

December 2001

**Features**

- Logic Level Gate Drive
- Internal Voltage Clamp
- ESD Gate Protection
- $T_J = 175^{\circ}\text{C}$
- 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 resistor are provided in the gate circuit.

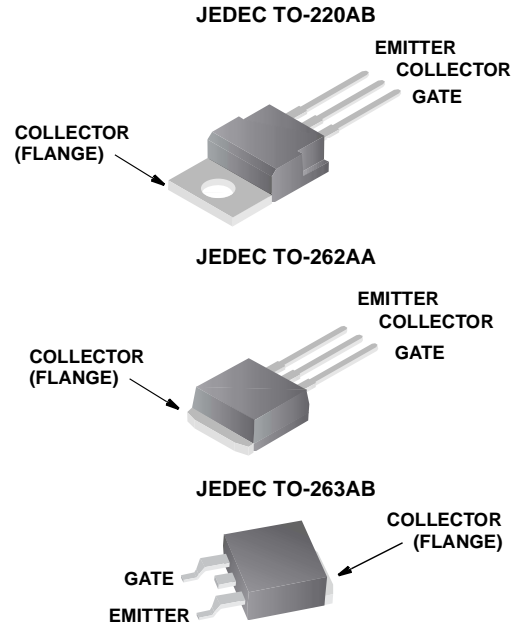
**PACKAGING AVAILABILITY**

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

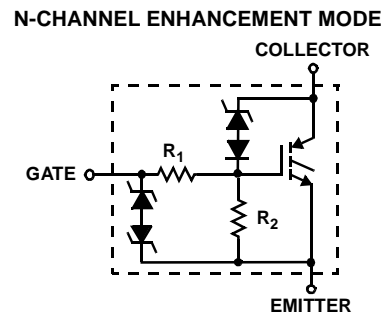
NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-263AB variant in the tape and reel, i.e., HGT1S14N36G3VLS9A.

The development type number for this device is TA49021.

**Packages**



**Terminal Diagram**



**Absolute Maximum Ratings**  $T_C = +25^{\circ}\text{C}$ , Unless Otherwise Specified

	HGTP14N36G3VL, HGT1S14N36G3VL, HGT1S14N36G3VLS	UNITS
Collector-Emitter Bkdn Voltage at 10mA	390	V
Emitter-Collector Bkdn Voltage at 10mA	24	V
Collector Current Continuous at $V_{GE} = 5\text{V}$ , $T_C = +25^{\circ}\text{C}$	18	A
at $V_{GE} = 5\text{V}$ , $T_C = +100^{\circ}\text{C}$	14	A
Gate-Emitter Voltage (Note)	$\pm 10$	V
Inductive Switching Current at $L = 2.3\text{mH}$ , $T_C = +25^{\circ}\text{C}$	17	A
at $L = 2.3\text{mH}$ , $T_C = +175^{\circ}\text{C}$	12	A
Collector to Emitter Avalanche Energy at $L = 2.3\text{mH}$ , $T_C = +25^{\circ}\text{C}$	332	mJ
Power Dissipation Total at $T_C = +25^{\circ}\text{C}$	100	W
Power Dissipation Derating $T_C > +25^{\circ}\text{C}$	0.67	W/ $^{\circ}\text{C}$
Operating and Storage Junction Temperature Range	-40 to +175	$^{\circ}\text{C}$
Maximum Lead Temperature for Soldering	260	$^{\circ}\text{C}$
Electrostatic Voltage at 100pF, 1500 $\Omega$	6	KV

