Phase Control Thyristor
Types N0255WC120 to N0255WC160

Absolute Maximum Ratings

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
V_{DRM}	Repetitive peak off-state voltage, (note 1)	1200-1600	V
V_{DSM}	Non-repetitive peak off-state voltage, (note 1)	1200-1600	V
V_{RRM}	Repetitive peak reverse voltage, (note 1)	1200-1600	V
V_{RSM}	Non-repetitive peak reverse voltage, (note 1)	1300-1700	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{T(AV)}$	Mean on-state current. T_{sink}=55℃ , (note 2)	255	A
$I_{T(AV)}$	Mean on-state current. T_{sink}=85℃ , (note 2)	176	A
$I_{T(AV)}$	Mean on-state current. T_{sink}=85℃ , (note 3)	99	A
$I_{T(RMS)}$	Nominal RMS on-state current. T_{sink}=25℃ , (note 2)	502	A
$I_{T(d.c.)}$	D.C. on-state current. T_{sink}=25℃ , (note 4)	439	A
I_{TSM}	Peak non-repetitive surge t_p=10ms, V_{rm}=0.6V_{RRM}, (note 5)	2450	A
I_{TSM2}	Peak non-repetitive surge t_p=10ms, V_{rm}≤10V, (note 5)	2695	A
I^2t	I^2t capacity for fusing t_p=10ms, V_{rm}=0.6V_{RRM}, (note 5)	$30×10^3$	A^2s
I^2t	I^2t capacity for fusing t_p=10ms, V_{rm}≤10V, (note 5)	$36.3×10^3$	A^2s
di_T/dt	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	2	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	℃
T_{stg}	Storage temperature range	-40 to +150	℃

Notes: -
1) De-rating factor of 0.13% per °C is applicable for T_j below 25℃ .
2) Double side cooled, single phase; 50Hz, 180° half-sinew ave.
3) Single side cooled, single phase; 50Hz, 180° half-sinew ave.
4) Double side cooled.
5) Half-sinewave, 125℃ T_j initial.
6) V_D=67% V_{DRM}, I_{TM}=500A, I_{FG}=2A, t_r≤0.5µs, T_{case}=125℃ .
7) Rated V_{DRM}.

Characteristics

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS (Note 1)	UNITS
V_{TM}	Maximum peak on-state voltage	-	-	1.75	I_{TM}=475A	V
V_0	Threshold voltage	-	-	1.57		V
r_S	Slope resistance	-	-	2.29		mΩ
dv/dt	Critical rate of rise of off-state voltage	200	-	-	V_D=80% V_{DRM}, linear ramp, Gate O/C	V/µs
I_{DRM}	Peak off-state current	-	-	20	Rated V_{DRM}	mA
I_{RRM}	Peak reverse current	-	-	20	Rated V_{RRM}	mA
V_{GT}	Gate trigger voltage	-	-	3.0	T_j=25℃ , V_D=6V, I_T=1A	V
I_{GT}	Gate trigger current	-	-	150		mA
I_H	Holding current	-	-	600	T_j=25℃	mA
t_{gd}	Gate controlled turn-on delay time	-	0.5	1.0	V_D=67%V_{DRM}, I_{TM}=500A, di/dt=10A/µs, I_{FG}=2A, t_r=0.5µs, T_j=25℃	µs
t_{gt}	Turn-on time	-	1.0	2.0		
Q_{rr}	Recovered Charge	-	280	-	I_{TM}=100A, t_p=500µs, di/dt=10A/µs, V_r=100V	µC
Q_{ra}	Recovered Charge, 50% chord	-	150	175		µC
I_{rm}	Reverse recovery current	-	40	-		A
t_{rr}	Reverse recovery time, 50% chord	-	7.5	-		µs
t_q	Turn-off time	-	100	120	I_{TM}=100A, t_p=500µs, di/dt=10A/µs, V_r=50V, V_{dr}=80%V_{DRM}, dV_{dr}/dt=20V/µs	µs
		-	135	160	I_{TM}=100A, t_p=500µs, di/dt=10A/µs, V_r=50V, V_{dr}=80%V_{DRM}, dV_{dr}/dt=200V/µs	
$R_{th(j-hs)}$	Thermal resistance, junction to heatsink	-	-	0.135	Double side cooled	K/W
		-	-	0.3	Single side cooled	K/W
F	Mounting force	3.3	-	5.5		kN
W_t	Weight	-	70	-		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
12	1200	1300	810
14	1400	1500	930
16	1600	1700	1040

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 Rate of rise of on-state current
The maximum un-primed rate of rise of on-state current must not exceed 1000A/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 500A/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.

6.0 Gate Drive
The recommended pulse gate drive is 30V, 30Ω with a short-circuit current rise time of not more than 0.5μs. This gate drive must be applied when using the full di/dt capability of the device.

The pulse duration may need to be configured according to the application but should be no shorter than 20μs, otherwise an increase in pulse current may be needed to supply the necessary charge to trigger.

