PROCESS CONTROLLER UNIT (PCU)

BOOK NO. IM 40.200CA UA ISSUE A

EQUIPMENT SERIAL NO. _____

DATE OF START-UP _____

START-UP BY _____

Prompt service available from nationwide authorized service contractors.

ORDERING INFORMATION

In order for us to fill your order immediately and correctly, please order material by description and part number, as shown in this book. Also, please specify the serial number of the equipment on which the parts will be installed.

WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgement of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgement of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to U.S. Filter/Wallace & Tiernan, Inc., but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

USFilter
WALLACE & TIERNAN PRODUCTS
1901 West Garden Road, Vineland, NJ 08360

INTRODUCTION

This instruction book provides installation, calibration, operation, service, and parts information for the U.S. Filter/Wallace & Tiernan (USF/W&T) Process Controller Unit (PCU).

This microprocessor-based controller is fully configurable to fit the needs of each control application. The user can select from four different types of control algorithms and can configure the alarm relays for the particular demands of the application. The controller also has serial communications capabilities that provide for interface to computer control systems.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED, AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK.

NOTE: When ordering material always specify model and serial number of apparatus.

Table Of Contents

VERY IMPORTANT SAFETY PRECAUTIONS

This page titled "Very Important Safety Precautions" provides, in brief, information of urgent importance relative to safety in the installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING PRECAUTIONS:

TROUBLESHOOTING OF THE CONTROLLER, SIGNALS, AND SOURCE POWER IS PERFORMED WITH A METER. ONLY PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK, ARE TRAINED WITH THIS EQUIPMENT, AND WHO HAVE A COMBINED KNOWLEDGE OF PROPER SAFETY PRECAUTIONS AND USF/W&T EQUIPMENT SHOULD PERFORM ANY TESTING AND/OR TROUBLESHOOTING.

KEEP COVER SECURELY TIGHTENED WHEN EQUIPMENT IS IN OPERATION. THIS ENCLOSURE IS NEMA 4X RATED. GASKET SEAL MUST BE MADE IN ORDER TO PROTECT THE INTERNAL COMPONENTS FROM MOISTURE AND FUMES.

TO AVOID ELECTRICAL SHOCK, TURN OFF POWER AND DISCONNECT SOURCE POWER BEFORE SERVICING.

TO AVOID ELECTRICAL SHOCK, TAKE NOTE THAT POWER MAY BE ON TERMINALS #18, #33, #34, #35, AND #36 WHEN THE CONTROLLER IS POWERED, UNLESS RESISTORS R1 AND R2 ARE REMOVED.

BE SURE TO USE THE PROPER FUSING FOR THE LINE VOLTAGE THAT WILL BE SUPPLIED TO THE CONTROLLER.

ALL WIRING MUST CONFORM TO LOCAL AND NATIONAL ELECTRICAL CODE (NEC) STANDARDS.

BE SURE TO PROPERLY CONNECT THE EARTH GROUND CABLE.

NEVER TRY TO MAKE A CONNECTION WITH THE POWER ON. TESTING OF THE POWER SUPPLY VOLTAGES REQUIRES ACCESS TO THE POWER SUPPLY BOARD WHILE THE POWER IS ON. TURN THE POWER OFF TO THE CONTROLLER, MAKE THE NECESSARY CONNECTIONS, THEN RESTORE POWER.

SHUT OFF THE GAS SUPPLY AT THE CYLINDERS. OPERATE THE GAS FEEDER UNTIL THE VACUUM GAUGE READS FULL SCALE (OR ZERO FOR PRESSURE SUPPLY FEEDERS) AND THE ROTAMETER FLOAT RESTS ON THE BOTTOM STOP.

VERY IMPORTANT SAFETY PRECAUTIONS (CONT'D)

TO ENSURE PROPER AND SAFE OPERATION OF THIS EQUIPMENT, USE ONLY USF/W&T LISTED PARTS, EXCEPT FOR COMMERCIALLY AVAILABLE PARTS AS IDENTIFIED BY COMPLETE DESCRIPTION ON PARTS LIST. THE USE OF UNLISTED PARTS CAN RESULT IN EQUIPMENT MALFUNCTIONS CAUSING POSSIBLE SEVERE PERSONAL INJURY.

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL FOR PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

USFILTER'S WALLACE & TIERNAN PRODUCTS
1901 W. GARDEN ROAD
VINELAND, NEW JERSEY 08360
PHONE: (856) 507-9000
FAX: (856) 507-4125

NOTE

Minor part number changes may be incorporated into USF/W&T products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local USF/W&T sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from USFilter's Wallace & Tiernan Products (USF/W&T), contact the office indicated below.

UNITED STATES

1901 West Garden Road
Vineland, NJ 08360
TEL: (856) 507-9000
FAX: (856) 507-4125

CANADA

If the equipment was purchased directly from USF/W&T Canada, contact the nearest office indicated below.

ONTARIO

250 Royal Crest Court
Markham, Ontario
L3R3S1
(905) 944-2800

QUEBEC

243 Blvd. Brien
Bureau 210
Repentigny, Quebec
(514) 582-4266

MEXICO

If the equipment was purchased directly from USF/W&T de Mexico, contact the office indicated below.

Via Jose Lopez Portillo 321
Col. Sta. Maria Cuautepec
Tultitlan, Edo. de Mexico
54900 Mexico
TEL: 525 879 0260
FAX: 525 875 2171

SECTION 1 - TECHNICAL DATA

Power Requirements:	105-125 Vac, 50/60 Hz, 14VA or (switch selectable with proper fusing) 207-253 Vac, 50/60 Hz, 14VA
Fusing	
Terminal Board:	115/230 Vac, F1: 1/2 amp
Power Supply Board:	115 Vac F1: 200 mA 230 Vac F1: 100 mA
Enclosure	NEMA 4X rating
Dimensions:	8.78" H x 5.27" W x 9.73" D
Weight:	4 pounds
Input Signal	
Flow Input:	4-20 mA dc 0-20 mA dc or (switch selectable with proper software configuration) 1-5 Vdc 0-5 Vdc
Residual/Spare Inputs:	4-20 mA dc
Input Impedances:	47 ohms for current inputs 100,000 ohms minimum for voltage inputs
mA Output:	Selectable Load capacity < 600 ohms, Accuracy 0.1% Full Scale, Temperature Effect: maximum 0.1%, 500 V galvanic isolation to earth ground
Digital Inputs:	230 V/115V/24V (ac/dc), selectable 500 V galvanic isolation to earth ground
Alarm Contact Ratings:	5 amp, 1/6 hp @ 125/250 Vac, 5 amp, 30 Vdc (30 Watts maximum) Normally open and normally closed contacts with common return.
Mounting:	Controller can be mounted up to 500 feet from actuator.
Signal Wire:	AWG No.20, stranded, twisted pair
Actuator power wire:	AWG No. 16
Dosage:	Flow input can be scaled from 10% to 400% of full scale (flow proportional mode only).

SECTION 1 - TECHNICAL DATA (CONT'D)

Flow Scaling:	Flow input can be scaled from 10% to 400% full scale.
Residual Range:	0 to 0.100 mg/l Cl_2 0 to 0.200 mg/l Cl_2 0 to 0.500 mg/l Cl_2 0 to 1.00 mg/l Cl_2 0 to 2.00 mg/l Cl_2 0 to 5.00 mg/l Cl_2 0 to 10.00 mg/l Cl_2 0 to 20.0 mg/l Cl_2 0 to 50.0 mg/l Cl_2 0 to 100 mg/l Cl_2 0.500 mg/l SO_2 to 0.500 mg/l Cl_2 1.00 mg/l SO_2 to 1.00 mg/l Cl_2 2.50 mg/l SO_2 to 2.50 mg/l Cl_2 5.00 mg/l SO_2 to 5.00 mg/l Cl_2 10.0 mg/l SO_2 to 10.0 mg/l Cl_2
Proportional Gain:	Keypad adjustable 0 to 100%.
Integral Gain:	Keypad adjustable 0 to 100%.
Total Lag Time:	Keypad adjustable from 0.1 to 60 minutes.
Fixed Lag Time:	Keypad adjustable from 0.1 to 60 minutes.
Residual Display:	4-digit, 7-segment display, 5-character alphanumeric display
Message Display:	Two 12-character alphanumeric displays
Bargraph Display:	20-segment display, 5% increments percent of full scale flow rate or percent of full scale actuator position, keypad selectable from Operation menu.
Operating Temperature Range:	32 to 120°F (0 to 50°C)
Storage Temperature Range:	4 to 158°F (-20 to 70°C)
Serial Communication:	RS-485, 19200 Baud 2-Wire, Bi-directional
Impedance:	100 ohms to 130 ohms
Capacitance:	<20pF/ft
Wire size:	AWG No. 22 minimum
Maximum distance:	3937 ft (1200 m)

SECTION 2 - INSTALLATION

List Of Contents

List Of Contents (Cont'd)

2.1 General

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED, AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK.

Read the instruction books provided with any other pieces of equipment and this instruction book completely before beginning installation.

2.2 Location

Choose a site for the equipment that will:

- Exclude unauthorized persons from the installation.
- Allow adequate working space for routine service.
- Provide the necessary electrical power to the system.
- If an alarm system is required: provide space, support, and electric power for the alarm system.

2.3 Unpacking

When the equipment and accessory items are unpacked, check all items against the packing list to verify that no parts are discarded with the packing material. Whenever possible, unpack the equipment at the installation site.

NOTE: Do not discard this instruction book when installation is complete. This book also includes operation and service instructions.

2.4 Mechanical Installation

The following paragraphs deal with equipment mounting, conversion, and assembly. Disregard any information that does not deal with your specific application.

2.4.1 Wall Mounting of Controller (See Dwg. 40.200.000.010)

To mount the controller, refer to Figure 2.1 and perform the following steps:

a. Locate and position the controller where it is to be mounted. Mark bracket holes on the mounting surface.

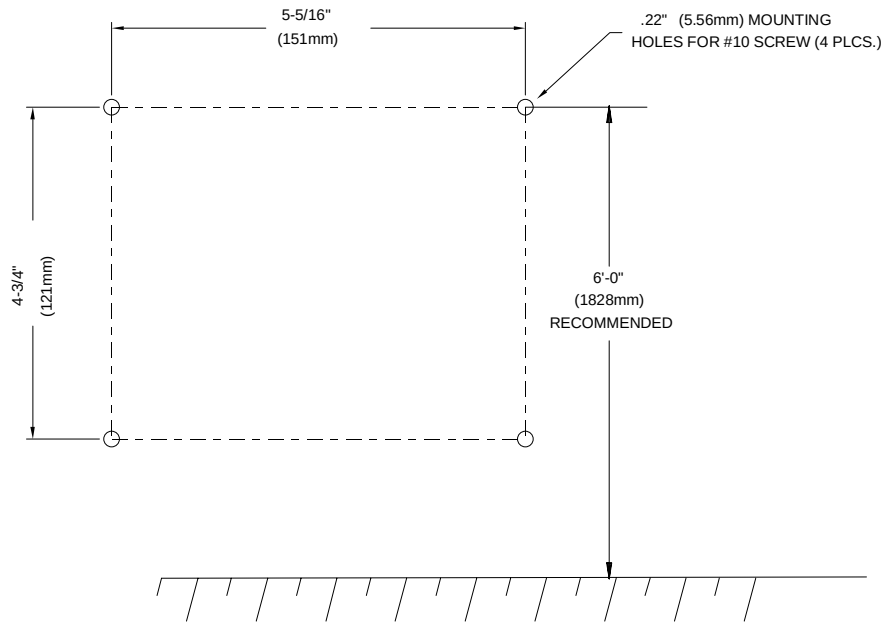


Figure 2.1 - Controller Mounting Detail

b. Drill holes, using adequately sized drill bit for the hardware being used.

c. Attach controller to mounting surface, using lag bolts, mollys, and/or heavy screws with washers.

2.5 Fuses

The controller has two fuse locations. One fuse is located on the terminal board, and the other on the power supply board within the metal case. The controller can be operated with either 115 Vac (nominal) or 230 Vac (nominal) power by setting the line voltage switch on the power supply board of the controller and choosing the proper fusing for both the power supply board and the terminal board. The following table outlines fuse requirements for each operating voltage. Dwg. 40.200.150.010 in Section 4 - Service shows the location of the fuse on the power supply board.

LINE VOLTAGE	TERMINAL BOARD	POWER SUPPLY BOARD
115 Vac (nominal)	1/2 amp	200 mAmp
230 Vac (nominal)	1/2 amp	100 mAmp

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, BE SURE TO USE THE PROPER FUSING FOR THE LINE VOLTAGE THAT WILL BE SUPPLIED TO THE CONTROLLER.

The terminal board fuse powers both the controller and the actuator.

2.6 Wiring

Wiring arrangements depend on the mounting of the controller and on the controller application. Use the following wiring instructions for the specific application. Mounting should be completed before wiring the unit.

2.6.1 General Wiring Instructions

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING PRECAUTIONS:

TROUBLESHOOTING OF THE CONTROLLER, SIGNALS, AND SOURCE POWER IS PERFORMED WITH A METER. ONLY PERSONNEL WHO ARE TRAINED WITH THIS EQUIPMENT AND WHO HAVE A COMBINED KNOWLEDGE OF PROPER SAFETY PRECAUTIONS AND USF/W&T EQUIPMENT SHOULD PERFORM ANY TESTING AND/OR TROUBLESHOOTING.

TO AVOID ELECTRICAL SHOCK, TURN OFF POWER AND DISCONNECT SOURCE POWER BEFORE SERVICING.

ALL WIRING MUST CONFORM TO LOCAL AND NATIONAL ELECTRICAL CODE (NEC) STANDARDS.

CAUTION: It is essential that all external wiring be connected exactly as shown on the INSTALLATION WIRING diagrams. Reversal of wiring connections or inadvertent grounding of conductors will cause improper operation of the equipment. If difficulty is experienced in placing the apparatus in operation, check all external wiring connections before any service is attempted on the equipment. With power off, use an ohmmeter and check all power leads for shorts to ground.

NOTE: To prevent signal interference, power (AC) and signal (DC) wires may not be run through the same conduit for distances greater than three feet.

The controller enclosure has three holes on the bottom for 1/2-inch conduit connections. Use flexible, liquid-tight conduit when connections are made to the controller.

The controller terminals are designed for bare stranded non-tinned copper wires from AWG No. 24 to 14, stripped 1/4 inch.

Color coding is recommended to simplify tracing of external wiring.

Power to the actuator is supplied at the terminal board through resistors R1 and R2.

Ground loops may cause improper equipment operation. Do not connect to earth ground except for required safety grounds. Review the complete control system, including accessories, for possible ground loops.

2.6.2 Controller Connections (See Dwg. 40.200.130.020)

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY, ELECTRICAL SHOCK, OR EQUIPMENT DAMAGE, TAKE NOTE THAT POWER MAY BE ON TERMINALS #18, #33, #34, #35, AND #36 WHEN THE CONTROLLER IS POWERED, UNLESS RESISTORS R1 AND R2 ARE REMOVED.

Be sure to remove resistors R1 and R2 if the control device does not use L1 as its input power.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, ALL WIRING MUST CONFORM TO LOCAL AND NATIONAL ELECTRICAL CODE (NEC) STANDARDS.

The controller is assembled at the factory for use with USF/W&T's actuator as the control device. The zero ohm resistor, R1, sends the input power, L1, to the actuator enable relay input, L EXT (terminal #18). The zero ohm resistor, R2, connects the output of this relay, ENABLE (terminal #36), to the actuator relay power input, ENABLE INPUT (terminal #34). Power, L1, emits from the INC terminal (#35) when the controller increases the actuator position and from the DEC terminal (#33) when the controller decreases the actuator position. See Dwg. 40.200.130.020.

If another control device is being used, check the manufacturer's instruction manual for appropriate wiring directions.

a. Run conduit for power, input signal(s), serial communications (if used), alarm relays (if used), and digital inputs (if used) to the controller box. Also run conduit to actuator for actuator power and feedback wiring.

b. Remove the two screws holding the terminal cover on the bottom of the controller. Remove the cover.

c. Remove the terminal blocks from the headers by pulling firmly on the blocks.

d. Wire to the terminal blocks according to the appropriate wiring drawings.

CAUTION: Terminal block will mount into the header one way only. To prevent crossed connections and damage to the equipment, be sure that the terminal block is wired with the proper orientation in mind.

e. Plug the terminal blocks back into the headers.

f. Seal all unused conduit openings using an appropriate hole plugs.

g. Replace the terminal cover and tighten the screws sufficiently to properly seal the terminal area against moisture.

2.6.3 Wiring to the Controller Inputs

The Flow Input can be configured to accept four different types of input signals, two voltage ranges, and two current ranges. The ranges are:

VOLTAGE - 1 to 5V, 0 to 5V
CURRENT - 4 to 20 mA, 0 to 20 mA

The Flow Input is configured at the factory for 4 to 20 mA, which is the typical input signal. If the application has an input signal that is different from 4 to 20 mA, see paragraph 3.4.4.5, Input/Output - Flow Input, for information on how to change the flow input signal type.

The residual and spare inputs are 4 to 20 mA inputs and cannot be changed. The spare input, if set up for flow, can only be used for a flow meter that emits a 4 to 20 mA signal. See the chart below for the appropriate input terminal connections.

INPUT TERMINAL CONNECTIONS		
INPUT	**TERMINAL NAME**	**TERMINAL NUMBER**
Flow	Flow Input + Flow Input -	5 6
Residual	Residual Input + Residual Input -	9 10
Spare	Spare Input + Spare Input -	7 8
Actuator Feedback	Fbk - Wiper Fbk +	15 16 17

2.6.4 Wiring to the Controller Serial Communications

There are two connections for the serial communications port: RS-485(A) on terminal #14, and RS-485(B) on terminal #13. See paragraph 3.10, RS485 Interface Operation, and Dwg. 40.200.130.030 in this section, for information on how to wire the serial communications.

2.6.5 Wiring to the Controller Relays

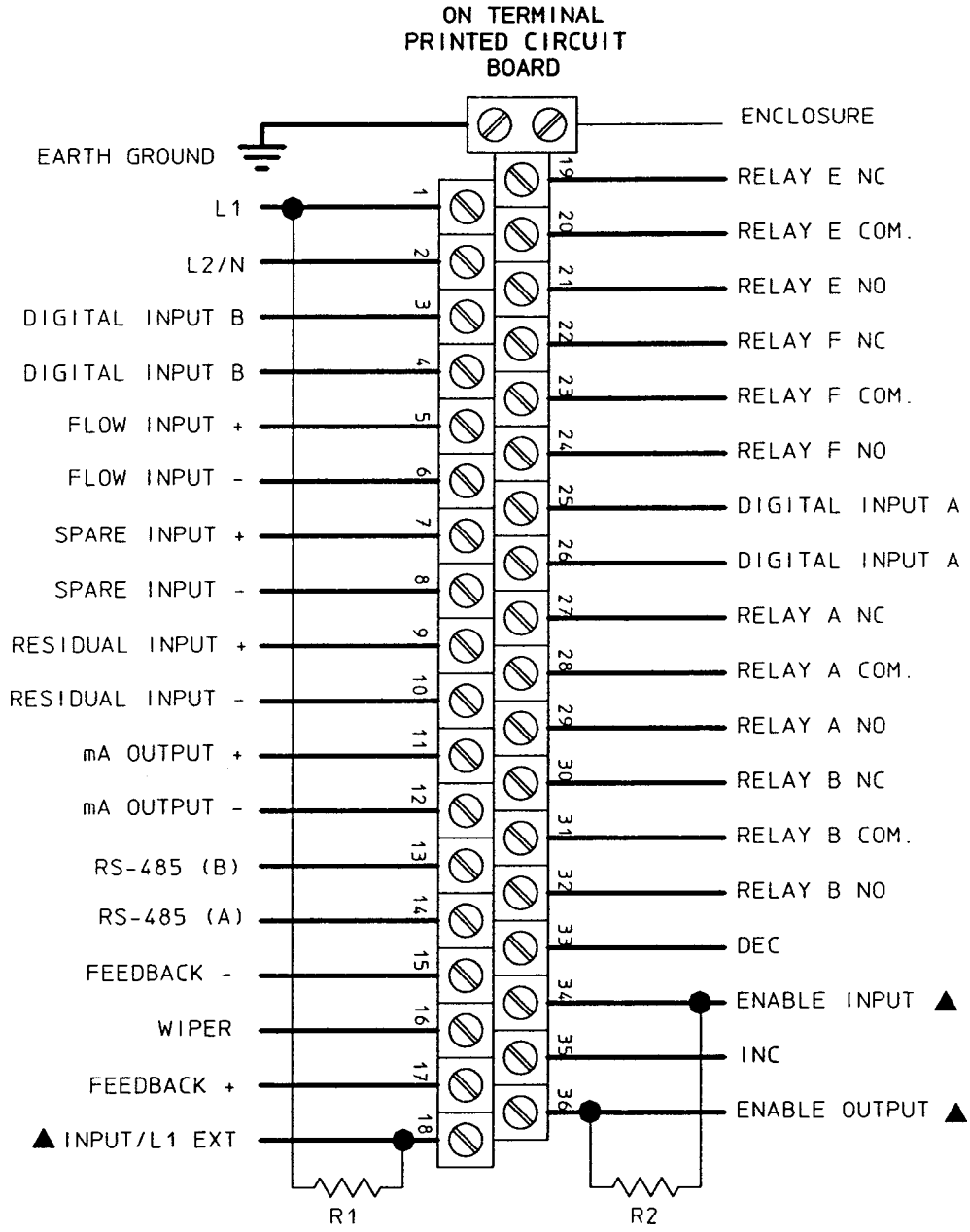
There are a total of six relays in the controller. Two are used exclusively for control output—actuator INC or DEC, pulse output for Pulse Frequency control, or pulse width for Dosing Pump control. Four relays are available for customer use—Relay A, Relay B, Relay E, and Relay F. All relays have dry, unpowered, form "C" contacts. Each has a normally open and a normally closed contact connection along with the common connection.

Alarms are usually wired to the normally open connections. If a fail-safe condition is desired, however, wire to the normally closed terminal and configure the relay for fail-safe operation. See paragraph 3.4.6, Relays.

These relays can be configured through the controller software to indicate a variety of alarm and status conditions. See paragraph 3.4.6, Relays.

2.6.6 General Application Wiring (See Dwgs. 40.200.130.070, .080, .090, .100, .110, .120, and .130)

General wiring diagrams are provided, for wiring the controller to different control devices—actuator, pulse pump, and dosing pump. Check the manual for the control device for specific directions.



NOTE: ▲ THESE CONNECTIONS ARE MADE INTERNALLY ON THE BACKPLANE PRINTED CIRCUIT BOARD FOR THE ACTUATOR, THROUGH ZERO OHM RESISTORS R1 AND R2.

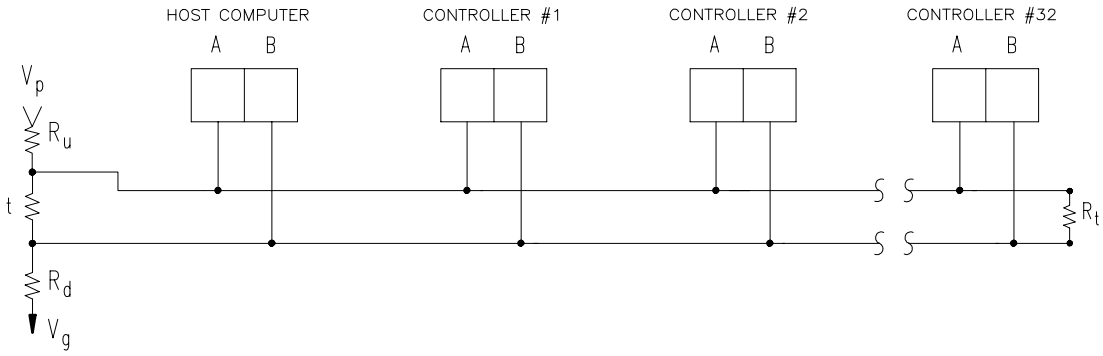
FIELD WIRING (NOT BY USF/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

CONTROLLER - INSTALLATION WIRING

40.200.130.020

ISSUE 0 4-95

RS 485



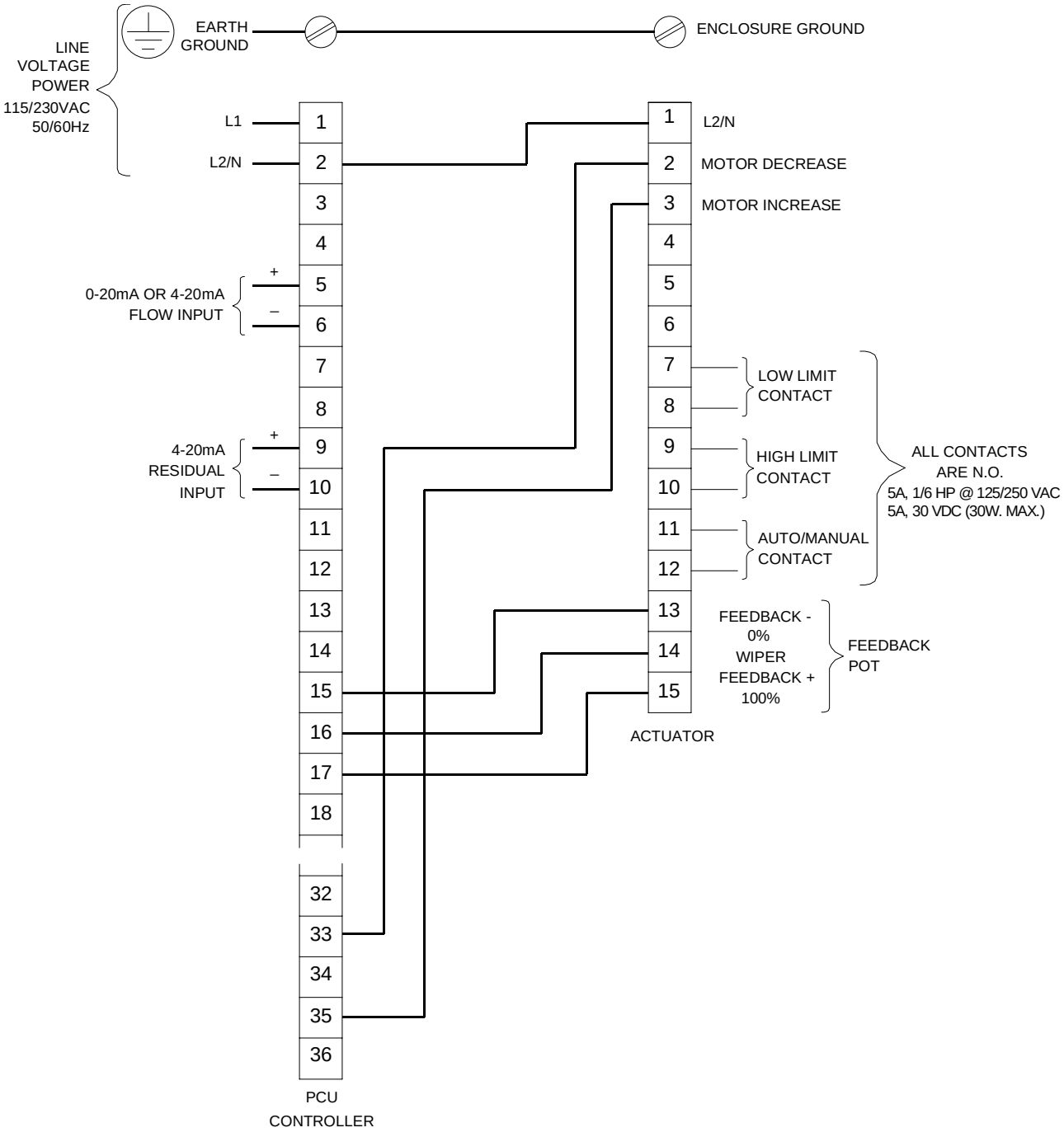
NOTES: SET DIFFERENT COMMUNICATION ADDRESS FOR EACH CONTROLLER.

SEE PARAGRAPH 3.10, RS485 INTERFACE OPERATION, FOR DETAILS ON CABLE TYPE, RESISTOR VALUES, AND V_P POTENTIAL.

