

63A, 600V, UFS Series N-Channel IGBT

The HGTG30N60C3 and HGT4E30N60C3S are MOS gated high voltage switching devices combining the best features of MOSFETs and bipolar transistors. These devices have the high input impedance of a MOSFET and the low on-state conduction loss of a bipolar transistor. The much lower on-state voltage drop varies only moderately between 25°C and 150°C.

These IGBTs are ideal for many high voltage switching applications operating at moderate frequencies where low conduction losses are essential, such as: AC and DC motor controls, power supplies and drivers for solenoids, relays and contactors.

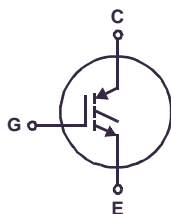
Formerly Developmental Type TA49051.

Ordering Information

PART NUMBER	PACKAGE	BRAND
HGTG30N60C3	TO-247	G30N60C3
HGT4E30N60C3S	TO-268	G30N60C3S

NOTE: When ordering, use the entire part number.

Symbol

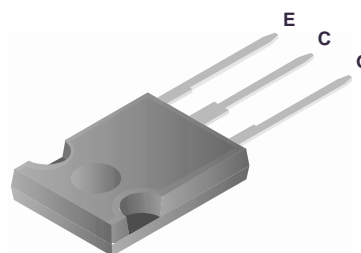


Features

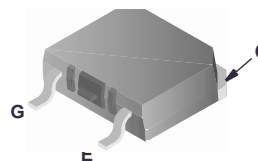
- 63A, 600V at $T_C = 25^\circ\text{C}$
- 600V Switching SOA Capability
- Typical Fall Time 230ns at $T_J = 150^\circ\text{C}$
- Short Circuit Rating
- Low Conduction Loss

Packaging

JEDEC STYLE TO-247



TO-268AA



FAIRCHILD 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	4,587,713
4,598,461	4,605,948	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	

HGTG30N60C3, HGT4E30N60C3S

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

	HGTG30N60C3, HGT4E30N60C3S	UNITS
Collector To Emitter Voltage BV_{CES}	600	V
Collector Current Continuous		
At $T_C = 25^\circ\text{C}$ I_{C25}	63	A
At $T_C = 110^\circ\text{C}$ I_{C110}	30	A
Collector Current Pulsed (Note 1) I_{CM}	252	A
Gate To Emitter Voltage Continuous V_{GES}	± 20	V
Gate To Emitter Voltage Pulsed V_{GEM}	± 30	V
Switching Safe Operating Area at $T_J = 150^\circ\text{C}$ (Figure 14) SSOA	60A at 600V	
Power Dissipation Total at $T_C = 25^\circ\text{C}$ P_D	208	W
Power Dissipation Derating $T_C > 25^\circ\text{C}$	1.67	W/ $^\circ\text{C}$
Reverse Voltage Avalanche Energy E_{ARV}	100	mJ
Operating and Storage Junction Temperature Range T_J, T_{STG}	-40 to 150	$^\circ\text{C}$
Maximum Lead Temperature for Soldering T_L	260	$^\circ\text{C}$
Short Circuit Withstand Time (Note 2) at $V_{GE} = 15\text{V}$ t_{SC}	4	μs
Short Circuit Withstand Time (Note 2) at $V_{GE} = 10\text{V}$ t_{SC}	15	μs

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. $V_{CE(PK)} = 360\text{V}$, $T_J = 125^\circ\text{C}$, $R_G = 25\Omega$.

