

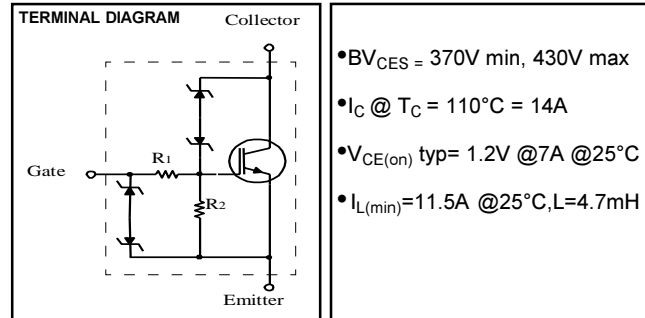
IGBT with on-chip Gate-Emitter and Gate-Collector clamps

Features

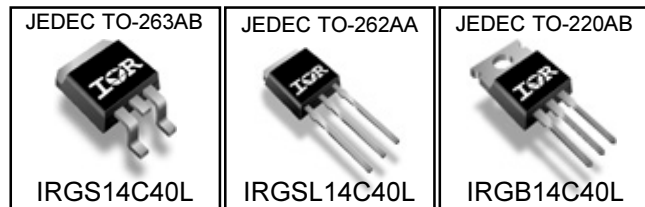
- Most Rugged in Industry
- Logic-Level Gate Drive
- > 6KV ESD Gate Protection
- Low Saturation Voltage
- High Self-clamped Inductive Switching Energy

Description

The advanced IGBT process family includes a MOS gated, N-channel logic level device which is intended for coil-on-plug automotive ignition applications and small-engine ignition circuits. Unique features include on-chip active voltage clamps between the Gate-Emitter and Gate-Collector which provide over voltage protection capability in ignition circuits.



- $BV_{CES} = 370V \text{ min, } 430V \text{ max}$
- $I_C @ T_C = 110^\circ C = 14A$
- $V_{CE(on)} \text{ typ} = 1.2V @ 7A @ 25^\circ C$
- $I_{L(min)} = 11.5A @ 25^\circ C, L = 4.7mH$



NOTE: IRGS14C40L is available in tape and reel. Add a suffix of TRR or TRL to the part number to determine the orientation of the device in the pocket, i.e, IRGS14C40LTRR or IRGS14C40LTRL.

Absolute Maximum Ratings

| | Parameter | Max | Unit | Condition |
|---------------------------|--|-------------|------------|-----------------------------------|
| V_{CES} | Collector-to-Emitter Voltage | Clamped | V | $R_G = 1K \text{ ohm}$ |
| $I_C @ T_C = 25^\circ C$ | Continuous Collector Current | 20 | A | $V_{GE} = 5V$ |
| $I_C @ T_C = 110^\circ C$ | Continuous Collector Current | 14 | A | $V_{GE} = 5V$ |
| I_G | Continuous Gate Current | 1 | mA | |
| I_{Gp} | Peak Gate Current | 10 | mA | $t_{PK} = 1ms, f = 100Hz$ |
| V_{GE} | Gate-to-Emitter Voltage | Clamped | V | |
| $P_D @ T_C = 25^\circ C$ | Maximum Power Dissipation | 125 | W | |
| $P_D @ T = 110^\circ C$ | Maximum Power Dissipation | 54 | W | |
| T_J | Operating Junction and | - 40 to 175 | $^\circ C$ | |
| T_{STG} | Storage Temperature Range | - 40 to 175 | $^\circ C$ | |
| V_{ESD} | Electrostatic Voltage | 6 | KV | $C = 100pF, R = 1.5K \text{ ohm}$ |
| I_L | Self-clamped Inductive Switching Current | 11.5 | A | $L = 4.7mH, T = 25^\circ C$ |

Thermal Resistance

| | Parameter | Min | Typ | Max | Unit |
|-----------------|--|-----|-----|-----|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | | | 1.2 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | | | 40 | |
| | (PCB Mounted, Steady State) | | | | |
| $Z_{\theta JC}$ | Transient Thermal Impedance, Junction-to-Case (Fig.11) | | | | |

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

| | Parameter | Min | Typ | Max | Unit | Conditions | Fig |
|------------|--|-----|-----|-----|---------------|--|-----|
| BV_{CES} | Collector-to-Emitter Breakdown Voltage | 370 | 400 | 430 | V | $R_G = 1\text{K ohm}$, $I_C = 7\text{A}$, $V_{GE} = 0\text{V}$ | |
| BV_{GES} | Gate-to-Emitter Breakdown Voltage | 10 | 12 | | V | $I_G = 2\text{m A}$ | |
| I_{CES} | Collector-to-Emitter Leakage Current | | | 15 | μA | $R_G = 1\text{K ohm}$, $V_{CE} = 250\text{V}$ | |
| | | | | 100 | μA | $R_G = 1\text{K ohm}$, $V_{CE} = 250\text{V}$, $T_J = 150^\circ\text{C}$ | |
| BV_{CER} | Emitter-to-Collector Breakdown Voltage | 24 | 28 | | V | $I_C = -10\text{m A}$ | |
| R_1 | Gate Series Resistance | | 75 | | ohm | | |
| R_2 | Gate-to-Emitter Resistance | 10 | 20 | 30 | K ohm | | |

