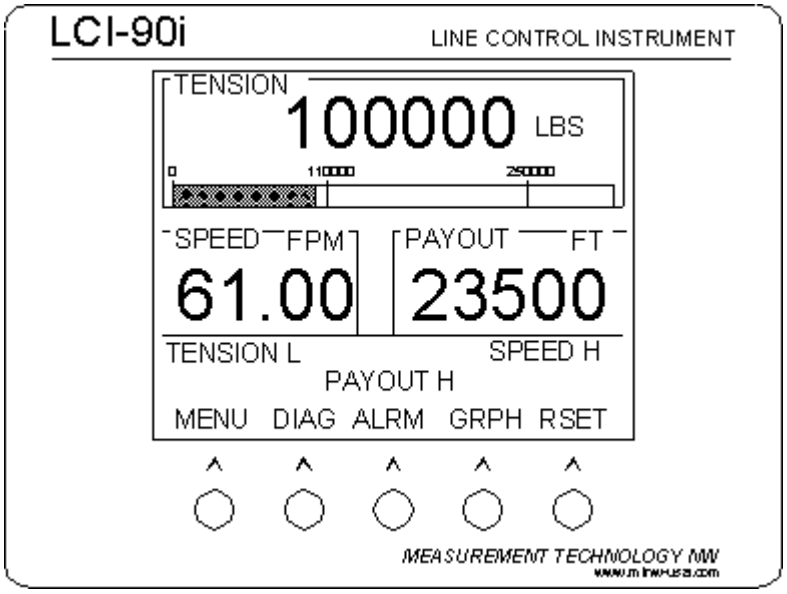
INSTALLATION MANUAL

LCI-90i Line Control Instrument

Revision 1.03
October 5, 2010



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1.0 Overview

The LCI-90i Line Control Instrument is a versatile instrument that displays line Tension, Payout, and Speed for winch and wire rope applications. The LCI-90i is a next generation device evolved from the previous unit, the LCI-90. The LCI-90i unit is a direct replacement for existing LCI-90, LCI-90R and LCI-100 units. The front panel and display technology has been retained as they have been proven to be highly robust and reliable but the internal electronics have has been upgraded and there are new features added to the unit which will be discussed below. Signals from Tension and Payout sensors are converted into engineering units and displayed on a high visibility electro-luminescent display. The display and the five front panel keys underneath it allow the operator to acknowledge alarms and to manipulate the calibration and configuration menus. The function of each key is indicated by the label that appears immediately above it on the Display. As the operator navigates through various displays the functions of these keys and their associated labels will change. The LCI-90i can be user configured to accept inputs from a range of Tension and Payout sensors, display the parameters in different locations and resolutions, enable as many as six different alarms, and utilize a variety of communication options.

This manual is intended to cover the installation, set-up, and operation of the LCI-90i in both local and remote configurations; including the LCI-90i Bridge Remote.

Figure 1.1 – LCI-90i Front Panel

1.1 New Features of the LCI-90i

- Tension and rotational sensors from four winches can be integrated with the display and evaluated simultaneously
- The display can view line parameter data from one to four winches, user selectable
- High speed analog data capture
- User selectable speed response tuning
- Four strain gage input channels, no external module required
- 20 mV or 100 mV strain gage level inputs
- Four onboard SPDT dry contact relays, no external modules required
- Four analog output channels, output range user selectable
- Rotational sensor load resistor user selectable, no DIP switch setting
- On board CF disk for data logging
- Improved CF disk logging to reduce amount of inert data
- Baud rate selectable for RS-232 and RS-485
- USB port (device) for local data logging
- Ethernet port added, 10 base T, UDP and TCP/IP
- Time series graph added
- Display update rate user selectable
- Enhanced lookup table interface
- Ability to use color TFT for night vision applications
- Metric tonnes added
- Fathoms added
- 10 point contrast interface, user selectable
- Save and load up to 8 different setups, user selectable
- 4 generic digital inputs for payout reset, and other functionality
- On board real-time clock for date and time, all data is time stamped

2.0 Quick Start

This section provides a subset of the full technical manual to facilitate installation and start-up of the LCI-90i. For a complete technical description please refer to Section 3.0 to Section 6.0.

2.1 Mounting

The LCI-90i will fit in a 7.15" x 5.25" cut-out, with a minimum of 4.028" depth clearance (see Appendix A – Dimensional Drawing). The instrument is held in place with removable panel clamps that index into the slotted holes on all sides of the display. Four clamps are included with each display.

After sliding the display into the cutout, clip the four 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-90i gasket to seal against the panel. Lock the jackscrews with hex nuts to prevent them from vibrating loose over time.

2.2 Basic Field Wiring

Basic field wiring connections for the LCI-90i are those required for power, the force transducer, and the quadrature payout sensors. The base unit LCI-90i is shipped with hardware settings to accommodate the following field devices: one 4-20 mA Tension signal and two PNP proximity switch inputs for payout, setup for one winch only. The LCI-90i can be connected to a broad range of field sensors; wiring connections for these are explained in detail in Section 4.0.

During installation, 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.

Input power requirements are 9-36VDC (nominal 24VDC) at 15 Watts. This device is a DC device. This device is approved for Overvoltage Installation Category III.

The connection diagrams for the factory standard power input, Tension sensors and Payout sensors are shown in the tables below. The LCI-90i terminal blocks are listed on the left, and the field devices are listed on the right.

DC Power Connection

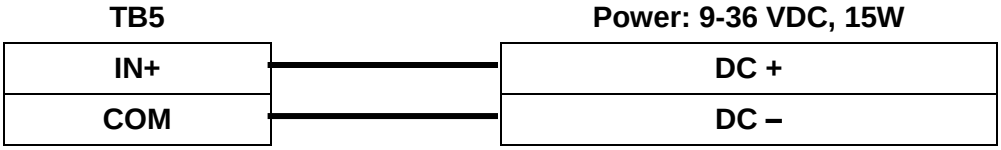


Figure 2.1 – Power Hookup – DC Power

Direct Input – 4-20 mA, Three Wire, Channel 1

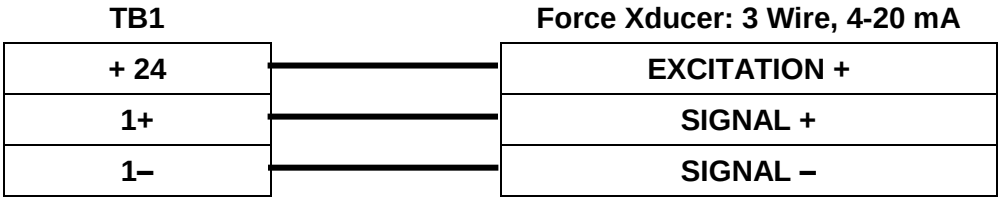


Figure 2.2 – Tension Hookup – 3 Wire 4-20 mA Signal

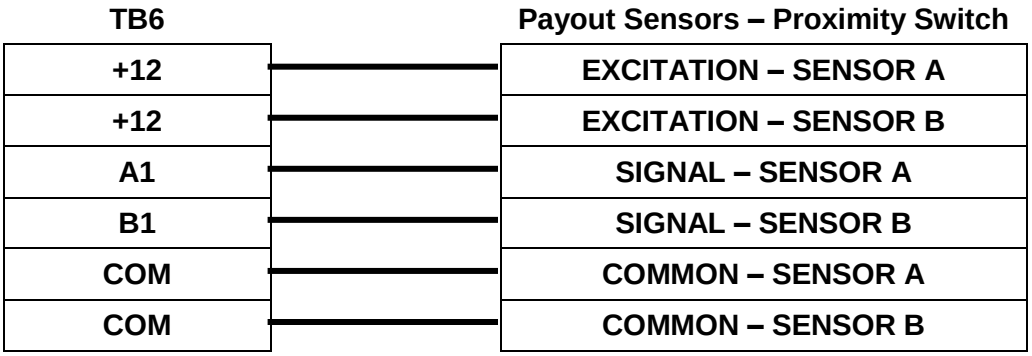


Figure 2.3 – Payout Hookup – 2 Channel 12VDC Proximity Switch

2.3 Basic Hardware Configuration

The base unit LCI-90i (i.e. no options) will accommodate the field device wiring and input devices shown in Section 2.2 above. However this is just a small portion of its functionality. No menu programming or DIP switch changes are necessary if these inputs are used. Setup procedures for alarms, analog outputs, and communication options are discussed in Sections 4.0-6.0.

2.4 Basic Operation

The LCI-90i base unit is configured at the factory to display only one winch's line parameter data. Tension is at the top of the screen, both numerically and as an analog bar graph immediately underneath. Speed is displayed in the middle on the left and Payout on the right, as shown on the cover of this manual. The factory setting for units is pounds and feet. Tension and Speed have 0 decimal places, while Payout has 1. Section 5.0 explains how to change these settings.

The calibration values for the Tension and Payout sensors must be set for each field application. The following is a description of the simplest calibration for the anticipated sensors described above. For complete instructions on the menu functions and calibration features refer to Section 5.0.

To calibrate either the Tension or Payout sensors, just press the **MENU** button to get the **0 MAIN MENU** shown below, then select **2 CALIBRATION**.

	0	MAIN MENU v 1.xx
	1	SET ALARMS
>	2	CALIBRATION
	3	DISPLAY CONFIGURATION
	4	SYSTEM CONFIGURATION

RUN	UP	DOWN	ENT	ESC

To calibrate the Payout sensor, use the **UP** and **DOWN** keys to align the pointer with menu item **3 PAYOUT AND SPEED CAL.**, and then press **ENT** to move to the input field. Make sure that item 1 is set to Winch 1.

	2.0 CALIBRATION		
	1	WINCH NUMBER	1
	2	TENSION CALIBRATION	
>	3	PAYOUT AND SPEED CAL.	
	4	WRAP ANGLE	120 DEG
	5	SHUNT CALIBRATION	OFF
	6	TENSION SAMPLE RATE	20 HZ
	7	TENSION SMOOTHING	OFF
	8	TENSION TARE	OFF

RUN	UP	DOWN	ENT	ESC

Use the **UP** and **DOWN** keys to align the pointer with menu item **1 PAYOUT SCALE**, then press **ENT** to move to the input field.

	2.3 PAYOUT CAL. WINCH 1		
>	**1**	**PAYOUT SCALE**	**1.000 P/FT**
	2	**PAYOUT PRESET**	**100.0 FT**
	3	**COUNTER MODE**	**QUAD 1X**
	4	**LOAD RESISTOR**	**PULL UP**
	5	**SPEED FILTER LEVEL**	**4**
	6	**SPEED RESPONSE TIME**	**4 S**
	7	**STRECTH COEFFICIENT**	**1.000**

RUN	**UP**	**DOWN**	**ENT**	**ESC**

Now use the **INCR** , **DECR** and → keys to change the value to the correct number of pulses per foot. (See Section 5.9 for details; the number of decimal places shown is adjusted to maintain four-digit accuracy.) Pressing **ENT** will accept the new value, pressing **ESC** will restore the old value. Pressing **RUN** saves the displayed value for future use and returns the instrument to RUN mode.

To calibrate the Tension sensor, select menu item **1 TENSION CALIBRATION** to move to the **2.2 TENSION CAL WINCH 1** menu shown below. Select Item 2 and enter the **full-scale** Tension sensor output in pounds. Then select Item 3 and enter the Tension **offset** in pounds. The **ENT** key accepts the new value; the **ESC** key restores the old value. Press **RUN** to save the new values for future use and to return to the RUN Screen display. This completes the initial calibration of the instrument.

	2.1 TENSION CAL METHOD 1		
	1	**CALIBRATION**	**SCL/OFS**
>	**2**	**FULL SCALE**	**20000 LBS**
	3	**OFFSET**	**50 LBS**

3.0 Mechanical Installation

The LCI-90i is designed for mounting on the front-panel of an electrical enclosure with a suitable environmental rating. The sealed front face of the LCI-90i is made of 12 gauge stainless steel, 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 5.7" high x 7.6" wide; the total depth is 4.028".

3.1 Environmental Considerations

The front face of the LCI-90i is designed for NEMA 4X applications. It consists of a 316 stainless steel top layer, a sealed Lexan window, and five membrane-sealed stainless steel push buttons. The rear cage is NEMA 1 and requires protection with a suitable enclosure. A polyurethane gasket, held in-place by a high temperature adhesive is applied to the back-side of the front face. When mounting the LCI-90i in open deck locations, a front-panel cover is recommended to protect the unit when it is not in use.

The standard temperature range of the LCI-90i is –40°C to +75°C.

3.2 Dimensions and Cutout

The LCI-90i will fit in a 7.15" x 5.25" cutout (tolerance –0.01, +0.100), with a minimum of 4.028" depth clearance (see Appendix A – Dimensional Drawing). The front panel can be up to 5/8" thick.

3.3 Display Mounting

The instrument is held in place with removable panel clamps that index into the slotted holes on all sides of the display. Four clamps are included with each display, but the unit can be installed using as few as two if a panel seal is not required. For thin panel mounting, as many as 8 clamps can be used to ensure a reliable panel seal.

After sliding the display into the cutout, clip the four 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-90i gasket to seal against the panel. Lock the jackscrews with hex nuts to prevent them from vibrating loose over time.

3.4 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.

3.5 Cleaning Instructions

To clean the front panel of the display, use a clean lint free cloth and a high quality and pure isopropanol. Do not apply the mild solvent directly to the polycarbonate window, instead wet the cloth or wipe first and then gently wipe the window and the stainless steel bezel.

4.0 Options and Wiring Diagrams

The LCI-90i can be configured for a wide range of signal input and output functions. Each of these functions requires the instrument to have the correct menu settings (Section 5.0), DIP switch settings (Appendix B), signal wiring and power wiring. The wiring diagrams are given in this Section. The table below gives of a summary of the LCI-90i functions, referenced to their associated menu and DIP switch numbers, required hardware options, and section of this manual covering the wiring termination.

Function	Menu Number	DIP Switch #	Wiring – Manual Section
DC Power	N/A	N/A	4.1.1
Analog Input 4-20 mA	4.5	SW2	4.1.2
Analog Input DC Voltage	4.5	SW2	4.1.2
Analog Input 4 Wire Strain Gage	4.5	N/A	4.1.2
Analog Input 6 Wire Strain Gage	4.5	N/A	
Payout Sensor Input	2.3	N/A	4.1.3
Alarm Output	4.7	N/A	4.1.4
Digital Input	4.3	N/A	
Analog Output 4-20 Ma	4.6	N/A	4.1.5
Analog Output DC Voltage	4.6	N/A	4.1.5
Serial Comm USB	4.821	N/A	4.1.5
Serial Comm. RS232	4.822	N/A	4.1.6
Serial Comm. RS485	4.823	SW3	4.1.6
Ethernet Comm.	4.81	N/A	4.1.6

Figure 4.1 – Identification of hardware interconnect, DIP switches and manual sections by function

4.1 Wiring Hookup – Local Display

This section provides wiring diagrams and related specifications for power and signal input and output connections for the LCI-90i.

4.1.1 Display power and fuse

The fuse, F1, is located on the rear panel of the display. Use a flat blade screwdriver to open the cover for access. The replacement part is a 5 x 20 mm fuse rated according to the system options. See the table below for fuse sizing.

Input Power Source	Fuse Rating	Littelfuse Part No
9V	1.75 A	218002
12V	1.25 A	2181.25
24V	0.625 A	218.630
36V	0.5 A	218.500

Figure 4.2 – Fuse rating and replacement part – Local display

During installation, 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.

Input power requirements are 9-36VDC (nominal 24VDC) at 15 Watts. This device is a DC device. This device is approved for Overvoltage Installation Category III.

The LCI-90i requires a 9-36 Volt DC power source. The connection for the power is shown below.

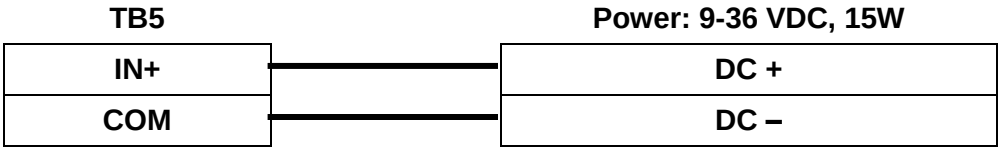


Figure 4.3 – Local Display Power Hookup – DC Power

4.1.2 Power for Field Sensors

The LCI-90i provides regulated excitation voltage to a variety of field sensors. The table below identifies the power, capacities and terminal block locations.

Power	Capacity	Location
+24VDC	1.1 A	TB1 +24
+5VDC	0.35 A	TB 6 +5
+12VDC	1.2 A	TB6 +12
+5VDC Strain Gage	277 mA	TB7 V+ and V-
+10VDC Strain Gage	277 mA	TB7 V+ and V-

Figure 4.4 – Regulated DC Power for Field Sensors

4.1.3 Tension Sensor Inputs

The Tension sensor analog inputs are terminated on TB1 for high level input and TB6 for low level strain gage signals. TB6 can accept +/-20mV or +/-100mV strain gauge inputs (factory configured). There are four inputs on TB6, referred to as AIN-1, AIN-2, AIN-3 and AIN-4 respectively. TB1 can accept 4-20 mA, 0-5VDC, 0-10VDC and ±5VDC sensors. Four such inputs are available on TB1 and these inputs are referred to as AIN-5, AIN-6, AIN-7 and AIN-8. The LCI-90i can accept eight analog inputs, allowing the output from multiple tension sensors to be summed or four unique winch tension sensors to be displayed. Each different input type requires a menu selection change. Additionally, if switching an input to or from a 4-20mA type input, then a DIP switch will need to be changed on the rear of the display (this is detailed in Appendex B).

Tension sensors can be externally powered, powered from the same 24VDC used by the display (as long as it is regulated), or powered from the regulated 24VDC or 12VDC provided by the LCI-90i display itself.

Note: The terminal labeled IN+ located on TB5 is a pass-through of the input power, not an internal regulated +24V supply. If it is to be used for sensor excitation, ensure that the voltage supply for the display is within the required limits for the sensor.

The LCI-90i can accept input from a dual axis load pin on any two channels. The channel selection is defined in menu 4.41. Refer to Sections 5.8 and 12-13 (Appendices D & E) for more details about this configuration.

Below are the wiring diagrams for the different sensor types and excitation scenarios.

4-20 mA, Three Wire, AIN-5

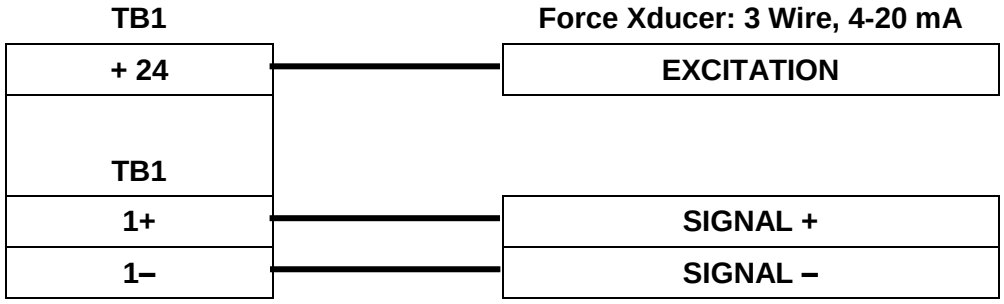


Figure 4.5 – Tension Hookup – 3 Wire 4-20 mA Signal

4-20 mA, Four Wire, AIN-5

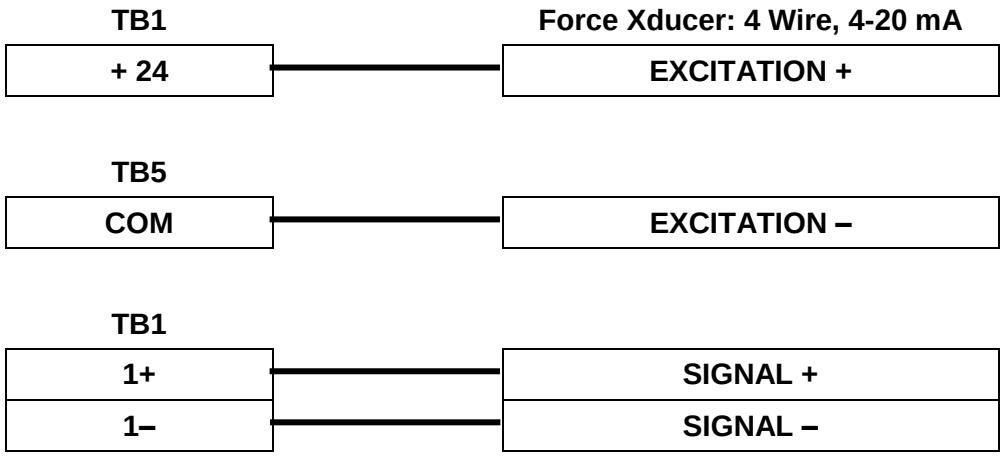


Figure 4.6 – Tension Hookup – 4 Wire 4-20 mA Signal

4-20 mA, Two Wire, AIN-5

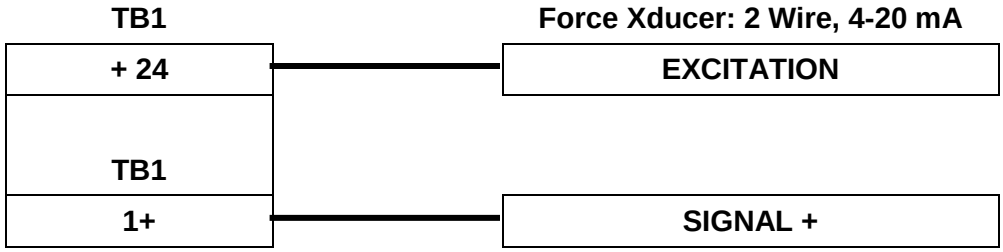


Figure 4.7 – Tension Hookup – 2 Wire 4-20 mA Signal

DC Voltage, +24 Volt Excitation, AIN-5

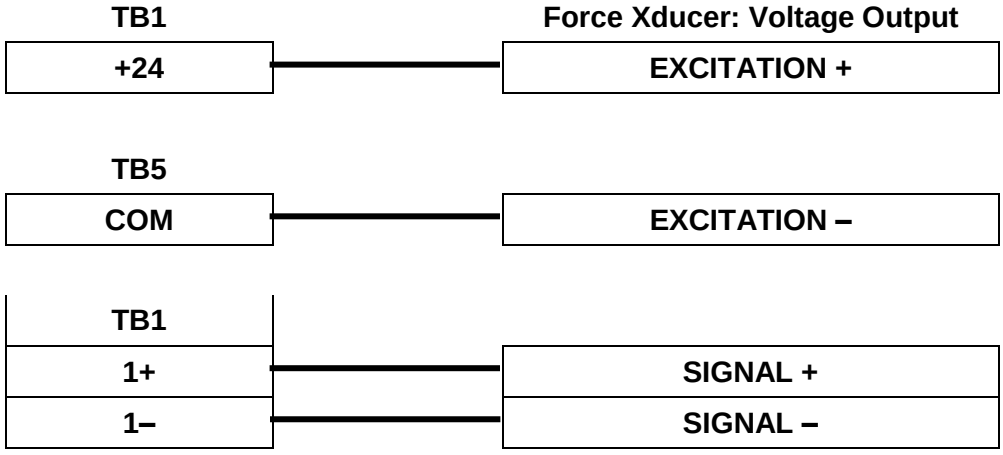
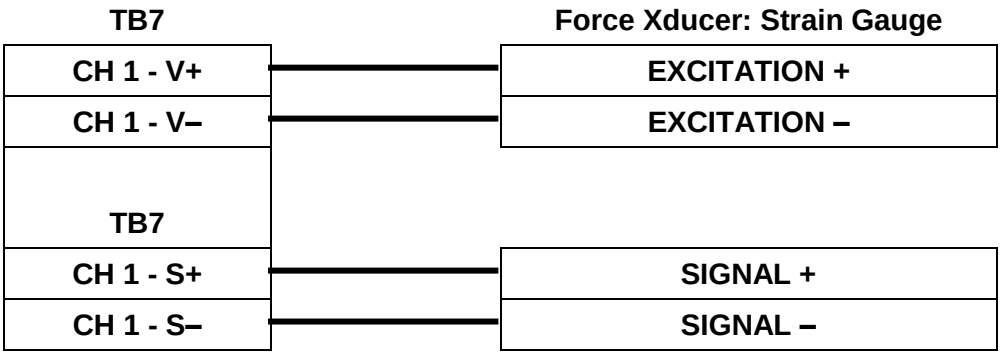


