KEPtrol F/C

Net Ratemeter & Net Totalizer

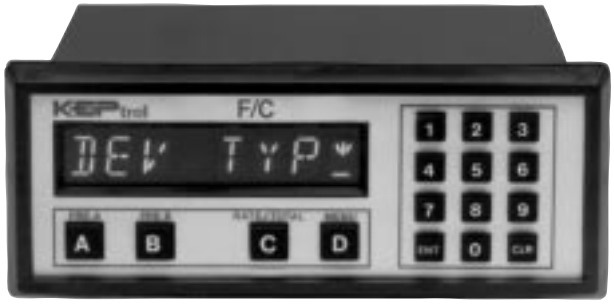
Kessler-Ellis Products Co.

Description

The KEPtrol F/C is designed to measure the net flow of boiler fuel. Separate K-Factors can be entered for A and B inputs. Two SPDT relay alarm outputs are standard. A scaled pulse output is standard for interfacing with remote devices. An analog output option is also available to interface with strip chart recorders.

Features

- ❑ Flow (A) - Flow (B) Displays Net Rate & Net Total
- ❑ Pulse Input to 10 kHz Count Frequency
- ❑ Separate K-Factors for A & B Inputs
- ❑ Set Point Alarms
- ❑ NEMA 4X / IP65 Front Panel



KEPtrol F/C

Application

The unit is normally used to measure the net flow of boiler fuel. The display may be toggled between net rate, and net total. Two programmable K-factors make keying-in engineering units easy. The unit accepts pulse or contact closures and provides two separate preset controls.

kep·com

http://www.kep.com

KESSLER-ELLIS PRODUCTS
10 Industrial Way East
Eatontown, NJ 07724
800-631-2165 • 732-935-1320
Fax 732-935-9344

SAFETY INSTRUCTIONS

The following instructions must be observed.

- This instrument was designed and is checked in accordance with regulations in force EN 60950 (“Safety of information technology equipment, including electrical business equipment”).
  A hazardous situation may occur if this instrument is not used for its intended purpose or is used incorrectly. Please note operating instructions provided in this manual.

- The instrument must be installed, operated and maintained by personnel who have been properly trained. Personnel must read and understand this manual prior to installation and operation of the instrument.

- The manufacturer assumes no liability for damage caused by incorrect use of the instrument or for modifications or changes made to the instrument.

Technical Improvements

- The manufacturer reserves the right to modify technical data without prior notice.

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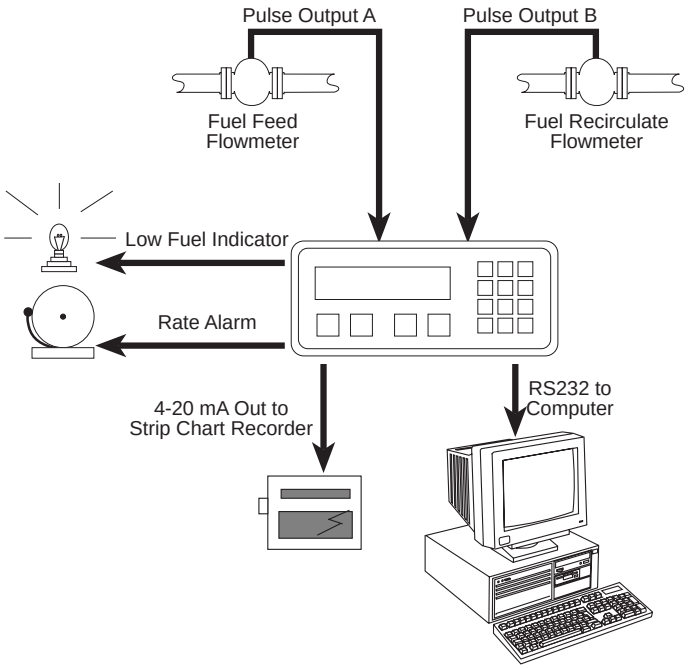
SECTION 1 INTRODUCTION

1-1 General Description

The two-setpoint, electronic, controller, is a microprocessor-based,panel-mounted, instrument. It is designed to be used in conjunction with primary flow sensors which have pulse or contact closure output. The main function of the unit is to provide net rate of flow, net totalization and control of process batch size and/or flow.

1-2 Typical Application



The above application is a boiler fuel consumption monitor. The Unit receives pulses from Feed and Recirculating flowmeters for total and for rate. Each pulse input is scaled by separate K Factors. Pulses from B are subtracted from A to give a net rate and total. The Analog output is directed to a strip chart recorder which gives a hardcopy of the net rate. Setpoint A alarms if net rate value is exceeded. Setpoint B illuminates light when set amount of fuel is consumed. Through the serial communications, a computer keeps a record of the daily events.

1-3 Principles of Operation

Presets

The user may assign the two preset setpoints to any of the following: "A" rate input, "B" rate input, the net rate or the net total. The presets are accessed by pressing the A or B buttons on the front panel. The 10A SPDT relays are activated when the display meets or exceeds the preset values.

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 by using the proper K Factors for the "A" and "B" inputs. It can sample from 2 to 24 seconds maximum, and auto range up to 6 digits of significant information. The ratemeter with both K Factors at 1, displays the net rate of pulses per second. Simply dial in the proper K Factors to display in minutes, hours or other units of measurement. The unit can be made to display the net rate and the net total. Press the C button, while the unit is displaying the net total, to display the net rate; 'R' is displayed on the left side of the display.

K Factors

The K Factors are used to convert the input pulses into workable units. The 8 digit K Factors are dividers with a range of 0.0001001 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 Unit. Thus, you may total in gallons and display rate in liters per hour. The maximum factored count speed is 9.98 KHz. The maximum factored rate is 7 digits.

Counter

The maximum count is 99999999. All counts are accumulated even if simultaneous pulses occur. In the setup mode choose "A-B" (Subtract input B from input A) or "A+B" (Adds both inputs together). Activating the CLR button while in the run mode, resets the Net Total counter. Net totals less than zero are displayed with a negative sign on the left.

1-3 Principles of Operation (continued)

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.

Scaled Pulse Output
The scaled pulse output corresponds to NET total. The unit gives one pulse out for each positive factored count. The output pulse duration is selectable by choosing one of the following frequencies: 20000, 2000, 200, 10. (see table below)

Speed (Hz)	10	200	2000	200000
Min. ON/OFF (mSec)	47.5	2.0	0.2	0.013

NOTE: In the event where the unit counts down (Input A signal momentarily lost), there will not be any pulses present at Terminal 2. The output pulses will be stored in an internal buffer. The buffer will hold up to 10,000 pulses. The display will show "DATALOST" if this buffer is filled. When normal operation resumes and the counter begins to count up, the output will remain OFF until the amount of "up" counts equals the amount of pulses in the buffer.

Analog Output (Optional)
The Analog Output option is controlled by an Open Collector transistor; it gives a 4 to 20mA (or 0-20mA) output which corresponds to predefined net rate or net 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. The output for values below the "low" setting will be 4 mA (0 mA). Compliance voltage 3 to 24 VDC. The output for values above the "high" setting will be 20 mA.

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 Unit 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.

Outcard (Optional)
RS232 or RS422 serial two-way communication is available. Up to 15 units can be linked together in parallel and addressed separately to transmit unit status or accept new set points in the standard ASCII format. Baud rates of 300, 600, 1200, 2400, 4800 or 9600 as well as choice of odd, even, space, or mark parity can be selected by keypad control. Special OptoMux® compatible RS422M is also available (See Section 8-12).