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
Collector To Emitter Breakdown Voltage	BV_{CES}	$I_C = 250\mu\text{A}$, $V_{GE} = 0\text{V}$	600	-	-	V	
Emitter To Collector Breakdown Voltage	BV_{ECS}	$I_C = 10\text{mA}$, $V_{GE} = 0\text{V}$	15	25	-	V	
Collector To Emitter Leakage Current	I_{CES}	$V_{CE} = BV_{CES}$, $T_C = 25^\circ\text{C}$	-	-	250	μA	
		$V_{CE} = BV_{CES}$, $T_C = 150^\circ\text{C}$	-	-	2.0	mA	
Collector To Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C = I_{C110}$, $V_{GE} = 15\text{V}$	$T_C = 25^\circ\text{C}$	-	1.5	1.8	V
			$T_C = 150^\circ\text{C}$	-	1.7	2.0	V
Gate To Emitter Threshold Voltage	$V_{GE(TH)}$	$I_C = 250\mu\text{A}$, $V_{CE} = V_{GE}$	3.0	5.2	6.0	V	
Gate To Emitter Leakage Current	I_{GES}	$V_{GE} = \pm 20\text{V}$	-	-	± 100	nA	
Switching SOA	SSOA	$T_J = 150^\circ\text{C}$, $R_G = 3\Omega$, $V_{GE} = 15\text{V}$, $L = 100\mu\text{H}$	$V_{CE(PK)} = 480\text{V}$	200	-	-	A
			$V_{CE(PK)} = 600\text{V}$	60	-	-	A
Gate To Emitter Plateau Voltage	V_{GEP}	$I_C = I_{C110}$, $V_{CE} = 0.5 BV_{CES}$	-	8.1	-	V	
On-State Gate Charge	$Q_{G(ON)}$	$I_C = I_{C110}$, $V_{CE} = 0.5 BV_{CES}$	$V_{GE} = 15\text{V}$	-	162	180	nC
			$V_{GE} = 20\text{V}$	-	216	250	nC
Current Turn-On Delay Time	$t_{d(ON)I}$	$T_J = 150^\circ\text{C}$, $I_{CE} = I_{C110}$, $V_{CE(PK)} = 0.8 BV_{CES}$, $V_{GE} = 15\text{V}$, $R_G = 3\Omega$, $L = 100\mu\text{H}$	-	40	-	ns	
Current Rise Time	t_{rI}		-	45	-	ns	
Current Turn-Off Delay Time	$t_{d(OFF)I}$		-	320	400	ns	
Current Fall Time	t_{fI}		-	230	275	ns	
Turn-On Energy	E_{ON}		-	1050	-	μJ	
Turn-Off Energy (Note 3)	E_{OFF}		-	2500	-	μJ	
Thermal Resistance	$R_{\theta JC}$		-	-	0.6	$^\circ\text{C/W}$	

NOTE:

3. Turn-Off Energy Loss (E_{OFF}) is defined as the integral of the instantaneous power loss starting at the trailing edge of the input pulse and ending at the point where the collector current equals zero ($I_{CE} = 0\text{A}$). The HGTG30N60C3 was tested per JEDEC Standard No. 24-1 Method for Measurement of Power Device Turn-Off Switching Loss. This test method produces the true total turn-off energy loss. Turn-On losses include diode losses.