7.0 Computer Modelling Parameters

7.1 Device Dissipation Calculations

$$I_{AV} = \frac{-V_0 + \sqrt{V_0^2 + 4 \cdot ff^2 \cdot r_s \cdot W_{AV}}}{2 \cdot ff^2 \cdot r_s}$$

and:

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

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

Where V_0=1.57V, r_s=2.29mΩ,

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	0.163	0.158	0.1537	0.1501	0.1442	0.1376	0.135
Square wave Single Side Cooled	0.3272	0.3194	0.3144	0.311	0.3064	0.3016	0.3
Sine wave Double Side Cooled	0.1588	0.1527	0.1487	0.1452	0.1367		
Sine wave Single Side Cooled	0.3191	0.3113	0.3076	0.3051	0.2995		

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		

7.2 Calculating V_T using ABCD Coefficients

The on-state characteristic I_T vs. V_T, on page 5 is represented in two ways;
(i)   the well established V_0 and r_s tangent used for rating purposes 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:

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

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	A	1.363425
B	9.70397×10^{-13}	B	-0.163894
C	1.5×10^{-3}	C	1.407181×10^{-3}
D	-2.12×10^{-13}	D	0.03353607

7.3 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
r_p	0.06851699	0.054884818	9.34826×10^{-3}
τ_p	0.2938852	0.08462396	5.255560×10^{-3}

D.C. Single Side Cooled				
Term	1	2	3	4
r_p	0.1966010	0.05600136	0.04252801	2.683698×10^{-3}
τ_p	2.808245	0.2099146	0.05054675	1.59759×10^{-3}

8.0 Reverse recovery ratings

(i) Q_{ra} is based on 50% I_{rm} chord as shown in 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) $$K \; Factor = \frac{t1}{t2}$$
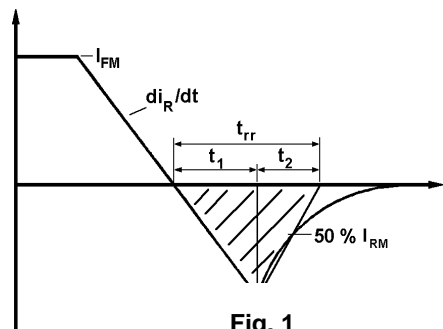
Fig. 1

Curves

Figure 1 - On-state characteristics of Limit device
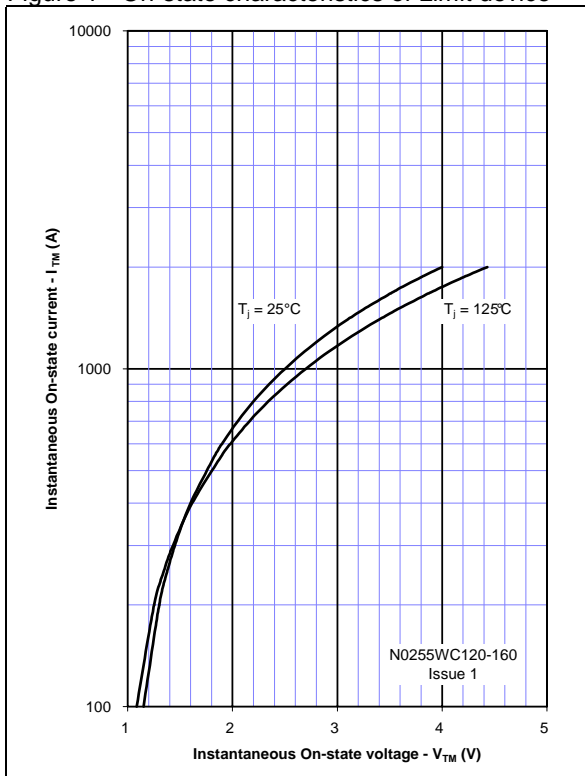
Figure 2 - Transient Thermal Impedance
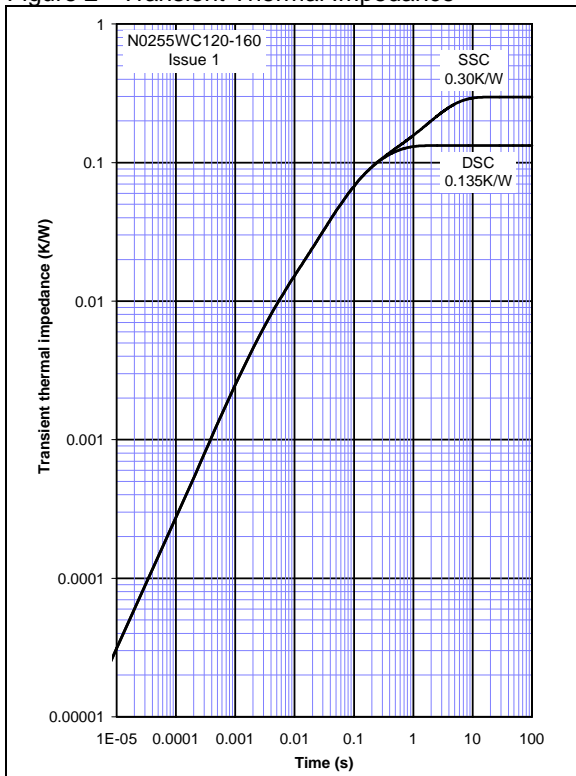
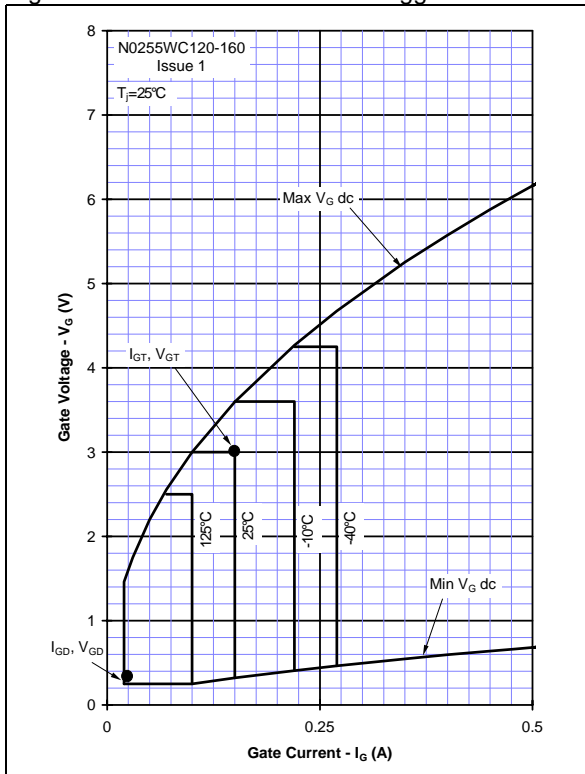Figure 3 - Gate Characteristics - Trigger Limits

