STX-ST1
Explosion Proof SUPERtrol-I

FLOWMETRICS, INC.
"Where Quality is Measurable"

9201 Independence Avenue, Chatsworth, California 91311
Phone: (818) 407-3420 Fax: (818) 700-1961 www.flowmetrics.com
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:

<table>
<thead>
<tr>
<th>Input Power</th>
<th>Recommended Fuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>115 VAC</td>
<td>160 mA slow blow fuse</td>
</tr>
<tr>
<td>230 VAC</td>
<td>80 mA slow blow fuse</td>
</tr>
<tr>
<td>12-24 VDC</td>
<td>800 mA slow blow fuse</td>
</tr>
</tbody>
</table>

Disconnect power supply before replacing fuse!

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

Symbols Used On Unit

<table>
<thead>
<tr>
<th>Number</th>
<th>Symbol</th>
<th>Publication</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>![symbol]</td>
<td>IEC 417, No. 5031</td>
<td>Direct current</td>
</tr>
<tr>
<td>2</td>
<td>![symbol]</td>
<td>IEC 417, No. 5172</td>
<td>Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION (equivalent to Class II of IEC 536–see annex H)</td>
</tr>
<tr>
<td>3</td>
<td>![symbol]</td>
<td>ISO 3864, No. B.3.1</td>
<td>Caution (refer to accompanying documents)</td>
</tr>
</tbody>
</table>

Technical Improvements

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

NOTICE!
This 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 op-erators 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.

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CONTENTS

1. Description
   1.1 Unit Description: .................................................................1
   1.2 Unit Features: .................................................................1
   1.3 Specifications ...............................................................2

2. Installation
   2.1 General Mounting Hints: ......................................................6
   2.2 Mounting Dimensions: .......................................................6

3. Applications
   3.1 Liquid Volume ......................................................................7
   3.2 Corrected Liquid Volume .....................................................8
   3.3 Liquid Mass .........................................................................9
   3.4 Batching ............................................................................10

4 WIRING
   4.1 Terminal Locations ............................................................11
   4.2 Terminal Designations .........................................................11
   4.3 Typical Batcher Wiring: .......................................................12
   4.4 Typical Rate/Total Wiring: .................................................12

5. UNIT OPERATION
   5.1 General Operation ................................................................13
   5.2 Front Panel Operation Concept for Rate/Total Mode ..............13
   5.3 Setup Sub-Menus ...............................................................15
   5.3.1 RateMeter/Totalizer Operation .........................................15
   5.3.2 Relay Operation in Rate/Total mode ..................................15
   5.3.3 Pulse Output in Rate/Total mode .......................................15
   5.3.4 Analog Output in Rate/Total mode .....................................15
   5.3.5 RS-232 Serial Port Operation in Rate/Total mode ............16
   5.3.6 RS-485 Serial Port (optional) ...........................................16
   5.4 Front Panel Operation Concept for Batcher Mode ...............17
   5.5 Batcher Operation ................................................................19
   5.5.1 Batcher Configuration ....................................................19
   5.5.2 Password Protection for Batcher Mode ..............................20
   5.5.3 Relay Operation in Batcher mode ......................................20
   5.5.4 Pulse Output in Batcher mode ..........................................20
   5.5.5 Analog Output in Batcher mode ........................................20
   5.5.6 RS-232 Serial Port Operation in Batcher mode ...............21
   5.5.7 RS-485 Serial Port (optional) ...........................................21

6. PROGRAMMING
   6.1 Front Panel Operation Concept for Program Mode ..............22
   6.1.1 TOP LEVEL SETUP MENU ............................................23
   6.1.2 EZ Setup Submenu Groups ..............................................23
   6.1.3 EZ Setup .................................................................23
   6.1.4 Top Level Setup Menu ......................................................24
   6.1.5 Submenu Groups ...........................................................24
   6.1.6 Setup Menus ...............................................................24
   6.1.7 SELECT EZ SETUP .......................................................25
   6.1.8 INSTRUMENT TYPE .....................................................25
   6.4 Setup Sub-Menus ...............................................................25
   6.4.1 SELECT FLOW EQUATION ............................................27
   6.4.2 SETUP INDICATORS (Total) ...........................................27
   6.4.3 SETUP INDICATORS (Rate) ............................................28
   6.4.4 SETUP INDICATORS (Temperature) ...............................28
   6.4.5 SETUP FLOW INPUT (Pulse - Ain & PS (A+B)) .................29
   6.4.6 SETUP FLOW INPUT (Pulse - Quadrature, Qx1 or Qx2) ....30
   6.4.7 SETUP FLOW INPUT (Analog) .........................................32
   6.4.8 SETUP AUX INPUT ......................................................33
   6.4.9 SET FLUID PROPERTIES ............................................34
   6.4.10 SETUP PULSE OUTPUT ...............................................35
   6.4.11 SETUP ANALOG OUTPUT ...........................................35
   6.4.12 SETUP RELAYS (Relay 1 & Relay 2) ................................36
   6.4.13 SETUP CONTROL INPUTS (RATE/TOTAL) .....................38
   6.4.14 SETUP CONTROL INPUTS (BATCH) .............................38
   6.4.15 SETUP REALTIME CLOCK (Time) ................................39
   6.4.16 SETUP REALTIME CLOCK (Date) ................................39
   6.4.17 SERIAL USAGE ..........................................................40
   6.4.18 SETUP DATALOG/PRINT (Configure) .........................41
   6.4.19 SETUP DATALOG/PRINT (Select_list) .........................42
   6.4.20 ADMINISTRATIVE SETUP ...........................................43
   6.4.21 SETUP NETWORK CARD (optional) ..............................44
   6.4.22 SETUP DISPLAY LIST (configuration) .........................44
CONTENTS

7. Principle Of Operation ............................................................... 45
  7.1 General: ........................................................................... 45
  7.2 Orifice Flowmeter Considerations ...................................... 45
  7.3 Flow Equations: ................................................................. 45
  7.4 Calculating the Expansion Factor ........................................ 48
  7.5 Computation of Viscosity Coef. A and B .............................. 49
  7.6 Linearization Table .............................................................. 50
    7.6.1 Linearization Table General Information ..................... 50
    7.6.2 Linearization Table for Pulse Inputs ............................ 50
    7.6.3 Linearization Table for Analog Inputs ........................... 50
    7.6.4 Linearization Table Interpolation ................................... 50

8. Test, Service and Maintenance .................................................. 51
  8.1 Test Menus......................................................................... 51
  8.2 Test Sub-Menues ................................................................. 52
    8.2.1 Audit Trail Submenu Group .......................................... 52
    8.2.2 Error History Submenu Group ...................................... 52
    8.2.3 Print System Setup Submenu Group ......................... 52
    8.2.4 Keypad test Submenu Group ........................................ 53
    8.2.5 Display test Submenu Group ......................................... 53
    8.2.6 Calibrate CH1 0mA Submenu Group ......................... 54
    8.2.7 Calibrate CH1 20mA Submenu Group ....................... 54
    8.2.8 Calibrate CH2 0mA Submenu Group ......................... 55
    8.2.9 Calibrate CH2 20mA Submenu Group ....................... 55
    8.2.10 Calibrate CH1 0V Submenu Group ............................ 56
    8.2.11 Calibrate CH1 10V Submenu Group ....................... 56
    8.2.12 Calibrate CH2 0V Submenu Group ........................... 57
    8.2.13 Calibrate CH2 10V Submenu Group ........................... 57
    8.2.14 Calibrate 100 ohm RTD Submenu Group .................. 57
    8.2.15 Calibrate 4mA Out Submenu Group ....................... 58
    8.2.16 Calibrate 20mA Out Submenu Group .................... 58
    8.2.17 Analog In Test Submenu Group ................................. 58
    8.2.18 Pulse input test Submenu Group .............................. 59
    8.2.19 Analog out test Submenu Group ................................ 59
    8.2.20 Excitation out test Submenu Group ....................... 59
    8.2.21 Pulse out test Submenu Group ................................ 60
    8.2.22 Relay test Submenu Group ........................................ 60
    8.2.23 Control input test Submenu Group ......................... 60
    8.2.24 Battery Voltage test Submenu Group .................... 61
    8.2.25 Data logger utility Submenu Group ....................... 61
    8.3 Internal Fuse Replacement.............................................. 62

9. RS-232 Serial Port .................................................................. 63
   9.1 RS-232 Port Description: .................................................... 63
   9.2 Instrument Setup by PC’s over Serial Port ....................... 63
   9.3 Operation of Serial Communication Port with Printers .......... 63
   9.4 RS-232 Terminal Block Pinout ......................................... 63

10. RS-485 Serial Port (optional) .................................................. 64
    10.1 RS-485 Port Description: ................................................ 64
    10.2 General ........................................................................ 64
    10.3 Operation of Serial Communication Port with PC ............. 64
    10.4 RS-485 Terminal Block Pinout ....................................... 64

11. Batch Setup Software ............................................................. 65
    11.1 System Requirements: ..................................................... 65
    11.2 Cable and Wiring Requirements: .................................... 65
    11.3 Installation .................................................................... 65
    11.4 Using the STX-ST1 Setup Software ................................. 66
    11.5 File Tab ....................................................................... 66
    11.6 Setup Tab .................................................................... 66
    11.7 View Tab ..................................................................... 67
    11.8 Misc. Tab .................................................................... 67

12. Glossary Of Terms ................................................................. 68

13. Diagnosis and Troubleshooting ............................................... 72
    13.1 Response of SYX-ST1 on Error or Alarm: ......................... 72
    13.2 Diagnosis Flow Chart and Troubleshooting ..................... 75
    13.3 Error & Warning Messages: ............................................ 74
    13.3.1 Sensor/Process Alarms ................................................ 74
    13.3.2 Self Test Alarms ......................................................... 75

APPENDIX A - Setup Menus ....................................................... 76
APPENDIX B - Batching Diagrams ............................................. 77

WARRANTY ........................................................................... 79
Ordering Information .................................................................. 79
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.

