

Tornado

digital torque tester

Operating Manual



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The Tornado

Introduction

Thank you for choosing Mecmesin's Tornado Digital Torque Tester. With correct use and regular re-calibration it will give many years of accurate and reliable service.

The Tornado has been specifically designed as a high-accuracy, portable instrument for measuring clockwise and counter-clockwise torques. Using the latest integrated circuit technology and intuitive programming, the Tornado is easy to use by all operators.

Before Use

Upon receiving the unit please check that no physical damage has occurred to the packaging material, plastic case or the instrument itself. If any damage is evident please notify Mecmesin immediately.

Operation

The most commonly used features, such as displaying torque, zeroing the display, transmitting data and changing the displayed units of measurement can all be done by pressing single dedicated keys on the front panel.

To configure the advanced features of the Tornado, a full menu-driven system is accessible using the keys identified on the front panel with blue text - see page 11, Advanced Menu Options.

Maintenance

When cleaning the keypad care must be taken to avoid liquids, especially alcohols, seeping around the edge of the membrane. Therefore, we recommend the use of a lightly dampened cloth to avoid liquid spillage onto the membrane.

Assembly of the Tornado 6N.m and 10N.m

When Tornado is in transit, the top plate is removed to avoid damage to the torque cell.

Fitting Instructions for the Torn Top Plate

Step 1. Tornado with torque drive shown



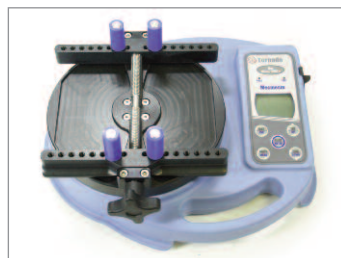
Step 2. Align top plate with torque drive. The handle is positioned to the left.



Step 3. Tighten screws hand-tight only.



Step 4. For use of Tornado with handle at front, repeat steps 1 to 3 but position top plate accordingly during step 2.



Unscrew the top plate handle so that the peg holders move towards the outside edge of the plate. Align the top plate with the torque drive so that the handle is on the left-hand side of the top plate. Using the 2.5mm Allen key (provided), tighten the four socket countersunk screws hand tight.

Assembly of the Tornado

1.5N.m and 3N.m

When Tornado is in transit, the top plate is removed to avoid damage to the torque cell.

Fitting Instructions for the Tornado Top Plate

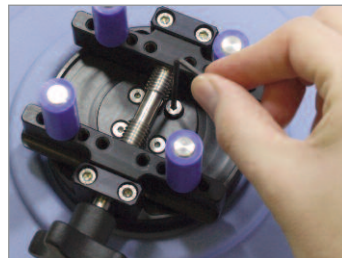
Step 1. Tornado with torque drive shown



Step 2. Align top plate with torque drive. The handle is positioned to the left.



Step 3. Tighten screws finger-tight only.



Step 4. For use of Tornado with handle at the front, repeat steps 1 to 3 but position top plate accordingly during step 2.



Unscrew the top plate handle so that the peg holders move towards the outside edge of the plate. Align the top plate with the torque drive so that the handle is on the left-hand side of the top plate. Using the 2.5mm Allen key (provided), tighten the four socket countersunk screws hand tight. **N.B. Do not overtighten as this may cause damage to the delicate sensor**

Powering the Tornado

Replacing rechargeable batteries

The Tornado is supplied with a set of 5 Nickel Metal Hydride AAA rechargeable batteries, which are supplied fully charged to allow use straight from the box. Do not use any other battery charger other than that supplied with the torque tester.

Under normal circumstances these rechargeable batteries will not need to be replaced. However, if required, to replace the rechargeable batteries you must first remove the base plate on the base of the torque tester by removing the 6 retaining screws. This will reveal a retaining plate. Remove this by releasing the 2 screws on the retaining plate. Remove the fitted rechargeable batteries and fit the 5 new rechargeable batteries in the battery holder, ensuring that you observe polarity and the batteries are placed on top of the 'release tag' and they will be freed from the spring-loaded contacts.

Refit the retaining plate and tighten the 2 screws. Refit the base plate and tighten the 6 retaining screws.

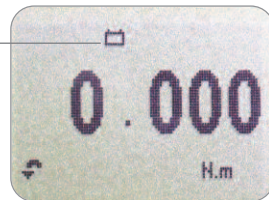
Connect the mains adaptor/charger to the Tornado charger socket located at the right hand side of the torque tester next to the display and charge the new set of rechargeable batteries for 14 - 16 hours. Only use the adaptor/charger supplied. A fully charged battery pack will provide approximately 20 hours constant use between charges.

Low battery warning

A low battery symbol will appear in the display approximately 2 minutes before the gauge powers down automatically. See Fig. 1, below.

Fig. 1

Low battery warning



Mains operation

The Tornado may also be powered directly from the mains. Simply maintain the mains adaptor/charger connection to your mains supply as above. Only use the adaptor/charger supplied.

Using the Tornado

Fitting accessories

When using the Tornado 1.5N.m, take care not to overtighten the sample in the pegs to avoid damaging the torque sensor.

Powering up

The Tornado is supplied with 4 pegs which grip the sample during testing.


Screw the pegs into the runners on the top fixture equally spaced to ensure the sample is securely gripped when the runners are brought together using the star handle on the end of the lead screws.

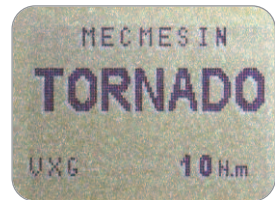
Ensure that the pegs are finger tight and the sample securely clamped otherwise rotation in the fixture will occur during testing.

As shown in Fig. 2 the control panel has 6 keys:

Fig. 2



To power up the Tornado press the red  key. A short self test runs during which the display will show the capacity in 'N.m' (newton metres).



After the self test, providing no torque has been applied to the instrument, the display will show all zeros. This is because the Tornado re-zeros itself during the self test routine.

If a torque is applied rotationally via the fixture, the reading on the display will register the applied torque.

Do not overload the torque sensor, as this could cause irreparable damage.

Loads greater than 120% of full-scale will produce an audible beep until the load is released and an OL symbol will appear on the display **for 30 seconds**.

Loads greater than 150% of full-scale will produce an audible beep until load is released and an OL symbol will appear **permanently** on the display. Consult your supplier to arrange repair.

To power down the Tornado press the red  key.

Basic Functions

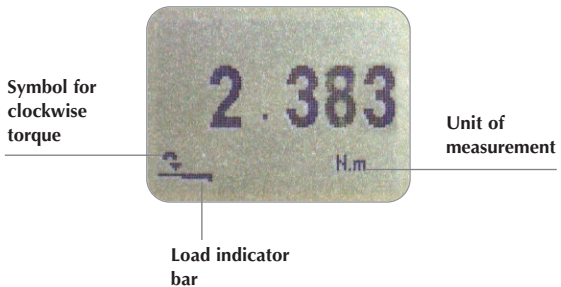
Clockwise and counter-clockwise values

If the Tornado has suffered a serious overload condition, the torque indicator bar will be partially displayed even when no torque is present. This is a warning that the torque sensor is damaged and you should immediately contact your supplier to arrange repair.

Clockwise torque is displayed on the Tornado and recognised by the symbol shown in Fig. 3.

Counter-clockwise torque is displayed on the Tornado and recognised by the symbol shown in Fig. 4c.

Fig. 3



A torque indicator bar alerts the operator to how much load has been applied to the torque sensor. As the load approaches the maximum rating of the torque sensor, the indicator bar changes appearance when above approximately 80% of the rated capacity. This warns the operator that steps should be taken to prevent excessive torque being applied.

When applying clockwise torque, the indicator bar begins solid in appearance, then becomes striped when the capacity is approached. When applying counter-clockwise torque, the indicator bar begins striped, then becomes solid (see Fig. 4b & 4c).

Zeroing the Tornado

During operation of the Tornado it is sometimes necessary to zero the display - e.g. when you wish to tare out a displayed torque applied by the sample, so it does not become part of the measured reading. Press and release the **ZERO** key.

Changing the unit of measurement

You can choose from the following units of measurement depending on the capacity of your Tornado: N.m, N.cm, mN.m, gf.cm, kgf.cm, lbf.ft, lbf.in, ozf.in.

To change the display units press and release the **UNITS** key. Each successive key press will select the next available units until the Tornado returns to its original setting. The Tornado automatically converts readings as new units of measure are selected.

Max (peak) readings

The Tornado detects and stores maximum (peak) torque in both clockwise and counter-clockwise directions.

Note: the following max display modes do not apply when the % TAMP EV function is enabled. See page 19 for alternative modes.

Max mode

Press the **MAX** key. The display will show the word **MAX** together with the highest counter-clockwise torque and the highest clockwise torque detected during the test. The current load being applied to the torque sensor is also displayed - see Fig. 4a.

