

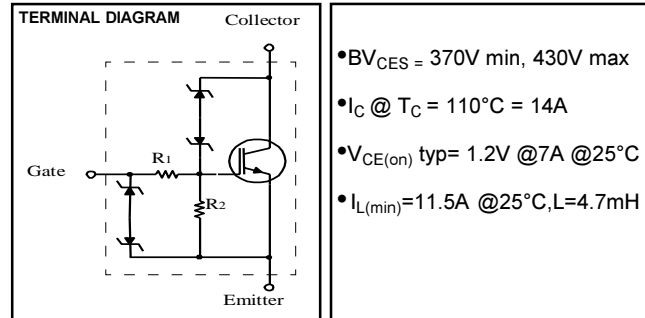
IGBT with on-chip Gate-Emitter and Gate-Collector clamps

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°C (unless otherwise specified)

	Parameter	Min	Typ	Max	Unit	Conditions	Fig
BV _{CES}	Collector-to-Emitter Breakdown Voltage	370	400	430	V	R _G = 1K ohm, I _C =7A, V _{GE} = 0V	
BV _{GES}	Gate-to-Emitter Breakdown Voltage	10	12		V	I _G =2m A	
I _{CES}	Collector-to-Emitter Leakage Current			15	μA	R _G =1K ohm, V _{CE} = 250V	
				100	μA	R _G =1K ohm, V _{CE} = 250V, T _J =150°C	
BV _{CER}	Emitter-to-Collector Breakdown Voltage	24	28		V	I _C = -10m 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°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 = 7A, V _{GE} = 4.5V	1
			1.35	1.55		I _C = 10A, V _{GE} = 4.5V	
			1.35	1.55		I _C = 10A, V _{GE} = 4.5V, T _C = -40°C	4
			1.5	1.7		I _C = 14A, V _{GE} = 5.0V, T _C = -40°C	
			1.55	1.75		I _C = 14A, V _{GE} = 5.0V	
			1.6	1.8		I _C = 14A, V _{GE} = 5.0V, T _C =150°C	
V _{GE(th)}	Gate Threshold Voltage	1.3	1.8	2.2	V	V _{CE} = V _{GE} , I _C = 1 m A, T _C =25°C	3, 5
		0.75		1.8		V _{CE} = V _{GE} , I _C = 1 m A, T _C =150°C	
g _{fs}	Transconductance	10	15	19	S	V _{CE} = 25V, I _C = 10A, T _C =25°C	
I _C	Collector Current	20			A	V _{CE} = 10V, V _{GE} = 4.5V	