1-4 Specifications

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

Dimensions:
Reference Figure 1-1

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

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)

Memory:
EEPROM stores all program 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., positive edge triggered.

Accuracy over full temperature range:
Digital - 100% (within specified voltage ranges)

Pulse Inputs:
3A: Standard. High impedance pulse input. Open or 0 to 1 VDC (low), 3 to 30 VDC (high), 10K ohm input impedance. 9980 Hz maximum speed (min. on / off 50.1 usec).

3B: Same as 3A except 4.7 K ohm pull up resistor to +5 VDC with respect to Terminal 12.

Scaled Pulse Output (Terminal 2):
NPN Open Collector; Sinks max. 100mA from a maximum of 30 VDC to a maximum 1 VDC.

Analog output:
4-20 mA (or 0-20 mA)
Sinking, (NPN transistor), Open Collector
Compliance voltage: 3 - 24 VDC, noninductive
Accuracy: ±100 uA worst case
Update Rate:

Tracking Rate:	follows displayed rate.
Tracking Total:	approximately 5 updates per second

Control Outputs (Each of two outputs):
1. NPN Transistor Version: (Optional)
Open Collector sinks maximum of 250 mA at 30 VDC when active
Note: When relays are used, 10 VDC is provided at transistor outputs through the relay coils. If current greater than 2 mA is drawn, the relay will remain energized. Applying greater than 10 VDC may destroy the unit. The transistor will sink 100 mA in the "ON" state with relays installed.
2. SPDT Relay Version: (Standard)
Contact rating: 10 A 120/240 VAC or 28 VDC.

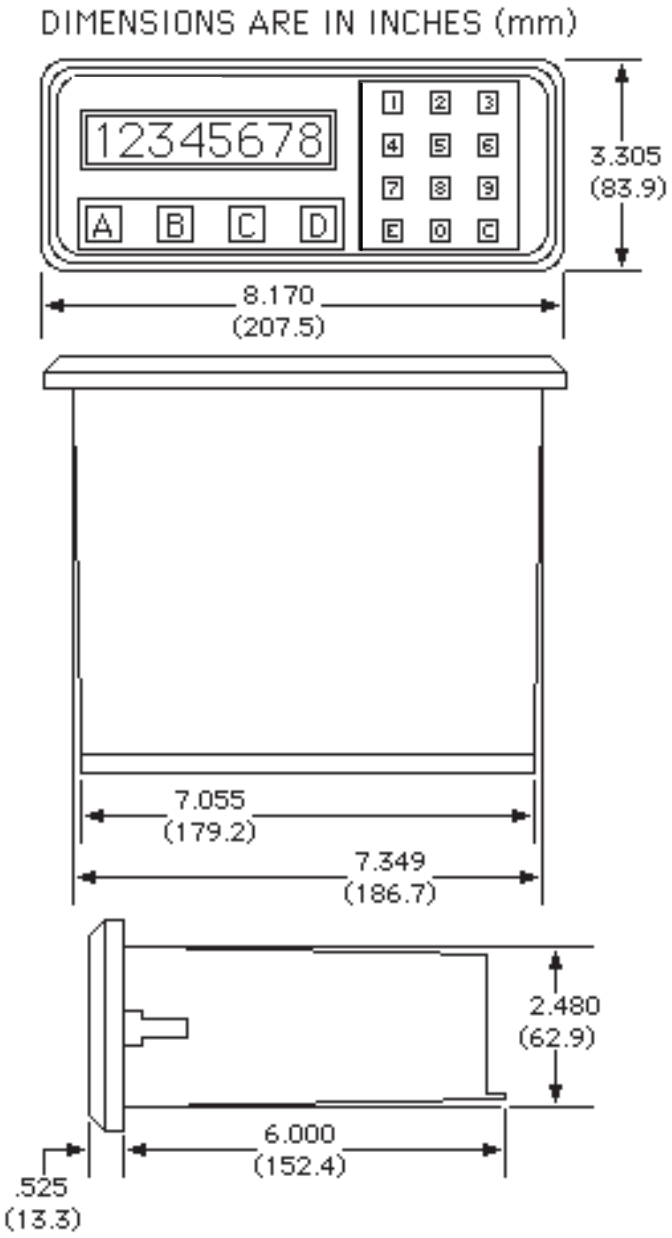
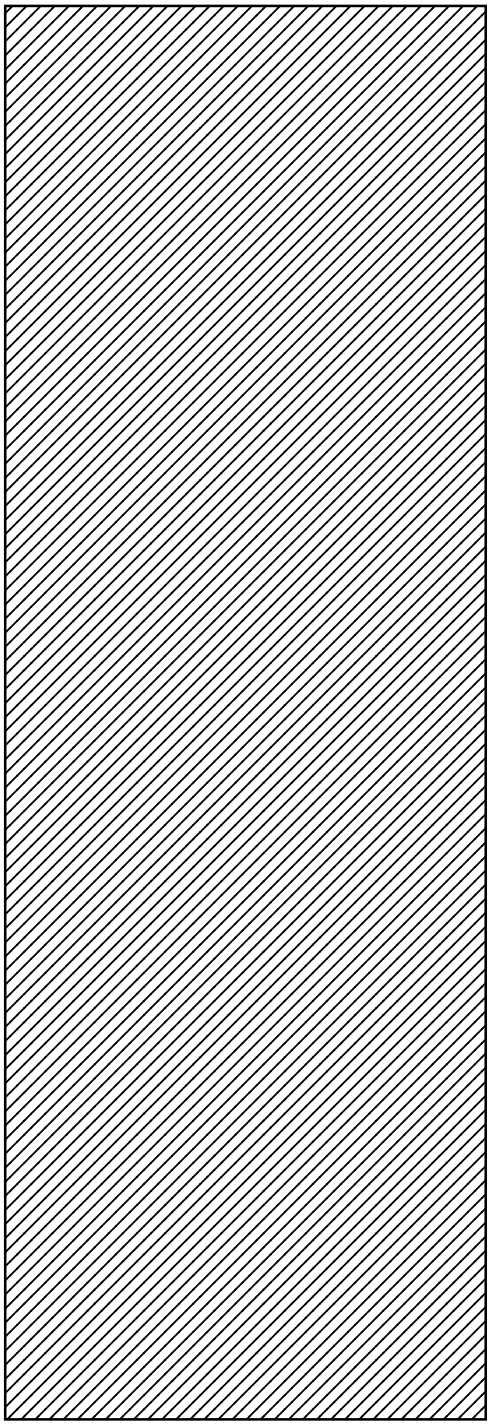


Figure 1-1



Full Size Panel Cutout Template

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 distributor.

Remove the Installation and Operation Instructions. 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 a Return Material Authorization. The RMA is obtained by calling your local authorized distributor.

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 Unit 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 Unit.

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.