SERIAL COMMUNICATION - INSTALLATION WIRING

40.200.130.030

ISSUE 1 3-97



NOTE: ——— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

V-NOTCH - UXB9685 (115VAC), UXA96285 (230VAC)

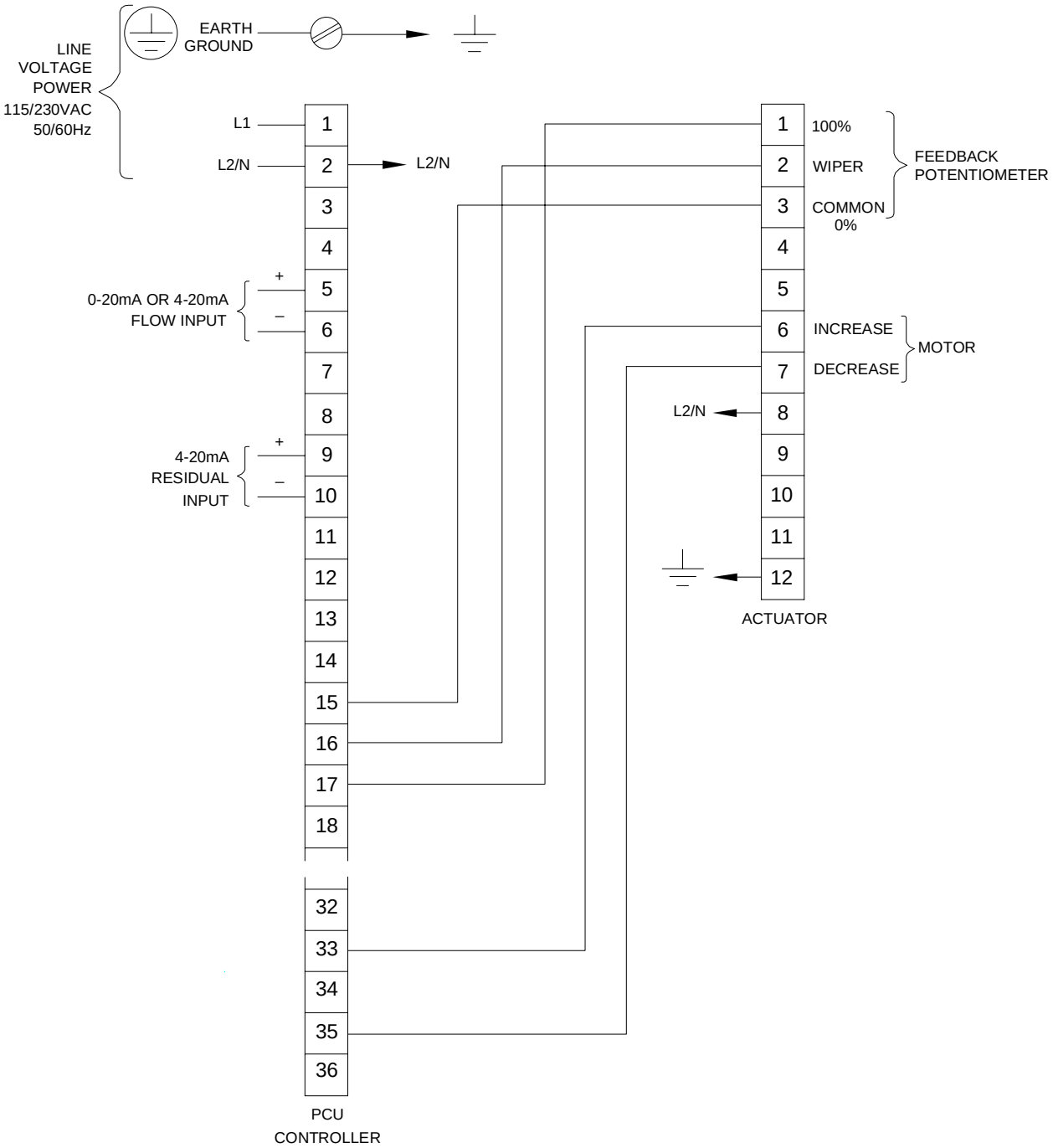
PUMP - AAA1277 (115VAC), AAA1280 (230VAC)

CONNECTING PCU TO MOTOR-CONTROLLED ACTUATORS - INSTALLATION WIRING

Used With V10K and S10K Gas Feeders; Encore® 700 Series & Chemtube® Series Metering Pumps; LVN-2000 Liquid Chemical Feed System

40.200.130.070

ISSUE 1 8-98



NOTE: 1) ——— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

2) RELEVANT INTERNAL FACTORY WIRING FOR U29202 ACTUATOR TERMINALS IS AS FOLLOWS:

WIRE #	TERMINAL
16	4
18	4
17	5

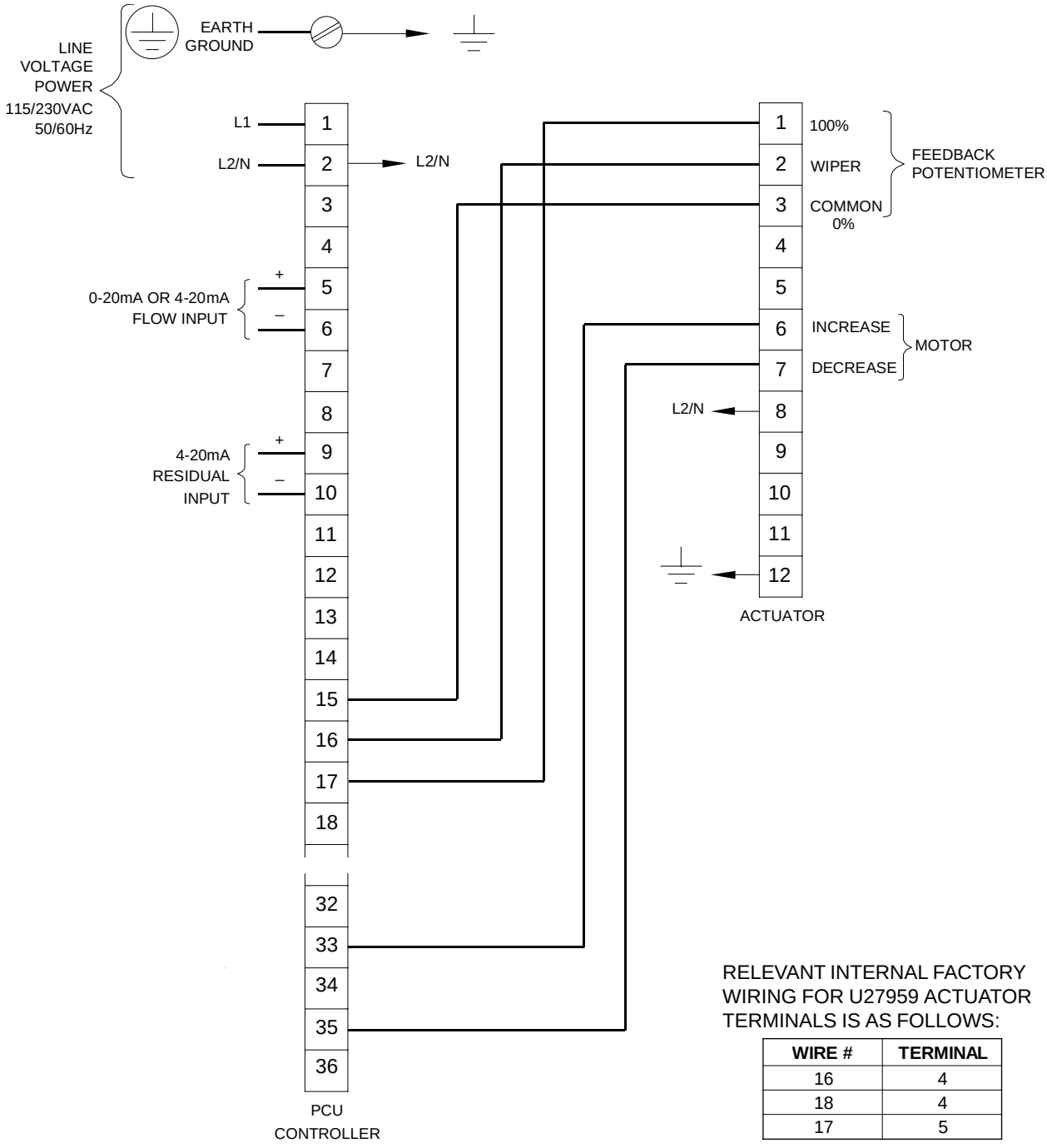
V-NOTCH - U27959

CONNECTING PCU TO MOTOR-CONTROLLED ACTUATORS - INSTALLATION WIRING

Used With V2000 Gas Feeders

40.200.130.080

ISSUE 1 4-97



RELEVANT INTERNAL FACTORY WIRING FOR U27959 ACTUATOR TERMINALS IS AS FOLLOWS:

WIRE #	TERMINAL
16	4
18	4
17	5

NOTE: —— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

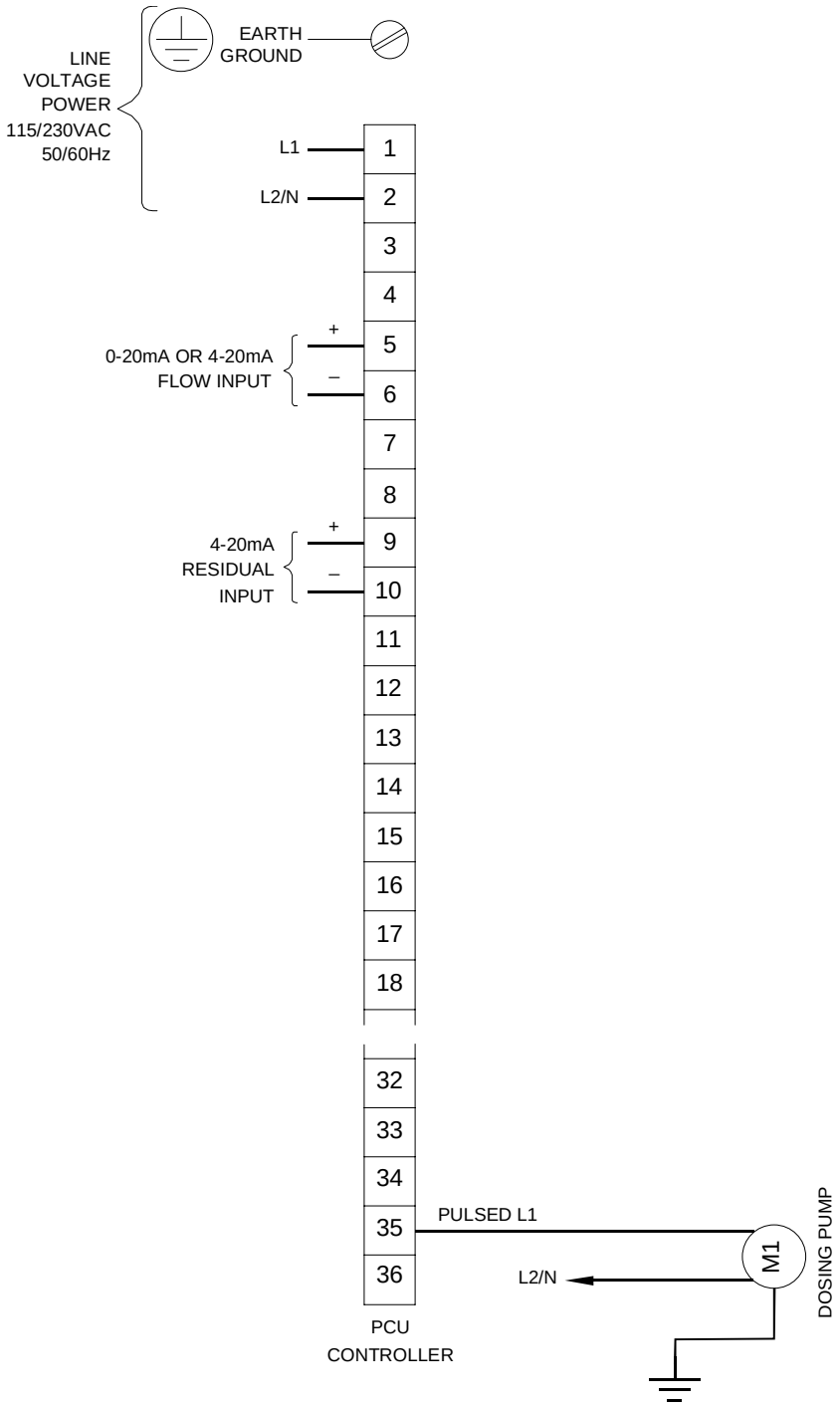
V-NOTCH - U29202

CONNECTING PCU TO MOTOR-CONTROLLED ACTUATORS - INSTALLATION WIRING

Used With V-75, V-100 and V-500 Gas Feeders

40.200.130.090

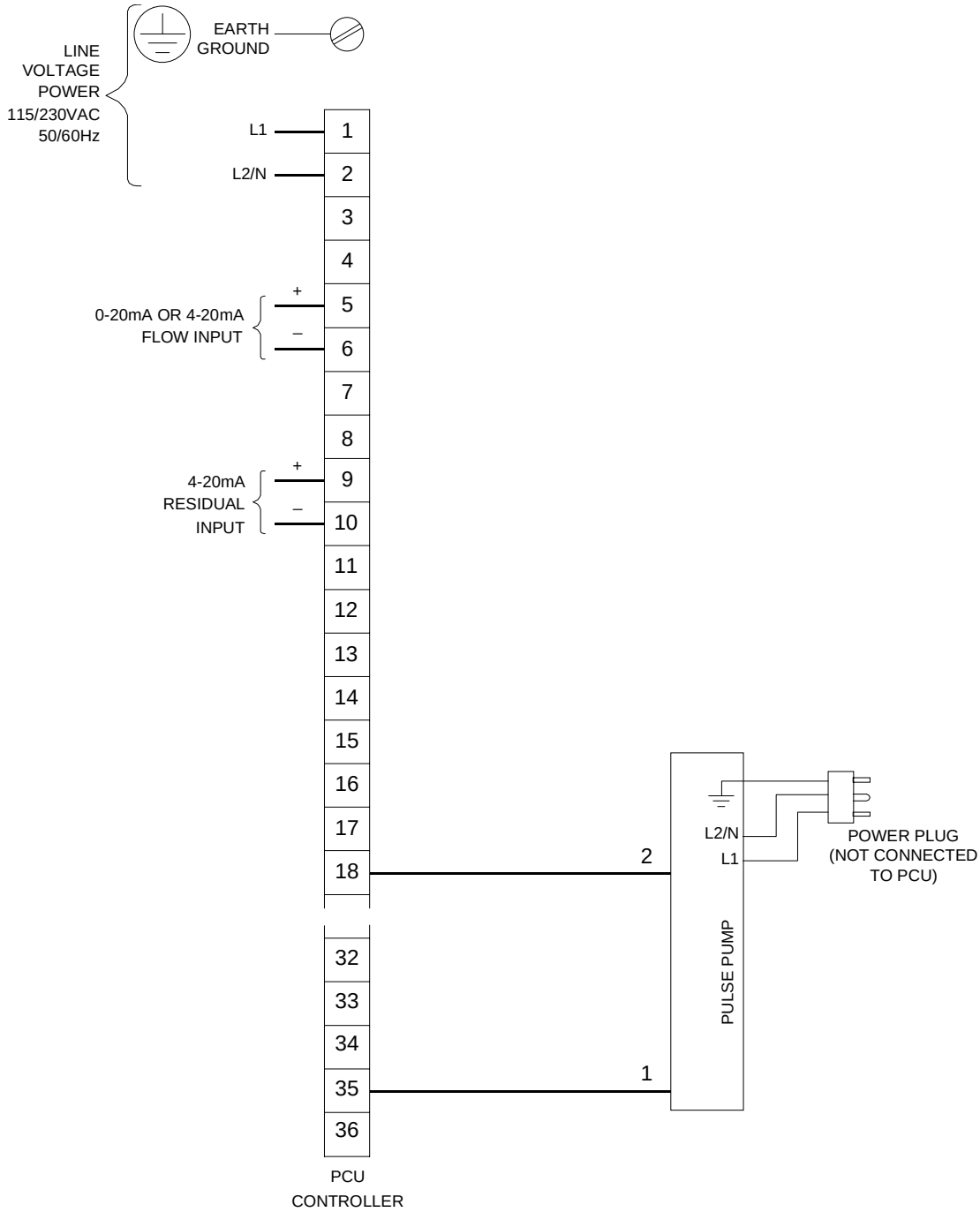
ISSUE 1 4-97



NOTE: —— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

CONNECTING PCU TO DOSING PUMP
- INSTALLATION WIRING

40.200.130.100
ISSUE 0 3-97



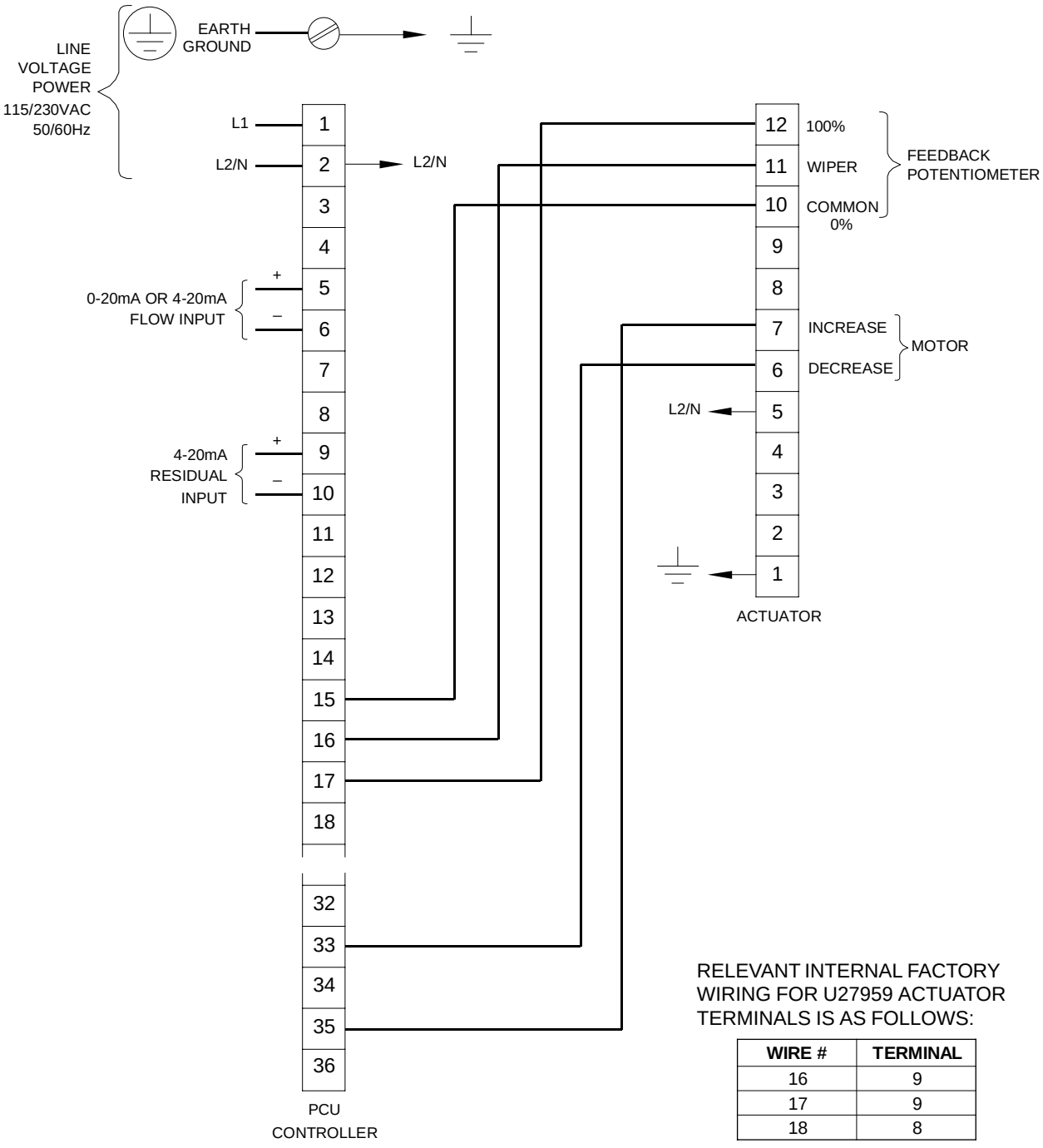
NOTE: ——— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

WARNING: CONTACT CLOSURE MUST BE UNPOWERED BY REMOVING RESISTOR "R1" FROM TERMINAL BOARD. FAILURE TO DO SO WILL DAMAGE THE PUMP.

CONNECTING PCU TO SERIES 45 CHEMPULSE PUMP - INSTALLATION WIRING

40.200.130.110

ISSUE 0 3-97



RELEVANT INTERNAL FACTORY WIRING FOR U27959 ACTUATOR TERMINALS IS AS FOLLOWS:

WIRE #	TERMINAL
16	9
17	9
18	8

NOTE: —— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

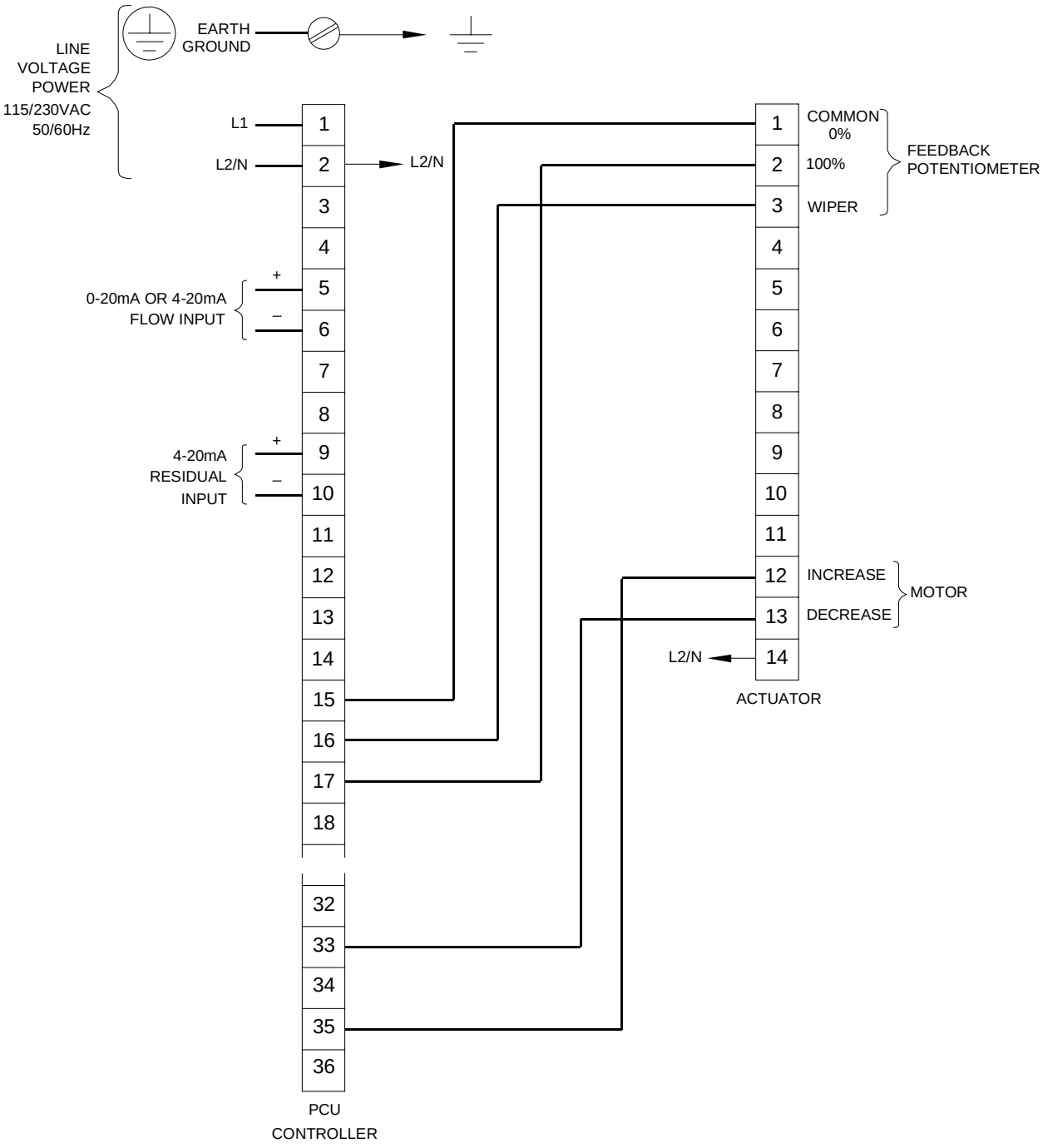
PUMP - U27960

CONNECTING PCU TO MOTOR-CONTROLLED ACTUATORS - INSTALLATION WIRING

Used With 44 Series Metering Pumps

40.200.130.120

ISSUE 0 4-97



NOTE: 1) ——— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

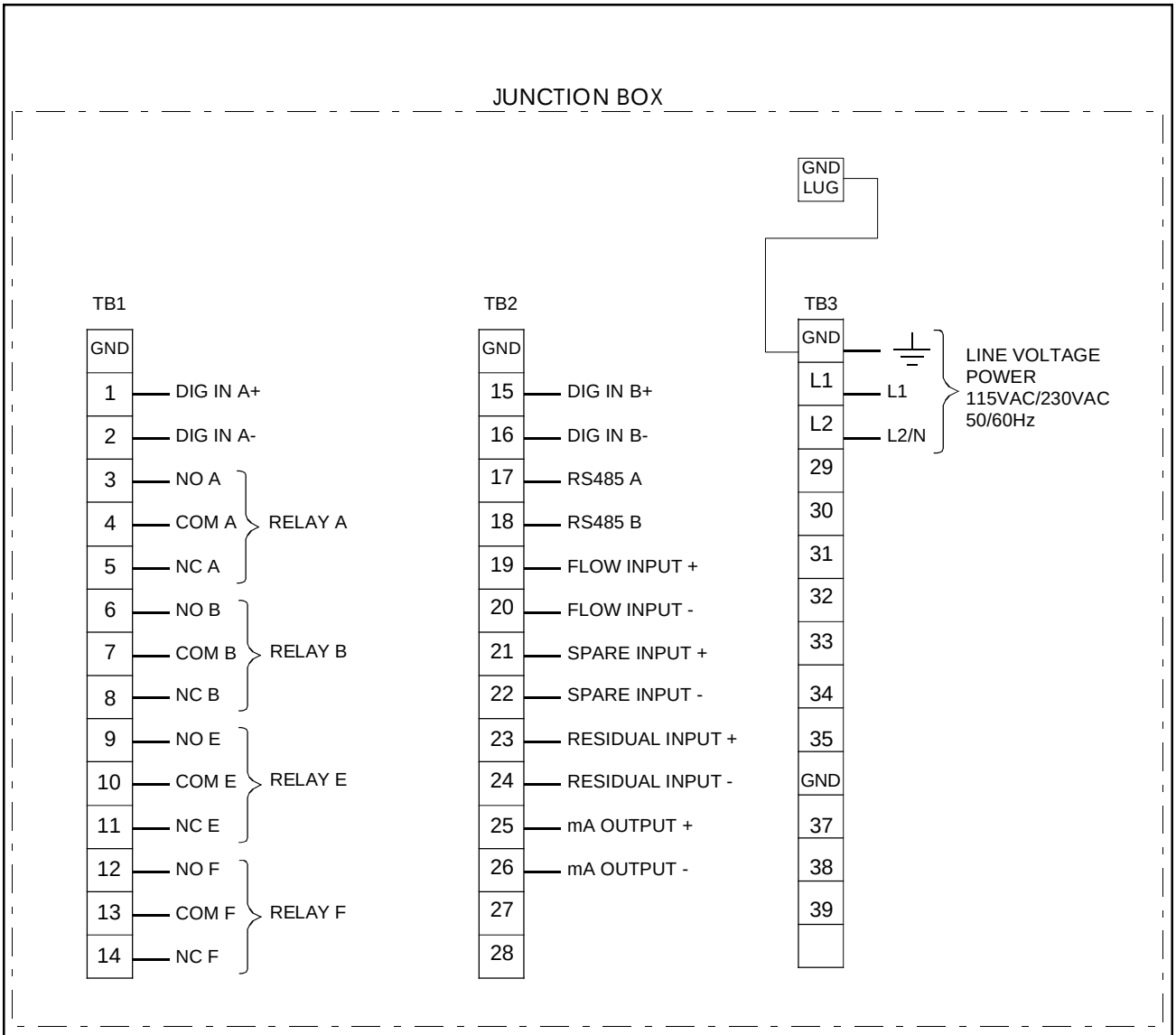
PUMP - U28342

CONNECTING PCU TO MOTOR-CONTROLLED ACTUATORS - INSTALLATION WIRING

Used With Series 43-300 HATD Pumps

40.200.130.130

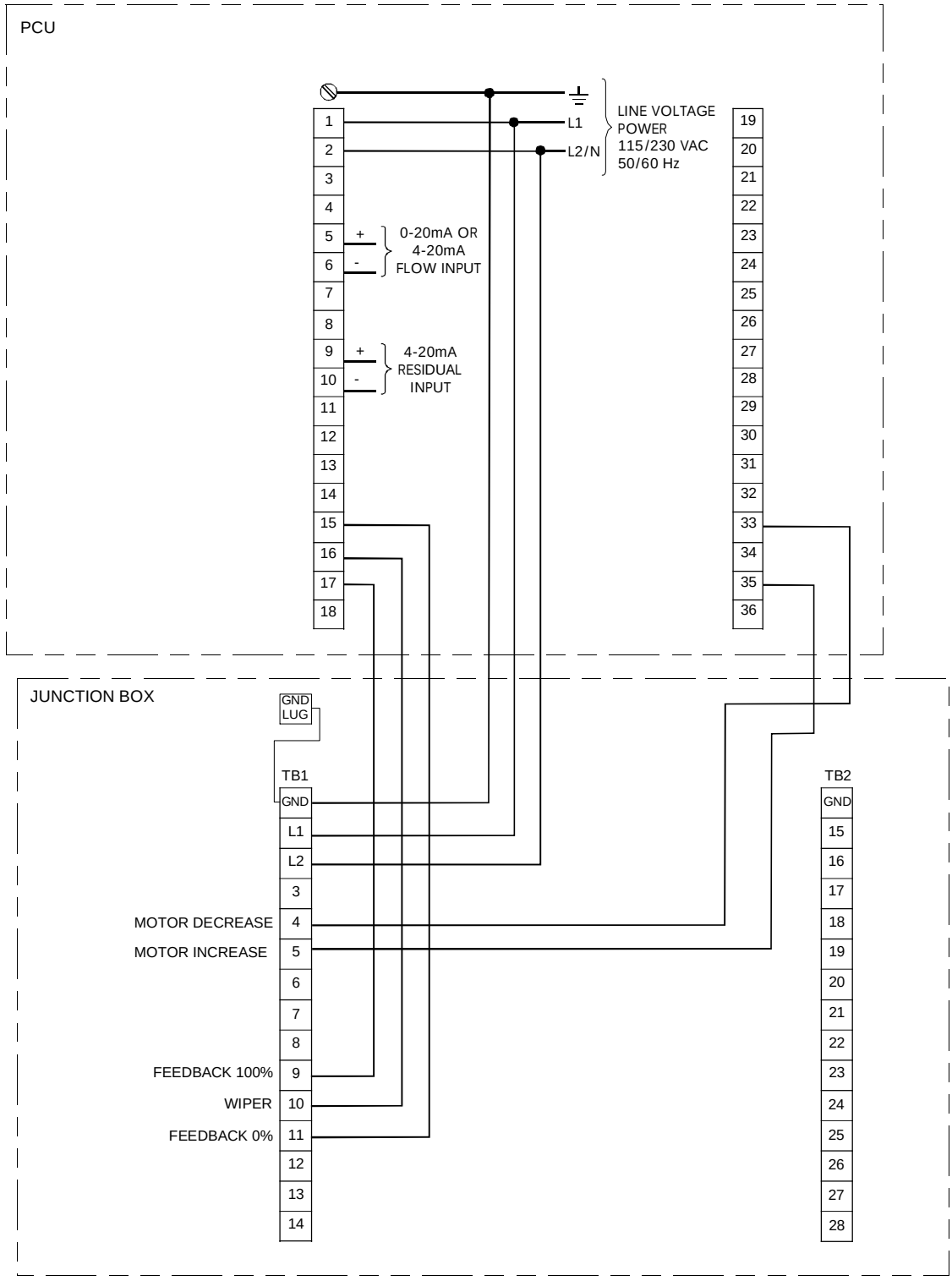
ISSUE 0 3-97



NOTE: ——— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

PCU CONTROLLER IN WALL-MOUNTED V2000 GAS FEEDER
- INSTALLATION WIRING

40.200.130.140
ISSUE 1 8-98

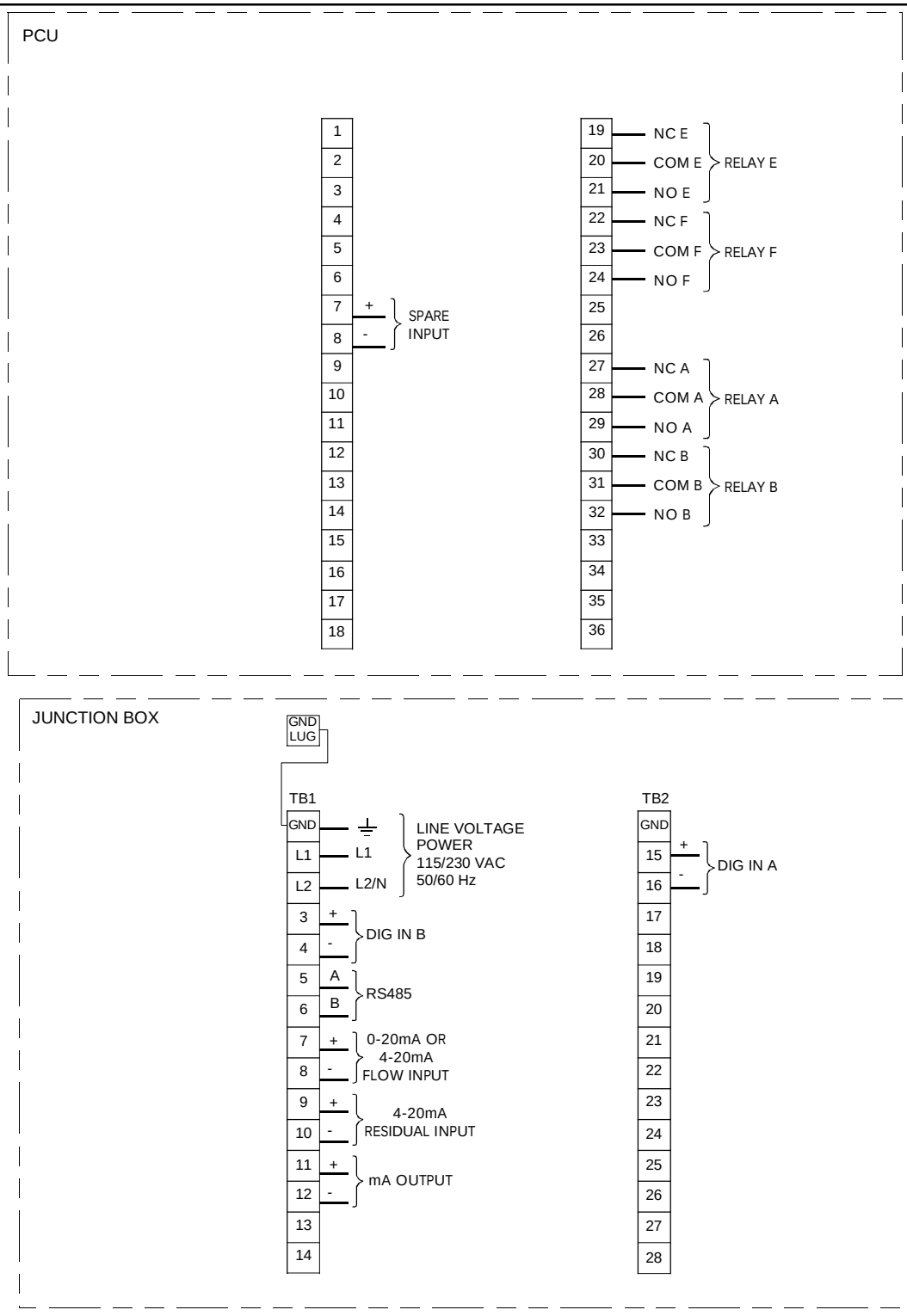


NOTE: —— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

REMOTE-MOUNTED PCU CONTROLLER / V2000 MODULE-MOUNTED GAS FEEDER - INSTALLATION WIRING

40.200.131.010

ISSUE 0 7-98

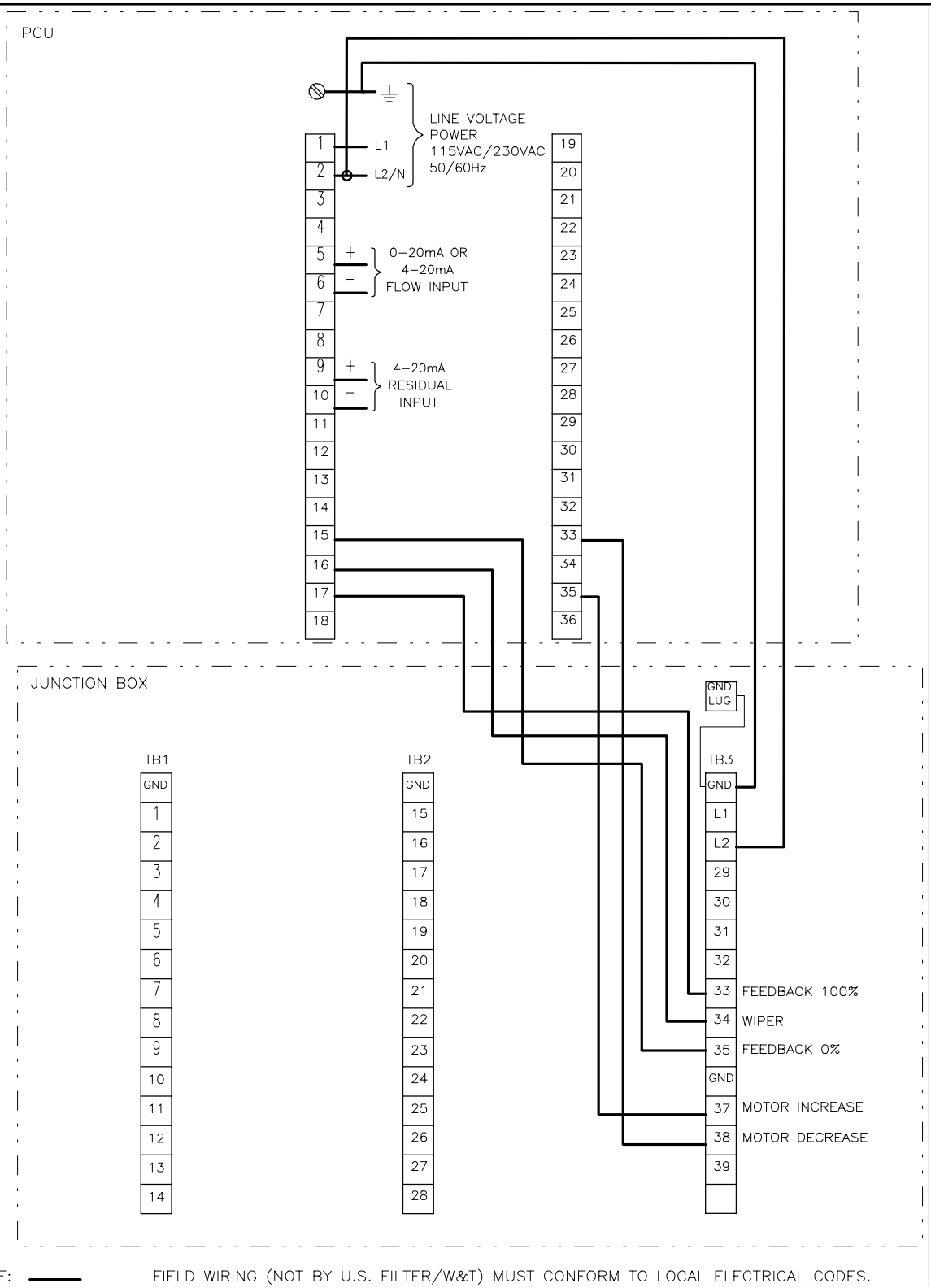


NOTE: —— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

MODULE-MOUNTED PCU CONTROLLER / V2000 MODULE-MOUNTED GAS FEEDER - INSTALLATION WIRING

40.200.131.020

ISSUE 0 7-98



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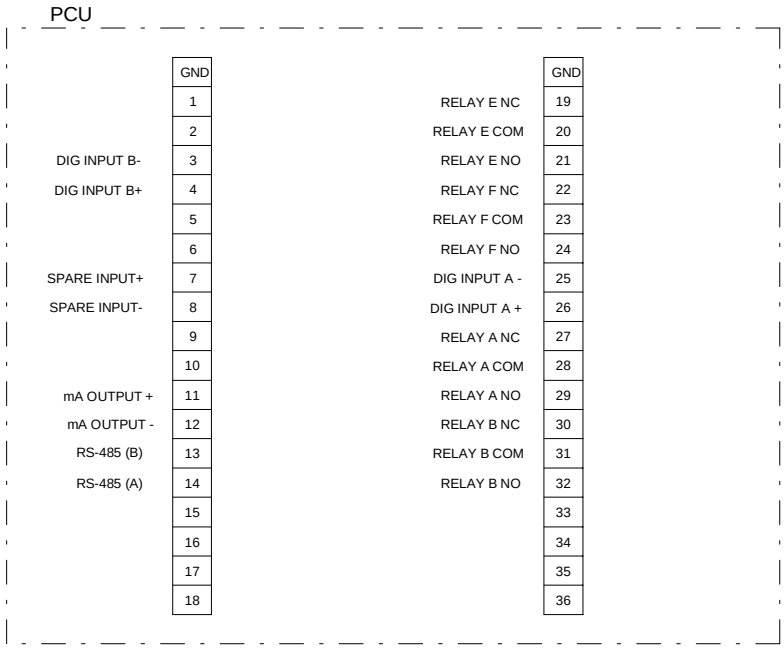
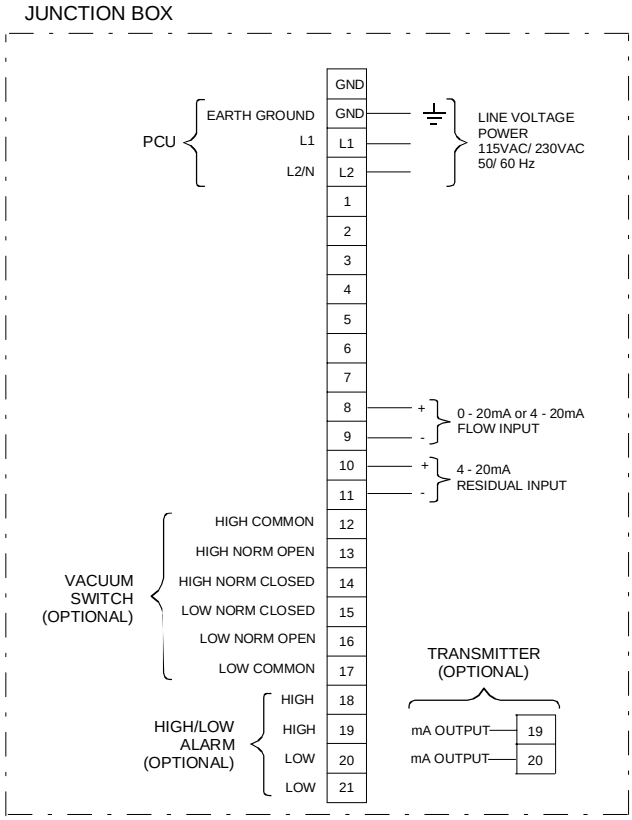
REMOTE-MOUNTED PCU CONTROLLER / V2000 WALL-MOUNTED GAS FEEDER - INSTALLATION WIRING

40.200.131.030

ISSUE 0 7-98



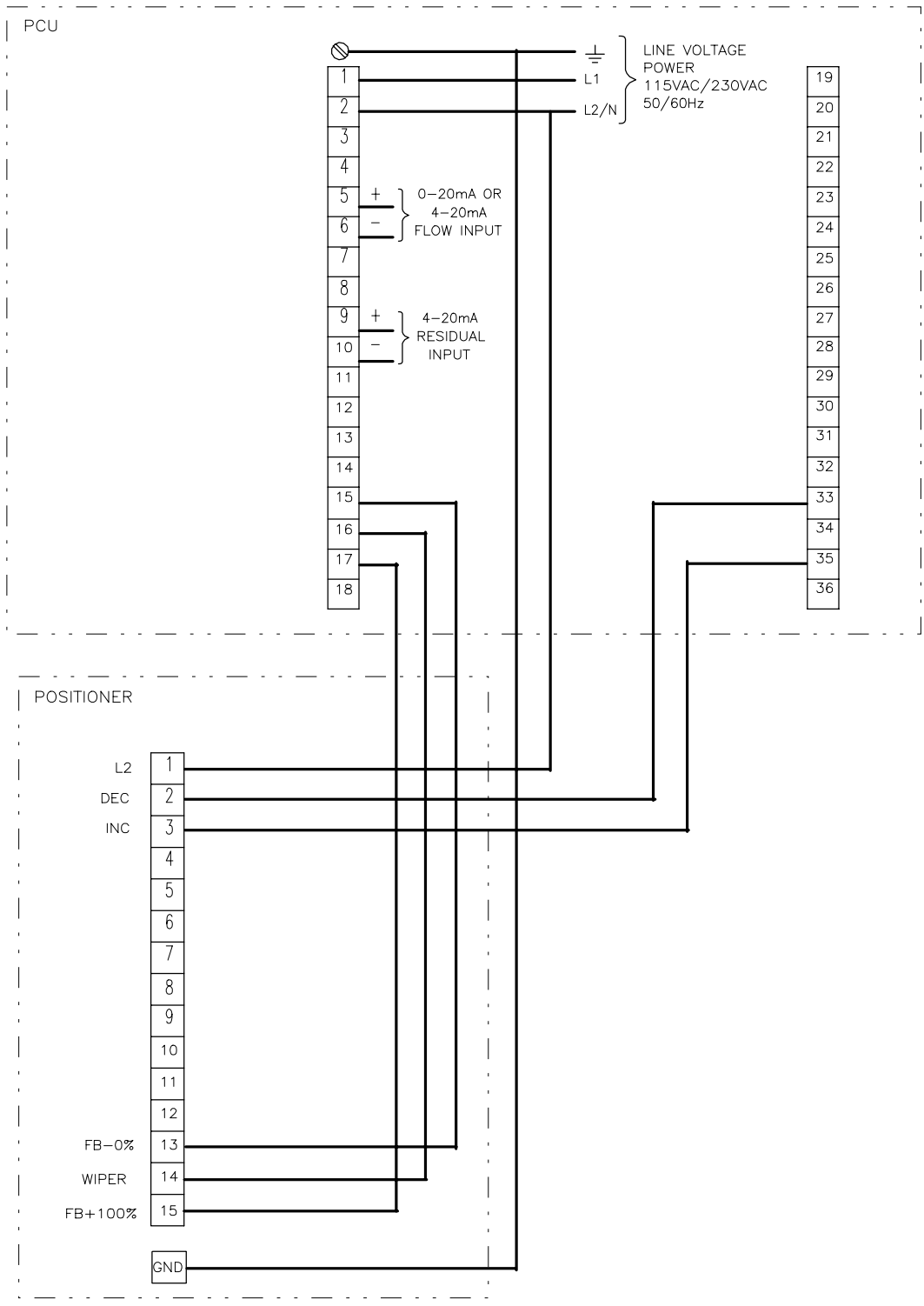


NOTE: ——— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES.

PANEL MOUNTED PCU CONTROLLER / LVN-2000 LIQUID CHEMICAL FEED SYSTEM - INSTALLATION WIRING

40.200.132.010

ISSUE 0 08-00

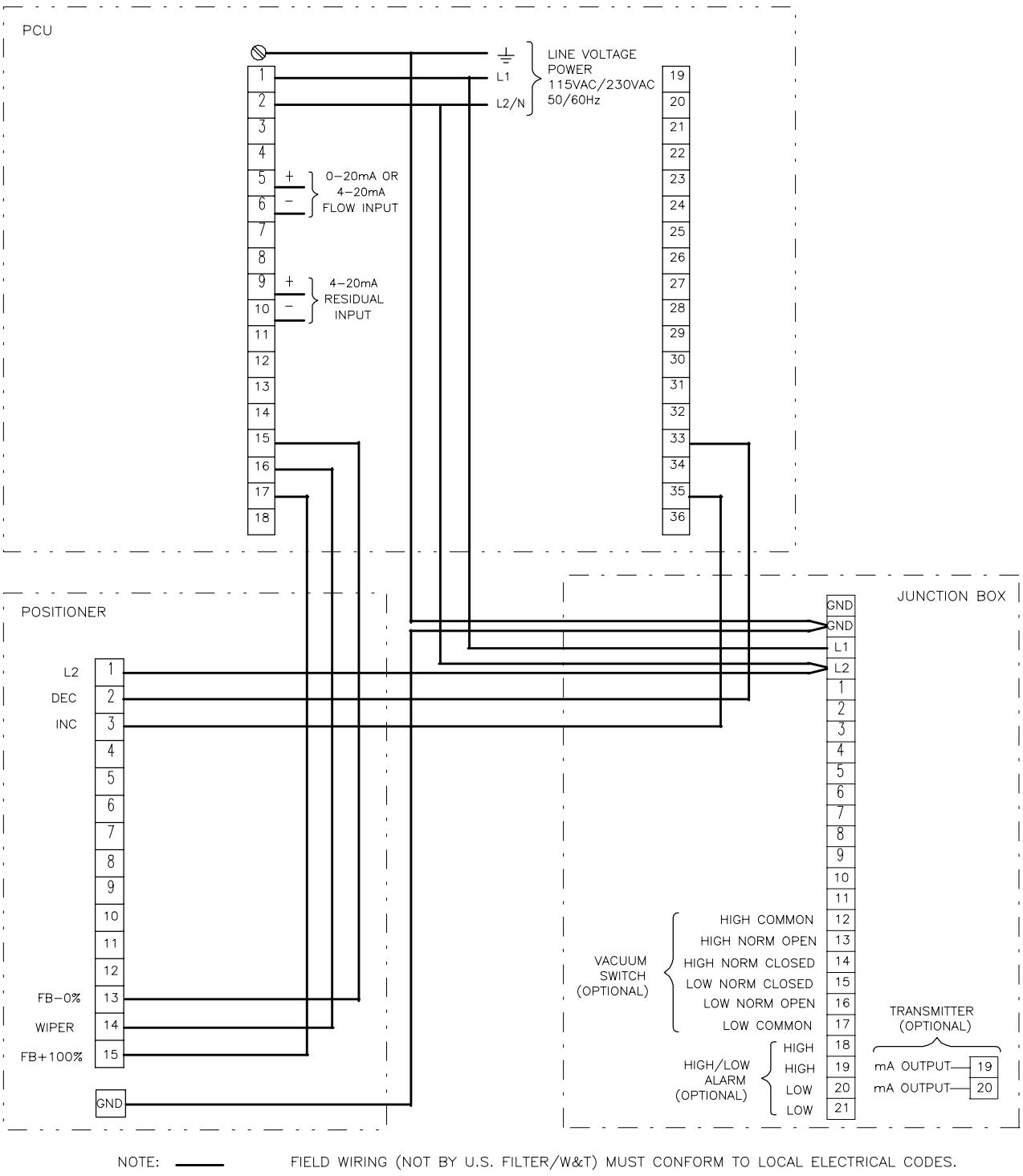


NOTE: ——— FIELD WIRING (NOT BY U.S. FILTER/W&T) MUST CONFORM TO LOCAL ELECTRICAL CODES

REMOTE MOUNTED PCU CONTROLLER WITHOUT JUNCTION BOX - LVN-2000 LIQUID CHEMICAL FEED SYSTEM - INSTALLATION WIRING

40.200.132.020

ISSUE 0 1-01



REMOTE MOUNTED PCU CONTROLLER WITH JUNCTION BOX
- LVN-2000 LIQUID CHEMICAL FEED SYSTEM
- INSTALLATION WIRING

40.200.132.030
ISSUE 0 08-00

SECTION 3 - OPERATION

List Of Contents

3.1 General Information

This section of the instruction book explains the operation of the controller. Read the entire Operation section before operating the unit.

3.2 Initial Startup

To perform initial startup, complete the following steps:

a. Confirm that installation of the controller and actuator has been completed per Section 2 - Installation.

b. Apply power to the controller.

c. Allow the controller a few seconds to power up, then check to see what message is displayed.

d. If an alarm message is displayed, press the ALARM ACKNOWLEDGE key to acknowledge the alarm. The possible alarm messages are:

HI RESIDUAL
LO RESIDUAL
HI DEVIATION
LO DEVIATION
LO FLOW
HI CNTL OUT
LO CNTL OUT
LOSS OF FLOW
LOSS OF RESIDUAL

Because the controller has not been previously configured, one or more of these messages may be displayed. Repeatedly press the ALARM ACKNOWLEDGE key until all of the alarm messages are cleared.

e. Complete each of the following paragraphs in order. Configure the controller for the correct application.

3.3 Controller Front Panel (See Dwg. 40.200.170.010)

The front panel provides the controller operator interface. The controller is programmed and operated using the six keys on the front panel. The location and function of each of these control panel features is described below.

3.3.1 Displays

- Root Display (1)

  The four-digit LCD display area on the top right displays the residual in mg/l for all control types except Proportional.

  For Proportional control, this display shows flow rate. Two dots appear on the root display when there is a LOSS OF RESIDUAL alarm, or in the case of Proportional control, LOSS OF FLOW alarm.

- Alphanumeric Display (3, 4, 5)

  The second line that displays information (3) is a five-character, dot matrix, LCD display. When the Root Display (1) is in Residual, this second line normally shows the units of the residual (mg/l). For chlorination systems, the unit of measure is mg/l chlorine. For center zero systems, the unit of measure is mg/l chlorine (Cl_2) or mg/l sulfur dioxide (SO_2).

  When the unit is in Proportional Control, the second line (3) shows the units of flow (%).

  The third (4) and fourth (5) lines that display information are 12-character, dot matrix, LCD display lines. These lines display most of the user interface information. They show the various main menu selections, as well as the various setup and operating parameters.

- Bargraph Display (12)

  The bargraph can be configured to display either the actuator position or the flow. It also can be turned off.

- Annunciators (2, 13, 14, 15)

  There are a number of annunciators to indicate certain status information:

  The up (15) and down (14) arrows are used to indicate the direction the actuator is moving. They are turned off when the actuator stops moving.

  The hand symbol (2) indicates that the unit is in manual mode. The output is not being controlled by the PCU when in this mode.

  The circular symbol with the arrow on the edge (13) indicates that the PCU is in the automatic mode and is therefore controlling the output based on the input signals.

3.3.2 Keypad

- Star Key (11) – This is the Alarm Acknowledge key. It is used to acknowledge the display alarm message and to turn off any relays associated with the alarm.

- Dot Key (10) – This is the Escape key. Use it to get out of any menu selection that the unit is currently in, without changing any information. Press this key continually to bring the unit back to the root display.

- Up Key (6) – This key is used to scroll the menu selections in reverse. It is also used to increase a parameter value.

- Down Key (9) – This key is used to scroll down the menu selections. It is also used to decrease a parameter value.

- "F" Key (7) – This is the Function key. It is used to move between the different main menu selections—(Root Menu), GLOBAL SETUP, RESIDUAL SET, INPUT/OUTPUT, ALARMS, RELAYS, CALIBRATION, and DIAGNOSTICS. It is active only when the unit is at the top of the menu selections.

- "E" Key (8) – This is the Enter key. It is used to enter a submenu selection or to select from the different operating or setup parameters. When a submenu is entered using this key, a "greater than" sign is displayed to the left of the selected parameter.

3.4 Controller Setup And Operation

For proper operation of the controller, the controller must be set up for each individual application. Be sure that the controller is calibrated for the different input signals, as well as the output machine being controlled. The menu selections are shown in the tables that follow for the different types of control.

The subsequent paragraphs explain, in detail, each of the different menu selections. Read this section to fully understand the function of each menu selection. Adjust the parameters for the particular application.

Table 3.1 - Selection Menu for Proportional Control

ROOT	GLOBAL SETUP	INPUT/OUTPUT	ALARM SETUP
Flow Rate Act Position (Control Out) Dosage Control Stat Bargraph Code	Language Lock Setting * Lock Code Control Type Save Job Restore Job Comm Addr X-Options Contrast Shutdown	Control Dev mAOut Setup Flow Input Flow Scaling **Spare Setup Digital In A Digital In B Sensitivity	Lo Flow Set Hi Cntl Set Lo Cntl Set Alrm Deadbnd
RELAY SETUP	**CALIBRATION**	**DIAGNOSTICS**	
Relay A Set Relay A Op Relay A Dly Relay B Set Relay B Op Relay B Dly Relay E Set Relay E Op Relay E Dly Relay F Set Relay F Op Relay F Dly	mAOut @ 0% mAOut @ 100% Flow @ 0% Flow @ 100% **Spare @ 0% **Spare @ 100% Actuator Cal	Display Test Keypad Test Relay Test Show Dig A Show mA out Show Resid Show Flow **Show Spare Show Act Fbk Software Iss Reset!!!	

* Lock Code is displayed only when PCU is unlocked.