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

# Specifications HGTP14N36G3VL, HGT1S14N36G3VL, HGT1S14N36G3VLS

## Electrical Specifications $T_C = +25^\circ\text{C}$ , Unless Otherwise Specified

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

Typical Performance Curves

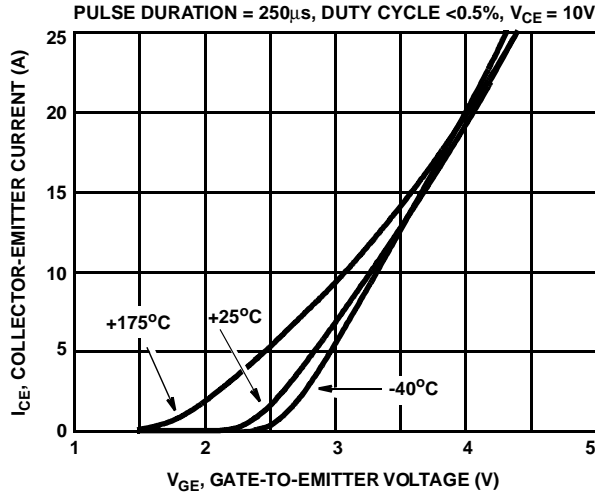


FIGURE 1. TRANSFER CHARACTERISTICS

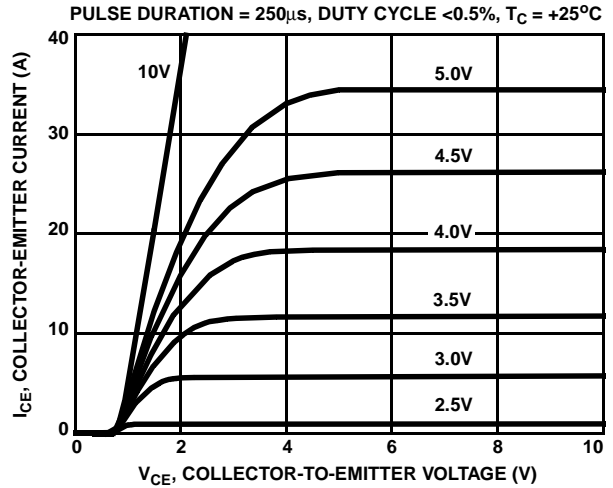


FIGURE 2. SATURATION CHARACTERISTICS

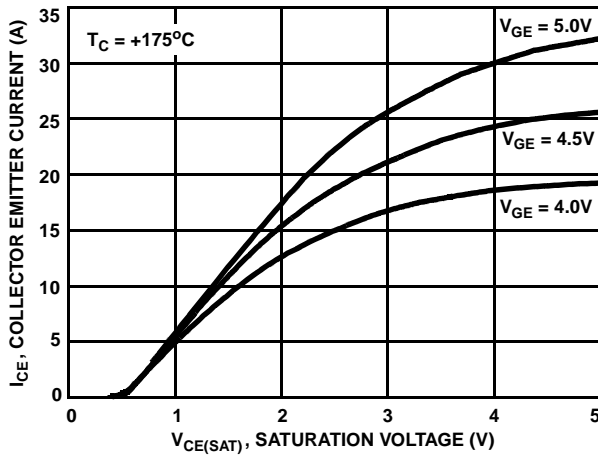


FIGURE 3. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF SATURATION VOLTAGE

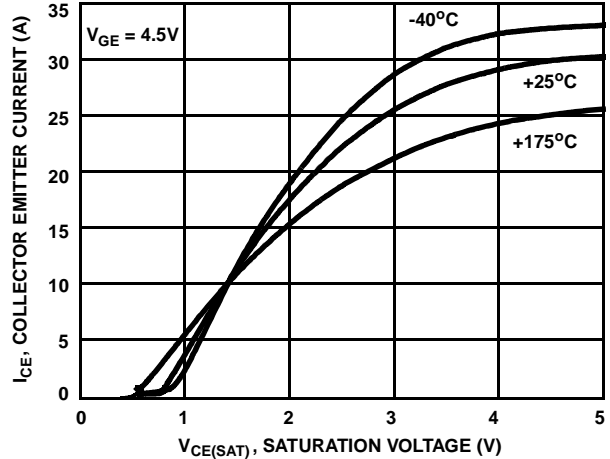


FIGURE 4. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF SATURATION VOLTAGE

