ALPHA & OMEGA SEMICONDUCTOR

# AOM033V120X2Q

## 1200 V αSiC Silicon Carbide Power MOSFET

## Features

- Proprietary αSiC MOSFET technology
- Low loss, with low $R_{DS,\ ON}$
- Fast switching with low $R_G$ and low capacitance
- Optimized gate drive voltage ($V_{GS}$ = 15 V)
- Low reverse recovery diode (Qrr)
- AEC-Q101 Automotive Qualified

## Product Summary

| | |
|---|---|
| $V_{DS}$ @ $T_{J,\ max}$ | 1200 V |
| $I_{DM}$ | 120 A |
| $R_{DS(ON),\ typ}$ | 33 mΩ |
| $Q_{rr}$ | 226 nC |
| $E_{OSS}$ @ 800 V | 63 µJ |
| 100% UIS Tested | |

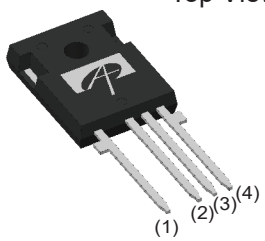
RoHS Compliant

## Applications

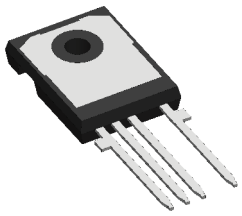
- xEV Charger
- Electric Vehicle Supply Equipment (EVSE)
- Motor Drives
- Automotive Inverters

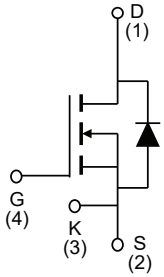
## Pin Configuration

Top View




Bottom View






| Ordering Part Number | Package Type | Form | Shipping Quantity |
|---|---|---|---|
| AOM033V120X2Q | TO-247-4L | Tube | 30/Tube |

## Absolute Maximum Ratings

($T_A$ = 25°C, unless otherwise noted)

| Symbol | Parameter | | AOM033V120X2Q | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | | 1200 | V |
| $V_{GS,\ MAX}$ | Gate-Source Voltage | Maximum | -8/+18 | V |
| $V_{GS,OP,TRANS}$ | | Max Transient[A] | -8/+20 | |
| $V_{GS,OP}$ | | Recommended Operating [B] | -5/+15 | |
| $I_D$ | Continuous Drain Current | $T_C$ = 25°C | 68 | A |
| | | $T_C$ = 100°C | 48 | |
| $I_{DM}$ | Pulsed Drain Current[C] | | 120 | |
| $E_{AS}$ | Single Pulsed Avalanche Energy[D] | | 1000 | mJ |
| $P_D$ | Power Dissipation[C] | | 300 | W |
| $T_J$, $T_{STG}$ | Junction and Storage Temperature Range | | -55 to 175 | °C |
| $T_L$ | Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | AOM033V120X2Q | Units |
|---|---|---|---|
| $R_{\theta JA}$ | Maximum Junction-to-Ambient (E,F) | 40 | °C/W |
| $R_{\theta JC}$ | Maximum Junction-to-Case (G) | 0.5 | °C/W |

## Electrical Characteristics

($T_A$ = 25°C, unless otherwise noted)

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $I_D$=250µA, $V_{GS}$=0V, $T_J$=25°C | | 1200 | | | V |
| | | $I_D$=250µA, $V_{GS}$=0V, $T_J$=150°C | | | 1200 | | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=1200V, $V_{GS}$=0V, $T_J$=25°C | | | | 100 | µA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{DS}$=0V, $V_{GS}$=+15/-5V | | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ , $I_D$=17.5mA | | | 2.8 | | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=15V, $I_D$=20A | $T_J$=25°C | | 33 | 43 | mΩ |
| | | | $T_J$=150°C | | 45 | | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=20V, $I_D$=20A | | | 15 | - | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=17.5A, $V_{GS}$=-5V | | | 4 | 5 | V |
| **DYNAMIC** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=800V, f=1MHz | | | 2908 | | pF |
| $C_{oss}$ | Output Capacitance | | | | 128 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | | 9.9 | | pF |
| $E_{oss}$ | Coss Stored Energy | | | | 63 | | µJ |
| $R_G$ | Gate Resistance | f=1MHz | | | 1.7 | | Ω |
| **SWITCHING** | | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=-5/+15V, $V_{DS}$=800V, $I_D$=20A, $I_{GS}$=50mA | | | 104 | | nC |
| $Q_{gs}$ | Gate Source Charge | | | | 37 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | | 32 | | nC |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{GS}$=-5V/+15V, $V_{DS}$=800V, $I_D$=40A, $R_G$=2Ω, L=60µH, FWD: AOM033V120X2Q | | | 13.3 | | ns |
| $t_r$ | Turn-On Rise Time | | | | 15.4 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | | 15.3 | | ns |
| $t_f$ | Turn-Off Fall Time | | | | 5.1 | | ns |
| $E_{on}$ | Turn-On Energy | | | | 297 | | µJ |
| $E_{off}$ | Turn-Off Energy | | | | 40 | | µJ |
| $E_{tot}$ | Total Switching Energy | | | | 337 | | µJ |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=20A, dI/dt=1500A/us, $V_{GS}$=-5V $V_{DS}$=800V | | | 48 | | ns |
| $I_{rm}$ | Peak Reverse Recovery Current | | | | 13 | | A |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | | | | 226 | | nC |

**Notes:**

A. $t_{pulse}$<1µs, f>1Hz

B. Device can be operated at $V_{GS}$=0/15V. Actual operating VGS will depend on application specifics such as parasitic inductance and dV/dt but should not exceed maximum ratings.

