

FLOWSTAR 2001™

USER'S MANUAL



HP-218
February 2004

HOFFER
Flow Controls

Perfecting Measurement™

107 Kitty Hawk Lane • P.O. Box 2145 • Elizabeth City, NC 27909
1-800-628-4584 • (252) 331-1997 • Fax (252) 331-2886
www.hofferflow.com email: info@hofferflow.com

Notice

HOFFER FLOW CONTROLS, INC. MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

This manual has been provided as an aid in installing, connecting, calibrating, operating, and servicing this unit. Every precaution for accuracy has been taken in the preparation of this manual; however, HOFFER FLOW CONTROLS, INC. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that may result from the use of the products in accordance with information contained in the manual.

HOFFER FLOW CONTROLS' policy is to provide a user manual for each item supplied. Therefore, all applicable user manuals should be examined before attempting to install or otherwise connect a number of related subsystems.

During installation, care must be taken to select the correct interconnecting wiring drawing. The choice of an incorrect connection drawing may result in damage to the system and/or one of the components.

Please review the complete model number of each item to be connected and locate the appropriate manual(s) and/or drawing(s). Identify all model numbers exactly before making any connections. A number of options and accessories may be added to the main instrument, which are not shown on the basic user wiring. Consult the appropriate option or accessory user manual before connecting it to the system. In many cases, a system wiring drawing is available and may be requested from HOFFER FLOW CONTROLS.

This document contains proprietary information, which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated to another language without the prior written consent of HOFFER FLOW CONTROLS, INC.

HOFFER FLOW CONTROLS' policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering. The information contained in this document is subject to change without notice.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the Hoffer Flow Controls Customer Service Department, telephone number (252) 331-1997 or 1-800-628-4584. BEFORE RETURNING ANY PRODUCT(S) TO HOFFER FLOW CONTROLS, PURCHASER MUST OBTAIN A RETURNED MATERIAL AUTHORIZATION (RMA) NUMBER FROM HOFFER FLOW CONTROLS' CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned RMA number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting HOFFER FLOW CONTROLS:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS OR **CALIBRATIONS**, consult HOFFER FLOW CONTROLS for current repair/calibration charges. Have the following information available BEFORE contacting HOFFER FLOW CONTROLS:

1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

LIMITED WARRANTY

HOFFER FLOW CONTROLS, INC. ("HFC") warrants HFC's products ("goods") described in the specifications incorporated in this manual to be free from defects in material and workmanship under normal use and service, but only if such goods have been properly selected for the service intended, properly installed and properly operated and maintained. This warranty shall extend for a period of (1) year from the date of delivery to the original purchaser (or eighteen (18) months if the delivery to the original purchaser occurred outside the continental United States). This warranty is extended only to the original purchaser ("Purchaser"). *Purchaser's sole and exclusive remedy is the repair and/or replacement of nonconforming goods as provided in the following paragraphs.*

In the event Purchaser believes the goods are defective, the goods must be returned to HFC, transportation prepaid by Purchaser, within twelve (12) months after delivery of goods (or eighteen (18) months for goods delivered outside the continental United States) for inspection by HFC. If HFC's inspection determines that the workmanship or materials are defective, the goods will be either repaired or replaced, at HFC's sole determination, free of additional charge, and the goods will be returned, transportation paid by HFC, using the lowest cost transportation available.

Prior to returning the goods to HFC, Purchaser must obtain a Returned Material Authorization (RMA) Number from HFC's Customer Service Department within 30 days after discovery of a purported breach of warranty, but no later than the warranty period; otherwise, such claims shall be deemed waived. See the Return Requests/Inquiries Section of this manual.

If HFC's inspection reveals the goods are free of defects in material and workmanship or such inspection reveals the goods were improperly used, improperly installed, and/or improperly selected for service intended, HFC will notify the purchaser in writing and will deliver the goods back to purchaser upon (i) receipt of Purchaser's written instructions and (ii) the cost of transportation. If Purchaser does not respond within 30 days after notice from HFC, the goods will be disposed of in HFC's discretion.

HFC does not warrant these goods to meet the requirements of any safety code of any state, municipality, or any other jurisdiction, and purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other machines or apparatus.

This warranty shall not apply to any HFC goods or parts thereof, which have been repaired outside HFC's factory or altered in any way, or have been subject to misuse, negligence, or accident, or have not been operated in accordance with HFC's printed instructions or have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications for such goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. HFC SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE RESULTING, DIRECTLY OR INDIRECTLY, FROM THE USE OF LOSS OF USE OF THE GOODS. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, THIS EXCLUSION FROM LIABILITY EMBRACES THE PURCHASER'S EXPENSES FOR DOWNTIME, DAMAGES FOR WHICH THE PURCHASER MAY BE LIABLE TO OTHER PERSONS, DAMAGES TO PROPERTY, AND INJURY TO OR DEATH OF ANY PERSON. HFC NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OR USE OF HFC'S GOODS, AND THERE ARE NO AGREEMENTS OR WARRANTIES COLLATERAL TO OR AFFECTING THE AGREEMENT. PURCHASER'S SOLE AND EXCLUSIVE REMEDY IS THE REPAIR AND/OR REPLACEMENT OF NONCONFORMING GOODS AS PROVIDED IN THE PRECEDING PARAGRAPHS. HFC SHALL NOT BE LIABLE FOR ANY OTHER DAMAGES WHATSOEVER INCLUDING INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TABLE OF CONTENTS

1 INTRODUCTION	5
1.1 INTRODUCTION	5
1.2 PERFORMANCE CHARACTERISTICS	5
1.3 ORDERING INFORMATION	9
1.4 WARRANTY	11
1.5 ENCLOSURE DETAIL	11
1.6 SHIPPING AND HANDLING	12
1.7 ENHANCEMENT FEATURES AND OPTIONS	13
1.7.1 LINEARIZATION	13
1.7.2 VISCOSITY COMPENSATION FOR TURBINE FLOWMETERS	13
1.7.3 INSTRUMENT COMMUNICATION OPTIONS	14
2 OPERATIONS OVERVIEW	15
2.1 INTRODUCTION	15
2.2 HARDWARE CONFIGURATION OF SOFTWARE OPTIONS	15
3 OPERATING MODE	17
3.1 INTRODUCTION	17
3.2 OPERATING MODE KEYBOARD OPERATION	18
3.3 OPERATING MODE LED AND SONIC ALARM OPERATIONS	18
4 SETUP MODE OPERATIONS	19
4.1 KEYBOARD OPERATION	19
4.2 SETUP MODE FIELD TYPES	19
4.3 SETUP MODE FIELD DESCRIPTIONS	19
4.3.1 CH1 TOT CONFIG	20
4.3.2 CH1 RATE CONFIGURE	21
4.3.3 CH1 SMOOTHING	22
4.3.4 CH1 POINT NUMBER	22
4.3.5 FLOW CALC METHOD	22
4.3.6 MASS FLOW METHOD	22
4.3.7 CH1 TABLE SELECT	22
4.3.8 DEF DENS LBS/FT ³	22
4.3.9 BASE DENS LBS/FT ³	23
4.3.10 DEF TEMP DEG R	23
4.3.11 DEF K P/UNIT	23
4.3.12 USER GAL TO UDEF	23
4.3.13 FREQ HZ 1-20	23
4.3.14 KFAC P/GAL 1-20	23
4.3.15 CH2 UNITS	23
4.3.16 CH2 LOW CAL	24
4.3.17 CH2 HIGH CAL	24
4.3.18 CH2 GAS INHIBIT	24
4.3.19 CH2 SMOOTHING	24
4.3.20 CH2 POINT NUMBER	24
4.3.21 CH2 TABLE SELECT	24
4.3.22 CH2 MEA PNT 1-10	24
4.3.23 CH2 CSTK PNT 1-10	24
4.3.24 CH2 LBS/FT ³ PNT 1-10	25
4.3.25 CH3 UNITS	25
4.3.26 CH3 LOW CAL	26
4.3.27 CH3 HIGH CAL	26
4.3.28 CH3 SMOOTHING	26
4.3.29 CH3 POINT NUMBER	26

4.3.30	CH3 MASS FLOW ME	26
4.3.31	CH3 TABLE SELECT	27
4.3.32	CH3 DEN LBS/FT ³	27
4.3.33	CH3 BASE LBS/FT ³	27
4.3.34	CH3 MEA PNT 1-5	27
4.3.35	CH4 UNITS	27
4.3.36	CH4 LOW CAL	27
4.3.37	CH4 HIGH CAL	28
4.3.38	CH4 GAS INHIBIT	28
4.3.39	CH4 SMOOTHING	28
4.3.40	CH4 POINT NUMBER	28
4.3.41	CH4 TABLE SELECT	28
4.3.42	CH4 MEA PNT 1-5	28
4.3.43	CH4 LBS/FT ³ PNT 1-5	28
4.3.44	AUX 1 UNITS AND AUX 2 UNITS	29
4.3.45	AUX1 CONFIG AND AUX2 CONFIG	30
4.3.46	ALARM X SET HIGH	30
4.3.47	ALARM X SET LOW	30
4.3.48	ALARM X DEADBAND	31
4.3.49	ALARM X AUDIBLE	31
4.3.50	DA1 CONFIG AND DA2 CONFIG	31
4.3.51	DAX MAX RANGE	31
4.3.52	CX PULSE WEIGHT	31
4.3.53	RELAY X CONFIG	32
4.3.54	SERIAL MODE	32
4.3.55	SERIAL MODE NUM	32
4.3.56	BAUD RATE	32
4.3.57	HANDSHAKE	33
4.3.58	SERIAL PROTOCOL	33
4.3.59	PASSWORD	33
4.3.60	DATE	33
4.3.61	DAY OF THE WEEK	33
4.3.62	TIME 24-HOUR CLOCK	33
4.3.63	RESTORE NEW UNIT	33
5	INSTALLATION	35
5.1	INSTALLATION WIRING LAYOUT FOR INTERCONNECTIONS	35
5.2	INSTALLATION OF THE FLOWSTAR	35
6	SERIAL COMMUNICATIONS	49
6.1	INTRODUCTION	49
6.2	REMOTE KEYBOARD	49
6.3	HOFFER PROTOCOL	52
6.3.1	CONTROL COMMAND CALLER MESSAGE FORMAT	52
6.3.2	READ DATA COMMAND CALLER MESSAGE FORMAT	53
6.3.3	WRITE DATA COMMAND CALLER MESSAGE FORMAT	54
6.3.4	DATA FORMAT DESCRIPTIONS	54
6.3.5	CHECKSUM DETERMINATION	55
6.3.6	TABLES	56

LIST OF FIGURES

Figure 1.1 Standard Panel Mount Enclosure	11
Figure 1.2 NEMA Enclosure	12
Figure 1.3 Explosion Proof Enclosure	12
Figure 5.1 RS-232/RS-422/RS-485 Wiring Detail	35
Figure 5.2 AC Power Input	36
Figure 5.3 DC Power Input	37
Figure 5.4 Single Magnetic Pickup Input	38
Figure 5.5 Quadrature Magnetic Pickup Input	39
Figure 5.6 MCP Pickup Coil Input	40
Figure 5.7 Remote Signal Conditioner Interface	41
Figure 5.8 Analog Output Connections	42
Figure 5.9 Two Wire Process Transmitter Input Connections	43
Figure 5.10 Three Wire Process Transmitter Input Connections	44
Figure 5.11 Pulse/Alarm Output Wiring	45
Figure 5.12 Pulse/Control Output Wiring	46
Figure 5.13 Control/Alarm Wiring For Batch Control	47
Figure 6.1 Program Item Properties	50
Figure 6.2 Flowstar Crosstalk Window	50
Figure 6.3 System Settings	51
Figure 6.4 Terminal Emulation Settings	51
Figure 6.5 Font Selection	52

LIST OF TABLES

Table 6.1 Unit Definitions	70
----------------------------------	----

1 INTRODUCTION

1.1 INTRODUCTION

The FLOWSTAR Series is a cost effective family of flow products designed to accept inputs from pulse producing or analog producing flowmeters such as turbine, vortex, magnetic, differential pressure, positive displacement, coriolis, ultrasonic and thermal flowmeters. The basic series consists of the following functions.

- Model 2001 Tauri (A) - Volumetric flowrate indicator/totalizer for liquids and gases.

Performance enhancement features such as flowmeter linearization, are available. Such performance enhancement techniques greatly improve the accuracy of the flow measurement system by correcting for known sources of measurement error.

The front membrane panel features a two line 16 character alpha numeric display that indicates function and unit of measure in English or metric units. The display is a backlit LED type with .32" (8.13 mm) character height. The keypad is a bubble switch membrane type and sealed to NEMA 4X rating.

The unit is factory programmed when purchased with a Hoffer turbine flowmeter. This feature should save the user numerous hours of set up time that is associated with other microprocessor based units available in the marketplace. Programming is done through the front panel keyboard, as well as via a two way RS-232 or RS-422/RS-485 multi-drop communication port.

Three analog input channels are available. These three channels can be used for temperature input and an additional flow input. Two analog output signals are available for transmission of process variables to remote data acquisition systems or chart recorders.

Four scaled pulse outputs are provided for such applications as driving a remote flow totalizer or computer pulse input card. High and low alarms are available in either an open collector pulse form or OPTO-22 relay form.

1.2 PERFORMANCE CHARACTERISTICS

DISPLAY

- Two line, 16 char Alpha numeric, LCD, LED backlit
- Character height 0.32", super-twist +/- 20 degree viewing angle, industrial grade, 0 to 70°C.
- Options: Front display heater, less LED backlight for battery supplied operations

ANNUNCIATORS

- 6 LED indicators for high/low flow, temperature.
- 1 piezo electric sonic alarm.

OUTPUTS(4): Output features are designed to meet as wide a variety of user applications as possible. In addition, output module changes can be performed by the end user. Each output will be software selectable from a list of available outputs. **All units will come standard with active low NPN open collector outputs.** For applications requiring additional output capabilities, a selection of on board modular relays will be provided for each output.

OPTIONAL OPTO-22 MODULE SELECTION

AC MODULE FEATURES

- Built in LED status indicator.
- Removable fuse.
- 4000 VAC optical isolation.
- Withstands one second surge @ 5 amps.
- Current rating of 3 Amps at 45°C.
- Line voltage 24 to 280 Vac.
- Operating temperature: -30 to 70°C.

DRY CONTACT MODULE FEATURES

- 100 VDC/130 VAC switching volts.
- 0.5 amps switching current.
- 1.5 amps carry current.
- 5,000,000 cycle life.
- 1500 VDC isolation voltage.
- Operating temperature: 0 to 70°C.

SOFTWARE SELECTABLE OUTPUT CHOICES (select any 4)

FLOW RELATED

- SCALED PULSE OUT.

ALARM RELATED

- ALARM (High and Low setpoints for process control).

AUXILIARY VOLTAGE OUTPUT

- 15 VDC, 60ma, if 12 vdc battery is used this option is not possible.

KEYPAD

- 12 key numeric, 8 key mode control keypad, bubble switch membrane.

INPUT

- Single channel, pulse input, 10 mVrms to 5 Vrms, 10 to 3500 Hz, 50 Kohm input impedance.
- Quadrature detection, pulse input, 10 mVrms to 5 Vrms, 10 to 3500 Hz, 50 Kohm input impedance.
- Optional: MCP pickup.

PROCESS INPUTS(3)

- 1-5Vdc(STD).
- 4-20mA current loop, (Optional).

ANALOG OUTPUTS(2)

- Standard 0-5Vdc.
- 0-10Vdc.
- 4-20mA current loop, meets and exceeds ISA-S50.1 specifications for TYPE 3, Class L and U.

SERIAL COMMUNICATION

- RS-422\RS-485 multi-drop.
- RS-232C, plug in sockets standard.

DIP SWITCH PROGRAMMABLE FEATURES (7)

- Program lockout.
- Remote/Local.
- Input Channel 2.
- Input Channel 3.
- Input Channel 4.
- Output Channel 1.
- Output Channel 2.

SELF DIAGNOSTIC

- Unit checks computer hardware for proper operation (RAM, ROM chksum, RTC test only).
- Unit checks for transmitter signal loss and over-range conditions.

INPUT POWER

- 110/220 VAC 50-60hz selectable on board or 12-24 VDC with external battery.

ENVIRONMENTAL

- 0 to 70°C Operating Temperature, -20 to 80°C Storage Temperature.

ENCLOSURE

- DIN Standard 43700, flame retardant, glass filled Noryl case, Dimensions: 7.4 x 3.6 x 7.25.

1.3 ORDERING INFORMATION

TAURI (A) FLOWSTAR COMPUTER MODEL 2001 MASS TOTALIZER/FLOW RATE COMPUTER FOR LIQUIDS, TEMPERATURE COMPENSATED

MODEL 2001

TOTAL DISPLAY / 10 DIGIT

RATE DISPLAY / 8 DIGIT

ANALOG OUTPUT / SELECT TWO

- (3) 0 - 5 VDC (STANDARD)
- (4) 0 - 10 VDC
- (7) 4 - 20 mA
- (7S) 4 - 12/12 - 20 mA (DUAL UNITS)

COMMUNICATION PORT/ SELECT ONE

- (R2) RS-232
- (R4) RS-485

SCALED DIGITAL OUTPUTS / SELECT FOUR /INCLUDES ALARM OPTIONS

- (1) OPEN COLLECTOR (STANDARD)
- (2) TTL/CMOS
- (3) OPTO-22 /SOLID STATE 4-16V

NUMBER OF CHANNELS

- (1) SINGLE CHANNEL
- (2) DUAL CHANNEL (2 FLOWMETERS)
- * NOTE: SELECT (1) CHANNEL FROM PULSE INPUT
SELECT ADDITIONAL CHANNEL FROM ANALOG INPUTS

PULSE INPUTS / SELECT ONE / ONE FLOWMETER

- (M) MAGNETIC COIL (STANDARD PULSE)
- (RF) MC3P COIL
- (MQ) MAGNETIC QUADRATURE

ANALOG INPUTS (SELECT ONE / DUAL CHANNEL FLOWMETER INPUT)

- (7) 4 - 20 mA (STANDARD)
- (7A) 4 - 20 mA CONFIGURED FOR AUTO RANGE CHANGE/2 CHANNEL

TEMPERATURE COMPENSATION (ANALOG INPUT) (ONE FLUID)

- | | |
|---------------------------|------------------------------|
| (1) CO2 | (2) LIN |
| (3) LOX | (4) LAR |
| (5) ASTM PETROLEUM TABLES | (6) AVIATION FUEL |
| (7) LPG | (8) LNG |
| (9) WATER | (10) FREON (SPECIFY TYPE) |
| (11) ANHYDROUS AMMONIA | (UVC) VISCOSITY COMPENSATION |

ALL TEMPERATURE OPTIONS REQUIRE A 100 OHM OR 1000 OHM RTD AND 4 - 20 mA TRANSMITTER, SEE SIGNAL CONDITIONER SECTION, PAGE 8 FOR MODEL REQUIRED AND PRICE. CONTACT YOUR SALES REPRESENTATIVE FOR LIQUIDS NOT LISTED.

POWER INPUT

- (1) 115 VAC 50/60 HZ
- (2) 220 VAC 50/60 HZ
- () 10.5 TO 24 VDC (INSERT ACTUAL VOLTAGE)
- (3) BATTERY/LEAD ACID, 115VAC RECHARGEABLE/12 HRS OPERATION
LIMITED TO OPEN COLLECTOR OUTPUT AND COMMUNICATION OPTIONS
DISPLAY NOT BACK LIT, PACKAGED IN PORTABLE CASE WITH FLOWSTAR.

