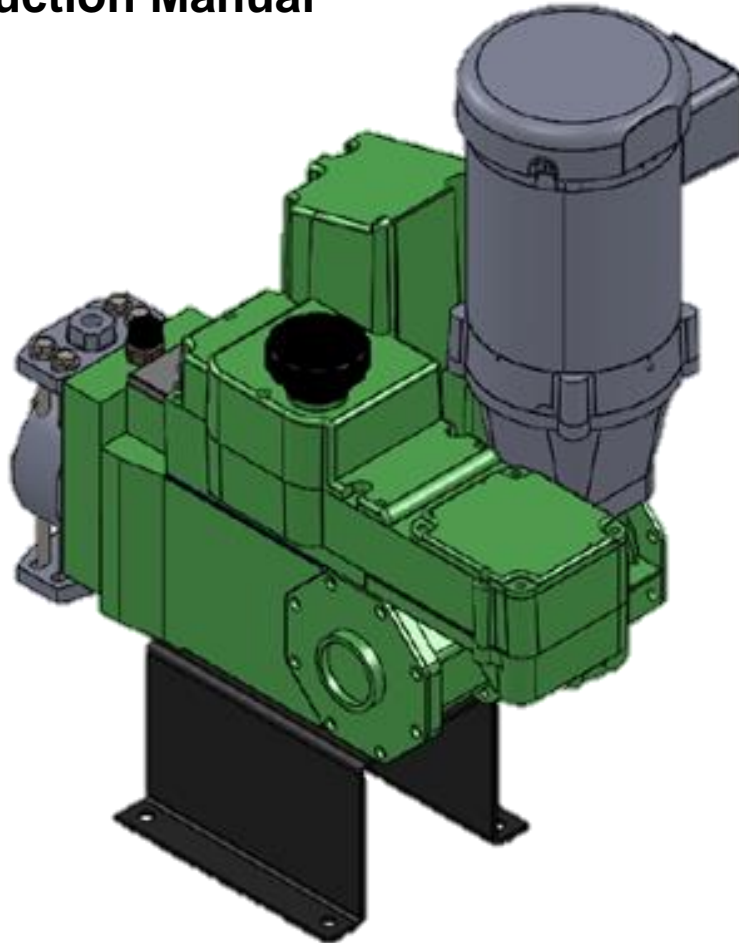




**Installation, Operation &
Maintenance Instruction Manual**



**PULSAR[®] DLCM
NEMA TYPE 4X
DIGITAL STROKE LENGTH & MOTOR
SPEED CONTROLLER**

Bulletin No.: IOM-CTL-DLCM-2004 Rev A

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Factory Service Policy

PULSAR® DLCM Controllers are microprocessor- based stroke length and motor speed controllers intended for use with PULSAR Diaphragm Metering Pumps. They include extensive on-board diagnostics. If you are experiencing a problem with your PULSAR DLCM Controller, first review the diagnostic menu, then consult the troubleshooting 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 (585) 292-8000 for further assistance. **Do not open or tamper with the DLCM enclosure as this will void the warranty set forth below.**

Trained individuals are available to help you diagnose your problem and arrange a solution. Solutions may include purchasing a replacement unit or returning the DLCM to the factory for inspection and repair.

All returns require a Return Material Authorization (RMA) number to be issued by Pulsafeeder. Replacements purchased under a possible warranty situation may be credited if, after an examination of the original PULSAR DLCM Controller by Pulsafeeder, it is determined that the issue is covered by the warranty set forth below.

Certain components may be purchased for replacement. Refer to **Section 15: Spare Parts** for more information and part numbers. Parts purchased to correct a warranty issue may be credited if after examination of the original parts by Pulsafeeder personnel it is determined that the issue is covered by the warranty set forth below. Parts returned for warranty consideration that test satisfactorily or are otherwise not covered by the warranty set forth below will be returned freight collect unless Pulsafeeder is directed otherwise.

Field modifications will void the warranty set forth below. Out-of-warranty repairs will be subject to Pulsafeeder's standard bench fees and testing costs associated with replacement components.

Warranty

Pulsafeeder warrants its PULSAR DLCM Controllers to be free of defects in material and workmanship under normal use and service for a period of one year from the date of shipment from Pulsafeeder's factory in Rochester, New York, USA. This warranty applies only to products which are properly stored, installed, operated and maintained. In order to be considered properly stored, installed, operated and maintained, a product (i) must be shaded from direct sunlight, (ii) must not be used in conditions that expose them to ambient temperatures below 32°F/0°C or above 120°F/49°C, (iii) must be protected against environmental conditions, and (iv) must be stored, installed, operated and maintained in accordance with all instructions and directions in Pulsafeeder's installation, operation and maintenance manuals for the product.

Before returning a product or part for warranty consideration, the claimant must first contact Pulsafeeder, describe the claim, identify the product model and serial numbers for which claim is being made, and submit proof of purchase and date of startup. If Pulsafeeder is willing to accept the warranty claim without return of the product or part, it shall so advise the claimant. If Pulsafeeder believes the warranty claim may potentially be a valid but is not willing to accept the warranty claim without return of the product or part, it will provide a written return authorization to the claimant. Following receipt of the written return authorization, the claimant may deliver the product or part to Pulsafeeder at its factory in Rochester, New York, USA, freight and duties

prepaid. The written return authorization must be included with the returned product or part. Pulsafeeder has no liability or obligation with respect to products or parts that are returned without a written return authorization.

Upon receipt of the returned product or part, a thorough examination will be conducted by Pulsafeeder to determine the cause of the issue with the product or part and whether it is covered by this warranty. This determination shall be made by Pulsafeeder in its sole reasonable judgement. If Pulsafeeder determines the issue with the returned product or part is not covered by this warranty, a report of Pulsafeeder's findings will be sent to the claimant.

Pulsafeeder's sole liability and obligation and the claimant's exclusive right and remedy under this warranty shall be limited to the replacement or repair of the defective product or part. The decision whether to replace or repair shall be made by Pulsafeeder in its sole discretion. Without in any way limiting the foregoing, Pulsafeeder shall not be liable under this warranty (i) for any costs of removal, installation, transportation or any other changes which may arise in connection with a warranty claim, (ii) for any loss, damage, injury, cost or expense directly or indirectly related to the use or failure of its products, including, but not limited to, any loss of or damage to other products, machinery, buildings or property and any injury to persons, or (iii) for consequential damages (including, but not limited to, loss of time, inconvenience, loss of product being pumped, loss of production, loss of business, or loss of contract),

This warranty shall be null and void with respect to a Pulsa Series or PULSAR Metering Pump if in the sole reasonable judgment of Pulsafeeder (i) it has been tampered with, disassembled, repaired or altered by anyone other than Pulsafeeder (unless authorized by Pulsafeeder in writing and then only if carried out strictly in accordance with Pulsafeeder's written instructions and directions), (ii) it has not been properly stored, installed, operated and maintained, or (iii) it has been used for a purpose or application for which it is not fit or appropriate. This warranty does not cover normal wear and tear of a product or damage to a product during shipment or after receipt.

PURCHASERS AND USERS OF PULSAR DLCM CONTROLLERS ARE SOLELY RESPONSIBLE FOR DETERMINING THE FITNESS AND APPROPRIATENESS OF SUCH PRODUCTS FOR THE PURPOSES AND APPLICATIONS FOR WHICH THEY ARE USED, AND PULSAFEEDER SHALL HAVE NO LIABILITY OR OBLIGATION UNDER THIS WARRANTY OR OTHERWISE IF A PULSAR DLCM CONTROLLER IS USED FOR A PURPOSE OR APPLICATION FOR WHICH IT IS NOT FIT OR APPROPRIATE.

THIS WARRANTY IS PULSAFEEDER'S SOLE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ALL IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH WARRANTIES ARE HEREBY EXPRESSLY EXCLUDED.

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Liability Exclusion and Limitation

To the maximum extent permitted by law:

- Pulsafeeder shall have no responsibility or liability for any personal injury, property damage or other loss or damage of any kind with respect to any PULSAR DLCM Controller that:
 - is not properly stored, installed, operated and maintained. In order to be considered properly stored, installed, operated and maintained, a PULSA DLCM Controller (i) must be shaded from direct sunlight, (ii) must not be used in conditions that expose them to ambient temperatures below 32°F/0°C or above 120°F/49°C, (iii) must be protected against environmental conditions, and (iv) must be stored, installed, operated and maintained in accordance with all instructions and directions in Pulsafeeder's installation, operation and maintenance manuals for the product .
 - is tampered with, disassembled, repaired or altered (except as may be authorized by Pulsafeeder in writing and then only if carried out strictly in accordance with Pulsafeeder's written instructions and directions)
 - is used for a purpose or application for which it is not fit or appropriate
 - is damaged during shipment or after receipt
- Pulsafeeder shall have no responsibility or liability for any:
 - costs of removal, installation, transportation or any other changes which may arise in connection with a warranty claim or other issue with a PULSAR DLCM Controller
 - loss, damage, injury, cost or expense directly or indirectly related to the use or failure of its products, including, but not limited to, any loss of or damage to other products, machinery, buildings or property and any injury to persons
 - consequential damages (including, but not limited to, loss of time, inconvenience, loss of product being pumped, loss of production, loss of business, or loss of contract)

Information in this manual is subject to change without notice. No part of this manual may be reproduced, stored in a retrieval system, or transmitted in any form or any means, electronic or mechanical, including photocopying and recording, for any purpose other than installing, operating and maintaining the PULSAR DLCM Controller for which it is provided without the written permission of Pulsafeeder.

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 cases 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. THIS MANUAL MUST BE CONSULTED IN ALL CASES WHERE THE WARNING SYMBOL IS MARKED IN ORDER TO FIND OUT THE NATURE OF THE POTENTIAL HAZARDS AND ANY ACTIONS WHICH HAVE TO BE TAKEN TO AVOID THEM.



CAUTION, POSSIBILITY OF ELECTRIC SHOCK.



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.

Revision History

| REV LEVEL | BRIEF DESCRIPTION | DATE |
|-----------|--------------------------|------------|
| - | New bulletin number | 08/28/2015 |
| A | 2.2 Explosive Atmosphere | 11/20/2015 |

REVISION LOG

| | |
|---|--|
| - | New, updated to current certified design |
| A | Updated atmosphere safety and warnings for explosion hazards |

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1 Introduction

The DLCM is an advanced microprocessor based controller designed for use with the PULSAR diaphragm metering pump. It controls the output of the pump by varying its stroke rate and the amount of fluid discharged with each stroke. It has many advanced features that allow it to operate in a wide variety of industrial environments. The operation and maintenance of the *PULSAR* metering pump is covered in the pump IOM. Please refer to this IOM for important safety and operational instructions for your PULSAR pump.

This instruction manual covers all standard features of the DLCM and where applicable, specific options.

1.1 Description

The DLCM integrates a motor speed controller and a stroke length controller into a single pump mounted package. Its purpose is to precisely adjust the flow of a process media by adjusting the pump motor speed and stroke length.

The DLCM 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. Pump output is displayed as a percentage of stroke length position and motor speed, or in units of calibrated flow: CMH, GPH, LPH, CCH, CMM, GPM, LPM, or CCM. In addition, the DLCM display supports any one of four languages: English, French, German or Spanish.

The DLCM supports a variety of remote control options. These inputs and outputs are fully isolated for improved protection and reliability. A Batch feature, with up to three independent programs, supplements the control features and allows for greater flow turn down.

The DLCM includes the *PULSAnet* Serial Communications system. This allows the DLCM to interface digitally to other DLC's, DLCM's, PLC's, or PC's using the MODBUS™ communications protocol over a 4 wire RS-485 network.

The DLCM 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 the need for stop-watches, calculators and reduces the possibility of human error. Analog signal calibration is also accomplished by simple key-pad entry. It includes real-time display of signal levels.

This eliminates the need for external meters.

The DLCM readily accepts PULSAlarm leak detection, Level-Input detection or Remote Start/Stop station inputs that can be configured to stop the pump and/or activate an alarm relay.



THE REMOTE START/STOP CANNOT BE CONFIGURED TO ACTIVATE THE ALARM RELAY.

Failures are time and date stamped into memory for later retrieval. Other diagnostics include analog signal failure and line power failure monitoring. These are also time and date stamped and may be preset to control stroke position or motor status upon detection of a failure.

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

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

1.2 DLCM Standard Features

- DC Motor Speed Control with tachometer feedback
- Manual Stroke Length Control
- Keypad
- Back-lit 2 line 16 character LCD display
- NEMA 4X Enclosure
- Two 4-20mA inputs for independent speed and stroke length control
- One 4-20mA output
- MODBUS RS-485 Serial Communications
- 10-Year Battery Backed Clock
- Solid State Alarm Relay
- Level Input/Remote Start-Stop Inputs
- PULSAlarm Leak-Detection Interface
- Diagnostics

1.3 Options

- Operating Voltage/Frequency

1.4 Accessories

- PULSAnet MODBUS DDE Server

2 Safety Considerations

The DLCM 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. In consideration of SAFETY, the user should be mindful of this relative to his/her safety, that of co-workers and of the process environment. Consider the following prior to the installation and operation of a DLCM controlled PULSAR metering pump.

- Read and understand all related instructions and documentation before attempting to install or maintain this equipment
- Observe all special instructions, notes, and cautions.
- Act with care and exercise good common sense and judgment during all installation, adjustment, and maintenance procedures.
- Ensure that all safety rules, work procedures, and standards that are applicable to your company and facility are followed during the installation, maintenance, and operation of this equipment.

2.1 General Safety

The DLCM was designed as a motor speed controller and stroke length position actuator for operation solely with the PULSAR metering pump. Use for any other application is considered unsafe and voids all certification markings and warranties.

2.2 Explosive Atmosphere Safety



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

Under expected operating conditions, and with the proper marking, this equipment is suitable for use in:

1. Class I, Division 2, Groups A, B, C, D Hazardous Locations;
2. Class 1, Zone 2, Groups IIC
3. Non-hazardous locations only

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, and D or non-hazardous locations only.



EXPLOSION HAZARD -- DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN REMOVED OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

EXPLOSION HAZARD – SUBSTITUTION OF ANY COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.



EXPLOSION HAZARD – DO NOT REMOVE OR REPLACE FUSES UNLESS POWER HAS BEEN DISCONNECTED OR THE AREA IS KNOWN TO BE FREE OF IGNITIBLE CONCENTRATIONS OF FLAMMABLE GASES OR VAPORS.

2.3 Electrical Safety

The DLCM can be considered an industrial stroke length controller with an integrated motor speed controller. Improper application and use can be hazardous. You are solely responsible for its use.

The DLCM'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. Certain calibration functions must be completed while the electronic section of the unit is exposed and power is applied to the unit, be certain to ensure that proper procedures are followed and that fingers, tools, and wiring do not contact exposed circuitry and components.

The DLCM emits electro-magnetic energy and generates radio frequency interference. Its use is restricted to industrial applications. The user bears all responsibility for shielding this energy/interference.

2.4 Fire Safety

US & Canada Only

In case of electrical fire, use a Class C fire extinguisher. Fire extinguishers with a Class C rating are suitable for fires in “live” electrical equipment. Never use water to extinguish a Class C fire.

Class C fires involve electrical equipment, such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive. This class is typically represented by a geometric symbol (blue circle).

Always refer to your country's occupational, health & safety regulations to ensure the correct fire extinguisher classification.

2.5 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 DLCM control.

The DLCM was designed to be service free. It contains no user-maintainable components. Removal of the entire DLCM as an assembly from the pump is permissible. Do not disassemble the DLCM enclosure unless instructed to do so in this manual. Evidence of disassembly shall void the warranty.

2.6 Hydraulic Safety

Thoroughly review and adhere to the contents of the PULSAR Installation, Operation, Maintenance and Instruction manual, for hydraulic installation of your PULSAR metering pump. As a microprocessor-controlled device, the DLCM 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.

2.7 Liability Exclusion

Pulsafeeder, Inc. is unable to monitor the observance of the instructions given in this manual, nor verify the actual working conditions and installation of the equipment, the correct operation and maintenance of the equipment and accessories. An incorrect installation, or misuse of the equipment, may cause serious damage and may pose a danger to persons or property. Any anomalies must be reported to the maintenance supervisor.



ATTEMPTS TO DISASSEMBLE, MODIFY OR TAMPER IN GENERAL BY UNAUTHORIZED PERSONNEL WILL VOID THE GUARANTEE AND WILL RELEASE PULSAFEEDER, INC. FROM ANY LIABILITY FOR DAMAGE CAUSED TO PERSONS OR PROPERTY RESULTING FROM SUCH ACTIONS.

Pulsafeeder, Inc. is considered released from any liability in the following cases:

- improper installation;
- improper use of the equipment by non-professional or inadequately trained operators
- use not in compliance with regulations in the Country of use;
- lack of maintenance or improperly performed;
- use of non-original spare parts or incorrect parts for the model in question;
- total or partial failure to observe the instructions;
- exceptional environmental events.

2.8 Pump Suitability to Site of Installation

Essential safety requirements against explosion hazard in dangerous areas are regulated by European directives 94/9/CE dated 23rd of March 1994 (concerning equipment and devices)

Upon equipment receipt, verify that pumps have not received any damage due to transportation and are complete with every eventual accessory. In case anomalies or damages are discovered prior to installation, please contact PULSAFEEDER, INC. Technical Service.

The following standards apply to this product:

- ISA 12.12.01-2013
- UL 840
- UL 508
- CSA C22.2 No. 14-13

3 Transport and Inspection

3.1 Consignment receipt and un-packaging

Immediately after receipt of the equipment it must be checked against the delivery/shipping documents for its completeness and that there has been no damage in transportation.

Check any crate, boxes or wrappings for any accessories or spare parts that may be packed separately with the equipment or attached to side walls of the box or equipment.

Each product is marked with a unique serial number. Check that this number corresponds with the documentation, and always reference this number in correspondence as well as when ordering spare parts or accessories.

Shortages or damage should be reported immediately to the carrier and your Pulsafeeder Representative.

3.2 Handling

Boxes, crates, pallets or cartons may be unloaded using fork lift vehicles or slings dependent on their size and construction.

3.3 Lifting

A crane must be used for all controller/pump sets in excess of 25 kg (55 lb). Fully trained personnel must carry out lifting, in accordance with local regulations.

Slings, ropes and other lifting gear should be positioned where they cannot slip and where a balanced lift is obtained.

3.4 Recycling and end of product life

This device is RoHS compliant, and should be disposed of in accordance with current regulations.

Make sure that hazardous substances are disposed of safely and that the correct personal protective **equipment is used. The safety specifications must be in accordance with the current regulations at all times.**

4 Storage Instructions

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

4.1 Storage Length

4.1.1 Short Term (0 - 12 months)

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



THE ADJUSTMENT KNOB SHOULD BE ROTATED IN ALTERNATE DIRECTIONS BY HAND ONE FULL REVOLUTION EVERY SIX MONTHS.

If the DLCM 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 DLCM is removed from the pump, it should be stored in the same pump mounted orientation. After removal of the DLCM from the PULSAR metering pump, seal the eccentric box opening with a dust and moisture proof material. If the DLCM 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 DLCM for periods of longer than twelve months is not recommended. If extended storage is unavoidable the DLCM 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. Inspect the unit carefully for any signs of damage and remove the desiccant before placing it into operation.



SPECIAL NOTE FOR LONG-TERM STORAGE:

IF AC INPUT POWER HAS NOT BEEN APPLIED TO THE DLCM FOR A PERIOD GREATER THAN 12 MONTHS, THE CONTROLLER MUST BE PREPARED FOR OPERATION. THE DLCM SHOULD HAVE AC POWER APPLIED AT THE INPUT FOR A PERIOD OF 8 HOURS BEFORE PLACING PUMP INTO NORMAL OPERATION. REFER TO INSTALLATION AND WIRING SECTION FOR AC POWER CONNECTION INSTRUCTIONS.

5 Installation

5.1 Location



REVIEW THE SAFETY SECTION PRIOR TO INSTALLING THE DLCM. IT CONTAINS INFORMATION REQUIRED TO PROPERLY INSTALL AND OPERATE THE DLCM IN AN INDUSTRIAL ENVIRONMENT.

The site selected for the installation of your DLCM is largely dependent on that of the PULSAR metering pump. Review the PULSAR Installation Operation Maintenance Instruction Manual 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 DLCM related issues when selecting a site.

- The DLCM 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 DLCM 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.

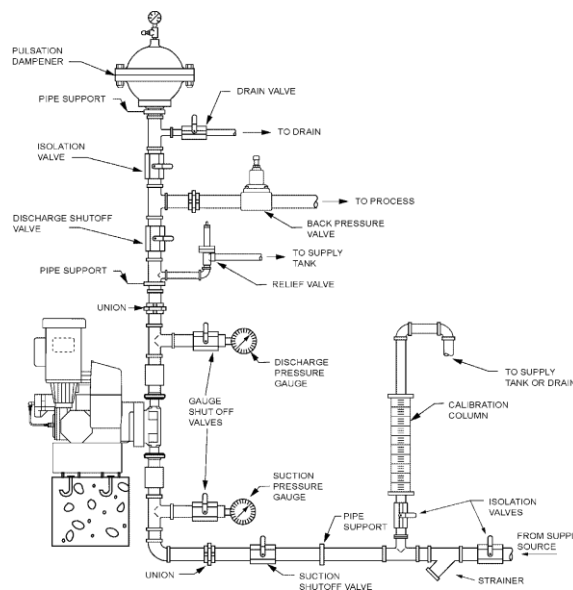


Figure 1 – Typical Installation



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

5.2 Installation Notes

1. The DLCM is a microprocessor based controller that uses electro-static sensitive CMOS components. Do not make any electrical connections (high or low voltage) without adequately grounding the DLCM and the worker to eliminate an electro-static charge between the two. A conductive wrist strap worn by the worker and attached to the DLCM enclosure is adequate to satisfy this requirement.
2. Calibration is an important element of successful DLCM 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 DLCM causing damage and void the warranty. In accordance with any applicable codes provide sealed entries and conduit drains near the point of entry as required. 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 DLCM has many advanced features that may make wiring the unit appear complicated. Wiring is actually very simple – one high-voltage connection is all that is required to take advantage of a majority of the DLCM's features. It is highly recommended that you take a step-by-step approach to wiring and confirming proper DLCM operation:

1. Make the high-voltage connection. These will allow you to operate the DLCM and attached PULSAR pump.
2. Power-up and test the DLCM to confirm the connections and check for proper operation.
3. Power-down the DLCM.
4. Decide which low-voltage Inputs (e.g., 4-20mA in) will be used and make those connections.
5. Power-up and test the DLCM to confirm the connections and check for proper operation.
6. Power-down the DLCM.
7. Decide which low-voltage outputs (e.g., 4-20mA out) will be used and make those connections.
8. Conduct a final power-up and test the DLCM to confirm the connections and check for proper operation.
9. Go to *Section 6: Startup Instructions* for details on how to perform the power-up tests.

5.3.1 Getting Started

The field wiring of the DLCM 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**).

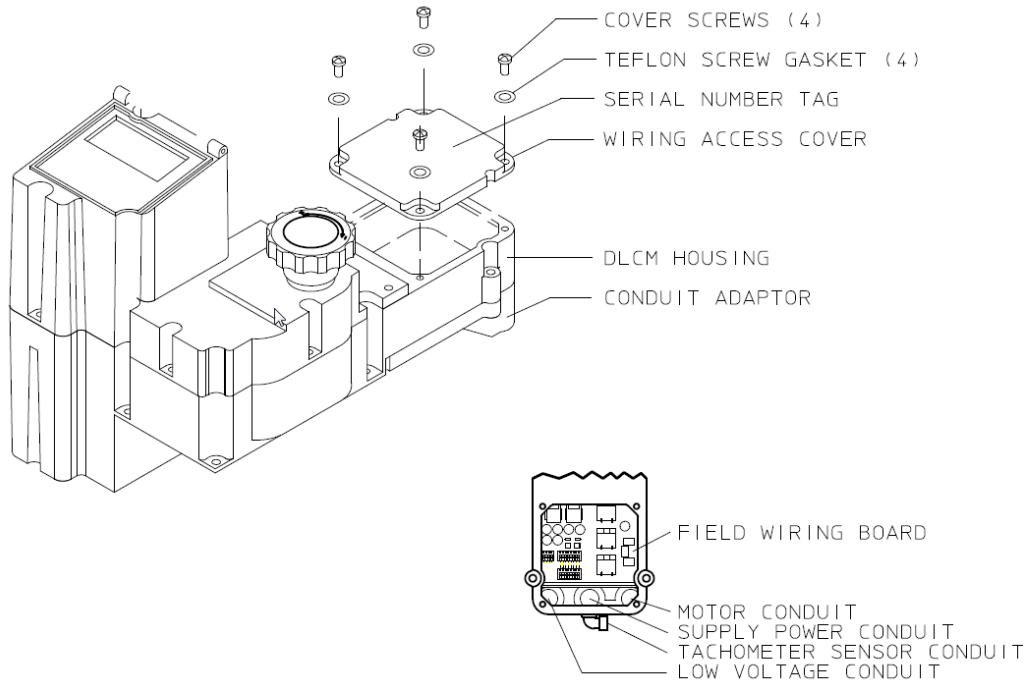


Figure 2 – Accessing the Field Wiring Board



THE FIELD WIRING ACCESS COVER HAS THE SERIAL NUMBER TAG ON IT. KEEP THE COVER WITH THE DLCM IT WAS REMOVED FROM. THE DLCM 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 forms a modular connector or plug. This allows the DLCM to be removed from the PULSAR unit without disturbing the conduit connections.



REMOVE THE CONDUIT ADAPTER AND FIELD WIRING BOARD FOR DLCM REPAIR/REPLACEMENT PURPOSES ONLY (REFER TO SECTION 12: BASIC REPAIRS) FOR FURTHER INFORMATION.

5.3.2 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-half side while the low-voltage connections are on the left. Refer to **Figure 3, Field Wiring Board** for specific connection and fuse locations.

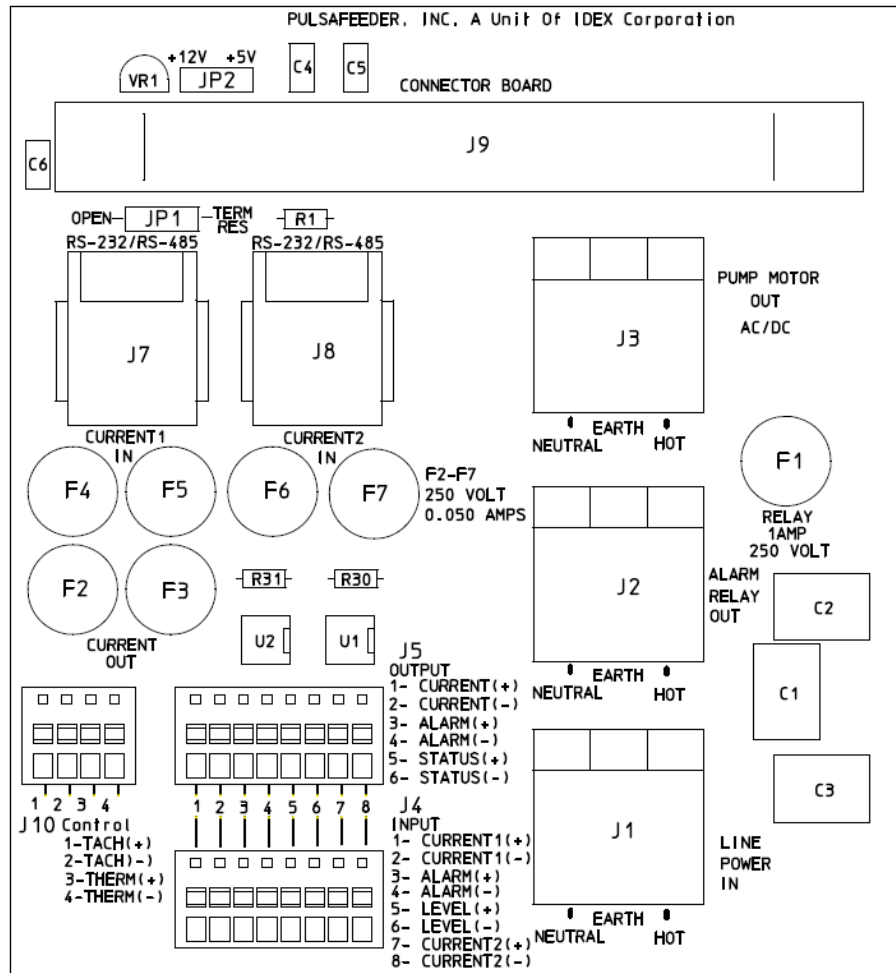


Figure 3 - Field Wiring Board

5.4 High-Voltage Connections

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

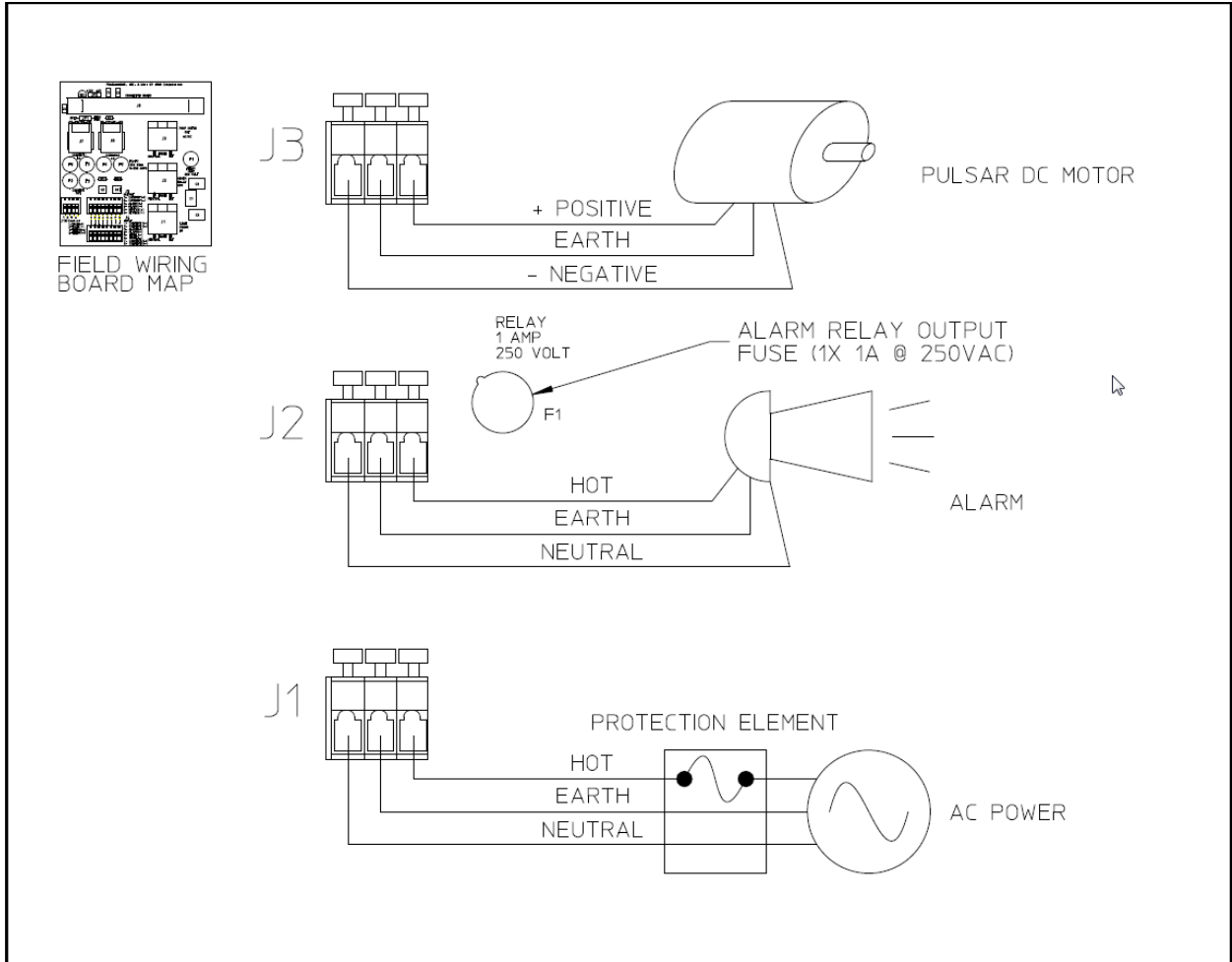


Figure 4 – High-Voltage Connections



THE POSITIVE (+) AND NEGATIVE (-) WIRES MAY NOT BE LABELED. DO NOT BE CONCERNED WITH POLARITY WHEN HOOKING UP THE MOTOR. IT DOES NOT MATTER WHAT DIRECTION THE MOTOR ROTATES.

5.4.1 Supply Power



THE DLCM REQUIRES ONE CONNECTION TO AN EXTERNAL POWER SOURCE. IT USES THIS SAME CONNECTION TO POWER ITS OWN SUPPLY, THE DC PUMP MOTOR AND THE ALARM RELAY OUTPUT. YOU MUST TAKE THESE EXTERNAL LOADS INTO CONSIDERATION WHEN SIZING THE BRANCH CIRCUIT.

The DLCM with attached PULSAR motor is not fuse protected. You are responsible for correctly sizing the protection element (i.e., fuse or circuit breaker at the distribution panel). Use the work sheet on the next page for correctly sizing the branch protection element.

The DLCM, 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, 105°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.

| 15VAC +/- 10% | | 50/60 Hz | | 230VAC +/- 10% | | 50/60 Hz | |
|---------------|---------------------------|-----------|--------------|----------------------------|------------|----------|--|
| Device | Current Requirement (Amp) | | Device | Current Requirements (Amp) | | | |
| DLCM | 1A | (1A Max.) | DLCM | .5A | (.5A Max.) | | |
| Pump Motor* | + | (8A Max.) | Pump Motor* | + | (5A 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.

Branch Circuit Protective Element Sizing Worksheet

The operating voltage and frequency of the DLCM 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 DLCM will display either an {OVER VOLTAGE} or {UNDER 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 stroke adjustment motor, potentially causing damage, until the voltage problem is corrected.



WARNING

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 32VDC) LINES IN A COMMON CONDUIT! FAILURE TO COMPLY WILL RESULT IN ELECTRICAL INTERFERENCE THAT MAY RESULT IN IMPROPER (AND POSSIBLY UNSAFE) OPERATION.

5.4.2 CE Compliance

The DLCM's DC motor, when running, can generate conducted emissions in excess of the limits specified by EN55011. To suppress these emissions a Line Filter kit (NP530314-000: Kit, Line Filter DLCM CE) must be installed in the distribution panel between the DLCM and the Protection Element as shown in Figure 4.1 Line Filter Installation.



WARNING

NOTE: THE LINE FILTER MUST BE INSTALLED BETWEEN THE PROTECTION ELEMENT AND DLCM. IT IS SIZED TO SUPPLY POWER TO ONLY ONE (1) DLCM. DO NOT FEED MULTIPLE DLCM'S THROUGH A SINGLE LINE FILTER.

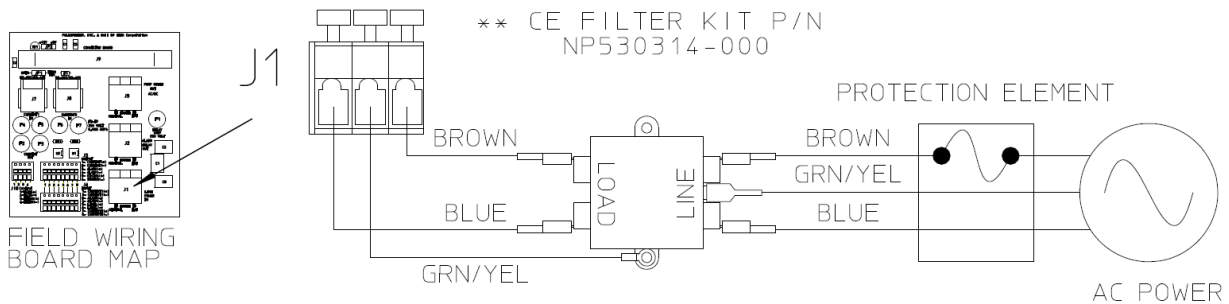


FIGURE 4.1 LINE FILTER INSTALLATION

5.4.3 PULSAR Pump Motor

In most cases the DLCM is supplied with a factory installed DC motor. If a motor was not supplied, it is important to select the proper type. Refer to the chart below for acceptable DLCM motors (refer to **Section 9: Specifications** for motor details):



MOTORS MUST BE PERMANENT MAGNET, SCR DRIVE RATED DC MOTORS. THE DLCM CANNOT CONTROL MOTORS WITH SEPARATE FIELD WINDINGS.

| Part Number | Developed HP | Armature Voltage | Full Load Current | Enclosure Type |
|-------------|--------------|------------------|-------------------|----------------|
|-------------|--------------|------------------|-------------------|----------------|

For 115 V line power

| | | | | |
|--------------|--------|------|----------|------|
| NP500059-000 | 1/4 HP | 90 V | 2.5 amps | TENV |
| NP500050-000 | 1/3 HP | 90 V | 3.2 amps | TENV |

For 230 V line power

| | | | | |
|--------------|--------|-------|----------|------|
| NP500051-000 | 1/3 HP | 180 V | 1.6 amps | TENV |
| NP500053-000 | 1.0 HP | 180 V | 5.0 amps | TENV |

Connect the permanent magnet DC pump motor to the J3 terminal block labeled 'PUMP MOTOR OUT AC/DC'. Use 14 AWG, 105°C insulation wire size or larger. If the DLCM supply voltage is 115VAC, you must use a 90Volt Armature motor. If the DLCM supply voltage is 230VAC, you must use a 180Volt Armature motor.



THE DLCM USES SOLID-STATE RELAYS FOR ITS 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.).



