

# GAMMA-3020

Thyristor Controlled Reactor (TCR) Converter Modules  
Datasheet



## General Description

GAMMA-3020 series thyristor-controlled reactor (TCR) converter modules dynamically adjust equivalent reactance of shunt reactors up to 7kVAr and support dynamic power factor control (PFC) applications where extremely fast reactive power compensation is necessary. Converter modules consist of three single-phase phase-controlled bidirectional thyristor units and can control each phase independently. Through phase control, the net RMS voltage across each shunt reactor can be varied continuously. This way, the net reactive power flow can be controlled and desired reactive power rating may be achieved instantaneously. GAMMA converter modules are internally protected against overheating. They are also equipped with external thermostat connection terminals to protect the shunt reactors from overheating. GAMMA modules protect the shunt reactors from overheating, overvoltage and transients, hence enabling long-lasting dynamic power factor control.

- Up to 400V single-phase shunt reactors
- Easy triggering from PFC relays or PLCs
- Instantaneous triggering and turn on
- Monitors status and temperature
- Protects shunt reactors through external thermostat connections
- Equipped with overheating protection and alarm LEDs
- Displays enabled phases through front panel LEDs
- Maintenance free
- Longer life expectancy
- Quiet operation



## Uygulama Alanları

- Welding
- Presses
- Elevators
- Cranes
- Arc furnaces
- Wind turbines
- Gas stations
- Commercial and industrial buildings

## Operation

Module is ready to start up as soon as power connections on L1, L2, L3 are completed and three separate single-phase shunt reactors are connected to R1, R2, R3 terminals. It is imperative to connect the shunt reactors to the neutral line. When the module is turned on it will be waiting for a trigger signal. As soon as a trigger signal is detected, the module triggers the thyristors instantaneously. The LED corresponding to the triggered phase will be lit to inform the user of the trigger status. When the trigger signal pulses are shut down, the thyristors will cut-off through line commutation. GAMMA modules are equipped with three status and one alarm LEDs. The functions of each LED are listed below:

L1 (red): Indicates that L1 phase is triggered.

L2 (red): Indicates that L2 phase is triggered.

L3 (red): Indicates that L3 phase is triggered.

OVERHEAT (red): Indicates that either the converter module or the shunt reactors are overheated.

GAMMA series TCR converter modules are compatible with any kind of power factor controller (PFC) which is capable of providing thyristor trigger signals for TCR units. Trigger signals are named as TRIG1, TRIG2, TRIG3 and COM. Depending on the PFC unit, the trigger signals might be NPN or PNP type. GAMMA modules can operate with both trigger types with trigger voltages between 5~24V.

## Technical Specifications

Technical specifications presented here are provided for 40°C ambient temperature and 70°C heat sink temperature, unless otherwise specified. Exceeding these guaranteed ratings will significantly reduce module life expectancy.

Nominal Ratings	Units	Min.	Typ.	Max.
Operating Voltage (line-to-line)	V	380	400	480
Operating Current	A	-	-	30
Trigger Voltage	V	5	12	24
<b>Absolute Maximum Ratings</b>			<b>Typ.</b>	
Blocking Voltage	V		1600	
Current Time Rate of Change ( $di/dt$ )	A/ $\mu$ s		50	
Voltage Time Rate of Change ( $dV/dt$ )	V/ $\mu$ s		1000	
$\int i dt$ (10 ms)	A <sup>2</sup> s		4000	
Heat sink Temperature	°C		80±5	
Ambient Temperature at Full Load	°C		50	
Storage Temperature	°C		-40~100	
Relative Humidity	%		5~95	
<b>Wiring and Mounting</b>				
Power Cable Cross Section (L1,L3,C1 and C3)	mm <sup>2</sup>		16	
Triggering Wire Cross Section	mm <sup>2</sup>		1.5	
Dry Contact Wire Cross Section	mm <sup>2</sup>		1.5	
External Thermostat Wire Cross Section	mm <sup>2</sup>		1.5	
Size (W x H x D)	mm		130x145x155	
IP Class	-		20	
Weight	kg		1.2	
<b>Operation</b>				
Switching Time	-		Instantaneous	
Repetitive-switching Time	-		7kVAR per phase	
Power Loss	W		102	
Fault Display	-		Through 4 LEDs	
Overheating Fault Temperature	°C		90±5	
Superfast Fuse Current Rating	A		63 (NH AC 690)	

The relationship between the RMS current and the power loss of GAMMA-3020 TCR converter modules are shown in Figure 1. The modules are tested under symmetrical loading on each phase. Figure 2 shows derating curves based on ambient temperature.

