

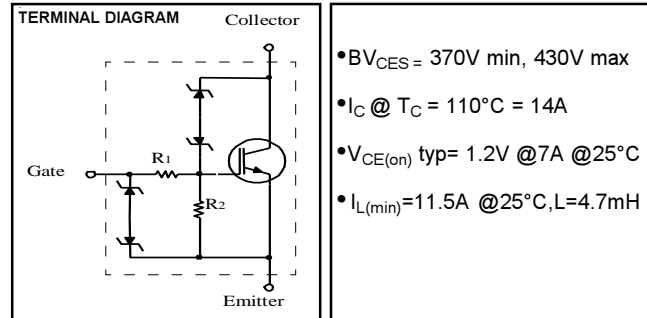
IGBT with on-chip Gate-Emitter and Gate-Collector clamps

**Features**

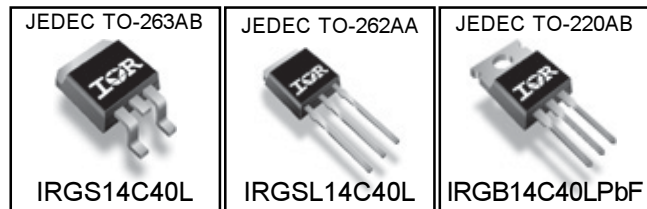
- Most Rugged in Industry
- Logic-Level Gate Drive
- > 6KV ESD Gate Protection
- Low Saturation Voltage
- High Self-clamped Inductive Switching Energy
- TO-220 is available in PbF as a Lead-Free

**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.



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



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	$\mu\text{A}$	$R_G = 1\text{K ohm}$ , $V_{CE} = 250\text{V}$	
				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				$\mu\text{s}$	$T_J = 150^\circ\text{C}$ , $V_{CC} = 16\text{V}$ , $L = 10\mu\text{H}$ $R_G = 1\text{K ohm}$ , $V_{GE} = 5\text{V}$	14
		120					

