FLOWSTAR 2006™

USER'S MANUAL

HP-265
April 1995

HOFFER Flow Controls

Perfecting Measurement™

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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 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 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.

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

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2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

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1. P.O. number to cover the COST of the repair/calibration,
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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.*

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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.

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1.INTRODUCTION

1.1. INTRODUCTION

The Flowstar series is a cost effective family of flow products designed to accept inputs from pulse producing flowmeters. This manual details instructions on the installation and use of the;

- Model 2006 - Volumetric flowrate indicator/totalizer for Gas.

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 alphanumeric display that indicates function and unit of measure in English or Metric units. The display is a backlit 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(half duplex) multi-drop communication port.

Two analog input channels are available. These two channels are used for temperature and pressure inputs. Two analog output signals are available for transmission of process variables to remote data acquisition systems or chart recorders.

A scaled pulse output is 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

1.2.1. DISPLAY

- Two line, 16 character alphanumeric, LCD, LED back-light
- Character height 0.32", super-twist +/- 20 degree viewing angle.
- Options: Front display heater, less LED back-light for battery supplied operations

1.2.2. ANNUNCIATORS

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

1.2.3. OUTPUTS(4):

Output features are designed to meet a wide variety of user applications as possible. Each output will be software selectable from a list of available outputs. **All units will come standard with active low MOSFET 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.

1.2.4. SOFTWARE SELECTABLE OUTPUT CHOICES (select any 4)

FLOW RELATED

- SCALED PULSE OUT.

ALARM RELATED

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

1.2.5. KEYPAD

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

1.2.6. INPUT

- Single channel, pulse input, 10 mVrms to 5 Vrms, 10 to 1000 Hz, 50 K-ohm input impedance, maximum input frequency is 3500 Hz.
- Quadrature detection, pulse input, 10 mVrms to 5 Vrms, 10 to 1000 Hz, 50 K-ohm input impedance, maximum input frequency is 3500 Hz.
- Optional: MCP pickup.

1.2.7. PROCESS INPUTS(2)

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

1.2.8. 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.

1.2.9. SERIAL COMMUNICATION

- RS-422\RS-485(Half Duplex) multi-drop.
- RS-232C, plug in sockets standard.

1.2.10. DIP SWITCH PROGRAMMABLE FEATURES (7)

- Program Enable.
- Local Control.
- Input Channel 2(Temperature).
- Input Channel 3(Pressure).
- Output Channel 1.
- Output Channel 2.
- Units English/Metric

1.2.11. SELF DIAGNOSTIC

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

1.2.12. INPUT POWER

- 110/220 Vac 50-60Hz selectable on board or 18-30 Vdc with external supplied source.

1.2.13. ENVIRONMENTAL

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

1.2.14. ENCLOSURE

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

1.3. 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.

1.4. SHIPPING AND HANDLING

CAUTION - The FLOWSTAR contains static-sensitive devices and standard practices 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 parts of Flowstar, due to their **STATIC SENSITIVE** nature, should be wrapped in 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 that can 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.

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

1.5. 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.

1.5.1. 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.

Higher precision is achieved with the FLOWSTAR by exploiting the repeatability of +/-.05 to +/-.1% over the repeatable flow range. The FLOWSTAR improves linear turbine flow measurement accuracy's to +/-0.1% over 20:1 to 100:1 repeatable flow ranges.

Flowstar can store up to 20 calibration points, for channel 1, and 2 points for channels 2 and 3. The system continuously samples the flowmeter frequency averaged over a programmed period. Stored calibration points are then accessed to determine the closest available calibration information. Using a linear interpolation routine, the actual calibration factor is determined and used in the instrument calculations to achieve the highest possible accuracy.

1.5.2. 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(half duplex) communication option. With this port, several instruments may be connected together over greater distances and communicate to a central computer at higher speeds than is possible with the RS-232 communication port. In a multi-drop configuration, the port has a unique feature which

> The 9 pin communication port on Flowstar is not wired to any standards. Please wire all communications cables per drawing 500-0037, "Flowstar Communication Cables". This drawing is located in the back of this manual.

permits it to only become active when its corresponding instrument identifier is called.

2.FLOWSTAR OVERVIEW

2.1. INTRODUCTION

The Flowstar 2006 has two modes of operation, the OPERATING and SETUP modes. The OPERATING mode is used during normal operations. The SETUP mode is used to enter in the calibration parameters of the connected flowmeter. It is also used to configure the operation parameters of the Flowstar during factory and on site customization. The SETUP mode is accessed by proper entry of a password.

Operator input to the Flowstar is by an 20 key membrane keypad. The system displays information on a 2 line by 16 character LCD display.

LED indicator lamps and a sonic alarm are provided. Alarm conditions can be accessed through the communications port using the Hoffer Interface.

2.2. HARDWARE CONFIGURATION OF SOFTWARE OPTIONS

Several fields in both the OPERATION and SETUP modes are dependent on the switch setting of S1. This switch is located on 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, then its OPERATING and SETUP fields will not be displayed.

The S1 switch block is located on the back side of the Flowstar PCB The following table details the operation of the S1 switch block.

Table 1 S1 Switch Functions

S1 SWITCH	*FUNCTION*	
from left to right	ON/UP	OFF/DOWN
1	ENGLISH UNITS,	METRIC UNITS
2	ENABLE ANALOG OUTPUT 2(DA2)	INHIBIT ANALOG OUTPUT 2(DA2)
3	ENABLE ANALOG OUTPUT 1(DA1)	INHIBIT ANALOG OUTPUT 1(DA1)
4	ENABLE CHANNEL 3(PRES) INPUT	INHIBIT CHANNEL 3(PRES) INPUT
5	ENABLE CHANNEL 2(TEMP) INPUT	INHIBIT CHANNEL 2(TEMP) INPUT
6	ENABLE LOCAL CONTROL	INHIBIT LOCAL CONTROL
7	PROGRAM ENABLE	PROGRAM LOCKOUT

2.2.1. Switch S1-1

This switch when set to ON enables the display of English units. With S1-1 set to OFF, Flowstar will display in Metric units.

2.2.2. Switch S1-2,3

These switches enable or disable respective digital to analog output channel. If an output channel is turned off, none of its respective configuration fields will be available in the SETUP mode.

2.2.3. Switch S1-4,5

These switches enable or disable their respective analog to digital input channels. If an input channel is turned off, none of its respective setup fields will be available in both the OPERATING and SETUP modes.

2.2.4. Switch S1-6

The switch enables LOCAL CONTROL of the Flowstar. When system is used via communication, set this switch off to disable the START, STOP, CLEAR MAN, AUTO, and REM keys.

2.2.5. Switch S1-7

The PROGRAM ENABLE option determines whether the SETUP mode is available. Turning this switch on enables the MODE key. Turning this switch off prevents entry into the SETUP mode and changing of SETUP parameters using the HFC-6 communication interfaces.

3.OPERATING MODE

3.1. INTRODUCTION

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

- CH1 TOTAL; direct key selectable by pressing TOTAL.
- CH1 RATE; direct key selectable by pressing RATE.
- CH2 (TEMPERATURE); direct key selectable by pressing TEMP1.
- DENSITY; direct key selectable by pressing TEMP2.
- CH3 (PRESSURE); direct key selectable by pressing PRES.
- SETPOINT 1; direct key selectable by pressing SETP1.
- SETPOINT 2; direct key selectable by pressing SETP2.
- AUXILIARY 1; direct key selectable by pressing AUX1.
- AUXILIARY 2; direct key selectable by pressing AUX2.
- 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.
- CH1 DUAL DISPLAY; direct key selectable by pressing HEAT.
- AUDIT TRIAL CAL; accessible by LAST and NEXT keys only.
- AUDIT TRIAL CON; accessible by LAST and NEXT keys only.

NOTE: CH1 DUAL DISPLAY displays both the flowrate and the total for channel 1.

The actual measured value and units displayed for each channel depends on the individual channel's configuration selected in the SETUP mode.

3.2. OPERATING MODE KEYBOARD OPERATION

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

3.2.1. TOTAL, RATE

Selects the display values for the pulsed flow channel 1. Actual display values are dependent on the SETUP configuration for channel 1.

3.2.2. TEMP2

Selects the display value for corrected flowing Density. Actual display values are dependent on the setting of switch S1-1.

3.2.3. TEMP1, PRES

Selects the display values for input channels 2 (Temperature) and 3 (Pressure) respectively. Actual display values are dependent on the SETUP configurations for each channel.

3.2.4. SETP1, SETP2

If TEMP1, or PRES were the previously selected display fields, then their respective alarm set-points will be displayed, else the Flowstar will display CH1 set-points.

3.2.5. CLEAR

The CLEAR key resets channel 1 total to zero unless CH1 ACCUM TOTAL is displayed, then the key will clear CH1 ACCUM TOTAL. Also clears any AUX channel that is configured for total unless CH1 ACCUM TOTAL is displayed.

3.2.6. 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, CH1)

3.2.7. SEL

This key acknowledges an alarm condition. It sets blinking LED's to solid. It will also silence the audible alarm.

3.2.8. REM

Pressing this key will generate a ticket, when the system is configured for printing and a printer is attached.

3.2.9. MODE

Prompts you for a password. This occurs only if the S1-7 switch is set to ON 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 while in the SETUP mode will cause the Flowstar unit to switch 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's 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 alarm condition subsides, the LED and sonic alarm, if still on, will deenergize. 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.

3.4. ERROR MESSAGES

During normal operation the Flowstar 2006 displays various error messages depending on current operating conditions. The error messages are described below:

3.4.1. TEMPERATURE XTMR OVER RANGE

TEMPERATURE TRANSMITTER OVER RANGE is flashed whenever the Temperature input on channel 2 exceeds the maximum allowable input value. The maximum allowable input value depends on the hardware selected and can be 5 Vdc, 10 Vdc or 20 mA. When Temperature Transmitter Over Range failure occurs, the system will use the Default Temperature for compensation.

3.4.2. TEMPERATURE SIGNAL LOSS

TEMPERATURE SIGNAL LOSS is flashed whenever the transmitter output falls below the minimum allowable input or the wiring to the transmitter fails, shorts or open circuits. The minimum allowable input value depends on the hardware selected and can be 1 Vdc or 4 mA. When Temperature Signal Loss occurs the system will use the Default Temperature for compensation.

3.4.3. PRESSURE XTMR OVER RANGE

PRESSURE TRANSMITTER OVER RANGE is flashed whenever the Pressure input on channel 3 exceeds the maximum allowable input value. The maximum allowable input value depends on the hardware selected and can be 5 Vdc, 10 Vdc or 20 mA. When Pressure Transmitter Over Range failure occurs, the system will use the Default Pressure for compensation.

3.4.4. PRESSURE SIGNAL LOSS

PRESSURE SIGNAL LOSS is flashed whenever the pressure transmitter output falls below the minimum allowable input or the wiring to the transmitter fails, shorts or open circuits. The minimum allowable input value depends on the hardware selected and can be 1 Vdc or 4 mA. When Pressure Signal Loss occurs the system will use the Default Pressure for compensation.

3.4.5. OUT OF COMP RANGE

This error message is displayed when process input variables (temperature and pressure) exceed the programmed temperature and pressure ranges of the optional Super Compressibility Table. This error message is not displayed on the standard Flowstar 2006

3.4.6. PRINTER IS OFF LINE

Printer is Off Line is displayed when a connected printer is "Out of Paper" or "Off Line". If the attached printer does not support "Paper Out" detection, then Flowstar will not be able to detect a Paper Out error. Hoffer Flow Controls sells a special cable for connecting a serial printer to the Flowstar.

In order for a serial printer to be used with the Flowstar, it must support the ASCII (IBM) character table and be RS232C compatible.

3.4.7. STOP FLOW

The "Stop Flow" error message is displayed when the Flowstar is configured for printing and an attempt is made to print a ticket while flow is present.

4.SETUP MODE OPERATIONS

4.1. INTRODUCTION

After the MODE key is pressed in the OPERATING mode, a password entry screen is displayed. Enter the proper password and press the MODE key, the Flowstar will enter the SETUP mode. After configuration and calibration parameters have been entered or viewed, press the MODE key once more to return to the OPERATING mode. If the SETUP mode is entered, the last item selected will be displayed again. The default password is 2001.

4.2. KEYBOARD OPERATION

The Flowstar 2006 uses an alternate key functionality when in the SETUP modes.

4.2.1. 3, 4, 5, 6, 7, 8, 9 and 0

These keys facilitate numeric entry in selected SETUP fields.

4.2.2. SEL, REM

Changes a selected SETUP fields discrete selection.

4.2.3. LAST, NEXT

Scrolls forward and backwards through the SETUP fields.

4.2.4. STOP(+/-)

Changes the sign of the related settings (i.e. Default Temperature, CH2 MPs, etc.).

4.2.5. MAN, and AUTO

Perform no functions in this mode, except where noted.

4.2.6. MODE

When pressed causes the program to exit the SETUP mode. Any altered values are stored in non volatile memory (EEPROM).

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 configuration/calibration fields for that channel will not be displayed.

Z-FACTOR METHOD setting is only displayed on Flowstar 2006s that are order with the Super Compressibility Table option.

4.3.1. Z-FACTOR METHOD

Selects the method for compressibility calculation when the Super Compressibility option is ordered. Select from:

- TABLE(default): uses the internal pre-programmed Super Compressibility table. for gas compensation.
- DEFAULT Z-FACTOIR: uses the Default Z-Factor for gas compensation.

4.3.2. 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.

Table 2 CH1 Total Units.

English Units	*Metric Units*
LBS	KG
SCF	SM3
ACF	AM3
GAL	LIT
NLIT	SLIT
NCC	SCC
ACC	ACC
NM3	SM3
UDEF	UDEF

4.3.3. CH1 RATE CONFIG:

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.

Table 3 CH1 Rate Units.

English Units	*Metric Units*
LBS/MIN	KG/MIN
LBS/HR	KG/HR
LBS/SEC	KG/SEC
SCF/MIN	SM3/MIN
SCF/HR	SM3/HR
SCFSEC	SM3/SEC
ACF/MIN	AM3/MIN
ACF/HR	AM3/HR
ACFSEC	AM3/SEC
GAL/MIN	LIT/MIN
GAL/HR	LIT/HR
GAL/SEC	LIT/SEC
NLIT/MIN	SLIT/MIN
NLIT/HR	SLIT/HR
NLIT/SEC	SLIT/SEC
NCC/MIN	SCC/MIN
NCCS/HR	SCC/HR
NCC/SEC	SCC/SEC
ACCMIN	ACC/MIN
ACC/HR	ACC/HR
ACC/SEC	ACC/SEC
NM3/MIN	SM3/MIN
NM3/HR	SM3/HR
NM3/SEC	SM3/SEC
UDEF/MIN	UDEF/MIN
UDEF/HR	UDEF/HR
UDEF/SEC	UDEF/SEC

4.3.4. TEMP UNITS

This selection determines the units of temperature used to enter all temperature related calibration information. The Flowstar uses DEG K as its base temperature unit. All temperature entries are converted to the base unit for storage. The Flowstar uses the base temperature unit to perform all temperature related calculation. The base unit values are converted back to the selected unit for display and communication accesses. Select from the following:

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

4.3.5. PRESSURE UNITS

This selection determines the units of pressure used to enter all pressure related calibration information. The Flowstar uses PSIA as its base pressure unit. All pressure entries are converted to the base unit for storage. The Flowstar uses the base pressure unit to perform all pressure related calculations. The base unit values are converted back to the selected unit for display and communication accesses. Select from the following:

- PSIA
- PSIG
- ATM
- BAR-A
- BAR-G
- KPAS-A
- KPAS-G

4.3.6. CH1 DATA ATIME

Channel 1 Data Average Time is the amount of time that the displayed rate indication is averaged. A value of 0.3 second will mean that no data averaging will occur. Enter a numeric value from 0.3 to 10.0 seconds. The default value for CH1 DATA ATIME is 1.0 seconds.