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

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

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

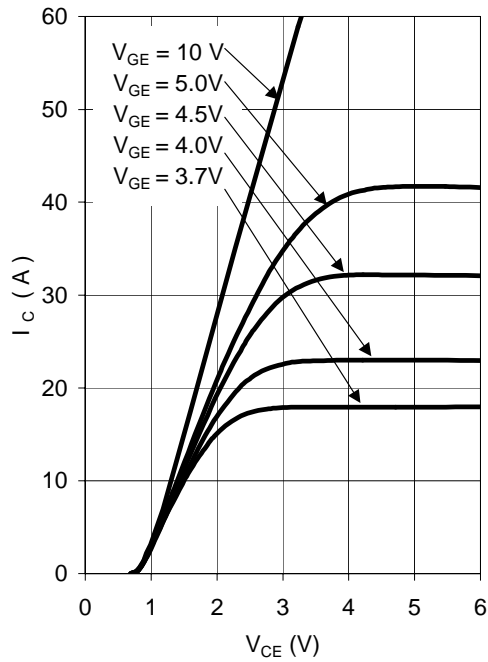


Fig.2 - Typ. Output Characteristics
 $T_J=125^\circ\text{C}$

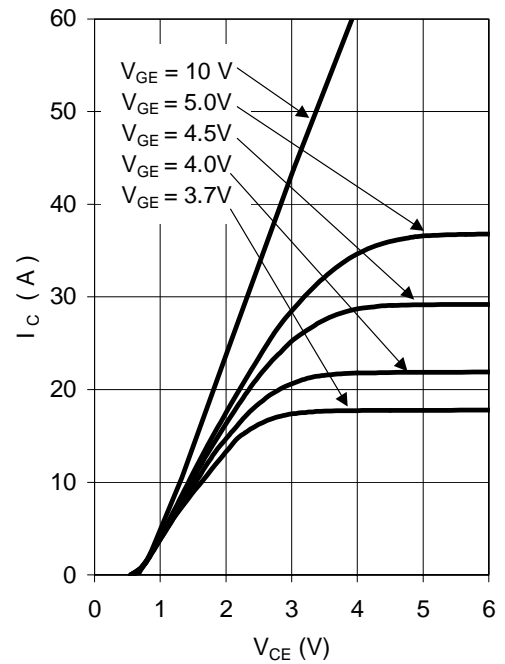


Fig.3 - Transfer Characteristics
 $V_{CE}=20\text{V}; t_p=20\mu\text{s}$

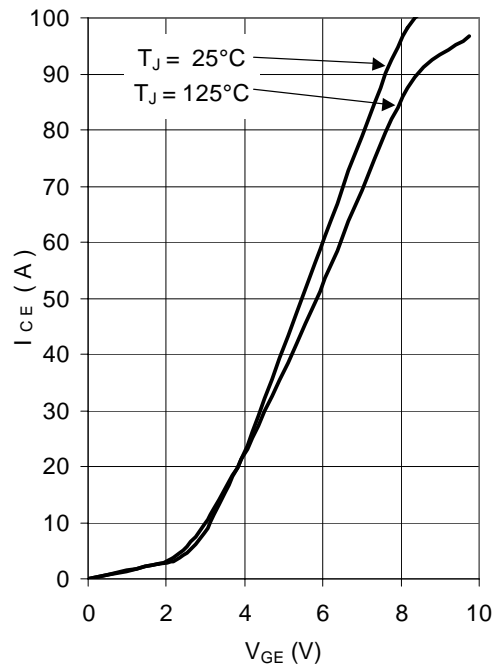
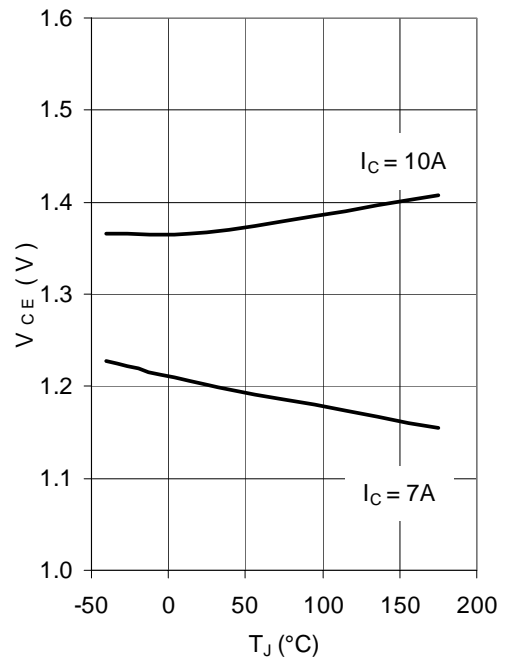


