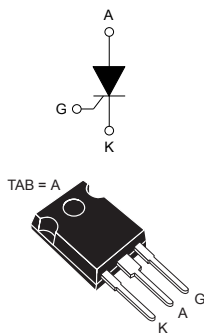



## 40 A 1200 V automotive grade thyristor (SCR)



TO-247 uninsulated

## Features

- AEC-Q101 qualified 
- High junction temperature: 150 °C
- AC off state voltage: +/- 1200 V
- Nominal on-state RMS current: 40 A<sub>RMS</sub>
- High noise immunity: 1000 V/μs
- Max. gate triggering current: 50 mA
- ECOPACK2 compliant component

## Applications

- On board charger
- Capacitor discharge
- Overvoltage crowbar protection
- Power supplies
- AC switches
- Solid state relays

## Description

The TN4050HP-12WY is an automotive grade SCR thyristor designed for applications such as automotive on board and stationary battery chargers.

This SCR Thyristor, rated for a 40 A RMS power switching, offers superior performances in peak voltage robustness up to 400 V sine wave pulse. Its key features allow the design of functions such as a 56 A RMS AC switch and a 50 A AC-DC controlled rectifier-bridge.

The TN4050HP-12WY is available in TO-247 package, ideal for a maximum thermal performance.

Product status	
TN4050HP-12WY	
Product summary	
I <sub>T(RMS)</sub>	40 A
V <sub>DRM</sub> /V <sub>RSM</sub>	1200 V
V <sub>DSM</sub> /V <sub>RSM</sub>	1400 V
I <sub>GT</sub>	50 mA
T <sub>j</sub>	-40 to 150 °C

# 1 Characteristics

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

Symbol	Parameter		Value	Unit
$I_{T(RMS)}$	RMS on-state current (180 ° conduction angle)		40	A
$I_{T(AV)}$	Average on-state current (180 ° conduction angle)			
$I_{TSM}$	Non repetitive surge peak on-state current, $V_R = 0$ V	$t_p = 8.3$ ms	440	A
		$t_p = 10$ ms		
$I^2t$	$I^2t$ value for fusing	$t_p = 10$ ms	800	$A^2s$
$di/dt$	Critical rate of rise of on-state current, $I_G = 2 \times I_{GT}$ , $t_r \leq 100$ ns	$f = 50$ Hz	200	$A/\mu s$
$V_{DRM} / V_{RRM}$	Repetitive off-state voltage		1200	V
$V_{DSM} / V_{RSM}$	Non repetitive surge peak off-state voltage	$t_p = 10$ ms	1400	V
$V_{GM}$	Peak forward gate voltage	$t_p = 20$ $\mu s$	10	V
$I_{GM}$	Peak forward gate current	$t_p = 20$ $\mu s$	8	A
$V_{RGM}$	Maximum peak reverse gate voltage		5	V
$P_{G(AV)}$	Average gate power dissipation		1	W
$T_{stg}$	Storage junction temperature range			-40 to +150 °C
$T_j$	Operating junction temperature			-40 to +150 °C

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

Symbol	Test Conditions		Value	Unit	
$I_{GT}$	$V_D = 12$ V, $R_L = 33$ $\Omega$	Min.	10	mA	
		Max.	50		
$V_{GT}$		Max.	1.3	V	
$I_{GD}$	$V_D = 800$ V, $R_L = 3.3$ $\Omega$	$T_j = 150$ °C	Min.	3	mA
$V_{GD}$	$V_D = 800$ V, $R_L = 3.3$ k $\Omega$	$T_j = 150$ °C	Min.	0.2	V
$I_H$	$I_T = 500$ mA, gate open		Max.	100	mA
$I_L$	$I_G = 1.2 \times I_{GT}$		Max.	125	mA
$dV/dt$	$V_D = 800$ V, gate open	$T_j = 150$ °C	Min.	1000	$V/\mu s$

**Table 3. Timing Parameters**

Symbol	Test Conditions		Value	Unit	
$t_{gt}$	$I_T = 80$ A, $V_D = 800$ V, $I_G = 100$ mA, $di_G/dt = 0.2$ A/ $\mu s$		Typ.	1	$\mu s$
$t_q$	$I_{TM} = 25$ A, $V_D = 800$ V, $di_T/dt = 10$ A/ $\mu s$ , $V_R = 75$ V, $dV_D/dt = 20$ V/ $\mu s$ , $t_p = 100$ $\mu s$	$T_j = 150$ °C	Typ.	150	$\mu s$

