# Insulated Gate Bipolar Transistor (Ultrafast IGBT), 106 A

**SOT-227**

## FEATURES

- Trench IGBT technology
- Square RBSOA
- Positive $V_{CE(on)}$ temperature coefficient
- Fully isolated package
- Very low internal inductance (≤ 5 nH typical)
- Industry standard outline
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

| PRIMARY CHARACTERISTICS | |
|---|---|
| $V_{CES}$ | 1200 V |
| $I_C$ DC | 106 A at 90 °C |
| $V_{CE(on)}$ typical at 75 A, 25 °C | 2.17 V |
| Speed | 8 kHz to 30 kHz |
| Package | SOT-227 |
| Circuit configuration | Single switch no diode |

## BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Easy to assemble and parallel
- Direct mounting on heatsink
- Plug-in compatible with other SOT-227 packages
- Low EMI, requires less snubbing

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|
| Collector to emitter voltage | $V_{CES}$ | | 1200 | V |
| Continuous collector current | $I_C$ | $T_C$ = 25 °C | 169 | A |
| | | $T_C$ = 90 °C | 106 | |
| Pulsed collector current | $I_{CM}$ | $T_J$ = 150 °C, $t_p$ = 6 ms, $V_{GE}$ = 15 V | 350 | |
| Clamped inductive load current | $I_{LM}$ | | 250 | |
| Gate to emitter voltage | $V_{GE}$ | | ± 20 | V |
| Power dissipation | $P_D$ | $T_C$ = 25 °C | 781 | W |
| | | $T_C$ = 90 °C | 375 | |
| Isolation voltage | $V_{ISOL}$ | Any terminal to case, t = 1 min | 2500 | V |

**ELECTRICAL SPECIFICATIONS** ($T_J$ = 25 °C unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
|---|---|---|---|---|---|---|
| Collector to emitter breakdown voltage | $V_{BR(CES)}$ | $V_{GE}$ = 0 V, $I_C$ = 4 mA | 1200 | - | - | V |
| Collector to emitter voltage | $V_{CE(on)}$ | $V_{GE}$ = 15 V, $I_C$ = 75 A | - | 2.17 | 2.60 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 75 A, $T_J$ = 125 °C | - | 2.44 | - | |
| | | $V_{GE}$ = 15 V, $I_C$ = 75 A, $T_J$ = 150 °C | - | 2.49 | - | |
| Gate threshold voltage | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 4 mA | 4.6 | 5.9 | 7.6 | |
| | | $V_{CE}$ = $V_{GE}$, $I_C$ = 4 mA, $T_J$ = 125 °C | - | 4.63 | - | |
| Temperature coefficient of threshold voltage | $V_{GE(th)}/\Delta T_J$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 4 mA (25 °C to 125 °C) | - | -13 | - | mV/°C |
| Collector to emitter leakage current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V | - | 0.9 | 100 | μA |
| | | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_J$ = 125 °C | - | 750 | - | |
| | | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_J$ = 150 °C | - | 2.7 | - | mA |
| Gate to emitter leakage current | $I_{GES}$ | $V_{GE}$ = ± 20 V | - | - | ± 250 | nA |

