AcraDyne®
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Phoenix II/Phoenix III Torque Wrench User Manual

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1. General Power Tool Safety Warnings

WARNING

Read all safety warnings, instructions, illustrations, and specifications provided with this power tool. Failure to follow all instructions listed below may result in electric shock, fire, and/or serious injury. Save all warnings and instructions for future reference.

1.1 Battery and Charger

- **Use only the official charger and battery.** Do not use any other chargers or batteries not designated in this manual.
- **Use the correct charger rated to the power source.** Failure to do so may damage the charger and equipment and cause abnormal heat generation, which may result in fire.
- **Do not use the charger with a damaged plug or damaged cable.** Doing so may cause an electric shock, short-circuit, and/or a fire.
- **Do not charge the battery in conditions outside of the –1 to 42 °C (30 to 107 °F) temperature range.**
- **Do not wrap the charger or battery with a cloth, etc.** This may hinder heat dissipation and, in an extreme case, may cause a fire.
- **When it is not in use, remove the plug from the power source.** This will prevent damage in cases such as if the line voltage swings outside the accepted values.
- **Do not use the charger or store the battery in the rain or other wet conditions. Do not use a charger or battery that was exposed to water.** This will damage the products and may lead to electrical shock.
- **Do not use or charge the product in an area near flammable liquid or gas.**
- **Do not throw the battery into a fire.** It will explode and may generate hazardous gases.
- **Do not handle the charger cable roughly.** Do not carry the tool by the charging cable. When pulling out the plug, handle it by the connector and not by the cable.
- **Carefully choose the charging location so that the cable is not subject to any external damage.** A damaged cable may cause an electric shock and/or fire.
- **Keep the charge cable away from heat, oil, and sharp corners.** Avoid physical damage to the cable.
- **When charging via USB, use the cable supplied with the product or one from a reliable source that complies with the USB standard.** Certify that the USB port also complies with the USB industry standard.
- **Immediately replace damaged cables.** Check the cable of the charger periodically. Working with a damaged cable may cause an electric shock and/or a fire.
- **When using an extension cord, conduct a periodic check and change with a new one if there is any damage.**

1.2 Accessories

- **Use only authorized accessories and optional equipment.** Do not use any accessories or optional equipment other than those designated in this manual or advised by the manufacturer. Doing so may decrease the safety of the product and reduce its performance, life, or cause product failure.
- **To change accessories, follow the instruction manual.**
- **Do not disassemble or modify the product or accessories.** Doing so will decrease the safety of the product and reduce its performance, life, or cause product failure.

1.3 Tool Usage and Workplace Condition

- **Use a natural and steady posture when using the tool.**
- **Keep your feet firnly on the ground and maintain your balance.** Pay attention to the condition of your workplace.
- **Keep the workplace brightly lit.** Working in a a poorly lit place may lead to an accident.
- **Always keep the workplace clean and uncluttered.** An untidy workplace may lead to accidents.
- **Keep the tool and its handle dry and clean.** Oil and grease may make a handle slippery and cause accidents and injury.
- **Choose the correct tool for the required operation.**
- **Before use, check the case and other parts to make sure they are functioning properly.** Check everything that may affect ordinary operation.
- **For best measurement accuracy, hold the center of the handle length and apply force at a right angle in relation to the wrench length.**
- **Connect the torque wrench and the interchangeable head firmly.**
- **When working in a high place, take appropriate measures to prevent the product and its accessories from falling.** Falling tools or sockets may cause accidents, injuries and/or product failures.
- **Keep other people away from the workplace.** A crowded workplace may lead to accidents.
- **Make sure the ratchet lever is completely switched to the direction your application requires.** Failure to do so may cause accident and/or injuries.
- **Do not extend the handle of the torque wrench with a pipe, etc.** This will cause an accuracy error and may damage the equipment and cause an accident.
- **Keep tool away from small children.** They don't know how to use wrenches.
- **When not in use, store tool properly, keep it dry, and lock it so unauthorized persons cannot use it.**
- **Do not allow the operating temperature of the tool to rise as high as 60 °C (140 °F).** Doing so may damage the battery, hinder product performance, and cause smoke and/or fire.
- **Do not use the product beyond its capacity.** In order to use the product safely, effectively, and to extend its life, use it always within its capacity. Using the product beyond its capacity may cause accidents or product failure.
- **Do not use the product for purposes other than intended.** Use it only for what is specifically designated in this manual. Doing otherwise so may cause an accident.
- **Take good care of all tools.**

2. Product Description

The Phoenix II/Phoenix III torque wrench is a world class design tailored for industrial applications. It offers in a single product, a variety of tightening strategies for use in production environments and a set of methods and software features for evaluating the residual torque for quality control and joint analysis.

No additional software licenses or hardware keys are required. All software features are standard.

Also included is TWConfig, configuration software which, among others features, can be used to configure the wrench, manage tightening programs, view and export results and tightening traces, and create quality control routes.

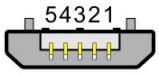
3 Specifications

3.1 Wrench

3.1.1 General Specification

Torque measuring range	1.5 Nm to 1200 Nm
Torque accuracy	± 0,5% readout between 20% and 100% of wrench nominal capacity ± 1% readout between 10% and 20% of wrench nominal capacity
Overload capacity	120% of wrench nominal capacity
Maximum angular speed	250 °/s
Minimum angular speed	15 '/s (0.25 °/s)
Angle measurement accuracy	±1° over 360°
Tightening results capacity	1,000,000 results (including a copy of the program used)
Tightening traces capacity	1,000,000 traces
Haptic feedback	Built-in vibration motor
Sound feedback	Built-in speaker 1.5W (94dB peak)
Visual feedback	9 RGB LEDs (4 in each side + 1 frontal)

3.1.2 USB Interface



Micro-B

Version	USB 2.0
Data rate	480 Mbit/s
Connector	Micro B receptacle
USB charge current	1A Maximum - Compatible to USB Battery Charger Spec (BC1.2)

3.1.3 Wi-fi Module

Wi-Fi Standards	802.11 b/g/n
Frequency Range	2.4 GHz - 2.5 GHz (2400 MHz – 2483.5 MHz)
Tx Power	802.11 b +20 dBm 802.11 g: +17 dBm 802.11 n: +14 dBm
Rx Sensitivity	802.11 b: -91 dBm (11 Mbps) 802.11 g: -75 dBm (54 Mbps) 802.11 n: -72 dBm (MCS7)
Security	WPA/WPA2
Encryption	WEP/TKIP/AES

3.1.4 Barcode Reader (optional)

Illumination	Red LED 625±10 nm
Symbologies	
2D	PDF 417, Data Matrix (ECC200, ECC000,050,080,100,140), QR Code
1D	Code 128, EAN-13, EAN-8, Code 39, UPC-A, UPC-E, Codabar, Interleaved 2 of 5, ITF-6, ITF-14, ISBN, Code 93, UCC/ EAN-128, GS1 Databar, Matrix 2 of 5, Code 11, Industrial 2 of 5, Standard 2 of 5, Plessey, MSI-Plessey.
Reading Precision	≥ 5mil
Depth of Field*	
EAN13 (13mil)	55mm – 185mm
Code 39 (5mil)	55mm – 100mm
PDF 417 (6.67mil)	40mm – 130mm
Data Matrix (10mil)	40mm – 135mm
QR Code (15mil)	40mm – 160mm
Symbol Contrast	≥ 30% reflectance difference
Scan Angle**	Roll: 360°, Pitch: ±55°, Skew: ±55°
Field of View	Horizontal 36°; Vertical 23°

* Test conditions: T = 23 °C, Illumination = 300 LUX

** Test conditions: Code 39, 3 Bytes; Resolution = 10mil; W:N = 3:1; PCS = 0.8; Barcode Height = 11 mm; Scan Distance = 120 mm, T = 23°C, Illumination = 300 LUX V1.0.0