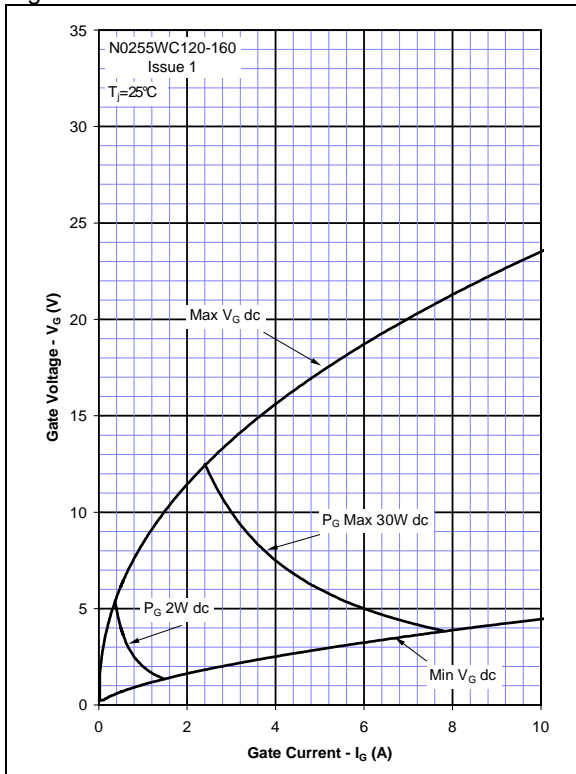Figure 4 - Gate Characteristics - Power Curves