DOUBLE CHECK ALL CONNECTIONS TO CONFIRM GOOD ELECTRICAL CONTACT BETWEEN THE TERMINAL BLOCK CLAMPS 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 THE DIVIDERS BETWEEN TERMINALS.

At high motor turndown settings the DC motor can overheat under certain conditions. Non-standard motors must include built-in thermal protection and a dry contact thermal switch for connection to the DLCM's Motor Thermostat input. **5.8: Installation, Motor Thermostat** for additional information.

5.4.4 Alarm Relay

The Alarm Relay is an output that is configured by the operator. 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 14 AWG 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 four pairs of inputs: Current 1, Alarm, Level and Current 2.

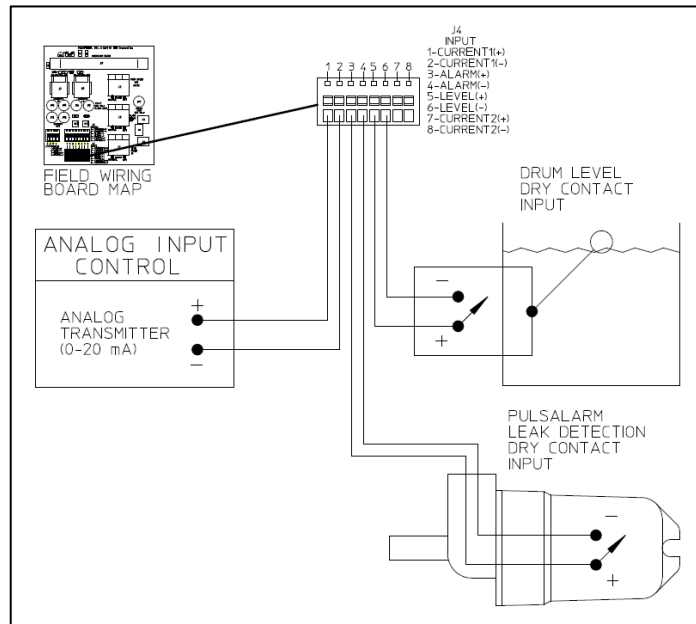


Figure 5 – Low-voltage Input



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, AND SERIAL COMMUNICATIONS 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 32VDC) LINES IN A COMMON CONDUIT! FAILURE TO COMPLY WILL CAUSE ELECTRICAL INTERFERENCE THAT MAY RESULT IN IMPROPER (AND POSSIBLY UNSAFE) OPERATION.

5.5.1 Analog Inputs

The DLCM can accept either one or two analog input signals. These signals ultimately control the pump's flow. Analog Input #1 is used to control both the pump stroke length and speed (refer to the note below) or the pump length stroke only. When Analog Input #2 is used, it controls motor speed only.



THE DLCM CAN OPERATE USING ONLY ANALOG INPUT #1 TO CONTROL BOTH STROKE LENGTH AND MOTOR SPEED. IF THIS IS THE DESIRED MODE OF OPERATION, THE INSTALLED SOFTWARE WILL DETERMINE WHAT STROKE AND SPEED ARE REQUIRED TO PRODUCE THE DESIRED FLOW RATE (REFER TO SECTION 7: GENERAL OPERATION, END-POINT SETUP FOR FURTHER INFORMATION).

The Analog input accepts current inputs 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 channels are electrically isolated, surge protected and fused for protection. The inputs are designed to avoid damage in the event high-voltage is inadvertently applied.

To make the Stroke Length Control connection, use 0.32mm² – 0.52mm² (22-20 AWG) wire 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.

To make the Motor Speed Control connection, use 0.32mm² – 0.52mm² (22-20 AWG) wire for hookup. Attach the analog signal generated by an external device (e.g.: PLC) to the connection points labeled '7-CURRENT2(+)' and '8-CURRENT2(-)' on the J4 terminal block labeled 'INPUT' (refer to **Figure 5**). Attach the Positive lead to position 7 and the Negative lead to position 8.

Position indicators are printed on the circuit board above the terminal. The DLCM will provide approximately 200 ohms of resistance to a current loop. Each Analog Input is isolated from all other inputs, outputs and earth ground. Follow the instructions in **Section 7: General Operation** for Analog Input signal calibration and setup.

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 0.32mm² – 0.52mm² (22-20 AWG) wire. 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 setup.

5.5.3 Level Input (Remote Start/Stop)

The Level Dry Contact Input is designed to monitor a single-point Level Input sensor and generate an alarm, activate the alarm relay and/or shut down the PULSAR motor. It can also be used with a Remote Start/Stop station (Dry Contact switch) to start and stop the pump's motor. The input is internally powered, only a mechanical switch closure is required for activation. Use 0.32mm² – 0.52mm² (22-20 AWG) wire. 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 Level / Start-Stop setup.

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 Status/Stroke.



THE TRANSISTOR BASED DRY CONTACT OUTPUTS ARE OPTICALLY ISOLATED. TO ACHIEVE TOTAL ISOLATION, THEY ARE NOT SELF-POWERED. THE EXTERNAL DEVICE MUST SUPPLY AND DETECT A RETURN VOLTAGE LEVEL (32VDC MAX).



THE WIRE USED TO CONNECT LOW-VOLTAGE INPUTS, OUTPUTS AND SERIAL COMMUNICATIONS 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 32VDC) LINES IN A COMMON CONDUIT! FAILURE TO COMPLY WILL RESULT IN ELECTRICAL INTERFERENCE THAT MAY RESULT IN IMPROPER (AND POSSIBLY UNSAFE) OPERATION.

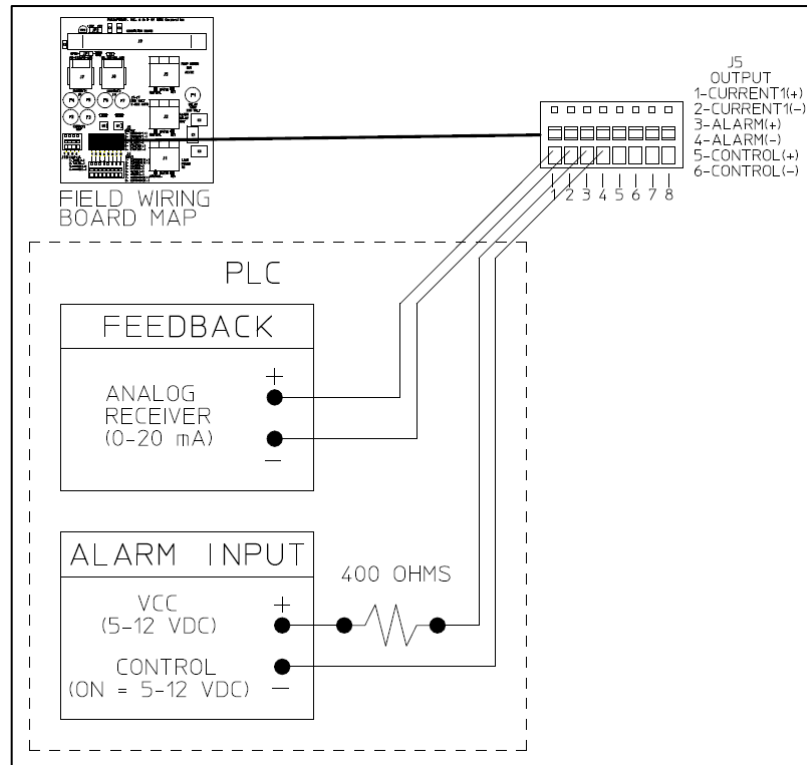


Figure 6 – Low-voltage Output

5.6.1 Current Output

The Current Output Channel can follow one of three signals:

1. Calibrated flow
2. Calibrated stroke length
3. True motor speed

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

Current Output is used to control slave devices (e.g., DLCM's, ELMA's, PULSAMATIC's, etc.) or to fulfill closed loop system requirements. Attach the connection points labeled '1-CURRENT (+)' and '2- CURRENT (-)' on connector J5-OUTPUT (refer to Figure 6) to the external device. Use $0.32\text{mm}^2 - 0.52\text{mm}^2$ (22-20 AWG) wire. 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 DLCM Analog Output could be used to drive two slave DLCM's. They, in turn, could each drive two additional slaves. The Analog Output is isolated from all other inputs, outputs and earth ground. Follow the instructions in **Section 7: General Operation, Analog Output Signal Calibration**.

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. If the Alarm Relay is on, the Alarm Dry Contact will be closed. If the Alarm Relay is off, the Alarm Dry Contact will be open. 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 RELAY IS ON. 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 output. As such, the external control equipment must generate the supply on the positive output and detect the return of that signal from the DLCM. In a typical application, use $0.32\text{mm}^2 - 0.52\text{mm}^2$ (22-20 AWG) 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 separately configured in 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 is **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 DLCM. In a typical application, use $0.32\text{mm}^2 - 0.52\text{mm}^2$ (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).



TIP

THERE IS ALSO AN INTERNAL STROKE COUNTER THAT IS RE-SETTABLE. REFER TO SECTION 7.2: MENU – DIAGNOSTICS, DIAG. MENU 11/11.

5.7 Tachometer Input

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

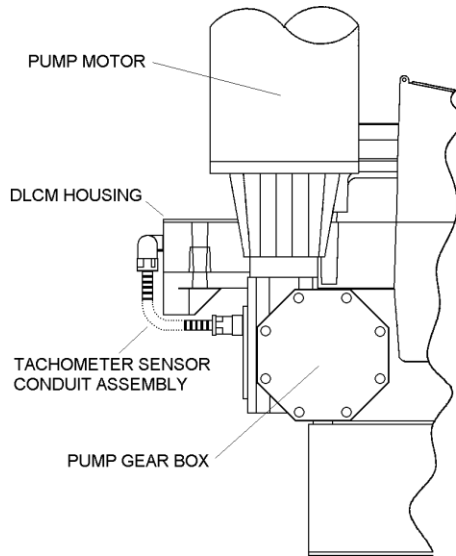


Figure 7 – Tachometer Sensor Conduit Assembly

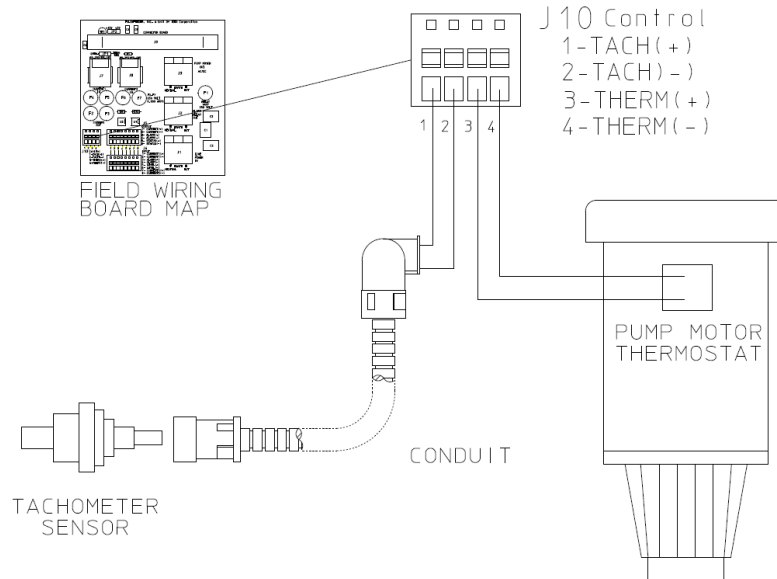


Figure 8 – Tachometer and Pump Motor Thermostat Connections

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, DLCM Replacement**.



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).

5.8 Motor Thermostat

The motor thermostat has been supplied as an equipment safety measure. This allows the DLCM 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 manufacturer's specification, the DLCM can be configured to:

- 1) Turn the motor off.
- 2) Sound an alarm.
- 3) Restart the motor when the temperature lowers to a safe level.



IT IS PERMISSIBLE TO RUN THE PUMP MOTOR THERMOSTAT IN THE SAME CONDUIT AS THE PUMP MOTOR POWER. THE SIGNAL IS CONDITIONED TO PREVENT ERRONEOUS OPERATION DUE TO CROSS-TALK.



FOR MORE INFORMATION ABOUT THE MOTOR THERMOSTAT SETTINGS, REFER TO SECTION 7: GENERAL OPERATION, MOTOR THERMOSTAT SETUP.

To connect the Motor Thermostat to the DLCM, 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 Serial Communications Input

The Serial Communications input is used to communicate digitally with the DLCM. It allows remote control and, if so configured, can be used to replace the analog input and output to allow one or more DLCM's to be slaved to a single DLC, DLCM, PLC, or PC master.

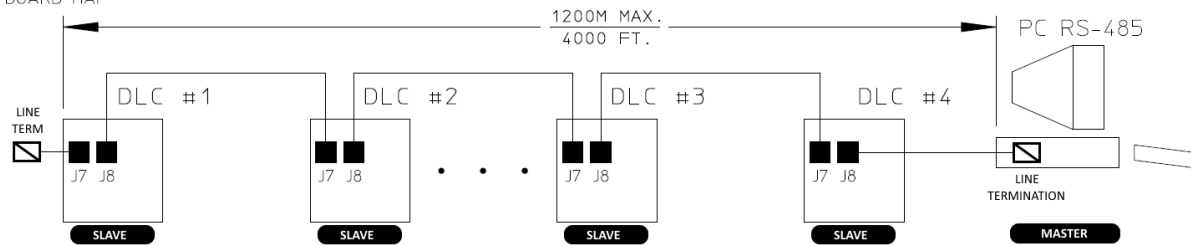
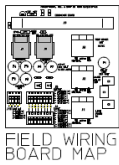


Figure 9 – Typical Serial Communications Connections

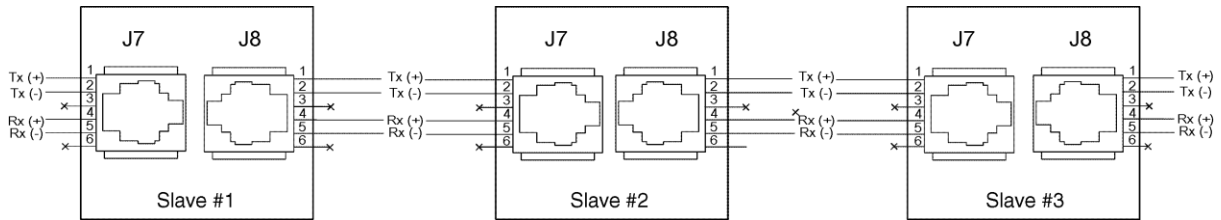
Use Belden™ Type 1590A data twist cable or equivalent. RJ-11 connectors (not supplied) are used to plug into jacks J7 & J8 (refer to **Figure 9**).

The DLCM uses a 4-wire RS-485 network. This uses two wires for transmit and two wires for receive. The RS-485 specification limits the total network length to 1200M (4000 ft). Multiple device networks may also require termination at both the first and last device. See Section 8: Diagrams: Installation for further details.

5.9.1 Important Wiring Detail

5.9.1.1 Slave to Slave

When connecting two **Slaves**, the wiring is straight through. For example: Connect the transmit lines to the transmit lines and the receive lines to the receive lines (refer to the drawing below).



5.9.1.2 Master to Slave

When wiring between a **Master** and a **Slave**, the Transmit and Receive lines must be crossed. For example: Connect the transmit lines to the receive lines (refer to the drawing below).

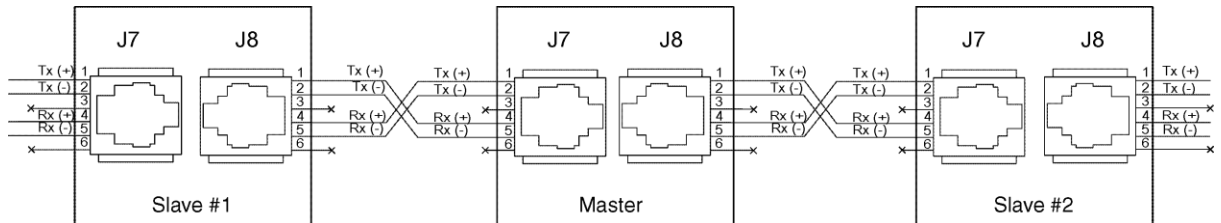


Figure 10 – Wiring Detail

5.10 Fuse Replacement

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

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

REPLACEMENT FUSE INFORMATION

Figure 11 details the location of these fuses on the Field Wiring Board.

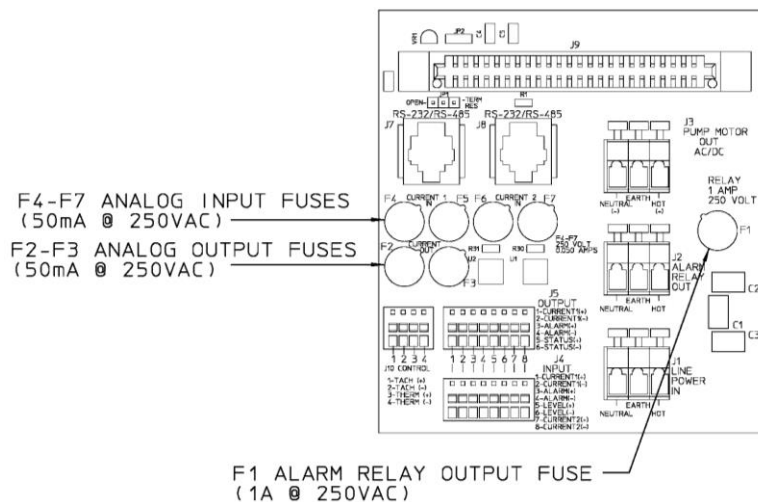


Figure 11 – Fuse Location.

The Internal DLCM power supply is fused at 2 Amps. This fuse is not user serviceable. The DLCM Stroke Length Adjustment Synchronous Motor is inherently protected. It can operate continuously in a locked rotor state. The DLCM also monitors this motor's duty cycle to maintain a 50% balance between ON and OFF times. The serial ports and the Remote Run Status Output are protected by self-resetting current limit devices. These components are not user serviceable.

6 Startup Instructions

6.1 Overview

Once all electrical connections have been made, your DLCM is ready for Startup. The following nine sections detail the procedures required to complete a DLCM startup.



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

6.1.1 User Interface Familiarization

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

1. Display
2. Keypad
3. Manual Adjustment Knob
4. Pump Motor

Refer to **Figure 12** to familiarize yourself with the location of these items before proceeding.

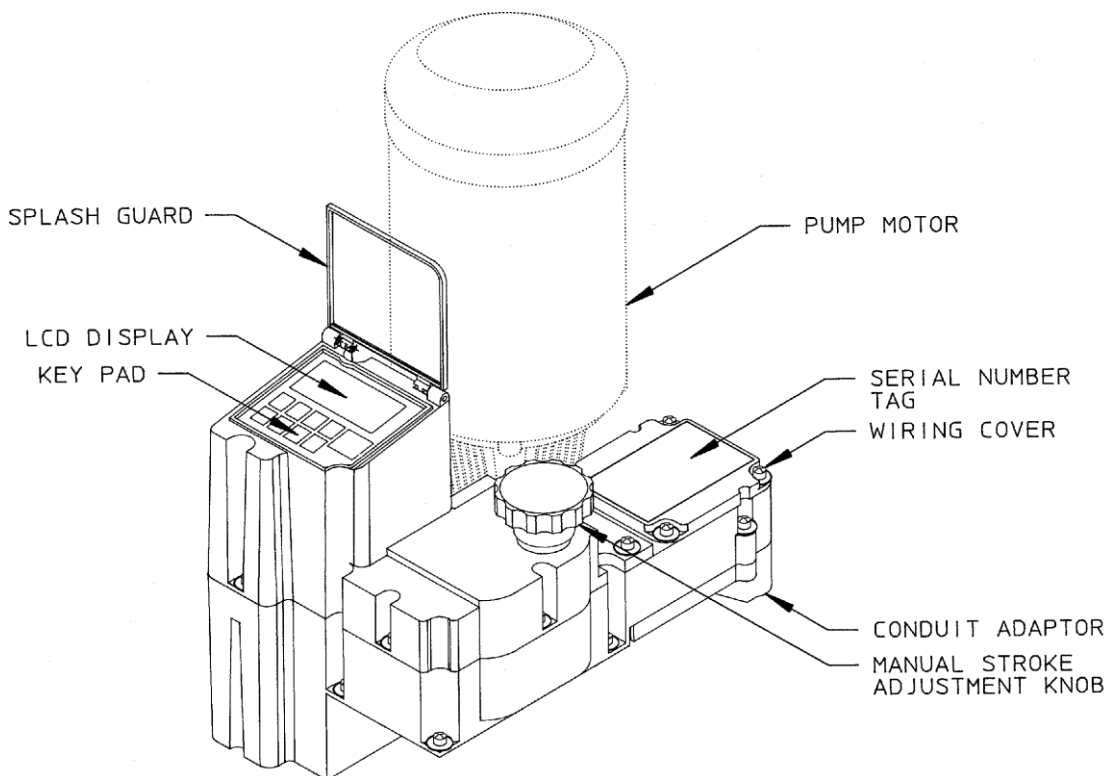


Figure 12 – Key DLCM startup elements.

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 13** to familiarize yourself with the function of each key before starting.

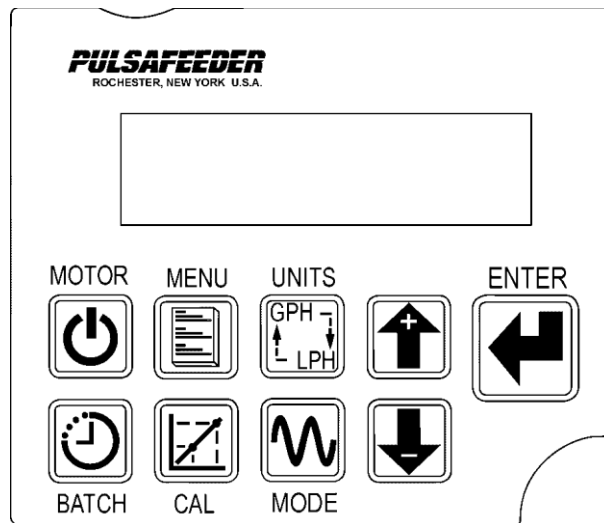


Figure 13 – Key Pad

- 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 mode (e.g., MANUAL MODE).
- UNITS** Press this key to cycle to the next flow unit type whenever a flow unit is displayed at the operating mode (e.g., MANUAL MODE).
- ARROWS** These keys are used to change values currently displayed on screen. Use [DOWN] to decrease the value and [UP] to increase it. Pressing both [UP] and [DOWN] 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. Press [BATCH] a second time to exit the Batch Setup function.
- CAL** Press [CAL] to activate the Calibration menu for Flow and Analog Signals. Press [CAL] a second time to exit the Calibration function.
- MODE** The [MODE] key is used to change the operating mode of the DLCM. For example, press once to change from MANUAL to ANALOG. Press a second time to change from ANALOG to MODBUS. Press a third time to change from MODBUS back to MANUAL.

6.1.1.3 Manual Adjustment Knob

The manual adjustment knob is mechanically attached to the PULSAR stroke length adjustment mechanism. The DLCM uses the shaft attached to this knob to make its automatic adjustments. Visually, the knob is a good indication of what the DLCM is doing. For example, if the DLCM is

increasing the pump stroke length – moving from 0 to 100% -- the knob will turn counter-clockwise until the desired position is achieved.

If you try to force the adjustment, the DLCM will automatically react to adjust the position to the programmed setting. If you manually adjust the knob while performing a pump calibration, the calibration session will be terminated.

While in the Analog Signal or MODBUS Mode – any attempts you make to change the stroke setting using the Manual Control Knob to a value other than that specified by the remote signal will cause the DLCM to make a correction.



THE MANUAL ADJUSTMENT KNOB SHOULD NOT BE ADJUSTED WHILE POWER IS REMOVED FROM THE DLCM. IF THE KNOB IS MOVED WHILE THE DLCM POWER IS OUT, UPON RE-STARTING THE DLCM WILL DETECT THE MOVEMENT AND PERFORM A ZERO CALIBRATION.



WHEN THE DLCM IS PERFORMING A ZERO CALIBRATION (THE DISPLAY WILL READ {CALIBRATING ZERO}), DO NOT TO TOUCH THE MANUAL ADJUSTMENT KNOB. DURING A ZERO CALIBRATION THE DLCM IS SEARCHING FOR A HARD MECHANICAL STOP. ANY MANUAL INTERVENTION COULD CAUSE THE DLCM 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 DLCM APPEARS TO 'OVER-SHOOT' ITS DESTINATION AND REVERSE DIRECTION FOR APPROXIMATELY 1/16 OF A REVOLUTION. THIS BEHAVIOR IS NORMAL. THE DLCM 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 with associated washers.



USE A SCREWDRIVER TO TIGHTEN THE RETAINING SCREWS EVENLY (14 in-lb / 1.6 N-M). FAILURE TO DO SO MAY CAUSE THE COVER TO LEAK AND VOID THE WARRANTY. THE SUPPLIED TEFLON WASHERS ARE REQUIRED TO PROPERLY SEAL THIS COVER. FAILURE TO REPLACE THESE COMPONENTS WILL VOID THE WARRANTY.

6.1.3 Confirm Correct Incoming Power

Check that the wiring access cover is on and tightened down. Whenever power is supplied to the DLCM, the display's back-lighting will 'glow' with a yellow-green light. The presence of this back-lighting is an excellent indication that the DLCM'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 the next section.



WITHOUT PRIOR OPERATING KNOWLEDGE, IT IS IMPOSSIBLE TO TELL IF THE PULSAR MOTOR WILL RUN WHEN POWER IS APPLIED TO THE DLCM. 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.



THE DLCM 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 DLCM's incoming power is connected correctly, the back-lighting on the DLCM's display will illuminate (depending on lighting conditions, it may be necessary to shade the display to confirm illumination). If the display is not illuminated, first check

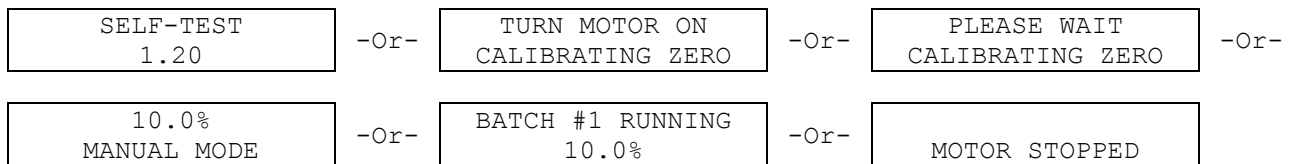
the line voltage with a volt meter. If the voltage is not correct, return to **Section 5: Installation: High-Voltage Connections**. Otherwise, proceed with the next step.

6.1.4 Confirm Display and Keypad Functionality



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 DLCM is receiving power, it is necessary to confirm that the display and keypad are functioning properly. On normal power-up, the {SELF-TEST} display appears for approximately 5 seconds. After that time, the display will change the message to one of the following:



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 is 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 above, proceed directly to the next section to perform a Factory Re-initialization on your DLCM.

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 DLCM performs (e.g., zero calibration) where the keypad has no effect. 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, Troubleshooting**.

6.1.5 Performing a Factory Re-initialization



WHEN RE-INITIALIZING YOUR DLCM, ALL OF THE SYSTEM SETTINGS WILL BE OVERWRITTEN BY THE ORIGINAL FACTORY DEFAULT SETTINGS. THE CONTROLLER MUST BE RE-CONFIGURED TO YOUR SPECIFICATIONS (E.G., RE-CALIBRATED).

If your DLCM appears to be functioning properly – the display is similar to one of those shown on the previous page – skip to **Section 6.1.6**.



A FACTORY RE-INITIALIZATION RESTORES ALL FACTORY DEFAULTS TO THE DLCM'S MEMORY, AND TYPICALLY IS NOT REQUIRED.

A Factory Re-initialization should be performed only if there is reason to believe that the internal DLCM memory has become corrupted. A number of factors could cause this including: long-term storage, disregard 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 DLCM, use one of the following procedures:



STARTUP FACTORY RE-INITIALIZATION

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

1. Cycle power to the unit (turn it OFF then ON).
2. Within the first 5 seconds of power on, depress and hold the [UNITS], [MODE], and [ENTER] keys simultaneously for approximately 1 second.
3. The display will continue to display the version number while the DLCM'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 Functionality**.



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. Factory Re-initialization can be found in the Configure Menu. Perform the following steps:

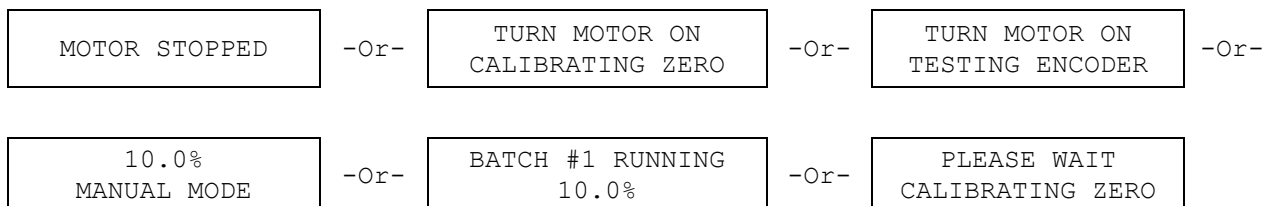
1. Apply power to the unit. Wait for the {SELF-TEST} display to disappear. The unit should display a standard power on screen.
2. Press [MENU]. The display will show the first menu item {DIAGNOSTICS}.
3. Press [DOWN]. The {FACTORY DEFAULTS} menu item should be displayed. If not, continue pressing [DOWN] 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 DLCM's memory is restored. The display should then display {TURN MOTOR ON / TESTING ENCODER}. Return to **Section 6.1.4: Confirm Display and Keypad Functionality**.

6.1.6 Test Pump Motor



THE LEVEL INPUT, 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} or {TURN MOTOR ON / TESTING ENCODER} as shown below.



If the display appears as shown above, 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: Troubleshooting**.



THE MOTOR SPEED MAY BE LOW ENOUGH THAT IT IS HARD TO TELL THAT IT IS RUNNING. CHECK FOR FLUID DISCHARGE.

6.1.7 Set Time and Date

The clock on your DLCM has been activated at the factory, but you should 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:



SET TIME AND DATE PROCEDURE

1. From the Current Operating Mode Display, press [MENU]. The {-MENU- / DIAGNOSTICS-0} screen is displayed (refer to illustrations below).
2. Press [UP] one time. 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 minute value displayed to the local time. Press [ENTER] twice (to accept the default MM/DD/YY format 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 (accepting the default Daylight Savings NO setting).

The time and date information has now been set.

| | | | | | |
|-------------------------|---------------|---------------------------|------------------|----------------|---------------------|
| MENU DIAGNOSTICS - 0 | Press [UP] | MENU SET TIME AND DATE | Press [ENTER] | 24 HR 21:07 | MM/DD/YY 1/22/01 |
|-------------------------|---------------|---------------------------|------------------|----------------|---------------------|

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



1-POINT CALIBRATION PROCEDURE

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 is displayed.
4. Press [ENTER]. The {LAST FLOW CAL / 11:32 1/22/01} screen is displayed.
5. Press [ENTER]. The {FLOW CALIBRATION / 1-POINT} screen is displayed.
6. Press [ENTER]. The {CALIBRATE ZERO? / YES} screen is displayed.



IF YOU ARE CONFIDENT WITH THE QUALITY OF YOUR ZERO CALIBRATION, PRESS [UP] AND THE {CALIBRATE ZERO? / NO} SCREEN IS DISPLAYED. PRESS [ENTER] AND CONTINUE WITH STEP 10.

7. Press [ENTER]. The {TURN MOTOR ON / TESTING ENCODER} screen is displayed, or if the pump motor was ON when you started the calibration process, the {PLEASE WAIT / TESTING ENCODER} screen is displayed.
8. Turn the pump motor on if necessary and the encoder performs its self-test. When the self-test is completed, the {PLEASE WAIT / CALIBRATING ZERO} screen is displayed. The DLCM will adjust the stroke to the 0% position and the motor speed to 100%.
9. When the zero calibration is complete the {PLEASE WAIT / MOTOR CAL.} screen is displayed.

| |
|---------------------------|
| PLEASE WAIT MOTOR CAL. |
|---------------------------|

With the stroke set at 0% the motor will run at 100% for a few seconds, and then decrease speed to 5%.



IT WILL TAKE ANYWHERE FROM APPROXIMATELY 10 SECONDS TO 5 MINUTES TO COMPLETE THE SPEED CHANGE. IF YOUR PUMP CONTINUES TO RUN AFTER 5 MINUTES THERE IS AN ERROR AND YOU SHOULD CONTACT TECHNICAL SERVICES.

10. The {PLEASE WAIT / XX% 100%} screen is displayed. The DLCM will adjust the stroke to the 100% position. The PULSAR motor will shut off.

| |
|-------------------------|
| PLEASE WAIT XX% 100% |
|-------------------------|

11. The {ENTER TO START/ 100% 2.641718 G} screen is displayed. The value '2.641718' represents the amount of fluid discharged over 60 seconds the last time a calibration was performed at the 100% stroke setting. Record the fluid base reading from your calibration column.
12. Press [ENTER]. The PULSAR motor will start to run. A timer is displayed counting down from 60 seconds. After 60 seconds the motor will stop automatically.

| |
|-----------------------------|
| TIMER: XX SEC 2.641718 G |
|-----------------------------|

13. The {ENTER VALUE 100% / 2.641718 G} screen is displayed. Calculate 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.
14. Pressing [ENTER] on the last position will cause the {CONFIRM CHANGE? / YES} screen to be displayed. Press [ENTER] to accept. Your 1-point calibration is now complete.

Refer to **Section 7: General Operation, Calibration, Pump Flow** for more detailed instructions on how to perform DLCM calibration.

6.1.9 Analog Input Calibration

If you are not using the 0-20mA input to the DLCM for control, skip this section. To calibrate the Input Current you must first correctly wire an external signal source. Refer to **Section 5: Installation, Low-voltage Input Connections, Analog 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.

6.1.9.1 One-Signal Analog Input Calibration



THE FOLLOWING IS A MINIMAL PROCEDURE FOR CALIBRATING THE ANALOG INPUT IF THE 1 – SIGNAL OPTION IS TO BE USED.

1. Press [CAL]. The {CALIBRATE / PUMP FLOW} screen is displayed.
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% = XXmA} screen is displayed. Adjust your PLC to output a minimum signal (i.e., 4.0mA). The DLCM display will update as the incoming signal changes.
5. When the displayed value stabilizes, press [ENTER] to accept it. The {INPUT ANALOG MAX / 100% = XXmA} screen is displayed. Adjust your PLC to output a maximum signal (i.e., 20.0mA). Again, the DLCM 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, Analog Input Signal Calibration** for more detailed instructions on how to perform Analog Input calibration.

6.1.9.2 Two-Signal Analog Input Calibration

To calibrate a 2 Signal Analog Input, the DLCM factory default must first have been changed from {STROKE & SPEED / 1-SIGNAL} to {STROKE & SPEED / 2-SIGNALS}. Refer to **Section 7: General Operation: {- MENU - / Analog Mode}** for information on configuring the Analog Mode.



THE FOLLOWING IS A MINIMAL PROCEDURE FOR CALIBRATING THE ANALOG INPUT IF THE 2 – SIGNALS OPTION IS TO BE USED.

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

12. Press [ENTER]. The {CALIBRATE / STROKE POSITION} screen is displayed.
13. Press [UP]. The {CALIBRATE / MOTOR SPEED} screen is displayed.
14. Press [ENTER]. The {0% = 4.0mA / 100% = 20.0mA} screen is displayed. These values represent the previous calibration.
15. Press [ENTER]. The {INPUT ANALOG MIN / 0% = XXmA} screen is displayed. Adjust your PLC to output a minimum signal (i.e., 4.0mA). The DLCM display will update as the incoming signal changes.
16. When the displayed value stabilizes, press [ENTER] to accept it. The {INPUT ANALOG MAX / 100% = XXmA} screen is displayed. Adjust your PLC to output a maximum signal (i.e., 20.0mA). Again, the DLCM display will update with the changing signal.
17. When the displayed value stabilizes, press [ENTER] to accept it. The {INPUT RATIO / 100% = XX.XmA} screen is displayed.
18. Press [ENTER] to accept the 100% Ratio setting. The {CONFIRM CHANGE? / YES} screen is displayed.
19. Press [ENTER]. The 2 – Signals Analog Input Calibration is complete. The DLCM is returned to its original operating mode.
20. Refer to **Section 7: General Operation, Analog Input Signal Calibration**, for more detailed instructions on how to perform Analog Input calibration.

Wrapping Up

Your PULSAR DLCM is now commissioned for use. Refer to **Section 7: General Operation** for specific instructions on how to access your DLCM's advanced features. Please don't be intimidated by your DLCM, take time to explore and experiment with its features. Remember, you cannot configure the software in a way that would damage the DLCM. 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 DLCM, you can always return to the Factory Defaults by repeating **Section 6.1.5**.

7 General Operation

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

7.1 General Operation Instructions

7.1.1 Pump Flow Calibration

Pulsafeeder recommends performing at minimum a Two-Point flow calibration on every PULSAR DLCM 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 DLCM DOES NOT AUTOMATICALLY COMPENSATE FOR CHANGING SYSTEM CONDITIONS (E.G., DISCHARGE PRESSURE, FLUID VISCOSITY, ETC.). YOU SHOULD RE-CALIBRATE WHENEVER THE APPLICATION CONDITIONS CHANGE.



NOTE

ALL FLOW CALIBRATIONS ARE PERFORMED AT 100% MOTOR SPEED. THE CALIBRATION PROCESS AFFECTS THE STROKE ADJUSTMENT MECHANISM ONLY. THE DLCM SELF-CALIBRATES ITS MOTOR SPEED.