Dual max

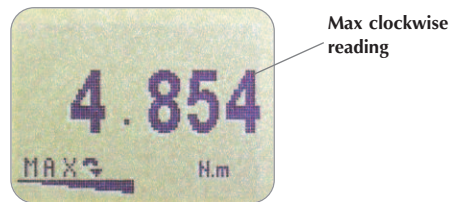
Fig. 4a



Max clockwise torque

Press the **MAX** key again and the display will show the maximum clockwise torque identified by its symbol.

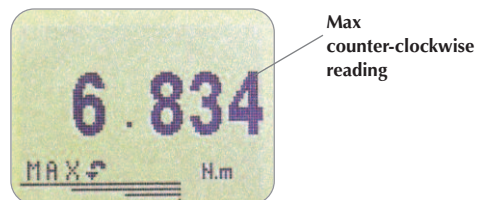
Fig. 4b



Max counter-clockwise torque

Press the **MAX** key again and the display will show the maximum counter-clockwise torque identified by its symbol.

Fig. 4c



Note: When % TAMP EV function is enabled, different max modes are shown, see page 19.

'Normal' mode

Press the **MAX** key again and the word MAX has now disappeared from the display. The display will now indicate torques applied in both directions as they are applied to the torque sensor and maintain a 'running' display.

Press the **RESET** key to clear both maximum registers and prepare for detecting the next maximum readings.

Data output

Analogue output

(See also COMMS section of Advanced Menu Options on page 23)

An uncalibrated analogue output is available from the 'D type' connector marked 'coms' for use with chart recorders, oscilloscopes or any other devices requiring analogue inputs. See technical specifications on pages 47 - 49 for details.

RS232 and
Digimatic output signals

It is possible to transmit the displayed reading to peripheral devices (e.g. PC, printer) via the communications port, by pressing and releasing the **TXD** key.

A full range of interface cables are available to connect your Tornado to peripheral devices - see page 49 for details.

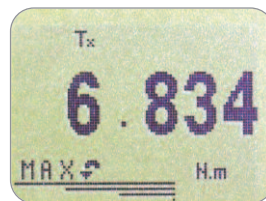
Displayed readings can also be requested individually from a PC via the RS232 interface by sending a "?" character. See page 32.

Continuous data
transmission

For sending a continuous data stream to a PC, printer, etc press and hold the **TXD** key for 2 seconds then release. TX will now appear in the display to indicate that data is being sent, (see figure 5). To stop sending data, simply press and release the **TXD** key, at which point TX will disappear from the display.

The continuous data stream rate is 25Hz, unless 115200 Baud is selected, when it is 50Hz.

Fig. 5



When using continuous transmission over RS232 only, select the TX METHOD as RS232 (see page 24). If DIGIMATIC or DUAL is selected, and no digimatic device is connected, the display will periodically freeze.

Please note that the continuous data output only starts when the load threshold default of 2% of the rated capacity of the Tornado is reached. This threshold can be set from 0-100% (see page 24).

PC Communication or other RS232 input device, eg. PLC.

Tornado uses 9600, 19200, 57600 or 115200 Baud, 8 data bits, 1 start bit, 1 stop bit, no parity and no flow control. (See Advanced Menu Options for setup details).

Advanced Menu Options

Navigating the menus

MAIN MENU PAGE 1

Hold down the Ctrl key on the PC keyboard and press:

- a to simulate pressing the **TXD** key*
- b to simulate pressing the **UNITS** key
- c to simulate pressing the **MAX** key
- d to simulate pressing the **RESET** key
- e to simulate pressing the **ZERO** key

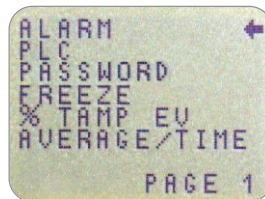
See page 32 for full table.

* Note that the continuous transmission mode cannot be entered via this method.

The Tornado Advanced Menus are navigated using the blue text on the function keys.

Press and hold the **MENU** key for approximately 3 seconds to access page 1 of the main-menu, (see Fig. 6). Pressing the **MENU** key again takes you to pages 2 and 3 of the main menu in turn. To move between the options listed on the 3 main-menu pages, press the **UP** and **DOWN** keys to move the cursor. Press the **ENTER** key to select sub-menus, activate features and enter values. Within sub-menus the **UP** and **DOWN** keys will also change numerical values. Press the **ESC** key to return to the relevant main-menu page and **ESC** again to return to the main display.

Fig. 6



Main menu page 1

ALARM

Alarms will not trigger in the first 1% of full-scale use.

ALARM sub-menu 1 (SETTING SELECTION)

ALARM sub-menu 2 (ALARM SET)

The Tornado has an audible and visual pass/fail alarm feature. A band of acceptable torque result values can be appointed, and the alarm set to trigger when recorded values fall outside of, or within this band.

Up to 5 alarm settings may be stored, but only one setting may be used at any one time.

To set an alarm, press and hold the **MENU** key until page 1 of the main-menu appears. The cursor arrow will point to ALARM. Press the **ENTER** key.

The display will show ALARM OFF, and 5 separate alarms, which may each be set up independently and stored by the user for easy access when changing test routines. The cursor will be positioned against the current alarm in use, or against ALARM OFF if no alarm is selected.

To activate an alarm, move the cursor to the desired alarm and press **ENTER**.

This will access the ALARM sub-menu 2, however this alarm has now been activated, and you can return to the main display by pressing the **ESC** key twice. The main display will now show an alarm 'bell' symbol accompanied by the number of the alarm selected, indicating that that alarm is activated (see Fig. 7).

If, however, you wish to change the settings of the selected alarm, choose SET by pressing the **ENTER** key in ALARM sub-menu 2.

Fig. 7

Alarm symbol with setting number in use



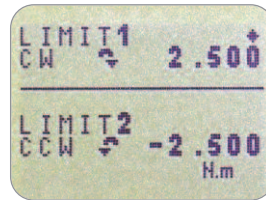
ALARM sub-menu 3
(ALARM LIMITS)

The display will now show the two limits - LIMIT 1 (lower limit) and LIMIT 2 (upper limit) - plus the value they are set to and whether they are in a clockwise (CW) or counter-clockwise (CCW) direction. A diamond cursor indicates which value is selected. Use the **UP** and **DOWN** keys to change the value, press and hold to scroll values. When the correct value is reached, press the **ENTER** key to set

LIMIT 1. Repeat procedure for LIMIT 2 (see Fig. 8).

Note: The alarm limits are not active below 1% of the capacity of the tester.

Fig. 8



ALARM sub-menu 4
(ALARM INDICATOR)

The display shows AUDIBLE, LED and BOTH with the arrow cursor indicating which feature is selected. This menu selects how the PASS/FAIL status of a value will be indicated.

- AUDIBLE Only the audible alarm will be activated when the value is a pass/fail.
- LED The PASS LED will illuminate green to indicate a pass status, the FAIL LED will illuminate orange or red to indicate low or high failures respectively.
- BOTH Both the LED and the audible alarm will be activated.

Use the **UP** and **DOWN** keys to move the cursor and press the **ENTER** key to select the desired feature.

ALARM sub-menu 5
(ALARM BAND)

The display shows OUT BAND and IN BAND. This menu selects which values are to be considered.

OUT BAND	Any value falling outside the set limits LIMIT 1 and LIMIT 2.
IN BAND	Any value falling between the set limits LIMIT 1 and LIMIT 2.

Use the **UP** and **DOWN** keys to move the cursor and press **ENTER** key to select the desired feature.

ALARM sub-menu 6
(ALARM PASS/FAIL)

The display shows PASS or FAIL. This menu sets the OUT BAND criteria.

PASS	Values, which fall either OUT BAND (or IN BAND, if selected), are a PASS and will cause an audible beep, illuminate an LED or both.
FAIL	Values, which fall either OUT BAND (or IN BAND, if selected), are a FAIL and will cause an audible beep, illuminate an LED or both.

Use **UP** and **DOWN** keys to move the cursor and press **ENTER** key to select the desired feature.

ALARM sub-menu 7
(ALARM BUZZER MODE)

The display shows BUZZER ON, CONTINUOUS and PULSE. This menu selects the length of time that the buzzer will sound, if AUDIBLE or BOTH has been selected in sub-menu 5.

CONTINUOUS	The buzzer sounds at a pre-set alarm value and stays on until the load falls below that pre-set.
PULSE	The buzzer pulses for a fixed time of one second every time the load crosses over each of the presets.

Use the **UP** and **DOWN** keys to move the cursor and press the **ENTER** key to select the desired feature.

The display will now return to the main menu page 1, press **ESC** to return the main display.

Fast Selection of Alarms

In order to quickly and easily switch between pre-set alarms, it is possible to instantly access an ALARM SELECT page by holding down the RESET key for 3 seconds whilst in the main display.

The ALARM SELECT page is similar to the ALARM sub-menu 1 - the display will show ALARM SELECT; OFF, and the 5 separate alarms. The cursor will be positioned against the current alarm in use, or against ALARM OFF if no alarm is selected.