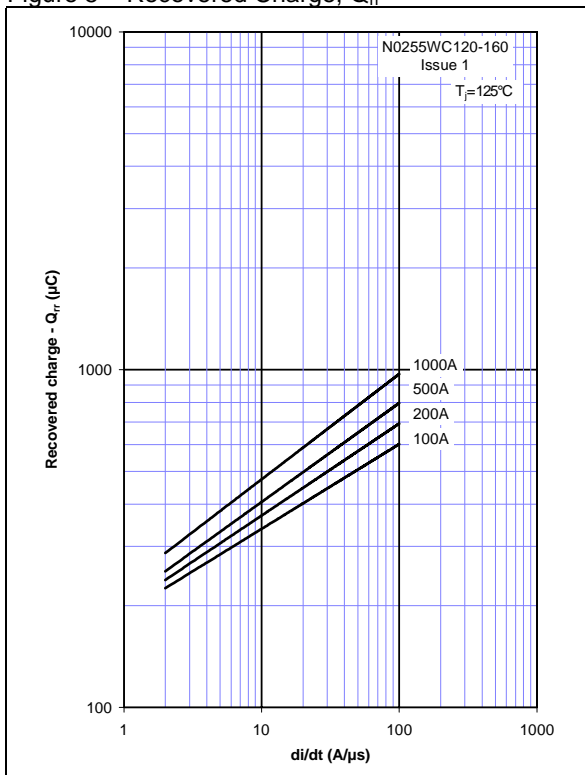Figure 5 – Recovered Charge, Q_{rr}

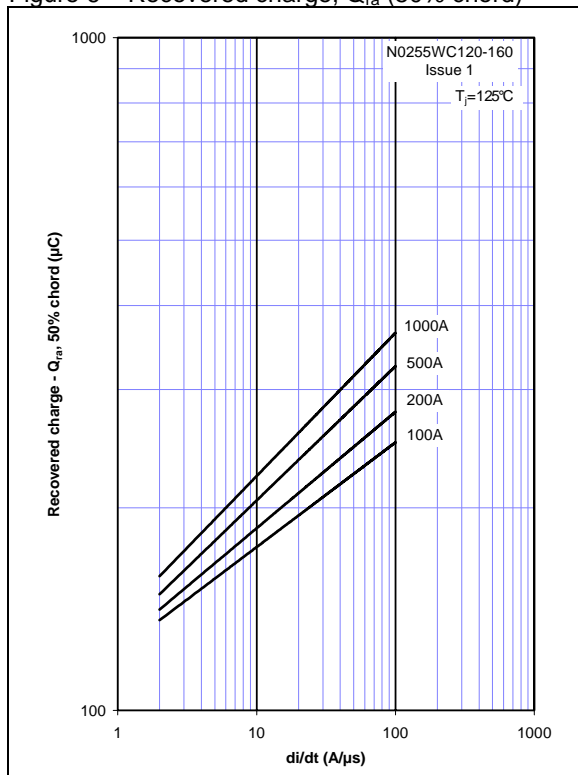

Figure 6 – Recovered charge, Q_{ra} (50% chord)

Figure 7 – Reverse recovery current, I_{rm}

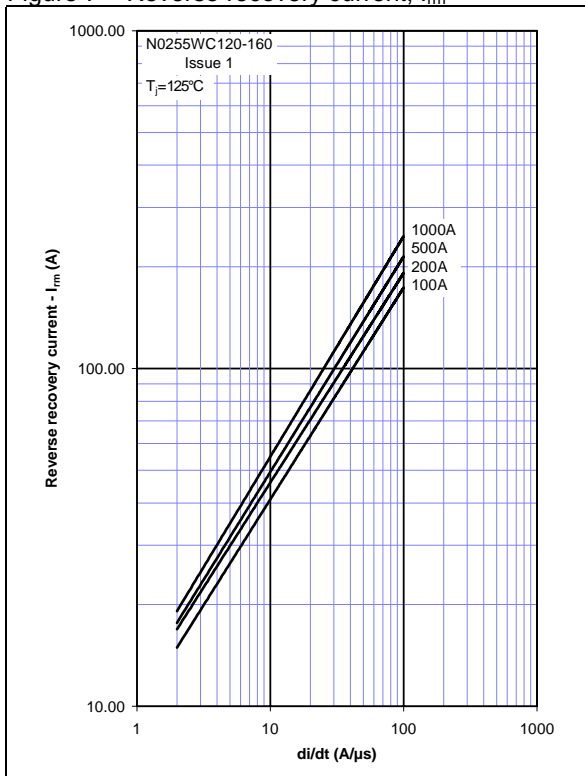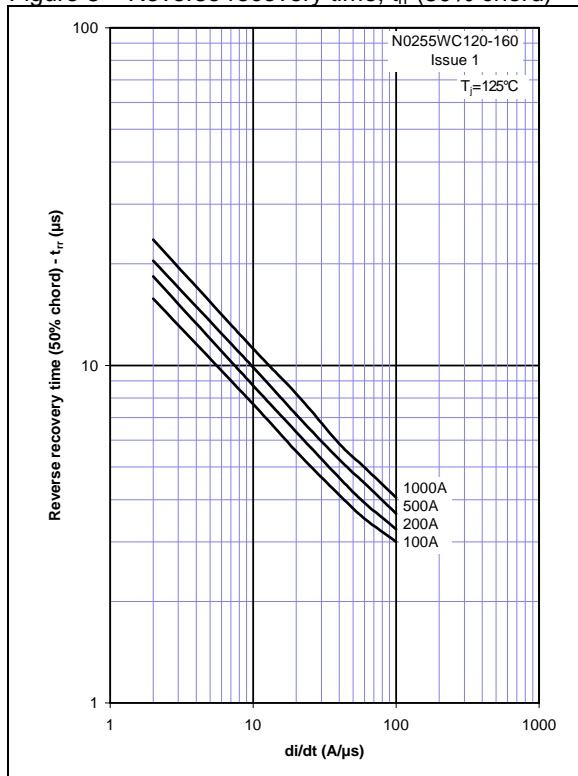Figure 8 – Reverse recovery time, t_{rr} (50% chord)

