TORKEL 820/840/860

TXL830/850/870/890

Battery Load Units

Extra Loads

User's Manual

Megger

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Extra Loads

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CE

Contents

1 Introduction

1.1 General

This manual explains how to use TORKEL 820, TORKEL 840 and TORKEL 860 Battery Load Units, and it also covers the TXL830, TXL850, TXL870 and TXL890 Extra Loads. Although performance differs from one model to the next, all models are used in the same way. Unless otherwise specified, what is set forth in this manual applies to all models.

TORKEL 820/840/860

These Battery Load Units are sophisticated instruments designed mainly for capacity tests. All three units can be programmed to test a battery bank at constant current, constant power, or using a user-defined load profile. TORKEL can also be used for testing battery chargers and other electrical equipment that require resistive load testing.

The three models have different maximum voltage ratings:

TORKEL 820	60 V DC
TORKEL 840	288 V DC
TORKEL 860	480 V DC

TORKEL has a number of functions that facilitate its use. Examples include:

- Warning and automatic stop functions for time, discharged capacity and low battery voltage.
- 9 memories where settings can be stored.
- Voltage curve can be stored for later transfer to a PC using the TORKEL Win program.
- Discharging can be started/stopped from external equipment.
- Testing can be carried out without disconnecting the regular load.

TXL830/850/870/890 (Extra Loads)

The TXL830, TXL850, TXL870 and TXL890 Extra Loads comprise resistive loads. They can be used together with TORKEL Load Units to increase loading capability. The TXL Extra Loads can not provide regulation by themselves but TORKEL measures total current from the battery and regulates the load characteristic. When TORKEL is stopped it sends a stop signal to the TXL Extra Load.

The four models have different maximum voltage ratings:

TXL830	28 V
TXL850	56 V
TXL870	280 V
TXL890	480 V

2 Safety

2.1 Symbols on the instrument

Caution, refer to accompanying documents.

Caution, risk of electric shock.

Hot, do not cover

Protective conductor terminal.

WEEE, Waste Electrical and Electronic Equipment. Please utilize your local WEEE collection facilities in the disposition of this product and otherwise observe all applicable requirements.

2.2 Safety instructions

Read / Follow / Retain all instructions

- All safety and operating instructions must be read before using TORKEL.
- All safety and operating instructions for TORKEL must be followed.
- All safety and operating instructions must be retained for future reference.

WARNING

1. The electrical voltage and current used in battery testing is potentially lethal.
   Ensure that the AC supply is isolated and any battery under test is disconnected before attempting any cleaning or maintenance of TORKEL.
2. Do not connect or disconnect any of the cables unless the circuit breaker F1 is in the lower (OFF) position.
3. Connection and disconnection procedures are extremely important. Be sure to follow the instructions faithfully.
4. Do not touch conducting parts of the clamps on the current cables or the voltage sensing cables when they are connected to TORKEL.
5. Explosion risk when using TORKEL and TXL (all models)
6. When a lead acid battery is charged or discharged i.e. when there is a current flow through the battery it is always a risk that the battery can explode.
   If there is a bad connection inside the battery and there is a current flow - the connection will burn off and there will be an arc, which will ignite the oxyhydrogen gas in the battery.
   For new open (vented) batteries the risk is medium to low but in old VRLA (sealed) batteries the risk is medium to high.
7. To minimize the risk for personnel injuries:
   Always place TORKEL/TXL as far away from the battery as possible - use long current cables and/or remote start/stop. Never stand close to a battery during charge/discharge.

8. Too high discharge current applied on a battery can cause the battery to explode or get overheated. Be sure to not set too high current.
9. If the external current measurement is interrupted or giving false values during the test, the current will rise to a higher level than the set value before the test is shut down. If the battery is too small for this current or in a bad condition - it may explode.
10. Never use the TORKEL/TXL Extra Load in an explosive environment. Never put the TORKEL/TXL Extra Load where it can be reached by battery gas.
11. Improperly connected cables carrying high current can cause fire. Make sure that the cables are not twisted in such a way that could cause them to turn and come loose from the connector.
12. Position TORKEL/TXL Extra Load where air flow is unobstructed and where it does not come into contact with any flammable or heat-sensitive material. Keep a free distance of 1.5 m (5 ft) to the vertical sides of TORKEL/TXL and 2.0 m (6.5 ft) above TORKEL/TXL.
13. Do not place TORKEL a) near another TORKEL, a TXL Extra Load or any other heat source or b) where the cooling airflow can be blocked. TORKEL will overheat if there is insufficient cooling.
14. External current shunt may not be used above 300 V DC
15. Do not use any other equipment other than what is provided or specified.

Important

1. When using the external current measurement function:
   - Check that the CT is connected in the right current direction.
   - Always replace the CT internal battery before a test.
   - Set the correct current ratio in the external current measurement menu.
2. Do not use liquid detergents or aero-sols when cleaning TORKEL or TXL units. Use a damp cloth.
3. If TORKEL has been stored below freezing for an extended period of time, you must allow 3 hours for it to adapt to room temperature.

3 Menu system

3.1 Main menu

Results

Displays voltage, capacity, current and testing period (time) from the last test.

Test battery

Submenu used to perform a test.

Auto-limits

Submenu used to provide automatic calculation and setting of limit values. Here, you specify the desired voltage per cell at which a) warnings are to be issued and b) the test is to be stopped. Examples: warning at 1.85 V/cell and stop at 1.75 V/cell. Then, when you begin a test, TORKEL asks you to enter the number of cells, whereupon it calculates the voltage and sets this voltage as the limit.

Memory

You can save and recall the settings in any of 9 memories. Moreover, you can recall the factory (standard) settings.

Select language

Here, you select the language that will be used in the display.

Basic settings

Here, you specify whether the current is to be measured internally within TORKEL or by means of a clamp-on ammeter. You can also adjust TORKEL to the mV/A ratio that appears on the clamp-on ammeter itself.

Test method

Here you specify one of the following test methods: constant current, constant power, constant resistance, current profile or power profile.

When you start a profile test you will be asked for the number of steps, the test duration (time) and the load value for each step.

4 TORKEL Control panel

The panels for the three TORKEL models differ somewhat but the functionality is the same.

1.

Operator control

Display

Display settings during programming and measured values during operation.

Keys

<**LIMITS**> key. Press to enter the LIMITS MENU

<**ESC**> key. Press to exit from a function without changing any data or to go backwards in the menu system.

Horizontal and vertical arrow keys, ◀ ▶ ▼ ▲. Used to select data and to change values.

<**SET LOAD**> key. Press to change the load.

<ENTER> key. Press to select and confirm parameters.

<START> key. Press to start discharging.

<STOP> key. Press to stop/pause discharging.

Lamps

OPERATING
a) LED will glow steadily while TORKEL is discharging.
b) LED will flash when the current (or power) can not be regulated to the desired value.

Vmin (V)
a) LED will glow steadily after TORKEL has shut down because the voltage has dropped to the stop limit.
b) LED will flash when the voltage has decreased to the warning limit.

I•t (Ah)
a) LED will glow steadily when TORKEL has shut down because the discharged capacity has reached the stop limit.
b) LED will flash when the discharged capacity has exceeded the warning limit.

Time (h)
a) LED will glow steadily when TORKEL has shut down after completing the preset time cycle
b) LED will flash when the time has exceeded the warning limit.

2. External current measurement

Input used to measure current in an external path by means of a clamp-on ammeter or a current shunt.

Input impedance	1 MΩ. Galvanically isolated.
Insulation voltage to battery current terminals	2300 V
Insulation voltage to ground	1350 V

3. External control

ALARM

Output equipped with a relay contact for triggering an external alarm device

Relay contact: 1 A / 100 VAC, 1 A / 50 VDC, 0.3 A / 250 VDC. This latter (250 V DC) is valid for resistive load only.

Connector insulation: Voltage to ground may not exceed 250 V

START/STOP

Input used for starting and stopping discharging from an external device. Galvanically isolated.

TXL

Output used for control of TXL Extra Loads. Galvanically isolated.

SERIAL

Serial port used for connection to a PC or other controlling equipment.

4. Circuit breaker

F1

Voltage controlled circuit breaker that connects / disconnects the loading circuits in TORKEL from the battery.

Note *F1 will not latch in upper (ON) position until TORKEL has issued a message reading"Switch on F1".*

5. Mains

Connector for mains supply, equipped with ON/OFF switch.

6. Connection terminals for the battery

+ (Terminal)

Positive (+) current connection for battery being tested.

– (Terminal)

Negative (-) current connection for battery being tested.

Insulation voltage to ground: 2200 V

VOLTAGE SENSE

Input for sensing voltage at the battery terminals.

Impedance to the battery current terminals is >1 MΩ.

5 Conducting a test

5.1 Test at constant current

Safety precautions

WARNING
Do not connect or disconnect any of the cables unless the circuit breaker F1 is in the lower (OFF) position.

Never use TORKEL/TXL Extra Load in an explosive environment. Never put TORKEL/TXL Extra Load in direct contact with battery gas.

Position TORKEL/TXL Extra Load so that the air flow is unobstructed and free from contact with any flammable or heat-sensitive material.

Do not place TORKEL near another TORKEL, a TXL Extra Load or any other heat source. TORKEL will overheat if there is insufficient cooling.

Inspect cable connections to make sure there is no short circuit.

Preparations for testing

1] Connect TORKEL to the mains voltage.

