WESTCODE

**Date:- 6 Feb, 2001**

**Data Sheet Issue:- 1**

# Phase Control Thyristor

## Types N0910LS200 to N0910LS260

**Absolute Maximum Ratings**

| | VOLTAGE RATINGS | MAXIMUM LIMITS | UNITS |
|---|---|---|---|
| $V_{DRM}$ | Repetitive peak off-state voltage, (note 1) | 2000-2600 | V |
| $V_{DSM}$ | Non-repetitive peak off-state voltage, (note 1) | 2000-2600 | V |
| $V_{RRM}$ | Repetitive peak reverse voltage, (note 1) | 2000-2600 | V |
| $V_{RSM}$ | Non-repetitive peak reverse voltage, (note 1) | 2100-2700 | V |

| | OTHER RATINGS | MAXIMUM LIMITS | UNITS |
|---|---|---|---|
| $I_{T(AV)}$ | Mean on-state current, $T_{sink}$=55°C, (note 2) | 910 | A |
| $I_{T(AV)}$ | Mean on-state current. $T_{sink}$=85°C, (note 2) | 630 | A |
| $I_{T(AV)}$ | Mean on-state current. $T_{sink}$=85°C, (note 3) | 386 | A |
| $I_{T(RMS)}$ | Nominal RMS on-state current. $T_{sink}$=25°C, (note 2) | 1788 | A |
| $I_{T(d.c.)}$ | D.C. on-state current. $T_{sink}$=25°C, (note 4) | 1569 | A |
| $I_{TSM}$ | Peak non-repetitive surge $t_p$=10ms, $V_{RM}$=0.6$V_{RRM}$, (note 5) | 9.2 | kA |
| $I_{TSM2}$ | Peak non-repetitive surge $t_p$=10ms, $V_{RM}$≤10V, (note 5) | 10.1 | kA |
| $I^2t$ | $I^2t$ capacity for fusing $t_p$=10ms, $V_{RM}$=0.6$V_{RRM}$, (note 5) | $423\times10^3$ | $A^2s$ |
| $I^2t$ | $I^2t$ capacity for fusing $t_p$=10ms, $V_{RM}$≤10V, (note 5) | $510\times10^3$ | $A^2s$ |
| $di_T/dt$ | Maximum rate of rise of on-state current (repetitive), (Note 6) | 300 | A/µs |
| | Maximum rate of rise of on-state current (non-repetitive), (Note 6) | 600 | A/µs |
| $V_{RGM}$ | Peak reverse gate voltage | 10 | 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% $V_{DRM}$, $I_{TM}$=2000A, $I_{FG}$=2A, $t_r$≤0.5µs, $T_{case}$=125°C.
7) Rated $V_{DRM}$, $T_{case}$=125°C.

## Characteristics

| | PARAMETER | MIN. | TYP. | MAX. | TEST CONDITIONS (Note 1) | UNITS |
|---|---|---|---|---|---|---|
| $V_{TM}$ | Maximum peak on-state voltage | - | - | 2.07 | $I_{TM}$=1700A | V |
| $V_0$ | Threshold voltage | - | - | 1.04 | | V |
| $r_S$ | Slope resistance | - | - | 0.606 | | mΩ |
| dv/dt | Critical rate of rise of off-state voltage | 1000 | - | - | $V_D$=80% $V_{DRM}$ | V/μs |
| $I_{DRM}$ | Peak off-state current | - | - | 60 | Rated $V_{DRM}$ | mA |
| $I_{RRM}$ | Peak reverse current | - | - | 60 | 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 |
| $R_\theta$ | Thermal resistance, junction to heatsink | - | - | 0.032 | Double side cooled | K/W |
| | | - | - | 0.064 | Single side cooled | K/W |
| F | Mounting force | 10 | - | 20 | | kN |
| $W_t$ | Weight | - | 340 | - | | g |

Notes:-

1) Unless otherwise indicated $T_j$=125°C.