2-5 Wiring Connections and Diagrams

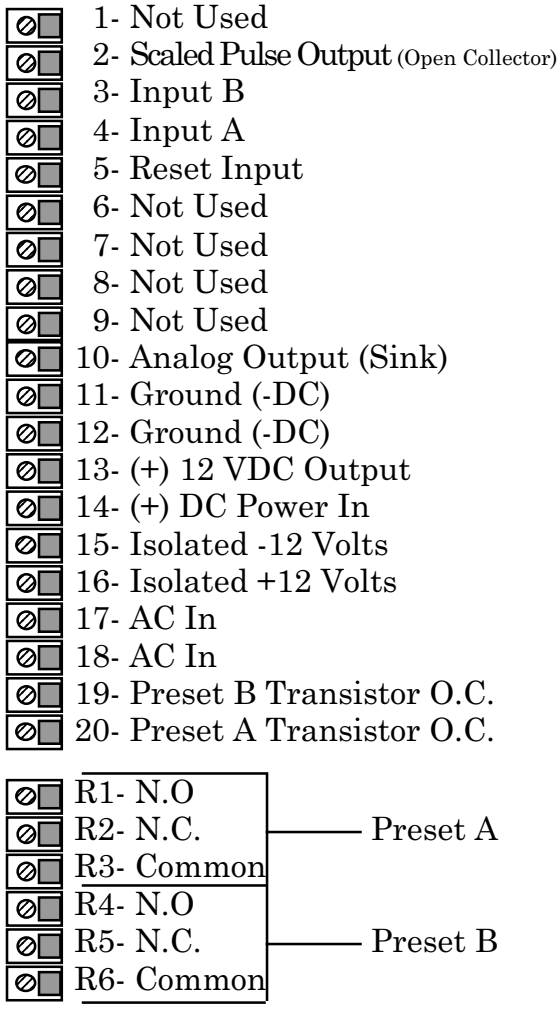


Figure 2-1 Terminal Block Connections

2-5 Wiring Connections and Diagrams (continued)

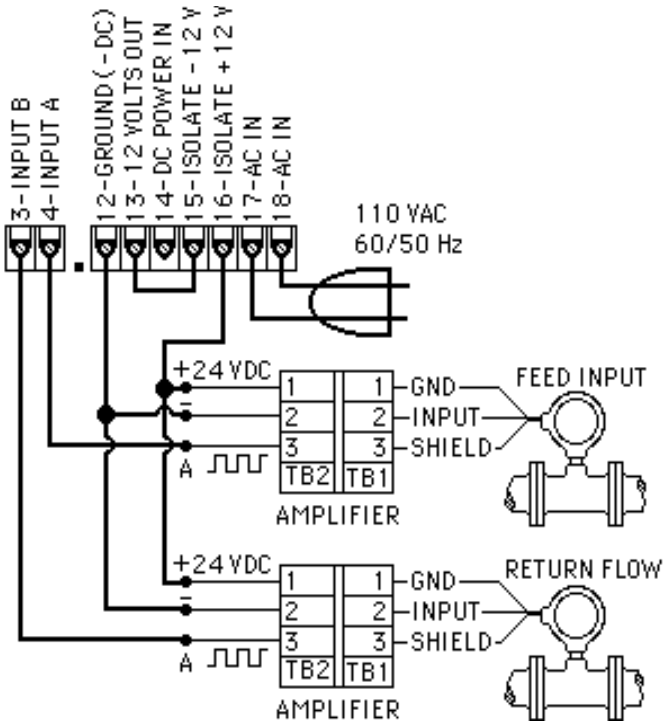


Figure 2-2 Typical Digital Input Wiring Connections

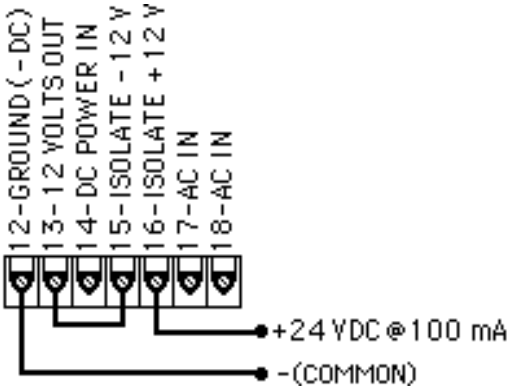


Figure 2-3 24 Volt DC Output Wiring Connections

SECTION 3 OPERATION

3-1 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 DEV TYP. To cycle to the next control parameter option, merely press the MENU button and LOCKOUT 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 DEV TYP.

The following is the sequence for entering a Preset quantity.

1. Depress the PRE A [A] button once. The display will read PRESET. After a one second pause the display will show the preset number.

2. The display will flash indicating that you are not in the Run Mode and not displaying the current rate or total.

3. If the displayed setpoint 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 a new number. Example: Suppose "250" is the new batch size. Press [2], then [5], then [0]. When the display holds the desired value, depress the [ENT] button. The new set point will be stored in memory and simultaneously The Unit will return to the Run Mode.

3-2 Frequently Asked Questions About Setting Up The Unit

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 the 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 output, does the OUTCARD or 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. 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. Otherwise, new numbers will be added to the end of the previous number.

Note: Sometimes the setup of the unit may seem confusing. Worksheets have been provided with the unit to make the setup easy. Most questions can be answered simply by reviewing the manual. If you still have problems or questions, please call your local Distributor.

3-3 Setup Procedure For The Unit

SETTING **PRESET A**

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

Preset A is Set.

SETTING **PRESET B**

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

Preset B is Set.

MENU ITEM 1 **DEV TYP**

This menu item is used to set up the ratemeter and totalizers. Please refer to the K Factor worksheets (Section 7) or other notes you may have prepared.

Setting the Ratemeter.

PRESS	DISPLAY
[D] Menu Button	DEV TYP ↓
[ENT]	RT ↓ CNT ↓
Enters routine to program the Ratemeter or Counter.	
[B]	K FACT A
This selects the Ratemeter portion of the unit. K FACT A flashes then shows the current rate K Factor for input A.	
[CLR]	0 Flashes.
Clears out existing A K FACTOR.	
1 2 D 0 5 6	12.056 Flashes.
Sample K Factor, or enter calculated value from notes or worksheet.	
[ENT]	K FACT B
We are still in the Ratemeter portion of the unit. K FACT B flashes then shows the current rate K Factor for input B.	
[CLR]	0 Flashes.
Clears out existing B K FACTOR.	
[7][6][D][2][8]	76.28 Flashes.
Sample K Factor, or enter calculated value from notes or worksheet.	
[ENT]	WEIGHT #.#
Store new K Factor. The weight is a multiplier assigned to the old rate that is averaged with the new sampled rate to prevent erratic change. A 0.0 setting shows the new rate immediately. A 9.9 setting averages the new sampled rate with 9.9 times of old displayed rate. (See section 3-5 Internal Operation.)	
[CLR]	WEIGHT 0.0
Clears out existing WEIGHT number value.	
[7][0]	WEIGHT 7.0
As an example, averages 7X old rate with new rate.	
[ENT]	WINDOW ##
Store new Weight.	
The window sets the minimum rate sampling time (02 to 24 sec). The unit accumulates the input pulses for the	

window amount of time and calculates the averaged rate. The selected "weight" is then averaged in. The display is updated after each rate sample.

PRESS	DISPLAY
CLR	WINDOW 00
Clears out existing WINDOW number value.	
5	WINDOW 05
As an example, extends the window to 5 seconds.	
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 ex., display will show only 4 significant figures.	
ENT	Last count, unit now in
Store new SIG FIG.	Run Mode.

The Ratemeter portion of The Unit is now setup. The next thing to do, is to set up the counter portion of the unit. This requires going back into the menu to DEV TYP.

MENU ITEM 1 **DEV TYP** (continued)

This menu item is used to set up the ratemeter and totalizers. Please refer to the K Factor worksheets (Section 7) or other notes you may have prepared.

Setting the Counter.

