MODEL 962

TRANSIENT RECORDER INSTRUCTION MANUAL

Software Version 7A+

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Manual 60809 Revision NR

CE

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GENERAL GUIDELINES

Operators should read this manual and become thoroughly familiar with its contents before attempting to operate the Model 962 recorder. Following the safety considerations and operation instructions outlined in this manual will minimize the possibility of accidents or injury. Although the procedures covered in this manual have proven safe in use, PCB Load & Torque assumes no responsibility for personal injury or damage to equipment resulting from their application. After reading this manual, personnel should review all instructions concerning safety procedures provided at the installation location. It is not possible to cover all safety considerations in this manual; therefore, always be alert and work safely. Only qualified system operators should perform the procedures covered in this manual.

WARNING SYMBOLS AND TERMS

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This system indicates safety, earth ground.

⚠	**CAUTION**
Indicates a potentially dangerous situation, which can lead to minor or moderate injury or property damage. It may also be used to alert against unsafe practices.	

⚠	**WARNING**
Indicates a potentially dangerous situation, which can lead to severe personal injury or death. Always read the associated information very carefully before performing the indicated procedure.	

⚠	**DANGER**
Indicates an imminently dangerous situation, which can lead to severe personal injury or death.	

1.0 PRODUCT INTRODUCTION

The Model 962 Portable Data Recorder manufactured by PCB Load & Torque, is a battery-operated, transient recorder with two transducer inputs that can be used with torque-only, torque-angle, or load transducers. It can serve as a portable threaded fastener laboratory for measuring fastener torque, angle of turn, and clamp load. Ideal for performing fastener analysis, for auditing and certifying power tools, and for testing hand torque wrenches; Model 962 is a cost effective, versatile, and easy-to-use recorder that can collect numeric peak data, XY graphic plots, and store the data to a thumb drive or PC. The data can be easily displayed or printed on the PC running FastPlot2 software. The alphanumeric setup and calibration menus assure ease of operation. The unit can be used with all RS Technologies' rotary torque-angle and clamp force transducers and other conventional and industry-standard strain gage transducers.

The Model 962 can print out a numeric data report that contains basic information about the test along with time and date-stamped data for peak torque, angle of turn, clamp load, and torque at tension data. Statistics including high, low, mean, ±3 Sigma, etc. are calculated and included on this report. The numeric test data and the graphic data can be uploaded to a computer via the USB port using the FastPlot2 data transfer and plotting utility. FastPlot2 can also provide additional graphic analysis.

1.1 Equipment

Please review the packing list to ensure that all equipment ordered has been received. Depending on the order, it may include any or all of the following (*indicates option at extra cost):

- Model 962 Recorder
- USB Cable (type A/B)
- FastPlot2 Software
- Battery Charger Module
- Carrying Case with Strap
- Calibration Certificates (for instrument & optional transducers)
- Torque/Torque-Angle Sensor(s)*
- Fastener Load Washer(s)*
- Clamp Load Cell(s)*
- Transducer Cable*
- Load Cell Cable*
- Transducer Junction Box*

In the event that some equipment is missing or damaged, please contact the freight carrier, your customs broker and the PCB Load & Torque factory.

1.2 Important Features

The Model 962 has some important features which may be helpful to understand prior to use.

1.2.1 Display Modes

The Model 962 has two display operating modes: Peak mode will display the Peak values for torque, angle, and load; Track mode will display the torque or load currently being applied to the transducer or load cell. Press the TASK button to toggle between the peak and track modes.

1.2.2 Input Channels

Channel 1 is primarily designed to measure torque or torque and angle. Channel 1 is the trigger channel. You will set a threshold or cycle start value for Channel 1 that will initiate the recording cycle. Channel 2 is primarily designed for load measurement using a clamp load cell or fastener load washer. You cannot trigger the recording process using Channel 2.

1.2.3 Limit Results Data/XY Graphic Plot Data

The Model 962 generates two kinds of data. The numeric limit results data, which includes time/date stamped peak torque, angle at peak, peak clamp, etc., is stored on-board the Model 962. After 3 runs are recorded, the Model 962 will calculate statistics for the recorded limits data and display some of which on the Main Screen. It will provide all statistics on the limit results printout and in a file that can be uploaded to a PC via FastPlot2.

The other form of data is the XY graphic plot data which includes all of the data samples recorded during the test. This data is used to construct various graphs and plots either displayed on the screen or after being uploaded to a PC. This graphic data is saved either onto a USB drive or uploaded after each run to a PC.

1.2.4 USB Ports

There are two USB ports provided on the Model 962. The USB A port is used to store data onto a USB memory stick/thumb drive or to send reports and graphs to a HP Deskjet USB printer. The USB B port is used to exchange information between the Model 962 and a desktop or laptop PC using the FastPlot2 application provided with the 962.

1.2.5 Instrument Operating Status

The lower left corner of the Main Screen will show the operating status of the Model 962. It will read one of the following:

"**Ready**" indicates that the instrument is armed and ready to begin a new test once the threshold/cycle start value for Channel 1 is reached. The Model 962 is put into Ready status either automatically through test setup, or manually by pressing the MAIN key.

"**Incyc**" means the Model 962 is in a recording cycle.

"**Done**" indicates that recording has been completed.

2.0 SAFETY PRECAUTIONS

⚠️ **CAUTION**

The Model 962 should not be opened by anyone other than factory personnel. There are no user serviceable parts inside of the Model 962 recorder. Attempting to service the Model 962 will void the warranty and could result in damage to the recorder.

⚠️ **CAUTION**

Cables can damage your equipment. High voltage electrostatic discharge can damage electrical devices. Similar to a capacitor, a cable can hold a charge caused by tribo-electric transfer, such as that which occurs in the following:

1. Laying on and moving across a rug.
2. Any movement through air.
3. The action of rolling out a cable.
4. Contact with a non-grounded person.

The solutions for ensuring product safety:

1. Connect the cables only with power switched OFF.
2. Temporarily "short" the end of the cable before attaching it to any signal input or output.

3.0 OVERVIEW

3.1 Specifications

Table 1 - Specifications

Torque and Force Input Channels	
Input Range:	±2.5 mV/V, ±4.5 mV/V, ±2.5 VDC
Excitation:	5 VDC, 120 mA Maximum
Resolution:	18-bit
Non-Linearity:	0.25% Maximum (F.S.)
Frequency Re-	10 kHz
Positive Voltage Peak Trap Circuit:	7µs Reset Time
Peak Threshold:	Software Programmable
Peak Reset:	Manual or Software Programmable (Automatic Reset)
Angle Input Channel	
Type:	Quadrature A/B Track
Excitation:	5 VDC
Input Frequency:	1000 kHz maximum
Display	
Viewing Area:	4.85 in x 2.68 in (123 mm x 68 mm)
Resolution:	240 x 128 Pixels, Backlit LCD
Battery	
Indication:	Battery Low Indication
Battery Life:	8 Hours Maximum, Continuous Use
Charge Time:	3.5 Hours Maximum
General	
Temperature	+32°F to +122°F (0°C to +50°C) Non-Condensing
Weight:	6.0 Lb (2.7 kg)

3.2 Dimensions

10.12 in
(257.0 mm)

8.50 in
(215.9 mm)

3.07 in
(77.9 mm)
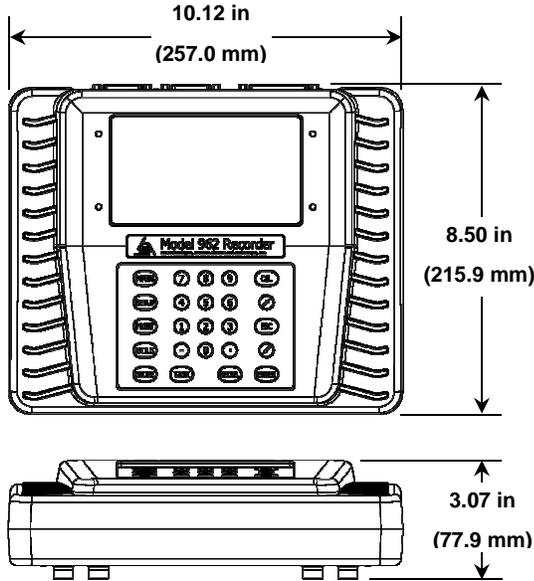
Figure 1 - Dimensions

3.3 Connector Panel

TTL/IO   Channel 2   Channel 1

ON/OFF
Switch

Battery
Charger
Indicator
LED

Battery
Charger
Jack

USB
Port A

USB
Port B
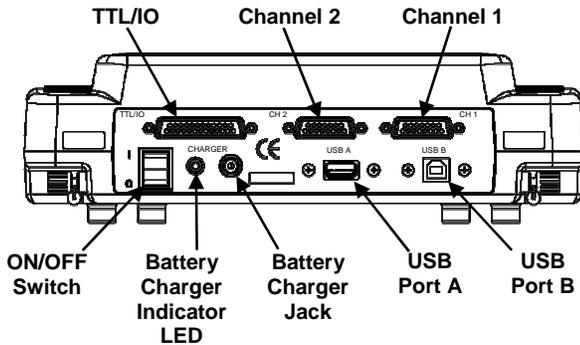
Figure 2 – Connector Panel

The following describes the connector panel features.

TTL/IO:	RS232 port provides for connection to data recorders or other devices.
Channels 1 & 2:	Typical setup is Channel 1 is set to torque with a torque-only or torque-angle transducer, and Channel 2 is set to force with a clamp load cell or fastener load cell.
ON/OFF Switch:	The power switch turns the Model 962 on and off.

Battery Charger Indicator LED:	LED will be lit when the internal battery is charging
Battery Charger Jack:	Receptacle for the battery charger.
USB Port A:	Provides for connection to a local USB printer (HP DeskJet compatible), or a flash drive memory stick to store numeric data, graphical data, test setups, and torque transducer/load cell definitions.
USB Port B:	Provides for connection to a desktop or laptop PC to upload recorded data, test setups, and tool definitions, or to download test setups, tool definitions, or program updates, using included FastPlot2 software.

Table 2 – Mating Connectors

Mating Connectors	
Channel 1, Channel 2:	DB, 15 Pins
TTL/IO:	DB, 25 Pins
USB Port A:	A Type
USB Port B:	B Type

3.4 Connector Pinouts

This section describes the pinouts for the TTL/IO and channel connectors.

3.4.1 TTL/IO Pinouts

Table 3 – TTL/IO Pinout

Pin	Function	Pin	Function
1	DGnd	14	Din4
2	RX1	15	DOut4
3	TX1	16	N.C.
4	RTS1	17	+5VDC
5	CTS1	18	DIn0
6	DSR1	19	DOut0
7	DGnd	20	DTR1
8	DCD1	21	DGnd
9	Analog_Out	22	RI1
10	DGnd	23	DIn1
11	DOut1	24	DIn2
12	DOut2	25	DIn3
13	DOut3		
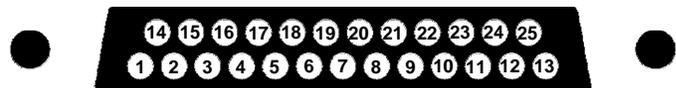
Figure 3 – DB 25 Pinout

3.4.2 Channel 1 & Channel 2 Pinouts

Table 4 – Channel 1 & Channel 2 Pinouts

Pin	Function	Pin	Function
1	-Signal	9	+Excitation
2	+Signal	10	-Excitation
3	GS1 (see below)	11	GS3
4	GS2 (see below)	12	GS4 (see below)
5	Analog Ground	13	Shunt
6	Transducer Type	14	Encoder A *
7	Encoder 5V *	15	Encoder B *
8	Digital Ground		

* Channel 1 only

A jumper **MUST** be added when wiring a connector for the Model 962 in order to scale the output of the transducer or input device properly unless the device output is ±2.5 VDC. The proper jumper positions are detailed in Table 4a below.

Table 4a – Connector Jumper Position

Jumper Position	Signal Level
3 & 12	Up to 2.5 mV/V
4 & 12	Up to 4.5 mV/V
None	Up to 2.5 VDC
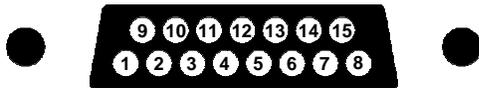
Figure 4 – DB 15 Pinout

3.4.3 Connecting a High Level Device

When connecting a high level input signal (±2.5 VDC) to the Model 962, connect a jumper between pins 1-5 on the DB 15 connector. Then connect the high level signal to pins 2 (+) and 1 (-) (also see Table 4).

3.5 Battery Use & Recharging

The Model 962 can operate for up to 8 hours on a fully charged internal battery. Battery and charger specs are list in Table 5.

Table 5 – Battery/Charger

Battery/Charger	
Battery:	10.8 VDC NiMH 2700 mAh
Charger:	18 VDC 1000 mA

NOTE: It is recommended that the instrument operate on battery power alone to minimize the interference of electrical noise in the acquired data.

3.6 Calibration Shunt Resistors

Calibration shunt resistors are used to scale the output values of the sensors used. The sensor's calibration value is matched to a calibration shunt resistor and can be found on the sensor's calibration certificate. Attach the resistor(s) as shown in Figure 5.

Channel 2 Calibration Shunt Resistor

Channel 1 Calibration Shunt Resistor
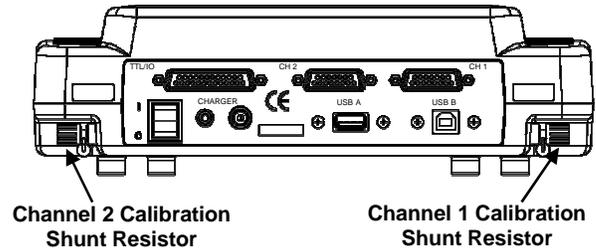
Figure 5 – Calibration Shut Resistors

3.7 File Types

There are four types of data that the Model 962 uses to store and upload its setup and recorded data, numeric results data, graphic plot data, test setup data, and tool definition data. The files can be saved on a USB flash drive or downloaded to a PC via the FastPlot2 software. The following describes the file types used in the Model 962.

