

IRG4BC15MDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST
SOFT RECOVERY DIODE

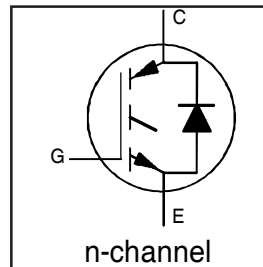
Short Circuit Rated
Fast IGBT

Features

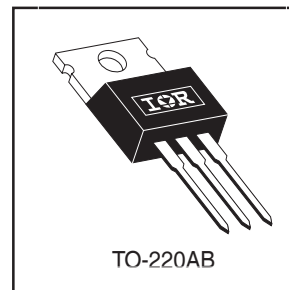
- Rugged: 10μsec short circuit capable at $V_{GS} = 15V$
- Low $V_{CE(on)}$ for 4 to 10kHz applications
- IGBT co-packaged with ultra-soft-recovery anti-parallel diodes
- Industry standard TO-220AB package

Benefits

- Best Value for Appliance and Industrial applications
- Offers highest efficiency and short circuit capability for intermediate applications
- Provides best efficiency for the mid range frequency (4 to 10kHz)
- Optimized for Appliance and Industrial applications up to 1HP
- High noise immune "Positive Only" gate drive - Negative bias gate drive not necessary
- For Low EMI designs - requires little or no snubbing
- Single Package switch for bridge circuit applications
- Compatible with high voltage Gate Drive IC's
- Allows simpler gate drive



| |
|-----------------------------------|
| $V_{CES} = 600V$ |
| $V_{CE(on)} \text{ typ.} = 1.88V$ |
| @ $V_{GE} = 15V, I_C = 8.6A$ |



Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---------------------------|---|-----------------------------------|-------|
| V_{CES} | Collector-to-Emitter Voltage | 600 | V |
| $I_C @ T_C = 25^\circ C$ | Continuous Collector Current | 14 | A |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current | 8.6 | |
| I_{CM} | Pulsed Collector Current ① | 28 | |
| I_{LM} | Clamped Inductive Load Current ② | 28 | |
| $I_F @ T_C = 100^\circ C$ | Diode Continuous Forward Current | 4.0 | |
| t_{sc} | Short Circuit Withstand Time | 12 | μs |
| I_{FM} | Diode Maximum Forward Current | 16 | A |
| V_{GE} | Gate-to-Emitter Voltage | ± 20 | V |
| $P_D @ T_C = 25^\circ C$ | Maximum Power Dissipation | 49 | W |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation | 19 | |
| T_J T_{STG} | Operating Junction and Storage Temperature Range | -55 to +150 | °C |
| | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | |
| | Mounting Torque, 6-32 or M3 Screw. | 10 lbf•in (1.1 N•m) | |

Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|-----------------|---|------|----------|------|--------|
| $R_{\theta JC}$ | Junction-to-Case - IGBT | — | — | 2.7 | °C/W |
| $R_{\theta JC}$ | Junction-to-Case - Diode | — | — | 7.0 | |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface | — | 0.50 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | — | — | 80 | |
| Wt | Weight | — | 2 (0.07) | — | g (oz) |

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International
 Rectifier

Electrical Characteristics @ T_J = 25°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 = 250μA |
| ΔV _{(BR)CES} /ΔT _J | Temperature Coeff. of Breakdown Voltage | — | 0.65 | — | V/°C | V _{GE} = 0V, I _C = 1.0mA |
| V _{CE(on)} | Collector-to-Emitter Saturation Voltage | — | 1.88 | 2.3 | V | I _C = 8.6A |
| | | — | 2.6 | — | | I _C = 14A |
| | | — | 2.1 | — | | I _C = 8.6A, T _J = 150°C |
| V _{GE(th)} | Gate Threshold Voltage | 4.0 | — | 6.5 | | V _{CE} = V _{GE} , I _C = 250μA |
| ΔV _{GE(th)} /ΔT _J | Temperature Coeff. of Threshold Voltage | — | -10 | — | mV/°C | V _{CE} = V _{GE} , I _C = 250μA |
| g _{fe} | Forward Transconductance ^④ | 2.3 | 3.4 | — | S | V _{CE} = 100V, I _C = 6.5A |
| I _{CES} | Zero Gate Voltage Collector Current | — | — | 250 | μA | V _{GE} = 0V, V _{CE} = 600V |
| | | — | — | 1400 | | V _{GE} = 0V, V _{CE} = 600V, T _J = 150°C |
| V _{FM} | Diode Forward Voltage Drop | — | 1.5 | 1.8 | V | I _C = 4.0A |
| | | — | 1.4 | 1.7 | | I _C = 4.0A, T _J = 150°C |
| I _{GES} | Gate-to-Emitter Leakage Current | — | — | ±100 | nA | V _{GE} = ±20V |

