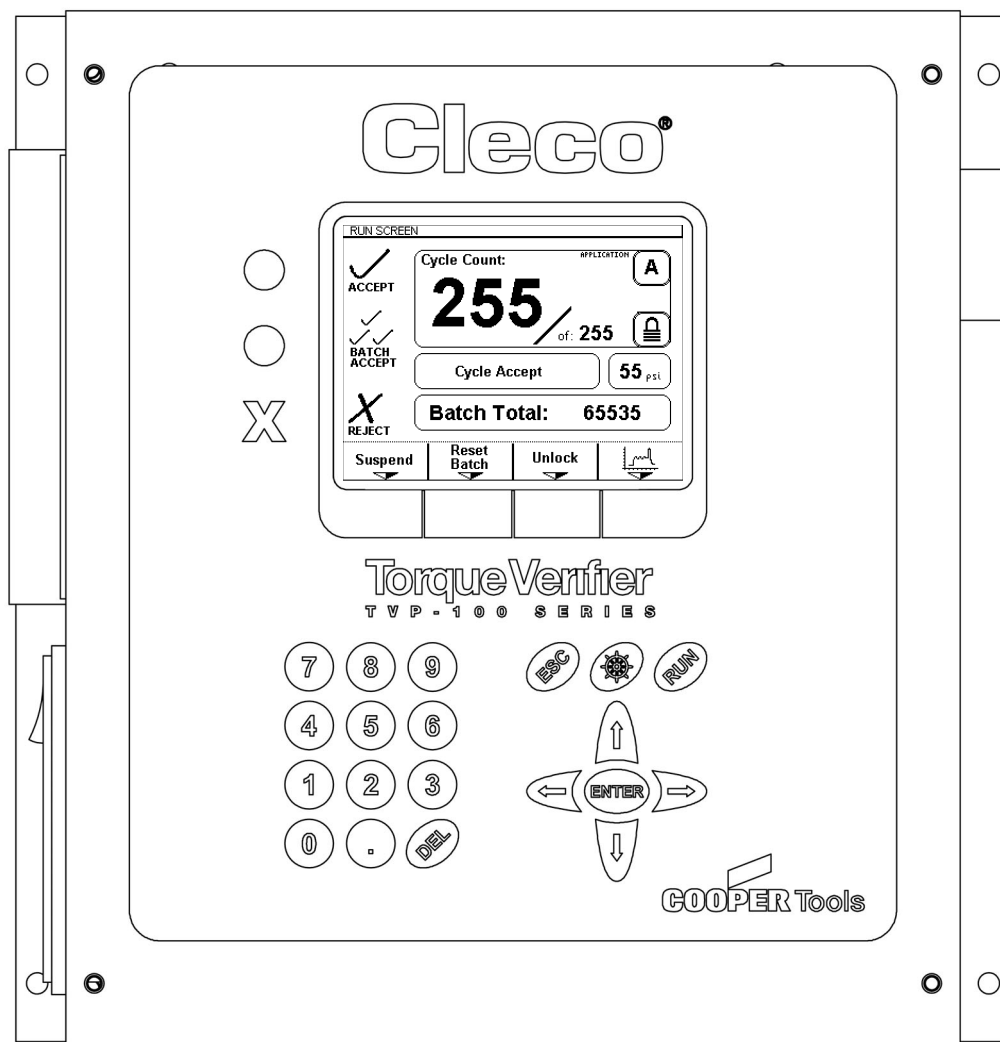


Cleco®

Pneumatic Tool Monitor TVP-100 Series Version 1.0



For additional product information visit our website at <http://www.coopertools.com>

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1 Getting Started

1.1 Safe Work Practices Symbol



This “Warning” symbol identifies all notes on safe work practices in this operating instruction, alerting to hazards for life and health of people. Please observe these notes and proceed with special care in the cases described. Pass all safety instructions on to other operators. In addition to the safety instructions in this operating instruction, the general local safety and accident prevention rules must be observed.



The signal word “Caution” identifies all portions of this operating instruction meriting special attention to ensure that guidelines, rules, hints and the correct work procedures are observed; and, to prevent damage to and destruction of the machine and/or parts

1.2 Checking Your Unit

Take the time to ensure that you have the required peripheral equipment and cables necessary to setup and run your unit. If you do not have all the necessary items, please contact your distributor.

1.3 Software

Your unit has been pre-loaded with its software and requires no additional software to start monitoring your fastening process. If you are trying to interface this unit to an external computer, additional software may be required. Please contact your distributor with inquires about interface software.

1.4 Installing The Unit

1.4.1 General



It is mandatory that national, state, and local safety and wiring standards be followed during installation. These standards would take precedence over any information presented in this section.

To avoid the hazard of electrical shock or burn, the following instructions must be adhered to. Failure to follow these instructions may also cause damage to your unit and void existing warranties.

- Do not energize the unit until all connections have been properly made.
- Equipment must be properly grounded before applying power. Units energized by cord and plug must be connected to an approved and properly grounded receptacle
- Ensure the power switch is in the “off” position before applying power.

1.4.2 Mounting

Each TVP-100 Series unit is intended to be used as a single tool process monitor in a work station or work area. This unit may be wall mounted, table mounted, beam mounted, suspended overhead, pedestal mounted, or used without mounting. Tabs have been provided on the base of this unit to ease this mounting process. Please take care in choosing a stable location for the unit to avoid the possibility of damage to the unit and/or operator injury through hitting, falling, vibration or inconvenient mounting. All cables attached to the unit should be located and secured in a manner to avoid potential operator and passer-by injury. As with all electric equipment, the unit will produce some heat and should be located so that ambient air can freely circulate around the box.

1.4.3 Location Consideration

Your unit should be located to allow access to the front panel and connectors. The unit should be installed for unrestricted and comfortable viewing of the LCD and LED's by the operator. The LCD menu screen, key pad and side panel connectors must be readily accessible for the setup. Depending on the peripheral equipment purchased, the unit may be remotely mounted but should still be accessible.

1.4.4 Source Power

This unit is capable of being run off of 110 or 220 VAC (both 50 and 60 Hz).

CAUTION!

Before powering up the unit for the first time, take care to notice which voltage the unit is set up to accept. Damage to the unit may occur if the voltage selection does not match the power that is supplied.

The TVP-100 is fused at 1 Amp.

1.5 Connecting Peripherals

A pressure transducer was supplied with your unit. This transducer needs to be properly connected to the tool that is being monitored and also to this unit. Other inputs and outputs are available for communicating with devices such as PLCs and PCs. Make sure these devices are connected to the proper ports before powering up the unit. Damage can occur to the units if these inputs and output points are used incorrectly.



To avoid the hazard of electrical shock or burn the following instructions must be adhered to. Failure to follow these instructions may also cause damage to your unit and void existing warranties.

- **Ensure the power switch is in the “off” position and that the box cover is properly secured before supplying power to the unit.**
- **Ensure equipment has been properly grounded before applying power.**

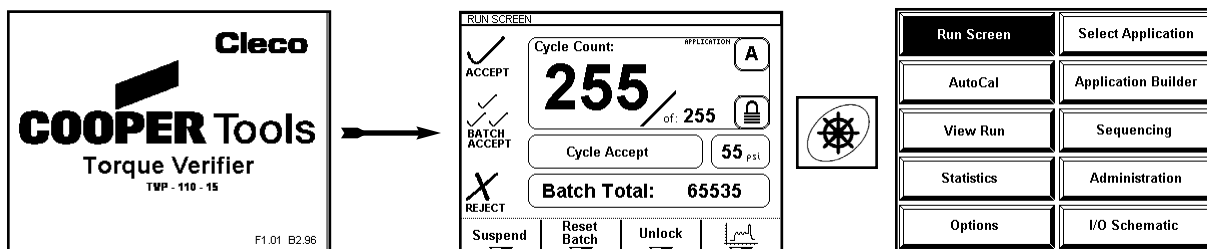
2 Quick Start Guide

2.1 Powering Up The Unit

This quick-start guide assumes that the unit is set up properly, that the unit can be powered up, and that the transducer is properly attached to the tool being monitored and this unit. If you need more guidance in any of these areas, please refer to the in depth directions found later in this manual.

