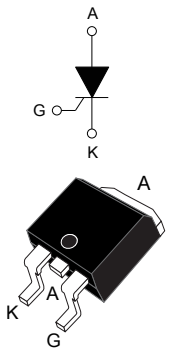
TN4050HA-12GY

Datasheet

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



Product status
TN4050HA-12GY

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

Features

- AEC-Q101 qualified
- Max. blocking voltage = V_{DRM}, V_{RRM} = 1200 V
- Max. surge voltage = V_{DSM}, V_{RSM} = 1400 V
- Nominal RMS on-state current: 40 A_{RMS}
- Max. junction temperature: 150 °C
- Maximum I_{GT} = 50 mA
- High dynamic performances at T_J = 150 °C
  - Off state dV/dt = 1500 V/µs
  - Turn on dI/dt = 200 A/µs
- ECOPACK2 compliant component
  - RoHS
  - Halogen Free molding compound

Application

- Off and on board charger
- Renewable energy inverters
- Uninterruptible power supply (UPS)
- Capacitor discharge
- Crowbar / fast discharge circuit
- Bypass solid state relay (SSR)
- AC DC inrush current limiter (ICL)
- AC DC voltage-controlled rectifier
- AC motor soft starter

Description

The TN4050HA-12GY, rated 40 A RMS current, offers superior performance in peak voltage robustness up to 1400 V and surge current handling up to 400 A 10 ms sine wave pulse.

Its key features allow the design of functions such as a 55 A RMS AC switch, dual back-to-back SCRs, and a 50 A average AC-DC controlled bridge rectifier for inrush current limitation, among other applications.

This SCR is an automotive grade thyristor designed for applications such as automotive on-board chargers, solid state relays, and stationary battery chargers where high off state immunity is required.

Available in D²PAK package, it is ideal for higher power compact SMD design on printed circuit board or insulated metal substrate board.

1 Characteristics

Table 1. Absolute ratings (limiting values)

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	RMS on-state current (180 ° conduction angle)		T_C = 128 °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	438	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	Critical rate of rise of on-state current, I_G = 2 x I_{GT} , tr ≤ 100 ns	f = 50 Hz	T_j = 150 °C	200	A/µs
V_{DRM} / V_{RRM}	Repetitive peak off-state voltage (50-60 Hz)		T_j = -40 to +125 °C	1200	V
			T_j = -40 to +150 °C	800	
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	5	V
I_{GM}	Peak forward gate current			8	A
V_{RGM}	Maximum peak reverse gate voltage			3.5	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				

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
V_{GD}	V_D = 800 V, R_L = 3.3 kΩ	T_j = 150 °C	Min.	0.2	V
I_{GD}	V_D = 800 V, R_L = 3.3 kΩ	T_j = 150 °C	Min.	2.5	mA
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 = 125 °C	Min.	3000	V/µs
		T_j = 150 °C	Min.	1500	

Table 3. Timing Parameters

Symbol	Test Conditions			Value	Unit
t_{gt}	I_T = 40 A , V_D = 800 V, I_G = 2 x I_{GT}, dI_G/dt = 0.2 A/µs	T_j = 25 °C	Typ.	2	µs
t_q	I_T = 40 A, V_D = 800 V, $(dI/dt)_{OFF}$ = 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} = 50 A, t_P = 380 µs	T_j = 25 °C	Max.	1.55	V
V_{TO}	On-state threshold voltage	T_j = 150 °C	Max.	0.85	V
R_D	On-state dynamic resistance	T_j = 150 °C	Max.	13	mΩ
I_{DRM}/I_{RRM}	$V_D = V_R$ = 1200 V	T_j = 25 °C	Max.	3	µA
		T_j = 125 °C		3	mA
	$V_D = V_R$ = 800 V	T_j = 150 °C		10	mA
I_{DSM}/I_{RSM}	$V_D = V_R$ = 1400 V	T_j = 25 °C	Max.	10	µA

Table 5. Thermal parameters

Symbol	Parameter		Value	Unit
$R_{th(j-c)}$	Thermal resistance junction to case (DC)	Max.	0.5	°C/W
$R_{th(j-a)}$	Junction to ambient, (DC, S_{CU} = 2.5 cm², e_{CU} = 70 µm)	Typ.	45	

