2 YEAR WARRANTY

MADE IN USA

OMEGA CARE℠ Extended Warranty Program

User's Guide

Shop online at

omega.com™

OMEGA®

www.omega.com

e-mail: info@omega.com

ISO 9001 CERTIFIED CORPORATE QUALITY
STAMFORD, CT

ISO 9002 CERTIFIED CORPORATE QUALITY
MANCHESTER, UK

DPF-310 SERIES

Rate Indicator/Batcher

omega.com™
OMEGA®

OMEGAnet® Online Service www.omega.com	Internet e-mail info@omega.com

Servicing North America:

USA:
ISO 9001 Certified
One Omega Drive, P.O. Box 4047
Stamford CT 06907-0047
TEL: (203) 359-1660 FAX: (203) 359-7700
e-mail: info@omega.com

Canada:
976 Bergar
Laval (Quebec) H7L 5A1
TEL: (514) 856-6928 FAX: (514) 856-6886
e-mail: info@omega.ca

For immediate technical or application assistance:

USA and Canada: Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA®
Customer Service: 1-800-622-2378 / 1-800-622-BEST®
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN®
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Mexico: En Español: (001) 203-359-7803 e-mail: espanol@omega.com
FAX: (001) 203-359-7807 info@omega.com.mx

Servicing Europe:

Benelux:
Postbus 8034, 1180 LA Amstelveen, The Netherlands
TEL: +31 (0)20 3472121 FAX: +31 (0)20 6434643
Toll Free in Benelux: 0800 0993344
e-mail: sales@omegaeng.nl

Czech Republic:
Rudé armády 1868, 733 01 Karviná 8
TEL: +420 (0)69 6311899 FAX: +420 (0)69 6311114
Toll Free: 0800-1-66342 e-mail: czech@omega.com

France:
9, rue Denis Papin, 78190 Trappes
TEL: +33 (0)130 621 400 FAX: +33 (0)130 699 120
Toll Free in France: 0800-4-06342
e-mail: sales@omega.fr

Germany/Austria:
Daimlerstrasse 26, D-75392 Deckenpfronn, Germany
TEL: +49 (0)7056 9398-0 FAX: +49 (0)7056 9398-29
Toll Free in Germany: 0800 639 7678
e-mail: info@omega.dl

United Kingdom:
ISO 9002 Certified
One Omega Drive, River Bend Technology Centre
Northbank, Irlam, Manchester
M44 5BD United Kingdom
TEL: +44 (0)161 777 6611 FAX: +44 (0)161 777 6622
Toll Free in United Kingdom: 0800-488-488
e-mail: sales@omega.co.uk

CONTENTS

CONTENTS

SECTION 1 INTRODUCTION

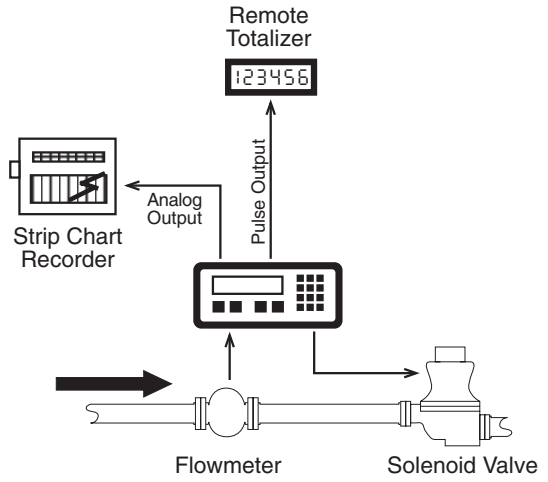
1-1 General Description

Sections 1 through 8 of this manual describe the wiring, programming and functionality of the standard DPF-310. Section 9 describes the wiring, programming and functionality of the DPF-310 with software version 8.7 (Option 6). Software version 8.7 incorporates Remote Start, Stop & Reset with EZ PRE (easy preset). EZ PRE is a useful tool for applications that require frequent changes to the Preset amount.

The DPF-310 uses the following software versions:

VER 8.7 (Basic unit; Remote Start, Stop & Reset with EZ PRE "Easy Preset")
VER 12.0 (Option 4; 16 point linearization)

1-2 Typical Application



The above application involves liquid flow. The start button is pushed and the DPF-310 receives pulses from the flowmeter. The pulses are scaled by the K Factor and sent out via the pulsed output to an external counter. The Analog output is directed to a strip chart recorder which gives a hardcopy of the rate. As the Prewarn is reached, the control valve partially closes. When the final Preset is reached the valve shuts down completely. At any time the flow can be suspended by hitting the stop button. Through the serial communications, a computer keeps a record of the daily events.

1-3 Principles of Operation

Presets

When the start button is pushed, two relays engage simultaneously to start flow. When the prewarn number is reached, one relay drops out. When the preset number is reached, the other relay drops out. The user may enter the two numbers when setting up the batch counter. The prewarn is set a certain number of counts less than the preset number. If the prewarn is set larger than the preset, the message "PREWRONG" will appear on the display.

Ratemeter

Accurate to 5 1/2 digits (±1 display digit). The ratemeter can be programmed to accept almost any number of pulses per unit of measurement, sample from 2 to 24 seconds maximum, and auto range up to 6 digits of significant information. The ratemeter with a K Factor of 1 displays the rate of pulses per second. Simply dial in the proper K Factor to display in minutes, hours or other units of measurement. Press the C button, while the unit is displaying the batch, to display the rate; 'R' is displayed on the left side of the display.

K Factor

The K Factor is used to convert the input pulses or analog input into workable units. The 8 digit K Factor is a divider with a range of 0.00011 to 99999999 (the decimal point may be keyed into any position). Separate K Factors may be entered into the count and rate sections of the DPF-310. Thus, you may batch in gallons and display rate in liters per hour. The maximum factored count speed is 20000 Hz. The maximum factored rate is 7 digits.

16 Point Linearization (-LIN option)

This option extends the accurate range by allowing users to dial in different K Factors for different input rates. This option may be used with digital or analog inputs. (See Section 7-3.)

Counter
The maximum count is 99999999. In the setup mode choose “RO” (Reset to Zero) for adding (count up) operation or “SP” (Set to Preset) for subtracting (count down) operation. At any time, the display can be made to flash the Grand Total by pressing the ENT button while in the run mode. Activating the CLR button while the Grand Total is flashing, resets the Grand Total counter.

Lockout
Unauthorized front panel changes can be prevented by entering a user selected, four digit code, in the “Lockout” mode. The status of the unit can be observed but “LOCK ON” appears if changes are attempted. Entering the code again returns the unit to “LOCK OFF” status.

Analog Output (-A option)
The Analog Output option is controlled by an Open Collector transistor, it gives a 4 to 20mA output which corresponds to predefined rate or total readings. In the Setup mode the user is prompted to set the low and high (4 to 20 mA) values and also decide if the analog signal will correspond to the ratemeter or totalizer.

A sinking driver generates a linear current across the user’s external device (such as a strip chart recorder, PLC, computer, external meter, etc). The DPF-310 can supply the 24 VDC to power the current loop. (Connect pin 15 to 13, Pin 16 is now +24 VDC with respect to pin 12.) Connect Pin 16 to the + DC side of the external device and connect Pin 3 to -DC side of the external device.

Frequency out
The DPF-310 generates a pulse out for each factored count. An NPN transistor output (Pin 2), can drive external devices at rates of 10, 200, 2000 or 20000 counts per second as selected through the keypad menu. If the K Factor scaled inputs generate pulses faster than the output speed selected, an internal buffer will store up to 9,999 counts before “DATA-LOST” flashes on the screen. This indicates that the counts being totaled and the scaled outputs may be incorrect. Note that all counts stored in the internal buffer will be pulsed out at the selected frequency even if the counter is reset.

STD PRE and EZ PRE Operation Modes

Version 8.7 of the DPF-310 software allows the user to choose between STD PRE (Standard Preset) and EZ PRE (Easy Preset) operation modes. STD PRE operation is well suited for batch amounts that do not change, since the program mode must be entered to change the preset and the batch count must be cleared before starting a new batch. EZ PRE has been designed for users who frequently change the batch amount. During EZ PRE operation, the preset can be viewed and changed without entering the program mode and another batch can be started without resetting the unit.

Note: *Before a batch is started and after a batch is complete, the unit will continue to totalize all inputs.*

Note: *EZ PRE is not available on units with 16 Point Linearization.*

Using STD PRE

Programming

Select STD PRE - Go into the Program Mode and select STD PRE in the PRE TYP sub menu.

Set the PRESET and PREWARN - Go into the Program Mode and enter the desired values for the PRESET and the PREWARN.

Program the Counter - Go into the Program Mode and set up the counter in the COUNT sub menu.

Operation

Start a Batch - In the Run Mode, reset the total by pressing “CLR”, then press “A” to start. When started, both relays energize and the counter begins to count. When the batch is complete, the relays drop out and the unit displays the amount that was batched (0 if in Set to Preset mode).

Stop a Batch - Press “B”, to temporarily stop process by de-energizing the PRESET and PREWARN relays. Press start, “A”, to continue process.

Repeat a Batch - In the Run Mode, reset the total and press the start button.

Change the Batch Size - Go to the Program Mode and enter new PRESET and PREWARN values.

Using EZ PRE

Programming

Select EZ PRE - Go into the Program Mode and select EZ PRE in the PRE TYP sub menu.

Set the PRESET and PREWARN - Go into the Program Mode and enter the desired values for the PRESET and the PREWARN.

Program the Counter - Go into the Program Mode and set up the counter in the COUNT sub menu.

Operation

Start a Batch - In the Run Mode, press “A” to start. When started, both relays energize and the counter begins to total. When complete, the relays drop out and the display flashes the current PRESET value.

Stop a Batch - Press “B”, to temporarily stop process by de-energizing the PRESET and PREWARN relays. Press start, “A”, to continue process.

Repeat a Batch - Press the start button.

Change the Batch Size - With the current PRESET flashing on the display, type a new number using the keypad. This number becomes the PRESET.

Display Batch Total or Rate - With the current PRESET flashing, press “ENT” to place the PRESET value in memory and use the “C” button to toggle between the Batch Total and the Rate.

1-5 Specifications

Housing:
High impact plastic case with NEMA 4X front panel.

Dimensions:
See Section 1-5, Page 4.

Display:
8 Digit, 0.55" High, 15 Segment, Red Orange, LED.

Input Power:
A: 110 VAC ± 15% or 12 to 27 VDC
B: 220 VAC ± 15% or 12 to 27 VDC

NOTE: AC Inputs are internally fused with a 160mA slow blow fuse.

Current:
Maximum 280 mA DC or 5.3 VA at rated AC voltage.

Output Power:
(On AC powered units only): +12 VDC at 100 mA. Separate Isolated 12 VDC at 100 mA to allow ± 12 VDC or +24 VDC, regulated ± 5% worst case.

Temperature:
Operating: +32°F (0° C) to +130 ° F (+54° C)
Storage: -40°F (-40° C) to +200 ° F (+93° C)
(Extended operating temperature range available, consult factory)

Memory:
EEPROM stores all program, display mode and count data for a minimum of 10 years if power is lost.

Reset
Front push button: "CLR" resets displayed number and control output.
Remote Input (Terminal 5): Open or 0 to 1 VDC (low), 3 to 30 VDC (high), 10K ohm input impedance to ground. Minimum pulse on / off time 5 msec.