C. The power dissipation $P_D$ is based on $T_{J(MAX)}$=175°C, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

D. L=5mH, $I_{AS}$=20A, $R_G$=25Ω, Starting $T_J$=25°C.

E. The value of $R_{\theta JA}$ is measured with the device in a still air environment with $T_A$ =25°C.

F. The $R_{\theta JA}$ is the sum of the thermal impedance from junction to case $R_{\theta JC}$ and case to ambient.

G. The value of $R_{\theta JC}$ is measured with the device mounted to a large heat-sink, assuming a maximum junction temperature of $T_{J(MAX)}$=175°C.

H. The static characteristics in Figures 1 to 8 are obtained using <300ms pulses, duty cycle 0.5% max.

I. These curves are based on $R_{\theta JC}$ which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)}$=175°C. The SOA curve provides a single pulse rating.

## Typical Electrical and Thermal Characteristics

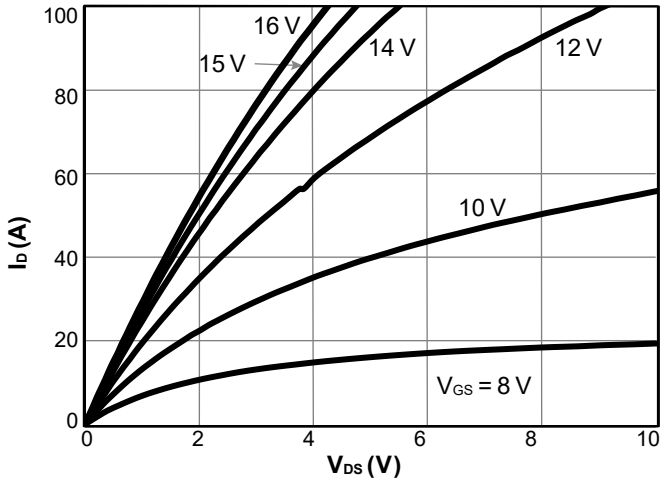



Figure 1. On-Region Characteristics $T_J$ = 25°C

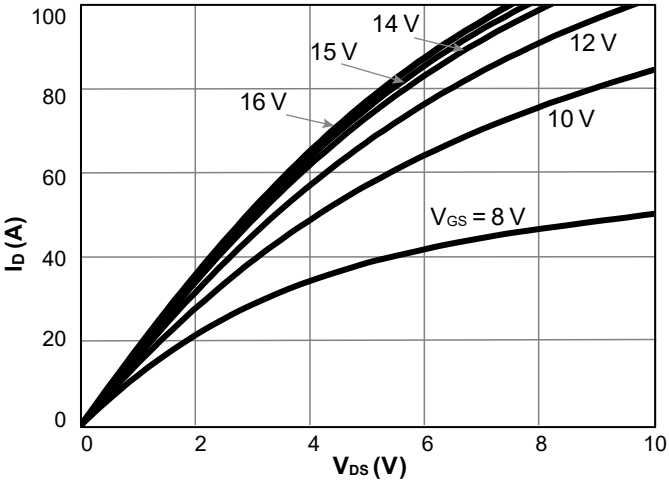



Figure 2. On-Region Characteristics $T_J$ = 175°C

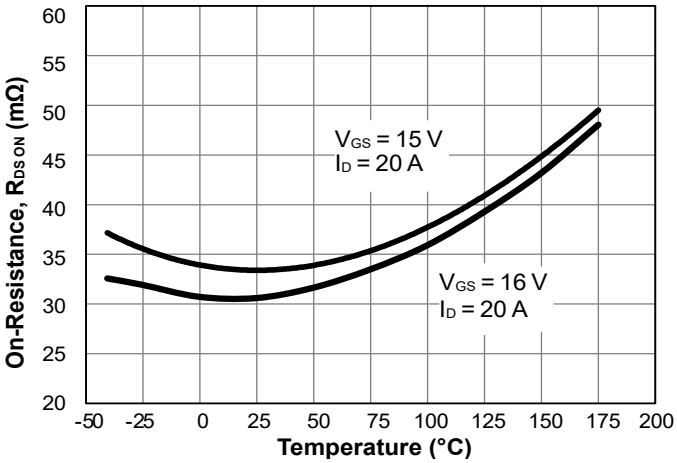



