



STGW20NB60KD

N-CHANNEL 20A - 600V TO-247 SHORT CIRCUIT PROOF PowerMESH™ IGBT

Table 1: General Features

| TYPE | V _{CES} | V _{CE(sat)} (Max) @25°C | I _C @100°C |
|--------------|------------------|-------------------------------------|--------------------------|
| STGW20NB60KD | 600 V | < 2.8 V | 25 A |

- OFF LOSSES INCLUDE TAIL CURRENT
- HIGH CURRENT CAPABILITY
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V_{cesat})
- LOW ON-LOSSES
- LOW GATE CHARGE
- VERY HIGH FREQUENCY OPERATION
- SHORT CIRCUIT RATED
- LATCH CURRENT FREE OPERATION

DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "K" identifies a family optimized for high frequency motor control applications with short circuit withstand capability.

APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- U.P.S
- WELDING EQUIPMENTS

Table 2: Order Codes

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|--------------|------------|---------|-----------|
| STGW20NB60KD | GW20NB60KD | TO-247 | TUBE |

Figure 1: Package

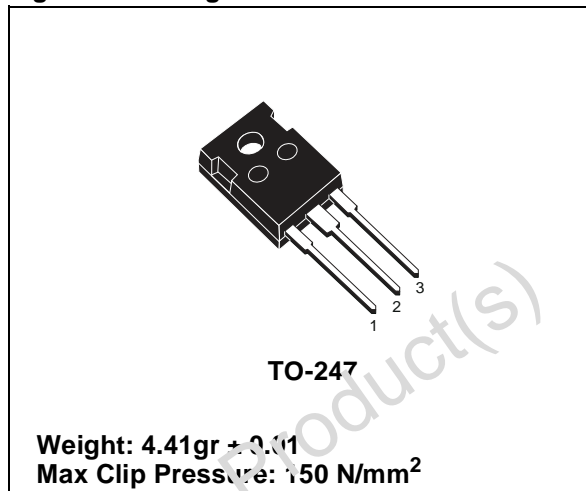


Figure 2: Internal Schematic Diagram

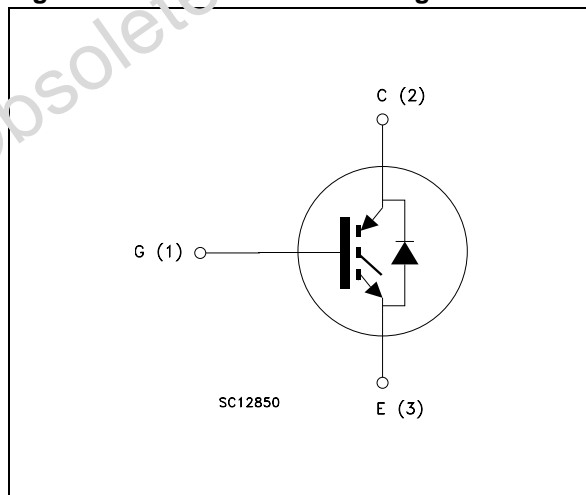


Table 3: Absolute Maximum ratings

| Symbol | Parameter | Value | Unit |
|---------------------|---|-------------|------|
| V _{CES} | Collector-Emitter Voltage (V _{GS} = 0) | 600 | V |
| V _{ECR} | Reverse Battery Protection | 20 | V |
| V _{GE} | Gate-Emitter Voltage | ± 20 | V |
| I _C | Collector Current (continuous) at 25°C (#) | 50 | A |
| I _C | Collector Current (continuous) at 100°C (#) | 25 | A |
| I _{CM} (1) | Collector Current (pulsed) | 100 | A |
| T _{SC} | Short Circuit Withstand | 10 | µs |
| P _{TOT} | Total Dissipation at T _C = 25°C | 170 | W |
| | Derating Factor | 1.2 | W/°C |
| T _{stg} | Storage Temperature | - 55 to 150 | °C |
| T _j | Operating Junction Temperature | | |

(1)Pulse width limited by max. junction temperature.