**Table 4. Static Characteristics**

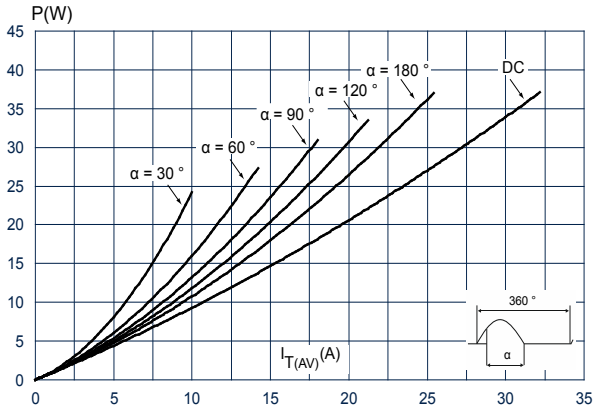
Symbol	Test Conditions			Value	Unit
$V_{TM}$	$I_{TM} = 80\text{ A}$ , $t_p = 380\ \mu\text{s}$	$T_j = 25\text{ }^\circ\text{C}$	Max.	1.55	V
$V_{TO}$	On-state threshold voltage	$T_j = 150\text{ }^\circ\text{C}$	Max.	0.83	V
$R_D$	On-state dynamic resistance	$T_j = 150\text{ }^\circ\text{C}$	Max.	10	m $\Omega$
$I_{DRM}/I_{RRM}$	$V_D = V_{DRM}$ , $V_R = V_{RRM}$	$T_j = 25\text{ }^\circ\text{C}$	Max.	5	$\mu\text{A}$
		$T_j = 125\text{ }^\circ\text{C}$		0.9	mA
		$T_j = 150\text{ }^\circ\text{C}$		6	mA
$I_{DSM}/I_{RSM}$	$V_D = V_{DSM}$ , $V_R = V_{RSM}$	$T_j = 25\text{ }^\circ\text{C}$	Max.	10	$\mu\text{A}$

**Table 5. Thermal parameters**

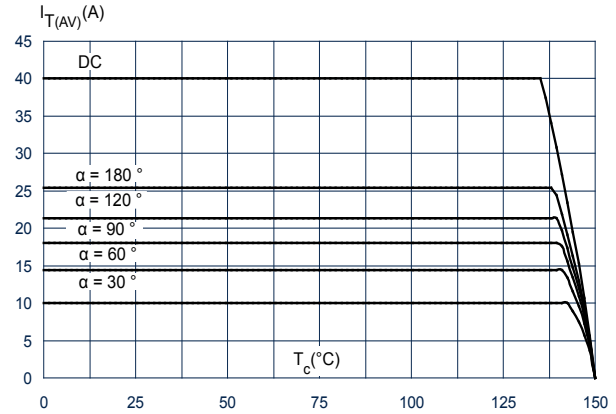
Symbol	Parameter		Value	Unit
$R_{th(j-c)}$	Junction to case (DC)	Max.	0.3	$^\circ\text{C/W}$
$R_{th(j-a)}$	Junction to ambient	Typ.	50	

### 1.1 Characteristics curves

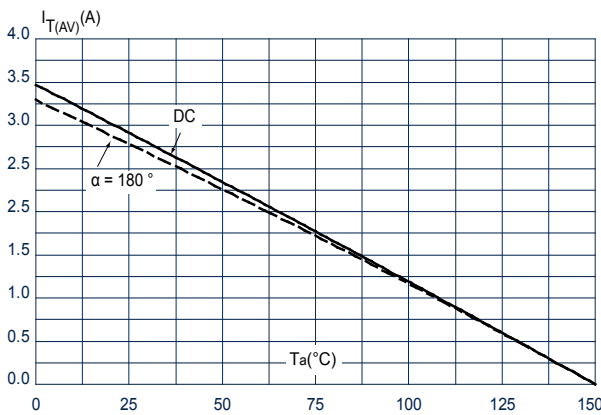
**Figure 1. Maximum average power dissipation versus average on-state current**



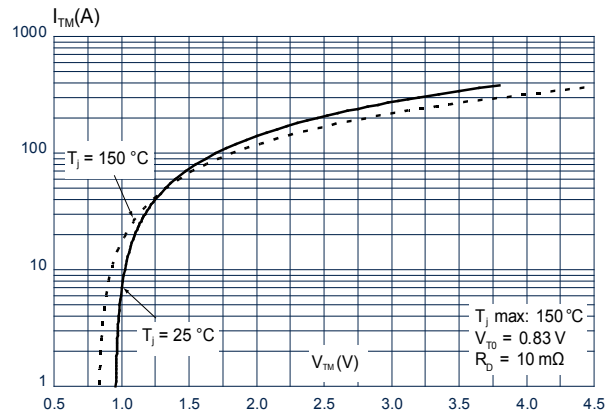
**Figure 2. Average and D.C. on-state current versus case temperature**



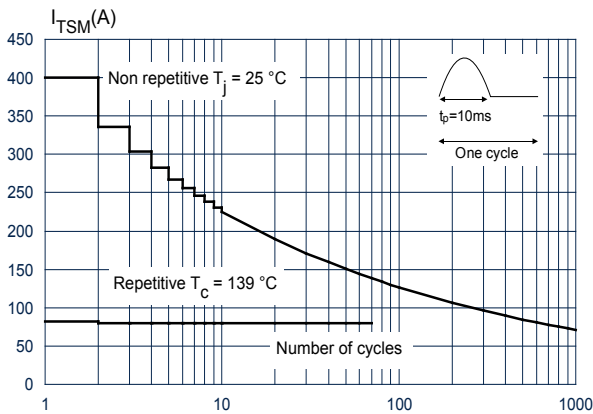
**Figure 3. Average and D.C. on-state current versus ambient temperature**



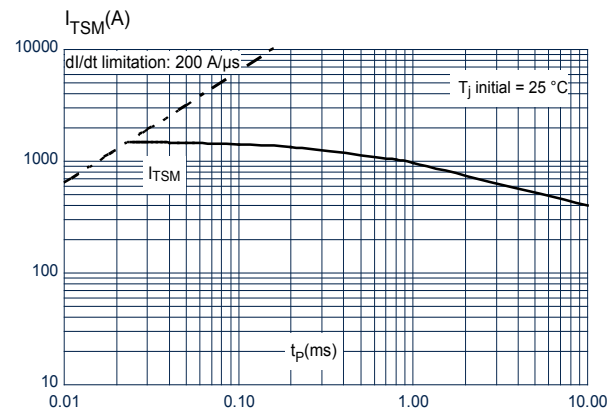
**Figure 4. On-state characteristics (maximum values)**



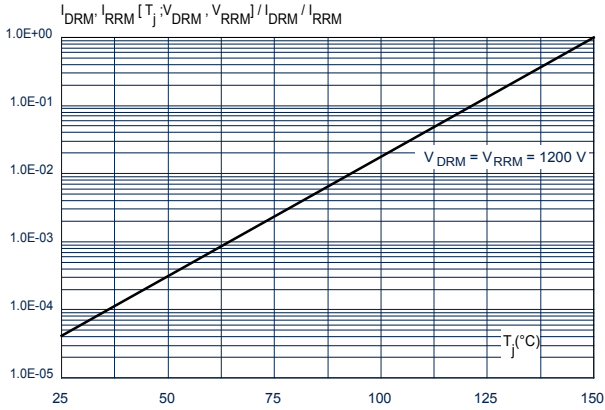
**Figure 5. Surge peak on-state current versus number of cycles**



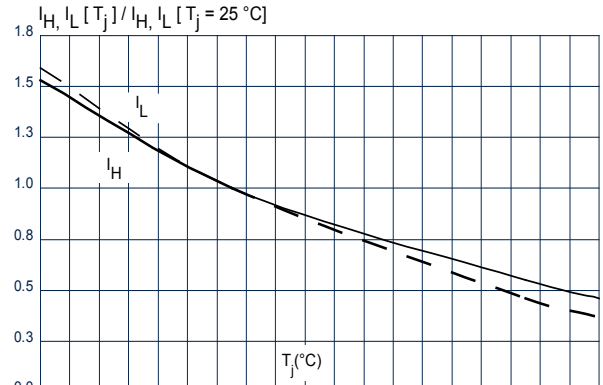
**Figure 6. Non repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10 \text{ ms}$**



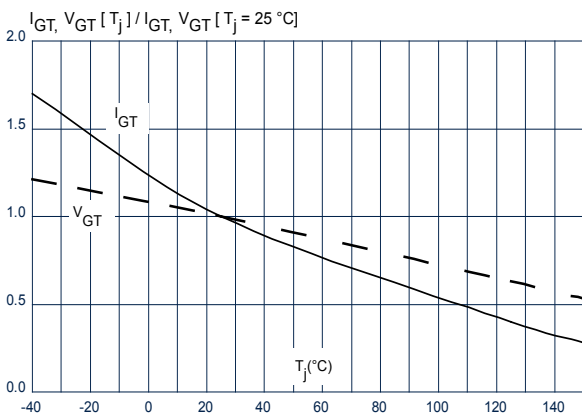
**Figure 7. Relative variation of leakage current versus junction temperature for different values of blocking voltage (typical values)**



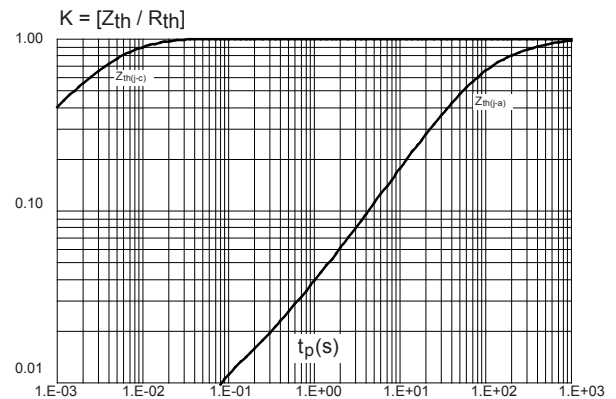
**Figure 8. Relative variation of holding and latching current versus junction temperature (typical values)**



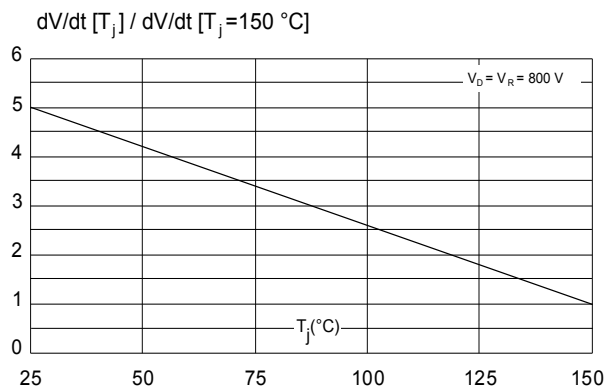
**Figure 9. Relative variation of gate trigger current and gate trigger voltage versus junction temperature (typical values)**



**Figure 10. Relative variation of thermal impedance junction to case and junction to ambient versus pulse duration**



**Figure 11. Relative variation of static dV/dt immunity versus junction temperature**



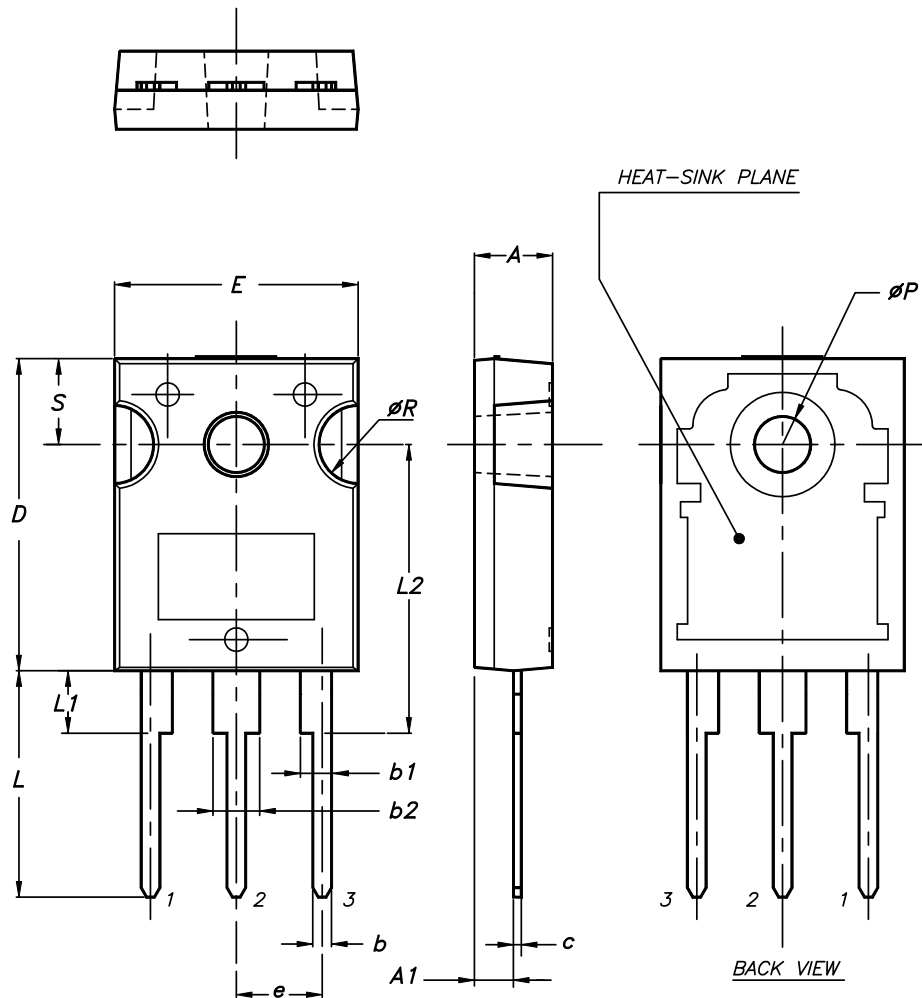
## 2 Package information

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.

### 2.1 TO-247 package information

- Epoxy meets UL 94,V0
- Recommended torque value: 0.8 N·m
- Maximum torque value: 1 N·m

Figure 12. TO-247 package outline



0075325\_9

**Table 6. TO-247 package mechanical data**

Dim.	Dimensions					
	Millimeters			Inches <sup>(1)</sup>		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.85		5.15	0.1909		0.2028
A1	2.20		2.60	0.0866		0.1024
b	1.0		1.40	0.0394		0.0551
b1	2.0		2.40	0.0787		0.0945
b2	3.0		3.40	0.1181		0.1339
c	0.40		0.80	0.0157		0.0315
D <sup>(2)</sup>	19.85		20.15	0.7815		0.7933
E	15.45		15.75	0.6083		0.6201
e	5.30	5.45	5.60	0.2087	0.2146	0.2205
L	14.20		14.80	0.5591		0.5827
L1	3.70		4.30	0.1457		0.1693
L2		18.50			0.7283	
ØP <sup>(3)</sup>	3.55		3.65	0.1398		0.1437
ØR	4.50		5.50	0.1772		0.2165
S	5.30	5.50	5.70	0.2087	0.2165	0.2244

1. Inch dimensions given only for reference
2. Dimension D plus gate protrusion does not exceed 20.5 mm
3. Resin thickness around the mounting hole is not less than 0.9 mm

### 3 Ordering information

Figure 13. Ordering information scheme

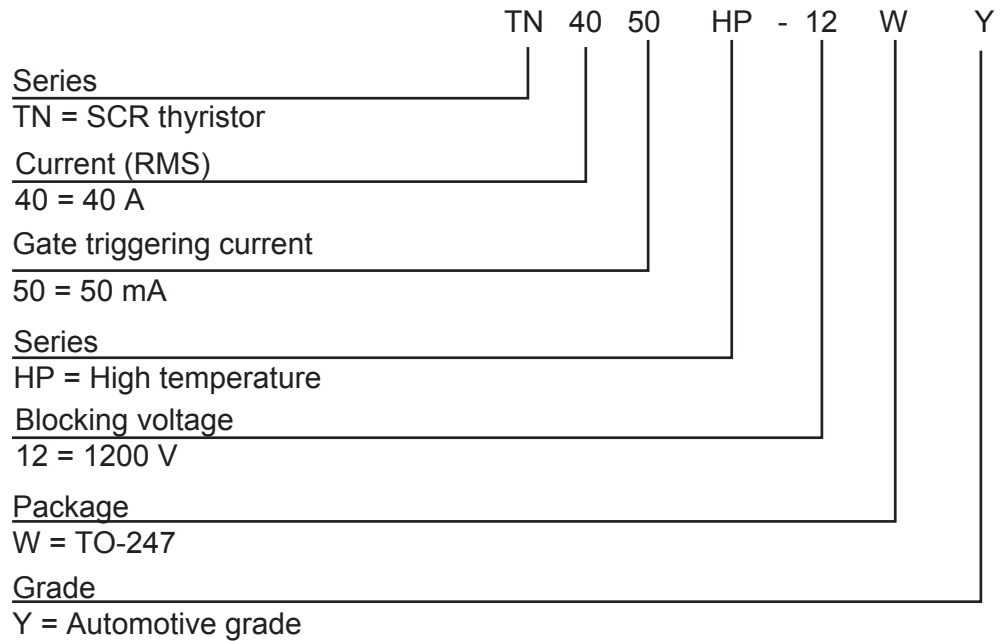


Table 7. Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
TN4050HP-12WY	TN4050HP12Y	TO-247	4.43 g	30	Tube



## Revision history

**Table 8. Document revision history**

Date	Revision	Changes
28-Jul-2021	1	Initial release.
04-Aug-2021	2	Updated description on cover page. Updated <a href="#">Table 1</a> and <a href="#">Figure 3</a> title.
16-Dec-2021	3	Updated <a href="#">Section 1.1 Characteristics (curves)</a> .

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