

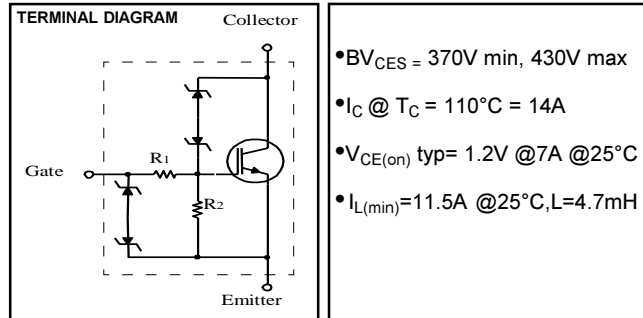
IGBT with on-chip Gate-Emitter and Gate-Collector clamps

**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.



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 <sub>CES</sub>	Collector-to-Emitter Voltage	Clamped	V	R <sub>G</sub> = 1K ohm
I <sub>C</sub> @ T <sub>C</sub> = 25°C	Continuous Collector Current	20	A	V <sub>GE</sub> = 5V
I <sub>C</sub> @ T <sub>C</sub> = 110°C	Continuous Collector Current	14	A	V <sub>GE</sub> = 5V
I <sub>G</sub>	Continuous Gate Current	1	mA	
I <sub>Gp</sub>	Peak Gate Current	10	mA	t <sub>PK</sub> = 1ms, f = 100Hz
V <sub>GE</sub>	Gate-to-Emitter Voltage	Clamped	V	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation	125	W	
P <sub>D</sub> @ T = 110°C	Maximum Power Dissipation	54	W	
T <sub>J</sub>	Operating Junction and	- 40 to 175	°C	
T <sub>STG</sub>	Storage Temperature Range	- 40 to 175	°C	
V <sub>ESD</sub>	Electrostatic Voltage	6	KV	C = 100pF, R = 1.5K ohm
I <sub>L</sub>	Self-clamped Inductive Switching Current	11.5	A	L = 4.7mH, T = 25°C

**Thermal Resistance**

	Parameter	Min	Typ	Max	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case			1.2	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient			40	
	(PCB Mounted, Steady State)				
Z <sub>θJC</sub>	Transient Thermal Impedance, Junction-to-Case (Fig.11)				

**Off-State Electrical Characteristics @ T<sub>J</sub> = 25°C** (unless otherwise specified)

	Parameter	Min	Typ	Max	Unit	Conditions	Fig
BV <sub>CES</sub>	Collector-to-Emitter Breakdown Voltage	370	400	430	V	R <sub>G</sub> = 1K ohm, I <sub>C</sub> =7A, V <sub>GE</sub> = 0V	
BV <sub>GES</sub>	Gate-to-Emitter Breakdown Voltage	10	12		V	I <sub>G</sub> =2m A	
I <sub>CES</sub>	Collector-to-Emitter Leakage Current			15	μA	R <sub>G</sub> =1K ohm, V <sub>CE</sub> = 250V	
				100	μA	R <sub>G</sub> =1K ohm, V <sub>CE</sub> = 250V, T <sub>J</sub> =150°C	
BV <sub>CER</sub>	Emitter-to-Collector Breakdown Voltage	24	28		V	I <sub>C</sub> = -10m A	
R <sub>1</sub>	Gate Series Resistance		75		ohm		
R <sub>2</sub>	Gate-to-Emitter Resistance	10	20	30	K ohm		

**On-State Electrical Characteristics @ T<sub>J</sub> = 25°C** (unless otherwise specified)

	Parameter	Min	Typ	Max	Unit	Conditions	Fig
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage		1.2	1.40	V	I <sub>C</sub> = 7A, V <sub>GE</sub> = 4.5V	1
			1.35	1.55		I <sub>C</sub> = 10A, V <sub>GE</sub> = 4.5V	
			1.35	1.55		I <sub>C</sub> = 10A, V <sub>GE</sub> = 4.5V, T <sub>C</sub> = -40°C	4
			1.5	1.7		I <sub>C</sub> = 14A, V <sub>GE</sub> = 5.0V, T <sub>C</sub> = -40°C	
			1.55	1.75		I <sub>C</sub> = 14A, V <sub>GE</sub> = 5.0V	
			1.6	1.8		I <sub>C</sub> = 14A, V <sub>GE</sub> = 5.0V, T <sub>C</sub> =150°C	
V <sub>GE(th)</sub>	Gate Threshold Voltage	1.3	1.8	2.2	V	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 m A, T <sub>C</sub> =25°C	3, 5
		0.75		1.8		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 m A, T <sub>C</sub> =150°C	
g <sub>fs</sub>	Transconductance	10	15	19	S	V <sub>CE</sub> = 25V, I <sub>C</sub> = 10A, T <sub>C</sub> =25°C	
I <sub>C</sub>	Collector Current	20			A	V <sub>CE</sub> = 10V, V <sub>GE</sub> = 4.5V	

