

International Rectifier

PD-5.045B

CPV362M4K

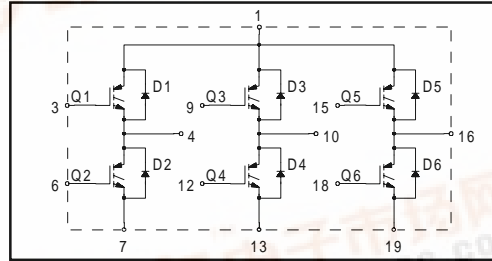
PRELIMINARY

IGBT SIP MODULE

Short Circuit Rated UltraFast IGBT

Features

- Short Circuit Rated UltraFast: Optimized for high operating frequencies >5.0 kHz, and Short Circuit Rated to 10μs @ 125°C, V_{GE} = 15V
- Fully isolated printed circuit board mount package
- Switching-loss rating includes all "tail" losses
- HEXFRED™ soft ultrafast diodes
- Optimized for high operating frequency (over 5kHz)
See Fig. 1 for Current vs. Frequency curve



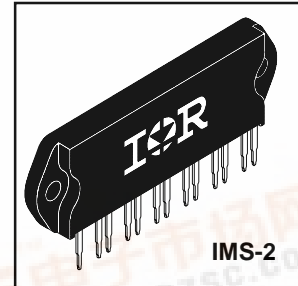
Product Summary

Output Current in a Typical 20 kHz Motor Drive

4.3 A_{RMS} per phase (1.27 kW total) with T_C = 90°C, T_J = 125°C, Supply Voltage 360Vdc, Power Factor 0.8, Modulation Depth 115% (See Figure 1)

Description

The IGBT technology is the key to International Rectifier's advanced line of IMS (Insulated Metal Substrate) Power Modules. These modules are more efficient than comparable bipolar transistor modules, while at the same time having the simpler gate-drive requirements of the familiar power MOSFET. This superior technology has now been coupled to a state of the art materials system that maximizes power throughput with low thermal resistance. This package is highly suited to motor drive applications and where space is at a premium.



Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|-----------------------------------|------------------|
| V _{CES} | Collector-to-Emitter Voltage | 600 | V |
| I _C @ T _C = 25°C | Continuous Collector Current, each IGBT | 5.7 | A |
| I _C @ T _C = 100°C | Continuous Collector Current, each IGBT | 3.0 | |
| I _{CM} | Pulsed Collector Current ① | 11 | |
| I _{LM} | Clamped Inductive Load Current ② | 11 | |
| I _F @ T _C = 100°C | Diode Continuous Forward Current | 3.4 | |
| I _{FM} | Diode Maximum Forward Current | 11 | |
| t _{sc} | Short Circuit Withstand Time | 10 | |
| V _{GE} | Gate-to-Emitter Voltage | ± 20 | V |
| V _{ISOL} | Isolation Voltage, any terminal to case, 1 minute | 2500 | V _{RMS} |
| P _D @ T _C = 25°C | Maximum Power Dissipation, each IGBT | 23 | W |
| P _D @ T _C = 100°C | Maximum Power Dissipation, each IGBT | 9.1 | |
| T _J | Operating Junction and | -40 to +150 | °C |
| T _{STG} | Storage Temperature Range | | |
| | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | |
| | Mounting torque, 6-32 or M3 screw | 5-7 lbf•in (0.55 - 0.8 N•m) | |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---------------------------|---|----------|------|--------|
| R _{θJC} (IGBT) | Junction-to-Case, each IGBT, one IGBT in conduction | — | 5.5 | °C/W |
| R _{θJC} (DIODE) | Junction-to-Case, each diode, one diode in conduction | — | 9.0 | |
| R _{θCS} (MODULE) | Case-to-Sink, flat, greased surface | 0.1 | — | |
| Wt | Weight of module | 20 (0.7) | — | g (oz) |