Fig.4 - Typical V_{CE} vs T_J
 $V_{GE}=4.5\text{V}$



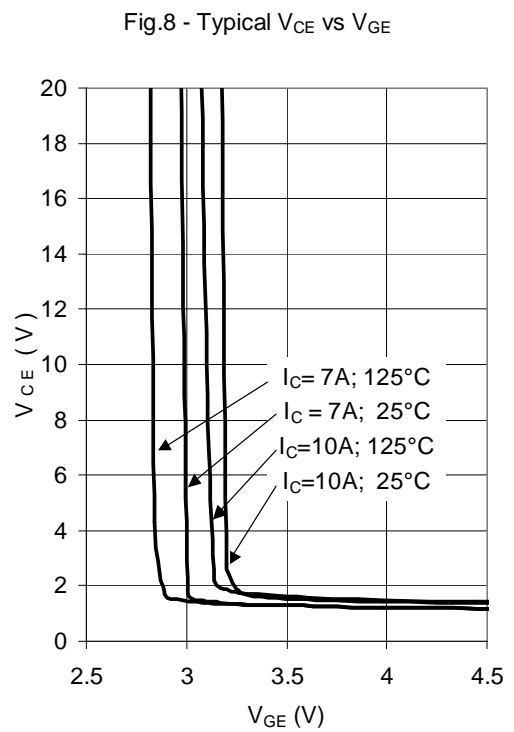
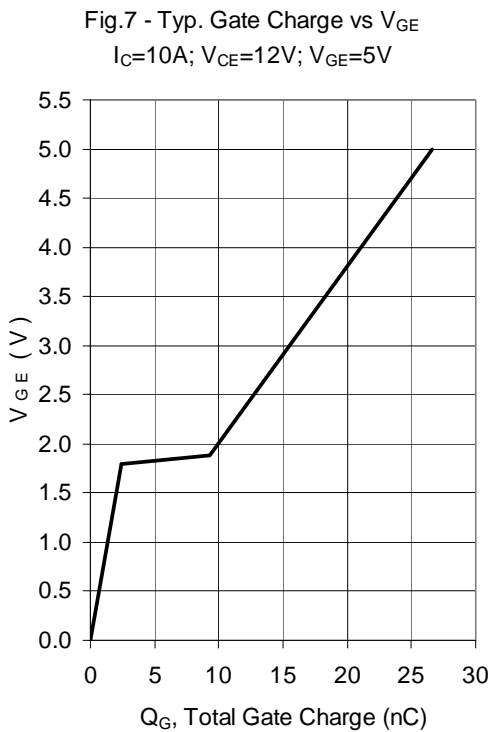
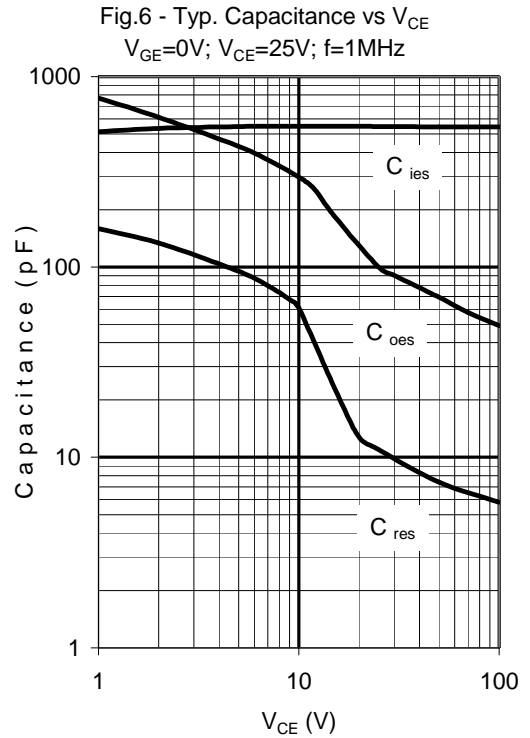
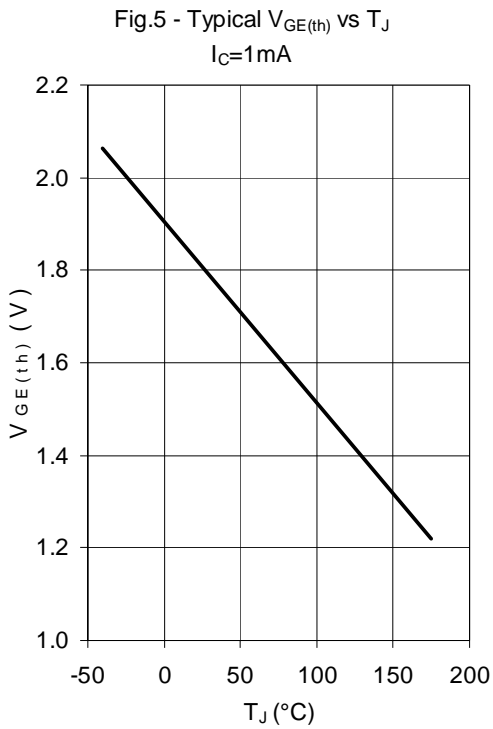