** Spare is displayed only when enabled in X-Options.

Table 3.2 - Selection Menu for Dual Signal Feed Forward Control

ROOT	GLOBAL SETUP	RESIDUAL SET	INPUT/OUTPUT
mg/L Cl2 (mg/L SO2) Act Position (Control Out) Flow Rate Dosage Control Stat Bargraph Code	Language Lock Setting *Lock Code Control Type Save Job Restore Job Comm Address X-Options Contrast Shutdown	Resid Range	Control Dev mAOut Setup Flow Input Flow Scaling **Spare Setup Digital In A Digital In B Sensitivity
ALARM SETUP	**RELAY SETUP**	**CALIBRATION**	**DIAGNOSTICS**
Hi Resid Set Lo Resid Set Lo Flow Set Hi Cntl Set Lo Cntl Set Alrm Deadbnd	Relay A Set Relay A Op Relay A Dly Relay B Set Relay B Op Relay B Dly Relay E Set Relay E Op Relay E Dly Relay F Set Relay F Op Relay F Dly	mAOut @ 0% mAOut @ 100% Resid @ 0% Resid @ 100% Flow @ 0% Flow @ 100% **Spare @ 0% **Spare @ 100% Actuator Cal	Display Test Keypad Test Relay Test Show Dig A Show Dig B Show Resid Show Flow **Show Spare Show Act Fbk Software Iss Reset!!!

* Lock Code is displayed only when PCU is unlocked.

** Spare is displayed only when enabled in X-Options.

Table 3.3 - Selection Menu for Direct Residual Control

ROOT	GLOBAL SETUP	RESIDUAL SET	INPUT/OUTPUT
mg/L Cl2 (mg/L SO2) Act Position (Control Out) Deviation Setpoint Control Stat Bargraph Code	Language Lock Setting *Lock Code Control Type Save Job Restore Job Comm Address X-Options Contrast Shutdown	Res Sig Type Resid Range Prop Gain Integ Gain Fixed Lag Cntl Action	Control Dev mAOut Setup **Spare Setup Digital In A Digital In B Sensitivity
ALARM SETUP	**RELAY SETUP**	**CALIBRATION**	**DIAGNOSTICS**
Hi Resid Set Lo Resid Set Hi Dev Set Lo Dev Set Hi Cntl Set Lo Dev Set Alrm Deadbnd	Relay A Set Relay A Op Relay A Dly Relay B Set Relay B Op Relay B Dly Relay E Set Relay E Op Relay E Dly Relay F Set Relay F Op Relay F Dly	mAOut @ 0% mAOut @ 100% Resid @ 0% Resid @ 100% **Spare @ 0% **Spare @ 100% Actuator Cal	Display Test Keypad Test Relay Test Show Dig A Show Dig B Show Resid Show Flow **Show Spare Show Act Fbk Next Sample Software Iss Reset!!!

* Lock Code is displayed only when PCU is unlocked.

** Spare is displayed only when enabled in X-Options.

Table 3.4 - Selection Menu for Compound Loop Control

ROOT	GLOBAL SETUP	RESIDUAL SET	INPUT/OUTPUT
mg/L Cl2 (mg/L SO2) Act Position (Control Out) Flow Rate Deviation Setpoint Control Stat Bargraph Code	Language Lock Setting *Lock Code Control Type Save Job Restore Job Comm Address X-Options Contrast Shutdown	Res Sig Type Resid Range Prop Gain Integ Gain Fixed Lag Total Lag Cntl Action	Control Dev mAOut Setup Flow Input Flow Scaling **Spare Setup Digital In A Digital In B Sensitivity
ALARM SETUP	**RELAY SETUP**	**CALIBRATION**	**DIAGNOSTICS**
Hi Resid Set Lo Resid Set Hi Dev Set Lo Dev Set Lo Flow Set Hi Cntl Set Lo Cntl Set Alrm Deadbnd	Relay A Set Relay A Op Relay A Dly Relay B Set Relay B Op Relay B Dly Relay E Set Relay E Op Relay E Dly Relay F Set Relay F Op Relay F Dly	mAOut @ 0% mAOut @ 100% Resid @ 0% Resid @ 100% Flow @ 0% Flow @ 100% **Spare @ 0% **Spare @ 100% Actuator Cal	Display Test Keypad Test Relay Test Show Dig A Show Dig B Show Resid Show Flow **Show Spare Show Act Fbk Next Sample Software Iss Reset!!!

* Lock Code is displayed only when PCU is unlocked.

** Spare is displayed only when enabled in X-Options.

3.4.1 Display (Root) Menu

This is the default menu for the controller. The different operating parameters are displayed here. Some parameters—dosage and setpoint—are set here also. Each selection is explained in the paragraphs below.

3.4.1.1 Residual

The residual display is the default (root) display for all the control types except Proportional. The four-digit LCD display shows the residual. For normal residual range selections, the message display shows:

mg/L Cl_2.

When center zero control is being used, the residual display shows:

mg/L Cl_2 or **mg/L SO_2.**

3.4.1.2 Act Position (Control Out)

This display shows for all of the control types. If an actuator is the control device, the display shows:

Act Position

If any other control device is selected, the display shows:

Control Out

This value varies from 0% to 100%.

3.4.1.3 Flow Rate

This is the default display for Proportional control. The flow rate is displayed on the four-digit LCD display for this control type only. For Dual Signal Feedforward and Compound Loop control types, the flow rate is shown on the two 12-character display lines.

The flow rate display shows for all control types except Direct Residual. It shows the rate of water flow as a percentage of the flow meter capacity. This value varies from 0% to 100%.

If a loss of flow alarm condition exists, the flow rate display will show four dashes:

Flow Rate
- - - -

3.4.1.4 Deviation

This display shows for Direct Residual and Compound Loop control types only. Displayed is the deviation from the programmed set point value.

deviation = {100 x (residual - setpoint)}/(resid range)

This value varies from -100% to +100%. If a LOSS OF RESIDUAL alarm condition exists, the deviation display will show:

Deviation
- - - -

3.4.1.5 Dosage

This display shows for Proportional or Dual Signal Feedforward control types only. It also appears if the control type is Compound Loop and there is a LOSS OF RESIDUAL alarm condition.

The dosage selection allows the user to set the controller's flow dosage. The dosage can be set from 10% to 500% by the user. The default dosage is 100%.

There are two special conditions under which the dosage is automatically changed to provide for a bumpless transfer. When in Compound Loop and the residual signal is lost, the controller will calculate the dosage required to make a bumpless transfer to Proportional control. The dosage will be changed to this number.

During this default condition, the dosage is displayed and can be modified by the user from the keypad. When the condition is corrected and the controller returns to Compound Loop control, the dosage returns to 100% and the integral sum is adjusted to provide for a bumpless transfer upon return. Dosage is no longer displayed.

The second condition is when the unit is in Dual Signal Feedforward control and the residual signal is lost. The controller will calculate the dosage required to make a bumpless transfer to Proportional control and will change the dosage

to this value. When the residual signal returns and the controller returns to Dual Signal Feedforward control, the dosage is returned to its original value.

3.4.1.6 Setpoint

This display shows for Direct Residual and Compound Loop control types only. The setpoint can be set to any value within the selected residual range. For a normal residual range type, this is from zero to the full scale range in mg/l Cl_2. The default setting is half of the full scale range. For a center zero range type, this is from full scale SO_2 range (-) to full scale Cl_2 range (+). The default setting is zero.

The setpoint is reset to the default setting when the range or range type is changed.

3.4.1.7 Control Stat

The control status display shows the present mode of the controller—MANUAL or AUTOMATIC. It allows you to change from automatic (operating) mode to manual mode or vice versa. When in automatic mode, the display shows:

Automatic

and the automatic annunciator is displayed. When in manual mode, the hand symbol is displayed along with the word:

Manual

3.4.1.8 Bargraph

This screen shows you the information being displayed by the bargraph. You can select between actuator position (control out), flow, or off. The default is the actuator position.

3.4.1.9 Code

This screen allows the user to enter the lock code (password) if the unit is locked. See paragraph 3.4.2.2, Global Setup - Lock Setting. The setup parameters cannot be modified without entering the code.

If the wrong code is entered, the unit will switch back to the root display. When the correct code is entered, it will remain on the display.

When the correct code is entered, five minutes are allowed (after the last keystroke) to make modifications. After this time, the unit will disable further modifications until the code is entered again.

To unlock the unit, scroll to the main menu selection "GLOBAL SETUP" and sub menu "Lock Setting" and select "unlocked". The unit will remain unlocked until it is locked again.

In case the lock code is forgotten, the unit can be accessed by entering the "back door" code: 010.

3.4.2 Global Setup

This main menu category allows you to set up certain parameters that affect the unit as a whole. The control type is selected here.

3.4.2.1 Language

There are four language selections to choose from: USA-English, UK-English, French, and Spanish. The default is USA-English.

3.4.2.2 Lock Setting

This screen allows the user to "lock" the controller to prevent any changes to the setup information, or to unlock it if it was previously locked. To unlock the controller, the user must enter the Lock Code (Password) in the Code screen, which is located in the Display Root Menu. If it is not entered or does not equal the Lock Code, ***Code?** will be displayed. This indicates the password is not entered and the unit will not be unlocked.

At first startup, leave the controller unlocked until it is initially configured.

3.4.2.3 Lock Code (Password)

This screen displays the current password and allows the user to change it, if needed. The password can be set from 001 to 999. "000" is the default unlocked setting. This screen will be displayed only when the controller is unlocked.

3.4.2.4 Control Type

The control type selection determines the type of control algorithm the controller will use to position the actuator or control the output device. There are four different control types to select from—Proportional, Dual Signal Feedforward, Direct Residual, and Compound Loop. The default control type setting is Compound Loop.

For details on how each control type works, see paragraph 3.9, Theory of Operation.

3.4.2.5 Save Job

This selection allows the current operating parameters to be saved to one of two job files. Information saved includes current operating parameters only.

3.4.2.6 Restore Job

This selection allows the user to restore the jobs that were saved previously. When the job is restored, all current operating information will be lost. If in doubt, save the current operating parameters first.

The save and restore job functions allow the operator to switch between diverse setup conditions (such as day/night or winter/summer) by changing just a single parameter.

3.4.2.7 Comm Address

The communication address selection allows the operator to configure the RS485 serial port to interface with a personal computer or some other device with this capability. This address is the address of the controller that the external device has to select in order to upload and download information from the controller.

This address varies from 0 to 31. The default is 1.

3.4.2.8 X-Options

This is the extended options selection screen. It allows the operator to select from certain special features that are not normally used. The extended option numbers are as follows:

0	-	all extended options disabled
1	-	
2	-	disable all alarms to relay
4	-	enable spare input
8	-	alarm acknowledge does not turn off relay C
16	-	alarm acknowledge does not turn off relay D
32	-	alarm acknowledge does not turn off relay E
64	-	alarm acknowledge does not turn off relay F
128	-	
256	-	change relay delay times from sec to min
512	-	
1024	-	
2048	-	Extended Service Mode

The extended options number is equal to the sum of the selected options. For example, if 1, 2, and 4 are desired, the extended options number would be 7 (1+2+4).

3.4.2.9 Contrast

The display contrast can be adjusted here for optimum readability. The adjustment range is 50% to 90%. Default is 50%.

3.4.2.10 Shutdown

"Shutdown" means that the controller is shut down and is the same as the controller being turned off. Shutdown is entered by pressing the "F" key to go to the Global Setup menu, then scrolling to the "Shutdown" selection. A second way to put the unit in shutdown is to energize the digital input A when its configuration is set to shutdown.

3.4.3 Residual Set

This main menu section does not appear for Proportional control type. It appears for the other control types. The different residual settings are selected here.

3.4.3.1 Res Sig Type (Norm or Center Zero)

This is the residual signal type selection screen. This screen appears for Direct Residual and Compound Loop control types only. It tells the controller how to interpret the input residual signal. If the range type is set to normal (default), 4 mA corresponds to zero residual and 20 mA to full scale residual. If center zero is selected then 4 mA corresponds to full scale SO_2, 12 mA to zero residual, and 20 mA to full scale Cl_2 residual.

A change in Res Sig Type resets the Resid Range and the high and low residual alarm settings to their default settings. It also resets the setpoint to its default value.

3.4.3.2 Resid Range

This screen appears for Dual Signal Feedforward, Direct Residual, and Compound Loop control types only. This selection allows the user to choose the range of the input residual signal. The possible ranges are listed below for normal and center zero range types:

Normal	Center Zero
0 to 0.100	+/-0.50
0 to 0.200	+/-1.00
0 to 0.500	+/-2.50
0 to 1.00	+/-5.00
0 to 2.00	+/-10.0
0 to 5.00	
0 to 10.0	
0 to 20.0	
0 to 50.0	
0 to 100	

A change in the residual range resets the residual high and low alarm settings to their default values. It also resets the setpoint to its default value.

3.4.3.3 Prop Gain and Integ Gain

The proportional gain and integral gain selection appears for Direct Residual and Compound Loop control types only.

The proportional gain selection sets the amount of proportional control action. The integral gain selection sets the amount of integral control action. Both can be set from 0 to 100% and both default to 50%.

A change in the proportional or integral gain settings causes the integral sum to be recalculated to provide for a bumpless transfer. Setting the integral gain to zero resets the integral sum to zero.

At initial startup, leave the gains at their default settings. Once the controller is up and running, see paragraph 3.6, Automatic Feedback Control Tuning, for information on how to set the gains.

See paragraph 3.9, Theory of Operation, for further information.

3.4.3.4 Fixed Lag

The fixed lag time screen appears for Direct Residual and Compound Loop control types only. This selection allows the user to set the fixed lag time of the system from 0 to 60 minutes in increments of 0.1 minute. The default setting is one minute.

The fixed lag time is defined as the portion of the total lag time of the system that does not change with variations in plant flow. In a typical application, the fixed lag time is the time it takes for sample water to flow from the sampling point to the analyzer and the time it takes for the analyzer to respond to the sample. This time is independent of plant flow.

For installations where the flow rate is constant, the time for a change in actuator position to be seen at the sample point is constant. In this case, the fixed lag time is equal to the total lag time. For Direct Residual control applications, the fixed lag time should be set to the time it takes for a change in actuator position to be seen at the analyzer. This includes flow rate from injection to sample.

At initial startup, leave the fixed lag time at its default setting. Once the controller is up and running, see paragraph 3.6, Automatic Feedback Control Tuning, for information on how to set the gains.

3.4.3.5 Total Lag

The total lag time screen appears for Compound Loop control type only. It allows the user to enter the total system lag time at the present flow. The total lag time can be set from 0 to 60 minutes in increments of 0.1 minute. The total lag time can never be less than the fixed lag time. The minimum total lag time is equal to the fixed lag time.

The total lag time is defined as the time it takes for a change in actuator position (or change in control device) to be seen at the controller. It is the sum of two components: the fixed lag time (which does not change with plant flow) and the

proportional lag time (which varies proportionally with plant flow). Because the proportional lag time is a function of the flow rate, the total lag time entered into the controller must be specified at a specific flow rate. As the flow changes, the controller will calculate the proper total lag for the new flow rate. The total lag time selection will be updated to this new value.

NOTE: It is important to remember that the total lag time does not stay constant, but changes as the flow rate changes. The value entered originally, therefore, may not be the value displayed.

If the total lag time is equal to the fixed lag time, the proportional lag is then computed to be zero and the total lag will not change with flow. This may be desirable in applications where the flow rate is constant or changes very little.

The maximum value of the total lag time is 60 minutes. If the flow drops so low that the calculated value would normally exceed 60 minutes, it would be set to 60 minutes.

3.4.3.6 Cntl Action

The control action selection appears for Direct Residual and Compound Loop control types only. The user selects whether the application is chlorination (Chlor), where chlorine is being added to the water, or de-chlorination (De-Chlor), sometimes called sulfonation, where sulfur dioxide is being added to the water.

If chlorine is being fed and chlorine residual is being measured, select Chlor. When this is selected, the controller will increase the actuator position if the residual input is less than the setpoint and decrease the position if the residual is greater than the setpoint.

If sulfur dioxide is being fed and chlorine or sulfur dioxide is being measured, select De-Chlor. The controller will then increase the actuator position if the residual input is greater than the setpoint and decrease the position if the residual is less than the setpoint.

3.4.4 Input/Output

The input signal information and output control information is set in this main menu section.

3.4.4.1 Cntl Device

The control device selection allows the user to tell the controller what type of output device is being controlled. There are four selections to choose from: Actuator, Pulse Freq., Dosing pump, and mA Output.

Select "Pulse Freq." if interfacing to a pulse pump or some other device that requires a pulse that varies in frequency from 0 pulse/min for 0% control output to the programmed pulse/min value at 100% control output. The pulses/minute changes in a linear fashion.

Select "Dosing Pump" if the output device requires a constant pulse rate at varying widths (on:off time ratio). The pulse width varies from approximately 100 milliseconds for 0% control output to the programmed pulse width value (PWM) for 100% control output.

If the device being controlled requires a milliampere input anywhere between 0 and 20 mA, select "mA Output".

3.4.4.2 Pulse/Min

This screen is only seen if "Pulse Freq." is selected as the control device. Set the maximum pulse frequency for 100% control output. Maximum pulse frequency from 10 pulse/min to 200 pulse/min is allowed.

3.4.4.3 Pulse Width Modulation - PWM

This screen is displayed when "Dosing Pump" is selected as the output device. Scroll to the maximum pulse width required for 100% control output. The maximum pulse width can be set from 10 seconds to 240 seconds.

3.4.4.4 mA Out Setup

This screen is seen when "mA Output" is **NOT** selected as the control device. This allows the user to configure the milliampere output to monitor either residual, actuator position (control output) or flow rate. A remote monitoring device can be connected to this output if desired.

3.4.4.5 Flow Input

This screen appears for all control types except Direct Residual.

The user must tell the controller the range and type (current or voltage) of input coming from the flow meter. There are four choices: 4-20 mA, 0-20 mA, 1-5 volts, and 0 to 5 volts.

3.4.4.6 Flow Scaling

This screen appears for all control types except Direct Residual. The flow input signal can be scaled if the flow meter is not properly sized for the application. This selection, which varies from 0.1 to 4.0, tells the controller by how much to multiply the input flow signal to correctly control for 0% to 100% flow.

3.4.4.7 Spare Setup

This screen appears if the spare input is activated in the extended options menu selection. Select whether the spare input is used for flow or residual input.

If "Flow" is selected, the controller looks to this input for the flow signal. It ignores the normal flow input. If "Residual" is selected, the controller looks for the residual signal at this input. The normal residual input is ignored.

The spare input should be activated only if a hardware malfunction occurs at the normal residual or flow inputs.

3.4.4.8 Digital In A and Digital In B

The digital input configuration selection (Digital In A and Digital In B) allows the user to select the meaning of the digital input.

Digital inputs can be used to temporarily set the controller to certain operating conditions. The messages and conditions are explained below:

	MESSAGE	**CONDITION**
DIGITAL INPUT A	Manual	put unit in manual mode
	Shutdown	shutdown unit
	Output > 0%	send actuator (control out) to 0%
	Output > 100%	send actuator (control out) to 100%
	Output > 2X	send actuator to 2 x current output
	Not Used	ignore digital input A
DIGITAL INPUT B	Select Job2	change unit setup to Job#2 and operate
	Not used	ignore digital input B

The controller stays in the selected state for the digital input as long as it is energized. When power is removed from the input, the controller returns to the state it was in prior to the input being energized. If the control type was Direct Residual or Compound Loop, the controller makes a bumpless transfer to the new actuator position. When using digital input B, the controller assumes that Job 1 was running and it returns to Job 1.

3.4.4.9 Sensitivity (actuator deadband)

The sensitivity selection allows the operator to set the sensitivity of the controller/actuator combination to small actuator position errors. In automatic control, the controller uses the control type algorithm to determine what the actuator position should be and moves the actuator to this position. The sensitivity selection sets the amount of error that is tolerable between the desired actuator position and the actual position as a percentage of the full scale actuator position.

For a small sensitivity setting, the amount of tolerable error is small and the controller will "work harder" to find the desired position. In some situations, this may cause the actuator to oscillate around the desired position. Constant oscillation of the actuator results in unnecessary wear and should be eliminated by increasing the sensitivity setting. Some experimentation may be necessary to find the best sensitivity setting for a particular installation.

Leave the sensitivity at the default of 0.2% at initial startup. If excessive actuator oscillation is noticed, increase the sensitivity setting accordingly.

3.4.5 Alarm Setup

The alarm limits are defined in this main menu category. Certain selections do not appear for certain control types. When these limits are exceeded, the display will flash the alarm messages. The Alarm Acknowledge key (*) must be pressed before accessing any other keypad function.

3.4.5.1 Hi Resid Set and Lo Resid Set

The high residual alarm (Hi Res Set) and low residual alarm (Lo Res Set) setting selections appear for all control types except Proportional.

The high and low alarm settings are the thresholds at which the high and low residual alarms trigger. For high alarms, if the residual is greater than the alarm setting, the alarm condition is entered. For low alarms, if the residual is less than the alarm setting, the alarm condition is entered.

Because the alarms trigger when the residual is greater than or less than the alarm setting (and not when they are equal), the alarms can be disabled by setting the high setting at the maximum residual value and the low setting at the minimum residual value. The settings are entered in residual units (mg/l). For the zero center range type the settings are entered with "a +" (Cl_2) or "a -" (SO_2).

The high and low alarm settings can be set to any value within the full scale range. The high setting cannot be set lower than the low setting and the low setting cannot be set higher than the high setting.

The default setting for high residual alarm settings is the maximum allowable setting. The default setting for low residual alarm settings is the minimum allowable setting.

The alarm settings are reset to their default values whenever the range type or range for that residual are changed.

3.4.5.2 Hi Dev Set and Low Dev Set

The high and low deviation alarm setting selections appear for Direct Residual and Compound Loop control only.

The high and low deviation alarm settings are the points at which the high and low deviation alarms trigger. For high alarms, if the deviation is greater than the alarm setting, the alarm condition is entered. For low alarms, if the deviation is less than the alarm setting, the alarm condition is entered.

Because the alarms trigger when the deviation is greater than or less than the alarm setting (and not when they are equal), the alarms can be disabled by setting the high setting at the maximum value and the low setting at the minimum value. The settings are entered in percent.

The high deviation setting can be set from +1 to +100% of the setpoint. The low deviation settings can be set from -1 to -100% of the setpoint.

The default setting for high deviation alarm setting is +100%. The default setting for low alarm setting is -100%.

3.4.5.3 Lo Flow Set

The low flow alarm setting selections appear for the Control Type Proportional, Dual Signal Feedforward, or Compound Loop control only.

The low flow alarm setting sets the percent of full scale flow at which the controller recognizes a low flow alarm condition. The flow rate must be less than the low flow alarm setting for the low flow alarm condition to be activated. This allows the user to disable the low flow alarm by setting it to 0.

The setting is entered in percent and can range from 0 to 100% of flow. The default low flow alarm setting is 0% (disabled).

3.4.5.4 Hi Cntl Set and Low Cntl Set

The high and low control output alarm setting, used in all control types, sets the percent of full scale control output at which the controller will enter the high or

low control output alarm condition. The control output value must be greater than the high control output alarm setting and less than the low control output alarm setting for the alarm condition to be activated. This allows the user to disable the high control output alarm by setting it to 100 or disable the low control output alarm by setting it to 0.

The high or low control output alarm setting can be set from 0 to 100%. The default setting is 100% (disabled) for the high alarm and 0% (disabled) for the low alarm.

3.4.5.5 Deadband

The alarm deadband is used with all the alarm settings found in the setup alarm menu and appears for all control types. The alarm deadband allows for the programming of hysteresis for the alarm settings. Once in the alarm condition, the alarming variable must return to the alarm setting, plus or minus the alarm deadband percent, to come out of the alarm condition.

The alarm deadband can be set from 0 to 20%. The default setting of the alarm deadband is 5%.

3.4.6 Relay Setup

There are four relays available for the operator to configure to respond to selected alarms or status conditions. They are called relay A, B, E, and F. Each relay can be used in either a normally open or normally closed configuration. The relays can be configured to represent a number of different alarm and status conditions.

3.4.6.1 Relay Set

The relay setup section (Relay A Set, Relay B Set, Relay E Set, and Relay F Set) allows the user to select the alarm or status condition to which the relay should respond. The selections are as follows:

Hi Res	-	high residual alarm condition
Lo Res	-	low residual alarm condition
Hi/Lo Res	-	high or low residual alarm condition
Hi Dev	-	high deviation alarm condition
Lo Dev	-	low deviation alarm condition
Hi/Lo Dev	-	high or low deviation alarm condition
Lo Flow	-	low flow alarm condition
Hi Cntl Out	-	high control output alarm condition
Lo Cntl Out	-	low control output alarm condition
Loss of Res	-	loss of residual alarm condition

Loss of Flow	-	Loss of flow alarm condition
Disengaged	-	actuator disengaged status condition
Manual	-	unit put in manual mode
Shutdown	-	unit has been put in shutdown mode
Power On	-	indicates unit is powered
Not Used	-	relay is not used

The default relay status is "Disengaged".

3.4.6.2 Relay Op

The relay operation selection allows the user to tell the controller how the relay should respond on activation of the selected alarm status condition.

If **Norm. Open** is selected, the relay energizes when the setup condition becomes active. This, in effect, closes the normally open contacts and opens the normally closed contacts of the relay.

If **Fail-safe** is selected, the relay de-energizes when the setup condition is active, and energizes when the condition goes away. In this case, the normally-closed contacts of the relay open (relay energized) when the relay setup condition is NOT active, and close (relay de-energized) when the relay setup condition becomes active. In case of a power loss or controller reset, the normally-closed contacts close.

The alarm device is usually wired to the normally-closed terminal when fail-safe operation is desired.

3.4.6.3 Relay Dly

The relay delay time screen (Relay A Dly, Relay B Dly, Relay E Dly, and Relay F Dly) allows the user to program a delay time for the relay. When the alarm or status condition selected for the relay becomes active, the delay time begins to count down and the condition is continually checked. If the condition remains when the delay time expires, the relay activates. If the condition stops and then reappears before the delay time expires, the delay time resets and counts down again.

The relay delay is adjustable from 1 to 120 seconds. The default is 5 seconds.

3.4.7 Calibration

The controller inputs and outputs are factory calibrated, but due to differences in system configurations, calibration of the inputs may be required on-site. This main menu selection allows you to calibrate for the different input and output

devices. The selections that appear depend on the control type and control device selected earlier.

3.4.7.1 mA Output Calibration

To calibrate the mA output, first select the general range of the output device in the "mA Out Range" section. Connect the output device to the mA output terminals, making sure the polarity is correct.

The first calibration message is:

mA Out @ 0%
1050 Digit

Press Enter. The display shows:

mA Out @ 0%
>1050 Digit

The default output for 0% is outputted at the mA terminals.

If the output value is not correct, use the up or down arrow keys to adjust the output until the output device reads 0%. Press the Enter key when this is correct.

Press the Down key to show:

mA Out @ 100%
3550 Digit

Press Enter. The display shows:

mA Out @ 100%
>3550 Digit

The default 100% output value is outputted at the mA terminals. If the output value needs adjustment, use the Up Arrow and Down Arrow keys to adjust the output until the device reads 100%. Press the Enter key when the output is correct.

3.4.7.2 Input Calibration - Residual and Flow

First apply the 0% input signal to the respective input. Depending on the control type, the display shows either:

Resid @ 0%
or
Flow @ 0%

If calibration is required press the Enter key. A ">" symbol shows on the second line. The display shows:

Resid @ 0%
>Apply/Enter
or
Flow @ 0%
>Apply/Enter

The Micro/2000 and Deox/2000 Analyzers have diagnostic features that allow the user to output 4, 12, and 20 mA on the 4 to 20 mA outputs. If this is not available, use a signal generator.

Apply the 0% 4.0 mA signal to the input and wait one minute for the signal to stabilize. Press the Enter key. The controller records this as the zero input level.

Press the down arrow key. Apply the 100% input signal. Depending on which input you are calibrating, the display shows:

Resid @ 100%
or
Flow @ 100%

If calibration is required, press the Enter key. A ">" symbol is shown on the second message line to the left of the message. The display shows:

Resid @ 100%
>Apply/Enter
or
Flow @ 100%
>Apply/Enter

Apply the 100% 20.0 mA input signal and wait one minute for it to stabilize. Press the Enter key. This value is recorded as the maximum input level.

3.4.7.3 Actuator Calibration

The actuator calibration selection allows the user to calibrate the controller to the actuator. During this calibration procedure, the controller records two or three input values coming from the actuator feedback potentiometer. These points are used to determine the correct actuator position.

The actuator can be calibrated at 0% and 100% (two-point calibration) or at 10% and 90% (three-point calibration with 50% as the third point). For gas feed equipment, the 10%/90% calibration is the preferred technique. For pumps, use the 0%/100% calibration.

Scroll down the Calibration main menu until the display shows:

Actuator Cal
0% and 100%
or
Actuator Cal
10% and 90%

If the desired type of calibration is not displayed, press the Enter key and use the up or down arrow keys to show the other calibration type.

- **10% and 90% Calibration.**

  After selecting the 10% and 90% calibration, press the down arrow key. The display shows:

  Actuator Cal
  Press Enter

  After pressing the Enter key the display shows:

  Actuator Cal
  >Please Wait

  The remaining process takes about one minute before the user is asked to do anything further. While this message is showing, the controller increases the actuator position until it trips the upper limit switch of the actuator and records the feedback potentiometer input value at this point. It then decreases the actuator position until it trips the lower limit switch and records the feedback potentiometer value at that extreme minimum actuator position. These two recorded values indicate the extremes of motion for the present actuator setup. The controller then runs the actuator to the midpoint between these two extreme values and displays:

  Act @ 50% OK?
  >Adjst/Enter

  The operator should now adjust the mechanical linkage of the actuator so that its output is at about the 50% level or use the up or down arrow keys

to adjust the actuator to the 50% output value. When this is done, press the Enter key.