2] Switch on TORKEL.
The following display will appear for a short time:

TORKEL 840 R01A

It will then change to:

MAIN MENU
Test battery

and then:

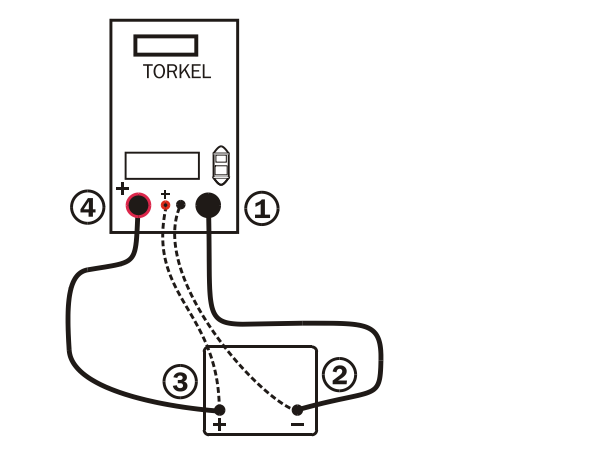
Connect battery

Note *Press ESC if you want to access the main menu.*

Important
Connection and disconnection procedures are extremely important. Be sure to follow the the instructions.

Connecting the current cables to the battery

Use the cables supplied with TORKEL or other cables of suitable size. Follow the numbered steps that are set forth below. Inspect each connection to make sure it is securely fitted.



Connecting TORKEL to a battery.

1] Connect one end of the first cable to the negative (-) terminal on TORKEL.

2] Connect the other end of the first cable to the negative (-) pole of the battery.

3] Connect one end of the second cable to the positive (+) pole of the battery.

4] Connect the other end of the second cable to the positive (+) terminal on TORKEL.

Tip
To get a more accurate voltage reading. Connect the voltage sensing cables between the "VOLTAGE SENSE" input on TORKEL and the battery terminals.

WARNING
Do not disconnect any of the above cables

until the test is completed and the circuit breaker F1 is in the lower (OFF) position.

Note *TORKEL automatically selects the voltage range when voltage is applied to the high-current terminals.*

Setting the current

1] Use the horizontal arrow keys (◀ or ▶) to select the position and the vertical arrow keys (▼ or ▲) to set the value.

```
Set Current
0001.0 A
```

2] Press <ENTER>.
After connecting the battery, about 30 seconds must elapse before you can switch on the circuit breaker F1 and start the test. TORKEL displays the amount of time you must wait as follows:

```
Please wait...
25 sec
```

When the time shown has elapsed, the following will appear:

```
Switch on F1
Press ENTER
```

3] Switch on F1 (press the lever upwards a second time if it fails to latch immediately).

4] Confirm by pressing <ENTER>.
TORKEL now displays the values currently in Ah:

```
51.6V          0.0 Ah
0.0 A          0:00:00
```

Tip
You can change the current at any time by pressing the <SET LOAD> key.

Warning and stop limit parameters

You can set TORKEL to issue a warning and/or to stop:

- When the voltage has reached a certain level.
- When a certain amount of capacity is discharged.
- After a specified time.

The settings for the warning and stop levels are independent of each other.

When a limit is reached, the contacts in the ALARM relay operate and a buzzer sounds. In addition, the lamp associated with the parameter on the control panel flashes when the warning level is reached and starts to glow steadily if TORKEL is stopped. See also the chapter headed "Alarm function".

Limits set-up

1] Press <LIMITS>

```
Warning        Umin
No             044.4 V
```

2] Use the horizontal arrow keys (◀ or ▶) to move the cursor and the vertical arrow keys (▼ or ▲) to activate the warning (Yes) and to set the voltage level.

3] Press <ENTER>

4] Proceed in the same way for other parameters you want to change.

5] Press <LIMITS> when you have finished setting the parameters.

Tip
The limits can be changed at any time during a test.

Starting the test

1] Press <START>.
The current value (A) will be displayed and the OPERATING lamp will light up.

Pausing the test

1] Press <STOP>.

2] Restart by pressing <START>.

Note *Any TXL Extra Loads connected to TORKEL must be restarted manually.*

Ending the test

1] Press the <STOP> key.

2] Press <ESC>

```
End Test?
Yes        No
```

3] Select "Yes" and press <ENTER>.

WARNING
Do not connect a discharged battery to a battery that has not been discharged. The batteries must be charged to the same potential (voltage) before they are connected together.

Viewing the results

1] Select the "RESULT" submenu via which you can read the values that were valid at the end of the last test. Voltage and discharged capacity are displayed in the first line.

2] Press the vertical up arrow key (▲) key to view current and time. You can scroll up and down among the displayed items with the vertical arrow keys (▼ or ▲).

3] Press <ENTER> to leave the sub-menu.

6 Testing at constant power / resistance

6.1 Constant power

TORKEL can be used to conduct a discharge test at constant power instead of constant current. All procedures are the same except that you must set TORKEL differently before starting – you set the power instead of the current.

WARNING
See the chapter "5 Conducting a test" on page 12 for safety precautions and how to prepare the test.

Important
When testing at constant power, the current will increase as the voltage decreases. Calculate the current at the end of the test (W / V = A). Then make sure that the total current does not exceed 2999 A. Also make sure that the TORKEL and TXL units can provide the required current load throughout the test.

Configuring TORKEL for constant power

1] Calculate the current at the end of the test (divide the power by the voltage). Then make sure that the total current does not exceed 2999 A and that the TORKEL and TXL units can load with the required current throughout the test.

2] Press <ESC> repeatedly until you see the "MAIN MENU".

3] Select "Test method" using the vertical arrow keys (▼ or ▲) and press <ENTER>.

4] Select "Constant P" and press <ENTER>.

5] Select "Test battery" and press <ENTER>.

6] Set the discharge power in the same way that you set the current. See the chapter "5 Conducting a test" on page 12.

6.2 Constant resistance

WARNING
See the chapter "5 Conducting a test" on page 12 for safety precautions and how to prepare the test

Configuring TORKEL for constant resistance

1] Press <ESC> repeatedly until you see the "MAIN MENU".

2] Select "Test method" using the vertical arrow keys (▼ or ▲) and press <ENTER>.

3] Select "Constant R" and press <ENTER>.

4] Select "Test battery" and press <ENTER>.

5] Set the resistance value in the same way that you set the current value. See the chapter headed "5 Conducting a test" on page 12.

7 Testing with a load profile

7.1 General

TORKEL can be used to conduct a test that incorporates a current profile or power profile. A profile can consist of up to 19 time intervals. The duration and the magnitude of the load can be specified for each interval.

7.2 Preparations

To configure TORKEL for a profile test, proceed as follows:

1] Press <ESC> repeatedly until you see the "MAIN MENU".

2] Select "Test method" using the vertical arrow keys (▼ or ▲) and press <ENTER>.

3] Select "PROFILE I" for a current profile (or "PROFILE P" for a power profile) and press <ENTER>.

7.3 Testing

1] Select "Test battery" and press <ENTER>.

```
Set Profile?
Yes          No
```

2] Select "Yes" and press <ENTER> if you want to set up the profile.

```
No. of Intervals?
02
```

3] Specify the number of time intervals you want to include in the profile and press <ENTER>.

```
SET T1
0:00:01    001.0A
```

4] Set the duration of the first time interval and the current (or power) value. Press <ENTER>.

5] Set the other intervals in the same way.

Starting the test

Proceed in the same way as set forth in the chapter "5 Conducting a test" on page 12.

8 External current measurement

8.1 General

The external current measurement function enables TORKEL to measure the total current in an external path and base regulation on this measurement.

A DC clamp-on ammeter (optional accessory) has to be used for this measurement. It can be applied at one of the battery terminals or at an inter-cell connector. The clamp-on ammeter must measure the total current, including that which passes through TORKEL.

A current shunt can also be used, but this requires opening the current path and connecting the shunt in series. The current shunt must be connected to the negative side of the battery.

WARNING
External current shunt may not be used above 300 V DC

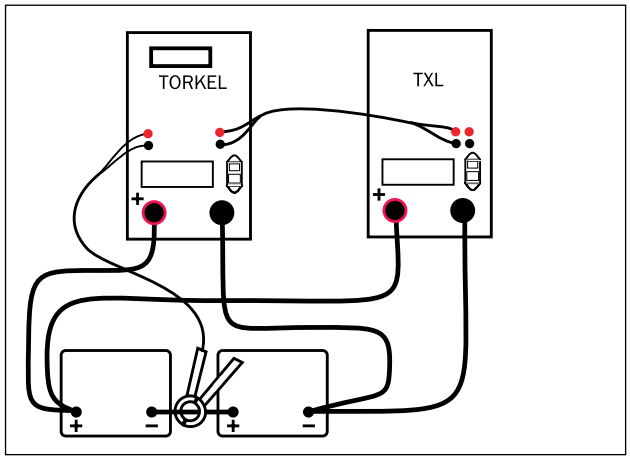
Important
The current shunt must be connected on the negative side of the battery.

Tip
For tests where it is important to obtain the desired current within a few seconds or less it is better to use internal current measurement since it provides faster regulation.

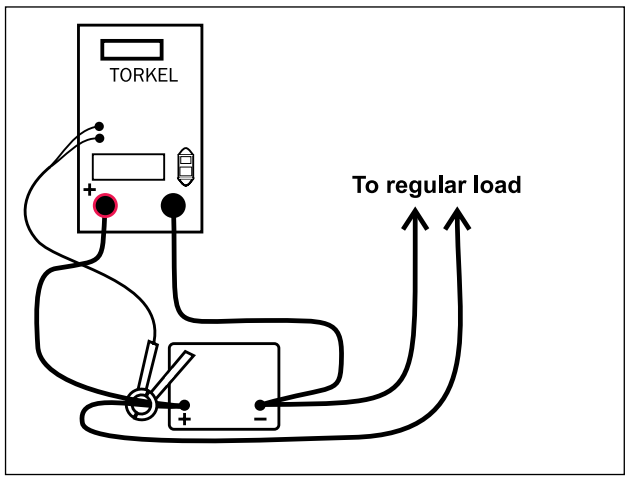
8.2 Applications

External current measurement must be used when:

- TORKEL is working together with TXL Extra Loads.
- Testing without disconnecting the regular load.
  Since total current is measured, TORKEL can compensate for changes attributable to the regular load. The total current from the battery is then kept at a constant value. This ensures accurate test results.