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--------------------------|---|------|------|------|-------|---|
| Q _g | Total Gate Charge (turn-on) | — | 46 | — | nC | I _C = 8.6A |
| Q _{ge} | Gate - Emitter Charge (turn-on) | — | 4.2 | — | | V _{CC} = 400V |
| Q _{gc} | Gate - Collector Charge (turn-on) | — | 15 | — | | V _{GE} = 15V |
| t _{d(on)} | Turn-On Delay Time | — | 21 | — | ns | T _J = 25°C |
| t _r | Rise Time | — | 38 | — | | I _C = 8.6A, V _{CC} = 480V |
| t _{d(off)} | Turn-Off Delay Time | — | 540 | 810 | | V _{GE} = 15V, R _G = 75Ω |
| t _f | Fall Time | — | 350 | 530 | | Energy losses include "tail" and diode reverse recovery. |
| E _{on} | Turn-On Switching Loss | — | 0.32 | — | mJ | T _J = 150°C, I _C = 8.6A, V _{CC} = 480V V _{GE} = 15V, R _G = 75Ω Energy losses include "tail" and diode reverse recovery. |
| E _{off} | Turn-Off Switching Loss | — | 1.93 | — | | |
| E _{ts} | Total Switching Loss | — | 2.25 | 3.6 | | |
| t _{d(on)} | Turn-On Delay Time | — | 20 | — | ns | T _J = 150°C, I _C = 8.6A, V _{CC} = 480V V _{GE} = 15V, R _G = 75Ω Energy losses include "tail" and diode reverse recovery. |
| t _r | Rise Time | — | 42 | — | | |
| t _{d(off)} | Turn-Off Delay Time | — | 650 | — | | |
| t _f | Fall Time | — | 590 | — | | |
| E _{ts} | Total Switching Loss | — | 3.0 | — | mJ | |
| L _E | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| C _{ies} | Input Capacitance | — | 340 | — | pF | V _{GE} = 0V V _{CC} = 30V f = 1.0MHz |
| C _{oes} | Output Capacitance | — | 35 | — | | |
| C _{res} | Reverse Transfer Capacitance | — | 8.8 | — | | |
| t _{rr} | Diode Reverse Recovery Time | — | 28 | 42 | ns | T _J = 25°C |
| | | — | 38 | 57 | | T _J = 125°C |
| I _{rr} | Diode Peak Reverse Recovery Current | — | 2.9 | 5.2 | A | T _J = 25°C |
| | | — | 3.7 | 6.7 | | T _J = 125°C |
| Q _{rr} | Diode Reverse Recovery Charge | — | 40 | 60 | nC | T _J = 25°C |
| | | — | 70 | 110 | | T _J = 125°C |
| di _(rec) M/dt | Diode Peak Rate of Fall of Recovery During t _b | — | 280 | — | A/μs | T _J = 25°C |
| | | — | 240 | — | | T _J = 125°C |