**Switching Characteristics @ T<sub>J</sub> = 25°C** (unless otherwise specified)

	Parameter	Min	Typ	Max	Unit	Conditions	Fig
Q <sub>g</sub>	Total Gate charge		27		nC	I <sub>C</sub> = 10A, V <sub>CE</sub> =12V, V <sub>GE</sub> =5V	7
Q <sub>ge</sub>	Gate - Emitter Charge		2.5			I <sub>C</sub> = 10A, V <sub>CE</sub> =12V, V <sub>GE</sub> =5V	15
Q <sub>gc</sub>	Gate - Collector Charge		10			I <sub>C</sub> = 10A, V <sub>CE</sub> =12V, V <sub>GE</sub> =5V	
t <sub>d(on)</sub>	Turn - on delay time	0.6	0.9	1.35	μs	V <sub>GE</sub> =5V, R <sub>G</sub> =1K ohm, L=1mH, V <sub>CE</sub> =14V	12
t <sub>r</sub>	Rise time	1.6	2.8	4		V <sub>GE</sub> =5V, R <sub>G</sub> =1K ohm, L=1mH, V <sub>CE</sub> =14V	
t <sub>d(off)</sub>	Turn - off delay time	3.7	6	8.3		V <sub>GE</sub> =5V, R <sub>G</sub> =1K ohm, L=1mH, V <sub>CE</sub> =300V	14
C <sub>ies</sub>	Input Capacitance		550	825	pF	V <sub>GE</sub> =0V, V <sub>CE</sub> =25V, f=1M H z	6
C <sub>oes</sub>	Output Capacitance		100	150		V <sub>GE</sub> =0V, V <sub>CE</sub> =25V, f=1M H z	
C <sub>res</sub>	Reverse Transfer Capacitance		12	18		V <sub>GE</sub> =0V, V <sub>CE</sub> =25V, f=1M H z	
I <sub>L</sub>	Self-Clamped Inductive Switching Current	25			A	L=0.7m H, T <sub>C</sub> =25°C	9
		15.5				L=2.2m H, T <sub>C</sub> =25°C	
		11.5				L=4.7m H, T <sub>C</sub> =25°C	10
		16.5				L=1.5m H, T <sub>C</sub> =150°C	
		7.5				L=4.7m H, T <sub>C</sub> =150°C	
		6				L=8.7m H, T <sub>C</sub> =150°C	
t <sub>sc</sub>	Short Circuit Withstand Time		120		μs	T <sub>J</sub> =150°C, V <sub>CC</sub> = 16V, L = 10μH R <sub>G</sub> = 1K ohm, V <sub>GE</sub> = 5V	14