## Notes on Ratings and Characteristics

### 1.0 Voltage Grade Table

| Voltage Grade 'H' | $V_{DRM}$ $V_{DSM}$ $V_{RRM}$ V | $V_{RSM}$ V | $V_D$ $V_R$ DC V |
|---|---|---|---|
| 20 | 2000 | 2100 | 1250 |
| 22 | 2200 | 2300 | 1350 |
| 24 | 2400 | 2500 | 1450 |
| 26 | 2600 | 2700 | 1550 |

### 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 Computer Modelling Parameters

#### 5.1 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 $V_0$=1.04V, $r_s$=0.606mΩ,

$R_{th}$ = 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 | 0.048 | 0.0436 | 0.0413 | 0.0388 | 0.036 | 0.0345 | 0.032 |
| Square wave Single Side Cooled | 0.079 | 0.0769 | 0.074 | 0.0716 | 0.0688 | 0.0665 | 0.064 |
| Sine wave Double Side Cooled | 0.0415 | 0.0394 | 0.0378 | 0.0355 | 0.032 | | |
| Sine wave Single Side Cooled | 0.0735 | 0.0718 | 0.07 | 0.0679 | 0.064 | | |

| 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 | | |

5.2 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 $V_o$ 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 | 0.908566 | A | 0.417877 |
| B | 0.02200912 | B | 0.1200233 |
| C | $3.661922 \times 10^{-4}$ | C | $6.308007 \times 10^{-4}$ |
| D | 0.005349066 | D | -0.007297986 |

5.3 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.
$\tau_p$ = Time Constant of $r_{th}$ term.

| D.C. Double Side Cooled | | | | |
|---|---|---|---|---|
| Term | 1 | 2 | 3 | 4 |
| $r_p$ | 0.01771901 | $4.240625 \times 10^{-3}$ | $6.963806 \times 10^{-3}$ | $3.043661 \times 10^{-3}$ |
| $\tau_p$ | 0.7085781 | 0.1435833 | 0.03615196 | $2.130842 \times 10^{-3}$ |

| D.C. Single Side Cooled | | | | | |
|---|---|---|---|---|---|
| Term | 1 | 2 | 3 | 4 | 5 |
| $r_p$ | 0.03947164 | 0.01022837 | $8.789912 \times 10^{-3}$ | $4.235162 \times 10^{-3}$ | $1.907609 \times 10^{-3}$ |
| $\tau_p$ | 4.090062 | 1.078983 | 0.08530917 | 0.01128791 | $1.240861 \times 10^{-3}$ |

## Curves

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

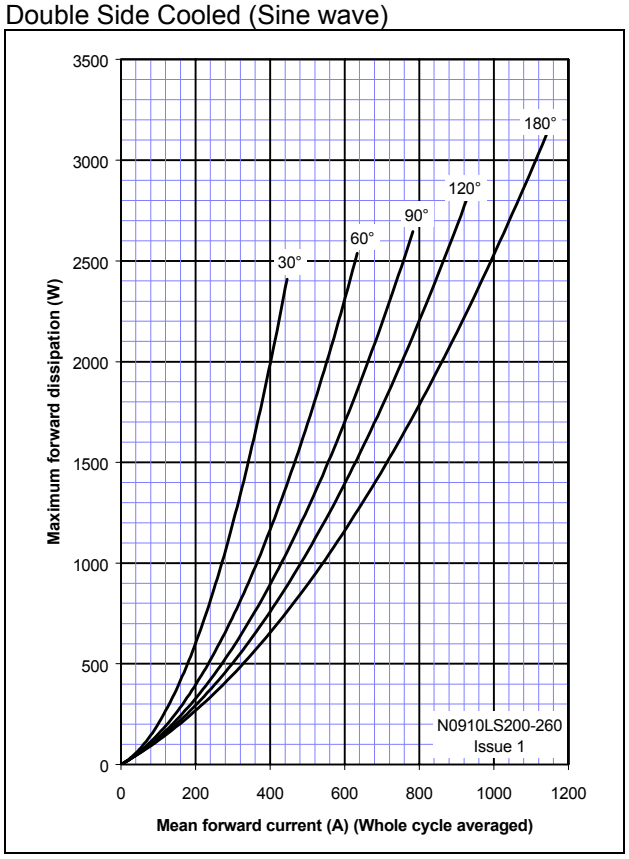



Figure 2 - On-state current vs. Heatsink temperature - Double Side Cooled (Sine wave)