| SWITCHING CHARACTERISTICS ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
| Total gate charge (turn-on) | $Q_g$ | $I_C$ = 90 A, $V_{CC}$ = 960 V, $V_{GE}$ = 15 V | | - | 307 | - | nC |
| Gate to emitter charge (turn-on) | $Q_{ge}$ | | | - | 33 | - | |
| Gate to collector charge (turn-on) | $Q_{gc}$ | | | - | 160 | - | |
| Turn-on switching loss | $E_{on}$ | $I_C$ = 75 A, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, $R_g$ = 5 Ω, L = 500 μH, $T_J$ = 25 °C | Energy losses include tail and diode recovery Diode used HFA16PB120 | - | 2.15 | - | mJ |
| Turn-off switching loss | $E_{off}$ | | | - | 2.59 | - | |
| Total switching loss | $E_{tot}$ | | | - | 4.74 | - | |
| Turn-on delay time | $t_{d(on)}$ | | | - | 36 | - | ns |
| Rise time | $t_r$ | | | - | 26 | - | |
| Turn-off delay time | $t_{d(off)}$ | | | - | 116 | - | |
| Fall time | $t_f$ | | | - | 82 | - | |
| Turn-on switching loss | $E_{on}$ | $I_C$ = 75 A, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, $R_g$ = 5 Ω, L = 500 μH, $T_J$ = 125 °C | | - | 2.23 | - | mJ |
| Turn-off switching loss | $E_{off}$ | | | - | 3.87 | - | |
| Total switching loss | $E_{tot}$ | | | - | 6.1 | - | |
| Turn-on delay time | $t_{d(on)}$ | | | - | 34 | - | ns |
| Rise time | $t_r$ | | | - | 27 | - | |
| Turn-off delay time | $t_{d(off)}$ | | | - | 123 | - | |
| Fall time | $t_f$ | | | - | 147 | - | |
| Reverse bias safe operating area | RBSOA | $T_J$ = 150 °C, $I_C$ = 250, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V to 0 V, $V_{CC}$ = 800 V, $V_P$ = 1200 V, L = 500 μH | | Fullsquare | | | |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Junction and storage temperature range | $T_J$, $T_{Stg}$ | | -40 | - | 150 | °C |
| Junction to case | $R_{thJC}$ | | - | - | 0.16 | °C/W |
| Case to heatsink | $R_{thCS}$ | Flat, greased surface | - | 0.05 | - | |
| Weight | | | - | 30 | - | g |
| Mounting torque | | Torque to terminal | - | - | 1.1 (9.7) | Nm (lbf.in) |
| | | Torque to heatsink | - | - | 1.8 (15.9) | Nm (lbf.in) |
| Case style | SOT-227 | | | | | |