Accuracy over full temperature range:
Analog - Zero error: ±0.175% full scale max.
Overall error: ±0.5% full scale max.
Digital - 100% (within specified voltage ranges)

Pulse Inputs (DPF-311):
Sourcing (standard): High impedance pulse input. Open or 0 to 1 VDC (low), 3 to 30 VDC (high), 10K ohm input impedance. 20 KHz maximum speed (min. on / off 25 usec).

Sinking (dip switch selectable): Same as above with 4.7 K ohm pull up resistor to +5 VDC with respect to Terminal 12.

Analog Inputs (DPF-312):
The 4-20mA current is converted to a highly linear 0 to 10 KHz frequency. This frequency can then be scaled by 8 digit K-factors to display rate or count in the appropriate engineering units.

Input Range:	4-20 mA
Input impedance:	250

1-5 Specifications (continued)

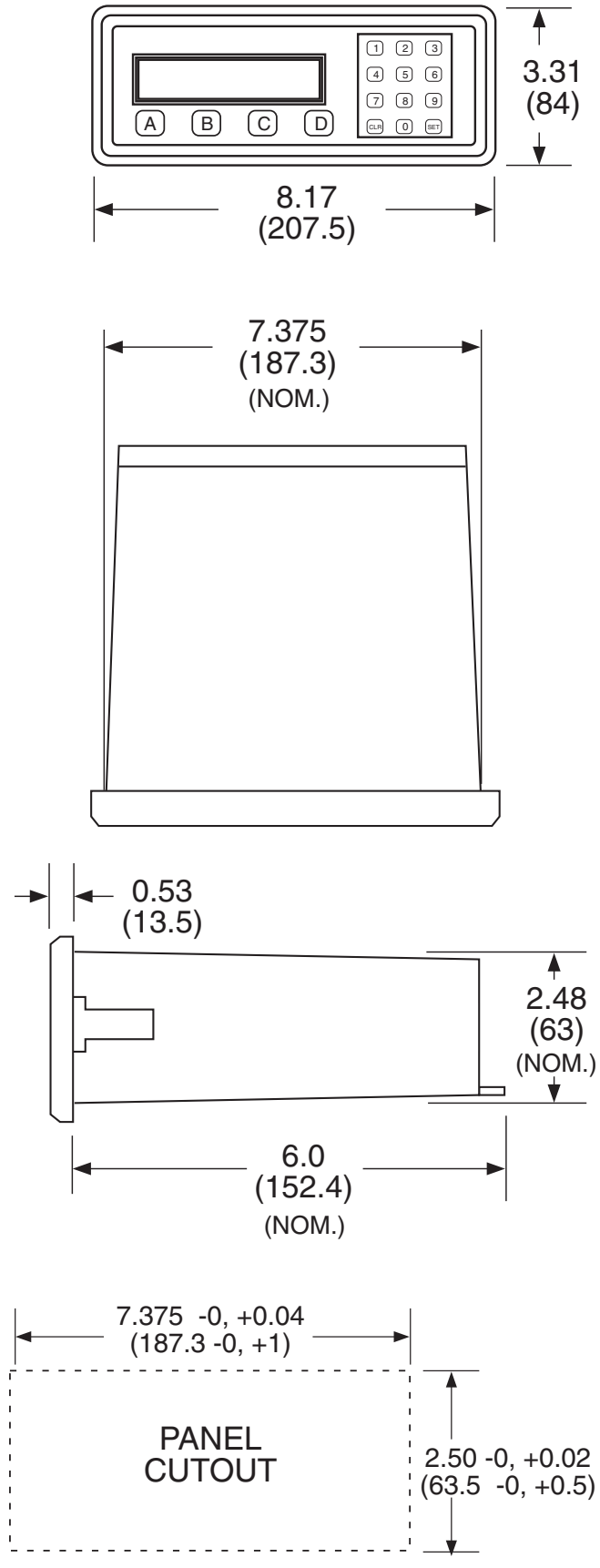
Factored Output:
One pulse per each factored count
Sinking (NPN Transistor)
Open Collector sinks 250 mA maximum to 1 volt maximum from 30 VDC maximum
Internal buffer: 9999 pulses
Output speed: user selectable (see table below)

Speed (Hz)	10	200	2000	20000
Min. on/off (msec)	47.5	2.0	0.2	0.013

Analog output (-A option):
4-20 mA
Sinking, (NPN transistor), Open Collector
Compliance voltage: 3-24 VDC, non-inductive
Accuracy: ±100 uA worst case
Update Rate: Follows ratemeter

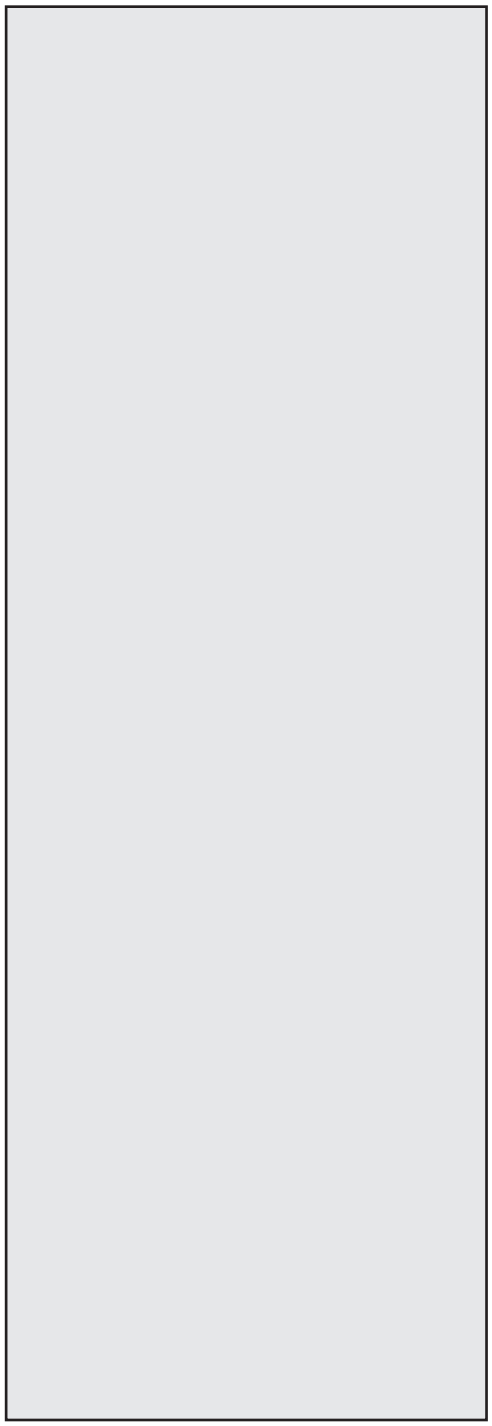
Control Outputs:
SPDT Relays
Contact rating: 10 A 120/240 VAC or 28 VDC.

1-6 Dimensions



All Dimensions in inches (mm)

1-5 Dimensions (continued)



Full Size Panel Cutout Template
(copy before using)

SECTION 2 INSTALLATION

2-1 Receipt of Equipment

When the equipment is received, the outside packing case should be checked for damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding his liability. A report should be submitted to the factory.

Carefully remove the equipment from the packing case and inspect for damaged or missing parts.

2-2 Return Shipment

Do not return assembly or part without an Authorization Return number (AR). The AR is obtained by calling Omega customer service.

2-3 Panel Mounting

The controller should be located in an area with a clean, dry atmosphere which is relatively free of shock and vibration. The DPF-310 is installed in a 7.365" (187 mm) wide by 2.495" (63.4 mm) high panel cutout. To mount the controller proceed as follows:

a. Prepare the panel opening.
b. Slip the gasket (provided) over the rear of the counter case and slide it forward until it engages the inner surface of the front bezel.
c. Install the screws (provided) in the mounting brackets and insert in the holes located on both sides of the DPF-310.
d. Tighten the screws firmly to attach the counter bezel to the panel.

2-4 Electrical Connections (Reference Figures 2-1 to 2-3)

All connections are completed at terminal blocks located at the rear of the case. Make sure all power is disconnected before making any electrical connections. In cases where cables are situated in areas with heavy electrical fields,

shielding is required for maximum noise immunity. One end of the shielding should be connected to earth ground. Relays or inductive coils connected to or located in the immediate area should be arc suppressed with appropriate diodes, MOV's or resistor capacitor networks.

Caution: An external fuse is required:
DC Power: 0.5 Amp
AC Power: 0.125 Amp

2-5 Wiring Connections and Diagrams

1 - Not Used
2 - Scaled Pulse Output O.C.
3 - Analog Output (optional)
4 - Input A (Pulse/Analog)
5 - Remote Stop/Reset Input
6 - Not Used
7 - Not Used
8 - Not Used
9 - Not Used
10 - Remote Start Input
11 - Ground (-DC), Input Common
12 - Ground (-DC), Input Common
13 - +12 Volts Out
14 - DC Power In (12 - 27 VDC)
15 - Isolate -12 Volts
16 - Isolate +12 Volts
17 - AC In
18 - AC In
19-Prewarn Transistor O.C.
20-Preset Transistor O.C.

R1-N.O
R2-N.C. — Preset
R3-Common
R4-N.O
R5-N.C. — Prewarn
R6-Common

Figure 2-1 Terminal Block Connections

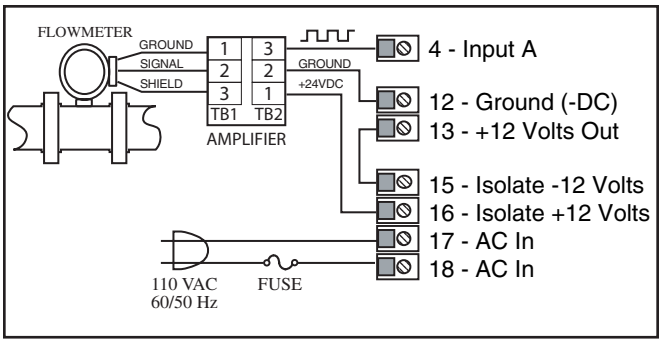


Figure 2-2
Typical Digital Wiring Connections

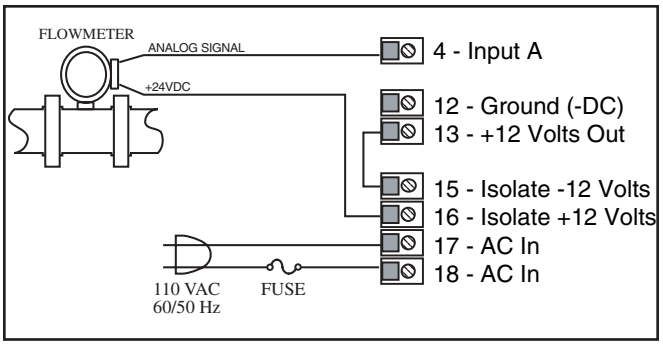
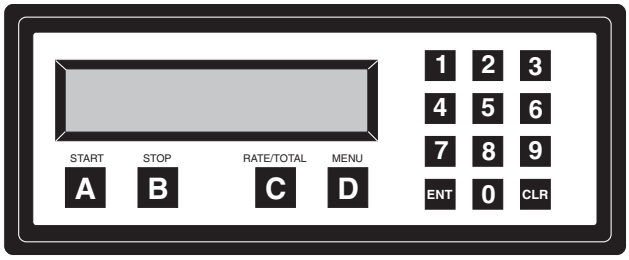


Figure 2-3
Typical Analog Wiring Connections

3-1 Front Panel Operation



A **START** - Pressing “A”, starts the process by energizing the PRESET and PREWARN relays. Press “CLR” to reset Batch Total before starting new batch.

