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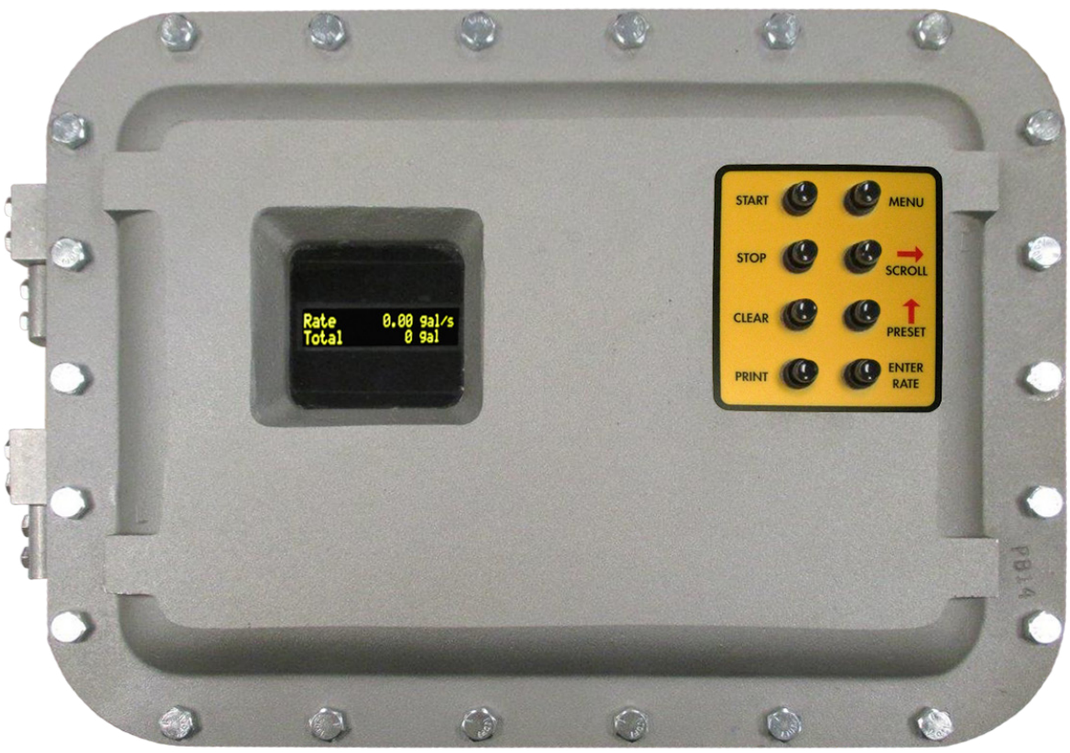
Email : IFSTechhelp@gmail.com

# STX-ST1

## EXPLOSION PROOF SUPERTROL-I



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# NOTICE!

The Kessler Ellis equipment is housed in an XCE 101404 N4 Explosion Proof Enclosure which is UL Classified for use in Class I, Division I, Groups B, C & D and Class II, Division I, Groups E, F & G and cUL Classified (Investigated to the CSA standards by UL) for use in Class I, Division I, Groups B, C & D and Class II, Division I, Groups E, F & G hazardous locations and includes miniature operators. Through the cover XMOBS 2 miniature operators are UL Listed and CSA Certified for use in Class I, Division I, Groups B, C & D and Class II, Division I, Groups E, F & G hazardous locations. The enclosure and operators have been investigated to and are approved for Type 4 applications.

Conduit entrances require approved seal fittings rated for the same hazardous locations within 18" of the enclosure.

# 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.

Comments

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. Replace the internal fuse with the following specified type and rating only:

| Input Power | Recommended Fuse |
|---|---|
| 115 VAC | 160 mA slow blow fuse |
| 230 VAC | 80 mA slow blow fuse |
| 12-24 VDC | 800 mA slow blow fuse |

**Disconnect power supply before replacing 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

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

## Technical Improvements

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

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**Unit Description**

## 1. Description

### 1.1 Unit Description:

The STX-ST1 satisfies the instrument requirements for a variety of flowmeter types in hazardous area rate/total and batching 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. User defineable display scrolling is supported.

The versatility of the STX-ST1 permits a wide range of functions within the instrument's explosion proof 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, 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 logging, transaction printing, or for connection to a modem for remote meter reading. Remote metering software available.

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.

**Unit Features**

### 1.2 Unit Features:

The STX-ST1 offers the following features:

- Explosion Proof Enclosure with LCD Display
- Rate/Total and Batching Functions
- Advanced Batching Features: Overrun Compensation, Print End of Batch, Slow Start of Batch Fill, Slow End of Batch Fill, 2 Stage Batching or Digital Control Valve
- Advanced Printing Capabilities
- "EZ Setup" Guided Setup for First Time Users
- Menu Selectable Hardware & Software Features
- Isolated Pulse, Analog and Relay Outputs Standard on AC Powered Models
- RS-232 Port Standard, Modbus RTU RS-485 Optional
- Windows™ Setup Software
- On Board Data Logging
- DDE Server & HMI Software Available
- User Definable Units of Measure
- Enhanced Modem Features for Remote Metering

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## 1.3 Specifications:

**Specifications:**

**Flow Meters and Computations**

Meter Types: All liquid linear and square law meters supported
including: vortex, turbine, magnetic, PD, target, orifice, venturi, v-cone, coriollis and many others
Linearization: Square root, 16 point table or UVC table
Computations: Volume, Corrected Volume & Mass
Fluid Computations: Temperature, Density, Viscosity and
API 2540 for petroleum.

**Environmental**

Operating Temperature: 0°C to +50°C
Storage Temperature: -40°C to +85 C
Humidity : 0-95% Non-condensing
Extended Temperature: -20°C to +55°C

**Display**

Type: 2 lines of 20 characters
Types: VFD, Backlit LCD or OLED
Character Size: 0.2” nominal
User programmable label descriptors and units of measure

**Keypad**

Keypad Type: Mechanical Pushbutton with 8 keys

**Enclosure**

Size: See Dimensions
Type: Class 1, Div 1, Groups C & D
Materials: Aluminum
Weight: 45 lbs.

**Real Time Clock**

The STX-ST1 is equipped with a battery backed real time clock with display of time and date.
Format: 12 or 24 hour time display
Day, Month, Year date display

**Power Input**

The factory equipped power option is internally fused. An internal filter and MOV are provided for added transient suppression.
110 VAC Power: 85 to 127 Vrms, 50/60 Hz
220 VAC Power: 170 to 276 Vrms, 50/60 Hz
DC Power: 12 VDC (10 to 14 VDC)
24 VDC (14 to 28 VDC)
Power Consumption:
AC: 11.0 VA (11W)
DC: 300 mA max.

**Flow Inputs:**

**Analog Input:**

Accuracy: 0.02% FS at 20° C
Ranges
Voltage: 0-10 VDC, 0-5 VDC, 1-5 VDC
Current: 4-20 mA, 0-20 mA
Basic Measurement Resolution:
16 bit
Update Rate: 4 updates/sec
Automatic Fault detection: Signal over/ under-range,Current Loop Broken
Calibration: Software Calibration (no trimmers) and Auto-zero Continuously
Extended calibration:
Learns Zero and Full Scale of each range using special test mode.
Fault Protection:
Reverse Polarity: No ill effects
Over-Voltage Limit: 50 VDC Over voltage protection
Over-Current Protection: Internally current limited protected to 24VDC

**Pulse Inputs:**

Number of Flow Inputs: one with or without quadrature or pulse security checking
Input Impedance: 10 KΩ nominal
Pullup Resistance: 10 KΩ to 5 VDC (menu selectable)
Pull Down Resistance: 10 KΩ to common
Trigger Level: (menu selectable)
High Level Input
Logic On: 3 to 30 VDC
Logic Off: 0 to 1 VDC
Low Level Input (mag pickup)
Sensitivity:
10 mV or 100 mV
Minimum Count Speed:
Menu selectable to 1 pulse every 99.9 sec.
Maximum Count Speed:
Menu Selectable: 40Hz, 3000Hz or 20 kHz
Overvoltage Protection: 50 VDC

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**Auxiliary / Compensation Input**

The auxiliary/compensation input is menu selectable for temperature, density or not used. This input is used for the compensated input when performing compensated flow calculations. It can also be used as a general purpose input for display and alarming.

Operation: Ratiometric
Accuracy: 0.02% FS at 20° C
Basic Measurement Resolution:
16 bit
Update Rate: 1 update/sec minimum
Automatic Fault detection:
Signal Over-range/under-range
Current Loop Broken
RTD short
RTD open
Fault mode to user defined default settings
Fault Protection:
Reverse Polarity: No ill effects
Over-Voltage Limit (Voltage Input): 50 VDC
Available Input Ranges
Voltage: 0-10 VDC, 0-5 VDC, 1-5 VDC
Current: 4-20 mA, 0-20 mA
Resistance: 100 Ohms DIN RTD (DIN 43-760, BS 1904):
Three Wire Lead Compensation
Internal RTD linearization learns ice point resistance
1 mA Excitation current with reverse polarity protection
Temperature Resolution: 0.01°C
Temperature Accuracy: ± 0.25°C

**Control Inputs**

Remote Switch Inputs are menu selectable for Start, Stop, Reset, Lock, Inhibit, Alarm Acknowledge, Print or Not Used.
Number of Control Inputs: 3
Control Input Specifications
Input Scan Rate: 10 scans per second
Logic 1: 4 - 30 VDC
Logic 0: 0 - 0.8 VDC
Input Impedance: 100 KΩ
Control Activation:
Positive Edge or Pos. Level based on product definition for switch usage.

**Excitation Voltage**

Menu Selectable: 5, 12 or 24 VDC @ 100 mA (fault protected)

**Relay Outputs**

The relay outputs are menu assignable to (Individually for each relay) Low Rate Alarm, Hi Rate Alarm, Prewarn Alarm, Preset Alarm, Digital Control Valve or General purpose warning (security), low temperature/high temperature.

Number of relays: 2 (4 optional)
Contact Style: Form C contacts
Contact Ratings: 5 amp, 240 VAC or 30 VDC

**Serial Communication**

The serial port can be used for printing, datalogging, modem connection and communication with a computer.
RS-232:
Device ID: 01-99
Baud Rates: 300, 600, 1200, 2400, 4800, 9600, 19200
Parity: None, Odd, Even
Handshaking: None, Software, Hardware
Print Setup: Configurable print list and formatting.
Print Out: Custom form length, print headers, print list items.
Print Initialization: Print on end of batch, key depression, interval, time of day, control input or serial request.
RS-485: (optional 2nd COM port)
Device ID: 01-247
Baud Rates: 2400, 4800, 9600, 19200
Parity: None, Odd, Even
Protocol: Modbus RTU (Half Duplex)

**Data Logging**

The data logger captures print list information to internal storage for approximately 250 transactions. This information can be used for later uploading or printing. Storage format is selectable for Comma-Carriage Return or Printer formats.

**Isolated Analog Output**

The analog output is menu assignable to correspond to the Uncompensated Volume Rate, Corrected Volume Rate, Mass Rate, Temperature, Density, Volume Total, Corrected Volume Total or Mass Total.
Type: Isolated Current Sourcing
Available Ranges: 4-20 mA, 0-20 mA
Resolution: 12 bit
Accuracy: 0.05% FS at 20° C
Update Rate: 1 update/sec minimum
Temperature Drift: Less than 200 ppm/C
Maximum Load: 1000 ohms (at nominal line voltage)
Compliance Effect: Less than .05% Span
60 Hz rejection: 40 dB minimum
Calibration: Operator assisted Learn Mode
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, Compensated Volume Total or Mass Total
Pulse Output Form: Photomos Relay
Maximum On Current: 25 mA
Maximum Off Voltage: 30 VDC
Saturation Voltage: 1.0 VDC
Maximum Off Current: 0.1 mA
Pulse Duration: 10 mSec or 100 mSec (user selectable)
Pulse output buffer: 256
Fault Protection
Reverse polarity: Shunt Diode

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**Operating (Run) Mode**

The STX-ST1 can be thought of as making a series of measurements of flow, temperature/density sensors and then performing calculations to arrive at a result(s) which is then updated periodically on the display. The analog output, the pulse output, and the alarm relays are also updated. The cycle then repeats itself.

Step 1: 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.

Step 2: Compute the Flowing Fluid Parameters-
The temperature, viscosity, and density equations are computed as needed based on the flow equation and input usage selected by the user.

Step 3 : Compute the Volumetric Flow-
Uncompensated flow is the term given to the flow in volume units. The value is computed based on the flowmeter input type selected and augmented by any performance enhancing linearization that has been specified by the user.

Step 4: Compute the Corrected Volume Flow at Reference Conditions-
In the case of a corrected liquid volume flow calculation, the corrected volume flow is computed as required by the selected compensation equation.

Step 5 : Compute the Mass Flow-
All required information is now available to compute the mass flow rate as volume flow times density.

Step 6: 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.

Step 7: Compute the Analog Output-
This designated flow rate value is now used to compute the analog output.

Step 8: Compute the Flow Totals by Summation-
A flow total increment is computed for each flow rate. This increment is computed by multiplying the respective flow rate by a time base scaler and then summing. The totalizer format also includes provisions for total rollover.

Step 9: Total Preset Comparisons-
The total associated with a preset function is then compared against the corresponding preset value and any required control actions taken.

Step 10: 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.

Step 11: 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 a numeric lock out code established by the user. In addition, a secret, manufacturers numeric unlock entry sequence is available.

The system also provides a minimum implementation of an "audit trail" which 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 software program is available which runs on a PC using a RS-232 Serial for connection to the STX-ST1. Illustrative examples may be down loaded 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 STX-ST1 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.

In the setup mode selections, several parameters are required to be input by the operator since these parameters are blank when the unit is received. The user will be prompted for these necessary values for his application.

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.

**Display Mode (Disp)**

The user can define a scrolling display list for lines 1 and 2. In batching applications line 2 is reserved for total amount filled in current batch cycle.

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**Maintenance Mode (Test):**

The Maintenance Mode of the STX-ST1 is the Test and Calibration Mode for the device. This mode provides a number of specialized utilities required for factory calibration, instrument checkout on start-up, 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 start-up 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:

Error History
Print Calibration/Maintenance Report
Examine Audit Trail
Perform Keypad Checkout
Perform Display Checkout
Perform Pulse Input Checkout
Perform Pulse Output Checkout
Perform Control Input Checkout
Perform Relay Output Checkout
Perform Analog Input Checkout
Perform Analog Output Checkout
Calibrate Analog Inputs using the Learn Feature
Calibrate Analog Output using the Learn Feature
Battery Check
Review/Clear/Print Datalogger

Note that 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 STX-ST1 has a general purpose RS-232 Port which may be used for any one of the following purposes:

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

**Instrument Setup by PC's over Serial Port**

A Diskette program is provided with the STX-ST1 that enables the user to rapidly configure the STX-ST1 using an 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**

STX-ST1's 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 history which have not been corrected and cleared.

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 STX-ST1 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.

An external modem is intentionally being used with the STX-ST1. 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 STX-ST1 is assumed to be operating in a remote metering role. The STX-ST1 will support key items in the Hayes Compatible "AT" Command Set. In this role, the STX-ST1 will have the following special abilities:

1. Monitor the modem status as a task of the system
2. Instruct the modem to answer an incoming call ATA
3. Respond to the calling modem at a compatible baud rate and protocol
4. Perform error checking in conjunction with the modem
5. Monitor the status of the carrier
6. Terminate the telephone connection in event the connection is lost.

In addition, the STX-ST1 will be capable of initiating a call to a designed telephone number in the event of a metering malfunction.

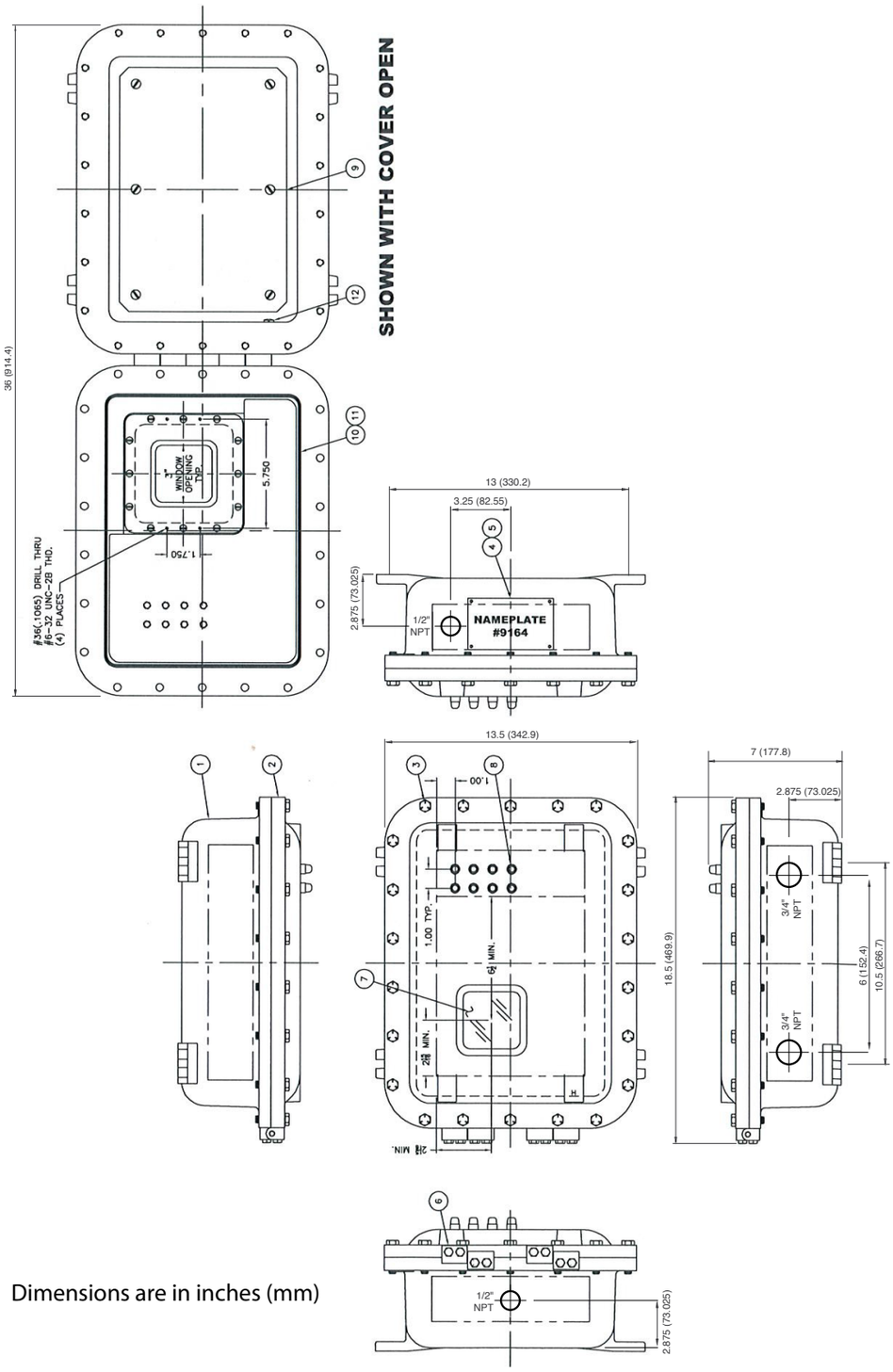
## 2. Installation

**General Mounting Hints**

### 2.1 General Mounting Hints:

The STX-ST1 should be located in an area with a clean, dry atmosphere which is relatively free of shock and vibration.

### 2.2 Mounting Dimensions:




Dimensions are in inches (mm)

## 3. Applications

**Liquid Volume**

### 3.1 Liquid Volume

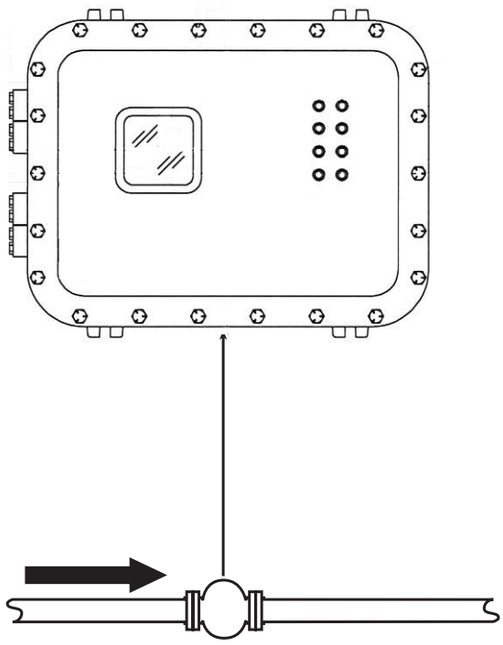
**Measurements:**
A flowmeter measures the actual volume in a liquid line. A temperature sensor can also be installed to correct for liquid thermal expansion (see 3.2 Corrected Volume).