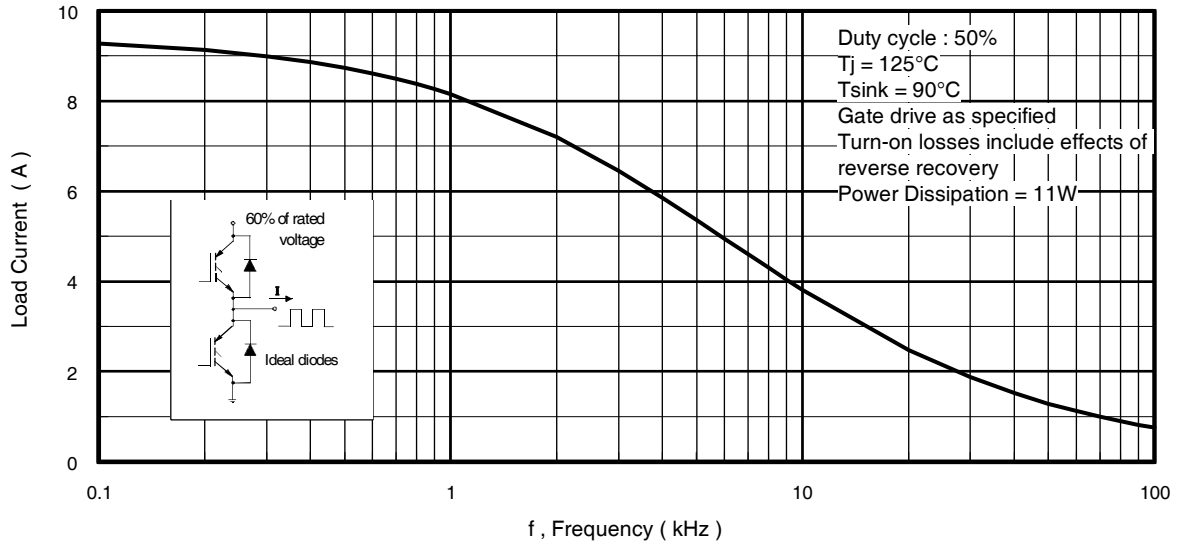


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

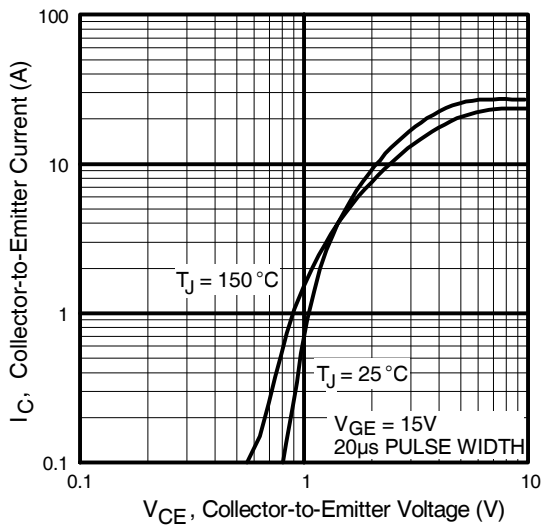


Fig. 2 - Typical Output Characteristics

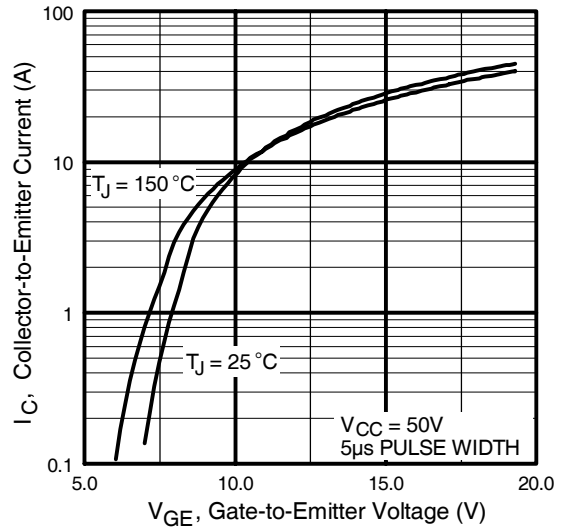


Fig. 3 - Typical Transfer Characteristics

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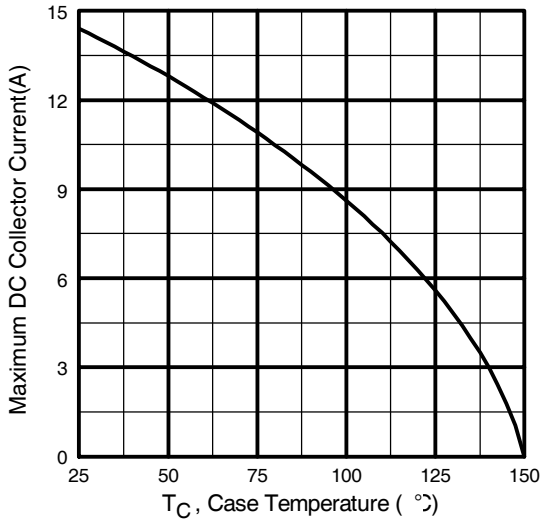