To activate an alarm, move the cursor to the desired alarm (or to OFF to deactivate alarms) and press **ENTER**. Alternatively, to cancel the command, press **ESC**.

The screen will return to the main display.

PLC

(Programmable Logic Controller)

For PLC applications, this function requires an external cable with a built-in solid-state relay - see Specifications on pages 47-48 for details of the signal.

To configure the signal output of the Tornado, press and hold the **MENU** key until page 1 of the main menu appears. Press the **DOWN** key to move the arrow cursor to PLC and press **ENTER**.

PLC sub-menu 1

The display will show PLC OUTPUT:

OFF	Indicates PLC function status
AT LIMITS	Will set PLC signal at specified load limits
AT ALARM	Will tie in PLC signal with the Tornado alarm settings

Select the desired function and press the **ENTER** key.

AT LIMITS sub-menu 1

The display will show:

RESET	When the load limit is reached, the output signal triggers and the RESET key must be pressed to clear the line before starting the next test.
CONTINUOUS	The output signal will be activated every time the load limit is reached and will remain on whilst the load exceeds the set limit.
PULSE	The output signal will be activated momentarily when the load limit is reached. The RESET key must be pressed before starting the next test.

AT LIMITS sub-menu 2

Select the desired function and press the **ENTER** key.

The display will show SET and a default load limit at which the output signal will trigger. To set the required load limit use **UP** and **DOWN** keys to adjust the value and the **ENTER** key to confirm the selection.

AT ALARM sub-menu 1

The display will show STATE:

HIGH	Will set PLC signal high at Tornado's alarm.
LOW	Will set PLC signal low at Tornado's alarm.

Select the desired function and press the **ENTER** key.

The display will revert back to PLC sub-menu 1 and PLC ON will now be displayed.

Press **ESC** key to return to the main menu page 1.

PASSWORD

Once the desired settings for the Tornado have been established, it is possible to password protect the menu pages, so that no further changes may be made without authorised access.

To access the PASSWORD function, press and hold the **MENU** key until page 1 of the main-menu appears. Using the **UP** and **DOWN** keys, move the arrow cursor to PASSWORD, and press **ENTER**.

PASSWORD sub-menu 1

The display shows MENU PASSWORD:

OFF Enables access to menu pages.

ON Requires a password be entered to access the menu pages.

Use the **UP** and **DOWN** keys to move the arrow cursor against the desired selection and press **ENTER**, then press the **ESC** key twice to return to the main display.

If the PASSWORD function has been enabled, and the **MENU** key is held down to access the menu pages from the main display, a screen showing 0000 will appear, and the menu password '6284' must be entered to proceed. Use the **UP** and **DOWN** keys to select the first number, followed by **ENTER** to move on to the next number, and so on. If the password is entered incorrectly, the display will return to the main display.

FREEZE

Use pins 7 & 10 for this function – page 48 for details.

When unconnected, pin 7 is pulled high internally.

This feature is used to 'freeze' the main-display when an external signal is received. The Tornado can be configured to freeze when going either low 1-0, falling edge (LO) or high 0-1, rising edge (HI). This is particularly useful for applications where an event occurs (e.g. rotary switch testing). To clear the display press the **RESET** key.

To configure this function, press and hold the **MENU** key until main menu page 1 appears. Press the **DOWN** key to move the arrow cursor to FREEZE and press the **ENTER** key.

FREEZE sub-menu 1

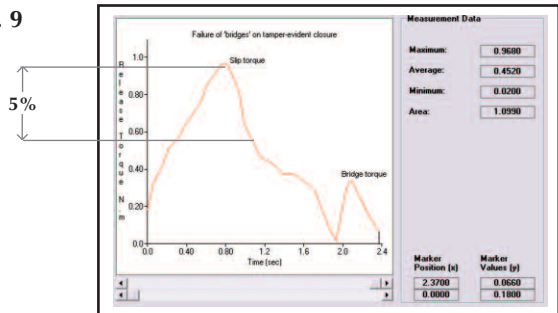
Select the desired LO or HI function using **UP** or **DOWN** arrow keys and press **ENTER** to select. When set, the sub-menu will display FREEZE ON. To disable the FREEZE function, align the cursor with FREEZE ON and press the **ENTER** key. FREEZE OFF will now be displayed. Press **ESC** to return to the main menu page 1.

% TAMP EV

When testing tamper-evident caps and seals, the Tornado enables the value at both the slip torque (1st peak) and bridge torque (2nd peak) to be measured and displayed. Once calculated, either result or both can be transmitted to a peripheral device (see COMMS on page 23).

Different designs for tamper-evident seals can produce slightly different profiles when tested. To accommodate this, the Tornado has an adjustable feature (% drop) to ensure the correct values are calculated on different types of seal.

Fig. 9



For illustration only

The % drop feature is based on the capacity of the Tornado unit, and refers to the amount that the 1st peak to be calculated must drop before the software starts to look for the 2nd peak. The default setting is based on a drop of 5% (see Fig. 9). This can be adjusted depending upon the profile of the cap to be tested.

To enable the % TAMP EV function, press and hold the **MENU** key until page 1 of the main menu appears. Press the **DOWN** key to move the cursor to % TAMP EV and press the **ENTER** key.

% TAMP EV sub-menu 1
(SET)

The display will show % DROP OFF and SET. Press the **ENTER** key to change OFF to ON. Press the **DOWN** key to move the arrow cursor to SET and press the **ENTER** key.

% TAMP EV sub-menu 2
(PERCENTAGE)

Use the **UP** and **DOWN** keys to set the percentage to the desired value and press the **ENTER** key.

**% TAMP EV sub-menu 3
(TX PEAKS)**

**Max Modes with
% TAMP EV
function enabled**

Testing Hints:

Where possible, apply torque to tamper evident closures in a smooth single turn. This will ensure that accurate peaks for both slip torque (1st peak) and bridge torque (2nd peak) are calculated.

When setting up the Tornado, a graphical representation of the test provides a clear insight into the % drop factor required. Please contact Mecmesin or your approved supplier for details on DataPlot graphical charting software.

The values which are to be transmitted to a peripheral device when using the **TXD** key on a dual max screen must now be selected. The following display will appear.

- TX 1st PEAK Sets the Tornado to transmit the slip torque (1st peak) only.
- TX 2nd PEAK Sets the Tornado to transmit the bridge torque (2nd peak) only.
- TX BOTH Sets the Tornado to transmit both the slip torque (1st peak) and the bridge torque (2nd peak).

Use the **UP** and **DOWN** keys to move the arrow cursor to the desired selection and press **ENTER**.

The display will return to the % TAMP EV sub-menu 1. Press **ESC** to return to the main menu page 1, and again to return to the main display.

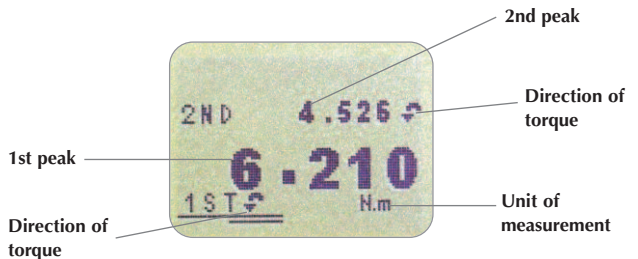
When the % TAMP EV function has been enabled, pressing the **MAX** key will scroll through the following max display modes, in order:

- 1) 1st and 2nd clockwise peaks
- 2) 1st clockwise peak only
- 3) 1st and 2nd counter-clockwise peaks (see Fig. 10).
- 4) 1st counter-clockwise peak only
- 5) Current 'live' reading

Mode 3) is required for measurement of tamper-evident closure slip and bridge release torques.

Fig. 10

Screen of 1st and 2nd peaks of tamper-evident closures

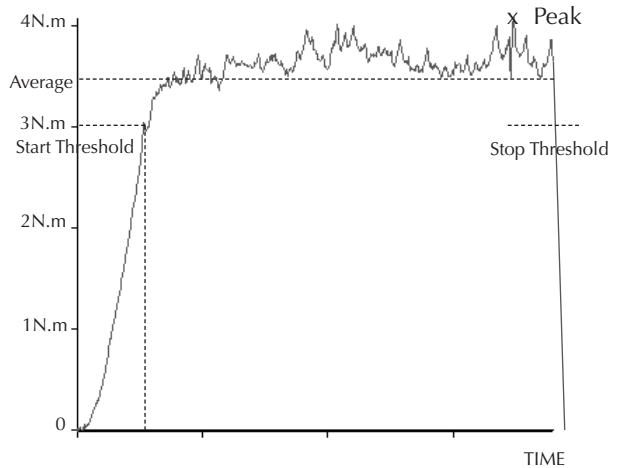


AV/TIME

The maximum duration of AV/TIME calculation is approx. 22 minutes.

AV/TIME sub-menu 1 (SET)

AV/TIME sub-menu 2 (PERCENTAGE START/STOP)



This function allows the average load reading to be displayed. The average starts being calculated when the START threshold (% of full-scale) is reached and stops being calculated when the load passes through the STOP threshold.