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

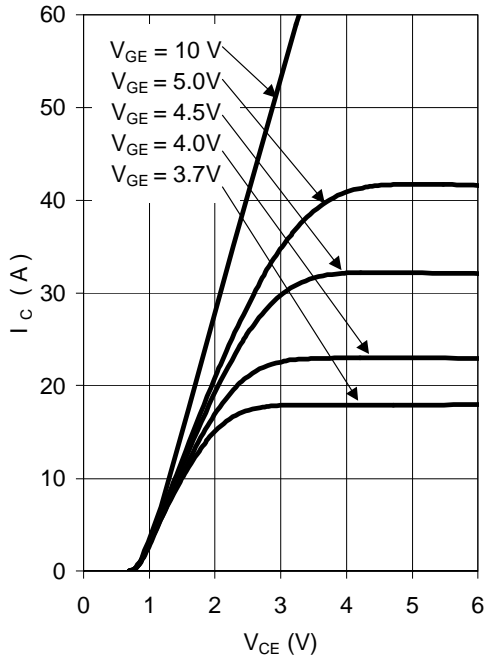


Fig.2 - Typ. Output Characteristics  
 $T_J=125^\circ\text{C}$

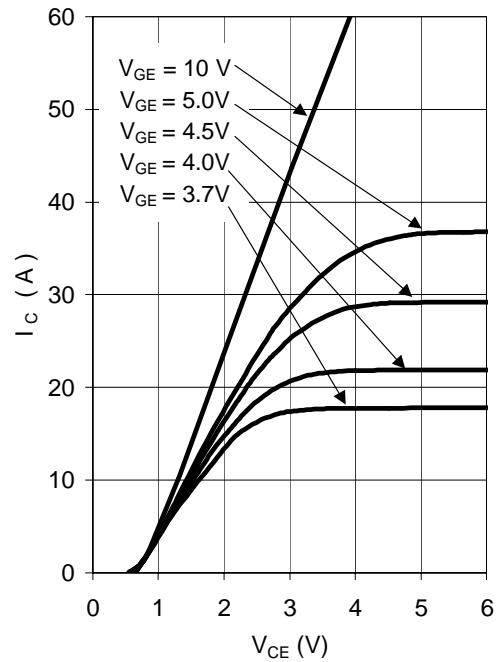


Fig.3 - Transfer Characteristics  
 $V_{CE}=20\text{V}; t_p=20\mu\text{s}$

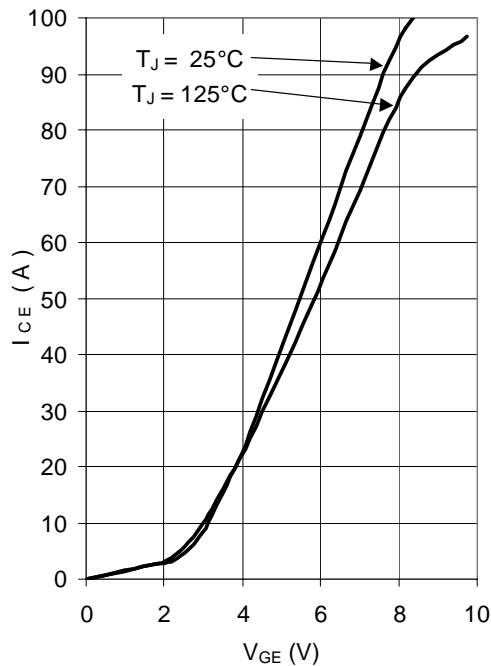
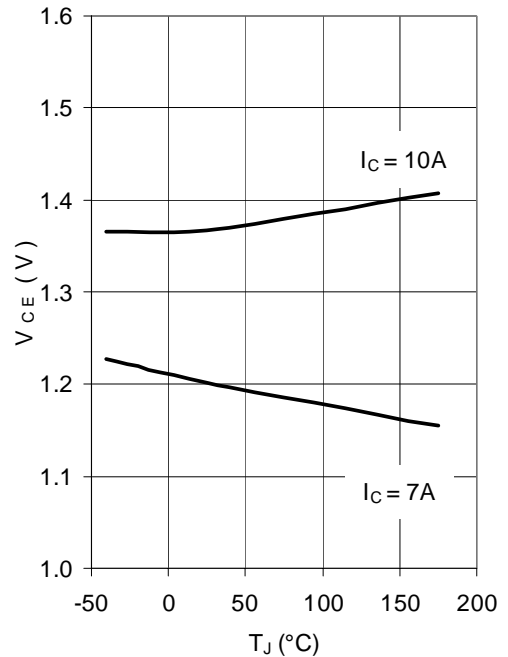


