It should be easier to adjust the stroke manually in the (+) counter clockwise direction.

NOTE **Do not adjust the stroke setting beyond the 100% (25 turns from 0%) setting.**

2. Disconnect the power to the MLC at the main. Power down all attached equipment (e.g., PLC's).
3. Remove the four screws and Teflon Gaskets that hold the wiring access cover to the MLC (refer to *Figure 23*).

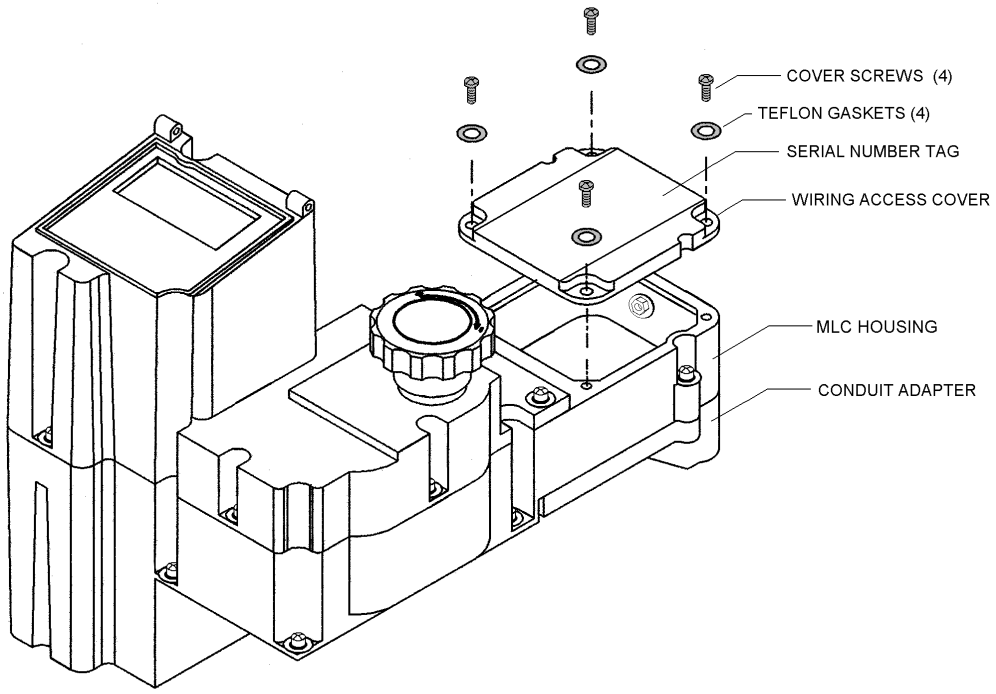

Figure 23 – Wiring Cover Access

4. Remove the Wiring Access Cover.

5. Remove the Tachometer Sensor Input Cable on the Field Wiring Board.
   a) Disconnect the wire (typically brown) connected to Pin 1 of J10.
   b) Disconnect the wire (typically blue) connected to Pin 2 of J10
6. Disconnect the Tachometer Sensor Conduit Assembly nut from the Tachometer Sensor Conduit Assembly and remove the Conduit Assembly and Tachometer Sensor wire from the MLC housing.