Figure 3. On-Resistance vs. Junction Temperature

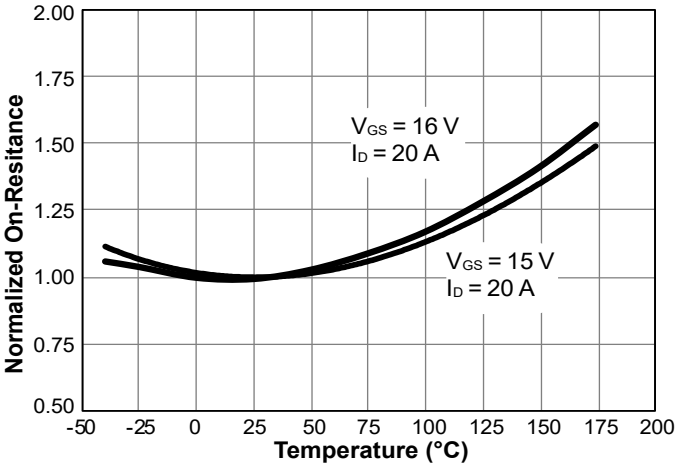



Figure 4. Normalized On-Resistance vs. Junction Temperature

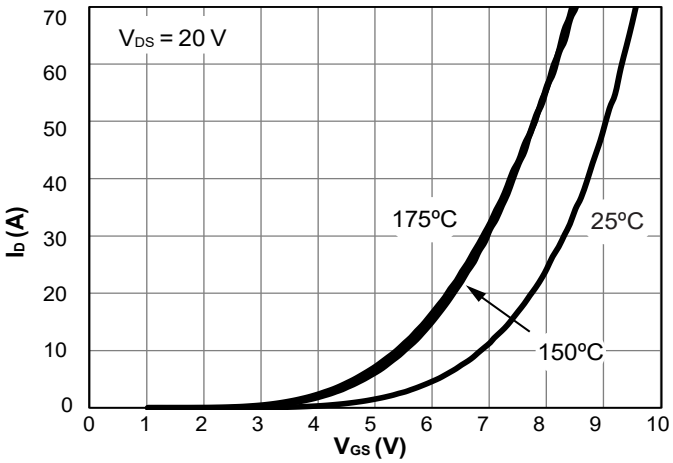



Figure 5. Transfer Characteristics

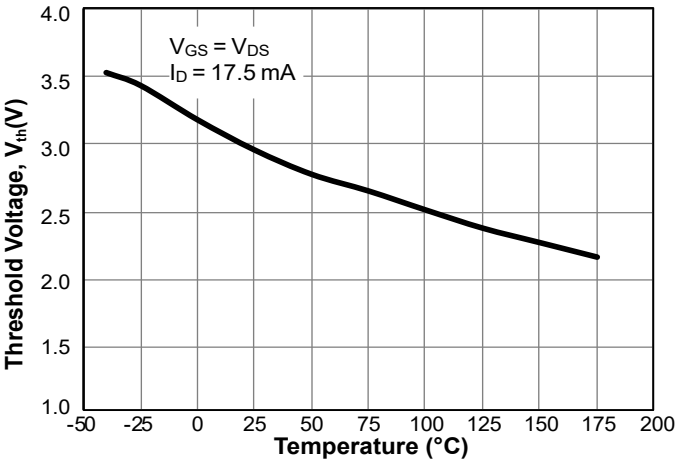



Figure 6. Threshold Voltage vs. Junction Temperature

## Typical Electrical and Thermal Characteristics *(Continued)*

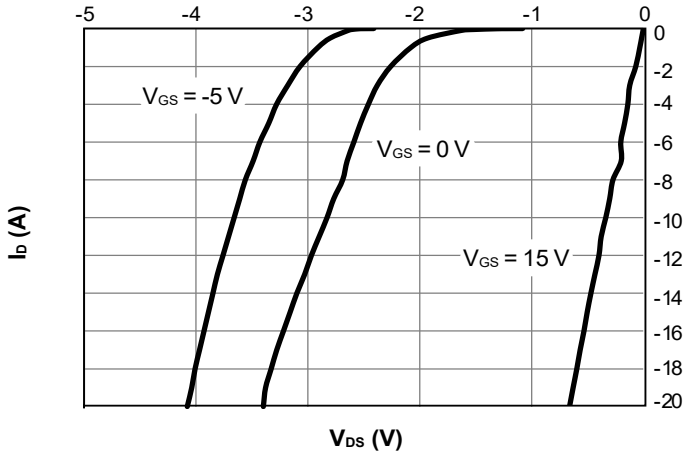



**Figure 7. Body-Diode Characteristics at 25°C**

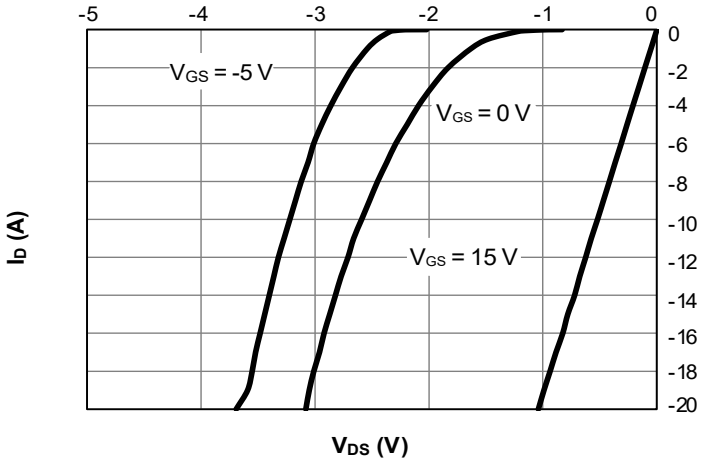