Fig.4 - Typical  $V_{CE}$  vs  $T_J$   
 $V_{GE}=4.5\text{V}$



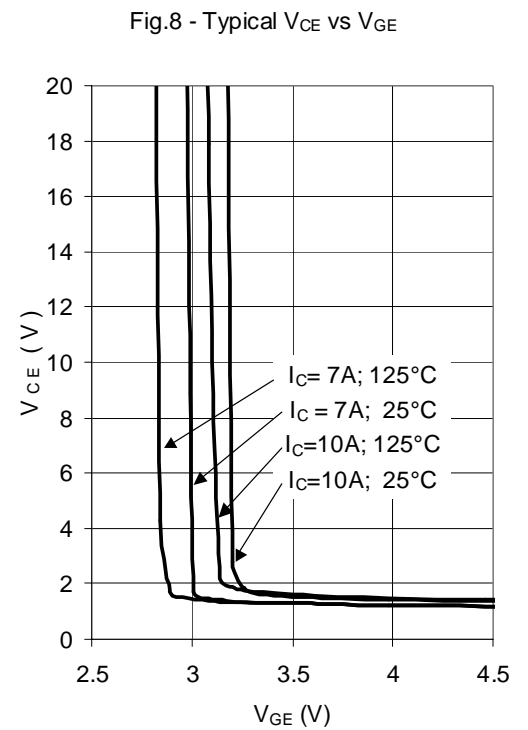
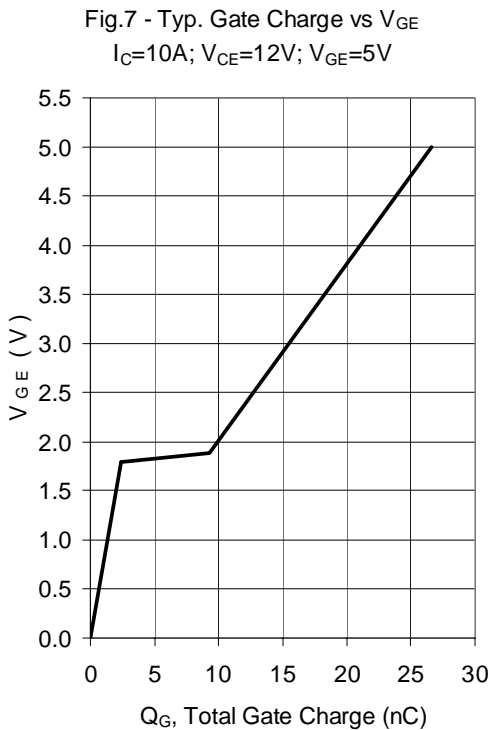
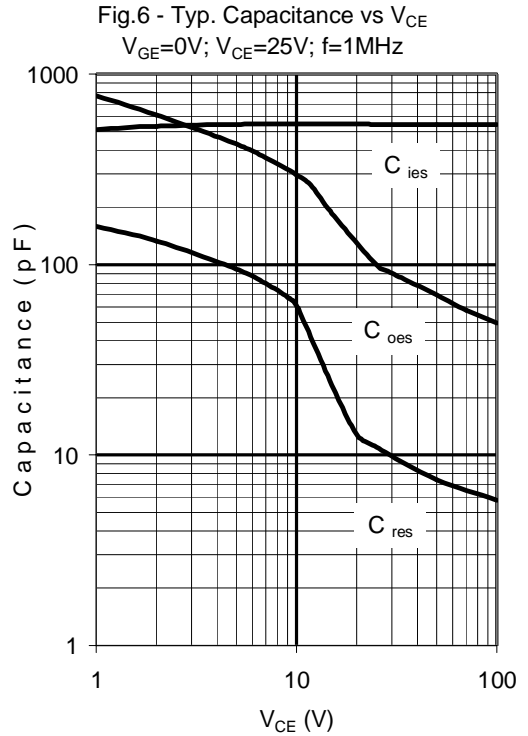
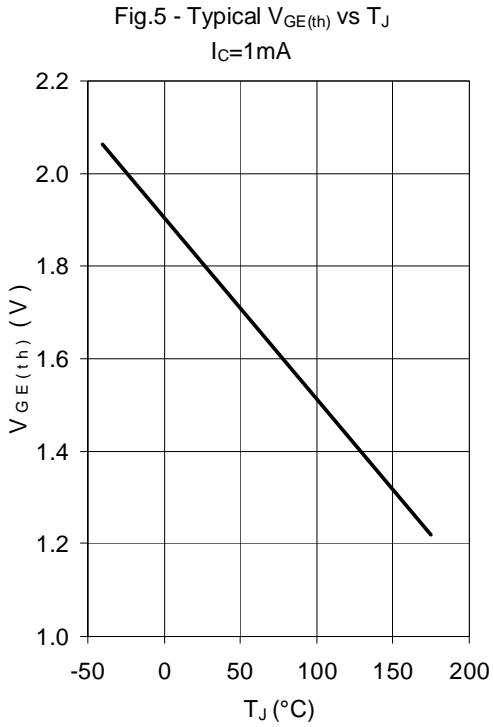


