

Product Summary

| | |
|-------------------|---------------------------------|
| V_{CE} | 650V |
| I_C | 50A @ $T_C=100^{\circ}\text{C}$ |
| $V_{CE(sat),Typ}$ | 1.55V @ $I_C=50\text{A}$ |

Trench Field Stop IGBT Co-packed with SiC Schottky Barrier Diode

Features

- Low $V_{CE(sat)}$
- Trench FS Technology
- High Speed Switching
- Hybrid SiC Discrete Device
- Halogen Free, RoHS Compliant

Applications

- UPS
- PV Inverter
- Welding Machine
- On-board Charger
- Totem Pole Bridgeless PFC

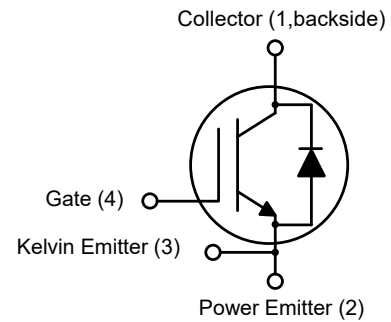
Package Pin Definitions

- Pin1 and backside - Collector
- Pin2 - Power Emitter
- Pin3 - Kelvin Emitter
- Pin4 - Gate

Package Parameters

| Part Number | Marking | Package |
|-------------|-------------|----------|
| BGH50N65ZF1 | BGH50N65ZF1 | TO-247-4 |

Package: TO-247-4



Maximum Ratings ($T_c=25^\circ\text{C}$ Unless Otherwise Noted)

| Symbol | Parameter | Value | Unit | |
|---------------|--|---|---------|------------------|
| V_{CE} | Collector-Emitter Breakdown Voltage, $T_j \geq 25^\circ\text{C}$ | 650 | V | |
| V_{GE} | Continuous Gate-Emitter Voltage | ± 20 | | |
| | Transient Gate-Emitter Voltage | ± 30 | | |
| I_C | DC Collector Current, limited by T_{jmax} | $T_c=25^\circ\text{C}$ | 114 | A |
| | | $T_c=100^\circ\text{C}$ | 50 | |
| I_F | Diode Forward Current, limited by T_{jmax} | $T_c=25^\circ\text{C}$ | 48 | A |
| | | $T_c=100^\circ\text{C}$ | 28 | |
| $I_{C,pulse}$ | Pulse Collector Current | $V_{GE}=15\text{V}$, limited by T_{jmax} | 200 | A |
| P_{tot} | Power Dissipation | $T_c=25^\circ\text{C}$ | 297 | W |
| T_j | Operating Junction Temperature | | -40~150 | $^\circ\text{C}$ |
| T_{stg} | Storage Temperature Range | | -55~150 | $^\circ\text{C}$ |

Thermal Characteristics

| Symbol | Parameter | Value | Unit |
|---------------|---|-------|------|
| $R_{th(j-c)}$ | IGBT Thermal Resistance-Junction to Case | 0.42 | K/W |
| $R_{th(j-c)}$ | Diode Thermal Resistance-Junction to Case | 0.81 | K/W |
| $R_{th(j-a)}$ | Thermal Resistance-Junction to Ambient | 32 | K/W |

Electrical Characteristics (Defined at $T_j=25^\circ\text{C}$ Unless Otherwise Specified)
IGBT Static Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit | |
|---------------|--------------------------------------|--|-------------------------|------|------|---------------|----|
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE}=15\text{V}$, $I_C=50\text{A}$ | $T_j=25^\circ\text{C}$ | 1.55 | 2.1 | V | |
| | | | $T_j=100^\circ\text{C}$ | 1.75 | | | |
| | | | $T_j=150^\circ\text{C}$ | 1.88 | | | |
| I_{CES} | Zero Gate Voltage Collector Current | $V_{CE}=650\text{V}$, $V_{GE}=0\text{V}$ | $T_j=25^\circ\text{C}$ | | 100 | μA | |
| | | | $T_j=150^\circ\text{C}$ | | 1000 | | |
| | | $V_{CE}=480\text{V}$, $V_{GE}=0\text{V}$ | $T_j=25^\circ\text{C}$ | | 80 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}=V_{CE}$, $I_C=500\mu\text{A}$ | $T_j=25^\circ\text{C}$ | 4.2 | 5 | 5.8 | V |
| I_{GES} | Gate-Emitter Leakage Current | $V_{CE}=0\text{V}$, $V_{GE}=\pm 20\text{V}$ | $T_j=25^\circ\text{C}$ | | | 100 | nA |

| | | | | | | |
|----------|------------------|-----------------------|--|----|--|---|
| g_{fs} | Transconductance | $V_{CE}=20V, I_C=40A$ | | 82 | | S |
|----------|------------------|-----------------------|--|----|--|---|