Fig. 4 - Maximum Collector Current vs. Case Temperature

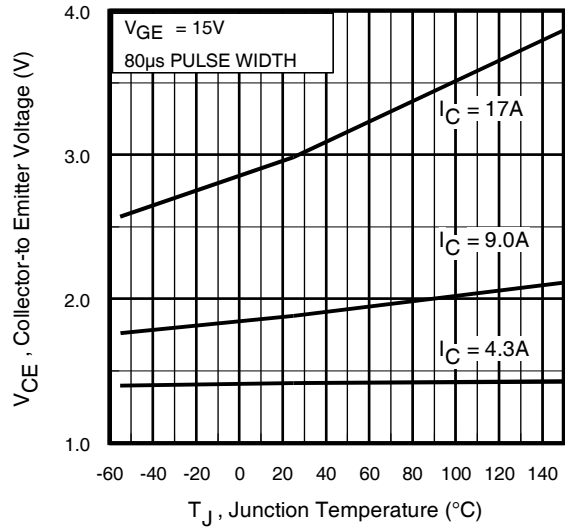


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

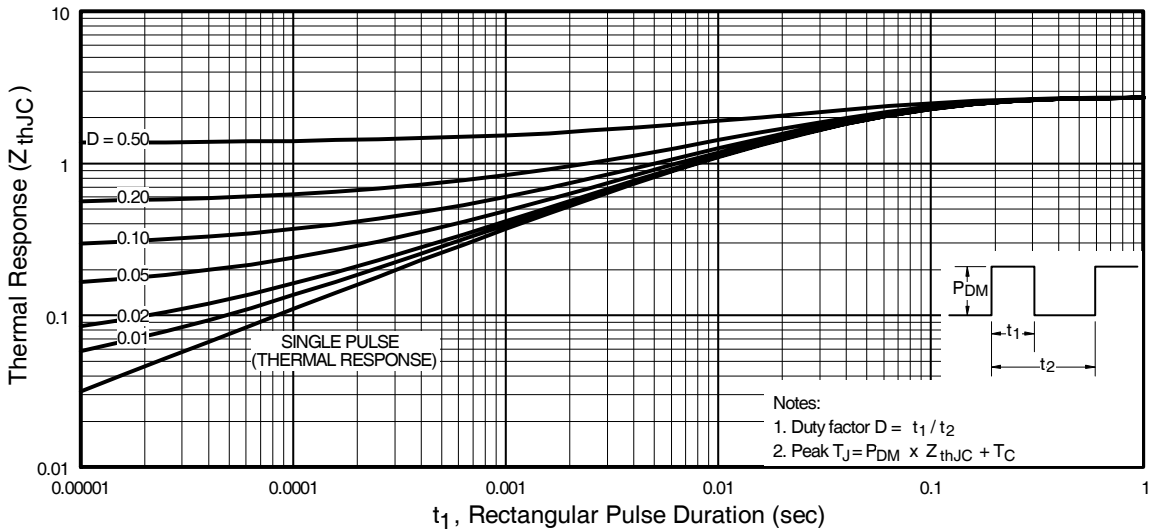


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

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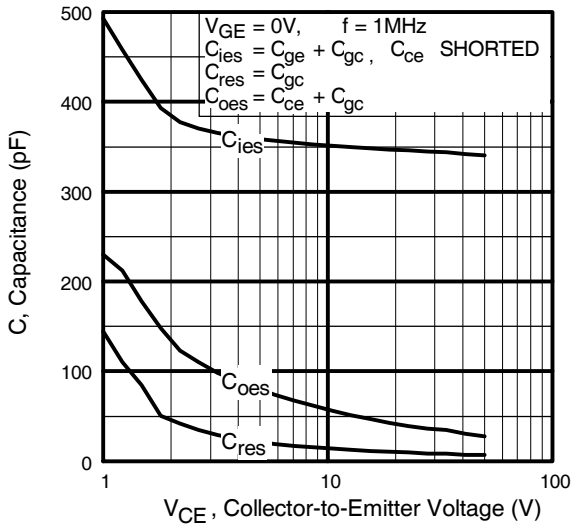


