MEASUREMENT Technology NORTHWEST

LCI-90i
User Manual

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1 Introduction

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

This document covers the installation, configuration, and maintenance of the LCI-90i Line Control Instrument.

2 Product Summary

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 the next generation of the LCI-90 series. It is a direct replacement for existing LCI-90, LCI-90R, and LCI-100 units. The front panel and display technology have been retained as they have been proven to be robust and reliable. The internal electronics have been upgraded for improved performance and to provide new features.

The high-visibility electroluminescent display shows signals from tension and payout sensors in engineering units. The display and the five front panel keys allow the operator to acknowledge alarms and to manipulate the calibration and configuration menus. The label that appears above each key indicates the function on the display. As the operator navigates through various screens, the functions of these keys and their associated labels will change. The operator can configure the LCI-90i to accept inputs from a range of tension and payout sensors, to display the parameters in different locations and resolutions, to enable alarms, and to utilize a variety of communication technologies.

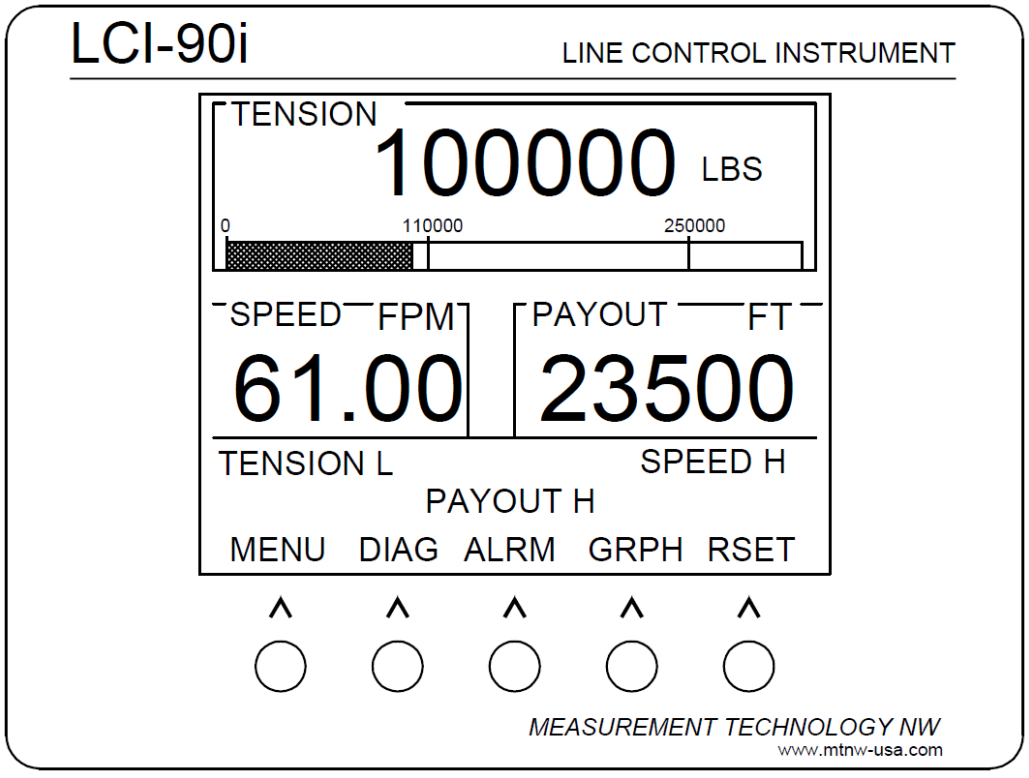


Figure 1 - LCI-90i Standard Display

2.1 Features of the LCI-90i

The new features of the LCI-90i are listed below:

- ***Measurement***
  - 20 mV or 100 mV strain gauge level inputs.
  - Tension and rotational sensors from four winches can be integrated with the display and measured simultaneously.
  - High-speed analog data capture up to 200 Hz.
  - Four strain gauge input channels, no external module required.
  - User-selectable line speed response tuning.
  - Four analog output channels, output range user-selectable.
  - Rotational sensor load resistor user selectable, no DIP switch setting.
  - Four onboard SPDT dry contact relays, no external modules required.
  - Multi-point calibration lookup table for analog inputs.
  - 4 generic digital inputs for payout reset and other functions.

- ***Display***
  - Display up to four winches.
  - Time series graph
  - User-configurable display refresh rate
  - Ability to use color TFT for night time applications
  - Multiple measurement units
    - Tension: Pounds, Kilograms, KIPs, Tons, Metric Tons
    - Payout: Feet, Meters, Fathoms
    - Speed: payout units per second or per minute
  - User-configurable contrast setting
  - Save and load up to eight configurations.

- ***Data Logging***
  - CF disk interface
  - Logic-based logging to reduce amount of idle data
  - Real-time clock for date and time, all data is time stamped

- ***Communications***
  - Baud rate selectable for RS-232 and RS-485
  - USB port (device) for local data logging
  - Ethernet interface, 10BASE-T, UDP and TCP/IP

3 Conditions of Safe Use

36V DC MAXIMUM INPUT VOLTAGE
17W MAX POWER
1.6A FAST-BLOW FUSE

-40°C ≥ Ambient Temperature ≥ +75°C

Maximum relative humidity 95 percent non-condensing

3.1 Hazardous Areas

If the gasket seal is damaged or protrudes beyond the frame of the LCI-90i, the degree of protection is not ensured. When operating the LCI-90i in hazardous areas, the following warnings apply.

SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C AND D HAZARDOUS LOCATIONS OR NONHAZARDOUS LOCATIONS ONLY.

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT WHILE THE CIRCUIT IS LIVE OR UNLESS THE AREA IS KNOW TO BE FREE OF IGNITABLE CONCENTRATIONS.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF ANY COMPONENT MAY IMPAIR SUITABILITY FOR USE IN HAZARDOUS LOCATION.

WARNING - DO NOT REMOVE OR REPLACE FUSE WHEN ENERGIZED.

WARNING - DO NOT OPEN, MAINTAIN, OR SERVICE IN AN AREA WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.

4 Specifications

Table 1 - LCI-90i Specifications

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{IN}	Input Voltage		9	24	36	V DC
I_{IN}	Input Current			0.410		A
$I_{IN\ VMIN}$	Minimum Voltage Current	V_{IN} = 9V DC		1.01		A
$I_{IN\ VNOM}$	Nominal Voltage Current	V_{IN} = 24V DC		0.410		A
$I_{IN\ VMAX}$	Maximum Voltage Current	V_{IN} = 36V DC		0.260		A
AIN_{VRANGE}	Analog Inputs Voltage		0		10	V
AIN_{IRANGE}	Analog Inputs Current		0		22	mA
CNT_{VRANGE}	Counter Inputs		0		12	V
$RS\text{-}232_{RANGE}$	RS-232 Interface		-30		30	V
$RS\text{-}485_{RANGE}$	RS-485 Interface		-12		12	V
$V_{RS485\ ISO}$	RS-485 Isolation Voltage		3000			V
$AOUT_{VRANGE}$	Analog Output Voltage		-5		10	V
$AOUT_{IRANGE}$	Analog Output Current		0		20	mA
$I_{ODOUT\ MAX}$	Maximum Current Optical Digital Outputs				150	mA
$V_{ODOUT\ RANGE}$	Voltage Range Optical Digital Outputs		0		300	V
$I_{DOUT\ MAX}$	Maximum Current Digital Outputs				1000	mA
$V_{DOUT\ RANGE}$	Voltage Range Digital Outputs		0		60	V DC
T_{AMB}	Operating Temperature		-40		75	°C
f_{COUNT}	Counter Frequency		0.05		20000	Hz
V_{DIN}	Digital Input Voltage Range		0		60	V
$V_{DIN\ LOW}$	Logic ‘low’ digital input				2.0	V
$V_{DIN\ HIGH}$	Logic ‘high’ digital input		3.3			V
$f_{ADC\ SAMPLE}$	ADC Sample Rate		1		200	Hz
Res_{ADC}	ADC Resolution			16		bits
Err_{ADC}	ADC Full scale error			0.05		% FS
R_{AIN}	AIN Impedance voltage mode	SW2 OFF		1		MΩ
	AIN Impedance current mode	SW2 ON		220		Ω
f_{AOUT}	AOUT Sample Rate		1		200	Hz
Res_{AOUT}	AOUT Resolution			12		Bits
Err_{AOUT}	AOUT Full scale error			0.05		% FS

4.1 Electrical Ratings for Hazardous Locations

Table 2 - Electrical Ratings for Hazardous Locations

Parameter	Terminal	Rating
Input Voltage	TB1	9-36Vdc, 17W max.
Input Current	TB1	16.5 V, 120 mA. max.
Counter Interface	TB6	0 V, 5 V dc, 12 V dc
RS-232 Interface	TB4	±5.7 V signal
Display Dimming	TB5	0 V to 5 V Input
Analog Inputs	TB1	0 V to 10 V 4-20 mA
Strain Gauge Inputs	TB7	±5 V input
Analog Outputs	TB2	±5 V, +10 V, 4-20 mA.
RS-485 Interface	TB4	±12 V signal
Optically Isolated Digital Outputs[1]	TB3	300V Max, 150mA
Digital Outputs[2]	TB3	60V Max, 1000mA
Digital Inputs	TB5	0 V, 3.3 V

1. Available on hazardous location model.
2. Available on standard model.

4.2 Mechanical

Parameter	Dimension
Front Panel	7.6” wide x 5.7” tall x 4.1” deep
Panel Cut-out	7.15” wide x 5.25” tall
Weight	3.5 lbs.
View Angle	160°
Viewing Area	4.7” wide x 3.6” tall
Pixel Area	320 x 240 pixels
Gasket Material	Urethane
Front Panel Material	316 Stainless Steel
Window Material	Polycarbonate
Front Panel Rating	NEMA 4X
Rear Enclosure Rating	NEMA 1

4.3 Certifications

Parameter	Dimension
UL, cUL	Class I Division 2 Groups A, B, C, and D UL File E355852

5 Quick Start

Use the quick start section to quickly set up the LCI-90i. This section addresses the process for setting up a LCI-90i for a basic configuration.

5.1 Mounting

The LCI-90i will fit in a 7.15" x 5.25" cut-out, with a minimum of 4.028" depth clearance. 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.

5.2 Basic Field Wiring

In its default configuration, the LCI-90i requires wiring for power, a force transducer, and two payout sensors to measure rotation. The LCI-90i can be connected to a broad range of field sensors. Note that the base unit LCI-90i is shipped with hardware settings for 4-20 mA tension signals. If voltage signals are used instead, set DIP switches accordingly.

The LCI-90i is a DC device approved for Overvoltage Installation Category III. It accepts power in the range of 9-36VDC (nominal 24VDC) rated at 17 Watts. 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.

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.

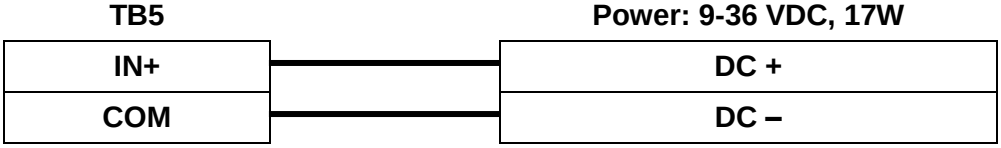


Figure 2 - Power Supply

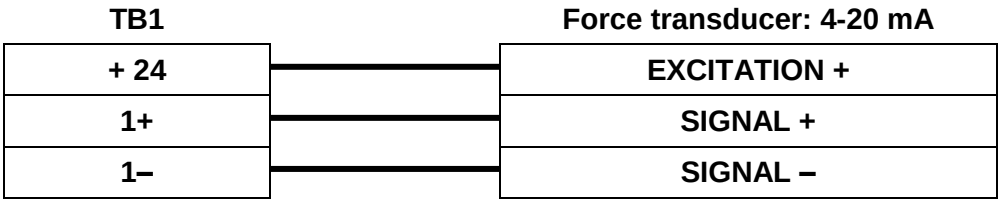


Figure 3 - Force Sensor Connection

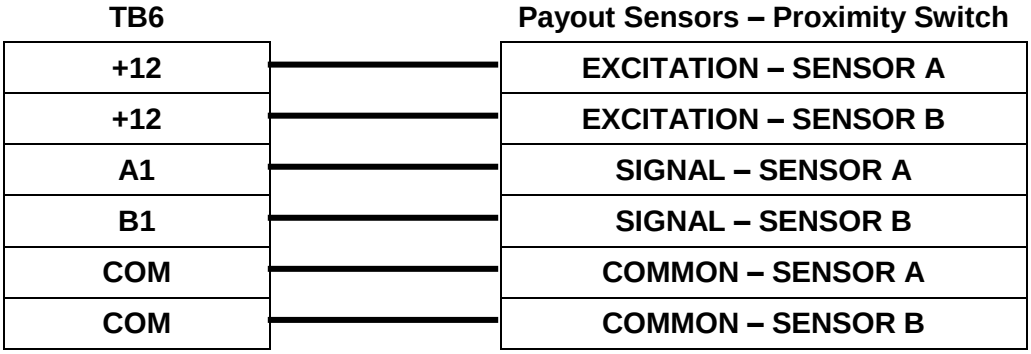


Figure 4 - Count Sensor Connection

5.3 Basic Operation

The LCI-90i is configured at the factory to display only one winch's line parameter data.

Tension is at the top of the screen. The tension measurement is shown in both numeric format and as a bar graph. The factory default setting for tension units is pounds (LBS) with one decimal place.

Speed is displayed on the middle left of the display. Speed is shown in meters per minute (MPM) with no decimal places.

Payout is displayed on the middle right of the display. Payout is shown in meters (M) with one decimal place.

The calibration values for the tension and payout sensors must be set for each system. The following describes the simplest calibration for the typical sensors indicated above.

To calibrate either the tension or payout sensors use the **UP** and **DOWN** keys to move the cursor to the **CALIBRATION** menu item. Press the **ENT** button to open the **CALIBRATION** menu.

	0	MAIN MENU v1.xx A
	1	SET ALARMS
>	2	CALIBRATION
	3	DISPLAY CONFIGURATION
	4	SYSTEM CONFIGURATION

RUN	UP	DOWN	ENT	ESC

Figure 5 - Main Menu

To calibrate the payout sensor, use the **UP** and **DOWN** keys to move the cursor to the **PAYOUT AND SPEED CAL.** menu item. Press **ENT** to open the Payout Calibration menu.

