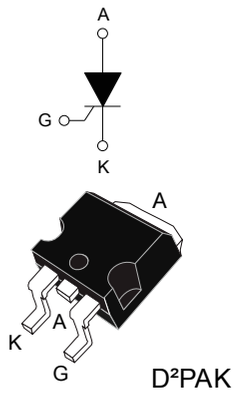
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TN4050HP-12GY-TR

Datasheet

40 A 1200 V automotive grade thyristor (SCR) in D²PAK



D²PAK

Features

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

Application

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

Product status
TN4050HP-12GY-TR

Product summary	
$I_{T(RMS)}$	40 A
V_{DRM}/V_{RRM}	1200 V
V_{DSM}/V_{RSM}	1400 V
I_{GT}	50 mA
T_j	-40 to 150 °C

Description

The TN4050HP-12GY-TR 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-12GY-TR is available in D²PAK surface mount package, ideal for automatic assembly lines.

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1 Characteristics

Table 1. Absolute ratings (limiting values)

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	RMS on-state current (180 ° conduction angle)		T_C = 135 °C	40	A
$I_{T(AV)}$	Average on-state current (180 ° conduction angle)			25	
I_{TSM}	Non repetitive surge peak on-state current, V_R = 0 V	t_p = 8.3 ms	T_j initial = 25 °C	440	A
		t_p = 10 ms		400	
I^2t	I^2t value for fusing	t_p = 10 ms	T_j = 25 °C	800	A^2s
dI/dt	I_G = 2 x I_{GT} , tr ≤ 100 ns Critical rate of rise of on-state current	f = 50 Hz	T_j = 150 °C	200	A/µs
V_{DRM} / V_{RRM}	Repetitive off-state voltage		T_j = 150 °C	1200	V
V_{DSM} / V_{RSM}	Non repetitive surge peak off-state voltage	t_p = 10 ms	T_j = 25 °C	1400	V
V_{GM}	Peak forward gate voltage	t_p = 20 µs	T_j = 150 °C	10	V
I_{GM}	Peak forward gate current	t_p = 20 µs	T_j = 150 °C	8	A
V_{RGM}	Maximum peak reverse gate voltage		T_j = 25 °C	5	V
$P_{G(AV)}$	Average gate power dissipation		T_j = 150 °C	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 Ω		Min.	10	mA
			Max.	50	
V_{GT}			Max.	1.3	V
I_{GD}	V_D = 800 V, R_L = 3.3 Ω	T_j = 150 °C	Min.	3	mA
V_{GD}	V_D = 800 V, R_L = 3.3 Ω	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 x I_{GT}		Max.	125	mA
dV/dt	V_D = 800 V, gate open	T_j = 150 °C	Min.	1000	V/µs

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/µs		Typ.	1	µs
t_q	I_{TM} = 25 A, V_D = 800 V, dI_T/dt = 10 A/µs, V_R = 75 V, dV_D/dt = 20 V/µs, t_p = 100 µs	T_j = 150 °C	Typ.	150	µs

Table 4. Static Characteristics

Symbol	Test Conditions			Value	Unit
V_{TM}	I_{TM} = 80 A, t_P = 380 µs	T_j = 25 °C	Max.	1.55	V

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Symbol	Test Conditions			Value	Unit
V_{TO}	On-state threshold voltage	T_j = 150 °C	Max.	0.83	V
R_D	On-state dynamic resistance	T_j = 150 °C	Max.	10	mΩ
I_{DRM}/I_{RRM}	$V_D = V_{DRM}$, $V_R = V_{RRM}$	T_j = 25 °C	Max.	5	µA
		T_j = 125 °C		0.9	mA
		T_j = 150 °C		6	mA
I_{DSM}/I_{RSM}	$V_D = V_{DSM}$, $V_R = V_{RSM}$	T_j = 25 °C	Max.	10	µA

Table 5. Thermal parameters

Symbol	Parameter		Value	Unit
$R_{th(j-c)}$	Junction to case (DC)	Max.	0.4	°C/W
$R_{th(j-a)}$	Junction to ambient (DC, S_{CU} = 2.5 cm², e_{CU} = 70 µm)	Typ.	45	

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1.1 Characteristics (curves)