**Calculations:**
- For Flowmeters with Pulse Outputs, Volume flow is calculated using the flowmeter frequency output and the user entered K-Factor.
- For Flowmeters with Analog Transmitters, Volume flow is calculated using the measured flowmeter signal and the user entered scale settings.

**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 STX-ST1 can monitor actual volume flow and total of any liquid. Flow alarms are provided via relays and datalogging is available via analog (4-20mA) and serial outputs.

**Liquid Volume Illustration**



Flowmeter

**Calculations**

*Pulse Input; Average K-Factor*

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

*Analog Input; Linear*

Volume Flow = % input * Full Scale Flow

**Corrected Liquid Volume**

## 3.2 Corrected Liquid Volume

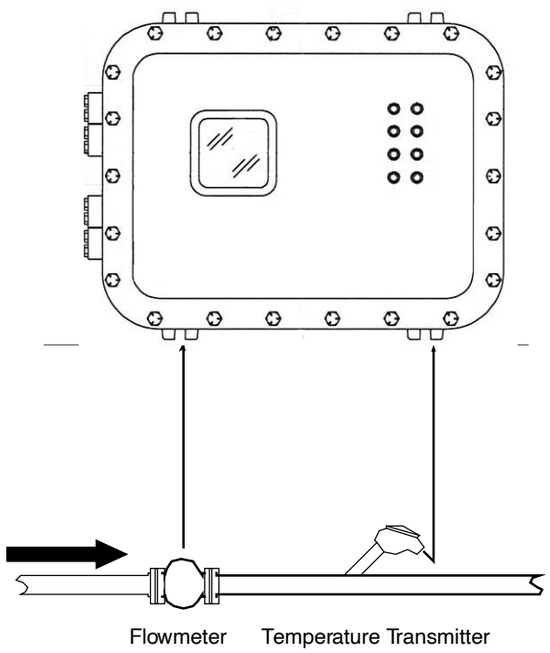
**Measurements:**
A flowmeter measures the actual volume in a liquid line. A temperature sensor is installed to correct for liquid thermal expansion.

**Calculations:**
- Corrected Volume is calculated using the flow and temperature inputs as well as the thermal expansion coefficient stored in the STX-ST1. Use the "SET FLUID PROPERTIES" submenu to define reference temperature and density values for standard conditions.

**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 (4-20mA) and serial outputs.

**Corrected Liquid Volume Illustration**




**Calculations**

*Volume Flow*

As calculated in section 3.1

*Corrected Volume Flow* (Temp. Transmitter)

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

or alternately API2540 equation

**Liquid Mass**

## 3.3 Liquid Mass

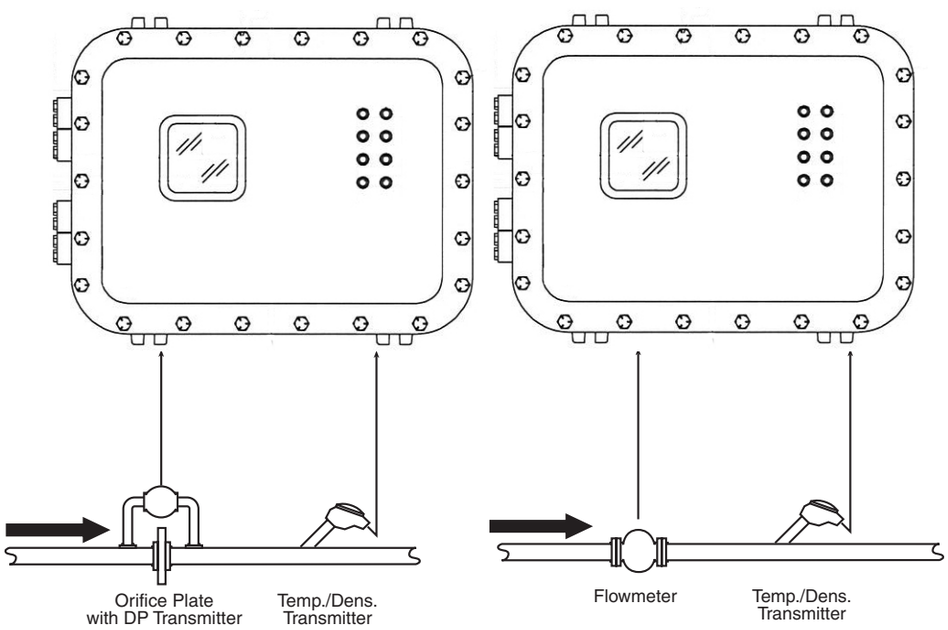
**Measurements:**
Actual volume is measured by the flow element (DP transmitter or Flowmeter). Temperature is measured by the temperature transmitter. A density transmitter can be used for direct density measurements.

**Calculations:**
- The density and mass flow are calculated using the reference density and the thermal expansion coefficient of the liquid (see "SET FLUID PROPERTIES" submenu)

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

**Liquid Mass Illustration**




**Calculations**

*Volume Flow*

As calculated in section 3.1

*Mass Flow*

Mass Flow = volume flow * density

**Batching**

## 3.4 Batching

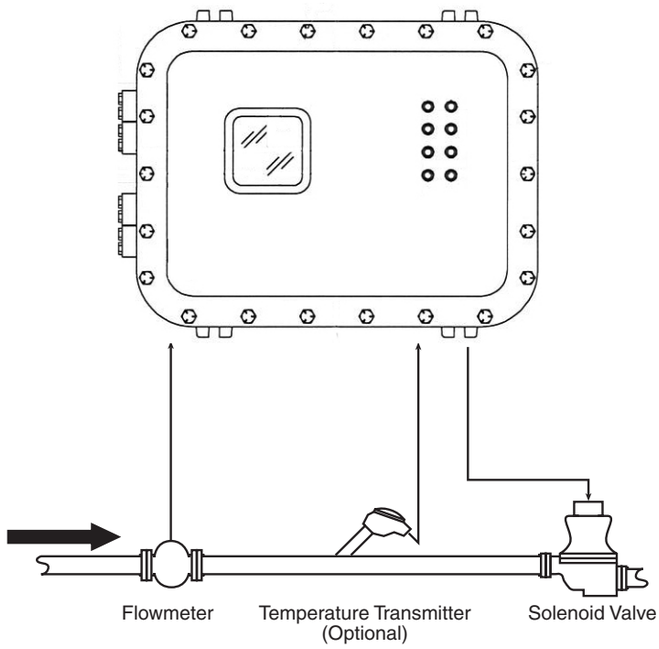
**Measurements:**
A flowmeter measures the actual volume in a liquid line. A temperature sensor can also be installed to correct for liquid thermal expansion (see 3.2 Corrected Volume or 3.3 Liquid Mass).

**Calculations:**
- For Flowmeters with Pulse Outputs, Volume flow is calculated using the flowmeter frequency output and the user entered K-Factor.
- For Flowmeters with Analog Transmitters, Volume flow is calculated using the measured flowmeter signal and the user entered scale settings.
- Corrected Volume is calculated using the flow and temperature inputs as well as the thermal expansion coefficient stored in the STX-ST1.

**Output Results:**
- Display Results
  Flow Rate, Batch Total, Non-Resettable Total, Temperature, Density
- Analog Output
  Rate, Total, Temperature or Density
- Pulse Output
  Total
- 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 (4-20mA) and serial outputs.

**Batching Illustration**




**Calculations**

*Volume Flow*

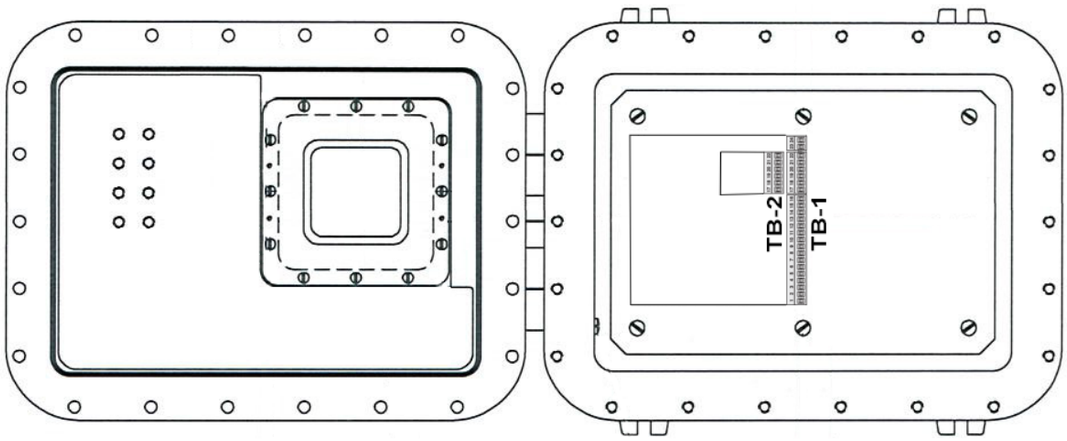
As calculated in section 3.1

*Mass or Corrected Volume Flow* (Temp. Transmitter) See Sections 3.2, 3.3

Corrected Vol. Flow = volume flow * (1 - Therm.Exp.Coef. *(Tf-Tref))$^2$

## 4 WIRING

### 4.1 Terminal Locations




**Shown with cover open**

### 4.2 Terminal Designations

**TB-1**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | DC OUTPUT | | FLOW | | | | |
| 2 | PULSE IN 1 | Vin + | IN | | | | |
| 3 | PULSE IN 2 | Iin + | | | | | |
| 4 | COMMON | | | | | | |
| 5 | -------- | Vin + | | | | | |
| 6 | RTD EXCIT + | | COMP | | | | |
| 7 | RTD SENS + | | IN | | | | |
| 8 | RTD SENS - | Iin + | | | | | |
| 9 | CNTR IN 1 | | | | | | |
| 10 | CNTR IN 2 | | SEE USER | | | | |
| 11 | CNTR IN 3 | | MANUAL | | | | |
| 12 | COMMON | | | | | | |
| 13 | PULSE OUTPUT + | | | | | | |
| 14 | PULSE OUTPUT - | | | | | | |
| 15 | ANALOG OUTPUT + | | 4-20 mA | | | | |
| 16 | ANALOG OUTPUT - | | | | | | |
| 17 | NC | | | 25 | NC | | |
| 18 | COM RLY1 | | | 26 | COM RLY3 | | |
| 19 | NO | | | 27 | NO | | |
| 20 | NC | | | 28 | NC | | |
| 21 | COM RLY2 | | | 29 | COM RLY4 | | |
| 22 | NO | | | 30 | NO | | |
| 23 | AC LINE | | | DC + | POWER IN* | | |
| 24 | AC LINE | | | DC - | | | |

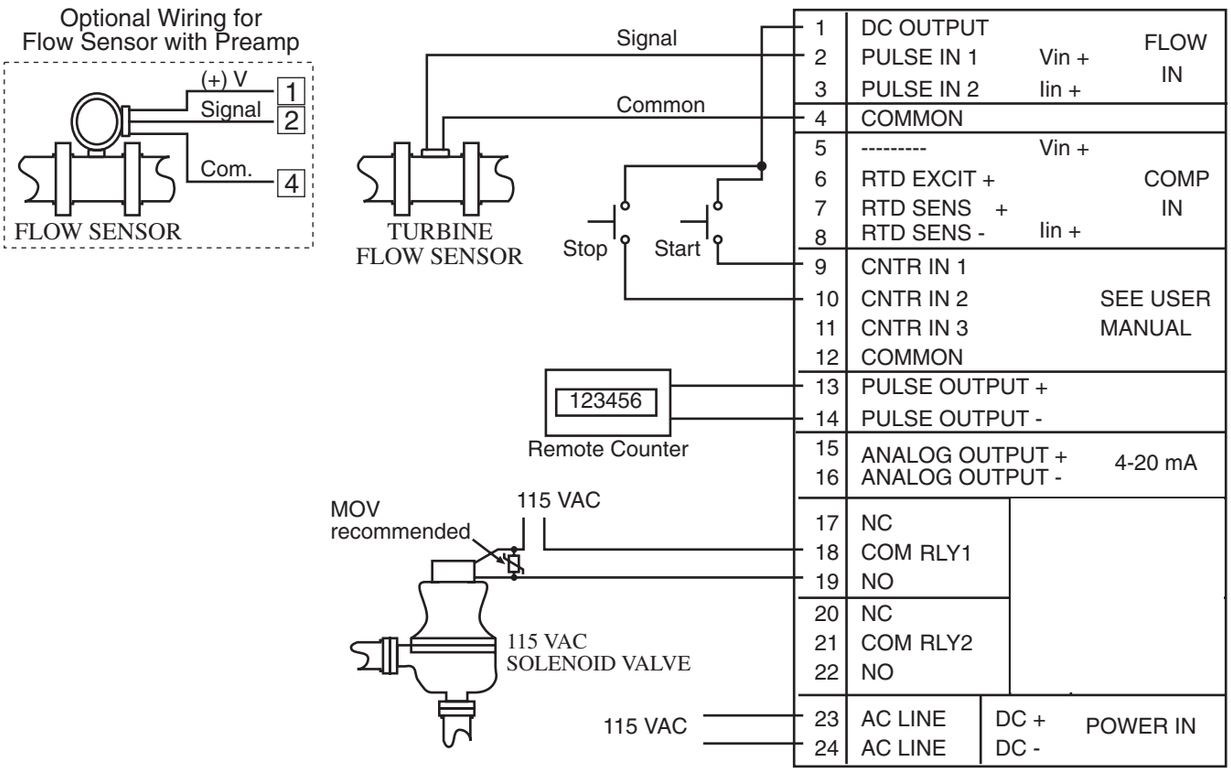
**TB-2**

| COMMUNICATION | | |
|---|---|---|
| | RS-232 | RS-485 |
| 1 | TX | |
| 2 | RX | |
| 3 | COM | |
| 4 | | TX/RC + |
| 5 | | TX/RC – |
| 6 | | GND 180REF |

* Power Terminals 23 & 24 used for DC Input only when ordered with DC INPUT option

**Batcher Wiring**

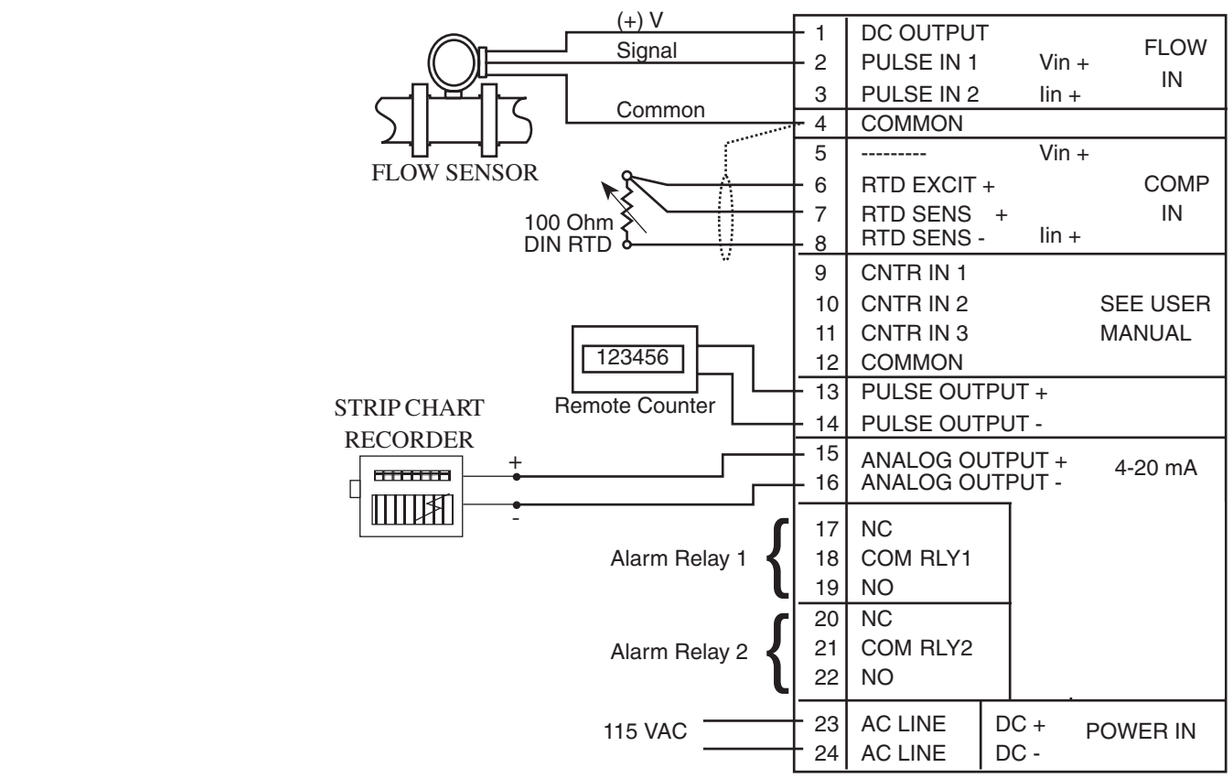
## 4.3 Typical Batcher Wiring:




NOTE:
Power Terminals 23 & 24 used for DC Input only when ordered with DC INPUT option

**Rate / Total Wiring**

## 4.4 Typical Rate/Total Wiring:




NOTE:
Power Terminals 23 & 24 used for DC Input only when ordered with DC INPUT option

# 5. UNIT OPERATION

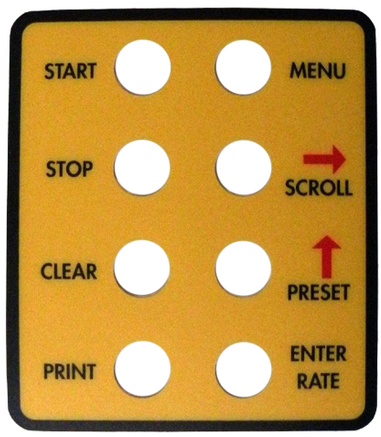
General Operation

## 5.1 General Operation

The unit can display: Rate, Total, Grand Total, Temperature, Density, Presets and Time of Day on scrolling display. The Temperature and/or Density can be displayed even if you are using the Volumetric Flow Equation (a Temperature or Density sensor must be installed). The unit can perform Mass or Corrected Volume equations using a temperature or density sensor (these equations can be computed without Temp/Dens sensors by using user defined default values). The unit can be programmed to perform Ratemeter/Totalizer or Batching functions.

## 5.2 Front Panel Operation Concept for Rate/Total Mode

A two line display and eight labeled push buttons are used as an interface between the operator and the STX-ST1. Some buttons have a single function while others have more than one function depending on whether the user is entering data or processing a batch or requesting a setup change.




**START**
Not used in Rate/Total Mode

**STOP**
Not used in Rate/Total Mode

**CLEAR**
Used to clear or reset a total to 0
Also used to clear a number to 0 during a numeric entry sequence

**MENU**
Used to request a setup change or to return to a previous setup menu.

**➔ / SCROLL**
Used to move the current cursor location during a numeric entry sequence / Display Scrolling List

**PRESET / ➔**
Used to request a new alarm setpoint
Also used to increment the digit value at the current cursor location during a numeric entry sequence

**ENTER / RATE**
Used to enter the value currently displayed / View Flow Rate.

**PRINT**
Used to initiate a request to datalog and print a transaction.

**HOW TO CLEAR THE TOTAL IN RATE / TOTAL MODE**
Press the ➔ key three times quickly. A message will appear "—ENTER PASSWORD—". Use ➔ and ➔ to create a valid password, then press "ENTER" A message will appear "Clear Total?". Press ➔ to cause “YES” to flash, then press "ENTER". Total will then clear to a zero value.

**HOW TO ENTER ALARM SETPOINT**
Press the PRESET key three times quickly. A message will appear "Editing PRE1". Press the CLEAR key to remove the previous value. Next use the ➔ arrow key to increment the first digit of the preset. Use ➔ arrow key to move to the next digit of the preset, then use ➔ to change the value in that digit. Repeat the process for each digit until the desired preset is viewed. Press ENTER to save that value. If Supervisor password is entered the Grand Total Reset sequence will also be offered.

**HOW TO PRINT A TRANSACTION DOCUMENT:**
The setup menus can be configured to automatically log and/or print by several automatic means.
Alternately a manually initiated print can be requested by pressing the PRINT button.

## 5.2 Front Panel Operation Concept for Rate/Total Mode (continued)

**HOW TO CONFIGURE YOUR TWO LINE DISPLAY**
The two line display may be configured to show various items of information. Refer to the DISP mode for details on configuring your two line display.

