Cox
Turbine Flow Meters

Flow Computers

Model FC30

Badger Meter

CXX-UM-02475-EN-02 (October 2021)

User Manual

CONTENTS

SCOPE OF THIS MANUAL

This manual describes how to install and program the FC30 Flow Computer. The electronic version of this manual is available on our website at *www.badgermeter.com*.

IMPORTANT

Read this manual carefully before attempting any installation or operation.
Keep the manual in an accessible location for future reference.

UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

SAFETY CONSIDERATIONS

Terminology and Symbols

⚠ DANGER Indicates a hazardous situation, which, if not avoided, *will* result in death or serious personal injury.

⚠ WARNING Indicates a hazardous situation, which, if not avoided, *could* result in death or serious personal injury.

⚠ CAUTION Indicates a hazardous situation, which, if not avoided, *could* result in minor or moderate personal injury or damage to property.

⚠ WARNING

THIS INSTRUMENT CONTAINS ELECTRONIC COMPONENTS THAT ARE SUSCEPTIBLE TO DAMAGE BY STATIC ELECTRICITY. PROPER HANDLING* PROCEDURES MUST BE OBSERVED DURING THE REMOVAL, INSTALLATION, OR HANDLING OF INTERNAL CIRCUIT BOARDS OR DEVICES.

HANDLING PROCEDURE

1. Power to unit must be removed.
2. Personnel must be grounded, via wrist strap or other safe, suitable means, before any printed circuit board or other internal device is installed, removed or adjusted.
3. Printed circuit boards must be transported in a conductive bag or other conductive container. Boards must not be removed from protective enclosure until the immediate time of installation. Removed boards must be placed immediately in protective container for transport, storage, or return to factory.

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, CMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, may exhibit early failure.

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.
- This instrument is internally fused. Disconnect power supply before replacing fuse. Replace the internal fuse with the following specified type and rating only:

Input Power	Recommended Fuse
115V AC	160 mA slow blow fuse
230V AC	80 mA slow blow fuse
12…24V DC	800 mA slow blow fuse

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

Symbols Used On Unit

Symbols Used on the Unit

Number	Symbol	Publication	Description
1		IEC 417, No. 5031	Direct current
2		IEC 417, No. 5172	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSUALTION (equivalent to Class II of IEC 536–see annex H)
3		ISO 3864, No. B.3.1	Caution (refer to accompanying documents)

DESCRIPTION

The FC30 Flow Computer satisfies the instrument requirements for dual rotor turbine flow meters in liquid and gas applications. Multiple flow equations and instrument functions are available in a single unit with many advanced features.

The alphanumeric display shows measured and calculated parameters in easy to understand format. Single key direct access to measurements and display scrolling is supported

The versatility of the FC30 permits a wide range of flow measurements within the instrument package. The various hardware inputs and outputs can be “soft” assigned to meet a variety of common application needs. The user “soft selects” the usage of each input/output while configuring the instrument.

The isolated analog output can be chosen to follow volume flow, corrected volume flow, mass flow, temperature, pressure or density by means of a menu selection. Most hardware features are assignable by this method.

The user can assign the standard RS-232 Serial Port for data recording, transaction printing, or for connection to a computer.

Front panel selection of fluid type is supported.

Linearization options include UVC, Strouhal/Roshko and 40 point flow meter linearization tables.

A Service or Test mode is provided to assist the user during start-up system check out by monitoring inputs and exercising outputs and printing system setup.

Features

The FC30 Flow Computer offers the following features:

- Supports Single and Dual Rotor Turbine Flow meters
- Universal Viscosity Curve (UVC) and Strouhal/Roshko Advanced Linearization Methods
- Gas & Liquid Flow Equations (Volume, Mass, Corrected Volume)
- API 2540, AGA-7 Equations
- 10 Selectable Fluid Tables
- Advanced Batching Features: Overrun Compensation, Print End of Batch
- Menu Selectable Hardware & Software Features
- Two Line LCD Display
- Isolated Pulse and Analog Outputs Standard
- RS-232 Port Standard, RS-485 Optional
- Windows™ Setup Software
- DDE Server & HMI Software Available

SPECIFICATIONS

CE Compliant, UL/CUL Listed

Power Requirements	**110V AC**	85…127V rms at 50/60 Hz
	220V AC	170…276V rms at 50/60 Hz
	10…14V DC	300 mA Max
	14…28V DC	
Linearization	40-point linearization table	
Internal Equations	Strouhal-Roshko, API 2540 and AGA-7	
Environmental	**Operating Temp**	32…122° F (0…50° C)
	Storage Temp	-40…185° F (-40…85° C)
	Humidity	0…95%, non-condensing
	Panel Rating	NEMA 4 (IP66)
Display	**Type**	2 x 20 character display, backlit LCD or VFD
	Character Size	0.2 inches
	Keypad	16-Key Membrane
Excitation Voltage	5, 12 or 24V DC at 100 mA	
Relay Outputs	Two (four optional), form C contacts. The relay outputs are menu assignable to (individually for each relay) low rate alarm, high rate alarm, pre-warning alarm, preset alarm or general purpose warning (security).	
Flow Input (Pulse)	One input available for single rotor turbine flow meters	
	Input Impedance	10 KΩ nominal
	Pull-up Resistance	10 KΩ to 5V DC (menu-selectable)
	Pull-down Resistance	10 KΩ to common
	Trigger Level (Menu Selectable)	High Level Input: Logic On (3…30V DC), Logic Off (0…1V DC) Low Level Input (Mag Pickoff): Sensitivity (10 or 100 mV)
	Minimum Count Speed	Menu Selectable
	Maximum Count Speed	Menu Selectable: 40, 3000 or 20,000 Hz
	Overvoltage Protection	50V DC
Control Inputs	Switch Inputs are menu selectable for *Start*, *Stop*, *Reset*, *Lock*, *Inhibit*, *Alarm Acknowledge*, *Print,* or *Not Used*.	
	Input Scan Rate	10 per second
	Logic 1	4…30V DC
	Logic 0	0…0.8V DC
	Input Impedance	100 k Ohms
	Control Activation	Positive Edge or Pos. Level based on product definition for switch usage

Auxiliary/ Compensation Input	Two auxiliary/compensation inputs are available and are menu selectable for temperature, pressure and density or not used. These inputs are used for calculating compensated flow output. It can also be used as a general purpose input for display and alarming.		
	Accuracy	± 0.02% of Full Scale at 68° F (20° C)	
	Input Ranges	Voltage	0…10V DC, 0…5V DC or 1…5V DC
		Current	4…20 MA or 0….20 mA
	Operation	Ratiometric	
	Resolution	16-bit	
	Refresh Rate	1 per second minimum	
	Automatic Fault Detection for signal over-range and under-range, broken current loop, RTD shot, RTD open, user defined fault modes		
	Fault Protection	Reverse Polarity	No ill effects
		Over-Voltage Limit	50V DC
	Temperature Resolution	0.01° C	
	RTD	100 Ohm, 3-Wire DIN RTD	
Serial Communication	EIA-232 and EIA-485 available for use in printing, data recording and communication with a computer		
Isolated Analog Output	The analog output is menu assignable to correspond to the uncompensated volume rate and corrected volume rate, mass rate, temperature, pressure, density, volume total, corrected volume total or mass total.		
	Accuracy	0.05% of Full Scale at 68° F (20° C)	
	Ranges	4…20 mA or 0…20 mA	
	Resolution	12 bit	
	Refresh Rate	1 per second minimum	
	Temperature Drift	<200 ppm/°C	
	Maximum Load	1000 Ohms	
	Averaging	User entry of damping constant to cause a smooth control action	
Isolated Pulse Output	The isolated pulse output is menu assignable to uncompensated volume total and compensated volume total or mass total		
	Form	Open Collector	
	Maximum on Current	25 mA	
	Maximum on Voltage	30V DC	
	Saturation Voltage	1V DC	
	Maximum off Current	0.1 mA	
	Pulse Duration	10 mS or 100 mS (user selectable)	
	Pulse Output Buffer	256	
	Fault Protection	Reverse polarity: shunt diode	

MODES OF OPERATION

Operating Mode

In *Operating* mode, the Flow Computer makes a series of measurements of flow, temperature/ pressure/density sensors and then performs calculations to arrive at a result(s), which are then updated periodically on the display. The analog output, the pulse output, and the alarm relays are also updated. The cycle then repeats itself.

In *Operating* mode, you can perform the following actions:

Action	Description
Update the measurements of input signals	Raw Input Measurements are made at each input using equations based on input signal type selected. The system notes the "out of range" input signal as an alarm condition.
Compute the flowing fluid parameters	The temperature, pressure, viscosity, and density equations are computed as needed based on the flow equation and input usage selected by the user.
Compute the volumetric flow	Uncompensated flow is the term given to the flow in volume units. The value is computed based on the flow meter input type selected and augmented by any performance enhancing linearization that has been specified by the user.
Compute the corrected volume flow at reference conditions	In the case of a corrected volume flow calculation, the corrected volume flow is computed as required by the selected compensation equation.
Compute the mass flow	All required information is now available to compute the mass flow rate as volume flow times density.
Check flow alarms	The flow alarm functions have been assigned to one of the above flow rates during the setup of the instrument. A comparison is now made by comparing the current flow rates against the specified hi and low limits.
Compute the analog output	This designated flow rate value or other process value is now used to compute the analog output.
Compute the flow totals by summation	A flow total increment is computed. The totalizer format also includes provisions for total rollover.
Total preset comparisons	The total associated with a preset function is then compared against the corresponding preset value and any required control actions taken.
Pulse Output Service	The pulse output is next updated by scaling the total increment which has just been determined by the pulse output scaler and summing it to any residual pulse output amount.
Update display and printer output	The instrument finally runs a task to update the various table entries associated with the front panel display and serial outputs.

Setup Mode

The *Setup* mode is password-protected by means of numeric operator and supervisor lockout codes established by the user. In addition, a secret, manufacturer's numeric unlock entry sequence is available.

The system also provides a minimum implementation of an "audit trail" that tracks significant setup changes to the unit. This feature is increasingly being found of benefit to users or simply required by Weights and Measurement Officials in systems used in commerce, trade, or "custody transfer" applications.

A Worksheet is provided to assist the user in setting up the instrument. In addition, a software program is available that runs on a PC using a RS-232 Serial for connection to the Flow Computer. Illustrative examples may be downloaded in this manner.

The *Setup* mode has numerous subgrouping of parameters needed for flow calculations. There is a well conceived hierarchy to the setup parameter list. Selections made at the beginning of the setup affect offerings further down in the lists.

In the *Setup* mode, the flow computer activates the correct setup variables based on the instrument configuration, the flow equation, and the hardware selections made for the compensation transmitter type, the flow transmitter type, and meter enhancements (linearization) options selected. All required setup parameters are enabled. All setup parameters not required are suppressed.

A help line prompt is provided for each entry. Press **HELP** to display a help message.

Also note that in the setup mode are parameter selections which have preassigned industry standard values. The unit will assume these values unless they are modified by the user.

Most of the process input variables have available a "default" or emergency value which must be entered. These are the values that the unit assumes when a malfunction is determined to have occurred on the corresponding input.

It is possible to enter in a nominal constant value for temperature or density, or analog flow inputs by placing the desired nominal value into both the lo and hi values. This is also a convenience when performing bench top tests without simulators.

Maintenance Mode

The *Maintenance* mode of the FC30 is the Test and Calibration Mode for the device. This mode provides a number of specialized utilities required for factory calibration, instrument checkout on startup, and periodic calibration documentation.

A supervisor password is required to gain access to this specialized mode of operation. Normally quality, calibration, and maintenance personnel will find this mode of operation very useful. It is also useful for factory testing.

Many of these tests may be used during startup of a new system. Inputs signals may be read, and output signals may be exercised to verify the electrical interconnects before the entire system is put on line.

The following action items may be performed in the *Maintenance* mode:

- Print Calibration/Maintenance Report Examine Audit Trail
- Keypad Checkout
- Display Checkout
- Pulse Input Checkout
- Pulse Output Checkout
- Control Input Checkout
- Relay Output Checkout
- Analog Input Checkout
- Analog Output Checkout
- Calibrate Analog Inputs using the Learn Feature
- Calibrate Analog Output using the Learn Feature
- Battery Check
- Datalog Printing and Clearing

NOTE: A calibration of the analog input/output will advance the audit trail counters since it effects the accuracy of the system.

RS-232 SERIAL PORT

The FC30 has a general purpose RS-232 port suitable for any of the following purposes:

- Transaction Printing
- Periodic Printing of Datalog
- Print Internal Datalog
- Remote Metering by Modem (optional) Computer
- Communication Link Configuration by Computer
- Print System Setup
- Print Calibration/Malfunction History
- Remote Control
- Instrument Setup via PC Serial Port

A Diskette program is provided with the FC30 that enables the user to rapidly configure the FC30 using a Personnel Computer. Included on the diskette are common instrument applications which may be used as a starting point for your application. This permits the user to have an excellent starting point and helps speed the user through the instrument setup.

Operation of Serial Communication Port with Printers

The RS-232 channel supports a number of operating modes. One of these modes is intended to support operation with a printer in metering applications requiring transaction printing, data logging and/or printing of calibration and maintenance reports.

For transaction printing, the user defines the items to be included in the printed document. The user can also select what initiates the transaction print generated as part of the setup of the instrument. The transaction document may be initiated via a front panel key depression, a remote contact closure, or upon completion of a batch.

In data logging, the user defines the items to be included in each data log as a print list. The user can also select when or how often he wishes a data log to be made. This is done during the setup of the instrument as either a time of day or as a time interval between logging.

The system setup and maintenance report lists all the instrument setup parameters and usage for the current instrument configuration. In addition, the Audit trail information is presented along with a status report listing any observed malfunctions which have not been corrected.

The user initiates the printing of this report at a designated point in the menu by pressing the print key on the front panel.

Operation of Serial Port with Modems (Optional)

The FC30 RS-232 channel supports a number of operating modes. One of these modes is intended to support operation with a modem in remote metering applications. FC30's role is that of DTE effecting file transfers under common file transfer protocols.

An external modem is intentionally being used with the FC30. This permits use with the variety of modem standards worldwide while avoiding the specialized approvals required for equipment that is deemed to fall under the category of telecommunication equipment.

In the modem mode, the FC30 is assumed to be operating in a remote metering role. The FC30 will support key items in the Hayes Compatible "AT" Command Set. In this role, the FC30 will have the following special abilities:

- Monitor the modem status as a task of the system
- Instruct the modem to answer an incoming calls ATA
- Respond to the calling modem at the programmed baud rate and protocol
- Terminate the telephone connection in event the connection is lost
- Initiate a call to a designated telephone number in the event of a metering malfunction

INSTALLATION

The FC30 Flow Computer 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 5.43 in. (138 mm) wide by 2.68 in. (68 mm) high panel cutout. (See *"Dimensions" on page 13*).

To mount the Flow Computer:

1. Prepare the panel opening.
2. Slide the unit through the panel cutout until it touches the panel.
3. Install the screws (provided) in the mounting bracket and slip the bracket over the rear of the case until it snaps in place.
4. Tighten the screws firmly to attach the bezel to the panel. Apply 3 in-lb of torque must be applied and the bezel must be parallel to the panel.

Termination Connectors

Minimum Wire Gauge: 22 AWG

Maximum Wire Gauge: 14 AWG

Voltage/current limits are limited by unit specifications.

Permanently Connected Equipment

UL 3101-1, Section 6.12.2.1 specifies that:

- A switch or circuit breaker shall be included in the building installation;
- It shall be in close proximity to the equipment and within easy reach of the OPERATOR;
- It shall be marked as the disconnecting device for the equipment.

Verify that the switch or circuit breaker chosen is suitable for the power requirements of the unit.

Mounting Diagrams

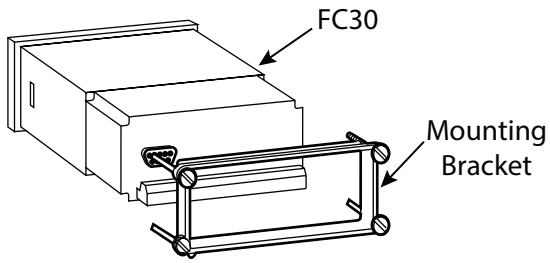


Figure 1: Standard mounting

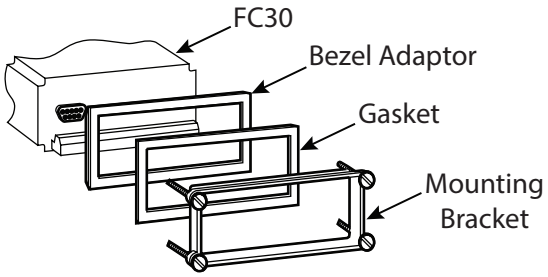
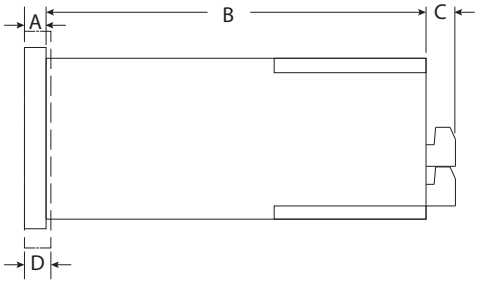


Figure 2: Bezel kit mounting

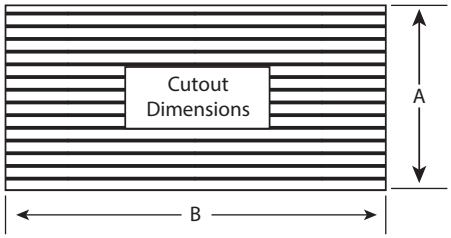
DIMENSIONS

Top View



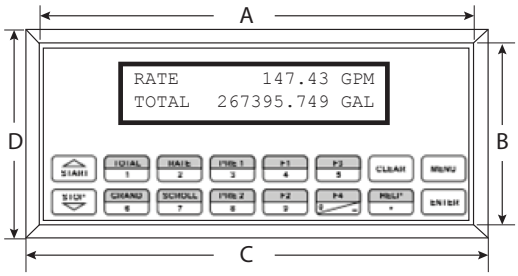
A	0.28 in. (7.2 mm)
B	6.15 in. (156 mm)
C	0.5 in. (13 mm)
D	0.4 in. (10 mm)

Cutout



A	2.68 in. (68 mm)
B	5.43 in. (138 mm)

Front View



A	5.67 in. (144 mm)
B	2.83 in. (72 mm)
C	6.18 in. (157 mm)
D	3.43 in. (87 mm)

Figure 3: Dimensions

APPLICATIONS

Liquid Volume

Measurements

A flow meter measures the actual volume in a liquid line. A temperature sensor can also be installed to correct for liquid thermal expansion (see *"Corrected Liquid Volume" on page 15*).