INCLUDES
CASE

ALARMS

(HO/LO)	HIGH/LOW	OPEN COLLECTOR
(L)	LOW	OPTO-22 24-240 VAC @ 3 AMPS SPST N/O
(H)	HIGH ALARM	OPTO-22 24-240 VAC @ 3 AMPS SPST N/O
(H/L)	HIGH/LOW ALARM	OPTO-22 24-240 VAC @ 3 AMPS SPST N/O

ENCLOSURE STYLE

(P)	PANEL MOUNT	COMPLIANCES: SEALED TO NEMA 4X
(NI)	FLOWSTAR MOUNTED INTERNALLY AND VISIBLE THROUGH WINDOW	COMPLIANCES: NEMA 3, 4X, 12 FIBERGLASS
(ND)	FLOWSTAR MOUNTED ON DOOR AND SEALED WITH KEYPAD ACCESSIBLE	COMPLIANCES: NEMA 3, 4X, 12 FIBERGLASS
(E)	EXPLOSION PROOF	COMPLIANCES: NEC CLASS I, GROUPS B, C & D CLASS II, GROUPS E, F, & G CLASS III, UL STANDARD 886 CSA STANDARD C22.2 NO. 30 & NEMA 4
(C)	PORTABLE (INCLUDES MATING CONNECTORS)	

ACCESSORIES/OPTIONS

(F)	FLOWMETER MOUNTED FOR (N) & (E) ENCLOSURES ONLY INCLUDES MOUNTING HUB & FLOWMETER RISER
(H)	HEATERS FOR (N) & (E) ENCLOSURES ONLY
(MS)	CONNECTORS FOR (N) ENCLOSURE ONLY INCLUDES MATING CONNECTORS

1.4 WARRANTY

Hoffer Flow Controls warrants that all equipment will be free from defects in workmanship and material provided that such equipment was properly selected for the service intended, properly installed, and not misused. Equipment which is returned transportation prepaid to Hoffer Flow Controls within 12 months after delivery of goods, or 18 months from date of shipment on equipment for destination outside the United States, and is found by Hoffer Flow Controls inspection to be defective in workmanship or material, will be repaired or replaced at Hoffer Flow Controls' sole option, free of charge and returned shipped using the lowest cost transportation prepaid.

In the event of product failure contact Hoffer Flow Controls at 919-331-1997 or 800-628-4584, for issuance of a **Returned Material Authorization (RMA)** number.

1.5 ENCLOSURE DETAIL

Figure 1.1 Standard Panel Mount Enclosure

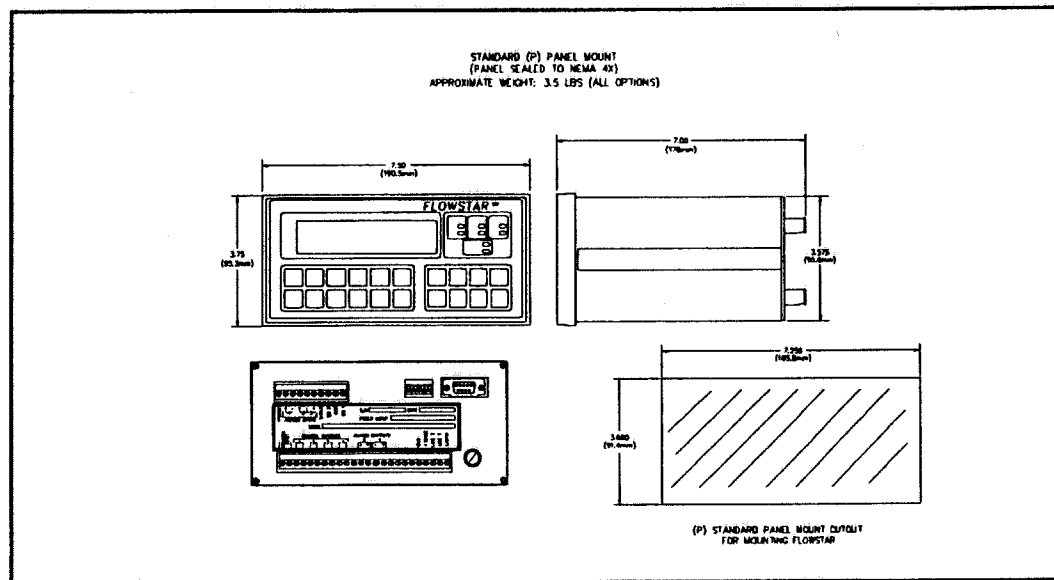


Figure 1.2 NEMA Enclosure

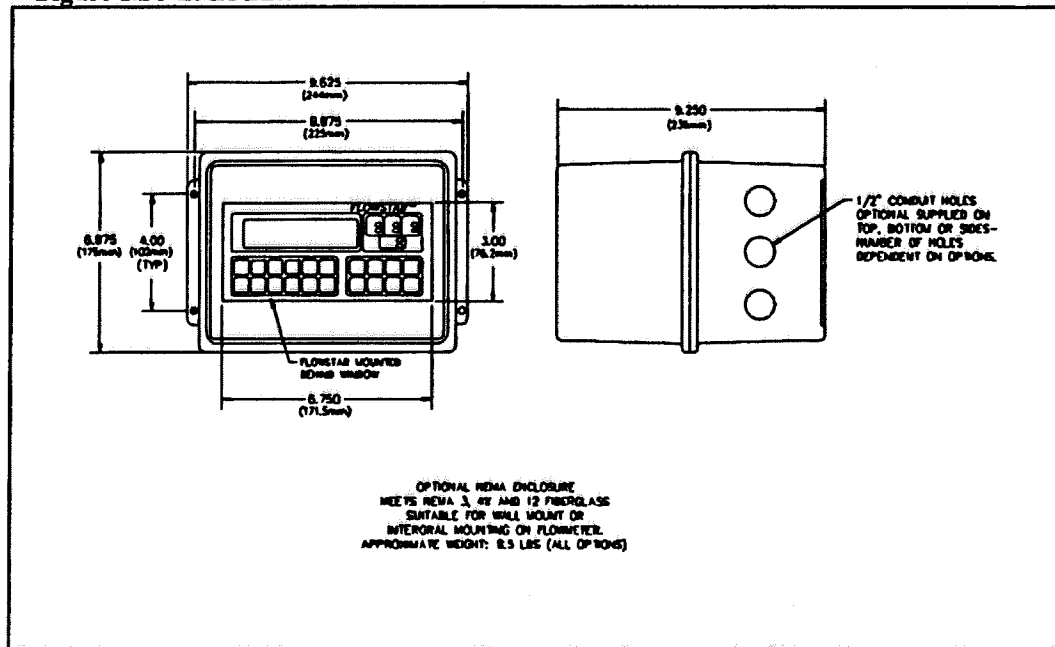
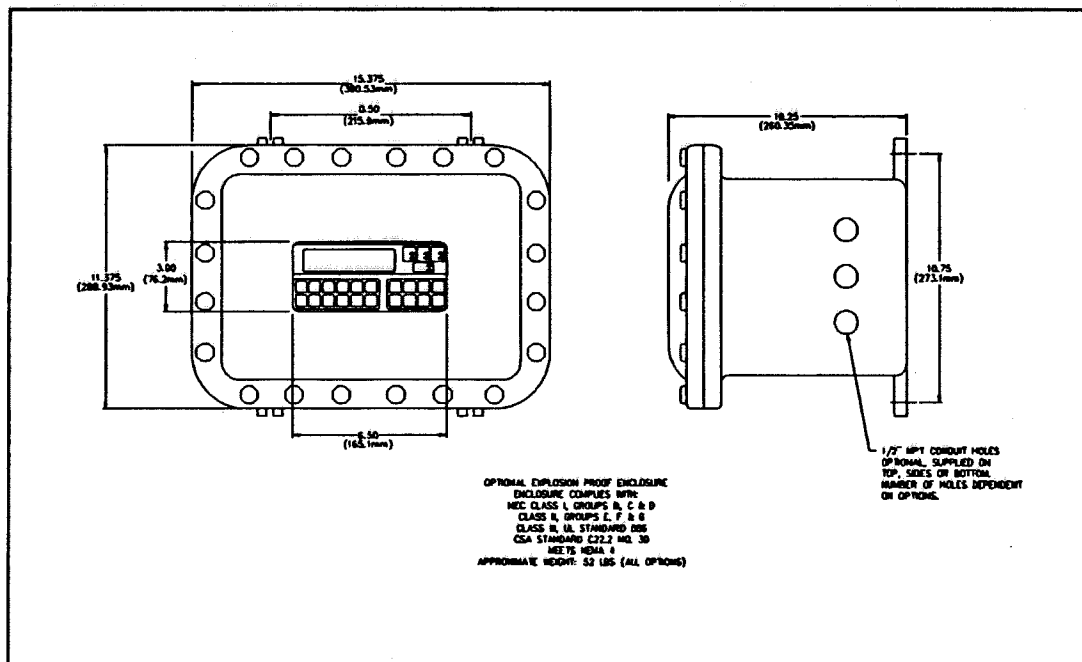


Figure 1.3 Explosion Proof Enclosure



1.6 SHIPPING AND HANDLING

CAUTION - The FLOWSTAR is a static-sensitive device and standard practice for static sensitive parts should be observed.

In the event of malfunctioning equipment the following guidelines should be observed for the preparation and shipment of the equipment. Failure to do so may result in the material reaching its destination damaged.

The electronic unit due to its **STATIC SENSITIVE** nature should be wrapped in a material conforming to MIL-B-81705 , Type II, and packaged in a heat sealable bag conforming to MIL-P-81997. These steps are necessary to protect the equipment from electrostatic charge(s) that may occur during handling.

The package should then be marked with a sensitive electronic device caution label conforming to MIL-STD-129, Appendix C. The equipment should then be wrapped in cushioning material, and placed into a close fitting box conforming to PPP-B-636 Domestic class.

The exterior shipping container should be marked with a sensitive electronic device caution label conforming to MIL-STD-129, Appendix C.

Clearly mark the factory provided RMA number on all paperwork and shipping packaging.

1.7 ENHANCEMENT FEATURES AND OPTIONS

Many instruments may be used with turbine flowmeters. Few offer the following enhancements for increasing the accuracy of the measurement system.

1.7.1 LINEARIZATION

Many flowmeters are much more repeatable than they are linear. When this is true, as it is in turbine flowmeters, higher measurement accuracy can be achieved by a linearization routine.

Most commonly, higher precision is achieved with the FLOWSTAR by exploiting the repeatability of ± 0.05 to $\pm 0.1\%$ over the repeatable flow range. The FLOWSTAR improves linear turbine flow measurement accuracies to $\pm 0.1\%$ over 20:1 to 100:1 repeatable flow ranges.

FLOWSTAR can store up to 20 calibration points, for channel 1, up to 10 points for channel 2, and up to 5 points for the remaining channels. The unit continuously samples the flowmeter frequency averaged over a 1 second period. Stored calibration points are then accessed to determine the closest available calibration information. Using a curve-fitting routine the actual calibration factor is determined and used in the instrument calculations to achieve the highest possible accuracy.

1.7.2 VISCOSITY COMPENSATION FOR TURBINE FLOWMETERS

For calibrations where the viscosity effects on a turbine flowmeter are significant, the turbine flowmeter's performance may be documented on an Universal Viscosity Curve. For this type of application the Universal Viscosity Curve is stored in a tubular form with FLOWSTAR's non-volatile memory, along with the fluids viscosity as a function of temperature characteristic.

FLOWSTAR will use the flowrate and inferred viscosity information to access the U.V.C. fit program to determine the viscosity and flowrate corrections which are to be applied. The result is an accurate turbine flowmeter based measurement at a lower cost than an instrument grade positive displacement flowmeter would provide.

1.7.3 INSTRUMENT COMMUNICATION OPTIONS

The RS-232 communication port permits many of the desirable, commonly required interface connections to user supplied printers, modems, terminals, and for some computer interfaces. The signals on this port meet or exceed the requirements of RS-232. The 9-pin connector supports the most commonly required handshaking signals. When used with remote computer interface or terminal, the port may be used to request information or to command the FLOWSTAR unit. Most of the capabilities can be controlled from the remote device in a manner similar to the operator panel.

Many requirements arise for the RS422/RS-485 communication option. With this port, several instruments may be connected together over greater distances and communicate to a central computer over higher speeds than is possible with the RS-232 communication port. In a multi-drop configuration, the port has a unique feature which permits it to only become active when its corresponding instrument identifier is called.

2 OPERATIONS OVERVIEW

2.1 INTRODUCTION

The FLOWSTAR 2001 (FS) has two modes of operation, the OPERATING mode and the SETUP mode. The OPERATING mode displays keyboard selected values. This is the mode used during normal operations. The SETUP mode is used during factory and on site customization. This mode can be accessed by proper entry of a password.

Normal operator input to the FLOWSTAR is through the keyboard interface. The serial port also allows the FLOWSTAR to be controlled by electronic means. User output from the FLOWSTAR is in the form of a 16 character, 2 line LCD display, LED indicator lamps and a sonic alarm.

2.2 HARDWARE CONFIGURATION OF SOFTWARE OPTIONS

Several fields in both the OPERATION and SETUP modes are optionally dependent on the switch selection of S1 located at the back of the FLOWSTAR. This switch determines which channels are selected and is only used during power up. Changes after power up to the S1 selector switch have no effect on program operation until a subsequent power up. If a channel is not selected their is no need to set that channel's option. Non-switch selected channels will not have their related fields displayed during setup.

S1 at the back of the PCA-138, PCB sets the selected channels for the FLOWSTAR. The following table details its use.

S1 1 2 3 4 5 6 7

							-----ON PROGRAM LOCKOUT
							-----ON LOCAL CONTROL ENABLE
							-----ON INPUT CHANNEL 2 ON
							-----ON INPUT CHANNEL 3 ON
							-----ON INPUT CHANNEL 4 ON
							-----ON OUTPUT CHANNEL 1 ON
							-----ON OUTPUT CHANNEL 2 ON

- S1-7: The program lockout option determines whether the setup mode is selectable. Turning this switch on disables the MODE key. This prevents an operator from having access to the SETUP mode.
- S1-6: When switch is turned ON, the front panel CLEAR key is disable. This prevents an operator from clearing the totalizer.
- S1-3,4,5: This switch enables or disables their respective analog to digital input channels. If an input channel is turned off, none of its respective configuration fields will be available in the SETUP mode.
- S1-1,2: This switch enables or disables their respective digital to analog output channels. If an output channel is turned off, none of its respective configuration fields will be available in the SETUP mode.

3 OPERATING MODE

3.1 INTRODUCTION

The OPERATING mode is where all measured values are displayed and batch controls are performed. Displaying a measured value is as simple as pressing a key. In this mode continuous monitoring of all channels is performed. The following display fields are available in the operating mode:

CH1 TOTAL	Direct Key Selectable
CH1 RATE	Direct Key Selectable
CH2	Direct Key Selectable
CH3	Direct Key Selectable
CH4	Direct Key Selectable
AUX 1	Direct Key Selectable
AUX 2	Direct Key Selectable
TIME	Accessible By LAST and NEXT Keys Only
DATE	Accessible By LAST and NEXT Keys Only
CH1 ACCUM	Accessible By LAST and NEXT Keys Only
CH3 ACCUM	Accessible By LAST and NEXT Keys Only
CH1 DUAL DISPLAY	Accessible By LAST and NEXT Keys Only
DENSITY LBS/FT ³	Accessible By LAST and NEXT Keys Only
VISCOSITY CSTK	Accessible By LAST and NEXT Keys Only

NOTE: CH1 DUAL DISPLAY will display the flowrate and total for channel 1 only.

NOTE: AUX1 and AUX2 can display totalization values of the other channels even if they are setup to display rate. This allows channels 2, 3 and 4 to display rates when their totalization values are displayed on the AUX1 or AUX2 display.

3.2 OPERATING MODE KEYBOARD OPERATION

This section details each key's function and response when pressed in the OPERATING mode.

- **TOTAL, RATE:** Selects the display values for the pulsed flow channel 1. Actual display values are dependent on the SETUP configuration for that channel.
- **TEMP1, TEMP2, PRES:** Select the display values for input channels 2, 3 and 4 respectively. Actual display values are dependent on the SETUP configuration for that channel.
- **SETP1, SETP2:** If the RATE, TEMP1, TEMP2, or PRES were the previously selected display fields, then their respective alarm setpoints will be displayed.
- **AUX1, AUX2:** Displays the SETUP selected values. Refer to the SETUP section for the possible selections.
- **CLEAR:** The CLEAR key resets the previously selected totalizer to zero.
- **LAST, NEXT:** These keys allow the operator to scroll through the display fields individually. In addition to the key selected fields, there are several miscellaneous fields which can only be viewed by scrolling past the original fields. I.E. TIME, DATE, CH 1, 2, 3, 4, and ACCUMULATED TOTALS.
- **SEL:** This key acknowledges an alarm condition. It sets blinking LED'S to solid. It will also silence the sonic alarm.
- **MODE:** Prompts you for a password. This occurs only if the S1-7 switch is set to OFF position during power up. Password entry is facilitated by using the numeric keys. Entry of a proper password will shift the unit into the SETUP mode. Pressing the MODE key in the SETUP mode will return you to the OPERATING mode.

3.3 OPERATING MODE LED AND SONIC ALARM OPERATIONS

During normal operating conditions in which none of the alarm conditions are met, the LED and SONIC ALARM are in the off state. If an alarm condition is met, then the associated LED will blink and the sonic alarm will sound. This is considered an alarming condition. To silence the alarm, the SEL key must be pressed. This will cause the sonic alarm to be silenced and the LED will stop blinking and remain in the on condition. This will indicate that an alarming condition is met and that it has been acknowledged. This is the alarm acknowledged state. If the alarming condition subsides, the LED and sonic alarm (if still on) will de-energize. This is the cleared state. If another alarm condition is met then the same sequence of events will occur. The steady LED on state of a previously acknowledged alarm will remain the same. The alarm conditions are fully configurable in the SETUP mode. When in the SETUP mode all alarm conditions are held in the cleared state. Even though the TEMP2, channel 3 does not have an associated alarm LED, it still has all of the above alarm functionality. It is possible depending on the channel 3 setup and the alarm 3 setpoints to get a channel 3 audible alarm. If this feature is used it must be noted that you will have an audible alarm with no blinking LED's. Silence this alarm using the SEL key.

4 SETUP MODE OPERATIONS

After the MODE key is pressed in the OPERATING mode, a password entry screen is displayed. If the proper password is entered, and the MODE key pressed, then the FLOWSTAR will enter the SETUP mode. After configuration parameters have been entered or viewed, press the MODE key once more to return to the OPERATING mode. If the SETUP mode is re-entered, the last SETUP selected field will be displayed again. This enhances corrections to specific fields when the OPERATING values are needed to fine tune the unit. The default password is 2001.

4.1 KEYBOARD OPERATION

- The FLOWSTAR uses an alternate key functionality when in the SETUP mode.
- 1, 2, 3, 4, 5, 6, 7, 8, 9, 0: These keys facilitate numeric entry in selected SETUP fields.
- SEL, REM: Scrolls forward and backward to select a field's discrete selection.
- LAST, NEXT: Scrolls forward and backward through the SETUP fields.
- STOP, CLEAR, AUTO, MAN: Perform no functions in this mode.
- MODE: Causes the program to exit the SETUP mode. Any altered values are stored in non-volatile memory (eeprom).

4.2 SETUP MODE FIELD TYPES

SETUP mode control keys consist of the MODE, LAST, and NEXT keys. Field data entry and option selection is facilitated by the NUMERIC, SEL and REM keys. Field parameters are presented in two basic forms. These are either English-like label fields (discrete) or numeric entry fields. Numeric fields require the entry of numbers using the NUMERIC keys for a particular parameter. Label fields display English messages showing what option is currently chosen for a particular setup option or parameter. Label type field alternate selections may be selected by pressing the SEL or REM key. The field selections wrap around once the last selection is passed.