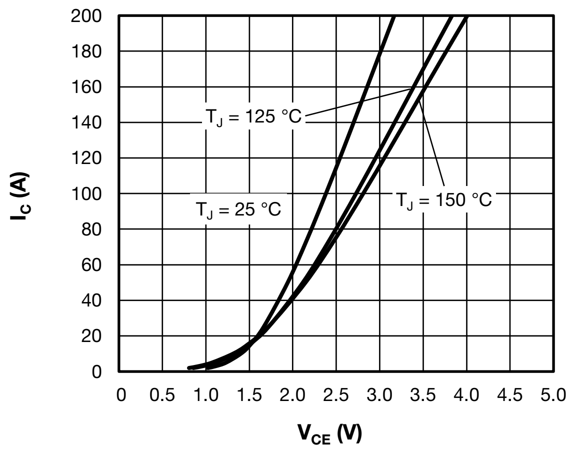



Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE}$ = 15 V

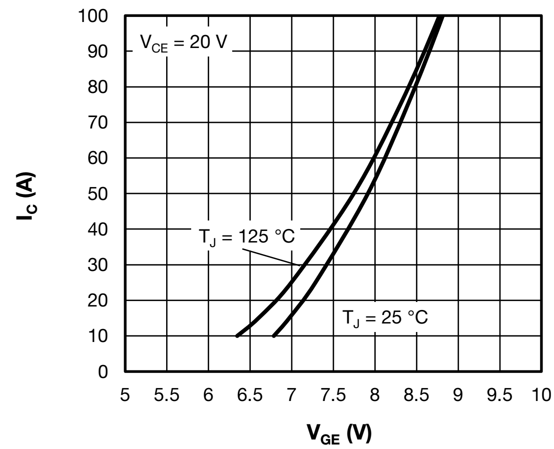



Fig. 4 - Typical Trench IGBT Transfer Characteristics

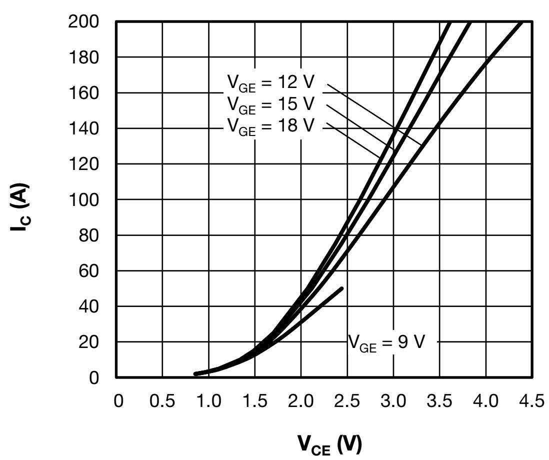



Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J$ = 125 °C

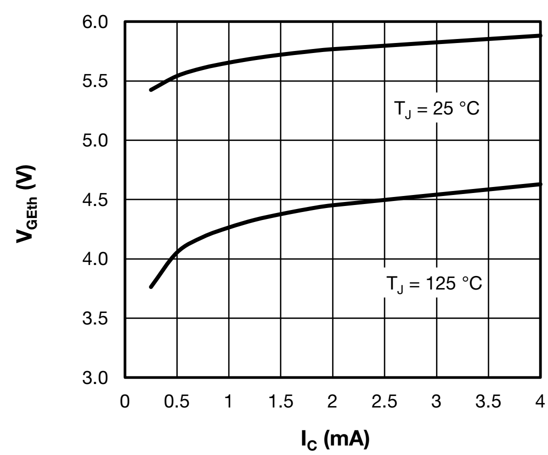



Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

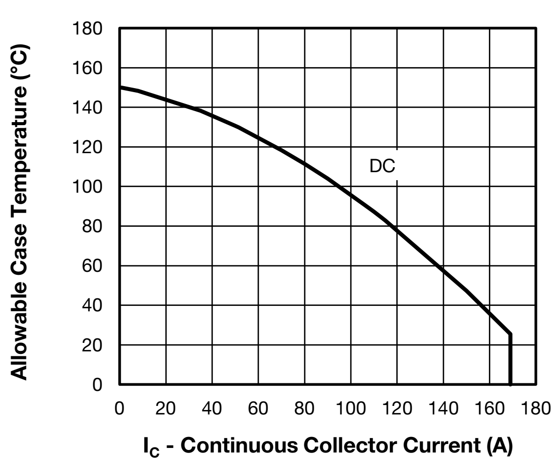



Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

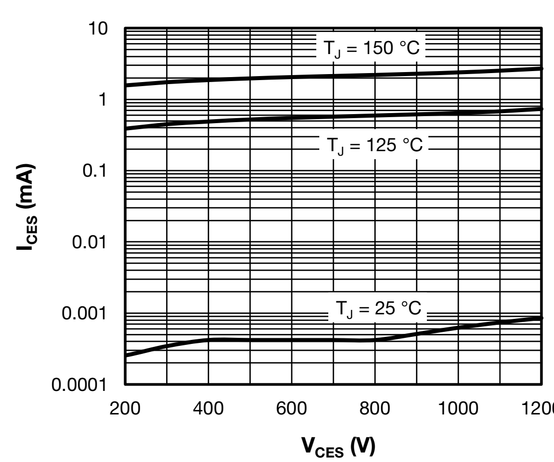



Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

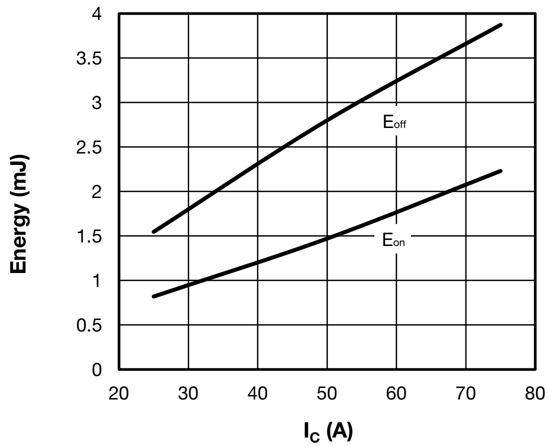



Fig. 7 - Typical Trench IGBT Energy Loss vs. $I_C$
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $R_g$ = 4.7 Ω, $V_{GE}$ = +15 V/-15 V, L = 500 μH