To set average over time, press and hold the **MENU** key until page 1 of the main menu appears. Using the **UP** and **DOWN** keys, move the arrow cursor to AV/TIME and press **ENTER**.

The display will show AV/TIME OFF and SET. Press the **ENTER** key to change OFF to ON. Press the **DOWN** key to move the arrow cursor to SET and press the **ENTER** key.

The display will now show the START and STOP thresholds and the values to which they are set (as a % of full-scale).

Any load reading above the START threshold will be averaged over time. Averaging stops when the load reading passes through the STOP threshold.

A diamond cursor will indicate which value is selected.

Use the **UP** and **DOWN** keys to change the value, press and hold to scroll values. When the correct value is reached press the **ENTER** key to set START. Repeat procedure for setting STOP. The display will revert back to AV/TIME sub-menu 1.

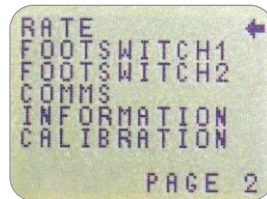
To disable the AV/TIME function, press the **ENTER** key when the cursor arrow is aligned with ON in AV/TIME sub-menu 1. It will now display OFF.

Press the **ESC** key to return to the main menu page 1, and again to return to the main display.

The maximum duration of AV/TIME calculation is approx. 22 minutes. When the time limit expires, 'AT' is displayed in the main display, and the **MAX** key must be pressed in order to clear 'AT' and continue use of the Tornado.

MAIN MENU PAGE 2

Fig. 11



Main menu page 2

RATE

This function allows the selection of the Tornado data capture rate, i.e. the amount of averaging performed by the internal electronics before the load reading is displayed. Data are sampled at 5000Hz and averaged to 2 levels:

MEDIUM	80Hz (Default)
HIGH	2000Hz

To set RATE, press and hold the **MENU** key until the main menu page 1 appears. Press and release the **MENU** key to access the main menu page 2. Using the **UP** and **DOWN** keys move the arrow cursor to RATE, and press **ENTER**.

RATE sub-menu 1

Using the **UP** and **DOWN** keys select the relevant level (MEDIUM or HIGH) and press the **ENTER** key.

Press the **ESC** key to return to the main menu page 2, and again to return to the main display.

FOOTSWITCH 1

The Tornado has two footswitch input pins on the 15-way D connector. This allows the footswitch to be assigned to replicate one of each of the five main key functions, **MAX**, **UNITS**, **TXD**, **ZERO** and **RESET**. This feature is useful when integrating the Tornado into test or production systems.

Note: A footswitch assigned to the **UNITS** key can allow entry into the menu page, but the Tornado will not respond to further footswitch operations from either footswitch 1 or 2 once in the menu.

To assign the function of a key to FOOTSWITCH 1, press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key to access the main menu page 2. Using the **UP** and **DOWN** keys, move the arrow cursor to FOOTSWITCH 1 and press **ENTER**.

FOOTSWITCH 1 sub-menu 1

Using the **UP** and **DOWN** keys, select the relevant key (**MAX**, **UNITS**, **TXD**, **ZERO** or **RESET**) then press the **ENTER** key, or to cancel this option, select OFF and press the **ENTER** key.

Press the **ESC** key to return to page 2 of the main-menu, and again to return to the main display.

FOOTSWITCH 2

To assign the function of a key to FOOTSWITCH 2, press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key to access the main menu page 2. Using the **UP** and **DOWN** keys move the arrow cursor to FOOTSWITCH 2, and press **ENTER**.

FOOTSWITCH 2 sub-menu 1

Using the **UP** and **DOWN** keys, select the relevant key (**MAX**, **UNITS**, **TXD**, **ZERO** or **RESET**) and press the **ENTER** key, or to cancel this option, select OFF and press the **ENTER** key.

Press the **ESC** key to return to page 2 of the main-menu, and again to return to the main display.

COMMS

Communications settings are selected to configure interfacing of the Tornado with peripheral devices. The menu is also used to configure the storage settings of the Tornado, which may store up to 500 readings in its on-board memory.

To access the COMMS settings, press and hold the **MENU** key until page 1 of the main menu appears. Press and release the **MENU** to access page 2 of the main menu, use the **DOWN** key to move the arrow cursor to **COMMS** and press **ENTER**.

COMMS sub-menu 1

The display shows:

PORT	Communicates with peripheral device. Transmission of the displayed load reading can be set to include unit of measurement (UNITS ON or OFF), and BAUD rate can also be set.
STORE MEM	Stores a single load reading to the internal memory. With this option selected, pressing the TXD key when in the max modes of the main display will send the displayed value to memory. Up to 500 readings may be stored in the memory.
SEND MEM	Sends all load readings stored in the internal memory to a peripheral device (e.g PC or data logger).
CLEAR MEM	Erases all load readings stored in memory.

Using **UP** and **DOWN** keys select the relevant option. When setting PORT, you will access PORT sub-menu 1.

PORT sub-menu 1 (TX UNITS)

Transmission of the displayed load reading can be set to include the unit of measurement, the display shows TX UNITS OFF or ON. Use the **UP** or **DOWN** key to position the arrow cursor against the desired selection and press the **ENTER** key.

PORT sub-menu 2 (TX SIGN)

The display will show TX SIGN OFF and ON. This will transmit a negative sign for counter-clockwise readings if set to ON.

Use the **UP** or **DOWN** key to position the arrow cursor against the desired selection and press the **ENTER** key

PORT sub-menu 3
(BAUD RATE)

The transmission (or Baud) rate can now be set. Use the **UP** or **DOWN** key to position the arrow cursor at the relevant speed (9600, 19200, 57600 or 115200). Press **ENTER** to select.

PORT sub-menu 4
(TERMINAL)

Additional characters can be appended to the transmitted load (RS232 only). These can be set to NULL (nothing), CR (carriage return), LF (line feed) or CR LF. Use the **UP** or **DOWN** key to position the arrow cursor at the desired setting. Press **ENTER** to select.

PORT sub-menu 5
(LINE DELAY)

If required, a LINE DELAY, to be executed after each reading is sent, can now be set. Use the **UP** or **DOWN** key to set this value from 0 to 5 seconds in one-second intervals. Press **ENTER** to select.

PORT sub-menu 6
(TX THRESHOLD)

For use with continuous readings only, a % threshold for the start of transmission can now be set. Use the **UP** or **DOWN** key to set this value from 0% to 100%. Press **ENTER** to select.

PORT sub-menu 7
(TX METHOD)

Method of transmission, RS232, DIGIMATIC or DUAL (both), can now be set. Use the **UP** or **DOWN** key to position the arrow cursor at the desired setting. Press **ENTER** to select.

COMMS sub-menu 1
(further options)

STORE TO MEMORY

The display will return to the COMMS sub-menu 1.

To set STORE MEM, move the arrow cursor against it in COMMS sub-menu 1 and press the **ENTER** key. This will cause a memory counter to appear in the main display, that is incremented each time a reading is stored, by pressing the **TXD** key. You will now return to COMMS sub-menu 1.

SEND FROM MEMORY

To set SEND MEM, move the arrow cursor against it in COMMS sub-menu 1 and press the **ENTER** key. This will cause a TX symbol to flash in the main display as the memory data is now transmitted to a peripheral device. The data is transmitted at the settings defined by PORT. After transmission of data you will now return to COMMS sub-menu 1.

CLEAR THE MEMORY

To set CLEAR MEM, move the arrow cursor against it in COMMS sub-menu 1 and press the **ENTER** key. This now erases all the data stored in the memory. The memory counter is now reset to zero. After clearing the memory you will now return to COMMS sub-menu 1.

Press the **ESC** key to return to page 2 of the main-menu, and again to return to the main display.

INFORMATION

Displays calibration information.

- ↻ Clockwise span
- ↺ Counter-clockwise span
- I Initial Zero
- G Gravitational constant
- Z Current zero

This is for information only and may be required for diagnostic purposes by your distributor.

CALIBRATION

An instrument showing an overload condition cannot be relied upon to provide accurate, repeatable measurement – consult your supplier.

If you suspect that your torque sensor has sustained an overload, it is possible to check the status of the torque sensor immediately.

Symptoms of overload may be (a) OL in display (b) buzzer sound (c) torque indicator bar present even under zero load.

Place the Tornado on a flat level surface. Press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key to access the main menu page 2. Using the **UP** and **DOWN** keys move the arrow cursor to CALIBRATION, and press **ENTER**.

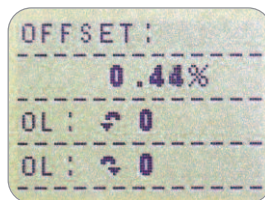
CALIBRATION sub-menu 1

The display will show 0000. Press the **ENTER** key four times (to enter 0000 as the password).

CALIBRATION sub-menu 2

CALIBRATION sub-menu 2 (the torque sensor diagnostic test screen) will appear on the display, as shown in Fig. 12.

