



Model CDS1000

Installation and Operation



PO Box 933, 15935 US Hwy 283 N.

Altus, OK 73522-0933

Seneca: 864-882-4544

<http://turbinesincorporated.com>

Manual part number 900484

Revision K

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Notice

Proprietary Notice

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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/or operation of the instrument.
- The manufacturer assumes no liability for damage caused by incorrect use of the instrument or for modifications or changes made to the instrument.
- All protection features for external delivery components are intended to be used with the operator present at delivery controls without exception

Technical Improvements

Turbines Incorporated may modify the technical data herein without notice.

Table of Contents

Warranty	4
Description	5
Features:	5
Overview:	5
Theory of Operation:	5
Modes of Operation:	6
Operating Mode	6
Programming Mode	6
Prove Mode	6
Installation	7
Operation	8
Programming	9
Specifications	13
Hardware:	13
Software:	13
Troubleshooting	14
Illustrations	15
Wiring	18
Return Policy	19
All Returns:	19
Warranty Claim:	19
Non-Warranty Repair:	19
Expedited Orders/Repairs:	19
Wrong Product/Excess Quantity Shipped:	19
Other Returns for Credit:	19
Turbines R&D Return Information:	19
Field Calibration	20
Calibration Methods:	20
Calculating new Kfactors:	20
Programming a new Kfactor:	21
Revision History	22

Warranty

Turbines Inc. of Altus Oklahoma provides the following statement of warranty and is subject to the following terms and conditions. No other warranty or guaranty express or implied shall be operative or binding upon the company at any time, or under any circumstances.

Turbines Inc. shall warranty that the product(s) described hereunder shall be free from material defect, shall be of the first quality, manufactured in accordance with the standards and practices of the highest workmanship and materials, for a period not to exceed 12 months (one year) following the date of purchase by the end user, subject to limitations as described:

Article 1: The warranty shall be limited to equipment for which the company has been fully paid. In the event of nonpayment, the company reserves the right to void any warranties that may otherwise apply.

Article 2: This warranty shall specifically exclude any deterioration or effects resulting from the normal wear and tear of the equipment or components thereof.

Article 3: This warranty shall specifically exclude damage that has resulted from improper installation of, improper maintenance of, unauthorized change or modification to, improper operation of, and/or misuse or abuse of the subject equipment.

Article 4: At the manufacturer's sole option, any equipment covered hereunder shall be either repaired or replaced at the manufacturer's expense during the term of the warranty, subject to said equipment being shipped prepaid to the manufacturer's place of business: Turbines R&D, LLC, 112 Lumber Lane Suite A, Seneca, SC, USA, 29672. No equipment shall be accepted unless first authorized in writing by the manufacturer. Non-warranty damage shall be repaired solely at the customer's expense.

Article 5: In no event shall the manufacturer's liability exceed the original cost of said equipment at the time of original purchase. The manufacturer shall, under no circumstances and/or at any time, assume any liability for merchantability, or any damages or contingent liabilities that may arise from the purchase or use of said equipment by any parties.

Article 6: This warranty is non-transferable and shall apply exclusively to the original end purchaser or end user of said equipment.

Article 7: The expected useful service life of said equipment shall vary dependent, among other factors, upon proper installation, use, handling, and maintenance.

Description

The **CDS1000** Flow Monitor is a microcontroller based rate/totalizer that is capable of calculating the effects of changes in temperature on computed values.

Features:

- Real time graphics and display of operating parameters
- Programmable 2-10 point flow meter linearization
- Delivery total can be toggled between metered and base conditions
- Battery backup for intermittent power outages
- All features/configuration settings are field programmable with plain text menus
- Pump control based on product or pump housing temperature to protect pump seals
- Optional pump control and protection based on pump discharge or differential pressure
- Large graphical display for showing various flow parameters
- Backlight for low light display viewing
- Built-in self test system of diagnostics
- Comprehensive internal warning and error reporting system
- Pump and turbine maintenance timers
- Non-resettable “Grand” totalizer
- RS-232 and Bluetooth communications available
- Level 3 Audit trail for all sealable meteorological parameters

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 **CDS1000**. The displayed total is corrected for temperature by sensing the resistance of the RTD temperature probe. Delivery information, consisting of 17 selectable parameters, is transmitted via Bluetooth or RS232 communications depending on which data collection device or printer is selected. This unique integrated system provides the end user a configurable, compact total delivery system.

Theory of Operation:

The **TI** turbine flowmeter is a velocity measurement device that measures fluid velocity and volume 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. **TI** turbine flow meters 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 Kfactor, 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 Kfactor. Because product density is influenced by fluid temperature; volumetric flow meters require temperature to 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.

Modes of Operation:

The **CDS1000** program offers 3 modes, Operating, Programming, and Prove. Any mode that can affect the calibration of the **CDS1000** is password protected. The **CDS1000** has a 2 tiered password level of security, Privileged and User/Weights and Measures. The Privileged password is maintained exclusively for Factory use and allows access to ALL menu options. The Weights and Measures password allows access to all displayed menu options except two, Initialization Options 5, 8 Hardware test/calibrate and Loaner respectively. If equipped with; *the **Program Enable Module (PEM)** must be removed from its recess on the enclosure underside to access any programming level.*

Operating Mode

The Operating mode is the power up mode for the **CDS1000**; all others must be accessed with a password. The Operating screen containing all delivery information is the normal display for this mode. The Detail screen is also accessible in this mode without a password.

Programming Mode

The Programming mode and associated menu's permit the **CDS1000** to be configured to the operating conditions of the application. When accessed, the first Display is **CDS1000** Initialization Options menu containing 9 options. Options 2, 3, 5 and 8 are password protected. Options 5, 8 require a Privileged password and are intended for **Factory use only**.

Prove Mode

The Prove mode permits convenient calibration of the trailer's delivery system. This mode temporarily aborts certain safeguard features and therefore is password protected. To access this mode, depress the SETUP key while in Operating mode. The system will prompt for a password, either User/Weights and Measures or Privileged, to be entered. If an incorrect password is entered or the ESC key is depressed, the **CDS1000** will revert to the Operating mode. The Prove mode allows entering, changing or viewing the Kfactor. The Prove mode is retained until the **CDS1000** is either turned "Off" or no flow activity is detected for 5 minutes. The Prove mode has the following operational characteristics:

- The ***CDS1000*** message is replaced with the **PROVER** message on the operating screen
- A password is not required to change the Kfactor
- Pump cooldown is disabled (pump enabled)
- The delivery totalizer can be reset regardless of the presence of flow
- **"Not a legal delivery"** is displayed above the delivery totalizer and on a printed ticket

Installation

For best equipment performance, follow these installation/operation/programming instructions:

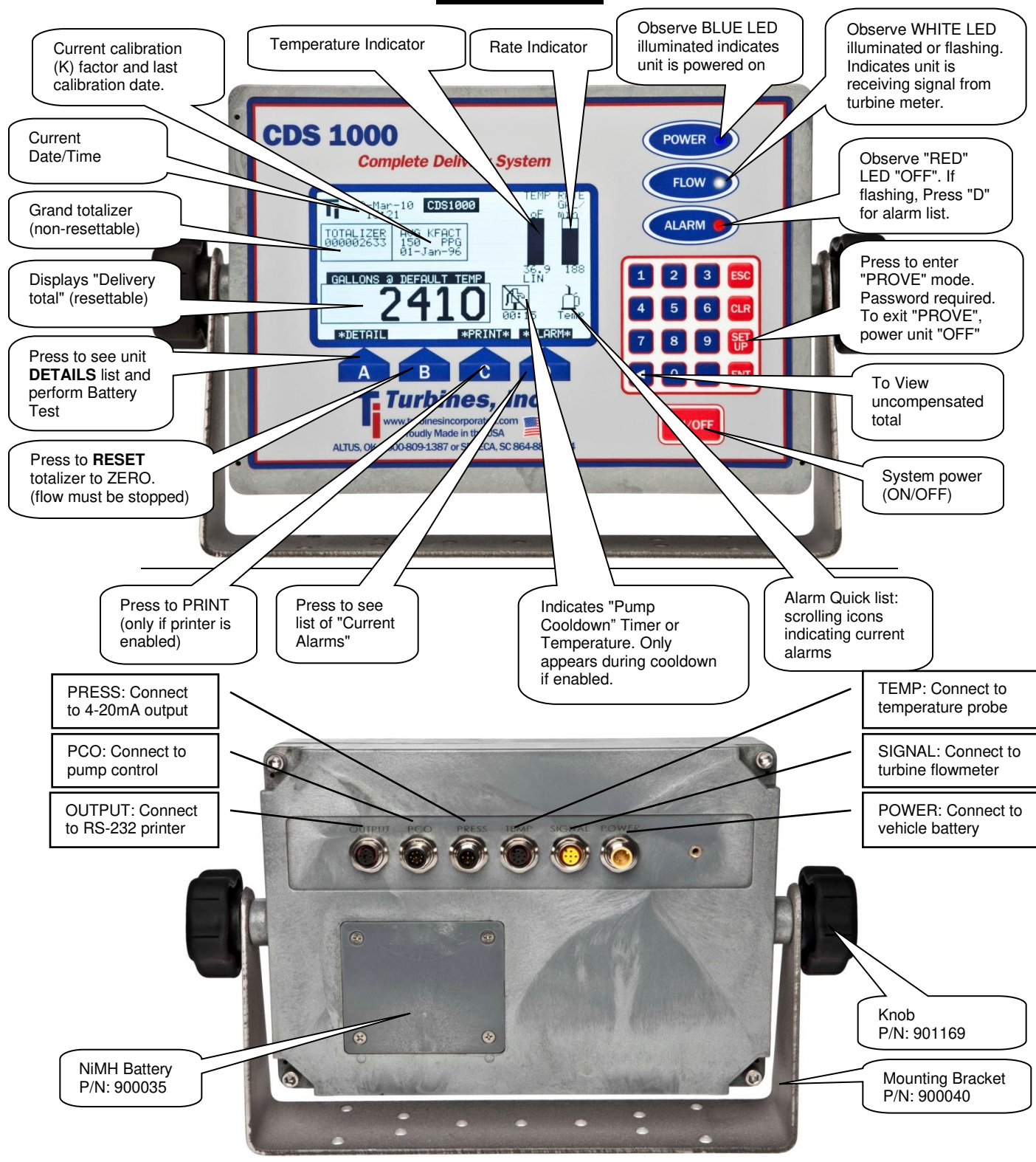
1. Ensure that you have removed all the equipment from the shipping box:

Model #	Description	CDS1000						
		LE	B	L	LEPS	LS	LEPD	LSO
CDS1000	Totalizer Main Unit	✓	✓	✓	✓	✓	✓	✓
900037	Power Cable	✓		✓	✓	✓	✓	✓
900038	Signal Cable	✓		✓	✓	✓	✓	✓
900039	Temperature Cable	✓			✓		✓	
900040	Mounting Bracket*	✓	✓	✓	✓	✓	✓	✓
900206	Temperature Sensor	✓		✓	✓	✓	✓	✓
900058	Knobs (2)*	✓	✓	✓	✓	✓	✓	✓
900039 Dual	Dual Temperature Cable			✓		✓		✓
901270	Pump Housing Temp Sensor**			✓		✓		✓
900062	PCO Cable **			✓	✓	✓	✓	✓
901329	Differential Pressure Sensor**						✓	✓
900063	Pressure Cable **				✓	✓	✓	✓
900558	Pressure Sensor **				✓	✓		
900559	Pressure Sensor Cable **				✓	✓		

* Part of the **CDS1000** ** Optional equipment

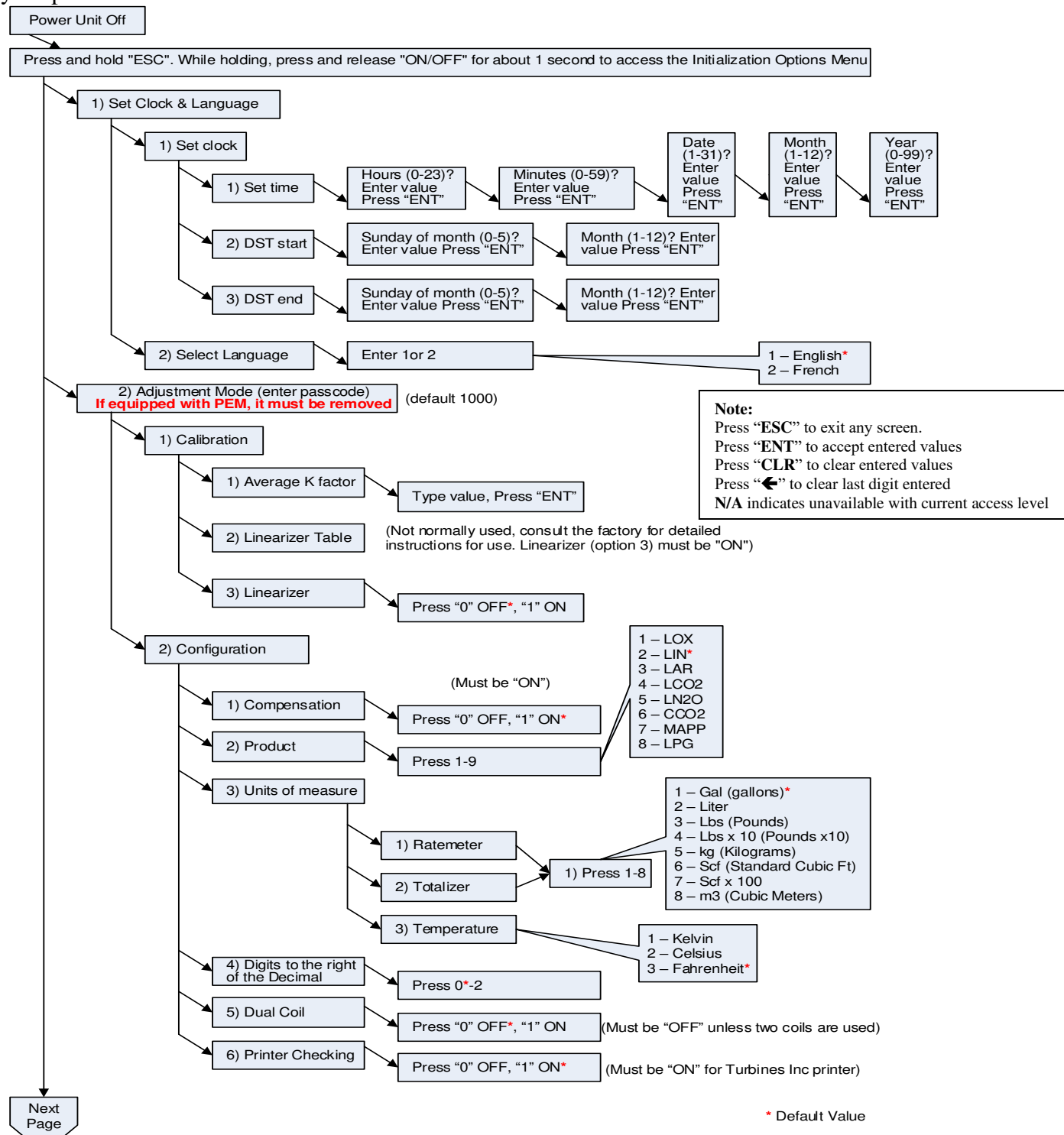
2. Install any piping that was ordered. Temperature probe coupling should be down-stream of the turbine.
3. Mount the **CDS1000** at a height and angle ensuring ease of accessibility and visibility.
 - a. Avoid installing under piping that defrosts often or near pumps that may spray liquid.
 - b. Use at least 4¼-20 bolts with lock washers and/or lock nuts.
4. Install cables and connect to the rear panel. **Do not over tighten!** Connectors should be hand tight.
 - a. Route cables and tie wrap excess so that no rubbing of the cables will occur.
 - b. Allow slack in the cables to allow the **CDS1000** to rotate for easy access to the rear panel.
5. Connect the power cable to the vehicle battery or other constant power source. It is not recommended to connect the power to the lighting system of the truck/trailer.
 - a. Power connections are polarity insensitive (+ and – may be reversed).
6. **Install the temperature probe:**
 - a. If using the PCO control: downstream of the pump
 - b. If not using the PCO: Downstream of the turbine
 - c. Connect the temperature probe wire to the top of the temperature probe. Tighten cable lock nut **hand tight**.
7. Install turbine meter and connect to signal cable or connect signal cable to existing meter. Tighten cable lock nut **hand tight**.
8. Press the **CDS1000** power button and observe LED lights are on or flashing. The main LCD screen will indicate run mode.

Operation

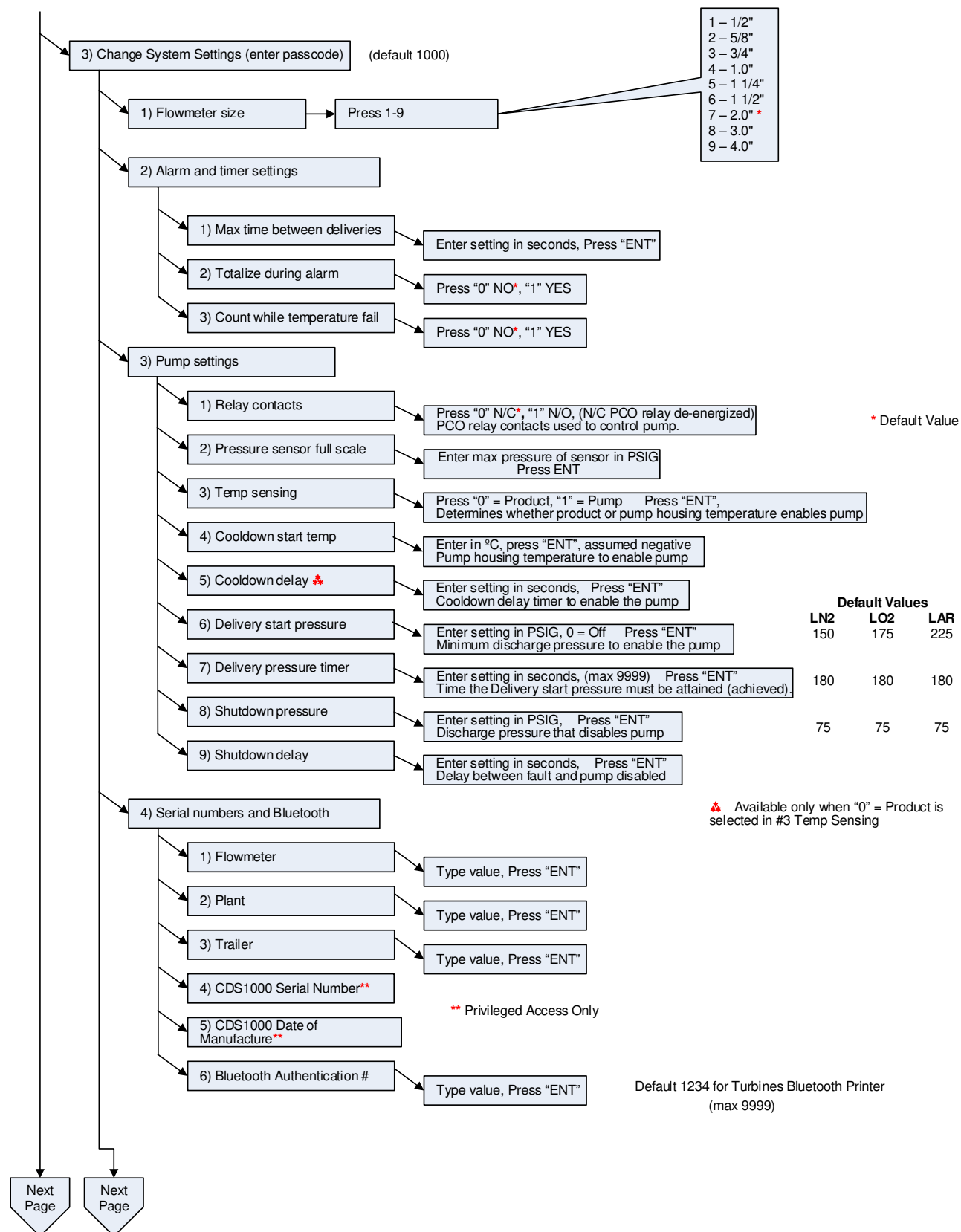


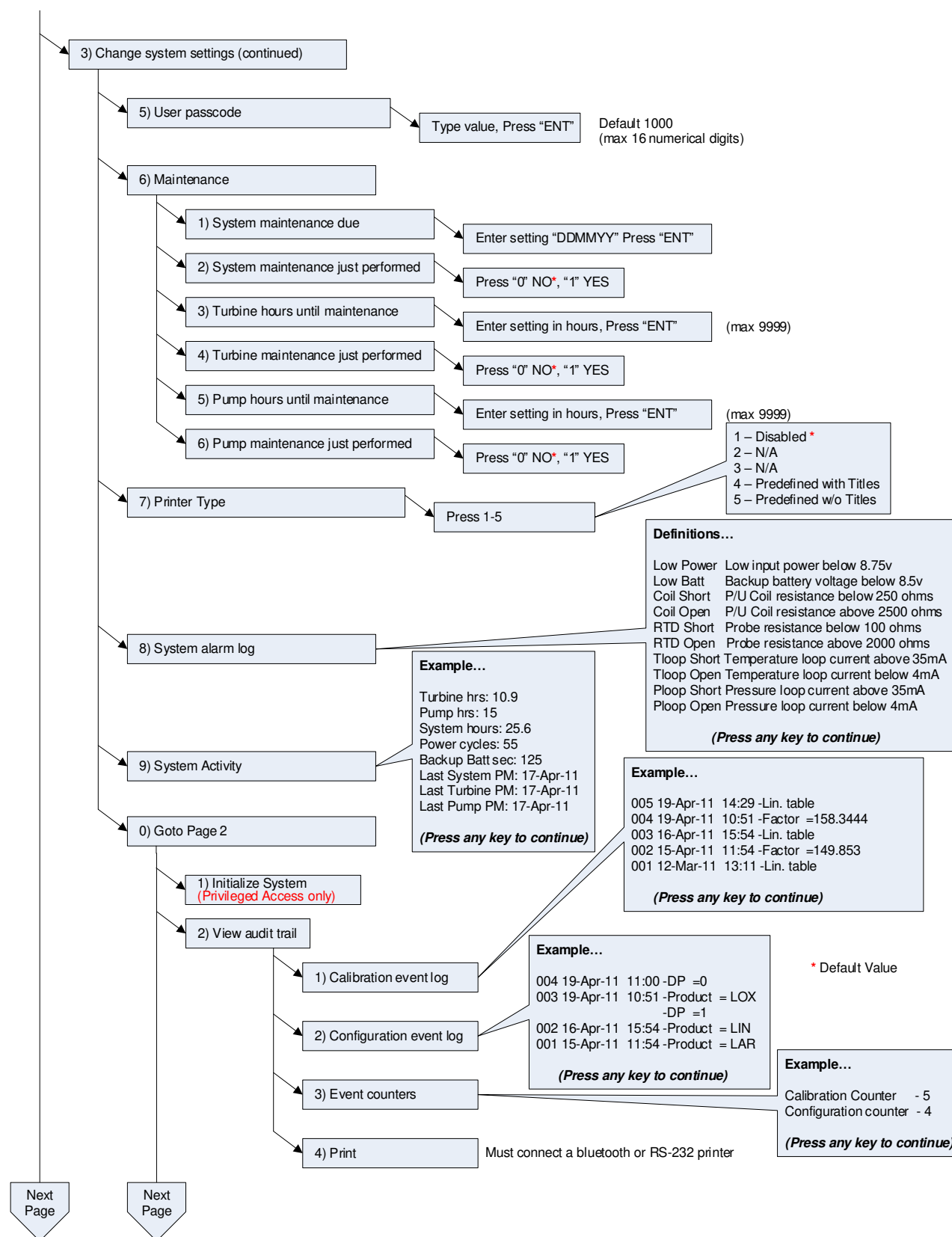
Programming

Your Model **CDS1000** is factory set. You should only use this programming guide to change your parameters or turn on additional features.



Next
Page







Specifications

Hardware:

- Amplifier Input:
 - Frequency range: 0-2500 Hz
 - Sensitivity:
 - 15mv RMS @ 10 Hz (min)
 - 100mv RMS @ 500 Hz (min)
 - 400mv RMS @ 2.5 KHz (min)
 - Impedance: Approx. 10k ohms
 - Noise immunity: High frequency roll off, FCO @ 2.5 KHz
 - Pickup coil failure detection: 500 μ A excitation to read coil resistance. 3250 ohms full scale.
- Sensor Inputs:
 - Temperature probes, product and pump housing:
 - 1000 ohm platinum 2 wire RTD probe; .00385 Ω / Ω °C European din curve
 - 8mA constant current sensor excitation, 200 ohms full scale
 - Ratio metric and chopper stabilized to avoid drift
 - Power: Continuous monitoring of main power, backup battery, & sensors.
 - Pressure transducer, 2 wire 4-20mA; loop excitation
- Outputs:
 - Pump Control: (1) Form C 2A relay
 - Alarm: (1) Form C 2A relay
 - Communications: RS232 & Bluetooth
- Indicators: Front panel LED's Power (blue), Signal (white), Alarm (red)
- Keypad: 16 button keypad, 4 softkey (A, B, C, D), ON/OFF button. Oil resistant, sealed
- Display:
 - 240x128 full graphic LCD with back light
 - Auto LCD bias control, self-regulating non-sweating temperature activated heater
- Power:
 - External: 9-26 Vdc, self-resetting fuse
 - 0.6A with heater OFF
 - 1.6A with heater ON
 - Transient protection
 - Internal: Rechargeable NiMH battery pack. Maintains power for up to 10 seconds after power loss. Typical service life: up to 5 years
- Physical & Environmental:
 - Operating temperature: -25 to +50°C
 - Humidity: 5-95% non-condensing
 - Sealed, shock vibration tested enclosure
 - Dimensions: 9.75(L) X 7.50 (H) X 3.75 (W)
 - Weight: 4 lbs
- ❖ Miscellaneous: Real time clock with daylight savings time adjustment, dual 8 MHz CPU's, 1M Flash/64K RAM, Watchdog timer, 8 channel 12 bit Hi-speed ADC. Buffered serial port, FIFO CPU communication.

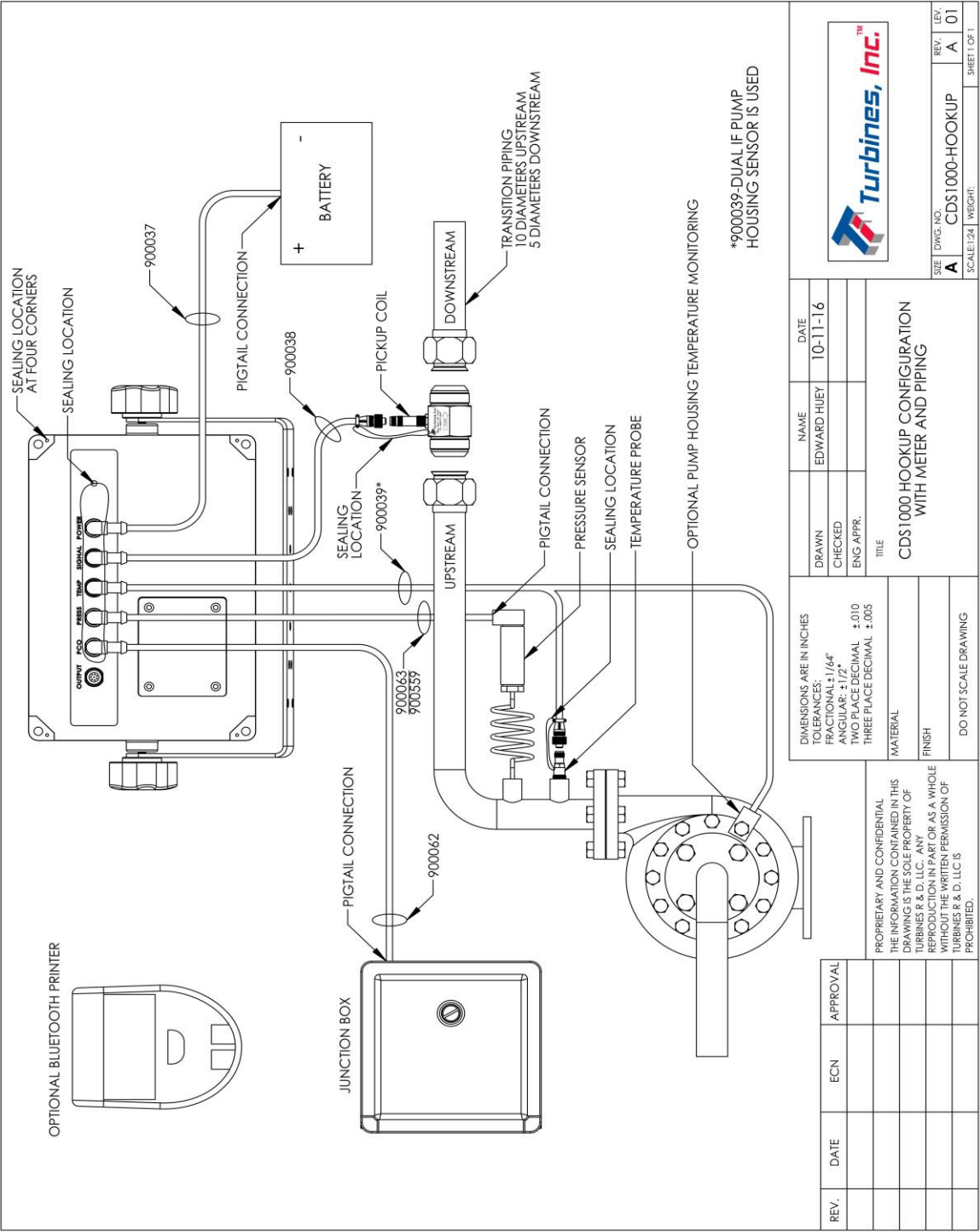
Software:

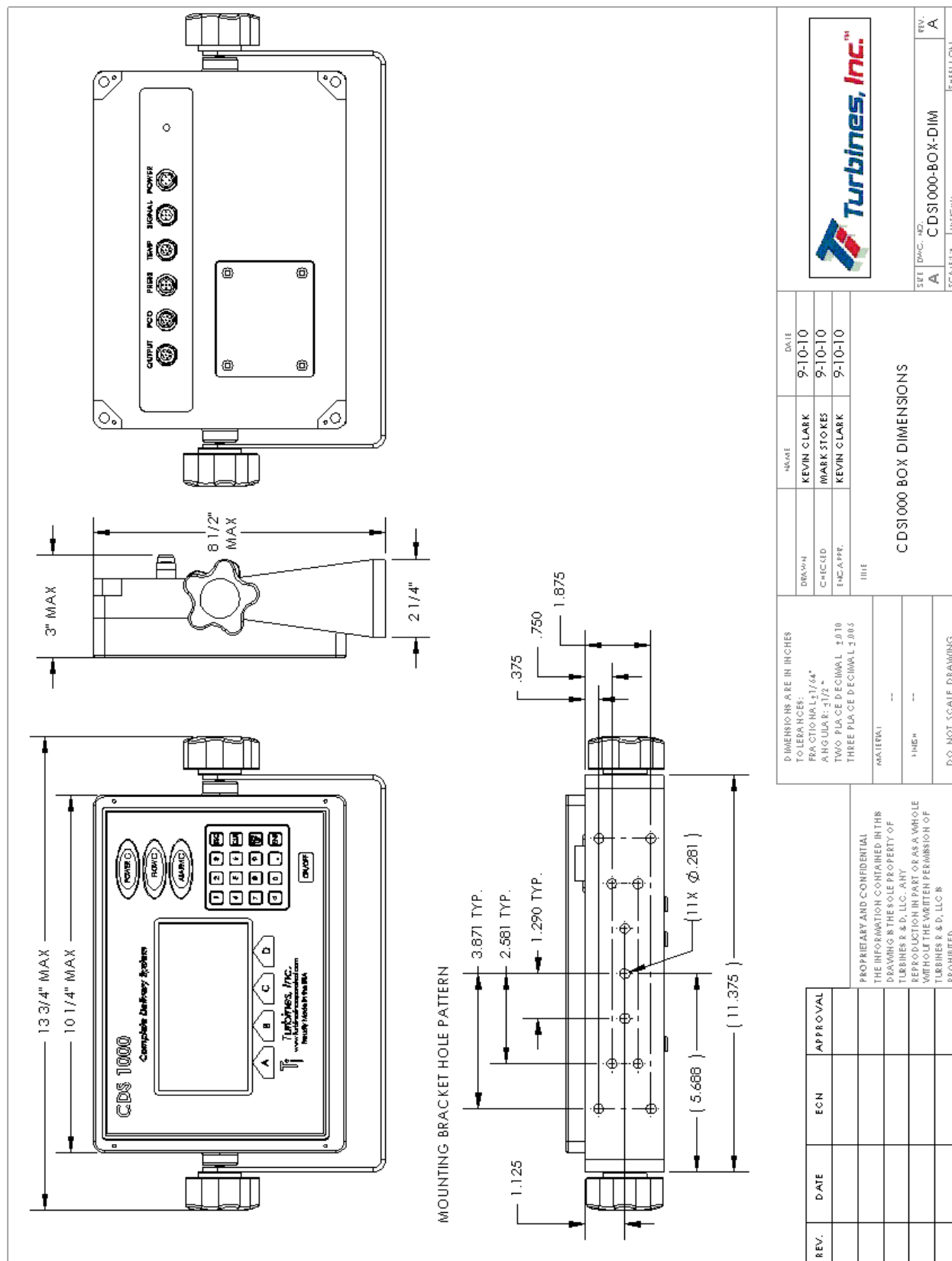
- System Integrity: Built-in diagnostics for all hardware. Power-on self test Constant system monitoring of inputs and sensors
- Sensor Resolution
 - RTD - 0.04 ohms approx
 - Loop- 0.006mA approx.
- Math Processing: Internal floating point (FP), 15 digits of precision.
- Overall Error: 0.001% max (excludes uncertainty of temperature & pressure probe)
- Power Management: CPU extinguishes backlight when operating on internal battery. Auto shutdown after 10 sec power loss

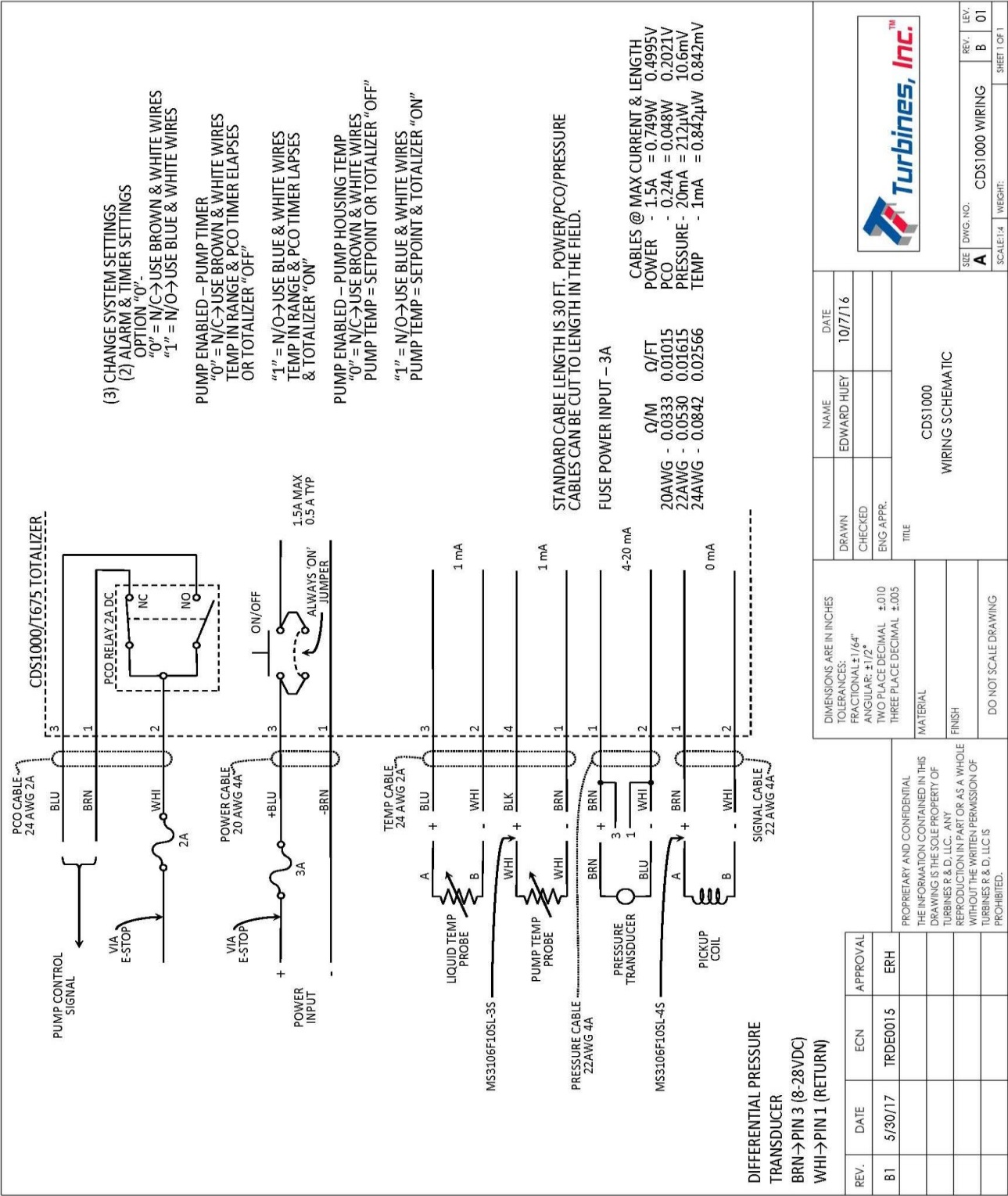
Troubleshooting

- 1) Check the following:
 - a) All connections are secure
 - b) Cables are not split or frayed
 - c) Power source is connected to the truck battery
 - d) No moisture is present in connectors
- 2) If the unit is able to run in Operating mode, observe "ALARM" list by pressing "D".
 - a) Low Power
 - i) Check power connection
 - ii) Check power source (must be equal to or greater than 9Vdc)
 - b) Low Batt
 - i) Exit Alarms and enter the Details screen. Press Test Batt. If test still fails continue:
 - ii) Check battery connection (inside rear battery access panel)
 - iii) Replace battery (Only with an approved Turbines, Inc. battery (P/N: 900035))
 - c) Coil Short or Coil Open
 - i) Check signal cable connections (both ends)
 - ii) Check cable for any loose or frayed ends. If so, replace (P/N: 900038)
 - iii) Check Coil Operation
 - (1) Check coil ohms: should be greater than 500 Ω or less than 3000 Ω (Ohms).
 - (2) Perform signal test:
 - (a) Remove pickup coil from turbine meter. Reconnect signal cable to coil.
 - (b) With a screw driver, rapidly scratch coil below the threads on the bottom surface.
 - (c) Observe **CDS1000** counts or "signal" light slightly illuminates or flashes. If yes, there is most likely a problem with the turbine meter.
 - d) RTD Short or RTD Open
 - i) Check temperature probe cable connection
 - ii) Check cable for any loose or frayed ends. If so, replace (P/N: 900039)
 - iii) Check temperature probe ohms: should be around 1060 Ω at 60°F. If not replace RTD (P/N: 900206)
 - e) Maintenance Due
 - i) This indicates the meter and turbine need to be recertified. This is based on the amount of time the system has flowed product since it was last recertified.
 - ii) To reset the indicator, go to "Programming" follow instructions to reset maintenance timer. Changes System Setting...5) Maintenance
- 3) Check turbine meter
 - a) Ensure the turbine is warm and under no pressure
 - b) Remove turbine from line and observe the following:
 - i) Rotor spins freely, if NOT, STOP, consult factory
 - ii) No wobble, if YES, STOP, consult factory
 - iii) Internals appear intact, if NOT, STOP, consult factory
 - c) Refer to the turbine installation and operation manual for further turbine maintenance.

Illustrations







Wiring

CDS1000 Wiring Connections					
Power		Signal		Temp	
Function	Color	Function	Color	Function	Color
1 Power1	Brown	1 Coil1 +	Brown	1 RTD S-	Brown
2 N/C	N/C	2 Coil1 -	White	2 RTD O-	White
3 Power 2	Blue	3 Coil2 +	Blue	3 RTD O+	Blue
4 Power 1	Black	4 Coil2 -	Black	4 RTD S+	Black
		5 Internal GND	Grey	5 N/A	Grey
				6 N/A	Pink

CDS1000 Wiring Connections (cont)						
Pressure			PCO		Output (RS-232)	
Function	Color*	Color*	Function	Color	Function	Color
1 Pressure Input (4-20mA) +	Brown	Brown	1 Pump NC	Brown	1 VCC or RTS	Red
2 Pressure Input (4-20mA) -	White	White	2 Pump C	White	2 CTS	N/C
3 Internal GND	Blue	Blue	3 Pump NO	Blue	3 RX	White
4 Rate Output (4-20mA) -	Black	Black	4 Alarm NC	Black	4 TX	Green
5 Rate Output (4-20mA) +	Grey	Green/Yellow	5 Alarm C	Grey	5 Internal GND	Black
			6 Alarm NO	Pink		

Wire colors are for standard **Turbines Inc.** supplied cables.

Caution: Do not connect the “Internal GND” connections to the truck/trailer DC ground (chassis).

NC – Normally Closed Contact

C – Common Contact

NO – Normally Open Contact

*Two wire colors are listed for the 4-20mA because two cables could be provided. They are electrically equivalent.

Return Policy

All Returns:

For all returns: (a) a return request must be made to Turbines R&D LLC Customer Service with type of Product, quantity, price paid, invoice number and date of purchase; (b) a Turbines R&D LLC Return Material Authorization (RMA) number must be obtained from Turbines R&D LLC Customer Service prior to the return; (c) the returned Product must be clearly marked with the RMA number on the outside of the packaging and on the packing list; (d) all components and parts of a meter or accessory that have been in contact with any product(s) must be drained and flushed prior to return to Turbines R&D LLC Customer Service; (e) a Material Safety Data Sheet for the product(s) must be attached to the outside of the packaging and included with the packing list; (f) Customer shall be responsible for freight in connection with the return; (g) unless other freight arrangements are agreed to by Turbines R&D LLC Customer Service, the returned Product must be shipped to Turbines R&D LLC freight prepaid and any replacement or repaired Product shall be shipped to the Customer freight collect; and (h) return acceptance and credit are subject to inspection of the returned Product by Turbines R&D LLC. Product returned for credit must be unused, undamaged and complete, in salable condition, and in its original box or packaging. Credits may not be deducted unless and until a credit memo has been issued by Turbines, Inc. Turbines R&D LLC retains the right to refuse to accept the return of any Product that is returned without complying with its return policy. Turbines R&D LLC reserves the rights to refuse any shipment that does not comply with Turbines R&D LLC return policy.

Warranty Claim:

If requested by Turbines R&D LLC, Product that is the subject of a warranty claim must be returned to Turbines R&D LLC. If the warranty claim is approved, replacement or repair of the defective Product or refund or credit of the purchase price of the defective Product, as the case may be, is typically made within 30 days after receipt of the Product by Turbines R&D LLC. If the warranty claim is not approved, the return will be treated as a Non-Warranty Repair as provided below.

Non-Warranty Repair:

If a Product is returned for repair, Turbines R&D LLC will provide an estimate of the repair charges on a time and materials basis and the time required to make the repair. If any repair estimate exceeds 60% of the price of a new unit, the customer will be notified and quoted the price of a new unit. If Customer authorizes the repair, Turbines R&D LLC will proceed with the repair on a time and materials basis. If Customer does not authorize the repair, Turbines R&D LLC will impose an inspection and evaluation charge per unit. This fee can be waived if the following conditions are met:

- 1) Purchase of a replacement unit. Paperwork required if outside the Turbines R&D LLC system.
- 2) Prior negotiations or contracted pricing

Determination of repair capability of any product return is at Turbines R&D LLC discretion due to product condition, attempted customer rework/modification, product discontinuance or any uneconomical or reliable repair outcome.

Expedited Orders/Repairs:

At Customers' request, Turbines R&D LLC may provide expedited service for both orders and repairs. An expedite fee will be applied at the time of request unless otherwise noted by a Turbines R&D LLC representative.

Wrong Product/Excess Quantity Shipped:

If the wrong Product or excess quantity is shipped, the wrong Product or excess quantity may be returned by Customer for credit within 30 days after date of shipment. If more than 30 days has elapsed since the date of shipment, the return will be treated as an Other Returns for Credit as provided below. If the wrong Product/excess quantity claim is approved, credit for the returned Product and return freight is typically made within 30 days after receipt of the Product by Turbines R&D LLC

Other Returns for Credit:

Except as provided above under Wrong Product/Excess Quantity Shipped, returns for credit (i) must be requested within 90 days after the date of shipment, (ii) are subject to restocking charges, and (iii) are at the sole discretion of Turbines R&D LLC. Custom and other non-standard Products are non-returnable. For individual meters and accessories, the minimum restocking charge is 20% of the original purchase price. If the return for credit is approved, credit for the returned Product less restocking charges is typically made within 30 days after receipt of the Product by Turbines R&D LLC

Turbines R&D Return Information:

Address: Turbines R&D 112 Lumber Lane Seneca, SC 29672

Phone: 1.864.882.4544

Fax: 1.864.882.4457



Field Calibration

Adjustment of a Kfactor that shifted over time or due to influences of the installation can be accomplished in the field under controlled conditions. Field calibration of the Kfactor by weigh scale isn't recommended when the **CDS1000** is programmed to use linearization.

Calibration Methods:

The two most popular field calibration methods are a calibration prover or a weigh scale. The metrological 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 resolution (intervals). The best practice when using a scale is to place the receiving vessel on the scale. For any procedure the **CDS1000** should be in the Prove mode. Depress the Setup key, enter the password when prompted, depress Enter and then ESC; this places the **CDS1000** in the prove mode operating screen. The Prove mode allows repeated access to adjust the Kfactor while the cooldown timer, flow inhibit of the reset function and Kfactor are disabled.

Calculating new Kfactors:

Calculating a new Kfactor is the identical regardless of calibration method. Although the TPS1500 Flow Calibration Prover calculates the new Kfactor not all competitive systems offer this convenience. A simple formula calculates the new Kfactor.

Note: Confirm that the engineering units of both the calibration method and the **CDS1000** are the same by using the appropriate liquid equivalencies.

$$\text{New Kfactor} = \frac{\text{CDS1000 total} * \text{present Kfactor}}{\text{Calibration Total}}$$

Example: Calibration total = 50,000 lbs., **CDS1000** total = 49,000 lbs., present Kfactor = 150

$$\text{New Kfactor} = \frac{\text{CDS1000 total} * \text{present Kfactor}}{\text{Calibration Total}} = \frac{49,000 * 150}{50,000} = 147$$

Example: Calibration total = 50,000 lbs. LIN, **CDS1000** total = 7265 gals, present Kfactor = 150

Convert 50,000 lbs. LIN to gallons:

$$\frac{50,000}{6.745 \# / \text{gal}} = 7413 \text{ gal}$$

$$\text{New Kfactor} = \frac{\text{CDS1000 total} * \text{present Kfactor}}{\text{Calibration Total}} = \frac{7265 * 150}{7413} = 147$$

Programming a new Kfactor:

If equipped with a Program Enable Module (PEM) cut the lead seal wire and remove the PEM. With the **CDS1000** powered up normally, depress Setup and if not already in Prove mode enter your password. Select Avg. Kfactor by depressing 1

Example: A new Kfactor is calculated to be 147; enter 147

Depress ESC to return to the Prover operating screen

To exit the Prove mode depress and hold the On/Off pushbutton until the **CDS1000** is off, then turn the unit back On.

Revision History

Revision	Description	Date
0	Initial Release	1/31/2012
A	Fix first flow chart page (Power Off)	11/12/2012
B	Delete duplicate programming on Pg11	12/21/2012
C	Incorporate Pressure PCO control feature and menu items	06/11/2014
D	Added missing menu item 3 – 2 – 7 Pump off @ flow rate err	8/29/2014
E	Added return policy & field calibration pages, text to Description, changed operating temp spec from -40°C to -25°C corrected typo's, miscellaneous font adjustments	4/12/2015
F	Added programming page 11 for Pump Housing Temp; updated chart on pg7 adding CDS1000LS and LSO columns and components, added PEM statement on pg6 Modes of Operation	10/14/15
G	Pg 10,11- changed Pump ON during alarm settings to NO/YES	12/03/15
H	Updated pg16 drawing, added pg18 drawing	10/12/16
I	Change System Settings - Corrected 3) “Serial numbers and Bluetooth” #2 Plant,3 Trailer on pages 10 & 11	2/2/17
J	Updated programming pgs 10-12, updated pg 7 chart adding CDS1000LE, LPS,LPD, deleting CDS1000.	5/13/17
K	Updated pg 17 drawing	5/31/17