	2.0 CALIBRATION			
	1	WINCH NUMBER	1	
	2	TENSION CALIBRATION		
>	3	PAYOUT AND SPEED CAL.		
	4	WRAP ANGLE	120	DEG
	5	SHUNT CALIBRATION		NONE
	6	TENSION SAMPLE RATE	20	Hz
	7	TENSION SMOOTHING		OFF
	8	TENSION TARE		OFF

RUN	UP	DOWN	ENT	ESC

Figure 6 - Calibration Menu

Use the **UP** and **DOWN** keys to move the cursor to the **PAYOUT SCALE** menu item. Press **ENT** to edit the **PAYOUT SCALE**.

	2.3 PAYOUT CAL. WINCH 1		
>	1	PAYOUT SCALE	1.000 P/M
	2	PAYOUT PRESET	0.0 M
	3	COUNTER MODE	QUAD 1X
	4	LOAD RESISTOR	PULL UP
	5	SPEED FILTER LEVEL	4
	6	SPEED RESPONSE TIME	4 S

RUN	UP	DOWN	ENT	ESC

Figure 7 - Payout Calibration Menu

Use the **INCR**, **DECR** and → keys to change the value to the correct number of pulses per meter. Pressing **ENT** will accept the new value and save to memory; pressing **ESC** will restore the previous value.

To calibrate the tension sensor, select **TENSION CALIBRATION** from the calibration menu. Move the cursor to the **FULL SCALE** menu item and press the **ENT** key to edit the field. Enter the full scale output of the force sensor. Pressing **ENT** will accept the new value and save to memory; pressing **ESC** will restore the previous value.

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

RUN	UP	DOWN	ENT	ESC

Figure 8 - Tension SCL/OFF Menu

6 Mechanical Installation

The LCI-90i is designed for mounting on the front panel of an enclosure with a suitable environmental rating. The front panel 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".

6.1 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 silicone gasket is attached to the backside 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.

6.2 Dimensions and Cutout

The LCI-90i will fit in a 7.15" x 5.25" cutout (tolerance –0.010", +0.100"), with a minimum of 4.028" depth clearance. The mounting surface can be up to 5/8" thick.

6.3 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 inserting 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.

6.4 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.

6.5 Cleaning Instructions

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

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

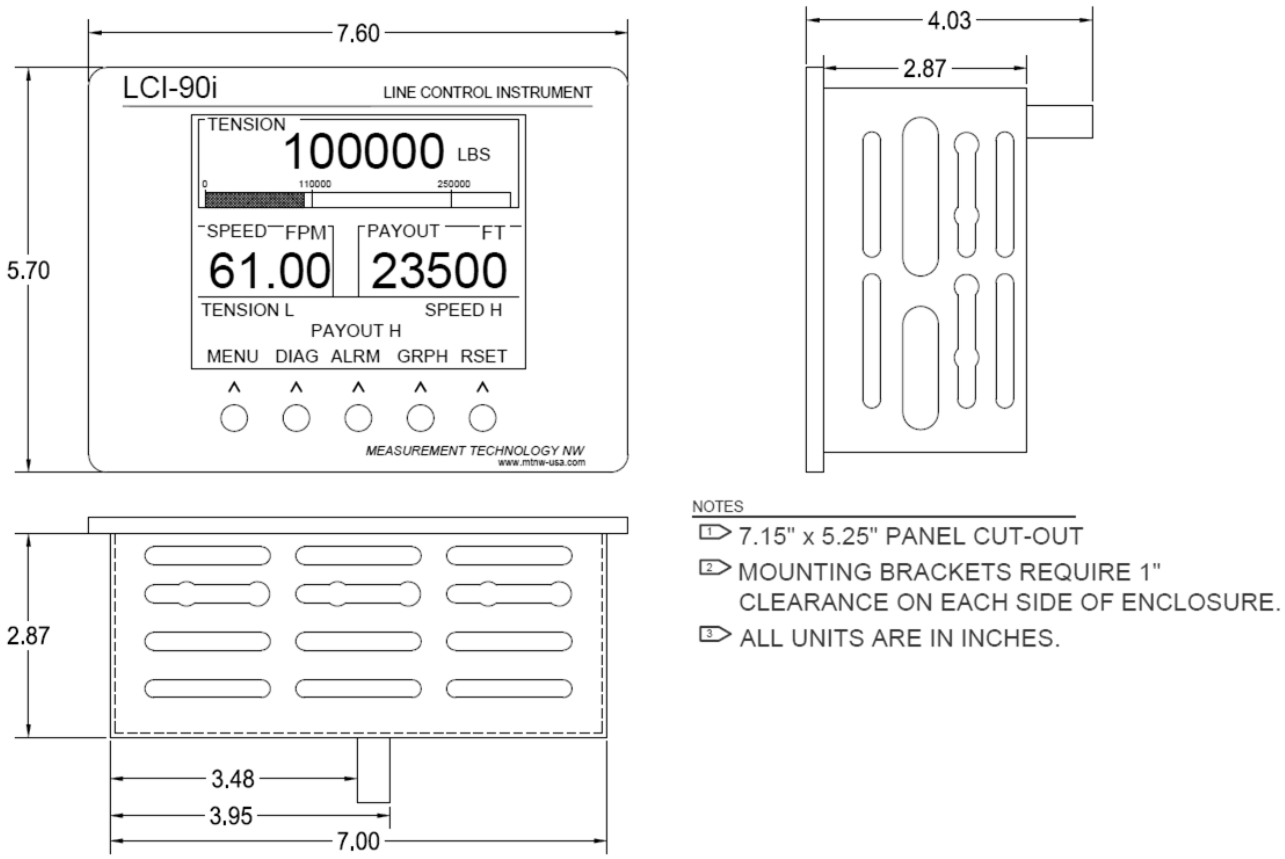


Figure 9 - Mechanical Dimensions

7 Field Wiring

The LCI-90i can be configured for a wide range of signal input and output functions. Use the following sections to connect the LCI-90i to power supplies, field sensors, and communication networks.

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

7.1 Power Input

The LCI-90i accepts 9 to 36 V DC. The input current varies based on the power supply voltage. The LCI-90i is approved for Overvoltage Installation Category III.

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.

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.

If the fuse needs to be replaced, use Table 3 to select the appropriate fuse and part number. The LCI-90i ships with a 0.625A fuse.

Table 3 - F1 Fuse Ratings

Power Supply Voltage	Fuse Rating	Littelfuse Part No.
9V DC	1.75A	218002.
12V DC	1.25A	2181.25
24V DC	0.625A	218.630
36V DC	0.5A	218.500

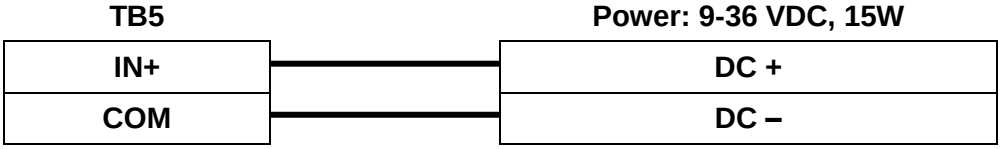


Figure 10 - DC Power Supply Connection

7.2 Sensor Power Supply

Several regulated power supplies are available from the LCI-90i to power field sensors. These power supplies are intended to provide a low-noise regulated supply to sensitive field sensors. All sensor power supplies are referenced to the electrical ground connected to COM on TB5.

Table 4 - Field Sensor Power Supplies

Supply	Terminal Block	Maximum Current Draw
+5V DC	TB6 +5	0.35A
+12V DC	TB6 +12	1.2A
+24V DC	TB1 +24	1.1A
±2.5V DC, ±5V DC	TB7 V+ / V-	0.277A

Each power supply output has an internal resettable fuse. In the event of an overload or short, disconnect the load from the power supplies. The resettable fuse will reset. Correct the issue with the load and reconnect to the LCI-90i.

It is possible to overload the circuit and cause damage beyond the capability of the resettable fuse. In this case the unit will need to be returned to Measurement Technology NW for review and repair.

7.3 Analog Inputs

Two types of analog inputs are available on the LCI-90i:

1. Four voltage/current inputs
2. Four strain gauge inputs

The voltage / current inputs can accept a range of voltage inputs or a 4-20mA current signal.

The strain gauge analog inputs are intended to be connected to a Wheatstone bridge as found in load cells and pressure sensors. The strain gauge analog inputs have a excitation voltage power supply for each of the inputs.

The LCI-90i can accept input from single-axis, dual-axis, summed, or averaged force sensor configurations.

Table 5 - Analog Input Configurations

Input Channel	Terminal Block	Configurations
AIN-1	TB7 – CH 1	±20mV Strain Gauge ±100mV Strain Gauge
AIN-2	TB7 – CH 2	
AIN-3	TB7 – CH 3	
AIN-4	TB7 – CH 4	
AIN-5	TB1 – 1+ and 1-	4-20mA 0-5V 0-10V ±5V
AIN-6	TB1 – 2+ and 2-	
AIN-7	TB1 – 3+ and 3-	
AIN-8	TB1 – 4+ and 4-	

It is possible to measure high-level signals (4-20mA, 0-5V, 0-10V, and ±5V) on input channels AIN-1 through AIN-4. Please contact Measurement Technology NW if additional high-level inputs are required.

7.3.1 Voltage / Current Inputs

The DIP switch SW2 controls the mode of the analog input. The switch connects a 220Ω resistor from the input to DC common. The DIP switch must be in the ON position if the signal is a 4-20mA type and OFF if the signal is a voltage.

Table 6 - Analog Input DIP Switch Settings

Analog Input Channel	OFF	ON*
AIN-5 [SW2-1]	Signal Type: Voltage High Impedance Input	Signal Type: Current (4-20mA) 220Ω load resistor
AIN-6 [SW2-2]		
AIN-7 [SW2-3]		
AIN-8 [SW2-4]		

* Factory Default

The DIP switch is ON when the switch is in the *UP* position. The ON position is marked on the DIP switch.

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

Analog sensors can be powered externally, from the same power supply used to power the LCI-90i, or from the regulated sensor power supplies (+5V, +12V, or +24V).

Note: The terminal labeled IN+ on TB5 is the power input for the LCI-90i. It is not the regulated supply output for sensor excitation. If the same power is used for both the display and the sensor, it is up to the user to ensure that the power supply is regulated to meet the requirements of both the sensor and the display.

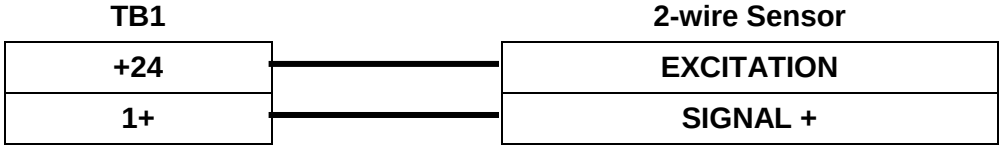


Figure 11 - 2-wire Sensor

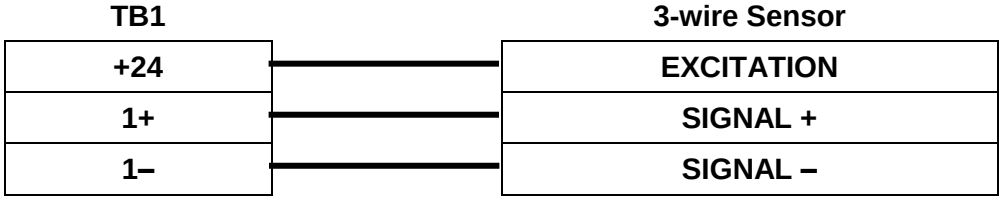
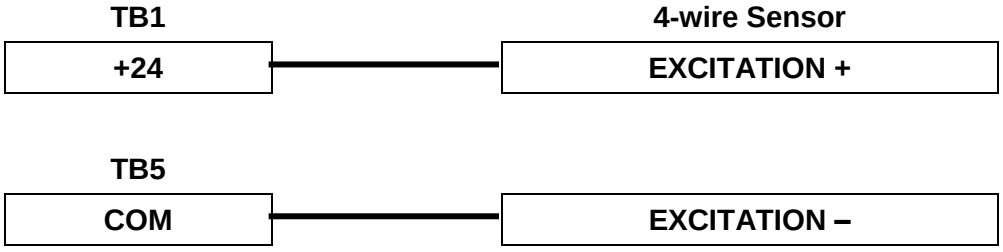


Figure 12 - 3-wire Sensor



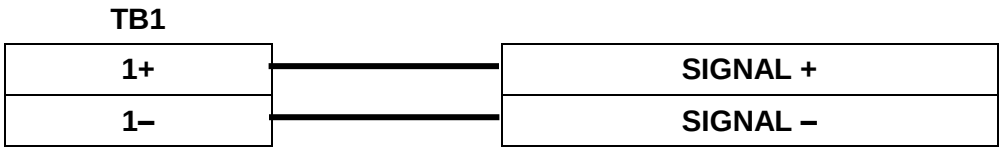


Figure 13 - 4-wire Sensor

7.3.2 Strain Gauge Inputs

The strain gauge inputs can accept ±20mV or ±100mV range sensors. There are four inputs on TB7, referred to as AIN-1, AIN-2, AIN-3, and AIN-4, respectively. The default factory setting is ±20mV input range.

