# AOM025V120X3Q

**1200V αSiC Silicon Carbide Power MOSFET**

ALPHA & OMEGA SEMICONDUCTOR

## Features

- Proprietary αSiC MOSFET technology
- Low loss, with low $R_{DS, ON}$
- Fast switching with low $R_G$ and low capacitance
- Flexible gate voltage range ($V_{GS}$ = 15 to 18V)
- Low reverse recovery diode (Qrr)
- AEC-Q101 Automotive Qualified

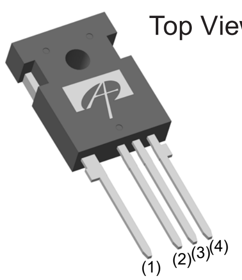
## Product Summary

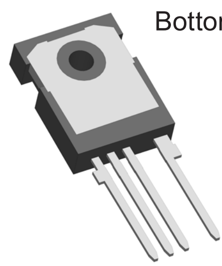
| | |
|---|---|
| $V_{DS}$ @ $T_{J, max}$ | 1200V |
| $I_{DM}$ | 180A |
| $R_{DS(ON), TYP}$ | 25mΩ |
| $Q_{rr}$ | 125nC |
| $E_{OSS}$ @ 800V | 63µJ |
| 100% UIS Tested | |

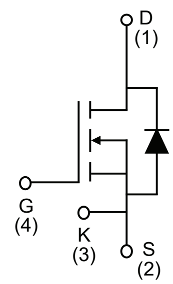
## Applications

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

## Pin Configuration




| Ordering Part Number | Package Type | Form | Shipping Quantity |
|---|---|---|---|
| AOM025V120X3Q | TO-247-4L | Tube | 30/Tube |

## Absolute Maximum Ratings

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

| Symbol | Parameter | | AOM025V120X3Q | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | | 1200 | V |
| $V_{GS,MAX}$ | Gate Source Voltage | Maximum | -8/+23 | V |
| $V_{GS,OP,TRANS}$ | | Max Transient(A) | -10/+25 | |
| $V_{GS,OP,ON}$ | | Recommended Operating Range(B) | 15...18 | |
| $V_{GS,OP,OFF}$ | | | -5...-3 | |
| $I_D$ | Continuous Drain Current(C) | $T_C$ = 25°C, $V_{GS}$ = 18V | 86 | A |
| | | $T_C$ = 100°C, $V_{GS}$ = 18V | 61 | |
| $I_{DM}$ | Pulsed Drain Current(D) | | 180 | |
| $I_{SD}$ | Continuous Body Diode Forward Current $V_{GS}$ = -3V, $T_C$ = 25°C | | 72 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy(E) | | 0.9 | J |
| $P_D$ | Power Dissipation(D) | | 357 | 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 | Typ | Max | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Maximum Junction-to-Ambient(F,G) | | 40 | °C/W |
| $R_{\theta JC}$ | Maximum Junction-to-Case(H) | 0.35 | 0.42 | °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, $T_J$=175°C | | 1200 | | | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=1200V, $V_{GS}$=0V | | | | 100 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{DS}$=0V, $V_{GS}$=+18/-3V | | | | ±200 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ , $I_D$=22mA | | 2.2 | 3 | 4.3 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=15V, $I_D$=22A | $T_J$ = 25°C | | 29 | 41 | mΩ |
| | | | $T_J$=175°C | | 51 | | |
| | | $V_{GS}$=18V, $I_D$=22A | $T_J$=25°C | | 25 | 35 | |
| | | | $T_J$=175°C | | 48 | | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=20V, $I_D$= 22A | | | 17 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=22A, $V_{GS}$=-3V | | | 4 | 5 | V |
| **DYNAMIC** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=800V, f=100kHz | | | 2911 | | pF |
| $C_{oss}$ | Output Capacitance | | | | 150 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | | 37 | | pF |
| $E_{oss}$ | $C_{oss}$ Stored Energy | | | | 63 | | μJ |
| $C_{o(er)}$ | Effective output capacitance, energy related(K) | $V_{GS}$=0V, $V_{DS}$=0 to 800V, f=100kHz | | | 196 | | pF |
| $C_{o(tr)}$ | Effective output capacitance, time related(L) | | | | 253 | | pF |
| $R_G$ | Gate Resistance | f=1MHz | | | 1.6 | | Ω |

## Electrical Characteristics *(Continued)*

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **SWITCHING** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=-3/+18V, $V_{DS}$=800V, $I_D$=22A | | 117 | | nC |
| $Q_{gs}$ | Gate Source Charge | | | 29 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 31 | | nC |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{GS}$=-3V/+18V, $V_{DS}$=800V, $I_D$=30A, $R_G$=2Ω, L=47.5μH, FWD: AOM025V120X3Q | | 11 | | ns |
| $t_r$ | Turn-On Rise Time | | | 12 | | ns |
| $t_{D(off)}$ | Turn-Off Delay Time | | | 19 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 9 | | ns |
| $E_{on}$ | Turn-On Energy | | | 259 | | μJ |
| $E_{off}$ | Turn-Off Energy | | | 63 | | μJ |
| $E_{tot}$ | Total Switching Energy | | | 322 | | μJ |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=30A, dI/dt=1500A/μs, $V_{GS}$=-3V $V_{DS}$=800V | | 18 | | ns |
| $I_{rm}$ | Peak Reverse Recovery Current | | | 14 | | A |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | | | 125 | | nC |