Dynamic Characteristics

| Symbol | Parameter | Test conditions | Value | | | Unit |
|------------|------------------------------|---------------------------------------|-------|------|------|------|
| | | | Min. | Typ. | Max. | |
| C_{iss} | Input Capacitance | $V_{GE}=0V, V_{CE}=25V$ $f=250kHz$ | | 5692 | | pF |
| C_{oss} | Output Capacitance | | | 339 | | pF |
| C_{riss} | Reverse Transfer Capacitance | | | 95 | | pF |
| Q_G | Total Gate Charge | $V_{CC}=520V, V_{GE}=15V, I_C=50A$ | | 308 | | nC |

Switching Characteristics, Inductive Load

| Symbol | Parameter | Test conditions | Value | | | Unit | |
|--------------|------------------------|--|--|------|------|------|----|
| | | | Min. | Typ. | Max. | | |
| $t_{d(on)}$ | Turn-On Delay Time | $T_j=25^\circ C$ $V_{DC}=400V, I_C=25A$ $V_{GE}=0/15V, R_{G(ext)}=10\Omega$ $L_\sigma=60nH$ | | 21 | | ns | |
| t_r | Rise Time | | | 16 | | | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 330 | | | |
| t_f | Fall Time | | | 48 | | | |
| E_{on} | Turn-On Energy | | | 203 | | uJ | |
| E_{off} | Turn-Off Energy | | | 298 | | | |
| E_{total} | Total Switching Energy | | | 501 | | | |
| $t_{d(on)}$ | Turn-On Delay Time | | $T_j=25^\circ C$ $V_{DC}=400V, I_C=50A$ $V_{GE}=0/15V, R_{G(ext)}=10\Omega$ $L_\sigma=60nH$ | | 25 | | ns |
| t_r | Rise Time | | | | 26 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 322 | | | |
| t_f | Fall Time | | | 30 | | | |
| E_{on} | Turn-On Energy | | | 403 | | uJ | |
| E_{off} | Turn-Off Energy | | | 623 | | | |
| E_{total} | Total Switching Energy | | | 1026 | | | |

SiC Schottky Barrier Diode Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit | |
|--------|-------------------------|-----------------------------|--------------------|------|------|------|---|
| V_F | Diode Forward Voltage | $V_{GE}=0V,$ $I_F=20A$ | $T_j=25^{\circ}C$ | | 1.51 | | V |
| | | | $T_j=100^{\circ}C$ | | 1.62 | | |
| | | | $T_j=150^{\circ}C$ | | 1.76 | | |
| Q_C | Diode Capacitive Charge | $V_R=400V, T_j=25^{\circ}C$ | | 46 | | nC | |
| C | Diode Capacitance | $V_R=1V, f=1MHz$ | | 713 | | pF | |
| | | $V_R=300V, f=1MHz$ | | 79 | | | |

Typical Performance

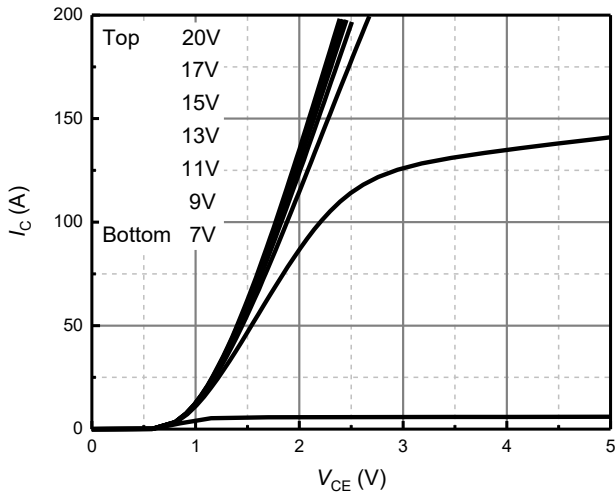


Figure 1 Output Characteristics
($T_j=25^\circ\text{C}$)