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

| | Parameter | Min | Typ | Max | Unit | Conditions | Fig |
|--------------|---|------|------|------|------|---|------|
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | | 1.2 | 1.40 | V | $I_C = 7\text{A}$, $V_{GE} = 4.5\text{V}$ | 1 |
| | | | 1.35 | 1.55 | | $I_C = 10\text{A}$, $V_{GE} = 4.5\text{V}$ | |
| | | | 1.35 | 1.55 | | $I_C = 10\text{A}$, $V_{GE} = 4.5\text{V}$, $T_C = -40^\circ\text{C}$ | 4 |
| | | | 1.5 | 1.7 | | $I_C = 14\text{A}$, $V_{GE} = 5.0\text{V}$, $T_C = -40^\circ\text{C}$ | |
| | | | 1.55 | 1.75 | | $I_C = 14\text{A}$, $V_{GE} = 5.0\text{V}$ | |
| | | | 1.6 | 1.8 | | $I_C = 14\text{A}$, $V_{GE} = 5.0\text{V}$, $T_C = 150^\circ\text{C}$ | |
| $V_{GE(th)}$ | Gate Threshold Voltage | 1.3 | 1.8 | 2.2 | V | $V_{CE} = V_{GE}$, $I_C = 1\text{ m A}$, $T_C = 25^\circ\text{C}$ | 3, 5 |
| | | 0.75 | | 1.8 | | $V_{CE} = V_{GE}$, $I_C = 1\text{ m A}$, $T_C = 150^\circ\text{C}$ | |
| g_{fs} | Transconductance | 10 | 15 | 19 | S | $V_{CE} = 25\text{V}$, $I_C = 10\text{A}$, $T_C = 25^\circ\text{C}$ | |
| I_C | Collector Current | 20 | | | A | $V_{CE} = 10\text{V}$, $V_{GE} = 4.5\text{V}$ | |

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

| | Parameter | Min | Typ | Max | Unit | Conditions | Fig |
|--------------|--|------|-----|------|---------------|--|-----|
| Q_g | Total Gate charge | | 27 | | nC | $I_C = 10\text{A}$, $V_{CE} = 12\text{V}$, $V_{GE} = 5\text{V}$ | 7 |
| Q_{ge} | Gate - Emitter Charge | | 2.5 | | | $I_C = 10\text{A}$, $V_{CE} = 12\text{V}$, $V_{GE} = 5\text{V}$ | 15 |
| Q_{gc} | Gate - Collector Charge | | 10 | | | $I_C = 10\text{A}$, $V_{CE} = 12\text{V}$, $V_{GE} = 5\text{V}$ | |
| $t_{d(on)}$ | Turn - on delay time | 0.6 | 0.9 | 1.35 | μs | $V_{GE} = 5\text{V}$, $R_G = 1\text{K ohm}$, $L = 1\text{mH}$, $V_{CE} = 14\text{V}$ | 12 |
| t_r | Rise time | 1.6 | 2.8 | 4 | | $V_{GE} = 5\text{V}$, $R_G = 1\text{K ohm}$, $L = 1\text{mH}$, $V_{CE} = 14\text{V}$ | 14 |
| $t_{d(off)}$ | Turn - off delay time | 3.7 | 6 | 8.3 | | $V_{GE} = 5\text{V}$, $R_G = 1\text{K ohm}$, $L = 1\text{mH}$, $V_{CE} = 300\text{V}$ | |
| C_{ies} | Input Capacitance | | 550 | 825 | pF | $V_{GE} = 0\text{V}$, $V_{CE} = 25\text{V}$, $f = 1\text{M H z}$ | 6 |
| C_{oes} | Output Capacitance | | 100 | 150 | | $V_{GE} = 0\text{V}$, $V_{CE} = 25\text{V}$, $f = 1\text{M H z}$ | |
| C_{res} | Reverse Transfer Capacitance | | 12 | 18 | | $V_{GE} = 0\text{V}$, $V_{CE} = 25\text{V}$, $f = 1\text{M H z}$ | |
| I_L | Self-Clamped Inductive Switching Current | 25 | | | A | $L = 0.7\text{m H}$, $T_C = 25^\circ\text{C}$ | 9 |
| | | 15.5 | | | | $L = 2.2\text{m H}$, $T_C = 25^\circ\text{C}$ | |
| | | 11.5 | | | | $L = 4.7\text{m H}$, $T_C = 25^\circ\text{C}$ | 10 |
| | | 16.5 | | | | $L = 1.5\text{m H}$, $T_C = 150^\circ\text{C}$ | 13 |
| | | 7.5 | | | | $L = 4.7\text{m H}$, $T_C = 150^\circ\text{C}$ | |
| | | 6 | | | | $L = 8.7\text{m H}$, $T_C = 150^\circ\text{C}$ | |
| t_{sc} | Short Circuit Withstand Time | | 120 | | μs | $T_J = 150^\circ\text{C}$, $V_{CC} = 16\text{V}$, $L = 10\mu\text{H}$ $R_G = 1\text{K ohm}$, $V_{GE} = 5\text{V}$ | 14 |