Fig.9 - Self-clamp Avalanche Current vs Inductance @ 25°C

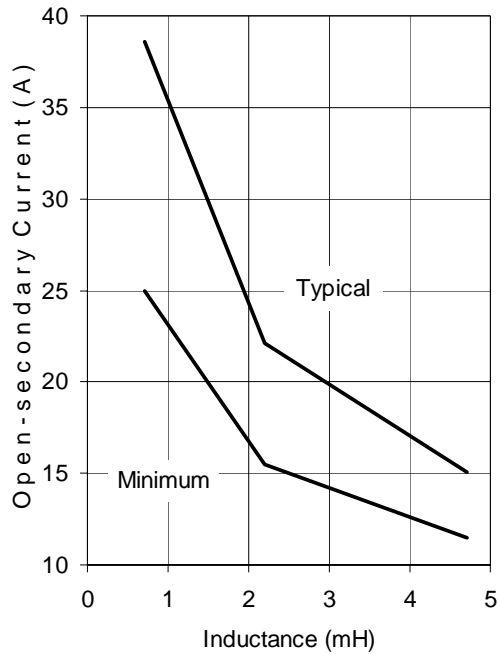


Fig.10 - Self-clamp Avalanche Current vs Inductance @ 150°C

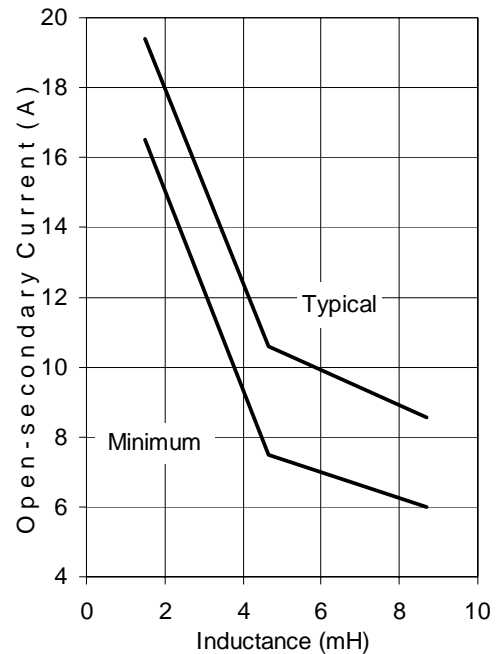


Fig.11 - Transient Thermal Impedance, Junction-to-Case

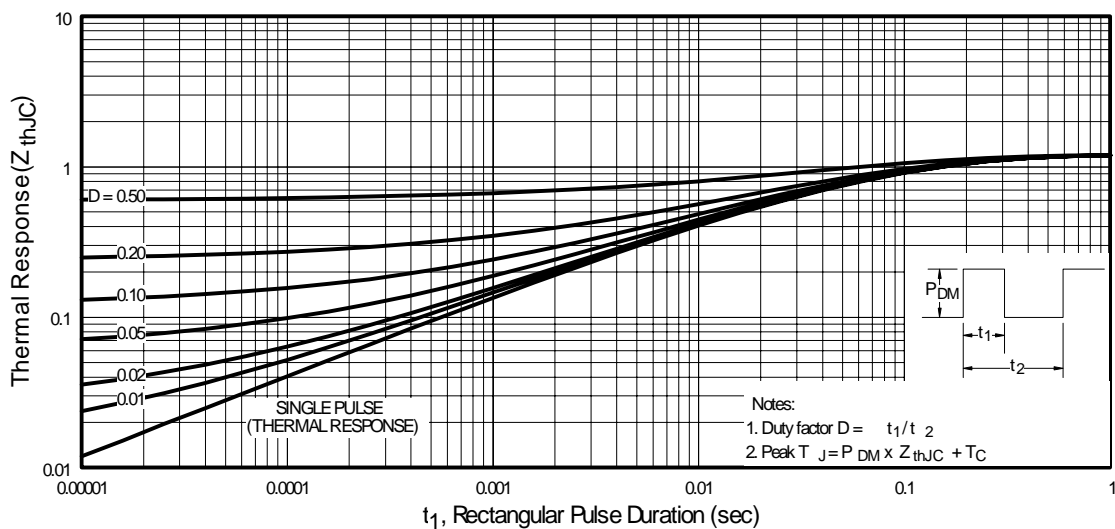


Fig.12 - Switching Waveform for Time Measurement