**HOW TO CONFIGURE A PRINTOUT**
Refer to the setup mode for details on configuring your printout

**VIEWING ALARM MESSAGES**
Alarm messages will appear as alternating messages when a sensor malfunction is detected.
Most alarm messages are self clearing one the indicated root-cause has been rectified. Refer to the TEST mode for other messages.

**HOW TO ACCESS SETUP, TEST, AND DISPLAY CONFIGURATION MODES**
Press MENU to begin accessing the various setup/test modes. You will be prompted for a proper password before any mode can be accessed. Use the CLEAR, “^”, “>” and ENTER keys to enter your password. If no password is entered or if an improper password is entered the unit will return to the run mode after either 1 minute or immediately.

**Rate/Total Operation**

## 5.3 Ratemeter/Totalizer Operation

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

**Password Protection** (Rate/Total mode)

### 5.3.1 Password Protection for Rate/Total mode

After a non-zero Operator and/or Supervisor Password is entered in the setup mode (see section 6.3, SETUP PASSWORD submenu), the unit will be locked. The unit will prompt the user for the password when trying to perform the following functions:

Clear Total
Enter Menu

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

**Relay Operation** (Rate/Total mode)

### 5.3.2 Relay Operation in Rate/Total mode

Up to four relays are available (two standard) for alarm outputs. The relays can be assigned to trip according to rate, total, temperature, density readings or general system alarms. The relays can be programmed for low or high alarms. Preset 1 (RLY1) is easily accessible by pressing the PRESET key on the front panel. Preset 2, Preset 3 and Preset 4 are accessible only through the setup menu.

**Pulse Output** (Rate/Total mode)

### 5.3.3 Pulse Output in Rate/Total mode

The isolated pulse output (open collector) is menu assignable to Volume Total, 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** (Rate/Total mode)

### 5.3.4 Analog Output in Rate/Total mode

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

**RS-232 Serial Port**
(Rate/Total mode)

### 5.3.5 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, 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 6.3.20 SET DATA OUTPUT, Select_list). The transaction document can be initiated by pressing the PRINT key or by a remote contact closure.

Data Logging
In 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).

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**
(Rate/Total mode)

### 5.3.6 RS-485 Serial Port (optional)

**RS-485 Port Description:**

The optional RS-485 card utilizes Modbus RTU protocol to access a variety of process parameters and totalizers. The Relays can be controlled 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**

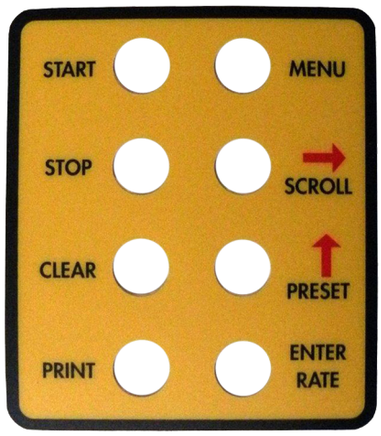
The STX-ST1's RS-485 channel supports a number of Modbus RTU commands. Modbus RTU drivers are available from third party sources for a variety of Man Machine Interface software for IBM compatible PC's.

The user reads and writes information from/to the RS-485 using the Modbus RTU commands. The STX-ST1 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.

## 5.4 Front Panel Operation Concept for Batcher Mode

A two line display and eight labeled push buttons are used as an interface between the operator and the STX-ST1. Some buttons have a single function while others have more than one function depending on whether the user is entering data or processing a batch or requesting a setup change.




**START**
Used to start a batch.

**STOP**
Used to pause or stop a batch.

**CLEAR**
Used to return a batch to an idle or ready condition.
Also used to clear a number to 0 during a numeric entry sequence.

**MENU**
Used to request a setup change or to return to a previous setup menu.

**➔ / SCROLL**
Used to move the current cursor location during a numeric entry sequence.

**PRESET / ↑**
Used to request a new preset batch size be entered when the batcher is stopped or idle.
Also used to increment the digit value at the current cursor location during a numeric entry sequence.

**ENTER / RATE**
Used to enter the value currently displayed / View Flow Rate.

**PRINT**
Used to initiate a request to datalog and print a transaction.

**HOW TO ENTER A BATCH QUANTITY IN THE STANDARD PRESET MODE**
Press the PRESET key three times quickly. A message will appear “Editing PRE1”. Press the CLEAR key to remove the previous value. Next use the “^” arrow key to increment the first digit of the preset. Use “>” arrow key to move to the next digit of the preset, then use “^” to change the value in that digit. Repeat the process for each digit until the desired preset is viewed. Press ENTER to save that value.

**HOW TO START A BATCH**
Press the START key to start a batch.

**HOW TO PAUSE A BATCH**
Press the STOP key to pause a batch.

**HOW TO RESUME A BATCH**
Pressing START after a pause will cause the batch to resume.

**HOW TO PREMATURELY END AND ABORT A BATCH**
Press STOP to pause a batch, then press CLEAR to abort the batch.

**HOW TO PRINT A TRANSACTION DOCUMENT**
The setup menus can be configured to automatically log and print each transaction when it is completed or aborted. Alternately a manually initiated print can be requested by pressing the PRINT button

**INFORMATIONAL SEQUENCE MESSAGES**
A series of messages will be displayed for a short time as the batch cycle is in progress. The display will then resume showing the PRESET requested and the current TOTAL for the batch. Informative messages will include:

- Batch Fill
- Slow Start of Fill
- Fast Fill
- Slow End of Fill
- Batch Done
- Printing

**ADDITIONAL MESSAGES INCLUDE**

- Batch Stop (after a batch Pause)
- Batch Idle (stopped and ready for next batch)

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**HOW TO CONFIGURE YOUR TWO LINE DISPLAY**
The two line display may be configured to show various items of information. Refer to the DISP mode for details on configuring your two line display.

**HOW TO CONFIGURE A PRINTOUT**
Refer to the setup mode for details on configuring your printout

**HOW TO USE OTHER BATCHING FEATURES**
Refer to the setup mode for details on available batching features and their use.

**VIEWING ALARM MESSAGES**
Alarm messages will appear as alternating messages when a sensor malfunction is detected.
Most alarm messages are self clearing one the indicated root-cause has been rectified. Refer to the TEST mode for other messages and for instructions on how to clear the error history.

**HOW TO ACCESS SETUP, TEST, AND DISPLAY CONFIGURATION MODES**
Press MENU to begin accessing the various setup/test modes. You will be prompted for a proper password before any mode can be accessed. Use the CLEAR, “^”, “>” and ENTER keys to enter your password. If no password is entered or if an improper password is entered the unit will return to the run mode after either 1 minute or immediately.

## 5.5 Batcher Operation

The STX-ST1 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.

Refer to Appendix B for additional diagrams for Batching concepts for conventional two stage batching and/or batching with a Digital Control Valve.

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

Batcher Configuration

### 5.5.1 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, Flow Signal Timeout, Maximum Drain Time, Slow Start Quantity, Start or Reset/Start, and Stop or Stop/Reset.

**Standard Preset or EZ Preset**
Use Standard Preset for applications in which the batch amount does not change frequently.
Use EZ Preset in applications in which the batch amounts change frequently. The EZ Preset mode was designed to enter presets with minimum key strokes.

**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 flowrate. 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.

**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.

**Digital Control Valve**
Digital Control Valve Functions slow fill rate, fast fill rate, fill rate hysteresis are supported. Refer to Appendix B for concept diagram.

**Pump Control**
Optional functions for Relay 3 include its use for Pump ON/OFF control in either one stage, two stage or digital control valve applications.

**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 voltage level to Control Input 2, configured for "STOP" will inhibit all Start inputs in either mode.

**Password Protection**
(Batch mode)

### 5.5.2 Password Protection for Batcher Mode

After a non-zero Operator and/or Supervisor Password is entered in the setup mode (see section 6.3, SETUP PASSWORD submenu), the unit will be locked. 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**
(Batch mode)

### 5.5.3 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. (see section 5.4 Batcher Operation for Relay 1 & Relay 2 functions)
Preset 1 (RLY1) is easily accessible by pressing the PRE 1 or PRE 2 key on the front panel. Preset 2, 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, overrun or alarm. When Rate is selected the relays can be programmed for low or high alarms.

**Pulse Output**
(Batch mode)

### 5.5.4 Pulse Output in Batcher mode

The isolated pulse output (open collector) is menu assignable to Volume Total, 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**
(Batch mode)

### 5.5.5 Analog Output in Batcher mode

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

**RS-232 Serial Port**
(Batch mode)

### 5.5.6 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, 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 6.3.20 SET DATA OUTPUT, 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 6.3.20 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).

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**
(Batch mode)

### 5.5.7 RS-485 Serial Port (optional)

**RS-485 Port Description:**

The optional RS-485 card utilizes 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 STX-ST1'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.

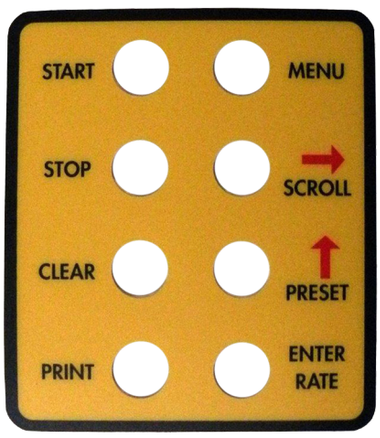
The user reads and writes information from/to the RS-485 using the Modbus RTU commands. The STX-ST1 then responds to these information and command requests.

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.

## 6. PROGRAMMING

### 6.1 Front Panel Operation Concept for Program Mode

The STX-ST1 is fully programmable through the front panel. Please review the following usage summary before attempting to use the instrument. Refer to Appendix A for a menu overview diagram




**Setup Mode:**

**How To Make Mode Changes**

**MODE CHANGES**
Pressing the MENU key will offer selections of RUN, SETUP, TEST, DISP. 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. DISP offers the setup sequence to configure the top and bottom lines of the display in the run mode.

**How To Navigate Through Sub-Menu Groups**

**Submenu GROUP NAVIGATION**
Use the UP arrow key to navigate up through the Sub-Menu groups when in the SETUP or TEST mode. Press the ENTER key to enter a desired setup or test Sub-Menu group.

**How To Select Program Choices**

**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 to move the cursor to the desired choice. The selected choice (will blink). Press the ENTER key to accept the selected choice.**

**How To Enter Numeric Values**

**NUMERIC ENTRY**
The keys labeled "→". "↑", CLEAR and ENTER are used to enter numerical values. A leading 0 will assume that you intend to enter a minus "–" sign. Press the CLEAR key to clear the existing value and to enable editing. Press ENTER to store the value shown.

**How To Enter Text Characters**

**TEXT CHARACTER ENTRY**
Some setup items (i.e. Descriptors, Units Label) require the user to enter text characters or strings. Press CLEAR to enable editing. The UP arrow key is used to scroll through the available character sets for each individual character. Press the ENTER key to accept the character and advance to the next character position.

## 6.2 EZ Setup

The EZ Setup routine is a quick and easy way to configure the unit for the most commonly used instrument functions for basic volume equations.
**IMPORTANT!** This setup assumes that you are measuring Volumetric Flow using a high level, DC Pulsing flow sensor. Entering the EZ Setup mode automatically sets many features. This may cause any previously programmed information to be lost or reset. For a complete configuration, see sections 6.3 and 6.4.

| Menus | Display | Notes |
|---|---|---|
| **6.2.1 TOP LEVEL SETUP MENU** | SELECT OPERATE STATE<br>Run **Setup** Test Disp | Select Setup to enter the instrument setup routine. |
| | **ENTER / RATE** | |
| **6.2.2 EZ Setup Submenu Groups** | SELECT EZ SETUP | Press ENTER to begin EZ Setup routine. |
| | **ENTER / RATE** | |
| | ARE YOU SURE?<br>No **Yes** | Confirm that you want to run EZ Setup. **Caution:** Any previous program settings may be lost or reset. |
| | **ENTER / RATE** | |
| | INSTRUMENT TYPE<br>Rate/Tot Batch | Instrument Function. |
| | **ENTER / RATE** | |
| | RATE TIME BASE<br>Sec Min Hour Day | Select the appropriate rate time base. |
| | **ENTER / RATE** | |
| | RATE DEC PLACES<br>0 | Enter the desired rate decimal location. 0-3 decimal places allowed. |
| | **ENTER / RATE** | |
| | TOTAL VOLUME UNITS<br>gal | Enter the desired totalizer units label. |
| | **ENTER / RATE** | |
| | TOTAL DEC PLACES<br>0 | Enter the desired totalizer decimal location. 0-3 decimal places allowed. |
| | **ENTER / RATE** | |
| | K_FACTOR TYPE<br>Avg LinTbl UVC | Enter the desired K-Factor Type. |
| | **ENTER / RATE** | |
| | AVERAGE KA-FACTOR<br>####### P/gal | If Average selected, Enter the desired Average K-Factor. |
| | LINEAR TABLE KA<br>Fre01:######### Hz | If LinTbl or UVC selected,<br>Enter the desired frequency/ K-Factor pair for each point in the Linearization Table. |
| | **ENTER / RATE** | |
| Through 16 Points | LINEAR TABLE KA<br>KA--01:########## | Enter a frequency of 0 for any point other than Fre01 to exit Linearization Table setup. |
| | **ENTER / RATE** | |
| | FS ANALOG OUT 20mA<br>#######gal/m | Enter the desired full scale setting for the analog output. |
| | **ENTER / RATE** | |
| | RATE 00.0 gal/m<br>TOTAL 0 gal | Return to Run Mode |

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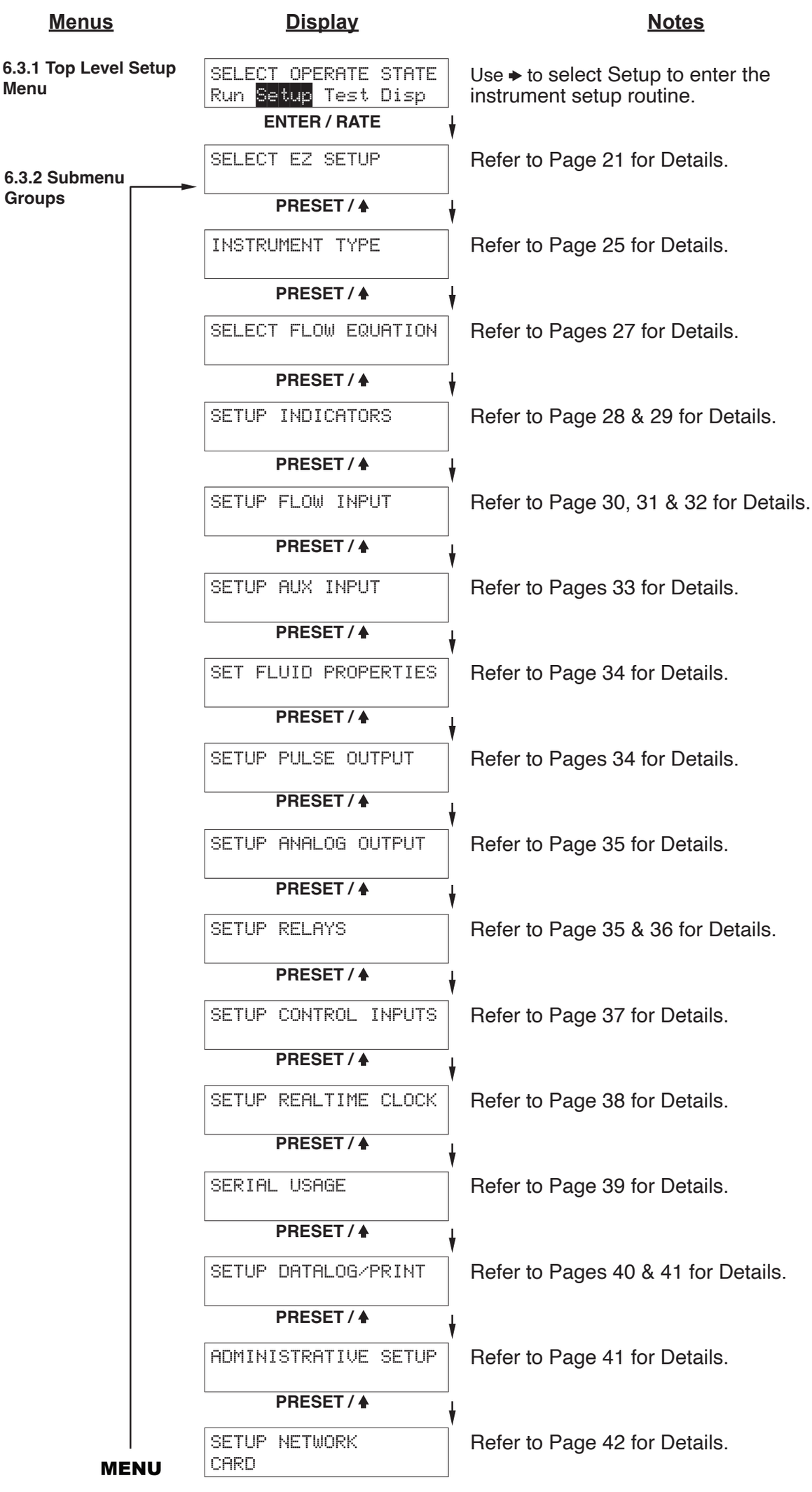
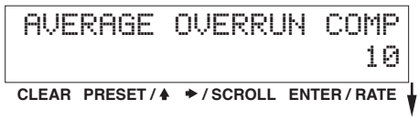
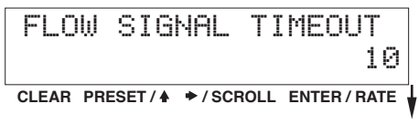
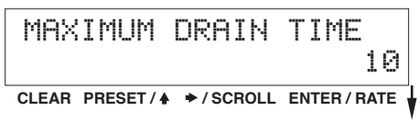
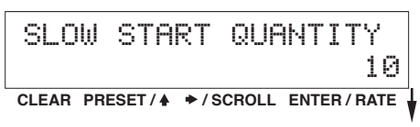
## 6.3 Setup Menus



## 6.4 Setup Sub-Menus

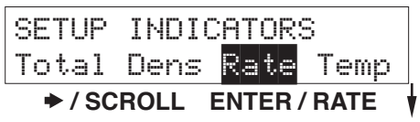
| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.1 SELECT EZ SETUP** | SELECT EZ SETUP | Refer to Section 6.2 for EZ Setup routine. |
| | **PRESET / ▲** | Press the UP (preset) button to advance to Instrument Type submenu group. |
| | Advance To INSTRUMENT TYPE | |
| **6.4.2 INSTRUMENT TYPE** | INSTRUMENT TYPE | Press ENTER to enter Instrument Type sub-menus. |
| | **ENTER / RATE** | Press ENTER when Rate/Total is flashing to configure the instrument as a Ratemeter/Totalizer. |
| **Rate/Tot** | INSTRUMENT TYPE<br>Rate/Tot Batch | If Rate/Tot selected, advance to Select Flow Equation. |
| | **ENTER / RATE** | |
| | Advance To SELECT FLOW EQUATION | |
| | INSTRUMENT TYPE | Press ENTER to enter Instrument Type sub-menus. |
| | **ENTER / RATE** | Use ➔ to select choice<br>Press ENTER when Batch is flashing to configure the instrument as a Batcher. |
| **Batch** | INSTRUMENT TYPE<br>Rate/Tot Batch | |
| | **➔ / SCROLL ENTER / RATE** | |
| | SELECT PRESET TYPE<br>Standard EZ Preset | Choose Standard or EZ Preset with ➔ button<br>Press ENTER to select choice. |
| | **➔ / SCROLL ENTER / RATE** | |
| | SELECT VALVE TYPE<br>Standard Digital | Choose Standard or Digital with ➔ button<br>Press ENTER to select choice. |
| | **➔ / SCROLL ENTER / RATE** | |
| | SLOW FILL RATE<br>10 | Enter the Slow Fill Rate. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | **CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE** | |
| | FULL FILL RATE<br>1000 | Enter the Full Fill Rate (Fast Fill Rate). Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | **CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE** | |
| | BATCH COUNT MODE<br>Up Down | Select UP to Reset to 0 and count up to preset. Select DOWN to reset to Preset and count down to 0. The ➔ button moved cursor. Press ENTER to select choice. |
| | **➔ / SCROLL ENTER / RATE** | |
| | MAXIMUM BATCH PRESET<br>1000.0 gal | Enter the maximum allowable Batch Preset. The operator will not be able to enter a batch preset larger than this value. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | **CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE** | |
| | BATCH OVERRUN COMP<br>Off Auto Manual | Select Manual to enter observed overrun. Select Auto to set the unit to operate using a Batch Overrun Compensation routine.<br>Select OFF to inhibit Batch Overrun Compensation routine. (See Section 5.5) |
| | **➔ / SCROLL ENTER / RATE** | |