For gas feeders the 50% level can be determined by viewing the rotameter of the gas feeder. For pumps the 50% level can be viewed on the pump itself. This adjustment action centers the range of motion between the two extremes. This 50% value is stored in the controller and is used in the actuator position calculation. Once the Enter key is pressed, the display shows:

Act @ 10%
>Adjst/Enter

Use the up and down arrow keys to run the actuator until the delivery system outputs 10%. Press the Enter key.

The controller records the input from the feedback potentiometer. The display now shows:

Act @ 90%
>Adjst/Enter

Repeat the above procedure to run the actuator until the delivery system outputs 90%. Press the Enter key.

At this point the controller calculates to see if the calibration is legitimate by verifying that, for the values inputted, the actuator is able to cover the full range of motion from 0% to 100%. If this is not the case, the display will show **>Check Act.!**.

This message is only a warning. Operation can continue with the calibration values entered, but the warning message flashes every five seconds in the main display.

If the calibration is good (the 0% or 100% positions are not beyond the limit switches), the display shows **>Calib. OK!**. Press Enter to exit this section. The display again shows **Actuator Cal**.

- **0% and 100%**

After selecting the 0% and 100% calibration, press the down arrow key. The display shows:

FBK @ 0%
0.0%

The 0.0% display will vary between 0% and 100% depending on the position of the actuator.

Press the Enter key. The display shows:

FBK @ 0%
>Adjst/Enter

Use the up and down arrow keys to run the actuator to the 0% level. Press the Enter key. The controller records the input from the feedback potentiometer. The display now shows:

FBK @ 0%
0.0%

Press the down arrow key. The display shows:

FBK @ 100%
0.0%

Press the Enter key. The display shows:

FBK @ 100%
>Adjst/Enter

Use the up and down arrow keys to run the actuator to the 100% level, where the delivery system outputs 100%. Press the Enter key. The controller records the input from the feedback potentiometer and the display now shows:

FBK @ 100%
100.0%

The controller must be in the manual mode and the motor engaged to run the actuator calibration. The manual mode is entered from the Control Stat option in the Root Display.

3.4.8 Diagnostics

In case of a malfunction, this main menu category runs certain diagnostics routines to help the user pinpoint the problem area. If the problem is not detected here, check Section 4 - Service, or call the factory.

3.4.8.1 Display Test

This selection exercises the display by showing the numbers 0 through 9 on the display at one second intervals and showing each annunciator individually. When the sequence is over, the full display shows. Press the Enter key to begin the test. Press it again to end the test.

3.4.8.2 Keypad Test

This selection allows the user to verify that each key is being recognized by the controller. Press Enter to begin the test. The display shows the following messages in sequence:

Press Star
Press Dot
Press Up
Press Down
Press "F"
Press "E"

As each key is recognized, the next message is displayed. After the last step is completed, the display shows:

Keypad Test
Press Enter

3.4.8.3 Relay Test

This selection exercises each relay. A continuity meter may be used to ensure that the relay contacts are closing properly. Press the Enter key to begin the test. Each relay turns on and off as the down arrow key is pressed. The display shows which relay is being activated, when it is On, and when it is Off:

Relay A On	**Relay E On**
Relay A Off	**Relay E Off**
Relay B On	**Relay F On**
Relay B Off	**Relay F Off**

Press the Enter key when this test is complete.

3.4.8.4 Show Dig A

This selection displays the status of digital input A. The display shows either **Energized** or **De-energized**.

3.4.8.5 Show Dig B

The status of digital input B is displayed here, similar to digital input A above.

3.4.8.6 Show Resid

The residual input selection displays the A/D (analogue/digital) input count value for the signal inputted at the residual input. See the chart below for approximate counts that should be displayed for different input signal values.

mA Input	A/D Count
0 mA	530
4 mA	1396
20 mA	4860

3.4.8.7 Show Flow

This display shows the A/D count for the flow input signal. See paragraph 3.4.8.6, Show Resid.

3.4.8.8 Show Spare

The spare input is activated in the extended options selection of the GLOBAL SETUP menu. See paragraph 3.4.8.6, Show Resid.

3.4.8.9 Show Act Fbk

This display shows the A/D count at the actuator feedback potentiometer input. See paragraph 3.4.8.6, Show Resid.

3.4.8.10 Next Sample

This display is for Direct Residual and Compound Loop control types only.

The Next Sample is the time remaining until the next correction in actuator position due to integral lag time control.

See paragraph 3.9, Theory of Operation, for further information on Residual Control and Lag Time.

3.4.8.11 Software Iss

This screen displays the current issue number for the software being used.

3.4.8.12 Reset

To restart the program without changing any RAM information go to this screen and press the Enter key. "NO" is displayed on the second message line. Use the down arrow key to scroll to "YES". Press the Enter key. The program restarts and the root menu screen is displayed.

To set defaults, hold the Star key while cycling power. The display shows ***** Init ***** while the defaults are re-entered. This does not erase the setups stored in the Save Job section.

3.5 Alarm And Status Conditions

Two types of conditions that affect controller operation are the alarm and status conditions. Alarm conditions are defined as process-related; status conditions are controller-related. Alarm and status messages are displayed in all upper-case letters.

ALARMS	STATUS
HI RESIDUAL	DISENGAGED
LO RESIDUAL	MANUAL
HI DEVIATION	
LO DEVIATION	
HI FLOW	
LO FLOW	
HI CNTL OUT	
LO CNTL OUT	
LOSS OF FLOW	
LOSS OF RESIDUAL	

3.5.1 Alarm Conditions

When an alarm condition occurs, the alphanumerics flash the alarm message repeatedly and any associated relay is energized. The other displays beside the alphanumerics are blanked and all keys except the ALARM ACKNOWLEDGE key are disabled. When the ALARM ACKNOWLEDGE key is pressed, the associated relay is turned off and all of the displays return to what they displayed prior to the alarm. The user is now able to change the system parameters to correct for the alarm condition. The alarm message is periodically flashed (once every five seconds) and all of the other displays are blanked out to indicate that the condition is still present.

The flash timing is reset each time a key is pressed so that the alarm message flashing does not prevent the user from using the keypad. The flashing continues until the alarm condition no longer exists.

The flashing of previously acknowledged alarm conditions is disabled whenever the calibration menu is entered.

If the alarm condition disappears before it is acknowledged, the alarm message is removed from the alphanumerics and the controller returns to normal operation.

If the operator wants the alarm relay to remain energized until the alarm condition no longer exists (as opposed to being turned off by the ALARM ACKNOWLEDGE key), this can be done by setting the number in the extended options.

Certain alarms are disabled under certain conditions. These conditions are outlined below:

ALARM	DISABLE WHEN:
high residual alarm	control type = proportional loss of residual alarm is active
low residual alarm	control type = proportional loss of residual alarm is active
high deviation alarm	control type = proportional control type = dual signal feedforward loss of residual alarm is active
low deviation alarm	control type = proportional control type = dual signal feedforward loss of residual alarm is active
low flow alarm	loss of flow alarm is active
loss of flow alarm	control type = direct residual
loss of residual alarm	control type = proportional

Two of the alarms cause the controller to either run the actuator to 0% or default to another control type. These default actions are outlined below.

- **loss of flow alarm**

  * Proportional – When the flow is lost, the controller runs the actuator position to 0%. When the flow returns, the controller reverts to proportional control and positions the actuator per the flow and the dosage.

* Dual Signal Feedforward – When the flow is lost, the controller runs the actuator position to 0%. When the flow returns, the controller reverts to dual signal feedforward control and positions the actuator per the flow, the residual, and the dosage.

* Direct Residual Control – There is no flow signal for direct residual control. The loss of flow alarm is disabled in this case.

* Compound Loop – When the flow is lost, the controller runs the actuator position to 0%. When the flow returns, the controller reverts to compound loop control and returns the actuator to the position it occupied prior to the loss of flow.

- **loss of residual alarm**

  * Proportional – There is no residual signal for proportional control so the loss of residual alarm is disabled in this case.

  * Dual Signal Feedforward – When the residual is lost, the controller defaults to proportional control. In order to make a smooth transition, the controller calculates the value of dosage needed to maintain the actuator at its present position and changes the dosage to that value. When the residual returns, the controller reverts to dual signal feedforward control and returns the dosage to its original value.

  * Direct Residual Control – When the residual is lost, the controller runs the actuator position to 0%. When the residual returns, the controller reverts to direct residual control and returns the actuator to the position it was at, prior to the loss of residual.

  * Compound Loop – When the residual is lost, the controller defaults to proportional control. In order to make a smooth transition the controller calculates the value of dosage needed to maintain the actuator at its present position and changes the dosage to that value. When the residual returns, the controller reverts to compound loop control. In order to make a smooth transition the controller calculates the value of integral sum needed to maintain the actuator at its present position and changes the integral sum to that value.

See paragraph 3.4.6, Relays, for detailed information on configuring the relays.

3.5.2 Status Conditions

When a status condition occurs, the alphanumerics immediately flash the status message and any associated relays are energized. All the displays except the alphanumerics, are blanked. The status message is periodically flashed once every five seconds until the condition is changed. The relay turned on by the status condition, remains energized until the status condition no longer exists.

The flash timing is reset each time a key is pressed, so that the alarm message flashing does not prevent the user from using the keypad. The flashing continues until the status condition disappears.

The disengaged status message indicates that the actuator motor is manually disengaged from the rack. It remains active until the motor is re-engaged.

The manual status annunciator indicates that the controller is in manual control (as opposed to being in automatic). There are several ways which the controller can be placed in manual. The primary way is to select this in the "control stat" section of the root menu. A second way is to energize digital input A when its configuration is set to **Manual**. The controller also goes into manual, if digital input A is energized and the digital input configuration is set to **Output > 0** (run the actuator to 0), **Output > 100** (run the actuator to 100) or **Output > 2x** (double the actuator position). In either of the digital input cases the controller remains in manual as long as the input is energized, and then returns to its previous state when power is removed from the input.

See paragraph 3.4.6, Relays, for detailed information on configuring the relays.

3.6 Automatic Feedback Control Tuning

When using either of the feedback control types (direct residual or compound loop), two sets of parameters must be adjusted for optimum control. These are the gains and the lag times.

The proportional and integral gains allow the operator to adjust the amount of proportional and integral control action. The proportional control action provides immediate corrective action for deviation from setpoint errors. The integral control action makes a corrective action once every lag time. The two types of control action work together to control the actuator position.

During initial startup, leave the gain settings at their default settings of 50%. Once the system is up and running, check the performance of the controller and adjust the gains as necessary.

Increasing the gains will allow the controller to respond faster to large deviation errors, but will also increase the chance of oscillations around the setpoint. Likewise, decreasing the gains will slow down response, but will make the controller more stable.

The other set of parameters that need to be adjusted are the lag times. The lag time settings of the controller determine how often an integral control action is initiated. For compound loop control, fixed and total lag time selections are provided. The fixed lag time should be set to the time it takes for a residual change at the sample point to be seen at the analyzer. The total lag time should be set to the time it takes for a change in actuator position to be seen at the analyzer at current flow rate.

For direct residual control, only the fixed lag time selection is used. In this case the fixed lag should be set to the time it takes for a change in actuator position to be seen at the analyzer. Because the flow in a direct residual system is close to constant, the lag time of the system is fairly stable.

NOTE: If the system lag time exceeds the lag time setting of the controller, then several integral control actions will occur prior to the initial change being sensed at the analyzer. In this case the control system may oscillate with long slow cycles.

3.7 Controller Features

3.7.1 Relays

Four relays are provided for the customer at the terminal board. Each relay can be used in either a normally open or normally closed configuration. The relays are configured through the controller software to represent a number of different alarm and status conditions. See paragraph 3.4.6, Relays, for detailed information on configuring the relays.

3.7.2 Digital Input

Connections for two digital inputs (Digital In A and Digital In B) are provided at terminals #25, 26 and #3, 4, respectively. These digital inputs can be remotely energized to trigger several different controller conditions. See paragraph 3.4.4.8, Input/Output - Digital In A and Digital In B, for detailed information on configuring the digital input.

The digital inputs are factory configured for 115 Vac or 230 Vac, depending on which voltage the power supply was configured. These inputs can be configured for 24, 115, or 230 volts ac or dc.

3.7.3 mA Output

A milliampere output signal is provided to enable the user to interface to any monitoring or control device that requires a mA input signal. The user can output actuator position (control out), flow rate, or residual. See paragraph 3.4.4.1, Input/Output - Control (Cntl.) Device, and paragraph 3.4.4.4, Input/Output - mA Out Setup, for more information.

3.7.4 Serial Communications

The controller is equipped with RS485 serial communications. RS485 can be used to link up to 32 controllers to a single computer. A remote computer can read and write most of the controller parameters. Communication is overseen using a version of USF/W&T communication protocol.

Refer to paragraph 3.10, RS485 Interface Operation, for details and operation on the Serial Interface.

3.8 Actuator Operation

3.8.1 Positioning the Actuator

The actuator can be positioned three different ways. The most typical way is to put the controller into automatic control and allow the controller to automatically position the actuator per the selected control type.

A second way the actuator can be positioned is, by using the "electric manual" feature of the controller. When the controller is in manual, the user can change the actuator position directly from the keypad. To do this, first move the display to the **act position** selection and verify that the controller is in manual (hand symbol on display). Press the Enter key and confirm that the display shows a > sign to the left of the number. Once the > sign is displayed, use the Up key to increment the actuator position or the Down key to decrement the actuator position. When done moving the actuator, press the ENTER key to turn off the > sign.

The third way to move the actuator position is to disengage the actuator motor and manually position the actuator.

3.9 Theory Of Operation

The controller and electric actuator units together provide for automatic process control of chemical feed equipment. The controller uses a microprocessor to process signals supplied to its inputs, and moves the actuator to its proper

position with regard to the input signals and user entered system parameters. The controller can be software configured to perform four different types of control.

- **Proportional Control** positions the actuator proportionally to the input signal. A single input signal is supplied to the controller and the actuator is positioned in direct proportion to the input signal. The actuator position is a function of the input signal and this relationship is written:

  actuator position = (input signal x dosage)/(Ks)

  where actuator position = percent of full scale actuator position
  input signal = percent of full scale input signal
  dosage = percent
  Ks = 100% (scaling factor)

  For example, if the input signal is 50 percent of its full scale value and the dosage is set to 50 percent, the actuator position is 25 percent of the full scale actuator position. If the dosage is then adjusted to 200 percent, the controller moves the actuator position to 100 percent.

  Flow proportional water treatment is a typical application of proportional control. In this case, the dosage is defined as the rate at which a chemical such as chlorine is applied to a flow of water. 100% dosage is achieved when the maximum actuator position is obtained at the maximum water flow. If, for example, a 400 lbs/day gas feeder is used with a system that has been designed for a maximum flow of 10 million gallons of water per day (mgd), 100% dosage will result in the application of 400 lbs of gas per 10 million gallons of water (40 lbs per million gallons of water). If the flow decreased to 5 mgd, then the flow proportional system will reduce the actuator position to 50% and will feed 200 lbs of chlorine per day, but the concentration of chlorine remains at 40 lbs per million gallons.

  Since the residual is governed by the demand of the water, 100% dosage may not be the correct dosage to obtain the desired residual. For this reason, the controller is designed to provide for a wide range of dosage adjustment from 5 to 500%.

- With **Dual Signal Feedforward Control**, a flow signal and a chlorine residual signal are supplied to the controller and the actuator is positioned in direct proportion to the product of the signals. The actuator position is a function of the input signals and this relationship is written:

  actuator position = {(flow x residual) x dosage}/(Ks)

where actuator position = percent of full scale actuator position
flow = percent of full scale flow signal
residual = percent of full scale residual signal
dosage = percent
Ks = 10,000% (scaling factor)

For example, if the flow signal is at 50 percent, the residual signal is at 50 percent and the dosage is set to 100 percent, the actuator position is 25 percent of the full scale actuator position. If the dosage is then adjusted to 200 percent, the controller moves the actuator position to 50 percent.

The typical application of dual signal feedforward control is feedforward sulfonator control.

If the controller is set up for dual signal feedforward control and the residual signal is lost, the controller defaults into proportional control.

The USF/W&T Controller uses a discontinuous control algorithm which is compatible with the "dead time" or "lag time" associated with water treatment.

The residual analyzer sends a feedback signal to the controller. This signal represents the sampled residual, resulting from the controller output, one lag time ago. The integral control component recognizes the difference, between the actual reading and the desired reading, and makes the adjustment once every lag time (integral gain * error). The controller output is then automatically discontinued since it has no immediately observable effect. The proportional control component, however, samples the feedback continuously and takes proportional corrective action continuously. A large proportional gain, in a system with a long lag time will, create oscillation. Similarly, the same effect occurs if the lag time is set too short, which causes the controller to make changes before the effects of the previous change reaches the analyzer.

The proportional component does have a positive effect, on performance, when it predicts the integral action and speeds the controller's response. If the incoming reading remains the same, the proportional contribution is reduced to zero. In this way, the integral component is similar to an offset bias from which a proportional control can work.

- With **Direct Residual Control**, a setpoint is entered into the controller and the controller uses both proportional and integral feedback control techniques to adjust the actuator per the single residual input.

Residual feedback control works as follows: The controller compares the user entered setpoint to the input residual signal and generates an error value. The error value is multiplied by the proportional gain. Once per lag time the error value is also multiplied by the integral gain. The present proportional error term and the last update of the integral error term are summed to generate the total error, and the actuator is positioned according to this error.

Proportional and integral gains are adjustable from 0 to 100%. The percentage indicates the amount of correction to be performed. For example, if the gain is set to 50% and the deviation is 50%, the controller will make a 25% change in actuator position.

Direct residual control is typically used when feedback control is desired, but a flow signal is unavailable or unnecessary (constant flow).

- With **Compound Loop Control**, a setpoint is entered into the controller and the controller uses both proportional and integral feedback control techniques to adjust the actuator per the single residual input. The flow input signal is multiplied by the error and is used to scale the actuator position to flow.

  The controller compares the user entered setpoint to the input residual signal and generates an error value. The error value is multiplied by the proportional gain. Once per lag time the error value is also multiplied by the integral gain. The present proportional error term and the last update of the integral error term are summed to generate the total error. The total error is multiplied by the flow signal and the actuator is positioned according to this error.

  Proportional and integral gains are adjustable from 0 to 100%. The percentage indicates the amount of correction to be performed, scaled by the flow signal. For example, if the gain is set to 50%, the deviation is 50% and the flow rate is 100%, the controller will make a 25% change in actuator position. For the same conditions, but a flow rate of only 50%, the change in actuator position would be 12.5%.

  This control type is typically used when closed loop control is desired and a flow signal is available.

  If the controller is set up for compound loop control and the residual signal is lost, the controller defaults into proportional control.

  Bumpless transfer assures that the actuator does not move under transition conditions. Certain control parameters are recalculated to prevent the

undesired movement. The conditions for which bumpless transfer occur are listed below:

a. Change from any other control type to direct residual control.

b. Change from any other control type to compound loop control.

c. Transition from motor disengaged to automatic control (if control type is direct residual or compound loop).

d. Transition from manual to automatic control (if control type is direct residual or compound loop).

e. Transition from standby to automatic control (if control type is direct residual or compound loop).

f. Transition from flow proportional to compound loop control when flow proportional was entered because of loss of residual (default).

g. Change in the proportional or integral gains.

h. Transition of digital input from energized to de-energized, if digital input configuration is set to run actuator (0, 100 or double) and control type is set to direct residual or compound loop.

i. Transition from compound loop or dual signal feedforward to flow proportional because of loss of residual.

j. Microprocessor reset or power off/on condition.

The integrator for direct residual and compound loop control is limited. For 5% flow and an integral gain setting of 100%, the actuator will make 100% actuator position.

3.10 RS485 Interface Operation

3.10.1 Description of the Rs485 Bus Interface of the Pcu

The serial RS485 bus interface of the PCU is designed as a symmetrical two-wire bus line to EIA RS485 (DIN 66259 Teil 4 bzw. ISO 8482), that enables data transfer at 19,200 baud, for up to 3937 ft. (1200 m).

The RS485 bus has the following characteristics:

- Data transfer in both directions
- Twin wire connection (half duplex)
- Bus structure (addressable interface, up to 32 bus users)

The interface works with differential voltage signals, ensuring high interference susceptibility.

The bus system consists of a maximum of 32 passive and one active user. Only the active user (computer system) is entitled to start communication. The PCU is always a passive member of the bus.

3.10.1.1 Cable

A twisted-shielded 2-wire cable should be used. It is recommended that the cable shield be grounded at the PCU end only.

The cable should have a surge impedance of between 100 and 130 ohms and a capacitance of less than 60 pF/m. The conductor size should be AWG (.22m2) minimum.

3.10.1.2 Interface Connection

The RS485 signal bus is connected to the PCU at terminals 13 (B) and 14 (A) of terminal printed circuit board (see Dwg. 40.200.130.020, 40.200.130.030) in Section 2 - Installation for details on these connections. The cable must be terminated at each end with a 150 ohm resistor. In addition, it is recommended that a 390 ohm resistor be connected from B to a plus 5 V source, and a 390 ohm resistor be connected from A to a O V source. This will establish a standby potential on the bus when no communication is taking place. The PCU cannot be used as a source of this potential. Specification for the resistors and standby potential power supply is shown in Dwg. 40.200.170.020.

3.10.2 RS485 Bus Specification

Synchronization Mode:	Asynchronous
Transmission Rate:	19,200 Baud
Data Format:	
Start Bit:	1 Bit
Data Bit:	8 Bit
Parity Bit:	Even
Stop Bit:	1 Bit

Signal Polarity:	Differential Voltage Logical 1: A-B > 0.2 V Logical 0: A-B < -0.2 V
Handshake:	None; fixed communication blocks are used.
Transmission Code:	ASCII standard

3.10.3 Transmission Protocol

Communication is done with special blocks of information being sent from the master and returned by the appropriate slave. These blocks contain all the appropriate bits to verify data is valid, to identify which slave is being polled, and to identify which variable is being read or written to. These blocks of information will be referred to as frames.

There are two kinds of communication frames sent by the master (e.g., PC computer) to the slave (passive user, i.e., PCU):

- **Request Frame:** The master requests information from a slave about a specific variable.
- **Set Frame:** The master seeks to change a variable on a slave.

There are three kinds of response frames sent by a slave to the master:

- **Answer Frame:** Provides the information sought by the master in response to a Request Frame.
- **Positive Confirmation Frame:** Confirms that a valid Set Frame was received by the slave.
- **Negative Confirmation Frame:** Confirms that an invalid Request Frame or Set Frame was received.

3.10.3.1 Description of the Bytes of the Frames

- **Synchronization bytes (SYN) –** The synchronization bytes are used to synchronize the communication devices. The value of SYN is 00h.
- **Start byte (SB) –** Marks the beginning of the frame. Its value depends on the type of frame, as follows:

  Request Frame: 10h
  Set Frame: 68h

Answer Frame: 68h
Positive Confirmation: A2h
Negative Confirmation: DCh

- **Slave Address (SA) –** Each slave on the bus is given a unique address, from 0 to 31 Dec. The PCU slave address is set by going to the GLOBAL SETUP menu and scrolling down to Comm Address.

- **Destination Address (ZA) –** The destination address determines which variable of the PCU is being read or written to. All destination addresses are provided in paragraph 3.10.5, Transmission Variables/Address Reference List.

- **Check Byte (KB)** – The check byte has three purposes:

  * To specify the format of the data.

  * To determine the type of information requested.

  * Used by the slave to send error messages. Used with positive or negative confirmation frames.

- **Data Format (bits 0 - 3):**

Bits:	Hex Val:	Format:	
0000	0	unsigned	Default (to address ref. list)
0001	1	signed	Default (to address ref. list)
0010	2	unsigned	Boolean
0011	3	signed	Boolean
0100	4	unsigned	character
0101	5	signed	character
0110	6	unsigned	integer
0111	7	signed	integer
1000	8	unsigned	long integer
1001	9	signed	long integer
1010	A	unsigned	float
1011	B	signed	float
1100	C	unsigned	ASCII
1101	D	signed	ASCII
1110	E	unsigned	Mixed data format
1111	F	signed	Mixed data format

- **Information Type (bits 4 - 7):**

Bits:	Hex Val:	Function:
0000	0	Actual value of the variable
0001	1	Provide additional information
0010	2	Default value of the variable
0100	4	Maximum value of the variable
1000	8	Minimum value of the variable

- **Error Messages (bits 0 - 7):**

Bits:	Hex Val:	Message:
0000 0000	00	Positive confirmation
0000 0001	01	End of address table
0000 0010	02	Wrong string format
0000 0100	04	Additional information not available
0000 1000	08	Value is not between min & max limits
0001 0000	10	Read access not permitted
0010 0000	20	Read permitted, but wrong password
0100 0000	40	Write access not permitted
1000 0000	80	Write permitted, but wrong password
1100 0000	C0	Write not permitted (e.g., PCU is in Manual Mode)

- **Number Byte (AB) –** The number of bytes to read or write.

- **Frame Check (FC) –** Frame check is the check sum of the control bytes of a frame:

FC = (unsigned char) SB + SA + ZA + KB + AB

- **Data Unit (DU) –** The actual data being sent by the slave or the master unit.

- **Data Check (DC) –** The check sum of the data bytes:

DC = (unsigned char) sum of DU

- **End Byte (EB) –** The end byte marks the end of a frame. Its value is always 16h.

3.10.3.2 Request Frame

The request frame is used by the Master to read information from a slave.

The format of the request frame is as follows:

Byte:	Symbol:	Description:
0-2	SYN	Synchronization bytes = 00h 00h 00h
3	SB	Start byte = 10h
4	SA	Slave address
5	ZA	Destination address
6	KB	Check byte
7	AB	Number of bytes
8	FC	Frame Check
9	EB	End byte - 16h

With the request frame, single variables or several consecutive variables may be read. The user may select which information to read from a variable, by appropriately setting the check byte, as described above. If additional information is requested, the data format and number byte will be ignored.

If the contents of a single destination address is requested, the number byte is set to 00h. In the answer frame, the data format and the number of bytes is returned by the PCU in the check byte and the number byte, respectively. A data format entered in the request format is ignored.

If the number byte is set in the request frame (request covering more than one consecutive address) the answer frame returns a check byte of 04h, indicating a data format of unsigned character. The number byte of the answer frame will have the same value as the number byte of the request frame. But the number byte must be set to cover the complete address space of the address space to be read.

E.G. Destination address 9 is a character (one byte) and address 10 is an integer (two bytes). The user wishes to read address 9 and 10. The destination address is set to 9, and the number byte is set to 3.

Valid request frames are answered with an answer frame. Invalid request frames are answered with a negative confirmation.

Example: The contents of destination address 02h is requested from slave 07h.

SYN	**SB**	**SA**	**ZA**	**KB**	**AB**	**FC**	**EB**
00h 00h 00h	10h	07h	02h	00h	00h	19h	16h

3.10.3.3 Set Frame

The set frame is used to change the value of a variable in a slave unit.

The format of the Set Frame is as follows:

Byte:	Symbol:	Description:
0-2	SYN	Synchronization Bytes = 00h 00h 00h
3	SB	Start Byte = 68h
4	SA	Slave Address
5	ZA	Destination Address of variable
6	KB	Check Byte
7	AB	Number Byte
8	FC	Frame Check
9-X	DU	Data Bytes
Y	DC	Data Check
Z	EB	End Byte = 16h

With the set frame, single variables or several consecutive variables may be written to. The value of a variable may be changed, or additional information can be written.

If a single destination address is written to, the number byte must be appropriate for the number of bytes for that data type (see paragraph 3.10.5, Transmission Variables/Address Reference List). The data format must be set to default or to the data format from the reference list.

If more than one variable is written, the data format must be set to default. The number byte must be set to the total number of bytes which cover those addresses to be written. The data for all addresses will be sent in consecutive bytes.

E.G. Destination address 9 is a character which will be changed to 53h, and address 10 is an integer which will be changed to 61A8h. The number byte is set to three, and the data sent to the PCU will be 5361A8h.

Valid set frames are answered with a positive confirmation. Invalid set frames are answered with a negative confirmation.

Example: Set the contents of destination address 02h of the slave 07h to 904d.

SYN			**SB**	**SA**	**ZA**	**KB**	**AB**	**FC**	**DU**		**DC**	**EB**
00h	00h	00h	68h	07h	02h	06h	02h	79h	03h	88h	88h	16h

3.10.3.4 Answer Frame

The answer frame is transmitted by a slave in response to a request by the master.

