

PRELIMINARY

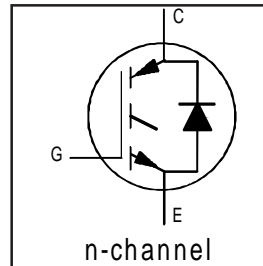
IRG4PSH71KD

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

Short Circuit Rated
UltraFast IGBT

Features

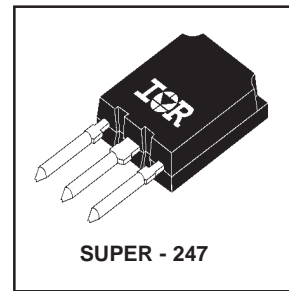
- Hole-less clip/pressure mount package compatible with TO-247 and TO-264, with reinforced pins
- High short circuit rating IGBTs, optimized for motorcontrol
- Minimum switching losses combined with low conduction losses
- Tightest parameter distribution
- IGBT co-packaged with ultrafast soft recovery antiparallel diode
- Creepage distance increased to 5.35mm



| |
|-----------------------------------|
| $V_{CES} = 1200V$ |
| $V_{CE(on)} \text{ typ.} = 2.97V$ |
| @ $V_{GE} = 15V, I_C = 42A$ |

Benefits

- Highest current rating copack IGBT
- Maximum power density, twice the power handling of the TO-247, less space than TO-264
- HEXFRED™ diode optimized for operation with IGBT, to minimize EMI, noise and switching losses



Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---------------------------|------------------------------------|-----------------------------------|------------|
| V_{CES} | Collector-to-Emitter Voltage | 1200 | V |
| $I_C @ T_C = 25^\circ C$ | Continuous Collector Current | 78 | A |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current | 42 | |
| I_{CM} | Pulsed Collector Current ① | 156 | |
| I_{LM} | Clamped Inductive Load Current ② | 156 | |
| $I_F @ T_C = 100^\circ C$ | Diode Continuous Forward Current | 42 | |
| I_{FM} | Diode Maximum Forward Current | 156 | |
| t_{sc} | Short Circuit Withstand Time | 10 | μs |
| V_{GE} | Gate-to-Emitter Voltage | ± 20 | V |
| $P_D @ T_C = 25^\circ C$ | Maximum Power Dissipation | 350 | W |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation | 140 | |
| T_J | Operating Junction and | -55 to +150 | $^\circ C$ |
| T_{STG} | Storage Temperature Range | | |
| | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | |

Thermal Resistance\ Mechanical

| | Parameter | Min. | Typ. | Max. | Units |
|-----------------|---|-----------|----------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case - IGBT | — | — | 0.36 | $^\circ C/W$ |
| $R_{\theta JC}$ | Junction-to-Case - Diode | — | — | 0.69 | |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface | — | 0.24 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | — | — | 38 | |
| | Recommended Clip Force | 20.0(2.0) | — | — | N (kgf) |
| | Weight | — | 6 (0.21) | — | g (oz) |