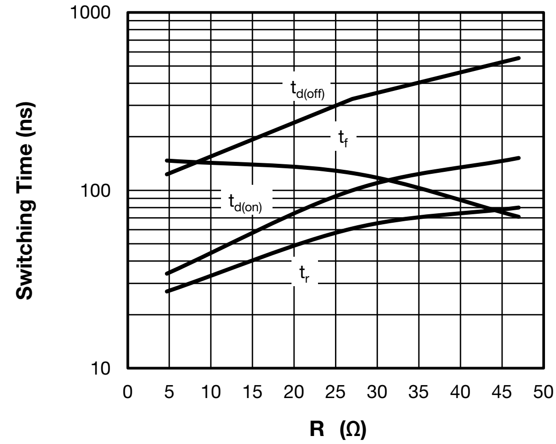



Fig. 10 - Typical Trench IGBT Switching Time vs. $R_g$
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $I_C$ = 75 A, $V_{GE}$ = +15 V/-15 V, L = 500 μH

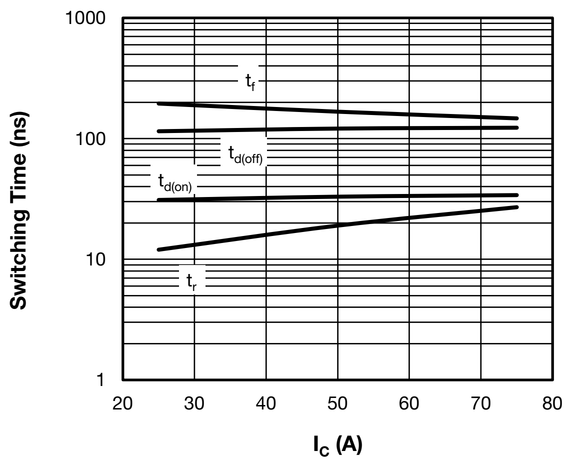



Fig. 8 - Typical Trench IGBT Switching Time vs. $I_C$
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $R_g$ = 4.7 Ω, $V_{GE}$ = +15 V/-15 V, L = 500 μH

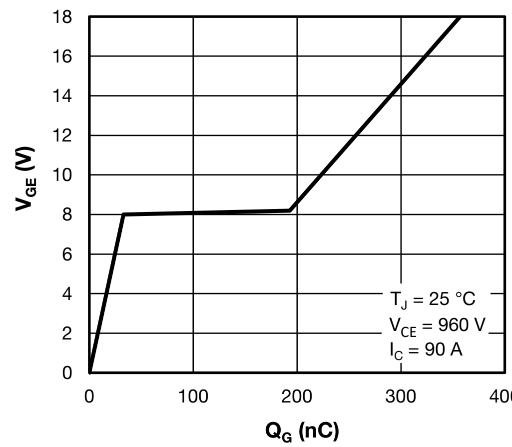



Fig. 11 - Typical Trench IGBT Gate Charge vs.
Gate to Emitter Voltage

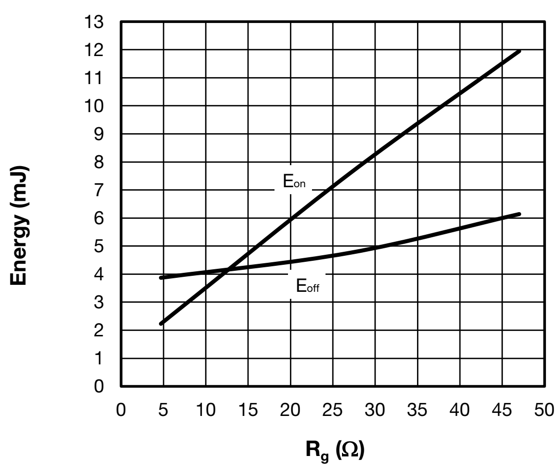



Fig. 9 - Typical Trench IGBT Energy Loss vs. $R_g$
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $I_C$ = 75 A, $V_{GE}$ = +15 V/-15 V, L = 500 μH