4.3 SETUP MODE FIELD DESCRIPTIONS

Many of the field selections in the setup mode are optional and are dependent on the S1 setup switch. If the specific channel selector switch is not enabled then all of the setup fields for that channel will not be displayed.

NOTE: FOR BEST ACCURACY OF CHANNEL 2, 3 AND 4 IT IS RECOMMENDED THAT ALL POINTS BE ENTERED.

WARNING: TABLE DATA POINTS FOR ANALOG INPUT CHANNELS MUST BE ENTERED. IN A LINEAR MANNER. FAILURE TO DO SO WILL RESULT IN MEASUREMENT ERROR.

4.3.1 CH1 TOT CONFIG

This field is used to assign display measured values in the TOTAL display for the pulsed flow input channel. The following units and options are available.

ENGLISH	METRIC
LBS	KG
FT³	M³
GAL	LIT
OZ	MLIT
FLOZ	CC
PINTS	MTON
BBL	UDEF
TON	
USERDEF	

4.3.2 CHI RATE CONFIGURE

This field is used to assign display measured values in the RATE display based off the pulsed flow input channel. The following units and options are available.

ENGLISH	METRIC
LBS/MIN	KG/MIN
LBS/HR	KG/HR
LBS/SEC	KG/SEC
FT ³ /MIN	M ³ /MIN
FT ³ /HR	M ³ /HR
FT ³ /SEC	M ³ /SEC
GAL/MIN	LIT/MIN
GAL/HR	LIT/HR
GAL/SEC	LIT/SEC
OZ/MIN	MLIT/MIN
OZ/HR	MLIT/HR
OZ/SEC	MLIT/SEC
FLOZ/MIN	CC/MIN
FLOZ/HR	CC/HR
FLOZ/SEC	CC/SEC
PNTS/MIN	MTON/MIN
PNTS/HR	MTON/HR
PNTS/SEC	MTON/SEC
BBL/MIN	UDEF/MIN
BBL/HR	UDEF/HR
BBL/SEC	UDEF/SEC
TON/MIN	
TON/HR	
TON/SEC	
UDEF/MIN	
UDEF/HR	
UDEF/SEC	

4.3.3 CHI SMOOTHING

This field is used to filter the channel 1 rate display. A value of 0.0 means no filtering will occur. A maximum value of 1.00 filters the signal 100 percent. Select a value somewhere between 0 and 1.0 if smoothing is desired. Factory default is set to 0.500.

4.3.4 CHI POINT NUMBER

This integer field determines how many points will be used in a linearization look-up table. Allowed values are from 0 to 20.

4.3.5 FLOW CALC METHOD

Select from the following based on the type of measurement calculation desired.

- KFACTOR
- SINGLE KFACTOR uses the default K-FACTOR of the selected table.
- TEMP VS VISCOSITY

4.3.6 MASS FLOW METHOD

Select from the following based on the type of mass measurement calculation desired. This method will only be used when a mass unit is selected for display on channel 1.

NOTE: These selections refer only to FLUID type calculations.

- MANUAL DENSITY
- TEMP VS DENSITY

This method will use the default base and density values.

4.3.7 CHI TABLE SELECT

Select from the following based on which table will be used in the linearization calculation. Channel 1 will accept a maximum of 4 tables each containing 20 point tables of both frequencies and K-factors.

- TABLE 1
- TABLE 2
- TABLE 3
- TABLE 4

4.3.8 DEF DENS LBS/FT³

This is the default density used when MASS FLOW METHOD is set to the MANUAL DENSITY. Enter a numeric value that corresponds to the density of the fluid being measured. Factory default is 62.32 #/FT³ or 998.30 KG/M³.

4.3.9 BASE DENS LBS/FT³

This is the base density used to compensate for specific fluids. Enter a number value that corresponds to the density of the fluid being measured, at the base conditions. Factory default is 62.32 LBS/FT³ or 998.30 KG/M³.

In order to achieve a readout of equivalent gas (SCF) at STP for cryogenic liquids, the following values must be used:

LIN: 0.0724655 #/ft³.
LOX: 0.0828092 #/ft³.
LAR: 0.103381 #/ft³.
LH₂: 0.00521868 #/ft³.

4.3.10 DEF TEMP DEG R

This is the temperature that will be used in the event of a transmitter failure. This value should represent the typical process line conditions.

4.3.11 DEF K P/UNIT

This is the default K Factor which will be used when the FLOW CALC METHOD is selected to SINGLE KFACTOR. Entry will be either P/GAL or P/LIT depending on the version.

4.3.12 USER GAL TO UDEF

This field is used when the channel 1 total or rate are configured for a user's defined units. Enter a value that when multiplied by gallons will give the user the proper units.

4.3.13 FREQ HZ 1-20

FREQUENCIES 1 through 20 are the flowmeter's characteristics used for the flow input channel when the KFACTOR method is selected for the FLOW CALC METHOD. Enter in a floating point value.

4.3.14 KFAC P/GAL 1-20

KFACTORS 1 through 20 are the flowmeter's characteristics used for the flow input channel when the KFACTOR method is selected for the FLOW CALC METHOD. Enter in a floating point value.

4.3.15 CH2 UNITS

NOTE: If channel 2 is disabled by S1-5 being turned OFF, then the settings from 4.3.15 to 4.3.24 will not be displayed.

WARNING: If UNITS are changed, then reprogram Channel 2 measurement points.

This selection determines the units of the generic analog to digital input channel's number 2. Since either a 1-5 volt or 4-20ma signal is used, the value chosen is not unique in the sense of measurability by the FLOWSTAR. Select from the following:

- DEG F
- DEG C
- DEG K
- DEG R

4.3.16 CH2 LOW CAL

This field is used to calibrate the low end of the channel. Set the channel input to its lowest value and then, (i.e., 1VDC) press the select button. This locks in the low point corresponding to the lowest selected table entry.

4.3.17 CH2 HIGH CAL

This field is used to calibrate the channel's high end. Set the channel's input to its highest value and then, (i.e., 5VDC) press the select button. This locks in the high point corresponding to the highest selected table entry.

4.3.18 CH2 GAS INHIBIT

When set to ON, if the temperature input goes above the CH2 HIGH ALARM setpoint, the totaling on CH1 will be inhibited.

- ON
- OFF

4.3.19 CH2 SMOOTHING

This field is used to filter the channel 2 temperature display. A value of 0.0 means no filtering will occur. A maximum value of 1.00 filters the signal 100 percent. Select a value somewhere between 0 and 1.0 if smoothing is desired. Factory default is 0.50.

4.3.20 CH2 POINT NUMBER

This numeric field determines how many points will be used in a linearization look-up table. Allowed values are from 0 to 10.

4.3.21 CH2 TABLE SELECT

Select from the following based on which table will be used in the linearization calculation. Channel 2 will accept a maximum of 2 tables containing up to 10 point tables each.

- TABLE 1
- TABLE 2

4.3.22 CH2 MEA PNT 1-10

These values are used to determine the measured value used in channel 2. The entries would consist of the temperature range corresponding to the 1-5 VDC or 4-20 mA input.

4.3.23 CH2 CSTK PNT 1-10

These values are used to determine the temperature related viscosity when FLOW CALC METHOD on CH1 is set to TEMP vs VISCOSITY. These point values entered in must be in step with the corresponding temperature in 4.3.22. These points will only be displayed when CH1's FLOW CALC METHOD is set to TEMP vs VISCOSITY.

4.3.24 CH2 LBS/FT³ PNT 1-10

These values are used to determine the temperature related density when MASS FLOW METHOD on CH1 is set to TEMP vs DENSITY. These point values must be the corresponding density for the temperature points entered in step 4.3.22. These points will only be displayed when CH1's MASS FLOW METHOD is set to TEMP vs DENSITY.

4.3.25 CH3 UNITS

NOTE: If channel 3 is disabled by S1-4 being turned OFF, then the settings from 4.3.25 to 4.3.34 will not be displayed.

WARNING: If UNITS are changed, then reprogram Channel 3 measurement points.

This selection determines the units of the generic analog to digital input channel number 2. Since either a 1-5 volt or 4-20ma signal is used, the value chosen is not unique in the sense of measurability by the FLOWSTAR. Select from the following:

ENGLISH	METRIC
LBS	KG
LBS/MIN	KG/MIN
LBS/HR	KG/HR
LBS/SEC	KG/SEC
FT ³	M ³
FT ³ /MIN	M ³ /MIN
FT ³ /HR	M ³ /HR
FT ³ /SEC	M ³ /SEC
GAL	LIT
GAL/MIN	LIT/MIN
GAL/HR	LIT/HR
GAL/SEC	LIT/SEC
OZ	MLIT
OZ/MIN	MLIT/MIN
OZ/HR	MLIT/HR
OZ/SEC	MLIT/SEC
FLOZ	CC
FLOZ/MIN	CC/MIN
FLOZ/HR	CC/HR
FLOZ/SEC	CC/SEC
PNTS	MTONS
PNTS/MIN	MTONS/MIN
PNTS/HR	MTONS/HR

ENGLISH	METRIC
LBS	KG
PNTS/SEC	MTONS/SEC
BBL	UDEF
BBL/MIN	UDEF/MIN
BBL/HR	UDEF/HR
BBL/SEC	UDEF/SEC
TONS	
TONS/MIN	
TONS/HR	
TONS/SEC	
UDEF	
UDEF/MIN	
UDEF/HR	
UDEF/SEC	

4.3.26 CH3 LOW CAL

This field is used to calibrate the low end of the channel. Set the channel's input to its lowest value and then, (i.e., 1VDC) press the select button. This locks in the low point corresponding to the lowest selected table entry.

4.3.27 CH3 HIGH CAL

This field is used to calibrate the channel's high end. Set the channel's input to its highest value and then, (i.e., 5VDC) press the select button. This locks in the high point corresponding to the highest selected table entry.

4.3.28 CH3 SMOOTHING

This field is used to filter the channel 3 rate display. A value of 0.0 means no filtering will occur. A maximum value of 1.00 filters the signal 100 percent. Select a value somewhere between 0 and 1.0 if smoothing is desired. Factory default is 0.50.

4.3.29 CH3 POINT NUMBER

This numeric field determines how many points will be used in a linearization look-up table. Allowed values are from 0 to 5.

4.3.30 CH3 MASS FLOW ME

Select from the following based on the type of mass measurement calculation desired. NOTE: This will only be used when a mass unit is selected for display on channel 3.

- MANUAL DENSITY
- TEMP vs DENSITY

4.3.31 CH3 TABLE SELECT

Select from the following based on which table will be used in the linearization calculation. Channel 2 will accept a maximum of 2 tables containing up to 10 point tables each.

- TABLE 1
- TABLE 2
- TABLE 3
- TABLE 4

4.3.32 CH3 DEN LBS/FT³

CH3 DEFAULT DENSITY's is in LBS/FT³ or KG/M³. This is the default density used when the MANUAL METHOD is chosen as the CH3 MASS FLOW ME, (i.e., MASS FLOW METHOD). Enter a numeric floating point value that corresponds to the density of the fluid being measured. This value is also used when CH3 MASS FLOW ME is set to TEMP vs DENSITY and channel 4 temperature probe fails. Factory default is 63.31772 LBS/FT³ or 998.2979 KG/M³.

4.3.33 CH3 BASE LBS/FT³

The DEF BASE DENSITY is in LBS/FT³ or KG/M³. Enter a numeric value that corresponds to the base density of the fluid being measured. Factory default is 63.31772 LBS/FT³ or 998.2979 KG/M³.

4.3.34 CH3 MEA PNT 1-5

These values are used to determine the measured value used in channel 3. The entries would consist of the flow range corresponding to the 1-5 VDC or 4-20 mA input. If the channel is set up to totalize, then the measuring point data must be expressed as the configured unit per minute. For example, channel units equals pounds, the measurement entered will be represented as pounds per minute.

4.3.35 CH4 UNITS

NOTE: If channel 4 is disable by S1-3 being turned OFF, then the settings from 4.3.35 to 4.3.43 will not be displayed.

WARNING: If UNITS are changed, then reprogram Channel 4 measurement points.

This selection determines the units of the generic analog to digital input channel number 2. Since either a 1-5 volt or 4-20ma signal is used, the value chosen is not unique in the sense of measurability by the FLOWSTAR. Select from the following:

- | | |
|---------|---------|
| • DEG F | • DEG C |
| • DEG K | • DEG R |

4.3.36 CH4 LOW CAL

This field is used to calibrate the low end of the channel. Set the channel's input to its lowest value and then, (i.e., 1VDC) press the select button. This locks in the low point corresponding to the lowest selected table entry.

4.3.37 CH4 HIGH CAL

This field is used to calibrate the channel's high end. Set the channel's input to its highest value and then, (i.e., 5VDC) press the select button. This locks in the high point corresponding to the highest selected table entry.

4.3.38 CH4 GAS INHIBIT

When set to ON, if channel 4 temperature goes above the channel 4 high alarm setpoint, channel 3 will be inhibited.

- ON
- OFF

4.3.39 CH4 SMOOTHING

This field is used to filter the channel 4 temperature display. A value of 0.0 means no filtering will occur. A maximum value of 1.00 filters the signal 100 percent. Select a value somewhere between 0 and 1.0 if smoothing is desired. Factory default is 0.50.

4.3.40 CH4 POINT NUMBER

This numeric field determines how many points will be used in a linearization look-up table. Allowed values are from 0 to 5.

4.3.41 CH4 TABLE SELECT

Select from the following based on which table will be used in the linearization calculation. Channel 4 will accept a maximum of 4, 5 point tables.

- TABLE 1
- TABLE 2
- TABLE 3
- TABLE 4

4.3.42 CH4 MEA PNT 1-5

These values are used to determine the measured value used in channel 4. The entries would consist of the temperature range corresponding to the 1-5 VDC or 4-20 mA input.

4.3.43 CH4 LBS/FT³ PNT 1-5

These values are used to determine the temperature related density used in channel 4 compensations. These values must be the corresponding density for the temperature points entered in step 4.3.42. There will be room for four tables of different densities. For metric units the densities are entered in KG/M³. These points will only be displayed when CH3's MASS FLOW METHOD is set to TEMP vs DENSITY.

4.3.44 AUX 1 UNITS AND AUX 2 UNITS

This selection sets the units to be used when the AUX 1 key is depressed in the OPERATING mode. These units should match the units of the channel being measured.

NOTE: AUX1 and AUX2 can display totalization values of the other channels even if they are setup to display rate. This allows channels 2, 3 and 4 to display rates while their totalization values are displayed on the AUX1 or AUX2 display. Also the clear key will clear the original totaled values if depressed while viewing the AUX channels.

ENGLISH	METRIC
LBS	KG
LBS/MIN	KG/MIN
LBS/HR	KG/HR
LBS/SEC	KG/SEC
FT ³	M ³
FT ³ /MIN	M ³ /MIN
FT ³ /HR	M ³ /HR
FT ³ /SEC	M ³ /SEC
GAL	LIT
GAL/MIN	LIT/MIN
GAL/HR	LIT/HR
GAL/SEC	LIT/SEC
SCF	MLIT
SCF/MIN	MLIT/MIN
SCF/HR	MLIT/HR
SCF/SEC	MLIT/SEC
ACF	ACM ³
ACF/MIN	ACM ³ /MIN
ACF/HR	ACM ³ /HR
ACF/SEC	ACM ³ /MIN
OZ	SCM ³
OZ/MIN	SCM ³ /MIN
OZ/HR	SCM ³ /HR
OZ/SEC	SCM ³ /SEC
PINTS	AM ³
PNTS/MIN	AM ³ /MIN
PNTS/HR	AM ³ /HR
PNTS/SEC	AM ³ /SEC
BBL	SM ³
BBL/MIN	SM ³ /MIN
BBL/HR	SM ³ /HR

ENGLISH	METRIC
BBL/SEC	SM ³ /SEC
UDEF	UDEF
UDEF/MIN	UDEF/MIN
UDEF/HR	UDEF/HR
UDEF/SEC	UDEF/SEC
DEG F	DEG F
DEG C	DEG C
DEG K	DEG K
KG channel must be lbs for this to work	LBS channel must be in KG
KG/MIN	LBS/MIN
M ³ channel must be ft ³ for this to work	FT ³ channel must be in M ³
M ³ /MIN	FT ³ /MIN
L channel must be gal for this to work	GAL channel must be in Lit
L/MIN	GAL/MIN

4.3.45 AUX1 CONFIG AND AUX2 CONFIG

This selection sets the value to be displayed when the AUX 1 key is pressed in the OPERATING mode. Select from the following channel selections. The pluses and minuses mean the channel values are added or subtracted.

NOTE: AUX1 and AUX2 can display totalization values of the other channels even if they are setup to display rate. This allows channel 3 to display rates while their totalization values are displayed on the AUX1 or AUX2 display. Also the clear key will clear the original totaled values if depressed while viewing the AUX channels.

C1
C2
C3
C4

4.3.46 ALARM X SET HIGH

NOTE: If the corresponding channel of an alarm is turned OFF by the S1 switch block, then the settings for that alarm will not be displayed.

This field sets the high alarm setpoint for CHANNEL 1, 2, 3, or 4. If a high alarm is not desired, set it to a known condition well above the operating range of the measured value.

4.3.47 ALARM X SET LOW

This field sets the low alarm setpoint for CHANNEL 1, 2, 3, or 4.

4.3.48 ALARM X DEADBAND

This field sets the deadband for alarms. Once the alarm setpoint is reached, the alarm will be locked in. For high alarms, the measured values must fall below the high alarm setpoint minus the deadband value. For low alarms, the measured values must rise above the low alarm setpoint plus the deadband value. The deadband reduces spurious alarms when close to the set points.

4.3.49 ALARM X AUDIBLE

This selects the conditions for the audible sonic alarm. Select from the following:

- YES
- NO

4.3.50 DA1 CONFIG AND DA2 CONFIG

NOTE: If the corresponding OUTPUT CHANNEL is turned OFF by the S1 switch block, then the SETUP settings for that output channel will not be displayed.

This field selects the mode of operation for the digital to analog output channel. After making a selection, only the applicable settings will be displayed that are related to this channel.

- MIMIC AUX2
- MIMIC AUX1
- MIMIC C1 FWD/REV: used to configure output for quadrature detection.
- MIMIC C1: used to configure analog output to mimic CH1.
- MIMIC C2: used to configure analog output to mimic CH2.
- MIMIC C3: used to configure analog output to mimic CH3.
- MIMIC C4: used to configure analog output to mimic CH4.

4.3.51 DAX MAX RANGE

When the output channel mode is selected to mimic, the maximum value of the measured variable must be entered. This value will correlate to the +5 volts output or the 20ma output depending on the hardware selected.

4.3.52 CX PULSE WEIGHT

When the relay configuration is set for FLOW C1, 2, 3 or 4 enter a value which corresponds to the pulses per unit of measure selected on the channels display field. For example, 1.00 will represent 1 pulse/volume, 10 will equal 10 pulses/volume and 0.1 will equal 10 times unit volume of units * 10.

4.3.53 RELAY X CONFIG

Each relay can have the following selections for the value to be sensed:

ALARM1	HIGH
ALARM1	LOW
ALARM2	HIGH
ALARM2	LOW
ALARM3	HIGH
ALARM3	LOW
ALARM4	HIGH
ALARM4	LOW
ALARM AUDIBLE	This will occur based on the conditions that the
PRE-WARN	Not available for Flowstar 2001.
CONTROL	Not available for Flowstar 2001.
C1	Select, if a scaled pulsed output is desired.
C2	Not available for Flowstar 2001.
C3	Select, if a scaled pulsed output is desired.
C4	Not available for Flowstar 2001.

Alarm 1, 2, 3, or 4 corresponds to channel 1, 2, 3, or 4 alarm setpoints.

4.3.54 SERIAL MODE

Selection of communication protocol. Communication options are RS-232, RS-422/RS-485.
NOTE: This is a hardware option at the time of order. User cannot change from RS-232 to RS-422 by simply changing this label.

