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PUBLICATION UPDATES AND TRANSLATIONS

The most current English versions of all Sponsler publications are available on our web site, www.sponsler.com.

It is the responsibility of the local distributor to provide the most current version of Sponsler manuals, instructions, and specification sheets in the required language of the country, or the language of the end user to which the products are shipping. If there are questions about the language of any Sponsler manuals, instructions, or specification sheets, please contact your local distributor.

1. GENERAL INFORMATION

1.1 INSTALLATION GUIDE

1.1.1 INTRODUCTION

The installation guidelines are specific to the T700 Totalizer. Please refer to the individual technical data sheets for information pertaining to the turbine flowmeter, RTD temperature probe, and printer. Compliance with the following basic guidelines permits the user to acquire maximum benefit of this asset.

1.1.2 PRECAUTIONS

The T700 incorporates sophisticated electronic components and many safeguards have been designed to minimize susceptibility to static discharge and stray voltages. Every precaution for safe handling should still be observed. The most common is to eliminate static or stray voltage by grounding oneself touching a conductive discharge surface.

Welding in the proximity of the T700 is not advised. Disconnect ALL cables at the T700 prior to welding activity.

The display lens is a plastic composite and should be cleaned with a soft fabric cloth. Paper towel products or dirty leather gloves will score the lens and obscure visibility.

1.1.3 TOTALIZER

The T700 should be mounted at a convenient viewing height and angle that minimizes the reduced visibility caused by direct sunlight. Accessibility is also a prime consideration. A thin application of an Oxygen compatible lubricant on the threaded bolts of the securing knobs eliminates any corrosion opportunity. The threaded brass receptacle prevents galling. Although the T700 has been designed to withstand the rigors of the cryogenic transport environment, placement under piping that defrosts or in the proximity of pumps that spray liquid is not recommended.

1.1.4 INTERCONNECTING CABLES

All cables should be secured in place with proper stress relief and avoiding contact with the piping. Sufficient slack should be maintained in the cables to permit the T700 Totalizer to be rotated forward for easy access to the rear panel connections. Additionally, a thin application of a non-conductive Oxygen compatible lubricant to the male threads of the nickel-plated connectors will provide an additional moisture barrier. To minimize interference of other operating systems or low voltage events the power cable should be terminated at the battery or the most direct input source. The power input is polarity insensitive. Sponsler strongly recommends that power for the T700 be direct to the source.

1.2 WARRANTY

Sponsler Inc. hereafter referred to as Sponsler, products are warranted to be free from defects in material and workmanship under normal use and intended service for a period of 1 year from the date of shipment. Any product returned prepaid to Sponsler within the warranty period and found by Sponsler to be defective in workmanship or material, will be repaired or replaced free of charge at the sole discretion of Sponsler. Return shipment will be prepaid using the lowest cost means of transportation.

The warranty excludes but is not limited to products which are subjected to abuse, improper installation, altered, repaired anywhere except Sponsler, repaired using parts other than issued by Sponsler, accident or used in service other than intended or purchased.

In the event of defective product, contact Sponsler (800) 258-1165 to receive a Return Material Authorization (RMA) number. The RMA number should be prominently displayed on the return package. Return shipments without an RMA number are not accepted by the Shipping and Receiving department.

2. SPECIFICATIONS



2.1 INTRODUCTION

The Sponsler T700 Flow Totalizer is the next generation in Cryogenic Measurement Systems, designed for reliability and ease of use. The T700 builds upon the highest standards of accuracy and reliability while offering a number of valuable features that incorporate today's cutting edge technology, such as: real-time calculations, complete audit trails, pump control output with programmable delay interval, customizable tickets with optional graphics, temperature and pressure volume compensation for up to six individual products, and Bluetooth printing. The T700 has been engineered to accommodate all of your Cryogenic Measurement needs.

Setup for the T700 is easy, with a 4.3" Touchscreen Color Display designed to compute and display in real time with pertinent flow parameters in both digital and graphic forms. Large, robust external buttons are built tough for everyday use, and an intuitive, bright color display clearly shows that product being delivered is continually corrected for the temperature of the product.

Maintenance enhancements have been made on the T700 to ensure an easy-to-service design which includes field-replaceable components. The flexible mounting bracket allows both simple installation and operation. The T700 can also easily replace the industry standard T675 with identical mounting brackets, cables, connections, and accessories.

2.2 FEATURES

- Large 4.3" touchscreen with color display
- 5-point flowmeter linearization
- Pump control output with programmable delay interval (Temperature and Cavitation monitoring)
- RS-232 communication port
- Optional Bluetooth® communication
- Temperature volume compensation for six individual products and pressures, including LIN, LOX, and LAR
- Real time calculations and graphics
- User-friendly menu-driven programming, no scrolling
- Complete system alarm display
- Complete audit trail
- Programmable maintenance based on actual turbine service
- NIST Handbook 44 approved

2.3 SPECIFICATIONS

INPUT POWER

- 10 - 14 VDC or 20 - 28 VDC
- 3 W typical, 15 W maximum

ENVIRONMENTAL

- -40° to 194° F (-40° to 90° C)