Table 4: Thermal Data

| | | Min. | Typ. | Max. | |
|-----------------------|-------------------------------------|------|------|------|------|
| R _{thj-case} | Thermal Resistance Junction-case | -- | -- | 0.73 | °C/W |
| R _{th-amb} | Thermal Resistance Junction-ambient | -- | -- | 50 | °C/W |

Electrical Characteristics (T_{case} =25°C unless otherwise specified)

Table 5: Off

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|---|------|------|-----------|----------|
| V _{BR(CES)} | Collectro-Emitter Breakdown Voltage | I _C = 250 µA, V _{GE} = 0 | 600 | | | V |
| I _{CES} | Collector-Emitter Leakage Current (V _{CE} = 0) | V _{GE} = Max Rating T _C =25°C T _C =125°C | | | 10 100 | µA µA |
| I _{GES} | Gate-Emitter Leakage Current (V _{CE} = 0) | V _{GE} = ± 20 V , V _{CE} = 0 | | | ± 100 | nA |

Table 6: On

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|--------------------------------------|--|------|------------|------|--------|
| V _{GE(th)} | Gate Threshold Voltage | V _{CE} = V _{GE} , I _C = 250 µA | 5 | | 7 | V |
| V _{CE(SAT)} | Collector-Emitter Saturation Voltage | V _{GE} = 15 V, I _C = 20A, T _j = 25°C V _{GE} = 15 V, I _C = 20A, T _j = 125°C | | 2.3 1.9 | 2.8 | V V |

(#) Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 7: Dynamic

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|--|--|------|-------------------|------|----------------|
| g_{fs} | Forward Transconductance | $V_{CE} = 25 \text{ V}, I_C = 20 \text{ A}$ | | 8 | | S |
| C_{ies} C_{oes} C_{res} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$ | | 1560 190 38 | | pF pF pF |
| Q_g Q_{ge} Q_{gc} | Total Gate Charge Gate-Emitter Charge Gate-Collector Charge | $V_{CE} = 480 \text{ V}, I_C = 20 \text{ A},$ $V_{GE} = 15 \text{ V},$ (see Figure 19) | | 85 14.4 51 | 115 | nC nC nC |
| tscw | Short Circuit Withstand Time | $V_{ce} = 0.5 \text{ BV}_{ces}, T_j = 125^\circ\text{C}$ $R_G = 10 \Omega, V_{GE} = 15 \text{ V}$ | 10 | | | μs |

Table 8: Switching On

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------------|---|--|------|------------|------|-----------------------------------|
| $t_{d(on)}$ t_r | Turn-on Delay Time Current Rise Time | $V_{CC} = 480 \text{ V}, I_C = 20 \text{ A}$ $R_G = 10 \Omega, V_{GE} = 15 \text{ V}, T_j = 25^\circ\text{C}$ (see Figure 17) | | 39 35 | | ns ns |
| $(di/dt)_{on}$ Eon (2) | Turn-on Current Slope Turn-on Switching Losses | $V_{CC} = 480 \text{ V}, I_C = 20 \text{ A}$ $R_G = 10 \Omega, V_{GE} = 15 \text{ V}, T_j = 125^\circ\text{C}$ (see Figure 17) | | 453 675 | | A/ μs μJ |

2) Eon is the turn-on losses when a typical diode is used in the test circuit in Figure 17. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode.

Table 9: Switching Off

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|---|------|----------------------------------|
| $t_r(V_{off})$ t_c $t_{d(off)}$ t_f E _{off} (3) E _{ts} | Off Voltage Rise Time Cross-over Time Turn-off Delay Time Current Fall Time Turn-off Switching Loss Total Switching Loss | $V_{CC} = 480 \text{ V}, I_C = 20 \text{ A},$ $R_{GE} = 10 \Omega, V_{GE} = 15 \text{ V}$ $T_j = 25^\circ\text{C}$ (see Figure 17) | | 25 160 105 95 0.5 0.9 | | ns ns ns ns mJ mJ |
| $t_r(V_{off})$ t_c $t_{d(off)}$ t_f E _{off} (3) E _{ts} | Off Voltage Rise Time Cross-over Time Turn-off Delay Time Current Fall Time Turn-off Switching Loss Total Switching Loss | $V_{CC} = 480 \text{ V}, I_C = 20 \text{ A},$ $R_{GE} = 10 \Omega, V_{GE} = 15 \text{ V}$ $T_j = 125^\circ\text{C}$ (see Figure 17) | | 46 175 130 150 0.70 1.35 | | ns ns ns ns mJ mJ |

(3) Turn-off losses include also the tail of the collector current.