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

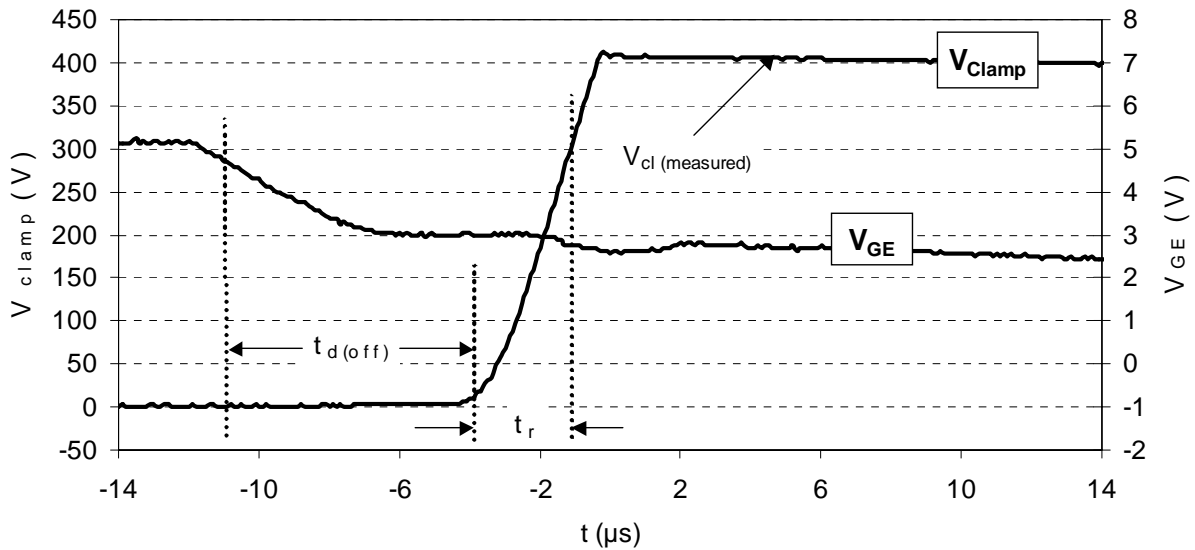


Fig.13 - Self-clamped Inductive Switching Waveform

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

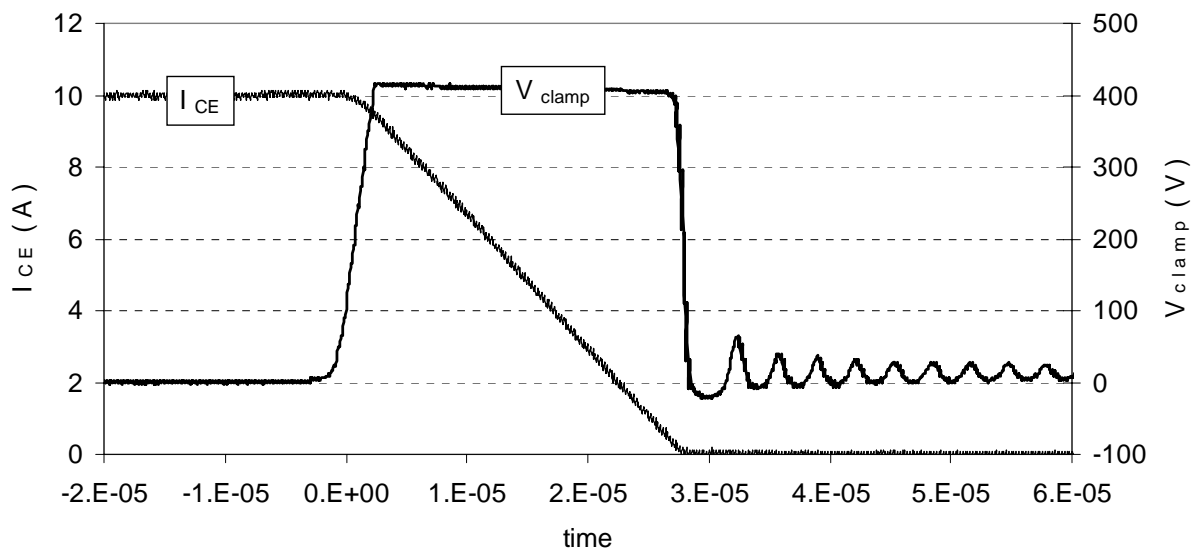


Fig.14 - Test Circuit

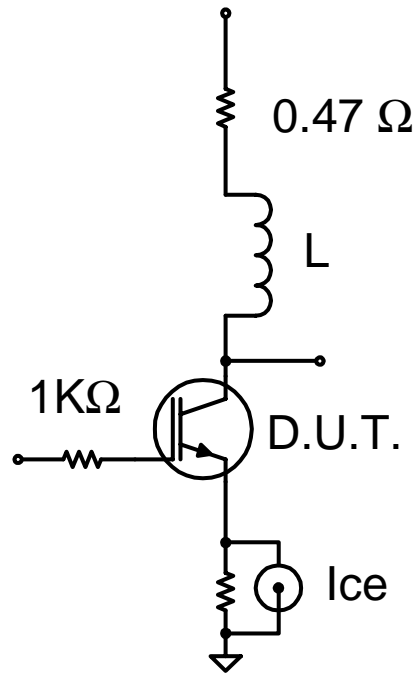
