WESTCODE

Date : Dec-99
Rat Rep : 99T06
Issue 2

Converter thyristor

Type N1083xx53xxx to N1083xx65xxx

Absolute maximum ratings

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
V_{DRM}	Repetitive peak off-state voltage, (note 1).	5300-6500	V
V_{DSM}	Non-repetitive peak off-state voltage, (note 1).	5300-6500	V
V_{RRM}	Repetitive peak reverse voltage, (note 1).	5300-6500	V
V_{RSM}	Non-repetitive peak reverse voltage, (note 1).	5400-6600	V

	RATINGS	MAXIMUM LIMITS	UNITS
$I_{T(AV)}$	Mean on-state current, Tsink=55°C, (note 2).	2310	A
$I_{T(AV)}$	Mean on-state current. Tsink=85°C, (note 5).	1460	A
$I_{T(AV)}$	Mean on-state current. Tsink=85°C, (note 3).	890	A
$I_{T(RMS)}$	Nominal RMS on-state current, 25°C, (note 2).	4680	A
$I_{T(d.c.)}$	D.C. on-state current, 25°C, (note 7).	4130	A
I_{TSM}	Peak non-repetitive surge tp=10ms, V_{RM}=0.6V_{RRM}, (note 4).	$40x10^3$	A
I_{TSM2}	Peak non-repetitive surge tp=10ms, V_{RM}≤10V, (note 4).	$45x10^3$	A
I^2t	I^2t capacity for fusing tp=10ms, V_{RM}=0.4V_{RRM}, (note 4).	$8.0x10^6$	A^2s
I^2t	I^2t capacity for fusing tp=10ms, V_{RM}≤10V, (note 4).	$10.1x10^6$	A^2s
I^2t	I^2t capacity for fusing tp=3ms, V_{RM}≤0.4V_{RRM}, (note 4).	$6.0x10^6$	A^2s
di/dt	Critical rate of rise of on-state current (continuous), (note 6).	150	A/µs
	Critical rate of rise of on-state current (Intermittent), (note 6).	300	A/µs
I_{FGM}	Peak forward gate current.	10	A
V_{RGM}	Peak reverse gate voltage.	5	V
$P_{G(AV)}$	Mean forward gate power.	5	W
P_{GM}	Peak forward gate power.	30	W
V_{GD}	Non-trigger gate voltage, (Note 5).	0.25	V
T_{HS}	Operating temperature range.	-40 to +115	°C
T_{stg}	Storage temperature range.	-40 to +150	°C

Notes:-
1) De-rating factor of 0.13% per K is applicable for T_j below 25°C.
2) Doubleside cooled, single phase; 50Hz, 180° half-sinewave.
3) Singleside cooled, single phase; 50Hz, 180° half-sinewave.
4) Half-sinewave, 115°C T_j initial.
5) Rated V_{DRM}.
6) V_D=67%V_{DRM}, I_T=5000A, I_{FG}=2A, t_r=500ns.
7) Doubleside cooled.

Characteristics

	CHARACTERISTICS	MIN	TYP	MAX	TEST CONDITIONS	UNITS
V_{TM}	Maximum peak on-state voltage.	-	-	2.10	I_T=3000A.	V
V_0	Threshold voltage.	-	-	1.23		V
R_T	Slope resistance.	-	-	0.29		mΩ
dv/dt	Critical rate of rise of off-state voltage.	200	1000	2000	V_D=80% V_{DRM}.	V/µs
I_{DRM}	Peak off-state current.	-	-	300	Rated V_{DRM}, note 2.	mA
I_{RRM}	Peak reverse current.	-	-	300	Rated V_{RRM}, note 2.	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_A=3A	mA
I_H	Holding current	-	-	1000	T_j=25°C.	mA
R_θ	Thermal resistance junction to sink.	-	-	9	Double side cooled.	K/KW
		-	-	18	Single side cooled.	K/KW
F	Mounting force.	81	-	98		kN
W_t	Weight.	-	2.80	-		kg