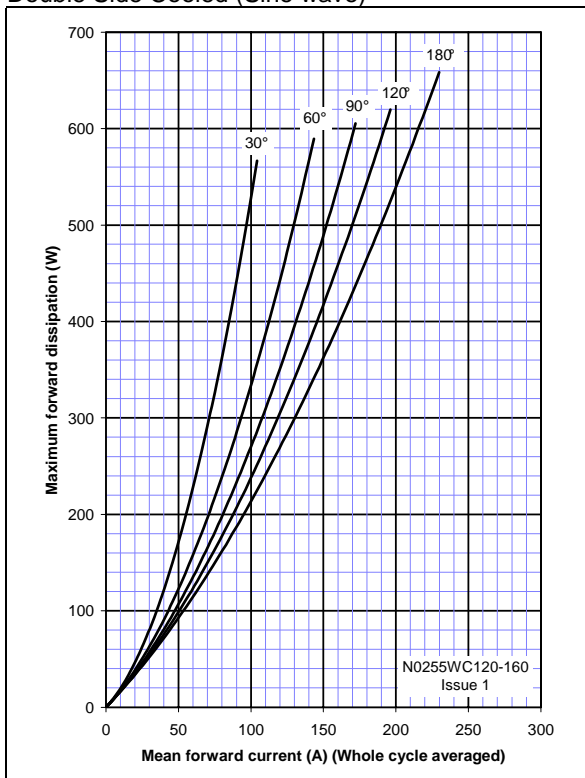Figure 9 – On-state current vs. Power dissipation – Double Side Cooled (Sine wave)

