INSTALLATION & OPERATION MANUAL

IT400

Remote Totalizer & Rate Indicator

Document # MN-IT400.doc

Revision: Original

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IDEX CORPORATION

Notice

Proprietary Notice

The information contained in this publication is derived in part from proprietary data and trade secrets. This information has been prepared for the expressed purpose of assisting operating and maintenance personnel in the efficient use of the instrument described herein. Publication of this information does not convey any rights to use or reproduce it or to use for any purpose other than in connection with the installation, operation and maintenance of the equipment described herein.

SAFETY INSTRUCTIONS

The following instructions must be observed.

- Every effort has been made to design and manufacture this instrument to be safe for its intended use. 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.
- An auto-resettable fuse internally protects this instrument. To reset the fuse, remove all power from the unit for one minute.
- The manufacturer assumes no liability for damage caused by incorrect use of the instrument or for modifications or changes made to the instrument.

Technical Improvements

Sponsler, Inc. may modify the technical data herein without notice.

Table of Contents

Description

General Unit Operation

The **IT400** Remote Totalizer and Rate Indicator is a microcontroller based flow instrument capable of translating flow information and conditions to the built-in display and various outputs.

Features

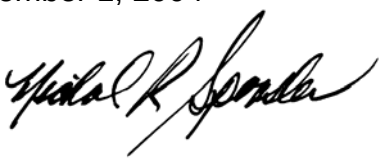
- Pulse input supports turbine as well as many other pulse-type flowmeters
- All features/configuration settings are available via field programmability
- Independent rate/total display
- Magnetically operated internal switches maintain enclosure integrity
- Built-in digital multimeter and simulation functions for testing
- 2-20 point Linearization available
- Non-resettable “Grand” totalizer
- All outputs are fully opto-isolated (not RS-232)
- RS-232 port available
- Temperature compensation (RTD probe) available
- Backlight and backlight timer for low light display viewing
- Autoranging Rate display (decimal point will shift based on the size of the rate)
- Selectable power modes for customized battery life

CE Declaration of Conformity

This is to certify that the listed equipment below conforms to the listed Directive and Product Standard.

Name of Manufacturer:	Sponsler, Inc. A Unit of IDEX Corporation 2363 Sandifer Boulevard Westminster, SC 29693 USA
Type of Equipment:	Flow Totalizer
Conforming Models:	IT400-DC-TRCL-X-RFARS2D (and derivatives)
Directive/Product Standard:	EMC Directive 89/336/EEC using EN61326
Equipment Type/Environment:	Normal Locations

Sponsler Company, Inc.
Date: September 1, 2004



Signature:
Title: President

Specifications

- **Display**
  - Total
    - 8 digit 5.40mm high LCD (continuous display)
      - Batch total (magnetic reset)
      - Grand total (no reset)
  - Rate
    - 5 digit 8.66mm high LCD (continuous display)
    - Range over/under limit indication
    - Refresh rate: Multiple depending on power mode (1/16s, 1/8s, 1/4s, 1s, 0.5s)
  - Backlighted green w/ LED (magnetically activated and timed)
  - Dual segment low-battery warning
  - Maintenance due warning
  - Temperature range warning
- **Power:**
  - Internal: D Lithium battery
    - Battery life: Various: typical per power mode: 1: 1yr, 2: 1yr; 3: 3.6yr; 4: 3yr; 5: 8yr
  - External DC: 5 to 48VDC reverse polarity protected
  - Loop: requires 7VDC of loop supply
    - Loop powered from the 4-20mA loop input (non-isolated)
- **K-Factor range**
  - Pulses per gallon: 0.0000001 to 999999
- **Signal Input (flow)**
  - Frequency: 0-3000Hz
  - Impedance: 10k ohms
  - Magnetic
    - Sensitivity: 50mV-36V (field adjustable) sine or square wave
  - Modulated carrier
    - Carrier frequency 50kHz (requires external power or loop power)
- **Compensation Input**
  - Temperature - RTD
    - Two wire 10k ohm
    - Coefficient of Thermal Expansion method
  - Frequency
    - Linearization table 2 to 20 points
- **Engineering Unit Conversions**
  - Pre-programmed units: Gallons, Liters, Ft^3, M^3, Pounds, BBL, KG (custom weight available)
    - Custom units available with given units/gallon
  - Rate and Total may have separate unit displays
- **Decimal Locations**
  - Total: Two places (and x10, x100)
  - Rate: Three places (and x10, x100), autorange
- **Time Base**
  - Rates can be displayed in units per second, minute, hour, day, and custom (in seconds)
- **Outputs**
  - Factored Pulse (150mA, 30VDC max)
    - Opto-isolated open collector output
    - Frequency or fixed pulse width (1, 2, 5, 10, 50, 100, & custom ms) output setting
    - Output pulse Divider: 1, 2, 5, 10, 50, 100, 1000, & custom
  - Alarm (150mA, 30VDC max)
    - Programmable opto-isolated open collector output
    - Can be used to control totalization
  - Rate (4-20mA)
    - Factored rate to current loop output
    - Programmable low and high
    - Fully isolated (unless loop powered)
- **Accuracy**
  - Display: ±0.01% reading (rate) or ± 1 count (total)
  - Analog output: ±0.025% of fs @20°C
  - Digital output: ±1 count
- **Environmental**
  - Operating: -30 to 75°C (-22 to 167°F)
  - Storage: -40 to 85°C (-40 to 185°F)
- **Enclosure**
  - Explosion Proof Aluminum
    - FM Approved, CSA Certified
    - Class I, Division1, Groups B, C, & D
    - Class II, Division 1, Groups E, F, & G
    - NEMA 4
    - Weight: 2.5lbs.
    - Mounts directly on flowmeter
- **Compliance**
  - CE, UL(pending), CSA (pending)
- **Communications**
  - RS-232
  - MMC Flash media card data logger
- **Other features**
  - EEPROM parameter/setup storage (>100 year retention)
  - All features/settings are field programmable. Convenient number input via 0-9 rotary switch and two pushbuttons

Wiring and Hookup Diagrams

The **IT400** has many connections all made through the bottom/mounting board. It is recommended to remove the battery when connecting wires to the connectors and when plugging the connectors into their sockets.

Wiring

In order to maintain the rated CE marking, the following practices must be followed:

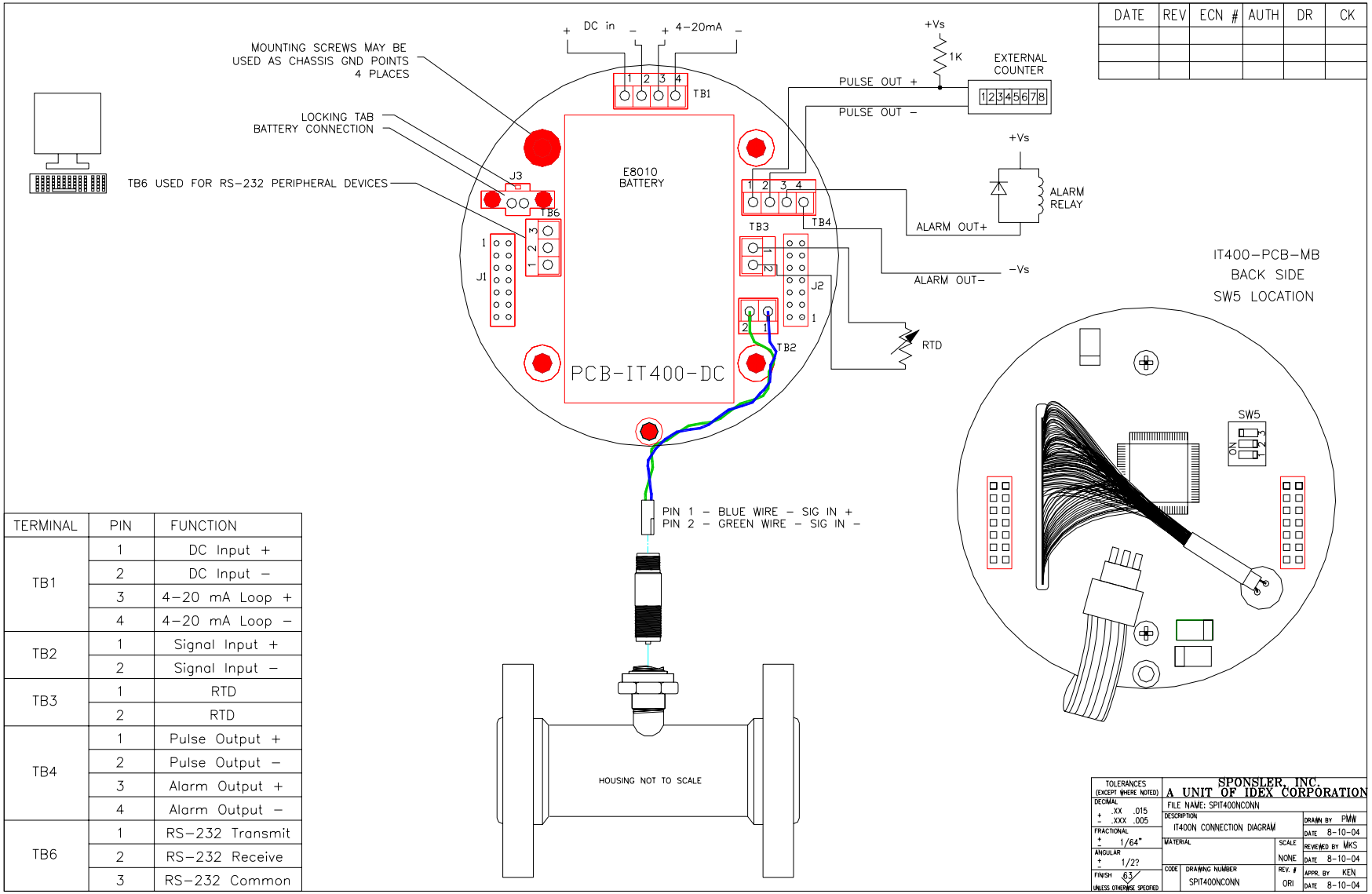
- All wires connected to the **IT400** must be shielded (exception: SI supplied signal cable).
  - All shields must be connected to one of the internal mounting screws to achieve their ground connection.
  - It is recommended that the non-**IT400** end of these shields is left unconnected. This will help avoid ground loops and unexpected behavior.
  - It is recommended that only one spade type terminal be used on each of the screws. Care should be taken to avoid shorting any spade with other circuitry on the mounting board.
  - Shields should not cover more than one pair of signal wires at a time.
- The **IT400**'s chassis must be connected to an earth ground via the screw attached to the outside of the unit. At least a 12 AWG preferably green wire is recommended.
- All connections are to be made to the unit via rigid conduit.
- Except for DC Power and the 4-20mA loop connections, no wires are to exceed 100 feet long.