**Notes:**

A. $t_{ON}$< 1μs, t<25hrs over lifetime. $t_{ON}$ is duration of $V_{GS}$ transient and t is total time spent at $V_{GS,OP,TRANS}$ over product lifetime.

B. Device can be operated at $V_{GS}$=0/18V. Actual operating $V_{GS}$ will depend on application specifics such as parasitic inductance and dV/dt but should not exceed maximum ratings.

C. Continuous drain current is calculated based on maximum $R_{\theta JC}$ and typical $R_{DSON}$ at 175°C.

D. 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.

E. L=5mH, $I_{AS}$=19A, $R_G$=25Ω, Starting $T_J$=25°C.

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

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

H. 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.

## Typical Electrical and Thermal Characteristics[I]

$T_A$ = 25°C, unless otherwise specified.

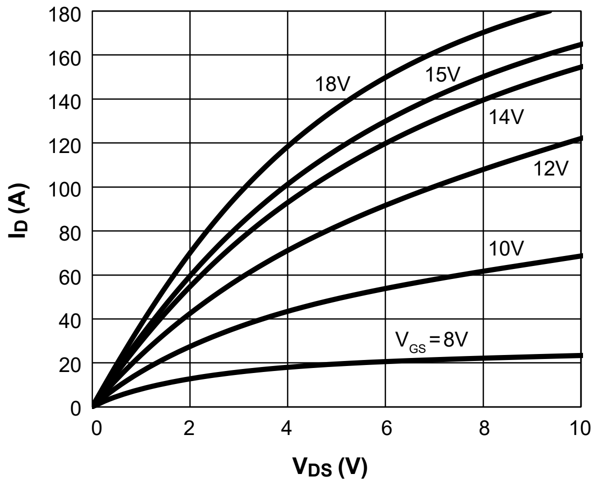



Figure 1. On-Region Characteristics $T_J$ = 25°C

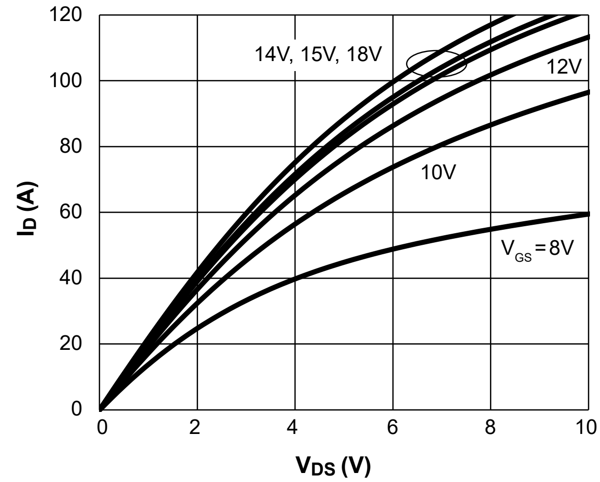



Figure 2. On-Region Characteristics $T_J$ = 175°C

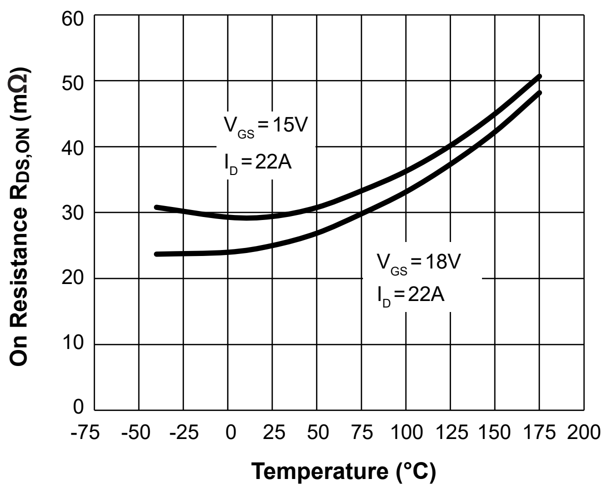



Figure 3. On-Resistance vs. Junction Temperature

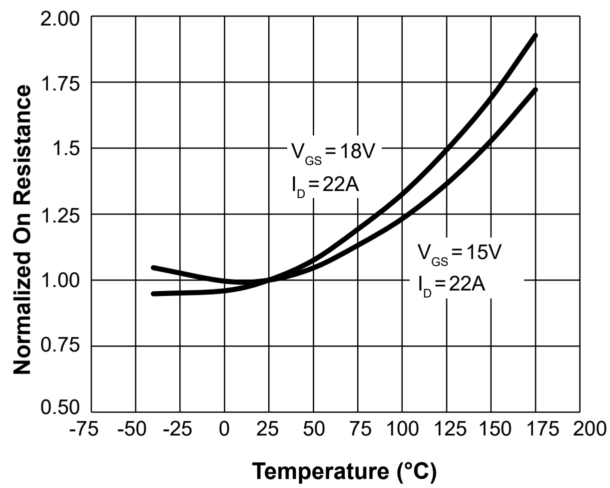



Figure 4. Normalized On-Resistance vs. Junction Temperature

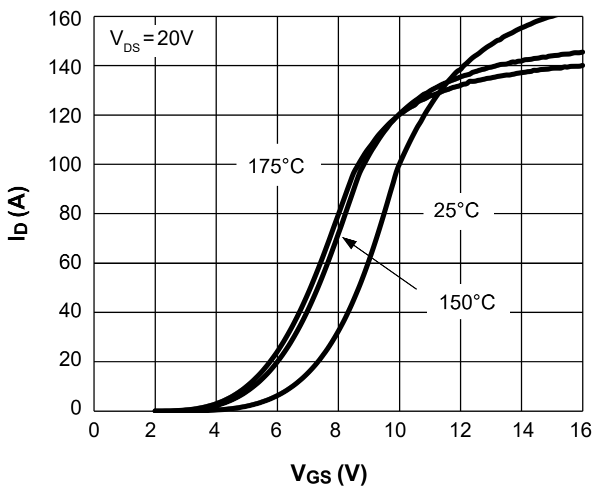



Figure 5. Transfer Characteristics

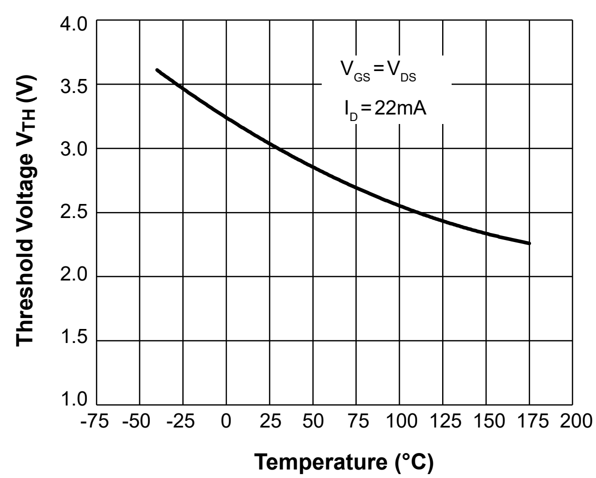



Figure 6. Threshold Voltage vs. Junction Temperature

## Typical Electrical and Thermal Characteristics[I] *(Continued)*

$T_A$ = 25°C, unless otherwise specified.