Notes:-

1) Unless otherwise indicated T_j=115°C.
2) Leakage current limit, this will be increased in the future to 600mA

Notes on Ratings and Characteristics

1 Voltage Grade Table

Voltage Grade 'H'	V_{DSM} V_{DRM} V_{RRM} V	V_{RSM} V	V_D V_R V_{DC}.
53	5300	5400	2650
55	5500	5600	2750
57	5700	5800	2850
59	5900	6000	2950
61	6100	6200	3050
63	6300	6400	3150
65	6500	6600	3250

2 Extension of Voltage Grades

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

3 De-rating Factor

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

4 Repetitive dv/dt

Higher dv/dt selections are available up to 2000V/µs on request.

5 Computer modelling parameters

5.1 Device dissipation calculations

$$I_{AV} = \frac{-V_o + \sqrt{V_o^2 + 4 \cdot ff^2 \cdot r_s \cdot W_{AV}}}{2 \cdot ff^2 \cdot r_s}$$

Where V_o = 1.22 V, r_s = 0.290mΩ

$$W_{AV} = \frac{\Delta T}{R_{th}} \qquad \Delta T = T_{jMax} - T_{Hs}$$

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

ff = Form factor, see table below.

Supplementary Thermal Impedance (at 50Hz operating frequency)				
Conduction Angle	**6 phase (60°)**	**3 phase (120°)**	**Half wave (180°)**	**d.c.**
Square wave Double Side Cooled	0.0098	0.0095	0.0093	0.0090
Square wave Single Side Cooled	0.0196	0.0190	0.0186	0.0180
Sine wave Double Side Cooled	0.0096	0.0093	0.0090	
Sine wave Single Side Cooled	0.0196	0.0186	0.0180	

Form Factors				
Conduction Angle	60°	120°	180°	d.c.
Square wave	2.45	1.73	1.41	1
Sine wave	2.78	1.88	1.57	

5.2 Calculating V_T using ABCD coefficients

The on-state characteristic I_T vs V_T, on Fig. 9, is represented in two ways; (i) the well established V_0 and r_S tangent and (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:

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

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

125°C Coefficients		25°C Coefficients	
A	1.22×10^{-00}	A	1.32×10^{-00}
B	-2.17×10^{-13}	B	-2.31×10^{-13}
C	2.80×10^{-04}	C	2.30×10^{-04}
D	2.47×10^{-14}	D	2.6×10^{-14}

5.3 D.C. Thermal impedance calculation

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

Where p = 1 to n, n is the number of terms in the series.

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
r_p	4.06E-03	2.91E-03	1.92E-03
τ_p	1.42E+00	2.92E-01	3.16E-02

D.C. Single Side Cooled			
Term	1	2	3
r_p	1.2E-02	5.10E-03	9.95E-04
τ_p	1.23E+01	2.88E-01	8.57E-04