Figure 4.8 – Tension Hookup – 4 Wire DC Voltage Input

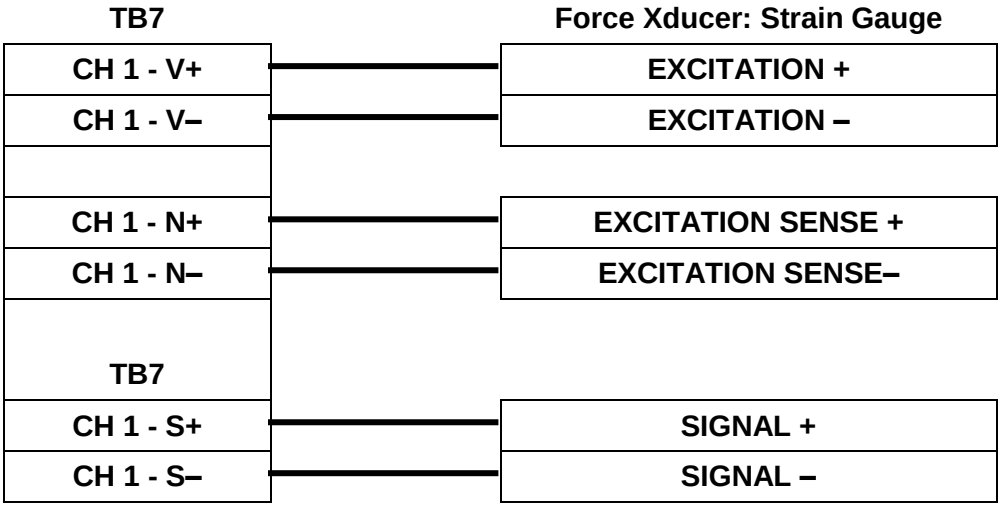
4 Wire Strain Gauge, AIN-1



Note: 4 wire strain gauge default range is 20 mV full scale.

Figure 4.9 – Tension Hookup – 4 Wire Strain Gauge

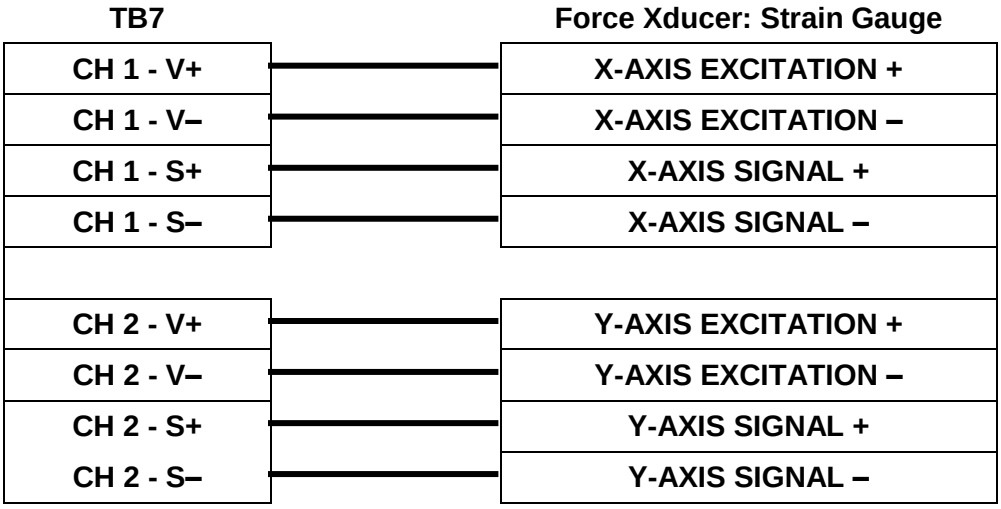
6 Wire Strain Gauge, AIN-1



Note: 4 wire strain gauge default range is 20 mV full scale.

Figure 4.11 – Tension Hookup – 6 Wire Strain Gauge

Dual Axis Input – Two 4 Wire Strain Gauges, AIN-1 and AIN-2



Note: Each 4 wire strain gauge module must be inserted in correct position.

Figure 4.12 – Dual Axis Tension Hookup – Two 4 Wire Strain Gauge Inputs

4.1.4 Rotational Sensor Inputs

The rotational sensor inputs are terminated on TB6. The LCI-90i can accept up to four separate quadrature counter sensors, each with a unique calibration. Each channel can accept NPN and PNP type proximity and Hall-Effect inputs, as well as TTL/CMOS encoder inputs. The input voltage thresholds are set to accommodate all these ranges with no adjustment. These thresholds are 3 Volts for low-high transitions, and 2 volts for high-low transitions.

Each different sensor type requires a specific menu settings; no DIP switch setting are required anymore. Below are the wiring diagrams for the different sensor types with typical excitation voltages.

Dual NPN/PNP Switches, +12 V Excitation, Counter 1

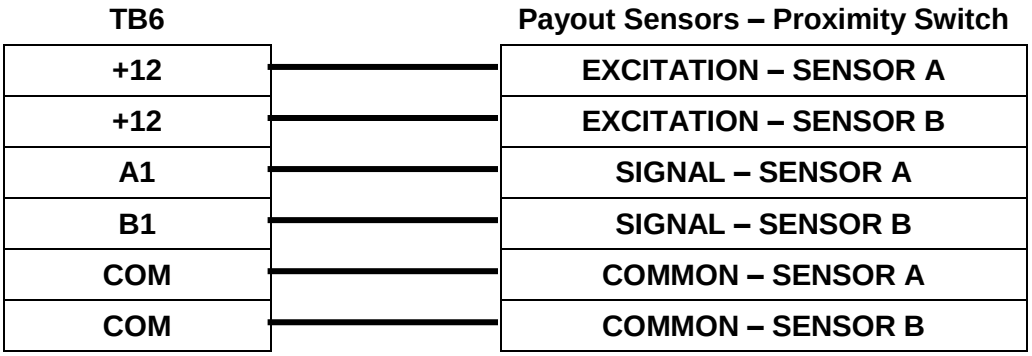


Figure 4.13 – Rotational Sensor Hookup – 12V NPN/PNP switches, Counter 1

Hall Effect Sensor, +12 V Excitation, Counter 4

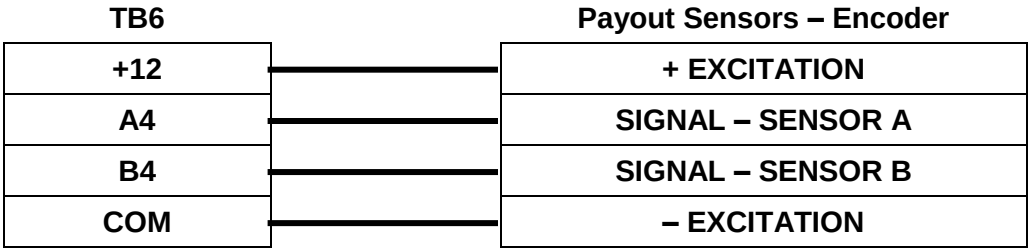


Figure 4.14 – Rotational Sensor Hookup – Hall Effect Sensor, Counter 4

TTL Encoder, +5 V Excitation, Counter 2

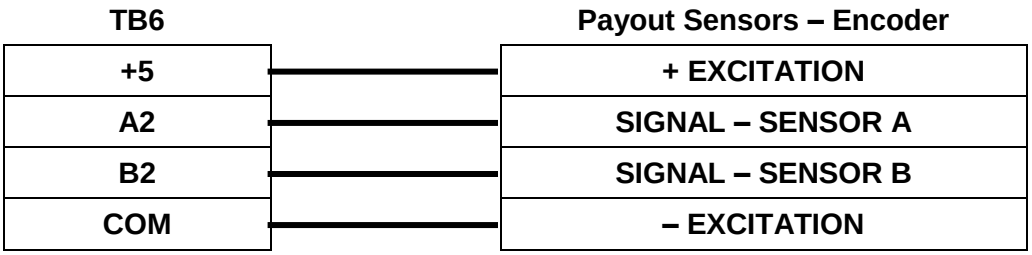


Figure 4.15 – Rotational Sensor Hookup – TTL Encoder, Counter 2

4.1.5 Alarm Outputs

The four alarm outputs are terminated on TB3. The LCI-90i has internal SPDT dry contact relays to implement the alarm outputs. Note that the **Input Check** alarm (Section 6.3.2) also uses Relay 4, and the **Shunt Cal** relay (Section 4.1.5, and Section 5.8) is variable per the menu selection in menu 2.0.

Alarm Outputs (4 channels total)

TB3	External Alarm/Device
OUT 1 - NC	RELAY 1 NORMALLY CLOSED
OUT 1 - C	RELAY 1 COM
OUT 1 – NO	RELAY 1 NORMALLY OPEN
OUT 2 - NC	RELAY 2 NORMALLY CLOSED
OUT 2 - C	RELAY 2 COM
OUT 2 – NO	RELAY 2 NORMALLY OPEN
OUT 3 - NC	RELAY 3 NORMALLY CLOSED
OUT 3 - C	RELAY 3 COM
OUT 3 – NO	RELAY 3 NORMALLY OPEN
OUT 4 - NC	RELAY 4 NORMALLY CLOSED
OUT 4 - C	RELAY 4 COM
OUT 4 – NO	RELAY 4 NORMALLY OPEN

Figure 4.16 – Alarm Output Hookup – 4 Channels

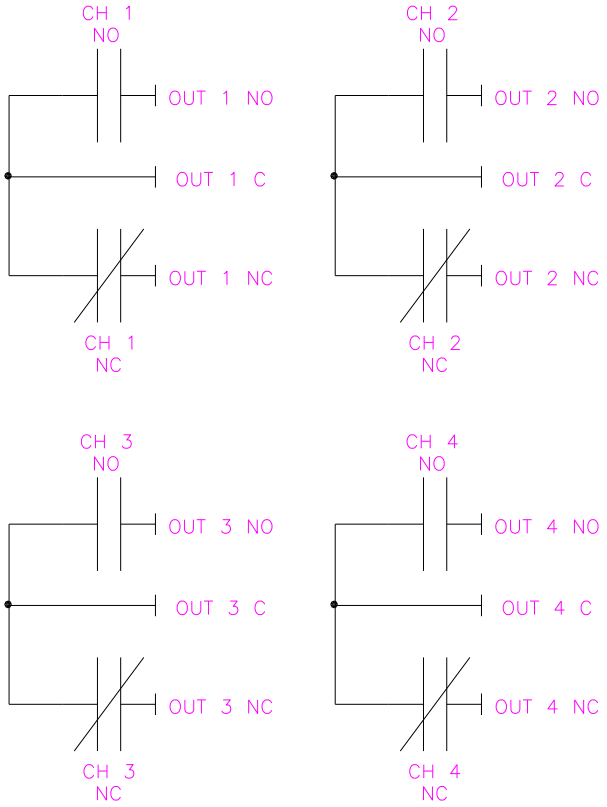
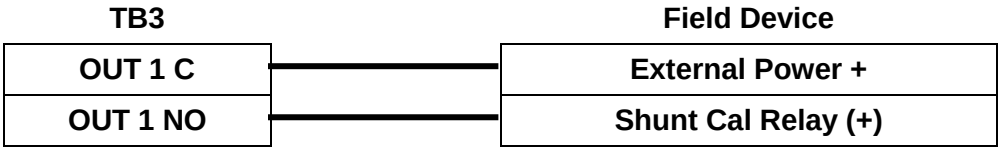


Figure 4.17 – Alarm Output Hookup – 4 Channels - Ladder Logic

4.1.6 Shunt Calibration

The LCI-90i provides a method for "shunt calibration" of a load cell or load pin. The sensor must have an internal relay that connects a precision resistor across one leg of the bridge. The LCI-90i has the ability to select the relay output channel through the menu structure, see section 5.8.

Shunt Calibration Connections Relay 1



Note: Shunt Cal relay must be referenced to external power common.

Figure 4.18 – Shunt Calibration Hookup Relay 1

4.1.7 Analog Outputs

The LCI-90i provides four analog outputs on TB2. These outputs can be 4-20 mA, 0-5 VDC, 0-10 VDC or ±5VDC. Below are wiring diagrams for the different output types.

Voltage Output Channel 1-4

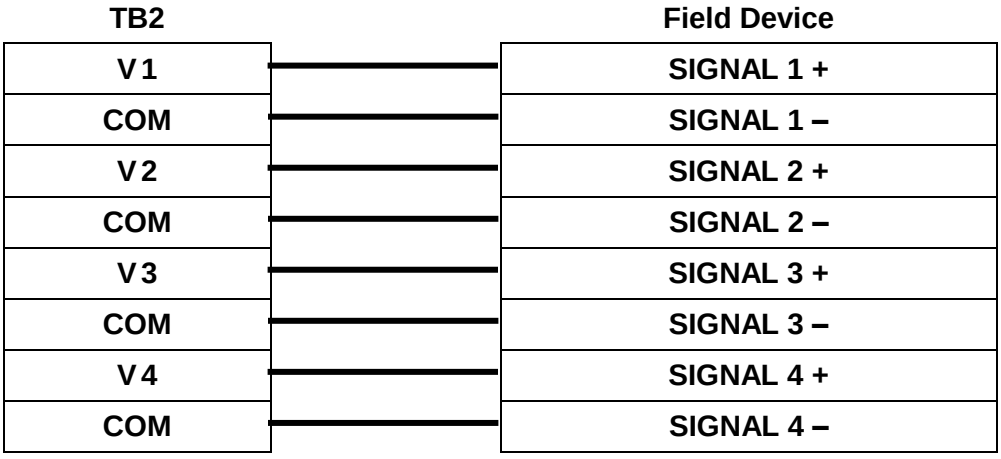


Figure 4.19 – Voltage Output Hookup – 4 Channels

4-20 mA Output Channels 1-4

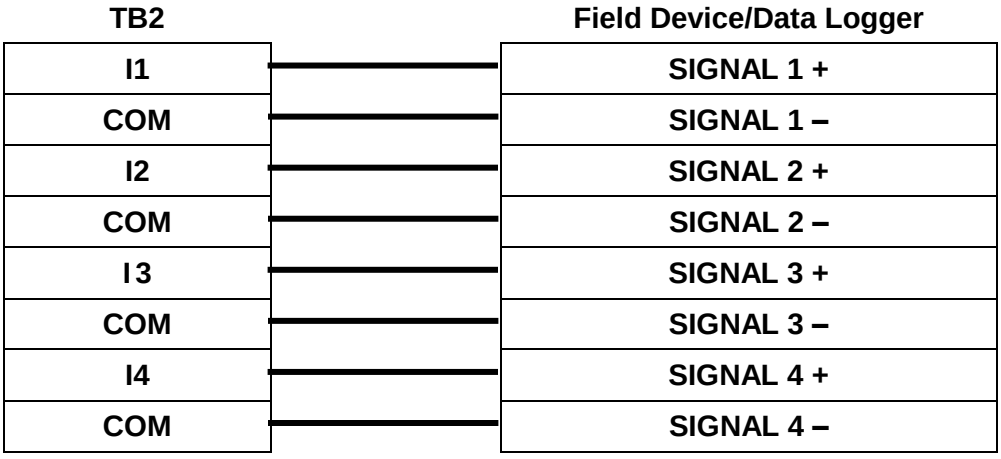


Figure 4.20 – 4-20 mA Current Output Hookup – 2 Channels

4.1.8 Serial Communications

The LCI-90 provides USB, RS-232 and RS-485 serial communication options. The base model has all three included. For long cable runs or multi-drop applications, the electrically-isolated RS-485 port is recommended.

The RS-485 serial termination is set using the DIP switch settings (SW3) in Appendix B.

Below are the wiring diagrams for all serial communications options.

RS-232 Connection

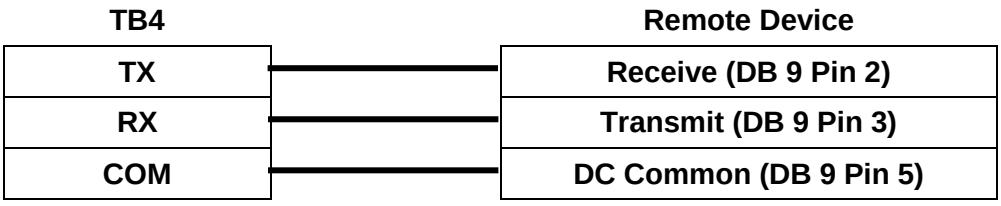


Figure 4.21 – RS-232 Communcation Hookup

USB Connection

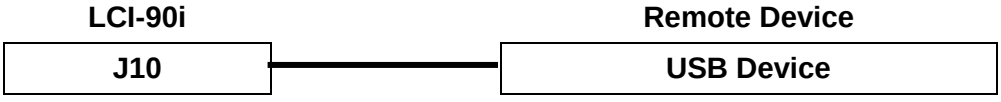
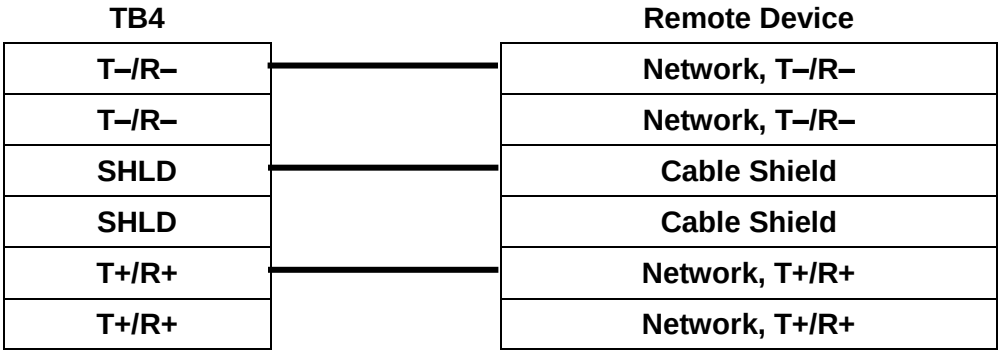


Figure 4.22 – RS-USB Communcation Hookup

RS-485 Connection



Note: the duplicate terminal blocks are used for daisy chaining multiple units.

Figure 4.23 – RS-485 Network Communcation Hookup

4.1.9 Ethernet Communications

The LCI-90i has been constructed with an Ethernet port on the rear of the unit. J8 is the designation. This is the preferred interconnect or architecture for exchanging data between local units and remote devices. Refer to Section 6.8.1 for a complete description. Any standard Ethernet cable can be used if the LCI-90i is being plugged into a router, hub or switch. If the LCI-90i is going to be connected directly to a PC or another LCI-90i then a cross over cable must be used.

Ethernet Connection – Hub/Switch

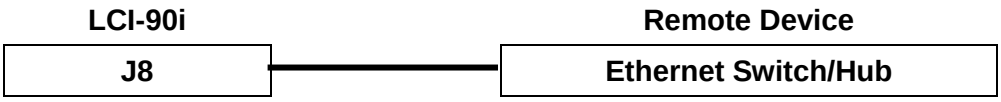
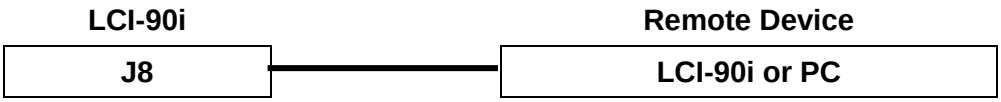


Figure 4.24 – Ethernet Communcation Hookup

Ethernet Connection – LCI-90i or PC



Note: Requires cross over cable

Figure 4.25 – Ethernet Communcation Hookup – to LCI-90i or PC

4.2 Wiring Hookup – LCI-90R Remote Display

MTNW recommends using a second LCI-90i as a remote display (this unit can be set as either a LOCAL or a REMOTE LCI). A legacy LCI-90R remote can be used to independently display (and optionally echo) all the line variables measured by a LCI-90i. The LCI-90R does not support field I/O and thus has a much reduced wiring and configuration specification compared to the LCI-90i. The protocol selection in the LCI-90i should be set to properly for the interface to the LCI-90R to be functional. The MTNW LEGACY communications protocol must be used, and the units must be connected using the RS-485 network port.