**Figure 8. Body-Diode Characteristics at 175°C**

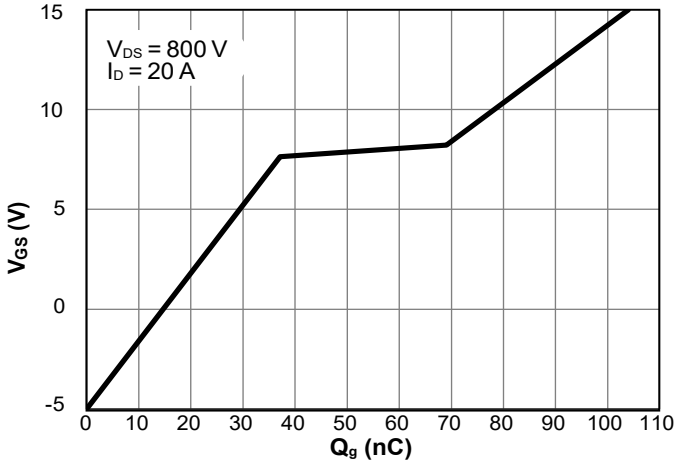



**Figure 9. Gate-Charge Characteristics**

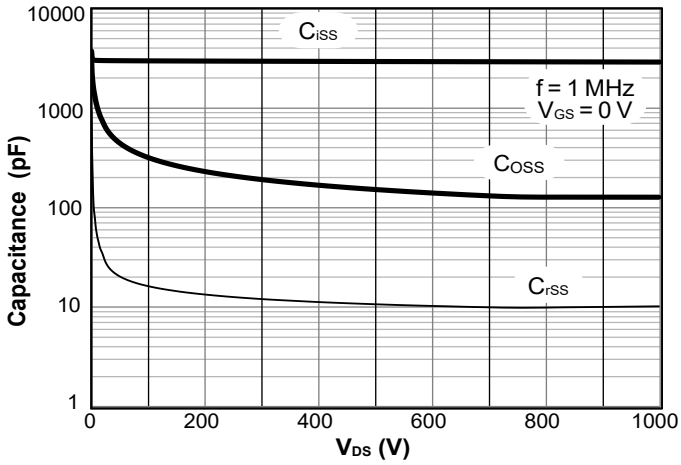



**Figure 10. Capacitance Characteristics**

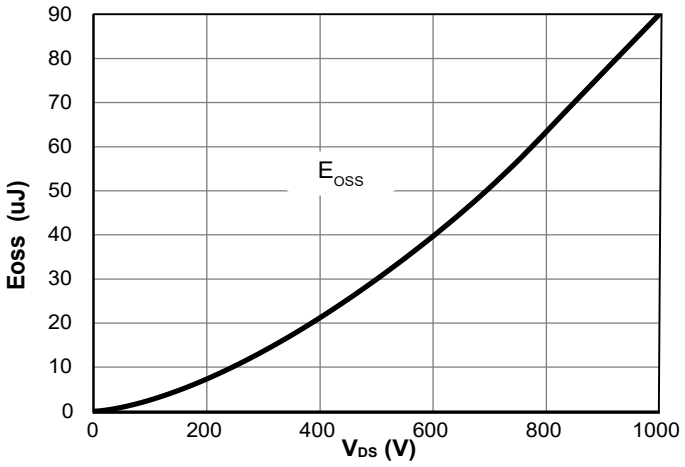



**Figure 11. Coss Stored Energy**

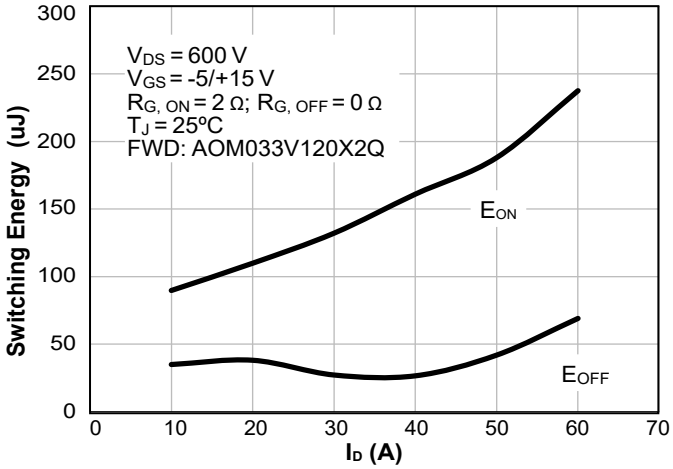



**Figure 12. Switching Energy vs. Drain Current**

## Typical Electrical and Thermal Characteristics *(Continued)*

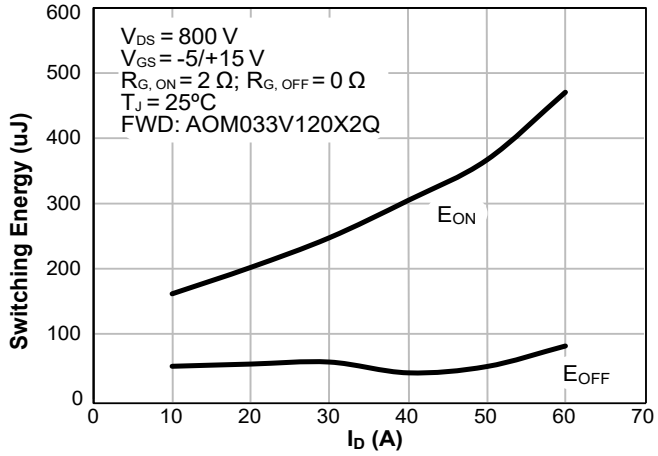



**Figure 13. Switching Energy vs. Drain Current**

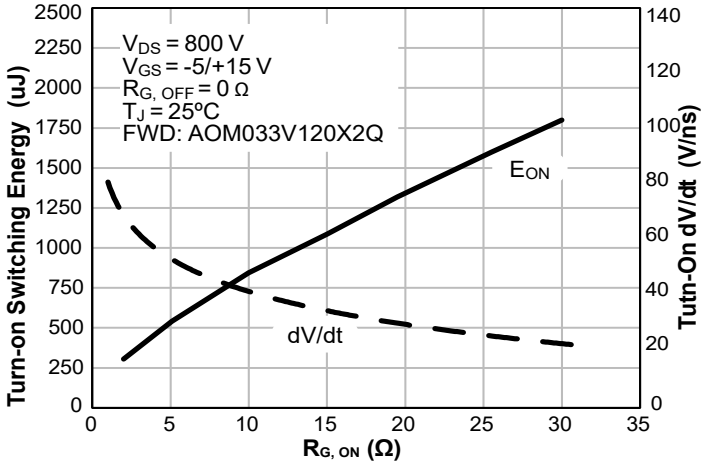