Calculations

Volume flow is calculated using the flow meter frequency output and the user entered K-Factor.

Pulse input, average k-factor

$$\text{Volume Flow} = \frac{\text{input frequency} * \text{time scale factor}}{\text{K-Factor}}$$

Output Results

Display Results	Flow Rate, Resettable Total, Non-Resettable Total
Analog Output	Rate or Total
Pulse Output	Total
Relay Outputs	Rate or Total Alarms

Applications

The Flow Computer can monitor actual volume flow and total of any liquid. Flow alarms are provided via relays and datalogging is available via analog (4…20 mA) and serial outputs.

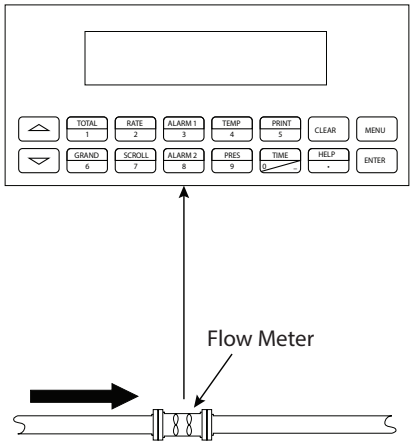


Figure 4: Liquid volume

Corrected Liquid Volume

Measurements

A flow meter measures the actual volume in a liquid line. A temperature sensor is installed to correct for liquid thermal expansion.

Calculations

Corrected Volume is calculated using the flow and temperature inputs as well as the thermal expansion coefficient stored in the flow computer. Use the *Set Fluid Properties* submenu to define reference temperature and density values for standard conditions.

Pulse input, average k-factor

$$\text{Volume Flow} = \frac{\text{input frequency} * \text{time scale factor}}{\text{K-Factor}}$$

Corrected volume flow, temperature transmitter

$$\text{Corrected Volume Flow} = \text{vol. flow} * (1 - \text{Therm.Exp.Coef.} * (Tf - Tref))^2$$

See API 2540 equation.

Output Results

Display Results	Flow Rate, Resettable Total, Non-Resettable Total, Temperature, Density
Analog Output	Rate, Total, Temperature or Density
Pulse Output	Total
Relay Outputs	Rate , Total or Temperature Alarms

Applications

Monitoring corrected volume flow and total of any liquid. Flow alarms are provided via relays and datalogging is available via analog (4…20 mA) and serial outputs.

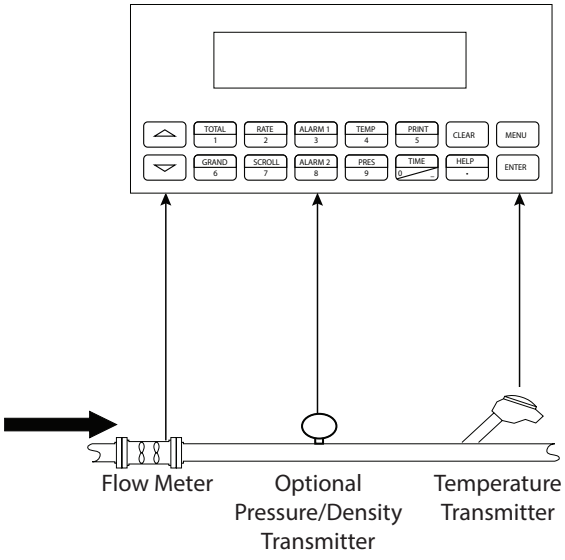


Figure 5: Corrected liquid volume

Liquid Mass

Measurements

Actual volume is measured by the flow element. Temperature is measured by the temperature transmitter. A density transmitter can be used for direct density measurements or a pressure transmitter may be utilized.

Calculations

The density and mass flow are measured directly or calculated using the reference density and the thermal expansion coefficient of the liquid (see *Set Fluid Properties* submenu).

Pulse input, average k-factor

$$\text{Volume Flow} = \frac{\text{input frequency} * \text{time scale factor}}{\text{K-Factor}}$$

Mass Flow

Mass Flow = volume flow * density

Output Results

Display Results	Flow Rate, Resettable Total, Non-Resettable Total, Temperature, Density or Pressure
Analog Output	Rate, Total, Temperature or Density or Pressure
Pulse Output	Total (corrected or uncorrected)
Relay Outputs	Flow Rate, Total, Temperature, Pressure or Density Alarms

Applications

Monitoring mass flow and total of any liquid. Flow alarms are provided via relays and datalogging is available via analog (4…20 mA) and serial outputs.

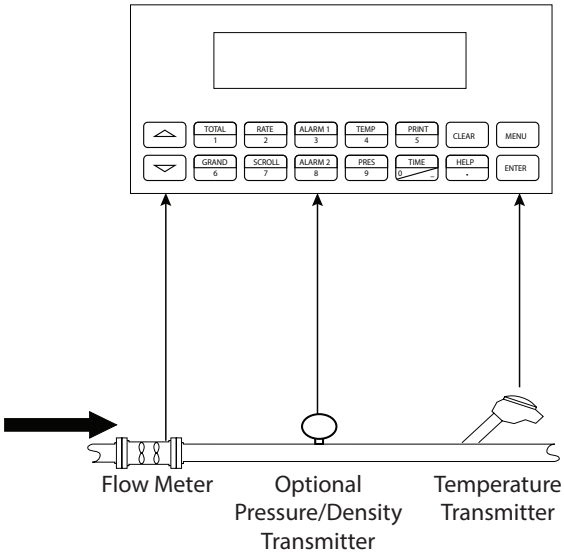


Figure 6: Liquid mass

Batching

Measurements

A flow meter measures the actual volume in a liquid line. A temperature sensor can also be installed to correct for liquid thermal expansion (see *"Corrected Liquid Volume" on page 15*).

Calculations

Volume flow is calculated using the flow meter frequency output and the user entered K-Factor.

$$\text{Volume Flow} = \frac{\text{input frequency} * \text{time scale factor}}{\text{K-Factor}}$$

Corrected Volume is calculated using the flow and temperature inputs as well as the thermal expansion coefficient stored in the flow computer.

$$\text{Corrected Volume Flow} = \text{vol. flow} * (1 - \text{Therm.Exp.Coef.} * (Tf - Tref))^2$$

See API 2540 equation.

Output Results

Display Results	Flow Rate, Batch Total, Non-Resettable Total, Temperature, Density or Pressure
Analog Output	Rate, Total, Temperature, Density or Pressure
Pulse Output	Total (volume or corrected volume/mass)
Relay Outputs	Batch Total, Rate, or Temperature Alarms

Applications

Batching and monitoring flow and total of any liquid. Batching is accomplished via relays and datalogging is available via analog (4…20 mA) and serial outputs.

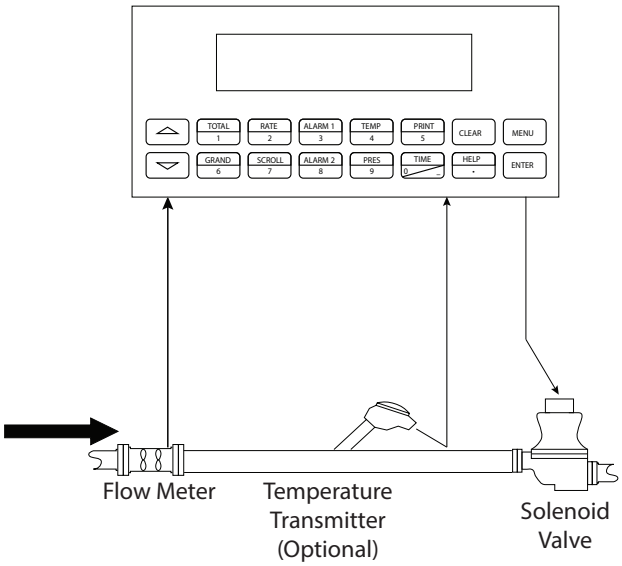


Figure 7: Batching

Corrected Gas Volume

Measurements

A flow meter measures the actual volume flow in a gas line. Temperature and pressure sensors are installed to measure temperature and pressure.

Calculations

Corrected Volume is calculated using the flow, temperature and pressure inputs as well as the gas characteristics stored in the flow computer (see Fluid Data submenu). Use the *Fluid* submenu to define reference temperature and reference pressure values for standard conditions.

Pulse input, average k-factor

$$\text{Volume Flow} = \frac{\text{input frequency} * \text{time scale factor}}{\text{K-Factor}}$$

$$\text{Corrected Volume Flow} = \text{Volume Flow} * \frac{P}{P_{ref}} * \frac{T_{ref}}{T} * \frac{Z_{ref}}{Z}$$

Output Results

Display Results	Corrected Volume or Actual Volume Flow Rate, Resettable Total, Non-Resettable Total, Temperature, Pressure, Density
Analog Output	Corrected Volume or Actual Volume Flow Rate, Temperature, Pressure, Density
Pulse Output	Corrected Volume or Actual Volume Total
Relay Outputs	Corrected Volume Flow Rate, Total, Pressure, Temperature, Density

Applications

Monitoring corrected volume flow and total of any gas. Flow alarms are provided via relays and datalogging is available via analog (4…20 mA) and serial outputs.

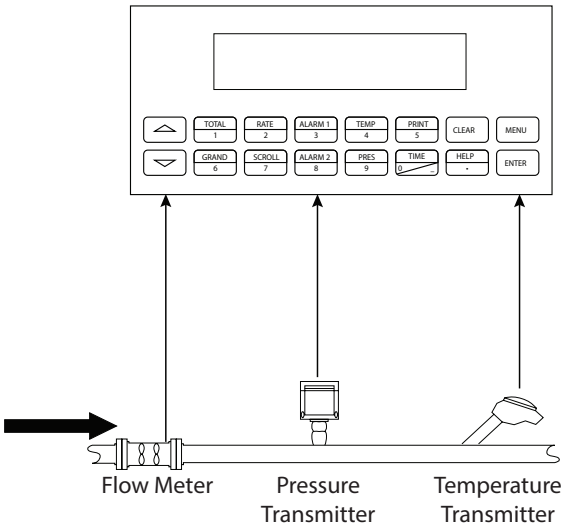


Figure 8: Corrected gas volume

Gas Mass

Measurements

A flow meter measures the actual volume flow in a gas line. Temperature and pressure sensors are installed to measure temperature and pressure.

Calculations

Density and mass flow are calculated using gas characteristics stored in the flow computer.

$$\text{Mass Flow} = \text{Actual Volume Flow} * \rho_{ref} * \frac{P}{P_{ref}} * \frac{T_{ref}}{T} * \frac{Z_{ref}}{Z}$$

ρ_{ref} = Reference density

T_{ref} = Reference temperature

P_{ref} = Reference pressure

Z_{ref} = Reference Z-factor

Output Results

Display Results	Mass or Volume Flow Rate, Resettable Total, Non-Resettable Total, Temperature, Pressure, Density
Analog Output	Mass or Volume Flow Rate, Temperature, Pressure, Density
Pulse Output	Mass or Volume Total
Relay Outputs	Corrected Volume Flow Rate, Total, Pressure, Temperature, Density Alarms

Applications

Monitoring mass flow and total of gas. Flow alarms are provided via relays and datalogging is available via analog (4…20 mA) and serial outputs.

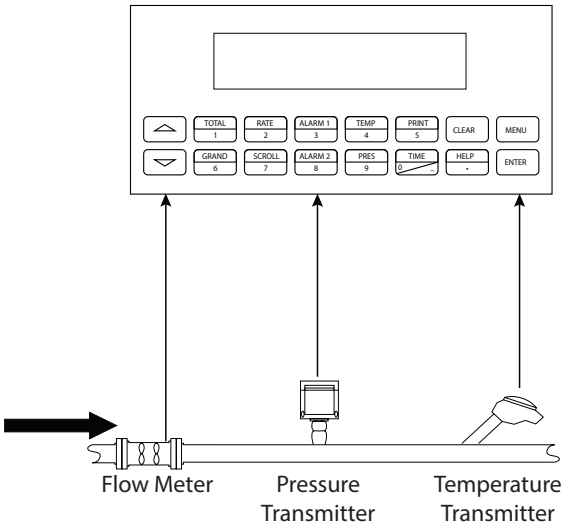


Figure 9: Gas mass

WIRING

Batcher Wiring

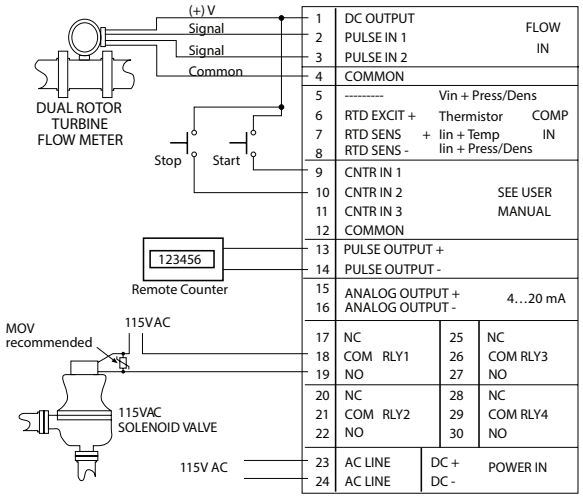


Figure 10: Batcher wiring

Rate / Total Wiring with RTD

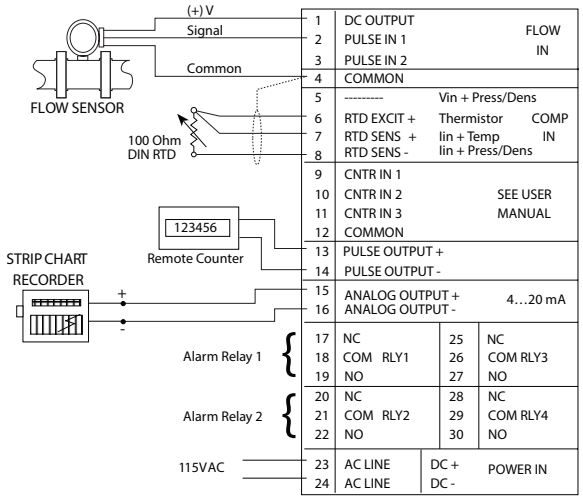


Figure 11: Rate/total wiring with RTD

Thermistor Wiring

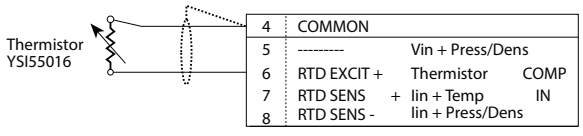


Figure 12: Thermistor wiring

Wiring in Hazardous Areas

Examples using MLT787S+ Barrier (MTL4755ac for RTD)

Temperature Input (4…20 mA Transmitter)

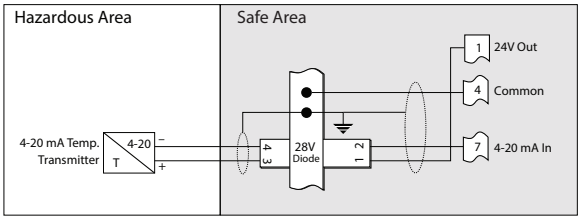


Figure 13: 4…20 mA transmitter

Temperature Input (RTD)

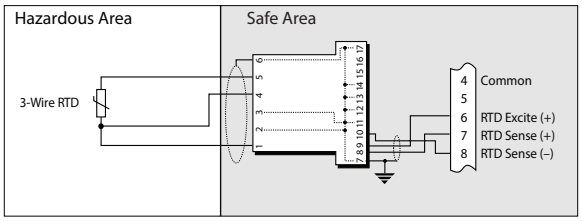


Figure 14: RTD

Pressure Input (4…20 mA Transmitter)

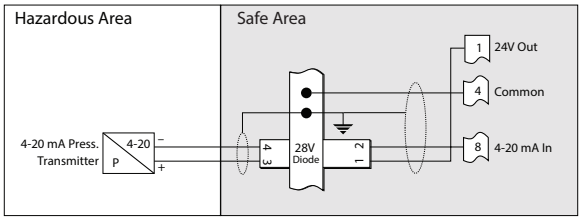


Figure 15: 4…20 mA transmitter

UNIT OPERATION

Front Panel Operation Concept for Run Mode

The FC30 is fully programmable through the front panel. Please review the following usage summary before attempting to use the instrument.

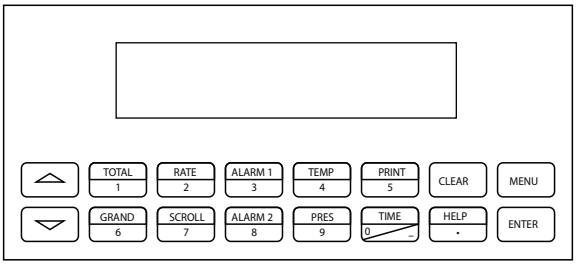


Figure 16: Corrected gas volume

HELP	Online help is available during *RUN* and *SETUP* modes simply by pressing **HELP**. Also use the *HELP* key to enter decimals when entering numeric values.
VIEWING PROCESS MODELS	In the *OPERATE* mode, several keys have a special, direct access feature, to display an item of interest (for instance RATE, TOTAL, ALARM SETPOINT). Press the key to view your choice. Press the ΔV keys to view other items in that group.
CLEARING TOTALIZER	To clear the totalizers, press **TOTAL** to select the totalizer group. Press the ΔV keys to select the required totalizer. Once the totalizer is displayed, press **CLEAR** to reset the total. A prompt asks you to verify the action and to enter a password if the unit is locked.
CLEARING GRAND TOTAL	To clear the grand totalizers, press **GRAND** and use the ΔV keys to select the required grand total. Press **CLEAR** to reset the grand total. A prompt asks you to verify this action and to enter the service password if the unit is locked.
ALARM SETPOINT KEYS	Press **ALARM 1** or **ALARM 2** to view or change the alarm setpoints. To *view* the setpoints, press the alarm setpoint key once. To *edit* the setpoints, rapidly press the alarm setpoint key several times. A prompt asks you enter a password if the unit is locked. Press **CLEAR**, "###", **ENTER** to enter value.
SCROLL	Press **SCROLL** to activate the scrolling display list. See REF display setup.
PRINT	Use **PRINT** to print on demand when the communication port is set for printer. When you press PRINT, a user-defined list of data (for instance TOTAL, RATE, ALARM SETPOINT) is sent to the RS-232 port. The message "PRINTING" displays to acknowledge the print request.
MENU KEY	Press **MENU** to enter the *SETUP* and *TEST* modes. (See section 6 for Setup mode, section 8 for Test mode). The *MENU* key is used as "escape" in Setup and Test Programming. Pressing *MENU* while programming in the Submenu groups returns the display to that Submenu group heading. Pressing *MENU* while viewing the Submenu groups returns the display to the Top Level Menu.
ACKNOWLEDGING ALARMS	Most alarm messages are self-clearing. Press **ENTER** to acknowledge and clear alarms. **NOTE:** Some keys and functions are password protected. Enter the password to gain access. The passwords are factory set as follows: Private = 1000 Service = 2000

General Operation

This instrument is used primarily to monitor flow rate and accumulated total. The inputs can be software configured for a variety of flow meter, temperature and pressure sensors. The standard output types include: Pulse, Relay, Analog and RS-232 The unit can display the flow rate, total and process variables. RS-485 is an available option for a second communication channel.

