User manual for TSM-LC-N

Thyristor module for dynamic power factor correction

Series/Type:
Ordering code:

Date: December 2020
Version: 2.2

General

The TSM-LC-N for dynamic PFC is a fast electronically controlled, self-observing thyristor switch for capacitive loads up to 50 kvar (380 to 440 VAC) which is capable to switch PFC capacitors within a few milliseconds as often and as long as required without abrasion.
Triggering can be done by means of dynamic power factor controllers, programmable logic controllers (PLC) or directly out of the technologic process.

- Thyristor module for dynamic compensation systems in grids from 380 to 440 V, 50/60 Hz, for 25 to 50 kvar
- Follow-on development TSM-LC-N
- Optimized switching behaviour by micro-processor controlled alignment to capacitor branches with detuning reactor or without (current limiting reactor 0.2% or 1%)
- No wear-out parts (no fan)
- Monitoring of voltage, phase and temperature; status via LEDs
- Switching without delay
- No auxiliary voltage required
- Maintenance free, long service life
- Enhanced connection via plugs
- Enhanced temperature management by disconnecting the complete module in case of over temperature fault, so that cooling of heat sink can be fast to switch it again.

Applications

Dynamical compensation in fast processes like:

- Presses
- Welding machines
- Elevators,
- Cranes,
- Wind turbines

Mounting and connection

The mechanical mounting is done directly on a mounting plate. The main terminals can be directly connected via lines to the main fuse resp. capacitor. (max. 35 mm^2).

Connection is done according picture 1. It is mandatory to use superfast electronic fuses as branch fuses to protect the semiconductor device! Basics of dimensioning must be obeyed!

Triggering of the module is taking place without any time delay by a 10 to 24 VDC signal (coming from the PFC-controller or an adequate control system) fed in at the connection X1 (signal).

If an increase of the stage output is needed, a cascading of several modules is possible.

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Putting into operation

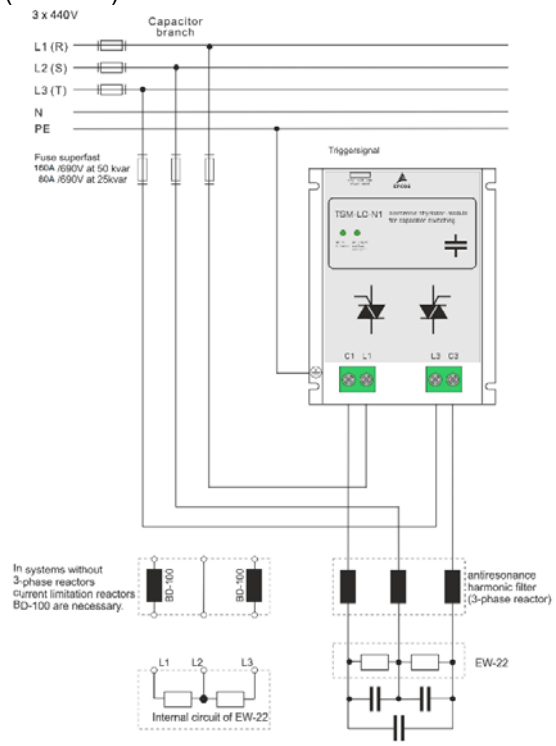
After switching on the net voltage (engaging of the branch fuse) the thyristor module is ready for operation.
The thyristor module has 2 status-LEDs with the following meaning:

LED - left side Green	Operating voltage activated, thyristor module standby
Red permanent	Capacitor without capacitance or not existant; thyristor or fuse defect
Red flashing	Net voltage L1/L3 missing or too low
LED - right side Green	”Module ON“ (Trigger)
Red flashing	Over-temperature