Fig.1 - Typ. Output Characteristics
 $T_J=25^\circ\text{C}$

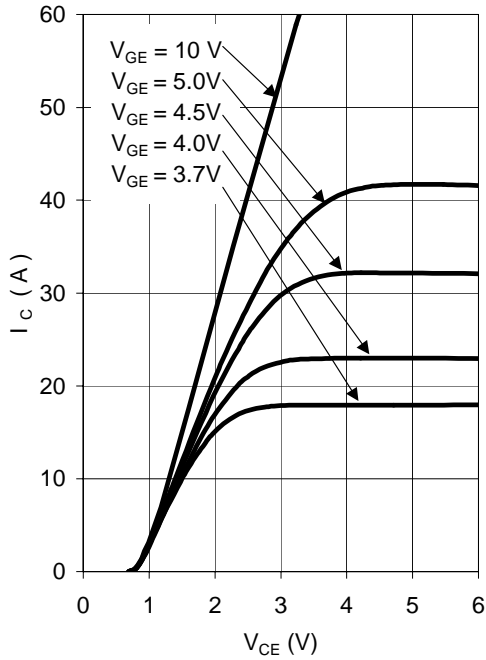


Fig.2 - Typ. Output Characteristics
 $T_J=125^\circ\text{C}$

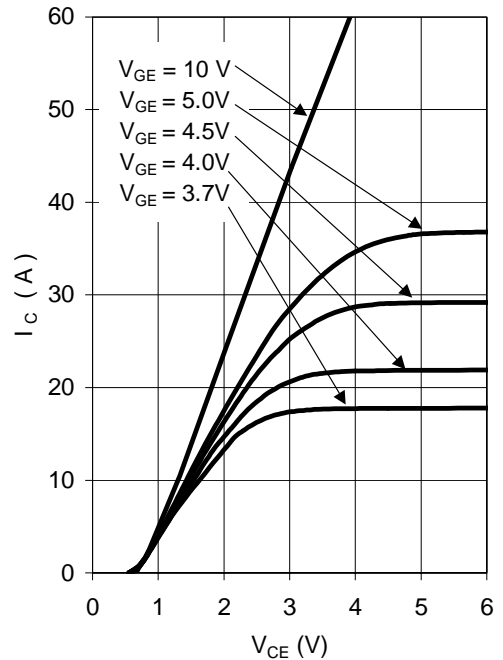


Fig.3 - Transfer Characteristics
 $V_{CE}=20\text{V}; t_p=20\mu\text{s}$

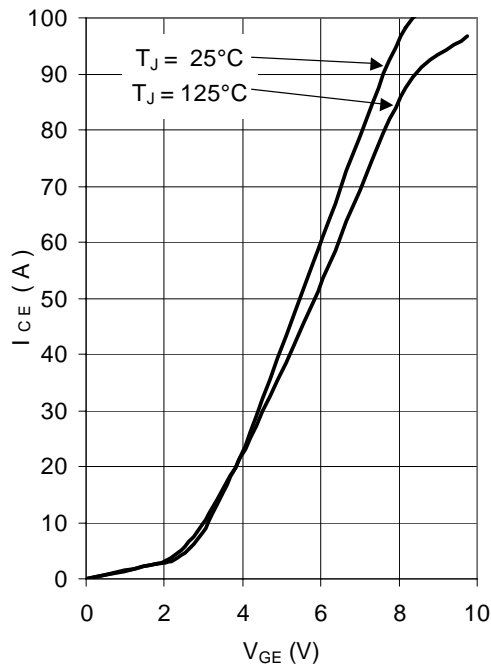
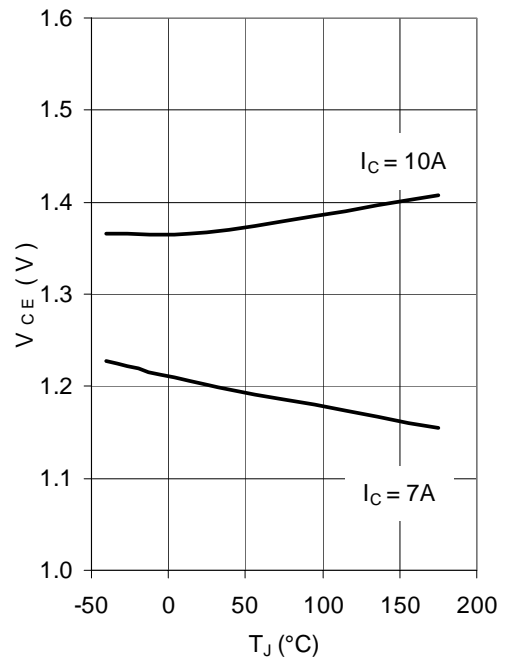