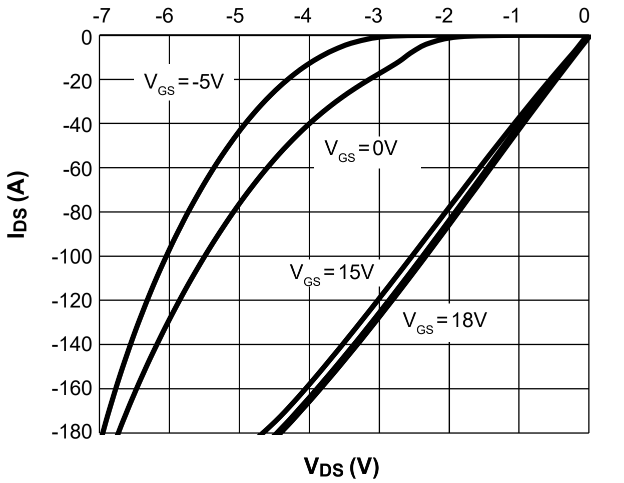



Figure 7. Body-Diode Characteristics at 25°C

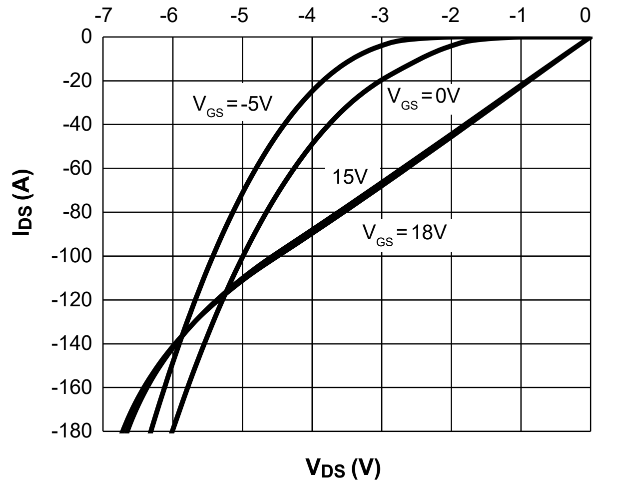



Figure 8. Body-Diode Characteristics at 175°C

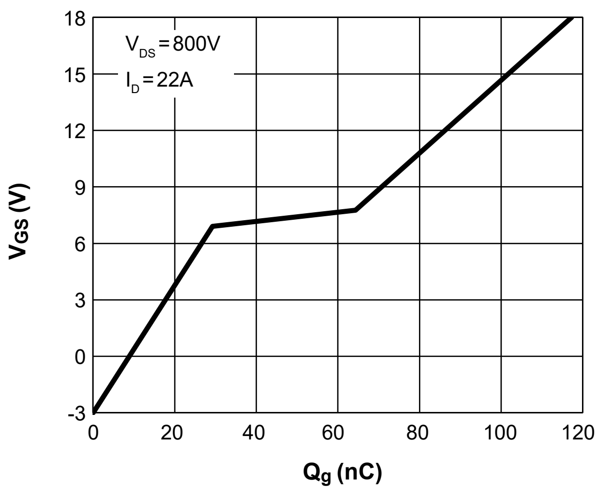



Figure 9. Gate-Charge Characteristics

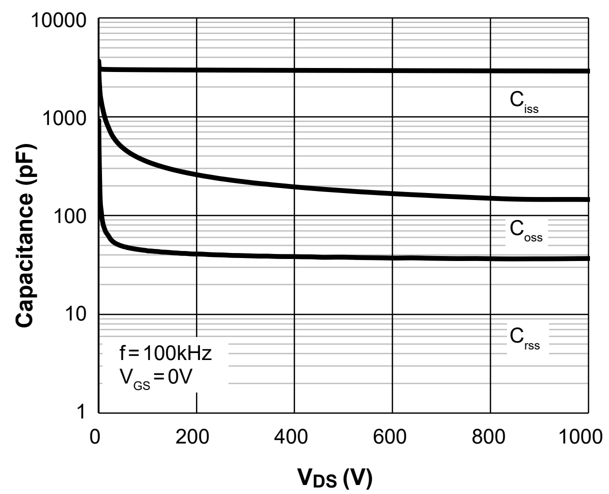



Figure 10. Capacitance Characteristics

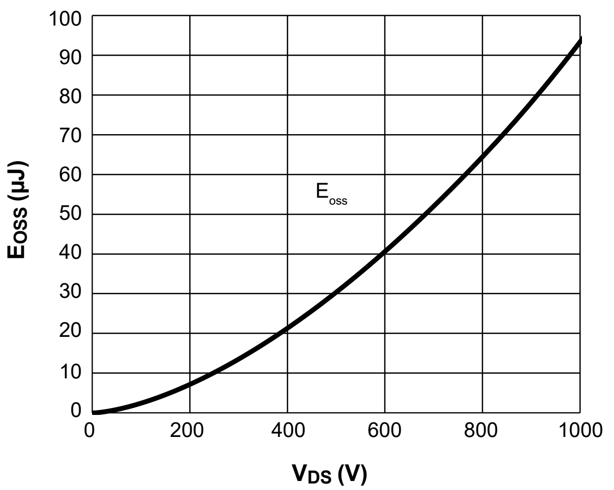



Figure 11. Coss Stored Energy

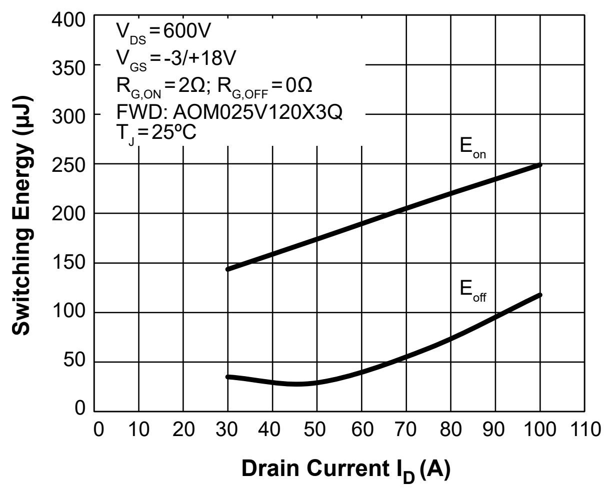



Figure 12. Switching Energy vs. Drain Current

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

$T_A$ = 25°C, unless otherwise specified.