4.2.1 LCI-90R display power and fuse

The LCI-90R, unlike the LCI-90i, can accept either DC power (standard) or AC power (optional). The fuse, F1, is located on the rear panel of the display. Use a flat blade screwdriver to open the cover for access. The replacement part is a 5 x 20 mm fuse rated according to the system options. See the table below for fuse sizing.

Model No	Fuse Rating	Littlefuse Part No
LCI-90R-DC	1/2 A	218.500
LCI-90R-AC	1/2 A	218.500

Figure 4.26 – Remote Display Fuse rating and replacement part

The standard LCI-90R requires an 18-36 V DC power source. The optional AC-powered unit requires an 85-265 V AC, 47-440Hz power source. The connection diagrams for these two power options are shown below.

DC Power Connection

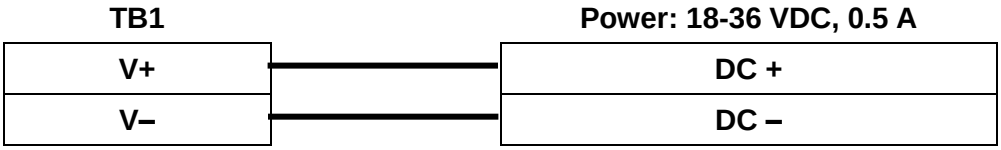


Figure 4.27 – Remote Display Power Hookup – DC Power

AC Power Connection (requires AC Power Option)

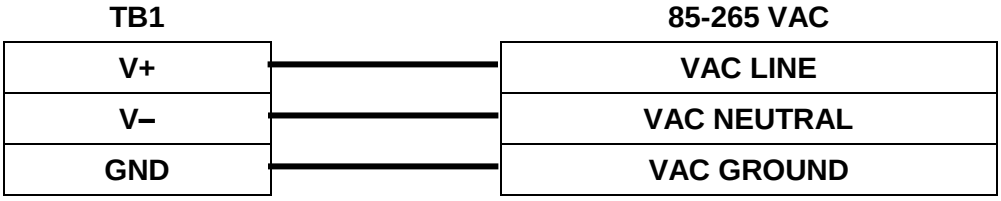


Figure 4.28 – Remote Display Power Hookup – AC Power

4.2.2 LCI-90R communication ports

The LCI-90R provides two serial communication ports on TB2, the network and the auxiliary ports. The connection to the LCI-90i is made via the RS-485 network port. The auxiliary port is RS-232, which can be configured via the Remote Setup feature described in Section 5.6 to transmit line variables to logging or display devices using a variety of protocols. Below are the wiring diagrams for the LCI-90R serial ports.

RS-232 Connection – Auxiliary Port

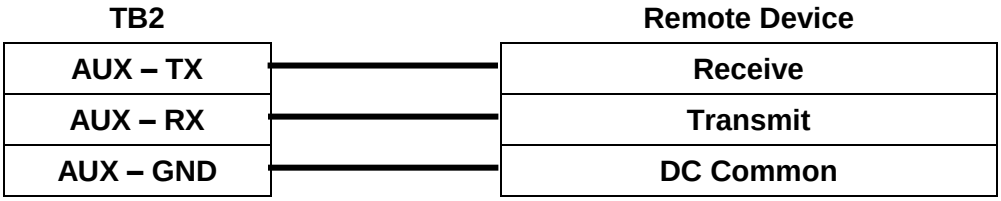
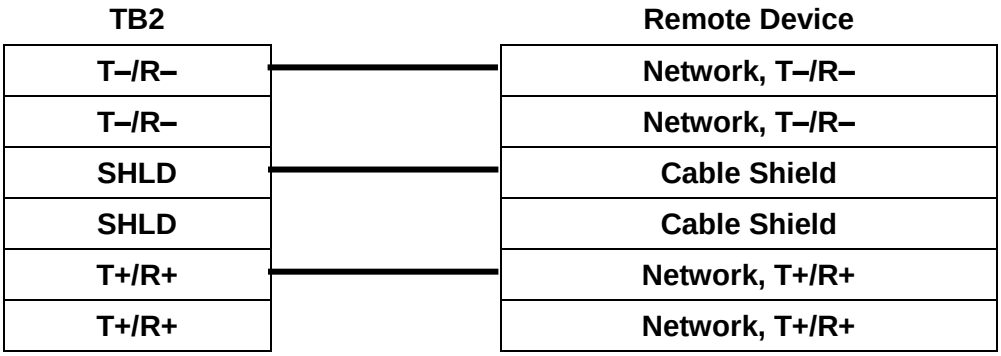


Figure 4.29 – LCI-90R Auxiliary RS-232 Hookup

RS-485 Connection – Network Port (requires RS-485 option)



Note: Duplicate terminal blocks are for daisy-chaining multiple units.

Figure 4.30 – LCI-90R Network RS485 Hookup

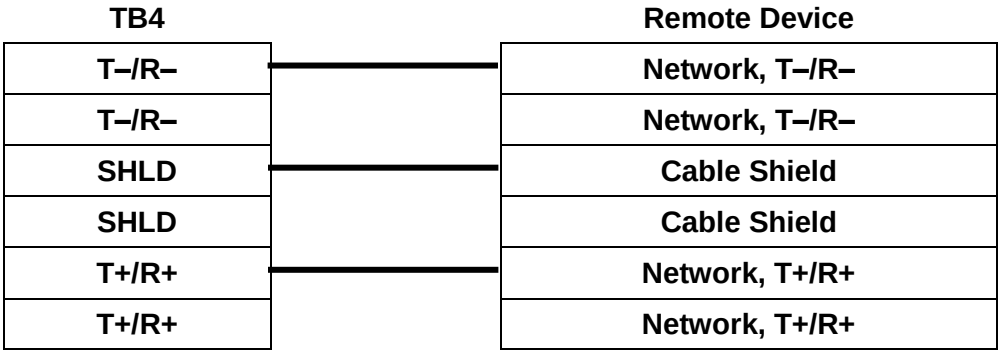
4.3 Wiring Hookup – LCI-90i Remote Display

MTNW recommends using an LCI-90i as a remote display. This gives the operator the opportunity to initiate a remote reset and to use current data exchange protocols which greatly improves the functionality of the remote device. The remote unit can be either a local LCI-90i set into a remote mode through the menu structure or the LCI-90i Bridge Remote. The LCI-90i Bridge Remote has a different display that allows the operators the ability to switch between day and night-vision colors (amber on black and red on black respectively).

There are two ways to connect these units together, the first is the more traditional RS-485 network scheme and the other is using the Ethernet interface. The Ethernet interface is available in both TCP and UDP formats. Refer to Section 6.8 for more information on the Ethernet protocols.

The power connections are the same as identified as for the LCI-90i in section 2.2.

RS-485 Connection



Note: the duplicate terminal blocks are used for daisy chaining multiple units.

Figure 4.31 – RS-485 Network Communcation Hookup – LCI-90i Remote

Ethernet Connection – Hub/Switch

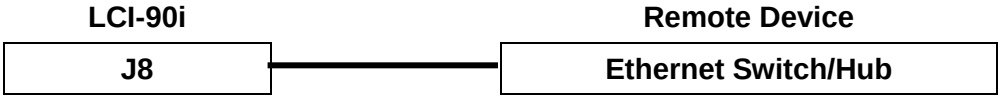
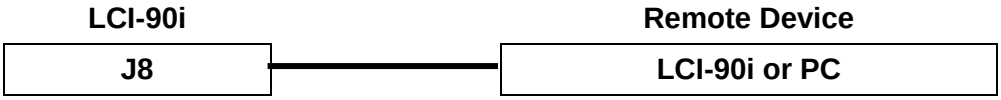


Figure 4.32 – Ethernet Communcation Hookup

Ethernet Connection – LCI-90i or PC

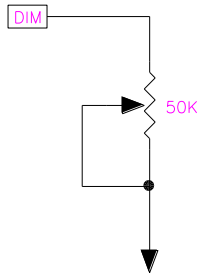


Note: Requires cross over cable

Figure 4.33 – Ethernet Communcation Hookup – LCI-90i or PC

4.4 Display brightness adjustment

The display brightness of the LCI-90i can be varied by either adjusting the contrast menu setting or by using an external potentiometer. Decreasing the brightness prolongs the life of the screen. The menu selection allows the operator the ability to pick a number from 1-10 with 10 being the brightest. Whenever you press the menu button the menu is always displayed with the maximum brightness. A 50K potentiometer can be connected to the rear of the display on the terminal block labeled DIM. Switching between the two dimming techniques requires jumpers to be changed on the processor board; contact the factory for assistance.



5.0 Local Display Operation

5.1 Front Panel Identification

The LCI-90i front panel, shown in Figure 5.1, 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. When a key is pressed its function (and the label) changes to reflect the current "operating mode" of the instrument.

In normal operation the RUN screen (shown below) is displayed. This screen is divided into three separate displays at the Top, Left, and Right, which can be user programmed to display Tension, Speed and Payout in any order. The Top display includes a bar graph with operator selectable limits and a visual indication of alarm set points. Alarm message displays are located below the parameter displays. Up to six alarm conditions can be shown in this area.

The function of the five menu keys during RUN mode are as follows:

MENU Displays the menu for programming and/or calibration of the unit. Section 5.2 describes the navigation and data editing within the programming menu

DIAG Switches to the diagnostics screen which shows raw sensor inputs and scaled Tension and Payout values. Once in DIAG mode, the RUN button returns the display to the RUN screen.

ALRM If an alarm condition is present, this button will reset all alarm output modules. **Double-pressing** this button within a two-second interval will bring up the **1.0 SET ALARMS** menu (§5.3.2)

GRPH Acts as a shortcut to the time series graph (See section 5.12.7).

RSET Resets Payout to zero. Requires two key-pushes within a 2-second period to zero the Payout display.

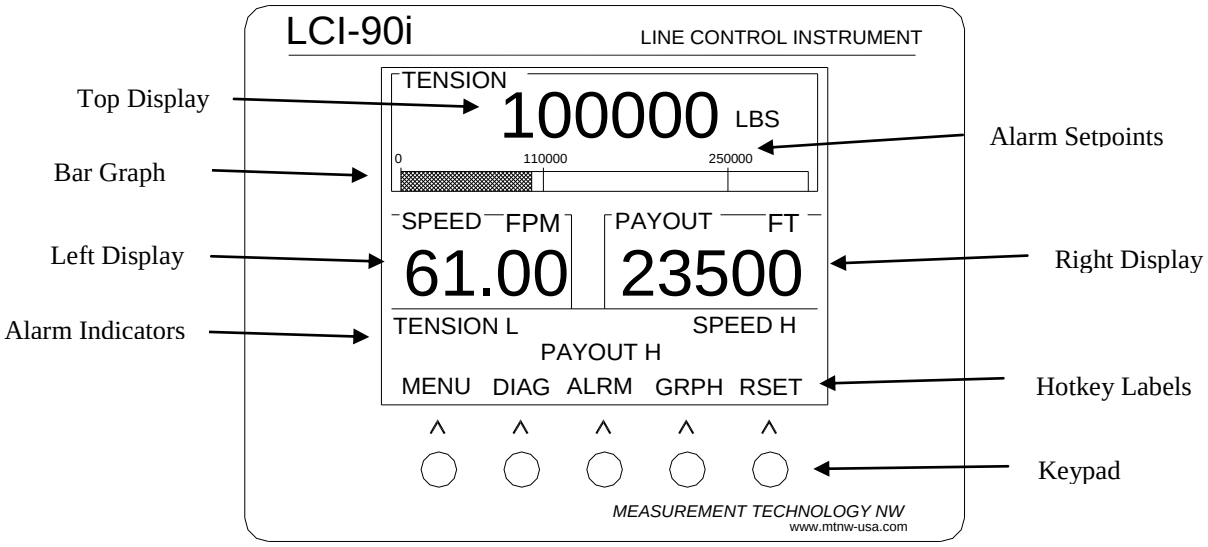


Figure 5.1 – LCI 90i Front Panel

5.2 Programming Menu

The LCI-90i 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. The menu tree is shown below in Figure 5.2.

Pressing the **MENU** key displays the **0 MAIN MENU** screen. The key labels also change to indicate the functions they perform in **Menu** mode, allowing the user to navigate through the menu system and select menu items. Once an item is selected, the keypad labels change again to reflect their uses in **Edit** mode for modifying data fields.

In Menu mode the keys have the following labels and functions:

RUN	UP	DOWN	ENT	ESC

RUN Returns to the Run Display, saving any changes made to menu items

UP Moves pointer up the menu (wraps to the bottom)

DOWN Moves pointer down the menu (wraps to the top)

ENT If the pointer indicates a sub-menu, jumps to that menu. If the pointer indicates a data field, enters **Edit** mode to allow changes on the selected field (see below).

ESC Moves back one menu level. When reaching the top menu, pressing this button will return the LCI-90i to Run mode

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

DECR	INCR	→	ENT	ESC

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

INCR 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 Rejects the edited value and return to **Menu** mode

Here is an overview of the LCI-90i menu system:

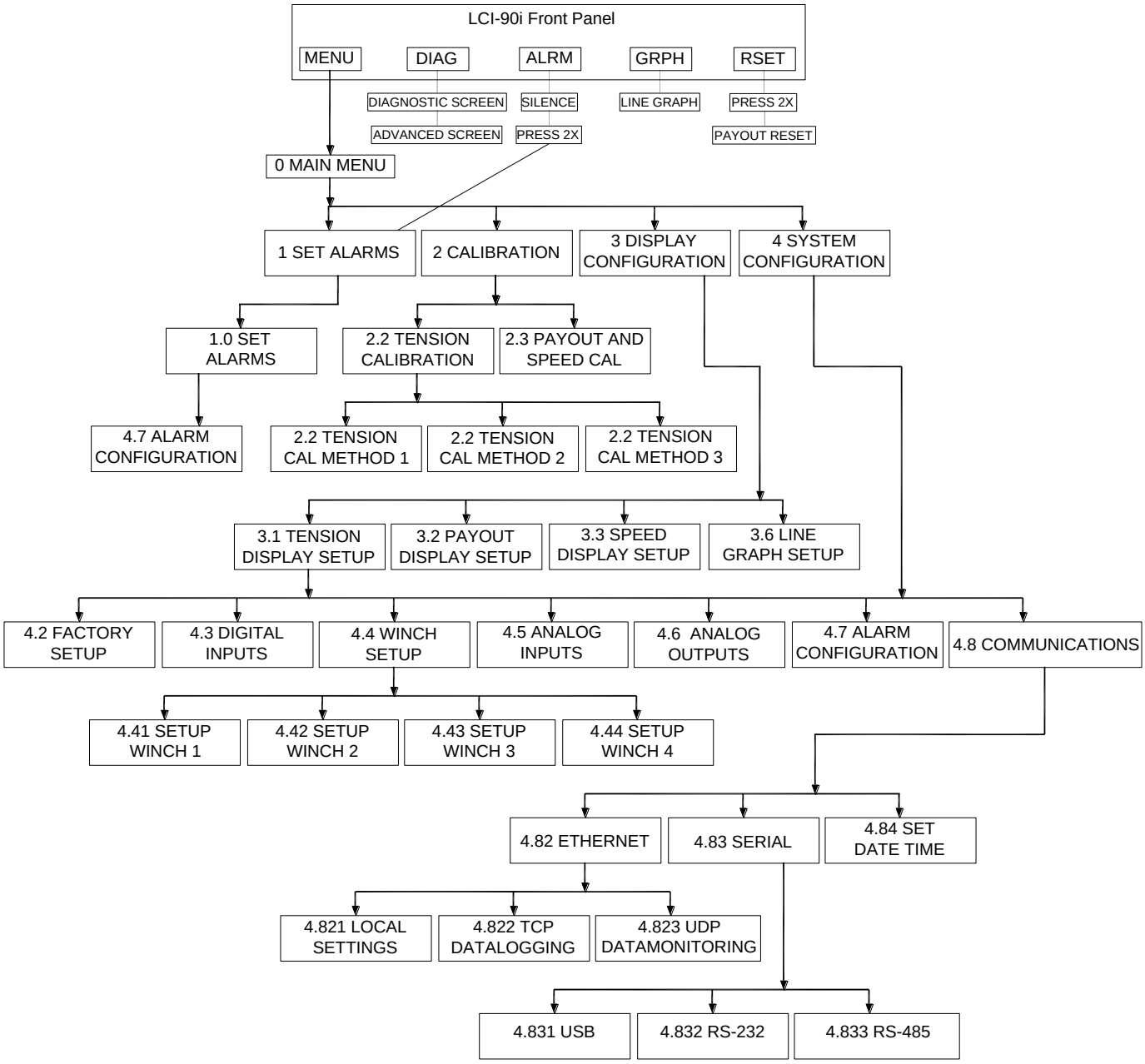


Figure 5.2 – LCI 90i Menu Tree

5.3 Alarms

The LCI-90i provides the user with up to six optional visual alarms that can be configured to indicate high and low conditions of Tension, Payout, and line Speed. The six visual alarms can be assigned to any winch but there will always be a total of six alarms to allocate. Each alarm can be assigned to any of the three measured variables for any of the four winches, and can be designated as a high or low alarm. Each alarm can also be assigned to any one of the four relay output channels that could be used to drive lights and/or horns. (Relay 4 is used for the input check alarm system).

The lower third of the Run Display is reserved for alarm messages. The alarm messages correspond to how the user configured them. Figure 5.3 below is an example display of alarms 1-2 being configured as high Tension alarms for winch 1, alarms 3-4 configured as Payout high and low alarms for winch 2, alarm 5 configured as a Speed high alarm for winch 4, and alarm 6 unused. It would be unlikely to have all these messages on the display at one time, but each has its own location to prevent them from overwriting each other.

TENSION1 H	PAYOUT2 H	SPEED4 H
TENSION1 H	PAYOUT2 L	

Figure 5.3 – Sample Alarm Message Display Winch 1

Two separate menus are used for alarms. One menu is dedicated to adjusting alarm limits only and is described in Section 5.3.2. This menu can be reached from the front panel by pressing the **ALRM** key **twice within two seconds**. A separate menu is used when setting up the instrument to identify the alarm variable and type, enable relay outputs, and set the deadband for each channel. This alarm configuration menu is covered in Section 5.3.3.

In addition to these six high-level alarms, the LCI-90i can be configured to monitor each analog input channel, watching for a low-level fault condition. This is particularly useful with multiple input configurations, where the failure of a single sensor might not be easily noticed. Enabling and responding to the **input check** alarms is described in Section 6.5.1.

5.3.1 Acknowledging alarms

When an alarm event occurs a message appears in the lower part of the Run Screen identifying the source of the alarm. This message remains on the screen as long as the alarm condition exists. The message will go away when the variable causing the alarm changes to a value beyond the dead-band range. If the user configures the alarm to output to a relay output, that module will track the screen display: 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.)

Pressing the **ALRM** key after an alarm condition occurs de-energizes all the relays currently energized. They will remain de-energized until a new alarm condition is generated. Note that even when an alarm is acknowledged by pressing the **ALRM** key, the on-screen message remains until the condition goes away.

When an alarm condition occurs, two quick presses on the **ALRM** key will still go directly to the **1.0 SET ALARMS** menu. This makes it convenient to view or correct alarm limits to prevent nuisance alarms.

5.3.2 Setting alarm limits

From the RUN screen push the **ALRM** key twice within 2 seconds, or press **MENU** and select the **1.0 SET ALARMS** item (shown below). Upper limits are indicated by a greater-than sign "**>**", and lower limits by a less-than sign "**<**". Press **ENT** to

change the set point using the **DECR, INCR** and → keys. Save the change with the **ENT** key. Keep the old value with the **ESC** key. Push the **RUN** key to return to the Run screen. To check or alter the configuration of the alarm settings choose item 7, or go to Menu **4.7 ALARM CONFIGURATION.**

	1.0 SET ALARMS			
>	1	TENSION 1	>	10000 TONS
	2	TENSION 1	>	8000 TONS
	3	PAYOUT 2	>	2500 FT
	4	PAYOUT 2	<	100 FT
	5	SPEED 4	>	250 FPM
	6	NONE		
	7	CHANGE CONFIGURATION		

5.3.3 Configuring Alarms

To configure the alarm settings, go to menu **4.7 ALARM CONFIGURATION** shown below by pressing the **MENU** key from the RUN screen and navigating through the menu (or by selecting Item 7 in the **1.0 SET ALARMS** menu above).

	4.7 ALARM CONFIGURATION		
>	1	ALARM NO.	1
	2	STATUS	ON
	3	VARIABLE	PAYOUT
	4	WINCH	1
	5	ALARM TYPE	HIGH
	6	LIMIT	1000 FT
	7	DEADBAND	20 FT
	8	RELAY	RELAY 1

Item 1 Directs the configuration to alarm numbers 1–6. Edit this field first to view the information for the desired alarm channel

Item 2 Determines if the alarm is ON or OFF (active or not).

Item 3 Sets the alarm to monitor Tension, Payout, or line Speed. There are no limits to how many of the six channels can be assigned to each variable.

Item 4 Determines which winch the alarm is to be evaluated from.

Item 5 Selects HIGH or LOW alarm conditions. A high alarm is active when the variable exceeds the limit. A low alarm is active when the variable is below

the limit. An algebraic comparison is used, thus a speed of "–60" is *below* a limit of "–50".

Item 6 This is the numerical value at which the alarm is triggered. This number can also be changed in the **1.0 SET ALARMS** menu.

Item 7 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 line variable is less than LIMIT – DEADBAND for high alarms, or greater than LIMIT + DEADBAND for low alarms.

