INSTALLATION AND OPERATION MANUAL

PUMP CONTROL UNIT

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SECTION 1 INTRODUCTION

Purpose

Instructions contained in this manual apply to the Pump Control Unit manufactured by Data Flow Systems. This manual is intended to furnish the user with all the information necessary to install and operate the Pump Control Unit PCU001.

Included in the Appendix is a Glossary defining terms used in the manual. A brief review of this Glossary is recommended before continuing with the discussions which follow.

Figure 1-1  Pump Control Unit

Description

The Pump Control Unit (PCU) is a microprocessor-based, solid-state, multi-pump controller designed as a self contained stand-alone unit. (Figure 1-1). The unit provides all the features necessary to monitor and control sewage lift stations and fresh-water tank filling operations. The PCU provides fail-safe H-O-A switches, elapsed-time meters, a 240 Vac three-phase power monitor, and electronics to alternate and stage up to three pumps. The PCU, motor breakers, motor starters, level-sensing device and optional alarm horn/light are all that is required to monitor and control a pumping station.
Figure 1-2 PCU front view with callouts of the controls
Principles of Operation

In water and wastewater industry, pumps are used to empty wells and to fill tanks along with other areas of moving liquid from place to place. In the following discussion and descriptions of pump control systems, pumps and their associated motors are considered inseparable since they are physically connected and operate as a unit. Whenever the word "pump" is used, it refers to the pump unit including its associated motor.

Automatic/Manual Control

When the Hand-Off-Auto (H-O-A) switches on the PCU are in the "Auto" position, the PCU provides automatic control over a pump system. However, there are two ways to partially or totally override the PCU and manually control the system.

The H-O-A switches on the front panel of the PCU provide a way to manually control the pumps connected to the unit. (See Figure 1-2 for callouts of the front panel display of the PCU). The "Hand" position overrides the PCU control and forces a pump "On". The "Off" position overrides the PCU control and forces a pump "Off". The H-O-A switches are fail-safe; they remain operational in the event the PCU fails or loses power.

Telemetry interface provides another way to override the PCU. All outputs of the PCU can be individually overridden, (forced on), or disabled, (forced off). Connecting to a telemetry system provides a remote HOA system.

The PCU can function partially overridden; that is, it can operate when as few as one H-O-A switch is in the "Auto" position. Automated control continues with outputs left in the automatic state.

Level Sensing Transducers

Two types of inputs can be accommodated by the PCU. The first is the binary type device such as contact closures, float switches and pressure switches. The second type is analog in nature and can be either analog current (4-20 mA) type or analog voltage (1-5V) type (pressure or linear resistive).

For the binary type devices, several of these may be connected to up to six discrete digital monitoring points to control the operation of pumps. Floats are an example of contact closure devices. The PCU is designed to handle the standard well configurations of simplex, duplex or triplex stations. Other devices such as pressure switches and bubbler mercury switches are adapted to this design.

For analog level input devices, any level detection transducer that supplies a 4-20 mA current signal or a 1-5 volt signal can be used. These devices can be self powered or can be powered by the PCU. By connecting this type of device to analog input terminals of the PCU and calibrating the maximum and minimum points and staging points, the station can be controlled.

Number of Pumps

Simplex Station

A simplex station consists of one pump. The simplex station uses as a minimum the OFF and LEAD staging levels.

Duplex Station

A duplex station consists of two pumps. The duplex station uses as a minimum the OFF, LEAD and LAG1 staging levels.
**Triplex Station**

A triplex station consists of three pumps. The triplex station uses a minimum the OFF, LEAD, LAG1 and LAG2 staging levels.

**Pumping Modes**

The PCU can be configured to operate in two different pumping modes, "pump down" or "pump up". The pump down mode is used to empty a well by maintaining the well level between the OFF and LEAD staging levels. The pump up mode fills a tank by maintaining the tank level between the OFF and LEAD levels.

**Pump Staging**

Pumps are automatically started and shut down based on staging levels.

**Staging Levels**

The PCU operates on six staging levels: LOW, OFF, LEAD, LAG1, LAG2 and HIGH. The function of the staging levels varies with the two different modes of pumping. These functions are described later for each of the modes. Figure 1-3 illustrates the difference in the designation of the staging levels for a lift station and a storage tank.

Staging levels can be monitored through a discrete system (float switches) or an analog system (pressure transducer). The discrete system is defined by six digital monitor inputs. In this system, contract closure is monitored at discrete (staging) levels in a well to define where a pump is started and when multiple pumps are run. These contract closures are biased with a selected voltage. Both the Low and High floats are optional as alarms. Since the low float input must be ON in the normal state, if it is not used it must be disabled through local PCU configuration to prevent a false alarm condition. If it is used it must be enabled.

The analog system uses a variable 4-20 mA or a 0-5 volt input supplied by a transducer which it compares to six previously established set points. An operator sets the 4 mA or the 0-volt input equal to the low range of the transducer and the 20 mA or 5-volt input equal to the high range of the transducer. The operator also sets the staging level in feet for the lead, lag1, and lag2 pumps to start. The PCU interprets the input signal and starts or stops pumps according to the chosen staging levels. When the analog level reaches the set point value, the corresponding Well Level LED illuminates and the PCU enters that staging level. In this case also, both a Low and a High float can be used as optional alarms. Since the emergency low input must be ON in the normal state, if it is not used it must be disabled to prevent a false alarm condition. If it is used it must be enabled. The emergency low-level input must be "ON" for normal PCU operation.

**Pump Down mode**

The following paragraphs describe the normal function of the six staging levels of the PCU in the pump down mode such as that used in a lift station.

**LOW Level**

The LOW staging level shuts down pumps and activates alarms. The LOW level is considered active when the well is below the LOW level. It must be set below all other levels.
**OFF Level**

The OFF level is set in a well at the desired minimum operational level. The PCU will shut down all pumps when the level drops below the OFF level.

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**Figure 1-3 Designation of the staging levels for a lift station (Pump Down) and a storage tank (Pump Up)**

**LEAD Level**

The LEAD level starts the LEAD (first) pump. The LEAD level is active when the well is above the LEAD level. When the LEAD is active, one pump is started.

**LAG1 Level**

The LAG1 level starts the LAG1 (second) pump. The LAG1 level is active when the well is above the LAG1 level. When the LAG1 level is active, the second pump is started.

**LAG2 Level**

The LAG2 level starts the LAG2 (third) pump. The LAG2 level is active when the well is above the LAG2 level. When the LAG2 level is active, the third pump is started.

**HIGH Level**

The HIGH staging level starts all three pumps and activates alarms. It is active when the well level is above the HIGH level. The HIGH level must be set above the other levels. (See "Entering CONFIGURE MODE Display Configuration - Fault Mode", Section 3, for additional information).
Pump Up Mode
The following paragraphs describe the function of the six staging levels of the PCU in the pump up mode such as that used in a storage tank.

**LOW Level**
The LOW level starts all pumps and activates alarms. The LOW level is considered active when the tank is below the LOW level. It must be set below all other levels.

**LAG2 Level**
The LAG2 level starts the LAG2 (third) pump. The LAG2 level is active when the tank is below the LAG2 level. When the LAG2 level is active all three pumps will be started.

**LAG1 Level**
The LAG1 level starts the LAG1 (second) pump. The LAG1 level is active when the tank is below the LAG1 level. When the LAG1 level is active, two pumps are started.

**LEAD Level**
The LEAD level starts the LEAD (first) pump. The LEAD level is active when the tank is below the LEAD level. When the LEAD level is active, one pump is started.

**OFF Level**
The OFF level is set in a tank at the desired maximum operational tank level. The PCU will stagger-stop all pumps when the level rises above the OFF level.

**HIGH Level**
The HIGH level shuts down all pumps and activates alarms. It is active when the tank level is above the HIGH level. The HIGH level must be set above the other levels.

Whenever staging levels are referred to hereafter, unless specifically noted as applicable to "well" or "tank", they apply equally to both.

**Pump Alternation**
The PCU provides an alternator function.
When the alternator is enabled it updates each time it starts a pump. If a pump fails to start, the alternator will advance to the next available pump. Pumps can be taken out of service with the HOA switches and the PCU will continue to alternate the remaining pumps.

When the alternator function is disabled, pump 1 is used as the lead pump, pump 2 as the lag1 pump and pump 3 as the lag2 pump.

**Display Modes**
There are three display modes available to the operator: the Status Mode, the Alarm Mode and the Configure Mode. When the PCU’s power is cycled "ON" it initializes the PCU and then the LCD enters the STATUS display mode. The configure mode and the alarm mode are entered from the status mode.
**Status Display Mode**

The PCU displays a firmware revision date and serial number during initialization. This date is used to identify firmware program updates. After initialization the LCD displays a STATUS display message.

The STATUS display mode of the LCD, when toggled, displays for each pump the Elapsed Time Meter, Average Pump Run Meter, Average Pump Flow Rate, Total Station Flow and Well Level. It also displays these messages: "VIEW ALARMS", "CONFIGURE MODE", "TIME OF DAY", "PHASE A-B VOLTAGE" and "PHASE A-C VOLTAGE".

**Statistical Data Collection**

The PCU maintains the following history of pump operations.

**Elapsed Time Meter**

Elapsed Time Meter contains the cumulative run time for a pump. The PCU provides one readout on the LCD display for each pump.

**Average Pump Run**

Average Run Time is the average of the time the pump is on. It is calculated each time the pump shuts down. The PCU provides one readout on the LCD for each pump.

**Average Pump Flow Rate**

Average Pump Flow Rate is calculated as an average based on the station Flow Volume, the individual pump RUN time, and the station fill rate. The Flow Rate will be displayed only if the well volume is configured.

**Total Station Flow**

The Total Flow Volume is calculated as an average based on the total time it takes the liquid level to move from the OFF level to the LEAD level. For this calculation to be made, the station volume between the OFF and LEAD levels must be entered into the PCU. Consult well or tank specification data for volume information. See "Flow Volume" in Appendix 3 for more information.

**Alarm Mode**

The PCU used in a standalone configuration - Alarm messages displayed in the LCD include those for power and bias, phase voltage and sequence, motor starter fault, high and low float and float sequence, and transducer fault. See Section 4, Maintenance, Troubleshooting and Service for a description of the alarm messages.

In this configuration, an alarm message will flash if the alarm is active. The display will not flash if the alarm condition is inactive.

Statically displayed messages are inactive alarms and are buffered in the PCU's alarm log until viewed. If the alarm becomes inactive while being viewed, it will stop flashing. The ALARM LED will continue to flash until there are no active alarms and all inactive alarms have been viewed. The ALARM LED is cleared when the alarm mode is exited.
The "UP" and "DOWN" keys allow the operator to scroll through the alarm displays. Refer to the Troubleshooting section of this manual for descriptions of the alarm messages.

**The PCU used in a telemetry configuration**

When the PCU is used as a remote in conjunction with the telemetry, an alarm (active alarm) cannot be cleared either by the PCU or the central telemetry until the fault is cleared. The telemetry system will poll the PCU and will display the alarm. While the alarm is active, it will be displayed both at the PCU and in telemetry. When the alarm clears, telemetry clears both displays.

**Configure Mode**

The CONFIGURE MODE is entered by displaying the "CONFIGURE MODE" message in the STATUS display mode and pressing and holding the "ENTER" key until the display changes. The CONFIGURE MODE cannot be entered unless all three HOA switches for the pumps are in the OFF position.

The configuration options can be displayed and changed in the CONFIGURE MODE.

**Configuration Entering & Storage**

**Keypad & LCD**

A three-key keypad is provided to allow the operator to scroll through displays and change the configuration. The keys are defined as UP, DOWN and ENTER. A 16-character LCD is provided to view status, alarms and the configuration.

**Nonvolatile Memory**

Statistical data and configuration data are stored in nonvolatile memory. The unit retains this data with the power disconnected.

**Communications Service Port**

The PCU provides an RS-232 interface on the front panel for diagnostics and configuration storage and updating. The configuration can be uploaded from the PCU to a portable computer and saved. If the PCU is replaced the configuration can be downloaded from the portable computer to the new PCU.

**Phase Monitor**

**Internal Phase Monitor**

A 240-Vac, three-phase power monitor is provided. The phase monitor detects phase reversal, phase loss, and high and low line-voltage phase faults. High and low Phase Monitor detection limits are set in the CONFIGURE mode. **A fault of phase reversal, phase loss, or line voltage will result in an alarm and will shut down all automatically controlled pumps.**

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Connections to the three-phase lines are used for monitoring phase sequence and voltage levels of the incoming power. The PCU's phase monitor is labeled for clockwise phase rotation. If the three-phase power is labeled for counter-clockwise rotation and is connected in accordance to the PCU's terminal label the PCU will detect a phase sequence fault. To correct this condition, reverse any two leads connected to the PCU's phase monitor.

**NOTE:** The PCU reads and displays voltage from peak to peak. It does not display RMS voltage readings like a voltmeter. Therefore, peak-to-peak voltage readings displayed at the PCU will not be consistent with your voltmeter reading.

*External Phase Monitor*

An input is provided on the PCU to accommodate an external phase monitor if one is required. *The external phase monitor must provide a set of contacts that open during a phase fault.*

*Phase Monitor Bypass*

If no phase monitor is desired, the PCU's phase monitor can be bypassed by biasing the external phase monitor input in the ON state.

*Motor Run Monitor*

The PCU provides three digital monitor inputs for monitoring the status of the motors controlled by the PCU's starter relays.

The input terminals are P2-1 MOTOR 1 RUN, P2-2 MOTOR 2 RUN, and P2-3 MOTOR 3 RUN. The MOTOR -1 RUN input monitors the circuit controlled by the MOTOR 1 STARTER output. This would be consistent with all three pumps. Care should be taken not to cross-wire the motor run inputs and starter outputs. For each pump controlled by the PCU the corresponding MOTOR RUN input must be connected. After the PCU starts a pump, it checks the motor run input to verify the pump is running. If the signal is not present it will shut down the pump, activate the pump's motor-starter alarm and try the next pump.

Although there are several different ways to monitor the Motor Run, the preferred method is to use phase A at the load side of the motor breaker as motor run bias and feed the bias through the starter auxiliary contacts to the motor run input terminal of the PCU with a proper bias resistor in the circuit. Monitoring the starter auxiliary contacts by using phase A as bias can provide fault detection of the PCU's starter relays, the motor-starter coils, heaters and overloads as well as an open breaker.

Other monitor points can be selected if motor starter auxiliary contacts are not available Any voltage point in the motor circuit may be used as a bias voltage with diminishing fault detection. (See Section 2 - Installation for Motor Run wiring instructions)

*Solid State Motor Starter Control Relays*

Three solid-state relays in the PCU control up to three motor starters. STARTER POWER, terminal P1-24, will be switched to the starter coils when the PCU's starter relays are energized, or when the HOA switches are placed in the "Hand" position. The PCU can control 120 Vac or 240 Vac starter coils. *A one-amp slow-blow fuse is required to protect the PCU's relays from short-circuited motor-starter coils.* Size 3 or larger.
starters should be isolated with a relay. If starters are not maintained over time, they can draw over one ampere.

**Auxiliary Input/Output**

The telemetry provides monitoring of the AUX INPUT and control of the AUX OUTPUT. This allows these points to be used as general monitor and control points.

Examples of auxiliary use are:
- Can be configured to cause a local light alarm.
- Can be used to provide a backup bubbler function.
- Can be used to switch "ON" a backup bubbler compressor when a fault is detected in the primary compressor by an air-flow switch.

**Alarm Light & Horn/Bell Outputs**

The PCU contains two mechanical relays for controlling an alarm light and horn. Alarm devices can be powered from ac or dc. If the PCU is connected to telemetry, these devices are not necessary and may be disabled through the CONFIGURE mode. All conditions that activate the Alarm Horn and Light report through the telemetry.

A Fail-Safe feature is incorporated into the PCU. In normal operation, Alarm/Light-output contacts are open. When power to the PCU is interrupted, the Light-output contacts are closed and the Alarm Light is lit. The Alarm Horn contacts are not effected on loss of power to the PCU and the Alarm Horn is not activated. Alarm outputs are activated only when the PCU detects an alarm condition. The alarm horn can be silenced with a momentary switch connected to the ALARM SILENCE input on the PCU or by entering the View Alarm Mode. (See Section 2 - Installation for Alarm Silence wiring instructions). Any new alarm condition will reactivate the Alarm horn. Both Alarm Light and Horn will become inactive when all alarm conditions clear. However, the ALARM LED on the front panel of the PCU will continue to flash and the alarm will continue to be available in the alarm mode of the LCD until it is viewed in the display. This is not the case if the PCU is used in the Telemetry configuration and the alarm has been acknowledged. See “Alarm Mode, this Section and Section 3.

The Alarm Horn and Alarm Light are powered from the ALARM POWER terminal, P1-18. Contacts of the ALARM HORN OUT, terminal P1-16, and ALARM LIGHT OUT, terminal P1-17, are rated up to 120 Vac or 24 Vdc at 1 Amp.

**LED Indicators**

The PCU provides 14 LEDs to provide system status at a glance.

**Pump RUN Indicators**

Each pump has an LED to indicate its ON/OFF state. The PUMP RUN LED also flashes to indicate a fault in the starter circuit.

**PCU POWER Indicator**

The PCU POWER indicator illuminates when the proper ac voltage is applied to the unit. It flashes when the unit is on battery power.
CPU FAULT Indicator

If the microcontroller in the PCU fails, a circuit disables the outputs and flashes the CPU FAULT LED. When the CPU FAULT LED is flashing all automated controls are disabled and operation of the pumps can be continued only by using the HOA switches.