B **STOP** - Pressing “B”, will temporarily stop the process by de-energizing the PRESET and PREWARN relays. Use START to continue the process from where it stopped.

C **RATE/TOTAL** - Pressing “C” toggles between rate and total count displays. The rate display has an “R” on the left side of the screen.

D **MENU** - Pressing “D” takes the unit out of the Run Mode and into the Programming Mode (See Programming, Page 43 and 45). “D” is also used make to some programming selections.

ENT **ENT** - With Count showing in the Run Mode, pressing “ENT” displays the Grand Total, which begins flashing on the screen. Press “ENT” again to return to the Count. In the Programming Mode, “ENT” is used to accept a selection (See Programming, Page 43 and 45).

CLR **CLR** - When the count total is displayed, pressing “CLR” will reset the counter to 0 or to Preset A depending on how it was programmed. When the Grand Total is displayed, pressing “CLR” will reset it to 0. When the Preset or Program Mode values are displayed, pressing “CLR” will reset them to 0, so that new values can be entered.

Weighted Averaging

Version 8.7 of the DPF-310 software includes weighted averaging of the rate display. Weighted averaging is not available on units with 16 Point Linearization.

Weighted averaging can be used to create a more stable display when the rate input is fluctuating. A weight, “W”, from 00 to 99 is applied to the old rate data before the new rate data is sent to the display. The following equation is used:

$$\text{Rate Display} = \frac{(\text{Old Data} \times W + \text{New Data})}{(W + 1)}$$

W = Weight (00-99)

If a weight of 00 is used, the new rate data will go directly to the display without being averaged. If a number other than 00 is entered for the weight, then the new data will be averaged with the old data before being sent to the display. Higher weight numbers will create a more stable rate display. Small rate changes will be more noticeable when lower weight numbers are used.

Programming Weighted Averaging

1. In the Program Mode, got to the RATE sub menu and program the K-FACTOR, the WINDOW, and the SIG FIG parameters.
2. When the display shows WEIGHTXX (XX represents the current WEIGHT value), either accept the current value and return to the Run Mode by pressing “ENT” or clear the current value by pressing “CLR”.
3. If the current value was cleared, the display shows WEIGHT00. Using the keypad, enter a new WEIGHT value from 00 to 99. Press “ENT” to accept the new value and return to the Run Mode.

Remote Start, Stop, and Reset
(not available on DPF-312-A)

A 4 to 30 VDC positive pulse will activate these inputs.

START (Pin 10): When activated, the unit will START as described in Front Panel Operation.

STOP/RESET (Pin 5): When activated, the unit will STOP (If the unit is started and the batch is not complete). A second pulse to pin 5 will reset the counter (When the unit is stopped or when the batch is complete). If pin 5 is held high (4 to 30 VDC), the display will flash “STOPPED” and any start inputs will be inhibited.

3-2 VER 8.8 Programming

Overview:

This Section of the manual provides an outline of programming procedures for the DPF-310 software version 8.7. Detailed descriptions and programming instructions for this unit are available in previous sections of this manual. Page number references are included to help you find related information in this manual.

Programming Procedures:

Enter Program Mode - Press the MENU button, "D", in the Run Mode.

Choosing a Sub Menu - Once in the Program Mode, continue pressing the "D" button until the desired Sub Menu is displayed. Press "ENT" to enter the selected Sub Menu.

Making a Selection - An arrow, "↓", appearing over only the "D" button indicates that "D" is used to change the selection. When an arrow appears over "B" and "D", one must be selected.

Entering a Value - The keypad is used to enter a number. Use the "D" button to enter a decimal. (Ex: 34.5 would be entered by pressing "3", "4", "D", and "5")

Accept a Value or Selection - Press "ENT" to accept the value and go to next step.

Exit Program Mode - Program or skip each step of one of the menus to return to the Run Mode. Pressing "ENT" allows a step to be skipped without changing its value.

Key to Programming Flow Chart:

Display - This box represents the unit's display. In the Run Mode, the flow rate, the batch total, or the grand total will be displayed.

XX **Current Value** - The number that is currently programmed for that step. It must be cleared (**CLR** button) before entering a new value.

00 **No Value** - Indicates that programmed value for that step has been cleared, and a new number may be entered.

Keypad - Use the front panel keypad to enter a value or select a decimal point location for this step.

3-3 VER 8.8 K-Factor Programming

(See Programming Flow Chart, Page 10)

The average sensor K-Factor is usually provided in pulses per unit volume, and will have to be modified before entering it into the instrument. On most flowmeters, the average sensor K-Factor is stamped on the nameplate or provided on its documentation. (see section 7 for Calculating K-Factors, for a complete example)

Count K-Factor:

The Count K-Factor must be modified to allow for the decimal point location chosen in the "DEC LOC" step.

$$\frac{\text{Sensor K-Factor}}{\text{DPF}} = \text{Count K-Factor}$$

DPF - The Decimal Point Factor is a divider to compensate for the displayed decimal point.

DPF Table

DPF	Decimal
1	XXXXXX.
10	XXXXX.X
100	XXXX.XX
1000	XXX.XXX
10000	XX.XXXX
100000	X.XXXXX

Rate K-Factor:

The Rate K-Factor must be determined to display the rate in the desired time unit. The floating decimal point displayed by the Rate Meter floats according to the significant figure setting used in the SIG FIG step.

$$\frac{\text{Sensor K-Factor}}{\text{TF}} = \text{Rate K-Factor}$$

Where:

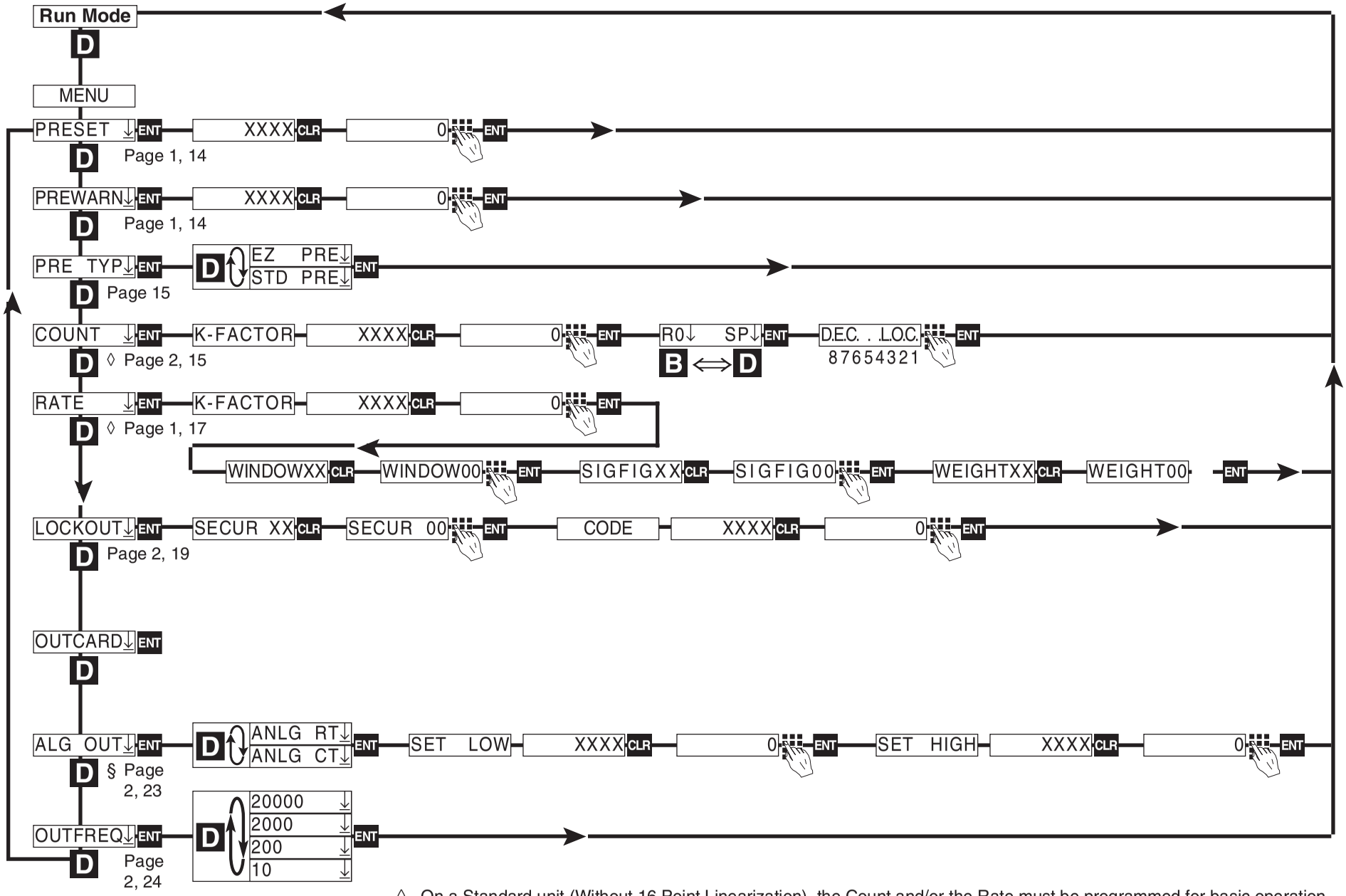
TF - The Time Factor is a divider to adjust the time units that the Rate Meter shows.

TF Table

TF	Time Units	Rate Display
1	Seconds	Units per Second
60	Minutes	Units per Minute
3600	Hours	Units per Hour
86400	Days	Units per Day

(For information on entering a K-Factor on a unit with 16 Point Linearization (-LIN option), see **16 Point Linearization Notes**, page 11)

Software Version 8.7 Programming Flow Chart



◊ - On a Standard unit (Without 16 Point Linearization), the Count and/or the Rate must be programmed for basic operation.
§ - Sub menu will always appear, but feature may not be included in the unit. (Check Model Number).

3-5 VER 12.0 Programming

Unit with 16 Point Linearization (-LIN option)

Overview:

This Section of the manual provides an outline of programming procedures for the software version 12.0. Detailed descriptions and programming instructions for this unit are available in the following sections of this manual. Page number references are included to help you find related information in this manual.

Programming Procedures:

Enter Program Mode - Press the MENU button, "D", in the Run Mode.

Choosing a Sub Menu - Once in the Program Mode, continue pressing the "D" button until the desired Sub Menu is displayed. Press "ENT" to enter the selected Sub Menu.

Making a Selection - An arrow, "↓", appearing over only the "D" button indicates that "D" is used to change the selection. When an arrow appears over "B" and "D", one must be selected.

Entering a Value - The keypad is used to enter a number. Use the "D" button to enter a decimal. (Ex: 34.5 would be entered by pressing "3", "4", "D", and "5")

Accept a Value or Selection - Press "ENT" to accept the value and go to next step.