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--------------------------------------|---|------|------|------|-------|---|
| V _{(BR)CES} | Collector-to-Emitter Breakdown Voltage ^③ | 1200 | — | — | V | V _{GE} = 0V, I _C = 250μA |
| ΔV _{(BR)CES/ΔT_J} | Temperature Coeff. of Breakdown Voltage | — | 1.1 | — | V/°C | V _{GE} = 0V, I _C = 10mA |
| V _{CE(on)} | Collector-to-Emitter Saturation Voltage | — | 2.97 | 3.9 | V | I _C = 42A V _{GE} = 15V |
| | | — | 3.44 | — | | I _C = 78A See Fig. 2, 5 |
| | | — | 2.60 | — | | I _C = 42A, T _J = 150°C |
| V _{GE(th)} | Gate Threshold Voltage | 3.0 | — | 6.0 | | V _{CE} = V _{GE} , I _C = 250μA |
| ΔV _{GE(th)/ΔT_J} | Temperature Coeff. of Threshold Voltage | — | -12 | — | mV/°C | V _{CE} = V _{GE} , I _C = 1.5mA |
| g _{fe} | Forward Transconductance ^④ | 25 | 38 | — | S | V _{CE} = 50V, I _C = 42A |
| I _{CES} | Zero Gate Voltage Collector Current | — | — | 500 | μA | V _{GE} = 0V, V _{CE} = 1200V |
| | | — | — | 10 | mA | V _{GE} = 0V, V _{CE} = 1200V, T _J = 150°C |
| V _{FM} | Diode Forward Voltage Drop | — | 2.5 | 3.7 | V | I _C = 42A See Fig. 13 |
| | | — | 2.4 | — | | I _C = 42A, 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) | — | 410 | 610 | nC | I _C = 42A |
| Q _{ge} | Gate - Emitter Charge (turn-on) | — | 47 | 70 | | V _{CC} = 400V See Fig.8 |
| Q _{gc} | Gate - Collector Charge (turn-on) | — | 145 | 220 | | V _{GE} = 15V |
| t _{d(on)} | Turn-On Delay Time | — | 67 | — | ns | T _J = 25°C |
| t _r | Rise Time | — | 84 | — | | I _C = 42A, V _{CC} = 800V |
| t _{d(off)} | Turn-Off Delay Time | — | 230 | 350 | | V _{GE} = 15V, R _G = 5.0Ω |
| t _f | Fall Time | — | 130 | 190 | | Energy losses include "tail" and diode reverse recovery |
| E _{on} | Turn-On Switching Loss | — | 5.68 | — | mJ | See Fig. 9,10,18 |
| E _{off} | Turn-Off Switching Loss | — | 3.23 | — | | |
| E _{ts} | Total Switching Loss | — | 8.90 | 11.6 | | |
| t _{sc} | Short Circuit Withstand Time | 10 | — | — | μs | V _{CC} = 720V, T _J = 125°C V _{GE} = 15V, R _G = 5.0Ω |
| t _{d(on)} | Turn-On Delay Time | — | 65 | — | ns | T _J = 150°C, See Fig. 11,18 |
| t _r | Rise Time | — | 87 | — | | I _C = 42A, V _{CC} = 800V |
| t _{d(off)} | Turn-Off Delay Time | — | 370 | — | | V _{GE} = 15V, R _G = 5.0Ω |
| t _f | Fall Time | — | 290 | — | | Energy losses include "tail" and diode reverse recovery |
| E _{ts} | Total Switching Loss | — | 13.7 | — | mJ | |
| L _E | Internal Emitter Inductance | — | 13 | — | nH | Measured 5mm from package |
| C _{ies} | Input Capacitance | — | 5770 | — | pF | V _{GE} = 0V |
| C _{oes} | Output Capacitance | — | 400 | — | | V _{CC} = 30V See Fig. 7 |
| C _{res} | Reverse Transfer Capacitance | — | 100 | — | | f = 1.0MHz |
| t _{rr} | Diode Reverse Recovery Time | — | 107 | 160 | ns | T _J = 25°C See Fig. 14 |
| | | — | 160 | 240 | | T _J = 125°C |
| I _{rr} | Diode Peak Reverse Recovery Current | — | 10 | 15 | A | T _J = 25°C See Fig. 15 |
| | | — | 16 | 24 | | T _J = 125°C |
| Q _{rr} | Diode Reverse Recovery Charge | — | 680 | 1020 | nC | T _J = 25°C See Fig. 16 |
| | | — | 1400 | 2100 | | T _J = 125°C |
| di _{(rec)M/dt} | Diode Peak Rate of Fall of Recovery During t _b | — | 250 | — | A/μs | T _J = 25°C See Fig. 17 |
| | | — | 320 | — | | T _J = 125°C |