If no wires are required for a particular installation; the only requirement is the chassis ground connection.

Battery Removal and Installation

Battery Removal: Unscrew the **IT400** cover, press and hold the menu button until the option to reset the totalizer appears, the totalizer/grand totalizer/service timer will be saved to memory. Using two fingers inserted in the slots on the top and bottom of the main board overlay, gently rock the board top to bottom while pulling straight out. If this is done too quickly or unevenly, the main board will be damaged. After the main board is removed, the battery is accessible by opening the hook-loop strap. Once the battery is loose, the battery clip is removed by compressing the locking tab on the connector (locking tab is on the top of the connector {J3}) and pulling it out.
Battery installation: Reverse the process for installation. Ensure the battery connector key is in the proper orientation prior to insertion.

Diagrams:



TERMINAL	PIN	FUNCTION
TB1	1	DC Input +
	2	DC Input -
	3	4-20 mA Loop +
	4	4-20 mA Loop -
TB2	1	Signal Input +
	2	Signal Input -
TB3	1	RTD
	2	RTD
TB4	1	Pulse Output +
	2	Pulse Output -
	3	Alarm Output +
	4	Alarm Output -
TB6	1	RS-232 Transmit
	2	RS-232 Receive
	3	RS-232 Common

Figure 1 IT400 Connections

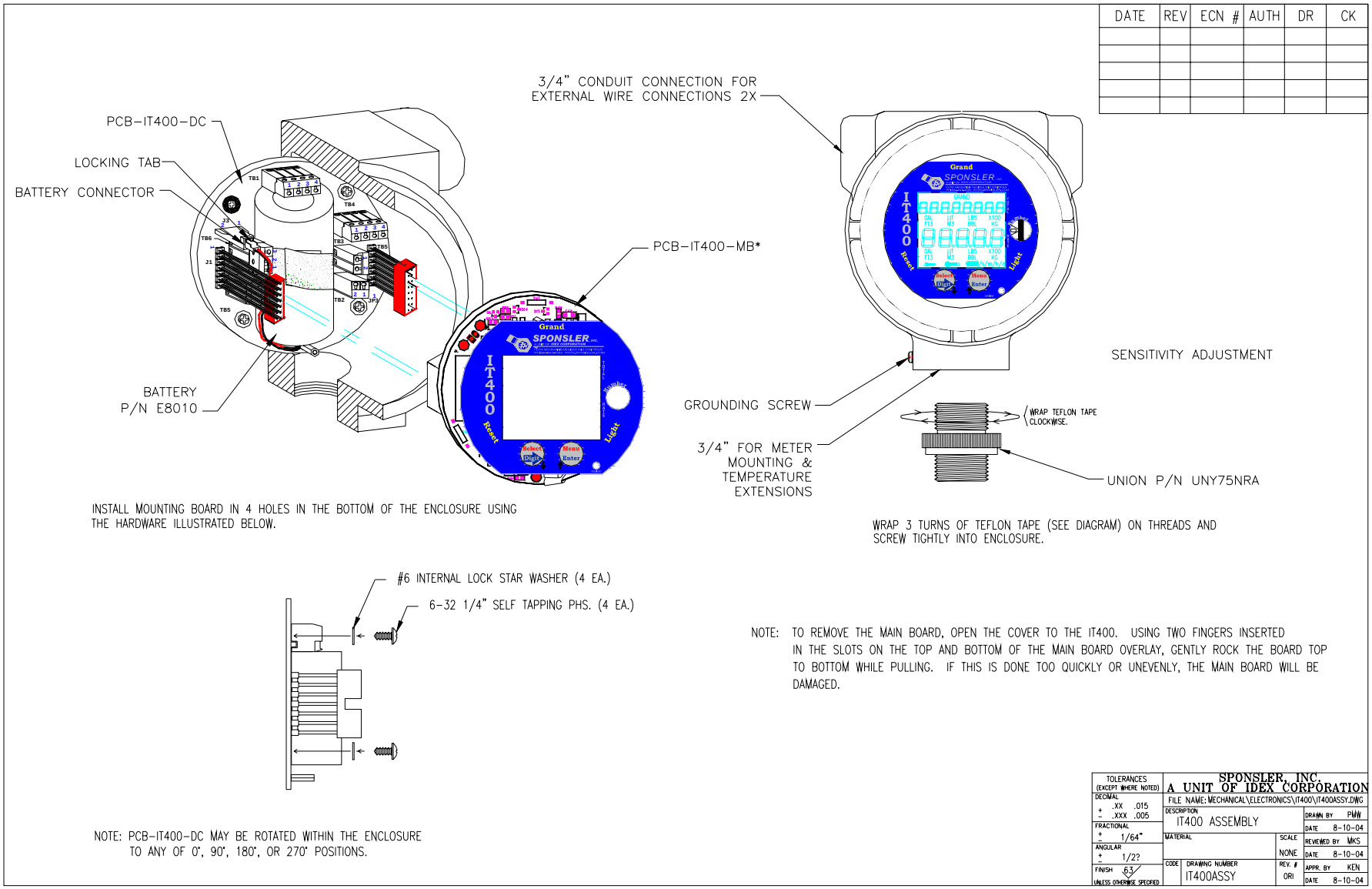


Figure 2 IT400 Board Stack Assembly and Battery Removal

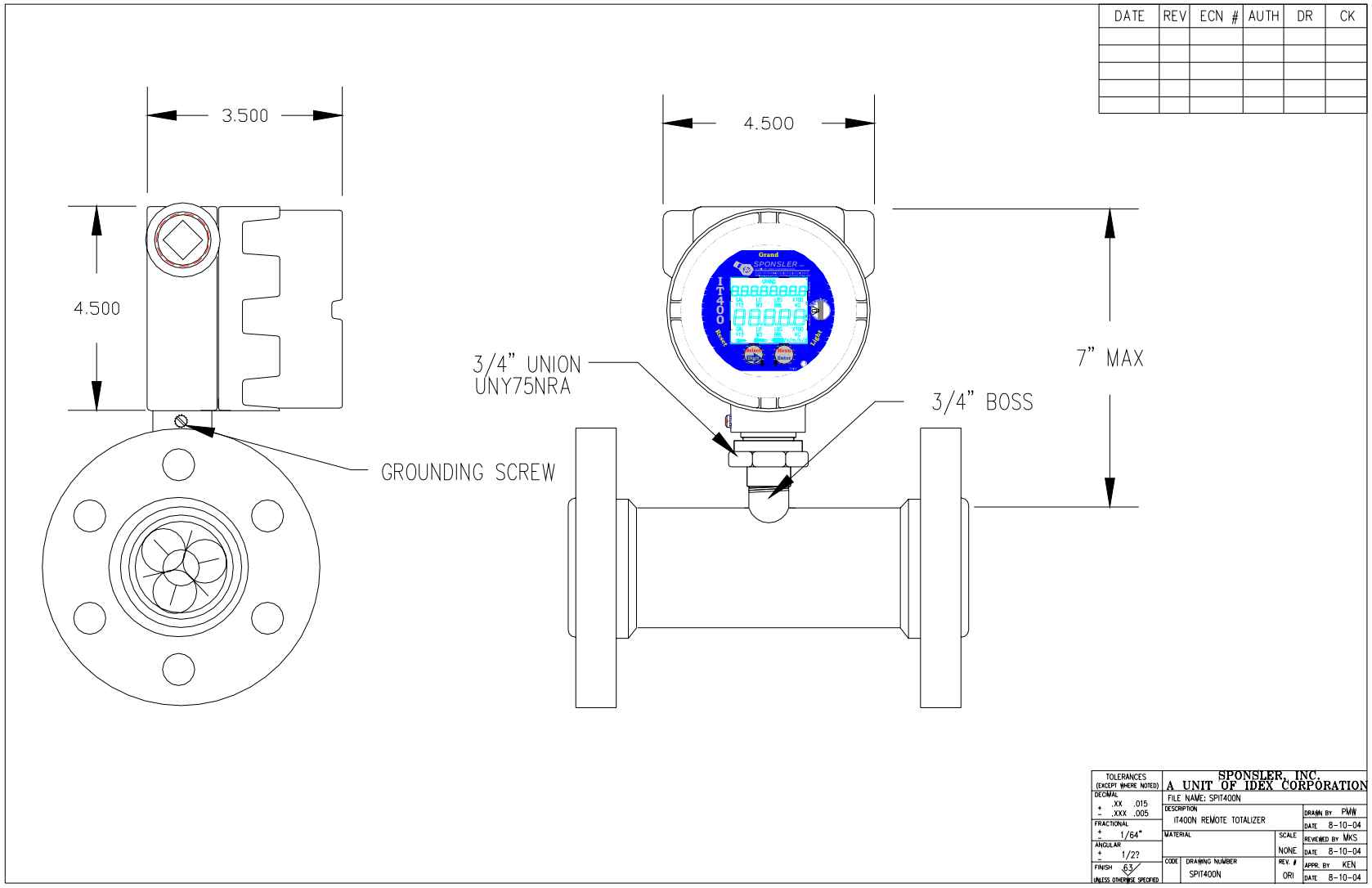


Figure 3 Meter Mounting and Dimensional

IT400 Operational Overview

The **IT400** flowmeter system will perform the necessary calculations to provide the user with an optional temperature compensated and optional linearized output of the following values:

- Rate
- Total
- Grand total
- Errors/warnings
- Various outputs

Calibration

Calibration of the IT400 is accomplished using either a linear K-Factor (pulses per gallon) or a linearized K-Factor linearization table (when the linearizer is enabled). Independent unit conversion factors and decimal points are available for the rate and total displays. Calibration and configuration data are stored in an onboard EEPROM for permanent storage. Calibration of the IT400's reference circuitry is factory set and is not user accessible. Calibration of the IT400's reference circuitry should be performed by factory trained service personnel.