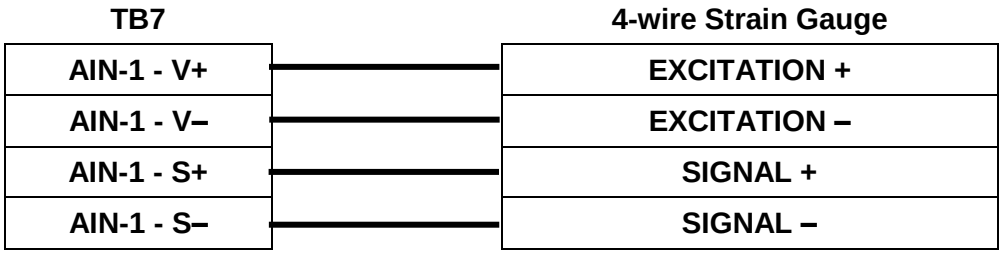


Figure 14 - 4-wire Strain Gauge

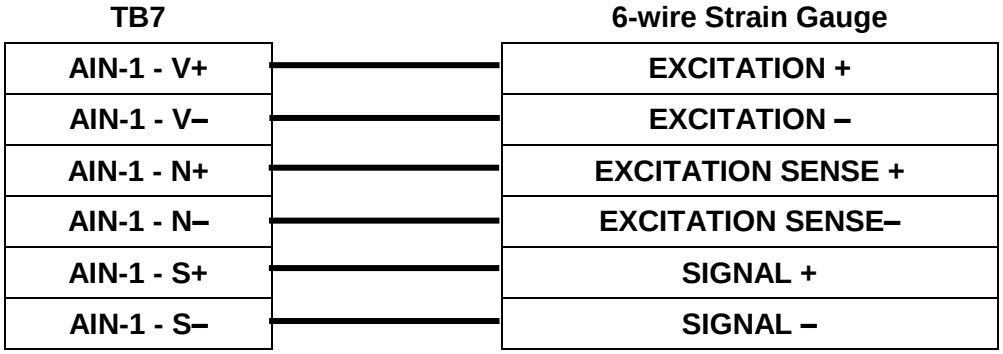


Figure 15 - 6-wire Strain Gauge

7.4 Counter Inputs

Up to four quadrature counter inputs can be connected the LCI-90i. Terminal block TB6 provides +5V, +12V, inputs, and electrical ground for count sensors. Each channel can accept NPN or PNP type proximity sensors, Hall-Effect sensors, NAMUR type sensors, or TTL/CMOS encoder inputs. The input voltage thresholds are set to accommodate the ranges of all these sensor types with no adjustment.

Voltage thresholds are 3 volts for low-high transitions, and 2 volts for high-low transitions.

Pull-up and pull-down resistors can be enabled using the **PAYOUT AND SPEED CAL.** menu system.

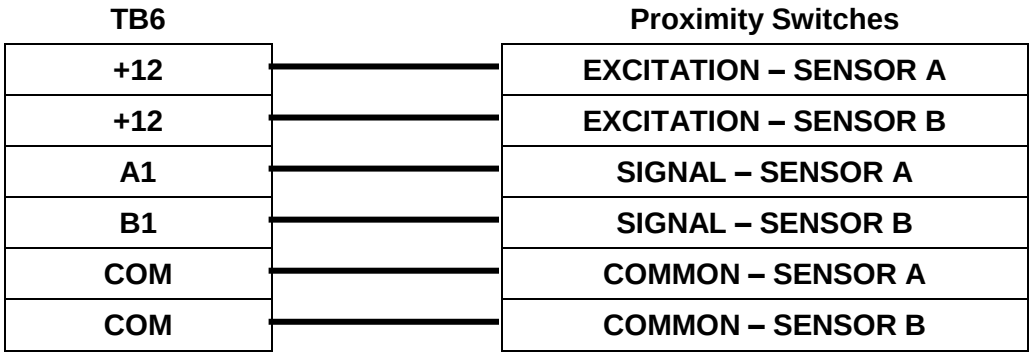


Figure 16 - NPN/PNP Proximity Sensors

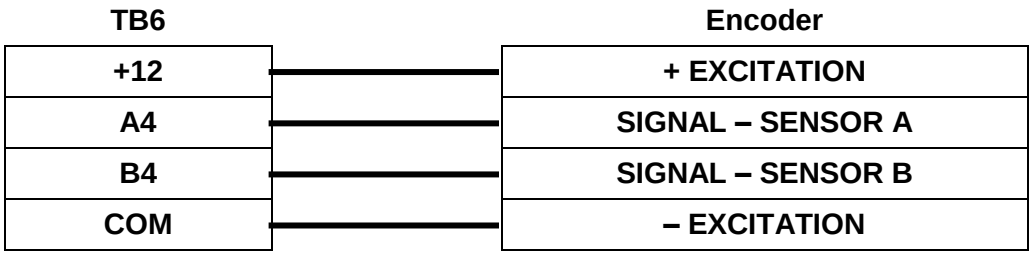


Figure 17 - Hall Effect Sensor

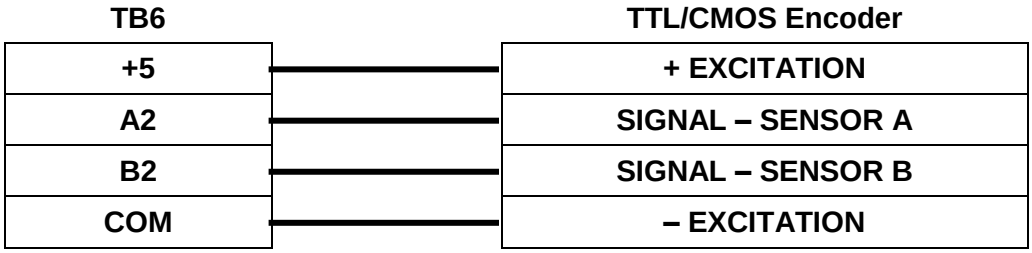


Figure 18 - TTL/CMOS Encoder

7.4.1 Magnetic Pickup Sensor

The counter inputs may be connected to a magnetic pickup sensor. The counter input is compatible with both digital (TTL) and analog (sine) signals. Four switches on the LCI-90i Terminal Board control the input type. To enable the magnetic pickup sensor interface place the switch in the up position.

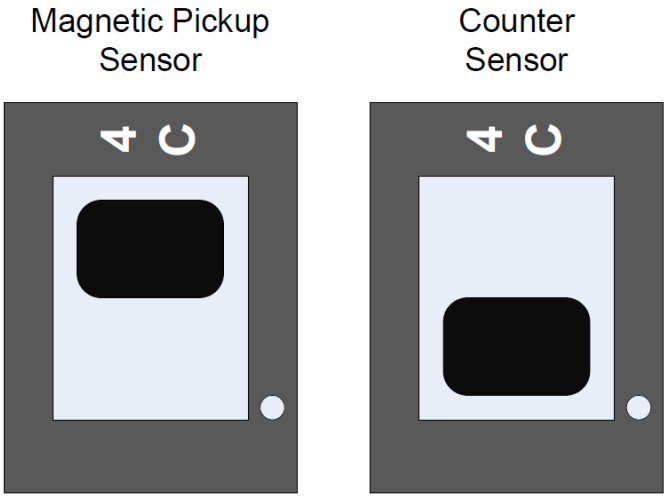


Figure 19 - Count Sensor Interface DIP Switch Positions

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

Connect the magnetic pickup sensor output signal to the 'A' input of a counter channel. The 'B' input controls the count direction. It can be left unconnected.

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

7.5 Digital Outputs

Four digital outputs are available on the LCI-90i. The digital outputs are asserted during alarm conditions. The LCI-90i uses internal SPDT dry contact relays or optically isolated outputs to represent the alarm states. The Input Check alarm uses Digital Output Channel 4. The Shunt Calibration feature may use any of the relays.

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

Figure 20 - Digital Output

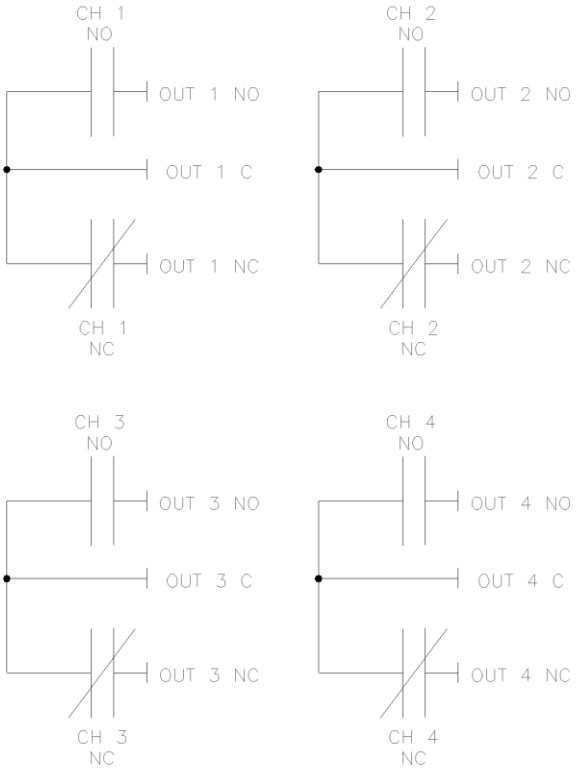


Figure 21 - Digital Output Circuit Schematic

7.6 Digital Inputs

The LCI-90i provides four digital inputs on terminal block TB5. The digital inputs can be configured using the menu system to change the display, reset payout measurements, and tare tension. Consult Measurement Technology NW if additional functionality is required.

The digital inputs are pulled low to DC common and are logic-high configuration.

It is recommended to use a normally-open momentary push button. The switch can be connected to +12V on TB6 or IN+ on TB5.

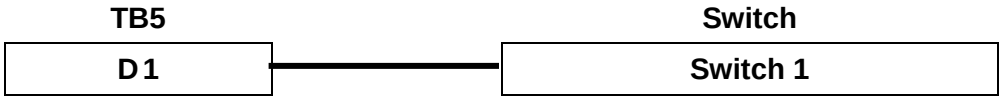


Figure 22 - Digital Inputs

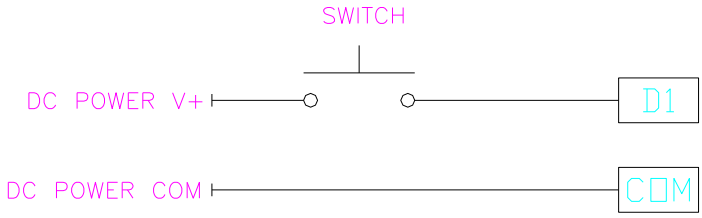


Figure 23 - Digital Input Using External Voltage Source

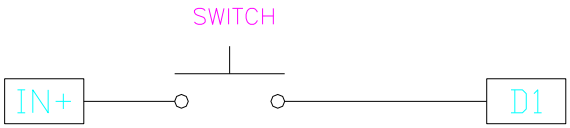


Figure 24 - Digital Input Using Internal Voltage Source

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).

7.7 Analog Outputs

The LCI-90i provides four analog outputs on terminal block 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.

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

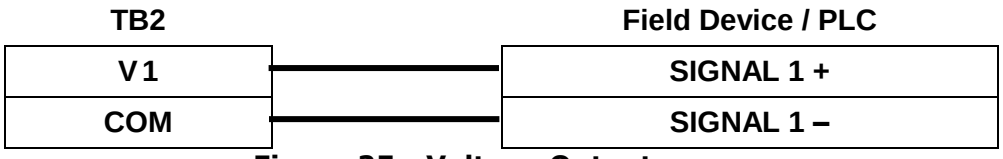


Figure 25 - Voltage Outputs

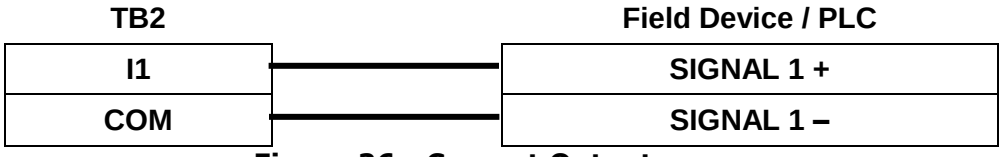


Figure 26 - Current Outputs

The output signal type is configured using the menu system. Each channel can be linked to a winch measurement (tension, speed, or payout) and scaled as needed.

7.8 Serial Communication

The LCI-90 provides USB, RS-232, and RS-485 serial communication interfaces. Use the electrically-isolated RS-485 port for long cable runs or multi-drop applications.

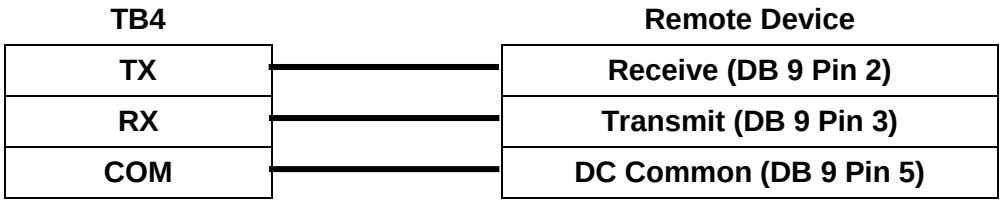


Figure 27 - RS-232 Serial Interface

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

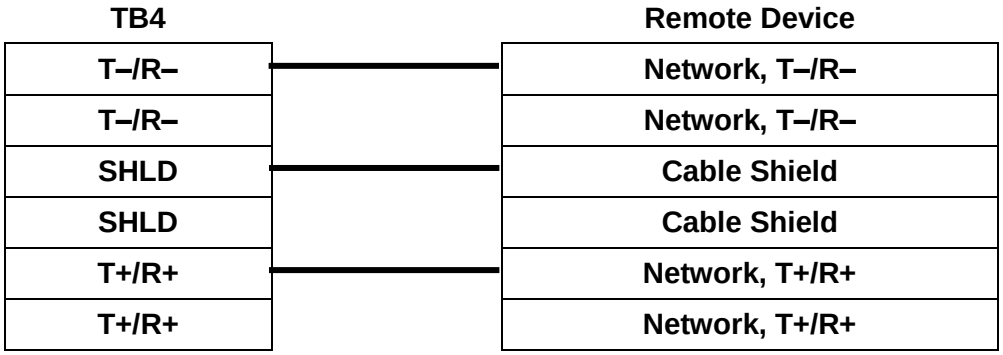


Figure 28 - RS-485 Serial Interface

The USB interface provides a virtual serial port on Microsoft Windows PCs. Before connecting the LCI-90i to a PC, ensure the correct software driver is installed. The software driver is available from Measurement Technology NW.

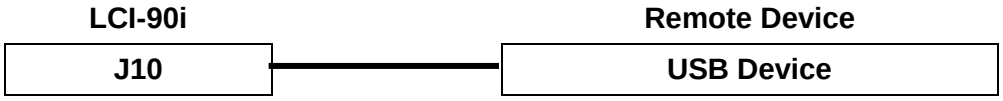


Figure 29 - USB Connection

7.9 Ethernet

The LCI-90i has an Ethernet port on the rear of the unit designated J8. This is the preferred interconnect for exchanging data between local units and remote devices.

Any standard Ethernet cable can be used if the LCI-90i is being plugged into a router, hub, or switch. However, if connecting the LCI-90i directly to a PC or another LCI-90i, use a crossover cable instead.