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
1.3 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, coriolis and many others.
- Linearization: Square root, 16 point table or UVC table.
- 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
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
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 use.

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 high 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.

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 low 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.
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 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 a Personnel Computer. Included on the diskette are common instrument applications which may be used as a starting point for your application. This permits the user to have an excellent starting point and helps speed the user through the instrument setup.

Operation of Serial Communication Port with Printers
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
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. 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-Facto.
- 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

**Calculations**

- **Pulse Input; Average K-Factor**

\[
\text{Volume Flow} = \frac{\text{input frequency} \times \text{time scale factor}}{\text{K-Factor}}
\]

- **Analog Input; Linear**

\[
\text{Volume Flow} = \% \text{ input} \times \text{Full Scale Flow}
\]
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.Coeff. *(Tf-Tref))^2

or alternately API2540 equation
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
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-Facto.
- 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

4 WIRING

4.1 Terminal Locations

4.2 Terminal Designations

* Power Terminals 23 & 24 used for DC Input only when ordered with DC INPUT option
### 4.3 Typical Batcher Wiring:

**Optional Wiring for Flow Sensor with Preamp**

- **Signal** (+) V
- **Common**
- **Flow Sensor**

**Flow Sensor**

**Turbine Flow Sensor**

**115 VAC**

**Solenoid Valve**

**Remote Counter**

**MOV recommended**

**NOTE:**

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

### 4.4 Typical Rate/Total Wiring:

- **Signal** (+) V
- **Common**
- **Flow Sensor**
- **100 Ohm DIN RTD**

**Remote Counter**

**Strip Chart Recorder**

**Alarm Relay 1**

**Alarm Relay 2**

**115 VAC**

**NOTE:**

Power Terminals 23 & 24 used for DC Input only when ordered with DC INPUT option.
5. UNIT 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 DIS 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 once 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.
5.3 Ratemeter/Totalizer Operation

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

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.

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.

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.

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.
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).

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)
5.4 Front Panel Operation Concept for Batcher 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 DIS 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 once 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).

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 than 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 Input 1 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 Input 1 or the front panel Start key is pressed (provided that the previous 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
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
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 prewarm. (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
The isolated pulse output (open collector) is menu assignale 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
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.
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).

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:**

**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.

**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.

**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.

**NUMERIC ENTRY**
The keys labeled “0”, “1”, 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.

**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 flo 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

6.2.1 TOP LEVEL SETUP MENU

6.2.2 EZ Setup Submenu Groups

<table>
<thead>
<tr>
<th>Menus</th>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELECT OPERATE STATE</td>
<td>Run Setp Test Disp</td>
<td>Select Setup to enter the instrument setup routine.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELECT EZ SETUP</td>
<td></td>
<td>Press ENTER to begin EZ Setup routine.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARE YOU SURE?</td>
<td>Yes</td>
<td>Confirm that you want to run EZ Setup. <strong>Caution:</strong> Any previous program settings may be lost or reset.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INSTRUMENT TYPE</td>
<td>Rate/Tot Batch</td>
<td>Instrument Function.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RATE TIME BASE</td>
<td>Sec Min Hour Day</td>
<td>Select the appropriate rate time base.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RATE DEC PLACES</td>
<td>0</td>
<td>Enter the desired rate decimal location. 0-3 decimal places allowed.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL VOLUME UNITS</td>
<td>gal</td>
<td>Enter the desired totalizer units label.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL DEC PLACES</td>
<td>0</td>
<td>Enter the desired totalizer decimal location. 0-3 decimal places allowed.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K_FACTOR TYPE</td>
<td>Avg LinTbl UVC</td>
<td>Enter the desired K-Factor Type.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVERAGE KA-FACTOR</td>
<td>******* P/gal</td>
<td>If Average selected, Enter the desired Average K-Factor.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINEAR TABLE KA</td>
<td>Fre01:******* Hz</td>
<td>If LinTbl or UVC selected, Enter the desired frequency/ K-Factor pair for each point in the Linearization Table.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINEAR TABLE KA</td>
<td>KA--01:**********</td>
<td>Enter a frequency of 0 for any point other than Fre01 to exit Linearization Table setup.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS ANALOG OUT 20mA</td>
<td>******gal/m</td>
<td>Enter the desired full scale setting for the analog output.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RATE</td>
<td>00.0 gal/m</td>
<td>Return to Run Mode</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0 gal</td>
<td></td>
</tr>
</tbody>
</table>
## 6.3 Setup Menus

### 6.3.1 Top Level Setup Menu

- **SELECT OPERATE STATE**
  - **Run**
  - **Setup**
  - **Test Disp**

- **ENTER / RATE**

- **SELECT EZ SETUP**

- **PRESET / †**

- **INSTRUMENT TYPE**

- **PRESET / †**

- **SELECT FLOW EQUATION**

- **PRESET / †**

- **SETUP INDICATORS**

- **PRESET / †**

- **SETUP FLOW INPUT**

- **PRESET / †**

- **SETUP AUX INPUT**

- **PRESET / †**

- **SET FLUID PROPERTIES**

- **PRESET / †**

- **SETUP PULSE OUTPUT**

- **PRESET / †**

- **SETUP ANALOG OUTPUT**

- **PRESET / †**

- **SETUP RELAYS**

- **PRESET / †**

- **SETUP CONTROL INPUTS**

- **PRESET / †**

- **SETUP REALTIME CLOCK**

- **PRESET / †**

- **SERIAL USAGE**

- **PRESET / †**

- **SETUP DATALOG/PRINT**

- **PRESET / †**

- **ADMINISTRATIVE SETUP**

- **PRESET / †**

- **SETUP NETWORK CARD**

### Notes

- Use † to select Setup to enter the instrument setup routine.

- Refer to Page 21 for Details.

- Refer to Page 25 for Details.

- Refer to Pages 27 for Details.

- Refer to Page 28 & 29 for Details.

- Refer to Page 30, 31 & 32 for Details.

- Refer to Page 33 for Details.

- Refer to Page 34 for Details.

- Refer to Pages 34 for Details.

- Refer to Page 35 for Details.

- Refer to Page 35 & 36 for Details.

- Refer to Page 37 for Details.

- Refer to Page 38 for Details.

- Refer to Page 39 for Details.

- Refer to Pages 40 & 41 for Details.

- Refer to Page 41 for Details.

- Refer to Page 42 for Details.
6.4 Setup Sub-Menus

**Sub-menues**

6.4.1 SELECT EZ SETUP

**Display**

SELECT EZ SETUP

PRESET / ↑

Advance To INSTRUMENT TYPE

**Notes**

Refer to Section 6.2 for EZ Setup routine.

Press the UP (preset) button to advance to Instrument Type submenu group.

6.4.2 INSTRUMENT TYPE

**Display**

INSTRUMENT TYPE

ENTER / RATE

Advance To INSTRUMENT TYPE

**Notes**

Press ENTER to enter Instrument Type sub-menus.

Press ENTER when Rate/Total is flashing to configure the instrument as a Ratemeter/otalizer.

If Rate/Tot selected, advance to Select Flow Equation.

Batch

**Display**

INSTRUMENT TYPE

ENTER / RATE

Rate/Tot

SELECT PRESET TYPE

Standard EZ Preset

SELECT VALUE TYPE

Standard Digital

**Notes**

Press ENTER when Batch is flashing to configure the instrument as a Batcher.

Use ↑ to select choice

Choose Standard or EZ Preset with ↑ button

Press ENTER to select choice.