3.1.5 Dimension and Weight

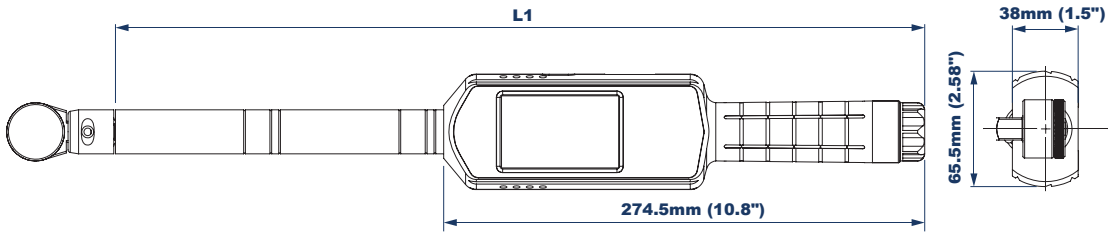


Figure 1 - Wrench drawing

	Capacity	Drive Connector	L1		Weight (without end fitting)	
Model	**Nm**	**mm**	**mm**	**in**	**kg**	**lb**
PHOENIX III 15	15	9 x 12	426	16.8	0.95	2.1
PHOENIX III 30	30	9 x 12	426	16.8	0.95	2.1
PHOENIX III 70	70	9 x 12	488	19.2	1.0	2.2
PHOENIX III 100	100	9 x 12	488	19.2	1.03	2.3
PHOENIX III 200	200	14 x 18	615	24.2	1.57	3.5
PHOENIX III 300	300	14 x 18	765	30.1	1.69	3.7
PHOENIX III 400	400	14 x 18	866	34.1	1.89	4.2
PHOENIX III 600	600	14 x 18	1050	41.3	2.02	4.5
PHOENIX III 800	800	Ø 20	1200	47.2	3.06	6.7
PHOENIX III 1000	1,000	Ø 20	1250	49.2	3.3	7.3
PHOENIX III 1200	1,200	Ø 27	1345	53.0	3.42	7.5

3.1.6 Environmental Conditions for Operation

• Internal use only	• Ambient temperature: –1 to 42 °C
• Environmental class: II	• Atmospheric humidity: 95%, non-condensing
• IP grade according to EN IEC 60529: IP50	• Altitude: Up to 2,100 m
• NEMA enclosure type: 1	

3.2 Battery

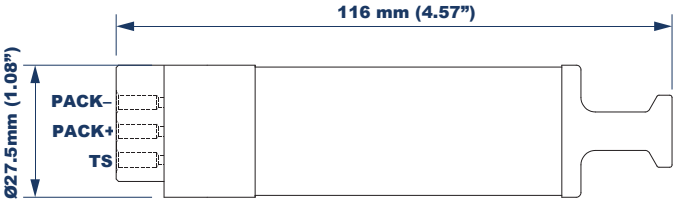


Figure 2 - Battery drawing

Chemistry Lithium-ion (Li-ion)
Endurance 9 hours (with Wi-fi enabled)
Nominal voltage 3.60V
Capacity 3500mAh

Charging time
7 h directly in the wrench connected in standard USB port

4.5 h directly in the wrench connected in a high-powered USB port or wall adapter

2.5 h in the dedicated charger model MSH-36A1

Relative capacity x temperature 100% at 23°C, 50% at –1°C

Capacity after 450 cycles 60% of Standard Capacity

3.3 Battery Charger Model PHX II BATT CGR

Figure 3 - Battery charger model PHX II BATT CGR

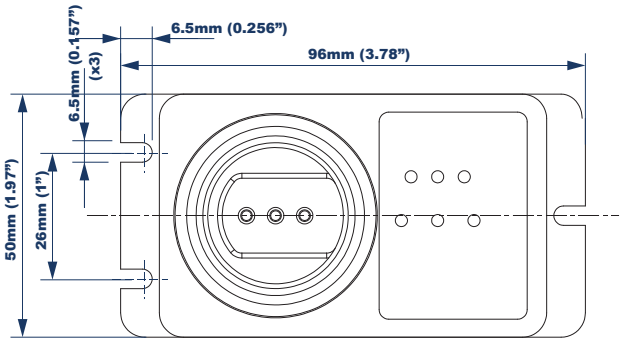


Figure 4 - Battery charger drawing

Input voltage	5V, 2A
Input power	Max. 10W
Protection	Thermal regulation, thermal shutdown and safety timer
DC Jack mating plug	Barrel type 3.5 mm OD, 1.35 mm ID
AC adapter	
Input voltage	100 – 260 VAC, 47– 63 Hz
Input current at full load	< 350mA, with 110 VAC
Input protection	Varistor associated with NTC and inductive filters

3.4 Companion Software TWConfig

The wrench companion software TWConfig runs on a Windows® environment, operating system version Windows XP or newer. It has been tested and works on Windows 7, Vista, 8, and 10.

A screen resolution of 1024 x 768 or higher is required.

A minimum of 30 MB of disk is needed for installation.

A portable version is available that does not need to be installed or administration rights to work, and can be run from a Pen drive.

TWConfig is a lightweight application that does not have a minimum computer requirement. If a given computer hardware runs a supported operating system version, then the application will run without issues.

To export results in XLS/XLSX format Microsoft Excel® must be installed.

4 User Interface

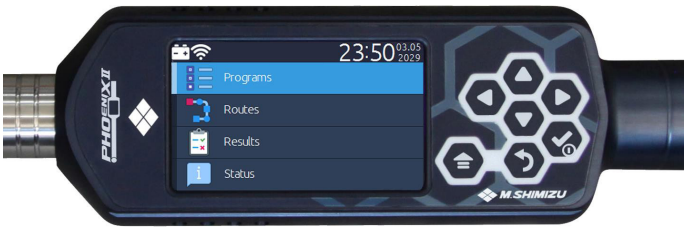


Figure 5 - Wrench user interface

4.1 Touch Screen

For easy access, the wrench is equipped with a resistive touch screen interface that can be operated with or without gloves. Almost all functions can be accessed by touching the option or holding down and moving up and down to scroll.

4.2 Operation Keys

All wrench navigation and operation can also be done via keyboard, if accidental damage to the touch screen is a concern. The screen can be protected without diminishing the tool usability.

4.2.1 Wrench key functions

- Enter/On-Off
- Go back
- Shift/Activate barcode (on tightening screen)
- Left navigation key
- Right navigation key
- Up navigation key
- Down navigation key

4.3 Status Bar

The status bar is at the top of the screen and offers the user quick information about the wrench operation state. On the left side of the status bar, the battery level, Wi-fi status, and other information are shown with intuitive icons. On the right-hand side of the status bar, the current date and time are shown. The date and time format can be changed via configuration software or via settings P0.10 and P0.11.

4.3.1 Status bar icons meaning

Wi-fi

The Wi-fi icon shows the signal strength and connection state. If this icon is not present, the Wi-fi hardware is not enabled. It can be enabled via the configuration software.

	Full strength, good Wi-fi signal
	Medium strength, acceptable signal level
	Low signal level
	Marginal signal. May not be suitable for operation if the wrench is controlled via Wi-fi
	Not connected to the Wi-fi network
	Wi-fi hardware error. Device may need to be serviced

Battery

The wrench is equipped with a fuel-gauge battery monitoring chip. The battery icon shows the battery level and charge status

	Wrench connected via USB or wall adapter. The battery is being charged
	Wrench connected via USB or wall adapter. Battery charging finished
	Battery level: The icon white color diminishes as the battery level decreases. Examples: 
	Battery level very low. Wrench may turn off automatically at any time
	Battery fuel-gauge error. This icon may appear if the battery is not inserted and the power is supplied via USB port

Tool Lock

This is icon indicates that the wrench was locked via a protocol interface. If this icon is not present the wrench is free to perform tightenings.

	Wrench is locked. Tightening cannot be performed

5 Wrench Operation

5.1 Main Menu

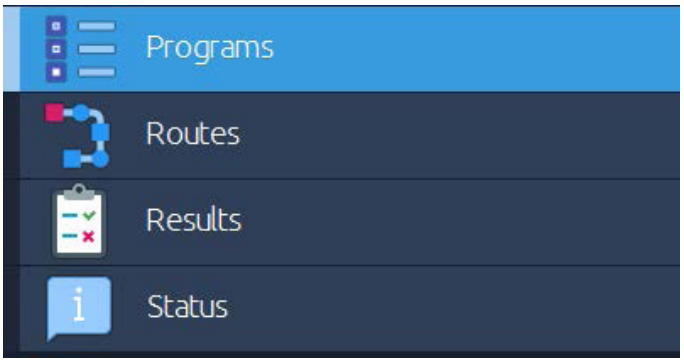


Figure 6 - Main menu

The main menu is the first screen shown upon turning the wrench on. From this list is possible to access the main wrench features. The user can navigate the list and access the options via keyboard or touch-screen. Holding down and moving the finger closer to the bottom or upper edge of the menu will scroll the list.

Pressing the *Go-back* key  at any time will show the tightening screen. Pressing go-back again will return to this main menu screen.

5.2 Tightening Screen

The picture below shows a typical tightening screen for a torque only program. On the left side, an analog gauge that follows the applied force gives a more natural feel of the torque needed to reach the target.