.results:	File type that contains the numerical test results and the statistical summary data for the test. (Also can be in the form of M*.* when saved to the USB flashdrive)
.test:	File type that contains all of the data points used to make up the data plots for the individual test. (Also can be in the form of D*.* when saved to the USB flashdrive)
.stp:	File type that contains individual test setup data.
.xdf:	File type that contains individual tool definition data.

NOTE: Limit results and XY plot data files saved to a flashdrive are saved in a format based on the date and time. For example, a limit results file is saved as Mmmddyym.mss, where M = file type (limit results), mm = month, dd=day, yy=year, m.m = minute, ss=second. A XY plot data file is saved as Dmmddyym.mss using the same convention.

3.8 Keypad

The Model 962 software utilizes easy to use menu driven navigation. Navigation and input of data is performed using the keypad located on the front of the meter. See Figure 6 below.
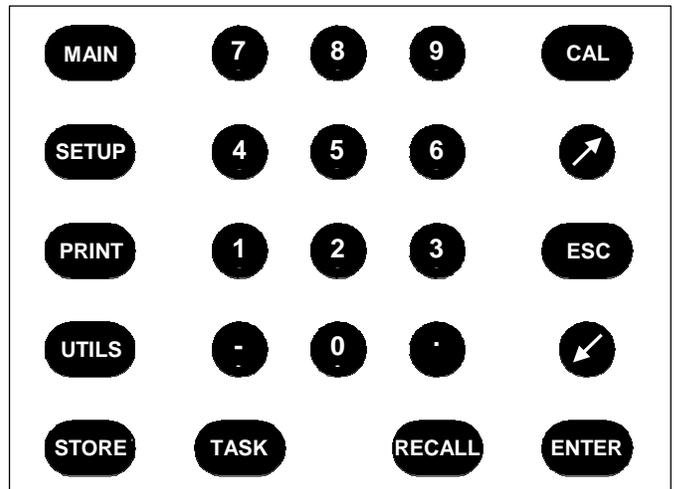
Figure 6 – Model 962 Keypad

The following describes the operations of the individual buttons on the keypad.

MAIN:	When Auto Reset is disabled, this button sets the Model 962 to be ready to perform a test. When not in the Ready mode no data can be collected. Must be on the MAIN SCREEN to use this button. See Section 4.2.
SETUP:	Press this button to enter the SETUP MENU. The SETUP MENU displays options to create and edit recording parameters along with various data analysis settings. Must be on the MAIN SCREEN to use this button. Refer to Section 4.3.
PRINT:	Press this button to enter the PRINT /DISK MENU. The PRINT/DISK MENU displays options to print or transfer numeric results, XY data, test setups, and tool definitions.
UTILS:	Press this button to enter the UTILITY MENU. The UTILITY MENU displays options to change settings, clear memory, and perform diagnostic functions.
STORE:	Press this button to manually update the numerical test results file. Must be on MAIN SCREEN and AutoStore must be disabled.
CAL:	Press this button to enter the CALIBRATION MENU. The CALIBRATION MENU displays options to calibrate the transducers to the Model 962 as well as add and edit transducers to the tool libraries.
ARROWS (↗↙):	Use the up and down arrow buttons to navigate through various menus or setup screens.
ESC:	Press this button to escape from a screen to the previous screen.
ENTER:	Press this button to save changed settings in various screens.
TASK:	Press this button to toggle between Peak and Track display modes. Must be on the MAIN SCREEN to use this button. See Section 4.2.
RECALL:	This button has no currently assigned function.
1-9,.,-:	Use these buttons to enter numeric data in various setup fields.

4.0 SCREENS AND MENUS

The Model 962 software utilizes various screens and menus to set up and perform the test, and to analyze the recorded data. The following sections give a brief overview of the various screens and menus.

4.1 Introductory Screen

When the Model 962 is powered up (using the "rocker-style" power switch located on the connector panel) the Introductory Screen is displayed. See Figure 7.

```
┌─────────────────────────────────────┐
│         MODEL 962 RECORDER          │
│                                     │
│        Torque-Angle Monitor         │
│                                     │
│          VERSION 7F-R1              │
│                                     │
│         PCB Load & Torque           │
│        24350 Indoplex Circle        │
│      Farmington Hills, MI 48335     │
│          Tel: 248-888-8260          │
│          Fax: 248-888-8266          │
└─────────────────────────────────────┘
```

Figure 7 – Introductory Screen

NOTE: The version number may be needed for some technical support.

The Introductory Screen will remain active for a few seconds, after which a calibration screen asking that you "zero" (refer to Figure 30) the enabled channels is displayed or the Model 962 will search to see if any "smart" transducers that include an ID chip are connected (refer to Section 4.6.4).

4.2 Main Screen

The MAIN SCREEN is the screen that is shown when a test is performed. It will appear automatically after the powering up sequence and acts as a "home" screen to activate the various menus available in the Model 962. The MAIN SCREEN contains the real-time plot data along with channel and statistical values. See Figure 8 below.

```
┌──────────────────────────────────────┐
│ 45395 N          64.3    pk CW       │
│ 156.25 deg                Nm         │
│ 75.0 Nm              TQ STATS        │
│                      L:    62.2      │
│ 48.0  ╱╲             M:    64.1      │
│      ╱  ╲            H:    66.0      │
│     │    │          S:     3.2      │
│     │    │          Cpk:  0.89      │
│     │     ╲                         │
│     │      ╲        Model#:         │
│     │       ╲        9250           │
│     │        ╲                      │
│ ────┘         ╲───  Cyc# 5          │
│ Done    sec        2.0              │
└──────────────────────────────────────┘
```
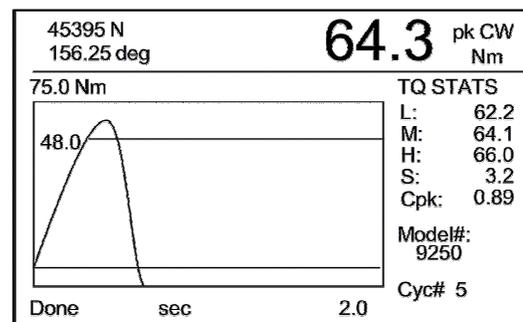
Figure 8 – MAIN SCREEN

The top section of the screen displays either the peak or track data readings from the enabled channels. The meter is in the peak mode if "pk" is visible in the top right corner of the MAIN SCREEN as shown in Figure 8. If "pk" is not visible then the meter is in track display mode.

The Model 962 can toggle between Peak and Track display modes by pressing the TASK button when the MAIN SCREEN is displayed. The Peak and Track modes are described below.

Peak Display Mode:	Displays the maximum data the channel read on the previously recorded rundown.
Track Display Mode:	Displays the real-time data that the channel is currently reading. Track Display Mode data does not get saved to memory.

NOTE: Only data for enabled channels will be displayed.

The MAIN SCREEN (see Figure 9) includes a real-time plot to graphically display the current test data as it is being recorded. Along the right side of the screen are the statistical values calculated on the test cycles saved for Channel 1. The number of rundowns from which the statistics are calculated is displayed in the bottom right corner Cyc#.

NOTE: A minimum of 3 cycles need to be saved in order to view the statistics.

Data recording can only be performed when viewing the MAIN SCREEN and when in the Ready mode. The Model 962 is in the Ready mode when "Ready" is displayed in the bottom left corner of the MAIN SCREEN as shown in Figure 9. The screen will display "Done" if not in the Ready mode.

NOTE: If Auto Reset is disabled, press the MAIN button when viewing the MAIN SCREEN to set the Model 962 to Ready mode. If Auto Reset is enabled the meter will automatically switch to the Ready mode after a set amount of time (refer to Section 4.3.6).
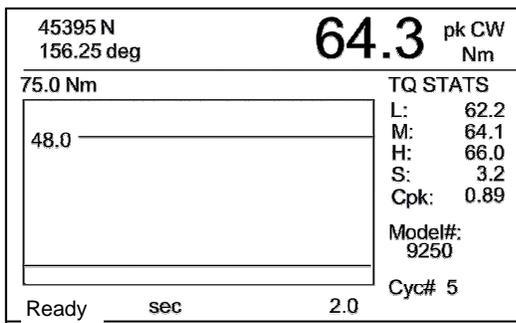
Figure 9 – MAIN SCREEN – Ready Mode

NOTE: The Model 962 does not have to be in the Ready mode to read Track Data to the screen.

NOTE: The Model 962 must be displaying the Main Screen before starting up the FastPlot2 software (refer to Section 6 for more on FastPlot2).

4.3 Setup Menu

The SETUP MENU displays options to create and edit recording parameters along with various data analysis settings. This menu can be viewed by pressing the SETUP button when on the MAIN SCREEN. See Figure 10.

Figure 10 – SETUP MENU

4.3.1 Channels Setup

Configure the data acquisition channels in the SETUP MENU by pressing the 1 button on the keypad. The CHANNELS SETUP screen is where the channel type is specified and the transducer is selected. See Figure 11.

Figure 11 – CHANNELS SETUP Screen

Navigate the CHANNELS SETUP screen using the Arrow (↗↙) buttons on the keypad. Press ESC to exit back to the SETUP MENU.

The Channel 1 Configuration is described below.

Type:	Press the 1 button on the keypad to toggle the Channel 1 type between TORQUE and FORCE. This should match to the sensor type connected to Channel 1.
Angle:	Press the 2 button on the keypad to ENABLE or DISABLE the ability to measure Angle on Channel 1.
Angle Count:	Press the 3 button on the keypad to toggle the Angle Count setting between ONEWAY and TWOWAY.
Transducer:	Press the 4 button on the keypad to select a transducer from a user-defined transducer library (refer to Figure 33).

Set the Angle Count to ONEWAY to allow for angle measurements to be positive for both clockwise (CW) and counter-clockwise (CCW) movements. Set the Angle Count to TWO-WAY to allow for positive and negative angle measurements. Figure 12 illustrates the difference between ONEWAY and TWOWAY Angle Counts.
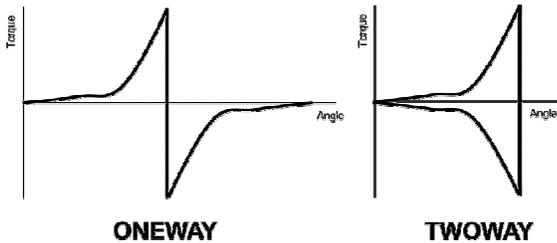
Figure 12 – Angle Count

NOTE: Most test setups will require the Angle Count to be set to TWOWAY.

NOTE: Angle measurements can only be performed with torque transducers with angle measuring capabilities. Angle values will read zero if the torque transducer cannot read angle or if the channel type is set to force even if Angle is set to ENABLE.

After a transducer has been selected, the channel precision needs to be set. Channel precision refers to how many digits to the right of the decimal place will be visible. The SET CHANNEL PRECISION screen is shown in Figure 13
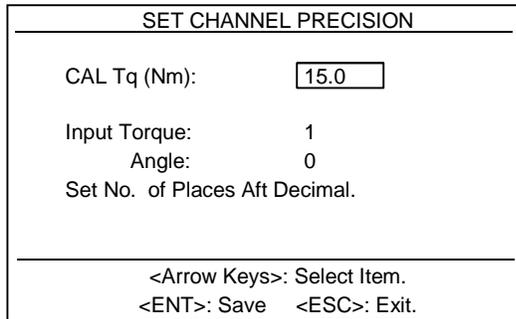
Figure 13 – SET CHANNEL PRECISION Screen

Navigate the SET CHANNEL PRECISION screen using the Arrow (↗↙) buttons on the keypad. Use the numeric buttons on the keypad to input the values. Press the ENTER button to save the values and press ESC to exit back to the CHANNELS SETUP screen.

NOTE: A transducer definition will need to be set up prior to being able to select one from the library.

The Channel 2 Configuration is described below.

Inputs:	Press the 5 button on the keypad to ENABLE or DISABLE Channel 2 data acquisition. If there is no sensor attached to Channel 2 then it should be set to DISABLED.
Type:	Press the 6 button on the keypad to toggle the Channel 2 type between TORQUE and FORCE. This should match to the sensor type attached to Channel 2.
Transducer:	Press the 7 button on the keypad to select a transducer from a user-defined transducer library (refer to Figure 33). Set CHANNEL PRECISION after selecting a transducer (see Figure 13).

NOTE: A typical setup is Channel 1 set to torque and Channel 2 is set to force. Depending on application, channels can be set to either both torque or both force. Never set Channel 1 to force while having Channel 2 set to torque.

NOTE: A transducer definition will need to be set up prior to being able to select one from the library. Refer to Section 4.4.4.

4.3.2 Units of Measure

The displayed and recorded units of measure are established in the SETUP MENU by pressing the 2 button on the keypad. Repeatedly pressing the 2 button will toggle through the available unit choices. The units displayed are the units that the meter is currently set for. Table 6 shows the order of the available units as they are toggled.

Table 6 – Units

Torque	Load	Dimension
lbft	lb	In
lbin	lb	In
ozin	Oz	In
Nm	N	mm
kNmm	N	mm
kgcm	kg	mm
kgm	kg	mm

4.3.3 Direction

The angle direction that is considered positive is set in the SETUP MENU by pressing the 3 button on the keypad. Repeatedly pressing the 3 button will toggle between CW and CCW. If CW is selected, then clockwise will be considered the positive angle direction. If CCW is selected, then counter-clockwise will be considered the positive angle direction.

