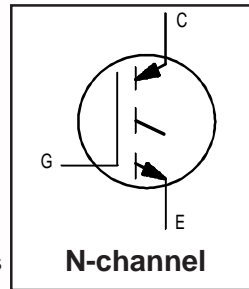


IRG4BC20W-S

INSULATED GATE BIPOLAR TRANSISTOR

Features

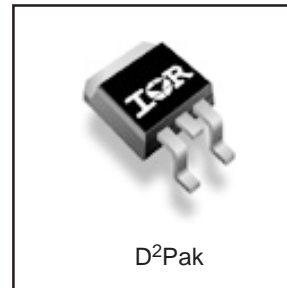
- Designed expressly for Switch-Mode Power Supply and PFC (power factor correction) applications
- Industry-benchmark switching losses improve efficiency of all power supply topologies
- 50% reduction of Eoff parameter
- Low IGBT conduction losses
- Latest-generation IGBT design and construction offers tighter parameters distribution, exceptional reliability



| |
|-----------------------------------|
| $V_{CES} = 600V$ |
| $V_{CE(on)} \text{ typ.} = 2.16V$ |
| @ $V_{GE} = 15V, I_C = 6.5A$ |

Benefits

- Lower switching losses allow more cost-effective operation than power MOSFETs up to 150kHz ("hard switched" mode)
- Of particular benefit to single-ended converters and boost PFC topologies 150W and higher
- Low conduction losses and minimal minority-carrier recombination make these an excellent option for resonant mode switching as well (up to >>300kHz)



Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---------------------------|--|------------------------------------|------------|
| V_{CES} | Collector-to-Emitter Breakdown Voltage | 600 | V |
| $I_C @ T_C = 25^\circ C$ | Continuous Collector Current | 13 | A |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current | 6.5 | |
| I_{CM} | Pulsed Collector Current ① | 52 | |
| I_{LM} | Clamped Inductive Load Current ② | 52 | |
| V_{GE} | Gate-to-Emitter Voltage | ± 20 | V |
| E_{ARV} | Reverse Voltage Avalanche Energy ③ | 200 | mJ |
| $P_D @ T_C = 25^\circ C$ | Maximum Power Dissipation | 60 | W |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation | 24 | |
| T_J T_{STG} | Operating Junction and Storage Temperature Range | -55 to + 150 | $^\circ C$ |
| | Soldering Temperature, for 10 seconds | 300 (0.063 in. (1.6mm) from case) | |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|-----------------|---|------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case | — | 2.1 | $^\circ C/W$ |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | 0.5 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | — | 40 | |
| Wt | Weight | 1.44 | — | 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 | 600 | — | — | V | $V_{GE} = 0V, I_C = 250\mu A$ |