**Figure 14. Turn-On Energy and dV/dt vs. External Gate Resistance**

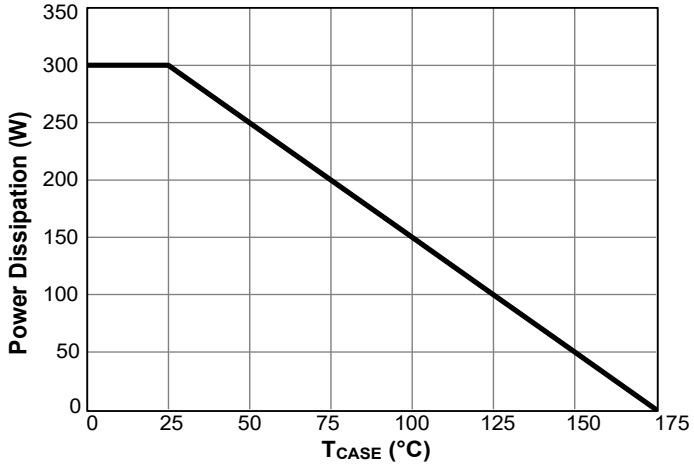



**Figure 15. Power Derating vs. Case Termperature (Note I)**

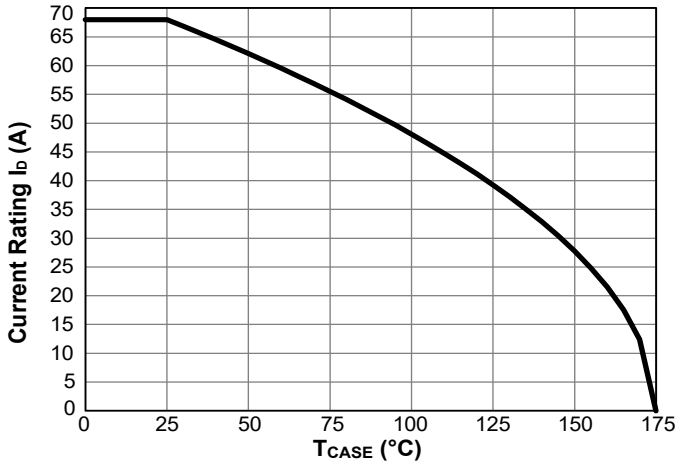



**Figure 16. Current Derating vs. Case Temperature (Note I)**

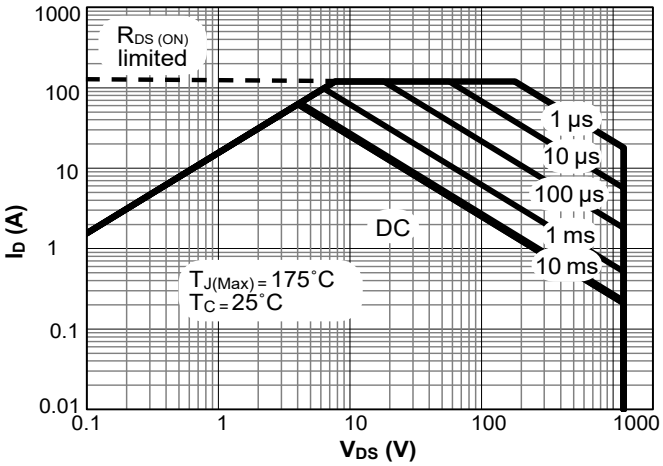



**Figure 17. Maximum Forward Biased Safe Operating (Note I)**

## Typical Electrical and Thermal Characteristics *(Continued)*

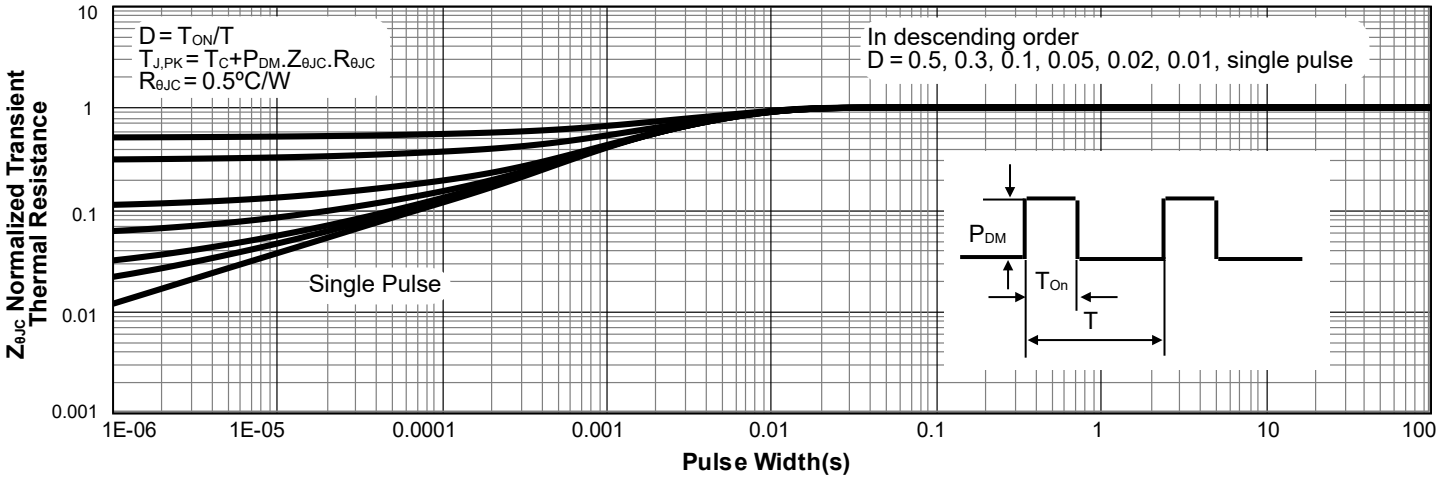