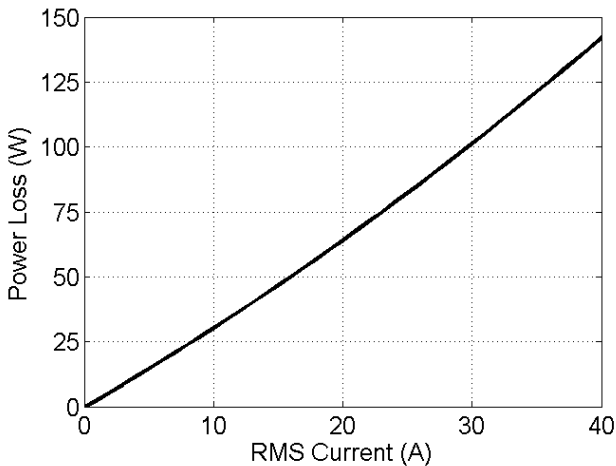


Figure 1: Power loss vs. RMS current

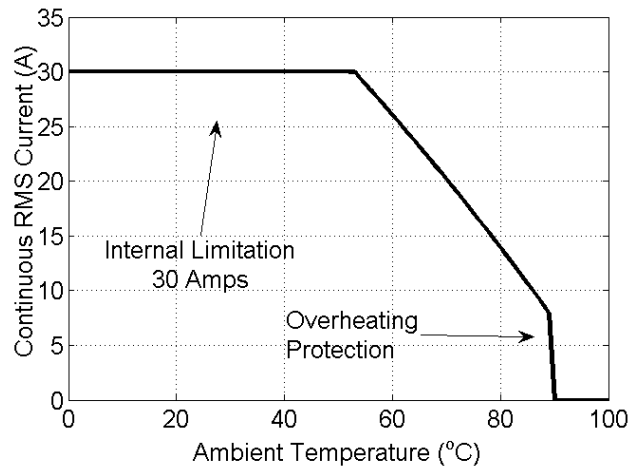
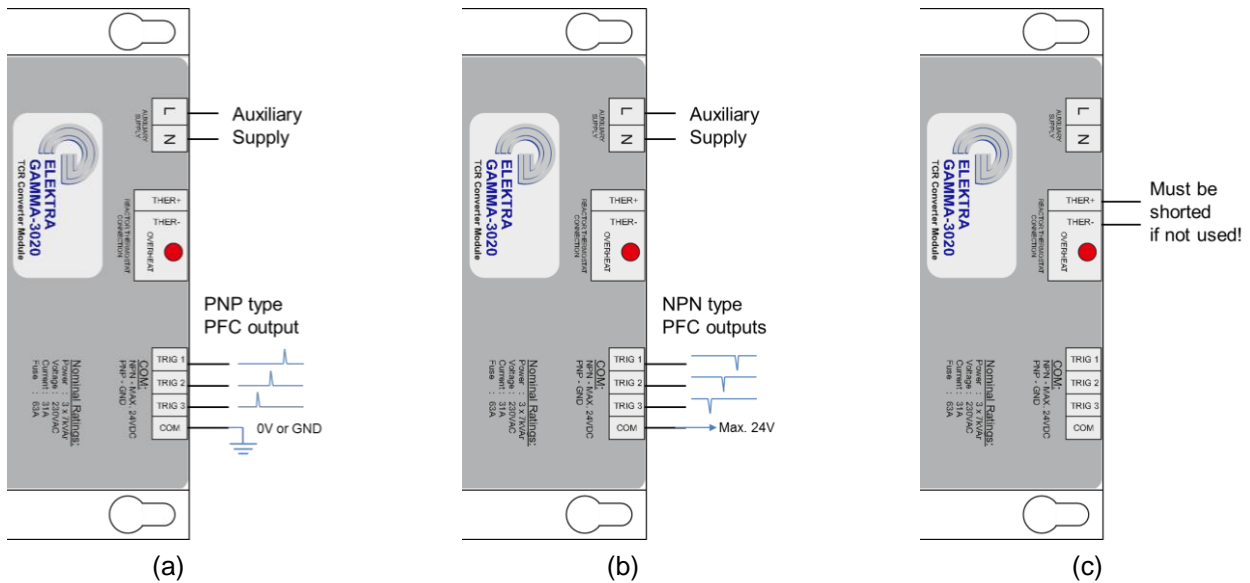