PRESS	DISPLAY
D	DEV TYP ↓
Menu Button.	
ENT	RT ↓ CNT ↓
Enters routine to program the Ratemeter or Counter.	
D	K FACT A
This selects the Counter portion of the unit. K FACT A flashes then shows the current A K Factor.	
CLR	0 Flashes.
Clears out existing A K FACTOR.	
3 7 D 6	37.6 Flashes.
Sample A K Factor, or enter calculated value from notes or worksheet.	
ENT	K FACT B
This selects the Counter portion of the unit. K FACT B flashes then shows the current B K Factor.	
CLR	0 Flashes.
Clears out existing B K FACTOR.	
6	6 Flashes.
Sample B K Factor, or enter calculated value from notes or worksheet.	
ENT	A+B ↓
Store new B K Factor.	

A+B adds input pulses from A and B together. A-B subtracts the pulses of input B from input A. This selection determines the calculation performed on the incoming data.

> Caution: When selecting A-B. Nega tive rates cannot be displayed only absolute values will be displayed. The display will go to all F's when the net rate goes beyond 7 digits.

PRESS	DISPLAY
[D]	A-B↓

Pressing D toggles between selections.

[ENT]	DEC LOC

Store calculation.

DEC LOC allows the user to choose where the decimal point will be located when the net total is displayed. The decimal point is for display only and does not affect K Factors. Press the keypad numbers to move the decimal point. Only one decimal point can be displayed. 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]	Last count, unit now in Run Store new DEC LOC. Mode.

The Counter portion of The Unit is now set up and the unit is ready to run.

If you would like to:
a. lockout the unit to prevent unwanted changes
b. setup serial communications
c. setup analog output
Access the menu and refer to the manual's appropriate section.

MENU ITEM 2 **LOCKOUT**

This menu item uses a 4 digit security code to prevent tampering and unwanted changes in the programming of The Unit. The unit is shipped from the factory with a lockout code of 1000.
For 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. You can still toggle between rate and total.
b. Presets A and B can still be accessed <u>but not changed.</u>
c. <u>The rest of the menu cannot be accessed</u>.
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 lockout code follow this setup procedure.

PRESS	DISPLAY
[D]	DEV TYP ↓

Menu Button

[D]	LOCKOUT ↓
[ENT]	CODE

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.

PRESS	DISPLAY
[1] [1] [1] [1]	1111 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] [1] [1] [1]	LOCK ON

Enter the sample / new value . . . the unit is now locked!

[1] [1] [1] [1]	LOCK OFF

Enter the sample / new value. . .the unit is now unlocked!

The lockout procedure is finished.

MENU ITEM 3 **OUTCARD**

If the unit is equipped with a serial communications card, the setup parameters in the following menu will make The Unit compatible with the master terminal. The Unit Identification Number (if multiple units are used), Baud Rate (speed at which the signal is transmitted) and Parity are selectable. A 7 bit, ASCII character, with one start bit, one stop bit and the parity makes up the standard ten bit transmission character. For more details see Section 8.

PRESS	DISPLAY
[D]	DEV TYP ↓

Menu Button

[D]	LOCKOUT ↓
[D]	OUTCARD ↓

[ENT]	UNIT ##

The Unit ID Number identifies the unit for multi-drop communications. Up to 15 units may be on one line. A unit will stay off line until its Unit ID number is received. It will then stay on line until a carriage return is sent. At which time, it will send any requested information and take itself off line. The range of the unit ID number is 00 to 15

> Idea:
> A Unit ID number of 00 will keep the unit on line at all times. No Unit Number prompt is needed and carriage returns will not take the unit off line.

Regardless of the above, all requests for information are replied to at the units earliest convenience.

PRESS	DISPLAY
[CLR]	UNIT 00

Clears out existing Unit ID number.

[1] [4]	UNIT 14

Sample Unit ID number.

[ENT]	PL ↓ SER ↓

Enters new Unit ID number. Note: PL selects OptoMux® RS422. Make selection and hit enter to continue.

[ENT]	BAUDRATE

BAUDRATE flashes then shows current Baud rate.

setting, the current driver will stay at 4 mA. This allows for offsetting the low end of the output signal. If the displayed rate or total exceeds the 20 mA setting the current driver will stay at 20 mA.

Note: The current sink follows (tracks) the display.

PRESS	DISPLAY
D Menu Button	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 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. (Press D for decimal point.)

ENT	SET HIGH

Low Setpoint is stored. SET HIGH flashes then shows the 20 mA Setpoint value.

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. (Press 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 5 **OUTFREQ**

All models of the Batcher have a pulse generator built in to them. The output pulse duration is selectable by choosing the corresponding frequency (see Pg. 3). If the count speed 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 Menu Button	DEV TYPE ↓
D	LOCKOUT ↓
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 ↓	

If output is not used, select 20000 to prevent DATALOST error.

Press ENT at desired Frequency.

ENT Last count, unit now in Run Mode.

Pulse Output is now set.

MENU ITEM 6 **RELAY**

This menu item is for assigning the function on which the relays trip. **Relays are used for controlling rate or metering batch size**. Both relays are "Form C" relays with contact ratings of 10A.

PRESS	DISPLAY
D Menu Button	DEV TYP ↓
D	LOCKOUT ↓
D	OUTCARD ↓
D	ALG OUT ↓
D	RELAY ↓
ENT	A TOTAL ↓

The A relay output may correspond to the net totalizer, rate of input A or the net rate. Pressing D scrolls through the selections. At the appropriate point, selection is made by pressing ENT.

D	A RATE ↓
D	A NET R ↓
ENT	B TOTAL ↓

For Example: "A" Relay trips when net rate meets or exceeds the value in Preset A.*

The B relay output may correspond to the net totalizer, rate of input B or the net rate. Pressing D scrolls through the selections. At the appropriate point, selection is made by pressing ENT.

D	B RATE ↓
D	B NET R ↓
D	B TOTAL ↓
ENT	DUR B 02

* Enters the routine for setting the duration that the relay will stay tripped. This routine occurs when either one of the relays is assigned to the totalizer. The range is 1 to 99 seconds. Entering 00 for this value latches the relay until the unit is reset.

From the previous page, we are setting the RELAY Menu.

CLR	DUR B 00
Clears out existing High Setpoint value.	
1 5	DUR B 15
For Example: Relay trips and holds for 15 seconds when the total is equal to or greater than Preset B.	
ENT	Last count, unit now in Run Mode. Relay outputs are set up.

3-4 Run Mode

3-4.1 The Display

In the Run Mode the display will initially display the last count.

The unit will accept input signals and display Net Rate or Total.

The Total is displayed as a number.

The Net Rate is displayed as "R" followed by a number.

To toggle between the Rate and Total, simply press the C button.

3-4.2 Resetting (Clearing) the Totalizer.

To clear the Totalizer, and set relays to "rest" state.

a) the unit must be in the Run Mode.
b) the unit must not be locked out.*

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

* 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.

3-4.3 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 Totalizer cannot be reset.

b) the Presets can be accessed but **not** changed.

c) the Menu cannot be accessed.

The unit will still:

d) accept input signals

e) display Net Rate and Total.

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 be 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.

3-4.4 Operation.

A typical operation proceeds as follows:

a) Preset A is accessed and changed to the amount desired.

b) The unit accepts input signals

c) The CLR button is pushed to reset the Totalizer.

d) The process begins.

e) Stopping the input pulses at any time halts the total. Upon continuation the process resumes from where it stopped.

f) The display shows Net Rate or Total.

g) Preset A is reached and the relay halts the process.