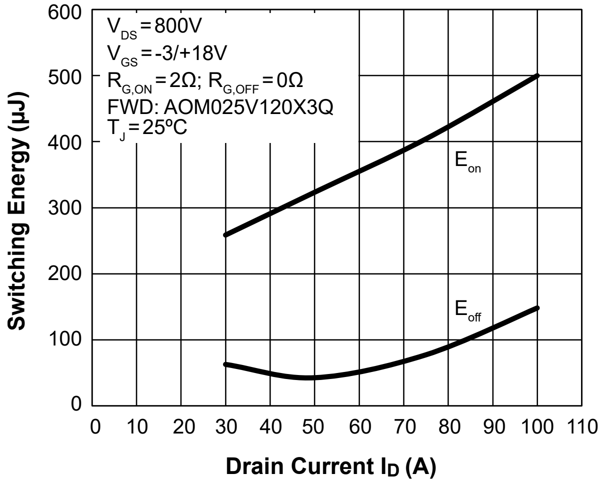



**Figure 13. Switching Energy vs. Drain Current**

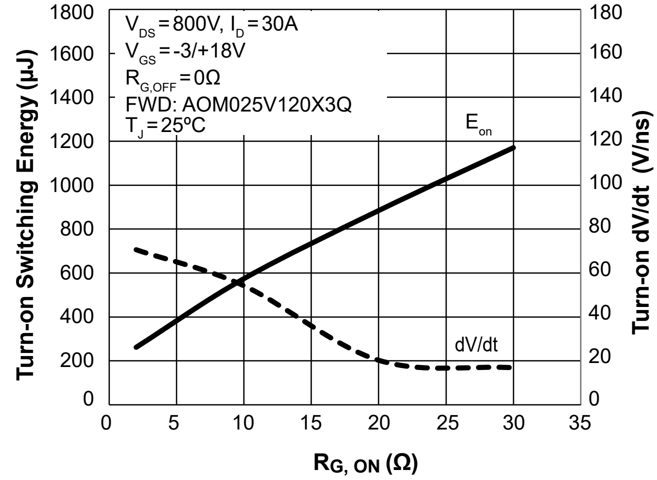



**Figure 14. Turn-On Energy and dV/dt vs. External Gate Resistance**

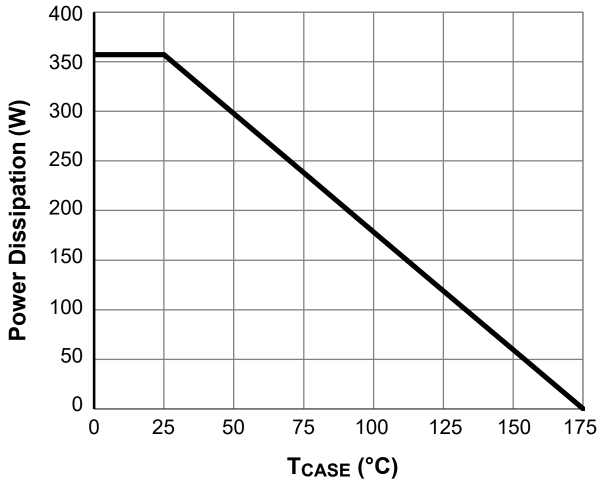



**Figure 15. Power De-rating (Note J)**

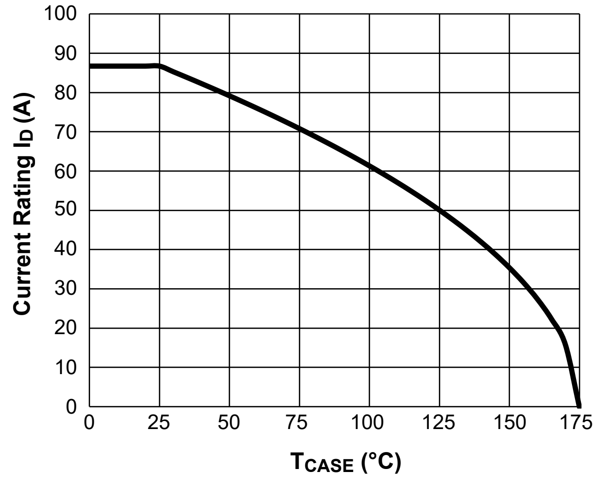



**Figure 16. Current De-rating (Note C, J)**

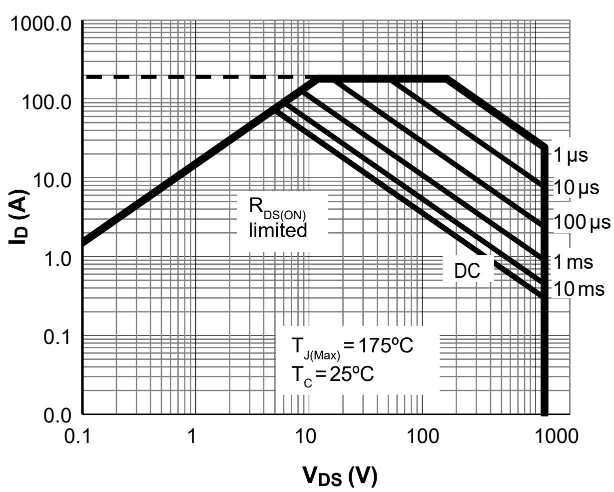



**Figure 17. Maximum Forward Biased Safe Operating Area for AOM025V120X3Q (Note J)**

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

$T_A$ = 25°C, unless otherwise specified.