4.3.7. CH1 POINT NUMBER

This integer field is the number of points used in a linearization lookup table. Allowed values are from 0 to 20. Default value is 20.

4.3.8. C1 PULSE WEIGHT

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/unit, 10 will equal 10 pulses/unit, and 0.1 will equal 1 pulse per 10 units. Default value is 1.00. This setting is only valid when RELAY X CONFIG(where X can be 1 or 2) is set to FWD or REV SCALED PULSE.

4.3.9. FLOW CALC METHOD

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

- SINGLE KFACTOR, uses DEF K.
- KFACTOR
- FWD REV KFACTOR

4.3.10. DEF TEMP

This is the temperature used to provide compensation when channel 2 fails or is turned off. The unit used for Default Temperature is dependent on the setting of TEMPERATURE UNIT. Default value is 70 deg. F(294.2611 deg. K)

4.3.11. DEF PRES

This is the pressure used to compensate liquid to conditions when channel 3 fails or is turned off. The unit used for Default Pressure is depended on the setting of PRESSURE UNIT. Default value is 0 PSIG(14.696 PSIA).

4.3.12. B TEMP UNIT

This is the base temperature used in the compensation calculation. The base temperature is displayed/entered in the units defined by the setting of the TEMPERATURE UNITS field. Default value is 70 deg. F(294.2611 deg. K).

4.3.13. B PRES UNIT

This is the base pressure used in the compensation calculation. The base pressure is displayed/entered in the units defined by the setting of the PRESSURE UNITS field. Default value is 0 PSIG(14.696 PSIA).

FLOWSTAR 2006 performs measurement of gas based on the following equation

$$SCF = ACF\,X\left(\frac{P_{FLOW}}{P_{BASE}}\right)X\left(\frac{T_{BASE}}{T_{FLOW}}\right)X\left(\frac{1}{Z}\right)$$

Where:

SCF = Standard Cubic Feet
ACF = Actual Cubic Feet
P_{FLOW} = Pressure of flowing gas.
P_{BASE} = Pressure that the system is correcting too.
T_{BASE} = Temperature that the system is correcting too.
T_{FLOW} = Temperature of the flowing gas.
Z = Compressibility Factor at the expected operating temperature and pressure of the gas. The Flowstar 2006 can be preprogram for a specified gas to perform "ON THE FLY" Super-Compressibility. Please contact the Sells department for information on the Super-Compressibility option.

4.3.14. DENS @ STP LB/FT3 or KG/M3

This is the density at standard temperature and pressure used to convert SCF to Mass units. The density at STP units (English/Metric) is selected by the S1setup switch.

4.3.15. DEF K P/ACF or P/AM3

This is the default K Factor which will be used when the FLOW CALC METHOD is set to SINGLE KFACTOR. Units are dependent on the setting of switch S1-1. Default value is 150 P/ACF.

4.3.16. DEF Z-FACTOR

This is the compressibility factor used to compensate gases to operating conditions.

4.3.17. USER ACF TO UDEF or USER AM3 TO UDEF

This field is used when the Channel 1 Total, Channel 1 Rate, AUX 1 or AUX 2 are configured for user's defined units. Enter a value that when multiplied by ACF or AM3 will give the proper units. The unit of UDEF is determined by the setting of switch S1-1.

4.3.18. FREQ HZ 1-20 or FWD FREQ 1-20

FWD FREQUENCY 1 through 20 are the forward flow, flowmeter characteristics used for the flow input channel when the KFACTOR or FWD REV KFACTOR method is selected for the FLOW CALC METHOD. Enter in a floating point value.

4.3.19. KFAC P/ACF or KFAC P/AM3 1-20 or FWD KFAC P/ACF 1-20 or FWD KFAC P/AM3 1-20

FWD K FACTOR 1 through 20 are the forward flow, flowmeter characteristics used for the flow input channel when the KFACTOR or FWD REV KFACTOR method is selected for the FLOW CALC METHOD. Enter in a floating point value. Units are dependent on the setting of switch S1-1.

4.3.20. REV FREQ HZ 1-20

REV FREQUENCY 1 through 20 are the reverse flow, flowmeter characteristics used for the flow input channel when the FWD REV KFACTOR method is selected for the FLOW CALC METHOD. Enter in a floating point value.

4.3.21. REV KFAC P/ACF or P/AM3 1-20

REV K FACTOR 1 through 20 are the reverse flow, flowmeter characteristics used for the flow input channel when the FWD REV KFACTOR method is selected for the FLOW CALC METHOD. Enter in a floating point value. Units are dependent on the setting of switch S1-1.

4.3.22. ATD DATA ATIME:

ATD Data Averaging Time is the amount of time that the displayed values for Temperature and Pressure are averaged Enter a numeric value from 0.1 to 10.0 seconds. The default value for ATD DATA ATIME is 5.0 seconds. A setting of 0.1 second means that no data averaging will occur.

NOTE: If channel 2 is disabled by S1-5 being turned OFF, then all of the channel 2 settings will not be displayed.

4.3.23. CH2 LOW CAL

This field is used to calibrate the channels low end. Set the channels input to its lowest value(1 Vdc or 4 mA) and press the SEL key. This locks in the low point corresponding to the lowest selected table entry.

4.3.24. CH2 HIGH CAL

This field is used to calibrate the channels high end. Set the channels input to its highest value(5 Vdc or 20 mA) and press the SEL key. This locks in the high point corresponding to the highest selected table entry.

4.3.25. CH2 MP UNIT 1-2

These values are used to determine the Temperature range used in channel 2. The units used to program CH2 MEASUREMENT POINT are determined by the setting of Temperature Units. For proper operation 2 measurement points must be entered.

NOTE: If channel 3 is disabled by S1-4 being turned OFF, then all of the channel 3 settings will not be displayed.

4.3.26. CH3 LOW CAL

This field is used to calibrate the channels low end. Set the channels input to its lowest value(1 volt or 4mA) and press the SEL key. 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 channels high end. Set the channels input to its highest value(5 volts or 20 mA) and press the SEL key. This locks in the high point corresponding to the highest selected table entry.

4.3.28. CH3 MP UNIT 1-2

These values are used to determine the Pressure range used in channel 3. The units used to program CH3 Measurement Points are determine by the setting of Pressure Units.

4.3.29. AUX 1 UNITS AND AUX 2 UNITS

This selection sets the units to be used when the AUX 1 or AUX 2 key is depressed in the OPERATING mode. Select a unit from one of the following three tables.

Table 4 Total units available on the Auxiliary displays

S1-1 Setting	*English Units*	*Metric Units*
TOTAL UNIT 1	LBS	KG
TOTAL UNIT 2	SCF	SM3
TOTAL UNIT 3	ACF	AM3
TOTAL UNIT 4	GAL	LIT
TOTAL UNIT 5	NLIT	SLIT
TOTAL UNIT 6	NCC	SCC
TOTAL UNIT 7	ACC	ACC
TOTAL UNIT 8	NM3	SM3
TOTAL UNIT 9	UDEF	UDEF

Table 5 Rate units available on the Auxiliary displays

S1-1 Setting	*English Units*	*Metric Units*
RATE UNIT 1	LBS/MIN	KG/MIN
	LBS/HR	KG/HR
	LBS/SEC	KG/SEC
RATE UNIT 2	SCF/MIN	SM3/MIN
	SCF/HR	SM3/HR
	SCFSEC	SM3/SEC
RATE UNIT 3	ACF/MIN	AM3/MIN
	ACF/HR	AM3/HR
	ACFSEC	AM3/SEC
RATE UNIT 4	GAL/MIN	LIT/MIN
	GAL/HR	LIT/HR
	GAL/SEC	LIT/SEC
RATE UNIT 5	NLIT/MIN	SLIT/MIN
	NLIT/HR	SLIT/HR
	NLIT/SEC	SLIT/SEC
RATE UNIT 6	NCC/MIN	SCC/MIN
	NCCS/HR	SCC/HR
	NCC/SEC	SCC/SEC
RATE UNIT 7	ACCMIN	ACC/MIN
	ACC/HR	ACC/HR
	ACC/SEC	ACC/SEC
RATE UNIT 8	NM3/MIN	SM3/MIN
	NM3/HR	SM3/HR
	NM3/SEC	SM3/SEC
RATE UNIT 9	UDEF/MIN	UDEF/MIN
	UDEF/HR	UDEF/HR
	UDEF/SEC	UDEF/SEC

Table 6 Conversion units available on the Auxiliary displays

S1-1 Setting	*English Units*	*Metric Units*
CONVERSION TOTAL UNIT 1	KG	LBS
CONVERSION TOTAL UNIT 2	SM3	SCF
CONVERSION TOTAL UNIT 3	AM3	ACF
CONVERSION RATE UNIT 1	KG/MIN	LBS/MIN
CONVERSION RATE UNIT 2	SM3/MIN	SCF/MIN
CONVERSION RATE UNIT 3	AM3/MIN	ACF/MIN
DENSITY CONVERSION UNIT	KG/M3	LBS/FT3

4.3.30. ALM1 S-H RATE UNIT

This field sets the high alarm set-point for channel 1. If a high alarm is not desired set it to a known condition well above the operating range of the measured value. Enter a floating point number. Default is 200.00.

4.3.31. ALM1 S-L RATE UNIT

This field sets the low alarm set-point for channel 1. Enter a floating point number. Default is 0.00.

4.3.32. ALM1 DBA RATE UNIT

This field sets the deadband for channel 1 alarms. Once an alarm set-point is reached, the alarm will be locked in. For high alarms, the measured values must fall below the high alarm set-points minus the deadband value. For low alarms, the measured values must rise above the low alarm set-points plus the deadband value. The deadband reduces spurious alarms when close to the set points.

NOTE: if the CH1 RATE CONFIG unit is changed after Alarm 1 setting are programmed then the Alarm 1 settings must be reprogrammed.

4.3.33. ALARM 1 AUDIBLE

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

- OFF
- HIGH ONLY
- LOW ONLY
- HIGH AND LOW

NOTE: If channel 2 is disabled by S1-5 being turned OFF, then all of the channel 2 settings will not be displayed.

4.3.34. ALM2 S-HI TEMP UNIT

This field sets the high alarm set-point for channel 2. If a high alarm is not desired set it to a known condition well above the operating range of the measured value. Enter a floating point number. Default is 73.60 °F(366.48 °K).

4.3.35. ALM2 S-LO TEMP UNIT

This field sets the low alarm set-point for channel 2. Enter a floating point number. Default is -459.67 °F(0.0 °K)..

4.3.36. ALM2 DBAN TEMP UNIT

This field sets the deadband for channel 2 alarms. Once the alarm set-point is reached, the alarm will be locked in. For high alarms, the measured values must fall below the high alarm set-point minus the deadband value. For low alarms, the measured values must rise above the low alarm set-points plus the deadband value. The deadband reduces spurious alarms when close to the set points.

4.3.37. ALARM 2 AUDIBLE

This selects the condition for the audible sonic alarm. Select from the following.

- OFF
- HIGH ONLY
- LOW ONLY
- HIGH AND LOW

NOTE: If channel 3 is disabled by S1-4 being turned OFF, then all of the channel 3 settings will not be displayed.

4.3.38. ALM3 S-HI PRES UNIT

This field sets the high alarm set-point for channel 3. If a high alarm is not desired set it to a known condition well above the operating range of the measured value. Enter a floating point number. Default is 185.3 PSIG(200 PSIA).

4.3.39. ALM3 S-LO PRES UNIT

This field sets the low alarm set-point for channel 3. Enter a floating point number. Default is -14.696 PSIG(0.00 PSIA).

4.3.40. ALM3 DBAN PRES UNIT

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

4.3.41. ALARM 3 AUDIBLE

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

- OFF
- HIGH ONLY
- LOW ONLY
- HIGH AND LOW

NOTE: If S1-3 is set to off, then the settings for Digital to Analog Channel 1 will not be displayed.

4.3.42. DA1 CONFIG

This field selects the mode of operation for the digital to analog output 1. Select from the following.

- MIMIC C1: used to configure the analog output to mimic CH1 rate.
- MIMIC C2: used to configure the analog output to mimic CH2 temperature.
- MIMIC C3: used to configure the analog output to mimic CH3 pressure.
- MIMIC C1 FWD/REV: used to configure the analog output for split 4-20 ma/1-5 volt output corresponding to channel 1 flowrate.
- MIMIC AUX 1: used to configure the analog output to mimic AUX 1 display. Can only be used when AUX 1is configured to display flowrate.
- MIMIC AUX 2: used to configure the analog output to mimic AUX 2 display. Can only be used when AUX 2 is configured to display flowrate.

4.3.43. DA1 MIN UNIT

Enter a floating value that corresponds to the minimum value expected on the selected mimic channel. This value will correlate to 0 volt, or 4 mA output depending on the hardware selected. The units are determine by the selected mimic channel's unit.

4.3.44. DA1 MAX UNIT

Enter a floating value that corresponds to the maximum value expected on the selected mimic channel. This value will correlate to 5 volts, 10 volts, or 20 mA output depending on the hardware selected. Unit is determine by the mimic channel's selected unit.

NOTE: If S1-2 is set to off, then the settings for Digital to Analog Channel 2 will not be displayed.

4.3.45. DA2 CONFIG

This field selects the mode of operation for the digital to analog output 2. Select from the following.

- MIMIC C1: used to configure the analog output to mimic CH1 rate.
- MIMIC C2: used to configure the analog output to mimic CH2 temperature.
- MIMIC C3: used to configure the analog output to mimic CH3 pressure.
- MIMIC C1 FWD/REV: used to configure the analog output for spilt 4-20 ma/1-5 volt output corresponding to channel 1 flowrate.
- MIMIC AUX 1: used to configure the analog output to mimic AUX 1 display. Can only be used when AUX 1is configured to display flowrate.
- MIMIC AUX 2: used to configure the analog output to mimic AUX 2 display. Can only be used when AUX 2 is configured to display flowrate.

4.3.46. DA2 MIN UNIT

Enter a floating value that corresponds to the maximum value expected on the selected mimic channel. This value will correlate to 0 volts, or 4 mA output depending on the hardware selected. Unit is determine by the mimic channel's selected unit.

4.3.47. DA2 MAX UNIT

Enter a floating value that corresponds to the maximum value expected on the selected mimic channel. This value will correlate to 5 volts, 10 volts, or 20 mA output depending on the hardware selected. Unit is determine by the mimic channel's selected unit.

NOTE: If an analog output channel is configured to MIMIC CH1 or MIMIC CH1 FWD/REV and CH1 RATE CONFIG is changed after programming of the DA output, then the DA output channel must be reprogrammed. If an analog output channel is configured to MIMIC AUX 1 or MIMIC AUX 2 and the flowrate unit is changed on AUX 1 or AUX 2 is changed, then reprogram the respective DA output channel.

4.3.48. RELAY 1 - 2 CONFIG

Each relay has the following selections:

- ALARM1 HIGH FLOW RATE
- ALARM1 LOW FLOW RATE
- ALARM2 TEMP OVER RANGE
- ALARM2 LOW TEMP
- ALARM3 PRES OVER RANGE
- ALARM3 LOW PRES
- ALARM AUDIBLE This will occur based on the settings of the audible alarms.
- FWD SCALED PULSE, select this item if a forward scaled pulsed output is desired.
- REV SCALED PULSE, select this item if a reverse scaled pulsed output is desired.

4.3.49. RELAY 3 - 4 CONFIG

Each relay has the following selections:

- ALARM1 HIGH FLOW RATE
- ALARM1 LOW FLOW RATE
- ALARM2 TEMP OVER RANGE
- ALARM2 LOW TEMP
- ALARM3 PRES OVER RANGE
- ALARM3 LOW PRES
- ALARM AUDIBLE This will occur based on the settings of the audible alarms.

