FLOW TRANSMITTERS

AW GEAR METERS

ELECTRONIC FOR INSTRUMENTATION

EMO-3000

Multi-Channel Flow Computer

User Manual

Rev 5.2

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Table of Contents

EMO-3000 HARDWARE

The EMO-3000 housing, power supply, and channel cards are integrated into a durable, efficient, and convenient housing. The housing is an anodized aluminum extrusion which is compatible with EURO module plug-in types. The 4 channel housing sections are interlocking, so the EMO-3000 is expandable to a maximum of 12 channels, in 4 channel increments. Each section has its own independent power supply.

The power supply uses plug-in type fuse holders allowing for easy replacement without removing the entire power supply card. There are also 3 LED's indicating whether the AC, positive, and negative legs are supplying the channel cards. Refer to Appendix I.

The EMO-3000 cards are mounted to the housing assembly with an anodized aluminum strip. At one end of this strip is the screw terminal slot for the housing which secures the card in place. At the other end, a 90° degree bend helps with removal or insertion of the card. The watchdog chip monitors the microprocessor activity and will issue a reset after a 1.6 second delay. Each channel card also has a Red LED which blinks when the microprocessor is running and blinks faster when a frequency input is applied to the channel.

EMO-3000 units manufactured after July, 1993, have serial communication protocol which is RS-232 and 4-wire RS-485. The RS-485 serial communication is backward compatible to the previous used 4-wire RS-422. As an option, these communications ports can be optically insulated from the rest of the EMO-3000.

The RS-232 to the DM-3000 is not optically insulated.

DM-3000 HARDWARE

In most cases the DM-3000 can be installed using only the 9 Pin D-Sub power/communication cable provided with the unit. The standard cable length is 15 feet. Maximum cable length is 50 feet. Longer lengths are not recommended, but can be provided for. The interference level is determined by the environment through which the cable is laid. Avoiding electric motors, servos and other noise sources is important to communication performance. See Appendix E for details on this cable.

> **Warning -- The serial communication cable which connects the EMO 3000 to the DM 3000, carries 15 VDC power. There is danger of damage if the 15 volts DC on Pin 1 is connected to a host computer or PLC. Only use the cable provided for its intended use.**

The DM-3000 is normally powered via the cable from the EMO 3000 but can be powered separately by hooking up a 12Vdc power pack or 12-15Vdc power supply to the power jack connector.

Once powered separately using a power supply or power pack, the DM-3000 will still require a communication cable with the pin layout shown in Appendix E. The 15 VDC on Pin 1 would no longer be required.

If both the power jack and the cable provided are used at the same time the DM-3000 will function normally.

EMO-3000 CARD HARDWARE DESCRIPTION

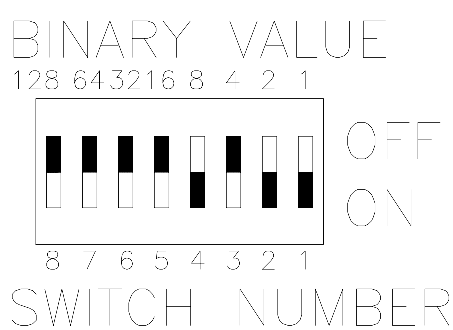
Each EMO-3000 channel card is an independent fluid monitor/control computer. The system is based on the V25 microprocessor, and utilizes a 256 Kbyte EPROM, and 8 Kbyte RAM. All communication is via RS-232C to the bus board, but the EMO-3000 channel card rack has both RS-232 and a 4-wire RS-422 type communication to PC or PLC. After July, 1993, the protocols are RS-232 and 4-wire RS-485. The RS-485 protocol is backward compatible with the RS-422 protocol. Also, optical insulated serial ports are available upon request (not to the DM-3000).

The Input/Output pins and the frequency inputs are isolated with an opto-coupler and a 4 position frequency divider for the A input, and an OP-Amp circuit in which the sensitivity can be set for 50mV, 1.75V, or 3.7V input for the B input. There is a 12 bit D/A converter, and a high speed multiplexing chip for the analog Input/Output control. All of the Analog control circuits employ high impedance buffer OP-Amps and diode protection to the microprocessor. The cards are mounted to the bus board using a 64 pin male connector. The 15 PIN connector is for the Limit I/O pins, the Analog I/O pins, the reset, and frequency inputs as well as a 15 Volt 25 mAmp power supply connection. Refer to Appendix Q and R.

The 15 position connecter is fully described in the next section.

On channel cards manufactured after July 1993, an 8-position DIP switch is used to set the cards channel number. This is only available if the EPROM has channel FF marked on it (default). Otherwise the channel number is hard-coded in the EPROM, and the channel number is marked on the EPROM label.

The channel number is a BINARY number. Switch #1 has a value of 1, #2 a value of 2, #3 a value of 4, #4 and value of 8, #5 a value of 16, and so on. For example to set the card to channel 7, switch# 1, 2 and 3 must be on (1+2+4=7). Channel 10 will need switch #2 and 4 on (2+8=10). In the picture below, the channel number is set to 11.



EMO 3000 CARD PIN LAYOUT

CHANNEL CARD CONNECTOR

1 – +15 VOLT OUT
2 – GROUND
3 – FREQUENCY IN – OP–AMP
4 – FREQUENCY IN – OPTO–COUPLER
5 – 4–20mA IN (+)
6 – 4–20mA IN (–)
7 – 4–20mA OUT (+)
8 – 0–5V IN (+)
9 – TOTALIZER RESET
10 – 0–5V OUT (+)
11 – TRANSPARENT ON/OFF
12 – HOLD
13 – HOLD TOTAL
14 – SETPOINT REACHED
15 – COMMON FOR 11–14

PIN 1 External power supply. The voltage level is set by a jumper on the power supply card (Refer to Appendix I). The options are 24 volts, 15 volts, 5 volts. The default setting is 15 volts. This supply pin will deliver 25 mAmp per card.

PIN 2 Common ground for pins 1,3,4,7,8,9, and 10. The EMO 3000 can be grounded to the central grounding point from this pin.

PIN 3 Secondary frequency input B. The input can be used for the secondary flow transmitter input in the Ratio mode. The input is Op-Amp isolated. The voltage sensitivity is set by a jumper for either 50mV, 1.75V, or 3.7V. The default setting is for 1.75V. (Refer to Appendix H & Q)

PIN 4 Primary frequency input A. The input is used for the primary flow transmitter for Monitor, PID, and Ratio modes. The input has an opto-coupler isolation circuit and a 4 position frequency divider chip. (Refer to Appendix H & Q)

PIN 5 4 - 20 mAmp (+) input. This will normally serve as the set point input for the PID mode. The isolation to ground is 400 Kohms.

PIN 6 4 - 20 mAmp (-) input current loop return for pin 5.

PIN 7 4 - 20 mAmp output. The ground reference for this signal is pin 2. The driver voltage is 20 - 24v. Therefore, the output will drive a load of approximately 800-1000 ohms.

PIN 8 0 - 5 volt input. The ground reference for this signal is pin 2. This is the Fluid Table Input. There are 32 separate color tables.

PIN 9 Reset input. The Totalized values for both the A and B inputs will be reset to 0 if a voltage is applied to this pin. The voltage level applied can be from 3 - 24 volts, momentary contact is recommended.

PIN 10 0 - 5 volts output. The ground reference for this signal is pin 2.

PIN 11 Transparent Input or Limit 1 Output. In the PID operating mode it is the Transparent Input or as Limit 1 Output in monitor mode. Refer to p.10 Input/Output Pin Control Section.

PIN 12 Analog Hold Input or Limit 2 Output. In the PID operating mode it is the Analog Hold or as Limit 2 in the monitor mode. Refer to p.10 Input/Output Pin Control Section.

PIN 13 Hold Totalizer Input or Limit 3. In the PID operating mode it is the Hold Totalizer or as Limit 3 Output in the monitor mode. Refer to p.10 Input/Output Pin Control Section.

PIN 14 Setpoint Reached Output or Limit 4. In the PID operating mode it is the Setpoint Reached Output or as Limit 4 Output in the monitor mode. Refer to p.10 Input/Output Pin Control Section.

PIN 15 This pin is the common line for pins 11 - 14. The separate common line allows for the isolation of pins 11,12,13 and 14 from the EMO-3000 internal ground.

OPERATING MODES

The EMO-3000 has 2 primary operating modes, monitor and PID 02 and a secondary mode PID 03. The PID 03 has all the same variables as PID 02, however this mode is reserved for experiential operations. Contact the AW Company before use. Selection of the desired mode is done under programming F4, and then General A F2 selection see page 20.

MONITOR MODE (operating mode = 01)

Monitor Mode is used for applications where it is important only to monitor flow rates and totals. This mode also provides analog and limit outputs. The programmable limit values can either turned on or off a relay contact. The 4-20 mA or 0-5 volt analog outputs can be scaled to the flow rate or the total which can be recorded in strip chart form, as a digital recording or sent to a PLC via the serial communication link.

If only flow rate and totalization are required, enter the programming mode F4, select General A F2 and program the desired variables see p.20 for specific details. Or for use of generic flow rate and totalization factors and engineering units enter the Quick Programming selection see p.31.

If analog outputs or limits are to be used in the monitor mode the following additional variables need to be programmed:

- **ANALOG GAIN FACTOR:** Scales the mA or the Voltage out.
- **POINTER:** Address for the variable that should be expressed.
- **OFFSET:** A programmed mAmp or Voltage output which corresponds to a zero input frequency.
- **LIMIT OUTPUTS:** See p.10-11 for further programming.

The channel cards, when originally shipped, are in monitor mode. However, the 4 opto-couplers, pins 11,12,13 and 14 are set for the PID mode in that three of them are inputs and one is an output. A pin can either be an input or an output depending on the way the opto-coupler chip has been set. If the monitor mode has been selected and you wish to use the limits, then the opto-coupler chips must be moved to make the pins functional. This can be change by the user if necessary. To change the Input/Output chips refer to the INPUT/OUTPUT section of this manual on page 10.

PID MODE 02 (operating mode = 02)

The PID mode 02 is designed for controlling fluid flows. To have the EMO 3000 operate in PID it is necessary to prepare several PID variables.

NOTE: Before starting to change modes and the variables it is advisable to disconnect the control valves and all control signals (such as hold , transparent etc.).

Important variables to program for PID Operation

(For details on programming the EMO-3000 with the DM-3000, see page 19)

Proportional: This factor determines the strength (or stiffness) of the closed loop control. In many cases this factor can only be determined by experimenting and it is well advised to start with a relatively low number (10...20). Too large a number can cause oscillations.

Integral: This variable is used in slow reacting closed loop systems, where a high proportional factor would cause the unit to go in to oscillation. For the most part, it would be recommended to make a design change to improve the system and hysteresis before employing this variable.

Derivative: The derivative part of the PID formula works against the proportional part if the general direction is towards the selected set-value. This is often used to stabilize the instability of high gain factors. This factor, like the proportional factor, is usually adjusted by experimentation.

Tolerance: The ∀ margin for "Set Point Reached". This variable determines when the PID pursuit of reaching the set-value will be stopped. For example: If the tolerance is 3 cc/min and the set value is 200 cc/m, then no PID correction will be made between 197..........203 cc/m. Depending on the mechanics of the system, it is advisable to start with a large window at first then, when system tuning is finished, this number can be reduced.

PID delta step: Delta step determines when a new variable is being accepted in to the scratch pad table. In general it can be stated that when the range to be covered by the closed loop is very wide, the delta step ought to be relatively large. With the delta step it is possible to manipulate the adaption speed. This variable can be programmed from 0...600Hz.

Initial kick: The initial kick is beneficial in cases where the regulator has a large hysteresis. The kick value will be applied to the analog output if there is a set-value present, no fluid flow and the analog out is less than the kick value. This is programmed in a range of 0000 to 4096 steps, where 0000 = 0mA and 4095 = 20 mA.

PID delay: Is the time delay in which PID control will be activated. The delay initiation starts from the selection of a new set point input or table pick. The PID delay is adjustable from 10 milliseconds to 600 seconds. In some cases the delay is the best way to make the PID wait for steady state flow.

ma-Scaler: The milliamp scaler will scale the 0 - 20 mAmp input signal on Pin 5 & 6 to the flow rate in engineering units/mA.

For example: 20mA = 1000 cc/min. Then,

$$\frac{1000}{B} = \text{mA-Scaler}$$

Where B = 20mA - mA Offset Value

With a mA Offset Value of 4mA, then mA-Scaler = 62.5 cc/min or 1mA = 62.5 cc/min.

This signal will serve as a flow rate setpoint in the PID mode after scaling.

mA's offset: The mA offset is used in a situation where there is not an exact 4 mA's at the low point of the analog input. The offset is the base line for calculating the set-value based on the analog input.

Important hardware connections for PID operation

None of the following external signals have to be wired. However they are very useful features in PID mode. (See Appendix P for details.)

Transparent: The transparent input will redirect the analog input, (PINS 5/6) directly to the mAmps output (PIN 7). It is necessary to use the transparent input if the channel is put in open loop simulation. This signal is located at PIN 11 on the backplane.

Hold Analog: This input signal will hold the analog output at the last set output. The hold input is often used in flush situations, where the controller is really supposed to be disabled. This signal is at PIN 12.

Hold total: Hold total input will disable the totalizer. This feature is often used during flush or soft-air push cycles. This signal is at PIN 13 on the backplane.

Set-value: This number has to be programmed in order to generate a flow rate in PID if the external 0-20 mAmp set value is not hooked up. This is considered the digital set value. It is important to know that the analog input set-value is overriding.

Set reached: Is an output that will be activated when the flow rate meets the set-value (+/- tolerance). This signal is at PIN 14.

Fluid Tables: There are 32 fluid tables supported by the EMO-3000. Each table can be externally accessed via pin #8 or via the DM-3000. The default fluid number is 00. Most variables affect all 32 fluid numbers, but a few variables require the fluid number to be entered when they are changed. In this event, an additional screen will appear with prompts. Each fluid table may be assigned to store flow data for a different fluid or color as it is being regulated. These data tables are continually adapted as each color is encountered. Each fluid is identified by a voltage of 0.15625 volts, which represents 5 V divided by 32. For example, the first color/fluid is indicated by the step voltage 0-0.15625 V. The fluid table is illustrated on Pg. 18.

EMO-3000 INPUT - OUTPUT PIN CONTROL

Pins 11-14 can be set as either inputs or outputs depending on the operating mode selected. In monitor mode all of the pins are limit outputs. In PID mode pins 11, 12, and 13 are inputs, while pin 14 is an output. By setting these Inputs and Outputs to suit the needs of the operating mode, as shown below, the user can take advantage of the LIMIT programming and PID the special functions for more efficient operations. The standard configuration of these 4 opto-coupler chips is for the PID mode.

NOTE: Refer to appendix H for location of the opto-couplers. Pin 6 on the opto-coupler IC must be cut off. Refer to Appendix P for external connections

PID Mode Configuration

PIN 11	U13	INPUT	TRANSPARENT
PIN 12	U12	INPUT	HOLD ANALOG OUT
PIN 13	U11	INPUT	HOLD TOTALIZER
PIN 14	U10	OUTPUT	SETPOINT REACHED

Monitor Mode Configuration

PIN 11	U13	OUTPUT	LIMIT 1
PIN 12	U12	OUTPUT	LIMIT 2
PIN 13	U11	OUTPUT	LIMIT 3
PIN 14	U10	OUTPUT	LIMIT 4

To change the standard configuration for the Monitor operating mode, the 3 opto-coupler chips set for INPUT should be removed and changed for OUTPUT. This will enable the LIMIT outputs as shown above.

LIMIT OPERATIONS

The EMO-3000 can be set up for 4 Limit Outputs by changing the factory set opto-coupler arrangement from the P I D settings of 3 inputs and 1 output, to the Monitor Mode settings of 4 outputs. Any opto-coupler set for an Output can be programmed to react to the following functions according to the LIMIT RULE programmed. See p.23.

LIMIT RULE	FUNCTION
11	Total Limit for A input
12	Rate Limit for A input
13	Ratio Limit for A input
21	Total Limit for B input
22	Rate Limit for B input
23	Ratio Limit for B input

If any of the above is selected to trigger a Limit, the next step is to program the Trip Point. This is accomplished under the LIMIT VARIABLES section see p.22. The choices are:

Total Limit 1 =	XXXXX.
Total Limit 2 =	XXXXX.
Total Limit 3 =	XXXXX.
Total Limit 4 =	XXXXX.
Flow Limit 1 =	XXXX.X
Flow Margin 1 =	XXXX.X
Flow Limit 2 =	XXXX.X
Flow Margin 2 =	XXXX.X
Flow Limit 3 =	XXXX.X
Flow Margin 3 =	XXXX.X
Flow Limit 4 =	XXXX.X
Flow Margin 4 =	XXXX.X
Ratio 1 +/- % =	XXXXX.
Ratio 2 +/- % =	XXXXX.
Ratio 3 +/- % =	XXXXX.
Ratio 4 +/- % =	XXXXX.

Note: The Flow Margin will operate as a +/- the programmed amount before tripping the Limit. For instance, if Flow Limit 1 were programmed to 100 cc/m and the Flow Margin 1 were programmed to 10cc/m, the Limit 1 would turn on anytime the Flow Rate went below 90 cc/m or above 110 cc/m.

RATIO OPERATIONS

The EMO-3000 can act as a Ratio Monitor by utilizing both the A (pin 4) and B (pin 3) frequency inputs. This is especially useful in 2 component systems where a ratio must be maintained within a defined margin.

The ratio calculation is based on the totalized volumes of fluid from Input A and Input B. The number of pulses programmed in the Ratio Sample variable will determine how often the ratio calculation is updated. When the number of pulses equal to the Ratio Sample is counted from either flowmeter, the Ratio calculation is performed. This is used to trigger Alarm and Warning limits under the Limit Rules for Ratio.

Note: The number for Ratio Sample has a decimal point which should be ignored when programming the number of pulses (4.00 is a sample size of 400 pulses).

ACTUAL RATIO = INPUT A TOTAL / INPUT B TOTAL

The calculation is performed when either Total A or Total B reaches the Ratio Sample number first.

The ratio display screen will show the Flow Rates for A and B, the Ideal Ratio, and the Actual Ratio. The Ideal Ratio is the ratio that should be maintained at the spray nozzle and needs to be programmed. The Ideal Ratio variable is under the GENERAL A variables in the DM-3000.

The Actual Ratio is compared to the Ideal Ratio and the Ratio Margin Limits when programmed. If the user would like warning or alarm functions for Ratio errors, the Ratio Limits can be programmed for the allowable error. The Input/Output pins may need to be set for outputs for the Limit functions. Refer to the Input/Output section on p. 10.

LINEARIZER OPERATION

The EMO-3000 features a fully programmable 10 point linearizer. The linearizer corrects for errors over the flow transmitters indicating range using the calibration data. The linearizer can **only** be used if there is an accurate calibration for that particular flow meter in the range required. The linearizer can be used in any of the operating mode the EMO-3000 is in, Monitor, PID, or Ratio. The corrections can be based on either the frequency input A, or B, or both A & B.