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

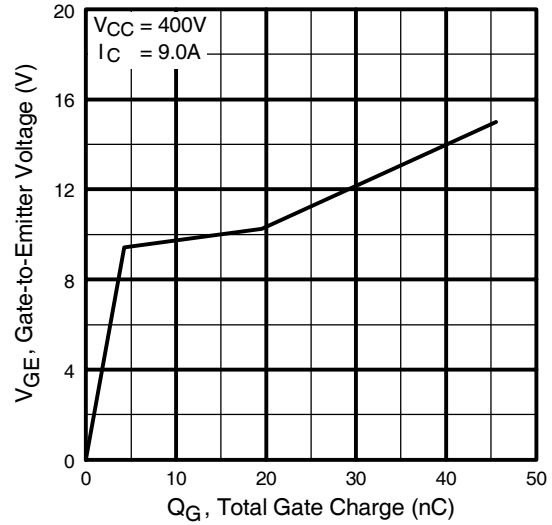


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

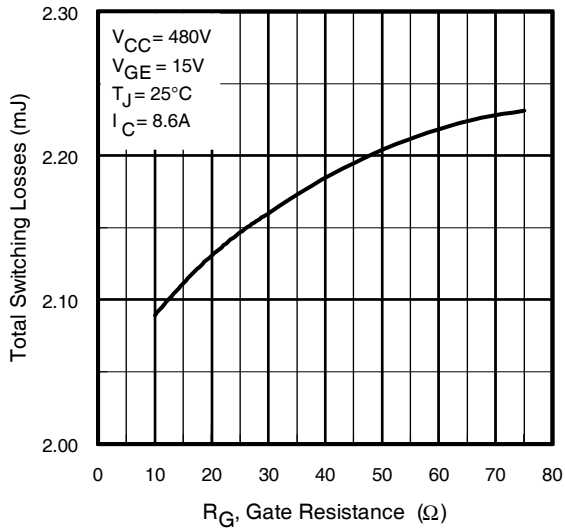


Fig. 9 - Typical Switching Losses vs. Gate Resistance

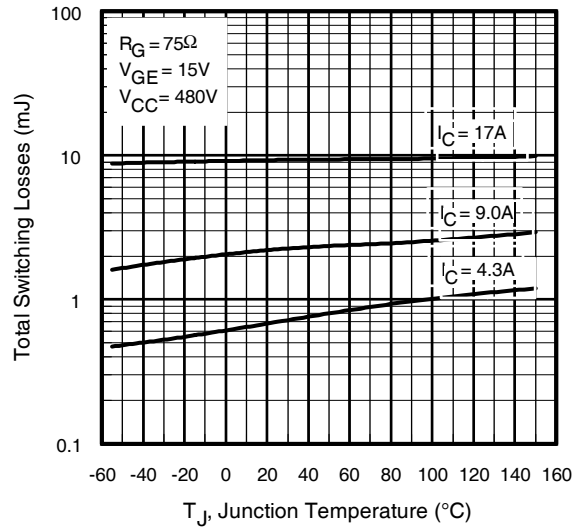


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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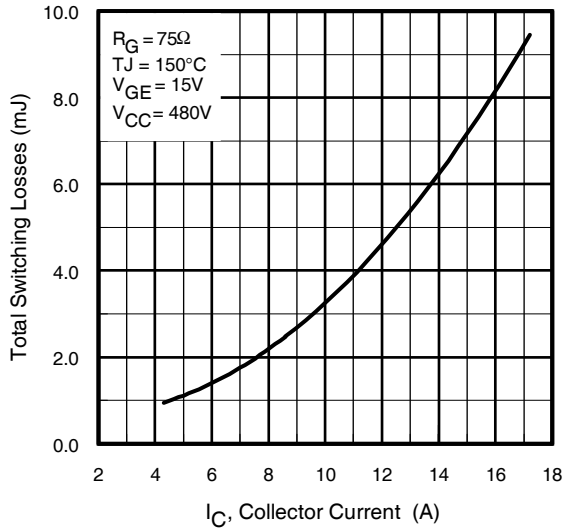