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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---------------------------------|---|------|------|-----------|---------|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage ^③ | 600 | — | — | V | $V_{GE} = 0V, I_C = 250\mu A$ |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temp. Coeff. of Breakdown Voltage | — | 0.49 | — | V/°C | $V_{GE} = 0V, I_C = 1.0mA$ |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | 1.70 | 1.93 | V | $I_C = 3.0A, V_{GE} = 15V$ See Fig. 2, 5 |
| | | — | 1.98 | — | | |
| | | — | 1.65 | — | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 6.0 | | $V_{CE} = V_{GE}, I_C = 250\mu A$ |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temp. Coeff. of Threshold Voltage | — | -13 | — | mV/°C | $V_{CE} = V_{GE}, I_C = 250\mu A$ |
| g_{fe} | Forward Transconductance ^④ | 2.0 | 3.0 | — | S | $V_{CE} = 100V, I_C = 12A$ |
| I_{CES} | Zero Gate Voltage Collector Current | — | — | 250 | μA | $V_{GE} = 0V, V_{CE} = 600V$ $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$ |
| | | — | — | 1700 | | |
| V_{FM} | Diode Forward Voltage Drop | — | 1.4 | 1.7 | V | $I_C = 8A$ See Fig. 13 $I_C = 8A, T_J = 150^\circ\text{C}$ |
| | | — | 1.3 | 1.6 | | |
| I_{GES} | Gate-to-Emitter Leakage Current | — | — | ± 100 | nA | $V_{GE} = \pm 20V$ |

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|------------------|--|------|------|------|------------|--|
| Q_g | Total Gate Charge (turn-on) | — | 38 | 57 | nC | $I_C = 3.0A$ $V_{CC} = 400V$ See Fig. 8 |
| Q_{ge} | Gate - Emitter Charge (turn-on) | — | 5.2 | 8 | | |
| Q_{gc} | Gate - Collector Charge (turn-on) | — | 18 | 27 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 23 | — | ns | $T_J = 25^\circ\text{C}$ $I_C = 3.0A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 51\Omega$ Energy losses include "tail" and diode reverse recovery. |
| t_r | Rise Time | — | 54 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 125 | 188 | | |
| t_f | Fall Time | — | 120 | 180 | mJ | See Fig. 9, 10, 18 |
| E_{on} | Turn-On Switching Loss | — | 0.14 | — | | |
| E_{off} | Turn-Off Switching Loss | — | 0.07 | — | | |
| E_{ts} | Total Switching Loss | — | 0.21 | 0.26 | μs | $V_{CC} = 360V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 51\Omega, V_{CPK} < 500V$ |
| t_{sc} | Short Circuit Withstand Time | 10 | — | — | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 25 | — | | |
| t_r | Rise Time | — | 51 | — | ns | $T_J = 150^\circ\text{C}$, See Fig. 10, 11, 18 $I_C = 3.0A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 51\Omega$ Energy losses include "tail" and diode reverse recovery. |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 308 | — | | |
| t_f | Fall Time | — | 166 | — | | |
| E_{ts} | Total Switching Loss | — | 0.33 | — | mJ | See Fig. 7 |
| C_{ies} | Input Capacitance | — | 450 | — | | |
| C_{oes} | Output Capacitance | — | 61 | — | | |
| C_{res} | Reverse Transfer Capacitance | — | 14 | — | pF | $V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$ |
| t_{rr} | Diode Reverse Recovery Time | — | 37 | 55 | | |
| | | — | 55 | 90 | | |
| I_{rr} | Diode Peak Reverse Recovery Current | — | 3.5 | 5.0 | A | $T_J = 25^\circ\text{C}$ See Fig. 14 $T_J = 125^\circ\text{C}$ 15 |
| | | — | 4.5 | 8.0 | | |
| Q_{rr} | Diode Reverse Recovery Charge | — | 65 | 138 | nC | $T_J = 25^\circ\text{C}$ See Fig. 16 $T_J = 125^\circ\text{C}$ 16 |
| | | — | 124 | 360 | | |
| $di_{(rec)M}/dt$ | Diode Peak Rate of Fall of Recovery During t_b | — | 240 | — | A/ μs | $T_J = 25^\circ\text{C}$ See Fig. 17 $T_J = 125^\circ\text{C}$ 17 |
| | | — | 210 | — | | |