In the programming screen of the DM-3000, if the programmer selects 3 = LINEARIZER the 10 error points and their associated error percentages can be programmed. The linearizer can then be "turned on" and directed to the correct input under the GENERAL A variables. The rule for operation is as follows:

LINEARIZER = 0 OFF
LINEARIZER = 1 FREQUENCY INPUT A
LINEARIZER = 2 FREQUENCY INPUT B
LINEARIZER = 3 BOTH A & B INPUTS

NOTE: In the great majority of cases it is unnecessary to program the linearizer. If using a Positive Displacement flow meter for the right application the errors are usually less than .5% and are therefore negligible. If the linearizer is programmed to correct for less than 1 %, there is little chance of improving the system performance.

Turbine flow meters are often where the linearizer would be most effective. The reason being is that often a turbine flow meter will react to differences in fluid speeds over a given range in a non-linear fashion. If an accurate calibration sheet is available showing the percent of deviation, the user can program the 10 point linearizer to correct the fluid flow rates indicated by the EMO-3000. For instance, if the calibration data for a particular flow meter were:

Frequency: HZ	Rate: GPM	K-Factor (Imp/Gal)	Error %
10	.26	2037.7	-5.2
100	2.6	2157.7	+0.5
500	13.00	2100.0	-2.5

Note: If the percentage of error is not given in the calibration data it can be calculated using the average k-factor.

MAIN MENU

The Main Menu is shown below. There are 6 selections possible.

```
        ****  DM-3000 MAIN MENU              V2.0.97
F1=ACTION DSP                F2 = SINGLE  CHANNEL
F3=RATIO  DSP                F4 = PROGRAMMING
F5=SEARCH CHA                F6 = UTILITY
 1=ACTION RATIO                2 = QUICK PROGRAM
 3=FLUID VARIABLES             4 = . . . . . . . . . . . .

….SELECT  ONE  OF  THE  ABOVE ALTERNATIVES
```

In any of the Action or Programming screens the **ESCAPE** will return the operator to the Main Menu.

Each choice is explained on these pages.

GENERAL OPERATION

Once the DM-3000 is installed and programmed, the Action screen, Single Channel screen, or the Ratio screen will serve as the normal operating screens.

The Action screens will display the fluid flow Rates, Totals, and Grand Totals for up to 12 active EMO-3000 monitor/control channels. The Totals and Grand Totals can be reset to zero by pushing the F6 key.

F1 = ACTION DSP (RATE)

```
   CNR         RATE        CNR        RATE
    01        XXXXX.X      07        XXXXX.X
    02        XXXX.XX      08        XXXX.XX
    03        XXX.XXX      09        XXX.XXX
    04        XXXX.XX      10        XXXX.XX
    05        XXXXX.X      11        XXXXX.X
    06        XXXXXXX      12        XXXXXXX
F1=ESC   F2=RATE   F3=TOTAL   F4=GRAND TOTAL
```

ACTION DSP (TOTAL)

```
   CNR         TOTAL        CNR       TOTAL
    01        XXXXX.         07       XXXXX.
    02        XXXXX.         08       XXXXX.
    03        XXXXX.         09       XXXXX.
    04        XXXXX.         10       XXXXX.
    05        XXXXX.         11       XXXXX.
    06        XXXXX.         12       XXXXX.
F1=ESC   F2=RATE   F6=RESET  ALL
```

ACTION DSP (GRAND TOTALS)

```
   CNR       GRAND TOT      CNR     GRAND  TOT
    01        XXXXX.         07       XXXXX.
    02        XXXXX.         08       XXXXX.
    03        XXXXX.         09       XXXXX.
    04        XXXXX.         10       XXXXX.
    05        XXXXX.         11       XXXXX.
    06        XXXXX.         12       XXXXX.
F1=ESC   F2=RATE   F6=RESET  ALL
```

F2 = SINGLE CHANNEL DISPLAY - Monitor Mode

NOTE: The next two displays are for Monitor Mode ONLY.

The Single Channel screen will display all the operational information needed for the specific channel selected. There are actually 2 single channel screens for each channel and 1 special transducer value screen for channels in the PID operating mode. The first screen is shown below.

SINGLE CHANNEL DISPLAY 1

```
 MONITOR MODE   DSP 01           CHANNEL = XX
 RATE =      XXXX.ccm
 TOTAL =     XXXX.cc       GRAND=    XXXX.cc
 LIMIT 1 - ->OFF
 LIMIT 2 - ->OFF
 LIMIT 3 - ->OFF
 LIMIT 4 - ->OFF
F1=ESC  F2=CHNL UP  F3=CHNL DN         F5 = D+
```

F2 will page the operator up through the channels.
F3 will page the operator down through the channels.
F5 will call up PID Displays 2 & 3.

The second of the 2 single channel display screens is shown below. This screen is entered by selecting F5 = D+ in the first screen.

SINGLE CHANNEL DISPLAY 2

```
MONITOR MODE     DSP 02               CHANNEL = XX
MA OUTPUT =XX.XX                   mA INPUT=XX.XX
V OUTPUT  =X.XXX                    V INPUT=X.XXX

TOTALIZER =       XXXXXXX. cc
GRAND TOT =       XXXXXXX. cc

F1 = ESC  F2 = TOT RESET  F3 = GRA RESET  F5 = D+
```

F2 will reset the totalizer.
F3 will reset the Grand Total.
F5 will call up the first single channel screen in Monitor Mode.

F2 = SINGLE CHANNEL DISPLAY - PID Mode

NOTE: The next three displays are for PID Mode ONLY.

SINGLE CHANNEL DISPLAY 1 - PID

```
P I D   MODE   DSP 01         CHANNEL = XX
 RATE = XXXX.X ccm          FLUID NBR = 00
 SET  = XXX.XX ccm     mA OUTPUT = 00.00
 TRANSPARENT - - >     OFF
 HOLD ANALOG - - >     OFF
 HOLD TOTAL  - - >     OFF
 SET REACHED - - >     OFF
F1 = ESC  F2 = UP  F3 = DN           F5 = D+
```

F2 will page the operator up through the channels.
F3 will page the operator down through the channels.
NOTE: The channel selection for programming is performed in this screen.

F5 will call up the second Single Channel screen.

SINGLE CHANNEL DISPLAY 2 - PID

```
P I D   MODE     DSP 02             CHANNEL = XX
MA OUTPUT =XX.XX                  mA INPUT=XX.XX
V OUTPUT  =X.XXX                  V OUTPUT=X.XXX

TOTALIZER =       XXXXXXX. cc
GRAND TOT =       XXXXXXX. cc

F1 = ESC  F2 = TOT RESET  F3 = GRA RESET  F5 = D+
```

F2 will reset the totalizer.
F3 will reset the Grand Total.
F5 will call up the third channel screen for PID Mode.

SINGLE CHANNEL DISPLAY 3 - PID VARIABLES

```
P I D   MODE   DSP 03   FLU=00   CHANNEL = XX
GAIN      =XXXX.        mA SCALER=XXXXX.
TOLERANCE=XXXX.         KFR FACTR=XXXXX.
I-KICK    =XXXX.        I-PART   =XXXXX.
MA OFFSET=XX.XX         D-PART   =XXXXX.
SAMPLE AM=XXXXX.        CUTOFF   =XXXXX.
DELAY    XXX.XX         DELTA STP=XXXXX.
F1 = ESC  F2 = FLU UP  F3 = FLU DN  F4= RES  F5=D+
```

F2 will page the operator up through the Fluid Numbers.
F3 will page the operator down through the Fluid Numbers.
F5 will call up the fourth channel screen for PID Mode.

SINGLE CHANNEL DISPLAY 4 - PID FLUID TABLES

This display screen shows 10 closed loop set points and 10 corresponding mA values. They are the Scratch Pad Values in the Fluid Tables.

```
P I D  MODE DSP 04  FLU=00  CHANNEL=XX
__SET_POINT_!_MA's_!__SET_POINT_!_MA's_!
  XXXXX..03.99   XXXXX..03.99
  XXXXX..03.99   XXXXX..03.99
  XXXXX..03.99   XXXXX..03.99
  XXXXX..03.99   XXXXX..03.99
  XXXXX..03.99   XXXXX..03.99
F1=ESC F2=FLU UP F3=FLU DN  4=RES F5=D+
```

F2 will page the operator up through the Fluid Numbers.
F3 will page the operator down through the Fluid Numbers.
F4 will reset the Scratch Pad Values for the selected Fluid Number
F5 will return to the PID Single Channel Display 1.

Note: This display is NOT available in Monitor Mode.

F3 = RATIO DISPLAY

The Ratio Display Screen can be selected from the Main Menu using F3. In this operation screen both the rates from frequency inputs A and B are shown and the Ratio A/B is computed and displayed as below.

RATIO DISPLAY

```
 RATIO DISPLAY      FOR CHANNEL  XX

RATE  A=          XXX.X ccm
RATE  B=          XXX.X ccm

RATIO A/B=       XXX.XX
SET RATIO=        XX.XX
F1=ESC  F2=CHNL UP  F3=CHNL DN
```

F2 will page the operator up through the channels.
F3 will page the operator down through the channels.

To show multiple channel displays of ratio refer to the ACTION RATIO section from the MAIN MENU.

PROGRAMMING WITH THE DM-3000

F4 = PROGRAMMING

Selecting Programming from the Main Menu will call up the screen below.

```
******** PROGRAMMING   MENU *****************
F1= MAIN MENU  (ESC)      F2= GENERAL A
F3= PID VARIABLES         F4= GENERAL B
F5= ANALOG VARIAB.        F6= LIMIT VAR.
 1= LIMIT RULES            2= RATIOS
 3= LINEARIZER             4= SPECIAL REPEAT
 CHANNEL CURRENTLY SELECTED IS XX
select  one  of the above ...................
```

For each of the selections above instructions will be provided to access and program the desired variable. This part of the manual is not intended to describe the effect of each variable in the EMO-3000 system. See pages 30 through 40 for detailed information in that regard. However, the programmer will most likely develop a general knowledge of the EMO-3000 from the various programming screens available in the DM-3000.

All variables may be viewed and reprogrammed via the F2 function shown above (General A). Short cuts to specific sections of the variable table are also provided via the other F keys shown above. A full list of variables is shown in page 41.

The choices are explained on these pages.

F1 = MAIN MENU (ESC)

This key simply returns out of the Programming screen to the Main Menu from the programming screens.

F2 = GENERAL A

The General A screen illustrated below show the first six variables from a complete list of 50 variables. The full list including default values appears in page 41.

```
 *** GENERAL  VARIABLES ***  CH = XXX
----> KFR FACTOR       =    XXXX.X
      RATE  ENG.UNIT   =   ??
      KFT - FACTOR     =     XXXXX.
      TOTAL ENG.UNIT   =   ??
      SAMPLE  AMOUNT   =     XXXXX.
      CUTOFF  FREQ.    =     XXXX.X
F1 = ESC  F2 = PGUP  F3 = PGDN  F4 = PRGM
```

All variables may be accessed by paging up through the General A menu using the F2 key. To change a variable value use the following procedure.

F2	Use page up to move the variable up to a position next to the printer.
F4	Allows programming
4146	The pass code only needs to be entered once for multiple changes. Enter new digits from left to right: Further prompts appear at the foot of the display.

F3 = PID VARIABLES

```
 ***     PID   VARIABLES       ***  CH=XXX
 --->    PID   PROPORT.        =    XXXXX.
         PID   INTEGRAL        =    XXXXX.
         PID   DERIVATIV       =    XXXXX.
         PID   TOLERANCE       =    XXXX.X
         PID   DELTA STEP      =    XXXX.X
         PID   INIT. KICK      =    XXXXX
F1=ESC     F2=PGUP      F3=PGDN     F4=PRGM
```

Additional variables are accessed by using the F2 or F3.
A full list is shown in page 41.

When the desired variable is moved to the arrow, select F4 = PROGRAM. The DM-3000 will then ask for the pass-code.

ENTER PASS CODE = XXXX
The code is " **4146** "

Key in the correct variable value and Enter with F6.

F4 = GENERAL B

```
  * * * B  CHANNEL  VARIABLES *  CH = XXX
----->KFR - FACTOR  B  =       XXXX.X
      RATE  B  UNITS   =     ??
      KFT  -FACTOR  B  =       XXXXX.
      TOTAL  B UNITS   =     ??
      SAMPLES  FOR  B  =       XXXXX.
      CUTOFF  FRE.  B  =       XXXX.X
F1 = ESC   F2 = PGUP  F3 = PGDN  F4 = PRGM
```

When the desired variable is moved to the arrow, select F4 = PROGRAM. The DM-3000 will then ask for the pass-code.

ENTER PASS CODE = XXXX
The code is " **4146** "

Key in the correct variable value and Enter with F6.

F5 = ANALOG VARIABLES

```
     * * * ANALOG  VARIABLES * * *   CH = XXX
---->mAs  OFFSET    =        XXX.XX
     mAs  GAIN      =        XXXXX.
     mAs  SHIFTER   =        XXXXX.
     mAs  POINTER   =        XXXXX.
     Volts OFFSET   =        XX.XXX
     Volts GAIN     =        XXXXX.
F1 = ESC  F2 = PGUP  F3 = PGDN  F4 = PRGM
```

NOTE: In the ANALOG VARIABLES screen there are 4 variables which are accessed by F2 = PGUP. They are:

```
Volts SHIFTER  =       XXXXX.
Volts POINTER  =       XXXXX.
mAs IN OFFSET  =       XXX.XX
Vos IN OFFSET  =       XXX.XX
```

When the desired variable is moved to the arrow, select F4 = PROGRAM. The DM-3000 will then ask for the pass-code.

ENTER PASS CODE = XXXX
The code is " **4146** "

Key in the correct variable value and Enter with F6.

F6 = LIMIT VARIABLES

```
    * * *  LIMIT  VARIABLES  * * *  CH = XXX
  ----> TOTAL  LIMIT  1  =     XXXXX.
        TOTAL  LIMIT  2  =     XXXXX.
        TOTAL  LIMIT  3  =     XXXXX.
        TOTAL  LIMIT  4  =     XXXXX.
        FLOW   LIMIT  1  =     XXXX.X
        FLOW   MARGIN 1  =     XXXX.X
  F1 = ESC  F2 = PGUP  F3 = PGDN  F4 = PRGM
```

NOTE: In the LIMIT VARIABLES screen there are variables which are accessed by F2 = PGUP. They are:

```
FLOW  LIMIT  2  =      XXXX.X
FLOW  MARGIN 2  =      XXXX.X
FLOW  LIMIT  3  =      XXXX.X
FLOW  MARGIN 3  =      XXXX.X
FLOW  LIMIT  4  =      XXXX.X
FLOW  MARGIN 4  =      XXXX.X
```

When the desired variable is moved to the arrow, select F4 = PROGRAM. The DM-3000 will then ask for the pass-code.

ENTER PASS CODE = XXXX The code is " **4146** "

Key in the correct variable value and Enter with F6.

The Limit Variables work in conjunction with the Limit Rules in the next section of this manual. The values entered under the Limit Variables will determine the trip points of any limit programmed to work as a function of them. For example, if Total Limit 1 in the Limit Variables section above were programmed to 1000, and the Limit Rule discussed in the next section of this manual were programmed to function with Total Limit 1, the limit output would turn on only when the totalized fluid value exceeded 1000 counts in the engineering units programmed. (gallons, ounces, CC's) Therefore, both the Limit Value and the Limit Rule are needed for the desired action to occur.

1 = LIMIT RULES

```
   * * * LIMIT  RULES         * * *  CH = XXX
----> LIMIT 1 RULE     =      000XX.
      LIMIT 2 RULE     =      000XX.
      LIMIT 3 RULE     =      000XX.
      LIMIT 4 RULE     =      000XX.
      RATIO 1 +/-%     =      XXXXX.
      RATIO 2 +/-%     =      XXXXX.
F1 = ESC  F2 = PGUP  F3 = PGDN  F4 = PRGM
```

NOTE: The last 2 variables in the screen above are not related to the LIMIT RULES. They appear as part of the variable listing only by coincidence.

When the desired variable is moved to the arrow, select F4 = PROGRAM. The DM-3000 will then ask for the pass-code.

ENTER PASS CODE = XXXX
The code is " **4146** "

Key in the correct variable value and Enter with F6.

The Limit Rules are set up so that by entering 1 of 4 two number combinations for each of the 4 limits the variable which determines the operating function can be selected according to the table below.

```
11 --- Total Limit for A input
12 --- Flow Rate Limit for A input
13 --- Ratio Error Limit for A

21 --- Total Limit for B input
22 --- Flow Rate Limit for B input
23 --- Ratio Error Limit for B
```

2 = RATIOS

```
 * * * RATIOS                        * * * CH = 003
 ----> RATIO  1  +/-%     =         XXXXX.
       RATIO  2  +/-%     =         XXXXX.
       RATIO  3  +/-%     =         XXXXX.
       RATIO  4  +/-%     =         XXXXX.
 F1 = ESC   F2 = PGUP   F3 = PGDN   F4 = PRG
```

The Ratios screen allows the programmer to set the error percentage at which the Limits would turn on if the EMO 3000 is in the Ratio operating mode. The calculation for the actual Ratio is input A/input B. The Ideal Ratio is strictly a programmable point the desired ratio should hold. Therefore, the percentage of error between the Actual and Ideal Ratio can control the Limit outputs if so programmed. For Example, if the Ideal Ratio were programmed to 2 (2 to 1 ratio), and the Actual Ratio measured were 2.2 the percentage of error between the two would be 10%. If the Limit Rule was set for Ratio and the Ratio error % were programmed for 10% or less the limit output would turn on.

3 = LINEARIZER

```
* * LINEARIZER  PROGRAM * * *  CH = XXX
 POINT 01 - - -> XXXX.X   ERROR = +XXX.XX
 POINT 02 - - -> XXXX.X   ERROR = +XXX.XX
 POINT 03 - - -> XXXX.X   ERROR = +XXX.XX
 POINT 04 - - -> XXXX.X   ERROR = +XXX.XX
 POINT 05 - - -> XXXX.X   ERROR = +XXX.XX
 POINT 06 - - -> XXXX.X   ERROR = +XXX.XX
 F1 = ESC  F2 = PGUP  F3 = PGDN  F4 = PRGM
```

The table continues for 10 points and errors by F2 = PGUP

```
POINT 07 - - -> XXXX.X   ERROR = +XXX.XX
POINT 08 - - -> XXXX.X   ERROR = +XXX.XX
POINT 09 - - -> XXXX.X   ERROR = +XXX.XX
POINT 10 - - -> XXXX.X   ERROR = +XXX.XX
```

Programming the Linearizer is different from the other screens so far in that it will call up the MENU BAR below if F4 = PRGM is selected.

```
F1 = ESC   F2 = POINT   F3 = ERROR
```

The programmer must select either the point or the error percentage for programming. If F2 = POINT is selected the MENU BAR will show the following choices.

```
F1 = ESC   F2 = CLR   F5 = DP   F6 = ENT
```

Key in the correct deviation point and enter with F6. Correct any mistakes using F2 = CLEAR, F5 = DECIMAL POINT.
If the programmer selects F3 = ERROR the MENU BAR will show the following choices.

```
F1 = ESC   F2 = CLR   F3 = SGN   F5 = DP   F6 = ENT
```

Key in the correct error percentage and the correct +/- sign using " F3 = SGN ". Enter using F6.

4 = SPECIAL REPEAT

If the programmer selects 4 =SPECIAL, the DM-3000 will return to the programming section last entered. This should be a handy feature if several channels need to be programmed in the same manner, or if quick changes need to be made for variables commonly used.