Curves

Figure 1, Maximum on-state characteristic

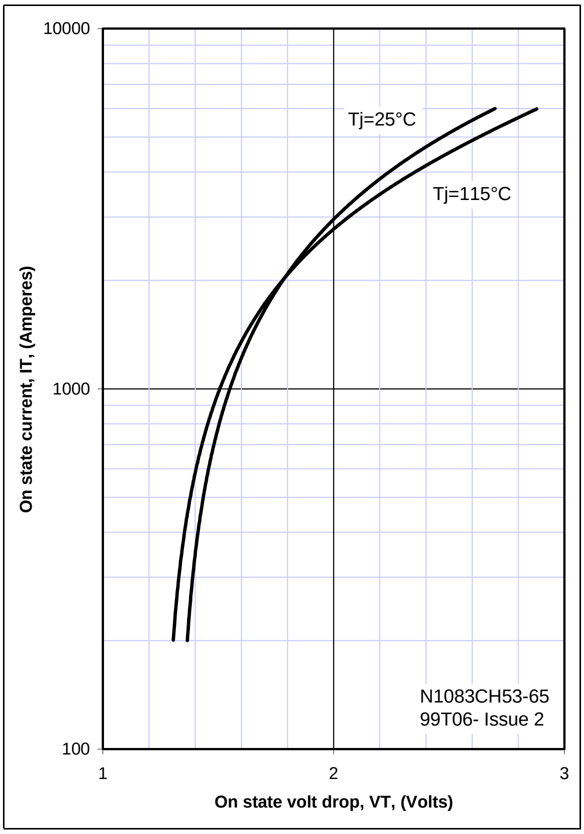


Figure 2, Transient thermal impedance

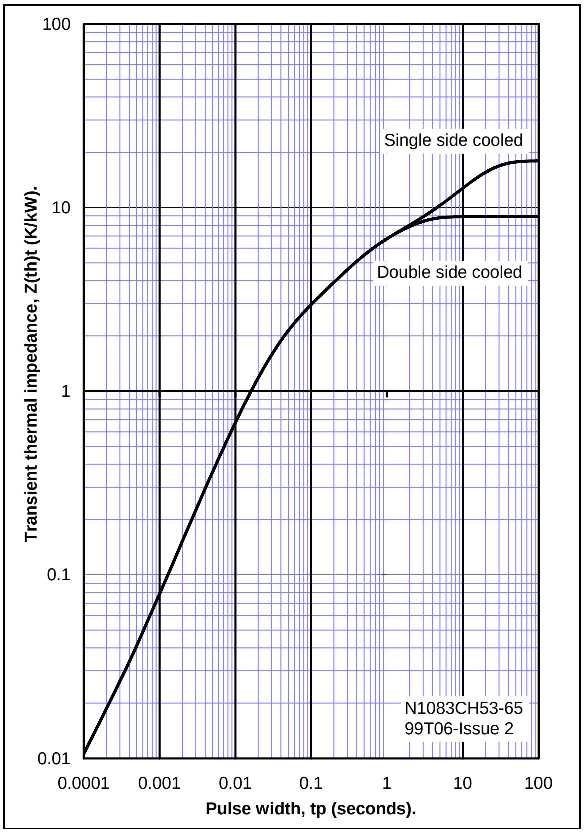


Figure 3, Maximum non repetitive surge

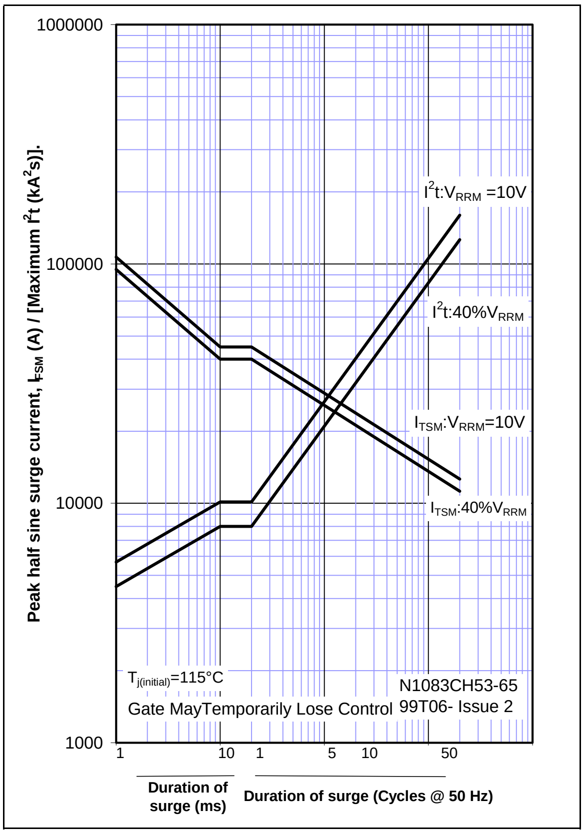


Figure 4, Gate characteristics, 25°C