Exit Program Mode - Program or skip each step of one of the menus to return to the Run Mode. Pressing "ENT" allows a step to be skipped without changing its value. (Note: "B" or "D" must be pressed on the first step in the DEV TYP menu)

Key to Programming Flow Chart:

Display - This box represents the unit's display. In the Run Mode, the flow rate, the batch total, or the grand total will be displayed.

XX **Current Value** - The number that is currently programmed for that step. It must be cleared (**CLR** button) before entering a new value.

00 **No Value** - Indicates that programmed value for that step has been cleared, and a new number may be entered.

Keypad - Use the front panel keypad to enter a value or select a decimal point location for this step.

3-6 VER 12.0 16 Point Linearization (-LIN option) Notes

(See Programming Flow Chart, Page 12)

A K-Factor and a Frequency must be entered for at least three points on a unit with Linearization.

Linearization K-Factor: The K-Factor for each Linearization point must be modified to allow for the display decimal point location chosen in the "DEC LOC" step of the "DEV TYP" menu. Modify each K-Factor using the following equation:

$$\frac{\text{K-Factor}}{\text{DPF}} = \text{Linearization K-Factor}$$

DPF - The Decimal Point Factor is a divider to compensate for the displayed decimal point.

DPF Table

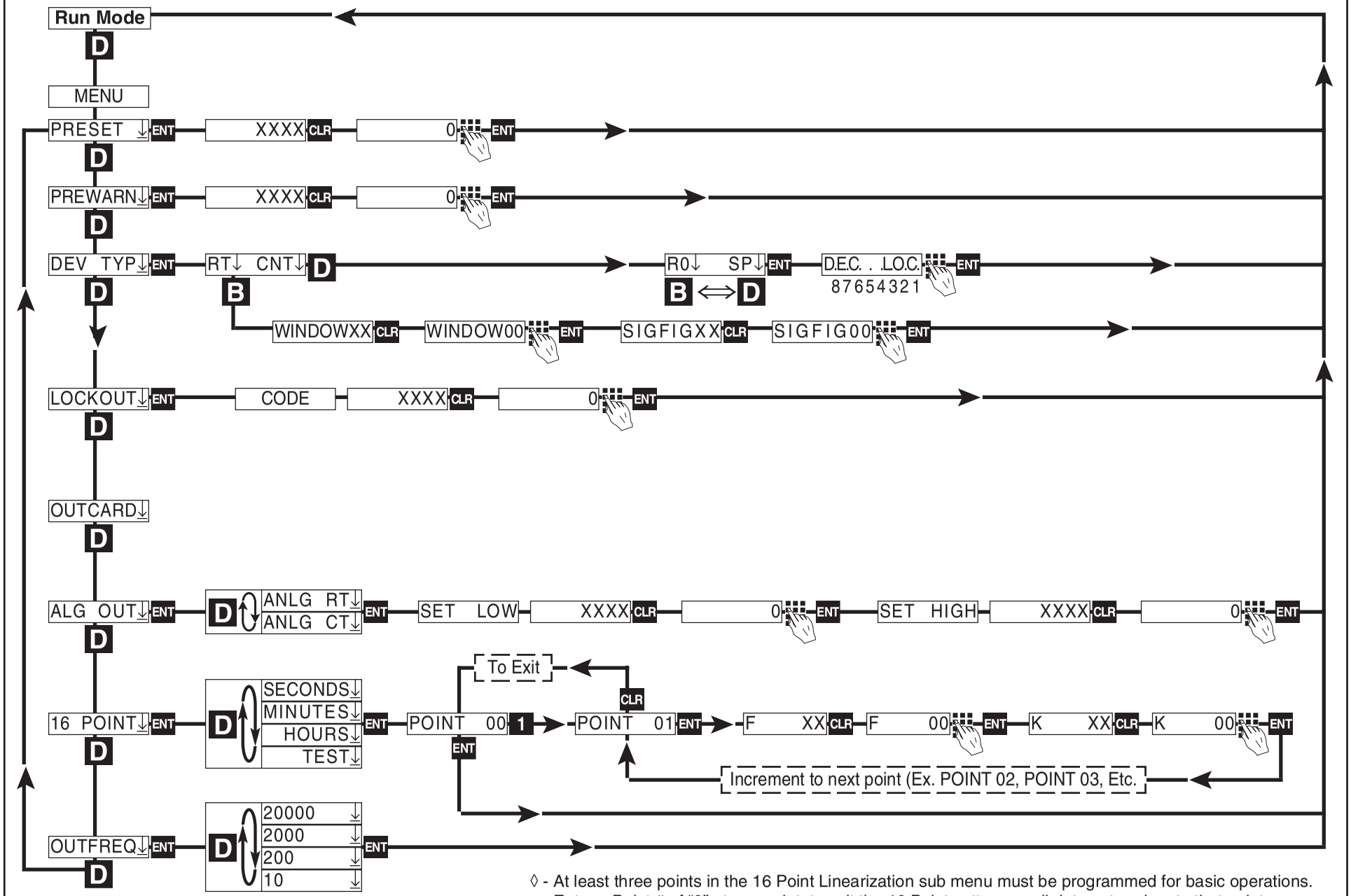
Desired Total Decimal Location:	**DPF**
XXXXXX.	1
XXXXX.X	10
XXXX.XX	100
XXX.XXX	1000
XX.XXXX	10000
X.XXXXX	100000

Example: for X.X, DPF = 10

Calculating K-Factors and Frequencies: If a Linearization table is not available, the K-Factor and the frequency for each point can be calculated using the Test Mode on the unit. Refer to Section 7-3.2, Test Mode Operation and K-Factor Calculation, on page 37.

Entering K-Factors and Frequencies: Refer to Section 7-3, Calculating 16 Point K-Factors, on page 37 and the programming step listing on page 25.

3-7 Software Version 12.0 16 Point Linearization Programming Flow Chart



◊ - At least three points in the 16 Point Linearization sub menu must be programmed for basic operations. Enter a Point # of "0" at any point to exit the 16 Point settupeep all data entered up to that point.

§ - Sub menu will always appear, but feature may not be included in the unit. (Check Model Number).

3-8 How to Program

The initial programming of the unit is accomplished by first depressing the MENU button. After pressing the MENU button once, the display will read preset. To cycle to the next control parameter option, merely press the MENU button and Prewarn will appear on the display. If the user does not wish to choose this section of the menu, depress MENU button again and the next control or parameter will appear.
Selection of all MENU control parameters is accomplished through the routine described for Preset.

The following is the sequence for entering a Preset quantity.

1. Depress the Menu D button once. The display will read MENU. After a one second pause the display will read PRESET.

2. Depress the Enter ENT button; the display will flash indicating that you are not in the Run Mode and not displaying the current batch total.

3. If the batch size is satisfactory, depress the ENT button. This value will be entered into memory. Simultaneously, the unit will return to the Run Mode.

4. To change the preset value, depress the CLR button and enter new number. Example: Suppose "250" is the new batch size. Press CLR, then 2 , then 5 , then 0 . When the display holds the desired value, depress the ENT button. The new batch size will be stored in memory and simultaneously the DPF-310 will return to the Run Mode.

3-9 Frequently Asked Questions About Setting Up The DPF-310

Q. Is there any way to backspace if the wrong button is hit by accident?
A. No, you can depress the CLR button and start entering the number all over again or press ENT repeatedly until back in the Run mode and start over again from there.

Q. Is there any way to put a decimal point in a number such as a preset or K Factor?
A. Yes, simply press the D button after the digit that you would like the decimal point. It will appear to the right of the digit.

Q. Is there any way to enter a negative number for one of the Presets or K Factors?
A. No, negative values are not allowed.

Q. Is there any way to ruin the unit or completely erase it by entering a bad number?
A. No, if a number or entry is not valid the unit will ignore it or flash an error message.

Q. If the unit does not have serial communications or analog out, does the OUTCARD and ALG OUT sections of the menu still have to be set up?
A. No, there are default settings from the factory already in the unit. No setup of these menu items is necessary for normal operation.

Q. Does the DPF-310 have to be told what type of input it has connected to it?
A. No, The input signals are conditioned in hardware. This allows the input cards to be interchanged without modifying the software.

Q. If CLR is not pressed, numbers can still be written over the Presets or K Factors. Will these numbers be accepted if the ENT button is pushed?
A. No, in order for a Preset or K Factor to be changed, the old number must be cleared out first by depressing the CLR button.

3-10 Setup Procedure

MENU ITEM 1 **PRESET**

PRESS	DISPLAY
D	PRESET ↓
Menu Button.	
ENT	Flashing PRESET number.
Enters Preset Routine.	
CLR	0 Flashes.
Clears out existing PRESET.	
1 **2** **3** **4**	1234 PRESET Flashes.
Sample Preset.	
ENT	Last count, unit now in run mode.
Store new Preset.	

Final Preset is Set.

MENU ITEM 2 **PREWARN**

The Prewarn value is the amount before the Preset value that the Prewarn relay will deactivate. For example, if you want the Prewarn relay to drop out 10 counts before the Preset and your Preset is 1234, then set your Prewarn at 10 (not at 1224). Enter a Prewarn of "0" for the Prewarn and Preset relays to activate together. To disable the Prewarn relay, enter the same value for Preset and Prewarn.

PRESS	DISPLAY
D	PRESET ↓
MENU Button.	
D	PREWARN ↓
ENT	Flashing PREWARN number.
Enters Prewarn Routine.	
CLR	0 Flashes.
Clears out existing PREWARN.	
1 **2** **3** **4**	1234 Prewarn Flashes.
Sample Prewarn.	
ENT	Last count, unit now in Run Mode.
Store new Prewarn.	

The Prewarn is Set.

Note: Remember, if the prewarn is a larger number than the preset, then the warning "**PREWRONG**" will flash on the display. Enter a prewarn value that is less than or equal to the preset to clear this warning.

MENU ITEM 3 **PRE TYP**

This menu item is used to set up the Preset Type.

PRESS		DISPLAY
D		PRESET ↓
D		PREWARN ↓
D		PRE TYP ↓
ENT		STD PRE ↓ EZ PRE↓
Press D toggle between selections.		
ENT	Enters displyed selection	Run Mode

The PRE TYP is Set.

MENU ITEM 4 **COUNT**

Setting the Counter

PRESS		DISPLAY
D		PRESET ↓
D		PREWARN ↓
D		PRE TYP ↓
D		COUNT↓
ENT		K FACTOR
K FACTOR flashes then shows the current K Factor. Note: The K Factor setup is skipped if the unit has 16 Point option. The unit goes directly to R0 SP.		
CLR		0 Flashes.
Clears out existing K FACTOR.		
3 7 D 6		37.6 Flashes.
Sample K Factor, or enter calculated value from notes or worksheet.		

continued on next page

MENU ITEM 4 **COUNT** (continued)

PRESS	DISPLAY
ENT	R0 ↓ SP ↓
Store new K Factor.	

RO is Reset to zero. SP is Reset to Preset. This selection determines whether the unit counts up or counts down. If RO is selected (B is pressed), the unit will count in the "up" direction towards the Preset (dropping out the Prewarn, if passed). If SP is selected (D is pressed), the unit starts at the Preset and counts "down" towards zero (dropping out the Prewarn at its set value.)

B or D	Selects by moving the cursor under the arrow by **R0** or **SP**
ENT	DEC LOC
Store R0 or SP.	