F5 = SEARCH CHANNELS

If the operator selects F5 = SEARCH CHANNELS the screen will flash the message "....searching for active channels". At this time the DM-3000 will start incrementing through channel numbers 1 through 16 and the screen will indicate any active responses as the character **I.** The DM-3000 will then automatically return to the Main Menu.

UTILITY FUNCTIONS

F6 = UTILITY Functions

The DM-3000 features a useful tool for troubleshooting installations by observing the system flow response over the full range of the analog output. The user can step through the complete range analog output range in 1 mA steps while observing the resulting flowrate and ripple on the flowrate that is often present in pumped systems. This is useful for observing the hysteresis, non-linearity and other irregularities in system response. This feature is also useful for determining the cracking pressure of a flow regulator to aid in setting the PID INITIAL KICK parameter.

As this feature takes open loop control of the system, beware of the potential volume of the resulting flow. To prevent unauthorized or intentional use, this function is protected by a password on each entry.

```
* * * UTILITY  MENU  * * * *
F1 = ESCAPE  TO  MAIN  MENU
F2 = STEP THRU ANALOG VALUES
F3 = ……………………………………….
F4 = ……………………………………….

select  one  of  the  above ........
```

F1 = ESCAPE TO MAIN MENU

F2 = STEP THRU ANALOG VALUES

If the programmer selects F2 the screen will first ask for the four-digit password. The password is "**4146**". Once the password is entered, the screen below will appear as below indicating the current active channel. To change to a different channel, exit using F1 to the main menu , enter SINGLE CHANNEL (F2) then select another channel using F2 (CHNL UP) or F3 (CHNL DN) as indicated and return to the utility menu via the main menu.

```
   *** STEPPING IN mAs CHANNEL XX ***

 mA's = 00.00!rate = 000000.ccm
 RIPPLE = 000000.


 F1 = ESC F2 = mA up F3 = mA down F4 = RIPPLE
```

Use F2 to step the mA output up one mA, F3 to step down. The resulting flow rate for each output value is displayed in engineering units. To observe ripple on the flowrate use the F4 key. The RIPPLE function (F4) will display the peak-to-peak ripple in engineering units for the duration of time that the F4 key is held in.

1 = ACTION RATIO

If 1 = Action Ratio display is selected from the Main Menu the screen will show the Rates, and Totals for inputs A and B as well as the Ratio A/B for all 12 channels.

CHA	---RATE A-	---RATE B----	-------RATIO---
01	XXXX.X	XXXX.X	XXX.XX
02	XXXX.X	XXXX.X	XXX.XX
03	XXXX.X	XXXX.X	XXX.XX
04	XXXX.X	XXXX.X	XXX.XX
05	XXXX.X	XXXX.X	XXX.XX
06	XXXX.X	XXXX.X	XXX.XX
F1=ESC	F2=CH-SWAP	F3=DI+	F4 = RES

F1 = ESC will return to Main Menu
F2 = CH-SWAP will show the next 6 channels (7-12)
F3 = DI+ will call up the Job Totals screen
F4 = RES is inactive for Rate screen

CHA	JOB TOTAL - A	JOB TOTAL - B	--RATIO
01	XXXXX.	XXXXX.	XXX.XX
02	XXXXX.	XXXXX.	XXX.XX
03	XXXXX.	XXXXX.	XXX.XX
04	XXXXX.	XXXXX.	XXX.XX
05	XXXXX.	XXXXX.	XXX.XX
06	XXXXX.	XXXXX.	XXX.XX
F1=ESC	F2=CH-SWAP	F3=DI+	F4 = RES

F1 = ESC will return to Main Menu
F2 = CH-SWAP will show the next 6 channels (7-12)
F3 = DI+ will call up the RATES screen
F4 = RES will reset the Job Totals and the Ratio will Reset accordingly

QUICK PROGRAMMING

2 - QUICK PROGRAM

The Quick Programming section of this manual is intended for the user who wishes to display the Flow Rates and Totals in the desired Engineering Units without any extensive programming involvement. The Flow Meter and Engineering Units can be selected from a menu and entered for each channel.

F1 = ESC will return to Main Menu
F2 = MTR will page METER through these choices

ZHM 01	HPM-15
ZHM 02/1	HPM-20
ZHM 02	HPM-30
ZHM 03	

```
 * * *  QUICK      PROGRAMMING      * * * * * *

METER = ZHM - 01      UNITS = CCM    CHA = 01

PRESS   F5  TO  ENTER  FOR  CHANNEL  A
PRESS   F6  TO  ENTER  FOR  CHANNEL  B
F1 = ESC   F2 = MTR   F3 = UNITS   F4 = CHANNL
```

F3 =UNITS will page UNITS through these choices
CCM OZM GPM
F4 =CHANNL will select the channel to be programmed
F5 =will enter the Meter and Units selected for the A input (pin 4)
F6 = will enter the Meter and Units selected for the B input (pin 3)

FLUID VARIABLES

3 – FLUID VARIABLES

View or edit PID-FLUID VARIABLES for individual color tables.

```
PROGRAMMING FLUID VARIBLES CHANNEL XX
   CURRENT FLUID NUMBER     =XX
   Press 1 for GAIN FACTOR  =    XXXX.
   Press 2 for TOLERANCE    =    XXXX.
   Press 3 for INITIAL KICK =    XXXX.


F1 ESC  F2=FLD UP  F3=FLD DN
```

F2 will page the operator up through the Fluid Numbers.
F3 will page the operator down through the Fluid Numbers.
1 press to program GAIN for current fluid number
2 press to program TOLERANCE for current fluid number
3 press to program INITIAL KICK for current fluid number

The DM-3000 will then ask for the pass-code.
ENTER PASS CODE = XXXX The code is " **4146** "

Key in the correct variable value and Enter with F6.

```
F1 ESC  F2=CLR  F6=ENT      ++NUMBERS++
```

F2 will clear the value for the selected Fluid Number.
F6 will enter the value for the selected Fluid Number..

VARIABLE DESCRIPTION

In the following pages each of the programmable variable is described with as much information as possible for proper usage. Also information for programming via the RS-232 serial port with a PC or PLC. See page 42 for details on Serial Communication programming.

Flow rate A mellow

This is the flow rate for channel A with a digital filter applied. The input pin for this signal is at pin 4 on the terminal strip.

USED IN	:	all modes
RELATED VARIABLES	:	Sample amount A / Engineering units for Rate
HEX ADDRESS	:	0020 HEX ------>same address used in EMO-2000
BYTES	:	4 Bytes DEFAULT : xxx
ASC form COMMAND	:	Reading 100 / Writing 500 / E is engineering units E is in selected engineering units with units attached. N is normalized units in Hertz down to 1/100th

Flow rate A instantaneous

This is the "raw" frequency applied to the input pin 4 on the back plane connector. There is no manipulating taking place to derive at the rate value. It is quite common to use this value for the analog output reflection.

USED IN	:	All modes
RELATED VARIABLES	:	KFR A / Engineering units for Rate
HEX ADDRESS	:	001C HEX ------>same address used in EMO-2000
BYTES	:	4 Bytes DEFAULT : xxx
ASC form COMMAND	:	Reading 130 / Writing 530 / E is engineering units E is in selected engineering units with units attached. N is normalized units in Hertz down to 1/100th

Totalizer for A

This is the totalized amount A. The input pin for this signal is at pin 4 on the terminal strip.

USED IN	:	All modes
RELATED VARIABLES	:	Engineering units for Total
HEX ADDRESS	:	0018 HEX ------>same address used in EMO-2000
BYTES	:	4 Bytes DEFAULT : xxx
ASC form COMMAND	:	Reading 101 / Writing 501 / E is engineering units E is in selected engineering units with units attached N is normalized units in pulses

Grand totalizer for A

This is the grand total of the channel A. The grand total is a product of adding total_A and grand total. When ever the intermediate totalizer is zeroed (keyboard or hardware) the total_A is added on to the grand total. This way the total_A can be looked upon as being the "job" total.

USED IN	:	All modes
RELATED VARIABLES	:	Engineering units for Total
HEX ADDRESS	:	0018 HEX and 00F8 HEX new for the EMO-3000
BYTES	:	4 Bytes DEFAULT : xxx
ASC form COMMAND	:	Reading 129 / Writing 529 / E is engineering units E is in selected engineering units with units attached N is normalized units in Hertz down to 1/100th

Active set value for PID

The active set value selected is either the value calculated by taking the 0 - 20 milli Amps in with the milli Amps scaler or the digital PID set-value. The milliamps input is the overriding set value. The judgement whether mA's are active is based on the milli Amps in offset.

USED IN	:	PID mode
RELATED VARIABLES	:	Digital set value / mA=s in and mA scaler / mA=s in offset
HEX ADDRESS	:	0043 HEX ---->same address used in EMO-2000
BYTES	:	4 Bytes DEFAULT : xxx
ASC form COMMAND	:	Reading 102/ Writing 502 / E is engineering units E is in selected engineering units with units attached. N is normalized units in Hertz down to 1/100th

Digital set value for PID

The digital set value is used for the PID mode if there is no analog input active. The analog input applicable for this feature is milliamps in (pin 5/6).

USED IN	:	PID mode
RELATED VARIABLES	:	Active set value / mA's in and mA scaler /mA's
HEX ADDRESS	:	00B4 HEX ----> same address used in EMO-2000
BYTES	:	4 Bytes DEFAULT : 360 cc/m
ASC form COMMAND	:	Reading 103 / Writing 503 / E is engineering units E is in selected engineering units N is normalized units in cc/m

Sample amount for Rate A

The sample amount has an effect on the "mellow" rate number. The sample amount is used in a digital filter formula to calculate the actual rate. The bigger the sample amount the more sluggish the rate reacts. The formula for the filter is as follows :

RATE MELLOW=(OLD RATE MELLOW*SAMPLE AMOUNT+NEW RATE)/(SAMPLE+1)

USED IN	:	All modes
RELATED VARIABLES	:	Rate A mellow
HEX ADDRESS	:	0087 HEX ----> same address used in EMO-2000
BYTES	:	2 Bytes DEFAULT : 2
ASC form COMMAND	:	Reading 104 / Writing 504 / E and N return same number.

K-Factor for Rate A KFR (including the decimal point)

The KFR is a factor that will scale the display to the incoming frequency on channel A, which is on pin 4. The decimal point can be entered in ASC-form communication. If the OPTO type communication is used then the decimal point has to be entered separately. The formula for calculating the KFR value is as follows :

KFR = 6000 / (X Pulses/Eng unit) (for units/minute)

The figure X Pulses per Eng. Unit can be found in the calibration sheets of the flow transmitter. It is advisable to use numbers bigger than 100 or less 9000.

The generic K-factors for the most common AW-Company transmitters are as follows :

Transmitter	KFR cc/min	KFR Gal/min	KFR Oz/min
ZHM-01	142.0	.0375	4.80
ZHM-02/1	720.0	.1915	24.51
ZHM-02	1363.	.360	46.00
ZHM-03	3448.	.911	116.6
HPM-15	720.0	.1915	24.51
HPM-20	1363.	.360	46.00
HPM-30	3448.	.911	116.6

These are generic K-factors and it is recommended to consult the calibration sheet supplied with the flow transmitter.

USED IN	:	All modes
RELATED VARIABLES	:	DP for Rate A KFR (only in OPTO communication)
HEX ADDRESS	:	00E2 HEX ----> same address used in EMO-2000
BYTES	:	2 Bytes DEFAULT : 720
ASC form COMMAND	:	Reading 106 / Writing 506 / E is with decimal point N is just the numeric value.

K-Factor for Total A KFT (including the decimal point)

The KFT is a factor that will scale the display to the incoming amount of pulses on channel A, which is on pin 4. The decimal point can be entered in ASC-form communication. If the OPTO type communication is used then the decimal point has to be entered separately. The formula for calculating the KFT value is as follows :

KFT = 10000 / (X Pulses/Eng unit) (for pulses)

The figure X Pulses per Eng. Unit can be found in the calibration sheets of the flow transmitter. It is advisable to use numbers bigger than 100 or less 9000.
The generic K-factors for the most common AW-Company transmitters are as follows :

Transmitter	KFT cc	KFR Gal	KFR Oz
ZHM-01	236.6	.0624	8.00
ZHM-02/1	1200.	.319	40.84
ZHM-02	2271.	.599	76.66
ZHM-03	5746.	1.518	194.0
HPM-15	1200.	.319	40.84
HPM-20	2271.	.599	76.66
HPM-30	5746.	1.518	194.0

These are generic K-factors and it is recommended to consult the calibration sheet supplied with the flow transmitter.

USED IN	:	All modes
RELATED VARIABLES	:	DP for Total A KFT(only in OPTO communication)
HEX ADDRESS	:	00E4 HEX ----> same address used in EMO-2000
BYTES	:	2 Bytes DEFAULT : 1200
ASC form COMMAND	:	Reading 107 / Writing 507 / E is with decimal point. N is just the numeric value.

Engineering units for KFR

The KFR units is stored away as a three letter string. This means that any engineering unit can be constructed if computer hookup is used.

USED IN	:	All modes
RELATED VARIABLES	:	KFT Engineering units
HEX ADDRESS	:	0052 HEX ----> NEW VARIABLE
BYTES	:	3 Bytes DEFAULT : cc/m
ASC form COMMAND	:	Reading 109 / Writing 509 / E is engineering

Engineering units for KFT

The KFT units is stored away as a three letter string. This means that any engineering unit can be constructed if computer hookup is used.

USED IN	:	All modes
RELATED VARIABLES	:	KFR Engineering units
HEX ADDRESS	:	0055 HEX ----> NEW VARIABLE
BYTES	:	3 Bytes DEFAULT : cc
ASC form COMMAND	:	Reading 110 / Writing 510 / E and N have same effect.

Operating mode

The operating mode selected can be 01 for monitor mode or 02 for totalizer mode. **WARNING !!!** If the operating mode is changed in midstream it is very important to take care of the discrete inputs/outputs before changing the mode. If there is a pin figured to be an output (in hardware terms) and some one hooks it up as an input there is a chance of blowing the output opto-coupler.

USED IN	:	All modes
RELATED VARIABLES	:	None
HEX ADDRESS	:	0089 HEX ----> SAME LOCATION IN EMO-2000
BYTES	:	1 Byte DEFAULT : 01
ASC form COMMAND	:	Reading 118 / Writing 518/ E and N have same effect.

Cutoff frequency at A

The rate indication will be zeroed automatically if the rate gets below the cutoff. This will not effect the totalized value. The totalizer will count all the way down to zero speed.

USED IN	:	All modes
RELATED VARIABLES	:	KFR A/ CUTOFF B
HEX ADDRESS	:	008F HEX ----> SAME LOCATION IN EMO-2000
BYTES	:	2 Bytes DEFAULT : 7 cc/m
ASC form COMMAND	:	Reading 119 / Writing 519 / E will return the value in engineering units N returns Hz value

Tolerance for PID A

Tolerance is the allowed deviation of the set value. The deviation is given in +/- format. If for example the tolerance were 3 cc/min and the set value were 200 cc/min , then between 197...203 cc/min the PID algorithm will not be effective and no corrections will be done.

USED IN	:	PID mode
RELATED VARIABLES	:	KFR A
HEX ADDRESS	:	00A9 HEX ----> NEW VARIABLE
BYTES	:	2 Bytes DEFAULT : 3 cc/m
ASC form COMMAND	:	Reading 112 / Writing 512 / E will return the value in engineering units N returns Hz value By adding /XXcr, where XX is color number, example: #01E112/12cr, the tolerance for the colors 12 will be returned. Omitting /XX will return the value for color 0.

Gain factor for PID A_KP (P-part)

Gain factor influences the closed loop action speed and how strongly the unit tries to enter the set-value. The commonly used values are 1....1500. The selected value is often determined by the systems ability to respond. The formula to describe the actions of the gain factor is as follows:

ANALOG OUT=ANALOG OUT old + (set-value-current-value)*GAIN

The algorithm is only being applied, when a pulse is completed (new information available). This feature makes the unit adapt to slow frequencies in a slower pace. In general the A_KP is a experimental value and will change from application to application.

USED IN	:	PID mode
RELATED VARIABLES	:	A_KD /A_KI
HEX ADDRESS	:	008D HEX ---> NEW LOCATION FOR THIS VARIABLE
BYTES	:	2 Bytes DEFAULT : 350
ASC form COMMAND	:	ASC form COMMAND : Reading 113 / Writing 513 / E and N will both have the same effect value. By adding /XXcr where XX is color number, example: #01E113/12cr, the Gain factor for the color 12 will be returned. Omitting /XX will return the value for color 0.

Integral factor for PID A_KI (I-part)

The integral factor will be added to the analog output register as long as the set-value is above the current rate. On the other hand, the integral part will be deducted if the set-value is below the current rate. This adding/subtracting will occur every time new information is available. This variable is used in systems where gain factors have to be kept small in order to avoid instability.

USED IN	:	PID MODE
RELATED VARIABLES	:	A_KD /A_KP
HEX ADDRESS	:	00A1 HEX ---->NEW LOCATION FOR THIS VARIABLE
BYTES	:	2 Bytes DEFAULT : 0
ASC form COMMAND	:	Reading 115 / Writing 515 / E and N will both have the same effect value.

Derivative factor for PID A_KD (D-part)

The derivative factor is used in applications where high gains (A_KP) are needed and instability is to be avoided. The derivative factor takes effect if the rate approaches the set-value, by slowing the approach down. In the same way as the gain factor the derivative factor is usually determined by empiric means. Normal and used values are 0...500.

USED IN	:	PID modes
RELATED VARIABLES	:	A_KI /A_KP
HEX ADDRESS	:	009F HEX ----> NEW VARIABLE
BYTES	:	2 Bytes DEFAULT : 0
ASC form COMMAND	:	Reading 114 / Writing 514 / E and N will both have the same effect value.

Delta step for PID

Delta step determines when a new variable is being accepted in to the scratch pad table. In general it can be stated that when the range to be covered by the closed loop is very wide , the delta step ought to be relatively large. With the delta step it is possible to manipulate the adaption speed. This variable can be programmed from 0...600Hz.

USED IN	:	PID mode
RELATED VARIABLES	:	A_KD /A_KP / A_KI
HEX ADDRESS	:	00A7 HEX ----> NEW VARIABLE
BYTES	:	2 Bytes DEFAULT : 7 cc/m
ASC form COMMAND	:	Reading 117 / Writing 517 / E and N will both have the same effect value.

Delay for PID

Every time a correction based on a table pick, is made to the analog output, any further action is delayed by the programmed amount. This feature is needed in a case where long delays in the mechanical system would cause the closed loop control to "over react". This variable can be programmed from 00...600 seconds.

USED IN	:	PID mode
RELATED VARIABLES	:	A_KD /A_KP / A_KI
HEX ADDRESS	:	00AB HEX ----> NEW VARIABLE
BYTES	:	2 Bytes DEFAULT : .80sec
ASC form COMMAND	:	Reading 108 / Writing 508 / E and N will both have the same effect value.

Kick for PID

The kick is used in systems where the fluid regulator closes the flow before 4 mA's output. Often this is a sign of a poorly matched system or a large hysteresis in the regulator.The kick will take effect if following conditions exist:

- rate is less than cutoff
- analog output is less than the kick value (this is measured on top of the offset value)
- set value is active (greater than 0)

The kick value is generally given in a number from 0....4095. The number really reflects the amount of analog step that will be added to the mA Offset. Each analog step represents approx. .004 mA's. Equation= $\frac{20mA - mA\ Offset}{4095}$

The Kick Value is added onto the mA Out Offset value.