Fig.4 - Typical V_{CE} vs T_J
 $V_{GE}=4.5\text{V}$



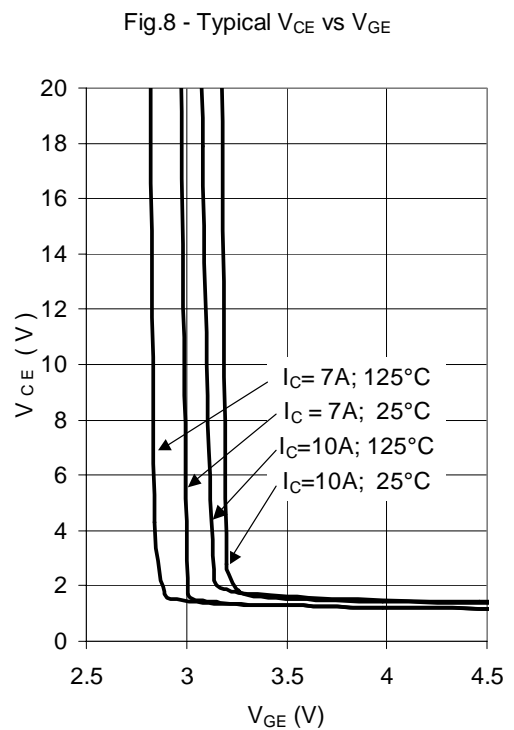
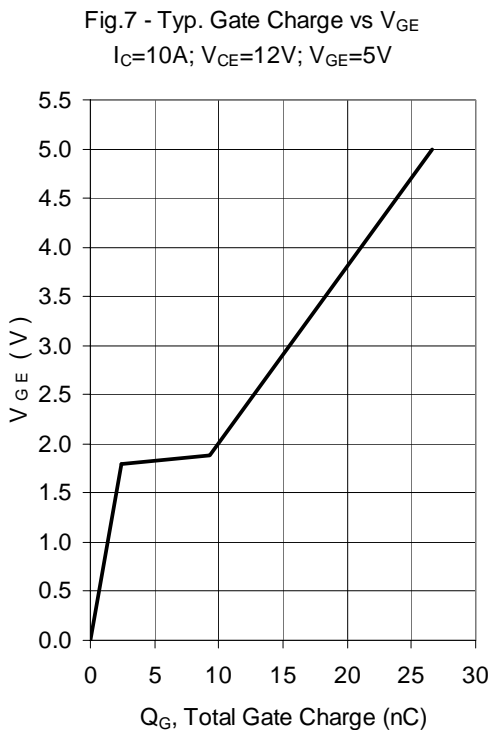
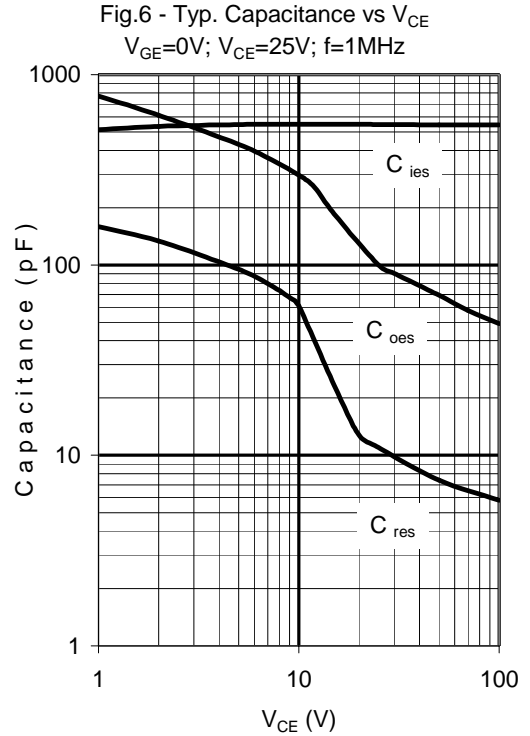
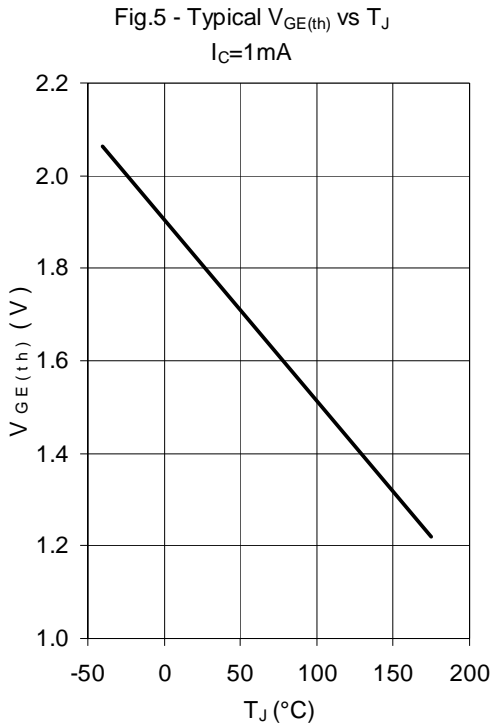