4.3.55 SERIAL MODE NUM

RS-422/RS-485 multi-drop communications requires a unique identifier for the unit. Enter in an integer for this field in the range of 0 to 31.

4.3.56 BAUD RATE

Select one of the following to determine the serial baud rate.

- 9600
- 4800
- 2400
- 1200
- 600
- 300
- 150
- 75

4.3.57 HANDSHAKE

Select one of the following to set the serial handshake method.

- NONE
- HARDWARE DTR
- XON/XOFF

4.3.58 SERIAL PROTOCOL

Determine the communication mode based on the hardware. Select one of the following.

- REMOTE KEYBOARD
- HOFFER INTERFACE

4.3.59 PASSWORD

This field allows the password to be changed from the factory default of 2001.

4.3.60 DATE

Enter the date using the numeric keys.

4.3.61 DAY OF THE WEEK

Select from one of the following fields.

- MON
- TUE
- WEN
- THU
- FRI
- SAT
- SUN

4.3.62 TIME 24-HOUR CLOCK

Set the time of day in 24 hour mode.

4.3.63 RESTORE NEW UNIT

To restore the unit to factory defaults, perform the following steps:

- Press the SEL key, the unit will display PASSWORD entry field.
- Enter password.
- Press MODE key, if correct password is entered then the unit will display RESTORING TO FACTORY DEFAULTS. If the incorrect password is entered, then display will return to RESTORE NEW UNIT.

WARNING: If the password is changed to "0000" then pressing the MODE key in the above step will cause the unit to RESTORE FACTORY DEFAULTS. To prevent restoring factory defaults by accident, do not assign the PASSWORD to "0000".

5 INSTALLATION

5.1 INSTALLATION WIRING LAYOUT FOR INTERCONNECTIONS

In considering the interconnections between the flowmeter and the flow measurement system some attention must be given to anticipated noise sources and to the coupling of these noise sources to the interconnecting wiring.

Noise signals may be coupled inductively or capacitively into the wiring between the sensor and the electronic measuring systems. In general, utilizing a shielded, twisted pair for the interconnection greatly reduces this coupling. The shield should be grounded on one end of the cable only. In general, grounding only on the electronic measuring system is best.

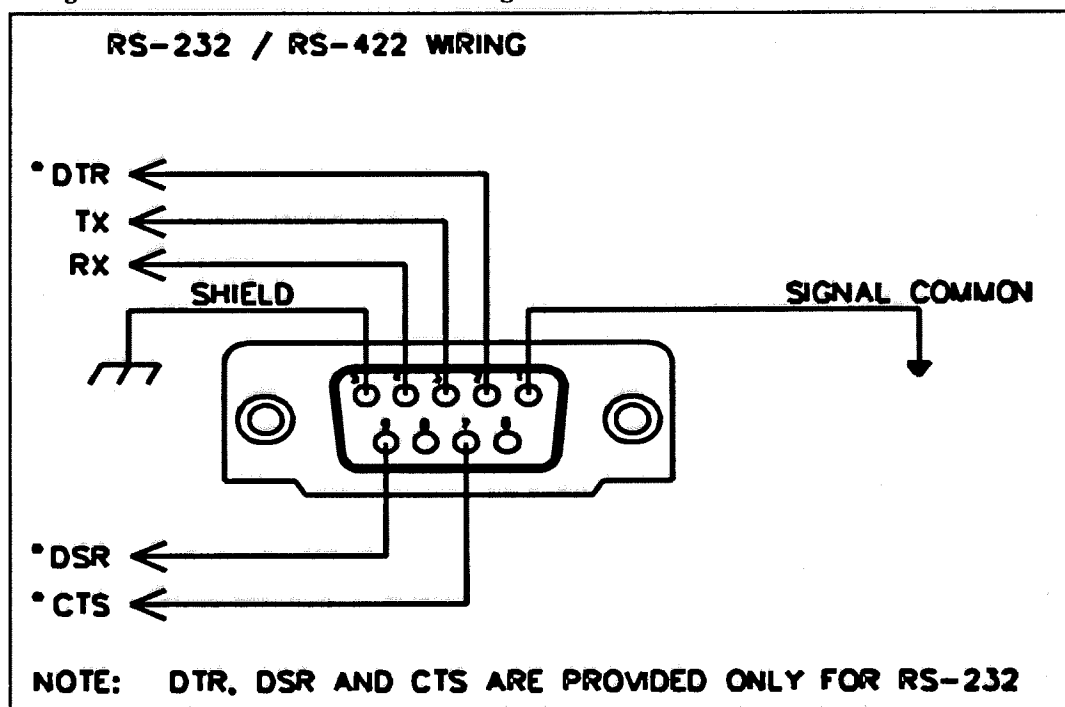
However, even with proper interconnecting cabling cross talk with other signal lines or power lines may still occur and should be avoided. Physical isolation of the wiring reduces the chance of potential problems.

5.2 INSTALLATION OF THE FLOWSTAR

FLOWSTAR should be placed in a convenient location which maintains access to the unit should repairs or readjustment be required.

Refer to following installation diagrams for proper connections of input power, process sensors, process output and control outputs.

Figure 5.1 RS-232/RS-422/RS-485 Wiring Detail



AC POWER INPUT

The diagram illustrates the AC power input section of a device. It features a central terminal block with multiple rows of terminals. The top row is labeled 'POWER INPUT' and has terminals for 'LINE 1 (HOT)', 'LINE 2 (NEUTRAL)', and 'EARTH GROUND'. The bottom row is labeled 'CASE GROUND' and has a terminal for 'CASE GROUND'. The middle row is labeled 'ANALOG OUTPUT' and has terminals for 'ANALOG OUTPUT 1', 'ANALOG OUTPUT 2', and 'ANALOG OUTPUT 3'. The left side of the terminal block has terminals for 'ANALOG INPUT 1', 'ANALOG INPUT 2', and 'ANALOG INPUT 3'. The right side of the terminal block has terminals for 'ANALOG INPUT 4', 'ANALOG INPUT 5', and 'ANALOG INPUT 6'. The diagram shows the following connections:

- A red wire from the 'LINE 1 (HOT)' terminal to the 'EARTH GROUND' terminal.
- A blue wire from the 'LINE 2 (NEUTRAL)' terminal to the 'CASE GROUND' terminal.
- A green wire from the 'EARTH GROUND' terminal to the 'CASE GROUND' terminal.