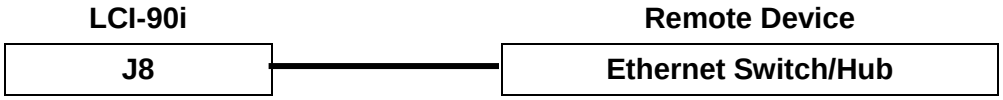


Figure 30 - Ethernet Interface

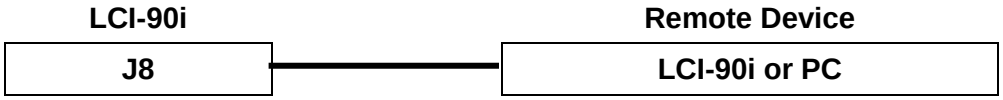


Figure 31 - Ethernet Interface (Crossover)

7.10 CF Disk

Winch parameters (tension, speed, and payout) can be recorded to a CF disk in real-time. All winch parameters are recorded with a timestamp for later analysis and review.

Measurement Technology NW recommends using industrial grade Delkin Devices CF Disks.

A CF disk can be inserted into the CF disk slot on the right side of the display. Do not insert or remove the disk while the device is powered on. Ensure the device is powered off before inserting or removing the disk.

7.11 Display Contrast

It is possible to externally control the display contrast using a potentiometer. The brightness of the LCI-90i display can be controlled by either adjusting the contrast menu setting or using an external potentiometer. Decreasing the brightness prolongs the life of the screen. The menu selection allows the operator the ability to adjust the contrast from 1-10 with 10 being the brightest. Note that whenever you press a menu button the menu is displayed at maximum brightness no matter which brightness level is selected. 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 Measurement Technology NW for assistance.

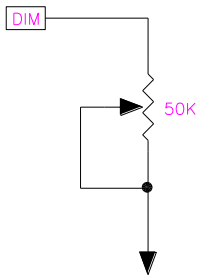


Figure 32 - Display Contrast Circuit Schematic

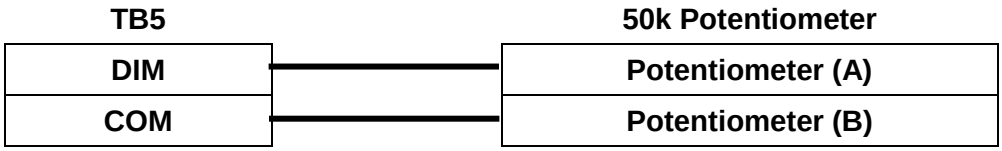


Figure 33 - Display Contrast Connection

8 Operation

The LCI-90i front panel, shown in Figure 34, features a high visibility display and a five-button keypad. Each key has a label at the bottom of the screen that identifies its function. The functions and labels of these keys change according to the current state of the display.

Upon power up the Main Screen is displayed. This screen is divided into 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.

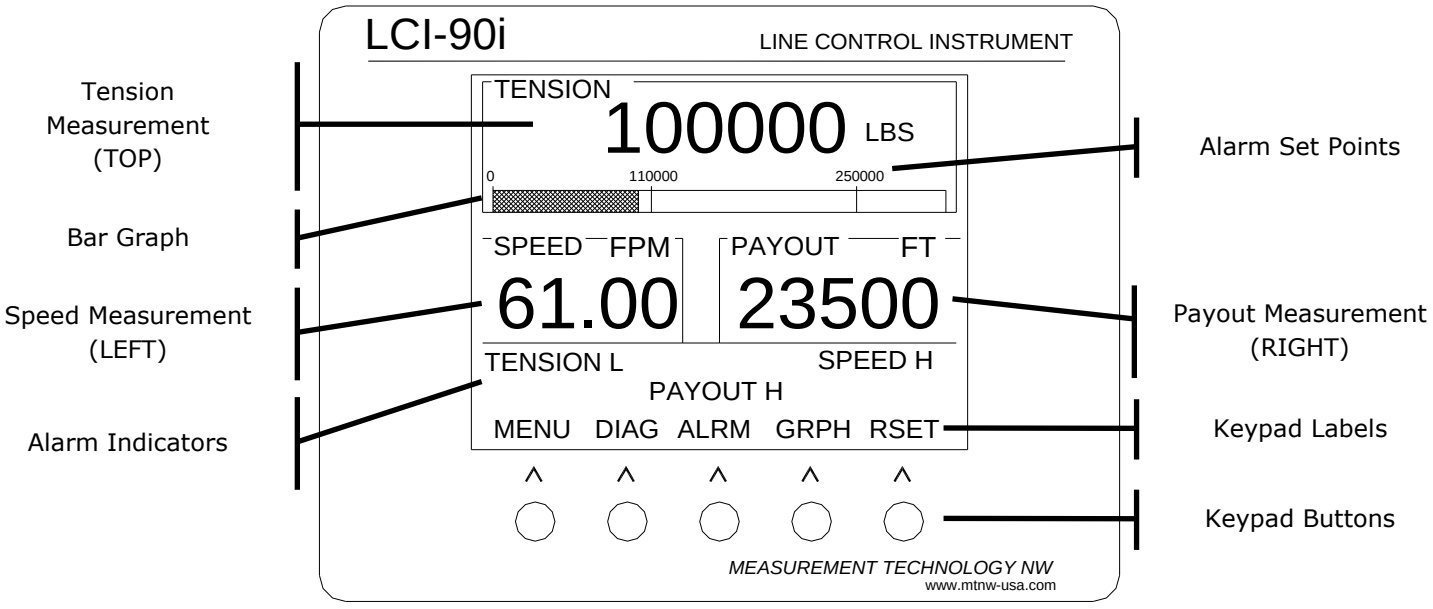


Figure 34 - LCI-90i Main Screen Layout

8.1 Keypad

The functions of the keypad during RUN mode are as follows:

MENU Displays the menu for programming and/or calibrating the unit. Section 8.2 describes how to navigate and edit data within the programming menus.

DIAG Displays 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. Further presses of the DIAG button toggle between diagnostic displays.

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

GRPH Displays the time series line graph.

RSET Resets the payout measurement to zero. Press the key twice to reset the payout to zero.

8.2 Menu System

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.

Pressing the **MENU** key displays the main menu. 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 Main Screen.

UP Moves the cursor up the menu.

DOWN Moves the cursor down the menu.

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

ESC Moves back one menu level. Pressing this button from the main menu returns the LCI-90i to the Main Screen.

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

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 Discards the edited value and returns to menu mode.

8.3 Alarms

The LCI-90i provides the user with up to six alarms that can be configured to indicate high and low conditions of tension, payout, and speed. The six alarms can be assigned to any winch. 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.

The lower third of the Main Screen is reserved for alarm messages. The alarm messages correspond to the alarm configuration.

In the example shown in Table 7, alarms 1-2 are configured as high tension alarms for winch 1, alarms 3-4 as high and low payout alarms for winch 2, alarm 5 as a high speed alarm for winch 4, and alarm 6 is unused. Each alarm has its own location.

Table 7 - Alarm Indicator Example

TENSION1 H	PAYOUT2 H	SPEED4 H
TENSION1 H	PAYOUT2 L	

Two separate menus are used for alarms. The Set Alarms summarizes alarms and allows adjusting alarm limits only. This menu can be reached from the front panel by double pressing the **ALRM** keypad button. The Alarm Configuration menu is used to configure the LCI-90i to identify the alarm variable and type, enable relay outputs, and set the dead-band for each channel.

8.3.1 Alarm Summary

The Set Alarms menu summarizes the enabled alarms and allows the alarm limit to be adjusted.

From the RUN screen double-press the **ALRM** keypad button, or press **MENU** and select the **SET ALARMS** item. Alarm limits will only be displayed if an alarm is enabled.

Upper limits are indicated by a greater-than sign **>** and lower limits by a less-than sign **<**. Press **ENT** to change the set point using the **DECR, INCR** and **→** keys. Save the change by pressing the **ENT** key.

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

8.3.2 Configuring Alarms

To configure the alarm settings, go to the Alarm Configuration menu shown below by pressing the **MENU** key from the RUN screen and navigating through the menu system. The Alarm Configuration menu is displayed by selecting the Alarm Configuration menu item from the main menu.

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

Figure 35 - Alarm Configuration Menu

Item 1 Selects one of the six alarms. Edit this field first to view the information for the desired alarm channel.

Item 2 Enable or disable the alarm.

Item 3 Measurement variable to monitor. An alarm can be configured to monitor tension, speed, or payout. Set to NONE to disable the alarm.

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 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 Sets the relay to be closed in the event of an alarm condition. See Table 8 for relay assignments.

Table 8 - Relay (Digital Output) Assignments

RELAY	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

8.3.3 Alarm Types

Alarms are activated 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 Set Alarms menu 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, and by the letter "L" in the alarm message.

	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			

8.3.4 Alarm Acknowledgment

When an alarm event occurs the alarm message is displayed in the lower part of the Main Screen identifying the source of the alarm. This message remains on the screen as long as the alarm condition exists. The message will clear when the alarm condition ceases. If a relay is assigned to an alarm the NO terminal will close and the NC terminal will open.

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

8.3.5 Alarm Relays

Each alarm can be configured to trigger one of four relays. Alarm conditions can also be used to turn on a warning light, generate an audible signal, or signal a remote monitoring system. More than one alarm can be assigned to the same relay.

> **Note:** Remember that Input Check errors will assert Relay 4 and the Shunt Calibration feature may be configured to use a relay. This may cause false alarms or other unintended operation.

The LCI-90 provides a quick method to disable a relay while still indicating to the user of an alarm condition. A single press of the **ALRM** button will de-energize all active relays, but the on-screen alarm messages will remain until the conditions goes away. Note that if the variable falls below the limit, but then exceeds it again, the alarm relay will reactivate. Pressing the **ALRM** button does not disable future alarms, it only resets current ones.

8.4 Calibration

The tension, speed, and payout measurements require calibration. Calibration consists of calculated values or live measurements in the field. The calibration menu allows the calibration of tension, speed, and payout measurements. The Calibration menu can be found by selection the **CALIBRATION** menu item from the Main Menu.

	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**

Figure 36 - Calibration Menu

Item 1 Selects one of the four winches. Edit this field first to set the winch to be calibrated.

Item 2 Display the **TENSION CALIBRATION** menu.

Item 3 Display the **PAYOUT AND SPEED CAL.** menu.

Item 4 Set the wrap angle of the winch line.

Item 5 Enables or disables the shunt calibration relay.

Item 6 The rate at which measurements are sampled. This also sets the rate at which data is transmitted over communication interfaces and recorded to the CF disk.

Item 7 Enables or disables averaging of analog measurements.

Item 8 Perform a tension tare and zero the tension measurement for the winch set in row 1.

8.4.1 Wrap Angle (Single Axis Load Pin)

To set the wrap angle for a single-axis load-pin, select the **WRAP ANGLE** menu item from the Calibration menu and press the **ENT** key to edit the value.

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.

The LCI-90i has the ability to correct for variations in sheave geometry by allowing the user to specify the wrap angle. 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 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. The two-point method automatically adjusts the scale and offset values to compensate for fixed wrap angles.

Note: 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).

8.4.2 Sensor Angle (Two Axis Load Pin)

To set the sensor angle for a two-axis load-pin application, select the **SENSOR ANGLE** menu item from the Calibration menu and press the **ENT** key to edit the value.

Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes.

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. Even small deviations from this orientation can lead to substantial errors. These errors can be corrected by specifying the correct Sensor Angle.

An angle of '0' corresponds to the 'ideal geometry'. 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. 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 MTNW for additional information.

8.4.3 Shunt Calibration

To perform a shunt calibration, select the **SHUNT CALIBRATION** menu item from the Calibration menu and press the **ENT** key to edit the value.

Select **SHUNT CALIBRATION** from the Calibration menu 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 close. To remove the shunt calibration, set the **SHUNT CALIBRATION** back to **NONE**.

Shunt calibration 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. A 24VDC relay in the load pin is recommended.

8.4.4 Tension Sample Rate

To modify the tension sample rate, select the **TENSION SAMPLE RATE** menu item from the Calibration menu and press the **ENT** key to edit the value.

Select **TENSION SAMPLE RATE** from the Calibration menu and press **ENT** to activate edit mode. Use the **INCR**, **DECR** and → keys to change the value. Press **ENT** to save the new value or **ESC** to cancel the changes.

The tension sample rate defines how frequent the display can run (i.e., measure 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 all active winches. However, this sample rate is not guaranteed when data logging or broadcasting is added over various channels. The LCI-90i samples as fast as possible up to the specified rate.

The display update rate is set independently.

8.4.5 Tension Smoothing

To modify the tension smoothing filter, select the **TENSION SMOOTHING** menu item from the Calibration menu and press the **ENT** key to edit the value.

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.

The tension smoothing filter level specifies the amount of noise filtering applied to tension measurements. The value indicated in the Tension Smoothing setting

corresponds to the number of tension samples averaged in the moving average filter. The default state for this is **OFF**, where no filtering is applied. This is recommended when accurate tension reporting is required.

Setting the filter level to 5 gives the maximum smoothing and noise reduction available. Tension Smoothing removes noise without reducing the tension sample rate. The downside is that some information, such as short tension spikes, may be lost in the smoothing.

8.4.6 Tension Tare

To perform a tension tare, select the **TENSION TARE** menu item from the Calibration menu and press the **ENT** key to edit the value.

Press the **ENT** key to activate edit mode. Set to ON to enable the tare mode.

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. 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.

The tare function is a way to zero a small displayed tension value. The tare function can be deactivated at any time, returning the unit to its normal tension display.

> **Warning**: 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.

8.5 Tension Calibration

To calibrate the tension measurement, select the **TENSION CALIBRATION** menu item from the Calibration menu and press the **ENT** key to edit the value.

Press **ENT** to display the tension calibration menu.

The **CALIBRATION MODE** menu item selects between the following calibration modes:

1. Scale and Offset
2. Two-point
3. Lookup Table

8.5.1 Scale and offset

The Scale and Offset calibration method is the least accurate of the three calibration methods. It relies on knowing the full-scale output of the sensor.

Several sources of error including mechanical and electrical influences can negatively affect the accuracy of the tension measurement.

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

Figure 37 - Scale and Offset Tension Calibration Menu

Item 1 Calibration mode: SCL/OFS, TWO-POINT, LOOKUP.