| $V_{(BR)ECS}$ | Emitter-to-Collector Breakdown Voltage ④ | 18 | — | — | V | $V_{GE} = 0V, I_C = 1.0A$ |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | — | 0.48 | — | V/°C | $V_{GE} = 0V, I_C = 1.0mA$ |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | — | 2.16 | 2.6 | V | $I_C = 6.5A, V_{GE} = 15V$ See Fig.2, 5 |
| | | — | 2.55 | — | | |
| | | — | 2.05 | — | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 6.0 | | $I_C = 6.5A, T_J = 150^\circ\text{C}$ $V_{CE} = V_{GE}, I_C = 250\mu A$ |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temperature Coeff. of Threshold Voltage | — | -8.8 | — | mV/°C | $V_{CE} = V_{GE}, I_C = 250\mu A$ |
| g_{fe} | Forward Transconductance ⑤ | 5.5 | 8.3 | — | S | $V_{CE} = 100V, I_C = 6.5A$ |
| I_{CES} | Zero Gate Voltage Collector Current | — | — | 250 | μA | $V_{GE} = 0V, V_{CE} = 600V$ $V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$ $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$ |
| | | — | — | 2.0 | | |
| | | — | — | 1000 | | |
| 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) | — | 26 | 38 | nC | $I_C = 6.5A, V_{CC} = 400V, V_{GE} = 15V$ See Fig.8 |
| Q_{ge} | Gate - Emitter Charge (turn-on) | — | 3.7 | 5.5 | | |
| Q_{gc} | Gate - Collector Charge (turn-on) | — | 10 | 15 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 22 | — | ns | $T_J = 25^\circ\text{C}$ $I_C = 6.5A, V_{CC} = 480V, V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" See Fig. 9, 10, 14 |
| t_r | Rise Time | — | 14 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 110 | 160 | | |
| t_f | Fall Time | — | 64 | 96 | | |
| E_{on} | Turn-On Switching Loss | — | 0.06 | — | mJ | See Fig. 9, 10, 14 |
| E_{off} | Turn-Off Switching Loss | — | 0.08 | — | | |
| E_{ts} | Total Switching Loss | — | 0.14 | 0.2 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 21 | — | ns | $T_J = 150^\circ\text{C}$ $I_C = 6.5A, V_{CC} = 480V, V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" See Fig. 10, 11, 14 |
| t_r | Rise Time | — | 15 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 150 | — | | |
| t_f | Fall Time | — | 150 | — | | |
| E_{ts} | Total Switching Loss | — | 0.34 | — | mJ | |
| L_E | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| C_{ies} | Input Capacitance | — | 490 | — | pF | $V_{GE} = 0V, V_{CC} = 30V, f = 1.0MHz$ See Fig. 7 |
| C_{oes} | Output Capacitance | — | 38 | — | | |
| C_{res} | Reverse Transfer Capacitance | — | 8.8 | — | | |

Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature. (See Fig. 13b)
- ② $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, L = 10\mu H, R_G = 50\Omega$, (See Fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ⑤ Pulse width $5.0\mu s$, single shot.

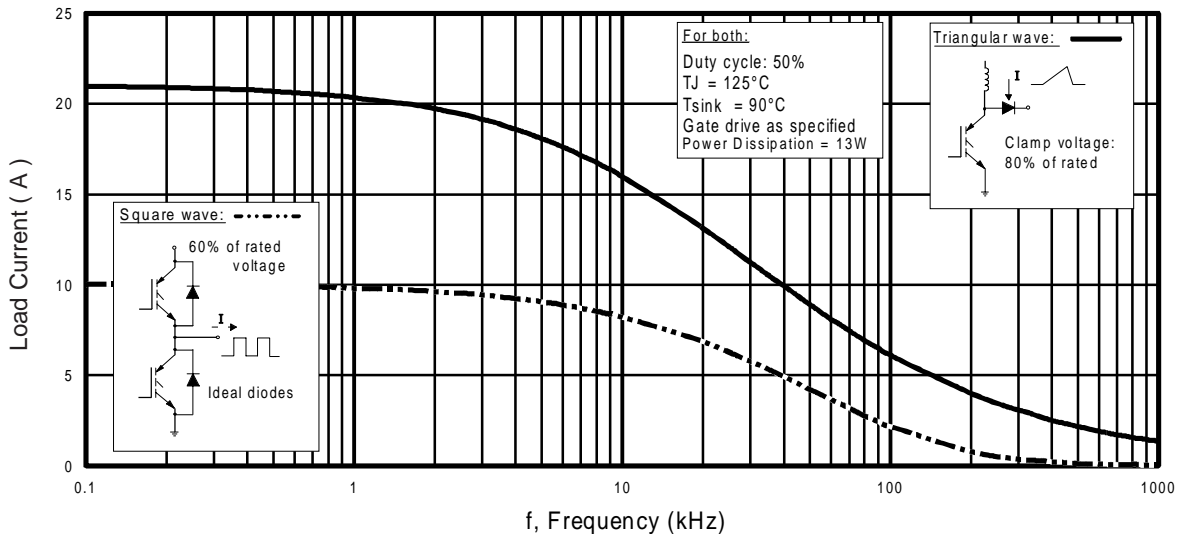


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

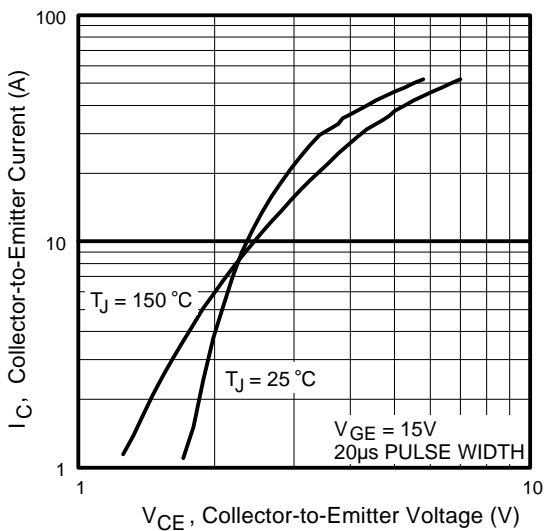


Fig. 2 - Typical Output Characteristics

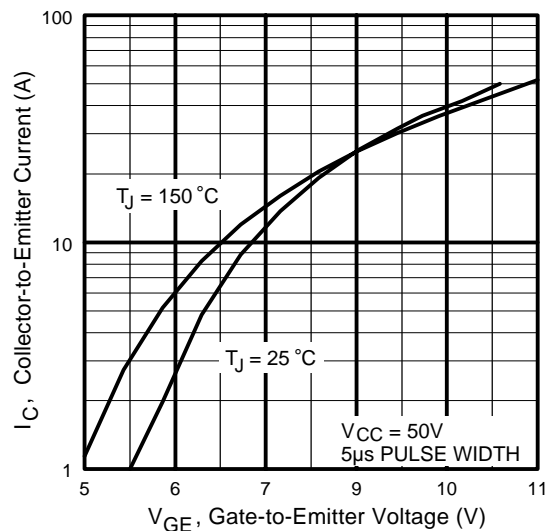


Fig. 3 - Typical Transfer Characteristics

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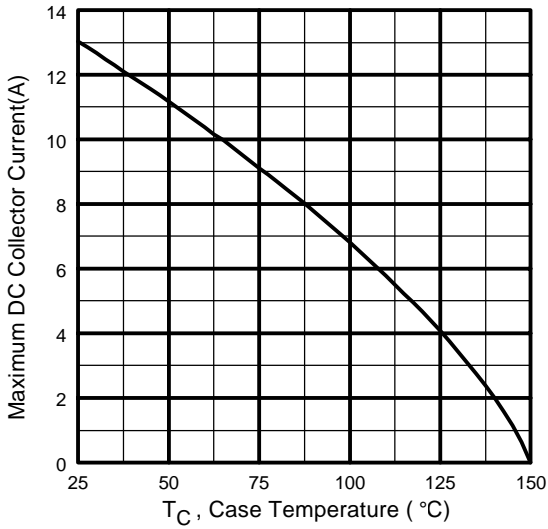