Item 8 Relates the alarm condition to an output relay as shown in the table below. There is no requirement for each alarm to have its own relay. All alarms can be assigned to a single relay that energizes a horn, if so desired. Conversely, alarms can be configured to only appear on the screen. Note that the Input Check Alarm (Section 6.5.1) always uses output relay 4, and the Shunt Cal relay (Section 5.6) can be selected to work on any output relay

Setting	Hardware/Terminal Block
RELAY 1	TB3 OUT 1 NC/C/NO
RELAY 2	TB3 OUT 2 NC/C/NO
RELAY 3	TB3 OUT 3 NC/C/NO
RELAY 4	TB3 OUT 4 NC/C/NO

Figure 5.4 – Digital Output Module Locations and Menu Names

5.4 Tension Calibration

To perform a Tension calibration, press **MENU** and select the **2.0 CALIBRATION** menu shown below.

	2.0 CALIBRATION		
	1	**WINCH NUMBER**	**1**
>	**2**	**TENSION CALIBRATION**	
	3	**PAYOUT AND SPEED CAL.**	
	4	**WRAP ANGLE**	**120 DEG**
	5	**SHUNT CALIBRATION**	**OFF**
	6	**TENSION SAMPLE RATE**	**20 HZ**
	7	**TENSION SMOOTHING**	**OFF**
	8	**TENSION TARE**	**OFF**

Make sure the current winch is selected in item 1. We will assume that we are using winch 1. Scroll up/down to item 2 **TENSION CALIBRATION** press **ENT** to display the tension calibration menu, **2.2 TENSION CAL. WINCH 1**, shown below. The calibration type will be displayed on item 1. Select Item 1 to display one of the three Tension calibration sub-menus: (1) scale and offset, (2) two point live calibration, or (3) look-up tables. These three methods are explained in Sections 5.4.1-3.

5.4.1 Scale and offset

The Scale and Offset values displayed in Menu 2.2 are the actual numbers used in the calculation of displayed Tension (unless a lookup table is being used).

The menu for setting scale and offset values, **2.2 TENSION CAL. WINCH 1**, is shown below. Select Item 2 and enter the full-scale Tension sensor output in the specified units. The full-scale value corresponds to the load at 20 mA on a 4-20 mA device, or to the load at 5.00 V, on a 0-5 Vdc device. Then select Item 3 and enter the Tension offset. The offset corresponds to the load at 4 mA on a 4-20 mA device, or to the load at 0.0 V, on a 0-5 Vdc device.

	2.2 TENSION CAL WINCH 1		
	1	**CALIBRATION MODE**	**SCL/OFS**
>	**2**	**FULL SCALE**	**20000 LBS**
	3	**OFFSET**	**50 LBS**

Once the calibration values have been entered, either press **RUN** to save the values and return to the run screen, or to discard the changes, press **ESC**.

5.4.2 Two point live calibration

The two point live calibration method allows the Tension input to be calibrated using actual weights or measured line Tensions in the field. The two-point live calibration automatically calculates the Scale and Offset values described in section 5.4.1, based on the applied weights. When you perform 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.

The menu for using the two point live calibration functions, **2.2 TENSION CAL. WINCH 1**, is shown below. Two known Tension loads are required to perform this calibration. Ideally these loads are near each end of the normal working load range, but not at either full-load or zero-load.

	2.2 TENSION CAL. WINCH 1		
>	1	CALIBRATION MODE	TWO-PT
	2	DISPLAY LOW	50 TONS
	3	DISPLAY HIGH	9500 TONS
	4	LIVE/EDIT	LIVE
	5	INPUT LOW	0.126 V
	6	INPUT HIGH	4.873 V

Perform this calibration as follows:

1) Apply known or measured **LOW** Tension to the cable.
2) Move to Item 2 using the **DOWN** key and press **ENT**. Edit the **DISPLAY LOW** value to correspond to the applied load. Press **ENT** when complete.
3) Set Item 4 to **LIVE**. This will make the LCI-90i read live data from the tension input sensor for the calibration. The alternative, **EDIT**, allows the user to manually set the **INPUT LOW** and **INPUT HIGH** values.
4) Move to Item 5 using the **DOWN** key and press **ENT**. The number shown will be a real-time measurement of the input signal. It should be near the low end of its full range for low loading conditions. The message above the keypad now reads: **PRESS ENT TO GRAB ENT ESC**. Once the reading has stabilized, press **ENT** to grab the value, or **ESC** to cancel the reading.
5) Repeat, applying a known or measured **HIGH** Tension to the cable.
6) Move to Item 3 using the **UP** key and press **ENT**. Edit the **DISPLAY HIGH** number to correspond to the applied load. Press **ENT** when complete.
7) Move to Item 6 using the **DOWN** key and press **ENT**. The number shown will be a real-time measurement of the input signal. It should be near the high end of its full range for high loading conditions. The message above the keypad now reads: **PRESS ENT TO GRAB ENT ESC**. Once the reading has stabilized, press **ENT** to grab the value, or **ESC** to cancel the reading.
8) While not recommended, there may be occasions where it would be helpful to numerically edit the **INPUT LOW** and **INPUT HIGH** fields. This is possible by moving to Item 4, and changing it from **LIVE** to **EDIT**. This will allow the **INPUT HIGH** and **LOW** values to be edited like any other menu item.
9) Press the **RUN** key to apply the two-point linear fit to the scale and offset values and save the results.

5.4.3 Look-up tables

The menu for selecting a look-up table calibration function is shown below with some sample user-defined lookup tables. By selecting Item 2, the Tension input signal can be calibrated using one of up to sixteen look-up tables (labeled A through P). These tables are intended to be installed by factory trained personnel, based on calibrations made on a test stand.

	2.3 TENSION CAL. WINCH 1	
1	CALIB MODE	LOOKUP
> 2	USE TABLE ID.	C
A	Traction Winch No. 2	
B	(no table)	
C	Traction Winch No. 4	
D	(no table)	
E	(no table)	
8	EDIT LOOKUP TABLE	

5.5 Payout and Speed Calibration

To set the Payout and Speed calibration, press **MENU** and select the **2.0 CALIBRATION** menu shown below.

	2.0 CALIBRATION		
1	WINCH NUMBER	1	
> 2	TENSION CALIBRATION		
3	PAYOUT AND SPEED CAL.		
4	WRAP ANGLE	120	DEG
5	SHUNT CALIBRATION	OFF	
6	TENSION SAMPLE RATE	20	HZ
7	TENSION SMOOTHING	OFF	
8	TENSION TARE	OFF	

Make sure the current winch is selected in item 1. We will assume that we are using winch 1. Scroll up/down to item 3 **PAYOUT AND SPEED CAL.**, then press **ENT** to display the payout and speed calibration menu, **2.3 PAYOUT CAL. WINCH 1**, shown below.

	2.3 PAYOUT CAL. WINCH 1		
>	1	PAYOUT SCALE	1.000 P/M
	2	PAYOUT PRESET	100 M
	3	COUNTER MODE	QUAD 1X
	4	LOAD RESISITOR	PULL-UP
	5	SPEED FILTER LEVEL	4
	6	SPEED RESPONSE TIME	20 S
	7	STRETCH COEFICIENT	1.000

In this example the units shown are in meters. To change to other units see Section 5.6.2. Items 1 and 2 allow the operator to set the scale factor (pulses per meter) and the preset value. These two settings are explained in Section 5.5.1-2.

5.5.1 Payout Scale

The payout scale factor represents the number of pulses per unit length. In a typical application the line will pay out over a sheave with a known circumference and number of targets (= pulses) per revolution. The payout scale factor is calculated as follows:

Payout Scale = Number of Targets / {(Sheave Root Diameter + Wire Diameter) * π}

The LCI-90i expects to receive pulses generated by a pair of offset sensors that see the targets in sequence (or quadruture pulses generated by a shaft encoder). The quadrature signal allows the count to increment or decrement depending on the direction of motion. The quadrature outputs of the two sensors (called A and B) look like two superimposed square waves that are 90 degrees out-of-phase (i.e. partially overlapped). A single pulse in terms of the scale factor consists of the two rising and the two falling edges of waves A and B. For encoder signals, the LCI-90i also counts the two rising and two falling edges as one pulse in QUAD 1X mode. In QUAD 4X mode this waveform is treated as 4 pulses (one pulse for each edge that is received).

It has been found that the best way to calibrate a payout and speed system is to complete an empirical live calibration similar to the tension two-point calibration. Put the display in DIAG mode. Note that the raw pulses are displayed. Zero the payout by pressing the reset button twice. The pulse count should be zero on the display. Mark the line, spool a known length of cable through the sheave. Note the number of pulses indicated on the display. Make the following calculation.

Payout Scale = Total Pulses / Length of Line Pulled Through Sheave

Enter the new data in item 1 of the calibration menu (**PAYOUT SCALE**). Check by pulling the wire back to the original mark: the same pulses and footage (negative) should be indicated on the screen.

If the display is reading payout in the opposite polarity, positive on the drum, then switch the A and B signal wires on the rear of the display.

5.5.2 Payout Preset

Selecting Item 2, Payout Preset value, allows the operator to manually enter a Payout value. This value is entered as a length in the current Payout units, but is saved by the LCI-90i as a scaled number of counts. If the scale value is subsequently changed, the saved value is adjusted to preserve the specified Preset.

5.5.3 Counter Mode

Selecting Item 3, Counter Mode setting, determines how the internal payout circuitry treats the incoming quadrature waveforms.

<table>
<tr><th>Setting</th><th>Waveform Treatment</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 TB1 Channel A) while the second input sets the counting direction (connects to TB1 Channel B). 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>Rising edge</td><td>High (typ. > 3V)</td><td>Decrement</td></tr>
<tr><td>Rising edge</td><td>Low (typ. < 2V)</td><td>Increment</td></tr>
</table>
</td></tr>
</table>

For most application the QUAD 1X mode will be adequate. In 4X mode, the LCI-90i 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 to the “on time” of the pulses then 4X mode will result in higher noise in the speed calculations).

5.5.4 Load Resistor

Selecting Item 3, **COUNTER MODE**, allows the operator to select the proper load resistor to interface to the external rotational sensors. 1000 ohm resistors are added to the input circuitry of the rotational sensors, on each A and B lines. On board

switches set them in the following configurations for any of the four pairs of lines: pull up to 12VDC, pull down to DC COM, and removed from the circuitry (none). The previous LCI-90 accomplished this by external DIP switches. The switches have been removed on the LCI-90i and the switching is handled internally. The following table identifies the load resistor settings.

Setting	External 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

5.5.5 Speed Filter Level

The **FILTER LEVEL** item specifies the intensity of the speed filter algorithm used by the LCI-90i. Select Item 5 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The selections are 1-5.

The value can vary from 1 to 5 and is a qualitative indication of the amount of smoothing applied to the incoming pulse stream when calculating the current speed. A value of five indicates maximum smoothing (least noise). See the following section regarding response time for more information as these two settings interplay with each other.

5.5.6 Speed Response Time

The **SPEED RESPONSE TIME** item specifies the settling time of the speed filter in response to step changes. It is the total amount of time that will have to elapse after a step change in speed before the change has fully passed through the speed filter, thus, it indicates the length of time that will elapse before the LCI-90i will provide an accurate speed reading. Select Item 6 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and →keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes.

The response value can be set between two seconds and twenty seconds.

It must be noted that the **FILTER LEVEL** and **RESPONSE TIME** 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 the frequency at which the speed value is recalculated and displayed.

Filter Level	Response	Output Noise	Update Rate
Low (eg. 1)	Low (eg. 2s)	Very high	Middle
Low (eg. 1)	High (eg. 20s)	Middle	Very slow
High (eg. 5)	Low (eg. 2s)	Middle	Very fast
High (eg. 5)	High (eg. 20s)	Very low	Middle
Middle (eg. 3)	Middle (eg. 6s)	Low	Fast

Figure 5.1 - Effect of Speed Filter Variables

In order to appropriately set these parameters, take into mind the frequencies of interest. If the speed is not expected to change quickly then a high response time (Eg. 20s) can be used, otherwise, if a faster response is required the variable must be set lower. Then, a tradeoff between calculation update rate and output noise should be evaluated in order to set the Filter Level. Some experimentation with different values will produce a satisfactory result.

5.5.7 Stretch Coefficient

At this time this is not implemented.

5.6 Wrap Angle (single-input configurations)

To set the correct wrap angle for a single-axis load-pin, press **MENU** and select the **2 CALIBRATION** item to display the main **2.0 CALIBRATION** menu shown below.

	2.0 CALIBRATION		
	1	**WINCH NUMBER**	**1**
	2	**TENSION CALIBRATION**	
	3	**PAYOUT AND SPEED CAL.**	
>	**4**	**WRAP ANGLE**	**120 DEG**
	5	**SHUNT CALIBRATION**	**OFF**
	6	**TENSION SAMPLE RATE**	**20 HZ**
	7	**TENSION SMOOTHING**	**OFF**
	8	**TENSION TARE**	**OFF**

Select Item 4 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. Note

that Sensor Angle replaces Wrap Angle when the input configuration is set to **DUAL-AXIS** mode.

5.6.1 Wrap angle adjustments

The LCI-90i has the ability to correct for variations in sheave geometry by allowing the user to specify the wrap angle. (See Section 11 for a definition of this angle, and a table showing the effect it has on the measured tension.) The wrap angle correction only applies to fixed sheave angle geometries; if this angle varies (for example, a sheave mounted on a movable boom, or a load that swings through an arc), a dual-axis load pin (Section 5.8), or a direct line-tension sensor is required to get accurate results.

In practical situations the wrong wrap angle can lead to a 40-50% error in the readout unless the LCI-90i is calibrated using the two-point live method described in Section 5.4.2. The two-point method automatically adjusts the scale and offset values to compensate for fixed wrap angles. For maximum accuracy with live calibrations (or for tension measurements that do not involve wrap angle), this item should be set to 120º (the factory default value).

5.7 Sensor Angle (two-axis input configurations)

To set the sensor angle for a two-axis load-pin application, press **MENU** and select the **2.0 CALIBRATION** to display the main **2.0 CALIBRATION** menu shown below.

	2.0	**CALIBRATION**		
	1	**WINCH NUMBER**		**1**
	2	**TENSION CALIBRATION**		
	3	**PAYOUT AND SPEED CAL.**		
>	**4**	**SENSOR ANGLE**	**120**	**DEG**
	5	**SHUNT CALIBRATION**		**OFF**
	6	**TENSION SAMPLE RATE**	**20**	**HZ**
	7	**TENSION SMOOTHING**		**OFF**
	8	**TENSION TARE**		**OFF**

Select Item 4 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. Note that Sensor Angle replaces Wrap Angle when the input configuration is set to **DUAL-AXIS** mode.

5.7.1 Sensor Angle Correction for Dual-Axis Load Pins

Dual-axis load pins are used in applications where the wrap angle varies. A dual axis load pin is constructed with two independent measurement bridges oriented 90° from each other, one labeled 'x', the other 'y'. The LCI-90i combines these signals to calculate the actual line tension, which is independent of the wrap angle. However, the calculation is only correct if the 'y' axis of the sensor is aligned exactly parallel to the winch line. (See Section 4.1.2 for sensor hookup, and Sections 12-13 for geometrical definitions.) Even small deviations from this orientation can lead to substantial errors, which can be corrected by specifying a non-zero Sensor Angle.

An angle of '0' corresponds to the 'ideal geometry' shown in Section 12. Positive angles represent a rotation of the x-axis toward the load, while negative angles represent a rotation of the x-axis away from the load. (The drawing in Section 13 shows a positive sensor angle.) While two-axis load pins are usually mounted quite accurately, the Sensor Angle adjustment allows the LCI-90i to work properly in non-standard installations. This adjustment can also be used to compensate for misaligned single-axis load pins; contact the factory for additional information.

5.8 Shunt Calibration

To perform a shunt calibration, press **MENU** and select Item 2 to display the main **2.0 CALIBRATION** menu shown below.

2.0	**CALIBRATION**			
1	**WINCH NUMBER**		**1**	
2	**TENSION CALIBRATION**			
3	**PAYOUT AND SPEED CAL.**			
4	**WRAP ANGLE**	**120**	**DEG**	
> **5**	**SHUNT CALIBRATION**		**OFF**	
6	**TENSION SAMPLE RATE**	**20**	**HZ**	
7	**TENSION SMOOTHING**		**OFF**	
8	**TENSION TARE**		**OFF**	

Select Item 5 and press **ENT** to activate the edit keys. Press either **INCR** or **DECR** to toggle between **OFF**, **RELAY1, RELAY2**, **RELAY3**, and **RELAY4**. Press **ENT** to accept the selection. At this time the contacts on the selected relay will either be closed. To remove the shunt calibration, set the item back to the off state.

5.8.1 Shunt Calibration

The Shunt Cal function requires a load pin or cell with an internal relay that, when energized, connects a precision resistor in parallel with one leg of the bridge. This

perturbation simulates a known change in tension, which can be used to verify the calibration of the unit. Setting Shunt Cal to one of the on states closes the contacts of the selected Relay in the LCI-90i. A 24VDC relay in the load pin is appropriate.

5.9 Tension Sample Rate

To modify the tension sample rate, press **MENU** and select item 2 to display the main **2.0 CALIBRATION** menu shown below.

2.0 CALIBRATION			
	1	**WINCH NUMBER**	**1**
	2	**TENSION CALIBRATION**	
	3	**PAYOUT AND SPEED CAL.**	
	4	**WRAP ANGLE**	**120 DEG**
	5	**SHUNT CALIBRATION**	**OFF**
>	**6**	**TENSION SAMPLE RATE**	**20 HZ**
	7	**TENSION SMOOTHING**	**OFF**
	8	**TENSION TARE**	**OFF**

Select Item 6 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes.

5.9.1 Tension Sample Rate

The Tension Sample Rate function defines how fast the display can run (evaluate the sensor signals, convert to engineering units and evaluate alarms). The menu setting allows the operator to select a sample rate of 1-200 Hz (or 200 samples per second). This will apply to any winch that has been enabled through the menu structure. However it is not guaranteed that when all four winches are active the LCI-90i can log data to the CF disk and broadcast the data to remote devices at the maximum setting (200Hz). The LCI-90i will simply attempt to attain a sample rate as fast as it can up to the specified rate. The table below provides a guideline of maximum sample rates.

Active Winches	Sensor Evaluation, Alarm, Display only.	Add CF Disk logging	Add Serial Out	Add Ethernet Out
1	200 Hz	Hz	Hz	Hz
2	200 Hz	Hz	Hz	Hz
3	200 Hz	Hz	Hz	Hz
4	200 Hz	Hz	Hz	Hz

The display update rate can be set independently. See section 5.12.8. The display update rate cannot be higher than the Tension Sample Rate.

5.10 Tension Smoothing

To modify the tension smoothing filter, press **MENU** and select item 2, then press **ENT** to accept the selection. Now you will be in be in menu **2.0 CALIBRATION**, shown below.

	2.0 CALIBRATION		
	1	WINCH NUMBER	1
	2	TENSION CALIBRATION	
	3	PAYOUT AND SPEED CAL.	
	4	WRAP ANGLE	120 DEG
	5	SHUNT CALIBRATION	OFF
	6	TENSION SAMPLE RATE	20 HZ
>	7	TENSION SMOOTHING	OFF
	8	TENSION TARE	OFF

Select Item 7 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The selections are OFF and 1-5.

5.10.1 Tension Smoothing

The tension smoothing filter level specifies the amount of noise filtering applied to tension measurements. The default state for this is **OFF**, where no filtering is applied, and this is recommended for situations where accurate reporting of tension is required. If this value is set to one of the other options, then that number of tension samples will be averaged together in a moving average filter. Thus, a filter level of 5 results in maximum smoothing and noise reduction. This filter will remove noise without reducing the tension sample rate. The downside is that information is lost in the smoothing, such as short tension spikes.

5.11 Tension Tare

To perform a tension tare, press **MENU** and select **2 CALIBRATION** then press **ENT** to accept the selection. Now you will be in be in menu **2.0 CALIBRATION**, shown below.

2.0	**CALIBRATION**		
1	**WINCH NUMBER**		**1**
2	**TENSION CALIBRATION**		
3	**PAYOUT AND SPEED CAL.**		
4	**WRAP ANGLE**	**120**	**DEG**
5	**SHUNT CALIBRATION**		**OFF**
6	**TENSION SAMPLE RATE**	**20**	**HZ**
7	**TENSION SMOOTHING**		**OFF**
> **8**	**TENSION TARE**		**OFF**

Select Item 8 and press **ENT** to activate the edit keys. Press either **INCR** or **DECR** to toggle between **ON** and **OFF**. Press **ENT** to accept the selection. When Tension Tare is turned **ON**, the tension input **at that moment** will be saved and subtracted from all future displayed values. This will apply to any and all winches that are enabled. To warn the user that the displayed value is not the real tension (which could be much higher!), an asterisk (*) is displayed after the TENSION label on the RUN screen. When Tension Tare is turned **OFF** the tare value (and the asterisk) are removed, and the actual tension is again displayed.

5.11.1 Tension Tare

The tare function is a way to zero a small displayed tension value. Care should be taken when using the tare function as the displayed value does not reflect actual line tension but rather line tension minus the tare value. Any alarms that are set to monitor the tension input will be triggered by the actual line tension value, not the displayed value. The tare function can be deactivated at any time, returning the unit to its normal tension display.

5.12 Display Configuration

The LCI-90i allows the user to change the display position of the three line variables on the **RUN** Screen, change the units of measure, and the number of decimal place, implement a screen saver to prolong the life of the display, change display contrast settings, change the display refresh rate, change line graph settings and the change the number of winches displayed. These features are accessed via the **3.0 DISPLAY CONFIGURATION** menu. Each of the three line variables, Tension, Speed and Payout, has its own sub-menu to customize the readout. These are described in Sections 5.12.1-4 below.

	3.0 DISPLAY CONFIGURATION		
>	1	TENSION DISPLAY	
	2	SPEED DISPLAY	
	3	PAYOUT DISPLAY	
	4	SCREEN SAVER	ON
	5	CONTRAST	10
	6	LINE GRAPH SETUP	
	7	DISPLAY REFRESH RATE	20 HZ
	8	VIEW	WINCH 1

5.12.1 Locating variables on screen

The LCI-90i screen has three locations for displaying line variables (when using the LCI-90i in single winch mode, for details of multi-winch display modes see Section 5.12.9). The **TOP** location can display up to 6 digits, and is usually used for the most important parameter since it includes a **bar graph** beneath the numeric display. The **RIGHT** location can display up to 5 digits, and the **LEFT** location can display up to 4 digits.

