

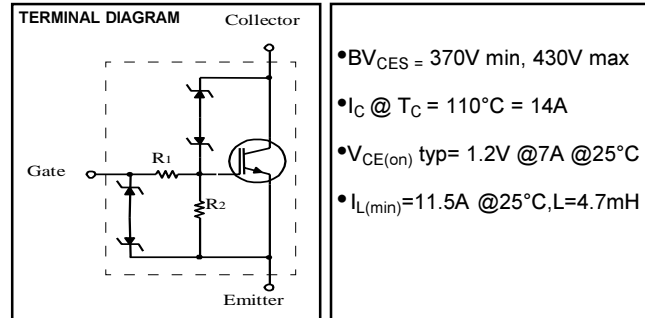
IGBT with on-chip Gate-Emitter and Gate-Collector clamps

**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.



- $BV_{CES} = 370V$  min,  $430V$  max
- $I_C @ T_C = 110^\circ C = 14A$
- $V_{CE(on)}$  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	$R_G = 1K$ 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	$C = 100pF, R = 1.5K$ 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	$\mu\text{A}$	$R_G = 1\text{K ohm}$ , $V_{CE} = 250\text{V}$	
				100	$\mu\text{A}$	$R_G = 1\text{K ohm}$ , $V_{CE} = 250\text{V}$ , $T_J = 150^\circ\text{C}$	
$BV_{CER}$	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	$\mu\text{s}$	$V_{GE} = 5\text{V}$ , $R_G = 1\text{K ohm}$ , $L = 1\text{mH}$ , $V_{CE} = 14\text{V}$	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		$\mu\text{s}$	$T_J = 150^\circ\text{C}$ , $V_{CC} = 16\text{V}$ , $L = 10\mu\text{H}$ $R_G = 1\text{K ohm}$ , $V_{GE} = 5\text{V}$	14