The format of the answer frame is as follows:

Byte:	Symbol:	Description:
0-2	SYN	Synchronization Bytes
3	SB	Start Byte = 68h
4	SA	Slave Address
5	ZA	Destination Address
6	KB	Check Byte
7	AB	Number Byte
8	FC	Frame Check
9-X	DU	Data Bytes
Y	DC	Data Check
Z	EB	End Byte = 16h

If the check byte and number byte are set to zero in the request frame, the answer frame will provide the data format and number of bytes shown in the reference list at the end of this manual.

Example:

Request frame:

SYN			**SB**	**SA**	**ZA**	**KB**	**AB**	**FC**	**EB**
00h	00h	00h	10h	07h	02h	00h	00h	19h	16h

Answer frame:

SYN			**SB**	**SA**	**ZA**	**KB**	**AB**	**FC**	**DU**		**DC**	**EB**
00h	00h	00h	68h	07h	02h	06h	02h	79h	00h	00h	8Bh	16h

3.10.3.5 Positive and Negative Confirmation Frame

The positive confirmation is transmitted by the slave when a valid set frame is received from the master. A negative confirmation is transmitted by the slave when a set frame or a request frame is received from the master which cannot be executed validly.

The format of the positive/negative confirmation frame is as follows:

Byte:	Symbol:	Description:
0-2	SYN	Synchronization Bytes
3	SB	Positive Conf: Start Byte = A2h
		Negative Conf: Start Byte = DCh
4	SA	Slave Address
5	ZA	Destination Address
6	KB	Check Byte
7	AB	Number Byte
8	FC	Frame Check
9	EB	End byte = 16h

The check byte is 00h for a positive confirmation and will contain an error message for a negative confirmation (these messages were listed previously in paragraph 3.10.3.1).

Example:

Positive Confirmation:

SYN	SB	SA	ZA	KB	AB	FC	EB
00h 00h 00h	A2h	07h	02h	00h	00h	ABh	16h

Negative Confirmation:

SYN	SB	SA	ZA	KB	AB	FC	EB
00h 00h 00h	DCh	07h	02h	00h	00h	A5h	16h

3.10.3.6 Data-Format in the Serial Data Stream

3.10.4 Password Protection

Most variables cannot be changed without first entering a password. This password is 911, and is distinct from the password entered locally at the PCU.

To enter the password, set the variable at address 2 to 911. The PCU must also be in the automatic mode before any variables can be changed.

The local PCU password may also be entered or changed, and the PCU can be locked or unlocked remotely through the RS485 bus (see paragraph 3.10.5, Transmission Variables/Address Reference List).

3.10.5 Transmission Variables / Address Reference List

data format	sequence in the data-stream
boolean	1byte of the stream: 00hex-false, FFhex-true
char	1byte of the stream
int	1byte of the stream: high-byte 2byte of the stream: low-byte
long	1byte of the stream: highword-highbyte 2byte of the stream: highword-lowbyte 3byte of the stream: lowword-highbyte 4byte of the stream: lowword-lowbyte
float	IEEE 32bit-floating point format S means the sign bit E means the two's exponent M means the 23bit normalized mantissa 1byte of the stream: MMMM MMMM bit7-bit0 of mantissa 2byte of the stream: MMMM MMMM bit15-bit8 of mantissa 3byte of the stream: EMMM MMMM bit0 of exponent, bit22-bit16 of mantissa 1byte of the stream: SEEE EEEE sign bit (1-neg./0-pos.), bit7-bit1 of exponent

NOTE: For any address with a factor, the factor is used as a data multiplier. For example, if the value to be transmitted or received is 33.1%, then the data will be 331 decimal, using a factor of 0.1.

Table 3.5 - Transmission Variables / Address Reference List

	Dest. Address 00	**Dest. Address 01**	**Dest. Address 02**
Function:	Software Version	Unit Name	RS485 Password
Format:	ASCII	ASCII	Unsigned Int
Length:	12 Byte	28 Byte	2 Byte
Range:	--	--	0...999
Unit:	--	--	--
Factor:	--	--	1.0
Status:	Read	Read	Read, write
Extra Info:	None	None	"911"
	Dest. Address 03	**Dest. Address 04**	**Dest. Address 05**
Function:	Residual	Control	Actuator Feedback
Format:	Float	Float	Float
Length:	4 Byte	4 Byte	4 Byte
Range:	Residual Range	0...100	0...100
Unit:	mg/l	%	%
Factor:	--	0.1	0.1
Status:	Read	Read	Read
Extra Info:	None	None	None
	Dest. Address 06	**Dest. Address 07**	**Dest. Address 08**
Function:	Flow Rate	Deviation	Dosage
Format:	Float	Float	Signed Int
Length:	4 Byte	4 Byte	2 Byte
Range:	0...100	-100...+100	10...500
Unit:	%	%	%
Factor:	0.1	0.1	1
Status:	Read	Read	Read, write with password
Extra Info:	None	None	None
	Dest. Address 09	**Dest. Address 10**	**Dest. Address 11**
Function:	Setpoint	Control Status	Bargraph Pointer
Format:	Signed Int	Unsigned Char	Unsigned Char
Length:	2 Byte	1 Byte	1 Byte
Range:	Residual Range	--	--
Unit:	mg/l	--	--
Factor:	--	--	--
Status:	Read, write with password	Read	Read, write with password
Extra Info:	None	Coding: 01h-Automatic 02h-Manual	Coding: 01h-Control Out 02h-Flow Rate 04h-Act.Position 08h-Off

Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 12	**Dest. Address 13**	**Dest. Address 14**
Function:	Code	Language	Lock Setting
Format:	Unsigned Int	Unsigned Char	Unsigned Char
Length:	2 Byte	1 Byte	1 Byte
Range:	0...999	--	--
Unit:	--	--	--
Factor:	1	--	--
Status:	Write	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-USA English 02h-UK English 08h-French 10h-Spanish	Coding: 01h-Locked 02h-Unlocked
	Dest. Address 15	**Dest. Address 16**	**Dest. Address 17**
Function:	Lock Code	Control Type	Save Job
Format:	Signed Int	Unsigned Char	Signed Int
Length:	2 Byte	1 Byte	2 Byte
Range:	0...999	--	1 or 2
Unit:	--	--	--
Factor:	1	--	1
Status:	Read with password, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-Proportional 02h-Dual Sig FF 04h-Direct Resid 08h-Comp Loop	None
	Dest. Address 18	**Dest. Address 19**	**Dest. Address 20**
Function:	Restore Job	Extended Options	Residual Signal Type
Format:	Signed Int	Signed Int	Unsigned char
Length:	2 Byte	2 Byte	1 Byte
Range:	1 or 2	0...4095	--
Unit:	--	--	--
Factor:	1	1	--
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: See Para 4.2.8, X-Options, in Section 3 of Instruction Book	Coding: 01h-Normal 02h-Center Zero

Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 21	**Dest. Address 22**	**Dest. Address 23**
Function:	Residual Range	Residual Range (Center Zero)	Proportional Gain
Format:	Unsigned Int	Unsigned Char	Signed Int
Length:	2 Byte	1 Byte	2 Byte
Range:	--	--	0...100
Unit:	mg/l	mg/l	%
Factor:	--	--	0.1
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	Coding: 01h- .100 mg/l 02h- .200 mg/l 04h- .500 mg/l 08h- 1.00 mg/l 10h- 2.00 mg/l 20h- 5.00 mg/l 40h- 10.00 mg/l 80h- 20.00 mg/l 100h- 50.0 mg/l 200h-100.0 mg/l	Coding: 01h- +/- 0.5 mg/l 02h- +/- 1.0 mg/l 04h- +/- 2.5 mg/l 08h- +/- 5.0 mg/l 10h- +/-10.0 mg/l	None
	Dest. Address 24	**Dest. Address 25**	**Dest. Address 26**
Function:	Integral Gain	Fixed Lag	Total Lag
Format:	Signed Int	Signed Int	Signed Int
Length:	2 Byte	2 Byte	2 Byte
Range:	0...100	0.1...60	0.1...60
Unit:	%	min	min
Factor:	0.1	0.01	0.01
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	None	None
	Dest. Address 27	**Dest. Address 28**	**Dest. Address 29**
Function:	Control Action	Control Device	Pulse Per Minute
Format:	Unsigned Char	Unsigned Char	Signed Int
Length:	1 Byte	1 Byte	2 Byte
Range:	--	--	10...200
Unit:	--	--	ppm
Factor:	--	1	
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	Coding: 01h-Chlor 02h-DeChlor	Coding: 01h-Actuator 02h-Pulse Freq 04h-Dosing Pump 08h-mA Output	None

Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 30	**Dest. Address 31**	**Dest. Address 32**
Function:	Pulse Width	mA Output Setup	Flow Input Signal
Format:	Signed Int	Unsigned Char	Unsigned Char
Length:	2 Byte	1 Byte	1 Byte
Range:	10...240	--	--
Unit:	Sec	--	--
Factor:	1	--	--
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-Control Out 02h-Residual 04h-Flow Rate 08h-Act Posit. 10h-Off	Coding: 01h-0..20mA 02h-4..20mA 04h-0..5V 08h-1..5V
	Dest. Address 33	**Dest. Address 34**	**Dest. Address 35**
Function:	Flow Input Scaling	Spare Input Setup	Digital Input A
Format:	Signed Int	Unsigned Char	Unsigned Char
Length:	2 Byte	1 Byte	1 Byte
Range:	0.1...4	--	--
Unit:	%	--	--
Factor:	0.1	--	--
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-Not Used 02h-Flow Input 04h-Resid Input 08h-Output >100 10h-Output >2X 20h-Not Used	Coding: 01h-Manual 02h-Shutdown 04h-Output > 0
	Dest. Address 36	**Dest. Address 37**	**Dest. Address 38**
Function:	Digital Input B	Sensitivity	Hi Residual Setup
Format:	Unsigned Char	Signed Int	Signed Int
Length:	1 Byte	2 Byte	2 Byte
Range:	--	0.2...9.9	Residual Range
Unit:	--	%	%
Factor:	--	0.1	0.01
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	Coding: 01h-Select Job 2 02h-Not used	None	Coding: See Residual Range Address 21/22

Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 39	**Dest. Address 40**	**Dest. Address 41**
Function:	Lo Residual Setup	Hi Deviation Setup	Lo Deviation Setup
Format:	Signed Int	Signed Int	Signed Int
Length:	2 Byte	2 Byte	2 Byte
Range:	Residual Range	-100...+100	-100...+100
Unit:	%	%	%
Factor:	0.01	0.1	0.1
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	Coding: See Residual Range Address 21/22	None	None
	Dest. Address 42	**Dest. Address 43**	**Dest. Address 44**
Function:	Lo Flow Setup	Hi Control Output	Lo Control Output
Format:	Signed Int	Signed Int	Signed Int
Length:	2 Byte	2 Byte	2 Byte
Range:	0...100	0...100	0...100
Unit:	%	%	%
Factor:	0.1	0.1	0.1
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	None	None

Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 45	**Dest. Address 46**	**Dest. Address 47**
Function:	Deadband	Relay A Setup	Relay A Operation
Format:	Signed Int	Unsigned Int	char
Length:	2 Byte	2 Byte	1 Byte
Range:	0...20	--	--
Unit:	%	--	--
Factor:	0.1	--	--
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-Hi Res. 02h-Lo Res. 04h-Hi/Lo Res. 08h-Hi Dev. 10h-Lo Dev. 20h-Hi/Lo Dev. 40h-Lo Flow 80h-Hi Cntl Out 100h-Lo Cntl Out 200h-Loss of Res 400h-Loss of Flow 800h-Disengaged 1000h-Manual 2000h-Shutdown 4000h-Power On 8000h-Not Used	Coding: 01h-Norm.Open 02h-Fail-safe

Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 48	**Dest. Address 49**	**Dest. Address 50**
Function:	Relay A Delay	Relay B Setup	Relay B Operation
Format:	Signed Int	Unsigned Int	char
Length:	2 Byte	2 Byte	1 Byte
Range:	0...120	--	--
Unit:	sec	--	--
Factor:	1	--	--
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-Hi Res. 02h-Lo Res. 04h-Hi/Lo Res. 08h-Hi Dev. 10h-Lo Dev. 20h-Hi/Lo Dev. 40h-Lo Flow 80h-Hi Cntl Out 100h-Lo Cntl Out 200h-Loss of Res 400h-Loss of Flow 800h-Disengaged 1000h-Manual 2000h-Shutdown 4000h-Power On 8000h-Not Used	Coding: 01h-Norm. Open 02h-Fail-safe

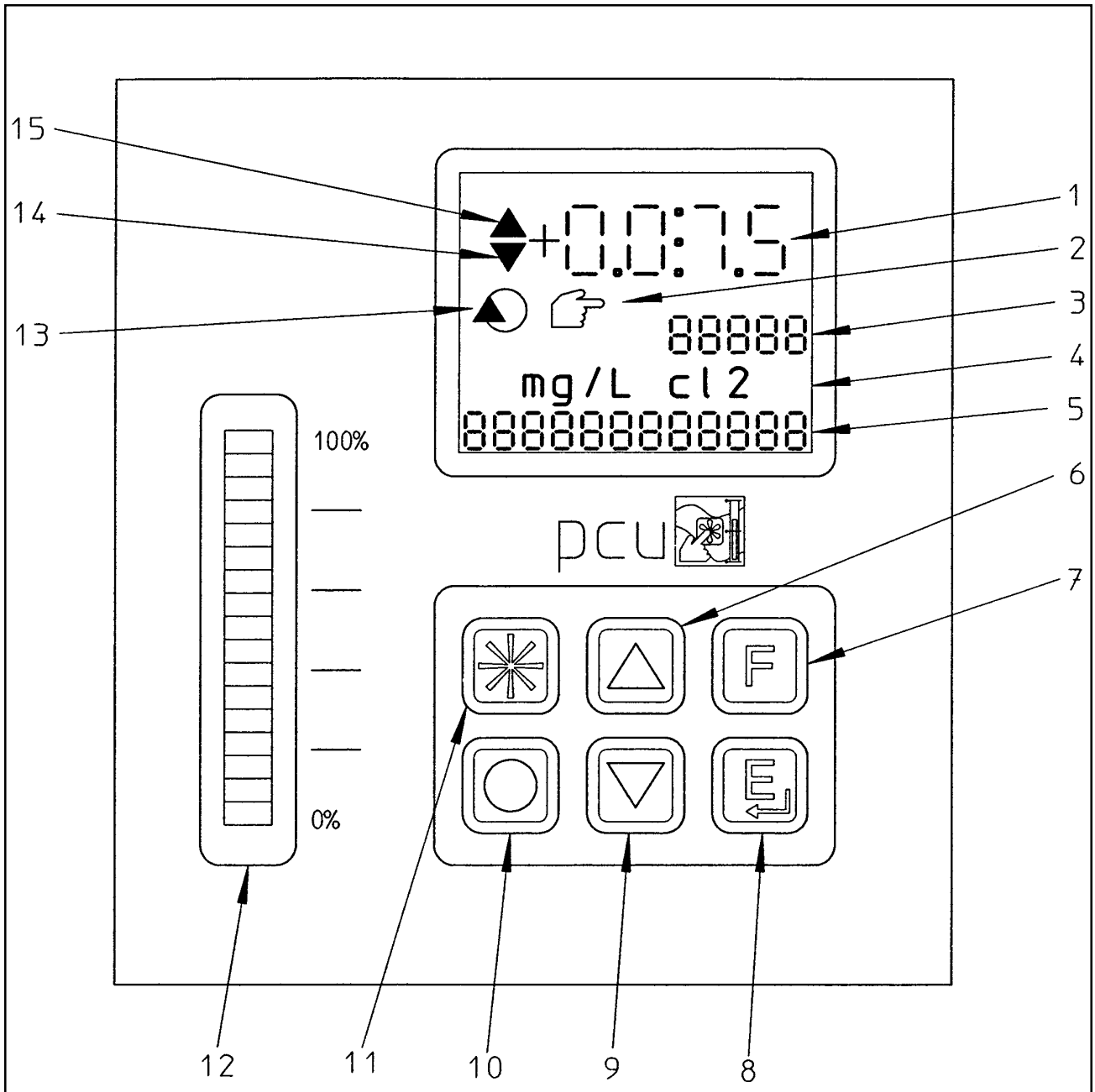
Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 51	**Dest. Address 52**	**Dest. Address 53**
Function:	Relay B Delay	Relay E Setup	Relay E Operation
Format:	Signed Int	Unsigned Int	Unsigned Char
Length:	2 Byte	2 Byte	1 Byte
Range:	0...120	--	--
Unit:	sec	--	--
Factor:	1	--	--
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-Hi Res. 02h-Lo Res. 04h-Hi/Lo Res. 08h-Hi Dev. 10h-Lo Dev. 20h-Hi/Lo Dev. 40h-Lo Flow 80h-Hi Cntl Out 100h-Lo Cntl Out 200h-Loss of Res 400h-Loss of Flow 800h-Disengaged 1000h-Manual 2000h-Shutdown 4000h-Power On 8000h-Not Used	Coding: 01h-Norm. Open 02h-Fail-safe

Table 3.5 - Transmission Variables / Address Reference List (Cont'd)

	Dest. Address 54	**Dest. Address 55**	**Dest. Address 56**
Function:	Relay E Delay	Relay F Setup	Relay F Operation
Format:	Signed Int	Unsigned Int	Unsigned Char
Length:	2 Byte	2 Byte	1 Byte
Range:	0...120	--	--
Unit:	sec	--	--
Factor:	1	--	--
Status:	Read, write with password	Read, write with password	Read, write with password
Extra Info:	None	Coding: 01h-Hi Res. 02h-Lo Res. 04h-Hi/Lo Res. 08h-Hi Dev. 10h-Lo Dev. 20h-Hi/Lo Dev. 40h-Lo Flow 80h-Hi Cntl Out 100h-Lo Cntl Out 200h-Loss of Res 400h-Loss of Flow 800h-Disengaged 1000h-Manual 2000h-Shutdown 4000h-Power On 8000h-Not Used	Coding: 01h-Norm. Open 02h-Fail-safe

	Dest. Address 57
Function:	Relay F Delay
Format:	Signed Int
Length:	2 Byte
Range:	0...120
Unit:	sec
Factor:	1
Status:	Read, write with password
Extra Info:	None



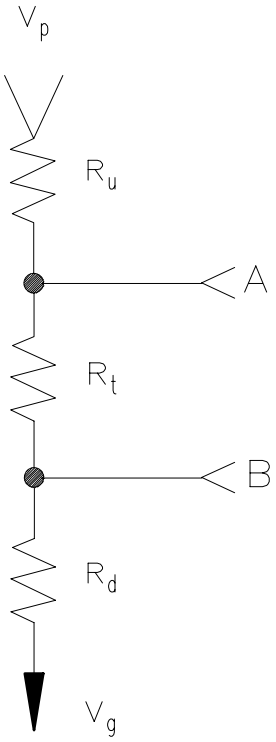
NOTE: THE DISPLAY SHOWN IS FOR DEMONTRATION PURPOSES ONLY. IT IS NOT AN ACTUAL DISPLAY EXAMPLE.

SEE INSTRUCTION BOOK TEXT FOR FUNCTION OF INDIVIDUAL FRONT PANEL COMPONENTS.

CONTROLS - OPERATION

40.200.170.010

ISSUE 0 4-95

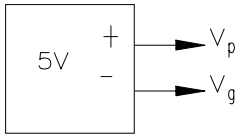


INTERFACE STAND–BY POTENTIAL RESISTORS

R_u = 390 ohm, +/– 2%, 1/4 WATT MIN., METAL FILM

R_d = 390 ohm, +/– 2%, 1/4 WATT MIN., METAL FILM

R_t = 150 ohm, +/– 2%, 1/4 WATT MIN., METAL FILM



POWER SUPPLY FOR STAND–BY POTENTIAL 5V, 1 WATT

NOTE: REFER TO PARAGRAPH 3.10.1.2, INTERFACE CONNECTION, FOR DETAILS.

RS485 INTERFACE CONNECTION - OPERATION

40.200.170.020

ISSUE 0 3-97

SECTION 4 - SERVICE

List Of Contents

4.1 Controller Disassembly and Assembly

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING PRECAUTIONS:

TROUBLESHOOTING OF THE CONTROLLER, SIGNALS AND SOURCE POWER IS PERFORMED WITH A METER. ONLY PERSONNEL WHO ARE TRAINED WITH THIS EQUIPMENT AND WHO HAVE A COMBINED KNOWLEDGE OF PROPER SAFETY PRECAUTIONS AND USF/W&T EQUIPMENT SHOULD PERFORM ANY TESTING AND/OR TROUBLESHOOTING.

TO AVOID ELECTRICAL SHOCK, TURN POWER OFF AND DISCONNECT SOURCE POWER BEFORE SERVICING.

ALL WIRING MUST CONFORM TO LOCAL AND NATIONAL ELECTRICAL CODE (NEC) STANDARDS.

In order to reconfigure a switch or jumper setting or to change any printed circuit boards (Power Supply Board, CPU Board, or Third Board), the controller must be disassembled. Follow these instructions to properly and safely disassemble and reassemble the controller.

4.1.1 Removing Controller From Enclosure and Reassembly (See Dwg. 40.200.000.010)

a. Remove the four screws from the four corners of the front frame surrounding the display/keypad panel.

b. Grasping two sides of the front frame, slowly pull the unit in the metal housing outward until access to the backplane connector, on the rear, is available.

CAUTION: To avoid equipment damage, do not pull out the unit too far, this could damage the connector and ground wire connected to the rear of the metal enclosure.

c. Hold the unit firmly in one hand. Push with the thumb on the top, middle part of the connector with the middle and ring finger against the rear of the metal enclosure, until the connector separates from the unit.

d. Unscrew the ground cable nut on the rear of the metal enclosure and remove the ground cable.

CAUTION: To avoid equipment damage, do not pull the cables when disconnecting. Always pull the cable connector. Pulling the cables themselves will damage the cable.

e. To reassemble the controller into the enclosure follow the above steps in reverse.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, KEEP COVER SECURELY TIGHTENED WHEN EQUIPMENT IS IN OPERATION. THIS ENCLOSURE IS NEMA 4X RATED. GASKET SEAL MUST BE MADE IN ORDER TO PROTECT THE INTERNAL COMPONENTS FROM MOISTURE AND FUMES.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, BE SURE TO PROPERLY CONNECT THE EARTH GROUND CABLE TO THE REAR OF THE METAL CASING.

4.1.2 Board Removal And Reassembly (See Dwg. 40.200.001.010)

a. Remove the controller from the enclosure as outlined above.

b. Place the controller in the metal enclosure, on a static free surface before disassembly.

c. Remove the six screws that hold the front frame to the display panel. Remove the front frame.

d. Remove the four screws on the top and bottom of the metal housing.

e. Hold the edge of the display panel and carefully pull out the unit from the metal housing.

f. Disconnect the ribbon cable between the power supply board and the CPU board, at the CPU board.

g. Disconnect the ribbon cable between the third board and the CPU board, at the CPU board.

h. To separate the boards, carefully remove the six screws at the display panel and the screws and spacers at the rear.

CAUTION: To avoid equipment damage, be sure that there is no static when handling the boards or permanent damage may result.

i. Follow the above steps in reverse to reassemble the controller.

4.1.3 Terminal Board Removal and Reassembly (See Dwgs. 40.200.000.010 And 40.200.001.020)

a. Remove the controller in metal housing as outlined above.

b. Remove the two middle sections of the enclosure and the aluminum bar.

c. Unscrew the four screws that hold the terminal board to the base of the enclosure. Remove the terminal board.

NOTE: The terminal board does not have to be removed to replace the fuse.

d. Follow the above steps in reverse to reassemble.

CAUTION: To avoid equipment damage, when reassembling the unit, place RTV sealer (which comes with the new terminal board assembly) at the two ends of the aluminum bar where the rubber gasket touches the enclosure. This ensures a watertight seal at these points.

4.1.4 EPROM Removal and Installation (See Dwgs. 40.200.001.010, 40.200.150.030, and 40.200.150.040)

WARNING: STATIC CAN POTENTIALLY DAMAGE CONTROL COMPONENTS WHEN THEY ARE OUT OF THE METAL HOUSING. WHEN REPLACING EPROM, A STATIC CONTROL MAT MUST BE USED. THE USER AND THE MAT MUST BE GROUNDED VIA GROUNDING CARDS.

a. Disassemble the controller as outlined in paragraph 1.1 and paragraph 1.2 up to step “e”. With the controller outside of its metal housing, it is not necessary to separate the boards to access the EPROM.

b. Lay the unit on its left side (bargraph on the bottom) on the static mat.

c. Looking through the top of the unit with the display on the right, locate the EPROM in its socket. It is the second chip from the right on the middle pc board on the side facing you. Its label contains a number and the letters “PCU” on it.

d. Using a small straight-edge screwdriver, carefully slide the edge under the short side of the EPROM facing you. Slowly pry the EPROM from the

socket by moving the screwdriver side-to-side. Be careful that other components on the board are not damaged and that the board is not scratched.

CAUTION: There is a capacitor in the socket below the EPROM. Be careful that the screwdriver does not damage it.

e. Before installing the new EPROM make sure the pins on both sides are straight. If not, carefully straighten them.

CAUTION: The EPROM pins could break easily.

f. Orient the EPROM with the notch side facing in the proper direction. Looking through the top of the unit with the display to the right the notched side of the EPROM would be facing you. The outline on the pc board below the socket also shows the proper orientation and the location of the notched side.

CAUTION: If the EPROM is not oriented correctly when it is inserted, it will get damaged when power is applied to the unit.

g. Carefully place the pins in the socket making sure they all fit in the socket before pushing down. Slowly push down on the EPROM from the 2 short sides making sure no pins are being bent.

h. Make sure the EPROM is seated properly or it may get dislodged during or after reassembly.

i. In the instruction manual follow paragraph 1.2 in reverse and then paragraph 1.1 in reverse to reassemble the unit.

j. Completely re-initialize the unit by holding down the "star" key while turning on the power to the unit. The controller should display "init" after the software version number while powering up.

k. Completely re-program the unit following the instructions in Section 3 - Operation.

4.2 Switch and Jumper Settings (See Dwgs. 40.200.001.010, 40.200.150.010, And 40.200.150.020)

The controller has configurable switches and jumpers on each of its three boards. They are factory configured as indicated in the chart below. If your application requires a different setting than those indicated, follow the disassembly instructions and set the switches as needed. See paragraph 4.1, Controller Disassembly and Assembly.

Dwg. 40.200.150.010, the component side of the Power Supply Board, shows the location of JP1. Use the jumper to connect pin 1 to the desired voltage option for Digital Input A. The location of S1 for Input Power Voltage Selection, is also shown.

Dwg. 40.200.150.020, the component side of the Third Board, shows the location of JP5. Use the jumper to connect pin 1 to the desired voltage option for Digital Input B.

Table 4-1. Switch and Jumper Settings for Controller Boards

LOCATION	NAME	FACTORY SETTING	PURPOSE
Power Supply Board	S1	115 V	Voltage Selection
	JP1	115 V	Digital Input A Voltage Selection
	JP2	IN	Enables RC Surge suppressers between
	JP3	IN	relay Common and NO or NC contacts.
	JP4	IN	
	JP5	IN	
	JP6	IN	
	JP7	IN	
	JP8	IN	
CPU Board			
SMD Module	1	OFF	Set for mA input
(MOD1)	2	OFF	
Flow Input	3	OFF	
	4	ON	
	5	ON	
	6	OFF	
SMD Module	1	OFF	Set for Voltage input
(MOD3)	2	ON	
Actuator Fbk.	3	OFF	
	4	OFF	
	5	ON	
	6	OFF	
Third Board	JP1	IN	Enables RC surge suppressers between
	JP2	IN	relay Common and NO or NC contacts
	JP3	IN	
	JP4	IN	
	JP5	115 V	Digital Input B Voltage Selection

4.3 Diagnostics

The controller software is equipped with diagnostic software that allows the operator to test some of the controller sub-systems and to view information concerning the controller performance. For directions on operating the diagnostic software, see the appropriate paragraph in Section 3 - Operation.

4.4 Troubleshooting

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING PRECAUTIONS:

TROUBLESHOOTING OF THE CONTROLLER, SIGNALS AND SOURCE POWER IS PERFORMED WITH A METER. ONLY PERSONNEL WHO ARE TRAINED WITH THIS EQUIPMENT AND WHO HAVE A COMBINED KNOWLEDGE OF PROPER SAFETY PRECAUTIONS AND USF/W&T EQUIPMENT SHOULD PERFORM ANY TESTING AND/OR TROUBLESHOOTING.

TO AVOID ELECTRICAL SHOCK, TURN POWER OFF AND DISCONNECT SOURCE POWER BEFORE SERVICING.

ALL WIRING MUST CONFORM TO LOCAL AND NATIONAL ELECTRICAL CODE (NEC) STANDARDS.

