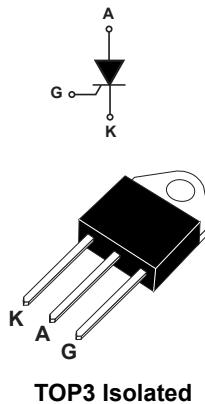


## 50 A 1200 V 150 °C junction temperature SCR in TOP3 package



### Features

- Max. blocking voltage =  $V_{DRM}$ ,  $V_{RRM} = 1200$  V
- Max. surge voltage =  $V_{DSM}$ ,  $V_{RSM} = 1400$  V
- $I_{GT}$  maximum = 50 mA
- Max. junction temperature = 150 °C at  $V_D/V_R = 800$  V
- High static and dynamic commutation:
  - $dl/dt = 200$  A/μs
  - $dV/dt = 1500$  V/μs
- ECOPACK2 compliant component (RoHS and HF compliance)
- Complies with UL1557 standard (file ref: E81734) rated at 2.5 kV RMS thanks to its ceramic insulator
- UL94, level V0 molding resin compliance

### Application

Product status
TN5050H-12PI

Product summary	
$I_{T(RMS)}$	50 A
$V_{DRM}/V_{RRM}$	1200 V
$V_{DSM}/V_{RSM}$	1400 V
$I_{GT}$ max.	50 mA
$T_j$ max.	150 °C

### Description

The TN5050H-12PI high temperature SCR is suitable in industrial applications where high immunity is required with a lower gate current, such as motor soft starter and power supply. In addition, its 1400 V surge capability brings robustness to grid application such as UPS or renewable energy inverters.

The insulated TOP3 package allows simplified design assembly thanks to its 2.5 kV certified rated insulation.

## 1 Characteristics

**Table 1. Absolute maximum ratings (limiting values)**

Symbol	Parameter	Value	Unit
$V_{DRM}, V_{RRM}$	Repetitive peak off-state voltage (50-60 Hz)	$T_j = 125^\circ C$	1200
		$T_j = 150^\circ C$	800
$V_{DSM}, V_{RSM}$	Non-repetitive surge voltage	$T_j = 25^\circ C$	1400
$I_{T(RMS)}$	On-state RMS current (180 ° conduction angle)	$T_c = 90^\circ C$	50
			32
$I_{T(AV)}$	Average on-state current (180 ° conduction angle)	$t_p = 8.3 \text{ ms}$	493
			450
$I_{TSM}$	Non repetitive surge peak on-state current ( $T_j$ initial = 25 °C), $V_R = 0 \text{ V}$	$t_p = 10 \text{ ms}$	450
		$t_p = 10 \text{ ms}$	1013
$I^2t$	$I^2t$ value for fusing	$f = 50 \text{ Hz}$	$A^2\text{s}$
$dI/dt$	$I_G = 2 \times I_{GT}, t_r < 100 \text{ ns}, T_j = 150^\circ C$	200	$A/\mu\text{s}$
		8	A
$I_{GM}$	Maximum peak positive gate current	$t_p = 20 \mu\text{s}$	5
			1
$V_{GM}$	Maximum peak positive gate voltage	$T_j = 150^\circ C$	W
			3.5
$P_{G(AV)}$	Average gate power dissipation	$T_j = 150^\circ C$	$^\circ C$
			-40 to +150
$V_{RGM}$	Maximum peak reverse gate voltage	$T_j = 150^\circ C$	1
			8
$T_{stg}$	Storage junction temperature range	$T_j = 150^\circ C$	5
			1
$T_j$	Operating junction temperature range	$T_j = 150^\circ C$	-40 to +150
			$^\circ C$

**Table 2. Electrical characteristics ( $T_j = 25^\circ C$  unless otherwise specified)**

Symbol	Test conditions	Value	Unit
$I_{GT}$ <sup>(1)</sup>	$V_D = 12 \text{ V}, R_L = 33 \Omega$	50	$\text{mA}$
	$V_D = 12 \text{ V}, R_L = 33 \Omega$		
$V_{GT}$	$V_D = 12 \text{ V}, R_L = 33 \Omega$	Max.	1.0
$V_{GD}$	$V_D = 800 \text{ V}_{DRM}, R_L = 3.3 \text{ k}\Omega$	Max.	0.15
$I_H$ <sup>(1)</sup>	$I_T = 500 \text{ mA}$ , gate open	Max.	100
$I_L$	$I_G = 1.2 \times I_{GT}$	Max.	125
$dV/dt$ <sup>(1)</sup>	$V_D = 67\% V_{DRM}$ , gate open	$T_j = 125^\circ C$	2.0
		$T_j = 150^\circ C$	1.5
$t_{gt}$	$I_T = 50 \text{ A}, V_D = V_{DRM}, I_G = 100 \text{ mA}, (dI_G/dt) \text{ max} = 0.2 \text{ A}/\mu\text{s}$	Typ.	2.5
$t_q$	$I_T = 50 \text{ A}, V_D = 800 \text{ V}, (dI/dt) \text{ max} = 10 \text{ A}/\mu\text{s}, V_R = 25 \text{ V}, dV/dt = 100 \text{ V}/\mu\text{s}$	Typ.	150

1. Measurements referenced to K.

**Table 3. Static characteristics**

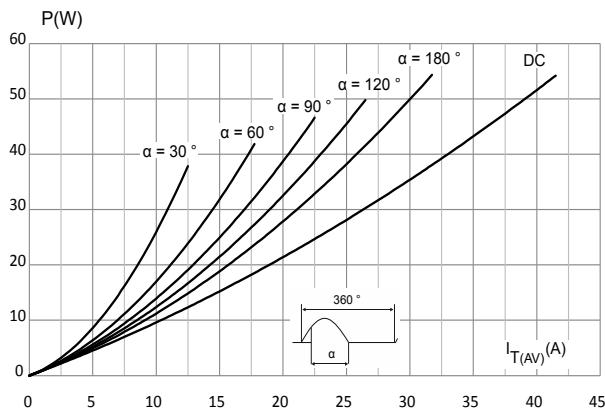
Symbol	Test conditions	Value	Unit
$V_{TM}$	$I_{TM} = 64 \text{ A}$ , $t_p = 380 \mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$	Max. 1.55
$V_{TO}$	Threshold voltage	$T_j = 150 \text{ }^\circ\text{C}$	Max. 0.85
$R_D$	Dynamic resistance	$T_j = 150 \text{ }^\circ\text{C}$	Max. 11 $\text{m}\Omega$
$I_{DRM}, I_{RRM}$	$V_{DRM} = V_{RRM} = 1200 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$	5 $\mu\text{A}$
		$T_j = 125 \text{ }^\circ\text{C}$	Max. 3.5 $\text{mA}$
	$V_{DRM} = V_{RRM} = 800 \text{ V}$	$T_j = 150 \text{ }^\circ\text{C}$	10 $\text{mA}$

**Table 4. Thermal parameters**

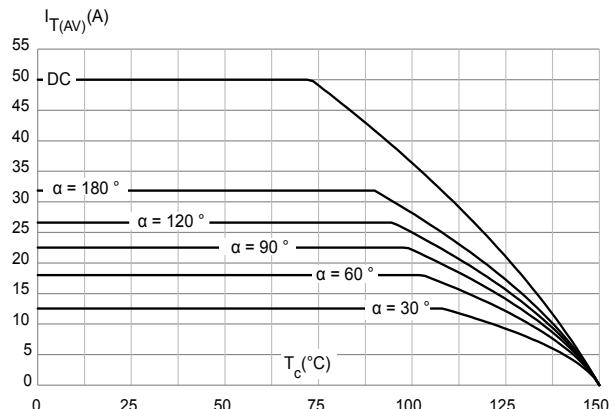
Symbol	Parameter	Value	Unit
$R_{th(j-c)}$	Junction to case (DC)	Typ. 0.9	$^\circ\text{C}/\text{W}$
$R_{th(j-a)}$	Junction to ambient	Typ. 50	$^\circ\text{C}/\text{W}$

## 1.1 Characteristics curves

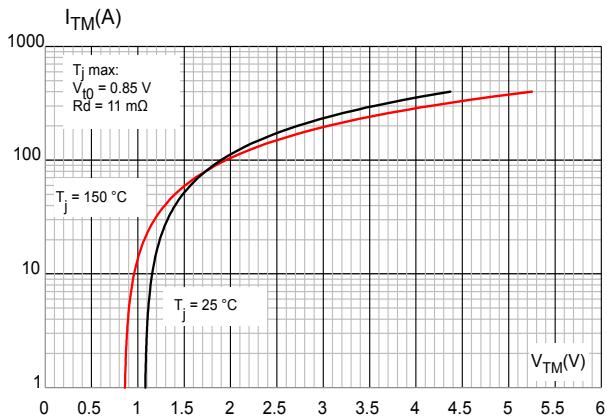
**Figure 1. Maximum average power dissipation versus average on-state current**