DEC LOC allows the user to choose where the decimal point will be located when the Batch Count or Grand Total are displayed. The decimal point is for display only and does not affect K Factors. (The K Factor must be scaled to reflect the DEC LOC, see Section 7 for calculating the K Factors) Simply press the keypad numbers to move the decimal point. Only one decimal point can be displayed, multiple decimal points are not available. Pressing 0 turns off the decimal point.

4	DEC LOC
As an example, the decimal point will move to the right of the fourth digit from the right (displays units and thousandths).	
ENT	Run Mode.
Store new DEC LOC.	

The Counter portion of the DPF-310 is now set up.

MENU ITEM 5 **RATE**

Setting the Ratemeter

PRESS	DISPLAY
D	PRESET ⇓
D	PREWARN ⇓
D	PRE TYP ⇓
D	COUNT⇓
D	RATE⇓
ENT	K FACTOR

This selects the Ratemeter portion of the menu.
K FACTOR flashes then shows the current Ratemeter K Factor.
Note: The K Factor setup is skipped if the unit has 16 Point option. The unit goes directly to WINDOW.

CLR	0 Flashes.

Clears out existing K FACTOR.

1 2 D 0 5 6	12.056 Flashes.

Sample K Factor, or enter calculated value from notes or worksheet.

ENT	WINDOW ##

Store new K Factor.
Normally the ratemeter updates each second. If no signal comes in during that time, the ratemeter will wait until the window times out or a signal comes in; the display will not update. The window is the maximum sample time, in seconds, on which the waiting period is based. The range is from 02 to 24 seconds.

CLR	WINDOW 00

Clears out existing WINDOW number value.

5	WINDOW 05

As an example, extends the window to 5 seconds.

continued on next page

MENU ITEM 6 **RATE** (continued from previous page)
From the previous page, we are in the SIG FIG setting portion of the Ratemeter setup Menu.

PRESS	DISPLAY
ENT	SIG FIG ##
Store new WINDOW.	

SIG FIG indicates how many meaningful digits are shown. For example, if SIG FIG is set at three; a rate of 24737.89 will be displayed as 24700; a rate of 0.739216 will be displayed as 0.739. Note that trailing zeroes will be inserted only if necessary. Digits beyond the SIG FIG value are truncated and zeroes are inserted as needed, no rounding is done.

CLR	SIG FIG 00
Clears out existing SIG FIG number value.	
4	SIG FIG 04
As an example,	display will show 4 significant figures.
ENT	WEIGHT##

Store new SIG FIG.
WEIGHT is an averaging factor. Higher settings provide more averaging for a more stable rate display. Derived from:

$$\frac{\text{(OLD DATA • “WEIGHT” + NEW DATA)}}{\text{(“WEIGHT + 1)}}$$

CLR	WEIGHT 00
Clears out existing WEIGHT value.	
4	WEIGHT04
As an example,	
ENT	RUN MODE

The Ratemeter portion of the DPF-310 is now setup.

MENU ITEM 6 **LOCKOUT**

This menu item uses a 4 digit security code to prevent unwanted changes in the programming or improper use of the DPF-310. The unit is shipped from the factory with a security setting of 00 and a lockout code of 1000.

Security example: First set the security shut down time in the Lockout menu then go to the Run Mode. Press the START button. The word STARTED should briefly appear. If no signal comes in before the security time is reached, the unit locks and displays SECURITY. Once the unit locks all buttons except 0 thru 9 are disabled. To unlock the unit simply press in the lock-out code. When the unit is unlocked all menu features are available for change.

Lockout example: To lock the unit, first make sure it is in the Run Mode, then press 1 - 0 - 0 - 0. The words LOCK ON should briefly appear. Once the unit is locked:

a. Preset can still be accessed and changed.
b. Prewarn can still be accessed but cannot be changed.
c. the rest of the menu cannot be accessed.

To unlock the unit simply press 1 - 0 - 0 - 0. The words LOCK OFF will appear briefly. When the unit is unlocked all menu features are available for change.

To put in a different security time or lockout code follow this setup procedure.

PRESS	DISPLAY
D	PRESET ↓
D	PREWARN ↓
D	DEV TYP ↓
D	LOCKOUT ↓
ENT	SECUR ##

SECUR is the time, in seconds, that the unit will wait between pulses or for a signal to come in once STARTED. For example: The SECUR is set at 15, in run mode the START button is pressed. If at any time the unit does not receive a signal for 15 seconds the display will go to security and the unit will lock itself. The unit retains elapsed security time if STOPPED before security times out. When restarted, the unit resumes security timing from where it left off. As soon as a signal comes in the security time is reset. Entering a security time of 00 disables the security feature.

CLR	SECUR 00
Clears out existing security time.	
3 4	SECUR 34
As an example, unit waits 34 seconds before Security Mode.	

Continued on next page

From the previous page, we are in the **CODE** setting portion of the Lockout setup Menu.

PRESS	DISPLAY
ENT	CODE
Store new security time.	

Enters device routine to program in a 4 digit Lockout Code. The word CODE appears briefly then the current Lockout Code number is displayed.

CLR	0 Flashes.
Clears out existing Lockout Code.	

---

1 2 3 4	1234 Flashes.
Sample Lockout Code, or enter desired value from notes or worksheet.	
Be sure to record any changes in the lockout code in case it is forgotten!	

ENT	Last count, unit now in Run Mode.
Store new LOCKOUT Code. (Sample tryout below.)	

---

1 2 3 4	LOCK ON
Enter the sample / new value . . . the unit is now locked!	

---

1 2 3 4	LOCK OFF
Enter the sample / new value. . . the unit is now unlocked!	

The lockout procedure is finished.

MENU ITEM 8 **ALG OUT** (-A option)
This section is for models of the DPF-310 with the analog output feature. **The Analog Output card is a 4 - 20 mA current sink**. The low (0mA) or (4 mA) and high (20mA) settings may be set at any range. Attempting to set the high setting lower than or the same as the low setting will display the warning message HIGH ≤ LOW and send the unit back to the low setting section of the routine. The unit will not exit the ALG OUT routine until a proper setting has been entered. If the displayed rate is below the 4 mA setting, the current driver will stay at 4 mA. This allows for offsetting the low end of the output signal. If the displayed rate exceeds the 20 mA setting the current driver will stay at 20 mA.

Note: The current sink follows (tracks) the display.
The Analog Output option is not available on Square Law Analog Input units.

PRESS	DISPLAY
D	PRESET ↓
D	PREWARN ↓
D	DEV TYP ↓
D	LOCKOUT ↓
D	OUTCARD ↓
D	ALG OUT ↓
ENT	ANLG RT ↓
The analog output may correspond to the ratemeter or the totalizer. At this point, the selection is made by pressing ENT on the appropriate prompt. ANLG RT is the prompt for the rate meter. ANLG CT is the prompt for the batch totalizer.	
D	ANLG CT ↓
Press D to toggle between selections.	
ENT	SET LOW
Enters the routine for setting up the Analog Output card. SET LOW flashes then shows the 4 mA Setpoint value.	
CLR	0 Flashes.
Clears out existing Low Setpoint value.	
1 7 5 D 5	175.5 Flashes.
Sample Low Setpoint, or enter value from notes or worksheet. (D for decimal point.)	
ENT	SET HIGH
Low Setpoint is stored. SET HIGH flashes then shows the 20 mA Setpoint value.	

Continued on next page.

From the previous page, we are in the **SET HIGH** setting portion of the ALG OUT setup Menu.

PRESS	DISPLAY
CLR	0 Flashes.
Clears out existing High Setpoint value.	
6 7 5 9 D 5	6759.5 Flashes.
Sample High Setpoint, or enter value from notes or worksheet. (D for decimal point.) If High Setpoint is too low, the warning HIGH≤LOW will be displayed and the unit will return to the SET LOW routine.	
ENT	Last count, unit now in Run Mode.
High Setpoint is stored.	

Analog Output is set.

MENU ITEM 9 **OUT FREQ**

All models of the DPF-310 have a pulse generator built in to them. **This Output Frequency generator sends pulses out which are scaled relative to the input signal via the counter K Factor.** This means that for every time the counter increments a pulse is available at the output. Various output frequencies are available to the user for driving external devices. In case the rate exceeds the output frequency selected, a 9999 pulse buffer is provided to hold the excess pulses. If the buffer is completely filled the warning message DATALOST will flash on the display.

PRESS	DISPLAY
D	PRESET ↓
D	PREWARN ↓
D Press until . . .	OUT FREQ ↓
ENT	20000 ↓
Enters the routine for setting up the Frequency Output. The display shows the last Frequency selection.	
D	2000 ↓
D	200 ↓
D	10 ↓
Press D to go to 20000 ↓ Press ENT at desired Frequency.	
ENT	Last count unit now in Run Mode.

Pulse Output is now set.

MENU ITEM 10 **16 POINT** (-LIN option)

This section is for models of the DPF-310 which have 16 Point Linearization. **This option allows the user to key in from 3 to 16 different frequency points (inputs per second) and assign different K Factors dividers from 0.00011 to 999999 for each of these frequencies.**

Please refer to the K Factor worksheets (Section 7) or other notes you may have prepared.

PRESS	DISPLAY
D	PRESET ↓
D	PREWARN ↓
D Press until . . .	16 POINT ↓
ENT	SECONDS ↓
D	MINUTES ↓
D	HOURS ↓

The unit calculates the base rate per second from the incoming frequency and the specified K Factor. The rate can then be displayed in 3 ways:
SECONDS: The base rate.
MINUTES: The base rate times 60.
HOURS: The base rate times 3600.

D TEST ↓

TEST is used to help set up the points and K Factors. In this mode the K Factor is automatically set to (1) one for both rate and total for all 16 points. Further information on this mode can be found in Section 7-3 of this manual.

ENT POINT 00

Press ENT on desired rate display. The unit now enters the Frequency and K Factor setup mode.

To escape from this mode, press ENT when POINT 00 is being displayed.
Enter any other point from 1 to 16 via the front keypad and press ENT to continue.
Note: If the point number entered is greater than 16, the unit will default back to point 16.

Continued on next page.

From the previous page, we are in the **POINT** setting portion of the 16 Point setup Menu.

PRESS	DISPLAY
1 then **ENT**	POINT 01
ENT	F 1
The unit displays the last frequency entered for Point 01.	
CLR	F 0
Clears out existing frequency for Point 01.	
1 **0** **0**	F 100
Sample frequency, or enter desired value from worksheets.	
ENT	K 1
The unit displays the last K Factor entered for Point 01.	
CLR	K 0
Clears out existing K Factor for Point 01.	
1 **0**	K 10
Sample K Factor, or enter desired value from worksheets.	
ENT	POINT 02
The above procedure is now repeated for Point 02. The setup continues in this manner until up to 16 points are entered.	

Note: A minimum of (3) three points must be entered. All frequencies of consecutive point numbers must be entered in ascending order, beginning with 0 for the first point.

Please read Section 7-3 for all rules concerning 16 Point Frequency and K Factor entry.

PRESS	DISPLAY
CLR	POINT 00
Clears Point number in preparation for exit of 16 Point setup routine.	
ENT	Last count, unit now in Run Mode.
Press ENT on Point 00 to exit 16 Point routine.	

Note: Unit will flash BAD FREQ if there is a sequence error. The unit will then display the sequence error point number so that corrections can be made.