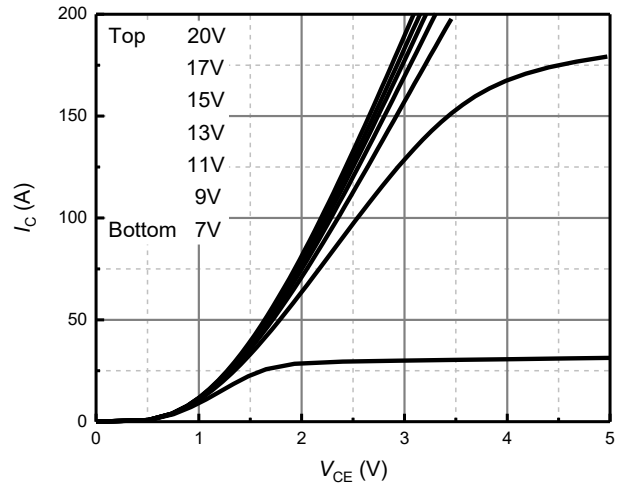


Figure 2 Output Characteristics
($T_j=150^\circ\text{C}$)

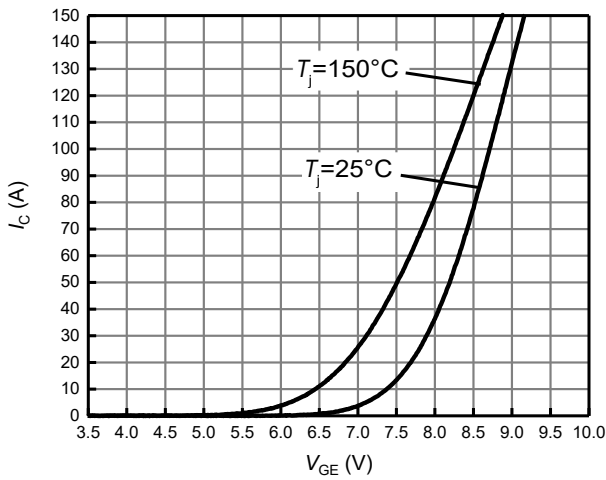


Figure 3 Transfer Characteristics for Various Temperature
($V_{CE}=20\text{V}$)

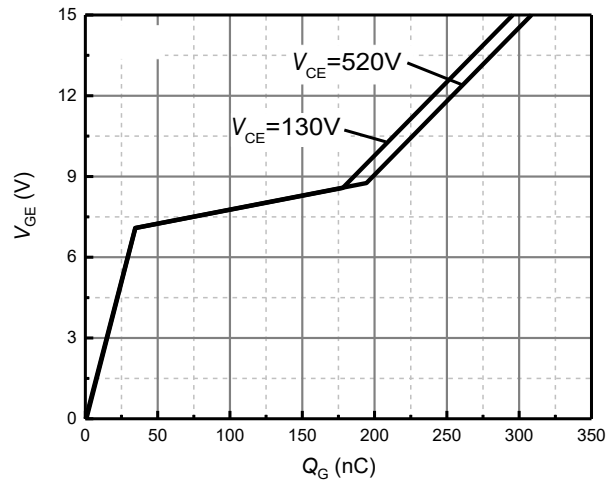


Figure 4 Gate Charge Characteristics
($I_C=50\text{A}$)

Typical Performance

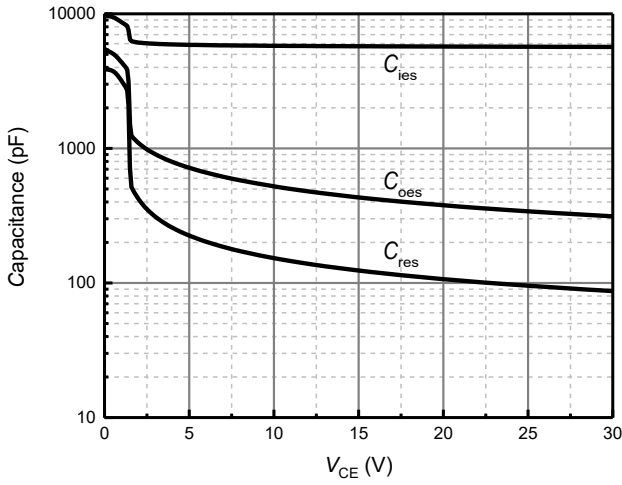


Figure 5 Capacitance Characteristics
($V_{GE}=0V$, $f=250kHz$)