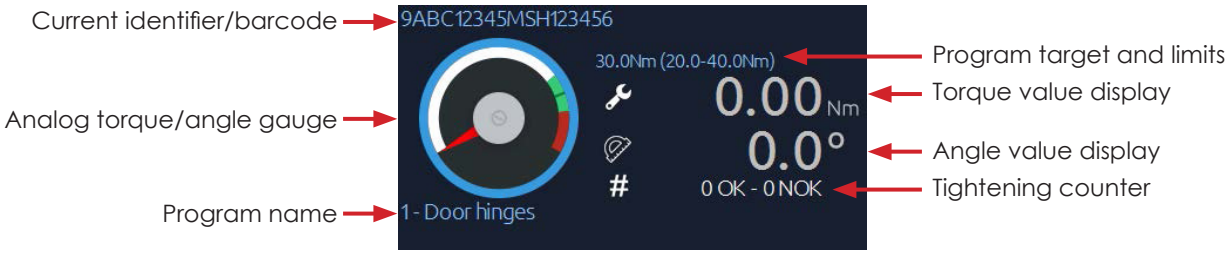


Figure 7 - Typical tightening screen

The actual values shown in the torque value display and angle value display changes according to current program strategy. For example, for a torque-only program, the torque shown is the peak torque (unlike the analog gauge which will track the current torque applied). That is, it will not go back to zero if the torque is released. It will retain the maximum value achieved, which will be the tightening torque result.

The torque and angle text color changes according to the result classification: green when it's within the limits, red when it's above the high limit, or yellow if it's below the low limit.

The tightening screen changes slightly according to the current strategy. Those changes are listed within each strategy description.

Pressing the *Right* key in the tightening screen shows the tightening trace of the last tightening. See section "5.5.1 Tightening Trace Screen" on page 10 for more information on how to navigate in this screen.

Pressing the *Down* key shows the tightening program details. See "Figure 11 - Program details screen" on page 9.

5.2.1 Activating the Barcode Scanner/Identifier Input

An identifier can be associated with a tightening cycle and stored with its result by reading a barcode (if the wrench is equipped with the barcode scanner option) or by entering it manually.

Pressing *Shift* key in the tightening screen will activate the barcode scanner and display a popup that allows the user to enter an identifier manually via an on-screen keyboard.

Figure 8 - Identifier input popup

This popup will close, and the barcode scanner turn off automatically after a few seconds or upon a successful reading. The user can hold down the *Shift* key to keep the barcode on for a longer period. Touching the cancel button or pressing the *Go-back* key closes the popup and turns the barcode scanner off.

Choosing *Manual input* opens an on-screen keyboard that allows the user to manually enter the identifier.

Figure 9 - On-screen keyboard

In this screen, the user can use the touch-screen or

the navigation keys to type in the identifier. The input can be canceled at any time by pressing *Go-back* .

The input can be erased by using the *Backspace* virtual button or by holding the *Shift* key and pressing *Go-back* .

The behavior of the *Enter* key changes whether the user chooses to use the touch-screen or the navigation keys as follows:

Upon entering the on-screen keyboard, the *Enter* key, when pressed, will activate the highlighted button (the button with a white rectangle around it). In order to finish the input, the user must hold down the *Shift* key and press *Enter*, or navigate to the return button (Highlighted in Figure 9) and press *Enter* .

When the user uses the touch-screen for the first time in the session, the *Enter* key will change behavior and, when pressed, will accept the input directly and close the popup (same function as the return button or using +).

Upper case, numbers and symbols can be entered by changing the keyboard layout using the shift button and symbols button ?123 .

In the firmware version covered by this manual, it is not possible to select a program via identifier. The identifier is only used tin association with the tightening result.

5.3 Program Selection

Selecting *Programs* in the main menu will display the program list screen. This screen shows the number, name, and strategy of the program. In this list (and all other lists) it's possible to quickly navigate an entire page at time instead of one item at time by holding *Shift* key and using *Up* or *Down* keys .

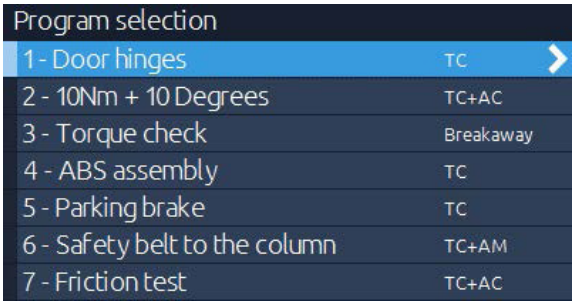


Figure 10 - Program selection screen

The strategy name is abbreviated:

TC	Torque control (torque only strategy)
TC+AM	Torque control with angle monitoring
TC+AC	Torque and angle control
Breakaway	Breakaway/Residual detection strategy

Selecting the program and pressing *Enter* will load the program and display the tightening screen. The wrench is now ready to perform tightenings.

Manual program selection can be disabled via configuration parameter P0.16

As shown by an arrow in the right-hand of the selected item, the *Right* key can be pressed to display the details of the program. This screen will show details like the last time the program was changed, the revision, name, limits, and other information relevant to the program strategy. Those parameters will be discussed further in the program creation section.

Figure 11 - Program details screen

5.4 Routes

Selecting *Routes* in the main menu will display the route selection screen. The route is built in a hierarchical fashion, like file and folders in a computer. Tasks appear in the root folder (the main folder that contains all items and is the first shown upon entering the route screen) and other folders that contain more tasks.

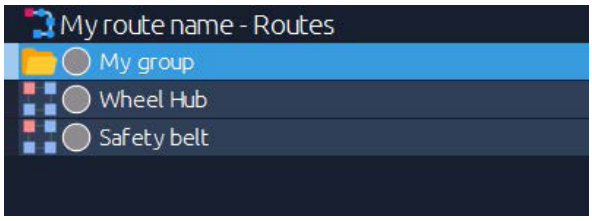


Figure 12 - Route screen

Navigating the route follows the same principle of the program list. Selecting a folder (indicated by the folder icon as in "My group" of Figure 12) and pressing *Enter* (or touching it directly) will list the folder contents, which can contain more folders and tasks.

Touching the title portion of the screen ("My route name – Routes" in Figure 12) has the same effect as pressing *Go-back* on the keyboard: it goes back one level. That is, if the user is inside a folder, it will go back to the parent folder (which may be another folder or the root folder). If the user is already in the root folder, then it will go back to the main menu. The concept and operation of Tasks and Tests will be discussed fully in the route section.

5.5 Results

Selecting *Results* in the main menu will display the result list. This list shows the previous tightenings with the most recent at the top. Navigate down the list to show older results. To navigate an entire page of results at a time instead of a line at time, hold the *Shift* key and press *Up* or *Down* keys .

Date/Time	Identifier	Tq. Nm	Angle	
04/06/19 14:35:09	12345678999	29.96	8.0	0/0
04/06/19 14:34:56	12345678999	24.67	45.1	0/0
04/06/19 14:34:48	12345678999	20.67	12.6	0/0
04/06/19 14:34:05		20.67	12.5	0/0
04/06/19 14:21:11	9SVE123456789	20.67	12.6	0/0
04/06/19 14:14:30	9SVE123456789	20.67	12.6	0/0
04/06/19 14:14:27	9SVE123456789	20.67	12.6	0/0
04/06/19 14:14:23	9SVE123456789	20.67	12.6	0/0
04/06/19 14:14:20	9SVE123456789	20.67	12.6	0/0
04/06/19 14:14:17	9SVE123456789	20.67	12.6	0/0
04/06/19 14:14:12	9SVE123456789	20.67	12.6	0/0
04/06/19 14:13:56	9SVE123456789	20.13	16.4	0/0

Figure 13 - Result list

Pressing *Right* shows the details of the program used to perform the highlighted tightening. This information is not the current program stored in the wrench, but a copy stored with the result when the tightening was performed. Every result in the wrench stores the tightening data, the program, and the tightening trace. This way is possible to verify the program parameters even after it has been changed or delete from the wrench.

It's not possible to erase results from the wrench.

Pressing *Enter* shows the tightening trace of the result.

5.5.1 Tightening Trace Screen

The tightening trace screen shows the Torque x Angle, Torque x Time, or Angle x time trace of the tightening.

Figure 14 - Tightening trace

The current trace type and units is shown at the top of the trace area. By default, the Torque x Angle trace is presented first, pressing *Enter* cycles through the other trace types. In the bottom right, the torque and angle (or Torque and time or Angle and time) of the selected point is shown. The tightening result point is highlighted by default. The cursor is shown in green if the tightening final status is OK and red if it is NOK.

The toolbar at the bottom left shows the tool selected, the tool can be changed by pressing *Shift*. Those tools are, from left to right: Zoom, Pan, and Track. Each tool changes the behavior of the keyboard arrow keys as follows:

5.5.1.1 Zoom

Up zooms in and *Down* zooms out. *Left* and *Right* are not used

5.5.1.2 Pan

Up and *Down* pans the trace vertically and *Left* and *Right* pans the trace horizontally.