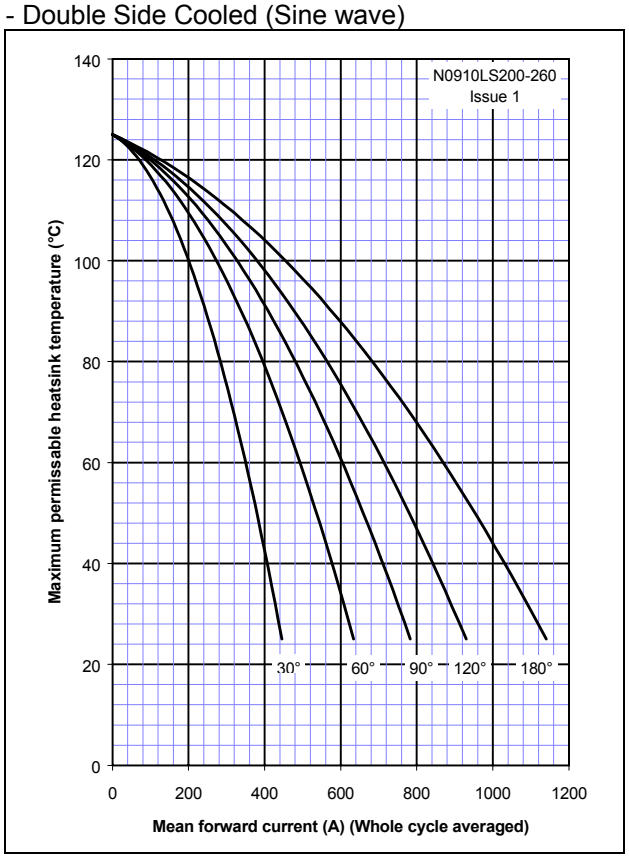



Figure 3 - On-state current vs. Power dissipation - Double Side Cooled (Square wave)

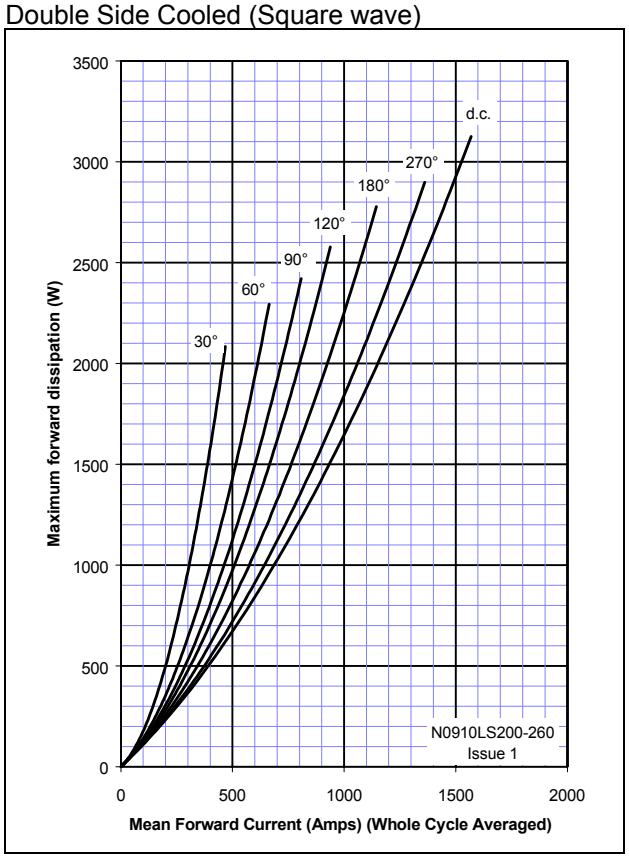



Figure 4 - On-state current vs. Heatsink temperature - Double Side Cooled (Square wave)

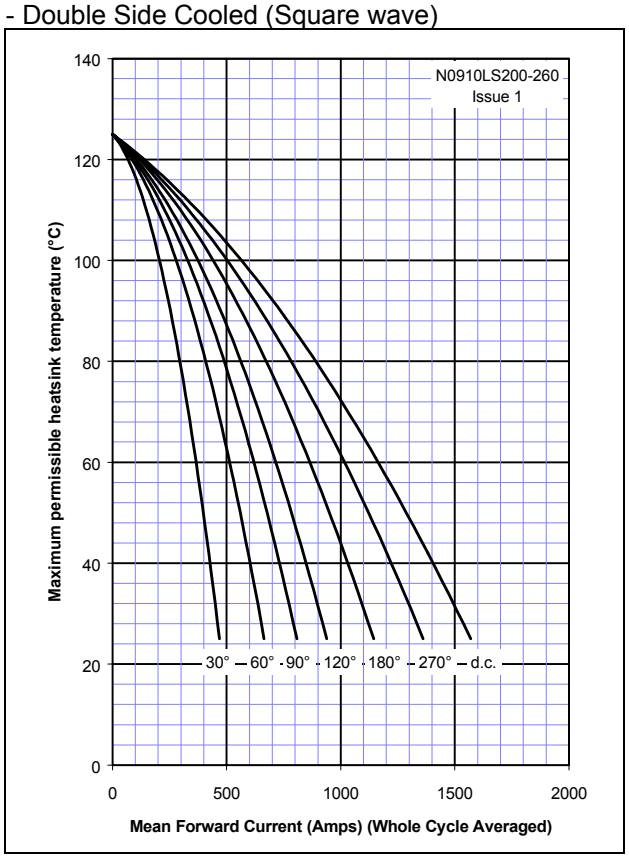


Figure 5 - On-state current vs. Power dissipation - Single Side Cooled (Sine wave)