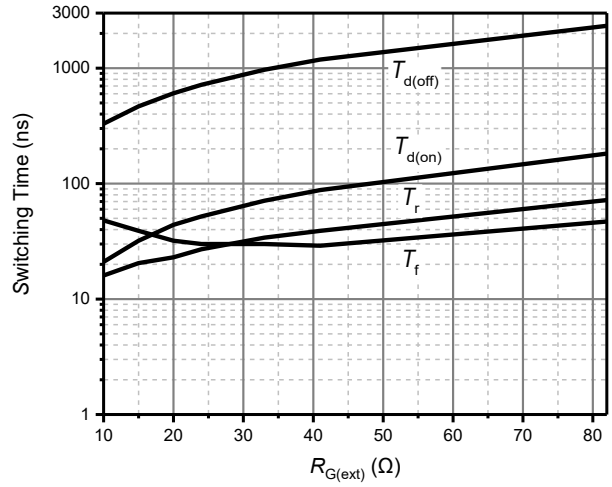


Figure 6 Switching Times vs. Gate Resistor
($V_{DC}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $T_j=25^\circ C$)

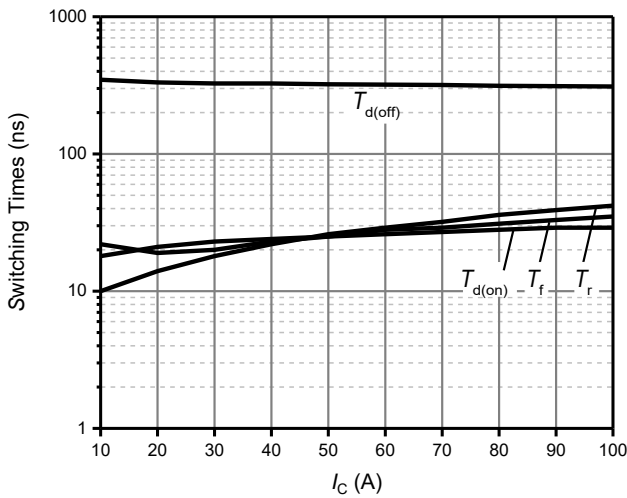


Figure 7 Switching Times vs. Collector Current
($V_{DC}=400V$, $V_{GE}=0/15V$, $R_{G(ext)}=10\Omega$, $T_j=25^\circ C$)

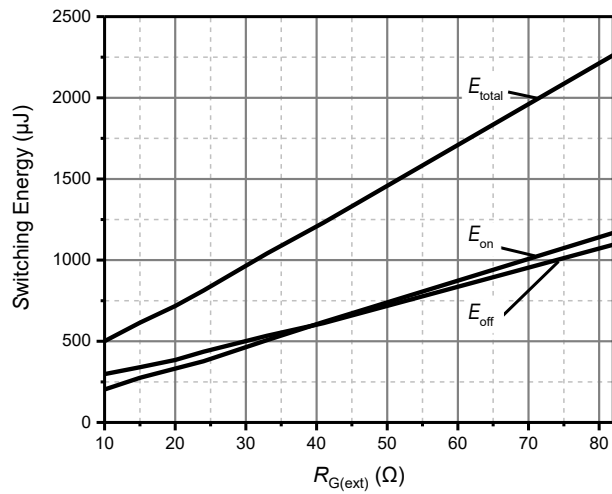


Figure 8 Switching Loss vs. Gate Resistor
($V_{DC}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $T_j=25^\circ C$)