Continue On Next Page

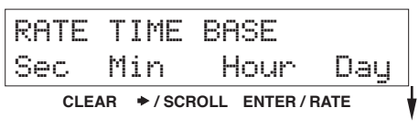
| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.2 INSTRUMENT TYPE (continued)** |  | This is the average amount of over-run that the unit has determined. This value will be used if AUTO selected. If MANUAL selected you can change the value. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| |  | Enter a time out of 0 to 99 seconds. If a batch is "Filling" and zero flow persists for more than this time, the batch will be aborted. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| |  | Enter time (0-99 sec.) 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. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. When using automatic over-shoot compensation the value (in seconds) entered into maximum drain time must be greater than the time required for the valve to close. |
| |  | 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. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | Advance To<br>SELECT FLOW EQUATION | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.3 SELECT FLOW EQUATION** | SELECT FLOW EQUATION<br>**ENTER / RATE** | Press ENTER to enter Select Flow Equation submenus. |
| | SELECT FLOW EQUATION<br>Volume Mass Cor/Vol<br>**ENTER / RATE** | Use ➧ to select choice. Press ENTER when desired flow equation is flashing. |
| | Advance To<br>SETUP INDICATORS<br>(Total) | |
| **6.4.4 SETUP INDICATORS (Total)** | SETUP INDICATORS<br>**ENTER / RATE** | Press ENTER to begin setup of the Indicators |
| | SETUP INDICATORS<br>Total Dens Rate Temp<br>**➧ / SCROLL ENTER / RATE** | Use ➧ to select choice. Press ENTER when Total is flashing to configure the Totalizer Indicators |
| | TOTAL DESCRIPTOR<br>TOTAL<br>**CLEAR PRESET / ▲ ➧ / SCROLL ENTER / RATE** | Enter the desired Total Descriptor using CLEAR, ➧ and ENTER to store. |
| | TOTAL VOLUME UNITS<br>gal<br>**CLEAR PRESET / ▲ ➧ / SCROLL ENTER / RATE** | Enter the desired Volume Units Label for the Totalizer using CLEAR, ➧ and ENTER to store. |
| | TOTAL DEC PLACES<br>0<br>**CLEAR PRESET / ▲ ➧ / SCROLL ENTER / RATE** | Select the desired Total Decimal Place. 0-3 decimal places allowed using CLEAR, ▲ and ENTER to store. |
| | Advance To<br>SETUP INDICATORS<br>(Density) | |
| **6.4.5 SETUP INDICATORS** (Density) | SETUP INDICATORS<br>Total Dens Rate Temp<br>**➧ / SCROLL ENTER / RATE** | Use ➧ to select choice. Press ENTER when Dens is flashing to configure the Density Indicators. |
| | DENSITY DESCRIPTOR<br>DENS<br>**CLEAR PRESET / ▲ ➧ / SCROLL ENTER / RATE** | Enter the desired Density Descriptor using CLEAR, ➧ and ENTER to store. |
| | DENSITY MASS UNITS<br>lbs<br>**CLEAR PRESET / ▲ ➧ / SCROLL ENTER / RATE** | Enter the desired Mass Units Label for Density using CLEAR, ➧ and ENTER to store. |
| | DENSITY DEC PLACES<br>0<br>**CLEAR PRESET / ▲ ENTER / RATE** | Select the desired Density Decimal Place. 0-3 decimal places allowed using CLEAR, ▲ and ENTER to store. |
| | Advance To<br>SETUP INDICATORS<br>(Rate) | |

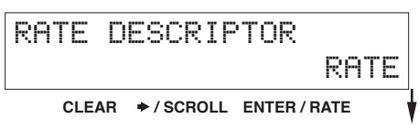
### 6.4.6 SETUP INDICATORS (Rate)




Use → to select choice. Press ENTER when Rate is flashing to configure the Ratemeter Indicators




Select the desired Rate Time Base using CLEAR, → and ENTER to store.




Enter the desired Descriptor for the Ratemeter using CLEAR, → and ENTER to store.

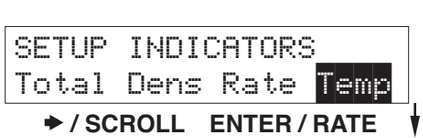

Select the desired Rate Decimal Place using CLEAR, ↑ and ENTER to store.
0-3 decimal places allowed.


Enter desired Rate Averaging Filter. Use CLEAR, → and ↑ to create value. Press ENTER to store.


Enter desired Percent of Change for Quick Update. Use CLEAR, → and ↑ to create value. Press ENTER to store.
If the current flowrate deviates by an amount greater than the percentage value entered, the Rate Averaging is inhibited.
(See Glossary for more details.)

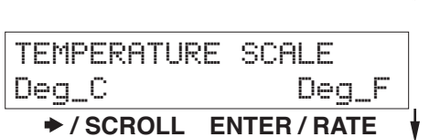
Advance To
SETUP INDICATORS
(Temperature)

### 6.4.7 SETUP INDICATORS (Temperature)

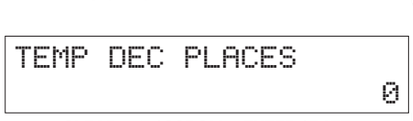



Use → to select choice. Press ENTER when Temp is flashing to configure the Temperature Indicators.


Enter the desired Temperature Descriptor using CLEAR, → and ENTER to store.



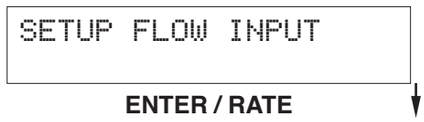

Enter the desired Temperature Scale. Use → to select choice and ENTER to store selection.



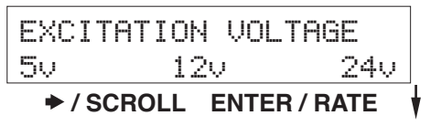

Select the desired Temperature Decimal Place using CLEAR, ↑ and ENTER to store.
0-3 decimal places allowed.

Advance To
SETUP FLOW INPUT

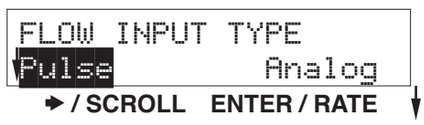
**6.4.8 SETUP FLOW INPUT (Pulse - Ain & PS (A=B))**




Press ENTER to begin setup of Flow Input.

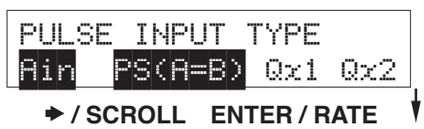



Select the desired Excitation Voltage. Use ➧ to select choice and ENTER to store selection.

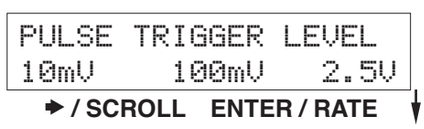



Use ➧ to select choice . Press ENTER when Pulse is flashing to configure the flow input for Pulse signals.

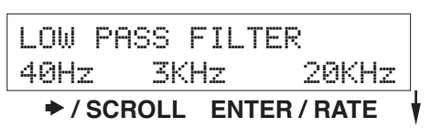
NOTE:
Ain = Single Pulse
PS(A=B) = Pulse Security
Qx1 = Quadrature
Qx2 = Quadrature x 2



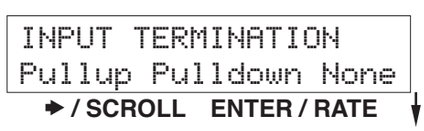

Enter the desired Pulse type. Use ➧ to select choice and ENTER to store selection.
**See side note.**



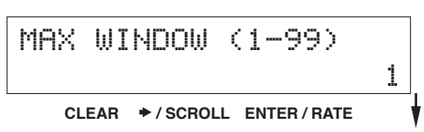

Select the desired Input Pulse Trigger Level. Use ➧ to select choice and ENTER to store selection.



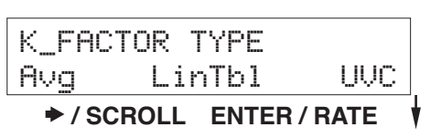

Select the desired Low Pass Filter. (Max. Count Speed). Use ➧ to select choice and ENTER to store selection.



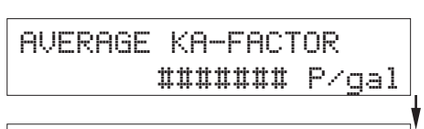

Select the proper input termination. Use ➧ to select choice and ENTER to store selection.



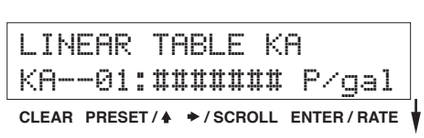

Enter the desired Maximum Sample Window Time (1-99 sec) using CLEAR, ➧ and ENTER to store.




Enter the desired K-Factor Type. Use ➧ to select choice and ENTER to store selection.



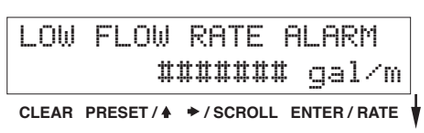

If Avg selected, Enter the desired Average K-Factor. Use CLEAR, ➧ and ▲ to create value. Press ENTER to store.


Through 16 Points

If LinTbl selected,
Enter the desired frequency/ K-Factor pair for each point in the Linearization Table. Use CLEAR, ➧ and ▲ to create value. Press ENTER to store.

**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.



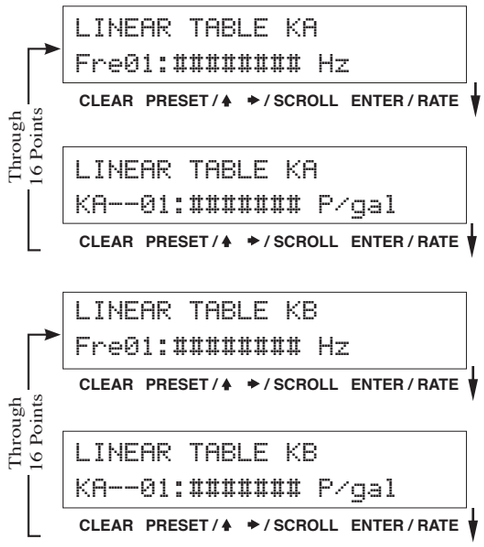

Enter the desired volumetric Low Rate Alarm. Use CLEAR, ➧ and ▲ to create value. Press ENTER to store.
This will trigger an alarm message if alarm conditions occur. The relays are not affected.


Enter the desired volumetric High Rate Alarm. Use CLEAR, ➧ and ▲ to create value. Press ENTER to store.
This will trigger an alarm message if alarm conditions occur. The relays are not affected.

Advance To
SETUP AUX INPUTS

| Submenus | Display | Notes |
|---|---|---|
| **6.4.9 SETUP FLOW INPUT (Pulse - Quadrature, Qx1 or Qx2)** | SETUP FLOW INPUT<br>**ENTER / RATE** | Press ENTER to begin setup of Flow Input. |
| | EXCITATION VOLTAGE<br>5v 12v 24v<br>**➔ / SCROLL ENTER / RATE** | Select the desired Excitation Voltage. Use ➔ to select choice and ENTER to store selection. |
| NOTE:<br>Ain = Single Pulse<br>PS(A=B) = Pulse Security<br>Qx1 = Quadrature<br>Qx2 = Quadrature x 2 | FLOW INPUT TYPE<br>Pulse Analog<br>**➔ / SCROLL ENTER / RATE** | Use ➔ to select choice . Press ENTER when Pulse is flashing to configure the flow input for Pulse signals. |
| | PULSE INPUT TYPE<br>Ain PS(A=B) Qx1 Qx2<br>**➔ / SCROLL ENTER / RATE** | Enter the desired Pulse type. Use ➔ to select choice and ENTER to store selection. **See side note.** |
| | PULSE TRIGGER LEVEL<br>10mV 100mV 2.5V<br>**➔ / SCROLL ENTER / RATE** | Select the desired Input Pulse Trigger Level. Use ➔ to select choice and ENTER to store selection. |
| | LOW PASS FILTER<br>40Hz 3KHz 20KHz<br>**➔ / SCROLL ENTER / RATE** | Select the desired Low Pass Filter. (Max. Count Speed). Use ➔ to select choice and ENTER to store selection |
| | INPUT TERMINATION<br>Pullup Pulldown None<br>**➔ / SCROLL ENTER / RATE** | Select the proper input termination.Use ➔ to select choice and ENTER to store selection |
| | MAX WINDOW (1-99)<br>1<br>**CLEAR ➔ / SCROLL ENTER / RATE** | Enter the desired Maximum Sample Window Time (1-99 sec). using CLEAR, ➔ and ENTER to store |
| | K_FACTOR TYPE<br>Avg LinTbl UUC<br>**➔ / SCROLL ENTER / RATE** | Select the desired K-Factor Type. Use ➔ to select choice and ENTER to store selection |
| | AVERAGE KA-FACTOR<br>####### P/gal<br>**CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE** | If Avg selected, Enter the desired Average K-Factor (KA for channel A). Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | AVERAGE KB-FACTOR<br>####### P/gal<br>**CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE** | Enter the desired Average K-Factor (KB for channel B). Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |

Continue on next page

| Submenus | Display | Notes |
|---|---|---|
| **6.4.9 SETUP FLOW INPUT** (Pulse - Quadrature, Qx1 or Qx2) **Continued** |  | If LinTbl selected,<br>Enter the desired frequency/ K-Factor pair for each point in the Linearization Table. (channel A)<br>**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.<br>Enter the desired frequency/ K-Factor pair for each point in the Linearization Table. (channel B)<br>**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.<br>Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | LOW FLOW RATE ALARM<br>######## gal/m<br>CLEAR PRESET/▲ ➔/SCROLL ENTER/RATE | Enter the desired volumetric Low Rate Alarm. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store.<br>This will trigger an alarm message if alarm conditions occur. The relays are not affected. |
| | HIGH FLOW RATE ALARM<br>######## gal/m<br>CLEAR PRESET/▲ ➔/SCROLL ENTER/RATE | Enter the desired volumetric High Rate Alarm. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store.<br>This will trigger an alarm message if alarm conditions occur. The relays are not affected. |
| | Advance To<br>SETUP AUX INPUTS | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.10 SETUP FLOW INPUT (Analog)** | `SETUP FLOW INPUTS`<br>**ENTER / RATE** ↓ | Press ENTER to begin setup of the Flow Input. |
| | `EXCITATION VOLTAGE`<br>`5v  12v  24v`<br>**→ / SCROLL  ENTER / RATE** ↓ | Select the desired Excitation Voltage. Use → to select choice and ENTER to store selection. |
| | `FLOW INPUT TYPE`<br>`Pulse  Analog`<br>**→ / SCROLL  ENTER / RATE** ↓ | Press ENTER when Analog is flashing to configure the flow input for Analog signals. Use → to select choice. |
| | `ANALOG SIGNAL TYPE`<br>`Voltage  Current`<br>**→ / SCROLL  ENTER / RATE** ↓ | Choose Analog Signal Type. Use → to select choice and ENTER to store selection. |
| | `ANALOG VOLTAGE RANGE`<br>`0-10V  0-5V  1-5V` | If Voltage selected, Choose desired Voltage Range. Use → to select choice and ENTER to store selection. |
| | `ANALOG CURRENT RANGE`<br>`4-20mA  0-20mA`<br>**→ / SCROLL  ENTER / RATE** ↓ | If Current selected,Choose desired Current Range. Use → to select choice and ENTER to store selection. |
| | `LINEARIZATION TYPE`<br>`Linear  Sqrt  LinTbl`<br>**→ / SCROLL  ENTER / RATE** ↓ | Select the desired Linearization Type. Use → to select choice and ENTER to store selection. |
| Through 16 Points | `LINEAR TABLE KA`<br>`APR01:######## gal/m`<br>**CLEAR  PRESET / ▲  → / SCROLL  ENTER / RATE** ↓ | If LinTbl selected,<br>Enter the desired Apparent Input Flow (APR) / Correction Factor (CFr) pair for each point in the Linearization Table.<br>**NOTE:** Enter 0 for APR value of any point (other than APR01) to exit the routine and use the values entered up to that point.<br>Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | `LINEAR TABLE KA`<br>`CFr01:########`<br>**CLEAR  PRESET / ▲  → / SCROLL  ENTER / RATE** ↓ | |
| | `FLOW LOW SCALE`<br>`#######  gal/m`<br>**CLEAR  PRESET / ▲  → / SCROLL  ENTER / RATE** ↓ | Enter the low flowrate corresponding to the low analog signal. Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | `FLOW FULL SCALE`<br>`#######  gal/m`<br>**CLEAR  PRESET / ▲  → / SCROLL  ENTER / RATE** ↓ | Enter the High flowrate corresponding to the High analog signal. Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | `LOW FLOW CUTOFF`<br>`#######  gal/m`<br>**CLEAR  PRESET / ▲  → / SCROLL  ENTER / RATE** ↓ | Enter the desired Low Flow Cutoff. Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | `LOW FLOW RATE ALARM`<br>`#######  gal/m`<br>**CLEAR  PRESET / ▲  → / SCROLL  ENTER / RATE** ↓ | Enter the desired volumetric Low Rate Alarm. Use CLEAR, → and ▲ to create value. Press ENTER to store.<br>This will trigger an alarm message if alarm conditions occur. The relays are not affected. |