16 Point linearization is now setup.

3-11 Run Mode

3-11.1 The Display

In the Run Mode the display will initially display:

a) Zero, if setup to reset to zero.
b) Preset number, if set to reset to preset .
c) A warning message (See Section 6-1)

The unit will accept input signals and display Rate, Batch Total or Grand total.

The Batch Total is displayed as a number.
The Rate is displayed as "R" followed by a number.
The Grand Total is displayed as a flashing number.
(The Grand Total flashes so that it will not be confused with the Batch Total.)

To toggle between the Rate and Batch Total, press the C button. Press the ENT button at any time to view the Grand Total, then press it again to go back to the Rate or Batch Total.

3-11.2 Resetting (Clearing) the Totalizers.

To clear the Batch Totalizer,

a) the unit must be in the Run Mode.
b) the unit must be displaying the Batch Total.
c) the unit must not be locked out.*

If the above conditions are met, press the CLR (clear) button. The display should then show the preset or zero depending on how the unit is configured.

To clear the Grand Totalizer,

a) the unit must be in the Run Mode.
b) the unit must be displaying the Grand Total.
c) the unit must not be locked out.

If the above conditions are met, press the CLR button. The display should then show zero.
* The unit may be reset if it is locked out by putting a 3-30 VDC signal to pin 5 on the rear of the unit.

3-11.3 Locking the Unit

The unit is shipped from the factory unlocked. To lock the unit, it must be in the Run Mode. The unit is shipped from the factory with a Lockout Code of 1000.

As a test, when you receive the unit, power it up and press 1 then 0 three times. The display should briefly show LOCK ON. This means that the unit is now "locked out". Press 1 then 0 three times again. The display should then show LOCK OFF briefly. This means that the unit is now unlocked.

What LOCK ON or "Locked Out" means:

a) the Grand Totalizer cannot be reset.
b) only the preset can be accessed and changed.
c) the prewarn can be accessed but **not** changed.
d) the rest of the Menu cannot be accessed.

The unit will still:

e) accept input signals
f) display Rate, Batch Total and Grand total.
g) have Start, Stop and Rate/Total buttons enabled.

LOCK OFF means that the unit functions normally as described in this manual.

The Lockout code can be changed or viewed by accessing Lockout in the setup Menu. (See Section 3-3; Menu Item 4; Lockout.) The unit must Unlocked to do this so be sure to record any Lockout code changes in case it is forgotten.

The Lock toggles back and forth from LOCK ON to LOCK OFF each time the code sequence is entered. The last four digits pressed, while in the Run mode, are the ones that the unit checks for Lockout code sequence. For example: while 1000 will unlock/lock a new unit from the factory, so will the number 347191000 (the last four digits are the code sequence, so, this number works also!).

RECORD ALL LOCKOUT CODE CHANGES.

3-11.4 Start and Stop Operation.
The DPF-310 is designed for batching operations. The batching operation is controlled by two internal relays, Preset and Prewarn settings and the CLR , START and STOP buttons on the front panel.
A typical operation proceeds as follows:

- **a)** The Preset is accessed and changed to the amount desired.
- **b)** The unit accepts input signals
- **c)** The CLR button is pushed to reset the Batch Totalizer.
- **d)** The Start button is pushed and the process begins.
- **e)** The Stop button can be pushed at any time to temporarily halt the process (the Start button resumes it from where it stopped).
- **f)** The display shows Rate, Total or Grand Total.
- **g)** The Prewarn is reached and the process is slowed down.
- **h)** The Preset is reached and the process is halted.

The DPF-310 will always accept input pulses whether the unit is Started or not! All pulses on the input terminal are counted and shown on the display. This means that all pre-run and post-run pulses will be recorded. For this reason, always press the CLR button before start.

The START button energizes the Preset and Prewarn relays.
The STOP button de-energizes the Preset and Prewarn relays.
(The CLR button is discussed in section 3-11.2.)

The START button initiates the batch sequence. Once the unit is started:

- **a)** The display will prompt the operator with the word STARTED.
- **b)** Both relays will engage (Unless the Prewarn has been reached already).
- **c)** All buttons on the front panel will be locked out except the STOP button and ENT button which allows access to the Grand Totalizer.

NOTE: Once both Prewarn and Preset points are reached, the unit cannot be started until it receives a reset signal or the CLR button is pressed.

The STOP button is used to stop a batch that has already started. When the STOP button is pressed:

- **a)** The display will prompt the operator with the word STOPPED.
- **b)** The Preset and Prewarn relays will de-energize.
- **c)** The unit will still accept input pulses.
- **d)** All buttons on the front panel will be usable.
- **e)** The unit may be restarted by pressing the START button.

3-12 Internal Operation

3-11.1 Digital Inputs and Computations

The 3-30 Volt input signal is filtered electronically (See Section 4-1, Digital Pulse Inputs).

Computations:

$$\frac{\text{Pulses In}}{\text{Count K Factor}} = \text{Count}$$

$$\frac{\text{Pulses In}}{\text{Rate K Factor}} = \text{Rate}$$

Batch Total = $\sum$ Count (since last Batch Reset)

Grand Total = $\sum$ Count (since last Grand Total Reset)

$$\textit{Rate} = \frac{\text{Rate}}{\text{Tau}}$$

Tau = 1 sec or WINDOW if (Rate / 1 sec) = 0
(See Sections 1-3 and 3-10, Setting the Ratemeter)

Frequency Out = Count
(Sequenced out as per OUT FREQ selection and buffered to 9999 pulses)
(See Sections 1-3 and 3-10, OUT FREQ)

$$\textit{Analog Out} = \frac{(\textit{Rate} - \text{SET LOW}) \times 16 + 4}{(\text{SET HIGH} - \text{SET LOW})}$$

(See Sections 1-3 and 3-10, ALG OUT)

Prewarn Out =
Count ≥ Preset - Prewarn (if Reset to 0)
Count ≤ Prewarn (if Reset to Preset)

Preset Out =
Count ≥ Preset (if Reset to Zero)
Count ≤ 0 (if Reset to Preset)

3-12.2 Analog Inputs and Computations

The Analog input signal is filtered electronically and converted to a 0 - 10000 Hz input frequency. (See Section 7, K Factor Calculation and Section 4-2, Analog Inputs).

Computations:

$$\frac{\text{Pulses In}}{\text{Count K Factor}} = \text{Count}$$

$$\frac{\text{Pulses In}}{\text{Rate K Factor}} = \text{Rate}$$

Batch Total = $\sum$ Count (since last Batch Reset)

Grand Total = $\sum$ Count (since last Grand Total Reset)

$$\textit{Rate} = \frac{\text{Rate}}{\text{Tau}}$$

Tau = 1 sec or WINDOW if (Rate/1 sec) = 0
(See Sections 1-3 and 3-10, Setting the Ratemeter)

Frequency Out = Count
(Sequenced out as per OUT FREQ selection and buffered to 9999 pulses)
(See Sections 1-3 and 3-10, OUT FREQ)

Prewarn Out =
Count ≥ Preset - Prewarn (if Reset to 0)
Count ≤ Prewarn (if Reset to Preset)

Preset Out =
Count ≥ Preset (if Reset to Zero)
Count ≤ 0 (if Reset to Preset)

SECTION 4 INPUTS

4-1 Digital Pulse Inputs DPF-311 (Terminal 4)

Digital Pulse Inputs: The input board is a separate board that is plugged into the mother board just behind the display. All digital inputs are on the same board. There are four dip switches on the board. The input conditioning characteristics may be altered by changing the dip switches. A valid pulse is one which makes a transition from the off state (low) to the on state (high): a positive going edge. The off state is 0 - 1 VDC with respect to Terminal 12 (Ground). The on state is 3 - 30 VDC with respect to Terminal 12. The input impedance is 10 K ohms. At 30 VDC, the current draw will be 3 mA. This should be the maximum current that the DPF-310 will draw. Acceptable pulse width is determined by the dip switch settings (See Table 4-1 below).

DIP SWITCH SETTINGS

SW1	SW2	SW3	SW4	Conditioning
ON	ON	---	---	0-40 Hz min. 12.5 msec on/off
ON	OFF	---	---	0-400 Hz min. 1.25 msec on/off
OFF	OFF	---	---	0-20000 Hz min. 0.25 usec on/off
---	---	OFF	OFF	needs sourcing input (drive input high)
---	---	OFF	ON	needs sinking input (pull input low)

Table 4-1

4-1 Digital Pulse Inputs (continued)

4-1.1 STANDARD: High Impedance (Terminal 4).
Has a 10 K Ohm pull down resistor to ground (Terminal 12) and must be driven high. Typical drivers include a contact closure from a 3-30 VDC source (such as Terminal 13), a PNP transistor (proximity switch or other device) or an amplified signal from an inductive pickup. Remember, the input signal must be referenced to Terminal 12 of the DPF-310. (See Section 2-5, Fig. 2-2 Typical Digital Wiring Connections)

4-1.2 High Impedance with pull-up (Terminal 4).
Has a 4.7 K Ohm pull up resistor to +5 VDC and must be pulled low. Typical drivers include a contact closure to Ground (such as Terminal 12), or an NPN transistor (proximity switch or other device). Remember, the input signal must be referenced to Terminal 12 of the DPF-310. (See Section 2-5, Fig. 2-2 Typical Digital Wiring Connections)

Idea: This input works well with TTL devices.

4-1.3 Reset Input (Terminal 5)
Identical to the Standard, High Impedance Input with one exception. The input speed is fixed for a minimum pulse width of 5 msec.
Note: The reset input will not be changed to a sourcing type of input even if the dip switch is set for pull up or is changed to the pull up settings.

4-2 Analog Inputs DPF-312 (Terminal 4)

The input signal modules are mounted, just like the Digital board, behind the display. Analog inputs all use the same board, likewise so do the Analog-In/Out inputs. These boards are not field modifiable (unlike the Digital board). Each board is calibrated at the factory for its particular input type.

4-2 Analog Inputs (continued)

4-2.1 4-20 mA; 250 input impedance.

The above input takes the analog signal and scales it from 0 to 10000 pulses per second by using a highly linear voltage to frequency converter. These pulses go to the processor to be scaled by the K Factors. To determine the K Factor, see Section 7, Calculating the K Factor.

4-2.2 Analog Inputs Calibration
(All units have been calibrated at the factory)

Warning: This unit contains static sensitive components. Observe proper precautions!

- **a)** Set the ratemeter at 6 SIG FIG; the window at 01; and the K Factor at 1.00.
- **b)** Remove the case and locate the analog input card mounted behind the display (see Section 6-3).
- **c)** Locate the two 0.3 inch square pots R3 and R15. These numbers should be silkscreened underneath them on the board.
- **d)** Input a very accurate low signal and adjust R3 (left side from the front) so that the display reads .0001 to 0000.
- **e)** Input a very accurate high signal and adjust R15 (right side from the front) so that the display reads 9999 to 10000.
- **f)** Repeat steps **d** and **e** until the unit is reading as close as possible to 0000 on the low side and 10000 on the high side. This should only take a few tries.
- **g)** Re-case the unit and setup the Menu as desired.

If problems occur during calibration please contact the factory for exchange or to arrange for factory calibration.