Figure 2: De-rating vs. ambient temperature

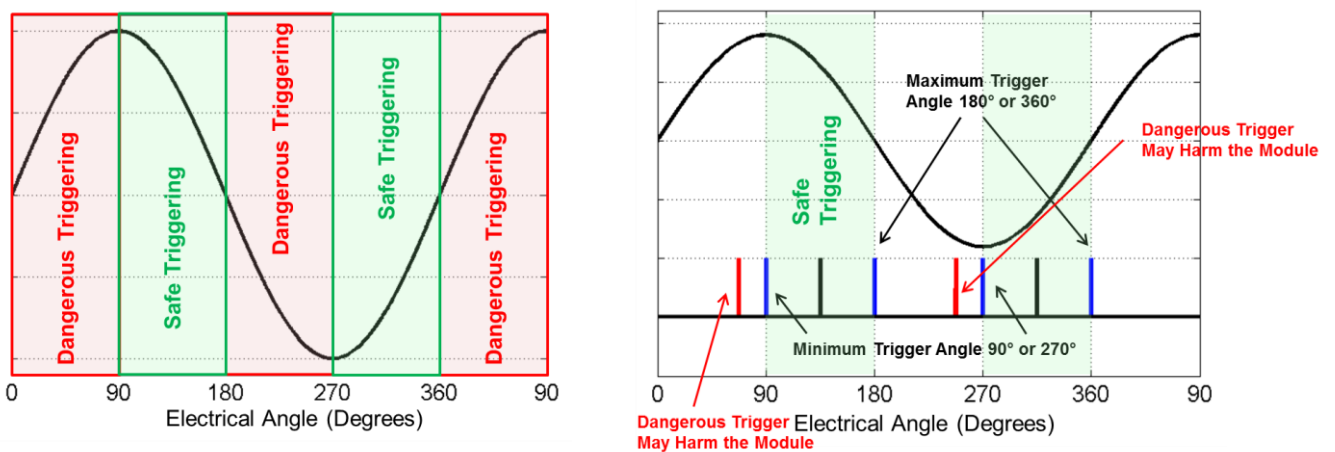
## Recommended Practice

GAMMA series TCR converter modules are compatible with any kind of power factor controller (PFC) which is capable of providing thyristor trigger signals for TCR units. Maximum allowed trigger voltage is 24V and minimum compatible trigger voltage is 5V. The modules are equipped with internal overheating protection. For guaranteed performance and operation of alarm and status LEDs, it is not recommended to trigger the modules below 12V. The modules are also equipped with external thermostat connections and overheating protection. To use this function, the external thermostat has to be connected as shown in Figure 3(c). Thermostat terminals of shunt reactors may be connected to this terminal. This allows the modules to protect the shunt reactors from overheating. If this function will not be used, these terminals should be shorted.



**Figure 3:** Connection and trigger signal illustration of GAMMA-3020 modules with (a) PNP and (b) NPN output type power factor controllers. If external thermostat connections will not be used, these terminals should be shorted as shown in (c).