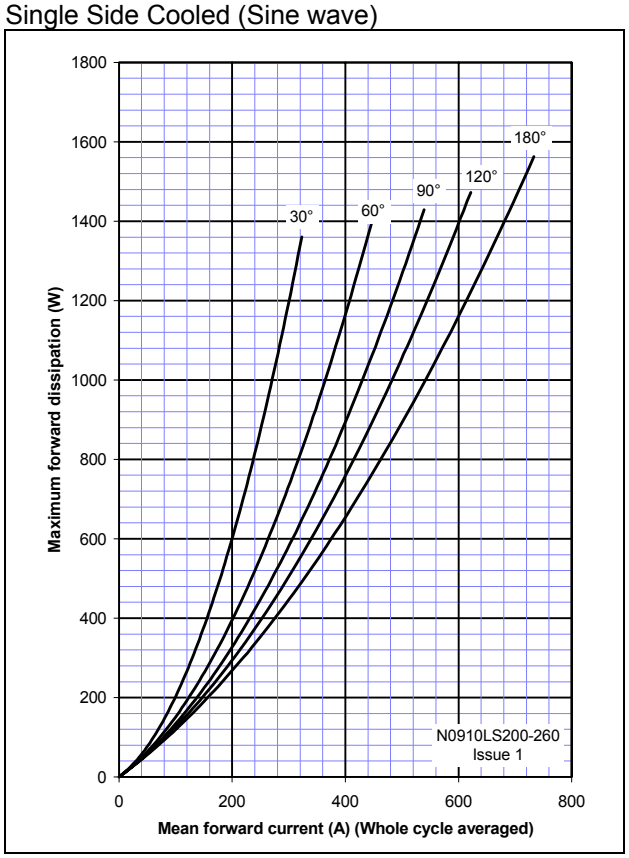



Figure 6 - On-state current vs. Heatsink temperature - Single Side Cooled (Sine wave)

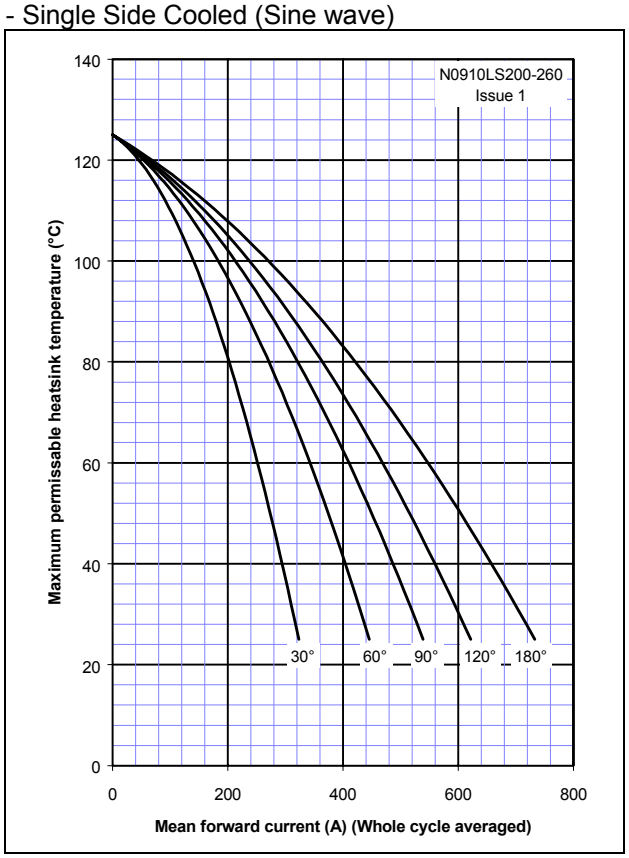



Figure 7 - On-state current vs. Power dissipation - Single Side Cooled (Square wave)