4.3.50. SERIAL MODE

Select the serial communications mode from the following.

- RS232
- RS422
- RS485

4.3.51. RS-485 NODE NUM

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.

4.3.52. BAUD RATE

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

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

4.3.53. SERIAL HANDSHAKE

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

- NONE
- HARDWARE DTR
- XON/XOFF

4.3.54. SERIAL PROTOCOL

Determine the communication mode based on the hardware. The communications operation is detailed in Chapter 6 of this manual. Select one of the following.

- REMOTE KEYBOARD
- HFC-6 INTERFACE
- PRINTER 2010(Hoffer's supplied panel mount printer).
- PRINTER

4.3.55. PASSWORD

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

4.3.56. DATE

Enter the date using the numeric keys.

4.3.57. DAY OF THE WEEK

Select from one of the following fields.

- MON
- TUE
- WED
- THU
- FRI
- SAT
- SUN

4.3.58. TIME 24-HOUR CLK

Set the time of day in 24 hour mode.

4.3.59. RESTORE NEW UNIT

NOTE: Complete calibration is loss if Flowstar is restored.

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

1. Press the SEL or REM key, the unit will display PASSWORD entry field.
2. Enter password.
3. 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.

5.INSTALLATION WIRING

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

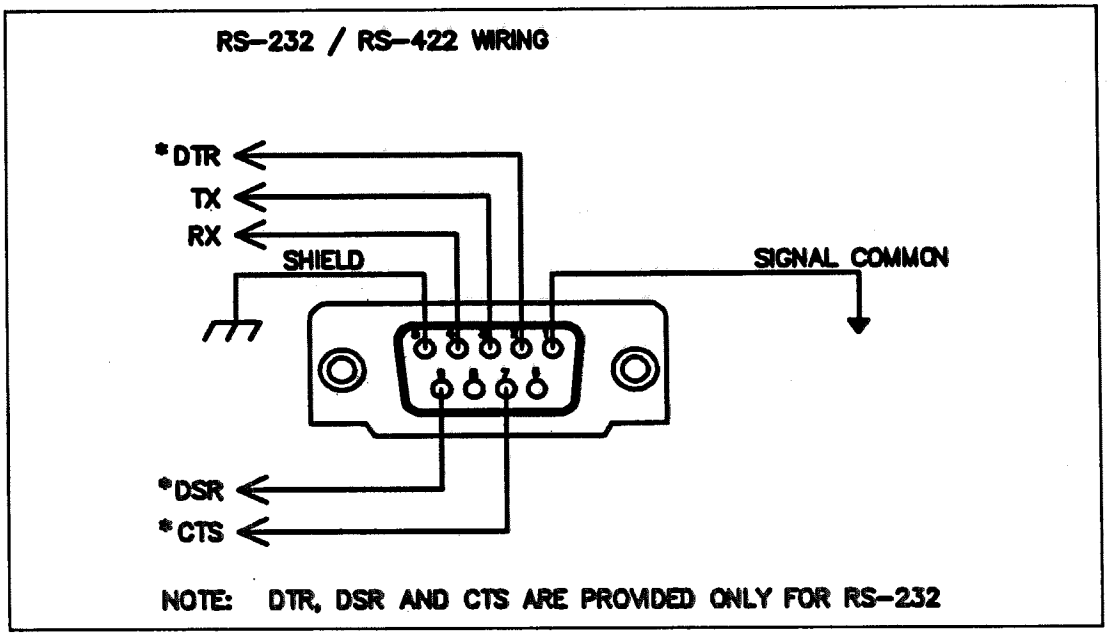


Figure 5.2 AC Power Input

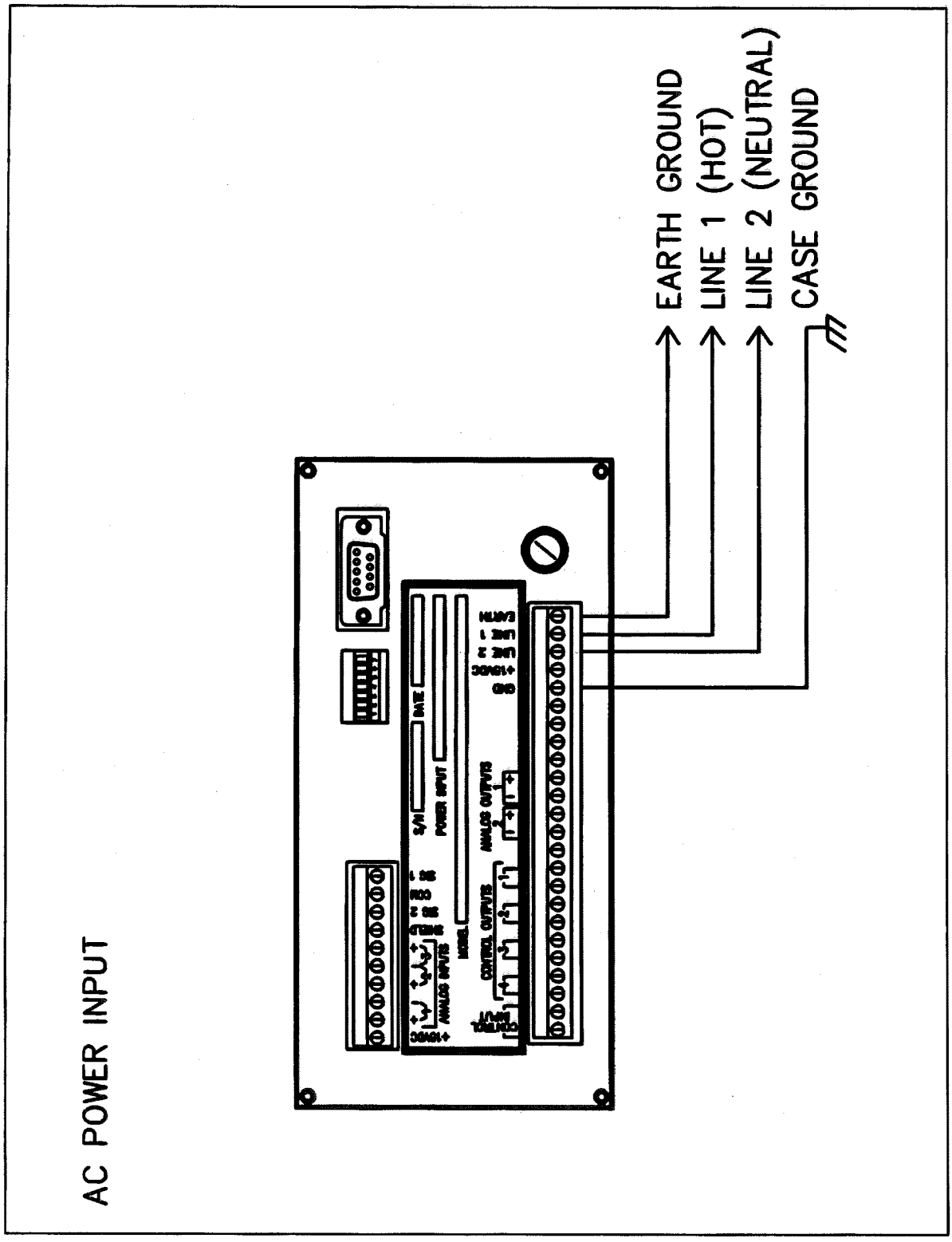


Figure 5.3 DC Power Input

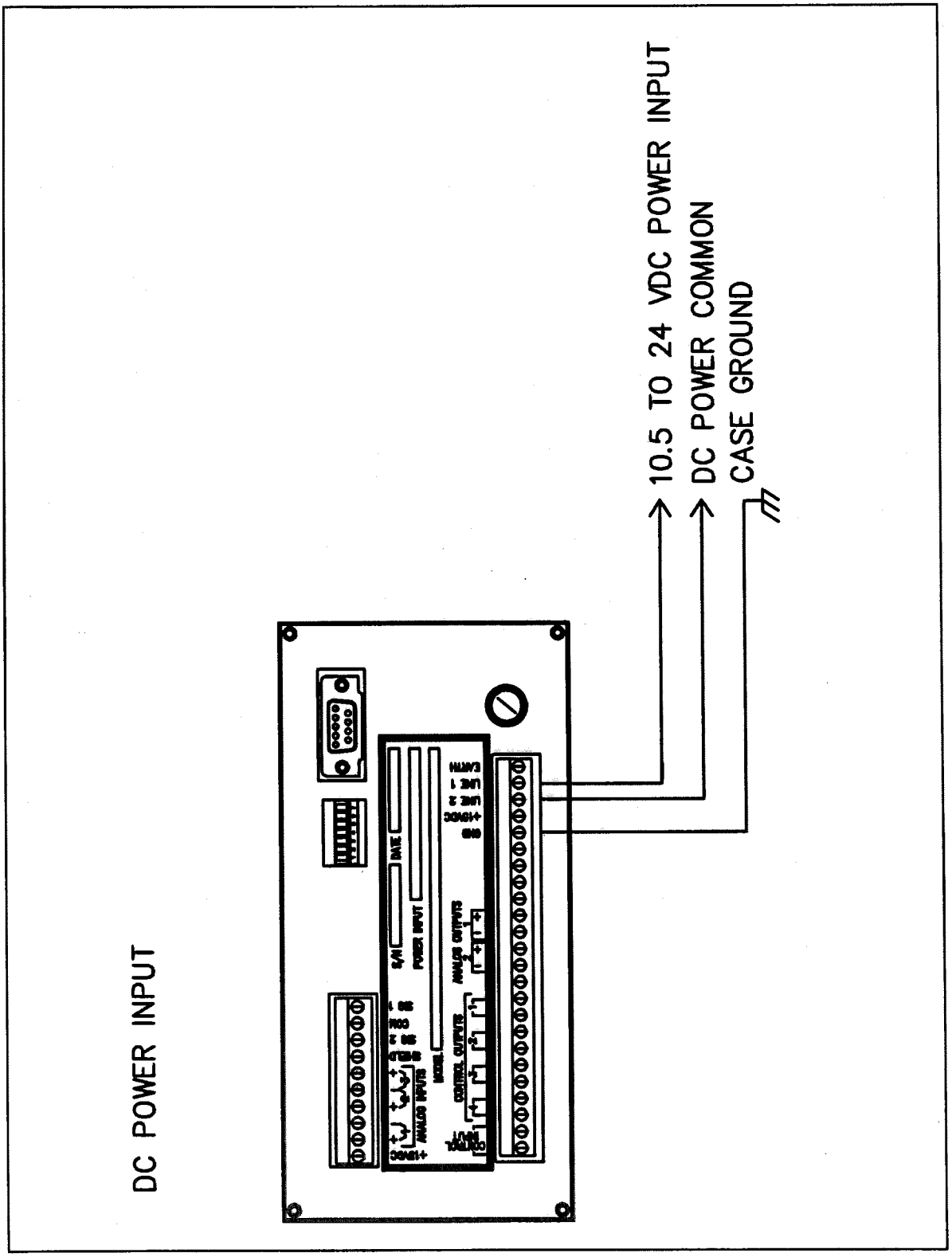


Figure 5.4 Single Magnetic Pickup Input

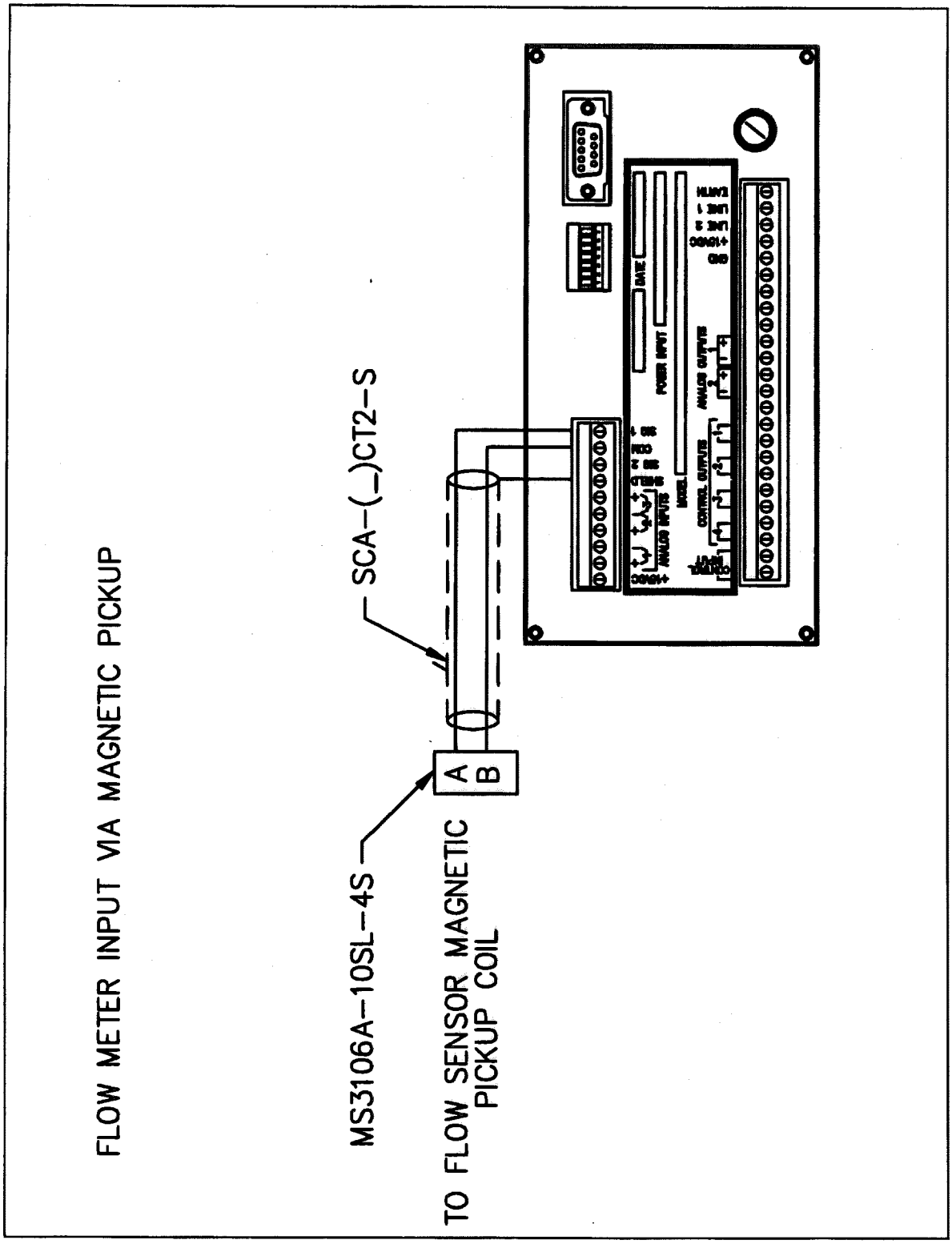


Figure 5.5 Quadrature Magnetic Pickup Input

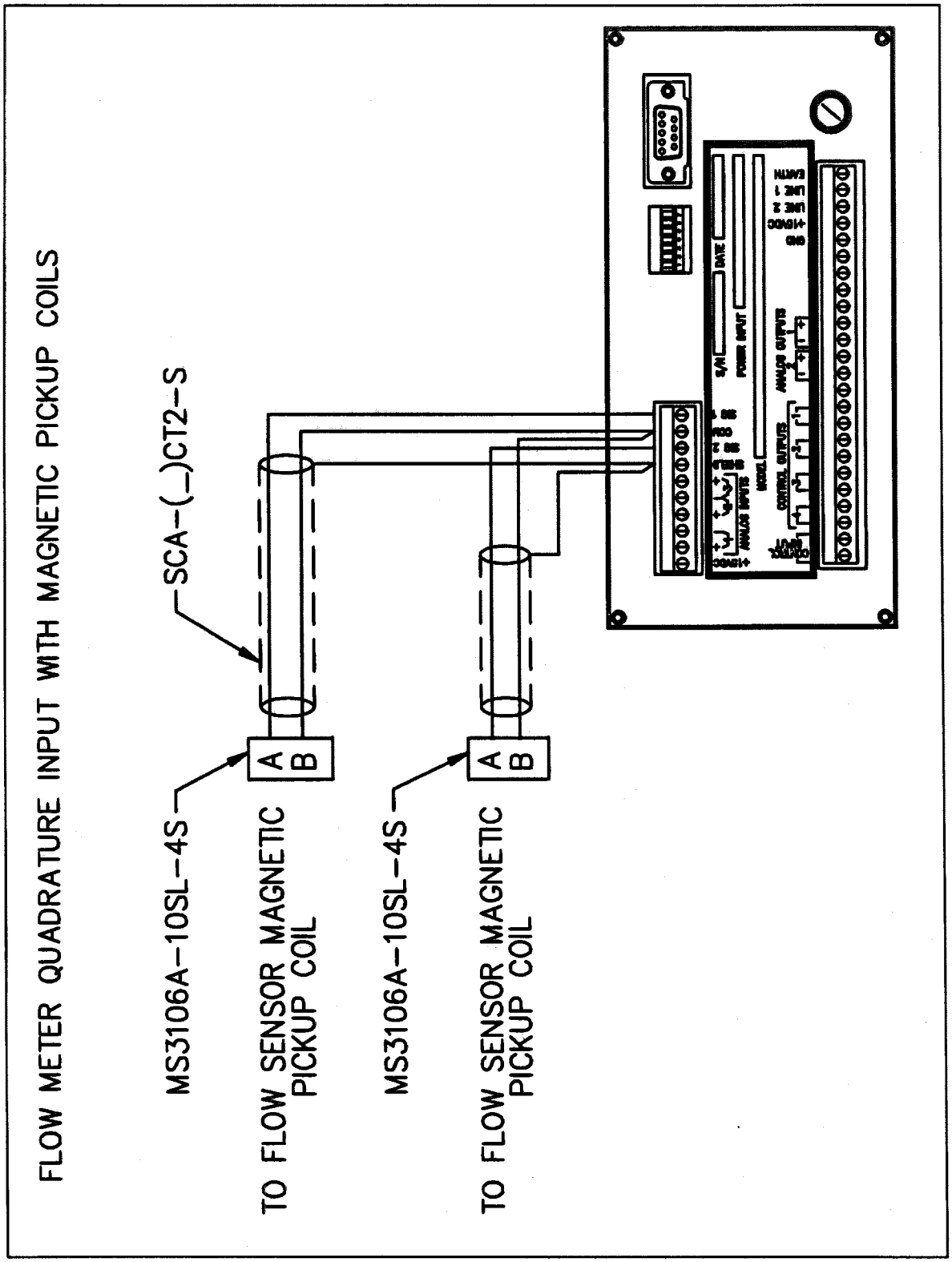


Figure 5.6 MCP Pickup Coil Input

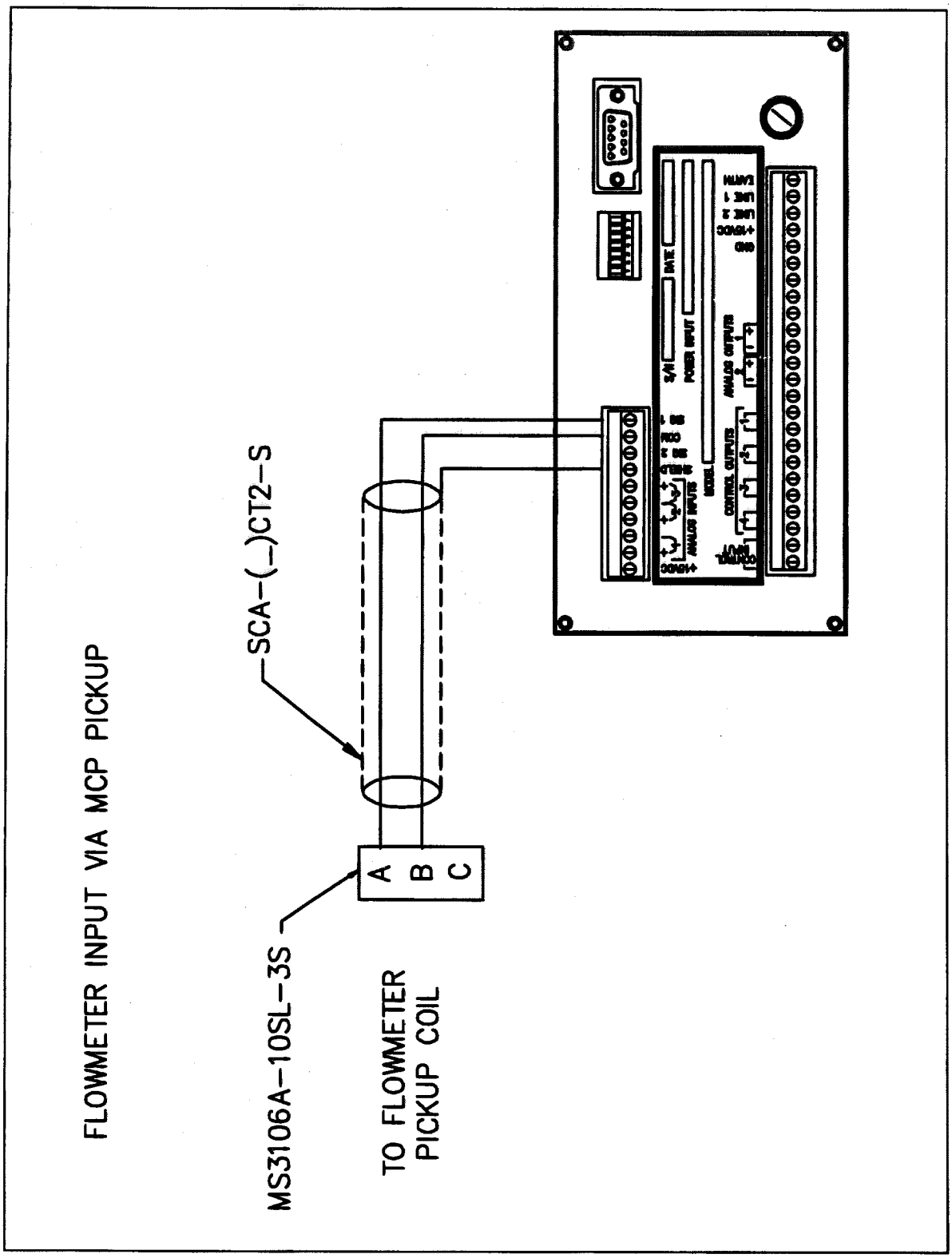


Figure 5.7 Remote Signal Conditioner Interface

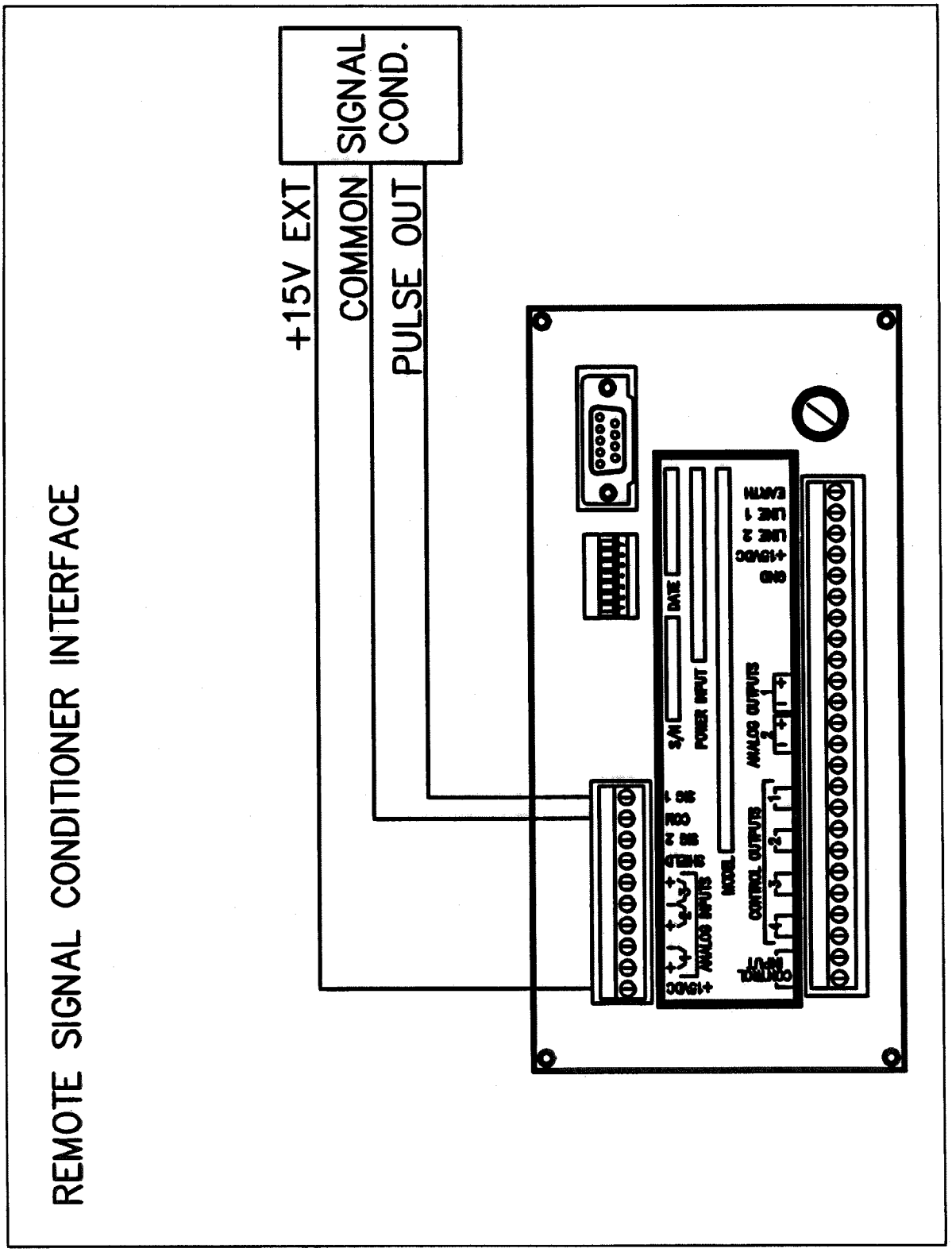


Figure 5.8 Analog Output Connections

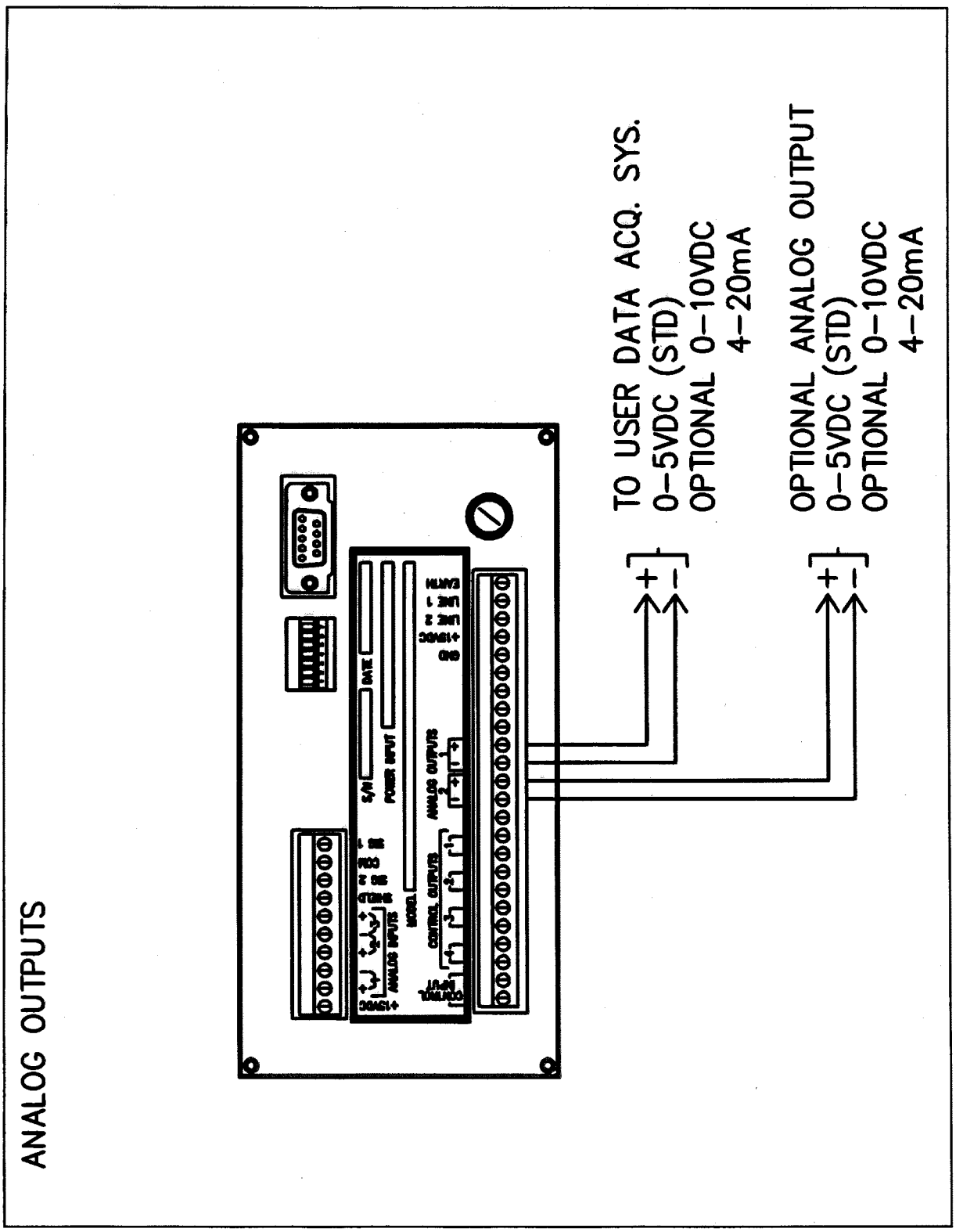


Figure 5.9 Two Wire process Transmitter Input Connections

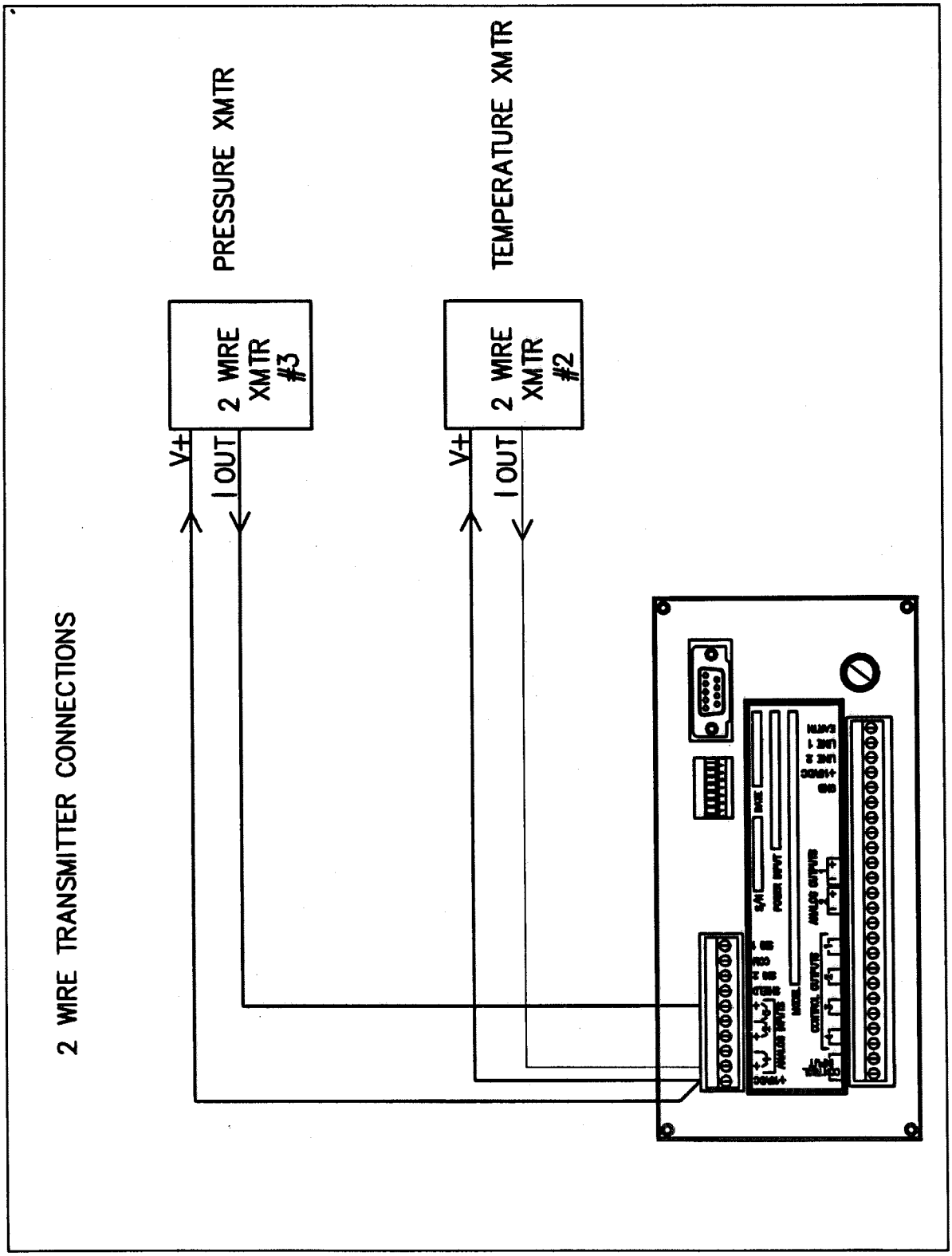


Figure 5.10 Three Wire Process Transmitter Input Connections

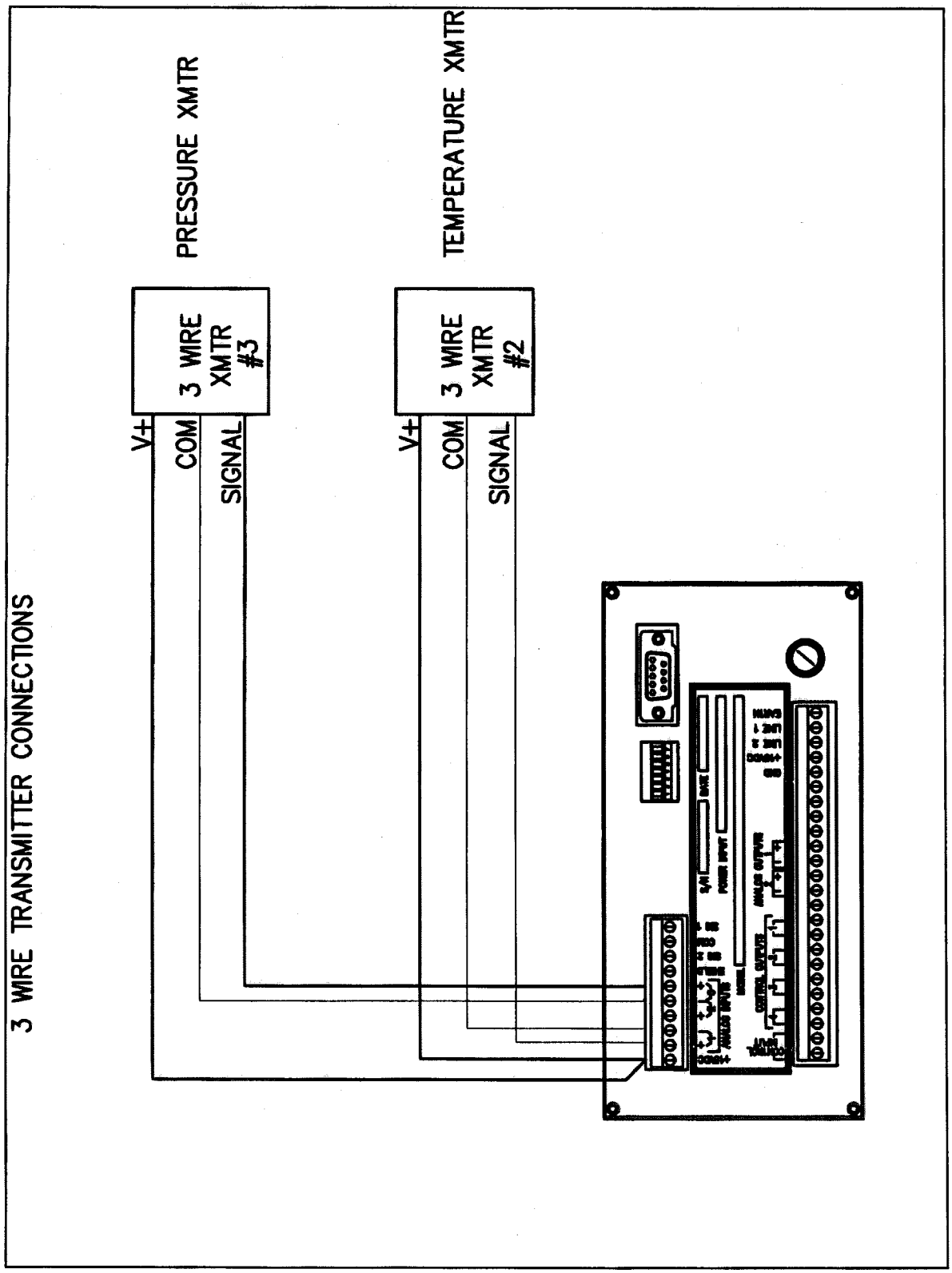


Figure 5.11 Pulse /Alarm Output Wiring

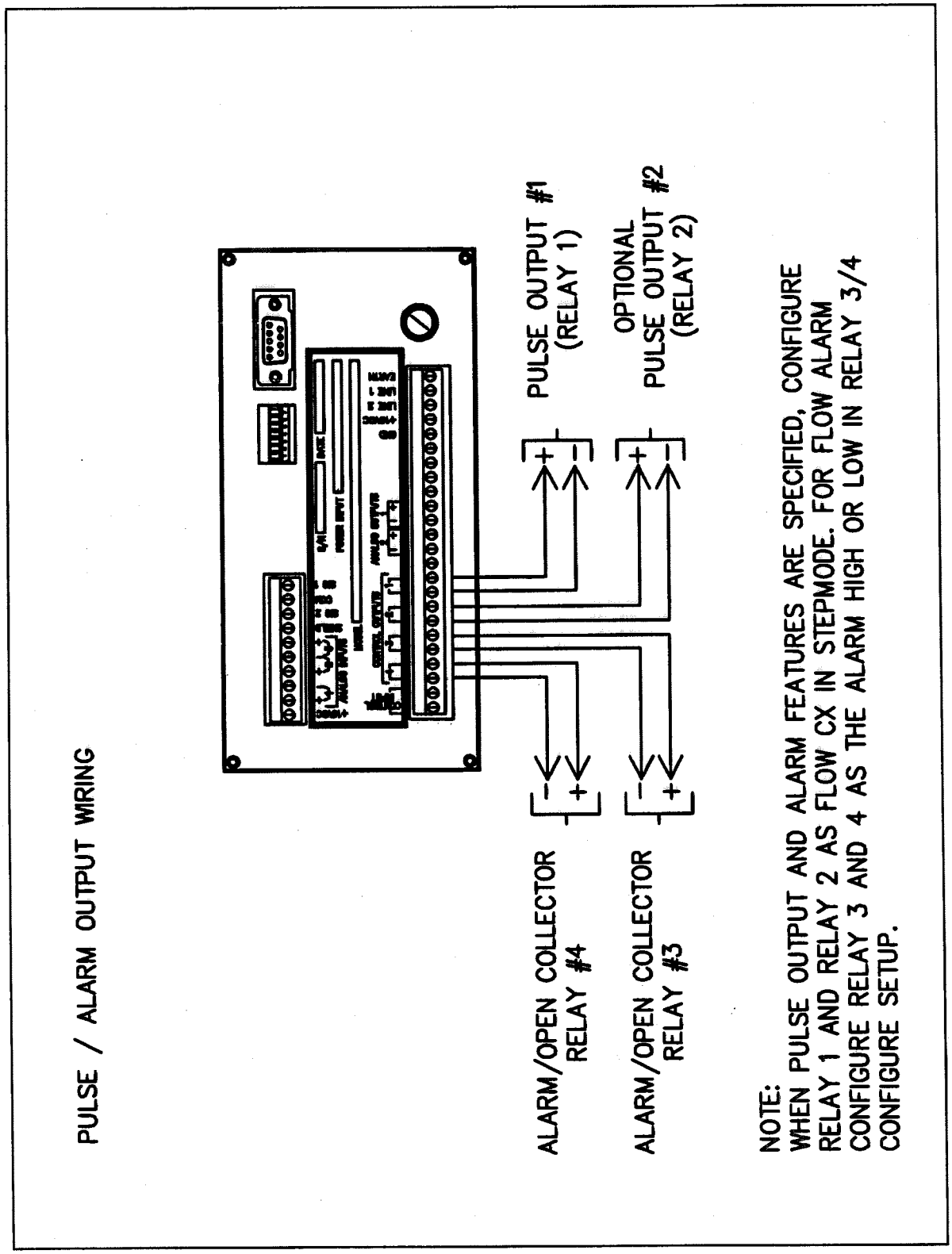
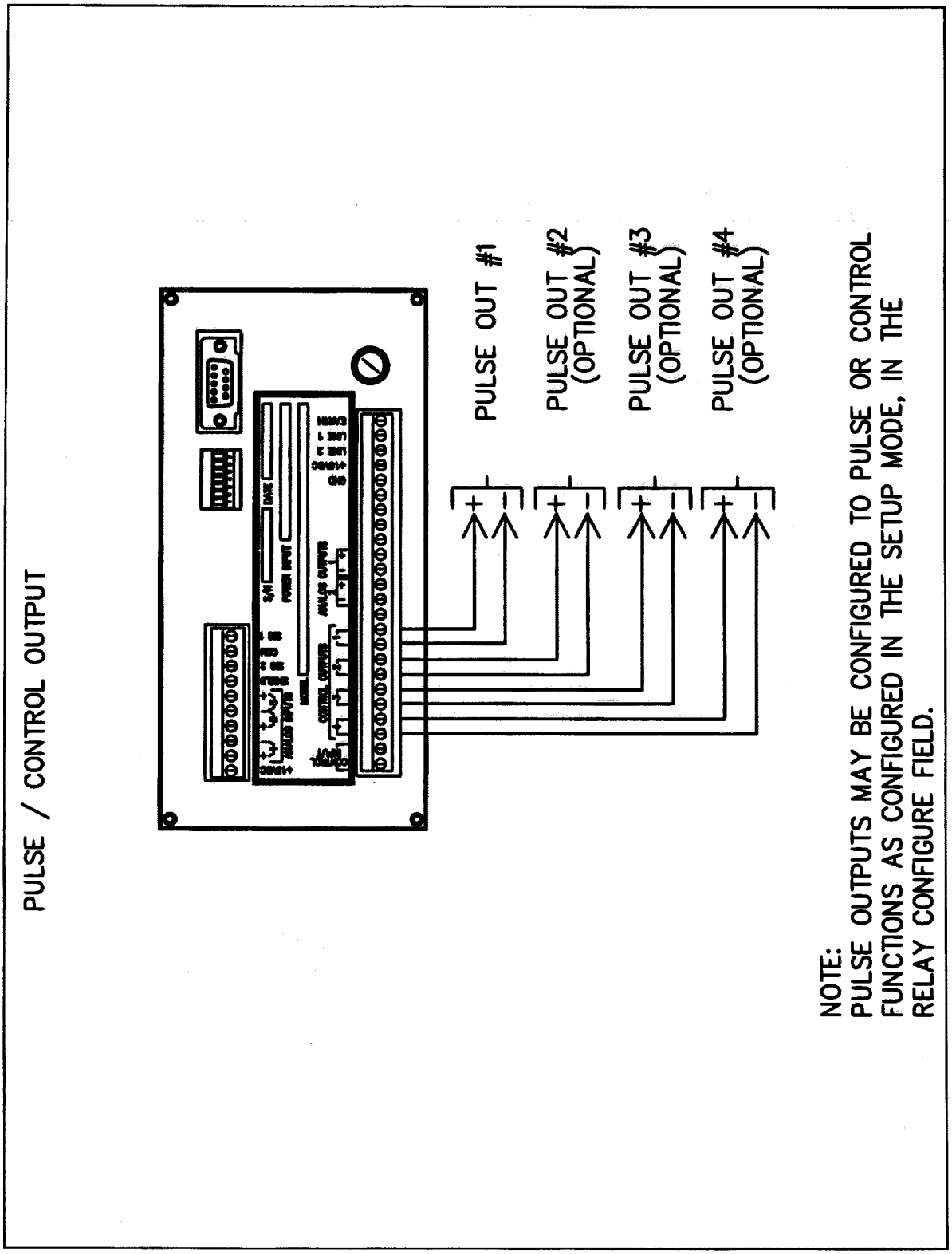


Figure 5.12 Pulse/Control Output Winring



6.SERIAL COMMUNICATIONS

6.1. INTRODUCTION

Flowstar's communication hardware port may configured as RS-232 or RS-422/RS-485(half duplex). The RS-232 port protocols may be configured as REMOTE KEYBOARD, HFC-6 INTERFACE, PRINTER 2010 or PRINTER. The RS-422/RS-485(half duplex) uses only the HFC-6 INTERFACE as the communication protocol. There are four communication protocols:

- REMOTE KEYBOARD this is a special configuration which allows Flowstar to be connected to a remote ANSI keyboard or personnel computer, via the RS-232. See the appendix, "USING FLOWSTAR with ANSI TERMINAL"
- HFC-6 INTERFACE allows for the two way communication between a host system and Flowstar.
- PRINTER 2010 allows connection of Hoffer supplied panel mount mini printer.
- PRINTER allows a standard serial printer to be connected to the RS-232 port of the Flowstar. A standard serial printer is an output printing device that supports RS-232C interface and ASCII (IBM) character code. The Flowstar can detect an OFF LINE printer if and only if the printer supports this feature through hardware hand-shaking.

The pin out wiring of the DB-9 connector on the back of the Flowstar is not standard. Please refer to drawing 500-0037(Flowstar Communication Cables) when making the connection between Flowstar and your computer

6.2. HFC-6 INTERFACE

The HFC-6 interface 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.

6.2.1. 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

6.2.2. 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

6.2.3. FLOWSTAR ID and S1 SWITCH STATUS

The ID and S1 switch status will be returned when "999" is sent as the data read access value "sss". The following data format string describes the return message.