MULTI-POINT CALIBRATION PROCEDURE

1. Press [CAL] to enter the Calibration Menu. Press [ENTER] to go to the calibrate pump flow sub- menu:

| | |
|------------------------|------------------|
| CALIBRATE PUMP FLOW | Press [ENTER] |
|------------------------|------------------|

2. The DLCM displays the last time the pump was calibrated. Press [ENTER] to continue with pump flow calibration.

| | |
|-------------------------------|------------------|
| LAST FLOW CAL 3:25 1/22/01 | 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: 100, 75, 50, 25, and 10.



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 standards. 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. For a standard multi-point calibration, set the number of calibration points to use and press [ENTER] to continue.



NOTE

YOU CAN "SKIP" A CALIBRATION POINT BY ENTERING A FLOW VALUE OF 0.0000. "SKIPPING" A POINT MEANS THAT IT WILL BE OMITTED FROM THE MATHEMATICAL REGRESSION TO ESTABLISH THE FLOW CURVE. VALUES WHICH ARE LESS THAN 10% OF THE PUMPS' RATED OUTPUT FLOW SHOULD BE SKIPPED.

4. Press [ENTER]. The {CALIBRATE ZERO? / YES} screen is displayed.

| | |
|------------------------|------------------|
| CALIBRATE ZERO? YES | Press [ENTER] |
|------------------------|------------------|



NOTE

IF YOU ARE CONFIDENT WITH THE QUALITY OF YOUR ZERO CALIBRATION, PRESS [UP] AND THE {CALIBRATE ZERO? / NO} SCREEN IS DISPLAYED. PRESS [ENTER] AND CONTINUE WITH STEP 8.

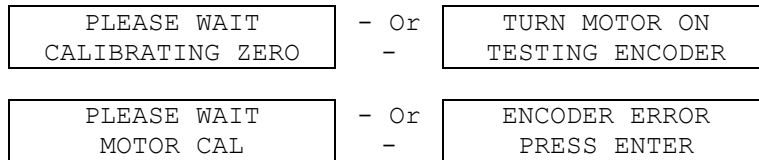
5. Press [ENTER]. The {TURN MOTOR ON / TESTING ENCODER} screen is displayed, or if the pump motor was ON when you started the calibration process, the {PLEASE WAIT / TESTING ENCODER} screen is displayed.

| | | |
|----------------------------------|--------|--------------------------------|
| TURN MOTOR ON TESTING ENCODER | - Or - | PLEASE WAIT TESTING ENCODER |
|----------------------------------|--------|--------------------------------|

6. Turn the pump motor on if necessary and the encoder performs its self-test. When the self-test is completed, the {PLEASE WAIT / CALIBRATING ZERO} screen is displayed.

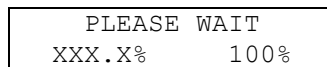
| |
|---------------------------------|
| PLEASE WAIT CALIBRATING ZERO |
|---------------------------------|

- The DLCM will now perform a ZERO CALIBRATION. First, it will turn on its motor and adjust its speed to 100%. Then it will test the encoder's position by increasing the stroke adjustment mechanism 2%. Then the DLCM 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 four messages:



If the {TURN MOTOR ON...} screen is displayed, start the PULSAR motor by pressing [MOTOR]. The DLCM will adjust to the 100% position. If you get the {ENCODER ERROR...} screen, refer to **Section 11: Troubleshooting Guide**.

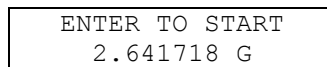
- The following screen is displayed.



If you get the {PRESS ENTER / TO START MOTOR} screen, start the PULSAR motor by pressing [ENTER] or [MOTOR].

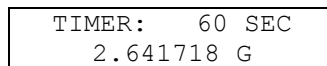
The XXX.X% represents the current stroke length adjustment setting and 100% is the stroke length destination.

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



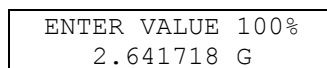
THE DISPLAY IS SHOWING THE AMOUNT OF FLUID DISCHARGED FROM THE PUMP THE LAST TIME THIS OPERATION WAS PERFORMED (E.G., 2.641718 GALLONS). THIS FLOW RATE IS BASED ON 60 SECONDS OF PUMP OPERATION. FILL THE CALIBRATION COLUMN IN THE SYSTEM TO THE PROPER LEVEL TO AVOID RUNNING THE PUMP DRY DURING CALIBRATION.

- When you are ready, press [ENTER], which will start the pump motor for a period of 60 seconds. The screen will show a 60 second timer and display its count down toward 0 seconds. During this time, the pump is operating at the designated stroke length setting and 100% motor speed.



IF YOU ALREADY KNOW THE DISPLACED VOLUME, YOU CAN BYPASS THE 60 SECOND TIMER BY PRESSING [UP] AND [DOWN] SIMULTANEOUSLY.

- 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 flow rate.



Read the new measured flow from the calibration column. Enter the new value one position at a time using [UP] or [DOWN]. Press [ENTER] to accept each digit 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 MAKE A MISTAKE ENTERING THE MEASURED FLOW RATE AND REALIZE IT BEFORE PRESSING [ENTER] ON THE LAST POSITION, PRESS [UP] AND [DOWN] SIMULTANEOUSLY AND THE CURSOR IS RETURNED TO THE FIRST DIGIT.



IF YOU WOULD LIKE TO "SKIP" A CALIBRATION POINT, ENTER A VALUE OF 0. ANY MEASURED VOLUME WHICH TRANSLATES TO LESS THAN 10% OF THE MAXIMUM RATED FLOW OF THE PUMP SHOULD BE DISREGARDED FROM THE CALIBRATION ROUTINE. TO DO THIS, ENTER A VALUE OF 0.0000.

- If a 2 through 5 point calibration was selected, the DLCM will automatically proceed to the next stroke length setting and repeat steps 8, 9, 10, and 11 as described above. After the DLCM 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
```

- Press [ENTER] to accept the calibration. The DLCM will display a {PLEASE WAIT} message while it performs the Least Squares curve fit to the data points and calculates the new flow curve. Any point entered with a value of 0.0000 will be ignored by the curve fitting routine. If you do not want to accept the new calibration, press [UP] to scroll to {NO} and press [ENTER]. The display is then returned to its original operating mode.



CHANGE CONSTANTS PROCEDURE

- Navigate to the Change Constants menu by pressing [CAL]. The {CALIBRATE / PUMP FLOW} menu is displayed. Press [ENTER] twice. The {FLOW CALIBRATION / 1 POINT} menu is displayed.
- Press [UP] until {FLOW CALIBRATION / CHANGE CONSTANTS} is displayed.

```
FLOW CALIBRATION
CHANGE CONSTANTS
```

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 flow (GPM). The output (i.e., y) represents stroke position in percent (%). 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:

```
SLOPE      %/GPM
0.3785415569416
```

You edit the calculated slope value in the displayed units (%/GPM in the example above) value one position at a time. Press [UP] or [DOWN] to set the digit. Press [ENTER] to move to the next digit.

It is possible for the CHANGE CONSTANTS display of numbers to be larger than the 16 character screen. If you have a number that overflows the screen in one direction or the other, a greater than (>) or less than (<) symbol is displayed to indicate this (e.g., <0.3785415569416>). Pressing [ENTER] as you edit the number string, moves the cursor one position to the right. Pressing [ENTER] on the last displayed number will shift the display one position to the left. This pattern will continue until the last digit in the string is reached. Press [ENTER] on the last digit to accept your change.

- The display prompts you to enter the y-intercept.

```
Y-INTERCEPT
0.00%
```

Use [UP] and [DOWN] to enter the calculated y-intercept value. The value can be positive or

negative (typically the value will be positive). Press [ENTER]. The {CONFIRM CHANGE? / YES} menu is displayed. Press [ENTER] to accept your changes. The DLCM will convert the constants to the other display units automatically.

The display is then returned to its original operating mode.



CALIBRATION / TUNE FLOW PROCEDURE

1. In this sub-menu the flow curve can be shifted to 'tune' the flow to one given point. The reason you might perform this procedure is the process you are currently running is too critical to be shut down to complete a full calibration. The Tune Flow procedure is a quick fix. Before entering the TUNE sub- menu, you should measure the actual flow rate at a specific stroke setting. For example, the DLCM is currently set at 60.0% stroke and it displays a calibrated flow rate of 6.0 GPH. An actual flow measurement is taken and found to be 5.775 GPH. Leaving the stroke setting at 60%, tune the flow rate to 5.775 GPH.



SINCE THE {TUNE FLOW} SCREEN DISPLAYS FLOW PER MINUTE, THE FLOW PER HOUR WILL HAVE TO BE CONVERTED. FOR EXAMPLE:

$$6.0 \text{ GPH} / 60 \text{ minutes per hour} = 0.1 \text{ GPM.}$$

2. Navigate to the Change Constants menu by pressing [CAL]. The {CALIBRATE / PUMP FLOW} menu is displayed. Press [ENTER] twice. The {FLOW CALIBRATION / 1 POINT} menu is displayed. Press [UP] until {CALIBRATION / TUNE} is displayed. Press [ENTER] to accept and continue with the {CALIBRATION / TUNE} menu. The following screen is displayed:

| | |
|-----------|----------|
| TUNE FLOW | 60.0% |
| | 0.1000 G |

Using [UP] or [DOWN] enter the volume displaced for 1 minute of pump flow at the current motor speed and stroke length. The percentage value displayed represents the net pump output (stroke and motor speed). Press [ENTER]. The pump will now display the 5.775 GPH value at the 60.0% stroke setting. Internally, the DLCM has retained the slope calculated at the last calibration and has off-set the flow curve to satisfy the current reading requirement.

7.1.2 Analog Input Signal Calibration

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



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.



THE STROKE POSITION CALIBRATION REFLECTS FLOW AT 100% MOTOR SPEED. THE DLCM CALIBRATES MOTOR SPEED DIRECTLY. FOR EXAMPLE: IN A HIGH PRESSURE APPLICATION, THE PULSAR BEGINS DISCHARGING FLUID AT 10% STROKE LENGTH. THUS IT HAS 0% FLOW AT 10% STROKE. IF YOU CALIBRATE 0% = 4.0MA, AND THEN INPUT A 4.0MA SIGNAL THE DLCM WILL ADJUST THE STROKE LENGTH TO 10%.

7.1.2.1 Analog Input #1 Calibration

The following is a minimal procedure for calibrating Analog Input #1. This will control the DLCM's Stroke Length (Calibrated) if the {2-Signal} option is configured. It will control Flow (Stroke Length and Speed) if the {1-Signal} option is configured. For more information about the Analog Input signal, refer to **Section 7.2.15: Analog Mode**.



ANALOG INPUT #1 CALIBRATION PROCEDURE

1. Press [CAL]. The {CALIBRATE / PUMP FLOW} screen is displayed.

```
CALIBRATE
PUMP FLOW
```

2. Press [UP] to scroll to the {CALIBRATE / ANALOG IN}.

```
CALIBRATE
ANALOG IN
```

Press [ENTER] to go to calibrate analog input sub-menu. If Two Signal is selected the following is displayed:

```
CALIBRATE
STROKE POSITION
```

3. Press [ENTER]. The display shows the previous 0% and 100% flow analog signal calibration values:

```
0% = 4.0 MA
100% = 19.8 MA
```



NOTE IF YOU WOULD LIKE TO SKIP THE CALIBRATION AND CHANGE ONLY THE SIGNAL RATIO, PRESS BOTH [UP] AND [DOWN] SIMULTANEOUSLY. SKIP TO STEP 6. PRESSING BOTH [UP] AND [DOWN] CAN ALSO SKIP EITHER THE MIN. OR THE MAX CALIBRATION.

Press [ENTER] to continue with Analog Input Calibration.

4. The display prompts you to input the minimum analog signal value, 0% flow.

```
INPUT STROKE MIN
0% = XX.X MA
```

Send the low analog signal to the DLCM (i.e., 0mA, 1mA, 4mA or 1 volt input to the J4 **Current 1** terminals) 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 DLCM will be receiving during operation. The DLCM 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 DLCM display reads 3.6mA. The DLCM also accepts voltage inputs (0-5VDC), but displays only mA. It is only important that the DLCM detects the full range of the instruments output. The DLCM will store this value as the 0% analog signal value. As the analog signal varies, the DLCM 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.

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

```
INPUT STROKE MAX
100% = XX.X MA
```

As the signal varies, the DLCM will display the fluctuating values. Wait approximately 10 seconds until the value stabilizes and press [ENTER]. The DLCM stores this value as the

100% flow analog signal value.

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

RANGE TOO SMALL
RE-ENTER

Press [ENTER] to return to step 4 to input the analog signal values again.

6. 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:

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

STROKE RATIO
50% = 19.8 MA



IF YOU DO NOT WANT TO USE THE INPUT RATIO OPTION, ENTER A VALUE OF 100%

7. The DLCM 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.

7.1.2.2 Analog Input #2 Calibration

The following is a minimal procedure for calibrating Analog Input #2 if the 2 – Signals option is to be used. Input #2 controls the motor speed. For more information about the Analog Input signal, refer to **Section 7.2.16: Analog Mode**.



ANALOG INPUT #2 CALIBRATION

1. Press [CAL]. The {CALIBRATE / PUMP FLOW} screen is displayed.

CALIBRATE
PUMP FLOW

2. Press [UP] to scroll to the {CALIBRATE / ANALOG IN}.

CALIBRATE
ANALOG IN

3. Press [ENTER] and the {CALIBRATE / STROKE POSITION} screen is displayed.

CALIBRATE
STROKE POSITION

4. Press [UP] to change to {CALIBRATE/MOTOR SPEED}

CALIBRATE
MOTOR SPEED

5. Press [ENTER] and the {0% = X.XmA / 100% = XX.XmA} screen is displayed.

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

| | | |
|------|---|---------|
| 0% | = | 4.0 MA |
| 100% | = | 19.8 MA |



IF YOU WOULD LIKE TO SKIP THE CALIBRATION AND CHANGE ONLY THE SIGNAL RATIO, PRESS BOTH [UP] AND [DOWN] SIMULTANEOUSLY. SKIP TO STEP 8.

Press [ENTER] to continue with Analog Input Calibration.

6. The display prompts you to input the minimum analog signal value, 0% flow.

| |
|-----------------|
| INPUT MOTOR MIN |
| 0% = XX.X MA |

Send the low analog signal to the DLCM (i.e., 0mA, 1mA, 4mA or 1 volt input to the J4 current 1 terminals) from the signal generating device (e.g., PLC). Refer to **Section 5: Installation, Low-Voltage Input Connections** and **Figure 5** for the wiring instructions. It is highly recommended that you use the actual signal the DLCM will be receiving during operation. The DLCM 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 DLCM display reads 3.6mA. It is only important that the DLCM detects the full range of the instrument's output. The DLCM will store this value as the 0% analog signal value. As the analog signal varies, the DLCM 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.

7. The display prompts you to input the maximum analog signal value, 100% flow. Send the maximum analog signal to the DLCM (i.e., 10mA, 20mA or 5 volts).

| |
|-----------------|
| INPUT MOTOR MAX |
| 100% = XX.X MA |

As the signal varies, the DLCM will display the fluctuating values. Wait approximately 10 seconds until the value stabilizes and press [ENTER]. The DLCM 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 or equal to 2mA, the DLCM will display the following:

| |
|-----------------|
| RANGE TOO SMALL |
| RE-ENTER |

Press [ENTER] to return to step 4 to input the analog signal values again.

8. 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:

| |
|---------------|
| SPEED RATIO |
| 50% = 19.8 MA |

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



IF YOU DO NOT WANT TO USE THE RATIO OPTION, ENTER A VALUE OF 100%.

9. The DLCM prompts you to accept the analog signal calibration programmed in the above referenced steps.

```
CONFIRM CHANGES
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].

10. The DLCM 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 6 and step 7. You can reverse Input #1 or Input#2 of the one and two signal calibration procedures separately.

1. In step 4, when the display requests the minimum analog signal value (0% flow), you should send the DLCM the high analog signal value (i.e., 10mA, 20mA or 5 volts).

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

Send high (20 mA)
signal

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

2. In step 5, when the display requests the maximum analog signal value (100%), you send the DLCM the low analog signal value (i.e., 0mA, 1mA, 4mA or 1 volt).

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

Send low (4 mA)
signal

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

```
0% = 20.0 MA
100% = 4.0 MA
```

3. Press [CAL] again to cancel the calibration at this point.

7.1.4 Analog Output Signal Calibration

Depending upon the option selected, {STROKE & SPEED} or {STROKE POSITION} or {MOTOR SPEED}, the DLCM will generate an analog output signal proportional to the selection. The signal can be calibrated to a standard range of 0-20mA, 4-20mA, 1-5mA, or 1-5 volts. It should be calibrated to the attached system.

For more information on configuring the Analog Output Signal refer to **Section 7.2.6: Analog Output Setup**.



THE VALUE THAT THE DLCM DISPLAYS IS NOT PRECISELY CALIBRATED TO ITS OUTPUT. THE VALUE THAT IS DISPLAYED (E.G., 4.0MA) IS FOR REFERENCE ONLY. IN MANY CASES, THE DISPLAYED VALUE WILL NOT EXACTLY MATCH THE VALUE READ BY THE ATTACHED EQUIPMENT.

THE ANALOG OUTPUT REFLECTS THE CALIBRATED OUTPUT (E.G., FLOW) NOT THE MECHANICAL OUTPUT (E.G., STROKE POSITION).

IF THE PUMP MOTOR IS OFF, THE OUTPUT WILL REPRESENT THE MINIMUM VALUE (0%) REGARDLESS OF THE OPTION SELECTED (E.G., {STROKE POSITION}).

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.

```
OUTPUT AT 0%
4.0 ma
```

Using [UP] or [DOWN], set the value for the desired output. Note the value that you set is for reference only. If you need a true 4.0mA'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 DLCM reads its output as 4.0mA. Increase the DLCM output (e.g., 4.2mA) until the PLC reads correctly.

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

```
OUTPUT AT 100%
20.0 MA
```

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

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

```
CONFIRM CHANGE?
YES
```

Press [ENTER] to accept the calibration. If you do not want to accept, press [UP] to display {NO} and then press [ENTER].

The display will return to the last operating mode.



YOU CAN SET THE ANALOG OUTPUT TO REVERSE ACTING BY SIMPLY SETTING THE OUTPUT AT 0% TO BE 20.0MA AND THE OUTPUT AT 100% TO BE 4.0MA.

7.2 Menu

The default values of the DLCM Controller have been factory set, but you may want to configure the DLCM to meet your specific application.

The [MENU] key activates the Configuration Menu system. This consists of 23 different sub-menus as shown below. Press [UP] or [DOWN] to scroll through the sub-menus

| | | | | | |
|-----------------------------|---------------|------------------------------|---------------|------------------------------|---------------|
| - MENU - DIAGNOSTICS - 0 | Press [UP] | - MENU - SET TIME & DATE | Press [UP] | - MENU - ANALOG SIG FAIL | Press [UP] |
| - MENU - MODBUS SIG FAIL | Press [UP] | - MENU - ANALOG OUTPUT | Press [UP] | - MENU - MOTOR SPEED | Press [UP] |
| - MENU - END POINT | Press [UP] | - MENU - LEAK DETECTION | Press [UP] | - MENU - LEVEL SWITCH | Press [UP] |
| - MENU - DIGITAL OUTPUT | Press [UP] | - MENU - MOTOR THERMOSTAT | Press [UP] | - MENU - OVER TEMPERATURE | Press [UP] |
| - MENU - POWER FAILURE | Press [UP] | - MENU - ALARM RELAY | Press [UP] | - MENU - ANALOG MODE | Press [UP] |
| - MENU - MODBUS MODE | Press [UP] | - MENU - SECURITY | Press [UP] | - MENU - NUMBER FORMAT | Press [UP] |
| - MENU - CONTRAST ADJUST | Press [UP] | - MENU - SERIAL COMM | Press [UP] | - MENU - SERIAL DIAG. | Press [UP] |
| - MENU - LANGUAGE | Press [UP] | - MENU - FACTORY DEFAULTS | | | |

Pressing the [UP] key takes you back to the –MENU– DIAGNOSTICS-0 screen.



AS YOU GO THROUGH THIS SECTION OF THE MANUAL, THE SCREENS ARE DISPLAYED AS DEFINED IN THE FACTORY DEFAULT SETTINGS. IF ANY OF THE SETTINGS ARE CHANGED, (E.G., DURING INITIAL SETUP OR MODIFYING OPERATING PARAMETERS) THE AVAILABILITY OF SCREENS DISPLAYED WITHIN A SUB-MENU ITEM SUB-SET MAY CHANGE.

7.2.1 Alarm and Error Messages

When an error occurs, the DLCM flashes Alarm and Error messages alternately with the standard display. If the error is catastrophic (e.g., Tachometer Failure), the catastrophic error message will remain displayed until the problem is repaired.

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

| MESSAGE | DISPLAYED WHEN |
|--|---|
| ANALOG SIG FAIL <i>or</i> ANALOG FAIL #1 <i>or</i> ANALOG FAIL #2 | The Analog signal has fallen below its calibrated range or fallen rapidly (indicating an open circuit). |
| LEAK DETECTION | The PULSAlarm leak-detection diaphragm has failed.* |
| LEVEL SWITCH | The Drum Level switch has been activated.* |
| POWER FAILURE | The input power to the DLCM was interrupted while the pump motor was running.* |
| OVER TEMPERATURE | The internal temperature of the DLCM 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 and is now in a cool down phase. |
| MOTOR THERMOSTAT | The temperature of the DLCM Pump Motor has reached its operating limit.* |
| REMOTE ON/OFF | If configured, displays when the remote On/Off switch is in the Off position. |
| OVER SPEED / SHUT DOWN | The motor control circuit has failed. Remove all power from the DLCM & Pump Motor. (Over speed shutdown) |
| TERMINATED / PRESS ANY KEY | The Manual Control Knob moved during calibration. |
| TACHOMETER FAILURE | Failed to detect shaft rotation with the motor turned on. |
| POSITION ERROR | Motion has not been detected when expected for a fairly long period of time. |
| MODBUS SIG FAIL | The digital command was not received within the timeout period. |
| OVER VOLTAGE | The incoming power exceeds the specified range. |
| UNDER VOLTAGE | The incoming power is below the specified range. |

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

7.2.2 Diagnostics

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



DIAGNOSTICS PROCEDURE

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

| |
|-----------------------------|
| - MENU - DIAGNOSTICS - 0 |
|-----------------------------|



IF A DIAGNOSTIC FAILURE WAS DETECTED, THE {DIAGNOSTICS - #} WOULD APPEAR. THE '#' INDICATES THE NUMBER OF ITEMS THAT HAVE FAILED.

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

| | | |
|--------------------------------|--------|----------------------------------|
| DIAG MENU 1/11 POWER IN: OK | - Or - | DIAG MENU 1/11 POWER IN: FAIL |
|--------------------------------|--------|----------------------------------|

3. Press [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 occurs. First, the signal falls below the calibrated range by 0.3mA (if the DLCM 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 8.8 mA 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 20mA's. Refer to **Section 7.2.4 Analog Signal Failure Setup** for further information.

| | | |
|---------------------------------|--------|-----------------------------------|
| DIAG MENU 2/11 ANALOG IN: OK | - Or - | DIAG MENU 2/11 ANALOG IN: FAIL |
|---------------------------------|--------|-----------------------------------|

4. Press [UP] to scroll to the next sub-menu. If the MODBUS communications fails, a failure will be detected and logged. A MODBUS signal failure is logged when the DLCM is in the MODBUS mode and the DLCM has not received a valid digital command within the timeout limit.

| | | |
|------------------------------|--------|--------------------------------|
| DIAG MENU 3/11 MODBUS: OK | - Or - | DIAG MENU 3/11 MODBUS: FAIL |
|------------------------------|--------|--------------------------------|

5. Press [UP] to scroll to the next sub-menu. If a PULSAlarm leak-detection diaphragm rupture is detected, the DLCM 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. Press [UP] to scroll to the next sub-menu. If the Level switch is configured as a {DRUM LEVEL} type and the switch is activated, the DLCM will show a failure in this diagnostic sub-menu. If the Level Input is configured as {START/STOP}, a failure will not be logged.

| | | |
|--------------------------------|--------|----------------------------------|
| DIAG MENU 5/11 LEVEL SW: OK | - Or - | DIAG MENU 5/11 LEVEL SW: FAIL |
|--------------------------------|--------|----------------------------------|

7. Press [UP] to scroll to the next sub-menu. The DLCM is equipped with a pump motor thermostat to monitor pump motor temperatures. If the temperature has exceeded its operating limit, the DLCM 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. Press [UP] to scroll to the next sub-menu. The DLCM is equipped with a thermistor to monitor internal enclosure temperatures. If the temperature approaches its operating limit, (70°C or 158°F) the DLCM will show a warning in this diagnostic sub-menu.

| | | |
|----------------------------------|--------|------------------------------------|
| DIAG MENU 7/11 DRIVE TEMP: OK | - Or - | DIAG MENU 7/11 DRIVE TEMP: FAIL |
|----------------------------------|--------|------------------------------------|

9. Press [UP] to scroll to the next sub-menu. The DLCM is equipped with a clock that is backed by a 10-year lithium battery. If the battery fails, the DLCM will show a failure in this diagnostic sub-menu. Consult factory.

| | | |
|-------------------------------|--------|---------------------------------|
| DIAG MENU 8/11 BATTERY: OK | - Or - | DIAG MENU 8/11 BATTERY: FAIL |
|-------------------------------|--------|---------------------------------|



NOTE

IF THE BATTERY FAILS, MAINTAIN LINE POWER AND CONSULT THE FACTORY.

10. Press [UP] to scroll to the next sub-menu. If errors are detected with the RAM, EEPROM or internal synchronous stroke adjustment motor, the FAIL message will flash in this diagnostic sub-menu. The error is automatically cleared when the component is replaced and power is applied to the DLCM.

The Motor: FAIL is only an indication that we shut down (Duty Cycle) the stroke adjustment motor to keep from overheating it.

| | | |
|-------------------------------|--------|---------------------------------|
| 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 {DIAG MENU / CIRCUIT: FAIL} screen by pressing [ENTER]. The lower level menus show more descriptive circuit information.

Press [UP] to scroll between sub-menus.

The DLCM tests its RAM at power-up. The results are shown as follows.

| | | |
|----------------------------|--------|------------------------------|
| CIRCUIT FAILURE RAM: OK | - Or - | CIRCUIT FAILURE RAM: FAIL |
|----------------------------|--------|------------------------------|

The DLCM tests EEPROM whenever it writes information to long term memory

| | | |
|-------------------------------|--------|---------------------------------|
| CIRCUIT FAILURE EEPROM: OK | - Or - | CIRCUIT FAILURE EEPROM: FAIL |
|-------------------------------|--------|---------------------------------|

The {MOTOR: FAIL} message only indicates that the Stroke Adjustment motor has exceeded its Duty Cycle limit.

| | | |
|------------------------------|--------|--------------------------------|
| CIRCUIT FAILURE MOTOR: OK | - Or - | CIRCUIT FAILURE MOTOR: FAIL |
|------------------------------|--------|--------------------------------|



NOTE

CIRCUIT FAILURES CAN ONLY BE CLEARED BY CYCLING THE POWER TO THE DLCM.

11. Press [UP] to scroll to the next sub-menu. The run time on the pump motor is displayed in this diagnostic sub-menu. To reset the run time, press [ENTER] and you are prompted to reset the total run time or continue counting the total operating hours.

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

- Press [UP] to scroll to the next sub-menu. The total Stroke count of the pump is displayed here. To reset the Stroke count, press [ENTER] and you are prompted to {RESET COUNT?} or continue with the original count.

| | | |
|---------------------------------|------------------|---------------------|
| DIAG MENU 11/11 STROKES XXXX | Press [ENTER] | RESET COUNT? YES |
|---------------------------------|------------------|---------------------|



IN STEPS 11 AND 12, IF YOU SELECT YES TO EITHER {RESET RUN TIME?} OR {RESET COUNT?}, THE {ARE YOU SURE?} PROMPT IS DISPLAYED. PRESS [UP] AND [ENTER] TO CONFIRM THE CHANGE.

- Press [ENTER] on any of the 'Fail' diagnostic screens (with the exception of BATTERY: FAIL and CIRCUIT FAIL) depicted above to display the time and date of the failure or more descriptive information.



ONLY THE FIRST OCCURRENCE OF AN ERROR WILL BE LOGGED. THE ERROR MUST BE CLEARED TO LOG FUTURE OCCURRENCES.

| | | |
|----------------------------------|------------------|--------------------------------|
| DIAG MENU 1/11 POWER IN: FAIL | Press [ENTER] | POWER FAILURE 13:27 1/22/01 |
|----------------------------------|------------------|--------------------------------|

- 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, press [UP] to scroll to {YES} and press [ENTER]. The DLCM will return to the first menu screen depicted in step 1.

| |
|----------------------------|
| POWER FAILURE CLEAR? NO |
|----------------------------|

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.



SET TIME/DATE PROCEDURE

- Press [MENU], then [UP] to display the menu:

| |
|-----------------------------|
| - MENU - SET TIME & DATE |
|-----------------------------|

Press [ENTER] to access the {Set Time and Date} sub-menu.

- 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.



THE 12 HOUR CLOCK SELECTION WILL ADD AN 'a' OR 'p' AFTER THE TIME.

Press [ENTER] to accept the desired time format.

| |
|---------------------------------|
| 12 HR MM/DD/YY 2:31a 1/22/01 |
|---------------------------------|

- The time will now be flashing with the cursor located under the hour position. Press [UP] or [DOWN] to adjust the time to your local time.

| |
|---|
| 12 HR MM/DD/YY <u>2</u> :31a 1/22/01 |
|---|



THE CURSOR LOCATED UNDER THE DIGIT IN THE TIME, INDICATES THE CHARACTER BEING CHANGED.

Once the hour is set, press [ENTER] and the cursor will move to the first digit in the minute setting. Press [UP] or [DOWN] to set the correct tens of minutes digit, then press [ENTER].

| | |
|----------------|----------|
| 12 HR | MM/DD/YY |
| 2:3 <u>1</u> a | 1/22/01 |

- 4. The cursor moves to the second digit of the minute setting. Press [UP] or [DOWN] to set the correct second minute digit, then press [ENTER].

| | |
|----------------|----------|
| 12 HR | MM/DD/YY |
| 2:3 <u>1</u> a | 1/22/01 |

- 5. If you selected the 12 hour format, the cursor moves under the a.m./p.m. character. Press [UP] or [DOWN] to set the correct a.m./p.m. character (a or p), then press [ENTER].

| | |
|---------------|----------|
| 12 HR | MM/DD/YY |
| 2:31 <u>a</u> | 1/22/01 |

- 6. The date format will now be flashing on the display. The date can be expressed in one of three formats: MM/DD/YY, DD/MM/YY, YY/MM/DD.

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

- 7. The date is now flashing on the display. Press [UP] or [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 press [UP] or [DOWN]. Press [ENTER] on the last date field to accept your setting.

| | |
|--------|-----------------|
| 12 HR | MM/DD/YY |
| 2:31 A | <u>1</u> /22/01 |



YOU ARE NOT ALLOWED TO EXIT THE DATE FIELD IF THE DATE DOES NOT EXIST. FOR EXAMPLE, JUNE 31 OR FEB 29 IN A NON- LEAP YEAR WOULD NEED TO BE CORRECTED TO A VALID DATE.

- 8. The DLCM prompts you to change the time and date for {DAYLIGHT SAVINGS / NO}. Press [UP] to scroll to {AUTO CHANGE}. 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 DLCM.

| |
|------------------|
| DAYLIGHT SAVINGS |
| AUTO CHANGE |



THE TIMES CHANGE OVER ON THE FIRST SUNDAY IN APRIL AND ON THE LAST SUNDAY IN OCTOBER.

- 9. If "AUTO CHANGE" was selected in the previous step, the DLCM 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.

| |
|-----------------|
| DAY OF THE WEEK |
| WEDNESDAY |

- The DLCM prompts you to accept the time and 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].

```
CONFIRM CHANGE?
YES
```

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

7.2.4 Analog Signal Failure Setup

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

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

An analog input failure is detected if one of the following conditions occurs. First, the signal falls below the lower calibrated range by 0.3mA. For example, if the DLCM is calibrated with a range of 4-20mA and the signal falls to 3.6mA, then a failure is recognized. 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 down to 0 (0.0mA).

When an Analog Input is calibrated in the 0-5mA or 0-20mA range and you are operating down near the lower end (<2.5mA) the detection of a failed signal may not occur because the slew rate (rate of change) is too low to be detected. If you are calibrated down to 0mA, operation after a failure will be restored immediately because 0mA is an in-range signal. In this case you should use the MOTOR OFF option rather than FREEZE or GO TO DEFAULT choices.



TIP

IF ANALOG INPUT SIGNAL FAILURE IS IMPORTANT TO OPERATION, AVOID CALIBRATING TO 0 MA.



SIGNAL FAILURE RESPONSE (ONE-SIGNAL MODE) PROCEDURE

- Press [MENU] and press [UP] or [DOWN] until {-MENU- / ANALOG SIG FAIL} is displayed.

```
- MENU -
ANALOG SIG FAIL
```

Press [ENTER] to continue to the Analog Signal Fail setup screens.

The first entry in the Analog Signal Failure menu determines how the DLCM recovers from a failed analog input. You can select from two {RESTORE TO:} modes: Analog or Manual. If {ANALOG MODE} is selected, the DLCM will resume automatically following the 4-20mA input. If {MANUAL MODE} is selected, the DLCM 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 a {RESTORE TO: / ANALOG MODE} is that it's totally automatic. If so programmed, the DLCM 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 DLCM freeze at the last signal is displayed.

```
ANALOG SIG FAIL
FREEZE @ LAST SIG
```

To accept this action, press [ENTER]. Go to step 5. If you desire a different action, press [UP].

3. The menu for having the DLCM shut the motor off is displayed.

```
ANALOG SIG FAIL
MOTOR OFF
```

To accept this action, press [ENTER]. Go to step 5. If you desire a different action, press [UP].

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

```
ANALOG SIG FAIL
GO TO DEFAULT
```

To accept this action, press [ENTER].

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

```
SIGNAL DEFAULT
10.0%
```

To accept this value, press [ENTER].

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

```
ERROR MESSAGE
ENABLED
```

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.

```
ERROR MESSAGE
DISABLED
```

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.



ANALOG SIGNAL FAILURE (TWO-SIGNAL MODE) PROCEDURE

1. Press [MENU] and press [UP] or [DOWN] until {-MENU- / ANALOG SIG FAIL} is displayed.

```

- 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 DLCM recovers from a failed analog input. You can select from two {RESTORE TO:} modes: Analog or Manual. If {ANALOG MODE} is selected, the DLCM will resume automatically following the 4-20mA input after the signal is restored.

If {MANUAL MODE} is selected, the DLCM 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 a {RESTORE TO: / ANALOG MODE} is that it's totally automatic. If so programmed, the DLCM can shut itself down, wait for a signal to return, and then start itself back up.

```

RESTORE TO:          Press          RESTORE TO:
ANALOG MODE         [UP]          MANUAL MODE

```



THE {RESTORE TO:} SETTING APPLIES TO BOTH CHANNELS (I.E., THERE IS ONLY ONE SETTING).

2. With the desired selection displayed, press [ENTER].

```

RESTORE TO:
ANALOG MODE

```



THE SUB-SCREENS FOR {ANALOG FAIL #1 / STROKE POSITION}, AND {ANALOG FAIL #2 / MOTOR SPEED} ARE IDENTICAL WITH THE EXCEPTION OF THE NUMBER (#1 OR #2) DISPLAYED AT THE END OF THE FIRST LINE OF TEXT. IF FOR EXAMPLE {ANALOG FAIL #1 / STROKE POSITION} IS SELECTED, SOME SUB- SCREENS WILL HAVE #1 DISPLAYED AT THE END OF THE FIRST LINE OF TEXT.

3. The first of two channel selection screens is displayed: Press [UP] or [DOWN]

```

ANALOG FAIL #1          Press          ANALOG FAIL #2
STROKE POSITION         [UP]          MOTOR SPEED

```

Select the desired channel and press [ENTER]. (For the purpose of this manual, {ANALOG FAIL #1 / STROKE POSITION} will be covered.)

4. The menu for having the DLCM freeze at the last signal is displayed.

```

ANALOG FAIL #1
FREEZE @ LAST SIG

```

To accept this action, press [ENTER] and then go to step 5. If you desire a different action, press [UP].

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

```

ANALOG FAIL #1
MOTOR OFF

```

To accept this action, press [ENTER] and then go to step 5. If you desire a different action, press [UP].

b) The menu for having the DLCM go to a default signal is displayed.

```
ANALOG FAIL #1
GO TO DEFAULT
```

To accept this action, press [ENTER].

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

```
SIGNAL DEFAULT
0.0%
```

To accept this value, press [ENTER].



THE {ERROR MESSAGE / ENABLED} – {ERROR MESSAGE / DISABLED} OPTION IS PROVIDED FOR USERS THAT ARE OPERATING IN THE TWO ANALOG INPUT CHANNEL MODE, BUT ARE ONLY USING ONE ANALOG SIGNAL AND HAVE SET UP THE OTHER CHANNEL TO “GO TO DEFAULT” (E.G.: CONTROLLING MOTOR SPEED, WHILE LEAVING THE STROKE AT A FIXED POSITION LIKE 50% OR 100%). IN THIS SITUATION THE SYSTEM IS CONFIGURED TO OPERATE WITHOUT ONE OF THE INPUT SIGNALS AND THE OPERATOR DOES NOT WANT TO SEE THE ERROR MESSAGE DISPLAYED.

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

```
ERROR MESSSAGE
ENABLED
```

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.

```
ERROR MESSSAGE
DISABLED
```

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

7.2.5 MODBUS Signal Failure Setup

This sub-menu allows you to set up the DLCM response if the MODBUS Signal fails. You can program the DLCM to have one of the following responses:

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

A MODBUS Signal failure is detected if the DLCM does not receive a valid message.



MODBUS SIGNAL FAURE SETUP PROCEDURE.

1. Press [MENU] and press [UP] or [DOWN] until the display reads {–MENU– / MODBUS SIG. FAIL}.