Choose Standard or Digital with ↑ button

Press ENTER to select choice.

SLOW FILL RATE

10

CLEAR PRESET / ◀ / SCROLL ENTER / RATE

FULL FILL RATE

1000

CLEAR PRESET / ◀ / SCROLL ENTER / RATE

BATCH COUNT MODE

Up Down

◆ / SCROLL ENTER / RATE

MAXIMUM BATCH PRESET

1000.0 gal

CLEAR PRESET / ◀ / SCROLL ENTER / RATE

BATCH OVERRUN COMP

Off Auto Manual

◆ / SCROLL ENTER / RATE

**Notes**

Enter the Slow Fill Rate. Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

Enter the Full Fill Rate (Fast Fill Rate). Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

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.

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.

Select Manual to enter observed overrun. Select Auto to set the unit to operate using a Batch Ove run Compensation routine. Select OFF to inhibit Batch Ove run Compensation routine. (See Section 5.5)
### Sub-menus

<table>
<thead>
<tr>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Overrun Comp</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Flow Signal Timeout</strong></td>
<td>Enter a time out of 0 to 99 seconds. If a batch is &quot;Filling&quot; and zero flow persists for more than this time, the batch will be aborted. Use CLEAR, † and ‡ to create value. Press ENTER to store.</td>
</tr>
<tr>
<td><strong>Maximum Drain Time</strong></td>
<td>Enter time (0-99 sec.) for Max. Drain Time. After batch quantity is reached, &quot;Batch Done&quot; is declared when the flow rate is &quot;0&quot; 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.</td>
</tr>
<tr>
<td><strong>Slow Start Quantity</strong></td>
<td>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.</td>
</tr>
</tbody>
</table>

**Advance To**

**Select Flow Equation**
### 6.4.3 SELECT FLOW EQUATION

**Display**

- **SELECT FLOW EQUATION**
  - ENTER / RATE

**Notes**

Press ENTER to enter Select Flow Equation submenus.

Use ‹ to select choice. Press ENTER when desired flow equation is flashing.

Advance To

**SETUP INDICATORS**

(Total)

### 6.4.4 SETUP INDICATORS (Total)

**Display**

- **SETUP INDICATORS**
  - ENTER / RATE

**Notes**

Press ENTER to begin setup of the Indicators.

Use ‹ to select choice. Press ENTER when Total is flashing to configure the Totalizer Indicators.

Enter the desired Total Descriptor using CLEAR, ‹ and ENTER to store.

Enter the desired Volume Units Label for the Totalizer using CLEAR, ‹ and ENTER to store.

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

Advance To

**SETUP INDICATORS**

(Density)

### 6.4.5 SETUP INDICATORS (Density)

**Display**

- **SETUP INDICATORS**
  - ENTER / RATE

**Notes**

Use ‹ to select choice. Press ENTER when Dens is flashing to configure the Density Indicators.

Enter the desired Density Descriptor using CLEAR, ‹ and ENTER to store.

Enter the desired Mass Units Label for Density using CLEAR, ‹ and ENTER to store.

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

Advance To

**SETUP INDICATORS**

(Rate)
6.4.6 SETUP INDICATORS (Rate)

**Sub-menus**

<table>
<thead>
<tr>
<th>Setup Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dens</td>
</tr>
<tr>
<td>✈ / SCROLL</td>
</tr>
</tbody>
</table>

**Display**

**Rate Time Base**

Sec Min Hour Day

CLEAR ✈ / SCROLL ENTER / RATE

**Rate Descriptor**

Rate

CLEAR ✈ / SCROLL ENTER / RATE

**Rate Dec Places**

0

CLEAR PRESET / ✈ / SCROLL ENTER / RATE

**Rate Avg Filter**

0

CLEAR PRESET / ✈ / SCROLL ENTER / RATE

**Quick Update %**

5

CLEAR PRESET / ✈ / SCROLL ENTER / RATE

**Notes**

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)

**Sub-menus**

<table>
<thead>
<tr>
<th>Setup Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dens</td>
</tr>
<tr>
<td>✈ / SCROLL</td>
</tr>
</tbody>
</table>

**Display**

**Temp Descriptor**

Temp

CLEAR ✈ / SCROLL ENTER / RATE

**Temperature Scale**

Deg_C | Deg_F

✈ / SCROLL ENTER / RATE

**Temp Dec Places**

0

CLEAR ✈ / SCROLL ENTER / RATE

**Notes**

Use ✈ to select choice. Press ENTER when Temp is flashing to configure 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.
### 6.4.8 SETUP FLOW INPUT (Pulse - Ain & PS (A=B))

**SETUP FLOW INPUT**

Press ENTER to begin setup of Flow Input.

**EXCITATION VOLTAGE**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>5v</th>
<th>12v</th>
<th>24v</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/ SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**FLOW INPUT TYPE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Pulse</th>
<th>Analog</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/ SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**PULSE INPUT TYPE**

<table>
<thead>
<tr>
<th>Type</th>
<th>PS(A=B)</th>
<th>Qx1</th>
<th>Qx2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/ SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**PULSE TRIGGER LEVEL**

<table>
<thead>
<tr>
<th>Level</th>
<th>10mV</th>
<th>100mV</th>
<th>2.5V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/ SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**LOW PASS FILTER**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>40Hz</th>
<th>3KHz</th>
<th>20KHz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/ SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**INPUT TERMINATION**

<table>
<thead>
<tr>
<th>Type</th>
<th>Pullup</th>
<th>Pulldown</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/ SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**MAX WINDOW (1-99)**

<table>
<thead>
<tr>
<th>Count</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLEAR ◀ / SCROLL ENTER / RATE</strong></td>
<td></td>
</tr>
</tbody>
</table>

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

**K_FACTOR TYPE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Avg</th>
<th>LinTbl</th>
<th>UVC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/ SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**AVERAGE K_FACTOR**

<table>
<thead>
<tr>
<th>Palgal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRESET ◀ / CLEAR / SCROLL ENTER / RATE</strong></td>
</tr>
</tbody>
</table>

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

**LINEAR TABLE KA**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>ka--01:</th>
<th>Palgal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLEAR PRESET ◀ / PRESET ◀ / CLEAR ◀ / SCROLL ENTER / RATE</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

**HIGH FLOW RATE ALARM**

<table>
<thead>
<tr>
<th>gal/m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLEAR PRESET ◀ / PRESET ◀ / CLEAR ◀ / SCROLL ENTER / RATE</strong></td>
</tr>
</tbody>
</table>

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.
### 6.4.9 SETUP FLOW INPUT

(Pulse - Quadrature, Qx1 or Qx2)

<table>
<thead>
<tr>
<th>Setup Flow Input</th>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENTER / RATE</strong></td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**Excitation Voltage**

- 5v
- 12v
- 24v

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

**Flow Input Type**

- Pulse
- Analog

Enter the desired Pulse type. Use † to select choice and ENTER to store selection.

**Pulse Type**

- Ain
- PS(A=B)
- Qx1
- Qx2

See side note.

**Pulse Trigger Level**

- 10mV
- 100mV
- 2.5V

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

**Low Pass Filter**

- 40Hz
- 3KHz
- 20KHz

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

**Input Termination**

- Pullup
- Pulldown
- None

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

**Max Window (1-99)**

- 1

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

**K_Factor Type**

- Avg
- LinTbl
- UVC

Select the desired K-Factor Type. Use † to select choice and ENTER to store selection.

If Avg selected, Enter the desired Average K-Factor (KA for channel A). Use CLEAR, † and † to create value. Press ENTER to store.

Enter the desired Average K-Factor (KB for channel B). Use CLEAR, † and † to create value. Press ENTER to store.

Continue on next page
6.4.9 SETUP FLOW INPUT
(Pulse - Quadrature, Qx1 or Qx2) Continued

**Linear Table KA**
- Fre01:######## Hz
  - CLEAR PRESET / ● / SCROLL ENTER / RATE

**Linear Table KB**
- KA--01:####### P/gal
  - CLEAR PRESET / ● / SCROLL ENTER / RATE

**Low Flow Rate Alarm**
- ####### gal/m
  - CLEAR PRESET / ● / SCROLL ENTER / RATE

**High Flow Rate Alarm**
- ####### gal/m
  - CLEAR PRESET / ● / SCROLL ENTER / RATE

Advance To
SETUP AUX INPUTS

If LinTbl selected,
Enter the desired frequency/ K-Factor pair for each point in the Linearization Table. (channel A)

**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 frequency/ K-Factor pair for each point in the Linearization Table. (channel B)

**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.

Use CLEAR, ● and ◆ to create value. Press ENTER to store.

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.
6.4.10 SETUP
FLOW INPUT (Analog)

Press ENTER to begin setup of the Flow Input.