STK|ee|iiii|c|ETX|CKS

STK = 0x02:
ee - error values
00= no errors
iiii = 0600(indicates Flowstar 2006)
c - character representing the current S1 switch status.
BIT 0 = 0
BIT 1 = S1-7 Units, 1 = English, 0 = Metric.
BIT 2 = S1-6 Analog Output 2,
BIT 3 = S1-5 Analog Output 1
BIT 4 = S1-4 Pressure Input
BIT 5 = S1-3 Temperature Input
BIT 6 = S1-2 Local Control
BIT 7 = .S1-1 Program Enable
ETX = 0x03
CKS - Exclusive or of each byte of data between the STX and ETX charactors.

6.2.4. 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

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 character 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 are not required here.

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

All characters between the STX and ETX must be ASCII alphanumeric characters. In addition all alphabet characters must be in upper case.

6.2.5. CHECKSUM DETERMINATION

The following routine used in the HFC-6 Interface protocol calculates a checksum on all data bytes between the STX and ETX character. It takes a pointer to a data 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:

EXCLUSIVE OR = EOR = $xy' + x'y$

(chksum & ~*in_buff_ptr) | (~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, EBCDII, 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. TABLES

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

Table 7 Equivalent Key Commands

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 for the process data command. This information will be used to read all displayed data.

Table 8 Process Data Command

COMMAND	nnn	DESCRIPTION	VALUES
RD	000	CHANNEL 1 TOTAL	flt
RD	001	CHANNEL 1 RATE	flt
RD	002	CHANNEL 2 TEMPERATURE	flt
RD	003	FLOWING DENSITY	flt
RD	004	CHANNEL 3 PRESSURE	flt
RD	007	AUX 1 (RATE or TOTAL)	flt
RD	008	AUX 2 (RATE or TOTAL)	flt
RD	011	CHANNEL 1 ACCUMULATED TOTAL	flt
RD	013	AUDIT TRAIL CALIBRATION	int
RD	014	AUDIT TRAIL CONFIGURATION	int
RD	015	Flowstar ID & S1 Switch Status	char

The following table is the field data table for the setup command data. This information will be used to read and write to the internal registers of Flowstar.

Table 9 Setup Command Data

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	017	Z-FACTOR METHOD	char 2006 only with special gas applications	SINGLE Z-FACTOR TABLE	174 175

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	018	CH1 TOTAL SEE TABLE 10 FOR DEFINITION.	char	UNIT 1 UNIT 2 UNIT 3 UNIT 4 UNIT 5 UNIT 6 UNIT 7 UNIT 8 UNIT 9	000 001 002 003 004 005 006 007 008
RD/WR	019	CH1 RATE SEE TABLE 10 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	009 010 011 012 013 014 015 016 017 018 019 020 021 022 023 024 025 026 027 028 029 030 031 032 033 034 035
RD/WR	020	TEMP UNITS		DEG F DEG R DEG C DEG K	096 097 098 099

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	021	PRESSURE UNITS		PSIG PSIA ATM BAR A BAR G KPAS A KPAS G	089 090 091 092 093 094 095
RD/WR	022	CH1 DATA ATIME	flt	0.0 - 10.0	
RD/WR	023	CH1 POINT NUMBER	int	00 - 20	
RD/WR	024	C1 PULSE WEIGHT	flt	PULSES/UNIT	
RD/WR	025	FLOW CALC METHOD	char	SINGLE KFACTOR KFACTOR FWD REV KFACTOR	086 087 088
RD/WR	026	DEF TEMP	flt	In selected temperature unit.	
RD/WR	027	DEF PRES	flt	In selected pressure unit.	
RD/WR	028	B TEMP	flt	In selected temperature unit. Used on Flowstar 2006.	
RD/WR	029	B PRES	flt	In selected pressure unit. Used on Flowstar 2006	
RD/WR	030	DEF DENS (CH1)	flt	Unit is LBS/GAL or KG/LIT depending on the setting of S1-1.	
RD/WR	031	DEF KFACTOR	flt	Unit is P/GAL or P/LIT depending on the setting of S1-1.	
RD/WR	032	DEF Z-FACTOR (CH1)	flt	Used when Z-FACTOR METHOD is set to SINGLE Z_FACTOR.	

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	033	USER DEFINE (CH1)	flt	Unit is USER GAL TO UDEF or USER LIT TO UDEF depending on the setting of S1-1.	
RD/WR	034 thru 053	FWD FREQ 1 thru FWD FREQ 20	flt	Unit is Hz(cycles per second).	
RD/WR	054 thru 073	FWD KFAC 1 thru FWD KFAC 20	flt	Unit is P/GAL or P/LIT depending on the setting of S1-1.	
RD/WR	074 thru 093	REV FREQ 1 thru REV FREQ 20	flt	Unit is Hz(cycles per second).	
RD/WR	094 thru 113	REV KFAC 1 thru REV KFAC 20	flt	Unit is P/GAL or P/LIT depending on the setting of S1-1.	
RD/WR	114	ATD DATA ATIME	flt	0.0 - 10.0	
RD/WR	115	CH2 POINT NUMBER	int	2 - 5	
RD/WR	118 thru 122	CH2 MP UNIT 1 thru 5	flt	In selected temperature unit.	
RD/WR	123	CH3 POINT NUMBER	int	2 - 5	
RD/WR	126 thru 130	CH3 MP UNIT 1 thru 5	flt	In selected pressure unit.	

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	131	AUX1 UNITS	char	UNIT 1	000
				UNIT 2	001
	132	AUX2 UNITS		UNIT 3	002
				UNIT 4	003
				UNIT 5	004
				UNIT 6	005
				UNIT 7	006
				UNIT 8	007
				UNIT 9	008
				UNIT 1/MIN	009
				UNIT 1/HR	010
				UNIT 1/SEC	011
				UNIT 2/MIN	012
				UNIT 2/HR	013
				UNIT 2/SEC	014
				UNIT 3/MIN	015
				UNIT 3/HR	016
				UNIT 3/SEC	017
				UNIT 4/MIN	018
				UNIT 4/HR	019
				UNIT 4/SEC	020
				UNIT 5/MIN	021
				UNIT 5/HR	022
				UNIT 5/SEC	023
				UNIT 6/MIN	024
				UNIT 6/HR	025
				UNIT 6/SEC	026
				UNIT 7/MIN	027
				UNIT 7/HR	028
				UNIT 7/SEC	029
				UNIT 8/MIN	030
				UNIT 8/HR	031
				UNIT 8/SEC	032
				UNIT 9/MIN	033
				UNIT 9/HR	034
				UNIT 9/SEC	035
				CONVERSION TOTAL UNIT 1	036
					037
				CONVERSION TOTAL UNIT 2	038
					039
				CONVERSION TOTAL UNIT 3	040
					041
				CONVERSION RATE UNIT 1	042
				CONVERSION RATE UNIT 2	
				CONVERSION RATE UNIT 3	
				CONVERT DENSITY	
RD/WR	133	ALM1 S-H Rate Unit	flt	In selected CH1 Rate Unit.	

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	134	ALM1 S- L Rate Unit	flt	In selected CH1 Rate Unit.	
RD/WR	135	ALM1 DBA Rate Unit	flt	In selected CH1 Rate Unit.	
RD/WR	136	ALARM1 AUDIBLE	char	OFF HIGH ONLY LOW ONLY HIGH AND LOW	132 133 134 134
RD/WR	137	ALM2 S-HI Temp Unit	flt	In selected Temperature Unit.	
RD/WR	138	ALM2 S-LO Temp Unit	flt	In selected Temperature Unit.	
RD/WR	139	ALM2 DBAN Temp Unit	flt	In selected Temperature Unit.	
RD/WR	140	ALARM2 AUDIBLE	char	OFF HIGH ONLY LOW ONLY HIGH AND LOW	132 133 134 135
RD/WR	141	ALM3 S-HI Pres. Unit	flt	In selected Pressure Unit.	
RD/WR	142	ALM3 S-L0 Pres. Unit	flt	In selected Pressure Unit.	
RD/WR	143	ALM3 DBAN Pres. Unit	flt	In selected Pressure Unit.	
RD/WR	144	ALARM3 AUDIBLE	char	OFF HIGH ONLY LOW ONLY HIGH AND LOW	132 133 134 135
RD/WR	145 148	DA1 CONFIG DA2 CONFIG	char	MIMIC CH1 RATE MIMIC CH2 TEMP. MIMIC CH3 PRES. MIMIC C1 FWD/REV MIMIC AUX 1 MIMIC AUX 2	117 118 119 120 121 122

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	146	DA1 MIN Unit	flt	In MIMIC channel's Unit.	
RD/WR	147	DA1 MAX Unit	flt	In MIMIC channel's Unit.	
RD/WR	149	DA2 MIN Unit	flt	In MIMIC channel's Unit.	
RD/WR	150	DA2 MAX Unit	flt	In MIMIC channel's Unit.	
RD/WR	151 152	RELAY1 CONFIG RELAY2 CONFIG	char	ALARM1 HIGH ALARM1 LOW ALARM2 HIGH ALARM2 LOW ALARM3 HIGH ALARM3 LOW ALARM AUDIBLE FORWARD SCALED PULSE REVERSE SCALED PULSE	123 124 125 126 127 128 129 130 131
RD/WR	153 154	RELAY3 CONFIG RELAY4 CONFIG	char	ALARM1 HIGH ALARM1 LOW ALARM2 HIGH ALARM2 LOW ALARM3 HIGH ALARM3 LOW ALARM AUDIBLE	123 124 125 126 127 128 129
RD/WR	155	SERIAL MODE	char	RS232 RS422 RS485	155 156 157
RD/WR	156	SERIAL MODE NUM	int	00 - 31	
RD/WR	157	SERIAL BAUD RATE	char	9600 4800 2400 1200 600 300 150 75	158 159 160 161 162 163 164 165

COMMAND	SSS	SPECIFIC FIELD	VALUES	FIELD SELECTION	DDD
RD/WR	158	SERIAL HANDSHAKE	char	NONE HARDWARE DTR XON/XOFF	166 167 168
RD/WR	159	SERIAL PROTOCOL	char	REMOTE KEYBOARD HOFFER INTERFACE PRINTER LC24X PRINTER	169 170 171 172
RD/WR	160	PASSWORD	int	0000-9999	
RD/WR	161	DATE	tim	mmddyy	
RD/WR	162	DAY OF WEEK	char	MON TUE WED THU FRI SAT SUN	136 137 138 139 140 141 142
RD/WR	163	TIME 24 HOUR CLK	tim	hhmmss	

Table 10 Unit Descriptions

Switch S1-1 Setting	ENGLISH	METRIC
UNIT 1	LBS	KG
UNIT 2	SCF	SM3
UNIT 3	ACF	AM3
UNIT 4	GAL	LIT
UNIT 5	NLIT	SLIT
UNIT 6	NCC	SCC
UNIT 7	ACC	ACC
UNIT 8	NM3	SM3
UNIT 9	UDEF	UDEF
CONVERSION UNIT 1	KG	LBS
CONVERSION UNIT 2	SM3	SCF
CONVERSION UNIT 3	AM3	ACF

6.4. PRINTER

In the PRINTER mode the Flowstar will generate Delivery Tickets whenever the REM key is depressed. The attached device must be a RS-232C serial printer that supports the ASCII (IBM) character code table. The Flowstar detects printer status only when the printer supports this feature through hardware hand-shaking. To enable the printer support the following settings must be made at the Flowstar.

1. SERIAL MODE = RS232
2. BAUD RATE = baud rate of attached device.
3. HANDSHAKE = NONE
4. SERIAL PROTOCOL = PRINTER.2010 or PRINTER

The pin connections of the DB-9 communications connection on the back of Flowstar are not standard. Please refer to 500-0037, *"Flowstar Communication Cables"*, when making your own cable to connect a printer to the FLOWSTAR. If your printer supports PAPER OUT detection, then contact Hoffer Flow Controls for information on the proper wiring of the Flowstar to your printer.

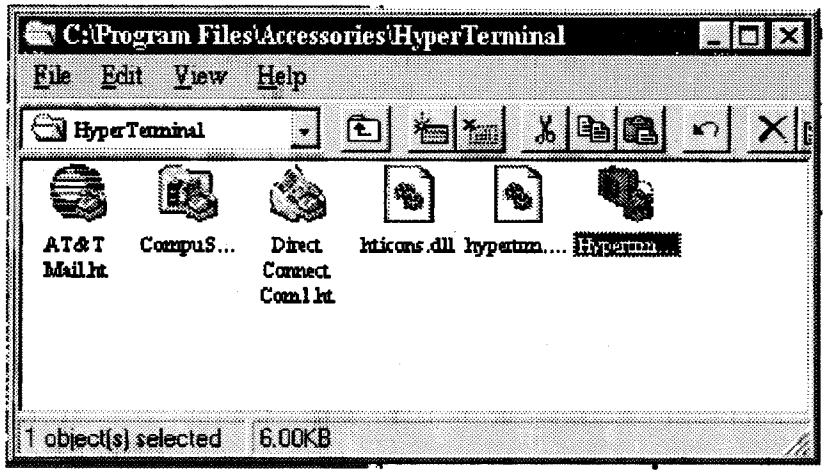
7.APPENDIX: COMMUNICATIONS OPTIONS

7.1. USING FLOWSTAR with ANSI TERMINAL

The Flowstar 2006 is configurable for use with an ANSI terminal. In this configuration FLOWSTAR may be connected to a ANSI terminal, via the RS-232 communication option when SERIAL PROTOCOL is configured for REMOTE TERMINAL Control is also possible by using a ANSI compatible communications software on a personal computer. HyperTerminal included with Windows 95, is ANSI compatible. Other examples of ANSI compatible communication software are ProCom, CrossTalk, Telix, and Windows 3.X Terminal. Listed below are the steps necessary to used HyperTerminal application with the Flowstar.

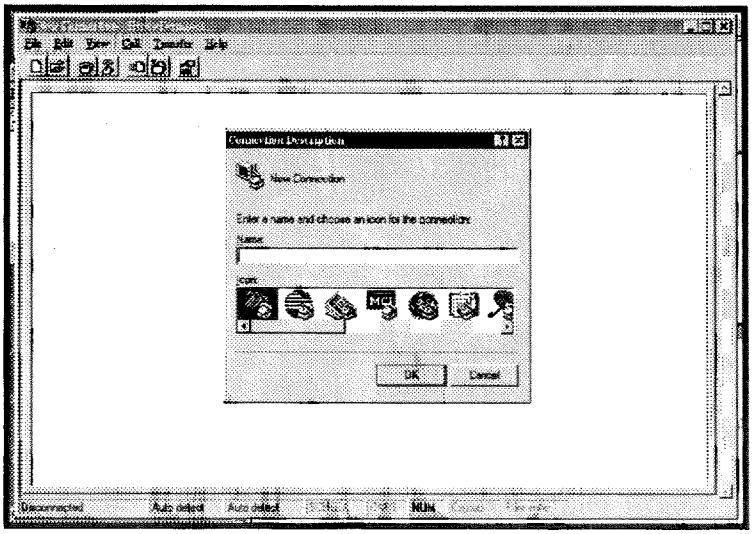
1. Using your mouse, point to the START button located on the Task Bar. Click on START, point to Accessories and drag the pointer of mouse down to the Hyper-Terminal Folder. Click on the HyperTerminal folder and it will appear on the screen.