Fig.9 - Self-clamp Avalanche Current vs Inductance @ 25°C

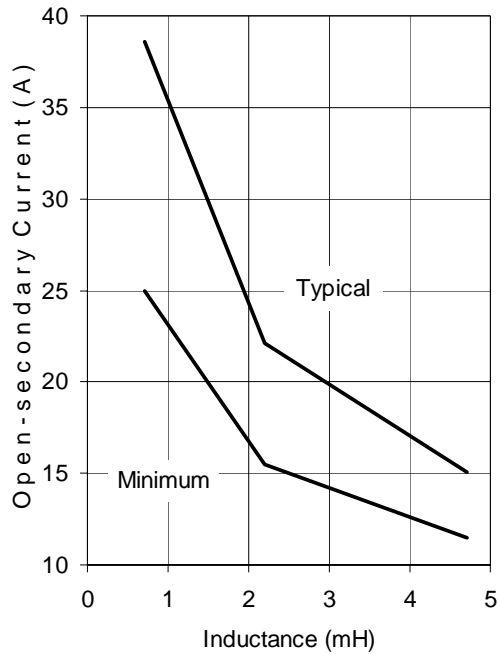


Fig.10 - Self-clamp Avalanche Current vs Inductance @ 150°C

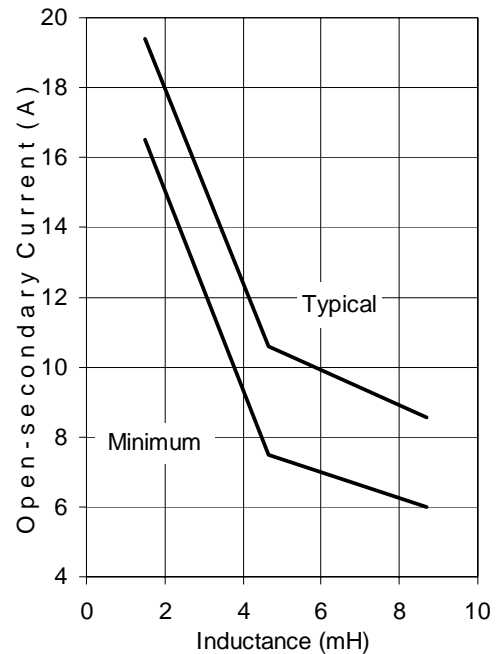


Fig.11 - Transient Thermal Impedance, Junction-to-Case

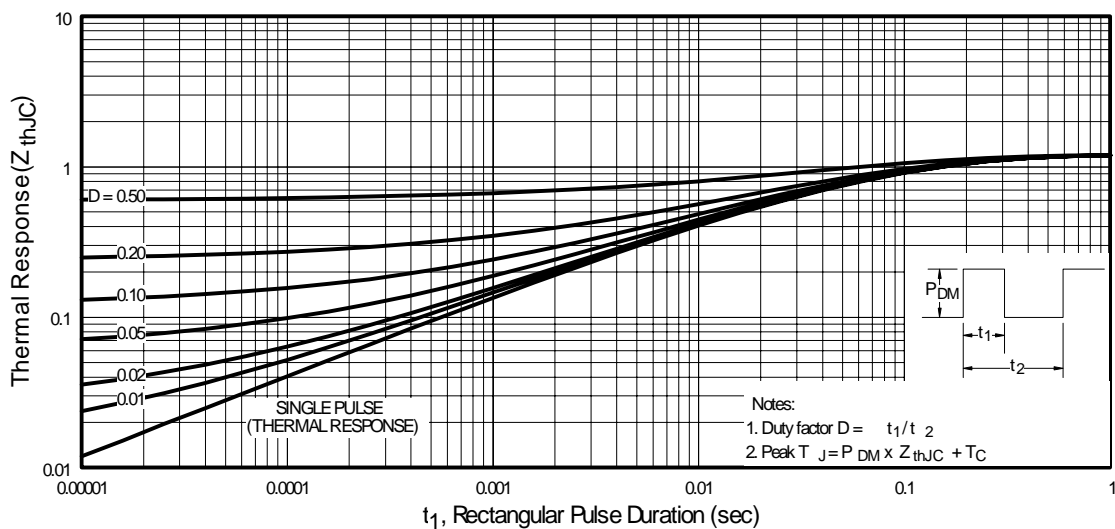


Fig.12 - Switching Waveform for Time Measurement

$V_{GE}=5V$; $R_G=1K\Omega$; $L=1mH$; $V_{CE}=14V$; used circuit in Fig.14