The Unit will always accept input pulses whether the relay is tripped or not! All pulses on the input terminal are counted and shown on the display. For this reason, pressing the [CLR] button before starting may be desirable. This means that all post-run pulses will be recorded.

(The CLR button is discussed in section 3-4.2.)

3-5 Internal Operation

3-5.1 Digital Inputs and Computations

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

Computations:

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

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

$$\frac{\text{A Pulses In}}{\text{A Rate K Factor}} = \text{A' Rate} \qquad \frac{\text{A' Rate}}{\text{Tau}} = \text{A Rate}$$

$$\frac{\text{B Pulses In}}{\text{B Rate K Factor}} = \text{B' Rate} \qquad \frac{\text{B' Rate}}{\text{Tau}} = \text{B Rate}$$

A+B Total = A Count + B Count (since last update)

A-B Total = A Count - B Count (since last update)

Net Rate = A Rate - B Rate (since last update)

If weighting is used:

$$\textit{Net rate} = \frac{(\text{Old Rate} \times \text{Weight}) + \text{New Rate}}{\text{Weight} + 1}$$

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

Preset Out =

Count ≥ A Preset or B Rate ≥ B Preset
or Count ≥ B Preset or Net Rate ≥ A Preset
or A Rate ≥ A Preset or Net Rate ≥ B Preset

SECTION 4 INPUTS

4-1 Digital Pulse Inputs (Terminal 3, 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 KEPtrol F/C 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	---	---	0-9980 Hz min. 50.1 usec on/off
---	---	OFF	OFF	needs sourcing input (drive input high).
---	---	OFF	ON	needs sinking input (pull input low).

↑
ON S1 S2 S3 S4

Table 4-1

4-1 Digital Pulse Inputs (continued)

4-1.1 Input 3A - STANDARD:
High Impedance (Terminal 3, 4).
Has 10 K Ohm pull down resistors 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 Unit. (See Section 2-2, Fig. 2-2 Typical Digital Wiring Connections)

4-1.2 Input 3B
High Impedance with pull-up (Terminal 3, 4).
Has 4.7 K Ohm pull up resistors 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 Unit. (See Section 2-2, 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. For a description of what the reset signal does, refer to Section 3-4.2.
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 DC Power Inputs (Terminals 12, 14)

The Unit 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.

4-3 AC Power Inputs (Terminals 17, 18)

The Unit 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 Unit 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 Unit 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.

The Unit has four different possible types of outputs for controlling external devices or monitoring the rate and totals. They are: Relay Outputs, Open Collector Outputs, and Optionally available Analog Output and RS232, RS422, or RS422M Serial Communications.

5-1 Control Outputs

5-1.1 SPDT Relay Version (Standard)

When a Preset is reached or exceeded, the corresponding relay engages. If the relay is assigned to the totalizer, it stays engaged for the duration that was entered in the RELAY menu. Once a relay is activated by a preset total, it will not engage again until the totalizer is reset. For rate assignments the relay engages as long as the rate meets or exceeds a Preset. The user may assign the two relays to rate or total when setting up in the RELAY menu (see Section 3-3, Menu Item 5). The contacts are rated at 10 A, 120/240 VAC or 28 VDC.

5-1.2 Open Collector Version (Terminal 19, 20).

The NPN, Open Collector Transistors, sink a maximum of 250 mA at 30 VDC when active. They behave in the same manner as the Relay Outputs (see Section 5-2.1 above). The Open Collector outputs are available on units with relay outputs, but, please observe the following precautions.

Note: When relays are used, 10 VDC is provided at the transistor outputs through the relay coils. If current greater than 2 mA is drawn, the relay will remain energized. **Applying greater than 10 VDC to the Open Collector outputs may destroy the unit. The transistor will sink 100 mA in the "ON" state with relays installed.**

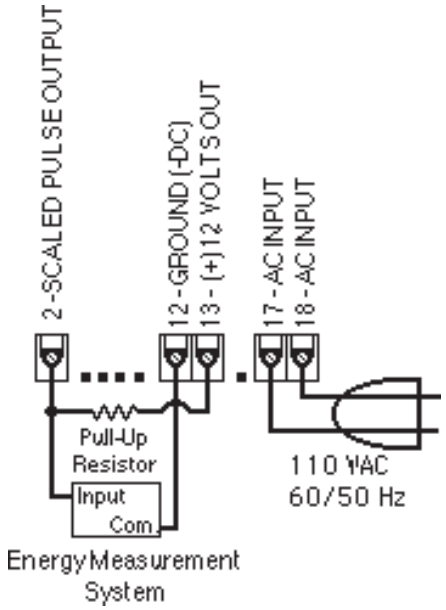
5-2.1 Scaled Pulse Output

The scaled pulse output corresponds to NET total. The unit gives one pulse out for each positive factored count. The output pulse duration is selectable by choosing one of the following frequencies: 20000, 2000, 200, 10. (see table below)

Speed (Hz)	10	200	2000	200000
Min. ON/OFF (mSec)	47.5	2.0	0.2	0.013

NOTE: In the event where the unit counts down (Input A signal momentarily lost), there will not be any pulses present at Terminal 2. The output pulses will be stored in an internal buffer. The buffer will hold up to 10,000 pulses. The display will show "DATALOST" if this buffer is filled. When normal operation resumes and the counter begins to count up, the output will remain OFF until the amount of "up" counts equals the amount of pulses in the buffer.

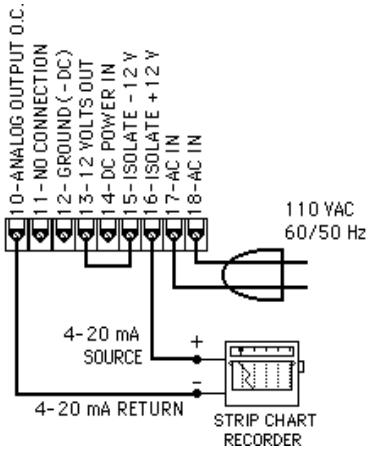
5-2.2 Scaled Pulse Output Wiring



5-3 Optional Analog Output (Terminal 10)

5-3.1 Electrical Characteristics of Analog Output
Controlled by an Open Collector transistor, it gives a linear 4 to 20 (or 0 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 (4/0 to 20mA) parameters to which the analog signal will correspond.

Idea:
The Unit 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 Pin10 to - DC side of the external device (see Figure 5-3.1).



5-4 Optional RS232 / RS422 Serial Communications

This option allows The Unit to act as a slave to a master terminal. It may be accessed for counts, rate, presets and K Factors. Up to 15 units can be linked together in parallel and addressed separately to transmit unit status or accept new set points using the standard ASCII format. Baud rates of 300, 600, 1200, 2400, 4800 or 9600 as well as choice of odd, even, space, or mark parity can be selected by keypad control. Further information and more details are provided in Section 8 at the end of this manual.

SECTION 6 TROUBLE SHOOTING AND MAINTENANCE GUIDE

6-1 Warning Messages

6-1.1 RFFFFFFF
Indicates that:
a) The factored input "A" rate has exceeded a 7 digit number.
b) The factored input net rate has exceeded a 7 digit number.

The ratemeter cannot handle numbers larger than 7 digits (i.e. 9999999). Change the Rate K Factors to larger numbers to correct this problem. See Section 3-3, Menu Item 1.