Table 10: Collector-Emitter Diode

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---|------|-----------|------|--------|
| I_f | Forward Current | | | | 20 | A |
| I_{fm} | Forward Current pulsed | | | | 80 | A |
| V_f | Forward On-Voltage | $I_f = 10\text{ A}$ $I_f = 10\text{ A}, T_j = 125\text{ °C}$ | | 1.27 1 | 2.0 | V V |
| t_{rr} | Reverse Recovery Time | $I_f = 10\text{ A}, V_R = 27\text{ V},$ $T_j = 125\text{ °C}, di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20) | | 80.5 | | ns |
| Q_{rr} | Reverse Recovery Charge | | | 181 | | nC |
| I_{rrm} | Reverse Recovery Current | | | 4.5 | | A |

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Figure 3: Output Characteristics

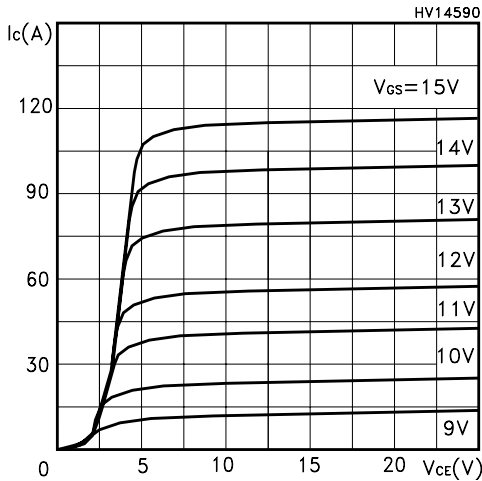


Figure 4: Transconductance

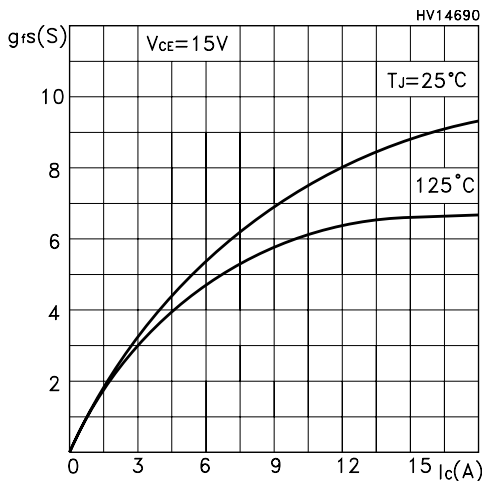


Figure 5: Collector-Emitter On Voltage vs Collector Current

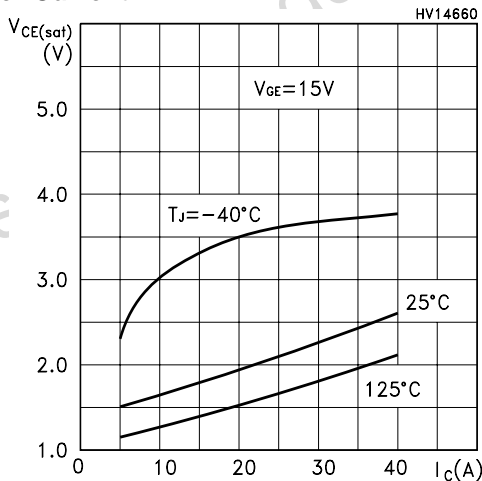


Figure 6: Transfer Characteristics

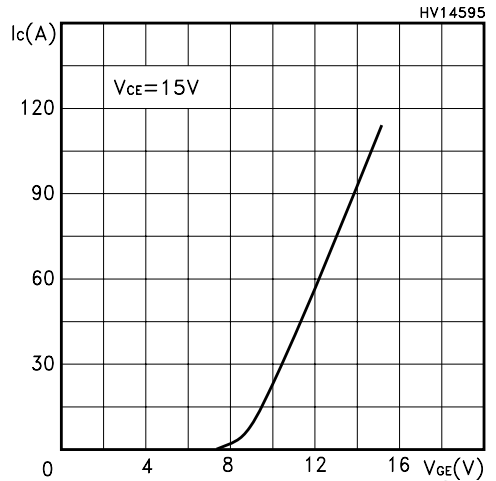


Figure 7: Collector-Emitter On Voltage vs Temperature

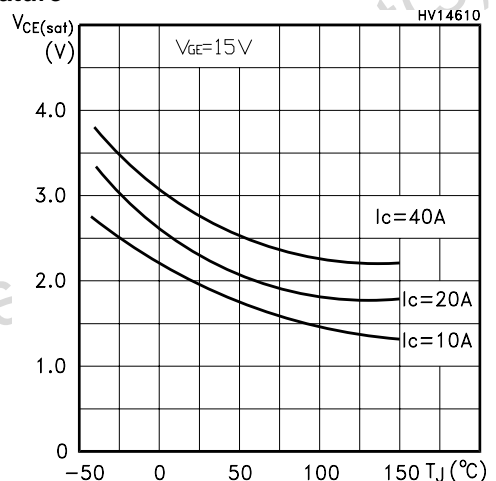


Figure 8: Normalized Gate Threshold vs Temperature

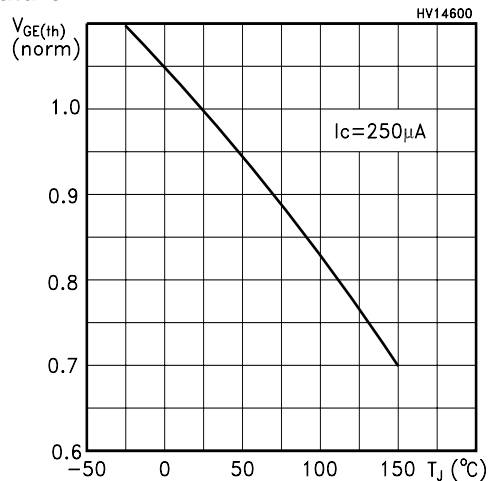


Figure 9: Normalized Breakdown Voltage vs Temperature