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

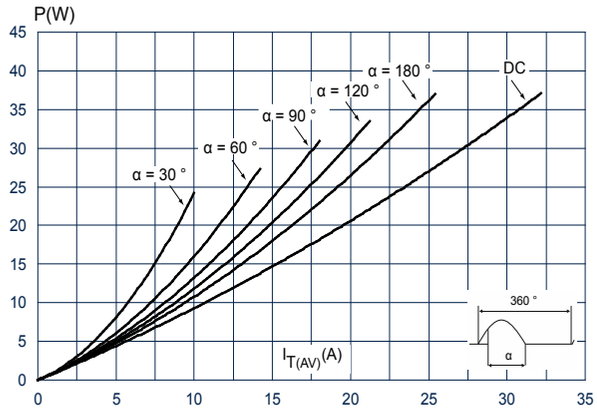


Figure 2. Average and D.C. on-state current versus case temperature

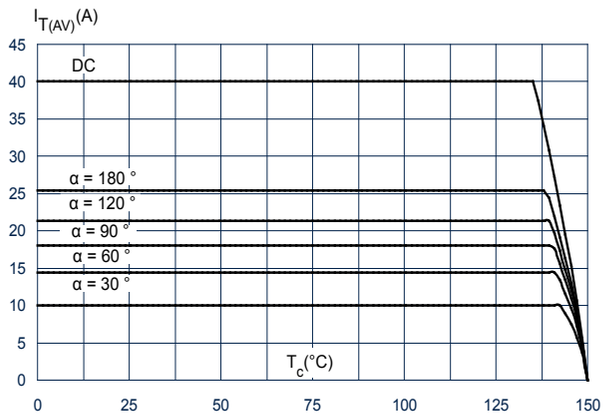


Figure 3. Average and D.C. on-state current versus ambient temperature

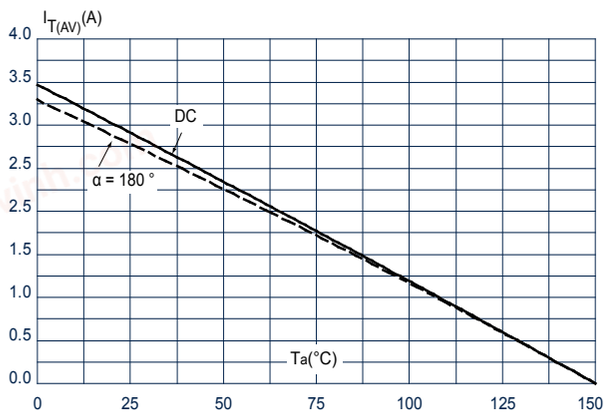


Figure 4. On-state characteristics (maximum values)

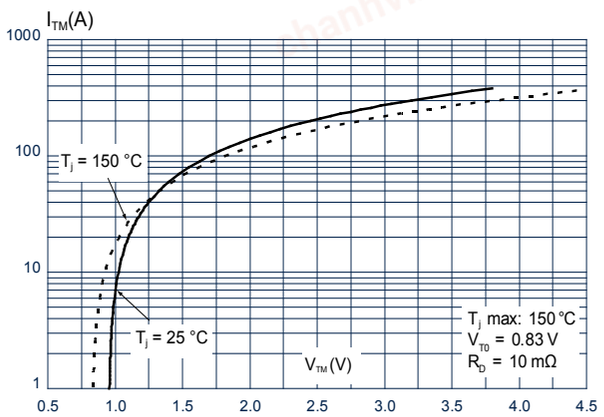


Figure 5. Surge peak on-state current versus number of cycles

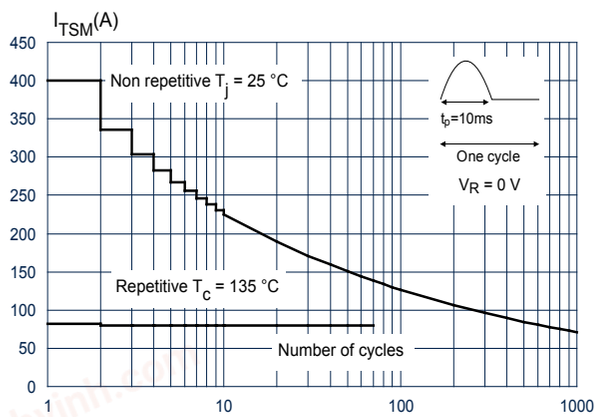
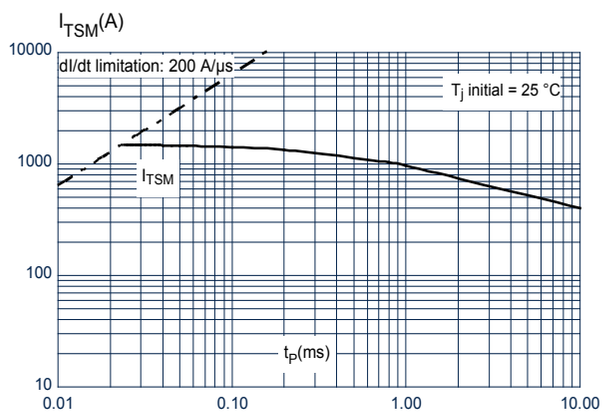