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

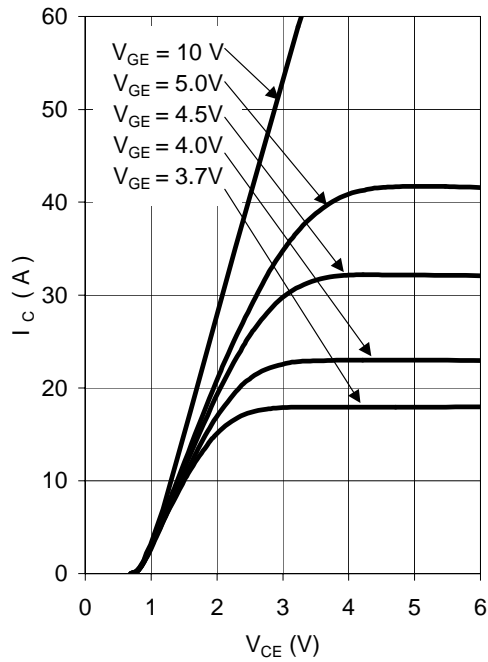


Fig.2 - Typ. Output Characteristics  
 $T_J=125^\circ\text{C}$

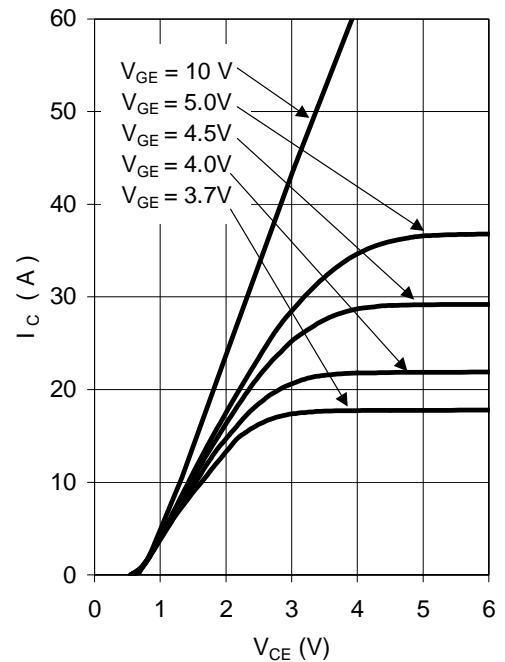


Fig.3 - Transfer Characteristics  
 $V_{CE}=20\text{V}; t_p=20\mu\text{s}$