4-3 DC Power Inputs (Terminals 12, 14)

The DPF-310 may be powered by an external DC power supply. The supply must provide 12 - 27 Volts DC and at least 280 mA of current. The positive side (+DC) of the DC supply should be hooked to Terminal 14 and the negative (or Ground) side to Terminal 12.
NOTE: Units powered by DC Voltages do not have an isolated voltage out on Terminals 15 and 16 or +12 VDC on Terminal 13.

4-4 AC Power Inputs (Terminals 17, 18)

The DPF-310 may be ordered for 110 or 220 VAC power. The unit requires single phase 50/60 Hz AC power.
The voltage range is ±15% of the rated voltage. Voltages below this range will not power the unit. Voltages above this range may damage the unit. The DPF-310 is relatively immune from electrical noise on the AC lines. However, in extremely noisy applications some line conditioning or filtering may be necessary. If fusing is required, external fusing must be supplied.
Note: The DPF-310 has no internal fuse to blow out. If the unit does not function when power is applied, contact the factory for assistance or to arrange for repair.

Caution: An external fuse is required:
DC Power: 0.5 Amp
AC Power: 0.125 Amp

SECTION 5 OUTPUTS

The DPF-310 has three different possible types of outputs for controlling external devices or monitoring the rate and totals. They are: Frequency Output, Relay Outputs and optionally available Analog Output.

5-1 Frequency Output (Terminal 2)

5-1.1 Electrical Characteristics of Frequency Output

The DPF-310 generates a pulse out for each factored count. A sinking NPN transistor output (see Figure 5-0.1), can drive external devices at various rates selected through the keypad menu see Table 5-0.2 below). The Open Collector sinks 30 VDC maximum to 1 volt maximum with a maximum current of 100 mA.

Speed (Hz)	10	200	2000	20000
Min. on/off (msec)	47.5	2.0	0.2	0.013

Table 5-0.2

Applications: Remote totalizers, ratemeters or other monitoring devices.

10 Hz: Electromechanical totalizers
Programmable Controller inputs

200 Hz: Electronic totalizers
Programmable controllers with high speed input cards.

2000 Hz: High speed totalizers.

20000 Hz: High speed totalizers.

5-1.2 Internal Buffer for Frequency Output

An internal buffer will store up to 9,999 counts if the scaled input generates pulses faster than the output speed selected. The warning message "DATALOST" flashes on the screen when the buffer overflows (see Section 6-1, Warning Messages). This indicates that the counts being totalled and the scaled outputs may be incorrect.

Note: All counts stored in the internal buffer will be pulsed out at the selected frequency even if the counter is reset before it is finished sending them.

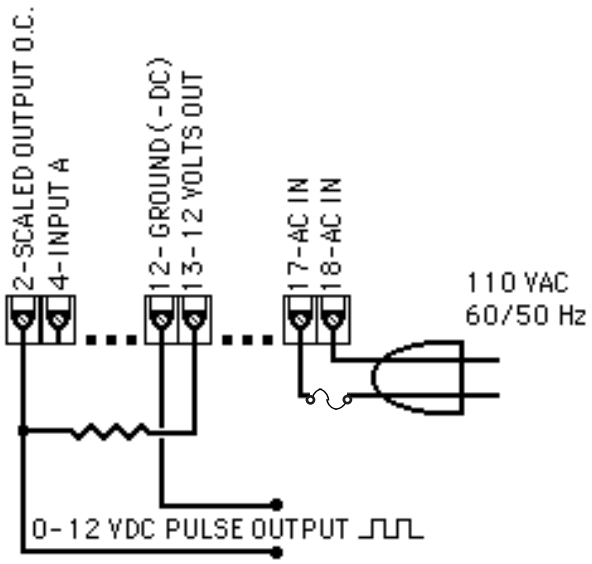


Figure 5-0.1

5-2 Control Outputs

5-2.1 SPDT Relay Version (Standard)

When the start button is pushed, the two relays engage simultaneously to start flow. When the prewarn number is reached, one relay drops out. When the preset number is reached, the other relay drops out. The user may enter the two numbers when setting up the batch counter (see Section 3-3, Menu Items 1 and 2). The contacts are rated at 10 A, 120/240 VAC or 28 VDC.

5-3 Analog Output (-A option) (Terminal 3)

5-3.1 Electrical Characteristics of Analog Output

The Analog Output option is controlled by an Open Collector transistor, it gives a linear 4 to 20 mA sink which corresponds to displayed rate or total readings. A sinking driver pulls a current to ground, across the user's external device (such as a strip chart recorder, computer, external meter, etc). In the Setup mode the user is prompted to set the output to correspond to rate or total and set the low and high (4 to 20mA) parameters to which the analog signal will correspond.

Idea: The DPF-310 can supply the 24VDC to power the current loop. (Connect pin 15 to 13, Pin 16 is now +24 VDC with respect to pin 12.) Connect Pin 16 to the + DC side of the external device and connect Pin 3 to -DC side of the external device (see Figure 5-2.1).

5-3 Analog Output (-A option) (continued)

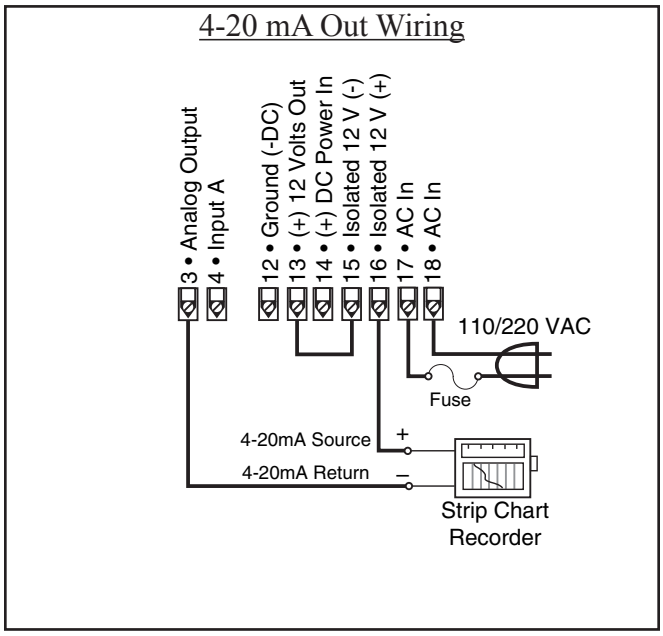


Figure 5-2.1

SECTION 6 TROUBLE SHOOTING AND MAINTENANCE GUIDE

6-1 Warning Messages

6-1.1 PREWRONG

Indicates that the values in Preset and Prewarn are not acceptable. This condition will occur when the Preset value is less than the Prewarn value. The display will continue to display this message until the error is corrected. To change the Preset and Prewarn values see Section 3-3, Setup Procedure.

6-1.2 DATALOST

Warning message that indicates the unit is receiving pulses faster than 20000 pulses per second or the data buffer is full. In either case the display will not show the proper count or rate and the frequency output will be inaccurate. There are three possible remedies:

- **a)** Check to see that your input is not exceeding the DPF-310 ratings of 20 KHz Max. Input speed.
- **b)** Change your OUT FREQ settings to handle a higher count speed (Section 3-3, Menu Item 7).
- **c)** Change your count K Factor to a larger number, since the output frequency is based on the factored count (Section 3-3, Menu Item 3).

6-1.3 RFFFFFFF

Indicates that the factored input rate has exceeded a 7 digit number. The ratemeter cannot handle numbers larger than 7 digits (i.e. 9999999). Change the Rate K Factor to a larger number (Section 3-3, Menu Item 3) to correct this problem.

6-1.4 LOCK ON

Indicates that the unit has been locked out! The unit must be unlocked before any changes can be made. See Section 3-3, Menu Item 4 to unlock the unit.

6-1 Warning Messages (continued)

6-1.5 BAD FREQ

Indicates that the values in the 16 Point setup are not acceptable. This condition will occur when the frequency values are not in ascending order. The display will continue to display this message until the error is corrected. To correct the error see Section 3-3, Setup Procedure.

6-1.6 SECURITY

Indicates that no signal has come in for the duration time set in the Lockout menu. Lockout code must be entered before the unit will continue. Section 3-3, Setup Procedure.

6-2 Troubleshooting

6-2.1 General

The following troubleshooting procedures have been developed as an aid in locating defects. Not every possible problem has been listed, but a general isolation procedure for tracking down problems has been given. A standard recommendation is the removal of power for 2 seconds. This allows the microprocessor to go through a reinitialization cycle at power up. If it is determined that the unit is faulty, contact your local Factory Representative or Sales Office concerning replacement. The DPF-310 is not field serviceable and all repairs should be performed by the factory.

6-2.2 Problems

Symptom: **Display will not light.**

Possible Cause: No power to unit, power to unit not to specifications or bad connection between display board and mother board.

Test Procedure: See Specifications Section 1-4 for proper input voltages. Then;

a) Check AC voltage input on terminals 17 & 18.

b) (if DC Powered unit) Check DC voltage input on terminals 12 & 14.

c) Check connection of display board to mother board

Corrective Action: If all checks okay, replace unit.

6-2.2 Problems

Symptom: **Unable to start batch.**

Possible Cause #1: Displayed Batch count already exceeds the Preset value.

Test Procedure: Check Preset value against the displayed value. If the Preset is less, go to corrective action.

Corrective Action: Reset the unit by pressing the CLR button or change the Preset to a larger value.

Possible Cause #2: Incorrect programming.

Test Procedure: Check for programming errors, review manual.

Corrective Action: Reprogram unit as required.

Possible Cause #3: Defective Circuit board or component.

Test Procedure: Press the Start button and check for relay action. An OHM meter across the appropriate relay terminals should give the proper indication. (Be sure to disconnect all power to the relay terminals first!)

Corrective Action: If no relay action replace unit.

Symptom: **Unit not totalizing.**

Possible Cause #1: Incorrect programming.

Test Procedure: Check for programming errors, review manual. For Example, if the K Factor is too large it may take some time before a count is registered on the display.

Corrective Action: Reprogram unit as required.

Possible Cause #2: Input signal invalid.

Test Procedure: See Specifications Section 1-4 for proper input signals. Then use oscilloscope to;

a) Check Analog input on terminals 3 and 12 for proper current or voltage levels.

b) (if Digital unit) Check Digital voltage input on terminals 3 and 12.

Corrective Action: If inputs check okay, replace unit.

6-3 Removing the Case

To install or change the input or data interface cards, the case must be removed. **Remove all power before opening the case.** CMOS logic is used so observe standard precautions against damage by static discharge. Next, remove the six (6) flat head screws behind the front bezel and lift off the bezel assembly. Slide the main board display out the front of the case by pushing from the rear. Once modifications are made, reverse the procedure to reassemble the unit. Make sure that the main board is in the track. The six (6) screws that hold the panel must be tight to seal the rubber keypad panel assembly, approximately 0.6 in-lb torque.

6-3.1 Input Card Modification

Follow the instructions for removing the case in Section 6-3. The Input card is mounted just behind the display and plugs onto the 15 pin post connector. Remove the board and make desired changes. When installing the Input card, make sure that the component side of the board is facing the front and that the 15 pin connector is mated properly and not offset to the side. Replace the front panel per Section 6-3.

6-4 Maintenance

The DPF-310 does not require any "Routine Maintenance" by the user. If a problem should occur, and all troubleshooting procedures have been exhausted, contact your local representative (phone number on cover of manual).