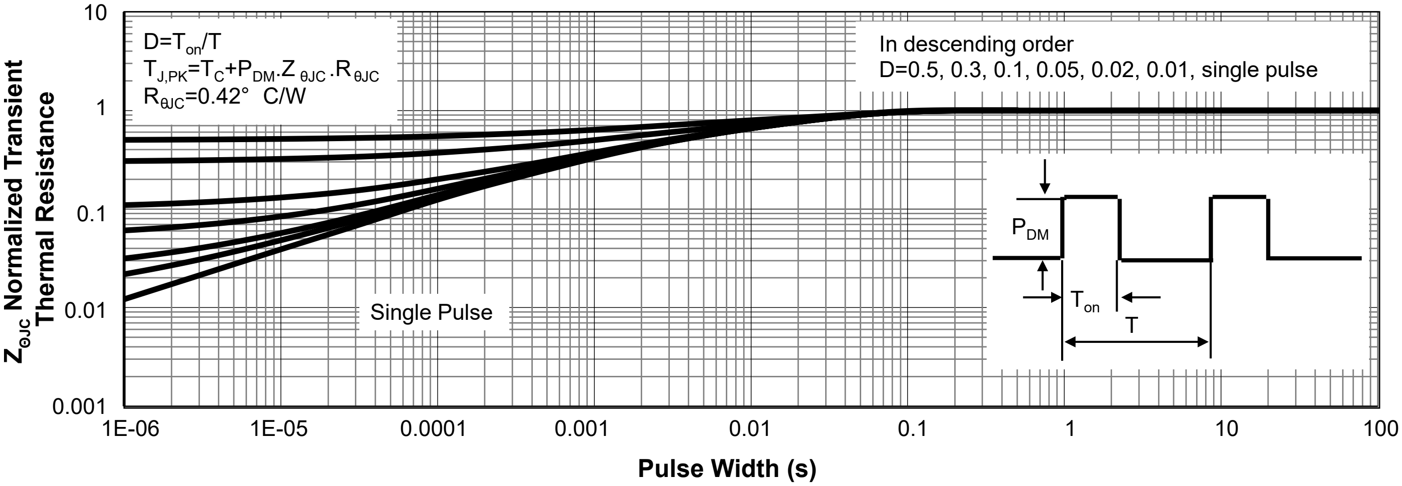



**Figure 18. Normalized Maximum Transient Thermal Impedance for AOM025V120X3Q (Note J)**

**Notes:**

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

J. 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.

K. $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{(BR)DSS}$.

L. $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{(BR)DSS}$.

## Test Circuits and Waveforms

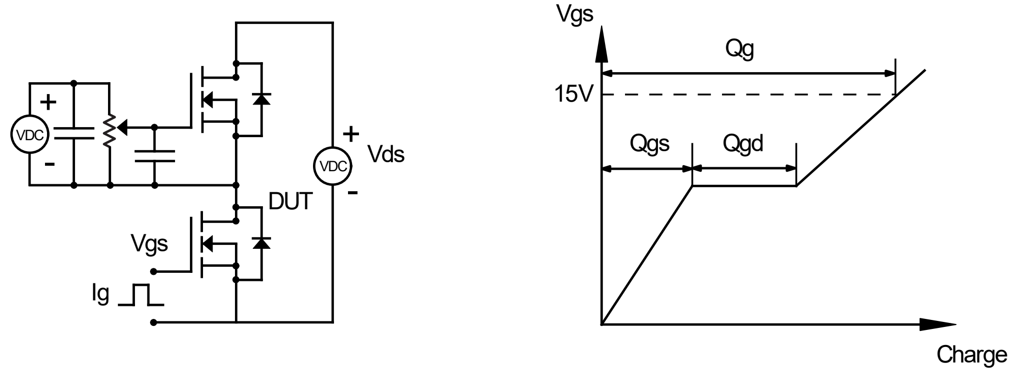