Fig. 4 - Maximum Collector Current vs. Case Temperature

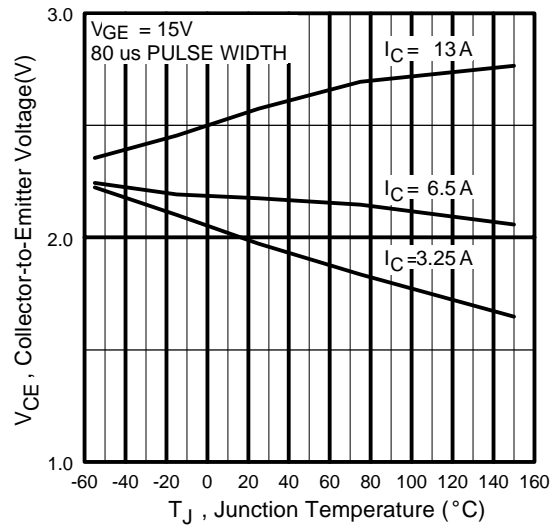


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

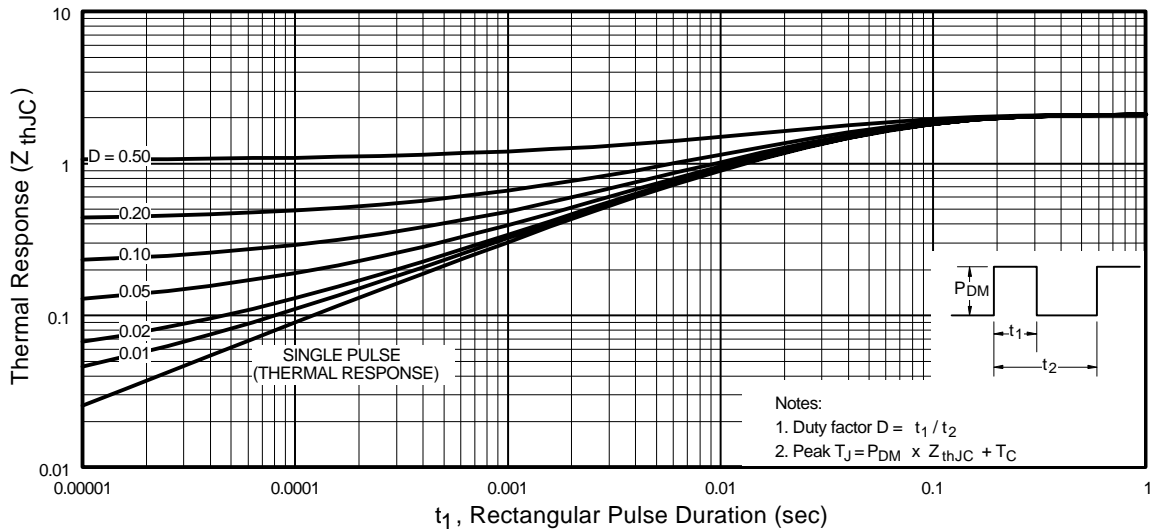


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

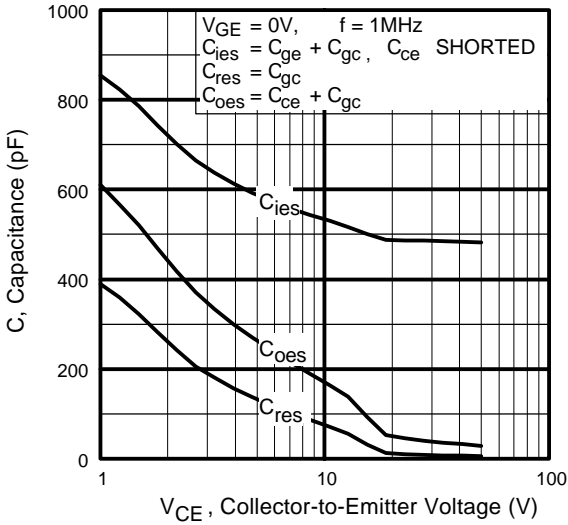


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

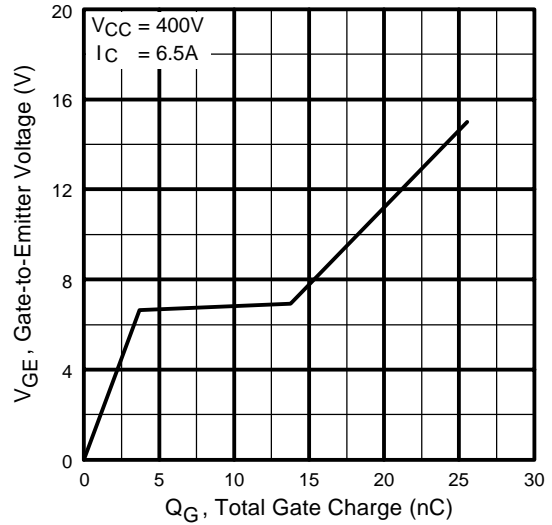


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