SECTION 7 CALCULATING THE K FACTORS

7-1 General

The key to accurate flow measurement with the DPF-310 is correct scaling. The electronics of the unit have been designed for stability and repeatability. Even the finest measuring device and equipment cannot make up for improper factoring and programming. Due to the complexity of the concept of K Factors, this special section has been provided for those who still find it hard to understand. A separate worksheet has also been provided with this manual to help in calculating the K Factors. It is hoped, that between this section of the manual and the worksheet, that any questions you may have, regarding the K Factor, will be answered.

7-1.1 What is a K Factor?

The K Factor is a divider. This means that if the K Factor is greater than 1, it will diminish any input signal. Conversely, if it is less than 1, it will increase any input signal. The K Factor range of the DPF-310 is from 0.0001001 to 99999999. This allows a wide range of factoring from greatly increasing (to display a large value) to decreasing the input (to display a very small value).

7-2 Calculating the K Factors.

The following steps are the recommended procedure forcalculating the K Factors. Take your time and go through the procedure slowly at first. After several tries you should be fairly adept at calculating the K Factor for any given input.

7-2.1 Calculating the K Factor for Digital Pulse Inputs.

Given the sensor K-factor and desired decimal point position for the Total (Count) display calculate the K-Factor as follows:

Step 1. From the documentation provided with the flow sensor, determine the average sensor K-factor.

Example : Sensor K-factor = 122 pulses/gallon which means the sensor produces 122 pulses for each gallon passing through the flowmeter.

Step 2. Determine the necessary DPF for the desired total decimal point location you wish to use in displaying total on the instrument from the following table:

DPF Table

Desired Total Decimal Location:	**DPF**
XXXXXX.	1
XXXXX.X	10
XXXX.XX	100
XXX.XXX	1000
XX.XXXX	10000
X.XXXXX	100000

Example: for X.X, DPF = 10

Step 3. The Count K Factor may be computed as follows:

$$\text{Count K-Factor} = \frac{\text{Sensor K-Factor}}{\text{DPF}}$$

Example: Count K-Factor of 122/10 = 12.2

Step 4. Enter the Count K-Factor as described in Section 3-3 referencing the Programming Flowchart (3-4) as needed.

Step 5. Determine the necessary TF (time factor) given the flow rate time base you wish to have displayed on the device using the following table:

TIME FACTOR (TF) TABLE

Rate Display Desired	**TF**
Rate / second	1
Rate / minute	60
Rate / hour	3600
Rate / day	86400

Example: For display of rate per minute; TF = 60

Step 6. Compute the Rate K-Factor from the average sensor K-Factor and the TF selected.

$$\text{Rate K-Factor} = \frac{\text{Sensor K-Factor}}{\text{TF}}$$

Example: Rate per minute:

$$\text{Rate K-Factor} = \frac{122}{60} = 2.0333$$

Step 7. Enter the Rate K-Factor as described in Section 3-3 referencing the Programming Flowchart (3-4) as needed.

7-2.2 Calculating the K Factor for Analog Inputs.

Obtain the Flow Rate value that corresponds to the meters full scale signal. This should be specified on your device or with its paper work.

Example: 20 mA = 200 Gal / min

The unit converts the analog input span to a 0-10000 Hz frequency. Given the full scale flow rate that corresonds to the analog input span, and the Time Factor (TF) that corresponds to the equivalent flow rate time base, the K-Factors can be calculated as follows:

Step-1 Calculate the equivalanet sensor K-Factor as follows:

$$\text{Equivalent Sensor K-Factor} = \frac{10000 * TF}{\text{Full Scale Flow Rate}}$$

Example: 4 to 20 mA corresponds to 0-200 Gal/min

$$\text{Equivalent Sensor K-Factor} = \frac{10000 * 60}{200}$$

= 3000 pulses/gal

Step 2. Determine the necessary DPF for the desired total decimal point location you wish to use in displaying total on the instrument from the following table:

DPF Table

Desired Total Decimal Location:	**DPF**
XXXXXX.	1
XXXXX.X	10
XXXX.XX	100
XXX.XXX	1000
XX.XXXX	10000
X.XXXXX	100000

Example: for X.X, DPF = 10

Step 3. The Count K Factor may be computed as follows:

$$\text{Count K-Factor} = \frac{\text{Sensor K-Factor}}{\text{DPF}}$$

Example: Count K-Factor of 3000 /10 = 300

Step 4. Enter the Count K-Factor as described in Section 3-3 referencing the Programming Flowchart (3-4) as needed.

Step 5. Determine the necessary TF (time factor) given the flow rate time base you wish to have displayed on the device using the following table:

TIME FACTOR (TF) TABLE

Rate Display Desired	**TF**
Rate / second	1
Rate / minute	60
Rate / hour	3600
Rate / day	86400

Example: For display of rate per minute; TF = 60

Step 6. Compute the Rate K-Factor from the average sensor K-Factor and the TF selected.

$$\text{Rate K-Factor} = \frac{\text{Sensor K-Factor}}{\text{TF}}$$

Example: Rate per minute:

$$\text{Rate K-Factor} = \frac{3000}{60} = 50$$

Step 7. Enter the Rate K-Factor as described in Section 3-3 referencing the Programming Flowchart (3-4) as needed.

7-3 Calculating 16 Point (-LIN option) K Factors

Units equipped with the 16 Point option allow the user to enter in from 3 to 16 different frequency points (inputs per second) and assign different K Factor dividers from 0.00011 to 999999 for each of these frequencies. The 16 Point unit determines the incoming frequency and calculates a K Factor line slope from the two closest data points that had been entered. The specific K Factor is then proportionally interpolated using 8 position floating math. This K Factor is applied to all inputs until the next frequency calculation, usually 1 second later. If a 0 frequency is entered into point 1, the point 1 K factor will be applied to all inputs received before the first frequency calculation.

In order to keep track of data, each Frequency / K Factor data entry is assigned a point number. Any point number may be selected to view and / or change the Frequency / K Factor data as long as the frequencies of the ascending point numbers are also entered in ascending frequencies.

7-3.1 Some Notes on 16 Point Setup

1) The unit will not accept a K Factor of (0) zero. If a zero is entered the unit automatically puts a (1) one in its place. Division by zero is not allowed.

2) Point 01 will be the low shut-off frequency. Below this frequency no rate will be displayed nor count recorded. Point 01 should be assigned a frequency of (0) zero with a K Factor for lowest flow especially if very slow flow is to be counted.

3) The entry of a frequency of (0) zero for Point 03 or above will tell the unit to continue the K Factor slope line calculated from the two previous Frequency / K Factor points and ignore any higher point data. If a fixed K Factor is desired, assign the same K Factor to two ascending frequency points and enter a frequency of (0) zero in the next higher point entry.

4) Extrapolated K Factors are always positive numbers. Make sure that the last two points do not project the K Factor slope towards zero.

5) The dummy decimal point is still set up with DEC LOC menu under DEV TYP. However, the auto-ranging decimal point in the rate display will be shifted to the left as the dummy decimal is shifted to the left. This is so that the rate display will be as same as the count. For example: The input pulses are coming in at 100 pulses per minute. The decimal point is set at (1) one (DEC LO.C). At the end of one minute the count will read 10.0. During the minute the rate will read 10.0 while it would show 100.0 if no decimal point were added.

7-3.2 Test Mode Operation and K Factor Calculation

A special TEST mode can be accessed through the 16 Point setup menu. This is used to help set the points and K Factors as well as calibration of the metering device. If TEST is selected, the K Factor is set to (1) one for all frequencies. Thus, the totalizer will accumulate one count for each incoming pulse. Below are steps for calculating the K Factors with pulsing devices or analog transmitters.

1) Set the 16 Point unit to TEST and press ENT on POINT 00 to go to the run mode.

2) At the lowest desired flow rate, reset the counter and let the unit count the incoming signal while the rate displayed is recorded.

3) Interrupt the input signal when the known tested amount has gone through the metering device. Switch to count display and read the number of counts that came in from the known volume as displayed on the unit. Divide the counts by the volume that passed through the meter to determine the number of counts for 1 unit of measure, gallon, cubic feet, etc.

4) Record this frequency and K Factor for later entry into Point 01 or Point 02. (See 7-3.1 Note 2 to determine if the data should be entered in point 1 or 2)

5) Assign ascending point numbers to corresponding ascending frequencies when recording Frequency / K Factor data. Repeat process until desired number of points are set up.

8 Programming Worksheet

Model # _____
Serial # _____
Unit # _____

PRESET _ _ _ _ _ _ _ _
PREWARN _ _ _ _ _ _ _ _
PREset TYPe ☐ **EZ PRE** ☐ **STD PRE**

COUNTer
K-FACTOR _ _ _ _ _ _ _ _
Reset to 0 ☐ Set to Preset ☐
Decimal Location (0-8)

8	7	6	5	4	3	2	1	0	
☐	☐	☐	☐	☐	☐	☐	☐	☐	None

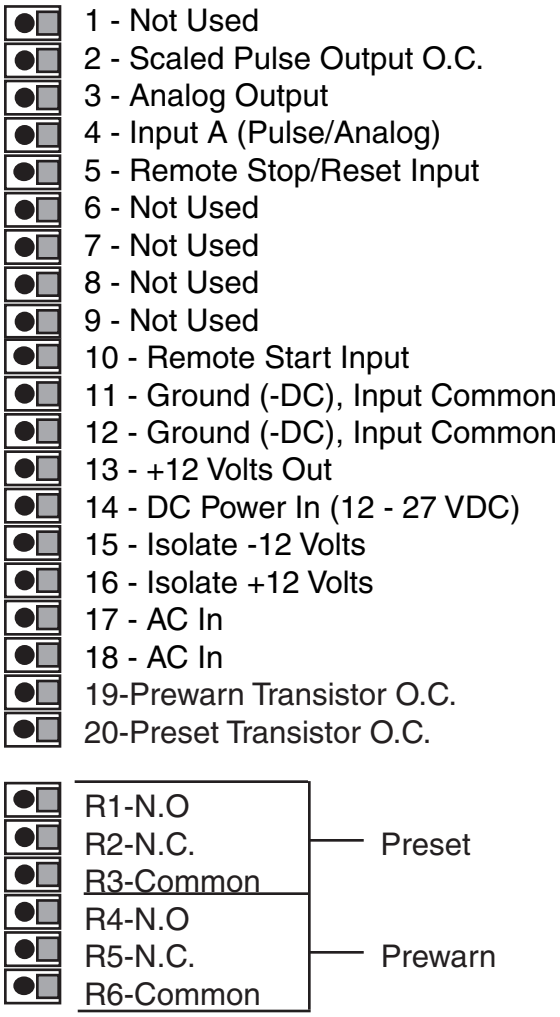
RATEmeter
K-FACTOR _ _ _ _ _ _ _ _
WINDOW (02-24) _ _
SIGnificant FIGures (1-6) _
WEIGHT (00-99) _ _

Lockout Code
SECUR _ _
CODE _ _ _ _

Analog Output (-A option) (If applicable)
Rate ☐ Count ☐
SET LOW 4 mA= _ _ _ _ _ _ _ _
SET HIGH 20 mA= _ _ _ _ _ _ _ _

OUTput FREQuency
20000 ☐
2000 ☐
200 ☐
10 ☐

Terminals



WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

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

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

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

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

Shop online at www.omega.com

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gages
- Load Cells & Pressure Gages
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments