RUGGEDCONTROLS

LCI-80x
User Manual

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Document Change Log

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A	23 Apr 2015	First issue	AP	PS	AJ
B	12 Nov 2015	Updated for LCI Communications	PS	AP	AP
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References
LCI Displays – Network Communication Guide
LCI-80x Calibration Procedures
LCI-80x Power Tong – System Calibration
LCI-80x Messaging System User Guide

Disclaimer
Rugged Controls endeavors to ensure that all information in this document is correct and fairly stated, but does not accept liability for any errors or omissions.

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1 Introduction

Rugged Controls designs and manufactures rugged winch control, wireline monitoring, and instrumentation used in demanding oil & gas, commercial, and oceanographic applications ranging from polar to tropical. Our products are used to control and monitor speed, payout, and tension in winch systems used for equipment deployment, barge positioning, fixed-place mooring, drawbridge controls, and wherever accurate and reliable line control is required.

This document provides information on the use of the LCI-80x platform developed and manufactured by Rugged Controls in Seattle, WA USA.

This user manual applies to firmware versions MVv2.5.0.0 and up.

2 Product Summary

The LCI-80x Multivariable Controller is a versatile instrument that measures and displays analog and digital sensors.

The LCI-80x has a rugged waterproof stainless-steel faceplate and daylight-visible Electroluminescent (EL) screen. The small form factor permits installation in areas where free space is limited.

Three precision analog inputs support current, voltage, and strain gauge sensors, while the counter input supports a wide range of rotational sensors. These inputs can be user-configured for nearly any measurement type, such as tension, torque, or temperature.

Measured data can be logged to a USB drive and/or transmitted via the RS-232, RS-485, or Ethernet communication interfaces. Additionally, the LCI-80x can share data with other 80x displays over these communication channels.

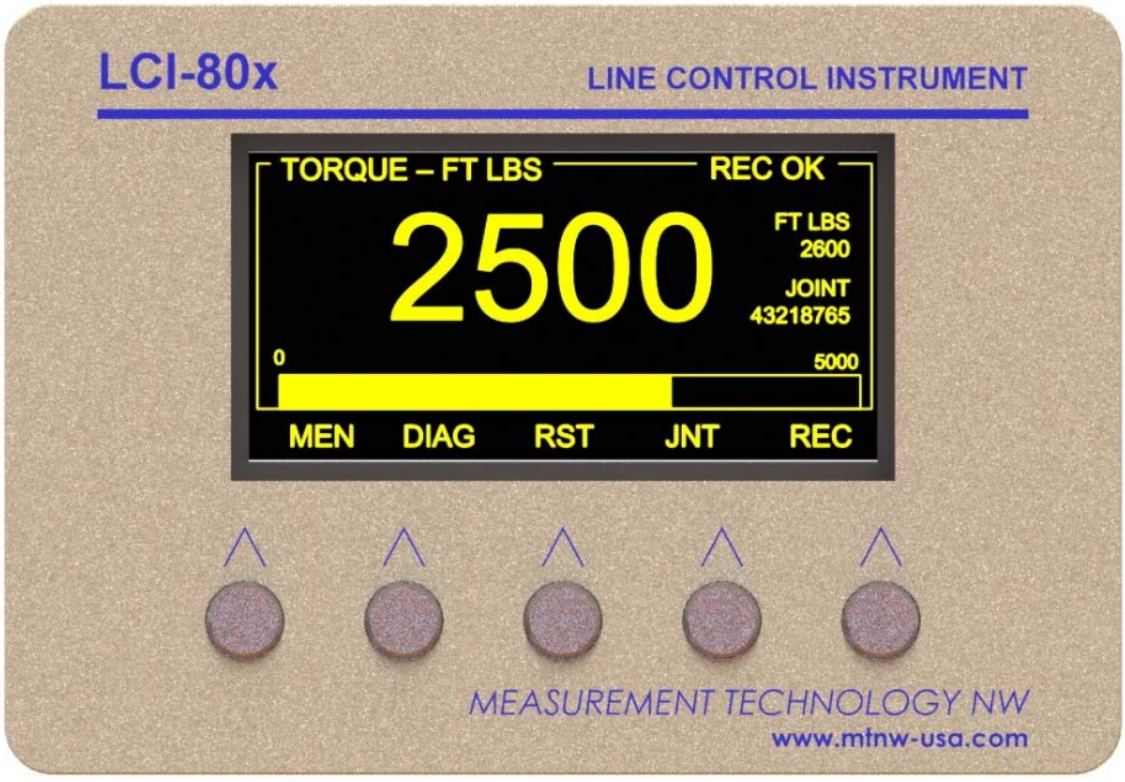

Figure 1 - LCI-80x Display

2.1 Features of the LCI-80x

- ***Measurement***
  - Two inputs configurable for 4-20mA or -5 V to +10 V signals
  - One 20 or 100 mV strain gauge level input
  - One rotation/count sensor supporting quadrature and count/direction
  - High-speed analog data capture up to 100 Hz
  - Tare and peak capture
  - Calibration via scale/offset, two-point calibration, or multipoint
  - Two digital inputs for resetting payout or other functions
  - RS-232 and RS-485 serial sensor support
  - Rotational load resistors menu-configurable
  - User-selectable measurement type units

- ***Output***
  - Twelve level-triggered alarms
  - Two onboard SPDT dry contact relays, triggered by alarm state
  - Two analog outputs configurable for 4-20mA or -5 V to +10V signals

- ***Display***
  - Display up to eight measurements on a single screen
  - Three active screens
  - Five different screen layouts
  - Bar graph display
  - Three programmable function keys per screen
  - User-configurable display refresh rate
  - User-configurable contrast setting
  - Backup/restore system settings
  - Passcode protection of system settings

- ***Data Logging***
  - USB data storage in CSV format with data integrity feature
  - Continuous or session-based USB logging modes
  - Polled or broadcast data available from all communication interfaces
  - All data is timestamped

- ***Communications***
  - Ethernet, RS-232, and RS-485
  - Supports networked operation with local and remote displays
  - Serial baud rate 2400 to 230400bps, parity configurable
  - Ethernet supports 10BASE-T/100Base-TX, UDP and TCP/IP
  - Modbus RTU interface over serial and TCP

3 Conditions of Safe Use

36V DC MAXIMUM INPUT VOLTAGE
15W MAX POWER
1.6A FAST-BLOW FUSE

-40°C ≤ Ambient Temperature ≤ +70°C

Maximum relative humidity 95 percent non-condensing

Not rated for use in Hazardous Locations.

4 List of Abbreviations

AIN	Analog Input
AOUT	Analog Output
CNT	Counter
ENT	Enter
ESC	Escape
SG	Strain Gauge
MEN	Menu

5 Specifications

5.1 Electrical

Table 1 - LCI-80x Electrical Specifications

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{IN}	Input Voltage		10	24	36	V DC
I_{IN}	Input Current	V_{IN} = 10V DC		0.700		A
		V_{IN} = 24V DC		0.260		A
		V_{IN} = 36V DC		0.190		A
AIN_{VRANGE}	Analog Inputs Voltage		-10		10	V
AIN_{IRANGE}	Analog Inputs Current		0		21	mA
CNT_{VRANGE}	Counter Input		0		10	V
MAG_{VRANGE}	Magnetic Pickup Input		-12		12	V
$RS\text{-}232_{RANGE}$	RS-232 Interface		-30		30	V
$RS\text{-}485_{RANGE}$	RS-485 Interface		-12		12	V
$V_{RS485\ ISO}$	RS-485 Isolation				2500	V
$AOUT_{VRANGE}$	Analog Output Voltage		-5		10	V
$AOUT_{IRANGE}$	Analog Output Current		0		20	mA
$I_{RELAY\ MAX}$	Maximum Current Relay Outputs				1.0	A
$V_{RELAY\ RANGE}$	Voltage Range Relay Outputs		0		60	V
t_{Alarm}	Relay Response Time	20Hz sampling			100	ms
		100Hz sampling			20	ms
T_{AMB}	Operating Temperature		-40		70	°C
f_{COUNT}	Counter Frequency				20000	Hz
V_{DIN}	Digital Input Voltage Range		0		30	V
$V_{DIN\ LOW}$	Logic ‘low’ digital input				2.0	V
$V_{DIN\ HIGH}$	Logic ‘high’ digital input		2.5			V
$f_{ADC\ SAMPLE}$	ADC Sample Rate		1		100	Hz
Res_{ADC}	Effective ADC Resolution	20 Hz sampling		16		bits
Err_{AIN}	AIN1, AIN2 4-20mA Full Scale Resolution	-50°C to 70°C		0.05		% FS
Err_{SG}	AIN3 100mV Full Scale Resolution (5V exc)	20°C		0.013		% FS
		-50°C to 70°C		0.71		% FS
R_{AIN}	AIN Impedance voltage mode	SW2 OFF		1		MΩ
	AIN Impedance current mode	SW2 ON		220		Ω
f_{AOUT}	AOUT Update Rate				100	Hz

Res_{AOUT}	AOUT Resolution		12	Bits
Err_{AOUT}	AOUT Full scale error	-50°C to 70°C	0.4	% FS

5.2 Mechanical

Table 2 – LCI-80x Mechanical Specifications

Parameter	Dimension
Front Panel	5.6” wide x 3.9” tall x 2.8” deep 142 mm wide x 98 mm tall x 70 mm deep
Panel Cut-out	5.27” wide x 3.55” tall 134 mm wide x 90 mm tall
Weight	1.7 lbs. 0.77 kg
Viewing Area	3.15” wide x 1.57” tall 80 mm wide x 40 mm tall
View Angle	160°
Pixel Area	160 x 80 pixels
Gasket Material	Silicone
Front Panel Material	316 Stainless Steel
Window Material	Polycarbonate
Front Panel Rating	NEMA 4X
Rear Enclosure Rating	NEMA 1

6 Quick Start

This section addresses the process for setting up a LCI-80x for displaying a single measurement. This process is described from start to finish, starting with mechanical installation and ending with a simple calibration. See the relevant sections of this user manual regarding further customization of the LCI-80x.

6.1 Install the LCI-80x

The LCI-80x will fit in a 5.25” x 3.5” cut-out, with a minimum of 2.6” depth clearance. The instrument is held in place with removable panel clamps that index into the slotted holes on both sides of the display. Two clamps are included with each display.

After sliding the display into the cutout, clip the panel clamps on the sides of the display, as shown in Figure 2. Slide the clamp as shown in Figure 3 to lock the clamp in place. Once the panel clamps are installed, tighten the jackscrews against the panel to compress the LCI-80x gasket to seal against the panel. Lock the jackscrews with the hex nuts to prevent them from vibrating loose over time.

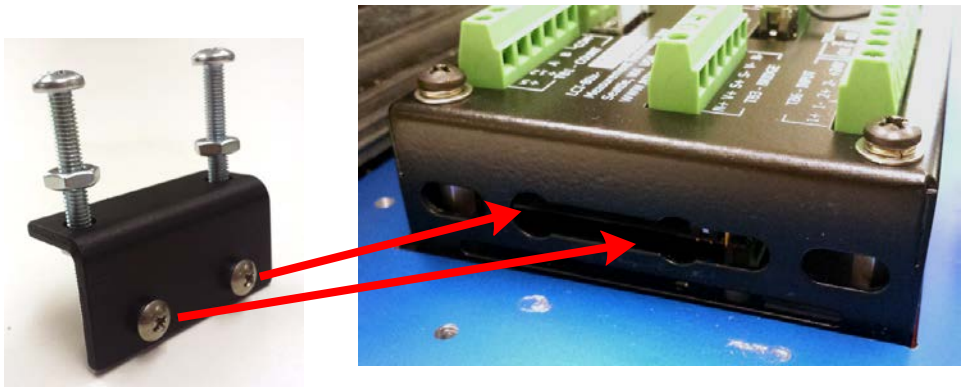

Figure 2 - Attaching panel clamps to display

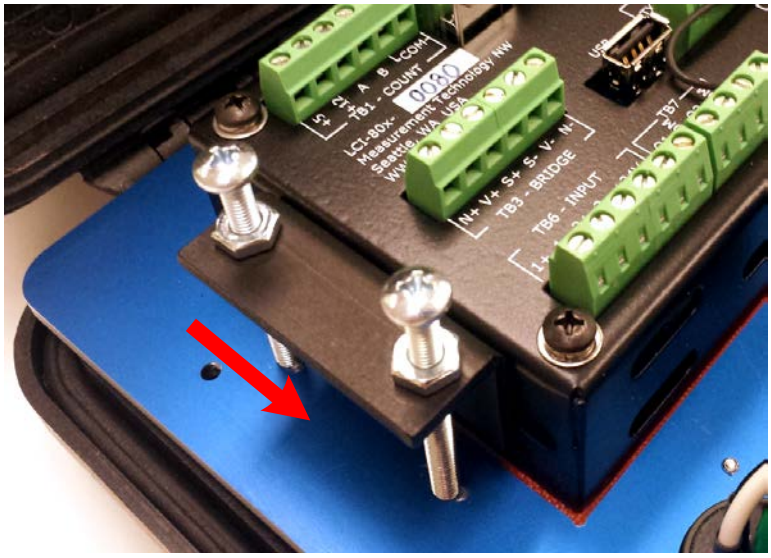

Figure 3 – Slide the clamp to the base of the slot.

6.2 Connect Power and Sensors

The LCI-80x can be powered from a 12-36V DC power supply. This power source should be rated for at least 15 watts. As the LCI-80x does not have a power switch, an appropriate switch must be installed separately to provide a means of disconnecting the display from power for servicing. Connect the power lines to TB-2 as shown in Figure 4 below.

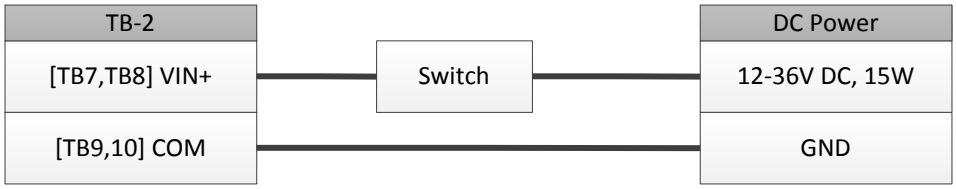

Figure 4 - DC Power Supply Connection

Analog sensors with current or volt outputs connect to TB-6 as shown in the example in Figure 5. Set DIP switch SW2 according to the sensor that is connected. For current sensors, SW2 must be turned on, enabling the load resistor (factory default). For volt sensors, SW2 must be turned off. See the table of DIP switch settings in Appendix A .

WARNING: The LCI-80x or attached sensors may be damaged if SW2 is not configured for the attached sensor! Make sure SW2 is set for the appropriate sensor mode (volt or current) before applying power to the system.

Analog sensors with millivolt outputs, such as strain gauges, connect to TB-3 as shown in Figure 6 and Figure 7.

Rotation/Count sensors should be connected as shown in Figure 8 and Figure 9. If the sensor has a single count output and no direction output, COUNTER A can be left disconnected.

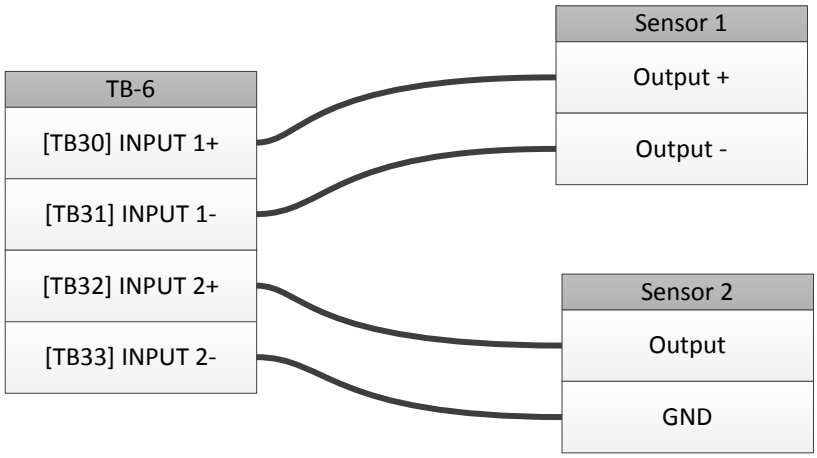

Figure 5 - Connecting two different volt sensors to the LCI-80x

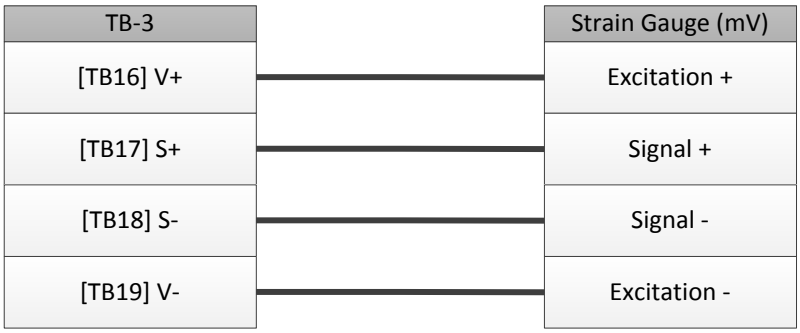

Figure 6 - Connecting a 4-wire mV sensor

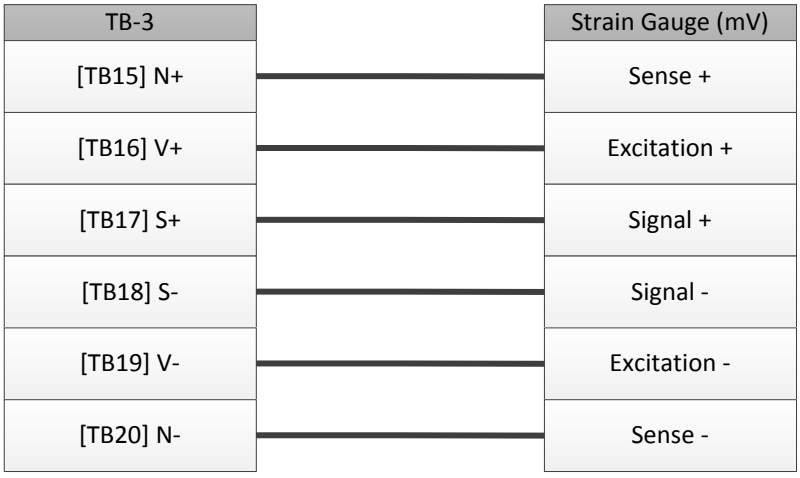

Figure 7 - Connecting a 6-wire mV sensor

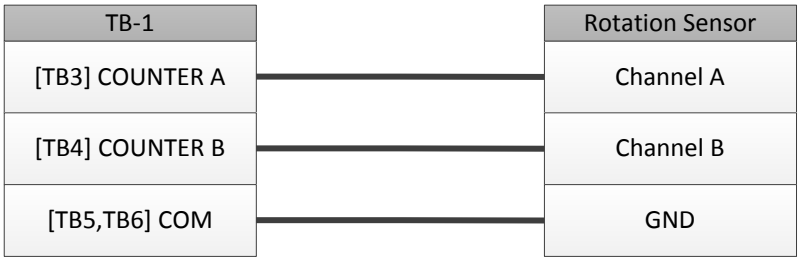

Figure 8 - Connecting rotation sensor with quadrature outputs

Figure 9 - Connecting rotation sensor with single counting output

The LCI-80x provides several regulated voltages to power a variety of field sensors. The following table lists the supplies and their location:

Table 3 - Available on-board power supplies

Power	Capacity	Location
+24 V_{DC}	0.5 A	TB-7 [TB34, TB35]
+5 V_{DC}	0.5 A	TB-1 [TB1]
+12 V_{DC}	0.5 A	TB-1 [TB2]

Connect power to the sensors according to their requirements. If the sensor requirements are not met by the LCI-80x supplies, an external power supply is needed.

6.3 Configure Sensors and Measurements

Apply power to the LCI-80x and sensors. The display will boot and show the Main Screen. The default measurement shown is a single force measurement using AIN-1. The measurement value is shown in a large font with a bar graph below it. Below the bar graph is the region where key labels are shown. These labels correspond to the buttons on the front panel.

6.3.1 Define the Measurement

To configure the LCI-80x, press the button under MEN to open the Main menu.

Using the UP and DWN buttons, scroll down to SYSTEM CONFIG and press ENT. The System Configuration menu will appear.

Scroll down to SENSOR CONFIG and press ENT. The Sensor Configuration menu will appear.

Scroll down to MEAS SETUP and press ENT. The Measurement Setup menu will appear wherein a measurement is defined. Each measurement on the LCI-80x is identified by an ID number, (1-8). Perform the following steps to define Measurement 1.

Scroll down to TYPE and press ENT. The type field will be highlighted, indicating Edit Mode. Using the DEC and INC buttons, change the measurement type to the one that most closely matches the application. Press ENT to save the change, or ESC to cancel.

Scroll down to UNITS. Press ENT and edit the value to match the desired units for this measurement.

Scroll down to INPUT, row 8. This is the sensor input of the LCI-80x that will provide this measurement. Press ENT and edit the value to match the input the sensor is connected to.

The Measurement has been fully defined. Press ESC to return to the Sensor Configuration menu. If using a rotation/count sensor, skip to section 6.4 Calibration. For analog sensors, continue to section 6.3.2.

6.3.2 Configure the Sensor

Scroll down to AIN CONFIG and press ENT. The AIN Configuration menu appears.

Press ENT and select the AIN channel the sensor is connected to.

Scroll down to RANGE and configure the AIN range to match the attached sensor. AIN-3 can only be configured for mV ranges, while AIN-1 and AIN-2 can be configured for mA or V ranges. SW2 must also be configured properly for current or voltage. See section 6.2.

If the sensor is a mV sensor, also configure the excitation range and sense configuration according to the application. The SENSE row should read INT for 4-wire mV sensors and EXT for 6-wire sensors.

Press RUN to return to the Main Screen. The previous measurement label at the top of the screen should be replaced by the configured measurement and units. If this is not the case, the display may need to be configured to display the measurement.

6.4 Calibration

It is necessary to calibrate the new measurement in order to correlate the sensor value (volts, counts, mA, etc.) to a measurement value (pounds, meters, PSI, etc.). This section describes two quick calibration procedures to get the system running in a minimum amount of time. For a more accurate calibration, perform a two-point or multipoint calibration for analog sensors.

6.4.1 Analog Quick Calibration

Press MEN to enter the Main menu. Scroll down to CALIBRATION and press ENT. The Calibration menu appears, showing the calibration for Measurement 1.

Scroll down to CAL. TYPE and press ENT. Change the calibration type to SCL/OFS.

Scroll down to SCALE and press ENT. In this Numeric Edit Mode, use DEC and INC to change the value of a digit and the → button to change digits. Press ENT to save the new value or ESC to cancel editing.

Change the SCALE value to the full-scale output of the sensor and press ENT to save the value.

Scroll down to OFFSET and press ENT. Change the offset value to match the sensor. This is the measured value at the bottom of the sensor range. Press ENT to save the value.

Press RUN to return to the Main Screen. The measurement shown is now roughly calibrated.

6.4.2 Counter Calibration

Press MEN to enter the Main menu. Scroll down to CALIBRATION and press ENT. The Calibration menu appears, showing the calibration for Measurement 1.

Scroll down to MODE and press ENT. Quadrature sensors should use one of QUAD1X-QUAD4X. Sensors with a single count output should use UP/DWN. QUAD1X will count 1 pulse for each full quadrature period. QUAD4X will count 4 pulses for each period, one for each signal edge.

Scroll down to LOAD RES. and configure the load resistor required by the count sensor. Options are pullup, pulldown, and no load resistor.

Scroll down to SCALE and press ENT. In this Numeric Edit Mode, use DEC and INC to change the value of a digit and the → button to change digits. Press ENT to save the new value or ESC to cancel editing.

Change the SCALE value to the number of pulses per unit of the measurement (e.g. 8 pulses/meter). When calculating this value, keep in mind that the quadrature mode will affect the number of pulses per unit.

Scroll down to PRESET and enter a count preset, such as 0. Press ENT to save.

Press RUN to return to the Main Screen. The measurement shown is now roughly calibrated.

7 Mechanical Installation

The LCI-80x is designed for mounting on the front-panel of an electrical enclosure with a suitable environmental rating. The sealed front face of the LCI-80x is made of a laminated stainless steel assembly and the slotted rear cage is designed to promote heat transfer, facilitate field wire terminations, and provide a purchase point for the panel clamps.

The front face is 3.9” high x 5.6” wide and the total depth is 2.38”.

7.1 Environmental Considerations

The front face of the LCI-80x is designed for NEMA 4X applications. It consists of a 316 stainless steel top layer, a sealed polycarbonate window, and five membrane-sealed stainless steel push buttons. A silicone gasket, held in-place by a high temperature adhesive, is applied to the backside of the front face. When mounting the LCI-80x in exposed locations, a front-panel cover is recommended to protect the unit when it is not in use.

The standard operating temperature range of the LCI-80x is –40°C to +70°C.

7.2 Dimensions and Cutout

The LCI-80x will fit in a 5.27” x 3.55” cutout (tolerance –0.01, +0.100); with a minimum of 2.8” depth clearance. The enclosure’s front panel can be up to 5/8” thick.

7.3 Display Mounting

The instrument is held in place with removable panel clamps that index into the slotted holes on all sides of the display. Two clamps are included with each display.

After inserting the display into the cutout, clip the two panel clamps on the sides of the display, with the flanged end of the clamp facing away from the panel. Once the panel clamps are installed, tighten the jackscrews against the panel to compress the LCI-80x gasket to seal against the panel. Lock the jackscrews with hex nuts to prevent them from vibrating loose over time.

7.4 Ventilation Requirements

The instrument should be mounted with a minimum of 0.75” spacing between the rear enclosure (all edges) of the display and adjacent equipment to allow for adequate ventilation and heat transfer.

7.5 Cleaning Instructions

To clean the front panel of the display, use a clean lint-free cloth and high quality pure isopropanol. Do not apply the solvent directly to the polycarbonate window;

instead wet the cloth first and then gently wipe the window and the stainless steel bezel.

8 Field Wiring

The LCI-80x can be configured for a wide range of signal input and output functions. Use the following sections to connect the LCI-80x to power supplies, field sensors, and communication networks.

It is recommended that all field conductors are of copper construction and are terminated with wire ferrules and wire labels.

8.1 Power Input

The LCI-80x accepts 12 to 36 V DC. The input current varies based on the power supply voltage. Typical current draw at 12V is under 1A.

An appropriate disconnect device must be installed to provide a means of disconnecting the display from the external power source for servicing. This disconnect device is not provided with this equipment.

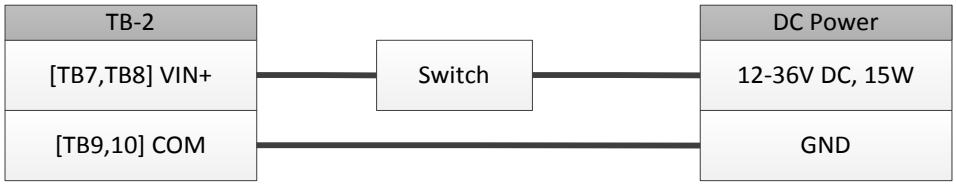

Figure 10 - DC Power Supply Connection

The fuse (F3) is located on the rear panel of the display, see Figure 11. The replacement part is a 5 x 20 mm fuse rated according to the system options.

If the fuse needs to be replaced, use Table 4 to select the appropriate fuse and part number. The LCI-80x ships with a 0.625A fuse.

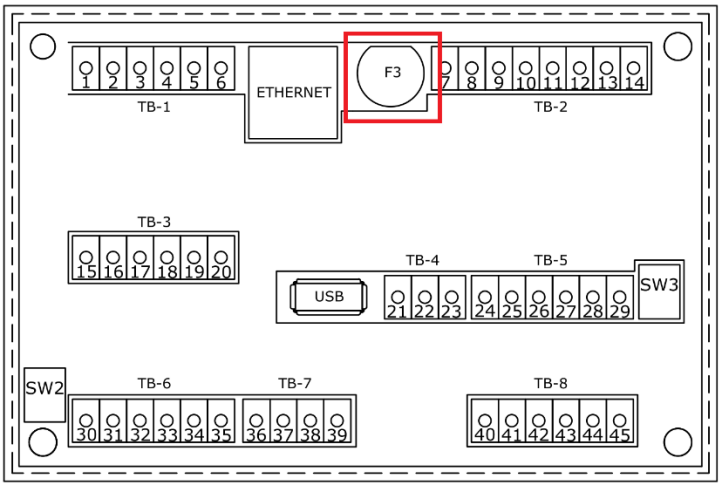

Figure 11 - Fuse holder location on back side of LCI-80x

Table 4 - F1 Fuse Ratings

Power Supply Voltage	Fuse Rating	Littelfuse Part No.
9V DC	2.0A	218002.
12V DC	1.25A	2181.25
24V DC	0.625A	218.630
36V DC	0.5A	218.500

8.2 Sensor Power Supply

Several regulated power supplies are available from the LCI-80x to power field sensors. These power supplies are intended to provide a low-noise regulated supply to sensitive field sensors. All sensor power supplies are referenced to the electrical ground connected to COM on TB-2.

Table 5 - Field Sensor Power Supplies

Supply	Terminal Block	Maximum Current Draw
+5V DC	TB-1 +5	0.5A
+12V DC	TB-1 +12	0.5A
+24V DC	TB-6 +24	0.5A
±2.5V DC, ±5V DC	TB-3 V+ / V-	0.277A

Each power supply output has an internal resettable fuse. In the event of an overload or short, disconnect the load from the power supplies. The resettable fuse will reset. Correct the issue with the load and reconnect to the LCI-80x.

It is possible to overload the circuit and cause damage beyond the capability of the resettable fuse. In this case the unit will need to be returned to Rugged Controls for inspection and repair.

8.3 Analog Inputs

Two types of analog inputs are available on the LCI-80x:

1. Two voltage/current inputs
2. One strain gauge input

The voltage/current inputs can measure a range within -5V to 10V in volt mode or 0mA to 20mA in current mode. The measured range is configurable.

The strain gauge analog input is intended to be connected to a Wheatstone bridge as found in load cells and pressure sensors. The strain gauge analog input has an excitation voltage power supply of ±2.5V DC or ±5V DC, as shown in Table 5.

Table 6 - Analog Input Configurations

Input Channel	Terminal Block	Configurations
AIN-1	TB-6 1+ and 1-	4-20mA 0-20mA 0-5V 0-10V ±5V
AIN-2	TB-6 2+ and 2-	
AIN-3	TB-3 S+ and S-	±20mV Strain Gauge ±100mV Strain Gauge

8.3.1 Voltage / Current Inputs

The DIP switch SW2 controls the mode of the analog input. The switch connects a 220Ω resistor from the input to DC common. The DIP switch must be in the ON position if the signal is a current type (i.e., mA signal) and OFF if the signal is a voltage.

WARNING: The LCI-80x or attached sensors may be damaged if SW2 is not configured for the attached sensor! Make sure SW2 is set for the appropriate sensor mode (volt or current) before applying power to the system.

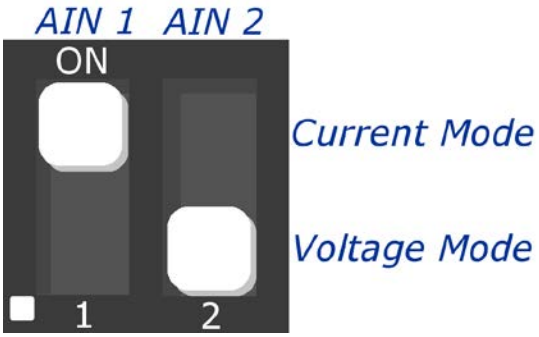

Figure 12 - AIN Mode DIP Switch (SW2)

The DIP switch is ON when the switch is in the *UP* position. The ON position is marked on the DIP switch. In Figure 12, AIN1 is configured for current mode, while AIN2 is configured for voltage mode.

The voltage / current analog inputs can interface with 4-20mA, 0-20mA, 0-5V, 0-10V, and ±5V signals.

Analog sensors can be powered externally, from the same power supply used to power the LCI-80x, or from the regulated sensor power supplies (+5V, +12V, or +24V).

NOTE: The terminal labeled IN+ on TB-2 is the power input for the LCI-80x. It is not the regulated supply output for sensor excitation. If the same power is used for both the display and the sensor, it is up to the user to ensure that the power supply is regulated to meet the requirements of both the sensor and the display.

Figure 13 - 2-wire Sensor

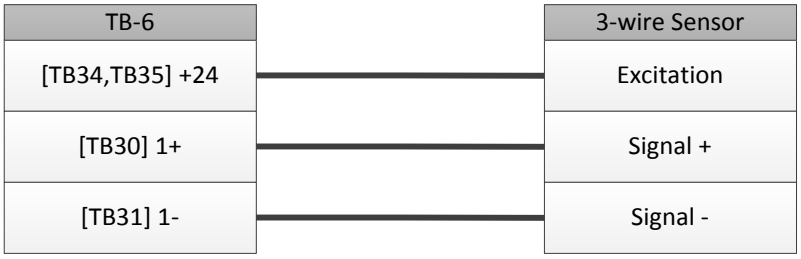

Figure 14 - 3-wire Sensor

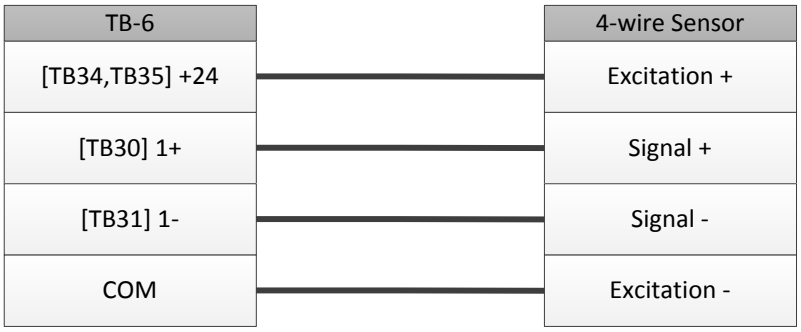

Figure 15 - 4-wire Sensor

8.3.2 Strain Gauge Input

The strain gauge input (AIN-3) can accept ±20mV or ±100mV range sensors. The LCI-80x is configured calibrated at the factory for a ±20mV range. If ±100mV sensors are to be used, contact Rugged Controls.

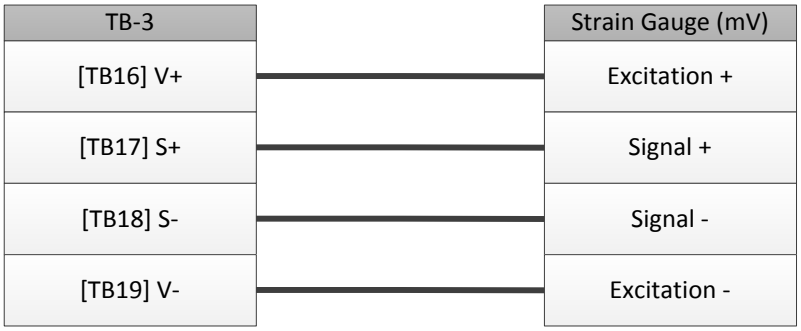

Figure 16 - 4-wire Strain Gauge

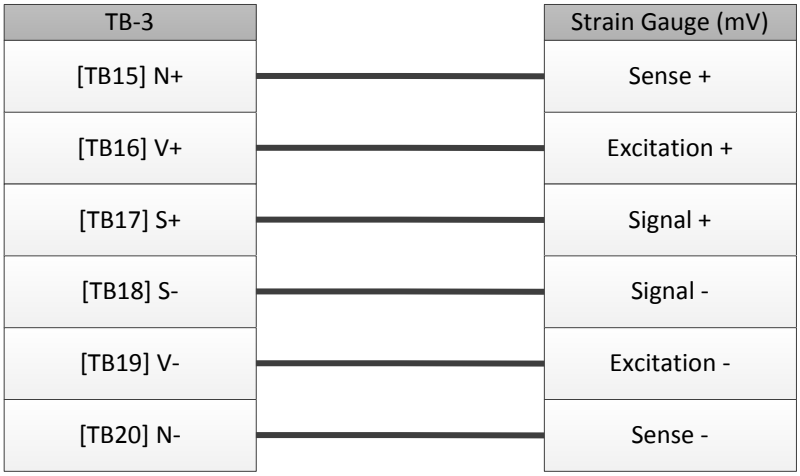

Figure 17 - 6-wire Strain Gauge

8.4 Counter Inputs

Terminal block TB-1 provides +5V, +12V, inputs, and electrical ground for handling a variety of pulse-based sensors. The counter input can accept NPN or PNP type proximity sensors, Hall-Effect sensors, NAMUR type sensors, or TTL/CMOS encoder inputs. The input voltage thresholds are set to accommodate the ranges of all these sensor types with no adjustment.

Voltage thresholds are 2.2 volts for low-high transitions, and 2 volts for high-low transitions.

Count+Direction (non-quadrature) sensors should use COUNTER-A as the direction input and COUNTER-B as the pulse input. COUNTER-A can be left unconnected if direction control is not needed.

Pull-up and pull-down resistors can be enabled using the Calibration menu.

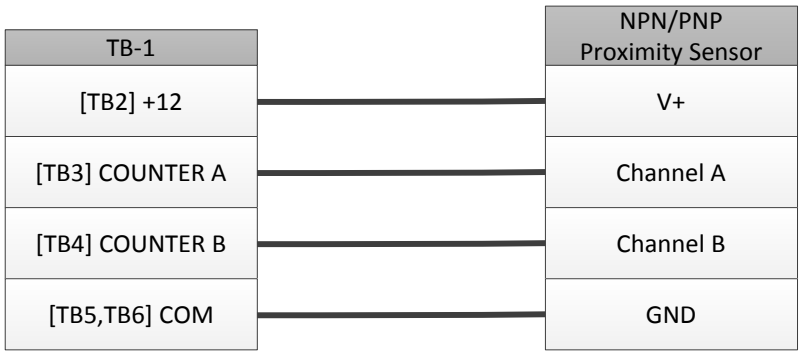

Figure 18 - NPN/PNP Proximity Sensors

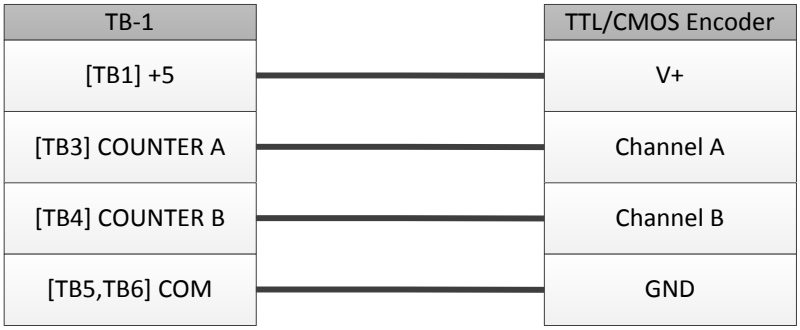

Figure 19 - TTL/CMOS Encoder

8.4.1 Magnetic Pickup Sensor

The counter input may be connected to a magnetic pickup sensor. The counter input is compatible with both digital (TTL) and analog (sine) signals. Switch SW4 on the

LCI-80x PCB controls the input type. To enable the magnetic pickup sensor interface place the switch in the down position.

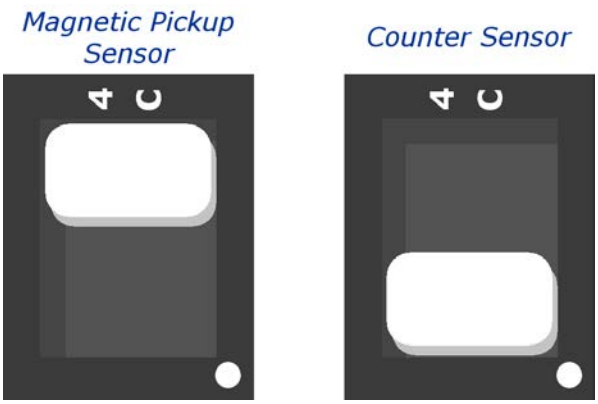

Figure 20 - Count Sensor Interface DIP Switch Positions

The magnetic pickup sensor interface has a frequency range of 0.5 to 20,000 Hz and a minimum switching voltage of 100mV.

Connect the magnetic pickup sensor output signal to the Counter-B input. The Counter-A input controls the count direction. It can be left unconnected.

NOTE: All proximity sensors, encoders, Hall effect, and magnetic pickup sensors have different power supply requirements. It is the responsibility of the user to ensure the correct power supply is used with a sensor.

8.5 Digital Outputs

Two digital outputs are available on the LCI-80x. The digital outputs are asserted during alarm conditions. The LCI-80x uses internal SPDT dry contact relays to represent the alarm states.

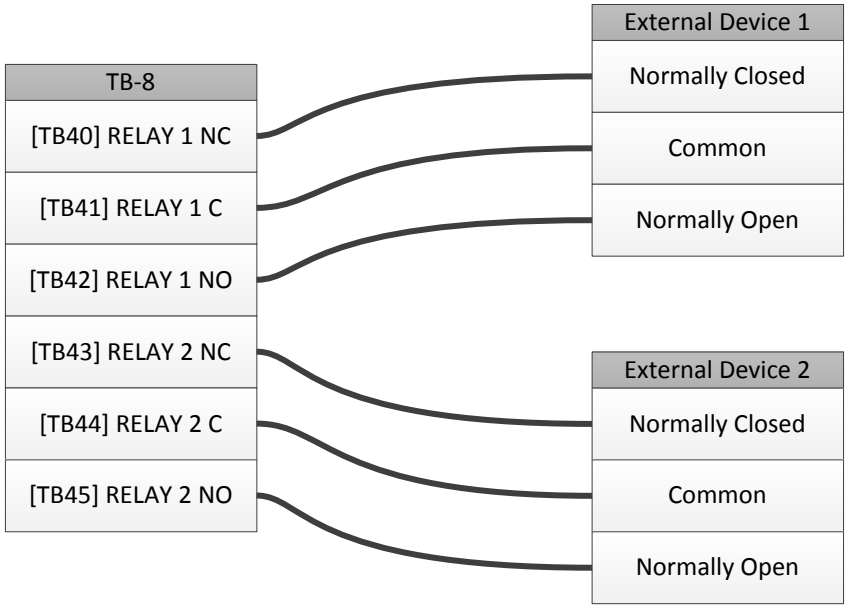

Figure 21 - Digital Output

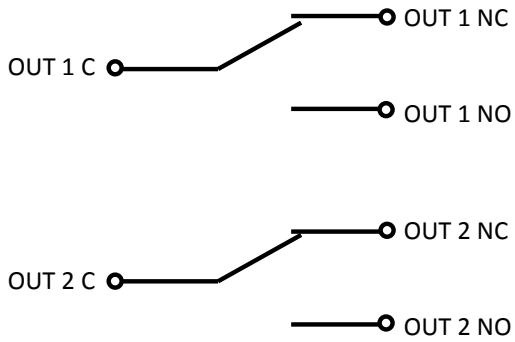

Figure 22 - Schematic of relays

8.6 Digital Inputs

The LCI-80x provides two digital inputs on terminal block TB-2. The digital inputs can be configured using the menu system to change the display, tare measurements, or other functions. They can also be used as an input to a measurement to allow for alarm monitoring.

The digital inputs are pulled low to DC common (off) and are active-high configuration. The input pins are tolerant of voltages between 0 VDC and 30 VDC. The switching point between logic low and logic high levels is 2.25V (CMOS logic).

The simplest digital input is a switch connected between +VIN and the digital input terminal. Relays, PLCs, or other electronics can provide alternative methods for triggering digital input functions. If an external source is used, the DC common of both systems should be connected.

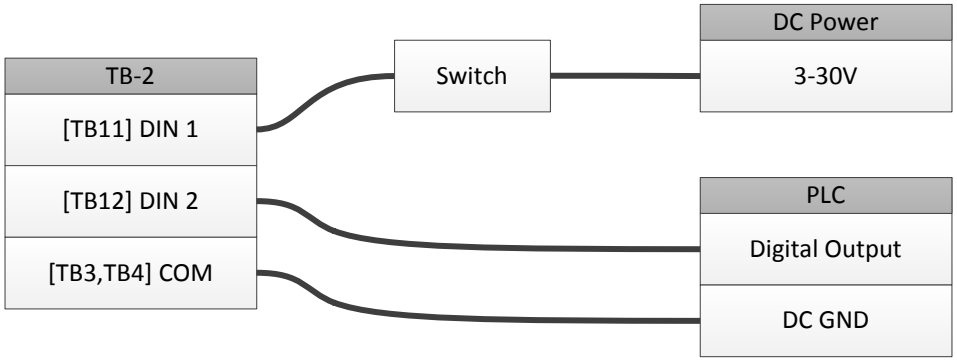

Figure 23 – Example connecting two different digital signals

8.7 Analog Outputs

The LCI-80x provides two analog outputs on terminal block TB-7. These outputs can be 4-20 mA, 0-5 VDC, 0-10 VDC or ±5VDC.

The 4-20mA output is a current source. Ensure that the load connected to the analog output is compatible with a current source.

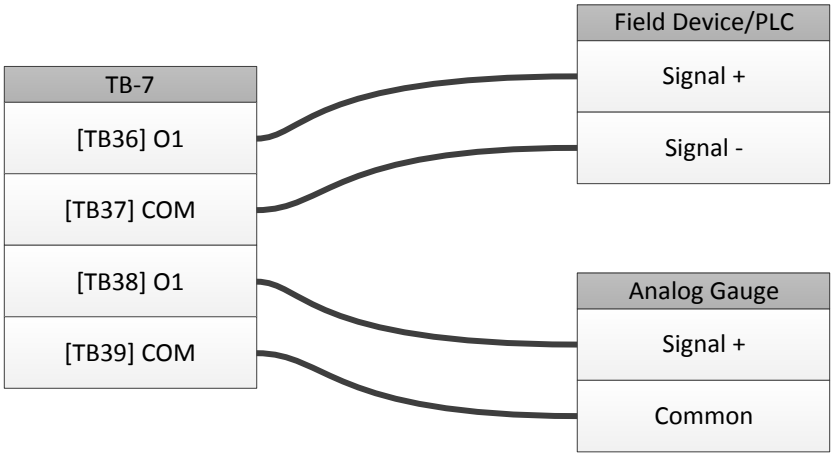

Figure 24 – Example connecting analog outputs to two different devices

The output signal type is configured using the menu system. Each channel can be linked to a measurement and scaled as needed.

8.8 Serial Communication

The LCI-80x provides RS-232, and RS-485 serial communication interfaces. Use the electrically-isolated RS-485 port for long cable runs or multi-drop applications.

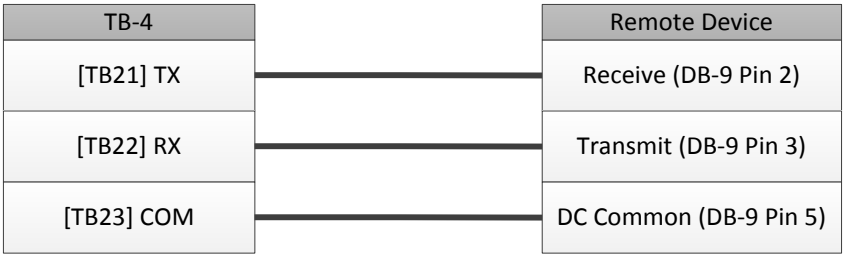

Figure 25 - RS-232 Serial Interface

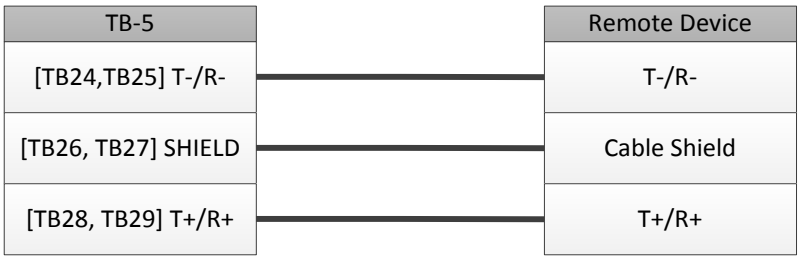

Figure 26 - RS-485 Serial Interface

The RS-485 termination is set by the DIP switch SW3. Place both switches in the ON position to enable 4.7kΩ termination. Place both switches in the OFF position to disable termination.

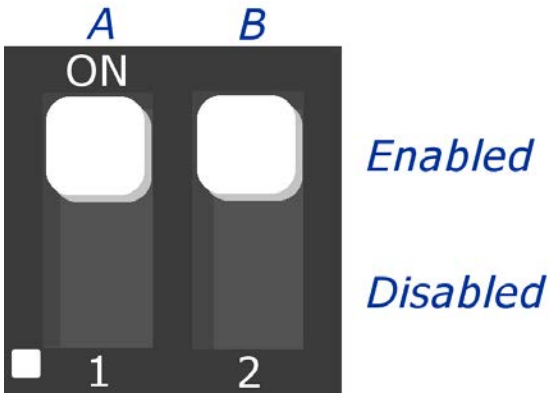

Figure 27 - RS-485 termination DIP Switch

8.9 Ethernet

The LCI-80x has an Ethernet port on the rear of the unit designated J5. This is the preferred interconnect for exchanging data between local units and remote devices.

Any standard Ethernet cable can be used if the LCI-80x is being plugged into a router, hub, or switch. However, if connecting the LCI-80x directly to a PC or another LCI-80x, use a crossover cable.

9 Operation

The LCI-80x front panel, shown in Figure 28, features a high visibility display and a five-button keypad. Each key has a label at the bottom of the screen that identifies its function. The functions and labels of these keys change according to the current state of the display.

Upon power up the Main Screen is displayed. This screen is divided into sections for displaying multiple measurements.

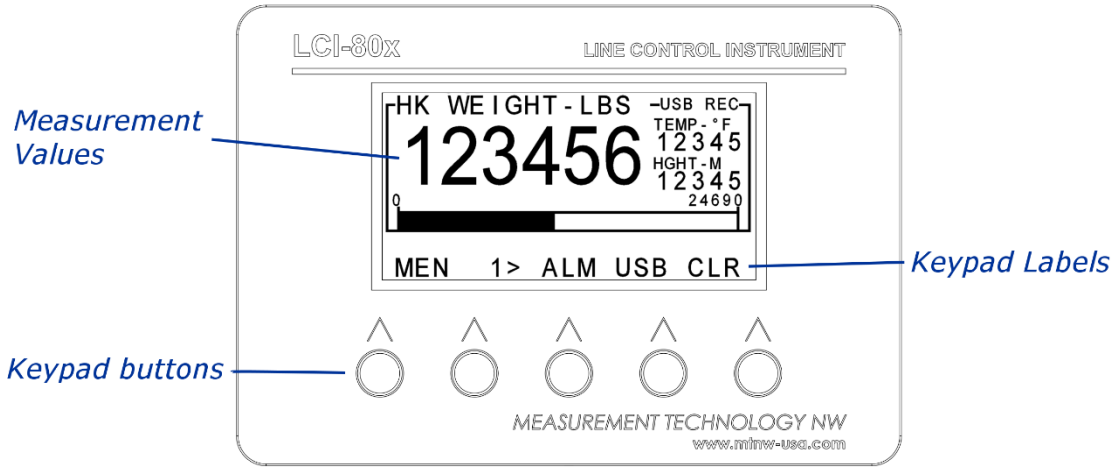

Figure 28 - Main Screen

9.1 Keypad

The functions of the keypad on the Main Screen are as follows:

MEN Displays the menu for programming and/or calibrating the unit. See section 9.2 for information on using the menu system.

1→ Displays the next main screen display configuration. A maximum of three displays can be configured and viewed.

F3 Function key #3.

F4 Function key #4.

F5 Function key #5.

Function keys #3, #4, and #5 can be configured to perform functions specified by the user. The Display Configuration menu allows the configuration of the three function keys. See section 9.6.2 for information on configuring function keys.

9.2 Menu System

The LCI-80x is user programmable via the front panel keypad and the display. Programming options include selection of input/output signal ranges, setting screen displays and formats, defining alarm points, and calibrating the unit.

Pressing the **MEN** key displays the Main menu. In menu mode the keys have the following labels and functions:

RUN	UP	DWN	ENT	ESC

RUN Returns to the Main Screen.

UP Moves the cursor up the menu.

DWN Moves the cursor down the menu.

ENT If the cursor is at a sub-menu, the sub-menu is displayed. If the cursor is on a field, the menu system enters edit mode to allow changes on the selected field.

ESC Moves back one menu level. Pressing this button from the Main menu returns the LCI-80x to the Main Screen.

When a data field is selected with the **ENT** key, the labels and functions of the keypad change to edit mode as shown below.

DEC	INC	→	ENT	ESC

DEC Decreases the selected digit by one when editing a numeric field, or reverse scrolls through a list of available options.

INC Increases the selected digit by one when editing a numeric field, or scrolls through a list of the available options.

→ Moves the edit cursor to next digit in data field, or scrolls through a list of choices.

ENT Accepts the edited value and returns to menu mode.

ESC Discards the edited value and returns to menu mode.

9.3 Alarms

The LCI-80x provides the user with up to 12 alarms that can be configured to indicate high or low conditions of any measurement. Watching for high or low rate of change conditions can be configured as well. Each alarm can also be assigned to any one of the two relay output channels, for example to drive warning lights and/or audible alarms.

When an alarm event triggers, the color of the measurement display is inverted. This display remains on the screen as long as the alarm condition exists. The display will return to normal when the variable(s) causing the alarm changes to a value beyond the dead-band range. If the user configures the alarm to switch a relay output, the relay can track the screen display. In normal relay mode, it will energize when the alarm event occurs and de-energize when the condition goes away. If multiple alarms use the same output relay, then all alarm conditions must clear before the relay will de-energize.

There are three types of alarms: Normal, Scaled, and Delta. The Normal alarm is triggered by exceeding a set Limit value. The Scaled alarm adjusts its Limit value based on a second measurement. The Delta alarm allows monitoring relative rates of change. The Delta alarm is triggered when the change in the primary measurement divided by the change in the secondary measurement exceeds the Limit value.

The Single and Multi Display configurations have space reserved for displaying alarm messages. These configurations will display a customizable alarm label while the alarm condition is active.

Two separate menus are used for alarms. The Alarm Summary menu summarizes alarms and allows adjusting alarm limits only. This menu can be reached by selecting SET ALARMS from the Main menu, or from the front panel by double pressing the **ALM** function key (if configured). The Edit Alarms menu is used to configure alarm parameters.

9.3.1 Alarm Summary

The Alarm Summary menu summarizes the enabled alarms and allows the alarm limit to be adjusted.

	1.0 ALARM SUMMARY			
	1	**EDIT ALARMS**		
>	**2**	**FORCE**	**>**	**2000 LBS**
	3	**NONE**		
V	**4**	**NONE**		

Figure 29 - Alarm Summary Menu

From the RUN screen, press **MEN** and select the SET ALARMS menu item. If the **ALM** function key is enabled, double-pressing the **ALM** key on the Main Screen will also open the Alarm Summary menu.

Alarm limits will only be displayed if an alarm is enabled. Upper limits are indicated by a greater-than sign **>** and lower limits by a less-than sign **<**. If the alarm type is SCALED, this row is read-only and shows the current Limit value. Otherwise, the Limit value can be edited by pressing **ENT** to enter edit mode. Change the set point using the **DEC, INC** and → keys. Save the change by pressing the **ENT** key.

To configure an alarm, use the Alarm Configuration menu item described in the next section.

9.3.2 Configuring Alarms

To configure the alarm settings, go to the Edit Alarms menu shown below by pressing the **MEN** key from the Main screen. Select SET ALARMS from the Main menu, then EDIT ALARMS from the Alarm Summary menu.

	1.1 EDIT ALARMS		
	1	ALARM	1
>	2	ENABLE	ON
	3	STATION	1
	4	MEAS	1 – WEIGHT
	5	TYPE	NORMAL
	6	LIMIT	> 2000 LBS
	7	DEADB	50 LBS
	8	RELAY	CR1
	9	MODE	NORMAL
	A	LABEL	OVL
	B	LINK	ON

Figure 30 – Edit Alarms Menu

ALARM Selects one of the 12 alarms. Edit this field first to view the information for the desired alarm channel.

ENABLE Enable or disable the alarm.

STATION Station ID of the measurement to monitor. Not present on Local displays.

MEAS Measurement variable to monitor.

TYPE Selects the Alarm type: NORMAL, DELTA, or SCALED. If DELTA or SCALED are selected, a link to the Delta Params or Scaled Params menu is shown below TYPE. See section 9.3.3 for information on configuring each type.

LIMIT This is the numerical value at which the alarm is triggered. This number can also be changed in the Alarm Summary menu. If the Alarm Type is SCALED, then this row is read-only and shows the current Limit value as calculated by LCI-80x.

DEADB Sets the dead-band associated with the alarm setting. The dead-band value prevents chattering. The alarm turns on at the limit specified and remains on until the measurement variable

is less than LIMIT – DEADBAND for high alarms, or greater than LIMIT + DEADBAND for low alarms.

RELAY Selects the relay associated with this alarm. See Table 7 for relay assignments. Multiple alarms can share a single relay.

MODE Selects relay mode. In normal mode, the relay will activate upon entering the alarm state, then deactivate when the alarm state is no longer active. Pulse mode pulses the alarm relay at 1-2Hz while the alarm state is active. In latch mode the alarm relay will activate upon entering the alarm state and stay activated until the user manually clears it by pressing the ALM function key.

LABEL Label to be displayed on the Main Screen during alarm conditions. This is only visible on the Single and Multi Display configurations. The default value is the measurement name.

LINK Allows the alarm limit to be linked with other displays on the network. If on, changes to the limit of this alarm will be pushed to all displays on the network that have link turned on for the same alarm number. The last change from any display will update all displays.

Table 7 - Relay (Digital Output) Assignments

RELAY	Terminal Block
Relay 1	TB-8 OUT 1 NC / C / NO
Relay 2	TB-8 OUT 2 NC / C / NO

9.3.3 Alarm Types

The LCI-80x offers three types of alarms: Normal, Scaled, and Delta.

Normal

Normal alarms are triggered when the Measurement value exceeds the Limit value. If the Limit value has a greater-than sign (**>**), this is a high limit and will be triggered when the value is greater than the Limit value. If the limit has a less-than sign (**<**), the alarm is a low limit and the alarm will trigger when the measurement is less than the Limit value. An algebraic comparison is used, thus a speed of -60 is *less* than a limit of -50.

Scaled

The Scaled alarm follows the same rules as the Normal alarm, but the Limit value is automatically scaled based on a second measurement. This second measurement is referred to as the Independent Variable in the Scaled Params menu, or IND VA. The Limit value is the result of the following calculation:

```
LIMIT = SLOPE * IND_VA + OFFSET
```

The current limit value is shown in the Limit row.

The Scaled Params menu is shown below:

	1.1.2 SCALED PARAMS		
	1	IND VA	3 – HOOKPAY
>	2	HI / LOW	HIGH
	3	SLOPE	25.0 LBS/FT
	4	OFFSET	100 LBS
	5	LIMIT	15800 LBS

Figure 31 - Scaled Params Menu

IND VA Secondary measurement to scale the alarm limit by.

HI/LOW Specifies if this is a high limit alarm or a low limit alarm.

SLOPE The slope value of the alarm limit calculation.

OFFSET The offset value of the alarm limit calculation.

LIMIT Shows the current limit value as calculated using the Slope and Offset values. Read-only.

Delta

The Delta alarm is an advanced mathematical function for triggering alarms. It is triggered based on the relative change of the primary measurement with respect to a secondary measurement (or time). The primary measurement is selected in the MEAS row of the Edit Alarms menu. The secondary measurement is selected in the IND VA row of the Delta Params menu. The Limit is set via the Limit row of the Edit Alarms Menu.

The LCI-80x calculates a delta alarm value according to the following formula:

$$DELTA = (PRI_{t2} - PRI_{t1}) / (SEC_{t2} - SEC_{t1})$$

PRI_{t2} is the current value of the primary measurement and PRI_{t1} is the value of the primary measurement at the start of the sample window. Similarly, SEC_{t2} and SEC_{t1} are the values of the secondary measurement at the end and start of the sample window, respectively. For example, if the Sample Rate is 10Hz and the Window is 5, then the time difference of the start and end of the window is 0.5 seconds.

To trigger based on a change over time, set VAR TYPE row to TIME. The alarm value for a time delta is simply:

$$DELTA = (PRI_{t2} - PRI_{t1})$$

The Direction and Threshold settings allow filtering the alarm based on the actions of the secondary measurement. If the Direction value is not BOTH, then the alarm will only trigger if the secondary measurement is increasing (INC) or decreasing (DEC). For Threshold, if the Delta of the secondary measurement is less than the Threshold (absolute value), the alarm is ignored. This prevents nuisance triggering if the system is idle.

The Delta Params menu is shown below:

	1.1.1 DELTA PARAMS		
	1	VAR TYPE	MEAS
	2	IND VA	3 – HOOKPAY
>	3	THOLD	0.100 FT
	4	DIRECTION	BOTH
	5	WINDOW	32
	6	DELTA	125.00 LBS/FT

Figure 32 - Delta Params Menu

VAR TYPE Type of the secondary measurement: TIME or MEAS. If TIME is selected, the IND VA, THOLD, and DIRECTION rows are not shown. DELTA will be calculated using only the primary measurement. If MEAS is selected, IND VA will select the secondary measurement to use for calculating DELTA.

IND VA Secondary measurement used to calculate DELTA.

THOLD Threshold value. Prevents alarm triggering if the difference in the secondary measurement is less than this value. Useful in situations where alarms are not wanted when the Secondary measurement is unchanging.

DIRECTION Prevents alarm triggering based on the direction of change in the Secondary measurement. If the Direction is INC, then the alarm will only trigger if the Secondary measurement is increasing. If the direction is DEC, the alarm will only trigger if the Secondary measurement is decreasing. BOTH triggers for both directions.

WINDOW The number of samples to calculate over. The options are 2 – 32. The samples are collected at the system sample rate, so at sample rate of 20Hz, each sample would be 0.05 seconds apart. The measurement differences are calculated by subtracting the current sample value from the sample value at the start of the sample window.

DELTA Shows the current delta value, calculated from the primary measurement and the secondary/time.

9.3.4 Alarm Acknowledgment

If the ALM function key is enabled, pressing the ALM key during an alarm state will de-energize all relays. They will remain de-energized until a new alarm condition is generated. Note that if the variable falls below the limit, but then exceeds it again, the alarm relay will reactivate. Pressing the **ALM** button does not disable future alarms, it only resets current ones.

Pressing the ALM button will not clear the on-screen alarm indication. The visual indication remains for the duration of the alarm condition.

To enable the ALM function key, see section 9.6.2 for information on configuring the function keys.

On Remote displays, the ALM function key will acknowledge alarms on the Remote and on a Local display, as configured in the Function Keys menu.

9.4 Analog Calibration

The LCI-80x analog sensor interfaces can be calibrated using three methods: Scale and Offset, Two-Point Calibration, and Look-up Table.

The Calibration menu and its submenus are only available on Local displays.

9.4.1 Scale and Offset

The Scale and Offset calibration method is the least accurate of the three calibration methods. It relies on knowing the full-scale output of the sensor. Several sources of error, including mechanical and electrical influences, can negatively affect the accuracy of the measurement.

Select Item 4 and enter the full-scale sensor output in the specified units. For example, the full-scale value corresponds to the measurement at 20 mA on a 4-20 mA device. Next, select Item 5 and enter the offset. The offset corresponds to the measured value at 4 mA on a 4-20 mA device.

	2.0 CALIBRATION		
>	1	MEAS	1-PRESSURE
	2	CAL. TYPE	SCL/OFS
	3	SCALE	1000 PSI
	4	OFFSET	0 PSI

Figure 33 - Scale and Offset Calibration

MEAS The measurement ID to be calibrated.

CAL. TYPE Selects the calibration type. For scale and offset, this reads SCL/OFS.

SCALE The full-scale value corresponds to the maximum output of the sensor. This is the real-world value at 20mA on a 4-20mA sensor or the value at 5V using a 0-5V sensor, etc.

OFFSET The offset corresponds to the real-world value at 4mA on a 4-20mA sensor, or to the value at 0V on a 0-5V sensor.

9.4.2 Two-Point Calibration

The Two-point live calibration method allows the sensor input to be calibrated using actual measurements in the field. The two-point live calibration automatically calculates the Scale and Offset values based on the applied measurement. After a two-point live calibration, the previous Scale and Offset values are automatically

updated to reflect the new calibration. This eliminates the chance of conflicting calibration values in the two modes. If the existing numbers are significant, they should be recorded before beginning this procedure.

Two known measurements are required to perform this calibration. Ideally these measurements are the minimum and maximum value of the working range of the sensor.

	2.0 CALIBRATION		
>	1	MEAS	4 - HK WGT
	2	CAL. TYPE	TWO-PT
	3	LIVE/EDIT	LIVE
	4	LOW	200.0 KG
	5	HIGH	10000.0 KG
	6	IN LO	4.000mA
	7	IN HI	20.000mA

Figure 34 - Two-Point Calibration

MEAS The measurement ID to be calibrated.

CAL. TYPE Selects the calibration type. For two-point, this reads TWO-PT.

LIVE/EDIT Sensor input capture mode: EDIT or LIVE. In edit mode the input (IN LO, IN HI) can be changed using the keypad. In live mode the input is updated directly from the sensor input. Live mode is used when performing a live calibration.

LOW The value to be displayed at the low input of the sensor. This value is typically zero or a value near zero.

HIGH The value to be displayed at the high input of the sensor. This value is ideally near the full-scale of the sensor.

IN LO The electrical value from the sensor at the low point given in the row LOW.

IN HI The electrical value from the sensor at the high point given in the row HIGH.

9.4.3 Look-up Table Calibration

The LCI-80x has the ability to store up to four lookup tables. Each of these tables can store up to 10 points of calibration. This is the most accurate method of calibration, especially for sensors whose outputs are not perfectly linear. This is also useful for switching between two different calibrations during operation, such as a hook calibration and a spreader bar calibration.

For each point a known or reference input is required to obtain the DISP value that is associated with the INPUT value.

	2.0 CALIBRATION		
>	1	MEAS	TEMP
	2	CAL. TYPE	LOOKUP
	3	USE TABLE	A
	4	EDIT TABLE	

Figure 35 - Lookup Table Calibration Menu

MEAS The measurement ID to be calibrated.

CAL. TYPE Selects the calibration type. For lookup table, this reads LOOKUP.

USE TABLE Selects the lookup table to use with the measurement chosen in row MEAS ID.

EDIT TABLE Enters the Lookup Table menu.

	2.1 LOOKUP TABLE		
	1	TABLE ID	1
>	2	NAME	BOILER
	3	POINTS	3
	4	EDIT POINT	1
	5	DISP	200 °C
	6	LIVE/EDIT	LIVE
	7	INPUT	4.000mA

Figure 36 - Lookup Table Menu

TABLE ID	The lookup table to be edited.
NAME	The name of the lookup table. The name can be changed to describe the lookup table, such as “HOOK”, or “150K”.
POINTS	The number of calibration points for this table. A minimum of two points to a maximum of ten calibration points can be specified.
EDIT POINT	The current calibration point to edit.
DISP	The displayed value of the measurement for this calibration point.
LIVE/EDIT	Sensor input capture mode: EDIT or LIVE. In edit mode, the row INPUT can be changed using the keypad. In live mode the row INPUT is updated directly from the sensor input. Live mode is used when performing a live calibration.
INPUT	The electrical value from the sensor for the current calibration point.

9.4.4 Torque Calibration

For torque measurements, the calibration menu contains additional rows for entering information about the torque sensor setup. These rows are inserted below Item 1 (MEAS).

	2.0 CALIBRATION		
>	1	MEAS	2 - TORQUE
	2	SENSOR	LOADLINK
	3	ARM	24.00 IN
	4	ANGLE	0.0 DEG
	5	CAL. TYPE	TWO-PT
	6	LIVE/EDIT	LIVE
	7	LOW	200.0 LBS
	8	HIGH	5000.0LBS
	9	IN LO	4.000mA
	A	IN HI	20.000mA

Figure 37 - Torque Calibration Menu, showing Two-point.

SENSOR Selects what torque sensor to use. Select LOADLINK if using a load cell measuring force on an arm. Select TORQUE if using a sensor which directly measures torque.

ARM Specify the length of the moment arm, which is the distance from the center of rotation to the load cell attachment point on the arm. This row is not displayed if TORQUE is selected in row SENSOR.

ANGLE Specify the angle between the moment arm and the load cell. This row is not displayed if TORQUE is selected in row SENSOR.

See the LCI-80x Power Tong – System Calibration guide for more information on calibrating torque setups.

9.5 Counter Calibration

Measurements using the Counter input have a different Calibration screen from those using other sensors. In this menu the count mode, scale, and other parameters can be adjusted.

The Calibration menu and its submenus are only available on Local displays.

	2.0 CALIBRATION		
>	1	MEAS	4 - PAYOUT
	2	MODE	QUAD4X
	3	LOAD RES.	UP
	4	SCALE	1.000 P/M
	5	PRESET	0.00 M
	6	FILTER	40
	7	RESPONSE	0.050 SECS

Figure 38 - Calibration menu for Counter input.

MEAS The measurement ID to be calibrated.

MODE Specify the count mode: QUAD1X, QUAD2X, QUAD4X, UP/DWN, and OFF.

LOAD RES. Enable/disable load resistors on the input lines. Options are pull-down, pull-up, and no load resistor.

SCALE Specify the number of pulses per unit of measurement, such as pulses per meter, or pulses per gallon.

PRESET Presets the counter to a given value. Set to 0.0 to reset the counter or some other value to preload an offset.

FILTER The filter level of the speed algorithm. Higher numbers apply a greater level of smoothing to the measurement.

RESPONSE The amount of time for which pulses are counted to create each speed sample. Shorter timespans will improve the update rate, but will make slow signals seem jumpy.

9.5.1 Counter Mode

The Counter Mode setting determines how the internal counter circuitry measures the incoming quadrature waveforms.

Table 8 - Counter Modes

<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td>Quad 1x</td><td>Used for Hall Effect, Proximity and general encoder applications. Treat the two rising and two falling edges as one pulse.</td></tr>
<tr><td>Quad 2x</td><td>Used for encoder applications only. Treat the two rising and two falling edges as two pulses.</td></tr>
<tr><td>Quad 4x</td><td>Used for encoder applications only. Treat the two rising and two falling edges as four pulses.</td></tr>
<tr><td>CNT + DIR</td><td>In count and direction mode, one counter input provides the pulse train of counts (this connects to TB-1 Channel B) while the second input sets the counting direction (connects to TB-1 Channel A). The direction input is active low, so a logic level 0 results in upwards counting while a logic 1 makes the device count downwards.
<table>
<tr><th>Count A</th><th>Count B</th><th>Counter</th></tr>
<tr><td>High (>3V)</td><td>Rising Edge</td><td>Decrement</td></tr>
<tr><td>Low (<2V)</td><td>Rising Edge</td><td>Increment</td></tr>
</table>
</td></tr>
</table>

For most applications the QUAD 1X mode is adequate. In 4X mode, the LCI-80x counts each edge, both rising and falling, as an independent count. Thus, the unit will receive four counts for every pair of quadrature pulses. This scheme is recommended for shaft encoder applications as the increased number of pulses produces smoother speed measurements at low speed and higher resolution payout measurements (Note: these benefits only apply to encoders with 50% duty cycle pulse streams. If the “off time” between pulses is different than the “on time” of the pulses then 4X mode will result in higher noise in the speed calculations).

9.5.2 Load Resistor

The Load Resistor setting allows the operator to select the appropriate load resistors to interface with the external sensor in use. If load resistors are enabled, 1000Ω resistors are connected to the inputs of both A and B sensor lines. The operator may select the following configurations: pull up to 12V DC, pull down to DC COM, or

disabled (none). The following table identifies the appropriate resistor configuration for different sensor types.

Table 9 - Count Sensor Load Resistor

Load Resistor	Count Sensors
Pull-up	NPN Type Sensors, Typically Proximity, Hall Effect Sensors, Some Encoders Depending on Driver Type
Pull-down	PNP Type Sensors, Typically Proximity, Hall Effect Sensors, Some Encoders Depending on Driver Type
None	Encoders with Driven Outputs

9.5.3 Speed Filter Level

The **FILTER** item specifies the intensity of the speed filter algorithm used by the LCI-80x. The value can vary from 1 to 100 and is a relative amount of smoothing applied to the incoming pulse stream when calculating the current speed. A value of 100 indicates maximum smoothing.

9.5.4 Speed Response Time

The **RESPONSE** item specifies the sample rate of the speed filter. The LCI-80x collects pulses over the interval given in the **RESPONSE** setting. The number of pulses is divided by the time interval to give the speed value. A longer interval improves the response at slow speeds (less jumpy), while a shorter interval will give a better response when speeds are changing quickly.

The response time can be set to 0.010 – 5.00 seconds.

Note that the **FILTER** and **RESPONSE** interact with one another. The following table summarizes the merits of various settings for these variables. In the table, Output Noise refers to the fluctuations in the displayed speed value and Update Rate refers to how often the speed value is recalculated and displayed.

Table 10 - Counter Filter and Speed Response Behavior

Filter Level	Speed Response Time (seconds)	Output Noise	Update Rate
5	0.010	High	Very Fast
5	5.000	Middle	Slow
40	0.500	Low	Fast
100	0.010	Middle	Very Fast
100	5.000	Very Low	Very Slow

When choosing the Filter Level setting and the Speed Response Time setting, first consider the speed response requirements. If the speed is not expected to change quickly, then a high response time setting (e.g. 2.0s) will perform adequately, reducing the output noise. If a faster response is required, the variable must be set lower. Next, evaluate the tradeoff between calculation update rate and output noise in order to set the Filter Level. Experimentation with different values should produce a satisfactory result.

Overall response time = (2 x Filter Level) * Response Time

Default speed settings:

FILTER = 40
RESPONSE = 0.050 seconds

9.6 Display Configuration

The LCI-80x allows the user to change the presentation of the measurement data on the Main Screen, change the units of measure, the number of decimal places, implement a screen saver to prolong the life of the display, and change the display refresh rate. Up to three displays can be configured. These features are accessed via the 3.0 DISPLAY CONFIGURATION menu.

	3.0 DISPLAY CONFIG		
	1	SCREEN 1	
>	2	SCREEN 2	
	3	SCREEN 3	
	4	REFRESH	10Hz
	5	SCREEN SAVER	ON
	6	CONTRAST	4

Figure 39 - Display Configuration Menu

SCREEN 1 Display the Screen 1 Configuration menu.

SCREEN 2 Display the Screen 2 Configuration menu.

SCREEN 3 Display the Screen 3 Configuration menu.

REFRESH Set the rate that the display updates: 1-30Hz. This is only the screen refresh rate, not the rate at which measurements are sampled, calculated, and recorded.

SCREEN SAVER Enable or disable the screen saver feature. To prolong the life of the display, the screen will go blank after 30 minutes if the unit has not detected an operator key press. To re-energize the display, simply press any key. This behavior is disabled if SCREEN SAVER is OFF.

CONTRAST Set the contrast level of the main screen display: 1-4. The brightest setting is 4.

9.6.1 Screen Configuration

The Screen Configuration menu configures the display layout of the selected screen.

	3.1 SCREEN 1 CONFIG		
	1	FUNCTION KEYS	
>	2	TYPE	DUAL
	3	POSITION 1	
	4	POSITION 2	

Figure 40 - Screen 1 Configuration Menu

FUNCTION KEYS Enter the Function Keys menu to configure the function keys for the selected screen. See section 9.6.2 for more information about function keys.

TYPE The type of display layout. Can be set to one of the following values:

- Off*
- Single
- Dual
- Quad
- Multi
- Table

* Screen 1 cannot be set to OFF.
See section 9.6.3 for a description of each display layout.

The remaining menu items after the Type menu item list the available display positions. A position will consist of a main (primary) element and 0-2 auxiliary elements. Each display element can be set to a measurement ID and configured.

9.6.2 Function Key Configuration

Three functions keys per screen are available for performing custom actions. Counting from the left side of the display, the function of the 3rd, 4th, and 5th buttons can be configured.

	3.1.1 FUNC KEYS CFG		
	1	KEY	3
>	2	FUNC	USB

Figure 41 - Function Key Configuration Menu

KEY The function key to be edited.

FUNC The function the key is to perform when pressed. Table 11 lists the available functions, the key label used, and a description of the action each key performs.

Further items will appear in this menu based on the function chosen.

Remotes can use function keys to influence Local displays. The following functions are forwarded to the Local whenever the key is pressed:

- Tare/Zero a measurement
- Clear peak*
- Reset the counter
- Preset the counter
- Alarm Acknowledge

Clear peak can be configured to apply either at the Local or the Remote. This is shown in the menu as “Send to Local”. To forward the event, set “Send to Local” to YES. To have the event apply to the Remote, set this option to NO.

Table 11 - Function Key Options

Function	Label	Description
NONE		Key performs no function. A blank label is placed above the function key button.
USB	USB	Toggle USB recording. The key label changes based on the USB state: **No drive** — The label reads “USB”. Function key has no effect. **Drive inserted, idle** — The label reads “REC”. Press REC to start logging. **Drive is logging data** — The label reads “END”. Press END to stop logging.
ZERO	ZER	Take a sample of the selected channel and subtract this value from all subsequent samples. This button will toggle the subtracted value from zero to an instantaneous value to allow the user to enable and disable the tare / zero feature. Selecting this function will display two additional menu rows: MEAS ID and MEAS. Select the measurement ID to be zeroed when this key is pressed.
CLEAR	CLR	Clear the peak value stored in memory. Selecting this function will display two additional menu rows: MEAS ID and MEAS. Select the measurement ID to be cleared when this is pressed.
RESET CNT	RST	Reset the count and speed measurements of the quadrature input system.
PRESET CNT	PRE	Preset the counter to the preset menu item in the counter calibration menu system.
ALARM	ALM	One press clears the relay outputs (CR1 and CR2). A double press displays the Alarm Summary menu system.
DIAGNOSTIC	DIA	Display the Diagnostic system.

9.6.3 Display Layouts

The LCI-80x offers five different layout formats for displaying measurement data. A layout is broken down into a number of positions. Each position has a main element and 0-2 auxiliary elements.

Single Display

The Single Display layout shows up to three measurements including the USB Flash Drive status. A bar graph and alarm bar are shown above the function key labels. The bar graph shows the main display measurement in a bar graph form. The minimum and maximum values of the bar graph can be configured using the menu system. The alarm bar is where visual indication of active alarms is shown. In the event of an alarm condition the alarm label is displayed in the alarm bar. If any of the currently displayed measurements are associated with the active alarm, their numeric indicator (if displayed) is displayed in inverted colors.

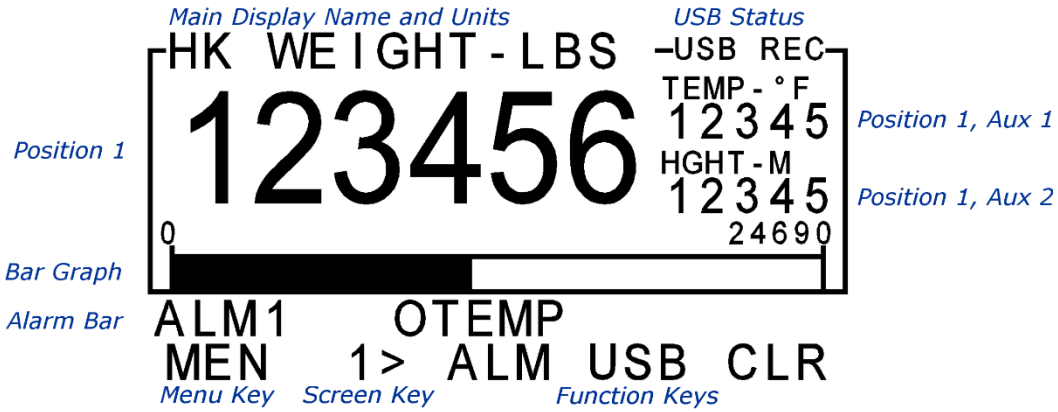

Figure 42 - Single Display

Dual Display

The Dual Display layout displays two large format measurements and two small format measurements. A bar graph is displayed for the top measurement. The measurement name and units label are displayed to the right of each large format measurement.

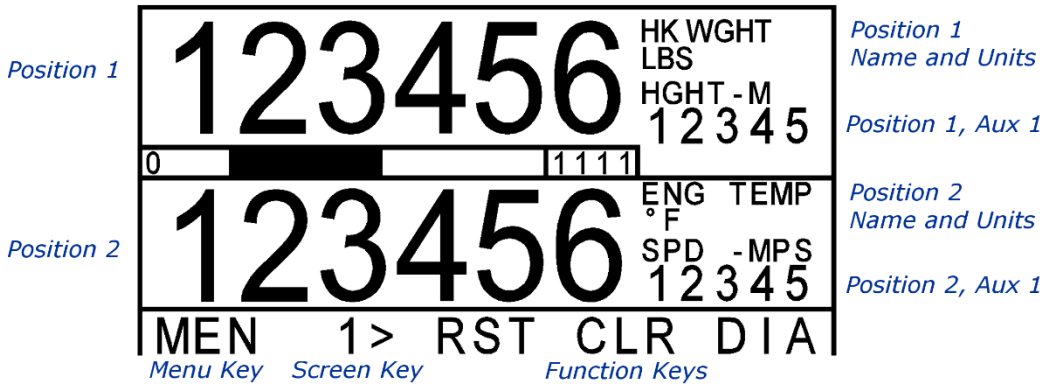

Figure 43 - Dual Display

Quad Display

The Quad Display layout displays four large format measurements. The measurement name and units label are shown in the upper-left corner of each large format measurement. A maximum of four digits can be shown for each measurement.

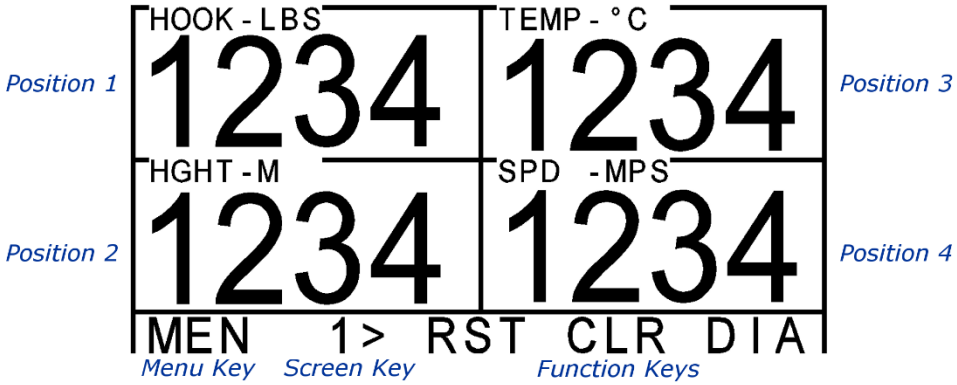

Figure 44 - Quad Display

Multi Display

The Multi Display layout shows up to seven measurements. The center measurement is in the large format font. The center measurement includes a small bar graph. The minimum and maximum values of the bar graph can be configured using the menu system. The remaining six measurement displays are in the small format font. An alarm bar is displayed above the function key labels. In the event of an alarm condition the alarm bar shows the alarm label associated with the alarm.

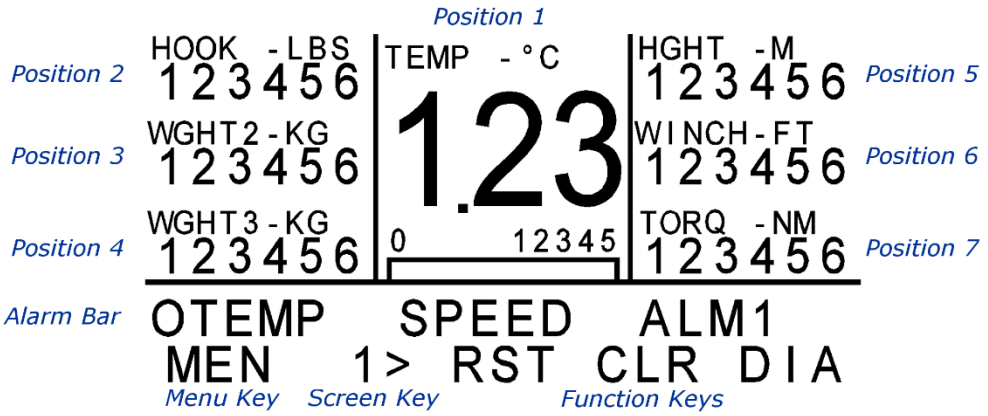

Figure 45 - Multi Display

Table Display

The Table Display layout displays up to eight measurements. Each measurement is in the small format font.

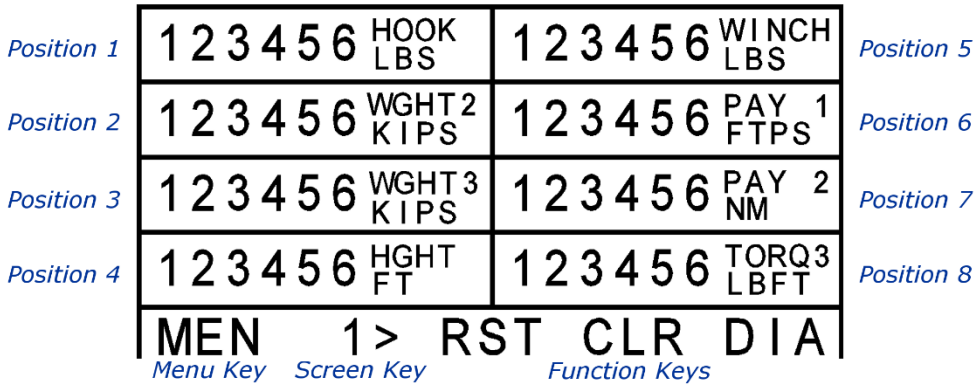

Figure 46 - Table Display

9.6.4 Position Configuration

The Position Configuration menu lists the individual measurement items that make up the display position. These items are a main element and 0-2 auxiliary elements. If the current display layout does not have any auxiliaries for this position, the main element configuration menu is shown instead.

	3.3.1 POS 1 CONFIG	
	1	MAIN
>	2	AUX1

Figure 47 - Position Configuration Menu

9.6.5 Main Element Configuration

The Main Element Configuration menu lists the options for customizing the element displayed at the chosen position, such as the measurement used, whether units are displayed, and the number of decimal places.

	3.3.1.1 MAIN CONFIG		
	1	STATION	1
>	2	MEAS	2 - PRESSURE
	3	UNITS	KPA
	4	UNITS LABEL	ON
	5	VALUE	NORMAL
	6	DEC. PLACES	1
	7	CNT BY	0.001
	8	MIN	0
	9	MAX	50000

Figure 48 - Main Element Configuration Menu

STATION The Station ID of the measurement to be displayed. Not shown for Local displays.

MEAS The measurement ID to be displayed in this element.

UNITS The units to use for this measurement.

UNITS LABEL If ON, displays the units alongside the measurement.

VALUE Enables normal measurement or peak measurement. Normal measurement displays the current measurement value. Peak will display the highest measurement value seen since reset.

DEC. PLACES Selects the number of decimal places to display: 0-3. If a value is too large to display in the available space, the system will automatically remove decimal digits in order to make it fit.

CNT BY Selects the displayed measurement resolution. The displayed value will be the largest value evenly divisible by the CNT BY value and less than the actual measurement. Example: if CNT BY = 100 and actual value = 4164.1, the displayed value is 4100.

MIN Sets the minimum value of the displayed bar graph. Not shown if this position does not have a bar graph element. The bar graph limits are adjusted automatically after a calibration change.

MAX Sets the maximum value of the displayed bar graph. Not shown if this position does not have a bar graph element. The bar graph limits are adjusted automatically after a calibration change.

9.6.6 Auxiliary Element Configuration

The Auxiliary Element Configuration menu lists the options for customizing the element displayed at the chosen position, such as the measurement displayed, whether units are displayed, and the number of decimal places.

	3.3.1.2 AUX1 CONFIG		
	1	STATION	1
>	2	MEAS	PRESSURE
	3	UNITS	KPA
	4	UNITS LABEL	OFF
	5	VALUE	PEAK
	6	DEC. PLACES	0
	7	CNT BY	0.001
	8	ENABLE	ON

Figure 49 - Auxiliary Element Configuration Menu

STATION ID The Station ID of the measurement to be displayed. Not shown on Local displays.

MEAS The measurement ID to be displayed in this element.

UNITS The units to use for this measurement.

UNITS LABEL If ON, displays the units alongside the measurement.

VALUE Enables normal measurement or peak measurement. Normal measurement displays the current measurement value. Peak will display the highest measurement value seen since reset.

DEC. PLACES Selects the number of decimal places to display: 0-3. If a value is too large to display in the available space, the system will automatically remove decimal digits in order to make it fit.

CNT BY Selects the displayed measurement resolution. The displayed value will be the largest value evenly divisible by the CNT BY value and less than the actual measurement. Example: if CNT BY = 100 and actual value = 4164.1, the displayed value is 4100.

ENABLE Enables the display of this auxiliary element. If OFF, a blank space is shown instead of the measurement.

9.7 System Configuration

The System Configuration menu, shown below, allows the LCI-80x to be customized for a particular installation. From this menu the operator can configure the inputs and outputs of the LCI-80x, save and restore settings, and enable passcode protection.

	4.0 SYSTEM CONFIG	
	1	ADMIN
>	2	SENSOR CONFIG
	3	COMMUNICATIONS
	4	USB STORAGE
	5	DIAG SCREEN

Figure 50 – System Configuration Menu

ADMIN Display the Admin menu.

SENSOR CONFIG Display the Sensor Config menu.

COMMUNICATIONS Display the Communications menu.

USB STORAGE Display the USB Storage menu.

DIAG SCREEN Display the Diagnostic Screen.

9.8 Admin Menu

The Admin menu enables the user to save/restore settings, change the time and date, and enable passcode protection.

	4.1 ADMIN		
	1	SECURITY	
>	2	NAME	80x-402
	3	LANGUAGE	ENGLISH
	4	FACTORY SETUP	
	5	SET DATE / TIME	
	6	SYSTEM RESET	

Figure 51 - Admin Menu

SECURITY Display the Security menu.

NAME Set the name of this display. This name is used in USB logging and is displayed in the Nodes menu of other displays.

LANGUAGE Set the user interface language.

FACTORY SETUP Display the Factory Setup menu to save or restore settings.

SET DATE/TIME Display the Set Time/Date menu.

SYSTEM RESET Reset the display.

9.8.1 Security Menu

The Security menu allows the user to set a passcode on the display settings to prevent unauthorized changes. Once enabled, the user will be required to enter the passcode before accessing the menu system.

	4.1.1 SECURITY		
	1	ENABLE	ON
>	2	CODE	443

Figure 52 - Security Menu

ENABLE Enable security protection. If ON, the user will be required to enter the security code in order to access the menu system. This setting will take effect on leaving the menu system.

CODE Passcode used to access the menu system if security is enabled. This can be any value between 1 and 255.

> **WARNING:** This number will become the security unlock code, so it should be kept in a safe place. Once the security lockout feature is enabled, it can only be disabled by re-entering the same number.

If the security code is lost or forgotten, contact Rugged Controls to unlock the LCI-80x.

9.8.2 Factory Setup

Once the LCI-80x has been fully configured and calibrated, the entire setup can be saved to memory. Up to four user-defined setups can be stored and recalled. Additionally, the system can be reset to original factory-default settings.

	4.1.2 FACTORY SETUP		
	1	SAVE SETUP	1
>	2	LOAD SETUP	2
	3	CURRENT	1

Figure 53 - Factory Setup Menu

Save Setup
Saves the current settings to the specified setup. The selections are 1-4. By default, the display will use setup 1. Select **SAVE SETUP** and press **ENT** to enter edit mode. Use the **INCR**, **DECR,** and → keys to change the value.

After pressing **ENT** to save the user will be prompted to confirm the change:

ARE YOU SURE: YES NO

Press the **YES** key to confirm and save the current settings. Press the **NO** key to cancel the operation.

Load Setup
Up to four different sets of settings can be reloaded into current memory from memory in addition to the factory default settings. Select Item 2 and press **ENT** to

activate the edit keys. Use the **INCR**, **DECR,** and → keys to change the value. The selections are 1-4, and FACT.

After pressing **ENT** to save the user will be prompted to confirm the change:

ARE YOU SURE: YES NO

Press the **YES** key to confirm and save the current settings. Press the **NO** key to cancel the operation.

Unless the chosen setup is FACT (factory default), the specified set of settings will become the new default setup, and the LCI will load that setup when it powers up from this point forward.

When the FACT setup is chosen, the display will overwrite the current setup with the factory default settings.

Current
This row indicates the active setup number. This setup is loaded when the LCI-80x powers on. To change the current setup, use LOAD SETUP to load a different setup.

9.8.3 Set Date/Time

The LCI-80x contains a real-time clock unit which keeps track of the current date and time, even when the unit is powered down. The Set Date/Time menu configures the time stored on the LCI-80x. The time is used for USB, Serial, and Ethernet data logging.

	4.1.3 SET DATE/TIME		
	1	DATE	09-16-2015
>	2	TIME	09:20:11

Figure 54 - Set Date/Time Menu

DATE The current date, shown as month-day-year. Press ENTER to enter EDIT mode and change the date.

TIME The current time, shown as 24-hour clock. Press ENTER to enter EDIT mode and change the time.

9.9 Sensor Configuration

The LCI-80x can support a wide range of analog and digital sensors. The Sensor Configuration menu allows the user to customize the display for the application by defining the measurements to be made and the sensors associated with each measurement.

	4.2 SENSOR CONFIG		
	1	SAMPLING	20 Hz
>	2	MEAS SETUP	
	3	AIN CONFIG	
	4	AOUT CONFIG	
	5	DIN CONFIG	

Figure 55 - Sensor Config Menu

SAMPLING Select the analog sampling rate used by the display. This is the rate at which the analog input sensors AIN1-AIN3 are updated with new data. On Remotes, this sample rate is used to limit the rate at which the Master feeds this Remote, which also affects how fast the Remote writes to USB and other data outputs.

Valid selections for sampling are 1-100Hz.

MEAS SETUP Enter the Measurement Setup menu. This menu allows the user to define the measurements created by the LCI-80x. This menu is only available to Locals.

AIN CONFIG Enter the AIN Config menu to configure the three onboard analog inputs of the LCI-80x. This menu is only available to Locals.

AOUT CONFIG Enter the AOUT Config menu to configure the two analog output channels.

DIN CONFIG Enter the DIN Config menu to configure the two digital inputs.

9.9.1 Measurement Setup

The Measurement Setup menu allows the configuration of up to 8 different measurements. A measurement is the end result of sampling a sensor(s), applying a calibration, and performing any additional math such as averaging or peak value. This menu is only available to Locals.

	4.2.1 MEAS SETUP		
	1	ID	1
>	2	TYPE	
	3	NAME	
	4	UNITS	
	5	DEC. PLACES	1
	6	FILTER	2
	7	RATE	-
	8	MODE	SINGLE
	9	INPUT	AIN-1

Figure 56 - Measurement Setup menu

ID Measurement ID. This ID number is used throughout the menu system to refer to this measurement.

TYPE Type of measurement. This affects the units available for this measurement. Available types are:

Force	Pressure	Distance	Torque
Weight	Length	Temperature	Unitless
Tension	Payout	Angle	
Current	Height	Volume	
Voltage	Depth	Speed	

NAME Name of the measurement. This field can be used to give a meaningful name to the measurement, such as “ENG TEMP”.

UNITS The units of the measurement. This item is dependent on the type of measurement.

DEC. PLACES The number of decimal places to be displayed.

FILTER Allows applying a smoothing filter to this measurement. Valid options are OFF and 1-5. If OFF, no filter is applied. 5 applies the most filtering, while 1 only applies a small amount of filtering. This is a simple averaging filter.

RATE Specify a rate of change for a measurement. Available options are:

None (-) Per Second Per Minute Per Hour

If the measurement type is SPEED or the sensor input is CNT, the rate option is disabled. The rate for speed types is chosen via the units option above.

MODE Specify the number of sensors that make up this measurement. Available options are:

SINGLE	Measure a single sensor.
SUM	The measurement is the sum of multiple sensors.
AVERAGE	The measurement is the average of multiple sensors.

INPUT Specify the sensor inputs that make up this measurement. SUM and AVERAGE mode allow multiple inputs.

9.9.2 Analog Input Configuration

The LCI-80x has three analog inputs, each configurable in a number of ways. The following table outlines the input names, where they are situated on the LCI-80x's terminal blocks, and signal ranges.

Table 12 - Analog Input Channel Definitions

Input Channel	Terminal Block Location	Available Input Configurations
AIN-1	TB-6 [TB30]	4-20mA 0-20mA 0-5V 0-10V +/-5V
AIN-2	TB-6 [TB32]	4-20mA 0-20mA 0-5V

		0-10V +/-5V
AIN-3	TB-3 [TB15 to TB20]	+/-20mV +/-100mV

The LCI-80x is configured and calibrated at the factory for 20mV range on AIN3. If 100mV sensors are to be used, contact Rugged Controls.

The various analog input options are configured through the AIN Config menu, shown below. This menu is only available to Locals. A description of each item in this menu is given below:

	4.2.2 AIN CONFIG		
	1	CHANNEL	AIN-1
>	2	RANGE	4-20mA

Figure 57 - AIN Config menu for AIN-1 and AIN-2

	4.2.2 AIN CONFIG		
	1	CHANNEL	AIN-3
>	2	RANGE	20mV
	3	EXCITATION	5V
	4	SENSE	INT

Figure 58 - AIN Config menu for AIN-3

CHANNEL Selects the channel number, AIN-1 to AIN-3. The channels correspond to specific terminal blocks on the back of the LCI-80x.

RANGE Selects the input range for the channel being configured. The choices are 4-20mA, 0-20mA, 0-5V, 0-10V, +/-5V, 20mV, and 100mV. Ensure SW2 is configured for the appropriate mode prior to connecting the sensor. See section 8.3.

EXCITATION Specifies the excitation voltage for a strain gauge sensor. This menu item is only available for AIN-3. In 5V mode the excitation voltages are +2.5V and -2.5V with reference to system ground. In 10V mode the excitation voltages are +5.0V and -5.0V with reference to system ground.

SENSE Sets the sense inputs for a strain gauge sensor. This menu item is only available for AIN-3. Six-wire strain gauges require this setting to be set to EXT to connect the sense lines. Four-wire strain gauges require this setting to be set to INT to disconnect the sense lines.

9.9.3 Analog Output Configuration

The analog output hardware is configured through the AOUT Config menu, shown below. The purpose of the analog output channels is to create a signal that mirrors a measurement over a user-determined range.

	4.2.3 AOUT CONFIG		
	1	CHANNEL	1
>	2	OUTPUT RANGE	0-5 V
	3	STATION	1
	4	MEAS	5 - TRAWL
	5	SCALE	1000 KIPS
	6	OFFSET	500 KIPS

Figure 59 - AOUT Config menu

CHANNEL Select the channel number that the configuration applies to. These channels correspond to the terminals O1 and O2 on TB-7.

OUTPUT RANGE Select the analog output range for the channel in Item 1. The choices are 4-20mA, 0-5V, 0-10V and ±5V.

STATION The Station ID of the measurement to base the output on. Not shown on Local displays.

MEAS Select the measurement to base the analog output on.

SCALE Set the analog output full scale value. This is the measurement value at which the output should be at the top of its range, e.g. 5V for the 0-5V range.

OFFSET Set the analog output offset. This is the measurement value at which the output should be at the bottom of its range, e.g. 4mA for the 4-20mA range.

9.9.4 Digital Input Configuration

The LCI-80x has two digital inputs. These inputs can be configured to trigger a variety of actions on the LCI-80x. The inputs are edge-triggered; they will only perform an action on the transition of the input from high to low and/or from low to high. Each digital input can be configured to have a unique action on both the rising and falling edge. See Table 13 for a list of available actions.

	4.2.4 DIGITAL INPUT		
	1	CHANNEL	DIN-1
>	2	RISE	
	3	FALL	

Figure 60 - Digital Input menu

CHANNEL The digital input to configure: DIN-1 or DIN-2.

RISE Enter the DIN Rise Config menu to configure the action triggered by a rising edge (low to high).

FALL Enter the DIN Fall Config menu to configure the action performed by a falling edge (high to low).

The DIN RISE and DIN FALL configuration menus configure the action performed by that edge. The first row specifies the function category (Alarm, USB, System, Counter, or Measurements), while the second row controls the specific action within that category. Additional rows are displayed when extra parameters are required for the action.

	4.2.4.1 DIN RISE CFG		
	1	FUNCTION	USB
>	2	ACTION	TOGGLE

Figure 61 - DIN Rise Config menu

Some digital input events are forwarded to the Local display, allowing for limited Remote control. The following events are forwarded from Remotes to Locals:

- Tare/Zero a measurement
- Force Measurement / Clear Force
- Clear peak*
- Reset the counter
- Preset the counter

- Alarm acknowledge *
- Alarm Force/Clear *
- Display on/off *
- Screen Select *

Events marked with a * can be configured to apply either at the Local or the Remote. This is shown in the DIN and Function Key menus as “Apply Locally”. To forward the event, set Apply Locally to NO. To have the event apply to the Remote, set Apply Locally to YES.

Table 13 - Available digital input actions

Function	Action	Description
Alarm	Ack	Acknowledge alarm, clearing all set alarm relays. See section 0
	Force	Force alarm into active state, triggering any configured alarm relays.
	Clear	Clear the forcing of alarm state.
USB	Start	Start recording data to USB.
	Stop	Stop recording data to USB.
	Toggle	Toggle recording data to USB.
System	Screen	Display the configured screen.
	Disp On	Turn on the display.
	Disp Off	Turn off the display.
Counter	Reset	Set the counter value to 0.
	Preset	Set the counter value to a predetermined value.
Meas	Zero	Tare/zero the measurement.
	Clear Peak	Clear the peak value.
	Force	Force the measurement to a predetermined value.
	Clear Force	Clear the forcing of the measurement.

9.10 Communications

The LCI-80x has three communication ports: RS-232, RS-485, and Ethernet. The ports are configurable and support several customized data streams, allowing the LCI-80x to be retrofitted into existing applications. The Communications menu controls how the LCI-80x uses its communications ports. For more information on using the LCI-80x to share data with other LCI-80x displays, PCs, or other connected devices, see our LCI Displays - Network Communication Guide.

	4.3 COMMUNICATIONS	
	1	MODE LOCAL
>	2	STATION 1
	3	ETHERNET
	4	SERIAL
	5	NODES
	6	ACTIONS

Figure 62 - Communications menu

MODE Selects the role of this LCI-80x display: Local, Remote, or Master. Remote and master units receive their data from the communications network, rather than from field sensors.

STATION Sets the station ID of this display, in the range 1-247. Master units are hardcoded to use ID 0. This ID is used for identifying the unit on all communications networks.

ETHERNET Enters the Ethernet communications menu.

SERIAL Enters the Serial communications menu.

NODES Enters the Nodes menu. Not available for Local units.

ACTIONS Enters the Actions menu.

9.10.1 Ethernet Menu

The Ethernet interface on the LCI-80x is a 10Base-T/100Base-TX interface that supports DHCP or a static IP address. Data and configuration values can be accessed using MODBUS or MTNW2 protocols.

	4.3.1 ETHERNET		
	1	ENABLE	ON
>	2	LOCAL SETTINGS	
	3	TCP / IP SETTINGS	
	4	UDP SETTINGS	

Figure 63 - Ethernet menu

ENABLE Enables/disables the Ethernet hardware on the LCI-80x.

LOCAL SETTINGS Enters the Local Settings menu to configure the local IP address, DHCP, and other Ethernet settings.

TCP/IP SETTINGS Enters the TCP/IP Settings menu to configure the TCP port and its mode.

UDP SETTINGS Enters the UDP Settings menu to configure the UDP port and its mode.

9.10.2 Local Ethernet Settings

The Local Settings menu is used to configure network settings such as IP address and subnet. These settings should be configured and verified before setting up subsequent settings for TCP/IP or UDP interfaces.

	4.3.1.1 ENET LOCAL		
	1	DHCP	ON
>	2	IP	192.68.1.123
	3	MAC	0050C2B62342
	4	SUBNET	
	5	GATEWAY	

Figure 64 - Local Ethernet Settings menu

DHCP Enables/Disables DHCP address requests. If enabled, the LCI-80x will obtain an IP address automatically from the network's DHCP server. If disabled, the LCI-80x will use the IP address configured manually in Item 2.

IP IP address of the LCI-80x. If DHCP is enabled, this row is read-only and will be set automatically when the 80x gets an IP address. If DHCP is disabled, the user may edit this row to set the IP address manually.

MAC The MAC address of the LCI-80x. This row is read-only.

SUBNET The subnet mask of the Ethernet interface. Default value is 255.255.255.0.

GATEWAY The gateway of the Ethernet interface. Default value is 0.0.0.0.

9.10.3 TCP/IP Settings

The LCI-80x can act as a TCP server in either broadcast or polled mode. Up to 32 simultaneous connections are allowed.

	4.3.1.2 ENET TCP/IP		
	1	MODE	POLLED
>	2	PORT	502

Figure 65 - TCP/IP Settings menu

MODE Operating mode of the TCP port: OFF, BROADCAST, or POLLED.

Broadcast mode continually sends ASCII-formatted data to any device which connects to this port. This broadcast happens at the sample rate specified in the Sensor Configuration menu (see section 9.9). The format follows the MTNW2 protocol. See section 9.10.10 for the format of MTNW2 data.

Polled mode sets the LCI-80x up as a Modbus slave. This is the default mode. See section 9.10.11 for details on using Modbus with the LCI-80x.

PORT The port to monitor for TCP connections.

9.10.4 UDP Settings

The LCI-80x can stream measurement data to a configured UDP port.

	4.3.1.3 ENET UDP		
	1	MODE	BCAST
	2	IP	192.168.1.123
>	3	PORT	502

Figure 66 - UDP Settings menu

MODE The operating mode of the UDP port: BROADCAST or OFF. Broadcast mode continually sends ASCII-formatted data to the configured IP and port. This broadcast happens at the sample rate specified in the Sensor Configuration menu (see section 9.9). The format follows the MTNW2 protocol. See section 9.10.10 for the format of MTNW2 data.

IP Destination IP address of the UDP broadcast.

PORT Destination port of the UDP broadcast.

9.10.5 Serial Menu

The serial communication interface provides RS-232 and RS-485 protocols. RS-232 offers full-duplex communication while RS-485 offers half-duplex and electrically isolated communication. Both serial ports allow baud rate up to 230,400 bps. The serial ports can be configured for four different modes: Broadcast, Polled, Driver, and Terminal.

Broadcast Mode

Broadcast mode continually sends ASCII-formatted data to any device which connects to this port. This broadcast happens at the sample rate specified in the Sensor Configuration menu (see section 9.9). The format follows the MTNW2 protocol. See section 9.10.10 for the format of MTNW2 data.

Polled Mode

Polled mode sets the LCI-80x up as a Modbus slave. This is the default mode. See section 9.10.11 for details on using Modbus with the LCI-80x.

Driver Mode

Driver mode configures this port to interface with serial sensors or other external devices. Available options vary based on application. Some common options are:

- YG WIND – R.M. Young wind sensor using NMEA output

- RL_LDSS – Red Lion scoreboard display
- DSC – Digital strain cell with serial output

Terminal Mode

Terminal mode is used to send keypresses over the serial line to the LCI-80x. This mode is reserved for internal use.

The Serial Menu is shown below:

	4.3.2 SERIAL	
	1	RS-232
>	2	RS-485

Figure 67 - Serial menu

RS-232 Display the RS-232 menu.

RS-485 Display the RS-485 menu.

9.10.6 RS-232

This menu configures the RS-232 port.

	4.3.2.1 RS232		
	1	MODE	BCAST
>	2	BAUD	115200
	3	DATA	8
	4	PARITY	NONE
	5	STOP	1

Figure 68 - RS-232 Configuration menu

MODE Operating mode of the serial port. Available options are Broadcast, Polled, Driver, Terminal, and Off.

BAUD Baud rate of the serial port. Available options are:

2400	9600	38400	115200
4800	19200	57600	230400

DATA Number of data bits to transmit. Fixed at 8 data bits.

PARITY Sets parity bit. Available options are even, odd, and none.

STOP Sets the number of stop bits: 1 or 2.

9.10.7 RS-485

This menu configures the RS-485 port.

	4.3.2.2 RS485		
	1	MODE	BCAST
>	2	BAUD	115200
	3	DATA	8
	4	PARITY	NONE
	5	STOP	1

Figure 69 - RS-485 Configuration menu

MODE Operating mode of the serial port. Available options are Broadcast, Polled, Driver, Terminal, and Off.

BAUD Baud rate of the serial port. Available options are:

2400	9600	38400	115200
4800	19200	57600	230400

DATA Number of data bits to transmit. Fixed at 8 data bits.

PARITY Sets parity bit. Available options are even, odd, and none.

STOP Sets the number of stop bits: 1 or 2.

9.10.8 Nodes Menu

The Nodes menu is used to configure a network of LCI displays. Remote and Master units can receive measurement data over this network from Local units. The Nodes menu is used to list the external nodes, their station ID, connection type, and whether to link settings. This data is stored in a table of nodes, navigable by an index number. The index number is arbitrary and has no relation to Station ID.

Master nodes must list all nodes in the network so that the master node can poll all locals and serve data to all remotes. Remote nodes only need list the local nodes they are receiving data from.

	4.3.3 NODES		
	1	INDEX	1
>	2	TYPE	LOCAL
	3	LINK	OFF
	4	STATION	2
	5	NAME	1
	6	CHANNEL	RS-485

Figure 70 - Nodes menu

INDEX The current entry in the node table to edit. 1-32.

TYPE The type of the external node. Options are: LOCAL, REMOTE, and OFF. If OFF, the following rows are blank.

LINK Whether to link settings with the external node. This row is only available if LOCAL was selected in Item 2.

STATION The Station ID of the external node.

NAME The name of the external node. This will be populated automatically when the LCI-80x connects with the node. Read-only.

CHANNEL The communication channel to use to connect to this node. This row is only available on Master units.

9.10.9 Actions Menu

The Actions menu contains utilities relevant to the communications system.

	4.3.4 ACTIONS	
	1	REQUEST SETTINGS
>	2	PING
	3	ANNOUNCE NOW

Figure 71 - Actions menu

REQUEST SETTINGS Enter the Request Settings menu, where remotes can request a settings update from a local. Not available on locals.

PING Enter the Ping Menu, which provides a simple function for pinging an IP address over a network.

ANNOUNCE NOW Announces the display over the network. This sends out a discovery message using UDP to port 9909.

9.10.9.1 Request Settings Menu

The Request Settings menu is used to request a copy of a local's settings. These settings will overwrite the current settings of this display.

	4.3.4.2 REQUEST		
	1	**STATION**	**2**
>	**2**	**REQUEST NOW**	

Figure 72 - Request Settings menu

STATION The station to request settings from.

REQUEST NOW Send the request. The user will be prompted for confirmation.

9.10.9.2 Ping

The Ping menu is used to send ping requests to remote devices across the network. This is useful for determining if a remote device is reachable.

	4.3.4.1 PING		
	1	**IP**	**192.168.2.123**
>	**2**	**REQUEST NOW**	
	3	**RESPONSE**	**NONE**

IP The IP address to ping

REQUEST NOW Send the ping. The user will be prompted for confirmation.

RESPONSE Shows the result of the ping. See Table 14 for a description of the ping status.

Table 14 - Ping status

Status	Description
WAIT	Ping has been sent but no reply received yet.
OK	Ping was successful.
NONE	Ping was not successful or ping has not been sent yet.

9.10.10 MTNW2 Protocol

The LCI-80x data broadcast follows the format of the MTNW2 remote data protocol.

The data format can be generalized as:

0x1E	0x01	**nn**	RD	,	**yyyy**	-	**mm**	-	**dd**
T	**HH**	:	**MM**	:	**SS**	.	**fff**	,	**m1**
,	**m2**	,	**m3**	,	**...**	,	**mN**	,	**cccc**

- **nn** - Station ID of the LCI.
- **yyyy** - timestamp year
- **mm** - timestamp month
- **dd** - timestamp date
- **HH** - timestamp hours
- **MM** - timestamp minutes
- **SS** - timestamp seconds
- **fff** - timestamp milliseconds
- **m#** - measurement
- **cccc** – checksum

The data string starts with the nonprintable characters RS (0x1E) and SOH (0x01), followed by the station ID, “RD”, then a timestamp.

All enabled measurements are included as a comma-separated list following the timestamp.

All data elements are fixed length with the number of digits shown above. Zeros are used to pad the numbers from the left side.
Negative signs use up one of the eight digits for data fields and are left justified. E.g. “-0005.23” is a valid data element.

The checksum is calculated as the sum of all ASCII values preceding but not including the checksum itself. All commas and header characters are included.

All measurement values are given in metric units to avoid confusion. The following units are used:

Table 15 - Units used for MTNW2 broadcasts

Type	Units
Length	meters
Weight/Force/Tension	kilogram
Volume	liter
Pressure	pascals
Angle	degrees

Type	Units
Torque	kilogram-meter
Temperature	Celsius
Voltage	volts
Current	amps
Frequency	hertz

9.10.11 Modbus Protocol

The LCI-80x supports Modbus RTU over RS-232, RS-485, and TCP. The following function codes are supported:

3 – Read Holding Register
4 – Read Input Register
6 – Write Single Register
16 – Write Multiple Registers

All sensor or measurement values are 4-byte IEEE 754 floating point format. Each number is returned as a pair of 16-bit words. Each word is big-endian, per Modbus specification. The pair of 16-bit words is little-endian. In the following example, A is the most-significant byte, D is the least-significant byte:

Float value: ABCD
Modbus value: CD AB

9.10.12 Messaging System

The LCI-80x supports a messaging system to allow users to configure custom messages for display on the LCI-80x during various alerts, warnings, alarms and events triggered from a device (ie. PLC) communicating with the LCI-80x over MODBUS TCP or RTU. This system is available when the LCI-80x is in slave (local) mode only. For more information on using the LCI-80x messaging system, see our "LCI-80x – Messaging System" Guide.

9.11 USB Storage

The LCI-80x can log data to a USB drive. All enabled measurements are logged to a comma-separated values (CSV) file at the sample rate specified in the Sensor Config menu (see section 9.9). Before removing the USB drive, logging should be halted by the USB function key (see section 9.6.2) or via the EJECT row in the USB Storage menu.

The USB drive must be formatted as a FAT32 filesystem.

9.11.1 Data File Format

The data file starts with a header describing the date of creation and the LCI-80x that created the file.

After the header is the data section. Each row of the data section contains an index number, timestamp, the measurement data, and a checksum for data integrity. The measurement data includes the Station ID, analog sensor value, the measured value, and the peak value.

9.11.2 Continuous vs Trigger Mode

The USB system can be configured for either Continuous or Trigger mode.

In Continuous mode, the LCI-80x will start recording data automatically after a USB drive is inserted. The data is stored in one file per day, up to 50MB.

In Trigger Mode, the LCI-80x will wait for the user to press the REC function key before starting logging. Each recording session is stored as a separate file, rather than appending to the same file.

9.11.3 USB Storage Menu

The USB Storage menu is used to configure the settings for USB logging.

	4.4 USB STORAGE		
	1	EJECT	OFF
>	2	LOGGING	ON
	3	LOG MODE	TRIG

Figure 73 - USB Storage menu

EJECT Closes logging and ejects the drive. Using eject before removing the USB drive prevents data corruption from half-written files.

LOGGING Enables/disables logging.

LOG MODE Sets the logging mode: Trigger (TRIG) or Continuous (CONT).

10 Troubleshooting

The diagnostics screen allows the user to quickly check raw input signals, power supplies, sample rates, and error codes. Common malfunctions of the instrument can be traced to incorrect wiring, jumper settings, or configuration. Consult the troubleshooting chart in section 10.2 to diagnose problems.

10.1 DIAG Screen

The DIAG screen can be entered by pressing the DIA function key or through the link in the System Configuration menu. The Diagnostic screen provides the operator with important feedback on all systems of the LCI-80x.

10.1.1 System Page

The System page lists the diagnostic flags, firmware version information, and device serial number.

10.1.2 AIN Page

The AIN page lists the raw values from the three onboard analog inputs as well as their actual sample rate. Comparing the displayed values with measurements from a multimeter can help identify if the fault lies in the sensor, wiring, or within the LCI-80x and its setup configuration.

10.1.3 Messages Page

The messages page shows all active messages. This dedicated screen for displaying messages shows all messages in a single, full-screen width column where each active message is shown left-justified on a single numbered row. Row numbers increment as each active message is found. As the number of rows grows beyond what is visible, scrolling controls are included to aide navigation.

10.1.4 Count Page

The Count page displays the stored counter value and the logic level of the A and B lines of the counter.

10.1.5 AOUT Page

The AOUT page displays the output values of the AOUT system. If a channel is disabled, the value reads “None”. This value is the nominal output as calculated by the firmware. If the AOUT hardware has been damaged, the actual output value may differ.

10.1.6 Communications Page

The Communications page displays the transmit and receive rates for each of the communications ports: Ethernet (ENET), RS-232, and RS-485.

10.1.7 Nodes Page

The Nodes page displays information relating to the network of LCI displays. The appearance changes depending on the role of this device.

For Locals and Remotes, this menu displays the status of this device: the station ID, type, and communication channel & update rate.

For the Master unit, this menu displays the total RX/TX rate for both Locals and Remotes, followed by a list of each node in the Node table. For each node, the status is shown, along with the TX/RX rate to that node, and the communication channel.

10.1.8 Power Page

The Power page displays the actual voltage levels of the various power supplies within the LCI-80x. If the values oscillate rapidly or differ significantly from their nominal value, there could be a problem with the LCI-80x or connected hardware.

10.2 Troubleshooting procedures

Possible issues are listed below. For each issue a list of possible causes and potential remedies are suggested.

Table 16 - Troubleshooting: Blank Screen

Issue:	Blank Screen	
Possible Causes	**Diagnosis**	**Remedies**
Screen saver is on	Activate display by pressing any key.	Disable screen saver if screen visibility is required during periods of inactivity.
Input power problem	Check voltage between TB-2 VIN+ and COM. Voltage is required to be in the range of 9 to 36 V DC.	Repair or replace power source to provide 9-36 VDC.
Fuse is blown	Check for voltage between TB-2 VIN+ and COM. If unit has power and there is no voltage, then the fuse is suspect.	Check and replace fuse.
Screen is faulty	Listen closely for high frequency hum coming from within the LCI-80x.	Contact Rugged Controls.
Internal power supply failure	Measure voltage between TB-1 +5 VDC and COM and also +12 VDC and COM. If these voltages are out of range, the internal power supply is suspect.	Contact Rugged Controls.
CPU failure	Check for communication with remote displays. If remote displays are not updating and the LCI-80x has power, then the CPU is suspect.	Contact Rugged Controls.

Table 17 - Troubleshooting: No Response from Sensor

Issue:	No Response or Zero Value for Sensor Signal	
Possible Causes	**Diagnosis**	**Remedies**
Incorrect scaling	Check Calibration menu for correct values of Offset and Full Scale.	Recalibrate if incorrect
No sensor input	Open the Diagnostics screen via the System Configuration menu. Use a multimeter to compare the measured value to the value shown in the Diagnostics screen.	If no input signal, then replace or repair sensor.
	Confirm that the sensor has excitation power with a multimeter. If using an external supply, ensure there are no grounding problems.	Review section 8 for discussion of sensor input hookup.
	Check AIN Config menu to ensure that the input is configured correctly.	Review section 9.9.2 for discussion of analog input configuration.
	Check Sensor Config and its submenus to ensure that the analog input is connected to the correct measurement.	Review section 9.9.1 for discussion of measurement setup.