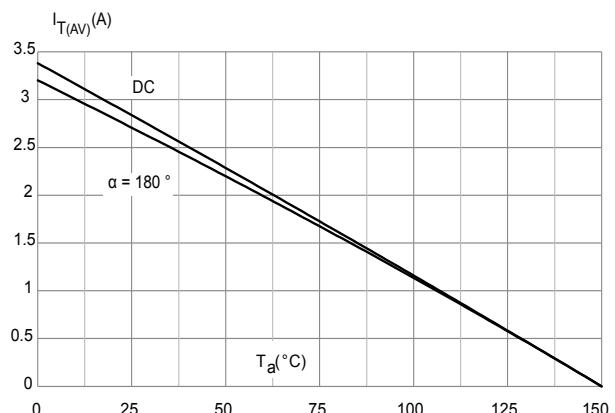
**Figure 2. Average and DC on-state current versus case temperature**



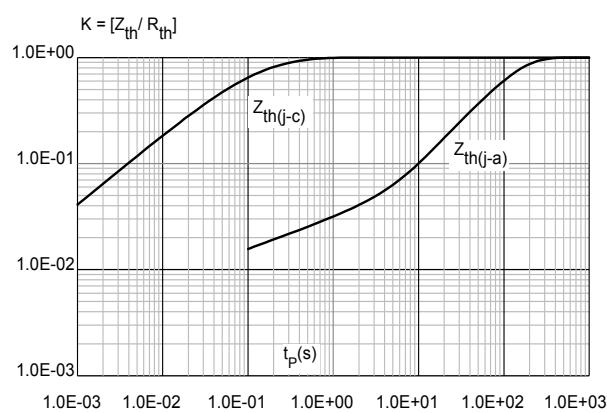
**Figure 3. On-state characteristics (maximum values)**



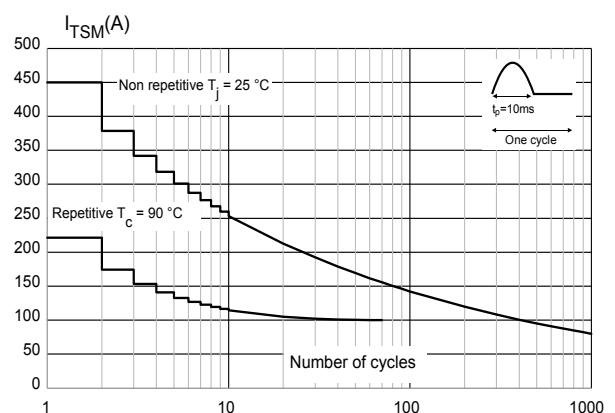
**Figure 4. Average and D.C. on-state current versus ambient temperature**



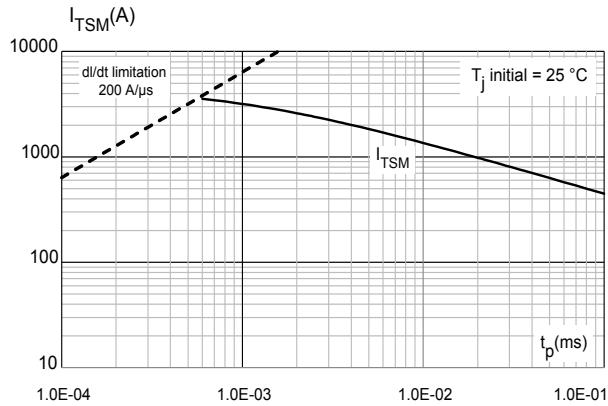
**Figure 5. Relative variation of thermal impedance junction to case and junction to ambient versus pulse duration**



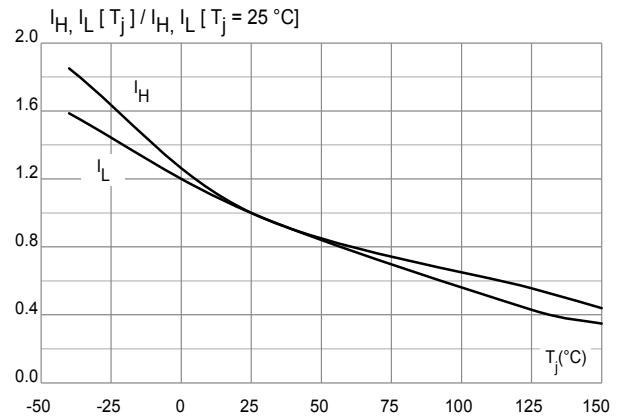
**Figure 6. Surge peak on-state current versus number of cycles**



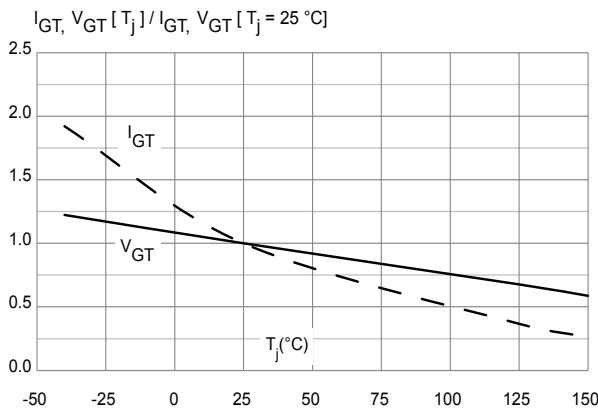
**Figure 7. Non repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10$  ms**



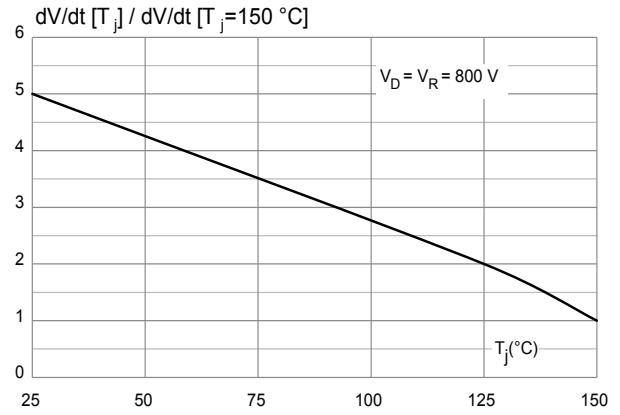
**Figure 8. Relative variation of holding current and latching current versus junction temperature (typical values)**



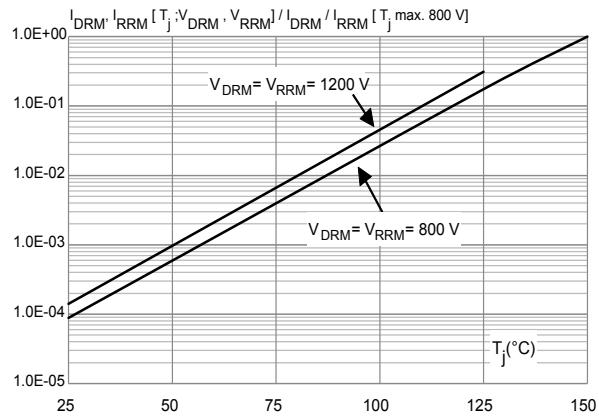
**Figure 9. Relative variation of gate triggering current and voltage versus junction temperature**



**Figure 10. Relative variation of static dV/dt immunity versus junction temperature**



**Figure 11. Relative variation of leakage current versus junction temperature for different values of blocking voltage (0.8 kV, 1.2 kV)**



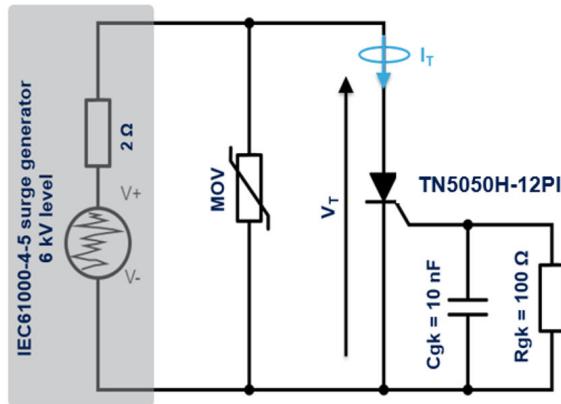
## 2 Application

### 2.1 Overvoltage surge management

The TN5050H-12PI specification in [Table 1](#) gives a non-repetitive surge voltage forward  $V_{DSM}$  and reverse  $V_{RSM}$  at 1400 V, for a surge duration up to 10 ms duration at 25 °C of junction temperature. This feature allows designers headroom for overvoltage surge management in final application, reducing ratings of AC Line input protections, but also for an increased reliability of the overall application in the field, such as UPS, AC/DC converters or motor controllers.