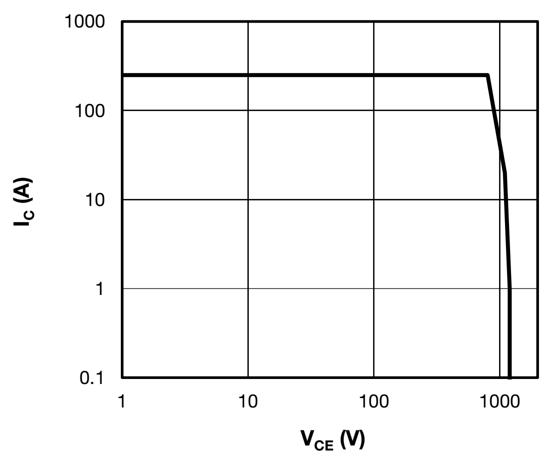



Fig. 12 - Trench IGBT Reverse BIAS SOA
$T_J$ = 150 °C, $I_C$ = 250 A, $R_g$ = 4.7 Ω, $V_{GE}$ = +15 V/0 V,
$V_{CC}$ = 800 V, $V_p$ = 1200 V

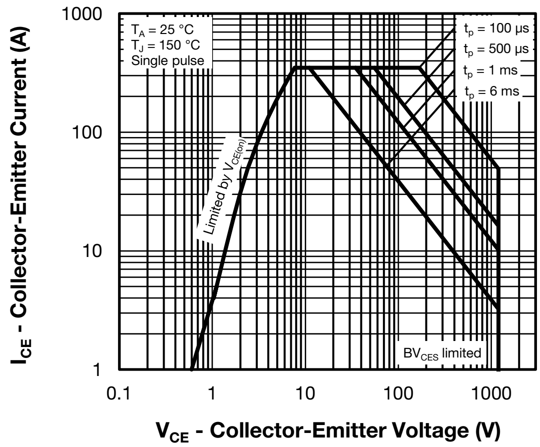



Fig. 13 - Trench IGBT Safe Operating Area

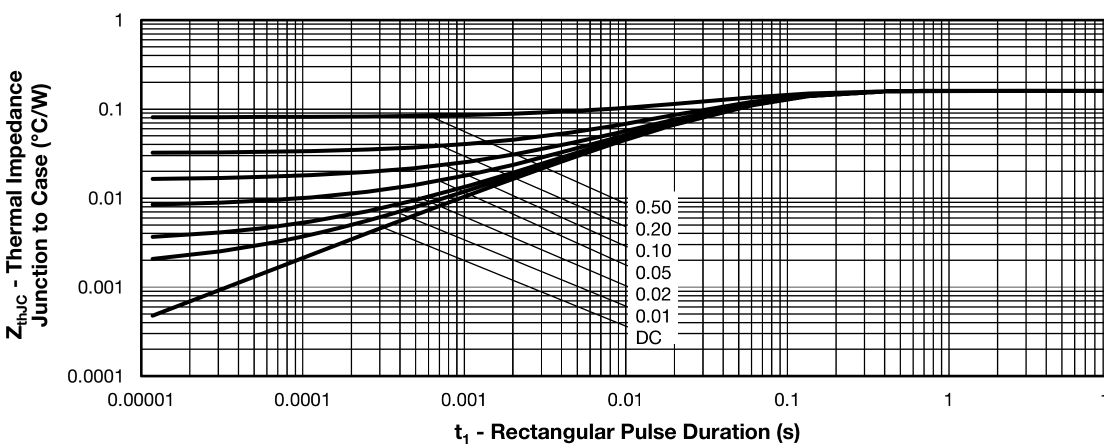
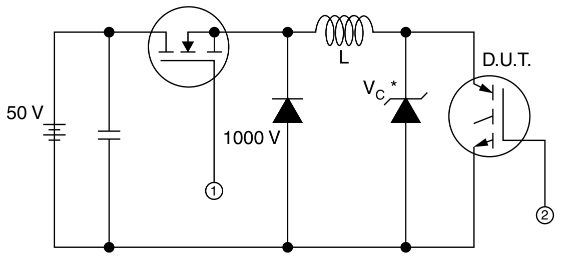