**Figure 19. Gate Charge Test Circuits and Waveforms**

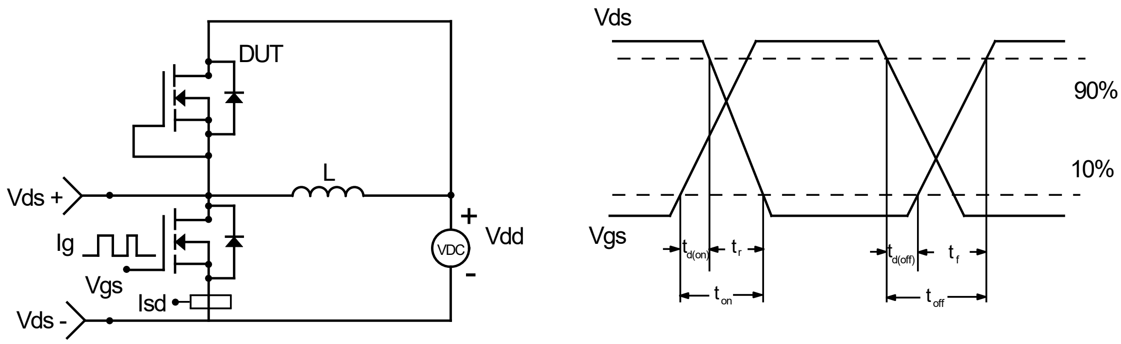



**Figure 20. Inductive Switching Test Circuit and Waveforms**

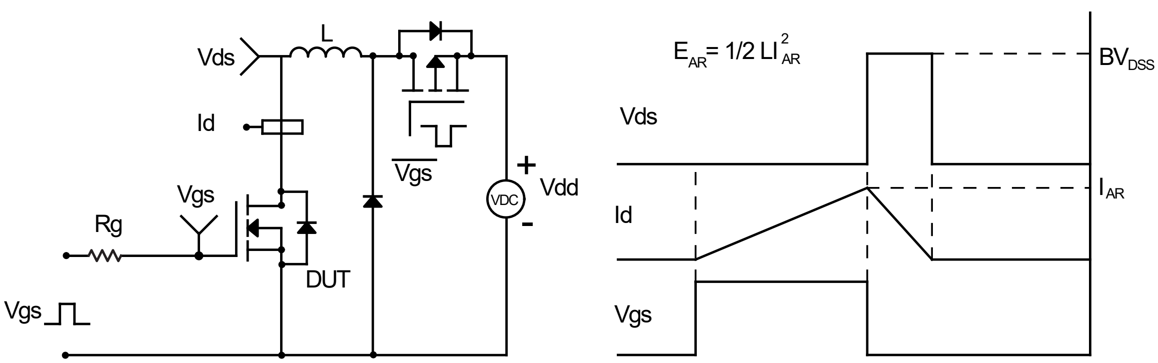



**Figure 21. Unclamped Inductive Switching (UIS) Test Circuit and Waveforms**

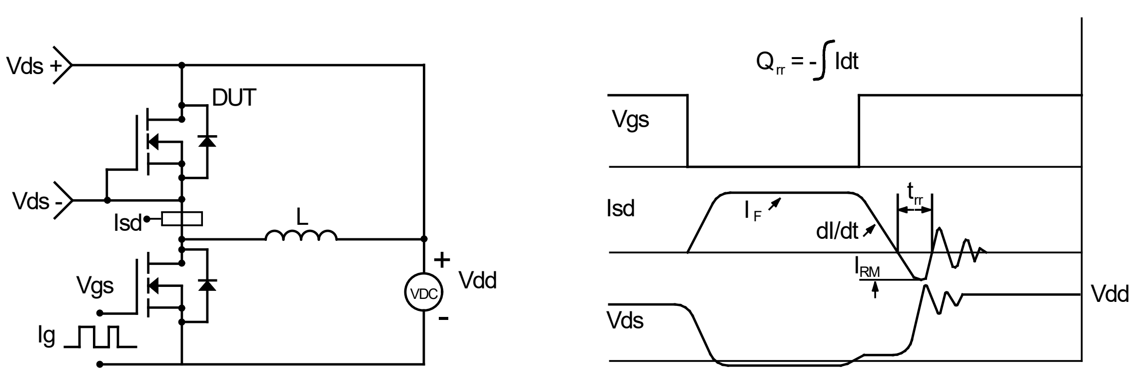
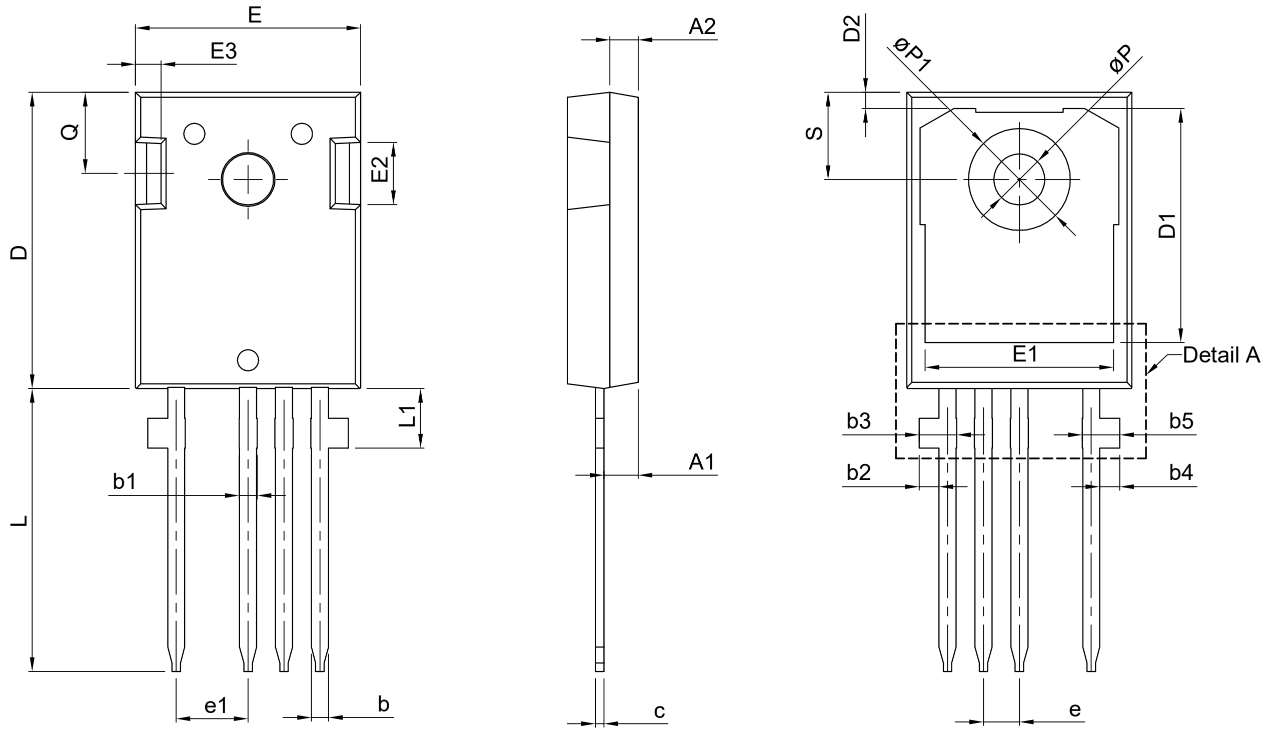
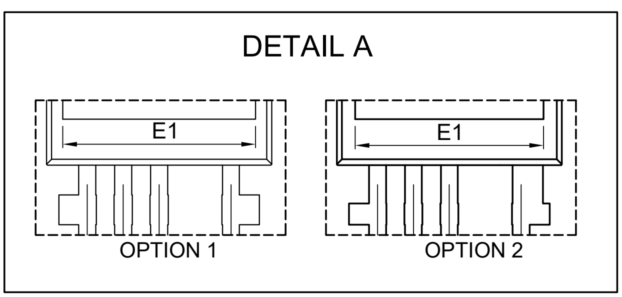