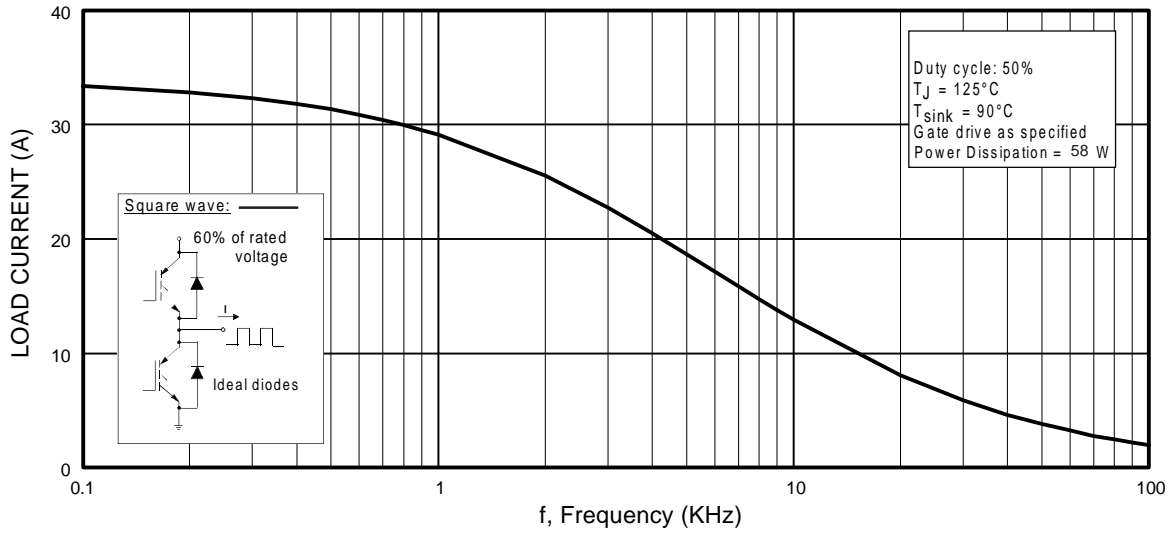


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

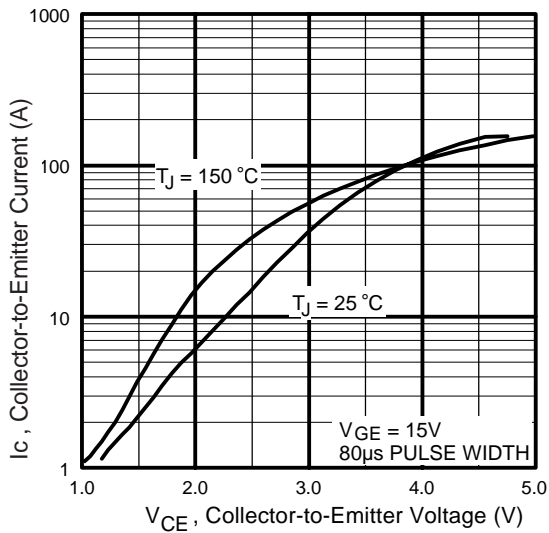


Fig. 2 - Typical Output Characteristics

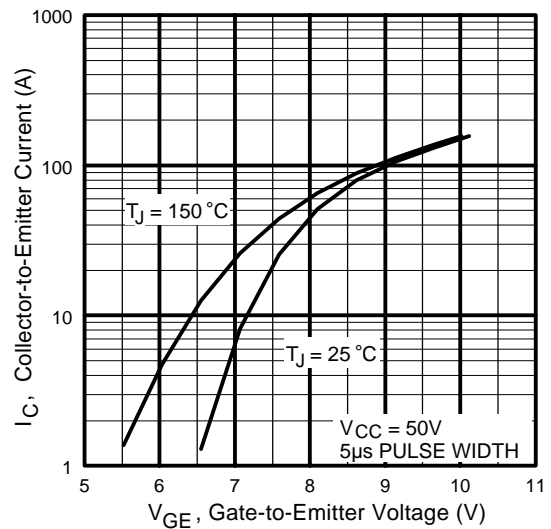


Fig. 3 - Typical Transfer Characteristics

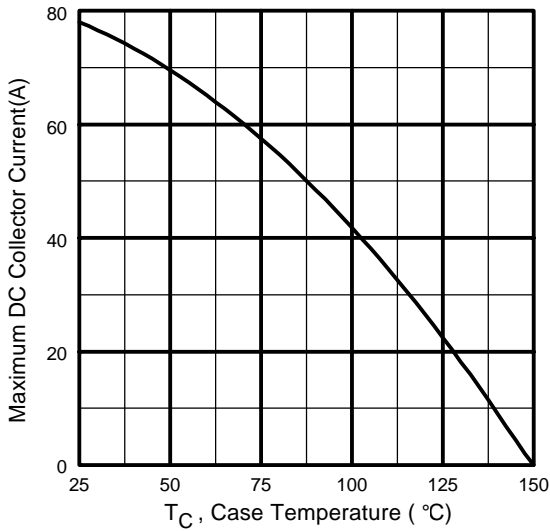


Fig. 4 - Maximum Collector Current vs. Case Temperature