Table 18 - Troubleshooting: No Values on Screen

Issue:	Run Screen Visible, No Numeric Values on Screen	
Possible Causes	**Diagnosis**	**Remedies**
Communication Error	If a unit is a Remote or Master, COM ER displayed on the screen indicates that there is no communication with the desired Local unit.	Fix communication error. Check Node settings and Display settings for correct node information.
Incorrect menu configuration	Unit is configured as Remote or Master when it should be a Local.	If unit is supposed to receive sensor input, then change the LOC/REMOTE mode to LOCAL.
	No data is displayed on the Main Screen	Check the Display Configuration and the display elements are configured to display an active and valid measurement ID.

Table 19 - Troubleshooting: Noisy Sensor Signal

Issue:	"Jumpy" Sensor Signal	
Possible Causes	**Diagnosis**	**Remedies**
Electrical noise	Check that cable shields are grounded near the LCI-80x for best noise immunity.	Try variations on shield grounding. Try grounding both ends or no grounding.
	Check input signal quality with oscilloscope. For some frequencies, an AC voltmeter can be used to measure the presence or absence of noise on a DC signal.	Use shielded cabling and/or conduit for sensor wiring
	Baseline noise – cannot be remedied	Lower sample rate to reduce the effective noise.
		Use a UPS to filter AC noise.
Ground loop	Draw or review a schematic of the tension input sensor/LCI-80x connection to identify any ground loops.	Remove ground loop.

Table 20 - Troubleshooting: No Outputs from Alarm Relays

Issue:	No Outputs from Alarm Relays	
Possible Causes	**Diagnosis**	**Remedies**
Incorrect menu configuration	Check the alarm configuration to make sure that the expected relay will be energized by the alarm condition. Each alarm must be programmed to output to Relay 1 or 2 to energize a relay.	Review section 9.3 for alarm use and configuration

Appendix A DIP Switch Settings

The LCI-80x has three user-configurable DIP switches. Two are located on the back of the LCI-80x. SW4 is located on the front side of the processor PCB, between the PCB and the front panel.

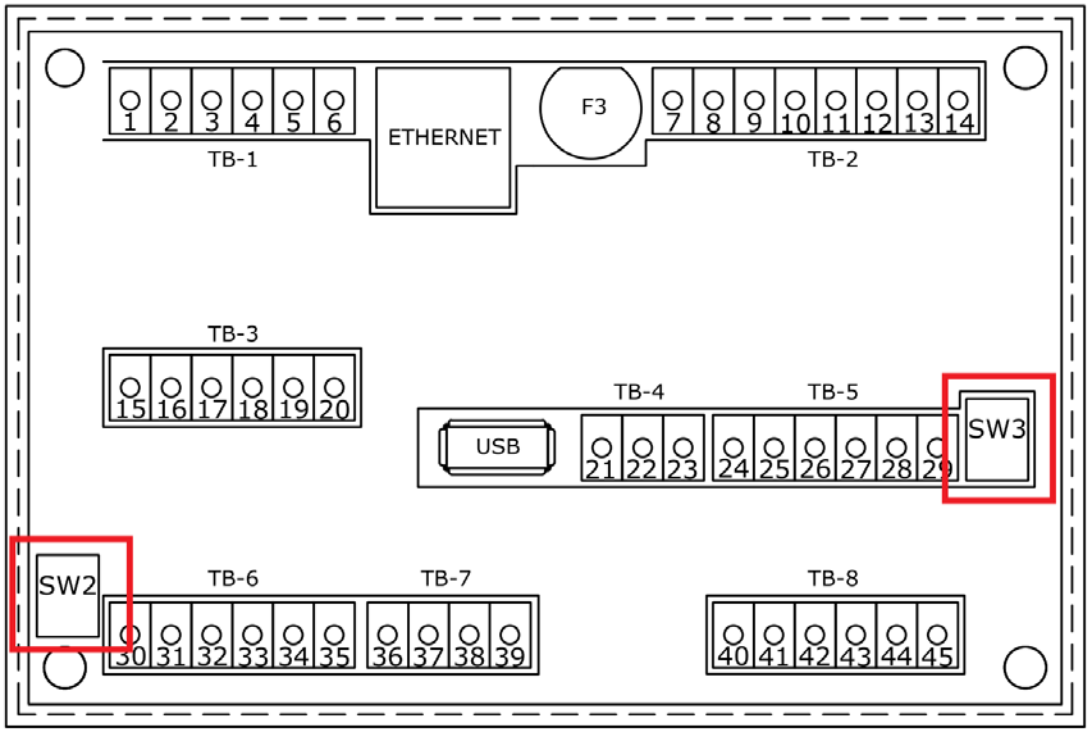

Figure 74 - DIP switch locations. SW4 is located on reverse, opposite TB-2.

Table 21 – SW2 Analog Input DIP Switch Settings

Analog Input Channel	Mode	Switch Position
AIN-1	Voltage	SW2-1 OFF
	Current*	SW2-1 ON
AIN-2	Voltage	SW2-2 OFF
	Current*	SW2-2 ON

Table 22 – SW3 RS-485 Termination DIP Switch Settings

RS-485 Termination	SW3-1	SW3-2
OFF	OFF	OFF
ON*	ON	ON

The ON position enables 4.7k termination resistors. Use the same setting for both SW3-1 and SW3-2. Failure to do so may result in erratic behavior.

Table 23 - SW4 Counter Mode Settings

Counter Mode	SW4
Normal*	OFF (UP)
Magnetic Pickup	ON (DOWN)

* Indicates factory default settings

Appendix B Jumper Settings

The following jumpers are present on the rear face of the 80x circuit board, between the display and the circuit board. These jumpers are set at the factory and should never be changed.

Table 24 - Jumper settings

Jumper	Purpose
JP1	RS-232 RX/CANH
JP2	RS-232 TX/CANL
JP3	AIN3 Gain Setting

Appendix C Mechanical Dimensions

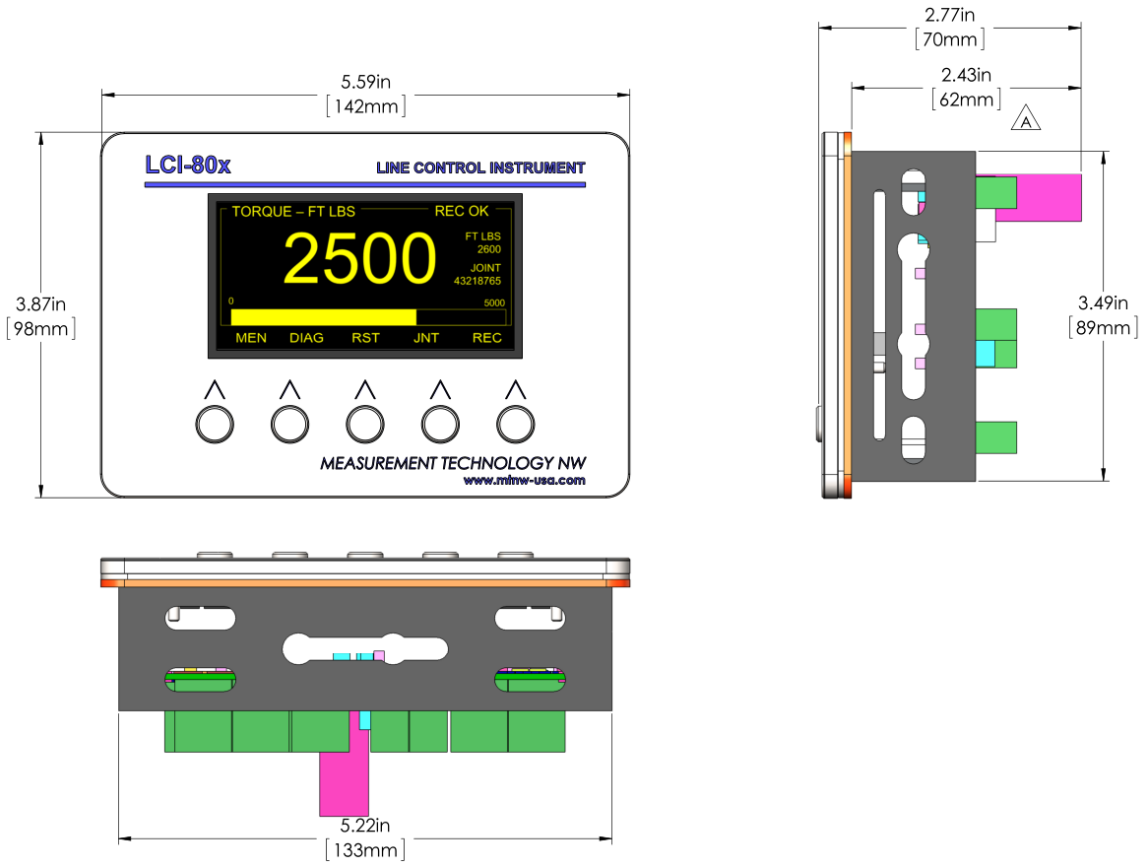

Figure 75 - Mechanical Dimensions

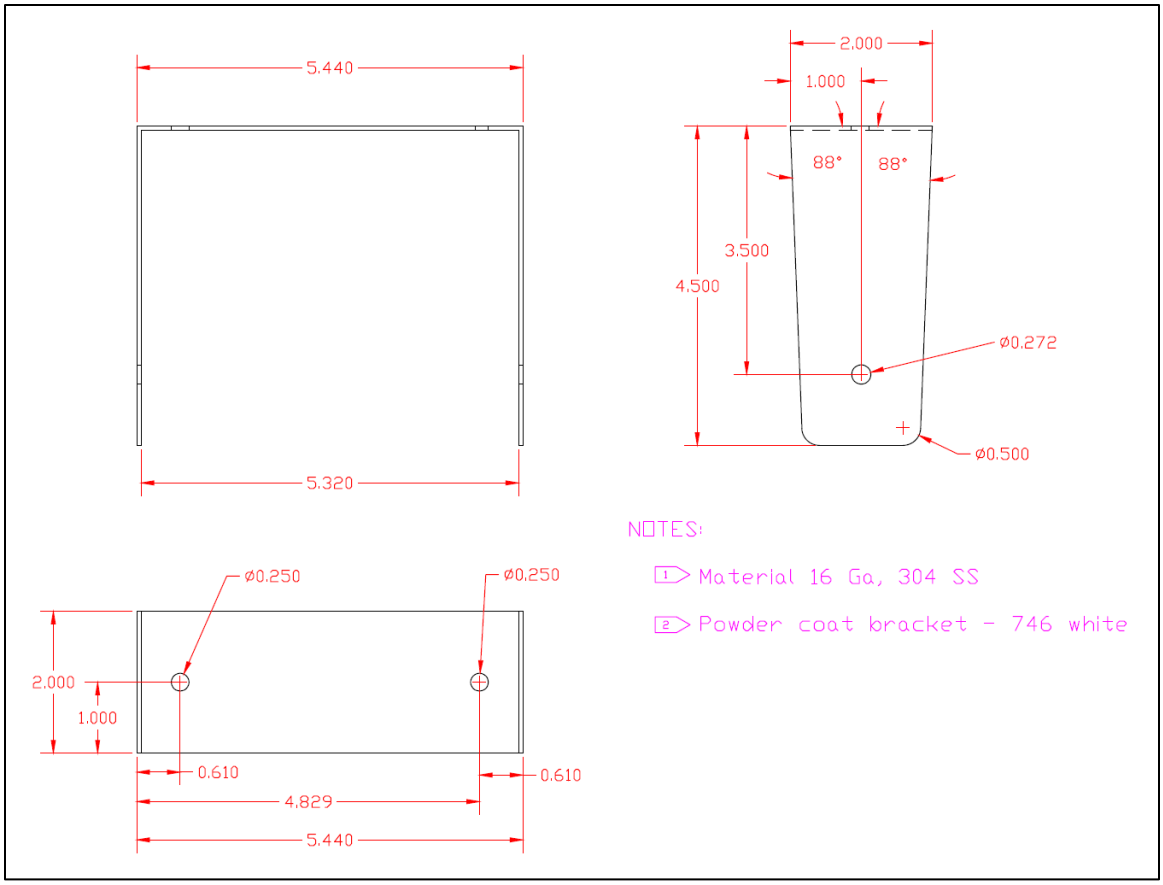

Figure 76 - Gimbal bracket dimensions

Appendix D Terminal Block Assignments

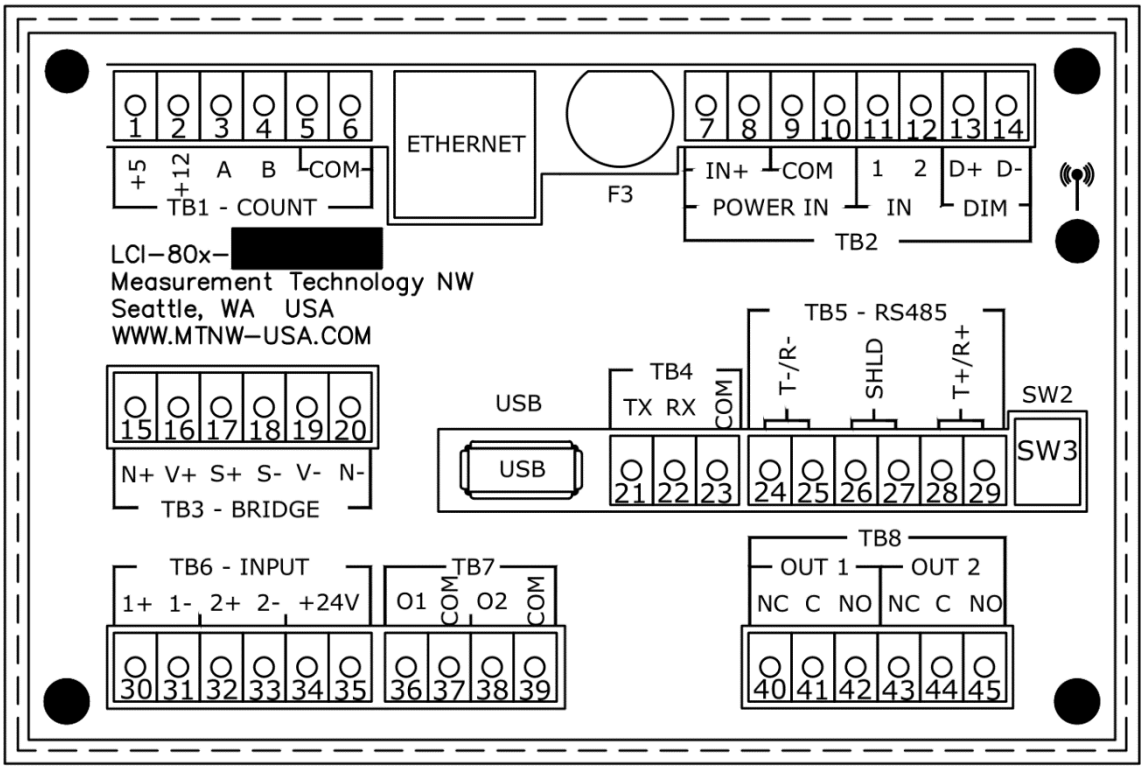

Figure 77 - Terminal blocks on the LCI-80x

Table 25 - Terminal block list

Function	Designator
+5 V_{DC} Power Supply Output	TB-1 [TB1]
+12 V_{DC} Power Supply Output	TB-1 [TB2]
COUNTER-A	TB-1 [TB3]
COUNTER-B	TB-1 [TB4]
COM	TB-1 [TB5, TB6]
VIN+ Power Supply Input	TB-2 [TB7, TB8]
COM	TB-2 [TB9, TB10]
DIGITAL IN-1	TB-2 [TB11]
DIGITAL IN-2	TB-2 [TB12]
DISPLAY DIM +	TB-2 [TB13]
DISPLAY DIM -	TB-2 [TB14]
STRAIN GAUGE N+	TB-3 [TB15]
STRAIN GAUGE V+	TB-3 [TB16]
STRAIN GAUGE S+	TB-3 [TB17]
STRAIN GAUGE S-	TB-3 [TB18]

Function	Designator
STRAIN GAUGE V-	TB-3 [TB19]
STRAIN GAUGE N-	TB-3 [TB20]
RS-232 TX	TB-4 [TB21]
RS-232 RX	TB-4 [TB22]
RS-232 COM	TB-4 [TB23]
RS-485 T-/R-	TB-5 [TB24, TB25]
RS-485 SHIELD	TB-5 [TB26, TB27]
RS-485 T+/R+	TB-5 [TB28, TB29]
ANALOG INPUT 1+	TB-6 [TB30]
ANALOG INPUT 1-	TB-6 [TB31]
ANALOG INPUT 2+	TB-6 [TB32]
ANALOG INPUT 2-	TB-6 [TB33]
+24 VDC Power Supply Output	TB-6 [TB34, TB35]
ANALOG OUTPUT 1	TB-7 [TB36]
COM	TB-7 [TB37]
ANALOG OUTPUT 2	TB-7 [TB38]
COM	TB-7 [TB39]
RELAY 1 OUT NC	TB-8 [TB40]
RELAY 1 OUT C	TB-8 [TB41]
RELAY 1 OUT NO	TB-8 [TB42]
RELAY 2 OUT NC	TB-8 [TB43]
RELAY 2 OUT C	TB-8 [TB44]
RELAY 2 OUT NO	TB-8 [TB45]

11 Technical Support

Technical support is available 8:00AM – 6:00PM Pacific Time via e-mail or phone. Please contact LCI Support at:

(206) 634-1308 or LCI@mtnw-usa.com

12 General Contact Information

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