```
- MENU -
MODBUS SIG FAIL
```

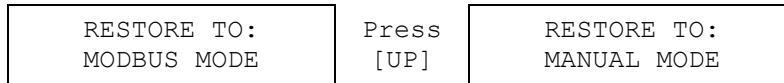
Press [ENTER] to continue to the MODBUS Signal Fail sub-menus.

- The {RESTORE TO:} menu is displayed. This setting determines how the DLCM will recover from a failed MODBUS Signal. You can select from two {RESTORE TO:} modes – MODBUS or Manual.

If {MODBUS MODE} is selected the DLCM will resume following the MODBUS signal automatically when the signal is restored.

If {MANUAL MODE} is selected, the DLCM will enter manual mode as soon as the signal loss is detected. The DLCM will remain in Manual Mode until it is changed manually (press [MODE] on the front panel).

The benefit of using {RESTORE TO: / MODBUS MODE} is that it's totally automatic. If so programmed, the DLCM can shut itself down, wait for the signal to return and then start itself back up.



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

- The next entry in the MODBUS SIG. FAIL sub-menu allows you to set the timeout value in seconds. This defines the maximum interval between messages addressed to this node. If a message is not received within this period, a MODBUS Signal failure will be detected. A number of factors influence the value you should set here:

- Number of nodes on the network
- Type of master
- Baud rate
- Electrical environment.

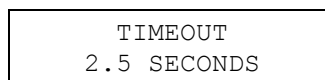
Here are some general guide lines:

- Increase this value as you increase the number of nodes on the network.
- Increase this value as you decrease the communications baud rate.
- Increase this value if the DLCM is a slave connected to a heavily loaded PC/PLC master.
- Increase this value if you are in an electrically noisy environment.
- Decrease this value if the DLCM is mission critical on a small (2-3 node) network.



ALWAYS USE THE DEFAULT SETTING (2.5 SECONDS) AS A STARTING POINT.

TO ADJUST THE VALUE, PRESS [UP] OR [DOWN], PRESS [ENTER] TO ACCEPT THE VALUE.



The screens to be displayed next are dependent on how your DLCM Serial Communications (ACTIVE) and MODBUS mode (1 – SIGNAL or 2 – SIGNAL) have been configured. If you have selected the 1 – SIGNAL option continues with step 4. If the 2 – SIGNAL option is selected go to step 7.

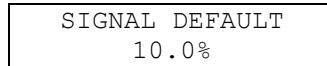
- The menu that selects the MODBUS Signal failure action is displayed. There are three available options:
 - Freeze at last signal
 - Motor off
 - Go to Default

Press [UP] or [DOWN] to select the desired option. Press [ENTER] to accept your setting.



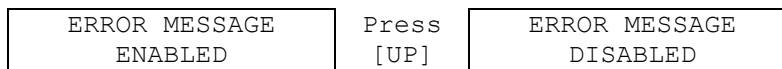
5. If you selected {FREEZE @LAST SIG} or {MOTOR OFF} in step 4, proceed to step 6. If you selected {GO TO DEFAULT}, you must set the default value.

Press [UP] or [DOWN] to set the default signal in percent.



Press [ENTER] to accept your setting.

6. The {ERROR MESSAGE} screen is displayed. Press [UP] or [DOWN] to select between {ENABLED} or {DISABLED}

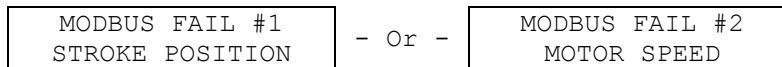


Press [ENTER] to accept your setting.



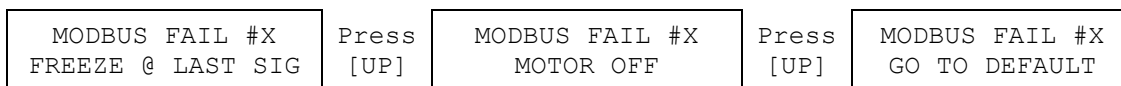
When the DISABLED setting is selected, the error will still be logged with the date and time, but the flashing error message on the screen will be suppressed. This option is for applications that intentionally interrupt the MODBUS Signal in the normal course of operations, stopping and re-starting the pump.

If {2 – SIGNAL} is selected two additional screens are displayed:



7. Select the condition to alarm for {STROKE POSITION} or {MOTOR SPEED} and then press [ENTER].
8. The menu that selects the MODBUS Signal failure action is displayed. There are three available options:
- 1) Freeze at last signal,
 - 2) Motor off,
 - 3) Go To Default

Press [UP] or [DOWN] to select the desired option



Press [ENTER] to accept your setting.



In the example screens above, at the end of the {MODBUS FAIL} line the last two characters are “#X”. In this case “X” will represent either “1” or “2” depending on which option (STROKE POSITION #1 or MOTOR SPEED #2) you are alarming for.

- If you selected {FREEZE @LAST SIG} or {MOTOR OFF} in step 8, proceed to step 10. If you selected {GO TO DEFAULT}, you must set the default value.

Press [UP] or [DOWN] to set the default signal in percent.

SIGNAL DEFAULT
 10.0%

Press [ENTER] to accept your setting.

- The {ERROR MESSAGE} screen is displayed. Press [UP] or [DOWN] to select between {ENABLED} or {DISABLED}.

ERROR MESSAGE
 ENABLED

Press [UP]

ERROR MESSAGE
 DISABLED

Press [ENTER] to accept your setting.



WHEN THE DISABLED SETTING IS SELECTED, THE ERROR WILL STILL BE LOGGED WITH THE DATE AND TIME, BUT THE FLASHING ERROR MESSAGE ON THE SCREEN WILL BE SUPPRESSED. THIS OPTION IS FOR APPLICATIONS THAT INTENTIONALLY INTERRUPT THE MODBUS SIGNAL IN THE NORMAL COURSE OF OPERATIONS, STOPPING AND RE- STARTING THE PUMP.

7.2.6 Analog Output Setup

This sub-menu allows you to control the DLCM's analog output channel. The Analog Output can be set up to:

- Send a signal to a recording device (e.g. chart recorder) located away from the pump/controller.
- Send a signal to a Programmable Logic Controller (PLC) to be used as a process control.
- Link DLCM's together to allow more than one pump to follow a single input, with the options of reverse-acting, split action and ratio as part of this special (second pump) operation.



ANALOG OUTPUT SETUP PROCEDURE



THE ANALOG OUTPUT CAN BE CONFIGURED TO REPRESENT STROKE, SPEED, OR STROKE AND SPEED.

- Press [MENU] to enter the {-MENU-} sub-system. Press [UP] or [DOWN] until {-MENU- / ANALOG OUTPUT} is displayed.

- MENU -
 ANALOG OUTPUT

Press [ENTER] to set up the Analog Output Options.

There are three Analog Output options: {STROKE & SPEED}, {STROKE POSITION}, and {MOTOR SPEED}. {STROKE & SPEED} is the Factory Default setting.

ANALOG OUTPUT
 STROKE & SPEED



THE STROKE & SPEED OUTPUT ACTUALLY REPRESENTS CALIBRATED FLOW WHERE 0% FLOW MAY NOT CORRELATE TO 0% STROKE POSITION.

Press [ENTER] to accept this selection. You are then returned to the {-MENU- / ANALOG OUTPUT} screen.

2. If the desired mode is {STROKE POSITION}, press [UP], and the {STROKE POSITION} screen is displayed.

```
ANALOG OUTPUT
STROKE POSITION
```



NOTE

THE STROKE OUTPUT ACTUALLY REPRESENTS CALIBRATED STROKE POSITION WHERE 0% ANALOG OUTPUT MAY NOT CORRELATE TO THE MECHANICAL 0% STROKE POSITION.

Press [ENTER] to accept your selection. You are then returned to the {-MENU- / ANALOG OUTPUT} screen.

3. If the desired mode is {MOTOR SPEED}, press [UP] until the {MOTOR SPEED} screen is displayed.

```
ANALOG OUTPUT
MOTOR SPEED
```



NOTE

THE MOTOR SPEED OUTPUT REPRESENTS THE TARGET MOTOR SPEED.

Press [ENTER] to accept your selection. You are then returned to the {-MENU- / ANALOG OUTPUT} screen.

7.2.7 Motor Speed Display

This sub-menu allows you to view the target and actual averaged motor speed. The average value represents the last 30 pump strokes or less.



MOTOR SPEED DISPLAY PROCEDURE

1. Press [MENU] to enter the {-MENU-} sub-system. Press [UP] or [DOWN] until {-MENU- / MOTOR SPEED} is displayed.

```
- MENU -
MOTOR SPEED
```

2. Press [ENTER] to display the {TARGET RPM / ACTUAL RPM} screen.

```
TARGET RPM XXXX
ACTUAL RPM XXXX
```



NOTE

PRESSING [UP] OR [DOWN] RESETS THE {ACTUAL RPM} AVERAGE TO 0. THE PUMP MUST COMPLETE 1 STROKE BEFORE AN ACTUAL RPM IS DISPLAYED.

3. Press [ENTER] to return to the {-MENU- / MOTOR SPEED} screen.

7.2.8 End-Point Setup

The End-Point Setup menu is a powerful tool that allows you to modify the performance of your DLCM. The term 'End Points' refers to the operating limits of the control elements. The DLCM has two control elements: the mechanical stroke adjustment and the motor speed adjustment. These elements have limits to their operation. The stroke adjustment can control from 0% stroke to 100% stroke. The motor speed adjustment can control from 5% speed (87.5 RPM) to 100% speed (1750 RPM). These settings are referred to as 'End Points'. You can adjust these End-

Point values to affect the way the DLCM operates. For example, you can limit the operating range of the stroke adjustment by setting its End Points to 0% and 50%. Thus, in normal operation, the DLCM will not adjust its stroke setting above 50% stroke.

Another aspect of the End-Points menu is the term 'Priority'. The DLCM has influence over two control elements. It needs to adjust these elements to produce a desired flow rate. Thus, if you desire the pump's output to be 0.1LPH, the DLCM must adjust the stroke length and motor speed to produce the desired flow. In most cases, there are an infinite variety of stroke length and motor speed combinations that will produce a desired flow rate. For example, if the desired flow output is 25%, it can be achieved by setting the stroke length to 100% and the motor speed to 25% ($1.00 * 0.25 = 0.25$). Or, the stroke length can be set to 50% and the motor speed set to 50% ($0.50 * 0.50 = 0.25$). The DLCM uses one rule when deciding how to adjust stroke and speed to obtain a given flow rate. This rule is as follows:



When adjusting from 100% flow to 0% flow, the 'Priority' control element (e.g., motor speed) will be adjusted first from its maximum End Point to its minimum End Point. When the 'Priority' control element's (e.g., motor speed) minimum End Point is achieved the second element (e.g., stroke length) will be adjusted from its maximum end point until it achieves its minimum.

The term 'Priority' refers to the element that is adjusted first or has 'Priority' when adjusting from 100% to 0%. The DLCM uses the following defaults for 'Priority' and 'End Points':

| Type | Default Value | |
|---------------|-------------------|------|
| Motor Speed | Minimum End Point | 10% |
| | Maximum End Point | 100% |
| Stroke Length | Minimum End Point | 0% |
| | Maximum End Point | 100% |

The following is a graphical representation of the Priority and End-Point operation. The x-axis represents Adjustment (e.g., the value you enter at the front panel). The y-axis represents flow.

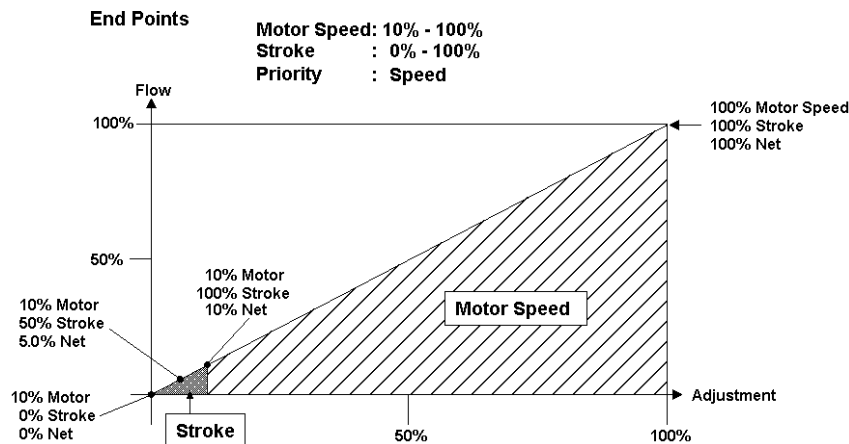


Figure 14 – Priority and End-Point Operation

At the 100% Adjustment (maximum value on the x-axis), the DLCM is operating at 100% stroke length and 100% motor speed. This results in a 100% flow output. As the Adjustment is decreased to 50% for example, the motor speed is adjusted to 50% (motor speed has 'Priority') and the stroke length remains at 100%. As we continue to decrease the Adjustment value, the DLCM continues to decrease motor speed until it reaches its minimum End-Point value (10%). At the 10% adjustment, the DLCM's motor speed will be 10% and the stroke length will be 100%. As the Adjustment is set below 10%, the motor speed setting will remain at its minimum End Point value of 10% and the stroke length will be adjusted. Thus, as the Adjustment is reduced to 5%, the DLCM will keep the motor speed at its minimum End Point value of 10% and adjust the Stroke Length to 50% ($0.10 * 0.50 = 0.05$). Finally, when the DLCM is at its minimum Adjustment

value (i.e., 0%), the motor speed will be at its minimum End Point value of 10% and the Stroke Length will be at its minimum End Point value of 0% ($0.10 * 0.00 = 0.00$). When increasing the adjustment value, the same rule system is followed in the opposite order. Thus, stroke length is increased until it reaches its maximum End Point, then speed is increased until it reaches its maximum End Point.

Looking at this graph, you will notice that 90% of the pump's flow output is covered by motor speed while 10% is covered by stroke length. The End Point and Priority settings allow you to change characteristics such as this. For example, if you set the 'Priority' value to Stroke Length, then 100% of the pump's flow is covered by stroke length (when the stroke length has a 0% Minimum End point, the motor speed will also be set to its Minimum End Point as the Adjustment value will be 0%).



WHEN CONTROLLING FROM A SINGLE ANALOG INPUT (1-CHANNEL), THE ABOVE STATED RULE APPLIES. WHEN CONTROLLING FROM TWO ANALOG INPUTS (2-CHANNEL), THE END POINT VALUES ARE ENFORCED, BUT THE PRIORITY IS NOT.

DURING PUMP FLOW CALIBRATION AND ZERO CALIBRATION, THE SELECTED END POINTS MAY BE VIOLATED.



YOU CAN FIX THE OPERATING POINT OF STROKE LENGTH OR MOTOR SPEED BY SETTING THE MINIMUM AND MAXIMUM END POINT VALUES EQUAL (E.G., YOU CAN FIX THE STROKE LENGTH AT 50% BY SETTING THE MINIMUM END POINT TO 50% AND THE MAXIMUM END POINT TO 50%).

7.2.8.1 End-Point Example

A PULSAR pump is purchased with the DLCM option. Due to anticipated future capacity growth, the pump is twice as large as currently required. The process will require the pump to typically operate between 5% and 35% flow. In addition, it is critical that the pump not operate above the 50% flow output. The pump will be controlled by a single analog signal.

There are a number of ways to assure that the pump does not exceed the 50% flow output. For example, the 4-20mA input calibration could be ratioed 50% to limit the output. But, this technique would not prevent someone from walking up to the pump and manually adjusting it above 50%. A better way is to adjust the End Point values. Using the default End Point and Priority values, the DLCM will typically operate the motor speed from 50% to 100% and the stroke length from 100% to 0%. Unfortunately, this means that in the 5% to 25% anticipated flow range, the DLCM will transition between stroke length and motor speed control (at the 10% flow point).

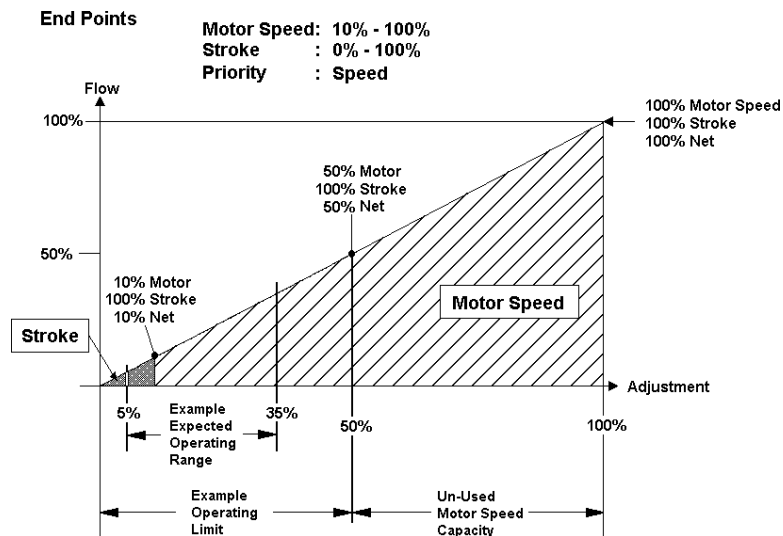


Figure 15 – Typical End Point Example

A better way to accomplish this is to modify the Maximum End Point for Stroke Length. If we

change the Maximum End Point value to 50% stroke length, then the maximum pump output will be limited to 50% (50% Length and 100% motor speed yields 50% output). This improves the control characteristics as 5% to 35% flow range is now covered fully with motor speed.

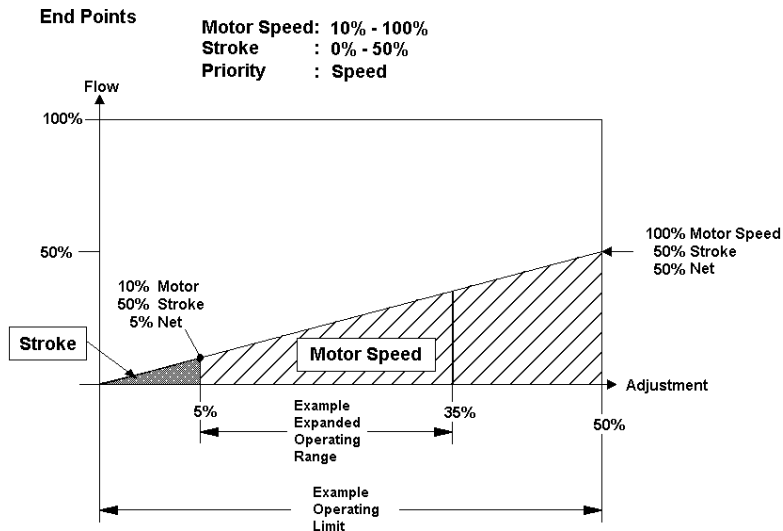


Figure 16 – Modified End Point Example



END POINT SETUP PROCEDURE

1. Press [MENU] to enter the {- MENU -} sub-system. Press [UP] or [DOWN] until {-MENU- / END POINT} is displayed.
2. Press [ENTER] to display the {STROKE END POINT / MINIMUM = XXX%} screen.

```
STROKE END POINT
MINIMUM = XXX%
```

Press [UP] or [DOWN] to set the value. Press [ENTER] to accept your setting.

3. The {STROKE END POINT / MAXIMUM = XXX%} screen is displayed.

```
STROKE END POINT
MAXIMUM = XXX%
```

Press [UP] or [DOWN] to set the value. Press [ENTER] to accept the setting.

4. The {SPEED END POINT / MINIMUM = XXX%} screen is displayed.

```
SPEED END POINT
MINIMUM = XXX%
```

Press [UP] or [DOWN] to set the value. Press [ENTER] to accept the setting.

5. The {SPEED END POINT / MAXIMUM = XXX%} screen is displayed.

```
SPEED END POINT
MAXIMUM = XXX%
```

Press [UP] or [DOWN] to set the value. Press [ENTER] to accept the setting.

6. The {PRIORITY SPEED} screen is displayed.

7. Press [UP] or [DOWN] to set the priority to either {SPEED} or {STROKE}.

| | | |
|-------------------|--------|--------------------|
| PRIORITY SPEED | - Or - | PRIORITY STROKE |
|-------------------|--------|--------------------|

Press [ENTER] to accept your selection.

8. The {FLOW RANGE} screen is displayed. This represents the available Flow Range based on your settings. Press [ENTER]

| |
|--------------------------|
| FLOW RANGE 1.0% - 90% |
|--------------------------|

9. The {CONFIRM CHANGE} screen is displayed.

| |
|-----------------------|
| CONFIRM CHANGE YES |
|-----------------------|

If you do not want to confirm these changes, press [DOWN] to display the {CONFIRM CHANGE = NO} screen.

| |
|----------------------|
| CONFIRM CHANGE NO |
|----------------------|

In either case, confirming or not confirming, press [ENTER] to complete the action. At this point, you are returned to the {-MENU- / END POINT} screen.

7.2.9 Leak-Detection Failure Setup

This sub-menu allows you to configure the DLCM to interact with a PULSAlarm Leak-Detection Diaphragm. You can modify the way the DLCM 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,
- Have no interaction with the Pump Motor or Alarm Relay other than log the diaphragm failure and display a message on the LCD display (this message is displayed until a key on the keypad is pressed).



THE LEAK SENSOR SWITCH MUST BE A DRY CONTACTING TYPE. REFER TO SECTION 5: INSTALLATION, LOW-VOLTAGE INPUT CONNECTIONS FOR WIRING INFORMATION.

NOTE

IF YOU SELECT THE 'MOTOR OFF' OPTION, THE MOTOR WILL HAVE TO BE MANUALLY RE-STARTED IF A LEAK-DETECTION FAILURE IS DETECTED (I.E., PRESS [MOTOR] TO START THE PUMP MOTOR).



LEAK-DETECTION FAILURE SETUP PROCEDURE

1. Press [MENU] to enter the {-MENU-} sub-system. Press [UP] or [DOWN] until {-MENU- / LEAK DETECTION} is displayed.

| |
|----------------------------|
| - MENU - LEAK DETECTION |
|----------------------------|

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, it should be set as {INACTIVE}.

```
LEAK DET INPUT
INACTIVE
```

Press [ENTER] to accept your selection. The {-MENU- / LEAK-DETECTION} screen is displayed.

3. If your pump is supplied with a PULSAlarm Leak-Detection Diaphragm, press [UP] to select the type of switch. The Leak-Detection Input switch can be configured as {NORMALLY OPEN},

```
LEAK DET INPUT
NORMALLY OPEN
```

Or press [UP] to configure the switch as {NORMALLY CLOSED}.

```
LEAK DET INPUT
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 occur (i.e., a leak is detected).

```
LEAK DETECTION
MOTOR OFF? NO
```

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 you to configure the alarm relay status (triggered or not 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.

7.2.10 Level / Remote Start-Stop Setup

This sub-menu allows you to configure the DLCM to interact with a level input. You can program the DLCM 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).



THE LEVEL SENSOR OR START/STOP SWITCH MUST BE A DRY CONTACTING TYPE. REFER TO SECTION 5: INSTALLATION, LOW-VOLTAGE INPUT CONNECTIONS.

IF YOU SELECT THE 'MOTOR OFF' OPTION, THE MOTOR WILL HAVE TO BE MANUALLY RE-STARTED WHEN A LEVEL FAILURE IS DETECTED (I.E., PRESS [MOTOR] TO START THE PUMP MOTOR).



LEVEL/START-STOP SETUP PROCEDURE

1. Press [MENU] to enter the { –MENU – } sub-system. Press [UP] or [DOWN] until { –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 it will not be used.

```
  LEVEL SWITCH  
  INACTIVE
```

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

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 following screen is displayed.

```
  LEVEL SWITCH  
  DRUM LEVEL
```

Select this option if the level input is to be connected to a drum level switch. Press [ENTER] to select. Go to step 7.



THE NORMAL STATE FOR DRUM LEVEL REFERS TO THE CONDITION THAT EXISTS WHEN THE DRUM LEVEL IS OK AND THE PUMP SHOULD BE RUNNING. FOR EXAMPLE, IF THE DRUM LEVEL SWITCH CLOSSES WHEN THE DRUM IS FULL (AND THE PUMP SHOULD BE RUNNING) THEN THE NORMAL STATE IS CLOSED.

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

```
  LEVEL SWITCH  
  START/STOP
```



THE NORMAL STATE FOR START/STOP, REFERS TO THE CONDITION THAT EXISTS WHEN THE START/STOP (CALL TO RUN) SIGNAL IS OK AND THE PUMP SHOULD BE RUNNING. FOR EXAMPLE, IF THE START/STOP SWITCH CLOSURES WHEN THE PUMP IS EXPECTED TO RUN THEN THE NORMAL STATE IS CLOSED.

6. Pressing [ENTER] from {LEVEL SWITCH / START/STOP} screen to configure the LEVEL SWITCH input for use with a remote motor On/Off switch.
7. The Level Switch Configuration screen is displayed:

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}.



WHEN {LEVEL SWITCH / START/STOP} HAS BEEN SELECTED, YOU ARE RETURNED TO THE {-MENU- / LEVEL SWITCH} SCREEN. THIS SETTING USES THE DEFAULT SETTINGS OF {MOTOR OFF? / YES} AND {ALARM RELAY / NO}. THESE SETTINGS CANNOT BE MODIFIED.

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 Drum Level input is sensed. Go to step 11.

10. If you want the PULSAR motor to stay on when a Drum Level is sensed, press [UP] to scroll to {NO}.and press [ENTER].

LEVEL SWITCH
 MOTOR OFF? NO

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

LEVEL SWITCH
 ALARM RELAY? YES

Press [ENTER] if you want the Alarm Relay to activate with the Drum Level Input. The display returns to the {-MENU- / LEVEL SWITCH} screen.

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

7.2.11 Digital Output Setup

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

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.

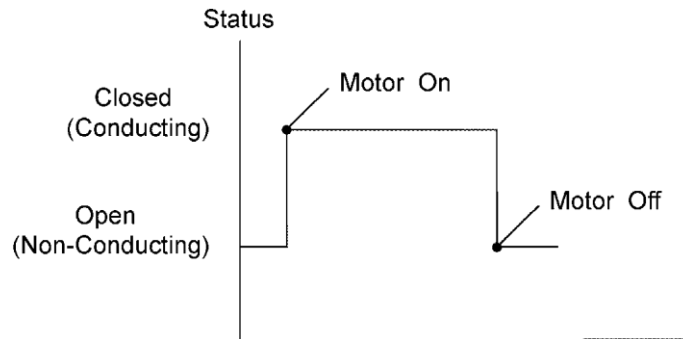


Figure 17 – Run/Stop Status

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.

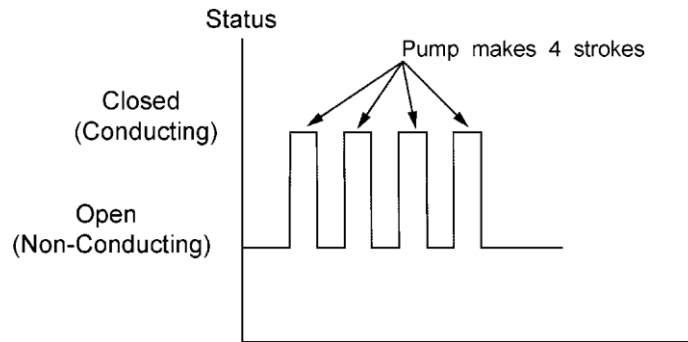


Figure 18 – Pump Stroke Status

If the Digital Output is set up as {MODE INDICATION / ANALOG MODE}, and {DIGITAL OUTPUT / NORMALLY OPEN} it will activate when the mode is set to {ANALOG} and deactivate in any other (e.g., {MANUAL MODE}) mode.

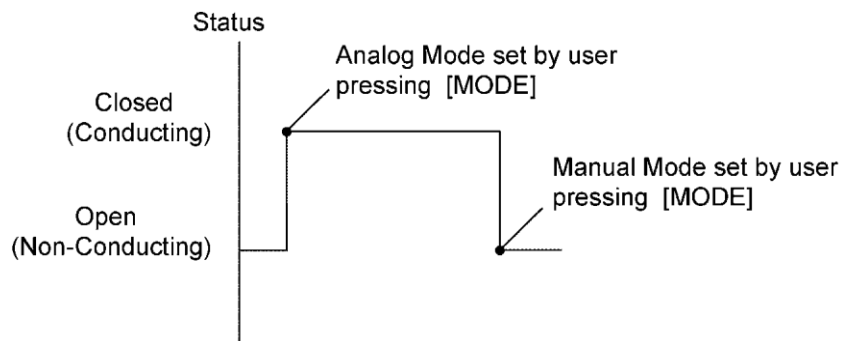


Figure 19 – Mode Indication



DIGITAL OUTPUT SETUP PROCEDURE

1. Press [MENU] once and then press [UP] or [DOWN] until the display reads {-MENU- / DIGITAL OUTPUT}.

```

- MENU -
DIGITAL OUTPUT

```

2. Press [DOWN]. 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]. Go to step 5.

3. Press [ENTER] to continue to program the Digital Output sub-menu. 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 5.

4. Press [DOWN]. The {DIGITAL OUTPUT / MODE INDICATION} screen is displayed.

```

DIGITAL OUTPUT
MODE INDICATION

```

To use the DIGITAL OUTPUT function as a Mode Indicator press [ENTER]. The following screens are displayed:

| | | | | |
|--------------------------------|---------------|--------------------------------|---------------|--------------------------------|
| MODE INDICATION MANUAL MODE | Press [UP] | MODE INDICATION ANALOG MODE | Press [UP] | MODE INDICATION MODBUS MODE |
|--------------------------------|---------------|--------------------------------|---------------|--------------------------------|

Press [UP] or [DOWN] to scroll through the screens shown above. Press [ENTER] to select the desired option.

5. The {DIGITAL OUTPUT / NORMALLY OPEN} screen is displayed.

In this mode, the output is open (non-conducting) when the motor is off or the Mode is wrong.

```

DIGITAL OUTPUT
NORMALLY OPEN

```

The output is closed (conducting) when the motor is on or the Mode is correct. Configure the output as {NORMALLY OPEN} by pressing [ENTER]. Go to step 7.

6. Press [UP] to open the {DIGITAL OUTPUT / NORMALLY CLOSED} screen.

In this mode, the output is open (non-conducting) when the motor is on or the Mode is correct.

```

DIGITAL OUTPUT
NORMALLY CLOSED

```

The output is closed (conducting) when the motor is off or the Mode is wrong. Press [ENTER] to configure the output as {NORMALLY CLOSED}.

7. The {-MENU- / DIGITAL OUTPUT} screen is displayed.

7.2.12 Motor Thermostat Setup

This sub-menu allows you to configure the DLCM to interact with the pump motor thermostat. Depending on the application, it is possible for the fan cooled pump motor to run at low RPM and high torque, which degrades the effectiveness of the fan and can cause heat buildup.

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

- Shut the motor off (no alarm) (no restart)
- Trigger the alarm relay (motor stays on)
- Shut the motor off and trigger the alarm relay (no restart)
- 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 SETUP PROCEDURE

1. Press [MENU] once and then press [UP] or [DOWN] 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 3.

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 [ENTER] to accept the {NORMALLY OPEN} configuration.

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.

```
RESTORE TO:
MOTOR ON
```

If you want the DLCM 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.

```
RESTORE TO:
MOTOR OFF
```

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

7.2.13 Over Temperature Setup

This sub-menu allows you to disable the warning message when the DLCM's internal temperature approaches its 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.



RUNNING THE DLCM AT ELEVATED TEMPERATURES COULD RESULT IN IMPROPER AND DANGEROUS OPERATION.



THIS WARNING DOES NOT AFFECT THE OPERATION OF THE DLCM, IT IS FOR YOUR INFORMATION ONLY. DISABLING THIS FLASHING WARNING MESSAGE DOES NOT INHIBIT THE LOGGING OF THE DIAGNOSTIC TIME AND DATE OF THE EVENT.



OVER TEMPERATURE SETUP PROCEDURE

1. Press [MENU] once and then [UP] or [DOWN] until the display reads {-MENU- / OVER TEMPERATURE}.

```
- MENU -
OVER TEMPERATURE
```

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

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

OVER TEMPERATURE
ENABLED

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.

OVER TEMPERATURE
DISABLED

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

- MENU -
OVER TEMPERATURE

7.2.14 Power Failure Setup

This sub-menu allows you to configure the way the DLCM reacts when power is restored after a power outage. Additionally this sub-menu allows setting the action to take if improper voltage is applied.

During the power up stage, the DLCM can either:

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



A POWER OUTAGE IS DEFINED AS THE LOSS OF POWER WHENEVER THE DLCM IS NOT IN THE {MOTOR OFF} STATE.

POWER FAILURE SETUP PROCEDURE

1. Press [MENU] once and then [UP] or [DOWN] 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 (factory default).

DURING POWER UP
MOTOR OFF

Press [ENTER] to accept. Go 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.

- The display prompts you for an action to take when the wrong voltage is detected.

| |
|---------------------------------|
| WRONG VOLTAGE HARD SHUT DOWN |
|---------------------------------|

The following options are available:

| SELECTION | ACTION |
|----------------------|--|
| Hard Shutdown | Display under/over voltage message |
| | Turn motor off |
| | Inhibit motor operation (Motor Key Disabled) |
| | Voltage correction and power cycle required to reset |
| Motor Off | Display under/over voltage message |
| | Turn motor off |
| Message Only | Display under/over voltage message |
| Ignore Error | None |

Press [UP] or [DOWN] to make your selection. Press [ENTER] to accept your selection.

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

7.2.15 Alarm Relay

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



THESE SCREENS CONFIGURE BOTH THE HIGH-VOLTAGE OUTPUT AND LOW-VOLTAGE SWITCH (TRANSISTOR).

ALARM RELAY SETUP PROCEDURE

- Press [MENU]. Press [UP] or [DOWN] until {-MENU- / ALARM RELAY} is displayed. Press [ENTER] to continue to program the Alarm Relay sub-menu.

| |
|-------------------------|
| - MENU - ALARM RELAY |
|-------------------------|

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

| |
|-------------------------------|
| RELAY OUTPUT NORMALLY OPEN |
|-------------------------------|

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

| |
|---------------------------------|
| RELAY OUTPUT NORMALLY CLOSED |
|---------------------------------|

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

- The display returns to the {-MENU- / ALARM RELAY} screen.

7.2.16 Analog Mode

Use the Analog Mode setting to activate or de-activate the analog mode and set the number of active signals. If deactivated, the analog mode will not appear when the [MODE] key is pressed. If you are not using the analog input (i.e., you have made no connections to J4-1, J4-2, and J4-7, J4-8) but have the Analog Mode set to ACTIVE then any time you press [MODE], by default the DLCM will generate an {ANALOG SIG FAIL} alarm. De-activating Analog Mode prevents this.

If Analog Mode is active, you must also configure the number of active signals. If you will be adjusting the stroke setting with one signal and the motor speed with a second signal, you must set the DLCM to the 2-signal operating mode.

You can also modify the way the DLCM responds to a signal. You can set the number of samples to be averaged (within a range of 1 to 100 samples), and you can set the interval, in number of samples, that the DLCM should adjust the stroke setting to the specified average (within a range of 1 to 100 samples). The DLCM samples the Analog Input every 0.25 seconds. The default value for the number of samples is 20 and the default value for the sample interval is 20. Therefore, the DLCM will average the last 20 samples and make an adjustment every 5 seconds ($20 \times 0.25 = 5.0$). Here are some general guidelines to assist you when adjusting these values:

- Increase the {SAMPLE SIZE} value to reduce the effect of electrical 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 DLCM is constantly adjusting the stroke setting (often resulting in a {DUTY CYCLE} alarm).
- Decrease the {UPDATE EVERY / XX SAMPLES} value to increase tracking response.



IN MOST SITUATIONS, THE DEFAULT VALUES WILL BE ADEQUATE.

ANALOG MODE SETUP PROCEDURE

1. Press [MENU] once and then [UP] or [DOWN] until the screen {-MENU- / ANALOG MODE} is displayed.

```
  - MENU -  
ANALOG MODE
```

Press [ENTER] to continue to program the Analog Mode sub-menu.

2. The {ANALOG MODE / ACTIVE} screen is displayed.

```
ANALOG MODE  
ACTIVE
```

Press [ENTER] to accept the default value.

If you want the analog mode to be inactive and {ACTIVE} is displayed, press [UP] to change the display to {INACTIVE}. Press [ENTER] to accept your selection. Go to step 12.

The {STROKE & SPEED / 1 – SIGNAL} screen is displayed.

```
STROKE & SPEED  
1 - SIGNAL
```

3. To accept the default value of 1 – SIGNAL, press [ENTER]. To select the 2-signal mode, go to step 7.
4. The {SAMPLE SIZE / XXX} screen is displayed.

```
SAMPLE SIZE  
XXX
```

Press [UP] or [DOWN] to set the number of samples taken from the 4-20mA input to average. The DLCM will adjust its output in accordance with the average of the number of

samples you set here. Enter a value in the range of 1 to 100 samples using the [UP] or [DOWN] key(s).

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 DLCM TO TRACK A RAPIDLY CHANGING SIGNAL MORE CLOSELY.

5. The {UPDATE EVERY / XXX SAMPLES} screen is displayed. Press [UP] or [DOWN] to set how often the DLCM will adjust to the current average value. The default value (20) causes the DLCM to adjust every 20 samples or every 5 seconds ($20 * 0.25 = 5$). You may enter a value in the range of 1 to 100 using the [UP] or [DOWN] key(s).



DECREASE THE VALUE TO BETTER FOLLOW A RAPIDLY CHANGING SIGNAL.

```
UPDATE EVERY
XXX SAMPLES
```

6. Press [ENTER] to accept your selection. Skip to step 12.
7. From the {STROKE & SPEED / 1 – SIGNAL} screen press [UP] to select the {2-SIGNALS} mode.

```
STROKE & SPEED
2 - SIGNALS
```

Press [ENTER] to accept your selection.