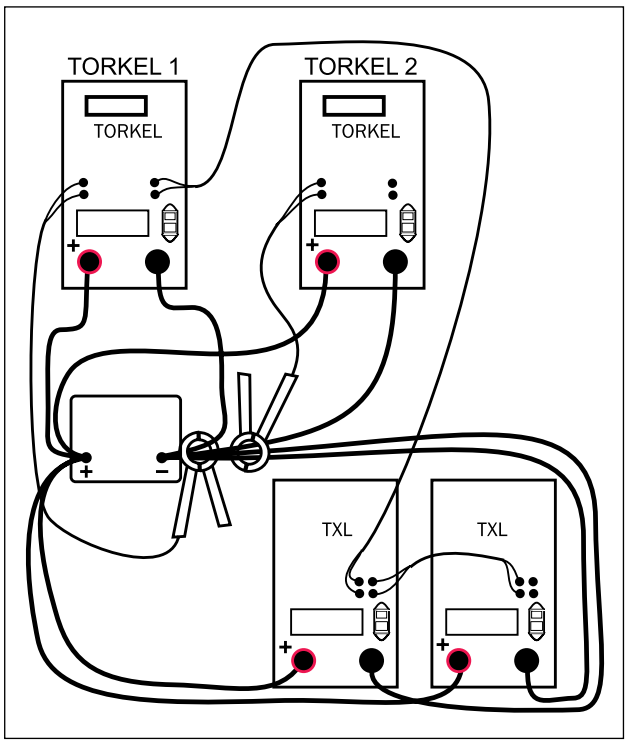


TORKEL used together with TXL Extra Load



Constant current, regular load connected.

- Two or more TORKEL and TXL units ca be used for discharging at up to 2999 A.



Two TORKEL units operating together using the external current measurement function.

8.3 Setting up external current measurement

TORKEL

1] Press <ESC> repeatedly until you see the "MAIN MENU".

2] Select "Basic settings" using the vertical arrow keys (▼ or ▲) and press <ENTER>.

MAIN MENU
Basic settings

3] Press <ENTER> to obtain:

I MEASUREMENT
Internal

4] Press <ENTER>.

5] Select "External" using the vertical arrow keys (▼ or ▲) and press <ENTER>.

6] Set the mV/A value to the value specified on the DC clamp-on ammeter and press ENTER.

I MEASUREMENT
Ext. 01.0 mV/A

The mV/A ratio for the input can be set to a value between 0.3 mV/A and 19.9 mV/A.

Important
The clamp-on ammeter output voltage must not exceed 1 V.

DC clamp-on ammeter

Note *Make sure that the clamp-on ammeter has fresh batteries. The batteries must last throughout the entire test.*

The clamp-on ammeter must be accurate and calibrated and it must be able to carry a load of 600 kΩ. Please note that a DC clamp-on ammeter is usually less accurate in the lowest part of its measurement range.

1] Place the clamp-on ammeter as far as possible from any magnetic field

2] Connect a DC voltmeter (set to 2 V full scale) to the clamp-on ammeter.

3] Switch on the clamp-on ammeter and adjust its zero knob to set the output to 0.0 V

Tip

Always activate the warning and stop limit functions when using external current measurement. This will protect your batteries if the DC clamp-on ammeter were to malfunction.

Connections

1] Connect the clamp-on ammeter to the EXTERNAL CURRENT MEASUREMENT input. Best results are obtained if the cables running from the clamp-on ammeter are twisted.

WARNING

Make sure the polarity is correct.

2] Apply the clamp-on ammeter to the conductor. See the figures in the section headed "Applications".

Note *The arrow on the clamp-on ammeter must point in the same direction as the current flow.*

The clamp-on ammeter must always be applied in such a way that current through TORKEL is included in the measurement.

3] Turn on the power switch on the clamp-on ammeter.

8.4 Troubleshooting

If the following message appears when you start the test:

Error:
External I

1] Check that the clamp-on ammeter is properly connected to TORKEL. Also check the polarity.

2] Check that the clamp-on ammeter is switched on.

3] Check that the clamp-on ammeter has fresh batteries.

4] Make sure that the clamp-on ammeter is clamped in the correct direction. A DC clamp-on ammeter normally has an arrow which should point in the direction which current flows through the conductor.

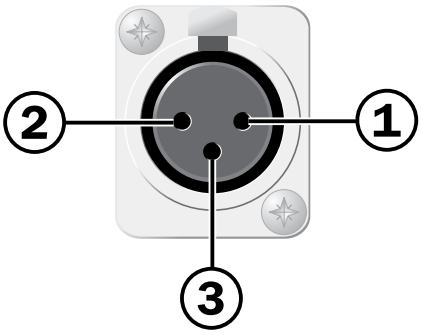
5] Check the following settings in "Basic setting" submenu:
- "I measurement" must be set to "External".
- The mV/A ratio must match the ratio that appears on the clamp-on ammeter itself.

9 Alarm function

9.1 Description

The TORKEL alarm function is provided by a buzzer and a relay connected to the <ALARM> - connector. An external alarm device can be connected to this connector if so desired.

When an alarm is issued, the relay closes the circuit between pin 2 and 3. (While no alarm is issued, the circuit between pin 1 and 3 is closed.)



Male connector for this terminal is "Neutrik NC3MX".

Relay contact

8 A / 28 V DC
0.28 A / 250 V DC (resistive load only)
8 A / 240 V AC

Connector insulation

Voltage to ground must not exceed 250 V.

The following events can cause an alarm to be issued

- Warning level is passed.
- Discharging is stopped because a stop level is reached.
- TORKEL can not regulate the current to the desired level.
- Thermal protection device trips or a fan has stopped rotating.
- The connection to the battery is broken.
- The mains (line) power to TORKEL is interrupted while a test is in progress.
- Other fault situations such as battery voltage too high or too low or excessive current through TORKEL.

Note *The alarm output will be activated if TORKEL is switched off and also if no mains voltage is present. When TORKEL is switched on, the alarm is reset automatically provided that a test was not in progress when the mains power was cut off.*

Resetting the alarm

You can reset the alarm by pressing any key.

10 Auto-limits

10.1 Invoking the auto-limits function

The auto-limits function automatically calculates and sets the limit values. Here, you must specify the voltage per cell at which you want a warning to be issued and the voltage per cell at which you want TORKEL to stop discharging the battery.

When you start the test, TORKEL asks you to enter number of cells and then sets the limits automatically.

This function can also be used to simplify the task of setting capacity and time limits.

Activating auto-limits

1] Press <ESC> repeatedly until you see the "MAIN MENU".

2] Select "Auto-limits" using the vertical arrow key (▼) and press <ENTER>.

Warning	Vmin
No	1.85V/cell

3] Use the vertical arrow keys (▼ or ▲) to activate the auto-limits function ("Yes") so that it will issue voltage warnings.

4] Set the voltage value/cell value.

5] Press <ENTER>.

Stop	Vmin
Yes	1.80 V/cell

6] Use the vertical arrow keys (▼ or ▲) to activate the auto-limits function so that it will provide voltage stops.

7] Set the voltage value/cell value.

8] Press <ENTER>.
You can set TORKEL to issue a warning when, say, 50 % of the test period (time) has elapsed.

Warning	Time
No	50%Rated

9] Press <ENTER>.
You can set TORKEL to stop discharging when, say, 100% of the test period (time) has elapsed.

Stop	Time
No	50%Rated

10] Press <ENTER>.
You can set TORKEL to issue a warning when, say, 50% of the rated capacity is discharged.

Stop	Ah
No	50%Rated

11] Press <ENTER>.
You can set TORKEL to stop discharging when, say, 100% of rated capacity is discharged.

Stop	Ah
No	100%Rated

12] Press <ENTER> to go to the MAIN MENU, "Auto-Limits" and press then vertical arrow (▲) to go to "Test battery".

13] Press <ENTER>.

Nr of cells?
012

14] Enter the number of cells.

15] Press <ENTER>.

Note *If you have stated "Yes" under any of the points 8 to 11 above you will see a display where you can set rated time and/or capacity. See example below.*

Rated time?
08:00:00

16] Press <ENTER>.

The last setting before you can start the test is to set the curent.

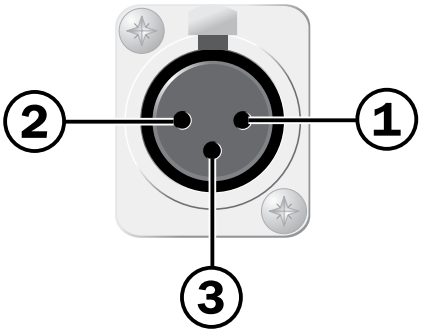
Set Current
50.0 A

17] Press <ENTER> and then <START>

11 Starting and stopping from an external device

11.1 Start/stop connector

Discharging can be started and stopped from external equipment via the connector named START/STOP.



Male connector for this terminal is "Neutrik NC3MX".

The start/stop circuits are galvanically isolated from other circuits in TORKEL.

Two or more TORKEL units can be started simultaneously since the START/STOP connectors can be connected in parallel and triggered by a single contact.

Starting

1] Connect a dry contact to pin 2 and pin 3 in the connector.
Closing and then opening the contact will cause TORKEL to start the discharge.
5 V is supplied for the dry contact and the current is limited internally to about 5 mA.