Select the desired Excitation Voltage. Use \( \uparrow \) to select choice and ENTER to store selection.

Press ENTER when Analog is flashing to configure the flow input for Analog signals. Use \( \uparrow \) to select choice.

Choose Analog Signal Type. Use \( \uparrow \) to select choice and ENTER to store selection.

If Voltage selected, Choose desired Voltage Range. Use \( \uparrow \) to select choice and ENTER to store selection.

If Current selected, Choose desired Current Range. Use \( \uparrow \) to select choice and ENTER to store selection.

Select the desired Linearization Type. Use \( \uparrow \) to select choice and ENTER to store selection.

If LinTbl selected, Enter the desired Apparent Input Flow (APR) / Correction Factor (CFr) pair for each point in the Linearization Table.

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.

Use CLEAR, \( \uparrow \) and \( \downarrow \) to create value. Press ENTER to store.

Enter the low flowrate corresponding to the low analog signal. Use CLEAR, \( \uparrow \) and \( \downarrow \) to create value. Press ENTER to store.

Enter the High flowrate corresponding to the High analog signal. Use CLEAR, \( \uparrow \) and \( \downarrow \) to create value. Press ENTER to store.

Enter the desired Low Flow Cutoff. Use CLEAR, \( \uparrow \) and \( \downarrow \) to create value. Press ENTER to store.

Enter the desired volumetric Low Rate Alarm. Use CLEAR, \( \uparrow \) and \( \downarrow \) to create value. Press ENTER to store.

This will trigger an alarm message if alarm conditions occur. The relays are not affected.
### 6.4.10 SETUP

#### FLOW INPUT

(Analog) Continued

---

**Notes**

**6.4.11 SETUP**

**AUX INPUT**

---

**Display**

- **HIGH FLOW RATE ALARM**
  - **gal/m**
  - **CLEAR PRESET:**
  - **/ SCROLL ENTER / RATE**

**Advance To**

- **SETUP AUX INPUT**

---

**Notes**

**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.**

**Press ENTER to begin setup of the Auxiliary Input.**

**Select Temperature to set the Auxiliary Input for Temperature inputs. Use ▲ to select choice and ENTER to store selection.**

**Choose Temperature Signal Type. Advance to "Aux Default", if RTD selected. Use ▲ to select choice and ENTER to store selection.**

**If Voltage selected, Choose desired Voltage Range. Skip if RTD. Use ▲ to select choice and ENTER to store selection.**

**If Current selected, Choose desired Current Range. Skip if RTD. Use ▲ to select choice and ENTER to store selection.**

**Enter the low temperature scale corresponding to the low temperature signal. Skip if RTD. Use CLEAR, ▲ and ▼ to create value. Press ENTER to store.**

**Enter the high temperature scale corresponding to the high temperature signal. Skip if RTD. Use CLEAR, ▲ and ▼ to create value. Press ENTER to store.**

**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.**

**Enter the Low setpoint for the Temperature Alarm. Use CLEAR, ▲ and ▼ to create value. Press ENTER to store.**

**Enter the High setpoint for the Temperature Alarm. Use CLEAR, ▲ and ▼ to create value. Press ENTER to store.**

**Choose the Density Extraction method to be used. Use ▲ to select choice and ENTER to store selection.**

---

**SUB-MENUS**

### 6.4.11 SETUP

**AUX INPUT**

---

**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.
6.4.12 SET FLUID PROPERTIES

Press ENTER at this prompt to Set Fluid Properties.

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.

Enter the Reference Temperature. Use CLEAR, ‹ and › to create value. Press ENTER to store.

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.

Enter the Calibration Density. Use CLEAR, ‹ and › to create value. Press ENTER to store. This is used in calculation of flow for analo inputs using SQRT.

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.

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.

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
SETUP PULSE OUTPUT
6.4.13 SETUP PULSE OUTPUT

Press ENTER at this prompt to setup the Pulse Output.

Select the desired Pulse Output Usage. Use ◀ to select choice and ENTER to store selection.

Select the desired Pulse Width for the Pulse Output. Use ◀ to select choice and ENTER to store selection.

Enter the desired Pulse Value for the Pulse Output (Units per Pulse). Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

Advance To SETUP ANALOG OUTPUT

6.4.14 SETUP ANALOG OUTPUT

Press ENTER when Analog is flashing to setup the Analog Output.

Select the desired Analog Output Usage. Use ◀ to select choice and ENTER to store selection.

Only if Rate selected & Flow EQ. = Mass, Cor/Vol
Select the desired Analog Output Flow. Use ◀ to select choice and ENTER to store selection.

Enter the desired current range for the Analog Output. Use ◀ to select choice and ENTER to store selection.

Enter desired Analog Output Low Scale Value. Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

NOTE: Units label will correspond with output usage type selected.

Enter desired Analog Output Full Scale Value. Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

Enter the desired Analog Output Damping Constant. Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

Advance To SETUP RELAYS
6.4.15 SETUP RELAYS (Relay 1 & Relay 2)

NOTE:
In Batch mode, Relay 1 is reserved for Preset, Relay 2 is reserved for Prewarn.

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.

Select the desired Relay for setup. Use ◀ to select choice and ENTER to store selection.
(Relays 3 & 4 Optional)

If Relay 1 or Relay 2 Selected, Select Rate, Total or NA. Use ◀ to select choice and ENTER to store selection.

If Rate selected, enter desired relay activation delay value. Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

Select the desired Relay Activation. Use ◀ to select choice and ENTER to store selection.
Low: Relay activates when reading is below setpoint.
High: Relay activates when reading is above setpoint.

If Total Selected, Enter desired Relay Duration. Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.

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.

If Rate, selected, Enter desired Relay Hysteresis. Use CLEAR, ◀ and ◀ to create value. Press ENTER to store.
6.4.15 (Continued) SETUP RELAYS (Relay 3 & Relay 4)

NOTE: Settings for Relays 3 & 4 may be entered even if relays are not supplied. The settings will still trigger display alarms.

SUB-MENUS

SETUP RELAYS

Rly1 Rly2 Rly3 Rly4

*/SCROLL ENTER/RATE

RELAY 3 USAGE

Rate Tot Aux Ovr PMP

RELAY 4 USAGE

Rate Tot Aux Alrm NA

*/SCROLL ENTER/RATE

RELAY 3 DELAY sec

0 CLEAR PRESET/● ●/SCROLL ENTER/RATE

RELAY 3 MODE

LO_ALARM HI_ALARM

*/SCROLL ENTER/RATE

RELAY 3 DURATION

########

CLEAR PRESET/● ●/SCROLL ENTER/RATE

RELAY 3 SETPOINT

####### gal

CLEAR PRESET/● ●/SCROLL ENTER/RATE

RELAY 3 HYSTERESIS

####### gal/m

CLEAR PRESET/● ●/SCROLL ENTER/RATE

Advance To

SETUP CONTROL INPUTS

Select the desired Relay for setup. Use ‹ to select choice and ENTER to store selection. (Relays 3 & 4 Optional)

If Relay 3 Selected, Choose Rate, Total, Aux, Overun or Pump (on/off). Use ‹ to select choice and ENTER to store selection.

If Relay 4 Selected, Choose Rate, Total, Aux, Alrm or NA. Use ‹ to select choice and ENTER to store selection.

If Rate / Aux selected, enter desired relay activation delay value. Use CLEAR, ‹ and † to create value. Press ENTER to store.

Select the desired Relay Activation for Rate/Aux. Use ‹ to select choice and ENTER to store selection.

Low: Relay activates when reading is below setpoint.

High: Relay activates when reading is above setpoint.

If Total Selected, Enter desired Relay Duration. Use CLEAR, ‹ and † to create value. Press ENTER to store.

Enter the desired Setpoint. Use CLEAR, ‹ and † to create value. Press ENTER to store.

If Rate, selected, Enter desired Relay Hysteresis. Use CLEAR, ‹ and † to create value. Press ENTER to store.

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.
6.4.16 SETUP CONTROL INPUTS (RATE/TOTAL)

SUB-MENUS

Notes

Setup Control Inputs

Press Enter to begin setup of the Control Inputs.

Select the desired Control Input for setup. Use ◄ to select choice and ENTER to store selection.

If Control Input 1 Selected, Select Inhibit Total or NA (Not Assigned). Use ◄ to select choice and ENTER to store selection.

If Control Input 2 Selected, Select Reset Total or NA (Not Assigned). Use ◄ to select choice and ENTER to store selection.

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.

Note: Alarms may reassert themselves if alarm conditions are still present.

Advance to

SETUP REALTIME CLOCK

6.4.17 SETUP CONTROL INPUTS (BATCH)

SUB-MENUS

Notes

Setup Control Inputs

Select the desired Control Input for setup. Use ◄ to select choice and ENTER to store selection.