TX DATA Indicator

The TX DATA LED is part of the telemetry and service port interface. It strobes when the PCU transmits data.

RX DATA Indicator

The RX DATA LED is part of the telemetry and service port interface. It strobes when the PCU receives data.

ALARM Indicator

This LED indicator flashes when the PCU enters an alarm state and continues to flash until the alarm is no longer active and has been viewed through the View Alarm display. Alarm conditions are displayed in the alarm mode of the LCD.

WELL LEVEL Indicators

The six well level LEDs indicate the present staging level of the PCU.

Hand-Off-Auto Switches

Three H-O-A switches on the front panel of the PCU are provided to manually override the PCU's automated control. The H-O-A switch for a pump motor must be in the "Auto" position for the PCU to provide automatic control of that motor. The "Hand" position overrides the PCU's control and forces the corresponding pump motor "ON". The "Off" position overrides the PCU's control and forces the corresponding pump motor "OFF". Unused switches should be left in the "Off" position. The H-O-A switches are fail safe; they operate with or without the PCU powered. They will continue to function in the Hand and Off positions with the PCU in a faulted state or powered down. Motor Starter faults are reset when the corresponding H-O-A switch is changed from the "Auto" position. All three H-O-A switches must be in the "Hand" or "Off" positions to enter the configure mode of the LCD.

Failure Modes

The PCU can operate around a pump that has failed and can be configured to retry the failed mode pump after a delay. If the retry function is disabled then the PCU will alternate around the faulted pump.

If the PCU detects a critical fault in the system it disables the pumps and activates the alarm outputs. Any phase fault disables the pumps, but the HOA switches can override the PCU and start the pumps.

Control & Monitoring via Telemetry (Optional)

Circuitry and firmware are provided by the PCU to interface into the DFS TAC II telemetry system. This telemetry interface allows the PCU to be controlled and monitored remotely. All inputs and alarms are available
through the telemetry for monitoring. All outputs of the PCU can be disabled or overridden independently through the telemetry.

**Alarm Horn and Light (Optional)**
A mechanical relay output is provided by the PCU to drive an alarm horn and light. These alarm devices can be either ac power or dc power to operate under power outages. The alarm light output remains active when the PCU is powered down.

**Battery Backup (Optional)**
An input is provided for connecting a battery to the PCU at connection P1-8 and P1-9. The battery provides backup power to operate the PCU when primary power is interrupted. Telemetry will continue to function and provide station status. The alarm horn and light can be powered from the battery to provide the alarm function during a power outage. All digital monitor inputs using BIAS+ (P2-16) as a bias-voltage source will continue to function.

A battery charger circuit is provided by the PCU to trickle charge a battery for backup operations. The battery is not necessary to retain statistical data or the PCU configuration data. Its main purpose is to provide telemetry during power outages. The battery can also be used to drive a dc powered alarm horn and light. Determine the maximum Horn and Light power requirements to establish proper battery size.
Features

**Multiple Level Sensor Type Inputs**

The PCU provides two different interfaces for level sensing devices. They are Digital Monitor Inputs and Analog Input - 4-20 mA or 0-5 Vdc.

*Digital Monitor Inputs*

Contact Closure Devices - The PCU provides six digital monitor inputs for monitoring contact closure type devices such as float switches, bubbler mercury switches and pressure switches.

*Analog 4-20 mA or 1-5 Vdc Input*

Analog Level Transducer

Analog level input devices can be used with the PCU. This includes any level detection transducer that supplies a 4-20 mA current signal or a 1-5 V signal. Transducer power in the form of 20-24 Vdc (unregulated) is supplied by the PCU to devices that require power.

**User Interface**

*Three-Key Keypad*

UP, DOWN and ENTER keys.

*16-Character LCD Display*

Displays status, alarms and configuration.

*Pump Run LEDs*

ON/OFF pump status. Flash for starter circuit faults.

*Well Level LEDs*

Discrete and logical well level indication.

*PCU System Status LEDs*

Indicates power, CPU and alarm status. Indicates communications function.

*Communications Service Port*

Configuration storage and download from a portable computer.

*Hand-Off-Auto Switches*

Fail safe, operates independent of PCU.
Motor Run Monitor

The PCU provides three digital monitor inputs for monitoring the status of the motors controlled by the PCU’s starter relays.

Phase Power Monitor

Detects phase reversal, loss of phase, low-and high-phase faults.

_**A fault of phase reversal, phase loss, or line voltage will result in an alarm and will shut down all automatically controlled pumps.**_

Solid State Motor Starter Control Relays

Solid state for long life.

Auxiliary Input/Output

The telemetry provides monitoring of the AUX INPUT and control of the AUX OUTPUT. This allows these points to be used as general monitor and control points. For instance:

- Can be used to provide a backup bubbler function, or independently.
- Can be configured to cause a local light alarm.

Alarm Light & Horn/Bell Outputs

The PCU contains two mechanical relays for controlling an alarm light and horn.

Connectorized Wire Terminals

PCU removable without disturbing field wiring.

Telemetry Interface

Remote monitoring and control

Internal Power Supply

120 Vac input (240 Vac factory option).

Battery Charger

Trickle charger for battery backup operation.
Specifications

Size: 5.75"w x 8.75"h x 3.25"d (See Figure 2-3).

Weight: 4.1 lbs.

Power Consumption: 20 watts, normal operation (50 watts max)

PCU Power Input: 120 Vac, single phase  (Factory option 240 Vac, single phase.)

Battery Charger: Charging voltage 13.8 Volts. Current limited to 100 mA.

Phase Monitor Input: 240 Vac, three-phase, labeled for clockwise rotation.

Digital Monitor Inputs:

- Input Common 1 (Pump Runs & Ext. Phase Monitor)
  - 10-30 Volts ac/dc, at 6K ohms.
- Input Common 2 (Level inputs, Alarm silence, Aux input)
  - 10-30 Volts ac/dc, at 6K ohms.

Input Protection: M.O.V., Transorb, and Opto-Isolated.

Bias+Bias-: 24 Vdc at 60mA, unregulated, isolated.

Transducer Interface: Transducer Power: 24 Vdc at 40 mA.

- Analog Input: 4-20 mA at 250 ohms, 1-5 Vdc at 100K ohms.
- Digital Interface: 9600 baud, 8 bit, no parity
- RX and TX multiplexed on XDCR DATA

Output Relays:

- Alarm Relays: 24-120 Vac @ 0.5 A, tungsten
- 12-24 Vdc @ 1.0 A
- Alarm Light, Normally closed contacts
- Alarm Horn, Normally open contacts
- Auxiliary Relay: 240 Vac, 240 VA, Pilot duty
- Motor Starter Relays: 240 Vac, 240 VA, Pilot duty


See Parts List; Section 5 Options to order.
Warranty Statement

Data Flow Systems, Inc. of Melbourne, Florida, warrants the Pump Control Unit, Model PCU001, to be free from defects in material and workmanship for a period of one year, providing that the unit is returned to the factory, post-paid. Parts and labor are covered. Transportation shipping costs from the factory to the customer are not covered. This warranty does not cover damage from misuse, vandalism, or natural disasters. See Section 4, Maintenance, Troubleshooting and Service, for additional information.

If the unit is purchased with the proper protective devices and if these devices and the PCU are installed according to DFS recommendations, this warranty may be extended from one to three years and may be broadened to include damage caused by lightning and/or electrical surge. Contact Data Flow Systems if more information is required.
SECTION 2 INSTALLATION

General

A qualified technician should perform installation of the PCU.

WARNING

Precautionary measures must be observed when installing, operating and servicing the PCU to prevent shock from voltages present.

Included in Appendix 4 is a Glossary defining terms used in the manual. A brief review of this Glossary is recommended before continuing with the discussions that follow.

Receipt of Equipment

When the equipment is received, examine the outside of the carton for any damage incurred during shipment. Remove the packing list and remove the PCU from the carton. Inspect the PCU carefully for damage. Resolve any damage with the local carrier; make a report to Data Flow Systems ([321]-259-5009) with the serial number of the unit and extent of the damage.

Environmental Constraints

The PCU is designed to operate under the following conditions:

Temperature: 0°C (32°F) to 60°C (140°F) With recommended backup battery in the same environment, the upper temperature limit is 50°C (122°F)

Enclosure: NEMA type 12 or equal
Mechanical Installation

**WARNING**

If the PCU is to be installed into an existing control panel, make sure all the breakers are shut off before starting the installation.

---

The PCU can be mounted in a control panel in several different ways. The unit can be mounted flush to the back plate of the panel, stood off the back plate or mounted to a front panel. Mounting brackets are provided with the PCU that can be used to mount the PCU in any of these positions as shown in Figure 2-1. Optional connectors to facilitate the various types of mountings are available as shown in Figure 2-2 and may be specified as described in Section 5, Parts List.

A dimensional drawing is provided in Figure 2-3 to aid in the installation. If a panel cutout is required the PCU can be installed with or without edge molding around the front-panel opening. The panel cutout is different for each mounting configuration. See Figures 2-4 & 2-5.
Figure 2-3 Dimensional drawing of the Pump Control Unit

Attention should be given to the location of the PCU to provide accessibility for wiring and servicing. Leave enough space around the PCU to access the PCU’s fuse and to remove the connectorized terminal strips. Install the PCU in the panel at a position where the LCD display can be read comfortably. The LCD is best viewed with eye level slightly above the display.
Electrical Installation

**WARNING**

If the PCU is to be installed into an existing control panel make sure all breakers are shut off before starting the installation.

**NOTE**

All wiring should conform to federal, state and local electrical codes.

The electrical interface to the PCU is broken down into several groups of signals. Wiring of each group is detailed in the following paragraphs. An installation checkout procedure follows the wiring instruction paragraphs.

A general wiring diagram of a typical installation for the PCU is shown in Figure 2 -6.
Figure 2-11 illustrates the use of Bias+ and Bias- as the common source for all 112 of the digital monitor point inputs.
**Connector Definitions**

The PCU has two removable connectors. They are referred to as the top connector **P1** and bottom connector **P2**.

### Top Connector P1

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-1</td>
<td>PHASE A</td>
</tr>
<tr>
<td>P1-2</td>
<td>PHASE B</td>
</tr>
<tr>
<td>P1-3</td>
<td>PHASE C</td>
</tr>
<tr>
<td>P1-4</td>
<td>SPARE (NC)</td>
</tr>
<tr>
<td>P1-5</td>
<td>AC POWER</td>
</tr>
<tr>
<td>P1-6</td>
<td>AC NEUTRAL</td>
</tr>
<tr>
<td>P1-7</td>
<td>EARTH GROUND</td>
</tr>
<tr>
<td>P1-8</td>
<td>BATTERY +</td>
</tr>
<tr>
<td>P1-9</td>
<td>BATTERY -</td>
</tr>
<tr>
<td>P1-10</td>
<td>TELEMETRY GROUND</td>
</tr>
<tr>
<td>P1-11</td>
<td>TELEMETRY PWR</td>
</tr>
<tr>
<td>P1-12</td>
<td>TELEMETRY CTS</td>
</tr>
<tr>
<td>P1-13</td>
<td>TELEMETRY RXD</td>
</tr>
<tr>
<td>P1-14</td>
<td>TELEMETRY TXD</td>
</tr>
<tr>
<td>P1-15</td>
<td>TELEMETRY RTS</td>
</tr>
<tr>
<td>P1-16</td>
<td>ALARM HORN OUT</td>
</tr>
<tr>
<td>P1-17</td>
<td>ALARM LIGHT OUT</td>
</tr>
<tr>
<td>P1-18</td>
<td>AUX OUTPUT</td>
</tr>
<tr>
<td>P1-19</td>
<td>AUX POWER</td>
</tr>
<tr>
<td>P1-20</td>
<td>MOTOR 3 STARTER</td>
</tr>
<tr>
<td>P1-21</td>
<td>MOTOR 2 STARTER</td>
</tr>
<tr>
<td>P1-22</td>
<td>MOTOR 1 STARTER</td>
</tr>
<tr>
<td>P1-23</td>
<td>STARTER POWER</td>
</tr>
</tbody>
</table>

*Note: Maximum wire size to PCU connectors is 12 AWG. Wire all PCU connectors in accordance with National, State, and Local Electrical Codes.*

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*Data Flow Systems, Inc., Melbourne, Florida*
Bottom Connector P2

- **P2-1** MOTOR 1 RUN .......................Motor 1 Run digital monitor input
- **P2-2** MOTOR 2 RUN .......................Motor 2 Run digital monitor input
- **P2-3** MOTOR 3 RUN .......................Motor 3 Run digital monitor input
- **P2-4** EXTERNAL P.M. .....................External Phase Monitor digital monitor input
- **P2-5** INPUT COMMON 1 ...................Motor Run & Ext. P.M. common return
- **P2-6** LOW LEVEL .........................Low level digital monitor input
- **P2-7** OFF LEVEL ...........................Off level digital monitor input
- **P2-8** LEAD LEVEL .........................Lead level digital monitor input
- **P2-9** LAG1 LEVEL .........................Lag1 level digital monitor input
- **P2-10** LAG2 LEVEL .........................Lag2 level digital monitor input
- **P2-11** HIGH LEVEL .........................High level digital monitor input
- **P2-12** AUX INPUT ..........................Auxiliary digital monitor input
- **P2-13** ALARM SILENCE ...................Alarm Silence Switch digital monitor input
- **P2-14** INPUT COMMON 2 ...................Input level, aux & alarm-silence return
- **P2-15** BIAS- ..............................Internally supplied 24 Vdc bias source return
- **P2-16** BIAS+ ...............................Internally supplied 24 Vdc bias source voltage
- **P2-17** SPARE (NC) ..........................DO NOT CONNECT
- **P2-18** XDCR DATA ..........................9600-baud multiplexed TX/RX data
- **P2-19** XDCR GROUND ......................Transducer power return
- **P2-20** CABLE SHIELD ......................Safety ground for shielded cable
- **P2-21** XDCR POWER .......................Transducer power
- **P2-22** ANALOG+ ...........................4-20 mA/1-5 V positive input
- **P2-23** ANALOG- ...........................4-20 mA/1-5 V return
- **P2-24** SHUNT ...............................4-20 mA select

Wiring Instruction, PCU AC Power

The PCU operates from 120 Vac. Verify the input voltage on the PCU's connector label before wiring. Three terminals are provided for wiring power, **P1-5 AC POWER, P1-6 AC NEUTRAL** and **P1-7 EARTH GROUND**.

Terminal **P1-7** is designated Earth or Safety ground. The case of the PCU is also connected to the EARTH GROUND terminal. Wire in accordance with National, State and Local Electrical Codes.

**Vac Installation**

Connect Terminal **P1-5** to 120 Vac and **P1-6** to neutral. See Figure 2-7 for a typical wiring diagram.

Connect 240 Vac power between terminals **P1-5** and **P1-6**.
Wiring Instructions, Motor Starter Outputs

Connect control power to STARTER POWER, terminal P1-24. Connect MOTOR 1 STARTER, terminal P1-23, through a one-amp slow-blow fuse to the coil of the motor starter designated as Pump 1. (This fuse protects the PCU relays from short-circuited coils). Connect the other side of the motor starter coil through appropriate disabling contacts to control power neutral. Make similar connections for Pump 2 and Pump 3 for duplex and triplex stations. A wiring diagram for the motor starter circuit is shown in Figure 2-8.

When the alternator function is bypassed (an option in the CONFIGURE MODE), MOTOR 1 STARTER output will control the lead pump, MOTOR 2 STARTER output will control the lag1 pump and MOTOR 3 STARTER output will control the lag2 pump. They should be wired accordingly.

Simplex stations use only MOTOR 1 STARTER output. Duplex stations use MOTOR 1 STARTER and MOTOR 2 STARTER outputs. Triplex stations use all three starter outputs. Unused starter outputs can be used as auxiliary outputs with control provided by telemetry.

NOTE

Be sure that the Starter Power (P1-24) and AC Power (P1-5) are both connected to the station’s control power. This will assure that all pumps under local control receive an emergency shutdown when the AC Power drops. Otherwise, multiple pumps could be commanded to start at the same time. Also be sure that proper fuses are installed for the Motor Starters (see Figure 2-8 below) and located as close as possible to the PCU to protect the PCU relays.
Figure 2-8 Motor Starter Wiring Diagram

Wiring Instructions, Alarm Light & Horn Outputs

The alarm light output is a normally closed set of contacts. The contacts are closed when the PCU is power down. A 1-amp slow-blow fuse is recommended to protect the PCU’s alarm relays from short circuits.

Connect ac or dc power to the ALARM POWER terminal, P1-18. Connect from the ALARM HORN terminal, P1-16, to the power terminal on an alarm horn. Connect the return terminal of the alarm horn to the return of the power source. Connect the ALARM LIGHT terminal, P1-17, to the power terminal of an alarm light. Connect the return terminal of the alarm light to the return of the power source. See Figure 2-9 for a wiring diagram of the alarm circuits.