Stopping

1] Connect a dry contact to pin 1 and pin 3 in the connector.
Closing and then opening the contact will cause TORKEL to stop the discharge.
5 V is supplied for the dry contact and the current is limited internally to about 5 mA.

12 How to obtain the desired current

12.1 General

You must make some simple calculations before starting a test to find out whether or not TORKEL will be able to provide the desired load current. You must also make certain that TORKEL will be able to sustain this current until the test ends. TORKEL regulates current by lowering its internal resistance as the voltage drops. However, the resistance elements built into TORKEL impose a limit beneath which further lowering is impossible.

12.2 TORKEL load capacity

The following tables present the TORKEL built-in current limitation (Imax) and also the resistance of the built-in resistance elements for the different voltage ranges.

TORKEL 820			
Range	**Max current (Imax)**	**Internal resistance (nominal)**	**Lowest voltage at which Imax can be obtained[1)]**
10-27.6 V	270 A	0.069 Ω	21.3 V
10-55.2 V	270 A	0.138 Ω	39.9 V
1) Requires use of two standard cables, 3 m (10 ft), 70mm² (1.5 mΩ).			

TORKEL 840/860			
Range	**Max current (Imax)**	**Internal resistance (nominal)**	**Lowest voltage at which Imax can be obtained[2)]**
10 - 27.6 V	110 A	0.165 Ω	20.8 V
10 - 55.2 V	110 A	0.275 Ω	32.9 V
10 - 144 V	110 A	0.550 Ω	63.1 V
10 - 288 V	55 A	3.3 Ω	184 V
2) Requires use of two standard cables, 3 m (10 ft), 25 mm², (4 mΩ).			

12.3 Calculating current

Imax

Check that the desired current load is not greater than the Imax for the TORKEL unit in question (column 2 in the tables above).

Max power

For the 10 – 480 V range on TORKEL 860, you must also check to see that current multiplied by maximum voltage does not exceed the 15 kW power limit.

Final voltage

If the final voltage is lower than the value set forth in column 4 (in the table above), the internal TORKEL resistance will limit the current so that it will be impossible to reach Imax (column 2 in the table above). In such case, you can calculate the current that will be obtained at the final voltage as follows:

1] Add the TORKEL internal resistance (column 3) to the cable resistance (which is 1.5 mΩ for TORKEL 820 and 4 mΩ for TORKEL 840/860 if you are using standard cables).

2] Subtract 2.2 V from the final voltage and divide by the resistance you obtained in step one (above).

Example: The final voltage is 10.8 V, and you want to find the maximum possible current at this voltage if you are using a TORKEL 840 and the voltage range is 10 – 27.6 V.

Calculate the resistance as follows:
0.165 Ω + 0.004 Ω = 0.169 Ω .

Calculate the maximum current as follows:
(10.8 V – 2.2 V) / 0.169 Ω = 50.9 A.

Examples of load capacities

TORKEL 820

12 V battery (6 cells) [1)]		
Final voltage	***Constant current***	***Constant power***
1.80 V/cell (10.8 V)	0 – 121 A	0 – 1.31 kW
1.75 V/cell (10.5 V)	0 – 117 A	0 – 1.23 kW
1.67 V/cell (10.0 V)	0 – 110 A	0 – 1.10 kW
24 V battery (12 cells) [1)]		
1.80 V/cell (21.6 V)	0 – 270 A	0 – 5.8 kW
1.75 V/cell (21.0 V)	0 – 266 A	0 – 5.59 kW
1.60 V/cell (19.2 V)	0 – 241 A	0 – 4.63 kW
48 V battery (24 cells) [1)]		
1.80 V/cell (43.2 V)	0 – 270 A	0 – 11.6 kW
1.75 V/cell (42.0 V)	0 – 270 A	0 – 11.3 kW
1.60 V/cell (38.4 V)	0 – 259 A	0 – 9,9 kW
1) 2.15 V per cell when test starts		

TORKEL 840/860

12 V battery (6 cells) [1)]		
Final voltage	***Constant current***	***Constant power***
1.80 V/cell (10.8 V)	0 – 50.0 A	0 – 0.54 kW
1.75 V/cell (10.5 V)	0 – 49.0 A	0 – 0.51 kW
1.67 V/cell (10.0 V)	0 – 46.0 A	0 – 0.46 kW
24 V battery (12 cells) [1)]		
1.80 V/cell (21.6 V)	0 – 110 A	0 – 2.37 kW
1.75 V/cell (21.0 V)	0 – 110 A	0 – 2.31 kW
1.60 V/cell (19.2 V)	0 – 100 A	0 – 1.92 kW
48 V battery (24 cells) [1)]		
1.80 V/cell (43.2 V)	0 – 110 A	0 – 4.75 kW
1.75 V/cell (42.0 V)	0 – 110 A	0 – 4.62 kW
1.60 V/cell (38.4 V)	0 – 110 A	0 – 4.22 kW
110 V battery (54 cells) [1)]		
1.80 V/cell (97.2 V)	0 – 110 A	0 – 10.7 kW
1.75 V/cell (94.5 V)	0 – 110 A	0 – 10.4 kW
1.60 V/cell (86.4 V)	0 – 110 A	0 – 9.5 kW
120 V battery (60 cells) [1)]		
1.80 V/cell (108 V)	0 – 110 A	0 – 11.9 kW
1.75 V/cell (105 V)	0 – 110 A	0 – 11.5 kW
1.60 V/cell (96 V)	0 – 110 A	0 – 10.5 kW
220 V battery (108 cells) [1)]		
1.80 V/cell (194 V)	0 – 55 A	0 – 10.7 kW
1.75 V/cell (189 V)	0 – 55 A	0 – 10.4 kW
1.60 V/cell (173 V)	0 – 51.0 A	0 – 8.82 kW
240 V battery (120 cells) [1)]		
1.80 V/cell (216 V)	0 – 55 A	0 – 11.9 kW
1.75 V/cell (210 V)	0 – 55 A	0 – 11.5 kW
1.60 V/cell (192 V)	0 – 55 A	0 – 10.5 kW
1) 2.15 V per cell when test starts		

TORKEL 860

UPS battery (180 cells) [1)] (TORKEL 860)		
1.70 V/cell (306 V)	0 – 38 A	0 – 15 kW
1.60 V/cell (288 V)	0 – 38 A	0 – 15 kW
UPS battery (204 cells) [1)] (TORKEL 860)		
1.80 V/cell (367 V)	0 – 34 A	0 – 15 kW
1.60 V/cell (326 V)	0 – 34 A	0 – 15 kW
1) 2.15 V per cell when test starts		

12.4 When a single TORKEL isn't enough

When a single TORKEL cannot provide the current you need, you can:

- Connect one or more TXL Extra Loads to TORKEL.
- Connect two or more TORKELs in parallel.
- Connect two or more TORKELs and two or more TXL Extra Loads into a single system.

When two or more TORKELs are connected into a single system, you will normally use the "External current measurement" function. But in situations where it is important for current to be regulated to the correct value within a second or so, it is better to use two or more TORKEL units set for internal current measurement and no TXL Extra Loads since these latter must be started manually. To obtain the total current, you must then add the current values (amperages) shown on all TORKEL units. The TORKEL units can be started and stopped synchronously via the START/STOP input.

TXL Extra Loads connected to TORKEL

TXLs are resistive loads which are unable to provide any sort of regulation. Regulation is provided by TORKEL which measures the total current and keeps it constant. See the chapter headed "External current measurement" which shows how to connect the TXL(s) and TORKEL(s).

When TXL Extra Loads are connected to TORKEL, you must check:

- That the current flowing through the TXLs when the test is started is not higher than intended.
- That TORKEL has enough regulation capability a) to compensate for the drop in current through the TXLs at the end of the test and b) to set the current to the correct value at the beginning of the test.

Calculating how many TORKELs and TXLs are needed

1. Number of TXLs – Current flowing through TXL(s) at beginning of a test

At the beginning of the test, as high a percentage as possible of the current must flow through the TXLs, thereby providing the TORKEL(s) with as much reserve regulation capability as possible. However, the current through the TXLs must not, of course, exceed, the desired current value (A).

Tip

Remember that the internal resistances of the TXLs can be set manually. For accurate calculation, add the cable resistance to the internal resistance.

- The current in an individual TXL can be obtained by dividing the voltage at the beginning of the test by the internal resistance of the TXL in question (see tables below).
- Calculate the number of TXLs that you can connect without exceeding the desired total current.

2. Current flowing through TXL(s) at final voltage

- Multiply the total current through the TXL(s) which you obtained in step 1 above by the final voltage, and then divide by the voltage at the beginning of the test.

3. Number of TORKELs – for the current regulation

The TORKEL or TORKELs in the system must regulate the current to the desired value and compensate for the drop in current through the TXL(s) that occurs at the final voltage.

- The amount of regulation needed can be obtained by subtracting the current value (A) obtained in step 2 above from the desired current.
- Calculate the number of TORKELs required for the current regulation.

4. Are all of the TXLs needed?

If the total load-providing capability of the TORKEL(s) exceeds the amount of regulation needed by a wide margin (as set fort in step 3 above), you can perhaps conduct the test with fewer TXLs. If this margin is wider than the current through one of the TXLs at the final voltage, this TXL is not needed.

TXL830		
Max voltage	***Possible resistance settings (nominal)***	***Position***
28 V	*0.275* Ω	1
	0.138 Ω	2
	0.092 Ω	3
TXL850		
56 V	*0.550* Ω	1
	0.278 Ω	2
	0.184 Ω	3
TXL870		
140 V	*2.480* Ω	2
	1.240 Ω	3
280 V	*4.950* Ω	1
TXL890		
230 V	3.52 Ω	3
230 V	7.05 Ω	2
480 V	14.1 Ω	1

Example

A lead-acid battery with 54 cells has to be tested at 250 A.