Fig. 12



The offset value provides an indication of the condition of the torque sensor, and is defined as the % difference between the initial zero and the current zero reading.

If the offset is between 5 - 10 %, please contact your supplier to arrange a re-calibration of your Tornado. If the offset is greater than 10 %, please contact your supplier to arrange for a possible torque sensor replacement.

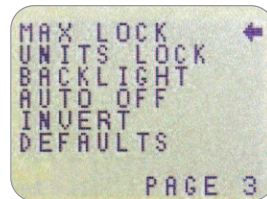
These values are given as an indicator only - the need for calibration/repair may vary according to the individual characteristics of the torque sensor.

In addition to the offset, the number of overloads (OL) experienced by the torque sensor in both clockwise and counter-clockwise directions are displayed. An overload is registered when a torque exceeding 150% of the rated capacity of the torque sensor is applied in either direction.

Press the **ESC** key to return to the main menu page 2, and again to return to the main display.

MAIN MENU PAGE 3

Fig. 13



Main menu page 3

MAX LOCK

Once the desired Max display mode has been selected, it is possible to lock the mode, so that further pressing the **MAX** key results in no change.

To access the MAX LOCK function, press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key twice to access the main menu page 3. Using the **UP** and **DOWN** keys, move the arrow cursor to MAX LOCK, and press **ENTER**.

MAX LOCK sub-menu 1

The display shows MAX LOCK:

- OFF Unlocks the max display mode.
- ON Locks the current max display mode.

Use the **UP** and **DOWN** keys to move the arrow cursor against the desired selection and press **ENTER**.

The display will return to the main menu page 3, press the **ESC** key to return to the main display.

UNITS LOCK

Once the desired unit of measurement has been selected, it is possible to lock the units, so that further pressing the **UNITS** key results in no change.

To access the UNITS LOCK function, press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key twice to access the main menu page 3. Using the **UP** and **DOWN** keys, move the arrow cursor to UNITS LOCK, and press **ENTER**.

UNITS LOCK sub-menu 1

The display shows UNITS LOCK:

- OFF Unlocks the units.
- ON Locks the units to the current setting.

Note: The UNITS/MENU key can still be used to enter the menu pages when the UNITS LOCK function is enabled.

Use the **UP** and **DOWN** keys to move the arrow cursor against the desired selection and press **ENTER**.

The display will return to the main menu page 3, press the **ESC** key to return to the main display.

BACKLIGHT

It is possible to activate a backlight on the Tornado display.

To access the BACKLIGHT function, press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key twice to access the main menu page 3. Using the **UP** and **DOWN** keys, move the arrow cursor to BACKLIGHT, and press **ENTER**.

BACKLIGHT sub-menu 1

The display shows BACKLIGHT OFF and ON: Use the **UP** and **DOWN** keys to move the arrow cursor against the desired selection and press **ENTER**.

Note: Battery consumption is doubled when using the backlight.

The display will return to the main menu page 3, press the **ESC** key to return to the main display.

When activated, the backlight will remain on for 30 seconds since the last key press or last load applied registering over 2% of full scale.

AUTO OFF

To conserve battery power, it is possible to activate an auto-off function so that the Tornado powers down 5 or 10 minutes after either the last key press, or the last load applied greater than 2% of full scale.

To access the AUTO OFF function, press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key twice to access the main menu page 3. Using the **UP** and **DOWN** keys, move the arrow cursor to AUTO OFF, and press **ENTER**.

AUTO OFF sub-menu 1

The display shows AUTO OFF:

- | | |
|------------|--|
| OFF | Disables auto-off function. |
| 5 MINUTES | Tornado will automatically power down after 5 mins. |
| 10 MINUTES | Tornado will automatically power down after 10 mins. |

Note: The AUTO OFF function is disabled whilst accessing the menu pages, regardless of setting.

Use the **UP** and **DOWN** keys to move the arrow cursor against the desired selection and press **ENTER**.

The display will return to the main menu page 3, press the **ESC** key to return to the main display.

INVERT

Note: The menu pages are not inverted when the INVERT function is enabled.

INVERT sub-menu 1

It may be desirable to reverse the display, so that it can be easily read with the top plate handle positioned on the right-hand side.

To access the INVERT function, press and hold the MENU key until page 1 of the main-menu appears. Press and release the **MENU** key twice to access the main menu page 3. Using the **UP** and **DOWN** keys, move the arrow cursor to INVERT, and press **ENTER**.

The display shows INVERT OFF and ON:
Use the **UP** and **DOWN** keys to move the arrow cursor against the desired selection and press **ENTER**.

The display will return to the main menu page 3, press the **ESC** key to return to the main display.

DEFAULTS

DEFAULTS sub-menu 1

To restore the factory default settings of your Tornado, press and hold the **MENU** key until page 1 of the main-menu appears. Press and release the **MENU** key twice to access the main menu page 3. Using the **UP** and **DOWN** keys, move the arrow cursor to DEFAULTS, and press **ENTER**.

The display shows DEFAULTS SET, press the **ENTER** key.

DEFAULTS sub-menu 2

The display shows RESTORE DEFAULTS YES and NO.
Align the arrow cursor with YES to restore default settings, or with NO to cancel the action, and press the **ENTER** key.

The display will return to the main menu page 3, press the **ESC** key to return to the main display.

Factory Default Settings

Menu Function	Default Setting
ALARM	OFF
PLC	OFF
PASSWORD	OFF
FREEZE	OFF
% TAMP EV	OFF
AV TIME	OFF
RATE	MEDIUM
FOOTSWITCH1	OFF
FOOTSWITCH2	OFF
COMMS	P,OFF,ON,9600,CL,0,2,S
PORT	SELECTED
UNITS	OFF
SIGN	ON
BAUD	9600
TERMINAL	CR AND LF
LINE DELAY	0 SECONDS
TX THRESHOLD	2%
TX METHOD	RS232
MAX LOCK	OFF
UNITS LOCK	OFF
BACKLIGHT	OFF
AUTO OFF	OFF
INVERT	OFF

RS232 Commands Table: Configuration

It is possible to remotely read/configure the settings of your Tornado by sending the following RS232 command characters:

Character in ASCII	Decimal	Hexadecimal	Function
M	77	0x4D	Current mode
U	85	0x55	Current units
C	67	0x43	Torque sensor capacity
@	64	0x40	Configuration status request
*	42	0x2A	Continuous transmit
r	114	0x72	Normal Screen
s	115	0x73	Dual Max*
t	116	0x74	Max Clockwise*
u	117	0x75	Max Counter-clockwise*
v	118	0x76	Dual Peak Clockwise**
w	119	0x77	1st Peak Clockwise**
x	120	0x78	Dual Peak Counter-clockwise**
y	121	0x79	1st Peak Counter-clockwise**
a	97	0x61	N.m
b	98	0x62	N.cm
c	99	0x63	mN.m
d	100	0x64	gf.cm
e	101	0x65	kgf.cm
f	102	0x66	kgf.m
g	103	0x67	ozf.in
h	104	0x68	lbf.ft
i	105	0x69	lbf.in
?	63	0x3F	Transmit the current reading
CTRL a	1	0x01	TXD key
CTRL b	2	0x02	UNITS key
CTRL c	3	0x03	MAX key
CTRL d	4	0x04	RESET key
CTRL e	5	0x05	ZERO key

Note: Displayed units will only change if it is applicable to the torque sensor capacity of the Tornado.

*Only if % TAMP EV function is disabled

**Only if % TAMP EV function is enabled

RS232 Command Responses: Information

It is possible to remotely interrogate your Tornado by sending the following RS232 commands. This will inform you which settings are currently configured.

Command: M

Response	Tornado Display Mode
Normal	Normal Mode
MaxC	Max Counter-clockwise
MaxT	Max Clockwise
MaxDual	Dual Max Screen
1stC	1 st Peak Counter-clockwise
1stC Dual	1 st Peak Counter-clockwise Screen
1stT	1 st Peak Clockwise
1stT Dual	Dual 1 st Clockwise Screen

Command: U

Response for Torque Sensor
N.m
N.cm
mN.m
gf.cm
kgf.cm
kgf.m
lbf.ft
lbf.in
ozf.in

Command: C

The torque sensor size, in the current selected units.

Note: 'xxxx' will be transmitted if the torque sensor is not calibrated, or has a serious fault. Contact Mecmesin or your supplier.