Figure 2-9, Alarm Horn and Alarm Light - Wiring Diagram

Wiring Instruction, Phase Monitor

Connect terminals P1-1, P1-2 and P1-3 through 1-amp slow-blow fuses to phases A, B and C respectively at the load side of the main breaker. If phase sequence alarm occurs, swap any two legs. If the alarm was caused by improper phases, this will clear the alarm. The fuses must be located as close as possible to the voltage source. See Figure 2-10 for a wiring diagram.
Figure 2-10, Phase Monitor Wiring Diagram

Bias Voltage Source Options for Digital Monitor Point Inputs

The PCU has 12 optically isolated digital monitor point inputs. These monitor points require an input and a return. To reduce the amount of wiring, several inputs share the same return. There are two common return terminals for the inputs. MOTOR 1 RUN, MOTOR 2 RUN, MOTOR 3 RUN and EXTERNAL P.M. circuits are internally connected to the INPUT COMMON 1 terminal P2-5. LOW LEVEL, OFF LEVEL, LEAD LEVEL, LAG1 LEVEL, LAG2 LEVEL, HIGH LEVEL, AUX INPUT and ALARM SILENCE circuits are all internally connected to the INPUT COMMON 2 terminal P2-14. Inputs with a common return must use the same bias voltage. No more than two bias voltage sources can be used to bias the 12 digital inputs, one for biasing inputs using the INPUT COMMON 1 terminal and one for biasing inputs using the INPUT COMMON 2 terminal.

Figure 2-11 illustrates the use of Bias+ and Bias- as the common bias source for all 12 of the digital monitor point inputs.
Figure 2-11 illustrates the use of Bias+ and Bias- as the common source for all 112 of the digital monitor point inputs.
**Internally Supplied Bias Voltage Source**

A voltage of 10 to 30 Vac or Vdc will bias the digital monitor inputs in the "ON" state. Any voltage less than 2Vac or 2Vdc will force the digital monitor inputs to the "OFF" state.

The internal bias source is BIAS+, terminal **P2-16** and BIAS-, terminal **P2-15**.

![Diagram of internally supplied bias voltage source](image)

**Figure 2-12 Biasing an input with BIAS+/BIAS- voltage**

**Externally Supplied Bias Voltage Source**

Externally supplied bias voltages can be used to bias the inputs. If the voltage is greater than 30 Vac/dc, then a voltage-dropping resistor must be placed in line with the input. See Table 2-1 for voltage and resistor values. A minimum voltage of 10 Vac/dc is required to indicate an ON state for the digital monitor inputs. See Figure 2-13 for a general wiring diagram showing an input biased with an external source.

![Diagram of externally supplied bias voltage source](image)

**Figure 2-13 Biasing an input with an external source**

Data Flow Systems, Inc., Melbourne, Florida
### Wiring Instructions, Motor Run Monitored at Output of Starter Auxiliary Contactor

For each pump controlled by the PCU, a corresponding MOTOR RUN input must be connected.

The bias voltage for the Motor Run input is taken from one phase of the motor power at the output of the motor breaker and through the motor starter auxiliary contact (see Figure 2-14). Connect a wire from this point, through a voltage-dropping resistor, to the corresponding Motor Run input (P2-1 for Motor Run 1, P2-2 for Motor Run 2, P2-3 for Motor Run 3). Connect INPUT COMMON 1, terminal P2-5, to the neutral. See Table 2-1 for the resistor value that corresponds to the line-to-neutral voltage used.

<table>
<thead>
<tr>
<th>Input Bias Voltage</th>
<th>Resistor Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIAS+</td>
<td>none</td>
</tr>
<tr>
<td>24 Vdc</td>
<td>none</td>
</tr>
<tr>
<td>24 Vac</td>
<td>none</td>
</tr>
<tr>
<td>120 Vac</td>
<td>47K, 1/2 W</td>
</tr>
<tr>
<td>240 Vac</td>
<td>100K, 1 W</td>
</tr>
<tr>
<td>480 Vac</td>
<td>200K, 2 W</td>
</tr>
</tbody>
</table>

Table 2-1 Resistor Sizing Chart
Level Sensing Transducers

Two different types of input-supported transducers can be accommodated by the PCU. The first is the binary type device such as contact closures, float switches and pressure switches. The second type is analog in nature and can be either analog current (4-20 mA) type or analog voltage (1-5V) type (pressure or linear resistive).
**Wiring Instructions, Contact Closure Devices**

The input terminals for the contact closure devices are P2-6 LOW LEVEL, P2-7 OFF LEVEL, P2-8 LEAD LEVEL, P2-9 LAG1 LEVEL, P2-10 LAG2 LEVEL and P2-11 HIGH LEVEL. These six inputs plus the P2-12 AUX INPUT and P2-13 ALARM SILENCE inputs are internally connected to P2-14 INPUT COMMON 2. All eight of these inputs must be biased with the same voltage source.

Simplex stations use input terminals P2-6 LOW LEVEL, P2-7 OFF LEVEL, P2-8 LEAD LEVEL and P2-11 HIGH LEVEL. Duplex stations add input P2-9 LAG1 LEVEL. Triplex stations add input P2-10 LAG2 LEVEL. It is recommended to use LOW LEVEL and HIGH LEVEL inputs. However, HIGH LEVEL can be omitted. If a LOW LEVEL is not used then the LOW LEVEL function must be disabled in the CONFIGURE MODE of the PCU.

Connect the bias voltage to the common side of all float or pressure switches. Connect the output of each switch to the corresponding input terminal on the PCU. Use voltage-dropping resistors if required. See Table 2-1 for dropping resistor sizes. See Figure 2-15 for a wiring diagram of a float-input circuit. For normally closed switches (inverted floats), see Appendix 5.

---

**Wiring Instructions, Analog Level Transducer**

The terminals for the analog interface are P2-20 CABLE SHIELD, P2-21 XDCR POWER, P2-22 ANALOG+, P2-23 ANALOG- and P2-24 SHUNT. CABLE SHIELD is provided to terminate the shield of a shielded transducer cable. This terminal is connected to the EARTH GROUND terminal P1-7 and the case of the PCU. ANALOG+ is the positive input for current and voltage signals. ANALOG- is the return terminal for both current and voltage signals. SHUNT
must be tied to ANALOG- for current signals. Jumping SHUNT to ANALOG- places a 250-ohm load across the ANALOG+ and ANALOG- terminals to convert the current signal to a voltage signal for the PCU. Wire the power for the analog transducer according to the transducer manufacturer's instructions. Connect the positive current or voltage signal from the transducer to terminal P2-22, ANALOG+. If required by the transducer, connect from terminal P2-23, ANALOG-, back to the return on the transducer. For current signals, jumper terminal P2-23, ANALOG- to terminal P2-24, SHUNT. See Figures 2-16 and 2-17 for typical analog transducer connections.

**Figure 2-16 - Analog Transducer with Internal Power Supply - Wiring Diagram.**
Transducer is powering the loop.

**Figure 2-17, Analog Transducer using External (PCU) Power Supply - Wiring Diagram.** PCU is powering the loop.
Optional Configurations and Hookups.

Tank Level Overlay

The PCU is manufactured in the configuration for use with a lift station (See Figure 1-2 - WELL LEVEL). It is shipped with an overlay for use when the PCU is used in a Tank configuration.

Peel off the backing on the overlay; place it so that the LED holes are lined up with the LEDs.

Wiring Instructions, Backup Battery

Two optional backup batteries are available for use with the PCU but a backup battery is not necessary for operation of the PCU but is recommended to prevent data loss at a power failure. Battery selection may be made at time of purchase and, depending on intended usage, may be either the YUASA NP 2.6-12 rated at 12 volts, 2.6 ampere hours or the YUASA NP 7.0-12 rated at 12 volts, 7.0 ampere hours. These batteries are interchangeable and maintenance free.

This circuit is not diode protected and therefore it is important to observe polarity when connecting the backup battery.

Connect terminal P1-8 (BATTERY+) to the positive terminal of the battery. Connect terminal P1-9 (BATTERY-) to the negative terminal of the battery.

Wiring Instructions, Alarm Silence Switch

The alarm horn, if installed, can be silenced in two ways: through the ALARM SILENCE input and by entering the View Alarms mode on the PCU’s LCD. The following describes the wiring of a momentary alarm silence switch.

![Figure 2-18, Alarm Silence Switch Wiring Diagram](image)

ALARM SILENCE, AUX INPUT and the LEVEL INPUT circuits are internally connected to terminal P2-14 INPUT COMMON 2. Each of these inputs must be wired with the same bias voltage and use the same voltage dropping resistor value for proper operation.

Connect a momentary switch (see Figure 2-18) from the bias voltage source through the proper voltage dropping resistor, if required, to terminal P2-13, ALARM SILENCE. The return for the bias voltage must be connected to terminal P2-14, INPUT COMMON 2. See Table 2-1 for the resistor value. See Figure 2-18 for a wiring diagram of the alarm silence switch circuit.
**Wiring Instructions, External Phase Monitor**

Connect a bias voltage to one side of the external phase monitor contacts. Connect the opposite side of the contacts through the proper voltage dropping resistor to terminal P2-4, EXTERNAL PM. See Table 2-1 for resistor value. **Use the same bias voltage source as used to bias the MOTOR RUN inputs.** The return for the bias voltage must be connected to terminal P2-5, INPUT COMMON 1. The MOTOR RUN and EXTERNAL P.M. input circuits are internally connected to terminal P2-5, INPUT COMMON 1.

![Wiring Diagram](image)

**Figure 2-19, External Phase Monitor Wiring Diagram**

Monitor contacts must open when a phase fault occurs. See Figure 2-19 for a wiring diagram showing the external phase monitor circuit.

**Wiring Instructions, Phase Monitor Bypass**

Operation of a station without three-phase power (e.g., use of single-phase motors) will cause the PCU to indicate a phase fault and shut down the pump(s). To prevent this false shut down, the PCU's phase monitor must be bypassed. This is accomplished by connecting a bias voltage through a voltage-dropping resistor, if required, directly into terminal P2-4 EXTERNAL P.M. Use the same bias voltage source as used to bias the MOTOR RUN inputs. The return for the bias voltage must be connected to terminal P2-5 INPUT COMMON 1. The MOTOR RUN and EXTERNAL P.M. input circuits are internally connected to terminal P2-5, INPUT COMMON 1. Note that the PCU Phase Monitor is designed for 200-240VAC 3-phase only.

**Auxiliary Input and Output Connections**

The PCU provides an auxiliary input and output that can be configured to function as an auxiliary relay. The AUX INPUT terminal P2-12 functions as one side of a relay coil and the INPUT COMMON 2 terminal P2-14 as the other. AUX POWER terminal P1-18 and AUX OUTPUT terminal P1-19 function as contacts for the relay.

*Data Flow Systems, Inc., Melbourne, Florida*
Wiring Instructions, Auxiliary Input

The AUX INPUT is an optically isolated digital monitor point and is wired the same as the other monitor points. Connect a bias voltage to one side of a contact closure device. Connect the other side through a voltage-dropping resistor, if required, to terminal P2-12, AUX INPUT. See Table 2-1 for resistor value. AUX INPUT must use the same bias voltage source as the LEVEL and ALARM SILENCE inputs. Connect the return for the bias source to terminal P2-14, INPUT COMMON 2. See Figure 2-20 for a wiring diagram of the AUX INPUT circuit.

![Figure 2-20, Wiring Instructions, Auxiliary Input](image)

Wiring Instructions, Auxiliary Output

The AUX OUTPUT is a solid state relay. Power is connected to terminal P1-20, AUX POWER. A load is connected between terminal P1-19, AUX OUTPUT and the power source return. See Figure 2-21 for a wiring diagram of the AUX OUTPUT circuit.

![Figure 2-21, Wiring Instructions, Auxiliary Output](image)

Wiring Instructions, Telemetry Hookup

Refer to the TAC II Telemetry System Installation Planning Guide supplied with the TAC II telemetry equipment for wiring instructions. See Parts List, Section 5 Options to order.

Data Flow Systems, Inc., Melbourne, Florida
Checkout

The following steps should be performed after the PCU has been installed.

1) Visually inspect all wiring. Check for loose wires and short circuits.

2) Verify that only one bias source is used to bias the eight digital monitor inputs sharing INPUT COMMON 2 terminal, and the bias source return is connected to the INPUT COMMON 2 terminal.

3) Verify that only one bias source is used to bias the four digital monitor inputs sharing INPUT COMMON 1 terminal, and the bias source return is connected to the INPUT COMMON 1 terminal.

4) Verify the proper voltage dropping resistors are installed in each digital monitor input circuit.

5) Verify wiring of the motor starter relays and that the proper fuses are installed for protection of the PCUs relays. Make sure each controlled starter is monitored by the PCU. Make sure the starter controlled by the MOTOR 1 STARTER relay is monitored by the MOTOR 1 RUN input, and so on.

6) Verify the voltage connected to the PCU’s ac power input. The operating voltage is marked on the PCU connector label.

7) Verify the wiring of the PCU’s phase monitor, external phase monitor or phase monitor bypass circuit. The PCU’s phase monitor is designed for 240 Vac line-to-line three-phase power. If not 240 Vac three-phase power, use external phase monitor or bypass the PCU’s phase monitor.

8) Make sure the PCU is properly grounded.

9) Verify that the level detection device(s) connected to the PCU is properly wired. If floats or pressure switches are used, check that they are in the correct sequence. If an analog 4-20 mA transducer is used, check that the jumper between the ANALOG- and SHUNT terminals is installed. If an analog 1-5 V transducer is used, check that the jumper between the ANALOG- and SHUNT terminals is removed.

10) Verify the wiring of the alarm light and horn, if used. The voltage connected to ALARM POWER is switched to the ALARM LIGHT and ALARM HORN terminals when the alarms are activated. The returns for the light and horn must be connected to the return of the source used to power them.
(11) Verify that the proper fuses are installed in the input circuit of the phase monitor and the output circuits of the motor starter, alarm light and horn, and auxiliary.

12) If telemetry is used, verify the wiring of the interface cable. See the TAC II Telemetry System Installation Planning Guide for telemetry check out procedures. See Parts List, Section 5 Options to order.

13) Before powering the PCU, place all three H-O-A switches in the "Off" position.

14) Turn circuit breakers "ON" one at a time. Turn the PCU switch "ON" last.

15) Checkout the motor starter circuits with the H-O-A switches. Place each H-O-A switch connected to a pump motor, one at a time, in the "Hand" position. The pump should start and the corresponding RUN LED should illuminate. Place each H-O-A switch connected to a pump motor in the "Off" position. The pumps should stop and the corresponding RUN LED should turn "OFF". Return all H-O-A switches to their "Off" positions.

16) Enter the CONFIGURE MODE of the LCD and configure the PCU accordingly. See Section 3 and Table 3-1, PCU’s Configuration Options. Set the PCU’s phase voltage limits, if used. "Exit and save" the configuration.

17) If any alarms are active, use the View Alarms mode of the LCD to display them. Make appropriate changes to correct the alarm conditions. Refer to the Troubleshooting section of this manual for descriptions of the alarm messages.

18) When the PCU is configured and all alarms are cleared, place the H-O-A switches of the connected pumps in the "Auto" position. Place unused H-O-A switches in the "off" position.

19) After the system is checked out, connect the backup battery, if used. Make sure the battery is properly connected. Observe polarity markings.

20) If the battery is charged, cycle the PCU’s ac power "OFF" and verify battery backup operation. Make sure to turn the PCU’s switch "ON" when finished checkout.
SECTION 3  OPERATION

Keypad & LCD Display

The PCU has a three-key keypad and a 16 character LCD for displaying status, alarms, and configuration. The keypad and LCD also provide an interface for changing configuration options and for viewing and resetting alarms. When the PCU’s power is cycled “ON” it initializes the PCU and then the LCD enters the STATUS display mode. The configure mode and the alarm mode are entered from the status mode.

"UP" & "DOWN" Key Function

The "UP" and "DOWN" keys are identified by the up arrow and down arrow labels, respectively, above the keys. The "UP" key functions to scroll the display up to the next message. In the CHANGE OPTION configuration, the "UP" key scrolls the display up to the next configuration option. If a numerical value is configured, the "UP" key will increment the number. The "DOWN" key functions similar to the "UP" key, except it scrolls down or decrements the display.

The "UP" and "DOWN" keys operate two ways. The keys are pressed and released to scroll the display up or down to the next message or configuration option. Or alternately, a key can be pressed and held to increment or decrement a numerical configuration option until the key is released.

"ENTER" Key Function

The "ENTER" key is identified by the label above the key. The "ENTER" key is used to enter the different display modes, and accept configuration changes.

The "ENTER" key operates two ways. It is pressed and released to enter and exit the alarm mode and accept configuration changes. Or alternately, the "ENTER" key must be pressed and held to enter and exit the CONFIGURE MODE display configuration and enter the CHANGE OPTION configuration.

The "ENTER" key has no function when displaying status and alarms.

STATUS Display Mode

The STATUS display mode of the PCU displays the Elapsed Time Meters, Average Run Meters, Average Pump Flow, Total Station Flow, Well Level, and Time-of-Day. It also displays the messages "VIEW ALARMS" and "CONFIGURE MODE".

When the PCU’s power is cycled "ON" it initializes the PCU and then the LCD enters the STATUS display mode. During initialization, the PCU displays a firmware and serial-number revision date. This date is used to identify firmware program updates. After initialization the LCD displays a STATUS display message.
Scrolling in STATUS Display Mode

When the LCD is in the STATUS display mode the "UP" and "DOWN" keys allow the operator to scroll through the available messages. The messages displayed are based on the configuration of the PCU. One Elapsed Time Meter, one Average Run Meter, and one Average Flow Rate are displayed when the PCU is configured for a simplex station, two each for a duplex station and three each for a triplex station. The "WELL LEVEL" message is displayed only for the analog level input configuration. "FLOW" is displayed when a volume is configured.