Item 2 The full-scale value corresponds to the load at 20mA on a 4-20mA sensor, or to the load at 5.00V on a 0-5V DC sensor.

Item 3 The offset corresponds to the load at 4mA on a 4-20mA sensor, or to the load at 0.0V on a 0-5V DC sensor.

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

8.5.2 Two-point Calibration

The two-point 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 based on the applied weights.

When a two-point live calibration is completed, the scale and offset values are automatically updated to reflect the new calibration. This eliminates the chance of conflicting calibration values in the two modes.

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

Figure 38 - Two-point Tension Calibration Menu

Item 1 Calibration mode: SCL/OFS, TWO-POINT, LOOKUP.

Item 2 The value to be displayed at the low input of the sensor. This value is typically zero or a value near zero.

Item 3 The value to be displayed at the high input of the sensor. This value is ideally near the full-scale of the sensor.

Item 4 Sensor input capture mode: EDIT or LIVE. In edit mode the input can be changed using the keypad. In live mode the input is updated directly from the analog input. Live mode is used when performing a calibration with weights or a known load.

Item 5 The electrical output of the sensor during a low load condition.

Item 6 The electrical output of the sensor during a high load condition.

8.5.3 Two-point Tension Calibration Procedure

1) Apply known or measured **LOW** tension to the winch line.

2) Move the cursor to **DISPLAY LOW** using the **DOWN** key and press **ENT**. Edit the **DISPLAY LOW** value to correspond to the applied load. Press **ENT** when complete.

3) Set **LIVE/EDIT** to **LIVE**. This will make the LCI-90i read live data from the tension input sensor for the calibration. As an alternative, **EDIT** allows the user to manually set the **INPUT LOW** and **INPUT HIGH** values.

4) Move the cursor to **INPUT LOW** 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**.

5) Once the reading has stabilized, press **ENT** to grab the value, or **ESC** to cancel the reading.

6) Repeat, applying a known or measured **HIGH** tension to the winch line.

7) Move the cursor to **DISPLAY HIGH** using the **UP** key and press **ENT**. Edit the **DISPLAY HIGH** number to correspond to the applied load. Press **ENT** when complete.

8) Move to **INPUT HIGH** 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**.

9) Once the reading has stabilized, press **ENT** to grab the value, or **ESC** to cancel the reading. While not recommended, the user may sometimes need to edit the **INPUT LOW** and **INPUT HIGH** fields. This may be accomplished by moving to **LIVE/EDIT** and changing it from **LIVE** to **EDIT**. This allows the **INPUT HIGH** and **LOW** values to be edited like any other menu item.

10) Press the **RUN** key to apply the two-point linear fit to the scale and offset values and save the results.

8.5.4 Look-up Table

The menu for selecting a look-up table calibration function is shown below with some sample user-defined lookup tables. Edit the **USE TABLE ID.** menu item to select the lookup table for the current winch set in the Calibration menu. 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	**CALIBRATION MODE LOOKUP**
>	**2**	**USE TABLE ID. C**
	A	**TRACTION WINCH 1**
	B	**NO TABLE**
	C	**TRACTION WINCH 4**
	D	**NO TABLE**
	E	**NO TABLE**
	8	**CREATE/EDIT LOOKUP TABLE**

Figure 39 - Look-up Table Tension Calibration Menu

Item 1 Calibration mode: SCL/OFS, TWO-POINT, LOOKUP.

Item 2 Lookup table to be used for tension measurement. Note the winch number in the menu system title.

Item A-E Lookup table name (if configured).

Item 8 Display the lookup table editor.

8.6 Payout and Speed Calibration

Press the **MENU** and select the **CALIBRATION** menu item to calibrate the payout and speed measurements. Scroll down to the **PAYOUT AND SPEED CAL.** menu item, then press **ENT** to display the payout and speed calibration menu, **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**	**4 S**

Figure 40 - Payout and Speed Calibration Menu

Item 1 The number of pulses per meter. Units are set by the Display Configuration menu system.

Item 2 The offset to the current payout measurement. Use this menu item to set the measurement if the line payout is not zero.

Item 3 Counter mode: Quad 1x, 2x, 4x, CNT + DIR

Item 4 Enable or disable a load resistor on the count signals: None, Pull-up, Pull-down.

Item 5 The filter level of the speed algorithm. Higher numbers apply a greater level of smoothing is applied to the measurement.

Item 6 The response time of the speed filter.

8.6.1 Payout Scale

The payout scale factor represents the number of pulses per unit length. This factor can be derived from the sheave circumference or determined by spooling out a known length of cable. The two methods are described below.

In a typical application the line will pay out over a sheave with a known circumference and number of targets. The payout scale factor can then be calculated as follows:

$$Payout\ Scale = \frac{Pulses\ per\ Revolution}{Sheave\ Root\ Diameter + Wire\ Diameter}$$

Take care to use the appropriate value for pulses per revolution, which depends on the COUNTER MODE setting.

If the counter mode set is set to Quad 2x, the LCI-90i counts two pulses for each passing target and pulses per revolution is twice the number of targets on the sheave.

If it is Quad 4x, the LCI-90i counts four pulses for each passing target and pulses per revolution is four times the number of targets on the sheave.

In Quad 1x and CNT+DIR modes, and pulses per revolution is equal to the number of targets on the sheave.

8.6.2 Payout Calibration Procedure

Field experience shows 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.

1) Ensure that counter mode is set appropriately.

2) Press the **DIAG** button to set the display in **DIAG** mode.

3) Zero the payout by pressing the **RSET** button twice. The pulse count should be zero on the display.

4) Mark two points on the cable of known length. It is recommended to use a length that is 10 times the circumference of the sheave. Use paint or flags to mark the two points.

5) Payout a known length of cable through the sheave. Note the number of pulses indicated on the display.

6) Perform the following calculation:

$$Payout\ Scale = \frac{Total\ Pulses}{Known\ Length\ of\ Cable\ Through\ Sheave}$$

7) Enter the new data in the **PAYOUT SCALE** menu item of the Payout Calibration menu.

8) Return to the **DIAG** mode by navigating the menu or pressing **RUN** and then pressing the **DIAG** button.

9) Zero the payout by pressing the **RSET** button twice.

10) Verify the calibration by pulling the wire back to the original mark: the same number of pulses should display and the scaled value shown should be negative, matching the known length spooled back in. If the display shows a positive reading when the cable is spooled back in, switch the A and B signal wires on the rear of the display.

8.6.3 Payout Preset

The Payout Preset value allows the operator to manually enter a payout value. The LCI-90i internally converts the value entered to a scaled number of counts so that subsequent changes to scale value do not affect the Payout Preset.

8.6.4 Counter Mode

The Counter Mode setting determines how the internal payout circuitry treats the incoming quadrature waveforms.

Table 9 - Counter Modes

<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td>Quad 1x</td><td>Used for Hall Effect, Proximity and general encoder applications. Treat the two rising and two falling edges as one pulse.</td></tr>
<tr><td>Quad 2x</td><td>Used for encoder applications only. Treat the two rising and two falling edges as two pulses.</td></tr>
<tr><td>Quad 4x</td><td>Used for encoder applications only. Treat the two rising and two falling edges as four pulses.</td></tr>
<tr><td>CNT + DIR</td><td>In count and direction mode, one counter input provides the pulse train of counts (this connects to 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 (> 3V)</td><td>Decrement</td></tr>
<tr><td>Rising edge</td><td>Low (< 2V)</td><td>Increment</td></tr>
</table>
</td></tr>
</table>

For most applications the QUAD 1X mode is 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 than the "on time" of the pulses then 4X mode will result in higher noise in the speed calculations).

8.6.5 Load Resistor

The Load Resistor setting allows the operator to select the appropriate load resistors to interface with the external rotational sensors in use. If load resistors are enabled, 1000Ω resistors are connected to the inputs of both A and B sensor lines of the winch being configured. The operator may select the following configurations for any of the four pairs of rotational sensors: pull up to 12VDC, pull down to DC COM, or disabled (none).

The LCI-90i eliminates the DIP switches and uses only the menu option. The following table identifies the appropriate resistor configuration for different sensor types.

Table 10 - Count Sensor Load Resistor

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

8.6.6 Speed Filter Level

The **FILTER LEVEL** item specifies the intensity of the speed filter algorithm used by the LCI-90i. The value can vary from 1 to 5 and is a relative amount of smoothing applied to the incoming pulse stream when calculating the current speed. A value of five indicates maximum smoothing. Note that a side effect of higher filter values is a slower response time.

8.6.7 Speed Response Time

The **SPEED RESPONSE TIME** item specifies the settling time of the speed filter in response to step changes. After a step change in speed, the Speed displayed and logged may not be accurate for the amount of time selected in the **SPEED RESPONSE TIME** setting. This is the amount of time the change takes to pass through the speed filter.

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

Note 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 how often the speed value is recalculated and displayed.

Table 11 - Counter Filter and Speed Response Behavior

Filter Level	Speed Response Time (seconds)	Output Noise	Update Rate
1	2	High	Very Fast
1	20	Middle	Slow
3	6	Low	Fast
5	2	Middle	Very Fast
5	20	Very Low	Very Slow

When choosing the Filter Level setting and the Speed Response Time setting, first consider the Speed response requirements. If the speed is not expected to change quickly, then a high response time setting (e.g. 20s) will perform adequately, reducing the output noise. If a faster response is required, the variable must be set lower. Next, evaluate the tradeoff between calculation update rate and output noise in order to set the Filter Level. Experimentation with different values should produce a satisfactory result.

8.7 Display Configuration

The LCI-90i allows the user to change the display position of the winch line variables on the main screen, change the units of measure, and the number of decimal places.

These features are accessed via the **DISPLAY CONFIGURATION** menu. The Display Configuration menu is accessible from the Main Menu. Each of the three line variables, tension, speed and payout, has its own sub-menu to customize the readout.

		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

Figure 41 - Display Configuration Menu

Item 1 Display the **TENSION DISPLAY** menu.

Item 2 Display the **SPEED DISPLAY** menu.

Item 3 Display the **PAYOUT DISPLAY** menu.

Item 4 Enable or disable the screen saver feature.

Item 5 Set the contrast level of the main screen display. The contrast level does not change for the menu system.

Item 6 Display the line graph setup menu.

Item 7 Set the rate that the display updates.

Item 8 Set the winch to be displayed. Set to ALL WINCHES to display multiple winches.

8.7.1 Measurement Display Configuration

In single winch display mode the LCI-90i screen has three locations for displaying line variables. The top location can display up to 6 digits and is usually used for the most important parameter. It includes a bar graph below 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 measurement unit such as KIPS instead of LBS.

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

Figure 42 - Tension Display Menu

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

Figure 43 - Speed Display Menu

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

Figure 44 - Payout Display Menu

The display of each of the three line measurements can be configured. Tension, speed, and payout measurements can be positioned on the screen. If more than one

measurement is configured for a given position, tension is given priority, followed by speed.

8.7.2 Setting display units

Each displayed variable can be individually set to use one of several common measurement units. The LCI-90i is designed to be units aware, meaning that any of the display units can be switched during operation without requiring re-calibration or re-setting set points.

For example, if the RUN screen shows **3000.0 LBS** on the tension display and has an alarm set point of 2000 LBS, changing tension units to tons causes the screen to immediately display 1.5 tons and the alarm set point to change to 1.0 tons with no other user input necessary.

The available units and their abbreviations are listed in the table below.

Table 12 - Measurement Units

Measurement	Available Units
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

8.7.3 Setting decimal places

The **DECIMAL PLCS** menu item sets the maximum number of digits displayed to the right of the decimal point for each line variable.

Up to three decimal places can be displayed. 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.

8.7.4 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 is set by the **FULL SCALE** menu item. This full scale value is only used for the bar graph upper limit and to the line graph system.

The tension measurement has a well-defined full scale limit based on the calibration and input range of the tension input channels. The LCI-90i calculates this full scale tension after every calibration operation and automatically updates the **FULL SCALE** menu item. 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.

8.7.5 Screen Saver

The LCI-90i is equipped with a screen saver to prolong the life of the display. The screen will turn off after 30 minutes if the unit has not detected a change in payout or a keypad button press. To re-energize the display, push any button.

8.7.6 Contrast

The LCI-90i is equipped with the ability to change the contrast of the display, either by adding an external potentiometer or by the Contrast Setting in the Display Configuration menu. 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. When the menu system is displayed the contrast uses the brightest setting.

8.7.7 Line Graph Setup

The LCI-90i can provide operators with a time series view of a measurement. This will provide operators a trending view of the tension over time. The y-axis scale and x-axis time range can be configured using the menu system. The y-axis scale is configured in the tension, speed, and payout display configuration menus.

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

Item 1 The winch to be displayed.

Item 2 The measurement to be charted on the time series graph.

Item 3 The time range of the x-axis. Up to 1 hour of data can be displayed.

Item 4 Display the time series graph.

8.7.8 Display Refresh Rate

The Display Update Rate defines how fast the display will display measurement data. It does not affect how fast the processor is running and sampling/logging the data; it only affects how fast the display updates. The menu setting allows the operator can select a display refresh rate between 1 Hz and 60 Hz.

8.7.9 View

The LCI-90i can interface with up to four force and rotational sensors at one time. Using the **VIEW** menu item, the operator can choose to display the line parameters of just one winch or all configured winches. The options **WINCH 1**, **WINCH 2**, **WINCH 3**, and **WINCH 4** will display that single winch on the Main Screen. The mode **ALL WINCHES** will display all active winches. The selections are **ALL WINCHES, WINCH 1, WINCH 2, WINCH 3** or **WINCH 4**. Note that winch names are not displayed when ALL WINCHES is selected.

Figure 45 - Dual Winch Display

Figure 46 - Triple Winch Display

Figure 47 - Quad Winch Display

8.8 System Configuration

The **SYSTEM CONFIGURATION** menu, shown below, allows the LCI-90i to be customized for a particular installation. From this menu the operator can configure the inputs and outputs of the LCI-90i, save and restore settings, and enable passcode protection. This menu also offers a security feature that locks out unauthorized changes once these settings have been made. However, if unwanted changes are made to the configuration it is possible to return to the "Factory Setup" configuration, which can be customized for a given installation.

	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 CONFIGURATION	
	8	COMMUNICATION	

Figure 48 - Digital Inputs Menu

Item 1 Enable or disable the security feature. Once enabled the user must enter the passcode to unlock the menu system.