USED IN	:	PID mode
RELATED VARIABLES	:	A_KD /A_KP / A_KI
HEX ADDRESS	:	00DE HEX ----> SAME ADDRESS AS IN EMO-2000
BYTES	:	2 Bytes DEFAULT : 210
ASC form COMMAND	:	Reading 123 / Writing 523 / E and N will both have the same effect value. By adding /XXcr, where XX is color number, example: #01E123/12cr, the kick value for the color 12 will be returned. Omitting /XX will return the value for color 0.

mA Scaler for PID

The milli amps scaler is used for scaling 0 - 20 mAmp analog signal coming input. Each milli amp above the milli amps in offset represents a certain amount of requested flow in engineering units or Hertz.

USED IN	:	PID mode
RELATED VARIABLES	:	mA' offset
HEX ADDRESS	:	01B3 HEX ----> SAME ADDRESS AS IN EMO-2000
BYTES	:	2 Bytes DEFAULT : 21 cc/m per mA
ASC form COMMAND	:	Reading 126 / Writing 526 / E will return the engineering units/mA and N returns Hz/mA's.

mA In Offset

This variable is used to even out sources that would not deliver exactly 4.00mA's. This in practical terms replaces a adjustment potentiometer.

USED IN	:	PID mode
RELATED VARIABLES	:	mA' in scaler
HEX ADDRESS	:	00E6 HEX ----> NEW VARIABLE
BYTES	:	2 Bytes DEFAULT : 825 (4.02mA)
ASC form COMMAND	:	Reading 124 / Writing 524 / E will return the mA's value N will return counts

mA Out Offset

The offset is used to bias the analog output signal to a preset level. Any value from 0.00...20.00 mA's is valid. The most commonly used value is 4.00mA's. It is some times advisable to use higher offset values in PID mode, particularly if the cracking pressure of the regulator is higher than normal. (*more next page*)

USED IN	:	PID mode / Monitor mode
RELATED VARIABLES	:	mA shifter / mA gain
HEX ADDRESS	:	0091 HEX ----> SAME ADDRESS AS IN EMO-2000
BYTES	:	2 Bytes DEFAULT : 819 (4.00mA)
ASC form COMMAND	:	Reading 111 / Writing 511 / E will return the mA's value N will return counts.

mA Gain factor

The gain is used to scale the analog output to the expected input frequency. This scaling factor will only apply in monitor mode and does not affect PID. Since the expected top frequencies can be any where from 3 Hz to 2000Hz there has to be a scaling possibility. The following formula can be applied to scale the gain factor correctly :

GAIN = mA's * 8350 / freq

where:

mA's - represents the requested mA' output at the frequency
freq - is usually the top frequency ever expected at 20mA's

The default value 167 would cause the input frequency of 1000 Hz to generate a 20.00 mA output.

USED IN	:	Monitor mode
RELATED VARIABLES	:	mA shifter / mA offset / mA pointer
HEX ADDRESS	:	0093 HEX ----> SAME ADDRESS AS IN EMO-2000
BYTES	:	2 Bytes DEFAULT : 167
ASC form COMMAND	:	Reading 116 / Writing 516 / E and N will return an integer number

mA Pointer

The pointer is used to point at different variables that should represent the analog output. This variable enables the unit to represent any variable available in the RAM space on the analog output. To be able to take full advantage of this variable some in depth study is needed for the different locations of common variables. The default value is the instantaneous rate (28).

USED IN	:	Monitor mode
RELATED VARIABLES	:	mA shifter / mA offset / mA gain
HEX ADDRESS	:	0095 HEX ----> SAME ADDRESS AS IN EMO-2000
BYTES	:	2 Bytes DEFAULT : 28
ASC form COMMAND	:	Reading 131 / Writing 531 / E and N will return a integer number.

mA Shifter

The shifter is necessary to scale some of the variables that are in different byte lengths. Also, the shifter provides a divider for variables that are very big. The shifter is really a two part variable as follows :

The upper nibble represents the amount of bytes that the variable has.
The lower nibble represents the divider.
The upper nibble should be a number 1..4.
The lower nibble should be a variable 0..12.
By OR'ing the two nibbles the result is the shifter.
The default value is OR'ed from the two following nibbles:

HIGH nibble 4h
LOW nibble Ch
By OR'ing 40H | 0Ch ===> 4Ch=76d

The default value is: 76d

USED IN	:	Monitor mode
RELATED VARIABLES	:	mA pointer / mA offset / mA gain
HEX ADDRESS	:	0097 HEX ----> SAME ADDRESS AS IN EMO-2000
BYTES	:	2 Bytes DEFAULT : 76
ASC form COMMAND	:	Reading 133 / Writing 533 / E and N will return a integer number.

NOTE: A listing of programmable variables is shown on page 41.

VARIABLE FACTORS		DEFAULT SETTINGS	
KFR-FACTORS	=	720	
RATE ENG. UNIT	=	cc/m	
KFT - FACTOR	=	1200	
TOTAL ENG. UNIT	=	cc	
SAMPLE AMOUNT	=	2	
CUTOF FREQ.	=	7	cc/m
OPERATING MODE	=	2	
LINEARIZER	=	0	
IDEAL RATIO	=	1.00	
RATIO SAMPLE	=	400	
PID PROPORT	=	350	
PID INTEGRAL	=	0	
PID DERIVATIVE	=	0	
PID TOLERANCE	=	3	cc/m
PID DELTA STEP	=	7	cc/m
PID INIT. KICK	=	210	= 1.02 mA
PID DEATH DELAY	=	.80	
mA SCALER	=	21	cc/m per mA
mA IN OFFSET	=	4.02	mA
PID SET VALUE	=	360	cc/m
KFR. FACTOR B	=	720	
RATE B UNITS	=	cc/m	
KFT - FACTOR B	=	1200	
TOTAL B UNITS	=	cc	
SAMPLES FOR B	=	10	
CUTOFF FREQ. B	=	7	cc/m
mAs OFFSET	=	3.99	mA
mAs GAIN	=	167	
mAs SHIFTER	=	76	
mAs POINTER	=	28	
VOLTS OFFSET	=	00.000	
VOLTS GAIN	=	3000	
VOLTS SHIFTER	=	76	
VOLTS POINTER	=	28	
mAs IN OFFSET	=	4.02	mA
VO=s IN OFFSET	=	00.000	
TOTAL LIMIT 1 - 4	=	0	
FLOW LIMIT 1 - 4	=	0	
FLOW MARGIN 1 -4	=	0	
LIMIT RULES	=	11 (1-4)	
RATIO RULES %	=	100 (1-4)	

COMMUNICATION PROTOCOL

We have introduced a new communication format **ASC-form**. This format is extremely convenient since it returns an ASCII string ready in engineering units and in some cases with the engineering units attached. In the request it can be selected whether the variable should be in engineering units or "normalized" (Hertz/Pulses). The protocol format is as follows:

Reading:

```
#01E100cr

^                      ....  Pound sign is the indication that ASC form is to be used
 ^                     ....  Channel number 01...FE . These are hex notations.
  ^                          Going through the Keyboard communication the regular
                             channel number is used. Going through the PLC input
                             the channel number is a sum of the channel number and
                             the channel offset.
   ^                   ....  E means that the information returned should be i
                             engineering units. N means normalized.
    ^^^                ....  Three digit command number 100...999. Not all the
                             numbers are implemented and more info is forth coming.
       ^               ....  Carriage return character (decimal 13 or hex 0D ).
```

Writing:

```
#01E5004.2cr
^                      ....  Pound sign is the indicates that ASC form is to be used
 ^                     ....  Channel number 01...FE .  See reading
  ^
   ^                   ....  E means that the entry is going to be in engineering
                             units.
    ^^^                ....  Three digit command number.
       ^^^             ....  Up to 6 digits with a decimal point.
          ^            ....  Carriage return character
```

Sample Quick-Basic Serial communication program available from AW Company on request. Ask for 3000DEMO.BAS (2 sheets)

SPECIFICATIONS

Power Supply	110/220 Volts, 50/60 Hz (jumper selected)
Weight	5 lb. 6 oz.
Communication	RS-232C and RS-485 Optional Optically Insulated 9 PIN & 25 PIN D-sub 9600 Baud, No Parity, 8 data bits 1 stop bit (N81). Disable RS, CS, DS and CD lines.
Enclosure	Aluminum anodized extrusion housing (custom made for AW Company)
Environmental	0 to 50 degrees (standard)
Dimensions	Height 7.22 inches Width 4.45 inches Depth 7.90 inches

* all specifications are for the 4 channel unit.

LIMITED WARRANTY

AW Company warrants the EMO-3000 flow computer with DM-3000 to be in good working order for a period of 1 (one) year from the date of purchase from **AW Company** or an authorized **AW Company** distributor.

Should the EMO-3000 or DM-3000 fail to be in good working order at any time during this 1 year warranty period, **AW Company** will, at its option, repair or replace the EMO-3000 or DM-3000, at no additional charge except as set forth below. Repair parts and replacement products will be furnished on an exchange basis and will be reconditioned or new. All replaced parts and products become the property of **AW Company**. This limited warranty does not include service to repair damage to the EMO-3000 or DM-3000 resulting from accident, disaster, abuse, or a Non-**AW Company** modification to the EMO-3000 or DM-3000.

Limited warranty service may be obtained by delivering the EMO-3000 or DM-3000 during the 1 year warranty period to **AW Company** and proof of purchase date. If this product is delivered by mail, you agree to insure the EMO-3000 or DM-3000 or assume the risk of loss or damage in transit, to prepay shipping charges to the warranty location and to use the original shipping container or equivalent.

For further information contact:

AW Company — **Tel: (262)884-9800**
8809 Industrial Drive — **Fax: (262)884-9810**
Franksville, WI 53126

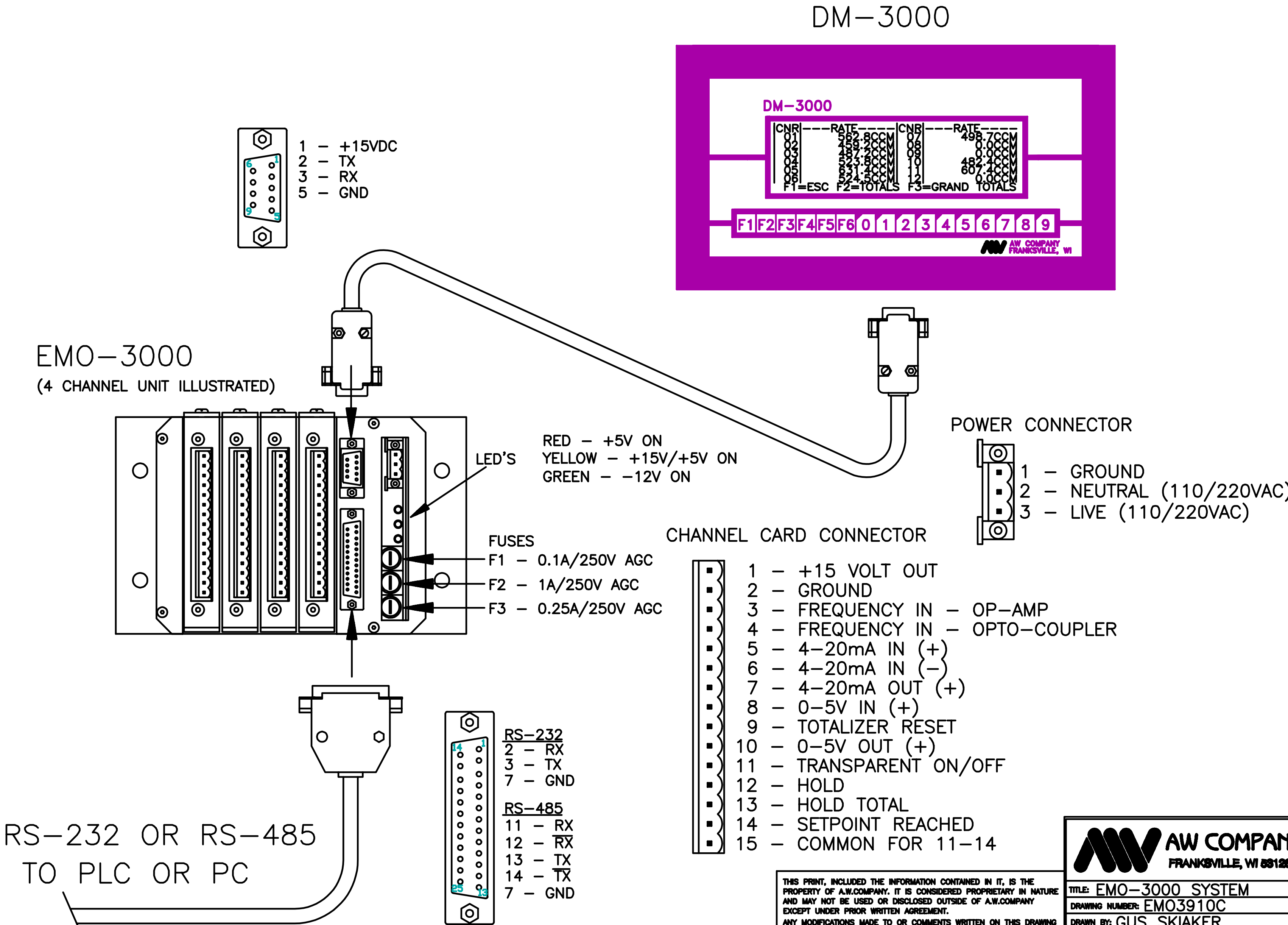
ALL EXPRESS AND IMPLIED WARRANTIES FOR THIS PRODUCT INCLUDING THE WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF 1 (ONE) YEAR FROM THE DATE OF PURCHASE, AND NO WARRANTIES, WHETHER EXPRESS OR IMPLIED, WILL APPLY AFTER THIS PERIOD. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

IF THIS PRODUCT IS NOT IN GOOD WORKING ORDER AS WARRANTED ABOVE, YOUR SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. IN NO EVENT WILL AW COMPANY BE LIABLE TO YOU FOR ANY DAMAGES, INCLUDING ANY LOST PROFITS, LOST SAVINGS OR INCIDENTAL OR CONSEQUENTIAL DAMAGE ARISING OUT OF THE USE OR INABILITY TO USE SUCH PRODUCT, EVEN IF AW COMPANY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY OTHER PARTY.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

REV. 5

EMO-3000 w/ DM-3000



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THIS IS NOT A MANUFACTURING DRAWING UNLESS INDICATED AS SUCH. ANY DIMENSIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

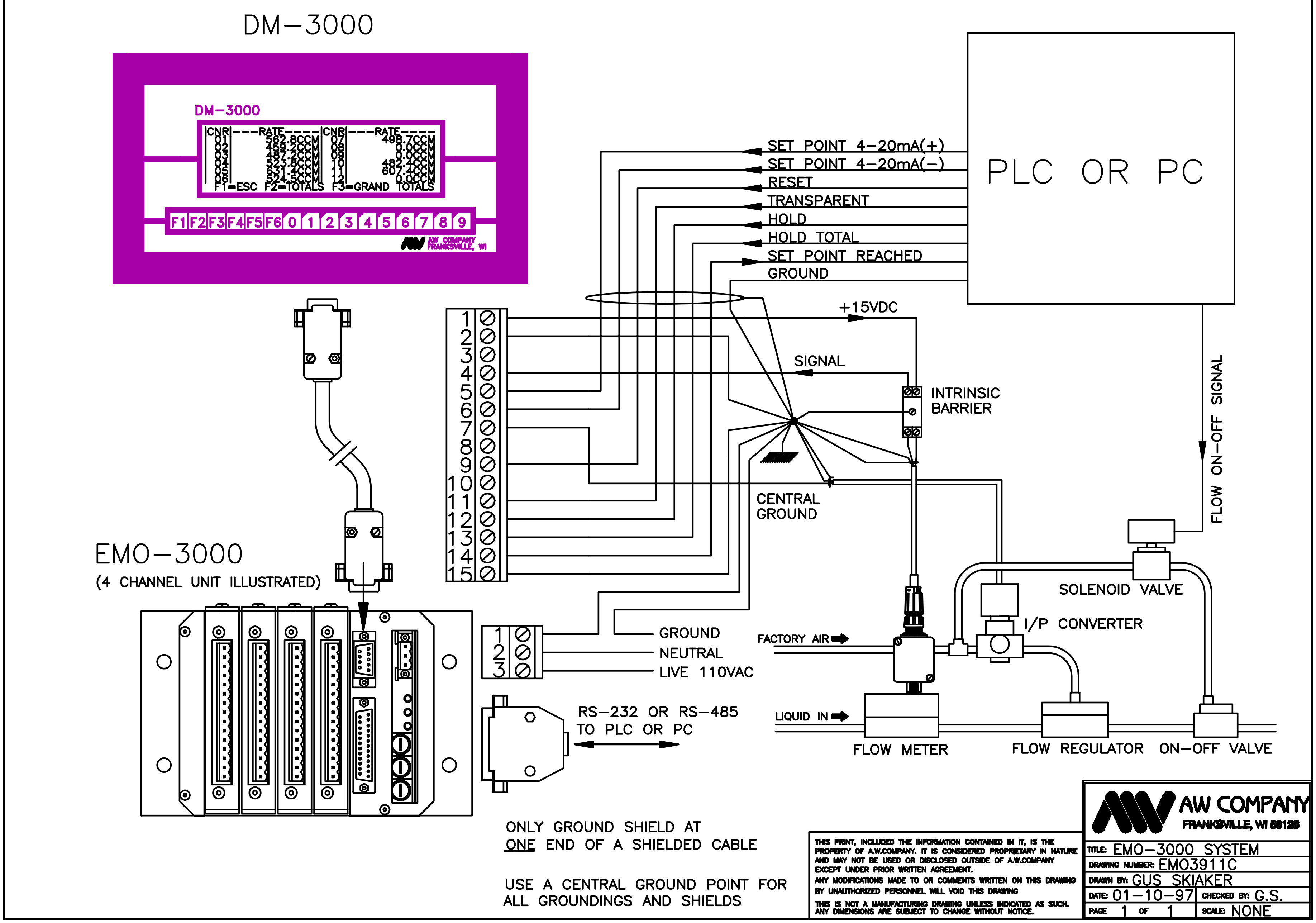
AW COMPANY
FRANKSVILLE, WI 53126

TITLE: EMO–3000 SYSTEM	
DRAWING NUMBER: EMO3910C	
DRAWN BY: GUS SKIAKER	
DATE: 01–10–97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