The "CONFIGURE MODE" message is included in the STATUS display mode only when the HOA switches are either in the Hand (H) or Off (O) position; the "VIEW ALARMS" message is included only if there are active alarms. These messages are used to enter the configure and alarm modes, respectively.

Level Display (LEVEL)

The PCU provides a display of the level in the well or tank in feet only if using an analog transducer. Float inputs cannot be used for this display, only an analog input device can be used.

Elapsed Time Meter Displays (M1 ETM, M2 ETM, M3 ETM)

The PCU provides an Elapsed Time Meter (ETM) for each of the three pump motors it controls. These meters are displayed in the status mode. Elapsed Time Meters are displayed for each pump configured. The Elapsed Time Meter for a pump motor displays the cumulative time the motor has run. The PCU uses the MOTOR RUN inputs to control the ETMs that are subsequently updated whether the pump is running in either the Hand or Auto position. The ETM updates when the MOTOR RUN input is "ON".

The ETM display can be reset through the configure mode of the PCU.

Average Run Meter Displays (M1 AVG, M2 AVG, M3 AVG)

The PCU provides an Average Run Meter (ARM) for each of the three pump motors it controls. These meters are displayed in the status mode for each pump configured. Average Run Meters are displayed for each pump configured.

The Average Run Meter for a pump motor displays the average time the motor has run calculated over the last 16 pump cycles. The PCU uses the MOTOR RUN inputs to control the ARMs. These meters only update when pumps are called to run automatically by the PCU, and do so after the particular pump turns off.

The ARMs can be reset through the configure mode of the PCU.

Average Pump Flow Rate Display (M1 FLOW, M2 FLOW, M3 FLOW)

The PCU provides an Average Pump Flow Rate calculation for each of the three pump motors it controls. The Flow Rate Display in the Status mode is the average pumping capacity for a particular pump (in volume/minute) as calculated according to the following equation:

\[
\text{Flow Rate} = \frac{\text{Flow Volume}}{\text{Pump Time}} + \text{Influent Rate}^* 
\]

*Influent Rate is equal to the time it takes to fill the well or tank from Off to Lead level. For Flow Volume, see Appendix 3.
As indicated by the equation, the calculation requires that a Flow Volume be calculated as outlined in the Configure Mode paragraphs of this Section. The Total Flow Display only updates when pumps are called to run automatically by the PCU and do so after the particular pump turns off. The Flow Rate Display can be reset as outlined in the Configure Mode section of this Section.

**Total Flow Display (FLOW)**

The PCU provides a derived Total Flow Meter (TFM) for the station. The Total Flow Meter displayed in the Status mode is the total flow volume pumped by this station as calculated by the following equation:

\[
\text{Total Flow Volume} = \text{Flow Volume} + (\text{Influent Rate}) (\text{Pump Time})
\]

As indicated by the equation, this calculation requires that a Flow Volume be configured as outlined in the Configure Mode paragraphs of this Section. If a Flow Volume is not configured, the TFM will not be displayed. The Total Flow Display only updates when pumps are called to run automatically by the PCU and does so when the Off float closes (which is the beginning of a new pump cycle). The TFM display can be reset through the configure mode of the LCD.

**Phase Voltage (AB Volts) (AC Volts)**

Phase voltage between legs A and B and between legs A and C are displayed in the Status mode; however, if an external phase monitor is used, there will not be a display on the PCU.

**Time (00:00:00)**

Time of Day is displayed in the Status mode in hours, minutes, and seconds.

**Entering Alarm Mode**

The alarm mode is entered by displaying the "VIEW ALARMS" message in the status mode and pressing and releasing the "ENTER" key. If the alarm horn is active, entering the alarm mode will silence it.

The ALARM LED on the front panel of the PCU will flash if there are any alarms to view. The LED will flash for active alarms and will be constant for inactive alarms that have not been viewed in the alarm mode. (Exception when used with telemetry: See Principles of Operation - Alarm Mode in Section 1)

**Scrolling in Alarm Mode**

The "UP" and "DOWN" keys allow the operator to scroll through the alarm displays. Refer to Troubleshooting Section 4 of this manual for corrective procedures for the alarm messages.

An alarm message will be displayed in two different ways. It will flash if the alarm is active. The display will be constant for active alarms that have not been viewed in the alarm mode or acknowledged over telemetry.
**PCU Power Fault (AC POWER FAULT)**

The "AC POWER FAULT" alarm is activated when the PCU determines ac power is interrupted. The PCU must be on backup battery power to function when the primary ac power fails. The Starter Power and the AC Power also must be connected to the station control power to assure that all pumps receive an emergency shutdown when the AC power fails. Multiple pumps could be commanded to start at the same time if this is not done.

**DC Bias Fault (DC BIAS FAULT)**

The BIAS+ voltage, provided for biasing the digital monitor inputs, is monitored by the PCU. If a fault occurs with the BIAS+ voltage, the "DC BIAS FAULT" alarm is activated.

**Low Level Alarm (LOW LEVEL ALARM)**

The "LOW LEVEL ALARM" fault indicates the LOW LEVEL input terminal is biased "OFF."

**High Level Alarm (HIGH LEVEL ALARM)**

The " LEVEL ALARM" fault indicates the HIGH LEVEL input terminal is biased "ON".

**Phase Voltage Fault (PHASE VOLTAGE FLT)**

The PCU's phase monitor is designed to detect phase losses, high-and low-phase faults and phase sequence faults. When the PCU detects a phase fault, it disables the pump motor outputs and activates the ALARM LIGHT and HORN relays. The H-O-A switches can be used to override the PCU's phase monitor and control the pumps during a phase fault.

**Phase Sequence Fault (PHASE SEQ FAULT)**

When the PCU detects a phase fault, it disables the pump motor outputs and activates the ALARM LIGHT and HORN relays. If a phase is missing or the power is interrupted, the PCU will also indicate a phase sequence fault. The label on the PCU's connector indicates the connection for clockwise phase rotation.

**Float Sequence Fault (FLOAT SEQ FAULT)**

The PCU can detect floats out of sequence. When a Float Sequence Alarm occurs, it will not be cleared until the station has completed a full pumping cycle in which no additional Float Sequence Alarms occur. A full pumping cycle occurs when a well or tank pumps to the OFF float, past the LEAD float and back to the OFF float.

**M1, M2, or M3 Starter Fault (M1 STARTER FAULT, M2 STARTER FAULT, M3 STARTER FAULT)**

A Starter Fault indicates that the PCU's Motor Run inputs do not agree with its Motor Run outputs when the HOA switch is in the Auto position. The default time allowed for the input to follow the output is two seconds, but the start delay and stop delay time intervals can be configured from 0-510 seconds.

*Data Flow Systems, Inc., Melbourne, Florida*
To accommodate applications where the Run signal may not be immediate, such as soft starts, Smith and Loveless panels, or Run signals from check valves, refer to the Motor Start and Stop delays in Appendix 1 – PCU Configuration Options.

Proper feedback is needed by the PCU to monitor pump motor run status. If the feedback signal malfunctions, the PCU will activate the motor starter fault alarm. The RUN LED under the H-O-A switch of the faulted pump will flash.

**EEPROM Fault (EEPROM FAULT)**

The "EEPROM FAULT" alarm indicated that the configuration data stored in the PCU's nonvolatile memory has been corrupted. The PCU will disable the pump motor outputs and activate the ALARM LIGHT and HORN relays.

**Transducer Fault (XDCR FAULT)**

If the analog transducer level-detection device malfunctions, the PCU will be unable to provide automatic control until the transducer malfunction is resolved. The pump motor outputs will be disabled and the ALARM LIGHT and HORN relays will be activated depending upon the Fault Mode configuration set in the Configuration Section.

If the transducer is determined to be functional, the PCU may require factory service. For removal, replacement and servicing of the PCU, see paragraph entitled "Factory Service" at the end of Section 4.

**CPU Fault**

If the microcontroller in the PCU malfunctions the CPU FAULT LED on the front panel of the PCU will flash. All outputs will be disabled and the station must be controlled by the H-O-A switches. The ALARM LIGHT relay will be activated.

**Exiting Alarm Mode**

The "DOWN" key must be used to scroll to the "EXIT ALARM VIEW" message. This forces the operator to view all alarm messages before exiting the alarm mode. Pressing and releasing the "ENTER" key when the "EXIT ALARM VIEW" message is displayed returns the LCD to the STATUS display mode and the "VIEW ALARMS" message. All inactive alarms will be cleared from the PCU's alarm log by exiting.

If no active alarm conditions exist, the ALARM LED will be cleared when the alarm mode is exited. (Exception when used with telemetry: See Principles of Operation - Alarm Mode in Section 1)

**Entering CONFIGURE MODE Display Configuration**

All three H-O-A switches on the front panel of the PCU must be in either the "Hand" or "Off" positions before entering the CONFIGURE MODE display configuration. If an H-O-A switch is changed to the "Auto" position while in the CONFIGURE MODE, the PCU will exit the CONFIGURE MODE, without saving changes, and return to the STATUS display mode. The H-O-A switches can be changed between "Hand" and "Off" positions without effecting the CONFIGURE MODE.

Data Flow Systems, Inc., Melbourne, Florida
The CONFIGURE MODE is entered by displaying the "CONFIGURE MODE" message in the STATUS display mode and pressing and holding the "ENTER" key until the display changes.

**Scrolling in CONFIGURE MODE Display Configuration**

Use the "UP" and "DOWN" keys to scroll through and display the PCU's configuration.

**Changing Configuration Options**

To change a configuration option, display the configuration item and press and hold the "ENTER" key until the option text flashes. Use the "UP" and "DOWN" keys to scroll through the available options. When the desired option is displayed, press and release the "ENTER" key. The option text will stop flashing.

The "UP" and "DOWN" keys can be pressed and held to scroll rapidly through numeric options. Press and release the keys to increment or decrement the option by one unit, or press and hold the keys to rapidly increment or decrement the option by several units.

**PCU Configuration Options**

The following paragraphs and Table 3-1 describe the PCU's configuration options. The configuration options can be displayed and changed in the CONFIGURE MODE of the LCD.

*Number of Pumps (NO. OF PUMPS)*

The PCU can be configured to control one, two or three pumps for simplex, duplex or triplex stations, respectively.

The number of pumps configured effects the number of Elapsed Time and Average Run and Average Flow Rate Meters displayed in the STATUS display mode. One meter will be displayed for each pump configured.

*Pump Arrangements (PUMP MODE)*

The PCU can operate in two pump arrangements, "pump up" or "pump down". The "pump up" arrangement is used to maintain a fill level in a tank system. The "pump down" arrangement is used to keep a well below a set level.

*Transducer Type (XDCR TYPE)*

Two different types of input-supported transducers can be accommodated by the PCU. The first is the binary type device such as contact closures, float switches and pressure switches. The second type is analog in nature and can be either analog current (4-20 mA) type or analog voltage (1-5V) type (pressure or linear resistive).

Analog set points can be ignored.
**Low Float Enable (LOW FLOAT) High Float Enable (HIGH FLOAT) [ENA, DIS]**

The PCU is designed to accommodate a High and Low level for backup alarms. These levels are recommended in both discrete and analog level detection systems. If a High level is not connected there is no effect to the operation of the PCU. However, the Low level **must** be disabled in the PCU's configuration if it is not connected. If the Low level is not used and not disabled, the LOW LEVEL ALARM will interfere with station operation. If the Low level is used then it **must** be enabled.

**Fault Mode (FAULT MODE) [DISABLE, FLOAT, TIMER]**

The Fault Mode provides three options, DISABLE, FLOAT or TIMER for operation when a Transducer Fault occurs. If set to DISABLE, the system will shut down when a Transducer fault occurs in either pump up or pump down station operation.

If the Fault Mode is set for FLOAT, a Transducer fault will signal a low-level alarm and will override pump control. For FLOAT Fault Mode, the following table applies:

<table>
<thead>
<tr>
<th>PUMP MODE</th>
<th>TRANSDUCER</th>
<th>ACTIVE FLOAT</th>
<th>PUMP CONTROL (ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP</td>
<td>OK</td>
<td>LOW</td>
<td>STAGGER ON</td>
</tr>
<tr>
<td>UP</td>
<td>OK</td>
<td>HIGH</td>
<td>STAGGER OFF</td>
</tr>
<tr>
<td>UP</td>
<td>FAULT</td>
<td>STAGGER ON</td>
<td></td>
</tr>
<tr>
<td>UP</td>
<td>FAULT</td>
<td>HIGH</td>
<td>STAGGER OFF</td>
</tr>
</tbody>
</table>

| DOWN       | OK         | LOW          | OFF                |
| DOWN       | OK         | HIGH         | STAGGER ON         |
| DOWN       | FAULT      | STAGGER OFF  |
| DOWN       | FAULT      | HIGH         | STAGGER ON         |

(High Float active closed; Low Float active open)

When set for TIMER, the Transducer Fault condition will signal a LOW alarm. If the ALTERNATOR is enabled, it also will cause pumps to run alternately (each one in turn for the Minimum Run set time and off for the Minimum Off set time) until the fault condition is resolved. If the ALTERNATOR is disabled, only the Lead pump participates in cycling.

**Alarm Horn/Light Enable (ALARM HORN) / (ALARM LIGHT) [ENA, DIS]**

In the “DIS” state, alarms are disabled at the station but are enabled through telemetry. In the “ENA” state, both the station and telemetry are enabled for the alarms. Select the desired alarm arrangement and configure accordingly.

**Auto Retry (AUTO RETRY) [ENA, DIS]**

The PCU can be configured to retry a faulted pump after a ten-minute delay. Each time a pump motor fails to start, the retry function will start a timer. The faulted pump will be skipped in the alternation cycle until the timer expires. In a situation that requires all pumps, the faulted pump motor will be retried every ten minutes. If the pump motor starts, the alarm condition will be cleared.

When the retry function is disabled (through the configuration process) the faulted pump will be taken out of the alternation cycle. If the retry function is disabled and the alternator is disabled, the level in the well or tank will have to
reach the next staging level to start the next pump. For example, in this disable situation, if the lead pump goes out of service, no pumping will take place until the level reaches the LAG1 level.

A motor starter fault can be cleared by switching the H-O-A switch of the faulted pump to either the "Hand" or "Off" position, and then back to "Auto".

**Alternator Bypass (ALTERNATOR) [ENA, DIS]**

The PCU's alternator can be bypassed. When disabled, pump 1 becomes the LEAD pump, pump 2 the LAG1 pump and pump 3 the LAG2 pump. When enabled, the PCU will alternate pumps each time it starts one.

**Flow Equalization (FLOW EQ) [ENA, DIS]**

Flow equalization is a Lift Station function implemented with telemetry. The volume of the wet well between the Lead Float and an added (Lag) Float is used as temporary storage. Upon receiving a control signal from telemetry, the PCU will raise the lead staging level that forces the station to delay pumping. When several secondary Lift Stations (feeding into a primary Lift Station hooked into a force main) are combined and controlled by the telemetry system, they can begin to pump in a synchronized fashion using the temporary storage to equalize the flow. This action will dramatically reduce pump cycling and line pressure. With more even flow, processing of the effluent is improved and operation of the Lift Station pumps is lessened.

This function should be disabled if not used. Contact Data Flow Systems for further information on setting up flow equalization for a particular system.

**Auxiliary Output (AUX OUTPUT) [ENA, DIS]**

The AUX OUTPUT and AUX INPUT terminals of the PCU can be configured to function as an auxiliary relay. When "AUX OUTPUT" is enabled the AUX INPUT controls the AUX OUTPUT. If this feature is disabled the AUX OUTPUT and AUX INPUT terminals function as standard control and monitor points for the telemetry.

**Auxiliary Output Trigger (AUX TRIGGER) [OPEN, CLOSED]**

When the AUX OUTPUT function is enabled, the AUX OUTPUT and AUX INPUT function as a programmable time-delay relay. The input trigger (AUX TRIGGER) determines whether the output follows the input (CLOSED) or is the opposite of the input (OPEN).

**Auxiliary Output Delay Mode (AUX DLY MODE) [ON, OFF]**

The delay mode determines whether the output is delayed when turning "ON" or when turning "OFF". (See Auxiliary Output Delay Timer).

**Auxiliary Input Alarm (AUX IN ALARM) [HI, LOW, DISABLE]**

The AUX INPUT terminal can be configured to activate the alarm horn and light. The alarm condition can be configured for an "HI" or "LOW" input state. The alarm can also be DISABLED.
The alarm will be latched in the PCU's alarm log until the condition clears and the alarm is viewed in the alarm mode of the LCD. The alarm horn can be silenced with the ALARM SILENCE input or by entering the alarm mode.

**Auxiliary Output Delay Timer (AUX DELAY) [0-510 sec]**

The delay time is the amount of time waited to turn the output "ON" or "OFF". The Timer can be set between 0 and 510 seconds in one-second increments. (See Auxiliary Output Delay Mode)

**Transducer Low and High (XDCR LO, XDCR HI) [0-60 ft]**

For Analog transducer application only. Analog transducers are calibrated by entering the 4 mA or 0 V level reading into the XDCR LO configuration point and the 20 mA or 5 V level reading into the XDCR HI configuration point. The level readings are in feet and range from 0 to 60. These points are configured from the range of the transducer. The PCU uses these points for calculating the well or tank level.

