User manual for TSM-LC10

Thyristor module for dynamic power factor correction

Series/Type:
Ordering code:

Date: December 2020
Version: 2.1

General

The TSM-LC10 for dynamic PFC is a fast electronically controlled self-observing thyristor switch for capacitive loads up to max. 12.5 kvar 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.

- Component for the design of dynamic PFC-systems in 415 / 440 V-grids
- Micro-processor controlled alignment to tuned or de-tuned capacitor branches (up to 14%) for optimized switching behavior.

For capacitive loads up to 12.5 kvar

- Monitoring of voltage and phase sequence; display of status via LED
- No system perturbation due to switching operations (transients)
- Switching without delay Maintenance free
- Long useful service life
- No noise emission during switching operation
- Compact module ready for connection

Applications

Dynamical compensation in fast processes like:

- Pressing
- Welding machines
- Elevators
- Cranes
- Wind turbines etc.
  with fast changing and high fluctuating loads.

Mounting and connection

The mechanical mounting is done directly on a mounting plate. The main terminals are designed as clamps and can be directly connected to the branch fuse resp. to the capacitor.

Connection is done according picture 1. It is mandatory to use superfast electronic fuses as branch fuses of the TSM-module 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).

Putting into operation

After switching on the net voltage (engaging of the branch fuse) the thyristor module is ready for operation.

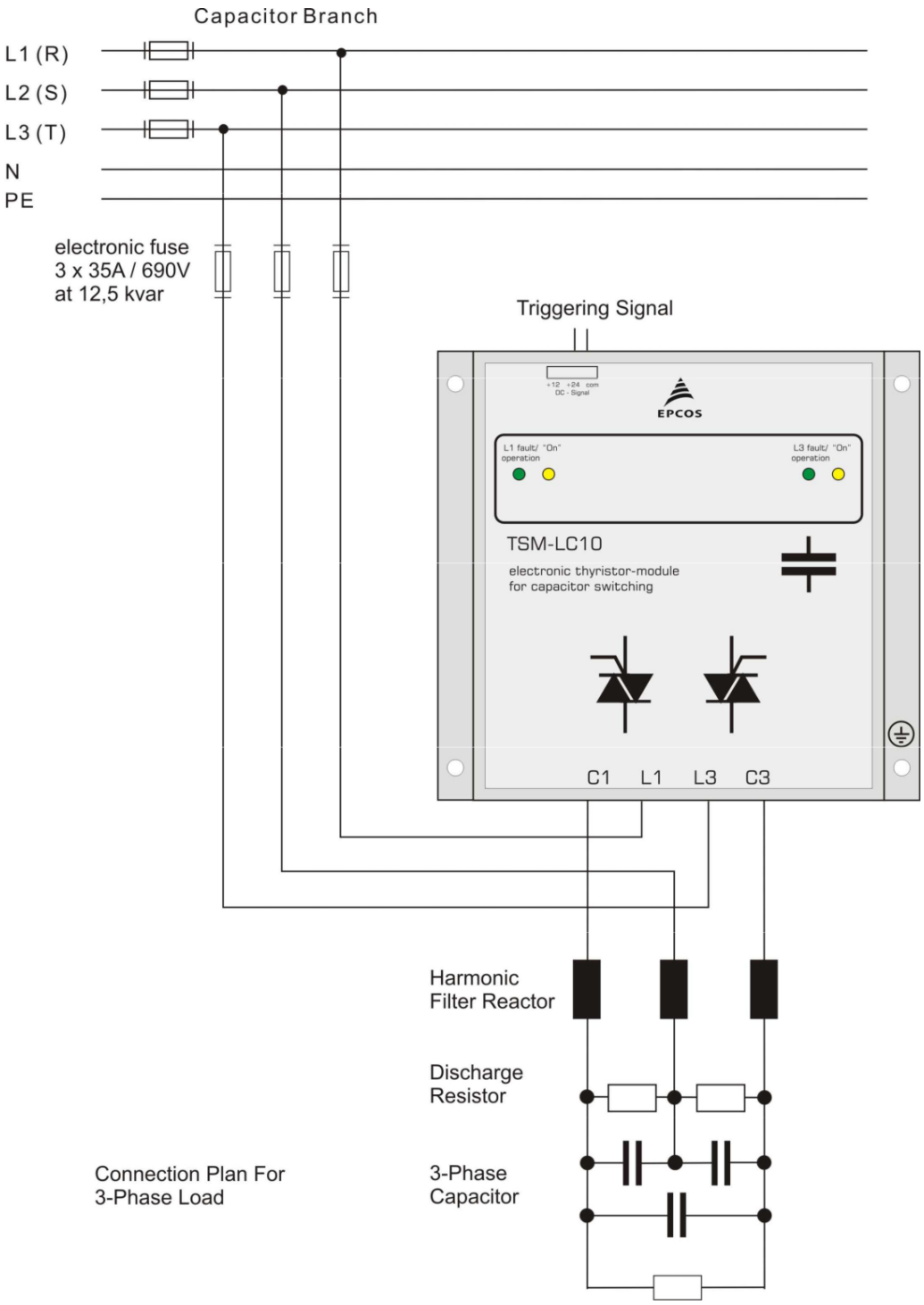
For each phase the thyristor module has 2 status-LEDs with the following meaning:

Green	Operating voltage activated, thyristor module standby
Red flashing	Phase voltage L1-L3 too low (under voltage <300 V)
Red permanent	Phase 2 is missing or under-voltage *or* phase L1 or L3 is missing *or* capacitor without capacitance or not existent
LED “On” (yellow)	“Module ON“

Technical data

Net voltage	415 … 440 V – 50/60 Hz
Switching capability	Nominal output 10 kvar at 415 / 440 V 12.5 kvar at 415 / 440 V with ambient temperature < 40 °C
Activation	10 ... 24 VDC (approx. 20 mA), via terminal clamp; internally insulated
Switching-on time	Approx. 5 ms
Re-switching time	Depending on degree of detuning and dimension of discharge resistor
Display	Via 4 LEDs : operation/error each phase, triggering signal
Monitoring	Permanent monitoring of net voltage and operation status
Power circuit	Direct connection 4-pole clamps, (D = 6mm² resp. 4 mm²) Connection from bottom
Max. voltage	In conventional PFC-systems (without reactors): 440 V - detuned 7%: 440 V - detuned 14%: 415 V
Power dissipation	Pv (W) = 2.0 x I (in A); at 400 V / 12.5 kvar typical 35 W therm.
Fuses	3x electronic fuse „superfast“ (BS 88 AC 690V) 12.5 kvar: 35 A (e.g. Cooper Bussmann part no. 35ET)
Dimensions	162 x 150 x 75 (w x h x d)
Mounting position	Vertical, min. 100 mm distance upwards and downwards
Weight	1.75 kg
Assembling	Direct mounting on mounting plate
Operating ambient temperature with nominal load	-10 ... 55 °C

Pict.1: Connection diagram: Three-phase load (standard)



December 2020

Attention: Please follow SAFETY INSTRUCTIONS!

General

- Thyristor-modules may only be used for the purpose they have been designed for.
- Thyristor-modules may only be used in combination with appropriate safety devices (e.g. superfast fuses).
- Thyristor-modules have to be projected in such a way that in case of any failure no uncontrolled high current and voltages may occur.
- The devices have to be protected against moisture and dust – a sufficient cooling has to be assured.
- 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 module the power-capacitors are permanently loaded to the peak value of the grid voltage (DC voltage) even when switched off! Therefore, following rules have to be obeyed in any case:

For PFC-systems in 415 / 400 V grids use capacitors of 525 V nominal voltage!

- In dynamic PFC-systems with TSM-modules no fast discharge reactors may be used (reactor = DC-wise short circuit).
- For tuned PFC- systems (without reactors) per thyristor module 2 current limitation reactors are mandatory! Available as accessory (BD100).
- Thyristor-modules in general have to be protected by superfast electronic fuses. Principles for dimensioning have to be considered. Fuses in the system have to be marked!
- Due to the special switching, the PFC-capacitors are fully loaded even when the particular step has been switched off. Protection against contact has to be guaranteed. Warning signals in the system are required!
- Even in switched off state no electrical isolation is achieved for electronic switches. Therefore, parts of the systems may not be touched after switching off the complete system before the capacitors have been completely discharged.

FAILURE TO FOLLOW CAUTIONS MAY RESULT, WORST CASE, IN PREMATURE FAILURES OR PHYSICAL INJURY.