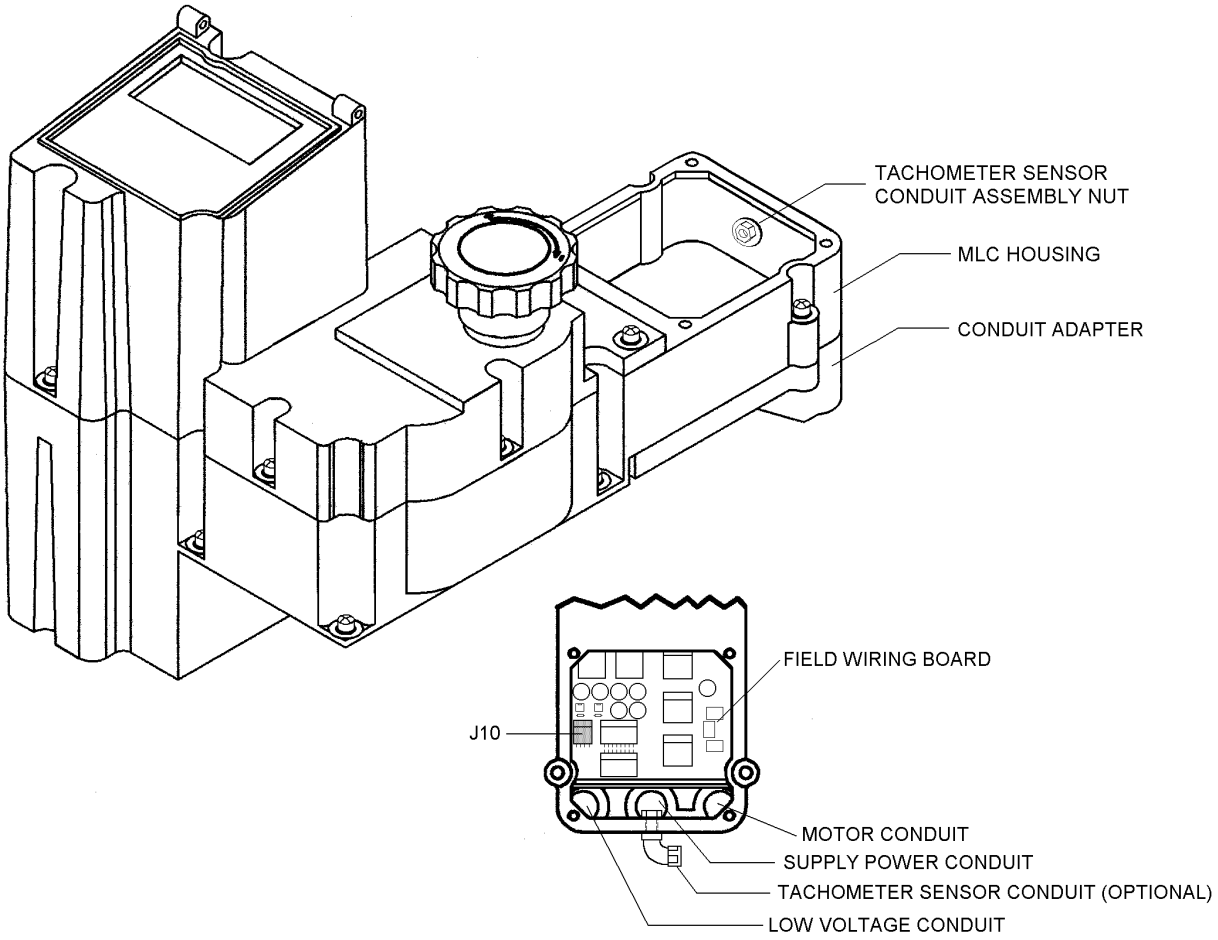

Figure 24 – Accessing the Tachometer Sensor Conduit

7. Remove the four screws and Teflon Gaskets that retain the conduit adapter. Refer to *Figure 25*.

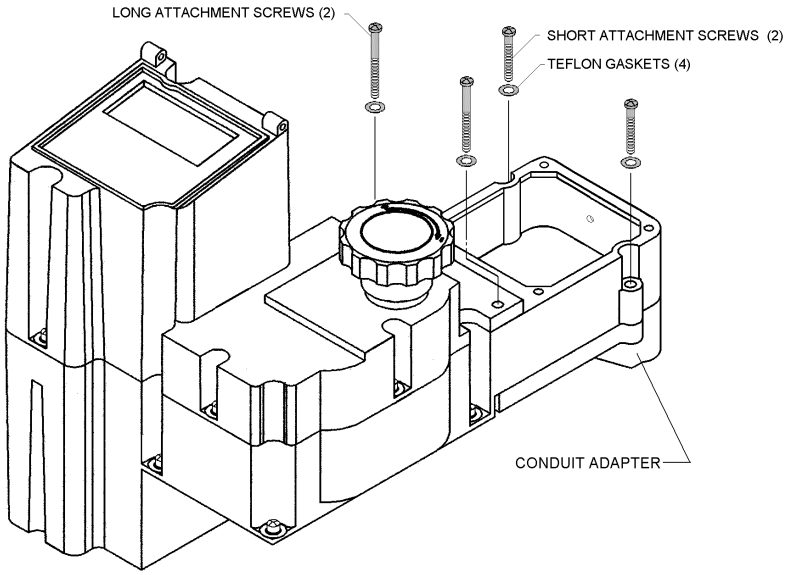

Figure 25 – Conduit Adapter Screw Removal

When removing the MLC in Step 8, the conduit adapter will stay with the wire and conduit. It plugs into the bottom of the MLC. When lifting the MLC off from the Conduit Adapter, it may be necessary to have a second person hold the Adapter while the MLC is 'un-plugged' from it.

8. Remove the four screws that hold the MLC to the PULSAR eccentric box. Refer to *Figure 26*.

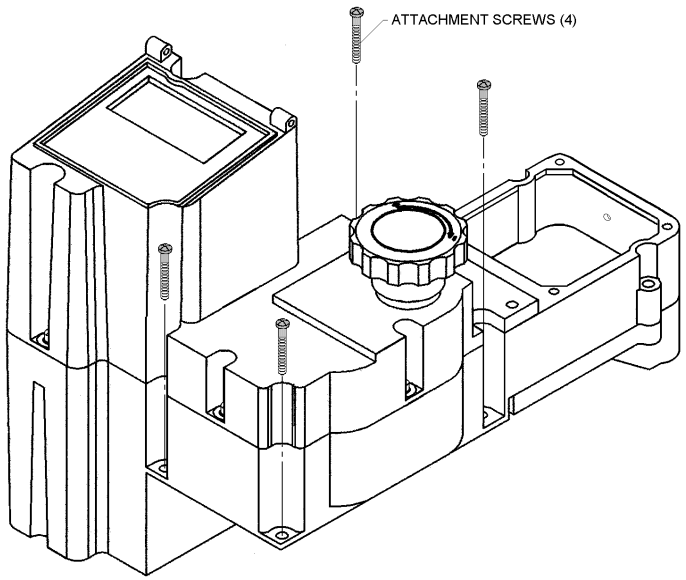

Figure 26 – MLC Removal for Replacement

9. Remove the MLC from the Eccentric Box by lifting vertically. Store it in the returnable packaging.
10. Bring the replacement MLC to the installation site.
11. If you are planning to re-wire the MLC during replacement, skip to step 12. Remove the Conduit Adapter from the replacement MLC by performing step 6 above. Attach the conduit adapter to the unit being returned.
12. Note the position of the PULSAR adjustment shaft 'flats'. They mate with a slot in the MLC drive coupling of the output shaft (the only external moving part on the MLC). The output shaft is connected to the adjustment knob. Familiarize yourself with these mating components prior to installation (refer to *Figure 27*).