Command: @

When all options are OFF, and the Tornado is set at defaults, you will receive the following information listing:

RESPONSE	EXPLANATION OF RESPONSE
Tornado	Gauge type
10.000	Torque sensor size in N.m as per transmitting 'C'
V01	Version number
Normal	Mode of operation as per transmitting 'M'
N	Units of operation as per transmitting 'U'

Menu Function	Default Setting
ALARM	OFF
PLC	OFF
PASSWORD	OFF
FREEZE	OFF
% TAMP EV	OFF
AV TIME	OFF
RATE	MED
FOOTSWITCH1	OFF
FOOTSWITCH2	OFF
COMMS	P,OFF,ON,9600,CL,0,2,S
MAX LOCK	OFF
UNITS LOCK	OFF
BACKLIGHT	OFF
AUTO OFF	OFF
INVERT	OFF

When all options are ON, you will receive the following information listing for each option:

ALARM ON options explained below:

ALARM ON,1,2,3,4,5,6,7	
1	Alarm Number Selected; 1, 2, 3, 4 or 5
2	x Limit1 value
3	x Limit2 value
4	B = Buzzer, L = LED, BL = Buzzer & LED
5	O = Out of Band, I = In Band
6	P = Pass, F = Fail
7	C = Continuous, P = Pulse, or blank

PLC ON options explained below:

PLC ON,L,1,2	
L	At limits
1	R = Reset, C = Continuous, P = Pulse
2	Limit value
PLC ON,A,1	
A	At alarm
1	H = High, L = Low

PASSWORD 1 options explained below:

PASSWORD 1	
1	Menu Password ON or OFF

FREEZE ON options explained below:

FREEZE ON,1	
1	L = Low, H = High

% TAMP EV ON options explained below:

% TAMP EV ON,1,2	
1	Drop in percent
2	Load Transmitted, 1st for 1st peak, 2nd for 2nd peak, 1st&2nd for both

AV TIME ON options explained below:

AV TIME ON,1,2	
1	Start Threshold value
2	Stop Threshold value

RATE 1 ON options explained below:

RATE 1	
1	M = Medium, H = High

FOOTSWITCH1 ON options explained below:

FOOTSWITCH1 ON,1	
1	Footswitch 1 - M = Max, U = Units, T = Txd, Z = Zero, R = Reset

FOOTSWITCH2 ON options explained below:

FOOTSWITCH2 ON,1	
1	Footswitch 2 - M = Max, U = Units, T = Txd, Z = Zero, R = Reset

COMMS settings are explained below:

COMMS 1,2,3,4,5,6,7,8	
1	P = Port, M = Store in memory
2	Units being transmitted, ON or OFF
3	Sign being transmitted, ON or OFF
4	Baud rate value
5	C = Carriage return, L = Line feed, CL = both
6	Line delay in seconds
7	Constant transmit threshold in percent
8	S = Serial RS232, D = Digimatic, B = Both

MAX LOCK 1 options explained below:

MAX LOCK 1	
1	Max key locked, ON or OFF

UNIT LOCK 1 options explained below:

UNITS LOCK 1	
1	Units key locked, ON or OFF

BACKLIGHT 1 options explained below:

BACKLIGHT 1	
1	Backlight enabled, ON or OFF

AUTO-OFF 1 options explained below:

AUTO-OFF 1	
1	Auto-off time, OFF, 5 mins or 10 mins

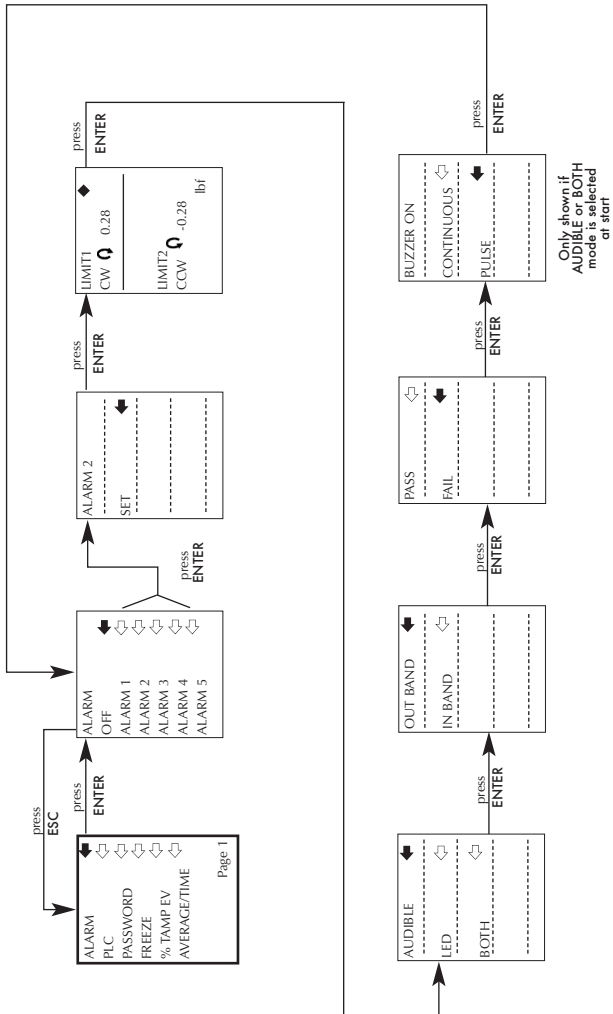
INVERT 1 options explained below:

INVERT 1	
1	Display inverted, ON or OFF

Advanced Menu Options Flow Chart Menu Page 1

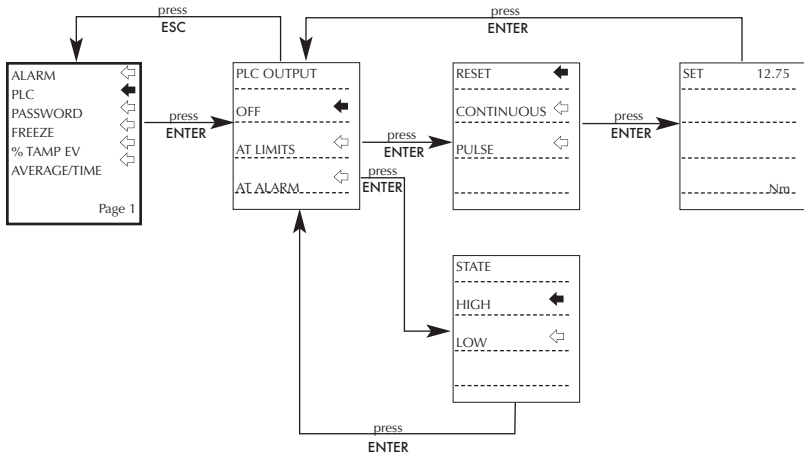
On the following pages are flowcharts to help you navigate the menus found in the Tornado. They appear in the order they appear on the three pages of the main menu on the instrument.