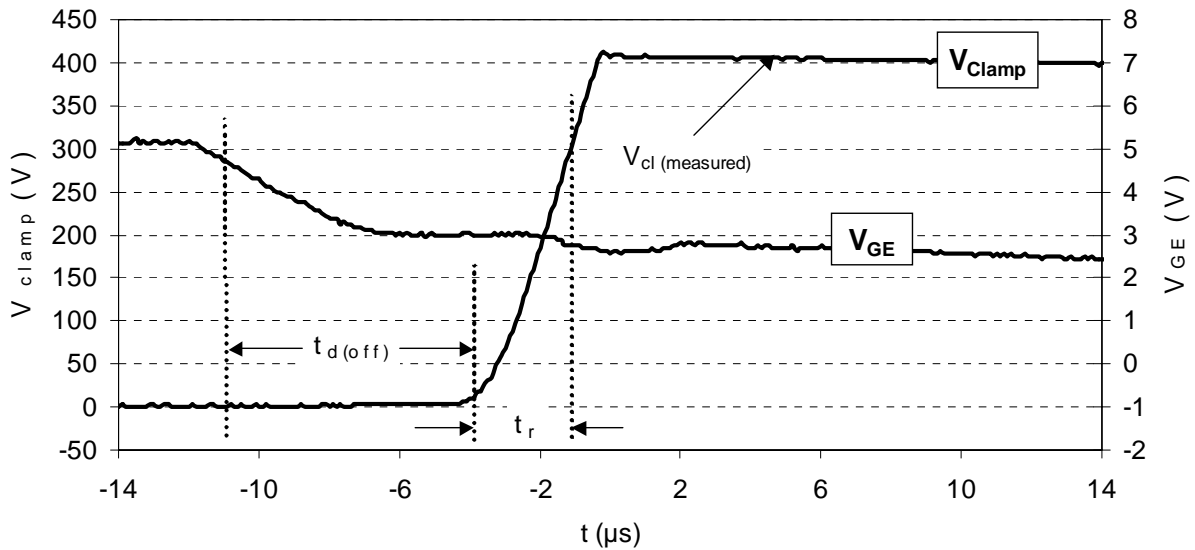


Fig.13 - Self-clamped Inductive Switching Waveform

$L=4.7mH$; $T_C=25^\circ C$; used circuit in Fig.14

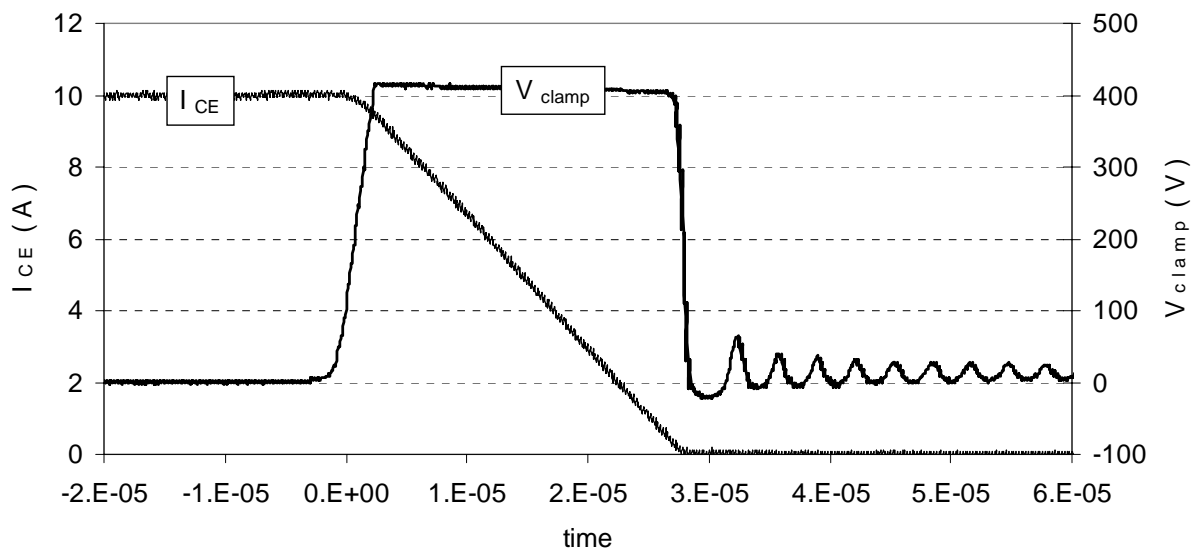


Fig.14 - Test Circuit

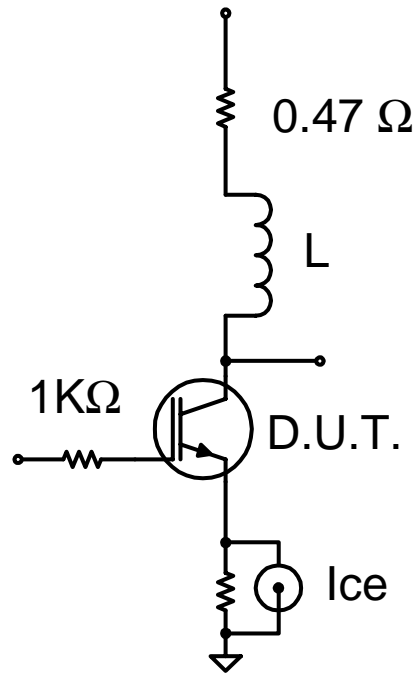
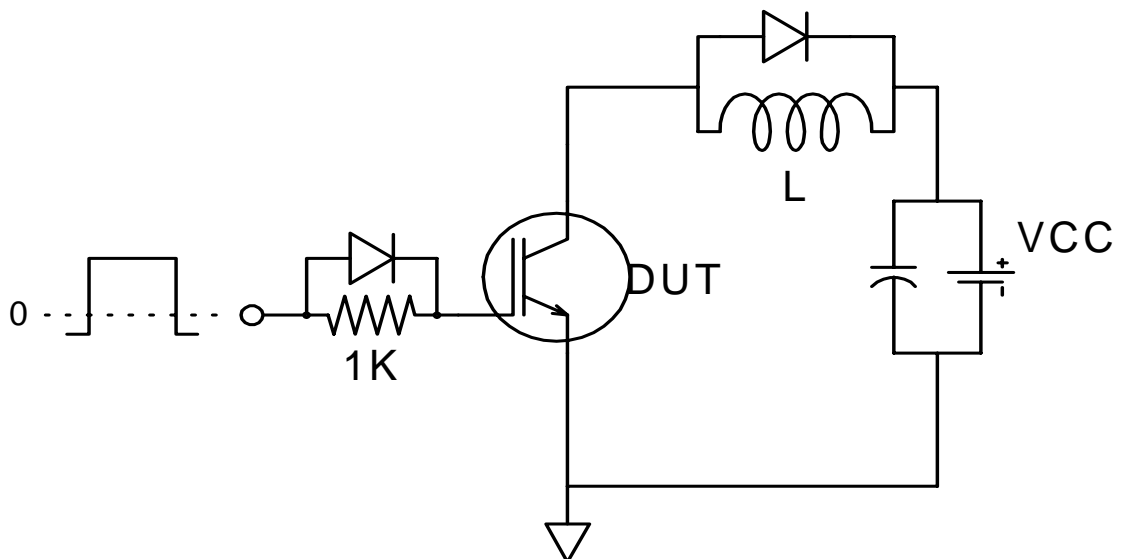
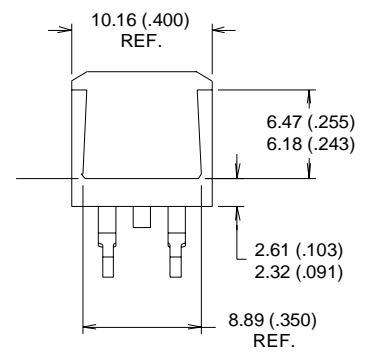
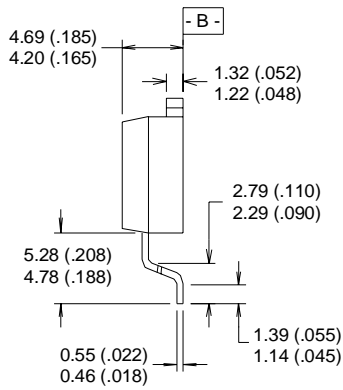
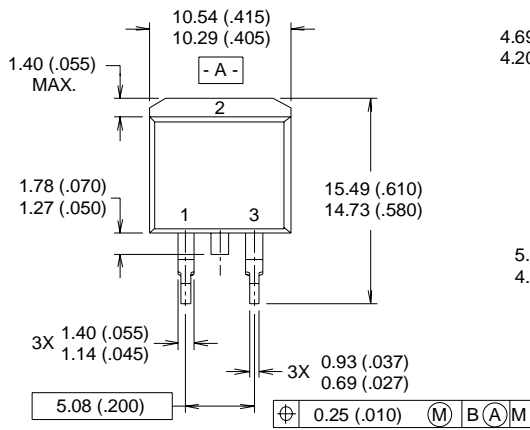