Temperature Compensation

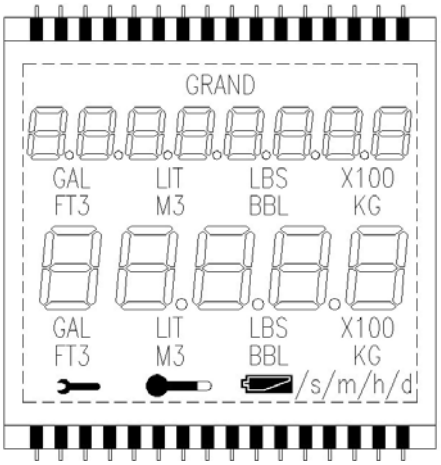
The temperature compensator utilizes a platinum RTD to detect the process temperature. Process temperature is used in conjunction with the reference temperature and Coefficient of Thermal Expansion of the measured liquid (menu items) to adjust the rate and total values. When the temperature compensation is enabled, the temperature warning annunciator (thermometer on the LCD) will indicate when the process temperature is out of a programmable range. Optionally, an alarm output as well as a totalizer inhibit function can also be tied to this temperature warning. Various Coefficient of Thermal Expansions and their reference temperatures can be found in the appendix. The temperature circuit and associated algorithm, when enabled, increase the IT400 current consumption from the power source and diminish battery life to if running solely from the battery. A programmable delay function has been provided in order to minimize the impact of the temperature sampling on the battery life. The delay feature specifies the number of seconds between temperature value samples. The higher the delay, the longer the battery life.

Linearization

The linearizer utilizes a linear interpolation algorithm to calculate the rate and total based on a set of calibration data points programmed by the user. The linearizer has21 points, the first point (lowest) is automatically set at zero hertz, the remaining 2 to 20 are user programmable. The linearizer table must have at least two data points in addition to the first (fixed) point and must be ascending in frequency from the first point to the last. To have fewer than 20 points in the linearizer table, after the last desired linearization point add one additional point and set the frequency at zero. Zero is an invalid frequency; this will indicate the end of the table. The IT400 will not allow frequencies to be entered out numerical order. Frequencies between zero and the first programmed point will use the K-Factor of the first programmed point.

LCD Display

The LCD display has three main areas: The 8 digit totalizer, 5 digit rate indicator, and the annunciators.



8 digit Total

5 digit Rate

- The 8-digit totalizer shows the total number of units of volume through put of the flowmeter since the last time the totalizer was reset. The totalizer is resettable by 2 methods, via a magnetic reed switch in the lower left side of the unit and by menu. The grand total is displayed as long as a magnet is placed near the top of the face of the unit. The word "GRAND" indicates the displayed value is the grand total It should be noted that grand should be activated prior to battery replacement to save total/grand total values to non-volatile memory. Engineering unit annunciators display the units and decimal place selected to compute total and grand total values. The grand totalizer uses engineering unit is programmed for the totalizer.
- The 5-digit rate display shows the rate of the flowmeter throughput. If the rate exceeds the range of the meter, "-oL-" is displayed. "-UL-" is displayed when the rate is under the range of the meter. Both warnings are displayed until normal flowrate resumes. The totalizer is not affected by this warning unless programmed to inhibit totalizer when out of range. The range limits are established by the programmed 4-20mA output setpoints in the menu system. Indicators on the display also show the engineering units of volume, time and decimal place used to compute the rate value.
  Note: When the Grand Total magnetic reed switch is activated (and **GRAND** is displayed on the screen), the rate display will display the current rate regardless of the range limits. This is helpful when troubleshooting flow condition problems when the 4-2-mA lower rate setpoint is set above zero.
- Refresh rate of the display of the unit happens at pre-determined intervals depending on the selected power mode (see "Power"). Once the power mode is programmed (in the menu), the refresh rate is fixed. This prevents a low refresh rate from being automatically selected which could cause measurement delay.
- Other display annunciators. These are warning indicators and do not inhibit the operation of the unit (unless explicitly enabled to do so by the alarm option). These indicators may however indicate the condition causing an inaccurate reporting of rate or total information.
  - Wrench – The service annunciator is user programmable to a specific amount of "turbine hours" (active flowmeter hours).
  - Thermometer – The thermometer annunciator is displayed any time the temperature compensator is enabled and the process temperature is out of range.
  - Battery – The battery annunciator is composed of two segments. The segments indicate the level of the battery charge, like an automotive gas gauge.
    - Two segments – The battery is within normal operating voltage range.

- One segment – A replacement battery should be acquired and installed. This will also cause lower temperature limits on the RTD temperature circuit.
- No segments – The battery must be replaced to guarantee accurate reporting.

User Controls

There are two main groups of user controls, internal and external. The internal controls are only accessible when the enclosure cover is removed. The external controls are magnetically accessed by strategic placement of a magnet along the outside of the unit.

- Internal
  - **Menu** / **Enter** Button – This button is used primarily within the menu system. Press this button at any time during **RUN mode** to enter the menu system. **Note:** the higher the power mode, the longer the button will need to be held down for it to trigger the menu system.
  - **Select** / **Digit** Button – This button is also used primarily within the menu system. However, when the temperature compensation option is purchased and enabled, pressing this button while in **RUN mode** causes the 5-digit display to indicate the current process temperature in degrees Fahrenheit.
  - **Number** Dial – The **number** dial is only used while selecting values or editing numbers while in the menu system. The **number** dial is disabled in **RUN mode**.
- External

  Magnetic Switches – There are three magnetically activated reed switches located around the edge of the **IT400** (indicated on the front panel with yellow text). These switches allow external activation of the following functions:

  Grand – The following actions are taken when the grand reed switch is activated:
  The total display will indicate the value of the grand totalizer.
  The rate display will indicate the current rate regardless of any out of range warning conditions.
  The **GRAND** annunciator will indicate.
  The **IT400** will store the values of the grand totalizer, the totalizer, and the elapsed service time to non-volatile memory. This is useful if the **IT400** is to be removed from service (replace battery, recalibrate, etc).

  Light – When activated, the backlight timer will be engaged according to the chart in the Backlight section.

  Reset – When activated, the main totalizer will be reset.

Note: The internal user controls are described in more detail in the **Menu** section.

Non-User interfaces

Non-user interfaces are those that are wired to external devices. 4-20mA rate output and open collector pulse output are standard, open collector alarm output, and RS-232 interface are optional.

- **4-20mA rate output** is a linear representation of flow rate between the programmed low and high setpoints.

  Example: A flowmeter has a calibrated range of 10 to 100gpm, the desired low and high setpoints of the 4-20mA output are 10 and 100 respectively. Using these values, the **IT400** will calculate and output the proper current reading for a given flowrate.

Given a flow rate of 25gpm, the current loop reading will be 6.667mA. The output engineering units are the same as for the rate display.

Note: For loop powered operation, refer to the **Power** section.

Note: The **IT400** requires 7VDC of the loop supply.

- **Pulse output** is an open collector design. A pull up resistor is required for interface with most systems. An output pulse occurs with each increment of the totalizer if a pulse output divider of 1 has been programmed. For programmed pulse divider values other than 1 the output pulse will occur at the divided value. Functions for a frequency output, pulse width, and pulse output divider are programmable. When the frequency output is not selected, pulses are output in bursts at each refresh.

  Example: The totalizer increments 15 pulses (over the last refresh rate increment) and the pulse output divider is 5. The number of output pulses that will be generated will be 3.

  Note: If the output pulse width programmed exceeds the time required to output the proper number of output pulses an *E* will be displayed in the left-most character of the total display. The IT400 will output as many pulses as time permits at the programmed pulse width.

  Example: At a maximum flow of 900gpm the proper number of output pulses is 15 per second, but the pulse width is programmed to 100ms and the pulse divider to 1. The 15 pulses would take 1.5 seconds (15x100ms); only 10 pulses would be outputted. Either the pulse width must be reduced or if acceptable the divider increased.

  Guideline: calculate the maximum output pulse width:

  Maximum pulse width = 1/(output pulses per second/output pulse divider)

  Using the example above – 1/(15/1) = 66.6ms is maximum pulse width.

- **Alarm output** is an open collector output that can be used to externally indicate the presence of several out of range conditions. These conditions include: temperature, flow rate, and battery level. The ranges of temperature and flow rate are edited in their respective sections of the **Menu** system. The Battery low level is factory set. Any Alarm condition of the enabled alarms will activate the alarm output. Identical to the output pulse, a pull up resistor is required to interface with most systems.
- **RS-232 interface** allows calculated values of the unit to be viewed upon request. To use this interface, a serial device (computer or datalogger) is used to poll the **IT400** by sending one of the listed letters (the letter by itself) to the serial port. No carriage return is necessary. The **IT400** will reply with the requested data and a CR+LF. The BAUD rate is fixed at 9600 baud 8N1. The functions available on this interface are:

R – Rate	Z – Reset Totalizer	K – K Factor
T – Total	Q – Total CF	L – Linearizer Table
G – Grand total	W – Rate CF	F – Process Temperature (Deg F)

Note: Using the RS-232 interface when loop powered will cause errors in the loop reading.

Inputs

The **IT400** has four inputs: RS-232 interface, user interface, temperature, and input signal.

- **RS-232** interface is described above.
- **User** interface is described above.
- **Temperature** input is a standard 2-wire platinum RTD temperature probe (0.385 TCR). The temperature probe is typically mounted within a few inches downstream of the attached

flowmeter. The temperature input will increase the drain rate on the battery when the **IT400** is battery powered. The temperature input is ignored if the temperature compensator is disabled.

- **Signal** input from practically any frequency generating device producing a sinusoidal signal, a square wave pulse or can be connected to a modulated carrier pickup coil.

  Sinusoidal signal: low amplitude crossing signal that doesn't exceed the **IT400**'s input specification. This signal can come directly from the pickup coil sensing rotation of the attached Sponsler, Inc. turbine flowmeter or other flowmeter device.
  Square signal: any zero referenced pulse that doesn't exceed the **IT400**'s input specification.
  Modulated carrier: derived by modulating a carrier signal of the pickup coil caused by the change in impedance resulting from the rotor blades passing in proximity to the coil. This is an inductive coil therefore there is no drag on the rotor. MC coil operation is factory enabled only. MC coil operation requires DC or loop power.
  Note: SW5-3 must be "**On**" for MC coil operation when externally DC powered.