The XDCR HI value can be less than the XDCR LO value for transducers that provide signals which decrease when the measured distance increases. The Height can be set between 0 and 60 feet in one-tenth foot increments.

**Set Point Levels (LOW POINT, OFF POINT, LEAD POINT, LAG1 POINT, LAG2 POINT, HIGH POINT) [0-60ft]**

Staging levels for analog systems are entered by way of set points. When the analog level reaches a set point value, the PCU enters that staging level and the corresponding Well Level LED illuminates. For example, suppose the LEAD set point is configured at 10 feet. When the analog transducer senses a well above 10 feet, the LEAD LED illuminates and the lead pump is started.

Simplex stations require that the LOW, OFF, LEAD and HIGH set points be configured. Duplex stations must include the LAG1 set point. Triplex station must configure all six set points. The Level can be set between 0 and 60 feet in one-tenth foot increments.

**Motor Start and Stop Delays (START DELAY, STOP DELAY) [0-510 sec]**

The PCU is designed to detect a motor that fails to start or stop. The start delay is the amount of time the PCU waits to receive the motor-run signal after starting the motor. If the start-delay timer expires, the motor-starter alarm is activated for the motor and the PCU shuts down the starter. The stop delay is the time waited for the motor to stop after the PCU shuts it down. Again, if the timer expires before the run signal goes away, the motor starter alarm will be activated for the motor.

These delay times allow the PCU to control solid-state starters with "soft-start" and "soft-stop" features. Some solid-state starters do not close the run contacts until the motor is ramped to 80 percent of the operating voltage. The ramp time is based on the "soft start" time. A similar situation occurs when the starter ramps the motor down; the run contacts stay closed until the output voltage drops by 80 percent. The start delay and stop delay times for the PCU must be set at a value greater than these "soft-start" and "soft-stop" times.
Minimum Pump Run Time (MINIMUM RUN) [0-2 hrs]

To prevent short cycling of the pumps, a minimum run time can be set into the PCU. This feature will cause a started pump to run for the selected time before it can be turned off. The Time can be set between 0 and 2 hours in 30-second increments.

Minimum Off Time (MINIMUM OFF) [0-2 hrs]

A minimum off time also can be set into the PCU. This feature will cause a pump that is turned off to remain off for the selected time before it can be started again. The Time can be set between 0 and 2 hours in 30-second increments.

High- and Low-Limit Phase Voltage (HI PHASE) / (LO PHASE) [0-300 volts]

The PCU's phase monitor is designed to detect high and low phase-to-phase voltage faults among other things. These limits are provided to allow for the usual variations in voltage from the Power Company. Limits can be set between zero and 300 volts in one-volt increments.

Flow Volume Configuration (FLOW VOLUME) [0-9999]

Average Flow Rate and Total Station Flow calculations require a volume to be configured into the PCU. The volume, a configured value from 0 to 9999 (See Appendix 3) is calculated between the OFF and LEAD Levels of a well or tank. If the volume is configured as 0, the Average Flow Meter and the Total Flow Meter will not be displayed. The register and display will handle accumulated numbers up to one billion units (12 digits)

Module Address (MODULE ADDRESS)

When used in a telemetry system, the PCU address can be selected as any module (A through O). In the default state, the display will show "MODULE ADDRESS A". The PCU will not communicate with the Control Center until a proper module letter (such as "MODULE ADDRESS A") is selected. Pressing the "down" key will increment the module address from A to O; pressing the "up" key will decrement the module address from O to A. The default address is Mod A. When not used in a telemetry system, Module Address has no effect on the PCU operation. Do not skip Module addresses.

Reset Elapsed Time Meters (RESET TIMERS)

The Elapsed Time Meters, Average Run Meters, Average Flow Rate and Total Flow displays can be reset. These timers can be restored by exiting the configure mode without saving the configuration changes.
<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>OPTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO. OF PUMP</td>
<td>1</td>
<td>Simplex Station</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Duplex Station</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Triplex Station</td>
</tr>
<tr>
<td>PUMP MODE</td>
<td>UP</td>
<td>Fill a tank</td>
</tr>
<tr>
<td></td>
<td>DOWN</td>
<td>Empty a well</td>
</tr>
<tr>
<td>XDCR TYPE</td>
<td>FLOATS</td>
<td>Float or pressure switch device</td>
</tr>
<tr>
<td></td>
<td>1-5 V</td>
<td>1-5 V Analog Transducer</td>
</tr>
<tr>
<td></td>
<td>4-20 mA</td>
<td>4-20 mA Analog Transducer</td>
</tr>
<tr>
<td>LOW FLOAT</td>
<td>DIS</td>
<td>Low level not connected</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>Low level connected</td>
</tr>
<tr>
<td>HIGH FLOAT</td>
<td>DIS</td>
<td>High level not connected</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>High level connected</td>
</tr>
<tr>
<td>FAULT MODE</td>
<td>DIS</td>
<td>Disables Fault Mode</td>
</tr>
<tr>
<td></td>
<td>FLOAT</td>
<td>Set Fault Mode to operate with floats</td>
</tr>
<tr>
<td></td>
<td>TIMER</td>
<td>Set Fault Mode to operate with Minimum Run time</td>
</tr>
<tr>
<td>ALARM HORN</td>
<td>DIS</td>
<td>Alarm Horn disconnected; output to telemetry only</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>Alarm Horn connected</td>
</tr>
<tr>
<td>ALARM LIGHT</td>
<td>DIS</td>
<td>Alarm Light disconnected; output to telemetry only</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>Alarm Light connected</td>
</tr>
<tr>
<td>AUTO RETRY</td>
<td>DIS</td>
<td>Disables the auto retry function</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>Enables the auto retry function</td>
</tr>
<tr>
<td>ALTERNATOR</td>
<td>DIS</td>
<td>Disables the alternator function</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>Enables the PCU's alternator</td>
</tr>
<tr>
<td>FLOW EQ</td>
<td>DIS</td>
<td>Disable switching LEAD staging level</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>Enable switching LEAD staging level</td>
</tr>
<tr>
<td>AUX OUTPUT</td>
<td>DIS</td>
<td>AUX output/input is independent</td>
</tr>
<tr>
<td></td>
<td>ENA</td>
<td>AUX output/input functions as a relay</td>
</tr>
<tr>
<td>AUX TRIGGER</td>
<td>OPEN</td>
<td>AUX output &quot;OFF&quot; when AUX TRIGGER&quot;OPEN&quot;</td>
</tr>
<tr>
<td></td>
<td>CLOSED</td>
<td>AUX output &quot;ON&quot; when AUX TRIGGER&quot;CLOSED&quot;</td>
</tr>
<tr>
<td>AUX DLY MODE</td>
<td>ON</td>
<td>Delay AUX output turning &quot;ON&quot;</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Delay AUX output turning &quot;OFF&quot;</td>
</tr>
<tr>
<td>AUX IN ALARM</td>
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<td>Disable AUX input alarm</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>Alarm when AUX input &quot;ON&quot;</td>
</tr>
<tr>
<td>AUX DELAY</td>
<td>1-510 s</td>
<td>Aux relay delay time</td>
</tr>
<tr>
<td>XDCR LOW</td>
<td>0.0-60.0'</td>
<td>Transducer 0 V or 4 mA level (xducer min)</td>
</tr>
<tr>
<td>XDCR HIGH</td>
<td>0.0-60.0'</td>
<td>Transducer 5 V or 20 mA level (xducer max)</td>
</tr>
<tr>
<td>LOW POINT</td>
<td>0.0-60.0'</td>
<td>LOW staging level set point</td>
</tr>
<tr>
<td>OFF POINT</td>
<td>0.0-60.0'</td>
<td>OFF staging level set point</td>
</tr>
<tr>
<td>LEAD POINT</td>
<td>0.0-60.0'</td>
<td>LEAD staging level set point</td>
</tr>
<tr>
<td>LAG1 POINT</td>
<td>0.0-60.0'</td>
<td>LAG1 staging level set point</td>
</tr>
<tr>
<td>LAG2 POINT</td>
<td>0.0-60.0'</td>
<td>LAG2 staging level set point</td>
</tr>
<tr>
<td>HIGH POINT</td>
<td>0.0-60.0'</td>
<td>HIGH staging level set point</td>
</tr>
<tr>
<td>START DELAY</td>
<td>0-510 s</td>
<td>Start delay time for starter fault</td>
</tr>
<tr>
<td>STOP DELAY</td>
<td>0-510 s</td>
<td>Stop delay time for starter fault</td>
</tr>
<tr>
<td>MINIMUM RUN</td>
<td>0-127.5m</td>
<td>Minimum run time to prevent short cycling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(half minute inc.)</td>
</tr>
<tr>
<td>MINIMUM OFF</td>
<td>0-127.5m</td>
<td>Minimum off time to prevent short cycling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(half minute inc.)</td>
</tr>
<tr>
<td>HI PHASE</td>
<td>0-300 V</td>
<td>Upper limit for Phase Monitor response</td>
</tr>
<tr>
<td>LO PHASE</td>
<td>0-300 V</td>
<td>Lower limit for Phase Monitor response</td>
</tr>
<tr>
<td>FLOW VOLUME</td>
<td>0-9999</td>
<td>Set Volume between OFF and LEAD Levels</td>
</tr>
<tr>
<td>MODULE ADDRESS</td>
<td>A-O</td>
<td>Set Module Address A through O</td>
</tr>
<tr>
<td>RESET TIMERS</td>
<td></td>
<td>Reset Elapsed Time Meters</td>
</tr>
<tr>
<td>SAVE &amp; EXIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO SAVE &amp; EXIT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3-1 PCU's Configuration Options

Data Flow Systems, Inc., Melbourne, Florida
Exiting Configure Mode

There are five ways to exit the configure mode. (1) The first is to scroll to the "SAVE AND EXIT" message and press and hold the "ENTER" key until the display changes. When this is done the PCU replaces the old configuration with the changes just made. (2) A second and similar way to exit is to scroll to the "NO SAVE AND EXIT" message and press and hold the "ENTER" key. The changes made are ignored and the old configuration is restored. The next three ways of exiting do not save the current changes and are considered safeguards. (3) As stated in a previous paragraph, changing an H-O-A switch to the "Auto" position will force the PCU to abort the current changes. (4) Leaving the PCU unattended for over five minutes will also force the PCU to abort any changes. (5) Finally, cycling the PCU power will cause the PCU to reload the old configuration from nonvolatile memory.

LED Indicators

LED indicators on the front panel of the PCU provide the operator with status and alarm information. When the PCU's power is cycled "ON", all 14 LEDs will momentarily turn "ON" for test.

The following paragraphs describe the status and alarm functions of the LEDs.

Pump Run LEDs

Three LEDs under the H-O-A switches provide Motor Run and Motor Starter Fault status. Under normal operation, the Run LEDs indicate the "ON" and "OFF" state of the pump motors. If a fault condition is detected the Run LED for the faulted pump motor will flash.

The fault condition displayed by the flashing of the RUN LEDs indicates a pump motor failed to start or stop when controlled by the PCU. The fault condition continues until the pump motor operates properly or until the PCU's control of the pump motor is overridden. If the "AUTO RETRY" function of the PCU is enabled in the configuration, the faulted pump motor will be retried. If this function is disabled, then the alarm must be reset manually. There are two ways to reset the alarm. The H-O-A switches placed in the "Hand" or "Off" position will override the PCU's control and reset the alarm. Alternately, the telemetry can also be used to override the PCU's automatic control and reset the alarm.

PCU Power LED

The PCU Power LED indicates the presence of the PCU's ac power source. If a backup battery is connected to the PCU, then the PCU Power LED will flash when primary ac power is interrupted.

CPU Fault LED

Internal circuitry is used to monitor the microcontroller of the PCU. If the circuitry detects a fault with the microcontroller it will reset it and strobe the CPU LED. If the microcontroller fails to reset, the CPU LED will flash. When this occurs, the PCU disables all of its output relays. The disabled state of the Alarm Light relay will activate an alarm light connected to the PCU.

The "Hand" and "Off" positions of the H-O-A switches continue to function under a CPU Fault condition.

Data Flow Systems, Inc., Melbourne, Florida
**TX DATA & RX DATA LEDs**

The PCU can communicate through the service port on its front panel and through the telemetry interface. TX and RX Data LEDs are provided to verify the communications function. The RX Data LED strobes each time the PCU receives data and the TX Data LED strobes each time the PCU responds. See Section 4, Troubleshooting, if the PCU fails to communicate.

**Alarm LED**

The Alarm LED starts to flash when any alarm condition is detected. It will continue to flash until the alarm condition is cleared and the alarm is acknowledged by entering and scrolling through the alarm mode of the LCD. (Exception when used with telemetry: See Principles of Operation - Alarm Mode in Section 1) See Section 1, Introduction for details of the alarm mode and Section 4, Maintenance, Troubleshooting and Service, for details about alarm messages.

**Well Level LEDs**

Six Well Level LEDs display the staging of the PCU. These staging levels can be from discrete switches or analog set points. For example, when the lead level switch closes or the level sensed by a pressure transducer reaches the lead set point, then the LEAD LED illuminates and the PCU starts the lead pump.

High and low level inputs can be used for backup alarms in an analog system. If the input devices detect alarm conditions undetected by the transducers, the HIGH or LOW LED will flash. See Section 1, Introduction, for details of the alarm mode and configure mode.

**Auxiliary Input/Output**

The PCU provides an auxiliary input and output. They can be used as an auxiliary relay or independently as monitor and control points for the telemetry. If the AUX OUTPUT function is enabled in the PCU's configuration, the AUX INPUT controls the AUX OUTPUT. When the function is disabled, the output must be controlled through the telemetry.

The auxiliary relay can be used to switch "ON" a backup compressor for a bubbler system. The backup compressor is connected to the AUX OUTPUT terminal. An air-flow switch for the primary compressor is connected to the AUX INPUT terminal. The AUX relay function can then be configured to turn "ON" the AUX OUTPUT when the flow switch detects no air flow. The AUX relay can be configured also to start the backup compressor only if the flow stops for greater than a set time. This is accomplished by setting up the AUX relay as a time-delay relay in the "ON" delay mode and setting the desired delay time.

**Communications Service Port**

The service port on the front panel of the PCU provides an RS-232 interface for diagnostics and configuration storage and updating. This allows a portable computer to be connected to the PCU through an interface cable. The configuration can be uploaded from the PCU to a portable computer and saved. If the PCU is replaced the configuration can be downloaded from the portable computer to the new PCU.

The interface cable can be purchased from Data Flow Systems or can be built from parts purchased locally. Figure 3-1 and the Parts List provide details for building or purchasing a cable.
The PCU can be monitored, controlled and configured only from the service port. All the telemetry functions for monitoring and controlling are available at the service port. With a portable computer, the configuration of the PCU can be saved and restored. Software is available from Data Flow Systems. See Parts List for ordering information.

If telemetry is connected to the PCU, it will be interrupted when the service port is used.
Control and Monitoring via Telemetry (Optional)

When the PCU is interfaced into the TAC II telemetry system, the pump station can be remotely monitored and controlled. All alarm conditions and pump activities are recorded at the telemetry central computer.

Refer to the TAC II Telemetry System Installation Planning Guide for additional information on the DFS TAC II Monitor and Control System.

Monitored Signals

The telemetry will monitor all 12 digital monitor inputs of the PCU. Some of the digital monitor inputs can be used for special monitoring functions when not needed to control the station. For example, unused motor run and level inputs can be used to monitor generator status and intrusion switches.

All alarm conditions are monitored by the telemetry. The operator can be aware of alarm conditions before the situation becomes critical.

Controlled Outputs

All six outputs of the PCU can be controlled by telemetry. The remote control allows individual pumps to be overridden to the "ON" or "OFF" state. Also, the entire station can be disabled (overridden "OFF") remotely. Unused outputs (those not needed for other station control functions) can be used for special functions. For example, unused starter outputs can be used to turn on auxiliary equipment.

Alarm Horn, Light and Silence Switch (Optional)

The ALARM HORN output relay closes to power a horn or bell when critical alarm conditions occur. These conditions include phase faults, low- and high-level faults and PCU faults. The relay will open when all critical alarm conditions clear or when it is overridden. A momentary switch connected to the ALARM SILENCE input provides one way of overriding the ALARM HORN output. Entering the alarm mode of the LCD will also override and silence the alarm. If telemetry is connected, the ALARM HORN output can be overridden and silenced remotely.

All alarm conditions activate the ALARM LIGHT output relay. This is a normally closed set of contacts that open when no alarms are active. The ALARM LIGHT relay closes when the PCU is faulted or powered down.

Battery Backup (Optional)

Connecting a battery to the PCU will allow it to operate uninterrupted. If power fails and the PCU is connected to telemetry, the power outage will be reported back to the central computer.

The internal bias voltage, BIAS+, will continue to operate under battery power and monitor points connected to it will remain operational. With telemetry, the well or tank level of the station can be remotely monitored during a power outage.
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SECTION 4 MAINTENANCE, TROUBLESHOOTING AND SERVICE

Maintenance

The PCU is designed for a minimum amount of maintenance. It is more important to maintain the station and the components connected to the PCU.

When cleaning the PCU's front panel, use only mild detergents and a damp rag. Do not use solvents to clean the PCU's front panel.

Troubleshooting

Troubleshooting the PCU and station control panel should only be performed by a certified electrical technician. Turn "OFF" all breakers before modifying any panel wiring or removing any device from the station control panel. Use caution when making voltage and current measurements. The H-O-A switches can be used to manually control the pump motors during troubleshooting.