If the number is too large for the assigned space, the rightmost digits are clipped to make it fit. In this case, the LCI-90i will display "**OR**" over the top of the rightmost digit to indicate the display is over the digit limit for that field. If this happens, consider switching that variable to a different display location or picking a different set of units (TONS or KIPS instead of LBS).

Menus **3.1 TENSION DISPLAY SETUP, 3.2 SPEED DISPLAY SETUP** and **3.3 PAYOUT DISPLAY SETUP** are listed below and referenced in the following sections.

To fully define the screen layout, Item 1, **LOCATION** must be set for each variable. The available choices are **TOP**, **LEFT**, **RIGHT**, and **NONE**. If **NONE** is selected, that variable will not be displayed on the RUN screen

	3.1 TENSION DISPLAY SETUP		
>	1	LOCATION	TOP
	2	UNITS	LBS
	3	DECIMAL PLCS	1
	4	FULL SCALE	5000 LBS

	3.2 SPEED DISPLAY SETUP		
>	1	LOCATION	LEFT
	2	UNITS	FPM
	3	DECIMAL PLCS	2
	4	FULL SCALE	200 FPM

	3.3 PAYOUT DISPLAY SETUP		
>	1	LOCATION	RIGHT
	2	UNITS	FT
	3	DECIMAL PLCS	0
	4	FULL SCALE	3000 FT

5.12.2 Setting display units

Each displayed variable can be individually set to use one of several common units. The LCI-90i was designed to be **units-aware**; meaning that any of the display units can be switched during operation without requiring re-calibration; the display's internal calculations automatically accommodate the changes (I.e. the LCI-90i will do the conversions for you). If the RUN screen shows **3000.0 LBS** on the Tension display, and the Tension units are changed to **tons**, the screen will immediately display **1.5 TONS** with no other changes necessary.

The available units, and their abbreviations, are listed in the table below. Item 2 in menus **3.1, 3.2,** and **3.3** (listed above in Section 5.10.1) determines the units used for each line variable. To change the units, scroll through the choices with the **INCR** or → keys, and push the **ENT** key when the desired units are displayed.

Variable	Units – Abbreviation
Tension	Pounds – LBS
	Tons – TONS
	Tonnes - MTNS
	Kilopounds – KIPS
	Kilograms – KGMS
Speed	Feet per Minute – FPM
	Meters per Minute – MPM
	Feet per Second – FPS
	Meters per Second – MPS
	Fathoms per Minute – FHPM
	Fathoms per Second – FHPS
Payout	Feet – FT
	Meters – M
	Fathoms - FTH

Figure 5.5 – LCI-90i Display Units

5.12.3 Setting decimal places

Item 3 in menus **3.1, 3.2,** and **3.3** (listed above in Section 5.10.1) sets the maximum number of digits displayed to the right of the decimal point for each line variable. To select decimal places scroll through the choices with the **INCR** or → keys, and push **ENT** when the desired value is displayed.

Each display variable can be set to have as many as 3 decimal places. If the value has too many digits for the assigned screen location, then trailing decimals are automatically dropped to make the number fit the available space. If the number is still too wide for the assigned space, then the rightmost digits are clipped to make it fit. In this case, the LCI-90i displays "**OR**" on top of the rightmost digit to indicate that the display is over the digit limit for that field. If this happens, consider switching that variable to a different display location or use a different set of units.

5.12.4 Setting Bar Graph Range

The top display of the LCI-90i includes a bar graph for visual indication of the current operating condition. The full scale of the bar graph can be set by the user via item 4 in menus **3.1, 3.2,** and **3.3** (listed above in Section 5.10.1). This full scale value is only used for the bar graph upper limit (note that this full scale is also applied to the line graph system).

The Tension input has a well-defined full scale limit based on the calibration and input range of the Tension input channels. This full scale Tension is calculated by the LCI-90i after every calibration operation, automatically updating menu 3.1 Item 4. This ensures that the full scale of the Tension bar graph is the true full scale of the sensor as calibrated. After calibration, the full scale value can be adjusted by the user to change the upper limit on the graph if desired.

Payout and Speed have no defined upper limit, so their full scale value must be entered manually into menus 3.2 and 3.3, Item 4.

5.12.5 Screen Saver

The LCI-90i is equipped with a screen saver to prolong the life of the display. The screen will go blank after 30 minutes if the unit has not detected a change in Payout or an operator key press. To re-energize the display, simply push any front panel button (preferably the **MENU** or **DIAG** buttons on the left). Note that the LCI-90R blind remote has no screen saver, since it has no front panel keypad.

To modify the contrast setting through the menu structure press **MENU** and select item 3, **3.0 DISPLAY CONFIGURATION,** press **ENT** to accept the selection. Now you will be in be in menu **3.0 DISPLAY CONFIGURATION** menu, shown below.

	3.0	**DISPLAY CONFIGURATION**	
	1	**TENSION DISPLAY**	
	2	**SPEED DISPLAY**	
	3	**PAYOUT DISPLAY**	
>	**4**	**SCREEN SAVER**	**ON**
	5	**CONTRAST**	**10**
	6	**LINE GRAPH SETUP**	
	7	**DISPLAY REFRESH RATE**	**20 HZ**
	8	**VIEW**	**WINCH 1**

Select Item 4 and press **ENT** to activate the edit keys. Then, use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The choices are OFF and ON.

5.12.6 Contrast

The LCI-90i is equipped with the ability to change the contrast of the display, either by modifying a menu selection or by adding an external potentiometer. To modify the contrast setting through the menu structure navigate the menus to the **3.0 DISPLAY CONFIGURATION** menu. Do this by pressing **MENU** and selecting item 3, then press **ENT** to accept the selection. Now you will be in be in menu **3.0 DISPLAY CONFIGURATION**, shown below.

	3.0 DISPLAY CONFIGURATION		
	1	TENSION DISPLAY	
	2	SPEED DISPLAY	
	3	PAYOUT DISPLAY	
	4	SCREEN SAVER	ON
>	5	CONTRAST	10
	6	LINE GRAPH SETUP	
	7	DISPLAY REFRESH RATE	20 HZ
	8	VIEW	WINCH 1

Select Item 5 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The selections are 1-10. The dimmest setting is 1 and the brightest setting is 10.

Note that the contrast setting only applies to the RUN, DIAG and line graph screens. Whenever you enter a menu the contrast defaults to the brightest setting.

The contrast can also be set using an external 50K ohm dimming potentiometer. This potentiometer should be installed in close proximity to the unit. A 50K ohm potentiometer can be connected to the rear of the display on the terminal block labeled DIM, and referenced to ground. Switching between the two types of dimming techniques requires jumpers to be changed on the processor board and so is a factory setting. Contact the factory for assistance if you require this to be modified.

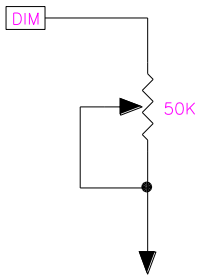


Figure 5.6 – External Dimming Potentiometer Connection

5.12.7 Line Graph Setup

The LCI-90i is equipped with the ability to provide operators with a time series view of the tension data (or the data Speed and Payout as well). This will provide the operators a trending view of the tension over time. To access the line graph settings through the menu structure press **MENU** and select item 3, **DISPLAY CONFIGURATION,** press **ENT** to accept the selection. Now you will be in be in menu **3.0 DISPLAY CONFIGURATION**, shown below.

	3.0 DISPLAY CONFIGURATION	
1	TENSION DISPLAY	
2	SPEED DISPLAY	
3	PAYOUT DISPLAY	
4	SCREEN SAVER	ON
5	CONTRAST	10
> 6	LINE GRAPH SETUP	
7	DISPLAY REFRESH RATE	20 HZ
8	VIEW	WINCH 1

Scroll up or down to item 6 and press **ENT.** Menu **3.6 LINE GRAPH SETUP** will appear, as shown below.

	3.6 LINE GRAPH SETUP	
1	WINCH NUMBER	1
2	VARIABLE	TENSION
3	TIMEBASE (SECONDS)	10
4	BEGIN GRAPHING	

5.12.7.1 Winch Number

The line graph can display any line parameter data from any winch on the time series plot. This menu selection determines which winch's data is displayed. Select Item 1 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The selections are 1-4, referencing the four winches that can be configured in an LCI-90i unit.

5.12.7.2 Variable

The line graph can display any line parameter data on the time series plot. This menu selection determines which line parameter data is displayed on the time series. Select Item 2 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The selections are Tension, Speed or Payout.

5.12.7.3 Time Base

The line graph's time base can be changed to adjust the total length of that can be displayed on a single page of the line graph. Select Item 3 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The

upper limit to the selection is 15,300 seconds (4.25 hours). When the time series reaches the right most point, the screen scrolls left approximately 1/5th of the time base to make new space on the right for subsequent data.

5.12.7.4 Begin Graphing

The line graph screen can be started by selecting Item 3 and press **ENT** to activate the line graph. Additionally, a button on the RUN screen, labeled **GRPH**, is used as a shortcut to begin graphing immediately without having to work through the menu system.

5.12.8 Display Refresh Rate

The Display Update Rate defines how fast the display will display the line parameters data. It does not affect how fast the processor is running and sampling/logging the data; this is only a visual artifact. The menu setting allows the operator to select a display refresh rate of between 1 Hz and 200 Hz (or 200 updates per second). Select Item 7 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes.

5.12.9 View

The LCI-90i can interface to up to four force and rotational sensors at one time. Through this menu selection the operator can pick the type of display that is required. One, two, three or four sets of line parameters can be chosen to be displayed at a time. If you are in multiple winch mode but only want to view a single winch (the winch that is currently being used) then select the active winch in this menu selection and it will be the only winch displayed on the RUN screen. If, on the other hand, you have multiple winches defined and wish to view them all simultaneously (as in a mooring operation) then this should be set to **ALL WINCHES**. Select Item 8 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes. The selections are **ALL WINCHES, WINCH 1, WINCH 2, WINCH 3** or **WINCH 4**.

	3.0 DISPLAY CONFIGURATION		
	1	**TENSION DISPLAY**	
	2	**SPEED DISPLAY**	
	3	**PAYOUT DISPLAY**	
	4	**SCREEN SAVER**	**ON**
	5	**CONTRAST**	**10**
	6	**LINE GRAPH SETUP**	
	7	**DISPLAY REFRESH RATE**	**20 HZ**
>	**8**	**VIEW**	**WINCH 1**

Examples of the four available RUN screen views follow.

Figure 5.7 – LCI-90i Dual Winch Mode

Figure 5.8 – LCI-90i Triple Winch Mode

Figure 5.9 – LCI-90i Four Winch Mode

6.0 Hardware Configuration

The LCI-90i will work with a wide variety of input sensors, output alarms and data systems. The **4.0 SYSTEM CONFIGURATION** menu, shown below, allows the LCI-90i to be customized for a particular installation. Once these settings have been made, this menu also offers a security feature that locks out unauthorized changes. Should it happen, however, that unwanted changes to the configuration are made, it is possible to return to the "Factory Setup" configuration, which can be customized for a given installation. The functions of each item in this menu are described in Sections 6.1-6.6.

	4.0 SYSTEM CONFIGURATION	
>	1	SECURITY OFF 0
	2	FACTORY SETUP
	3	DIGITAL INPUTS
	4	WINCH SETUP
	5	ANALOG INPUTS
	6	ANALOG OUTPUTS
	7	ALARM SETTINGS
	8	SERIAL COMMUNICATION

6.1 Security

Security is either **OFF (0)** or **ON**. When Security is **ON** most of the menu functions are disabled. The user can access the DIAG screen(s), line graph screen and can silence alarms, but all menu items are locked out except for the security option.

To change the Security setting, press **ENT**. This will highlight the default value (0=off), and allow the operator to enter a security code. This number can be any value between 1 and 255, which will become the security unlock code, so it should be kept in a safe place. Once a number is entered (and **RUN** is pressed to save the change), the security lockout feature is enabled, and can only be disabled by re-entering the **same number**.

6.2 Factory Setup

Once a LCI-90i has been fully configured and calibrated, the entire setup can be saved to non-volatile memory, batter backed. To modify or recall the setups, Select Item 2 and press **ENT** to enter the selection, menu **4.2 FACTORY SETUP,** shown below.

	4.2 FACTORY SETUP		
>	**1**	**SAVE SETUP**	**1**
	2	**LOAD SETUP**	**1**
	3	**CURRENT SETUP: 1**	

The operator can save up to eight user defined setups with a ninth reserved for the factory default settings. This is s great way of saving multiple setups for different winches if the display is used in a rental fleet. Also is has proven valuable for winches with multiples sheaves that require different calibrations for either rotation or force. This operation should also be used in cases where the LCI-90 does not seem to be working properly and it is desired to return to a known configuration in order to perform long-distance troubleshooting.

6.2.1 Save Setup

Up to eight different setups can be saved to non-volatile memory. By default, the display will use setup number 1. Select Item 1 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. The selections are 1-8. The operator will be prompted with:

ARE YOU SURE YES NO

Press the key under the desired function. The current settings will then be saved to the specified setup address.

6.2.2 Load Setup

Up to eight different sets of settings can be reloaded into current memory from non-volatile memory, a factory default set of 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 1-8, and FACT. The operator will be prompted with:

ARE YOU SURE YES NO

Press the key under the desired function. The specified set of settings will then be loaded into the display's memory. Additionally, if the chosen setup was anything other than FACT (factory default) then the default setup for the LCI-90i will be switched to the setup that has just been loaded. Thus, from this point forwards, the LCI will always load that setup when it powers up.

When the FACT setup is chosen, the display will load the factory default settings. The current default setup will remain as it was previously, so in order for the factory default settings to become permanent it is necessary to re-enter the menu and save the new settings to one of the eight settings spaces.

6.2.3 Current Setup

The item indicatesd the current default setup that is loaded in active memory. This item is read only.

6.3 Digital Input Configuration

The LCI-90i has the ability to accept DC digital inputs from external sources to accomplish a variety of tasks. To define the digital input functionality, Select Item 3 and press **ENT** to enter menu **4.3 DIGITAL INPUTS,** as shown below.

		4.3 DIGITAL INPUTS	
>	**1**	**DIGITAL INPUT NO. 1**	**RRSET**
	2	**DIGITAL INPUT NO. 2**	**WINCH 1**
	3	**DIGITAL INPUT NO. 3**	**WINCH 2**
	4	**DIGITAL INPUT NO. 4**	**VIEWALL**

Select Item 1-4 and press **ENT** to activate the edit keys. Use the **INCR**, **DECR** and → keys to change the value. The selections are NONE, RRSET, WINCH 1, WINCH 2, WINCH 3, WINCH 4 and VIEWALL. They are defined below.

Setting	Display Effect
NONE	No function, input is disabled.
RRSET	Remote Reset: a Logic High Signal on the Input Pin Will Reset the Current Payout to Zero.
WINCH 1	Turn Winch 1 Display ON, Rest OFF
WINCH 2	Turn Winch 2 Display ON, Rest OFF
WINCH 3	Turn Winch 3 Display ON, Rest OFF
WINCH 4	Turn Winch 4 Display ON, Rest OFF
VIEWALL	Turn All Winches ON

The LCI-90i is equipped with four CMOS level digital inputs on TB5. These inputs are monitored by the unit and can be used to remotely trigger events in the LCI-90i. Items 1-4 in menu shown above are used to specify the functionality of the four digital inputs. The following table lists the input functions available in the factory default LCI-90i unit. If you require an input function not listed here, please contact the manufacturer to discuss your needs.

The input pins are tolerant of voltages between 0 VDC and 60 VDC. The switching point between logic low and logic high levels is 2.5V (CMOS logic).

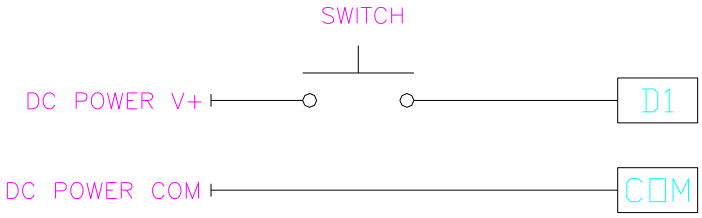


Figure 6.1 – Wiring Digital Input 1 External Power

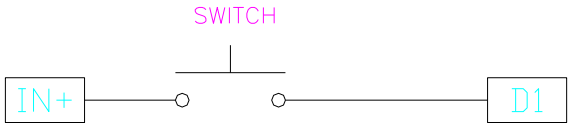


Figure 6.2 – Wiring Digital Input 1 Internal Power

6.4 Winch Setup

The LCi-90i can interface to rotation and force sensors from up to four winches. The Winch Setup menu defines the sensor channels that apply to each winch. In addition to setting up the winches, you will be required to set up the analog inputs that will be used by the winches, as detailed in section 6.5 of this manual.

The Winch Setup menu is accessed from the System Configuration menu; select Item 4 and press **ENT** to enter the selection, menu **4.4 WINCH SETUP,** as shown below.

	4.4 WINCH SETUP	
>	**1**	**WINCH 1**
	2	**WINCH 2**
	3	**WINCH 3**
	4	**WINCH 4**
	5	**PROCESS WINCHES ALL**

The last item in this menu, **PROCESS WINCHES**, sets the LCI-90i's operating mode. The two choices are:

ALL This operating mode is for systems where all winches are to be operated simultaneously. While in this mode, all winches that are configured in the LCI-90i will be active at all times (I.e. the LCI-90i will monitor tension, speed and payout).

SINGLE This operating mode is for systems where only one winch will be used at a time. The LCI-90i will only measure tension, speed and payout for the winch

which is currently being displayed on the unit's main screen. Thus, no data from other winches that have been configured will be produced, displayed, logged to disk or transmitted over a communications link. This mode is recommended for systems where high data throughput is critical.

The first four items of the menu link to submenus, one for each winch that can be configured in the LCI-90i. Select the winch that you wish to edit and press **ENT** to bring up the menu shown below.

	4.41 SETUP WINCH 1		
>	**1**	**TENSION MODE**	**SINGLE**
	2	**TENSION INPUT**	**AIN-5**
	3	**COUNTER INPUT**	**CNT-1**
	4	**WINCH NAME**	
	5	**WIRE SERIAL NUM**	

Note: some items in this menu may not appear when the tension mode is set to UNUSED.

The first item of the menu selects the type of tension input that will be used to calculate Tension for this winch. Options are:

Tension Mode	Function
UNUSED	The winch is not active
SINGLE	A single analog input value will be used to measure tension.
SUM	The measurements from up to four analog inputs will be summed together to calculate tension.
AVERAGE	The measurements from up to four analog inputs will be averaged to calculate tension.
DUAL-AXIS	A dual-axis load pin (with X and Y analog inputs to the LCI) is used to measure tension.

Figure 6.3 – Tension Mode Options

Following this, a number of rows are used to set the analog input channels that are used to calculate tension for the winch. These rows are labeled as **TENSION INPUT** (for SINGLE mode), **ANALOG IN** (for SUM and AVERAGE modes) and **X-AXIS** or **Y-AXIS** (for DUAL-AXIS mode). The number of rows available depends on the tension mode being used. Once the tension mode has been set, proceed to link the required analog inputs, as determined by the physical connections used by the sensors on the LCI-90i's terminal blocks. Set each item to the analog input channel required: **AIN-1** through **AIN-8**, or **NONE**.

For example: to average the values from two load cells which are connected to **AIN-5** and **AIN-6** respectively, set the tension mode to **SUM**, set **ANALOG IN 1** to **AIN-5**, and set **ANALOG IN 2** to **AIN-6**.

Following the analog input setup items, the **COUNTER INPUT** item is used to link a counter channel to the winch. This counter channel (**CNT-1** through **CNT-4**) will then be the source of payout and speed measurements for the winch. If no payout or speed sensor is required, set this item to **UNUSED**.

The last two items in the menu are text strings. Using the **WINCH NAME** item you can give the winch a name with up to ten alpha-numeric characters. This name will appear on the main screen of the display when the winch is being viewed, and can also be included in any datalogging or communications systems. In addition, a serial number string can be given to the winch to identify the wire that is currently installed on the winch.

6.5 Analog Input Configuration

The LCI-90i has eight analog inputs, each of which can be configured in a number of ways. The following table outlines the inputs, where they are situated on the LCI-90i's terminal blocks, and how they can be configured.

Once the analog inputs connected to the LCI-90i have been configured using this menu, the user can link the inputs to winches within the LCI, as described in Section 6.4 of this manual.

Input Channel	Terminal Block Location	Available Configurations
AIN-1	TB7 – CH 1	+/-20mV Strain gauge input +/-100mV Strain gauge input (0-5V and 4-20mA inputs – by request to manufacturer)
AIN-2	TB7 – CH 2	+/-20mV Strain gauge input +/-100mV Strain gauge input (0-5V and 4-20mA inputs – by request to manufacturer)
AIN-3	TB7 – CH 3	+/-20mV Strain gauge input +/-100mV Strain gauge input (0-5V and 4-20mA inputs – by request to manufacturer)
AIN-4	TB7 – CH 4	+/-20mV Strain gauge input +/-100mV Strain gauge input (0-5V and 4-20mA inputs – by request to manufacturer)
AIN-5	TB1 – 1+ and 1-	4-20mA input 0-5V input 0-10V input +/-5V input
AIN-6	TB1 – 2+ and 2-	4-20mA input 0-5V input 0-10V input +/-5V input
AIN-7	TB1 – 3+ and 3-	4-20mA input 0-5V input 0-10V input +/-5V input
AIN-8	TB1 – 4+ and 4-	4-20mA input 0-5V input 0-10V input +/-5V input

Figure 6.4 – Analog Input Configurations

The various analog input options are configured through menu **4.5 ANALOG INPUTS**, shown below. A description of each item in this menu is given below:

	4.5 ANALOG INPUTS		
>	**1**	**CHANNEL NO.**	**AIN-1**
	2	**INPUT RANGE**	**0 – 5 V**
	3	**INPUT CHECK**	**OFF**
	4	**LOWER LIMIT**	**0.050 V**
	5	**UPPER LIMIT**	**4.950 V**
	6	**STRAIN GAUGE EXC.**	

Item 1 Selects the channel number, AIN-1 to AIN-8. The channels correspond to specific terminal blocks on the back of the LCI-90 as shown in Figure 6.4 above.