Backlight

The backlight is controlled by a combination of system parameters. The following table lists the operation of the backlight and how it is controlled by these various system parameters:

DC Powered	4-20mA Powered*	Battery Condition	bLitE value	Backlight in -run-	Backlight in Menu
Yes	Don't Care	Don't Care	Non-Zero	ON	ON
No	No	Good	Non-Zero	Timer	ON
No	No	Low	Don't Care	Manual	OFF
No	Yes**	Good	Non-Zero	Timer	ON
No	Yes	Don't Care	Don't Care	Manual	OFF
Don't Care	Don't Care	Don't Care	diSAbLEd	Manual	OFF

* SW5-1, SW5-2, & SW5-3 "**On**".
** SW5-3 "**Off**" (4-20mA loop to power modulated input and battery to power main circuit)
The front panel magnetic reed switch activates the backlight regardless of anything (as long as power is applied). Backlight activation may increment one additional input pulse.

Power

The **IT400** may be powered externally by any 5-48VDC source, 4-20mA loop, internally by battery, or by a combination of these. Power consumption is affected by programmed options, input signal frequency, and the programmed power mode.

- **External Power**
  - **DC:** 5-48VDC
  - **4-20mA Loop:** used to power the **IT400** or just the modulated carrier circuit (which requires more voltage than is available from the battery). The IT400 requires 7VDC of the loop supply.
- **Internal Battery:** functions either as a primary power source or as a backup to either of the external power sources. Battery life estimates are in the Power Mode chart below and are affected by the options enabled. The battery may be replaced at any time with the only side effect being a loss of normal operation (all calibration and configuration information is

maintained). Total, Grand Total, and service hours may be saved at any time by activating the **Grand Total** display or by entering the menu system. Upon system startup, the saved values will be retrieved.

External DC	Loop Isolation	Battery Powered	SW5-1	SW5-2	SW5-3	Main **IT400** Power	Modulated Carrier Power
Yes	Yes*	No	Off	Off	On	External	External
No	No**	No	On	On	On	Loop	Loop
No	No**	Yes	On	On	Off	Battery	Loop

*For External power, the loop isolation switches SW5-1, 2 must be "**Off**" (isolated).
** Loop powered operation, the loop isolation switches SW5-1, 2 must be "**On**" (non-isolated).

- **Power Mode:** controls the refresh rate of both the display and outputs of the **IT400** and is a user selectable menu item. Refresh times and approximate battery life are in the following table:

Mode	Refresh	Input frequency	Approximate Battery (years)
1	16 refreshes/s	0	
		500	
2	8 refreshes/s	0	
		500	
3	4 refreshes/s	0	6.5
		500	3.2
4	1 refreshes/s	0	
		500	
5	2s/refresh	0	
		500	

*Battery life calculations are worst case based on continuous flow, enabled linearizer, temperature compensator, 4-20mA output, and pulse output.

Enclosure

The **IT400** is contained in an explosion proof enclosure. This enclosure is typically meter mounted via a union or a temperature extension (consult factory for lengths and applications). There is typically a short wire (4 feet) that connects the **IT400** to an external temperature probe (a few inches downstream). Rigid conduit is recommended for this connection to maintain the explosion proof rating of the enclosure and to maintain CE marking.

Menu System

The **IT400**'s menu system is designed to allow a simple means of entering all of the data required for the system to perform its calculations. This section steps through the menu system and provides a description of each item. To enter the menu system, simply press **Menu**.

Button functions

Menu / **Enter** – The menu button advances through the menu system. When editing values, this button provides the "enter" function. **Note:** The menu may be exited while viewing any main menu item by pressing and holding **Menu**, then pressing and holding **Select**, then releasing **Menu**, next releasing **Select**.
Select / **Digit** – The select button is used to change values and edit numbers. To edit a displayed number, **Select** is pressed to allow editing. When editing numbers, each press of **Digit** shifts right the digit to be edited. When selecting between two values, **Select** is used (this includes YES/no, EnAbLEd/dI SAbLEd, and PoS/nEG)
Number – The number dial is used to set the current displayed item to a specific value. When editing numbers, the flashing number will change according to the number dial. When editing decimal placement of a number, the decimal point will change according to the number dial.

Editing numbers

Some menu items require the editing of a number. All three controls are used to edit the number. Here is a short example of editing the low temperature set point:

1. Number to be edited is displayed:
2. Press **Select** to edit the number.
3. If the number can be positive or negative, press **Select** to toggle between positive (PoS) and negative (nEG).

4. Press **Enter** to accept the desired sign.
5. Next, the actual number can be edited. Numbers are edited from left to right. The digit that is currently being edited will flash. Use the **Number** dial to change the flashing number to the desired value. If no change is needed, do not move the **Number** dial.

6. Press **Digit** to move the edit focus to the next digit. Repeat these steps as necessary to edit all the digits in the number.
7. Press **Enter** to accept the changes to the number.
8. If the number can have a decimal, the current decimal location will flash. Use the **Number** dial to change the flashing decimal to the desired location. If no change is needed, do not move the **Number** dial.
9. Press **Enter** to accept the decimal location.
10. In most cases, an opportunity to re-edit the number is presented.

Menu descriptions

The menu is composed of a list of editable items which control the operation of the **IT400**. This is a listing of all of the menu items. The **IT400** reverts to the **Run** Mode if no user input is detected within 30 seconds while viewing any of the following top level menu items (items without a decimal point).

1. Reset Totalizer

Resets the totalizer without using an external magnet. If the totalizer reset is set to no, the subsequent submenu is not displayed.

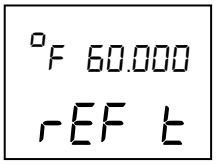
1.1 Reset Totalizer Done

This is an informational message that indicates that the main totalizer has been reset.

2. Temperature Compensation Enable

Displayed only if purchased as an option. Temperature compensation can be enabled or disabled. If compensation is dI SAbLEd, the next six sub-menus are skipped..

Note: If temperature compensation is dI SAbLEd, any low or high temperature alarms will be automatically set dI SAbLEd.



2.1 Reference Temperature

Temperature at which the Coefficient of Thermal Expansion is referenced. The temperature units are degrees Fahrenheit and must match the Coefficient of Thermal Expansion used in the next item (and is listed in the Appendix).

2.2 Coefficient of Thermal Expansion

The Coefficient of Thermal Expansion for select fluids can be found in the Appendix.

2.3 Temperature delay

The number of seconds to wait between temperature measurements. The shorter the delay, the more accurately the temperature profile will represent the flow. Shorter delay periods reduce battery life (when powered exclusively by battery). The 10s default is recommended. To edit the delay, turn the **Number** dial to select from one of the pre-programmed values, or select 15 (dial position 9) and edit the number for a custom delay. In **Run Mode**, the temperature annunciator will flash each time the temperature is sampled.

2.4 Edit Temperature Limits

The editing of the low/high temperature limits used for the on-screen temperature range warning and the alarm set points (if purchased) is allowed when YES is selected here. Temperature limits may be positive or negative.

2.5 Edit Low Temperature Limit

The minimum valid temperature before triggering a low temperature warning.

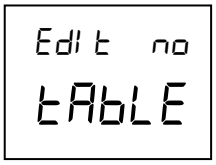
2.6 Edit High Temperature Limit

The maximum valid temperature before triggering a high temperature warning.
Note: If either of the temperature limits were edited, an opportunity to edit them will be redisplayed (return to menu 2.4 Edit Temperature Limits)

3. Linear Interpolation Enable

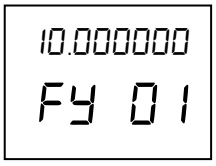
Displayed only if purchased as an option. Linear interpolation can be enabled or disabled. If linearization is dISAbLEd, the next three sub-menus are skipped.

3.1 Linear Interpolation Table Edit



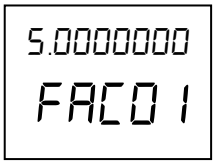
Permits the editing of the linearizer table and is only set if the linearizer has been enabled. If set to no, the linearizer table will not be edited and the menu system jumps to menu 4 (**K-Factor**) below. If the table is to be edited, the menu will step through the list of points in the order of frequency then K factor. The frequency values must be ascending starting with the first point being the lowest.
Note: To enter a table of fewer than 20 points in the linearizer table, after the last desired linearization point add one additional point and set the frequency to zero. Example: For 15 point linearization, set the frequency for point 16 to zero.
Note: The table must have at least two points.

3.2 Frequency Input



Permits setting of the frequency of a given run in the linearizer. The number listed on the display indicates which point in the table is being edited. Frequencies must be in ascending order (point 1 is the lowest frequency). When the frequency is set, press **Enter** to accept.
Note: If a frequency point is entered that is not ascending, the device will restore the original value and return to the frequency for that point.

3.3 K-Factor Input



Allows the setting of the K-Factor of a given point in the linearizer. The number listed on the display indicates which point in the table is being edited. When the K-Factor is set, press **Enter** to accept.
Note: If the table was edited, upon accepting the last K-Factor, the menu will return to menu 3.1 Linear Interpolation Table Edit.
Note: The table edit may be exited while viewing any K-Factor by pressing and holding **Menu**, then pressing and holding **Select**, then releasing **Menu**, then releasing **Select**.

4. K-Factor

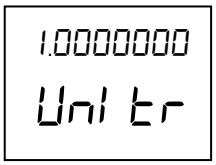
Only available if the linearizer is dISAbLEd. The K-Factor is the non-linearized base meter factor and is always in pulses per gallon. Both total and rate displays use this K-factor in their base conversion.

5. Totalizer Units

Set by turning the **Number** dial to the desired position. The dial positions allow several standard conversions as well as three customizable settings. The conversion (from gallons) of each position is listed in the upper display. The customizable settings are LBS, KG, and {blank}. For each of these engineering units, the system allows a customized "per gallon" conversion to be entered. The {blank} item is for engineering units that are not included in the standard list. **Example:** To display pounds of liquid nitrogen, LBS (#2) is selected with the number dial and the value is edited to read 6.745 (6.745 pounds of LN2 per gallon).

6. Totalizer Decimal Place

Set by turning the **Number** dial to the desired position. If no decimal is shown, the decimal is assumed one place to the right of the least significant digit.



7. Ratemeter Units

Set by turning the **Number** dial to the desired position. The dial positions allow several standard conversions as well as three customizable settings. The conversion (from gallons) of each position is listed in the upper display. The customizable settings are LBS, KG, and {blank}. For each of these engineering units, the system allows a customized "per gallon" conversion to be entered. The {blank} item is for engineering units that are not included in the standard list. **Example:** To display pounds of liquid nitrogen, LBS (#2) is selected with the number dial and the number is edited to read 6.745 (6.745 pounds of LN2 per gallon).