5.5.1.3 Track

Left and *Right* moves the cursor point by point. *Up* and *Down* moves the cursor 10 points at time. Each time the cursor is moved, the value displayed in the bottom right is updated.

5.6 Status

The status screen shows some basic information about the wrench and network connection.

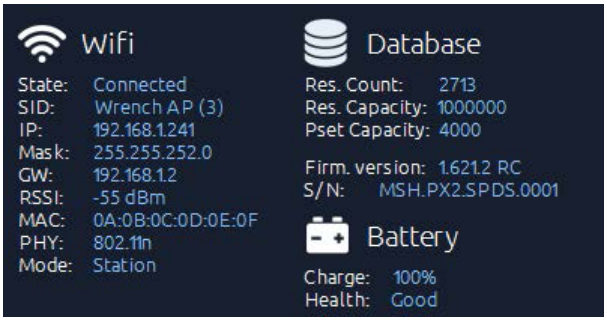


Figure 15 - Status screen

5.6.1 Wi-fi Status

The Wi-fi section shows the state of the connection, the access point SID (with the current channel in brackets), and address information along with the wrench MAC address and signal strength in dBm.

5.6.2 Database

This section shows the amount of results stored and the result and program capacity. When the result count reaches the capacity, the oldest tightening will be overwritten.

The wrench firmware version and serial number is also shown.

5.6.3 Battery

The battery charge percentage and health are shown is this section. The wrench is equipped with a specialized circuit that tracks the battery impedance and calculates its health.

The possible health status is listed below:

Very good	The battery is new or has a small number of cycles
Good	Battery is used but it's in good condition
Fair	Battery is usable but may hold less than 60% of its rated capacity
Poor	Battery is near the end of its life. Plan to replace it
Bad	Replace the battery as soon as possible

5.7 Free Test

The free test option allows the user to use the wrench freely while reading the torque and angle applied. No tightening result will be generated.

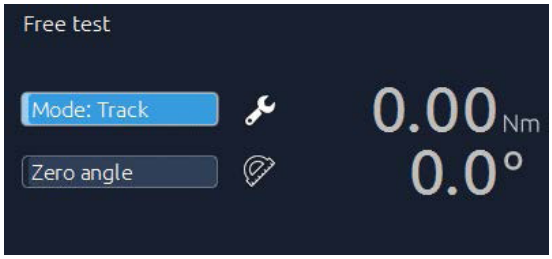


Figure 16 - Free test screen

The torque display has two modes, Track and Peak, that can be alternated by pressing the *Mode* screen. The track mode shows the current torque value applied, while the peak mode holds the maximum torque applied in this session. To zero the peak value, switch to Track mode and back to Peak again.

The angle can be zeroed using the screen button Zero angle.

5.8 Calibrate Touch Screen

The touch screen may change its properties with use along with other factors. In order to maintain accuracy, a calibration procedure can be performed.

To calibrate the touch screen, touch in the center of the crosshair shown. A stylus pen can be used to aid the procedure. Do not use sharp objects. After touching the first point, the crosshair will move to the next location, this will continue for each corner. After touching the needed points, the wrench will show a message confirming that the procedure was finished successfully. The touch screen can then be tested by touching random points in the screen and checking the position of the green crosshair drawn.

Pressing *Enter* will save the calibration data in the wrench memory and complete the procedure.

Go-back can be pressed at any time to cancel the procedure and discard the collected calibration data.

If an error message appears after the procedure is completed, the touch hardware may be damaged.

6 Wrench Management Software TWConfig

TWConfig is a windows-based software package developed to manage the Phoenix II/Phoenix III torque wrench. It's lightweight and offers an intuitive and easy-to-use interface for managing the wrench via a USB cable or Wi-fi connection.

Among other features, it's possible to create and edit programs, configure wrench settings, create and upload routes, save and restore wrench backup, and visualize and export results and tightening traces.

TWConfig software is distributed in two forms. Both are the same software. The only difference is the way it's installed in the target computer:

- ***Setup version:*** It's installed on the computer like other standard Windows applications and runs from the start menu. It may need administration rights to install.
- ***Portable version:*** Does not need to be installed on the computer (and as such doesn't need administration rights). It can be run from a USB stick or can be simply copied to the target computer and executed directly.

6.1 Licensing

The software is free of charge for Phoenix II/Phoenix III torque wrench owners. Use of the software with third-party products is now allowed.

Please read the end user license agreement that's available with the software.

6.2 Basic Operation

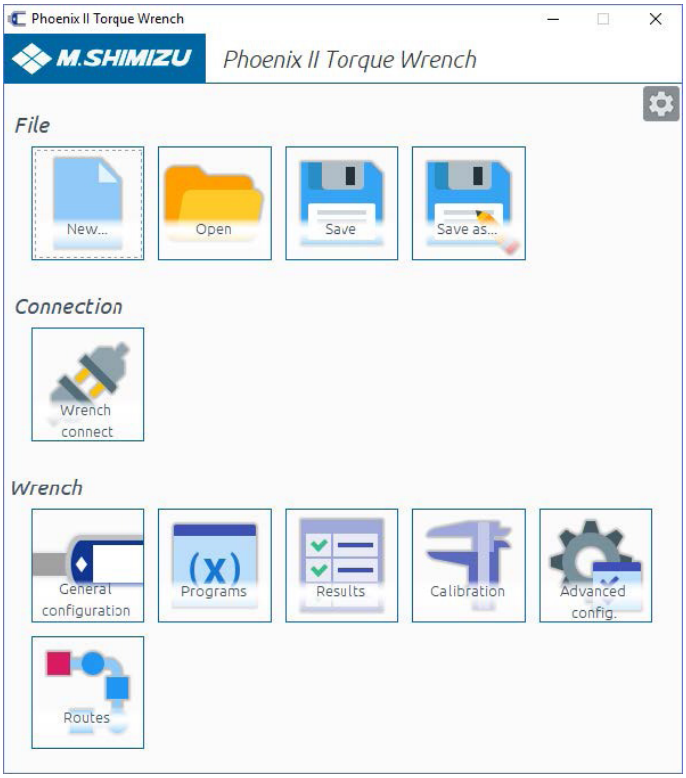
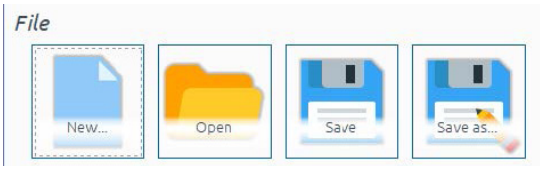


Figure 17 - TWConfig main interface

6.2.1 File Management



The TWConfig software works, like other Windows applications, storing and loading data from files. The behavior of file operation changes wherever the wrench is currently connected. It's possible to create programs and routes while offline and upload the configuration to the wrench later.

The action of each option under the file section:

6.2.1.1 New

Disconnected: Unload any loaded file and start with an empty template.
Connected: No action.

6.2.1.2 *Open*

Disconnected: Open a file for viewing and editing. Previous saved results and traces can be viewed and exported. Program and configurations can be edited.

Connected: Opening a file with the wrench connected imports the contents of the file into the wrench. This can be used to restore the wrench configuration with the contents of a file (e.g. restore a previous backup). The results present in the wrench are not changed.

Upon opening the file, a prompt allows the user to select which parts of file to upload to the wrench, this way it's possible to maintain, for example, the wrench calibration and network configuration while restoring all other configurations.

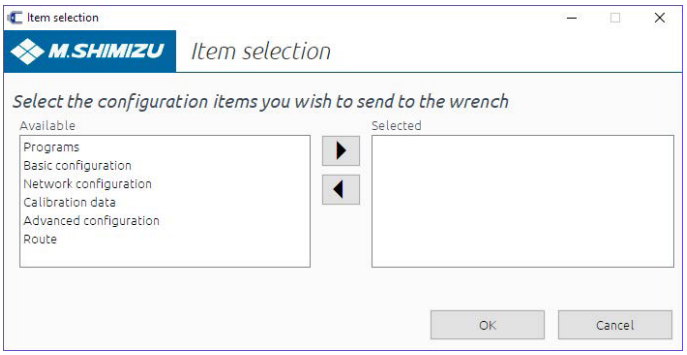


Figure 18 - Configuration upload prompt

6.2.1.3 *Save*

Disconnected: Save the configuration to the current open file. If a file wasn't saved previously, the software will prompt from a place to save one.

Connected: The current wrench configuration will be downloaded and saved to the current file. The downloaded results and traces are also stored. If no results have been previously loaded, then the last 10 will be downloaded. More results can be saved by loading them, prior to saving the file, using the Results option.

6.2.1.4 *Save as…*

The *save as…* button has the same functionality as the *save* button except that it always prompts to save the configuration in a new file instead of using the current open file.