If the problem occurs with a new wiring installation, then first review all wiring. Refer to the Check List at the end of Section 2 for new-installation checkout procedures.

The PCU monitors itself and the station for alarm conditions. If an alarm condition is determined, the PCU will activate the appropriate ALARM output relays and flash the ALARM LED. The ALARM LIGHT relay will become active for all alarm conditions. The ALARM HORN relay will become active for critical alarms such as, High and Low Level faults, Phase faults, transducer faults and PCU memory faults.

Alarm Messages

Alarm conditions are displayed in the alarm mode of the LCD. If the alarm message flashes, the alarm is active. Statically displayed messages are inactive alarms and are buffered in the PCU's alarm log until viewed. If the alarm becomes inactive while being viewed, it will stop flashing. The ALARM LED will continue to flash until there are no active alarms and all inactive alarms have been viewed. The ALARM LED is cleared when the alarm mode is exited.

(Exception when used with telemetry: See Principles of Operation - Alarm Mode in Section 1)

The following paragraphs describe the alarm messages displayed in the alarm mode of the LCD and the probable causes of the alarms. If the problem is determined to be with the PCU, see paragraph entitled "Factory Service" below for removal, replacement and servicing instructions.

PCU Power Fault (AC POWER FAULT)

The "AC POWER FAULT" alarm is activated when the PCU determines ac power is interrupted. The PCU must be on backup battery power to function when the primary ac power fails.
NOTE
Be sure that the Starter Power (P1-24) and AC Power (P1-5) are both connected to the stations control power. This will assure that all pumps under local control receive an emergency shutdown when the AC Power drops. Otherwise, multiple pumps could be commanded to start at the same time.

If the alarm occurs and the PCU is battery backed up, check to see that all circuit breakers are "ON". Also, check if any circuit breaker has tripped. If a station control panel breaker has tripped, resolve the problem. If the PCU's fuse has blown, measure the input voltage and check the wiring to the PCU's connector. The operating voltage is marked on the connector label. Try replacing the fuse only when the proper voltage is connected.

DC Bias Fault (DC BIAS FAULT)

The BIAS+ voltage, provided for biasing the digital monitor inputs, is monitored by the PCU. If a fault occurs with the BIAS+ voltage, the "DC BIAS FAULT" alarm is activated.

If the "DC BIAS FAULT" alarm occurs, measure the voltage between the BIAS+ and BIAS- terminals. The voltage should be 20-24 Vdc. Check for a short circuit condition between the BIAS+ and BIAS- terminals if the measured voltage is 0 Vdc. If the voltage is less than 10 Vdc, check the current load on the BIAS+ source. It should be less than 100 mA.

NOTE: BIAS+ is provided only for biasing the 12 digital monitor inputs of the PCU.

If the current load is excessive, disconnect and isolate BIAS+ and BIAS- terminals to determine if the fault is with the bias source or in the external circuitry. If the fault appears to be with the external circuitry, try isolating each input connected to the BIAS+ voltage until the problem is found. If the problem can not be isolated, the PCU may require factory service.

Low Level Alarm (LOW LEVEL ALARM)

The "LOW LEVEL ALARM" fault indicates the LOW LEVEL input terminal P2-6 is biased "OFF". If a low level or pressure switch is not being used, disable the function in the configuration. If a low level or pressure switch is used and an erroneous alarm occurs, check the switch and wiring. When the switch is closed, 10-30 Vac or Vdc should be measured at the LOW LEVEL input. Measure the voltage between the LOW LEVEL and INPUT COMMON 2 terminals. Make sure the return for the LOW LEVEL input bias source is connected to the INPUT COMMON 2 terminal.

High Level Alarm (HIGH LEVEL ALARM)

The "LEVEL ALARM" fault indicates the HIGH LEVEL input terminal P2-11 is biased "ON". If an erroneous alarm occurs check the high float or pressure switch and wiring. When the switch is opened, zero volts, ac or dc, should be measured at the HIGH LEVEL input. Measure the voltage between the HIGH LEVEL and INPUT COMMON 2 terminals. Make sure the high float or pressure switch is not fouled or shorted. If necessary, disconnect the HIGH LEVEL input to isolate the problem further.
If the problem is determined to be with the PCU see paragraph entitled "Factory Service" at the end of this Section for removal, replacement and factory servicing of the PCU.

**Phase Voltage Fault (PHASE VOLTAGE FLT)**

When the PCU detects a phase fault it disables the pump motor outputs and activates the ALARM LIGHT and HORN relays. The internal Phase Monitor of the PCU is compatible only with a 240Vac phase-to-phase system.

The PCU's phase monitor is designed to detect phase losses, high and low-phase faults and phase sequence faults. If a voltage is missing, turn "OFF" the main breaker and check the external phase monitor fuses. If an erroneous alarm occurs, check to see that the upper and lower voltage limits are set (in the CONFIGURE mode) properly.

The H-O-A switches can be used to override the PCU's phase monitor and control the pumps during a phase fault.

If the problem cannot be resolved, the PCU may require factory service. See paragraph entitled "Factory Service" at the end of this Section for removal, replacement and servicing of the PCU.

**Phase Sequence Fault (PHASE SEQ FAULT)**

When the PCU detects a phase fault it disables the pump motor outputs and activates the ALARM LIGHT and HORN relays.

The PCU's phase monitor is designed to detect phase losses, high and low phase faults and phase sequence faults. If the sequence fault occurs, check the phase rotation of the incoming power. If a phase is missing or the power is interrupted, the PCU will also indicate a phase sequence fault.

The label on the PCU's connector indicates the connection for clockwise phase rotation. If the incoming power is labeled for counter-clockwise phase rotation, two of the leads must be swapped. Turn "OFF" the main breaker before making any wiring changes. After the changes are made, turn "ON" the main breaker and reconfigure the PCU's High and Low phase-voltage thresholds.

If the problem cannot be resolved, the PCU may require factory service. See the paragraph entitled "Factory Service" below for removal, replacement and servicing of the PCU.

**Float Sequence Fault (FLOAT SEQ FAULT)**

When a Float Sequence Alarm occurs, it is reported to the telemetry system and acknowledged. It will not be cleared, however, until the station has completed a full pumping cycle in which no additional Float Sequence Alarms occur. A full pumping cycle occurs when a well or tank pumps to the OFF float, past the LEAD float and back to the OFF float.

The PCU can detect floats out of sequence. When the alarm occurs, check the floats or pressure switches for the fault. Verify that when each float or pressure switch is "ON" that the corresponding Well Level LED illuminates. Also, measure the voltage between the corresponding level input terminal and the INPUT COMMON 2 terminal. The voltage should be 10-30 V ac or dc with the switch closed and 0 V with the switch opened. Check the wiring and verify (1), that only one bias source is used to bias all floats or pressure switches, (2), that the same voltage dropping resistor is used for all floats or pressure switches, and (3), that the return for the bias voltage is properly connected to the INPUT COMMON 2 terminal. Also, if the ALARM SILENCE and AUX inputs are used, verify that they use the same bias voltage and dropping resistor value as the level inputs.
If the problem can not be resolved, the PCU may require factory service. See the paragraph entitled "Factory Service" below for removal, replacement and servicing of the PCU.

M1, M2, or M3 Starter Fault (M1 Starter Fault, M2 Starter Fault, M3 Starter Fault)

The proper feed back is needed by the PCU to monitor pump motor run status. If the feed back signal malfunctions, the PCU will activate the motor starter fault alarm. The RUN LED under the H-O-A switch of the faulted pump will flash.

The PCU's starter relays are solid-state devices with up to eight mA off-state leakage current. This should not cause any problems with starter coils. However, it may force a solid-state starter with a high input impedance to energize, in which case, there are two options to try. First, try connecting a bleed resistor across the solid-state starter input. Select a resistance and wattage to shunt the leakage current. A second option requires installing isolating relays between the PCU and the solid-state starter. Connect the PCU's starter relays to the coils of the isolating relays and control power through the isolating relay contacts to the solid-state starter inputs.

Check the starter circuit for faults. Use the H-O-A switches to control the pumps. Verify that the RUN LED and the pump motor turn "ON" when the H-O-A switch is in the "Hand" position, and "OFF" when the switch is in the "Off" position. Switching the H-O-A switch out of the "Auto" position should clear the flashing RUN LED. If the LED does not turn "ON" when the motor starts and "OFF" when the motor stops, then check the wiring and verify that only one bias source is used to bias all motor run inputs, the same voltage dropping resistor is used for all motor run inputs and that the return for the bias voltage is properly connected to the INPUT COMMON 1 terminal. Also, if the EXTERNAL PM input is used, make sure that it uses the same bias voltage and dropping resistor as the motor run inputs.

If solid state starters are used, make sure the start and stop delay times configured in the PCU are properly set. Check the configurations of Minimum Run and Minimum Off.

If the problem can not be resolved, the PCU may require factory service. See the paragraph entitled "Factory Service" below for removal, replacement and servicing of the PCU.

EEPROM Fault (EEPROM FAULT)

The "EEPROM FAULT" alarm indicated that the configuration data stored in the PCU's nonvolatile memory has been corrupted. The PCU will disable the pump motor outputs and activate the ALARM LIGHT and HORN relays.

The PCU may require factory service, but first try reconfiguring it. If the alarm does not clear after reconfiguring, the PCU will require servicing. See paragraph entitled "Factory Service" below for removal, replacement and servicing of the PCU.

Transducer Fault (XDCR FAULT)

If the analog transducer level-detection device malfunctions, the PCU will be unable to provide automatic control until the transducer malfunction is resolved. The PCU will function according to the Fault Mode configuration and the ALARM LIGHT and HORN relays will be activated.

When using an analog transducer, measure the voltage across the ANALOG+ and ANALOG- terminals. This voltage should be 1-5 Vdc for a 4-20 mA transducer and 1-5 Vdc for a 1-5 Vdc transducer. Make sure the jumper is installed between the ANALOG- and SHUNT terminals only for 4-20 mA transducers. The voltage measured between the ANALOG+ and ANALOG- terminals should vary according to the well or tank level.

_Data Flow Systems, Inc., Melbourne, Florida_
If the transducer is determined to be functional, the PCU may require factory service. See paragraph entitled "Factory Service" below for removal, replacement and servicing of the PCU.

**CPU Fault**

If the microcontroller in the PCU malfunctions the CPU FAULT LED on the front panel of the PCU will flash. All outputs will be disabled and the H-O-A switches must control the station. The ALARM LIGHT relay will be activated.

Try cycling power to the PCU. If a backup battery is connected, disconnect it. If the CPU FAULT LED continues to flash, the PCU will require Factory service. See paragraph entitled "Factory Service" below for removal, replacement and servicing of the PCU.

**PCU Replacement**

If the PCU is determined to need servicing, it can easily be removed and replaced with a backup PCU. (See paragraph entitled "Factory Service" at the end of this Section for factory servicing of the PCU). First, either make a note of the PCU configuration or download the configuration into a computer. Turn "OFF" all circuit breakers before attempting to remove the PCU. The terminals are connectorized for removal. Use a screwdriver and gently pry the connectors free. Remove the mounting fasteners that connect the PCU to its mounting brackets. The PCU should be able to be lifted from it mounting brackets. Install the replacement PCU, replace the fasteners and reconnect the terminals. Place the replacement PCU's three H-O-A switches into the "Off" position and turn the breakers back "ON".

The replacement PCU will require reconfiguring. If the faulted PCU's configuration was backed up on a portable computer, it can be restored on the replacement PCU. After configuring the PCU, place the required H-O-A switches in the "Auto" position.

**Factory Service**

If it is determined that the PCU requires factory service, contact Data Flow Systems for a Return Authorization (RA) number and shipping instructions.

Contact: Data Flow Systems, Inc.
605 N. John Rodes Boulevard
Melbourne, Florida 32934
Phone (321) 259-5009
FAX 259-4006
SECTION 5  PARTS LIST

Parts List, Furnished Parts
Pump Control Unit
Mounting Bracket, Installation, 2 each
Installation and Operating Manual
Tank Label Overlay
2 each Connector, Electrical (for PCU End Wire Entry)

Parts List, Optional Parts
Battery, rechargeable, 12v, 2.6Ah
   YUASA Part No. NP 2.6-12
Battery, rechargeable, 12v, 7.0Ah
   YUASA Part No. NP 7-12
PCU Test Kit (Manual, Service Port communications cable, RTU Test software)
   Part No. DFS-00242-008-2
2 each Connector, Electrical (for PCU Rear Wire Entry)
   Part No. DFS-00286-008-1
2 each Connector, Electrical (for PCU Front Wire Entry)
   Part No. DFS-00286-008-2
Module, Bus Extender
   Part No. DFS-00223-009 (See Appendix for wiring instructions)
Transducer Assembly, Pressure
   Part No. DFS-00219-008-50
TAC II Telemetry System Installation Planning Guide
   Part No. DFS-00308-011
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APPENDIX 6 - BackPack Radio/ TAC Pack INSTALLATION AND OPERATION MANUAL
## APPENDIX 1 CONFIGURING LEVEL INPUT DEVICES

### Configuring a Station with Analog Input Devices

To enter the Configure Mode, place all H-O-A switches in the "H" or "O" position and scroll to "Configure"

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO. OF PUMPS</td>
<td>[ 1 ] [ 2 ] [ 3 ] (circle one)</td>
</tr>
<tr>
<td>PUMP MODE</td>
<td>[UP] [DOWN] (circle one)</td>
</tr>
<tr>
<td>XDCR TYPE</td>
<td>[4-20 mA] [1-5V] [FLOATS] (circle one)</td>
</tr>
<tr>
<td>LOW FLOAT</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>HIGH FLOAT</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>FAULT MODE</td>
<td>[DIS] [FLOAT] [TIMER] (circle one)</td>
</tr>
<tr>
<td>ALARM HORN</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>ALARM LIGHT</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>AUTO RETRY</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>ALTERNATOR</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>FLOW EQ</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>AUX OUTPUT</td>
<td>[DIS] [ENA] (circle one)</td>
</tr>
<tr>
<td>AUX TRIGGER</td>
<td>[OPEN] [CLOSED] (circle one)</td>
</tr>
<tr>
<td>AUX DLY MODE</td>
<td>[OFF] [ON] (circle one)</td>
</tr>
<tr>
<td>AUX IN ALARM</td>
<td>[DIS] [HI] [LOW] (circle one)</td>
</tr>
<tr>
<td>AUX DELAY</td>
<td>[seconds (0-510)]</td>
</tr>
<tr>
<td>XDCR LOW</td>
<td>[feet (0-60)] (equivalent to 4mA or 0 volts)</td>
</tr>
<tr>
<td>XDCR HIGH</td>
<td>[feet (0-60)] (equivalent to 20mA or 5 Volts)</td>
</tr>
<tr>
<td>LOW POINT</td>
<td>[feet (0-60)] (Low alarm activates)</td>
</tr>
<tr>
<td>OFF</td>
<td>[feet (0-60)] (All pumps OFF)</td>
</tr>
<tr>
<td>LEAD</td>
<td>[feet (0-60)] (First pump OFF)</td>
</tr>
<tr>
<td>LAG 1</td>
<td>[feet (0-60)] (Second pump OFF)</td>
</tr>
<tr>
<td>LAG 2</td>
<td>[feet (0-60)] (Third pump OFF)</td>
</tr>
<tr>
<td>HIGH POINT</td>
<td>[feet (0-60)] (High alarm activates)</td>
</tr>
<tr>
<td>START DELAY</td>
<td>[seconds (0 to 510)]</td>
</tr>
<tr>
<td>STOP DELAY</td>
<td>[seconds (0 to 510)]</td>
</tr>
<tr>
<td>MIN RUN</td>
<td>[hrs:min:sec]</td>
</tr>
<tr>
<td>MIN OFF</td>
<td>[hrs:min:sec]</td>
</tr>
<tr>
<td>HI PHASE</td>
<td>[Volts (0-300)] Upper limit</td>
</tr>
<tr>
<td>LO PHASE</td>
<td>[Volts (0-300)] Lower limit</td>
</tr>
<tr>
<td>FLOW VOLUME</td>
<td>[units (0-9999)] [gal] [cu ft] [other________] (circle one)</td>
</tr>
<tr>
<td>MODULE ADDRESS</td>
<td>[A through O]</td>
</tr>
</tbody>
</table>

*Use this sheet to document the PCU configuration. File a copy of the completed sheet with the PCU.*

*(See next page for configuring Float Ball inputs)*
Configuring a Station with Float Ball Inputs

- Be sure H-O-A switches are in the "H" or "A" position
- Number of Pumps: [ 1 ] [ 2 ] [ 3 ] (circle one)
- Pump: [UP] [DOWN] (circle one)
- Level Input: [4-20 mA] [1-5V] [FLOAT] (circle one)
- LOW FLOAT: [DIS] [ENA] (circle one)
- ALARM HORN: [DIS] [ENA] (circle one)
- ALARM LIGHT: [DIS] [ENA] (circle one)
- AUTO RETRY: [DIS] [ENA] (circle one)
- ALTERNATOR: [DIS] [ENA] (circle one)
- FLOW EQ: [DIS] [ENA] (circle one)
- AUX OUTPUT: [DIS] [ENA] (circle one)
- AUX TRIGGER: [OPEN] [CLOSED] (circle one)
- AUX DLY MODE: [DIS] [ENA] (circle one)
- AUX IN ALARM: [ON] [OFF] (circle one)
- AUX DELAY: [ ] seconds (0-510)
- START DELAY: [ ] seconds (0 to 510)
- STOP DELAY: [ ] seconds (0 to 510)
- HI PHASE: [ ] Volts (0-300)
- LO PHASE: [ ] Volts (0-300)
- FLOW VOLUME: [ ] units (0-9999) [gal] [cu ft] [other_____] (circle one)

See Appendix 3 for Flow Volume calculation.