Ratemeter/Totalizer Operation

The Ratemeter/Totalizer mode is used primarily to monitor flow rate and accumulated total. The relays can be used to trigger flow, total, temperature pressure or density alarms.

Password Protection for Rate/Total Mode

After a Private and/or Service Code is entered in the *System Parameters* Submenu Group. (See *"Private Code" on page 71*), the unit will be locked. The unit will prompt the user for the password when trying to perform the following functions:

- Clear Totals
- Clear Grand Totals (service code required)
- Edit a Setup Menu Item
- Edit Alarm Setpoints (ALARM 1 & ALARM 2 Keys)

The Service Code should be reserved for service technicians. The Service Code allows access to restricted areas of the Service and Test menus. Changes in these areas may result in lost calibration information.

Relay Operation in Rate/Total Mode

Two relay *alarm* outputs are standard. The relays may also be used for *pulse* outputs. The relays can be assigned to trip according to various rate, total, temperature or pressure readings. The relays can be programmed for low/high alarms, latch or unlatch, or as relay pulse outputs.

ALARM SETPOINT 1 (RLY1) and ALARM SETPOINT 2 (RLY2) are accessible by pressing **ALARM 1** or **ALARM 2** on the front panel.

Pulse Output in Rate/Total Mode

The isolated pulse output (open collector) is menu-assignable to Volume Total and either the Corrected Volume Total or Mass Total. The pulse output duration can be set for 10 mS (50 Hz max) or 100 mS (5 Hz max). A pulse output scale factor (pulse value) can be set to scale the pulse output. The pulse output is ideal for connecting to remote totalizers or other devices such as a PLC. See section 1.3 for electrical specifications.

Analog Output in Rate/Total Mode

The isolated pulse output is menu assignable to any of the available totals. The pulse output duration and scaling can be set by the user. The pulse output is ideal for connecting to remote totalizers or other devices such as a PLC. See section 1.2 for electrical specifications.

Function Keys; Display Grouping

TOTAL	Press the ΔV keys to view Heat Total, Mass Total, Corrected Volume Total, Volume Total
GRAND TOTAL	Press the ΔV keys to view Grand Heat, Grand Mass, Grand Corrected Volume, Grand Volume
RATE	Press the ΔV keys to view Heat, Mass , Corrected Volume, Volume, Peak Demand, Demand Last Hour
TEMPERATURE	Press the ΔV keys to view Temperature 1, Temperature 2, Delta Temperature, Density
PRESSURE	Press the ΔV keys to view Pressure, Differential Pressure, Specific Enthalpy
TIME	Press the ΔV keys to view Time/Date, Peak Time/Date, Accumulative Power Loss Time, Time of Last Power Outage, Time Power was Last Restored

RS-232 Serial Port Operation in Rate/Total Mode

The RS-232 serial port can be used for programming (using the Setup Disk) or for communicating to printers and computers in the Operating Mode (Run Mode).

PC Communications

The Setup Disk also allows the user to query the unit for operating status such as Flow Rate, Flow Total, Temperature, Pressure, Density, Presets and so on.

Operation of RS-232 Serial Port with Printers

Transaction Printing	The user defines the items to be included in the printed document (see section 6.3.20 SET DATA OUTPUT, Select_list). The transaction document can be initiated by pressing **PRINT** or by a remote contact closure.
Data Logging	The user defines the items to be included in each data log (see section 6.3.20 SET PRINTER OUTPUT, Select_list). The user can also select when (time of day) or how often (print interval) the data log is to be made (see section 6.3.19 SET PRINTER OUTPUT, Configure). Data logs can also be initiated by pressing **PRINT** or control input.
System Setup and Maintenance Report	The system setup and maintenance report lists all of the instrument setup parameters and usage for the current instrument configuration. The audit trail information and a status report is also printed. This report is initiated in the Test menu (see section 8.2.3 PRINT SYSTEM SETUP).

RS-485 Serial Port (Optional)

The RS-485 serial port is intended to permit operation of the flow computer in a RS-485 network. Access is limited to reading process variables, totalizers, error logs and to executing action routines such as clearing totalizers, alarms, and changing setpoints.

Pause Computations Prompt

The user will be prompted with a "Pause Computations" message when making significant setup changes to the instrument. Pausing computations is necessary to make any significant changes. With computations paused, all outputs assume a safe state equal to that of an unpowered unit. Computations resume when exiting the setup menu.

Batcher Operation

The Batcher mode is used primarily to control batches. The main difference between the Batch mode and Rate/Total mode is the relay operation. The Batch mode allows the operator to "START" the unit via the front panel or remote input. Once started, the relays (RLY1 & RLY2) will energize and send power to a flow control device (i.e. solenoid valve or pump). The flow sensor will send a signal to the unit and total accumulation will begin. When the Prewarn value (PRE 2) is reached, Relay 2 will drop out (this is ideal for flow slow down). When the Batch amount (PRE 1) is reached, Relay 1 will drop out and the Batch is complete.

Several messages will be displayed during normal batch operation (i.e. Batch Fill, Batch Stopped). The keypad is disabled for the duration of these timed messages (approx. 2 sec).

Batcher Configuration

When the unit is programmed for batch mode, several batch operation choices are available. These choices include: Up or Down Counting, Maximum Batch Preset, Batch Overrun Compensation, Auto Batch Restart, Time Delay, Flow Signal Timeout, Maximum Drain Time, Slow Start Quantity, Start or Reset/Start, and Stop or Stop/Reset.

Batch Count Mode

The Batch Count Mode allows the user to choose whether the unit will batch up to a preset value or batch down from a preset value to zero.

Maximum Batch Preset

The Maximum Batch Preset allows the user to program the Maximum Batch value allowed to be entered by the operator. If an operator should try to program a batch higher then this value, the unit will not allow the value to be entered and will prompt the user with an error message saying that the Maximum Batch Preset has been exceeded.

Batch Overrun

The Batch Overrun is used for batch applications that have slow responding valves and a consistent batching flow rate. When the Batch Overrun is set, the unit will compensate for batch overruns by computing an averaged overrun value from the last four batches. This average is used to internally adjust the batch setpoint to minimize overrun.

Auto Batch Restart

The Auto Batch Restart function allows the user to set an amount of time to automatically restart a batch after the completion of a batch. This time can be set from 1 to 99 seconds.

Time Delay

The Time Delay for Auto Batch Restart functions as follows: When a batch is completed, the next batch will automatically start after the amount of time entered here.

Flow Signal Timeout

The Flow Signal Timeout allows the user to enter a timeout of 0 to 99 seconds. If a batch is "Filling" and zero flow persists for more than the user entered time then the batch will be aborted. This prevents over flows due to faulty flow sensors and/or wiring.

Maximum Drain Time

The unit declares that a batch is "done" when the flow rate equals "0". A flow rate may be present long after the Preset Relay de-energizes due to slow reacting valves or leaky valves. The Maximum Drain Time allows the user to enter an amount of time (0 to 99 seconds) to wait before declaring "Batch Done". After the Preset Batch quantity is reached, the unit will declare "Batch Done" when the flow rate is "0" or the Maximum Drain Time has expired. The batch data will then be available for printing and datalogging.

Slow Start Quantity

The Slow Start Quantity is a function that allows an amount to be entered for a Slow Start up. This function requires two stage valve control. RLY 1 (slow flow) will energize for Slow Start and RLY 2 (fast flow) will energize after the Slow Start Quantity has been delivered. This helps reduce turbulence when filling an empty container.

START, RESET/START and STOP, STOP/RESET

When configuring the control inputs, Control Input1 can be set for START or RESET/START. When set for START, the unit will start batching when a signal is applied to Control Input1 or the front panel Start key is pressed. A separate Reset signal must be used to clear the previous batch total. When set for RESET/START, the unit will automatically reset then start when a signal is applied to Control Input1 or the front panel Start key is pressed (provided that the pervious batch was completed). If a previous batch was stopped during a batch cycle, the unit will Start from where it was stopped.

Control Input 2 can be set for STOP or STOP/RESET. When set for STOP, the unit will stop batching when a signal is applied to Control Input 2 or the front panel Stop key is pressed. A separate Reset signal must be used to clear the batch total. When set for STOP/RESET, a running batch will stop when a signal is applied to Control Input 2 or the front panel Stop key is pressed. If the unit is Stopped or after a completed batch, the unit will reset when a signal is applied to Control Input 2 or the front panel Stop key is pressed.

NOTE: Applying a high logic level to Control Input 2 will inhibit all Start inputs in either mode.

Password Protection for Batcher Mode

After an Operator and/or Supervisor Password is defined in the setup mode (see section 6.4.23, ADMINISTRATIVE SETUP submenu), the unit will be locked when you return to the run mode. The unit will prompt the user for the password when trying to perform the following functions:

Clear Grand Total Enter Menu

The Supervisor password should be reserved for supervisors. The Supervisor password will allow access to restricted areas of the Setup and Test menus.

The passwords are factory set as follows:

Operator = 0

Supervisor = 2000

Relay Operation in Batcher mode

Up to four relays are available (two standard) for alarm outputs. Preset 1 (RLY1) is reserved for batch amount, Preset 2 (RLY2) is reserved for prewarn. Preset 1 (RLY1) and Preset 2 (RLY2) are easily accessible by pressing the PRE 1 or PRE 2 key on the front panel. Preset 3 and Preset 4 are accessible only through the setup menu.

Relays 3 and 4 can be assigned to trip according to rate, total, temperature, pressure, density, overrun or alarm. When rate, temperature, pressure or density is selected the relays can be programmed for low or high alarms.

Pulse Output in Batcher mode

The isolated pulse output (open collector) is menu assignable to Volume Total, and either Corrected Volume Total or Mass Total. The pulse output duration can be set for 10mS (50 Hz max) or 100mS (5 Hz max). A pulse output scale factor (pulse value) can be set to scale the pulse output. The pulse output is ideal for connecting to remote totalizers or other devices such as a PLC. See section 1.3 for electrical specifications.

Analog Output in Batcher mode

The analog output is menu assignable to correspond to the Volume Rate, Corrected Volume Rate or Mass Rate, Temperature, Pressure, Density, and Total. The analog output is ideal for "trend" tracking using strip chart recorders or other devices.

RS-232 Serial Port Operation in Batcher mode

The RS-232 serial port can be used for programming (using the Setup Disk) or for communicating to printers and computers in the Operating Mode (Run Mode).

PC Communications

The Setup Disk also allows the user to query the unit for operating status such as Flow Rate, Flow Total, Temperature, Pressure, Density, Presets, etc.

Operation of RS-232 Serial Port with Printers

Transaction Printing For transaction printing, the user defines the items to be included in the printed document (see section 6.4.22 SET DATALOG/PRINT, Select_list). The transaction document can be initiated by pressing the PRINT key, by a remote contact closure or print at end of batch.

Data Logging In data logging, the user defines the items to be included in each data log (see section 6.4.22 SET DATALOG/PRINT, Select_list). The user can also select when (time of day) or how often (print interval) the data log is to be made (see section see section 6.4.21 SET DATALOG/PRINT, Configure).

System Setup and Maintenance Report The system setup and maintenance report lists all of the instrument setup parameters and usage for the current instrument configuration. The audit trail information and a status report is also printed. This report is initiated in the Test menu (see section 8.2.3 PRINT SYSTEM SETUP).

RS-485 Serial Port (Optional)

RS-485 Port Description

The optional RS-485 card uses Modbus RTU protocol to access a variety of process parameters and totalizers. Batches/Relays can be controlled remotely via Modbus. In addition, action routines can be executed. For further information, contact factory and request RS-485 Protocol manual.

Operation of Serial Communication Port with PC

The flow computer's RS-485 channel supports a number of Modbus RTU commands. Modbus RTU drivers are available from third party sources for a variety of Man Machine Interface software for IBM compatible PC's.

The user reads and writes information from/to the RS-485 using the Modbus RTU commands. The FC30 then responds to these information and command requests.

Process variables and totalizers are read in register pairs in floating point format. Time and date are read as a series of integer register values. Alarms are individually read as coils. Action routines are initiated by writing to coils.

PROGRAMMING

Front Panel Operation Concept for Program Mode

The FC30 is fully programmable through the front panel. Please review the following usage summary before attempting to use the instrument.

Mode Changes

Pressing the MENU key will offer selections of RUN, SETUP, TEST. RUN is the normal operating mode for the instrument. SETUP offers various sub-menus used for instrument setup. TEST offers various sub-menus for Test, Calibration and System Start-up.

Submenu Group Navigation

Use the UP and DOWN arrow keys to navigate up and down through the Sub-Menu groups when in the SETUP or TEST mode. Press **ENTER** to enter a desired setup or test Sub-Menu group.

Selection of Item

During setup, the unit will often offer multiple choices for a given topic. The topic prompt appears on the top line of the display. The choices are shown on the lower line of the display.

To select an item, press the key beneath the desired choice. The selected choice will blink. Press **ENTER** to accept the selected choice.

Numeric Entry

The keys labeled "*0 - 9*", "–", ".", *CLEAR* and *ENTER* are used to enter numerical values. A leading 0 will assume that you intend to enter a minus "–" sign. Press **CLEAR** to clear the existing value and to enable editing.

Text Character Entry

Some setup items (for instance Descriptors, Units Label) require the user to enter text characters. Press **CLEAR** to enable editing. Use the $\Delta\nabla$ keys to scroll through the available character sets for each individual character. Press **ENTER** to accept the character and advance to the next character.

Setup Menus

Menus	Display	Notes
	SELECT OPERATE STATE Run **Setup** Test MENU ENTER	Select *Setup* to enter the instrument setup routine.
Top Level Setup Menu	START INSTRUMENT TYPE	See *"Instrument Type" on page 29*.
Submenu Groups	STOP START SELECT FLOW EQUATION	See *"Select Flow Equation" on page 30*.
	STOP START SETUP INDICATORS	See *"Setup Indicators" on page 30*.
	STOP START SETUP FLOW INPUT	See *"Setup Flow Input" on page 33*.
	STOP START SETUP AUX1 INPUT	See *"Setup Aux1 Input" on page 35*.
	STOP START SETUP AUX2 INPUT	See *"Setup Aux2 Input" on page 36*.
	STOP START SET FLUID PROPERTIES	See *"Set Fluid Properties" on page 37*.
	STOP START SETUP PULSE OUTPUT	See *"Setup Pulse Output" on page 38*.
	STOP START SETUP ANALOG OUTPUT	See *"Setup Analog Output" on page 38*.
	STOP START SETUP RELAYS	See *"Setup Relays" on page 39*.
	STOP START SETUP CONTROL INPUTS	See *"Setup Control Inputs" on page 41*.
	STOP START SETUP REALTIME CLOCK	See *"Setup Realtime Clock" on page 42*.
	STOP START SERIAL USAGE	See *"Serial Usage" on page 43*.
	STOP START SETUP DATALOG/PRINT	See *"Setup Datalog/Print" on page 44*.
	STOP START ADMINISTRATIVE SETUP	See *"Administrative Setup" on page 45*.
	STOP START SETUP NETWORK CARD STOP	See *"Setup Network Card" on page 46*.