Item 2 Display the Factory Setup menu.

Item 3 Display the Digital Inputs menu.

Item 4 Display the Winch Setup menu.

Item 5 Display the Analog Inputs menu.

Item 6 Display the Analog Outputs menu.

Item 7 Display the Alarm Settings menu.

Item 8 Display the Serial Communication menu.

8.8.1 Security

Security is either **OFF (0)** or **ON**. When Security is **ON** the menu functions are disabled. The user can access the diagnostic screens, time series graph, and silence alarms. All menu items are locked out. 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.

> ***Warning:*** This number 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.

If the security code is lost or forgotten, contact Measurement Technology NW to unlock the LCI-90i.

8.9 Factory Setup

The configuration of a LCI-90i can be saved to non-volatile memory. Up to seven configurations can be saved and recalled. An eighth setup reserved for the factory default settings. The ability to save multiple setups is great for applications where different winches are used. It has also proven valuable for winches with multiple sheaves that require different calibrations. Saving setups is also recommended to allow the operator to return to a known configuration when performing long-distance troubleshooting

	4.2 FACTORY SETUP		
>	1	SAVE SETUP	1
	2	LOAD SETUP	1
	3	CURRENT SETUP: 1	
	4	RESET LOOKUP:	YES

Figure 49 - Factory Setup Menu

Item 1 Save the current configuration to a memory slot (1-7).

Item 2 Load a saved configuration from a memory slot (1-7).

Item 3 The current setup configuration. Any changes through the menu system will be saved to this memory slot.

Item 4 Reset the lookup tables to the factory default settings.

8.9.1 Save Setup

Up to seven different setups can be saved to non-volatile memory. By default, the display will use setup 1. Select **SAVE SETUP** and press **ENT** to enter edit mode. Use the **INCR**, **DECR,** and → keys to change the value. The selections are 1-7.

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

ARE YOU SURE: YES NO

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

8.9.2 Load Setup

Up to seven different sets of settings can be reloaded into current memory from non-volatile memory in addition to the 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 1-7, and FACT.

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

ARE YOU SURE: YES NO

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

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

When the FACT setup is chosen, the display will 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 Factory Setup menu and save the new settings to one of the seven settings spaces.

8.9.3 Current Setup

This item indicates the current default setup that is loaded in active memory. This setup is loaded when the LCI-90i powers up. This item is read only.

8.9.4 Reset Lookup

To reset the lookup table data, select the RESET LOOKUP menu item. Select **YES** and press the **ENT** button. The lookup table data will be reset to the factory settings. The user will be prompted to confirm the change. Press the **YES** button to confirm and reset the look-up tables or press the **NO** button to cancel the operation.

8.10 Digital Inputs

Four digital inputs can be triggered from external sources to modify the LCI-90i behavior.

	4.3 DIGITAL INPUTS		
>	1	DIGITAL INPUT NO.	1
	2	FUNCTION	TARE
	3	RESET BUTTON	ALL

Figure 50 - Digital Inputs Menu

Item 1 Digital input channel selection (1-4).

Item 2 Digital input function assignment.

Item 3 RSET button function.

The selections for **FUNCTION** are NONE, RRSET, WINCH 1, WINCH 2, WINCH 3, WINCH 4 and VIEWALL.

Table 13 - Digital Input Modes

Mode	Function
NONE	No function, input is disabled.
RRSET	Reset the payout measurement to zero.
WINCH 1	Display Winch 1.
WINCH 2	Display Winch 2.
WINCH 3	Display Winch 3.
WINCH 4	Display Winch 4.
VIEWALL	Display all active winches.
INDICATOR	Display a message on the Main Screen.
TARE	Tare the tension measurement.

8.10.1 Reset Button Configuration

The operation of the RSET button can be configured in the DIGITAL INPUTS menu. The RSET button can be configured to reset the payout count of all winches or the payout count of the active winch.

8.11 Winches and Processing

The Winch Setup menu configures the number of winches connected to the LCI-90i and the number and type of sensors for each winch.

The first four items of the menu link to submenus, one for each winch that can be configured in the LCI-90i.

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

Figure 51 - Winch Setup and Processing Menu

Item 1-4 Display Winch 1-4 Setup menus.

Item 5 Set the processing mode to either **SINGLE** or **ALL**.

8.11.1 Process Winches

The LCI-90i can be configured to process all active winches or only the displayed winch. The PROCESS WINCHES menu item affects how measurements are acquired, stored on the CF disk, and transmitted over the communication interfaces.

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

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 any other winches 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.

8.12 Winch Setup

A winch consists of a tension measurement sensor and a count sensor. Each winch can have a name and a wire serial number.

	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	

Figure 52 - Winch Setup Menu

Item 1 Set the tension measurement calculation type: unused, single axis, sum, average, or dual axis.

Item 2 The analog inputs used to measure tension. The number of tension input channels may be more than one channel depending on the calculation type.

Item 3 The counter input channel associated with the winch.

Item 4 The name of the winch. This value is included in the CF Disk data and MTNW3 protocol data.

Item 5 The serial number of the wire rope used on the winch. This value is included in the CF Disk data.

8.12.1 Tension Mode

Several modes are available to measure line tension. The menu system will change based the mode selected.

Table 14 - Tension Modes

Tension Mode	Description
Unused	No analog input. No tension measurement is available.
Single	One analog input is used to measure tension. This is the most common mode of tension measurement.
Sum	Up to four analog inputs are summed to obtain a tension measurement. The Winch Setup menu will display four analog input channels to be configured.
Average	Up to four analog inputs are averaged to obtain a tension measurement. The Winch Setup menu will display four analog input channels to be configured.
Dual-axis	Two analog inputs are used (x-axis and y-axis) to obtain a tension measurement. The Winch Setup menu will display two analog input channels to be configured.

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 **AVERAGE**, set **ANALOG IN 1** to **AIN-5**, and set **ANALOG IN 2** to **AIN-6**.

8.12.2 Counter Input

The **COUNTER INPUT** item is used to link a counter input 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**.

8.12.3 Winch Name

The **WINCH NAME** is displayed on the main screen if a single winch layout is displayed. The winch name will also be included in the CF disk data file and MTNW3 communication protocol.

8.12.4 Wire Serial Number

The wire serial number is included in the CF disk data file.

8.13 Analog Inputs

The LCI-90i has eight analog inputs. These can be via the Analog Inputs menu shown below. The range and input check can be configured.

	4.5 ANALOG INPUTS		
>	1	CHANNELNUMBER	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.	

Figure 53 - Analog Inputs Menu

Item 1 Selects the analog input channel: AIN-1 to AIN-8.

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 Enables or disables the input check feature. If the analog input is out of range then the Diagnostic screen is displayed instead of the Main screen. The out of range signal must be corrected before the Main screen is displayed.

Item 4 Sets the lower limit for the input check feature.

Item 5 Sets the upper limit for the input check feature.

Item 6 Displays the Strain Gauge Excitation menu.

8.13.1 Sensor Input Check Alarm

Sensor input checking is a unique feature of the LCI-90i. This is particularly important for multiple input configurations, but can also be useful for single input operation as well. When the input check feature is **ON**, analog input values less than the lower limit or greater than the upper limit will automatically switch the normal Main screen to the Diagnostic screen. The out-of-range channel is displayed in inverted color. At the same time, Relay 4 will be asserted. This relay may be connected to an external alarm if desired.

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 monitoring, if properly configured, can provide enhanced operator safety.

8.14 Strain Gauge Excitation

The Strain Gauge Excitation menu is used to configure the supply voltage provided on TB7 (V+ and V-) for energizing strain gauge circuits.

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

Figure 54 - Strain Gauge Excitation Menu

Item 1 Sets the strain gauge excitation range to either 5V or 10V. In 5V mode the excitation voltages are +2.5V and -2.5V with reference to system ground. In 10V mode the excitation voltages are +5V and -5V with reference to system ground.

Item 2 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.

8.15 Analog Outputs

Four analog outputs can be configured using the Analog Output menu. From this menu the user can link an analog output to a line measurement (tension, speed, or payout) and configure the output type and range.

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

Figure 55 - Analog Output Menu

Item 1 Selects the channel number (1-4) to configure. These channels correspond to specific terminal blocks on the LCI-90i.

Table 15 - Analog Output Terminals

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

Item 2 Selects the output range for the channel. The available options are 4-20mA, 0-5V, 0-10V, and ±5V. When using any of the voltage ranges use the voltage output terminals on the rear of the LCI-90i. When using the output in 4-20mA mode use the current output terminals.

Item 3 Sets winch number the analog output is linked to.

Item 4 Links the analog output to a line measurement: none, tension, speed, or payout.

Item 5 Sets the analog output full scale value.

Item 6 Sets the analog output offset.

8.15.1 Analog Output Calibration

The **FULL SCALE** and **OFFSET** menu items calibrate the analog output.

The **OFFSET** menu item is the value of the variable that corresponds to the lower limit of the output range – for example, the value that produces 4mA or 0V. Line values below the offset will be truncated by the analog output circuitry.

The **FULL SCALE** menu item is the upper limit of the output range, i.e. 20mA or 5V, etc. Line values above the full scale value generate the maximum output.

8.16 Alarm Configuration

The Alarm Configuration menu item will display the Alarm Configuration menu system. Please refer to section 8.3 for a complete description.

8.17 Communications

The Communication menu allows the configuration of the communication interfaces. The LCI-90i has four communication interfaces: RS-232, RS-485, USB, and Ethernet. The ports are configurable and support several protocols.

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

Figure 56 - Communication Menu

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 measuring field sensors.

Item 2 Displays the Ethernet Communication menu.

Item 3 Displays the Serial Communication menu. This menu configure the RS-232, RS-485, and USB communication interfaces.

Item 4 Displays the System Date and Time menu system.

Item 5 Sets the LAN ID number of this LCI-90i. Generally, when multiple units are on a single network each unit needs a unique identifier. A LAN ID of zero for a remote display indicates that it will receive data from any LAN ID.

Item 6 Displays the CF Disk menu system.

Item 7 In **LOCAL** mode, setting this item to **YES** and pressing **ENT** uploads the entire set of configuration parameters to all remote LCI-90i units or WinchDAC software platforms attached to this unit.

In **REMOTE** mode, this item enables or disables sending settings acknowledgements to a local display. This should be set to **OFF** if the WinchDAC software application is used.

8.18 Ethernet Communication

LCI-90i units have an Ethernet interface which can be used to communicate with remote LCI-90i units, a data logger, or a PC.

The LCI-90i can be connected to any existing Ethernet network without much effort. It is required for a user to have knowledge of their network architecture and configuration. The descriptions of the LCI-90i settings will be limited here to information pertinent to the setup of the LCI-90i itself. For further information on how to configure your network to handle the LCI-90i Measurement Technology NW recommends that you work closely with your network administrator.

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

Figure 57 - Ethernet Communication Menu

Item 1 Displays the Local Ethernet Settings menu.

Item 2 Displays the TCP Data Logging menu.

Item 3 Displays the UDP Data Monitoring menu.

8.19 Local Ethernet Settings

The Local Ethernet Settings configures the Ethernet interface on the LCI-90i.

	4.821 LOCAL ETHERNET		
>	1	IP ADDRESS	192.168.002.201
	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 2
	7	AUTOMATIC DIAGNOSTICS	ON

Figure 58 - Local Ethernet Settings Menu

Item 1 Sets the IP address of the LCI-90i. The LCI-90i requires a static IP address. The address must be 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. A typical subnet mask is 255.255.255.000 and will work with most networks.

Item 3 The gateway address is only required if data from the LCI-90i connects to other network devices through a router or gateway.

Item 4, 5 The primary and secondary DNS server addresses. These are typically not used and do not need to be configured for most networks.

Item 6 Sets the communication protocol for TCP Data Logging and UDP Data Monitoring. See section 8.28.1 Data Protocols for more information.

Item 7 The LCI-90i contains an automatic diagnostics system which allows MTNW representatives to easily troubleshoot the devices externally. This setting will not affect the performance or operation of the unit and is used by Measurement Technology NW for diagnostic purposes.

8.20 TCP Data Logging

TCP Data Logging uses the TCP protocol to transfer data and is recommended for connections where data integrity is crucial. Transmitted line data is formatted by the data protocol specified in the Local Ethernet Settings menu.

	4.822 TCP DATALOGGING		
>	1	ACTIVE	ON
	2	MODE	POLLED
	3	OUTGOING PORT	24
	4	DESTINATION	192.168.2.206
	5	INACTIVITY ALARM	OFF

Figure 59 - TCP/IP Data Logging Menu

Item 1 Enable or disable the TCP Data Logging feature.

Item 2 Operate in **POLLED** or **BRDCST** mode. In **POLLED** mode the LCI-90i only transmits data upon a request. In **BRDCST** mode the LCI-90i will continuously transmit line data at the tension sample rate set in the Calibration menu.

Item 3 The port that the LCI-90i attempts to connect to at the specified IP address.

Item 4 The destination field sets the IP address of the device to which the LCI-90i is to transmit messages. For example, it could be the IP address of a PC that is running WinchDAC software. The LCI-90i is a TCP/IP client and will attempt to establish a connection with the destination every five seconds.

Item 5 If enabled and the LCI-90i has not received a data request after a five second period, an alarm indicator will be displayed on the main screen that reads "NO DATA RQST". This feature is useful when using WinchDAC or another means of collecting TCP/IP data from the LCI-90i. It will indicate if the device polling the LCI-90i has stopped.

8.21 UDP Data Monitoring

UDP Data Monitoring uses UDP to transmit data and is used for systems where speed of operation is critical but data integrity is not. The UDP system is used for sending data to remote LCI-90i displays. Transmitted line data is formatted by the protocol specified in the Local Ethernet Settings menu.

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

Figure 60 - UDP Data Monitoring Menu

Item 1 Enable or disable the UDP Data Monitoring feature.

Item 2 Operate in **POLLED** or **BRDCST** mode. In **POLLED** mode the LCI-90i only transmits data upon a request. In **BRDCST** mode the LCI-90i will continuously transmit line data at the tension sample rate set in the Calibration menu.

Item 3 The port that the LCI-90i will receive UDP data on.

Item 4 The port that the LCI-90i will transmit UDP data to.

Item 5 The destination field sets the IP address of the device to which the LCI-90i is to transmit messages. Set to 255.255.255.255 to broadcast data across the entire network.