PHYSICAL DIMENSIONS

- 7.812 x 13.510 x 4.875" with bracket

WEIGHT

- 6 lbs with bracket

SIGNAL INPUT

- 0 - 5000 HZ, 15 - 50 mV RMS

SENSOR INPUTS

- (1) RTD and (1) 4-20mA loop powered

RTD

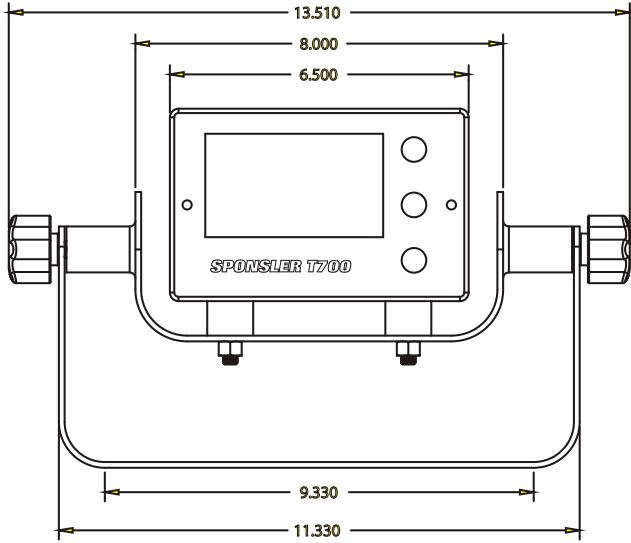
- Platinum, 1kΩ, two wire

OUTPUTS

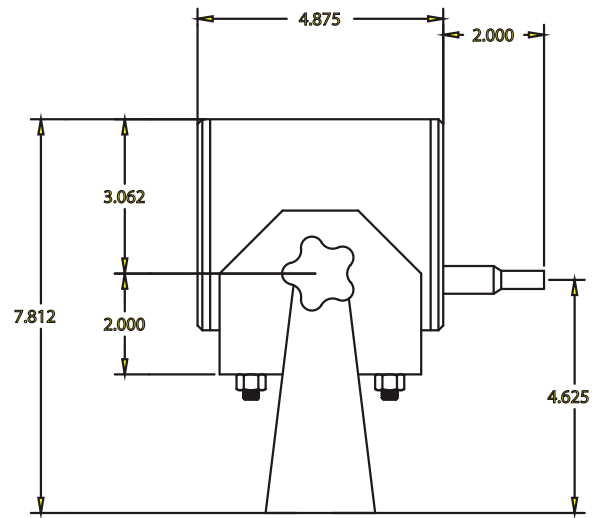
- Form C, 30A Relay, RS-232, optional Bluetooth®

3. DIMENSIONS

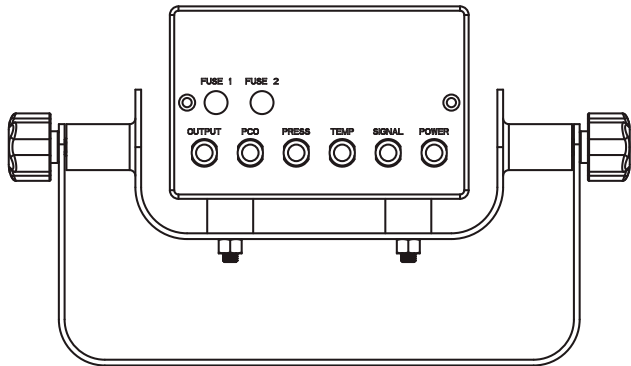
FRONT



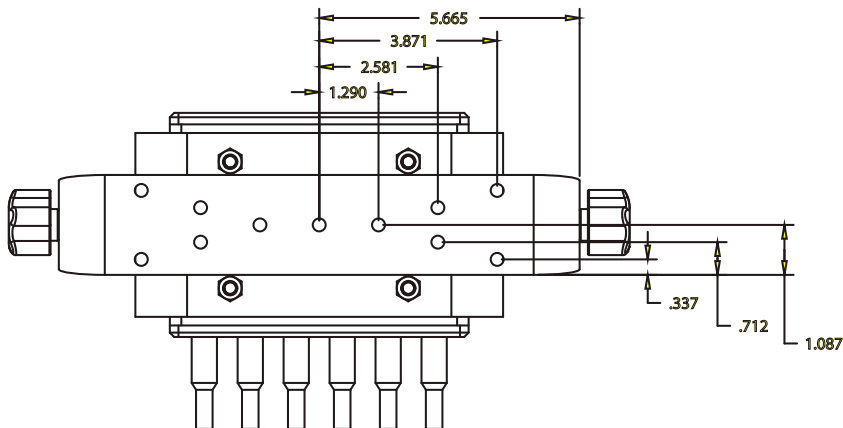
SIDE



BACK



BOTTOM



4. FEATURES OVERVIEW

4.4 SYSTEM OVERVIEW

When introduced to flow, the turbine flowmeter generates an AC sinewave signal within the pickup coil located directly above the turbine's rotor. The signal of the pickup coil is amplified, divided, corrected, and displayed by the T700. The displayed total is corrected for temperature by sensing the resistance of the RTD temperature probe. Delivery information is transmitted via Bluetooth, or RS232 communications port depending on which data collection device or printer is selected. This unique integrated system provides the end user a configurable, compact total delivery system.

4.5 THEORY OF OPERATION

The Sponsler turbine flowmeter is a volumetric measurement device that measures fluid velocity with one moving component, the rotor. The momentum of the flowing fluid engages the low mass rotor resulting in the rotor rotating at an angular velocity that is proportional to the fluid velocity. The rotor's rotation generates an AC sinewave signal in the pickup coil. Sponsler turbine flowmeters are linear devices therefore the signal output frequency is proportional to the flowrate within the designed flow range. Another benefit of a linear turbine meter is its K-Factor, the number of pulses generated per unit volume (gallons, pounds etc.) is consistent over the entire flow range. The total number of pulses generated is directly related to the total volume. The displayed total in the desired engineering unit is acquired by dividing the total pulses by the K-Factor. Because volumetric flowmeters and product density are influenced by fluid temperature, temperature must be measured and calculated into the final summation for the displayed total to be exact. A temperature compensation algorithm accomplishes this by computing the fluid density for the measured temperature and adjusts the volumetric or mass delivery total.

Simply stated, temperature compensation adds pulses to the pulse total when the detected temperature is colder than the products reference temperature and subtracts pulses when the product temperature is warmer than the reference temperature. The rate at which the pulses are added or subtracted is determined by the measured temperature departure from the products reference temperature.

5. SYSTEM OVERVIEW

The front panel includes a 4.3" full color graphical display and 3 rugged panel sealed pushbuttons. The back panel includes environmentally sealed military style electrical connectors for all standard and optional

I/O connections. The electronics are housed in a 4.35" L X 6.54" W X 4.125" H aluminum enclosure with tilt bracket.

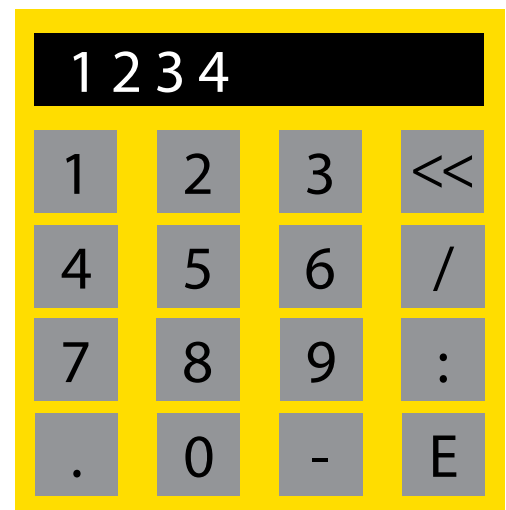


T700 Front Panel

5.1 THE USER INTERFACE

The T700 is designed to be a user-friendly component of the delivery system, with an intuitive interface and easy access to the most common operations. The pushbuttons allow the user to quickly CLEAR the totalizer, PRINT a delivery ticket or change the MODE of operation.

The T700 is equipped with a touch screen feature that allows easy entry of data parameters by authorized personnel. A numeric keypad simplifies the entry of numeric data for password entry or programming.



The Numeric Keypad

<< The BACKSPACE button erases an incorrect entry.

E The ENTER button accepts the entered value.

6. MODES OF OPERATION

The T700 user interface is organized into 4 distinct modes of operation:

DELIVERY MODE

MAINTENANCE MODE

TURBINE CALIBRATION MODE

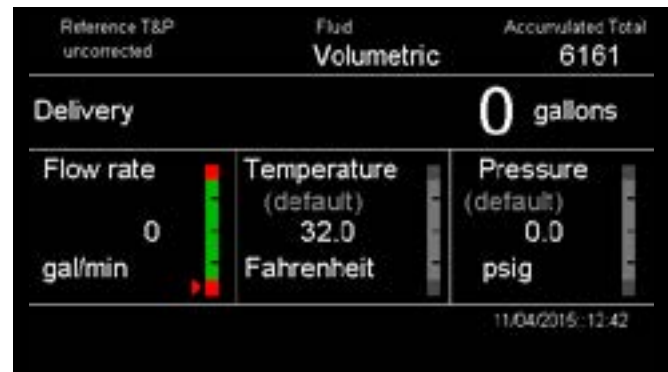
SYSTEM CONFIGURATION MODE

Although a password is required to make configuration changes, the settings in each mode may be viewed by pressing the MODE button. When prompted for a password, simply press MODE to advance to each of the 3 other mode screens until returning to the Delivery Mode.

6.1 DELIVERY MODE

The Delivery Mode is the primary mode of operation for The T700, where all delivery data and error messages are displayed on a single screen for easy viewing. This is the default mode of operation when The T700 is powered on, or when the display timeout expires in one of the other modes.

T700 Delivery Mode Screen



DELIVERY MODE DISPLAY PARAMETERS

Display Item	Digits	Decimal Places	Description
Delivery Total	8	0 (00000000)	The total quantity of product dispensed in selected volume or mass units. Pressing the CLEAR button while in the Delivery Mode will clear the Delivery Total and log the delivery information to the trip log.
Flow Rate	6	0 (000000)	The measured flow rate expressed in units per minute. Units are determined by the selection for Delivery Total.
Temperature	4	1 (000.0)	The measured operating temperature. If the temperature sensor fails or is removed, the default temperature for the selected liquid is used for calculations and indicated with the word DEFAULT.
Pressure	4	bar – 2 (00.00) psi – 1 (000.0)	The measured operating pressure. If the pressure sensor fails or is removed, the default pressure for the selected liquid is used for calculations and indicated with the word DEFAULT.
Accumulated Total	12	0 (000000000000)	The total quantity of product dispensed from all deliveries. Units are determined by the selection for Delivery Total.

ADDITIONAL DELIVERY MODE DISPLAY ITEMS

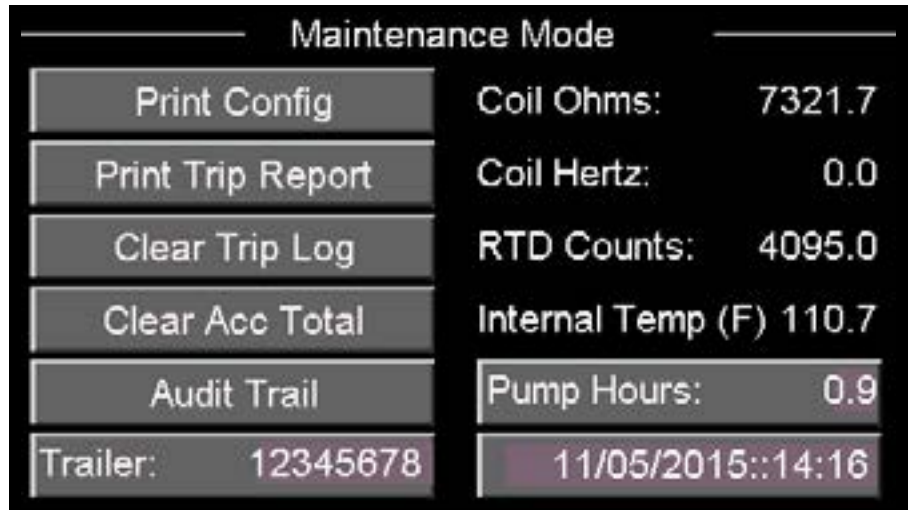
Display Item	Description
Fluid Name	The current fluid selected for dispensing.
Reference T&P	The reference temperature and pressure display is dependent on the compensation method and delivery units selected: <ul style="list-style-type: none"> • If compensation method is NONE, “Uncorrected” will be displayed • If Compensation Method is something other than NONE and Delivery Units are gallons or liters, “NBP, (1 atm)” is displayed • If Compensation Method is something other than NONE and Delivery Units are ft3, ft3X100 or m3, the actual temperature and pressure reference is displayed, i.e. 21 C, 101.325 kPa
Date/Time	The current date and time.
Message Area	The bottom portion of the screen is reserved for displaying error messages.

The CLEAR button clears the Delivery Total from the Delivery Mode screen. The PRINT button prints a Delivery Ticket from the Delivery Mode screen.

6. MODES OF OPERATION

6.2 MAINTENANCE MODE

The Maintenance Mode contains diagnostic fields, programmable fields for Trailer Number and Date/Time as well as some additional Clear and Print functions. Fields not enclosed in a gray button are read only items, used for diagnostic purposes. If a correct password has been entered, touching a gray button on the display will execute the Print or Clear function or bring up the screen to edit a setting.



T700 Maintenance Mode Screen

MAINTENANCE MODE MENU OPTIONS

Menu Item	Selection	Description
Print Config	N/A	Prints the current T700 configuration parameters to an attached printer.
Print Trip Log	10, 20, 40, 100	Prints the most recent delivery information from the trip log for the selected number of entries.
Clear Trip Log	Clear Trip Log	Clears all delivery information from the trip log and resets the delivery number.
Clear Acc Total	Clear Acc Total	Clears the Accumulated Delivery Total.
Audit Trail	10, 20, 50, 100, 500, 1000	Displays/Prints the most recent configuration changes with date/time stamp for the selected number of entries.
Trailer:	Numeric Entry	Enter up to an 8-digit number between 1 and 99999999.
Coil Ohms:	Display Only	Displays the turbine coil resistance in Ohms.
Coil Frequency:	Display Only	Displays the turbine frequency in Hertz.
RTD Counts:	Display Only	Displays the A/D counts for the RTD Temperature Input. Range is 0 - 4095.
Internal Temp (F):	Display Only	Displays the ambient temperature inside the T700 enclosure in degrees F.
Pump Hours:	Display/Clear	Displays the number of hours of liquid flow at a resolution of 1/10th of an hour. Press the Pump Hours button to reset.
Date/Time	Numeric Entry	Enter the Date/Time as mm/dd/yyyy::hh:mm

6. MODES OF OPERATION

6.3 TURBINE CALIBRATION MODE

The Turbine Calibration Mode screen is used to configure all parameters related to the turbine flowmeter calibration. Touching any gray button on the display will bring up the edit screen for that field.

Note: Values must be entered in order of ascending frequency.

Turbine Calibration Mode	
Meter SN: 45678	Meter Size (inch): 2.00
Average K: 148.000	Min Flow (gpm): 15.0
K Method: Linear	Max Flow (gpm): 225.0
K-factor Table	Min Delivery (lb): 220.0
Last Cal: 09/08/2015	
Next Cal: 10/01/2016	T700 SN: 123456789

Turbine Calibration Mode Screen

Frequency & K-Factor Table	
Frequency 1 54.859	K-Factor 1 822.927
Frequency 2 54.876	K-Factor 2 822.927
Frequency 3 97.348	K-Factor 3 824.481
Frequency 4 138.628	K-Factor 4 823.121
Frequency 5 206.648	K-Factor 5 888.000

Frequency and K-Factor Table Screen

6. MODES OF OPERATION

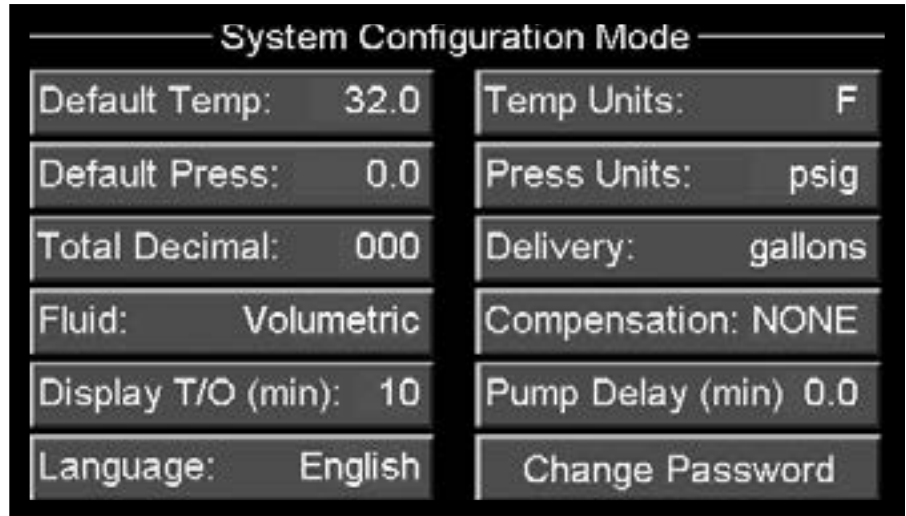
TURBINE CALIBRATION MODE MENU OPTIONS

Menu Item	Selection	Description
Meter SN	Numeric Entry	Enter the turbine serial number. Valid entry is a number up to 9 digits between 0 and 999999999.
Average K	Numeric Entry	Enter a number between 0.001 and 99999.999 for the average K-Factor.
K Method	Average Linearization	Select flowmeter linearization method as Average (single K-Factor) or Linearization (5-point linearization table).
K-Factor Table	Numeric Entry of 5 frequency and K-Factor points	Enter the 5-point K-Factor table.
	Frequency 1 - 5	Frequency points 1 - 5 must be a number between 0.100 and 5000.001, and must be at least 0.015 greater than the previous frequency entry.
	K-Factor 1 - 5	K-Factor points 1 - 5 must be a number between 0.001 and 99999.999.
Last Cal	Numeric Entry	Enter the date of the last calibration in the format mm/dd/yyyy.
Next Cal	Numeric Entry	Enter the date the next calibration is due in the format mm/dd/yyyy.
Meter Size	0.75 inch 1.00 inch 1.25 inch 1.50 inch 2.00 inch 2.50 inch 3.00 inch	Select the appropriate turbine meter size for the current application.
Min Flow (gpm):	Display Only	Displays the minimum flowrate in gallons per minute for the selected meter size.
Max Flow (gpm):	Display Only	Displays the maximum flowrate in gallons per minute for the selected meter size.
Min Delivery (lb):	Display Only	Displays the minimum delivery in pounds for the selected meter size.
T700 SN	Numeric Entry	Enter the T700 serial number. Valid entry is a number up to 9 digits between 0 and 999999999.

6. MODES OF OPERATION

6.4 SYSTEM CONFIGURATION MODE

The System Configuration Mode provides configuration parameters related to the flow measurement process and display preferences. Touching any gray button on the display will bring up the edit screen for that field.



System Configuration Mode Screen

6. MODES OF OPERATION

SYSTEM CONFIGURATION MODE MENU OPTIONS

Menu Item	Selection	Description
Default Temp:	Numeric Entry	Enter the default value for the fluid temperature to be used in case of a temperature probe failure. Valid entry is between 20 degrees Kelvin and the maximum temperature in the compensation range for a selected fluid.
Default Press:	Numeric Entry	Enter the default value for the fluid temperature to be used in case of a temperature probe failure. Valid entry is between 0.0 and 499.99 psia.
Total Decimal:	000 00.0 0.00	Select the display resolution for the delivery total.
Fluid:	LIN LOX LAR CO2 SINGLE CO2 DUAL N2O	Select the fluid to be measured.
Display T/O (min)	Numeric Entry	Enter the number of minutes before The T700 defaults back to the Delivery Mode screen from another mode. Valid entry is between 1 and 99 minutes. The display timeout is strictly time based, not activity based.
Temp Units:	Kelvin Fahrenheit Celsius	Select the units of measure for Temperature.
Press Units:	psia psig bar-a bar-g	Select the units of measure for Pressure.
Del Units:	gallons liters ft3 ft3X100 m3 pounds kilograms	Select the units of measure for Delivery Total. Flowrate will be displayed in the same units. <i>NOTE: If Compensation Method is set to NONE, only gallons and litres will be available.</i> If Fluid Type is CO2, only pounds and kilograms will be available.
Compensation:	None Temperature Temp & Default P	Select the method of compensation. Select None for pure volumetric measurement.
Pump Delay (min)	Numeric Entry	Enter the number of minutes between 0.0 and 99.0 used for the cool down phase.
Change Password	Numeric Entry	Enter a 4-digit password between 0000 and 9999. Default password is 0000.

7. THE DELIVERY PROCESS

There are three basic steps to the delivery process for The T700:

COOLING THE SYSTEM

DISPENSING THE PRODUCT

ENDING THE DELIVERY

7.1 COOLING THE SYSTEM

When The T700 is powered on, an RTD temperature sensor detects when liquid is present at the pump and begins the Pump Cooling Timer. The timer, which is displayed on the Delivery Mode Screen, counts down from the value entered for the Pump Delay parameter in the System Configuration Mode. If equipped, the Pump Relay is enabled after the timer reaches zero and is disabled whenever gas is detected in the system.

7.2 DISPENSING THE PRODUCT

Once the system has been cooled down, the user should ensure that the T700 is zeroed and ready for dispensing. When the delivery valve is opened, the T700 begins totalizing the liquid flowing through the turbine and the one-minute start phase begins. During the first minute of the delivery, errors are displayed but not recorded in the Trip Log. After the first minute of the delivery, any error occurring more than one minute is recorded in the Trip Log. See section "Error Messages" for a comprehensive list of error messages.

7.3 ENDING THE DELIVERY

After dispensing the required amount of liquid, the delivery valve is closed to stop the liquid flow. The delivery remains active until one of the following occurs:

A DELIVERY TICKET HAS BEEN PRINTED

THE DELIVERY TOTAL HAS BEEN CLEARED

Once the PRINT or CLEAR function is executed, the active delivery ends and the delivery information is recorded in the Trip Log.

While a delivery is active, the configuration may be viewed by pressing MODE, however no changes to the configuration are allowed. If an attempt is made to edit a configuration parameter while a delivery is active, the following message is displayed:

Delivery Active. Press CLEAR to exit.

Print ticket or clear total to end the delivery.

Pressing the CLEAR button removes the message and returns the user to the previous view. Press the MODE button to return to the Delivery Mode and press CLEAR or PRINT to end the active delivery.

8. PRINT FUNCTIONS

Delivery Tickets, Trip Reports, Configuration parameters, and the Audit Trail may be printed by connecting an optional serial printer to the RS232 port.

The RS232 port settings are listed below and are not user configurable.

Parameter	Value
Handshaking:	XON / OFF
Baud Rate:	9600
Word Length:	8 bits
Parity:	None

When a print function is requested, The T700 checks to ensure that the printer is online and available and that there is paper in the printer. The following messages may be displayed when executing print functions:

Message	Description
Printer out of paper	There is no paper detected in the printer.
Printer offline, no response from printer	The printer power is off or the serial cable is not connected between the T700 and printer.

8.1 DELIVERY TICKET

Press the PRINT button from the Delivery Mode screen to print a Delivery Ticket. This action ends the current active delivery and logs the delivery to the Trip Log. The number of decimal places for the Delivery Total follows the selection for Total Decimal in the System Configuration Mode.