Setup Sub-Menus

Menus	Display	Notes
Instrument Type	INSTRUMENT TYPE	Press **ENTER** to enter *Instrument Type* submenus.
	ENTER ↓	
Rate/Tot	INSTRUMENT TYPE Rate/Tot Batch	Press **ENTER** when Rate/Total is flashing to configure the instrument as a Ratemeter/ Totalizer.
	STOP START ENTER ↓	
	Advance To SELECT FLOW EQUATION	If you selected Rate/Tot, advance to Select Flow Equation.
	INSTRUMENT TYPE	Press **ENTER** to enter Instrument Type sub- menus.
	ENTER ↓	
Batch	INSTRUMENT TYPE Rate/Tot Batch	Press **ENTER** when Batch is flashing to configure the instrument as a Batcher.
	STOP START ENTER ↓	
	BATCH COUNT MODE Up Down	Select Up to Reset to 0 and count up to preset. Select Down to reset to Preset and count down to 0.
	STOP START ENTER ↓	
	MAXIMUM BATCH PRESET 1000.0 gal	Enter the maximum allowable Batch Preset. The operator will not be able to enter a batch preset larger than this value.
	STOP START ENTER ↓	
	BATCH OVERRUN COMP Off On	Select On to set the unit to operate using a Batch Overrun Compensation routine. Select Off to inhibit Batch Overrun Compensation routine. (See Section 5.4)
	STOP START ENTER ↓	
	AUTO BATCH RESTART Off On	Select On to enable the Auto Batch Restart. This will automatically restart the unit at the end of each batch run. Select Off if this is not desirable.
	STOP START ENTER ↓	
	TIME DELAY (1-99 sec) 10	Enter Time Delay for Auto Batch Restart. When a batch is completed, the next batch will start after the amount of time entered here.
	ENTER ↓	
	FLOW SIGNAL TIMEOUT 10	Enter a timeout of 0…99 seconds. If a batch is "Filling" and zero flow persists for more than this time, the batch will be aborted.
	ENTER ↓	
	MAXIMUM DRAIN TIME 10	Enter time (0…99 seconds) for Max. Drain Time. After batch quantity is reached, "Batch Done" is declared when the flow rate is "0" or the Maximum Drain Time has expired.
	ENTER ↓	
	SLOW START QUANTITY 10	Enter a quantity for a Slow Start up. RLY 2 (slow flow) will energize for Slow Start and RLY 1 (fast flow) will energize after the Slow Start Quantity has been delivered.
	ENTER ↓	
	NO TOT FOR BATCH DLY No Yes	Select Yes to inhibit totalization during the auto batch restart delay.
	ENTER ↓	
	Advance To SELECT FLOW EQUATION	

Menus	Display	Notes
Select Flow Equation	SELECT FLOW EQUATION	Press **ENTER** to enter Select Flow Equation submenus.
	ENTER ↓	
	SELECT FLUID MEDIA Liquid Gas	Press **ENTER** when desired fluid media is flashing.
	ENTER ↓	
	SELECT FLOW EQUATION Volume Mass Cor/Vol	Press **ENTER** when desired flow equation is flashing.
	ENTER ↓	
	Advance To SETUP INDICATORS (Total)	
Setup Indicators (Total)	SETUP INDICATORS	Press **ENTER** to begin setup of the Indicators.
	ENTER ↓	
	SETUP INDICATORS Tot Dns Rte Tmp Pres	Press **ENTER** when Total is flashing to configure the Totalizer Indicators.
	ENTER ↓	
	TOTAL DESCRIPTOR TOTAL	Enter the desired Total Descriptor.
	ENTER ↓	
	TOTAL VOLUME UNITS gal	Enter the desired Volume Units Label for the Totalizer.
	ENTER ↓	
	TOT DEC PLACES (0-3) 0	Select the desired Total Decimal Place (0…3 decimal places allowed).
	ENTER ↓	
	Advance To SETUP INDICATORS (Density)	
Setup Indicators (Density)	SETUP INDICATORS Tot Dns Rte Tmp Pres	Press **ENTER** when Dens is flashing to configure the Density Indicators.
	ENTER ↓	
	DENSITY DESCRIPTOR DENS	Enter the desired Density Descriptor.
	ENTER ↓	
	DENSITY MASS UNITS lbs	Enter the desired Mass Units Label for Density.
	ENTER ↓	
	DENS DEC PLACES (0-6) 4	Select the desired Density Decimal Place (0…6 decimal places allowed).
	ENTER ↓	
	DENSITY DEFAULT 1 lbs/g	Enter the default density setting.
	ENTER ↓	
	Advance To SETUP INDICATORS (Rate)	

Submenus	Display	Notes
Setup Indicators (Rate)	SETUP INDICATORS Tot Dns **Rte** Tmp Pres	Press **ENTER** when Rate is flashing to configure the Ratemeter Indicators
	ENTER ↓	
	RATE TIME BASE Sec Min Hour Day	Select a Rate Time Base.
	ENTER ↓	
	RATE DESCRIPTOR RATE	Enter a Descriptor for the Ratemeter.
	ENTER ↓	
	RATE DEC PLACES (0-3) 2	Select a Rate Decimal Place (0…3 places allowed).
	ENTER ↓	
	RATE AVG FILTER 0	Enter a Rate Averaging Filter.
	ENTER ↓	
	QUICK UPDATE % 1	Enter the Percent of Change for Quick Update. If the current flow rate deviates by an amount greater than the percentage value entered, the Rate Averaging is inhibited.
	ENTER ↓	
	Advance To SETUP INDICATORS (Temperature)	
Setup Indicators (Temperature)	SETUP INDICATORS Tot Dns Rte **Tmp** Pres	Press **ENTER** when Temp is flashing to configure the Temperature Indicators.
	ENTER ↓	
	TEMP DESCRIPTOR TEMP	Enter the Temperature Descriptor.
	ENTER ↓	
	TEMPERATURE SCALE Deg_C Deg_F	Enter the Temperature Scale.
	ENTER ↓	
	TEMP DEC PLACES (0-3) 1	Select the Temperature Decimal Place (0…3 decimal places allowed).
	ENTER ↓	
	TEMPERATURE DEFAULT 60 F	Enter the default temperature
	ENTER ↓	
	Advance To SETUP INDICATORS (Pressure)	

Submenus	Display	Notes
Setup Indicators (Pressure)	SETUP INDICATORS Tot Dns Rte Tmp **Pres**	Press **ENTER** when Pr is flashing to configure the Pressure Indicators.
	ENTER ↓	
	PRES UNITS Absolute Gauge	Enter the Pressure Units Referenced.
	ENTER ↓	
	PRESSURE DESCRIPTOR PRESS	Enter the Pressure Descriptor using the up/down arrow keys.
	ENTER ↓	
	PRESSURE UNITS psia	Enter the Pressure Units using the up/ down arrow keys.
	ENTER ↓	
	PRES DEC PLACES (0-3) 2	Select the Pressure Decimal Place (0…3 decimal places allowed).
	ENTER ↓	
	PRESSURE DEFAULT 50.000 psia	Enter the default Pressure.
	ENTER ↓	
	Advance To SETUP FLOW INPUT	

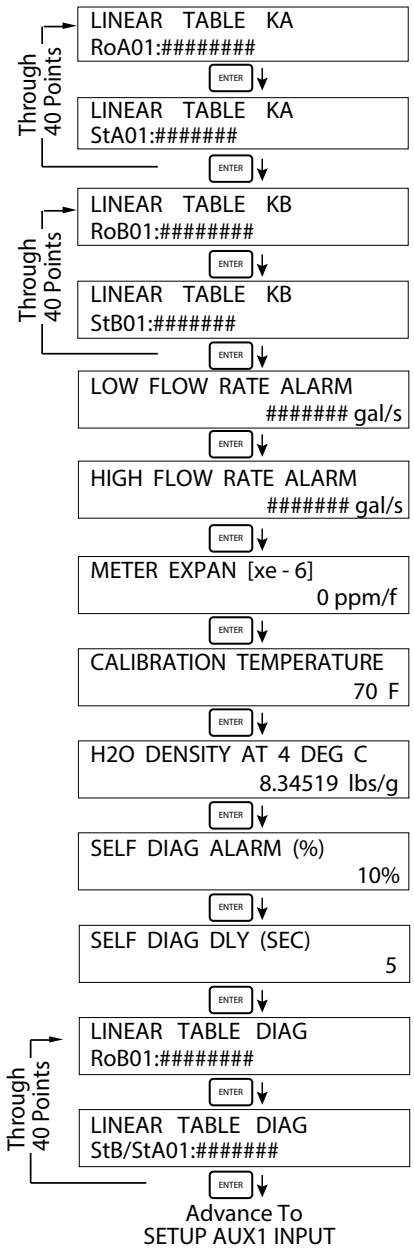
Submenus	Display	Notes
Setup Flow Input	SETUP FLOW INPUT	Press **ENTER** to begin setup of Flow Input.
	ENTER ↓	
	EXCITATION VOLTAGE 5v 12v 24v	Select an Excitation Voltage.
	ENTER ↓	
NOTE: ChA = Single Pulse A=B = Pulse Security Dual = Dual Rotors Qx1 = Quadrature Qx2 = Quadrature x 2	PULSE INPUT TYPE ChA A=B Dual Qx1 Qx2	Enter a Pulse type. See side note.
	ENTER ↓	
	PULSE TRIGGER LEVEL 10mV 100mV 2.5V	Select an Input Pulse Trigger Level.
	ENTER ↓	
	LOW PASS FILTER 40Hz 3KHz 20KHz	Select a Low Pass Filter. (Max. Count Speed).
	ENTER ↓	
	INPUT TERMINATION Pullup Pulldown None	Select the input termination.
	ENTER ↓	
	MAX WINDOW (1-99) 1 sec	Enter the Maximum Sample Window Time (1…99 sec).
	ENTER ↓	
NOTE: AvgK = Average K-Factor LinTbl = Linearization Table UVC = Universal Viscosity Curve StRo = Strouhal Roshko Curve	K_FACTOR TYPE AvgK LinTbl UVC StRo	Enter the K-Factor Type. See side note.
	ENTER ↓	
	AVERAGE KA-FACTOR ####### P/gal	If you selected Avg, enter the Average K- Factor (KA for channel A).
	AVERAGE KB-FACTOR ####### P/gal	Enter the Average K-Factor (KB for channel B).
Through 40 Points	LINEAR TABLE KA Fre01:######## Hz	If you selected LinTbl, enter a frequency/K-Factor pair for each point in the Linearization Table (channel A)
	ENTER ↓	
	LINEAR TABLE KA KA--01:####### P/gal	**NOTE:** Enter 0 for Fre value of any point (other than Fre01) to exit the routine and use the values entered up to that point.
	ENTER ↓	
Through 40 Points	LINEAR TABLE KB Fre01:######## Hz	Enter a frequency/K-Factor pair for each point in the Linearization Table (channel B).
	ENTER ↓	
	LINEAR TABLE KB KB--01:####### P/gal	**NOTE:** Enter 0 for Fre value of any point (other than Fre01) to exit the routine and use the values entered up to that point.
	ENTER ↓	
Through 40 Points	LINEAR TABLE KA Fre01:######## Hz/ck	If you selected UVC, enter a frequency/K-Factor pair for each point in the Linearization Table (channel A).
	ENTER ↓	
	LINEAR TABLE KA KA--01:####### P/gal	**NOTE:** Enter 0 for Fre value of any point (other than Fre01) to exit the routine and use the values entered up to that point.
	ENTER ↓	
Through 40 Points	LINEAR TABLE KB Fre01:######## Hz/ck	Enter a frequency/K-Factor pair for each point in the Linearization Table (channel B).
	ENTER ↓	
	LINEAR TABLE KB KB--01:####### P/gal	**NOTE:** Enter 0 for Fre value of any point (other than Fre01) to exit the routine and use the values entered up to that point.
	ENTER ↓	

Continued On Next Page

Submenus

Setup Flow Input
(continued)

Display



Notes

If you selected StRo, enter the St/Ro pair for each point in the Linearization Table (channel A).

NOTE: Enter 0 for Ro value of any point (other than RoA01) to exit the routine and use the values entered up to that point.

Enter the St/ Ro pair for each point in the Linearization Table (channel B).

NOTE: Enter 0 for Ro value of any point (other than RoB01) to exit the routine and use the values entered up to that point.

Enter the volumetric Low Rate Alarm. This will trigger an alarm message if alarm conditions occur. The relays are not affected.

Enter the volumetric High Rate Alarm. This will trigger an alarm message if alarm conditions occur. The relays are not affected.

If you selected StRo, enter the expansion coefficient for the meter housing.

If you selected StRo, enter the calibration temperature.

If you selected UVC or StRo, enter the density of water at 4° C.

If you selected Dual Rotor and StRod, enter the self-diagnostic alarm deviation. If the value is greater than the setpoint, an alarm message will appear and relay 4 will trip (if desired).

If you selected Dual Rotor and StRo, enter the amount of time to elapse before the self-diagnosis alarm is tripped.

If you selected Dual Rotor and StRo, enter the self-diagnosis table with the desired RoB to StB/StA pair for each point in the table (up to 40 points).

NOTE: Enter 0 for RoB value of any point (other than RoB01) to exit the routine and use the values entered up to that point.

Submenus	Display	Notes
Setup Aux1 Input	SETUP AUX1 INPUT	Press **ENTER** to begin setup of the Auxiliary 1 Input.
	ENTER ↓	
	AUX1 INPUT TYPE None Temp	Select Temperature to set the Auxiliary 1 Input for Temperature inputs.
	ENTER ↓	
	AUX1 SIGNAL TYPE Therm Current RTD	Choose Temperature Signal Type. (If RTD selected, AUX2 will not be available for Density or Pressure)
	ENTER ↓	
	INPUT SIGNAL RANGE 4-20mA 0-20mA	If you selected Current, choose a Current Range. Skip this step for Thermistor or RTD.
	ENTER ↓	
	AUX1 LOW SCALE ###### F	Enter the low temperature scale corresponding to the low temperature signal. Skip this step for Thermistor or RTD.
	ENTER ↓	
	AUX1 FULL SCALE ###### F	Enter the high temperature scale corresponding to the high temperature signal. Skip this step for Thermistor or RTD.
	ENTER ↓	
	OFFSET TEMPERATURE ###### F	Enter the Offset temperature.
	ENTER ↓	
	AUX1 LOW ALARM ###### F	Enter the Low setpoint for the Temperature Alarm.
	ENTER ↓	
	AUX1 HIGH ALARM ###### F	Enter the High setpoint for the Temperature Alarm.
	ENTER ↓	
	Advance To SETUP AUX2 INPUT	

Submenus	Display	Notes
Setup Aux2 Input	SETUP AUX2 INPUT	Press **ENTER** to begin setup of the Auxiliary Input 2.
	ENTER ↓	
NOTE: When Density (Dens) is selected, The menu prompts will be very similar to the Pressure prompts. The menus will prompt the user for density values and density units.	AUX 2 INPUT TYPE None Dens Press	Select Pressure to set the Auxiliary Input 2 for Pressure inputs.
	ENTER ↓	
	AUX 2 SIGNAL TYPE Voltage Current	Choose Pressure Signal Type.
	ENTER ↓	
	CURRENT RANGE 4-20mA 0-20mA	If you selected Current, choose a Current Range.
	ENTER ↓	
	AUX LOW SCALE ###### PSIA	Enter the low pressure scale corresponding to the low pressure signal.
	ENTER ↓	
	AUX FULL SCALE ###### PSIA	Enter the high pressure scale corresponding to the high pressure signal.
	ENTER ↓	
	AUX LOW ALARM ###### PSIA	Enter the Low setpoint for the Pressure Alarm.
	ENTER ↓	
	AUX HIGH ALARM ###### PSIA	Enter the High setpoint for the Pressure Alarm.
	ENTER ↓	
	DENS EXTRACT METHOD Therm_Coef API_2540	If you selected None or Press, choose the Density Extraction method to be used.
	ENTER ↓	
	Advance To SET FLUID PROPERTIES	

Submenus	Display	Notes
Set Fluid Properties	SET FLUID PROPERTIES	Press **ENTER** at this prompt to Set Fluid Properties.
	ENTER ↓	
	FLUID NUMBER (0-9) 0	Up to 10 Fluid types may be stored in the unit. Select the number of the fluid you want to edit.
	ENTER ↓	
	FLUID NAME Generic #0	Shows name and number of the fluid selected. Enter the desired name using the up/down arrow keys.
	ENTER ↓	
	REF. DENSITY ###### lbs/g	Enter the Reference Density. This is used in the calculation of density when you have a temp transmitter and used for corrected flow calculation if you have a density transmitter.
	ENTER ↓	
	REF. TEMPERATURE ###### F	Enter the Reference Temperature.
	ENTER ↓	
	EXPAN. FACTOR [xe-6] ########	Enter the proper Fluid Expansion Factor. (If Temp Compensated for Mass or Corrected Volume) See Section 7.3, Calculating the Expansion Factor.
	ENTER ↓	
	VISCOSITY COEF. A 0.000	Enter the Viscosity A Coefficient. See section 7.4, Computation of Viscosity Coef. A and B.
	ENTER ↓	
	VISCOSITY COEF. B 0.000	Enter the Viscosity B Coefficient. See section 7.4, Computation of Viscosity Coef. A and B.
	ENTER ↓	
	REFERENCE PRESSURE ####### PSIA	Enter the Pressure of the fluid at reference conditions.
	ENTER ↓	
	BAROMETRIC PRESSURE ####### PSIA	Enter the Atmospheric Pressure at the altitude or elevation of the installation(14.696 psia typical).
	ENTER ↓	
	Z-FACTOR #######	Enter the Z-Factor for a gas at reference conditions.
	ENTER ↓	
	Z-FACTOR FLOWING #######	Enter the Z-Factor for a gas at flowing conditions.
	ENTER ↓	
	Advance To SETUP PULSE OUTPUT	

Submenus	Display	Notes
Setup Pulse Output	SETUP PULSE OUTPUT	Press **ENTER** at this prompt to setup the Pulse Output.
	ENTER ↓	
	PULSE OUTPUT USAGE Off Vol CVol/Mass	Select a Pulse Output Usage.
	ENTER ↓	
	PULSE WIDTH 10mS 100mS	Select a Pulse Width for the Pulse Output.
	ENTER ↓	
	PULSE VALUE ####### gal/P	Enter a Pulse Value for the Pulse Output (Units per Pulse).
	ENTER ↓	
	Advance To SETUP ANALOG OUTPUT	
Setup Analog Output	SETUP ANALOG OUTPUT	Press **ENTER** when Analog is flashing to setup the Analog Output.
	ENTER ↓	
	ANALOG OUTPUT USAGE Rte Tot Tmp Den Pres	Select an Analog Output Usage.
	ENTER ↓	
	ANALOG OUT FLOW TYPE Vol CVol/Mass	Only if you selected Rate & Flow EQ. = Mass, Cor/Vol, select an Analog Output Flow.
	ENTER ↓	
	ANALOG OUTPUT RANGE 4-20mA 0-20mA	Select the a current range for the Analog Output.
	ENTER ↓	
	LS ANALOG OUTPUT ####### gal/m	Enter an Analog Output Low Scale Value. **NOTE:** Units label will correspond with output usage type selected.
	ENTER ↓	
	FS ANALOG OUT 20mA ####### gal/m	Enter an Analog Output Full Scale Value.
	ENTER ↓	
	ANALOG OUT DAMPING 0.0	Enter an Analog Output Damping Constant. Increase this value to slow the response time and eliminate bounce.
	ENTER ↓	
	Advance To SETUP RELAYS	

Submenus	Display	Notes
Setup Relays (Relay 1 & Relay 2) **NOTE:** In Batch mode, Relay 1 is reserved for Preset, Relay 2 is reserved for Prewarn.	SETUP RELAYS Rly1 Rly2 Rly3 Rly4	Select the Relay for setup. Relays 3 & 4 Optional.
	ENTER ↓	
	RELAY 1 USAGE RATE TOTAL NA	If you selected Relay 1 or Relay 2, select Rate, Total or NA.
	ENTER ↓	
	RELAY 1 DELAY sec 0	If you selected Rate, enter a relay activation delay value.
	ENTER ↓	
	RELAY 1 MODE LO_ALARM HI_ALARM	Select the Relay Activation: Low: Relay activates when reading is below setpoint. High: Relay activates when reading is above setpoint.
	ENTER ↓	
	RELAY 1 DURATION #####	If you selected Total, enter the Relay Duration.
	ENTER ↓	
	RELAY 1 SETPOINT ####### gal	Enter the Setpoint. You can edit the Setpoint in Run mode using the PRE 1 key (PRE 2 key for Relay 2).
	ENTER ↓	
	RELAY 1 HYSTERESIS ##### gal/m	If you selected Rate, enter the Relay Hysteresis.
	ENTER ↓	
	Advance To SETUP RELAYS 3, 4	

Submenus	Display	Notes
Setup Relays (Relay 3 & Relay 4)	SETUP RELAYS Rly1 Rly2 Rly3 Rly4	Select the Relay for setup. Relays 1 & 2 optional.
	ENTER ↓	
NOTE: Settings for Relays 3 & 4 may be entered even if relays are not supplied. The settings will still trigger display alarms.	RELAY 3 USAGE Rate Tot Aux Ovr NA	If you selected Relay 3, choose Rate, Total, Aux, Ovr or NA.
	RELAY 4 USAGE Rate Tot Aux Alrm NA	If you selected Relay 4, choose Rate, Total, Aux, Alrm or NA.
	ENTER ↓	
	ASSIGN AUX CHANNEL AUX 1 AUX 2	If you selected Aux, enter an auxiliary channel.
	ENTER ↓	
	RELAY 3 DELAY sec 0	If you selected Rate / Aux, enter a relay activation delay value.
	ENTER ↓	
	RELAY 3 MODE LO_ALARM HI_ALARM	Select a Relay Activation for Rate/Aux. Low: Relay activates when reading is below setpoint. High: Relay activates when reading is above setpoint.
	ENTER ↓	
	RELAY 3 DURATION #####	If you selected Total, enter a Relay Duration.
	ENTER ↓	
	RELAY 3 SETPOINT ####### gal	Enter a Setpoint.
	ENTER ↓	
	RELAY 3 HYSTERESIS ##### gal/m	If you selected Rate, enter the Relay Hysteresis.
	ENTER ↓	
	Advance To SETUP CONTROL INPUTS	

Relay Notes & Considerations

- Relay activation is based on the computed readings not the displayed value. Therefore the display damping factor will not affect the relay response time. The RELAY DELAY feature allows the user to enter a time delay for relay activation. This feature is very useful in applications where short over/ under range conditions are not considered alarm conditions.
- When INSTRUMENT TYPE is set to batcher, Relay 1 is reserved for PRESET and Relay 2 is reserved for PREWARN.
- Setting the relays to NA (Not Assigned), allows the relay activation to be controlled via the RS- 232 Serial and/or RS-485 Modbus ports.
- Relay 3 and Relay 4 settings may be used to trigger display alarm conditions, even if the relays are not supplied.