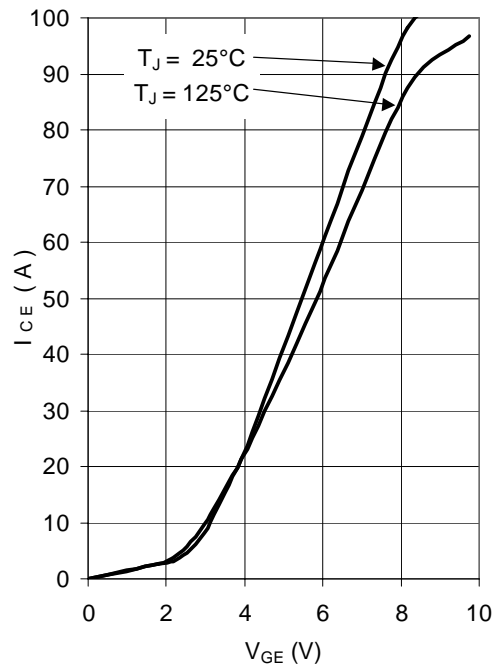
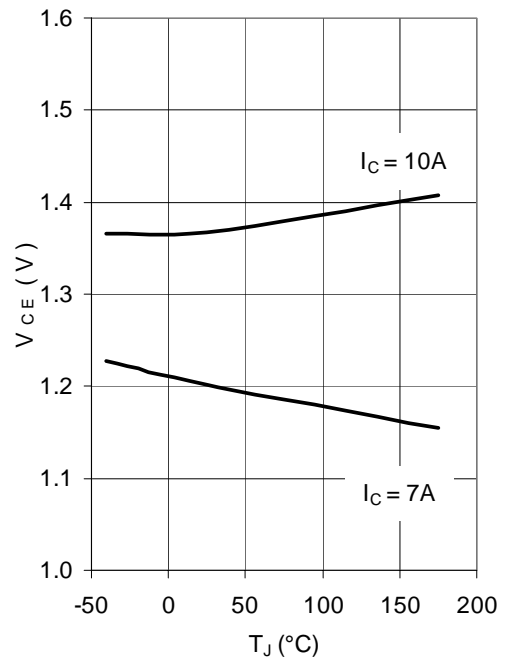


Fig.4 - Typical  $V_{CE}$  vs  $T_J$   
 $V_{GE}=4.5\text{V}$



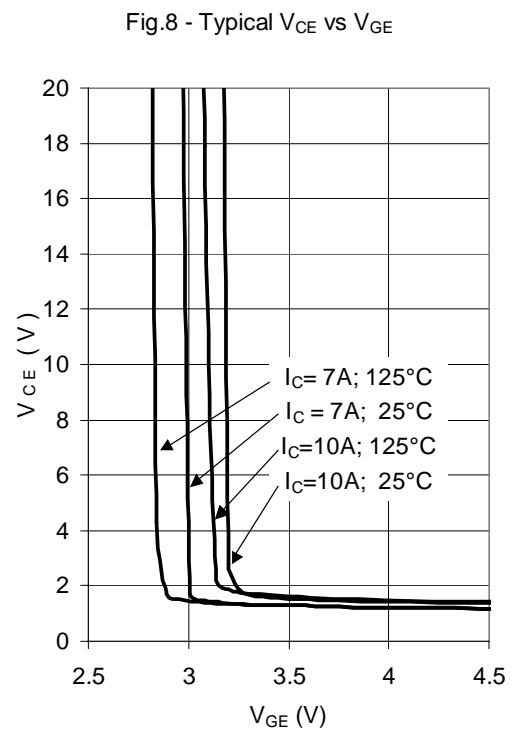
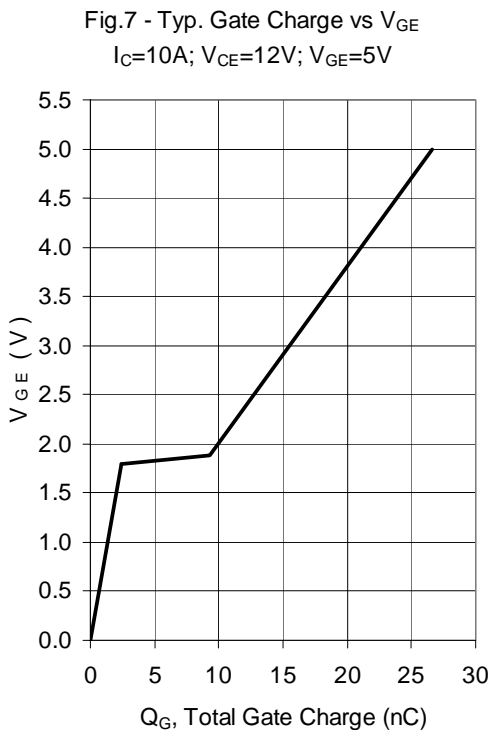
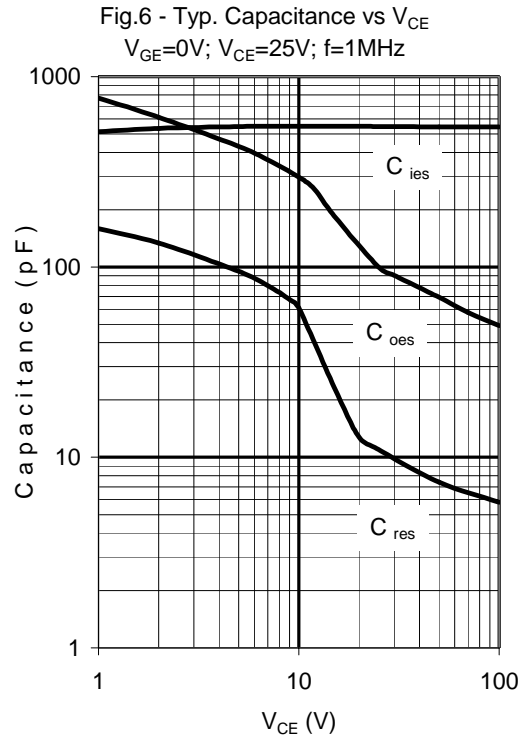
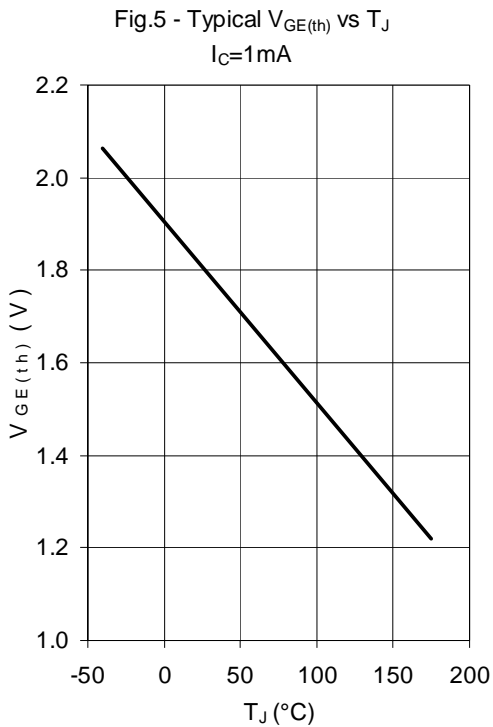