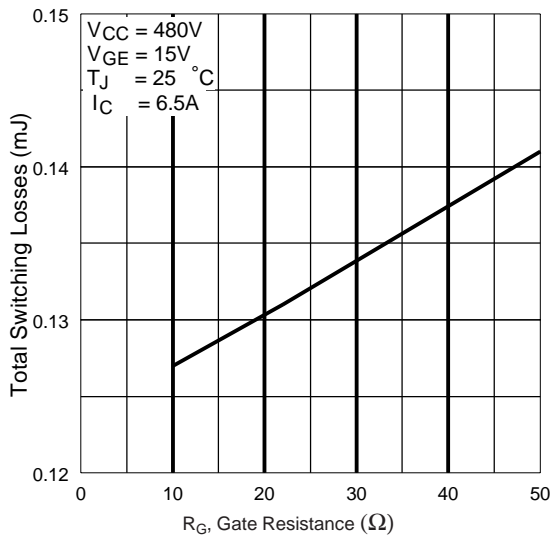


Fig. 9 - Typical Switching Losses vs. Gate Resistance

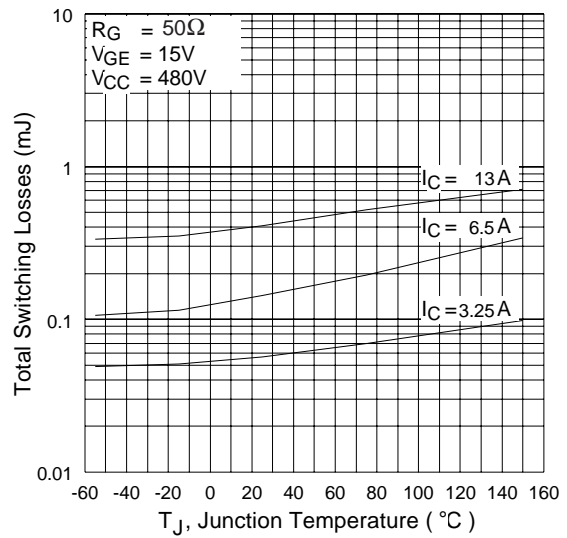


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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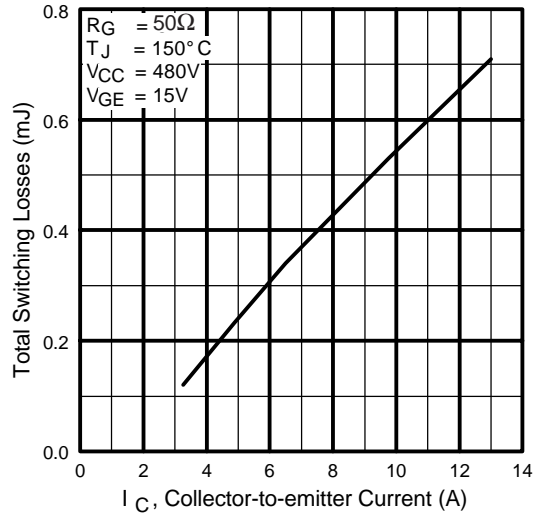


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

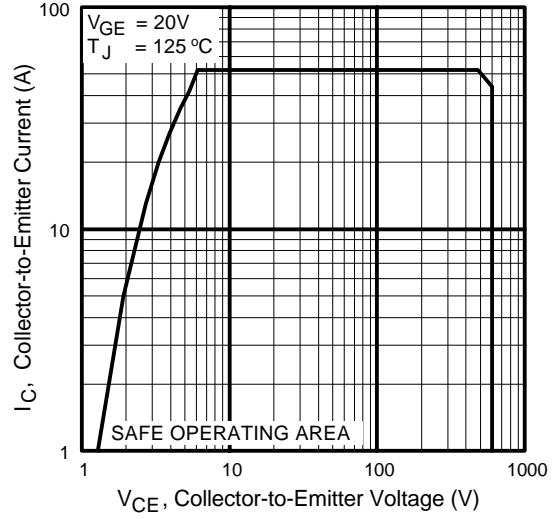
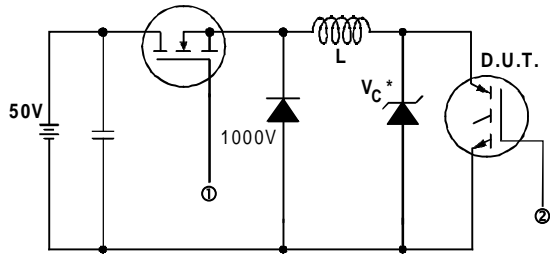