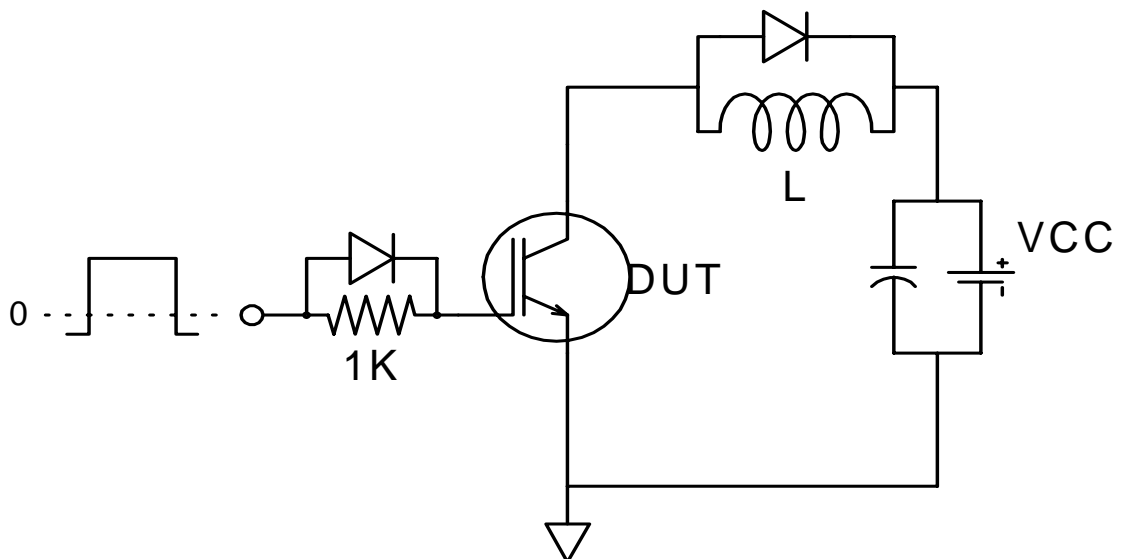
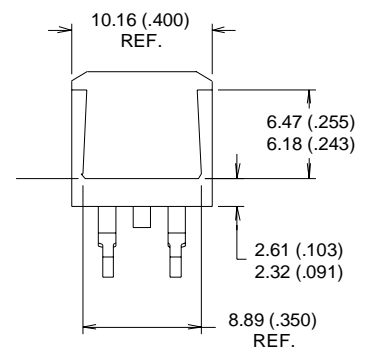
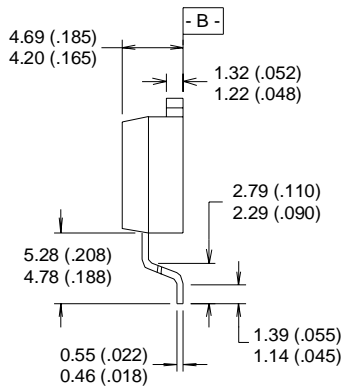
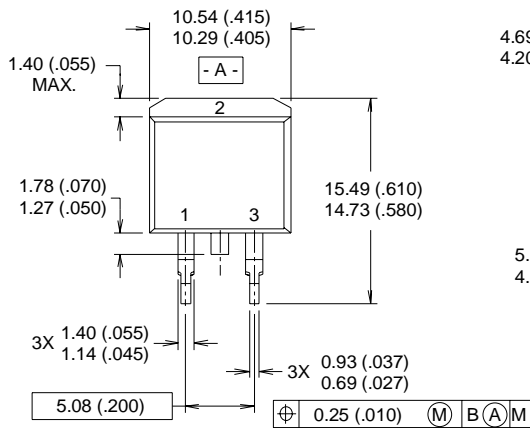


Fig.15 - Gate Charge Circuit

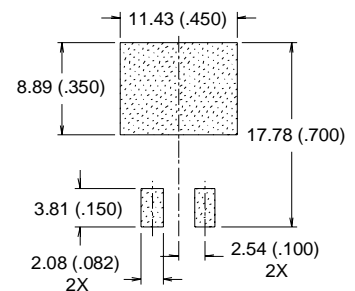


TO-263AB Package Outline

Dimensions are shown in millimeters (inches)



MINIMUM RECOMMENDED FOOTPRINT



NOTES:

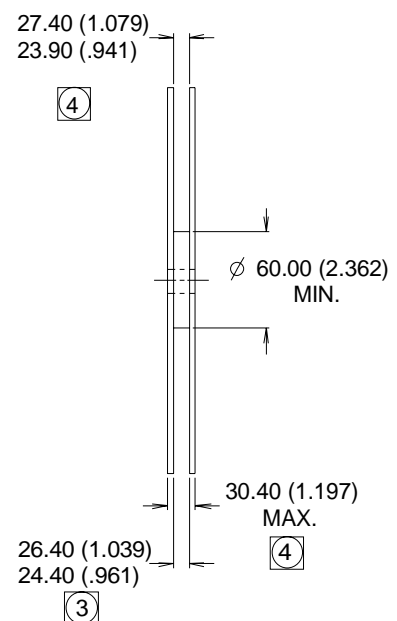
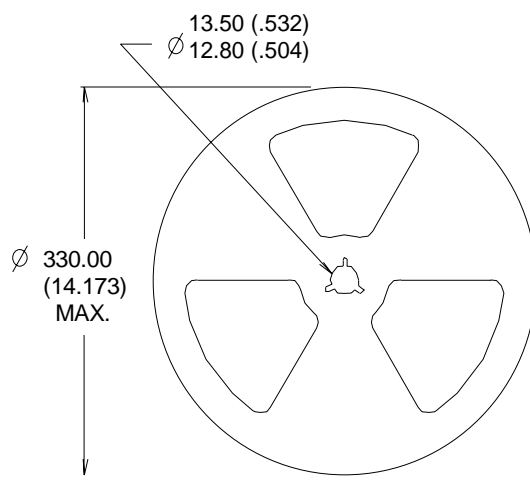
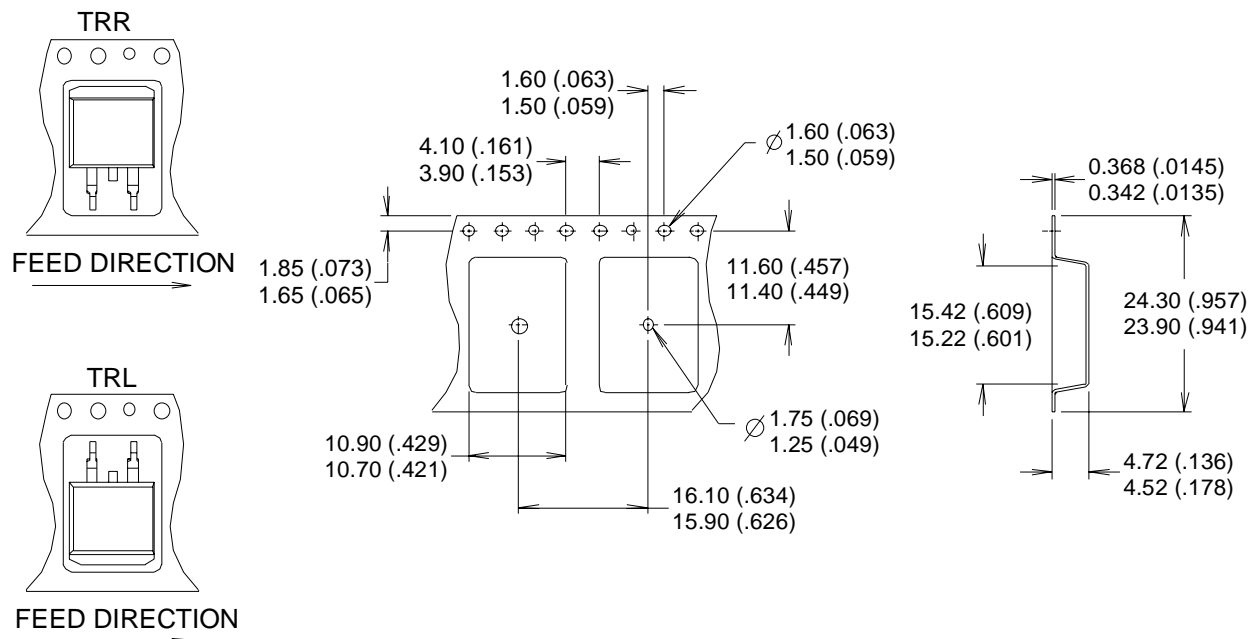
- 1 DIMENSIONS AFTER SOLDER DIP.
- 2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 3 CONTROLLING DIMENSION : INCH.
- 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

LEAD ASSIGNMENTS

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

TO-263AB Package Outline in Tape and Reel

Dimensions are shown in millimeters (inches)