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

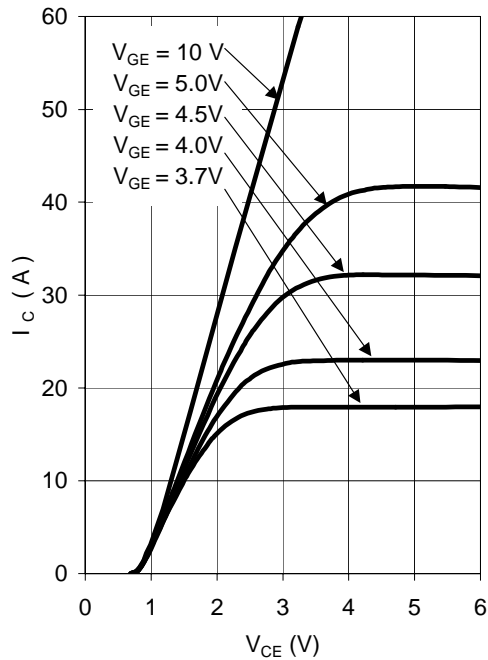


Fig.2 - Typ. Output Characteristics  
 $T_J = 125^\circ\text{C}$

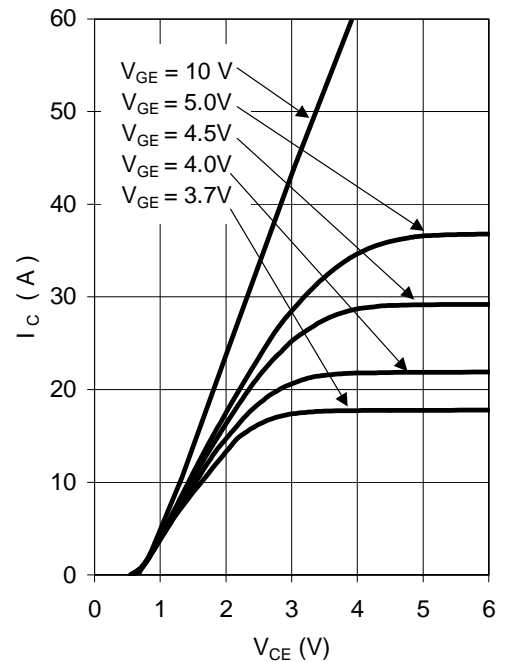


Fig.3 - Transfer Characteristics  
 $V_{CE} = 20\text{V}; t_p = 20\mu\text{s}$

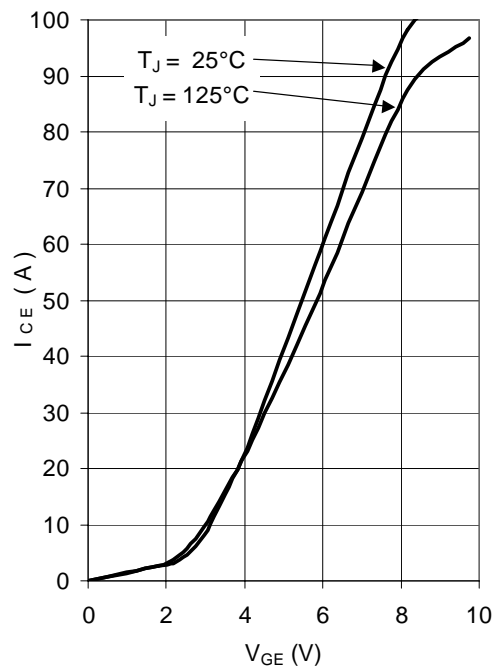
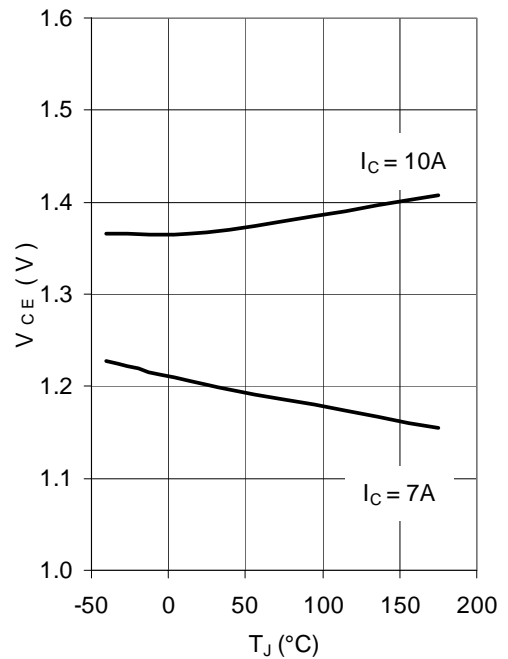