8.22 Serial Communications

The Serial Communication menu is used to access the menus for configuring the three serial ports.

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

Figure 61 - Serial Communication Menu

Item 1 Display the USB Communication menu.

Item 2 Display the RS-232 Communication menu.

Item 3 Display the RS-485 Communication menu.

Item 4 Enable or disable the Terminal mode of the LCI-90i. Enable only for debugging or firmware upgrade operations. 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.

8.23 USB Interface

The LCI-90i provides a USB Type B receptacle for connecting the LCI-90i to a PC. Ensure that the appropriate drivers are available and installed on the target PC before connecting the LCI-90i. The USB drivers are available upon request from Measurement Technology NW.

	4.831 USB		
>	1	ACTIVE	ON
	3	PROTOCOL	MTNW 1
	4	MODE	POLLED

Figure 62 - USB Interface Menu

Item 1 Enable or disable the USB interface.

Item 2 Set the data protocol of the data transmitted on the USB interface. Available options are MTNW1, MTNW2, MTNW3, and MTNW LEGACY. See the section 8.28.1 Data Protocols for more information on data protocols.

Item 3 Operate in **POLLED** or **BRDCST** mode. In **POLLED** mode the LCI-90i only transmits data upon a request. In **BRDCST** mode the LCI-90i will continuously transmit line data at the tension sample rate set in the Calibration menu.

8.24 RS-232 Interface

The LCI-90i provides a RS-232 interface to be used for data monitoring. The baud rate, protocol, and mode can be configured. The serial interface is configured for 8-bit data, no parity, and one stop bit.

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

Figure 63 - RS-232 Interface Menu

Item 1 Enable or disable the RS-232 interface.

Item 2 Set the baud rate of the RS-232 interface. Available options are 2400, 4800, 9600, 19200, 38400, 57600, 115200, and 230400.

Item 3 Set data protocol of the data transmitted on the RS-232 interface. Available options are MTNW1, MTNW2, MTNW3, and MTNW LEGACY. See the section 8.28.1 Data Protocols for more information on data protocols.

Item 4 Operate in **POLLED** or **BRDCST** mode. In **POLLED** mode the LCI-90i only transmits data upon a request. In **BRDCST** mode the LCI-90i will continuously transmit line data at the tension sample rate set in the Calibration menu.

8.25 RS-485 Interface

The LCI-90i provides a RS-485 interface to be used for data monitoring. The baud rate, protocol, and mode can be configured. The serial interface is configured for 8-bit data, no parity, and one stop bit. The RS-485 is optically isolated up to 3000V. It is recommended that the shield is connected especially for applications with long cable runs greater than 50'. The RS-485 interface cannot be disabled.

	4.833 RS-485		
>	1	BAUD	115200
	2	PROTOCOL	MTNW 1
	3	MODE	POLLED
	4	INACTIVITY ALARM	OFF

Figure 64 - RS-485 Interface Menu

Item 1 Set the baud rate of the RS-485 interface. Available options are 2400, 4800, 9600, 19200, and 38400.

Item 2 Set data protocol of the data transmitted on the RS-485 interface. Available options are MTNW1, MTNW2, MTNW3, and MTNW LEGACY. See the section 8.28.1 Data Protocols for more information on data protocols.

Item 3 Operate in **POLLED** or **BRDCST** mode. In **POLLED** mode the LCI-90i only transmits data upon a request. In **BRDCST** mode the LCI-90i will continuously transmit line data at the tension sample rate set in the Calibration menu.

Item 4 If enabled and the LCI-90i has not received a data request after a five second period, an alarm indicator will be displayed on the main screen that reads "NO DATA RQST". This feature is useful when using WinchDAC or another means of collecting data from the LCI-90i. It will indicate if the device polling the LCI-90i has stopped.

8.26 Date and Time

The LCI-90i contains a real-time clock (RTC) that tracks of the current date and time. The RTC is battery-backed to allow an accurate clock even when the unit is powered down.

	4.84 SET DATE/TIME		
>	1	DATE	12-31-1999
	2	TIME	16:30:15

Figure 65 - Date and Time Menu

Item 1 Set the date of the LCI-90i. The data is in the format of Month - Day - Year.

Item 2 Set the time of the LCI-90i. Uses a 24-hour clock in the format of Hour : Minute : Second.

8.27 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 and read by a Windows PC. The files can be read directly using WinchDAC.

The LCI-90i uses a FAT 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. If a CF disk has partitions, only the first partition will be used for recording Using a partitioned CF disk is not recommended and is not supported by MTNW.

To prevent data corruption, 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

Figure 66 - CF Disk Menu

Item 1 This item indicates the state of the CF Disk. If no CF disk is present, the disk has been successfully dismounted, or the disk is full, the menu item will read **NO CF DISK PRESENT**.

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 off.

Item 2 The **THRESHOLD VALUE** menu item determines the trigger 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.

Item 3 To prevent jitter if the measured tension is oscillating around the threshold value, a timeout value is used: **THRESHOLD TIME**. After

tension drops below the threshold value set in Item 2, the LCI-90i continues to record to the CF disk for the amount of time set in **THRESHOLD TIME.** If at any point the measured tension is greater than the threshold value again, the timer is reset and stopped until the measured value is below threshold. This prevents temporary dips below the threshold from halting data logging to the CF disk

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

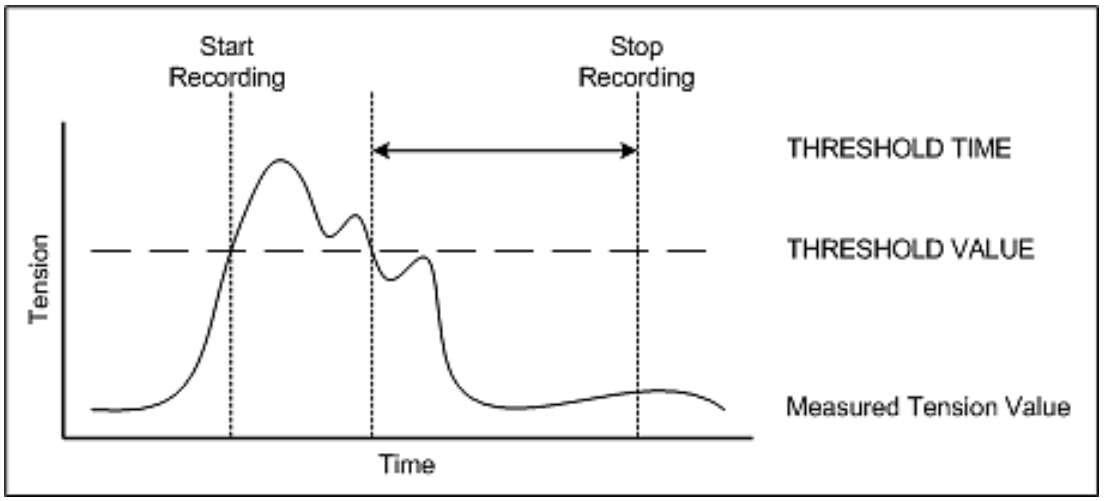


Figure 67 - CF Disk Logging

8.28 Remote Display Configuration

The remote configuration feature transmits the configuration of a local display to remote displays. 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, connect one or more remote units to a local using RS-485 or Ethernet interface. Ensure that all remote displays to be programmed are set to be in remote mode. Verify all units are powered up and seem to be working properly (data from the local unit should be visible on the remotes if the local unit is broadcasting).

On the local unit select the **CONFIGURE REMOTES** menu item in the **4.8 COMMUNICATIONS** menu, select **YES** and press **ENT**. The remote displays will flicker for a few seconds as the settings take effect, then resume operation with the new set of parameters.

A noisy network connection could corrupt data. If the Remote unit detects any errors in the transfer, it will cease the operation and any settings which have not been sent across yet will not update. Should this happen, the best approach is retrying sending the configuration. If difficulties persist the communications link should be evaluated.

8.28.1 Data Protocols

The data transmitted on any communications port by the LCI-90i can be formatted using a number of protocols. The appropriate protocol to use is determined by the data requirements of the device which will 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, it will produce a tension value which will appear in the communications messages. Similarly, if a counter channel is assigned to a winch in the **WINCH SETUP** menu, the winch will produce Payout and Speed values that will also appear 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 (based on line values present), the LCI-90i creates 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"

All protocols use a comma-separated format. All values are zero-padded to full length. Each packet has a four digit checksum.

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

8.28.2 Common Protocol Elements

Each packet begins with a pair of header bytes, which can be useful for synchronizing an incoming data stream or for getting over any turn-on periods with 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 timestamp is 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).

The data fields follow the timestamp. The number and order of the fields is described at the beginning of this section of the manual. After all data fields is a checksum. The checksum is a decimal number with a maximum of four digits. (Any checksum greater than 9999 will be truncated and the leftmost digits 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 terminated with a pair of carriage return and line feed characters (<CR><LF>).

8.28.3 MTNW1 Protocol

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:

```
<RS><SOH>RD,yyyy-mm-ddThh:mm:ss.sss,ddddddddd,...,ddddddddd,cccc<CF><LF>
```