NOTE: Use CCW when recording loosening of right-handed threads or when tightening left-handed threads.

4.3.4 Set Torque Limits

Set the Torque Limits by pressing the 4 button on the keypad when viewing the SETUP MENU. The Torque Limits set the recording parameters and visual target values for the real-time plot on the MAIN SCREEN. See Figure 14 below.

```
                Set Torque Limits

   Cycle Start (Nm):        [ 5.0 ]
   Cycle End (Nm):            4.0
   Cycle End Time (sec):      2.0
   Low Torque (Nm):          20.0
   Target Torque (Nm):       25.0
   High Torque (Nm):         30.0


        <Arrow Keys>: Select Item.
        <ENT>: Save    <ESC>: Exit.
```
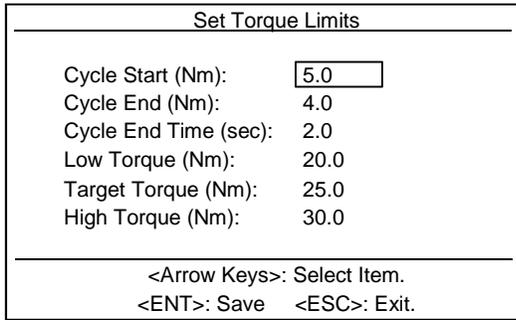
Figure 14 – Set Torque Limits Screen

Navigate the Set Torque Limits screen using the Arrow (↗↙) buttons on the keypad. Use the numeric buttons on the keypad to input the values. Press the ENTER button to save the values and press ESC to exit back to the SETUP MENU.

NOTE: Setup values entered into the Model 962 will not be saved unless the ENTER button is pressed.

The recording window is set using the Cycle Start, Cycle End, and the Cycle End Time parameters. The recording cycle starts once the Channel 1 data point designated by Cycle Start is measured. The recording cycle ends once the Channel 1 data set falls below the Cycle End value for the time set by Cycle End Time. This sequence is illustrated in Figure 15. The Cycle Start and Cycle End parameters are described below.

Cycle Start:	The Channel 1 data point that triggers the start of the data recording. This data point also designates the starting point for measuring angle.
Cycle End:	The Channel 1 data point that triggers that begins the sequence for ending the data recording. This value should be less than the Cycle Start value.
Cycle End Time:	The time value that the Channel 1 data pint must be below the Cycle End value to end the data recording.
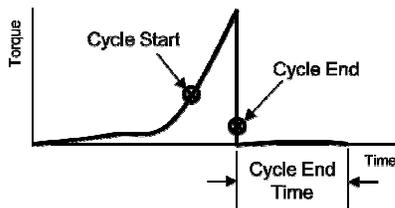
Figure 15 – Recording Window Parameters

NOTE: Data recording will end when either the Channel 1 input drops below Cycle End for the length of the time in Cycle End Time, or when the Full Scale data recording time (see Section 4.3.5) is completed, whichever comes first.

The Low, Target, and High Torque parameters are described below.

Low Torque:	The Channel 1 data point that signifies the minimum acceptable peak value. This value is used to calculate The Cpk statistic. Must be greater than Cycle Start.
Target Torque:	The Channel 1 data point that signifies the target peak value. This value is displayed on the real-time plot on the MAIN SCREEN. Must be greater than Low Torque and less than High Torque.
High Torque:	The Channel 1 data point that signifies the maximum acceptable peak value. This value is used to calculate the Cpk statistic and is used to scale the real-time plot on the MAIN SCREEN. Must se greater than Target Torque.

Some additional features of the MAIN SCREEN are shown in Figure 16 below.
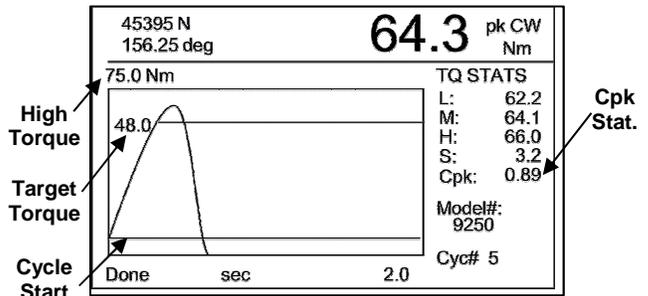
Figure 16 – MAIN SCREEN

4.3.5 Set Recording Time

Set the Recording Time by pressing the 5 button on the keypad when viewing the SETUP MENU. The Recording Time parameters establish a length for the recording window. See Figure 17.

```
                  RECORDING TIME

    Full Scale (sec):      [ 10.0 ]
    Advance Time (sec):      2.0




        <Arrow Keys>: Select Item.
        <ENT>: Save    <ESC>: Exit.
```
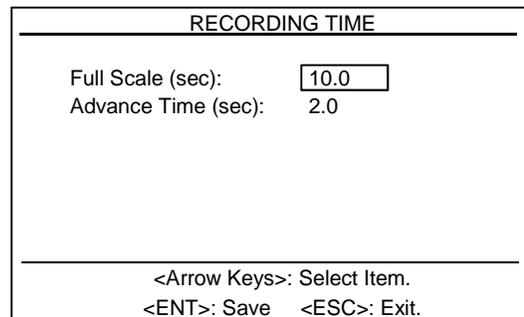
Figure 17 – RECORDING TIME Screen

Navigate the Recording Time screen using the Arrow (↗↙) buttons on the keypad. Use the numeric buttons on the keypad to input the values. Press the ENTER button to save the values and press ESC to exit back to the SETUP MENU.

NOTE: Input values will not be saved unless the ENTER button is pressed.

The Recording Time parameters are described below and illustrated in Figure 18.

Full Scale:	This value sets the duration of the test in seconds. Be sure this value is set to a time period long enough to record the entire test including the Advance Time.
Advance Time:	This value designates a portion of the Full Scale time to record data prior to the Cycle Start value. Any time set aside for recording prior to Cycle Start must be accounted for when setting the Full Scale time.
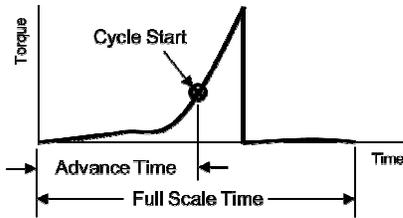
Figure 18 – RECORDING TIME Parameters

NOTE: The Recording Window is made up of parameters from the Set Torque Limits (refer to Section 4.3.4) and the Recording Time. If the Recording Time is not long enough to capture the entire parameters set by the Torque Limits the Recording Window will end when the Recording Time runs out.

4.3.6 Set Auto Options

The Auto Options are set in SETUP MENU by pressing the 6 button on the keypad. This menu is illustrated in Figure 19.

```
              AUTO OPTIONS
Enable desired options:
 1) Auto Reset:              ENABLED
 2) Reset Time (sec):        10
 3) AutoStore Results:       DISABLED
 4) AutoStore XYData:        DISABLED
 5) AutoSend at EOT:         DISABLED



        Make Selection or <ESC>: Exit.
```

Figure 19 – AUTO OPTIONS Screen

Navigate the AUTO OPTIONS screen using the Arrow (↗↙) buttons on the keypad. Press ESC to exit back to the SETUP MENU. The Auto Options parameters are described as follows.

Auto Reset:	When ENABLED, automatically resets the Model 962 to the Ready mode after the test is performed and the amount of time set in the Reset Time field elapses. When DISABLED, press the MAIN button on the keypad to reset the Model 962 to the Ready mode.
Reset Time:	Amount of time designated in seconds that the Model 962 will wait after a test to set the recorder back into the Ready mode. This parameter is available only if the Auto Reset is ENABLED.
AutoStore Results:	When ENABLED, the numerical results of the last recorded test are automatically stored into the results memory. When DISABLED, the STORE button on the keypad must be pressed to store the numerical results of the last test into the results memory (refer to Figure 6).
AutoStore XYData:	When ENABLED, the XY (plot) data from the last recorded test are automatically stored to a USB drive placed in the USB A port (refer to Figure 2). When DISABLED, the PRINT button on the keypad must be pressed to open the PRINT/DISK MENU and store the graphic data to the USB drive, or to the connected PC.
AutoSend at EOT:	When ENABLED, a data packet is automatically sent via the RS232 port of the IO connector at the end of each recorded test. The data packet contains the numeric peak value results of the test. Data is sent using 38400 baud, no parity, 8 bits, and 1 stop bit. When DISABLED, no End Of Test data will be sent to the PC.

4.3.7 Torque-Force Points

The Torque-Force Points are set in SETUP MENU by pressing the 7 button on the keypad. The Torque-Force Points are used to pull a torque value at a specified load or a load value at a specified torque from the current test and place it in the results file.

NOTE: This feature is available only if Channel 2 is ENABLED (refer to Section 4.3.1). To view data on the results report, make sure that Torque-Force is ENABLED in the REPORT FORMAT screen (refer to Section 4.3.9).

```
         Set Torque-Force Points
Select Point Type:        FORCE
FORCE-PT0 (N):          [ 26689 ]
FORCE-PT1 (N):            0
FORCE-PT2 (N):            0
FORCE-PT3 (N):            0
FORCE-PT4 (N):            0
PT=0 to Disable


       <Arrow Keys>: Select Item.
     <ENT>: Save     <ESC>: Exit.
```

Figure 20 – Set Torque-Force Points Screen

Navigate the Set Torque-Force Points screen using the Arrow (↗↙) buttons on the keypad. Use the numeric buttons on the keypad to input the values. Press the ENTER button to save the values and press ESC to exit back to the SETUP MENU.

NOTE: Input values will not be saved unless the ENTER button is pressed.

The Torque Force parameters are described below.

Select Point Type:	With the box around the Select Point Type field, press the ENTER button on the keypad to toggle between TORQUE and FORCE. If TORQUE is selected then load values will be pulled out of the data file at the designated torque value. If FORCE is selected then torque values will be pulled out of the data file at the designated load value. See Figure 21.
FORCE / TORQUE PTS 0-4:	Using the numeric buttons on the keypad, input the designated torque or force points. Set the point to 0 (zero) to disable the point.
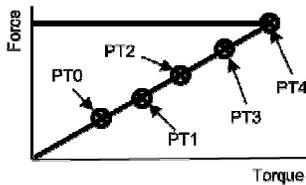
Figure 21 – Torque-Force Points

4.3.8 Analysis Setup

Access the ANALYSIS MENU from the SETUP MENU by pressing the 8 button on the keypad. Specialized data analysis can be performed on the test data when the parameters from the ANALYSIS MENU are set (see Figure 22). The results of the analysis are placed in the results file.

Figure 22 – ANALYSIS MENU

4.3.8.1 Measurement Window Feature

This feature is used when testing may produce an initial spike that should not be captured as the peak value, such as when using an impulse-type tool. A window can be programmed at the end of the data recording that will be used to determine the peak val-

ue. For example, if 5 seconds of data are recorded and the Measurement Window is set to 4 seconds, only the last 4 seconds of data will be used to determine the peak value; any peak torque that occurs during the first 1 second of data is ignored. Set this window by pressing the 1 button on the keypad from the ANALYSIS MENU to display the screen shown in Figure 23.

Figure 23 – Measurement Window Parameters Screen

The Measurement Window parameters are described below.

Window Type:	Press the 1 button on the keypad to toggle between TIME, ANGLE, and OFF. Set the Window Type to TIME or ANGLE to set a window at the end of the recording time. Set the Window Type to OFF to disable this feature.
Window Size:	Press the 2 button on the keypad to set the Window Size in units of either seconds or degrees. Once a value has been input press the ENTER button on the keypad to save the entry.

4.3.8.2 M-Alpha Feature

Enable the M-Alpha torque-angle signature analysis method by pressing the 2 button while in the ANALYSIS MENU. The M-Alpha method is used to estimate the amount of clamp load (force) in a bolted joint by studying the torque-angle relationship. See Figure 24.

NOTE: To view data on the results report, make sure that M-alpha Data is ENABLED in the REPORT FORMAT screen (refer to Section 4.3.9).

Figure 24 – M-Alpha Parameters Screen

The M-Alpha parameters are described below.

Lower Tangent Tq:	Press the 1 button on the keypad to ENABLE or DISABLE this function. When ENABLED, the clamp angle (see Figure 25) from the M-Alpha process will be included on the results file.
Percent of Peak:	When the Lower Tangent Tq is set to ENABLE press the 2 button on the keypad to set the Percent of Peak to establish a point to project a tangent line through using the peak torque value as the second point (see Figure 25). It is important that both the Peak and the Percent of Peak values lie within the elastic tightening zone. Once a value has been input press the ENTER button on the keypad to save the entry.
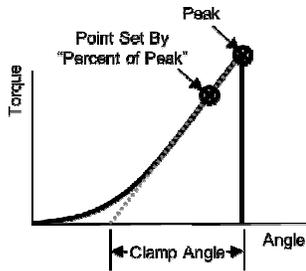
Figure 25 – M-Alpha Analysis

NOTE: For more information on the M-Alpha Torque-Angle Signature Analysis Methods refer to Section 7.

4.3.8.3 Friction Coefficient

Enable friction coefficient analysis by pressing the 3 button while in the ANALYSIS MENU. See Figure 26. The Reference Friction Parameters are used to calculate the Reference friction coefficient per the DIN 946 specification.

NOTE: This feature is only available when Channel 2 is enabled and set to FORCE. To view data on the results report, make sure that Friction Data is ENABLED in the REPORT FORMAT screen (refer to Section 4.3.9).

NOTE: The Reference friction coefficient of the DIN 946 specification is calculated with the same equations used for the Total friction coefficient of the ISO 16047 specification.