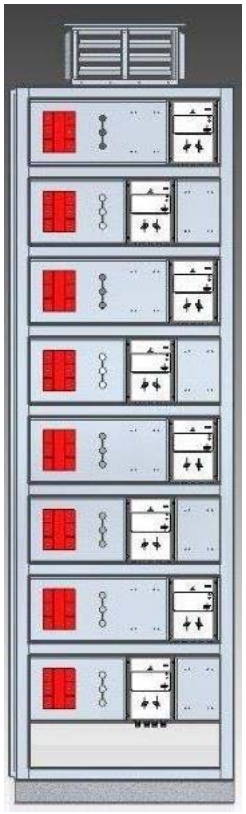
Maintenance, repair

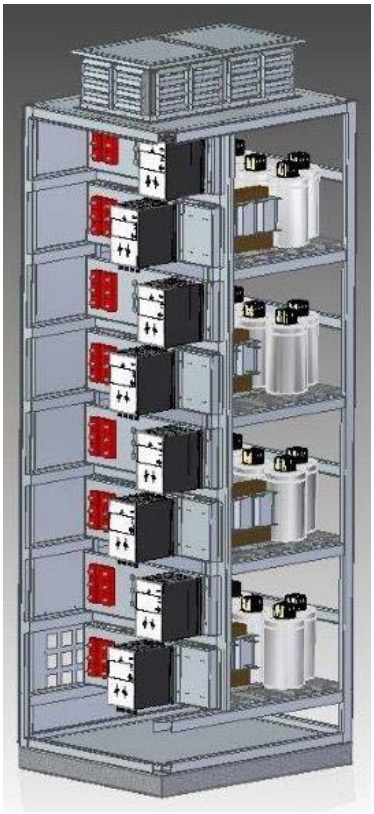
The thyristor-switch has to be deactivated for maintenance purpose and main circuit breaker must be released. It must be assured that it cannot be switched on during maintenance. It must be checked that there is no voltage at all. Maintenance must only be executed by specially skilled personnel.

In case any repairs are needed, this must only be done from the manufacturers of the TSM-thyristor-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.

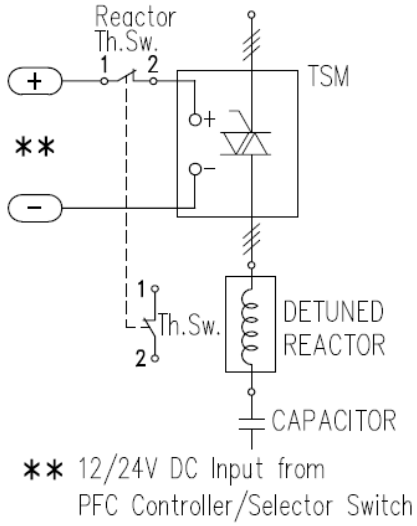
Note: There should not any barrier between two feeder's TSM, so that hot air inside the panel can be thrown out from top side (hood) more efficiently.

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.

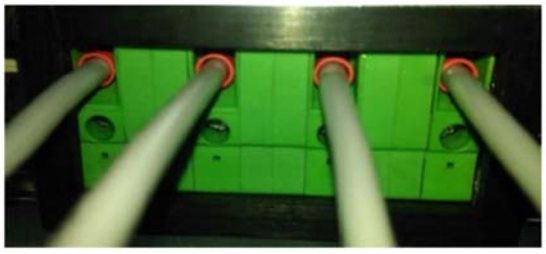
9) While performing the HV test on Thyristor switched APFC panel recommended to shorted all the power terminals of module and perform the test between shorted terminals and earth.

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

10) For connection use PVC copper flexible wire with lug and use 4 mm^2 copper flexible wire for 10 kvar with lugs.
Use special sleeved tubular lugs and crimping tool as shown below.
Use torque min. 0.5 Nm, max. 0.6 Nm for connection.

For 10 kvar – EHI 04-12 (Make Ashwin tools),
CCES-4012 Chetna Engg. Make).

Lug details	Crimping tool details	Crimping method of lug with copper flexible wire
 EHI-04-12 / CCES- 4012	HT 005 	
 EHI-04-12 / CCES- 4012	HT 005 SPL 	

Lug after crimping with copper flexible wire	Connections of copper flexible wire with lug and TSM LC10	
		

Caution
If user /Panel builders 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.

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

Display of ordering codes for TDK Electronics products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications, on the company website, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products**. Detailed information can be found on the Internet under www.tdk-electronics.tdk.com/orderingcodes.

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule we are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether a product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.tdk-electronics.tdk.com/material). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

   We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply.**
7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard.** The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements (“CSR”) TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System.** For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.

Important notes

8. The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, ModCap, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap, XieldCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.tdk-electronics.tdk.com/trademarks.

Release 2020-06