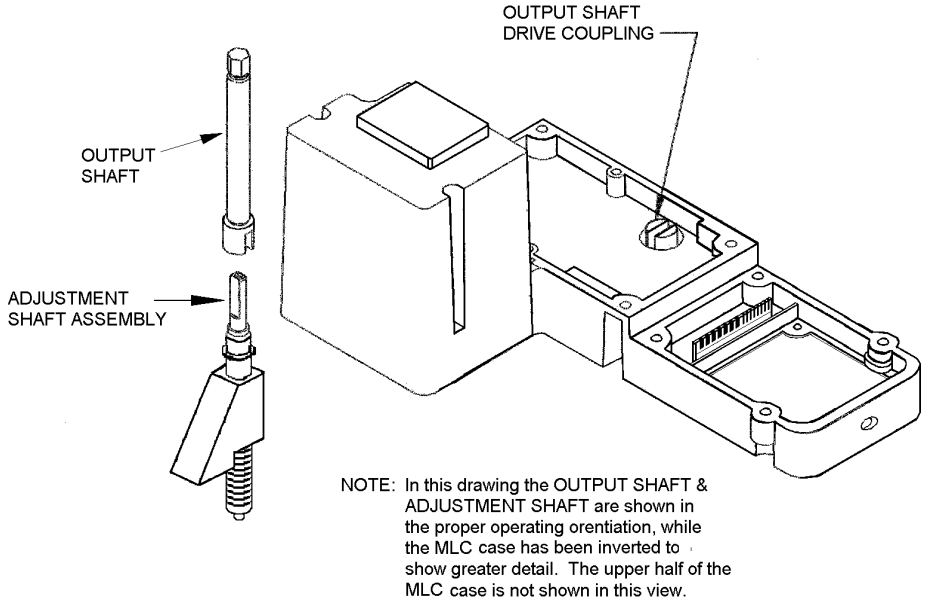

Figure 27 – MLC/Eccentric Mating Components

13. Locate the face on the bottom of the MLC that mates with the face of the lip of the eccentric box.

    The MLC is oriented such that the control pad and display sit to the left of the pump's reagent head (as viewed standing in front of the reagent head looking at the motor). The conduit connections and access panel (with Serial Tag) reside at the rear of the pump near the gear box.

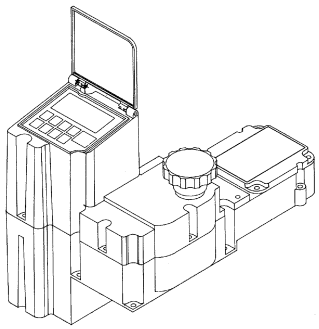

Figure 28 – Installation Orientation

14. Orient the MLC properly at a comfortable height above the pump and align the slot in the MLC coupling with the 'flats' on the adjustment shaft by turning the Manual Control knob on the MLC.

NOTE **Do not turn the PULSAR adjustment shaft!**

15. Lower the MLC onto the eccentric.

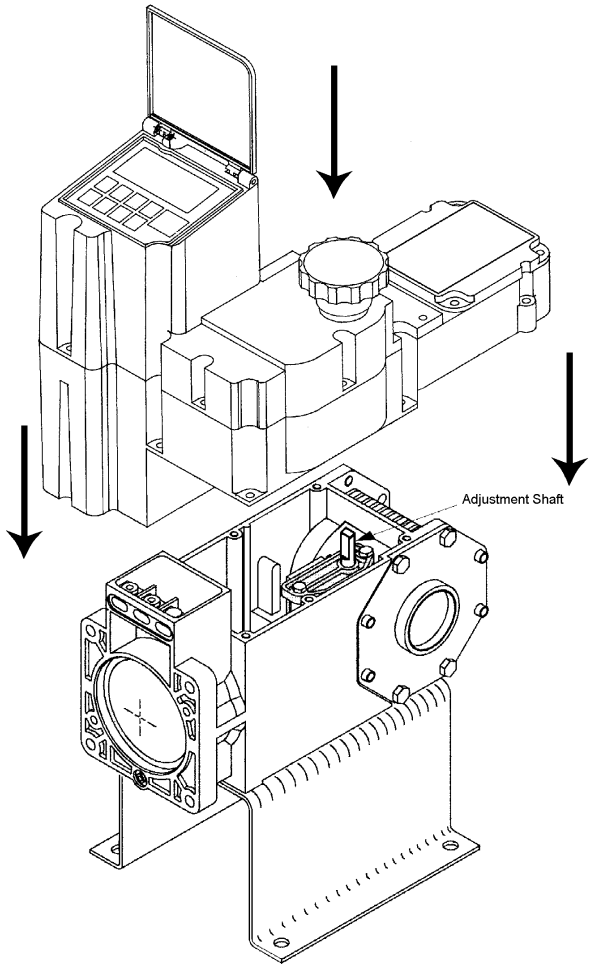

Figure 29 – Positioning the MLC

It may be necessary to tip the MLC slightly towards the motor to clear the Motor adapter.

a) With the MLC approximately 25mm inch (1 inch) above the eccentric box, make a fine adjustment to align the slot in the MLC coupling with the adjustment shaft 'flats'.
b) Once aligned, lower the MLC to mate with the eccentric box.