Figure 26 – Reference Friction Parameters Screen

Navigate the Reference Friction Parameters screen using the Arrow (↗↙) buttons on the keypad. Use the numeric buttons on the keypad to input the values. Press the ENTER button to save the values and press ESC to exit back to the SETUP MENU.

NOTE: Input values will not be saved unless the ENTER button is pressed.

The Friction parameters are described below.

Calc Friction At:	With the box around the Calc Friction At field, press the ENTER button on the keypad to toggle between FORCE and TORQUE. If FORCE is selected, then a clamp load value will be specified at which the Reference friction coefficient is calculated. If TORQUE is selected, then a torque value will be specified at which the Reference friction coefficient is calculated.
Clamp / Torque:	Use the numeric buttons to enter a value at which the Reference friction coefficient will be calculated. Once a value has been input press the ENTER button on the keypad to save the entry.
Nominal Dia:	The nominal diameter of the fastener being tested (see Figure 27).
Pitch:	Thread pitch of the fastener being tested (see Figure 27).
Bearing Dia:	The bearing diameter of either the bolt head or nut (whichever one is being turned (see Figure 27).
Thru Dia:	The through hole diameter of the washer (see Figure 27).
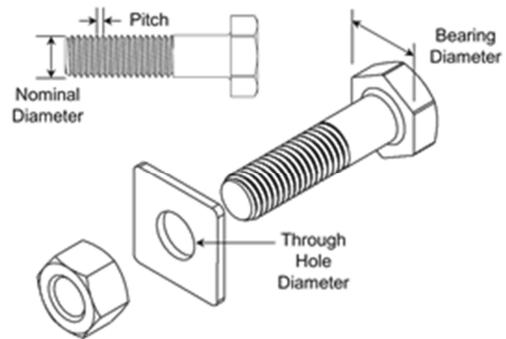
Figure 27 – Fastener Dimensions for Friction Calculations

NOTE: Thread Pitch is determined as the length or width of the thread. For example, a metric fastener may be specified as a M10 x 1.5. M10 indicates nominal diameter of 10 mm and the thread pitch of 1.5 mm. For English fasteners, an additional calculation is needed to determine thread pitch. For example, an English fastener may be specified as a 3/8-20 with 3/8 being the nominal diameter (3/8-inch = 0.375 in) and 20 indicating 20 threads per inch. To determine the thread pitch, divide 1 by the threads per inch to get the width of the threads in inches (1 / 20 = 0.05 in).

4.3.9 Set Report Format

The results file can be customized to show as much or as little data as needed. Set the REPORT FORMAT in the SETUP MENU by pressing the 9 button on the keypad. See Figure 28.

```
              REPORT FORMAT
Enable desired report data:
  1)  Enabled Channels:          ENABLED
  2) Test Setup:                 ENABLED
  3)  Standard Results:          ENABLED
  4)  Torque-Force:              DISABLED
  5)  Friction Data:             DISABLED
  6)  M-alpha Data:              DISABLED


          Make Selection or <ESC>: Exit.
```
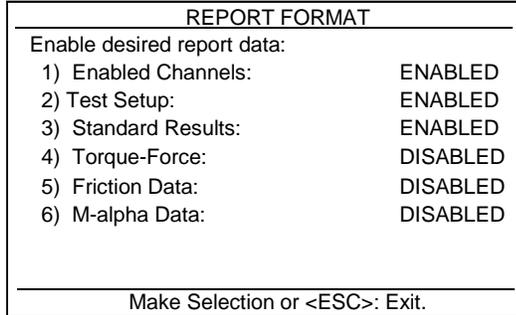
Figure 28 – REPORT FORMAT Screen

Press the keypad number that corresponds with the report data to ENABLE/DISABLE the data. ENABLE the data to include it in the results file. DISABLE the data to omit it from the results file.

4.4 Calibration Menu

The CALIBRATION MENU displays options to calibrate the attached transducers to the meter, "zero" the channels, add transducers to the library, or edit existing transducers in the library. This menu can be viewed by pressing the CAL button when on the MAIN SCREEN. See Figure 29.

Calibration operations scale the output of the transducer to the meter to insure that the voltage readings by the meter translate to the proper torque or load measurements.

```
              CALIBRATION MENU
  1)  ZERO Only
  2)  AUTO Calibration
  3)  MANUAL Calibration
  4)  Add/Edit Torque Transducer
  5)  Add/Edit Force Transducer




          Make Selection or <ESC>: Exit.
```
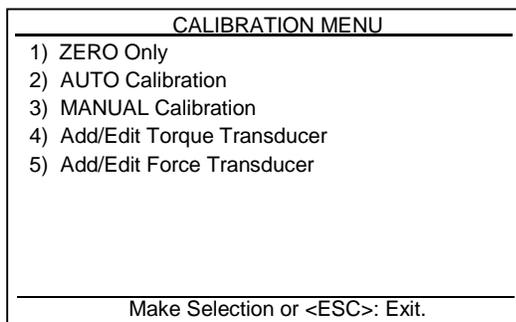
Figure 29 – CALIBRATION MENU

4.4.1 ZERO Only

ZERO the data acquisition channels in the CALIBRATION MENU by pressing the 1 button on the keypad. See Figure 30. The CHANNELS SETUP ZERO screen is where the enabled channels zeroing operation is performed. This includes sending zero volts through the attached unloaded transducers and recording the output. The Model 962 uses this output as the reference for unloaded conditions and makes sure that no artificial offsets are present in the collected data.

```
              CALIBRATION MENU
 Torque (Nm):
    Model: 03923   PPR: 1440
    F.S.: 67.0   CAL: 68.0

 CH2-Force (N):
    Model: 59810
    F.S.: 25000   CAL: 23830

          UNLOAD TRANSDUCERS!
          Press <ENT>: for ZERO.
```
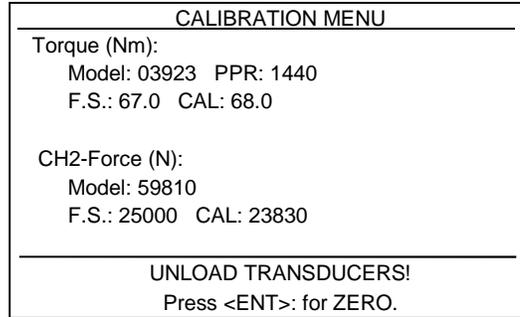
Figure 30 – CALIBRATION MENU ZERO Screen

Unload the enabled channels and press the ENTER button on the keypad to perform the operation.

NOTE: It is recommended that a ZERO operation be performed after the channels are calibrated.

4.4.2 AUTO Calibration

AUTO Calibration refers to the operation of automatically calibrating the transducer to the Model 962 using the shunt calibration method. The operation consists of the meter using a precision resistor (mounted on the binding posts of the meter) to simulate an output signal and scaling the simulated output to the defined calibration value. The AUTO CALIBRATION MENU is accessed through the CALIBRATION MENU by pressing the 2 button on the keypad. See Figure 31.

```
              CALIBRATION MENU
  1)  Torque Channel
  2)  CH2-Force Channel







          Make Selection or <ESC>: Exit.
```
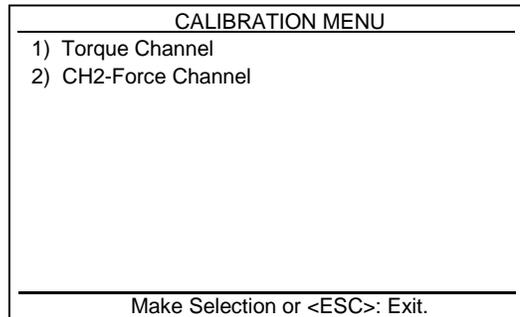
Figure 31 – AUTO CALIBRATION MENU

From the AUTO CALIBRATION MENU press the 1 button on the keypad to AUTO calibrate Channel 1 and press the 2 button on the keypad to AUTO calibrate Channel 2. When prompted make sure the appropriate channel is unloaded and then press the ENTER button on the keypad. The Model 962 will perform a zero balance check and display "Zero Taken", it will then perform an automatic shunt calibration and should display "Shunt Calibration Successful". This procedure should be performed for both channels if enabled.

NOTE: An error will occur if an acceptable voltage change between the zero and shunted reading is not measured. In the case of an error, the AUTO calibration will be aborted. If an error occurs check to make sure the transducers connections are tight and also check to see that the shunt calibration resistors are installed correctly.

The CALIBRATION MENU will display automatically after this operation.

NOTE: It is recommended that a ZERO operation be performed after a calibration operation (refer to Section 4.4.1).

4.4.3 MANUAL Calibration

MANUAL Calibration refers to the operation of manually calibrating the transducer to the Model 962. The operation consists of the meter sending a zero voltage through the attached transducer to get a baseline. A calibration load is then applied to the transducer. The resulting output signal is read by the Model 962 and used to scale the meter's gain. The MANUAL CALIBRATION MENU is accessed through the CALIBRATION MENU by pressing the 3 button on the keypad. See Figure 32.

```
             CALIBRATION MENU
  1) Torque Channel
  2) CH2-Force Channel




           Make Selection or <ESC>: Exit.
```
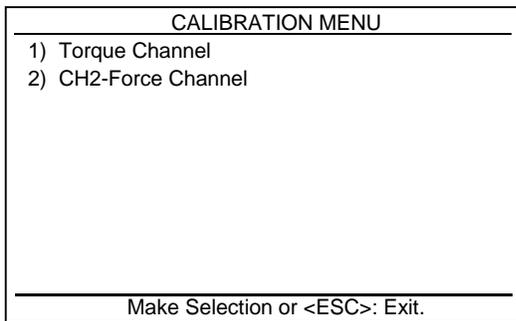
Figure 32 – MANUAL CALIBRATION MENU

From the MANUAL CALIBRATION MENU press the 1 button on the keypad to MANUALLY calibrate Channel 1 or press the 2 button on the keypad to MANUALLY calibrate Channel 2. When prompted make sure the appropriate channel is unloaded and then press the ENTER button on the keypad. The Model 962 will perform a zero balance check and display "Zero Taken". Manually apply the calibration load load to the transducer and press the ENTER button on the keypad. The voltage difference will be measured and the outputs will be scaled accordingly. This procedure should be performed for both channels if enabled.

NOTE: The MANUAL Calibration can be performed if an automatic shunt calibration is not possible, or if you have access to a certified load or torque application device. It requires accurate calibration loading to ensure accurate results.

NOTE: It is recommended that a ZERO operation be performed after a calibration operation (refer to Section 4.4.1).

4.4.4 Add/Edit Torque/Force Transducer

The Model 962 allows for storage of transducer definitions for ease of transducer selection when setting up a test. Adding and editing stored transducers can be accessed through the CALIBRATION MENU by pressing the 4 key for torque transducers or 5 key for load cells on the keypad. See Figure 33.

Model#	F.S. (Nm)	Cal (Nm)	PPR
02727	813.5	813.8	2898
03922	15.0	15.0	1440
03923	67.8	68.0	1440
12548	67.8	68.1	1440
39050	136.0	136.0	0
39225	0.0	0.0	0

```
        <Arrow Keys>: Select Tool.
        <ENT>: Select   <ESC>: Exit.
```

Figure 33 – Add/Edit Torque Transducer Screen

Navigate the Add/Edit Transducer screen using the Arrow (↗↙) buttons on the keypad. Place the box around a currently defined transducer and press the ENTER button to edit the definition. See Figure 34. Place the box around a blank space (at end of list) and press the ENTER button to add a new definition. Press the ESC button to exit back to the CALIBRATION MENU.

```
             DEFINE TOOL MENU

     Model No:          03922
     Serial No:         51069
     FS Tq (Nm):        15.0
     Cal Tq (Nm):       15.0
     Pulses Per Rev:    1440

  PPR=0 FOR TOOLS W/NO ANGLE
        <Arrow Keys>: Select Item.
        <ENT>: Save   <ESC>: Exit.
```
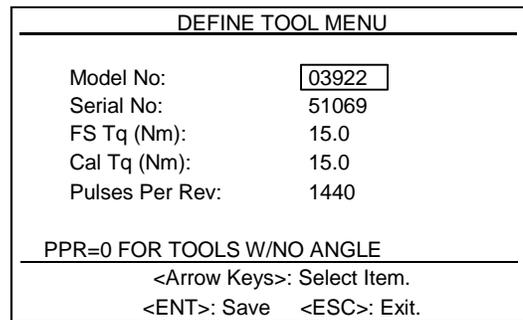
Figure 34 – DEFINE TOOL MENU Torque Screen

NOTE: The load cell definition screens are identical to the torque screens except they do not have a field for Pulses Per Rev (PPR).

Navigate the DEFINE TOOL MENU screen using the Arrow (↗↙) buttons on the keypad. Place the box around a field and use the numeric buttons to input the definitions. The transducer definition parameters are described below.

Model No:	Define the transducer with a model number (up to 5 digits).
Serial No:	Define the transducer with a serial number (up to 8 digits).
FS Tq/Force:	Input the full scale torque or load value of the transducer. This value can be found on the unit's calibration certificate. Make sure the proper units are current (refer to Section 4.3.2)
Cal Tq/Force:	Input the calibration torque or load value of the transducer. This value can be found on the unit's calibration certificate. Make sure the proper units are current (refer to Section 4.3.2)

Pulses Per Rev:	Input the pulses per revolution to define the angle encoder of the torque transducer. This value can be found on the unit's calibration certificate. This value is not applicable for load cells.

NOTE: Input values will not be saved unless the ENTER button is pressed.