Fig.4 - Typical  $V_{CE}$  vs  $T_J$   
 $V_{GE} = 4.5\text{V}$



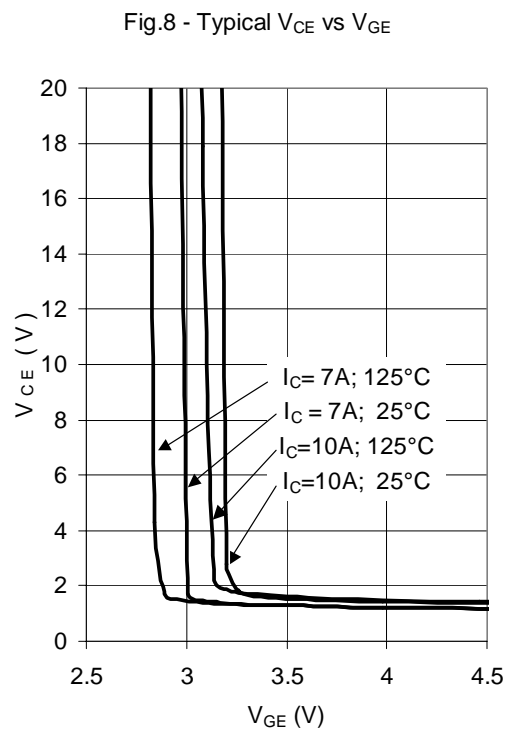
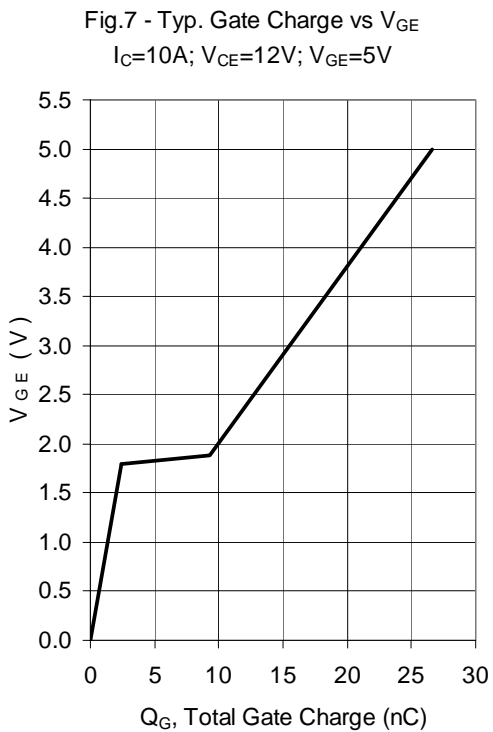
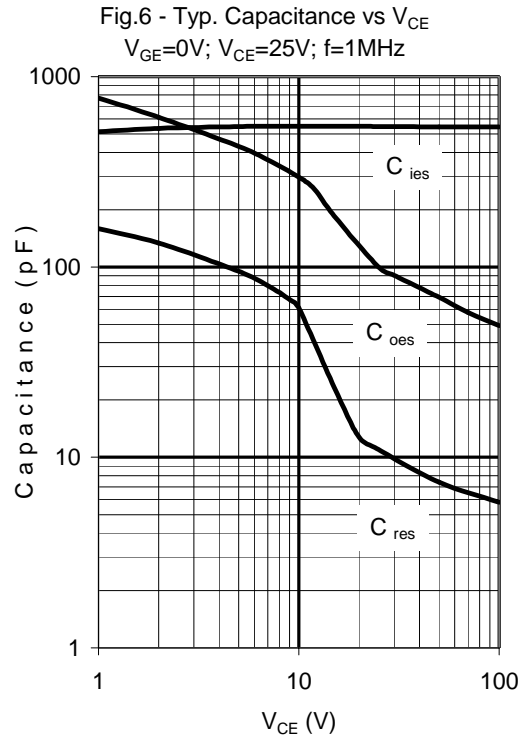
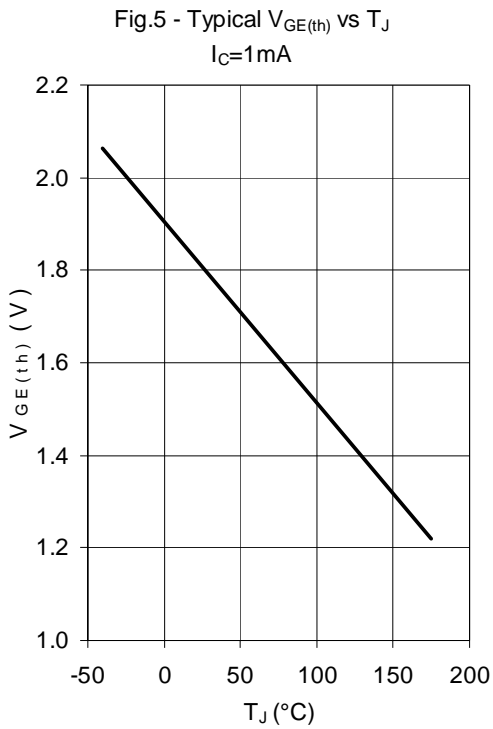