Fig.9 - Self-clamp Avalanche Current vs Inductance @ 25°C

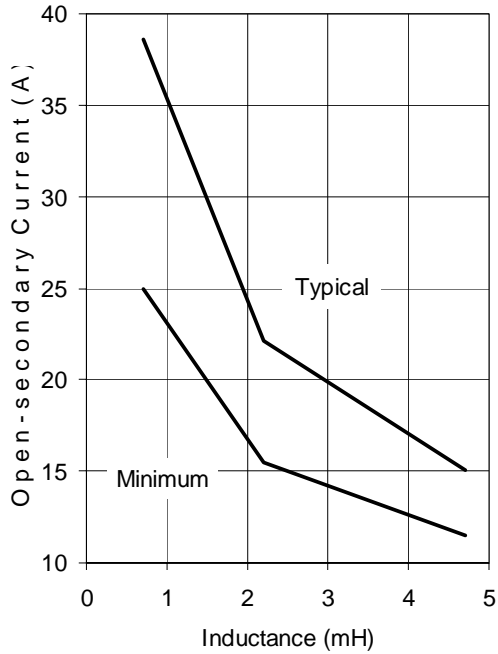


Fig.10 - Self-clamp Avalanche Current vs Inductance @ 150°C

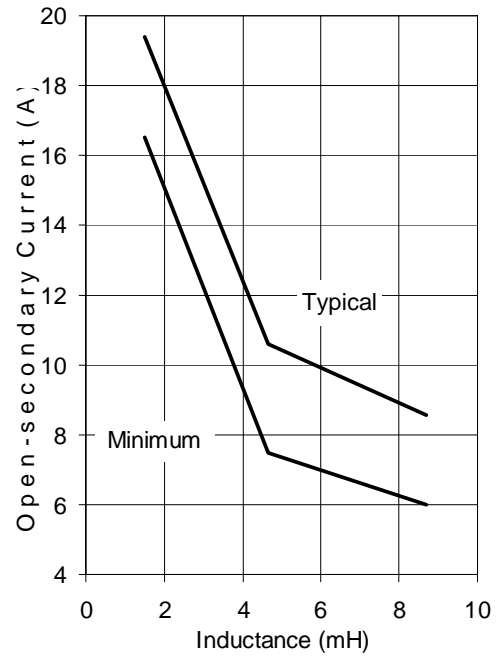


Fig.11 - Transient Thermal Impedance, Junction-to-Case

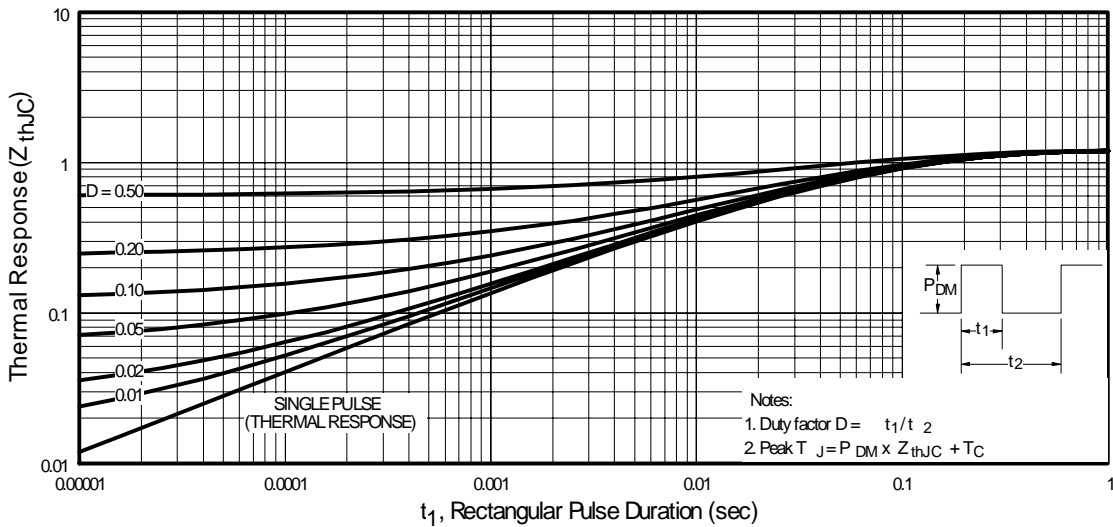


Fig.12 - Switching Waveform for Time Measurement

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

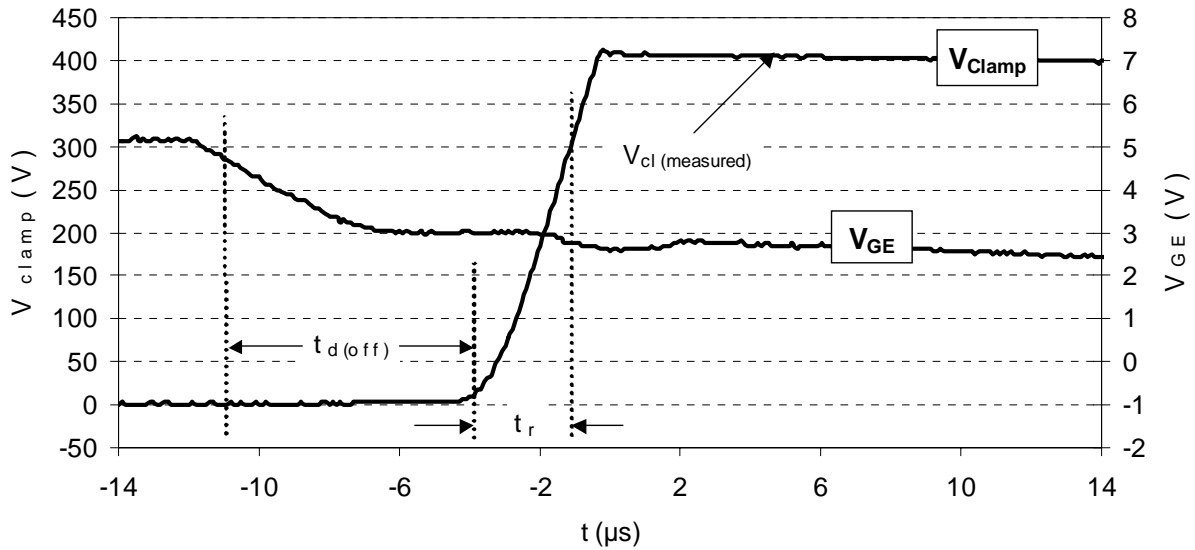