6.2.2 Connection

It's possible to connect to the wrench using the USB port or via Wi-fi using a TCP/IP connection.

Clicking the *Wrench connect* button opens the connection prompt where it's possible to select which method to use.

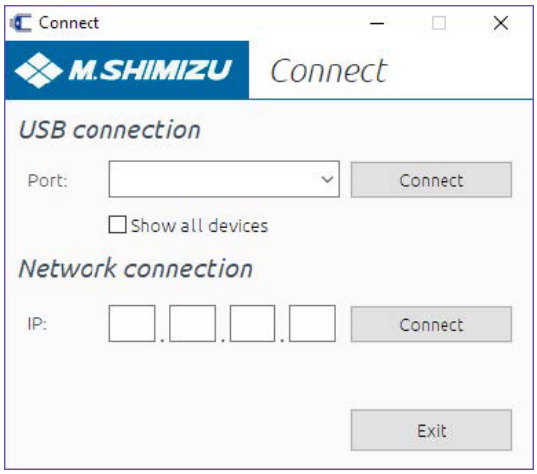


Figure 19 - Wrench connection prompt

6.2.2.1 *USB connection*

Upon opening the screen, a list of wrenches connected via USB port will appear in the *Port* combo box. Multiple wrenches can be connected to the computer at the same time, but the software can only manage one at time. After selecting the device, the connection can be made using the *Connect* button

The *Show all devices* is used in some Windows version where the computer is unable to correctly identify that a wrench is connected. This option lists all ports available. The correct port can then be found by trial and error. It's advised to remove all other devices connected to the computer before executing this procedure.

6.2.2.2 *Network connection*

If the wrench is connected to a Wi-fi network accessible by the computer, the connection can be done without cables using the wrench IP address.

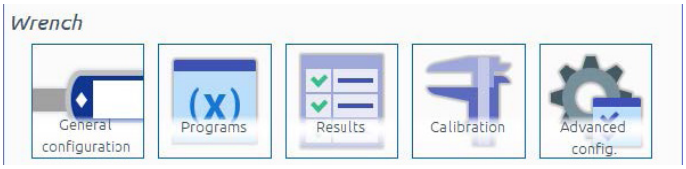
After entering the wrench IP address in the *IP* field, a connection can be made using the Connect button. The previously configured wrench IP can be found directly in the wrench using the *Status* option.

Make sure that the Wi-fi network to which the wrench is connected is accessible by the computer, and that the IP address of the computer is within the same range of the device.

If an error occurs while trying to connect with the wrench, contact your IT department, providing them the error shown, the address of the wrench, and which computers are being used to connect. The error descriptions given by the software are standard Windows messages that are common to other networked devices and may help identify the root cause even if IT personnel are unfamiliar with the device.

Regardless of the connection method, the software operation is the same. The USB connection usually is faster depending of the signal quality of the wireless network.

6.2.3 Wrench Configuration



The *wrench* section in the lower part of the main screen shows the major options for configuring and setting up wrench parameters. Each option is briefly described below and will be discussed in detail later.

6.2.3.1 General configuration

Access to the basic wrench setup such as display language, units, date, time, and network configuration.

6.2.3.2 Programs

The program management option contains the program list and allows the user to edit or duplicate an existing program or create a new one.

6.2.3.3 Results

List the results of a connected wrench or open file. Has the option to view the tightening trace and export the result to formats such as .txt, .csv, or Excel®.

6.2.3.4 Calibration

Interface to calibrate the wrench torque transducer and angle gyroscope gain.

6.2.3.5 Advanced config.

This options lists all the wrench configurations and allows fine control of the wrench behavior.

6.3 Wrench General Configuration

From the TWConfig main interface, select *General configuration* and the following screen is displayed:

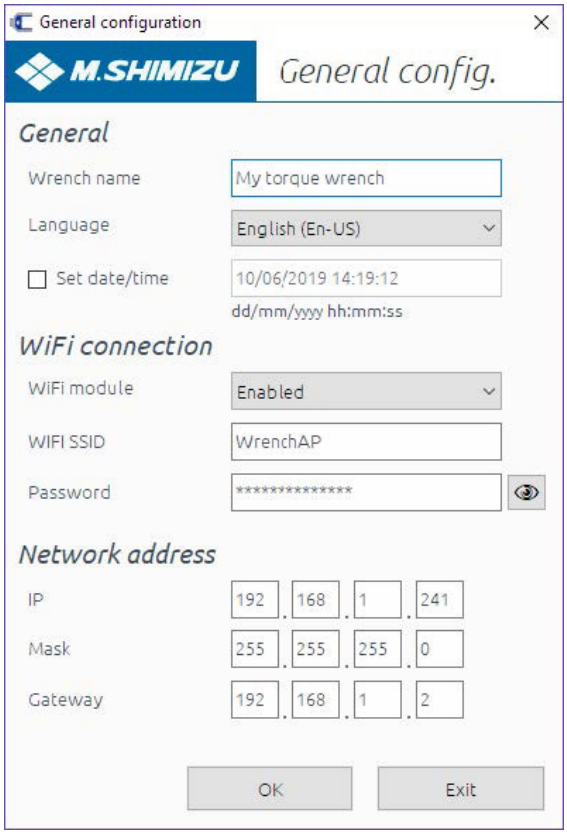


Figure 20 - General configuration screen

6.3.1 General

Wrench name

Text that identifies the wrench. This value is also used in some protocols that require a name to be returned.

Language

Selects the wrench display language. The supported languages in the wrench version covered in this manual are English and Brazilian Portuguese.

Date/time

Ticking the *Set date/time* check box enables the user to enter a new date/time to be sent to the wrench. This new value will be sent when the OK button is pressed.

6.3.2 Wi-fi Connection

Set up the wrench Wi-fi connection. If the wireless connection will not be used, the wrench radio can be disabled to save battery.

The information needed to connect to the Wi-fi network is the network name (SID) and password. The cryptography type is automatically detected.

6.3.3 Network address

The IP address and network mask are the two basic network configurations that must be entered in order to be able to establish a connection with the wrench. The gateway address is not always needed and can be left blank in network setups that don't use it.

After all configuration is done, pressing OK will validate and send the data to the wrench.

6.4 Programs

Clicking the *Programs* button opens the program list. From here, you can create a new program, and edit, duplicate, or delete an existing program.

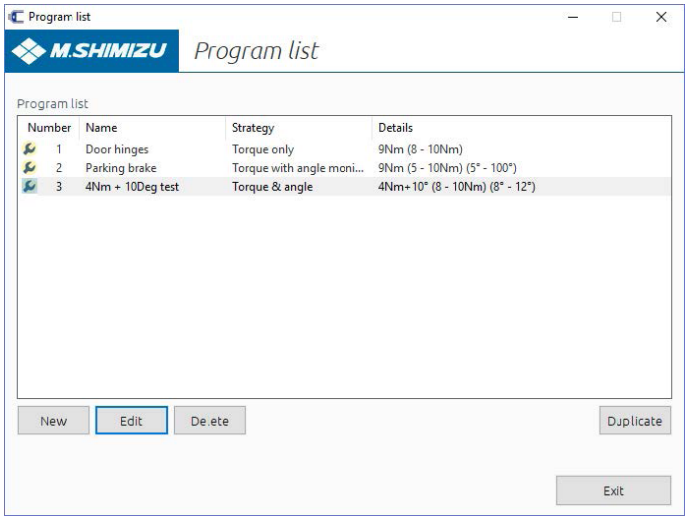


Figure 21 - Program management screen

The program list shows the number, name, strategy, and basic details of the existing programs. The items can be edited, deleted, or duplicated using the button in the lower part of the list. When an existing program is duplicated, the next available number is used. This number can be changed afterward to any value within the wrench range (1 to 4,000). This number is used to select the program via protocol connection and must be unique.

6.4.1 Creating and Editing a Program

The steps to create or edit an existing program are basically the same. Select a program and choose Edit or New. This opens the following program editing screen.

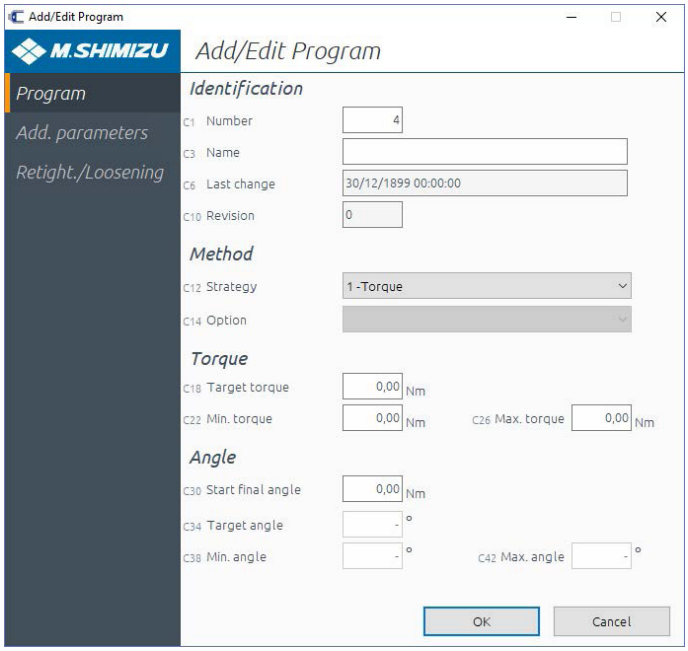


Figure 22 - Add/Edit program screen

The program parameters are divided into sections and each parameter has a unique code to easily identify and locate them.