Fig. 12 - Turn-Off SOA



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

Fig. 13a - Clamped Inductive Load Test Circuit

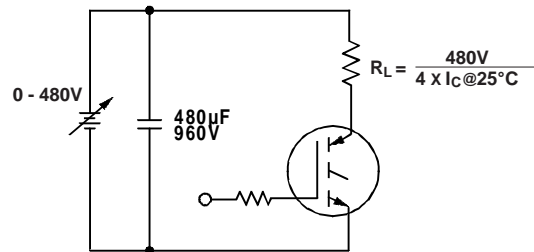


Fig. 13b - Pulsed Collector Current Test Circuit

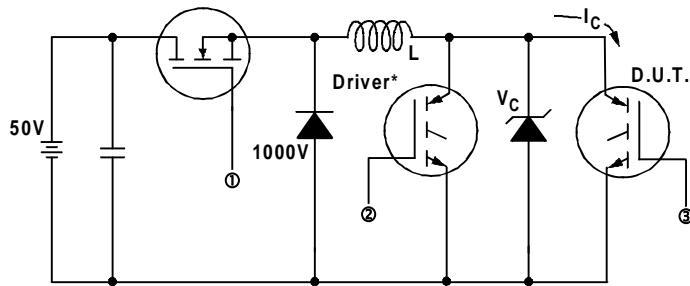


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_C = 480V$

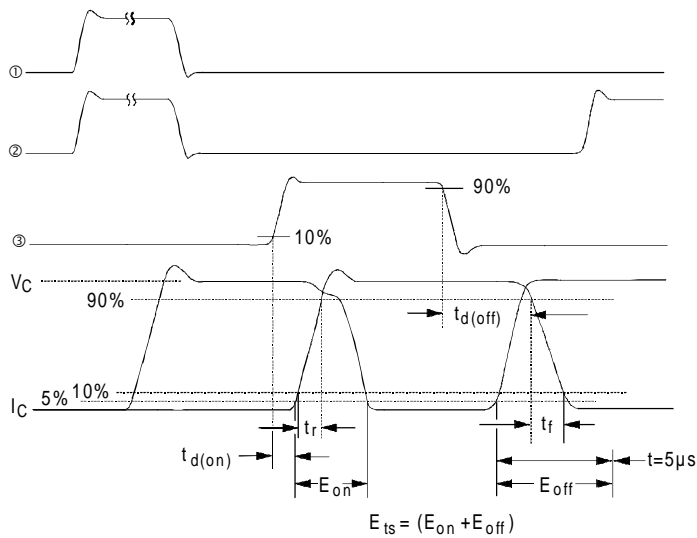
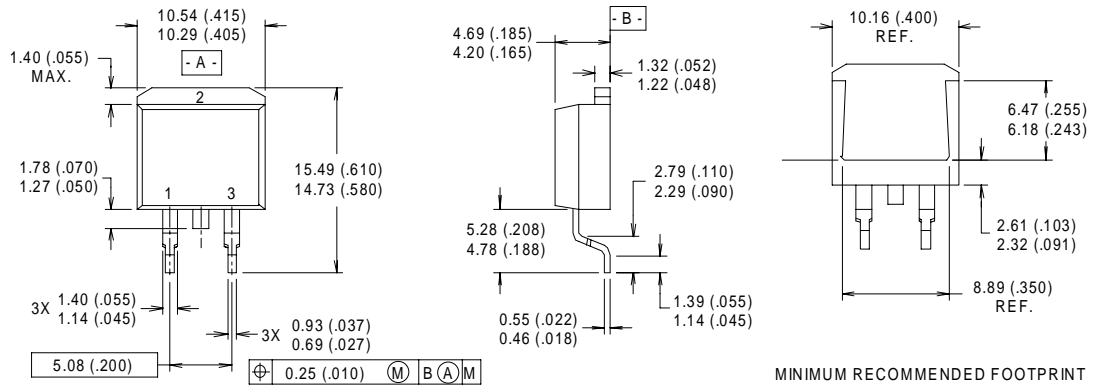