Typical Performance

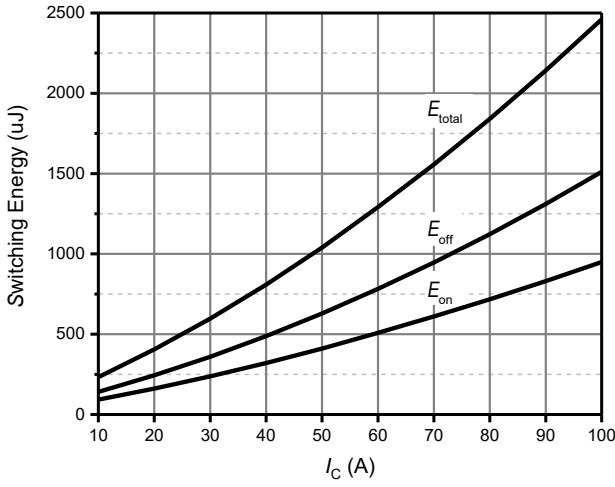


Figure 9 Switching Loss vs. Collector Current ($V_{DC}=400V$, $V_{GE}=0/15V$, $R_{G(ext)}=10\Omega$, $T_j=25^\circ C$)

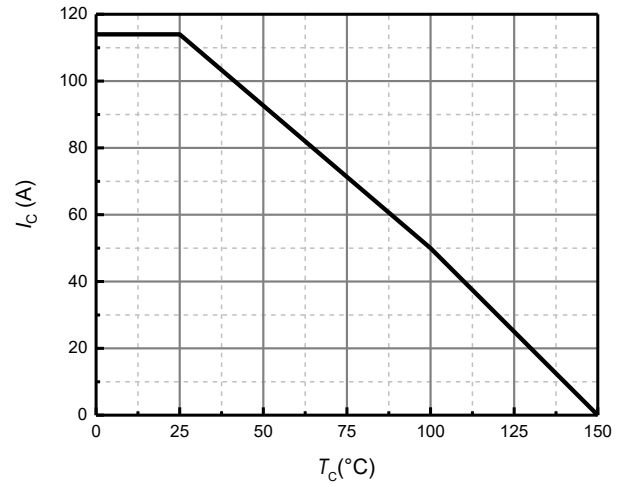


Figure 10 Maximum Collector-current vs. Case Temperature

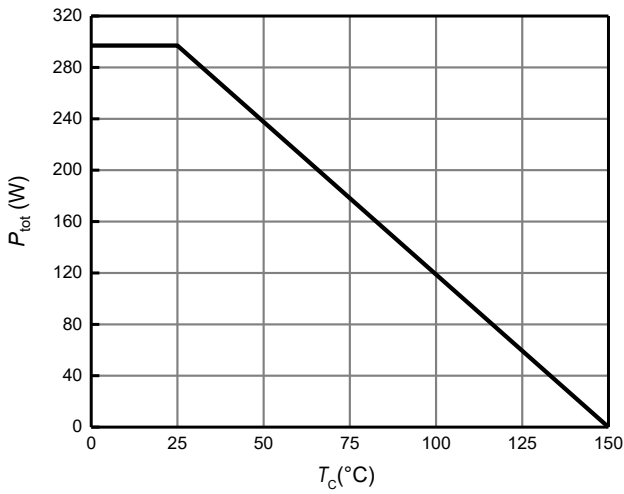


Figure 11 Power Dissipation vs. Case Temperature

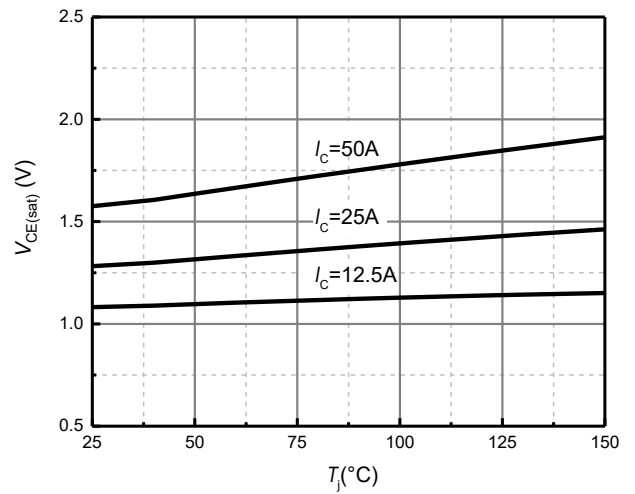


Figure 12 Collector-Emitter Saturation Voltage vs. Junction Temperature ($V_{GE}=15V$)

