FAIRCHILD SEMICONDUCTOR®

HGTP14N36G3VL, HGT1S14N36G3VL, HGT1S14N36G3VLS

14A, 360V N-Channel, Logic Level, Voltage Clamping IGBTs

September 2001

Features

- **Logic Level Gate Drive**
- **Internal Voltage Clamp**
- **ESD Gate Protection**
- **$T_J = 175^oC$**
- **Ignition Energy Capable**

Description

This N-Channel IGBT is a MOS gated, logic level device which is intended to be used as an ignition coil driver in automotive ignition circuits. Unique features include an active voltage clamp between the collector and the gate which provides Self Clamped Inductive Switching (SCIS) capability in ignition circuits. Internal diodes provide ESD protection for the logic level gate. Both a series resistor and a shunt resister are provided in the gate circuit.

PACKAGING AVAILABILITY

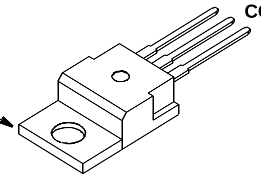
PART NUMBER	PACKAGE	BRAND
HGTP14N36G3VL	TO-220AB	14N36GVL
HGT1S14N36G3VL	TO-262AA	14N36GVL
HGT1S14N36G3VLS	TO-263AB	14N36GVL

NOTE: When ordering, use the entire part number. To obtain the TO-263AB in tape and reel, drop the S and add the suffix T; i.e., HGT1S14N36G3VLT.

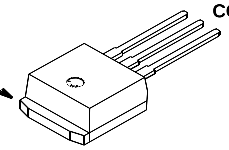
The development type number for this device is TA49021.

Packages

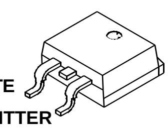
JEDEC TO-220AB



JEDEC TO-262AA

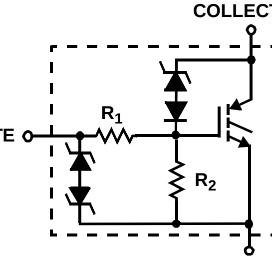


JEDEC TO-263AB



Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



Absolute Maximum Ratings $T_C = +25^oC$, Unless Otherwise Specified

	HGTP14N36G3VL, HGT1S14N36G3VL, HGT1S14N36G3VLS	UNITS
Collector-Emitter Bkdn Voltage at 10mA . . . . BV_{CER}	390	V
Emitter-Collector Bkdn Voltage at 10mA . . . . BV_{ECS}	24	V
Collector Current Continuous at V_{GE} = 5V, $T_C = +25^oC$ . . . . I_{C25}	18	A
at V_{GE} = 5V, $T_C = +100^oC$ . . . . I_{C100}	14	A
Gate-Emitter Voltage (Note) . . . . V_{GEM}	±10	V
Inductive Switching Current at L = 2.3mH, $T_C = +25^oC$ . . . . I_{SCIS}	17	A
at L = 2.3mH, $T_C = +175^oC$ . . . . I_{SCIS}	12	A
Collector to Emitter Avalanche Energy at L = 2.3mH, $T_C = +25^oC$ . . . . E_{AS}	332	mJ
Power Dissipation Total at $T_C = +25^oC$ . . . . P_D	100	W
Power Dissipation Derating $T_C > +25^oC$	0.67	$W/^oC$
Operating and Storage Junction Temperature Range . . . . T_J, T_{STG}	-40 to +175	^oC
Maximum Lead Temperature for Soldering . . . . T_L	260	^oC
Electrostatic Voltage at 100pF, 1500Ω . . . . ESD	6	KV

NOTE: May be exceeded if I_{GEM} is limited to 10mA.

