



## **Film Capacitors**

Installation and maintenance instructions for thyristor modules  
TSM-LC series

**Series/Type:** Thyristor modules TSM-LC  
**Ordering code:** B44066T....E402

<b>Read this first!</b>	Read the following »Installation and Maintenance Instructions« carefully before installing a thyristor module into your application.
<b>About this manual</b>	The information stated in this manual applies to typical, approved usage. Please refer to our product specifications, or request our approval for your own individual specifications, before installing thyristor modules. For detailed information about PFC key components and cautions, refer to the latest version of the EPCOS PFC Product Profile.
<b>Technical data</b>	For detailed technical data about thyristor modules, please refer to the datasheets available in the EPCOS-Internet.
<b>For your safety!</b>	Disregarding the guidelines in this manual can result in operational failure, bursting and fire. In case of doubt, contact your local EPCOS sales organization or distributor for assistance.
<b>General safety notes for installation and operation</b>	Ensure you are using the correct thyristor module type for your application. Please refer to the EPCOS product catalog for proper selection of modules. Please contact EPCOS for any assistance required in selection.
<b>Storage and operation conditions</b>	<ul style="list-style-type: none"> <li>■ Do not use or store thyristor modules in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or similar substances are present. In a dusty environment regular maintenance and cleaning is required.</li> <li>■ In the area of capacitor switching devices, flame retardant and self-extinguishing materials may be used only, because abnormal temperatures within the area of the resistance spirals cannot be excluded.</li> </ul>
<b>Caution!</b>	Thyristor modules should not be installed or used in case of mechanical or any other kind of damage!

**Description:**

The series TSM-LC for dynamic PFC are fast electronically controlled, self-observing thyristor switches for capacitive loads, which are capable to switch PFC capacitors within a few milliseconds as often and as long as required.

**Application:**

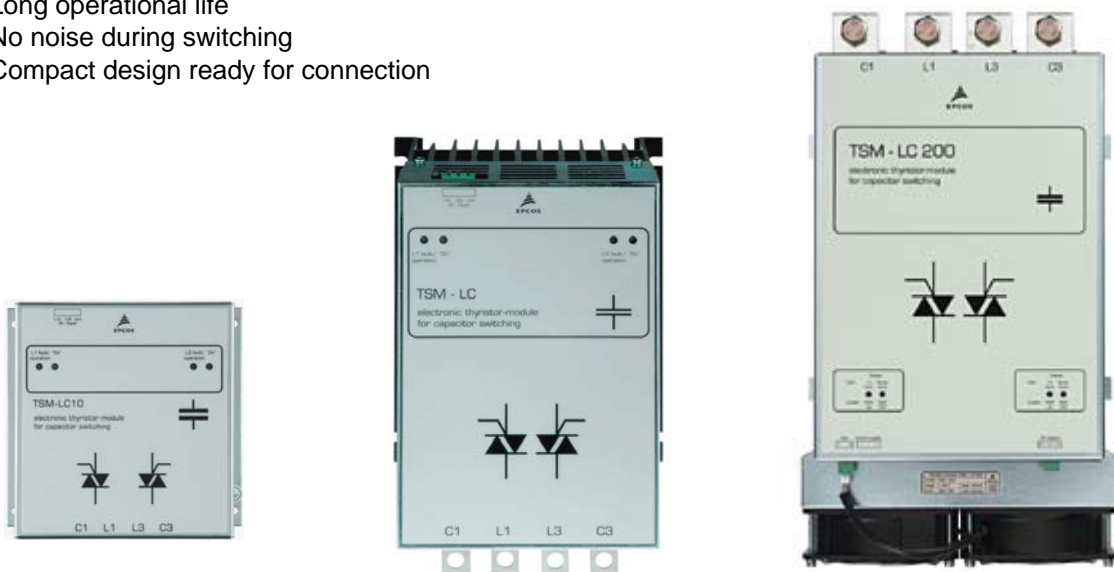
Dynamic (“real time”) PFC is usually applied for fast processes, e.g.

- pressing
- welding machines
- elevators
- cranes
- wind turbines etc.

with fast changing and high fluctuating loads.

Triggering can be done by means of dynamic power factor controllers, programmable logic controllers (PLC) or directly out of the respective installation by an adequate control signal.