2.2 The Ship's Wheel

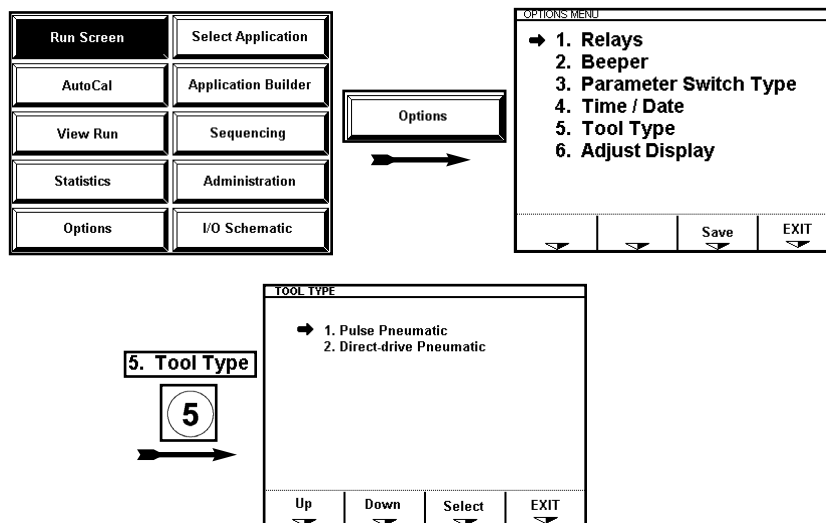
When the unit powers up, a splash screen will be displayed momentarily followed by the main run screen. In order to set up any given tool, press the “ship’s wheel” key and go to the navigation menu.



2.3 Selecting Tool Type

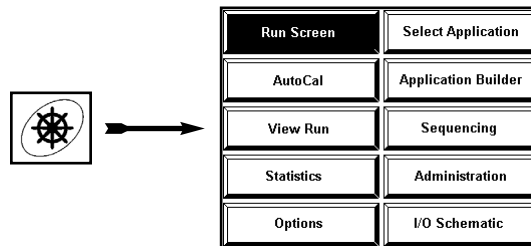
With the navigation menu showing, use the arrow keys to highlight the “Options” icon and then use the “Enter” key to select “Options”. You may be prompted to enter a password. If so enter it using the numeric keypad, the default is “0 1 0 4”. At this point, the Options Screen will appear. From the Options Screen select the fifth option (Tool Type) by pressing the 5 key. The Tool Type screen will appear at this point. If a Cleco Pulse tool is to be monitored, option one (Pulse Pneumatic) should be selected. For all other pneumatic tools option two (Direct-drive Pneumatic) should be selected.

Pressing the “Ship’s Wheel” will return the user to the navigation menu.

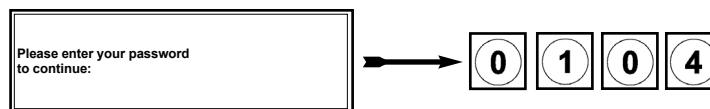


2.4 Calibration (AutoCal)

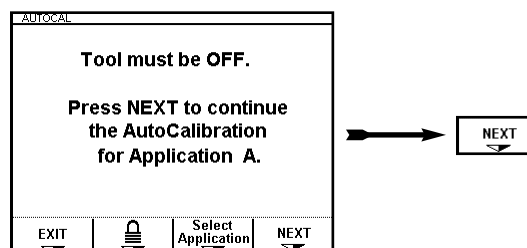
Before a tool can be monitored properly, the current application must be set up to monitor that tool. The AutoCal option will do this for you automatically. In order to access the AutoCal routine, press the “Ship’s Wheel” button and go to the navigation screen. From the navigation screen, use the arrow keys to highlight the AutoCal option and then press enter.



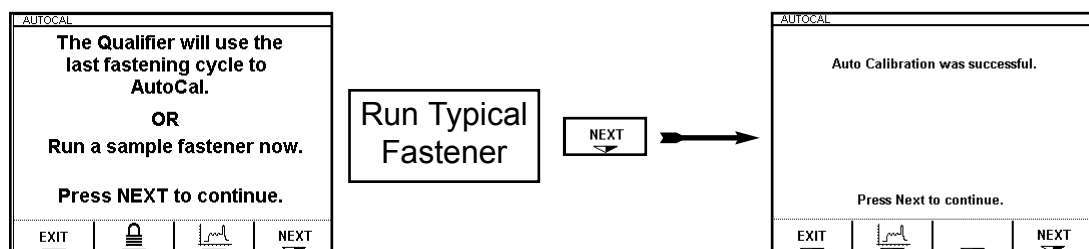
You may be prompted to enter a password. If so enter it using the numeric keypad. The default password is “0 1 0 4”.



The first screen associated with the AutoCal process will inform the user that the tool must be off and also that they should press the “Next” key. This screen also reminds the user which application set is active. The calibration will only effect that application. At this point, make sure the transducer is connected to both the tool and the box and also that the tool is not running. Then press the “Next” softkey.



The second AutoCal screen will appear next. This screen will prompt the user to run a typical fastener and then to press the “Next” softkey. After these steps are completed, the result of the calibration will appear on the screen.

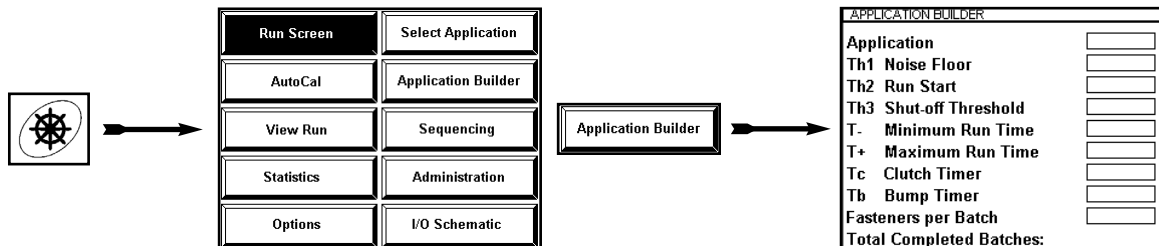


If the calibration was not successful, you may need to check the tool connection to the unit. On the “Run Screen” there is a portion of the window that shows the active pressure within the tool. Check this pressure as the tool is running to see if a change is occurring. Press the “Ship’s Wheel” to return to the navigation menu.

2.5 Setting Fasteners Per Batch

The final step in setting up any given application is to program the number of fasteners which will be in each batch or group. For example, if this unit is to monitor the fastening of five lug nuts into a car's wheel, the batch might be set to five.

In order to set the batch, press the "Ship's Wheel" and go to the navigation menu. From the navigation menu select the "Application Builder" option.



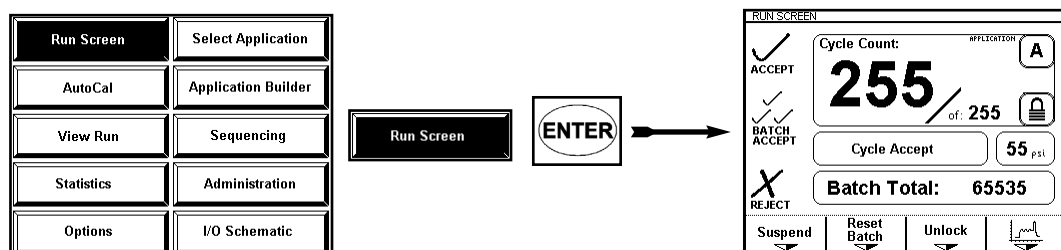
Once inside the "Application Builder" menu you'll want to use the up and down arrows on the keypad to highlight the "Fasteners per Batch" option. When the "Fasteners per Batch" option is highlighted, press Enter and a cursor will appear allowing you to edit the value within the option.

While the cursor is flashing, the left and right arrow keys will allow you to highlight any of the three active digits. The number keys will allow you to change any of those digits to the desired value. The batch can be any value between 1 and 255.

Once the batch shows the desired value, press the Save soft-key to save that value. Pressing the "Ship's Wheel" button will return the unit to the navigation menu.

2.6 Running the Unit

In order to reach the "Run Screen" from the navigation menu, use the arrow keys to highlight the "Run Screen" option and then press the Enter button.