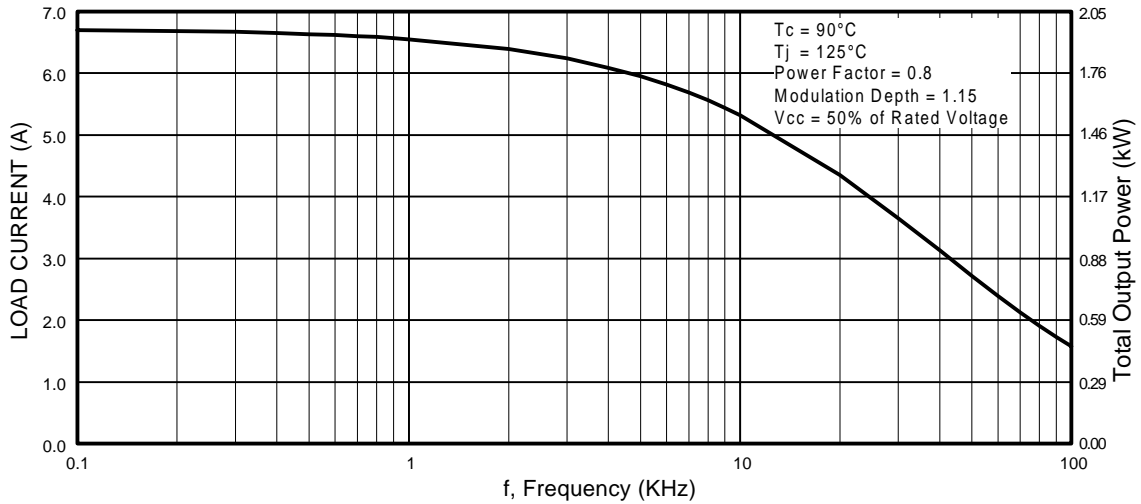


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

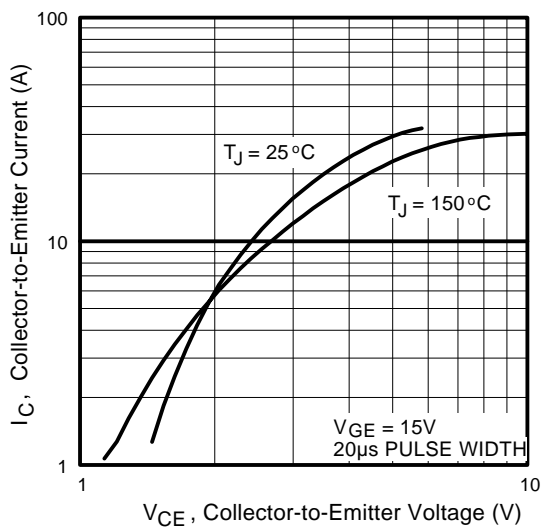


Fig. 2 - Typical Output Characteristics

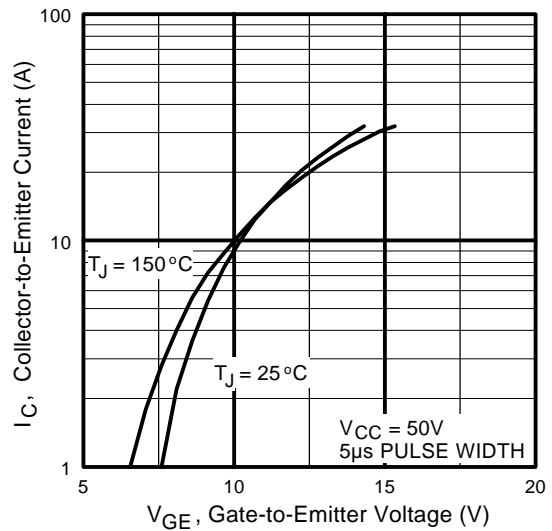


Fig. 3 - Typical Transfer Characteristics

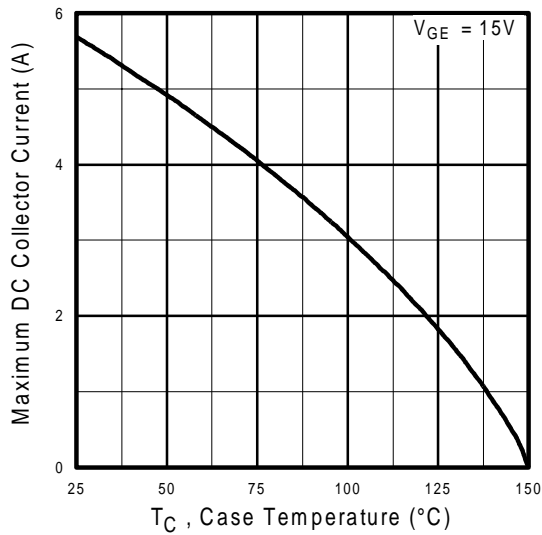


Fig. 4 - Maximum Collector Current vs. Case Temperature