Electrical Specifications T_C = +25°C, Unless Otherwise Specified

PARAMETERS	SYMBOL	TEST CONDITIONS		LIMITS MIN	TYP	MAX	UNITS
Collector-Emitter Breakdown Voltage	BV_{CER}	I_C = 10mA, V_{GE} = 0V R_{GE} = 1kΩ	T_C = +175°C	320	355	400	V
			T_C = +25°C	330	360	390	V
			T_C = -40°C	320	350	385	V
Gate-Emitter Plateau Voltage	V_{GEP}	I_C = 7A, V_{CE} = 12V	T_C = +25°C	-	2.7	-	V
Gate Charge	$Q_{G(ON)}$	I_C = 7A, V_{CE} = 12V	T_C = +25°C	-	24	-	nC
Collector-Emitter Clamp Breakdown Voltage	$BV_{CE(CL)}$	I_C = 7A R_G = 1000Ω	T_C = +175°C	350	380	410	V
Emitter-Collector Breakdown Voltage	BV_{ECS}	I_C = 10mA	T_C = +25°C	24	28	-	V
Collector-Emitter Leakage Current	I_{CER}	V_{CE} = 250V R_{GE} = 1kΩ	T_C = +25°C	-	-	25	μA
			T_C = +175°C	-	-	250	μA
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	I_C = 7A V_{GE} = 4.5V	T_C = +25°C	-	1.25	1.45	V
			T_C = +175°C	-	1.15	1.6	V
		I_C = 14A V_{GE} = 5V	T_C = +25°C	-	1.6	2.2	V
			T_C = +175°C	-	1.7	2.9	V
Gate-Emitter Threshold Voltage	$V_{GE(TH)}$	I_C = 1mA V_{CE} = V_{GE}	T_C = +25°C	1.3	1.8	2.2	V
Gate Series Resistance	R_1		T_C = +25°C	-	75	-	Ω
Gate-Emitter Resistance	R_2		T_C = +25°C	10	20	30	kΩ
Gate-Emitter Leakage Current	I_{GES}	V_{GE} = ±10V		±330	±500	±1000	μA
Gate-Emitter Breakdown Voltage	BV_{GES}	I_{GES} = ±2mA		±12	±14	-	V
Current Turn-Off Time-Inductive Load	$t_{D(OFF)I}$ + $t_{F(OFF)I}$	I_C = 7A, R_L = 28Ω R_G = 25Ω, L = 550μH, V_{CL} = 300V, V_{GE} = 5V, T_C = +175°C		-	7	-	μs
Inductive Use Test	I_{SCIS}	L = 2.3mH, V_G = 5V,	T_C = +175°C	12	-	-	A
			T_C = +25°C	17	-	-	A
Thermal Resistance	$R_{\theta JC}$			-	-	1.5	°C/W

Typical Performance Curves

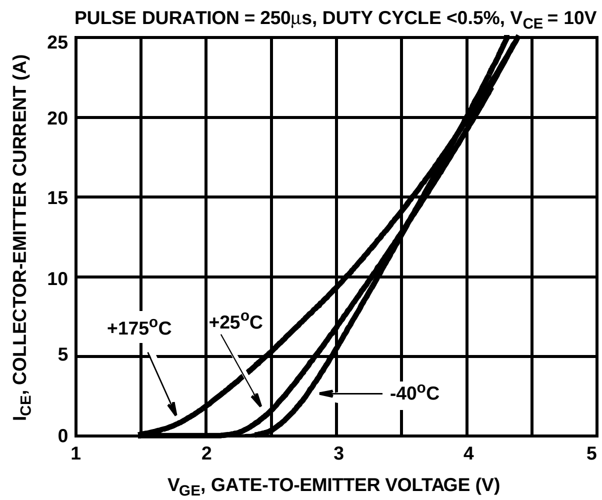


FIGURE 1. TRANSFER CHARACTERISTICS

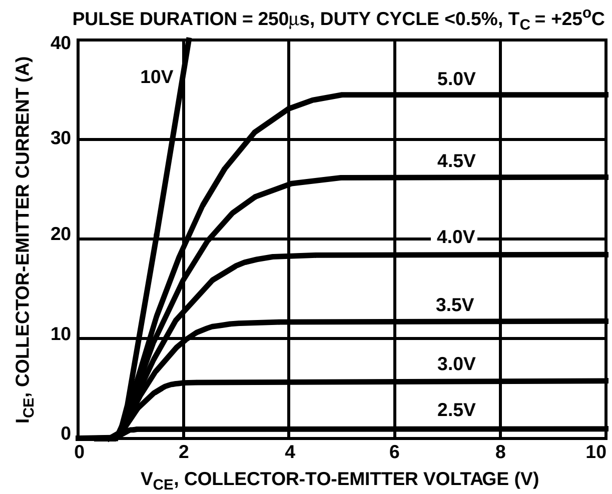


FIGURE 2. SATURATION CHARACTERISTICS

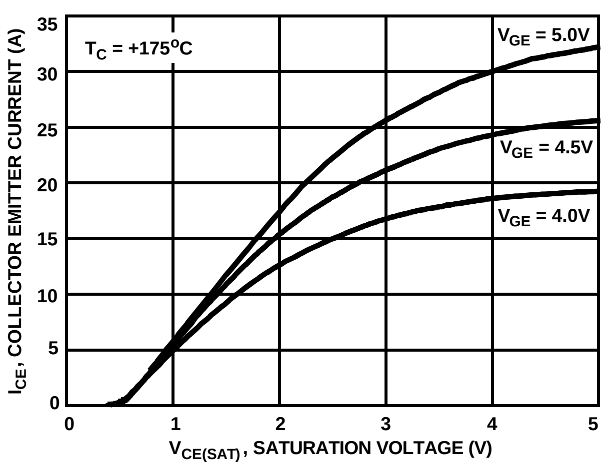


FIGURE 3. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF SATURATION VOLTAGE