Submenus	Display	Notes
Setup Control Inputs (Rate/Total)	SETUP CONTROL INPUTS	Press Enter to begin setup of the Control Inputs.
	ENTER ↓	
	SETUP CONTROL INPUTS Input1 Input2 Input3	Select a Control Input for setup.
	ENTER ↓	
	CONTROL INPUT1 USAGE INHIBIT_TOTAL NA	If you selected Control Input 1, select Inhibit Total or NA (Not Assigned).
	CONTROL INPUT2 USAGE RESET_TOTAL NA	If you selected Control Input 2, select Reset Total or NA (Not Assigned).
	CONTROL INPUT3 USAGE Prn Ack KeyLk NA	If you selected Control Input 3, select Prn (Print), Ack (acknowledge), KeyLk (Keylock) or NA (Not Assigned). ACK will acknowledge and clear alarms and warning messages. **NOTE:** Alarms may reassert themselves if alarm conditions are still present.
	ENTER ↓	
	Advance To SETUP REALTIME CLOCK	
Setup Control Inputs (Batch)	SETUP CONTROL INPUTS Input1 Input2 Input3	Select the Control Input for setup.
	ENTER ↓	
	CONTROL INPUT1 USAGE Inh Strt Rst/Strt NA	If you selected Control Input 1, select Inhibit, Start,Reset/Start, NA (Not Assigned).
	CONTROL INPUT2 USAGE Stop Stop/Rst NA	If you selected Control Input 2, select Stop, Stop/Reset, NA (Not Assigned).
	CONTROL INPUT3 USAGE Rst Prn KeyLk Ack NA	If you selected Control Input 3, select Prn (Print), Ack (acknowledge), KeyLk (Keylock) or NA (Not Assigned). ACK will acknowledge and clear alarms and warning messages. **NOTE:** Alarms may reassert themselves if alarm conditions are still present.
	ENTER ↓	
	Advance To SETUP REALTIME CLOCK	

Submenus	Display	Notes
Setup Realtime Clock (Time)	SETUP REALTIME CLOCK	Press Enter to begin setup of the Realtime Clock.
	ENTER ↓	
	SETUP REALTIME CLOCK Time Date	Select Time to set the time.
	ENTER ↓	
	CLOCK TYPE 24HR 12HR	Select 24Hr or 12Hr clock.
	ENTER ↓	
	SELECT CLOCK AM/PM AM PM	If you selected 12Hr Clock, enter AM or PM.
	ENTER ↓	
	TIME OF DAY HH:MM:SS ##:##:##	Enter time of day.
	ENTER ↓	
	Advance To SETUP REALTIME CLOCK (Date)	
Setup Realtime Clock (Date)	SETUP REALTIME CLOCK Time Date	Select Date to enter the date.
	ENTER ↓	
	DATE: MONTH, DAY, YEAR ##/##/####	Enter the date (Month, Day, Last two digits of Year).
	ENTER ↓	
	Advance To SERIAL USAGE	

Submenus	Display	Notes
Serial Usage (RS-232/485)	SERIAL USAGE	Press Enter to begin setup of the Serial Port.
	ENTER ↓	
	SERIAL HARDWARE RS232 RS485	Select Serial Hardware type for standard port. (See SETUP NETWORK CARD for RS485 Modbus option.)
	ENTER ↓	
	DEVICE ID ##	Select the Device ID.
	ENTER ↓	
	BAUD RATE 300 600 1200 <more>	Select the Baud Rate.
	BAUD RATE 2400 4800 9600 19200	If you selected <more>:
	ENTER ↓	
	PARITY None Odd Even	Select the Parity.
	ENTER ↓	
	HANDSHAKING None Softwre Hardwre	Set the Handshake.
	ENTER ↓	
	DEVICE LINE FEED <CR> <CR+LF>	Choose end of line termination. Only choose <CR> if your external device automatically assigns a line feed for every <CR> carriage return.
	ENTER ↓	
Serial Usage (Modem Options)	MODEM OPTIONS No Yes	Select Yes if the serial port will be used to control a modem.
	ENTER ↓	
	MODEM INIT MASTER No Yes	Select Yes to have the unit engage in a configuration conversation with the modem on powerup .
	ENTER ↓	
	MODEM AUTO ANSWER No Yes	If you selected Yes for Modem Init Master, choose the desired Modem Auto Answer mode.
	ENTER ↓	
	CALL OUT DAY OF WEEK 1	Enter the day of the week to perform Call Out transmission. (0 = daily, 1 1…7 = Mon…Sun)
	ENTER ↓	
	CALL OUT TIME ##:##:##	Enter the time of day to perform Call Out transmission (HH:MM:SS).
	ENTER ↓	

Continued on Next Page

Submenus	Display	Notes
Serial Usage (Modem Options, continued)	CALL ON ERROR/ALARM No Yes	Select Yes to have the unit perform a Call Out transmission upon error/ alarm condition.
	ENTER	
	CALL OUT PHONE # 0	Call Out Phone Number to be dialed for "Call Out Time" or "Print On Error/Alarm". Up to 20 digits with "," used to pause between digits.
	ENTER	
	NUMBER OF REDIALS 0	Enter the number of redials to be performed on call out time if busy or no answer (error/ alarm tries until connected).
	ENTER	
	HANGUP IF 2 MIN INACT No Yes	Select Yes to perform hangup if there is inactivity for more than 2 minutes.
	ENTER	
	Advance To SETUP DATALOG/PRINT	
	SETUP DATALOG/PRINT	Press Enter to setup the Datalog/Print information.
	ENTER	
	SETUP DATALOG/PRINT Config Select_list	Select Config to configure the Datalog/Print information.
	ENTER	
	OUTPUT FORMAT Printer Term Dbase	Select the type of Output Format.
	ENTER	
Setup Datalog/ Print (Configure)	PAGE LENGTH [99 max] 99	Enter the Page Length, if Printer selected above.
	ENTER	
	TOP MARGIN [99 max] 3	Enter the Top Margin, if Printer selected above.
	ENTER	
	DATALOG ONLY No Yes	Select Yes to record events to the datalogger only. Events will not be sent to the serial port.
	ENTER	
	PRINT TIME HH:MM:SS 00:00:00	Enter Print Time, printer will print at this time every day. Enter 00:00:00 to inhibit print time.
	ENTER	
	PRINT INTERVAL 00:00:00	Enter Print Interval. Enter 00:00:00 to inhibit print interval.
	ENTER	
	ENABLE PRINT KEY NO YES	Select YES to enable Print Key. Select NO to disable Print Key.
	ENTER	
	CLEAR TOTAL IF PRINT NO YES	Select Yes to clear the total after printing.
	ENTER	
	PRINT END OF BATCH NO YES	Batch mode only. Select Yes to print at end of batch.
	ENTER	
	Advance To SETUP DATALOG/PRINT (Select_list)	

Submenus	Display	Notes
Setup Datalog/ Print	SET DATALOG/PRINT	Press **ENTER** to begin Setup Datalog/Print routine.
(Select_list)	ENTER ↓	
	SET DATALOG/PRINT Config Select_list	Press **ENTER** when Select_list is selected to setup print list.
List Items: FLUID TIME RATE TOTAL GRAND TEMP DENS PRE1 PRE2 PRESS VISC FREQ1 FREQ2 KA-F KB-F DIAG	STOP START PRINT LIST ITEMS FLUID YES	Use Up and Down arrow keys to view list status.
	PRINT LIST ITEMS TIME YES	Press the Corresponding function key to the items that you wish to add or remove from the list.
	PRINT LIST ITEMS RATE YES	Items marked with Yes will be added to the list. items marked with No will be removed from the list.
	ENTER ↓	
	PRINT LIST ITEMS DataLog size = 001489	The Select Print List Information display shows the current possible Datalog size.
	ENTER ↓	
	Advance To ADMINISTRATIVE SETUP	
Administrative Setup	ADMINISTRATIVE SETUP	Press Enter to begin Administrative Setup.
	ENTER ↓	
	TAG NUMBER FT XXXX	Use the up and down arrow keys to define the tag number.
	ENTER ↓	
	OPERATOR PASSWORD ****	Enter Operator Password (Factory Set to 0).
	ENTER ↓	
	SUPERVISOR PASSWORD ****	Enter Supervisor Password, if logged in as supervisor (Factory Set to 2000).
	ENTER ↓	
	SOFTWARE VERSION vxx.xx	This display shows the software version of the installed software.
	ENTER ↓	
	PRODUCT ORDER CODE SL93xxxxxxx	This display shows the product order code (model number).
	ENTER ↓	
	UNIT SERIAL NUMBER 00000	This display shows the unit's serial number.
	ENTER ↓	
	SENSOR SERIAL NUMBER 00000	This display shows the sensor's serial number.
	ENTER ↓	
	DISPLAY NEW ERR ONLY No Yes	If yes is selected, an error message will only appear once until acknowledged by user.
	ENTER ↓	
	Advance To SETUP NETWORK CARD	Advance to Network Card only if a Network Card is installed.

Submenus	Display	Notes
Setup Network Card (Optional)	SETUP NETWORK CARD	Press Enter to setup Network Card
	ENTER ↓	
	SELECT NTW PROTOCOL Modbus RTU	Select a Network Protocol.
	ENTER ↓	
	NETWORK DEVICE ID 1	Enter the device address on network (00…255).
	ENTER ↓	
	BAUD RATE 2400 4800 9600 19200	Select a desired Baud Rate.
	ENTER ↓	
	PARITY None Odd Even	Select the Parity.
	ENTER ↓	
	Advance To INSTRUMENT TYPE	

PRINCIPLE OF OPERATION

The FC30 Flow Computer uses several internal calculations to compute the compensated flow based on specific data input. Several computations are performed to arrive at the uncompensated flow, temperature, pressure, density and viscosity. This information is then used to compute the Corrected Volume Flow or Mass Flow.

NOTE: The user will be prompted for Fluid Information during the setup of the instrument. See also Appendix A for common fluid properties for liquids and gases.

Flow Equations

Input Temperature Computation	*General Case*	Tf = [% input span • (temp FS - Temp low scale)] + temp low scale	
	RTD Case	Tf = f(measured input resistance)	
Input Density Computation	*Temperature Transmitter*	Density = reference density • (1 - Therm.Exp.Coef. • (Tf-Tref))2	
	Density Transmitter	Density = [% input span • (density FS - density low scale)] + density low scale	
Input Pressure Computation	*General Case*	Pf = [% input span • (pressure FS - Pressure Low Scale)] + Pressure Low Scale	
	Gauge Case	Pf = Pf + Barometric	
	Manual Case or In Event of Fault	Pf = Pressure Default Value	
Fluid Properties	*Liquid Generic Case*	Liquid density = reference density • (1 - (Therm. Exp. Coef. x 1e-6 (Tf-Tref))	
	Liquid API Case	Liquid density = reference density • (UCF API2540)	
	Gas Case	Gas density = reference density • $\frac{Pf}{Pref} \cdot \frac{Tref}{Tf} \cdot \frac{Zref}{Zf}$ Where flowing and reference temperature and pressure are in absolute scale	
Viscosity Computation	*Liquid Case*	† centistokes = $\frac{\left(A \exp \frac{B}{(Deg\ F + 459.67)}\right)}{Absolute\ Density}$	
		Where: centistokes = cP/(kg/l)	
	Gas Case	cP viscosity = A • $(Tf + 459.67)^B$	
Uncompensated Flow Computation	*Pulse Input; Average K-Factor*	Volume Flow = $\frac{\text{input frequency * time scale factor}}{\text{K-Factor}}$	
	Pulse Input; Linear Table	Volume Flow = $\frac{\text{input frequency * time scale factor}}{\text{K-Factor (Hz)}}$	
	Pulse Input: UVC Table	Volume Flow = $\frac{\text{input frequency * time scale factor}}{\text{K-Factor (Hz/cstk)}}$	
	Pulse Input: Strouhal/ Roshko Table	Volume Flow = $\frac{\text{input frequency * time scale factor}}{\text{Strouhal Cal / (1 + 3 * meter exp coeff. * } 1^{e\text{-}6} \text{ (Tf=Tref)}}$	
		Volume Flow = $\frac{\text{input frequency * (1 + 2 * meter exp coeff. * } 1^{e\text{-}6} \text{ (Tf=Tref)}}{\text{cstk}}$	
Corrected Volume Flow Computation	*Liquid Case*	Temperature Transmitter	Standard Volume Flow = volume flow • (1 - Therm.Exp.Coef. • (Tf-Tref))2
		Density Transmitter	Standard Volume Flow = volume flow •density reference density
	Gas Case	std. volume flow = volume flow • $\frac{Pf}{Pref} \cdot \frac{(Tref + 459.67)}{(Tf + 459.67)} \cdot \frac{Zref}{Zf}$	
Mass Flow Computation	Mass Flow = volume flow • density		

API 2540 Density Equation

API 2540 Equation. The American Petroleum Institute, in a joint program with the National Bureau of Standards (NIST), developed a density equation based on 463 samples of five different oil products. The results of this work are incorporated into Chap. 11.1, "Volume Correction Factors," of API Standard 2540 (1987).

The density equation is based on the thermal-expansion coefficient of the product at 60°F (15.6°C) base temperature, which is calculated from the base density as

$$\alpha_b = \frac{K_0}{\rho_b^{*2}} + \frac{K_1}{\rho_b^*} \tag{2.188}$$

where the base density ρ_b^* is in kilograms per cubic meter. The empirically derived constants K_0 and K_1 for the five product groups are given in Table 2.23. The density of the product at flowing temperature is then calculated as

$$\rho_F^* = \rho_b^* \exp\left[-\alpha_b \Delta T_F (1 + 0.8\alpha_b \Delta T_F)\right] \tag{2.189}$$

where $\Delta T_F = T_F - 60$. The specific gravity at flowing or measured temperature is then

TABLE 2.23 Constants K_0 and K_1 for Five Product Groups

Product group	K_0	K_1
Crude oils and JP4†	341.0957	0.0
Jet fuels, kerosenes, solvents	330.3010	0.0
Gasolines and naphthenes	192.4571	0.2438
Lubricating oils	144.0427	0.1895
Diesel oil, heating oils, fuel oils	103.8720	0.2701

Note: Pentanes and hydrocarbons lower in the hydrocarbon chain are *not* covered by this data.

†API News Release 1987 added JP4.

The above information was obtained from "Flow Measurement Engineering Handbook, 3rd Edition" by Richard W Miller.

API 2540 Expansion Factor Equation

1. Select the values for K_0 and K_1 for the fluid group to be measured.
2. Convert the base reference density for your fluid into the corresponding density units of kg/m^3.
3. Solve for α_b using equation above.
4. $C = \alpha_b \cdot 1{,}000{,}000$.

Calculating the Fluid Expansion Factor

The liquid density is a function of the flowing temperature for many fluids. This unit solves an equation which represents this physical property of the fluid.

The information which the unit uses to describe the fluid is entered by the user in the following variables: Reference Temperature, Reference Density, Fluid Expansion Factor. Values for common fluids are listed in Appendix A.

This information is available for many fluids in one or more of the following forms:

- Fluid Specific Gravity vs. Temp. Table
- Specific Gravity vs. Temp. Graph
- Fluid Density vs. Temp. Table
- Fluid Density vs. Temp. Graph

Begin by obtaining one of the fluid properties for the fluid you are using from available manufacturers information or Engineering Handbooks. In some cases this information is listed on the Material Safety Data Sheet for the fluid.

Two temperature-specific gravity pairs will be required to compute the temperature coefficient.

The reference temperature is simply chosen by the user. Common reference temperatures are 60° F or 15° C.

However, for cryogenic fluids, the normal boiling point may also be used. In some cases the fluid data may list properties at 100° F. This temperature may also be used as the reference temperature.

The reference temperature should be chosen so that it is in the application temperature range. For instance, application temperature range -10…120° F, reference temperature of 60° F chosen.

Enter the reference temperature you have chosen at this point.

The reference-specific gravity corresponds to the fluid-specific gravity at the reference temperature chosen.

You may convert the fluid density information to specific gravity if it is in units other than specific gravity. Use EQ1.

Expansion Factor Equations

EQ1 Spec.Grav. = Density of Fluid / Density of Water

Given the reference temperature, reference specific gravity, a second temp. and a second Spec.Grav., the Expansion Factor (C Factor) can be computed as follows:

EQ2 Used for Liquid Mass and Corrected Volume Equations

$$C = \left[\frac{1 - \sqrt{(Spec.Grav.2 / Ref.Spec.Grav.)}}{Temp.2 - Ref.Temp}\right] \times 1{,}000{,}000$$

Given the reference temperature, reference density, a second temp. and a second density, the Expansion Factor (C Factor) can be computed as follows:

EQ3 Used for Liquid Mass and Corrected Volume Equations

$$C = \left[\frac{1 - \sqrt{(Dens.2 / Ref.Dens.)}}{Temp.2 - Ref.Temp}\right] \times 1{,}000{,}000$$

C = Fluid Expansion Factor

Computation of Viscosity Coef. A and B

The flow computer solves an equation that computes the viscosity as a function of temperature. Two parameters must be entered for this calculation to be performed. These are the setup parameters Viscosity Coef. A and Viscosity Coef. B. A table listing these values for common fluids is available in Appendix A.