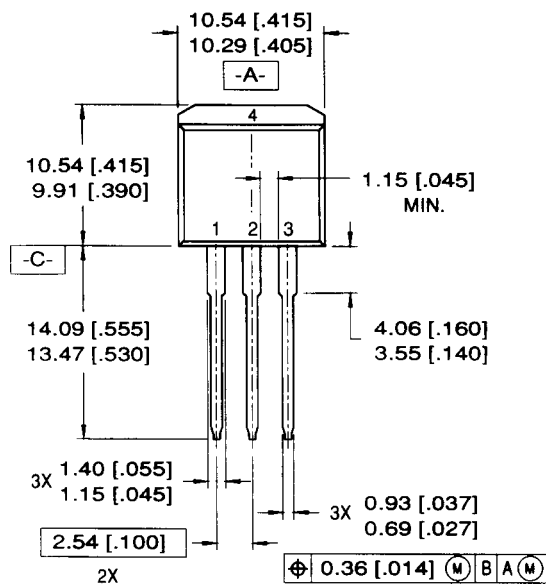


NOTES :

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

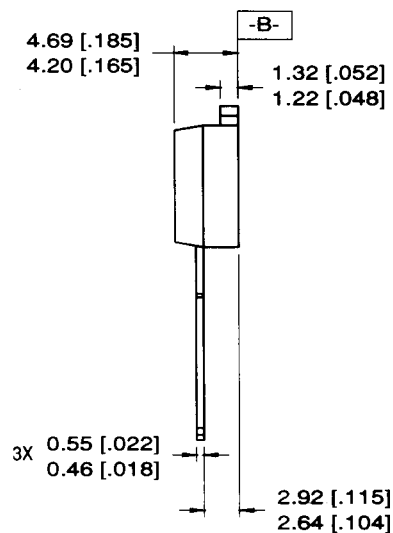
TO-262AA Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS

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

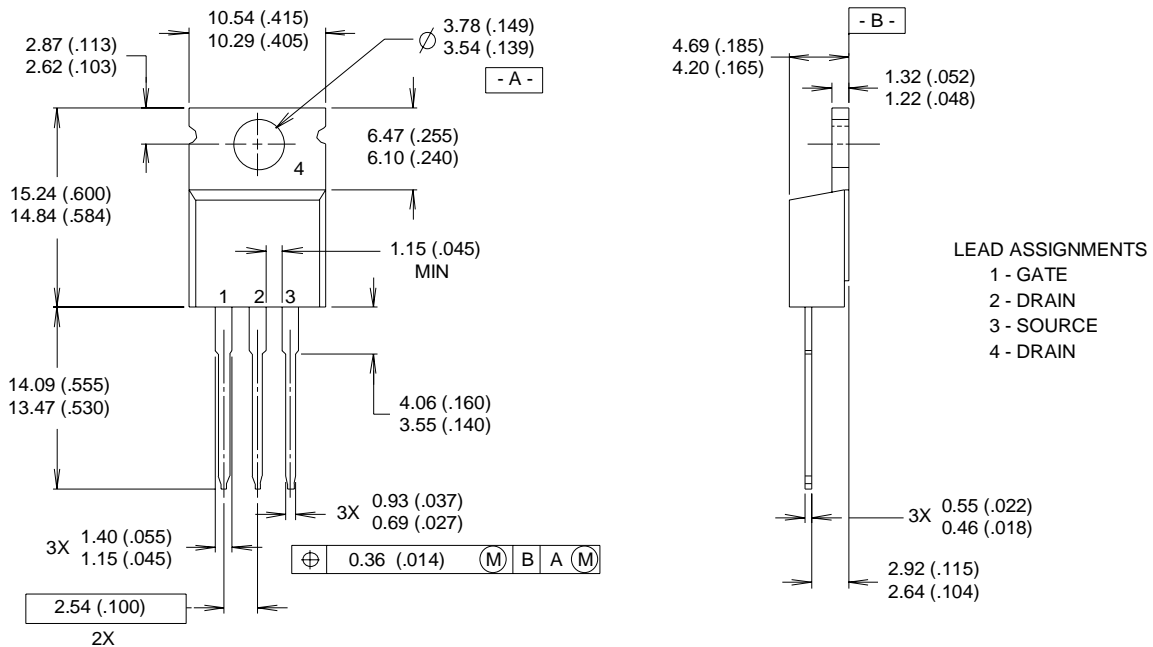


NOTES:

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.

Note: For the most current drawings please refer to the IR website at:
<http://www.irf.com/package/>

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