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

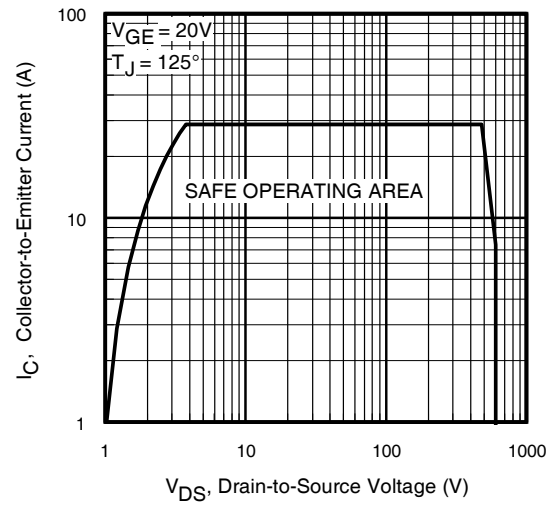
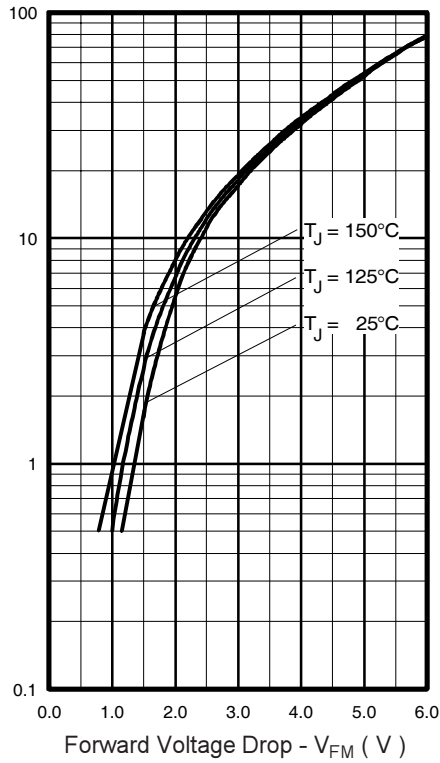


