

Silicon Carbide (SiC) MOSFET - EliteSiC, 960 mohm, 1700 V, M1, TO-247-3L NTHL1000N170M1

Features

- Typ. $R_{DS(on)}$ = 960 m Ω
- Ultra Low Gate Charge (typ. $Q_{G(tot)}$ = 14 nC)
- Low Effective Output Capacitance (typ. C_{oss} = 11 pF)
- 100% Avalanche Tested
- RoHS Compliant

Typical Applications

- Solar Inverters
- Electric Vehicle Charging Stations
- Electric Storing Systems
- SMPS (Switch Mode Power Supplies)
- UPS (Uninterruptible Power Supplies)

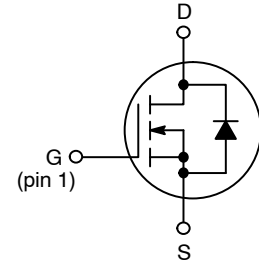
MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | | Symbol | Value | Unit | |
|---|--------------------------|---|-------------|------------------|---|
| Drain-to-Source Voltage | | V_{DSS} | 1700 | V | |
| Gate-to-Source Voltage | | V_{GS} | -15/+25 | V | |
| Recommended Operation Values of Gate-to-Source Voltage | | $T_C < 175^\circ\text{C}$ V_{GSop} | -5/+20 | V | |
| Continuous Drain Current (Note 1) | Steady State | $T_C = 25^\circ\text{C}$ | I_D | 4.2 | A |
| | | | P_D | 48 | W |
| Power Dissipation (Note 1) | Steady State | $T_C = 100^\circ\text{C}$ | I_D | 3 | A |
| | | | P_D | 24 | W |
| Pulsed Drain Current (Note 2) | $T_C = 25^\circ\text{C}$ | | I_{DM} | 14 | A |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | -55 to +175 | $^\circ\text{C}$ | |
| Source Current (Body Diode) | | I_S | 9.5 | A | |
| Single Pulse Drain-to-Source Avalanche Energy (Note 3) | | E_{AS} | 24 | mJ | |
| Maximum Lead Temperature for Soldering (1/25" from case for 10 s) | | T_L | 270 | $^\circ\text{C}$ | |

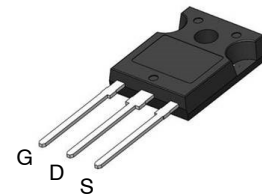
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Repetitive rating, limited by max junction temperature.
3. E_{AS} of 24 mJ is based on starting $T_J = 25^\circ\text{C}$; $L = 1$ mH, $I_{AS} = 6.9$ A, $V_{DD} = 120$ V, $V_{GS} = 20$ V.

| $V_{(BR)DSS}$ | $R_{DS(ON)}$ TYP | I_D MAX |
|---------------|-----------------------|-----------|
| 1700 V | 960 m Ω @ 20 V | 4.2 A |



N-CHANNEL MOSFET



TO-247-3LD
CASE 340CX

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability
HL1000N170M1 = Specific Device Code

ORDERING INFORMATION

| Device | Package | Shipping |
|----------------|-----------|-----------------|
| NTHL1000N170M1 | TO-247-3L | 30 Units / Tube |

NTHL1000N170M1

THEMAL RESISTANCE MAXIMUM RATINGS

| Parameter | Symbol | Max | Unit |
|--|-----------------|-----|------|
| Junction-to-Case – Steady State (Note 1) | $R_{\theta JC}$ | 3.1 | °C/W |

ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

OFF CHARACTERISTICS

| | | | | | | |
|---|-------------------|---|---------------------------|-----|---------|---------------|
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$ | 1700 | | | V |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = 1\text{ mA}$, referenced to 25°C (Note 4) | | 0.5 | | V/°C |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{GS} = 0\text{ V}, V_{DS} = 1700\text{ V}$ | $T_J = 25^\circ\text{C}$ | | 100 | μA |
| | | | $T_J = 175^\circ\text{C}$ | | 1 | mA |
| Gate-to-Source Leakage Current | I_{GSS} | $V_{GS} = +25/-15\text{ V}, V_{DS} = 0\text{ V}$ | | | ± 1 | μA |