Voltage at the beginning of the test (Vstart) is:
116.1 V (54 x 2.15 V)

Voltage at end of the test (Vend) is:
97.2 V (54 x 1.80 V)

Since the current is so high, you must use TXLs . A TXL870 is suitable since it is rated for the voltage in question.

1 – Number of TXLs – Current flowing through TXL(s) at beginning of a test.

The current through a TXL870 set for a resistance of 2.48 Ω is 46.8 A, and current through a TXL870 with a resistance of 1.24 Ω is 93.6 A. If two TXLs are set to 1.24 Ω and one TXL is set to 2.48 Ω the current will be 234 A, and they can be connected without having the current exceed 250 A.

2 – Current flowing through TXL(s) at final voltage.

234 A x 97.2 V / 116.1 V = 196 A

3 – Number of TORKELs – for the current regulation.

250 A – 196 A = 54 A. A single TORKEL 840 is enough for this.

4 – Are all of the TXLs needed?

The loading capability of the TORKEL unit is 110 A at the final voltage. This exceeds the amount needed by 110 A – 54 A = 56 A. This unused margin is perhaps wide enough to eliminate the need for one TXL. At the end of the test, the current through the TXL that is set to 2.48 Ω is 97.2 V / 2.48 Ω = 39 A. Since the unused TORKEL margin is wider than 39 A, this TXL is not needed.

TORKEL/TXL system examples

Systems containing TORKEL 820 and TXL830

12 V battery (6 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 820***	***Number of units TXL830***
234	1	1
346	1	2
459	1	3
571	1	4
693	2	4
806	2	5
918	2	6
1031	2	7
Dashed line shows the calculating limit (1000 A) for TORKEL WinCalc.		

24 V battery (12 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 820***	***Number of units TXL830***
495	1	1
720	1	2
945	1	3
1170	1	4
1440	2	4
1665	2	5
1890	2	6
2115	2	7
2340	2	8
Dashed line shows the calculating limit (1000 A) for TORKEL WinCalc.		

Systems containing TORKEL 820 and TXL850

48 V battery (24 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 820***	***Number of units TXL850***
499	1	1
729	1	2
959	1	3
1189	1	4
1459	2	4
1688	2	5
1918	2	6
2148	2	7
2378	2	8
2608	2	9
2837	2	10
Dashed line shows the calculating limit (1000 A) for TORKEL WinCalc.		

Systems containing TORKEL 840/860 and TXL830

24 V battery (12 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 840/860***	***Number of units TXL830***
263	1	1
445	2	1
670	2	2
895	2	3
1005	3	3
1230	3	4
1455	3	5
Dashed line shows the calculating limit (1000 A) for TORKEL WinCalc.		

Systems containing TORKEL 840/860 and TXL850

48 V battery (24 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 840/860***	***Number of units TXL850***
339	1	1
449	2	1
679	2	2
909	2	3
1019	3	3
1249	3	4
1478	3	5
Dashed line shows the calculating limit (1000 A) for TORKEL WinCalc.		

Systems containing TORKEL 840/860 and TXL870

110 V battery (54 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 840/860***	***Number of units TXL870***
188	1	1
266	1	2
344	1	3
422	1	4
532	2	4
610	2	5
688	2	6
766	2	7

120 V battery (60 cells)		
Discharge from 2.15 to 1.75 V/cell		
Maximum constant current (A)	***Number of units TORKEL 840/860***	***Number of units TXL870***
194	1	1
278	1	2
363	1	3
473	2	3
557	2	4
642	2	5
726	2	6

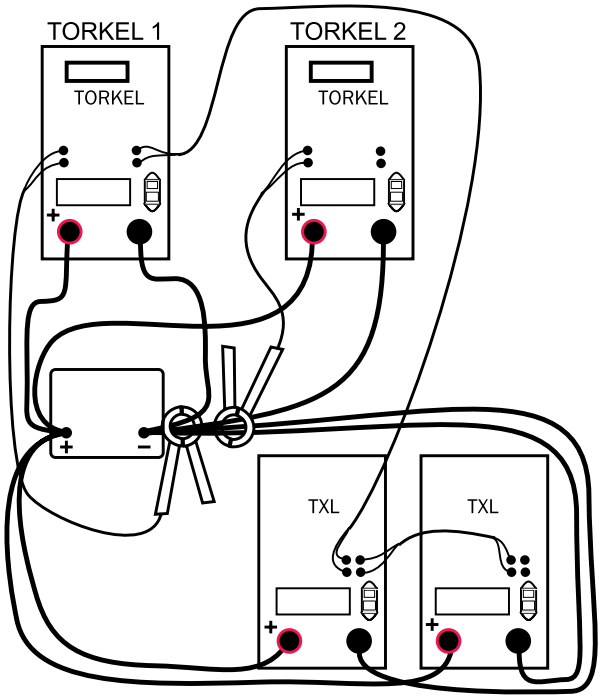
220 V battery (108 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 840/860***	***Number of units TXL870***
94	1	1
133	1	2
188	2	2
227	2	3
266	2	4
306	2	5
345	2	6

Systems containing TORKEL 840/860 and TXL890

408 V battery (204 cells)		
Discharge from 2.15 to 1.8 V/cell		
Maximum constant current (A)	***Number of units TORKEL 840/860***	***Number of units TXL890***
57	1	1
83	1	2

12.5 Test conducted using a system comprising TORKEL and TXL units

One of the TORKEL units (we shall call it **TORKEL No. 1** is to measure the entire battery current. **TORKEL No. 2** measures all current except the current through **TORKEL No. 1**. **TORKEL No. 3** measures all current except the currents through **TORKEL No. 2** and **TORKEL No. 1** (and so forth). The last TORKEL measures only the current through itself and the TXLs.



Example of a system comprising TORKEL and TXL units.

Hookup and settings

Important
The chapter headed "Conducting a test" presents safety precautions and explains how to prepare for testing. Be sure to comply with what is set forth in this chapter.

1] Apply the clamp-on ammeters as illustrated above.

2] Set the desired total current (same value) on all TORKEL units.
As a result, the maximum regulation capability of all TORKEL units will be used. You do not need to pay any attention to the message reading "Cannot regulate" as long as it does not appear on TORKEL No. 1.

3] Set warning limits only on TORKEL No. 1.

4] Set the stop limits. The voltage and test period (time) can be set on each individual TORKEL. Stopping after a certain capacity (Ah) is reached can only be activated on TORKEL No. 1.

Note *Only TORKEL No. 1 is to control the TXLs.*

Only TORKEL No. 1 is to be connected to the PC.

Starting discharge

1] Set switch <F1> to the upper (ON) position on the TXLs.

2] Then start the TORKEL that has the highest number (when numbered as set forth above). Now start the TORKEL with the second highest number, then the third highest, etc. Finally, start TORKEL No. 1. Starting the TORKELs in this order prevents the current from being higher than desired at the beginning of the test.

13 TXL Extra Loads

13.1 Panel

The panels for the four TXL models differ somewhat but the functionality is the same.

1. Selector switch

Selector switch used to set the desired voltage range and/or resistance value.

Warning

Do not exceed maximum voltage.

2. Control

CONTROL IN

Input for control signal from TORKEL-unit. Galvanically isolated.

CONTROL OUT

Output used for the control signal sent from TORKEL to the adjacent TXL-unit. Galvanically isolated.

3. Circuit breaker

F1

Voltage-controlled circuit breaker that connects the resistors in the TXL Extra Load to the battery.

Note *F1 will not latch or remain at upper (ON) position unless the mains switch is turned on and a control signal from TORKEL is present at the "CONTROL IN" input. Furthermore, TORKEL must be in the "Test battery" sub-menu.*

4. Mains inlet

MAINS

Connector used for mains supply, equipped with ON/OFF switch.

5. Connection terminals for the battery

+ (Terminal)

Positive (+) current connection for battery being tested.

- (Terminal)

Negative (-) current connection for battery being tested.

Insulation voltage to ground: 2200 V

13.2 Setting up the extra load

When an extra load is to be used, you must use the external current measurement function (see the chapter headed "8 External current measurement" on page 18).

Important
Never connect a TXL to a voltage higher than specified for the range in question.

1] Set the range selector switch to the desired position.

2] Connect as shown in the illustrations.

3] Connect the control wires between the "TXL" output on TORKEL and the "CONTROL IN" input on the TXL.
If two or more TXLs are to be used, provide a connection between the "CONTROL OUT" output on the first TXL and the "CONTROL IN" input on the second TXL, etc.

4] Connect the TXL to the mains voltage

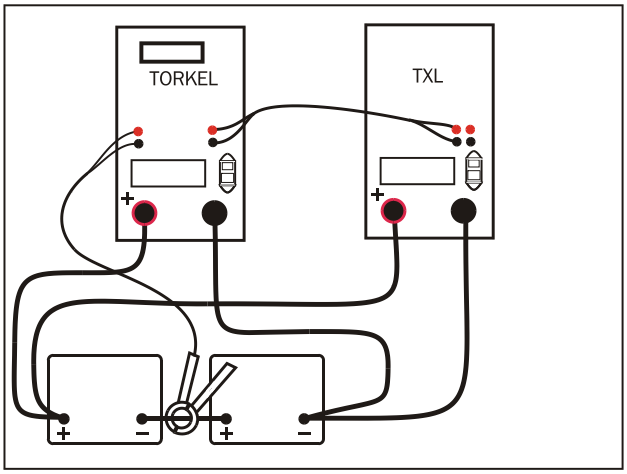
5] Switch on the TXL.