Fig. 12 - Turn-Off SOA



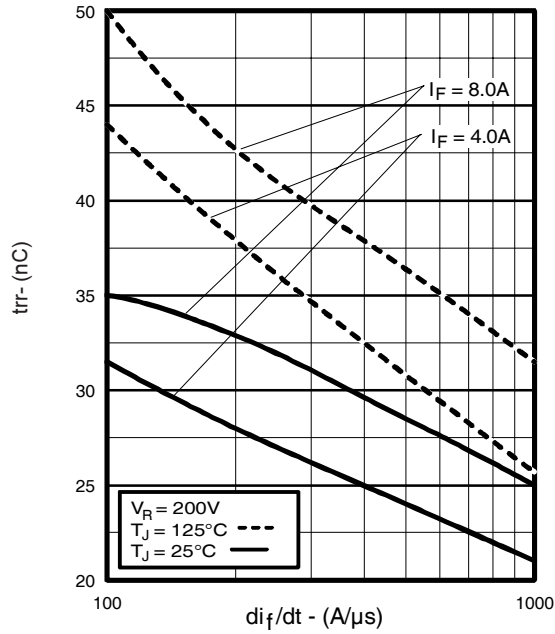


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

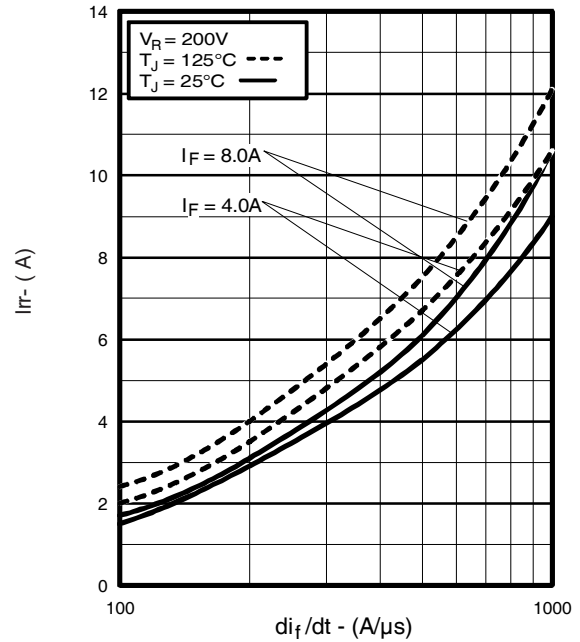


Fig. 15 - Typical Recovery Current vs. di_f/dt

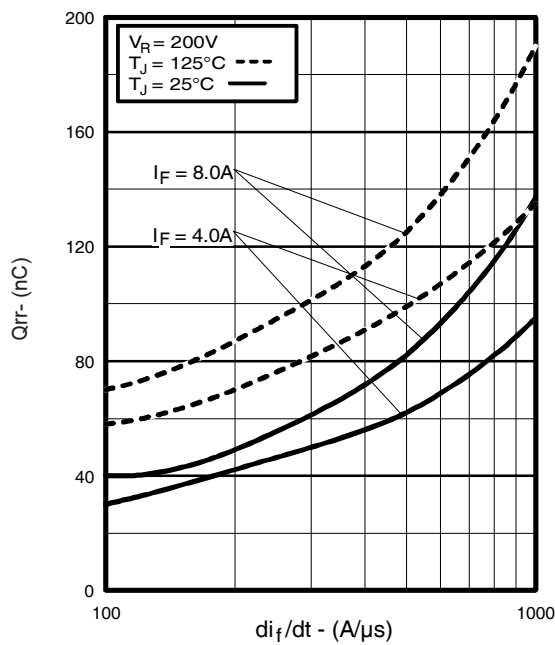


Fig. 16 - Typical Stored Charge vs. di_f/dt

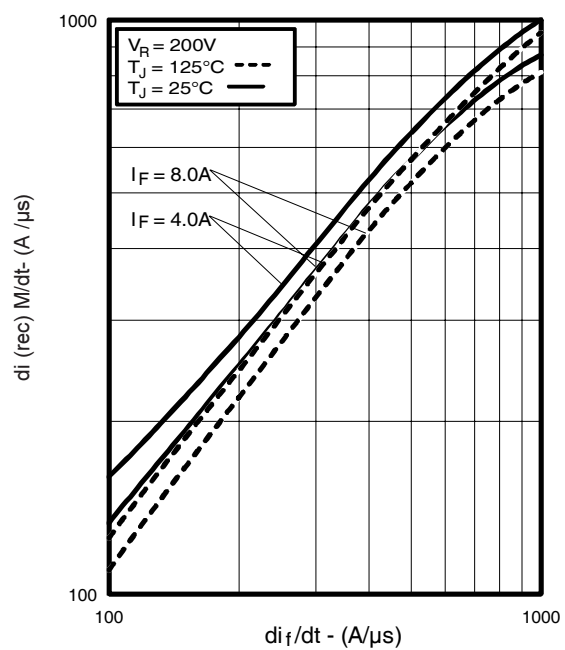


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt ,

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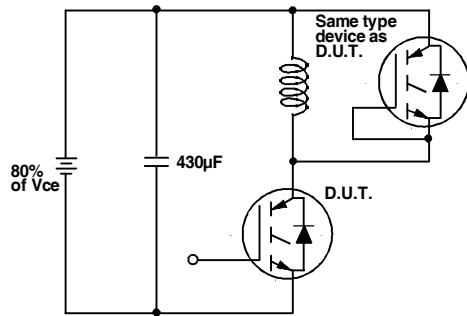