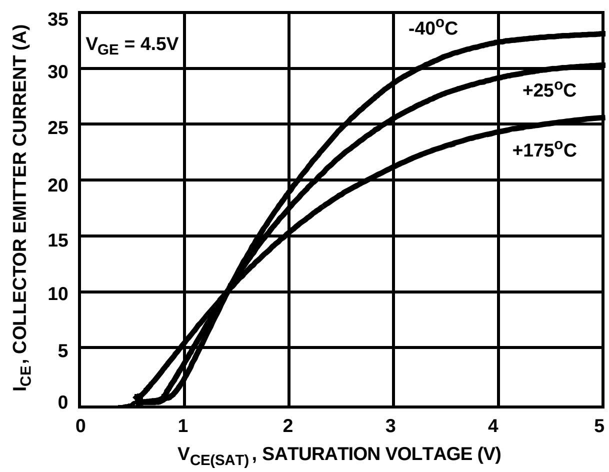


FIGURE 4. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF SATURATION VOLTAGE

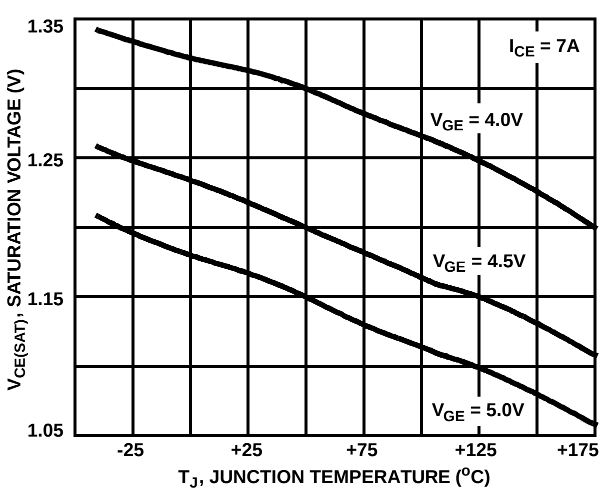


FIGURE 5. SATURATION VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE

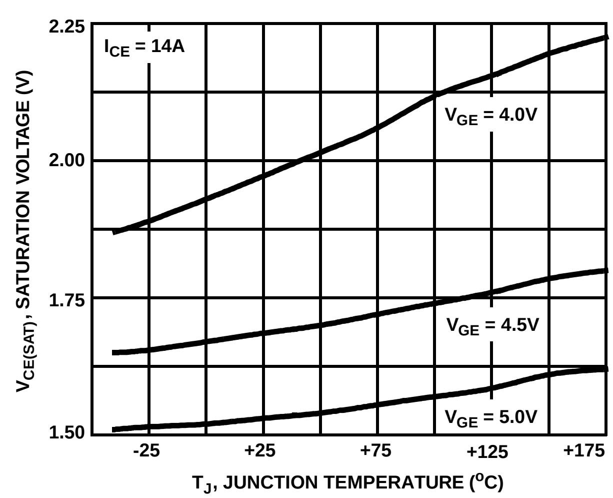


FIGURE 6. SATURATION VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

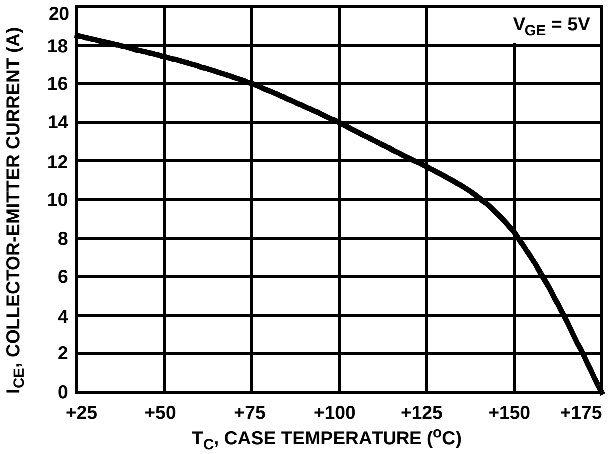


FIGURE 7. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF CASE TEMPERATURE

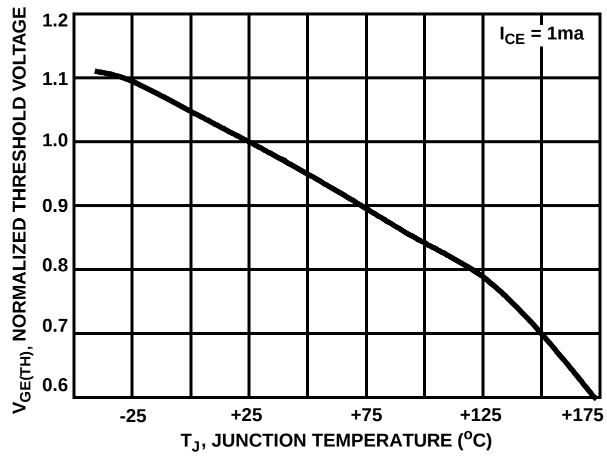


FIGURE 8. NORMALIZED THRESHOLD VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE

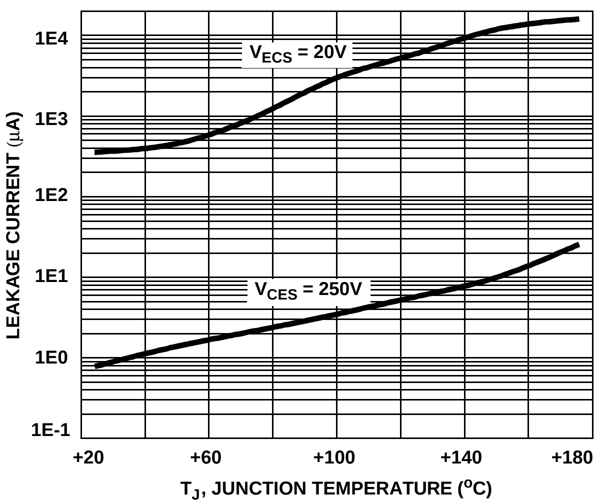


FIGURE 9. LEAKAGE CURRENT AS A FUNCTION OF JUNCTION TEMPERATURE

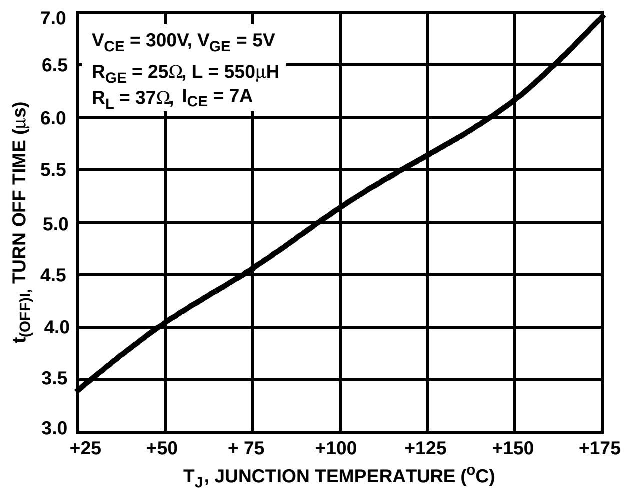


FIGURE 10. TURN-OFF TIME AS A FUNCTION OF JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