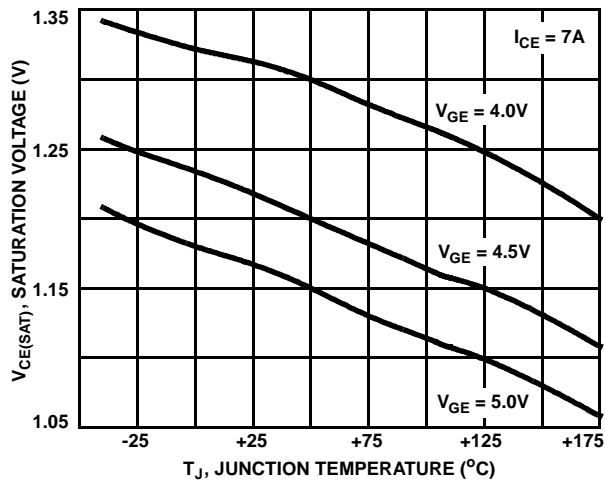


FIGURE 5. SATURATION VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE

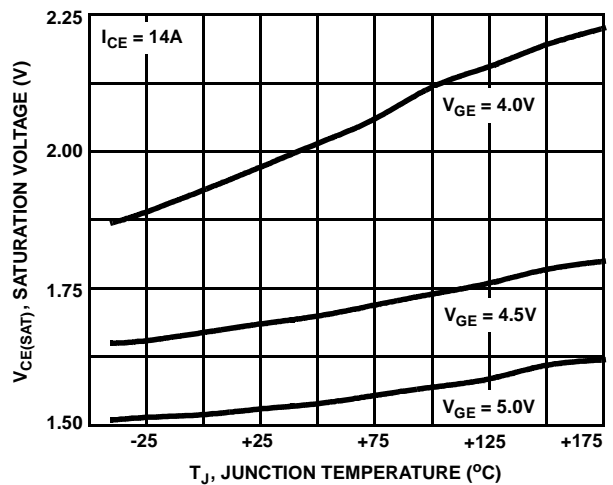


FIGURE 6. SATURATION VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

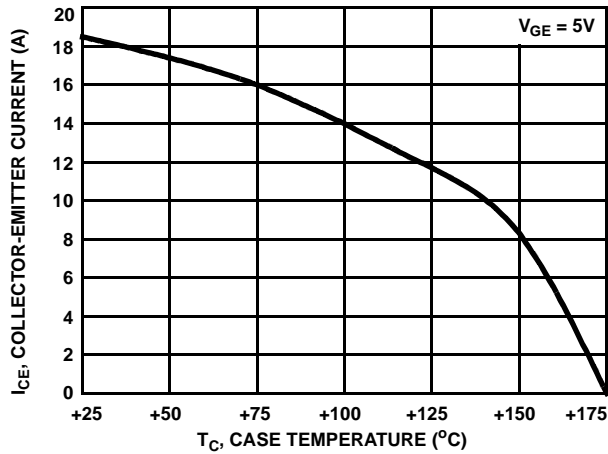


FIGURE 7. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF CASE TEMPERATURE

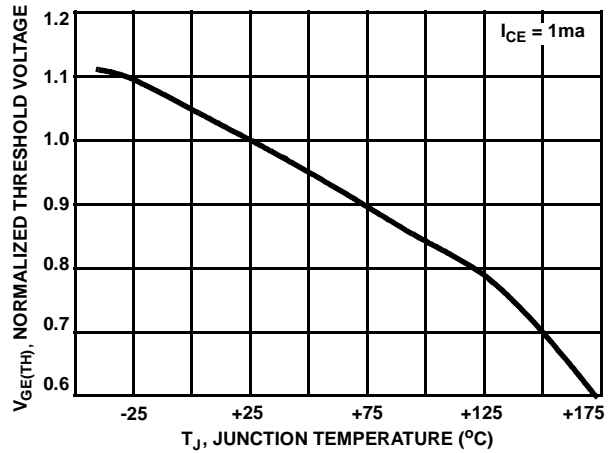


FIGURE 8. NORMALIZED THRESHOLD VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE

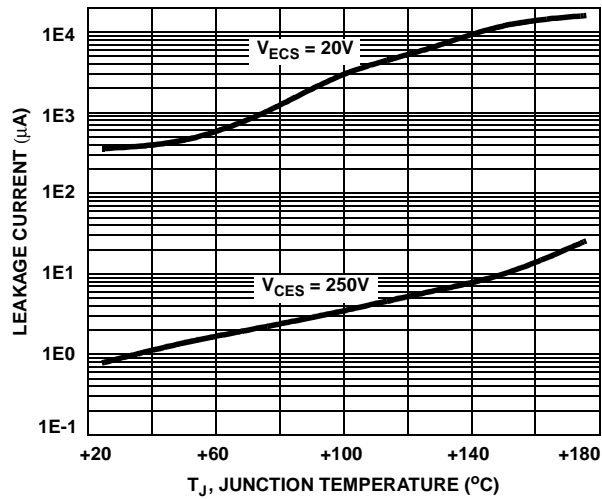


FIGURE 9. LEAKAGE CURRENT AS A FUNCTION OF JUNCTION TEMPERATURE

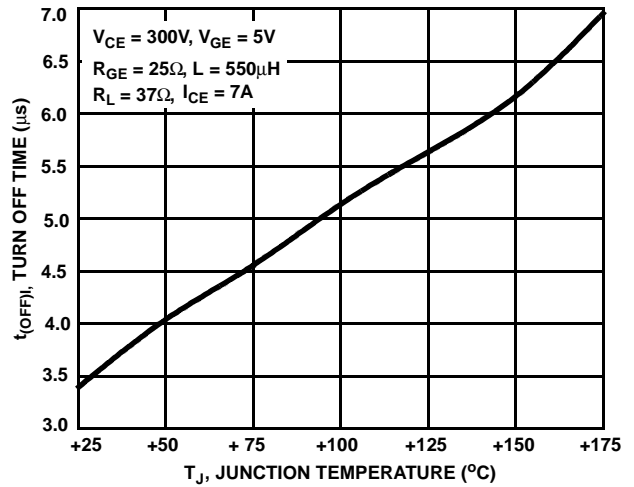


FIGURE 10. TURN-OFF TIME AS A FUNCTION OF JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