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

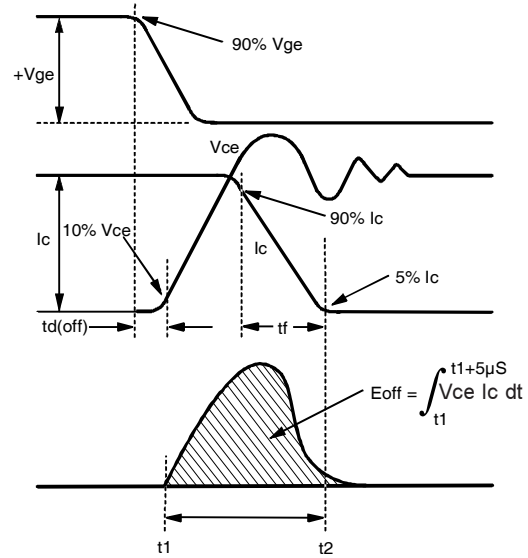


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

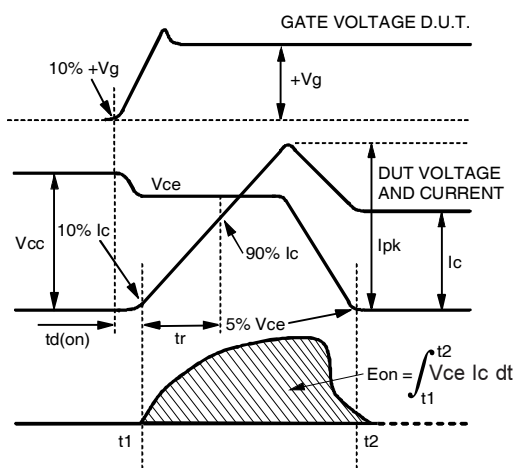


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

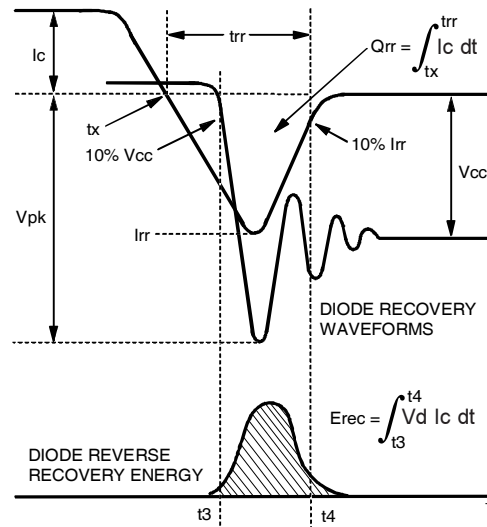


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

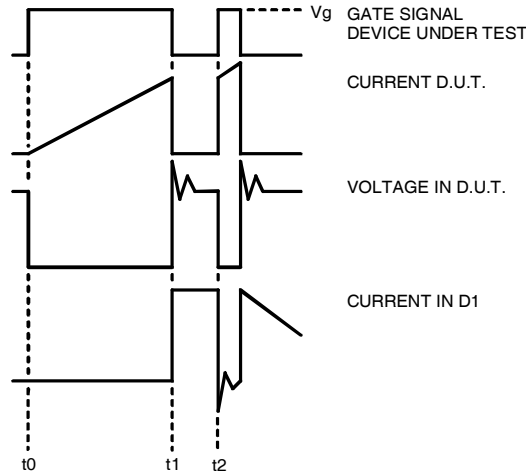


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

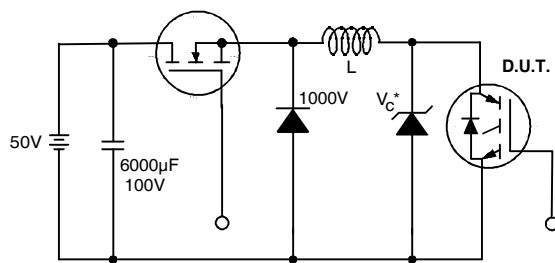


Figure 19. Clamped Inductive Load Test Circuit

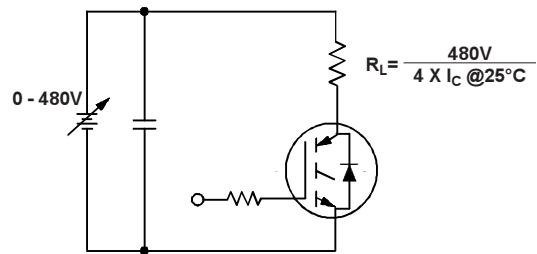


Figure 20. Pulsed Collector Current Test Circuit

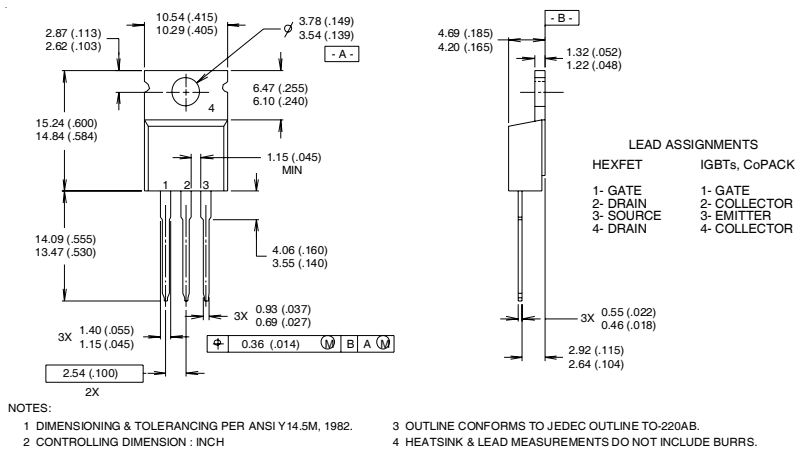
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Notes:

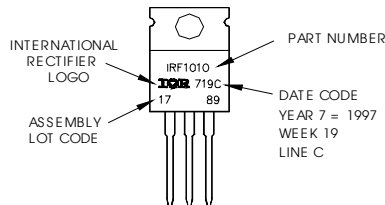
- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 75\Omega$
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

TO-220AB Package Outline



TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
 LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"
Note: "P" in assembly line
 position indicates "Lead-Free"



Data and specifications subject to change without notice.
 This product has been designed and qualified for the industrial market.
 Qualification Standards can be found on IR's Web site.



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