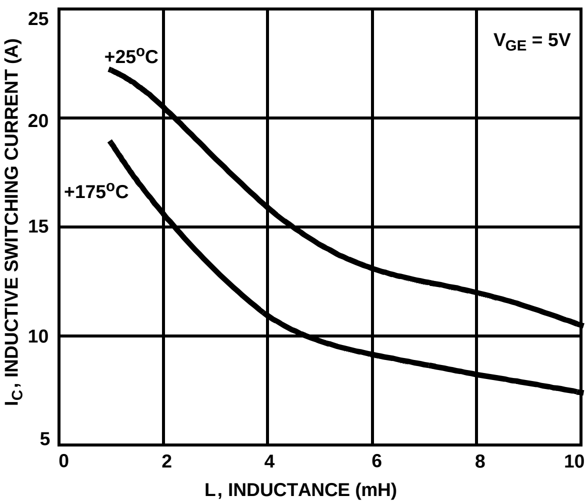


FIGURE 11. SELF CLAMPED INDUCTIVE SWITCHING CURRENT AS A FUNCTION OF INDUCTANCE

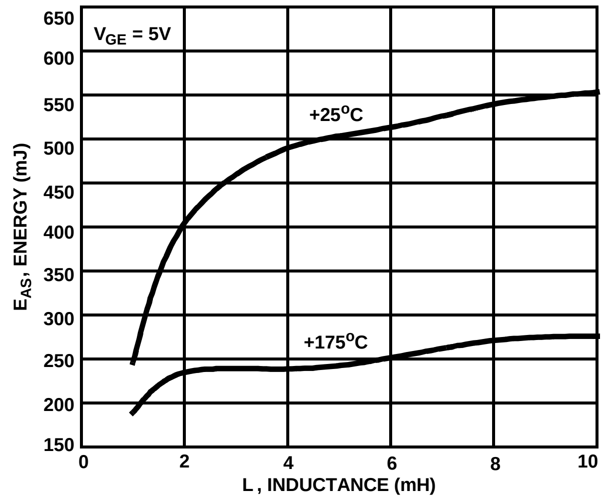


FIGURE 12. SELF CLAMPED INDUCTIVE SWITCHING ENERGY AS A FUNCTION OF INDUCTANCE

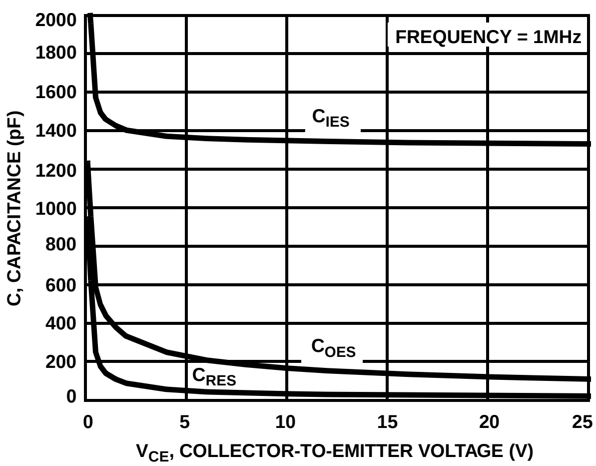


FIGURE 13. CAPACITANCE AS A FUNCTION OF COLLECTOR-EMITTER VOLTAGE

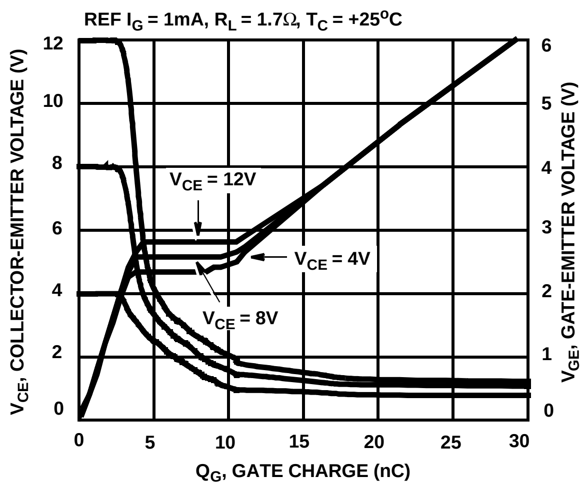


FIGURE 14. GATE CHARGE WAVEFORMS

Typical Performance Curves (Continued)