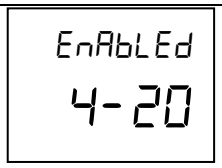
8. Ratemeter Decimal Place

Set by turning the **Number** dial to the desired position. If no decimal is shown, the decimal is assumed one place to the right of the least significant digit. There is one special setting named AUtorAnGE. The autorange setting allows the ratemeter display to self adjust the decimal point based on the size of the number to be displayed. **Example:** Ratemeter decimal set to AUtorAnGE. If the rate is 12.873 GPM, then 12.873 will be displayed. If the rate increases to 128.73 GPM, then 128.73 will be displayed.

9. Rate Time Base

The time the ratemeter is based on in seconds. The **Number** dial positions allow several standard time bases as well as one customizable setting. The conversion (in seconds) of each position is listed in the upper display. The customizable setting is indicated by the absence of any time annunciator at the bottom of the display. The {blank} item is for units that are not included in the standard list. **Example:** To display the rate in units per week, the customized number would be edited to read 604800.00 and no annunciator is displayed.

10. 4-20mA Output and Rate Limits



The 4-20mA analog output is enabled or disabled in this menu. If the 4-20mA output is dISAbLEd, the next two sub-menu items are skipped.

Note: The rate display uses the 4-20mA setpoints for its bounds checking. To edit them for the rate display and leave 4-20mA output disabled: enable the 4-20mA output, edit the numbers, then return to the 4-20mA output and disable it.

10.1 4-20mA Output Low Setting

Used by the 4-20mA output as the low setpoint. This setting is also used as the ratemeter low warning setpoint. Edit the number to read the desired low flowrate setting. The setpoint engineering units are the same as the ratemeter engineering units.

Note: In order to have the rate display show a low flow warning (-LL-) at zero flow, set this output low setting to 0.0001.

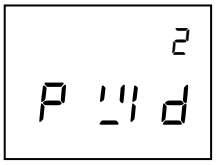
10.2 4-20mA Output High Setting

Used by the 4-20mA output as the high setpoint. This setting is also used as the ratemeter high warning setpoint. Edit the number to read the desired high flowrate setting. The setpoint engineering units are the same as the ratemeter engineering units.

11. Pulse Output Enable

The pulse output is enabled or disabled in this menu. If the pulse output is disabled, the next two sub-menu items are skipped.

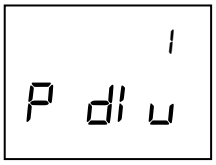
11.1 Pulse Output - Pulse Width



The pulse width of the pulse output is set by turning the **Number** dial to the desired position. The dial positions allow several standard pulse widths as well as one customizable setting. The selected pulse width in milliseconds is listed in the upper display. There is one special setting named FrEQUEnCY. The frequency setting allows the pulse output to auto adjust the pulse width based on the number of pulses to be outputted per second. **Example:** Pulse width set to FrEQUEnCY. If the totalizer is counting to 14 every second, then the output pulse width will be 71.428ms. If the totalizer is now counting to 55 every second, then the output pulse width will auto adjust to 18.2ms. The FrEQUEnCY setting is especially useful when using the pulse output as a ratemeter, however, if a ratemeter output is desired, the 4-20mA loop will provide better results. Dial position #7 provides a customized pulse output setting initially set to 75, which can be edited for any pulse width (max 999ms).

Note: If the pulse width exceeds the inverse of the number of requested output pulses per second, the total display will indicate this error with an E in the left most totalizer character during **Run Mode**. When the E is displayed, output pulses are being lost. **Example:** If the pulse width is set to 500ms, then the maximum number of pulses that may be outputted is two per second.

11.2 Pulse Output - Pulse Divider



Divides the pulse output by the displayed value. The divider is set by turning the **Number** dial to the desired position. The dial positions allow several standard

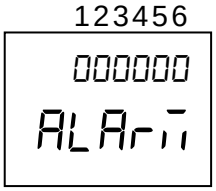
pulse dividers as well as one customizable setting. The selected pulse divider is listed in the upper display. The customized pulse divider setting is switch position #8 (initially set to 75), and can be edited for any value (max 9999).

12. Backlight Timer

Determines the length of time the backlight remains "**On**" when activated. Set by turning the **Number** dial to the desired position. The dial positions allow several standard timer values in seconds as well as one customizable setting. The selected timer value is listed in seconds in the upper display. The customized backlight timer setting is switch position #9 (initially set to 75), and can be edited for any number of seconds (max 9999s).
Note: The backlight timer is only a timer. Even when disabled, the backlight may be used when a magnet is located by the **Light** magnetic reed switch.
Note: The backlight is the highest current drawing component of the **IT400**. Use it sparingly; excessive use will quickly reduce the battery life (when running on the internal battery).

13. Power Mode

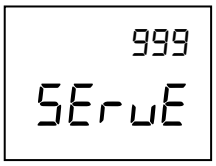
Sets the **IT400**'s internal power savings functions and the refresh rate. The power mode is set by turning the **Number** dial to the desired position. Power modes range from mode 1 (fastest refresh, shortest battery life) to mode 5 (slowest refresh, longest battery life). The power mode is described in greater detail in the Power section of this manual.



14. Alarm

Displayed only if purchased as an option. The alarm menu allows the setting of various system warnings to trigger an alarm. The number at the top of the display indicates which alarms are enabled: A 1 indicates the associated alarm is enabled, and a 0 indicates disabled. Starting from the left side of the screen, the alarms are in order in the following list:

1. LbAtt – Low battery. Enables the low battery warning (absence of any battery annunciator when running off battery) to trigger the alarm.
2. tEmPU – Temperature under. Enables a low process temperature warning to trigger the alarm.
3. tEmPo – Temperature over. Enables a high process temperature warning to trigger the alarm.
4. rAtEU – Rate under. Enables a low flow rate warning to trigger the alarm.
5. rAtEo – Rate over. Enables a high flow rate warning to trigger the alarm.
6. notot – No totalize during alarm. Inhibits the totalizer whenever there is an alarm condition. Using this setting prevents special "out of range" flow conditions from affecting the totalizer.
   Example: The temperature set points are set for the liquid state range of LN2, and the notot is set to EnAbLEd. The totalizer will not count any "gassing" of the meter (it will not totalize when the detected temperature is outside the liquid temperature range).



15. Service Hours

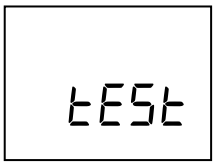
Displays the number of hours remaining until the service hours have elapsed. If the service hours setpoint is to be programmed or to reset the service hours counter, press **Select**. Press **Menu** to skip the next two sub-menu items.

15.1 Service Hours Set Point

Displays the number of hours the flowmeter sees a rate other than zero before the wrench annunciator is displayed. When this number is edited (press **Select**), the Service Hours counter is automatically reset to zero elapsed hours (proceed to the next menu item). To exit without resetting the Service Hours counter, press **Menu** (skip the next sub-menu item).

15.2 Service Hours Set Point Edit/Reset

When the Service Hours setpoint Edit/Reset menu is entered, the Service Hours counter is automatically reset to zero. The Service Hours setpoint may be set to any number of hours less than 99999 hours.



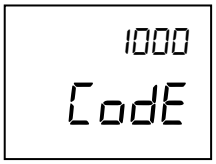
16. Test

The test menu allows the viewing, testing, and simulating of various system inputs and outputs. Here is a listing of the test items:

1. rAW FrEQ – The displayed value is the raw input frequency (autoranged) being received by the flowmeter input. The value is in Hz.
2. rtd ohm – The displayed value is the raw resistance value of the RTD in ohms. The value is indeterminate if no RTD is installed.
3. bAttEry / -uln- / -LooP- – The displayed value is the battery voltage (if bAttEry is displayed) or internal voltage regulator if -uln- or -LooP- is displayed.
4. LCd tESt – Pressing **Select** causes the **IT400**'s LCD to indicate all segments.
5. 4-20tESt – Pressing **Select** causes the **IT400** to simulate five values on the 4-20mA output. The **Number** dial is used to step through the following values: 0%, 25%, 50%, 75%, & 100%.

17. Menu Lockout Enable

Enables or disables the menu lockout. If the menu lockout is disabled, the menu is exited and **RUN mode** is resumed.



17.1 Menu Lockout Code

Displays and allows the edit of the code that must be entered to gain access to the menu. A code of 0000 disables the lockout. Edit the number to read the desired lockout code setting. Only four digits are available for the lockout code. The default lockout code is 1000.

Appendix

Appendix 1: Menu Quick Reference

1. Reset Totalizer
- Done

2. Enable Temperature Compensation
- Reference Temperature*
- Coefficient of Thermal Expansion*
- Delay
  - 0) 1s
  - 1) 2s
  - 2) 5s
  - 3) 10s
  - 4) 30s
  - 5) 1m
  - 6) 3m
  - 7) 5m
  - 8) 10m
  - 9) Custom*
- Edit Temperature
  - Low*
  - High*

3. Enable Linearizer
- Edit Linearizer Table
- Table Points*

4. K Factor (if Linearizer is disabled)*

5. Totalizer Units
- 0) Gallons
- 1) Liters
- 2) Pounds*
- 3) Cubic Feet
- 4) Cubic Meters
- 5) Barrels
- 6) Kilograms*
- 7) Custom*

6. Totalizer Decimal Place
- 0) 0.01
- 1) 0.1
- 2) none
- 3) x10
- 4) x100

7. Ratemeter Units
- 0) Gallons
- 1) Liters
- 2) Pounds*
- 3) Cubic Feet
- 4) Cubic Meters
- 5) Barrels
- 6) Kilograms*
- 7) Custom*

8. Ratemeter Decimal Place
- 0) 0.001
- 1) 0.01
- 2) 0.1
- 3) none
- 4) x10
- 5) x100
- 6) Auto-range

9. Ratemeter Time-base
- 0) Seconds
- 1) Minutes
- 2) Hours
- 3) Days
- 4) Custom*

10. Enable 4-20mA Output
- 4-20mA Output Low*
- 4-20mA Output High *

11. Enable Pulse Output
- Pulse Width
  - 0) Frequency
  - 1) 1 ms
  - 2) 2 ms
  - 3) 5 ms
  - 4) 10 ms
  - 5) 50 ms
  - 6) 100ms
  - 7) Custom*
- Pulse Output Divider
  - 0) 1
  - 1) 2
  - 2) 5
  - 3) 10
  - 4) 50
  - 5) 100
  - 6) 1000
  - 7) Custom*