Fig.13 - Self-clamped Inductive Switching Waveform

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

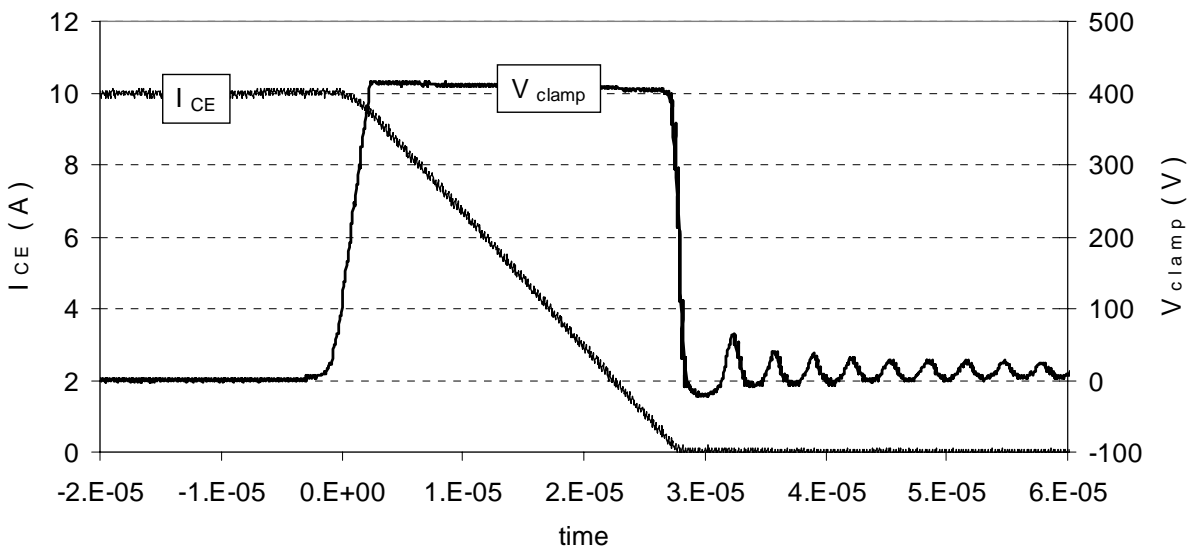


Fig.14 - Test Circuit

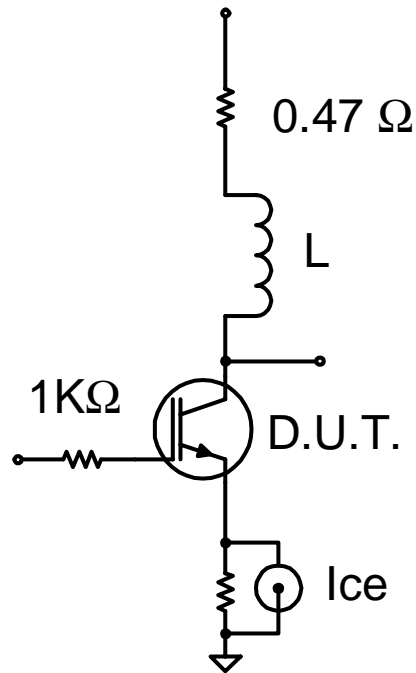
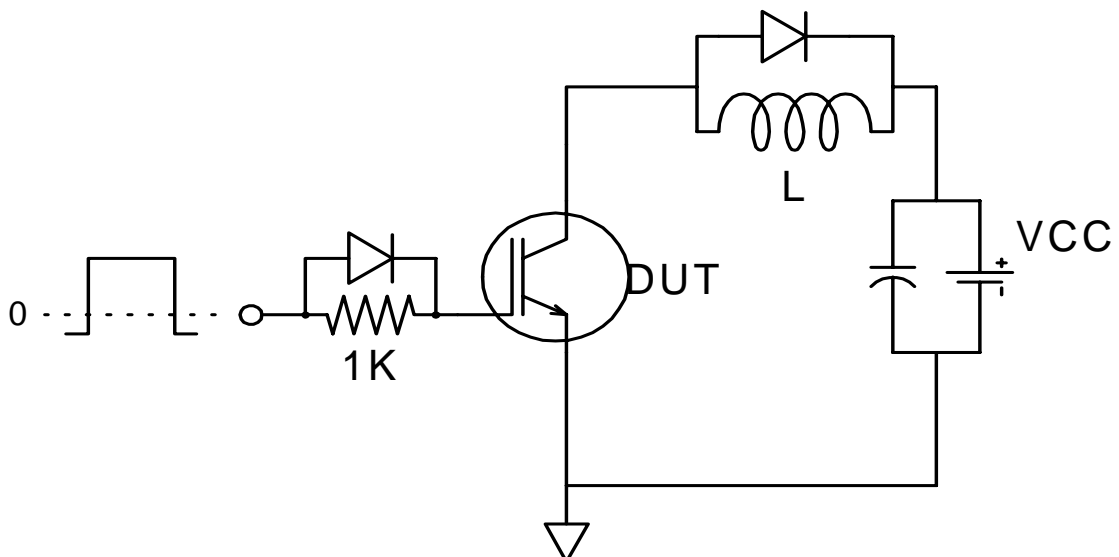
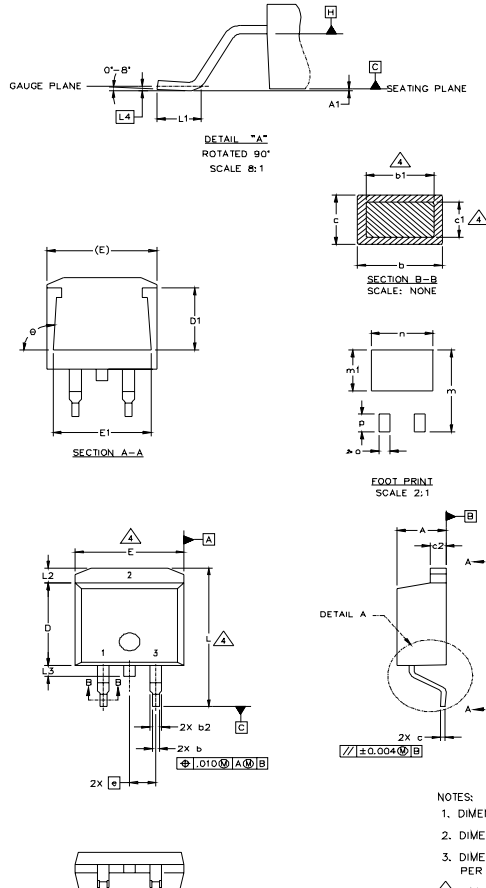


Fig.15 - Gate Charge Circuit



### D<sup>2</sup>Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1		0.127		.005	
b	0.51	0.99	.020	.039	4
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	
c	0.43	0.63	.017	.025	4
c1	0.38	0.74	.015	.029	
c2	1.14	1.40	.045	.055	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2		1.65		.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
θ	90°	93°	90°	93°	

LEAD ASSIGNMENTS

HEXFET	IGBTs, CoPACK	DIODES
1.- GATE	1.- GATE	1.- ANODE *
2.- DRAIN	2.- COLLECTOR	2.- CATHODE
3.- SOURCE	3.- EMITTER	3.- ANODE

\* PART DEPENDENT.