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>
```

8.28.4 MTNW2 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. System messages such as configuration between LCI-90i units are also sent using this format. The packet format is:

<RS><SOH>01RD,yyyy-mm-ddThh:mm:ss.sss,dddddddd,...dddddddd,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.

8.28.5 MTNW3 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 are included after the timestamp and before the data fields. The winch names are listed in order, matching the order of the subsequent data fields. An example packet follows:

<RS><SOH>01RD,yyyy-mm-ddThh:mm:ss.sss,winch_name1,winch_name2,...,
Ddddddd,...,ddddddddd,cccc<CF><LF>

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

8.28.6 MTNW LEGACY Protocol

This protocol is designed to exactly match the protocol used by the previous generation of LCIs, the LCI-90. It is used when an LCI-90i needs 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 to delineate value fields. (Excel calls this a 'CSV', Comma Separated Values, format). "CCCC" is a 4-digit 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 does not

matter if the receiving device uses "7-bit" or "8-bit" characters. Each record ends with a carriage-return line-feed (<CR><LF>) pair which is not included in the checksum.

8.28.7 Data Polling

Each communication interface can be configured to either transmit data continuously or respond to data requests. Polled mode is the preferred method of operation since it allows the remote device to control the data flow, and thus to receive data only when it is ready for it.

In polled mode, the MTNW2 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 line-feed (<CR><LF>) pair to complete the packet.

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).

The polling string for RS-232 and USB is 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.

9 Troubleshooting

The diagnostics screen allows the user to quickly check raw input signals, power supplies, sample rates, and error codes. Common malfunctions of the instrument can be traced to incorrect wiring, jumper settings, or configuration. Consult the troubleshooting chart in section 9.3 to diagnose problems.

9.1 DIAG Screen

Pressing the **DIAG** key on Main screen will display the Diagnostics screen. The Diagnostic screen provides the operator with important feedback on raw signal inputs, and scaled display values for Tension and Payout.

From the Diagnostic screen, pressing the **DIAG** button again will display the Advanced Diagnostics screen. The instrument will continue normal operation while in diagnostic mode, including updating remote displays and checking alarm limits. However it may not be able to run at its maximum sample 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 68 - Diagnostics Display

Although all four winches are displayed, some winches may not have analog inputs associated with them. An inactive winch or a winch without a tension measurement a value of zero is displayed. The value column for these first four lines shows the raw input signal from all force sensors associated with the winch. The value is calculated from these sensors according to the tension mode (unused, single, sum, average, dual-axis). The resulting scaled tension is displayed in the scaled column.

Following the analog input values are four rows showing the current state of the counter channels. The left-hand column shows the raw number of counts that have been seen by the counter. In the right-hand column, the scaled payout values are shown.

Comparing the displayed values with measurements from a multimeter can help identify if the fault lies in the sensor, wiring, or within the instrument and its setup configuration.

When an Input Check Alarm occurs, the LCI-90i automatically displays the DIAG screen with the outlying input channel highlighted. Relay 4 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.

9.2 Advanced Diagnostics Screen

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

AIN-1	=	-20.185mV	SAMPLE	=	20HZ
AIN-2	=	0.000V	DATALOG	=	20HZ
AIN-3	=	0.000V	DISPLAY	=	20HZ
AIN-4	=	0.000V	DISK	=	20HZ
AIN-5	=	1.862V	CPU ERR	=	27
AIN-6	=	0.000V			13
AIN-7	=	0.000V			13
AIN-8	=	0.000V			27
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	S/N	=	1000
EXC+	=	2.510V			
EXC-	=	-2.515V			

Figure 69 - Advanced Diagnostics Screen

The raw analog inputs, external power supply input, internal power supplies, processing rates, error codes, and serial number are displayed.

9.3 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 display contrast to higher value. 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.
Contrast cable failure	Check the 6-pin gray contrast cable that is connected between the processor PCB and the EL display PCB.	Remove contrast cable to set the display to maximum brightness.

Problem: *Zero Speed/Payout Not Changing*

Possible Causes	Diagnosis	Remedies
Scale Factor is zero or very small	Check the payout scale factor in the Counter Calibration menu for an incorrect value.	Recalibrate the payout based on true physical values.
Counter input is not connected to the Winch being displayed	Check the Counter Calibration menu and its submenus to ensure that the counter channel being used is associated with the winch being displayed. Check the Display Configuration menu to see which winch is being viewed on the display at this moment.	Setup 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.	Independently check operation of count sensors and replace if faulty.
	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.	
	Check the Counter Calibration menu to ensure that the pull-up and pull-down resistors, and the counter chip, are configured correctly.	Set the correct load resistor for the sensor type.
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 the Tension Calibration menu 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, 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 tension sensor wiring.
	Check the Analog Inputs menu to ensure that the input is configured correctly.	Review analog input configuration.
	Check the Winch Setup menu and its submenus to ensure that the analog input is connected to the correct winch, and that the winch is being displayed.	Review 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 LCI 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 either ends, or no grounding.
	Baseline noise – cannot be remedied	Adjust Tension Smoothing filter to reduce the effective noise.
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. Assess environment. The tension measurements may differ from the estimated behavior of the system (i.e., ocean waves are causing the tension signal to oscillate as the ship rolls.)

Problem: *"NO VALID DATA" Displayed on Remote unit.*

Possible Causes	Diagnosis	Remedies
Incorrect menu configuration	If using the display as a local, check the LCI MODE in the Communication menu.	Change the 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.
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 menu 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 for alarm use and configuration.

10 Appendix A – DIP Switch Settings

Table 16 - Analog Input DIP Switch Settings

Analog Input Channel	Mode	Switch Position
AIN-5	Voltage	SW2-1 OFF
	Current*	SW2-1 ON
AIN-6	Voltage	SW2-2 OFF
	Current*	SW2-2 ON
AIN-7	Voltage	SW2-3 OFF
	Current*	SW2-3 ON
AIN-8	Voltage	SW2-4 OFF
	Current*	SW2-4 ON

Table 17 - RS-485 Termination DIP Switch Settings

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

* Indicates factory default settings

11 Appendix B – Wrap Angle Calculations

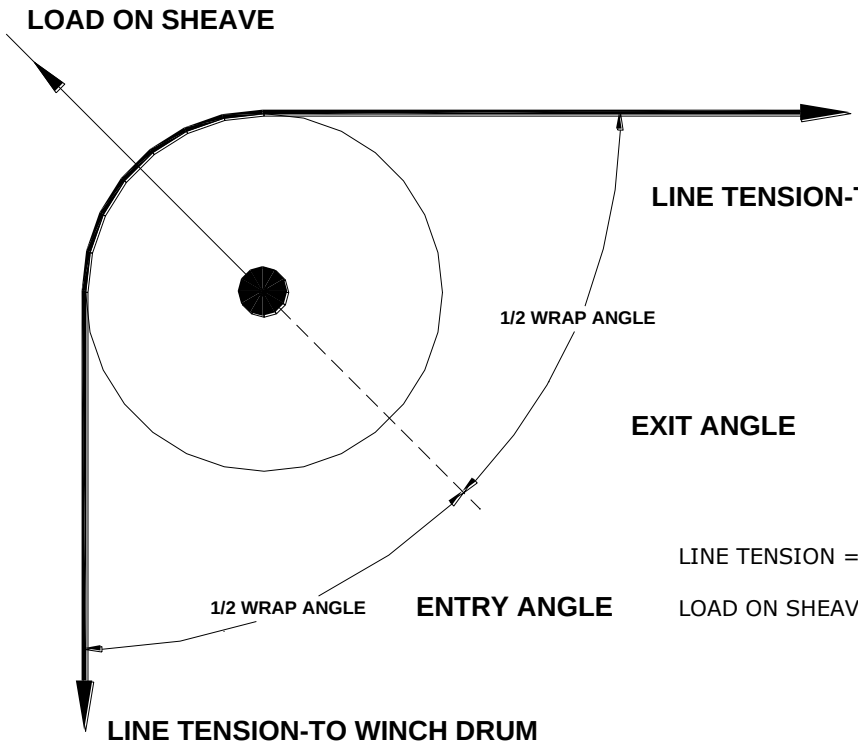
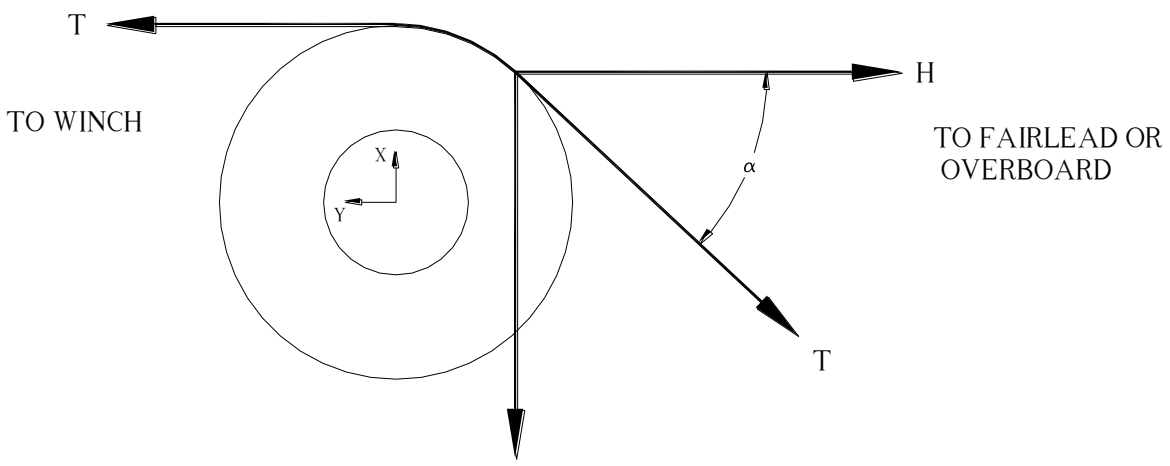


Table 18 - Wrap Angle Correction Factor (WACF)

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 Appendix C – Idealized Dual Axis Load Pin Geometry



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.

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

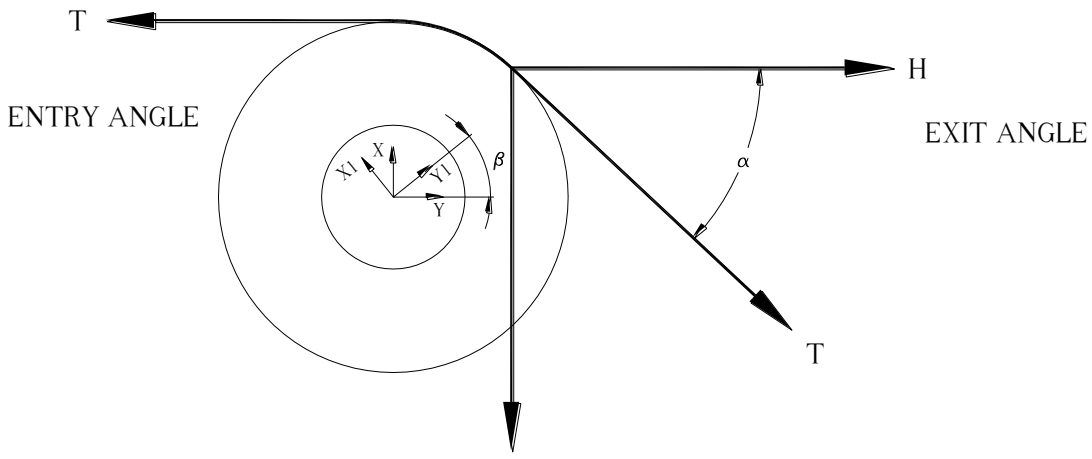
$$\sum \overline{F}y = 0 \quad Y - T\cos\alpha - T = 0 \quad \cos\alpha = 1 - \frac{Y}{T} \quad \cos^2\alpha = \frac{Y^2}{T^2} - \frac{2Y}{T}$$

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

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

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

13 Appendix D – 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 Appendix E – Terminal Block List

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

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

Function	User Manual Reference	Designator
RS 485 T+/R+	T+/R+	TB12-54
RS 485 T+/R+	T+/R+	TB12-55
RS 485 SHD	SHLD	TB12-56
RS 485 SHD	SHLD	TB12-57
RS 485 T-/R-	T-/R-	TB12-58
RS 485 T-/R-	T-/R-	TB12-59
RS 232 Transmit - Data	TX	TB14-51
RS 232 Receive - Data	RX	TB14-52
RS 232 Ground - Data	COM	TB14-53
Ethernet port	J8	J8
USB port	J10	J10

15 Appendix F – LCI-90i Terminal Board Interface

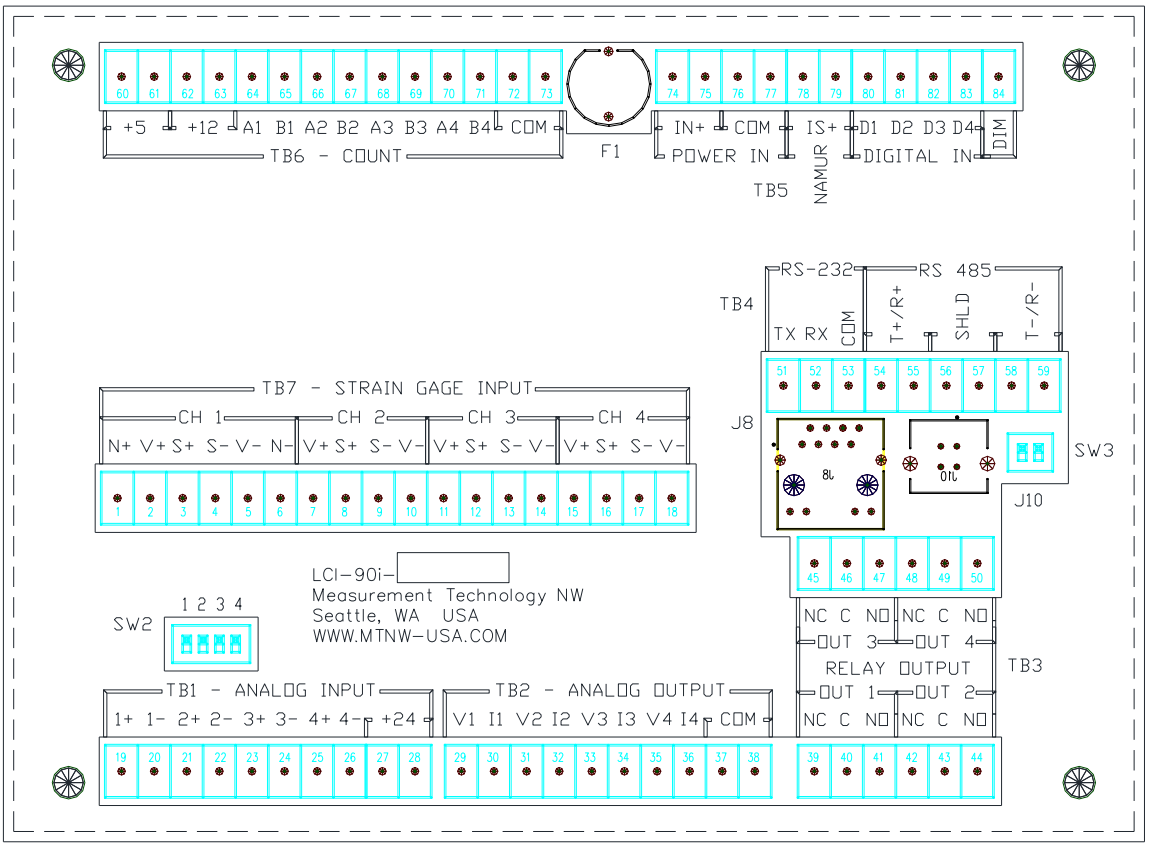


Figure 70 - LCI-90i Terminal Board Interface

16 Appendix G – LCI-90i SS Bracket Mounting Footprint

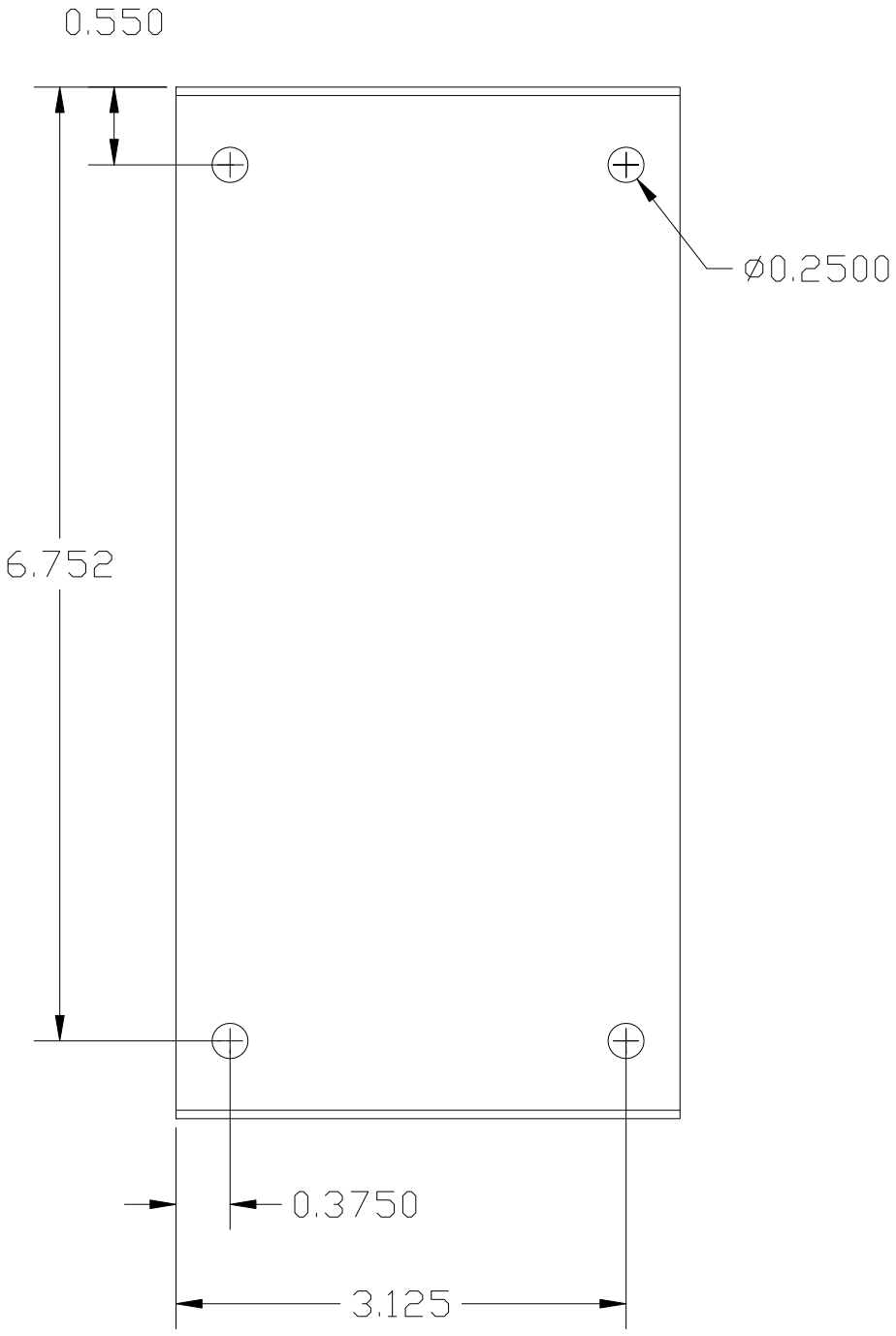


Figure 71 - LCI-90i Mounting Bracket Footprint

17 Technical Support

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

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18 General Contact Information

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