Continue on next page

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.10 SETUP FLOW INPUT** (Analog) **Continued** | HIGH FLOW RATE ALARM<br>####### gal/m<br>CLEAR PRESET/▲ ►/SCROLL ENTER/RATE | Enter the desired volumetric High Rate Alarm. Use CLEAR, ► and ▲ to create value. Press ENTER to store.<br>This will trigger an alarm message if alarm conditions occur. The relays are not affected. |
| | Advance To<br>SETUP AUX INPUT | |
| | SETUP AUX INPUT<br>ENTER / RATE | Press ENTER to begin setup of the Auxiliary Input. |
| **6.4.11 SETUP AUX INPUT** | AUX INPUT TYPE<br>None Dens Temp<br>►/SCROLL ENTER/RATE | Select Temperature to set the Auxiliary Input for Temperature inputs. Use ► to select choice and ENTER to store selection. |
| **NOTE:** When Density (Dens) is selected, The menu prompts will be very similar to the Temperature prompts. The menus will prompt the user for density values and density units. | AUX SIGNAL TYPE<br>Voltage Current RTD<br>►/SCROLL ENTER/RATE | Choose Temperature Signal Type. Advance to "Aux Default", if RTD selected. Use ► to select choice and ENTER to store selection. |
| | INPUT SIGNAL RANGE<br>0-10V 0-5V 1-5V | If Voltage selected,Choose desired Voltage Range. Skip if RTD. Use ► to select choice and ENTER to store selection. |
| | INPUT SIGNAL RANGE<br>4-20mA 0-20mA<br>►/SCROLL ENTER/RATE | If Current selected,Choose desired Current Range. Skip if RTD. Use ► to select choice and ENTER to store selection. |
| | AUX LOW SCALE<br>###### F<br>CLEAR PRESET/▲ ►/SCROLL ENTER/RATE | Enter the low temperature scale corresponding to the low temperature signal. Skip if RTD.Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | AUX FULL SCALE<br>###### F<br>CLEAR PRESET/▲ ►/SCROLL ENTER/RATE | Enter the high temperature scale corresponding to the high temperature signal. Skip if RTD.Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | AUX DEFAULT<br>###### F<br>CLEAR PRESET/▲ ►/SCROLL ENTER/RATE | Enter the Default Temperature. Use CLEAR, ► and ▲ to create value. Press ENTER to store. The unit will use this value if the temperature input fails. |
| | AUX LOW ALARM<br>###### F<br>CLEAR PRESET/▲ ►/SCROLL ENTER/RATE | Enter the Low setpoint for the Temperature Alarm. Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | AUX HIGH ALARM<br>###### F<br>CLEAR PRESET/▲ ►/SCROLL ENTER/RATE | Enter the High setpoint for the Temperature Alarm.Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | DENS EXTRACT METHOD<br>Therm_Coef API_2540<br>►/SCROLL ENTER/RATE | Choose the Density Extraction method to be used. Use ► to select choice and ENTER to store selection. |
| | Advance To<br>SET FLUID PROPERTIES | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.12 SET FLUID PROPERTIES** | SET FLUID PROPERTIES<br>ENTER / RATE | Press ENTER at this prompt to Set Fluid Properties. |
| | REF. DENSITY<br>###### lbs/g<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the Reference Density. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. 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. |
| | REF. TEMPERATURE<br>###### F<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the Reference Temperature. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | EXPAN. FACTOR [xe-6]<br>########<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the proper Expansion Factor. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. (If Temp Compensated for Mass or Corrected Volume) See Section 7.4, Calculating the Expansion Factor. |
| | CALIBRATION DENSITY<br>########<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the Calibration Density. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. This is used in calculation of flow for analog inputs using SQRT. |
| | VISCOSITY COEF. A<br>0.000<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the Viscosity A Coefficient. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. See section 7.5, Computation of Viscosity Coef. A and B. |
| | VISCOSITY COEF. B<br>0.000<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the Viscosity B Coefficient. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. See section 7.5, Computation of Viscosity Coef. A and B. |
| | BASE DENSITY H2O@4C<br>###### lbs/g<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the Base Density H2O@4C. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. This is used in the centistoke calculation for UVC. |
| | Advance To<br>SETUP PULSE OUTPUT | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.13 SETUP PULSE OUTPUT** | SETUP PULSE OUTPUT<br>**ENTER / RATE** | Press ENTER at this prompt to setup the Pulse Output. |
| | PULSE OUTPUT USAGE<br>Off Vol CVol/Mass<br>**→ / SCROLL ENTER / RATE** | Select the desired Pulse Output Usage. Use → to select choice and ENTER to store selection. |
| | PULSE WIDTH<br>10mS 100mS<br>**→ / SCROLL ENTER / RATE** | Select the desired Pulse Width for the Pulse Output. Use → to select choice and ENTER to store selection. |
| | PULSE VALUE<br>####### gal/P<br>**CLEAR PRESET / ↑ → / SCROLL ENTER / RATE** | Enter the desired Pulse Value for the Pulse Output (Units per Pulse). Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | Advance To<br>SETUP ANALOG OUTPUT | |
| **6.4.14 SETUP ANALOG OUTPUT** | SETUP ANALOG OUTPUT<br>**ENTER / RATE** | Press ENTER when Analog is flashing to setup the Analog Output. |
| | ANALOG OUTPUT USAGE<br>Rate Total Temp Dens<br>**→ / SCROLL ENTER / RATE** | Select the desired Analog Output Usage. Use → to select choice and ENTER to store selection. |
| | ANALOG OUT FLOW TYPE<br>Vol CVol/Mass<br>**→ / SCROLL ENTER / RATE** | Only if Rate selected & Flow EQ. = Mass, Cor/Vol Select the desired Analog Output Flow. Use → to select choice and ENTER to store selection. |
| | ANALOG OUTPUT RANGE<br>4-20mA 0-20mA<br>**→ / SCROLL ENTER / RATE** | Select the desired current range for the Analog Output. Use → to select choice and ENTER to store selection. |
| | LS ANALOG OUTPUT<br>####### gal/m<br>**CLEAR PRESET / ↑ → / SCROLL ENTER / RATE** | Enter desired Analog Output Low Scale Value. Use CLEAR, → and ↑ to create value. Press ENTER to store.<br>**NOTE:** Units label will correspond with output usage type selected. |
| | FS ANALOG OUT 20mA<br>####### gal/m<br>**CLEAR PRESET / ↑ → / SCROLL ENTER / RATE** | Enter desired Analog Output Full Scale Value. Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | ANALOG OUT DAMPING<br>0.0<br>**CLEAR PRESET / ↑ → / SCROLL ENTER / RATE** | Enter the desired Analog Output Damping Constant. Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | Advance To<br>SETUP RELAYS | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.15 SETUP RELAYS (Relay 1 & Relay 2)** | SETUP RELAYS<br>Rly1 Rly2 Rly3 Rly4<br>→ / SCROLL ENTER / RATE | Select the desired Relay for setup. Use → to select choice and ENTER to store selection. (Relays 3 & 4 Optional) |
| **NOTE:**<br>In Batch mode, Relay 1 is reserved for Preset, Relay 2 is reserved for Prewarn.<br><br>When using Digital Control Valves Relay -2 is required to be assigned to Prewarn. The numerical value of the prewarn corresponds to the slow end of flow. This value must be greater than maximum amount of valve over-shoot possible when the valve is closing. | RELAY 1 USAGE<br>RATE TOTAL NA<br>→ / SCROLL ENTER / RATE | If Relay 1 or Relay 2 Selected, Select Rate, Total or NA. Use → to select choice and ENTER to store selection. |
| | RELAY 1 DELAY sec<br>0<br>CLEAR PRESET / ↑ → / SCROLL ENTER / RATE | If Rate selected, enter desired relay activation delay value. Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | RELAY 1 MODE<br>LO_ALARM HI_ALARM<br>→ / SCROLL ENTER / RATE | Select the desired Relay Activation. Use → to select choice and ENTER to store selection.<br>Low: Relay activates when reading is below setpoint.<br>High: Relay activates when reading is above setpoint. |
| | RELAY 1 DURATION<br>#####<br>CLEAR PRESET / ↑ → / SCROLL ENTER / RATE | If Total Selected, Enter desired Relay Duration. Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | RELAY 1 SETPOINT<br>####### gal<br>CLEAR PRESET / ↑ → / SCROLL ENTER / RATE | Enter the desired Setpoint. The Setpoint can be edited in run mode using the PRE 1 key (PRE 2 key for Relay 2). Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | RELAY 1 HYSTERESIS<br>##### gal/m<br>CLEAR PRESET / ↑ → / SCROLL ENTER / RATE | If Rate, selected, Enter desired Relay Hysteresis. Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | Advance To<br>SETUP RELAYS 3, 4 | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.15** (Continued) **SETUP RELAYS (Relay 3 & Relay 4)** | SETUP RELAYS<br>Rly1 Rly2 Rly3 Rly4<br>→ / SCROLL ENTER / RATE | Select the desired Relay for setup. Use → to select choice and ENTER to store selection. (Relays 3 & 4 Optional) |
| **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<br>Rate Tot Aux Ovr PMP<br>RELAY 4 USAGE<br>Rate Tot Aux Alrm NA<br>→ / SCROLL ENTER / RATE | If Relay 3 Selected,Choose Rate, Total, Aux, Overun or Pump (on/off). Use → to select choice and ENTER to store selection.<br>If Relay 4 Selected,Choose Rate, Total, Aux, Alrm or NA. Use → to select choice and ENTER to store selection. |
| | RELAY 3 DELAY sec<br>0<br>CLEAR PRESET / ▲ → / SCROLL ENTER / RATE | If Rate / Aux selected, enter desired relay activation delay value. Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | RELAY 3 MODE<br>LO_ALARM HI_ALARM<br>→ / SCROLL ENTER / RATE | Select the desired Relay Activation for Rate/Aux. Use → to select choice and ENTER to store selection.<br>Low: Relay activates when reading is below setpoint.<br>High: Relay activates when reading is above setpoint. |
| | RELAY 3 DURATION<br>#####<br>CLEAR PRESET / ▲ → / SCROLL ENTER / RATE | If Total Selected, Enter desired Relay Duration. Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | RELAY 3 SETPOINT<br>####### gal<br>CLEAR PRESET / ▲ → / SCROLL ENTER / RATE | Enter the desired Setpoint. Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | RELAY 3 HYSTERESIS<br>##### gal/m<br>CLEAR PRESET / ▲ → / SCROLL ENTER / RATE | If Rate, selected, Enter desired Relay Hysteresis.Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | Advance To<br>SETUP CONTROL INPUTS | |

## RELAY NOTES & CONSIDERATIONS

1. 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.

2. When INSTRUMENT TYPE is set to batcher, Relay 1 is reserved for PRESET and Relay 2 is reserved for PREWARN.

3. Setting the relays to NA (Not Assigned), will allow the relay activation to be controlled via the RS-232 Serial and/or RS-485 Modbus ports.

4. Relay 3 and Relay 4 settings may be used to trigger display alarm conditions even if the relays are not supplied.

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.16 SETUP CONTROL INPUTS (RATE/ TOTAL)** | SETUP CONTROL INPUTS<br>**ENTER / RATE** | Press Enter to begin setup of the Control Inputs. |
| | SETUP CONTROL INPUTS<br>Input1 Input2 Input3<br>**→ / SCROLL ENTER / RATE** | Select the desired Control Input for setup. Use → to select choice and ENTER to store selection. |
| | CONTROL INPUT1 USAGE<br>INHIBIT_TOTAL NA | If Control Input 1 Selected, Select Inhibit Total or NA (Not Assigned). Use → to select choice and ENTER to store selection. |
| | CONTROL INPUT2 USAGE<br>RESET_TOTAL NA | If Control Input 2 Selected,Select Reset Total or NA (Not Assigned). Use → to select choice and ENTER to store selection. |
| | CONTROL INPUT3 USAGE<br>Prn Ack KeyLk NA<br>**→ / SCROLL ENTER / RATE** | If Control Input 3 Selected, Select Prn (Print), Ack (acknowledge), KeyLk (Keylock) or NA (Not Assigned). Use → to select choice and ENTER to store selection.<br>ACK will acknowledge and clear alarms and warning messages.<br>**Note:** Alarms may reassert themselves if alarm conditions are still present. |
| | Advance To<br>SETUP REALTIME CLOCK | |
| **6.4.17 SETUP CONTROL INPUTS (BATCH)** | SETUP CONTROL INPUTS<br>Input1 Input2 Input3<br>**→ / SCROLL ENTER / RATE** | Select the desired Control Input for setup. Use → to select choice and ENTER to store selection. |
| | CONTROL INPUT1 USAGE<br>Start Rst/Start NA | If Control Input 1 Selected,Select Start ,Reset/ Start, NA (Not Assigned). Use → to select choice and ENTER to store selection. |
| | CONTROL INPUT2 USAGE<br>Stop Stop/Rst NA | If Control Input 2 Selected, Select Stop, Stop/ Reset, NA (Not Assigned). Use → to select choice and ENTER to store selection. |
| | CONTROL INPUT3 USAGE<br>Rst Prn KeyLk Ack NA<br>**→ / SCROLL ENTER / RATE** | If Control Input 3 Selected,Select Prn (Print), Ack (acknowledge), KeyLk (Keylock) or NA (Not Assigned). Use → to select choice and ENTER to store selection. ACK will acknowledge and clear alarms and warning messages.<br>**Note:** Alarms may reassert themselves if alarm conditions are still present. |
| | Advance To<br>SETUP REALTIME CLOCK | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.18 SETUP REALTIME CLOCK (Time)** | SETUP REALTIME CLOCK<br>**ENTER / RATE** | Press Enter to begin setup of the Realtime Clock. |
| | SETUP REALTIME CLOCK<br>Time Date<br>**→ / SCROLL ENTER / RATE** | Select Time to set the time. Use → to select choice and ENTER to store selection. |
| | CLOCK TYPE<br>24HR 12HR<br>**→ / SCROLL ENTER / RATE** | Select 24Hr or 12Hr clock. Use → to select choice and ENTER to store selection. |
| | SELECT CLOCK AM/PM<br>AM PM<br>**→ / SCROLL ENTER / RATE** | If 12Hr Clock, Enter AM or PM. Use → to select choice and ENTER to store selection. |
| | TIME OF DAY HH:MM:SS<br>##:##:##<br>**CLEAR PRESET / ▲ → / SCROLL ENTER / RATE** | Enter time of day. Use CLEAR, → and ▲ to create value. Press ENTER to store selection. |
| | Advance To<br>SETUP REALTIME CLOCK<br>(Date) | |
| **6.4.19 SETUP REALTIME CLOCK (Date)** | SETUP REALTIME CLOCK<br>Time Date<br>**→ / SCROLL ENTER / RATE** | Select Date to enter the date. Use → to select choice and ENTER to store selection. |
| | DATE: MONTH,DAY,YEAR<br>##/##/#### | Enter the date. (Month, Day, Last two digits of Year). Use CLEAR, → and ▲ to create value. Press ENTER to store. |
| | **CLEAR PRESET / ▲ → / SCROLL ENTER / RATE** | |
| | Advance To<br>SERIAL USAGE | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.20 SERIAL USAGE** | SERIAL USAGE<br>**ENTER / RATE** | Press Enter to begin setup of the Serial Port. |
| | SERIAL HARDWARE<br>RS232 RS485<br>**→ / SCROLL ENTER / RATE** | Select Serial Hardware type for standard port. Use → to select choice and ENTER to store selection. (See SETUP NETWORK CARD for RS485 Modbus option) |
| | DEVICE ID<br>##<br>**CLEAR PRESET / ↑ → / SCROLL ENTER / RATE** | Select the Device ID. Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | BAUD RATE<br>300 600 1200 <more><br>**→ / SCROLL ENTER / RATE** | Select the desired Baud Rate. Use → to select choice and ENTER to store selection. |
| | BAUD RATE<br>2400 4800 9600 19200 | (If <more> selected) |
| | PARITY<br>None Odd Even<br>**→ / SCROLL ENTER / RATE** | Select the desired Parity. Use → to select choice and ENTER to store selection. |
| | HANDSHAKING<br>None Softwre Hardwre<br>**→ / SCROLL ENTER / RATE** | Set the Handshake. Use → to select choice and ENTER to store selection. |
| | DEVICE LINE FEED<br><CR> <CR+LF><br>**→ / SCROLL ENTER / RATE** | Choose end of line termination. Only choose <CR> if your external device automatically assigns a line feed for every <CR> carriage return. Use → to select choice and ENTER to store selection. |
| | MODEM OPTIONS<br>No Yes<br>**→ / SCROLL ENTER / RATE** | Select "Yes" if the serial port will be used to control a modem. Use → to select choice and ENTER to store selection. |
| | MODEM INIT MASTER<br>No Yes<br>**→ / SCROLL ENTER / RATE** | Select "Yes" to have the unit send a configuration conversation to the modem on power up . Use → to select choice and ENTER to store selection. |
| | MODEM AUTO ANSWER<br>No Yes<br>**→ / SCROLL ENTER / RATE** | Select the desired Modem Auto Answer mode. Use → to select choice and ENTER to store selection. |
| **NOTE:**<br>1 = Sunday<br>2 = Monday<br>3 = Tuesday<br>4 = Wednesday<br>5 = Thursday<br>6 = Friday<br>7 = Saturday | CALL OUT DAY OF WEEK<br>1<br>**→ / SCROLL ENTER / RATE** | Enter the day of week to perform Call Out transmission. Use → to select choice and ENTER to store selection. |
| | CALL OUT TIME<br>##:##:##<br>**CLEAR PRESET / ↑ → / SCROLL ENTER / RATE** | Enter the time of day to perform Call Out transmission. Use CLEAR, → and ↑ to create value. Press ENTER to store. |
| | CALL ON ERROR/ALARM<br>No Yes<br>**→ / SCROLL ENTER / RATE** | Select "Yes" to have the unit perform a Call Out transmission upon error/alarm condition. Use → to select choice and ENTER to store selection. |

Continued on Next Page

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.20 SERIAL USAGE (continued)** | CALL OUT PHONE #<br>0<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the Call Out Phone Number to be dialed for "Call Out Time" or "Print On Error/Alarm". Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | NUMBER OF REDIALS<br>0<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the number of redials to be performed on call out time if busy or no answer. (error/alarm tries until connected) Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | HANGUP IF 2MIN INACT<br>No Yes<br>➔ / SCROLL ENTER / RATE | Select "Yes" to perform hangup if there is inactivity for more than 2 minutes. Use ➔ to select choice and ENTER to store selection. |
| | Advance To<br>SETUP DATALOG/PRINT | |
| **6.4.21 SETUP DATALOG/PRINT (Configure)** | SETUP DATALOG/PRINT<br>ENTER / RATE | Press Enter to setup the Datalog/Print information. |
| | SETUP DATALOG/PRINT<br>Config Select_list<br>➔ / SCROLL ENTER / RATE | Select Config to configure the Datalog/Print information. Use ➔ to select choice and ENTER to store selection. |
| | OUTPUT FORMAT<br>Printer Term Dbase<br>➔ / SCROLL ENTER / RATE | Select the type of Output Format. Use ➔ to select choice and ENTER to store selection. |
| | PAGE LENGTH [66 max]<br>66<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the desired Page Length. If Printer selected above. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | TOP MARGIN [60 max]<br>3<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter the desired Top Margin. If Printer selected above. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | DATALOG ONLY<br>No Yes<br>➔ / SCROLL ENTER / RATE | Select Yes to record events to the datalogger only. Events will not be sent to the serial port. Use ➔ to select choice and ENTER to store selection. |
| | PRINT TIME HH:MM:SS<br>00:00:00<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter Print Time, printer will print at this time every day. Enter 00:00:00 to inhibit print time. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | PRINT INTERVAL<br>00:00:00<br>CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE | Enter Print Interval,<br>Enter 00:00:00 to inhibit print interval. Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | Advance To<br>SETUP DATALOG/PRINT<br>(Select_list) | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.21 SETUP DATALOG/ PRINT** (Configure) **Continued** | ENABLE PRINT KEY<br>NO YES<br>**→ / SCROLL ENTER / RATE** | Select YES to enable Print Key. Select NO to disable Print Key. Use → to select choice and ENTER to store selection. |
| | PRINT END OF BATCH<br>NO YES<br>**→ / SCROLL ENTER / RATE** | Batch mode only. Select Yes to print at end of batch. Use → to select choice and ENTER to store selection. |
| | Advance To<br>SETUP DATALOG/PRINT<br>(Select_list) | |
| **6.4.22 SETUP DATALOG/PRINT (Select_list)** | SET DATALOG/PRINT<br>**ENTER / RATE** | Press enter to begin Setup Datalog/Print routine. |
| | SET DATALOG/PRINT<br>Config Select_list<br>**→ / SCROLL ENTER / RATE** | Press enter when Select_list is selected to setup print list. Use → to select choice and ENTER to store selection. |
| **List Items:**<br>TOTAL<br>RATE<br>PRE1<br>TEMP<br>GRAND<br>PRE2<br>DENS<br>TIME | PRINT LIST ITEMS<br>TOTAL YES<br>PRINT LIST ITEMS<br>RATE YES<br>PRINT LIST ITEMS<br>PRE 1 YES<br>**PRESET / ↑ →/ SCROLL ENTER / RATE** | Use ↑ to view list status.<br>Press PRINT to select YES or NO for the items that you wish to add or remove from the list. Items marked with Yes will be added to the list, items marked with No will be removed from the list. Press ↑ to advance to next item. Press ENTER to store Print List. |
| | PRINT LIST ITEMS<br>DataLog size = 215<br>**ENTER / RATE** | The Select Print List Information display shows the current possible Datalog size. |
| | Advance To<br>ADMINISTRATIVE SETUP | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.23 ADMINISTRATIVE SETUP** | ADMINISTRATIVE SETUP<br>**ENTER / RATE** | Press Enter to begin Administrative Setup. |
| | TAG NUMBER<br>FT#####<br>CLEAR PRESET / ▲ ► / SCROLL ENTER / RATE | Enter Tag Number. Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | OPERATOR PASSWORD<br>*****<br>CLEAR PRESET / ▲ ► / SCROLL ENTER / RATE | Enter Operator Password. (Factory Set to 0) Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | SUPERVISOR PASSWORD<br>*****<br>CLEAR PRESET / ▲ ► / SCROLL ENTER / RATE | Enter Supervisor Password. (Factory Set to 2000) Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | SOFTWARE VERSION<br>Vxx.xx<br>**ENTER / RATE** | This display is used to show the software version of the installed software. |
| | PRODUCT ORDER CODE<br>xxxxxxxxxxxx | This display is used to show the product order code (model number). |
| | UNIT SERIAL NUMBER<br>00000<br>**ENTER / RATE** | This display is used to show the unit's serial number. |
| | SENSOR SERIAL NUMBER<br>00000<br>CLEAR PRESET / ▲ ► / SCROLL ENTER / RATE | This display is used to show the sensor's serial number. Use CLEAR, ► and ▲ to create value. Press ENTER to store. |
| | Advance To<br>SETUP NETWORK CARD | |

| Sub-menus | Display | Notes |
|---|---|---|
| **6.4.24 SETUP NETWORK CARD (optional)** | SETUP NETWORK CARD<br>**ENTER / RATE** ↓ | Press Enter to setup Network Card |
| | SELECT NTW PROTOCOL<br>ModbusRTU<br>**ENTER / RATE** ↓ | Select desired Network Protocol. |
| | NETWORK DEVICE ID<br>1<br>**CLEAR PRESET / ▲ ➔ / SCROLL ENTER / RATE** ↓ | Enter the device address on network (00-255). Use CLEAR, ➔ and ▲ to create value. Press ENTER to store. |
| | BAUD RATE<br>2400 4800 9600 19200<br>**➔ / SCROLL ENTER / RATE** ↓ | Select the desired Baud Rate.Use ➔ to select choice and ENTER to store selection. |
| | PARITY<br>None Odd Even<br>**➔ / SCROLL ENTER / RATE** ↓ | Select the desired Parity. Use ➔ to select choice and ENTER to store selection. |
| | Advance To<br>SELECT EZ SETUP? | |
| **6.4.25 SETUP DISPLAY LIST (configuration)** | SELECT OPERATE STATE<br>Run Setup Test Disp<br>**➔ / SCROLL ENTER / RATE** ↓ | Use ➔ to move cursor to DISP then press ENTER to select. |
| | SELECT DISPLAY ITEM<br>Total Line Two<br>**PRESET / ▲ ENTER / RATE** ↓ | Use ▲ to select line assignment. Choose between Removed, Line One, and Line Two. Press ENTER to save that items assignment and move to next item. |
| ↕ | SELECT DISPLAY ITEM<br>Rate Line One<br>**PRESET / ▲ ENTER / RATE** ↓ | Repeat the steps above for all the available items:. TOTAL, RATE, PRE 1, TEMP, GRAND, PRE 2, DENS, TIME.<br>Press ENTER on last item to save selections and return to SELECT OPERATE STATE |
| | Return To<br>SELECT OPERATE STATE | |

# 7. Principle Of Operation

**General Operation**

## 7.1 General:

The STX-ST1 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, density and viscosity. This information is then used to compute the Corrected Volume Flow or Mass Flow.