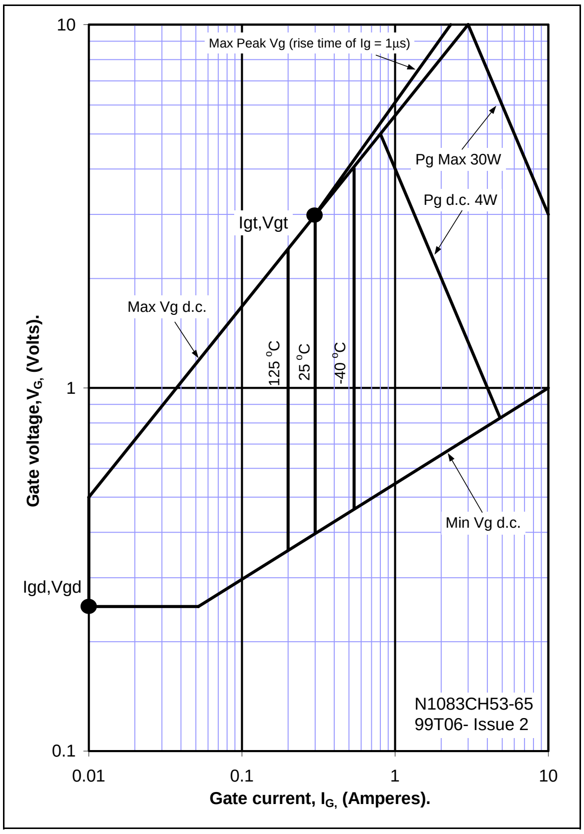


Figure 5, Power dissipation vs. mean current, sinewave, double side cooled

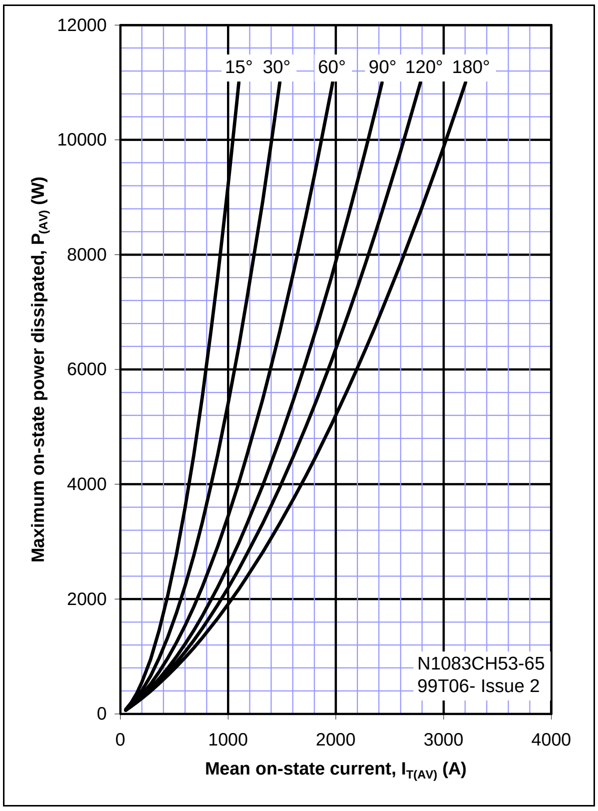


Figure 6, Power dissipation vs. mean current, sinewave, single side cooled

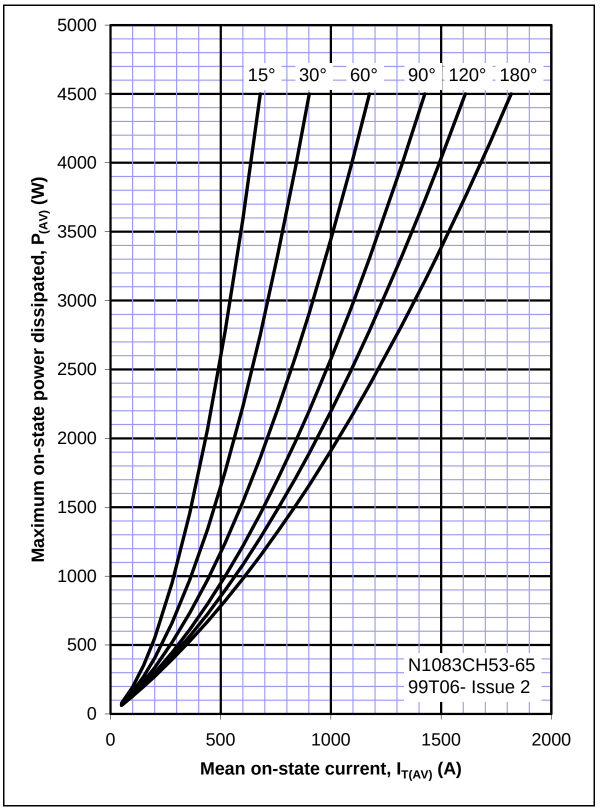