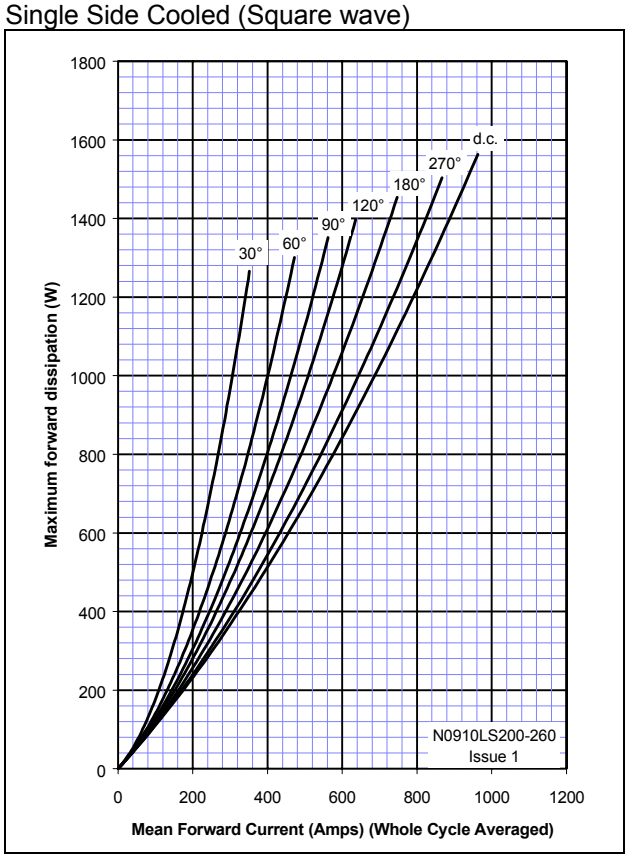



Figure 8 - On-state current vs. Heatsink temperature - Single Side Cooled (Square wave)