Item 2 Selects the input range for the channel being configured. The choices are 4-20 mA, 0-5V, 0-10V, +/-5V, 20mV, 100mV and NONE.

Item 3 Selects whether input from this channel is monitored for out-of-range values or not. This is a unique feature of the LCI-90 – see Section 6.5.1 for details.

Item 4 Selects the lower limit for sensor input, below which an "input check" error will occur. See Section 6.5.1 for details.

Item 5 Selects the upper limit for sensor input, above which an "input check" error will occur. See Section 6.5.1 for details.

Item 6 Opens a menu where the strain gauge excitation voltage system can be configured. See Section 6.5.2 for details.

6.5.1 Sensor Input Check Alarm

Sensor input checking is a unique feature of the LCI-90, which is particularly important for multiple input configurations, but can be useful for single input operation as well. When input checking is turned **ON** (as shown in the sample menu above), input values less than the Lower Limit (item 4, shown as 0.050 V) or greater than the Upper Limit (item 5, shown as 4.950 V) will automatically switch from the normal **RUN** screen to the **DIAG** screen, with the offending channel(s) displayed in inverted color. At the same time Relay Output 4 will be turned on which can be connected to an external alarm if desired. (It can be turned off in the usual way by pressing the **ALRM** button.)

The input check is applied to the raw sensor data before any SUM, AVERAGE or similar calculation is undertaken by the LCI-90i. Thus, input checking allows faulty load cells in a multiple-cell configuration to be instantly identified – something that is not possible with summing boxes. This feature also provides an independent check for over-range conditions, even when an appropriate TENSION alarm has *not* been

set up. This double-level of monitoring, if properly configured, can provide enhanced operator safety.

6.5.2 Strain Gauge Excitation

Selecting item 6 in the ANALOG INPUTS menu will open the **4.51 STRAIN GAUGE SETUP** menu shown below. This menu is used to configure the supply voltage provided on TB7 (V+ and V-) for powering strain gauge circuits.

	4.51 STRAIN GAUGE SETUP		
>	1	OUTPUT RANGE	5 V
	2	EXCITATION SENSE	OFF

Item 1 of this menu, **OUTPUT RANGE** sets the strain gauge excitation outputs to be either 5V or 10V. Note: in 5V mode, the actual excitation voltages will be +2.5V and -2.5V with reference to system ground.

The second item, **EXCITATION SENSE**, is used to enable or disable the external sense lines (N+ and N-). Six-wire strain gauges require this setting to be **ON** to enable the sense lines.

6.6 Analog Output Channels

The analog output hardware is configured through the **4.6 ANALOG OUTPUTS** menu, shown below. The purpose of the analog output channels is to create a signal that mirrors one of the line variables over a user determined range. A description of each item in this menu is given below:

	4.6 ANALOG OUTPUTS		
>	1	CHANNEL NUMBER	1
	2	OUTPUT RANGE	0 – 5 V
	3	WINCH	WINCH 1
	4	VARIABLE	TENSION
	5	FULL SCALE	6000 LBS
	6	OFFSET	3000 LBS

Note: if items 2, 3 or 4 are set to NONE then some rows of this menu will be hidden from view.

Item 1Selects the channel number, 1-4, that the configuration applies to. These channels correspond to specific terminal blocks on the back of the LCI-90i as shown below:

Channel	Terminal Block
AOUT – 1	TB2 - V1, I1
AOUT – 2	TB2 – V2, I2
AOUT – 3	TB2 – V3, I3
AOUT – 4	TB2 – V4, I4

Figure 6.5 – Analog Output Locations and Menu Names

Item 2 Selects the analog output range for the channel in Item 1. The choices are 4-20 mA, 0-5 V, 0-10V and ±5V. When using any of the voltage ranges, use the voltage connections on the rear of the LCI (eg. TB2-V1 and TB2-COM). When using the output in 4-20 mA mode though, the connection should be made to the current output pin (eg. TB2-I1 and TB2-COM).

Item 3 Specifies the Winch that is to provide the data for this analog output.

Item 4 Assigns the analog output to a given line variable. The choices are **NONE**, **TENSION**, **SPEED** or **PAYOUT**.

Item 5 Sets the analog output full scale value (see Section 6.6.1).

Item 6 Sets the analog output offset (see Section 6.6.1).

6.6.1 Calibrating the analog output signal

Items 5 and 6 in the **4.6 ANALOG OUTPUTS** menu allow the analog output for a given line variable to be scaled in any way the user desires. Item 6 specifies the "offset", which is the value of the variable that corresponds to the lower limit of the output range – for example, the value that produces 4 mA or 0 V. Line values below the "offset" will be truncated by the analog output circuitry. Similarly, item 5 specifies the value of the line variable that corresponds to the upper limit of the output range, i.e. 20 mA or 5 V, etc. Line values above the "full scale" value generate the same (maximum) output. This flexible arrangement allows the LCI-90i to meet the requirements of almost any conceivable data system or output device.

6.7 Alarm Configuration

The **4.7 ALARM CONFIGURATION** menu is distinct from the **1.0 SET ALARMS** menu, which was described in Section 5.3.2. **SET ALARMS** allows one to conveniently change the *value* of a 'trip point', while **ALARM CONFIGURATION** allows the user to disable the alarm completely, change the variable associated with the alarm, or change the alarm from a "High" (value above) to a "Low" (value below) condition. Menu **4.7**, as described below, can be reached either through Item 7 of the **1.0 SET ALARMS** menu, or Item 7 of the **4.0 SYSTEM CONFIG** menu.

	4.7 ALARM CONFIGURATION		
>	1	ALARM NO.	1
	2	STATUS	ON
	3	VARIABLE	PAYOUT
	4	WINCH	1
	5	ALARM TYPE	HIGH
	6	LIMIT	1000 FT
	7	DEADBAND	20 FT
	8	RELAY	RELAY 1

Item 1 Selects one of the six available alarms to be edited settings. Each alarm, when activated, displays a message on the RUN SCREEN that remains until the alarm condition disappears, and optionally turns on one of the four output relays, which can be used to signal a remote data system, flash a light or sound an alarm.

Item 2 Activates or disables the alarm.

Item 3 Selects the line variable to be monitored. The choices are **NONE**, **TENSION**, **SPEED** and **PAYOUT**. A setting of **NONE** disables the remaining items.

Item 4 Selects the winch number (of the four available in each LCI-90i) that is to be monitored by this alarm.

Item 5 Specifies whether the alarm is turned on when the value is above the limit (**HIGH**) or below the limit (**LOW**). See Section 6.7.1.

Item 6 Sets the limit above or below which the alarm occurs. If the variable is assigned to the top display, this value also appears as a 'tick mark' on the bar graph. The limit is compared *algebraically* with the line variable, thus a speed of **–10 FPM** is *above* a limit of **–11 FPM**.

Item 7 Specifies how much the value must change before the alarm is turned *off*; alarms always turn *on* at the specified limit. In the menu above, Alarm #3 will turn on when Payout exceeds 1000 feet, remaining on until Payout falls below 980 feet (1000ft-20ft).

Item 8 Selects a digital output relay to be triggered when the alarm is active. Four relays are included in the LCI-90i and can be activated by any alarm as specified by this item, and both normally-open and normally-closed connections are available on the LCI's terminal blocks.

6.7.1 Alarm types

Alarms are tripped when the line variable is either on the "high side" (above the limit), or on the "low side" (below the limit). High limits are indicated by a ">" ("greater than") symbol in the **1.0 SET ALARMS** menu (Section 5.3.2) and by an "H" following the variable name in the alarm message on the run screen. Low limits are indicated by a "<" ("less than") symbol in menu 1.0, and by the letter "L" in the alarm message.

6.7.2 Alarm limits

There are no restrictions on the value entered as the limit; the comparison is made algebraically with the line variable, thus a High Limit of "–1000" will cause an alarm if the variable goes to "–900". Few applications use negative limits, hence "high" usually means a value whose magnitude is larger than the limit.

6.7.3 Alarm outputs

When an alarm condition occurs, the thing that *always* happens is that a message appears on the RUN screen. This message stays there until the condition goes away, i.e. the value changes by more than the specified deadband (in the correct direction).

Alarm conditions can also be used to turn on a warning light, create a raucous sound, or signal a remote monitoring system. These actions are accomplished by turning on one of the relays which can be wired to set off an external alarm. More than one alarm can be assigned to the same relay, but keep in mind that Input Check errors (Section 6.5.1) always turns on Relay 4 and the Shunt Cal feature (Section 5.6) also may be set to work on one of the alarm channels.

Since external alarms are both useful *and* annoying, the LCI-90 provides a simple way to turn off the buzzer while still reminding the user of the alarm condition. A single press of the **ALRM** button will turn off all relays, but the screen display will remain until the condition goes away. Note that if the variable falls below the limit, but then exceeds it again, the external alarm will come on again. Pressing the **ALRM** button does not disable future alarms, it only resets current ones.

6.8 Communication

The LCI-90i has four communication ports: RS-232, RS-485, USB, and Ethernet. The ports are highly configurable and support several customized data streams, allowing the LCI-90i to be retrofit into existing applications. The **4.8 COMMUNICATIONS** menu controls how the LCI-90i uses its communications ports.

	4.8 COMMUNICATIONS		
>	**1**	**LCI MODE**	**LOCAL**
	2	**ETHERNET**	
	3	**SERIAL**	
	4	**SET DATE/TIME**	
	5	**LAN ID.**	
	6	**CF DISK**	
	7	**CONFIGURE REMOTES**	**NO**

Item 1 Selects **LOCAL** or **REMOTE** modes of operation. **REMOTE** mode configures the LCI-90i into a remote display, receiving data from another LCI-90i through a network communication port, rather than from field sensors. See Section 7.0 for details.

Item 2 This item opens a menu for configuring the Ethernet port.

Item 3 This item opens a menu for configuring the serial ports (RS-232, RS-485 and USB).

Item 4 This item opens a menu where the user can check or set the current date and time.

Item 5 Sets the ID number of this LCI-90i. When multiple units are on a single network it is necessary to give each unit a unique identifier, so as to tell them apart.

Item 6 This item opens a menu where the user can set the CF disk logging parameters and determine the amount of available disk space.

Item 7 This item only appears when units are set to **LOCAL** mode. Selecting this item, changing it to **YES**, and pressing **ENT** downloads the entire set of configuration parameters to all remote LCI-90i units or WinchDAC software platforms attached to this unit. See Section 7 for more details.

6.8.1 Ethernet Settings

LCI-90i units have an in-built Ethernet port which can be used to communicate with other LCI-90i units, with a datalogger, or with a PC. The **4.82 ETHERNET** menu, and the subsequent **4.821 LOCAL ETHERNET**, **4.822 TCP DATALOGGING** and **4.823 UDP DATAMONITORING** menus shown below are used to configure this port.

The LCI-90i can be connected into any existing Ethernet network without much effort, however, in some situations it will be necessary for a user to have knowledge of their network architecture and configuration (e.g. for connecting LCI-90i units across a router). The descriptions of the LCI's settings will be limited here to information pertinent to the setup of the LCI itself. For further information on how to configure your network to handle the LCI it is recommended that you work closely with your network administrator.

	4.82 ETHERNET	
>	**1**	**LOCAL SETTINGS**
	2	**TCP DATALOGGING**
	3	**UDP DATAMONITORING**

The **4.82 ETHERNET** menu is used to link to the three settings menus shown below.

	4.821 LOCAL SETTINGS		
>	1	IP ADDRESS	192.168.001.150
	2	SUBNET MASK	255.255.255.000
	3	GATEWAY	192.168.001.001
	4	PRI. DNS	169.254.001.001
	5	SEC. DNS	000.000.000.000
	6	DATA PROTOCOL	MTNW 3
	7	AUTOMATIC DIAGNOSTICS	ON

	4.822 TCP DATALOGGING		
>	1	ACTIVE	ON
	2	MODE	POLLED
	3	INCOMMING PORT	24
	4	OUTGOING PORT	24
	5	DESTINATION	192.168.1.100

	4.823 UDP DATAMONITORING		
>	1	ACTIVE	ON
	2	MODE	BRDCST
	3	INCOMMING PORT	25
	4	OUTGOING PORT	25
	5	DESTINATION	192.168.1.100

The common Ethernet settings are all included in the **4.821 LOCAL SETTINGS** menu. The settings in this menu are:

Item 1 This sets the IP address of the LCI-90i. The address must be static, unique and should be provided by the network administrator.

Item 2 The subnet mask will be defined by your network and should be provided by the administrator. It typically will remain fixed at 255.255.255.000.

Item 3 The gateway address is only required if data from the LCI-90i needs to be sent outside of the local network through a gateway or router.

Item 4 and 5 The primary and secondary DNS server addresses are not typically required by the LCI-90i but can be set if need be.

Item 6 This item sets the communication protocol used by the LCI-90i's Ethernet ports. See Section 6.8.6 for details of the available protocols.

Item 7 The LCI-90i contains an automatic diagnostics system which allows MTNW representatives to easily troubleshoot the devices externally. Under normal operation, this setting will not affect the performance or operation of the unit.

The LCI-90i's Ethernet port has two subsystems within it. The first is referred to us TCP Datalogging. This system uses the TCP protocol to transfer data and is recommended for connections where data integrity is crucial as the system focuses on data integrity. The second system is referred to as UDP Datamonitoring and is used for systems where speed of operation is critical but data integrity is not. For example, the TCP system is used for connections to datalogging software such as the WinchDAC suite, while the UDP system is used for sending data to remote LCI-90i displays (that only need to display data, not log it). The two systems are configured independently of one another, but have the same list of parameters as described in the following list:

Item 1 Active: setting this to ON enables the communications system.

Item 2 Mode: the communications port can be set in either **POLLED** or **BRDCST** (broadcast) mode. When in polled mode, the LCI-90i will only transmit data packets after a polling string has been received on that port. In broadcast mode, the unit will transmit the data as soon as it becomes available.

Item 3 The incoming port specifies the TCP/IP port number that the LCI-90i will look in for incoming messages. This must match the port number being used by devices that are to send information to the LCI.

Item 4 Similarly, the outgoing port specifies the port number on which the LCI-90i will transmit messages.

Item 5 The destination field sets the IP address of the device that the LCI-90i is to transmit messages to. For example, it could be the IP address of a PC that is running WinchDAC software.

The Ethernet port is very flexible and can be used in a number of arrangements achieve various tasks. For specific information on your network requirements and how to effectively incorporate an LCI it is recommended that you contact Measurement Technology NW directly for technical advice.

6.8.2 Serial Port Settings

The **4.83 SERIAL** menu is shown below. It is used to access the menus for configuring the three serial ports. Additionally, a setting labeled **TERMINAL** is included. Turning the **TERMINAL** to **ON** will convert the USB and RS-232 ports into debugging terminals that trained technicians can use for troubleshooting and diagnostics purposes. Under all other situations, this should remain in the **OFF** state.

	4.83 SERIAL		
>	**1**	**USB**	
	2	**RS-232**	
	3	**RS-485**	
	4	**TERMINAL**	**OFF**

All of the three serial ports – USB, RS-232 and RS-485 – are configured in the same fashion. The following menu is indicative of the settings available for all three of the ports. Note: not all of these settings are available on some of the ports.

	4.832 RS-232		
>	**1**	**ACTIVE**	**ON**
	2	**BAUD**	**115200**
	3	**PROTOCOL**	**MTNW 1**
	4	**MODE**	**POLLED**

Item 1 Active: setting this to ON enables the communications port.

Item 2 The baud rate of the serial port can be set to a number of common values between 2400 and 230400.

Item 3 Sets the protocol used by the port for all messages. See Section 6.8.6 for details of the available protocols

Item 4 The communications port can be set in either **POLLED** or **BRDCST** (broadcast) mode. When in polled mode, the LCI-90i will only transmit data packets after a polling string has been received on that port. In broadcast mode, the unit will transmit the data as soon as it becomes available.

6.8.3 Set Date/Time

The LCI-90i contains a real-time clock unit which keeps track of the current date and time, even when the unit is powered down. The **4.84 SET DATE/TIME** menu is used to view and edit the current date and time. Press **ENT** on either the date or time to enter edit mode.

	4.84 SET DATE/TIME		
>	**1**	**DATE**	**06-03-2010**
	2	**TIME**	**16:30:15**

6.8.4 Local/Remote operation modes

The basic LCI-90i is a self-contained instrument, which both measures and displays the three standard line variables: Tension, Speed and Payout. When operating in this manner the instrument is said to be in **LOCAL** mode. All features of the instrument are available in this mode, including the ability to behave as a Remote display, whereby the instrument does not measure the variables locally, but instead displays values that are sent to it from another unit. This is of use in situations where the line variables need to be monitored in multiple locations, such as by the winch and in the pilot house.

LCI-90i units can communicate to one another using either the RS-485 or Ethernet ports (both TCP and UDP can be used).

A REMOTE LCI-90i links with a LOCAL display and attempts to keep its settings matched between the two units. If a setting is changed on one of the two displays, then the change will take effect on both units, thus keeping the system correctly synchronized and guaranteeing the validity of data. To link a REMOTE to its LOCAL, both units must share the same LAN ID and have their communications port correctly configured to allow data to flow between the two units (Note: when using an Ethernet connection it is necessary for the destination IP address of both units be set to point to one another. If only one of the displays is provided with a valid destination address then the communications link will not be bi-directional and the units will not be able to synchronize their settings.)

Setting a Remote LAN ID to zero configures the remote to ignore LAN IDs and display any data that it receives. This configuration is useful when more than one local is on a hard-switched network and a single remote or multiple remotes are to display data coming from multiple remotes.

Some settings are not included in the synchronization which allows the remote unit to be configured for some flexible situations. For example, the local display can interface with sensors and be located near the physical location of the winch. A second LCI-90i can be configured through the menu as a REMOTE and can output serial communications to nearby data loggers operating independently from the

LOCAL unit. It is possible to set the communications settings, digital inputs, and analog outputs in this way.

6.8.5 CF Disk

The Compact Flash (CF) Disk provides on-board data storage. Data that is sampled by the LCI-90i (tension, speed, and payout) is written to a CF disk and time-stamped. The recorded data can be retrieved using an Ethernet connection and WinchDAC or the CF disk can be removed from the LCI-90i read by a Windows-based desktop and the files can be read directly using WinchDAC.

The LCI-90i uses a FAT32 file system for data storage. Before inserting a CF disk into the LCI-90i verify that the CF disk is formatted as a FAT32 file system. To determine the file system type, insert the CF disk in a desktop computer or a laptop. Locate the CF disk drive using Windows Explorer and open the properties of the CF disk. For best results format the CF disk in FAT32 before inserting into the LCI-90i. If a CF disk has partitions only the first partition will be used for recording. It is not recommended to use a CF disk that contains partition and is not supported by MTNW.

To prevent data corruption and loss of data, recording will stop once the CF disk has less than 4 megabytes of free space remaining. The status of the disk is displayed at the top-center of the main screen of the LCI-90i. The following status labels are displayed:

DISK IDLE – A CF disk is present, but not recording due to the measured tensions being below the **THRESHOLD VALUE**.
DISK REC – A CF disk is present, has enough free space and data is being recorded to disk.
DISK FULL – A CF disk is present, but there is not enough space to record data. The disk is dismounted and it is safe to remove the disk.
DISK ERR – An error has occurred while communicating with the disk. Verify that there is enough free space on the disk, the disk is not corrupt, and the disk is functioning properly.

If no disk is present or the disk is dismounted then no label is displayed.

For best results, power-down the LCI-90i before inserting or removing a CF disk. The CF disk can be inserted or removed while the LCI-90i is powered on, but may require a power cycle to properly initialize the CF disk. This phenomenon has been observed with some CF disk manufacturers.

	4.86 CF DISK		
>	**1**	**DISMOUNT CF DISK**	
	2	**THRESHOLD VALUE**	**100.0 lbs**
	3	**THRESHOLD TIME**	**30 secs**
	4	**USED SPACE**	**8 MB**
	5	**FREE SPACE**	**7256 MB**
	6	**DISK CAPACITY**	**7264 MB**

Item 1 This item indicates the state of the CF Disk slot. If a CF disk is successfully initialized and has available free space the menu item will display **DISMOUNT CF DISK**. The menu item also acts as a mechanism to safely remove the CF disk. By selecting the **DISMOUNT CF DISK** menu item all open files will be closed and communication with the CF disk will cease. It is important to dismount the CF disk before removal. Removing a CF disk without dismounting can cause loss of data, damage to the LCI-90i and damage to the CF disk.

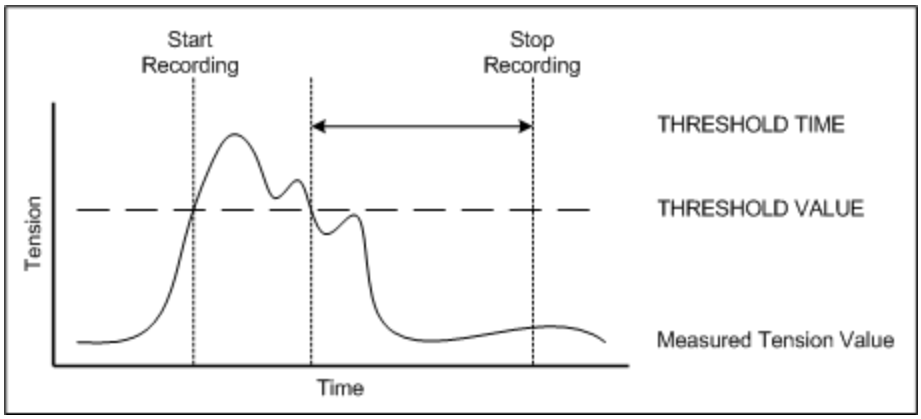
The CF disk can be safely removed if the LCI-90i is unpowered (no voltage supplied).

If no CF disk is present, the disk has been successfully dismounted, or the disk is full the menu item will change to **NO CF DISK PRESENT**.