4.5 Print/Disk Menu

The PRINT/DISK MENU displays options to print, save, and download the test data. View this menu by pressing the PRINT button on the keypad when on the MAIN SCREEN. See Figure 35.

```
            PRINT/DISK MENU
1) Printer
2) USB Drive
3) USB Host




        Make Selection or <ESC>: Exit.
```

Figure 35 – PRINT/DISK MENU

4.5.1 Printer

To print directly from the Model 962, press the 1 button while in the PRINT/DISK MENU to open the PRINTER MENU. See Figure 36. The numerical results file or various test plots can be directly printed to a USB HP Desk Jet-compatible printer connected to the USB A port.

```
            PRINTER MENU
1) Print Results
2) Print XY Plot




        Make Selection or <ESC>: Exit.
```

Figure 36 – PRINTER MENU

4.5.1.1 Print Results

Press the 1 button on the keypad when in the PRINTER MENU to print the Limit Results file directly to a HP Desk Jet-compatible printer connected to the USB A port.

4.5.1.2 Print XY Plot

Press the 2 button on the keypad when in the PRINTER MENU to open the SELECT XY PLOT MENU. See Figure 37.

```
            SELECT XY PLOT
1) InpTq vs. Time
2) InpTq vs. Angle
3) RPM vs. Time
4) RPM vs. Angle
5) InpTq, Angle vs. Time
6) InpTq, CH2-Force vs. Time
7) InpTq, CH2-Force vs. Angle
8) CH2-Force vs. InpTq

        Make Selection or <ESC>: Exit.
```

Figure 37 – SELECT XY PLOT MENU

Press the numeric number button on the keypad corresponding to the desired test plot to view the plot on screen. Once the plot is displayed on the screen, press the PRINT button on the keypad to send the plot directly to a printer or press the ESC button on the keypad to escape back to the SELECT XY PLOT MENU.

NOTE: XY Plot choices depend on meter setup. If angle is not enabled, the angle choices are not displayed. If a load cell is not being used, the load/force choices are not displayed.

4.5.2 USB Drive

To save data to a USB flash drive from the Model 962, press the 2 button while in the PRINT/DISK MENU to open the USB DISK DRIVE MENU. See Figure 38. The results files, rundown files, setup files, and tool definitions can be saved to a USB flash drive via the USB A port. Using this menu, test setups and tool definitions can be uploaded from a flash drive to the Model 962.

```
        USB DISK DRIVE MENU
1) Results File → Disk
2) Current Rundown → Disk
3) Current Setup → Disk
4) Tool Definitions → Disk
5) Disk → Current Setup
6) Disk → Tool Definitions


        Make Selection or <ESC>: Exit.
```

Figure 38 – USB DISK DRIVE MENU

The USB drive options are described below.

Results File → Disk:	Press the 1 button on the keypad to save the currently stored numeric data results to a USB flash drive in port USB A (refer to Figure 2).

Current Rundown → Disk:	Press the 2 button on the keypad to save the XY data of the current test to a USB flash drive in port USB A.
Current Setup → Disk:	Press the 3 button on the keypad to save the current test setup to a USB flash drive in port USB A.
Tool Definitions → Disk:	Press the 4 button on the keypad to save the transducer libraries to a USB flash drive in port USB A.
Disk → Current Setup:	Press the 5 button on the keypad to upload the test setup from the USB flash drive in USB A port into the Model 962.
Disk → Tool Definitions:	Press the 6 button on the keypad to upload the transducer definitions from the USB flash drive in the USB A port into the Model 962.

4.5.3 USB Host

To send the data to a PC from the Model 962, press the 3 button while in the PRINT/DISK MENU to open the USB HOST MENU. See Figure 39. The results files, rundown files, setup files, and tool definitions can be uploaded to a connected PC via the USB B port.

NOTE: FastPlot2 software must be installed on the PC to transfer data with the Model 962.

```
                  USB HOST MENU
1)  Results File → Host
2)  Current Rundown → Host
3)  Current Setup → Host
4)  Tool Definitions → Host




              Make Selection or <ESC>: Exit.
```

Figure 39 – USB HOST MENU

The USB Host menu options are described below.

Results File → Host:	Press the 1 button on the keypad to send the numeric data results to a PC via the USB B port.
Current Rundown → Host:	Press the 2 button on the keypad to send the current XY data to a PC via the USB B port.
Current Setup → Host:	Press the 3 button on the keypad to send the current test setup to a PC via the USB B port.
Tool Definitions → Host:	Press the 4 button on the keypad to send the transducer libraries to a PC via the USB B port.

NOTE: For more information on the FastPlot2 software refer to Section 6.

4.6 Utility Menu

The UILITY MENU displays options to manage miscellaneous Model 962 settings. This menu can be viewed by pressing the SETUP button when on the MAIN SCREEN. See Figure 40.

```
                  UTILITY MENU
1)  Set Date and Time
2)  Clear Results
3)  Install Defaults
4)  Check for Smartducers-OFF
5)  Set 962 Serial Number
6)  Mode: STANDARD
7)  Set Analog Outputs
8)  Diagnostics Menu
9)  Change Password
              Make Selection or <ESC>: Exit.
```

Figure 40 – UTILITY MENU

4.6.1 Set Date and Time

To set the date and time on the Model 962, press the 1 button on the keypad while in the UTILITY MENU to open the SET DATE AND TIME screen. See Figure 41.

```
                SET DATE AND TIME

    Month (1-12):           3
    Day (1-31):            14
    Year (xx):            14

    Hour (0-23):          12
    Min (0-59):            3

            <Arrow Keys>: Select Item.
        <ENT>: Save    <ESC>: Exit.
```

Figure 41 – SET DATE AND TIME Screen

Navigate the SET DATE AND TIME screen using the Arrow (↗↙) buttons on the keypad. Use the numeric buttons on the keypad to input the values. Press the ENTER button to save the values and press ESC to exit back to the UTILITY MENU.

NOTE: Input values will not be saved unless the ENTER button is pressed.

4.6.2 Clear Results

To clear the numeric results file on the Model 962, press the 2 button on the keypad while in the UTILITY MENU to open the CLEAR RESULTS screen. Refer to Figure 42.

```
                CLEAR RESULTS
 ────────────────────────────────────────

  Clear all results?




 ────────────────────────────────────────
       <ENT>: Clear    <ESC>: Exit.
```
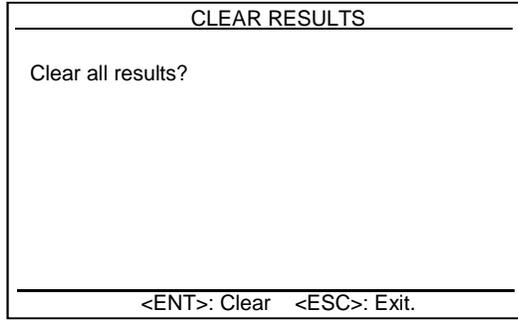
Figure 42 – CLEAR RESULTS Screen

Press the ENTER button on the keypad to clear the numeric results file. Press the ESC button to exit back to the UTILITY MENU.

NOTE: Be sure to print or save the numeric results file prior to clearing the results.

4.6.3 Install Defaults

To set the Model 962 back to factory preset condition, press the 3 button on the keypad while in the UTILITY MENU to open the INSTALL DEFAULTS screen. See Figure 43.

NOTE: This operation will erase all of the settings and transducer definitions. Make sure this information is saved or documented prior to installing defaults.

NOTE: The password is set in the Change Password screen (refer to Section 4.6.9). The default password is 268.

```
                INSTALL DEFAULTS
 ────────────────────────────────────────

  Password:              [       ]


  CAUTION:  Installing Defaults
  WILL Erase Current Settings


```
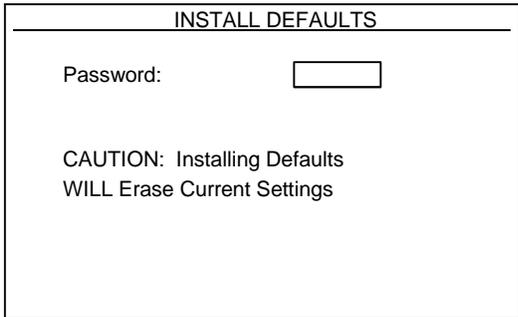
Figure 43 – INSTALL DEFAULTS Screen

Use the numeric buttons on the keypad to input the password. If any of the information is incorrect an error will appear and the Model 962 will return to the UTILITY MENU.

4.6.4 Check for Smartducers

To set the Model 962 to check for transducers with Auto-ID chips, press the 4 button on the keypad while in the UTILITY MENU to toggle this mode between ON and OFF.

NOTE: This feature is typically enabled only if the Model 962 will be used with multiple transducers that have Auto-ID chips to simplify the setup and calibration.

4.6.5 Set 962 Serial Number

To set the serial number on the Model 962, press the 5 button on the keypad while in the UTILITY MENU to open the SET 962 SERIAL NO screen. See Figure 44.

```
              SET 962 SERIAL NO
 ────────────────────────────────────────

  Serial No:     [                    ]




 ────────────────────────────────────────
       <ENT>: Save    <ESC>: Exit.
```
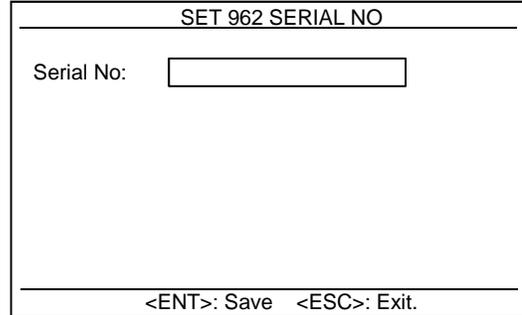
Figure 44 – SET 962 SERIAL NO Screen

Use the numeric buttons on the keypad to input the serial number. Press the ENTER button to save the values and press ESC to exit back to the UTILITY MENU.

NOTE: Input values will not be saved unless the ENTER button is pressed.

4.6.6 Mode

To change the mode of the Model 962 to GMPT, press the 6 button on the keypad while in the UTILITY MENU to toggle this mode between STANDARD and GMPT.

NOTE: GMPT mode is for a very specific application and will not record data unless commended by a tool station controller. This mode should typically be set to STANDARD.

4.6.7 Set Analog Outputs

To enable and set up the analog output on the IO connector on the Model 962, press the 7 button on the keypad while in the UTILITY MENU to open the SET OUTPUTS screen. See Figure 45. The Model 962 can thus be set up to transmit real-time the output signal from Channel 1, or the Angle on Channel 1, or the output signal of Channel 2.

```
                 SET OUTPUTS
 ────────────────────────────────────────

  1) Output Channel:        CHAN 1
  2) Full Scale (Nm):       [ 0.0 ]

  Full Scale is 10vdc Output



 ────────────────────────────────────────
     Make Selection or <ESC>: Exit.
```
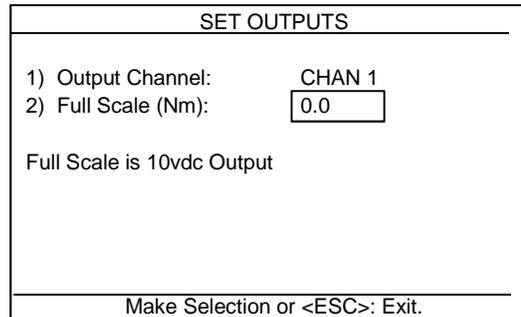
Figure 45 – SET OUTPUTS Screen

Press the 1 button on the keypad to toggle the Output Channel between: OFF, CHAN 1, CHAN 2, and ANGLE. Press the 2 button on the keypad to enter the full scale output. Press the ESC button on the keypad to exit back to the UTILITY MENU.

NOTE: Enabling the analog outputs is used for very specific applications where these output signals will be read by remote data acquisition or control equipment. This mode should typically be set to OFF.

4.6.8 Diagnostics Menu

To check the channel inputs on the Model 962, press the 8 button on the keypad while in the UTILITY MENU to open the TRANSDUCER INPUTS screen. See Figure 46.

```
            TRANSDUCER INPUTS
  Torque (AD Cnts):              10
  Angle (Enc Cnts):               0
  Force (AD Cnts):               14
  Ang2 (Enc Cnts):                0
  Battery:       161 counts    12.5V

  Channel Shunt:          OFF


       <ENT>:  Toggle Channel Shunt
            <ESC>: Exit.
```

Figure 46 – TRANSDUCER INPUTS Screen

Press the ENTER button to toggle the Channel Shunt between ON and OFF and press ESC to exit back to the UTILITY MENU.

4.6.9 Change Password

To set the password on the Model 962, press the 9 button on the keypad while in the UTILITY MENU to open the CHANGE PASSWORD screen. See Figure 47.

```
            CHANGE PASSWORD

  Password:       ****

  New Password:          ****
      Verify:            ****


  Password Change Successful!

```

Figure 47 – CHANGE PASSWORD Screen

Use the numeric buttons on the keypad to input the values. Once the numbers are entered the next field will appear. If any of the information is incorrect an error will appear and the Model 962 will return to the UTILITY MENU.

NOTE: This password is only used to protect the re-initialize process (Install Defaults).

5.0 USING FASTPLOT2

Use the following procedure to start and use FastPlot2. This procedure assumes you have installed the software on the computer by running the *setup.exe* file located on the installation disc.