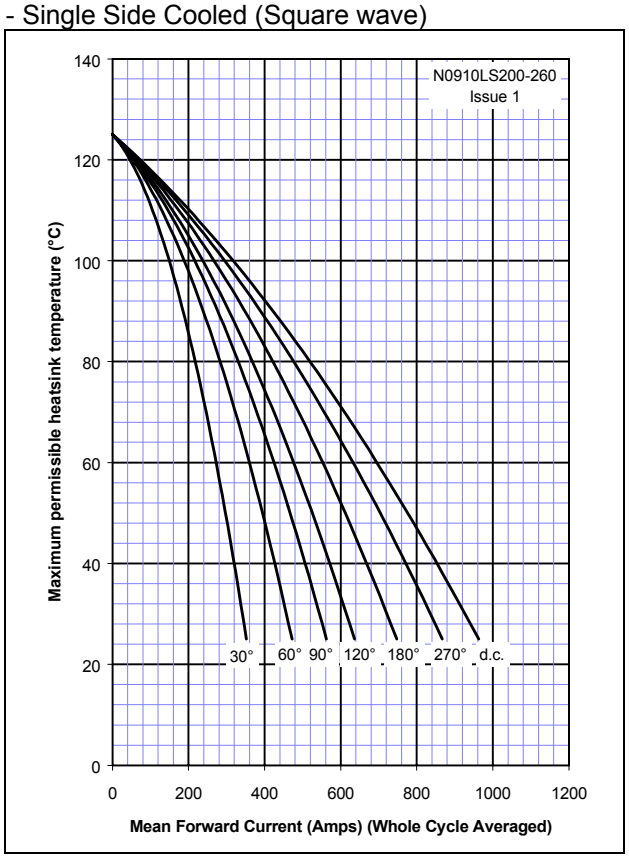


Figure 9 - On-state characteristics of Limit device

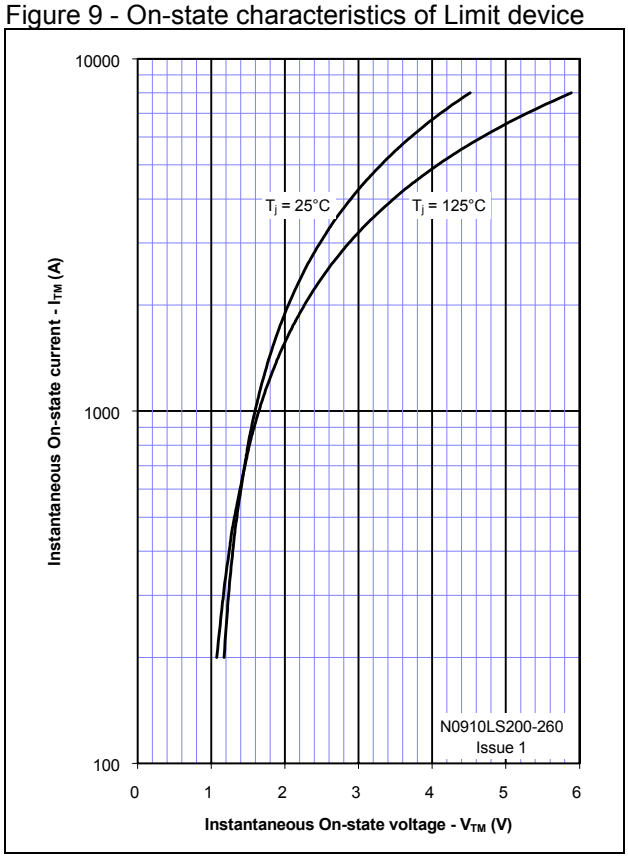



Figure 10 - Transient Thermal Impedance

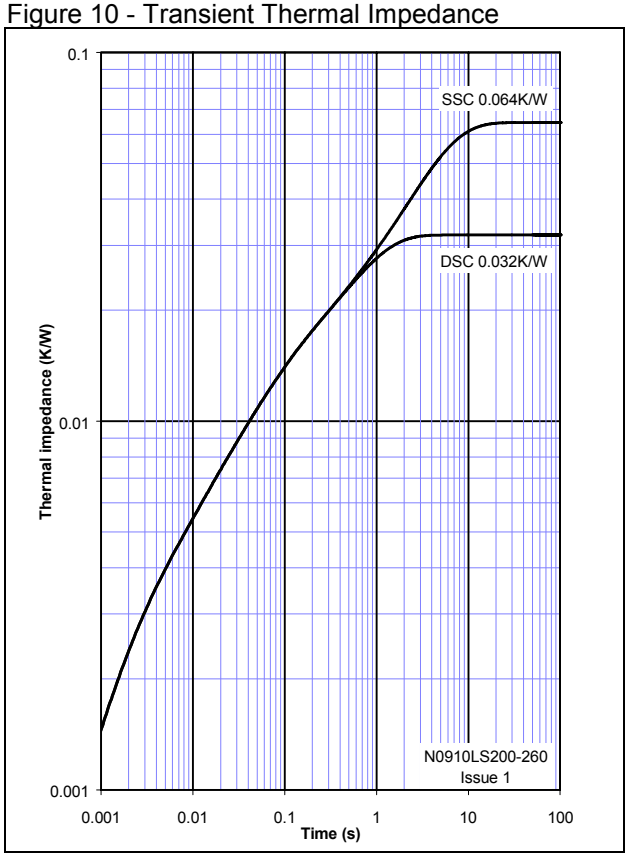



Figure 11 - Gate Characteristics - Trigger Limits

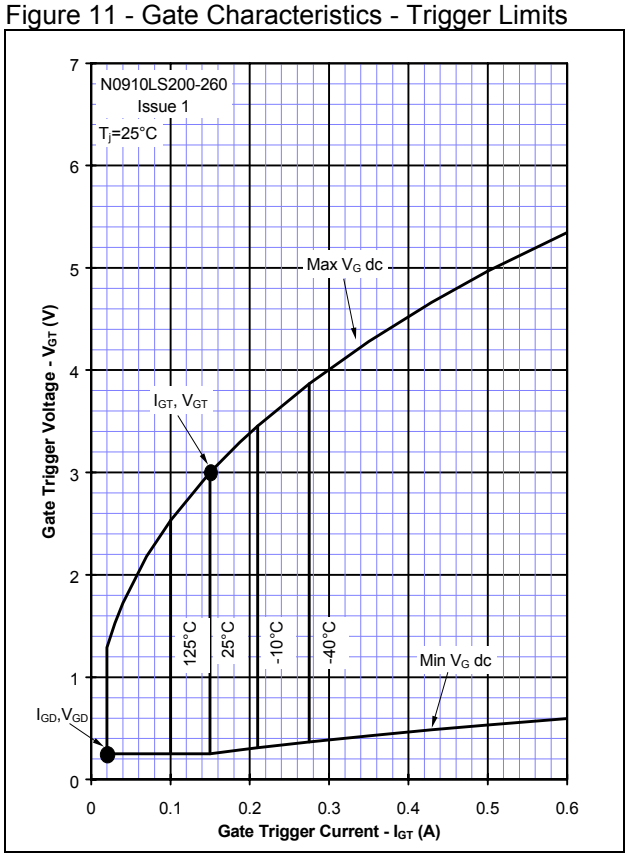