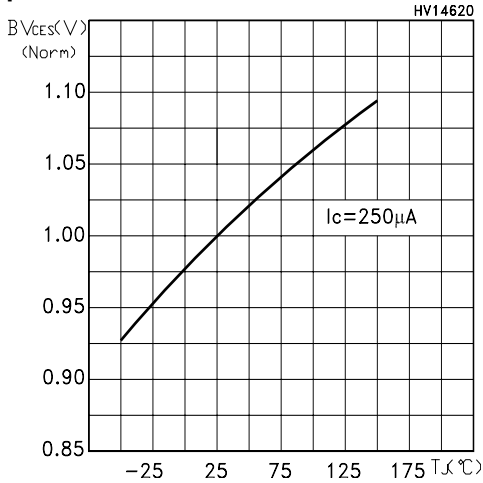


Figure 10: Capacitance Variations

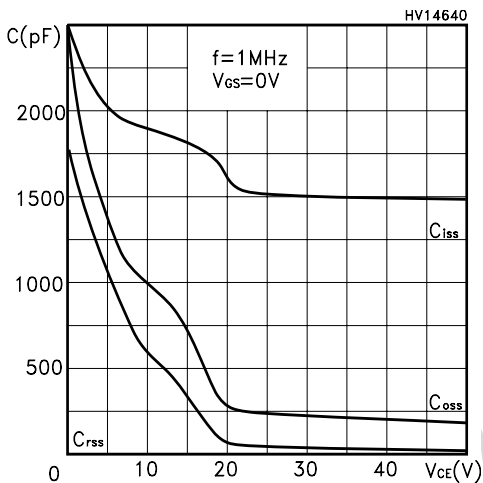


Figure 11: Turn-Off Energy Losses vs Temperature

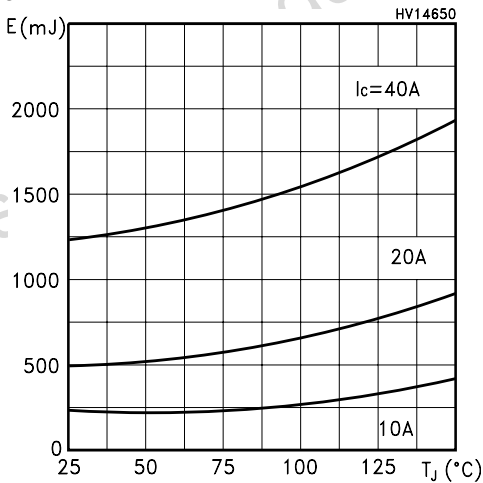


Figure 12: Gate Charge vs Gate-Emitter Voltage

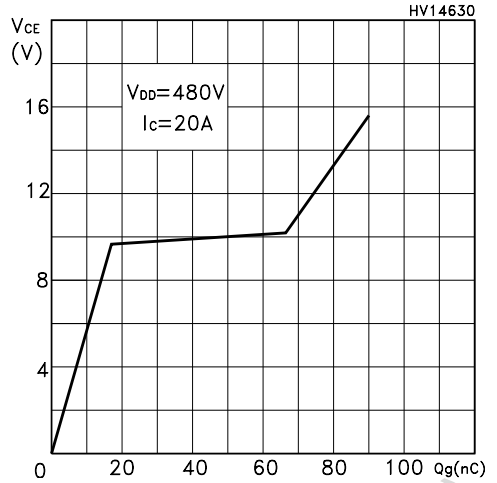


Figure 13: Diode Forward Voltage

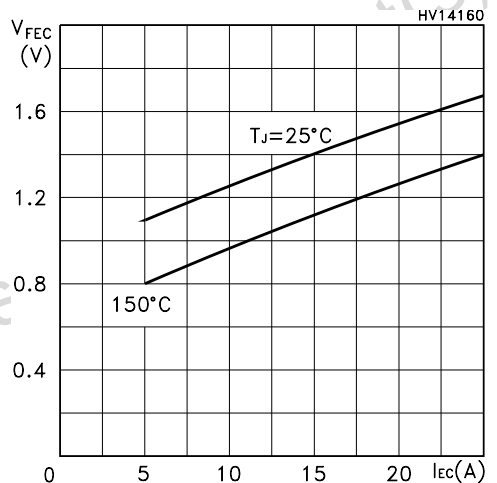


Figure 14: Total Switching Losses vs Collector Current

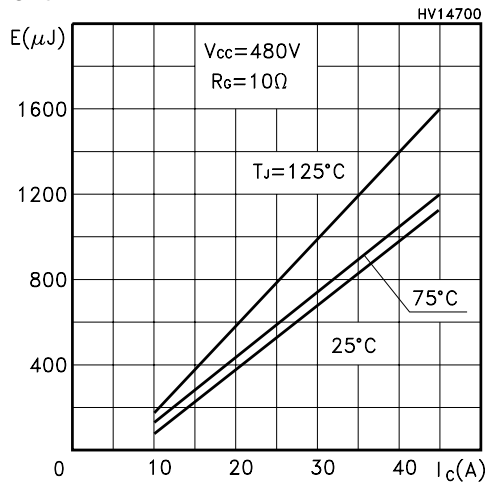


Figure 15: Thermal Impedance

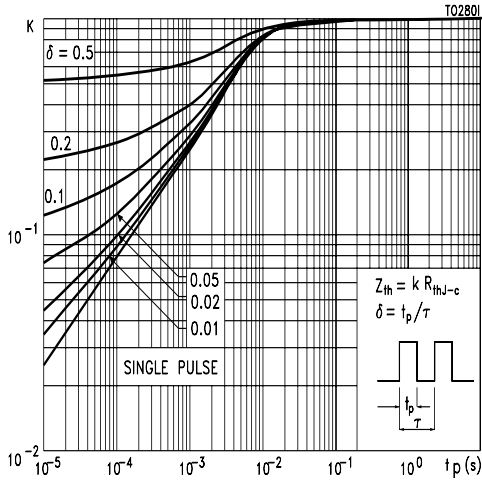
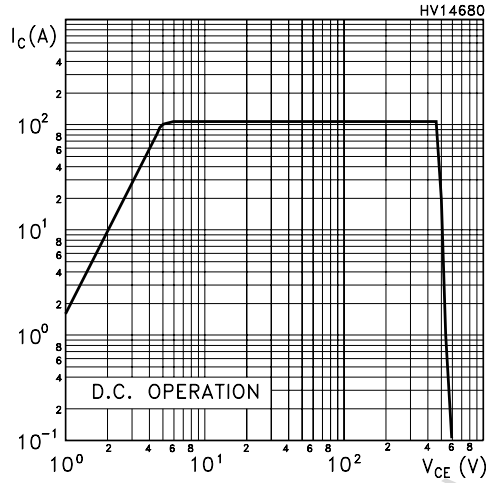