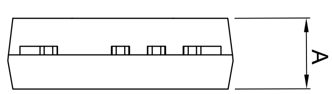

**Figure 22. Diode Recovery Test Circuits and Waveforms**

## Package Dimensions, TO-247-4L

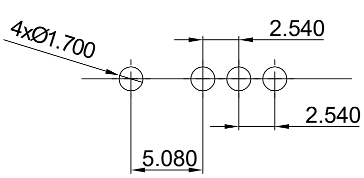



TOP VIEW SIDE VIEW BOTTOM VIEW




SIDE VIEW




RECOMMENDED THROUGH HOLES FOR LAND PATTERN

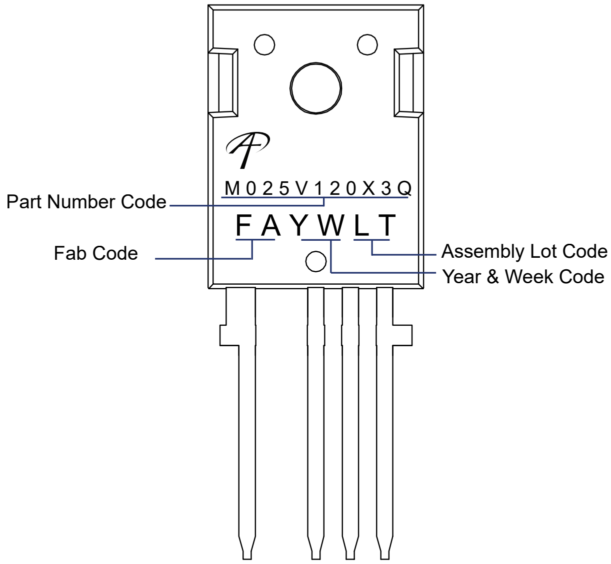
| SYMBOLS | DIM. IN MM | | | DIM. IN INCH | | |
|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 4.90 | 5.00 | 5.10 | 0.193 | 0.197 | 0.201 |
| A1 | 2.29 | 2.42 | 2.54 | 0.090 | 0.095 | 0.100 |
| A2 | 1.90 | 2.00 | 2.10 | 0.075 | 0.079 | 0.083 |
| b | 1.17 | 1.22 | 1.27 | 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(Option1) | 13.43 | 13.63 | 13.83 | 0.529 | 0.537 | 0.544 |
| E1(Option2) | 13.18 | 13.33 | 13.48 | 0.519 | 0.525 | 0.531 |
| 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.

## Part Marking

**AOM025V120X3Q**
**TO-247-4L**

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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.