If Control Input 1 Selected, Select Start, Reset/Start, NA (Not Assigned). Use ◄ to select choice and ENTER to store selection.

If Control Input 2 Selected, Select Stop, Stop/Reset, NA (Not Assigned). Use ◄ to select choice and ENTER to store selection.

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.

Note: Alarms may reassert themselves if alarm conditions are still present.

Advance to

SETUP REALTIME CLOCK
### Sub-menus

#### 6.4.18 SETUP REALTIME CLOCK (Time)

**Display**

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>SETUP REALTIME CLOCK</td>
<td>SETUP REALTIME CLOCK</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td>ENTER / RATE</td>
</tr>
<tr>
<td>Time</td>
<td>Date</td>
</tr>
<tr>
<td>✧ / SCROLL ENTER / RATE</td>
<td>✧ / SCROLL ENTER / RATE</td>
</tr>
<tr>
<td><strong>CLOCK TYPE</strong></td>
<td><strong>CLOCK TYPE</strong></td>
</tr>
<tr>
<td>24HR</td>
<td>12HR</td>
</tr>
<tr>
<td>✧ / SCROLL ENTER / RATE</td>
<td>✧ / SCROLL ENTER / RATE</td>
</tr>
<tr>
<td><strong>SELECT CLOCK AM/PM</strong></td>
<td><strong>SELECT CLOCK AM/PM</strong></td>
</tr>
<tr>
<td>AM</td>
<td>PM</td>
</tr>
<tr>
<td>✧ / SCROLL ENTER / RATE</td>
<td>✧ / SCROLL ENTER / RATE</td>
</tr>
<tr>
<td><strong>TIME OF DAY HH:MM:SS</strong></td>
<td><strong>TIME OF DAY HH:MM:SS</strong></td>
</tr>
<tr>
<td>⬅️ CLEAR PRESET: ✧ ✧ / SCROLL ENTER / RATE</td>
<td>⬅️ CLEAR PRESET: ✧ ✧ / SCROLL ENTER / RATE</td>
</tr>
</tbody>
</table>

**Press Enter to begin setup of the Realtime Clock.**

**Select Time to set the time. Use ✧ to select choice and ENTER to store selection.**

**Select 24Hr or 12Hr clock. Use ✧ to select choice and ENTER to store selection.**

If 12Hr Clock, Enter AM or PM. Use ✧ to select choice and ENTER to store selection.

**Enter time of day. Use CLEAR, ✧ and ✧ to create value. Press ENTER to store selection.**

Advance To

SETUP REALTIME CLOCK (Date)

#### 6.4.19 SETUP REALTIME CLOCK (Date)

**Display**

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>SETUP REALTIME CLOCK</td>
<td>SETUP REALTIME CLOCK</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td>ENTER / RATE</td>
</tr>
<tr>
<td>Time</td>
<td>Date</td>
</tr>
<tr>
<td>✧ / SCROLL ENTER / RATE</td>
<td>✧ / SCROLL ENTER / RATE</td>
</tr>
<tr>
<td><strong>DATE: MONTH, DAY, YEAR</strong></td>
<td><strong>DATE: MONTH, DAY, YEAR</strong></td>
</tr>
<tr>
<td>###/###/####</td>
<td>###/###/####</td>
</tr>
<tr>
<td>⬅️ CLEAR PRESET: ✧ ✧ / SCROLL ENTER / RATE</td>
<td>⬅️ CLEAR PRESET: ✧ ✧ / SCROLL ENTER / RATE</td>
</tr>
</tbody>
</table>

Select Date to enter the date. Use ✧ to select choice and ENTER to store selection.

Enter the date. (Month, Day, Last two digits of Year). Use CLEAR, ✧ and ✧ to create value. Press ENTER to store.

Advance To

SERIAL USAGE
**6.4.20 SERIAL USAGE**

**Display**

**Press Enter to begin setup of the Serial Port.**

**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**

**Select the Device ID. Use CLEAR, ✧ and ✧ to create value. Press ENTER to store.**

**BAUD RATE**

**Select the desired Baud Rate. Use ✧ to select choice and ENTER to store selection. (If <more> selected)**

**PARITY**

**Select the desired Parity. Use ✧ to select choice and ENTER to store selection.**

**HANDSHAKING**

**Set the Handshake. Use ✧ to select choice and ENTER to store selection.**

**DEVICE LINE FEED**

**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**

**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**

**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**

**Select the desired Modem Auto Answer mode. Use ✧ to select choice and ENTER to store selection.**

**CALL OUT DAY OF WEEK**

**Enter the day of week to perform Call Out transmission. Use ✧ to select choice and ENTER to store selection.**

**CALL OUT TIME**

**Enter the time of day to perform Call Out transmission. Use CLEAR, ✧ and ✧ to create value. Press ENTER to store.**

**CALL ON ERROR/ALARM**

**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**
### 6.4.20 SERIAL USAGE (continued)

#### Sub-menus

<table>
<thead>
<tr>
<th>6.4.20 SERIAL USAGE (continued)</th>
</tr>
</thead>
</table>

#### Display

<table>
<thead>
<tr>
<th>CALL OUT PHONE #</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEAR PRESET/↑</td>
<td>/SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NUMBER OF REDIALS</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEAR PRESET/↑</td>
<td>/SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HANGUP IF 2MIN INACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>/ /SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

#### Notes

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.

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.

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

SETUP DATALOG/PRINT

#### 6.4.21 SETUP DATALOG/PRINT (Configure)

<table>
<thead>
<tr>
<th>SETUP DATALOG/PRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTER / RATE</td>
</tr>
</tbody>
</table>

SELECT CONFIG |

<table>
<thead>
<tr>
<th>OUTPUT FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printer Term Dbase</td>
</tr>
<tr>
<td>ENTER / RATE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAGE LENGTH [66 max]</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
</tr>
<tr>
<td>CLEAR PRESET/↑</td>
</tr>
<tr>
<td>/SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOP MARGIN [60 max]</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>CLEAR PRESET/↑</td>
</tr>
<tr>
<td>/SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATALOG ONLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>/ /SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRINT TIME HH:MM:SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00</td>
</tr>
<tr>
<td>CLEAR PRESET/↑</td>
</tr>
<tr>
<td>/SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRINT INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00</td>
</tr>
<tr>
<td>CLEAR PRESET/↑</td>
</tr>
<tr>
<td>/SCROLL ENTER/RATE</td>
</tr>
</tbody>
</table>

Press Enter to setup the Datalog/Print information.

Select Config to configure the Datalog/Print information. Use ↑ to select choice and ENTER to store selection.

Select the type of Output Format. Use ↑ to select choice and ENTER to store selection.

Enter the desired Page Length. If Printer selected above. Use CLEAR, ↑ and ↓ to create value. Press ENTER to store.

Enter the desired Top Margin. If Printer selected above. Use CLEAR, ↑ and ↓ to create value. Press ENTER to store.

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.

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.

Enter Print Interval, Enter 00:00:00 to inhibit print interval. Use CLEAR, ↑ and ↓ to create value. Press ENTER to store.

Advance To

SETUP DATALOG/PRINT (Select_list)
<table>
<thead>
<tr>
<th>Sub-menus</th>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.4.21 SETUP</strong></td>
<td><strong>ENABLE PRINT KEY</strong></td>
<td>Select YES to enable Print Key. Select NO to disable Print Key. Use ◄ to select choice and ENTER to store selection.</td>
</tr>
<tr>
<td><strong>DATALOG/PRINT</strong></td>
<td><strong>PRINT END OF BATCH</strong></td>
<td>Batch mode only. Select Yes to print at end of batch. Use ◄ to select choice and ENTER to store selection.</td>
</tr>
<tr>
<td><strong>(Configure)</strong></td>
<td><strong>SET DATALOG/PRINT</strong></td>
<td>Press enter to begin Setup Datalog/Print routine.</td>
</tr>
<tr>
<td><strong>Continued</strong></td>
<td><strong>SET DATALOG/PRINT</strong></td>
<td>Press enter when Select_list is selected to setup print list. Use ◄ to select choice and ENTER to store selection.</td>
</tr>
<tr>
<td></td>
<td><strong>PRINT LIST ITEMS</strong></td>
<td>Use ◄ to view list status. 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.</td>
</tr>
<tr>
<td></td>
<td><strong>PRINT LIST ITEMS</strong></td>
<td>The Select Print List Information display shows the current possible Datalog size.</td>
</tr>
</tbody>
</table>

List Items:
- TOTAL
- RATE
- PRE1
- TEMP
- GRAND
- PRE2
- DENS
- TIME

Advance To
ADCNTRALISTE SETUP
6.4.23 ADMINISTRATIVE SETUP

Sub-menus

Display

Notes

ENTER / RATE

ADMINISTRATIVE SETUP

Press Enter to begin Administrative Setup.