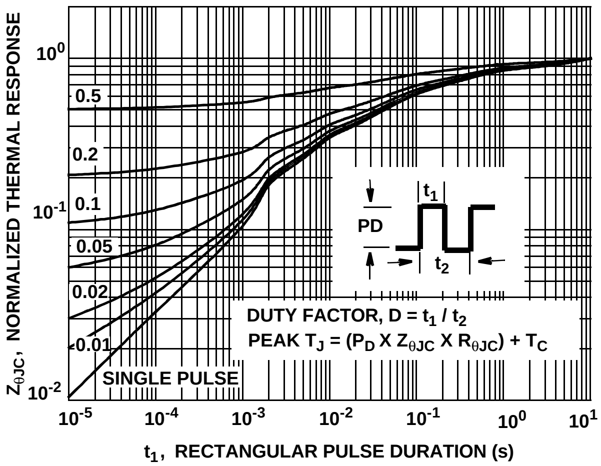


FIGURE 15. NORMALIZED TRANSIENT THERMAL IMPEDANCE, JUNCTION TO CASE

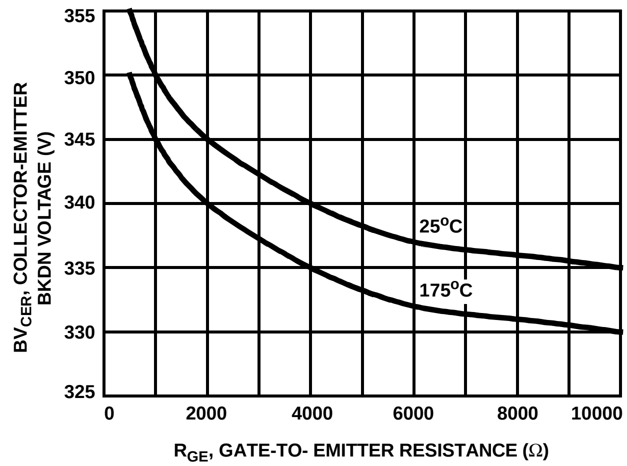


FIGURE 16. BREAKDOWN VOLTAGE AS A FUNCTION OF GATE-EMITTER RESISTANCE

Test Circuits

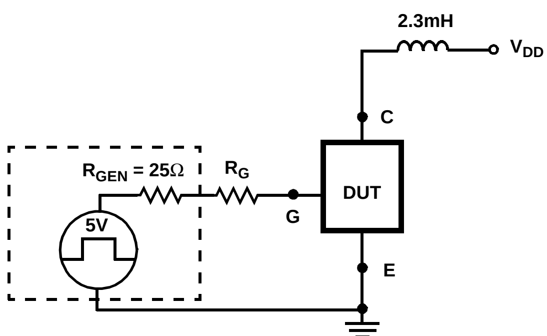


FIGURE 17. SELF CLAMPED INDUCTIVE SWITCHING CURRENT TEST CIRCUIT

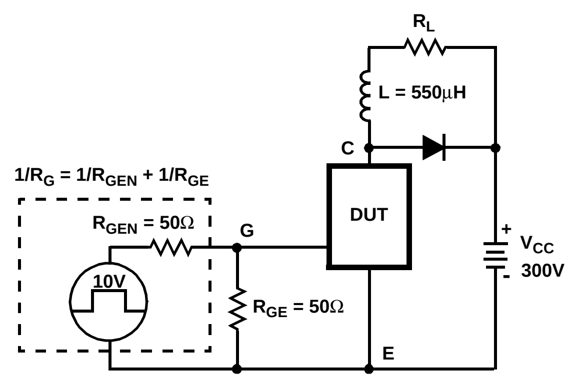


FIGURE 18. CLAMPED INDUCTIVE SWITCHING TIME TEST CIRCUIT

Handling Precautions for IGBT's

Insulated Gate Bipolar Transistors are susceptible to gate-insulation damage by the electrostatic discharge of energy through the devices. When handling these devices, care should be exercised to assure that the static charge built in the handler's body capacitance is not discharged through the device. With proper handling and application procedures, however, IGBT's are currently being extensively used in production by numerous equipment manufacturers in military, industrial and consumer applications, with virtually no damage problems due to electrostatic discharge. IGBT's can be handled safely if the following basic precautions are taken:

1. Prior to assembly into a circuit, all leads should be kept shorted together either by the use of metal shorting springs or by the insertion into conductive material such as †"ECCOSORBD LD26" or equivalent.
2. When devices are removed by hand from their carriers, the hand being used should be grounded by any suitable means - for example, with a metallic wristband.
3. Tips of soldering irons should be grounded.
4. Devices should never be inserted into or removed from circuits with power on.
5. **Gate Voltage Rating** -The gate-voltage rating of V_{GEM} may be exceeded if I_{GEM} is limited to 10mA.

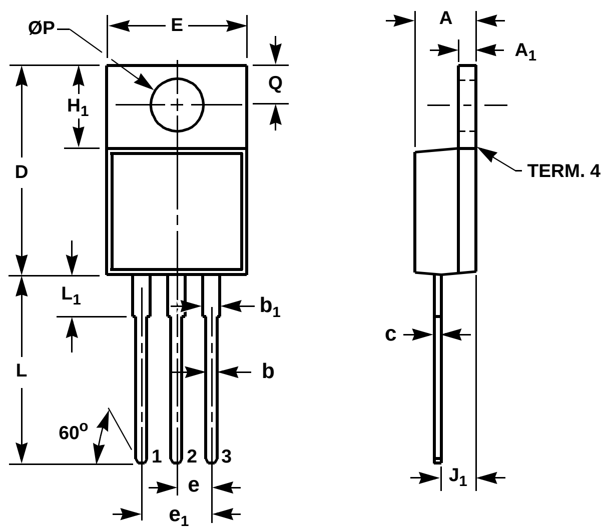
† Trademark Emerson and Cumming, Inc

INTERSIL CORPORATION IGBT PRODUCT IS COVERED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS:

4,364,073	4,417,385	4,430,792	4,443,931	4,466,176	4,516,143	4,532,534	4,567,641
4,587,713	4,598,461	4,605,948	4,618,872	4,620,211	4,631,564	4,639,754	4,639,762
4,641,162	4,644,637	4,682,195	4,684,413	4,694,313	4,717,679	4,743,952	4,783,690
4,794,432	4,801,986	4,803,533	4,809,045	4,809,047	4,810,665	4,823,176	4,837,606
4,860,080	4,883,767	4,888,627	4,890,143	4,901,127	4,904,609	4,933,740	4,963,951
4,969,027							

TO-220AB (Alternate Version)

3 LEAD JEDEC TO-220AB PLASTIC PACKAGE

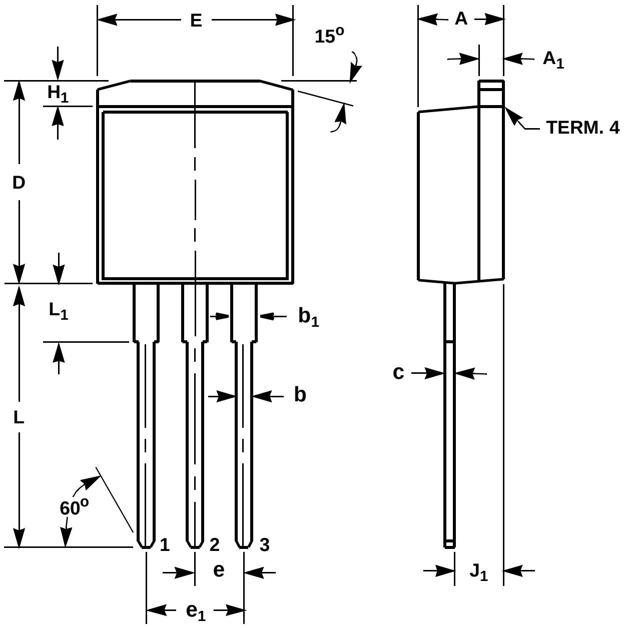


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.170	0.180	4.32	4.57	-
A_1	0.048	0.052	1.22	1.32	2, 4
b	0.030	0.034	0.77	0.86	2, 4
b_1	0.045	0.055	1.15	1.39	2, 4
c	0.018	0.022	0.46	0.55	2, 4
D	0.590	0.610	14.99	15.49	-
E	0.395	0.405	10.04	10.28	-
e	0.100 TYP		2.54 TYP		5
e_1	0.200 BSC		5.08 BSC		5
H_1	0.235	0.255	5.97	6.47	-
J_1	0.095	0.105	2.42	2.66	6
L	0.530	0.550	13.47	13.97	-
L_1	0.110	0.130	2.80	3.30	3
ØP	0.149	0.153	3.79	3.88	-
Q	0.105	0.115	2.66	2.92	-