ON CHARACTERISTICS (Note 2)

| | | | | | | |
|-------------------------------|--------------|--|-----|------|------|------------|
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS} = V_{DS}, I_D = 640\ \mu\text{A}$ | 1.8 | 3.2 | 4.3 | V |
| Recommended Gate Voltage | V_{GOP} | | -5 | | +20 | V |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | $V_{GS} = 20\text{ V}, I_D = 2\text{ A}, T_J = 25^\circ\text{C}$ | | 960 | 1430 | m Ω |
| | | $V_{GS} = 20\text{ V}, I_D = 2\text{ A}, T_J = 175^\circ\text{C}$ (Note 4) | | 1800 | | |
| Forward Transconductance | g_{FS} | $V_{DS} = 10\text{ V}, I_D = 2\text{ A}$ (Note 4) | | 0.6 | | S |

CHARGES, CAPACITANCES & GATE RESISTANCE (Note 4)

| | | | | | | |
|------------------------------|--------------|--|--------------------|-----|-----|----|
| Input Capacitance | C_{ISS} | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 1000\text{ V}$ | | 150 | | pF |
| Output Capacitance | C_{OSS} | | | 11 | | |
| Reverse Transfer Capacitance | C_{RSS} | | | 0.6 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = -5/20\text{ V}, V_{DS} = 800\text{ V}, I_D = 2\text{ A}$ | | 14 | | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | 1.5 | | |
| Gate-to-Source Charge | Q_{GS} | | | 2.6 | | |
| Gate-to-Drain Charge | Q_{GD} | | | 7.5 | | |
| Gate-Resistance | R_G | | $f = 1\text{ MHz}$ | | 5.7 | |

SWITCHING CHARACTERISTICS (Notes 4, 5)

| | | | | | | |
|-------------------------|--------------|--|--|-----|--|---------------|
| Turn-On Delay Time | $t_{d(ON)}$ | $V_{GS} = -5/20\text{ V}, V_{DS} = 800\text{ V}, I_D = 2\text{ A}, R_G = 25\ \Omega$ inductive load $L = 300\ \mu\text{H}$ | | 5.6 | | ns |
| Rise Time | t_r | | | 30 | | |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | 11 | | |
| Fall Time | t_f | | | 84 | | μJ |
| Turn-On Switching Loss | E_{ON} | | | 120 | | |
| Turn-Off Switching Loss | E_{OFF} | | | 11 | | |
| Total Switching Loss | E_{tot} | | | 131 | | |

DRAIN-SOURCE DIODE CHARACTERISTICS

| | | | | | | |
|--|-----------|--|--|-----|-----|----|
| Continuous Drain-Source Diode Forward Current (Note 1) | I_{SD} | $V_{GS} = -5\text{ V}, T_J = 25^\circ\text{C}$ | | | 9.5 | A |
| Pulsed Drain-Source Diode Forward Current (Note 2) | I_{SDM} | | | | 48 | |
| Forward Diode Voltage | V_{SD} | $V_{GS} = -5\text{ V}, I_{SD} = 2\text{ A}, T_J = 25^\circ\text{C}$ | | 4.2 | | V |
| Reverse Recovery Time | t_{RR} | $V_{GS} = -5/20\text{ V}, I_{SD} = 2\text{ A}, di/dt = 1000\text{ A}/\mu\text{s}$ (Note 4) | | 5.9 | | ns |
| Reverse Recovery Charge | Q_{RR} | | | 11 | | nC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Defined by design, not subject to production test.