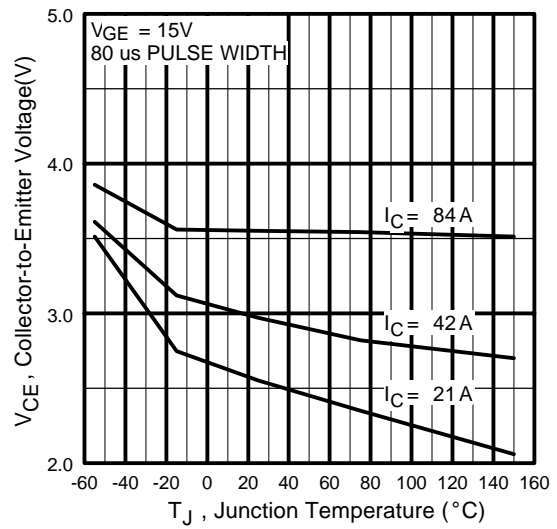


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

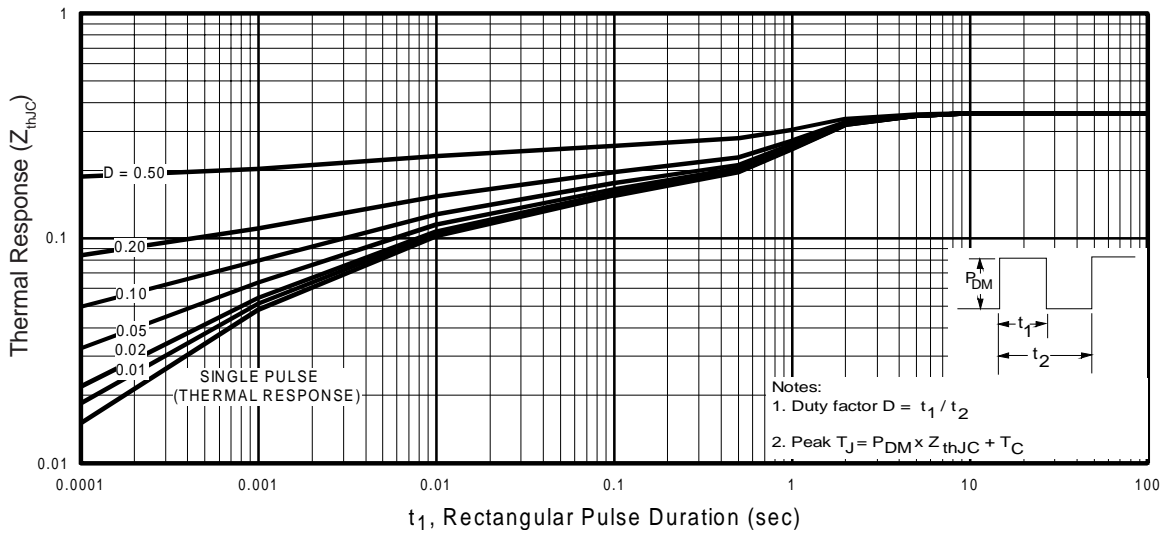


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

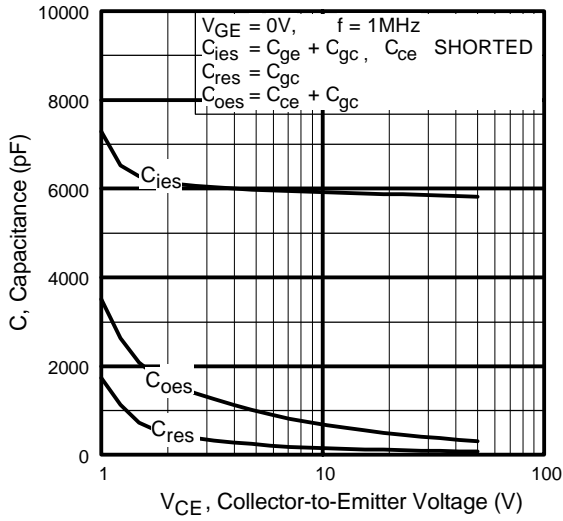


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

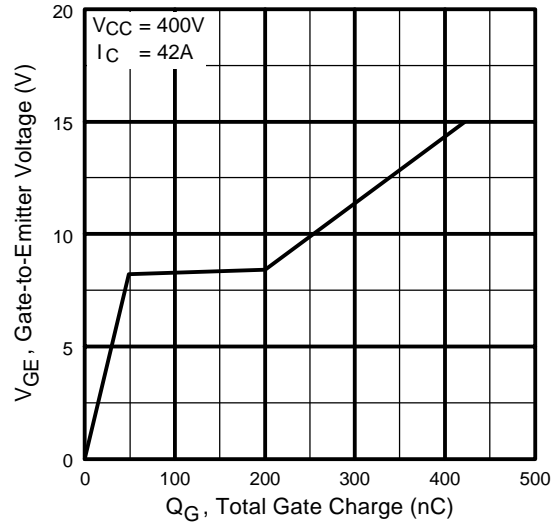


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