APPENDIX A

REV. 5

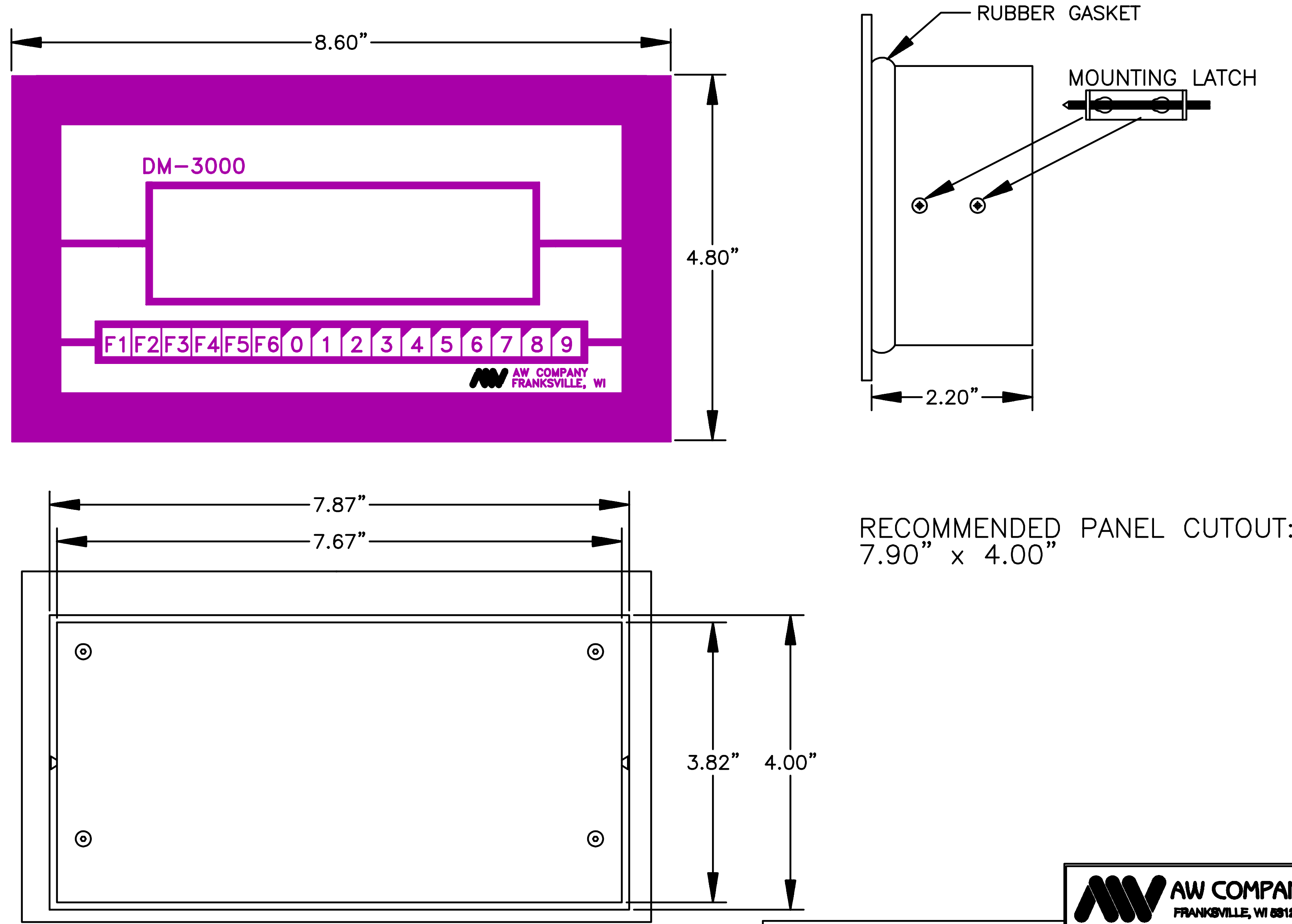
EMO-3000 FLOW CONTROL SYSTEM



APPENDIX B

REV. 5

DM-3000 DIMENSIONS



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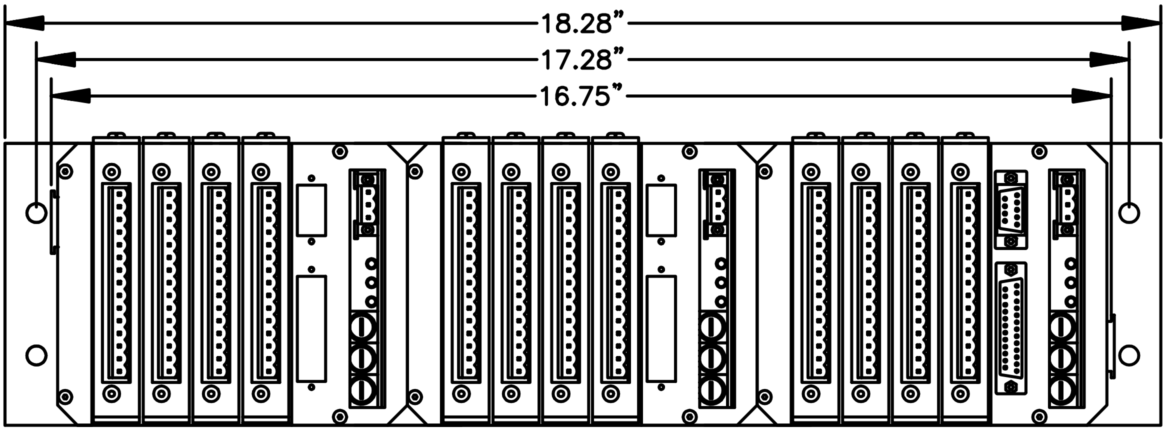
THIS IS NOT A MANUFACTURING DRAWING UNLESS INDICATED AS SUCH. ANY DIMENSIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

AW COMPANY
FRANKSVILLE, WI 53126

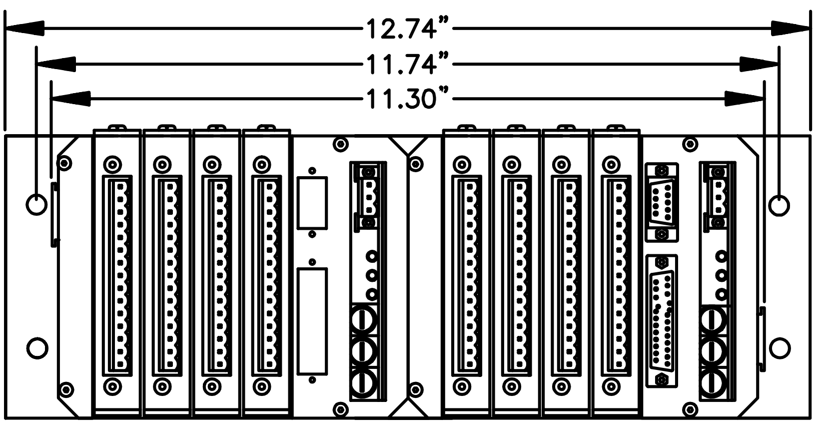
TITLE: DM–3000 DIMENSIONS	
DRAWING NUMBER: EM03912C	
DRAWN BY: GUS SKIAKER	
DATE: 01–10–97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

APPENDIX C

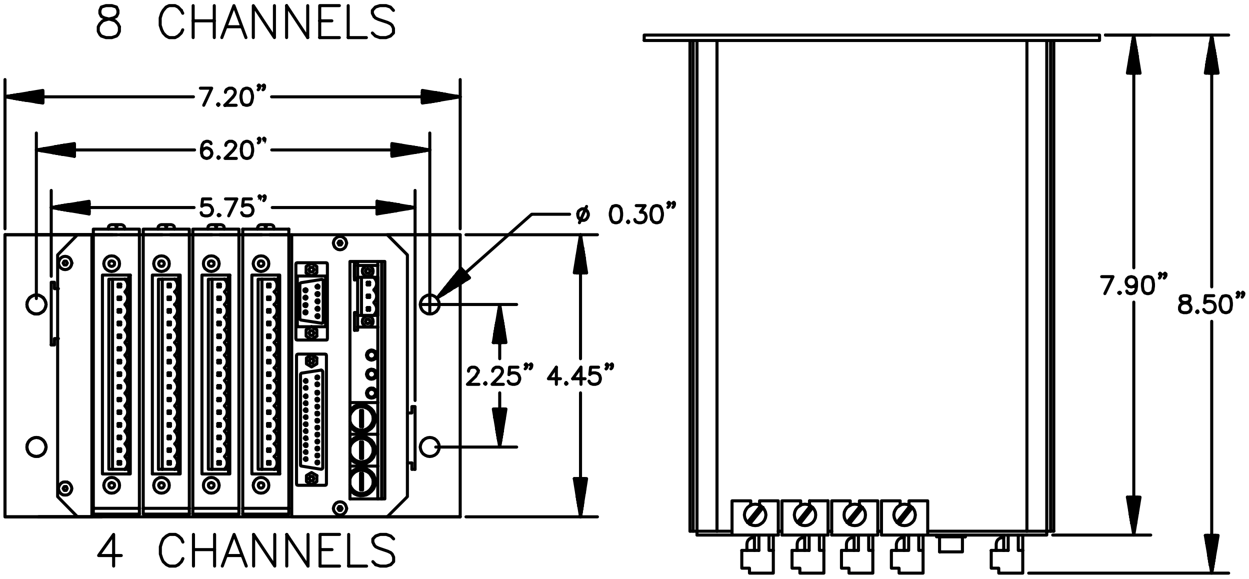
EMO-3000 DIMENSIONS



12 CHANNELS



8 CHANNELS



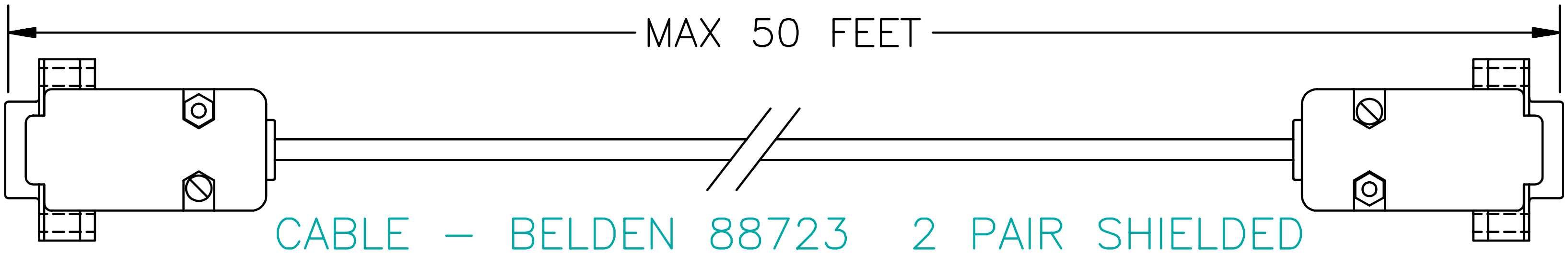
4 CHANNELS

AW COMPANY
FRANKSVILLE, WI 53126

TITLE: EMO-3000 DIMENSIONS	
DRAWING NUMBER: EMO3913C	
DRAWN BY: GUS SKIAKER	
DATED: 01-10-97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

REV. 5

DM-3000 TO EMO-3000 CABLE

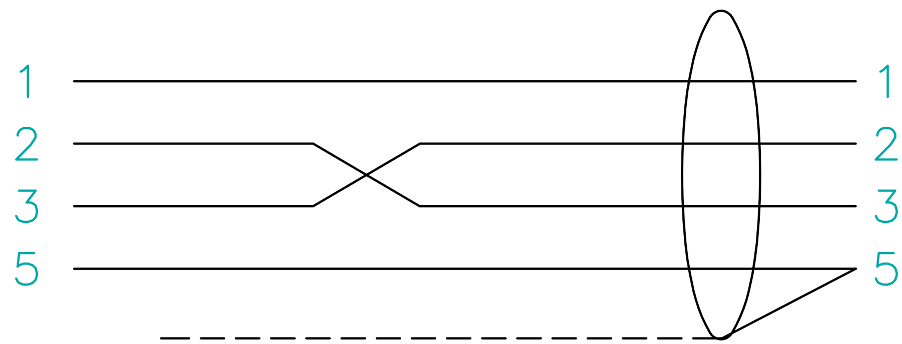


CABLE — BELDEN 88723 2 PAIR SHIELDED
OR EQUIVALENT.

D—SUB 9 FEMALE
TO DM—3000

D—SUB 9 MALE
TO EMO—3000

PIN 1 — +15VDC
PIN 2 — RS—232 IN/OUT
PIN 3 — RS—232 OUT/IN
PIN 5 — GROUND
NOTE: ONLY GROUND
SHIELD IN ONE END.



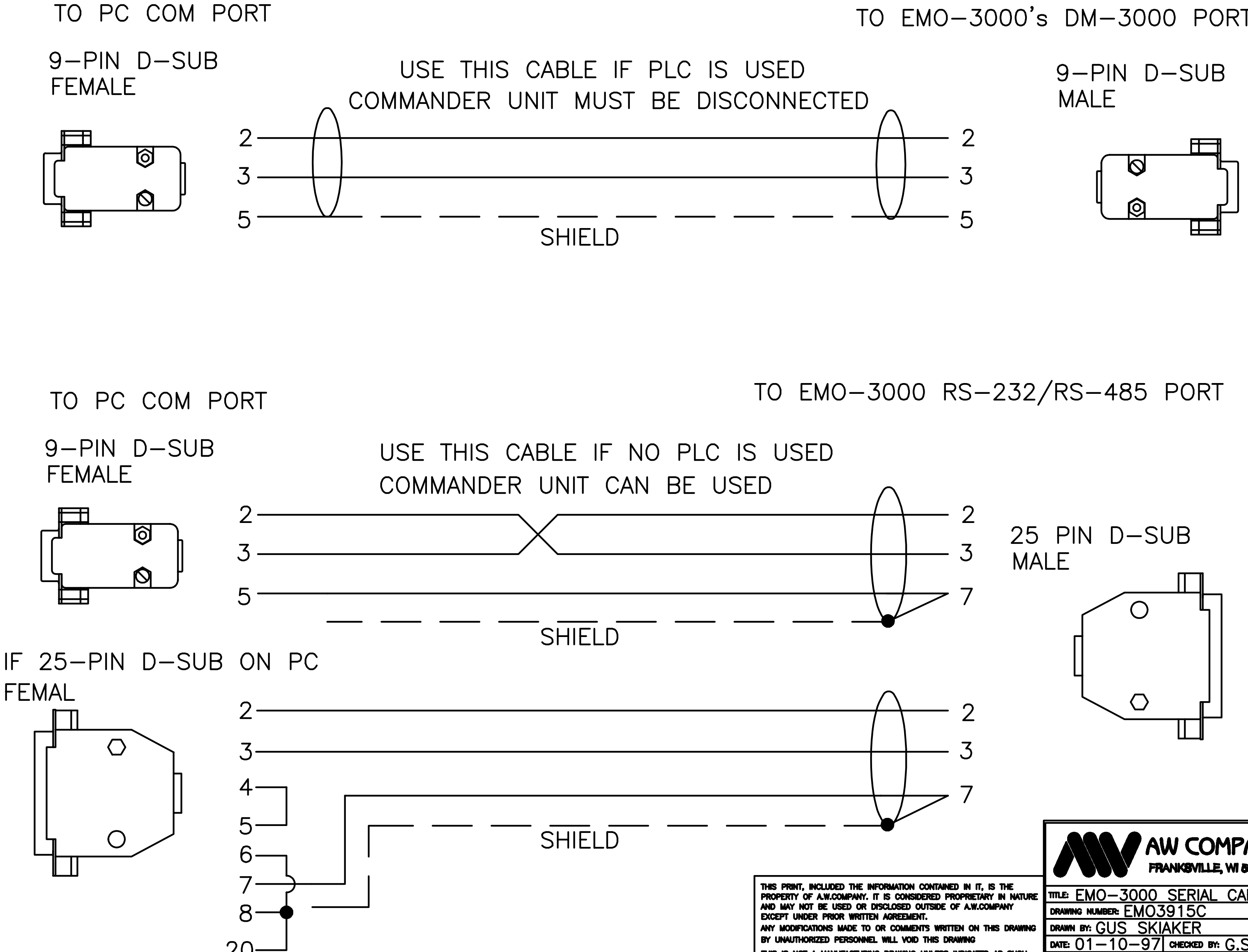
AW COMPANY
FRANKSVILLE, WI 53126

TITLE: EMO—3000 TO DM—3000	
DRAWING NUMBER: EMO3914C	
DRAWN BY: GUS SKIAKER	
DATE: 01—10—97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

APPENDIX E

REV. 5

EMO-3000 RS-232 SERIAL COMMUNICATION

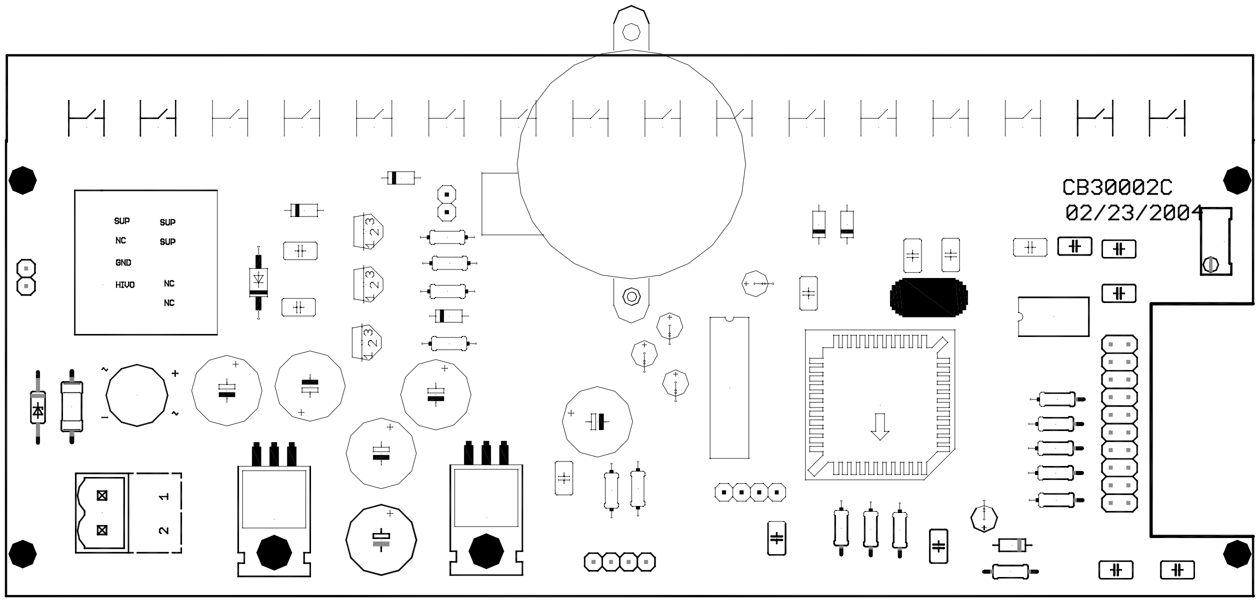


AW COMPANY
FRANKSVILLE, WI 53126

TITLE: EMO–3000 SERIAL CABLES	
DRAWING NUMBER: EMO3915C	
DRAWN BY: GUS SKIAKER	
DATE: 01–10–97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

APPENDIX F

REV. 5



AW COMPANY USE ONLY

AW-LAKE COMPANY
A TASI GROUP COMPANY

8809 INDUSTRIAL DRIVE
FRANKSVILLE, WI 53126
TEL. # (262) 884-9800
FAX. # (262) 884-9810

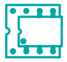
TITLE: DM-3000 BOARD			
DRAWING NUMBER: EMO3932B			
DATE: 03-11-08	REV: B	DRAWN BY: ROB CHILDS	
CHECKED BY: -.-.	PAGE 1 OF 1	SCALE: NONE	

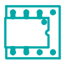
APPENDIX G

REV. 5

EMO-3000 CHANNEL CARD JUMPER SETTINGS

U10 – U13


SET AS OUTPUT

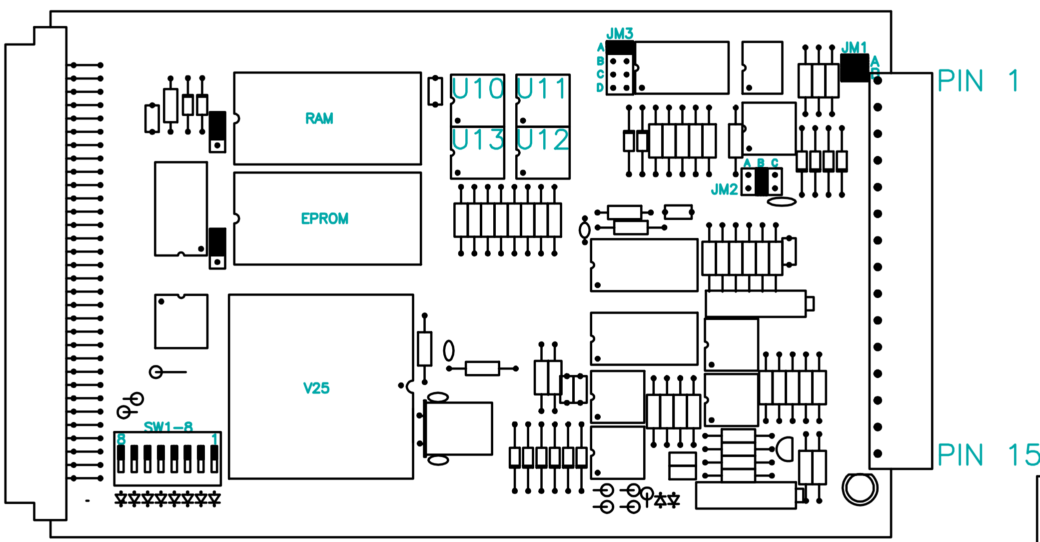

SET AS INPUT

PIN 6 ON 4N32 MUST BE CUT OFF
U10 = IN/OUT PIN 14
U11 = IN/OUT PIN 13
U12 = IN/OUT PIN 12
U13 = IN/OUT PIN 11

JM1 – FREQUENCY TO INPUT A, PIN 4
"A" ONLY – PIN 2 INSULATED FROM GROUND
"A+B" – PIN 2 GROUNDED

JM2 – SENSIVITY FOR B INPUT, PIN 3
"A" – 50mV
"B" – 1.75V
"C" – 3.75V

JM3 – FREQUENCY FOR A INPUT, PIN 4
"A" – 1000Hz IN
"B" – 2000Hz IN
"C" – 4000Hz IN *
"D" – 8000Hz IN *
* CONSULT WITH AW COMPANY IF USED FOR INPUT FREQUENCY OVER 2000Hz



DEFAULT CHANNEL NUMBER IS TYPED ON A LABEL ON THE EPROM.