8. The {#1 SAMPLE SIZE / XXX} screen is displayed.

```
#1 SAMPLE SIZE
XXX
```

Press [UP] or [DOWN] to set the {#1 SAMPLE SIZE}. The '#1' refers to the signal that controls the STROKE adjustment.



INCREASE THE NUMBER OF SAMPLES TO SMOOTH OUT A NOISY INPUT. DECREASE THE NUMBER OF SAMPLES TO CAUSE THE DLCM TO TRACK A RAPIDLY CHANGING SIGNAL MORE CLOSELY.

Press [ENTER] to accept your selection.

9. The {#1 UPDATE EVERY / XXX SAMPLES} screen is displayed.

```
#1 UPDATED EVERY
XXX SAMPLES
```

Press [UP] and [DOWN] to set the {#1 UPDATE EVERY / XXX SAMPLES}. Press [ENTER] to accept your selection.



DECREASE THE VALUE TO BETTER FOLLOW A RAPIDLY CHANGING SIGNAL.

10. The {#2 SAMPLE SIZE / XXX} screen is displayed.

```
#2 SAMPLE SIZE
XXX
```

Press [UP] or [DOWN] to set the #2 SAMPLE SIZE. The '#2' refers to the signal that controls the MOTOR SPEED adjustment.

Press [ENTER] to accept your selection.

11. The {#2 UPDATE EVERY / XXX SAMPLES} screen is displayed.

#2 UPDATE EVERY
XXX SAMPLES

Press [UP] or [DOWN] to set the {#2 UPDATE EVERY / XXX SAMPLES}. Press [ENTER] to accept your selection.

12. The {-MENU- / ANALOG MODE} screen is displayed.

7.2.17 MODBUS Mode

Use the MODBUS mode setting to activate or de-activate the DLCM's ability to follow a MODBUS serial signal. If deactivated, the MODBUS mode will not appear when [MODE] is pressed. If you are not using the serial input (i.e., you have made no connections to J7 or J8) but have the MODBUS mode set to active, then any time you mistakenly press [MODE], by default the DLC will generate a {MODBUS SIGNAL FAILURE} alarm. De-activating MODBUS mode prevents this.



THE [MODE] KEY ALLOWS YOU TO SELECT AN OPERATING MODE. IT ACTS AS A MASTER SWITCH ALLOWING YOU TO SELECT THE SIGNAL THAT CONTROLS THE DLCM. IT DOES NOT INHIBIT MODBUS COMMUNICATIONS. IT ONLY INHIBITS MODBUS COMMANDS THAT PERTAIN TO THE OPERATION (E.G., YOU CANNOT TURN THE PUMP MOTOR ON USING MODBUS UNLESS THE MODE IS SET TO MODBUS).



MODBUS MODE SETUP PROCEDURE:

TO ACCESS THE {MODBUS MODE} MENU YOU MUST HAVE SERIAL COMM ENABLED AND THE CLASS SET TO SLAVE. REFER TO THE SERIAL COMMUNICATIONS SECTION LATER IN THIS CHAPTER.

1. Press [MENU]. Press [UP] or [DOWN] until the {-MENU- / MODBUS MODE} screen is displayed.

- MENU -
MODBUS MODE

Press [ENTER] to continue to program the MODBUS mode. The {MODBUS MODE / INACTIVE} screen is displayed.

MODBUS MODE
INACTIVE

{MODBUS MODE / INACTIVE} would be selected if you do not intend to control the DLCM using the MODBUS protocol. Pressing [ENTER] when {INACTIVE} is displayed will cause the screen to return to the {-MENU- / MODBUS MODE} menu.

2. {MODBUS MODE / ACTIVE} would be selected if you are going to control the DLCM using the MODBUS protocol.

With the {MODBUS MODE / INACTIVE} screen displayed, press [UP] to display the {MODBUS MODE / ACTIVE} screen.

MODBUS MODE
INACTIVE

Press
[UP]

MODBUS MODE
ACTIVE

3. While in the {ACTIVE} mode there are two options to select from: {STROKE & SPEED / 1 – SIGNAL} and {STROKE & SPEED / 2 – SIGNALS}.

STROKE & SPEED
1 – SIGNAL

- Or -

STROKE & SPEED
2 – SIGNALS

4. While the {STROKE & SPEED / 1 – SIGNAL} is displayed, press [ENTER] to select this option. The {INPUT RATIO / 100%} screen is displayed.
5. Use the {INPUT RATIO} setting to scale the serial input value to meet your needs. Press [UP] or [DOWN] to set the ratio value between 20% and 100%.

| |
|---------------------|
| INPUT RATIO 100% |
|---------------------|

Press [ENTER] to accept your changes. The {ACTION / FORWARD} screen is displayed.

6. You can also instruct the DLCM to act on the MODBUS signal in a forward or reverse direction. When {ACTION / FORWARD} is selected, the DLCM “acts” in the same direction as the signal. If the signal changes from 25% to 75%, the DLCM will adjust its output from 25% to 75% (assuming the ratio is set to 100%). When {ACTION / REVERSE} is selected the DLCM will “act” in the opposite direction. If the signal changes from 25% to 75% the DLCM will adjust its output from 75% to 25% (assuming the ratio is set to 100%).

Press [UP] or [DOWN] to switch between {ACTION / FORWARD} and {ACTION / REVERSE}.

| | | |
|-------------------|-------|-------------------|
| ACTION FORWARD | Press | ACTION REVERSE |
| | [UP] | |

Press [ENTER] to accept your selection.

7. The {-MENU- / MODBUS MODE} screen is displayed. (Skip to 13.)
8. With the {STROKE & SPEED / 1 – SIGNAL} screen displayed (refer to *step 3*), press [UP] to display the {STROKE & SPEED / 2 – SIGNALS} screen.

| |
|-------------------------------|
| STROKE & SPEED 2 - SIGNALS |
|-------------------------------|

Press [ENTER] to accept your selection. The {STROKE RATIO / 100%} screen is displayed.

9. Use the {STROKE RATIO} setting to scale the serial input value to meet your needs. Press [UP] or [DOWN] to set the ratio value between 20% and 100%.

| |
|----------------------|
| STROKE RATIO 100% |
|----------------------|

Press [ENTER] to accept your changes. The {STROKE ACTION / FORWARD} screen is displayed.

10. Use the {STROKE ACTION} setting to determine the stroke direction to meet your needs. When {STROKE ACTION / FORWARD} is selected, the DLCM “acts” in the same direction as the signal. When {STROKE ACTION / REVERSE} is selected the DLCM will “act” in the opposite direction as the signal. Press [UP] or [DOWN] to select between {STROKE ACTION / FORWARD} and {STROKE ACTION / REVERSE}.

| | | |
|--------------------------|-------|--------------------------|
| STROKE ACTION FORWARD | Press | STROKE ACTION REVERSE |
| | [UP] | |

Press [ENTER] to accept your changes. The {SPEED RATIO / 100%} screen is displayed.

11. Use the {SPEED RATIO} setting to scale the pump speed to meet your needs. Press [UP] or [DOWN] to set the ratio value between 20% and 100%.

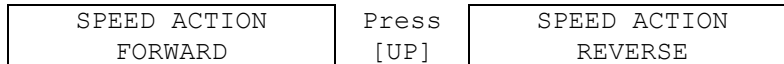
| |
|---------------------|
| SPEED RATIO 100% |
|---------------------|

Press [ENTER] to accept your changes. The {SPEED ACTION / FORWARD} screen is displayed.

12. Use the {SPEED ACTION} setting to determine the pump speed reaction to meet your needs. When

{SPEED ACTION / FORWARD} is selected pump speed will “act” in the same direction, and if the signal changes from 25% to 75%, the pump speed will adjust its output from 25% to 75% (assuming the ratio is set to 100%). When {SPEED ACTION / REVERSE} is selected pump speed will “act” in the opposite direction. If the signal changes from 25% to 75% pump speed will adjust its output from 75% to 25% (assuming the ratio is set to 100%).

Press [UP] or [DOWN] to switch between {SPEED ACTION / FORWARD} and {SPEED ACTION / REVERSE}.



Press [ENTER] to accept your changes.

13. The {-MENU- / MODBUS MODE} screen is displayed.

7.2.18 Security

The DLCM has three modes of security:

1. None (OFF)
2. Tamper Proof
3. Calibration

With Tamper Proof security active, the DLCM will lockout all of the front panel keys with the exception of [MOTOR]. To use any other key you will be prompted to enter a four digit Personal Identification Number (PIN). Successful entry of a PIN allows you to access all DLCM functions without PIN re-entry. With Calibration security set, the DLCM will lockout access to the [CAL] sub-menu, Pin Setup and Factory Reset Ability. 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 SETUP PROCEDURE

1. Press [MENU]. Press [UP] or [DOWN] until {-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. Press [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 press [UP], [DOWN] and [ENTER] to set the four digit password.



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 or you don't want the selected security level, press [UP] to change the display to {CONFIRM CHANGE? / NO}

CONFIRM CHANGE?
NO

Press [ENTER] to reject the security changes.

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



REMEMBERING THE PIN # YOU SET, IS PROBABLY ONE OF THE MOST IMPORTANT FUNCTIONS OF SETTING SECURITY.

7.2.19 Number Format

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



TIP

REFER TO THE TABLE IN SECTION 10: FACTORY DEFAULTS FOR FACTORY DECIMAL POSITION SETTINGS.



NUMBER FORMAT SETUP PROCEDURE

1. Press [MENU]. Press [UP] or [DOWN] 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.

| | | |
|------------------------------------|---------------|------------------------------------|
| E.G.: 9,999.99 DECIMAL OR COMMA | Press [UP] | E.G.: 9.999,99 DECIMAL OR COMMA |
|------------------------------------|---------------|------------------------------------|

Press [ENTER] to accept the displayed format.

3. The decimal position screen is displayed. Press [DOWN] to move the decimal position one place to the left. Press [UP] to move the decimal position one place to the right. For example, the screen displays 9.99999, pressing [DOWN] causes the display to change to 0.999999. The valid range is 999.999 to 0.0999999. When the decimal position satisfies your needs press [ENTER] to accept.

| | | |
|-----------------------------------|-----------------|------------------------------------|
| E.G.: 9.99999 DECIMAL POSITION | Press (DOWN) | E.G.: 0.999999 DECIMAL POSITION |
|-----------------------------------|-----------------|------------------------------------|

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



NOTE

PERFORM A PUMP FLOW CALIBRATION AFTER CHANGING THE DECIMAL POSITION.

7.2.20 Contrast Adjust

The DLCM display contrast can be adjusted to a desired setting.



CONTRAST ADJUSTMENT PROCEDURE

1. Press [MENU]. Press [UP] or [DOWN] until the display reads {-MENU- / CONTRAST ADJUST}. Press [ENTER] to continue in the contrast adjust sub-menu.

| |
|-----------------------------|
| - MENU - CONTRAST ADJUST |
|-----------------------------|

2. Press and hold [UP] to darken the characters on the display. Press and hold [DOWN] to lighten the characters.

| |
|----------------------------------|
| USE ARROWS TO ADJUST CONTRAST |
|----------------------------------|



NOTE

BY GOING TOO FAR IN EITHER DIRECTION THE SCREEN CAN BE EXTREMELY DIFFICULT TO READ. PRESS AND HOLD THE OPPOSITE ARROW TO CORRECT THE DISPLAY OR YOU CAN RETURN TO THE FACTORY SETTING BY PRESSING [UP] AND [DOWN] SIMULTANEOUSLY WHILE IN THIS MENU.

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 AND HOLDING [MENU] AND [UP] OR [DOWN] SIMULTANEOUSLY.

7.2.21 Serial Communications

Use {–MENU– / SERIAL COMM} to configure the serial communications port for operation using the MODBUS protocol (refer to **Section 14: Pulsanet Specification** section at the back of this manual for further information).

By using the serial communications port you can communicate digitally with your DLCM. This allows a PC/PLC or another DLC or DLCM to send and receive exact values. This eliminates inaccuracies typically associated with analog signal conversion.

In order for two or more devices to communicate using serial communications they must:

- Be electrically connected (refer to Section 5: Instrumentation, Electrical Wiring).
- Enabled.
- Speak the same language (protocol).
- Speak at the same speed (baud rate).
- Use the same error detection protocol.
- Have unique addressing in the network.
- Have only one master on a given network.

The {SERIAL COMM} menu allows the setting of these communication parameters.

If you are installing this DLCM into an existing network, retrieve the following parameters (**bold** indicates default DLCM values not network defaults).

| COMMUNICATION PARAMETERS WORKSHEET | | | | | | | | |
|-------------------------------------|--|--------------------------------|-------------------------------|-------------------------------|-------------------------------|--|---------------------------------|---------------------------------|
| MODBUS Type | <input checked="" type="checkbox"/> RTU | <input type="checkbox"/> ASCII | | | | | | |
| Baud Rate | <input type="checkbox"/> 300 | <input type="checkbox"/> 600 | <input type="checkbox"/> 1200 | <input type="checkbox"/> 2400 | <input type="checkbox"/> 4800 | <input checked="" type="checkbox"/> 9600 | <input type="checkbox"/> 19,200 | <input type="checkbox"/> 38,400 |
| Data Parity | <input checked="" type="checkbox"/> Even | <input type="checkbox"/> Odd | <input type="checkbox"/> None | | | | | |
| Slave Address (Mark one or more) | <input checked="" type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 | <input type="checkbox"/> 8 |
| | <input type="checkbox"/> 9 | <input type="checkbox"/> 10 | <input type="checkbox"/> 11 | <input type="checkbox"/> 12 | <input type="checkbox"/> 13 | <input type="checkbox"/> 14 | <input type="checkbox"/> 15 | <input type="checkbox"/> 16 |
| | <input type="checkbox"/> 17 | <input type="checkbox"/> 18 | <input type="checkbox"/> 19 | <input type="checkbox"/> 20 | <input type="checkbox"/> 21 | <input type="checkbox"/> 22 | <input type="checkbox"/> 23 | <input type="checkbox"/> 24 |
| | <input type="checkbox"/> 25 | <input type="checkbox"/> 26 | <input type="checkbox"/> 27 | <input type="checkbox"/> 28 | <input type="checkbox"/> 29 | <input type="checkbox"/> 30 | <input type="checkbox"/> 31 | <input type="checkbox"/> 32 |



COMMUNICATIONS SETTINGS FOR DLCM'S OPERATING IN A MULTIPLEXED ENVIRONMENT (I.E., ONE MOTOR DRIVING ONE OR MORE PUMP HEADS) ARE PRE-CONFIGURED.



COMMUNICATIONS SETUP PROCEDURE

1. To access the Serial Communications menu press [MENU] and then press [UP] or [DOWN] until the {–MENU– / SERIAL COMM} screen is displayed.

| |
|-------------------------|
| – MENU – SERIAL COMM |
|-------------------------|

Press [ENTER] to view/modify the settings.

2. The display prompts you to enable or disable the DLCM's communications function.

| | | |
|-------------------------|---------------|------------------------|
| SERIAL COMM DISABLED | Press [UP] | SERIAL COMM ENABLED |
|-------------------------|---------------|------------------------|

Press [UP] or [DOWN] to reveal your selection. Press [ENTER] to accept your setting.

- The display prompts you for the type of communications. The DLCM supports the standard MODBUS protocol. This standard defines two ways for devices to format the data they exchange:
 - “RTU” is a binary format that offers improved data throughput.
 - “ASCII” is a format based on the ANSI character standard. It has larger message blocks that yield reduced data throughput.

If you are installing a DLCM into an existing network, you must match the setting you marked on the worksheet.

If this is a new **DLC/DLCM only** installation, choose “RTU”. Press [UP] or [DOWN] to select your choice.

| | | |
|-------------|---------------|---------------|
| TYPE RTU | Press [UP] | TYPE ASCII |
|-------------|---------------|---------------|

Press [ENTER] to accept.

- The display prompts you to set the baud rate. The baud rate must be common for the network (i.e., all devices must be set at the same baud rate).

Set this value to that recorded on your worksheet previously or use the default setting of 9600.

| |
|-------------------|
| BAUD RATE 9600 |
|-------------------|

Press [UP] or [DOWN] to select your choice. Press [ENTER] to accept.

- The data parity display instructs the DLCM on the use of the parity bit for error checking transferred data. This setting must match that of the existing network (refer to the selection you made on the work sheet). Otherwise, select the default value of **EVEN**.

| | | | | |
|---------------------|---------------|--------------------|---------------|---------------------|
| DATA PARITY EVEN | Press [UP] | DATA PARITY ODD | Press [UP] | DATA PARITY NONE |
|---------------------|---------------|--------------------|---------------|---------------------|

Press [UP] or [DOWN] to set the parity type.

- The Class setting defines how the DLCM will operate in the network. If **Class** is set to **Master**, then the DLCM tells other equipment (e.g., other DLCM’s) that are configured as slaves what to do (e.g., adjust stroke percent to 50%). If the Class setting is set for **Slave**, then the DLCM is expecting a command from a **Master** unit.



YOU CAN ONLY HAVE ONE MASTER IN A NETWORK. THUS, THE CLASS SETTING WILL TYPICALLY BE SLAVE.

Press [UP] or [DOWN] to set the Class setting.

| | | |
|----------------|---------------|-----------------|
| CLASS SLAVE | Press [UP] | CLASS MASTER |
|----------------|---------------|-----------------|

Press [ENTER] to accept your setting.



THE MASTER DOES NOT HAVE A NETWORK ADDRESS. SKIP TO STEP 8.

- Every slave attached to a MODBUS network must have a unique address. Use the {NET ADDRESS} menu to set the address for this DLCM.

If this is a new installation, check your worksheet for an available address.

| |
|------------------|
| NET ADDRESS 1 |
|------------------|

Press [UP] or [DOWN] to set the address. Press [ENTER] to accept your setting.

- If you selected **Master** in step 6, you must also set the amount of time the DLCM should wait for a response from a **Slave**. If the **Slave** fails to respond within this time period, the **Master** will attempt to communicate with the next **Slave** on its list.

```
RESPONSE TIME
1.5 SECONDS
```

Press [UP] or [DOWN] to set the response time value (refer to the beginning of this section for tips on making this setting).

- If you selected **Master** in step 6, then you will be presented with a menu that allows you to identify **Slaves**. Otherwise go to step 10.

You can use the {IDENTIFY SLAVES} menu in one of two ways:

- Set the **Slave** addresses manually
- Use the **Auto Detect** feature

To use the **Auto Detect** feature, press [UP] or [DOWN] to change the setting to **Auto Detect**. Press [ENTER] to accept your selection.

```
IDENTIFY SLAVES
AUTO DETECT
```

The DLCM will then display a status screen as it scans the 32 addresses for slave devices. The address under test is indicated to the right of **AUTO DETECT**.

```
PLEASE WAIT
AUTO DETECT #
```



YOU CAN USE THE AUTO DETECT FEATURE TO VALIDATE COMMUNICATIONS BETWEEN A MASTER DLCM AND ONE OR MORE SLAVES. YOU CAN ALSO USE THE SERIAL DIAGNOSTIC MENU (REFER TO THE NEXT SECTION).

- After the AUTO DETECT completes, you are returned to the {-MENU- / SERIAL COMM} screen. Repeat steps 1 through 9 without selecting AUTO DETECT to return to this menu.

7.2.22 Serial Diagnostics

The Serial Diagnostics menus are designed to assist you in the troubleshooting of the communications system.



SERIAL DIAGNOSTIC PROCEDURE

- To access the Serial Diagnostics menu press [UP] or [DOWN] until the {-MENU- / SERIAL DIAG.} is displayed.

```
- MENU -
SERIAL DIAG
```

Press [ENTER].

- The first menu shows the number of MODBUS messages exchanged by this node while the menu is displayed.

```
RECEIVE: 640
TRANSMIT: 640
```

- Press either [UP] or [DOWN] to reset the count value. Press [ENTER] to proceed to the next screen.

```
LOOPBACK TEST
NO
```

- Or -

```
LOOPBACK TEST
YES
```

Selecting {YES} will start the test (skip to Step 6), or if {NO} is selected you are sent to the {ECHO TEST / NO} screen.

- The {ECHO TEST / NO} screen is displayed.

```

ECHO TEST
NO
    
```

The Echo test causes the DLCM to echo back all characters it received, much like the Loopback Device. You can then use another piece of equipment (e.g., PC) to originate characters.

- Press [ENTER] to skip the echo test or press [UP] and then [ENTER] to set {ECHO TEST / NO} to {ECHO TEST / YES} and initiate the test. The following screen is displayed:

```

ECHO CHARACTERS
TEST IN PROGRESS
    
```

When the Echo Test is complete, the following screen is displayed:

```

GOOD      XXXX
BAD       XXXX
    
```

- Press [ENTER] to exit the Echo Test and return to the {-MENU- / SERIAL COMM} screen.



Loopback Test Procedure

- The Loopback test is helpful in the identification of wiring errors and the possible need for line terminators at the ends of the network. While this menu is displayed the DLCM transmits and expects to receive characters back. The display shows the percent (%) of successful characters exchanged.

The Loopback test requires the installation of a Loopback device at the end of the cable segment under test. This can be constructed according to **Figure 20** below:

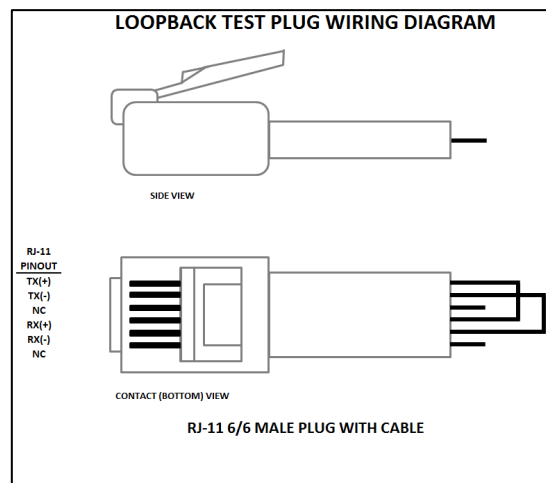


Figure 20 – Loopback Device Wiring Diagram

8. Install the cable under test in the second port. (J7 or J8)
9. Install the loop back device at the far end of the cable under test.

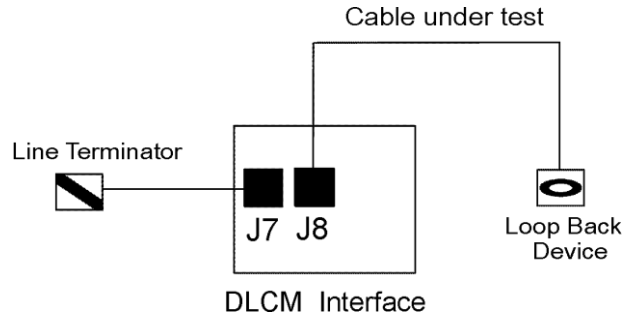
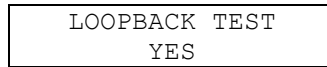
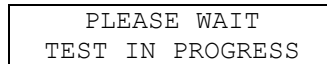


Figure 20.1 – Loop Back Circuit (Line Terminator Optional)

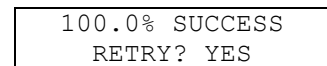
10. With the {LOOPBACK TEST YES} screen displayed, press [ENTER].



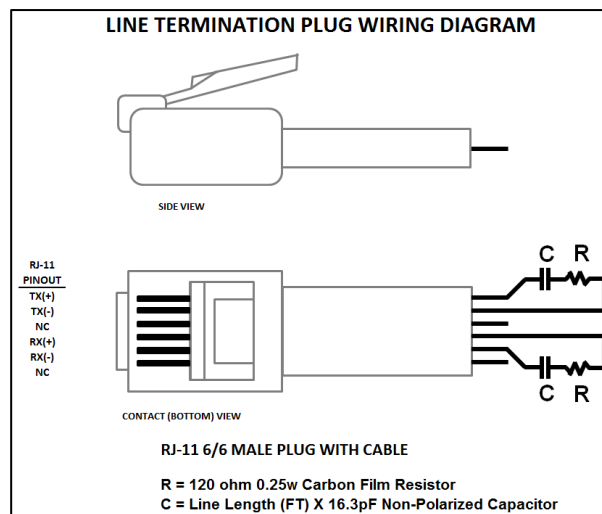
11. While the LOOPBACK test is being conducted, the following screen is displayed:



When the test is completed, a result screen is displayed:



12. If the indicated percent of success is 100%, the cable segment is good and no further action is required. Skip to the end of this procedure.
13. If the indicated percent of success is less than 100% then double check the connections. Repeat the test by pressing [ENTER]. Refer to Section 8: Installation/Component for further details wiring details.
14. If the indicated percent of success persists network termination at the far ends of the network may be required. Install the line terminator in one port of the DLCM in J7 or J8.



15. Figure 20.2 - Line Terminator

Alternatively, it may be possible to lower the baud rate on the network or use an ASCII message format instead of the RTU default. See Section 7 General Operations, Menu, Serial Communications for further details.

16. To exit the diagnostic menu press [UP] and then press [ENTER]. The {-MENU- / SERIAL COMM} screen is displayed.

7.2.23 Language

All displayed text can be displayed in English, Spanish, French or German.



LANGUAGE SETUP PROCEDURE

1. Press [MENU]. Press [UP] or [DOWN] until {-MENU- / LANGUAGE} is displayed.

```
- MENU -  
LANGUAGE
```

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.

| | | | |
|--------------------------------------|---------------|---------------------------------------|---------------|
| <pre>LANGUAGE TYPE ENGLISH</pre> | Press [UP] | <pre>LANGUAGE TYPE FRANCAIS</pre> | Press [UP] |
| <pre>LANGUAGE TYPE DEUTSCH</pre> | Press [UP] | <pre>LANGUAGE TYPE ESPANOL</pre> | |

When the correct language is displayed, press [ENTER] to activate. All text will be displayed in the selected language.

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

7.2.24 Factory Defaults Reset Procedure

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



FACTORY DEFAULTS RESET PROCEDURE

1. Press [MENU], then [UP] or [DOWN] until the {-MENU- / FACTORY DEFAULTS} screen is displayed.

```
- MENU -  
FACTORY DEFAULTS
```

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 a Factory Reset is not desired, press [ENTER] to go back to the {-MENU- / FACTORY DEFAULTS} screen.

3. If the DLCM is to be reset to the factory defaults, press [UP] to scroll the value to {YES}.

```
FACTORY RESET?  
YES
```

Press [ENTER] to accept your selection.

- The display prompts you to verify your action.



RESETTING FACTORY DEFAULTS WILL DESTROY ALL USER CALIBRATION INFORMATION.

ARE YOU SURE?
NO

Press [UP] to change the value to {YES}. Press [ENTER] to accept your selection. The following message is displayed:

PLEASE WAIT

- The first screen displayed during the Re-Set procedure prompts you to turn the motor on.

TURN MOTOR ON
TESTING ENCODER

- Press [MOTOR]. You will hear the pump motor spin up, and the DLCM will perform an Encoder test (displaying the following message):

PLEASE WAIT
TESTING ENCODER

- When the Encoder test is complete, (usually takes about 2 or 3 seconds) the DLCM performs a Zero Calibration (displaying the following message):

PLEASE WAIT
CALIBRATING ZERO

- When the Zero Calibration is complete, you are returned to the {-MENU- / FACTORY DEFAULTS} screen.

- Press [MENU] and the next screen displayed is:

MOTOR STOPPED

- Re-establish any Menu and Calibration settings that are non-standard at this time.

7.3 Units

By pressing [UNITS] with the motor on, the display will scroll through the CMH, GPH, LPH, CCH, CMM, GPM, LPM, CCM, % flow, % stroke length or % motor speed. The DLCM will automatically convert the motor and stroke settings based on the calibrated flow, to the above referenced units.

The accuracy of the flow rate display is dependent on the pump flow calibration accuracy.

7.4 Varying the Flow Rate - Manually

When the DLCM is in Manual Mode, pump flow rate can be increased by pressing [UP]. The flow rate is decreased by pressing [DOWN]. The DLCM will display the corresponding value of the flow adjustment.

If you attempt to adjust the DLCM's hand-wheel while it is under power, the DLCM will re-adjust back to the position specified by its programming. The hand-wheel is for emergency manual override only. Refer to **Section 13: General Repairs, Emergency Manual Pulsar Operation.**



DO NOT ADJUST THE DLCM'S HAND-WHEEL WHILE THE POWER IS OFF. THIS WILL CAUSE THE DLCM TO LOSE ITS ZERO POINT AND FORCE A {ZERO CALIBRATION} AT STARTUP.

7.5 Mode

Pressing [MODE], switches the DLCM's operating mode. If the ANALOG MODE is set to ACTIVE, then pressing [MODE] will switch between {MANUAL MODE} and {ANALOG MODE}. When MODBUS MODE is set to ACTIVE, pressing [MODE] will switch between {MANUAL MODE} and {MODBUS MODE}. In essence, this key acts like a local auto/manual switch.

7.6 Batch

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



WHEN DAYLIGHT SAVINGS IS SET TO AUTO CHANGE, USE CAUTION WHEN SETTING UP BATCHES THAT RUN THROUGH OR START OR STOP IN THE TIME CHANGE OVER PERIODS WHERE ONE FULL HOUR EITHER DOESN'T EXIST AT ALL OR OCCURS TWICE CONSECUTIVELY. IF YOU ARE IN DOUBT, SET THE {DAYLIGHT SAVINGS} OPTION TO [NO]. (REFER TO SECTION 7: GENERAL OPERATION, SET TIME AND DATE)

7.6.1 One-Time Only

The One Time Only batch will start at a specified time and run for a specified duration at a specified flow rate that you define (refer to **Figure 21**).

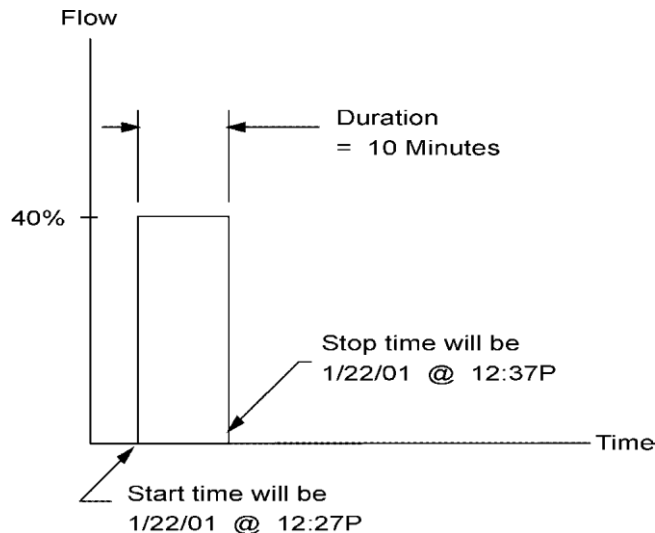


Figure 21 – One Time Only Batch

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 22*).



ANY OF THE THREE BATCHES CAN BE SPECIFIED AS ONE TIME ONLY OR REPEATING.

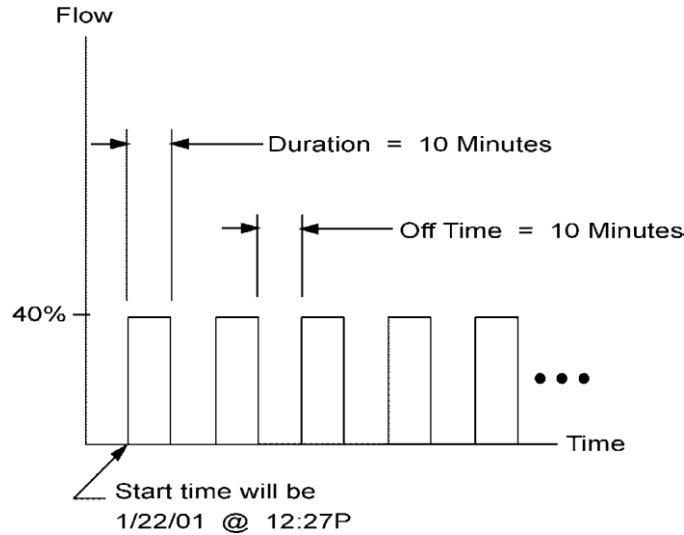


Figure 22 - Repeating Batch.

7.6.3 Overlapped

The batches can also be overlapped (refer to *Figure 23* below).

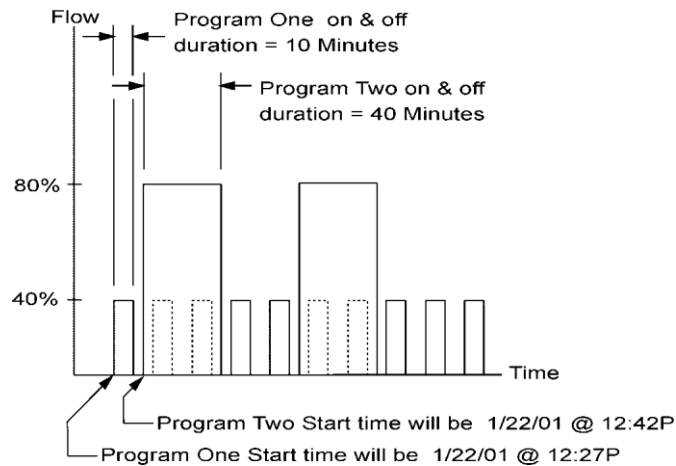


Figure 23 – Overlapping Batch.



WHEN THE BATCHES ARE OVERLAPPED, THE FLOW RATES ARE NOT ADDITIVE. THE HIGHEST OF THE TWO OR THREE FLOW RATES IS USED.

THE DLCM CAN MAKE A 1% PER SECOND ADJUSTMENT OF PUMP STROKE LENGTH. REMEMBER THAT WHEN A BATCH STARTS, THE DLCM 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 SETUP PROCEDURE

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



NOTE

SETTING THE BATCH SYSTEM TO ACTIVE WILL CAUSE ANY PRE-CONFIGURED BATCHES THAT ARE SCHEDULED TO START AT THIS TIME, TO START IMMEDIATELY, SO YOU MIGHT WANT TO DO THIS LAST.

| | | |
|-------------------|---------------|---------------------|
| BATCHES ACTIVE | Press [UP] | BATCHES INACTIVE |
|-------------------|---------------|---------------------|

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 DLCM is supplied with three user 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. Press [UP] or [DOWN] to set the value.



NOTE

IF A VALUE HAS BEEN SET PREVIOUSLY IT WILL BE USED AS A STARTING POINT FOR THE NEW SETTING.



TIP

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.

| |
|------------------------------------|
| BATCH #1 DURATION 12 HRS 30 MIN |
|------------------------------------|

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

| |
|------------------------------------|
| BATCH #1 DURATION 12 HRS 30 MIN |
|------------------------------------|

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

| |
|------------------------------------|
| BATCH #1 DURATION 12 HRS 30 MIN |
|------------------------------------|

8. The cursor then moves to the second digit of the minutes field. Use [UP] or [DOWN] to scroll through the numbers 0-9. Set the second digit of the minute value. Press [ENTER] to accept the desired second digit of the minute setting which completes the batch duration entry and exits the Batch duration screen.

```
BATCH #1 DURATION
12 HRS 30 MIN
```

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

```
BATCH #1 TYPE
ONE TIME ONLY
```

10. You can select from one of 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.

```
BATCH #1 TYPE
ONE TIME ONLY
```

Press
[UP]

```
BATCH #1 TYPE
REPEATING
```

Press [ENTER] to select the type of batch desired. If you select {ONE TIME ONLY} skip to step 12.

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
```

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

```
BATCH #1 START
8:01a 2/3/01
```

13. The display shows {BATCH #1 CONFIRM? / YES}. Press [ENTER] to confirm the batch or press [UP] to scroll to the {NO} value and then press [ENTER] to disregard the changes to the batch.

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

Follow the procedure outlined in steps 3 through 13 for the Remaining Batches if desired.

14. If the batch was made active, 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 2/3/01
```

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], [DOWN] or [ENTER].

```
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.

```
MOTOR OFF
```

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

```
BATCH #1 PENDING
6:45a  2/4/01
```

7.6.4 Inactivating the Batches

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



BATCH INACTIVATION

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

8 Diagrams: Installation / Component

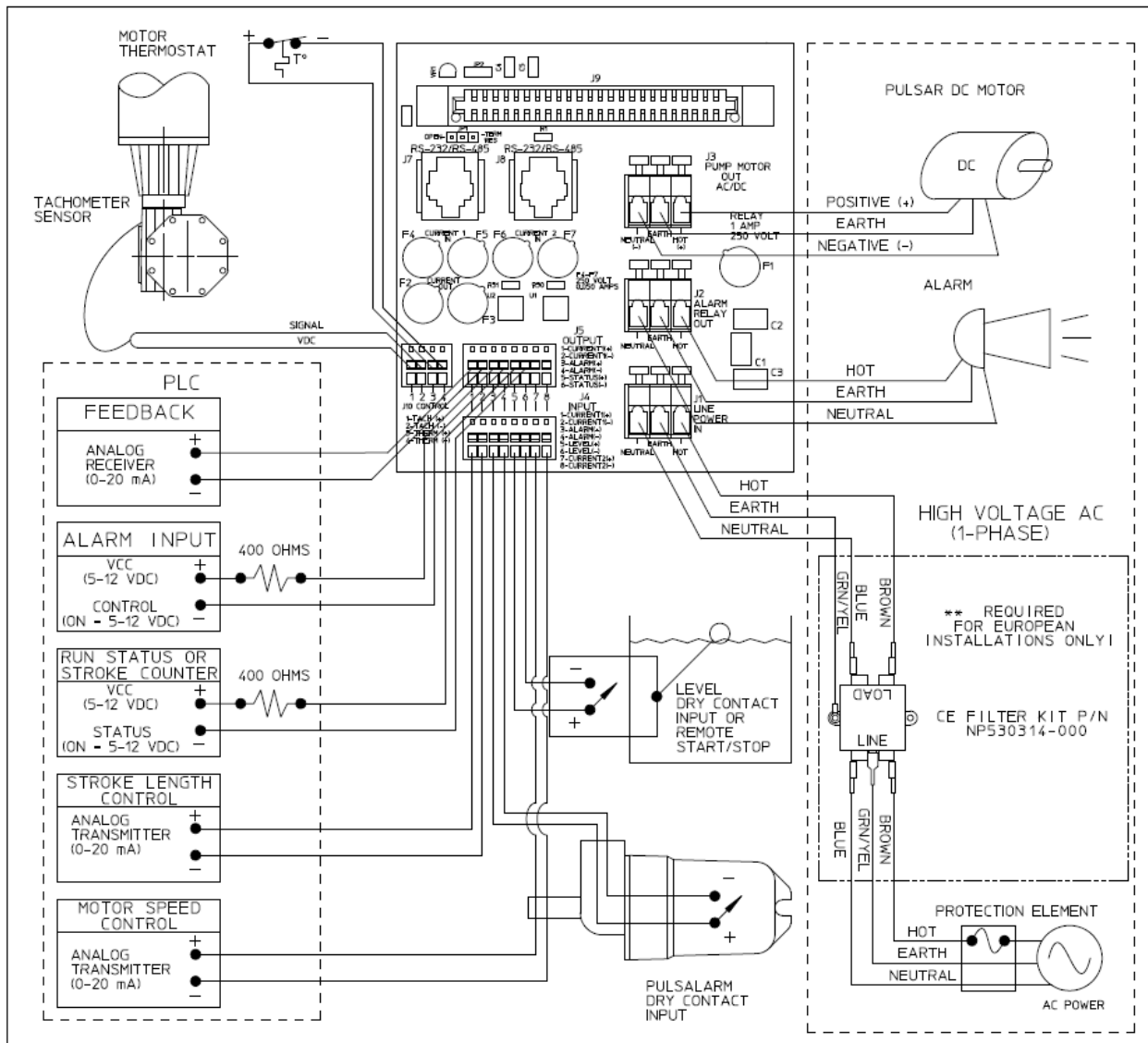


DIAGRAM 1 – DLCM Wiring Diagram

Serial Communications - RS 485 Connections

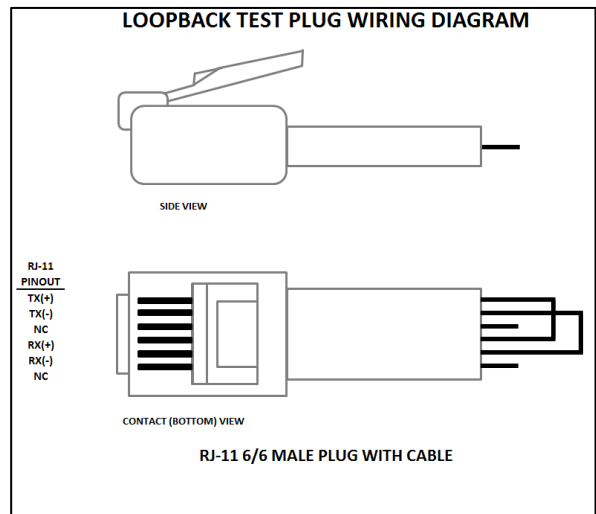
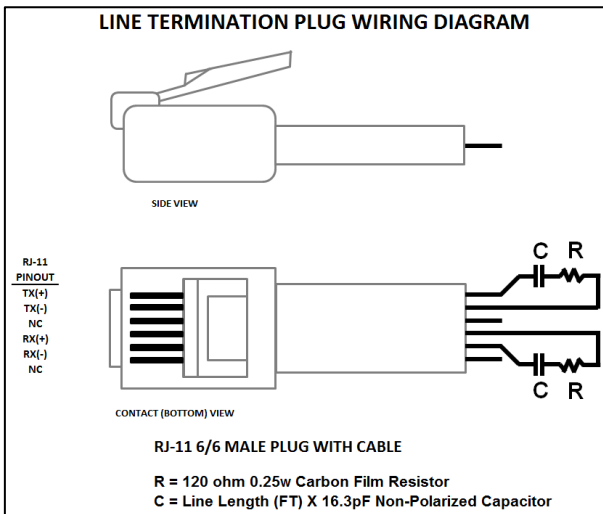
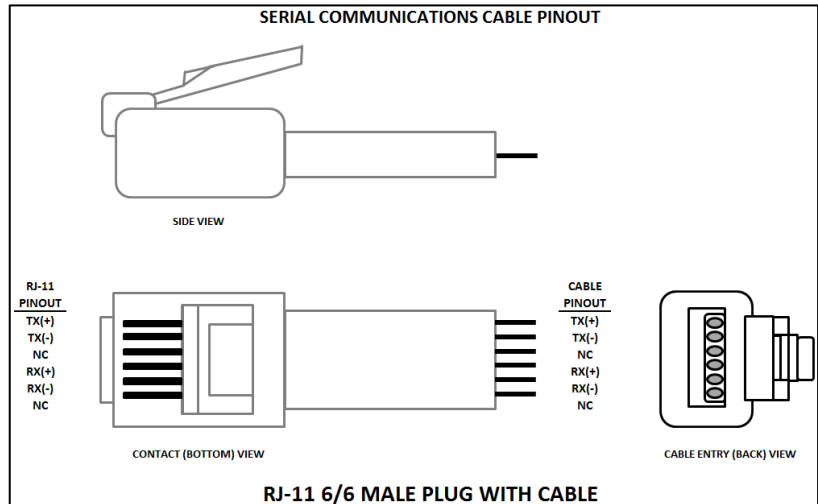
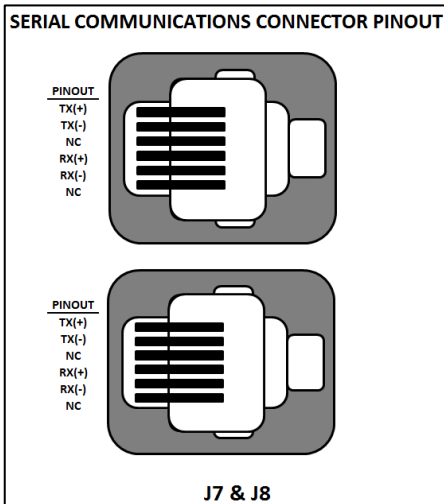
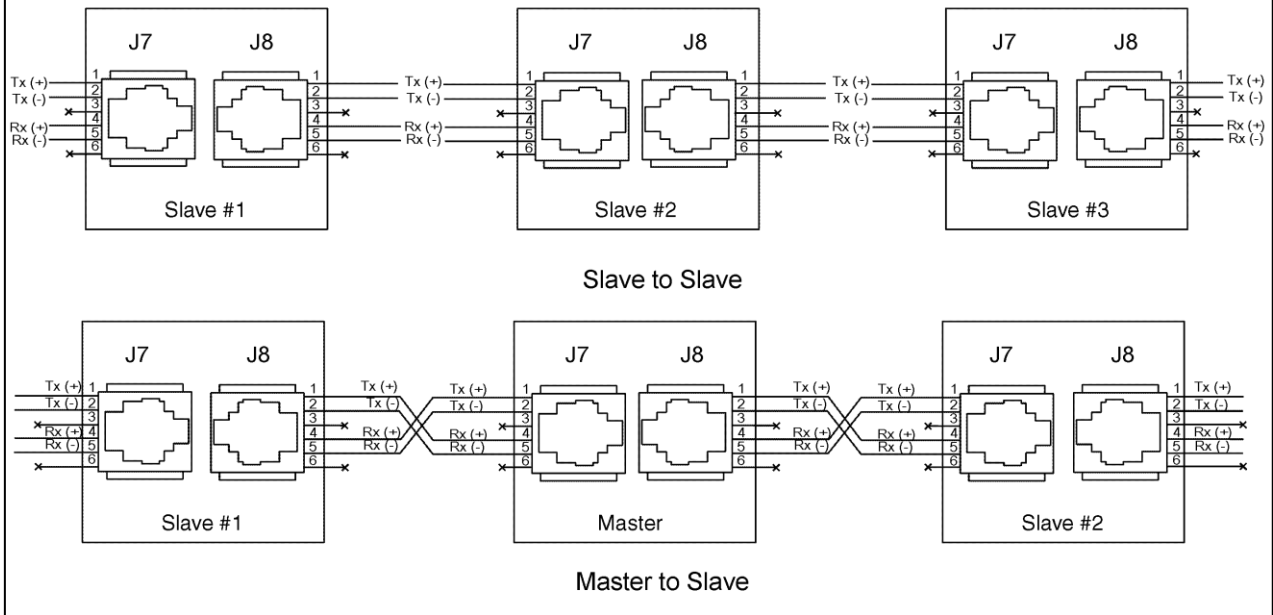


Diagram 2 – Serial Communications – RS 485 Connections

9 Specifications

Overview

The DLCM controller for Pulsar Pumps is an upgrade from the DLC stroke length controller, which provides all of the same functions, but adds the capability of motor speed control using SCR control of the armature voltage applied to a permanent magnet DC motor.

STROKE LENGTH CONTROL

0-100% control range (Software programmable, 0% – 100% factory default)
 0.1% resolution
 10:1 turndown for accuracy specification

MOTOR SPEED CONTROL

5-100% control range. (Software programmable, 10% – 100% factory default)
 0.1% resolution
 20:1 turndown for accuracy specification

COMBINED CALIBRATED FLOW

50:1 total turndown for accuracy specification.
 6 significant digits for displayed units of flow

PUMP ACCURACY

| Accuracy | Standard Diaphragm | Diaphragm With Leak Detection | Single Solid Teflon Diaphragm | Capacity Reference | Turndown Range | | |
|---------------|--------------------|-------------------------------|-------------------------------|--------------------|----------------|-------------|-------------------|
| | | | | | Stroke Length | Motor Speed | Combined Turndown |
| Steady State | ±0.5% | ±0.5% | ±0.5% | Set Point | 10:1 | 20:1 | 50:1 |
| Repeatability | ±0.5% | ±1.0% | ±1.0% | Full Rating | 10:1 | 20:1 | 50:1 |
| Linearity | ±1.0% | ±3.0% | ±3.0% | Full Rating | 10:1 | 20:1 | 50:1 |

ADJUSTMENT RESPONSE

1% per second on stroke length
 1% per second on steady state speed

TEMPERATURE

–18°C to 40°C (0°F to 104°F) Operation
 –18°C to 60°C (0°F to 140°F) Storage

LOW-VOLTAGE INPUTS

| Inputs | Field Wiring Location | Specification / Description |
|------------------------|--------------------------------|--|
| Analog Input Channel 1 | J4 Pin 1 is + J4 Pin 2 is – | Any signal within the range of 0 to 25mA (e.g.: 4-20) or 0 to 5 volts (e.g., 1-5v) Minimum span of 2mA or 0.4 volts. Note: No jumpers used. Displayed in mA. Split Ranging, Reverse Acting and Ratio Control standard on all units; accessible via calibration. Fused at 50mA. Protected against mis-wiring. Surge Protection: 7.4 Joules Isolation: 500 volts from all other inputs, outputs, and ground. |

LOW-VOLTAGE INPUTS (continued)

| Inputs | Field Wiring Location | Specification / Description |
|---|--------------------------------|---|
| Analog Input Channel 2 | J4 Pin 7 is + J4 Pin 8 is – | Specifications same as Channel 1. |
| PULSAlarm (Leak Detection) | J4 Pin 3 is + J4 Pin 4 is – | Dry Contact. (Optically Isolated) – Do not apply powered signal. Isolation: Not isolated from Digital Input or Motor Thermostat, 500 volts from all other inputs, outputs and ground. May be software configured as Normally Open or Normally Closed. May be software configured to operate the Alarm Relay. May be configured to turn the Pump Motor off. |
| Digital Input Programmable as Level Input Or Remote Run / Stop | J4 Pin 5 is + J4 Pin 6 is – | Dry Contact. (Optically Isolated) – Do not apply powered signal. Isolation: Not isolated from PULSAlarm or Motor Thermostat, 500 volts from all other inputs, outputs and ground. May be software configured as Normally Open or Normally Closed. May be software configured to operate the Alarm Relay (Level Input Only). May be configured to turn the Pump Motor off. (Level Input Only) |

LOW-VOLTAGE OUTPUTS

| Outputs | Field Wiring Location | Specification / Description |
|--|--------------------------------|---|
| Analog Output Channel Programmable to output either Calibrated stroke length, percent speed, Or Calibrated flow | J5 Pin 1 is + J5 Pin 2 is – | Any signal within the range of 0 – 20mA (e.g.: 4-20). Minimum span of 2mA. Maximum load: 700 ohms. Reverse Acting standard on all units, which is accessible via calibration. Fused at 50mA protected against mis-wiring. Surge Protection: 7.4 Joules Isolation: 500 volts from all inputs and outputs. |
| Alarm Status | J5 Pin 3 is + J5 Pin 4 is – | Dry Contact (Transistor Type) VCE (SAT): 0.3 volts Max forward current: 50mA Maximum 32VDC On-state resistance: 100 ohms Isolation: 5000 volts from all inputs, outputs and ground. Follows the state of High-Voltage Alarm Output, which may be software configured as Normally Open or Normally Closed. |

LOW-VOLTAGE OUTPUTS (continued)

| Outputs | Field Wiring Location | Specification / Description |
|--|--------------------------------|---|
| Digital Output Programmable as Remote Run Status Or Stroke Counter Or Mode Indication | J5 Pin 5 is + J5 Pin 6 is – | Dry Contact (Transistor Type) VCE (SAT): 0.3 volts Max forward current: 50mA Maximum 32VDC On-state resistance: 100 ohms Isolation: 5000 volts from all inputs, outputs and ground. May be software configured as Normally Open or Normally Closed. (Remote Run Status and Mode Indication only). |

HIGH-VOLTAGE INPUTS

| Inputs | Field Wiring Location | Specification / Description |
|--------------------|------------------------------|---|
| Line Power: | J1 | Factory configured to one of the following: 115VAC $\pm 10\%$, 50/60 Hz, 10 Amp max (with 90 volt armature motors only) 230VAC $\pm 10\%$, 50/60 Hz, 5 Amp max (with 180 volt armature motors only) Surge Protection: 7.4 Joules Software protected against Over/Under voltage. (user selectable) |

HIGH-VOLTAGE OUTPUTS

| Inputs | Field Wiring Location | Specification / Description |
|--------------------|------------------------------|---|
| Alarm Relay | J2 | Fused at 1 amp at rated Line voltage. May be software configured as Normally Open or Normally Closed. |
| Pump Motor | J3 | Permanent Magnet SCR Drive DC Motors with thermostat. Base Speed: 1750 RPM, NEMA 56C Frame, Class F or better insulation. 90 Volt armature, 5.0 amps max. at 115 VAC Input Power. 180 Volt armature, 5.0 amps max at 230 VAC Input Power. |

SERIAL COMMUNICATIONS

| Inputs | Field Wiring Location | Specification / Description |
|---------------|------------------------------|---|
| RS-485 | J7 & J8 | Max Cable length: 1219 meters (4000 feet) Max Address sites: 32 See Section 8: Diagrams Installation/Component for further line termination when required. Isolation: 500 volts from ground and all other inputs and outputs. |

CONTROL INPUTS

| Control Inputs | Field Wiring Location | Specification / Description |
|--------------------------|------------------------------------|---|
| Tachometer Sensor | J10 Pin 1 is VDC J10 Pin 2 is Tach | Connection point for Tach Sensor. Used for sensing Motor Speed. |
| Motor Thermostat | J10 Pin 3 is + J10 Pin 4 is - | Dry Contact (Optically Isolated) – Do not apply powered signal. Isolation: Not isolated from PULSAlarm or Digital Input, 500 volts from all other inputs, outputs, and ground. May be software configured as Normally Open or Normally Closed (default). May be software configured to operate the Alarm Relay (default is YES). May be software configured to turn the Pump Motor OFF (default). If MOTOR OFF is selected may optionally restart the Pump Motor when the thermostat resets (default). |

10 Factory Default Values

CALIBRATION

| | |
|---------------|---|
| Pump Flow | 1-Point Calibration on PULSAR at Rated Flow and Pressure. |
| Analog Input | 4.0 - 20.0mA @ 100% Ratio |
| Analog Output | 4.0 - 20.0mA @ 100% Ratio |

DIAGNOSTICS

| | |
|--------|---------|
| Alarms | Cleared |
|--------|---------|

DATE/TIME

| | |
|-----------------------|----------|
| Date Format | MM/DD/YY |
| Time Format | 24:00 |
| Daylight Savings Time | No |

ANALOG INPUT

| | |
|---------------------------|---|
| Failure Mode channel #n | Enabled – Number of input channels enabled is one. |
| Sample Average channel #n | Freeze at last signal / Restore to Analog Mode/ Error message enabled |
| Sample Update channel #n | 20 Samples |
| Sample Average channel #n | 20 Samples (5.0 Seconds) |

ANALOG OUTPUT

| | |
|--------------------------|--------------------------------------|
| Stroke and Speed setting | Calibrated Stroke and Speed combined |
|--------------------------|--------------------------------------|

END POINT & PRIORITY

| | |
|----------------|-------|
| Stroke Minimum | 0% |
| Stroke Maximum | 100% |
| Speed Minimum | 10% |
| Speed Maximum | 100% |
| Priority | Speed |

LEAK DETECTION

| | |
|-------------------------|--|
| Failure Mode | Inactive |
| LEVEL INPUT | |
| Failure Mode | Inactive |
| DIGITAL OUTPUT | |
| Run/Stop | Normally Open |
| MOTOR THERMOSTAT | |
| Input | Enabled |
| Switch | Normally Closed |
| Motor | Off |
| Alarm | On |
| Restore to | Motor On |
| OVER TEMPERATURE | |
| Error Message | Enabled |
| POWER FAILURE | |
| Failure Mode | During power up – Motor Off |
| Wrong Voltage | During power up – Motor Off |
| ALARM RELAY | |
| Relay Output | Normally Open |
| SECURITY | Remains as previously set |
| NUMBER FORMAT | |
| Separators | X , XXX . XX (Comma / Decimal) |
| Position | PULSAR dependent (e.g., 9.99999, 0.999999, etc.) Factory set to match pump head size. Refer to Factory Decimal Position Settings below. |
| CONTRAST | Restored to initial Factory setting |
| SERIAL COMM | |
| Net Address | Disabled |
| LANGUAGE | English |
| MODE | Manual – Motor Off |
| 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 |
| FLOW RATE | 0% |
| Stroke Position | 0% |
| Motor Speed | 10% |

FACTORY DECIMAL POSITION SETTINGS

| RATED CAPACITY RANGE | | UNITS | -MENU- / DECIMAL POSITION | |
|----------------------|-----------------|-------|---------------------------|---|
| 5.99999 | to 59.9999 | cmh | 999.999 | |
| 1,585.03 | to 15,850.3 | gph | 999.999 | |
| 5,999.99 | to 59,999.9 | lph | 999.999 | |
| 5,999,990 | to 59,999,990 | cch | 999.999 | |
| 0.0999999 | to 0.999999 | cmm | 999.999 | |
| 26.4172 | to 246.172 | gpm | 999.999 | |
| 99.9999 | to 999.999 | lpm | 999.999 | |
| 99,999.9 | to 999,999 | ccm | 999.999 | |
| <hr/> | | | | |
| 0.599999 | to 5.99999 | cmh | 99.9999 | |
| 158.503 | to 1,585.03 | gph | 99.9999 | |
| 599.999 | to 5,999.99 | lph | 99.9999 | |
| 599,999 | to 5,999,990 | cch | 99.9999 | |
| 0.00999999 | to 0.0999999 | cmm | 99.9999 | |
| 2.64172 | to 26.4172 | gpm | 99.9999 | |
| 9.99999 | to 99.9999 | lpm | 99.9999 | |
| 9,999.99 | to 99,999.9 | ccm | 99.9999 | |
| <hr/> | | | | |
| 0.0599999 | to 0.599999 | cmh | 9.99999 (default size) | Actual flow is usually slightly larger than the rated flow. |
| 15.8503 | to 158.503 | gph | 9.99999 (default size) | |
| 59.9999 | to 599.999 | lph | 9.99999 (default size) | |
| 59,999.9 | to 599,999 | cch | 9.99999 (default size) | |
| 0.000999999 | to 0.00999999 | cmm | 9.99999 (default size) | |
| 0.264172 | to 2.64172 | gpm | 9.99999 (default size) | |
| 0.999999 | to 9.99999 | lpm | 9.99999 (default size) | |
| 999.999 | to 9,999.99 | ccm | 9.99999 (default size) | |
| <hr/> | | | | |
| 0.00599999 | to 0.0599999 | chm | 0.999999 | |
| 1.58503 | to 15.8503 | gph | 0.999999 | |
| 5.99999 | to 59.9999 | lph | 0.999999 | |
| 5,999.99 | to 59,999.9 | cch | 0.999999 | |
| 0.0000999999 | to 0.000999999 | cmm | 0.999999 | |
| 0.0264172 | to 0.264172 | gpm | 0.999999 | |
| 0.0999999 | to 0.999999 | lpm | 0.999999 | |
| 99.9999 | to 999.999 | ccm | 0.999999 | |
| <hr/> | | | | |
| 0.000000001 | to 0.00599999 | cmh | 0.0999999 | |
| 0.000001 | to 1.58503 | gph | 0.0999999 | |
| 0.000001 | to 5.99999 | lph | 0.0999999 | |
| 0.001 | to 5,999.99 | cch | 0.0999999 | |
| 0.00000000001 | to 0.0000999999 | cmm | 0.0999999 | |
| 0.00000001 | to 0.264172 | gpm | 0.0999999 | |
| 0.00000001 | to 0.0999999 | lpm | 0.0999999 | |
| 0.00001 | to 99.9999 | ccm | 0.0999999 | |

11 Troubleshooting Guide

11.1 System Diagnostics

Your DLCM contains extensive diagnostics that allow it to determine the source of common problems. If your DLCM is not operating properly, your first course of action should be to review the {DIAGNOSTICS} sub-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 DLCM (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 1/11 / POWER IN: OK} is displayed.
5. Repeatedly press [UP] to cycle through all nine 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. (This paragraph does not apply should you encounter a Battery Fail or Circuit Fail situation).

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 DLCM failed while the pump motor was running. | Place DLCM in {MOTOR OFF} operating mode before disconnection power. Refer to POWER Troubleshooting. |
| DIAG 2/11 ANALOG IN: FAIL | The Analog Input signal fail under the calibrated range, or fell to 0 within 0.25 seconds (i.e., the signal was changing by more than 8.8 mA per second and was less than 0.3 mA). | Place DLCM in {MANUAL MODE} or OFF before the signal loss occurs. Recalibrate Analog Input. Condition Analog Input Signal. Refer to ANALOG INPUT troubleshooting. |
| DIAG 3/11 MODBUS FAIL | A properly formatted and addressed MODBUS message was not received in the allotted time. | Increase the Response Time setting. |
| DIAG 4/11 LEAK DETECTION: FAIL | The Leak-Detection Switch closure activated according to its configuration. | Diaphragm may have failed. Refer to Pump IOM or review Section 7: General Operation, Leak-Detection Failure Setup. Refer to PULSAlarm Leak-Detection Troubleshooting. |

| MENU (DIAGNOSTICS) | | |
|-------------------------------------|--|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| DIAG 5/11 LEVEL INPUT: FAIL | The Level Input Switch closure activated according to its configuration. | If abnormal, review Section 7: General Operation, Level Input Failure Setup. Refer to LEVEL INPUT troubleshooting. |
| DIAG 6/11 MOTOR TEMP | The motor exceeded its maximum internal temperature. | Relocate to a cooler area and/or out of direct sunlight. Increase minimum motor speed setting. |
| DIAG 7/11 DRIVE TEMP: FAIL | The DLCM internal temperature has exceeded the rating. | Re-locate the DLCM to an environment with lower ambient temperatures. Refer to Section 9: Specifications. |
| DIAG 8/11 BATTERY: FAIL | The DLCM clock is backed by a Lithium Battery with a 10 year life. | The life expectancy is over. Contact Technical Service. |
| 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 Programmable Read Only Memory (EEPROM) on the mother board cannot be read and/or written to. | Cycle Power on unit to double check error. Contact Technical Services. |
| DIAG 9/11 CIRCUIT: FAIL *MOTOR* | The DLCM's internal motor failed to respond when given a command to do so. | Cycle Power on unit to double check error. Review MANUAL KNOB / DLCM INTERNAL DRIVE MOTOR troubleshooting. Contact Technical Services. |
| DIAG 9/11 CIRCUIT: FAIL *MOTOR* | The DLCM's internal motor has achieved its Duty Cycle limit: 50% over a 20 minute interval. | Cycle Power to clear. Reduce motor run time by changing batch or conditioning analog input or Averaging Parameters. |
| DISPLAY | | |
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| No display back-lighting | No power supplied | Check power source. Plug & Circuit Breaker |
| | 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 Service |
| No display back-lighting | Low-voltage power supply failed | Contact Technical Service |
| | The DLCM internal temperature has exceeded the rating. | Relocate the DLCM to an environment with lower ambient temperatures. Refer to Section 9: Specifications. |
| 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 40°C (104°F) | Relocate to another area |

| POWER | | |
|---------------------|---------------------------------------|---|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| No power indicators | No power supplied | Check power source. Plug & Circuit Breaker |
| | 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 Service |

| PULSAR DC MOTOR | | |
|------------------------|---|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Motor will not start | No power supplied | Check power source to DLCM |
| | Motor wired incorrectly | Check wiring |
| | Supply power outside of specification | Check voltage/frequency against name plate |
| | Motor key not pressed. Keypad problem | Press [MOTOR] to start motor. Refer to Keypad Troubleshooting section. |
| | Remote Motor Switch is off | Turn switch on |
| | Software did not initiate properly | Cycle power |
| | Alarm or Level input set with option MOTOR OFF? Set to YES. | Correct Alarm or Level condition. Set MOTOR OFF? To NO. |
| | PULSAR mechanicals locked | Check pump, reference PULSAR IOM. |
| | Motor Thermostat not connected or programmed | Connect or program the Motor Thermostat |
| | Solid-state relay failed | Contact Technical Service |
| | MODBUS in control | Check MODBUS Control Application |

| PULSAR DC MOTOR (continued) | | |
|--|---|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Motor will not stop | Motor wired incorrectly | Check wiring |
| | Software did not initiate properly | Cycle power |
| | Motor key not pressed. Keypad problem. | Press [MOTOR] to stop motor. Refer to the Keypad Troubleshooting section |
| | Solid-state relay failed | Contact Technical Services |
| Motor running too fast (run-away). Display may show {OVER SPEED! / SHUTDOWN!} | Tachometer not adjusted properly | Refer to Tachometer Troubleshooting or contact Technical Services for readjustment procedures. |
| | Tachometer input is not wired correctly | Refer to Section 5: Installation, Tachometer Input for wiring instructions. |
| | Solid-state relay failed | Contact Technical Services |
| Motor stepping. Typically associated with running at extremely low speeds (<10%) | Normal operation | At high discharge pressures and low motor speeds, the motor will cog during the discharge portion of the stroke. This is only a problem if it causes excessive heat in the motor, or stalls for long periods of time. |
| | Torque too high | Reduce discharge pressure |
| | Speed setting too low | Increase speed setting. If the standard pump operating conditions call for the pump motor to operate at high turndowns (<10%), it is wise to change the stroke End Point to reduce the Maximum End Point value. Refer to Section 7: General Operation, End Point Setup for more information. |
| Motor stalled. Display may show {TACHOMETER FAILURE} | Tachometer not adjusted properly | Refer to Section 11: Troubleshooting, Tachometer Troubleshooting for readjustment procedures. |
| | Tachometer input is not wired correctly | Refer to Section 5: Installation, Tachometer Input for wiring instructions or Section 11: Troubleshooting, Tachometer Troubleshooting |
| | Solid-state relay failed | Contact Technical Services |

| ALARM RELAY (High-Voltage J2) | | |
|--------------------------------------|----------------------------------|---|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Alarm Relay will not activate | Relay wired incorrectly | Check wiring |
| | Relay fuse blown | Replace with 1A@250 VAC fuse |
| | Software not configured properly | Refer to Section 7: General Operation, Menu |

| ANALOG INPUT | | |
|---|---|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Not responding to Analog (mA) Input | Input wired incorrectly | Check wiring |
| | Input not wired to correct channel | Refer to Section 5: Installation, Analog Input for wiring instructions. |
| | Input fuse(s) blown | Replace F4 & F5 w/ 50 mA@250 VAC for channel #1 and F6 & F7 for channel #2 |
| | Not in Analog Operation Mode | Press [MODE] or configure Active. Refer to Section 7: General Operation, Analog Mode |
| | Input not calibrated properly | Review Section 7: General Operation, Analog Input Signal 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: less than 0.3 mA and changing by more than 8.8 mA/s | Condition signal. Change failure mode. Recalibrate. |
| Lo Analog Input point (e.g., 4.0 mA) does not equate to 0% unit reading | Miss-calibrated | Recalibrate |
| | 0% calibration value mis-interpreted | The "0% = 4.0 mA" calibration screen refers to 0% flow. Not 0% stroke. |
| | Jitters or slow response | Change averaging parameters. Refer to Section 7: General Operation, Analog Mode. |

| PULSAlarm (Leak Detection) | | |
|-----------------------------------|-------------------------------|---|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Not responding to PULSAlarm Input | Relay wired incorrectly | Check wiring |
| | Input not configured properly | Review Section 7: General Operation: Menu, Leak-Detection Failure Setup |
| | Solid-state device used | Remove and replace with dry contact. If no change, contact Technical Service. |

| 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, Level Input Failure Setup |
| | Solid-state device used | Remove and replace with dry contact. If no change, contact Technical Service. |

| ANALOG OUTPUT | | |
|-------------------------------|--------------------------------|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| No Analog (mA) signal present | Output wired incorrectly | Check wiring |
| | Output fuse(s) blown | Replace F2 & F3 with 50 mA@250 VAC. |
| Not tracking | Output not calibrated properly | Review Section 7: General Operation: Analog Output Calibration |

| ALARM RELAY OUTPUT (Low-Voltage J5) | | |
|--|-------------------------------------|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| No Output | Output wired incorrectly | Check wiring |
| | External device not powering output | Refer to Section 8: Diagram 1, DLCM Wiring Diagram. External device must supply voltage to solid-state switch. |
| | Alarm options not set | Review Section 7: General Operation, Leak-Detection/Level-Input Setup/Alarm Relay. |

| MANUAL ADJUSTMENT KNOB/DLCM INTERNAL DRIVE MOTOR | | |
|--|--|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Knob will not turn under DLCM control. Display shows {DUTY CYCLE} | Internal DLCM 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 'cool-down' period. Refer to Section 5: Installation, High-Voltage Connections, PULSAR Motor. |
| Knob turns at power-up | Normal Zero Calibration. Display should read {PLEASE WAIT / CALIBRATING ZERO} | Do not turn knob by hand while DLCM's power is off. |
| Note that the Stroke doesn't always adjust. Most of the DLCM flow adjustment is made by varying the motor speed. Also check Section 7: General Operation, End-Point Setup for equal MIN & MAX stroke settings. | | |

| KEYPAD | | |
|--|---|---|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Display does not respond to keypad entry | Display contrast out of adjustment. See Display Troubleshooting. Software did not initiate properly | Cycle power |
| | Memory corrupted | Cycle power. Perform factory re-initialize. |
| | Keypad connector loose | Contact Technical Services |

| BATCH OPERATION | | |
|---|--|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Activated batch appears to be running through batches rapidly | Repeating Batch activated with Old Start Date. For example, today is 1/22/16, you have a repeating batch programmed to start on 1/5/16. The display will show the 'run-through' of all batches between the start day and time and today. | Change Batch start-time/date to current 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. Press any key to clear message. |

| 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 – 000000 | High pressure pump. Due to compressibility, the pump will not discharge fluid until the Stroke Adjustment is above a non-zero value (e.g., set the adjustment to 3% and the pump discharges fluid. Set the adjustment below 3% and no fluid will be discharged). When the stroke is set below the zero point, the display shows -000000. | Display is normal. Increase the stroke setting until the unit reads properly. Re-calibrate. |

| SERIAL COMMUNICATIONS | | |
|------------------------------|--|---|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| No response to Master | Wiring | Master / Slave wiring incorrect. Refer to Section 5: Installation, Serial Communications Input. |
| | Communications setting mismatch between Master & Slave | Check Communications Settings. Refer to Section 7: General Operation, Serial Communications. |
| | Master not receiving | Use serial diagnostics to check receipt and transmission of characters. Refer to Section 7. |

| SERIAL COMMUNICATIONS | | |