Fig. 14b - Switching Loss Waveforms

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D²Pak Package Outline



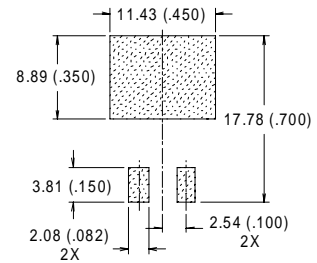
NOTES:

- 1 DIMENSIONS AFTER SOLDER DIP.
- 2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 3 CONTROLLING DIMENSION : INCH.
- 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

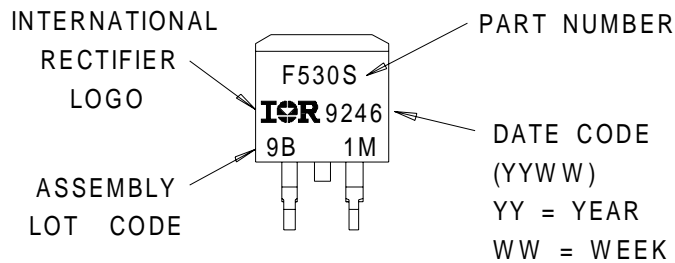
LEAD ASSIGNMENTS

- 1 - GATE
- 2 - DRAIN
- 3 - SOURCE

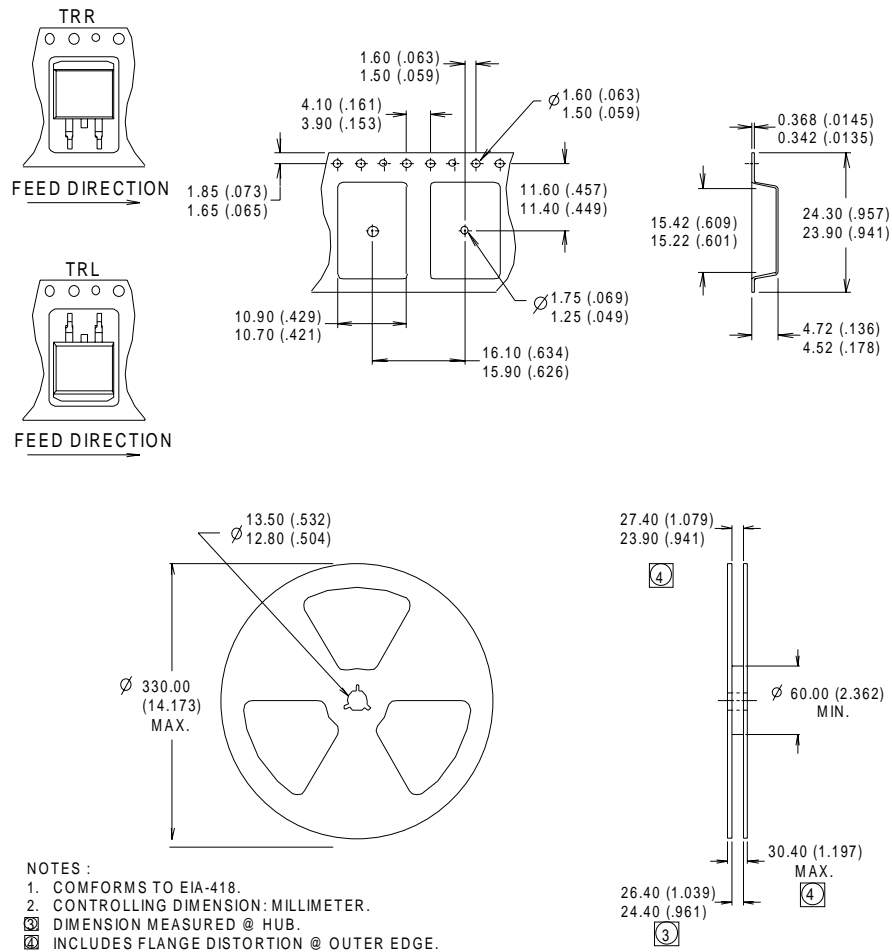
MINIMUM RECOMMENDED FOOTPRINT



D²Pak Part Marking Information



D²Pak Tape & Reel Information



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.