Item 2 and 3 The **THRESHOLD VALUE** menu item determines the value at which data is recorded to the CF disk. If any of the measured tensions are above the threshold value then data will be recorded to disk. Recording to disk will start immediately once one of the measured tensions is above the threshold value.

To prevent jitter in the event the measured tension is oscillating around the threshold value a timeout value is used, **THRESHOLD TIME**. The threshold time is a timer that starts once the measured tension drops below the threshold value. For example, if the measured tension drops below the threshold value data will continue to be recorded to the CF disk for the threshold time. If at any point the measured tension is greater than the threshold value the timer is reset and stopped until the measured value is below threshold.

Setting the threshold time to zero disables the threshold recording and data will be recorded at all times regardless of the measured tension values.



Item 4 The **USED SPACE** menu item is the sum of the file sizes on the disk. The value displayed is in megabytes. If no CF disk is present, the CF disk is full, or the CF disk is dismounted the menu item will not be displayed. The Used Space menu item is informational only and cannot be modified by the user.

Item 5 The **FREE SPACE** menu item is the difference between the disk capacity and the used space. The free disk space value is displayed in megabytes. If no CF disk is present, the CF disk is full, or the CF disk is dismounted the menu item will not be displayed. The Free Space menu item is informational only and cannot be modified by the user.

Item 6 The **DISK CAPACITY** is calculated from the boot sector from the first partition of the CF disk. The disk capacity value is displayed in megabytes. If no CF disk is present, the CF disk is full, or the CF disk is dismounted the menu item will not be displayed. The Disk Capacity menu item is informational only and cannot be modified by the user.

The table below shows the relationship between the disk capacity and the hours of recording:

Disk Capacity	Approximate Hours of Recording
512 MB	100
1 GB	200
2 GB	405
4 GB	810
8 GB	1620

6.8.6 Programming remote displays

Although the remote units will attempt to keep their settings synchronized with their LOCAL it is not possible to guarantee this over all foreseeable situations. Thus, a feature has been included so that the entire collection of settings can be downloaded from a local display to its remote in one operation. This is especially useful when setting up the network for the first time as it will immediately update the remotes with the current settings.

To perform a "remote configuration", simply connect one or more remote units to a local using RS-485 or one of the Ethernet Communications systems. Ensure that all

remote displays to be programmed are set to be in remote mode in the **4.8 COMMUNICATIONS** menu. After all units are powered up and seem to be working properly (if the local unit is broadcasting data then it should be visible on the remote displays), select the **CONFIGURE REMOTES** menu item in the **4.8 COMMUNICATIONS** menu, change it to **YES** (it always defaults to **NO**) and press **ENT**. The displays will flicker for a few seconds as the settings take effect, then resume operation with the new set of parameters.

It is possible that a very noisy network connection (this *does* happen!) could corrupt the data. If the Remote unit detects any errors in the transfer then it will cease the operation and any settings which have not been sent across yet will fail to be updated. Should this happen, the best approach is simply to repeat the operation; if difficulties persist, then the communications link will need to be evaluated.

6.8.7 Protocol descriptions

The data transmitted on any communications port by the LCI-90i can be formatted using a number of communications protocols. Each protocol is unique and the appropriate protocol to use is determined by the data requirements of the device which is going to be reading the data from the LCI-90i.

Each winch that is defined within the LCI-90i can provide up to three values: Tension, Speed and Payout. If a winch has an analog input assigned to it, through the **WINCH SETUP** menu, then it will produce a tension value which will then appear in the communications messages. Similarly, if a counter channel is assigned to a winch in the **WINCH SETUP** menu, then the winch will produce Payout and Speed values that will be present in the communications messages.

If the LCI-90i is operating in **SINGLE WINCH** mode (see **PROCESS WINCHES** option in **WINCH SETUP** menu) then the LCI-90i will only produce data for the winch (or winches) which are currently being displayed on the LCI-90i's screen; therefore, the number of data fields in communications messages will also be limited to the values displayed.

Once the number of data fields in the packets has been determined, using the above discussed information, the LCI-90i will create the packets in the specified protocol format. In all formats, the order of data values remains constant: all tension values are listed first, followed by all speed values, with all payout values completing the data values.

For example, if Winch 1 has an active analog input and a counter input, Winch 2 has only a counter input, and Winch 4 has both an analog input and a counter input, then the data values will be ordered as follows:

"Tension 1, Tension 4, Speed 1, Speed 2, Speed 4, Payout 1, Payout 2, Payout 4"

The protocol formats are as follows.

<u>MTNW 1 Protocol</u>

This protocol is a simplified protocol using Measurement Technology NW's standard formatting system. It is a check-summed, comma-separated, maximum precision, zero-filled format, of the form:

"<HEAD>RD,yyyy-mm-ddThh:mm:ss.sss,ddddddddd,….,ddddddddd,cccc<CF><LF>"

Each packet begins with a pair of header bytes, which in most cases can be ignored but can be useful for synchronizing an incoming data stream, and for getting over any turn-on periods on non-duplex connections. The two bytes are ASCII characters #RS (record separator, Hex 0x1E) and #SOH (start of heading, Hex 0x01).

Following the header bytes, the packet type field defines the packet. For all data packets this field is fixed as "RD".

The next field is a timestamp, in ISO 8601 format. The field is formed with a four digit year, two digit month and day, a "T" character to separate date from time, two digit fields for hours (in 24 hour format) and minutes, and a six digit seconds field (including a decimal point and three decimal places).

Following the timestamp will be the data fields. The number and order of the fields is defined as described at the beginning of this section of the manual.

After all data fields there is a checksum. This is decimal number, up to a maximum of four digits (any checksum greater than 9999 will be truncated and the leftmost digits will be removed). The checksum is calculated as the sum of all ASCII values in the string, prior to the checksum, but not including the two header bytes.

The message is finished with a carriage return and line feed character.

A sample packet is shown below for reference:

"<RS><SOH>RD,2010-06-04T09:45:54.101,000000.0,00000000,000001.0,2713<CR><LF>"

MTNW 2 Protocol

This protocol is based on the MTNW 1 protocol but includes the LAN ID at the start of the packet. This protocol is the default used for communication between an LCI-90i and WinchDAC. Also, system messages (configuration) between LCI-90i units are sent using this format. Packet format is:

"<HEAD>01RD,yyyy-mm-ddThh:mm:ss.sss,ddddddddd,….,ddddddddd,cccc<CF><LF>"

As can be seen, the only change between MTNW 1 and MTNW 2 protocols is the addition of the LAN ID field before the "RD" packet type field. The LAN ID characters are included in the calculation of the checksum.

MTNW 3 Protocol

This protocol is an expanded version of the MTNW 2 protocol that includes the **WINCH NAME** in data packets. The names of all winches that are producing data will be included after the timestamp and before the data fields. The winch names will be listed in order, matching the order of the subsequent data fields. An example packet follows:

"<HEAD>01RD,yyyy-mm-ddThh:mm:ss.sss,winch_name1,winch_name2,…,
ddddddddd,….,ddddddddd,cccc<CF><LF>"

The winch name field can be up to ten characters in length.

MTNW LEGACY Protocol

This protocol is designed to exactly match the protocol used by the previous generation of LCIs, the LCI-90. It is to be used when an LCI-90i is required to send data to an older display, such as a LCI-90R remote unit.

This protocol is a check-summed, comma-separated, maximum precision, zero-filled format, consisting of strings with the form:

"RD,–TTTTT.TT,–SSSS.SSS,–PPP.PPPP,CCCC<CR><LF>"

where "RD" identifies the record as a Remote Data string, "–" stands for an optional minus sign, which is always the first character (but omitted if the data is positive). "TTT" is the Tension, "SSS" is the Speed, and "PPP" is the Payout. Each field is 8 characters long, with leading '0's as needed. The indicated decimal points are only symbolic – integer values will not have a decimal point, and the number of digits following the decimal point (if any) is adjusted on a record-by-record basis to reflect the internal accuracy of the data.

Programs written to parse these strings should look for the commas. (Excel calls this a 'CSV', Comma Separated Values, format). "CCCC" is a 4-digit (always!) decimal field, which contains the sum of the ASCII values of all proceeding characters, including the commas (but not including the four CCCC characters). All characters included in the sum have ASCII values less than 127; hence it will not matter if the receiving device uses "7-bit" or "8-bit" characters. Spurious characters preceding "RD" may occur, and should be ignored. Each record ends with a Carriage Return (ASCII 13) + Line Feed (ASCII 10), which are not included in the checksum.

Additional, or alternative, protocols can be supported. Contact Measurement Technology NW for advice on this matter.

6.8.8 Polling Strings

Each communications port can be configured to either transmit data continuously ("BRDCAST" mode), or only after the LCI-90i has received a specified "Polling

String" ("POLLED" mode). Polled mode is generally the preferred method of operation, since it allows the remote device, such as a datalogger, to control the data flow, and thus to receive data only when it is ready for it.

The communications ports that are used for networking LCI-90i units (Ethernet and RS-485) require full polling strings that address and request data specifically. In these systems, the polling string is of the form:

"01SD<CR><LF>"

The string is formed with the LAN ID of the LCI-90i which is being addressed followed by the command "SD" for send data, and a carriage return to complete the packet. When using protocols MTNW 2 and MTNW 3 this is the only string which will successfully poll the LCI-90i for data.

When using the MTNW 1 protocol, the LAN ID is not a required field in the polling string (as this protocol does not use LAN IDs), however, the string will successfully poll the LCI-90i whether the LAN ID is present or not.

For the short-range serial communications systems (RS-232 and USB), the polling string is simply a carriage return character. Regardless of any characters prior to the carriage return, these systems will respond with a data packet as soon as a carriage return is detected.

7.0 Remote Display Operation

For applications where data from a local LCI-90i needs to be displayed at another physical location, a second LCI-90i displayed can be used by configuring it in Remote mode.

Remote displays receive their data from either the RS-485 or Ethernet ports. The data is sent using a flexible, check-summed protocol (described in Section 6.8.6), which maintains the full accuracy of the instrument.

Remote displays depend on a steady stream of data from the Local unit, hence if that stream is interrupted for more than two (2) seconds, (for example the Local unit is powered down, or the Network is disconnected), then the Remote will overwrite their display with the text "**NO VALID DATA**".

When acting as a Remote display, the LCI-90i will attempt to match its settings to those of the Local display. In other words, when any setting is changed on either the Local or the Remote, then the effect will take place on both displays. There are some exceptions to this: the communications settings, the analog output settings, and the display contrast. This allows the remote unit to have some independent functionality, such as communicating with a datalogger or analog gauge, which is not also occurring at the Local unit.

When a Remote is first connected to a Local, or if an interruption in communications has caused the settings to become un-synchronized, it is possible to download the entire settings space of the Local unit to the Remote using the **CONFIGURE REMOTES** option on the **4.8 COMMUNICATIONS** menu. This will immediately update the remote with all of the current settings and get the two units synchronized.

To connect a Remote to a Local it is necessary to use either the RS-485 port or one of the two Ethernet ports. Be sure to configure the two displays independently for the communications port, matching the destination addresses of each unit to the source addresses of their partner. Once the network is connected and the units are turned on, the Remote unit's display should immediately "come to life". If the Remote does not receive valid data within a 2-second time period, it will not display data and will indicate the communications failure as described above. If this should happen, first check the Network connection, and then check that the unit is actually set for Remote operation.

8.0 Troubleshooting

The LCI-90i was designed with the user in mind. Using full language menus and a minimum of abbreviations makes the programming and operation much easier to understand. A diagnostics screen described in the section below is easily accessible by the user to check raw input signals. Most apparent malfunctions of the instrument can usually be traced to incorrect wiring, jumper settings, or programming. Consult the troubleshooting chart in section 8.3 to diagnose apparent problems.

8.1 DIAG screen operation

Pressing the **DIAG** key from the Run mode display will bring up the Diagnostics screen. This display, shown in Figure 8.1, provides the operator with important feedback on raw signal inputs, and scaled display values for Tension and Payout. To return to normal operation from this menu, press the **RUN** button. From the DIAG screen, the same button will take the system to an Advanced Diagnostics screen which is described in Section 8.2. The instrument will continue normal operation while in diagnostic mode, including updating remote displays and checking alarm limits in the background, however, it may not be able to run at its maximum data rate while in this mode.

INPUT	VALUE	SCALED
WINCH1	4.765 mA	1450 LBS
WINCH2	7.430 mA	2308 LBS
WINCH3	0.000mV	0 LBS
WINCH4	0.000 mV	0 LBS
CNT1	2452 P	12630 FT
CNT2	0 P	0 FT
CNT3	0 P	0 FT
CNT4	0 P	0 FT

Figure 8.1 – Diagnostics Screen Display

The first items displayed are analog input values being read by each Winch. All four winches are displayed, however, not all winches may have analog inputs associated with them (two are shown to have inputs in Fig 8.1). These lines show the raw input signal as measured by the LCI-90, after any SUM, AVERAGE or DUAL-AXIS calculation has been made. That is, these show the combined sensor input values for that winch. Beside the sensor measurements, the resulting scaled Tension is displayed (this will match the values displayed on the RUN screen).

Following the analog input values, there are four rows showing the current state of all four counter channels within the LCI-90i. The left-hand column shows the raw number of counts (pulses) that have been seen by the counter. In the right-hand column the scaled Payout values are shown (these match the payout values displayed on the RUN screen).

The utility of the DIAG screen is clear when a malfunction occurs. Comparing the displayed values with measurements from a multi-meter can help identify if the fault lies in the sensor/wiring, or within the instrument and its setup configuration.

An additional function of the DIAG screen is described in Section 6.5.1. When an Input Check Alarm occurs, the LCI-90 automatically displays the DIAG screen with the outlying input channel highlighted (as shown in Fig 8.1 for channel 1). An alarm connected to relay 4 (TB3-OUT4) is also turned on. Pressing the **ALRM** button will silence the alarm but the DIAG screen will remain visible until the error condition is removed (if required, the user can enter the menus from the DIAG screen to disable the Input Check system for that input, thus allowing operation of the LCI-90i to continue despite the failed sensor).

8.2 Advanced Diagnostics Screen

Pressing the DIAG button a second time will bring up the Advanced Diagnostics screen as shown in figure 8.2. This screen is useful for monitoring the operation of the LCI-90i hardware systems.

AIN-1	=	-20.185mV		SAMPLE	=	99HZ
AIN-2	=	0.000V		DATALOG	=	89HZ
AIN-3	=	0.000V		DISPLAY	=	20HZ
AIN-4	=	0.000V		DISK	=	99HZ
AIN-5	=	1.862V		CPU ERR	=	27
AIN-6	=	0.000V				13
AIN-7	=	0.000V				13
AIN-8	=	0.000V				27
						13
INPUT V	=	23.575V				
+24V	=	24.201V		COM ERR	=	27
+12V	=	12.121V				27
+5V	=	5.015V				27
+3.3V	=	3.299V				27
+12 ANL	=	12.019V				27
-12 ANL	=	-12.005V				
+5V ANL	=	5.034V				
EXC+	=	2.510V				
EXC-	=	-2.515V				

Figure 8.2 – Advanced Diagnostics Screen Display

This screen details exactly what is going on inside the unit. The first eight values show the raw sensor values from the eight analog input channels. These values are measured prior to any combination, scaling, or other adjustment that is made by the LCI-90i when calculating Tension, thus, this a useful tool for determining if a sensor is functioning correctly.

Following this, all internal voltage levels used by the LCI-90i are measured and displayed.

In the right-hand column, the current sample rate (number of tension samples per second), datalog rate (number of data packets sent out to remote displays, data loggers, or PCs in the last second), and display refresh rate (number of data samples displayed to the screen in a second) are displayed. Below this is a log of the last ten errors reported by the LCI-90i's internal error management system, which can be used by MTNW technicians to diagnose and troubleshoot the display.

8.3 Troubleshooting procedures

Problem Blank Screen

Possible Causes	Diagnosis	Remedies
Screen saver is on	Activate display by pressing any key or by changing payout	Disable screen saver if screen visibility is required during periods of inactivity
Input power problem	Check voltage between TB5 IN+ and GND. 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 TB1 +24 and TB5 GND. 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-90i	Contact supplier
Display brightness adjustment set too low	If using the menu dimming option, press the MENU button (left-most button on display) to open the menu. This will bring the display to maximum brightness. If using an external potentiometer for dimming, adjust the potentiometer to maximum impedance (or remove it entirely) to achieve maximum brightness.	Set potentiometer to desired brightness level for normal operation
Internal power supply failure	Measure voltage between TB6 +5 and COM and also +12 and COM. If these voltages are out of range, the internal power supply is suspect.	Contact supplier
CPU failure	Check for communication with remote displays. If remote displays are not updating and the LCI-90i has power, then the CPU is suspect	Contact supplier

Problem	Zero Speed/Payout Not Changing	
Possible Causes	**Diagnosis**	**Remedies**
Scale Factor is zero or very small	Check menu 2.3, Item 1 for an incorrect value.	Recalibrate the payout based on true physical values.
Counter input is not connected to the Winch being displayed	Check menu 4.4 and its submenus to ensure that the counter channel being used is associated with the Winch being displayed. Check menu 3.0 to see which Winch is being viewed on the display at this moment.	Set-up the LCI-90i to have the counter channel linked to the correct Winch, and to have that Winch displayed on the screen.
LCI-90 not receiving pulse inputs	Press **DIAG** to view diagnostics screen. Turn sheave to increment pulse counter and look for updates on screen.	
	Measure voltage between TB6 A and COM, and B and COM as the sheave is turning. There should be a significant voltage change between on-target and off-target.	Independently check operation of count sensors and replace if faulty.
	Check menu 2.3, items 3 and 4 to ensure that the pull-up and pull-down resistors, and the counter chip, are configured correctly.	Set correct values. See Sections 5.5.3 and 5.5.4 for details.
Input sensors not in quadrature configuration	Ensure that there is an overlap between on-time of channels A and B on the payout sensor.	Adjust sensor mounting or target width to guarantee overlap.

Problem	No Response or Zero Value for Tension Signal	
Possible Causes	**Diagnosis**	**Remedies**
Incorrect scaling	Check menu 2.2 for correct values of Offset and Full Scale	Recalibrate if incorrect
No sensor input	Press **DIAG** to view diagnostics screen. Use a multimeter to compare the raw input value with the LCI-90i displayed input	If no input signal, then replace or repair tension sensor
	Confirm that the sensor has excitation power with a multimeter. If using an external supply, ensure there are no grounding problems.	Review Section 4.1.2 for discussion of Tension input hookup.
	Check menu 4.5 to ensure that the input is configured correctly.	Review Section 6.5 for discussion of analog input configuration..
	Check menu 4.4 and its submenus to ensure that the analog input is connected to the correct winch, and that the winch is being displayed.	Review Section 6.4 for discussion of winch configuration.

Problem	Run Screen Visible, No Numeric Values on Screen	
Possible Causes	**Diagnosis**	**Remedies**
Incorrect menu configuration	This will occur when a unit is set to Remote mode and doesn't receive valid serial communication.	If unit is supposed to receive sensor input, then change the LOC/REMOTE mode to LOCAL.

Problem "Jumpy" Tension Signal

Possible Causes	Diagnosis	Remedies
Electrical noise	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
	Check that cable shields are grounded near the LCI-90i for best noise immunity.	Try variations on shield grounding. Try both ends, or no grounding.
	Baseline noise – cannot be remedied	Adjust Tension Smoothing filter to reduce the effective noise. See Section 5.10
Ground loop	Draw or review a schematic of the tension input sensor/LCI-90 connection to identify any ground loops.	Remove ground loop.
Wave motions affecting tension signal	Confirm that the tension display varies at the same frequency as the wave motion.	Adjust the Tension Smoothing filter. See Section 5.10

Problem "NO VALID DATA" Displayed on Remote unit.

Possible Causes	Diagnosis	Remedies
Incorrect menu configuration	If using the display as a local, check Menu 4.8, Item 1.	Change the Menu 4.5 Item 1, LCI Mode, to LOCAL
Incorrect serial communication wiring	Check polarity of the wiring for RS-485, with T+R+ on the local to T+R+ on the remote.	Correct any wiring errors
Incorrect serial termination	For RS-485, the display on each end of the chain should be terminated for best performance.	Check SW3 settings. See Appendix B
Incorrect communications settings		Thoroughly check the communications settings for the port being used.

Problem	No Outputs from Alarm Channels	
Possible Causes	**Diagnosis**	**Remedies**
Incorrect menu configuration	Check the alarm configuration in Menu 4.7 to make sure that the expected relay will be energized by the alarm condition. Each alarm must be programmed to output to Relay 1-4 to energize a relay.	Review manual Section 5.3 for alarm use and configuration

8.4 Technical support

The resolution of technical problem should first be attempted using the Troubleshooting Guide in Section 8.3 or by reading the appropriate sections of the manual. If this fails, either contact the supplier from whom you purchased the display, or the manufacturer, for additional technical support. When seeking technical support, please fax or e-mail notes including a description of the problem, all relevant menu, DIP switch and jumper settings, any hardware options installed, plus a description of the field devices in use and how they are terminated on the LCI-90i.