Table 4-2. Troubleshooting

TROUBLE	REMEDY
THE CONTROLLER DISPLAYS A "LOSS OF FLOW" OR "LOSS OF RESIDUAL" MESSAGE, BUT THESE SIGNALS ARE PRESENT AT THE CONTROLLER INPUTS.	Verify input configuration is set to the proper value.
	Verify polarity of input wiring.
	Verify that the flow voltage/current switch is set properly on module MOD1.
NO ACTIVITY ON ANY OF THE CONTROLLER DISPLAYS (DIGITS, ALPHANUMERICS, ANNUNCIATORS OR BAR GRAPH).	Verify power is present at the controller.
	Verify continuity of fuse(s).
	Verify that input voltage switch on the power supply board is set to the proper voltage (115 or 230).

Table 4-2. Troubleshooting (Cont'd)

TROUBLE	REMEDY
CONTROLLER DOES NOT AUTOMATICALLY POSITION THE ACTUATOR.	Verify that the controller is in automatic mode.
	Verify that the controller is not in shutdown (absence of SHUTDOWN message).
	Verify that the actuator motor is engaged (absence of DISENGAGED message).
	Verify lag time settings.
	Verify sensitivity setting.
	Verify that the actuator position is not already at 0 or 100%.
	Verify that one of the actuator limit switches is not activated.
	Check relay C and D. Replace relays as necessary.
CONTROLLER DISPLAY FLASHES ALARM MESSAGE CONTINUOUSLY AND KEYPAD DOES NOT WORK.	Acknowledge alarm by pressing alarm acknowledge key.
WHEN IN MANUAL AND TRYING TO POSITION THE ACTUATOR USING THE KEYPAD, ACTUATOR POSITION DOES NOT MOVE.	Actuator position can be moved from keypad only when the following conditions hold: 1) controller is in manual 2) motor is engaged 3) display shows actuator position and “>” is showing to left of value.
CONTROLLER CAUSES ACTUATOR POSITION TO OSCILLATE.	Verify that the lag time settings of the controller are greater than or equal to the actual system lag time.
	Reduce the gain settings.
FLOW INPUT WILL NOT WORK CORRECTLY.	Verify CPU board is properly configured for desired flow input signal type.
	Verify that the flow input signal type selection of the INPUT/OUTPUT menu is set correctly.
CONTROLLER CAUSES ACTUATOR TO RUN TO EXTREME (0 OR 100%) AND REMAINS THERE.	Verify control action selection of the residual input setup is set correctly.

WARNING LABELS

The following warning labels and tags are attached to the equipment:

L2016: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, TURN POWER OFF BEFORE SERVICING.

L2257: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, TURN POWER OFF BEFORE SERVICING.

P59440: SEE INSTRUCTION BOOK FOR PROPER FUSE RATING.

P60056: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, SEE INSTRUCTION BOOK FOR PROPER FUSING WHEN CHANGING LINE VOLTAGE.

AKG5924: TO AVOID POSSIBLE SEVERE PERSONAL INJURY FROM ELECTRICAL SHOCK, TURN POWER OFF FROM ALL SOURCES INCLUDING CONTACTS BEFORE SERVICING.

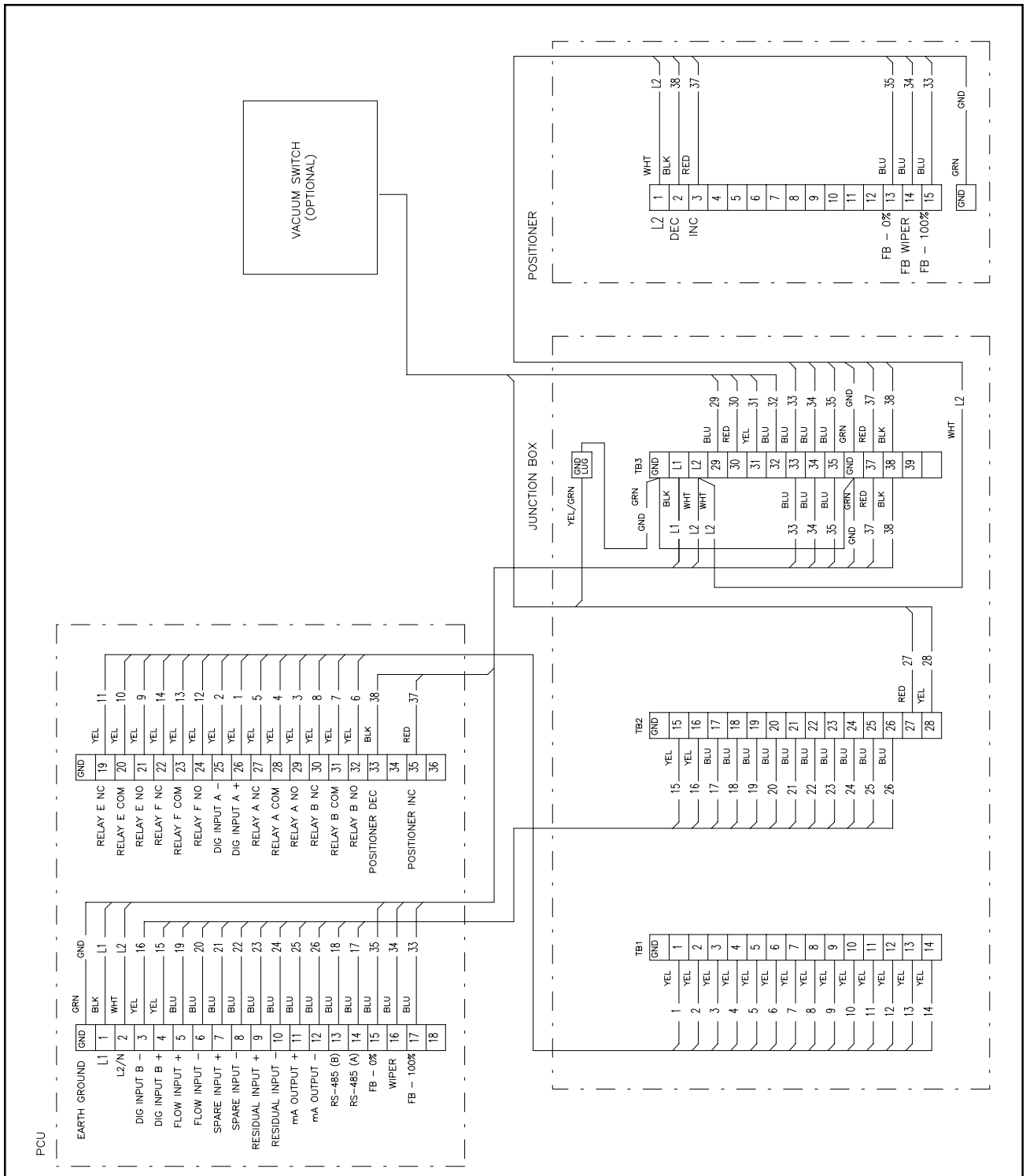
KEEP COVER SECURELY TIGHTENED WHEN EQUIPMENT IS IN OPERATION.

THIS ENCLOSURE IS NEMA 4X RATED.

GASKET SEAL MUST BE MADE IN ORDER TO PROTECT THE INTERNAL COMPONENTS FROM MOISTURE.

TO PREVENT POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THE INSTRUCTION BOOK PROVIDED.

METAL CONDUIT MUST BE BONDED TO GROUND. OTHERWISE USE NONMETALLIC CONDUIT.

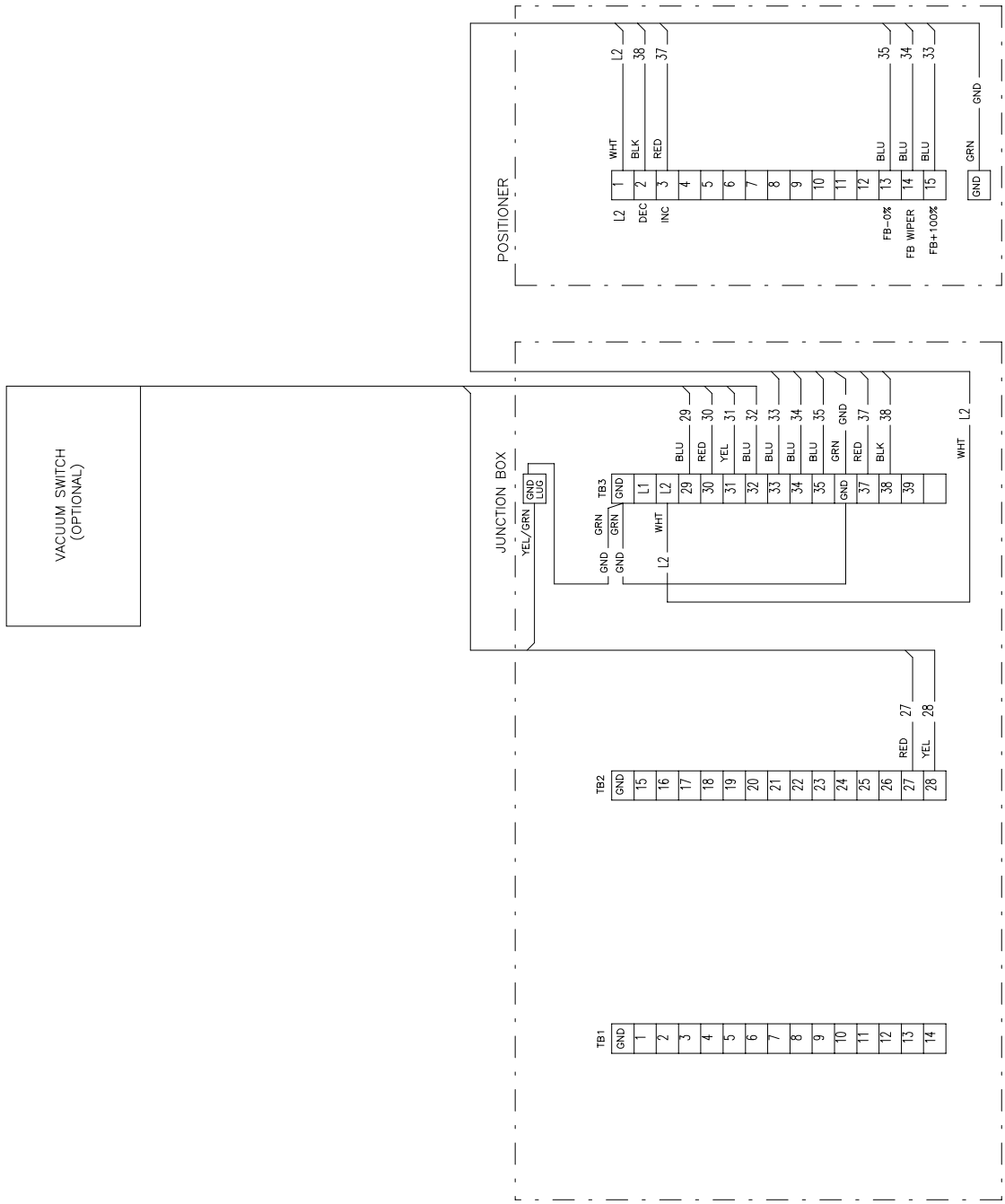


NOTE: ——— WIRING BY USF/W&T.

PCU CONTROLLER IN WALL-MOUNTED V2000 GAS FEEDER - WIRING

40.200.140.050

ISSUE 0 8-98

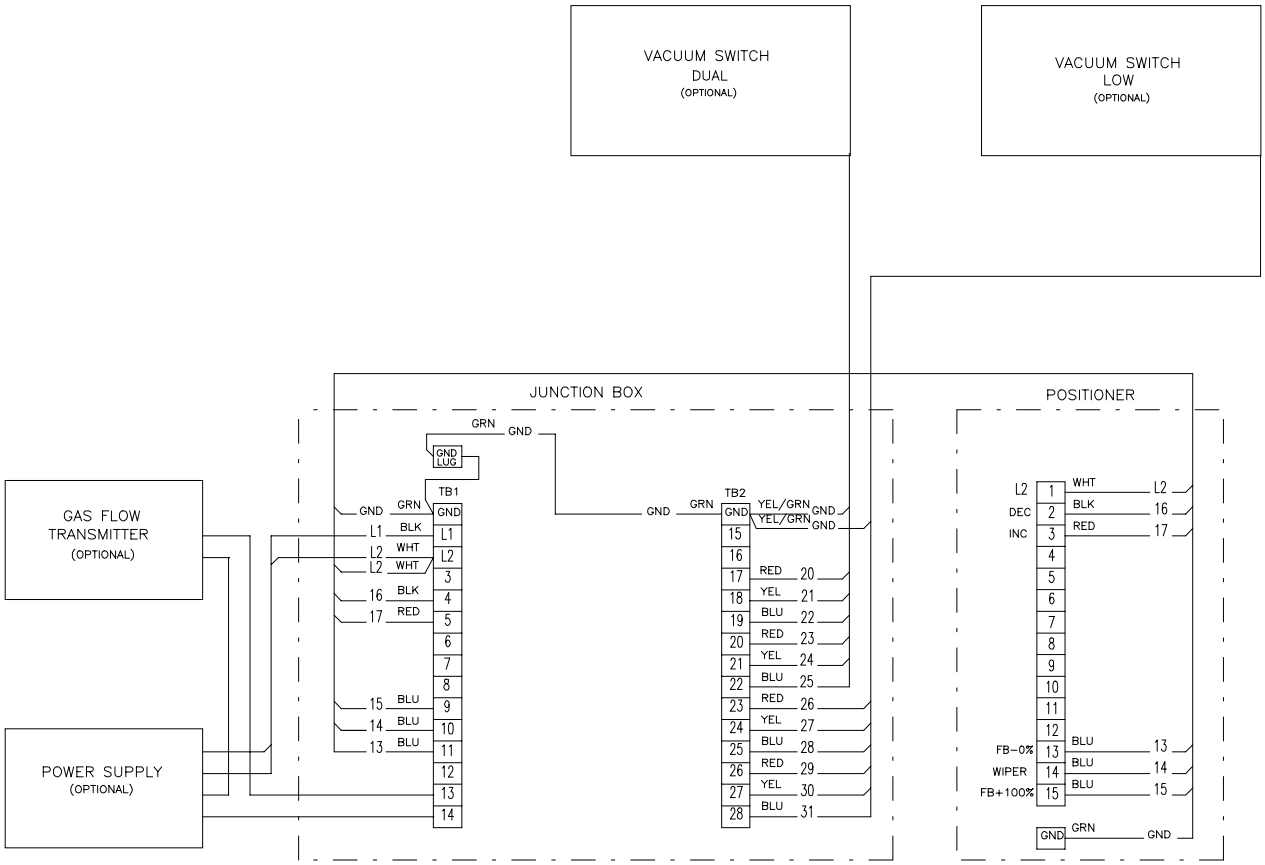


NOTE: ——— WIRING BY USF/W&T.

REMOTE-MOUNTED CONTROLLER / V2000 WALL-MOUNTED GAS FEEDER - WIRING

40.200.140.060

ISSUE 0 8-98

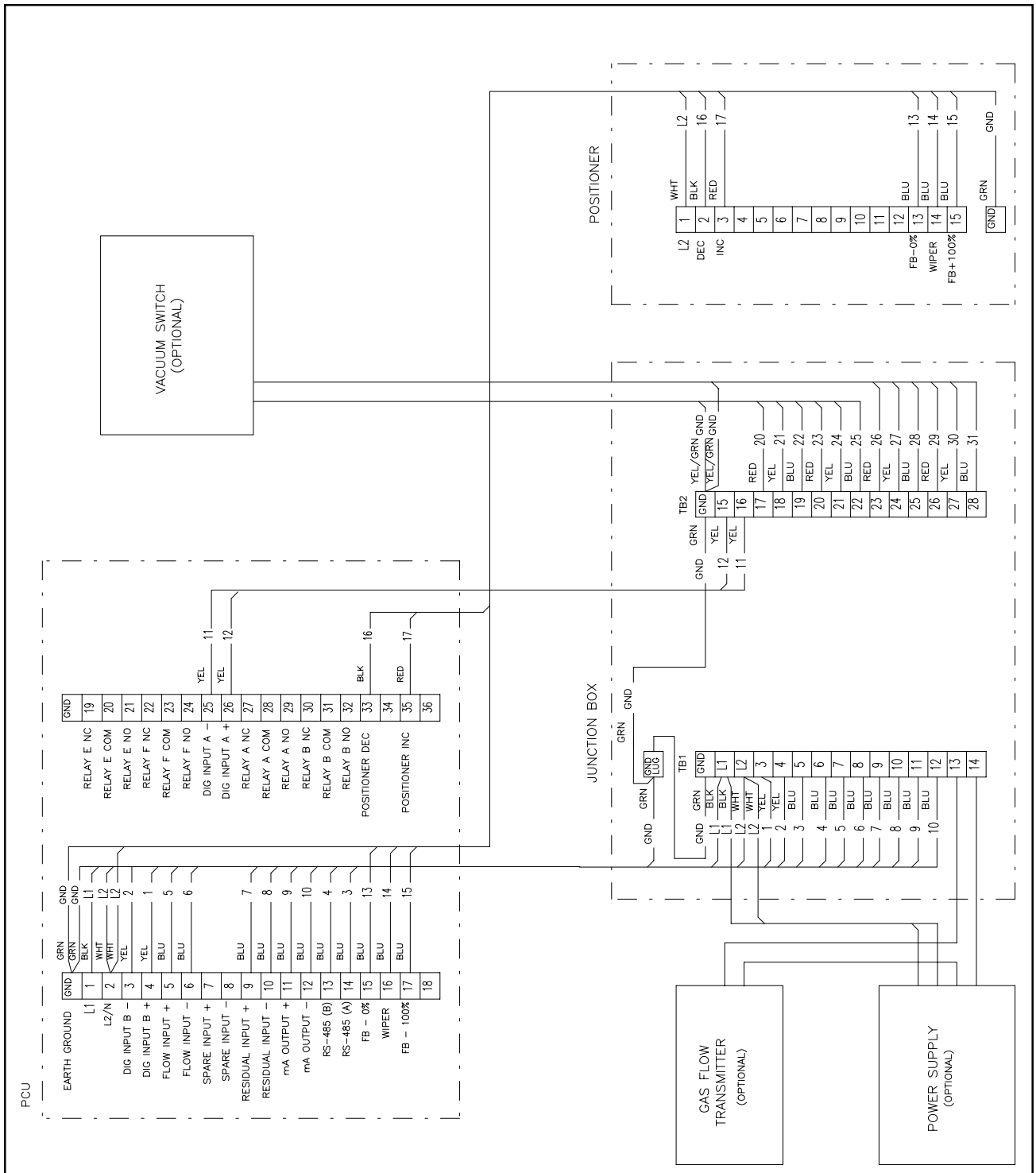


NOTE: ——— WIRING BY USF/W&T.

REMOTE-MOUNTED CONTROLLER / V2000 MODULE-MOUNTED GAS FEEDER - WIRING

40.200.140.070

ISSUE 0 8-98

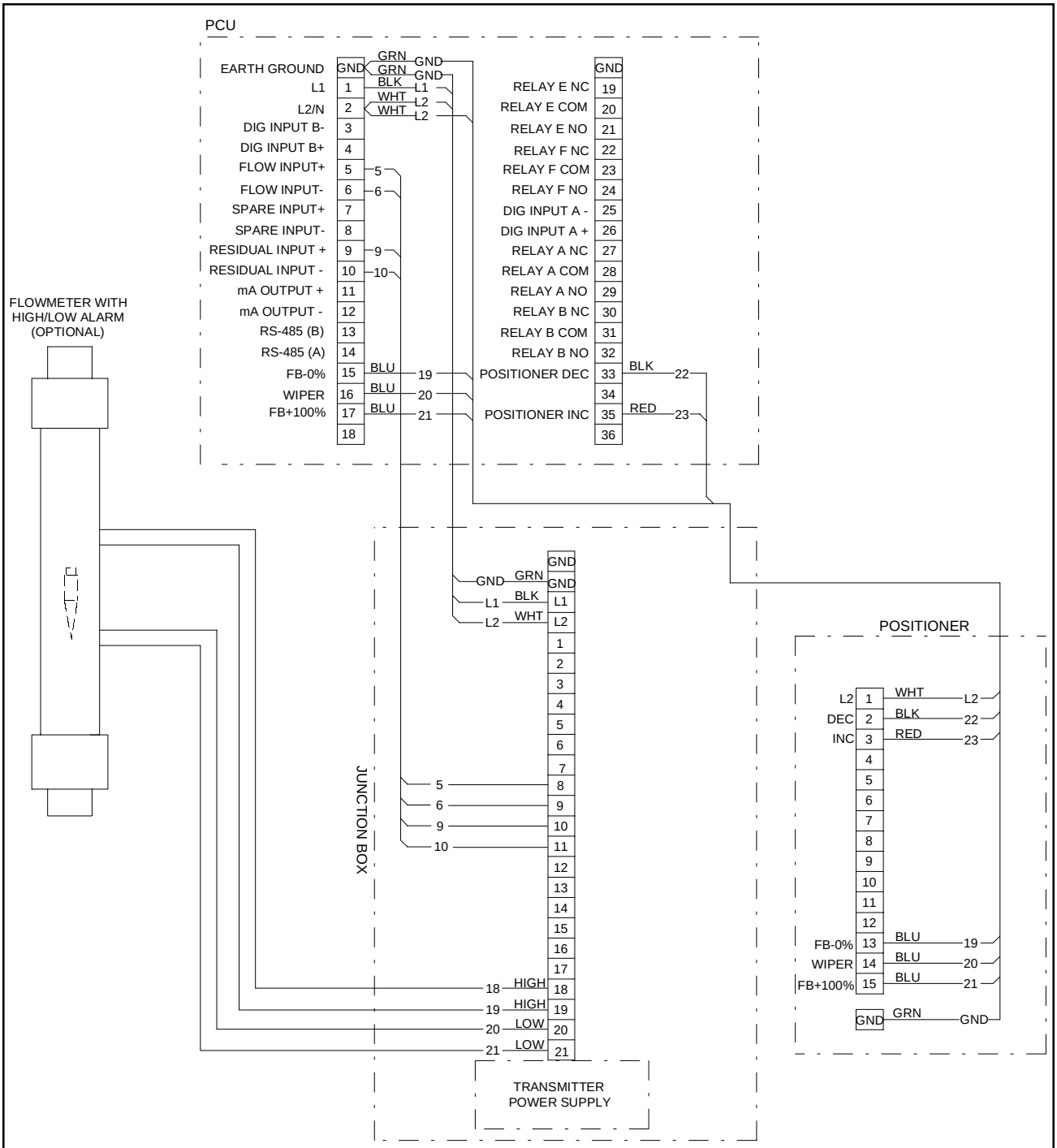


NOTE: ——— WIRING BY USF/W&T.

PCU CONTROLLER IN MODULE-MOUNTED V2000 GAS FEEDER - WIRING

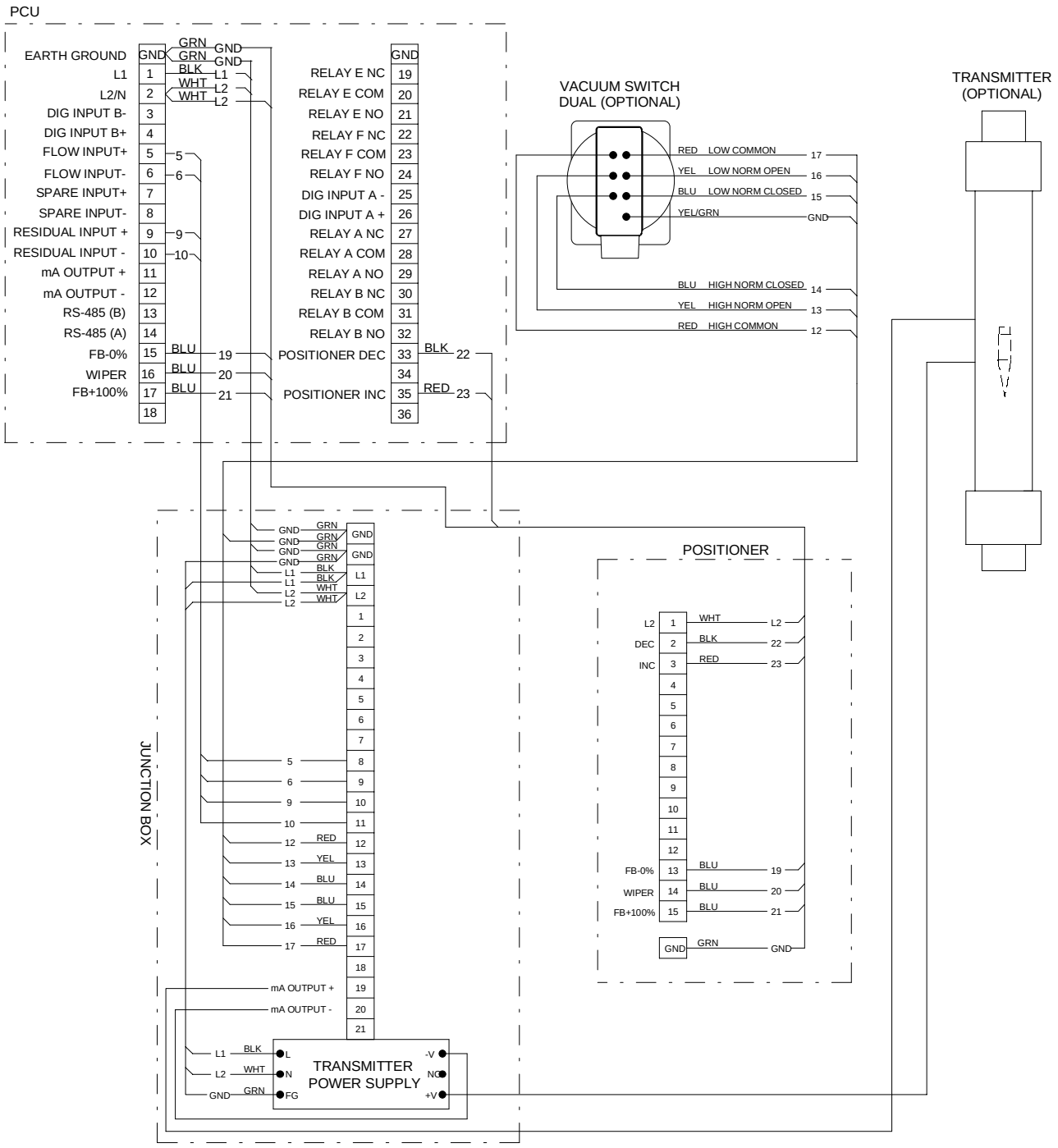
40.200.140.080

ISSUE 0 8-98



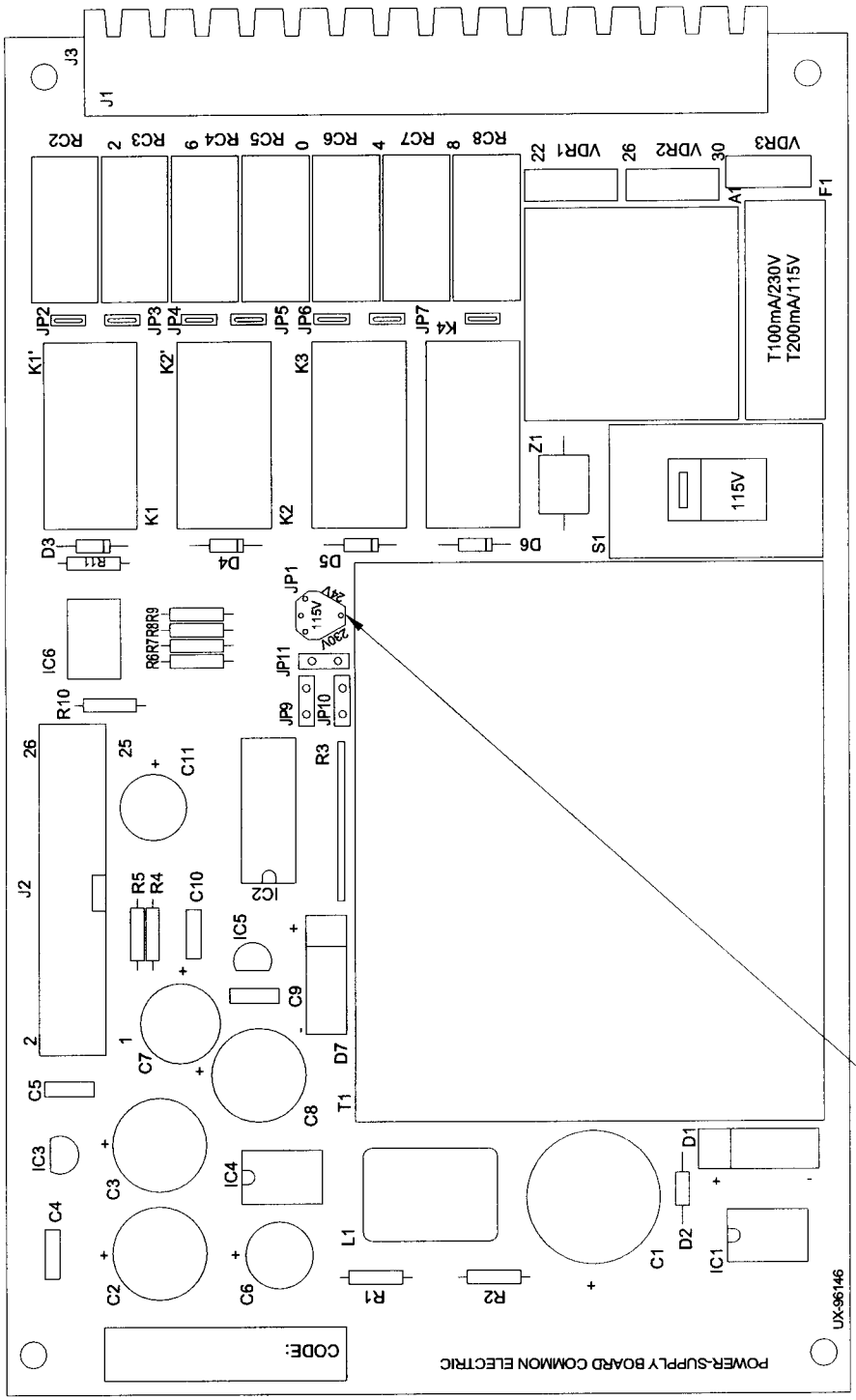
PANEL MOUNTED PCU CONTROLLER
WITH OPTIONAL DUAL ALARM SWITCH
LVN-2000 LIQUID CHEMICAL FEED SYSTEM
- WIRING