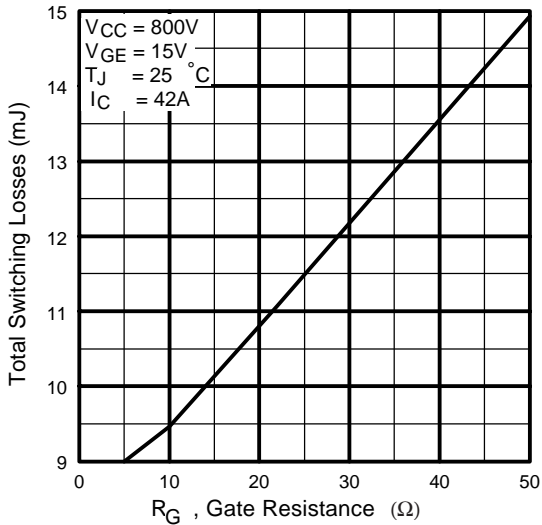


Fig. 9 - Typical Switching Losses vs. Gate Resistance

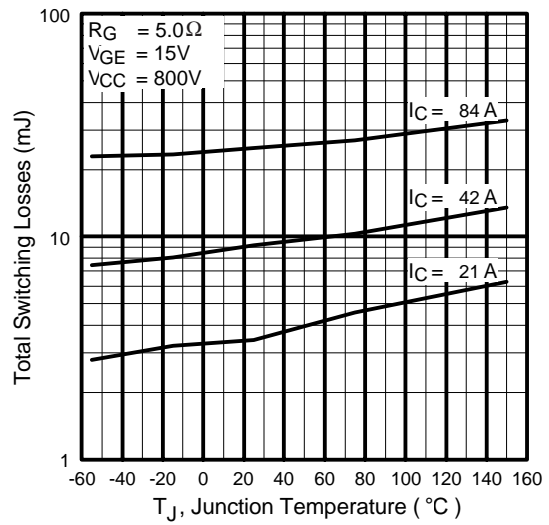
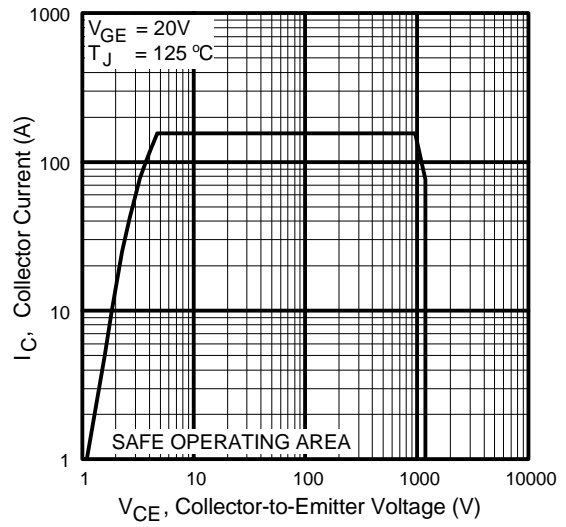
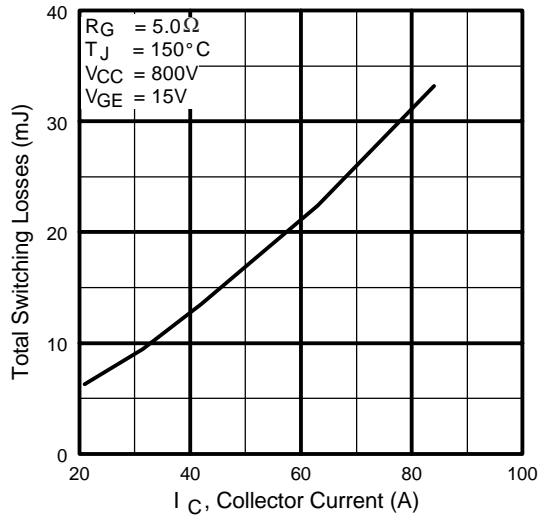


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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Collector-to-Emitter Current