Figure 7, Heatsink temperature vs. mean current, sinewave, double side cooled

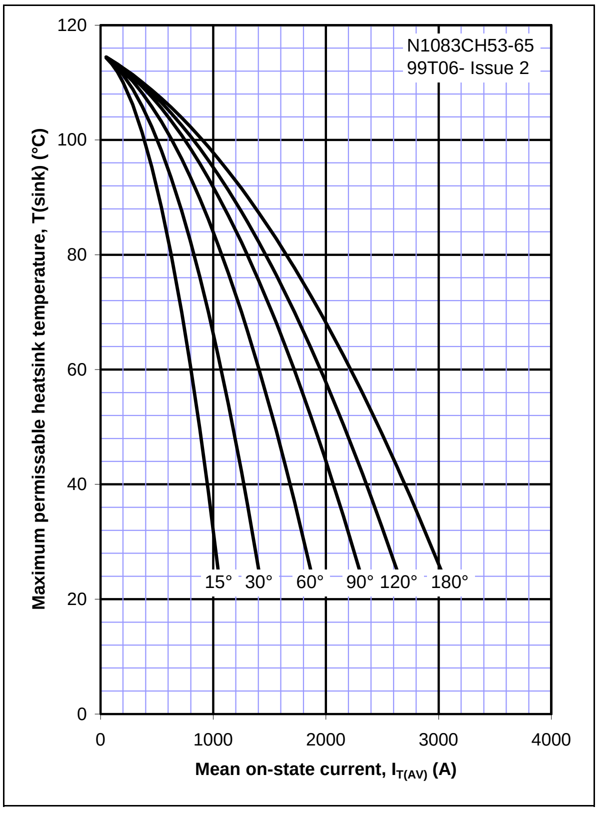


Figure 8, Heatsink temperature vs. mean current, sinewave, single side cooled

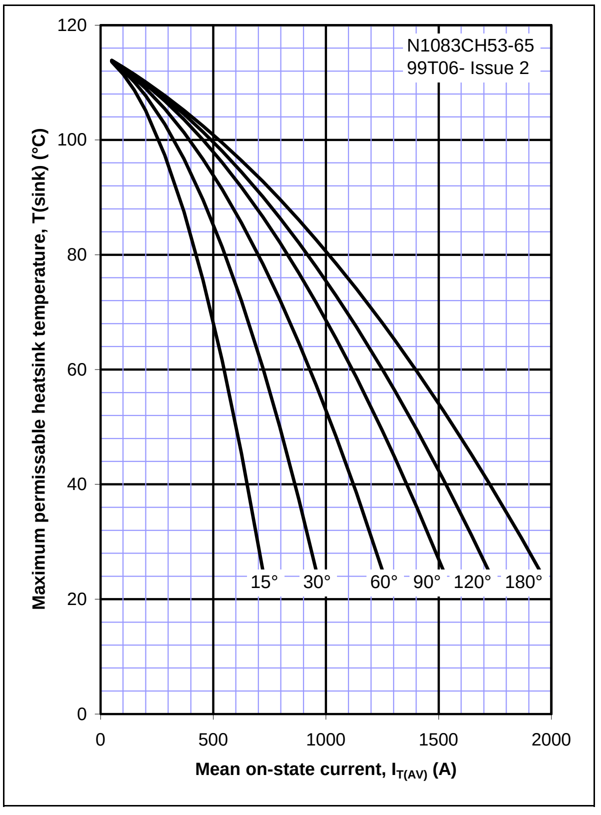


Figure 9, Power dissipation vs. mean current, squarewave, double side cooled