NOTE **Do not force the cover! When the coupling is properly aligned, the MLC will seat itself under its own weight.**

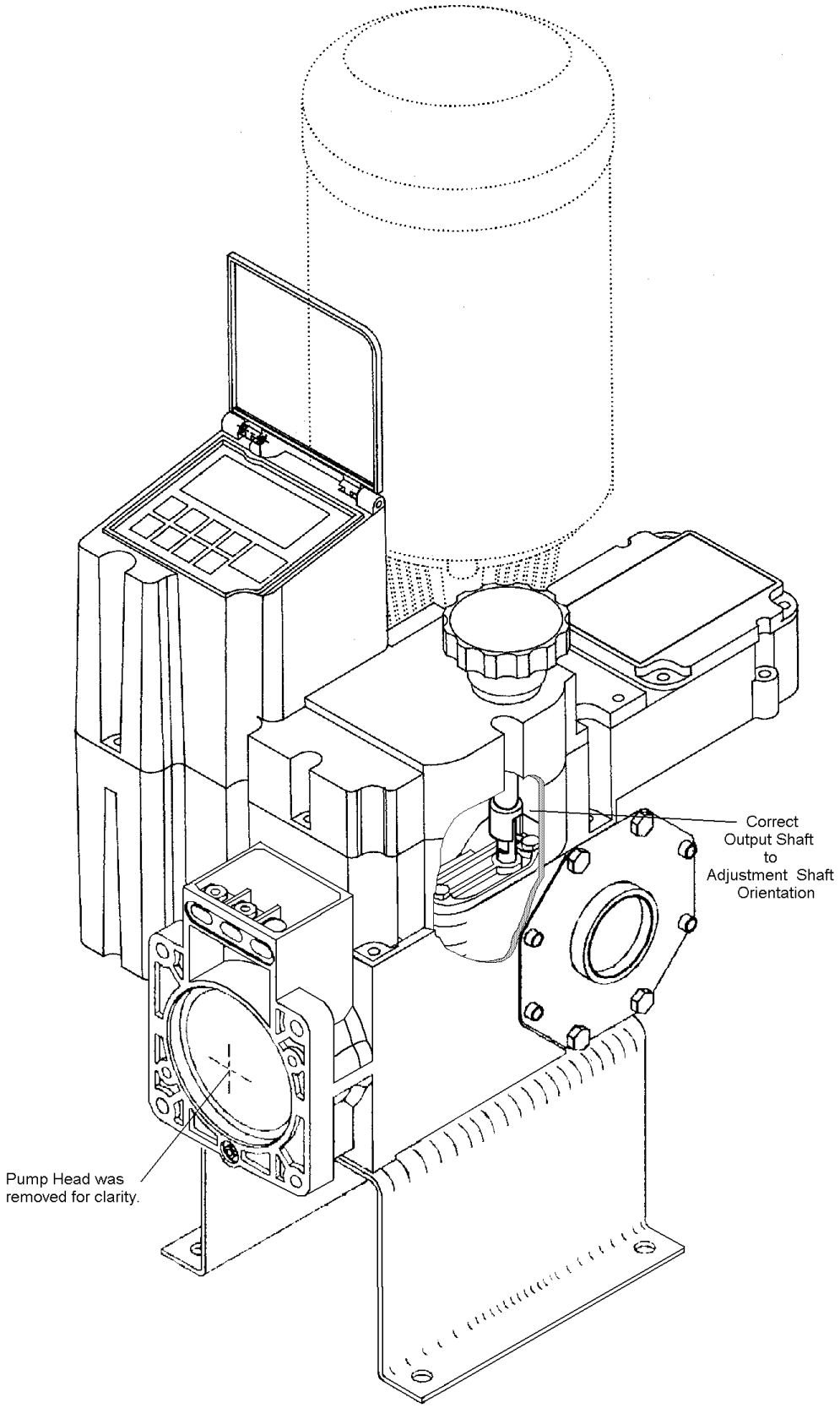

Figure 30 – Shaft Alignment

16. Align the Conduit Adapter with the mating surface on the MLC.

    A card edge in the MLC housing will mate with an edge connector on the Conduit Adapter. Once properly aligned, the units will mate with moderate force (approximately 20nt or 5lbf).
17. Install the four screws and Teflon Gaskets that hold the Conduit Adapter to the MLC.