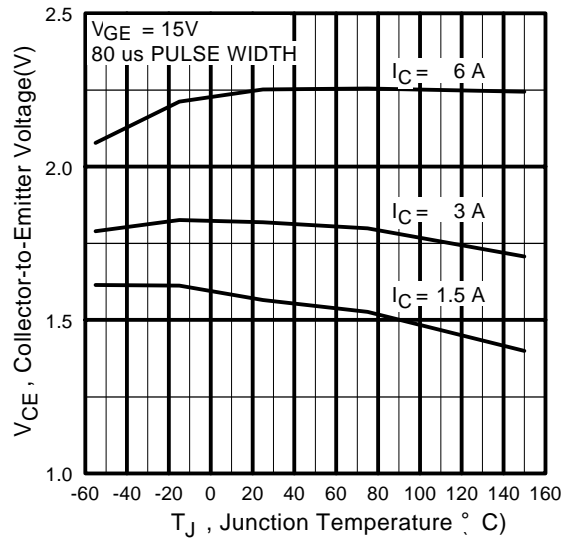


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

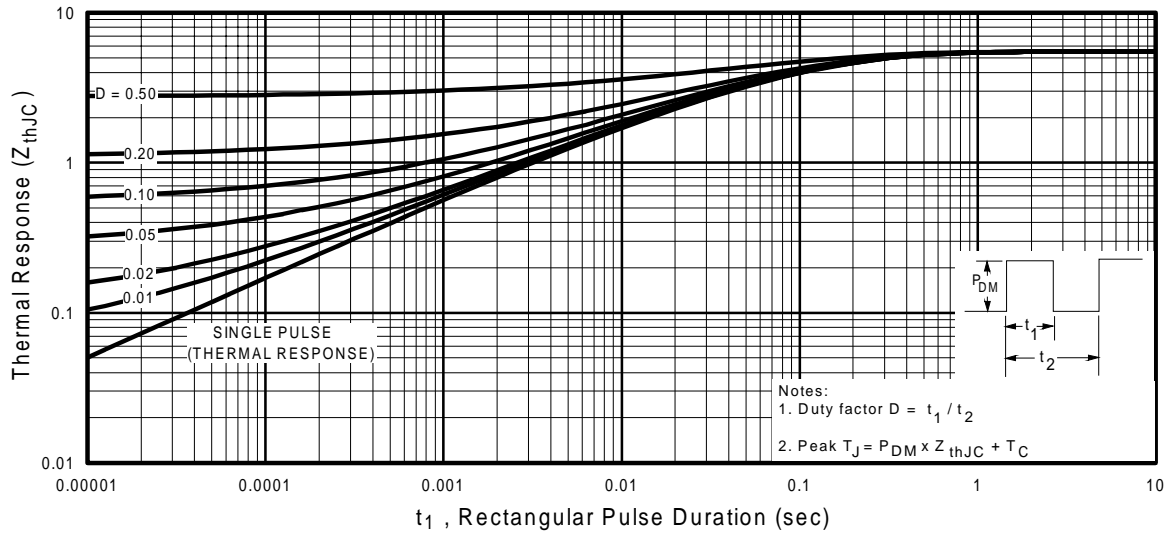


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

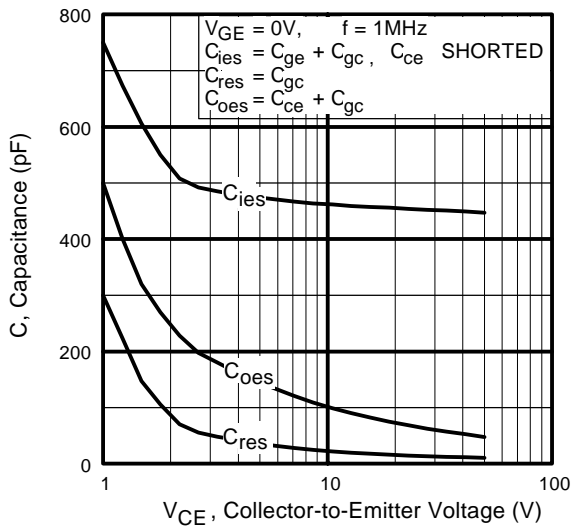


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

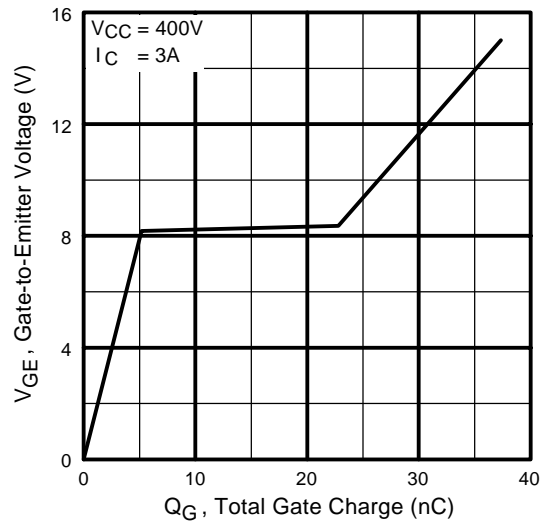