ENTER / RATE

TAG NUMBER

Enter Tag Number. Use CLEAR, ↑ and ↓ to create value. Press ENTER to store.

CLEAR PRESET / △ / SCROLL ENTER / RATE

FT####

OPERATOR PASSWORD

Enter Operator Password. (Factory Set to 0)

Use CLEAR, ↑ and ↓ to create value. Press ENTER to store.

CLEAR PRESET / △ / SCROLL ENTER / RATE

*****

SUPERVISOR PASSWORD

Enter Supervisor Password. (Factory Set to 2000)

Use CLEAR, ↑ and ↓ to create value. Press ENTER to store.

CLEAR PRESET / △ / SCROLL ENTER / RATE

*****

SOFTWARE VERSION

This display is used to show the software version of the installed software.

ENTER / RATE

vxx.xx

PRODUCT ORDER CODE

This display is used to show the product order code (model number).

ENTER / RATE

xxxxxxxxxxxxxxxx

UNIT SERIAL NUMBER

This display is used to show the unit’s serial number.

ENTER / RATE

00000

SENSOR SERIAL NUMBER

This display is used to show the sensor’s serial number. Use CLEAR, ↑ and ↓ to create value. Press ENTER to store.

CLEAR PRESET / △ / SCROLL ENTER / RATE

00000

Advance To

SETUP NETWORK CARD
### Sub-menus

<table>
<thead>
<tr>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **6.4.24 SETUP**  
**NETWORK CARD** (optional) | Press Enter to setup Network Card |
| **SELECT NTW PROTOCOL**  
ModbusRTU | Select desired Network Protocol. |
| **NETWORK DEVICE ID**  
1 | Enter the device address on network (00-255). Use CLEAR, ◀ and ▲ to create value. Press ENTER to store. |
| **BAUD RATE**  
2400 4800 9600 19200 | Select the desired Baud Rate. Use ◀ to select choice and ENTER to store selection. |
| **PARITY**  
None Odd Even | Select the desired Parity. Use ◀ to select choice and ENTER to store selection. |

Advance To  
**SELECT EZ SETUP?**

### 6.4.25 SETUP  
**DISPLAY LIST** (configuration)

<table>
<thead>
<tr>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **SELECT OPERATE STATE**  
Run Setup Test | Use ◀ to move cursor to DISP then press ENTER to select. |
| **SELECT DISPLAY ITEM**  
Total Line Two | 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**  
Rate Line One | Repeat the steps above for all the available items: TOTAL, RATE, PRE 1, TEMP, GRAND, PRE 2, DENS, TIME. Press ENTER on last item to save selections and return to SELECT OPERATE STATE |

Return To  
**SELECT OPERATE STATE**
7. Principle Of 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.

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.

7.3 Flow Equations:

Input Flow Computation:

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

Orifice
Input Flow = [(√% input span) * (flow FS - flow low scale)] + flow low sc

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.Coe. * (Tf-Tref))^2

Density Transmitter
density = [% input span * (density FS - density low scale)] + density low scale
7.3 Flow Equations: (Continued)

Flow Equations

Input Viscosity Computation:

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

Where: centistokes = cP/(kg/l)

Uncompensated Flow Computation:

**Pulse Input; Average K-Factor**

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

**Pulse Input; Linear Table**

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

**Pulse Input; UVC**

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

**Analog Input; Linear**

Volume Flow = \(\text{input flo}\)

**Analog Input; Linear Table**

Volume Flow = \(\text{input flow} \times \text{correction factor (input flo)}\)

**Analog Input; Orifice or External SQRT**

Volume Flow = \(\sqrt{\frac{\text{calibrated density}}{\text{density}}}\)

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

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

Corrected Volume Flow Computation:

**Temperature Transmitter**

Standard Volume Flow = \(\text{volume flow} \times (1 - \text{Therm. Exp. Coef.} \times (\text{Tf} - \text{Tref}))^2\)

**Density Transmitter**

Standard Volume Flow = \(\frac{\text{density}}{\text{reference density}}\)

Mass Flow Computation:

Mass Flow = \(\text{volume flow} \times \text{density}\)
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

\[
\alpha_b = \frac{K_0}{\rho_b^0} + \frac{K_1}{\rho_b^0}
\]  

(2.188)

where the base density \(\rho_b^0\) 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

\[
\rho_f^* = \rho_b^0 \exp \left[ -\alpha_b \Delta T_f (1 + 0.8\alpha_b \Delta T_f) \right]
\]

(2.189)

where \(\Delta T_f = T_f - 60\). The specific gravity at flowing or measured temperature is then

<table>
<thead>
<tr>
<th>TABLE 2.23</th>
<th>Constants (K_0) and (K_1) for Five Product Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product group</td>
<td>(K_0)</td>
</tr>
<tr>
<td>Crude oils and JP4(^\dagger)</td>
<td>341.0957</td>
</tr>
<tr>
<td>Jet fuels, kerosenes, solvents</td>
<td>330.3010</td>
</tr>
<tr>
<td>Gasolines and naphthenes</td>
<td>192.4571</td>
</tr>
<tr>
<td>Lubricating oils</td>
<td>144.0427</td>
</tr>
<tr>
<td>Diesel oil, heating oils, fuel oils</td>
<td>103.8720</td>
</tr>
</tbody>
</table>

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


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

\[
\text{Spec.Grav.} = \frac{\text{Density of Fluid}}{\text{Density of Water}}
\]

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:

\[
C = \left[1 - \sqrt{\frac{\text{Spec.Grav.}^2}{\text{Ref.Spec.Grav.}}} \right] \times 1,000,000
\]

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

\[
C = \left[1 - \sqrt{\frac{\text{Dens.}^2}{\text{Ref.Dens.}}} \right] \times 1,000,000
\]
7.5 Computation of Viscosity Coef. A and 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 your 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:

\[
B = \frac{(T_1 + 459.67) \cdot (T_2 + 459.67) \cdot \ln \left( \frac{cP_1}{cP_2} \right)}{(T_2 + 459.67) - (T_1 + 459.67)}
\]

\[
A = \frac{cP_1}{\exp \left( \frac{B}{(T_1 + 459.67)} \right)}
\]

**NOTE:** $c_S = \frac{cP \cdot \text{Density of Water at } 4^\circ \text{C}}{\text{Density of Liquid}}$
7.6 Linearization Table

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.

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.

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.

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.

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

\[
\frac{H - Y}{X - Y} \times (\frac{KA}{KB}) + KB = KN
\]
8. Test, Service and Maintenance

8.1 Test Menus

<table>
<thead>
<tr>
<th>Menus</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8.1.1 TOP LEVEL TEST MENUS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SELECT OPERATE STATE</strong></td>
<td>Use → to select Test to enter the instrument test &amp; calibration routine. <strong>NOTE:</strong> Supervisor (Service) password required to gain access to this mode.</td>
</tr>
<tr>
<td>Run Setup</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td>Test</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td>Disp</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td><strong>ENTER / RATE</strong></td>
<td></td>
</tr>
<tr>
<td>Audit Trail</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td>Error history</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td>Print System Setup</td>
<td>Refer to Page 52 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 53 Details.</td>
</tr>
<tr>
<td>Keypad Test</td>
<td>Refer to Page 53 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 53 for Details.</td>
</tr>
<tr>
<td>Display test</td>
<td>Refer to Page 53 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Pages 54 - 57 for Details.</td>
</tr>
<tr>
<td>Calibrate</td>
<td>Refer to Pages 54 - 57 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 58 Details.</td>
</tr>
<tr>
<td>Analog In Test</td>
<td>Refer to Page 58 Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 59 for Details.</td>
</tr>
<tr>
<td>Pulse input test</td>
<td>Refer to Page 59 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 59 for Details.</td>
</tr>
<tr>
<td>Analog out test</td>
<td>Refer to Page 59 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 59 for Details.</td>
</tr>
<tr>
<td>Excitation out test</td>
<td>Refer to Page 60 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 60 for Details.</td>
</tr>
<tr>
<td>Pulse out test</td>
<td>Refer to Page 60 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 60 for Details.</td>
</tr>
<tr>
<td>Relay Test</td>
<td>Refer to Page 60 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 60 for Details.</td>
</tr>
<tr>
<td>Control inputs test</td>
<td>Refer to Page 61 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 61 for Details.</td>
</tr>
<tr>
<td>Battery Voltage Test</td>
<td>Refer to Page 61 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td>Refer to Page 61 for Details.</td>
</tr>
<tr>
<td>Data logger utility</td>
<td>Refer to Page 61 for Details.</td>
</tr>
<tr>
<td>PRESET/↑</td>
<td></td>
</tr>
</tbody>
</table>
### 8.2 Test Sub-Menus

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

#### 8.2.4 Keypad test Submenu Group

<table>
<thead>
<tr>
<th>Keypad test</th>
<th>Press Enter to enter keypad test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENTER / RATE</strong></td>
<td>Press the various keys and the display will show the key that was pressed. Press Menu to exit the test</td>
</tr>
<tr>
<td><strong>MENU</strong></td>
<td>Press Menu to get back to Keypad test top-level menu.</td>
</tr>
</tbody>
</table>

#### 8.2.5 Display test Submenu Group

<table>
<thead>
<tr>
<th>Display test</th>
<th>Press Enter to enter display test.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENTER / RATE</strong></td>
<td>Upon pressing enter the each digit on the display will scroll 0-9 then A-Z. Press menu to exit the test.</td>
</tr>
<tr>
<td><strong>MENU</strong></td>
<td>Press Menu to get back to Display test top-level menu.</td>
</tr>
</tbody>
</table>
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.