**Orifice Flowmeter Considerations**

## 7.2 Orifice Flowmeter Considerations:

Head class flowmeters are supplied by the manufacturers with a 4-20 mA output span which is already in flow units. The STX-ST1 permits the user to enter this flowmeter information directly. However, closely associated with this information is the density that was assumed during flowmeter calibration. This information must also be input if the user is to obtain maximum accuracy.

It is assumed that the user has the printout from a standardized orifice sizing program for the particular device he will be using. Such standardized printouts list all the necessary information which the user will then be prompted for.

Several specialized flow equations are listed that are not intended for the standard unit but to be offered to appropriate OEMs or as special order items. These are designated by a "†".

**Note concerning Fluid Information**
The user will be prompted for Fluid Information during the setup of the instrument. The Factory will assist you in preparing application information for your fluid type.

**Flow Equations**

## 7.3 Flow Equations:

**Input Flow Computation:**

*Linear or External SQRT*
Input Flow = [% input span * (flow FS - flow low scale)]+ flow low scale

*Orifice*
Input Flow = [($\sqrt{\%}$ input span) * ( flow FS - flow low scale)] + flow low scale

**Input Flow 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

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## 7.3 Flow Equations: (Continued)

**Flow Equations**

**Input Viscosity Computation:**

$$\text{centistokes} = \frac{\left(A \exp \frac{B}{(\text{Deg F} + 459.67)}\right)}{\text{Absolute Density}}$$

**Where:** centistokes = cP/(kg/l)

**Uncompensated Flow Computation:**

*Pulse Input; Average K-Factor*

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

*Pulse Input; Linear Table*

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

*Pulse Input; UVC*

$$\text{Volume Flow} = \frac{\text{input frequency} * \text{time scale factor}}{\text{K-Factor (Hz/cstk)}}$$

*Analog Input; Linear*

Volume Flow = input flow

Analog Input; Linear Table

Volume Flow = input flow * correction factor (input flow)

*Analog Input; Orifice or External SQRT*

$$\text{Volume Flow} = \text{input flow} * \frac{\sqrt{(\text{calibrated density})}}{\sqrt{(\text{density})}}$$

*Analog Input; Orifice Linear Table or External SQRT Linear Table*

$$\text{Volume Flow} = CF(rn) * \text{input flow} * \frac{\sqrt{(\text{calibrated density})}}{\sqrt{(\text{density})}}$$

**Corrected Volume Flow Computation:**

*Temperature Transmitter*

Standard Volume Flow = volume flow * (1 - Therm.Exp.Coef. *(Tf-Tref))$^2$

*Density Transmitter*

$$\text{Standard Volume Flow} = \text{volume flow} * \frac{\text{density}}{\text{reference density}}$$

**Mass Flow Computation:**

Mass Flow = volume flow * density

## 7.3 Flow Equations: (Continued)

**Flow Equations**

***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 $\rho_b^*$ 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.

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## 7.4 Calculating the Expansion Factor

**Calculating 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, Expansion Factor.
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. i.e. application temperature range -10 to 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.

$$\text{Spec.Grav.} = \text{Density of Fluid} \ / \ \text{Density of Water}$$

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

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

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

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

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## 7.5 Computation of Viscosity Coef. A and B

**Computation of Viscosity Coef. A & B**

The STX-ST1 solves an equation which 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 from THE FACTORY.

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 you 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:** $$cS = \frac{cP \cdot \text{Density of Water at } 4°C}{\text{Density of Liquid}}$$

**Linearization Table General Information**

### 7.6.1 Linearization Table General Information

The Linearization Table is used when the flow input device gives a nonlinear input signal. The unit uses up to 16 different point pairs, as entered by the operator, to form a curve for linearizing the input signal.

Notes:
1) A minimum of three points must be set up.

2) If "0" is entered for the frequency of any point other than point 1, the STX-ST1 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.

3) 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.

4) Frequencies or apparent flows should be entered in ascending order.

**Linearization Table** (Pulse Inputs)

### 7.6.2 Linearization Table for Pulse Inputs

The linearization table for pulse inputs programming is quite simple when values of frequency and flow are known. The STX-ST1 asks for 16 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 flowmeter.

**Linearization Table** (Analog Inputs)

### 7.6.3 Linearization Table for Analog Inputs

The Linearization Table for Analog inputs programming is similar to the Pulse input setup. The STX-ST1 asks for 16 different flow rates (apparent flow) and 16 corresponding Correction Factors. It then uses this data to determine what the Actual flow is for any given apparent input signal. Again, a minimum of three points must be set up.

$$\text{Correction factor} = \frac{\text{Actual Flow}}{\text{Apparent Input Flow}}$$

The same rules that applied for the Digital setup apply for the Analog setup as well.
The STX-ST1 prompts you for the Apparent input signal (APR) and a correction factor CFr) to multiply it by to yield true actual flow.

**Linearization Table Interpolation**

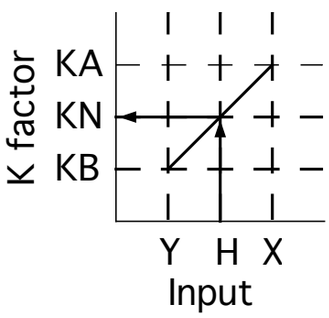
### 7.6.4 Linearization Table Interpolation

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 interpolate 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:

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

## 8.1 Test Menus

| Menus | Display | Notes |
|---|---|---|
| 8.1.1 TOP LEVEL TEST MENUS | SELECT OPERATE STATE<br>Run Setup **Test** Disp | Use ➔ to select Test to enter the instrument test & calibration routine.<br>**NOTE:** Supervisor (Service) password required to gain access to this mode. |
| | **ENTER / RATE** ↓ | |
| | Audit Trail | Refer to Page 52 for Details. |
| | **PRESET / ▲** ↓ | |
| | Error history | Refer to Page 52 for Details. |
| | **PRESET / ▲** ↓ | |
| | Print System Setup | Refer to Page 52 for Details. |
| | **PRESET / ▲** ↓ | |
| | Keypad Test | Refer to Page 53 Details. |
| | **PRESET / ▲** ↓ | |
| | Display test | Refer to Page 53 for Details. |
| | **PRESET / ▲** ↓ | |
| | Calibrate | Refer to Pages 54 - 57 for Details. |
| | **PRESET / ▲** ↓ | |
| | Analog In Test | Refer to Page 58 Details. |
| | **PRESET / ▲** ↓ | |
| | Pulse input test | Refer to Page 59 for Details. |
| | **PRESET / ▲** ↓ | |
| | Analog out test | Refer to Page 59 for Details. |
| | **PRESET / ▲** ↓ | |
| | Excitation out test | Refer to Page 59 for Details. |
| | **PRESET / ▲** ↓ | |
| | Pulse out test | Refer to Page 60 for Details. |
| | **PRESET / ▲** ↓ | |
| | Relay Test | Refer to Page 60 for Details. |
| | **PRESET / ▲** ↓ | |
| | Control inputs test | Refer to Page 60 for Details. |
| | **PRESET / ▲** ↓ | |
| | Battery Voltage Test | Refer to Page 61 for Details. |
| | **PRESET / ▲** ↓ | |
| | Data logger utility | Refer to Page 61 for Details. |
| | **PRESET / ▲** → back to Audit Trail | |

## 8.2 Test Sub-Menus

| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.1 Audit Trail Submenu Group** | `Audit Trail` | Press Enter to view the audit trail information. |
| | **ENTER / RATE** ↓ | |
| | `Audit Trail nnnnn`<br>`hh:mm:ss mm/dd/yy` | The audit trail is viewed in this format: nnnnn= number of critical menu changes, hh:mm:ss; mm/dd/yy = time and date of last change. |
| | **MENU** ↓ | |
| | `Audit Trail` | Press Menu to get back to audit trail top-level menu. |
| | ↓ | |
| **8.2.2 Error History Submenu Group** | `Error history` | Press Enter to view error history.<br>**NOTE:** Press Print Key to print Error History. Printout will include time/date of each errors first occurrence. |
| | **ENTER / RATE** ↓ | |
| | `Error history`<br>`Flow rate alarm low` | Use ▲ to scroll through error message history. Press CLEAR to clear entire error log. |
| | **MENU** ↓ | |
| | `Error history` | Press Menu to get back to error history top=level menu. |
| | ↓ | |
| **8.2.3 Print System Setup Submenu Group** | `Print System Setup` | Press enter key to enter print system setup submenu |
| | **ENTER / RATE** ↓ | |
| | `Print System Setup`<br>`Press ENTER to print` | Press enter to begin printing the system setup. |
| | **ENTER / RATE** ↓ | |
| | `Print System Setup`<br>`-- Printing ---` | This message will display as the data transmission takes place. |
| | **MENU** ↓ | |
| | `Print System Setup` | Press Menu to get back to print system setup top-level menu. |

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| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.4 Keypad test Submenu Group** | Keypad test | Press Enter to enter keypad test |
| | **ENTER / RATE** ↓ | |
| | Keypad test<br>Key pressed-> ENTER | Press the various keys and the display will show the key that was pressed. Press Menu to exit the test |
| | **MENU** ↓ | |
| | Keypad test | Press Menu to get back to Keypad test top-level menu. |
| **8.2.5 Display test Submenu Group** | Display test | Press Enter to enter display test. |
| | **ENTER / RATE** ↓ | |
| | 0000000000000000000000<br>0000000000000000000000 | Upon pressing enter the each digit on the display will scroll 0-9 then A-Z. Press menu to exit the test. |
| | **MENU** ↓ | |
| | Display test | Press Menu to get back to Display test top-level menu. |

**ALL UNITS ARE CALIBRATED AT THE FACTORY PRIOR TO SHIPMENT**
**CAUTION:**
This unit must be calibrated using precision and calibrated equipment.

Equipment needed is as follows: Frequency Generator, Digital Multimeter, Precision Current/Voltage Source, Oscilloscope, Frequency Counter.

| Sub-menus | Display | Notes |
|---|---|---|
| **Calibration Submenu Group** | `Calibrate` | Press Enter to begin the calibration routine. (Please note the caution above) |
| | **ENTER / RATE** ↓ | |
| **8.2.6 Calibrate CH1 0mA Submenu Group** | `Calibrate ch1 0mA`<br>`Iin=TB1-3 GND=TB1-4` | Connect Current Source (+) TB1-3, (-) TB1-4. Input 0mA and press Enter. |
| | **ENTER / RATE** ↓ | |
| | `Calibrate ch1 0mA`<br>`CALIBRATING --` | This message is displayed during calibration. |
| | ↓ | |
| | `Calibrate ch1 0mA`<br>`*** DONE ***` | This message is displayed when the 0mA calibration is finished. |
| | ↓ | |
| | `Calibrate ch1 0mA`<br>`Iin=TB1-3 GND=TB1-4` | The display will automatically return to the Calibrate CH1 0mA submenu. Press the ▲ arrow button to advance to the CH1 20mA calibration. |
| | ↓ | |
| **8.2.7 Calibrate CH1 20mA Submenu Group** | `Calibrate ch1 20mA`<br>`Iin=TB1-3 GND=TB1-4` | Connect Current Source (+) TB1-3, (-) TB1-4. Input 20mA and press Enter. |
| | **PRESET / ▲** ↓ | |
| | `Calibrate ch1 20mA`<br>`0 CALIBRATING --` | This message is displayed during calibration. |
| | ↓ | |
| | `Calibrate ch1 20mA`<br>`*** DONE ***` | This message is displayed when the 20mA calibration is finished. |
| | ↓ | |
| | `Calibrate ch1 20mA`<br>`Iin=TB1-3 GND=TB1-4` | The display will automatically return to the Calibrate CH1 20mA submenu. Press the ▲ arrow button to advance to the CH2 0mA calibration. |
| | **PRESET / ▲** ↓ | |
| | Advance to<br>`Calibrate ch2 0mA` | |

| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.8 Calibrate CH2 0mA Submenu Group** | `Calibrate ch2 0mA`<br>`Iin=TB1-8 GND=TB1-4`<br>**ENTER / RATE** | To Calibrate: Connect Current Source (+) TB1-8, (-) TB1-4. Input 0mA and press Enter. |
| | `Calibrate ch2 0mA`<br>`0 CALIBRATING --` | This message is displayed during calibration. |
| | `Calibrate ch2 0mA`<br>`*** DONE ***` | This message is displayed when the 0mA calibration is finished. |
| | `Calibrate ch2 0mA`<br>`Iin=TB1-8 GND=TB1-4`<br>**PRESET / ▲** | The display will automatically return to the Calibrate CH2 0mA submenu. Press the ▲ arrow button to advance to the CH2 20mA calibration. |
| **8.2.9 Calibrate CH2 20mA Submenu Group** | `Calibrate ch2 20mA`<br>`Iin=TB1-8 GND=TB1-4`<br>**ENTER / RATE** | To Calibrate: Connect Current Source (+) TB1-8, (-) TB1-4. Input 20mA and press Enter. |
| | `Calibrate ch2 20mA`<br>`0 CALIBRATING --` | This message is displayed during calibration. |
| | `Calibrate ch2 20mA`<br>`*** DONE ***` | This message is displayed when the 20mA calibration is finished. |
| | `Calibrate ch2 20mA`<br>`Iin=TB1-8 GND=TB1-4`<br>**PRESET / ▲** | The display will automatically return to the Calibrate CH2 20mA submenu. Press the ▲ arrow button to advance to the CH1 0V calibration. |
| | Advance to<br>`Calibrate ch1 0V` | |

| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.10 Calibrate CH1 0V Submenu Group** | `Calibrate ch1 0V`<br>`Vin=TB1-2 GND=TB1-4`<br>**ENTER / RATE** ↓ | To Calibrate: Connect Voltage Source (+) TB1-2, (-) TB1-4. Input 0V and press Enter. |
| | `Calibrate ch1 0V`<br>`0 CALIBRATING --` ↓ | This message is displayed during calibration. |
| | `Calibrate ch1 0V`<br>`*** DONE ***` ↓ | This message is displayed when the 0V calibration is finished. |
| | `Calibrate ch1 0V`<br>`Iin=TB1-2 GND=TB1-4`<br>**PRESET / ▲** ↓ | The display will automatically return to the Calibrate CH1 0V submenu. Press the ▲ arrow button to advance to the CH1 10V calibration. |
| **8.2.11 Calibrate CH1 10V Submenu Group** | `Calibrate ch1 10V`<br>`Iin=TB1-2 GND=TB1-4`<br>**ENTER / RATE** ↓ | To Calibrate: Connect Voltage Source (+) TB1-2, (-) TB1-4. Input 10V and press Enter. |
| | `Calibrate ch1 10V`<br>`0 CALIBRATING --` ↓ | This message is displayed during calibration. |
| | `Calibrate ch1 10V`<br>`*** DONE ***` ↓ | This message is displayed when the 10V calibration is finished. |
| | `Calibrate ch1 10V`<br>`Iin=TB1-2 GND=TB1-4`<br>**PRESET / ▲** ↓ | The display will automatically return to the Calibrate CH1 10V submenu. Press the ▲ arrow button to advance to the CH2 0V calibration. |
| | Advance to<br>`Calibrate ch2 0V` | |

| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.12 Calibrate CH2 0V Submenu Group** | `Calibrate ch2 0V`<br>`Vin=TB1-5 GND=TB1-4`<br>**ENTER / RATE** | To Calibrate: Connect Voltage Source (+) TB1-5, (-) TB1-4. Input 0V and press Enter. |
| | `Calibrate ch2 0V`<br>`0 CALIBRATING --` | This message is displayed during calibration. |
| | `Calibrate ch2 0V`<br>`*** DONE ***` | This message is displayed when the 0V calibration is finished. |
| | `Calibrate ch2 0V`<br>`Iin=TB1-5 GND=TB1-4`<br>**PRESET / ▲** | The display will automatically return to the Calibrate CH2 0V top-level menu. Press the ▲ arrow button to advance to the CH2 10V calibration. |
| **8.2.13 Calibrate CH2 10V Submenu Group** | `Calibrate ch2 10V`<br>`Iin=TB1-5 GND=TB1-4`<br>**ENTER / RATE** | To Calibrate: Connect Voltage Source (+) TB1-5, (-) TB1-4. Input 10V and press Enter. |
| | `Calibrate ch2 10V`<br>`0 CALIBRATING --` | This message is displayed during calibration. |
| | `Calibrate ch2 10V`<br>`*** DONE ***` | This message is displayed when the 10V calibration is finished. |
| | `Calibrate ch2 10V`<br>`Iin=TB1-5 GND=TB1-4`<br>**PRESET / ▲** | The display will automatically return to the Calibrate CH2 10V top-level menu. Press the ▲ arrow button to advance to the 100 ohm RTD calibration. |
| | Advance to<br>`Calibrate 100ohm RTD` | |
| **8.2.14 Calibrate 100 ohm RTD Submenu Group** | `Calibrate 100ohm RTD`<br>`JMP TB1-6,7 100R=7,8`<br>**ENTER / RATE** | To Calibrate: Connect a jumper wire between TB1-6 and TB1-7, Place a 100 ohm 0.1% resistor between TB1-7 and TB1-8. Press enter to calibrate. |
| | `Calibrate 100ohm RTD`<br>`0 CALIBRATING --` | This message is displayed during calibration. |
| | `Calibrate 100ohm RTD`<br>`*** DONE ***` | This message is displayed when the RTD calibration is finished. |
| | `Calibrate 100ohm RTD`<br>`JMP TB1-6,7 100R=7,8`<br>**PRESET / ▲** | The display will automatically return to the Calibrate 100 ohm RTD top-level menu. Press the ▲ arrow button to advance to the 4mA out calibration. |
| | Advance to<br>`Calibrate 4mA out` | |

| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.15 Calibrate 4mA Out Submenu Group** | `Calibrate  0mA out`<br>`+ TB1-15  - TB1-16`<br>**ENTER / RATE** ↓ | Connect ammeter to (+) TB1-15, (-) TB1-16. Press enter. |
| | `Calibrate  0mA out`<br>`Enter mA: 0.00000`<br>**ENTER / RATE** ↓ | To trim 0mA output: Press CLEAR, → and ↑ to begin editing and enter a small negative number (i.e. -0.100) to force a display reading, then clear and enter small quantity measured on your meter. |
| | `Calibrate  0mA out`<br>`+ TB1-15  - TB1-16`<br>**PRESET / ↑** ↓ | The display will return to Calibrate 0mA out. Press the ↑ arrow button to advance to Cal. 20mA out or repeat above if necessary. |
| **8.2.16 Calibrate 20mA Out Submenu Group** | `Calibrate 20mA out`<br>`+ TB1-15  - TB1-16`<br>**ENTER / RATE** ↓ | Connect ammeter to (+) TB1-15, (-) TB1-16. Press enter. |
| | `Calibrate 20mA out`<br>`Enter mA: 20.00000`<br>**ENTER / RATE** ↓ | To trim 20mA output: Press CLEAR, → and ↑ to begin editing and enter the current reading that is on the ammeter display. Press enter. |
| | `Calibrate 20mA out`<br>`+ TB1-15  - TB1-16`<br>**MENU** ↓ | The display will automatically return to the Calibrate 20mA out submenu. Calibration is complete. |
| | `Calibrate` | Press the Menu key to go back to Calibrate top-level menu. |
| **8.2.17 Analog In Test Submenu Group** | `Analog In Test`<br>**ENTER / RATE** ↓ | Press enter to test the analog inputs. |
| | `Analog In Test Volts`<br>`T2:00.000  T5:00.000`<br>**PRESET / ↑** ↓ | To check voltage input accuracy: Use TB1-4 as Reference Ground, input 0-10 Volts to TB1-2 and/or TB1-5. Display should show voltage being input. Use voltage meter to verify input. |
| | `Analog In Test  mA`<br>`T3:00.000  T8:00.000`<br>**PRESET / ↑** ↓ | To check current input accuracy: Use TB1-4 as Reference Ground, input 0-20mA to TB1-3 and/or TB1-8. Display should show current being input. Use ammeter to verify input. |
| | `Analog In Test  OHMS`<br>`RTD  00.000`<br>**MENU** ↓ | 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 should show 100 ohms ±0.1%. |
| | `Analog In Test` | Press Menu key to return to Analog In Test top-level menu. |

| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.18 Pulse input test Submenu Group** | `Pulse input test` | Press Enter key to test the pulse input. |
| | **ENTER / RATE** | |
| 2.5V<br>10mV<br>100mV | `Pulse input test`<br>`Trigger level 2.5V` | Use the ▲ arrow button to select the appropriate trigger level. Press ENTER. |
| | **ENTER / RATE** | |
| 40Hz<br>3KHz<br>20kHz | `Pulse input test`<br>`count speed 3kHz` | Use the ▲ arrow button to select the appropriate frequency range. Press ENTER. |
| | **ENTER / RATE** | |
| | `Pulse input test`<br>`F1: 0 F2: 0` | To check Pulse input accuracy: Use TB1-4 as reference ground, input a frequency on TB1-2. The display should show frequency being input. Use a frequency counter to verify input. |
| | **MENU** | |
| | `Pulse input test` | Press Menu key to return to Pulse input test top-level menu. |
| **8.2.19 Analog out test Submenu Group** | `Analog out test` | Press Enter to test the analog output. |
| | **ENTER / RATE** | |
| | `Analog out test`<br>`*0 4 10 15 20 mA` | To simulate analog output: Connect an ammeter to (+) TB1-15, (-) TB1-16. Use the ► arrow button to move the asterisk (*). The unit should output the selected current. |
| | **MENU** | |
| | `Analog out test` | Press Menu key to return to Analog out test top-level menu. |
| **8.2.20 Excitation out test Submenu Group** | `Excitation out test` | Press Enter to test the excitation output. |
| | **ENTER / RATE** | |
| | `Excitation out test`<br>`*5v 12v 24v` | To test the excitation output: Connect a voltmeter to (+) TB1-1, (-) TB1-4. Use the ► arrow button to move the asterisk (*). The unit should output the selected voltage. |
| | **MENU** | |
| | `Excitation out test` | Press Menu key to return to Excitation out test top-level menu. |

| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.21 Pulse out test Submenu Group** | `Pulse out test` | Press Enter key to test the pulse output. |
| | **ENTER / RATE** ↓ | |
| | `Pulse out test`<br>`*0Hz  1Hz 10Hz  20Hz` | To simulate a frequency on the pulse output: Connect a frequency counter to (+)TB1-13, (-)TB1-14. Use the → arrow button to move the asterisk (*). The unit should output the selected frequency. |
| | **MENU** ↓ | |
| | `Pulse out test` | Press Menu key to return to Pulse out test top-level menu. |
| | **ENTER / RATE** | |
| **8.2.22 Relay test Submenu Group** | `Relay Test` | Press Enter to test the relays. |
| | ↓ | |
| | `Rly1 Rly2 Rly3 Rly4`<br>`Off  Off  Off  Off` | To manually control the relay outputs: Press the → key to select the desired relay. Use the ↑ to toggle the relays On/Off. Use an ohmmeter to check the relay contacts. |
| | **MENU** ↓ | |
| | `Relay Test` | Press Menu key to return to Relay Test top-level menu. |
| **8.2.23 Control input test Submenu Group** | `Control inputs test` | Press Enter to test the control inputs. |
| | **ENTER / RATE** ↓ | |
| | `TB1-9  TB1-10 TB1-11`<br>`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 will show ON when input is active, OFF when inactive. |
| | **MENU** ↓ | |
| | `Control inputs test` | Press Menu key to return to control input test top-level menu. |

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| Sub-menus | Display | Notes |
|---|---|---|
| **8.2.24 Battery Voltage test Submenu Group** | Battery Voltage Test | Press Enter key to view the battery voltage. |
| | **ENTER / RATE** ↓ | |
| | Battery Voltage Test<br>3.312 Volts | The display will show the battery voltage. Replace battery at 2.5 VDC or below. |
| | **MENU** ↓ | |
| | Battery Voltage Test | Press Menu key to return to battery voltage test top-level menu. |
| **8.2.25 Data logger utility Submenu Group** | Data logger utility | Press Enter to use data logger utility. |
| | **ENTER / RATE** ↓ | |
| | Data logger utility<br>Log 10 958 Max | The displays shows the number of Data Logs. Press the ▲ arrow button to advance to PRT (print) or CLR (clear). |
| | **PRESET / ▲** ↓ | |
| | Data logger utility<br>Log 00001 PRT CLR | Press PRINT key to output data logger logs to printer, Press CLEAR key to clear the data logger contents. |
| | **MENU** ↓ | |
| | Data logger utility | Press Menu key to return to Data logger utility top-level menu. |

### 8.3 Internal Fuse Replacement

**Instructions:**

1. Make sure you follow proper E.S.D. and hazardous area Precautions. All persons performing this replacement must follow proper grounding procedures.
2. Turn the power to the unit off.
3. Remove the machine screws which hold the cover to rear case
4. The front panel should swing away from the rest of the case. (see fig. 1) With the cover open the fuse will be located at the lower right of PC board.
5. Locate the Fuse F1 (see fig. 2) and unplug the fuse from its socket.
6. Insert the new fuse into the socket. Insure that the pins are fully inserted and straight.
7. Reassemble the case and install the cover screws
8. Turn the unit back on.

**Fuse Specifications:**

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

fig. 1

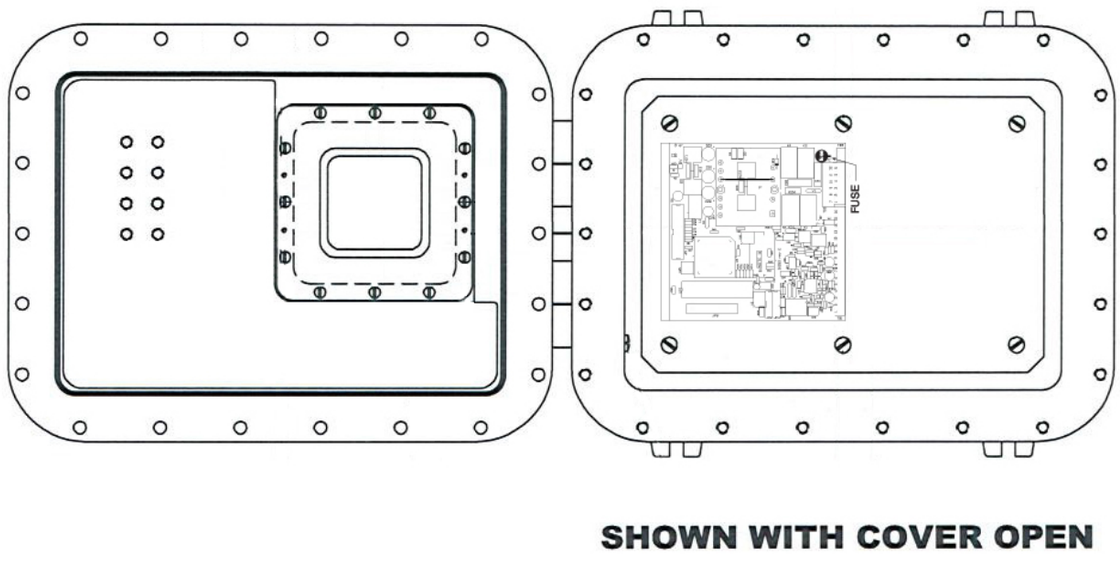
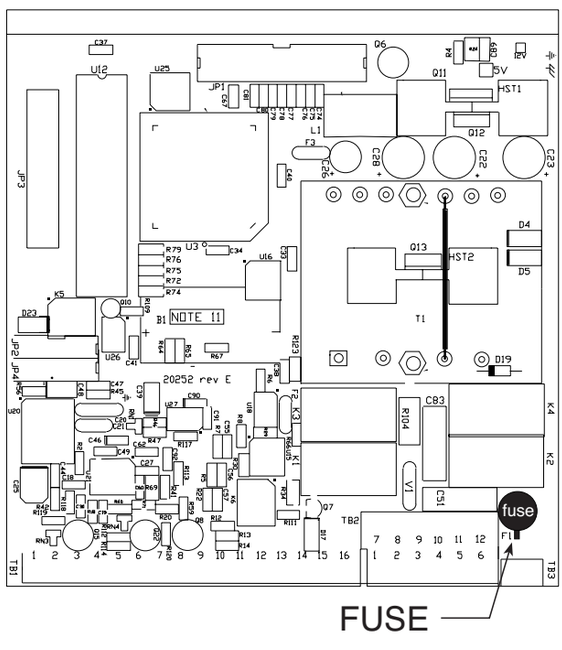



fig. 2



# 9. RS-232 Serial Port

## 9.1 RS-232 Port Description:

The STX-ST1 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

## 9.2 Instrument Setup by PC's over Serial Port

A setup program is provided with the STX-ST1 that enables the user to rapidly configure the STX-ST1 using a Personal Computer. Included on the disk 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. Any cabling or accessories must be purchased separately.

## 9.3 Operation of Serial Communication Port with Printers

Batcher's 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.

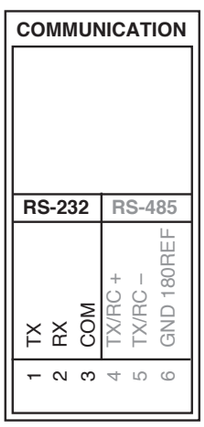
For transaction printing, the user defines the items to be included in the printed document. The user can also select what initiates the transaction print generated as part of the setup of the instrument. The transaction document may be initiated via a front panel key depression, a remote contact closure,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

## 9.4 RS-232 Terminal Block Pinout

**TB-2**



## 10. RS-485 Serial Port (optional)

### 10.1 RS-485 Port Description:

The STX-ST1 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, 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

### 10.2 General

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

### 10.3 Operation of Serial Communication Port with PC

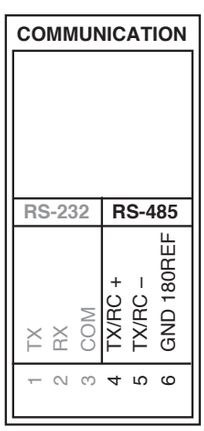
The STX-ST1's RS-485 channel supports a number of Modbus RTU commands. Refer to port pinout (below) for wiring details. Modbus RTU drivers are available from third party sources for a variety of Man Machine Interface software for IBM compatible PC's.

The user reads and writes information from/to the RS-485 using the Modbus RTU commands. The STX-ST1 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.

### 10.4 RS-485 Terminal Block Pinout

**TB-2**



## 11. Batcher Setup Software

The STX-ST1 setup program provides for configuring, monitoring and controlling a Batcher unit.

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 STX-ST1 (*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 STX-ST1 unit (Up*loading* 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.

### 11.1 System Requirements:

Windows® XP/Vista/7/8/10

4 MB RAM

3 MB free disk space

Communication Port - RS-232 (A USB to RS232 converter is required for PCs without RS-232 port)

RS-232 Cable as needed

### 11.2 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. It is recommended to purchase a modem cable which matches the available communication port on your PC and 3 wire lead connection for the STX-ST1 serial port.

### 11.3 Installation

**CD Installation**
The Setup Software Disk includes an installation program which copies the software to your hard drive.

Insert Setup Disk; if install doesn't automatically begin then browse the disk and double-click the file named Setup_STX-ST1

Follow the instructions on your screen. If you're prompted for an administrator password or confirmation, type the password or provide confirmation.

**Download and Installation**
The Setup Software can also be downloaded from the KEP website (www.kep.com).

Download the file from www.kep.com (downloads section) and note the location where the file is being saved.

When download is complete. Browse to the downloaded file location and double-click on the file named Setup_STX-ST1.

Follow the instructions on your screen. If you're prompted for an administrator password or confirmation, type the password or provide confirmation.

### 11.4 Using the STX-ST1 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.

### 11.5 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 Load 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 *Create new file*, 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 *Template* 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:

- Open up a predefined template from the supplied list
- Choose ‘Save As’ to save this to a new file name
- Proceed to customize the template by making any changes that are needed
- Save the template to disk (if you want to reuse this template)
- Download the template to an attached unit.

The **Communications with Batcher Section** allows the user to upload a template file from the unit, download the program’s current template to the unit.

The **Print (report) Section** allows the user to:

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

### 11.6 Setup Tab

The Setup tab is where majority of the STX-ST1 instrument setup modifications are done. The Setup tab is divided into five sections.

**System Section:** Parameters, Display, Indicators

**Input Section:** Flow, Fluid, Compensations, Control Inputs

**Output Section:** Pulse, Currents

**Relay Section:** Relays

**Other Settings Section:** Administration, Communication, Printing

**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.

### 11.7 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 (i.e. rate, temperature)

Totalizers (i.e. total, grand total)

The setup software assumes the current setup has been uploaded from the STX-ST1 into the PC. It is important that the setup program and the STX-ST1 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 STX-ST1 device, the word 'Error' will appear in place of the actual value. If the connection to the STX-ST1 is lost, the viewer will time out with a message saying the device is not responding.

The viewer will attempt to communicate with the STX-ST1 device matching the device ID set in the communications screen. If you are having trouble establishing communication, compare settings for the PC and the STX-ST1. Also verify the connections between the PC and STX-ST1.

### 11.8 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, Create Print Header

The Actions section is used to send commands to the unit.

Reset Totalizers, Reset Alarms

The Options section has the following selections:

Additional capabilities may be provided in the future.

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

## 12. Glossary Of Terms

**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 STX-ST1. 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.

**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 STX-ST1 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 (STX-ST1), flowmeter and control valve. The STX-ST1 opens and closes the valve through the use of relays and measures the amounts of liquid being dispensed via the flowmeter.

**Baud Rate**
The speed of serial communication transmissions, expressed in bits per second.

**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 STX-ST1 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 STX-ST1 offers excitation voltages of 5VDC, 12VDC or 24VDC 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

**EZ Preset**
The EZ Preset mode was designed for users who frequently change the batch amount.

**Fast Fill Rate**
The user specified flow rate for the fast fill portion of a batch cycle when used in batching application with a digital control valve.

**Flow Alarm**
A visual indication that the volumetric flowrate is above or below the flow alarm setpoint specified by the user.

**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.

## 12. Glossary Of Terms (Continued)

**Flow Equation**
A flow control expression or algorithm describing a mathematical equation to be solved by the STX-ST1 in the desired application.

**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.

**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 STX-ST1 contains such resistors and may be enabled via the setup menu.

**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 STX-ST1 when fluid is present.

**K-Factor**
A scaling factor derived from the pulses produced by a flowmeter output, expressed in pulses per unit (i.e. pulses/gallon)

**LCD**
Abbreviation for: Liquid Crystal Display

**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 Flowmeter**
A flow measurement device whose output is proportional to flow.

**Linearization**
The mathematical correction of a nonlinear device. The STX-ST1 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 Flow Cutoff**
A value set at which any flow measurements read below this value will be ignored.

**Low Pass Filter**
A low pass filter passes low input frequencies while blocking high frequencies. In the STX-ST1, 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.

## 12. Glossary Of Terms (Continued)

**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.
**NOTE:** When using automatic over-shoot compensation the value (in seconds) entered into maximum drain time must be greater than the time required for the valve to close.

**Max Window**
The max. window time sets the maximum sample time (1 to 99 sec) for the ratemeter.

**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".

**Orifice Plate Flowmeter**
A class of flow measurement devices where the measured signal (differential pressure) has a square law relationship to flow.

**Parity**
A method for detecting errors in transmissions of serial communications data.

**Preset**
A set point used to trigger the relay outputs of the STX-ST1.

**Print Interval**
The print interval allows the STX-ST1 to transmit information to the serial port at selectable time intervals.

**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**
Any sensor information which 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 STX-ST1 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 flowmeter 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 STX-ST1 quick setup provides the following:
1) Prompts the user for only critical information.
2) 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:

$$\frac{(\text{OLD DATA} \times \text{"Avg. Filter"} + \text{NEW DATA})}{(\text{"Avg. Filter"} + 1)}$$

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## 12. Glossary Of Terms (Continued)

**Ratemeter**
Any device used to display the speed of a process. The ratemeter in the STX-ST1 displays flow rate.

**Ref. Dens.**
Abbreviation for Reference Density. This is the fluid density at reference temperature.

**Ref. Temp.**
Abbreviation for Reference Temperature. This represents the base or reference condition to which corrected flow will be computed.

**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.

**Single_Pulse**
The Single_Pulse setting is used for flowmeters with single pulse outputs.

**Slow Fill Rate**
The user specified flow rate for the slow start of fill and slow end of fill portion of the batching cycle in a batching application with a digital control valve.

**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.

**Sqrt**
Abbreviation for Square Root Extraction. Used for flow elements using differential pressure measurements.

**Standard Preset**
The Standard Preset mode should be used in applications where the batch amount does not change often.

**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.

**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 flowrate/viscosity calibration for a turbine flowmeter.

**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.

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## 13. Diagnosis and Troubleshooting

### 13.1 Response of SYX-ST1 on Error or Alarm:

Error and warning indications which occur during operation are indicated in the RUN mode alternately with the measured values. The STX-ST1 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 the ENTER button to acknowledged and clear alarms. Alarms may reassert themselves if the alarm condition is still present.

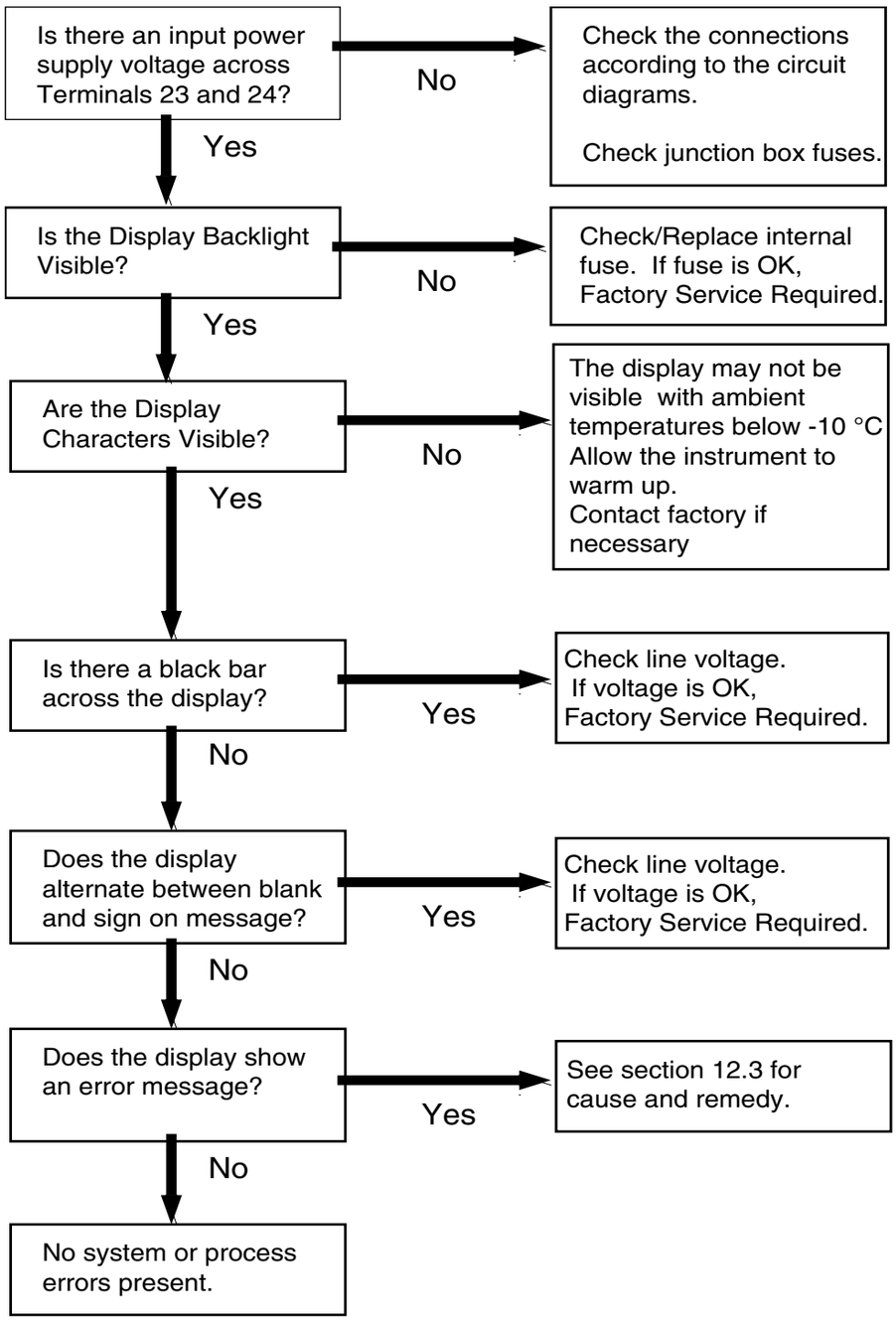
**NOTE:** A historical error alarm log is available in the "Test Mode".