5. E_{ON}/E_{OFF} result is with body diode.

TYPICAL CHARACTERISTICS

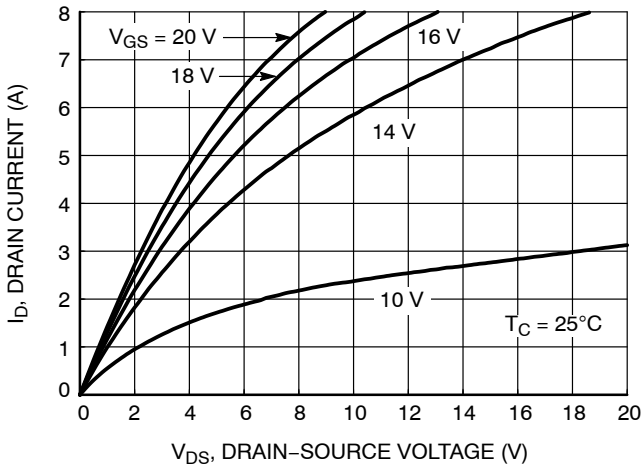


Figure 1. On-Region Characteristics

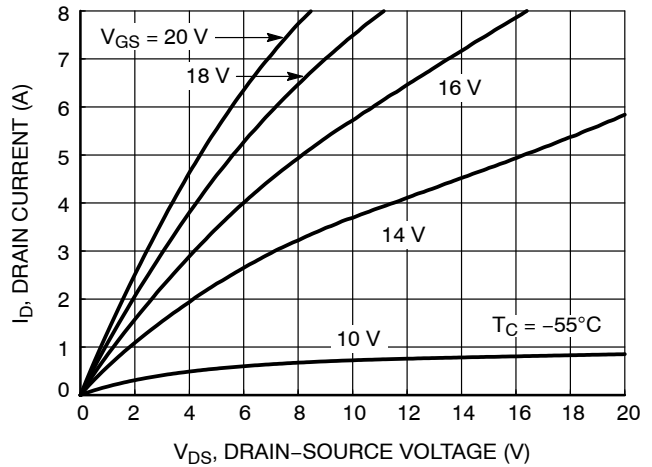


Figure 2. On-Region Characteristics

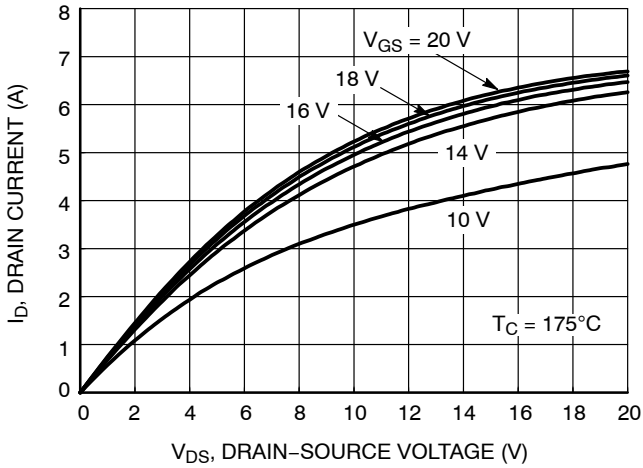


Figure 3. On-Region Characteristics

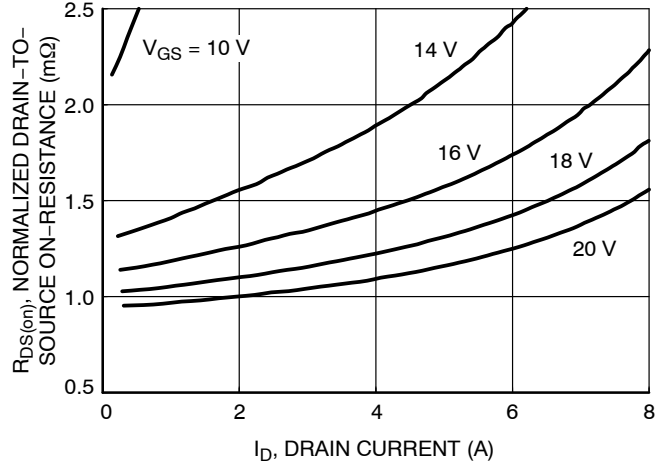


Figure 4. Normalized On-Resistance vs. Drain Current and Gate Voltage

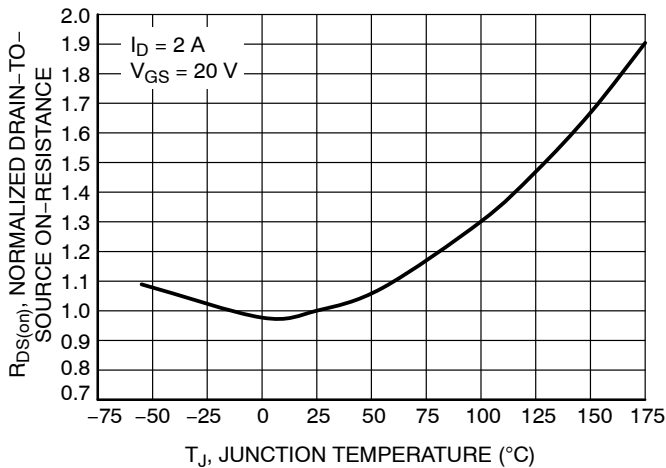


Figure 5. Normalized On-Resistance Variation with Temperature

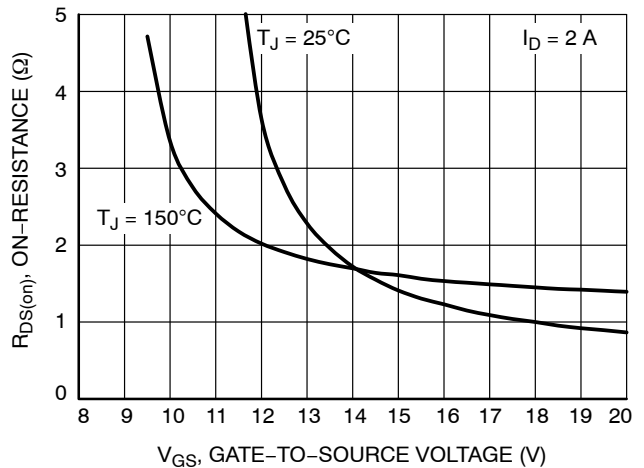


Figure 6. On-Resistance vs. Gate-to-Source Voltage

NTHL100N170M1