Figure 16: Turn-Off SOA



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Figure 17: Test Circuit for Inductive Load Switching

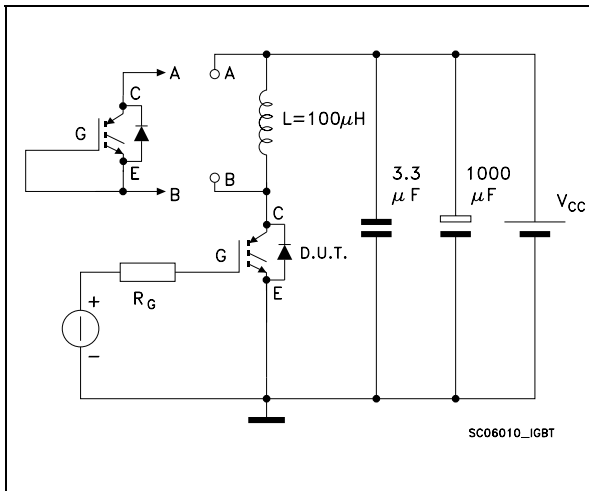


Figure 18: Switching Waveforms

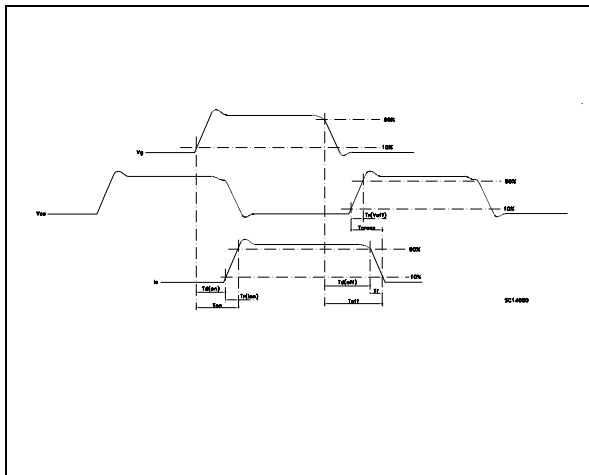


Figure 19: Gate Charge Test Circuit

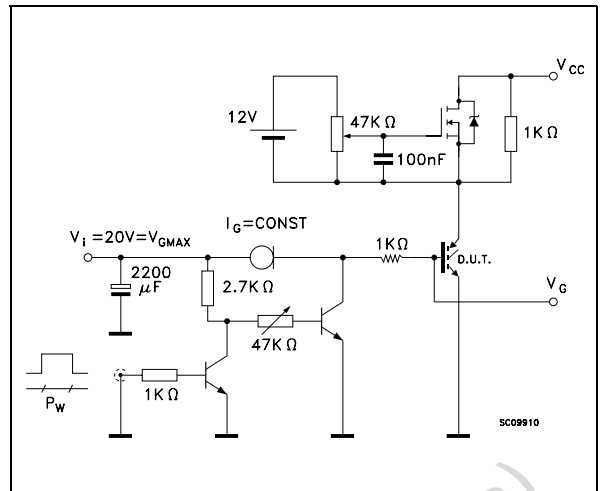
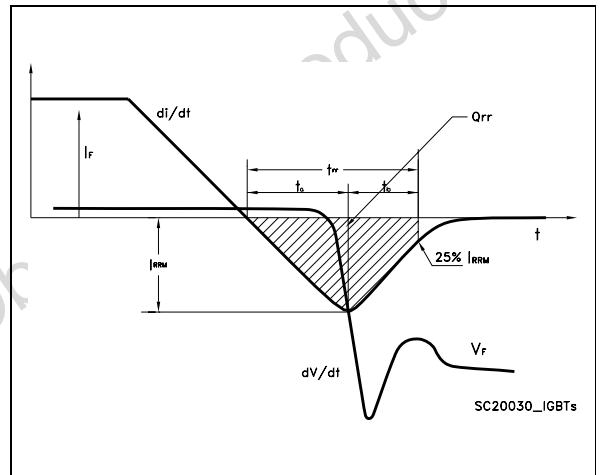