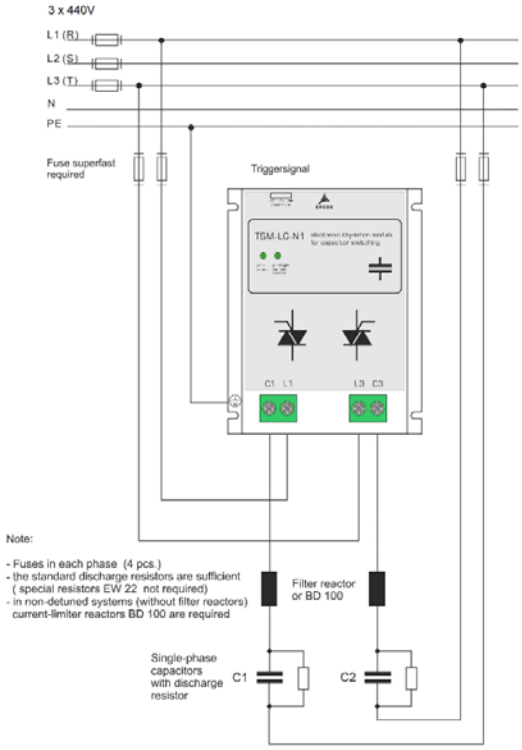
Technical data

Net voltage	380 ... 440 V - 50/60 Hz
Max. power	Max. 75 A (up to 50 kvar/400 V)
Activation	10...24 VDC (approx. 10 mA) via terminal clamp, internally insulated
Switching-on time	Approx. 5 ms
Re-switching time	Depending on degree of de-tuning and dimension of discharge resistor
Display	Via 2 LEDs
Monitoring	Permanent monitoring of net voltage, true current, and temperature and operation status. Before re-switching after temperature fault, heat sink temperature must be below 50 °C (hysteresis)! The over temperature trip limit is set at 80 ºC (±5 º C)
Power circuit	Direct connection 4-pole via high-current clamps (cables 35 mm^2), connection from bottom
Max. RMS-current	100 A - No continuos current - thermal load has to be considered!
Power dissipation	Pv (W) = 2.0 x I (in A); at 400 V / 50 kvar typical 150 W
Max. voltage	440 V
Fuses	3x electronic fuse „superfast“ (BS 88 AC 690V) 50 kvar: 160 A (e.g. Cooper Bussmann Part.No.:160EET) 25 kvar: 80 A (e.g. Cooper Bussmann Part No. : 80ET)
Dimensions	157 x 200 x 180 (w x h x d)
Weight	4.8 kg
Assembling	Direct mounting on mounting plate
Mounting position	Vertical, minimum 150 mm distance upwards, downwards and from sides
Operating ambient temperature with nominal load	-10 ... 55 °C

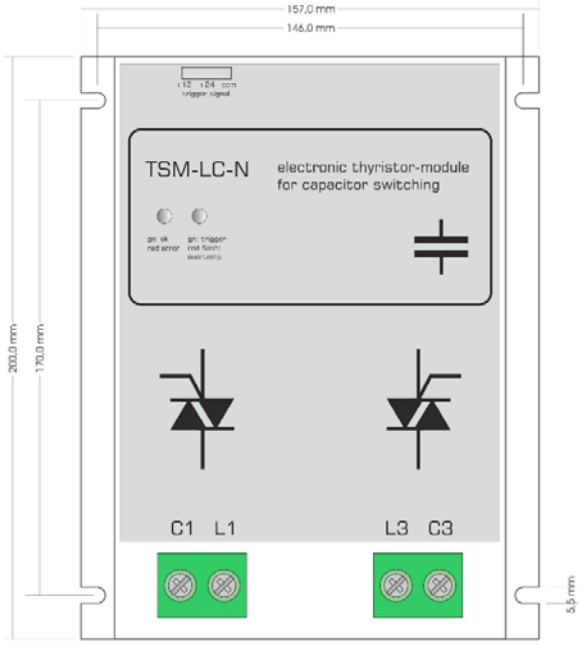
Pict.1: Connection diagram three phase load (standard)



Pict.2: Connection diagram two phase load



Pict.3: Dimensions TSM-LC-N



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Attention: Please follow SAFETY INSTRUCTIONS!

General

- The TSM-LCN thyristor-modules may only be used according their intended utilization.
- The TSM-LCN thyristor-modules must only be used in combination appropriate safety devices (e.g. superfast fuses).
- The TSM-LCN thyristor-modules have to be projected in such a way that no uncontrolled high currents and voltages can occur in case of faults.
- The devices have to be protected against humidity and dust – a sufficient ventilation has to be assured.
- The TSM-LCN thyristor-modules must only be switched to the net if any harm or danger to human beings or the PFC-system is eliminated.