Fig. 14 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics




* Driver same type as D.U.T.; $V_C$ = 80 % of $V_{ce(max)}$
* Note: Due to the 50 V power supply, pulse width and inductor will increase to obtain Id

Fig. 15 - Clamped Inductive Load Test Circuit

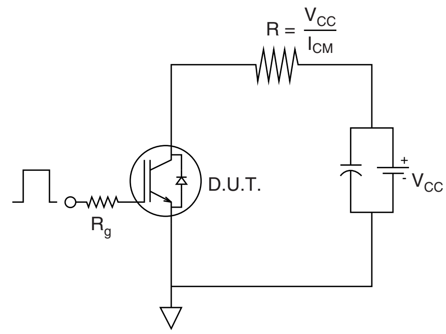



Fig. 16 - Pulsed Collector Current Test Circuit

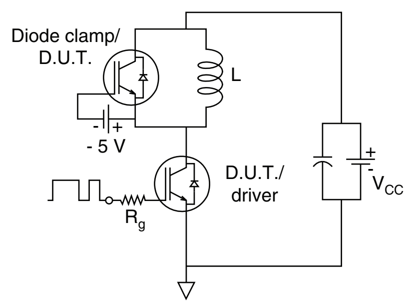



Fig. 17 - Switching Loss Test Circuit

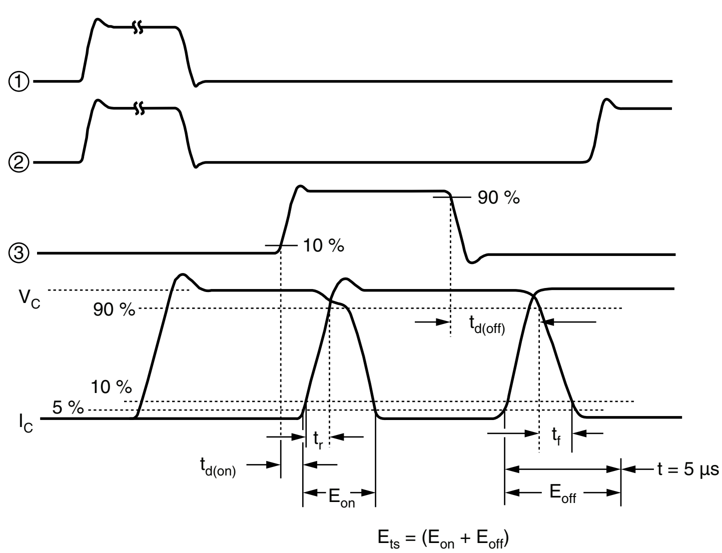
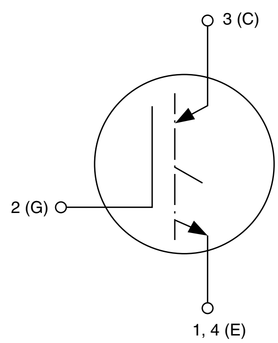
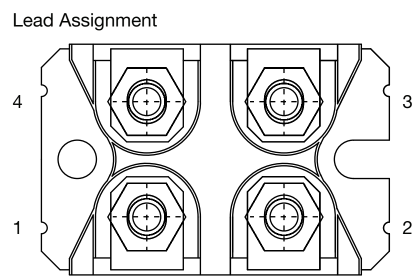



Fig. 18 - Switching Loss Waveforms Test Circuit

## ORDERING INFORMATION TABLE

| Device code | VS- | G | T | 90 | S | A | 120 | U |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