ALARM

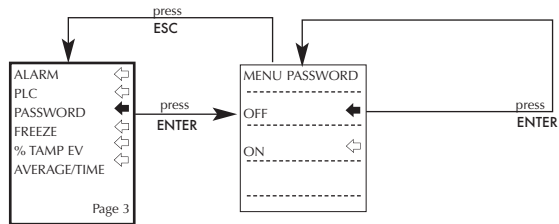


Advanced Menu Options Flow Chart Menu Page 1

PLC

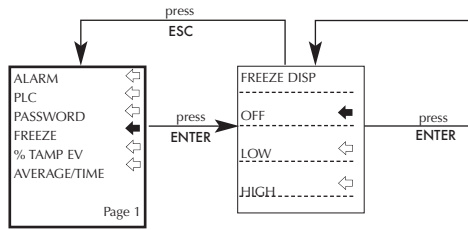


PASSWORD

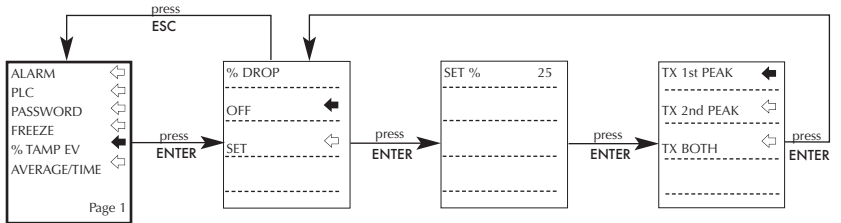


Advanced Menu Options Flow Chart Menu Page 1

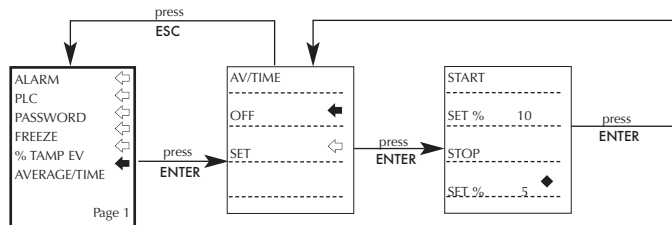
FREEZE



% TAMP EV

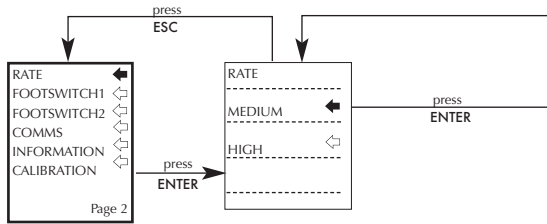


AVERAGE/TIME

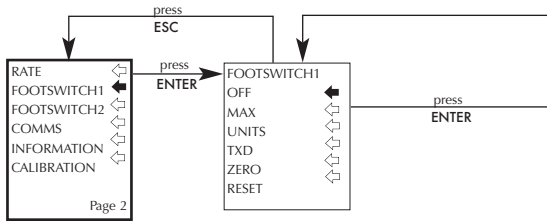


Advanced Menu Options Flow Chart Menu Page 2

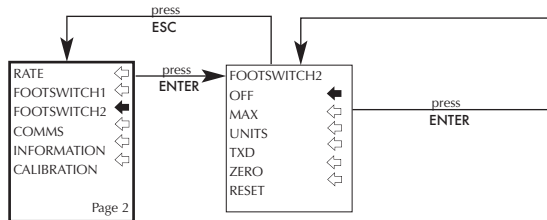
RATE



FOOTSWITCH1

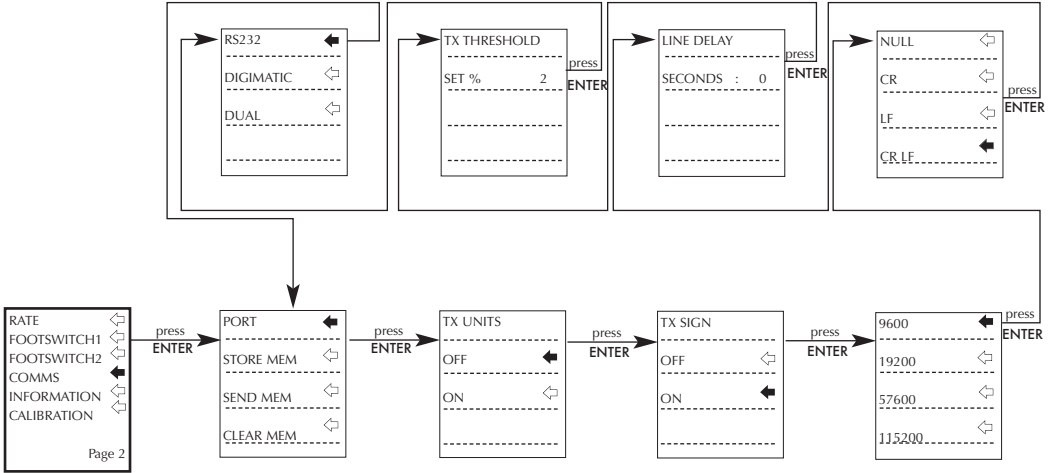


FOOTSWITCH2

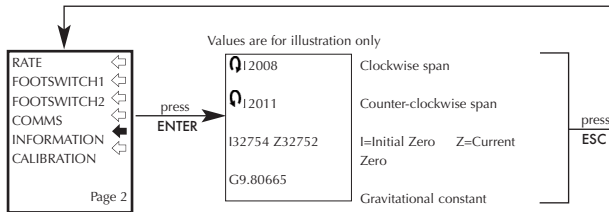


Advanced Menu Options Flow Chart Menu Page 2

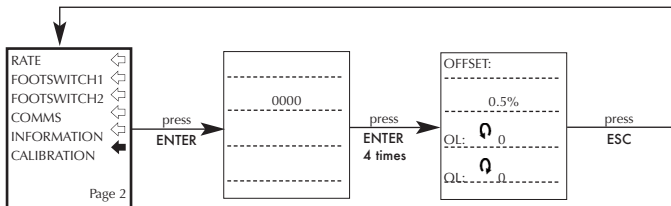
COMMS



INFORMATION

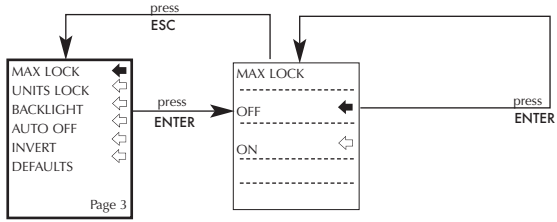


CALIBRATION

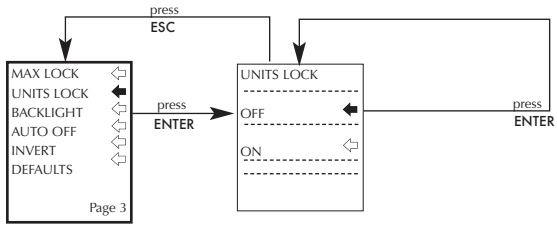


Advanced Menu Options Flow Chart Menu Page 3

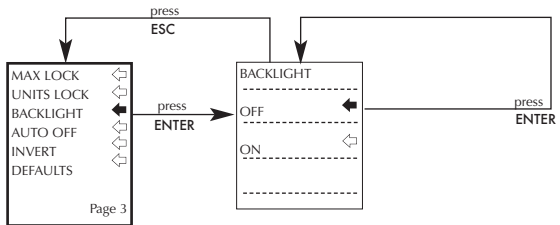
MAX LOCK



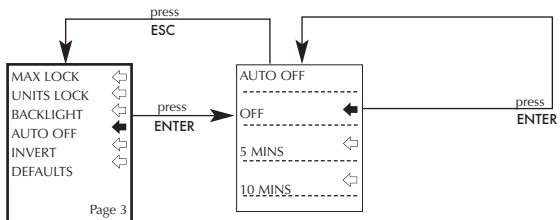
UNITS LOCK



BACKLIGHT

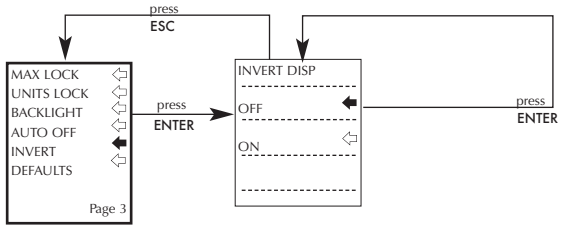


AUTO OFF

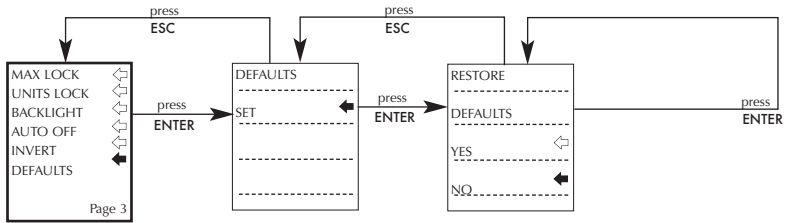


Advanced Menu Options Flow Chart Menu Page 3

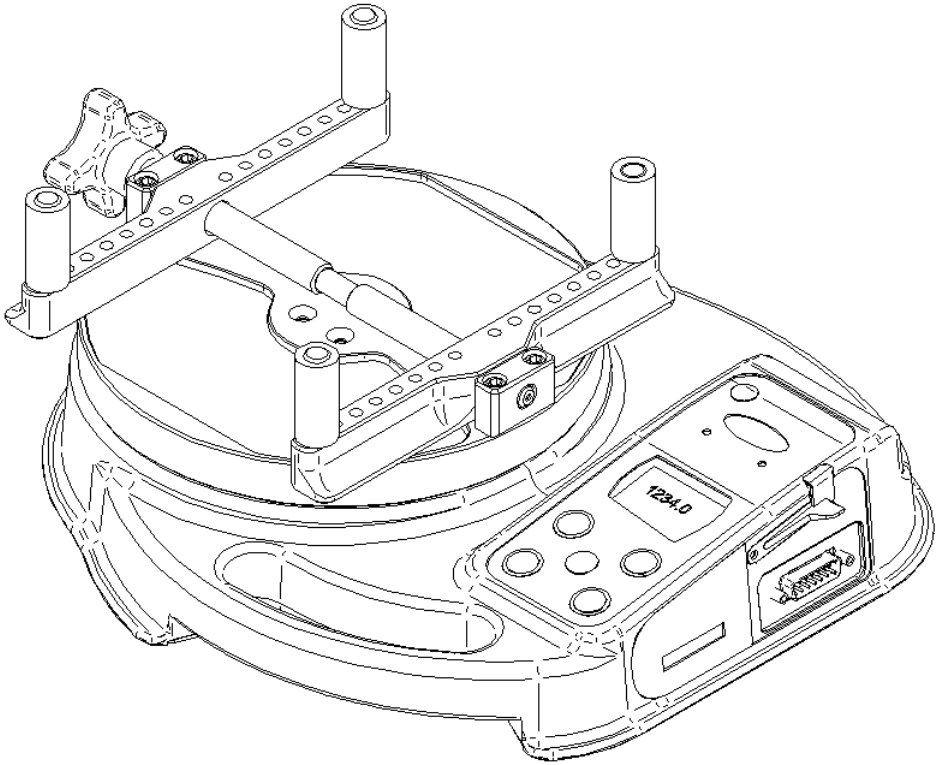
INVERT



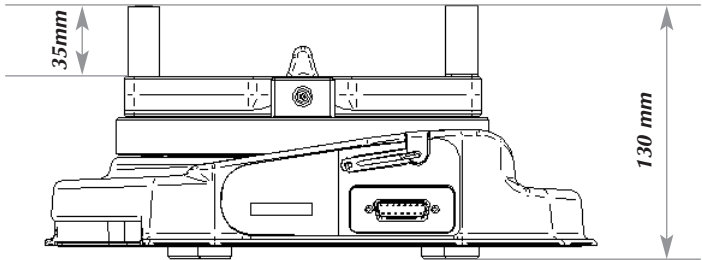
DEFAULTS



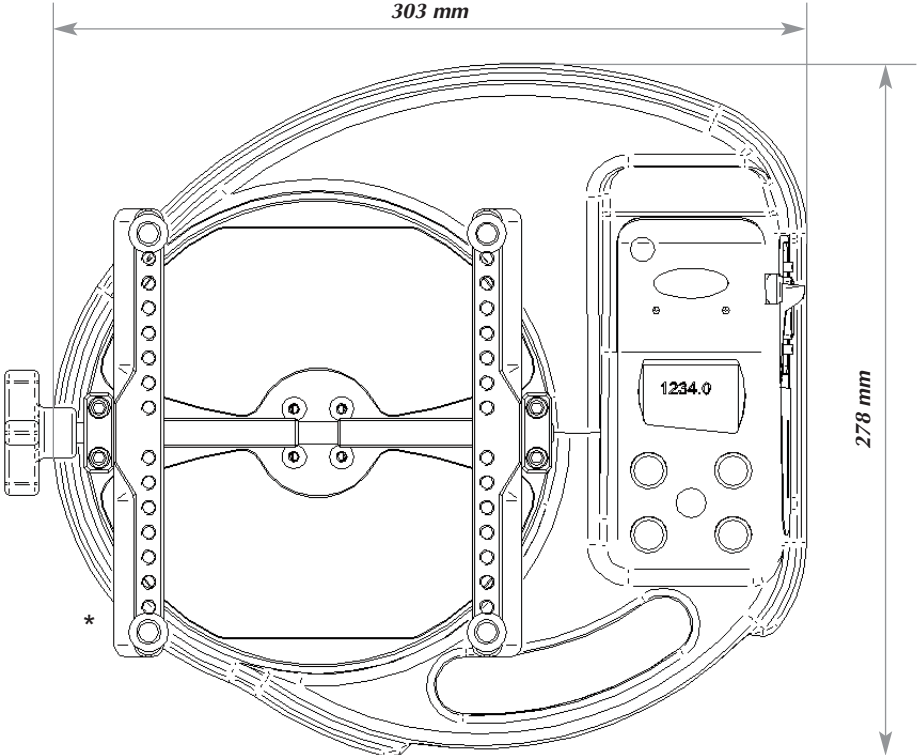
DIMENSIONS



Side view



Top view



*Min-Max opening: 10 - 190 mm diameter - Tornado 10N.m & 6N.m
10 - 78 mm diameter - Tornado 3N.m & 1.5N.m

TORNADO SPECIFICATIONS

RANGE & RESOLUTION ACCURACY

Capacity (N.m)	N.m	N.cm	mN.m
1.5	1.5 x 0.0005	150 x 0.05	1500 x 0.5
3.0	3.0 x 0.001	300 x 0.1	3000 x 1
6.0	6.0 x 0.002	600 x 0.2	6000 x 2
10	10 x 0.002	1000 x 0.2	10000 x 2
Capacity (N.m)	gf.cm	kgf.cm	kgf.m
1.5	15296 x 5	15.296 x 0.005	N/A
3.0	30592 x 10	30.59 x 0.01	0.3059 x 0.0001
6.0	61184 x 20	61.18 x 0.02	0.6118 x 0.0002
10	101973 x 20	101.97 x 0.02	1.0197 x 0.0002
Capacity (N.m)	ozf.in	lbf.ft	lbf.in
1.5	212.42 x 0.05	1.1064 x 0.0002	13.276 x 0.002
3.0	424.8 x 0.1	2.2127 x 0.0005	26.553 x 0.005
6.0	849.7 x 0.2	4.425 x 0.001	53.11 x 0.01
10	1416.1 x 0.5	7.376 x 0.002	88.51 x 0.02

±0.5% of full-scale

Calibration temperature: 20°C ± 2°C

Operating temperature: 10°C - 35°C

Temperature shift at zero load: ± 0.01% of full-scale/°C

OUTPUT

RS232-C: 8 data bits, 1 Start bit, 1 Stop bit, no parity

Digimatic (BCD) Output

Analogue:

0V at 0 load
1.5N.m, 3N.m
and 10 N.m:

Approx. ±2.5V uncalibrated for
full scale clockwise/counter-clockwise

6N.m:

Approx. ±1.5V uncalibrated for
full scale clockwise/counter-clockwise

PLC Signals:

The output of the pin is high 5V, low 0V

TORNADO SPECIFICATIONS

RELAY DESCRIPTION

using Tornado-PLC cable
Part number 351-063