FAILURE TO INSTALL THE TEFLON GASKETS WILL CAUSE YOU TO LOSE THE NEMA4X RATING ON YOUR ENCLOSURE, AND WILL VOID THE PRODUCT WARRANTY.

18. Install the 4 MLC mounting screws and washers provided.
19. Remove the 4 wiring access panel screws and cover.
20. Insert the Tachometer Sensor Conduit Assembly and wires (removed in step 6) in the hole provided in the back of the MLC housing.
21. Slide the Tachometer Sensor Assembly nut over the wires, and re-attach the Tachometer Sensor Conduit assembly.

You are attaching a plastic conduit assembly with a steel nut. Do not over tighten or damage will occur to the conduit assembly.

22. On the Field Wiring Board. insert the wire labeled VDC (typically brown) in J10 Pin 1 (removed in step 4).
23. On the Field Wiring Board, insert the wire labeled TACH (typically blue) in J10 Pin 2 (removed in step 5).
24. Follow the instructions in ***Section 5-Installation:*** *Electrical Wiring* for electrical connections.
25. Perform the steps detailed in ***Section 6-Start-up***.
26. Review ***Section 7-General Operation*** for detailed information on configuring your MLC and its advanced features.
27. Pack the defective unit in the returnable packing for shipment to PULSAFEEDER.

Include the PULSAR Diagnostic Form with as much descriptive information about the problem as possible. This document will be critical to obtaining credit for your return

14. Index

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15. Spare Parts

User replaceable parts for the MLC.

Table 4: Miscellaneous Replacement Parts

Pulsafeeder P/N	Description	Qty
NP250014-000	Clear Lexan Keypad / Display Cover	1
NP991209-003	Cover Pins	2
NP260003-GPC	Manual Adjustment Knob	1
NP550003-MLC	Manual Adjustment Knob Decal	1
NP992207-STL	Connector Board Assembly Screw (short)	2
NP992208-STL	Connector Board Assembly Screw (long)	2
NP992205-STL	Wiring Access Cover Screw	4
NP460016-TFE	Teflon Gasket	8

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Notes

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Diagnostic Form

PULSAR® MLC

Pulsafeeder. Inc.
2883 Brighton Henrietta TL Road
P.O. Box 22909
Rochester, New York, 14692-2909 USA
Attn: Technical Support
Telephone (716) 292-8000 Fax (716) 424-5619

Company Name: _____ Contact Name: _____

MLC Serial #: _____ Pump Serial #: _____

RMA#: _____ Date: _____ Completed by: _____

State the problem, including all symptoms:

Steps used to Diagnose the problem: **Cycle power and record the following:**

Power In:	OK	❑	Fail	❑	Circuit:	OK	❑	Fail	❑
Analog In	OK	❑	Fail	❑	Circuit Failure	OK	❑	Fail	❑
Leak Det.	OK	❑	Fail	❑	RAM	OK	❑	Fail	❑
Drum Level	OK	❑	Fail	❑	EEPROM	OK	❑	Fail	❑
Battery	OK	❑	Fail	❑	Motor	OK	❑	Fail	❑

What area did the problem fall into: (Refer to the Bulletin No. PMP-MLC-IOM-99, Section 11 – Trouble Shooting Guide)

Check the one that applies:

- ❑ Menu
- ❑ Display
- ❑ Power
- ❑ Pulsar Motor (1 Phase)
- ❑ Alarm Relay
- ❑ Analog Input
- ❑ Pulsalarm
- ❑ Level
- ❑ Analog Output
- ❑ Alarm Relay Output
- ❑ Manual Adjustment Knob / MLC Internal Drive Motor
- ❑ Keypad
- ❑ Batch Operation
- ❑ Calibration
- ❑ Units
- ❑ Miscellaneous

Did you try the suggested solutions? ❑ Yes ❑ No

If Yes what happened: (Use the back of the form if additional space is needed)

Additional comments:

BULLETIN No. PMP-MLC-IOM-99

PULSAFEEDER
A Unit of IDEX Corporation

Manufactures of Quality Pumps,
Controls and Systems

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