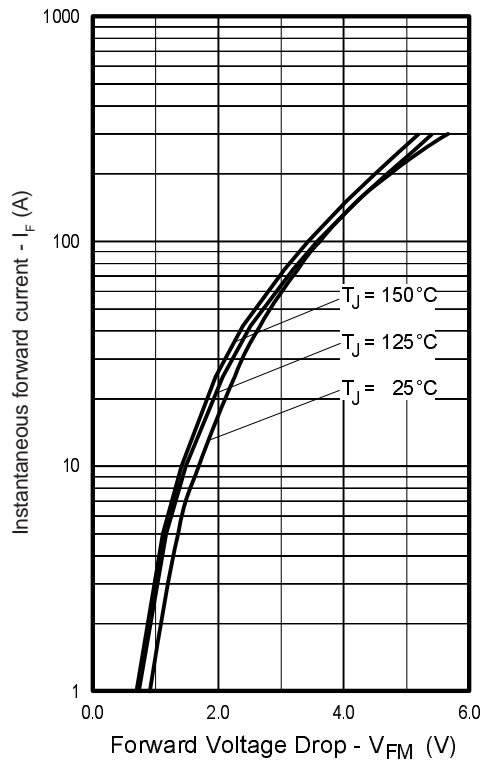


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

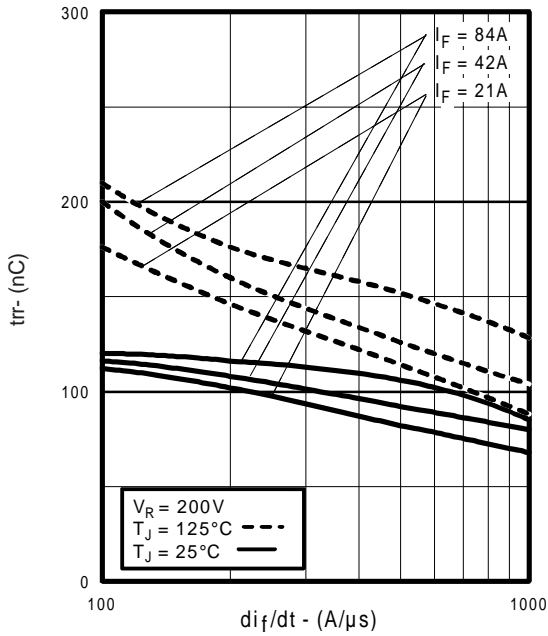


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

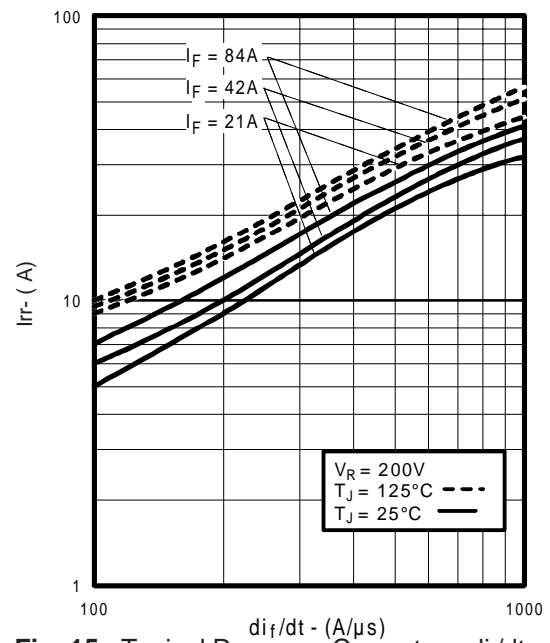


Fig. 15 - Typical Recovery Current vs. di_f/dt

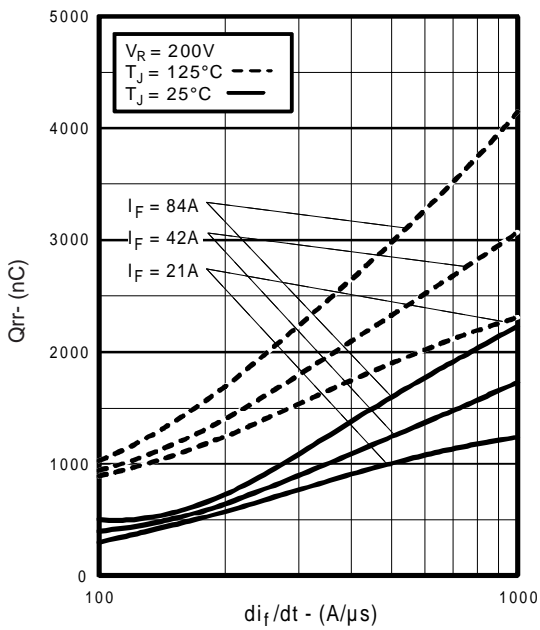


Fig. 16 - Typical Stored Charge vs. di_f/dt
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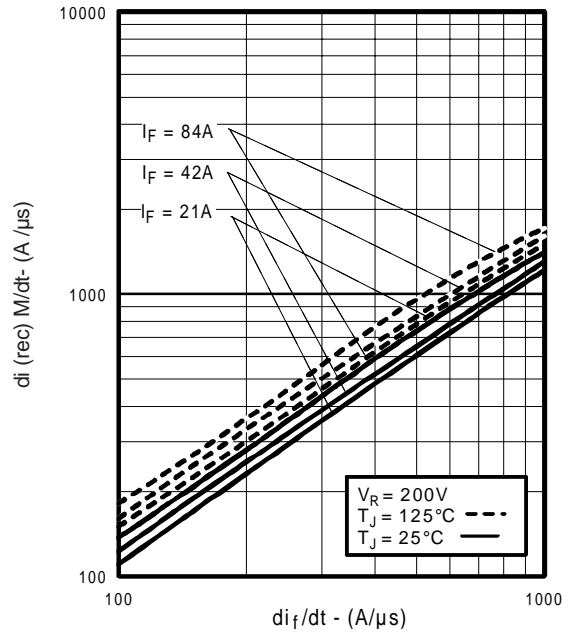


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

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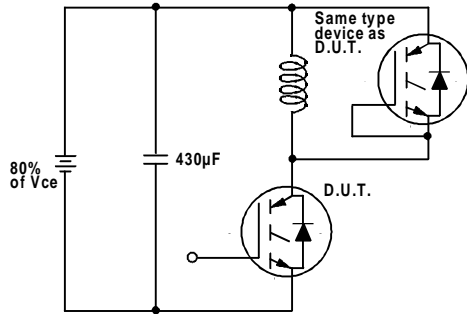