Typical Performance

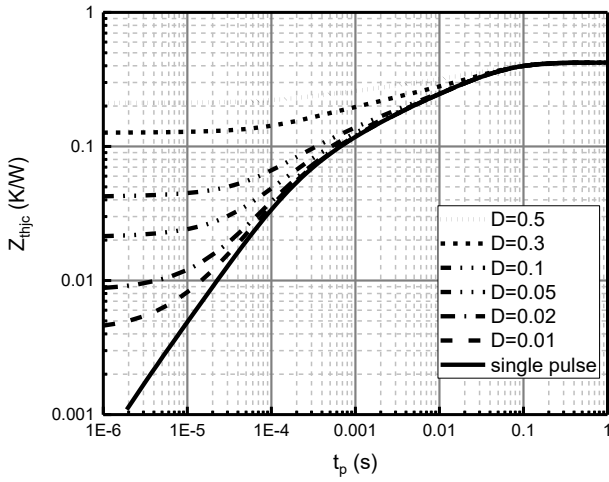


Figure 13 IGBT Transient Thermal Response Curve

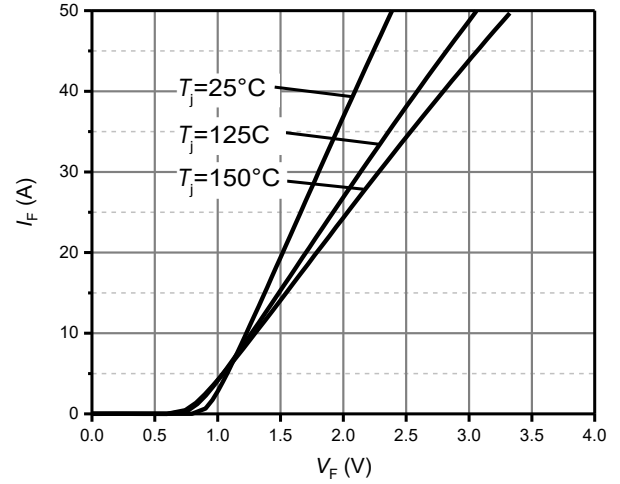


Figure 14 Forward characteristic of Diode

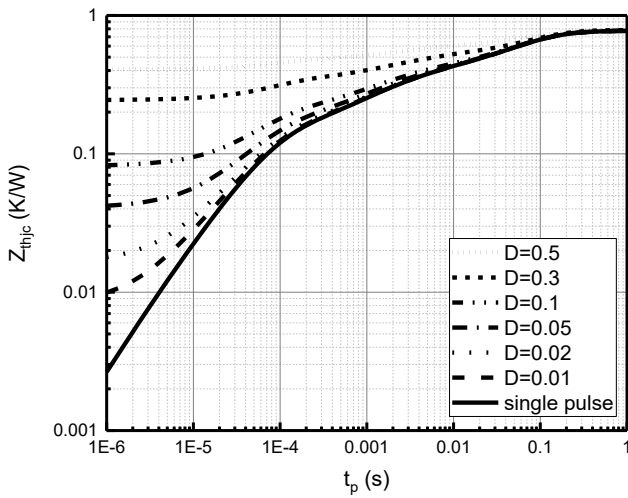


Figure 15 Diode Transient Thermal Response Curve

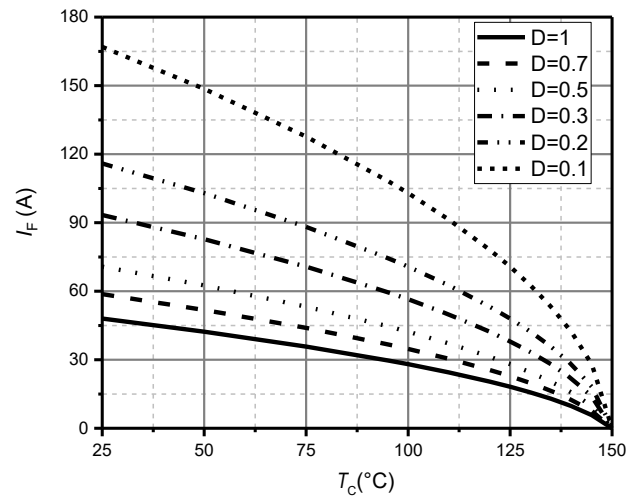
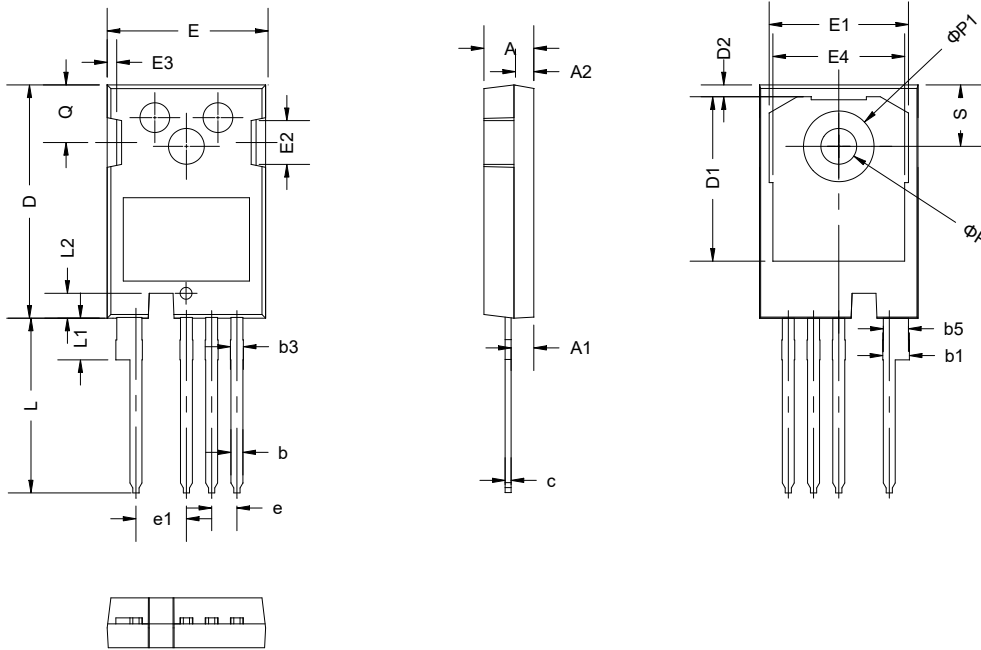


Figure 16 Diode Forward Current as Function of Temperature, D=duty cycle

Package Dimensions


| SYMBOL | mm | | |
|--------|----------|-------|-------|
| | MIN | NOM | MAX |
| A | 4.83 | 5.02 | 5.21 |
| A1 | 2.29 | 2.41 | 2.54 |
| A2 | 1.91 | 2.00 | 2.16 |
| b | 1.07 | 1.20 | 1.33 |
| b1 | 2.39 | 2.67 | 2.84 |
| b3 | 1.07 | 1.30 | 1.60 |
| b5 | 2.39 | 2.53 | 2.69 |
| c | 0.55 | 0.60 | 0.68 |
| D | 23.30 | 23.45 | 23.60 |
| D1 | 16.25 | 16.55 | 17.65 |
| D2 | 0.95 | 1.19 | 1.25 |
| E | 15.75 | 15.94 | 16.13 |
| E1 | 13.10 | 14.02 | 14.15 |
| E2 | 3.68 | 4.40 | 5.10 |
| E3 | 1.00 | 1.45 | 1.90 |
| E4 | 12.38 | 13.26 | 13.43 |
| e | 2.54 BSC | | |
| e1 | 5.08 BSC | | |
| L | 17.31 | 17.57 | 17.82 |
| L1 | 3.97 | 4.19 | 4.37 |
| L2 | 2.35 | 2.50 | 2.65 |
| φ P | 3.51 | 3.61 | 3.65 |
| φ P1 | 7.19 REF | | |
| Q | 5.49 | 5.79 | 6.00 |
| S | 6.04 | 6.17 | 6.30 |

Revision History

| Document Version | Date of Release | Description of Changes |
|-------------------------|------------------------|-------------------------------|
| Rev. 0.0 | 2022-10-11 | Draft datasheet created. |
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