13.3 Testing

WARNING
See the chapter "5 Conducting a test" on page 12 for safety precautions and how to prepare the test

1] Proceed in the same way as set forth in the chapter headed "Conducting a test" but before you start TORKEL you must set switch F1 to upper (ON) position on the TXL. (You must do this manually.)

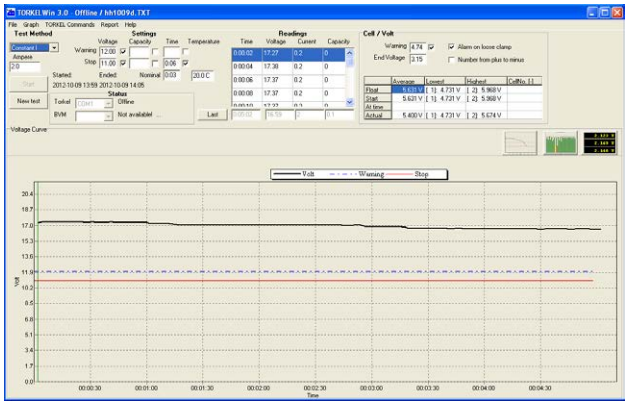
2] Start TORKEL by pressing <ENTER>.



TORKEL with one TXL

14 Optional accessories

TORKEL Win software



The TORKEL Win program, which runs on a PC under Windows®, builds up a voltage curve on the screen in real time and displays the current, voltage and capacity readings. You can also use TORKEL Win to control TORKEL during the test. The program stores the results in a text file, and it can generate reports.

BVM - Battery Voltage Monitor

The BVM (Battery Voltage Monitor) is a battery voltage measurement device that is used for the capacity testing of large, industrial battery banks commonly found in electrical power sub-stations, telecom facilities and computer data center UPS systems. In conjunction the TORKEL unit, and test data management software, such as PowerDB or TORKEL Win, the BVM enables a completely automated battery bank capacity test to be performed.

BVM is available in three kits:

- BVM150 with 16 BVM units
- BVM300 with 31 BVM units
- BVM600 with 61 BVM units

Cables

- Cable set, 2 x 3 m (10 ft), for connecting TORKEL to the battery:
  70 mm² 270 A cable for TORKEL 820.
  25 mm² 110 A cable for TORKEL 840 and TORKEL 860.
- Cables for controlling a TXL Extra Load from TORKEL.
- Sensing leads, 2 x 5 m (16 ft), used to measure voltage at the battery terminals.
- Extension cable, 2 x 3 m (10 ft), 25 mm², 110 A.

Clamp-on DC ammeter

- 200 A clamp-on DC ammeter
- 1000 A clamp-on DC ammeter

15 Troubleshooting

Display on TORKEL is dark

- Check that the mains cable is properly plugged in.
- Check the mains voltage

Impossible to switch on the circuit breaker F1

It is only possible to switch on F1 in the "Test battery" submenu. Furthermore, you must:

1] Connect the battery to TORKEL

2] Set the current

3] Wait for message reading "Switch on F1".

4] Push the lever of F1 to the ON position a second time if it does not latch directly.

Voltage reading on the display is lower than the battery voltage

- You responded to the "Switch on F1" message by pressing <ENTER> without switching on F1.
- You have accidentally switched off F1 manually.

TXL connected to TORKEL

When a TXL and TORKEL are connected via the signal cable connected to the "Control In" input, the following can happen:

Impossible to switch on the circuit breaker F1 on the TXL-unit.

- You have not received the message "Switch on F1" on TORKEL.
- You have not connected the input CONTROL IN properly to TORKEL.
- The TXL have no mains power. If the fans are not running, check the mains connection and the mains switch.

BVM connected to TORKEL

BVM port doesn't get online

- Check/verify com port driver
- Change COM port on computer

Communication lost with BVM units

- Check cables, BVM units and Power supply to the BVM units
- If more than 60 BVM units connected, extra cable needed. See the connection diagram.

Messages on display

"Connect battery" does not disappear.

- Check connection to the battery.
- Check the polarity of the connection to the battery.
- When you first connect a higher voltage to TORKEL and then a lower voltage, you may have to wait for some time.

"Error: Connection"

TORKEL has indicated that the battery voltage has disappeared.

- Check the connection to the battery.

"CHECK F1"

This message appears if the current is 0 A when current should be flowing.

- Check that circuit breaker F1 is switched on.

"CHECK F1 Input voltage "

- Check that circuit breaker F1 is switched on, that the battery is properly connected and that the battery voltage is not less than 10 V.

"Unable to regulate"

The message appears when TORKEL can not regulate the current (or power or resistance) to the desired value.
The TORKEL-unit can not regulate because it can not decrease its resistance further.

- You must decrease the current or connect more TORKEL or TXL units.
- This is not a fault-situation if the actual TORKEL is operating in a system of several TORKEL units and another TORKEL (TORKEL nr 1) takes care of the total regulation.

"Error: External I"

The measured external current is less than the internal current
See also chapter headed "External Current Measurement".

1] Check the setting in sub menu "Basic setting", "I measurement".

2] Select "***External***" if you want to use the input External Current Measurement.

3] Select "***Internal***" if you do **not** want to use External Current Measurement

4] Check that the mV/A ratio complies with the clamp-on ammeter

TORKEL is set for "External Current Measurement" but the clamp-on ammeter:

- is not properly connected
- is not switched on
- is not correctly applied on the conductor.
- has bad batteries

"Overheated"

The internal thermal protection device has tripped.

- Check cooling and ambient temperature

A fan may be damaged (not rotating or slow).

- Call for service.

"Overcurrent"

The current through TORKEL is higher than allowed because of a fault in TORKEL´s internal current limitation.

"Input voltage too high".

The battery voltage is higher than specified for your TORKEL.

"Input voltage > 27.6 V"
"Input voltage > 55.2 V"
"Input voltage > 144 V"
"Input voltage > 288 V"
"Input voltage > 480 V"

When you connect the battery, TORKEL will automatically select the voltage range and arrange the internal resistors for highest possible current.
If one of the messages above appears, TORKEL has stopped because the input voltage has increased and exceeded the range. You can continue the test but TORKEL will choose a higher voltage range and rearrange the internal resistors.
Note: The current rating for the new range is probably lower than the previous range (see chapter headed "Specifications").

"Input voltage too low"

The battery voltage is too low*) (less than 10 V, which is frequent on defective batteries) for safe operation with TORKEL.

*) or bad connection

"Calibrate!"

A calibration is recommended. TORKEL is now using calculated and standardised calibration values.

"Checksum error! Switch off"

Read error in TORKEL's control-memory.

- Switch off TORKEL and switch on again. If the message remains it might be necessary to perform the reset procedure in the chapter "Calibration".

"Power failure"

TORKEL has lost the mains power for a while when a test was in progress. TORKEL displays the values when the test was interrupted.

- You can choose to continue or end the test.

"8X0"

You need to restore TORKEL, follow instructions below.

1] Connect TORKEL to the PC and start TORKEL. Press "ESC" to enter the main menu.

2] Run the file "restore.exe" and select the file xxxxxxx.set (contact our Customer Service if you do not have the file).

3] Click the icon "TORKEL Restore" and select the "Com port".

4] When the message "Restoring complete" is shown, click "OK".

5] Calibrate TORKEL.

16 Calibration

16.1 General

TORKEL has four circuits used for testing that require calibration:

- Internal current
- Internal voltage
- External voltage
- External current

The calibration procedure has four main steps:

1] Calibrating zero levels

2] Calibrating internal current (Int I)

3] Calibrating internal and external voltage (V)

4] Calibrating external current (Ext I)

For main steps 2, 3 and 4 you can decide whether or not to perform them.

Note *Calibrate once a year to maintain proper accuracy.*

Stable voltage and current sources (which vary less than 1% per second) and accurate reference instruments must be used. The current source must be able to supply high current at a voltage between 10 and 30 V. One or two 12 V batteries can be used here.

16.2 How to calibrate

WARNING
Do not connect or disconnect any of the cables when the circuit breaker F1 is in the upper (ON) position.

Do not touch conducting parts of the clamps on the current cables or the voltage sensing cables when they are connected to TORKEL.

1] Switch on TORKEL.

2] In the "MAIN MENU" select "BASIC SETTINGS".

3] Set "I MEASUREMENT" to "INTERNAL".

4] Switch off TORKEL.

5] Press the <Esc> and <Stop> keys simultaneously, while switching on TORKEL.

1. Calibrating zero levels

1] Message reading:

Press ENTER
to calibrate

2] Press <ENTER>.
Message reading:

Short-circuit
inputs

3] Short-circuit the inputs.
a) "EXTERNAL CURRENT MEASUREMENT"
b) Positive (+) and negative (-) terminals for battery current.
c) "VOLTAGE SENSE"
Message reading:

Switch on F1
Press ENTER

4] Set switch F1 to its upper (ON) position.

5] Press <ENTER>.
Message reading:

Calibrating
Zero levels

F1 will trip.

6] Remove all short circuits (see step 3).

2. Calibrating internal current

1] Message reading:

CALIBRATE Int.I ?
No

2] Change to "Yes" using the vertical arrow keys (▼ or ▲).

3] Connect the current source (two car batteries in series for example) to the battery current terminals on TORKEL.

Note *The current source must be able to supply a high stable current.*

4] Connect an accurate current measurement reference instrument (for instance a current shunt with a voltmeter) in series with the batteries.

5] Press <ENTER>
Message reading:

000 000 0
R:135 T:123 F1

6] Change the displayed numbers to read as follows by using the vertical arrow keys (▼ or ▲).