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

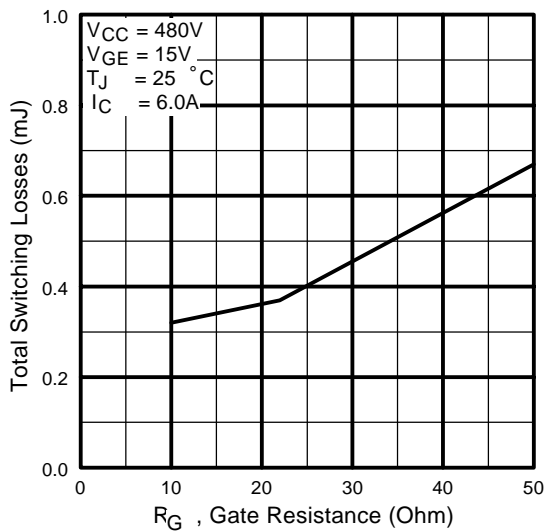


Fig. 9 - Typical Switching Losses vs. Gate Resistance

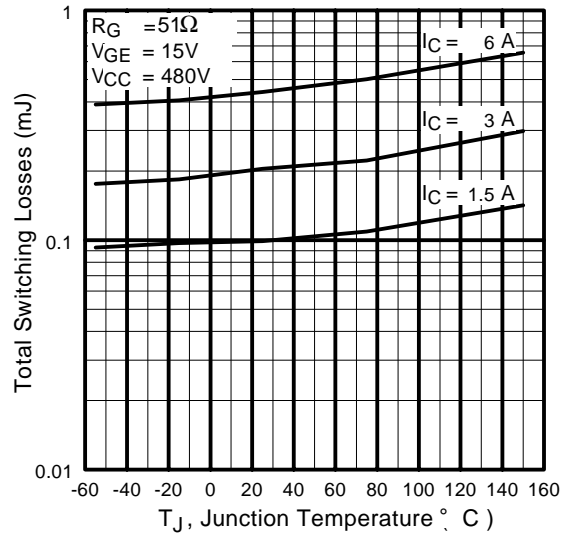


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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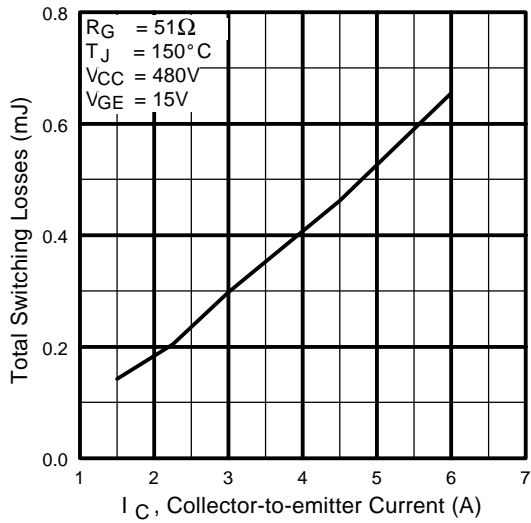