5.1 Start FastPlot2

Before starting FastPlot2, the USB cable must be connecting the Model 962 to the PC, and the Model 962 must be powered up and displaying the Main Screen. Click on the FastPlot2 icon on your desktop or select FastPlot2 from the Program Group in which you have installed the program. The initial FastPlot2 screen looks like that shown in Figure 48 below.
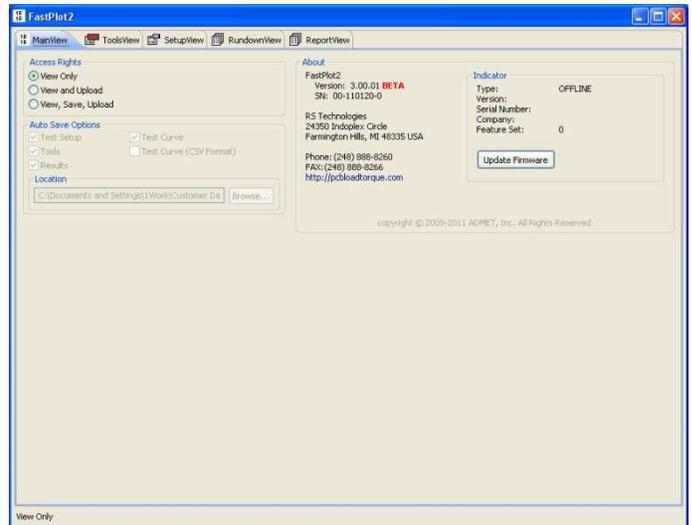
Figure 48 – FastPlot2 MainView Screen

Note the following parts of the screen:

- The **Title Bar** at the top of the screen that identifies the application on the left and provides the *Minimize*, *Full Screen/Window*, and *Exit* buttons on the right.

- The **Tab Bar** below the **Title Bar** that gives you access to the *Main View, ToolsView, SetupView, RundownView,* and *Reports View* screens.

The functions of the FastPlot2 software are divided up into the different view screens. Most of the screens have a context menu that is displayed by right-clicking on the screen. This will provide you with additional functions such as Load, Save, Print, etc.

5.2 MainView Tab

In the MainView Tab you can accomplish the following tasks.

Access Rights: Choose which way to access the data generated by the Model 962.

View Only:	Select this to just receive the data and view it.
View and Upload:	Select this to receive the data, view it, and upload tool definitions and test setups to the Model 962
View, Save, Upload:	Select this to receive data and view it, save the data to a computer drive, and upload tool definitions and test setups to the Model 962.

NOTE: The password for being able to View and Upload is "379", and the password for being able to View, Upload, and Save is "157".

Auto Save Options: This feature lets you assign a location for saving data file when they are sent to the PC using FastPlot2. Checking any of the options will store the respective file in the location entered into the location field using the browse function.

Test Setup:	Stores the Model 962 test setup.
Tools:	Stores the transducer definitions currently saved in the Model 962.
Results:	Stores the numerical results from the Model 962.
Test Curve:	Stores the data that makes up the test curve. Saving the XY Plot data using this selection stores the file in a compressed format that cannot be read by standard spread sheet programs
Test Curve (CSV Format:	Stores the data that makes up the test curve. Saving the XY Plot data using this selection stores the file in a csv (comma separated value) format that can be read easily by most spreadsheet programs

About: Provides version information about the FastPlot2 software and technical support. It also provides information about the Model 962 you are connected to and also the means to upload a firmware update.

NOTE: The password to update the firmware is "12345".

5.3 ToolsView Tab

This view lets you set up the torque transducers and load cells that you will be using with your Model 962. See Figure 49. There is a separate library for all of the transducer and load cell data. Once the tools are entered here, they can be selected for use in the SetupView tab. The data for the transducers and load cells is entered on the right side of the screen and all of the tools entered into the FastPlot2 library are listed on the left side of the screen.

There is a Context Menu that can be displayed by right-clicking anywhere on the window. From this menu you can do the following:

- Load a previously saved tool definition file (*.xdf)

- Save the displayed tool definitions to the PC
- Upload the displayed tool definitions to the Model 962
- Upload a previously save tool definition file to the Model 962
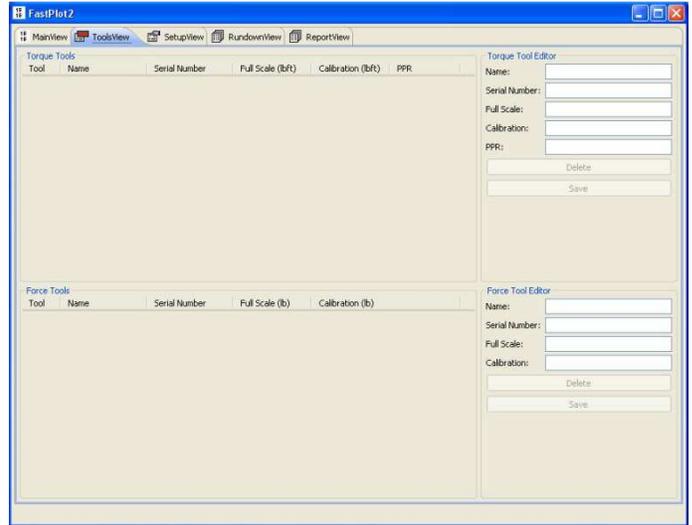
Figure 49 – ToolsView Tab

Tool Editor: Provides a method of defining transducers using the FastPlot2 software.

Name:	Define the transducer with a model number (up to 5 digits)
Serial Number:	Define the transducer with a serial number (up to 8 digits)
Full Scale:	Input the full scale torque or load value of the transducer. This value can be found on the unit's calibration certificate.
Calibration:	Input the calibration torque or load value of the transducer. This value can be found on the unit's calibration certificate.
PPR:	Input the pulses per revolution to define the angle encoder of the torque transducer. This value can be found on the unit's calibration certificate. This value is not applicable to load cells.

5.4 SetupView Tab

This tab lets you enter the information needed to set up a test in the Model 962. See Figure 50. There is also a Context Menu that you can display by right-clicking at any place on the window. From the Context Menu you can do the following:

- Load a previously saved setup file (*.stp)
- Set default values
- Save the displayed setup to the PC
- Upload the displayed setup to the Model 962
- Upload a stored setup file to the Model 962
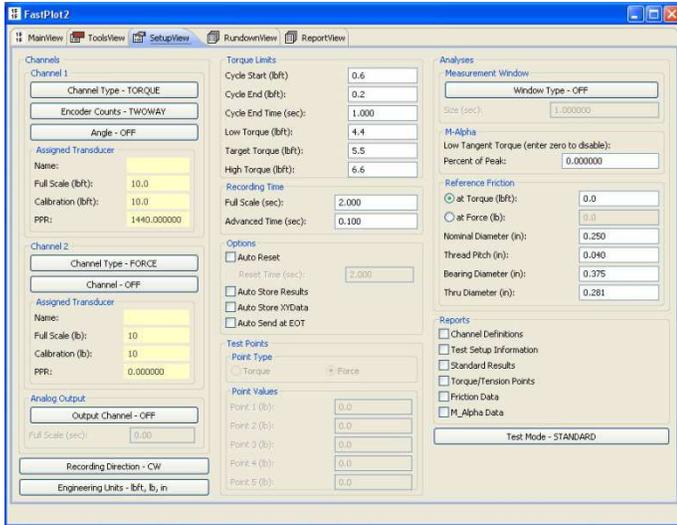
Figure 50 – SetupView Tab

The following describes the SetupView options.

Channels:	For Channel 1, select the type of transducer being used, torque or force; if the torque transducer has an angle encoder, turn the angle measurement ON or OFF, and select TWOWAY or ONEWAY angle recording. The same options are available for the Channel 2 load cell or transducer, when enabled. The data for the transducer/load cell will be indicated in the Assigned Transducer box. Reference Section 4.3.1
Analog Output:	Click the button to toggle between OFF, Chan 1 (Torque), Chan 2 (Load), or Angle. **NOTE:** Only one of these signals can be provided. Enabling allows you enter a full scale value for the selected output. (This may not necessarily be the full scale of the torque or load sensor.)
Recording Direction:	Click the button to toggle between CW and CCW. Reference Section 4.3.3.
Engineering Units:	Click the button to toggle between the various selections that are available. Reference Section 4.3.2.
Torque Limits:	Input values to setup the recording parameters. Reference Section 4.3.4.
Recording Time:	Input values to setup the length of the test. Reference Section 4.3.5.
Options:	Select the automatic options for resetting the Model 962 after a test, storing the data and plot data automatically, and sending an End Of Test data packet after each test is complete. Reference Section 4.3.6.

Test Points:	Select either torque values at which to record clamp load or force points at which to record torque values. Those torque/force points are set in the space below the Point Type. Reference Section 4.3.7.
Analyses:	Click the button to toggle between the optional analytical features available with the Model 962. Set the set the measurement window, the M-Alpha point, and enter the geometry of the fastener to obtain the Reference Friction. Reference Section 4.3.8.
M-Alpha:	If M-Alpha is selected in **Analyses** then input the percentage of Peak. Reference Section 4.3.8.2.
Reference Friction:	If Reference Friction is selected in A**nalyses** then input the calculation points and joint geometry. Reference Section 4.3.8.3.
Reports:	Select the data that will be included in the numeric data report. Reference Section 4.3.9.
Test Mode:	Click the button to toggle between the Standard Test mode and the GMPT mode. This mode should be set to STANDARD unless a GMPT controller is being used. Reference Section 4.6.6.

5.5 RundownView Tab

The RundownView Tab lets you view the rundown data that has been uploaded from the Model 962. See Figure 51.
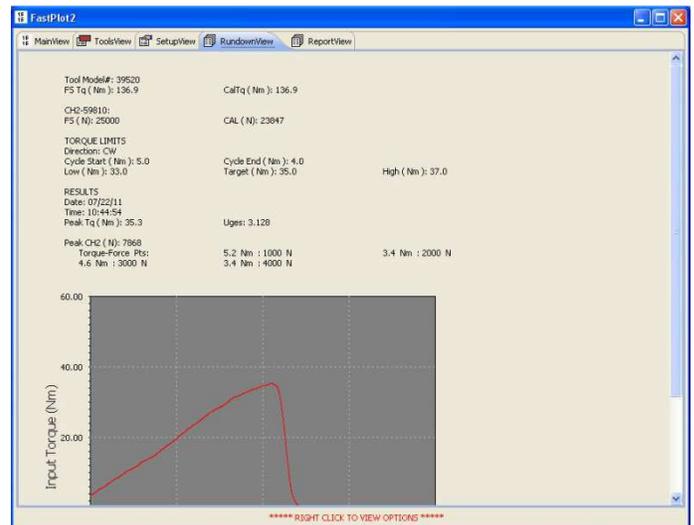
Figure 51 – RundownView Tab

As with the other views, you can obtain a Context Menu by right-clicking on the window. See Figure 52.
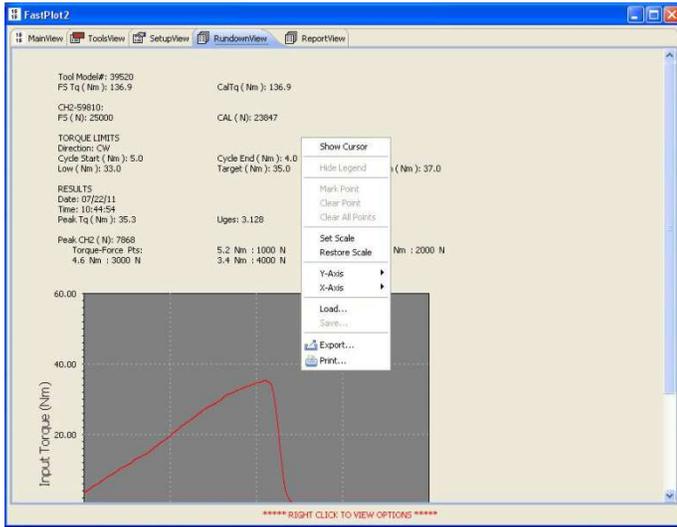
Figure 52 – Rundown with Context Menu

From the Rundown Context menu you can perform several other important options including the following:

Show Cursor:	Displays a crosshair that follows the displayed plot data and allows for a data point to be marked by clicking the mouse. Up to 5 data points can be marked. The data points are displayed in the upper left corner of the plot, and can be referred to as the Legend. Once the cursor is selected, you can display the Context Menu and choose to hide it.
Hide Legend:	Removes the labeling from the plot. Once the legend text is removed, it can be re-displayed by selecting Show Legend from the Context Menu.
Mark Point:	Marks a point on the plot.
Clear Point/Clear All Points:	Clears any or all of the marked data points on the plot.
Set Scale:	Displays a box into which scaling and division boundaries for the plot can be input. This provides the ability to zoom in to view a particular section of the data.
Restore Scale:	Restores the plot to the original display axis scaling.
Y-Axis:	Select which of the recorded or calculated data will be displayed on the Y-axis of the plot.
X-Axis:	Select which of the recorded or calculated data will be displayed on the X-axis of the plot.
Load:	Open up and display a previously saved plot file.

Save:	Save the displayed data to the PC.
Export:	Exports and saves the data in a *.CSV format that can be accessed by another program such as Microsoft Excel.
Print:	Brings up the computer's print window so that the printer and other print options needed to print out the data can be selected.