Inductive loads such as shunt reactors, continuously store magnetic energy when they are connected to power source. This energy oscillates continuously as current alternates. If the TCR converter modules are triggered before the energy stored in shunt reactors are released back to the grid, then the stored energy in the reactors will build up and the current drawn from the power line will have a large DC component. This violates the operation of TCR converters and shunt reactors and may be destructive. To avoid such risks, safe trigger phase regions and dangerous trigger instants are shown in Figure 4. For a reliable and safe operation, the phase trigger angles relative with respect to the corresponding line voltage must be between  $90^\circ$  and  $180^\circ$  or  $270^\circ$  and  $360^\circ$ .



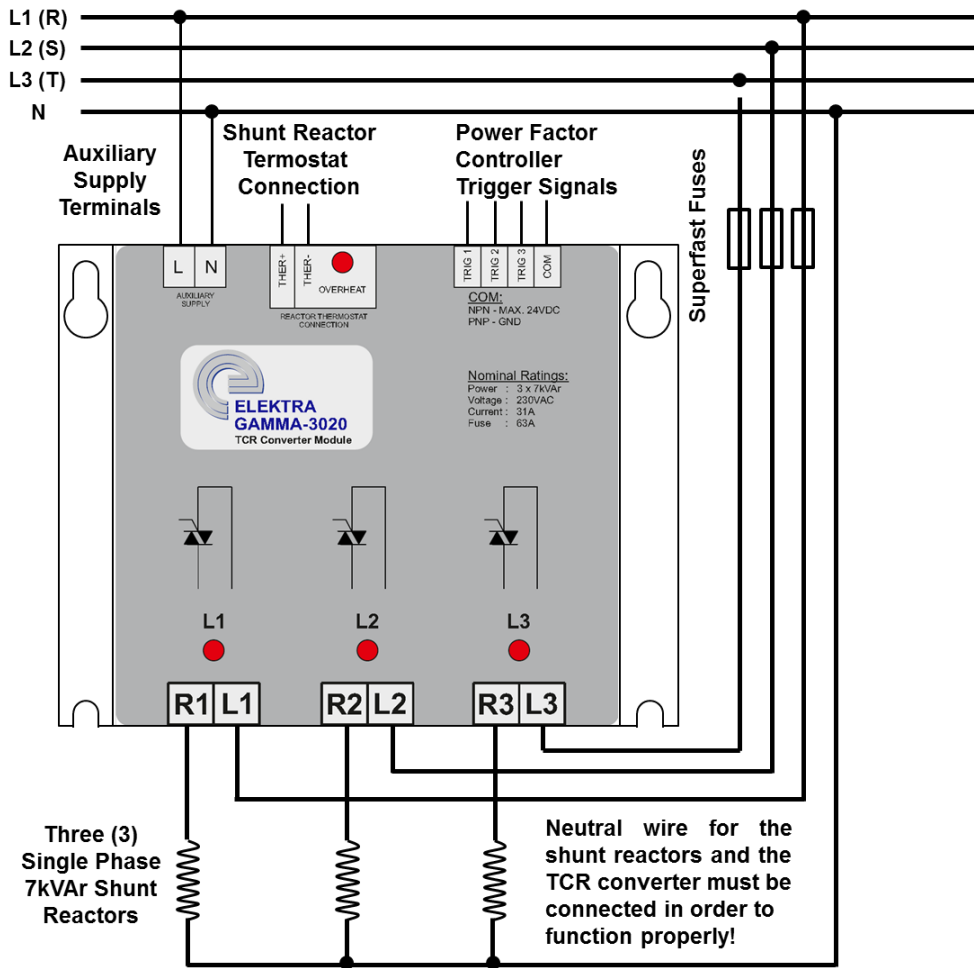
**Figure 4:** Safe and dangerous trigger instants for TCR converter modules.