Fig.9 - Self-clamp Avalanche Current vs Inductance @ 25°C

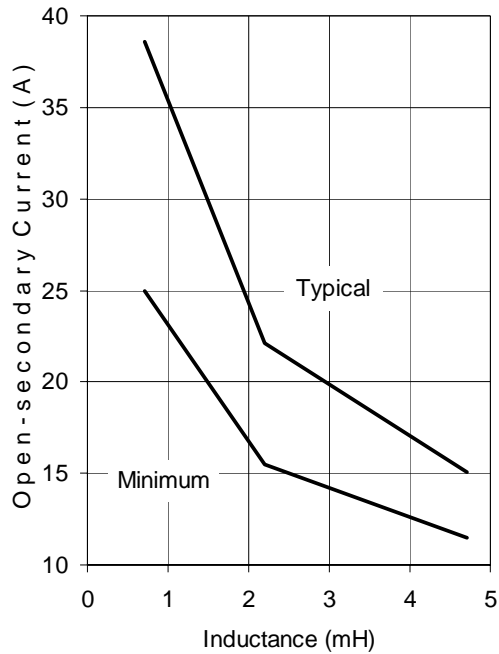


Fig.10 - Self-clamp Avalanche Current vs Inductance @ 150°C

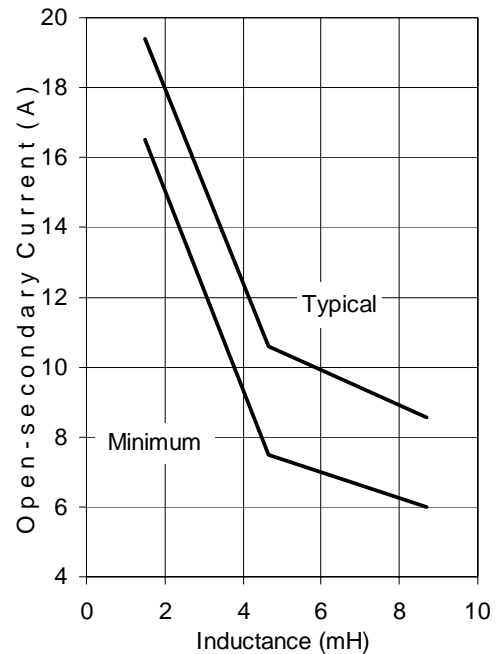


Fig.11 - Transient Thermal Impedance, Junction-to-Case

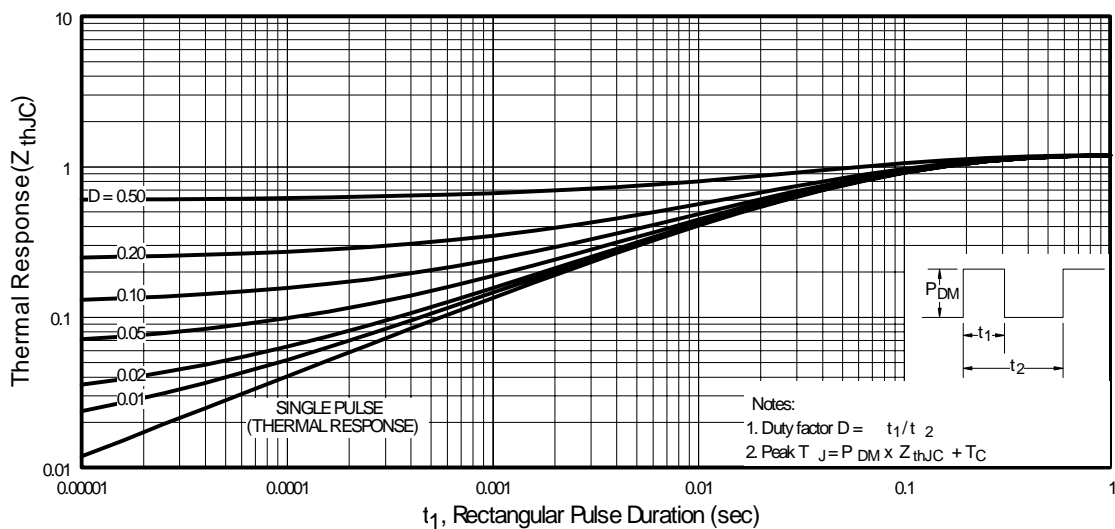


Fig.12 - Switching Waveform for Time Measurement

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

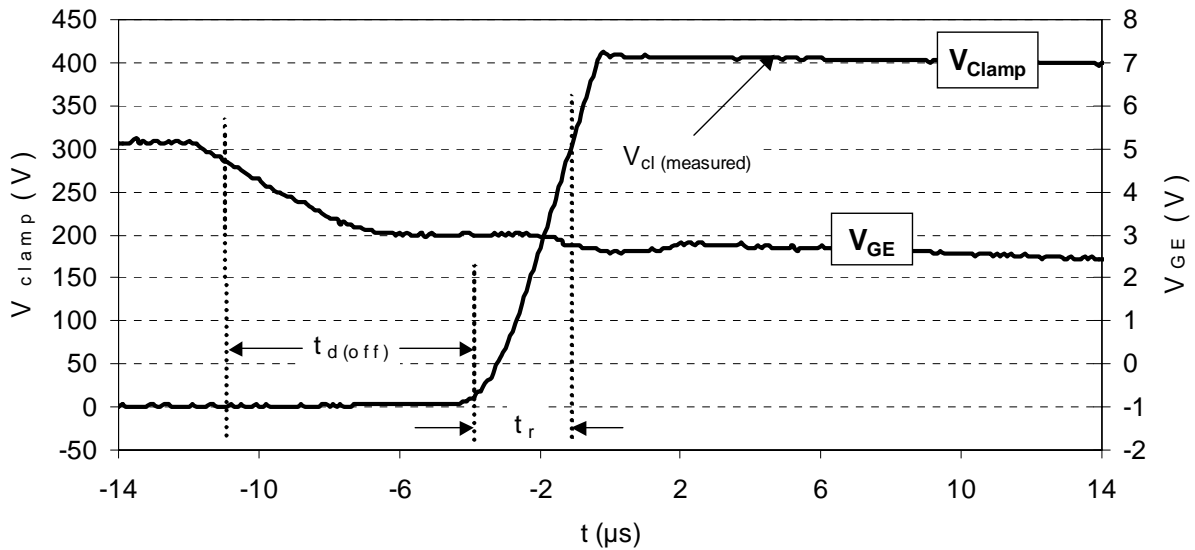
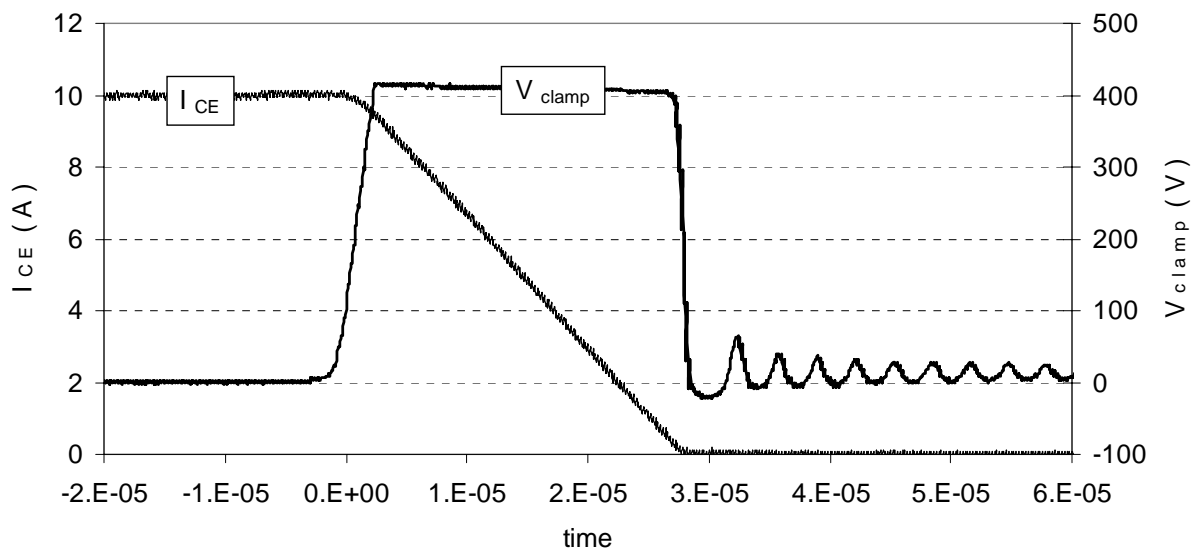
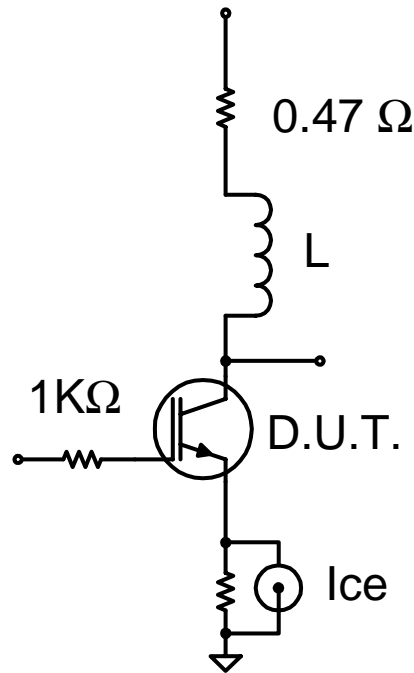