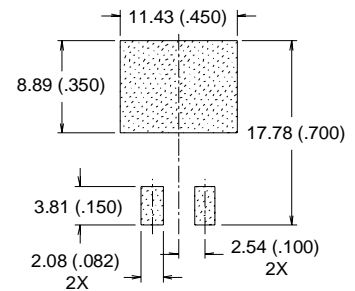
Fig.15 - Gate Charge Circuit



TO-263AB Package Outline
 Dimensions are shown in millimeters (inches)



MINIMUM RECOMMENDED FOOTPRINT



NOTES:

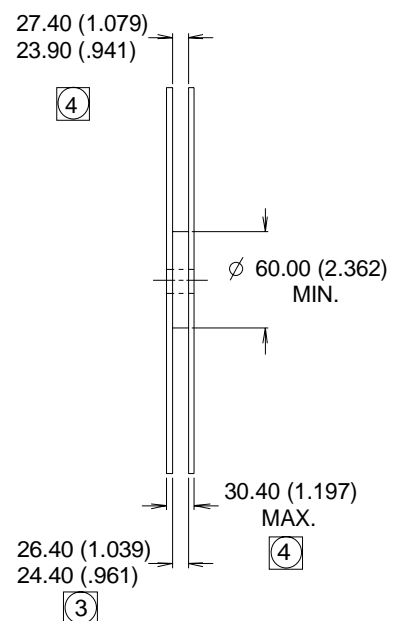
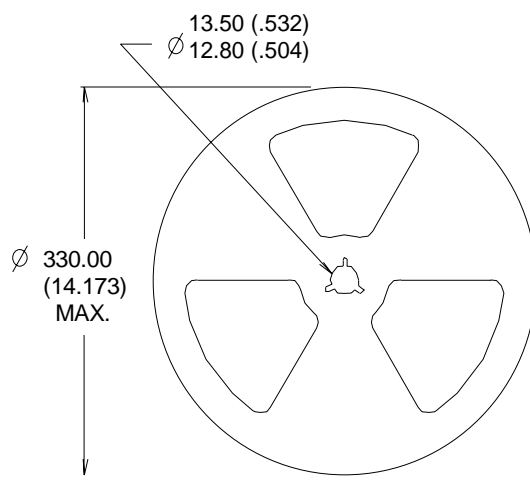
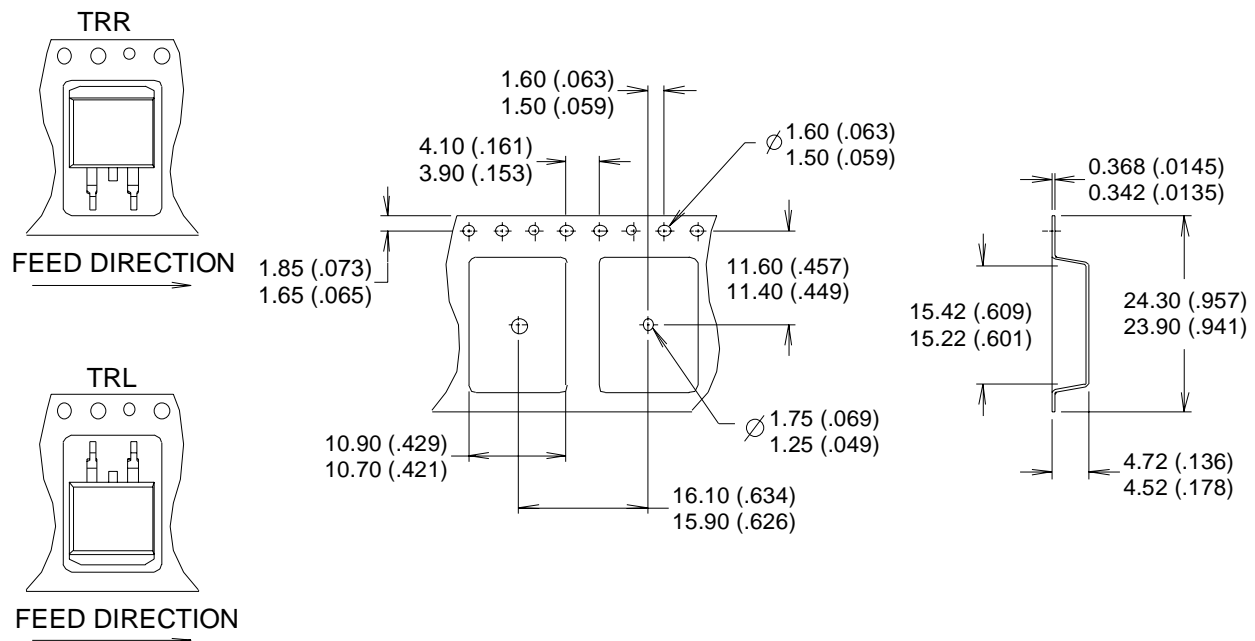
- 1 DIMENSIONS AFTER SOLDER DIP.
- 2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 3 CONTROLLING DIMENSION : INCH.
- 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