NOTE: SEE MANUAL UNDER CHANNEL CARD DESCRIPTION REGARDING CHANNEL SELECTION WITH THE DIP–SWITCHES

CHANNEL CARDS WITH DIP–SWITCHES MANUFACTURED AFTER JULY 1993.

AW COMPANY
FRANKSVILLE, WI 53126

TITLE: EMO–3000 JUMPERS	
DRAWING NUMBER: EMO3917C	
DRAWN BY: GUS SKIAKER	
DATE: 01–10–97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

APPENDIX H

REV. 5

EMO-3000 POWER SUPPLY

SENSOR VOLTAGE ON PIN 1 – JM3

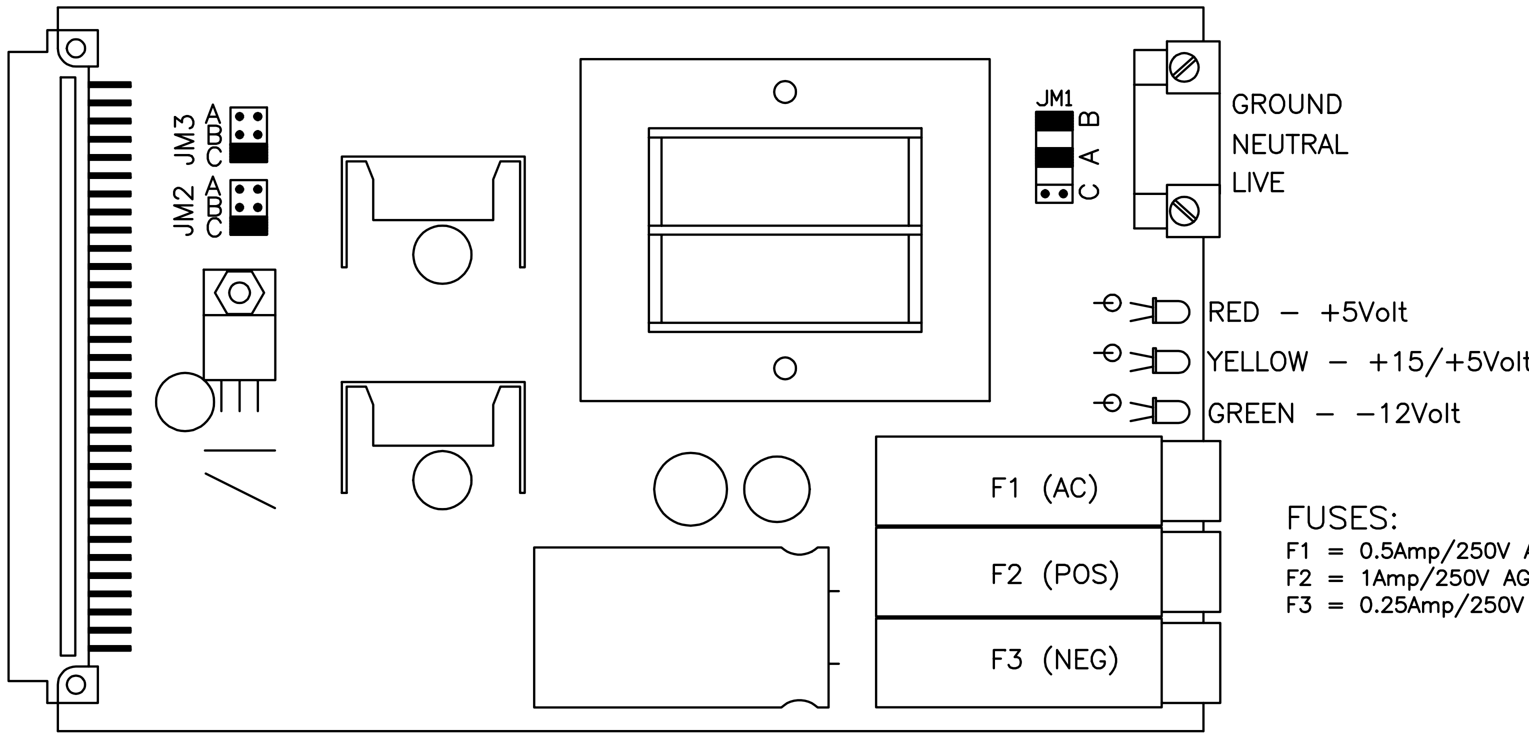
24Volt = A
15Volt = C <– DEFAULT
5Volt = B

ANALOG OUTPUT VOLTAGE – JM2

24Volt = C <– DEFAULT
15Volt = B
NONE = A

110V/220V (JM1)

110V = A & B <– DEFAULT
220V = C ONLY



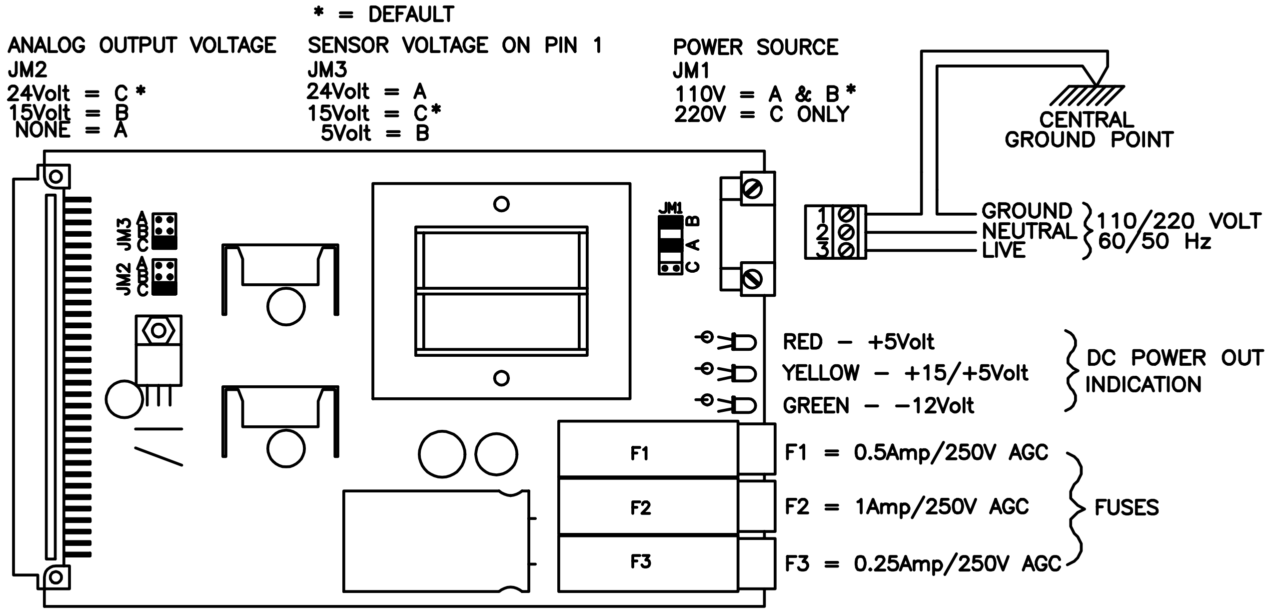
FUSES:
F1 = 0.5Amp/250V AGC
F2 = 1Amp/250V AGC
F3 = 0.25Amp/250V AGC

AW COMPANY
FRANKSVILLE, WI 53126

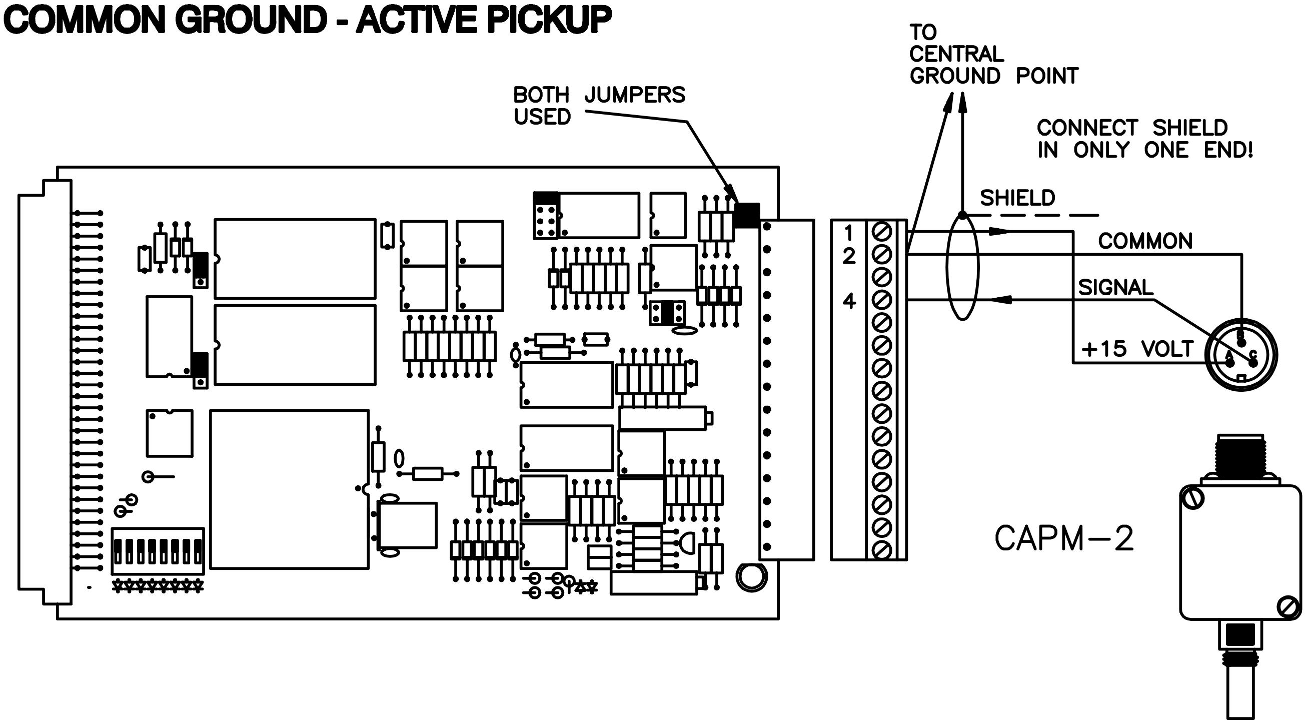
TITLE: EMO POWER SUPPLY	
DRAWING NUMBER: EMO3918C	
DRAWN BY: GUS SKIAKER	
DATE: 01–10–97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