Due to the switching principle of the thyristor modules the PFC-capacitors are permanently loaded at the peak value of the grid voltage (DC current) even when they are disconnected! Therefore, the following instructions have to be obeyed:

- In non-detuned systems (with 0.2% or 1% current limiting reactor) (400 V grid) you need capacitors with a voltage of 440 V!
- In detuned systems (440 V grid) you need capacitors with a voltage of 525 V!
- For discharging the capacitors special high-voltage resistors are required (e.g. type EW22) Standard resistors cannot be used. Remove the discharge resistor of capacitors and connect EW22 discharge resistor separately.
- In dynamic PFC-systems with TSM-LCN thyristor-modules not to be used with fast discharge reactors. (reactor = direct current short circuit.)
- In non-detuned PFC-systems (without reactors) 2 current limitation reactors per thyristor-module are mandatory! Available as accessory (BD100).
- The TSM-LCN thyristor modules have to be protected by superfast electronic fuses in any case. Dimensioning principles have to be observed. Fuses in the PFC-system must be marked!
- Due to the special switching the PFC-capacitors are fully loaded even if the step is switched off. An appropriate protection against touch must be assured!
- Even when electronic switches are turned off, no electrical isolation is given. Therefore even after switching off the complete PFC-system (main circuit breaker), parts of the PFC-system must only be touched after the discharge-time of the PFC-capacitor elapsed.
- In the PFC-system warning signs indicating the presence of residual voltage even at disconnected stage have to be visible.

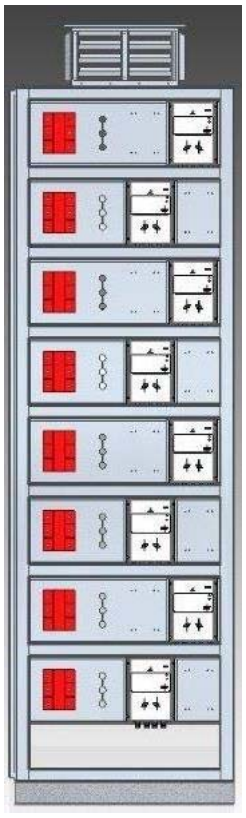
Maintenance, repair

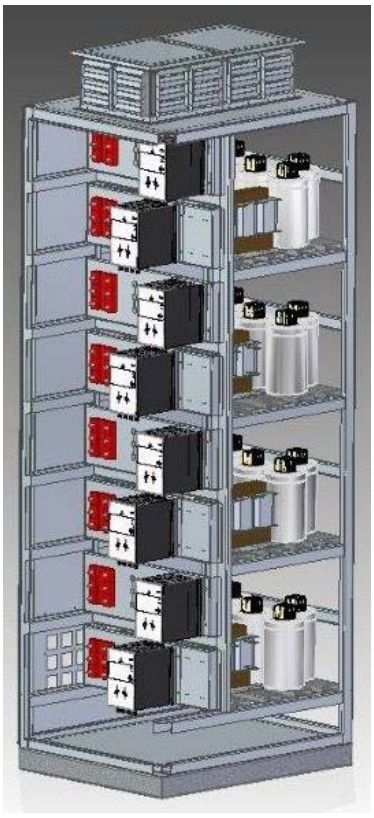
The TSM-LCN thyristor-switch has to be deactivated for maintenance purpose and main circuit breaker must be released. It must be assured that it cannot be switched on during maintenance. It must be checked that there is no voltage at all. Maintenance must only be executed by specially skilled personnel.

In case any repairs are needed, this must only be done from the manufacturers of the TSM hyristor-module!

Tips on design of Thyristor Switched APFC Panel to ensure intended life of TDK Electronics Components

1) TSM Mounting arrangement in Zig zag manner. So that the TSM mounted on top side should not affect due to heating of TSM mounted below. Refer the picture for more clarity.

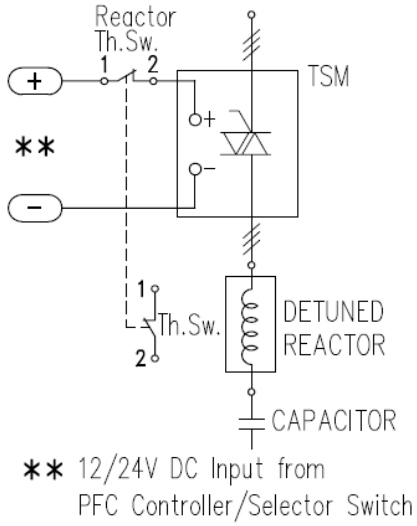




2) Select the appropriate fan size as per required air flow inside the panel around the components i.e. 1.2 m/sec.
3) Fans are mounted on top side of the panel and louvers at the bottom side.

Note: There should not any barrier between two feeder's TSM, so that hot air inside the panel can be thrown out from top side (hood) more efficiently.

4) High speed fuse is the mandatory requirement. Thyristor is the electronic device to protect the electronic device high speed fuse required. In some cases end user used the MCCB, SD, SFU along with thyristor for isolate the power connections, in this case high speed fuse used mandatory in series with TSM supply.
5) Connect earth to each thyristor module.
6) The selection of fan size depends on the total power consumed inside the panel and the total surface area for heat dissipation. So while calculating the Fan size or air flow consider the total watt loss inside the panel means summation of all individual components losses.
7) Thyristor switched module always used with detuned reactor, hence the trigger input of each thyristor must be in series with thermal switch detuned reactor.



8) Minimum clearance required around the APFC panel.
Front- 1000/1500 mm. Rear-more than 750 mm and from side-minimum 500 mm.

9) While performing the HV test on Thyristor switched APFC panel recommended to shorted all the power terminals of module and perform the test between shorted terminals and earth.

Do not perform the Phase to phase HV test of thyristor.

10) For connection use PVC copper flexible wire with lug and use 35 mm^2/ 16 mm^2 copper flexible wire for 50 kvar / 25 kvar with lugs.
Use special sleeved tubular lugs and crimping tool as shown below.
Use torque min. 2 Nm, max 4 Nm for connection

For 50 kvar – EHI 35-18 (Make Ashwin tools)
For 25 kvar – EHI 16-18 (Make Ashwin tools)

<table>
<tr><th>Lug details</th><th>Crimping tool details</th><th>Crimping method of lug with copper flexible wire</th></tr>
<tr>
<td>  </td>
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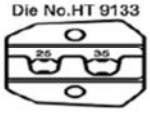
<table>
<tr><td>Specification</td><td>AWG 4/2 DIN 25 /35mm^2</td></tr>
<tr><td>Crimping Cable size</td><td>25 /35mm2</td></tr>
<tr><td>Lug</td><td>Nylon-Insulated Cord End Terminals 25 /35mm2</td></tr>
</table>
Die No.HT 9133


<table>
<tr><td>Specification</td><td>AWG 10/6 DIN 6 /16mm^2</td></tr>
<tr><td>Crimping Cable size</td><td>6 / 16mm2</td></tr>
<tr><td>Lug</td><td>Nylon-Insulated Cord End Terminals 6 /16mm2</td></tr>
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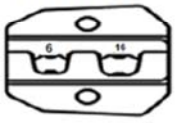
Die No. HT 9171