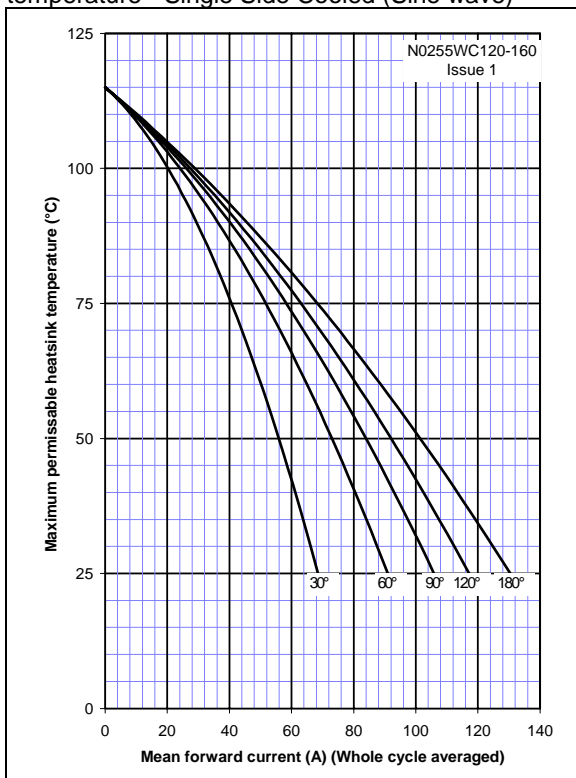Figure 10 – On-state current vs. Heatsink temperature - Double Side Cooled (Sine wave)
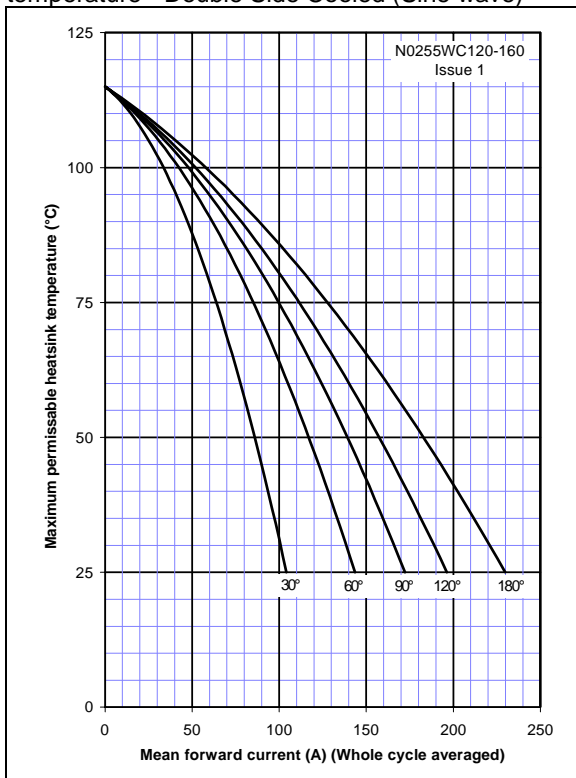
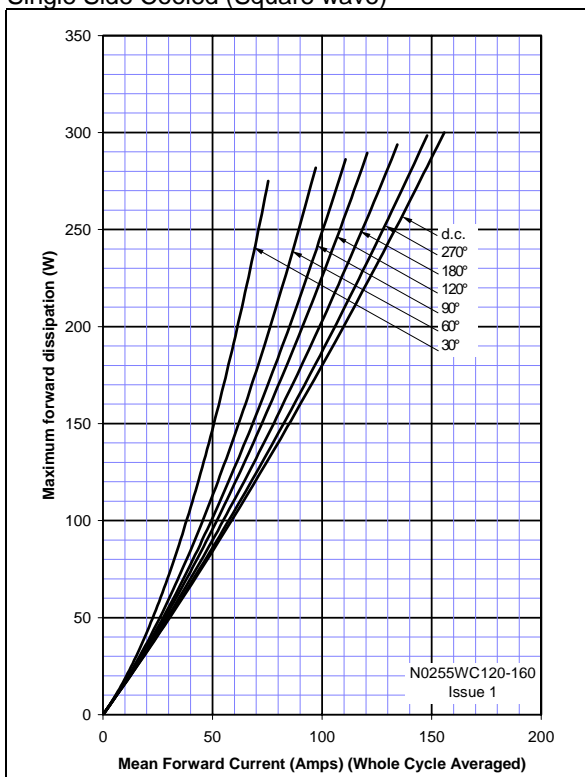Figure 11 – On-state current vs. Power dissipation – Double Side Cooled (Square wave)
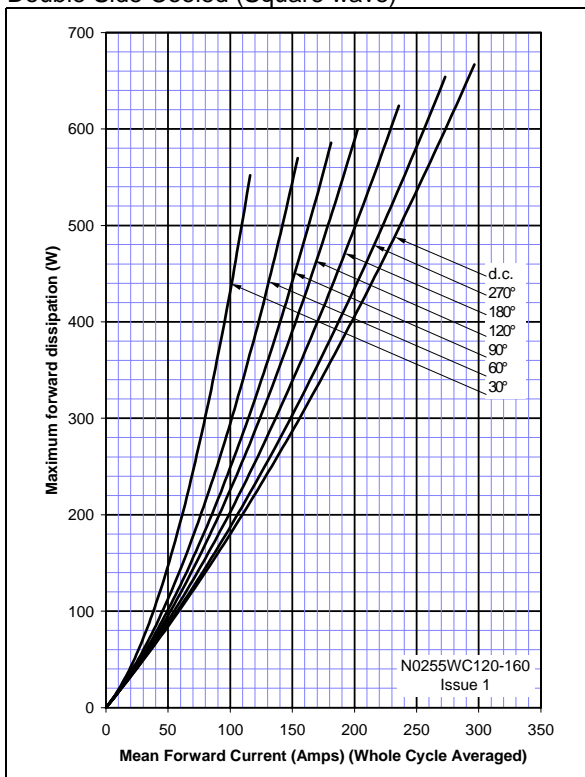
Figure 12 – On-state current vs. Heatsink temperature - Double Side Cooled (Square wave)
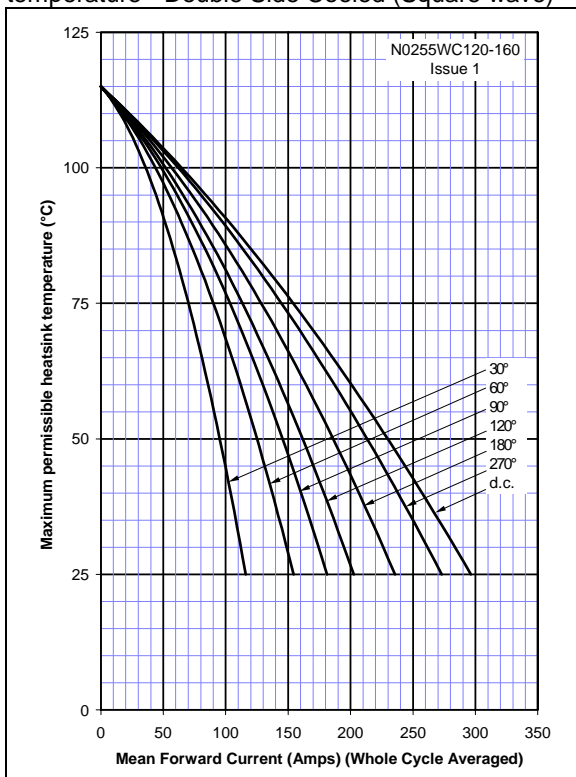
Figure 13 – On-state current vs. Power dissipation – Single Side Cooled (Sine wave)
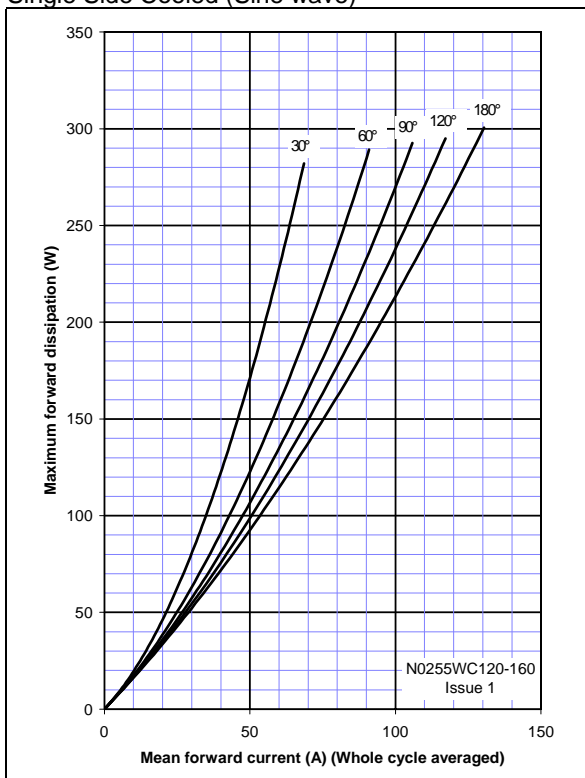
Figure 14 – On-state current vs. Heatsink temperature - Single Side Cooled (Sine wave)