Figure 12 - Gate Characteristics - Power Curves

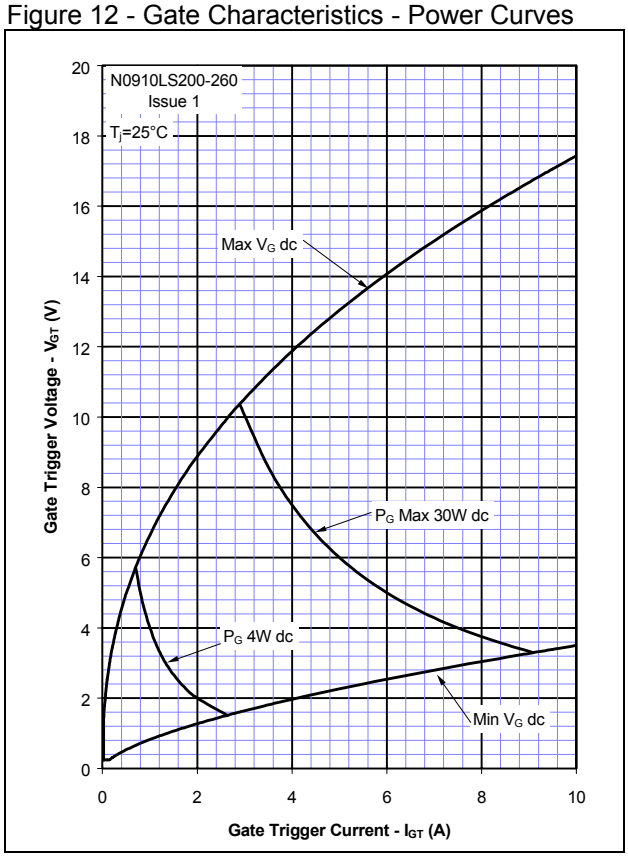
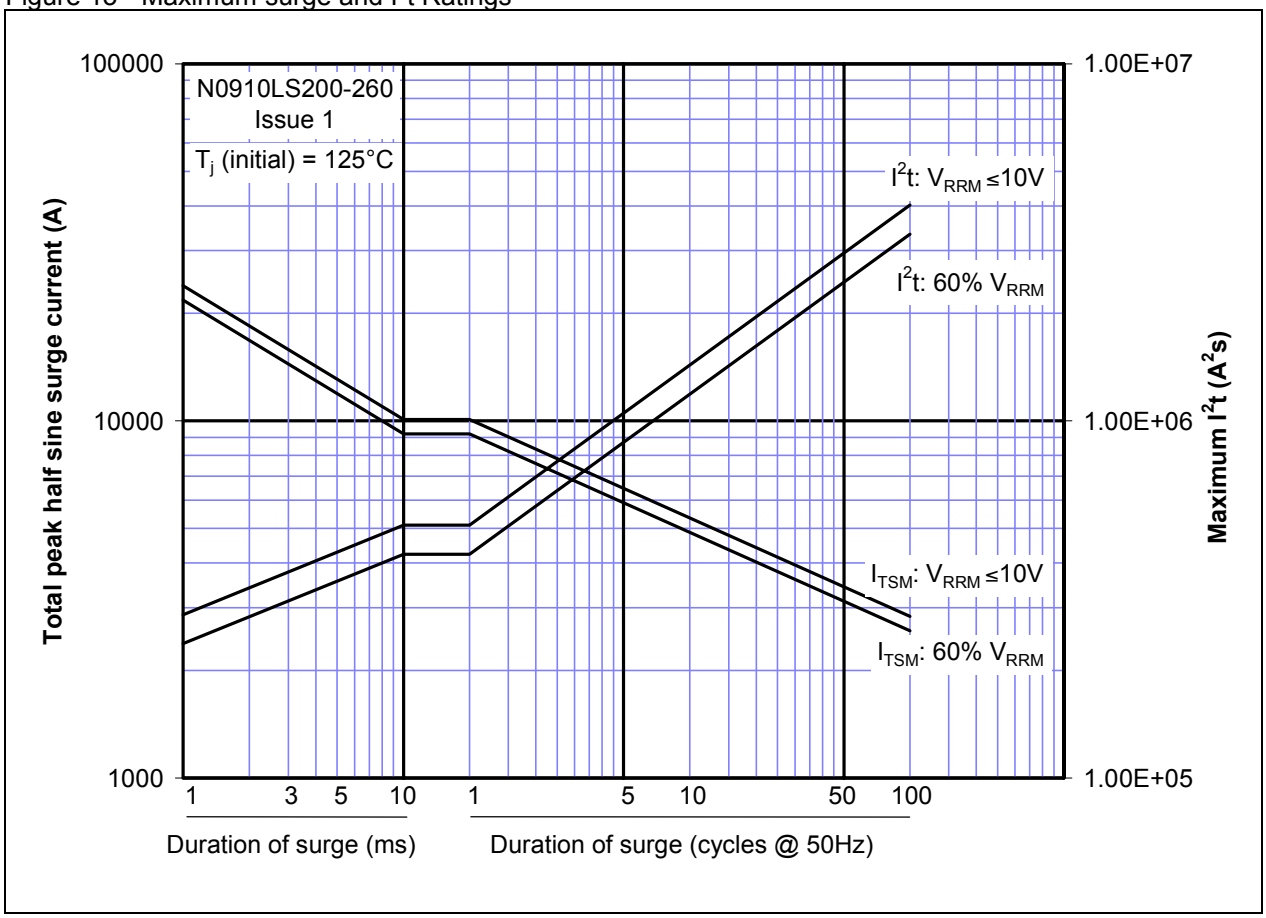
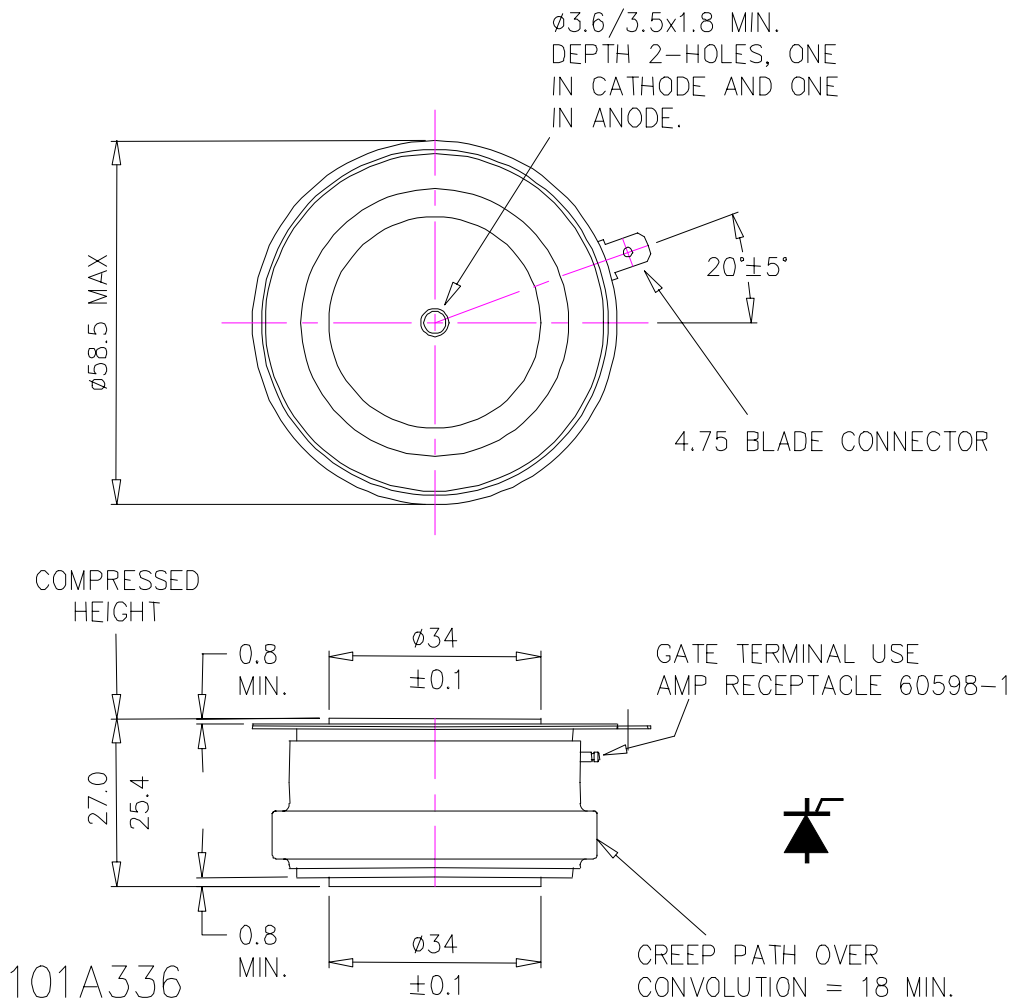


Figure 13 - Maximum surge and $I^2t$ Ratings



## Outline Drawing & Ordering Information




| ORDERING INFORMATION | | (Please quote 10 digit code as below) | |
|---|---|---|---|
| **N0910** | **LS** | **◆◆** | **0** |
| Fixed<br>Type Code | Fixed<br>Outline Code | Voltage Code<br>20-26 | Fixed turn-off<br>time code |

Typical order code : N0910LS180 – 1800V $V_{DRM}$, $V_{RRM}$, 1000V/µs dv/dt, 27mm clamp height capsule.

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