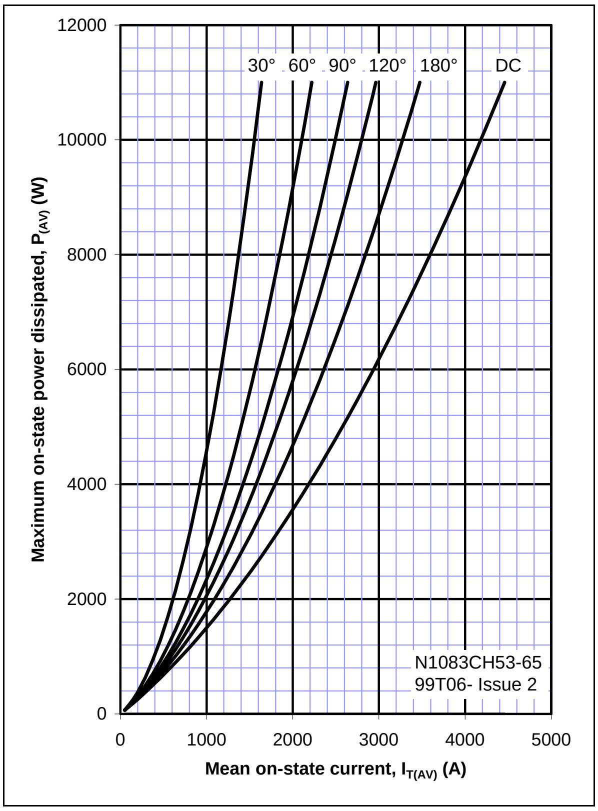


Figure 10, Power dissipation vs. mean current, squarewave, single side cooled

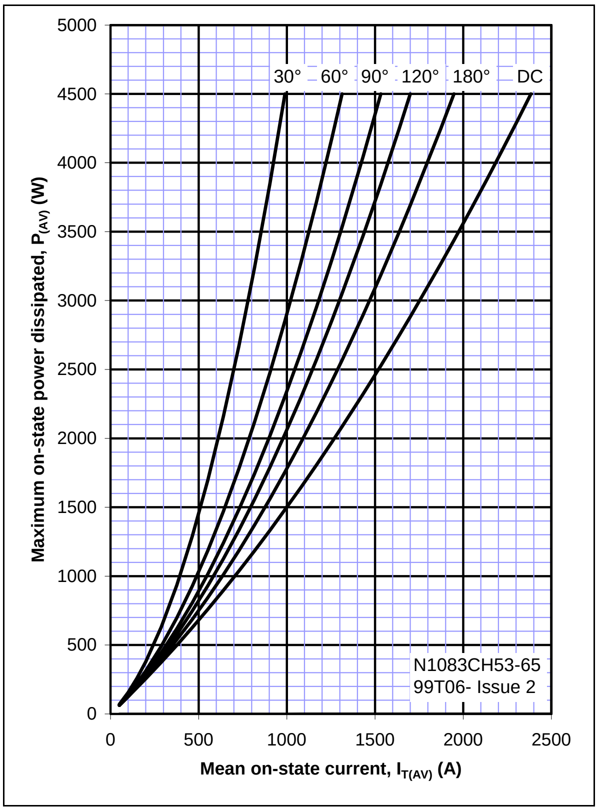


Figure 11, Heatsink temperature vs. mean current, squarewave, double side cooled

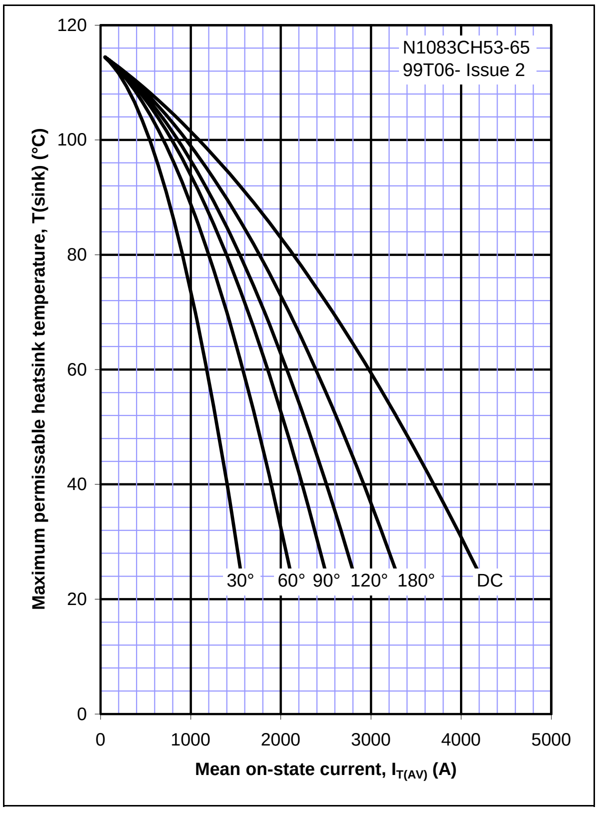
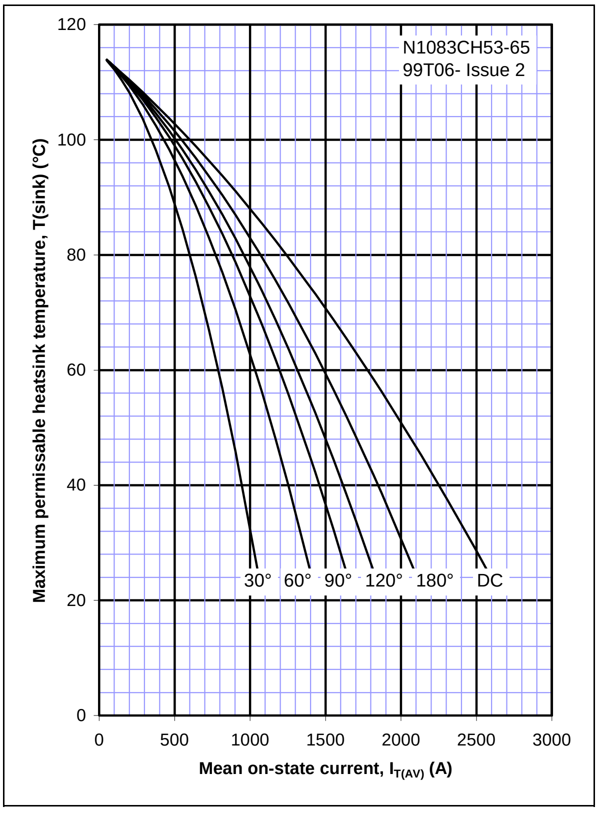