6-1.2 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 2 to unlock the unit.

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

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

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

Corrective Action: If Power checks okay, replace unit.

Symptom: **Relays do not trip.**
Possible Cause #1: Incorrect programming.
Test Procedure: Check for relay assignment and/ or duration times, review manual.
Corrective Action: Reprogram unit as required.

Possible Cause #3: Defective Circuit board or component.
Test Procedure: Input pulses 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.

Note: Presets are entered only as positive numbers. If display has (-) sign relay will not trip.

Note: Relay tripped by total counter will not trip again until unit has been reset.

6-2.2 Problems

Symptom: **Unit not totalizing.**
Possible Cause #1: Incorrect programming.
Test Procedure: Check for programming errors, review manual. For Example, if a K Factor is too large or at zero, 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 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. On units with RS232 or RS422, two screws on the back, holding the top left connector, have to be removed. 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 Removing the Case (continued)

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.

6-3.2 Serial Communications Interface Installation
Follow the instructions for removing the case in Section 6-3. The RS232, RS422 and RS422M cards have a 15 contact ribbon cable that plugs into the female connector next to the heat sink. Choose the proper Interface card. With components on top and subminiature connector to the back plug in the harness and mount the card on the four (4) standoffs provided. After the main board is inserted into the case replace the front panel as per Section 6-3.

6-4 Maintenance
The Unit 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 or distributor (phone number on cover of manual).

SECTION 7 CALCULATING THE K FACTORS

7-1 General

The key to accurate measurement with The Unit 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 is from 0.0001001 to 99999999. This allows a wide range of factoring from greatly increasing (to a large value) to decreasing the input (to a very small value).

7-2 Calculating the K Factors.

The following is from the K Factor Worksheet. It is suggested that you make several copies of the worksheet for use in conjunction with this section. 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.

Step 1. Find out what value the pulses represent. This should be specified on your device or with its paper work.
Example #1: 360 Pulses = 1 yard
Example #2: 1 Pulse = 2 gallons
Example #3: 2000 Pulses = 1 m^3

Step 2. The Base K Factor is equal to the number of pulses per value from Step 1(Pulses ÷ Value).
Example #1: Base K Factor = 360
Example #2: Base K Factor = 0.5 (1 pulse ÷ 2 gallons)
Example #3: Base K Factor = 2000

Step 3. Modify the Base K Factor to reflect any units conversions to the Count K Factor This is done by dividing the Base K Factor by a Units Conversion Factor. If no conversion is necessary skip this step and let the Count K Factor be the same as the Base K Factor. REFER TO THE UNITS CONVERSION CHART AS NEEDED.
Example #1: No conversion needed. Count K Factor = 360
Example #2: Convert gallons of water to pounds of water.
Count K Factor = 0.5 ÷ 8.3378 = 0.0599679
Example #3: Convert m^3 to ft^3.
Count K Factor = 2000 ÷ 35.3147 = 56.63364

UNITS CONVERSION CHART			
To convert:	divide by	To convert:	divide by
ft to m	0.3048	kg to lb	2.2046
ft^2 to m^2	0.0929	l to ft^3	0.0353
ft^3 to m^3	0.02832	l to gal	0.2642
ft^3 to gal	7.4805	m to ft	3.2808
gal to l	3.7854	m^2 to ft^2	10.7639
gal to m^3	0.00379	m^3 to ft^3	35.3147
gal to ft^3	0.1337	m^3 to gal	264.172
gal to lb(H_2O)	8.3378	lb to kg	0.45359

Step 4. Enter the Count K Factor. (See Section 3-3, Menu Item 3).

Step 5. Modify the Count K Factor to reflect any time conversions for the rate display to the Rate K Factor. This is done by dividing the Count K Factor by the Time Conversion Factor. If no conversion is necessary skip this step and let the Rate K Factor be the same as the Count K Factor. USE THE TIME CONVERSION CHART AS NEEDED.
Example #1: Convert yds per sec to yds per hour.
Rate K Factor = 360 ÷ 3600 = 0.100
Example #2: Convert pounds per min to pounds per sec.
Rate K Factor = 0.0599679 ÷ .1666667 = 0.3598073
Example #3: No conversion necessary.
Rate K Factor = 56.63364

Step 6. Enter the Rate K Factor.
(See Section 3-3, Menu Item 1)

TIME CONVERSION CHART			
To convert:	divide by	To convert:	divide by
sec to min	60.00	min to hr	60.00
sec to hr	3600	hr to min	0.1666667
min to sec	0.1666667	hr to sec	0.0002778

7-2.2 Digital K Factor Formulas

$$\text{Pulses} = \text{Base K Factor}$$
$$\text{Units Value}$$

$$\text{Base K Factor} = \text{Count K Factor}$$
$$\text{Units Conversion Factor}$$

$$\text{Count K Factor} = \text{Rate K Factor}$$
$$\text{Time Conversion Factor}$$

SECTION 8 SERIAL COMMUNICATIONS

8-0 Outcard RS232/RS422 Serial/Strobe Interface

This section applies to units which have the Serial Communications interface option. Up to 15 units can be linked together. Unit status can be accessed and new set points and K Factors can be entered through the serial port. The unit cannot be taken out of the Run Mode through the serial port. Menu changes must always be made through the front keypad (except Preset A, Preset B, and K Factors). Data is transmitted at selected baud rates using standard seven bit ASCII characters and parity with two additional bits of "Start" and "Stop" to make up the standard ten bit character.

8-1 Unit Code

Each Unit in the hookup must be assigned a code number from 1 to 15, through the front keypad, in the OUTCARD setup mode (see Section 3-3, Menu Item 5). Number "00" is reserved for a dedicated hookup to only one terminal and its transmit output line remains in an "on" active state. (Units assigned other numbers have outputs that remain in the "off" high impedance state until addressed by their code number or brought on line by a positive edge of the Strobe input). Once a unit is addressed, do not address another unit until the data has been sent and any data requested has been transmitted back.

8-2 Baud Rate

The Baud rate is the speed at which data is transmitted, expressed in bits per second. Baud rates of 300, 600, 1200, 2400, 4800, or 9600 are available. Use the front keypad to call up the OUTCARD setup mode (see Section 3-3, Menu Item 3) and select the desired baud rate that is compatible with the remote terminal.

8-3 Parity

Parity is a bit of information that is inserted before the stop bit and is used to help check if the transmission is correct. In the OUTCARD setup mode, select between:

a) ODD (Parity bit is logical zero if total number of logical 1's in the first seven bits is odd)

b) EVEN (Parity bit is logical zero if total number of logical 1's in the first seven data bits is even.)

c) MARK (Parity data bit is always logical 1.)

d) SPACE (Parity data bit is always logi cal 0.).

The Unit does not check the parity but does transmit the parity chosen.

> Idea:
> Use the MARK parity for terminals that need two stop bits and/or no parity since these terminals ignore the parity anyway.

Note: If the parity of the terminal is not known, it is often practical to key in a different parity until the correct one is found.

8-4 RS232 Electrical Requirements

The Unit uses standard EIA specifications. Standard inputs must present a load of 3000 to 7000 ohms. A voltage level of +3 V to +25 V (referenced to signal ground) is read as a "Space" or "0" and indicates an active state (asserts a control line). A voltage level of -3 V to -25 V (referenced to signal ground) is read as a "Mark" or "1" and does not indicate an active state (does not assert a control line). Outputs must send a voltage of +5 V to +25 V (referenced to signal ground) for a "Space" and a voltage level of -5 to -25 V for a "Mark" when loaded with a 3000 ohm load to signal ground. Outputs must be capable of being shorted to other signal lines without burning out.