Fig.9 - Self-clamp Avalanche Current vs Inductance @ 25°C

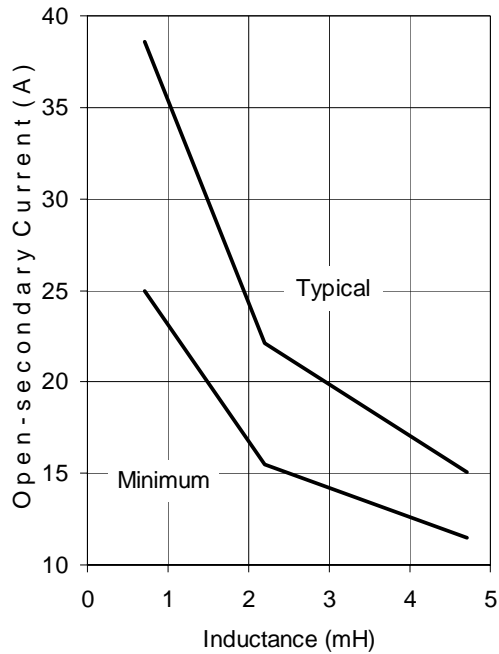


Fig.10 - Self-clamp Avalanche Current vs Inductance @ 150°C

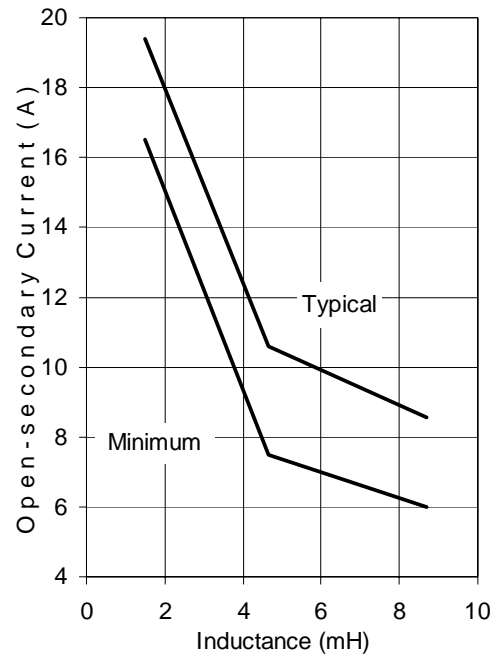


Fig.11 - Transient Thermal Impedance, Junction-to-Case