6.4.1.1 Identification

Number

Unique number to identify the program. This number is used to select the program remotely via a protocol interface.

Name

Free text value to help the user identify the program. This name is show in the wrench screen.

Last change

This field is automatically set by the program every time the program is changed.

Revision

This number is automatically incremented by the system every time the program is changed and helps keep track of program versions used in production. Every time a result is saved, this value gets saved with it, so it's possible to pinpoint the program revision used in every tightening performed.

6.4.1.2 Method

Sets the program strategy and strategy option to be used. In the current firmware version the following strategies are supported:

1. **Torque:** Torque only strategy
2. **Torque with Angle Monitoring:** Torque control with angle monitoring
3. **Torque & Angle:** Torque and angle control. Result can be the torque at the angle peak or the peak torque
4. **Breakaway:** Automatic residual torque detection

Each strategy will be discussed in detail in their own section later in this manual.

The parameters of torque and angle needed will be enabled according to the strategy selected. Clicking in a parameter input box will show on the left side of the screen a description of its function.

6.4.2 Additional Parameters

Selecting the *Add. parameters* tab will show more program settings to help tune the program for specific needs.

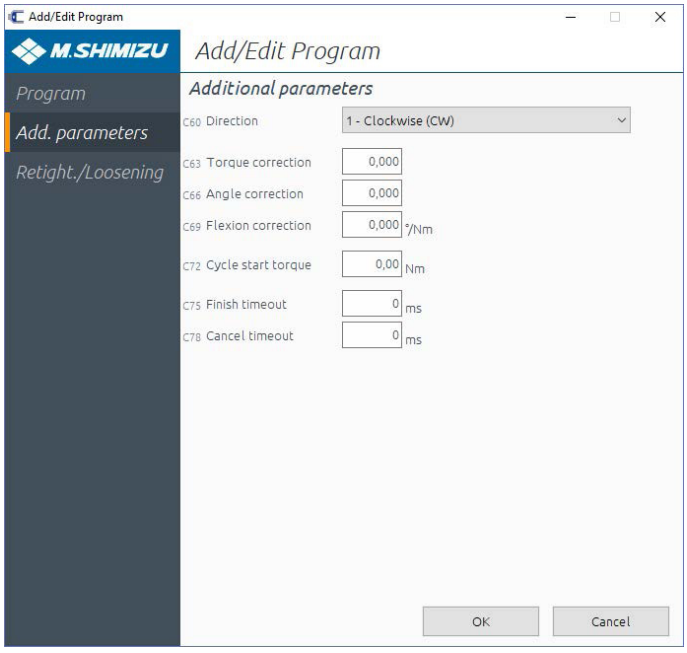


Figure 23 - Program additional parameters

Direction
Tightening direction, clockwise or counterclockwise.

Torque correction
This is a multiplication factor used to compensate for sockets or extensions that change the arm length of the wrench. If this value is zero, the global value set in P0.28 is used. If both values are zero, a default of 1 is used. This value changes the torque read in the wrench and saved with the results. The factor used to perform a tightening is saved with each result.

Angle correction
Multiplication factor for the angle measurement. Although not as commonly used as the torque counterpart, this parameter is useful, for example, if a torque multiplier is utilized. If zero, the value set in P0.29 is used. This value is also saved with the results when a tightening is performed.

Flexion correction
The flexion correction is measured in degrees per Newton meter. It is used to compensate for flexion in the wrench arm during the torque application (especially in larger wrenches of 200 Nm and above). Angle measurement is made indirectly by using a gyroscope in the wrench body, and flexion in the wrench arm can add a few degrees to the final result measurement. Usually this value is preset when the wrench is manufactured in the global configuration P0.6. However, as in the case of the torque and angle correction, the global value can be overridden by the value set in the program.

Cycle start torque
After a program is selected, the wrench shows the tightening screen and waits for the user to apply torque. This torque value must be reached in order to start the tightening cycle. Upon crossing this threshold, the internal cycle counters are incremented and the data for the tightening trace starts to be collected. A result is generated only if the torque goes beyond this value to start the cycle. If zero, the default of 1% of the wrench capacity is used.

Finish timeout
This timeout value is used to finish the tightening quickly after completion, but allow some time for ratcheting the wrench during operation. This timer is triggered after at least the minimum torque is reached (or minimum angle in an angle strategy). It starts to runout only after the torque falls below the Start torque. If the torque goes up again, the time is reset. The wrench will finish the tightening only if the torque is kept below Start torque for this amount of time. If zero, the default set in P0.7 is used. Usually the default is 500 ms.

Cancel timeout
This timeout value cancels the tightening when a cycle is started (Start torque is reached) and no further torque is applied. It is triggered when a cycle starts but starts to runout only after the torque falls below the Start torque again. The wrench will finish

the tightening if a cycle is started and the torque is kept below Start torque for this amount of time. If zero, the default set in P0.8 is used, usually the default is 5000ms.

The tightening cycle can also be finished immediately by pressing *Enter* on the keyboard.

6.4.3 Retightening and Loosening Detection

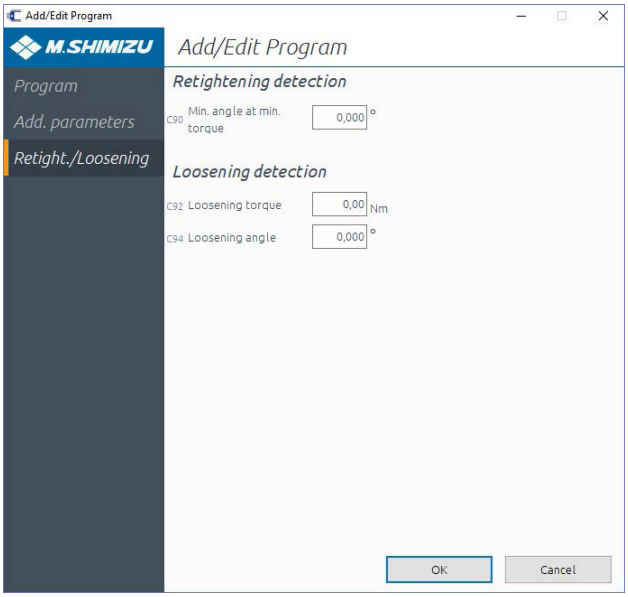


Figure 24 - Program re-hit and loosening detection

Retightening
The wrench can detect torque being applied on an already tightened bolt by checking the angle measured when the minimum torque value set in the program strategy is reached. When the bolt is already tightened, the angle turn to reach this torque is very low in comparison to a bolt not tightened. Even if the bolt is pre-assembled, this value can be determined empirically by testing both conditions and picking a middle ground between them.

The wrench will warn the user that a retightening condition was detected. A result will be generated with the status NOK – retightening.

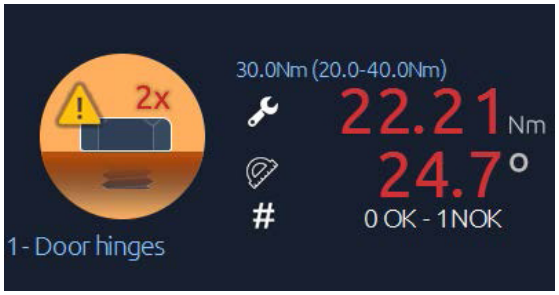


Figure 25- Retightening status screen

Loosening detection
The loosening of a bolt already tightened can be detected by setting the loosening torque and loosening angle parameters. When the torque reaches loosening torque in the opposite direction set for the program selected, the loosening angle starts to be incremented. If the user keeps turning the wrench, and the angle value reaches the value set in loosening angle, a loosening is detected. When this happens, the wrench will warn the user and save the results with the status NOK – loosening.