APPENDIX I

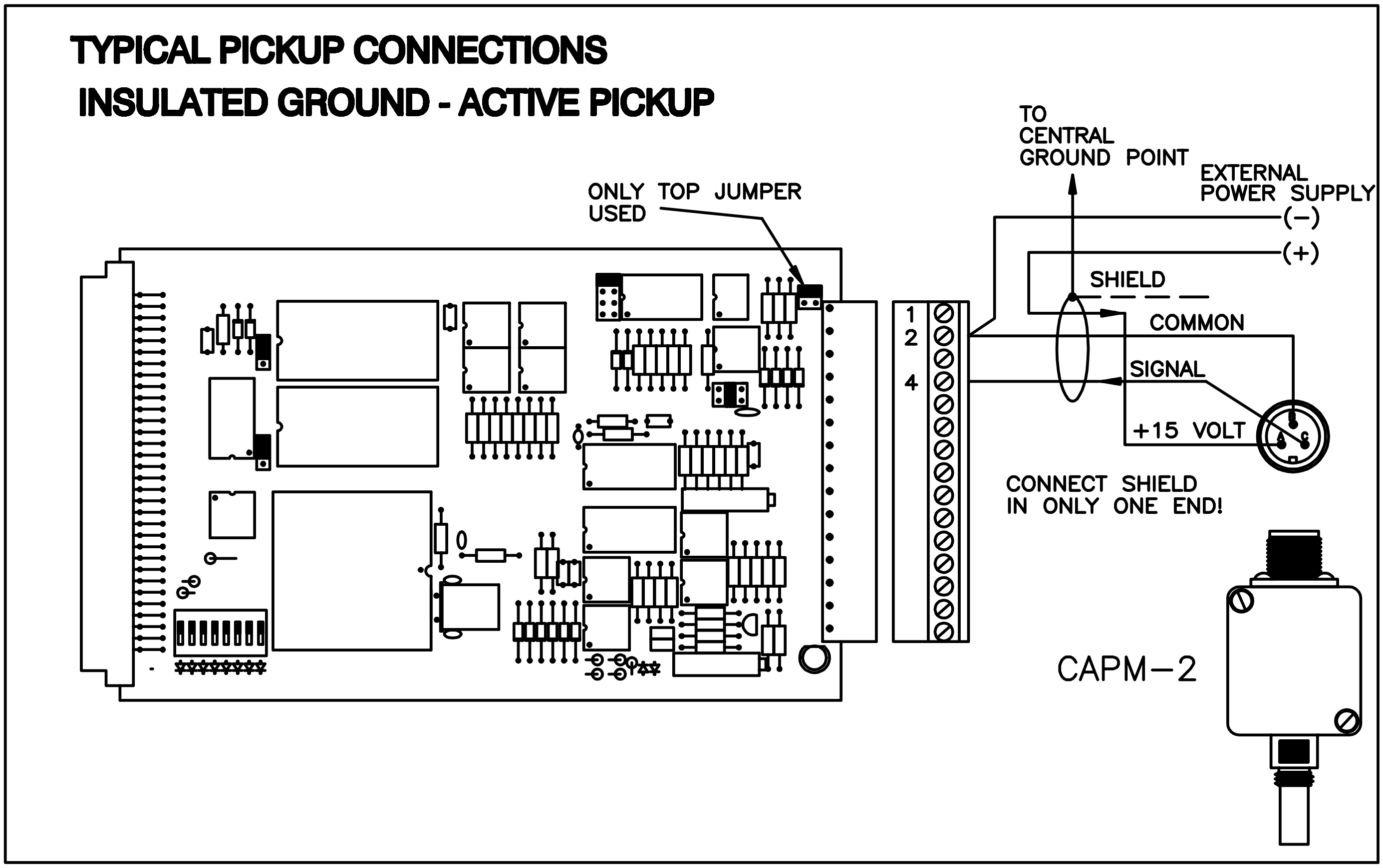
POWER CONNECTIONS AND POWER SUPPLY

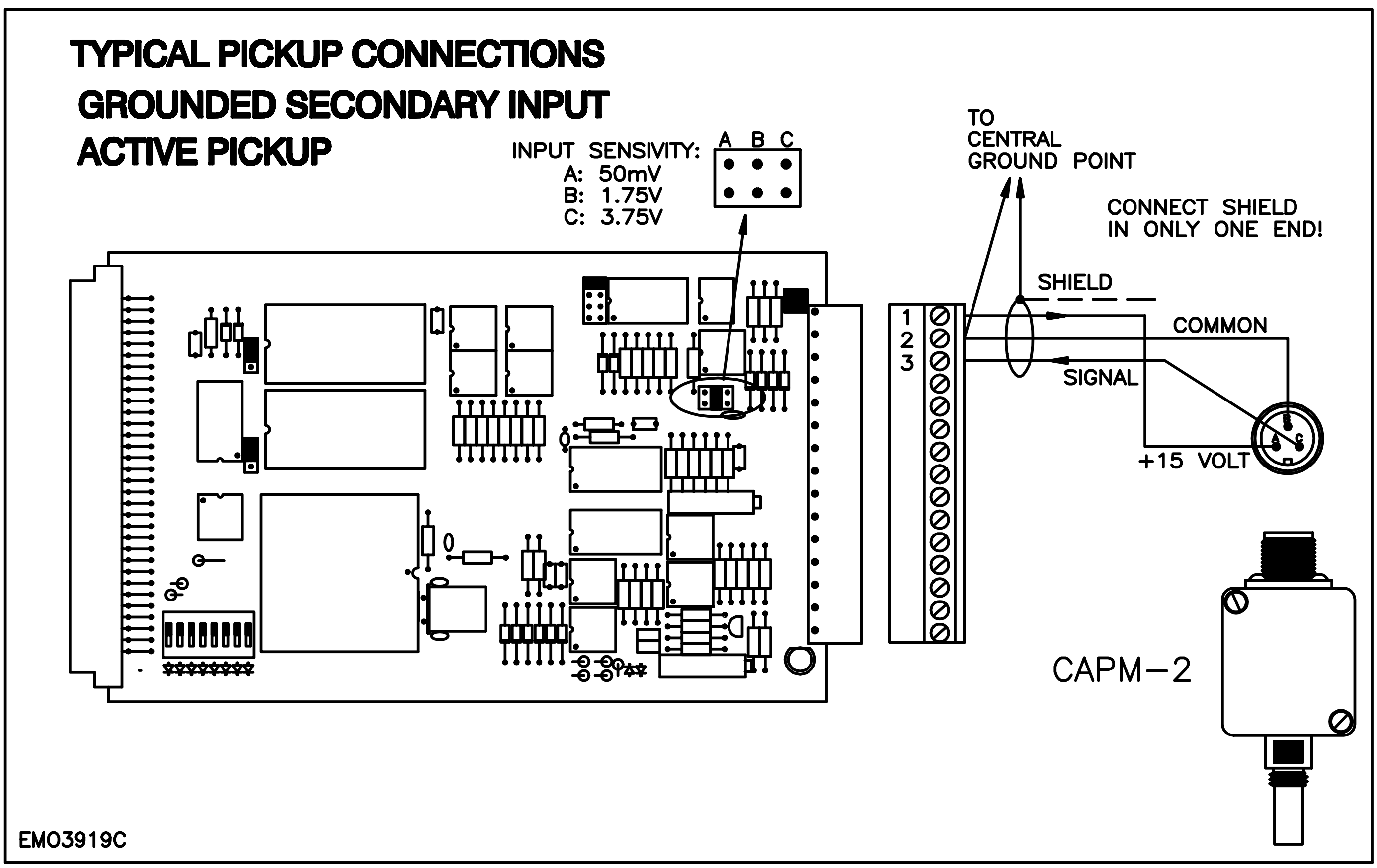


TYPICAL PICKUP CONNECTIONS
COMMON GROUND - ACTIVE PICKUP



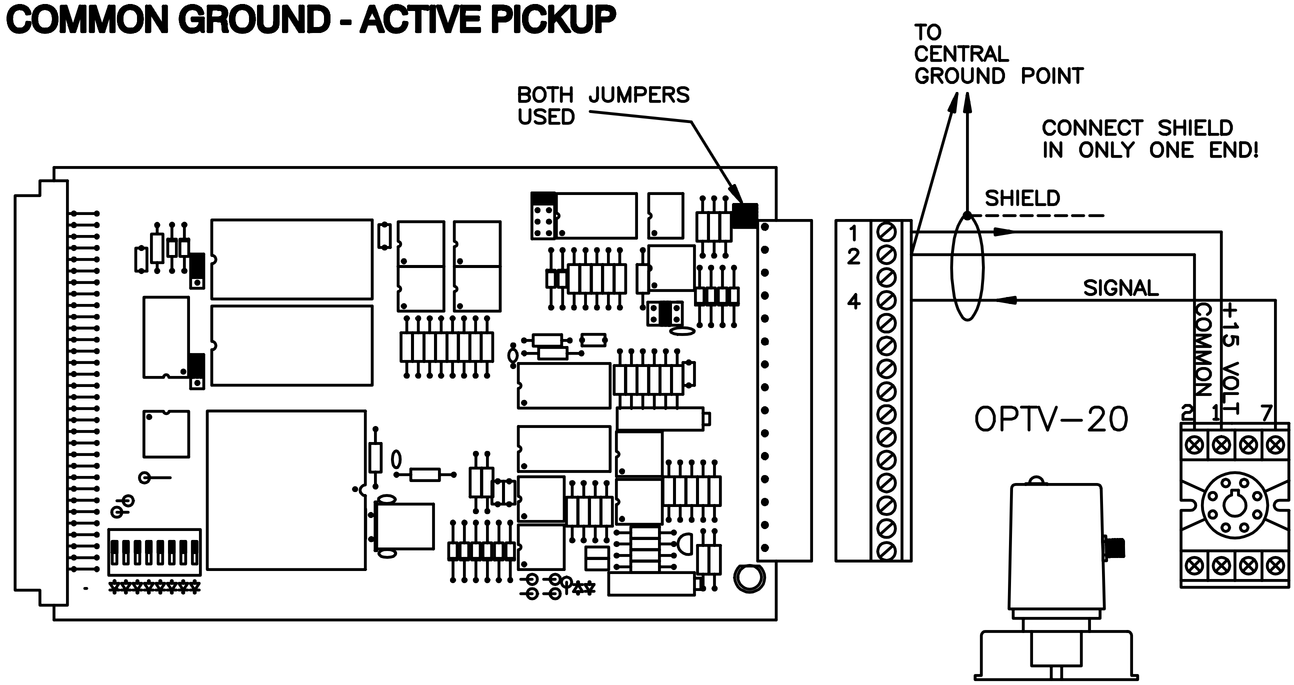
EM03919C


TYPICAL PICKUP CONNECTIONS
INSULATED GROUND - ACTIVE PICKUP
TO
CENTRAL
GROUND POINT
EXTERNAL
POWER SUPPLY
(−)
(+)
ONLY TOP JUMPER
USED
SHIELD
COMMON
SIGNAL
+15 VOLT
1
2
4
CONNECT SHIELD
IN ONLY ONE END!
CAPM−2

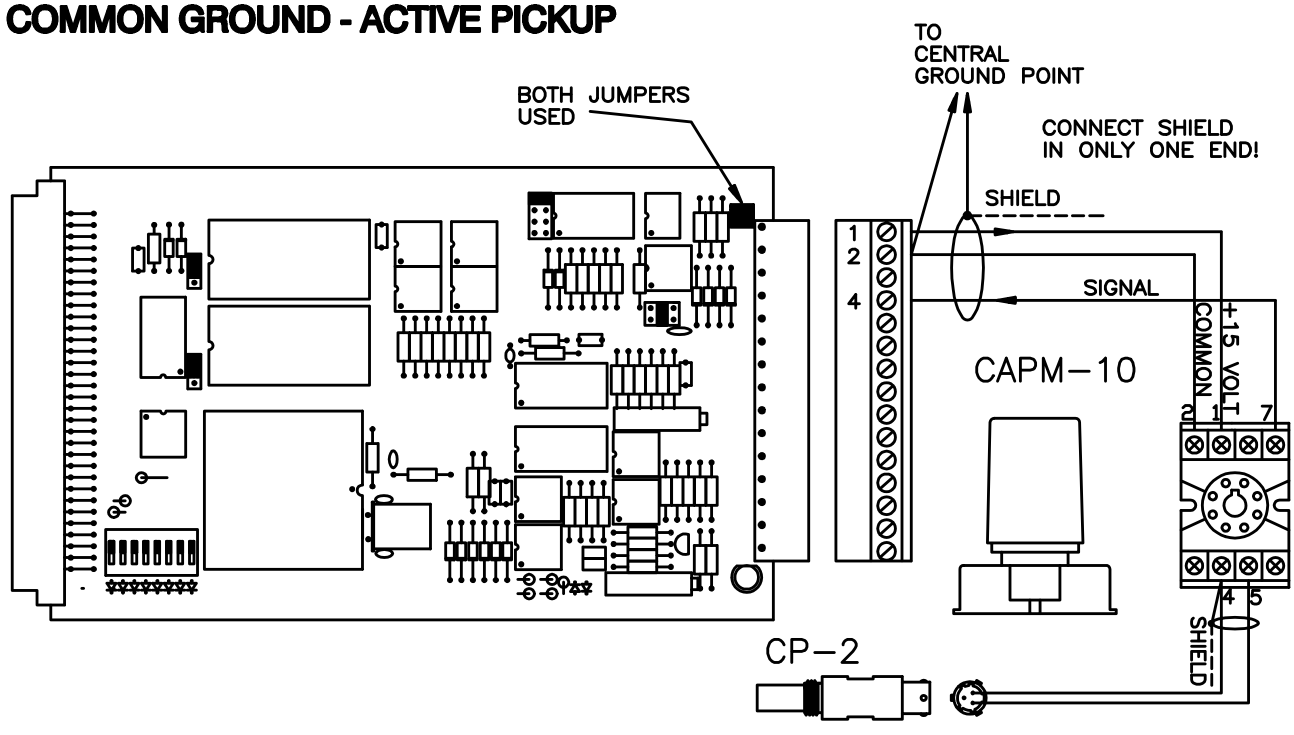

TYPICAL PICKUP CONNECTIONS
GROUNDED SECONDARY INPUT
ACTIVE PICKUP
INPUT SENSIVITY:
A: 50mV
B: 1.75V
C: 3.75V
A B C
TO
CENTRAL
GROUND POINT
CONNECT SHIELD
IN ONLY ONE END!
SHIELD
COMMON
SIGNAL
+15 VOLT
1
2
3
CAPM−2
EM03919C