Figure 20: Diode Recovery Times Waveform



TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|----------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.85 | | 5.15 | 0.19 | | 0.20 |
| A1 | 2.20 | | 2.60 | 0.086 | | 0.102 |
| b | 1.0 | | 1.40 | 0.039 | | 0.055 |
| b1 | 2.0 | | 2.40 | 0.079 | | 0.094 |
| b2 | 3.0 | | 3.40 | 0.118 | | 0.134 |
| c | 0.40 | | 0.80 | 0.015 | | 0.03 |
| D | 19.85 | | 20.15 | 0.781 | | 0.793 |
| E | 15.45 | | 15.75 | 0.608 | | 0.620 |
| e | | 5.45 | | | 0.214 | |
| L | 14.20 | | 14.80 | 0.560 | | 0.582 |
| L1 | 3.70 | | 4.30 | 0.14 | | 0.17 |
| L2 | | 18.50 | | | 0.728 | |
| ϕP | 3.55 | | 3.65 | 0.140 | | 0.143 |
| ϕR | 4.50 | | 5.50 | 0.177 | | 0.216 |
| S | | 5.50 | | | 0.216 | |

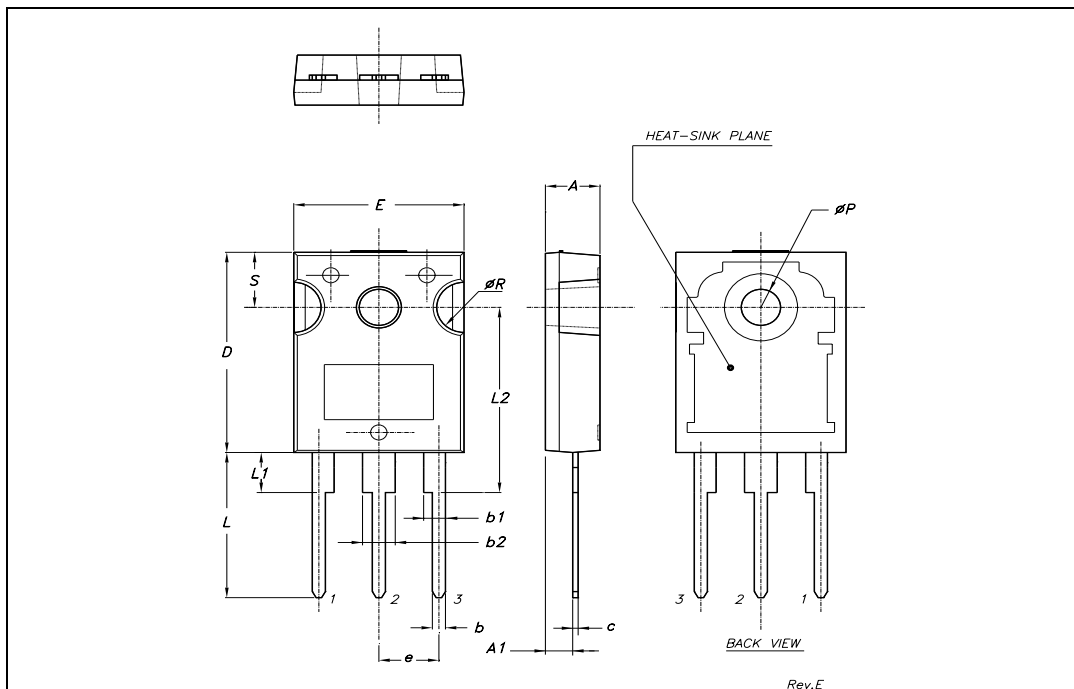


Table 11: Revision History

| Date | Revision | Description of Changes |
|-------------|-----------------|---|
| 21-Mar-2005 | 2 | New stylesheet. Some value changed on Table 3 and 4 |
| 05-Apr-2005 | 3 | New updated values in table 3 |

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