**Figure 18. Normalized Maximum Transient Thermal Impedance for AOM033V120X2Q (Note I)**

## Test Circuits and Waveforms

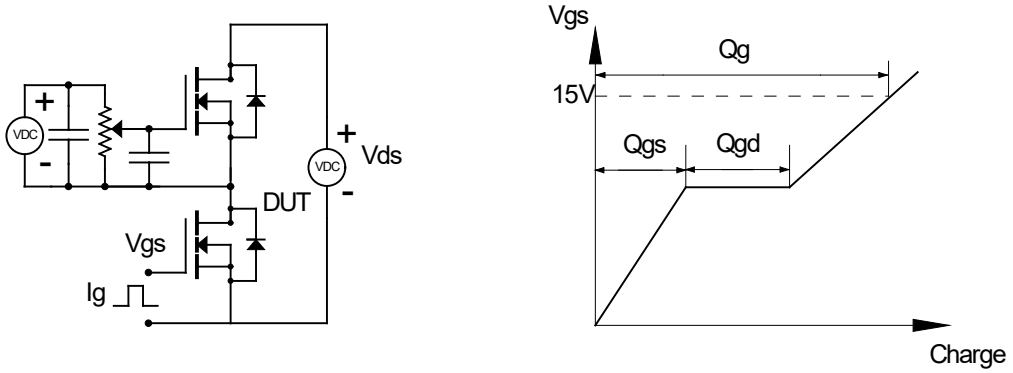



**Figure 19. Gate Charge Test Circuits and Waveforms**

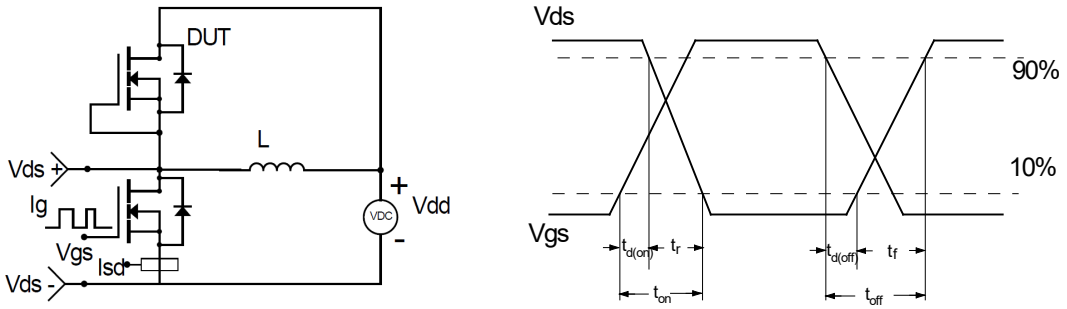



**Figure 20. Inductive Switching Test Circuit and Waveforms**

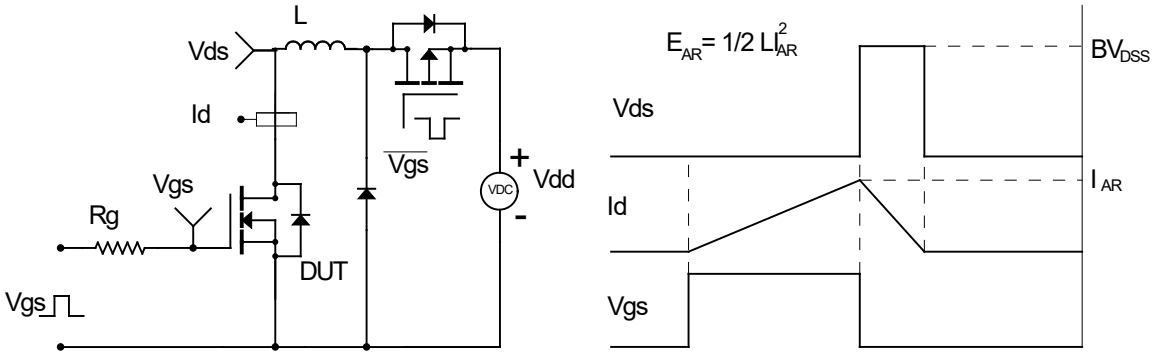



**Figure 21. Unclamped Inductive Switching (UIS) Test Circuit and Waveforms**

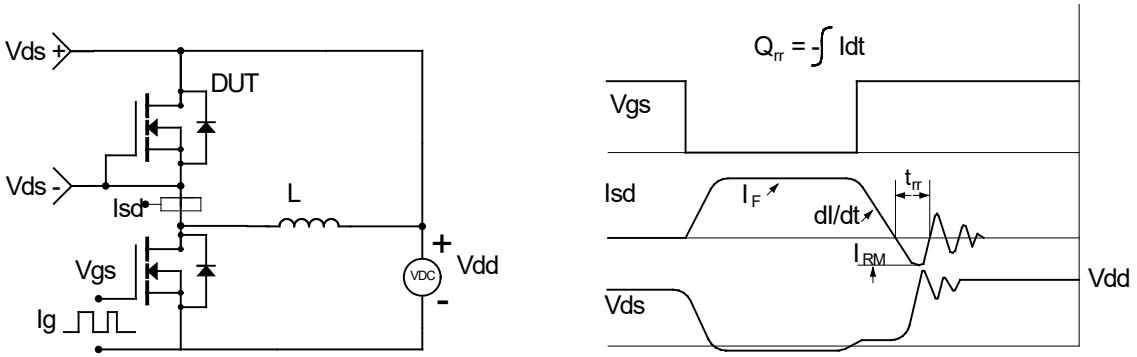
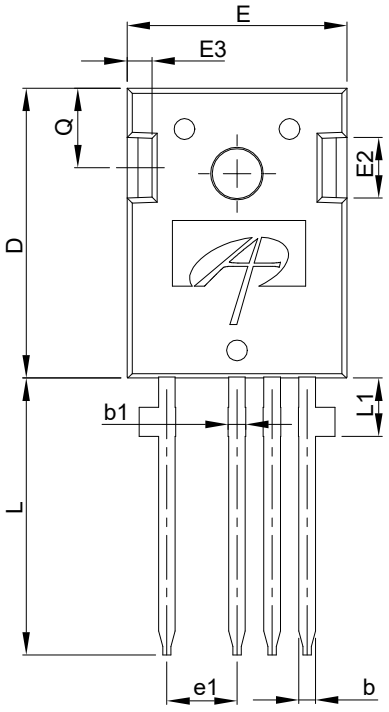
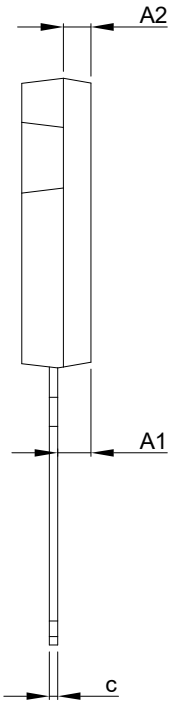