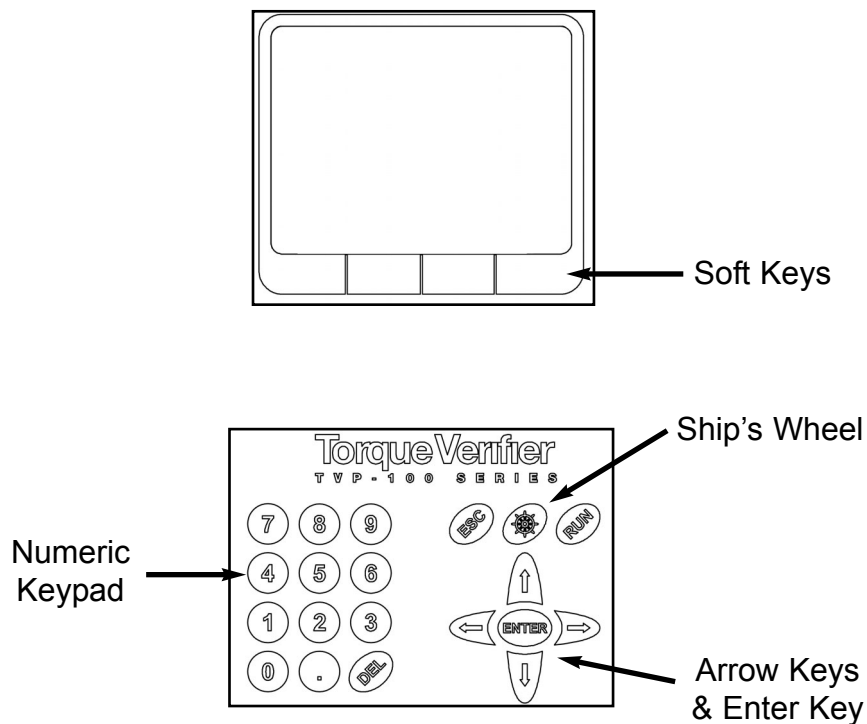
The Run Screen will be the most useful source of information for the tool operator during production.

3 Controller Specifications

3.1 Understanding the Keypad

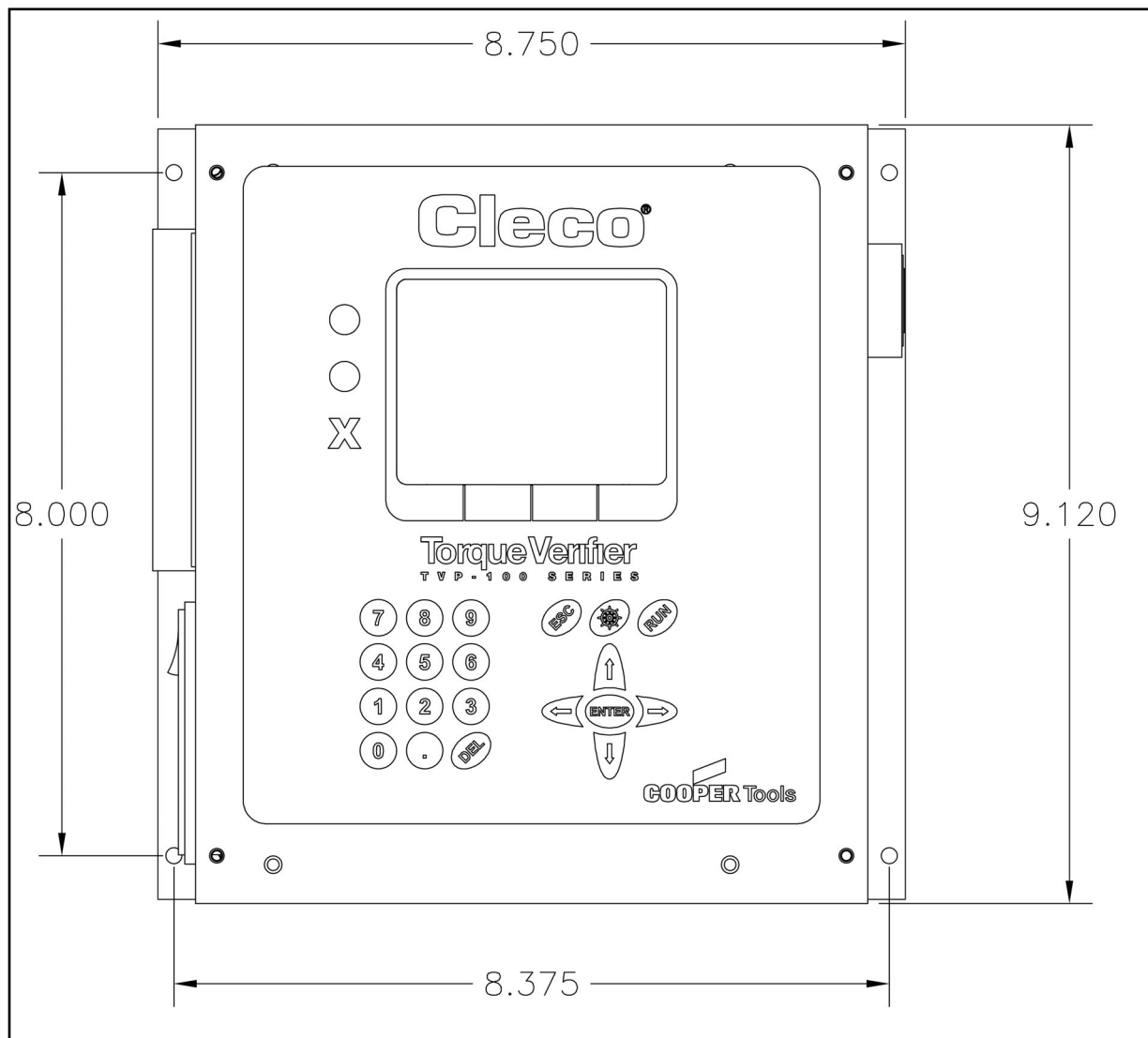
The following is a brief explanation of the keypad keys. Familiarity with the keys simplifies the programming process.

Soft Keys (F1-F4)	- used to select functions based on the screen display
ESC Key	- used at any time to return to the previous screen or escape an edit mode
DEL Key	- used to delete numeric values
Arrow Keys	- used to move highlighted or selected areas on the screen
ENTER Key	- used to select or choose a value on the LCD screen
Ship's Wheel	- used to return to the navigation screen
Run	- used to return to the run screen from most other screens



3.2 Specifications

3.2.1 Enclosure



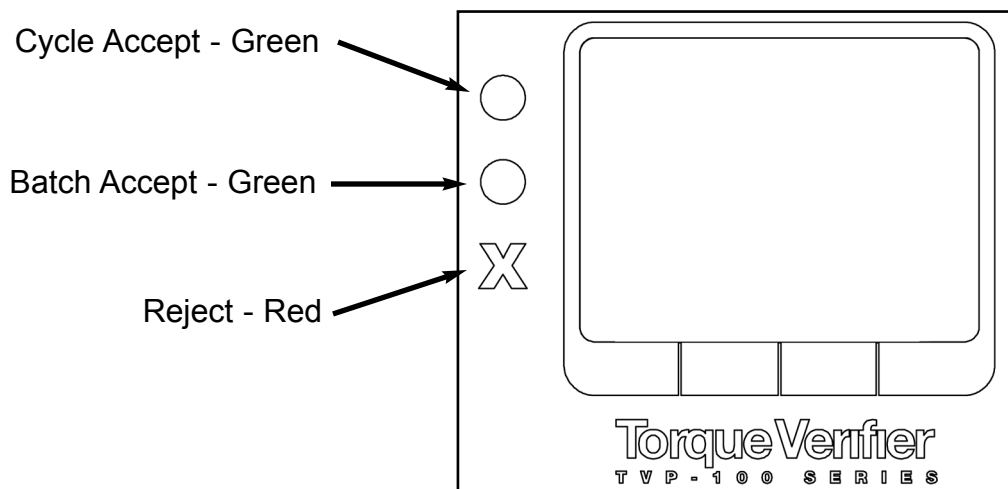
- Height 9.125 in./232 mm
- Width 8.75 in./222 mm
- Depth 4.125 in./105 mm
- Weight 6 lbs/2.72 kg
- Removable Fuse Compartment
- Settings for 110/220 VAC 50/60Hz
- Exposed I/O Strip