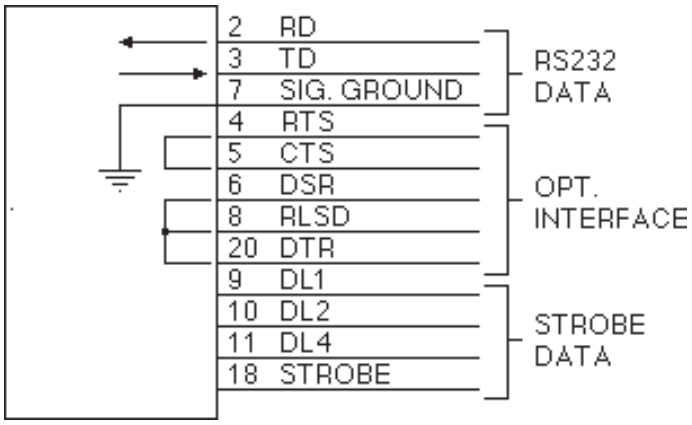
Note: It is normally recommended that cable length be limited to 50 feet.

8-5 RS232 Card Wiring

This option has a subminiture D, 25 pin, female connector and is wired as a DCE (Data Communications Equipment) device. If it is connected to a DTE (Data Terminal Equipment) device, the interconnect cable should have wires 2 and 3 connected straight to the same pins on each end.

If it is connected to another DCE device, Pins 2 and 3 must be crossed. This means that the wire to pin 2 on one end goes to pin 3 on the other end and the wire to pin 3 on one end goes to pin 2 on the other end.

8-5.1 Wiring Diagram RS232 / Strobe (25 Pin Connector)



8-5.2 RS232 Wiring Notes

The Unit requires only three wires for RS232 communication:

- **a)** Pin 7 (Signal Ground)
- **b)** Pin 2 (Receive Data)
- **c)** Pin 3 (Transmit Data)

Other pins are jumped to simulate appropriate responses required for some terminals.

- **a)** Pin 4 (Request To Send), Pin 5 (Clear To Send). Jumped internally to echo back signals.
- **b)** Pin 6 (Data Set Ready), Pin 8 (Received Line Signal Detector), Pin 20 (Data Terminal Ready). Jumped internally to echo back signals.

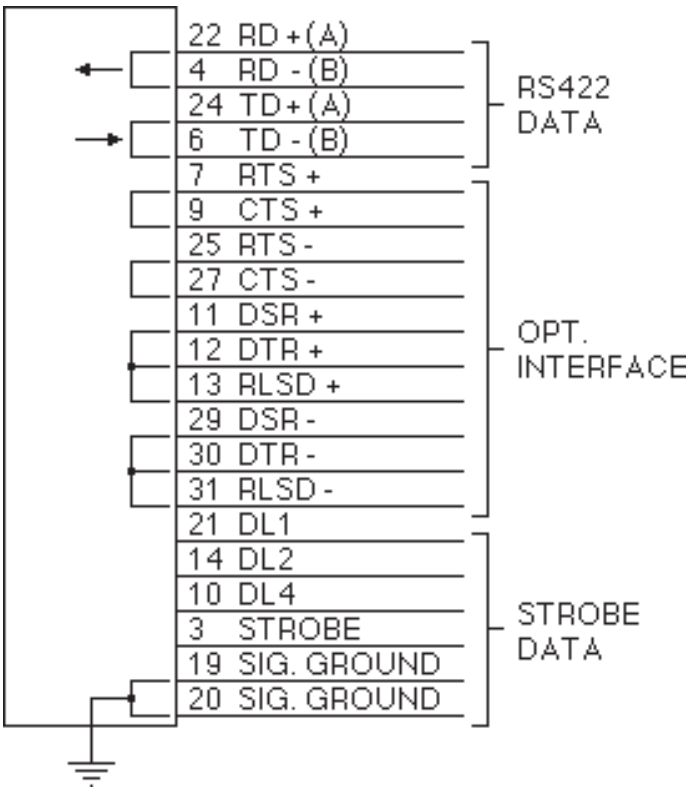
8-6 RS422 Electrical Requirements

The input of The Unit follows the standard EIA high impedance minimum of 12 K Ohms. When the 422+ (A) input is more positive than the 422- (B) input by 0.2 V to 6 V, a "1" or "Mark" condition is recognized. When the 422+ input is more negative than the 422- input by 0.2 V to 6V, a "0" or "Space" is recognized. Data is recognized by the polarity of the voltage difference between the two lines. Noise picked up in the line will make little difference since the noise is usually added to each line and the voltage differential remains the same. The output driver drives the transmit lines to a differential of 2 to 6 V. It is designed to handle loads up to 60 mA of sink or source current and features positive and negative current conditions. Since the RS422 is more immune to noise, cable links up to 1000 feet or more can be used. Because of the high input impedance of RS422, line terminating loads are recommended. For hookup to a single unit, a 150 to 200 Ohm resistor across Receive Data+ and Receive Data(-), at the Unit and at the remote terminal is often sufficient. For multiple hookups, other standard terminations should be used. **Note:** Total loading should not be greater than 90 Ohms.

8-7 RS422 Card Wiring

This option has a subminiture D, 37 pin, female connector and is wired as a DCE (Data Communications Equipment) device. It is designed to be connected to a DTE (Data Terminal Equipment) device. If it must be connected to a DCE device, it will be necessary to cross wires 4 and 6 as well as 22 and 24 at one end of the connector harness.

8-7.1 Wiring Diagram RS422 / Strobe (37 Pin Connector)



8-7.2 RS422 Wiring Notes

The Unit requires only four wires for RS422 communication:

a) Pin 22 (Receive Data +A)
b) Pin 4 (Receive Data -B)
c) Pin 24 (Transmit Data +A)
d) Pin 6 (Transmit Data -B)

Other pins are jumped to simulate appropriate responses required for some terminals.

a) Pins 7, 25 (Request To Send), Pins 9, 27 (Clear To Send). Jumped internally to echo back signals.
b) Pins 11, 29 (Data Set Ready), Pins 13, 31 (Received Line Signal Detector), Pins 12, 30 (Data Terminal Ready). Jumped internally to echo back signals.

8-8 Strobe Input Electrical Requirements

Both the RS232 and RS422 interface option cards have inputs that allow data to be requested over a separate strobe input and a 3 bit, data request, code input. Any number of units, data request, code lines can be linked in parallel; as long as the source can drive the combined load of all inputs linked together (1.5 K Ohm divided by the total number linked together). Data is transmitted over the serial lines using standard RS232 or RS422 characteristics.

Note: Strobe and data request inputs are positive true with signal ground as reference:

8-8.1 Strobe Input Levels

0 or low: Open or 0 to 1 VDC
1 or high: 3 to 30 VDC
Impedance: 1.5 K Ohm

8-9 Strobe Wiring

8-9.1 Strobe Wiring (RS232, 25 Pin Connector)

The 3 data lines are hooked up to Pins 9, 10, and 11. These lines must be held high while a strobe of at least 25 milliseconds is given on Pin 18. Data is transmitted in RS232 serial format on the Transmit Data Line (Pin 3).

a) Pin 9, Binary 1's Input
b) Pin 10, Binary 2's Input
c) Pin 11, Binary 4's Input
d) Pin 18, Strobe Input
e) Pin 3, Transmit Data
f) Pin 7, Signal Ground for Reference

Refer to 8-5.1 Wiring Hookup RS232 / Strobe (25 Pin Connector) for diagram.