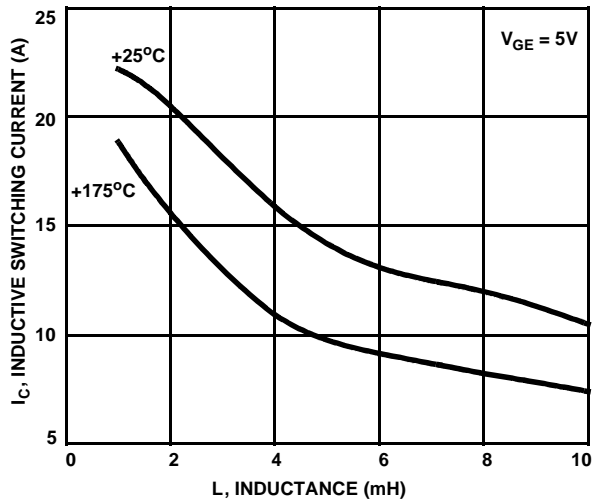


FIGURE 11. SELF CLAMPED INDUCTIVE SWITCHING CURRENT AS A FUNCTION OF INDUCTANCE

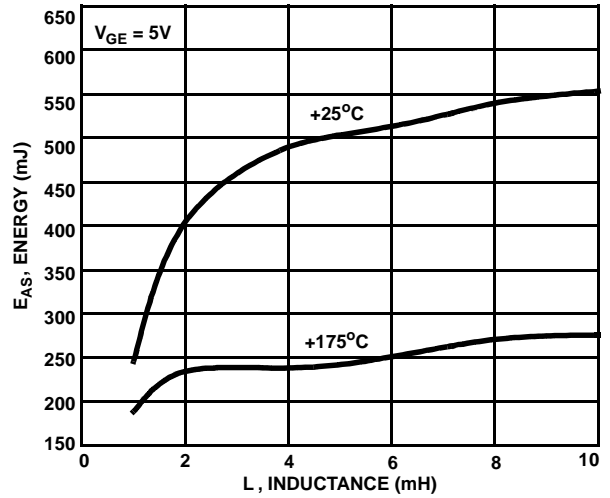


FIGURE 12. SELF CLAMPED INDUCTIVE SWITCHING ENERGY AS A FUNCTION OF INDUCTANCE

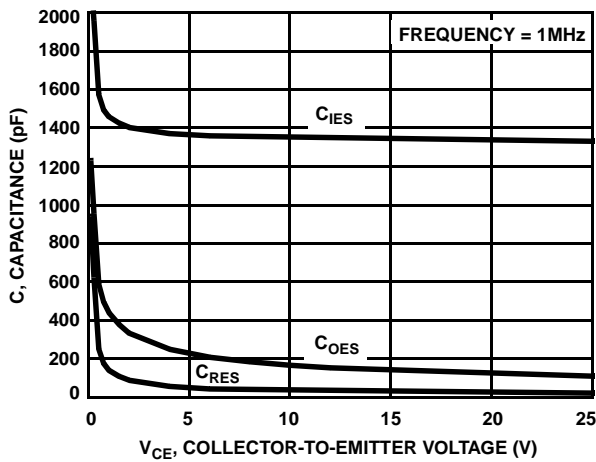


FIGURE 13. CAPACITANCE AS A FUNCTION OF COLLECTOR-EMITTER VOLTAGE

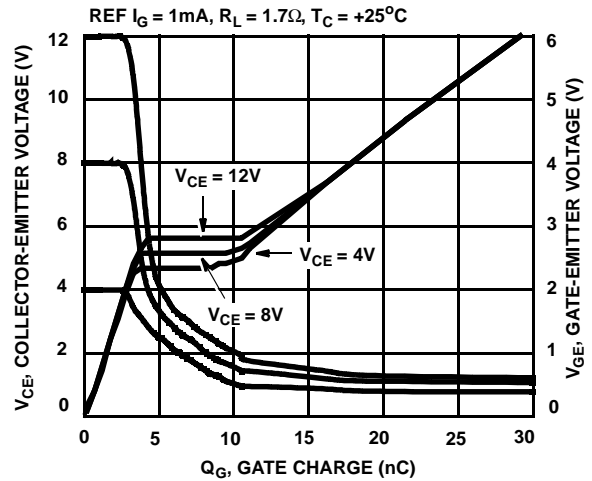


FIGURE 14. GATE CHARGE WAVEFORMS

## Typical Performance Curves (Continued)

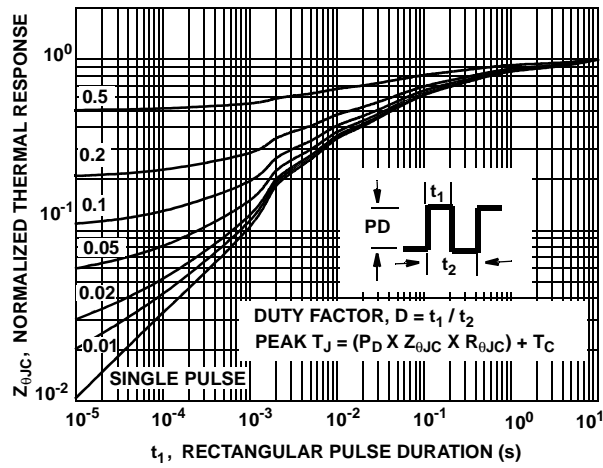


FIGURE 15. NORMALIZED TRANSIENT THERMAL IMPEDANCE, JUNCTION TO CASE

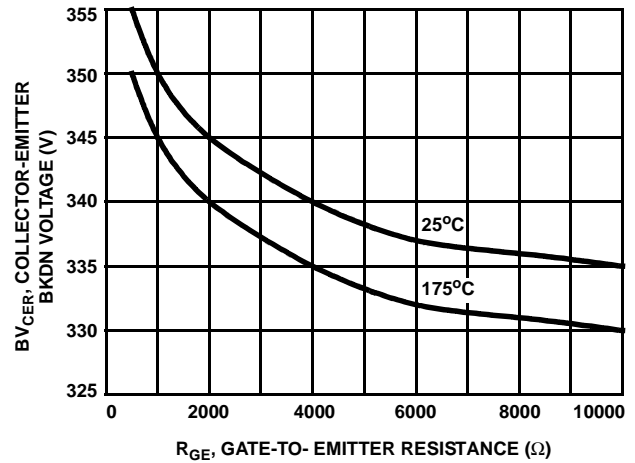


FIGURE 16. BREAKDOWN VOLTAGE AS A FUNCTION OF GATE-EMITTER RESISTANCE