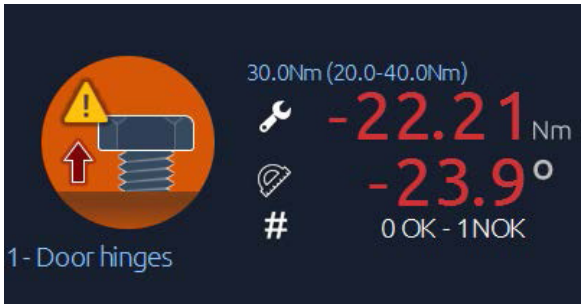


Figure 26 - Loosening detected screen

6.4.4 Program Strategies

6.4.4.1 Torque

The torque strategy measures and classifies only the torque read. The angle is still measured, but is not considered to determine the final result.

Strategy parameters:

C18 Target torque	Torque target
C22 Min. torque	Minimum torque value of the torque classification window
C23 Max. torque	Maximum torque value of the torque classification window
C30 Start final angle	Starting from this torque value, the angle will start to be measured

6.4.4.2 Torque with angle monitoring

This strategy is similar to the torque strategy but also classifiesd the angle value according to a set window.

Strategy parameters:

C18 Target torque	Torque target
C22 Min. torque	Minimum torque value of the torque classification window
C23 Max. torque	Maximum torque value of the torque classification window
C30 Start final angle	Starting from this torque value, the angle will start to be measured
C38 Min. angle	Minimum angle value of the angle classification window
C42 Max. angle	Maximum angle value of the angle classification window

6.4.4.3 Torque & angle

This strategy can be separated in two steps. First, an initial torque must be reached, then the wrench must be turned a set number of degrees. The final torque and angle is then classified using the set window.

This strategy has two options for which torque value is used as the final result torque.

Strategy option:

Result is torque peak	The maximum torque collected during the tightening will be used as the final torque
Result is torque at angle peak	The wrench will collect the torque value when the maximum angle is achieved

Strategy parameters:

C30 Torque 1st stage	Initial torque to be applied. The angle will start to be measured after this torque is reached
C22 Min. torque	Minimum torque value of the final torque
C23 Max. torque	Maximum torque value of the final torque
C34 Target angle	Angle to be turned after C30 is reached
C38 Min. angle	Minimum angle value of the angle classification window
C42 Max. angle	Maximum angle value of the angle classification window

6.4.4.4 Automatic breakaway/ residual torque

The automatic breakaway strategy is used for a quality control check, and automatically detects the moment the bolt starts to move when retightened. This strategy is used to check a tightening operation already performed in order to ascertain the residual torque in the joint.

Strategy option

When a screw is rotated further, the torque x angle graph can assume two forms. In the first case, there's a clean transition from the moment the bolt is static to when it starts to move. This transition is marked by a change of gradient as pictured in Figure 27 – Case 1, Clean Breakaway. In this case, the breakaway torque and the residual torque are the same.

In the second case, due to high friction in the bolt head, conical seats, and other factors, a torque peak may be present in the transition moment. This peak is the breakaway torque and is normally not considered as the residual torque. The residual torque is taken as the lower value that follows the breakaway as pictured in Figure 28 – Case 2, Breakaway with Peak.

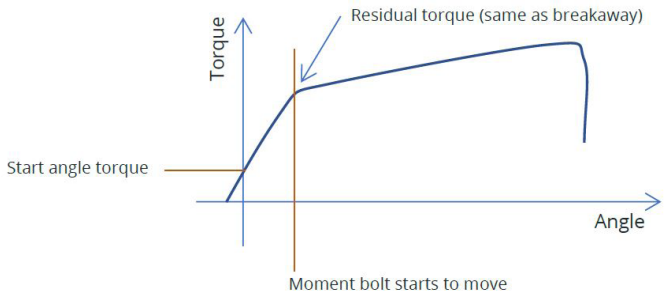


Figure 27 – Case 1, clean breakaway

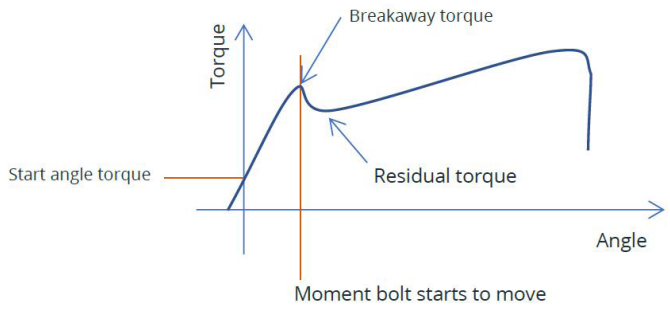


Figure 28 – Case 2, Breakaway with Peak

There are two options regarding those cases.

1. **Residual torque:** The wrench will always collect

the residual torque as shown in Figure 27 and Figure 28, ignoring the breakaway peak if present.

2. **Breakaway torque:** The wrench will always collect the breakaway torque as shown in Figure 27 and Figure 28.

Strategy parameters

C22 Min. torque Minimum torque value of the breakaway/residual torque detected

C23 Max. torque Maximum torque value of the breakaway/residual torque detected

C43 Start final angle Starting from this torque value the angle will start to be measured

C46 Stop angle If this value is zero the wrench automatically detects when the breakaway happens and signals the user to stop applying torque, this detection may take a few degrees after the bolt moves (this is so to avoid false detection) which causes more torque to be added to what's already in the joint, a known angle value (taken empirically) which resides after the breakaway can be set in this parameter to make the wrench signal early, the wrench will still analyze the trace and correctly detect the breakaway point.

C48 Torque limit Maximum torque value allowed during the tightening process, if this value is reached the results will always be set to NOK regardless of the value of the residual torque

C50 Angle limit Maximum angle value allowed during the tightening process, if this value is reached the results will always be set to NOK regardless of the value of the residual torque

6.5 Results

The wrench tightening database can hold up to 1.000.000 results, also include with those results are the tightening trace and a copy of the program used. The TWConfig tightening screen when opened loads and shows, by default, the 10 last tightening results and tightening trace but the button load more can be used to download more results to the local computer.

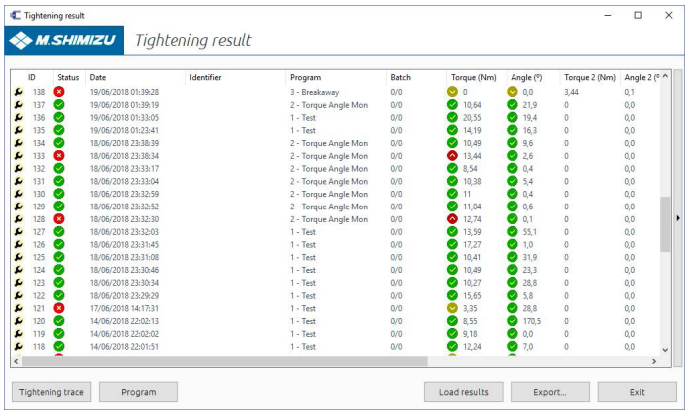


Figure 29 – TWConfig result list

The tightening trace and program can be viewed by selecting a result and clicking Tightening trace or Program button.

6.6 Calibration

The wrench calibration can be performed by applying a known torque and comparing the torque shown by the wrench while setting the gain or calibration factor to equalize them. The calibration procedure is regulated by local and/or international technical standards and must be perform by a certified laboratory. The following information is intended to aid the calibration technician perform its task an is not a procedure to be followed.

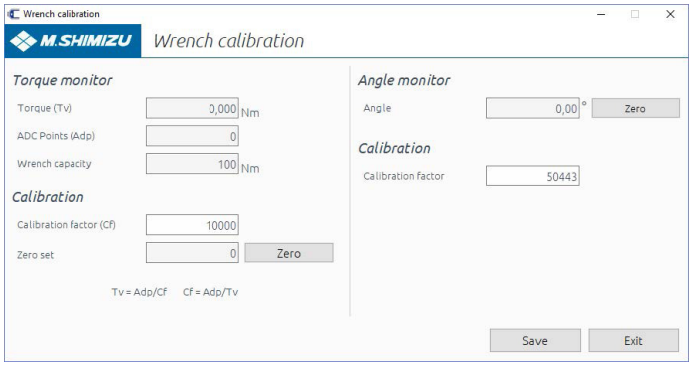


Figure 30 - Wrench calibration

6.6.1 Torque calibration

Before starting the torque calibration, the wrench zero may be set using the Zero button, this removes the torque offset due to the idiosyncrasies of the strain gauge installation in the torque transducer which varies from one device to another.
Torque (Tv) shows the current torque being applied, ADC points (Adp) is the internal engineering value

used by the wrench, the wrench capacity is shown as a quick information of maximum torque that may be applied.
As the formula in the lower part of the screen indicates the wrench torque (Tv) is calculated by dividing the ADC points (Adp) by the calibration factor (cf). As soon as a new value is typed in the new torque is calculated based in this new information.

The torque and angle values shown in the wrench screen is calculated using the wrench calibration data, so the values entered in this screen has no effected until they are saved.
The current calibration data in the wrench is not changed until the calibration is sent to the wrench using the Save button.

6.6.2 Angle calibration

The angle calibration is somewhat simpler than the torque counterpart as the zero it's measured from a chosen reference and is not absolute, so the Zero option here only resets the measurement and has no effect in the calibration value.

Internally the angle is measured using a MEMS gyroscope which detects angular displacement and outputs the turning speed in degrees/second, this value is them integrated to obtain the final angle. The gyroscope angular zero reference is initially set when the wrench is turn on and is tracked and adjusted internally with no need to setup by the user. The calibration factor set in this screen is in fact the integration factor used in the calculation and can be fine-tuned to attain the maximum accuracy in the angle measurement.

The angle calibration factor is a unitless values and changes from wrench to wrench due to the gyroscope manufacturing. This value is usually adjusted slightly between angle tests until a satisfactory angle accuracy is achieved.

6.7 Advanced configuration

The advance configuration screen lists all wrench configurations, each configuration has a unique code in the format PX.Y which helps identify a particular parameter.

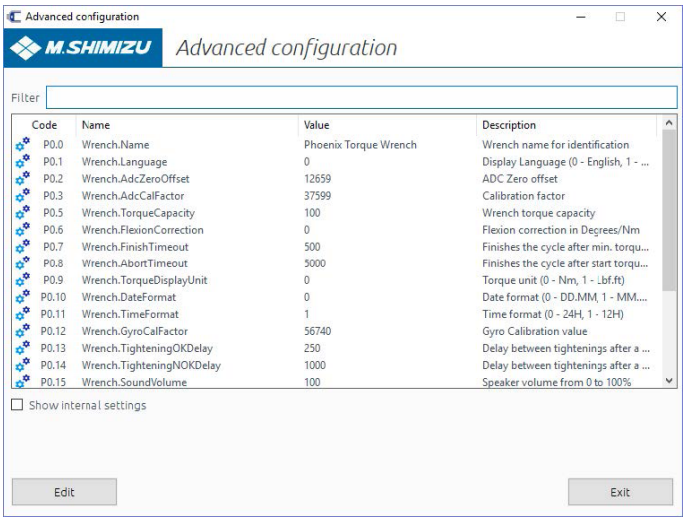


Figure 31 - Advanced configuration

Selecting an item in the list shows a small description with its function, most configurations also have a default value, when the current value is different than the default the line is shown in bold.

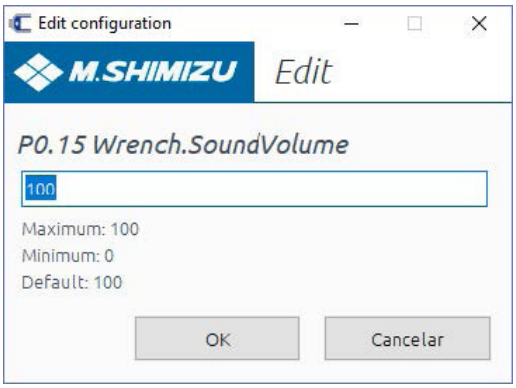


Figure 32 - configuration example

Double clicking in a list item or selecting it and clicking Edit will open a popup to edit its value, the default, minimum and maximum limits for the configuration are shown.

Ticking *Show internal settings* checkbox shows internal wrench configurations, those configurations are not meant for end user setup and may affect the stability and performance of the device, only change them if instructed by the manufacturer or distributor.

6.8 Routes

The route functionality is used in quality control to perform a series of tests in a structured manner, the main item of the route is the task which holds the

programs to be performed along with configurations such as how many times it should be executed. The route program is separated from the wrench programs so both can co-exist in the same wrench, deleting a route has no affect in the wrench programs and modifying the wrench programs has no effect in the route.

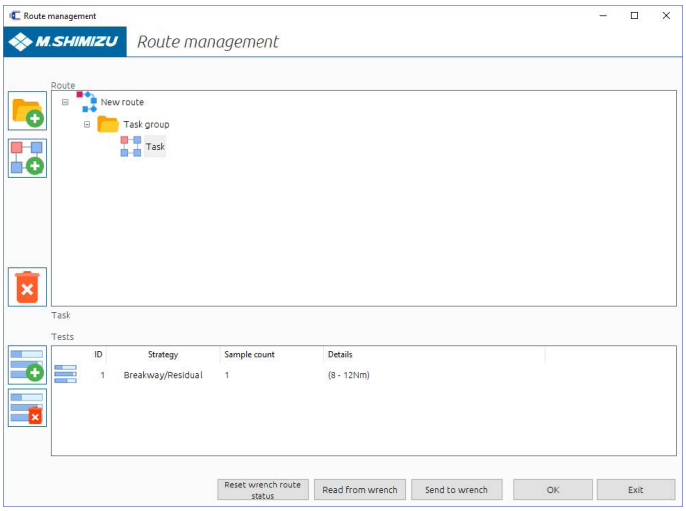


Figure 33 - Route management screen

The route structure is organized as a tree hierarchy such a files and folder inside a computer for easy navigating in the wrench. The tree main items of the route are Group, Task and Test.

6.8.1 Groups

Groups act like a folder in a computer and can contain tasks or more groups inside.

6.8.2 Task

The task is the main item in the route, each task holds up to 8 tests (Each test is basically a program) to be performed a number of times each (this count is set in the test) and they can all be repeated a number of times (set in the task). In the most common used form a task holds just one test to be executed a number of times and the task itself is performed a number of times.

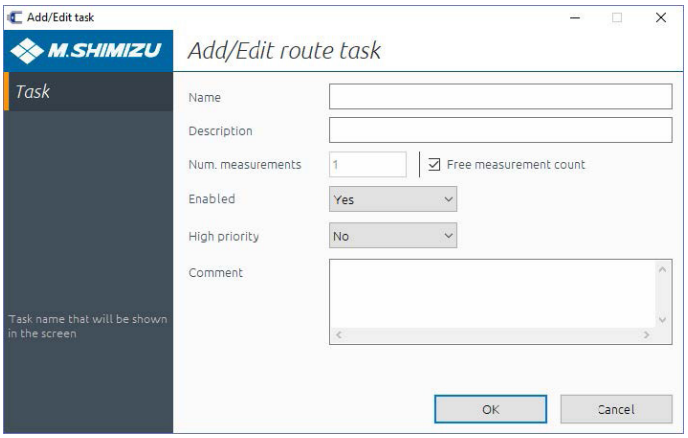


Figure 34 - Route task

Name
The task name is visible in the wrench and is used to identify the task.

Description
A small text with any additional information.

Num. measurements
How many times the tests inside the task should be performed, this is not the bolt count, it's the number of times the whole task needed to be executed, each test has its own measurement count. When this count is reached the task is completed and cannot be performed again until the results are download and the wrench route reset.

Enabled
Tasks can be disabled to help remove a task from the route without the need to delete it.

High priority
When high priority is enabled the wrench will show an icon with the task name to inform the user that this task is more critical than the others.

Comment
Free user text.

6.8.3 Test

A test is a program that is added to a Task as a step to be performed, usually a task holds only one test but up to 8 tested can be added to each task, each test has it's own number of measurements, so the total tightenings that must be performed to complete a task is the Task number of measurements times the sum of the number of measurements of each test it holds.

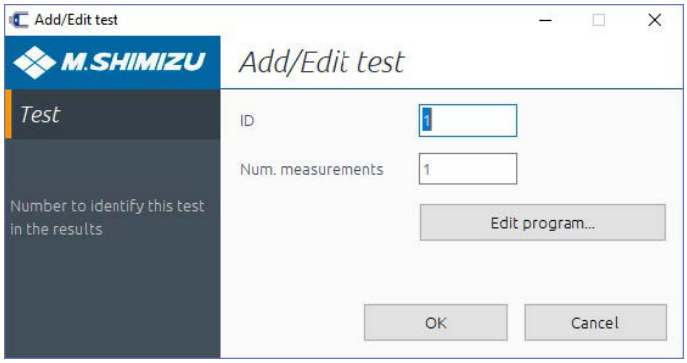


Figure 35 - Route test

ID
The ID is a unique number used to identify the test in the result list (this number is saved with the results), this number is automatically assigned but can be changed by the user.

Num. measurements
Number bolts that need to be measured.

Edit program…
Edits the program used in this test, the program are created in the very same way as the wrench programs in the section 7.4 Programs.

The task/test concept can be illustrated with the following example:

> To setup the measurement of a Door hinge fastening that has 2 bolts a task named door hinges is created, inside the task a test with the appropriate strategy is added, as there is 2 bolts to be measured in each piece the num. measurements in the test is set to 2, if the user desires to collect the sample of 10 door hinges then task num. measurements is set to 10.

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