Typical Performance Curves

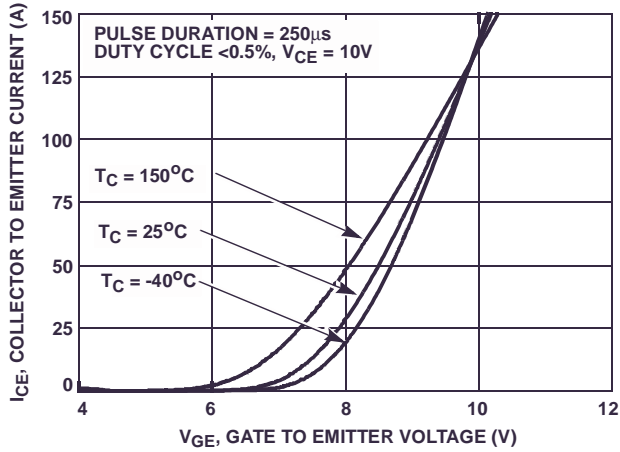


FIGURE 1. TRANSFER CHARACTERISTICS

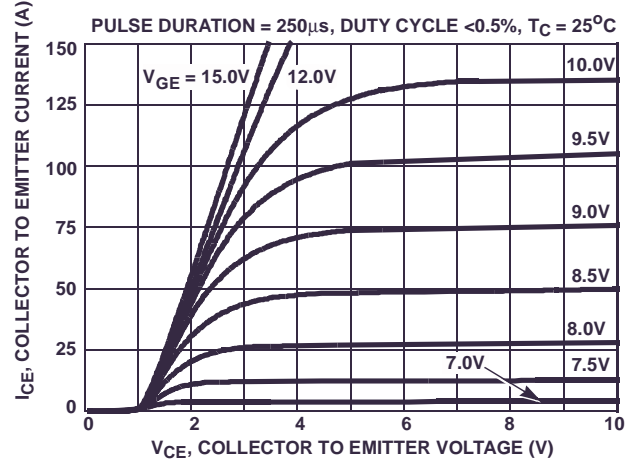


FIGURE 2. SATURATION CHARACTERISTICS

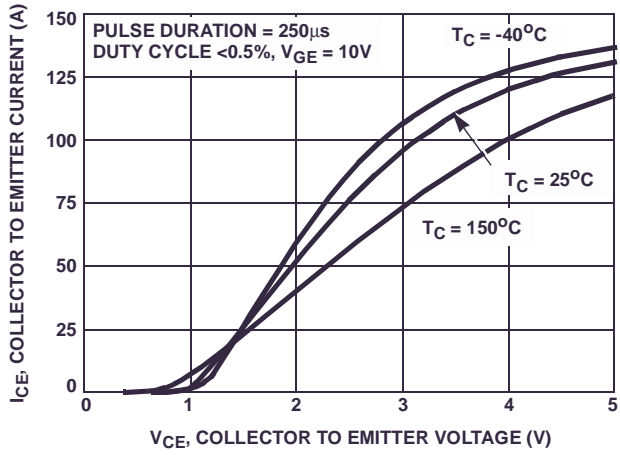


FIGURE 3. COLLECTOR TO EMITTER ON-STATE VOLTAGE

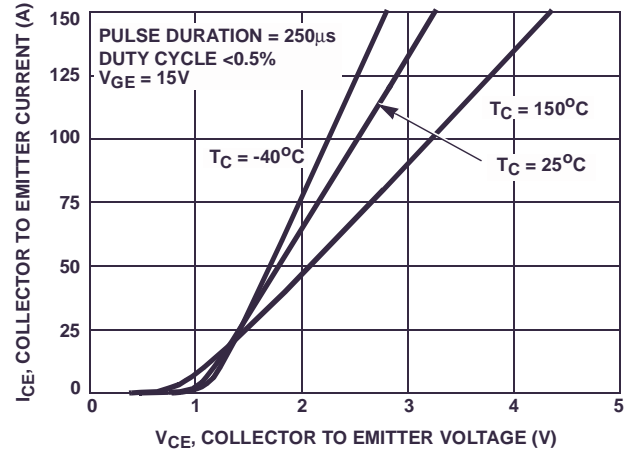


FIGURE 4. COLLECTOR TO EMITTER ON-STATE VOLTAGE

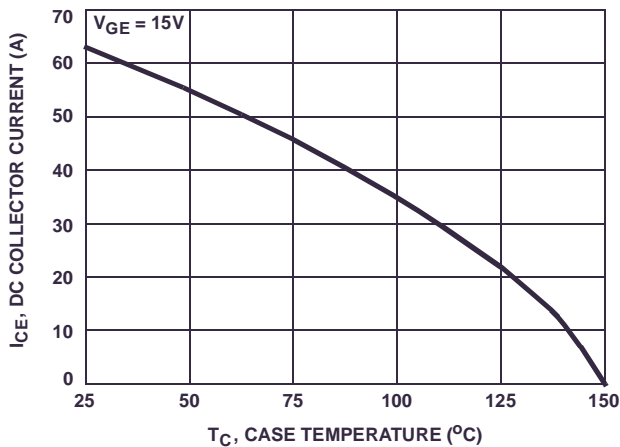


FIGURE 5. MAXIMUM DC COLLECTOR CURRENT vs CASE TEMPERATURE

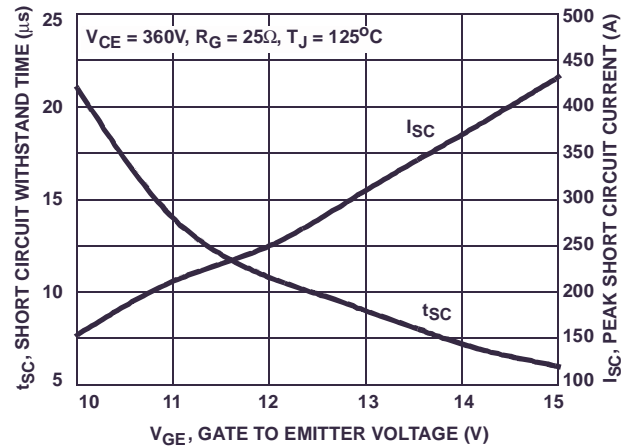


FIGURE 6. SHORT CIRCUIT WITHSTAND TIME

Typical Performance Curves (Continued)