Note: All other configuration items can be ignored.

Use this sheet to document the PCU configuration. File a copy of the completed sheet with the PCU.
APPENDIX 2 CONFIGURATION OF THE PCU WHEN USED WITH TELEMETRY

To install and configure the PCU when operated as a remote unit of telemetry, the following steps must be taken.

1. First of all, install a Bus Extender Module in the RTU with the connections described below.

   Install the Bus Extender Module in the selected slot A through O, but first remove the address strap.

   ![Connections Table](image)

   Connections:

   The PCU takes any unused Module address: A through O. Do not skip module addresses. Once a module address is selected in this sequence for the PCU, module addresses P, Q, and S are used to extend the data points for all the PCU inputs and outputs (address R is reserved for the Radio Interface Module [RIM]).

2. Configure the PCU as follows:

   On the TAC II screen,

   Select: "Z other"/

   "C configure"/

   "station number [ 1 ]" (or station number assigned to the PCU)

   "Enter/change station name [PCU Configuration]".

   At this point, decide:

   (A), if the default configuration is desired

   or (B), if different point names and labels are desired.

   (A). For the default configuration,

   Select: "Enter module letter, or Z for other choices [ Z ]"/

   "[C copy configuration of another station]" /

   "Enter station number to copy, or M or U [ U ]".

   Press Esc and the default configuration is entered. A complete listing of names and labels for the 48 points of the PCU (showing the default points without an asterisk [*] ) are given on the following pages. The asterisked (*) points are not configured in the default state but may be configured as in "B" if desired.

   A complete screen will not be configured in the default configuration because of the limits of the screen. To establish the proper screen configuration,

   Select: [Z other]

   Select: [C configure]

   Enter station number or Z for other choices [ Z ]

   Select: [S customize screen for this station]

   Select: [M modify]

   Select: [P pump control module/unit]

   Press Esc until the menu returns to

   Select: S screen   D display   P print   C control   [ Z other], then

   Select: L log   [X exit]   C configure   T test

   (B). For different point names and labels,

   Select: "Enter module letter [A]"/

   Enter point number [1] (or point number to be changed)

   Enter the point name and labels .

   Press Esc to enter a second point number, etc., until all the desired points with names and labels are entered.

CONFIGURING THE PCU WITH TELEMETRY
### Station 1, "PCU Configuration" Module A, Type = E

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Point Name</th>
<th>Labels (0/1)</th>
<th>Alarm Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;Low Level&quot;</td>
<td>OFF/ON</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>2</td>
<td>&quot;Off Level&quot;</td>
<td>OFF/ON</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>3</td>
<td>&quot;Lead Level&quot;</td>
<td>OFF/ON</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>4</td>
<td>&quot;Lag 1 Level&quot;</td>
<td>OFF/ON</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>5</td>
<td>&quot;Lag 2 Level&quot;</td>
<td>OFF/ON</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>6</td>
<td>&quot;High Level&quot;</td>
<td>OFF/ON</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>7</td>
<td>&quot;Auxiliary Input&quot;</td>
<td>OFF/ON</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>8</td>
<td>&quot;Alarm Horn&quot;</td>
<td>ENABLED/SILENCED</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>9</td>
<td>&quot;Pump 1&quot;</td>
<td>OFF/RUNNING</td>
<td>KEY=PUMP</td>
</tr>
<tr>
<td>10</td>
<td>&quot;Pump 2&quot;</td>
<td>OFF/RUNNING</td>
<td>KEY=PUMP</td>
</tr>
<tr>
<td>11</td>
<td>&quot;Pump 3&quot;</td>
<td>OFF/RUNNING</td>
<td>KEY=PUMP</td>
</tr>
<tr>
<td>12</td>
<td>&quot;Phase Monitor&quot;</td>
<td>ENABLED/BYPASSED</td>
<td></td>
</tr>
</tbody>
</table>

### Module P, Type = F

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Point Name</th>
<th>Labels (0/1)</th>
<th>Alarm Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;Phase Voltage&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>2</td>
<td>&quot;Phase Sequence&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>3</td>
<td>&quot;Pump 1 Starter&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>4</td>
<td>&quot;Pump 2 Starter&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>5</td>
<td>&quot;Pump 3 Starter&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>6</td>
<td>&quot;Pump 1 Stop&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>7</td>
<td>&quot;Pump 2 Stop&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>8</td>
<td>&quot;Pump 3 Stop&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>9</td>
<td>&quot;Float Sequence&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>10</td>
<td>&quot;Transducer&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>11</td>
<td>&quot;Backup Memory&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>12</td>
<td>&quot;AC Power&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>13</td>
<td>&quot;Isolated DC Bias&quot;</td>
<td>OK/FAULT</td>
<td>ALARM=FAULT</td>
</tr>
<tr>
<td>14</td>
<td>&quot;Low Well&quot;</td>
<td>OK/LOW</td>
<td>ALARM=LOW</td>
</tr>
<tr>
<td>15</td>
<td>&quot;High Well&quot;</td>
<td>OK/HIGH</td>
<td>ALARM=HIGH</td>
</tr>
<tr>
<td>19</td>
<td>&quot;HOA Switch 1&quot;</td>
<td>-/HAND</td>
<td>ALARM=OFF</td>
</tr>
<tr>
<td>20</td>
<td>&quot;HOA Switch 1&quot;</td>
<td>-/OFF</td>
<td>ALARM=OFF</td>
</tr>
<tr>
<td>21</td>
<td>&quot;HOA Switch 1&quot;</td>
<td>-/AUTO</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>&quot;HOA Switch 2&quot;</td>
<td>-/HAND</td>
<td>ALARM=HAND</td>
</tr>
<tr>
<td>23</td>
<td>&quot;HOA Switch 2&quot;</td>
<td>-/OFF</td>
<td>ALARM=OFF</td>
</tr>
<tr>
<td>24</td>
<td>&quot;HOA Switch 2&quot;</td>
<td>-/AUTO</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>&quot;HOA Switch 3&quot;</td>
<td>-/HAND</td>
<td>ALARM=HAND</td>
</tr>
<tr>
<td>26</td>
<td>&quot;HOA Switch 3&quot;</td>
<td>-/OFF</td>
<td>ALARM=OFF</td>
</tr>
<tr>
<td>27</td>
<td>&quot;HOA Switch 3&quot;</td>
<td>-/AUTO</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>&quot;Auxiliary output&quot;</td>
<td>OFF/ON</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>&quot;Alarm Horn&quot;</td>
<td>OFF/RINGING</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>&quot;Alarm Light&quot;</td>
<td>FLASHING/OFF</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>&quot;Any Pump&quot;</td>
<td>OFF/RUNNING</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>&quot;Local Configuration&quot;</td>
<td>-/UPDATED</td>
<td>ALARM=UPDATED</td>
</tr>
</tbody>
</table>

### Module Q, Type = J

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Point Name</th>
<th>Labels (0/1)</th>
<th>Alarm Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>&quot;Analog Input&quot; 1/ma</td>
<td>LO=0/0, HI=20/255</td>
<td>(Typical)</td>
</tr>
<tr>
<td>2*</td>
<td>&quot;Analog Input&quot; 0.1/V</td>
<td>LO=0/0, HI=5/255</td>
<td>(Typical)</td>
</tr>
<tr>
<td>3</td>
<td>&quot;Phase AB Voltage&quot;</td>
<td>5/VAC, LO=151/0, HI=300/255</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>&quot;Phase AC Voltage&quot;</td>
<td>5/VAC, LO=151/0, HI=300/255</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>&quot;Well Level&quot;</td>
<td>0.5/ft, LO=0/0, HI=60/600</td>
<td></td>
</tr>
</tbody>
</table>

---

Data Flow Systems, Inc., Melbourne, Florida
## Station 1, "PCU Configuration" Module A, Type = E

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Detects whether the LOW LEVEL sensor is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>2</td>
<td>Detects whether the OFF LEVEL sensor is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>3</td>
<td>Detects whether the LEAD LEVEL sensor is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>4</td>
<td>Detects whether the LAG1 LEVEL sensor is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>5</td>
<td>Detects whether the LAG2 LEVEL sensor is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>6</td>
<td>Detects whether the HIGH LEVEL sensor is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>7</td>
<td>Detects whether the AUXILIARY INPUT is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>8</td>
<td>Gives status of external alarm-silence switch.</td>
</tr>
<tr>
<td>9</td>
<td>Detects whether pump 1 is in the OFF state or the RUNNING state.</td>
</tr>
<tr>
<td>10</td>
<td>Detects whether pump 2 is in the OFF state or the RUNNING state.</td>
</tr>
<tr>
<td>11</td>
<td>Detects whether pump 3 is in the OFF state or the RUNNING state.</td>
</tr>
<tr>
<td>12</td>
<td>Detects whether the PHASE MONITOR is ENABLED or BYPASSED.</td>
</tr>
</tbody>
</table>

## Module P, Type = F

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Allows telemetry to sense PHASE VOLTAGE failure and activate the alarm.</td>
</tr>
<tr>
<td>2</td>
<td>Allows telemetry to sense PHASE SEQUENCE failure and activate the alarm.</td>
</tr>
<tr>
<td>3</td>
<td>Allows telemetry to sense PUMP 1 STARTER failure and activate the alarm.</td>
</tr>
<tr>
<td>4</td>
<td>Allows telemetry to sense PUMP 2 STARTER failure and activate the alarm.</td>
</tr>
<tr>
<td>5</td>
<td>Allows telemetry to sense PUMP 3 STARTER failure and activate the alarm.</td>
</tr>
<tr>
<td>6</td>
<td>Activates the alarm any time Pump 1 is running and stops without control by the PCU.</td>
</tr>
<tr>
<td>7</td>
<td>Activates the alarm any time Pump 2 is running and stops without control by the PCU.</td>
</tr>
<tr>
<td>8</td>
<td>Activates the alarm any time Pump 3 is running and stops without control by the PCU.</td>
</tr>
<tr>
<td>9</td>
<td>Allows telemetry to sense FLOAT SEQUENCE fault and activate the alarm.</td>
</tr>
<tr>
<td>10</td>
<td>Detects malfunction of a Transducer and activates the alarm.</td>
</tr>
<tr>
<td>11</td>
<td>Detects failure of the EEPROM backup memory and activates the alarm.</td>
</tr>
<tr>
<td>12</td>
<td>Detects the presence of AC Power and activates the Alarm when absent.</td>
</tr>
<tr>
<td>13</td>
<td>Detects the presence of Isolated DC Bias and activates the Alarm when absent.</td>
</tr>
<tr>
<td>14</td>
<td>Detects whether the LOW LEVEL sensor is OK or in the FAULT (Emergency Low) state.</td>
</tr>
<tr>
<td>15</td>
<td>Detects whether the HIGH LEVEL sensor is OK or in the HIGH state.</td>
</tr>
<tr>
<td>16</td>
<td>Detects position of the HOA switch 1 and activates the alarm for HAND position.</td>
</tr>
<tr>
<td>17</td>
<td>Detects position of the HOA switch 1 and activates the alarm for OFF position.</td>
</tr>
<tr>
<td>18</td>
<td>Detects position of the HOA switch 1 and indicates the AUTO position.</td>
</tr>
<tr>
<td>19</td>
<td>Detects position of the HOA switch 2 and activates the alarm for HAND position.</td>
</tr>
<tr>
<td>20</td>
<td>Detects position of the HOA switch 2 and activates the alarm for OFF position.</td>
</tr>
<tr>
<td>21</td>
<td>Detects position of the HOA switch 2 and indicates the AUTO position.</td>
</tr>
<tr>
<td>22</td>
<td>Detects position of the HOA switch 3 and activates the alarm for HAND position.</td>
</tr>
<tr>
<td>23</td>
<td>Detects position of the HOA switch 3 and activates the alarm for OFF position.</td>
</tr>
<tr>
<td>24</td>
<td>Detects position of the HOA switch 3 and indicates the AUTO position.</td>
</tr>
<tr>
<td>25</td>
<td>Detects whether the AUXILIARY OUTPUT is in the OFF state or the ON state.</td>
</tr>
<tr>
<td>26</td>
<td>Detects whether the ALARM HORN is in the OFF state or the RINGING state.</td>
</tr>
<tr>
<td>27</td>
<td>Detects whether the ALARM LIGHT is in the FLASHING state or the OFF state.</td>
</tr>
<tr>
<td>28</td>
<td>In the Flow Equalization mode, indicates the status with any pump.</td>
</tr>
<tr>
<td>29</td>
<td>Detects whether the Local Configuration has been updated and activates the alarm for UPDATE.</td>
</tr>
</tbody>
</table>

## Module Q, Type = J

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>Settings for Analog Input when used with analog-current type transducer.</td>
</tr>
<tr>
<td>or 1*</td>
<td>Settings for Analog Input when used with analog-voltage type transducer.</td>
</tr>
<tr>
<td>2</td>
<td>Settings for Phase AB Voltage for phase monitor.</td>
</tr>
<tr>
<td>3</td>
<td>Settings for Phase AC Voltage for phase monitor.</td>
</tr>
<tr>
<td>4</td>
<td>Calibration points for displaying Well Level.</td>
</tr>
</tbody>
</table>
### Module S, Type = G

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Point Name</th>
<th>Labels (0/1)</th>
<th>Alarm Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;Pump 1 Override&quot;</td>
<td>AUTO/OVERRIDE</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>&quot;Pump 2 Override&quot;</td>
<td>AUTO/OVERRIDE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>&quot;Pump 3 Override&quot;</td>
<td>AUTO/OVERRIDE</td>
<td></td>
</tr>
<tr>
<td>4*</td>
<td>&quot;Auxiliary Output&quot;</td>
<td>AUTO/OVERRIDE</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>&quot;Alarm Horn&quot;</td>
<td>AUTO/OVERRIDE</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>&quot;Alarm Light&quot;</td>
<td>AUTO/DISABLED</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>&quot;Station&quot;</td>
<td>AUTO/DISABLED</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>&quot;Pump 1&quot;</td>
<td>AUTO/DISABLED</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>&quot;Pump 2&quot;</td>
<td>AUTO/DISABLED</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>&quot;Pump 3&quot;</td>
<td>AUTO/DISABLED</td>
<td></td>
</tr>
<tr>
<td>11*</td>
<td>&quot;Auxiliary Output&quot;</td>
<td>AUTO/DISABLED</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>&quot;Alarm Horn&quot;</td>
<td>AUTO/DISABLED</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>&quot;Alarm Light&quot;</td>
<td>AUTO/OVERRIDE</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>&quot;Override Reset&quot;</td>
<td>DISABLED /ENABLED</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>&quot;Analog Updates&quot;</td>
<td>OFF/ON</td>
<td></td>
</tr>
</tbody>
</table>

### Module R, Type C8

12 "RTU Power" ............ OFF/ON ........................ ALARM=OFF ..........................

(continued)
### Module S, Type = G

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In the OVERRIDE state, allows telemetry to control Pump 1 and bypass the PCU.</td>
</tr>
<tr>
<td>2</td>
<td>In the OVERRIDE state, allows telemetry to control Pump 2 and bypass the PCU.</td>
</tr>
<tr>
<td>3</td>
<td>In the OVERRIDE state, allows telemetry to control Pump 3 and bypass the PCU.</td>
</tr>
<tr>
<td>4*</td>
<td>In the OVERRIDE state, allows telemetry to control the Auxiliary Output.</td>
</tr>
<tr>
<td>5</td>
<td>In the OVERRIDE state, allows telemetry to control the Alarm Horn.</td>
</tr>
<tr>
<td>6</td>
<td>In the DISABLED state, allows telemetry to control the Alarm Light.</td>
</tr>
<tr>
<td>7</td>
<td>In the DISABLED state, allows telemetry to cut power to all pump Motors.</td>
</tr>
<tr>
<td>8</td>
<td>In the DISABLED state, allows telemetry to cut power to Pump 1.</td>
</tr>
<tr>
<td>9</td>
<td>In the DISABLED state, allows telemetry to cut power to Pump 2.</td>
</tr>
<tr>
<td>10</td>
<td>In the DISABLED state, allows telemetry to cut power to Pump 3.</td>
</tr>
<tr>
<td>11*</td>
<td>Detects whether the AUXILIARY OUTPUT is in the AUTO state or the DISABLED state.</td>
</tr>
<tr>
<td>12</td>
<td>Detects whether the ALARM HORN is in the AUTO state or the DISABLED state.</td>
</tr>
<tr>
<td>13</td>
<td>Allows telemetry to override the Alarm Light and activate the alarm at the central site.</td>
</tr>
<tr>
<td>15</td>
<td>When set, allows the OFF Level input to reset pump overrides.</td>
</tr>
<tr>
<td>16</td>
<td>Enables Analog readings.</td>
</tr>
</tbody>
</table>

### Module R, Type C8

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Detects RTU POWER failure and activates the alarm at the central site.</td>
</tr>
</tbody>
</table>
APPENDIX 3 FLOW VOLUME CALCULATIONS

To set the Flow Volume, determine the well or tank volume between the OFF Level and the LEAD Level. First determine the difference between the OFF Level and the LEAD Level (height) in feet. Next determine the area of the well or tank. For a rectangular well or tank, multiply width times length; for a circular well or tank, square the radius and multiply by 3.14. Multiply height by area to give volume in cubic feet. To convert to gallons, multiply the volume in cubic feet by 7.48.