Press Enter to begin the calibration routine. (Please note the caution above)

Connect Current Source (+) TB1-3, (-) TB1-4. Input 0mA and press Enter.

The display will automatically return to the Calibrate CH1 0mA submenu. Press the arrow button to advance to the CH1 20mA calibration.

Connect Current Source (+) TB1-3, (-) TB1-4. Input 20mA and press Enter.

The display will automatically return to the Calibrate CH1 20mA submenu. Press the arrow button to advance to the CH2 0mA calibration.

Advance to Calibrate ch2 0mA
8.2.8 Calibrate CH2 0mA Submenu Group

Calibrate ch2 0mA
Iin=TB1-8 GND=TB1-4

8.2.9 Calibrate CH2 20mA Submenu Group

Calibrate ch2 0mA
Iin=TB1-8 GND=TB1-4

Advance to Calibrate ch1 0V

Notes

To Calibrate: Connect Current Source (+) TB1-8, (-) TB1-4. Input 0mA and press Enter.

This message is displayed during calibration.

This message is displayed when the 0mA calibration is finished.

The display will automatically return to the Calibrate CH2 0mA submenu. Press the arrow button to advance to the CH2 20mA calibration.

To Calibrate: Connect Current Source (+) TB1-8, (-) TB1-4. Input 20mA and press Enter.

This message is displayed during calibration.

This message is displayed when the 20mA calibration is finished.

The display will automatically return to the Calibrate CH2 20mA submenu. Press the arrow button to advance to the CH1 0V calibration.
8.2.10 Calibrate CH1 0V Submenu Group

**Display**

Calibrate ch1 0V

V_in=TB1-2 GND=TB1-4

**Notes**

To Calibrate: Connect Voltage Source (+) TB1-2, (-) TB1-4. Input 0V and press Enter.

This message is displayed during calibration.

0 CALIBRATING ——

This message is displayed when the 0V calibration is finished.

*** DONE ***

The display will automatically return to the Calibrate CH1 0V submenu. Press the arrow button to advance to the CH1 10V calibration.

Calibrate ch1 10V

I_in=TB1-2 GND=TB1-4

8.2.11 Calibrate CH1 10V Submenu Group

**Display**

Calibrate ch1 10V

**Notes**

To Calibrate: Connect Voltage Source (+) TB1-2, (-) TB1-4. Input 10V and press Enter.

This message is displayed during calibration.

0 CALIBRATING ——

This message is displayed when the 10V calibration is finished.

*** DONE ***

The display will automatically return to the Calibrate CH1 10V submenu. Press the arrow button to advance to the CH2 0V calibration.
### 8.2.12 Calibrate CH2 0V Submenu Group

#### Display

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrate ch2 0V</td>
<td>To Calibrate: Connect Voltage Source (+) TB1-5, (-) TB1-4. Input 0V and press Enter.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td>This message is displayed during calibration.</td>
</tr>
<tr>
<td>Calibrate ch2 0V 0 CALIBRATING ---</td>
<td></td>
</tr>
<tr>
<td>Calibrate ch2 0V *** DONE ***</td>
<td>This message is displayed when the 0V calibration is finished.</td>
</tr>
<tr>
<td>Calibrate ch2 0V Iin=TB1-5 GND=TB1-4</td>
<td>The display will automatically return to the Calibrate CH2 0V top-level menu. Press the arrow button to advance to the CH2 10V calibration.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
</tr>
<tr>
<td>Calibrate ch2 10V 0 CALIBRATING ---</td>
<td></td>
</tr>
<tr>
<td>Calibrate ch2 10V *** DONE ***</td>
<td></td>
</tr>
<tr>
<td>Calibrate ch2 10V Iin=TB1-5 GND=TB1-4</td>
<td></td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
</tr>
<tr>
<td>Advance to Calibrate 100 ohm RTD</td>
<td></td>
</tr>
</tbody>
</table>

### 8.2.13 Calibrate CH2 10V Submenu Group

#### Display

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrate ch2 10V</td>
<td>To Calibrate: Connect Voltage Source (+) TB1-5, (-) TB1-4. Input 10V and press Enter.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td>This message is displayed during calibration.</td>
</tr>
<tr>
<td>Calibrate ch2 10V 0 CALIBRATING ---</td>
<td></td>
</tr>
<tr>
<td>Calibrate ch2 10V *** DONE ***</td>
<td>This message is displayed when the 10V calibration is finished.</td>
</tr>
<tr>
<td>Calibrate ch2 10V Iin=TB1-5 GND=TB1-4</td>
<td>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.</td>
</tr>
</tbody>
</table>
| ENTER / RATE | }

### 8.2.14 Calibrate 100 ohm RTD Submenu Group

#### Display

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrate 100 ohm RTD</td>
<td>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.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td>This message is displayed during calibration.</td>
</tr>
<tr>
<td>Calibrate 100 ohm RTD 0 CALIBRATING ---</td>
<td></td>
</tr>
<tr>
<td>Calibrate 100 ohm RTD *** DONE ***</td>
<td>This message is displayed when the RTD calibration is finished.</td>
</tr>
<tr>
<td>Calibrate 100 ohm RTD JMP TB1-6,7 100R=7,8</td>
<td>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.</td>
</tr>
<tr>
<td>ENTER / RATE</td>
<td></td>
</tr>
<tr>
<td>Advance to Calibrate 4mA out</td>
<td></td>
</tr>
</tbody>
</table>
### Sub-menus

#### 8.2.15 Calibrate 4mA Out Submenu Group

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrate 0mA out</td>
<td>Connect ammeter to (+) TB1-15, (-) TB1-16. Press enter.</td>
<td>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.</td>
</tr>
<tr>
<td>Calibrate 0mA out Enter mA: 0.00000</td>
<td>The display will return to Calibrate 0mA out. Press the ↑ arrow button to advance to Cal. 20mA out or repeat above if necessary.</td>
<td></td>
</tr>
<tr>
<td>Calibrate 0mA out + TB1-15 - TB1-16</td>
<td>Connect ammeter to (+) TB1-15, (-) TB1-16. Press enter.</td>
<td>To trim 20mA output: Press CLEAR, ↑ and ↓ to begin editing and enter the current reading that is on the ammeter display. Press enter.</td>
</tr>
<tr>
<td>Calibrate 20mA out</td>
<td>The display will automatically return to the Calibrate 20mA out submenu. Calibration is complete.</td>
<td></td>
</tr>
<tr>
<td>Calibrate 20mA out Enter mA: 20.00000</td>
<td>Press the Menu key to go back to Calibrate top-level menu.</td>
<td></td>
</tr>
<tr>
<td>Calibrate 20mA out + TB1-15 - TB1-16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 8.2.16 Calibrate 20mA Out Submenu Group

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrate 20mA out</td>
<td>Connect ammeter to (+) TB1-15, (-) TB1-16. Press enter.</td>
<td></td>
</tr>
<tr>
<td>Calibrate 20mA out Enter mA: 20.00000</td>
<td>To trim 20mA output: Press CLEAR, ↑ and ↓ to begin editing and enter the current reading that is on the ammeter display. Press enter.</td>
<td></td>
</tr>
<tr>
<td>Calibrate 20mA out + TB1-15 - TB1-16</td>
<td>Press the Menu key to go back to Calibrate top-level menu.</td>
<td></td>
</tr>
<tr>
<td>Calibrate 20mA out + TB1-15 - TB1-16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 8.2.17 Analog In Test Submenu Group

<table>
<thead>
<tr>
<th>Sub-menu</th>
<th>Display</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog In Test</td>
<td>Press enter to test the analog inputs.</td>
<td></td>
</tr>
<tr>
<td>Analog In Test Volts T2:00.000 T5:00.000</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Analog In Test mA T3:00.000 T8:00.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog In Test OHMS RTD 00.000</td>
<td>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%.</td>
<td></td>
</tr>
</tbody>
</table>

Press Menu key to return to Analog In Test top-level menu.
8.2.18 Pulse input test Submenu Group

**Sub-menus**

**Display**

Pulse input test

**Notes**

Press Enter key to test the pulse input.