111 111 1
R:135 T:123 F1

7] Press <ENTER>
The fans will start.

8] Message reading:

Calib internal I
Input: 085.00A

9] Set switch <F1> to its upper (ON) position.

10] Change the current value on the display to the value read from the reference instrument.

11] Press <ENTER>.
F1 will trip.

Note *If a message reading "Error: Unstable current" appears, press <ENTER> and try again. This can be caused by excessively high current from the batteries. Repeat the calibration at a lower current by changing the numbers in the message shown in step 6 to 111 010 1 or 111 100 1.*

Note *If a message reading" Error: >15%" appears, calibration has been rejected because it deviates too much from a calculated standardized value. Press <ESC> to repeat the calibration or to select "No" for this main step of the calibration. If you skipped one of the main steps in the calibration procedure (internal current for example) the calibration value for the skipped main step will be set to a calculated standardized value.*

3. Calibrating internal and external voltage

1] Message reading:

Calibrate V?
No

2] Change to "Yes" using the vertical arrow keys (▼ or ▲).
The voltage measurement range must be calibrated at two points, hereinafter designated P1 and P2.
Recommendation: Calibrate P1 at 12 V and P2 close to the top of the range or close to the highest voltage at which TORKEL is to be used.
Ranges:
TORKEL 820: 0-60 V
TORKEL 840: 0-288 V
TORKEL 860: 0-480 V

3] Connect a stable variable voltage source to the battery current terminals on TORKEL.

4] Connect the same voltage source to the "VOLTAGE SENSE" input.

5] Connect an accurate reference instrument (voltmeter) across the voltage source.

6] Adjust the voltage source to the first point (P1) at which the voltage measurement is to be calibrated.
Recommended voltage: 12 V.

7] Press <ENTER>.
Message reading:

Please wait…
20sec

Switch on F1
Press ENTER

8] Set switch F1 to its upper (ON) position.

9] Press <ENTER>
Message reading:

P1
Input: 012.00V

10] Change the voltage shown on the display to the value read from the reference instrument (voltmeter).

11] Press <ENTER>.

Note *If a message reading* ***"Error !!! Input too low"*** *appears, check that the voltage source is connected properly to the "VOLTAGE SENSE" input and also the terminals used for the battery current.*

12] Message reading:

P2: max. 480V
Input: 450.00V

13] Adjust the voltage source to the value to be used for point 2 (P2).

Note *The P2 value suggested by TORKEL is different for TORKEL 820, TORKEL 840 and TORKEL 860.*
Change the voltage shown on the TORKEL display to the value read from the reference instrument (voltmeter).

14] Press <ENTER>.
Message reading:

Disconnect
Battery!

15] Disconnect TORKEL from the voltage source. F1 will trip.

4. Calibrating of external current

1] Message reading:

CALIBRATE Ext.I ?
No

2] Change to "Yes" using the vertical arrow keys (▼ or ▲).

Calibration must be done at two points, called P1 and P2.

3] Press <ENTER>
Message reading:

P1:10mV
Input: 010.00mV

4] Connect the voltage source to the EXTERNAL CURRENT MEASUREMENT input.
Adjust the voltage source to the value to be used for point 1 (P1).
Measure the voltage with a reference instrument. Change the voltage shown on the TORKEL display to the value read from the reference instrument (voltmeter).

5] Press <ENTER>.
Message reading:

P2: 900mV
Input: 900.00mV

6] Adjust the voltage source to the value to be used for point 2 (P2).
Change the voltage shown on the TORKEL display to the value read from the reference instrument (voltmeter).

7] Press <ENTER>.
Message reading:

PRESS ENTER TO
STORE CALIB DATA

8] Press <ENTER>
Message reading:

MAIN MENU
Test battery

Connect
Battery !

Calibration is now completed.

16.3 Resetting TORKEL

General

This procedure has two purposes:

- To set the calibration values to calculated standardized values (useful if the calibration has become invalid or is lost).
- To restore the contents of the control memory after a message reading **"Checksum error"** has appeared.

Resetting TORKEL can never be fully equivalent with regular calibration carried out using accurate and traceable reference instruments. However, it provides you with a quick and simple way to deal with a situation in which no calibration values at all are available. The result of the reset procedure is about 1 to 3% accurate except for the external current measurement where the accuracy will be poorer. Resetting must always be followed by calibration of the zero levels, which is a part of the regular calibration procedure. A complete calibration procedure should be conducted as soon as possible however.

It is possible to combine resetting and calibration. First perform a reset and then calibrate the measurement ranges for which required sources are available. Answer "No" for the ranges that cannot be calibrated. Standard calibration values will then be used for these ranges.

Note *When a reset is performed on TORKEL the settings will be changed to the factory (default) settings.*

Performing a reset

1] Press the <ESC> key and the arrow up (▲) key simultaneously while switching on TORKEL.

2] Press <ENTER> to confirm the reset as prompted on the display.

17 Specifications

TORKEL 820

Specifications are valid at nominal input voltage and an ambient temperature of +25°C, (77°F). Specifications are subject to change without notice.

Environment	
Application field	The instrument is intended for use in high-voltage substations and industrial environments.
Temperature	
Operating	0°C to +40°C (32°F to +104°F)
Storage & transport	-40°C to +70°C (-40°F to +158°F)
Humidity	5% – 95% RH, non-condensing
CE-marking	
LVD	2006/95/EC
EMC	2004/108/EC
General	
Mains voltage	100 – 240 V AC, 50/60 Hz
Power consumption (max)	150 W
Protection	Thermal cut-outs, automatic overload protection
Dimensions	
Instrument	210 x 353 x 700 mm (8.3" x 13.9" x 27.6")
Transport case	265 x 460 x 750 mm (10.4" x 18.1" x 29.5")
Weight	22.3 kg (49.2 lbs) 40.4 kg (89.1 lbs) with accessories and transport case
Display	LCD
Available languages	English, French, German, Spanish, Swedish
Measurement section	
Current measurement	
Display range	0.0 – 2999 A
Basic inaccuracy	±(0.5% of reading +0.2 A)
Resolution	0.1 A
Internal current measurement	
Range	0 – 300 A
Input for clamp-on ammeter	
Range	0 – 1 V
mV/A-ratio	Software settable, 0.3 to 19.9 mV/A
Input impedance	>1 MΩ
Voltage measurement	
Display range 0.0 – 60 V	
Basic inaccuracy	±(0.5% of reading +0.1 V)
Resolution	0.1 V
Display range 0.0 – 500 V	
Basic inaccuracy	±(0.5% of reading +1 V)
Resolution	0.1 V
Time measurement	
Basic inaccuracy	±0.1% of reading ±1 digit

Storage of measured values	
TORKEL stand alone	
Time (max)	10 h
Time interval	6 s
TORKEL Win	
Time (max)	24 h
Time interval	1 – 24 s
Load section	
Battery voltage	10 – 60 V DC
Max. current	270 A
Max. power	15 kW
Load patterns	Constant current, constant power, constant resistance, current or power profile
Current setting	0-270.0 A (2999.9 A) [1]
Power setting	0-15.00 kW (299.99 kW) [1]
Resistance setting	0.1-2999.8 Ω
Battery voltage range	2 ranges, selected automatically at start of test
Stabilization (For internal current measurement)	±(0.5% of reading + 0.5 A)

	Battery voltage	***Highest permissible current***	***Resistor element (Nominal values)***
Range 1	10 – 27.6 V	270 A	0.069 Ω
Range 2	10 – 55.2 V	270 A	0.138 Ω

1) Maximum value for a system with more than one load unit

Inputs, maximal values	
EXTERNAL CURRENT MEASUREMENT	1 V DC, 300 V DC to ground. Current shunt should be connected to the negative side of the battery
START/STOP	Closing/opening contact Closing and then opening the contact will start/stop TORKEL. It is not possible to keep the contacts in closed position. (Min. time open is 25 ms).
Delay until start	200 – 300 ms
Stop delay	100 – 200 ms
Battery	60 V DC, 500 V DC to ground
VOLTAGE SENSE	60 V DC, 500 V DC to ground
SERIAL	< 15 V
ALARM	250 V DC 0.28 A 28 V DC 8 A 250 V AC 8 A
Outputs, maximal values	
START/STOP	5 V, 6 mA
TXL	Relay contact
SERIAL	< 15 V
ALARM	Relay contact

Discharging capacity, examples		
12 V battery (6 cells) [2)]		
Final voltage	***Constant current***	***Constant power***
1.80 V/cell (10.8 V)	0 – 121 A	0 – 1.31 kW
1.75 V/cell (10.5 V)	0 – 117 A	0 – 1.23 kW
1.67 V/cell (10.0 V)	0 – 110 A	0 – 1.10 kW
24 V battery (12 cells) [2)]		
1.80 V/cell (21.6 V)	0 – 270 A	0 – 5.8 kW
1.75 V/cell (21.0 V)	0 – 266 A	0 – 5.59 kW
1.60 V/cell (19.2 V)	0 – 241 A	0 – 4.63 kW
48 V battery (24 cells) [2)]		
1.80 V/cell (43.2 V)	0 – 270 A	0 – 11.6 kW
1.75 V/cell (42.0 V)	0 – 270 A	0 – 11.3 kW
1.60 V/cell (38.4 V)	0 – 259 A	0 – 9,9 kW

2) 2.15 V per cell when test starts

TORKEL 840/860

Specifications are valid at nominal input voltage and an ambient temperature of +25°C, (77°F). Specifications are subject to change without notice.