TYPICAL CHARACTERISTICS

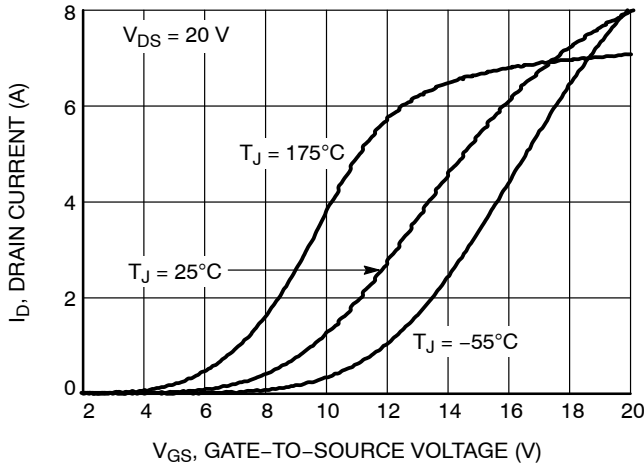


Figure 7. Transfer Characteristics

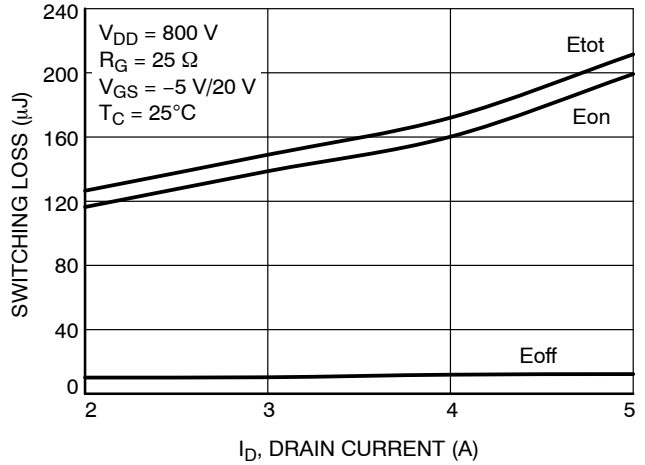


Figure 8. Switching Loss vs. Drain Current

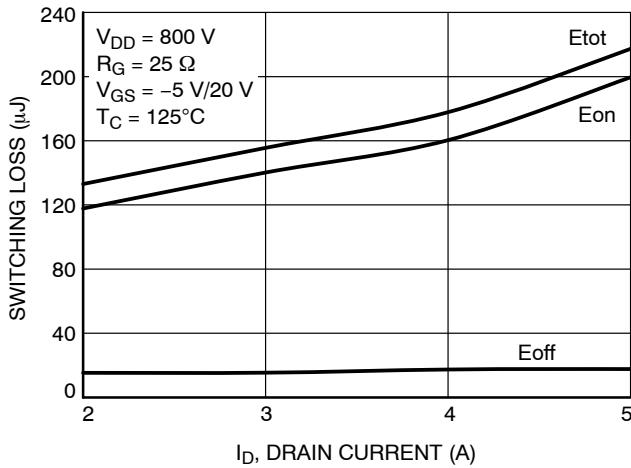


Figure 9. Switching Loss vs. Drain Current

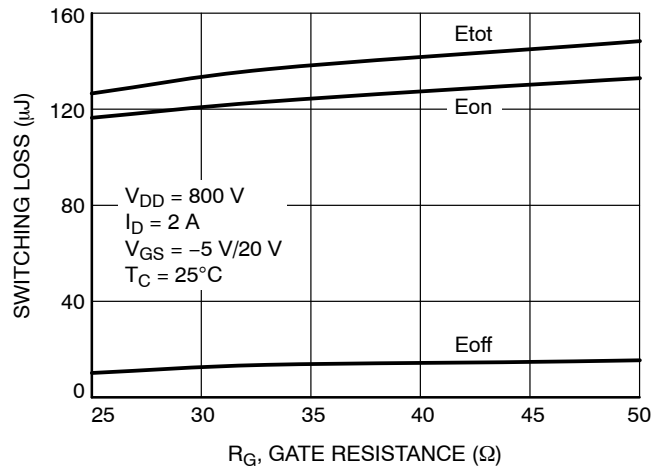


Figure 10. Switching Loss vs. Gate Resistance

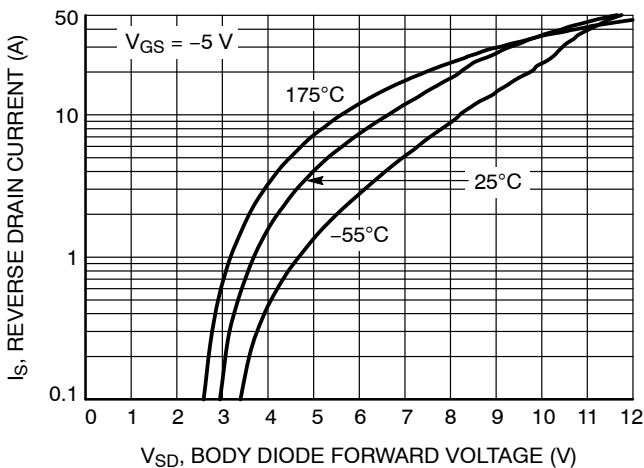


Figure 11. Reverse Drain Current vs. Body Diode Forward Voltage

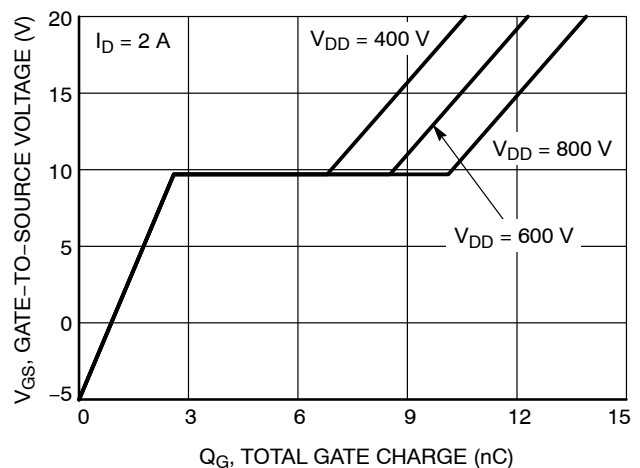


Figure 12. Gate-to-Source Voltage vs. Total Gate Charge

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TYPICAL CHARACTERISTICS