3.2.2 Display

- 320 x 240 LCD
- LED Backlight
- Adjustable Contrast

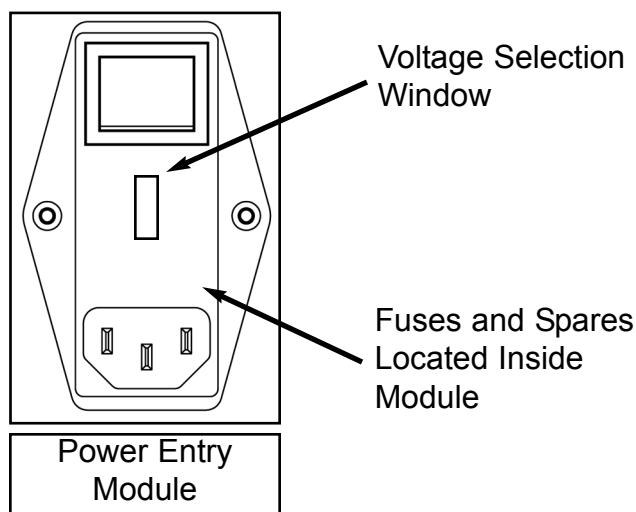
3.2.3 Indicators

3 Highly Visible Indicators



3.2.4 AC Input Power

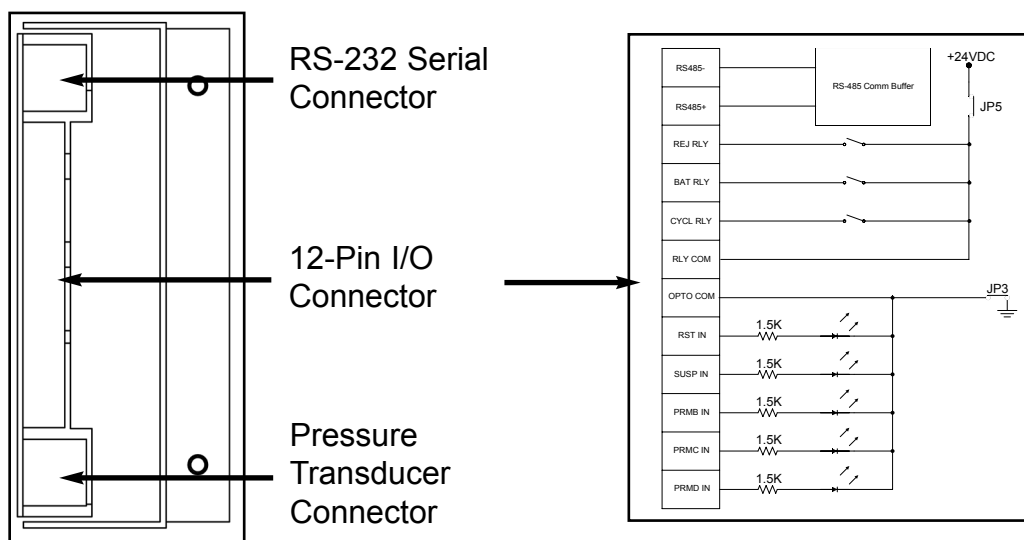
- Selectable 115 VAC or 230 VAC Power
- Fuse access in power entry module
- Spare fuses inside power entry module
- Unit fused at 1Amp



3.2.5 Input/Output Connectors

- | | |
|-------------------------|--------------------------|
| • RS-232 Connection | RJ12 (6-Conductor Phone) |
| • I/O Connector | Phoenix 1757569 |
| • Transducer Connection | RJ12 (6-Conductor Phone) |

3.2.5 Input/Output Connectors (continued)



RS-232 Serial Port (RJ12)		
PIN #	Description	Value
1	UNUSED	N/A
2	UNUSED	N/A
3	RX (Receive)	-25V to +25V
4	TX (Transmit)	-25V to +25V
5	GND	0V
6	UNUSED	N/A

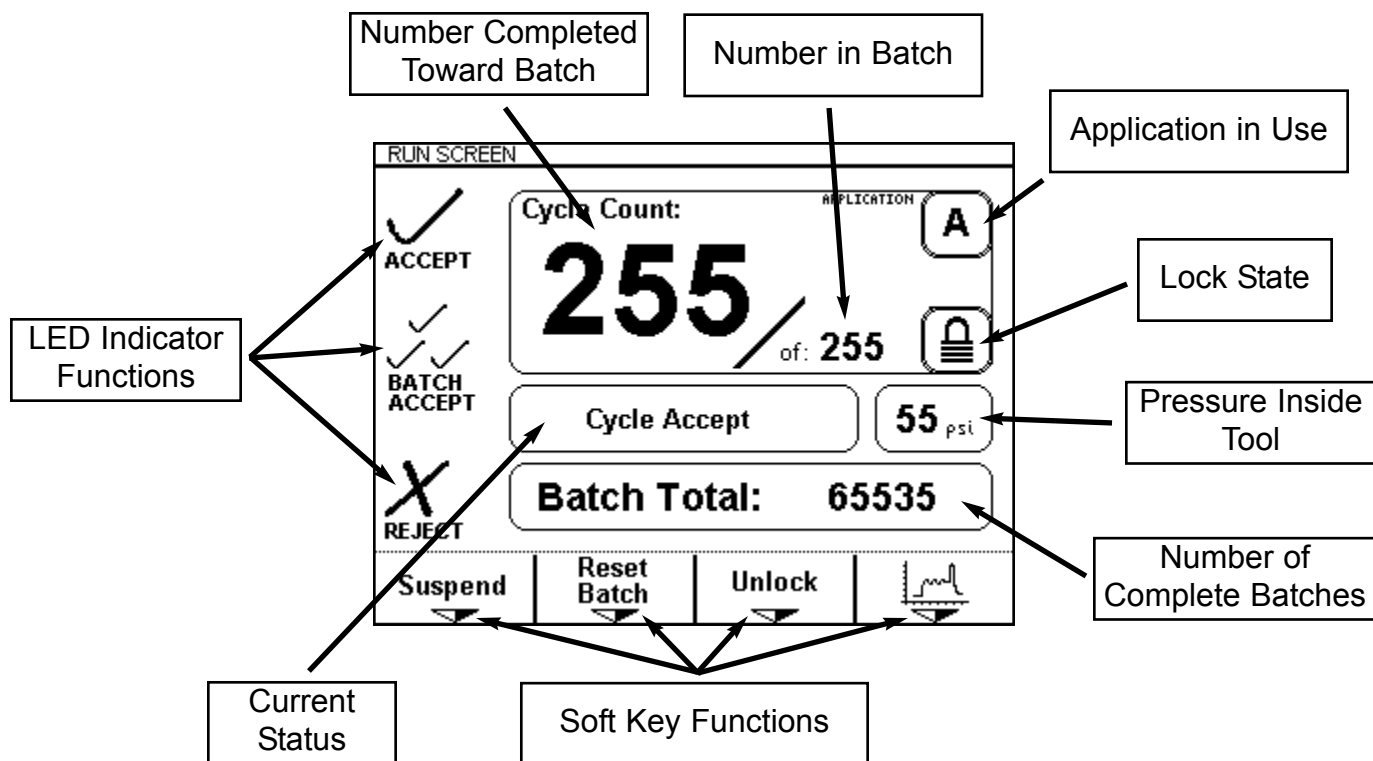
Pressure Transducer Port		
PIN #	Description	Value
1	Power Out	+5 VDC
2	Analog Pressure IN	0V to 5V
3	RS-485+	-1V to 6.5V
4	RS-485-	-1V to 6.5V
5	GND	0V
6	UNUSED	N/A

12-Pin Phoenix Input/Output Connector		
PIN #	Description	Value
1	RS485-	-1V to 6.5V
2	RS485+	-1V to 6.5V
3	Reject Relay Output	+24VDC
4	Batch Relay Output	+24VDC
5	Cycle Relay Output	+24VDC
6	+24VDC OUT/Relay Common	+24VDC
7	Ground/Opto Common	0VDC
8	Reset Optically Isolated Input	0V to 24V
9	Suspend Optically Isolated Input	0V to 24V
10	Parameter B Optically Isolated Input	0V to 24V
11	Parameter C Optically Isolated Input	0V to 24V
12	Parameter D Optically Isolated Input	0V to 24V

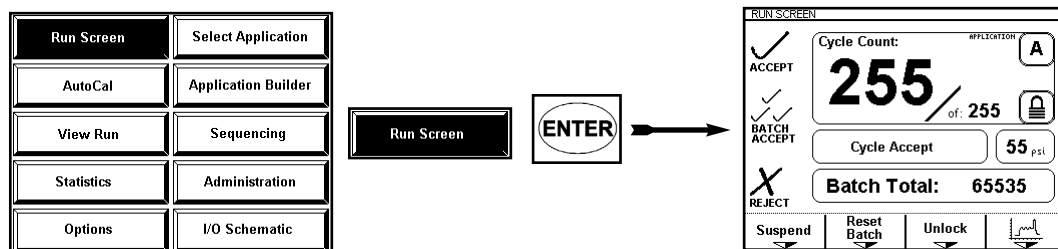
4 Programming

4.1 Run Screen

The Run Screen is the main screen that will be used while the tool is in operation. This screen contains a wealth of information about what is occurring in the assembly process at any given time. From this screen a user can ascertain how many fasteners have been completed towards a batch, the current application, the last fastener status, the pressure within the tool, whether the unit is locked or un-locked, and the total number of batches that have been completed.

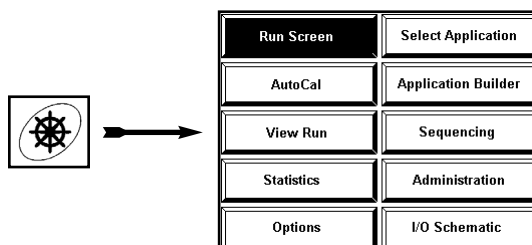


This screen automatically appears at the end of the power up sequence. This screen may also be reached by selecting the "Run Screen" option from the navigation menu.