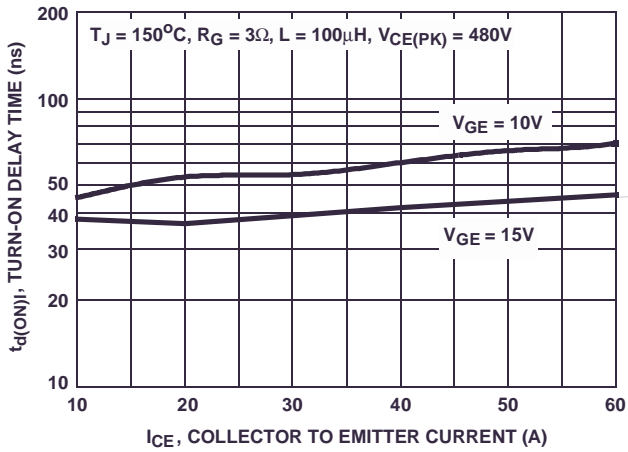


FIGURE 7. TURN-ON DELAY TIME vs COLLECTOR TO EMITTER CURRENT

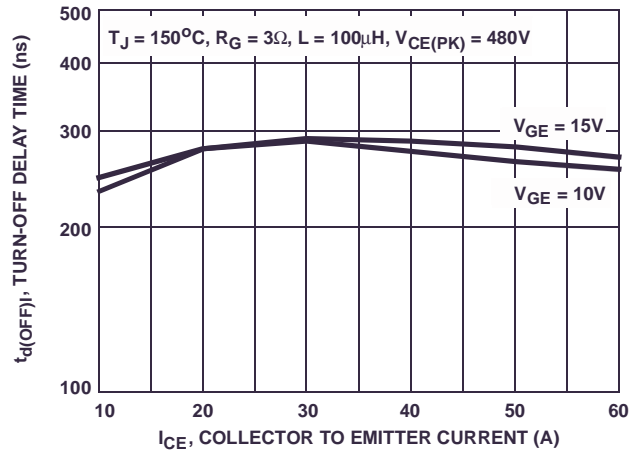


FIGURE 8. TURN-OFF DELAY TIME vs COLLECTOR TO EMITTER CURRENT

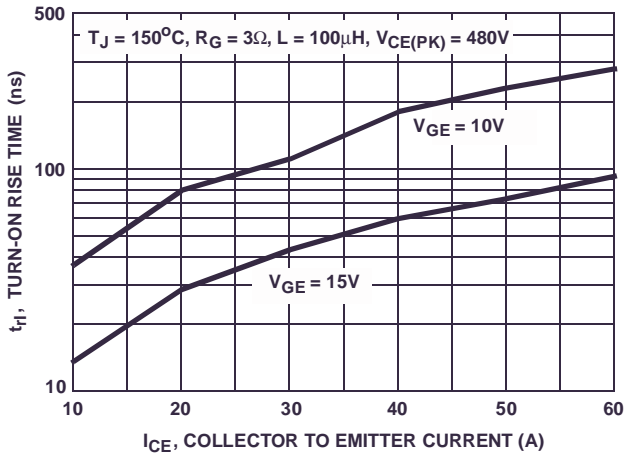


FIGURE 9. TURN-ON RISE TIME vs COLLECTOR TO EMITTER CURRENT

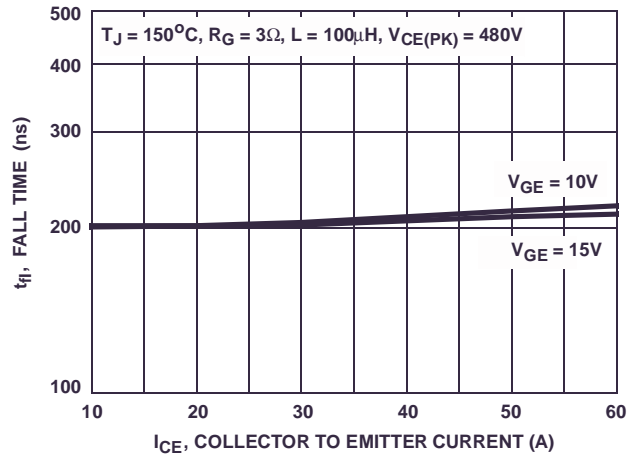


FIGURE 10. TURN-OFF FALL TIME vs COLLECTOR TO EMITTER CURRENT

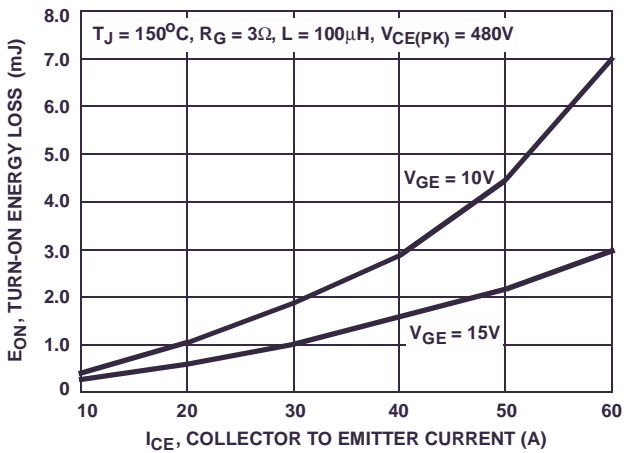


FIGURE 11. TURN-ON ENERGY LOSS vs COLLECTOR TO EMITTER CURRENT

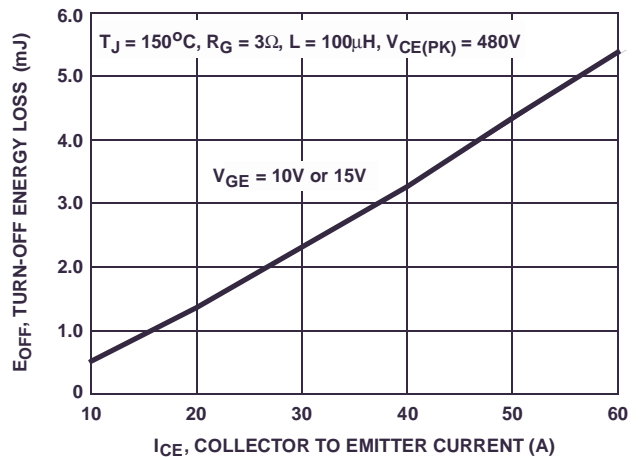


FIGURE 12. TURN-OFF ENERGY LOSS vs COLLECTOR TO EMITTER CURRENT

Typical Performance Curves (Continued)