Fig.13 - Self-clamped Inductive Switching Waveform

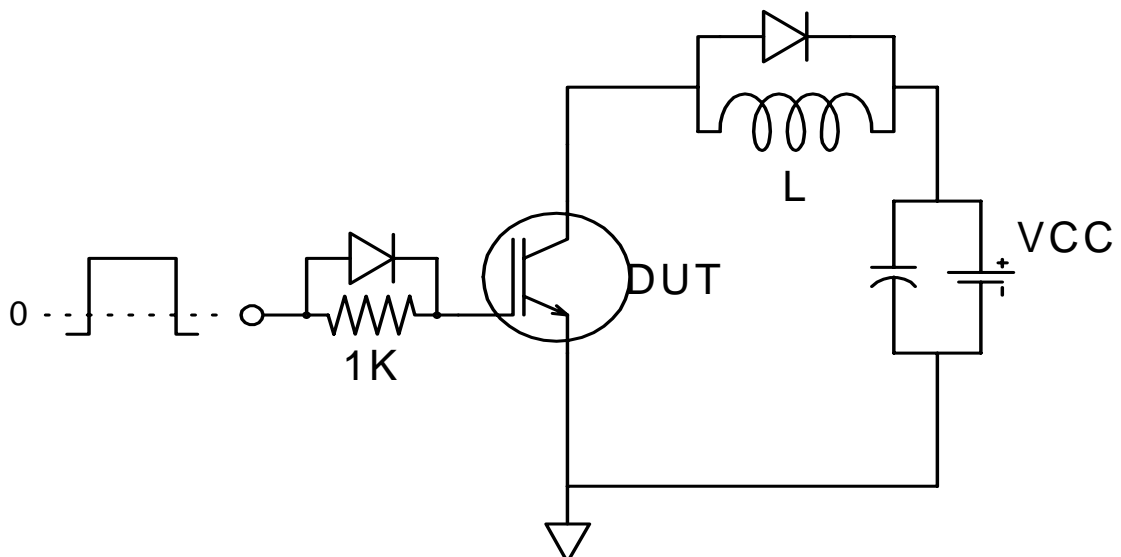
$L = 4.7mH$ ;  $T_C = 25^\circ C$ ; used circuit in Fig.14



**Fig.14 - Test Circuit**

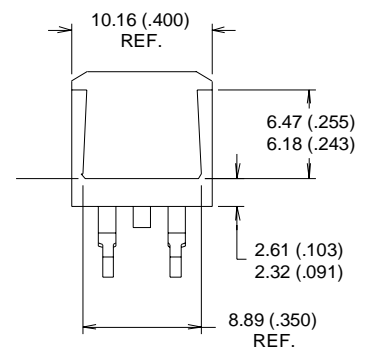
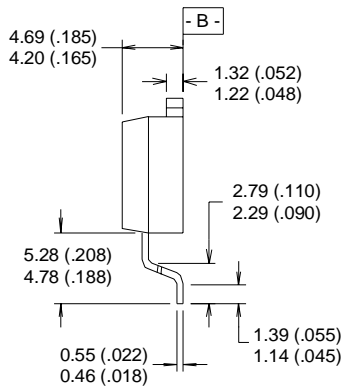
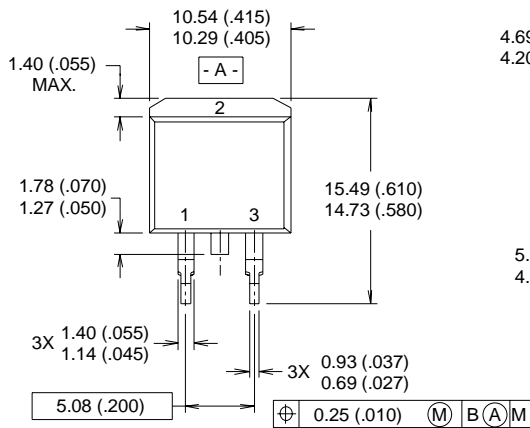