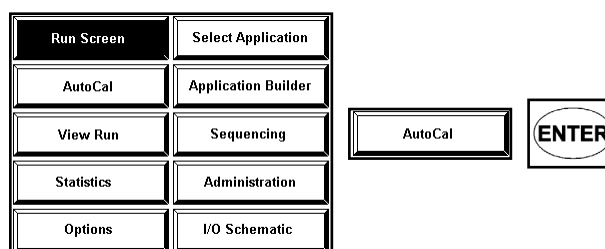
4.2 Navigation Menu

The Navigation Menu is the leaping off point to all functions within this unit. The Ship's Wheel key may be pressed at any time, and the Navigation Menu will appear. From the Navigation menu, the user can go to the Run Screen, perform an AutoCal, view a rundown, review statistics, set the units options, select the application in use, adjust any given application, enable sequencing, perform administrative functions, and look at a schematic that aids in external wiring.

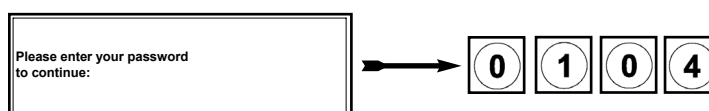


4.3 AutoCal

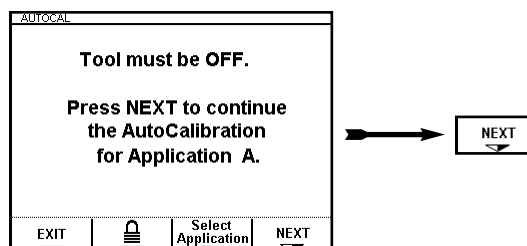
In order for this unit to function properly, the thresholds and timers within the application need to be set appropriately with regards to the tool's pneumatic signature. The AutoCal feature provides a very quick and easy means of performing this set-up. To reach the AutoCal function, select "AutoCal" from the navigation menu.



If the unit was locked prior to making this selection, you'll be prompted to enter the password. The default password is "0 1 0 4".



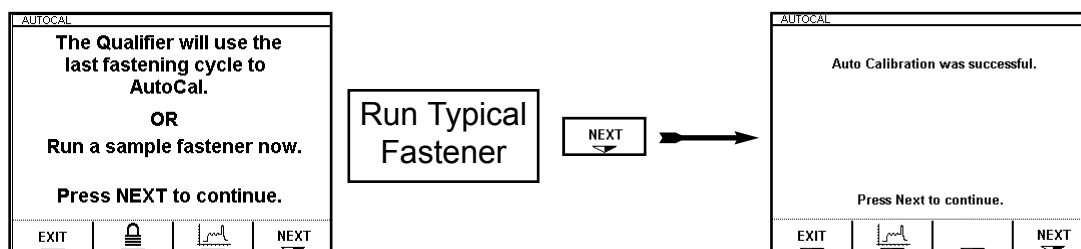
The first screen associated with the AutoCal process will inform the user that the tool must be off and also that they should press the "Next" key. This screen also reminds the user which application set is active. The calibration will only effect that application. At this point, make sure the transducer is connected to both the tool and the box and also that the tool is not running. Then press the "Next" softkey.



4.3 AutoCal (continued)

The second AutoCal screen will appear next. This screen will prompt the user to run a typical fastener and then to press the “Next” softkey. When running a “typical” fastener, the user should start with the tool off and then run the fastener to its completion allowing the tool’s clutch to turn the tool off. The tool’s trigger should then be released and left alone until the “NEXT” softkey is pressed on the unit.

After these steps are completed, the result of the calibration will appear on the screen.



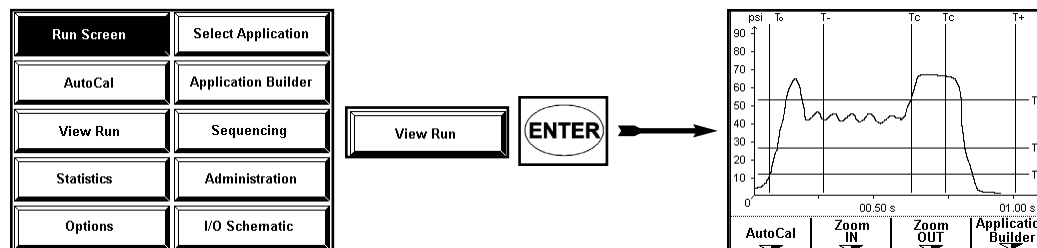
If the calibration was not successful, check the tool and transducer connections. The transducer needs to be properly connected to both the tool and this unit in order for the system to function correctly.

The Run Screen may be used to determine if a pressure change is occurring while the tool is running. When the tool is off, the pressure should be near to if not 0 psi. While the tool is running, the pressure will be around 50 or 60 psi. When the clutch shuts the tool off, the pressure will rise almost to line pressure.

It's also very important that the appropriate tool type is selected. Pulse tools and direct drive tools are monitored differently. Be sure that the appropriate tool has been selected under the Options screen.

4.4 Viewing A Run

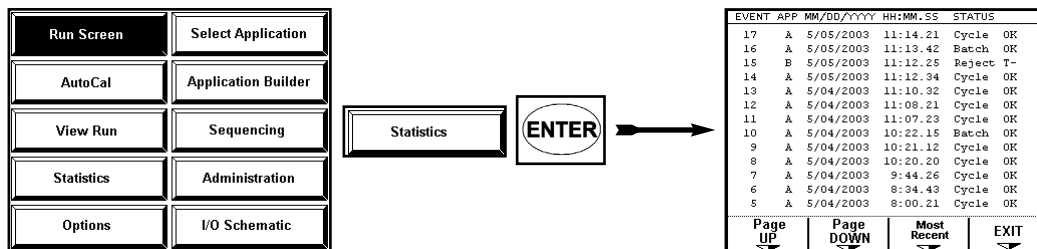
A graph of the last run down may be viewed by selecting the “View Run” option from the navigation menu. Once again, you may be prompted to enter a password if the unit has not been un-locked.



While viewing a run, the “1” key may be pressed to draw and erase the thresholds and timers. Pressing the “2” key will draw and erase the tool’s signature. If a new fastening cycle is run, the “ENTER” key may be pressed to retrieve and view this new curve.

4.5 Statistics

This unit will hold information pertaining to the last 1000 events. That information can be viewed by going to the “Statistics” screen. In order to reach the “Statistics” screen, highlight the Statistics option on the navigation menu and press “ENTER”.



There are five columns worth of information on the Statistics screen. Column one holds the event number. The second column displays the application the unit was using when that event occurred. The date and time that the even occurred is displayed in column three and column four. Column five holds a description of the event itself. The event description will be a Cycle OK, a Batch OK or a Reject.

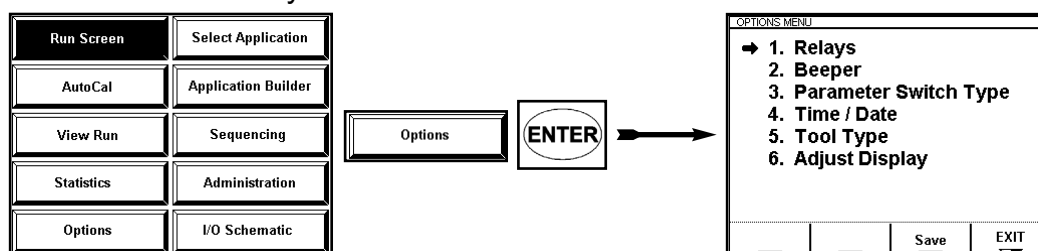
The Cycle OK status tells you that a single fastening was completed properly. A Batch OK tells you that a single fastening was completed properly and that it was the last fastener in the batch. A Reject status informs the user that for some reason that fastening was rejected. Each Reject status is accompanied with a reason to help you discern why that fastening was rejected.

The soft-keys provide functions that allow a user to view more statistics than can be showed on the screen at one time. The “Page Up” and “Page Down” soft-keys can be pressed to view events that occurred further back in time or more recently. Pressing the “Most Recent” soft-key will place the most recent event at the top of the screen and the events that preceeded it directly below.

Pressing the “Exit” soft-key or the Ship’s Wheel will take the unit back to the navigation menu.

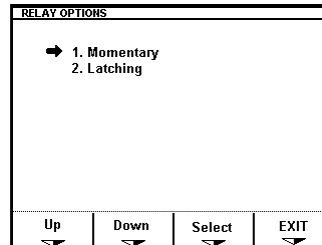
4.6 Options

Several user adjustable features can be accessed from the “Options” menu. In order to reach the “Options” menu, highlight the Options button on the navigation menu and press the “ENTER” key.