The solid-state relay is mounted on a PCB, which is housed in a 15 pin D-type connector. Connection to the relay output is via a 5 metre length screened cable. The end of the cable is left with bare wires to allow appropriate termination to the peripheral PLC device.

ELECTRICAL

Supply voltage: The relay is powered from a 5V regulator inside the Tornado.
Input control: The relay state is controlled via a TTL signal from the Tornado and is in a 'closed position' when a logic '1' input is applied.

Output characteristics of Relay (351-063)

Peak relay ac voltage:	350 V
Continuous relay load current (PEAK AC):	120 mA
Maximum relay peak load current:	300 mA
Typical relay contact resistance at 100 mA:	17 Ω (Ohm)
Isolation voltage between Tornado and relay output:	1500 V ac

WATER RESISTANCE

The Tornado is rated to IP54 water resistance.

Note: This IP rating is only valid when no charger or comms cables are connected, and the charger socket cap and comms connector cover are in place.

ADAPTOR/CHARGER UNIT

The mains adaptor/charger supplied with the Tornado is a constant-current type.

Primary:	230V - 50Hz (110V - 60Hz version also available)
Secondary:	100mA constant current at 9V
Charger output plug:	Centre = positive Outer = negative

Communications Cables

Interface cables for connecting your Tornado to peripheral devices:

Cable	Mecmesin Part Number
Tornado to RS232 (9-pin D-type)	351-059
RS232 (9-pin D-type) to USB converter kit	432-228
Tornado to Digimatic (Mitutoyo 10-way IDC)	351-058
Tornado to Analogue	351-060
Tornado to PLC	351-063
Tornado to Footswitch 1	351-061-vo1
Tornado to Footswitch 2	351-061-vo2
Universal Expansion Module (for connected up to 5 cables simultaneously)	432-127

Allocation for the pins on the male 15 way 'D Type' Communication Connector:

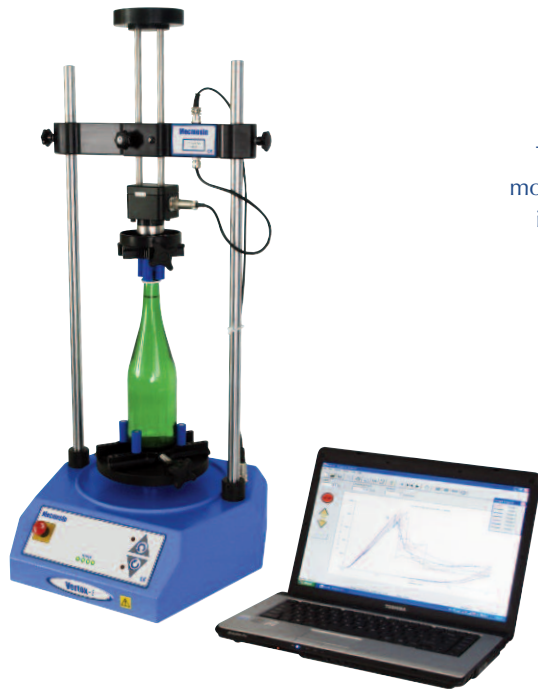
Pin Out:	
1	Analogue Output
2	RS232 Transmit
3	RS232 Receive
4	Digimatic Clock Output
5	Digimatic Ready Output
6	+5 volts
7	FREEZE Reading Input
8	not used
9	Footswitch 2 Input
10	Ground
11	Digimatic Request Input
12	Digimatic Data Output
13	Footswitch 1 Input
14	PLC Output
15	not used

Also Available from Mecmesin...

Orbis

The Orbis digital torque tester offers a simple, cost effective alternative to the Tornado. Featuring the same highly accurate digital torque capture, but without the Tornado's advanced programming functions, the Orbis is suitable for a broad range of basic torque applications.

- 6N.m
- Clear, intuitive controls
- Compact, portable & affordable
- Mains or battery powered



Vortex-i

The Vortex-*i* is a fully computer-controlled motorised torque testing system. The Vortex-*i* improves reproducibility, eliminating error arising from manual torque application.

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