Figure 7.1 Program Selection



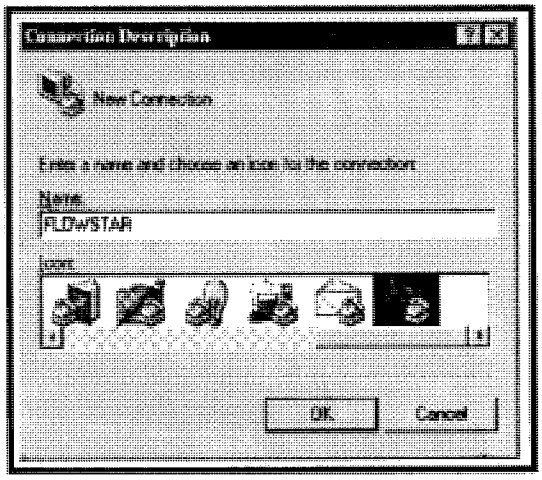
2. Double-click on the Hyper-Terminal icon, the Hyper Terminal program will start.

Figure 7.2 Icon Selection



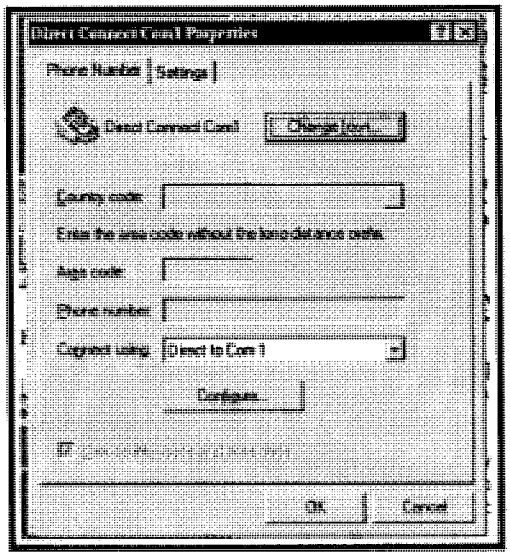
2. When the Hyper-Terminal program starts up, a new Connections Properties box will appear. Enter the name for the new connection and choose an icon. Click OK when finish. Example is shown below.

Figure 7.3 Command Line Description



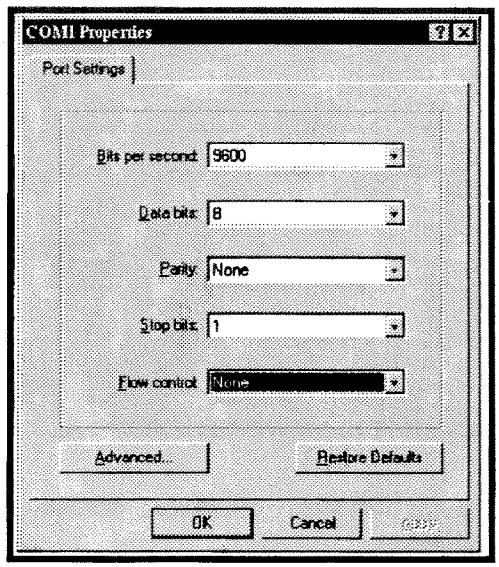
3. Select the port that will be connected to the Flowstar. Click OK when you are finished selecting the port.

Figure 7.4 Direct Connection Properties



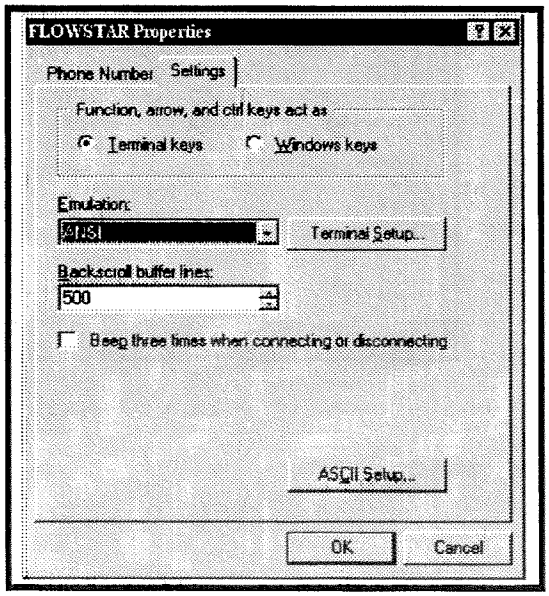
4. The Port Settings dialog box will appear next. Set the Bit Per Second speed to 9600. Set the Flow Control to None. Check the rest of the settings. Click OK when all settings are corrected.

Figure 7.5 COM Port Properties



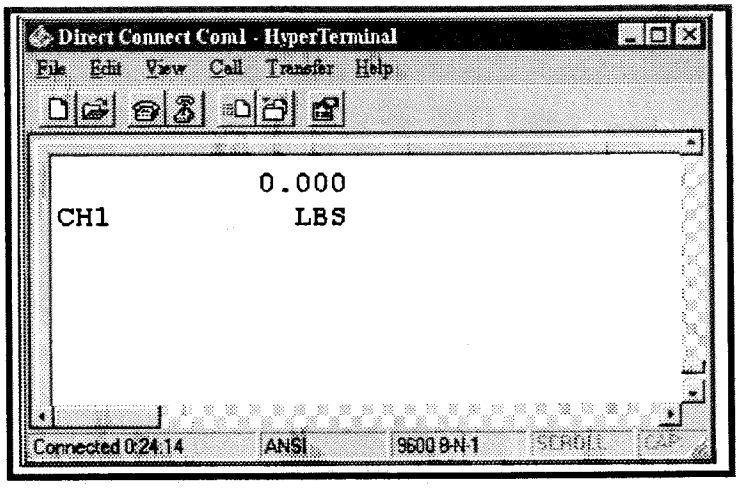
5. Next click on File and then on Properties. The Flowstar Properties dialog will appear. Click on the Settings tab and set Emulation to ANSI. Click OK after making the setting.

Figure 7.6 Connection Properties



6. You can adjust the size and position of the terminal window in Hyper-Terminal. It should look something like the example shown below when its properly working.

Figure 7.7 Program Display



7.1.1. ANSI TEMINAL KEY-MAPPING

ANSI terminals and emulation programs will accept commands from the keyboard and send them to the Flowstar. The following table shows the key-mapping used to control Flowstar from ANSI terminals and PC emulation programs.

Table 11 ANSI Key Mapping for Remote Terminal

Flowstar Keys	PC Keys
TOTAL / 1	1
RATE /2	2
TEMP 1 /3	3
TEMP 2 /4 (DENSITY)	4
PRES /5	5
HEAT /DUAL/ 6	6
SEP1 / 7	7
SEP2 / 8	8
AUX1 / 9	9
AUX2 / 0	0
START / .	.
STOP / SHIFT (+/-)	-
MODE	M,m
LAST / <	<
NEXT / >	>,ENTER
SEL	S,s,+
CLEAR	C,c
MAN	N,n
AUTO	A,a
REM/PRINT	R,r

7.1.2. ANSI TERMINAL SCREEN REFRESH

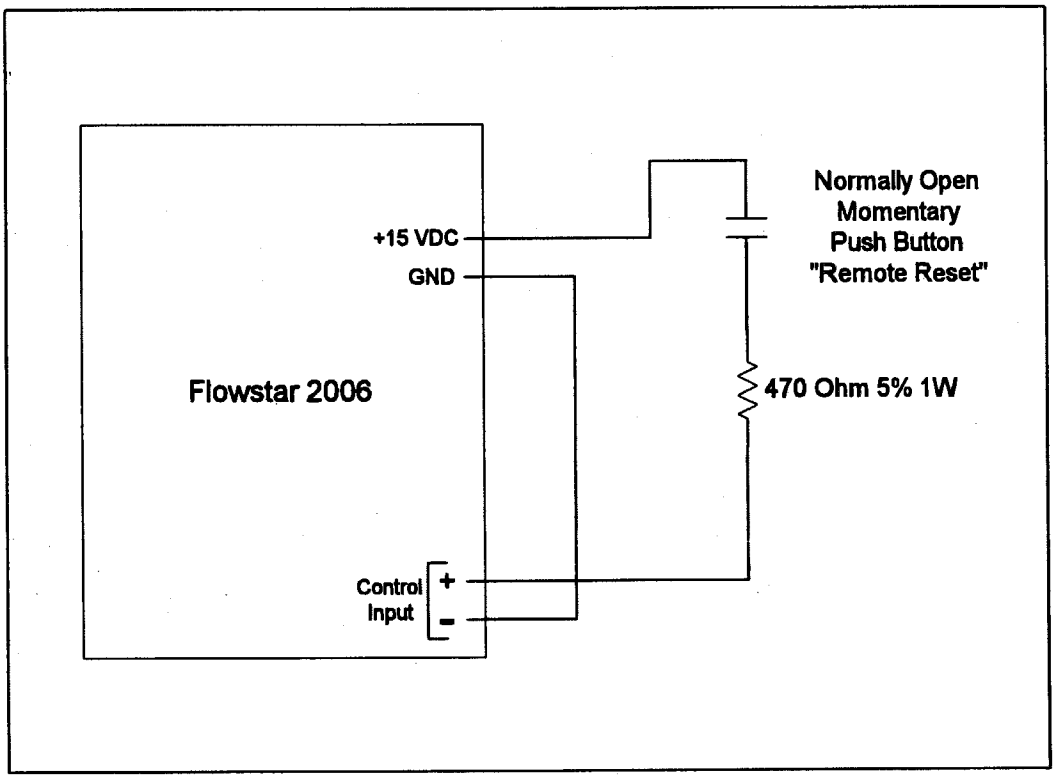
If the display on you PC or ANSI terminal becomes garbled, press the small letter <k> to refresh the display.

8.APPENDIX: SALES BROCHURE

9.APPENDIX: REMOTE RESET

9.1. Wiring Remote Reset Function

If using the Flowstar internal power supply, wire the Remote Reset per the drawing below.



WARNING If using an external power supply to supply voltage to the Remote Reset circuit, the power supply should have an output of 5 to 16 VDC.

9.2. Clearing the Flowstar 2006 using the REMOTE RESET

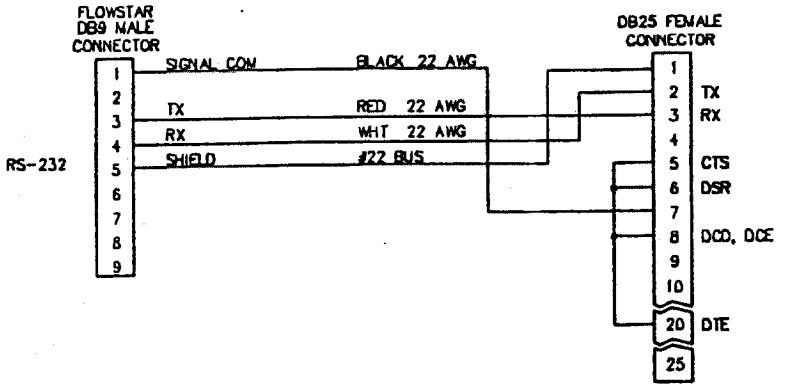
The Remote Reset functions in the same manner as the CLEAR key located on the Flowstar. Please refer to the OPERATING MODE section of this manual for information on using the CLEAR key. To clear the Flowstar while CH1 total is being displayed, press and release the Remote Reset button.

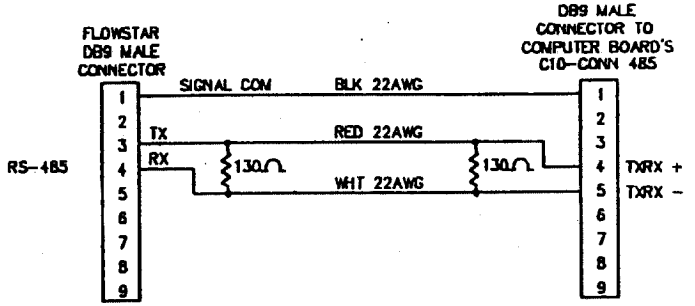
10.APPENDIX: DRAWINGS

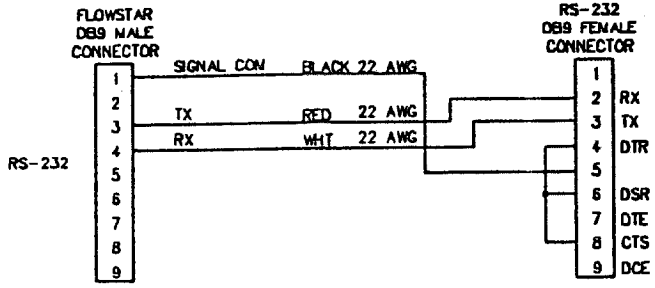
DWG NO.	500-0037	SH 1	REV A

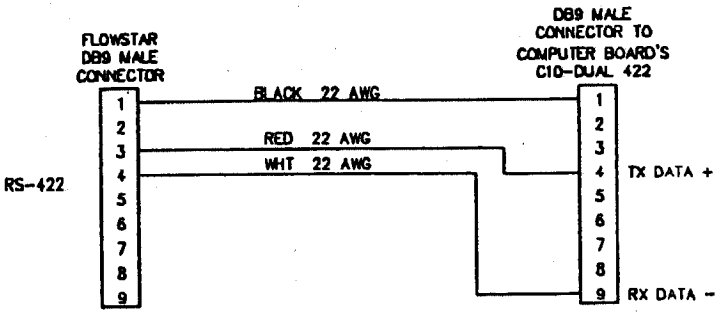
REVISIONS

ZONE	REV	DESCRIPTION	DATE	APP
	A	ZN B1, PIN 9 WAS PIN 5, ADDED TX DATA + AND RX DATA −. (CS)	941102	









		MATERIAL	DRAWN SWEET	DATE 941018
			CHECK BRE	941024
			PRODUCTION	
		FINISH	PROJ ENG J.DEFEO	941024
			MACH SHOP	
NEXT ASSY	USED ON	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 SIZE OF RAW MATERIAL SHALL BE HELD AS FOLLOWS: 2 PLACE DECIMALS ± .01; 3 PLACE DECIMALS ± .005; FRACTIONAL ± 1/64; ANGULAR ± 1/2°	
APPLICATION				

HOFFER FLOW CONTROLS, INC
ELIZABETH CITY, NC 27909

TITLE
FLOWSTAR COMMUNICATIONS CABLES

SIZE	CAGE CODE	DWG NO	REV
C	33321	500-0037	A

SCALE NONE SHEET 1 OF 1

DWG NO.	TRANS-908	SH 1	REV C

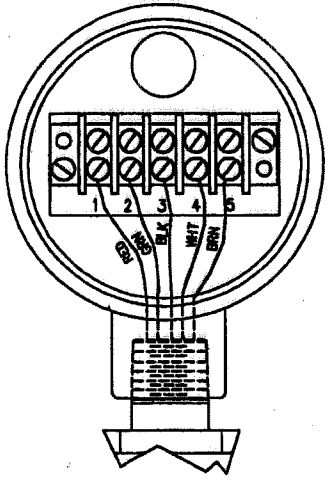
REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APP
	A	REMOVED MODEL 870. (CS)	941214	JD
	B	ADDED MODEL 770. (CS)	950912	JD
	C	REVISED PER ECP 454, CHANGED TB TO 3 POSITION FOR MODEL 570 DWG NO WAS 500-0041	000223	

ELECTRICAL CONNECTIONS:

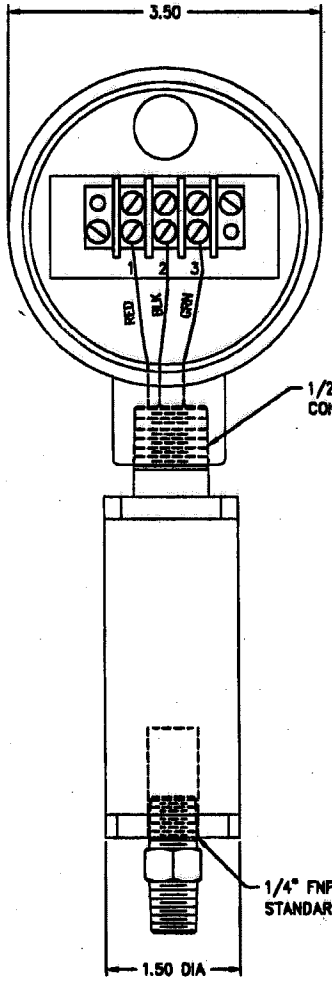
MODEL 570 1/2" MNPT. 3 WIRES 18AWG
- RED + POWER/SIGNAL
- BLACK - POWER/SIGNAL
- GREEN CASE GROUND