CAUTION
Well volumes less than 500 gallons or 37 ft³ are prone to accuracy errors

EXAMPLE:
Assume a circular well of 10 feet diameter (5-foot radius) with OFF Level at 2 feet and LEAD Level at 5 feet.

LEAD Level      5 feet
OFF Level (-)2 feet
Liquid Height 3 feet
Well radius (5') squared 25 ft²
conversion constant (pi) x 3.14
Area 78.5 ft²

To calculate Volume:
Liquid Height 3 feet
Area x 78.5 ft²
Volume (cu.ft.) 235.5 ft³ Enter 236 in configuring Volume in cu.ft.

To convert to gallons:
VOLUME (cu.ft.) 235.5 ft³ conversion constant x 7.48 gal/ft³
VOLUME gal. 1761.54 gallons Enter 1762 in configuring Volume in gallons

The display will show VOLUME in the same terms as you have entered. For instance, if you entered "236" in this example, the VOLUME would display in cubic feet; if you entered 1762, the VOLUME would display in gallons.
APPENDIX 4 GLOSSARY

Alternation  To pass the turning on of pumps from one pump to another in succession.
Bias+  Internal dc voltage
Bias-  Internal dc ground
Bias Voltage  Voltage used to bias (or hold) an input in the ON state. Absence of the voltage forces the input in the OFF state.
Configure  Choosing from a menu the operating conditions of the station controlled by the PCU.
Display Mode  Selected display in the LCD display of the PCU. Appears as Status display mode, Alarm display mode, or Configure display mode.
Delay Mode  Menu selection for delay in pump-motor start or stop an Auxiliary Input or Output.
External  Equipment outside the PCU and not supplied with the PCU.
Failure Mode  Failure conditions displayed in the Alarm display mode in the LCD of the PCU.
Flow Volume  Well or tank Volume between the Off level and the Lead level set in the system.
Ground  Zero voltage reference point of a circuit. May be connected to earth ground or used as a common connection point.
Input  Inputs to the PCU consist of three phase monitor inputs, six telemetry inputs, and 12 digital monitor inputs.
Input Common  Point where multiple leads are terminated
LCD  Liquid-crystal display used to display messages
LED  Light-emitting diode used to indicate an on/off condition
Line  Input side of switch or relay contacts
Load  Output side of switch or relay contacts
Neutral  Zero reference point of an ac voltage
Optional  Equipment that can be supplied with the PCU
Output  Digital monitor output of the PCU
Override  set aside and replace by another
Pump Mode  Selected method of pumping for either a well (pump down) or storage tank (pump up)
Return  ac neutral or Bias -
Set Points  Those points selected in a station using an analog transducer. Pseudo levels corresponding to the desired levels are selected for the analog input voltage (1-5 volts) or current (4-20 mA) from the transducer. After calibrating the minimum and maximum points of the station, the points (equivalent in feet) for starting or stopping pumps and for turning on alarms are selected.
Source  External voltage, ac or dc.
Staging Levels  Levels in a well or tank at which an action (pump start or stop, or alarm activation) occurs.
Telemetry  Radio system used to monitor and control a remote unit or units.
Total Flow Volume  The Total Flow Volume is calculated as an average based on the total time it takes the liquid level to move from the OFF level to the LEAD level.
APPENDIX 5 - INVERTED FLOAT INTERFACE

In some instances, it is necessary to detect a float failure (such as in a high-well float) during normal operation. Such failure can be detected by using an inverted float (contacts closed when in the "down" position) and using the connections to the PCU as indicated below.
APPENDIX 6 – CONNECTING A PCU TO A REMOTE RTU

Bus Extender Module Wiring Diagram

6-CONDUCTOR 25-GA. SHIELDED CABLE. MAXIMUM LENGTH 1000 FT.
BackPack Radio/ TAC Pack
Installation and Operation
Instruction Manual

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605 N. John Rodes Boulevard
Melbourne, Florida 32934
(321) 259-5009
FAX 259-4006

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<td></td>
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<td>10</td>
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</table>
SECTION 1 INTRODUCTION

Purpose

The BackPack Radio (BPR) is a microprocessor-controlled unit that functions as the interface between the Pump Control Unit (PCU001) or System Control Unit (SCO001) and the Data Flow Systems Radio Telemetry. The addition of a Back Pack Radio to either an SCU001 or a PCU001 creates a cost effective Remote Terminal Unit (RTU) which is commonly referred to as a TAC Pack.

Description

This unit has the same footprint as the PCU/SCU. When used in the radio-transceiver mode, the TAC Pack is more susceptible to heat and therefore should be mounted in an enclosure away from direct sunlight or other heat sources. Radio current, receiver sensitivity and BPR temperature are monitored for system diagnostics.

A secondary configuration strap is reserved for data inversion, data swap and ASCII communications.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Size</th>
<th>Power supply current</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.75&quot;w x 8.75&quot;h x 4.38&quot;d</td>
<td>5-watt radios 30mA avg., 2A max. @ 120-130Vac</td>
</tr>
<tr>
<td>Circuit protection</td>
<td>others ................200mA avg., 1A max @ 12-14Vdc</td>
</tr>
<tr>
<td>Radio interface</td>
<td>RS-232 (ASCII)</td>
</tr>
<tr>
<td>Service port</td>
<td>DFS TAC II/HyperTAC II</td>
</tr>
<tr>
<td>Temperature</td>
<td>0 - 54.5 °C</td>
</tr>
</tbody>
</table>
Features

- Interfaces with other RTUs in a TAC II/HyperTAC II system.
- On board communications and functional firmware
- Integral PCU/SCU mounting hardware
- Mounting brackets identical to those of the PCU/SCU
- Unit removable/replaceable without disturbing field wiring or configuration jumpers
- Quick disconnect connectors
- Runs off battery during power failure
- Environmentally sealed/ corrosion resistant enclosure
- Enclosed radio transceiver
- RS-232 interface

BackPack Radio Assemblies

BackPack Radios are selected according to frequency requirements, power output needs and FCC restrictions. DFS has a set of radios that meet current requirements and that have been tested and approved in field operation. Requirements are constantly reviewed and revised as new requirements appear to keep the list up to date. You may be assured that the best radio for your application will be selected. Currently approved frequency ranges and power output capabilities are listed in this table.

<table>
<thead>
<tr>
<th>BackPack Radio Number</th>
<th>Description and Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPR-001-1</td>
<td>2 Watt UHF 450-470 MHz</td>
</tr>
<tr>
<td>BPR-001-7</td>
<td>900 MHz 4.5 dv</td>
</tr>
<tr>
<td>BPR-001-10</td>
<td>5 Watt UHF 140-170 MHz</td>
</tr>
<tr>
<td>BPR-001-16</td>
<td>2 Watt 200 MHz</td>
</tr>
<tr>
<td>BPR-001-18</td>
<td>Synthesized 200 MHz</td>
</tr>
</tbody>
</table>
SECTION 2 INSTALLATION

Installing the BPR with a PCU/SCU in a new installation.

Prepare the installation for the PCU/SCU as described in the PCU/SCU Manual. Cable the installation with sufficient slack to reach the PCU/SCU while stacked on top of the BPR. The TAC Pack unit comes already assembled. Mount the unit in the brackets and tighten with the thumb screws. Connect the antenna cable to the BPR pigtail which extends from the bottom of the BPR. Configure the PCU/SCU on the telemetry central computer system.

Installing the BPR with an existing PCU/SCU

To perform this installation, you must remove the PCU/SCU from the control-panel mounting brackets and install the BPR in its place using the same brackets. To do this, remove the connectors, P1 and P2, from the PCU/SCU. Then, unscrew the thumb screws on either side of the PCU/SCU and take out the PCU/SCU. Place the BPR in the position formerly held by the PCU/SCU which has the same screw footprint. Using the removed thumb screws, insert them into the BPR and tighten. Place the PCU/SCU on top of the BPR being careful to align and connect the 8-pin umbilical connector into the back of the PCU/SCU. Screw the thumb screws in place so that the BPR and the PCU/SCU are stacked and screwed together.

Usually in existing installations, the PCU/SCU connectors, P1 and P2, have not been wired with enough slack to allow them to reach the PCU/SCU in its new position, about four additional inches. If that is the case, either rewire the cabling for the connectors to allow for the additional length, or shift the control panel mounting holes for the TAC Pack.
Connect the antenna cable to the BPR pigtail which extends from the bottom of the BPR. Configure the PCU/SCU on the telemetry central computer system. Installation is complete.

For instruction wiring the Backpack in the field, see "Field Wiring".

**Digital Status**

The digital status is divided into four control points and eight monitor points. These points should be configured as follows:

<table>
<thead>
<tr>
<th>Point #</th>
<th>Point Type</th>
<th>Point Name</th>
<th>0/1</th>
<th>Alarm Label</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control</td>
<td>Battery test</td>
<td>OFF/ON</td>
<td></td>
<td>5 Watt or greater</td>
</tr>
<tr>
<td>Point 2</td>
<td>control</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 3</td>
<td>control</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 4</td>
<td>control</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 5</td>
<td>monitor</td>
<td>Radio status</td>
<td>OK/Shutdown</td>
<td>Shutdown</td>
<td></td>
</tr>
<tr>
<td>Point 6</td>
<td>monitor</td>
<td>Temperature (H)</td>
<td>OK/HIGH</td>
<td>HIGH</td>
<td></td>
</tr>
<tr>
<td>Point 7</td>
<td>monitor</td>
<td>Temperature (L)</td>
<td>OK/LOW</td>
<td>LOW</td>
<td></td>
</tr>
<tr>
<td>Point 8</td>
<td>monitor</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 9</td>
<td>monitor</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 10</td>
<td>monitor</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 11</td>
<td>monitor</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 12</td>
<td>monitor</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Point 1 (Battery test) turns off power provided by the BPR's internal auxiliary power supply when the control point is turned on. Use for 5 watt or greater radio.
- Point 5 (Radio status) is turned on if the BPR has determined that the non-keyed radio current is above the factory-set threshold, thereby shutting down the power to the radio.
- Point 6 (Temperature (H)) is turned on if the temperature of the BPR exceeds 54.5°C (130°F) factory specified limit.
- Point 7 (Temperature (L)) is turned on if the temperature of the BPR drops below 0°C (32°F)
Analog Status

The analog status is divided into four monitor points. These points should be configured as follows.

<table>
<thead>
<tr>
<th>Point #</th>
<th>Point Name</th>
<th>Low Conversion</th>
<th>High Conversion</th>
<th>Accuracy per Unit</th>
<th>Alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 1</td>
<td>Key current</td>
<td>0/0</td>
<td>2.55/255</td>
<td>0.5/Amp</td>
<td>Optional</td>
</tr>
<tr>
<td>Point 2</td>
<td>RSSI</td>
<td>0/0</td>
<td>255/255</td>
<td>5/Relative</td>
<td>Optional</td>
</tr>
<tr>
<td>Point 3</td>
<td>Temperature</td>
<td>0/0</td>
<td>250/255</td>
<td>5/deg. F</td>
<td>Optional</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-18/0</td>
<td>121/255</td>
<td>5/deg. C</td>
<td>Optional</td>
</tr>
</tbody>
</table>

- Point 1 (Key current) is the averaged current consumed by the radio while keying.
  
  *Note: This is not a calibrated value, and accuracy may differ from unit to unit.*

- Point 2 (RSSI) is the value of the radio's Receiver Signal Strength Input for the previous reception. This value is a relative indication of the strength of an incoming RF signal.
  
  *Note: This signal is only available on selected radios.*

- Point 3 (Temperature) is the component level temperature of the BPR.

These conversions allow for temperature readings in Fahrenheit (°F) or Celsius (°C).

*Note: It is recommended that the above Analog Status points be left unconfigured in the interest of minimizing the TAC II poll loop time. These points are provided for debugging purposes only.*

Field Wiring

Three things must be considered in wiring the BackPack in the field: the address strap, the configuration strap, and the 120Vac power input. Straps, in the form of a comb, are modified by bending the teeth out to turn the bit on, or leave in (to be grounded) to turn the bit off.

Pins on the connector are identified as follows:
Pins 10 and 11 are used in special situations where interference is experienced with a telemetry system in another location on the same frequency. They are used to change the data format by byte inverting or nibble swapping. If interference becomes a problem, contact Data Flow Systems for further information and assistance.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Function</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>bit 0</td>
<td>1</td>
</tr>
<tr>
<td>Pin 2</td>
<td>bit 1</td>
<td>2</td>
</tr>
<tr>
<td>Pin 3</td>
<td>bit 2</td>
<td>4</td>
</tr>
<tr>
<td>Pin 4</td>
<td>bit 3</td>
<td>8</td>
</tr>
<tr>
<td>Pin 5</td>
<td>bit 4</td>
<td>16</td>
</tr>
<tr>
<td>Pin 6</td>
<td>bit 5</td>
<td>32</td>
</tr>
<tr>
<td>Pin 7</td>
<td>bit 6</td>
<td>64</td>
</tr>
<tr>
<td>Pin 8</td>
<td>bit 7</td>
<td>128</td>
</tr>
<tr>
<td>Pin 9</td>
<td>bit 8</td>
<td>256</td>
</tr>
<tr>
<td>Pin 10</td>
<td>ground</td>
<td>--</td>
</tr>
<tr>
<td>Pin 11</td>
<td>invert data</td>
<td>--</td>
</tr>
<tr>
<td>Pin 12</td>
<td>swap data</td>
<td>--</td>
</tr>
<tr>
<td>Pins 13 &amp; 14</td>
<td>unused</td>
<td>--</td>
</tr>
</tbody>
</table>

Addressing the BPR

The address is obtained by turning on bits which add up to the station number desired. For instance, if station 47 is desired, teeth on pins 6 (32), 4(8), 3(4), 2(2), and 1(1) would be bent out to turn on these bits and equal 47. Alternately, pins 4, 5, 7, 8, and 9 would be left in to be connected. If no tooth is inserted, the station number would be 511, the sum of all the bits.

Configuration Strap

Inverting or swapping data is accomplished by strapping pin 11 (invert data) or pin 12 (swap data) to pin 15 (ground).

120Vac Power

BackPacks having a 5-Watt or greater radio (see Table above entitled BackPack Radio Assemblies) require a 120Vac power input; others do not. These 5-Watt radios have a 50-Watt power supply which requires the 120Vac input. The current supplied by the 120Vac source should be limited by a 1 amp, slow-blow fuse.
SECTION 3  OPERATION

Modes of Operation

The BPR operates in one or more of the following modes as follows:

Normal Mode

The BPR powers up in this mode, and operates much like the RIM. It will only respond to messages that match its station address, and incoming and outgoing radio traffic can be monitored at the service port.

Service Mode

This mode is entered by connecting a laptop/notebook computer into the BPR service port running the test program "RTU Test". When in the Service Mode, the BPR's test LED will be lit and all radio traffic from the Central Terminal Unit (CTU) will be ignored. In effect, the CTU which normally polls the BPR is disconnected and replaced by the laptop computer. The laptop computer can then address the BPR by entering any address that is compatible with the CTU and the BPR, and the BPR will respond as though it were being polled by the CTU. Normal Mode can be reentered by pressing and holding the test button or waiting for the five-minute time out.

Test Mode

The BPR has a test button used to conduct tests of the station's radio, and the Test Mode is entered by holding the test button during power up. When in Test Mode, the BPR's test LED will be lit and the BPR will behave as if strapped for station 255. This feature works in conjunction with TAC II to assist in antenna alignment (see RTU Manual). While in Test Mode, Pressing and holding the test button will cause the radio to key and the test LED to blink as long as the test button is depressed. This action will allow technicians to test the output and reflected power of the radio, a basic functional test.

Normal Mode can be reentered by resetting the power to the BPR and not holding the test button or by waiting for the five-minute time out. The service port is fully functional in this mode.

Radio Shutdown Mode

This mode is entered when the average non-keyed radio current exceeds the factory-set threshold of approximately 380mA. When in this mode, the test LED will blink and power is removed from the radio for the duration of the five-minute time out. After the time out, non-keyed radio current is reevaluated (for approximately 10 seconds) to determine if another radio shutdown cycle is required. If non-keyed radio current is at an acceptable level, Normal Mode is resumed. The service port is fully functional in this mode.
Patch Disable Mode

This mode is entered when Telemetry GND (P1-10) and Telemetry TXD (P1-14) terminals on the PCU/SCU are shorted together during power up. When in this mode, any installed patch remains installed but is disabled. The patch can be re-enabled by resetting the power to the BPR. Listed below are BPR version messages indicating BPRs in various patch mode.

- BPR not patched .................. BPR001  PROM_version  serial_number
- BPR patched  ..................... BPR001  PROM_version  <patch_version>  serial_number
- BPR patched disabled .......... BPR001  PROM_version
SECTION 4 MAINTENANCE AND SERVICE

The BPR has a service port on it as well as that on the PCU/SCU. By plugging a laptop computer into the service port on the BPR, you can monitor the radio traffic that the BPR sees coming off the radio as well as PCU/SCU communications.

The Service Mode is entered by transmitting any message to the BPR via the service port. When in the Service Mode, the BPR's test LED will be lit and all radio traffic will be ignored. Normal Mode can be reentered by pressing the test button or waiting for the five-minute time out.