APPENDIX K

TYPICAL PICKUP CONNECTIONS
COMMON GROUND - ACTIVE PICKUP

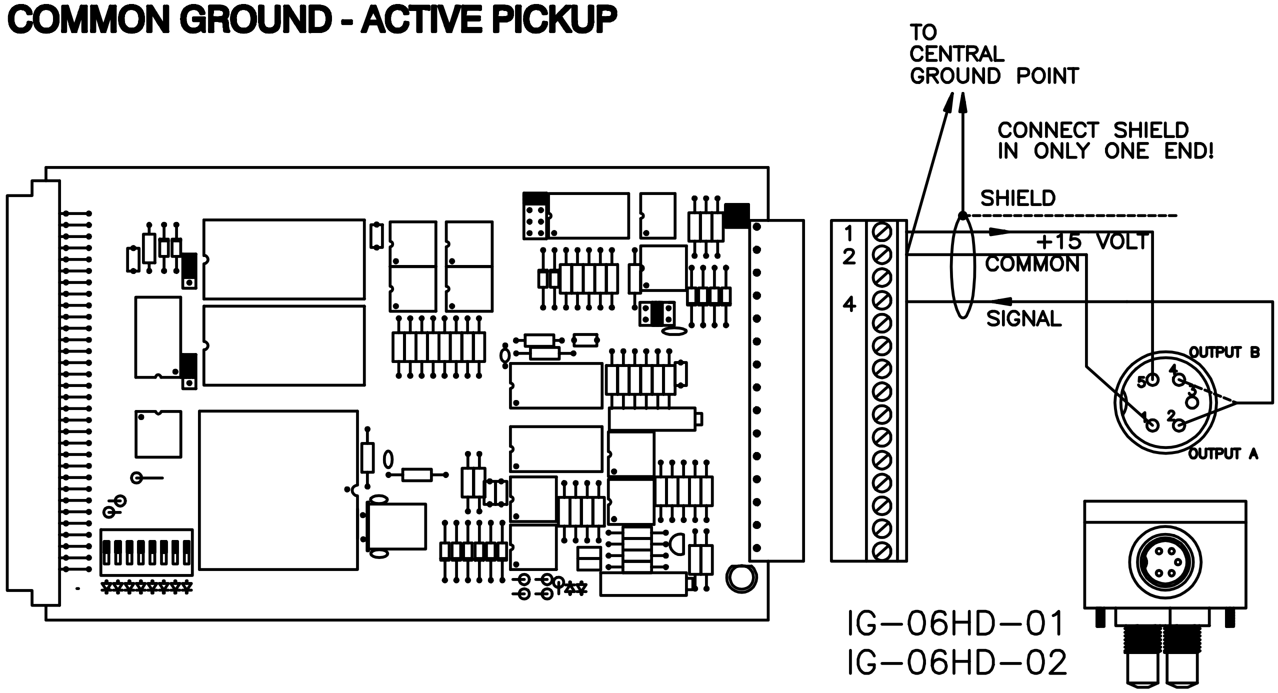


TYPICAL PICKUP CONNECTIONS
COMMON GROUND - ACTIVE PICKUP

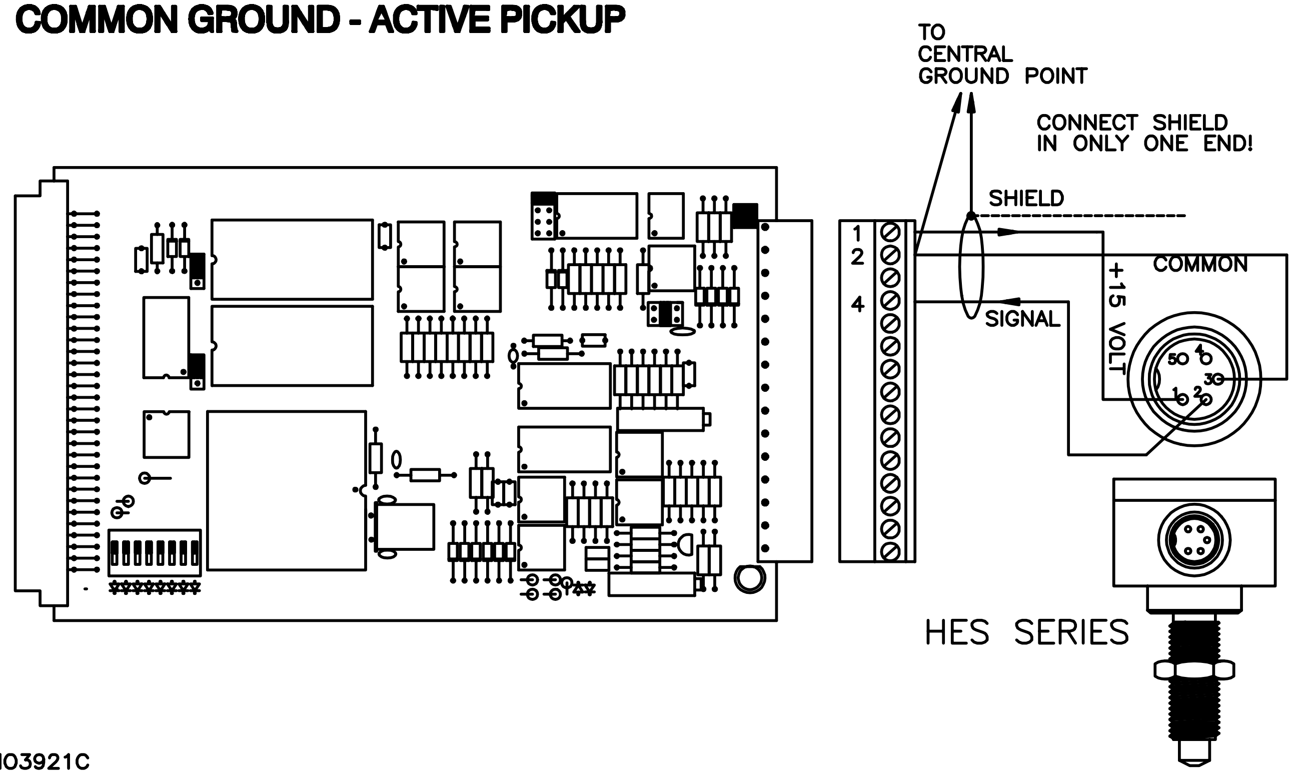


EM03920C

TYPICAL PICKUP CONNECTIONS
COMMON GROUND - ACTIVE PICKUP



TYPICAL PICKUP CONNECTIONS
COMMON GROUND - ACTIVE PICKUP

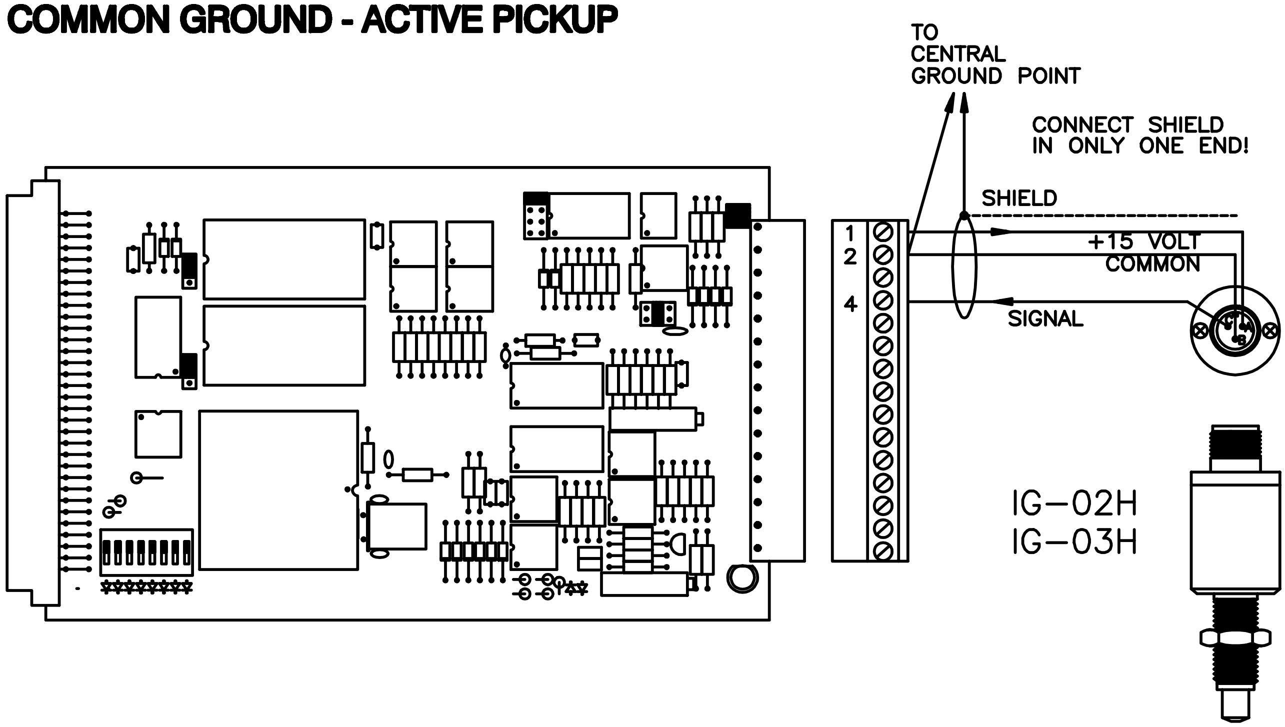


EM03921C

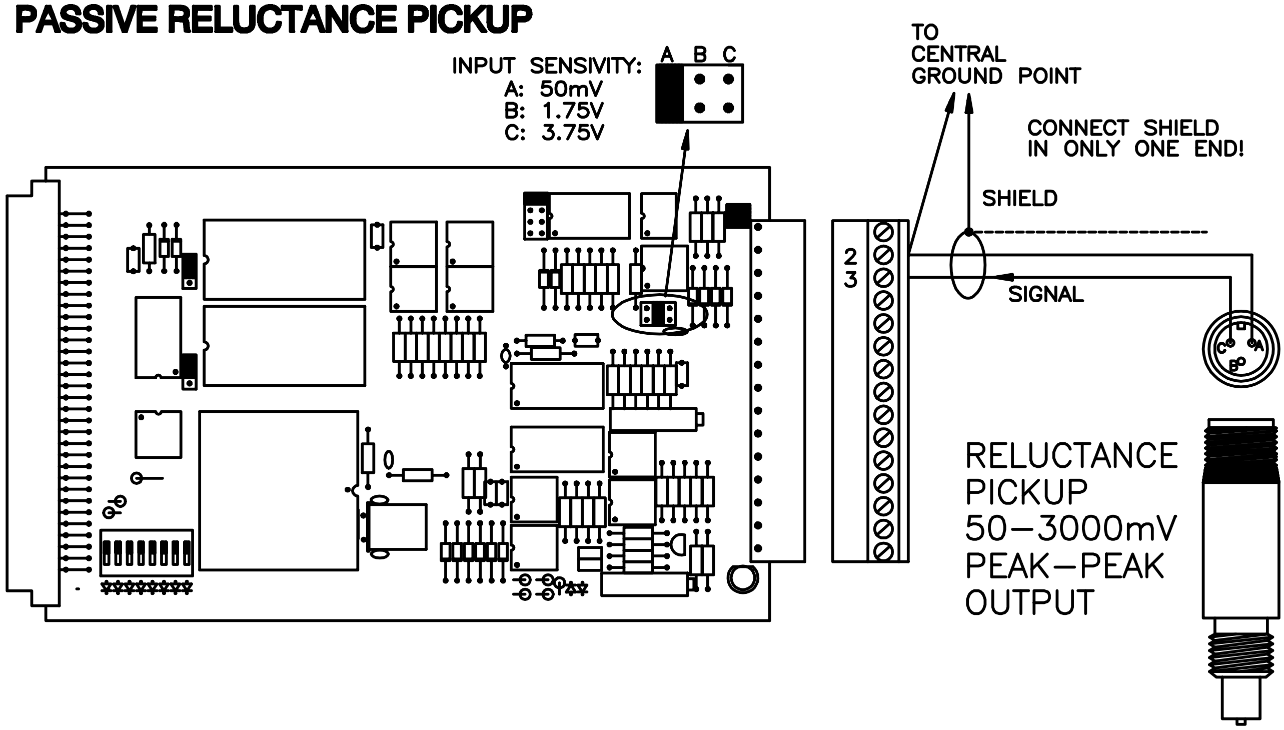
REV. 5

APPENDIX M

TYPICAL PICKUP CONNECTIONS
COMMON GROUND - ACTIVE PICKUP

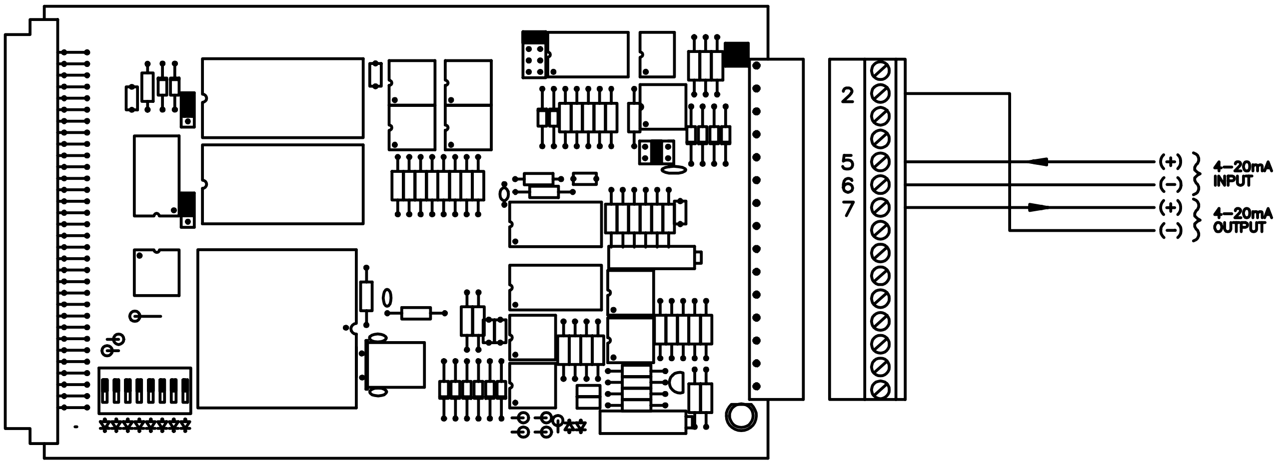


TYPICAL PICKUP CONNECTIONS
PASSIVE RELUCTANCE PICKUP

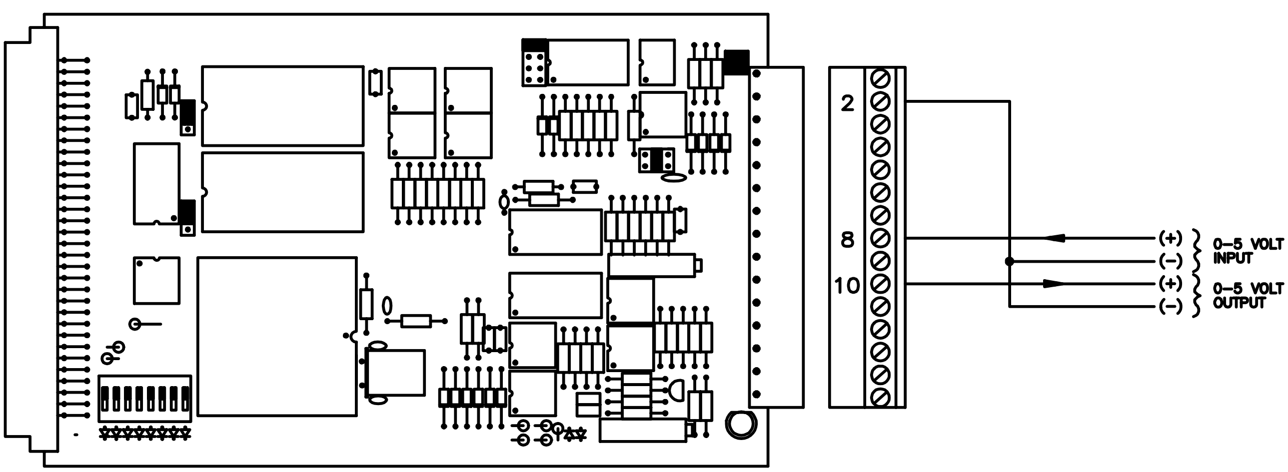


EM03921C

ANALOG I/O CONNECTIONS
4-20mA

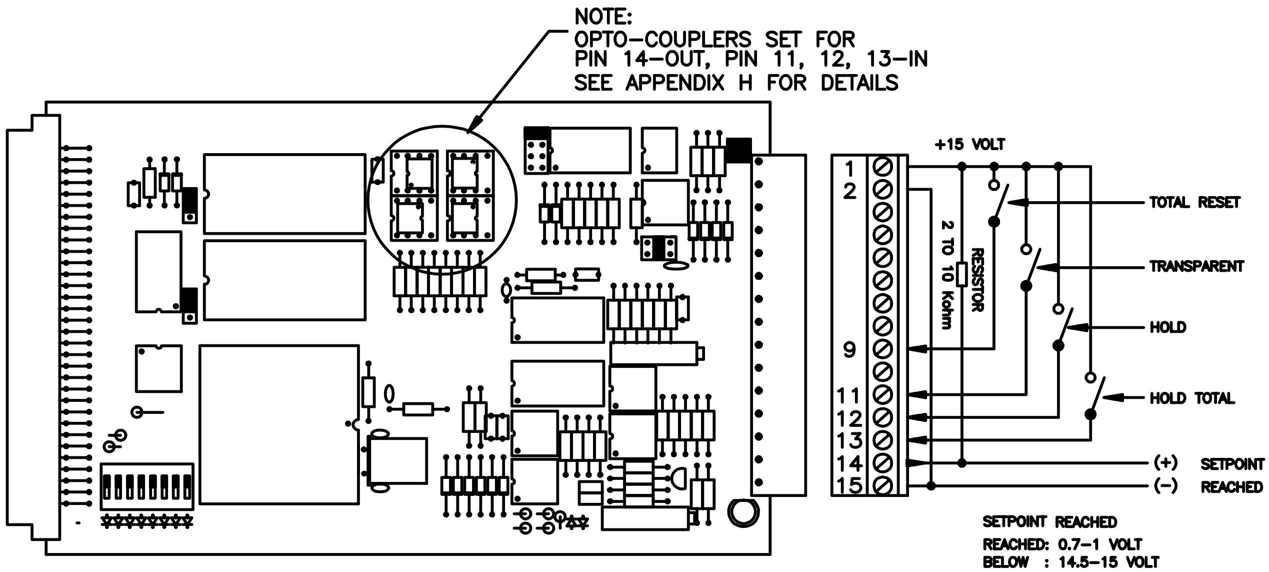


ANALOG I/O CONNECTIONS
0-5 VOLT

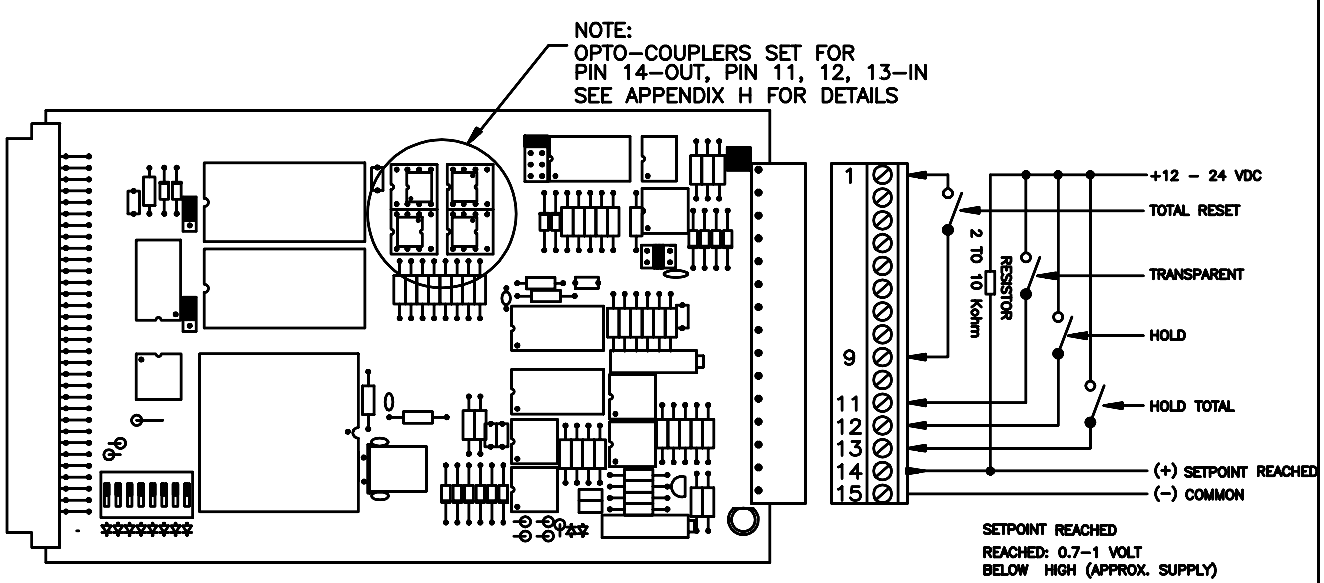


EMO3922C

LIMITS INPUTS/OUTPUTS
PID MODE - LOCAL POWER



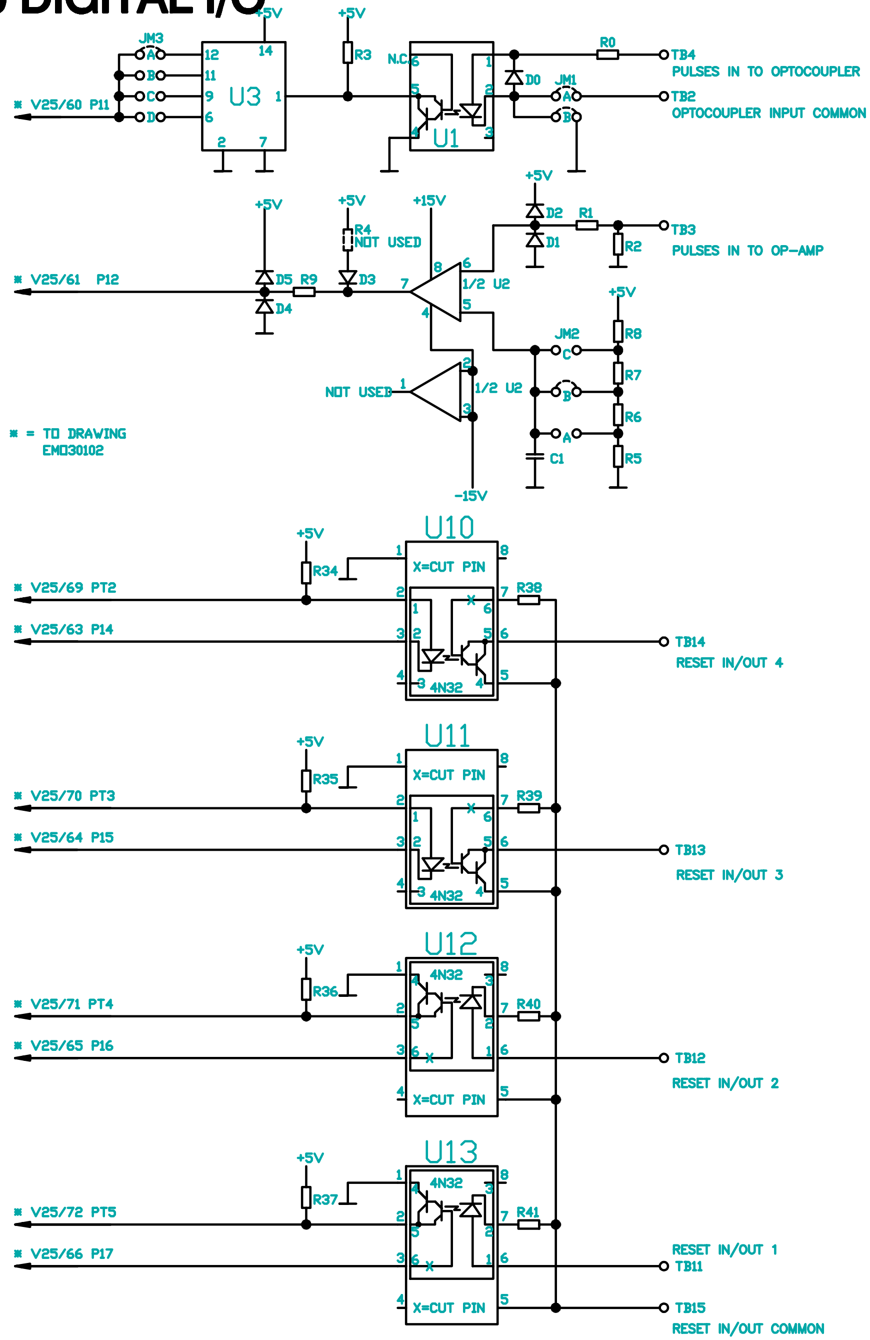
LIMITS INPUTS/OUTPUTS
PID MODE - REMOTE POWER

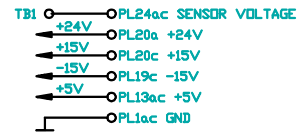


EM03922C

REV. 5

EMO-3000 DIGITAL I/O





JM1 – PULSES TO OPTOCOUPLER INSULATOR
"A" ONLY – COMMON INSULATED FROM GROUND
"A+B" – COMMON GROUNDED

JM2 – SENSITIVITY SETTINGS FOR OP-AMP INPUT
"A" – 50mV
"B" – 1.75V
"C" – 3.7V

JM3 – FREQUENCY IN TO OPTOCOUPLER DIVIDER
"A" – 1000Hz IN
"B" – 500Hz IN
"C" – 250Hz IN
"D" – 125Hz IN

EXAMPLE ONLY:
U10 AND U11 SET AS OUTPUTS
U12 AND U13 SET AS INPUTS

4N32's PIN 6 MUST BE CUT OFF
WHEN USED IN U10 – U13 SOCKETS

AW COMPANY
FRANKSVILLE, WI 53126

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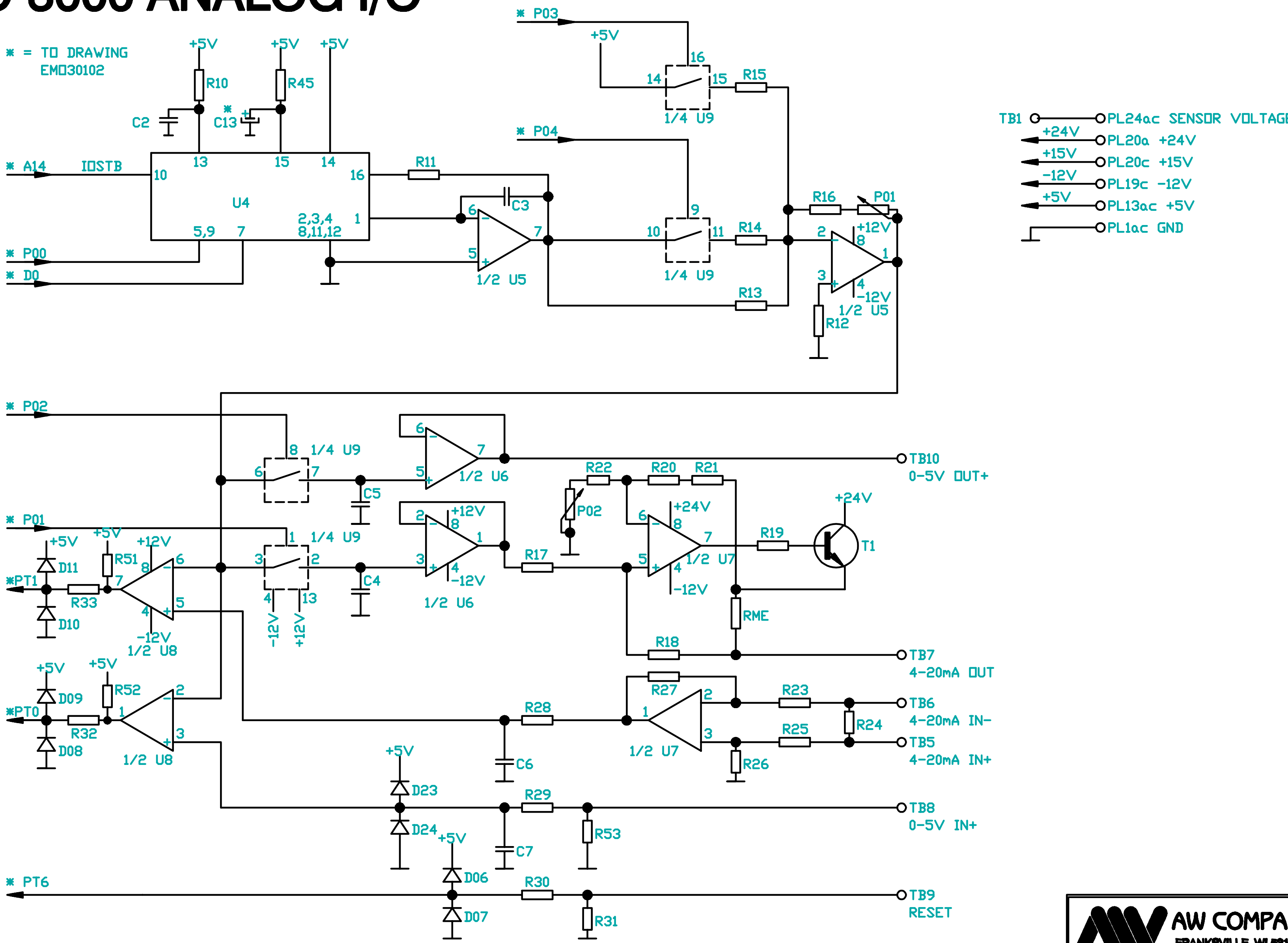
DRAWING NUMBER: EMO3923C	
DRAWN BY: GUS SKIAKER	
DATE: 01-13-97	CHECKED BY: G.S.
PAGE 1 OF 1	SCALE: NONE

APPENDIX Q

REV. 5

EMO-3000 ANALOG I/O



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APPENDIX R