Environment	
Application field	The instrument is intended for use in high-voltage substations and industrial environments.
Temperature	
Operating	0°C to +40°C (32°F to +104°F)
Storage & transport	-40°C to +70°C (-40°F to +158°F)
Humidity	5% – 95% RH, non-condensing
CE-marking	
LVD	2006/95/EC
EMC	2004/108/EC
General	
Mains voltage	100 – 240 V AC, 50/60 Hz
Power consumption (max)	150 W
Protection	Thermal cut-outs, automatic overload protection
Dimensions	
Instrument	210 x 353 x 700 mm (8.3" x 13.9" x 27.6")
Transport case	265 x 460 x 750 mm (10.4" x 18.1" x 29.5")
Weight	21.5 kg (47.4 lbs) 38 kg (83.8 lbs) with accessories and transport case.
Display	LCD
Available languages	English, French, German, Spanish, Swedish
Measurement section	
Current measurement	
Display range	0.0 – 2999 A
Basic inaccuracy	±(0.5% of reading +0.2 A)
Resolution	0.1 A
Internal current measurement	
Range	0 – 300 A
Input for clamp-on ammeter	
Range	0 – 1 V
mV/A-ratio	Software settable, 0.3 to 19.9 mV/A
Input impedance	>1 MΩ
Voltage measurement	
Display range 0.0 – 60 V	
Basic inaccuracy	±(0.5% of reading +0.1 V)
Resolution	0.1 V
Display range 0.0 – 500 V	
Basic inaccuracy	±(0.5% of reading +1 V)
Resolution	0.1 V
Time measurement	
Basic inaccuracy	±0.1% of reading ±1 digit
Storage of measured values	
TORKEL stand alone	
Time (max)	10 h
Time interval	6 s
TORKEL Win	
Time (max)	24 h
Time interval	1 – 24 s

Load section

Max. battery voltage	288 V DC (TORKEL 840) 480 V DC (TORKEL 860)
Max. current	110 A
Max. power	15 kW
Load patterns	Constant current, constant power, constant resistance, current or power profile
Current setting	0-110.0 A (2999.9 A) [1]
Power setting	0-15.00 kW (299.99 kW) [1]
Resistance setting	0.1-2999.8 Ω
Battery voltage range, TORKEL 840	4 ranges, selected automatically at start of test
Battery voltage range, TORKEL 860	5 ranges, selected automatically at start of test
Stabilization (For internal current measurement)	±(0.5% of reading +0.5 A)

	Battery voltage	***Highest permissible current***	***Resistor element (Nominal values)***
Range 1	10 – 27.6 V	110 A	0.165 Ω
Range 2	10 – 55.2 V	110 A	0.275 Ω
Range 3	10 – 144 V	110 A	0.55 Ω
Range 4	10 – 288 V	55 A	3.3 Ω
Range 5 [2]	10 – 480 V	55 A (max power 15 kW)	3.3 Ω

1) Maximum value for a system with more than one load unit

2) TORKEL 860

Inputs, maximal values

EXTERNAL CURRENT MEASUREMENT	1 V DC, 300 V DC to ground. Current shunt should be connected to the negative side of the battery
START/STOP	Closing/opening contact Closing and then opening the contact will start/stop TORKEL. It is not possible to keep the contacts in closed position. (Min. time open is 25 ms).
Delay until start	200 – 300 ms
Stop delay	100 – 200 ms
Battery	480 V DC, 500 V DC to ground
VOLTAGE SENSE	480 V DC, 500 V DC to ground
SERIAL	< 15 V
ALARM	250 V DC 0.28 A 28 V DC 8 A 250 V AC 8 A

Outputs, maximal values

START/STOP	5 V, 6 mA
TXL	Relay contact
SERIAL	< 15 V
ALARM	Relay contact

Discharging capacity, examples

Final voltage	***Constant current***	***Constant power***
12 V battery (6 cells) [3]		
1.80 V/cell (10.8 V)	0 – 50.0 A	0 – 0.54 kW
1.75 V/cell (10.5 V)	0 – 49.0 A	0 – 0.51 kW
1.67 V/cell (10.0 V)	0 – 46.0 A	0 – 0.46 kW
24 V battery (12 cells) [3]		
1.80 V/cell (21.6 V)	0 – 110 A	0 – 2.37 kW
1.75 V/cell (21.0 V)	0 – 110 A	0 – 2.31 kW
1.60 V/cell (19.2 V)	0 – 100 A	0 – 1.92 kW
48 V battery (24 cells) [3]		
1.80 V/cell (43.2 V)	0 – 110 A	0 – 4.75 kW
1.75 V/cell (42.0 V)	0 – 110 A	0 – 4.62 kW
1.60 V/cell (38.4 V)	0 – 110 A	0 – 4.22 kW
110 V battery (54 cells) [3]		
1.80 V/cell (97.2 V)	0 – 110 A	0 – 10.7 kW
1.75 V/cell (94.5 V)	0 – 110 A	0 – 10.4 kW
1.60 V/cell (86.4 V)	0 – 110 A	0 – 9.5 kW
120 V battery (60 cells) [3]		
1.80 V/cell (108 V)	0 – 110 A	0 – 11.9 kW
1.75 V/cell (105 V)	0 – 110 A	0 – 11.5 kW
1.60 V/cell (96 V)	0 – 110 A	0 – 10.5 kW
220 V battery (108 cells) [3]		
1.80 V/cell (194 V)	0 – 55 A	0 – 10.7 kW
1.75 V/cell (189 V)	0 – 55 A	0 – 10.4 kW
1.60 V/cell (173 V)	0 – 51.0 A	0 – 8.82 kW
240 V battery (120 cells) [3]		
1.80 V/cell (216 V)	0 – 55 A	0 – 11.9 kW
1.75 V/cell (210 V)	0 – 55 A	0 – 11.5 kW
1.60 V/cell (192 V)	0 – 55 A	0 – 10.5 kW
UPS battery (180 cells) [3] (TORKEL 860)		
1.70 V/cell (306 V)	0 – 38 A	0 – 15 kW
1.60 V/cell (288 V)	0 – 38 A	0 – 15 kW
UPS battery (204 cells) [3] (TORKEL 860)		
1.80 V/cell (367 V)	0 – 34 A	0 – 15 kW
1.60 V/cell (326 V)	0 – 34 A	0 – 15 kW

3) 2.15 V per cell when test starts

TXL830/850/870/890

Specifications are valid at nominal input voltage and an ambient temperature of +25°C, (77°F). Specifications are subject to change without notice.

Environment	
Application field	The instrument is intended for use in high-voltage substations and industrial environments.

Temperature	
Operating	0°C to +40°C (32°F to +104°F)
Storage & transport	-40°C to +70°C (-40°F to +158°F)
Humidity	5% – 95% RH, non-condensing

CE-marking	
LVD	2006/95/EC
EMC	2004/108/EC

General	
Mains voltage	100 – 240 V AC, 50/60 Hz
Power consumption	75 W *(max)*
Protection	Thermal cut-outs, automatic overload protection
Dimensions	
Instrument	210 x 353 x 600 mm (8.3" x 13.9" x 23.6")
Transport case	265 x 460 x 750 mm (10.4" x 18.1" x 29.5")
Weight	13 kg (29 lbs) 21.4 kg (47 lbs) with transport case
Cable sets	
for TXL830/850	2 x 3 m (9.8 ft), 70 mm2, 270 A, with cable lug. Max. 100 V. 5 kg (11 lbs)
for TXL870/890	2 x 3 m (9.8 ft), 25 mm2, 110 A, with cable clamp/lug. Max. 480 V. 3 kg (6.6 lbs)

Load section	***TXL830***	***TXL850***	***TXL870***	***TXL890***
Voltage (DC) max.	28 V	56 V	140/280 V	230/480 V
Current max.	300 A	300 A	112 A at 140 V 56 A at 280 V	63 A at 230 V 32 A at 480 V
Power max.	8.3 kW	16.4 kW	15.8 kW	15.4 kW

Internal resistance, 3-position selector				
Position 1	***TXL830***	***TXL850***	***TXL870***	***TXL890***
Current	0.275 Ω	0.55 Ω	4.95 Ω	14.10 Ω
100 A	at 27.6 V (12 x 2.3 V)	at 55.2 V (24 x 2.3 V)	–	–
78.5 A	at 21.6 V (12 x 1.8 V)	at 43.2 V (24 x 1.8 V)	–	–
50.1 A	–	–	at 248.4 V (108 x 2.3 V)	–
39.2 A	–	–	at 194.4 V (108 x 1.8 V)	–
32.3 A	–	–	–	at 469.2 V (204 x 2.3 V)
26.0 A	–	–	–	at 367.2 V (204 x 1.8 V)
Position 2	***TXL830***	***TXL850***	***TXL870***	***TXL890***
Current	0.138 Ω	0.275 Ω	2.48 Ω	7.05 Ω
200 A	at 27.6 V	at 55.2 V (24 x 2.3 V)	–	–
156 A	at 21.6 V	43.2 V (24 x 1.8 V)	–	–
35.2 A	–	–	–	at 248.4 V (108 x 2.3 V)
27.8 A	–	–	–	at 194.4 V (108 x 1.8 V)
Position 3	***TXL830***	***TXL850***	***TXL870***	***TXL890***
Current	0.092 Ω	0.184 Ω	1.24 Ω	3.52 Ω
300 A	at 27.6 V	at 55.2 V (24 x 2.3 V)	–	–
235 A	at 21.6 V	43.2 A (24 x 1.8 V)	–	–
100 A	–	–	at 124.2 V (54 x 2.3 V)	–
78.4 A	–	–	at 97.2 V (54 x 1.8 V)	–
70.5 A	–	–	–	at 248.4 V (108 x 2.3 V)
55.2 A	–	–	–	at 194.4 V (108 x 1.8 V)

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