**Fig.15 - Gate Charge Circuit**

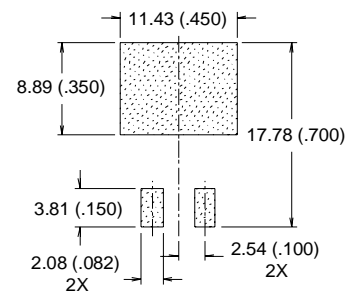


TO-263AB Package Outline

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.

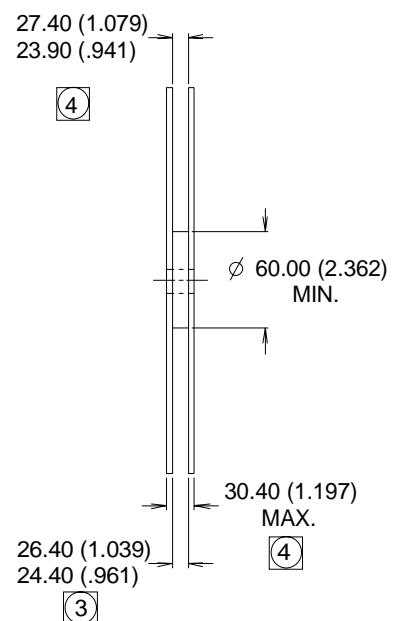
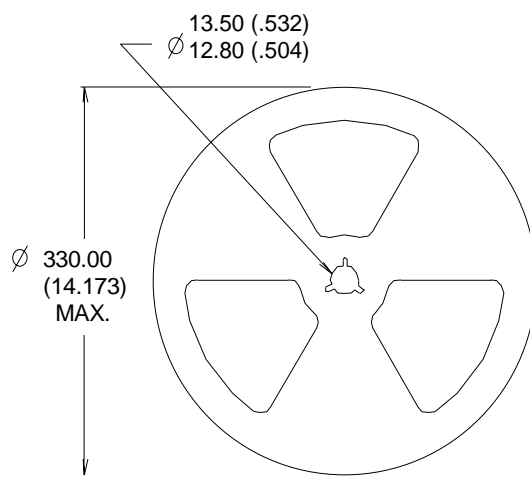
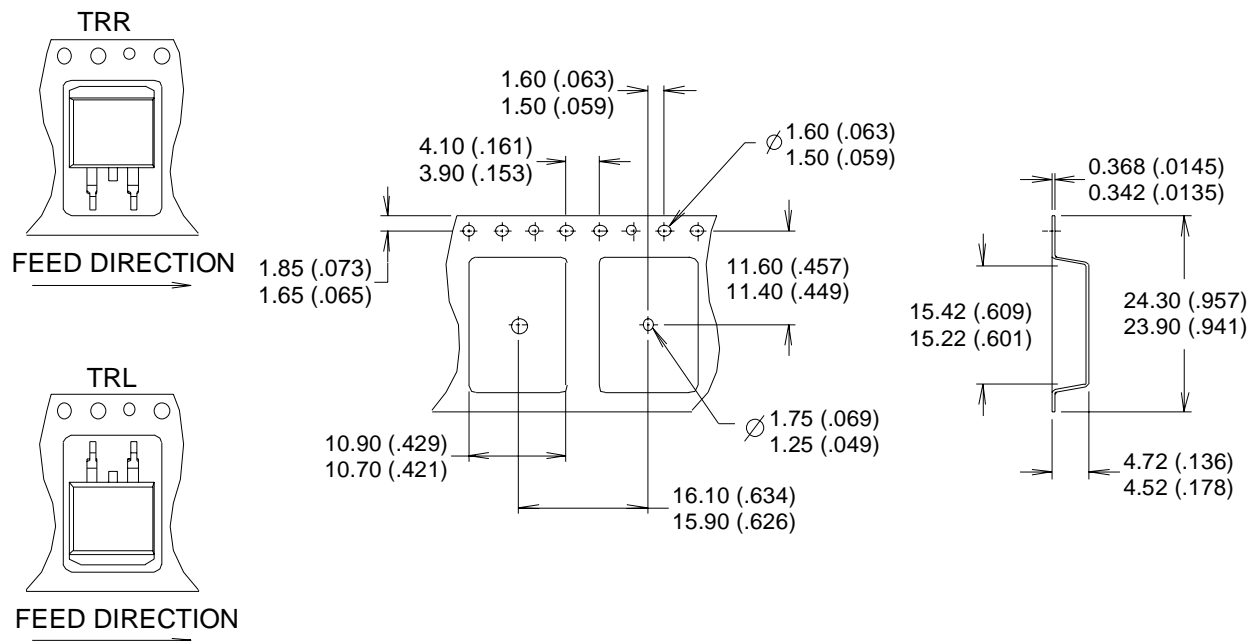
LEAD ASSIGNMENTS