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

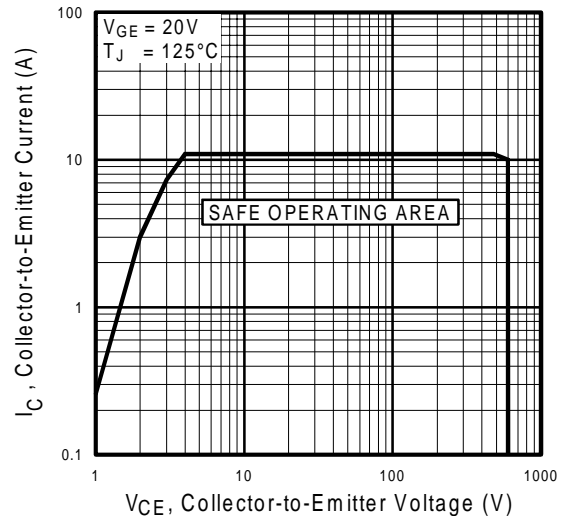


Fig. 12 - Turn-Off SOA

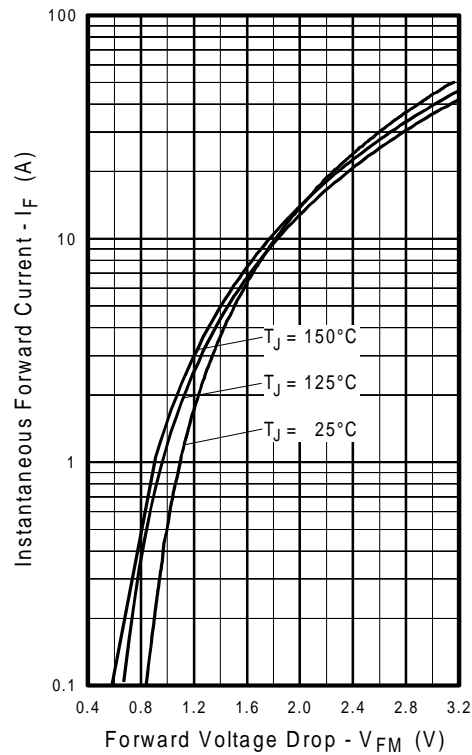


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

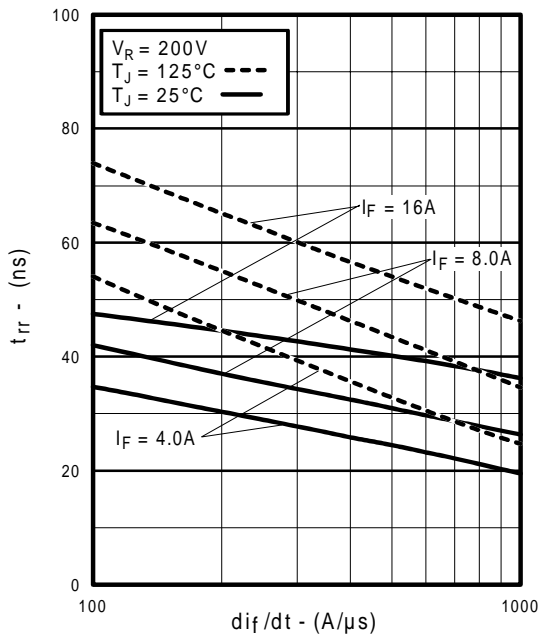


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

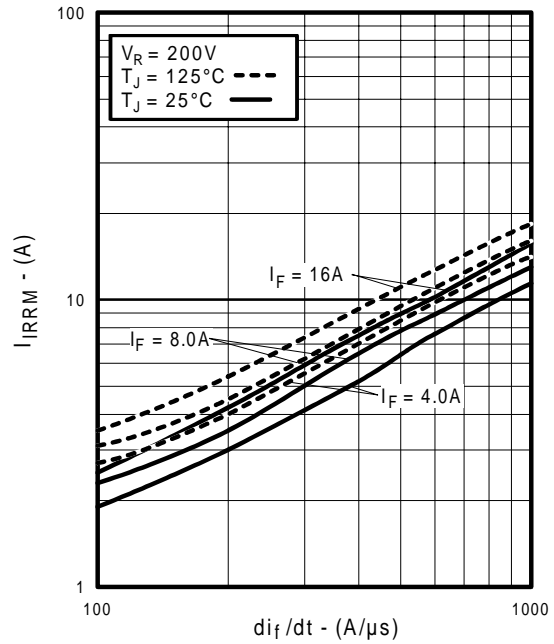


Fig. 15 - Typical Recovery Current vs. di_f/dt

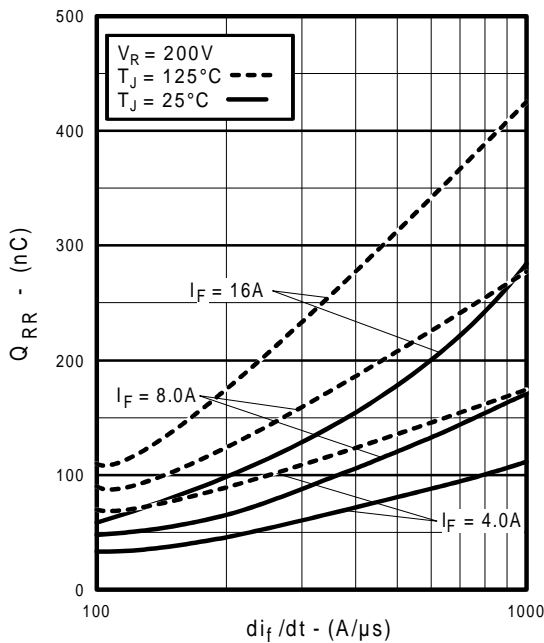


Fig. 16 - Typical Stored Charge vs. di_f/dt

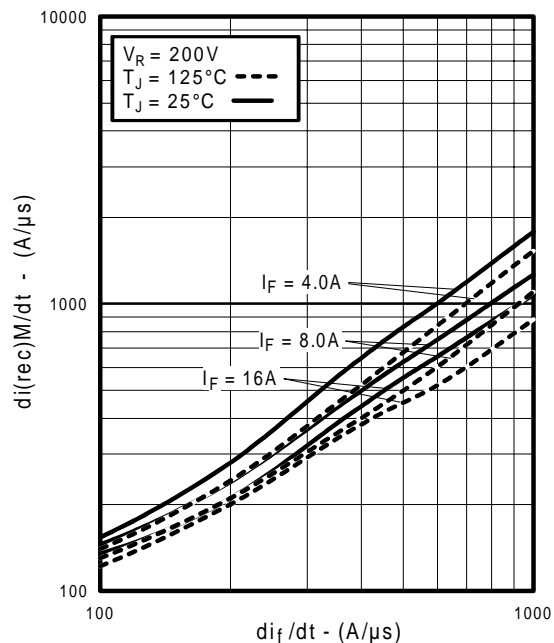