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

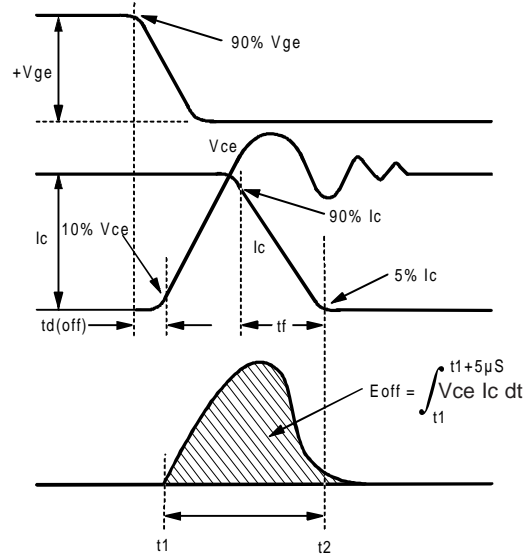


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

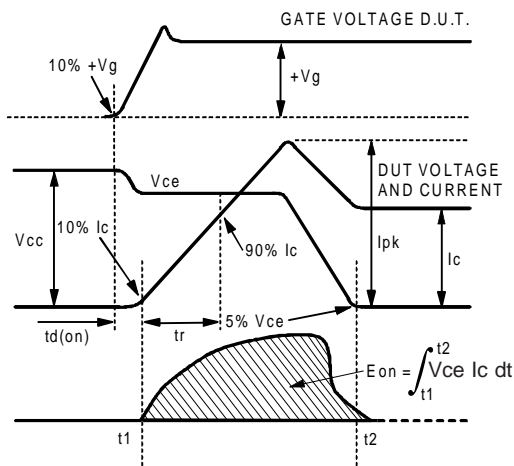


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

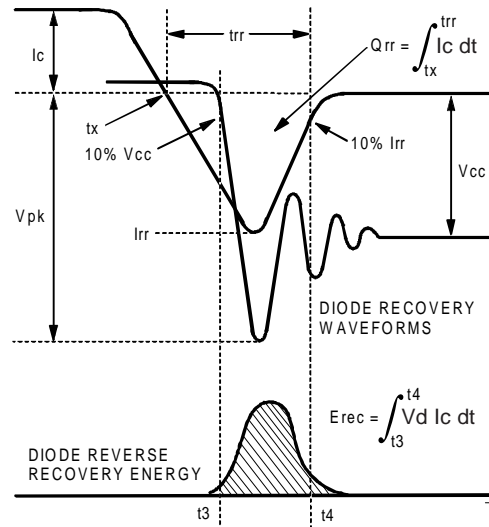


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

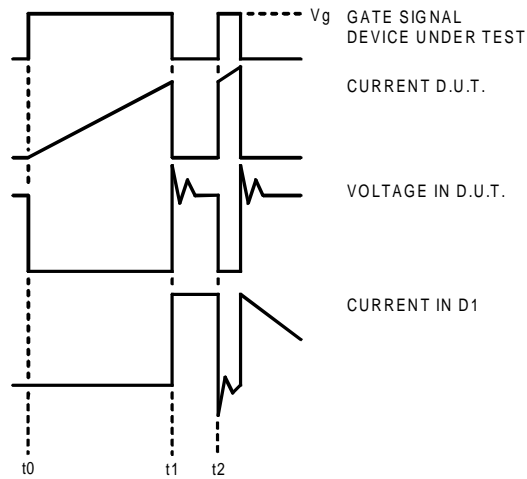


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

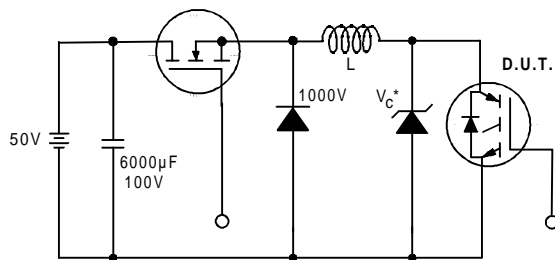