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

### 13.2 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.



## 13.3 Error & Warning Messages:

### 13.3.1 Sensor/Process Alarms

| Error/Warning Message | Cause | Remedy |
|---|---|---|
| **TOTALIZER ROLLOVER** | Displayed when totalizer rolls over beyond the maximum limit | Acknowledge Rollover, Remedy not required |
| **AUX INPUT TOO LOW** | 4-20 mA Input current at aux input smaller than 3.5 mA:<br>• Faulty Wiring<br>• Transmitter not set to "4-20 mA"<br>• Transmitter defective | • Check wiring<br>• Check function of sensor |
| **RTD OUT OF RANGE** | Input current at RTD input too low:<br>• Faulty wiring<br>• RTD defective | • Check wiring<br>• Check function of RTD sensor |
| **RATE OVERFLOW ERROR** | Pulse counter overflowed. The remote totalizer may have lost counts. | • Report error to factory<br>• Check application conditions<br>• Check wiring |
| **PULSE OUT OVERFLOW** | Calculated pulse frequency too large:<br>• Pulse width setting too long<br>• Larger pulse scaler needed | • Adjust pulse value<br>• Adjust pulse width<br>• Check process conditions |
| **FLOW RATE ALARM LOW**<br>**FLOW RATE ALARM HIGH**<br><br>**TEMP ALARM LOW**<br>**TEMP ALARM HIGH**<br><br>**DENSITY ALARM LOW**<br>**DENSITY ALARM HIGH** | Limit value exceeded. | • Check application if necessary<br>• Check limit value<br>• Adjust the limit value if required |
| **BATCH OVERRUN ALARM** | Batch size exceeded by more than set limit. | • Check valves in system for proper operation and/or leaks<br>• Check limit value<br>• Adjust the limit value if required |
| **MODEM NOT PRESENT** | The setup expects modem usage and a modem is not responding. | • Check setup for proper baud rate, parity, etc.<br>• Check modem connection and cycle power to Batcher<br>• Replace modem |
| **SOFTWARE ERROR RESET** | Watchdog Error. Transient likely | • Cycle power to Batcher |
| **EXTENDED PFI LOCKUP** | Unit was operated with an input power level lower than safe operating range for an extended period of time. | • Check data in unit. Totalizer may have inaccuracies<br>• Investigate brownout cause. |

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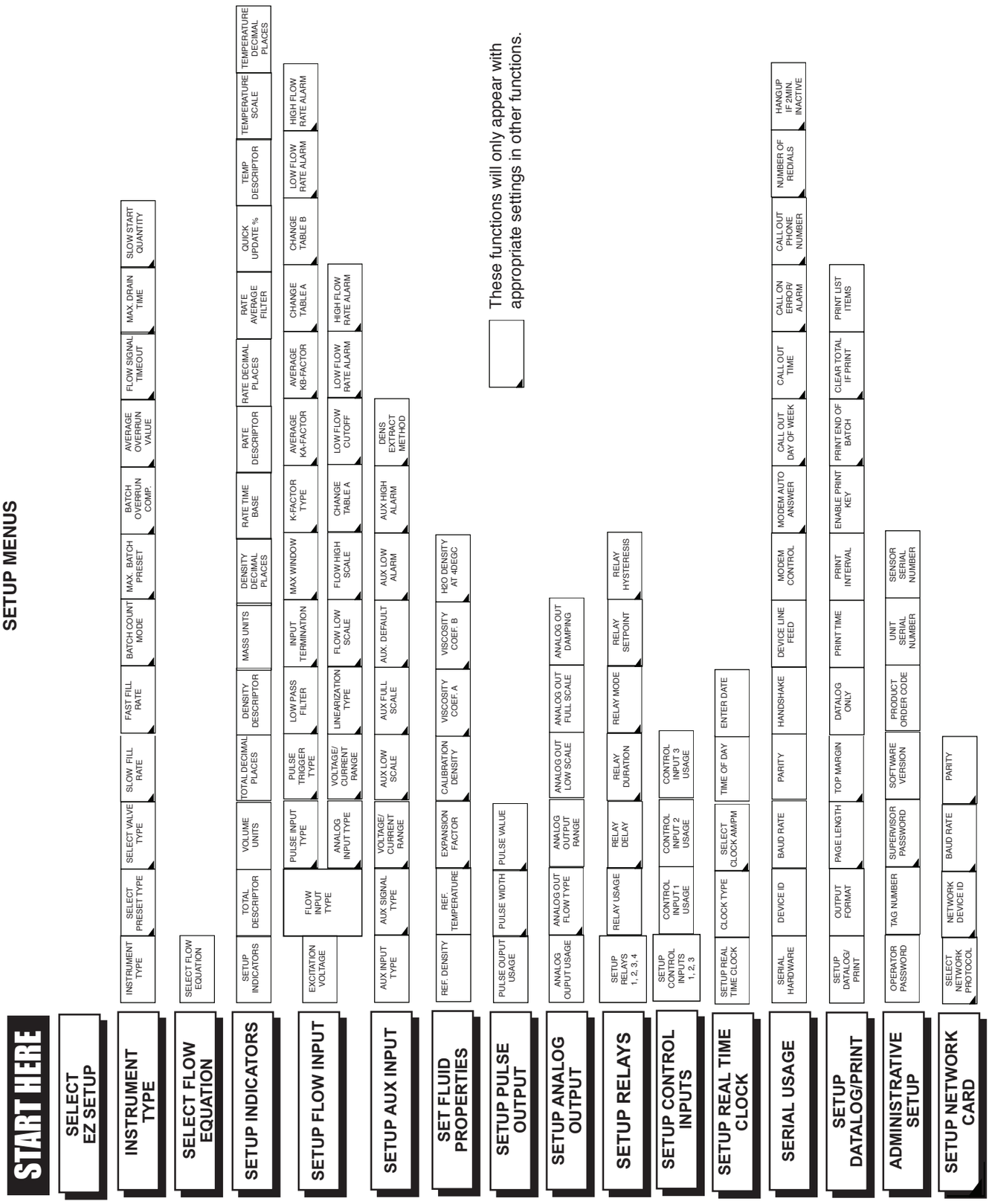
## 13.3 Error & Warning Messages: (Continued)

### 13.3.2 Self Test Alarms

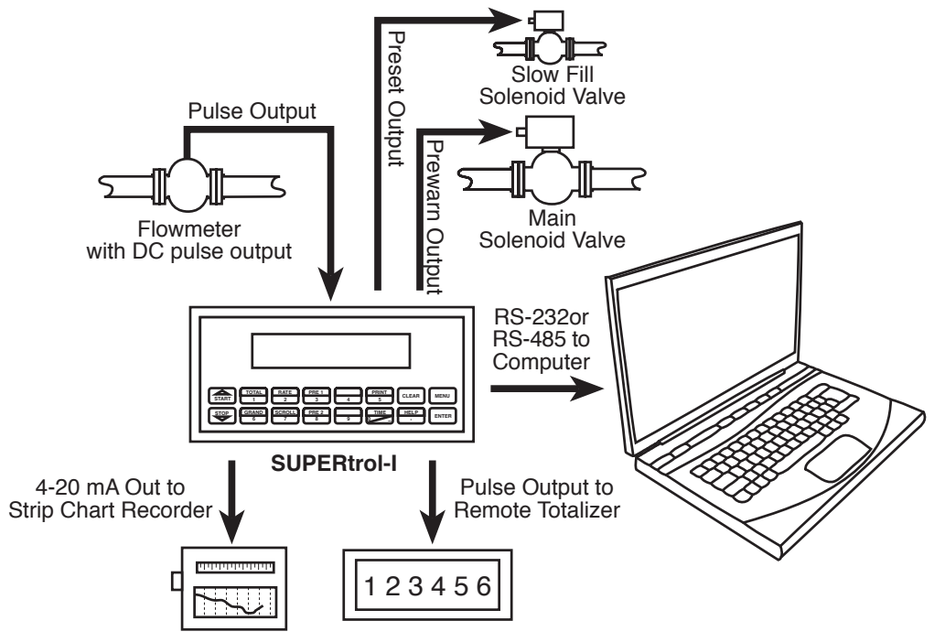
| Error/Warning Message | Cause | Remedy |
|---|---|---|
| **FLOW INPUT TOO HIGH** | Analog input signal of the flow input exceeded by more than 3%:<br>• Sensor overranged<br>• Incorrect full scale setting of flowmeter<br>• Function error in transmitter or faulty wiring | • Check analog signal range<br>• Check the application conditions<br>• Check wiring |
| **AUX INPUT TOO HIGH** | Analog input signal of the auxiliary input exceeded by more than 3%:<br>• Sensor overranged<br>• Incorrect full scale setting of transmitter<br>• Function error in transmitter or faulty wiring | • Check analog signal range<br>• Check the application conditions<br>• Check wiring |
| **FLOW INPUT TOO LOW** | Analog input signal of the flow input fell below the low scale range by more than 3% of full scale value:<br>• Flowmeter not set to 4-20 mA<br>• Function error in transmitter or faulty wiring | • Check wiring<br>• Check calibration of flowmeter<br>• Check function of flowmeter |
| **BATTERY LOW WARNING** | Battery voltage too low | • Replace Battery<br>• Consult Factory for service information |
| **A to D NOT CONVERTING** | Fault in analog/digital converter | • Unit may self correct, Press ENTER to acknowledge & clear alarm<br>• If error reasserts, factory service is required |
| **TIME CLOCK ERROR** | The correct time/date is no longer shown | • Re-enter time and date.<br>• If error occurs again 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 |

## APPENDIX A - Setup Menus

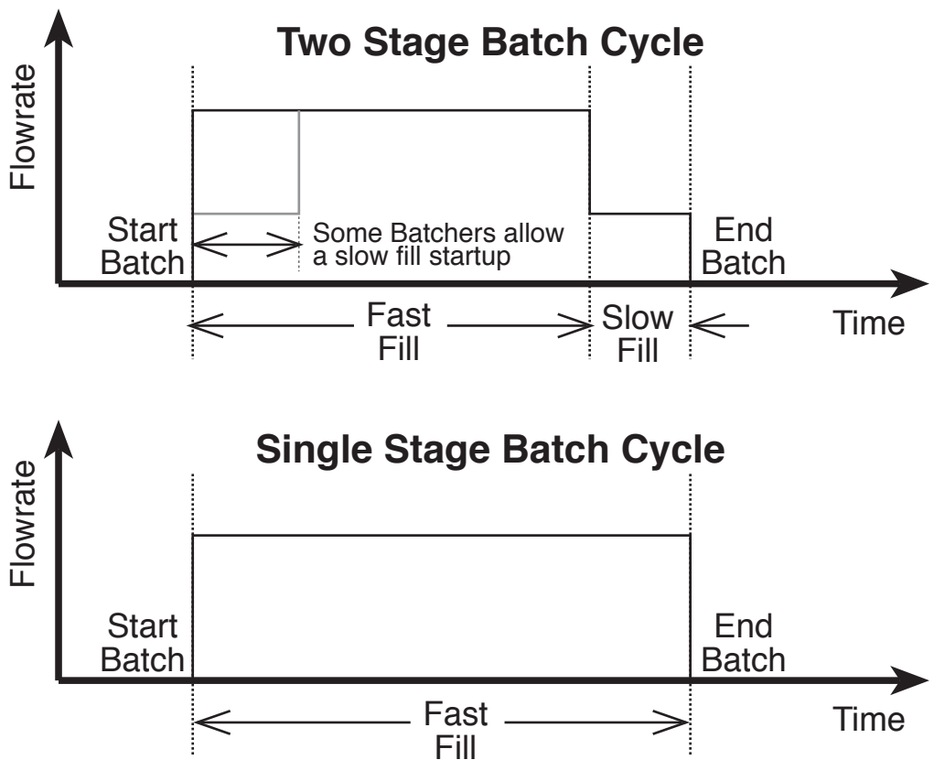


## APPENDIX B - Batching Diagrams

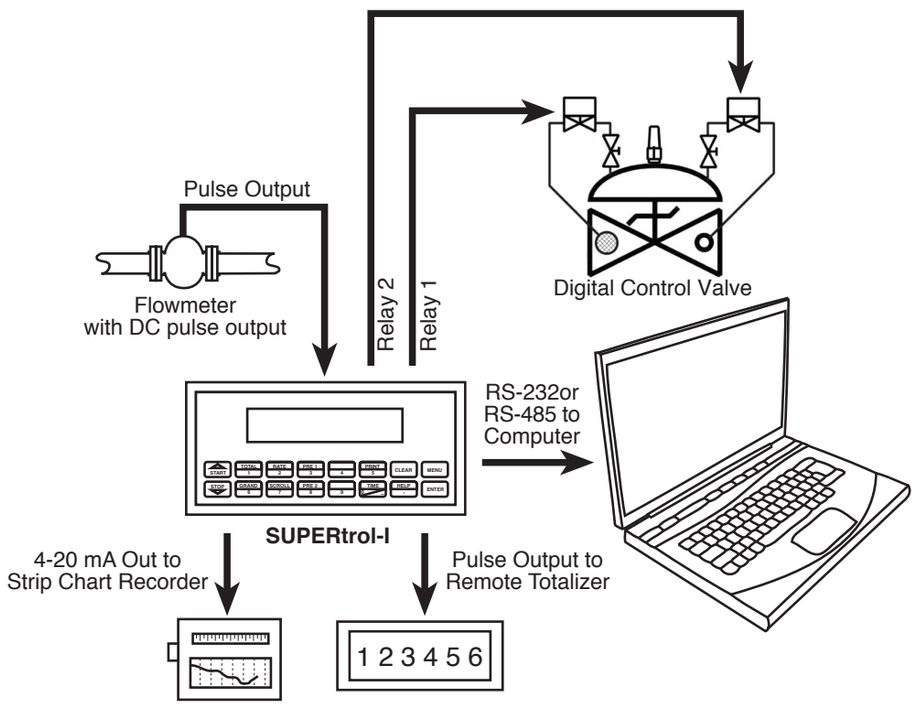
Typical Batcher Application with STANDARD Valve(s)



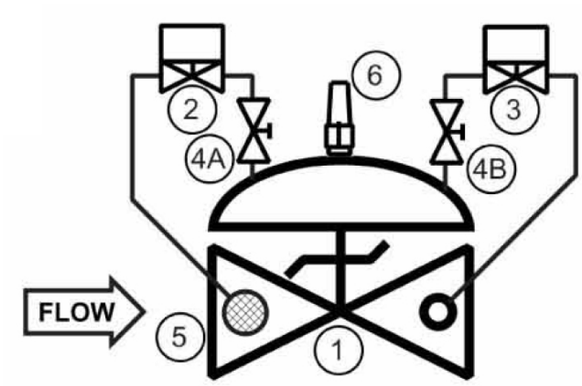

Two Stage vs. Single Stage Batching Illustration with STANDARD Valve(s)



## Typical Batcher Application with DIGITAL CONTROL VALVE



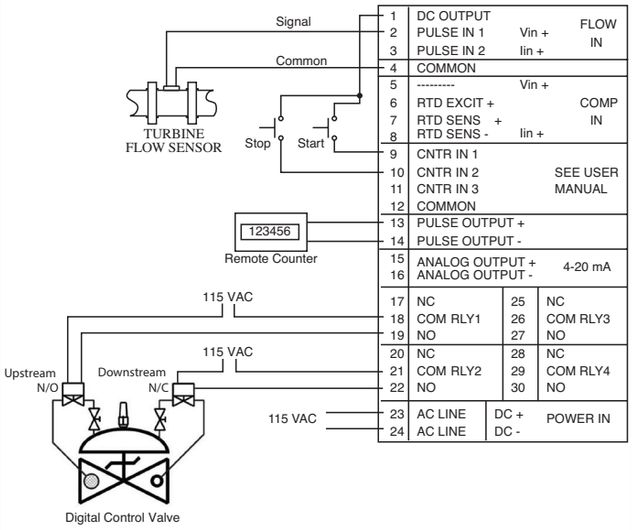

## DIGITAL CONTROL VALVE Diagram



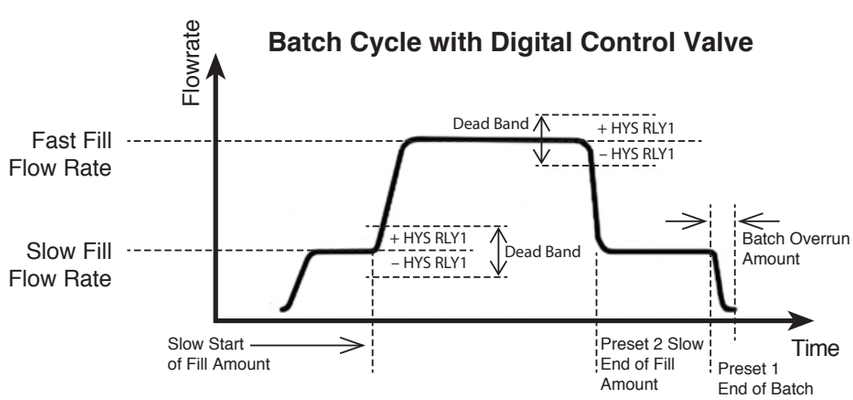

1. Basic Control Valve (Fail Closed)
2. Two-Way Solenoid Pilot (upstream N/O)
3. Two-Way Solenoid Pilot (downstream N/C)
4. Needle Valve
5. Inline Strainer
6. Visual Indicator

| STX Relay 1 | STX Relay 2 | Function |
|---|---|---|
| ON | ON | Opening Valve (increase flow rate) |
| ON | OFF | Hold Position (maintain flow rate) |
| OFF | OFF | Closing Valve (reduce flow rate) |

## DIGITAL CONTROL VALVE Wiring




## Batch Cycle with Digital Control Valve



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## WARRANTY

This product is warranted against defects in materials and workmanship for a period of two (2) years from the date of shipment to Buyer.

The Warranty is limited to repair or replacement of the defective unit at the option of the manufacturer. This warranty is void if the product has been altered, misused, dismantled, or otherwise abused.

ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ARE EXCLUDED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

## Ordering Information

**Ordering Example**

**Example STX-ST1 L 1 A 0 X ET**

**Series:**
STX-ST1= Supertrol-1 Explosion Proof

**Display Type:**
O= OLED (STD)
L= LCD
V= VFD

**Input Type:**
1= 110 VAC
2= 220 VAC
3= 12 VDC (10 to 14 VDC)
4= 24 VDC (14 to 28 VDC)

**Relays:**
A= 2 SPDT Relays
B= 4 Relays (consult factory)

**Network Card:**
0= None (STD)
2= RS485/Modbus (optional 2nd COM port)

Mounting:
X= Explosion Proof

Options:
ET= Extended Temperature LCD Display
-4°F to 131°F (-20°C to 55°C)
IM = Internal Modem
M = Modem Power Option

Accessories:
OPC/DDE Server for RS232 Port
OPC/DDE Server for Modbus Suite
Modem Available, see MPP-2400N (requires M option)
Serial printer available, see P1000, P295
Ethernet Port Server available, see IEPS for RS232 port
Ethernet Port Server Modbus TCP available, see ADAM4572
RS-422/485 to RS-232 Communication Adaptor available, see CA285
Remote metering and data collection software available, see TROLlink
Quencharc 32145 - Relay Contact Protection

**REVISIONS**
02/18/14 - Original Release
03/11/14 - PMP (Pump) selection added to Relay 3 on page 37
06/25/14 - Updated Cover Photo, updated dimension drawing on page 6, updated ordering code page 79
07/30/14 - Updated Keypad Labels throughout the manual to reflect new product labeling
04/13/15 - Updated Keypad Labels throughout the manual to reflect new button assignment on keypad labeling
05/26/16 - Optimized graphic files to reduce PDF file size
10/04/16 - Added conduit entry specifications to dimension drawing on page 6
10/04/16 - Updated Setup Software Installation on page 65
04/23/25 - Updated contact information for Industrial Flow System.