Figure 5.3 DC Power Input

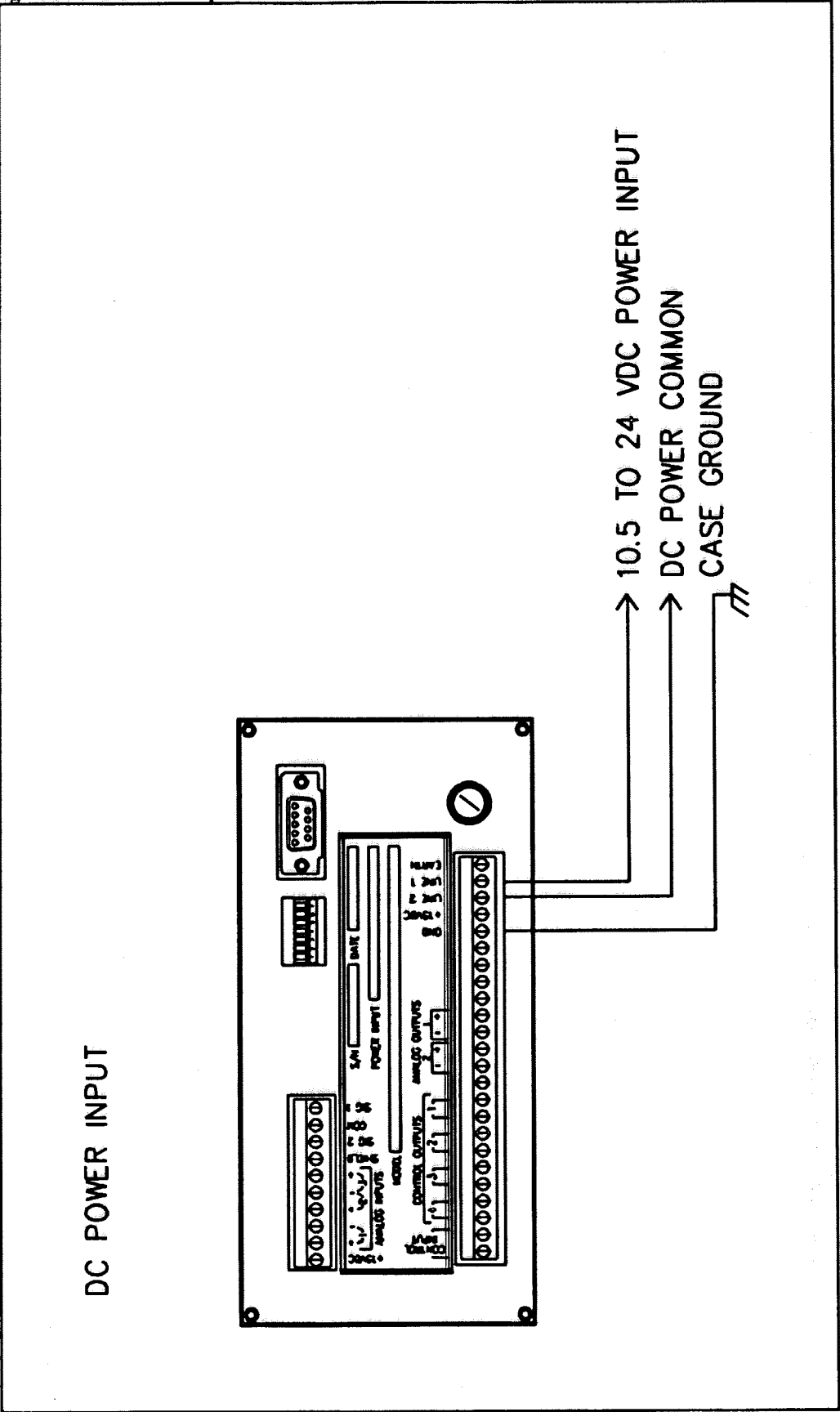


Figure 5.4 Single Magnetic Pickup Input

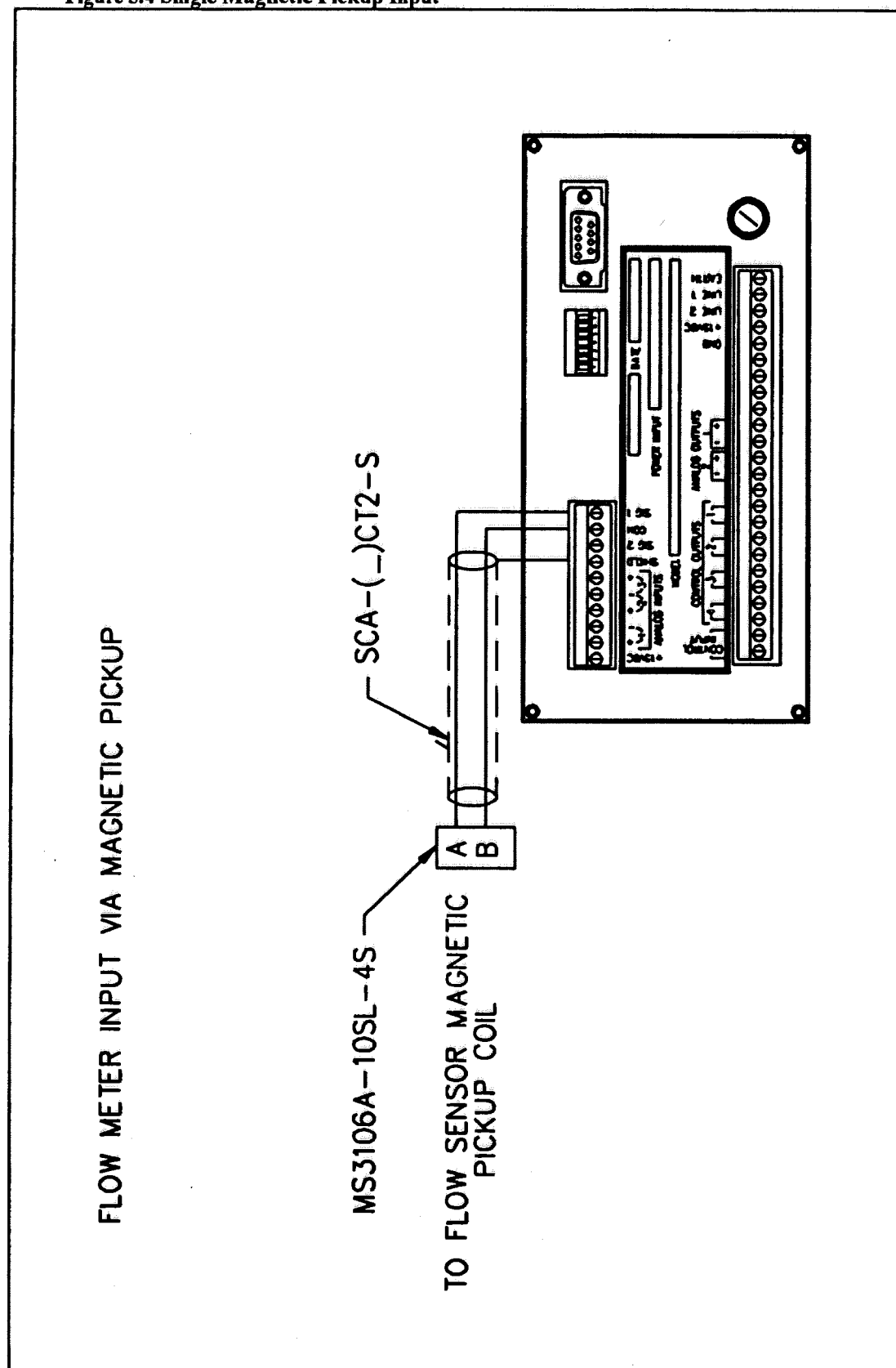


Figure 5.5 Quadrature Magnetic Pickup Input

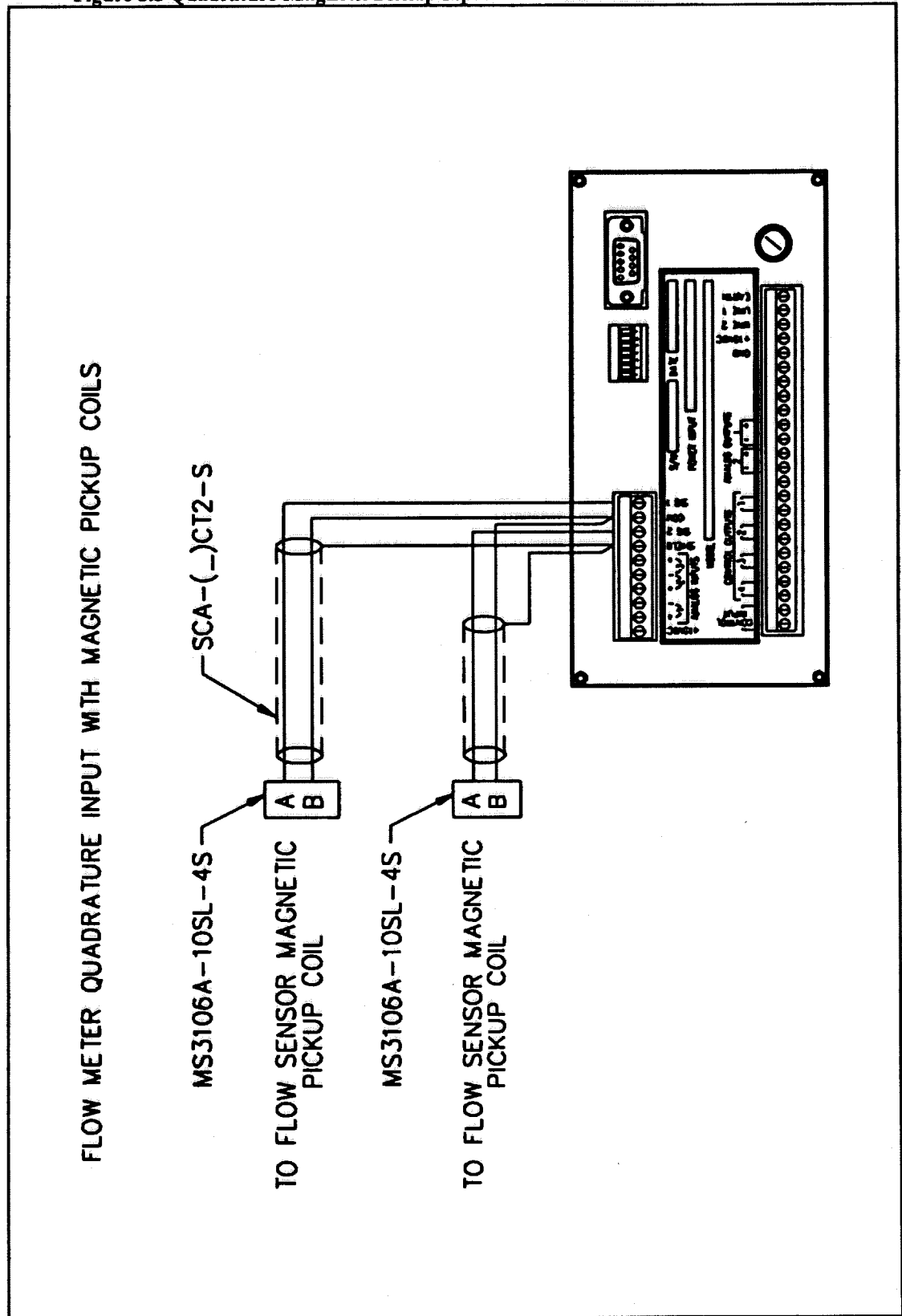


Figure 5.6 MCP Pickup Coil Input

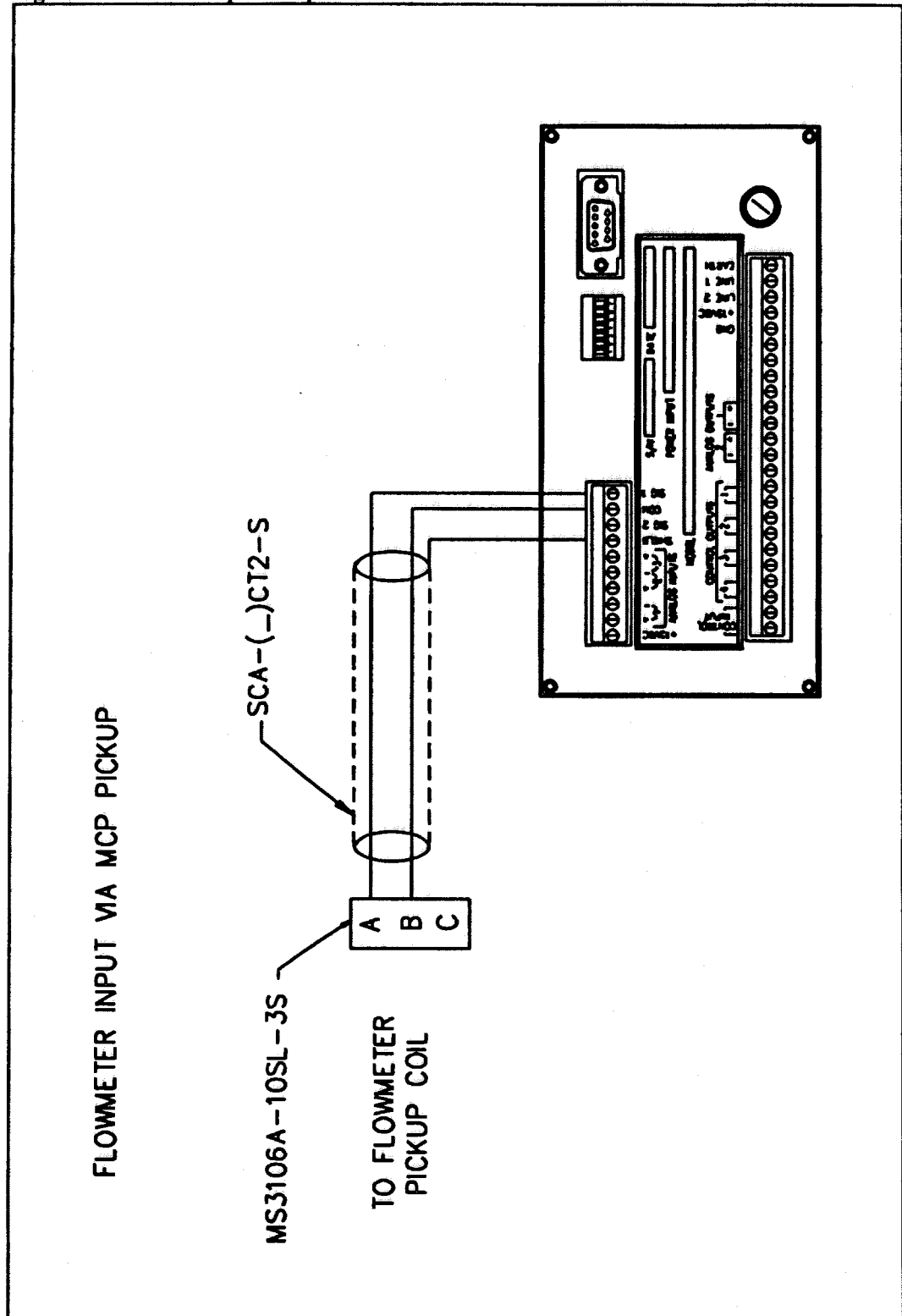


Figure 5.7 Remote Signal Conditioner Interface

REMOTE SIGNAL CONDITIONER INTERFACE

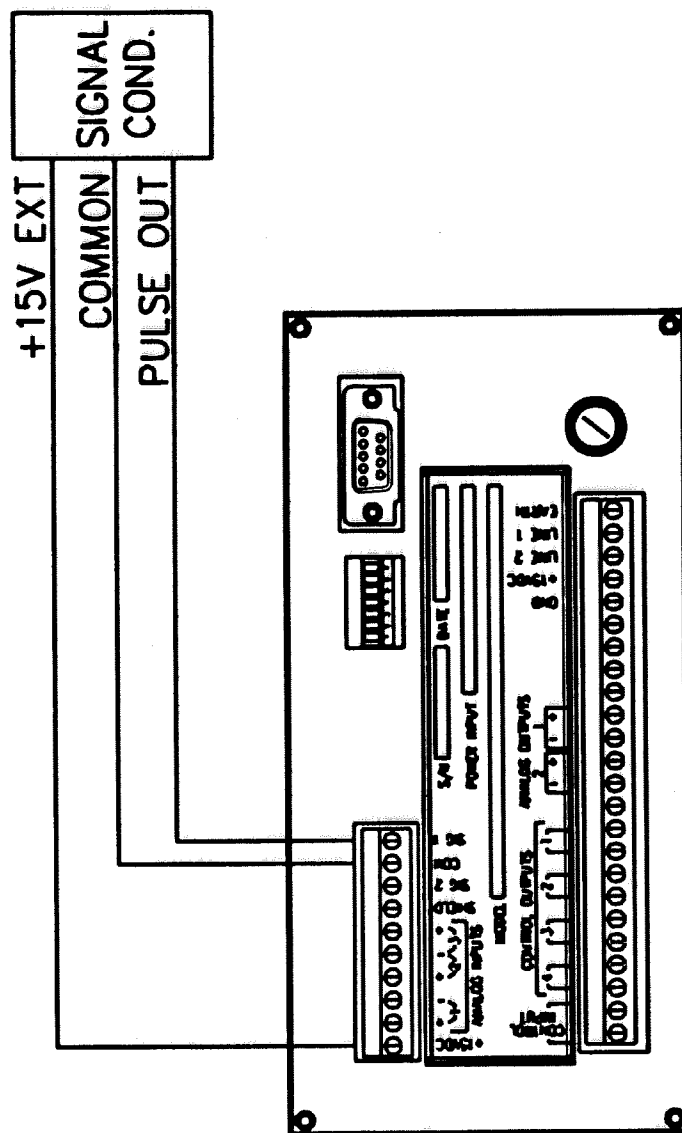


Figure 5.8 Analog Output Connections

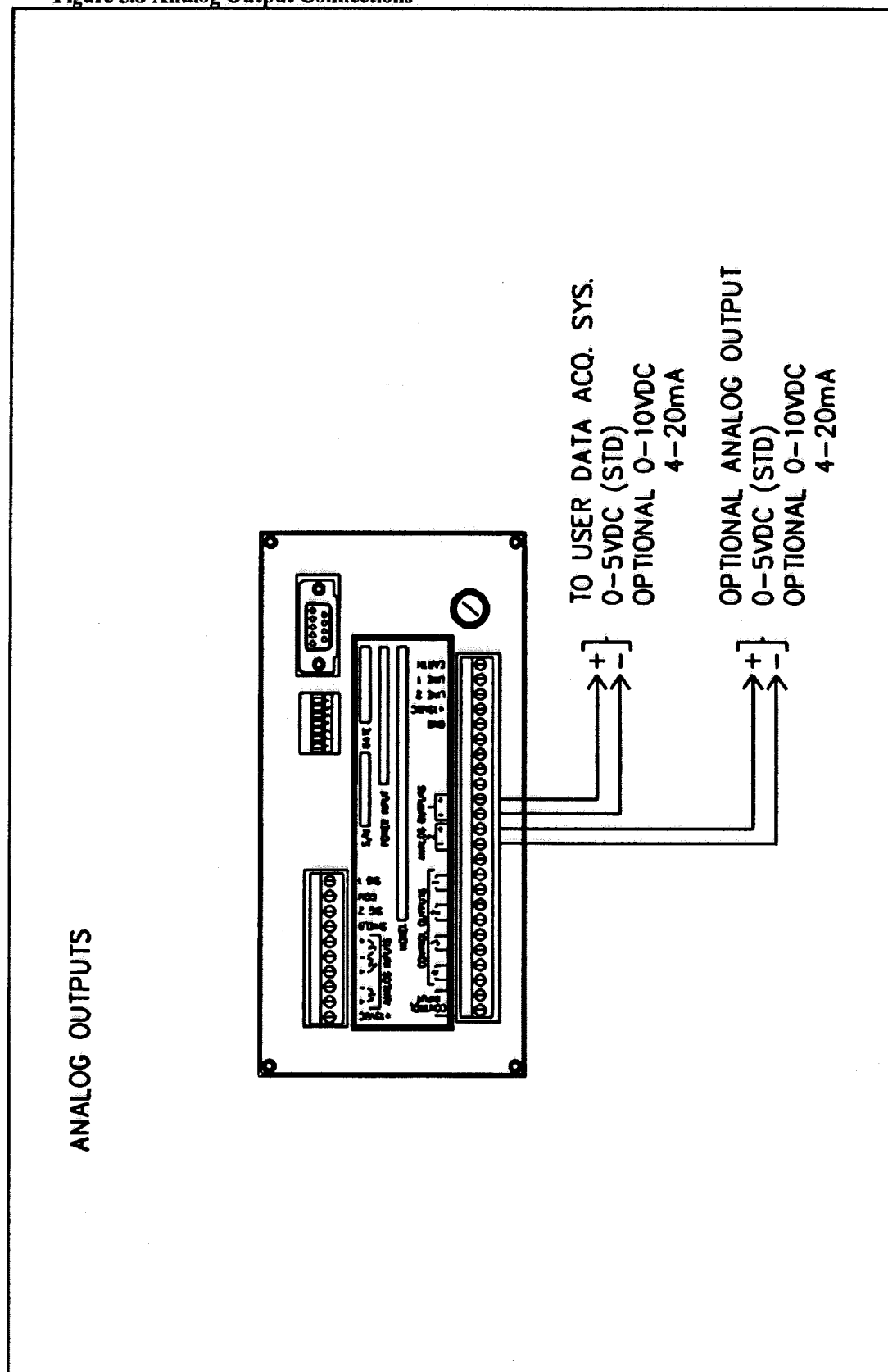


Figure 5.9 Two Wire Process Transmitter Input Connections

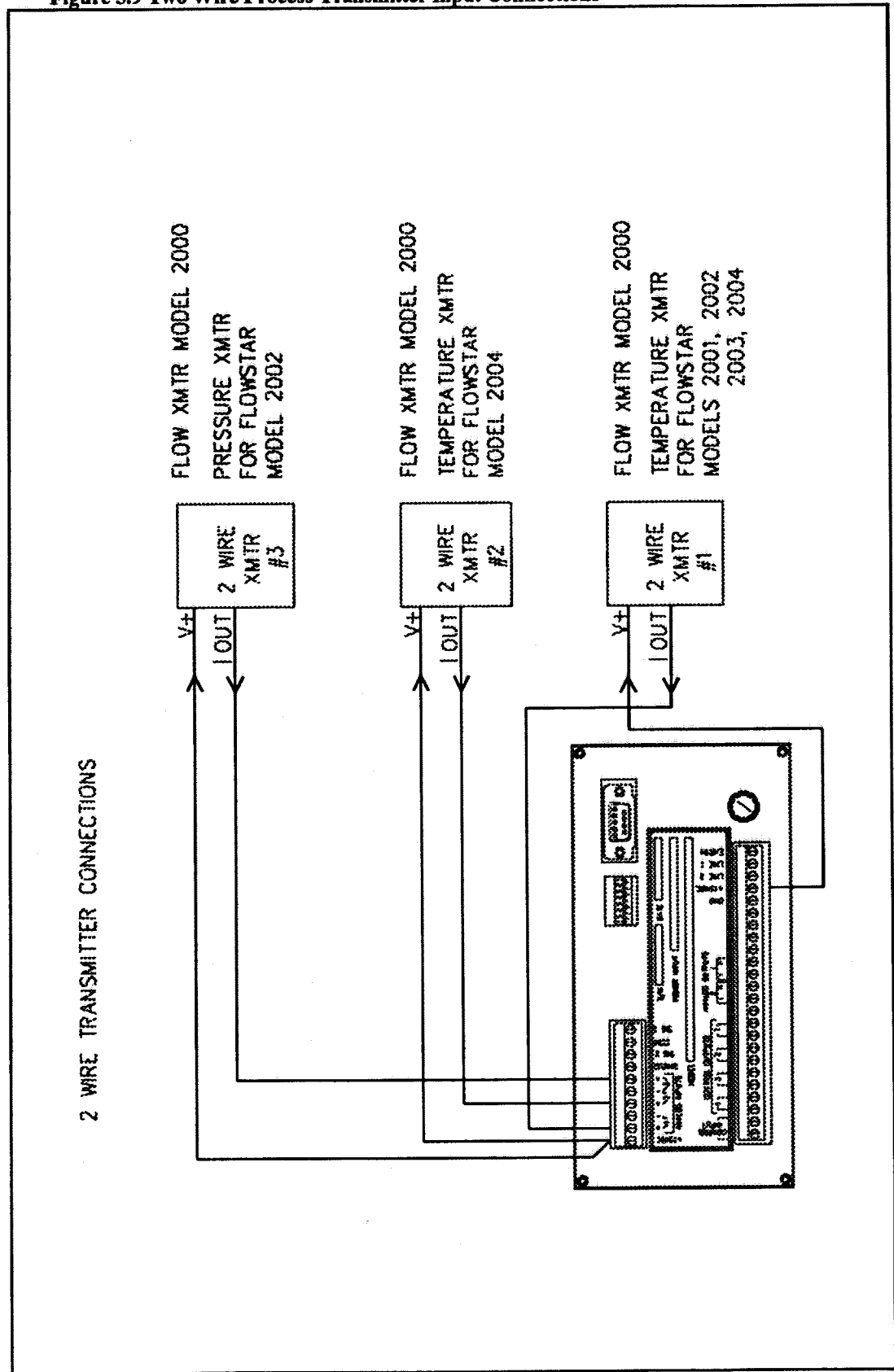


Figure 5.10 Three Wire Process Transmitter Input Connections

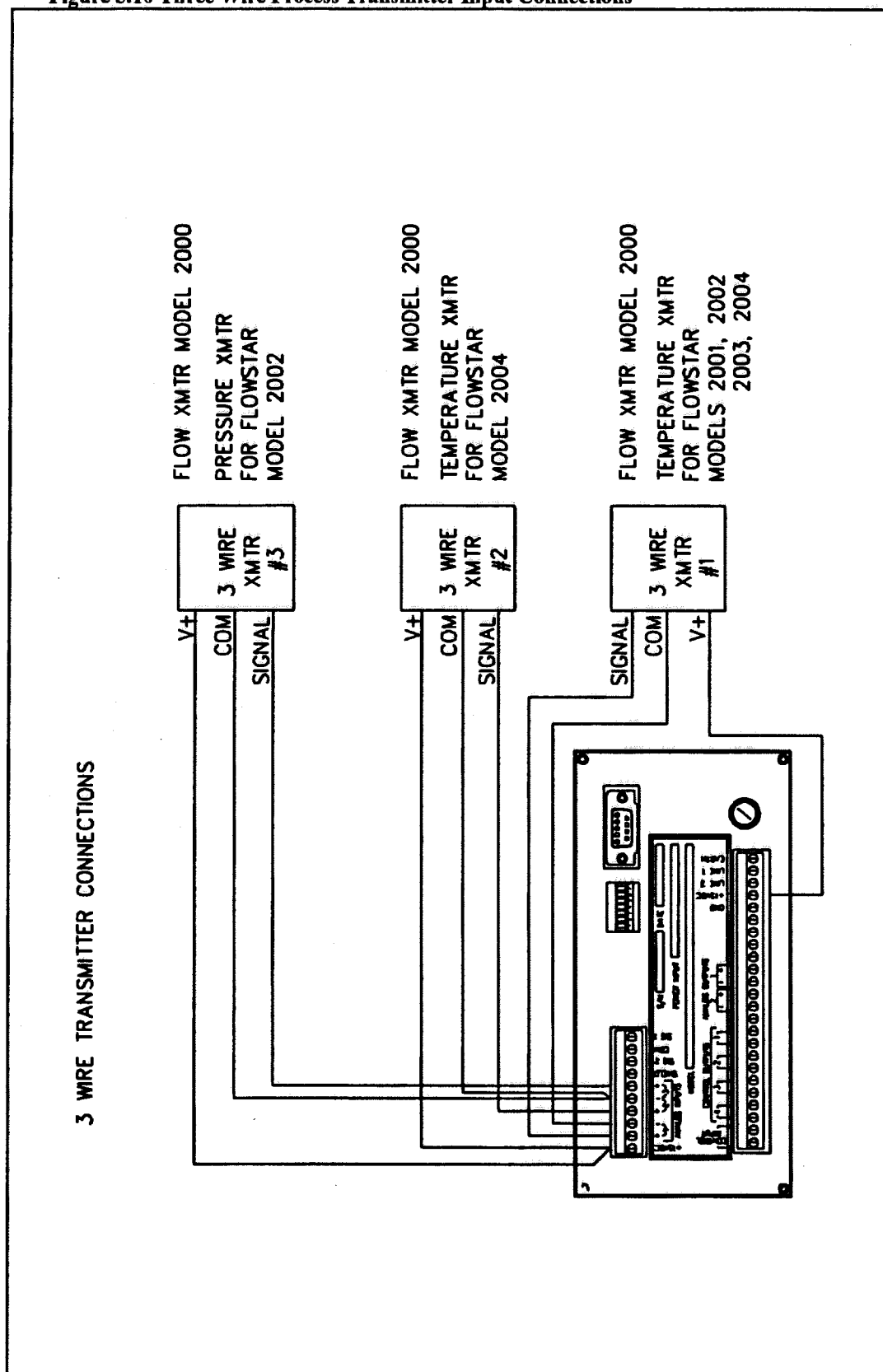
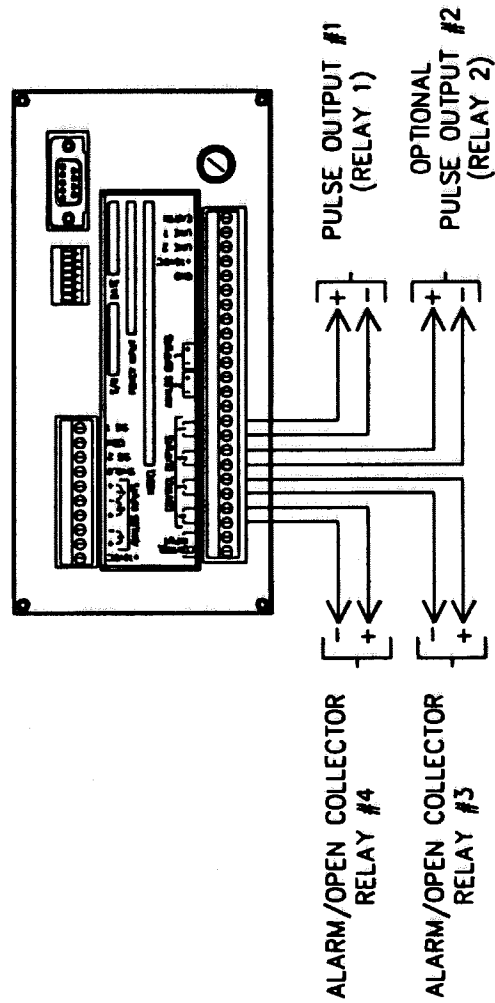


Figure 5.11 Pulse/Alarm Output Wiring

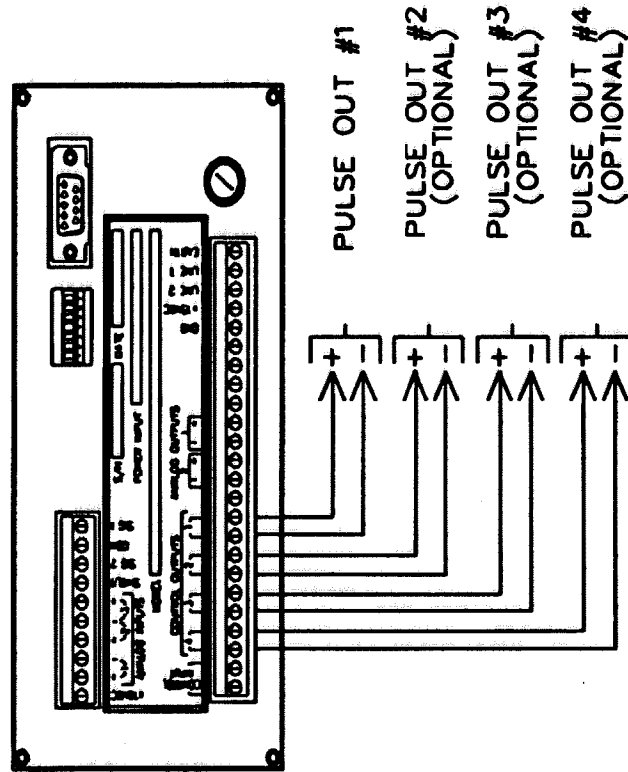
PULSE / ALARM OUTPUT WIRING



NOTE:
WHEN PULSE OUTPUT AND ALARM FEATURES ARE SPECIFIED, CONFIGURE RELAY 1 AND RELAY 2 AS FLOW CX IN STEPMODE. FOR FLOW ALARM CONFIGURE RELAY 3 AND 4 AS THE ALARM HIGH OR LOW IN RELAY 3/4 CONFIGURE SETUP.

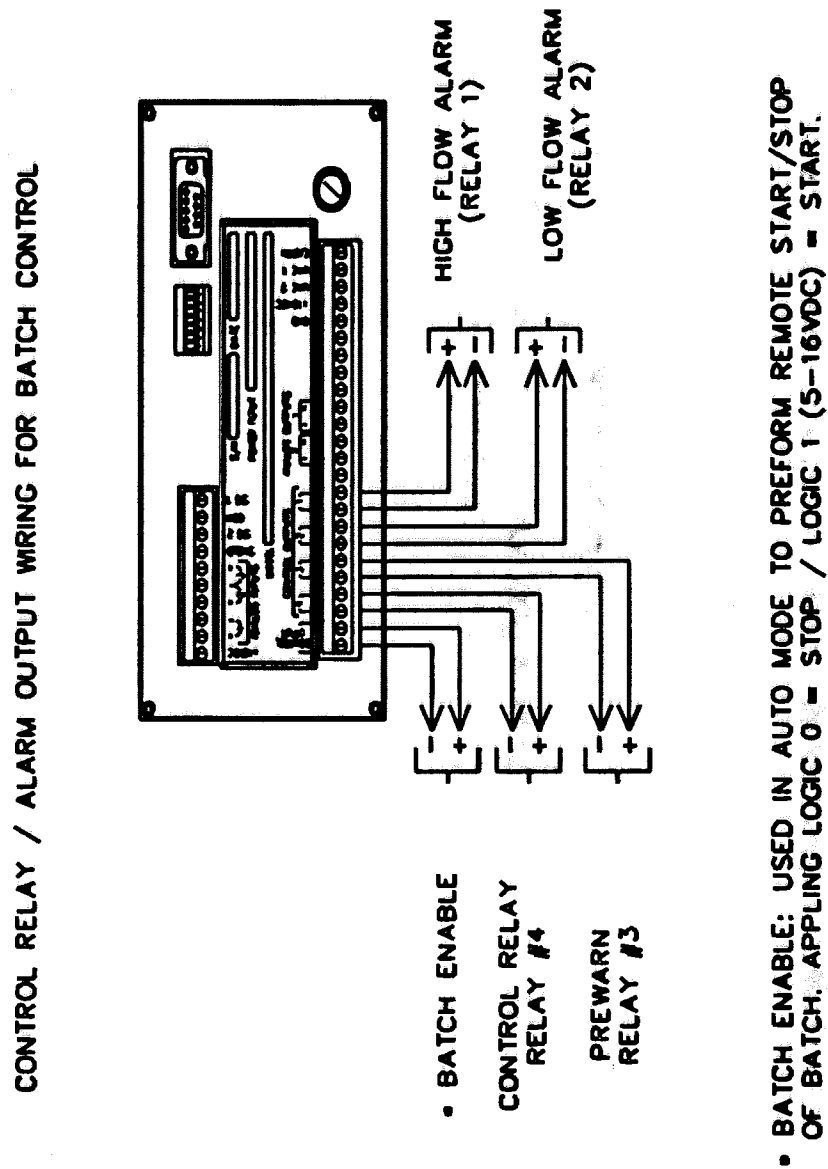
Figure 5.12 Pulse/Control Output Wiring

PULSE / CONTROL OUTPUT



NOTE:
PULSE OUTPUTS MAY BE CONFIGURED TO PULSE OR CONTROL
FUNCTIONS AS CONFIGURED IN THE SETUP MODE, IN THE
RELAY CONFIGURE FIELD.

Figure 5.13 Control/Alarm Wiring For Batch Control



6 SERIAL COMMUNICATIONS

6.1 INTRODUCTION

FLOWSTAR's communication port may be either RS-232 or RS-422/RS-485, and has several uses. The port may be configured as REMOTE KEYBOARD or HOFFER INTERFACE.

- **REMOTE KEYBOARD** this is a special configuration which allows FLOWSTAR to be connected to a remote keyboard or personnel computer, via the RS-232. Flowstar may be directly connected to a remote pc via Windows compatible software.
- **HOFFER INTERFACE** allows for the two way communication between a host system and FLOWSTAR.

6.2 REMOTE KEYBOARD

In this configuration FLOWSTAR may be connected to a personnel computer, via the RS-232 communication option only. Control is possible by using Windows compatible communication software.

Hoffer Flow has written drivers that allow for Flowstar to be connecter to a host personal computer via Cross Talk for Windows. Windows is a registered trademark of Microsoft and Crosstalk is a registered trademark of Digital Communication Associates, Inc..

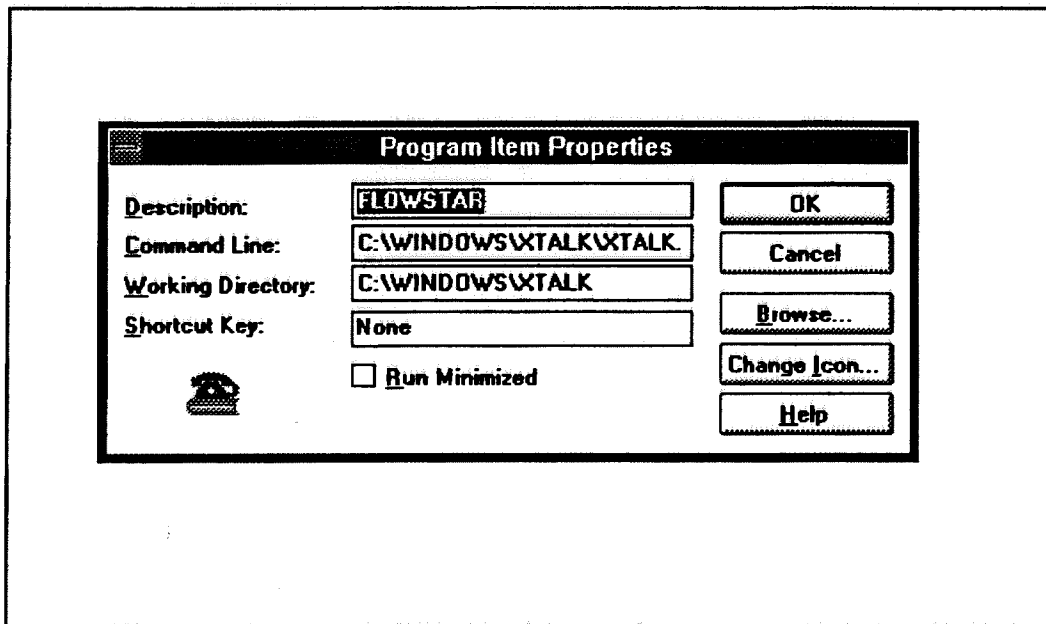
Installation is as follows:

Install CrossTalk for window as per manufacture's instructions. Copy the files copy the files FSREMOTE.XWS and FSREMOTE.XWC into the Crosstalk subdirectory XWS. Also copy the file FLOWSTAR.XWP into the Crosstalk directory XWP.

- Run Windows and click the mouse on the Crosstalk icon.
- Get into the Program Items Properties and modify as shown in figure 6.1, and as follows. Note this example assumes that your path is c:\window\xtalk, modify as your system requires.

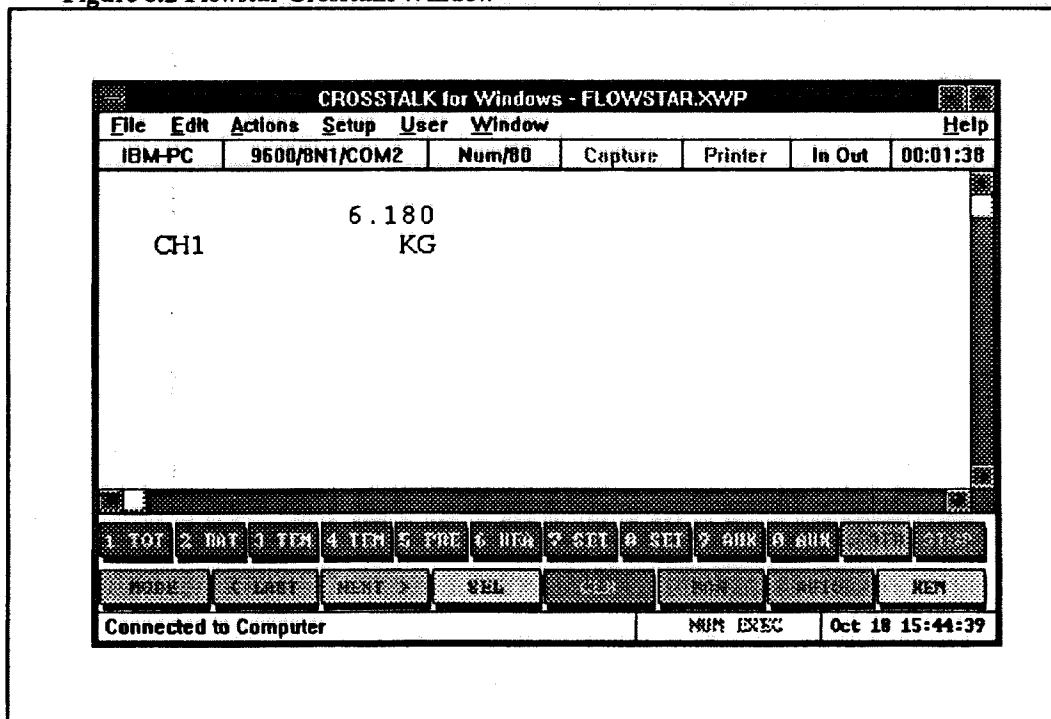
Description:	Flowstar
Command line:	c:\windows\xtalk\xtalk.exe flowstar.xwp
Working directory:	c:\windows\xtalk
Shortcut Key:	None

Figure 6.1 Program Item Properties



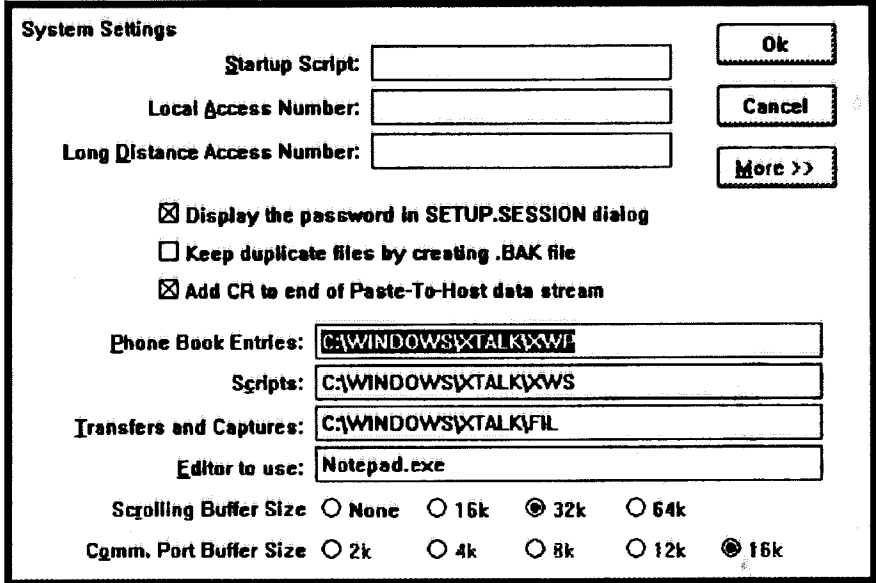
- Select the desired icon to represent FLOWSTAR, and exit Program Item Properties.
- Click the mouse on the FLOWSTAR icon. The computer will now establish an initial link to FLOWSTAR as shown in figure 6.2.

Figure 6.2 Flowstar Crosstalk Window



- Click the mouse on Setup and select System. Verify and modify as required. Refer to figure 6.3 for detail.

Figure 6.3 System Settings



System Settings

Startup Script:

Local Access Number:

Long Distance Access Number:

☒ Display the password in SETUP.SESSION dialog

☐ Keep duplicate files by creating .BAK file

☒ Add CR to end of Paste-To-Host data stream

Phone Book Entries:

Scripts:

Transfers and Captures:

Editor to use:

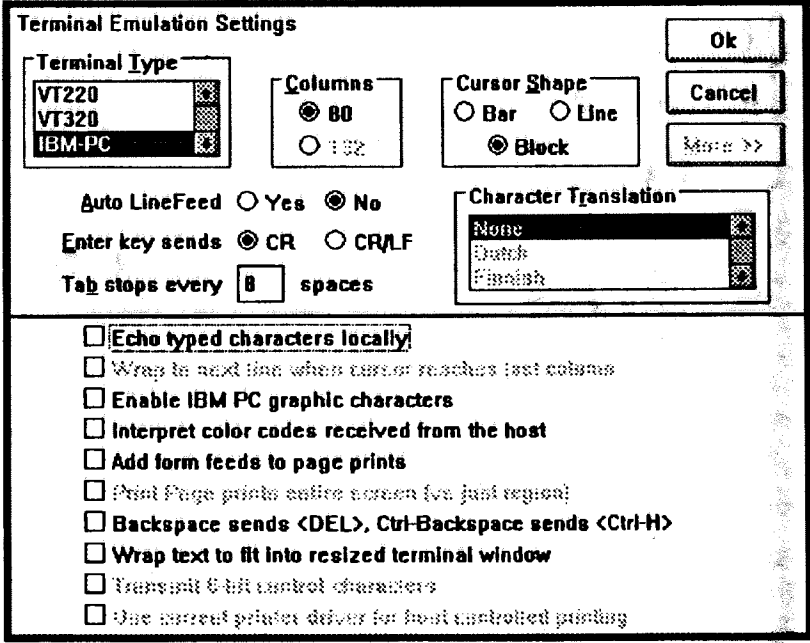
Scrolling Buffer Size ☐ None ☐ 16k ☒ 32k ☐ 64k

Comm. Port Buffer Size ☐ 2k ☐ 4k ☐ 8k ☐ 12k ☒ 16k

Ok Cancel More >>

- Click the mouse on Setup and select Terminal. Verify setup and modify as required as per figure 6.4.

Figure 6.4 Terminal Emulation Settings



Terminal Emulation Settings

Terminal Type: VT220, VT320, IBM-PC

Columns: ☒ 80 ☐ 132

Cursor Shape: ☐ Bar ☐ Line ☒ Block

Auto LineFeed ☐ Yes ☒ No

Enter key sends ☒ CR ☐ CR/LF

Tab stops every spaces

Character Translation: None, Dutch, Finnish

☒ Echo typed characters locally

☐ Wrap to next line when cursor reaches last column

☐ Enable IBM PC graphic characters

☐ Interpret color codes received from the host

☐ Add form feeds to page prints

☐ Print Page prints entire screen (vs. just region)

☐ Backspace sends , Ctrl-Backspace sends <Ctrl-H>

☐ Wrap text to fit into resized terminal window

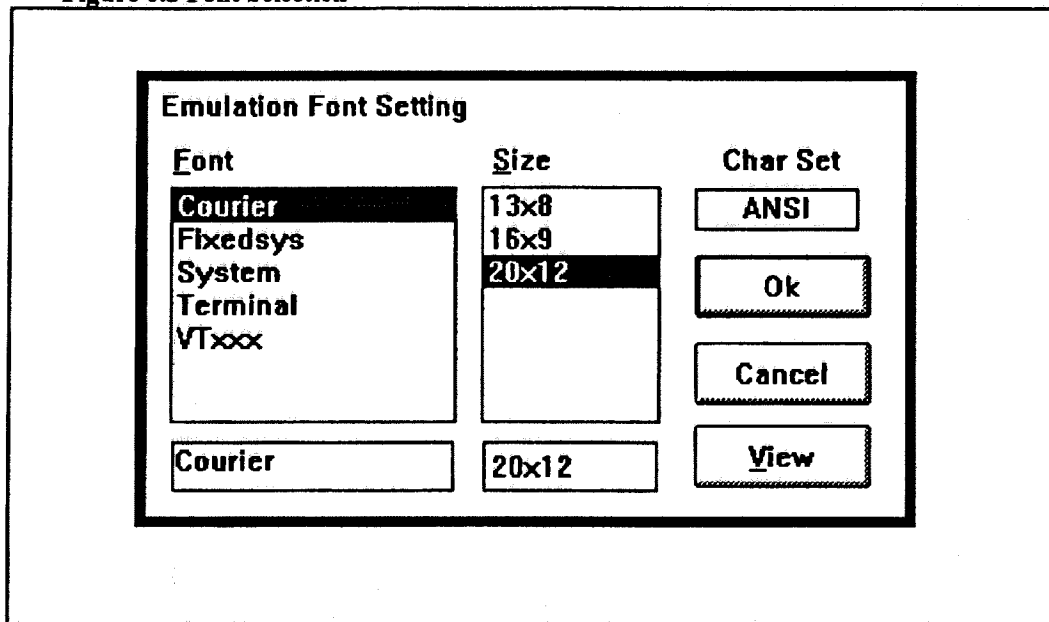
☐ Transmit 8-bit control characters

☐ Use current printer driver for host controlled printing

Ok Cancel More >>

- Click the mouse on Setup and select Fonts. It should be noted that true type fonts are not recommended as system response will be slowed. Recommended selection is given in figure 6.5.

Figure 6.5 Font Selection



- FLOWSTAR is initially shipped from Hoffer Flow configured as a Remote Terminal, baud rate equal to 9600, and no handshaking. Crosstalk is also initially configured for 9600 baud, 8 data bits, no parity, one stop bit, and set for COM2. Should these settings require change, click the mouse on Actions and then Disconnect. Then click the mouse on Setup then Device and modify as required. All that may be required for change would be the COM port use.

6.3 HOFFER PROTOCOL

The Hoffer protocol allows for two way serial communications between the RS-232 or RS-422/RS-485 port to a host computer. The communication string consists of a start transmission code, unit ID number, a command code, specific data requested, data sent, end of transmission and checksum.

6.3.1 CONTROL COMMAND CALLER MESSAGE FORMAT

The following command format is used to perform remote operation of the Flowstar keypad. Execution of these commands will change the displayed information on the unit. The executed command will simply function as if the key were pressed on the actual unit. Flowstar will not respond back to the host with the new displayed data until a read data transmission is generated.

STX | nn | CT | sss | ETX | CKS

STX = 0x02

nn - unit id, 00 - 31

CT - control command

sss - keyboard input key number, ie., { 000 }

ETX - 0x03

CKS - exclusive or of each byte of data between the STX and ETX

Upon completion of the requested command, Flowstar will return an error code for the control command using the following:

STX | ee | ETX | CKS

STX = 0x02

ee - error codes:

00=no errors

01=invalid command

02=data out of range

03=access denied

Access is denied under the following conditions:

- A "FLOW" condition exist.
- Unit is in the SETUP mode.

ETX - 0x03

CKS - exclusive or of each byte of data between the STX and ETX

6.3.2 READ DATA COMMAND CALLER MESSAGE FORMAT

This group of commands allows the host computer system to read process conditions, and unit calibration data. To access data from Flowstar the read request must use the following command format.

STX | nn | RD | sss | ETX | CKS

STX = 0x02

nn - unit id, 00 - 31 for RS485. This value will be 00 for RS232.

RD - Read command.

sss - 3 characters specifying the specific field (000 - 421), as outlined in the Field Format Table.

ETX - 0x03

CKS - exclusive or of each byte of data between the STX and ETX

After receiving a read command from the host Flowstar will respond with the read response command. This response will be in the following format:

STX | ee | ddd | ETX | CKS

STX = 0x02

ee - error codes:

00=no errors

01=invalid command

02=data out of range

ddd=Value=char; response 3 digit numeric from Field Format Table column DDD.

Value=flt; response may consist of 16 numeric characters with decimal point. Leading zeros are not required. ie. 123456.789.

Value=int; response may consist of 16 numeric characters. Leading zeros are not required. ie. 123456789.

ETX - 0x03

CKS - exclusive or of each byte of data between the STX and ETX

6.3.3 WRITE DATA COMMAND CALLER MESSAGE FORMAT

This command format allows the host computer system to write directly to the internal microprocessor registers of Flowstar. To write data to Flowstar the read request must use the following command format.