5.6 ReportView Tab

This view lets you display the numeric test results recorded by and uploaded from the Model 962. See Figure 53.
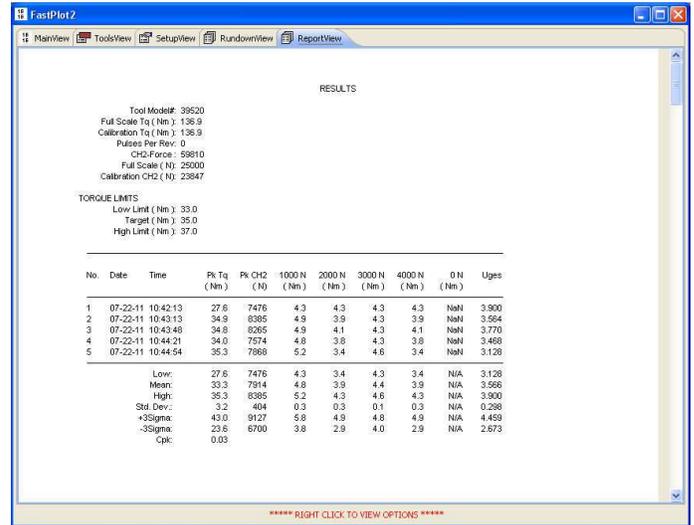
Figure 53 – ReportView Tab

The Context Menu for this tab provides for the following options:

Load:	Displays a previously saved numeric data file.
Remove Results:	Allows for the removal of a selected line of data from the results file. **Note:** Once a line of data is removed it cannot be restored.
Save:	Saves the displayed numeric data report to the PC.
Export:	Saves the displayed numeric data report in a format (*.CSV) that can be imported by another program such as Microsoft Excel.
Print:	Displays the computer's Print window so that the numeric report can be printed.

5.7 Exit FastPlot2

To exit the program, click on the red *Exit* button in the upper right corner.

5.8 Installations of Software Upgrade

Software upgrades are installed by uploading the new firmware from a remote laptop or desktop computer, via the USB port and FastPlot2 software. From the MainView tab of FastPlot2 click on the Update Firmware button and follow the prompts. When prompted for a password, enter "12345".

6.0 M-ALPHA ANALYSIS

The Model 962 is ideal for threaded fastener joint analysis. One of the best tools is our patented M-Alpha analysis that lets you estimate fastener tension simply by recording and analyzing torque-angle signatures. This section provides a brief overview of how the Model 962 can be used for M-Alpha analysis.

6.1 M-Alpha Overview

There are three basic steps to conducting an M-Alpha analysis on a problematic bolted joint. The first step is to qualify the joint components by performing some preliminary tests to determine the relationship between torque, angle, and tension. Once a consistent relationship between angle and tension is established, you can calculate the angle-tension coefficient in terms of tension per degrees of turn. Finally you can audit the assemblies and estimate the tension on the fastener by analyzing the torque-angle curve.

6.2 M-Alpha Analysis Procedure

Use the following steps to conduct an M-Alpha Analysis using the Model 962.

NOTE: The M-Alpha analysis method can be used for analyzing test data recorded in the elastic tightening region of the torque angle curve. Therefore the Peak Torque and the Lower Tangent Torque value must both lie within this region for the analysis calculation to be accurate.

1. Using your Model 962, rotary torque sensor, and clamp force sensor run a series of torque-angle-tension tests. Make sure that you have set the Lower Tangent Torque properly as described in Section 4.3.8. After the tests are done, print out the numeric and graphic data.

2. Examine the torque-angle graphs to determine if you are recording data in the elastic clamping zone. This means that the slope of the torque-angle curve is a straight line leading up to the final torque being reached. A bend or curve in the line means that embedment or thread strip or some other factor is adversely affecting the joint.

3. Examine the numeric data and locate the data listed in the column labeled Elas Pk. This is the tightening angle or the amount of turn of the fastener that went directly into clamping the parts together.

4. To determine the angle-tension coefficient, divide the average tension by the average tightening angle (Elas Pk). The result will be in terms of clamp load vs. degrees. For example, if your average tension is 7500 N and your average tightening angle is 40 degrees, your angle-tension coefficient is 187.5, meaning for every degree of turn, 187.5 N of clamping force is generated.

5. Subsequently, when you conduct torque-angle audits of the bolted joint using your Model 962 and a rotary torque-angle sensor, estimate your clamp load by multiplying the resulting tightening angle (Elas Pk) by the angle-tension coefficient.

NOTE: The effectiveness of the M-Alpha analysis method is affected by yield in the fastener and by the state of friction in the joint. The presence of yield or differences in friction can produce errors in the estimation of clamp load. Slight differences in the plating finish or protective coating on the fastener may produce error as well.

More complete information on the M-Alpha process and other possible uses for the Model 962 recorder can be found in the Knowledge Library on the PCB Load & Torque website at the following link:

https://www.pcb.com/WhitePaperLibrary.aspx#Fastening

7.0 MAINTENANCE

Routine maintenance of the Model 962 should include inspection and cleaning of the electrical connectors, housings, and mounting surfaces. Since the Model 962 instrument is computer equipment, use the same cleaning routine as you would for a laptop computer, iPad, tablet, or cell phone.

> ⚠ **CAUTION**
>
> Keep solvent-type cleaners away from the front panel display and keyboard as they may damage those components.

> ⚠ **CAUTION**
>
> The Model 962 is not watertight, so do NOT submerge the unit, pour liquids poured on it, or let the unit get wet. Never use a pressure washer on the Model 962 or the torque transducers and load cells typically used with it.

7.1 Battery Use & Re-Charging

The Model 962 is a portable instrument. It can operate for up to 8 hours on a fully charged internal battery.

NOTE: It is recommended that you take data while using battery power only. This will minimize the interference of electrical noise in the acquired data.

7.2 Handling & Placement

Please observe the precautions contained in the following paragraphs.

In general, since the Model 962 is computer equipment, take the same precautions with it as you would a portable or laptop personal computer.

Allow adequate air circulation to prevent internal heat buildup.

Do not set up or operate in close proximity to heat sources such as radiators or air ducts.

Do not use in a corrosive environment or place near equipment such as salt-spray cabinets, etc.

The cast aluminum housing of the Model 962 makes the instrument a durable design, but you should avoid conditions that will induce vibration, and avoid dropping the instrument.

Since the Model 962 is computer equipment, use the same cleaning routine as you would for a personal computer. The Model 962 is NOT watertight so do NOT let the instrument get wet. Keep solvent-type cleaners away from the front panel display and keypad. Care for the keypad as you would for a personal computer.

8.0 TROUBLE SHOOTING

Proper performance of the Model 962 with the connected torque transducers and load cells requires careful attention to both electrical and mechanical aspects of the equipment as a measurement system. A basic understanding of the electrical and mechanical installation requirements is recommended. For basic trouble-shooting guidance, please refer to the following table.

Problem	Description	Action
Model 962 does not power up	Battery pack fully discharged	Recharge the battery pack
Battery will not charge	Charging LED not ON	Defective or improper charging wall adapter
	Battery pack defective	Return to factory for evaluation
Battery charge does not last	Battery not fully charged	Charge battery until LED is OFF
	Battery pack weak/defective	Return to factory for evaluation
Channel values random and floating after power ON	Model 962 not calibrated to the transducers	Calibrate Model 962 to transducers
Recorded signal "Noisy"	Charging battery pack during test	Remove charger for testing
	Transducer cable is loose	Tighten cable firmly to Model 962
	Cable has intermittent connection	Replace or repair cable
	Transducers and cables near high energy equipment or wires	Route/move transducers and cables away from electro-magnetic radiating wires and equipment
	Transducer may need service	Contact support for assistance
Recorded signal is saturated	Transducer cable is loose	Tighten cable firmly to Model 962
	Cable not attached to transducer	Attach cable to transducer
	Cable intermittent or defective	Replace or repair cable
	Transducer may need to be serviced	Contact support for assistance
Calibration Error – Low Output	Calibration resistor not installed on Model 962	Install proper calibration resistor
	Calibration resistor is loose	Tighten firmly
	Calibration resistor has a broken wire	Replace calibration resistor
	Cable has open or shorted wires	Replace or repair cable
	Transducer may need service	Contact support for assistance
Calibration Error – Zero Offset	Transducer cable is loose	Tighten firmly to Model 962 and transducer
	Cable has open or shorted wires	Replace or repair cable
	Transducer may need service	Contact support for assistance
Scaling Errors	Selected transducer not calibrated to Model 962	Calibrate Model 962 to transducer
	Wrong calibration resistor is installed	Install proper calibration resistor, the resistor is called out in the calibration certificate

Problem	Description	Action
Display not showing Peak values	Model 962 is in "Track" mode	Press the "TASK" button to toggle peak mode to ON
Error saving limit values	Cycle End not < Cycle Start	Adjust parameter value
	Low Limit not > Cycle Start	Adjust parameter value
	Target not > Low Limit	Adjust parameter value
	High Limit not > Target	Adjust parameter value
Rundown status always "In-Cycle"	Cycle Start value set too low	Adjust parameter value
	Transducer cable is loose	Tighten cable firmly
	Model 962 not calibrated to transducer	Calibrate Model 962 to transducer
Readings are not being saved to Limits memory	Auto save is disabled	Enable auto save if desired
	Manual save mode is enabled	Press the "STORE" button after recording has completed
Cannot connect to PC via USB	Model 962 not connected to PC USB	Connect USB to PC
	Model 962 not on MAIN SCREEN when connecting to FastPlot2	Put Model 962 on the MAIN SCREEN, then run FastPlot2
	Model 962 – SiLabs USB drive not installed or is not working	Re-install driver from software CD, Drivers folder
	USB port on PC not working	Try a different USB port
USB flash drive not working	Flash drive not compatible or defective	Try another flash drive

9.0 CALIBRATION / REPAIR SERVICES

A yearly calibration cycle is recommended to ensure that the unit's performance matches the factory specifications.

PCB Load & Torque offers calibration and repair services. The PCB Calibration Laboratory in Farmington Hills, Michigan is A2LA Accredited per ISO/IEC 17025.

Standard calibration certificates list ten load points ascending. Additional data points are available at extra cost upon request.

Certificate information includes tabulated measurements, deviations of nonlinearity, a Best Fit Calibration Equation, specifications for accuracy, standard deviation, and uncertainty, and traceability statements.

If an initial evaluation shows that a transducer requires repair, PCB will provide the customer with an estimate prior to taking any corrective action.

Before sending a load cell back to the factory for any reason, please contact PCB Load & Torque Customer Service to request a return material authorization (RMA). For calibration services, if possible, a copy of the purchase order covering the requested services should be included with the returned instrument.

10.0 WARRANTY

Standard warranty on the Model 962 covers parts and workmanship. For full details, refer to the Warranty Statement supplied with each instrument.

If the Model 962 is defective for any reason, please contact PCB Load & Torque to request technical assistance. If we are unable to assist you, return it to the factory for detailed evaluation. Factory evaluation may show that the instrument is repairable or non-repairable, and if repair or replacement will be under warranty. If not under warranty, the customer will be contacted with the cost of repair and recalibration. Once authorization to proceed is received, a delivery date will be provided.

11.0 SAMPLE TEST SETUPS

The following paragraphs provide information on some of the most common ways the Model 962 is set up and used.

11.1 Torque-Tension Testing

Torque-tension testing is typically used to test the coating or plating on a surrogate test bolt or test part. Torque-tension testing is a common means of estimating the frictional characteristics of the plating or coating process.

11.1.1 Scope

Testing consists of installing a test bolt, washer, and nut into a clamp load cell and applying torque until a shutoff value is reached. Torque-tension points are set to either pick off the applied torque values at specified fastener tension values, or pick off fastener tension values at specified applied torque values. It is also possible to calculate the Reference Friction (or Total Friction) value at a specified torque or tension value.

Figure 54 illustrates a typical set of torque-tension test equipment using a Model 962 for data acquisition.
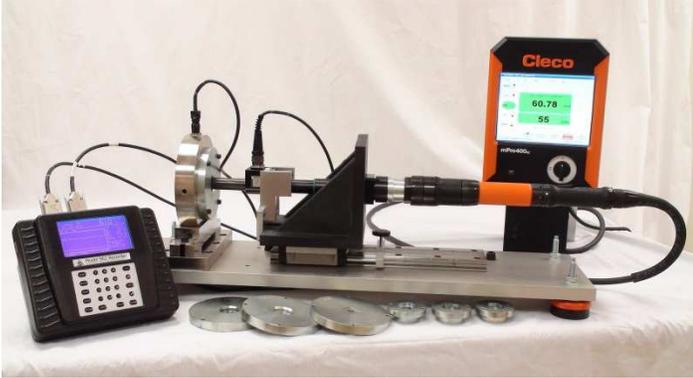
Figure 54 – Basic Model 962 Torque vs. Tension System

The setup selections for a torque-tension test for a M10 grade 10.9 surrogate bolt might resemble the following. Note that certain setup values will differ depending on the size of the test bolt and the test specification being used.

NOTE: Be sure to consult the test specification when setting up to perform torque-tension testing to ensure all of the values and procedures are accounted for.