- Component for the design of Dynamic PFC-systems in 380 V and 400 V-grids (50/60 Hz)
- Automatically adapted by microprocessor to de-tuned and conventional capacitor branches (up to 14%); therefore optimization of the switching behavior
- Available for capacitive loads from 10 to 200 kvar
- Monitoring of voltage, phase sequence, temperature
- Display of status via LED
- Switching without time lag
- No system perturbation caused by switching operations (no transients)
- TSM-LC100 and TSM-LC200: Auxiliary voltage 230 V AC needed for fan
- Maintenance free
- Long operational life
- No noise during switching
- Compact design ready for connection



### **Installation and connection of the TSM-LC**

The mechanical mounting is done directly on a mounting plate. The main terminals are designed as bus bars 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-LC-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 a dynamic PF controller or an adequate control system) fed in at the connection input signal. If an increase of the stage output is needed, a cascading of several modules is possible.

### **Usage of discharge resistors**

If fast re-switching time of capacitors is required, fast discharge resistors EW-22 (ordering code B44066T0022E400) have to be used. At least 1 piece per step has to be used for all types of TSM-LC.

TSM-LC10, TSM-LC25, TSM-LC50:	1 EW-22 needed
TSM-LC100:	1 – 2 EW-22 in parallel needed
TSM-LC200:	2 – 4 EW-22 in parallel needed

### **PFC systems without detuning reactors**

Current limitation reactor BD-100 (ordering code B44066T0100E400) has to be used for 10 kvar, 25 kvar or 50 kvar. 2 units per step required.

Note: BD-100 is not suitable for TSM-LC100, TSM-LC200 and TSM-HV200. In case of application without detuned reactors please contact your local TDK-EPC representative.

### **Putting into operation**

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

When switching on the voltage the first time, the internal processor will optimize the switching behavior to the connected steps (without reactors / de-tuned). This results in optimized switching times during operation later. These parameters are internally stored.

The TSM-LC features status-LEDs for each phase with the following functions:

- standby
- module on
- under-voltage
- phase missing
- over-temperature (varies depending on type of switch)

**Technical data**

Net voltage:	380 ... 400 V (50/60Hz)	
Auxiliary supply (applicable only for TSM-LC100 and TSM-LC200):	230 V AC	
Max. voltage allowed:	conventional PFC systems (without reactors)	440 V
	De-tuning factor 7%:	max 440 V (no upwards tolerance)
	De-tuning factor 14%:	400 V
Max. power:	TSM-LC 10:	up to 12.5 kvar
	TSM-LC 25:	up to 25 kvar
	TSM-LC 50:	up to 50 kvar
	TSM-LC100:	up to 100 kvar
	TSM-LC 200:	up to 200 kvar
Max. current:	depending on cooling and location of the system. In case of doubts, please contact your regional sales representative.	
Activation:	10 ... 24 V DC (ca. 20 mA) via terminal clamp, internally galvanic uncoupled	
Switching time:	ca. 5 ms	
Re-switching time:	depending on degree of detuning and dimension of the capacitor's discharge resistor	
Display:	via 2 LEDs per phase: Operation / Error plus triggering signal	
Monitoring:	permanent monitoring of net voltage, phase, temperature and operation status	
Main circuit:	direct connection 4-pole via bus bar	
Power dissipation:	$P_v (n W) = 2.0 \cdot I$ (in A) ; at 400 V / 50 kvar ca. 150 W	