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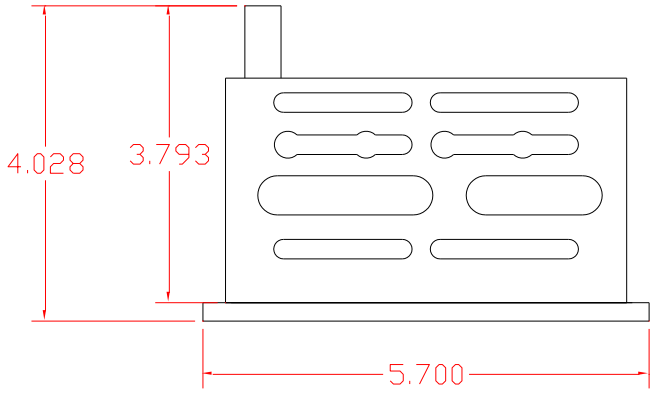
Office Hours: 8:30 AM to 5:30 PM - Pacific Time

9.0 Appendix A – Dimensional Drawing

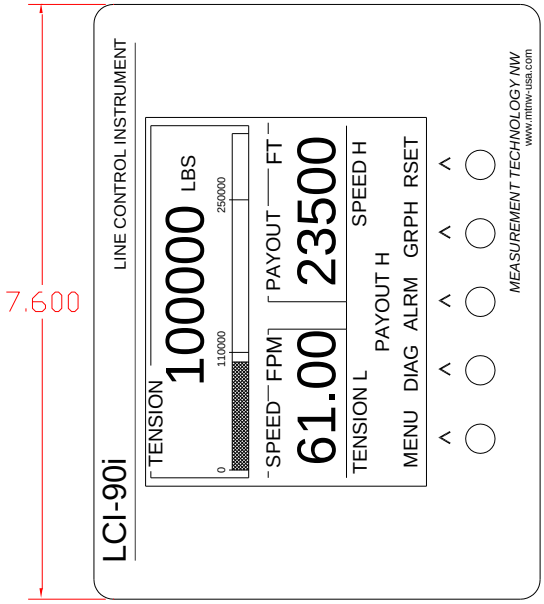


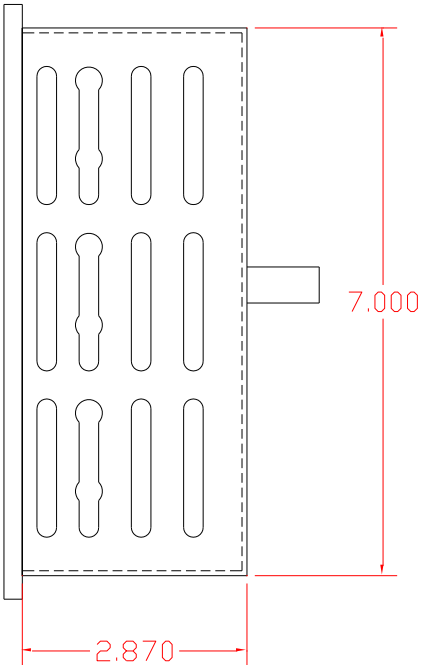
NOTES:

1: Unit fits into 7.15" x 5.25" cutout
The mounting brackets require 1" clearance on each side of the rear enclosure

2: All units in inches

3: Panel mount configuration shown





10.0 Appendix B – DIP Switch Settings

SW-2: Analog Input

CH Select	SW1-1	SW1-2	SW1-3	SW1-4
AIN-5 is voltage input	OFF	•	•	•
AIN-5 is 4-20mAinput *	ON	•	•	•
AIN-6 is voltage input	•	OFF	•	•
AIN-6 is 4-20mAinput *	•	ON	•	•
AIN-7 is voltage input	•	•	OFF	•
AIN-7 is 4-20mAinput *	•	•	ON	•
AIN-8 is voltage input	•	•	•	OFF
AIN-8 is 4-20mAinput *	•	•	•	ON

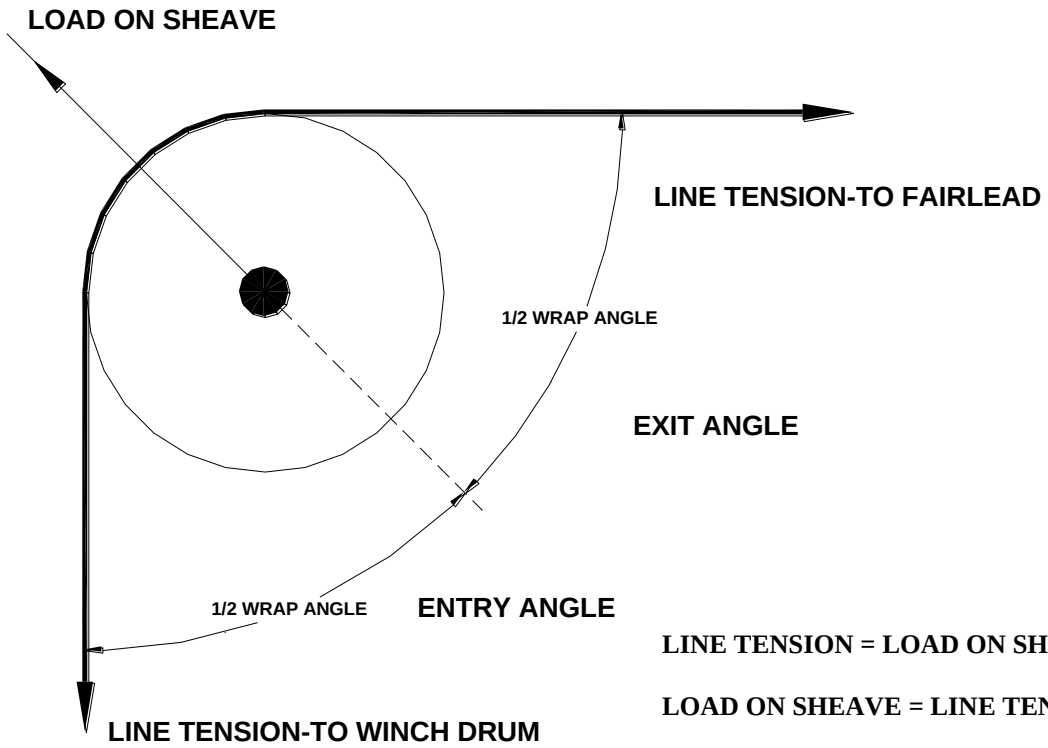
SW-3: RS-485 Serial Termination

Function	SW3-1	SW3-2
RS 485 Term OFF	OFF	OFF
RS 485 Term ON*	ON	ON

- Denotes switch setting does not affect parameter configuration.

* Denotes factory default settings

11.0 Appendix C – Wrap Angle Calculations



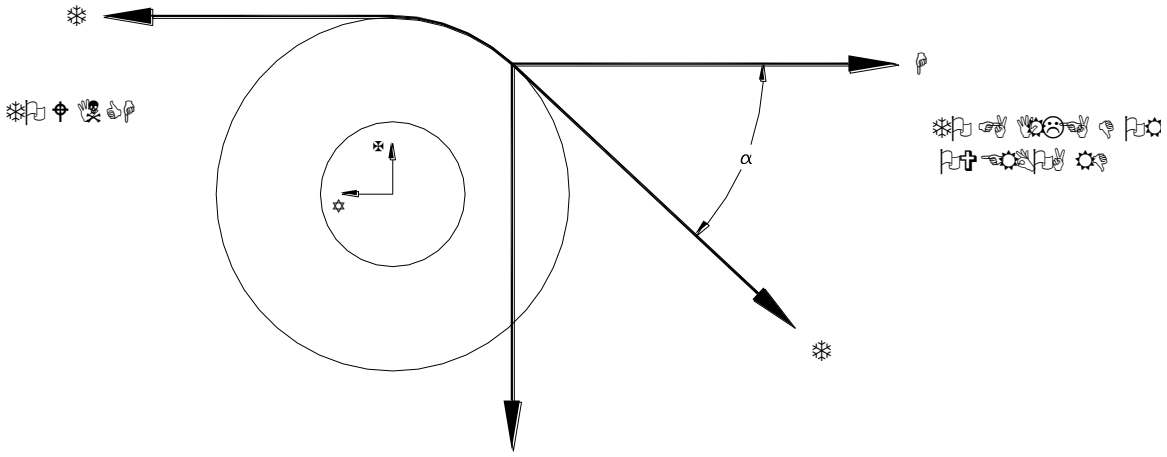
LINE TENSION = LOAD ON SHEAVE * WACF

LOAD ON SHEAVE = LINE TENSION / WACF

Wrap Angle Correction Factor (WACF)

Angle	WACF	Angle	WACF	Angle	WACF	Angle	WACF	Angle	WACF
0	0.50000	38	0.52881	76	0.63451	114	0.91804	152	2.06678
2	0.50080	40	0.53209	78	0.64338	116	0.94354	154	2.22271
4	0.50030	42	0.53557	80	0.65270	118	0.97080	156	2.40487
6	0.50069	44	0.53927	82	0.66251	120	1.00000	158	2.62042
8	0.50122	46	0.54318	84	0.67282	122	1.01539	160	2.87939
10	0.50191	48	0.54732	86	0.68366	124	1.06503	162	3.19623
12	0.50275	50	0.55169	88	0.69508	126	1.10134	164	3.59265
14	0.50375	52	0.55630	90	0.70711	128	1.14059	166	4.10275
16	0.50491	54	0.56116	92	0.71978	130	1.18310	168	4.78339
18	0.50623	56	0.56629	94	0.73314	132	1.22930	170	5.73686
20	0.50771	58	0.57168	96	0.74724	134	1.27965	172	7.16779
22	0.50936	60	0.57735	98	0.76213	136	1.33473	174	9.55366
24	0.51117	62	0.58332	100	0.77786	138	1.39521	175	11.46279
26	0.51315	64	0.58959	102	0.79451	140	1.46190		
28	0.51531	66	0.59618	104	0.81213	142	1.53578		
30	0.51764	68	0.60311	106	0.83082	144	1.61803		
32	0.52015	70	0.61039	108	0.85065	146	1.71015		
34	0.52285	72	0.61803	110	0.87172	148	1.81398		
36	0.52573	74	0.62607	112	0.89415	150	1.93185		

12.0 Appendix D – Idealized Dual Axis Load Pin Geometry



Note: This is the idealized condition where the Y-axis is parallel to the line going to the winch. This is a fixed relationship, but as the equations below show, α can vary without changing the calculated Tension.

Equations:

$$\sum \overline{F}x = 0 \quad X - T\sin\alpha = 0 \qquad \sin\alpha = \frac{X}{T} \qquad \sin^2\alpha = \frac{X^2}{T^2}$$

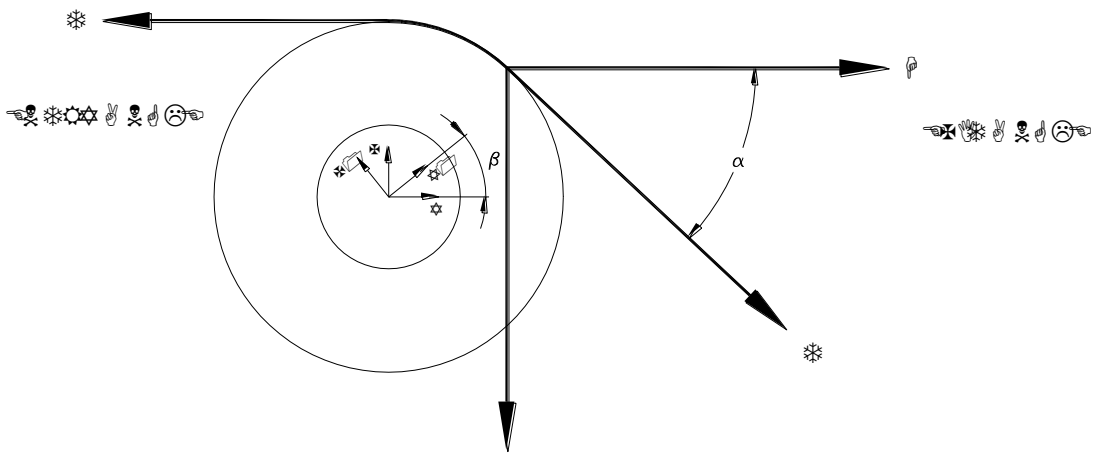
$$\sum \overline{F}y = 0 \quad Y - T\cos\alpha - T = 0 \quad \cos\alpha = 1 - \frac{Y}{T} \quad \cos^2\alpha = \frac{Y^2}{T^2} - \frac{2Y}{T} + 1$$

$$\sin^2\alpha + \cos^2\alpha = 1 \quad \frac{X^2}{T^2} + \frac{Y^2}{T^2} - \frac{2Y}{T} + 1 = 1 \quad \frac{X^2 + Y^2}{T^2} = \frac{2Y}{T}$$

$$H = T\cos\alpha = T - Y = \frac{X^2 + Y^2}{2Y} - Y = \frac{X^2 - Y^2}{2Y}$$

$$T = \frac{X^2 + Y^2}{2Y}$$

13.0 Appendix E – Non Idealized Dual Axis Load Pin Geometry



In an actual installation the load pin may not be aligned such that the y-axis of the load pin is exactly parallel to the winch line. The LCI-90 has the ability to correct for this orientation error. In the example above the load pin is oriented along X1 and Y1 axis. The idealized condition discussed in the previous section had the load pin oriented along the X and Y axis. The angle β is the Sensor Angle specified in the 2.0 Calibration menu.

14.0 Appendix F – LCI-90i Specifications

LCI-90	PHYSICAL/POWER	Std/Option
Temp.	-40˚C to 75˚C	Std
Environmental	NEMA 4X front panel	Std
	NEMA 1 rear enclosure	Std
Dimensions	7.6” wide x 5.7” high x 4.1” deep	Std
	Cut out: 7.15” wide x 5.25 high	Std
Weight	3.5 pounds	Std
Materials	Stainless Steel 316 front panel	Std
	Polycarbonate display window	Std
	Urethane front panel gasket	Std
Power	9-36 VDC, 0.5 A typical, 15W maximum	Std
Heat Output	8 Watts typical	Std

LCI-90	DISPLAY	Std/Option
Type	Graphic electro-luminescent, 320 x 240 pixels	Std
View Angle	160 degrees	Std
Viewing Area	4.7” wide x 3.6” high	Std
Brightness	High brightness – 50 cd/m2	Std
	Ultra high brightness – 340 cd/m2	HT
Contrast	Fixed	Std
	Adjustable	HT
Characters	6 at top center, 4 at lower left, 5 at lower right	Std

LCI-90	COUNT SENSOR INTERFACE	Std/Option
Type	Inductive proximity, quadrature, PNP, NPN, 2 or 3 wire	Std
	Quadrature encoder, CMOS or TTL	Std
	NAMUR proximity sensors	Std
Frequency	0.05 Hz to 20 kHz	Std
Excitation	12 VDC, 250 mA (total for device)	Std
	5 VDC, 250 mA (total for device)	Std
Thresholds	3 V Low-High transition, 2 V High-Low transition	Std

LCI-90	DIGITAL I/O – ALARMS	Std/Option
Channels	Four digital Input channels	Std
	Four relay outputs for alarms	Std
Type	TTL digital inputs	Std
	Output relays: rated for 0.5A at 125VAC and 1A at 24VDC	Std

LCI-90	COMMUNICATION	Std/Option
Type	RS-232, non-isolated	Std
	RS-485, 2 wire, isolated	Std
	USB	Std
	Ethernet (10 BaseT)	Std
Baud Rate	RS-232: 230400, RS-485: 19200	Std
Protection	RS-485, 1000 VDC, 5000 Vrms	Std

LCI-90	ANALOG SENSOR INPUT	Std/Option
Type	4 to 20 mA, non-isolated, 2,3 and 4 wire	Std
	0-5 VDC, non-isolated	Std
	0-10 VDC, non-isolated	Std
	+/-5 VDC, non-isolated	Std
	4 or 6 Wire Strain Gauge, load range 10 kΩ to 75Ω, 20mW or 100mV input range	Std
Channels	Four strain gauge input channels, plus four high level voltage/current inputs	Std
	Eight 0-5V or 4-20mA inputs	1
Protection	16 V peak DC	Std
Impedance	Non isolated 4 to 20 mA input: 220 Ω	Std
	Non isolated VDC input: > 1,000,000 Ω	Std
	Strain gauge: 100 G Ω, 2pF	Std
Resolution	24 bits (>16 bits effective)	Std
Accuracy	Base unit: 0.05%	Std
Scan Rate	Up to 200Hz	Std
Excitation	12 VDC, 250 mA (total for device)	Std
	5 VDC, 250 mA (total for device)	Std
	For strain gauge: 5V or 10V excitation with external sense	Std

LCI-90	ANALOG OUTPUT	Std/Option
Type	4 to 20 mA, non-isolated, 24 VDC maximum	Std
	0-10 VDC, non-isolated, load range 1000 Ω and up	Std
	0-5 VDC, non-isolated, load range 500 Ω and up	Std
	+/-5 VDC, non-isolated, load range 500 Ω and up	Std
Channels	Four channels total	Std
Protection	16 V peak DC	Std
Resolution	12 bits (1/4096)	Std
Accuracy	0.05% (± 1 LSB)	Std
Update	Up to 200 Hz (matches analog input scan rate)	Std

15.0 Appendix G – LCI-90i Wirelist

Function	Manual Reference	Terminal Board Designator (used when LCI-90i is used with stainless steel rear enclosure)
Strain Gauge Input Sense +	TB7 N+	TB5-1
Strain Gauge Input Sense -	TB7 N-	TB5-6
Strain Gauge Input 1 Exc +	TB7 CH1 V+	TB5-2
Strain Gauge Input 1 Signal +	TB7 CH1 S+	TB5-3
Strain Gauge Input 1 Signal -	TB7 CH1 S-	TB5-4
Strain Gauge Input 1 Exc -	TB7 CH1 V-	TB5-5
Strain Gauge Input 2 Exc +	TB7 CH2 V+	TB5-7
Strain Gauge Input 2 Signal +	TB7 CH2 S+	TB5-8
Strain Gauge Input 2 Signal -	TB7 CH2 S-	TB5-9
Strain Gauge Input 2 Exc -	TB7 CH2 V-	TB5-10
Strain Gauge Input 3 Exc +	TB7 CH3 V+	TB5-11
Strain Gauge Input 3 Signal +	TB7 CH3 S+	TB5-12
Strain Gauge Input 3 Signal -	TB7 CH3 S-	TB5-13
Strain Gauge Input 3 Exc -	TB7 CH3 V-	TB5-14
Strain Gauge Input 4 Exc +	TB7 CH4 V+	TB5-15
Strain Gauge Input 4 Signal +	TB7 CH4 S+	TB5-16
Strain Gauge Input 4 Signal -	TB7 CH4 S-	TB5-17
Strain Gauge Input 4 Exc -	TB7 CH4 V-	TB5-18
Analog Input 5 High	TB1 1+	TB4-19
Analog Input 5 Low	TB1 1-	TB4-20
Analog Input 6 High	TB1 2+	TB4-21
Analog Input 6 Low	TB1 2-	TB4-22
Analog Input 7 High	TB1 3+	TB4-23
Analog Input 7 Low	TB1 3-	TB4-24
Analog Input 8 High	TB1 4+	TB4-25
Analog Input 8 Low	TB1 4-	TB4-26
24VDC Output	TB1 +24	TB2-27
24VDC Output	TB1 +24	TB2-28
Analog Output 1 – Volts	TB2 V1	TB7-29
Analog Output 1 – mA	TB2 I1	TB7-30
Analog Output 2 – Volts	TB2 V2	TB7-31
Analog Output 2 – mA	TB2 I2	TB7-32
Analog Output 3 – Volts	TB2 V3	TB7-33
Analog Output 3 – mA	TB2 I3	TB7-34
Analog Output 4 - Volts	TB2 V4	TB7-35
Analog Output 4 - mA	TB2 I4	TB7-36
DC Common	TB2 COM	TB7-37
DC Common	TB2 COM	TB7-38

Function	Manual Reference	Terminal Board Designator (used when LCI-90i is used with stainless steel rear enclosure)
Relay Output 1 Normally Closed	TB3 OUT 1 NC	TB10-39
Relay Output 1 Common	TB3 OUT 1 C	TB10-40
Relay Output 1 Normally Open	TB3 OUT 1 NO	TB10-41
Relay Output 2 Normally Closed	TB3 OUT 2 NC	TB10-42
Relay Output 2 Common	TB3 OUT 2 C	TB10-43
Relay Output 2 Normally Open	TB3 OUT 2 NO	TB10-44
Relay Output 3 Normally Closed	TB3 OUT 3 NC	TB11-45
Relay Output 3 Common	TB3 OUT 3 C	TB11-46
Relay Output 3 Normally Open	TB3 OUT 3 NO	TB11-47
Relay Output 4 Normally Closed	TB3 OUT 4 NC	TB11-48
Relay Output 4 Common	TB3 OUT 4 C	TB11-49
Relay Output 4 Normally Open	TB3 OUT 4 NO	TB11-50
5VDC Output	TB6 +5	TB8-60
5VDC Output	TB6 +5	TB8-61
12VDC Output	TB6 +12	TB8-62
12VDC Output	TB6 +12	TB8-63
Channel 1 Count A	TB4 A1	TB8-64
Channel 1 Count B	TB4 B1	TB8-65
Channel 2 Count A	TB4 A2	TB8-66
Channel 2 Count B	TB4 B2	TB8-67
Channel 3 Count A	TB4 A3	TB8-68
Channel 3 Count B	TB4 B3	TB8-69
Channel 4 Count A	TB4 A4	TB8-70
Channel 4 Count B	TB4 B4	TB8-71
DC Common	TB4 COM	TB8-72
DC Common	TB4 COM	TB8-73
9-36VDC Input	TB5 IN+	TB1-74
9-36VDC Input	TB5 IN+	TB1-75
DC Common	TB5 COM	TB1-76
DC Common	TB5 COM	TB1-77
NAMUR Sensor Power Supply	TB5 IS+	TB13-78
NAMUR Sensor Power Supply	TB5 IS+	TB13-79
Digital Input 1	TB5 D1	TB9-80
Digital Input 2	TB5 D2	TB9-81
Digital Input 3	TB5 D3	TB9-82
Digital Input 4	TB5 D4	TB9-83
External Dimming	TB5 DIM	TB3-84

Function	Manual Reference	Terminal Board Designator (used when LCI-90i is used with stainless steel rear enclosure)
RS 485 T+/R+	TB4 T+/R+	TB12-54
RS 485 T+/R+	TB4 T+/R+	TB12-55
RS 485 SHD	TB4 SHLD	TB12-56
RS 485 SHD	TB4 SHLD	TB12-57
RS 485 T-/R-	TB4 T-/R-	TB12-58
RS 485 T-/R-	TB4 T-/R-	TB12-59
RS 232 Transmit - Data	TB4 TX	TB14-51
RS 232 Recieve - Data	TB4 RX	TB14-52
RS 232 Ground - Data	TB4 COM	TB14-53
Ethernet port	J8	J8
USB port	J10	J10

16.0 Appendix H – LCI-90 SS Bracket Mounting Footprint