Alternately, if your intended fluid is not listed, the Viscosity Coef. A and B can be derived from two known temperature/viscosity pairs. Begin by obtaining this information for the intended fluid. Convert these known points to units of Degrees F and centipoise (cP).

The information is now in a suitable form to compute the Viscosity Coef. A and Viscosity Coef. B using the following equation based on the fluid state.

For a liquid, A and B are computed as follows:

$$B = \frac{(T1 + 459.67) \cdot (T2 + 459.67) \cdot \ln [cP1/cP2]}{(T2 + 459.67) - (T1 + 459.67)}$$

$$A = \frac{cP1}{\exp [B / (T1 + 459.67)]}$$

NOTE: $cS = \frac{cP \cdot \text{Density of Water at 4° C}}{\text{Density of Fluid at Flowing Conditions}}$

For a gas, A and B are computed as follows:

$$B = \frac{\ln [cP2 / cP1]}{\ln (T2 + 459.67) / (T1 + 459.67)}$$

$$A = \frac{cP1}{(T1 + 459.67)B}$$

NOTE: $cS = \frac{cP \cdot \text{Density of Water at 4° C}}{\text{Density of Fluid at Flowing Conditions}}$

Linearization Table

The Linearization Table is used when the flow input device gives a nonlinear input signal. The unit uses up to 40 different points, as entered by the operator, to form a curve for linearizing the input signal.

NOTES:

- A minimum of three points must be set up.
- If "0" is entered for the frequency of any point other than point 1, the Flow Computer assumes there are no more points above the points that preceded them. The display will advance to the next setup prompt. Extrapolation is taken from the last two nonzero points.
- If the input frequency is above the highest or below the lowest frequency programmed, the unit will use the last known point for the K factor in computing the resulting actual flow.
- Frequencies, Hz/Cstks or Roshko numbers should be entered in ascending order.

Linearization Table for Pulse Inputs

The linearization table for pulse inputs programming is quite simple when values of frequency and flow are known. The Flow Computer asks for 40 different frequencies (Freq) and 16 corresponding K factors (K). It then uses this data to determine what the actual flow is for any given input frequency. Usually the necessary data is provided with the flow meter.

Linearization Table Interpolation

The Linearization Table routine uses the entered data to determine the K factor for any given input frequency or input flow signal. This is done by taking the closest data points above and below the input signal, then using those points to extrapolate the K-factor (correction factor), then calculating the uncompensated flow from the data. Below are the formulas.

Parameters

Determine closest point above input signal; signal = X, K factor (correction factor) = KA

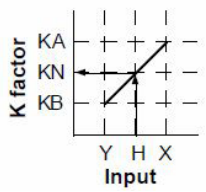
Determine closest point below input signal; signal = Y, K factor (correction factor) = KB

Let input signal = H,

unknown K factor (correction factor) = KN

To find KN, use this formula:

$$\frac{H - Y}{X - Y} \times (KA - KB) + KB = KN$$



Universal Viscosity Curve (UVC)

A Universal Viscosity Curve is a presentation of the calibration of a turbine flow meter's K-Factor as a function of the Hz/cstks. It is used to represent the combined effects of flow rate and viscosity on the calibration of the flow meter. It is entered as a table of point pairs in ascending order of Hz/cstks.

Strouhal Roshko Curve (StRo)

A Strouhal Roshko Curve is a presentation of the calibration of a turbine flow meter's calibration as a table or curve of Strouhal number as a function of Roshko number. It is used to represent the combined effects of flow rate, flowing temperature and viscosity on the calibration of the turbine flow meter. It is entered as a table of point pairs in ascending order of Roshko numbers.

TEST, SERVICE AND MAINTENANCE

Test Menus

Menus	Display	Notes
	SELECT OPERATE STATE Run Setup Test	Select **Test** to enter the instrument test and calibration routine. **NOTE:** Supervisor (Service) password required to gain access to this mode.
	ENTER	
Top Level Test Menu	START Audit Trail	See *"Audit Trail Submenu Group" on page 53*.
	STOP START Error History	See *"Error History Submenu Group" on page 53*.
	STOP START Print System Setup	See *"Print System Setup Submenu Group" on page 53*.
	STOP START Keypad Test	See *"Keypad Test Submenu Group" on page 54*.
	STOP START Display Test	See *"Display Test Submenu Group" on page 54*.
	STOP START Calibrate	See *"Calibration Submenu Group" on page 55*.
	STOP START Analog In Test	See *"Analog In Test Submenu Group" on page 59*.
	STOP START Pulse Input Test	See *"Pulse Input Test Submenu Group" on page 60*.
	STOP START Analog Out Test	See *"Analog Out Test Submenu Group" on page 60*.
	STOP START Excitation Out Test	See *"Excitation Out Test Submenu Group" on page 60*.
	STOP START Pulse Out Test	See *"Pulse Out Test Submenu Group" on page 61*.
	STOP START Relay Test	See *"Relay Test Submenu Group" on page 61*.
	STOP START Control Inputs Test	See *"Control Input Test Submenu Group" on page 61*.
	STOP START Battery Voltage Test	See *"Battery Voltage Test Submenu Group" on page 62*.
	STOP START Data Logger Utility	See *"Data Logger Utility Submenu Group" on page 62*.

Submenus	Display	Notes
Audit Trail Submenu Group	Audit Trail	
	ENTER ↓	
	Config_Audit nnnnn hh:mm:ss mm/dd/yy	The configuration *Audit Trail* format: nnnnn= number of critical menu changes, hh:mm:ss; mm/dd/yy = time and date of last change.
	MENU ↓	
	Cal_Audit nnnnn hh:mm:ss mm/dd/yy	The calibration *Audit Trail* format: nnnnn= number of calibration changes, hh:mm:ss; mm/dd/yy = time and date of last change.
	MENU ↓	Press **MENU** to return to *Audit Trail* top-level menu.
	Audit Trail	
Error History Submenu Group	Error History	Press **ENTER** to view the *Error History* information. **NOTE:** Press **Print Key** to print Error History. Printout will include time/date of each error's first occurrence.
	ENTER ↓	
	Error History Flow rate alarm low	Press **Up/Down** arrow keys to scroll through error message history. Press **CLEAR** to clear entire error log.
	MENU ↓	
	Error History	Press **MENU** to return to *Error History* top-level menu.
Print System Setup Submenu Group	Print System Setup	Press **ENTER** to enter *print system setup* submenu.
	ENTER ↓	
	Print System Setup Press ENTER to print	Press **ENTER** to begin printing the system setup.
	ENTER ↓	
	Print System Setup -----Printing-----	This message displays as the data transmission takes place.
	MENU ↓	
	Print System Setup	Press **MENU** to return to the *Print System Setup* top-level menu.

Submenus	Display	Notes
Keypad Test Submenu Group	Keypad Test	Press **ENTER** to enter *Keypad Test*.
	ENTER ↓	
	Keypad Test Key pressed—> ENT	Press any key and the display shows the key you pressed. Press **MENU** to exit the test.
	MENU ↓	
	Keypad Test	Press **MENU** to return to *Keypad Test* top-level menu.
Display Test Submenu Group	Display Test	Press **ENTER** to enter *Display Test*.
	ENTER ↓	
	00000000000000000000 00000000000000000000	Each digit on the display scrolls 0…9 then A…Z. Press **MENU** to exit the test.
	MENU ↓	
	Display Test	Press **MENU** to return to *Display Test* top- level menu.

⚠CAUTION

ALL UNITS ARE CALIBRATED AT THE FACTORY PRIOR TO SHIPMENT. THIS UNIT MUST BE CALIBRATED USING PRECISION AND CALIBRATED EQUIPMENT. EQUIPMENT REQUIRED IS AS FOLLOWS: FREQUENCY GENERATOR, DIGITAL MULTIMETER, PRECISION CURRENT/VOLTAGE SOURCE, OSCILLOSCOPE AND FREQUENCY COUNTER.

Submenus	Display	Notes
Calibration Submenu Group	Calibrate	Press **ENTER** to begin the calibration routine. (Please note the caution above).
	ENTER ↓	
Calibrate Aux1: 0 mA Submenu Group	Calibrate Aux1: 0mA Iin=TB178 GND=TB1-4	Connect Current Source (+) TB1-7, (-) TB1-4. Input 0 mA and press **ENTER**.
	ENTER ↓	
	Calibrate Aux1: 0mA 0 CALIBRATING ------	This message displays during calibration.
	↓	
	Calibrate Aux1: 0mA *** DONE ***	This message displays when the 0 mA calibration is finished.
	↓	
	Calibrate Aux1: 0mA Iin=TB1-7 GND=TB1-4	The display automatically returns to the *Calibrate Aux1: 0 mA* submenu. Press the **Down** arrow to advance to the *Calibrate Aux1: 20 mA* submenu.
	STOP ↓	
Calibrate Aux1: 20 mA Submenu Group	Calibrate Aux2: 20mA Iin=TB1-8 GND=TB1-4	Connect Current Source (+) TB1-7, (-) TB1-4. Input 20 mA and press **ENTER**.
	ENTER ↓	
	Calibrate Aux1: 20mA 0 CALIBRATING ------	This message displays during calibration.
	↓	
	Calibrate Aux1: 20mA *** DONE ***	This message displays when the 20 mA calibration is finished.
	↓	
	Calibrate Aux1: 20mA Iin=TB1-7 GND=TB1-4	The display automatically returns to the *Calibrate Aux1: 20mA* submenu. Press the **Down** arrow key to advance to the *Calibrate Aux2: 0 mA* submenu.
	STOP ↓	
	Advance to Calibrate Aux2: 0mA	

Calibrate Aux2: 0 mA Submenu Group

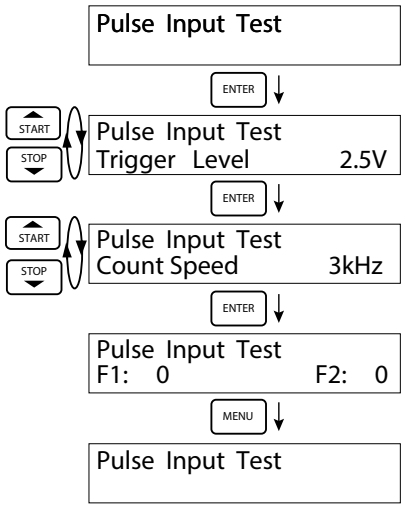
Submenus	Display	Notes
Calibrate Aux2: 0 mA Submenu Group	Calibrate Aux2: 0mA lin=TB1-8 GND=TB1-4	Connect Current Source (+) TB1-8, (-) TB1-4. Input 0 mA and press **ENTER**.
	ENTER ↓	
	Calibrate Aux2: 0mA 0 CALIBRATING ------	This message displays during calibration.
	↓	
	Calibrate Aux2: 0mA *** DONE ***	This message displays during calibration.
	↓	
	Calibrate Aux2: 0mA lin=TB1-8 GND=TB1-4	This message displays when the 0 mA calibration is finished.
	STOP ↓	
	Calibrate Aux2: 20mA lin=TB1-8 GND=TB1-4	The display automatically returns to the *Calibrate Aux2: 0 mA* submenu. Press the **Down** arrow to advance to the *Calibrate Aux2: 0 mA* submenu.
	ENTER ↓	
Calibrate Aux2: 20 mA Submenu Group	Calibrate Aux2: 20mA 0 CALIBRATING ------	Connect Current Source (+) TB1-8, (-) TB1-4. Input 20 mA and press **ENTER**.
	↓	
	Calibrate Aux2: 20mA *** DONE ***	This message displays during calibration.
	↓	
	Calibrate Aux2: 20mA lin=TB1-8 GND=TB1-4	This message displays when the 20 mA calibration is finished.
	STOP ↓ Advance to Cal Therm: 100 Ohms	The display automatically returns to the *Calibrate Aux2: 20 mA* submenu. Press the **Down** arrow to advance to the *Calibrate Thermistor 100 Ω* submenu.

Submenus	Display	Notes
Cal Therm: 100 Ohms Submenu Group	Cal Therm: 100 Ohms Therm TB1-6 to TB1-4 ENTER ↓	Place a 100 Ω 0.1% resistor between TB1-6 and TB1-4. Press **ENTER** to calibrate.
	Cal Therm: 100 Ohms 0 CALIBRATING ------	This message displays during calibration.
	Cal Therm: 100 Ohms *** DONE ***	This message displays when the calibration is finished.
	Cal Therm: 100 Ohms Therm TB1-6 to TB1-4 STOP Advance to Cal Therm: Open	The display automatically returns to the *Cal Therm: 100 Ohms* top-level menu. Press the **Down** arrow to advance to the *Calibrate Thermistor Open* submenu.
Cal Therm: Open Submenu Group	Cal Therm: Open Therm TB1-6 to TB1-4 ENTER ↓	Remove the 100 Ω 0.1% resistor from TB1-6 and TB1-4 and leave open. Press **ENTER** to calibrate.
	Cal Therm: Open 0 CALIBRATING ------	This message displays during calibration.
	Cal Therm: Open *** DONE ***	This message displays when the calibration is finished.
	Cal Therm: Open Therm TB1-6 to TB1-4 STOP Advance to Calibrate Aux2: 0V	The display automatically returns to the *Cal Therm: 100 Ohms* top-level menu. Press the **Down** arrow to advance to the *Calibrate Aux2: 0V* submenu.

Submenus	Display	Notes
Calibrate Aux2: 0V Submenu Group	Calibrate Aux2: 0V Vin=TB1-5 GND=TB1-4	Connect Voltage Source (+) TB1-5, (-) TB1-4. Input 0V and press **ENTER** to calibrate.
	ENTER ↓	
	Calibrate Aux2: 0V 0 CALIBRATING ------	This message displays during calibration.
	↓	
	Calibrate Aux2: 0V *** DONE ***	This message displays when the calibration is finished.
	↓	
	Calibrate Aux2: 0V lin=TB1-5 GND=TB1-4	The display automatically returns to the *Calibrate Aux2: 0V* top-level menu. Press the **Down** arrow key to advance to the *Aux2: 10V* calibration.
	STOP ↓	
Calibrate Aux2: 10V Submenu Group	Calibrate Aux2: 10V lin=TB1-5 GND=TB1-4	Connect Voltage Source (+) TB1-5, (-) TB1-4. Input 10V and press **ENTER** to calibrate.
	ENTER ↓	
	Calibrate Aux2: 10V 0 CALIBRATING ------	This message displays during calibration.
	↓	
	Calibrate Aux2: 10V *** DONE ***	This message displays when the calibration is finished.
	↓	
	Calibrate Aux2: 10V lin=TB1-5 GND=TB1-4	The display automatically returns to the *Calibrate Aux2: 10V* top-level menu. Press the **Down** arrow key to advance to the *100 Ohm RTD* calibration.
	STOP ↓	
	Advance to Cal RTD: 100 Ohms	
Calibrate 100 Ohm RTD Submenu Group	Cal RTD 100ohm JMP TB1-6,7 100R=7,8	Connect a jumper wire between TB1-6 and TB1-7. Place a 100 Ohm 0.1% resistor between TB1-7 and TB1-8 and press **ENTER** to calibrate.
	ENTER ↓	
	Cal RTD 100ohm 0 CALIBRATING ------	This message displays during calibration.
	↓	
	Cal RTD 100ohm *** DONE ***	This message displays when the calibration is finished.
	↓	
	Cal RTD 100ohm JMP TB1-6,7 100R=7,8	The display automatically returns to the *Calibrate Aux2: 10V* top-level menu. Press the **Down** arrow key to advance to the *100 Ohm RTD* calibration.
	STOP	
	Advance to Calibrate 0mA Aout	

Submenus	Display	Notes
Calibrate 0 mA Aout Submenu Group	Calibrate 0mA Aout + TB1-15 - TB1-16	Connect ammeter to (+) TB1-15, (-) TB1-16. Press **ENTER**.
	ENTER ↓	
	Calibrate 0mA Aout Enter mA: 0.00000	To trim 0 mA analog output: Press **CLEAR** to enable editing and enter a small negative number (for instance -0.100) to force a display reading, then clear and enter small quantity measured on your meter.
	ENTER ↓	
	Calibrate 0mA Aout + TB1-15 - TB1-16	The display returns to *Calibrate 0 mA Aout*. Press the **Down** arrow key to advance to the *Calibrate 20 mA Aout* submenu or repeat above if necessary.
	STOP ↓	
Calibrate 20 mA Aout Submenu Group	Calibrate 20mA Aout + TB1-15 - TB1-16	Connect ammeter to (+) TB1-15, (-) TB1-16. Press
	ENTER ↓	
	Calibrate 20mA Aout Enter mA: 20.00000	To trim 20 mA analog output: Press **CLEAR** to enable editing and enter the current reading from the ammeter display. Press **ENTER**.
	ENTER ↓	
	Calibrate 20mA Aout + TB1-15 - TB1-16	The display automatically returns to the *Calibrate 20 mA Aout* submenu. Calibration is complete.
	MENU ↓	
Analog In Test Submenu Group	Calibrate	Press **MENU** to return to the *Calibrate* top-level menu.
	Analog In Test	Press **ENTER** to test the analog inputs.
	ENTER ↓	
	Analog In Test Volts T5:00.000	To check voltage input accuracy: Use TB1-4 as Reference Ground, input 0…10 Volts to TB1-5. Display shows voltage being input. Use a voltage meter to verify input.
	STOP ↓	
	Analog In Test mA T7:00.000 T8:00.000	To check current input accuracy: Use TB1-4 as Reference Ground, input 0…20 mA to TB1-7 and/or TB1-8. Display shows current being input. Use an ammeter to verify input.
	STOP ↓	
	Analog In Test Ohms Therm:100.000	To check RTD input accuracy: Connect a jumper wire between TB1-6 and TB1-7. Place a 100 Ohm 0.1% resistor between TB1-7 and TB1-8. Display show 100 Ohms ±0.1%.
	MENU ↓	
	Analog In Test	Press **MENU** to return to the *Analog In Test* top-level menu.

Pulse Input Test Submenu Group



Press **ENTER** to test the *Pulse Input*.