STX | nn | WR | sss | ddd | ETX | CKS

STX = 0x02

nn - unit id, 00 - 31

WR - Write command

sss - specific data, 3 characters specifying the specific field (000 - 421)

ddd - Value=char; response 3 digit numeric from Field Format Table column.

Value=flt; response may consist of 16 numeric characters with decimal point. Leading zeros are not required. ie. 123456.789.

Value=int; response may consist of 16 numeric characters. Leading zeros are not required. ie. 123456789.

ETX - 0x03

CKS - exclusive or of each byte of data between the STX and ETX

After receiving a write command from the host Flowstar will respond with the read response command. This response will be in the following format:

STX | ee | ETX | CKS

STX = 0x02

ee - error codes:

00=no errors

01=invalid command

02=data out of range

ETX - 0x03

CKS - exclusive or of each byte of data between the STX and ETX

6.3.4 DATA FORMAT DESCRIPTIONS

Data may be transmitted to Flowstar using data formatted as either a character(char), floating(flt) numeric or an integer(int) numeric value.

Refer to the FIELD DATA TABLE for specific field formats.

For all char fields, 3 digit numeric entries are required corresponding to the specific field as listed in the FIELD DATA TABLE.

Floating fields may consist of up to 16 numeric characters with a decimal point. ie., {293.034}. Leading zeroes is not required here.

Integer values may also consist of up to 16 characters. Leading zeroes is not required here.

All characters between the STX and ETX must be ASCII alpha/numeric characters. In addition all alphabetic characters must be in upper case.

6.3.5 CHECKSUM DETERMINATION

The following routine used in the serial protocol calculates a checksum of all data bytes between the STX and ETX character. It takes as input a pointer to a string and the length of the string to calculate the checksum on. Its output is an unsigned character containing the checksum. The checksum itself is an exclusive or of all the bytes of data.

From Boolean algebra:

$$\text{EXCLUSIVE OR} = \text{EOR} = xy' + x'y$$

$$(\text{chksum} \& \sim *in_buff_ptr) | (\sim \text{chksum} \& *in_buff_ptr)$$

Notice the similarity in the code to perform the EXCLUSIVE OR function. The rest of the code in the routine will perform the EOR the correct number of times on the input data string. The format (ASCII, EBCDIC, GRAY CODE, or what ever) of the bytes forming the string is completely irrelevant.

The following is a sample C program which may be used for the determination of the correct checksum.
/*****

```
unsigned char check_sum( unsigned char *in_buff_ptr, unsigned int abslen )
```

```
{
  unsigned short int i;
  unsigned char chksum;

  chksum = *in_buff_ptr++;
  for (i = 1; i < abslen; in_buff_ptr++, i++)
    chksum = (chksum & ~*in_buff_ptr) | (~chksum & *in_buff_ptr);
  return( chksum );
}
```

```
*****/
```

6.3.6 TABLES

The following table indicated the equivalent code values for the specific keypad keys.

SSS	KEY EQUIVALENT
000	STOP
001	START
002	TOTAL
003	HEAT
004	CLEAR
005	MODE
006	RATE
007	SETP1
008	MAN
009	LAST
010	TEMP1
011	SETP2
012	AUTO
013	NEXT
014	TEMP2
015	AUX1
016	REM
017	SEL
018	PRES
019	AUX2

The following table is the Field Data Table. This information will be used to read all displayed data.

COMMAND	nnn	DESCRIPTION	VALUES
RD	000	AUX 2 TOTAL	flt
RD	001	CHANNEL 1 TOTAL	flt
RD	002	CHANNEL 1 RATE	flt
RD	003	CHANNEL 2 TOTAL/RATE	flt
RD	004	CHANNEL 3 TOTAL/RATE	flt
RD	005	CHANNEL 4 TOTAL/RATE	flt
RD	008	AUX 1 TOTAL	flt
RD	011	CHANNEL 1 ACCUMULATED TOTAL	flt
RD	012	CHANNEL 2 ACCUMULATED TOTAL	flt
RD	013	CHANNEL 3 ACCUMULATED TOTAL	flt
RD	014	CHANNEL 4 ACCUMULATED TOTAL	flt

The following table is the Field Data Table. This information will be used to read and write to the internal registers of Flowstar.

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	020	CH1 TOTAL * SEE TABLE 6.1 FOR DEFINITION.	char	UNIT 1 UNIT 2 UNIT 3 UNIT 4 UNIT 5 UNIT 6 UNIT 7 UNIT 8 UNIT 9 UNIT 10 UNIT 11	/* 000 */ /* 001 */ /* 002 */ /* 003 */ /* 004 */ /* 005 */ /* 006 */ /* 007 */ /* 008 */ /* 009 */ /* 010 */

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	021	CHI RATE * SEE TABLE 6.1 FOR DEFINITION.	char	UNIT 1/MIN UNIT 1/HR UNIT 1/SEC UNIT 2/MIN UNIT 2/HR UNIT 2/SEC UNIT 3/MIN UNIT 3/HR UNIT 3/SEC UNIT 4/MIN UNIT 4/HR UNIT 4/SEC UNIT 5/MIN UNIT 5/HR UNIT 5/SEC UNIT 6/MIN UNIT 6/HR UNIT 6/SEC UNIT 7/MIN UNIT 7/HR UNIT 7/SEC UNIT 8/MIN UNIT 8/HR UNIT 8/SEC UNIT 9/MIN UNIT 9/HR UNIT 9/SEC UNIT 10/MIN UNIT 10/HR UNIT 10/SEC UNIT 11/MIN UNIT 11/HR UNIT 11/SEC	/* 011 */ /* 012 */ /* 013 */ /* 014 */ /* 015 */ /* 016 */ /* 017 */ /* 018 */ /* 019 */ /* 020 */ /* 021 */ /* 022 */ /* 023 */ /* 024 */ /* 025 */ /* 026 */ /* 027 */ /* 028 */ /* 029 */ /* 030 */ /* 031 */ /* 032 */ /* 033 */ /* 034 */ /* 035 */ /* 036 */ /* 037 */ /* 038 */ /* 039 */ /* 040 */ /* 041 */ /* 042 */ /* 043 */
RD/WR	021	CHI SMOOTHING	flt	0.0 - 1.0	
RD/WR	023	CHI POINT NUMBER	int	00 - 20	
RD/WR	024	FLOW CALC METHOD	char	KFACTOR SINGLE KFACTOR TEMP VS VISCOSITY	/* 044 */ /* 045 */ /* 046 */
RD/WR	025	MASS FLOW METHOD	char	MANUAL DENSITY TEMP VS DENSITY	/* 047 */ /* 048 */

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	026 267 302	CH1 TABLE SELECT CH3 TABLE SELECT CH4 TABLE SELECT	char	TABLE1 TABLE2 TABLE3 TABLE4	/* 049 */ /* 050 */ /* 051 */ /* 052 */
RD/WR	027	DEF DENS (CH1)	flt		
RD/WR	028	BASE DENS (CH1)	flt		
RD/WR	029	DEF TEMP (CH1)	flt		
RD/WR	030	BASE TEMP (CH1)	flt		
RD/WR	031	DEF PRES (CH1)	flt		
RD/WR	032	BASE PRES (CH1)	flt		
RD/WR	033	DEF KFACTOR	flt		
RD/WR	034	DEFAULT Z FACTOR (CH1)	flt		
RD/WR	035	USER DEFINE (CH1)	flt		
RD/WR	036 thru 055	FREQ1_1 thru FREQ1_20	flt		
RD/WR	056 thru 075	FREQ2_1 thru FREQ2_20	flt		
RD/WR	076 thru 095	FREQ3_1 thru FREQ3_20	flt		
RD/WR	096 thru 115	FREQ4_1 thru FREQ4_20	flt		

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	116 thru 135	KFAC1_1 thru KFAC1_20	flt		
RD/WR	136 thru 155	KFAC2_1 thru KFAC2_20	flt		
RD/WR	156 thru 175	KFAC3_1 thru KFAC3_20	flt		
RD/WR	176 thru 195	KFAC4_1 thru KFAC4_20	flt		

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	196 263 298	CH2 UNITS CH3 UNITS CH4 UNITS	char	UNIT 1 UNIT 1/MIN UNIT 1/HR UNIT 1/SEC UNIT 2 UNIT 2/MIN UNIT 2/HR UNIT 2/SEC UNIT 3 UNIT 3/MIN UNIT 3/HR UNIT 3/SEC UNIT 4 UNIT 4/MIN UNIT 4/HR UNIT 4/SEC UNIT 5 UNIT 5/MIN UNIT 5/HR UNIT 5/SEC UNIT 6 UNIT 6/MIN UNIT 6/HR UNIT 6/SEC UNIT 7 UNIT 7/MIN UNIT 7/HR UNIT 7/SEC UNIT 8 UNIT 8/MIN UNIT 8/HR UNIT 8/SEC UNIT 9 UNIT 9/MIN UNIT 9/HR UNIT 9/SEC UNIT 10 UNIT 10/MIN UNIT 10/HR UNIT 10/SEC UNIT 11 UNIT 11/MIN UNIT 11/HR UNIT 11/SEC	/* 068 */ /* 069 */ /* 070 */ /* 071 */ /* 072 */ /* 073 */ /* 074 */ /* 075 */ /* 076 */ /* 077 */ /* 078 */ /* 079 */ /* 080 */ /* 081 */ /* 082 */ /* 083 */ /* 084 */ /* 085 */ /* 086 */ /* 087 */ /* 088 */ /* 089 */ /* 090 */ /* 091 */ /* 092 */ /* 093 */ /* 094 */ /* 095 */ /* 096 */ /* 097 */ /* 098 */ /* 099 */ /* 100 */ /* 101 */ /* 102 */ /* 103 */ /* 104 */ /* 105 */ /* 106 */ /* 107 */ /* 108 */ /* 109 */ /* 110 */ /* 111 */
		NOTE: THESE OPTIONS ARE AVAILABLE AS FOLLOWS: MODEL CH# 2000 ALL 2001 CH3 2002 CH3 2003 .. NONE			

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION		DDD
		NOTE: THESE OPTIONS ARE AVAILABLE AS FOLLOWS: MODEL CH# 2000 .. NONE 2001 CH2 2002 CH2, CH4 2003 CH2		PSIG PSIA AJM BAR KPAS	* CH4 DISPLAYED VALUES	/* 053 */ /* 054 */ /* 055 */ /* 056 */ /* 057 */
				DEG F DEG R DEG C DEG K	* CH2 DISPLAYED VALUES	/* 058 */ /* 059 */ /* 060 */ /* 061 */
RD/WR MODEL 2001 & 2003 ONLY	199	CH2 GAS INHIBIT	CHAR	ON OFF		/* 125 */ /* 126 */
RD/WR	200	CH2 SMOOTHING	flt	0.0 - 1.0		
RD/WR	201	CH2 POINT NUMBER	int	00 - 10		
RD/WR	202	CH2 TABLE	int	1 - 4	TABLE 1	/* 49 */
					TABLE 2	/* 50 */
RD/WR	203 thru 212	CH2 MEASURE PNT 1_1 thru 1_10	flt			
RD/WR	213 thru 222	CH2 MEASURE PNT 2_1 thru 2_10	flt			
RD/WR MODEL 2001 & 2003 ONLY	223 thru 232 233 thru 242	CH2 VISCOSITY PNT 1_1 thru 1_10 2_1 thru 2_10	flt			
RD/WR MODEL 2001 & 2003 ONLY	243 thru 252 253 thru 262	CH2 DENSITY PNT 1_1 thru 1_10 2_1 thru 2_10	flt			
RD/WR	266	CH3 SMOOTHING	flt	0.0 - 1.0		

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION		DDD
RD/WR	267	CH3 POINT NUMBER	int	00 - 5		
RD/WR	268	MASS FLOW METHOD	char			
RD/WR	269	CH3 TABLE	int	1 - 4	TABLE 1	/* 49 */
					TABLE 2	/* 50 */
					TABLE 3	/* 51 */
					TABLE 4	/* 52 */
RD/WR	270	DEFAULT DENS CH3	flt			
RD/WR	271	BASE DENS CH3	flt			
RD/WR	272	DEFAULT TEMP OR CH3	flt			
RD/WR	273	BASE TEMP CH3	flt			
RD/WR	274	DEFAULT PRES CH3	flt			
RD/WR	275	BASE PRES CH3	flt			
RD/WR	278 thru 282	CH3 MEASURE PNT 1 1 thru 1 5	flt			
RD/WR	283 thru 287	CH3 MEASURE PNT 2 1 thru 2 5	flt			
RD/WR	288 thru 292	CH3 MEASURE PNT 3 1 thru 3 5	flt			

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION		DDD
RD/WR	293 thru 297	CH3 MEASURE PNT 4 1 thru 4 5	flt			
RD/WR <i>MODEL 2001 & 2003 ONLY</i>	301	CH4 GAS INHIBIT	char	ON OFF		/* 125 */ /* 126 */
RD/WR	302	SCH4_SMOOT H	flt	0.0 - 1.0		
RD/WR	303	CH4 POINT NUMBER	int	00 - 5		
RD/WR	304	CH4 TABLE	int	1 - 4	TABLE 1	/* 49 */
					TABLE 2	/* 50 */
					TABLE 3	/* 51 */
					TABLE 4	/* 52 */
RD/WR	305 thru 309	CH4 MEASURE PNT 1 1 thru 1 5	flt			
RD/WR	310 thru 314	CH4 MEASURE PNT 2 1 thru 2 5	flt			
RD/WR	315 thru 319	CH4 MEASURE PNT 3 1 thru 3 5	flt			
RD/WR	320 thru 324	CH4 MEASURE PNT 4 1 thru 4 5	flt			
RD/WR <i>MODEL 2001 ONLY</i>	325 thru 329	CH4 DENSITY PNT 1 1 thru 1 5	flt			

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	345 347	AUX1 UNITS	char	KG	/* 062 */
		AUX2 UNITS		KG/MIN	/* 063 */
				M³	/* 064 */
				M³/MIN	/* 065 */
				LIT	/* 066 */
				LIT/MIN	/* 067 */
				UNIT 1	/* 068 */
				UNIT 1/MIN	/* 069 */
				UNIT 1/HR	/* 070 */
				UNIT 1/SEC	/* 071 */
				UNIT 2	/* 072 */
				UNIT 2/MIN	/* 073 */
				UNIT 2/HR	/* 074 */
				UNIT 2/SEC	/* 075 */
				UNIT 3	/* 076 */
				UNIT 3/MIN	/* 077 */
				UNIT 3/HR	/* 078 */
				UNIT 3/SEC	/* 079 */
				UNIT 4	/* 080 */
				UNIT 4/MIN	/* 081 */
				UNIT 4/HR	/* 082 */
				UNIT 4/SEC	/* 083 */
				UNIT 5	/* 084 */
				UNIT 5/MIN	/* 085 */
				UNIT 5/HR	/* 086 */
				UNIT 5/SEC	/* 087 */
				UNIT 6	/* 088 */
				UNIT 6/MIN	/* 089 */
				UNIT 6/HR	/* 090 */
				UNIT 6/SEC	/* 091 */
				UNIT 7	/* 092 */
				UNIT 7/MIN	/* 093 */
				UNIT 7/HR	/* 094 */
				UNIT 7/SEC	/* 095 */
				UNIT 8	/* 096 */
				UNIT 8/MIN	/* 097 */
				UNIT 8/HR	/* 098 */
				UNIT 8/SEC	/* 099 */
				UNIT 9	/* 100 */
				UNIT 9/MIN	/* 101 */
				UNIT 9/HR	/* 102 */
				UNIT 9/SEC	/* 103 */
				UNIT 10	/* 104 */
				UNIT 10/MIN	/* 105 */
				UNIT 10/HR	/* 106 */
				UNIT 10/SEC	/* 107 */
				UNIT 11	/* 108 */
				UNIT 11/MIN	/* 109 */
				UNIT 11/HR	/* 110 */
				UNIT 11/SEC	/* 111 */

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR <i>MODEL 2001 ONLY</i>	330 thru 334	CH4 DENSITY PNT 2_1 thru 2_5	flt		
RD/WR <i>MODEL 2001 ONLY</i>	335 thru 339	CH4 MEASURE PNT 3_1 thru 3_5	flt		
RD/WR <i>MODEL 2001 ONLY</i>	340 thru 344	CH4 MEASURE PNT 4_1 thru 4_5	flt		

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	346 348	AUX1 CONFIG AUX2 CONFIG	char	C1 C2 C3 C4 C1+C2 C1+C2+C3 C1+C2+C3+C4 C1-C2 C2-C3 C3-C4 C1-C3	/* 112 */ /* 113 */ /* 114 */ /* 115 */ /* 116 */ /* 117 */ /* 118 */ /* 119 */ /* 120 */ /* 121 */ /* 122 */
RD/WR	349	CH1 AUTO SWITCH	char	OFF CH1 LOW - CH2 HIGH	/* 123 */ /* 124 */
RD/WR	350	ALARM1 SET HIGH	flt		
RD/WR	351	ALARM1 SET LOW	flt		
RD/WR	352	ALARM1 DEADBAND	flt		
RD/WR	353	ALARM1 AUDIBLE	char	YES NO	/* 125 */ /* 126 */
RD/WR	354	ALARM2 SET HIGH	flt		
RD/WR	355	ALARM2 SET LOW	flt		
RD/WR	356	ALARM2 DEADBAND	flt		
RD/WR	357	ALARM2 AUDIBLE	char	YES NO	/* 125 */ /* 126 */
RD/WR	358	ALARM3 SET HIGH	flt		
RD/WR	359	ALARM3 SET LOW	flt		
RD/WR	360	ALARM3 DEADBAND	flt		

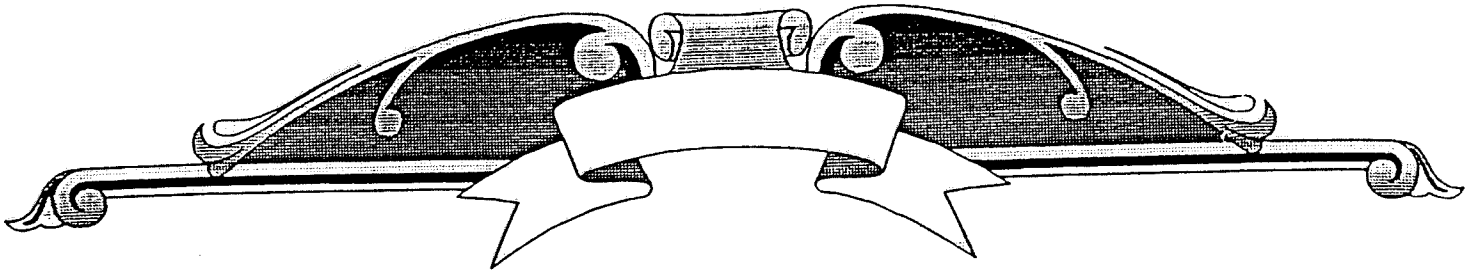
COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	361	ALARM3 AUDIBLE (ALL OTHERS) CONT1 BATCH FOR MODEL 2003	char	YES NO	/* 125 */ /* 126 */
RD/WR	362	ALARM4 SET HIGH	flt		
RD/WR	363	ALARM4 SET LOW	flt		
RD/WR	364	ALARM4 DEADBAND	flt		
RD/WR	365	ALARM4 AUDIBLE	char	YES NO	/* 125 */ /* 126 */
RD/WR <i>MODEL 2003 ONLY</i>	366	PREWARN SETPOINT MODEL 2003	flt		
RD/WR <i>MODEL 2003 ONLY</i>	367	CONTROL SETPOINT MODEL 2003	flt		
RD/WR	368 370	DA1 CONFIG DA2 CONFIG	char	MIMIC AUX1 MIMIC AUX2 MIMIC CH1 FWD/REV MIMIC CH1 MIMIC CH2 MIMIC CH3 MIMIC CH4	/* 127 */ /* 128 */ /* 129 */ /* 130 */ /* 131 */ /* 132 */ /* 133 */
RD/WR	369	DA1 MAX RANGE	flt		
RD/WR	371	DA2 MAX RANGE	flt		
RD/WR	372	CH1 PULSE WEIGHT	flt		
RD/WR	373	CH2 PULSE WEIGHT	flt		