|-------------------------------------|------------------------|--|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Poor performance | Wiring/interference | Use proper wire type. Limit total network length to 1200M (4000 ft) Do not run communication wire in the same conduit with the power wire. Avoid runs near large motors. Add Termination. |
| | Communication Settings | Refer to the guidelines in Section 7: General Operation: Serial Communications. |
| Frequent message {MODBUS SIG. FAIL} | Time out setting | Refer to Section 7: General Operation, MODBUS Signal Failure Setup for guidelines on time out settings. |

| MISCELLANEOUS | | |
|---|--|---|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Over voltage or under voltage message displayed | Incoming Power un-reliable Note: you must power off and then power back up to clear | DLCM should have separate branch circuit taken from main. Re-wire. Consider surge-suppression. |
| | DLCM factory configured for operating voltage other than input | DLCM 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 DLCM down. |
| Tachometer failure message displayed | Tachometer Sensor wiring incorrect | Check wiring |
| | Failed or mis-adjusted sensor | Contact Technical Services |
| | Motor over speed | Failed solid state relay |
| | Motor stalled | Check pump pressure Note: you must power off and then power back up to clear |
| | Failed to detect shaft rotation with the motor turned on | The tachometer has failed. Remove power to the DLCM and pump motor. Turn the power back on and repeat the startup procedure. If the TACHOMETER FAILURE message is displayed again, remove all power from the DLCM. Refer to Section 5: Installation, Tachometer Input for information on how to access the Tachometer Sensor wiring connections, located on the Field Wiring Board. Verify the condition of the TACHOMETER SENSOR connections (refer to Tachometer Troubleshooting). If these connections are correct, contact Technical Services. |

| ENCODER ERROR | | |
|--|---|---|
| SYMPTOM | PROBABLE CAUSE | POSSIBLE SOLUTION |
| Message: {ENCODER ERROR/PRESS ENTER} displays during encoder test. | Encoder defective | Refer to Section 11: Troubleshooting, Encoder Diagnostics. |
| | Internal Motor unable to turn adjustment knob | Broken or jammed gears – refer to Section 11: Troubleshooting, Encoder Diagnostics. |
| | | Defective motor – refer to Section 11: Troubleshooting, Encoder Diagnostics. |
| | | Defective Drive circuits – refer to Section 11: Troubleshooting, Encoder Diagnostics. |
| | | Defective encoder or wiring |

11.2 Encoder Diagnostics

Pulsafeeder supplies the DLCM electronic controllers on the PULSAR line of metering pumps. This controller utilizes a common drive system to actuate the stroke length mechanism within the pump. This drive system consists of a motor, gear train, and a digital encoder, which allows the controller to track the position of the stroke mechanism. The encoder produces digital pulses as the adjustment shaft rotates. By tracking these pulses, the controller can adjust the stroke position with a very high level of accuracy.

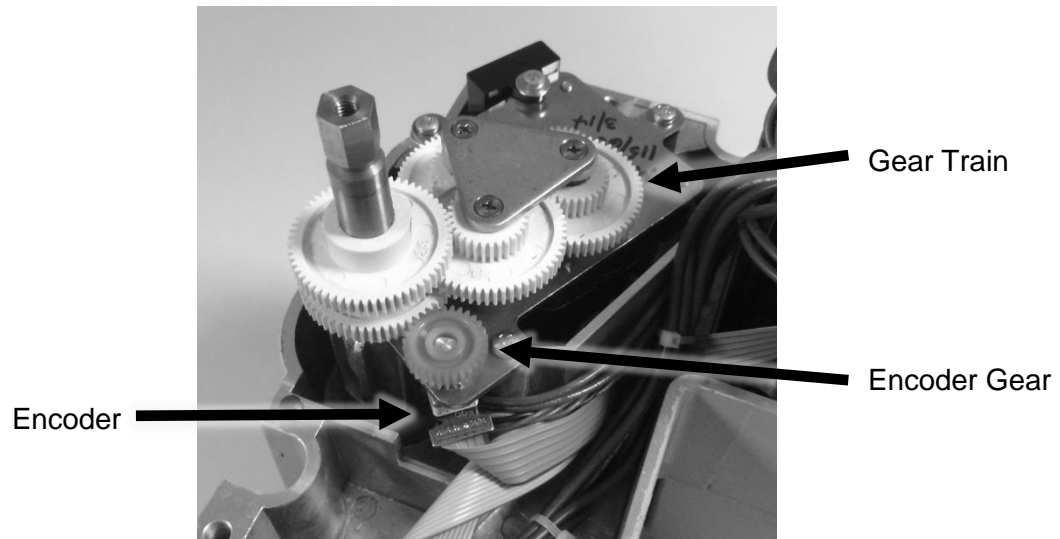
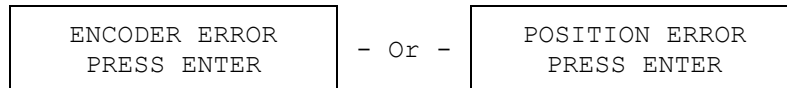


Figure 24 – Encoder position within the enclosure

If, at any time during this process the DLCM detects an error the following screen is displayed:



NOTE: THERE COULD BE INTERNAL DAMAGE TO THE ENCODER OR GEAR TRAIN – POSSIBLY AN OBSTRUCTION OR A BROKEN GEAR.

There can be a number of reasons for this failure; the following will guide you through several possibilities.

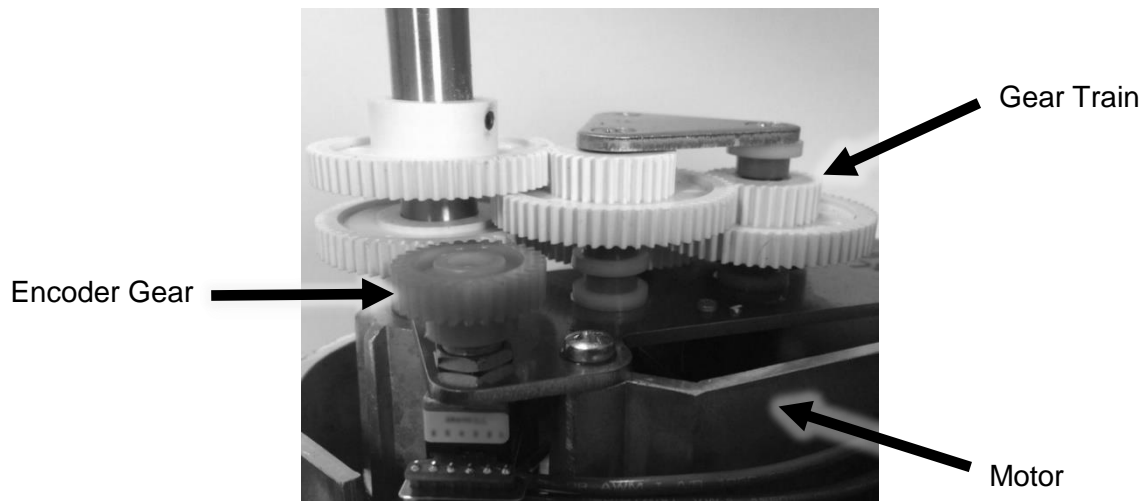


Figure 25 – Encoder and Gear Train layout

11.2.1 Troubleshooting

11.2.1.1 First Steps

1. Remove AC power from the controller.
2. Rotate the stroke adjustment knob several turns manually to increase the setting (Counter Clockwise). The knob can be turned 25 turns. The mechanism includes hard stops at 0% and 100% that prevent over rotation. Do not force the knob – try turning in the opposite direction.
3. Ensure that the knob rotates smoothly for several full revolutions in BOTH directions. Skip to step 5.
4. A majority of encoder issues with the DLC are associated with mis-alignment of the DLC's output coupling with the pumps stroke adjustment mechanism. To eliminate this condition, **loosen but do not remove the 4 screws that hold the controller to the top of the pump.** See Figure 26, Controller Pump Interface
5. Replace covers if necessary and re-apply power to the controller. Use [UP] or [DOWN] to cause the DLC to adjust the stroke setting.
6. If the cause of the error was a mechanical jam, it may be necessary to perform a Zero Calibration. See Section 6: Startup Instructions, Overview, Performing a Factory Reinitialization. If the cause was a mis-alignment issue, the control should start adjusting properly.
7. If the hold down screws were loosened in step 4, retighten evenly while the unit is adjusting.
8. Monitor the unit as necessary for further faults.

11.2.1.2 Mechanical Problem

A primary cause of encoder errors is a mechanical problem within the pump or the controller. In these cases, it may or may not be possible to rotate the knob as described above. Suggested troubleshooting sequence:

1. Remove the controller from the pump to separate the mechanisms
2. Rotate the stroke adjustment mechanism in the pump and then the controller by hand to determine which part may not be functioning correctly
3. If the trouble appears isolated to the pump, see 11.2.1.3 for further information
4. If the trouble appears to be within the controller, see 11.2.1.4 for access to the interior of the controller

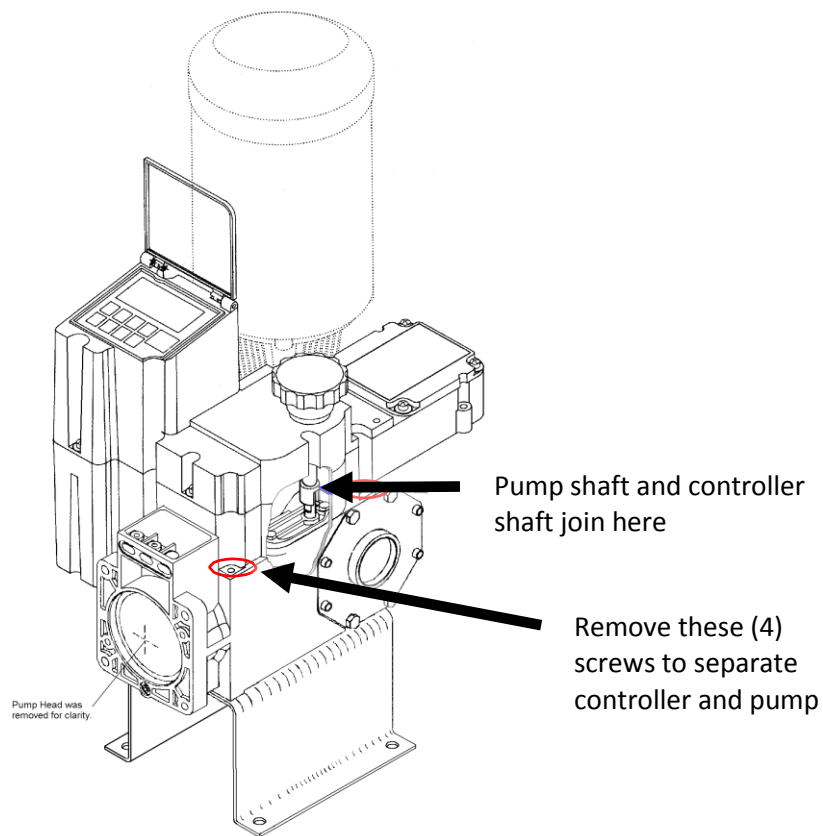


Figure 26 – Controller/Pump interface

11.2.1.3 Gear Train Problem

The internal motor and gear train used for stroke length adjustment may be damaged or worn. Some potential problems include:

1. Jammed or damaged motor
2. Broken or fractured gears
3. Gears with broken or missing teeth

11.2.1.4 Encoder Setscrew Problem

A number of encoder issues have been related to the setscrew that secures the encoder gear to the encoder shaft coming loose. Carefully check this gear by hand to ensure it is securely attached to the encoder shaft. Take care to avoid applying excessive force to the encoder shaft as this can damage it.

11.2.1.5 Electrical Problem

Electrical problems can affect both the circuit boards within the controller, and the encoder itself. The circuits within the controller cannot be tested without specialized fixtures and test equipment.

If no mechanical cause for an encoder error is located the next most likely cause is a malfunction of the encoder itself.

11.2.1.6 Pump Interface

The Pulsafeeder DLCM controller connects mechanically to the PULSAR pump using a two-section shaft. The lower section is mounted within the pump, and drives the stroke adjustment mechanism, regulating the stroke length and therefore the flow output of the pump. The upper section is mounted within the controller. This allows the controller to regulate the stroke length of the pump.

Pump Stroke Length Mechanism Troubleshooting

The PULSAR metering pump utilizes a screw and slider cam system to regulate the stroke length of the pump. The screw shaft is rotated by the electronic controller. The rotation drives the wedge-shaped slider cam up or down on the shaft. As the cam moves up or down, it actuates a follower pin, which limits the rearward travel of the piston:

- a) Slider cam moves up, follower pin is moved forward for shorter strokes and lower flow rates
- b) Slider cam moves down, follower pin is moved back for longer strokes and higher flow rates

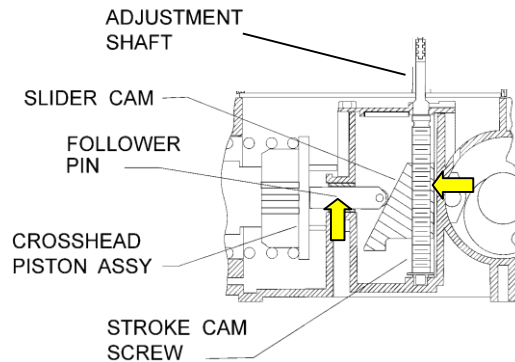


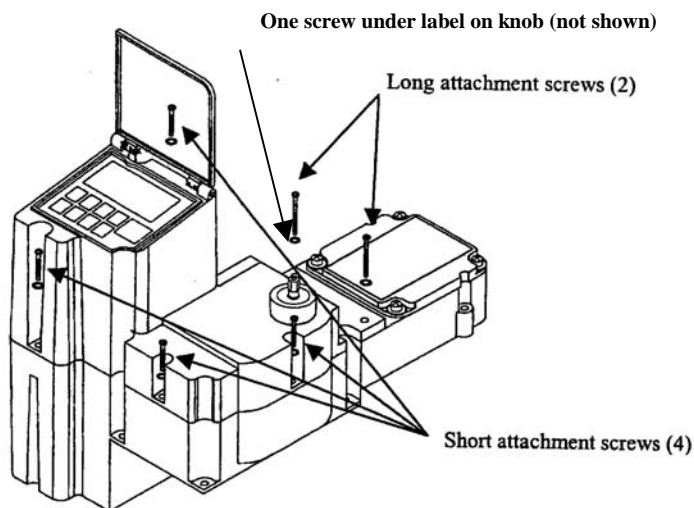
Figure 27 – Pulsar pump stroke adjustment mechanism

11.2.1.7 Possible Mechanical Malfunction Causes

1. Damage to the threads on the screw shaft, which do not allow the cam to travel smoothly
2. A bent or warped screw shaft
3. Damage to the threads on the cam
4. Damage to the face of the cam, which does not allow the follower pin to slide smoothly
5. Damage or rotation of the follower pin, which does not allow it to extend or retract smoothly

11.2.2 Encoder/Gear Train Access

FOLLOW ALL APPROPRIATE SAFETY PROCEDURE WHEN OPENING ANY ELECTRICAL ENCLOSURE TO PROTECT PERSONEL AND PROCESSES.



Note: For certain motor frame sizes, the DLCM may have to be lifted slightly from the pump to allow access to all screws.

Figure 28 – Upper cover assembly removal



PROCEDURE:

1. Remove 6 retaining screws and the washers as shown in Figure 28.
2. Lift the top cover straight up.



FOR DLC CONTROLLERS THE KEYPAD AND DISPLAY MODULE IS ATTACHED TO THE UPPER COVER. USE CARE WHEN REMOVING THIS COVER, AS THERE IS A RIBBON CABLE THAT CONNECTS FROM THE INTERNAL CIRCUIT BOARDS TO THE UPPER COVER ASSEMBLY. RAISE THE COVER SLOWLY, UNTIL THIS WIRING CAN BE IDENTIFIED AND SECURED. THE WIRING MAY BE CAREFULLY UNPLUGGED FROM THE CIRCUIT BOARD SO THAT THE UPPER COVER ASSEMBLY CAN BE SET ASIDE FOR SERVICE.

11.2.3 Encoder Replacement

Encoders for the DLCM controller come complete with the ribbon cable and plug attached. The current Pulsafeeder part number for this assembly is NP530100-000. Encoders are kept as a stock item at the factory.

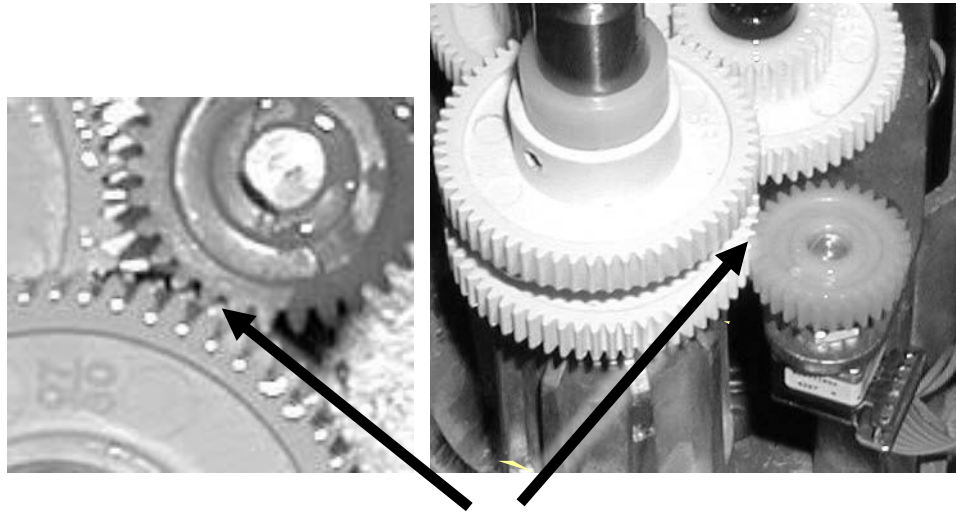
To replace the encoder:

1. Disconnect power to the controller and follow all applicable procedures to ensure personal and process safety.
2. Remove the top cover from the controller as described previously in this document.
 - 2.1 Inspect the gear train for broken, worn or missing teeth. See Figure 29. If these conditions exist, contact the factory for replacement gear train.
3. Unplug the encoder cable from the circuit board.
4. Loosen the setscrew and remove the drive gear from the encoder shaft.
5. Remove the nut and lock washer (if present), and remove the encoder from the mounting plate.



CAUTION: WHEN HANDLING THE NEW ENCODER, DO NOT LOAD THE SHAFT RADially (TO THE SIDE), FOR EXAMPLE WHEN ADJUSTING ITS POSITION OR TIGHTENING THE SETSCREW.

6. Install the new encoder carefully, replace the lock washer (as per the original configuration) and nut onto the shaft, but do not completely tighten them at this time.
7. Re-install the gear, aligning the height of the encoder gear to match the mating gear.
8. Apply a small drop of non-permanent locking compound to the setscrew and tighten gently, following the caution mentioned.
9. Adjust the position of the encoder as per the photographs in **Figure 29**. Allow for a small amount of backlash between the gears. There should be no radial loading of the encoder shaft. Off axis loads on this shaft will cause premature encoder failure.
10. Once position is established, tighten the encoder mounting nut to secure it to the plate.



Note spacing

Figure 29 – Encoder positioning for proper gear engagement for proper gear engagement

11.2.4 Tachometer Troubleshooting

The DLCM 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 DLCM will malfunction. This typically results in the display of the {TACHOMETER / FAILURE} or {OVER SPEED / SHUT-DOWN} message. If your DLCM displays either of these messages, use the following procedure to trouble shoot the device:

Required Tools:

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

11.2.4.1 Motor Rotation

If the drive motor is not rotating, a tach failure is displayed. Potential issues are as follows:

1. Drive motor brushes dirty – clean out brush area
2. Drive motor brushes not contacting commutator – clean area, check springs
3. Drive motor brushes worn – replace (brush part number is on the motor nameplate and these can be sourced from your local motor shop).
4. Motor coupling loose or damaged – repair or replace
5. Motor failed – replace

11.2.4.2 Tach Sensor Wiring

If any recent work has been done within the DLCM control, the wiring from the tach sensor may have been damaged or come loose from the terminals. The tach sensor wires enter the junction box at the back of the controller through a small diameter black conduit on the back surface. Check that the blue and black leads are secure in their terminals as in Figure 30. Make sure the terminals are making good contact with the stripped portion of each wire.

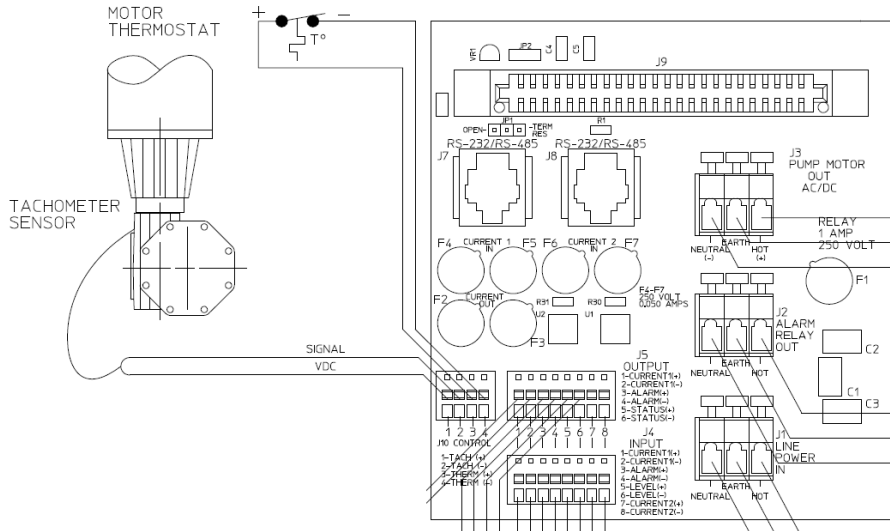


Figure 30 – Field wiring of Tach Sensor

11.2.4.3 Tach Sensor Adjustment and Testing

Key:

- 2. Mounting busing
- 3. Sealing O-ring
- 4. Tach Sensor
- 5. Locking Nut

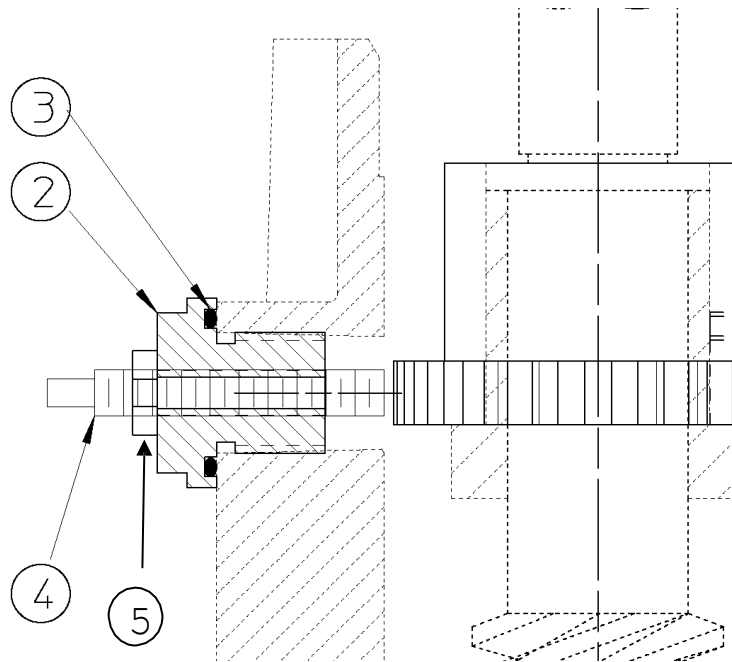


Figure 31 – Tach Sensor



11.2.4.4 Basic tach sensor adjustment procedure:

1. Unscrew and gently pull back the black plastic conduit connector (not shown on the diagram above), this will reveal the threaded tach body (#4) surrounded by a locking jam-nut (#5).
2. Loosen the jam nut. This will allow the tachometer sensor itself to be rotated, which moves it in and out of the gearbox.
3. Turn the body of the tachometer sensor clockwise until it goes all the way inwards and (gently) bottoms in the fitting, this means it has contacted the gear teeth as illustrated in Figure 31.
4. Retract the sensor approximately $\frac{1}{2}$ to $\frac{3}{4}$ of a turn counter-clockwise (outwards), and then hold it in place and re-tighten the jam nut (#5).
5. Replace the plastic conduit connector and re-wire the tach.

To electrically test and adjust the tach sensor:

1. Apply power to the DLCM.
2. Note the following terminals:
 - J 5-8** signal ground (VDC -)
 - J10-1** voltage output (12 VDC +)
 - J10-2** tachometer signal (VDC variable +)
3. Measure voltage between J5-8 and J10-1, it should read 12VDC (see note below).
4. Remove the top cover of your drive motor so that you can access the shaft.
5. Measure the voltage between terminals J5-8 and J10-2, and rotate the motor shaft until you have the lowest voltage reading.
6. Loosen the locknut on the tachometer body, and adjust the position of the tachometer sensor until the voltage reads 1.0 VDC.
7. Rotate the motor shaft again, and observe the voltage, the highest voltage observed should be 5.5 – 6.0 VDC.
8. As the motor shaft is rotated, the voltage should vary between 1.0 and 5.5 to 6.0 VDC.
9. Make necessary adjustments to achieve this range, and then tighten the locknut on the tachometer body.
10. Secure all wiring, replace all covers, and prepare the pump for operation as per normal procedures.



NOTE

NOTE: Some older controllers utilized a 5 volt control system. If you read 5 volts during step # 3 above, you have an older system. Older systems should be factory upgraded to the new 12 volt design for more reliable tachometer operation. Consider contacting your local Pulsafeeder Representative about arranging for a factory update on your controller. For some older models, depending on age and condition, replacement of the complete controller is a more cost effective solution.

11.2.4.5 Tach Sensor Replacement

If none of the above restores proper operation, and the electrical tests do not result in the proper voltage readings, then the tach sensor may be bad. The Pulsafeeder part number for a replacement sensor is:

NP530052-000 Inductive Sensor, DLCM

Contact your local Pulsafeeder Representative for price and delivery information.

12 Conversion (Manual to DLCM)

Your PULSAR can be converted from a Manual Stroke Adjustment Mechanism to the DLCM. The DLCM 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. Remove AC motor and replace with DC motor. Refer to **Section 5: Installation, Pulsar Pump Motor** for motor specifications.
3. Remove the six Phillips Head screws that hold the Manual Cover Assembly to the Eccentric Box (refer to **Figure 32**).

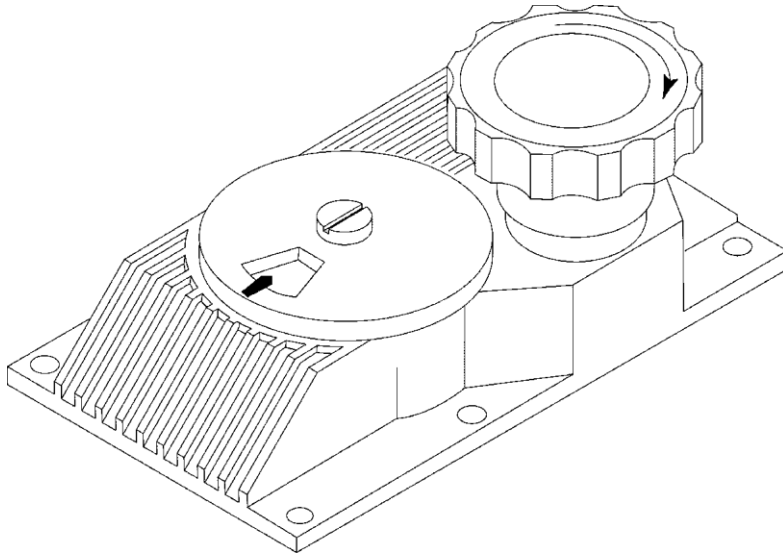


Figure 32 – Manual Cover Assembly

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-DLC-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 DLCM output shaft. Familiarize yourself with these mating components prior to installation (refer to **Figure 33**).

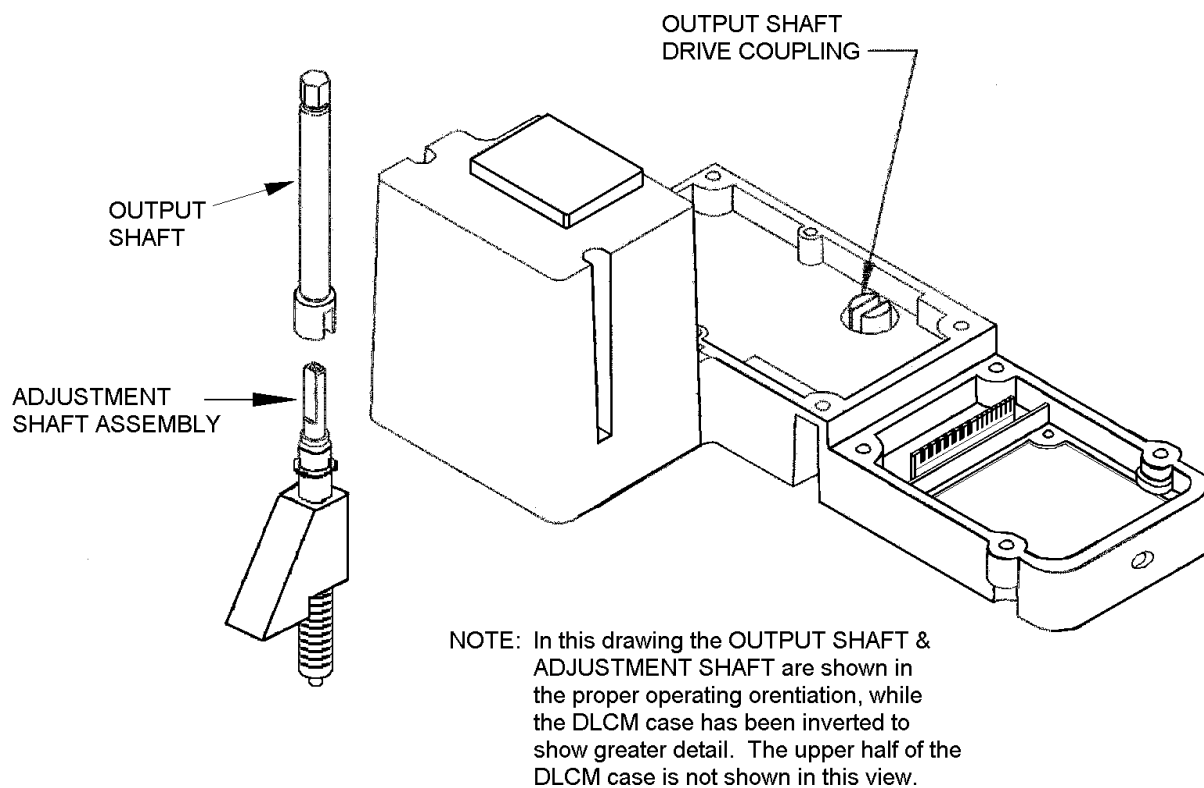


Figure 33 – DLCM/Eccentric mating components

7. Locate the face on the bottom of the DLCM that mates with the face of the lip of the eccentric box. The DLCM 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 DLCM properly at a comfortable height above the pump and align the slot in the DLCM coupling with the 'flats' on the adjustment shaft by turning the black hand knob on the DLCM. Do not turn the adjustment shaft!
9. Lower the DLCM onto the eccentric box. It may be necessary to tip the DLCM slightly towards the motor to clear the motor adapter. With the DLCM approximately 25mm (1 inch) above the eccentric box, make a fine adjustment to align the slot in the DLCM coupling with the adjustment shaft 'flats'. Once aligned, lower the DLCM to mate with the eccentric box. Do not force the cover! When the coupling is properly aligned, the DLCM will seat properly under its own weight.
10. Install the 4 DLCM 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 of pump DC motor and tachometer.
13. Perform the steps detailed in **Section 6: Startup Instructions**.
14. Review **Section 7: General Operation** for detailed information on configuring your DLCM and its advanced features.

13 General Repairs

In the unlikely event that your DLCM needs service, it can be returned to Pulsafeeder for evaluation and repair. Contact PULSAFEEDER Customer Service at (585) 292-8000 for a return material authorization number and further instructions.

13.1 Emergency Manual Pulsar Operation

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

1. Remove power from the DLCM.
2. Replace the DC motor with an AC motor or drive the DC motor with an external SCR drive.
3. Start the motor.



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

4. Rotate the manual adjustment knob on the DLCM clockwise to zero the pump. It will be difficult to rotate as you are back-driving the DLCM stroke adjustment motor. Be careful! Do not force the knob. Try to turn 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 the DLCM cover with pieces of tape to use as a position 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 in a counter-clockwise direction from the zero position.

13.2 DLCM Removal and Replacement



THE FOLLOWING PROCEDURE ASSUMES THAT YOU HAVE RECEIVED YOUR DLCM 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 DLCM. If necessary, use the Manual Adjustment knob. It should be easier to adjust the stroke manually in the (+) counter clockwise direction.



DO NOT ADJUST THE STROKE SETTING BEYOND THE 100% (25 TURNS FROM 0%) SETTING.

2. Disconnect the power to the DLCM 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 DLCM (refer to **Figure 34**).

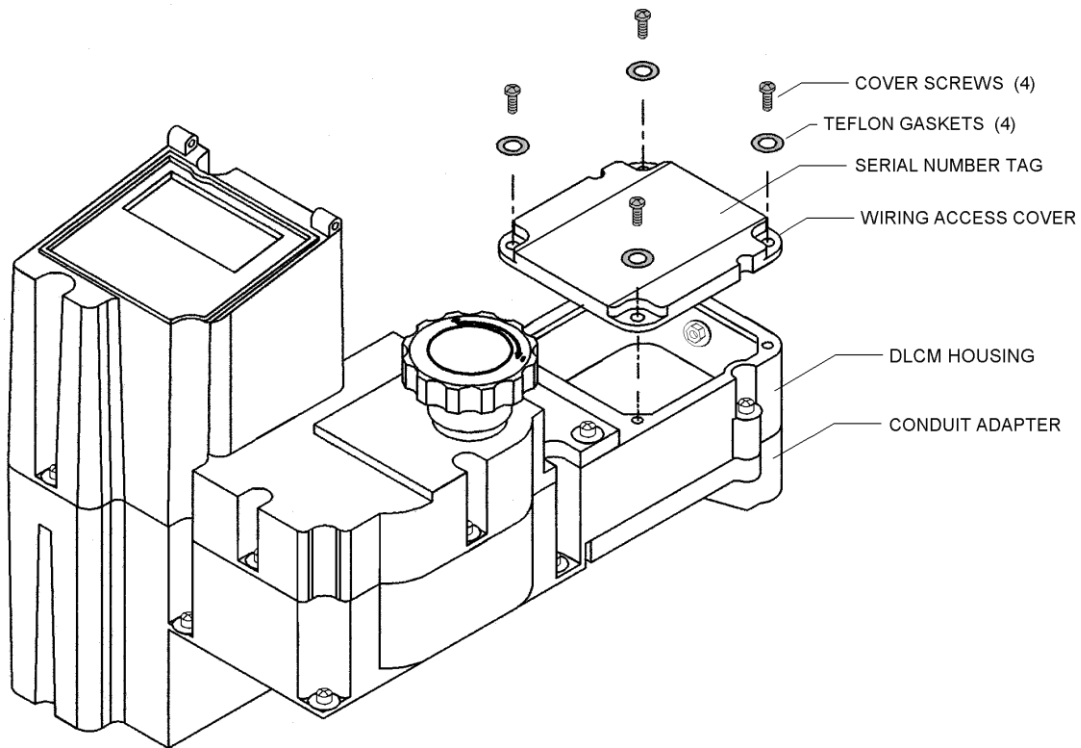


Figure 34 – Wiring Cover Access

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 DLCM housing.

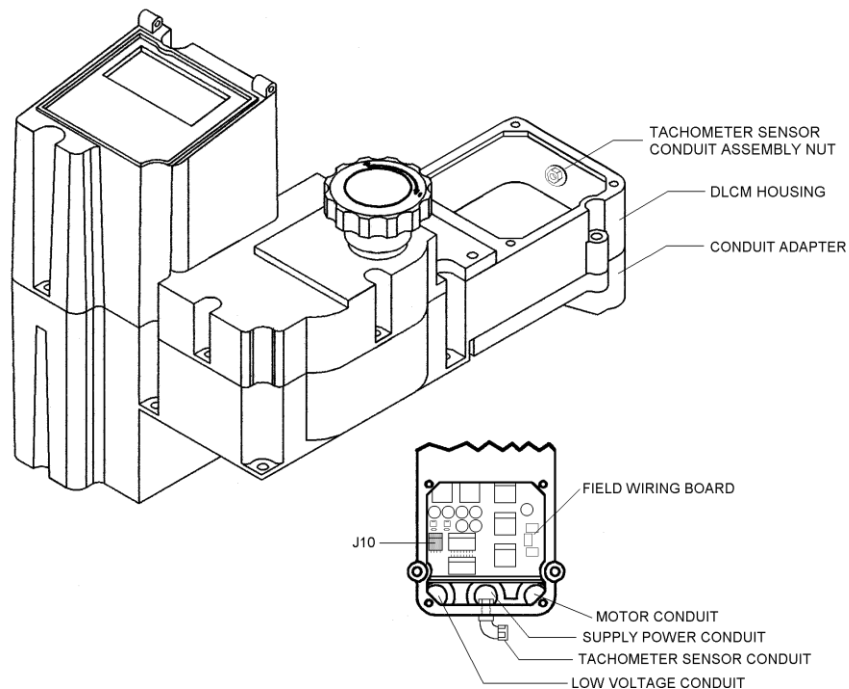


Figure 35 – Accessing the Tachometer Sensor Conduit

7. Remove the four screws and Teflon Gaskets that retain the conduit adapter (refer to **Figure 36**).

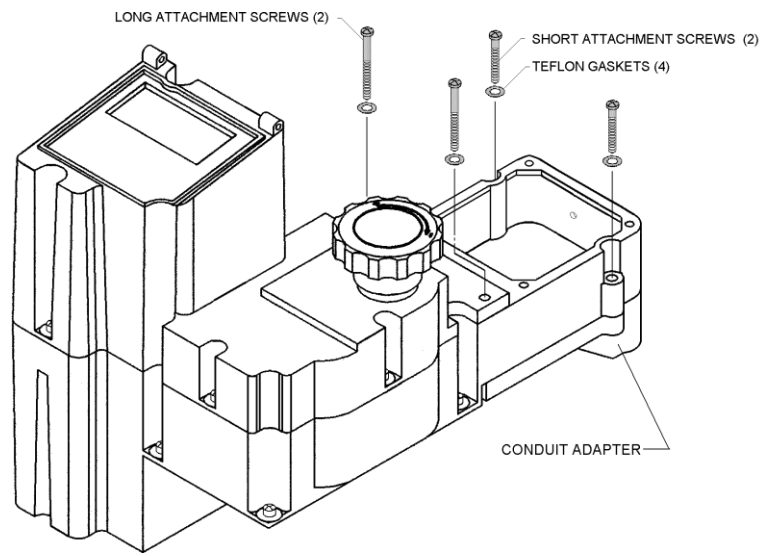


Figure 36 – Conduit Adapter Screw Removal

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

8. Remove the four screws that hold the DLCM to the PULSAR gearbox (refer to **Figure 37**).

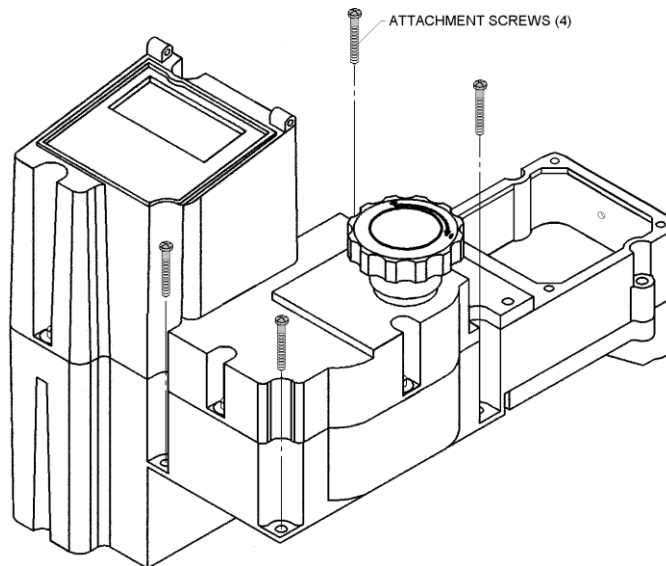


Figure 37 – DLCM Removal for Replacement

9. Remove the DLCM from the gear box by lifting vertically.
10. Bring the replacement DLCM to the installation site.
If you are planning to re-wire the DLCM during replacement, skip to step 12.
11. Remove the Conduit Adapter from the replacement DLCM by performing step 7. 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 DLCM drive coupling of the output shaft. The output shaft is connected to the adjustment knob. Familiarize yourself with these mating components prior to installation (refer to **Figure 38**).

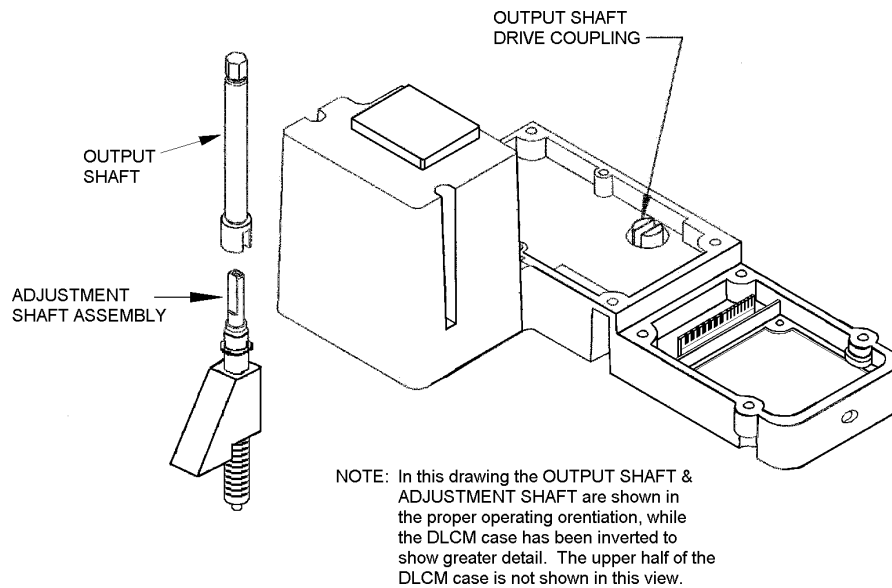


Figure 38 – DLCM/Eccentric Mating Components

13. Locate the face on the bottom of the DLCM that mates with the face of the lip of the gear box.

The DLCM is normally 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 (refer to **Figure 39**).

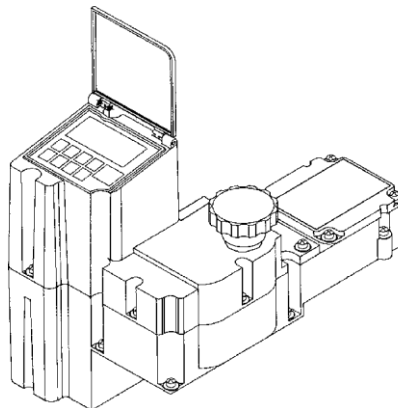


Figure 39 – Installation Orientation

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



DO NOT TURN THE PULSAR GEAR BOX ADJUSTMENT SHAFT!

14. Lower the DLCM onto the gear box.

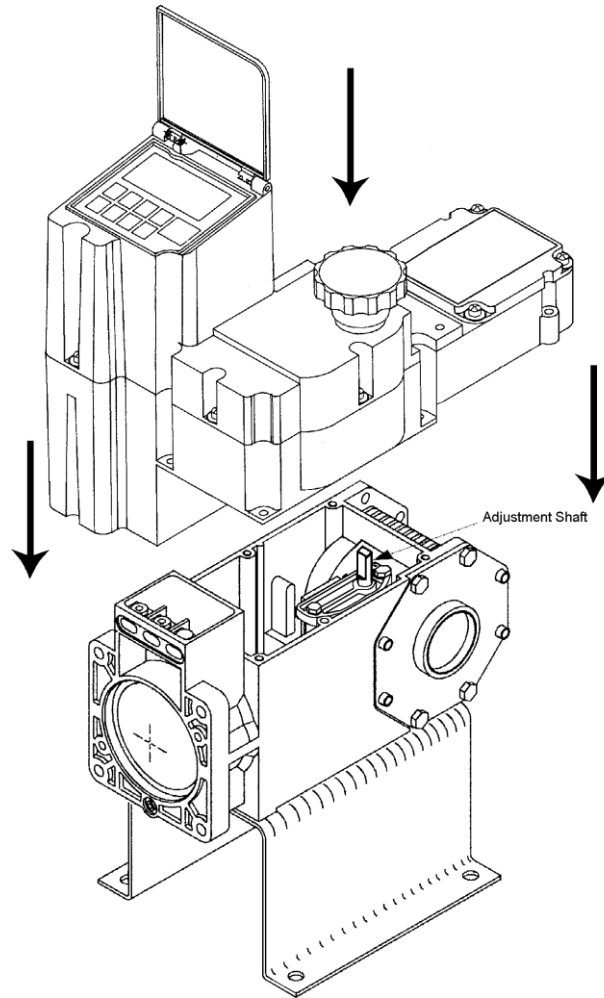


Figure 40 – Positioning the DLCM

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

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



DO NOT FORCE THE COVER! WHEN THE COUPLING IS PROPERLY ALIGNED, THE DLCM WILL SEAT ITSELF UNDER ITS OWN WEIGHT

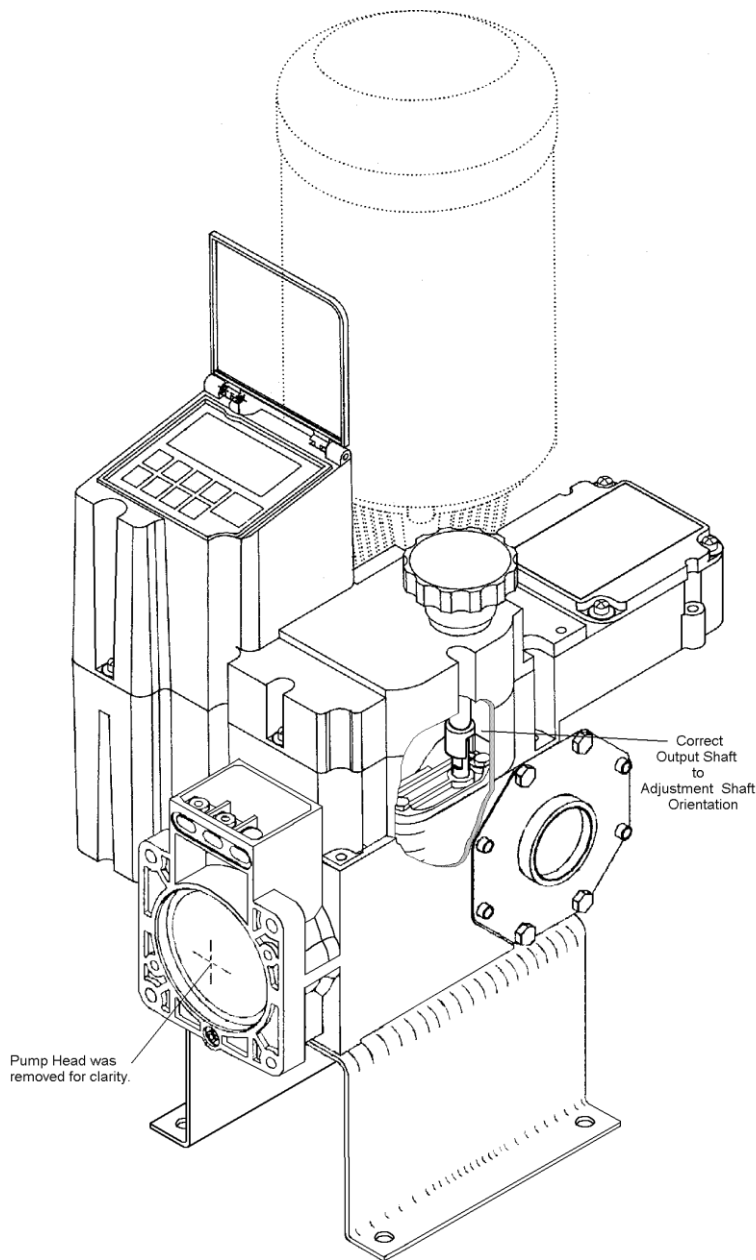


Figure 41 – Shaft Alignment

15. Align the Conduit Adapter with the mating surface on the DLCM.

A card edge in the DLCM housing will mate with an edge connector on the Conduit Adapter. Once properly aligned, the units will mate with moderate force (approximately 20 Newtons or 4.5 pounds of force).

a) Install the four screws and Teflon Gaskets that hold the Conduit Adapter to the DLCM (refer to Figure 36).



FAILURE TO INSTALL THE TEFLON GASKETS WILL CAUSE YOU TO LOSE THE NEMA-4X RATING ON YOUR ENCLOSURE AND WILL VOID THE PRODUCT WARRANTY.

16. Install the 4 DLCM to gearbox mounting screws (refer to **Figure 37**).

17. Remove the 4 wiring access cover screws and cover (refer to **Figure 34**).

18. Insert the Tachometer Sensor Conduit Assembly and wires (removed in step 6) in the hole provided in the back of the DLCM housing.
19. 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.

20. On the Field Wiring Board, attach the wire labeled VDC (typically brown) in J10 Pin 1 (removed in step 5.a).
21. On the Field Wiring Board, attach the wire labeled TACH (typically blue) in J10 Pin 2 (removed in step 5.b).
22. Follow the instructions in **Section 5: Installation: Electrical Wiring** for electrical connections.
23. Perform the steps detailed in **Section 6: Startup**.
24. Review **Section 7-General Operation** for detailed information on configuring your DLCM and its advanced features.

14 PULSAnet Specification

14.1 Introduction



FOR SIMPLICITY, THE DLC AND DLCM VARIATIONS WILL ALL BE REFERRED TO AS THE DLC UNLESS OTHERWISE NOTED

The DLC PULSAAnet communication system is an implementation of the industry standard MODBUS® protocol. The physical layer uses an RS-485 four-wire multi-drop scheme. Up to 32 slave units can be connected to a single master on the same set of wires. They can share those wires with PLC's and PC's that use the same method of communication.

The MODBUS protocol was created in 1978 by Modicon as a simple way for transferring data between controllers. Since its creation it has become a de-facto industry standard used by multiple control and sensor companies. Today the MODBUS® protocol is the single, most supported protocol amongst automation devices.

The MODBUS protocol is both a trademark and a fully owned product of Schneider Automation. The specification is freely distributed on the Schneider Automation home page on the World Wide Web.

With the few noted exceptions in this document, PULSAAnet complies with the Schneider MODBUS protocol specification. If you are interested in developing a MODBUS application to interface with PULSAAnet, please obtain the MODBUS specification from the Schneider Automation web site.

14.2 Operational Overview

The DLC has several different methods of operation when it comes to Serial Communications and MODBUS Mode.

1. A PC or PLC MASTER can Monitor Information in the DLC while it is in any mode of operation.
2. A PC or PLC MASTER can also WRITE certain information when the DLC is in MODBUS MODE.
3. A DLC MASTER can control up to 32 DLC SLAVES in a similar way that Analog signals can be used to daisy chain units together. Additional features that are available are:
 - a) The DLC SLAVE can follow the on/off motor state of the master and,
 - b) The DLCM SLAVE can follow the STROKE and SPEED separately of a DLCM MASTER.

4. A DLC MULTIPLEX MASTER can control MULTIPLEX slaves permitting better integration of the 'motor-less' DLC's.

14.3 MODBUS Messaging

The MODBUS protocol was written for use with PLC's. Programmable Logic Controllers (PLC's) typically have relay outputs, digital inputs, analog inputs, analog outputs and general system settings (e.g., setpoints, alarm points, etc.). To access this data the MODBUS protocol uses the following basic message structure (ASCII shown):

| Start | Address | Function | Data | Check | End |
|--------|---------|----------|--------|--------|--------|
| 1 Char | 2 Char | 2 Char | N Char | 2 Char | 2 Char |

Start identifies the start of a message, Address contains the slave's address, Function identifies the function to perform, Data contains the data required by the Function, Check is the LRC or CRC checksum of the message and End identifies the end of the message.