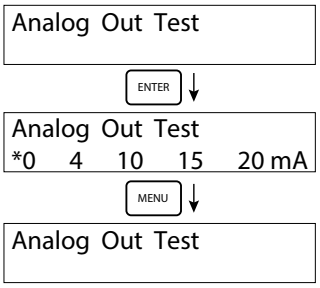
Use the **Up/Down** arrow keys to select the trigger level.

Use the **Up/Down** arrow keys to select the frequency range.

To check *Pulse Input* accuracy: Use TB1-4 as reference ground, input a frequency on TB1-2. The display shows the frequency being input. Use a frequency counter to verify input.

Press **MENU** to return to *Pulse Input Test* top-level menu.

Analog Out Test Submenu Group

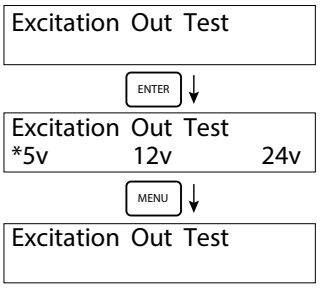


Press **ENTER** to test the *Analog Output*.

To simulate *Analog Output*: Connect an ammeter to (+) TB1-15, (-) TB1-16. Press the key under the required setting to move the asterisk (*). The unit outputs the selected current.

Press **MENU** to return to *Analog Output Test* top-level menu.

Excitation Out Test Submenu Group



Press **ENTER** to test the *Excitation Output*.

To test the *Excitation Output*: Connect a voltmeter to (+) TB1-1, (-) TB1-4. Press the key under the required setting to move the asterisk (*). The unit outputs the selected voltage.

Press **MENU** to return to *Excitation Output Test* top-level menu.

Submenus	Display	Notes
Pulse Out Test Submenu Group	Pulse Out Test	Press **ENTER** to test the pulse output.
	ENTER ↓	
	Pulse Out Test *0Hz 1Hz 10Hz 20Hz	To simulate a frequency on the pulse output: Connect a frequency counter to (+) TB1-13, (-) TB1-14. Press the key under the required setting to move the asterisk (*). The unit outputs the selected frequency.
	MENU ↓	
	Pulse Out Test	Press **MENU** to return to *Pulse Out Test* top-level menu.
Relay Test Submenu Group	Relay Test	Press **ENTER** to test the relays.
	ENTER ↓	
	Rly1 Rly2 Rly3 Rly4 Off Off Off Off	To manually control the relay outputs: Press the key under the required relay to toggle the relays On/Off. Use an Ohmmeter to check the relay contacts.
	MENU ↓	
	Relay Test	Press **MENU** to return to *Relay Test* top-level menu.
Control Input Test Submenu Group	Control Inputs Test	Press **ENTER** to test the control inputs.
	ENTER ↓	
	TB1-9 TB1-10 TB1-11 Off Off Off	To check the control inputs: Use TB1-12 as reference, input a DC signal to TB1-9, TB1-10 and/or TB1-11. The display shows "ON" when input is active, "OFF" when inactive.
	MENU ↓	
	Control Inputs Test	Press **MENU** to return to *Control Input Test* top-level menu.

Submenus	Display	Notes
Battery Voltage Test Submenu Group	Battery Voltage Test	Press **ENTER** to view the battery voltage.
	ENTER ↓	
	Battery Voltage Test 3.312 Volts	The display shows the battery voltage. Replace battery at 2.5V DC or below.
	MENU ↓	
	Battery Voltage Test	Press **MENU** to return to *Battery Voltage Test* top-level menu.
Data Logger Utility Submenu Group	Data Logger Utility	Press **ENTER** to use the *Data Logger Utility*.
	ENTER ↓	
	Data Logger Utility Log 10 958 Max	The displays shows the number of Data Logs. Press the **Down** arrow to advance to PRT (print) or CLR (clear).
	STOP ↓	
	Data Logger Utility Log 00001 PRT CLR	Press **PRINT** to output data logger logs to printer. Press **CLEAR** to clear the data logger contents.
	MENU ↓	
	Data Logger Utility	Press **MENU** to return to the *Data Logger Utility* top-level menu.

Internal Fuse Replacement

1. Make sure you follow proper E.S.D. Precautions. All persons performing this replacement must follow proper grounding procedures.
2. Turn off power to the unit.
3. Disconnect the two piece connector rear terminal block, leaving all connections in place.
4. Remove the unit from the panel.
5. Remove the four machine screws (see *Figure 17*) which hold the two sections of the case together.
6. The rear section of the case should detach from the rest of the case. It may be necessary two cut the wiring label along the joint where the two sections connect. With the rear section of the case removed the fuse will be exposed (located near the rear terminal, AC connection).
7. Locate the Fuse F1 (see *Figure 18*) and unplug the fuse from its socket.
8. Insert the new fuse into the socket. Insure that the pins are fully inserted and straight.
9. Reassemble the case and install the four machine screws which join the two sections of the case.
10. Reinstall the unit into the panel.
11. Reconnect the rear terminal block.
12. Turn the unit back on.

Fuse Specifications

110V AC Power	160 mA/250V, TD Wickman 19372-030-k or equivalent
220V AC Power	80 mA/250V, TD Wickman 19372-026-k or equivalent
12/24V DC Power	800 mA/250V, TD Wickman 19374-046-k or equivalent

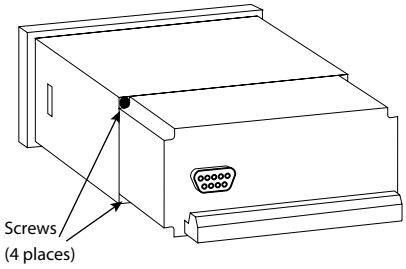


Figure 17: Screws

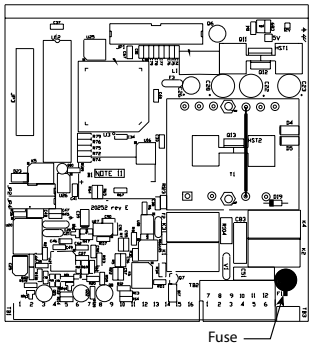


Figure 18: Fuse

RS-232 SERIAL PORT

The FC30 has a general purpose RS-232 port which may be used for any one of the following purposes:

- Transaction Printing Data Logging
- Remote Metering by Modem (optional) Computer Communication Link Configuration by Computer
- Print System Setup
- Print Calibration/Malfunction History

Instrument Setup by PCs over Serial Port

A Diskette program is provided with the FC30 that enables the user to rapidly configure the FC30 using a Personal Computer. Included on the diskette are common instrument applications which may be used as a starting point for your application. This permits the user to have an excellent starting point and helps speed the user through the instrument setup.

Operation of Serial Communication Port with Printers

The FC30 RS-232 channel supports a number of operating modes. One of these modes is intended to support operation with a printer in metering applications requiring transaction printing, data logging and/or printing of calibration and maintenance reports.

For transaction printing, the user defines the items to be included in the printed document. The user can also select what initiates the transaction print generated as part of the setup of the instrument. The transaction document may be initiated via a front panel key depression, a remote contact closure, or upon completion of a batch.

In data logging, the user defines the items to be included in each data log as a print list. The user can also select when or how often he wishes a data log to be made. This is done during the setup of the instrument as either a time of day or as a time interval between logging.

The system setup and maintenance report list all the instrument setup parameters and usage for the current instrument configuration. In addition, the Audit trail information is presented as well as a status report listing any observed malfunctions which have not been corrected.

The user initiates the printing of this report at a designated point in the menu by pressing the print key on the front panel.

FC30 RS-232 Port Pinout

1	Handshake Line
2	Transmit
3	Receive
4	Do Not Use
5	Ground
6	Do Not Use
7	Do Not Use
8	Do Not Use
9	Do Not Use

RS-485 SERIAL PORT (OPTIONAL)

The FC30 has a an optional general purpose RS-485 Port which may be used for any one of the following purposes:

- Accessing Process Parameters
- Rate, Temperatures, Density, Pressure, Viscosity, Setpoints, Month, Day, Year, Hour, Minutes, Seconds, etc.
- Accessing System Alarms
- System, Process, Self Test, Service Test Errors Accessing Totalizers
- Totalizer and Grand Totalizer Executing Various Action Routines
- Reset Alarms, Reset Totalizers, Print Transaction, Reset Error History, Start, Stop, Clear

General

The optional RS-485 card utilizes Modbus RTU protocol to access a variety of pro- cess parameters and totalizers. In addition, action routines can be executed. For further information, contact factory and request RS-485 Protocol manual for FC30.

Operation of Serial Communication Port with PC

The flow computer's RS-485 channel supports a number of Modbus RTU commands. Refer to port pinout (below) for wiring details. Modbus RTU drivers are available from third party sources for a variety of Man Machine Interface software for IBM compatible PC's.

The user reads and writes information from/to the RS-485 using the Modbus RTU commands. The FC30 then responds to these information and command requests.

Process variables and totalizers are read in register pairs in floating point format. Time and date are read as a series of integer register values. Alarms are individually read as coils. Action routines are initiated by writing to coils.

FC30 RS-485 Port Pinout

1	Ground
2	Ground
3	Ground
4	TX/RX (+)
5	TX/RX (-)
6	Do Not Use
7	Terminating Resistor (180 Ω)
8	TX/RX (+)
9	TX/RX (-)

FLOW COMPUTER SETUP SOFTWARE

The FC30 setup program provides for configuring, monitoring and controlling an FC30 unit over the RS-232 link.

Sample applications are stored in disk files. The setup program calls these Templates. You can store the setup from the program's memory to either the FC30 (Downloading the file) or to a disk file (Saving the file) for later usage. Similarly you can load the setup in program memory from either a disk file (Opening a file) or from the FC30 unit (Uploading a file).

The program can monitor outputs from the unit while it is running. The program can reset alarms and totalizers.

For assistance there are mini-helps at the bottom of each screen in the program. There is also context sensitive help available for each screen accessible by pressing the F1 key.

System Requirements

- IBM PC or compatible with 386 or higher class microprocessor 4 MB RAM
- 3 MB free disk space
- VGA or higher color monitor at 640 x 480 Microsoft® Windows™ 3.1 or 3.11 or Windows 95™
- Communication Port RS-232
- RS-232 cable

Cable and Wiring Requirements

The serial communication port on your PC is either a 25-pin or 9-pin connector. No cabling is supplied with the setup software. A cable must be purchased separately or made by the user. Purchase a modem cable that matches the available communication port on your PC and a 9-pin male connection for the FC30 serial port.

Installation for Windows® 3.1 or 3.11

The Setup Software includes an installation program that copies the software to your hard drive.

Insert Setup Disk 1 in a floppy drive.

In the Program Manager, click File, and then select Run.

For Windows 95™:

1. Click **Start**.
2. Select **Run**.
3. Type the floppy drive letter followed by a colon (:) and a backslash (\), and the word "setup." For Example: a:\setup
4. Follow the instructions on your screen.

Using the Flow Computer Setup Software

The setup software window consists of several menu "Tabs". Each tab is organized into groups containing various configuration and/or monitoring functions. To view the tab windows, simply click on the tab. The previous tab window will be hidden as the new tab window is brought to the foreground.

File Tab

The File Tab has three sections. Any of the options on this tab can also be accessed from the File submenu.

The Template Section provides for opening and saving templates. The Save and Save As buttons provide the standard Windows functionality for dealing with files. The Open button is used to open existing templates.

There are two additional menu items available only from the File menu: Create new file and Templates.

The Open, option allows for creating custom templates using the existing template in memory as the starting point. Assign a new name for this template. The template will be saved under this new name.

The Open option will bring up a list of predefined templates that can be loaded into the program. These predefined templates are useful as a starting point when defining custom templates.

A typical scenario using the setup program would be the following:

1. Open up a predefined template from the supplied list.
2. Choose 'Save As' to save this to a new filename.
3. Customize the template by making any changes that are needed.
4. Save the template to disk (if you want to reuse this template).

Download the template to an attached unit.

The Communications with FC30 Section lets you upload a template file from the unit, download the program's current template to the unit or compare the program's current template with the unit.

Use the *Print* (report) section to:

- Configure the current Windows printer through the Select Printer option.
- Print a Maintenance Report through the PC's printer using the Print Maintenance option.
- Print the current template through the PC's printer using Print Setup option.

Setup Tab

The Setup tab is where majority of the FC30 instrument setup modifications are done. The Setup tab is divided into five sections.

System Section: Flow Equation, Indicators, Function Keys

Input Section: Flow, Fluid, Compensation Inputs 1 & 2, Control Inputs

Output Section: Pulse, Currents

Relay Section: Relays

Other Settings Section: Administration, Communication, Printing, Time & Date

NOTE: Many setup items are enabled or disabled depending on previous setup selections, It is important to work your way through the above list in the order shown. Be sure to verify your selections when you are through programming to insure that no settings were changed automatically.

View Tab

The View Tab screen allows for viewing selected group items on the PC in a similar format as shown on the unit display. Data from the following groups can be viewed in the List of Values section:

Process Parameters (for instance rate or temperature) Totalizers (i.e. total, grand total).

Signal Inputs Error Log Software Version

The setup software assumes the current setup has been uploaded from the flow computer into the PC. It is important that the setup program and the FC30 unit are using the same setup information at all times or the data will be inconsistent. It is best to upload or download the setup before using this feature.

To start the viewer, first check the boxes of items to view and then click the start button. The data will appear in the appropriate sections and will be continuously updated. The refresh rate is dependent on the number of items that are being viewed and the baud rate of the connection. Data in the List of Values section can be collapsed by clicking on the 'minus' sign in front of the group title. The data can be expanded by clicking on the 'plus' sign in front of the group title. If a group is collapsed and data in the group changes on refresh, the group will automatically expand. Changing the view items requires stopping the current viewing, checking the new selections and then restarting the viewer.

If communication errors occur while reading data from the FC30 device, the word 'Error' will appear in place of the actual value. If the connection to the FC30 is lost, the viewer will time out with a message saying the device is not responding.

The viewer will attempt to communicate with the FC30 device matching the device ID set in the communications screen. If you are having trouble establishing communication, compare settings for the PC and the flow computer. Also verify the connections between the PC and flow computer.

Misc. Tab

This tab has three sections: Tools, Actions and Options.

The tools section contains various system administration activities such as creating/ modifying the initial sign-on screen or calibration, service test etc.

Create Sign-on and Create Print Header

The Actions section is used to send commands to the FC30 unit. Reset Totalizers, Reset Alarms, Reset Alarm History

The Options section has the following selections: Network Card Setup

Additional capabilities may be provided in the future.

NOTE: Future options appear as disabled buttons on the screen.

GLOSSARY OF TERMS

Term	Definition
Acknowledge & Clear Alarms	Acknowledge is used to clear alarm relays and remove any visual alarm messages from the display. In the run mode, press the **ENTER** key or activate CONTROL INPUT 3 (if set for ACK) to momentarily clear alarms and alarm messages. Alarms will reassert themselves if alarm conditions are still present.
Analog Output	The analog signal (4-20mA) that is generated by the FC30. It can correspond to the Rate, Total, Temperature or Density. This output is used primarily for transmission of process information to remote systems.
Audit Trail	The audit trail is used to track the number of changes made to the units setup program.
Auto Batch Restart	The Auto Batch Restart function allows the user to set an amount of time to automatically restart a batch after the completion of a batch. This time can be set from 1 to 99 seconds.
Barometric Pressure	An entry of the average, local atmospheric pressure at the altitude or elevation of the installation. (Typically 14.696 psia)
Batch Count Mode	Batch Count Mode specifies the user preference for count direction. The "Up" selection begins with a value of "0" and counts up until the batch size is reached. The "Down" selection begins with a value equal to the desired batch size and counts down to "0".
Batch Overrun	The FC30 offers a batch overrun compensation routine. If batch overrun occurs due to slow valve response time, the unit will compensate for the overrun amount on the next batch. This feature can be disabled if desired.
Batcher	An instrument which controls the dispensing of desired batch amounts. Liquid batching systems are usually comprised of a batch controller (batcher), flow meter and control valve. The batcher opens and closes the valve through the use of relays and measures the amounts of liquid being dispensed via the flow meter.
Baud Rate	The speed of serial communication transmissions, expressed in bits per second.
Calibration Temperature	The temperature at which a flow sensor was calibrated on a test fluid.
C-Factor (Fluid Expansion Factor)	A parameter in a flow equation which is used to describe the relationship between density or volume and temperature changes.
Corrected Volume Flow	The equivalently volume at a reference temperature condition which involves the measurement of liquid volume flow using a flow sensor and temperature sensor to compensate for thermal expansion.
Custody Transfer	Weights and Measure metering codes often specify several requirements for instruments and mechanisms to prevent and track changes in the setup of an instrument which may be used in the commercial sale of goods. The FC30 tracks changes via the Audit Trail.
Data Logger	The capturing of information for later use and the mechanism for specifying the conditions where a capture should be made.
DC Output / Excitation Voltage	An on-board DC power supply used to power peripheral sensors. The FC30 offers excitation voltages of 5V DC, 12V DC or 24V DC when powered by AC voltage.
Default Value	The value to be used by the instrument if a sensor failure or out of ranch signal is detected.
Expansion Factor	See C-Factor
Flow Alarm	A visual indication that the volumetric flow rate is above or below the flow alarm setpoint specified by the user.
Flow Equation	A recognized relationship between the process parameters for flow, temperature, pressure and density used in flow measurements.
Flow Signal Timeout	The Flow Signal Timeout allows the user to enter a timeout of 0 to 99 seconds. If a batch is “Filling” and zero flow persists for more than the user entered time then the batch will be aborted. This prevents over flows due to faulty flow sensors and/or wiring.
Flowing Z-Factor	The mean Z-Factor under flowing conditions of temperature and pressure for a specific gas.