NOTES:

1. These dimensions are within allowable dimensions of Rev. J of JEDEC TO-220AB outline dated 3-24-87.
2. Dimension (without solder).
3. Solder finish uncontrolled in this area.
4. Add typically 0.002 inches (0.05mm) for solder plating.
5. Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.
6. Position of lead to be measured 0.100 inches (2.54mm) from bottom of dimension D.
7. Controlling dimension: Inch.
8. Revision 3 dated 7-97.

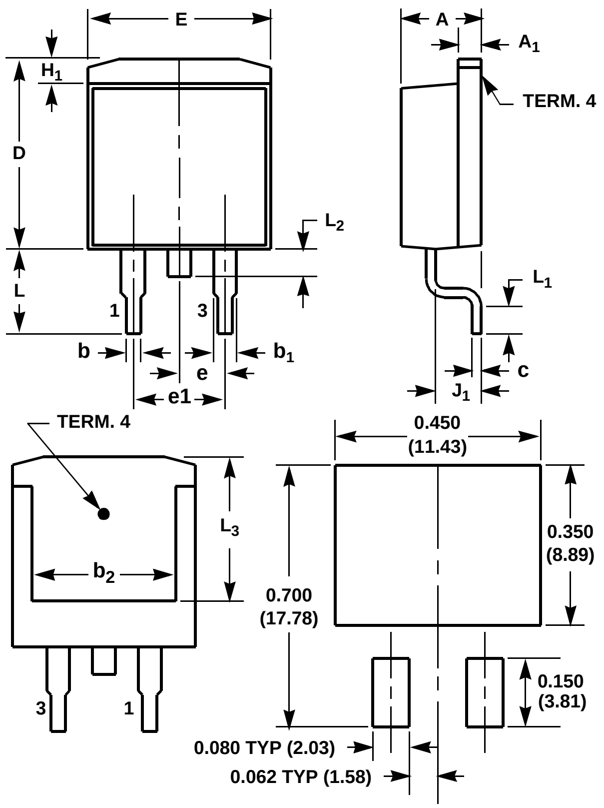
TO-262AA 3 LEAD JEDEC TO-262AA PLASTIC PACKAGE



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.170	0.180	4.32	4.57	-
A_1	0.048	0.052	1.22	1.32	3, 4
b	0.030	0.034	0.77	0.86	3, 4
b_1	0.045	0.055	1.15	1.39	3, 4
c	0.018	0.022	0.46	0.55	3, 4
D	0.405	0.425	10.29	10.79	-
E	0.395	0.405	10.04	10.28	-
e	0.100 TYP		2.54 TYP		5
e_1	0.200 BSC		5.08 BSC		5
H_1	0.045	0.055	1.15	1.39	-
J_1	0.095	0.105	2.42	2.66	6
L	0.530	0.550	13.47	13.97	-
L_1	0.110	0.130	2.80	3.30	2

NOTES:
1. These dimensions are within allowable dimensions of Rev. A of JEDEC TO-262AA outline dated 6-90.
2. Solder finish uncontrolled in this area.
3. Dimension (without solder).
4. Add typically 0.002 inches (0.05mm) for solder plating.
5. Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.
6. Position of lead to be measured 0.100 inches (2.54mm) from bottom of dimension D.
7. Controlling dimension: Inch.
8. Revision 5 dated 7-97.