Use the ◁ arrow button to select the appropriate trigger level. Press ENTER.

Use the ◁ arrow button to select the appropriate frequency range. Press ENTER.

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.

Press Menu key to return to Pulse input test top-level menu.

8.2.19 Analog out test Submenu Group

**Sub-menus**

**Display**

Analog out test

**Notes**

Press Enter to test the analog output.

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.

Press Menu key to return to Analog out test top-level menu.

8.2.20 Excitation out test Submenu Group

**Sub-menus**

**Display**

Excitation out test

**Notes**

Press Enter to test the excitation output.

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.

Press Menu key to return to Excitation out test top-level menu.
### Sub-menues

#### 8.2.21 Pulse out test Submenu Group

**Display**

<table>
<thead>
<tr>
<th>Pulse out test</th>
</tr>
</thead>
</table>

**Notes**

Press Enter key to test the pulse output.

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.

Press Menu key to return to Pulse out test top-level menu.

#### 8.2.22 Relay test Submenu Group

**Display**

<table>
<thead>
<tr>
<th>Relay Test</th>
</tr>
</thead>
</table>

**Notes**

Press Enter to test the relays.

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.

Press Menu key to return to Relay Test top-level menu.

#### 8.2.23 Control input test Submenu Group

**Display**

<table>
<thead>
<tr>
<th>Control inputs test</th>
</tr>
</thead>
</table>

**Notes**

Press Enter to test the control inputs.

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.

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

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RX</td>
</tr>
<tr>
<td>2</td>
<td>COM</td>
</tr>
<tr>
<td>3</td>
<td>TX/RC +</td>
</tr>
<tr>
<td>4</td>
<td>TX/RC –</td>
</tr>
<tr>
<td>5</td>
<td>GND 180REF</td>
</tr>
<tr>
<td>6</td>
<td>COMMUNICATION</td>
</tr>
</tbody>
</table>

**RS-232**

**RS-485**
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 (Uploading a file).

The program can monitor outputs from the unit while it is running.

The program can reset alarms and totalizers.

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

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.
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 range 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:
\[(\text{OLD DATA} \times \text{Avg. Filter} + \text{NEW DATA}) / (\text{Avg. Filter} + 1)\]
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.
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:

<table>
<thead>
<tr>
<th>TYPE OF ERROR</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor/Process Alarms</td>
<td>Errors detected due to sensor failure or process alarm conditions</td>
</tr>
<tr>
<td>Self Test Errors</td>
<td>Errors detected during self test.</td>
</tr>
<tr>
<td>System Alarms</td>
<td>Errors detected due to system failure</td>
</tr>
</tbody>
</table>

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.

Is there an input power supply voltage across Terminals 23 and 24?  
Yes, No

Is there a black bar across the display?  
Yes, No

Does the display alternate between blank and sign on message?  
Yes, No

Does the display show an error message?  
Yes, No

No system or process errors present.
## 13.3 Error & Warning Messages:

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

### 13.3.1 Sensor/Process Alarms

- **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: • Faulty Wiring • Transmitter not set to "4-20 mA" • Transmitter defective. Check wiring, Check function of sensor.
- **RTD OUT OF RANGE**: Input current at RTD input too low: • Faulty wiring • RTD defective. Check wiring, Check function of RTD sensor.
- **RATE OVERFLOW ERROR**: Pulse counter overflowed. The remote totalizer may have lost counts. Report error to factory, Check application conditions, Check wiring.
- **PULSE OUT OVERFLOW**: Calculated pulse frequency too large: • Pulse width setting too long • Larger pulse scaler needed. Adjust pulse value, Adjust pulse width, Check process conditions.
- **FLOW RATE ALARM LOW** • Check application if necessary, Check limit value, Adjust the limit value if required.
- **FLOW RATE ALARM HIGH** • Check application if necessary, Check limit value, Adjust the limit value if required.
- **TEMP ALARM LOW** • Check valves in system for proper operation and/or leaks, Check limit value, Adjust the limit value if required.
- **TEMP ALARM HIGH** • Check valves in system for proper operation and/or leaks, Check limit value, Adjust the limit value if required.
- **DENSITY ALARM LOW** • Check valves in system for proper operation and/or leaks, Check limit value, Adjust the limit value if required.
- **DENSITY ALARM HIGH** • Check valves in system for proper operation and/or leaks, Check limit value, 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, Check limit value, 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., Check modem connection and cycle power to Batcher, 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, Investigate brownout cause.
### 13.3 Error & Warning Messages: (Continued)

#### 13.3.2 Self Test Alarms

<table>
<thead>
<tr>
<th>Error/Warning Message</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLOW INPUT TOO HIGH</strong></td>
<td>Analog input signal of the flow input exceeded by more than 3%:</td>
<td>• Check analog signal range</td>
</tr>
<tr>
<td></td>
<td>• Sensor overranged</td>
<td>• Check the application conditions</td>
</tr>
<tr>
<td></td>
<td>• Incorrect full scale setting of flowmeter</td>
<td>• Check wiring</td>
</tr>
<tr>
<td></td>
<td>• Function error in transmitter or faulty wiring</td>
<td></td>
</tr>
<tr>
<td><strong>AUX INPUT TOO HIGH</strong></td>
<td>Analog input signal of the auxiliary input exceeded by more than 3%:</td>
<td>• Check analog signal range</td>
</tr>
<tr>
<td></td>
<td>• Sensor overranged</td>
<td>• Check the application conditions</td>
</tr>
<tr>
<td></td>
<td>• Incorrect full scale setting of transmitter</td>
<td>• Check wiring</td>
</tr>
<tr>
<td></td>
<td>• Function error in transmitter or faulty wiring</td>
<td></td>
</tr>
<tr>
<td><strong>FLOW INPUT TOO LOW</strong></td>
<td>Analog input signal of the flow input fell below the low scale range</td>
<td>• Check wiring</td>
</tr>
<tr>
<td></td>
<td>by more than 3% of full scale value:</td>
<td>• Check calibration of flowmeter</td>
</tr>
<tr>
<td></td>
<td>• Flowmeter not set to 4-20 mA</td>
<td>• Check function of flowmeter</td>
</tr>
<tr>
<td></td>
<td>• Function error in transmitter or faulty wiring</td>
<td></td>
</tr>
<tr>
<td><strong>BATTERY LOW WARNING</strong></td>
<td>Battery voltage too low</td>
<td>• Replace Battery</td>
</tr>
<tr>
<td><strong>A to D NOT CONVERTING</strong></td>
<td>Fault in analog/digital converter</td>
<td>• Unit may self correct, Press ENTER to acknowledge &amp; clear alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If error reasserts, factory service is required</td>
</tr>
<tr>
<td><strong>TIME CLOCK ERROR</strong></td>
<td>The correct time/date is no longer shown</td>
<td>• Re-enter time and date,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If error occurs again contact factory</td>
</tr>
<tr>
<td><strong>CAL CHECKSUM ERROR</strong></td>
<td>Calibration constants have been corrupted</td>
<td>• Report error to factory</td>
</tr>
<tr>
<td><strong>SETUP CHECKSUM ERROR</strong></td>
<td>The units setup has been corrupted</td>
<td>• Report error to factory</td>
</tr>
</tbody>
</table>
These functions will only appear with appropriate settings in other functions.
APPENDIX B - Batching Diagrams

Typical Batcher Application with STANDARD Valve(s)

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

Two Stage Batch Cycle

Single Stage Batch Cycle

Flowrate

Start Batch

Fast Fill

Slow Fill

End Batch

Time

Flowrate

Start Batch

Fast Fill

End Batch

Time
Typical Batcher Application with DIGITAL CONTROL VALVE

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

<table>
<thead>
<tr>
<th>STX Relay 1</th>
<th>STX Relay 2</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>ON</td>
<td>Opening Valve (increase flow rate)</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Hold Position (maintain flow rate)</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Closing Valve (reduce flow rate)</td>
</tr>
</tbody>
</table>

Batch Cycle with Digital Control Valve

Digital Control Valve

DIGITAL CONTROL VALVE Diagram

DIGITAL CONTROL VALVE Wiring

Flowrate

Preset 2 Slow End of Fill Amount

Preset 1 End of Batch

Fast Fill Flow Rate

Slow Fill Flow Rate

Dead Band

Preset 2 Slow Start of Fill Amount

Preset 1 End of Batch

Power Rate

Time

STX-ST1 - Explosion Proof SUPERtrol-I
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

Example STX-ST1

| 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