12. Backlight Timer
- 0) Disabled
- 1) 2s
- 2) 5s
- 3) 10s
- 4) 30s
- 5) 1m
- 6) 3m
- 7) 5m
- 8) 10m
- 9) Custom*

13. Power Mode Selection
- 0) Mode 1 refresh 16/s
- 1) Mode 2 refresh 8/s
- 2) Mode 3 refresh 4/s
- 3) Mode 4 refresh 1/s
- 4) Mode 5 refresh 2s

14. Alarm Bits
- Low Battery
- Temperature Under
- Temperature Over
- Rate Under
- Rate Over
- No Totalize During Alarm

15. Service Hours
- Service Hours Set Point
- Service Hours Set Point Edit/Reset*

16. Unit Test
- Raw Frequency
- RTD ohms
- DC Input / Battery Voltage (DC in if > 2.7Vdc)
- LCD Test
- 4-20mA Output Test
  - 0) 0
  - 1) 25
  - 2) 50
  - 3) 75
  - 4) 100%

17. Enable Menu Lockout
- Menu Lockout Code*

* User Editable value

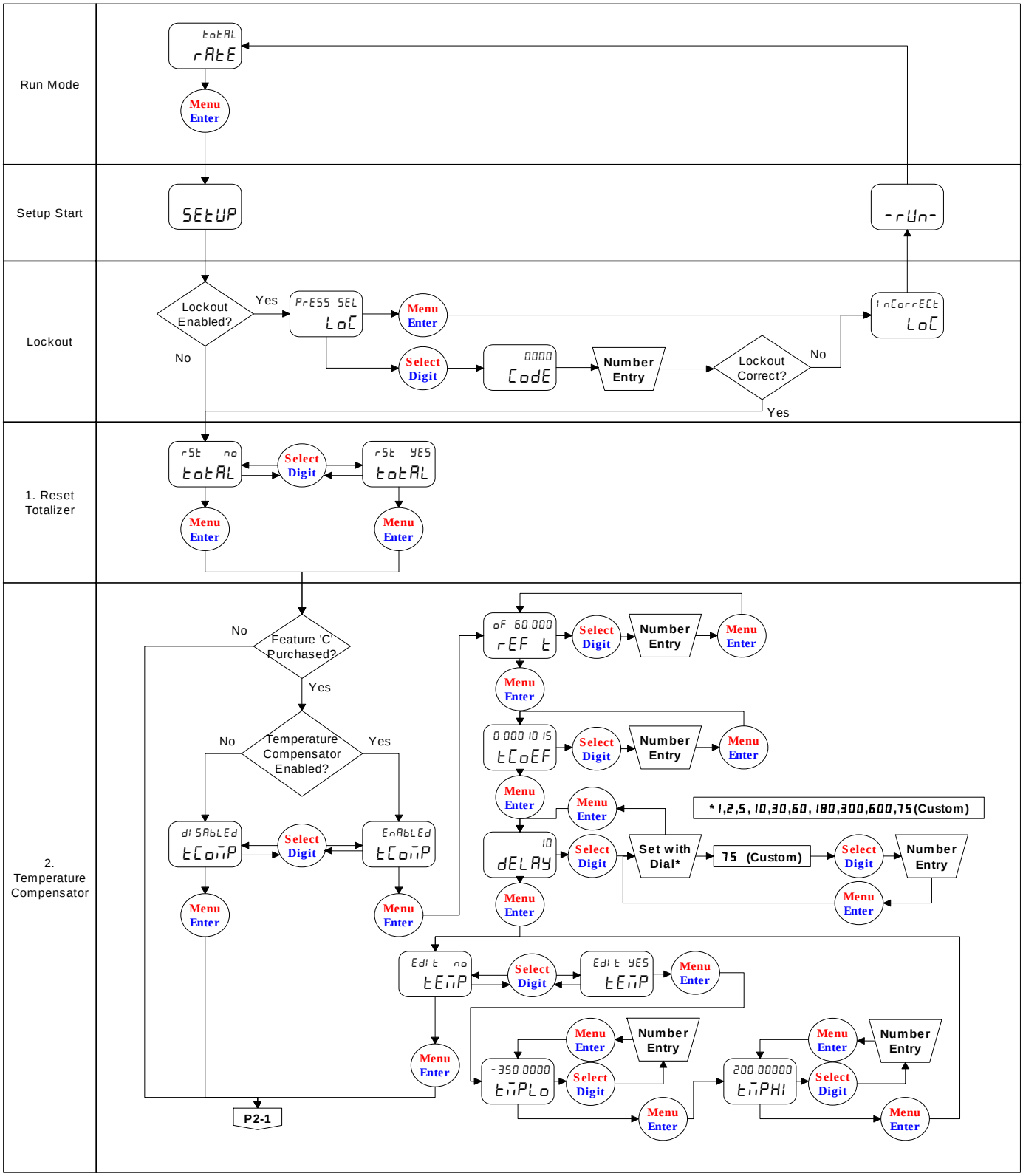
Appendix 2: Coefficient of Thermal Expansion for Common Fluids