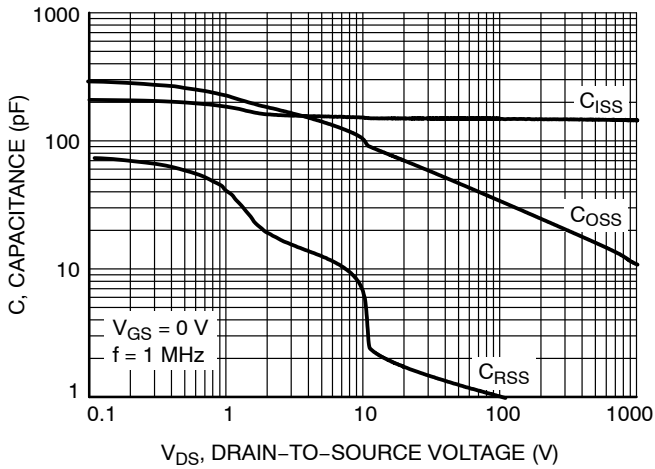


Figure 13. Capacitance vs. Drain-to-Source Voltage

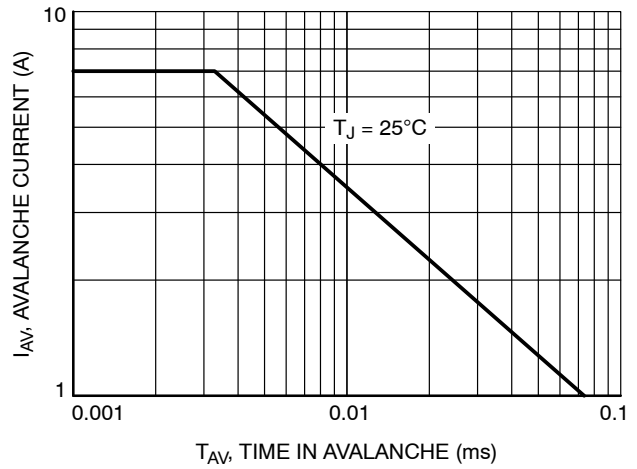


Figure 14. Unclamped Inductive Switching Capability

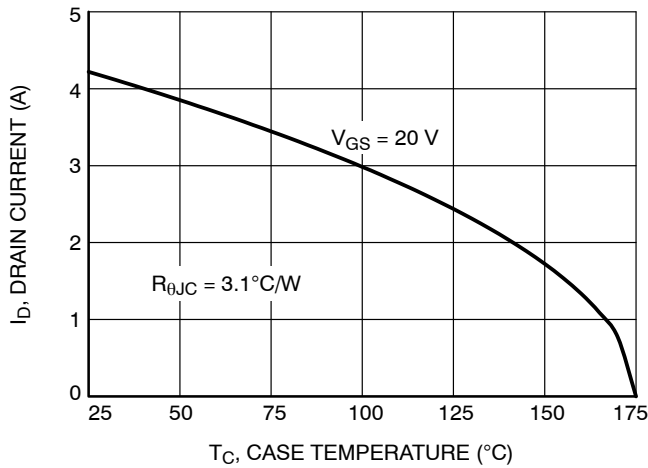


Figure 15. Maximum Continuous Drain Current vs. Case Temperature

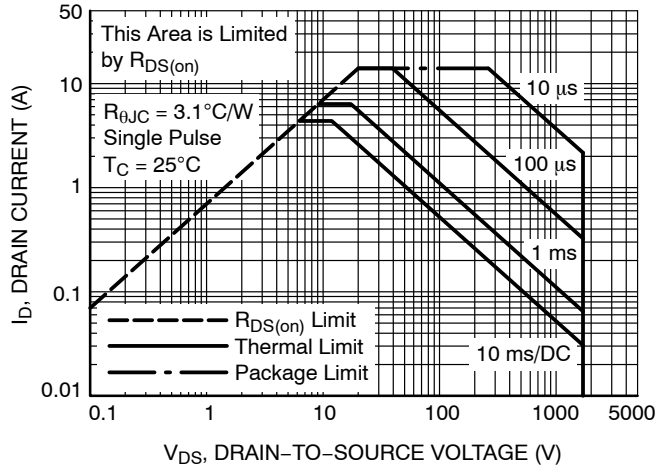


Figure 16. Maximum Rated Forward Biased Safe Operating Area

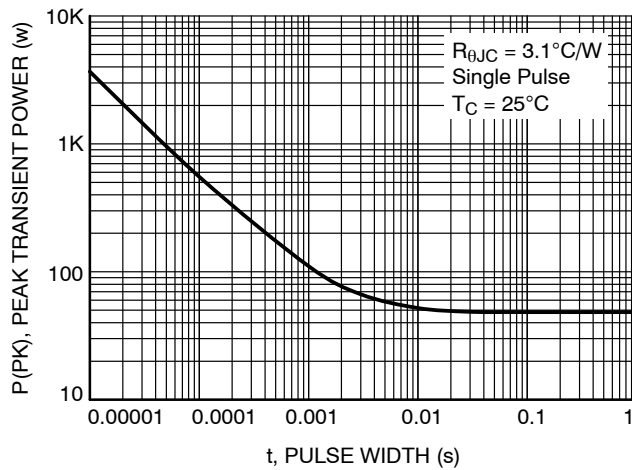


Figure 17. Single Pulse Maximum Power Dissipation

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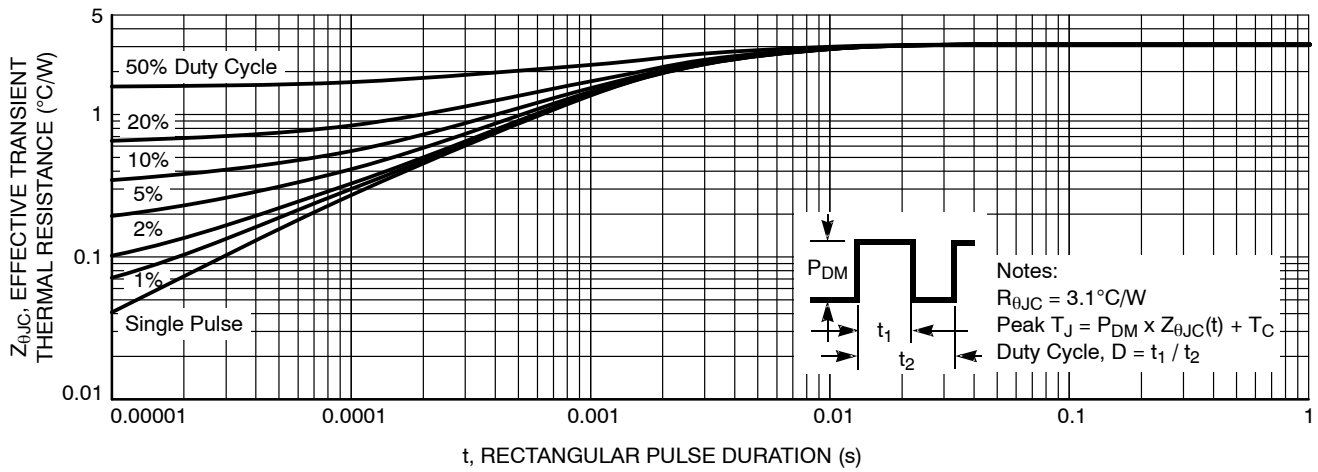


Figure 18. Transient Thermal Impedance