MODEL 770
- RED +INPUT
- GREEN -INPUT
- BLACK +OUTPUT
- WHITE -OUTPUT
- BROWN CASE GROUND

MODEL 770



MODEL 570



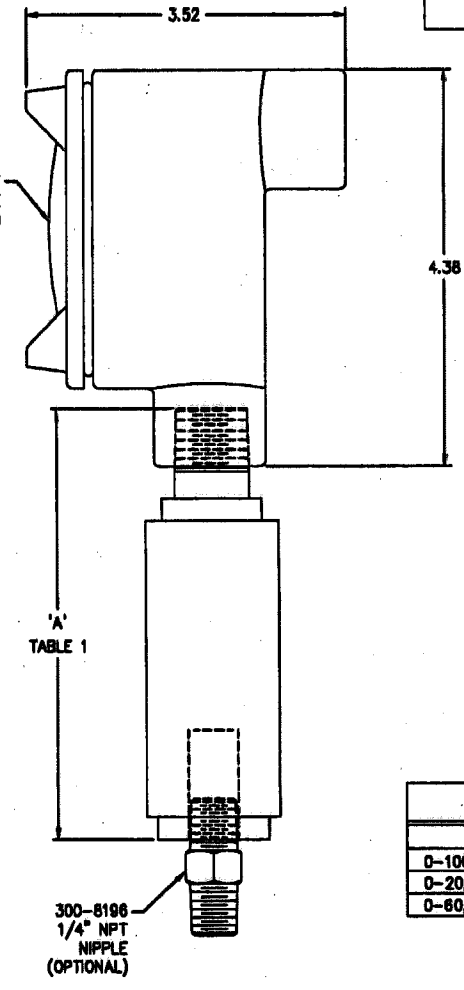


TABLE 1	DIM 'A'	
RANGE	MODEL 570	MODEL 770
0-100 THRU 0-15,000 PSIS	4.94	5.19
0-20,000 THRU 0-50,000 PSIS	5.06	5.32
0-60,000 THRU 0-100,000 PSIS	5.81	6.06

		MATERIAL	DRAWN SWEET	DATE 941102
			CHECK J.DEFEO	941102
			PRODUCTION	
		FINISH	PROJ ENG KRH	941102
			MACH SHOP	
NEXT ASSY	USED ON			
APPLICATION				

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES OTHER THAN THE SIZE OF RAW MATERIAL SHALL BE HELD AS FOLLOWS:

2 PLACE DECIMALS	± .01
3 PLACE DECIMALS	± .005
FRACTIONAL	± 1/64
ANGULAR	± 1/2°

HOFFER FLOW CONTROLS, INC
ELIZABETH CITY, NC 27909

TITLE
INSTALLATION DRAWING, MODEL 570 & 770 PRESSURE TRANSMITTER

SIZE	CAGE CODE	DWG NO	REV
C	33321	TRANS-908	C

SCALE NONE SHEET 1 OF 1

DWG NO.	TRANS-100	SH 1	REV B

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APP
	A	DRAWING NO. WAS TRANS-100. (CS)	950831	JD
	B	DRAWING NO. WAS 500-0179 DELETED NOTE 3	990524	

NOTES:

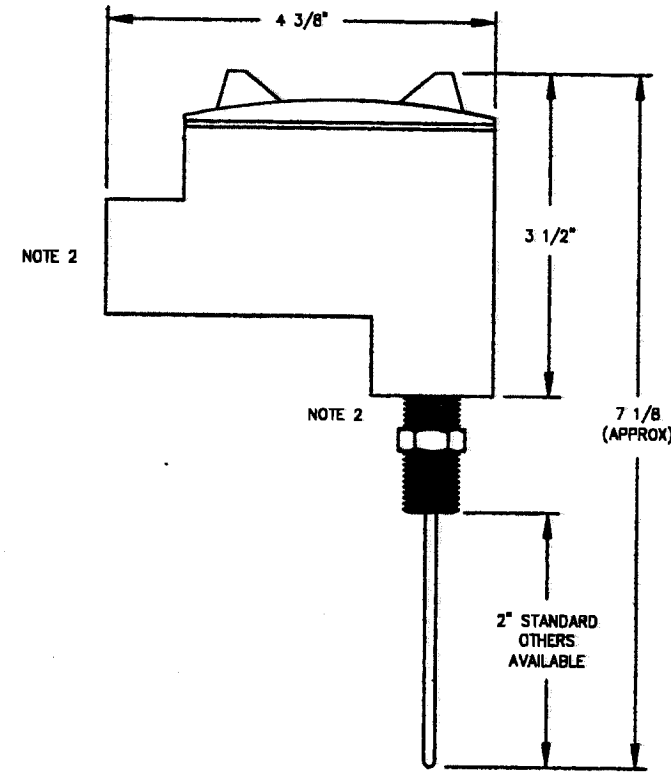
1. TWO WIRE TRANSMITTER IS A WEED INSTRUMENT MODEL 4111. RANGES AVAILABLE OVER -100 TO 600° C, CONSULT FACTORY FOR AVAILABLE SPANS.

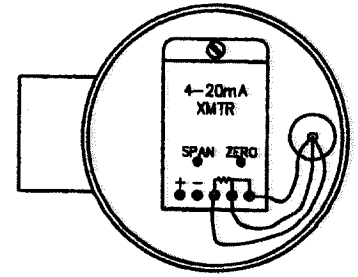
   OUTPUT: 4Ø TO 20mA
   RTD: 100 OHM @ 0° C
   POWER SUPPLY: 9.5V TO 36VDC.

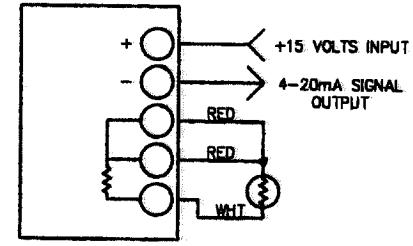
2. THREAD CONNECTIONS ARE 1/2" NPT ON PROCESS TAP AND FOR CONDUIT.

PT101-X-2-100-4150(*)-GUAC/O-X

* SPECIFY TEMPERATURE RANGE WITH AT LEAST A 35° F SPREAD.







REPLACES 500-0179

MATERIAL		DRAWN	DW	12-18-98
		CHECK	JD	12-18-98
		QA	H.COVELL	12-18-98
FINISH		PROJ ENG	KRH	12-18-98
		MACH SHOP		

NEXT ASSY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES OTHER THAN THE SIZE OF RAW MATERIAL SHALL BE HELD AS FOLLOWS:

2 PLACE DECIMALS	± .01
3 PLACE DECIMALS	± .005
FRACTIONAL	± 1/64
ANGULAR	± 1/2°

HOFFER FLOW CONTROLS, INC
ELIZABETH CITY, NC 27909

TITLE: INSTALLATION DRAWING, PT101

SIZE	CAGE CODE	DWG NO	REV
C	33321	TRANS-100	B

SCALE: NONE | SHEET 1 OF 1

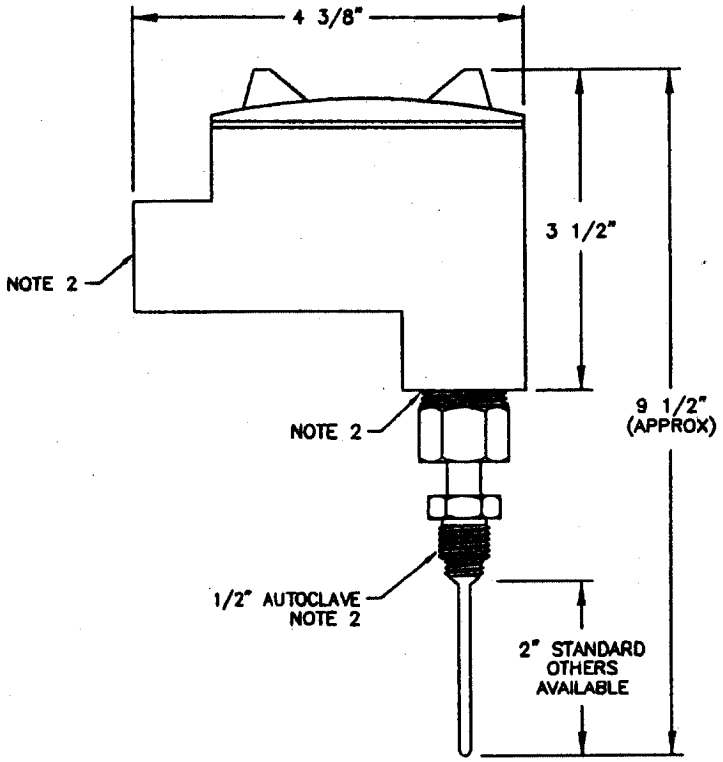
DWG NO.	TRANS-102	SH 1	REV C

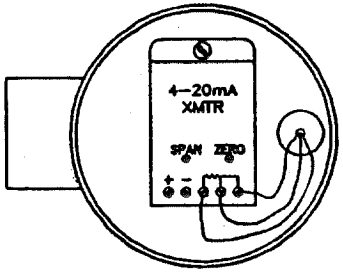
REVISIONS

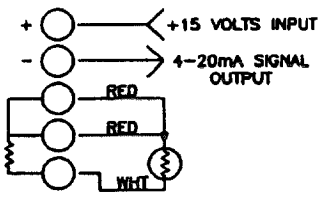
ZONE	REV	DESCRIPTION		DATE	APP
	A	DRAWING NO. WAS TRANS-102.	(CS)	951106	JD
	B	REVISED PER CPA 310.	(CS)	960214	KRH
	C	DRAWING NO WAS 500-0267	(CS)	961031	

NOTES:

1. TWO WIRE TRANSMITTER IS A WEED 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 36VDC.
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-1000-2-4154(*)-GUAC/0-X

* SPECIFY TEMPERATURE RANGE WITH AT LEAST A 35° F SPREAD.

REPLACES 500-0267

		MATERIAL	DRAWN DW	DATE 2-7-02
			CHECK JD	2-7-02
			QA H.COVELL	2-7-02
		FINISH	PROJ ENG KRH	2-7-02
			MACH SHOP	
NEXT ASSY	USED ON			
APPLICATION				

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES OTHER THAN THE SIZE OF RAW MATERIAL SHALL BE HELD AS FOLLOWS:

3 PLACE DECIMALS	± .01
2 PLACE DECIMALS	± .025
FRACTIONAL	± 1/64
ANGULAR	± 1/2°

HOFFER FLOW CONTROLS, INC
ELIZABETH CITY, NC 27909

TITLE: INSTALLATION DRAWING, PT102- TEMPERATURE PROBE

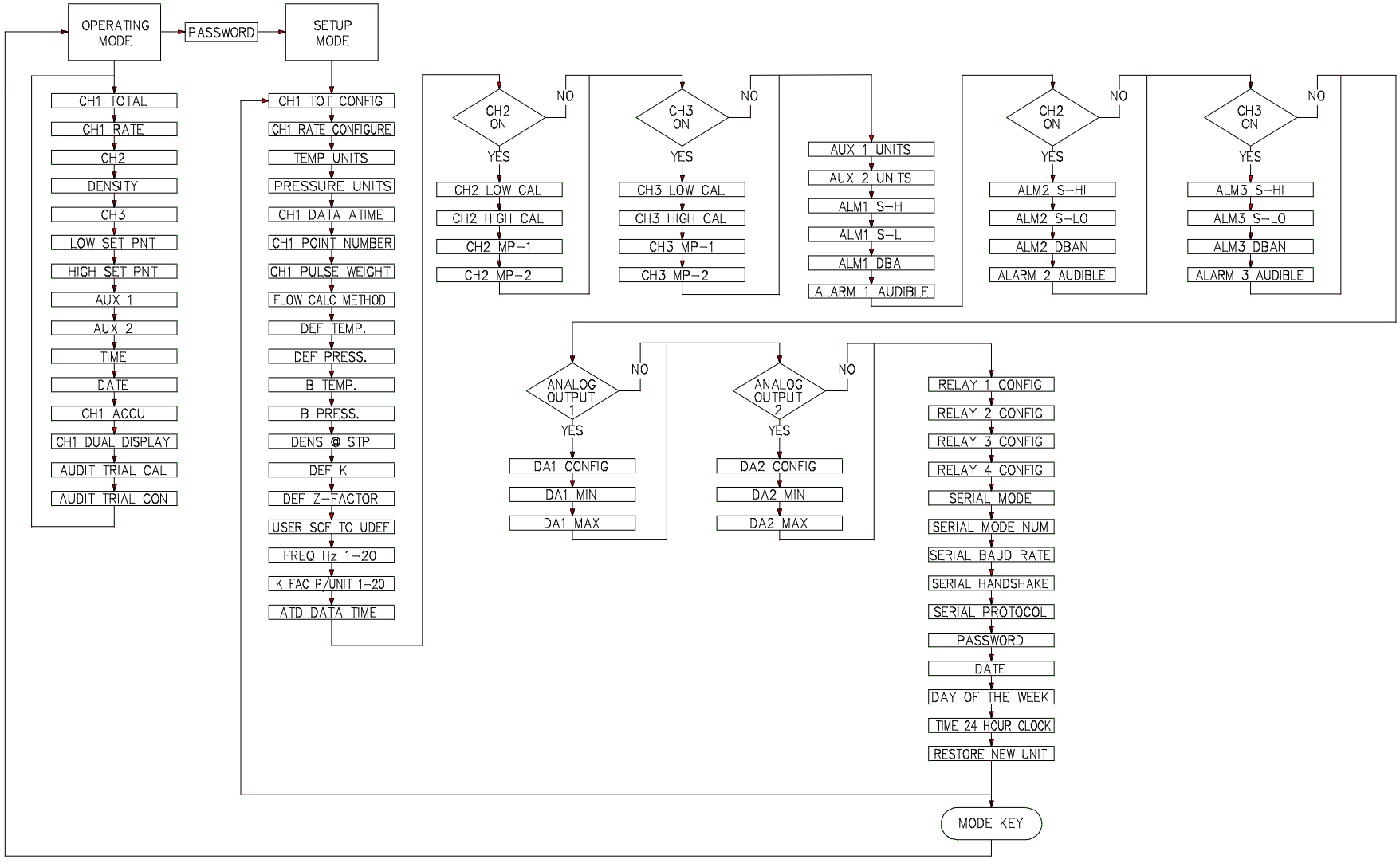
SIZE	CAGE CODE	DWG NO	REV
C	33321	TRANS-102	C

SCALE NONE SHEET 1 OF 1

DWG NO.	500-0350	SH 1	REV –

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APP



SOFTWARE VER 1.08

		MATERIAL	DRAWN	DATE
			CHECK	
			PROJ ENG	
		FINISH		
NEXT ASSY	USED ON			
APPLICATION				

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES, TOLERANCES OTHER THAN THE SIZE OF RAW MATERIAL SHALL BE HELD AS FOLLOWS:

2 PLACE DECIMALS	± .01
3 PLACE DECIMALS	± .005
FRACTIONAL	± 1/64
ANGULAR	± 1/2?

HOFFER FLOW CONTROLS, INC
ELIZABETH CITY, NC 27909

TITLE

FLOWSTAR 2006 FLOWCHART

SIZE	CAGE CODE	DWG NO	REV
C	33321	500-0350	–
SCALE	NONE		SHEET 1 OF 1