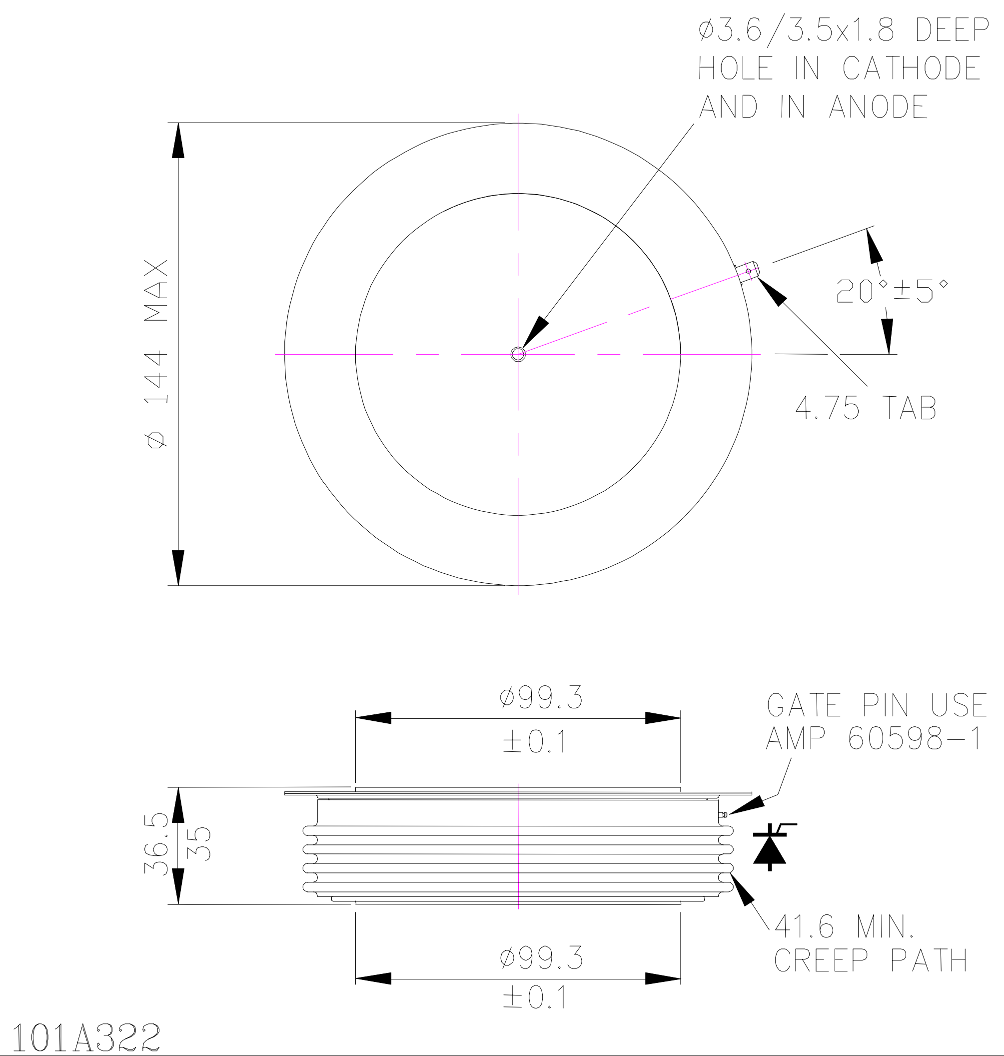


Figure 12, Heatsink temperature vs. mean current, squarewave, single side cooled



Outline drawing & ordering information



ORDERING INFORMATION (Please quote 12 digit code as below)

N1083	C	♦	♦ ♦	♦ ♦ ♦		
Fixed Type Code	Outline Code		Voltage Code V_{DRM} / 100	dv/dt Code		
		H – standard explosion Z – enhanced explosion		Blank = 200V/µs JOO = 500V/µs	GOO = 300V/µs KOO = 750V/µs	HOO = 400V/µs LOO = 1000V/µs

Typical order code : N1083CZ65 – 6.5kV V_{DRM}, enhanced explosion rating capsule thyristor

WESTCODE

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