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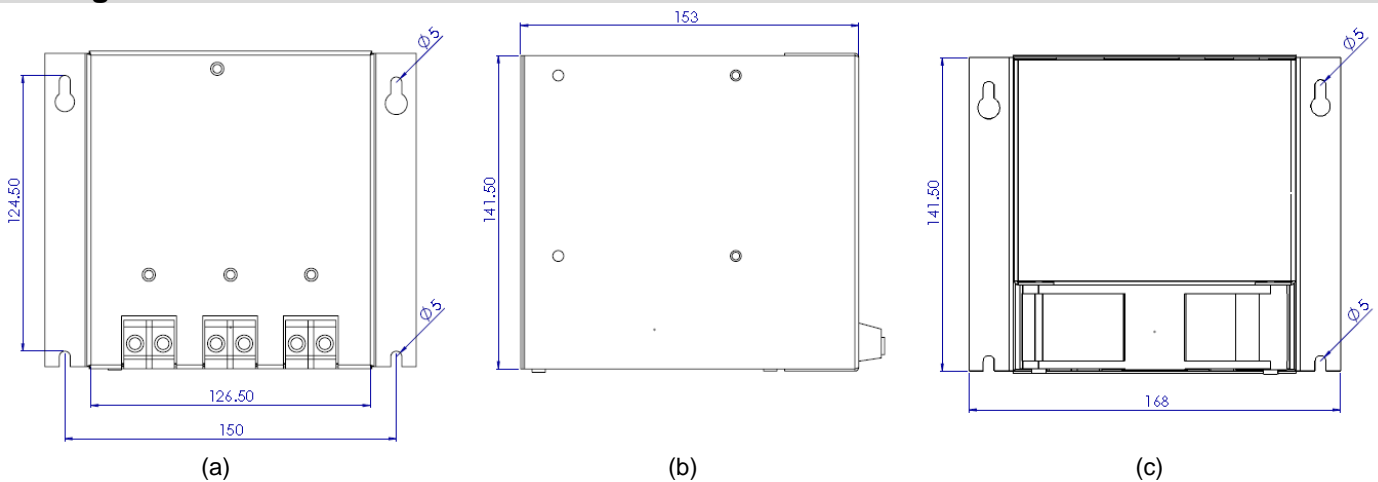


## Wiring Diagram



**Figure 5:** Wiring diagram of GAMMA-3020 modules. It is imperative to use a separate single phase shunt reactor for each phase, and the neutral connection of the shunt reactors must be connected to the neutral terminal on the GAMMA-3020 module and grid neutral wire.

## Drawings



**Figure 6:** GAMMA-3020 module technical drawings

General tolerance is  $\pm 0.5\text{mm}$

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## Cautions

Please follow safety instructions!

- GAMMA modules may only be utilized according to their intended use.
- Appropriate safety measures have to be taken with GAMMA modules, such as using superfast fuses, surge arresters, etc.
- GAMMA modules have to be sufficiently ventilated and protected against dust and humidity.
- GAMMA modules must not be triggered unless all life-threatening risks are eliminated.
- When operating under phase control, the trigger signals must be applied after the voltage peak occurs on the respective line voltage. This corresponds to minimum of 90° phase angle. Otherwise, the current through the shunt reactors will have a DC component. This may destroy the shunt reactors or TCR converter modules.
- GAMMA modules must be protected by superfast electronic fuses.
- Installation must be done by skilled personnel only.
- Before any assembly or maintenance work is started, all installations and equipment must be disconnected from the power source and assured that the PFC-capacitors are completely discharged.

Noncompliance with these instructions and warnings may lead to death, serious injury or major damage to equipment.  
**FAILURE TO FOLLOW CAUTIONS MAY RESULT IN FAILURES AND/OR PHYSICAL INJURY.**

## Terms and Conditions

GAMMA modules are warranted against manufacturing defects for 1 (one) year. If the modules are used with ELEKTRA shunt reactors, then the warranty covers them for 2 (two) years. The modules are out of warranty in case of user error, uses not in accordance with recommended practice presented in this datasheet, internal circuits are tampered with and/or the cover is removed.

The manufacturer is not responsible for:

- Any costs resulting from a failure if the installation, setup, repair, alteration, or ambient conditions of the module do not follow the requirements specified in the documentation delivered with the module and other relevant documentation.
- Modules subjected to misuse, negligence or accident

In no event shall the manufacturer, its suppliers or subcontractors be liable for special, indirect, incidental or consequential damages, losses or penalties. If you have any questions concerning your GAMMA modules, please contact the local distributor or ELEKTRA A.Ş. The technical data, information and specifications are valid at the time of printing. The manufacturer reserves the right to make modifications without prior notice.