ESD RATINGS

| ESD Test | Classification | Standard |
|----------|----------------------|------------------------|
| ESD-HBM | 0B (125 V to <250 V) | ANSI/ESDA/JEDEC JS-001 |
| ESD-CDM | C3 (>1000 V) | ANSI/ESDA/JEDEC JS-002 |

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
- D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
- E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

| DIM | MILLIMETERS | | |
|-----|-------------|-------|-------|
| | MIN | NOM | MAX |
| A | 4.58 | 4.70 | 4.82 |
| A1 | 2.20 | 2.40 | 2.60 |
| A2 | 1.40 | 1.50 | 1.60 |
| D | 20.32 | 20.57 | 20.82 |
| E | 15.37 | 15.62 | 15.87 |
| E2 | 4.96 | 5.08 | 5.20 |
| e | ~ | 5.56 | ~ |
| L | 19.75 | 20.00 | 20.25 |
| L1 | 3.69 | 3.81 | 3.93 |
| ØP | 3.51 | 3.58 | 3.65 |
| Q | 5.34 | 5.46 | 5.58 |
| S | 5.34 | 5.46 | 5.58 |
| b | 1.17 | 1.26 | 1.35 |
| b2 | 1.53 | 1.65 | 1.77 |
| b4 | 2.42 | 2.54 | 2.66 |
| c | 0.51 | 0.61 | 0.71 |
| D1 | 13.08 | ~ | ~ |
| D2 | 0.51 | 0.93 | 1.35 |
| E1 | 12.81 | ~ | ~ |
| ØP1 | 6.60 | 6.80 | 7.00 |

GENERIC MARKING DIAGRAM*



- XXXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- WW = Work Week
- G = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

| | | |
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