LEAD ASSIGNMENTS

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

TO-263AB Package Outline in Tape and Reel

Dimensions are shown in millimeters (inches)

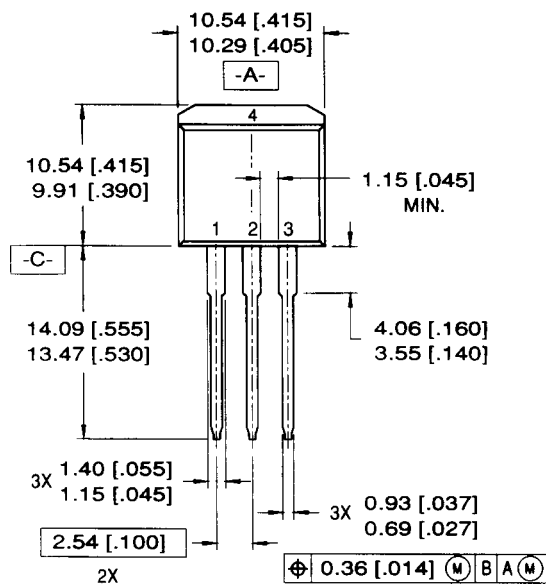


NOTES :

1. CONFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
- ③ DIMENSION MEASURED @ HUB.
- ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

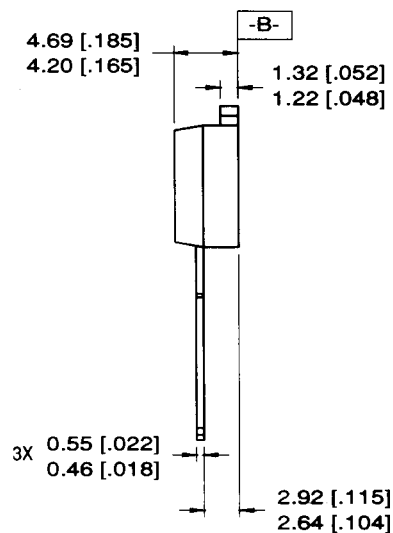
TO-262AA Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS

- 1 = GATE 3 = SOURCE
- 2 = DRAIN 4 = DRAIN

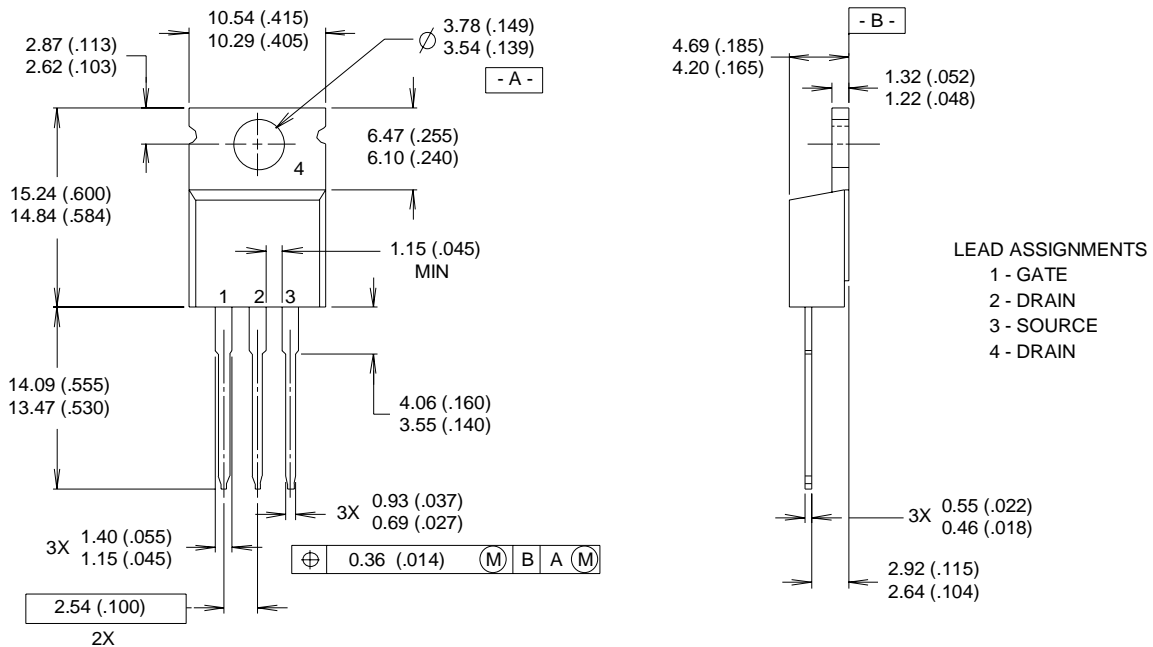


NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH

- 3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
- 4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.