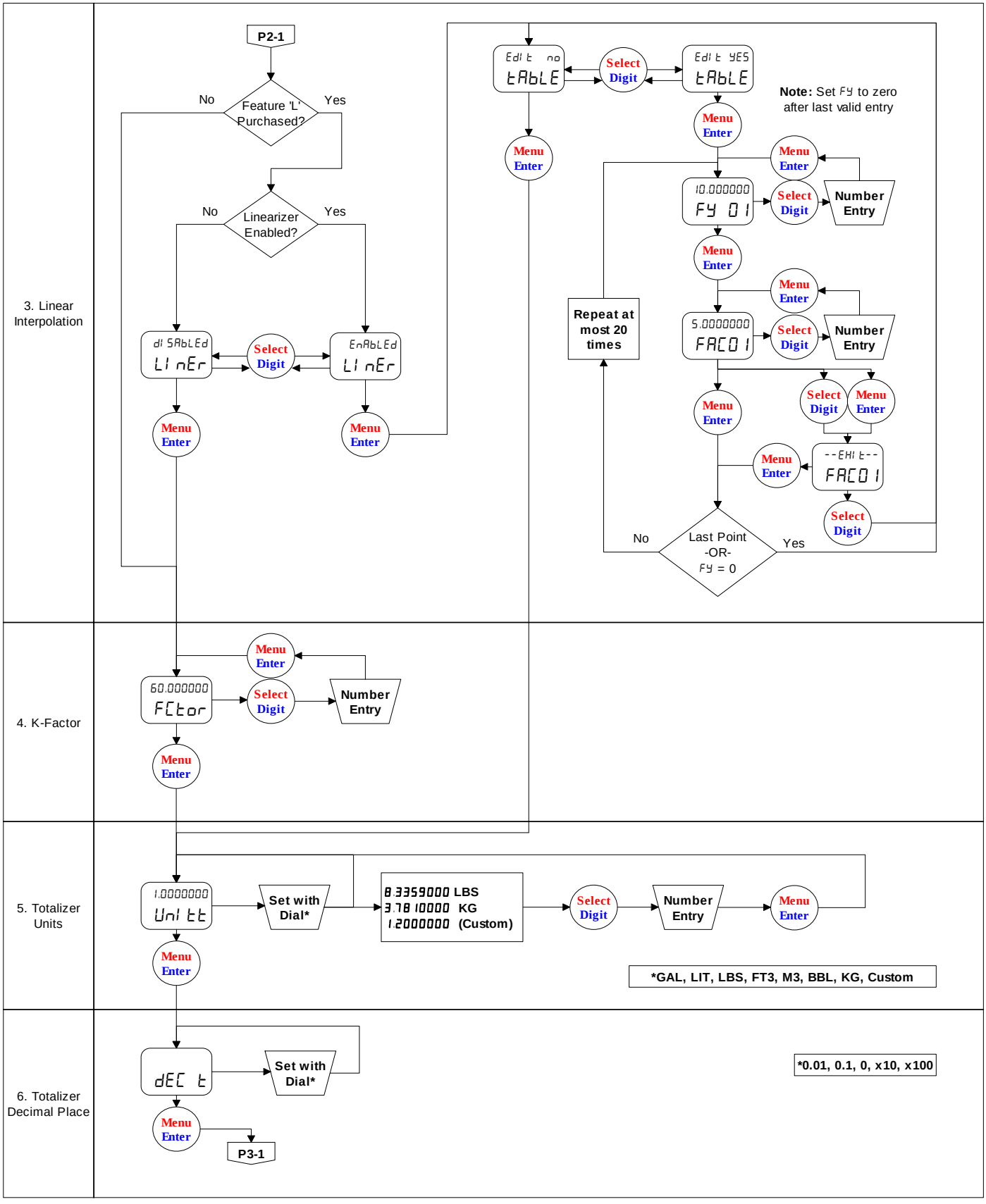
Fluid Properties Table

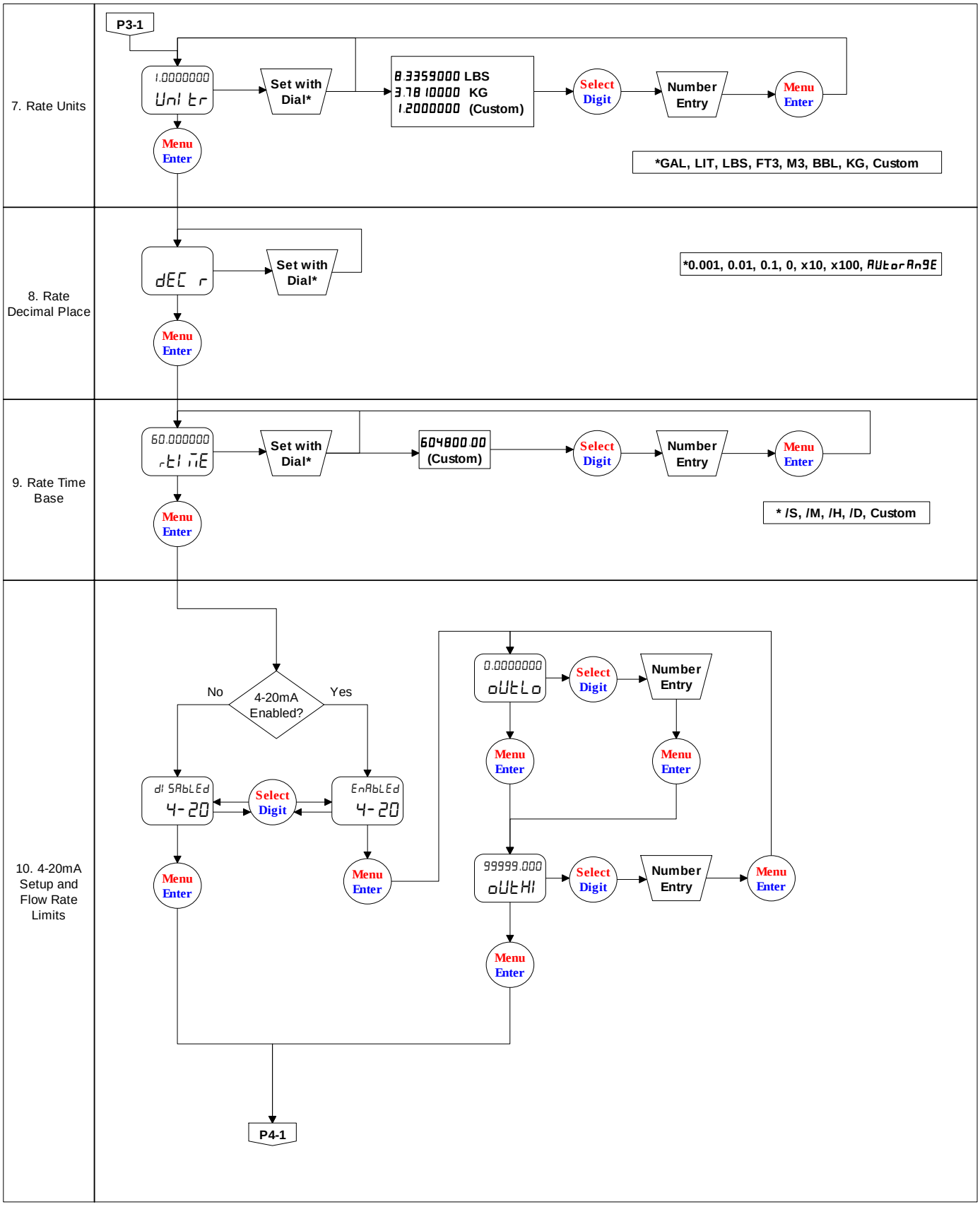
LIQUID

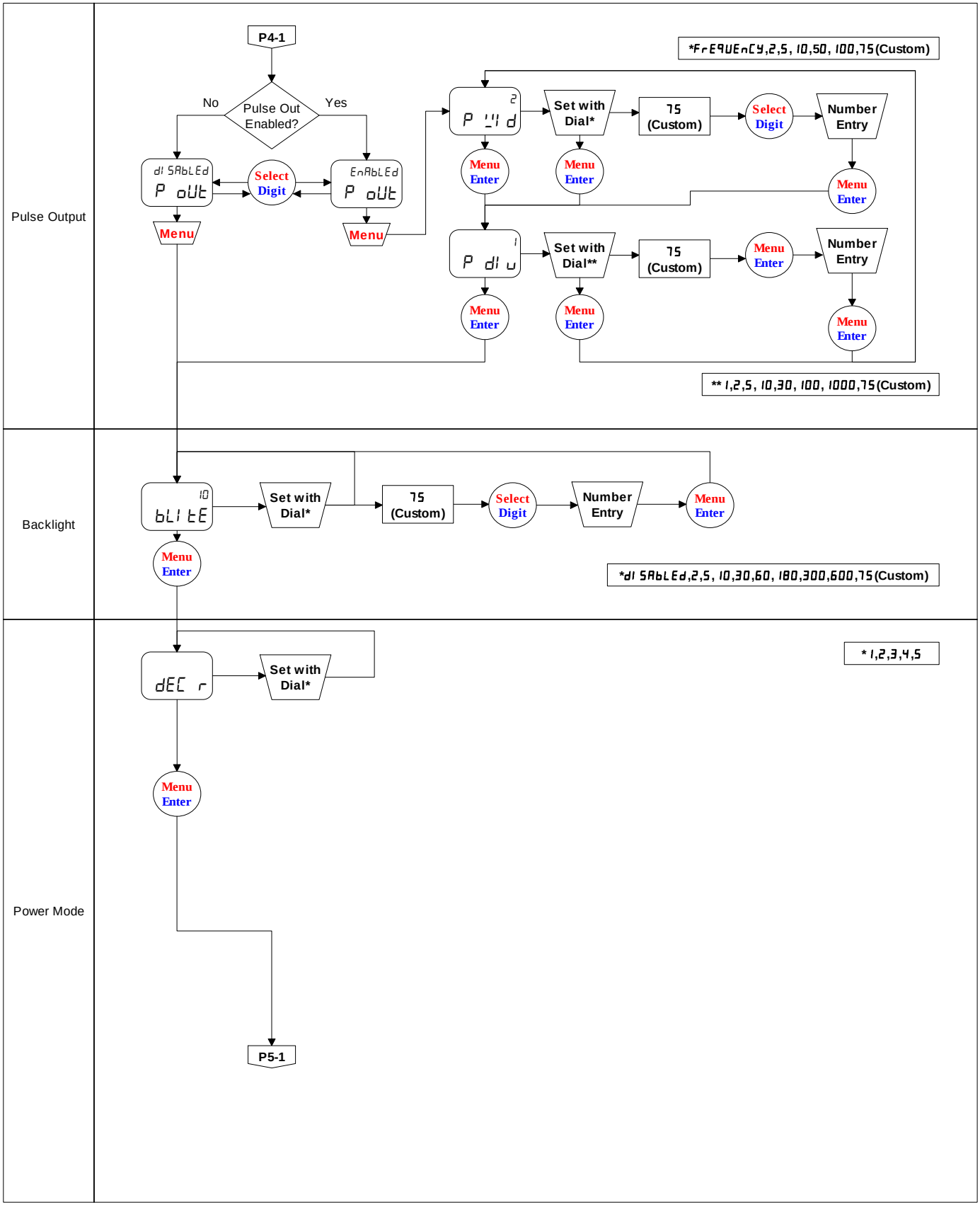
Fluid	Reference Density (Lb/Ft^3)	Reference Temperature (^oF)	Coefficient of Thermal Expansion
Air	54.56	-317.8	0.0016262
Ammonia	42.63	-28.2	0.0005704
Argon	86.89	-302.6	0.0014861
CO^2	65.33	-10.0	0.0012609
Methane	26.48	-258.7	0.0010523
Natural Gas	26.48	-258.7	0.0010523
Nitrogen	50.44	-320.4	0.0014917
Oxygen	71.21	-297.4	0.0013458
Propane	31.67	60.0	0.0007178
Gasoline	46.80	60.0	0.0003703
Kerosene	51.79	60.0	0.0002681
#2 Fuel Oil	58.97	60.0	0.0000885
Water	62.37	60.0	0.0001015