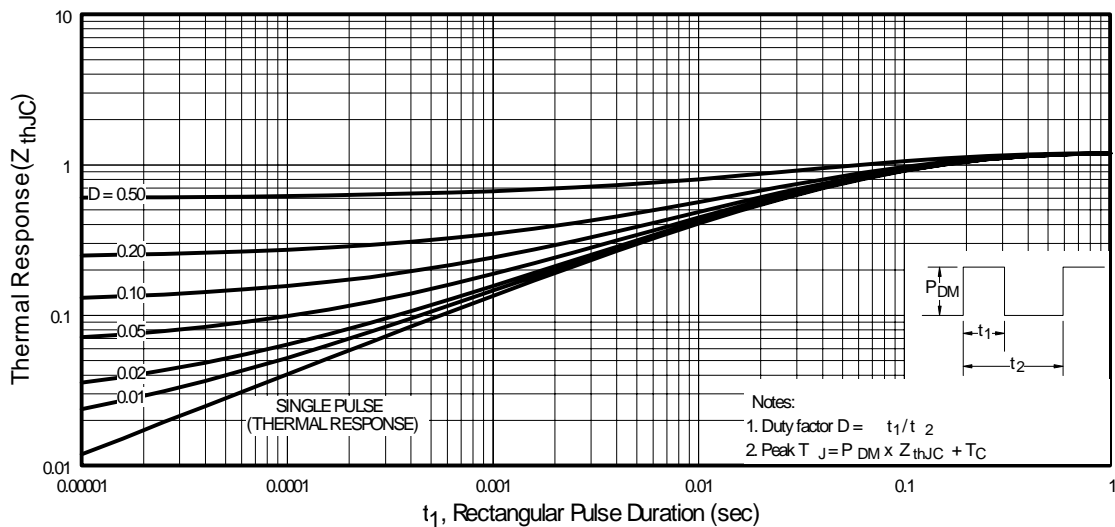


Fig.12 - Switching Waveform for Time Measurement

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

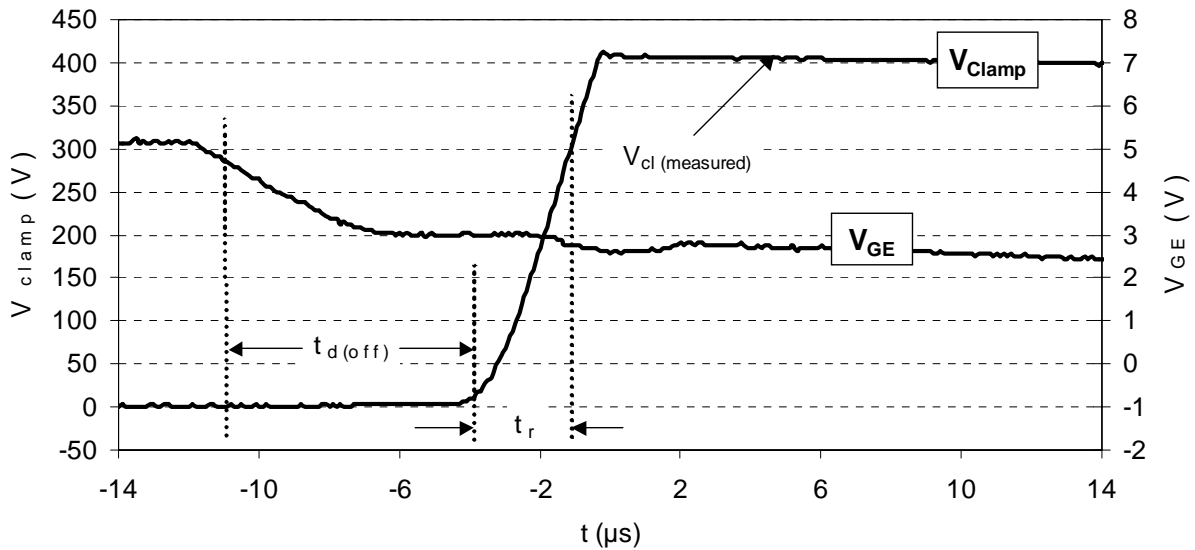
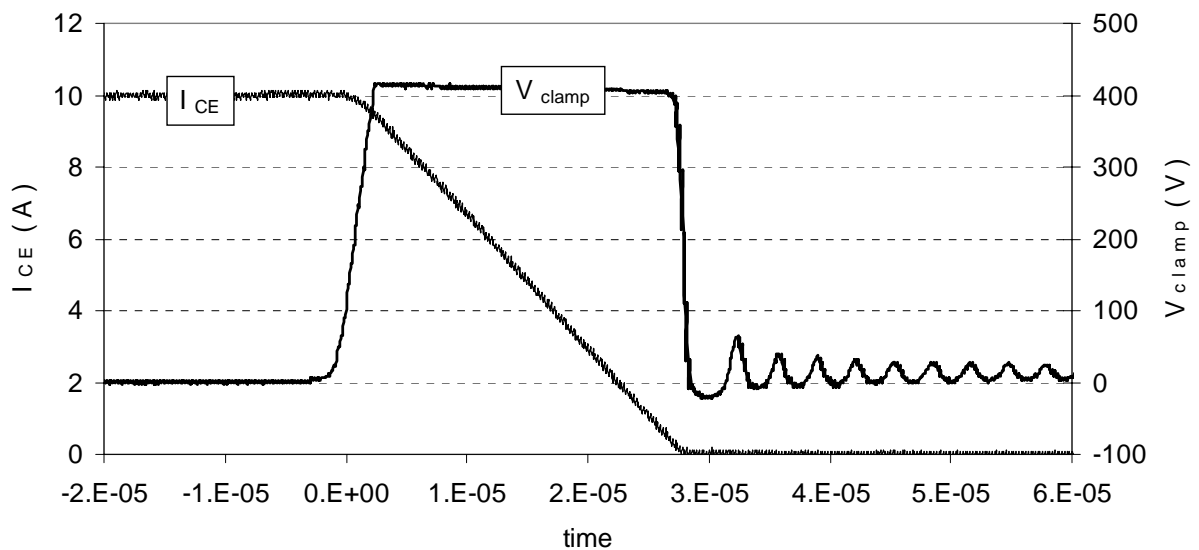
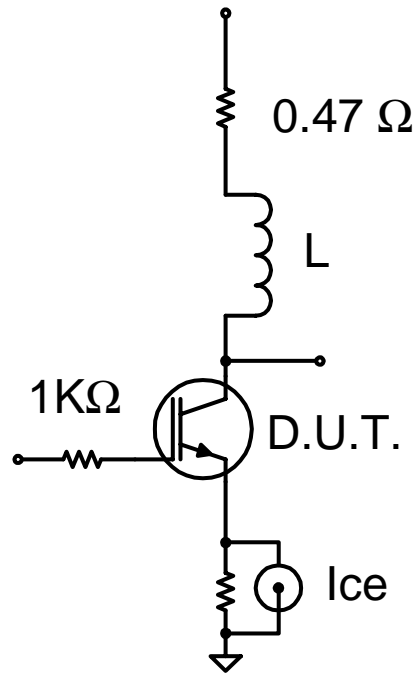