40.200.141.010
ISSUE 0 08-00



PANEL MOUNTED PCU CONTROLLER
WITH OPTIONAL VACUUM SWITCH AND FLOW TRANSMITTER
LVN-2000 LIQUID CHEMICAL FEED SYSTEM - WIRING

40.200.141.020
ISSUE 0 08-00



DIGITAL INPUT A JUMPER/ENERGIZE OPTIONS

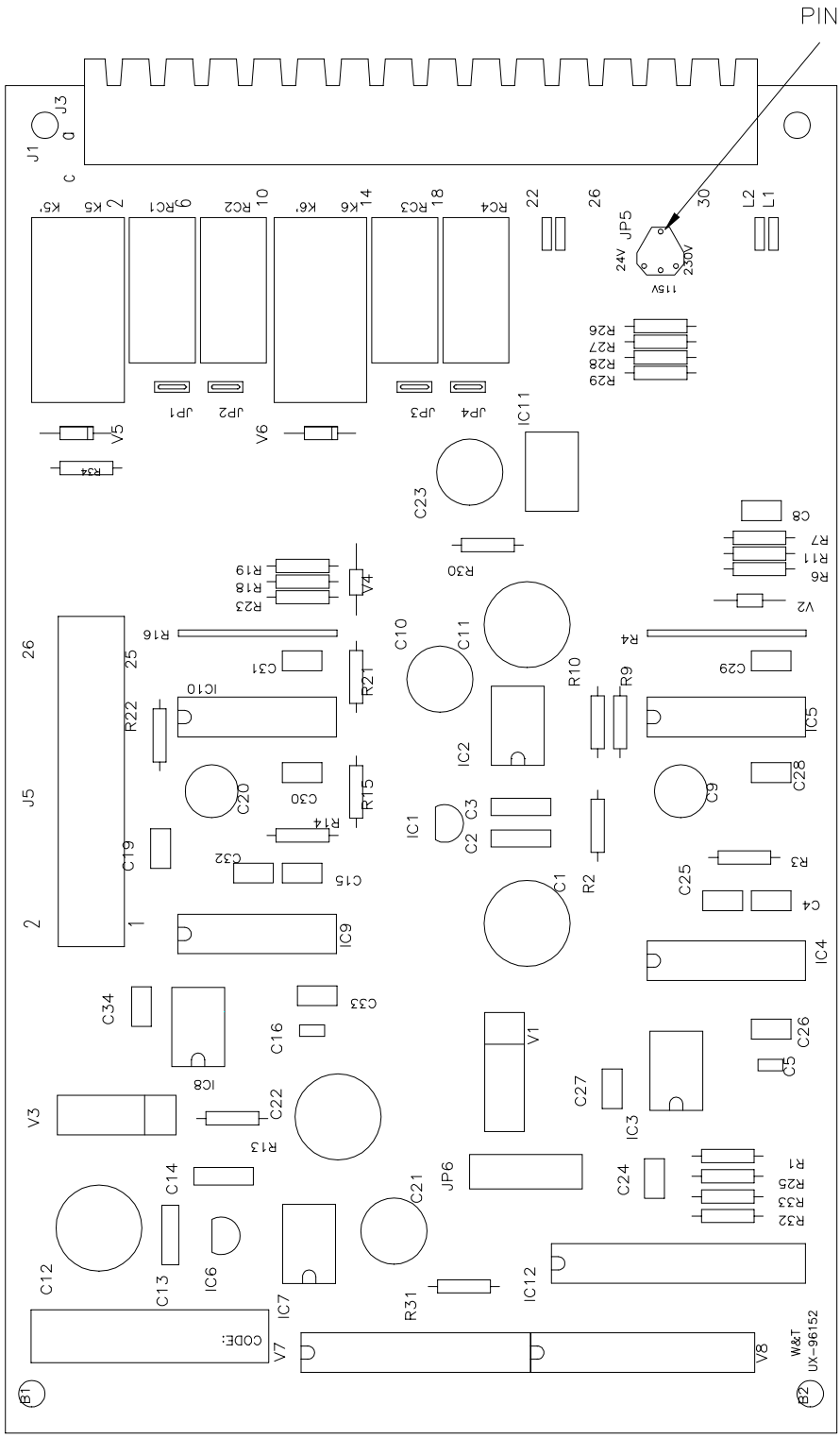
JP9	JP10	JP11	JP1 jump pins	Digital Input A Voltage
Out	Out	In	1-230V	230Vac/dc
Out	Out	In	1-115V	115Vac/dc
Out	Out	In	1-24V	24Vac/dc
In	In	Out	Out	Dry Contact (no voltage)

POWER SUPPLY BOARD - COMPONENT SIDE

DIGITAL INPUT A - JUMPER/ENERGIZE OPTIONS - SERVICE

40.200.150.010

ISSUE 1 12-99



THIRD BOARD – COMPONENT SIDE

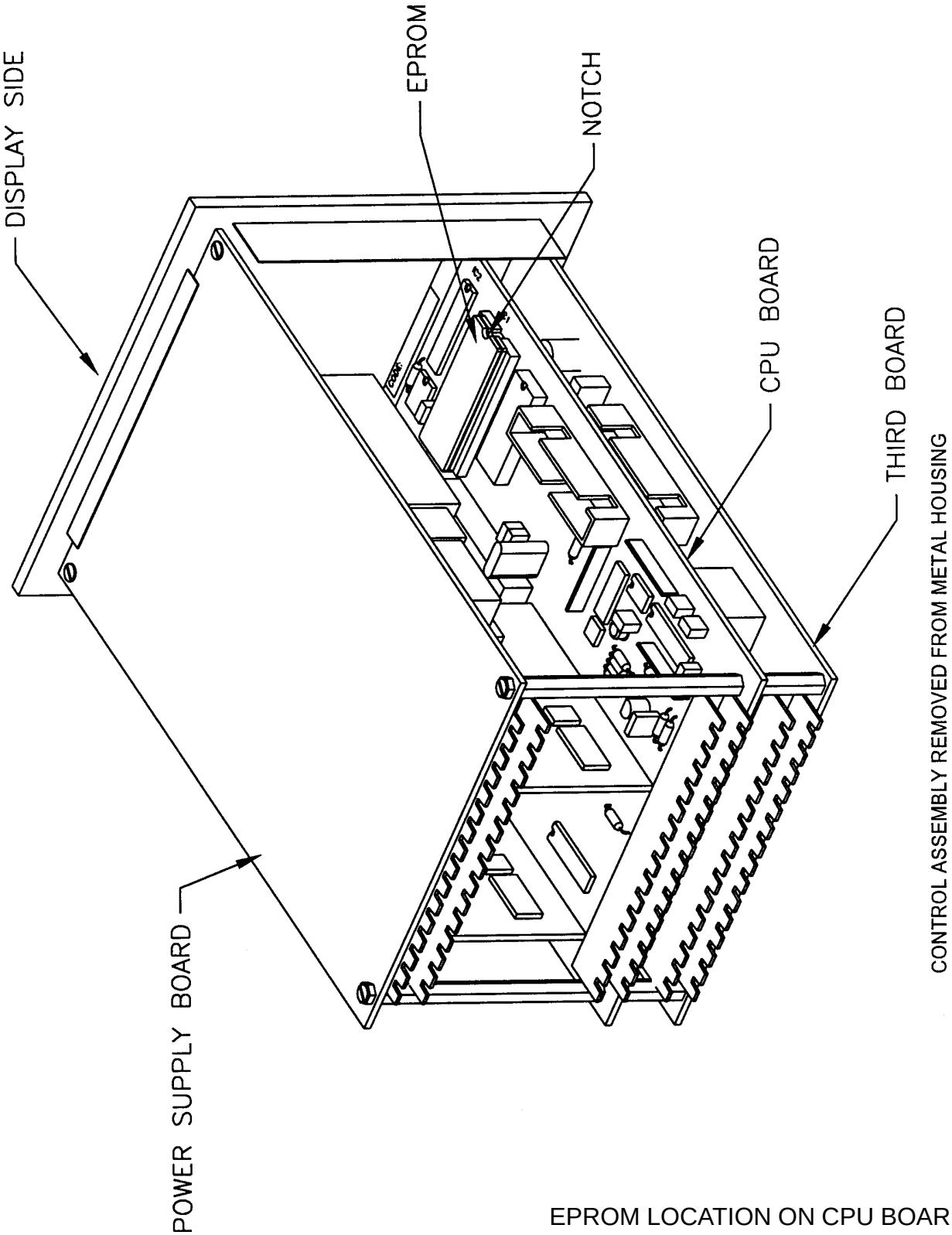
JP5
DIGITAL INPUT B
VOLTAGE OPTIONS

JUMP PINS	VOLTAGE OPTION
1-230V	230VAC/DC
1-115V	115VAC/DC
1-24V	24VAC/DC

JP5 - DIGITAL INPUT B - VOLTAGE OPTIONS - SERVICE

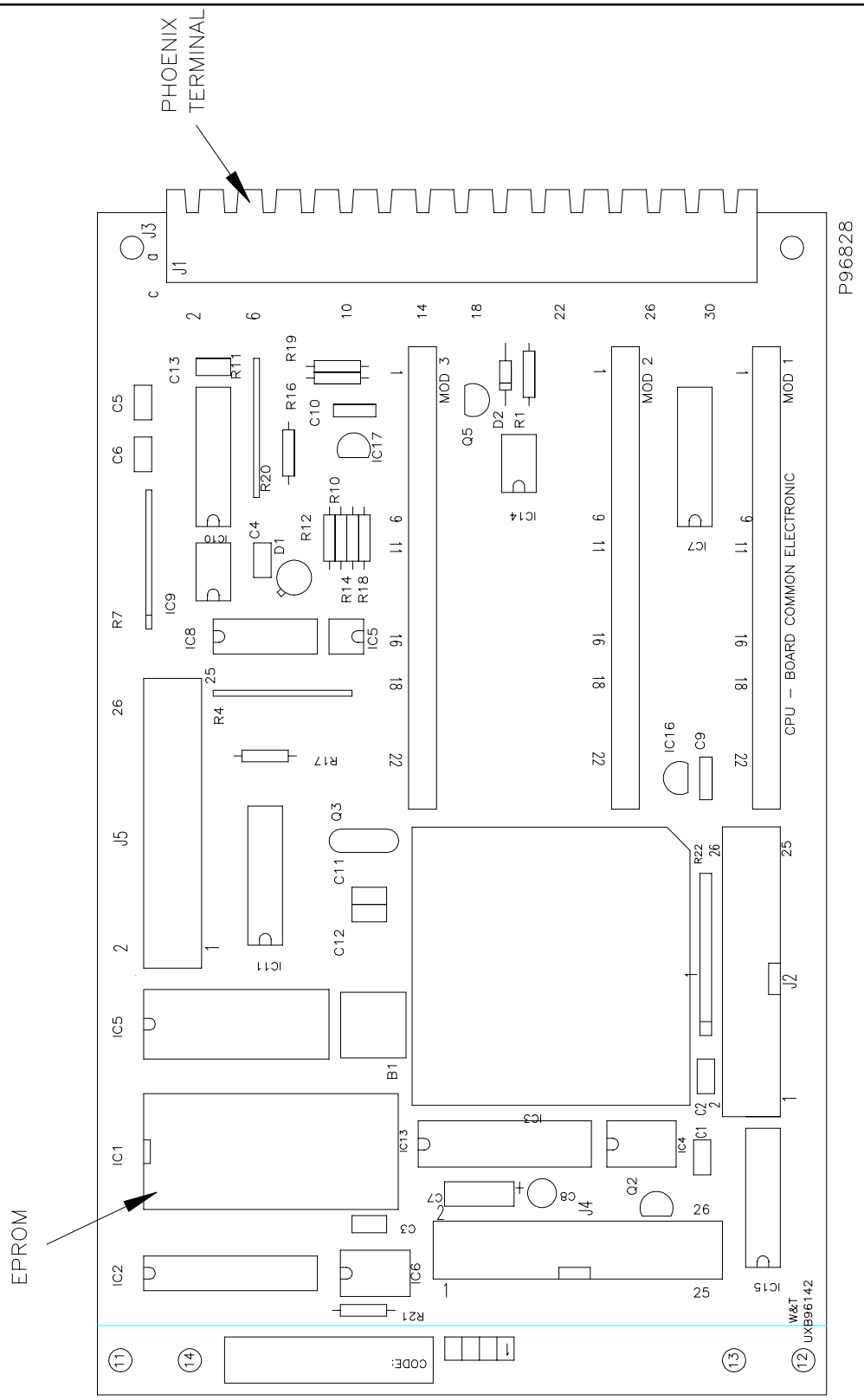
40.200.150.020

ISSUE 0 3-97



EPROM LOCATION ON CPU BOARD
- SERVICE

40.200.150.030
ISSUE 0 3-97



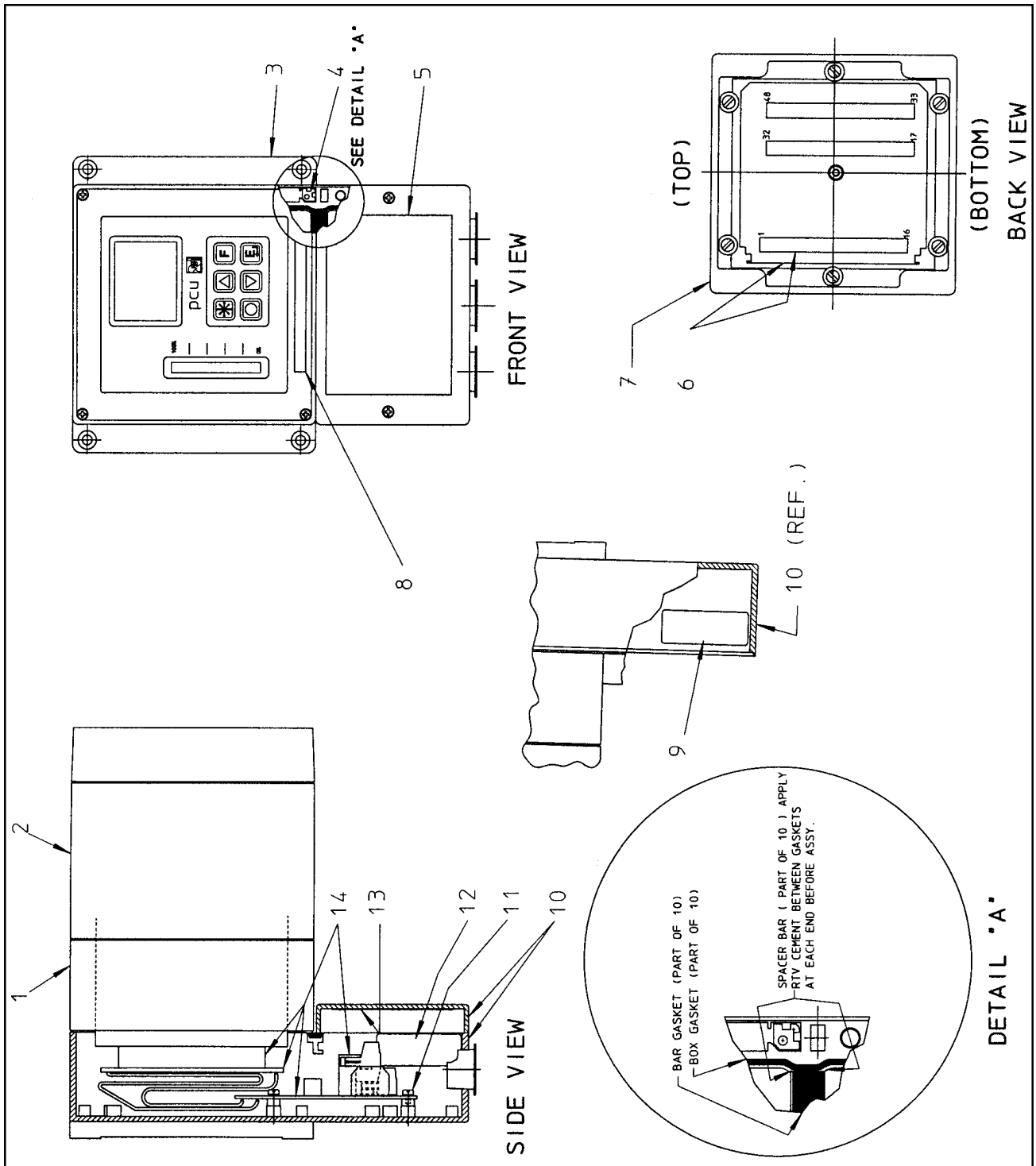
CPU BOARD - COMPONENT SIDE - SERVICE

40.200.150.040

ISSUE 0 3-97

SECTION 5 - ILLUSTRATIONS

List Of Contents



NOTE: FOR PARTS LIST, SEE DWG. 40.200.000.010B.

AOO3629 - 115VAC; AMK3623 - 230VAC

PROCESS CONTROLLER UNIT - PARTS

40.200.000.010A

ISSUE 0 4-95

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	AKG 5136	1	CENTER SECTION (2.01)
2	AOO 5142	1	CENTER SECTION (3.44)
3	APQ 5131	1	WALL MOUNTING FRAME
4	AIA 5295	4	TIE BAR, 6.36 LG.
5	AKG 5924	1	WARNING LABEL
6	APS 5149	1	CONTROL UNIT, 115 VAC (SEE DWG. 40.200.001.010)
	OR		
	ALI 5155	1	CONTROL UNIT, 230 VAC (SEE DWG. 40.200.001.010)
7	APS 5122	1	OPEN FRONT FRAME
8	L 2257	1	WARNING LABEL
9	L 2016	1	WARNING LABEL
10	AOO 5158	1	DEEP REAR COVER
11	--------	4	SCR. M3X10 (SS) PAN HD.
12	P 59440	1	CAUTION LABEL
13	AIA 5920	1	TERMINAL POSITIONS LABEL
14	APS 5870	1	TERMINAL PRINTED CIRCUIT BOARD (SEE DWG. 40.200.001.020)

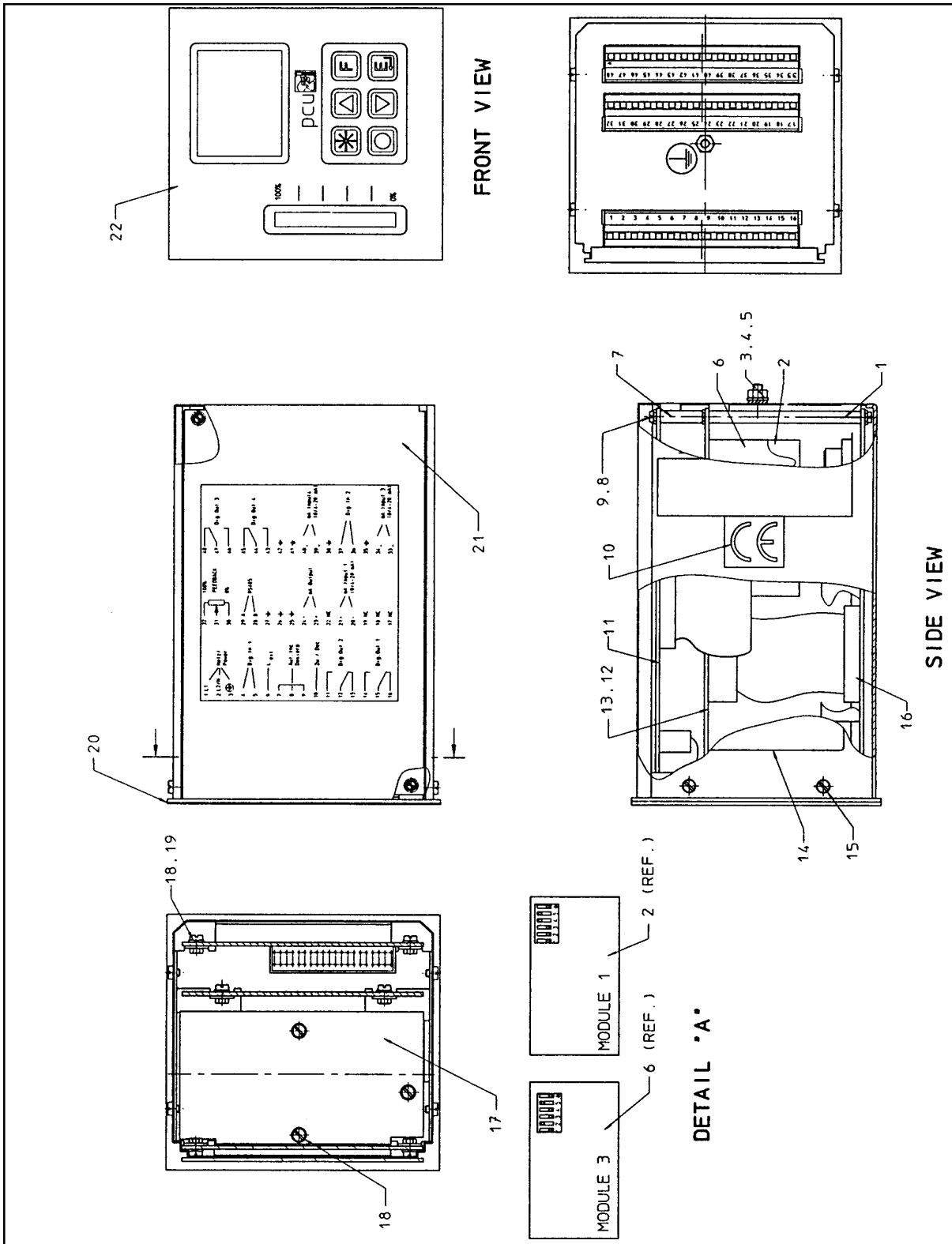
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

AOO3629 - 115VAC; AMK3623 - 230VAC

PROCESS CONTROLLER UNIT - PARTS LIST

40.200.000.010B

ISSUE 0 4-95



NOTE: FOR PARTS LIST, SEE DWG. 40.200.000.020B.

APS5149 - 115VAC; ALI5155 - 230VAC

CONTROL UNIT - PARTS

40.200.001.010A

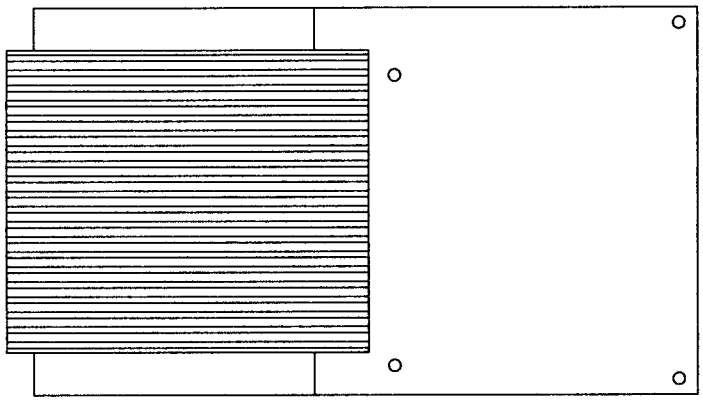
ISSUE 0 4-95

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	----	2	STANDOFF, M2.5 x 63
2	U 96120	1	SMD - MODULE
3	----	1	NUT, M4
4	----	1	WASHER, 4.3mm
5	----	1	LOCKWASHER, FORM J 4.3mm
6	U 96120	1	SMD - MODULE
7	----	2	STANDOFF, M2.5 x 18.8
8	----	6	LOCKWASHER, FORM A, 2.7mm
9	----	4	SCREW, PAN HD. M2.5 x 5
10	L 90245	1	CD - LOGO
11	UXD 96152	1	3RD BOARD
12	----	1	EPROM
13	----	1	CPU
14	P 60056	1	WARNING LABEL
15	----	4	SCREW, PAN HD. M3 x 3
16	UXC 96146	1	POWER SUPPLY, 230V
	OR		
	UXD 96146	1	POWER SUPPLY, 115V
17	U 96345	1	DISPLAY, MFA, PCU
18	----	13	SCREW, PAN HD. M3 x 5
19	----	10	LOCKWASHER, FORM A, 3.2mm
20	AKG 5037	1	FRONTPLATE
21	P 96911	1	METAL HOUSING
22	AAA 4760	1	KEYPAD

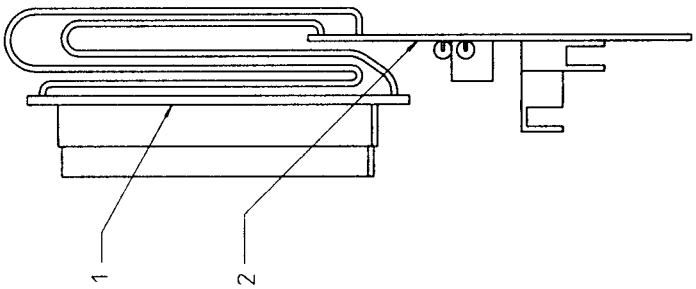
WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

APS5149 - 115VAC; ALI5155 - 230VAC
CONTROL UNIT - PARTS LIST

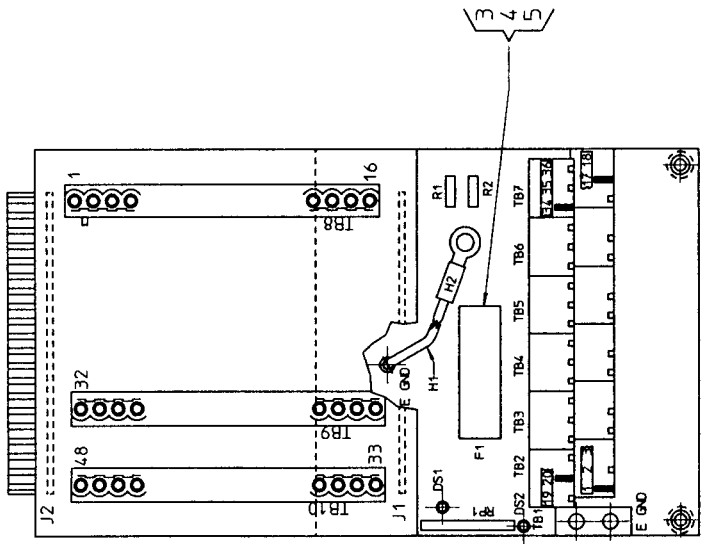
40.200.001.010B
ISSUE 2 02-00



REAR VIEW



SIDE VIEW



FRONT VIEW

KEY NO.	PART NO.	QTY.	DESCRIPTION
1	AOO 3006	1	CONNECTOR
2	AMK 2999	1	TERMINAL
3	P 96993	1	FUSE HOLDER
4	UXL 92568	1	FUSE, 0.5A SLO-BLO
5	P 96994	1	FUSE COVER

WHEN ORDERING MATERIAL, ALWAYS SPECIFY MODEL AND SERIAL NUMBER OF APPARATUS.

TERMINAL PRINTED CIRCUIT BOARD - PARTS

40.200.001.020

ISSUE 0 4-95

SECTION 6 - SPARE PARTS LIST

QTY	DESCRIPTION	PART NO.
1	Relay	PXE96829
1	Terminal Board Fuse, 115/230 Vac (0.5 amp)	UXL92568
1	Power Supply Board Fuse, 115 Vac (200 mA)	UXG92568
	or	
1	Power Supply Board Fuse, 230 Vac (100 mA)	UXD92568
1	Power Supply Board, 115 Vac	UXD96146
	or	
1	Power Supply Board, 230 Vac	UXC96146
1	CPU Board	UXB96142
1	Third Board	UXD96152
1	Terminal Board Assembly (RTV Sealer Included)	APS5870
1	Display Board	U96345
1	EPROM, PCU	AAA7319
1	Keypad	AAA4760