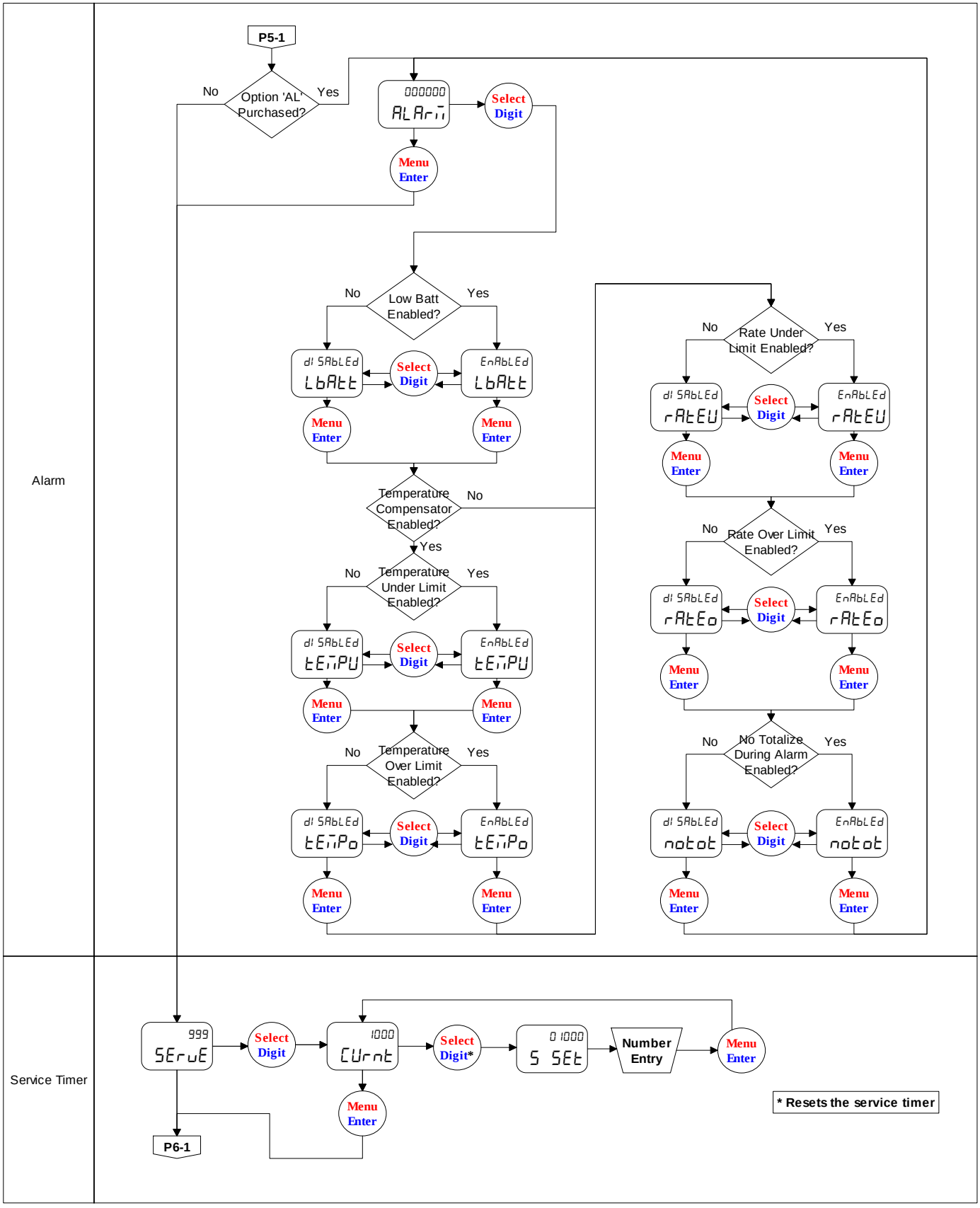
Appendix 3: Menu Flow Chart

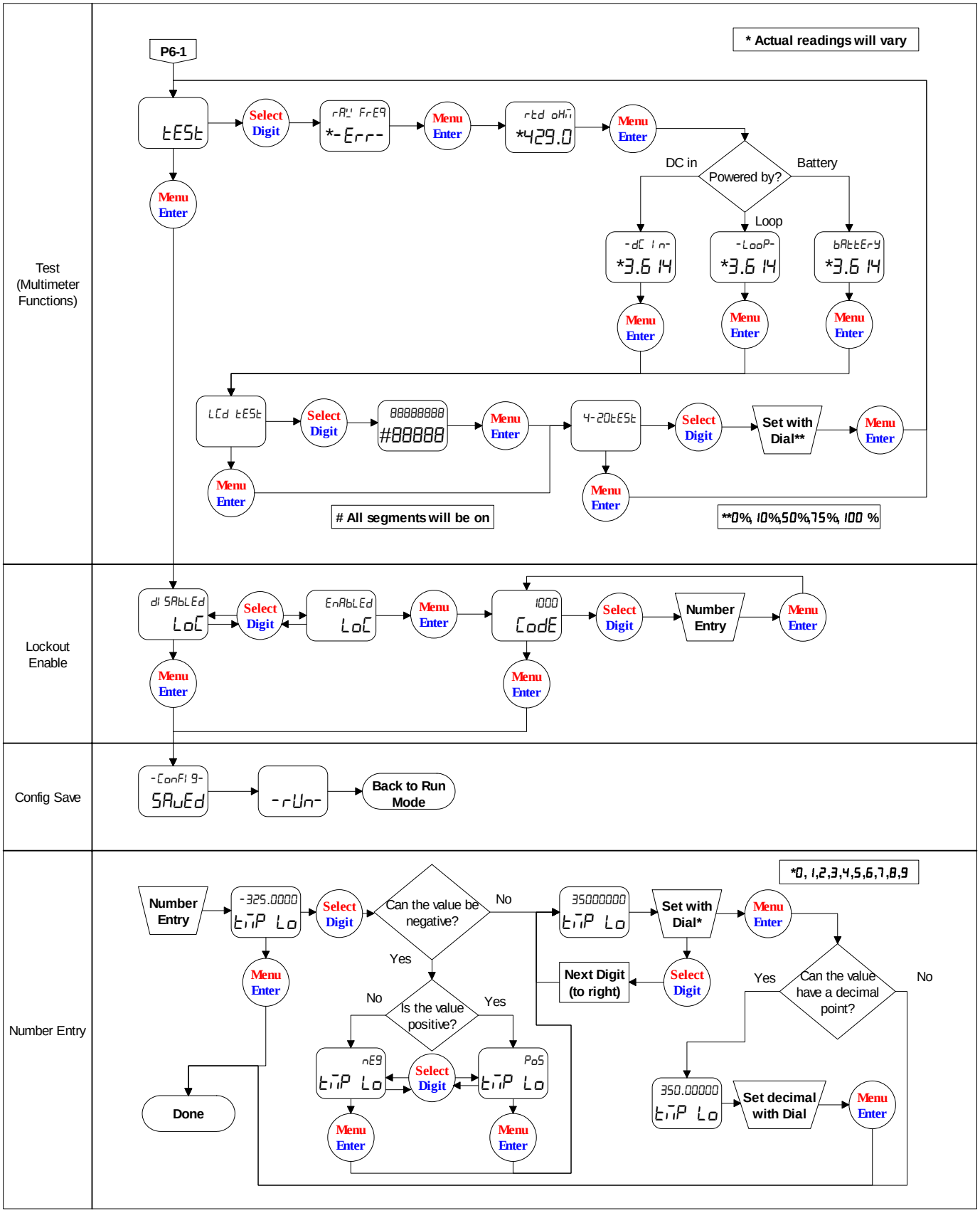



3. Linear Interpolation
P2-1
Feature 'L' Purchased?
No
Yes
Linearizer Enabled?
No
Yes
diSAbLEd LInEr
Select Digit
EnAbLEd LInEr
Menu Enter
Menu Enter
EdIt no tAbLE
Select Digit
EdIt YES tAbLE
Menu Enter
Note: Set FY to zero after last valid entry
Menu Enter
10.000000 FY 01
Select Digit
Number Entry
Menu Enter
Repeat at most 20 times
5.0000000 FAC01
Select Digit
Number Entry
Menu Enter
Select Digit
Menu Enter
Menu Enter
--EHIt-- FAC01
Select Digit
No
Last Point -OR- FY = 0
Yes
4. K-Factor
Menu Enter
60.000000 FCtor
Select Digit
Number Entry
Menu Enter
5. Totalizer Units
1.0000000 UnItt
Set with Dial*
8.3359000 LBS
3.78 10000 KG
1.2000000 (Custom)
Select Digit
Number Entry
Menu Enter
Menu Enter
*GAL, LIT, LBS, FT3, M3, BBL, KG, Custom
6. Totalizer Decimal Place
dEC t
Set with Dial*
Menu Enter
P3-1
*0.01, 0.1, 0, x10, x100


7. Rate Units
P3-1
1.0000000
Unit r
Set with Dial*
8.3359000 LBS
3.78 10000 KG
1.2000000 (Custom)
Select Digit
Number Entry
Menu Enter
Menu Enter
*GAL, LIT, LBS, FT3, M3, BBL, KG, Custom
8. Rate Decimal Place
dEC r
Set with Dial*
Menu Enter
*0.001, 0.01, 0.1, 0, x10, x100, AUtorAnGE
9. Rate Time Base
60.000000
rtI mE
Set with Dial*
604800.00 (Custom)
Select Digit
Number Entry
Menu Enter
Menu Enter
* /S, /M, /H, /D, Custom
10. 4-20mA Setup and Flow Rate Limits
No
4-20mA Enabled?
Yes
di SAbLEd
4-20
Select Digit
EnAbLEd
4-20
Menu Enter
Menu Enter
0.0000000
oUtLo
Select Digit
Number Entry
Menu Enter
Menu Enter
99999.000
oUtHi
Select Digit
Number Entry
Menu Enter
Menu Enter
P4-1


Pulse Output
P4-1
Pulse Out Enabled?
No
Yes
dI SAbLEd
P oUt
Select Digit
EnAbLEd
P oUt
Menu
Menu
P Hi d
2
Set with Dial*
75 (Custom)
Select Digit
Number Entry
Menu Enter
Menu Enter
Menu Enter
P di v
1
Set with Dial**
75 (Custom)
Menu Enter
Number Entry
Menu Enter
Menu Enter
Menu Enter
*FrEQUEnCy,2,5, 10,50, 100,75(Custom)
** 1,2,5, 10,30, 100, 1000,75(Custom)
Backlight
bLI tE
10
Set with Dial*
75 (Custom)
Select Digit
Number Entry
Menu Enter
Menu Enter
*dI SAbLEd,2,5, 10,30,60, 180,300,600,75(Custom)
Power Mode
dEC r
Set with Dial*
* 1,2,3,4,5
Menu Enter
P5-1


Alarm
P5-1
No
Option 'AL' Purchased?
Yes
000000
ALArm
Select Digit
Menu Enter
No
Low Batt Enabled?
Yes
diSAbLEd
LbAtt
Select Digit
EnAbLEd
LbAtt
Menu Enter
Menu Enter
No
Temperature Compensator Enabled?
Yes
No
Temperature Under Limit Enabled?
Yes
diSAbLEd
tEmPU
Select Digit
EnAbLEd
tEmPU
Menu Enter
Menu Enter
No
Temperature Over Limit Enabled?
Yes
diSAbLEd
tEmPo
Select Digit
EnAbLEd
tEmPo
Menu Enter
Menu Enter
No
Rate Under Limit Enabled?
Yes
diSAbLEd
rAtEU
Select Digit
EnAbLEd
rAtEU
Menu Enter
Menu Enter
No
Rate Over Limit Enabled?
Yes
diSAbLEd
rAtEo
Select Digit
EnAbLEd
rAtEo
Menu Enter
Menu Enter
No
No Totalize During Alarm Enabled?
Yes
diSAbLEd
notot
Select Digit
EnAbLEd
notot
Menu Enter
Menu Enter
Service Timer
999
SErvE
Select Digit
1000
CUrnt
Select Digit*
0 1000
S SEt
Number Entry
Menu Enter
Menu Enter
P6-1
* Resets the service timer


Test (Multimeter Functions)
* Actual readings will vary
P6-1
tESt
Select Digit
rAt FrEq
*-Err-
Menu Enter
rtd oHi
*429.0
Menu Enter
Menu Enter
DC in
Powered by?
Battery
Loop
-dC In-
*3.6 14
-LooP-
*3.6 14
bAttEry
*3.6 14
Menu Enter
Menu Enter
Menu Enter
LCd tESt
Select Digit
88888888
#88888
Menu Enter
4-20tESt
Select Digit
Set with Dial**
Menu Enter
Menu Enter
Menu Enter
All segments will be on
**0%, 10%,50%,75%, 100 %
Lockout Enable
dI SAbLEd
LoC
Select Digit
EnAbLEd
LoC
Menu Enter
1000
CodE
Select Digit
Number Entry
Menu Enter
Menu Enter
Menu Enter
Config Save
-ConFI 9-
SAvEd
-rUn-
Back to Run Mode
Number Entry
*0, 1,2,3,4,5,6,7,8,9
Number Entry
-325.0000
tYP Lo
Select Digit
Can the value be negative?
No
Yes
35000000
tYP Lo
Set with Dial*
Menu Enter
Menu Enter
Next Digit (to right)
Select Digit
Yes
Can the value have a decimal point?
No
No
Is the value positive?
Yes
nEG
tYP Lo
Select Digit
PoS
tYP Lo
350.00000
tYP Lo
Set decimal with Dial
Menu Enter
Done
Menu Enter
Menu Enter