Figure 19. Clamped Inductive Load Test Circuit

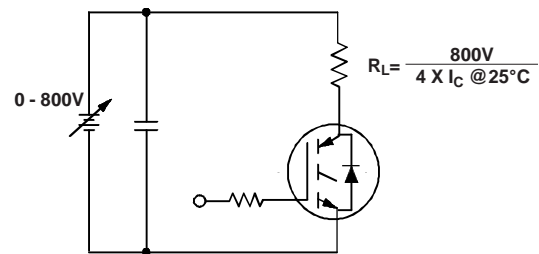


Figure 20. Pulsed Collector Current Test Circuit

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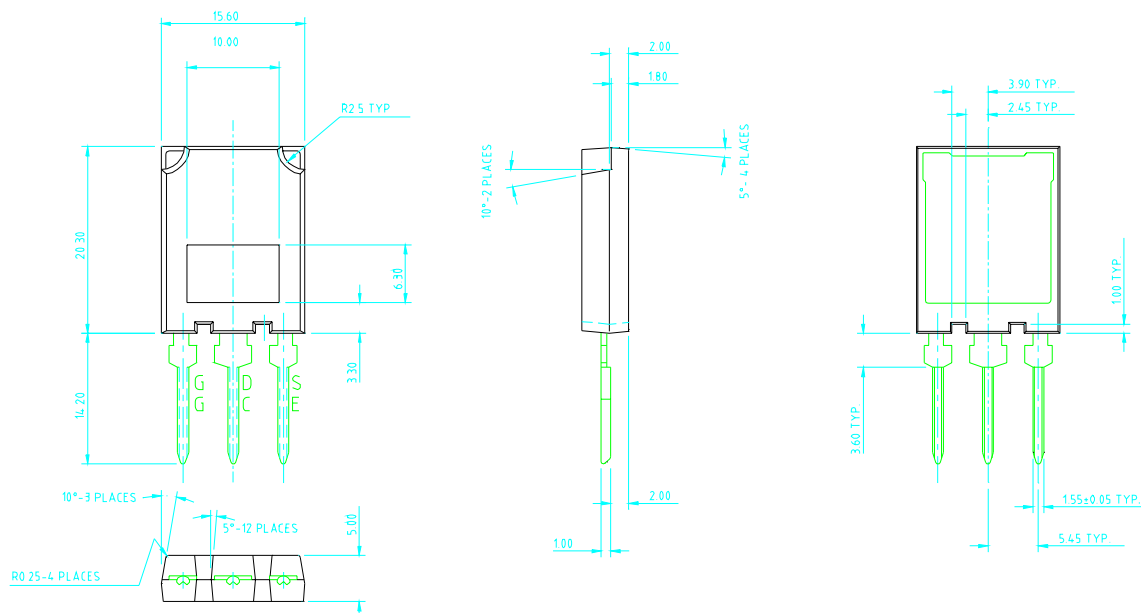
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Notes:

- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G=5.0\Omega$ (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 and Dimensions — Super-247

Dimensions are shown in millimeters



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