4.6.1 Relay Options

The first item on the Options screen list is Relays. By selecting this option the user can choose to set the relays to “latching” or “momentary”. To select “Relays” from the Options screen list either press the “1” key or highlight the “Relays” option and press “ENTER”



Once at the “Relays Options” screen you can choose how the relay outputs are going to act. If the relays are set to momentary, each time an event occurs the corresponding relay will turn on for 200ms and then turn back off. If the relays are set to latching, the appropriate relay will turn on and remain on when an event occurs. That relay will turn back off at the beginning of the next cycle (the next time the tool starts).

To make a selection on this screen, the number key that corresponds with the selection may be pressed. If you use this number key method, the selection will be made and stored. The screen will also return to the “Options” menu.

A selection may also be made by using the arrow keys or the “UP” and “DOWN” soft-keys to highlight the desired selection and then pressing the “Select” soft-key.

The “EXIT” soft-key, the “Ship’s Wheel”, or the “ESC” key may be pressed to return to the “Options” screen without making and storing a new selection.

4.6.2 Beeper Options

The second item on the Options screen list is Beeper. The unit can be programmed to double-beep or be silent upon the completion of a batch. In order to choose the Beeper option either press the “2” key or highlight the Beeper option using the Arrow keys and then press “ENTER”

4.6.2 Beeper Options (continued)

BEEPER OPTIONS			
→	1. Double beep on Batch Accept. 2. Beep on Reject only.		
Up	Down	Select	EXIT

To make the box double-beep on a batch accept, either press the “1” key at the Beeper Options screen or highlight the “Double Beep” option and press the “Select” soft-key.

If a double-beep is not desired either press the “2” key at the Beeper Options screen or highlight the “Beeper on Reject” option and press the “Select” key.

4.6.3 Application Select Input

Applications can be select through external inputs. These inputs can be used in two different schemes. The inputs can either select one of four different applications. Or, when set to “binary”, these three inputs can be used to select eight different inputs.

APPLICATION SELECT INPUTS			
→	1. Binary, 1 of 8. 2. Discrete, 1 of 4.		
Up	Down	Select	EXIT

Binary (1 of 8) is the first option on the “Applications Select Inputs” screen. In order to choose this option either press the “1” key at this screen or highlight the option and press the “Select” soft-key.

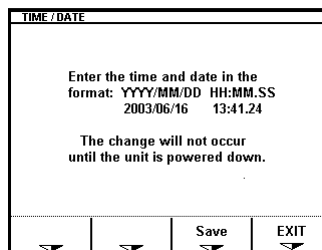
Param D INPUT	Param C INPUT	Param B INPUT	Application (Binary)	Application (Discrete)
OFF	OFF	OFF	A	A
OFF	OFF	ON	B	B
OFF	ON	OFF	C	C
OFF	ON	ON	D	C
ON	OFF	OFF	E	D
ON	OFF	ON	F	D
ON	ON	OFF	G	D
ON	ON	ON	H	D

If discrete (1 of 4) is how you would prefer to select applications either press the “2” key or highlight this option and press the “Select” soft-key.

4.6.4 Time and Date

This unit will keep track of the current time and date even when the unit is turned off. Each time an event occurs (like an accept or reject), that event is stored in memory along with a time and date stamp.

The time and date may be edited by pressing the “4” key at the Options screen or by highlighting the “Time / Date” element and pressing the “Select” soft-key.



TIME / DATE

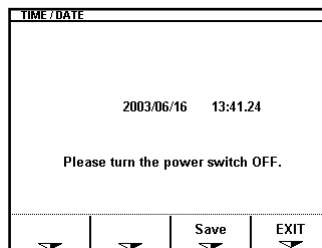
Enter the time and date in the
format: YYYY/MM/DD HH:MM.SS
2003/06/16 13:41.24

The change will not occur
until the unit is powered down.

Navigation buttons: Left arrow, Right arrow, Save, EXIT

Once at the TIME / DATE edit screen, the left and right arrows may be used to select a character within the time or date. Once the desired character is highlighted the number keys may be used to alter its value.

Once the time and date are set to the desired value, either the “Save” soft-key or the “ENTER” key may be pressed to save the new value. If a new value is saved, the unit will have to be powered down and powered back up again before the changes take effect.



TIME / DATE

2003/06/16 13:41.24

Please turn the power switch OFF.

Navigation buttons: Left arrow, Right arrow, Save, EXIT

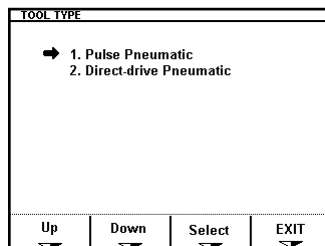
To leave the TIME / DATE screen without making any changes either the “EXIT” soft-key or press the “ESC” key.

4.6.5 Tool Type

It's very important to select the correct tool type for the application. There are two different choices for monitoring tools within this unit. The first choice is Pulse Pneumatic and should be used for monitoring Pulse Tools. When set to Pulse Pneumatic, this unit will not only use the timers and thresholds. This unit will actually count and confirm that a certain number of pulses occurred.

The Direct-drive Pneumatic is used for monitoring pneumatic clutch tools that do not pulse.

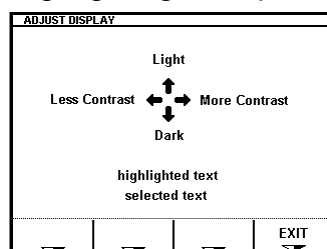
To set Tool Type, from the Options Screen select the fifth option (Tool Type) by pressing the 5 key or highlight the option and press "ENTER". The Tool Type screen will appear at this point. If a Pulse tool is to be monitored, option one (Pulse Pneumatic) should be selected. For all other pneumatic tools option two (Direct-drive Pneumatic) should be selected.



Pressing the numeric key associated with the desired option (either "1" or "2") will select and write that option to memory. Alternatively, your option can be highlighted and then "ENTER" can be pressed to make a selection.

4.6.6 Adjusting The Display

The unit's display is set for optimal viewing at the factory. However, it may be necessary at some point to make the display darker or lighter for easier viewing. If the display needs adjusted, option six can be selected from the Options menu by either pressing the "6" key or by highlighting the option and pressing "ENTER".

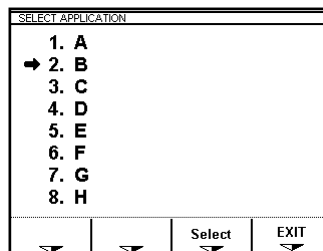


The arrow keys are used to alter the display from the Adjust Display screen. Once the display has the desired appearance, press the "EXIT" soft-key to return. The default LCD values can be re-written if the "." button is pressed during the power-up screen or at the "Run" screen.

4.7 Selecting Application

An application is a set of parameters that governs how a given tool is monitored. There are two different ways to choose which application is in use. One way is through external inputs. The other method can be accomplished through the keypad. A dip-switch inside the box controls which method can be used.

If dip-switch one on the backboard is in the “ON” position, then applications can be selected through the keypad. In order to change the application, go to the navigation menu and choose “Select Application”.



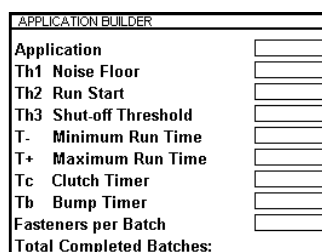
On the “Select Application” screen, an arrow will point to indicate which application is currently selected. To change this selection, you can press the number on the keypad that is associated with the application you want to select. Or, you can highlight the desired selection with the arrow keys and then press the “Select” soft-key.

To leave this screen without making any changes, the “EXIT” soft-key can be pressed or the “ESC” key can be pressed. The “Ship’s Wheel” has no effect at this screen.

4.8 Application Builder

An application is a set of timers, thresholds, and a batch value that are used in monitoring the pneumatic tool. The best way to develop these values is to make use of the AutoCal feature. By using AutoCal, the timers and thresholds will be generated automatically for any given application.

A situation may arise where these values need to be manipulated manually. If so, select the “Application Builder” option from the navigation menu. This action will take the unit to the “Application Builder” screen.



4.8 Application Builder (continued)

To edit an item from the Application Builder, highlight the item you want to edit and then press “ENTER”. A cursor will appear. While that cursor is highlighting a digit, use the numeric keypad to alter its value or use the left and right arrows to select a different character.

