IXYS UK WESTCODE

Date:- 02 August 2012

Data Sheet Issue:- 2

Phase Control Thyristor

Types N1547NC160 to N1547NC200

Absolute Maximum Ratings

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
V_{DRM}	Repetitive peak off-state voltage, (note 1)	1600-2000	V
V_{DSM}	Non-repetitive peak off-state voltage, (note 1)	1600-2000	V
V_{RRM}	Repetitive peak reverse voltage, (note 1)	1600-2000	V
V_{RSM}	Non-repetitive peak reverse voltage, (note 1)	1700-2100	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{T(AV)}$	Mean on-state current, T_{sink}=55°C, (note 2)	1547	A
$I_{T(AV)}$	Mean on-state current. T_{sink}=85°C, (note 2)	1056	A
$I_{T(AV)}$	Mean on-state current. T_{sink}=85°C, (note 3)	633	A
$I_{T(RMS)}$	Nominal RMS on-state current, 25°C, (note 2)	3064	A
$I_{T(d.c.)}$	D.C. on-state current, 25°C, (note 4)	2632	A
I_{TSM}	Peak non-repetitive surge t_p=10ms, V_{RM}=0.6V_{RRM}, (note 5)	23.3	kA
I_{TSM2}	Peak non-repetitive surge t_p=10ms, $V_{RM}\leq$10V, (note 5)	25.6	kA
I^2t	I^2t capacity for fusing t_p=10ms, V_{RM}=0.6V_{RRM}, (note 5)	2.71×10^6	A^2s
I^2t	I^2t capacity for fusing t_p=10ms, $V_{RM}\leq$10V, (note 5)	3.28×10^6	A^2s
$(di/dt)_{cr}$	Maximum rate of rise of on-state current (repetitive), (Note 6)	500	A/µs
	Maximum rate of rise of on-state current (non-repetitive), (Note 6)	1000	A/µs
V_{RGM}	Peak reverse gate voltage	5	V
$P_{G(AV)}$	Mean forward gate power	4	W
P_{GM}	Peak forward gate power	30	W
V_{GD}	Non-trigger gate voltage, (Note 7)	0.25	V
T_{HS}	Operating temperature range	-40 to +125	°C
T_{stg}	Storage temperature range	-40 to +150	°C

Notes:-
1) De-rating factor of 0.13% per °C is applicable for T_j below 25°C.
2) Double side cooled, single phase; 50Hz, 180° half-sinewave.
3) Single side cooled, single phase; 50Hz, 180° half-sinewave.
4) Double side cooled.
5) Half-sinewave, 125°C T_j initial.
6) V_D=67% V_{DRM}, I_{TM}=1500A, I_{FG}=2A, $t_r\leq$0.5µs, T_{case}=125°C.
7) Rated V_{DRM}.

Characteristics

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS (Note 1)	UNITS
V_{TM}	Maximum peak on-state voltage	-	-	1.56	I_{TM}=2550A	V
V_{T0}	Threshold voltage	-	-	0.92		V
r_T	Slope resistance	-	-	0.252		mΩ
$(dv/dt)_{cr}$	Critical rate of rise of off-state voltage	1000	-	-	V_D=80% V_{DRM}	V/µs
I_{DRM}	Peak off-state current	-	-	100	Rated V_{DRM}	mA
I_{RRM}	Peak reverse current	-	-	100	Rated V_{RRM}	mA
V_{GT}	Gate trigger voltage	-	-	3.0	T_j=25°C	V
I_{GT}	Gate trigger current	-	-	300	T_j=25°C. V_D=10V, I_T=2A	mA
I_H	Holding current	-	-	1000	T_j=25°C	mA
R_{thJK}	Thermal resistance, junction to heatsink	-	-	0.024	Double side cooled	K/W
		-	-	0.048	Single side cooled	K/W
F	Mounting force	19	-	26		kN
W_t	Weight	-	510	-		g

Notes:-

1) Unless otherwise indicated T_j=125°C.

Notes on Ratings and Characteristics

1.0 Voltage Grade Table

Voltage Grade	V_{DRM} V_{DSM} V_{RRM} V	V_{RSM} V	V_D V_R DC V
16	1600	1700	1040
18	1800	1900	1150
20	2000	2100	1250

2.0 Extension of Voltage Grades

This report is applicable to other and higher voltage grades when supply has been agreed by Sales/Production.

3.0 De-rating Factor

A blocking voltage de-rating factor of 0.13%/°C is applicable to this device for T_j below 25°C.

4.0 Repetitive dv/dt

Standard dv/dt is 1000V/µs.

5.0 Snubber Components

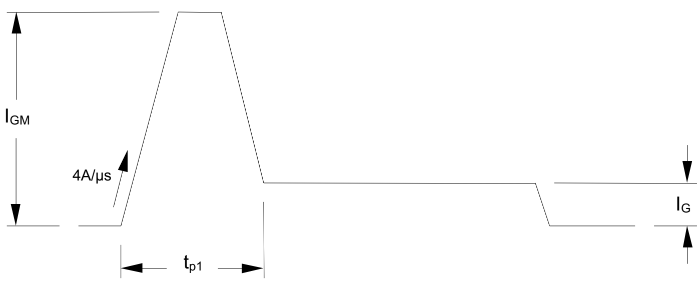
When selecting snubber components, care must be taken not to use excessively large values of snubber capacitor or excessively small values of snubber resistor. Such excessive component values may lead to device damage due to the large resultant values of snubber discharge current. If required, please consult the factory for assistance.

6.0 Rate of rise of on-state current

The maximum un-primed rate of rise of on-state current must not exceed 600A/µs at any time during turn-on on a non-repetitive basis. For repetitive performance, the on-state rate of rise of current must not exceed 300A/µs at any time during turn-on. Note that these values of rate of rise of current apply to the total device current including that from any local snubber network.

7.0 Gate Drive

The nominal requirement for a typical gate drive is illustrated below. An open circuit voltage of at least 30V is assumed. This gate drive must be applied when using the full di/dt capability of the device.



The magnitude of I_{GM} should be between five and ten times I_{GT}, which is shown on page 2. Its duration (t_{p1}) should be 20µs or sufficient to allow the anode current to reach ten times I_L, whichever is greater. Otherwise, an increase in pulse current could be needed to supply the necessary charge to trigger. The 'back-porch' current I_G should remain flowing for the same duration as the anode current and have a magnitude in the order of 1.5 times I_{GT}.

8.0 Computer Modelling Parameters

8.1 Device Dissipation Calculations

$$I_{AV} = \frac{-V_{T0} + \sqrt{V_{T0}^{2} + 4 \cdot ff^{2} \cdot r_T \cdot W_{AV}}}{2 \cdot ff^{2} \cdot r_T}$$

and:

$$W_{AV} = \frac{\Delta T}{R_{th}}$$

$$\Delta T = T_{j\max} - T_{Hs}$$

Where V_{T0}=0.92V, r_T=0.252mΩ,

R_{th} = Supplementary thermal impedance, see table below.

ff = Form factor, see table below.

Supplementary Thermal Impedance							
Conduction Angle	30°	60°	90°	120°	180°	270°	d.c.
Square wave Double Side Cooled	0.0293	0.0285	0.0278	0.0271	0.0261	0.0249	0.024
Square wave Single Side Cooled	0.0534	0.053	0.0524	0.0518	0.0509	0.0497	0.0489
Sine wave Double Side Cooled	0.0286	0.0276	0.0269	0.0263	0.0248		
Sine wave Single Side Cooled	0.0531	0.0523	0.0517	0.0511	0.0497		

Form Factors							
Conduction Angle	30°	60°	90°	120°	180°	270°	d.c.
Square wave	3.46	2.45	2	1.73	1.41	1.15	1
Sine wave	3.98	2.78	2.22	1.88	1.57		

8.2 Calculating V_T using ABCD Coefficients

The on-state characteristic I_T vs. V_T, on page 7 is represented in two ways;

(i) the well established V_{T0} and r_T tangent used for rating purposes

(ii) a set of constants A, B, C, D, forming the coefficients of the representative equation for V_T in terms of I_T given below:

$$V_T = A + B \cdot \ln(I_T) + C \cdot I_T + D \cdot \sqrt{I_T}$$

The constants, derived by curve fitting software, are given below for both hot and cold characteristics. The resulting values for V_T agree with the true device characteristic over a current range, which is limited to that plotted.

25°C Coefficients		125°C Coefficients	
A	1.15681	A	1.263354
B	-0.04240896	B	-0.1245303
C	1.467552×10^{-4}	C	1.159989×10^{-4}
D	0.00668987	D	0.01932804

8.3 D.C. Thermal Impedance Calculation

$$r_t = \sum_{p=1}^{p=n} r_p \cdot \left(1 - e^{\frac{-t}{\tau_p}}\right)$$

Where *p* = *1* to *n, n* is the number of terms in the series and:

- t = Duration of heating pulse in seconds.
- r_t = Thermal resistance at time t.
- r_p = Amplitude of p_{th} term.
- τ_p = Time Constant of r_{th} term.

D.C. Double Side Cooled					
Term	1	2	3	4	5
r_p	0.01249139	6.316833×10^{-3}	1.850855×10^{-3}	1.922045×10^{-3}	6.135330×10^{-4}
τ_p	0.8840810	0.1215195	0.03400152	6.742908×10^{-3}	1.326292×10^{-3}

D.C. Single Side Cooled						
Term	1	2	3	4	5	6
r_p	0.02919832	4.863568×10^{-3}	3.744798×10^{-3}	6.818034×10^{-3}	2.183558×10^{-3}	1.848294×10^{-3}
τ_p	6.298105	3.286174	0.5359179	0.1186897	0.02404574	3.379476×10^{-3}

9.0 Reverse recovery ratings

(i) Q_{ra} is based on 50% I_{rm} chord as shown in Fig. 1

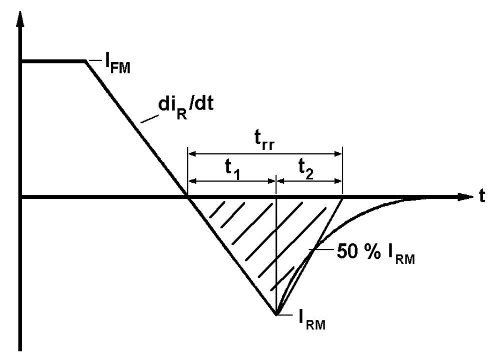


Fig. 1

(ii) Q_{rr} is based on a 150µs integration time i.e.

$$Q_{rr} = \int_0^{150\mu s} i_{rr}.dt$$

(iii)

$$K\ Factor = \frac{t1}{t2}$$

Curves

Figure 1 - On-state current vs. Power dissipation - Double Side Cooled (Sine wave)

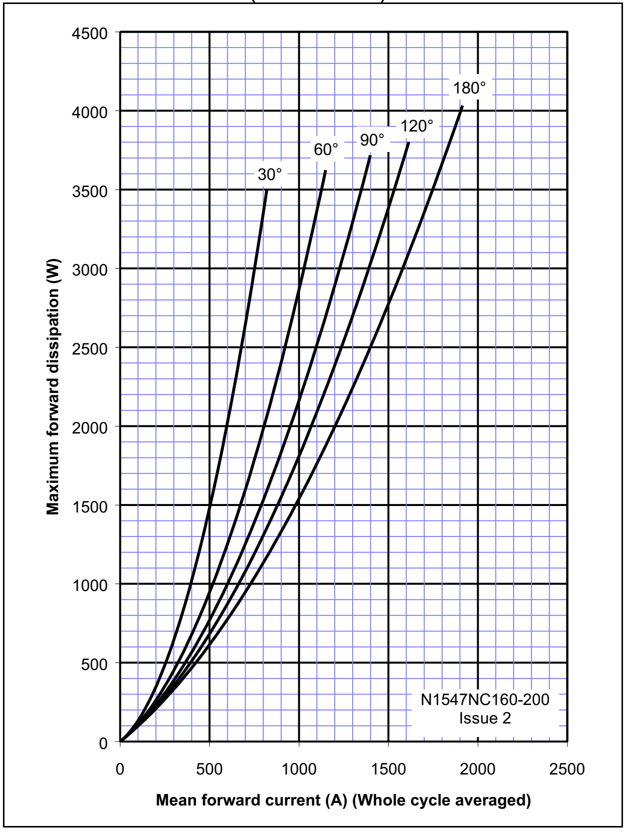


Figure 2 - On-state current vs. Heatsink temperature - Double Side Cooled (Sine wave)

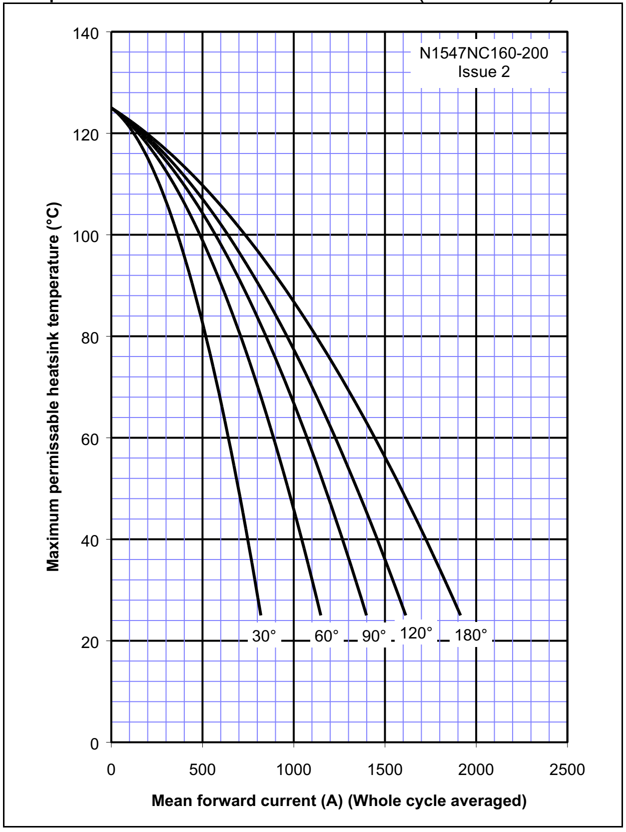


Figure 3 - On-state current vs. Power dissipation - Double Side Cooled (Square wave)

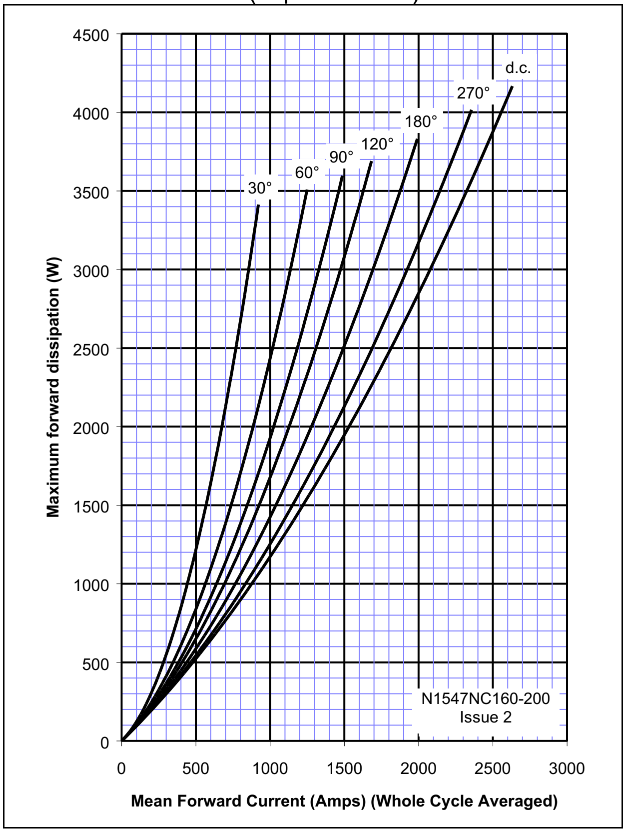


Figure 4 - On-state current vs. Heatsink temperature - Double Side Cooled (Square wave)

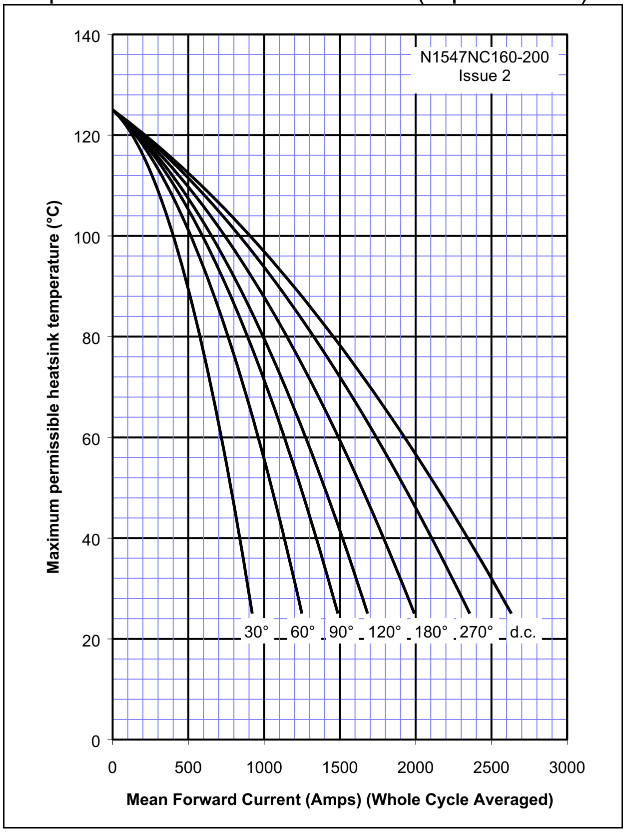


Figure 5 - On-state current vs. Power dissipation - Single Side Cooled (Sine wave)

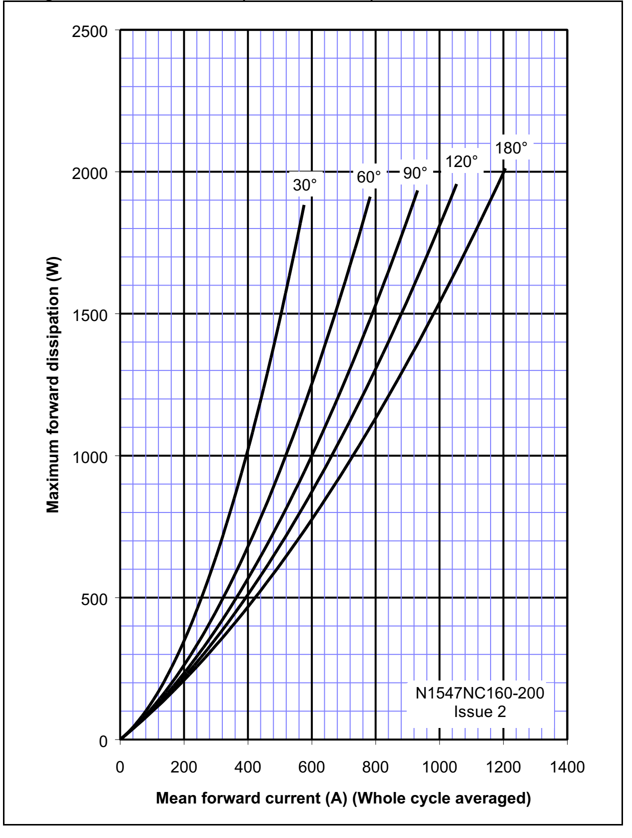


Figure 6 - On-state current vs. Heatsink temperature - Single Side Cooled (Sine wave)

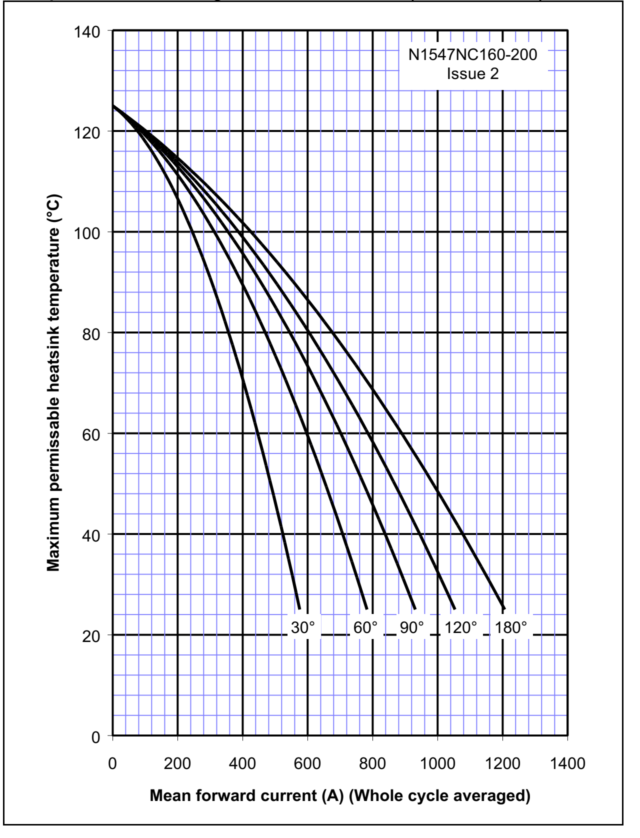


Figure 7 - On-state current vs. Power dissipation - Single Side Cooled (Square wave)

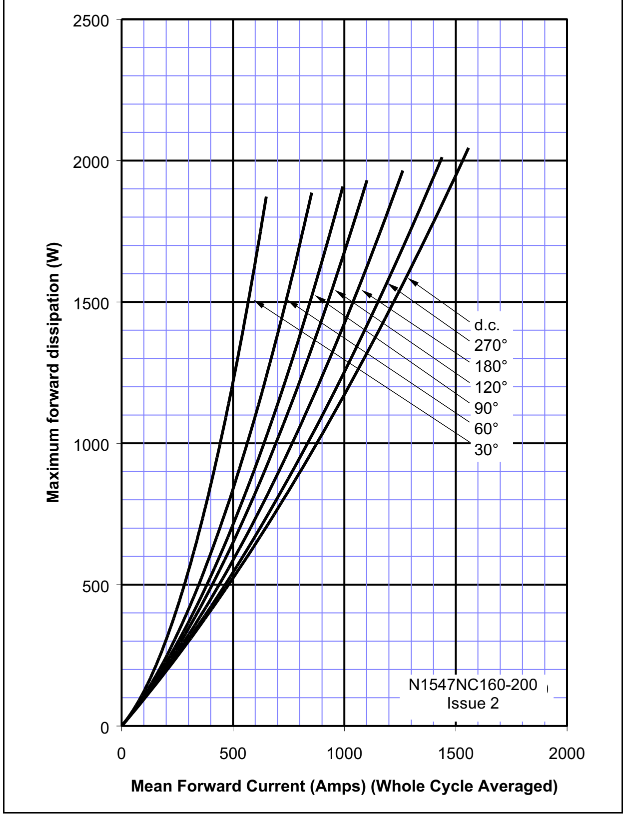


Figure 8 - On-state current vs. Heatsink temperature - Single Side Cooled (Square wave)

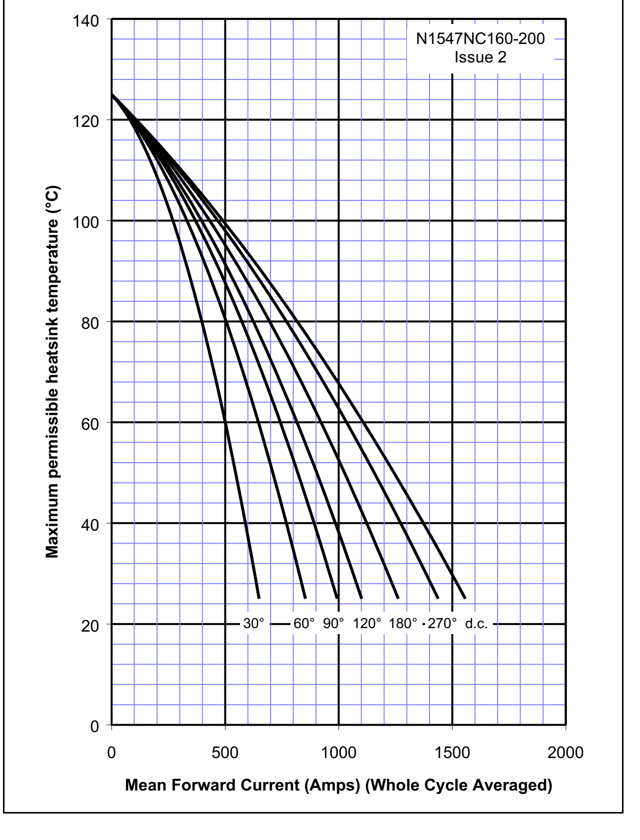


Figure 9 - On-state characteristics of Limit device

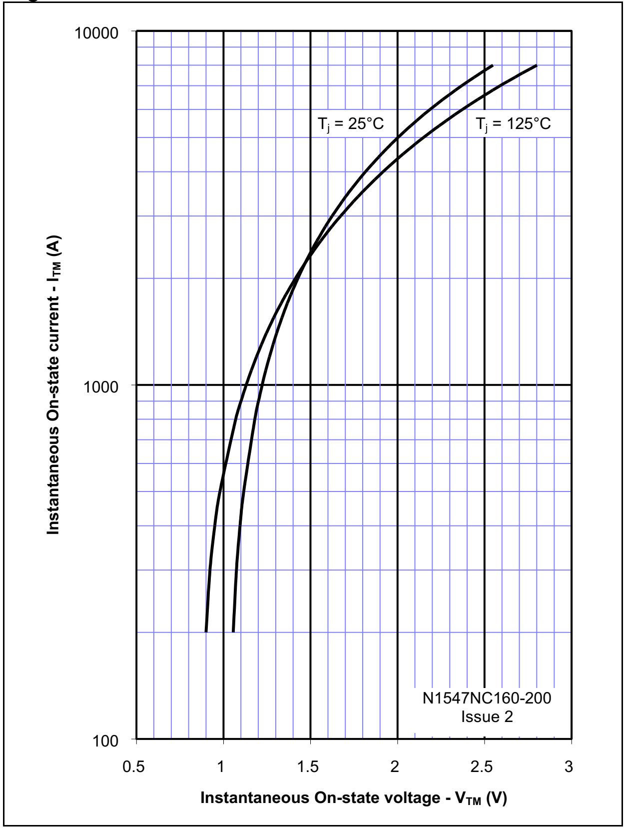


Figure 10 - Transient Thermal Impedance

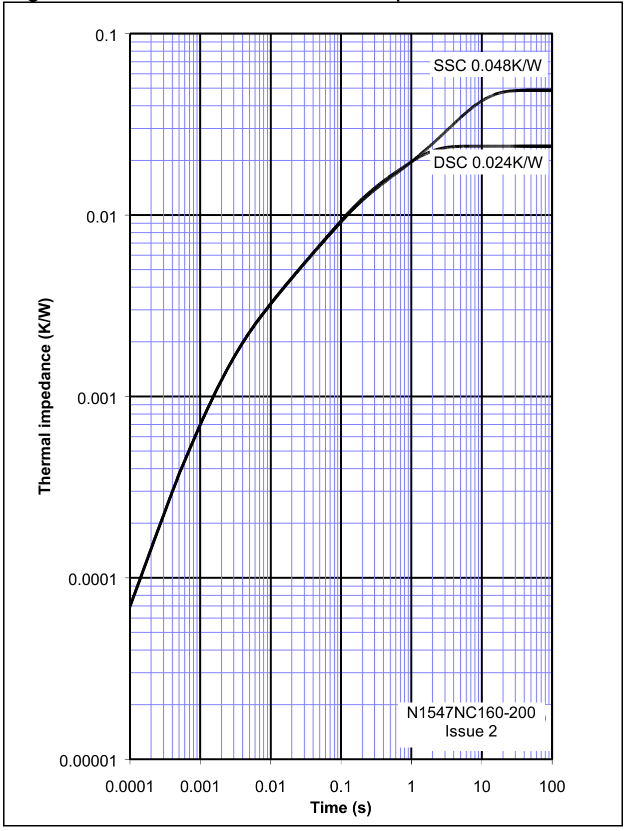


Figure 11 - Gate Characteristics - Trigger Limits

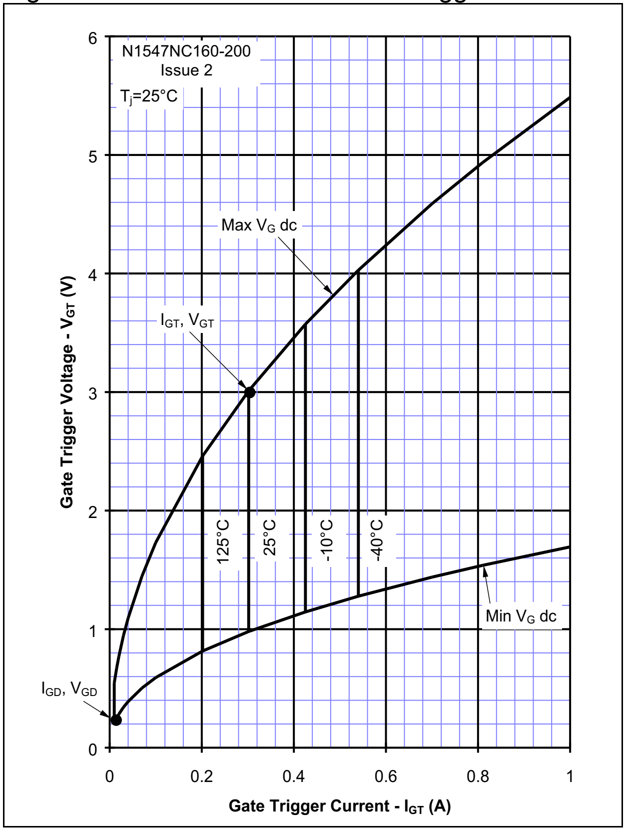


Figure 12 - Gate Characteristics - Power Curves

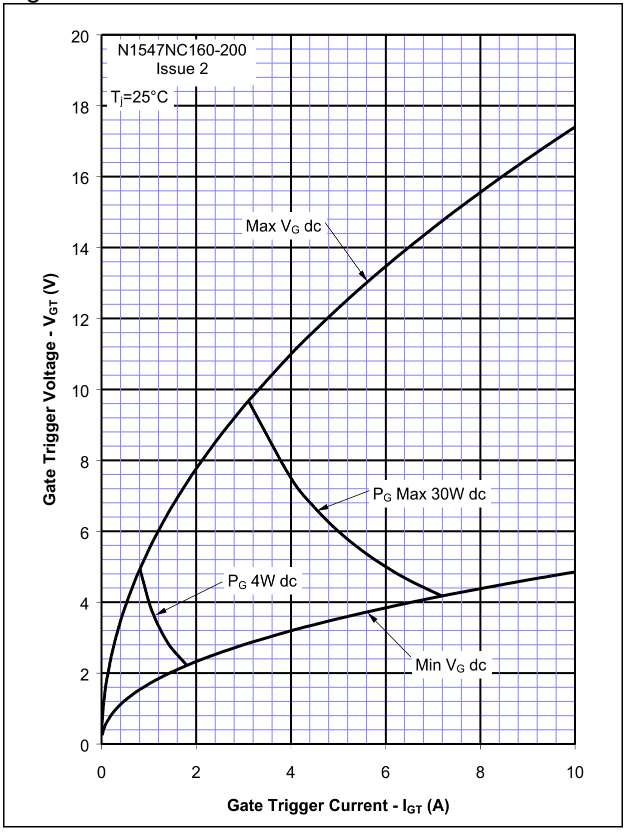
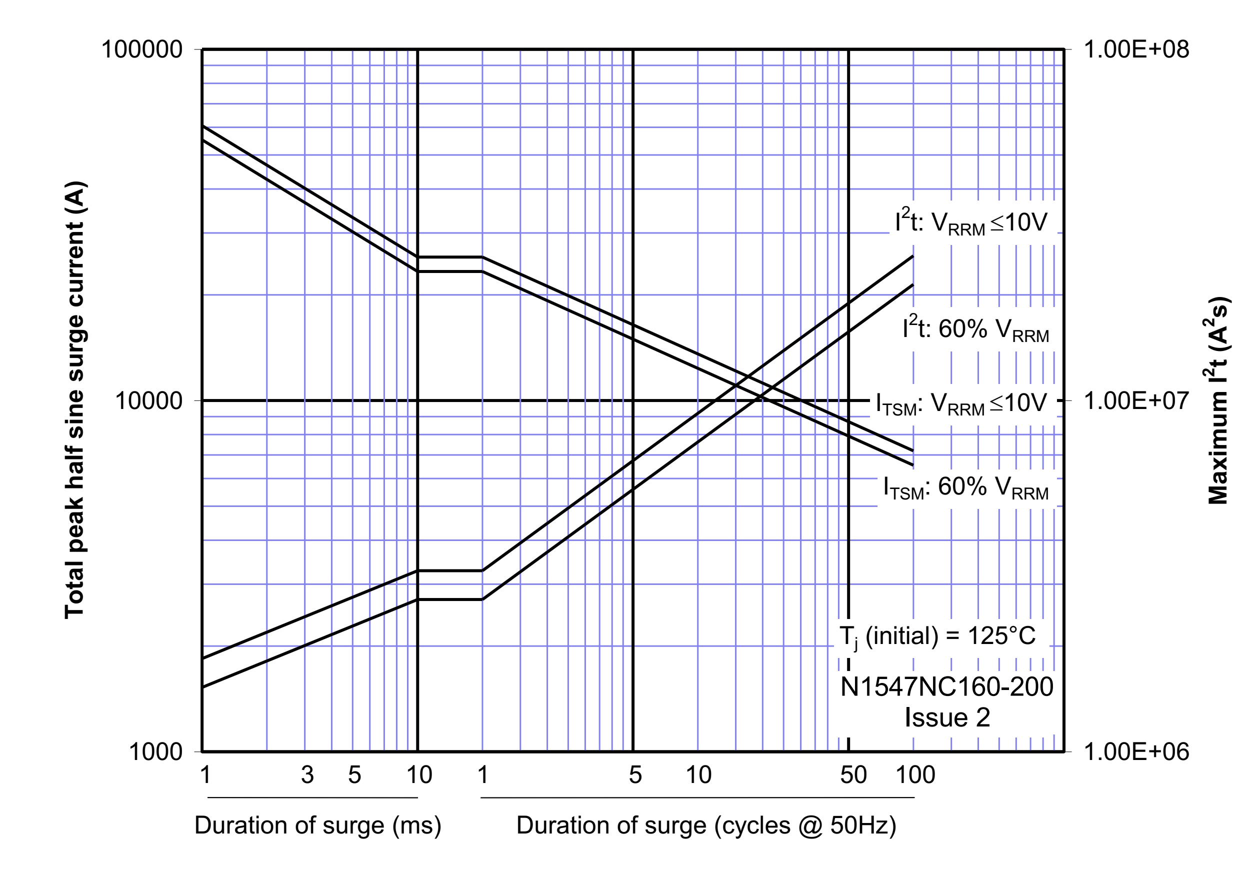
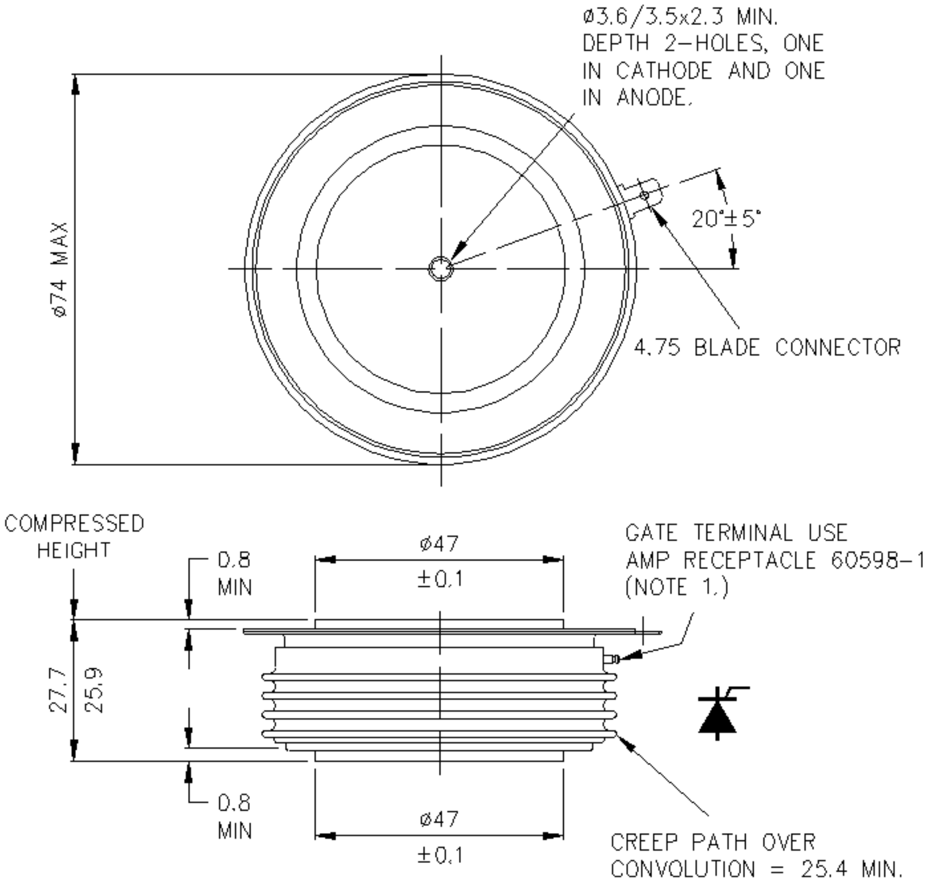


Figure 13 - Maximum surge and I^2t Ratings



Outline Drawing & Ordering Information



110A223

ORDERING INFORMATION (Please quote 11 digit code as below)

N1547	NC	♦ ♦	0
Fixed Type Code	Fixed Outline Code	Voltage Code 16-20	Fixed turn-off time code

Typical order code : N1547NC180 – 1800V V_{DRM}, V_{RRM}, 1000V/µs dv/dt, 27mm clamp height capsule.

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