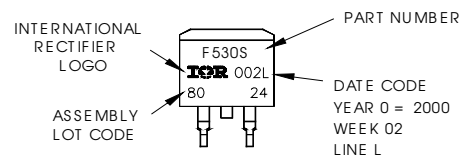
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

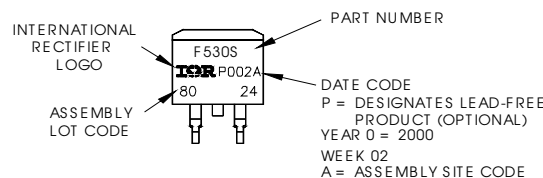
### D<sup>2</sup>Pak Part Marking Information (Lead-Free)

EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line  
position indicates "Lead-Free"



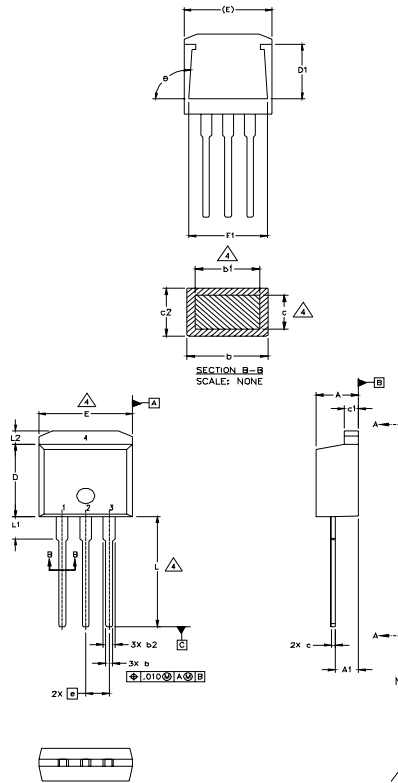
**OR**





### TO-262 Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.38	0.63	.015	.025	4
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54	BSC	.100	BSC	
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

LEAD ASSIGNMENTS

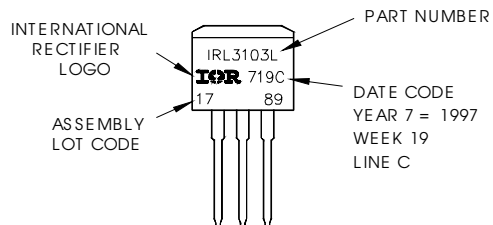
HEXFET	IGBT
1.- GATE	1 - GATE
2.- DRAIN	2 - COLLECTOR
3.- SOURCE	3 - EMITTER
4.- DRAIN	

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
  3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
  5. CONTROLLING DIMENSION: INCH.

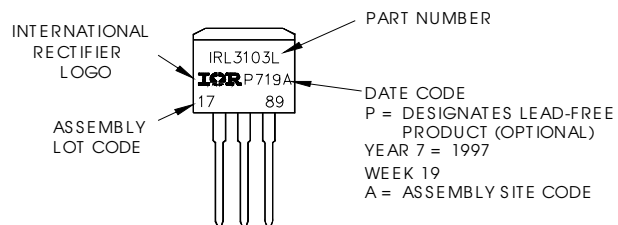
### TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L  
LOT CODE 1789  
ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE "C"

Note: "P" in assembly line position indicates "Lead-Free"