Fig.13 - Self-clamped Inductive Switching Waveform

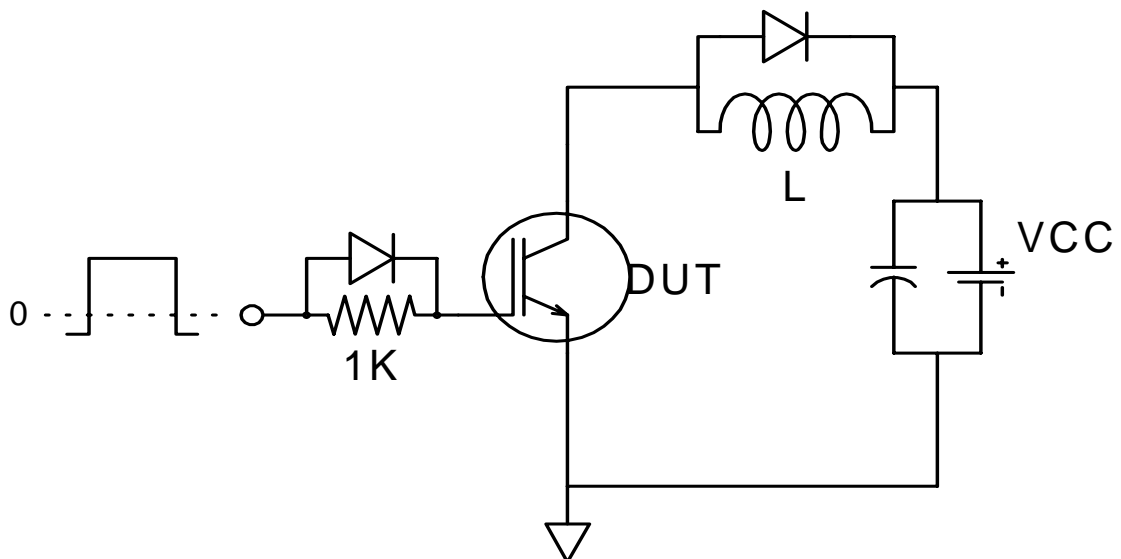
$L=4.7mH$ ;  $T_C=25^\circ C$ ; used circuit in Fig.14



**Fig.14 - Test Circuit**

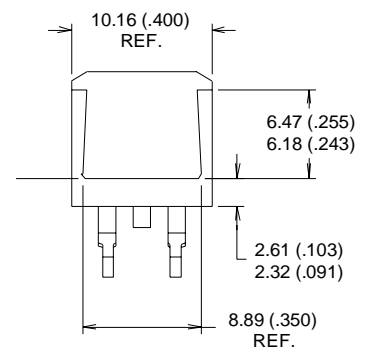
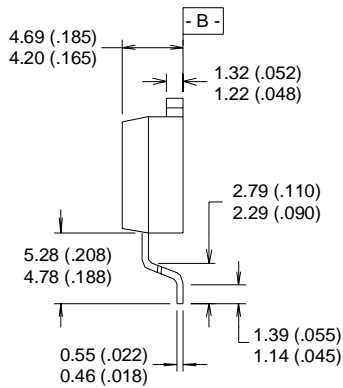
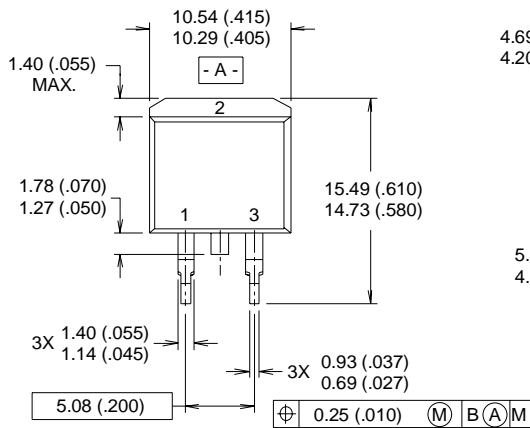


**Fig.15 - Gate Charge Circuit**

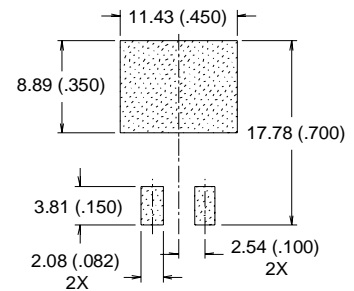


**TO-263AB Package Outline**

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.