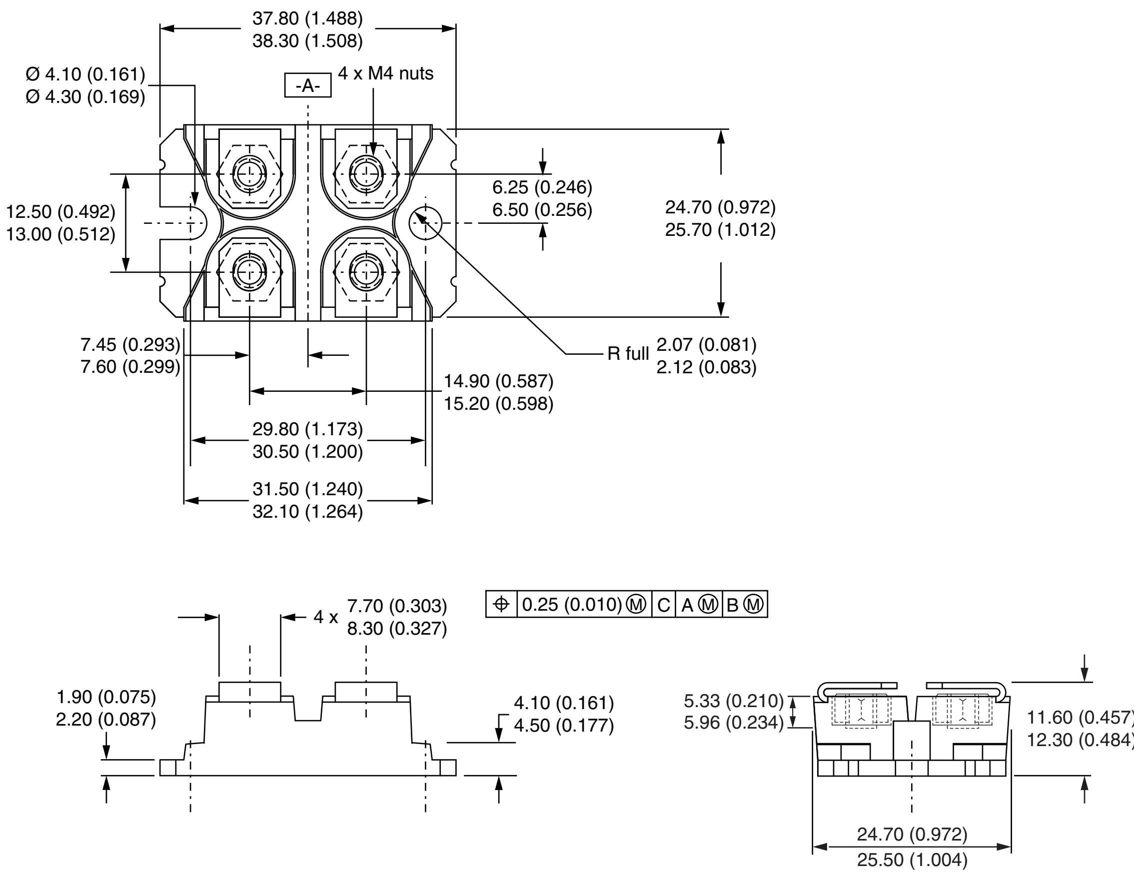
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - T = Trench IGBT
4 - Current rating (90 = 90 A)
5 - Circuit configuration (S = single switch no diode)
6 - Package indicator (A = SOT-227)
7 - Voltage rating (120 = 1200 V)
8 - Speed/type (U = ultrafast IGBT)

| CIRCUIT CONFIGURATION | | |
|---|---|---|
| **CIRCUIT** | **CIRCUIT CONFIGURATION CODE** | **CIRCUIT DRAWING** |
| Single switch no diode | S |     |

| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95423 |
| Packaging information | www.vishay.com/doc?95425 |

# SOT-227 Generation 2

**DIMENSIONS** in millimeters (inches)




**Note**

- Controlling dimension: millimeter


For technical questions, contact: DiodesAmericas@vishay.com

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