The FUNCTION CODE is the defining element in the message. It serves two purposes, 1) it defines an operation, and 2) it identifies an optional block of data as the operand. When the FUNCTION CODE operates on a block of data the ADDRESS of that data is transmitted in the DATA portion of the message. For example to read the Digital Level Input from the DLC we would use FUNCTION CODE 0x02 and ADDRESS 0x000A. To read the analog input #1 we would use FUNCTION CODE 0x04 and ADDRESS 0x0000.

These FUNCTION CODEs and associated data are organized into categories as follows:

| MODBUS Category | Function Code(s) | Description | PulsaNet Application |
|------------------|--|---|--|
| COIL | 0x01 (Read) | A relay output with either a 1 (ON) or 0 (OFF) status. | Digital output, Alarm Relay Status. |
| INPUT BITS | 0x02 (Read) | A dry contact or open collector input with either a 1 (ON) or 0 (OFF) status. | Keyboard KEYS, LEAK, LEVEL and THERMOSTAT switch inputs. |
| INPUT REGISTER | 0x04 (Read) | A16-bit Analog input. | 4-20mA, Internal Temperatures. |
| HOLDING REGISTER | 0x03 (Read) 0x06 (Write) 0x10 (Write Multiple) | A 16-bit multipurpose register value. | Display contents, keyboard, counters and various status and process variables. |

Each MODBUS Category constitutes a block of data with ADDRESSES of 0x0000 to 0xFFFF.

The MODBUS protocol also supports FUNCTION CODEs that do not apply to data. For example, FUNCTION CODE 0x11, REPORT SLAVE ID, returns identifying information about the SLAVE (e.g., gives Run Status, Prom Version and Serial Number).

14.4 PULSAnet DDE Server Messaging

Up to this point, this discussion is related specifically to MODBUS messaging. It would typically concern someone developing an application that would communicate directly with the DLC. Most users will access data through a Data Server like the PulsaNet DDE Server. To use such a program you specify a data REFERENCE value. The server interprets the REFERENCE value to determine what FUNCTION CODE and ADDRESS should be used. In the following Data Category tables, you will find the FUNCTION CODE, ADDRESS and DDE REFERENCE relationships.

14.5 Coils

Coils are discrete, single bit outputs like the ALARM OUTPUT and DIGITAL OUTPUT.

Notes:

1. Read only.
2. The coil information is packed as 8 coils per byte.
3. Coils are accessible through Function Code 0x01.
4. The requested value is returned in the least significant bit.

| Function | Address | DDE Ref. | Purpose | Data Format |
|-------------|---------|----------|----------------|----------------|
| Read (0x01) | 0x0000 | 000001 | Alarm Output | Bit(0x01 = On) |
| Read (0x01) | 0x0001 | 000002 | Digital Output | Bit(0x01 = On) |

14.6 Input Bits (1X References)

Input Bits are discrete, single bit inputs such as the keyboard KEYS, LEAK DETECTION, LEVEL INPUT and THERMOSTAT inputs.

Notes:

1. Read only.
2. The input information is packed as 8 input bits per message byte.
3. Input Bits are accessible through Function Code 0x02.
4. The requested value is returned in the least significant bit.

| Function | Address | DDE Ref. | Purpose | Data Format |
|-------------|---------|----------|--|--------------|
| READ (0x02) | 0x0000 | 100001 | Key Pad Input: START/STOP | Bit(0x01=On) |
| READ (0x02) | 0x0001 | 100002 | Key Pad Input: BATCH | Bit(0x01=On) |
| READ (0x02) | 0x0002 | 100003 | Key Pad Input: UP | Bit(0x01=On) |
| READ (0x02) | 0x0003 | 100004 | Key Pad Input: MENU | Bit(0x01=On) |
| READ (0x02) | 0x0004 | 100005 | Key Pad Input: CALIBRATE | Bit(0x01=On) |
| READ (0x02) | 0x0005 | 100006 | Key Pad Input: DOWN | Bit(0x01=On) |
| READ (0x02) | 0x0006 | 100007 | Key Pad Input: UNITS | Bit(0x01=On) |
| READ (0x02) | 0x0007 | 100008 | Key Pad Input: MODE | Bit(0x01=On) |
| READ (0x02) | 0x0008 | 100009 | Key Pad Input: ENTER | Bit(0x01=On) |
| READ (0x02) | 0x0009 | 100010 | Digital Input: LEAK DETECT (J4-3, J4-4) | Bit(0x01=On) |
| READ (0x02) | 0x000A | 100011 | Digital Input: LEVEL INPUT (J4-5, J4-6) | Bit(0x01=On) |
| READ (0x02) | 0x000B | 100012 | Digital Input: MOTOR THERMOSTAT (J10-3, J10-4) | Bit(0x01=On) |
| READ (0x02) | 0x000C | 100013 | Encoder: Channel B | Bit(0x01=On) |
| READ (0x02) | 0x000D | 100014 | Encoder: Channel A | Bit(0x01=On) |
| READ (0x02) | 0x000E | 100015 | Digital Input: Tachometer (J10-1, J10-2) | Bit(0x01=On) |

14.7 Input Registers

These 16-bit input registers contain Analog (4-20mA) and Thermistor input readings.

Notes:

1. The input information is returned as 16-bit integers.
2. Input Registers are accessible through Function Code 0x04.

| Function | Address | DDE Ref. | Purpose | Data Format |
|-------------|---------|----------|--|------------------------------|
| Read (0x04) | 0x0000 | 300001 | Raw Analog Input #1 (4-20mA): STROKE (J4-1, J4-2) | WORD (0x0 – 0xFFFF) [NOTE#1] |
| Read (0x04) | 0x0001 | 300002 | Raw Analog Input #2 (4-20mA): SPEED (J4-7, J4-8) | WORD (0x0 – 0xFFFF) [NOTE#1] |
| Read (0x04) | 0x0002 | 300003 | Raw Analog Input: MOTHER BOARD TEMPERATURE | WORD (0x0 – 0xFFFF) [NOTE#2] |
| Read (0x04) | 0x0003 | 300004 | Raw Analog Input: DRIVE BOARD TEMPERATURE | WORD (0x0 – 0xFFFF) [NOTE#2] |

Notes:

1. This is the Raw analog value returned by the 10-bit Analog to Digital Converter. Use the following formula to yield approximate 4-20mA values:
 - a) $\text{Analog(mA)} = \text{Raw Value} * 0.025$
2. This is the raw analog value returned by the 10-bit Analog to Digital Converter. Use the following formula to yield approximate temperature:
 - a) $\text{Temperature (C)} = (\text{Raw Value} * 0.116538952) - 8.480204328$
 - b) $\text{Temperature (F)} = (\text{Raw Value} * 0.209770114) + 16.73563219$

14.8 Holding Registers

These 16-bit holding registers contain display, keyboard, counters and various status and process variables. Holding Registers are accessible through several Function Codes:

Function Code = 0x03 Read Holding Registers.

- a) Function Code = 0x06 Preset Single Holding Register.
- b) Function Code = 0x10 Preset Multiple Holding Registers.

Notes:

1. The input information is returned as 16-bit integers.
2. Reading a write-only HOLDING REGISTER will return the value that was written previously.
3. Writing to a read-only HOLDING REGISTER will NOT write and will NOT return an error.

| Function | Address | DDE Ref. | Purpose | Data Format |
|-------------|---------|----------|-----------------------------------|-------------------------------|
| Read (0x03) | 0x0000 | 400001 | Screen Character: Row 1, Column 1 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0001 | 400002 | Screen Character: Row 1, Column 2 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0002 | 400003 | Screen Character: Row 1, Column 3 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0003 | 400004 | Screen Character: Row 1, Column 4 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0004 | 400005 | Screen Character: Row 1, Column 5 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0005 | 400006 | Screen Character: Row 1, Column 6 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0006 | 400007 | Screen Character: Row 1, Column 7 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0007 | 400008 | Screen Character: Row 1, Column 8 | Word (0x0 – 0xFFFF) [Note #1] |

| Function | Address | DDE Ref. | Purpose | Data Format |
|-------------|---------|----------|------------------------------------|-------------------------------|
| Read (0x03) | 0x0008 | 400009 | Screen Character: Row 1, Column 9 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0009 | 400010 | Screen Character: Row 1, Column 10 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x000A | 400011 | Screen Character: Row 1, Column 11 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x000B | 400012 | Screen Character: Row 1, Column 12 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x000C | 400013 | Screen Character: Row 1, Column 13 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x000D | 400014 | Screen Character: Row 1, Column 14 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x000E | 400015 | Screen Character: Row 1, Column 15 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x000F | 400016 | Screen Character: Row 1, Column 16 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0010 | 400017 | Screen Character: Row 2, Column 1 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0011 | 400018 | Screen Character: Row 2, Column 2 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0012 | 400019 | Screen Character: Row 2, Column 3 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0013 | 400020 | Screen Character: Row 2, Column 4 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0014 | 400021 | Screen Character: Row 2, Column 5 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0015 | 400022 | Screen Character: Row 2, Column 6 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0016 | 400023 | Screen Character: Row 2, Column 7 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0017 | 400024 | Screen Character: Row 2, Column 8 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0018 | 400025 | Screen Character: Row 2, Column 9 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0019 | 400026 | Screen Character: Row 2, Column 10 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x001A | 400027 | Screen Character: Row 2, Column 11 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x001B | 400028 | Screen Character: Row 2, Column 12 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x001C | 400029 | Screen Character: Row 2, Column 13 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x001D | 400030 | Screen Character: Row 2, Column 14 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x001E | 400031 | Screen Character: Row 2, Column 15 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x001F | 400032 | Screen Character: Row 2, Column 16 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0020 | 400033 | Flash Character: Row 2, Column 1 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0021 | 400034 | Flash Character: Row 1, Column 2 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0022 | 400035 | Flash Character: Row 1, Column 3 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0023 | 400036 | Flash Character: Row 1, Column 4 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0024 | 400037 | Flash Character: Row 1, Column 5 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0025 | 400038 | Flash Character: Row 2, Column 6 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0026 | 400039 | Flash Character: Row 2, Column 7 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0027 | 400040 | Flash Character: Row 1, Column 8 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0028 | 400041 | Flash Character: Row 1, Column 9 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0029 | 400042 | Flash Character: Row 1, Column 10 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x002A | 400043 | Flash Character: Row 1, Column 11 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x002B | 400044 | Flash Character: Row 1, Column 12 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x002C | 400045 | Flash Character: Row 1, Column 13 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x002D | 400046 | Flash Character: Row 1, Column 14 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x002E | 400047 | Flash Character: Row 1, Column 15 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x002F | 400048 | Flash Character: Row 1, Column 16 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0030 | 400049 | Flash Character: Row 2, Column 1 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0031 | 400050 | Flash Character: Row 2, Column 2 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0032 | 400051 | Flash Character: Row 2, Column 3 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0033 | 400052 | Flash Character: Row 2, Column 4 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0034 | 400053 | Flash Character: Row 2, Column 5 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0035 | 400054 | Flash Character: Row 2, Column 6 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0036 | 400055 | Flash Character: Row 2, Column 7 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0037 | 400056 | Flash Character: Row 2, Column 8 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0038 | 400057 | Flash Character: Row 2, Column 9 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0039 | 400058 | Flash Character: Row 2, Column 10 | Word (0x0 – 0xFFFF) [Note #1] |

| Function | Address | DDE | Purpose | Data Format |
|---|---------|--------|--|-------------------------------|
| Read (0x03) | 0x003A | 400059 | Flash Character: Row 2, Column 11 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x003B | 400060 | Flash Character: Row 2, Column 12 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x003C | 400061 | Flash Character: Row 2, Column 13 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x003D | 400062 | Flash Character: Row 2, Column 14 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x003E | 400063 | Flash Character: Row 2, Column 15 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x003F | 400064 | Flash Character: Row 2, Column 16 | Word (0x0 – 0xFFFF) [Note #1] |
| Read (0x03) | 0x0040 | 400065 | Cursor: Flag & Position | Word (0x0 – 0xFFFF) [Note #2] |
| Write (0x06) Write Mult. (0x10) | 0x0041 | 400066 | Key-press | Word (0x0 – 0xFFFF) [Note #3] |
| Read (0x03) Write (0x06) Write Mult. (0x10) | 0x0042 | 400067 | Pump Motor Status | Word (0x0 – 0xFFFF) [Note #4] |
| Read (0x03) Write (0x06) Write Mult. (0x10) | 0x0043 | 400068 | Desired Percent Stroke (hundredths %) | Word (0x0 – 0xFFFF) [Note #5] |
| Read (0x03) Write (0x06) Write Mult. (0x10) | 0x0044 | 400069 | Desired Percent Speed (hundredths %) | Word (0x0 – 0xFFFF) [Note #6] |
| Read (0x03) Write (0x06) Write Mult. (0x10) | 0x0045 | 400070 | Stroke Counter High 16 Bits | Word (0x0 – 0xFFFF) [Note #7] |
| Read (0x03) Write (0x06) Write Mult. (0x10) | 0x0046 | 400071 | Stroke Counter Low 16 Bits | Word (0x0 – 0xFFFF) [Note #7] |
| Read (0x03) | 0x0047 | 400072 | Under/Over Voltage Error Flag | Word (0x0 – 0xFFFF) [Note #8] |
| Read (0x03) | 0x0048 | 400073 | Actual Stroke Position (hundredths %) | Word (0x0 – 0xFFFF) [Note #9] |
| Read (0x03) Write (0x06) Write Mult. (0x10) | 0x0049 | 400074 | Actual Average Motor Speed (hundredths %) | Word (0x0 – 0xFFFF) [Note #9] |
| Read (0x03) | 0x004A | 400075 | Security PIN # | (0000-9999) [Note #10] |
| Read (0x03) | 0x004B | 400076 | Security Type | (0,1,2) [Note #11] |
| Read (0x03) | 0x004C | 400077 | Current Mode | (0,1,2,3) [Note #12] |
| Read (0x03) | 0x004D | 400078 | Find Zero Calibration | (0,1) [Note #13] |
| Read (0x03) | 0x004E | 400079 | Year of Century | (00-99) |
| Read (0x03) | 0x004F | 400080 | Month of Year | (1-12) |
| Read (0x03) | 0x0050 | 400081 | Day of Month | (1-31) |
| Read (0x03) | 0x0051 | 400082 | Day of Week | (1-7, 1 = Sunday) |
| Read (0x03) | 0x0052 | 400083 | Hour of Day | (0-23) |
| Read (0x03) | 0x0053 | 400084 | Minute of Hour | (0-59) |
| Read (0x03) | 0x0054 | 400085 | Second of Minute | (0-59) |
| Read (0x03) | 0x0055 | 400086 | Motor Type | (0=AC, 1=DC, 2=None) |

Notes:

1. There is one character per 16-bit value, which resides in the least significant byte.
2. The most significant byte contains the cursor status (0 = cursor off, 1 = cursor on). The least significant byte contains the cursor position offset (0-15 for the first line and 16-31 for the second).
3. Used to invoke Key-presses. The key value must be sent in the least significant byte (the most significant byte is unused).



THIS REGISTER (0X0041 – KEY PRESS) MUST NOT BE USED FOR AUTOMATION PURPOSES. IT CAN PRESENT HAZARDOUS CONDITIONS TO THE OPERATOR. ACTIVATING CODE 0X01 (STOP_START_KEY) WILL OVERRIDE LOCAL KEYPAD CONTROL! USE REGISTER 0X0042 – PUMP MOTOR STATUS FOR AUTOMATED MOTOR CONTROL.

Note that the UP Key and Down Key are inhibited from modifying the stroke length and motor speed. Use 0x0043 and 0x0044 for that purpose. The following codes are assigned:

| | | | |
|------------|-----------------------|-------------|---------------|
| 0 = 0x00 = | NO_KEY | 10 = 0x0A = | UP_ENTER_KEY |
| 1 = 0x01 = | STOP_START_KEY (motor | 11 = 0x0B = | DOWN_KEY |
| 2 = 0x02 = | MENU_KEY | 12 = 0x0C = | DN_REPEAT_KEY |
| 3 = 0x03 = | UNITS_KEY | 13 = 0x0D = | DN_ENTER_KEY |
| 4 = 0x04 = | BATCH_KEY | 14 = 0x0E = | UP_DOWN_KEY |
| 5 = 0x05 = | CALIBRATE_KEY | 15 = 0x0F = | SECRET_1_KEY |
| 6 = 0x06 = | MODE_KEY | 16 = 0x10 = | SECRET_2_KEY |
| 7 = 0x07 = | ENTER_KEY | 17 = 0x11 = | SECRET_3_KEY |
| 8 = 0x08 = | UP_KEY | 18 = 0x12 = | TIMEOUT_KEY |
| 9 = 0x09 = | UP_REPEAT_KEY | | |

- The most significant byte contains the desired condition (0 = user desires pump off, 1 = user desires pump on). The least significant byte contains the actual motor status (0 = pump motor off, 1 = pump motor on). When writing, only write to the Most Significant byte. The Least Significant byte must be set to 0x00 or an error will be returned.
- Percent-Stroke value is expressed in hundredths of percent i.e. 0x01F4 = 500 = 5.00%. The 0-10,000 value range may be modified by Ratio and Reverse Acting and further limited by end-points.
- Percent-Speed value is expressed as hundredths of percent i.e. 0x2710 = 10000 = 100.00%. The 0-10,000 value range may be modified by Ratio and Reverse Acting and further limited by end-points. This value is write-able only in a DLCM. A DLC will always return 100.00%.
- Stroke Counter 16-bits (Most significant or Least significant depending on register). The combination of these addresses constitutes a 32-bit unsigned LONG value. It is useful only if the tachometer option is installed (e.g., DLCM).
- The least significant bit contains the Under/Over Voltage Flag (0=False[No Error], 1=True[Error]).
- The Actual Stroke Position value is expressed in hundredths of percent i.e. 0x01F4 = 500 = 5.00%.
- The Actual Average Motor Speed value is expressed in hundredths of percent i.e. 0x01F4 = 500 = 5.00%. The Average Interval is 10 pump strokes. Writing any value will reset the Average.
- Writing while security is disabled sets a new PIN #. Writing while security is enabled compares to the old PIN #.
- Reading returns the current condition from RAM that can be either 0=Security Off, 1=Tamper Proof, 2=Calibration Settings. Writing while security is disabled, enables the chosen security type. NOTE that you should write the PIN # before enabling security here.
- This is provided because you can only write items while in MODBUS MODE. 0=MANUAL MODE, 1=ANALOG MODE, 2=MODBUS MODE, 3=BATCH MODE.
- Reading determines if we are currently performing a Find Zero Calibration. (0=no, 1=in progress) This register can be written with a '1' to force a Find Zero Calibration to occur.

SUPPORTED FUNCTION CODES and SUB-FUNCTION CODES

| | | |
|------|---|---------------|
| 0x01 | READ COIL STATUS (bits) | SUPPORTED |
| 0x02 | READ INPUT STATUS (bits). | SUPPORTED |
| 0x03 | READ HOLDING REGISTERS (16-bit integers) | SUPPORTED |
| 0x04 | READ INPUT REGISTERS (16-bit integers) | SUPPORTED |
| 0x05 | FORCE SINGLE COIL (bits) | NOT supported |
| 0x06 | PRESET SINGLE HOLDING REGISTER (16-bit integer) | SUPPORTED |
| 0x07 | READ EXCEPTION STATUS (8-bits only) | NOT supported |
| 0x08 | DIAGNOSTIC FUNCTIONS | PARTIALLY |
| | 0x0000 RETURN QUERY DATA (ECHO) | SUPPORTED |
| | 0x0001 RESTART COMMUNICATIONS PORT | SUPPORTED |
| | 0x0002 RETURN DIAGNOSTIC REGISTER | NOT supported |
| | 0x0003 CHANGE ASCII INPUT DELIMITER <LF> | SUPPORTED |
| | 0x0004 SET LISTEN ONLY MODE | SUPPORTED |
| | 0x0005 - 0x0009 reserved | NOT supported |
| | 0x000A CLEAR CTRS AND DIAGNOSTIC REGISTER | NOT supported |
| | 0x000B RETURN BUS MESSAGE COUNT | NOT supported |
| | 0x000C RETURN BUS COMM. ERROR COUNT | NOT supported |
| | 0x000D RETURN BUS EXCEPTION ERROR COUNT | NOT supported |
| | 0x000E RETURN SLAVE MESSAGE COUNT | NOT supported |
| | 0x000F RETURN SLAVE NO RESPONSE COUNT | NOT supported |
| | 0x0010 RETURN SLAVE NAK COUNT | NOT supported |
| | 0x0011 RETURN SLAVE BUSY COUNT | NOT supported |
| | 0x0012 RETURN BUS CHAR. OVERRUN COUNT | NOT supported |
| | 0x0013 RETURN OVERRUN ERROR COUNT | NOT supported |
| | 0x0014 CLEAR OVERRUN COUNTER AND FLAG | NOT supported |
| | 0x0015 GET/CLEAR MODBUS® PLUS STATISTICS | NOT supported |
| | 0x0016 - 0xFFFF reserved | NOT supported |
| 0x09 | PROGRAM MODICON 484 CONTROLLER | NOT supported |
| 0x0A | POLL MODICON 484 CONTROLLER | NOT supported |
| 0x0B | FETCH COMMUNICATIONS EVENT COUNTER | NOT supported |
| 0x0C | FETCH COMMUNICATIONS EVENT LOG | NOT supported |
| 0x0D | PROGRAM CONTROLLER | NOT supported |
| 0x0E | POLL CONTROLLER | NOT supported |
| 0x0F | FORCE MULTIPLE COILS. | NOT supported |
| 0x10 | PRESET MULTIPLE HOLDING REGISTERS | SUPPORTED |
| 0x11 | REPORT SLAVE ID | SUPPORTED |

----- Return Message Contains -----

0x22 = Byte Count (length of data field to follow) (34 decimal)

0x99 = Slave ID

0x## = Run Status (of the pump motor) 0x00=off, 0xFF=on

16 characters from prom_ver[] string like: " 1.24 "

16 characters from Serial Number string entered at Factory Setup

Example: "B156045-D10 "

| | | |
|--|---------------------------|---------------|
| 0x12 | PROGRAM 884/M84 | NOT Supported |
| 0x13 | RESET COMMUNICATIONS LINK | NOT supported |
| 0x14 | READ GENERAL REFERENCE | NOT supported |
| 0x15 | WRITE GENERAL REFERENCE | NOT supported |
| 0x16 | MASK WRITE 4X REGISTERS. | NOT supported |
| 0x17 | READ/WRITE 4X REGISTERS. | NOT supported |
| 0x18 | READ FIFO QUEUE | NOT supported |
| 0x19 to 0x7f | UNUSED | NOT assigned |
| Exception: 0x6f is used ONLY for the DLC to DLC MODBUS Mode. | | |

Notes:

1. Function codes that are NOT SUPPORTED or NOT ASSIGNED return an ILLEGAL FUNCTION CODE response.
2. Unsupported SUB-FUNCTION CODES under DIAGNOSTIC FUNCTIONS return INVALID DATA.MODBUS Mode

14.9 MODBUS Mode

14.9.1 Introduction

The serial communications supplied with the DLC/M is similar in operation to that with the 4-20mA signal. The [MODE] key controls the current operating mode: MANUAL, ANALOG (4-20mA) or MODBUS. Serial communications can occur with the DLC/M regardless of the mode setting. Never the less, only when the DLC/M is in the MODBUS MODE can a value be written – changing the operation of the device. In any other mode, values can only be read. Note that even in MODBUS MODE, the arrow keys cannot be used to adjust the flow, stroke or speed.

14.9.2 General Discussion

A PC or PLC MASTER controls a DLC SLAVE by writing to the Holding Registers for Percent Stroke, Percent Speed and Motor Status values. When the MASTER READS from the Stroke and Speed, it retrieves the User Desired Position and User Desired Speed. When the MASTER WRITES to the Stroke and Speed, it changes the Digital-Stroke and Digital-Speed values. This allows the application of the RATIO and REVERSE ACTING factors and checking of the end points limits. The written values must be in the range of 0.00% – 100.00% (0-10000). In addition, if this is **NOT** a **DLCM**, writing anything at all to the Motor Speed will return an error. The FLOW RATE cannot be set directly by the MASTER, it is calculated from the Stroke and Speed settings.



WARNING: FOR SAFETY, IF AN OPERATOR WANTS TO DISABLE THE MODBUS REMOTE CONTROL OF THE DLCM, THEN THEY MUST SWITCH THE DLCM OUT OF MODBUS MODE. TURNING OFF THE MOTOR WILL NOT PROTECT THEM AGAINST THE PUMP BEING TURNED BACK ON BY THE PC/PLC. WHENEVER PERFORMING MAINTENANCE, THE POWER SHOULD BE REMOVED COMPLETELY FROM THE DLCM.

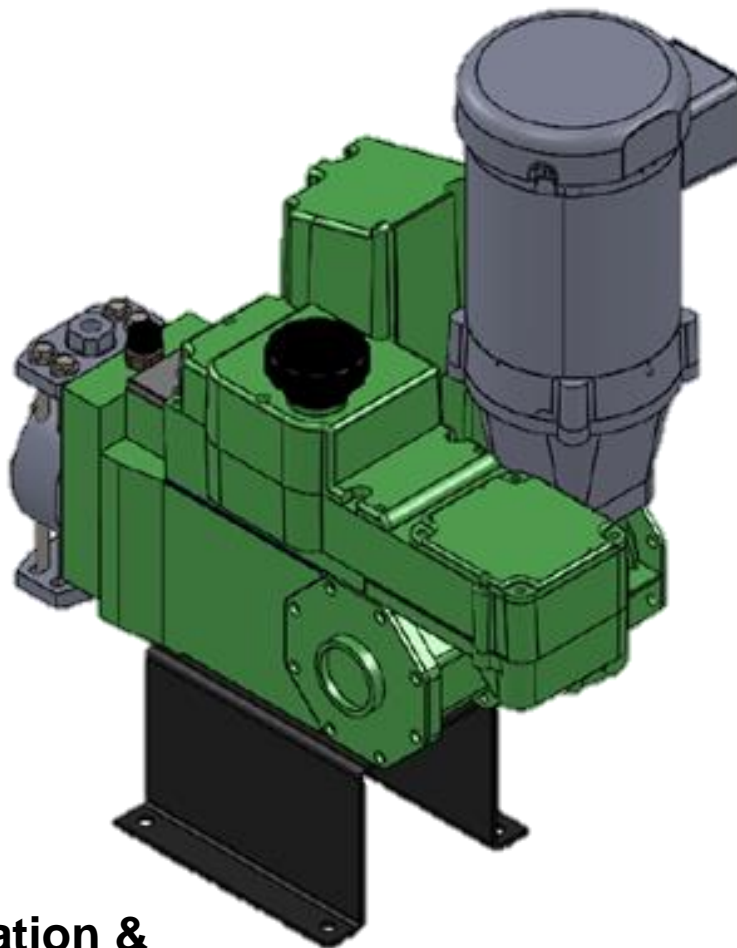
To prevent operators from modifying the operation of the DLC (e.g., changing the MODE from MODBUS to MANUAL), Tamper Proof Security should be invoked. When doing this, carefully select options in the {MODBUS SIG. FAIL} menu. If the DLC/DLCM is configured to restore to MANUAL MODE, and a MODBUS signal failure is detected, the PC/PLC will no longer be in control of the DLC. If Security is enabled, then operators will not be able to control the DLC/DLCM either (except for the motor key, which is never protected by security).

15 Spare Parts

User replaceable parts for the DLCM.

Table 4: Miscellaneous Replacement Parts

| Pulsafeeder P/N | Description | Qty |
|-----------------|--|-----|
| NP250012-000 | Clear Lexan Keypad / Display Cover | 1 |
| NP991209-003 | Cover Pins | 2 |
| NP260003-GPC | Manual Adjustment Knob | 1 |
| NP550003-DLC | 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 Screw Gasket | 8 |
| NP530314-000 | CE Filter Kit (Required for CE only) | 1 |



Installation, Operation & Maintenance Instruction Manual

PULSAR[®] DLCM NEMA TYPE 4x DIGITAL STROKE LENGTH & MOTOR SPEED CONTROLLER

Bulletin No.: IOM-CTL-DLCM-2004



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