## Test Circuits

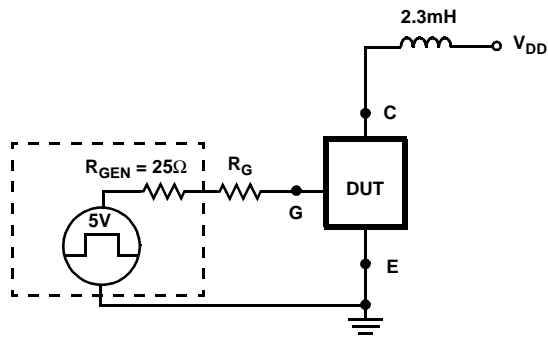


FIGURE 17. SELF CLAMPED INDUCTIVE SWITCHING CURRENT TEST CIRCUIT

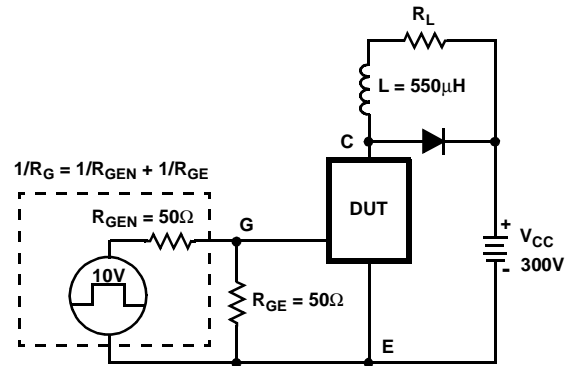


FIGURE 18. CLAMPED INDUCTIVE SWITCHING TIME TEST CIRCUIT

## HGTP14N36G3VL, HGT1S14N36G3VL, HGT1S14N36G3VLS

### 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 †"ECCOSORB 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

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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							

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Datasheet Identification	Product Status	Definition
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