Application Element	Description:
Th1 Noise Floor	Pressure threshold that sets a pressure level for the unit to begin capturing data
Th2 Run Start	Pressure threshold that sets a pressure level which after crossed a status will be generated (either accept or reject).
Th3 Shut-off Threshold	Pressure threshold that sets a pressure level above which the tool is considered to have “clutched” out.
T- Minimum Run Time	Minimum amount of time the tool must run before clutching out with out generating a reject.
T+ Maximum Run Time	Maximum amount of time tool can run before clutching out without generating a reject.
Tc Clutch Timer	Amount of time user must hold tool trigger after tool clutches out without generating a reject.
Tb Timer Bump	Timer used to cancel incidental runs in the case of a push to start tool. If this timer is violated without the clutch firing, no status will be generated. AutoCal sets this timer to 0.
Fasteners per Batch	Number of fasteners associated with a batch. Every time this number of fasteners is completed, a Batch Accept will be generated.
Total Completed Batches	This number represents the number of batches that have been completed.

The “ESC” key will stop the cursor from flashing and allow you to select a different element to be edited.

The “SAVE” soft-key must be pressed in order to save any changes made within the Application Builder. The “EXIT” soft-key will allow a user to leave the Application Builder without making any changes.

The “Globalize” soft-key allows you to copy an application to all of the other applications.

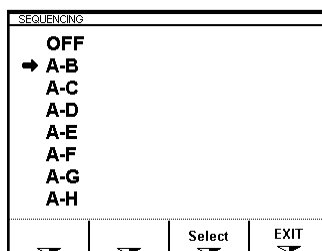
The “Clear Total” soft-key sets the total back to zero.

4.9 Sequencing

This unit has the ability to automatically switch from application to application if the “Sequencing” feature is enabled. If Sequencing is enabled, the unit will start in Application A. Once the batch is complete in Application A, the unit will automatically switch to Application B. This switching from application to application will continue upon the completion of each batch until the end application is reached.

Once the end application is reached and the batch is completed, a batch accept will be generated and the unit will revert back to Application A. The batch accept output will only be generated on the final application in the sequence.

In order to program the Sequence function, select the “Sequencing” item from the navigation menu.

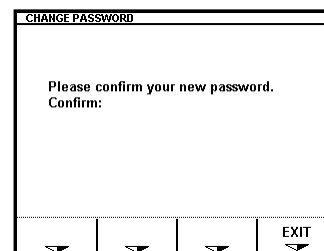
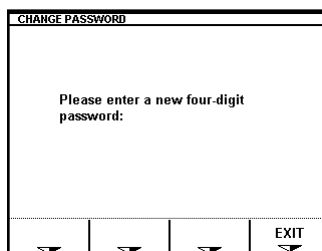
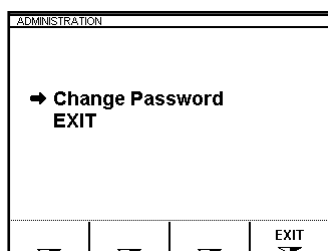


Using the arrow keys or the “UP” and “DOWN” soft-keys, you can highlight the type of sequencing you wish to employ. Once the desired selection is highlighted, pressing the “Select” soft-key will move the arrow to indicate that the selection has changed.

The “EXIT” soft-key, the “ESC” key, and the “Ship’s Wheel” will all take the unit back to the navigation menu.

4.A Administration

The unit’s password can be altered from the Administration screen. To alter the unit’s password, choose “Administration” from the navigation menu. There are only two options on the Administration screen, one is “Change Password” and the other is “Exit”. Choose the “Change Password option by highlighting it and pressing the “ENTER key.



4.A Administration (continued)

After “ENTER” is pressed, a screen will appear prompting you to enter a new four-digit password. Use the numeric keypad to enter this new code or press the “Exit” soft-key to escape without changing the password.

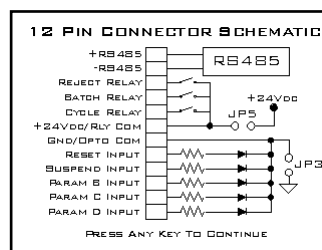
Once the new four-digit code is entered, the unit will prompt you to confirm this four digit code. If you enter the same code the second time, the unit will politely ask you to remember your new password. If for some reason the same code is not entered twice, the unit will inform you that your confirmation failed.

In either case, after a short delay, the unit automatically returns to the navigation menu.

4.B I/O Schematic

The final option on the navigation menu is “I/O Schematic” if this option is selected a schematic appears on the screen which shows the function of the 12-pin I/O connector and the circuitry behind it.

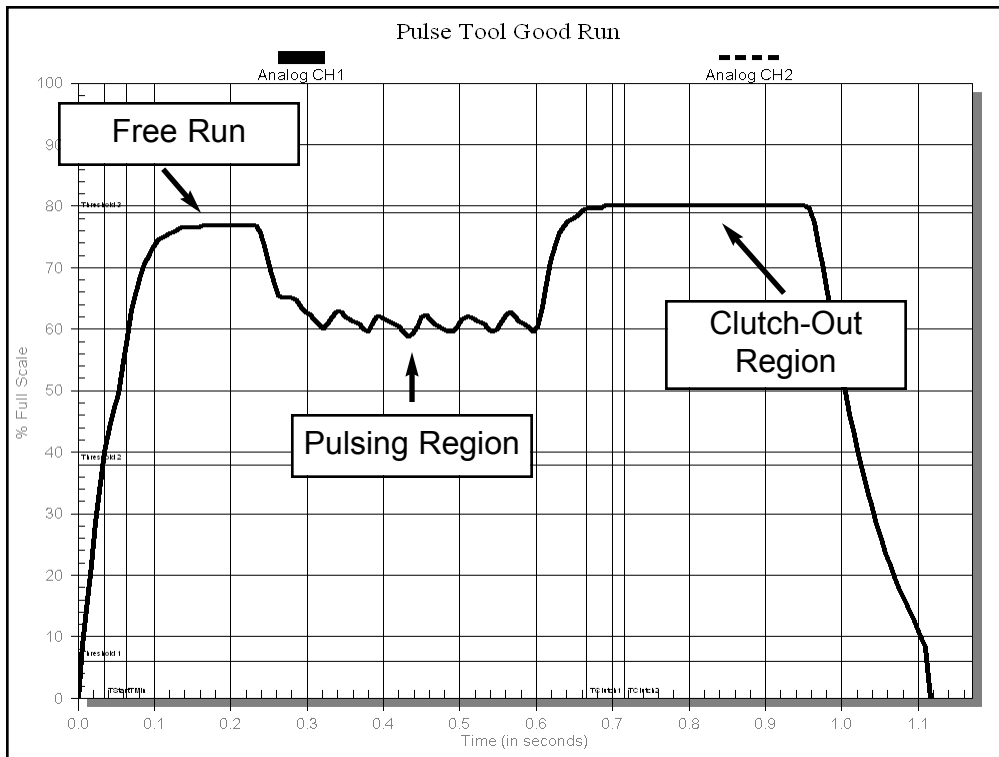
Pressing any key while the schematic is being displayed will return the unit to the navigation menu.



A Appendix

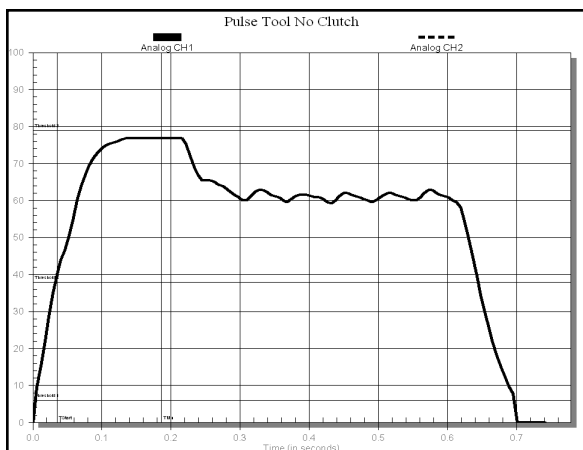
A.1 Pneumatic Curves (Pulse Tool)

Good Run Down:



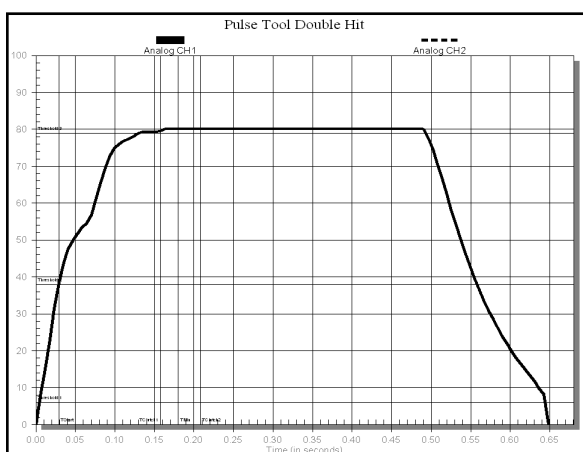
The picture to the left shows the analog data from a good fastening process using a pulse tool. There are a few hallmarks in this curve that are worth noticing. This tool was set up to pulse at least four times. If the tool does not pulse at least four times, there is a good chance that it will generate reject statuses.

