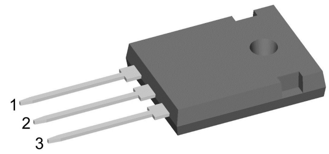
High Efficiency Thyristor

V_{RRM} = 1200 V
I_{TAV} = 40 A
V_T = 1.23 V

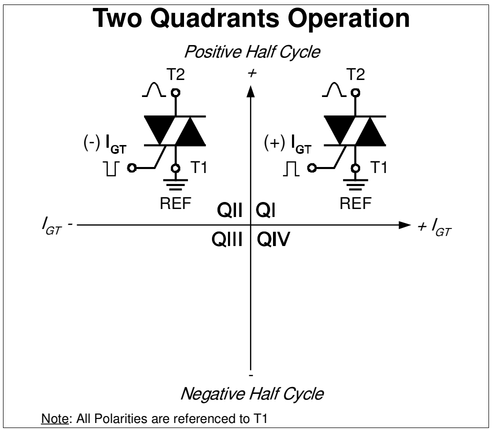
Two Quadrants Operation QI & QII
Single Thyristor with two gate polarities

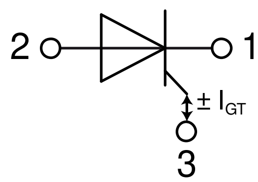
Part number

CLA40E1200NHB



Backside: anode





Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Two gate current polarities usable
  - positive -> quadrant I
  - negative -> quadrant II
- Thyristor can be used as Triac
  - anti-parallel combination with AGT
  - Anode-Gated-Thyristor covers quadrant III
  - AGT-counterpart: CLB40I1200PZ

Applications:

- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

Package: TO-247

- Industry standard outline
- RoHS compliant
- Epoxy meets UL 94V-0

Disclaimer Notice

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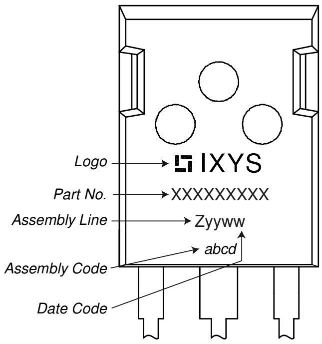
Thyristor

Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM/DSM}$	*max. non-repetitive reverse/forward blocking voltage*		T_{VJ} = 25°C			1300	V
$V_{RRM/DRM}$	*max. repetitive reverse/forward blocking voltage*		T_{VJ} = 25°C			1200	V
$I_{R/D}$	*reverse current, drain current*	$V_{R/D}$ = 1200 V	T_{VJ} = 25°C			10	µA
		$V_{R/D}$ = 1200 V	T_{VJ} = 125°C			2	mA
V_T	*forward voltage drop*	I_T = 40 A	T_{VJ} = 25°C			1.28	V
		I_T = 80 A				1.55	V
		I_T = 40 A	T_{VJ} = 125°C			1.23	V
		I_T = 80 A				1.59	V
I_{TAV}	*average forward current*	T_C = 120°C	T_{VJ} = 150°C			40	A
$I_{T(RMS)}$	*RMS forward current*	180° sine				63	A
V_{T0}	*threshold voltage*	*for power loss calculation only*	T_{VJ} = 150°C			0.85	V
r_T	*slope resistance*					9.2	mΩ
R_{thJC}	*thermal resistance junction to case*					0.4	K/W
R_{thCH}	*thermal resistance case to heatsink*				0.25		K/W
P_{tot}	*total power dissipation*		T_C = 25°C			310	W
I_{TSM}	*max. forward surge current*	t = 10 ms; (50 Hz), sine	T_{VJ} = 45°C			520	A
		t = 8,3 ms; (60 Hz), sine	V_R = 0 V			560	A
		t = 10 ms; (50 Hz), sine	T_{VJ} = 150°C			440	A
		t = 8,3 ms; (60 Hz), sine	V_R = 0 V			475	A
I^2t	*value for fusing*	t = 10 ms; (50 Hz), sine	T_{VJ} = 45°C			1.35	kA²s
		t = 8,3 ms; (60 Hz), sine	V_R = 0 V			1.31	kA²s
		t = 10 ms; (50 Hz), sine	T_{VJ} = 150°C			970	A²s
		t = 8,3 ms; (60 Hz), sine	V_R = 0 V			940	A²s
C_J	*junction capacitance*	V_R = 400 V f = 1 MHz	T_{VJ} = 25°C		19		pF
P_{GM}	*max. gate power dissipation*	t_P = 30 µs	T_C = 150°C			10	W
		t_P = 300 µs				5	W
P_{GAV}	*average gate power dissipation*					0.5	W
$(di/dt)_{cr}$	*critical rate of rise of current*	T_{VJ} = 150 °C; f = 50 Hz	repetitive, I_T = 120 A			150	A/µs
		t_P = 200 µs; di_G/dt = 0.3 A/µs;					
		I_G = 0.3 A; V = ⅔ V_{DRM}	non-repet., I_T = 40 A			500	A/µs
$(dv/dt)_{cr}$	*critical rate of rise of voltage*	V = ⅔ V_{DRM}	T_{VJ} = 150°C			500	V/µs
		R_{GK} = ∞; method 1 (linear voltage rise)					
V_{GT}	*gate trigger voltage*	V_D = 6 V	T_{VJ} = 25°C			1.7	V
			T_{VJ} = -40°C			1.9	V
I_{GT}	*gate trigger current*	V_D = 6 V	T_{VJ} = 25°C			± 35	mA
			T_{VJ} = -40°C			± 55	mA
V_{GD}	*gate non-trigger voltage*	V_D = ⅔ V_{DRM}	T_{VJ} = 150°C			0.2	V
I_{GD}	*gate non-trigger current*					± 1	mA
I_L	*latching current*	t_p = 10 µs	T_{VJ} = 25°C			100	mA
		I_G = 0.3 A; di_G/dt = 0.3 A/µs					
I_H	*holding current*	V_D = 6 V R_{GK} = ∞	T_{VJ} = 25°C			70	mA
t_{gd}	*gate controlled delay time*	V_D = ½ V_{DRM}	T_{VJ} = 25°C			2	µs
		I_G = 0.3 A; di_G/dt = 0.3 A/µs					
t_q	*turn-off time*	V_R = 100 V; I_T = 40A; V = ⅔ V_{DRM}	T_{VJ} = 125 °C		150		µs
		di/dt = 10 A/µs dv/dt = 20 V/µs	t_p = 200 µs				

Package TO-247			Ratings			
Symbol	**Definition**	**Conditions**	**min.**	**typ.**	**max.**	**Unit**
I_{RMS}	*RMS current*	per terminal			70	A
T_{VJ}	*virtual junction temperature*		-40		150	°C
T_{op}	*operation temperature*		-40		125	°C
T_{stg}	*storage temperature*		-40		150	°C
Weight				6		g
M_D	*mounting torque*		0.8		1.2	Nm
F_C	*mounting force with clip*		20		120	N

Product Marking



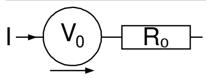
Part description

C = Thyristor (SCR)
L = High Efficiency Thyristor
A = (up to 1200V)
40 = Current Rating [A]
E = Single Thyristor with two gate polarities
1200 = Reverse Voltage [V]
N = Three Quadrants operation: QI - QIII
HB = TO-247AD (3)

Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	CLA40E1200NHB	CLA40E1200NHB	Tube	30	524548

Equivalent Circuits for Simulation

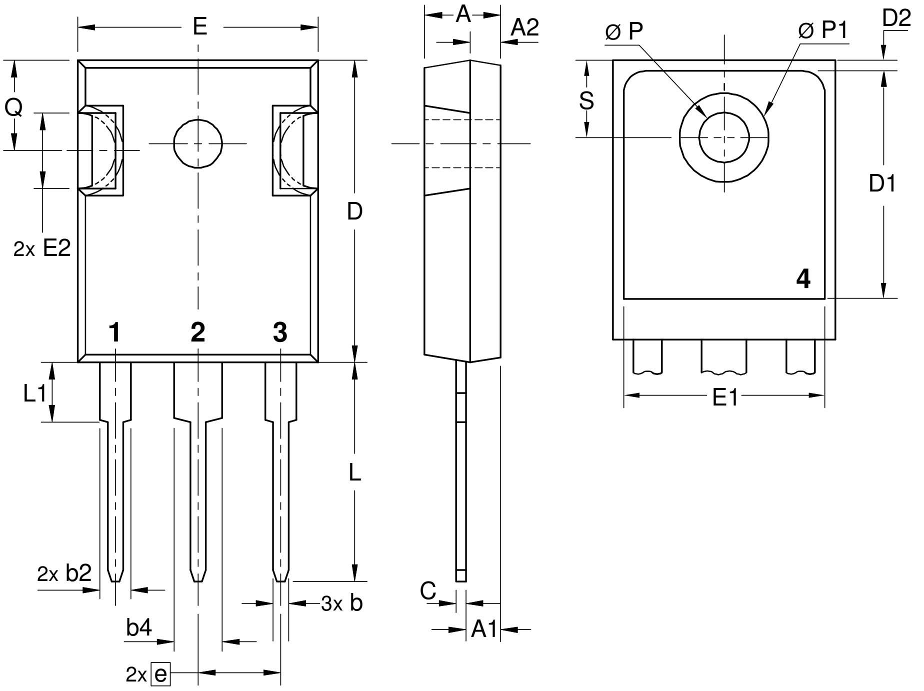
** on die level* $T_{VJ} = 150\,°C$



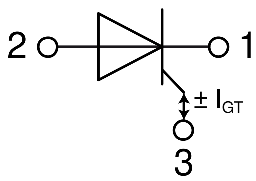
		Thyristor	
$V_{0\,max}$	*threshold voltage*	0.85	V
$R_{0\,max}$	*slope resistance **	6.7	mΩ

IXYS reserves the right to change limits, conditions and dimensions. Data according to IEC 60747and per semiconductor unless otherwise specified 20190618a

Outlines TO-247



Sym.	Inches		Millimeter	
	min.	max.	min.	max.
A	0.185	0.209	4.70	5.30
A1	0.087	0.102	2.21	2.59
A2	0.059	0.098	1.50	2.49
D	0.819	0.845	20.79	21.45
E	0.610	0.640	15.48	16.24
E2	0.170	0.216	4.31	5.48
e	0.215 BSC		5.46 BSC	
L	0.780	0.800	19.80	20.30
L1	-	0.177	-	4.49
Ø P	0.140	0.144	3.55	3.65
Q	0.212	0.244	5.38	6.19
S	0.242 BSC		6.14 BSC	
b	0.039	0.055	0.99	1.40
b2	0.065	0.094	1.65	2.39
b4	0.102	0.135	2.59	3.43
c	0.015	0.035	0.38	0.89
D1	0.515	-	13.07	-
D2	0.020	0.053	0.51	1.35
E1	0.530	-	13.45	-
Ø P1	-	0.29	-	7.39



Thyristor

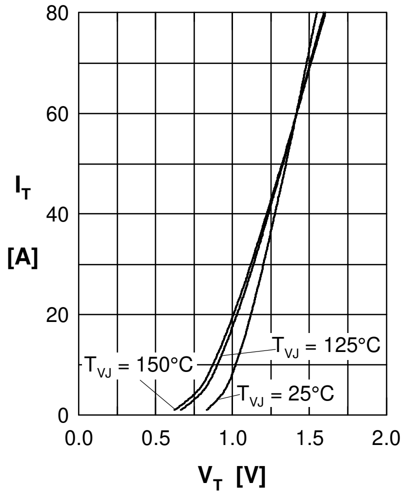


Fig. 1 Forward characteristics

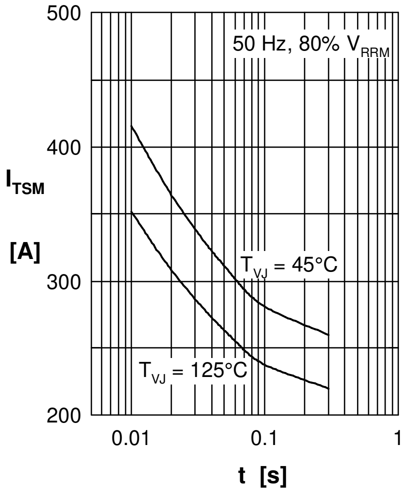


Fig. 2 Surge overload current
I_{TSM}: crest value, t: duration

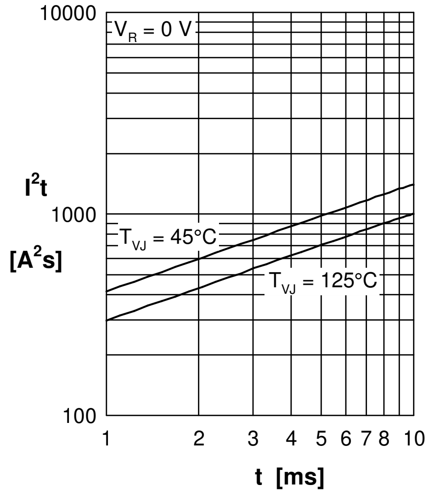


Fig. 3 I^2t versus time (1-10 s)

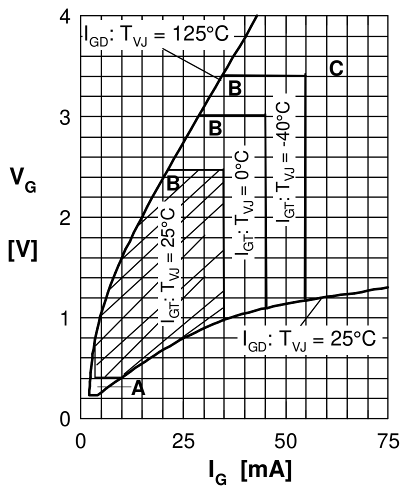


Fig. 4 Gate voltage & gate current

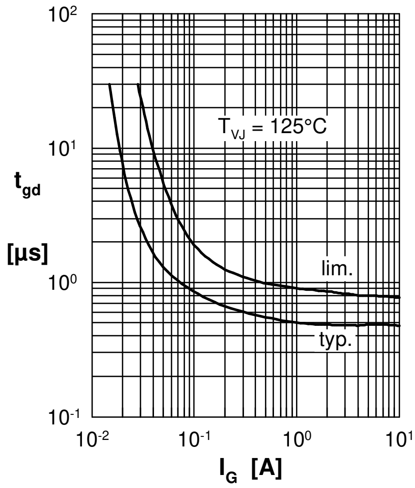


Fig. 5 Gate controlled delay time t_{gd}

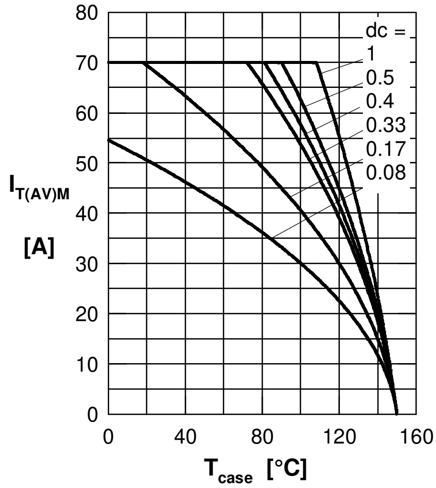


Fig. 6 Max. forward current at case temperature

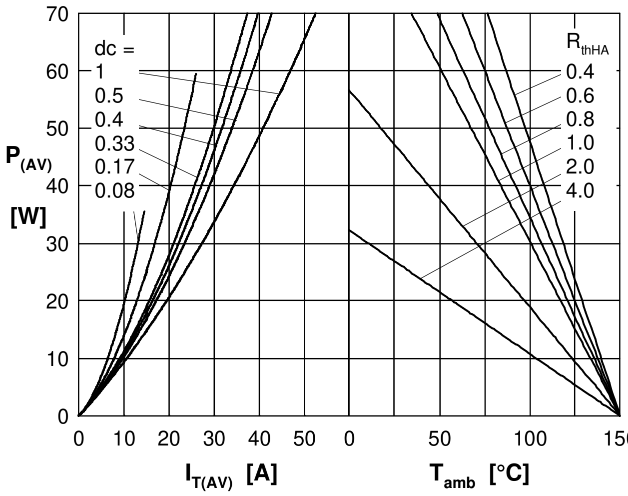
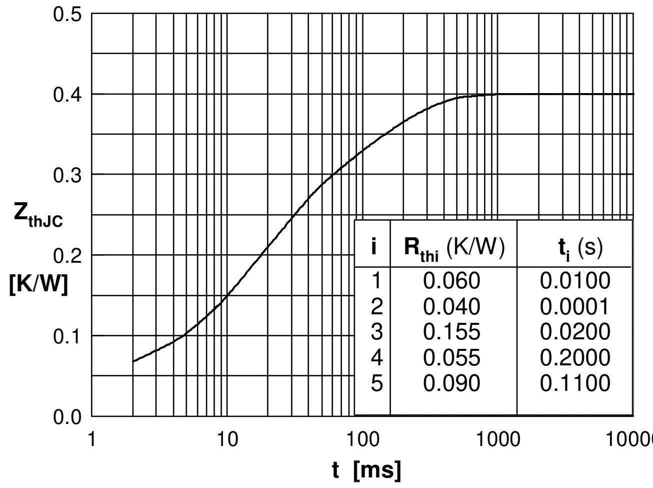


Fig. 7a Power dissipation versus direct output current
Fig. 7b and ambient temperature



i	R_{thi} (K/W)	t_i (s)
1	0.060	0.0100
2	0.040	0.0001
3	0.155	0.0200
4	0.055	0.2000
5	0.090	0.1100

Fig. 7 Transient thermal impedance junction to case