## Film capacitors - PFC

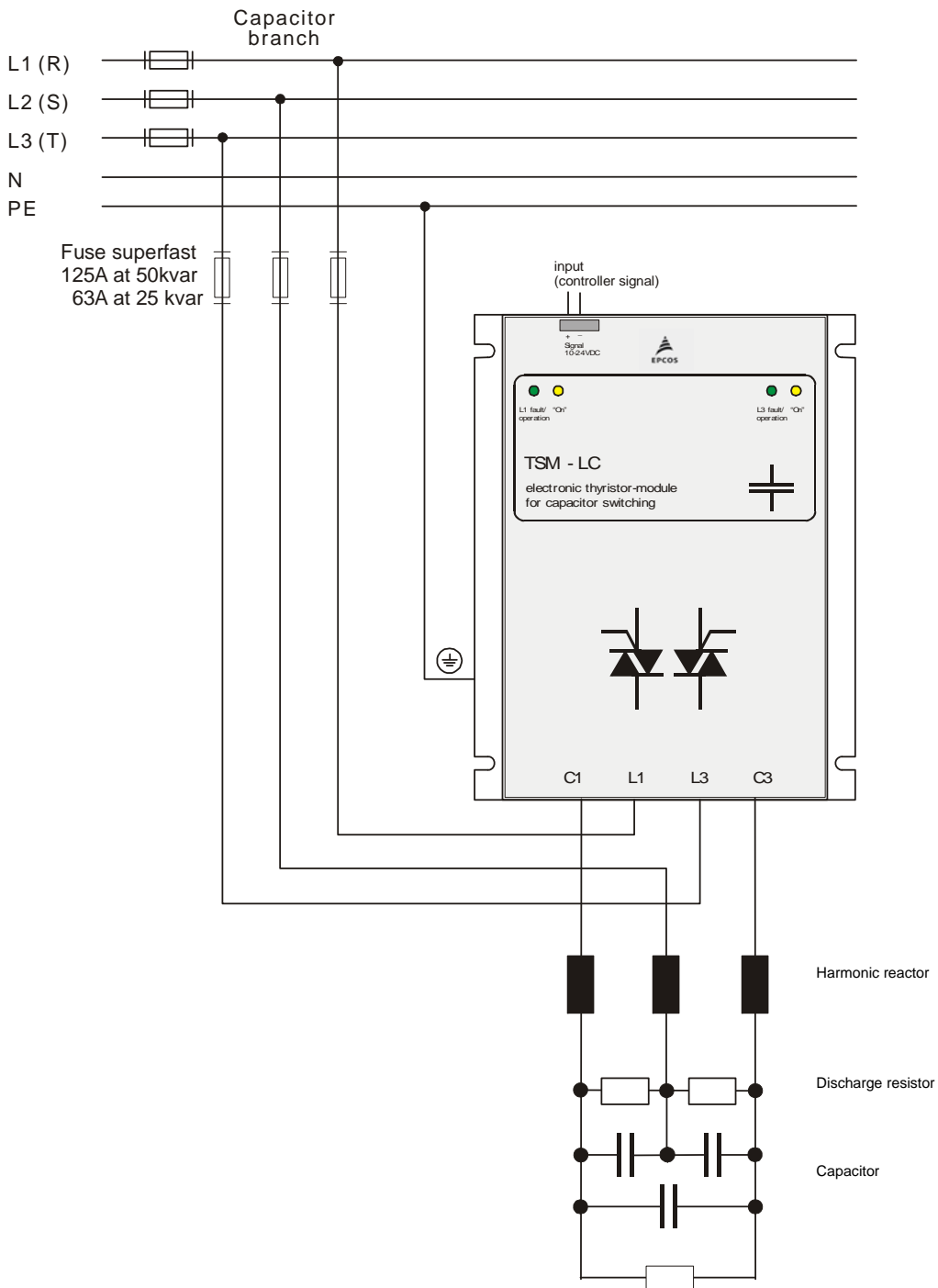
### Installation and maintenance instructions for thyristor modules TSM-LC series

Fuses:	3x electronic fuses “superfast”
	10 kvar: 35 A (NH00 AC690 V)
	25 kvar: 63 A (NH00 AC690 V)
	50 kvar: 125 A (NH00 AC690 V)
	100 kvar: 250 A (NH1 AC690 V)
	200 kvar: 450 A (NH2 AC690 V)
Dimensions:	TSM-LC10: 163 x 152 x 75 (W x H x D)
	TSM-LC25 / 50: 157 x 200 x 180 (W x H x D)
	TSM-LC100: 157 x 240 x 195 (W x H x D)
	TSM-LC 200: 250 x 480 x 160 (W x H x D)
Weight:	TSM-LC10: 1.75 kg
	TSM-LC25 / 50: 4.8 kg
	TSM-LC100: 5.5 kg
	TSM-LC 200: 11.5 kg
Mounting position:	vertical, minimum 100 mm distance upwards and downwards, minimum 50 mm right and left side
Assembling:	direct mounting on mounting plate
Operating ambient temperature with nominal load:	-10 °C ... 55 °C

## Film capacitors - PFC

### Installation and maintenance instructions for thyristor modules TSM-LC series

**Picture 1:**  
 Connecting diagram  
 Three-phase load  
 (Standard)  
 Example: TSM -LC50



## Film capacitors - PFC

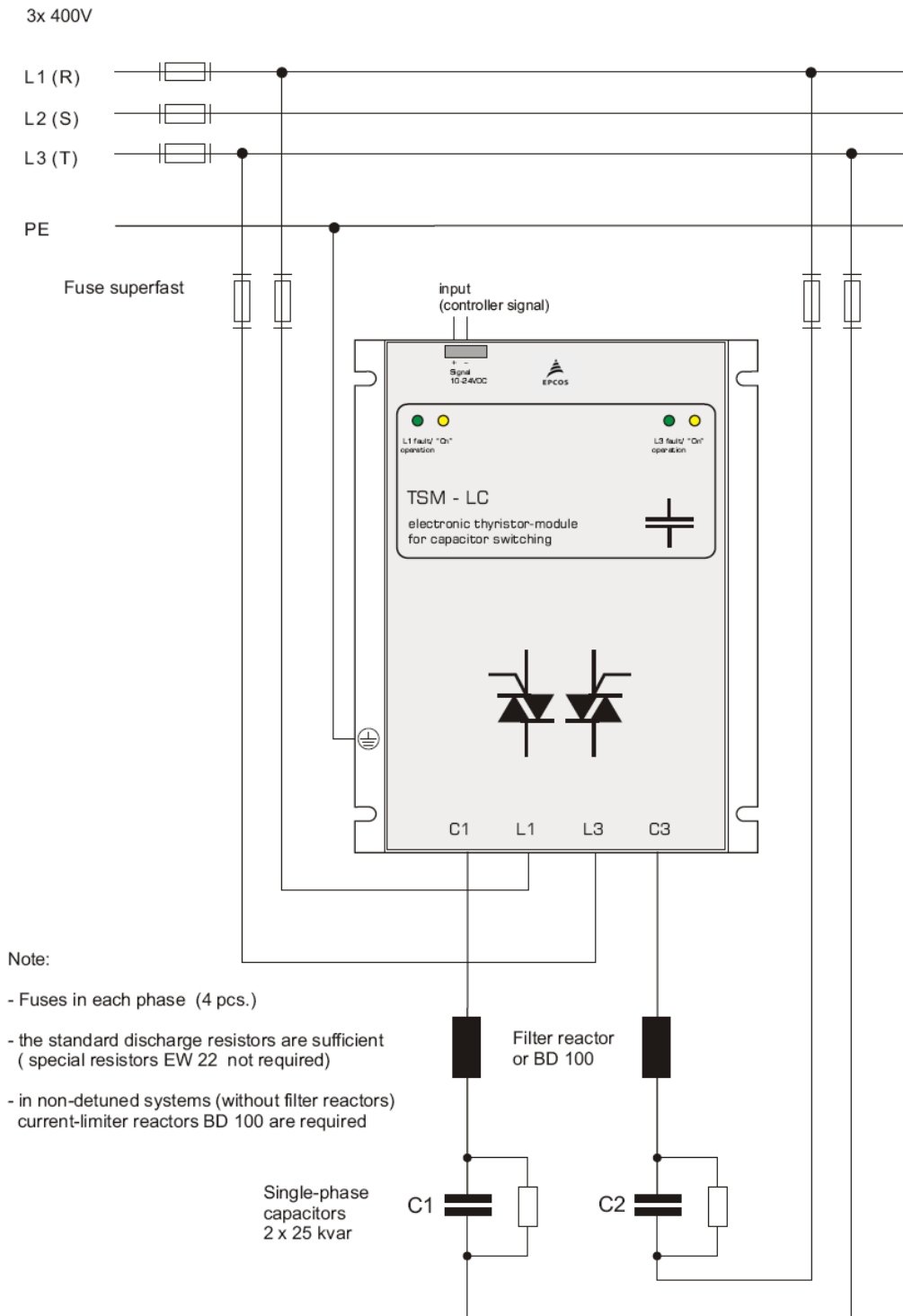
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**Picture 2:**

Connecting diagram

Two-phase load

e.g. single-phase welding machines





**Attention: Please follow safety instructions!**

**General:**

- The TSM-LC-thyristor-modules may only be used according to their intended utilization.
- The TSM-LC-thyristor-modules must only be used in combination with appropriate safety devices (e.g. superfast fuses).
- The TSM-LC-thyristor-modules have to be installed in a way that no uncontrolled high currents and voltages can occur in case of faults. In critical networks where uncontrolled high current or voltage peaks may occur, surge arrester or other protection devices need to be installed externally.
- The devices have to be protected against humidity and dust – sufficient ventilation has to be assured.
- The TSM-LC-thyristor-modules must only be connected to the grid if any kind of possible harm or danger to human beings or the PFC system is eliminated.

**Special note:**

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 standard PFC systems (without reactors) power capacitors of 440 V nominal voltage have to be used; for detuned systems PFC capacitors of 525 V nominal voltage have to be used.
- Due to the high voltage (2 x peak value of nominal voltage) that occurs, the discharge resistors of the power capacitors have to be replaced by special types (accessory EW-22).
- In dynamic systems with TSM modules no fast discharge reactors may be used (reactor = DC-wise short circuit).
- For standard PFC systems (without reactors) 2 current limiting reactors are mandatory per thyristor module (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 as “superfast” – they must not be replaced with standard fuses!
- 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 systems 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.
- In the PFC system warning signs indicating the presence of residual voltage even at disconnected stage have to be visible.

**Maintenance, repair:**

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

- **In case any repairs are needed, this has to be done from the manufacturers of the TSM-LC-thyristor-module only!**

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

## 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, EPCOS is 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 an EPCOS 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.
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