**Figure 22. Diode Recovery Test Circuits and Waveforms**

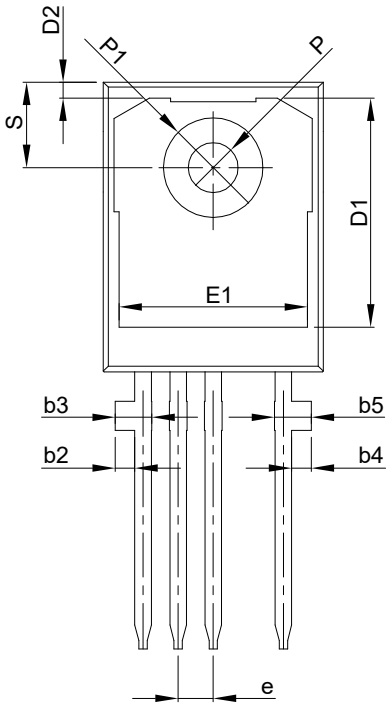
## Package Dimensions, TO-247-4L




TOP VIEW

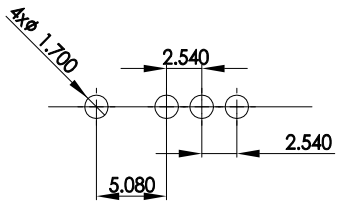



SIDE VIEW




BOTTOM VIEW


SIDE VIEW




RECOMMENDED THROUGH HOLES FOR LAND PATTERN

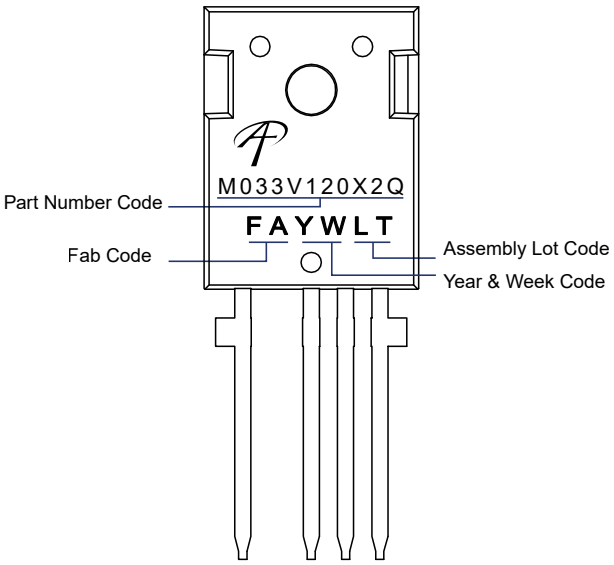
| SYMBOLS | DIM. IN MM | | | DIM. IN INCH | | |
|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 4.90 | 5.00 | 5.10 | 0.193 | 0.197 | 0.201 |
| A1 | 2.32 | 2.42 | 2.52 | 0.091 | 0.095 | 0.099 |
| A2 | 1.90 | 2.00 | 2.10 | 0.075 | 0.079 | 0.083 |
| b | 1.17 | 1.22 | 1.27 | 0.046 | 0.048 | 0.050 |
| b1 | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| b2 | 1.31 | 1.41 | 1.51 | 0.052 | 0.056 | 0.059 |
| b3 | 2.45 | 2.65 | 2.85 | 0.096 | 0.104 | 0.112 |
| b4 | 1.31 | 1.41 | 1.51 | 0.052 | 0.056 | 0.059 |
| b5 | 2.45 | 2.65 | 2.85 | 0.096 | 0.104 | 0.112 |
| c | 0.57 | 0.62 | 0.67 | 0.022 | 0.024 | 0.026 |
| D | 20.80 | 20.95 | 21.10 | 0.819 | 0.825 | 0.831 |
| D1 | 16.25 | 16.55 | 16.85 | 0.640 | 0.652 | 0.663 |
| D2 | 1.00 | 1.15 | 1.30 | 0.039 | 0.045 | 0.051 |
| E | 15.77 | 15.92 | 16.07 | 0.621 | 0.627 | 0.632 |
| E1 | 13.43 | 13.63 | 13.83 | 0.529 | 0.536 | 0.544 |
| E2 | 4.29 | 4.39 | 4.49 | 0.169 | 0.173 | 0.177 |
| E3 | 1.70 | 1.80 | 1.90 | 0.067 | 0.071 | 0.075 |
| e | 2.54BSC | | | 0.1000BSC | | |
| e1 | 5.08BSC | | | 0.2000BSC | | |
| N | 4 | | | 4 | | |
| L | 19.82 | 20.02 | 20.22 | 0.780 | 0.788 | 0.796 |
| L1 | 4.01 | 4.21 | 4.41 | 0.158 | 0.166 | 0.174 |
| P | 3.50 | 3.60 | 3.70 | 0.138 | 0.142 | 0.146 |
| P1 | 7.00 | 7.20 | 7.40 | 0.276 | 0.283 | 0.291 |
| Q | 5.65 | 5.75 | 5.85 | 0.222 | 0.226 | 0.230 |
| S | 6.07 | 6.17 | 6.27 | 0.239 | 0.243 | 0.247 |

NOTE:

1. CONTROLLED DIMENSIONS ARE IN MILLIMETERS.
2. THIS IS AN ENGINEERING DRAFT FOR REVIEW. AOS CONFIDENTIAL.

## Part Marking

**AOM033V120X2Q**
**TO-247-4L**

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As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.

2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.