Term	Definition
Follow, Alarm	Alarm relays which are non latching and whose output state is based solely on the comparison of the current process value and the alarm setpoint (trip point).
Function Key	A key on a push-button panel or keyboard (whose function is described by the key label) used to perform an instrument function or special routine.
Handshake	A means of controlling the information flow between two pieces of equipment to prevent the sending device from transmitting information at a rate faster than what can be accepted by the receiver.
Gas Cor. Vol Eq.	An equation where the corrected volume flow of gas at STP is computed from measured volume flow, temperature and pressure as well as stored gas properties.
Gas Mass Eq.	An equation where the mass flow of a gas is computed from measured volume flow, temperature and pressure as well as stored gas properties.
Hysteresis	The relay hysteresis is a "dead band" setting which allows the relay to remain energized for a given amount below the setpoint. This is used to prevent relay chatter when the process value is near the setpoint value. Example: If the Preset is set at 100, and the hysteresis is set at 10, the relay will energize when the rate, temp or dens. reaches 100, the relay will remain energized until the reading falls below 90.
Input Termination	Input signal lines on digital inputs often require pullup or pulldown resistor configurations to operate properly with different sensor configurations. The FC30 contains such resistors and may be enabled via the setup menu.
Inlet Pipe Bore	The internal pipe diameter upstream of the flow measurement element.
Inhibit Totalizer	"Inhibit Total" is a Control Input 1 setting that is used to stop the totalization. If enabled, a voltage level on control input 1 will inhibit the total as long as the voltage is present. This feature is useful during meter proving and in applications that provide a sensor to signal the flow computer when fluid is present.
K-Factor	A scaling factor derived from the pulses produced by a flow meter output, expressed in pulses per unit. For instance, pulses/gallon.
Limit Setpoint	An alarm trip point setting which specifies the value or magnitude of a process parameter necessary to activate an alarm indicator or control relay.
Linear Flow Meter	A flow measurement device whose output is proportional to flow.
Linearization	The mathematical correction of a nonlinear device. The FC30 uses a linearization Table which is made up of input/output values and makes interpolations of the table to arrive at a "linearized" measurement.
LinTbl	Abbreviation for Linearization Table.
Low Pass Filter	A low pass filter passes low input frequencies while blocking high frequencies. In the FC30, this is the maximum input count speed to be encountered in an application. It is expressed in counts per second (Hz).
Mass Flow	Mass Flow is inferred by the volumetric flow and density (or implied density) of a fluid.
Maximum Batch Preset	The Maximum Batch Preset allows the user to program the Maximum Batch value allowed to be entered by the operator. If an operator should try to program a batch higher then this value, the unit will not allow the value to be entered and will prompt the user with an error message saying that the Maximum Batch Preset has been exceeded.
Maximum Drain Time	The unit declares that a batch is “done” when the flow rate equals “0”. A flow rate may be present long after the Preset Relay de-energizes due to slow reacting valves or leaky valves. The Maximum Drain Time allows the user to enter an amount of time (0 to 99 seconds) to wait before declaring “Batch Done”. After the Preset Batch quantity is reached, the unit will declare “Batch Done” when the flow rate is “0” or the Maximum Drain Time has expired. The batch data will then be available for printing and datalogging.
Max Window	The max. window time sets the maximum sample time (1 to 99 sec) for the ratemeter.
Meter Expansion Coef.	A coefficient in an equation which may be used to correct for changes in flow meter housing dimensional changes with temperature.
Modem Init Master	The "Modem Init Master" menu allows the user to select whether the unit will engage in a configuration conversation with the modem on power up or impart no setup information to the modem and use it "as is". For most users it is recommended to choose "yes" for "Modem Init Master".
Parity	A method for detecting errors in transmissions of serial communications data.
Preset	A set point used to trigger the relay outputs of the FC30.
Print Interval	The print interval allows the FC30 to transmit information to the serial port at selectable time intervals.

Term	Definition
Private Code	An operator password code which authorizes changes to the setup of the instrument but blocks access to the Service/Calibration/Test mode. The private code also blocks the clearing of the Grand Total.
Process Parameters	Sensor information that has been scaled to engineering units including Flow, Temperature and Density.
Pulldown (Input Termination)	The termination of an input at which the input is pulled down to ground through a resistor. Inputs that are terminated by this method need to be driven high with a positive voltage pulse.
Pullup (Input Termination)	The termination of an input at which the input is pulled up to a positive voltage through a resistor. Inputs that are terminated by this method need to be pulled low with a sinking current or contact to ground .
Pulse Output	The pulse output of the FC30 is available for remote accumulation of the total or sent to peripheral devices, such as a PLC. The output can be scaled using the Pulse Output Scaling Constant.
Quad	Abbreviation for Quadrature. Quadrature signals are used for direction control. Two flow meter signals are output with a 90° phase shift. The counter counts UP when channel A precedes channel B, and counts DOWN when Channel A lags Channel B.
Quick Setup	A utility that provides for rapid configuration of an instrument. The FC30 quick setup provides the following: Prompts the user for only critical information. Automatically sets specifications to common uses. After following the Quick Setup procedure, the unit will be operational to perform the basic measurement. The setup can be further customized using the setup menus.
Quick Update %	This feature is used to disable the rate averaging filter when a significant change in the flow rate occurs. The user can enter the percent of change needed to be detected to disable the averaging feature. This is especially useful during start-up and shutdown of flow.
Rate Averaging Filter	The rate averaging filter is used to stabilize fluctuating rate displays. Higher settings provide more averaging for a more stable display. Derived from the equation: (OLD DATA x "Avg. Filter" + NEW DATA)/ ("Avg. Filter" + 1)
Ratemeter	Any device used to display the speed of a process. The ratemeter in the FC30 displays flow rate.
Ref. Dens.	Abbreviation for Reference Density. This is the fluid density at reference conditions of temperature and pressure.
Ref. Temp.	Abbreviation for Reference Temperature. This represents the base or reference condition to which corrected flow will be computed.
Ref. Z-Factor	Abbreviation for Reference Z-Factor. The Z-Factor for a gas at reference conditions of temperature and pressure.
Reset/Start Control Input	In a batching system, a single operator activation of the START key or Control Input 1 will reset the total then start the batch process.
Roshko	A parameter defined as: f • temperature correction/cstk
Single_Pulse	The Single_Pulse setting is used for flow meters with single pulse outputs.
Slow Start Quantity	The Slow Start Quantity is a function that allows an amount to be entered for a Slow Startup. This function requires two-stage valve control. RLY 1 (slow flow) will energize for Slow Start and RLY 2 (fast flow) will energize after the Slow Start Quantity has been delivered. This helps reduce turbulence when filling an empty container.
Stop/Reset Control Input	In a batching system, a single operator activation of the STOP key or Control Input 2 will stop the batch process then reset the total.
STP Reference	The users desired pressure and/or temperature to be considered as the reference condition in the computation of fluid properties or corrected volume conditions.
Strouhal	A calibration parameter defined as temperature corrected K-factor for a turbine flow meter.
Time Constant	A damping factor for an averaging filter for the analog output. (See also Rate Averaging Filter)
Totalizer	Any device which accumulates and displays a total count.
UVC	Abbreviation for Universal Viscosity Curve. A presentation of the combined flow rate/viscosity calibration for a turbine flow meter.
VFD	Abbreviation for Vacuum Fluorescent Display
Visc Coef	Abbreviation for Viscosity Coefficient. One or more coefficients in an equation used to describe the viscosity as a function of temperature for a fluid.
Volume Flow	The measurement of volumetric flow.

DIAGNOSIS AND TROUBLESHOOTING

Response of FC30 on Error or Alarm:

Error and warning indications which occur during operation are indicated in the RUN mode alternately with the measured values. The FC30 Flow Computer has three types of error:

Type of Error	Description
Sensor/Process Alarms	Errors detected due to sensor failure or process alarm conditions
Self Test Errors	Errors detected during self test.
System Alarms	Errors detected due to system failure

Some alarms are self clearing. Other alarms require the user to acknowledge and clear the alarm. Press **ENTER** to acknowledged and clear alarms. Alarms may reassert themselves if the alarm condition is still present.

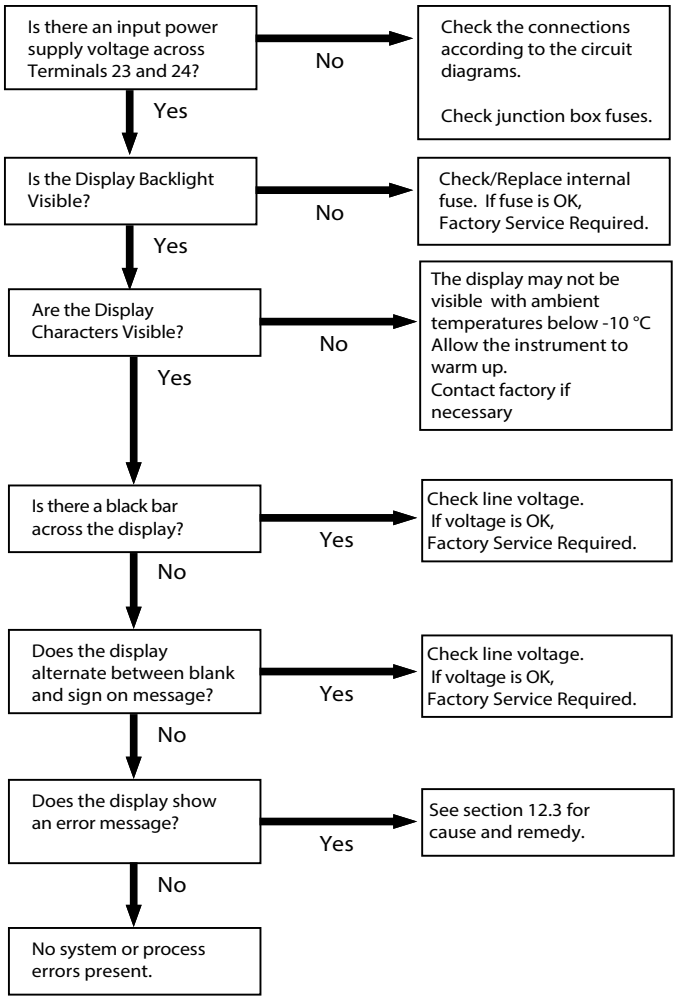
NOTE: An historical error alarm log is available in the *Test Mode*.

The following descriptions suggest possible causes and corrective actions for each alarm message.

Diagnosis Flow Chart and Troubleshooting

All instruments undergo various stages of quality control during production. The last of these stages is a complete calibration carried out on state-of-the-art calibration rigs.

A summary of possible causes is given below to help you identify faults.



Error & Warning Messages

Sensor/Process Alarms

Error/Warning Message	Cause	Remedy
TOTALIZER ROLLOVER	Displayed when totalizer rolls over	• Acknowledge rollover • Remedy not required
AUX INPUT TOO LOW!	4…20 mA input current at aux input is smaller than 3.5 mA due to faulty wiring, transmitter not set to 4:20 mA, or defective transmitter	• Check wiring • Check function of sensor
RTD OUT OF RANGE	Input current at RTD input too low due to faulty wiring or defective RTD	• Check wiring • Check function of RTD sensor
RATE OVERFLOW ERROR	Pulse counter overflowed Totalizer may have lost counts	• Report error to factory • Check application conditions • Check wiring
PULSE OUT OVERFLOW	Calculated pulse frequency too large because pulse width setting is too long or a larger pulse scaler is needed	• Adjust pulse value • Adjust pulse width • Check process conditions
FLOW RATE ALARM LOW FLOW RATE ALARM HIGH TEMP ALARM LOW TEMP ALARM HIGH DENSITY ALARM LOW DENSITY ALARM HIGH	Limit value exceeded	• Check application • Check limit value • Adjust the limit value
PRESSURE ALARM LOW PRESSURE ALARM HIGH BATCH OVERRUN ALARM	Batch size exceeded by more than set limit	• Check system valves for proper operation and /or leaks • Check limit value • Adjust the limit value
MODEM NOT PRESENT	The setup expects modem usage and a modem is not responding	• Check setup for proper baud rate, parity and other parameters • Check modem connection and cycle power to the unit • Replace modem
SOFTWARE ERROR RESET	The setup expects modem usage and a modem is not responding	• Check setup for proper baud rate, parity and other parameters • Check modem connection and cycle power to the unit • Replace modem

Self Test Alarms

Error/Warning Message	Cause	Remedy
AUX INPUT TOO HIGH!	Analog input signal of auxiliary input exceeded by more than 3%: • Sensor over-ranged • Incorrect full scale setting of transmitter • Function error in transmitter or faulty wiring	• Check analog signal range • Check the application conditions • Check wiring
BATTERY LOW WARNING	Battery voltage is too low	• Replace battery • Consult factory for service information
A to D NOT CONVERTING	Fault in analog/digital converter	• Unit may self-correct. Press **ENTER** to acknowledge and clear alarm • If error recurs, factory service is required
TIME CLOCK ERROR	The correct tine/date is no longer shown	• Re-enter time and date • If error recurs, contact factory
CAL CHECKSUM ERROR	Calibration constants have been corrupted	Report error to factory
SETUP CHECKSUM ERROR	The units setup has been corrupted	Report error to factory
RTD/THERM FAILURE	Input current at RTD or thermistor input too low due to faulty wiring or defective RTD/thermistor	• Check wiring • Check function of RTD/thermistor sensor
METER OUT OF RANGE	Signal from flow meter indicates an error	• Check wiring • Check function of flow sensor

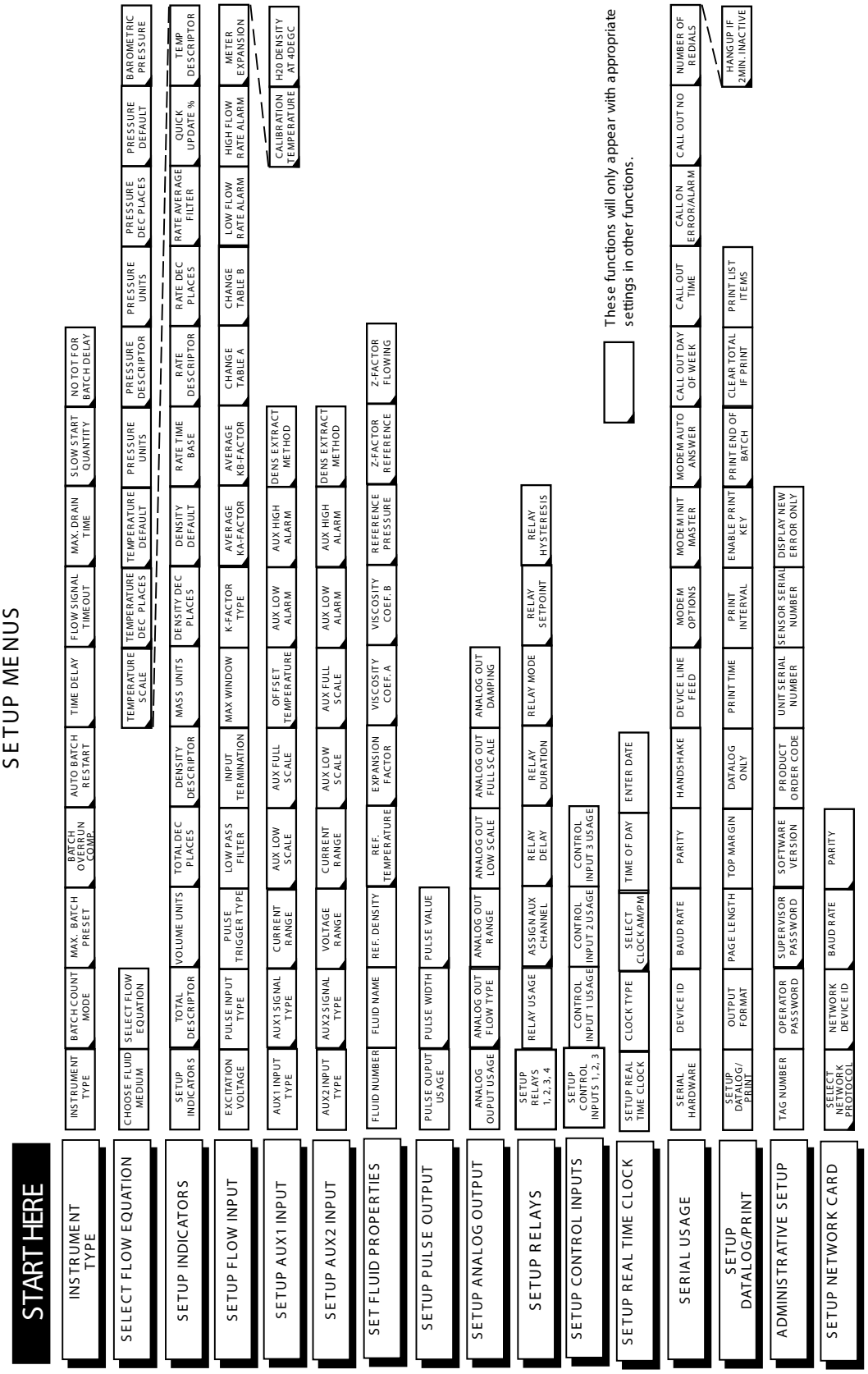
FLUID PROPERTIES TABLE

Liquid

Fluid	Ref. Density (lb/gal)	Ref. Temp. (°F)	Coeff. of Expansion (e-6 format)	Liq. Visc. Andrede's Equation Coeff. "A"	Viscosity By Andrede's Equation Coeff. "B"
Air	7.2947	-317.8	1626.2	0.172	0
Ammonia	5.6996	-28.2	570.4	0.00157	2228.25
Argon	11.6172	-302.6	1486.1	0.011291	511.34
CO_2	8.735	-10.0	1260.9	0.000001	5305.44
Methane	3.5404	-258.7	1052.3	0.006819	526.08
Nat. Gas	3.5404	-258.7	1052.3	0.006819	526.08
Nitrogen	6.7438	-320.4	1491.7	0.006524	434.94
Oxygen	9.5208	-297.4	1345.8	0.019773	340.29
Propane	4.2344	60	717.8	0.009969	1267.35
Nx-19	3.5404	-258.7	1052.3	0.006819	526.08
Gasoline	6.2572	60	370.3	0.045617	1432.26
Kerosene	6.9243	60	268.1	0.004378	3245.78
No. 2 Fuel	7.8843	60	88.5	0.000453	4946.15
Water	8.3389	60	101.5	0.001969	3315.61

Gas

Fluid	Ref. Density (lb/ft^3)	Ref. Temp. (°F)	Ref. Z Factor (14.696 psia)	Z Factor at 100 psia and 60° F	Viscosity by Andrede's Equation Coeff. "A"	Viscosity by Andrede's Equation Coeff. "B"
Air	0.076	60	1	0.997	0.000138	0.775522
Ammonia	0.045	60	1	0.955	0.000013	1.05951
Argon	0.105	60	1	0.995	0.00021	0.750757
CO_2	0.116	60	1	0.954	0.000049	0.91136
Methane	0.042	60	1	0.970	0.000018	1.015892
Nat. Gas	0.0456	60	1	0.970	0.000018	1.015892
Nitrogen	0.074	60	1	0.998	0.000202	0.7128734
Oxygen	0.084	60	1	0.995	0.000169	0.761811
Propane	0.116	60	1	0.870	0.00002	0.952092
Nx-19	0.0456	60	1	0.97	0.000018	1.015892



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