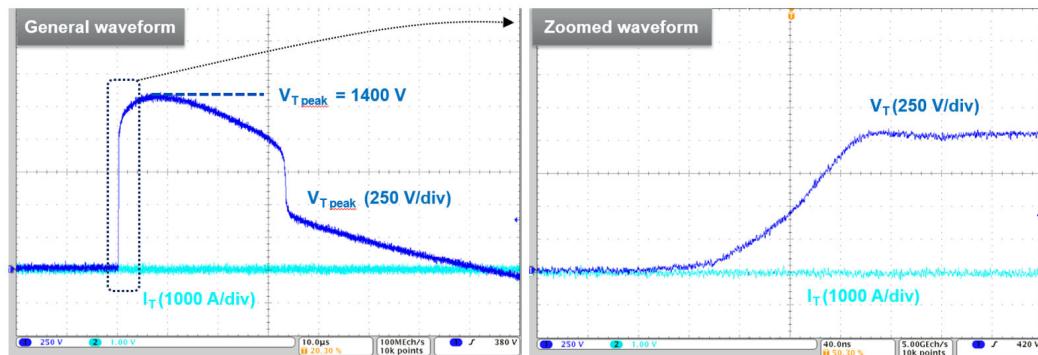
Here below is an example of an overvoltage surge, as defined in IEC61000-4-5 electromagnetic compatibility standard, applied to the TN5050H-12PI. The [Figure 12](#) details a simplified application front-end circuit, including the surge protection, made of metal oxide varistor, in parallel of the TN5050H-12PI.

**Figure 12. Simplified front-end circuit using TN5050H-12PI**



When an 1.2/50  $\mu$ s overvoltage surge occurs on the AC line, the application input protection clamps the voltage across the TN5050H-12PI SCR. Thanks to the extra  $V_{DSM}$  /  $V_{RSM}$  specification, the maximum allowed voltage across the SCR is 1400 V. The waveform [Figure 13](#) right, illustrates the voltage across the AC line and the SCR during a 6 kV surge event, performed within the [Figure 12](#) left test schematic, when the junction temperature equals the maximum junction temperature of the TN5050H-12PI:  $T_j$  max = 150 °C, the device still withstands the stress when the occurrence is up to 10 surges, on each polarity, according to the IEC61000-4-5 standard.

**Figure 13. Waveform of line and SCR voltages**



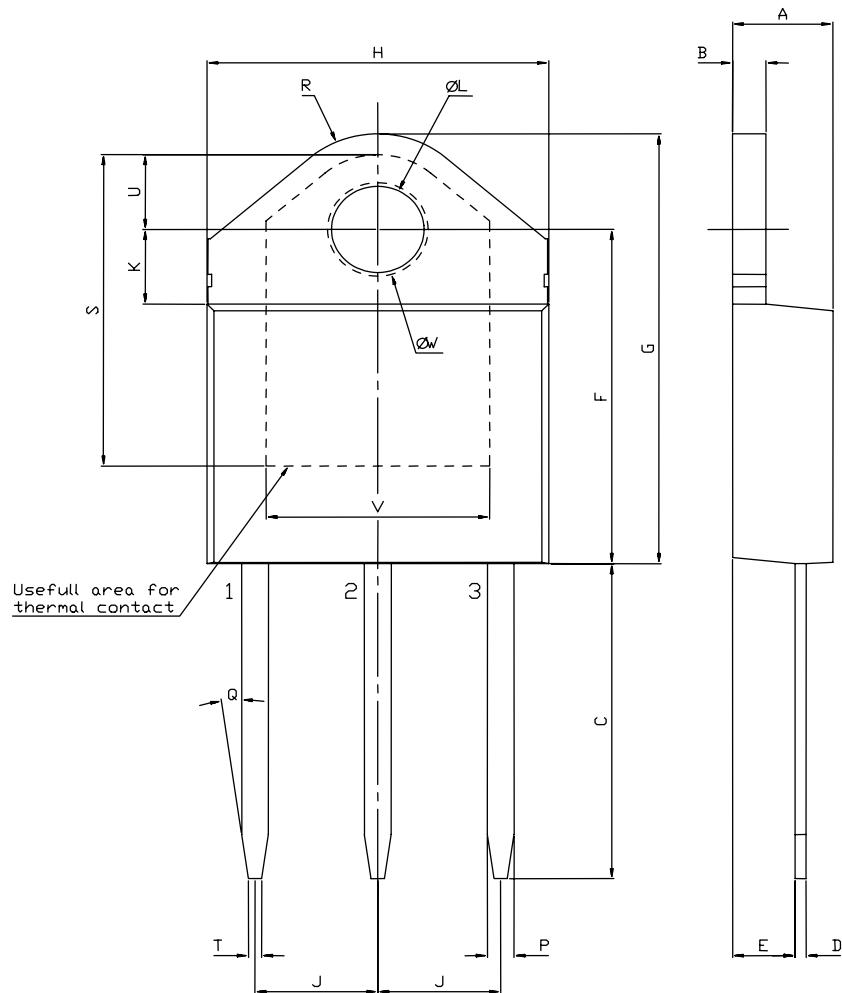
## 3 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 3.1 TOP3 insulated package information

- **ECOPACK** (lead-free plating and halogen free package compliance)
- Lead-free package leads finishing
- Halogen-free molding compound resin meets UL94 standard level V0
- Recommended torque: 1.05 N·m (max. torque: 1.2 N·m)

**Figure 14. Package outline**



**Table 5. Mechanical data**

Ref.	Dimensions					
	mm			Inches <sup>(1)</sup>		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.1732		0.1811
B	1.45		1.55	0.0571		0.0610
C	14.35		15.60	0.5650		0.6142
D	0.50		0.70	0.0197		0.0276
E	2.70		2.90	0.1063		0.1142
F	15.80		16.50	0.6220		0.6496
G	20.40		21.10	0.8031		0.8307
H	15.10		15.50	0.5945		0.6102
J	5.40		5.65	0.2126		0.2224
K	3.40		3.65	0.1339		0.1437
L	4.08		4.17	0.1606		0.1642
P	1.10		1.30	0.0430		0.0510
R		4.60			0.1811	

1. Inches given for reference only

## 4 Ordering information

Figure 15. Ordering information scheme

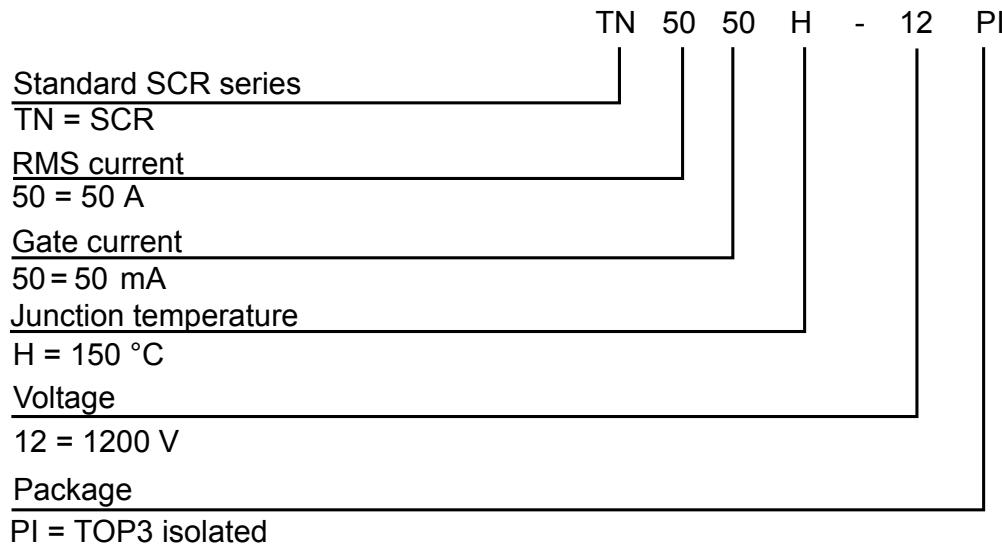


Table 6. Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
TN5050H-12PI	TN5050H12	TOP3 insulated	4.48 g	30	Tube

## Revision history

**Table 7. Document revision history**

Date	Revision	Changes
14-Apr-2023	1	Initial release.
27-JuL-2023	2	Updated <a href="#">Table 5. Mechanical data</a> .

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