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	374	CH3 PULSE WEIGHT	flt		
RD/WR	375	CH4 PULSE WEIGHT	flt		
RD/WR	376 377 378 379	RELAY1 CONFIG RELAY2 CONFIG RELAY3 CONFIG RELAY4 CONFIG	char	ALARM1 HIGH ALARM1 LOW ALARM2 HIGH ALARM2 LOW ALARM3 HIGH ALARM3 LOW ALARM4 HIGH ALARM4 LOW ALARM AUDIBLE PREWARN CONTROL FLOW CH1 FLOW CH2 FLOW CH3 FLOW CH4	/* 134 */ /* 135 */ /* 136 */ /* 137 */ /* 138 */ /* 139 */ /* 140 */ /* 141 */ /* 142 */ /* 143 */ /* 144 */ /* 145 */ /* 146 */ /* 147 */ /* 148 */
RD/WR	380	SERIAL MODE	char	RS232 RS422 RS485	/* 156 */ /* 157 */ /* 158 */
RD/WR	381	SERIAL MODE NUM	int	00 - 31	
RD/WR	382	SERIAL BAUD RATE	char	9600 4800 2400 1200 600 300 150 75	/* 159 */ /* 160 */ /* 161 */ /* 162 */ /* 163 */ /* 164 */ /* 165 */ /* 166 */
RD/WR	383	SERIAL HANDSHAKE	char	NONE HARDWARE DTR XON/XOFF	/* 167 */ /* 168 */ /* 169 */
RD/WR	384	SERIAL PROTOCOL	char	REMOTE KEYBOARD HOFFER INTERFACE	/* 170 */ /* 171 */
RD/WR	385	PASSWORD	int	0000-9999	
RD/WR	386	DATE	tim	mmddyy	

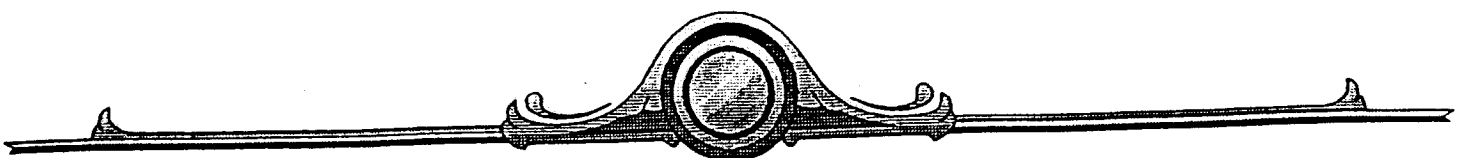
COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	387	DAY OF WEEK	char	MON TUE WEN THU FRI SAT SUN	/* 149 */ /* 150 */ /* 151 */ /* 152 */ /* 153 */ /* 154 */ /* 155 */
RD/WR	388	TIME 24 HOUR CLK	tim	hhmmss	

Table 6.1 Unit Definitions

UNIT #	ENGLISH		METRIC	
	LIQUID	GAS	LIQUID	GAS
UNIT 1	LBS	LBS	KG	KG
UNIT 2	FT ³	ACF	M ³	SM ³
UNIT 3	GAL	SCF	LIT	AM ³
UNIT 4	OZ	UDEF	MLIT	NM ³
UNIT 5	FLOZ		CC	SCC
UNIT 6	PNTS		MTON	ACC
UNIT 7	BBL		UDEF	NCC
UNIT 8	TONS			LIT
UNIT 9	UDEF			NLIT
UNIT 10				SLIT
UNIT 11				UDEF



Related Drawings



NOTES:

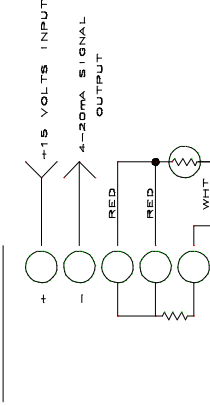
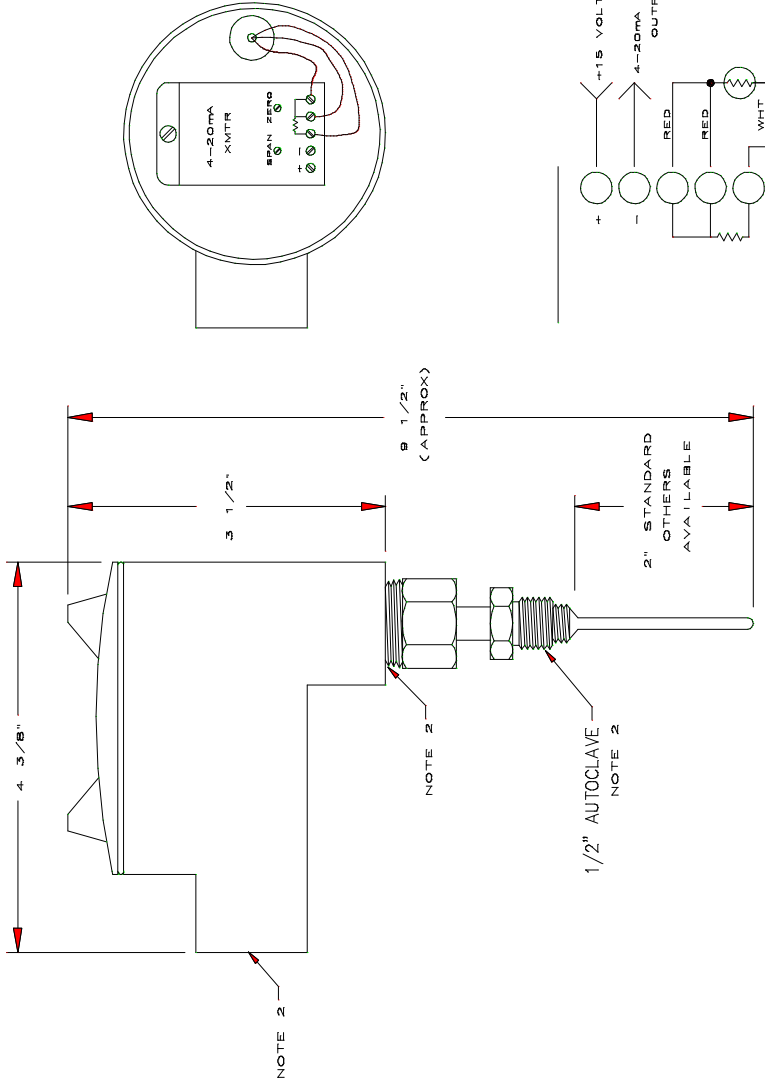
1. TWO WIRE TRANSMITTER IS A WEEED INSTRUMENT MODEL 4154.
RANGES AVAILABLE OVER -100 TO 600° C, CONSULT
FACTORY FOR AVAILABLE SPANS.

OUTPUT: 4.0 TO 20mA
RTD: 1000 OHM @ 0° C
POWER SUPPLY: 9.5V TO 38VDC.

2. THREAD CONNECTIONS ARE 1/2" NPT FOR CONDUIT
AND 1/2" AUTOCLAVE FOR PROCESS TAP.

3. OPERATIONAL TEMPERATURE LIMITS 0° - 60° C.

PT102-X-2-1000-4154(*) -GUAC/O-X
* SPECIFY TEMPERATURE RANGE WITH AT LEAST
A 35° F SPREAD.

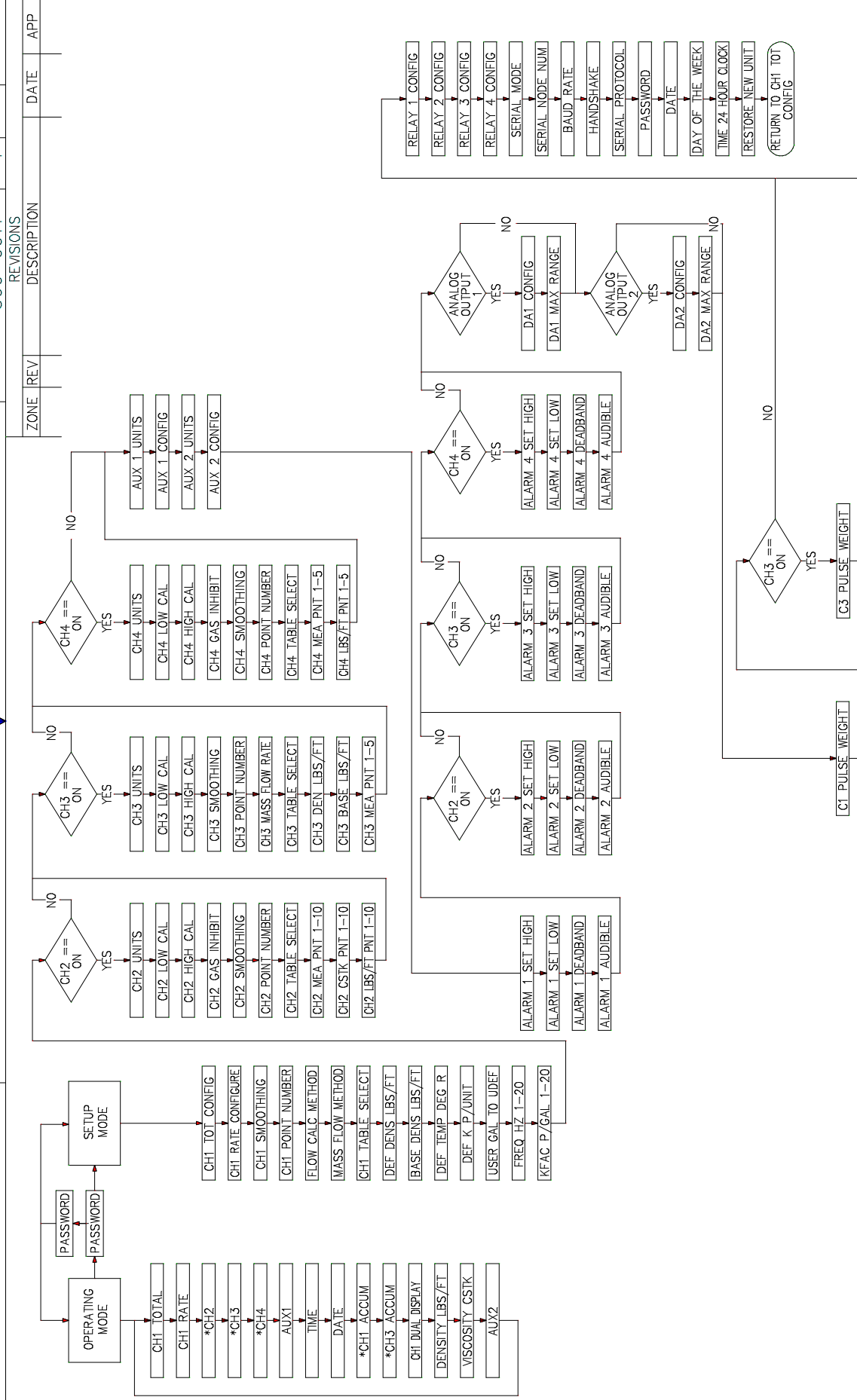


REPLACES 500-0267

HOFFER FLOW CONTROLS, INC
ELIZABETH CITY, NC 27909

INSTALLATION DRAWING,
PT102-
TEMPERATURE PROBE

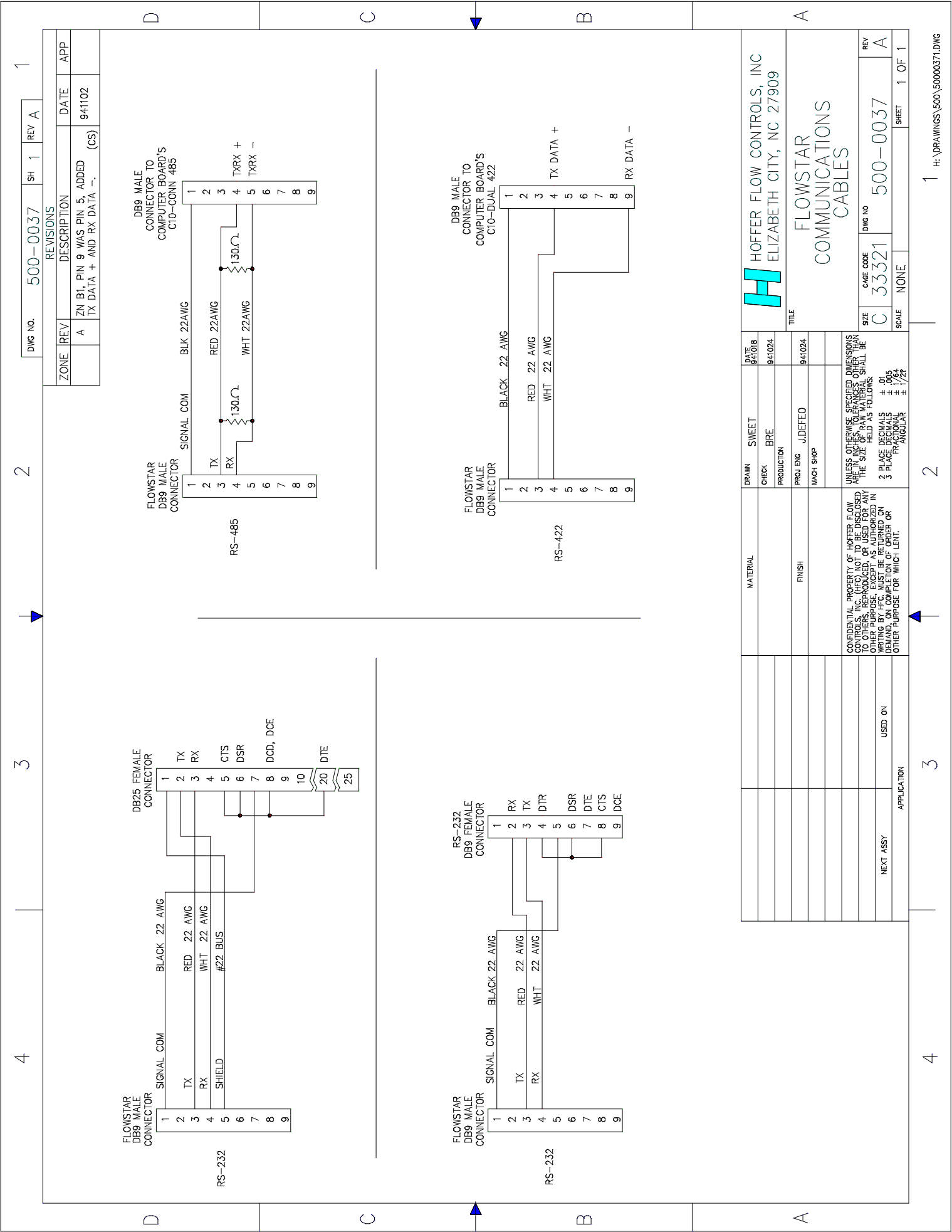
SIZE	CAGE CODE	DWG NO	REV
C	33321	TRANS-102	C
SCALE	NONE	SHEET	1 OF 1



FLOWSTAR 2001
FLOWCHART

3 PLACE DECIMALS	01	C	33321	500-0011	REV —
3 PLACE FRACTIONAL	± 0/5				
3 PLACE ANGULAR	± 1/22				
<p>ARE IN INCHES. DIMENSIONS OTHER THAN THE SIZE OF SHEET SHALL BE AS FOLLOWS:</p>		SCALE	NONE	SHEET	1 OF 1

CONTROL, INC. (HFC) NOT TO BE DISCLOSED TO OTHERS, REPRODUCED, OR USED FOR ANY OTHER PURPOSE, EXCEPT AS AUTHORIZED IN WRITING BY FORTRESS. BEING ORDERED OR OTHER PURPOSE FOR WHICH LENT.	USED ON	APPLICATION
NEXT ASSY		



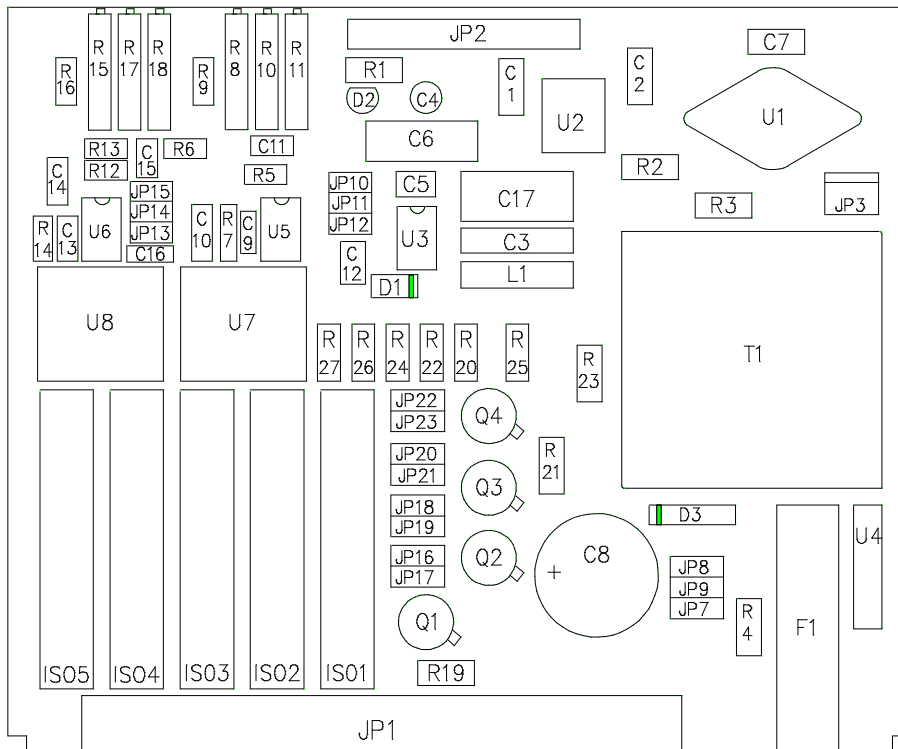
NOTES:

1. FOR 110VAC EQUIP JP8, JP9 AND U4 (OPTIONAL)

FOR 220VAC EQUIP JP7, REMOVE U4 IF EQUIPPED.

REVISIONS

REV	DESCRIPTION	DATE	APP



		MATERIAL	DRAWN	DATE	<div>H</div> HOFFER FLOW CONTROLS, INC. ELIZABETH CITY, NC 27909			
			CHECK					
			PRODUCTION					
			PROJ ENG					
		FINISH			TITLE AC POWER CONVERSION INSTRUCTIONS PCA-139			
		CONFIDENTIAL PROPERTY OF HOFFER FLOW CONTROLS, INC. (HFC) NOT TO BE DISCLOSED TO OTHERS, REPRODUCED, OR USED FOR ANY OTHER PURPOSE, EXCEPT AS AUTHORIZED IN WRITING BY HFC. MUST BE RETURNED ON DEMAND, ON COMPLETION OF ORDER OR OTHER PURPOSE FOR WHICH LENT.	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES OTHER THAN RAW MATERIAL SHALL BE HELD AS FOLLOWS: 2 PLACE DECIMAL ±.01 3 PLACE DECIMAL ±.005 FRACTIONAL ±1/64 ANGULAR ±1/2°					
NEXT ASSY	USED ON				SIZE A	CAGE CODE 33321	DWG NO 700-0136	REV —
APPLICATION					SCALE NONE		SHEET 1	OF 1