Figure 6. Non repetitive surge peak on-state current for a sinusoidal pulse with width t_p < 10 ms



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

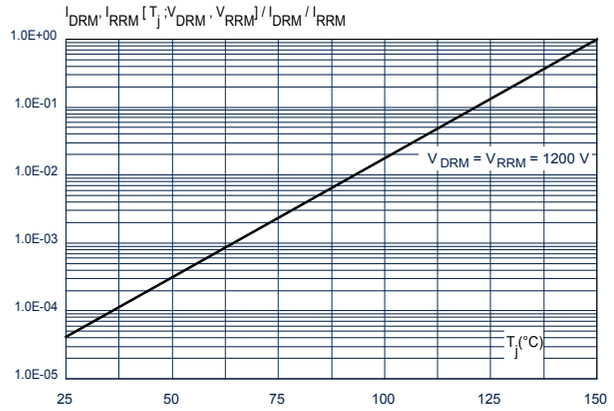


Figure 8. Relative variation of holding and latching current versus junction temperature (typical values)

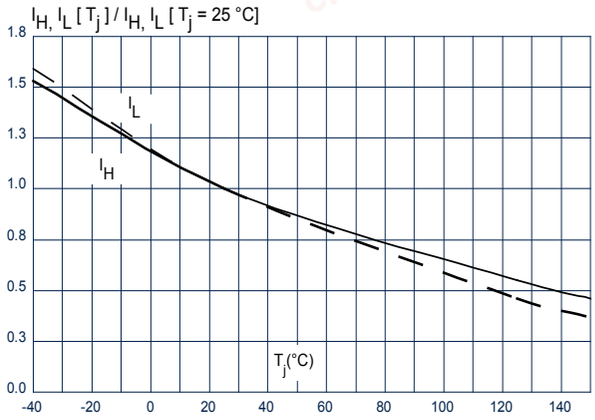


Figure 9. Relative variation of gate trigger current and gate voltage versus junction temperature (typical values)

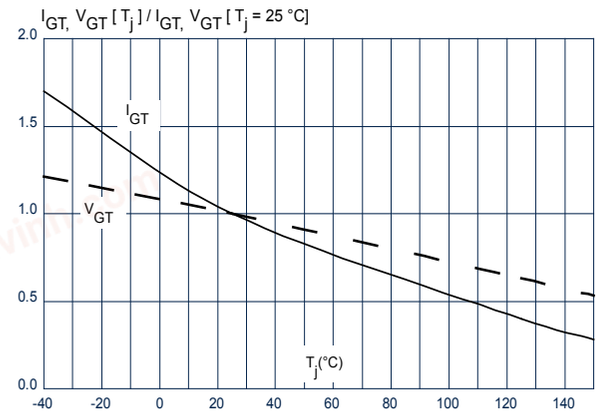


Figure 10. Relative variation of thermal impedance junction to case and junction to ambient versus pulse duration

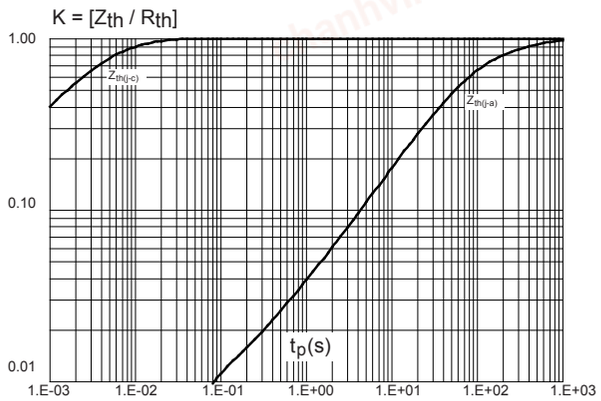


Figure 11. Thermal resistance junction to ambient versus copper surface under tab (typical values, epoxy printed board FR4) (D²PAK)

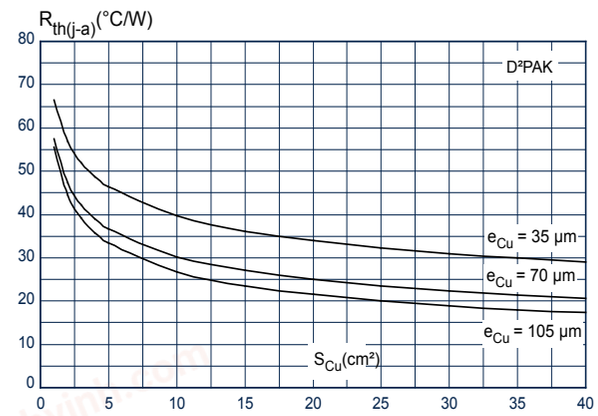
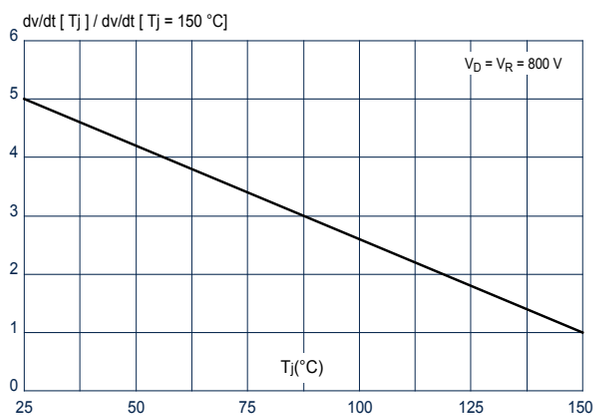


Figure 12. Relative variation of static dV/dt immunity versus junction temperature



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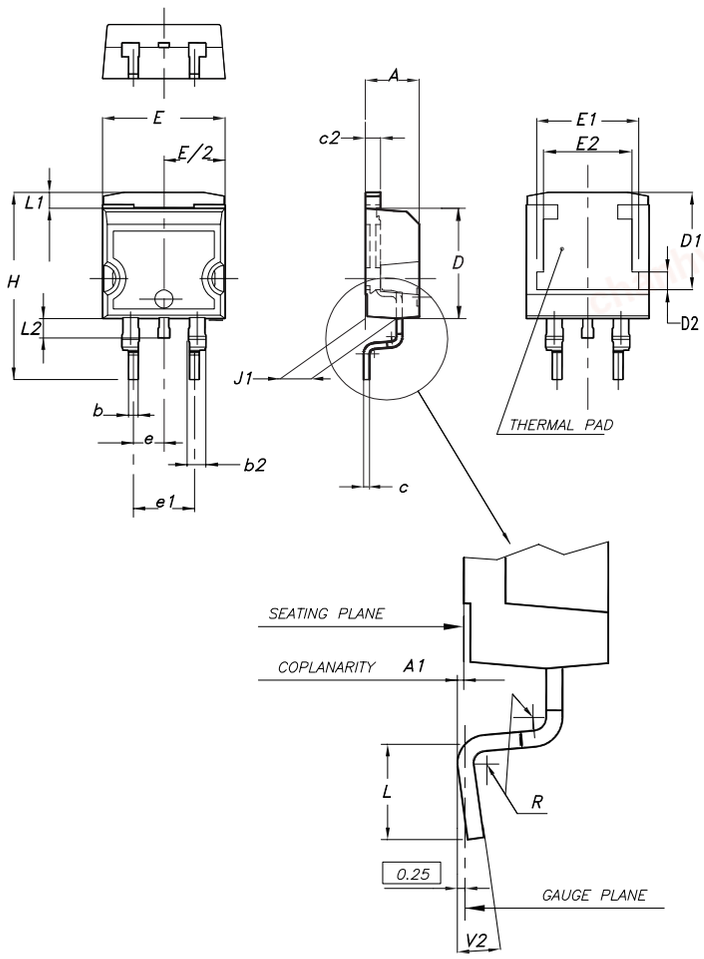
2 Package information

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. ECOPACK is an ST trademark.

2.1 D²PAK package information

- Epoxy meets UL94, V0.
- Cooling method: by conduction (C)

Figure 13. D²PAK package outline



Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

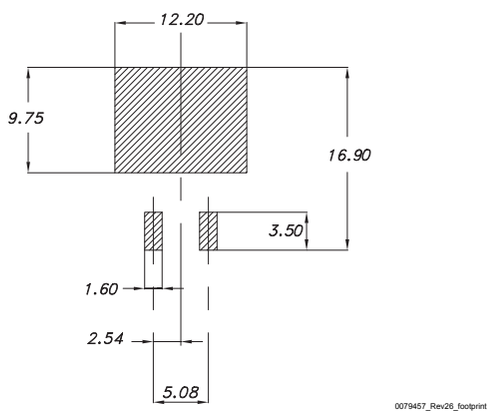
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Table 6. **D²PAK package mechanical data**

Ref.	Dimensions					
	Millimeters			Inches[1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.1732		0.1811
A1	0.03		0.23	0.0012		0.0091
b	0.70		0.93	0.0276		0.0366
b2	1.14		1.70	0.0449		0.0669
c	0.45		0.60	0.0177		0.0236
c2	1.23		1.36	0.0484		0.0535
D	8.95		9.35	0.3524		0.3681
D1	7.50	7.75	8.00	0.2953	0.3051	0.3150
D2	1.10	1.30	1.50	0.0433	0.0511	0.0591
E	10		10.40	0.3937		0.4094
E1	8.30	8.50	8.70	0.3267	0.3346	0.3425
E2	6.85	7.05	7.25	0.2697	0.2776	0.2854
e		2.54			0.1000	
e1	4.88		5.28	0.1921		0.2079
H	15		15.85	0.5906		0.6240
J1	2.49		2.69	0.0980		0.1059
L	2.29		2.79	0.0902		0.1098
L1	1.27		1.40	0.0500		0.0551
L2	1.30		1.75	0.0512		0.0689
R		0.4			0.0157	
V2	0°		8°	0°		8°

1. *Dimensions in inches are given for reference only*

Figure 14. **D²PAK recommended footprint (dimensions are in mm)**



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3 Ordering information

Figure 15. **Ordering information scheme**

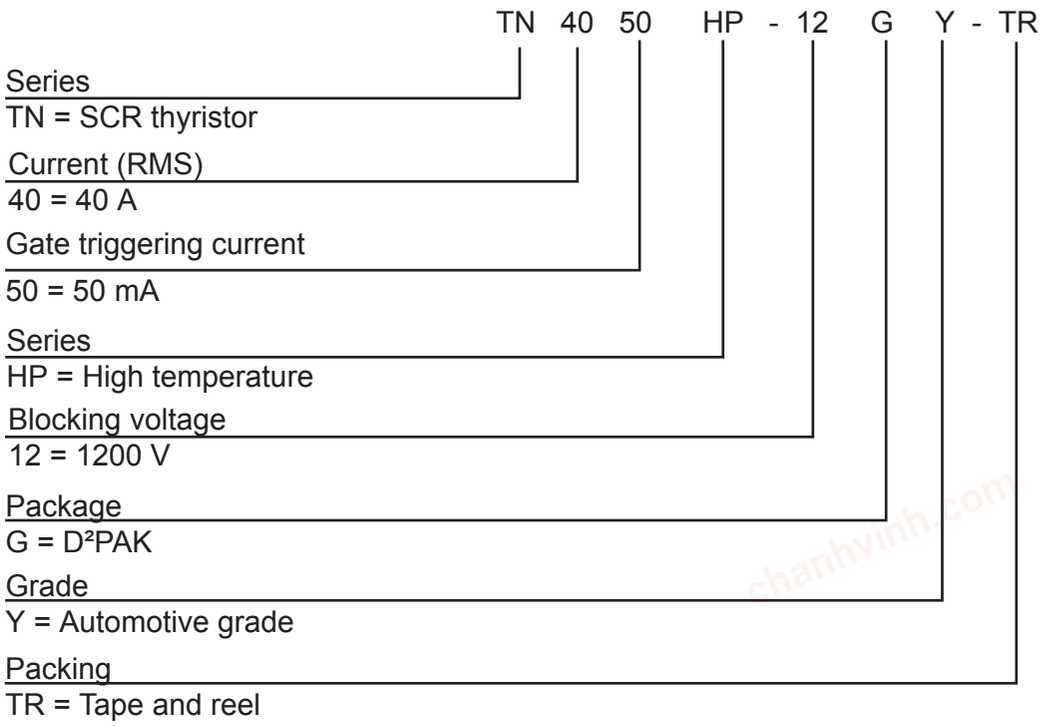


Table 7. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Delivery mode
TN4050HP-12GY-TR	TN40P12YB	D²PAK	1.38 g	1000	Tape and reel 13"

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Revision history

Table 8. **Document revision history**

Date	Revision	Changes
16-Dec-2021	1	Initial release.

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