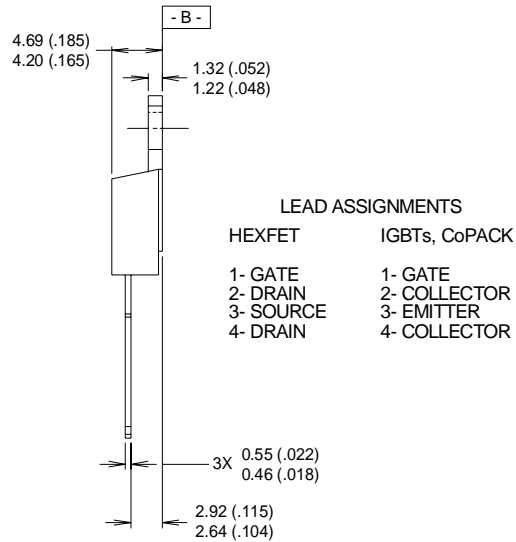
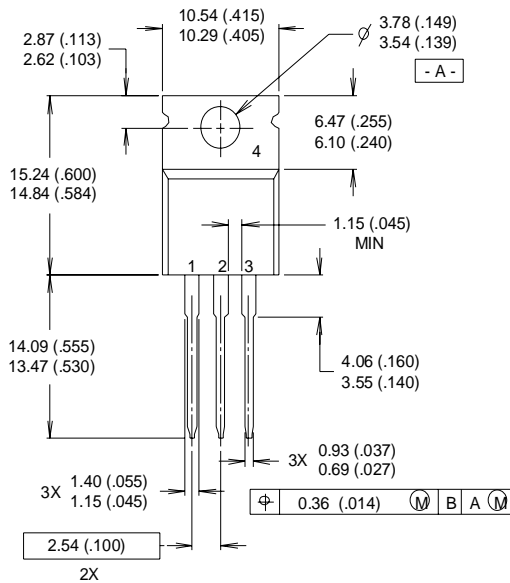


OR



### TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



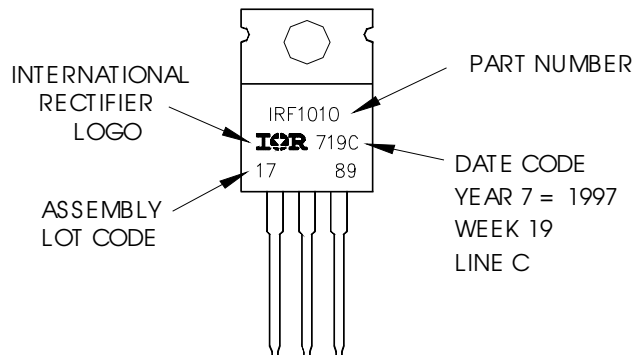
LEAD ASSIGNMENTS	
HEXFET	IGBTs, CoPACK
1- GATE	1- GATE
2- DRAIN	2- COLLECTOR
3- SOURCE	3- EMITTER
4- DRAIN	4- COLLECTOR

**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.

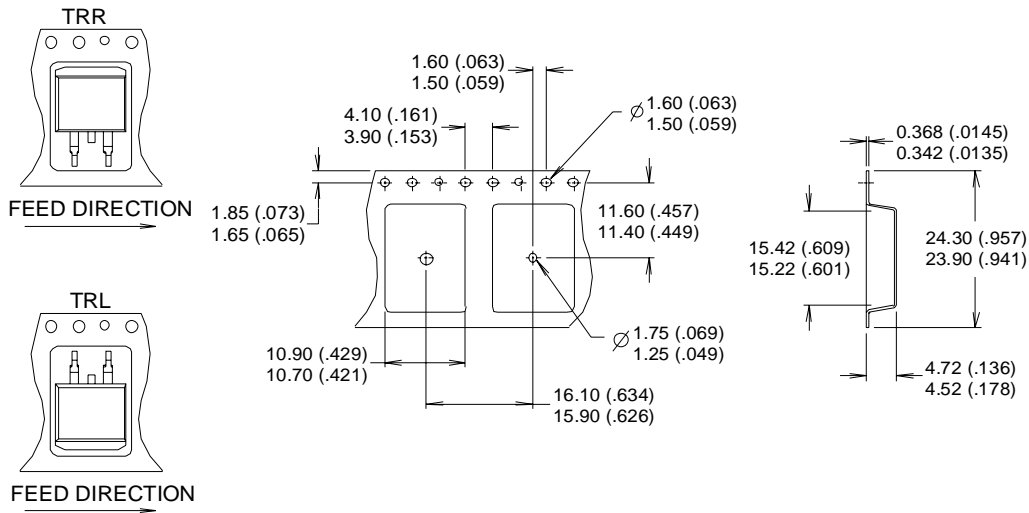
### TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"  
**Note:** "P" in assembly line position indicates "Lead-Free"



D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



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

Data and specifications subject to change without notice.

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