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

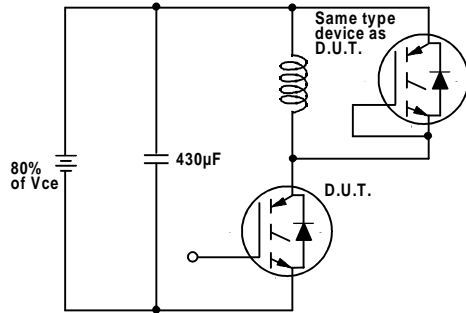


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

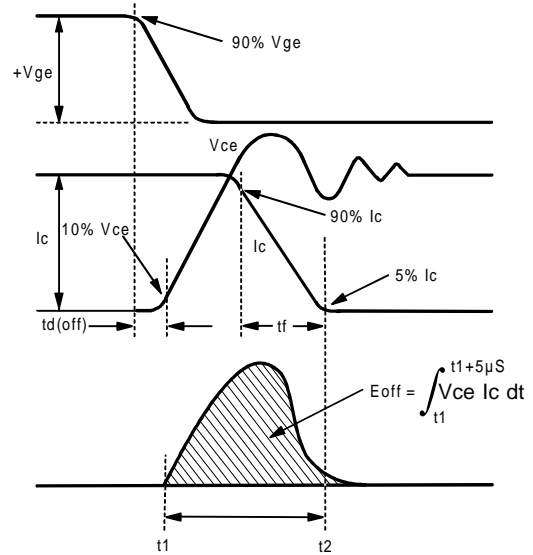


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

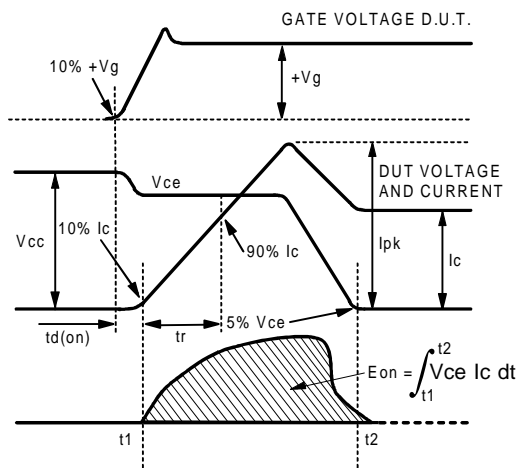


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

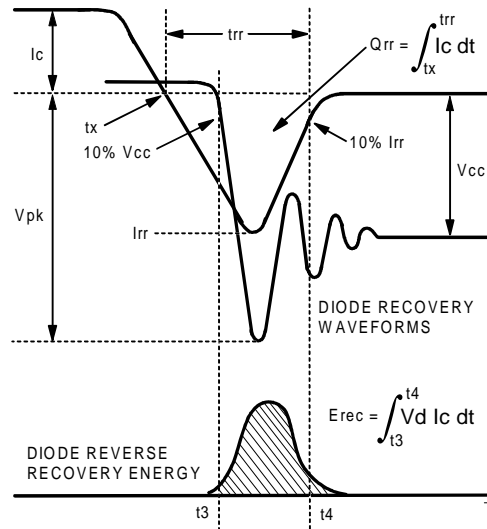


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

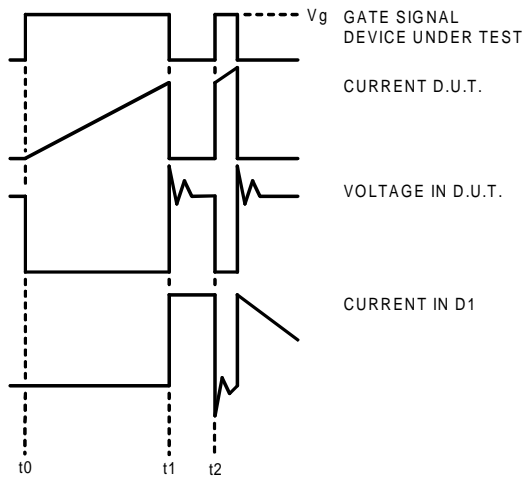