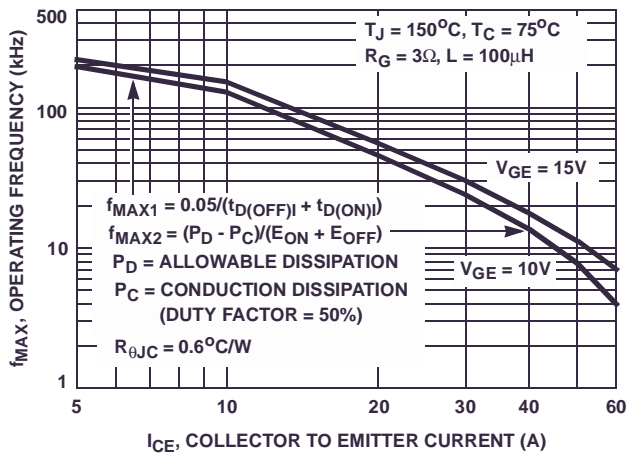


FIGURE 13. OPERATING FREQUENCY vs COLLECTOR TO EMITTER CURRENT

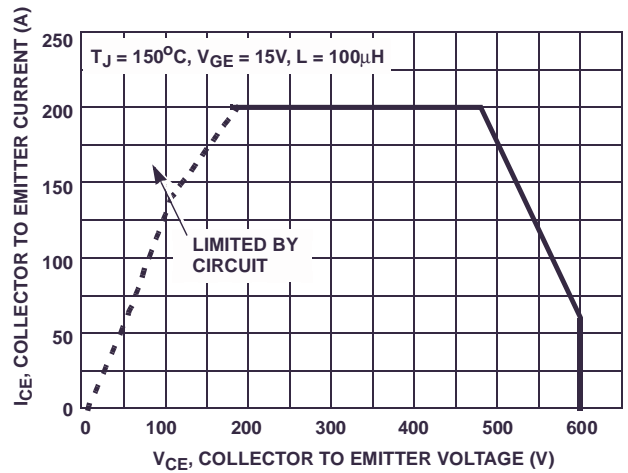


FIGURE 14. SWITCHING SAFE OPERATING AREA

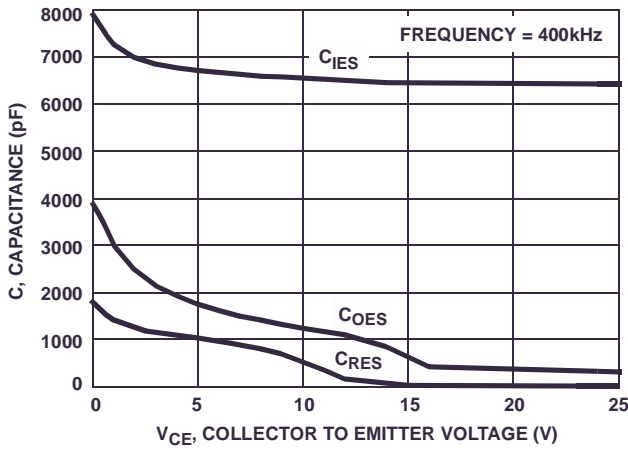


FIGURE 15. CAPACITANCE vs COLLECTOR TO EMITTER VOLTAGE

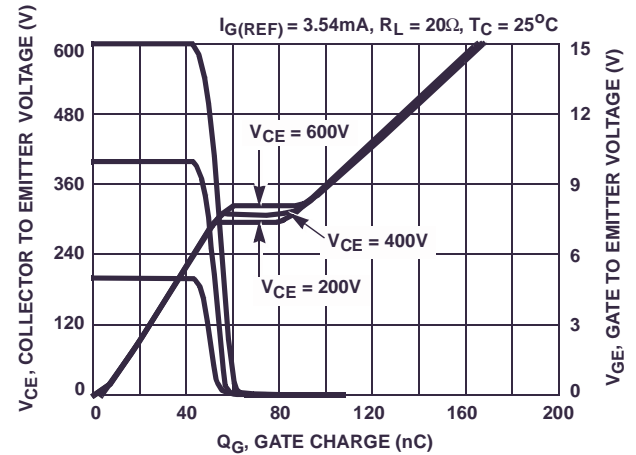


FIGURE 16. GATE CHARGE WAVEFORMS

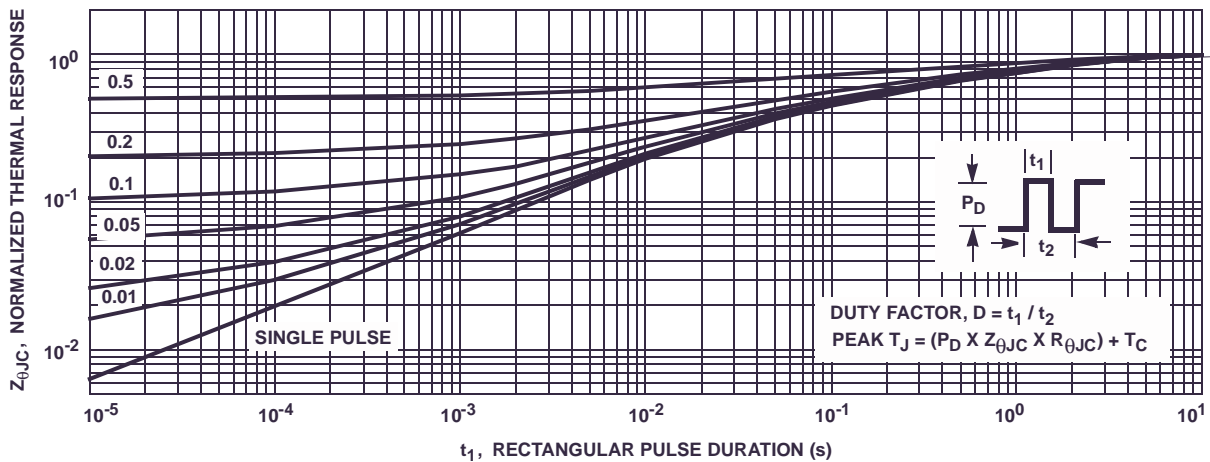


FIGURE 17. IGBT NORMALIZED TRANSIENT THERMAL IMPEDANCE, JUNCTION TO CASE

Test Circuit and Waveforms

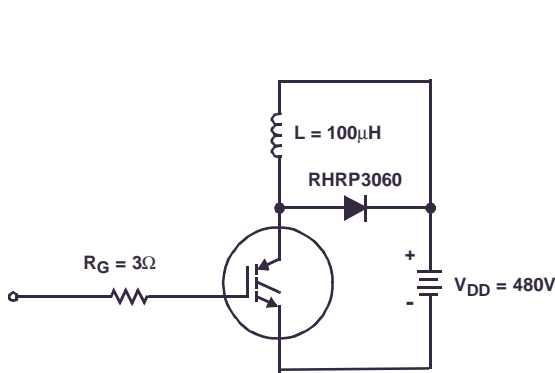


FIGURE 18. INDUCTIVE SWITCHING TEST CIRCUIT

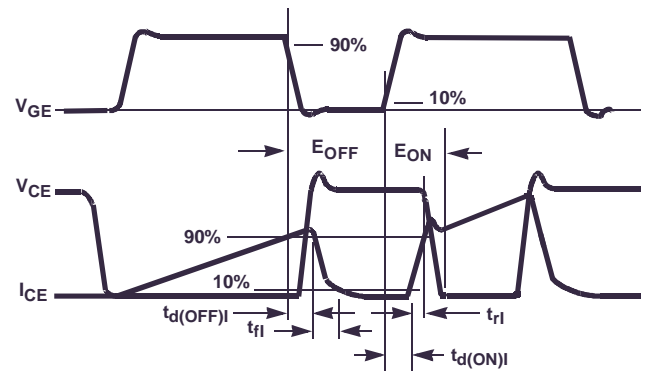


FIGURE 19. SWITCHING TEST WAVEFORMS

Handling Precautions for IGBTs

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, IGBTs 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. IGBTs 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** - Never exceed the gate-voltage rating of V_{GEM} . Exceeding the rated V_{GE} can result in permanent damage to the oxide layer in the gate region.
6. **Gate Termination** - The gates of these devices are essentially capacitors. Circuits that leave the gate open-circuited or floating should be avoided. These conditions can result in turn-on of the device due to voltage buildup on the input capacitor due to leakage currents or pickup.
7. **Gate Protection** - These devices do not have an internal monolithic Zener Diode from gate to emitter. If gate protection is required an external Zener is recommended.

Operating Frequency Information

Operating frequency information for a typical device (Figure 13) is presented as a guide for estimating device performance for a specific application. Other typical frequency vs collector current (I_{CE}) plots are possible using the information shown for a typical unit in Figures 4, 7, 8, 11 and 12. The operating frequency plot (Figure 13) of a typical device shows f_{MAX1} or f_{MAX2} , whichever is smaller at each point. The information is based on measurements of a typical device and is bounded by the maximum rated junction temperature.