Also, at the end of the pulsing phase, the pressure steps up almost to line level. This region indicates the tool's clutch shut the tool off when torque was achieved.



Incomplete Run Down:

This picture shows the curve generated by an incomplete fastening process. Notice how the curve does not step up to line pressure at the end of the run. This indicates that the clutch did not engage.



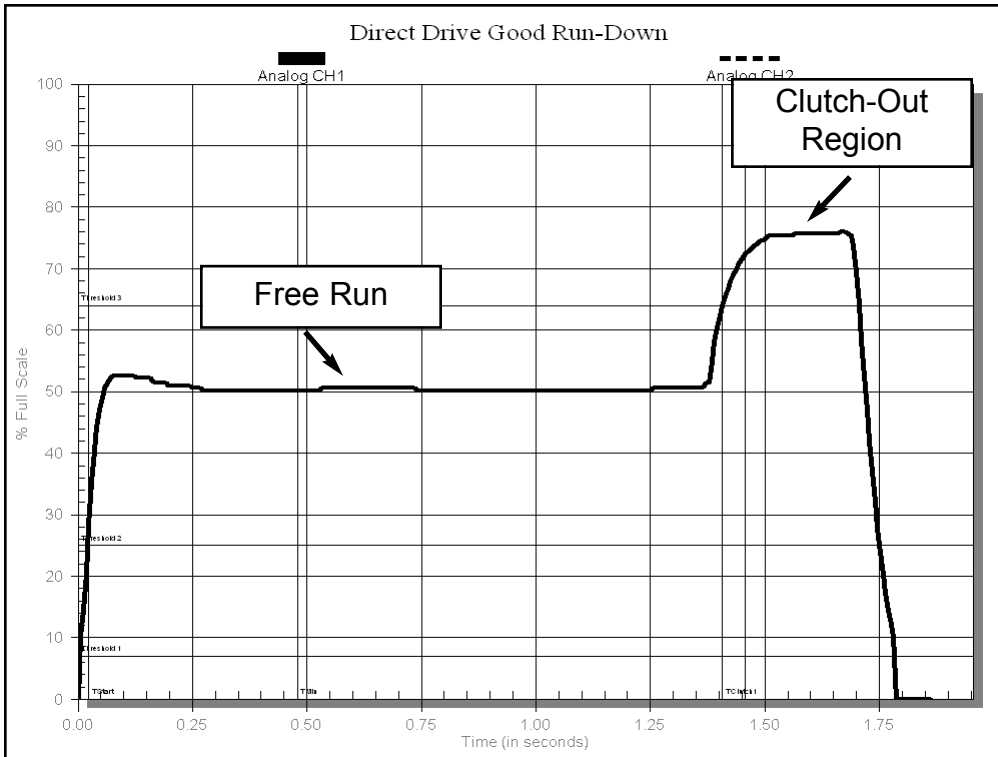
Double-Hit:

This picture show the curve generated by a double hit. Notice how the curve immediately steps up to line pressure and stays there. There is little or no pulsing region. This curve would be typical of a fastener being "hit" again after the fastener had already been tightened to torque.

A Appendix

A.2 Pneumatic Curves (Direct Drive Tool)

Good Run Down:

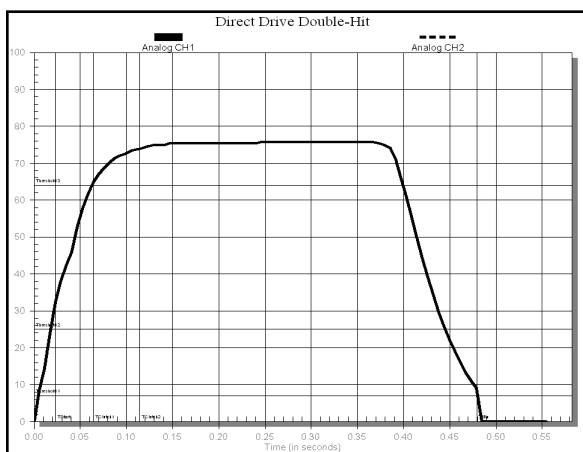


The picture to the left shows the analog data from a good fastening process using a direct drive tool. There are two hallmarks in this curve worth noticing. First, during free run the tool runs at a constant pressure which is lower than the shut-off or clutch-out pressure. Then, after to tool's clutch engages the pressure steps up to near line pressure.



Incomplete Run Down:

This picture shows the curve generated by an incomplete fastening process. Notice how the curve does not step up to line pressure at the end of the run. This indicates that the clutch did not engage.

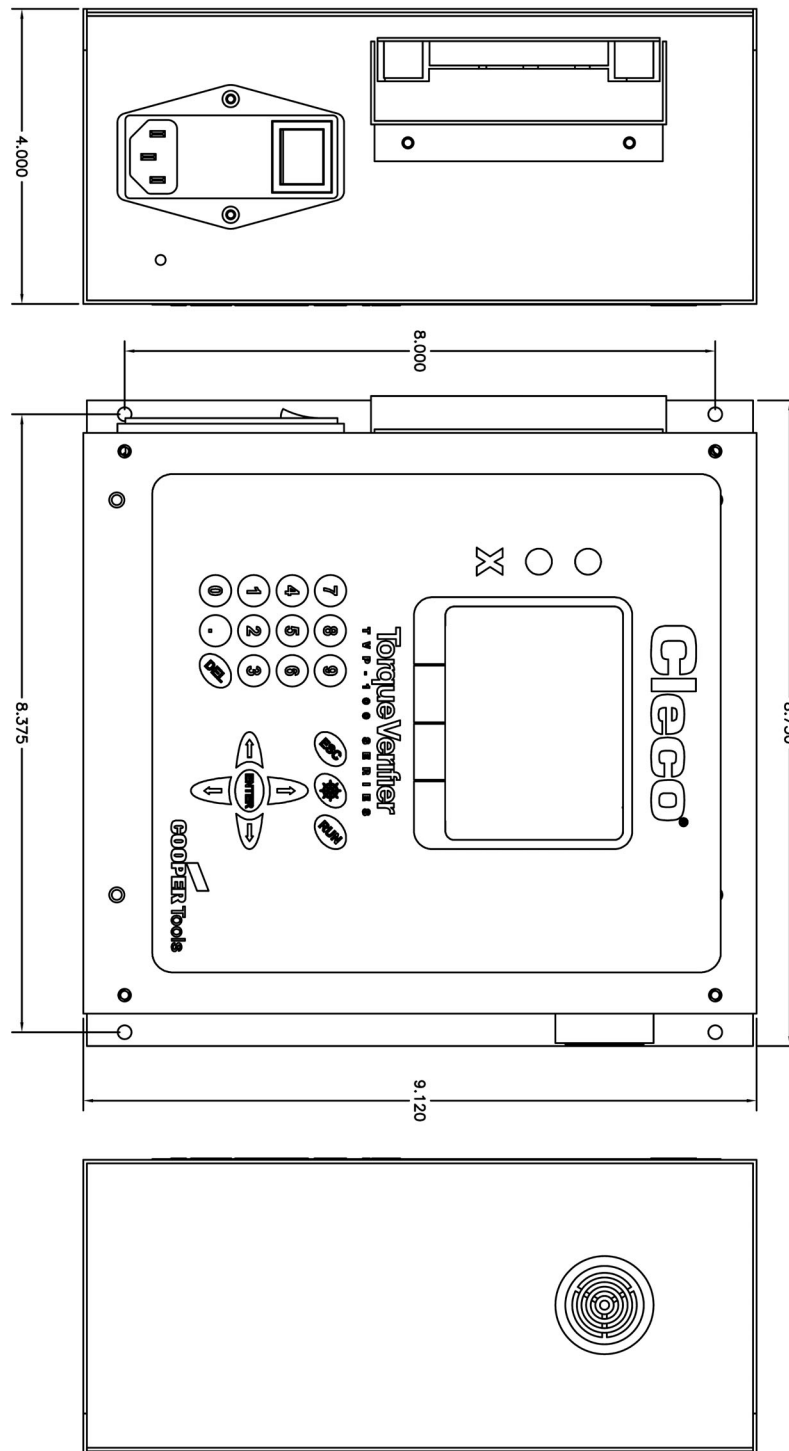


Double-Hit:

This picture show the curve generated by a double hit. Notice how the curve immediately steps up to line pressure and stays there. There is no free run region. This curve would be typical of a fastener being "hit" again after the fastener had already been tightened to torque.

A Appendix

A.3 Box Dimensions



A Appendix

A.4 Tool and Box Diagram