Figure 15 – On-state current vs. Power dissipation – Single Side Cooled (Square wave)

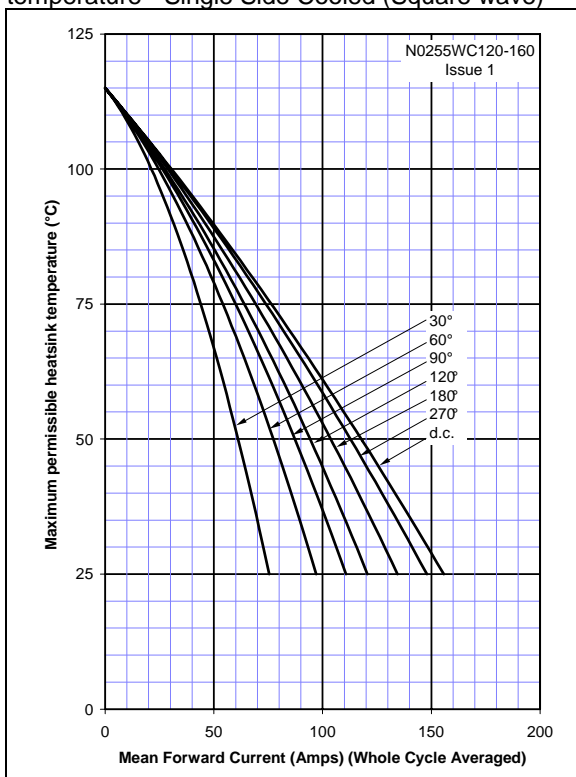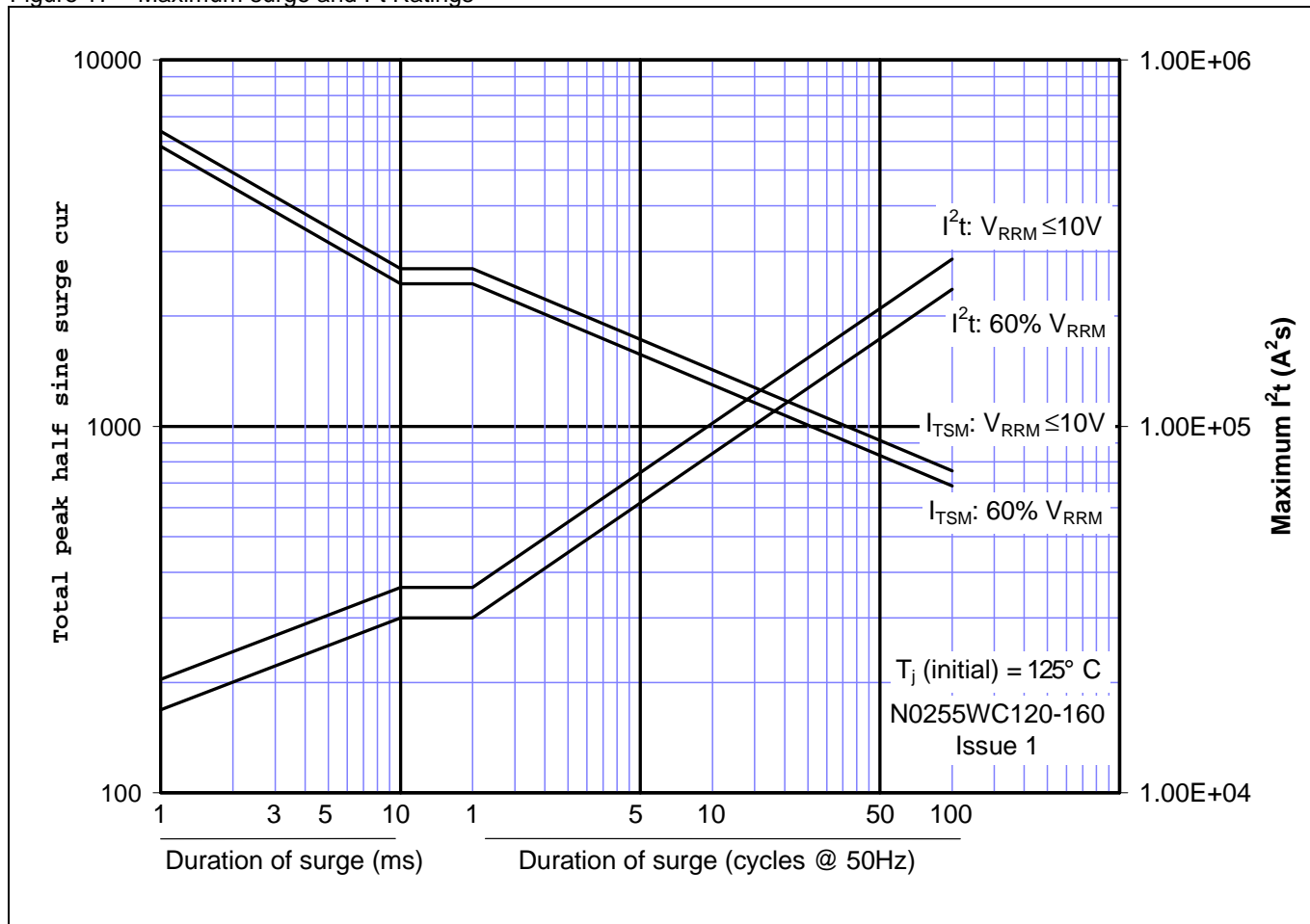Figure 16 – On-state current vs. Heatsink temperature - Single Side Cooled (Square wave)
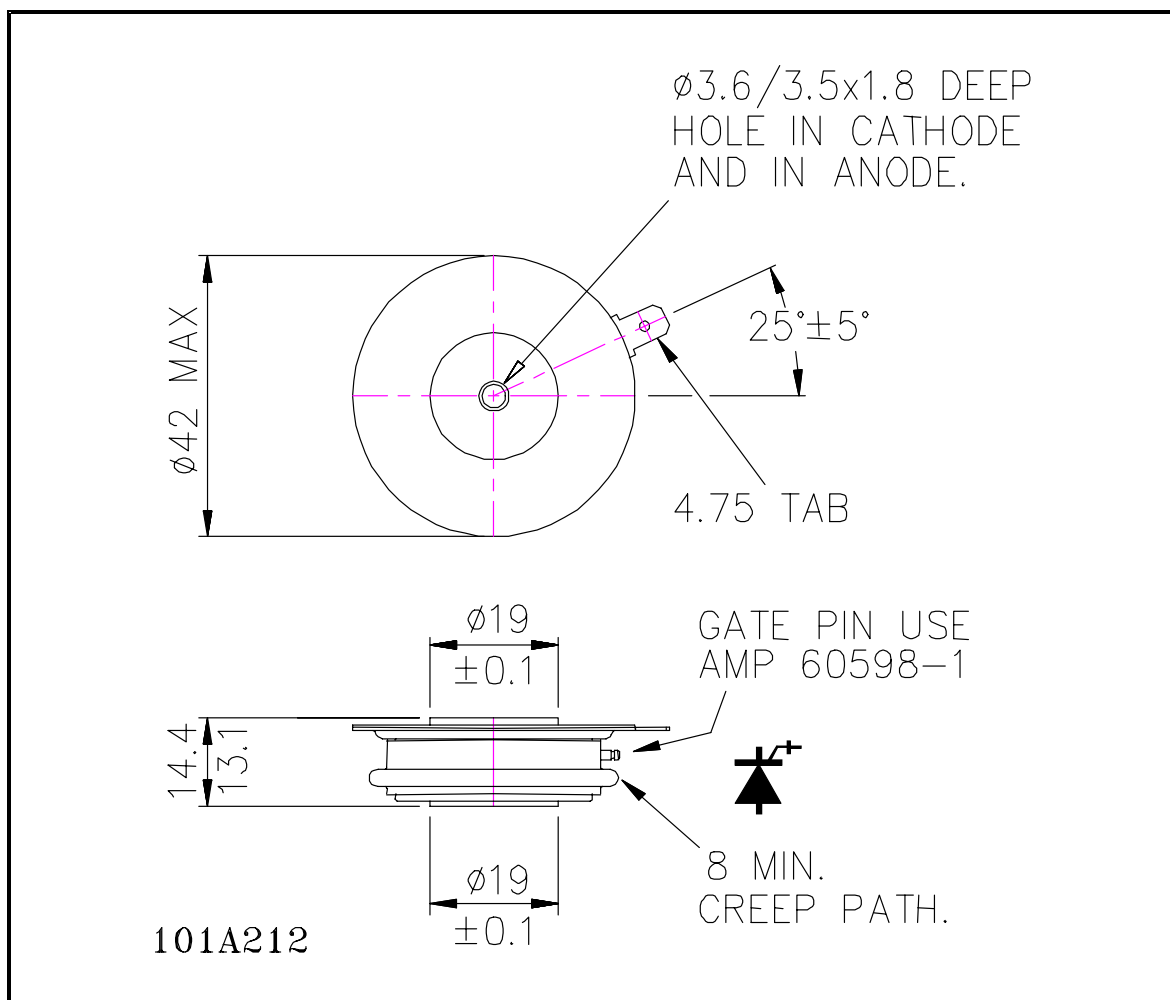
Figure 17 – Maximum surge and I^{2}t Ratings

Outline Drawing & Ordering Information

∅3.6/3.5x1.8 DEEP HOLE IN CATHODE AND IN ANODE.

25°±5°

4.75 TAB

∅42 MAX

∅19 ±0.1

14.4
13.1

∅19 ±0.1

101A212

GATE PIN USE AMP 60598-1

8 MIN. CREEP PATH.

ORDERING INFORMATION		(Please quote 10 digit code as below)	
N0255	**WC**	**◆ ◆**	**0**
Fixed Type Code	Fixed Outline Code	Voltage Code 12-16	Fixed turn-off time code

Typical order code: N0255WC140 – 1400V V_{DRM}/V_{RRM}, 14.4mm clamp height capsule.

WESTCODE

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