11.1.2 Torque-Tension Testing Equipment Setup

1) Channels Setup
   CHANNEL 1
1) TYPE:	TORQUE
2) ANGLE:	ENABLED
3) ANGLE COUNT:	TWOWAY
4) TRANSDUCER:	39250

   CHANNEL 2
5) INPUTS:	ENABLED
6) TYPE:	FORCE
7) TRANSDUCER:	59810

2) Units Nm, N, mm
3) Direction CW
4) Set Torque Limits
Cycle Start (Nm):	20.00
Cycle End (Nm):	10.00
Cycle End Time (sec):	0.10
Low Torque (Nm):	40
Target Torque (Nm):	70
High Torque (Nm):	160.00

5) Set Recording Time
Full Scale (sec):	5.00
Advance Time (sec):	0.50

6) Set Auto Options
   Enable desired options:
1) Auto Reset:	ENABLED
2) Reset Time (sec):	10
3) AutoStore Results:	ENABLED
4) AutoStore XY Data:	ENABLED
5) AutoSend at EOT:	DISABLED

7) Torque Force Points
   Select Point Type:
FORCE-PT0 (N):	20000
FORCE-PT1 (N):	30000
FORCE-PT2 (N):	36100

FORCE-PT3 (N):	0
FORCE-PT4 (N):	0

8) Analysis Setup
   1) Measurement Window
   2) M-Alpha
   3) Friction Coefficient
Calc Friction at:	FORCE
Clamp (N):	36100
Nominal Dia (mm):	10
Pitch (mm):	1.5
Bearing Dia (mm):	15.0
Thru Dia (mm):	10.4

9) Set Report Format
   Enable desired report data:
1) Enabled Channels:	ENABLED
2) Test Setup:	ENABLED
3) Standard Results:	ENABLED
4) Torque-Force:	ENABLED
5) Friction Data:	ENABLED
6) M-alpha Data:	DISABLED

The test setup for a torque vs. tension example would be displayed in FastPlot2 as follows:
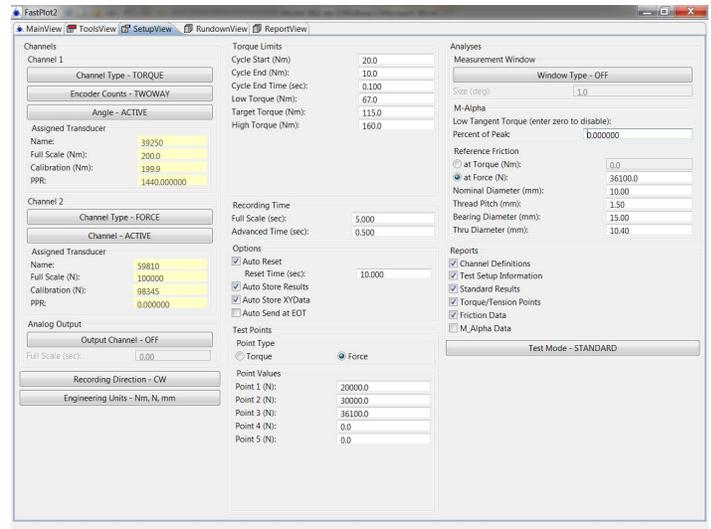
Figure 55 – FastPlot2 Torque-Tension Test Setup

11.1.3 Test Procedure

1. The test bolt, washer, and nut are installed in the clamp force load cell and tightened close to finger-tight. Refer to Figures 56 and 57.
2. The socket on the drive motor is engaged with the bolt head.
3. The Model 962 is placed in the "READY" mode.
4. The drive motor is started and run at a precise speed (typically 30 RPM) to its shutoff point (typically a torque value greater at or around the High Torque value).
5. The data from the test is stored automatically or manually as programmed.
6. When all fasteners have been tested, the limit results report is printed from the Model 962 or uploaded to the PC via FastPlot2 for printing or storage.
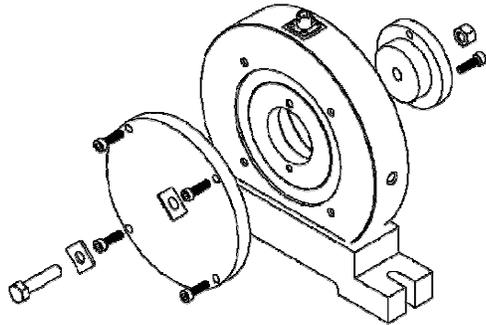
Figure 56– Torque-Tension Test Fixturing Stack-up

At least 2 threads should be protruding from the nut when fully tightened.
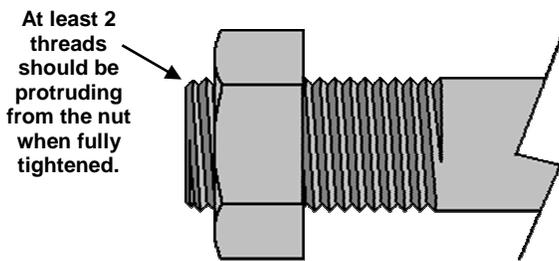
Figure 57– Torque-Tension Test Proper Thread Engagement

11.2 Power Tool Testing

Ensuring the proper operation of assembly tools in an important part of building quality assemblies. PCB Load & Torque can provide the equipment needed to verify the performance characteristics of most electric and pneumatic power torque tools.

11.2.1 Scope

This test procedure provides the basic steps necessary to verify the performance characteristics of most hand held electric and pneumatic power tools.

NOTE: This is provided as an example only. There are several established tool testing specifications so be sure to refer to the required specification for precise settings.
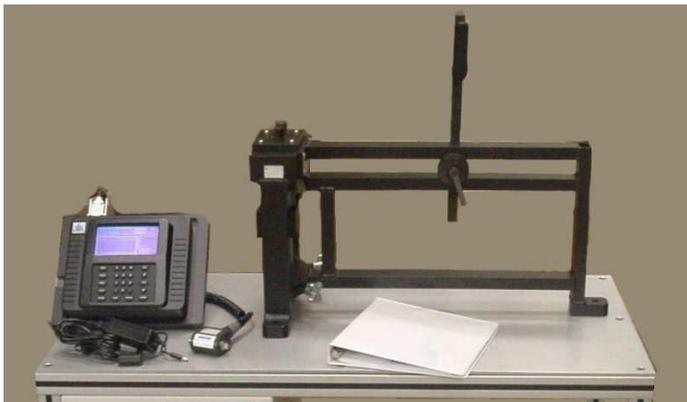
Figure 56 – Typical Power Tool Audit Setup

11.2.2 Power Tool Testing Equipment Setup

A typical set of equipment for testing power tools is listed below.

1. **Model 962 Instrument**: Displays peak torque values for power tools and torque wrenches.
2. **Rotary Torque Transducer**: Measures the amount of torque that is supplied by the tool.
3. **Power Tool Joint Simulator**: Provides mounting and positioning for tool, and a series of Belleville-type washers that can be set up in various arrangements to simulate hard, medium, or soft joint rates.
4. **Transducer Cable**: Connects rotary torque sensor to Model 920 instrument.
5. **Printer (optional)**: Prints out data and statistics recorded by the data acquisition. Not shown.
6. **Power Tool and Controller**: The tool to be tested and its controller. Not Shown.

11.2.3 Setup Menu for Power Tool Testing

The setup selections for testing a power tool designed to shutoff at 50 Nm ±5% might be set as follows.

```
1) Channels Setup
    CHANNEL 1
        1) TYPE:                  TORQUE
        2) ANGLE:                 ENABLED
        3) ANGLE COUNT:           TWOWAY
        4) TRANSDUCER:            39250
    CHANNEL 2
        5) INPUTS:                DISABLED
        6) TYPE:                  FORCE
        7) TRANSDUCER:            59810
2) Units Nm, N, mm
3) Direction CW
4) Set Torque Limits
    Cycle Start (Nm):             7.00
    Cycle End (Nm):               5.00
    Cycle End Time (sec):         2.00
    Low Torque (Nm):              45.00
    Target Torque (Nm):           50.00
    High Torque (Nm):             55.00
5) Set Recording Time
    Full Scale (sec):             10.00
    Advance Time (sec):           2.00
6) Set Auto Options
    Enable desired options:
        1) Auto Reset:            ENABLED
        2) Reset Time (sec):      10
        3) AutoStore Results:     ENABLED
        4) AutoStore XY Data:     ENABLED
        5) AutoSend at EOT:       DISABLED
7) Torque Force Points
8) Analysis Setup
9) Set Report Format
    Enable desired report data:
        1) Enabled Channels:      ENABLED
        2) Test Setup:            ENABLED
        3) Standard Results:      ENABLED
        4) Torque-Force:          DISABLED
        5) Friction Data:         DISABLED
        6) M-alpha Data:          DISABLED
```

The test setup above would be displayed in FastPlot2 as shown in Figure 57.
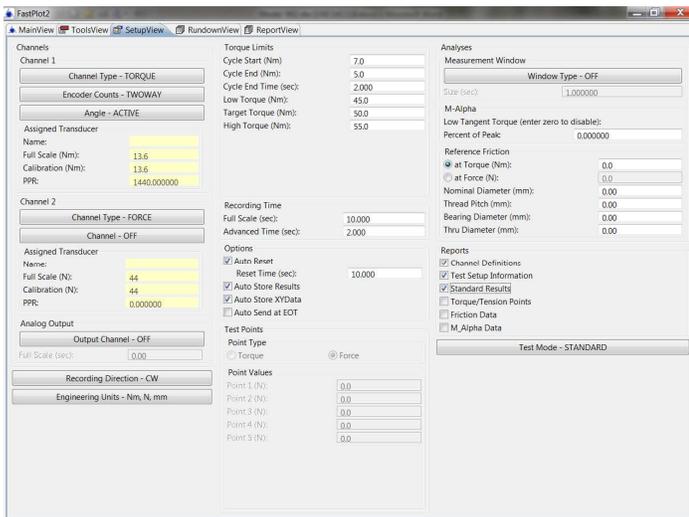
Figure 57 – Tool Testing Setup View

11.2.4 Power Tool Verification Procedure

The following procedure outlines the steps required to verify power tool performance.

NOTE: Be sure to refer to the required specification for precise settings.

1. Connect the instrument to the torque transducer and power it up.
2. Perform a transducer calibration and clear the memory.
3. Make sure that the Measurement Mode of the instrument is set to read Peak torque. Refer to the Model 920 instruction manual.
4. Set up the joint simulator to emulate the desired joint rate.
5. Position the tool on the joint simulator with the output drive of the power tool inserted into the input end of the rotary torque sensor. Then position the rotary torque sensor on the input drive of the joint simulator. Adjust the tool as needed. Refer to the photo above as needed.
6. Activate the power tool and run it until it shuts off or stalls.
7. Back off the joint simulator and return it to the start position.
8. Repeat steps 6 and 7 until the number of runs required by the test procedure are recorded. Typically, 10 to 25 rundowns are recommended.
9. If the tool does not meet the required torque shutoff specification, make the necessary adjustments to the tool or the tool controller, and repeat Steps 6 and 7.
10. If necessary, repeat Step 9 until the tool is performing within specification.
11. Print out the final test data or upload it to a computer as desired.

12.0 QUICK REFERENCE

This section is designed to give a quick overview of common functions of the Model 962 recorder. The following functions are covered:

12.1 Add/Edit Transducers
12.2 Setup a Test
12.3 Calibrate Transducers
12.4 Perform a Test
12.5 Save Rundown
12.6 Update Report
12.7 View a Plot
12.8 Export Data
12.9 Clear Results
12.10 View Diagnostics

12.1 Add/Edit Transducers

Reference Section 4.4.4

1. From the MAIN SCREEN press the CAL button.

2. From the CALIBRATION MENU:

   a. Press 4 to Add/Edit a Torque Transducer.

   b. Press 5 to Add/Edit a Force Transducer.

12.2 Setup a Test

Reference Section 4.3

1. From the MAIN SCREEN press the SETUP button.

2. From the SETUP MENU go through selections 1 – 9 (reference Sections 4.3.1 – 4.3.9).

12.3 Calibrate Transducers

Reference Section 4.4

1. From the MAIN SCREEN press the CAL button.

2. From the CALIBRATION MENU:

   a. Press 2 to perform an AUTO Calibration (reference Section 4.4.2).

   b. Press 3 to perform a MANUAL Calibration (reference Section 4.4.3).

NOTE: A ZERO operation should be performed immediately after a calibration operation (refer to Section 4.4.1).

12.4 Perform a Test

Reference Section 4.2

1. Press the ESC button until the MAIN SCREEN is visible (refer to Figure 8).

2. Make sure that "Ready" is displayed in the bottom left corner of the MAIN SCREEN (see Figure 9). If "Done" is displayed press the MAIN button.

3. Perform the test.

12.5 Save Rundown

Reference Sections 4.5.2, 4.5.3, 4.3.6

1. If AutoStore XY Data is DISABLED then press the PRINT button (while still on the MAIN SCREEN).

   a. From the PRINT/DISK MENU:

      i. Press 2 to save rundown data to an attached USB flash drive (reference Section 4.5.2).

      ii. Press 3 to save rundown data to an attached host computer via the FastPlot 2 software (reference Section 4.5.3).

2. If AutoStore XY Data is ENABLED then the rundown data will be automatically stored to a USB flash drive (if connected).

NOTE: Reference Section 4.3.6 to ENABLE/DISABLE the AutoStore XY Data function.

12.6 Update Report

Reference Sections 3.8, 4.3.6

1. If AutoStore Results is DISABLED then press the STORE button (while still on the MAIN SCREEN, reference Section 3.8).

2. If AutoStore Results is ENABLED then the rundown data will be automatically stored to the Model 962 memory.

NOTE: Reference section 4.3.6 to ENABLE/DISABLE the AutoStore Results function.

12.7 View a Plot

Reference Section 4.5.1

1. After a test is run, press the PRINT button (while still on the MAIN SCREEN).

2. From the PRINT/DISK MENU press 1 for the Printer.

3. From the PRINTER MENU press 2 to Print XY Plot.

4. From the SELECT XY PLOT menu select a plot to view on the screen.

NOTE: A plot can only be viewed for the current rundown in memory.

12.8 Export Data

Reference Sections 4.5.2, 4.5.3

1. From the MAIN MENU press the PRINT button.

2. From the PRINT/DISK MENU:

   a. Press 2 to export data to a USB flash drive (reference Section 4.5.2).

   b. Press 3 to export data to a host computer (reference Section 4.5.3).

12.9 Clear Results

Reference Sections 4.6.2

1. From the MAIN MENU press the UTILS button.

2. From the UTILITY MENU press 2 to Clear Results.

3. From the CLEAR RESULTS screen press the ENTER button to clear the results.

12.10 View Diagnostics

Reference Sections 4.6.8

1. From the MAIN MENU press the UTILS button.

2. From the UTILITY MENU press 8 to view the Diagnostics Menu from the TRANSDUCER INPUTS screen.

NOTES: