ALPHA & OMEGA SEMICONDUCTOR

# AOGT020V120X2Q

## 1200 V αSiC Silicon Carbide Power MOSFET

### Features

- Proprietary αSiC MOSFET technology
- Low loss, fast switching speeds with low $R_G$
- Optimized drive voltage ($V_{GS}$ = 15 V) for broad driver compatibility
- Robust body diode and low Qrr
- AEC-Q101 Automotive Qualified

### Product Summary

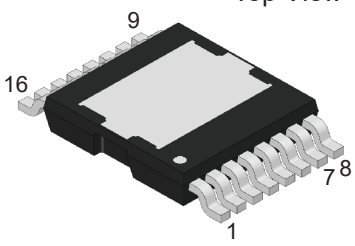
| | |
|---|---|
| $V_{DS}$ @ $T_{J, max}$ | 1200 V |
| $I_{DM}$ | 200 A |
| $R_{DS(ON), typ}$ | 20 mΩ |
| $Q_{rr}$ | 290 nC |
| $E_{OSS}$ @ 800 V | 88 µJ |
| 100% UIS Tested | |

### Applications

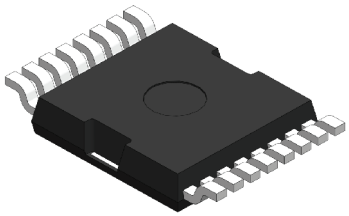
- xEV Charger
- Electric Vehicle Supply Equipment (EVSE)
- Motor Drives
- Automotive Inverters

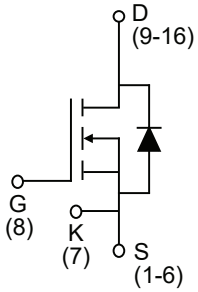
### Pin Configuration

Top View




Bottom View






| Ordering Part Number | Package Type | Form | Shipping Quantity |
|---|---|---|---|
| AOGT020V120X2Q | GTPAK™ | Tape & Reel | 800/Reel |

### Absolute Maximum Ratings

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

| Symbol | Parameter | | AOGT020V120X2Q | 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 | 91 | A |
| | | $T_C$ = 100°C | 64 | |
| $I_{DM}$ | Pulsed Drain Current(C) | | 200 | |
| $I_{SD}$ | Continuous Body Diode Forward Current $V_{GS}$ = -5V | | 81 | |
| $E_{AS}$ | Single Pulsed Avalanche Energy(D) | | 1.2 | J |
| $P_D$ | Power Dissipation(C) | $T_C$ = 25°C | 394 | 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(J) | | 260 | °C |

## Electrical Characteristics

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

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **STATIC** | | | | | | | |
| $B_{VDSS}$ | 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 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=1200V, $V_{GS}$=0V | | | | 100 | µA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{DS}$=0V, $V_{GS}$=+15/-5V | | | | ±200 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$=27mA | | 1.8 | 2.8 | 3.5 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=15V, $I_D$=27A | $T_J$=25°C | | 20 | 28 | mΩ |
| | | | $T_J$=175°C | | 32 | | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=20V, $I_D$=27A | | | 23 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=27A,$V_{GS}$=-5V | | | 4.3 | 5 | V |
| **DYNAMIC** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=800V, f=1MHz | | | 5180 | | pF |
| $C_{oss}$ | Output Capacitance | | | | 208 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | | 18 | | pF |
| $E_{oss}$ | Coss Stored Energy | | | | 88 | | µJ |
| $R_G$ | Gate Resistance | f=1MHz | | 0.3 | 1 | 1.3 | Ω |
| **SWITCHING** | | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=-5/+15V, $V_{DS}$=800V, $I_D$=30A | | | 157 | | nC |
| $Q_{gs}$ | Gate Source Charge | | | | 57 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | | 44 | | nC |
| $t_{D(on)}$ | Turn-On Delay Time | $V_{GS}$=-5V/+15V, $V_{DS}$=800V, $I_D$=30A, $R_G$=2Ω, $L_a$=60µH, FWD: AOGT020V120X2Q | | | 16 | | ns |
| $t_r$ | Turn-On Rise Time | | | | 12 | | ns |
| $t_{D(off)}$ | Turn-Off Delay Time | | | | 22 | | ns |
| $t_f$ | Turn-Off Fall Time | | | | 11 | | ns |
| $E_{on}$ | Turn-On Energy | | | | 349 | | µJ |
| $E_{off}$ | Turn-Off Energy | | | | 67 | | µJ |
| $E_{tot}$ | Total Switching Energy | | | | 416 | | µJ |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=30A,dI/dt=1500A/µs, $V_{GS}$=-5V, $V_{DS}$=800V | | | 72 | | ns |
| $I_{rm}$ | Peak Reverse Recovery Current | | | | 11 | | A |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | | | | 290 | | nC |

## Thermal Characteristics

| Symbol | Parameter | Typ | Max | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance Junction-to-Ambient(E,F) | | 47 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance Junction-to-Case, Top(G) | 0.32 | 0.38 | °C/W |
| $\Psi_{JL}$ | Thermal Characterization Parameter, Junction-to-Lead (Pin 1-7) | | 20 | °C/W |
| $\Psi_{JL}$ | Thermal Characterization Parameter, Junction-to-Lead (Pin 9-16) | | 8 | °C/W |

**Notes:**
A. $t_{ON}$ < 1% *(Duty Cycle)/(Frequency), t < 25 hrs over lifetime
B. Device can be operated at $V_{GS}$ = 0/15 V. Actual operating $V_{GS}$ 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 = 5 mH, $I_{AS}$ = 22 A, $R_G$ = 10 Ω, 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 heatsink, assuming a maximum junction temperature of $T_{J(MAX)}$ = 175°C.
H. The static characteristics in Figures 1 to 8 are obtained using < 300 µs 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.
J. GTPAK is not recommended for wave soldering.

## Typical Electrical and Thermal Characteristics

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

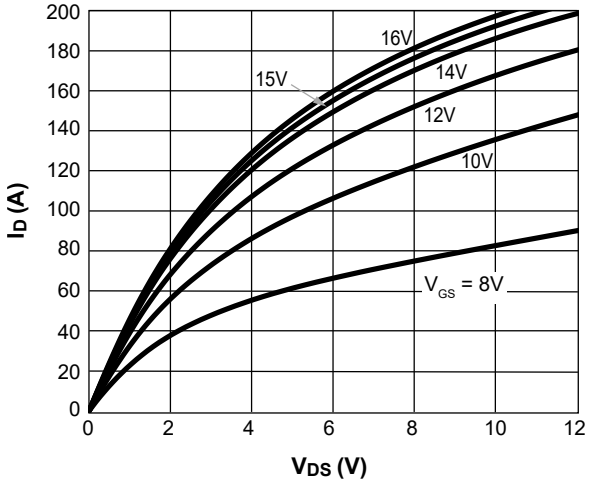



**Figure 1. On-Region Characteristics $T_J$ = 25°C**

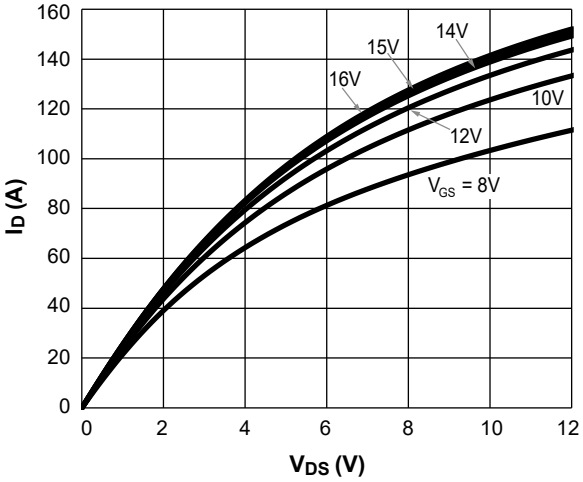



**Figure 2. On-Region Characteristics $T_J$ = 175°C**

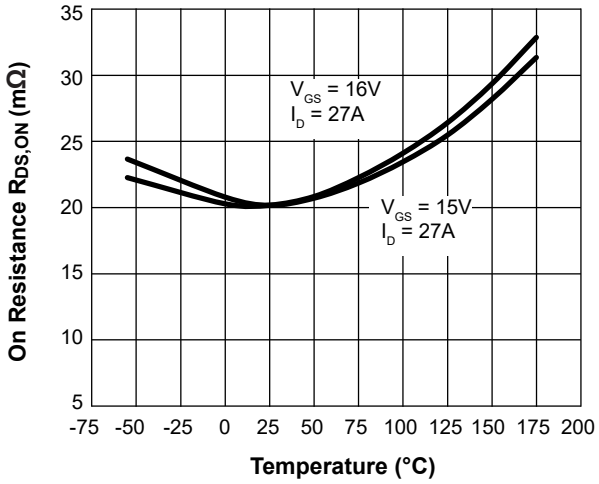



**Figure 3. On Resistance vs. Junction Temperature**

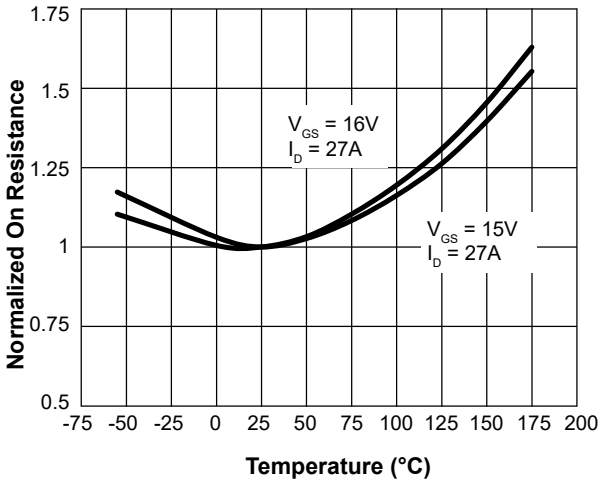



**Figure 4. Normalized On Resistance vs. Junction Temperature**

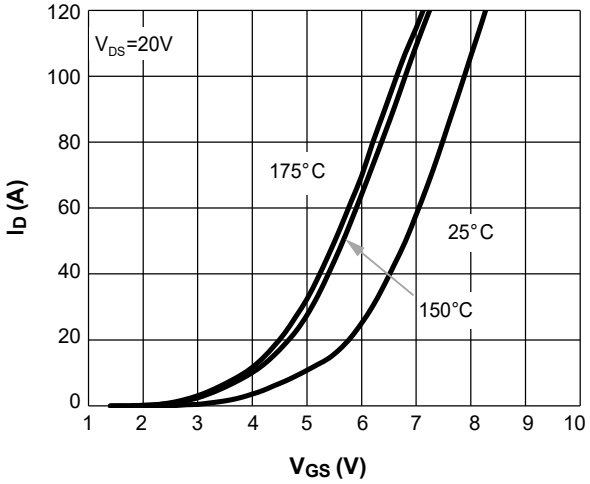



**Figure 5. Transfer Characteristics**

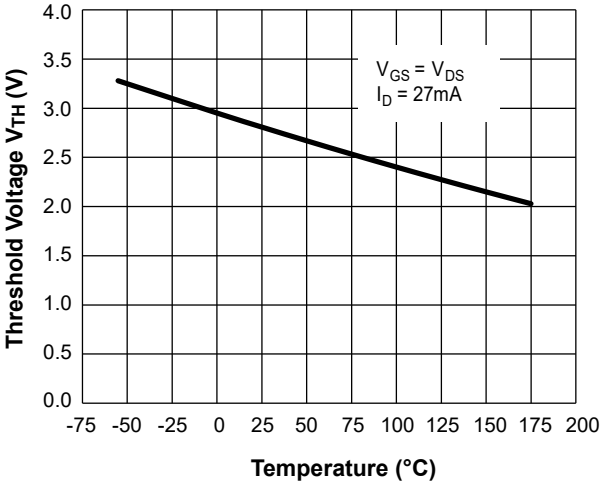



**Figure 6. Threshold Voltage vs. Junction Temperature**

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

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

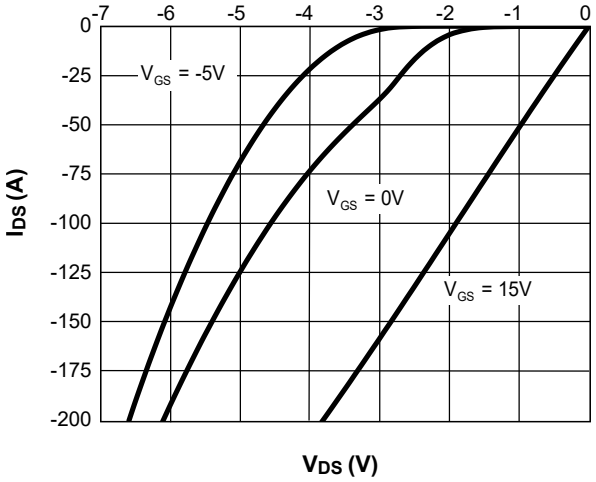



**Figure 7. Body-diode Characteristics at 25°C**

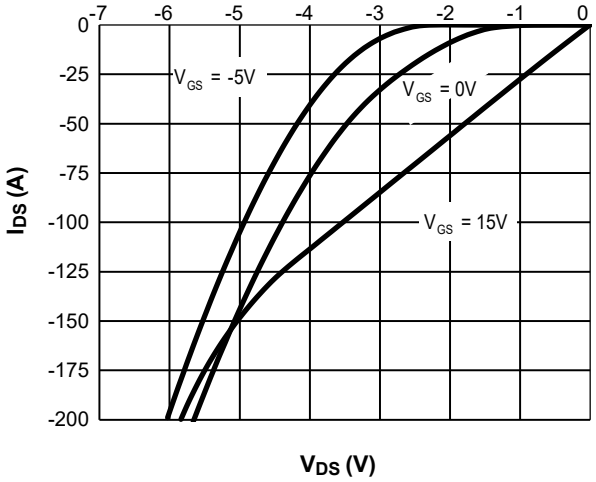



**Figure 8. Body-diode Characteristics at 175°C**

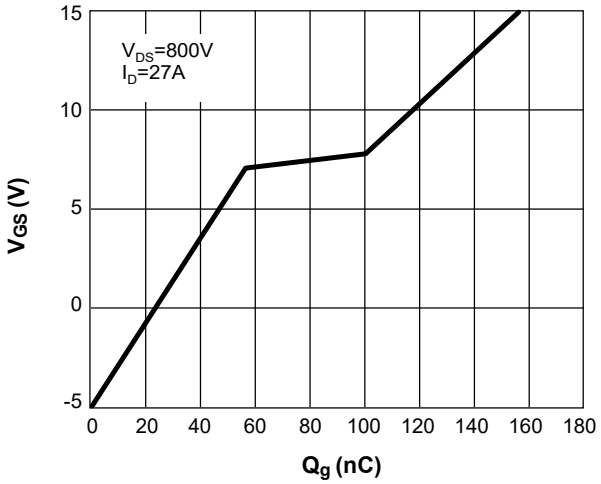



**Figure 9. Gate-charge Characteristics**

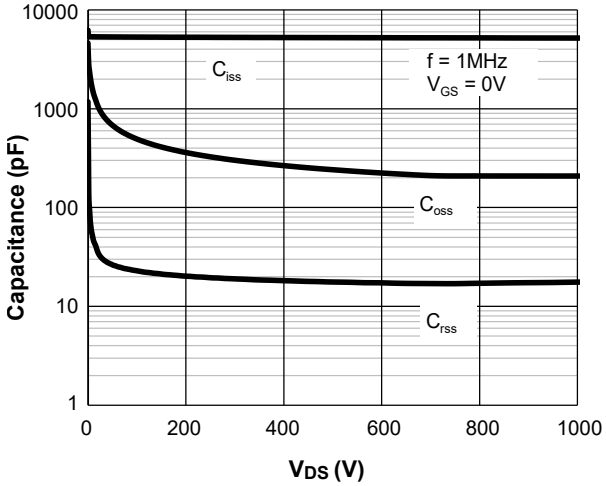



**Figure 10. Capacitance Characteristics**

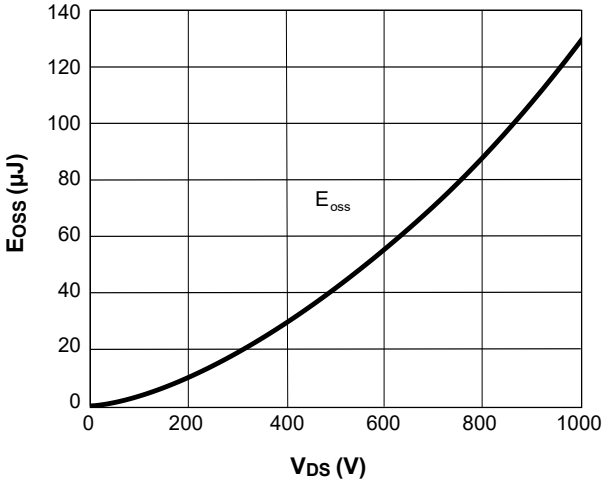



**Figure 11. Coss Stored Energy**

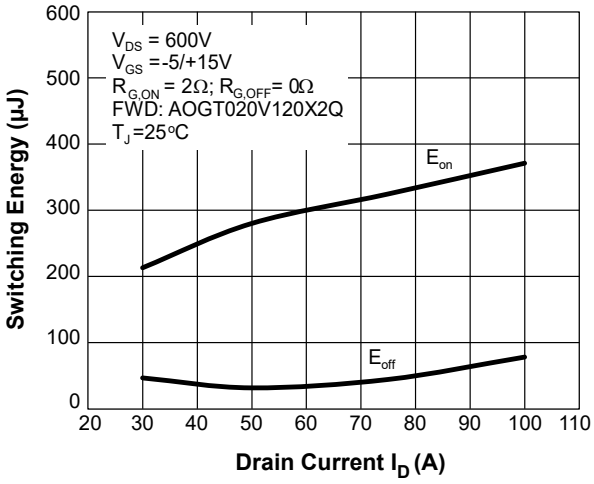



**Figure 12. Switching Energy vs. Drain Current**

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

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

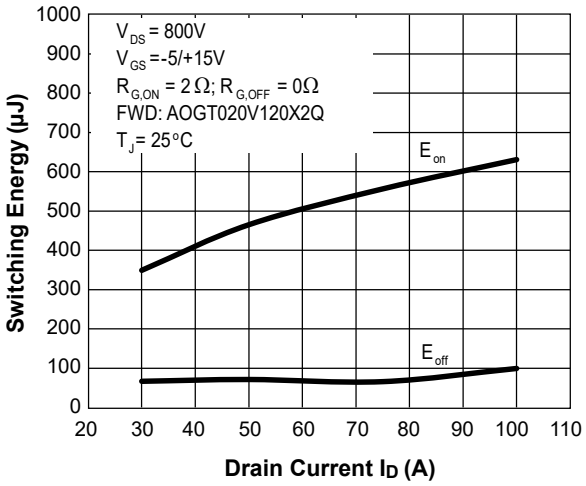



**Figure 13. Switching Energy vs. Drain Current**

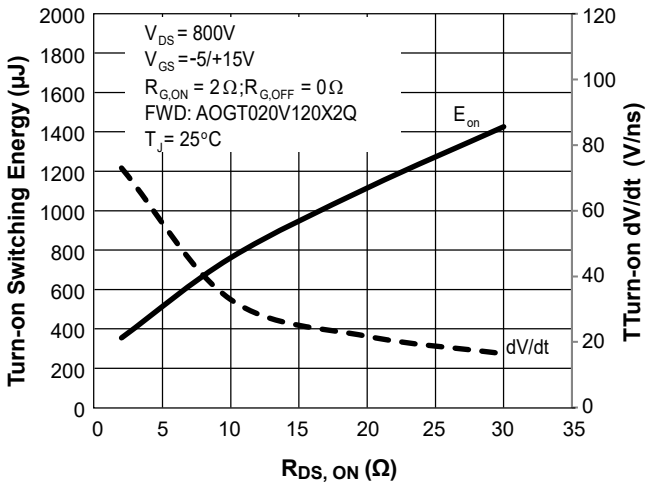



**Figure 14. Turn-on Energy and dV/dt vs. External Gate Resistance**

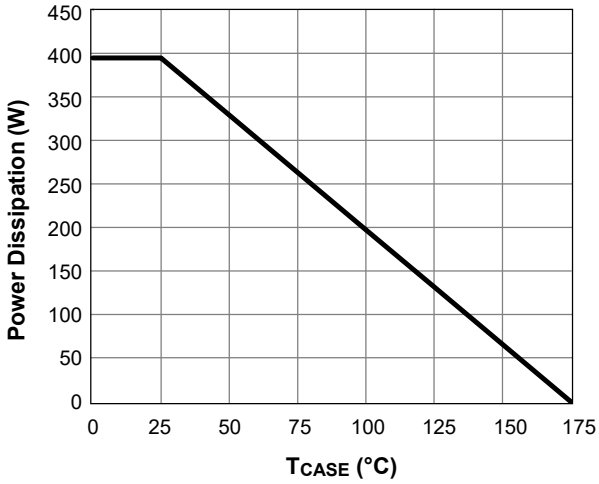



**Figure 15. Power De-rating (Note 1)**

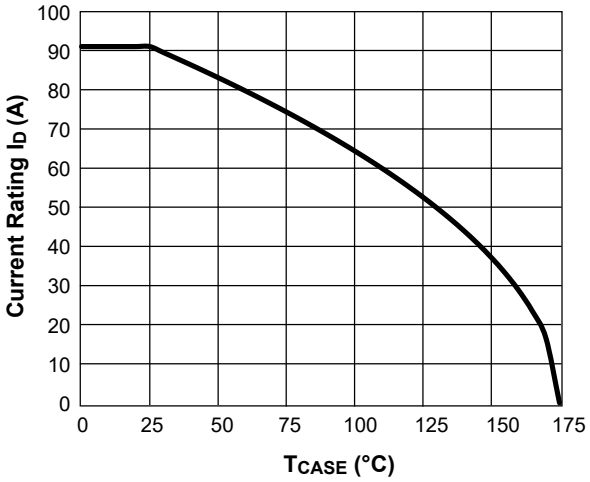



**Figure 16. Current De-rating (Note 1)**

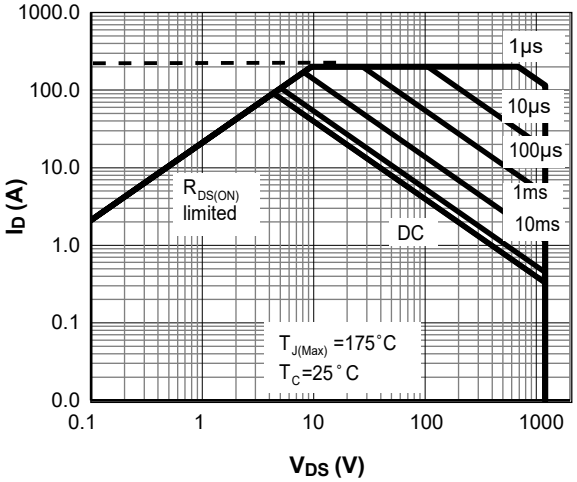



**Figure 17. Maximum Forward Biased Safe Operating Area for AOGT020V120X2Q (Note 1)**

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

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

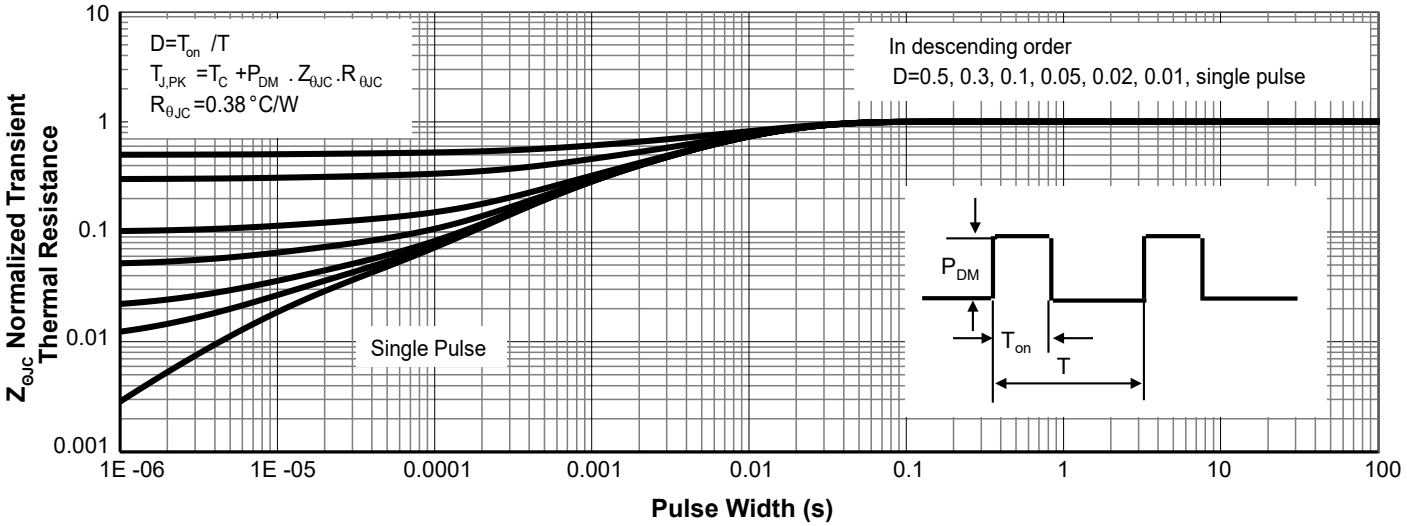



**Figure 18. Normalized Maximum Transient Thermal Impedance for AOGT020V120X2Q (Note I)**

## Test Circuits and Waveforms

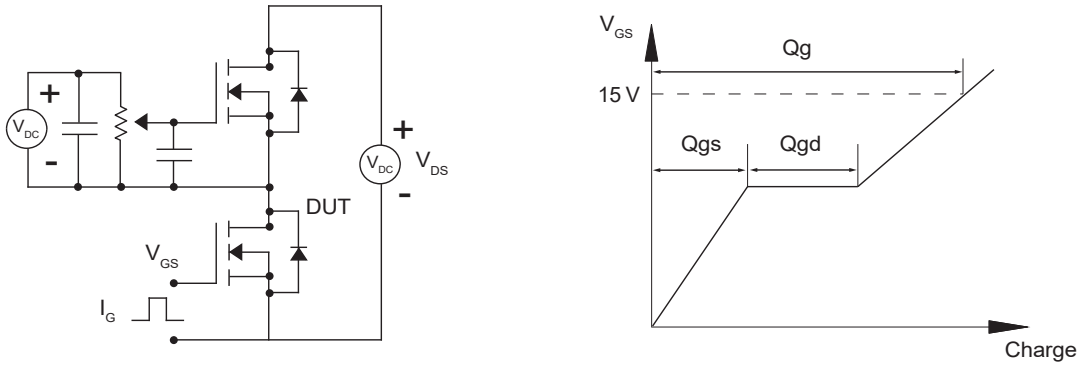



**Figure 19. Gate Charge Test Circuits and Waveforms**

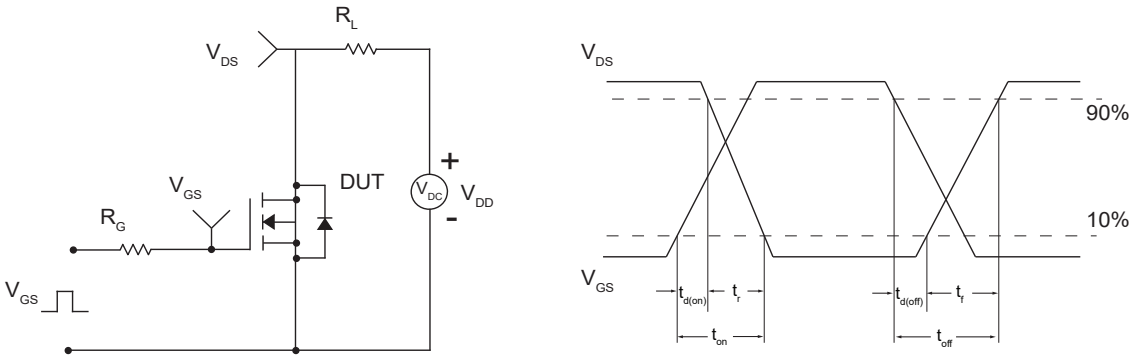



**Figure 20. Resistive Switching Test Circuit and Waveforms**

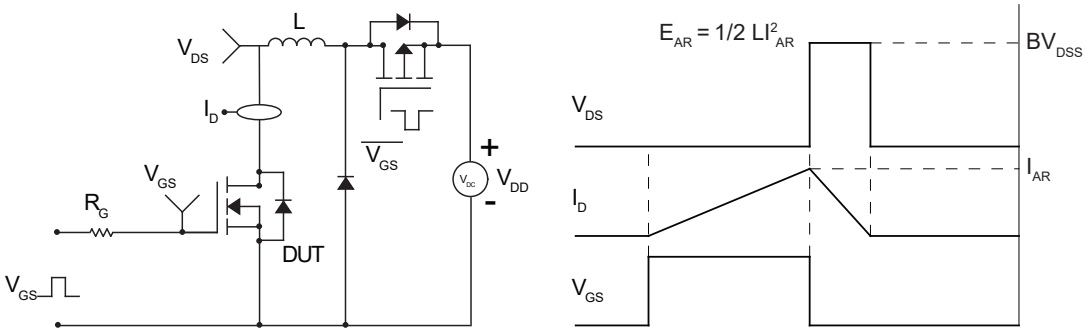



**Figure 21. Unclamped Inductive Switching (UIS) Test Circuit and Waveforms**

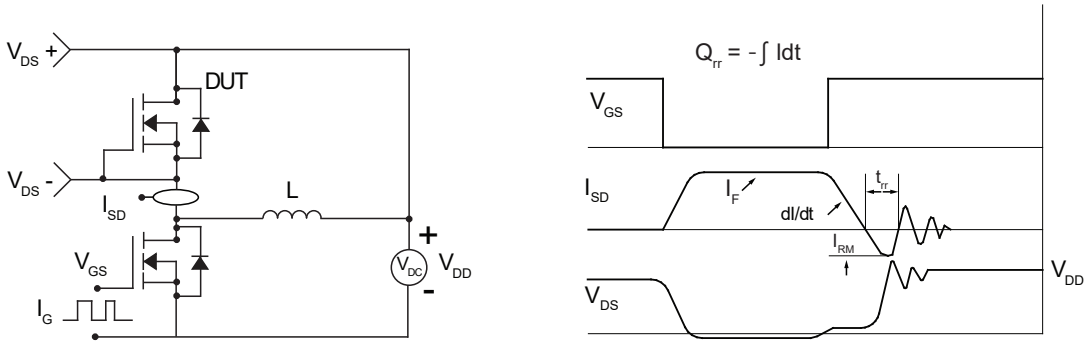
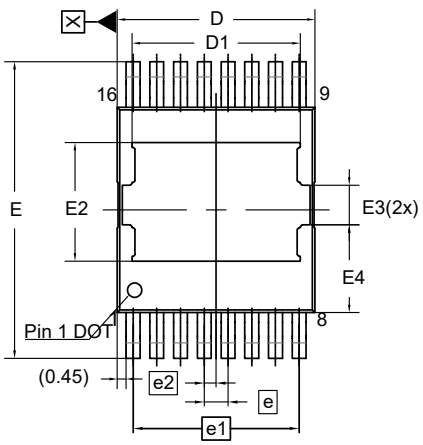
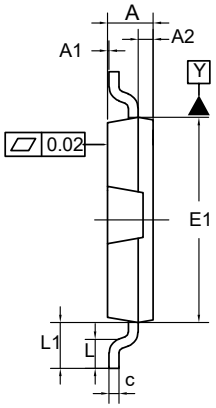



**Figure 22. Diode Recovery Test Circuits and Waveforms**

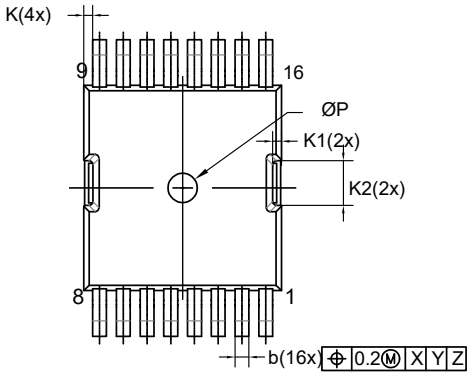
## Package Dimensions, GTPAK-16L



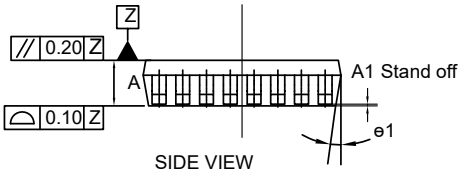

TOP VIEW




SIDE VIEW

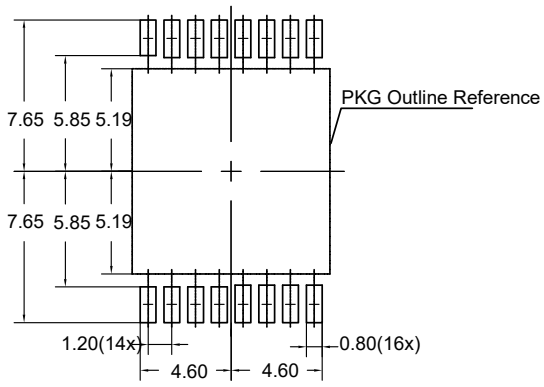



BOTTOM VIEW




SIDE VIEW

LAND PATTERN RECOMMENDATIONS




UNIT: mm

| SYMBOLS | DIMENSION IN MILLIMETERS | | | DIMENSION IN INCHES | | |
|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 2.200 | 2.300 | 2.400 | 0.087 | 0.091 | 0.094 |
| A1 | 0.010 | 0.075 | 0.145 | 0.000 | 0.003 | 0.006 |
| A2 | 0.600 | 0.750 | 0.900 | 0.024 | 0.030 | 0.035 |
| b | 0.600 | 0.700 | 0.800 | 0.024 | 0.028 | 0.031 |
| c | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| D | 9.800 | 10.000 | 10.200 | 0.386 | 0.394 | 0.402 |
| D1 | 8.300 | 8.500 | 8.700 | 0.327 | 0.335 | 0.343 |
| E | 14.800 | 15.000 | 15.200 | 0.583 | 0.591 | 0.598 |
| E1 | 10.180 | 10.380 | 10.580 | 0.401 | 0.409 | 0.417 |
| E2 | 5.805 | 6.005 | 6.205 | 0.229 | 0.236 | 0.244 |
| E3 | 1.800 | 2.000 | 2.200 | 0.071 | 0.079 | 0.087 |
| E4 | 4.240 | 4.440 | 4.640 | 0.167 | 0.175 | 0.183 |
| e | 1.200 BSC | | | 0.047 BSC | | |
| e1 | 8.400 BSC | | | 0.331 BSC | | |
| e2 | 0.600 BSC | | | 0.024 BSC | | |
| K | 0.250 | 0.450 | 0.650 | 0.010 | 0.018 | 0.026 |
| K1 | 0.260 | 0.460 | 0.660 | 0.010 | 0.018 | 0.026 |
| K2 | 2.065 | 2.265 | 2.465 | 0.081 | 0.089 | 0.097 |
| L | 1.360 | 1.460 | 1.560 | 0.054 | 0.057 | 0.061 |
| L1 | 2.210 | 2.310 | 2.410 | 0.087 | 0.091 | 0.095 |
| P | 1.300 | 1.500 | 1.700 | 0.051 | 0.059 | 0.067 |
| θ1 | 10° TYP. | | | 10° TYP. | | |

NOTES:

A) PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
MOLD FLASH SHOULD BE LESS THAN 6 MIL.

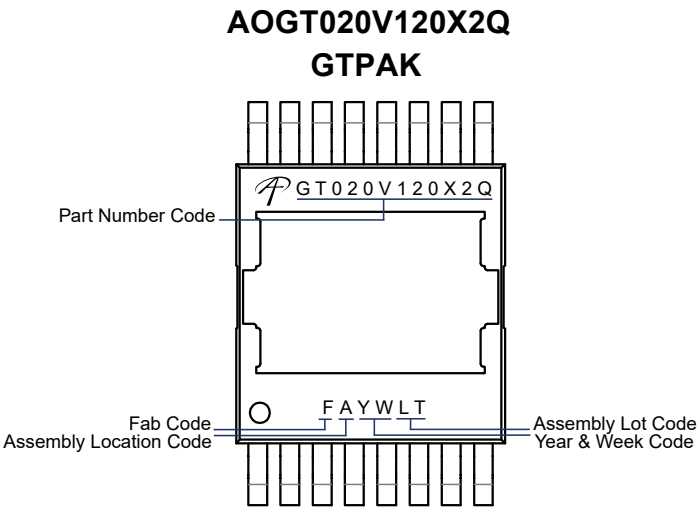
B) TOLERANCE 0.100 MILLIMETERS UNLESS OTHERWISE SPECIFIED.

C) CONTROLLING DIMENSION IS MILLIMETER.
CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

D) UNSPECFIED DRAFT ANGLE FOR MOLD BODY IS 10deg

E) ( ) IS FOR REFERENCE

## Part Marking

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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.