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

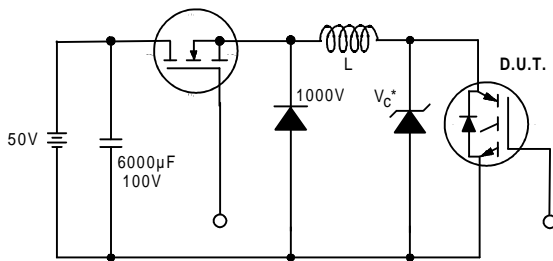


Figure 19. Clamped Inductive Load Test Circuit

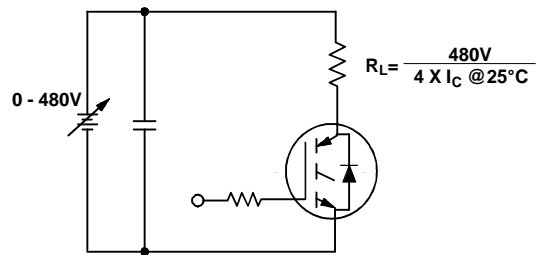


Figure 20. Pulsed Collector Current Test Circuit

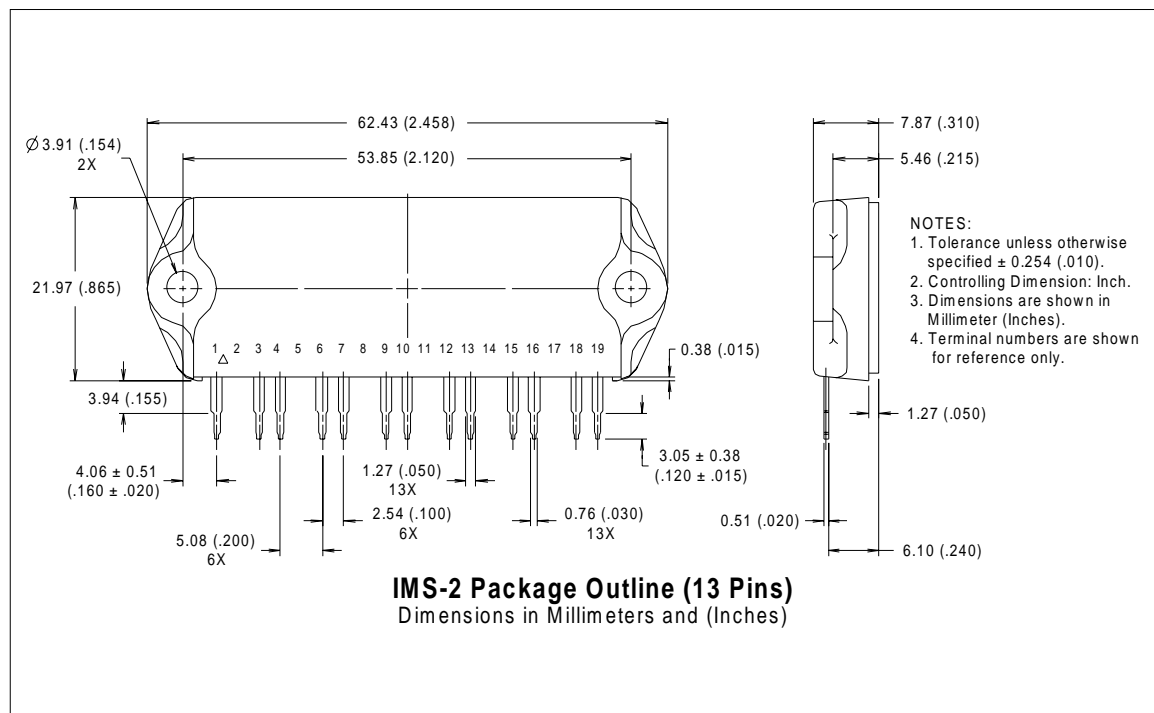
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Notes:

- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 23\Omega$ (Figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

Case Outline — IMS-2



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