</td>
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</tr>
<tr><th>Lug after crimping with copper flexible wire</th><th colspan="2">Connections of copper flexible wire with lug and TSM LCN</th></tr>
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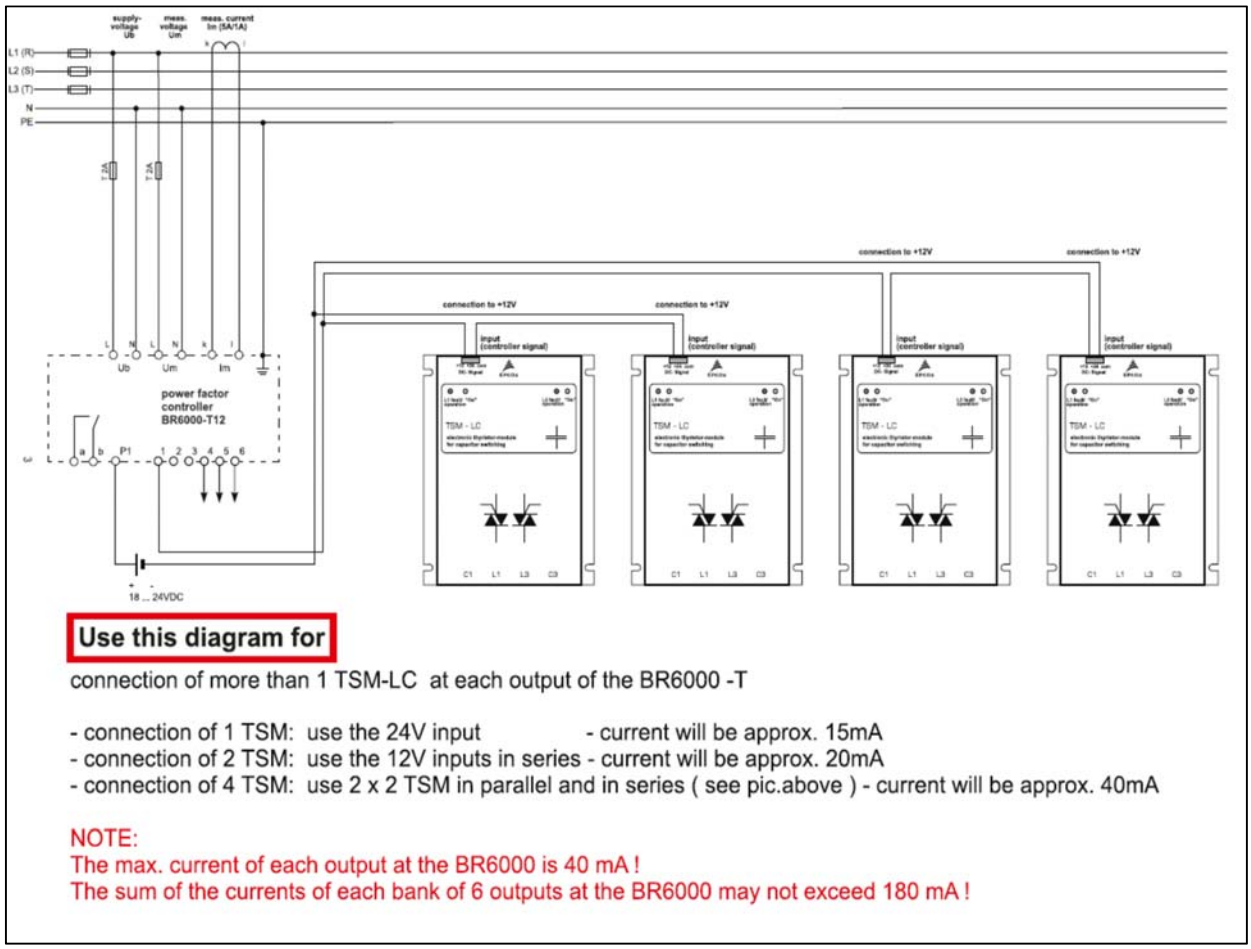
Caution

If user /Panel builders are use the flexible copper cables without lugs for connection, must ensures that no shorting of power cable strands with cover near connection terminals. Use proper sleeve for copper flexible wire.



Use this diagram for

connection of more than 1 TSM-LC at each output of the BR6000 -T

- connection of 1 TSM: use the 24V input - current will be approx. 15mA
- connection of 2 TSM: use the 12V inputs in series - current will be approx. 20mA
- connection of 4 TSM: use 2 x 2 TSM in parallel and in series (see pic.above) - current will be approx. 40mA

NOTE:
The max. current of each output at the BR6000 is 40 mA !
The sum of the currents of each bank of 6 outputs at the BR6000 may not exceed 180 mA !

Disposal

The Thyristor switching module contains certain components which can dispose as per recommendation.

The recommended disposal practice for components are as indicated below:

Please refer to prevailing statutory norms, local regulations, standards and guidelines before actual disposal.

Sr. No.	Item	**Major Materials used**	Recommended disposal method.
1	Power transformer	Copper Lamination (CRGO/CRNGO)	Recycle Recycle
2	Capacitors	Ceramic	Refer general disposal guideline for material
3	PCB	Glass fiber reinforced (fiberglass) Copper	Refer general disposal guideline for material Recycle
4	Electrolytic capacitor	Polluting gradients	Refer the general disposal guideline of Electrolytic capacitor
5	Thyristor device	DCB (direct copper bonding chip) Copper terminal	Refer the general disposal guideline of thyristor device

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Important notes

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