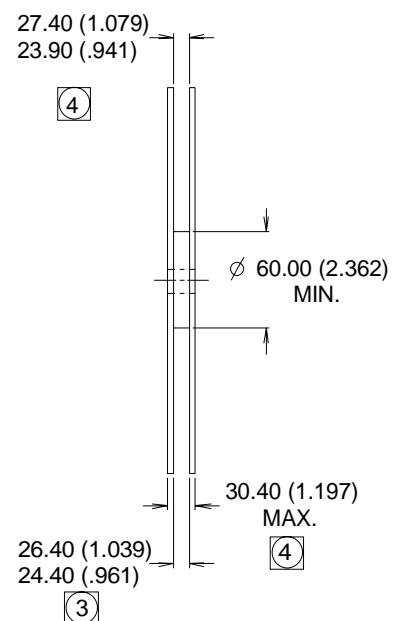
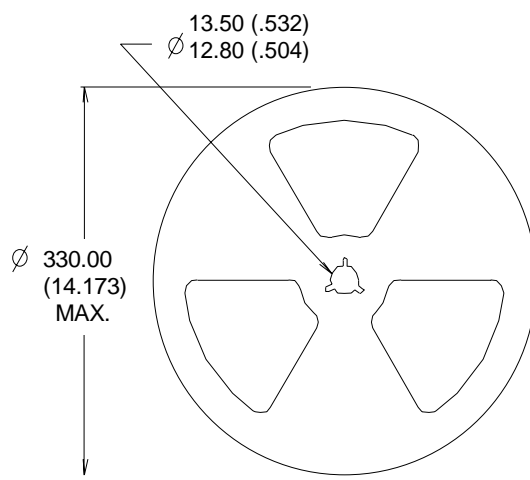
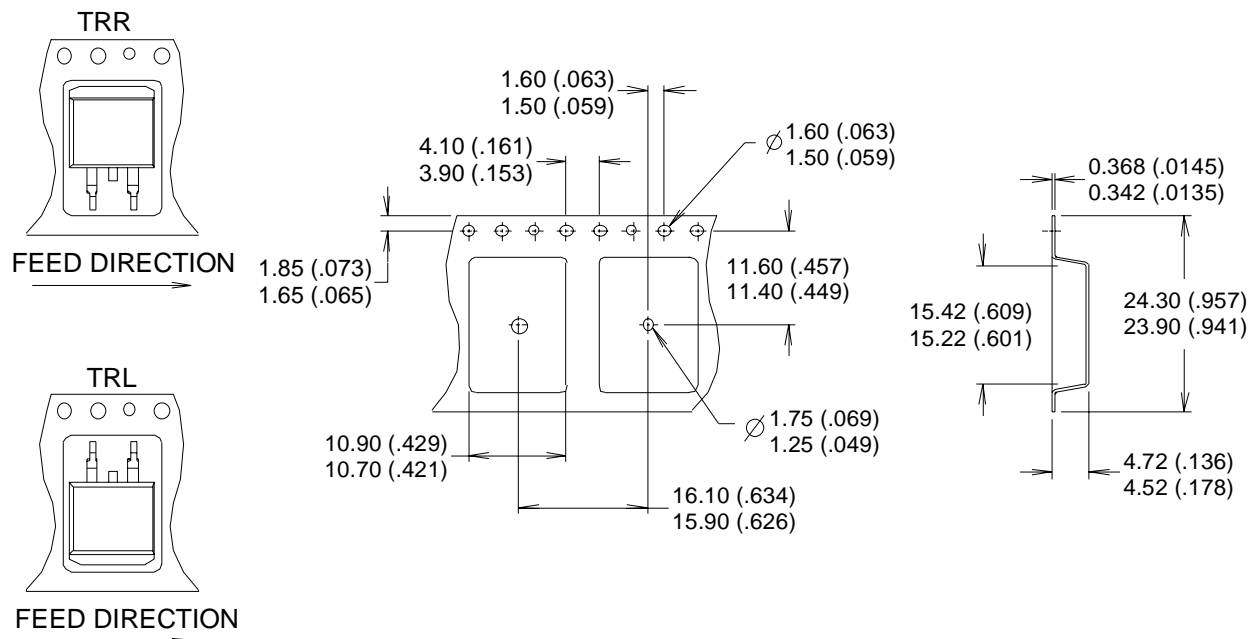
**LEAD ASSIGNMENTS**

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



TO-263AB Package Outline in Tape and Reel

Dimensions are shown in millimeters (inches)