The image shows a sample delivery ticket on a roll of paper. At the top left is the SPONSLER logo, which includes a stylized 'S' and 'P' inside a circle, followed by the word 'SPONSLER' in large, bold, sans-serif letters. Below the logo is the address: '19471 283-8082 185 Wabasha Dr. Lake Bluff, IL 60044'. The ticket is titled 'METER DELIVERY TICKET'. It contains the following information: Date: 06-Jan-16, Time: 09:56. Customer: (blank line). Product: LIN. Total: 91 gallons. Trailer: 12345678. T700 S/N: 123456789. Meter S/N: 45678. Delivery #: 4. Driver: (blank line). Signature: (blank line). At the bottom, it says 'Thank you for choosing Sponsler'.

Sample Delivery Ticket

8. PRINT FUNCTIONS

NOTE: If using an SP843 or SP844, the ticket format needs to be disabled for trip report, configuration, or audit trail to print correctly.

8.2 PRINTING A MOBILE PRINTER CONFIGURATION LABEL

- Turn the printer off. Load the media compartment with journal media (media with no black bars printed on the back).
- Press and hold the Feed button.
- Press and release the Power button, and keep the Feed button pressed. When printing starts, release the Feed button.
- The unit will print a line of interlocking 'x' characters to insure all elements of the printhead are working/ Print out the software version loaded in the printer and then print two reports.

The first report indicates model, ROM version, serial number, baud rate, etc. The second report prints out more detailed information on the printer's configuration and parameter settings.

8.3 TRIP REPORT

The Trip Report prints the stored trip log containing up to 100 previous deliveries. It can be thought of as series of delivery tickets, with the addition of any errors that were logged during each delivery.

From the Maintenance Mode screen, press the Print Trip Report button on the display. A screen will be displayed to select the last 10, 20, 40, or 100 stored deliveries to be printed. A password is not required to print the Trip Report.

If desired, after printing the Trip Report, press the Clear Trip Log button to clear all delivery information from the trip log. The following delivery will be logged as delivery number 1. A valid password entry is required to clear the trip log.

8.4 PRINT CONFIGURATION

From the Maintenance Mode screen, press the Print Config button on the display to print a detailed report containing the current configuration settings. A password is not required to print the configuration settings.



8. PRINT FUNCTIONS

8.4 AUDIT TRAIL

The Audit Trail contains a log of the last 1000 configuration changes in the following format:

1	Date/Time	3 Character Variable Code
Old Value	New Value	

From the Maintenance Mode screen, press the Audit Trail button on the display to bring up a screen to select the number of most recent entries to print. A password is not required to print the Audit Trail.

```

BEGIN AUDIT TRAIL
DATE: 02/18/2010
TIME: 16:20
1 12/18/2009::08:35 AKF
100,000 226,123
2 01/22/2010::13:22 FLU
LIN LDX
3 02/05/2010::11:05 MSZ
1.50 2.00
END OF AUDIT TRAIL
    
```

Audit Trail Variable Code	Description
DTE	Date/Time
CAT	Clear Accumulated Total
AKF	Average K-Factor
KFM	K-Factor Method
F01 – F05	Frequency 1 – 5 for Linearization Table
K01 – K05	K-Factor 1 – 5 for Linearization Table
MSZ	Meter Size
DFT	Default Temperature
DFP	Default Pressure
FLU	Fluid
TEU	Temperature Units
PRU	Pressure Units
DLU	Delivery Units
CPM	Compensation Method

8. PRINT FUNCTIONS

8.5 ERROR MESSAGES

The T700 provides extensive self-checking capability to assist the user in resolving faults and operational errors. Error messages are displayed on the bottom portion of the Delivery Mode screen and are recorded in the Trip Log if they occur for longer than one minute during a delivery.

Displayed Message	Description
GAS PRESENT, TOTALIZATION STOPPED	The operating temperature is warmer than the specified liquid range and/or the operating pressure is below the saturated pressure. There is no longer liquid in the metering run. The T700 stops totalizing and disables the pump relay if equipped.
GAS WARNING	The operating pressure is between saturated pressure and 5 psia above saturated pressure. The liquid is approaching a point where it may contain bubbles, resulting in a delivery error.
HIGH FLOW RATE	The flow rate has exceeded the limit defined by the Max Flow field for the selected meter size in the Turbine Calibration Mode. This message may appear if the turbine is being spun by gas.
LOW FLOW RATE	The flow rate has dropped below the limit defined by the Min Flow field for the selected meter size in the Turbine Calibration Mode.
COIL OPEN	Coil resistance is greater than 3000 Ohms. This message will appear if the turbine signal cable is removed.
COIL SHORT	Coil resistance is less than 200 Ohms.
TEMPERATURE OPEN	Temperature probe resistance input is greater than 1800 Ohms. This message will appear if the temperature cable is removed.
TEMPERATURE SHORT	Temperature probe resistance input is less than 90 Ohms.
PRESSURE FAIL	Pressure Analog input signal is less than 4 mA.
PRESSURE OVERRANGE	Pressure Analog input signal has exceeded 20 mA.
LOW BATTERY	Internal battery has dropped below 2.2 Volts DC and should be replaced as soon as possible.
MIN DELIVERY NOT REACHED	This message is displayed on the Delivery Ticket only and indicates that the minimum measurable quantity for the selected meter size has not been reached. The minimum delivery amount for the selected meter size is indicated on the Turbine Calibration Mode screen.
PULSE ERROR	Missing or double pulses have been detected in a dual coil meter system.
EXCESS PULSE ERROR	The number of missing or double pulses detected has exceeded the acceptable percentage of delivery total.
PULSE ERROR EXCEEDS LIMIT	This message is displayed on the Delivery Ticket only and indicates that the number of missing or double pulses detected during a delivery has exceeded the acceptable percentage of delivery total.

9. FIELD CALIBRATION:

Field calibration to adjust a K-Factor that shifted due to the influences of the installation is only practical when the T700 is programmed to use the Average K-Factor for calculating the delivery total.

9.1 METHODS

There are numerous calibration procedures that are widely practiced. This discussion will be confined to two: a calibration prover and the weigh scale. The metrologically-preferred method is the prover due to superior accuracy. The scale offers an approximation and should be conducted with large volumes to minimize the error introduced by the magnitude of the scale graduations. Another consideration when using a scale is to place the receiving vessel on the scale.

9.2 CALCULATING A NEW K-FACTOR

Calculating the new K-Factor is the same regardless of the calibration method employed. Although the SP1200 Flow Calibration Prover calculates the new K-Factor, not all competitive systems offer this convenience. A simple formula calculates the new K-Factor.

Note: Always insure that the engineering units of both the T700 and the calibration method are the same by using the appropriate liquid equivalencies.

$$K_{NEW} = \frac{V_{T700} \times K_{ORIG}}{V_{CAL}} = \frac{M_{T700} \times K_{ORIG}}{M_{CAL}} = \frac{W_{T700} \times K_{ORIG}}{W_{CAL}}$$

T700 Total T700

cal Total Calibration

V Volume

M Mass

W Weight

K_{orig} Present k-factor in T700 at time of calibration

K_{new} New k-factor based on calibration

EXAMPLE 1

$$W_{T700} = 45,000 \text{ lbs.}$$

$$W_{cal} = 50,000 \text{ lbs.}$$

$$K_{orig} = 150$$

$$K_{new} = \frac{W_{T700} \times K_{orig}}{W_{cal}} = \frac{45,000 \text{ lbs.} \times 150}{50,000 \text{ lbs.}} = 135$$

For either method the T700 should be placed in the Prove mode. Depress the Setup key, enter the passcode when prompted, and depress Enter. The Prove mode format is a calibration convenience allowing repeated access to adjust the K-Factor, and overrides the cooldown timer and flow inhibit of the reset and K-Factor function.

9.3 INSTALLING A NEW K-FACTOR

Enter the new K-Factor from the Turbine Calibration Mode Screen [section 6.3] on page 11.

EXAMPLE 2

$$V_{T700} = 45,000 \text{ lbs.}$$

$$W_{cal} = 50,000 \text{ lbs.}$$

$$K_{new} = 150$$

$$\rho, \text{ density of product} = \frac{11.62 \text{ lbs}}{\text{gal}}$$

$$V_{cal} = \frac{W_{cal}}{\rho} = \frac{50,000 \text{ lbs}}{11.62 \frac{\text{lbs}}{\text{gal}}} = 4303 \text{ gal}$$

$$K_{new} = \frac{V_{T700} \times K_{orig}}{V_{cal}} = \frac{3873 \text{ gal} \times 150}{4303 \text{ gal}} = 135.01$$

10. INSTALLATION GUIDELINES

- The T700 should be installed with enough clearance to allow easy access to all cables. Care should also be taken to install the T700 away from thawing pipes to minimize direct contact with moisture.
- Do not over tighten the mounting bolts. The recommended tightening torque for the shock mounts is 105 lbs-in.
- Sponsler recommends powering the T700 directly from the truck battery. The DC+ power line may be wired through an external switch if desired, or the T700 may be ordered with an optional power switch installed.
- Refer to the installation drawings located in the back of this manual for wiring information (pages 22 - 23).

11. T700 TECHNICAL SPECIFICATIONS

ENVIRONMENTAL

Operating Temperature: -40°C to +70°C
Storage Temperature: -30°C to +70°C
Relative Humidity: 0-95% Non-condensing

PHYSICAL

Enclosure Dimensions: 4.35" L x 6.54" W x 4.125" H
11.05cm x 16.61cm x 10.47cm
Fully Assembled: 7.812" L x 13.510" W x 4.875" H
Weight: 4.2 lbs. (1.91 kg)

APPROVALS

Design Approvals, Standards, and Regulatory Compliance

Emissions EN55022 & FCC Part 15
Immunity EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-6
MIL-STD810G (Shock and Vibration)
NCWM Publication 14
NIST Handbook 44

National and State Legal for Trade

United States – NTEP & CTEP

ENCLOSURE

Rugged aluminum NEMA 4X with shock mounts

DISPLAY

4.3" Color LCD with touch screen

KEYPAD

Clear, Print and Mode Keys. Numeric keypad for data entry via touch screen

11. T700 TECHNICAL SPECIFICATIONS

POWER SUPPLY

Input Voltage: Range 10-14 VDC or 20-28 VDC
Note: Indicate voltage when ordering
Current: 0.25A at 12VDC typical
1.25A with LCD heater option ON
Protection: Overcurrent / reverse polarity protected
Battery: User-replaceable 3V lithium coin cell for real-time clock, 2 - 4 years typical battery life

FLOW METER INPUT

Frequency range: 0.2 to 5000 Hz
Amplitude: 15mV RMS to 50V RMS
Impedance: 10 k Ω
Linearization: Single K-Factor or 5-point flow meter linearization
Pickup Coil Diagnostics: Coil Short / Open Detection

RTD TEMPERATURE INPUT

RTD type: 1000 Ω platinum probe, 2 wire
Resolution: 12-bit
Accuracy: 0.025%
Diagnostics: Probe Short/Open Detection

PRESSURE INPUT

Type: 4-20mA loop powered
Resolution: 12-bit
Accuracy: 0.025%
Diagnostics: Sensor Fail Detection

PUMP INTERLOCK RELAY

Form C, 30A Relay, RS-232
Optional Bluetooth[®]

SERIAL COMMUNICATIONS

RS-232 printer port
Handshaking: XON / XOFF
Word Length: 8 bits
Parity: None

MISCELLANEOUS SYSTEM FEATURES

Non-volatile memory for configuration parameters and delivery data
Real Time Clock

SECURITY FEATURES

Audit Trail records last 1000 configuration changes with Time/Date stamp
Password protection to prevent unauthorized configuration changes

DIAGNOSTIC FEATURES

Failure detection for RTD, analog and flow meter inputs
Multiple error messages
Tracking of pump operational hours