TO-263AB SURFACE MOUNT JEDEC TO-263AB PLASTIC PACKAGE



MINIMUM PAD SIZE RECOMMENDED FOR SURFACE-MOUNTED APPLICATIONS

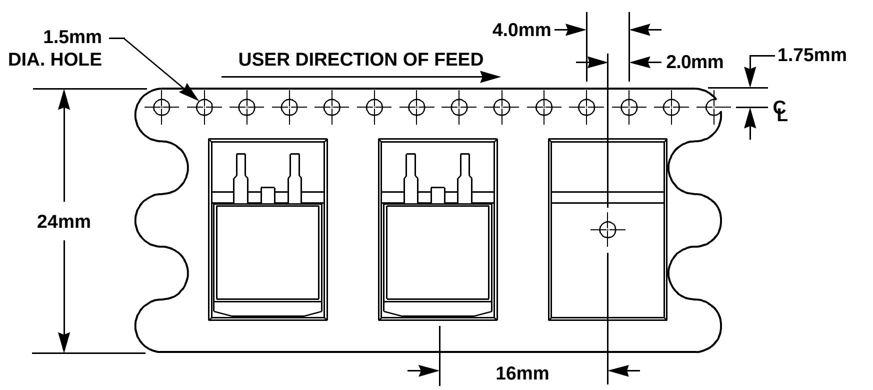
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.170	0.180	4.32	4.57	-
A_1	0.048	0.052	1.22	1.32	4, 5
b	0.030	0.034	0.77	0.86	4, 5
b_1	0.045	0.055	1.15	1.39	4, 5
b_2	0.310	-	7.88	-	2
c	0.018	0.022	0.46	0.55	4, 5
D	0.405	0.425	10.29	10.79	-
E	0.395	0.405	10.04	10.28	-
e	0.100 TYP		2.54 TYP		7
e_1	0.200 BSC		5.08 BSC		7
H_1	0.045	0.055	1.15	1.39	-
J_1	0.095	0.105	2.42	2.66	-
L	0.175	0.195	4.45	4.95	-
L_1	0.090	0.110	2.29	2.79	4, 6
L_2	0.050	0.070	1.27	1.77	3
L_3	0.315	-	8.01	-	2

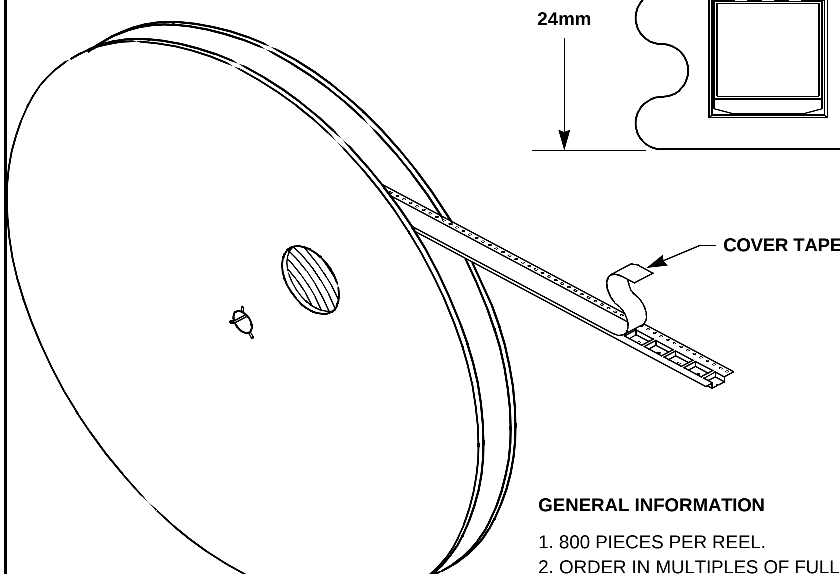
NOTES:

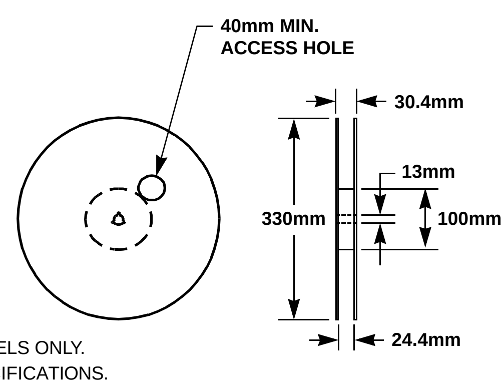
1. These dimensions are within allowable dimensions of Rev. C of JEDEC TO-263AB outline dated 2-92.
2. L_3 and b_2 dimensions established a minimum mounting surface for terminal 4.
3. Solder finish uncontrolled in this area.
4. Dimension (without solder).
5. Add typically 0.002 inches (0.05mm) for solder plating.
6. L_1 is the terminal length for soldering.
7. Position of lead to be measured 0.120 inches (3.05mm) from bottom of dimension D.
8. Controlling dimension: Inch.
9. Revision 10 dated 5-99.

TO-263AB

24mm TAPE AND REEL







GENERAL INFORMATION

1. 800 PIECES PER REEL.
2. ORDER IN MULTIPLES OF FULL REELS ONLY.
3. MEETS EIA-481 REVISION "A" SPECIFICATIONS.

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CROSSVOLT™	GlobalOptoisolator™	POP™	SuperSOT™-3	
DenseTrench™	GTO™	Power247™	SuperSOT™-6	
DOME™	HiSeC™	PowerTrench®	SuperSOT™-8	
EcoSPARK™	ISOPLANAR™	QFET™	SyncFET™	
E^2CMOS™	LittleFET™	QS™	TinyLogic™	
Ensigna™	MicroFET™	QT Optoelectronics™	TruTranslation™	
FACT™	MicroPak™	Quiet Series™	UHC™	
FACT QuietSerie™	MICROWIRE™	SILENT SWITCHER®	UltraFET®	

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As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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