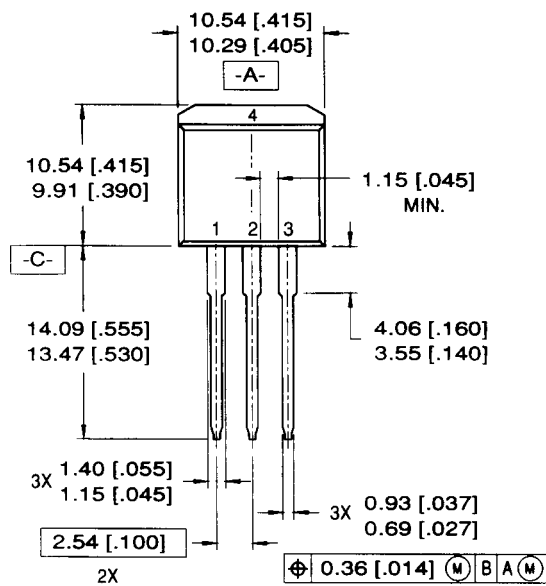


NOTES :

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

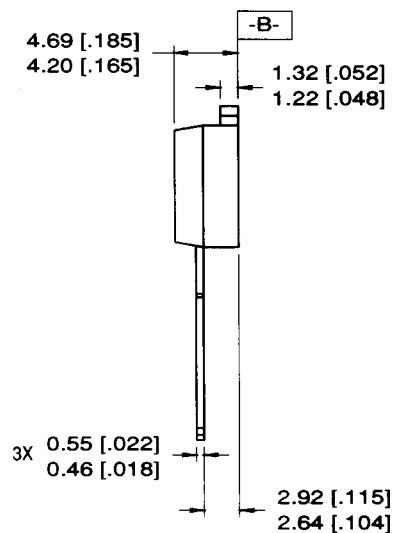
TO-262AA Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS

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

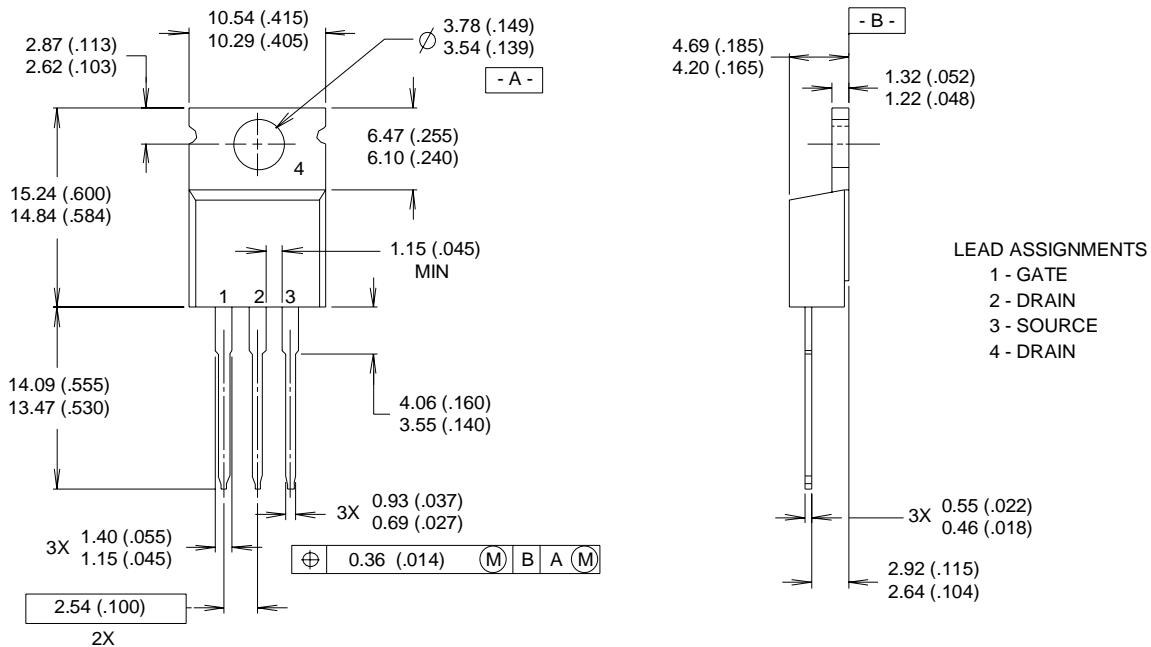


NOTES:

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.