f_{MAX1} is defined by $f_{MAX1} = 0.05 / (t_{d(OFF)I} + t_{d(ON)I})$. Deadtime (the denominator) has been arbitrarily held to 10% of the on-state time for a 50% duty factor. Other definitions are possible. $t_{d(OFF)I}$ and $t_{d(ON)I}$ are defined in Figure 19.

Device turnoff delay can establish an additional frequency limiting condition for an application other than T_{JM} . $t_{d(OFF)I}$ is important when controlling output ripple under a lightly loaded condition.

f_{MAX2} is defined by $f_{MAX2} = (P_D - P_C) / (E_{OFF} + E_{ON})$. The allowable dissipation (P_D) is defined by $P_D = (T_{JM} - T_C) / R_{\theta JC}$. The sum of device switching and conduction losses must not exceed P_D . A 50% duty factor was used (Figure 13) and the conduction losses (P_C) are approximated by $P_C = (V_{CE} \times I_{CE}) / 2$.

E_{ON} and E_{OFF} are defined in the switching waveforms shown in Figure 19. E_{ON} is the integral of the instantaneous power loss ($I_{CE} \times V_{CE}$) during turn-on and E_{OFF} is the integral of the instantaneous power loss ($I_{CE} \times V_{CE}$) during turn-off. All tail losses are included in the calculation for E_{OFF} ; i.e. the collector current equals zero ($I_{CE} = 0$).

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CROSSVOLT TM	GlobalOptoisolator TM	POPT TM	SuperSOT TM -3	
DenseTrench TM	GTO TM	Power247 TM	SuperSOT TM -6	
DOMET TM	HiSeC TM	PowerTrench [®]	SuperSOT TM -8	
EcoSPARK TM	ISOPLANAR TM	QFET TM	SyncFET TM	
E ² CMOS TM	LittleFET TM	QST TM	TinyLogic TM	
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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.
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