1.1 Characteristics (curves)

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

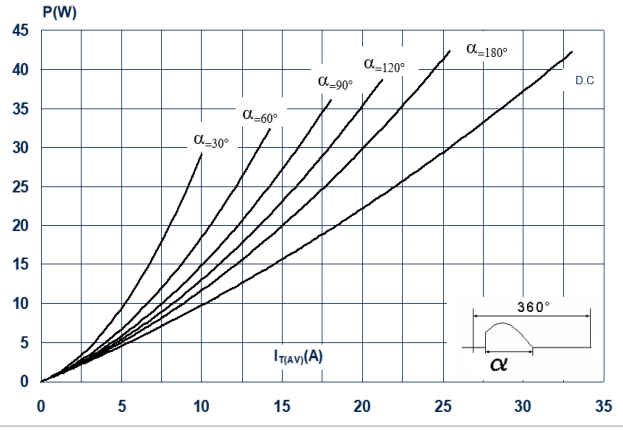


Figure 2. Average and D.C. on-state current versus case temperature

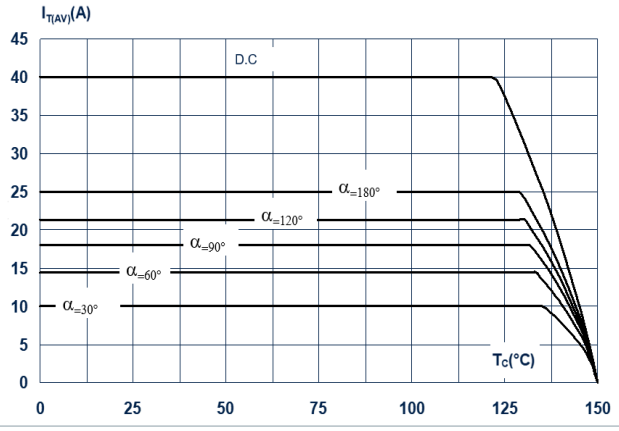


Figure 3. On-state characteristics (maximum values)

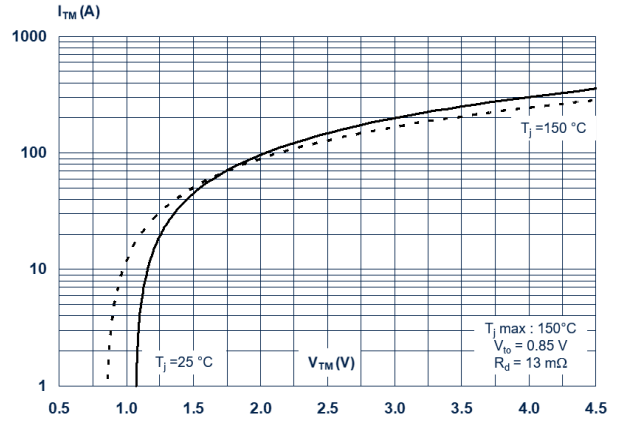


Figure 4. Average and D.C. on-state current versus ambient temperature

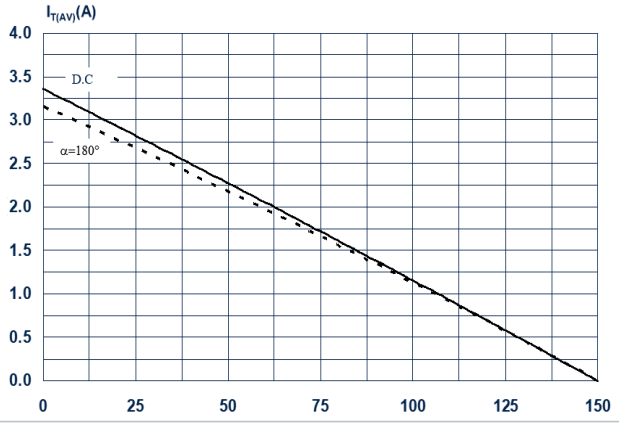


Figure 5. Relative variation of thermal impedance junction to case and junction to ambient versus pulse duration

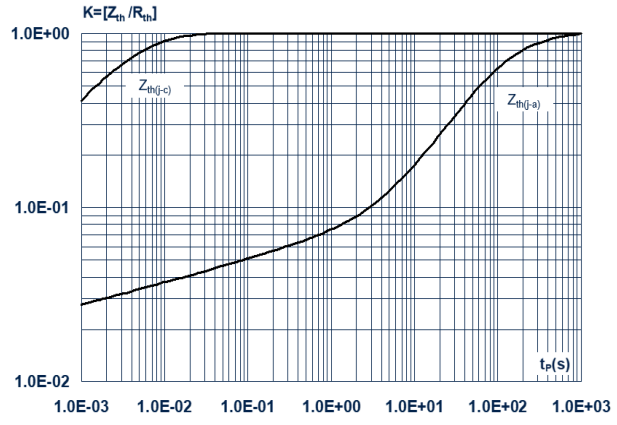


Figure 6. Surge peak on-state current versus number of cycles (V_R = 0 V)

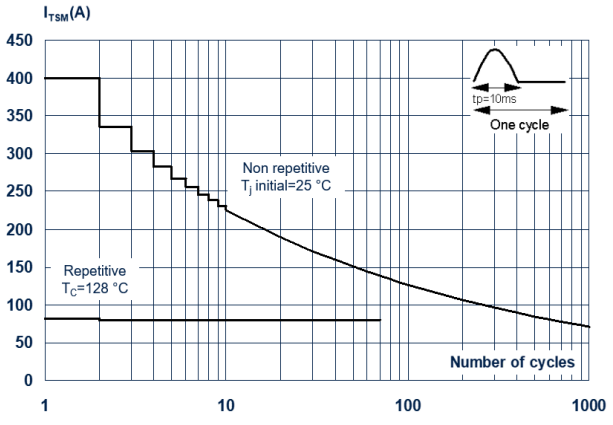


Figure 7. Non repetitive surge peak on-state current for a sinusoidal pulse with width t_p < 10 ms (V_R = 0 V)

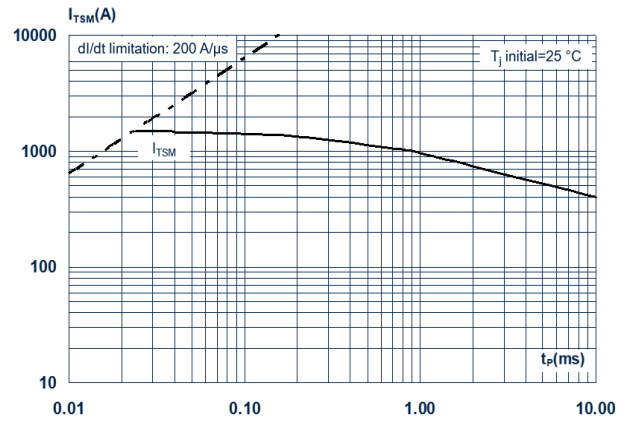


Figure 8. Relative variation of holding and latching current versus junction temperature (typical values)

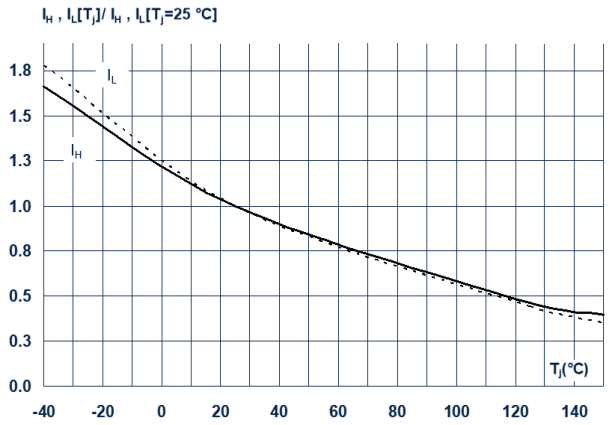


Figure 9. Relative variation of gate trigger current and gate voltage versus junction temperature (typical values)

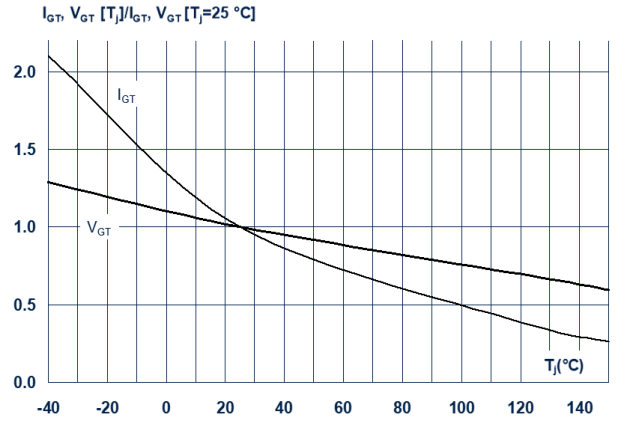


Figure 10. Gate characteristics, voltage versus current

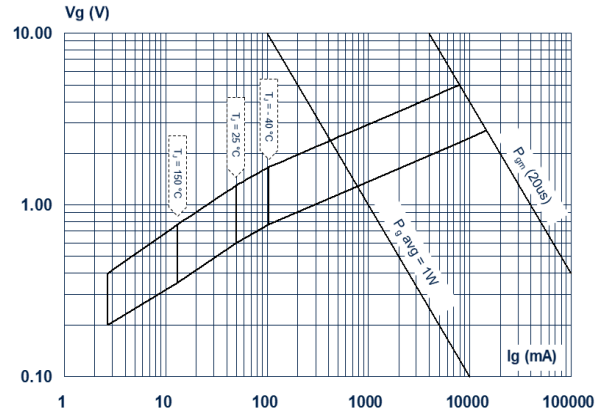


Figure 11. Relative variation of static dV/dt immunity versus junction temperature

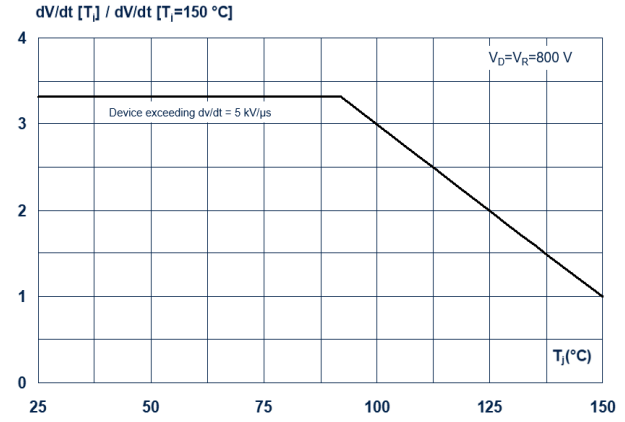


Figure 12. Relative variation of leakage current versus junction temperature for different values of blocking voltage (typical values)

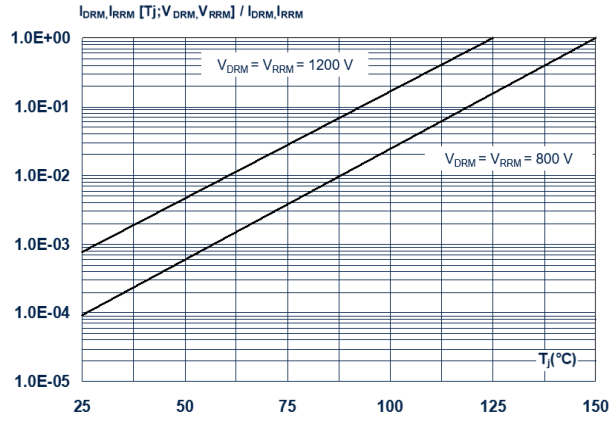
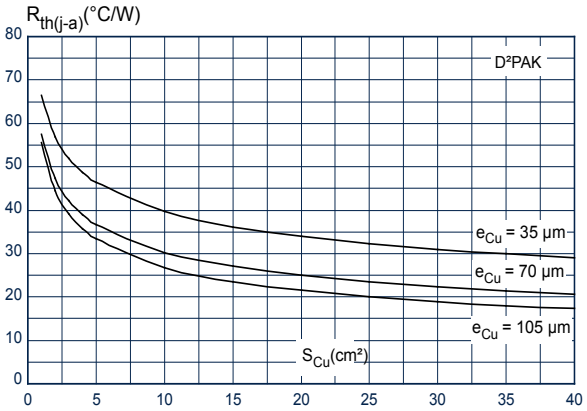


Figure 13. Thermal resistance junction to ambient versus copper surface under tab (typical values, epoxy printed board FR4) (D²PAK)



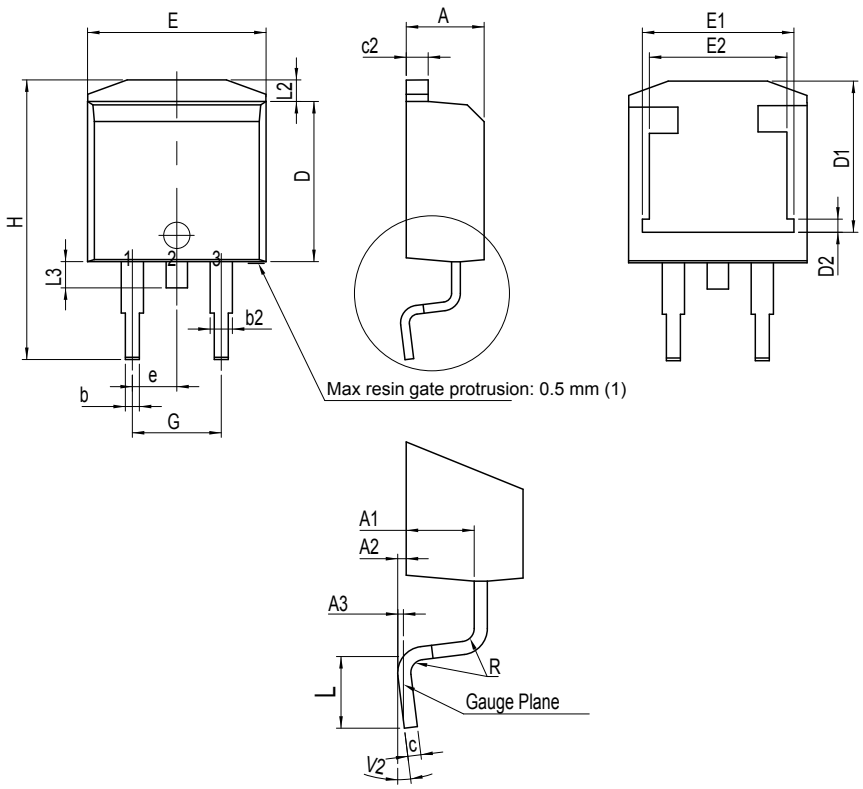
2 Package information

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

- Molding compounded resin is halogen free and meets UL94 flammability standard, level V0
- Lead-free package leads plating

Figure 14. D²PAK package outline



(1) Resin gate is accepted in each of position shown on the drawing, or their symmetrical.

Table 6. **D²PAK package mechanical data**

Ref.	Dimensions					
	Millimeters			Inches[1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.30		4.60	0.1693		0.1811
A1	2.49		2.69	0.0980		0.1059
A2	0.03		0.23	0.0012		0.0091
A3		0.25			0.0098	
b	0.70		0.93	0.0276		0.0366
b2	1.25		1.7	0.0492		0.0669
c	0.45		0.60	0.0177		0.0236
c2	1.21		1.36	0.0476		0.0535
D	8.95		9.35	0.3524		0.3681
D1	7.50		8.00	0.2953		0.3150
D2	1.30		1.70	0.0512		0.0669
e		2.54			0.1	
E	10.00		10.28	0.3937		0.4047
E1	8.30		8.70	0.3268		0.3425
E2	6.85		7.25	0.2697		0.2854
G	4.88		5.28	0.1921		0.2079
H	15		15.85	0.5906		0.6240
L	1.78		2.28	0.0701		0.0898
L2	1.19		1.40	0.0470		0.0551
L3	1.40		1.75	0.0551		0.0689
R		0.40			0.0157	
V2	0°		8°	0°		8°

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

Figure 15. **D²PAK recommended footprint (dimensions are in mm)**

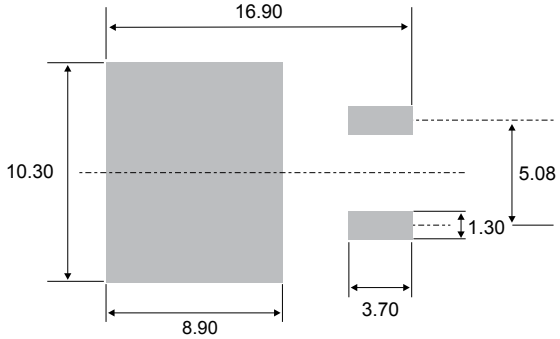
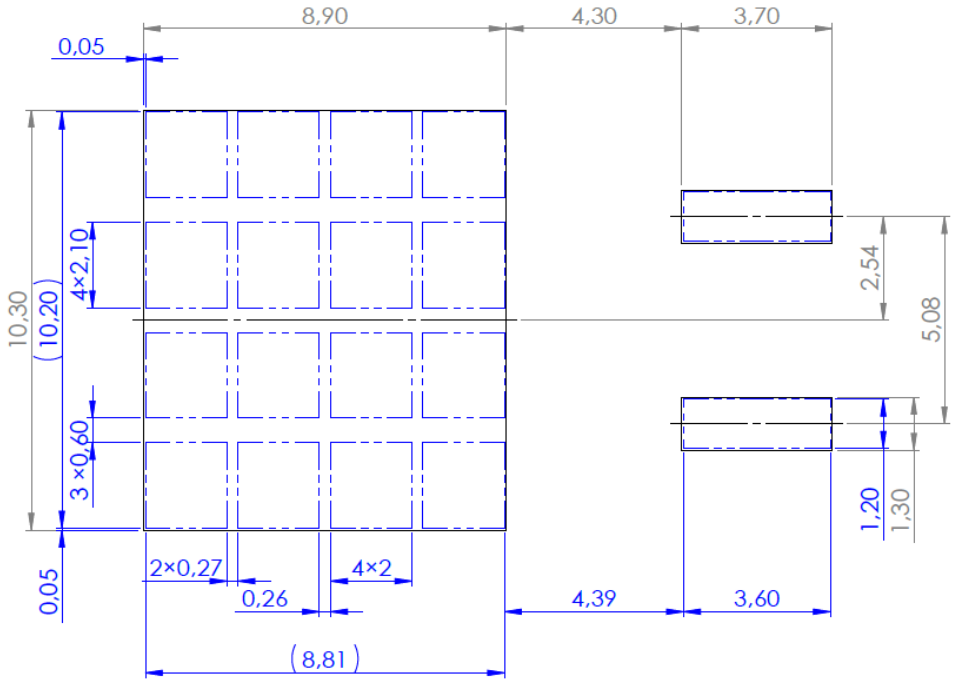


Figure 16. D²PAK stencil definitions (dimensions are in mm)



3 Ordering information

Figure 17. **Ordering information scheme**

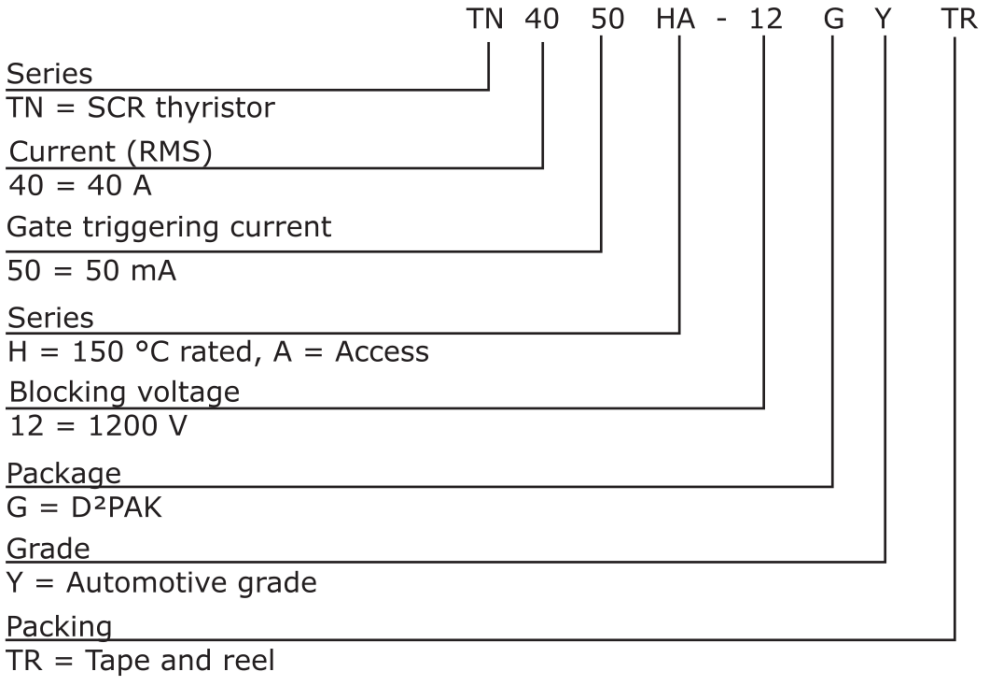


Table 7. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Delivery mode
TN4050HA-12GY-TR	TN4050HA12GY	D²PAK	1.38 g	1000	Tape and reel
TN4050HA-12GY	TN4050HA12GY			50	Tube

Revision history

Table 8. **Document revision history**

Date	Revision	Changes
29-Jun-2022	1	Initial release.