MEASURED PRODUCTS

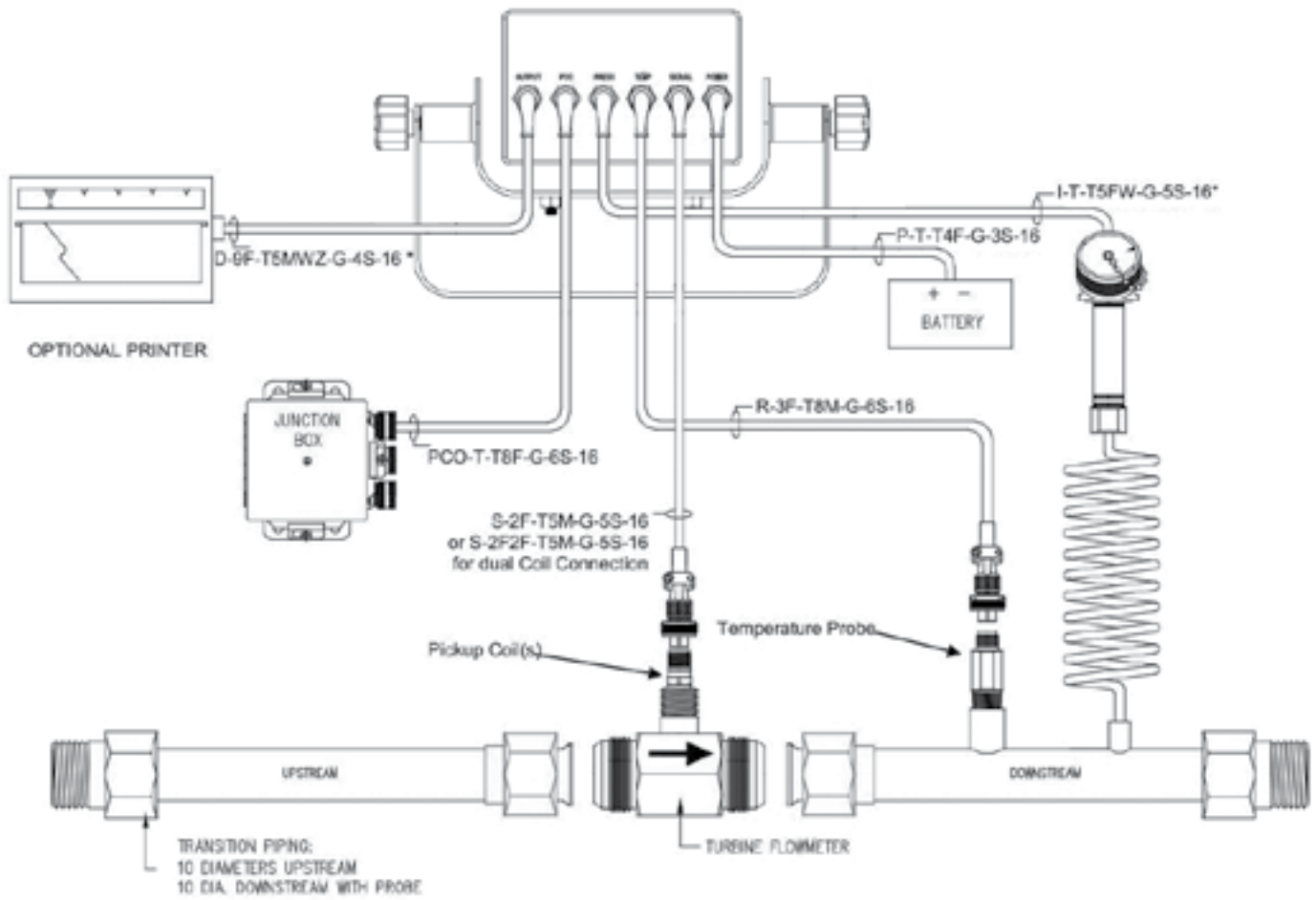
Supports measurement of several predefined liquids: LIN, LOX, LAR, CO2 Single Pipe, CO2 Dual Pipe and LN2O

UNITS OF MEASURE

Rate and Total: gal, L, lb, kg, ft³, ft³ x 100, m³
Temperature: K, F, C
Pressure: psia, psig, bar-g, bar-a

12. APPENDIX A

DELIVERY COMPONENTS INTERCONNECT WIRING



12. APPENDIX A

REAR PANEL CONNECTOR PIN ASSIGNMENTS

PIN	OUTPUT	PCO	PRESS	TEMPERATURE	SIGNAL	POWER	PIN
1	BRN-CTS	BRN-PUMP ENABLED (N/O)	BRN-PCL +IN	BRN-RTD S - IN	BRN-COIL 1+	BRN-BATT +	1
2	BLU-RX	BLU-PUMP ENABLED (N/C)	BLU-GND	BLU-EXEC + OUT	BLU-COIL 2+	BLU-BATT -	2
3	WHI-RTS	WHI-PUMP C	WHI-PCL -IN	WHI-EXEC - OUT	WHI-COIL 1-		3
4	BLK-TS			BLK-RTD X + IN	BLK-COIL 2-	BLK-GND	4
5	GRY-GND				SHD-GND		5



Connections shown for reference only. Dual coil implemented at factory.

PRODUCT TEMPERATURE RANGES

PRODUCT	TEMPERATURE								
	LOW			REFERENCE			HIGH		
	°K	°C	°F	°K	°C	°F	°K	°C	°F
LOX	90.00	-183.15	-297.67	97.60	-175.55	-283.99	135.00	-138.15	-216.67
LIN	75.00	-198.15	-324.67	83.90	-189.25	-308.65	120.00	-153.15	-243.67
LAR	85.00	-188.15	-306.67	94.50	-178.65	-289.57	125.00	-148.15	-234.67
LCO2	222.04	-51.11	-60.00	256.48	-16.67	1.99	272.04	-1.11	30.00
LN20	233.15	-40.00	-40.00	238.47	-40.00	-40.00	293.15	-6.67	20.00
CCO2	222.04	-51.11	-60.00	256.48	-16.67	1.99	272.04	-1.11	30.00



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