8-9.2 Strobe Wiring (RS422, 37 Pin Connector)

The 3 data lines are hooked up to Pins 9, 10, and 11. These lines must be held high while a strobe of at least 25 milliseconds is given on Pin 3. Data is transmitted in RS422 format on the Transmit Data Line (Pins 6, 24).

a) Pin 21, Binary 1's Input
b) Pin 14, Binary 2's Input
c) Pin 10, Binary 4's Input
d) Pin 3, Strobe Input
e) Pins 6, 24, Transmit Data
f) Pins 19, 20, Signal Ground for Reference

Refer to 8-7.1 Wiring Hookup RS422 / Strobe (37 Pin Connector) for diagram.

8-10 Serial Interface Operation

Data is received and transmitted over standard EIA RS232 or RS422 levels. To address a Unit, transmit a "D" (device) followed by the 1 to 15 code number and a "Space". Once the space has been received The Unit becomes active and responds back, "Device XX:" (Device number). (Once active, the unit works in a full duplex echo back mode, so that data sent from the terminal will be transmitted back for verification.) Once the unit is "on line", use the proper serial transmit codes to request data or set a new value. (See Section 8-10.2 RS232/RS422 Serial Input Codes). Up to 80 characters of data may be linked together and transmitted to The Unit (as long as there is a space between the different codes). If an error is made, a correction can be made by back spacing and retyping correct data before the "Carriage Return" (Enter) is sent. Once "Carriage Return" (Enter) is sent, the unit starts processing the data and will transmit the requested data on a non-priority basis over the data transmit line. A Unit keypad entry or incoming data will halt the data communication cycle. Therefore, there should be a pause after data is requested to insure that all data has been transmitted before another unit is addressed and brought on line. When transmitting, the unit will precede each data value with a "Carriage Return" and "Line Feed" code and answer only with requested data in the order the requests were made. After all requested data has been transmitted any new communication must be started again by DXX (Device number) and space.

8-10.1 Serial Communications Timing.

If The Unit is not busy, it should not require more than 5 msec to process each request. To find the cycle time to process and transmit a request, calculate the bit transmit time by dividing 1 by the baud rate; multiply that by 80 (8 characters each; 10 bits per character); add 5 msec. to this product and multiply by the number of requests made. Example: Typical time to transmit 1 uninterrupted request at 300 baud rate is .272 sec = (1÷300) x (80) + 0.005. This time will be extended if The Unit must service the front keypad or one of the inputs. In practice, if transmission has not started within 2 seconds after data is requested, it can be assumed that there is a problem.

8-10.2 RS232/RS422 Serial Input Codes

DXX(S) (Device and address number followed by space) activates The Unit that had been assigned that number. That unit comes on line and transmits "Device XX:". Unit is now ready to receive a code or string of codes separated by a space. A "Carriage Return" (Enter) code enters the codes and processing of requests begins.

Note: After device is activated, there must be a delay to allow "Device # _ _" to be transmitted by the unit before any new commands are sent to the unit.

AL	Will transmit Analog Low value.
AH	Will transmit Analog High value.
DC	Will transmit Count.
DR	Will transmit Rate.
KA	Will transmit counter A K Factor.
KA(S)XXX	Will load Counter A K Factor number.
KB	Will transmit counter B K Factor.
KB(S)XXX	Will load Counter B K Factor number.
KC	Will transmit rate A K Factor.
KC(S)XXX	Will load Rate A K Factor number.
KD	Will transmit rate B K Factor.
KD(S)XXX	Will load Rate B K Factor number.
PA	Will transmit Preset A value.
PA(S)XXX	Will load Preset A value number.
PB	Will transmit Preset B value.
PB(S)XXX	Will load Preset B value number.
RC	Will reset counter to zero if in "RO" mode (adding) or set counter to Preset value if in "SP" mode (subtracting). Output is reset.
RC(S)XXX	Will set counter to number (no other change is made).

8-10.3 RS232/RS422 Serial Input Examples

Example A: (S) = Space

Transmit from terminal	Receive from The Unit
D13(S) [Unit 13 activated]	Device #13
PA(S)76546(S)PA(S)	PA 76546 PA
KB(S)1575(S)KB(S)	KB 1575 KB
RC(ENTER)	RC

{Preset A set to 76546, Count "B" K Factor set to 1575, and Counter is reset.}

Example B: (S) = Space

Transmit from terminal	Receive from The Unit
D7(S) [Unit 7 activated]	Device #7
PA(S)12347(S)PA(S)	PA 12347 PA
RC(S)456789(S)RCC(S)	RC 456789 RC

{Unit Preset set to 12347, Counter set to 456789}

8-11 Strobe Address Operation

Another method of reading the status of a unit with either a RS232 or RS422 option is by means of a separate strobe address and a 3 bit data request code. The strobe address method does not allow changes of set points. Theoretically hundreds of units could be linked together to transmit data from The Unit over a serial transmit line. The units could be assigned any code number except "00".

The 3 bit data request code would be latched in at the positive edge of a 3 to 30 VDC strobe input that remained high a minimum of 25 milliseconds. Requests are processed on a non-priority basis. Normally data will begin to be transmitted from The Unit over the RS232 or RS422 serial transmit lines within 5 msec unless interrupted by a keypad entry or other signal input.

Note: No other unit should be brought on line until data requested has been transmitted.

8-11.1 Strobe Input Codes

#	DL4	DL2	DL1	Code	Description
0	0	0	0	PA	Transmits Preset A value.
1	0	0	1	PB	Transmit Preset B value.
2	0	1	0	KA	Transmits K Factor counter A.
3	0	1	1	KB	Transmits K Factor counter B.
4	1	0	0	KC	Transmits K Factor rate A.
5	1	0	1	KD	Transmits K Factor rate B.
6	1	1	0	DR	Will transmit Rate.
7	1	1	1	DC	Will transmit Count.

CONCLUSION

This manual has attempted to cover all aspects of operation of The Unit. It is written to cover most anticipated problems and misunderstandings. If some questions still arise, or you feel some improvements can be made to this manual, please feel free to contact your local Representative.

Decoding Part Number

EX: KF/C8 A 3A 2 A 2

Series
KEPtrol F/C

Operating Voltage
A: 110 VAC ±15% or 12 to 27 VDC
B: 220 VAC ±15% or 12 to 27 VDC

Control Inputs
*3A: STD High Impedance
Pulse 3-30 VDC, 20KHz Max.
*3B: same as 3A with 4.7 K Ω pull up resistors

Control Outputs
1: Open Collector
2: SPDT Relay 10 A

Input Speed
*A: 0-40 CPS
*C: 0-400 CPS
*E: 0-10K CPS

* Dip switch selectable, all units can be field modified easily.

Options
1: RS232 Serial Interface
2: RS422 Serial Interface
3: 4-20 mA Output

Accessories

NEMATROL 4X1 - NEMA 4X Enclosure for wall mounting accommodating 1 'trol Series unit.

NEMATROL 4X2 - NEMA 4X Enclosure for wall mounting accommodating 2 'trol Series unit.

FLEXCOVER #30120
Clear membrane for front panel. Prevents dirt build up on buttons.