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



TO-263AB Package Outline in Tape and Reel

Dimensions are shown in millimeters (inches)

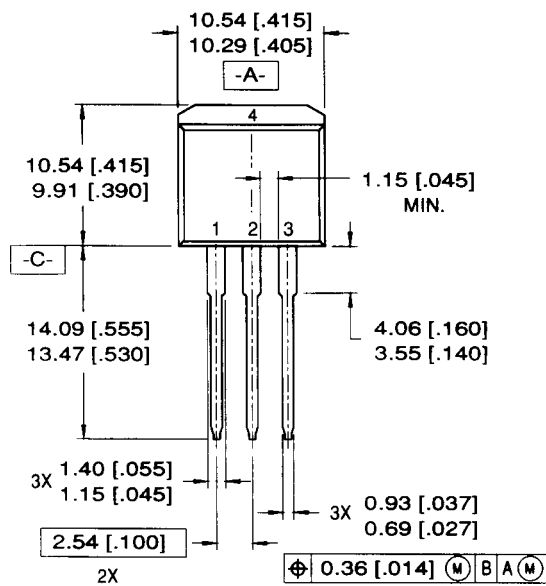


NOTES :

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

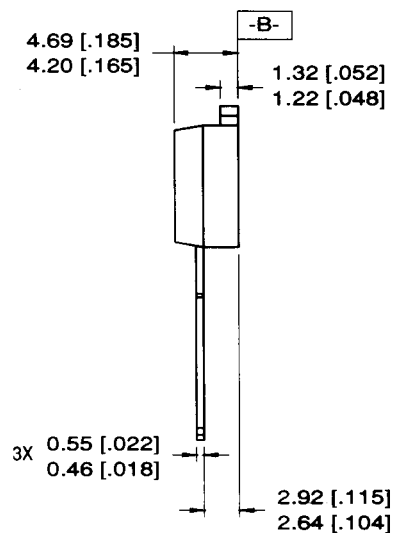
TO-262AA Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS

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

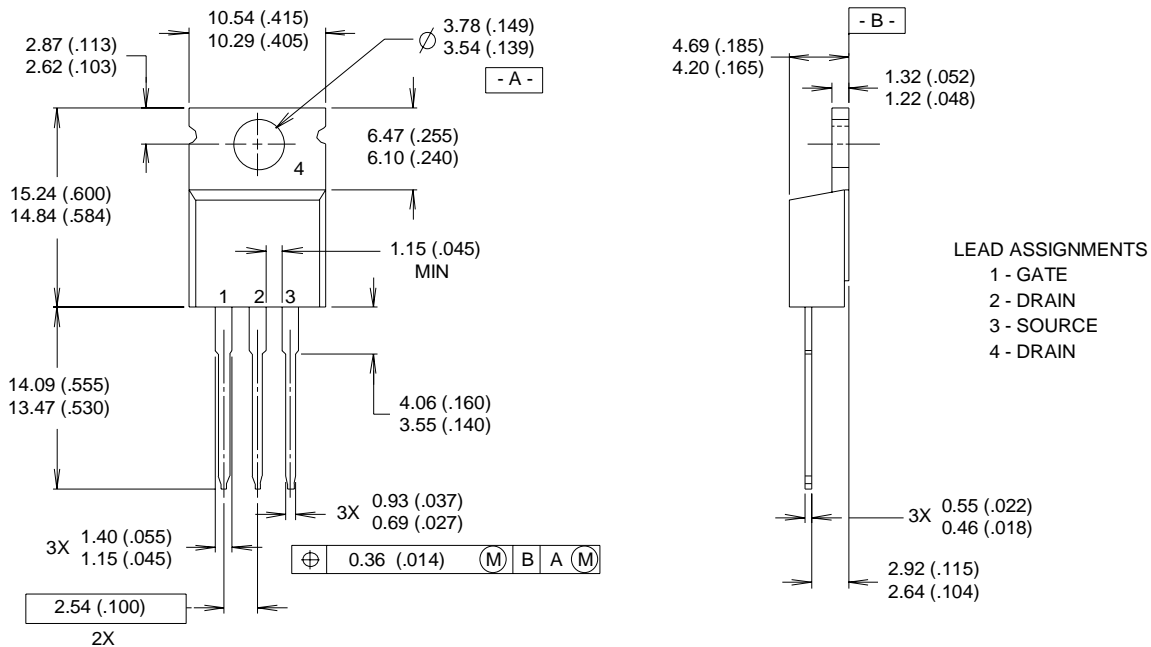


NOTES:

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.