HGTP2N120CN, HGT1S2N120CN
13A, 1200V, NPT Series N-Channel IGBT

Features

- 13A, 1200V, T_C = 25°C
- 1200V Switching SOA Capability
- Typical Fall Time 360ns at T_J = 150°C
- Short Circuit Rating
- Low Conduction Loss
- Avalanche Rated
- Temperature Compensating SABER™ Model
  Thermal Impedance SPICE Model
  www.fairchildsemi.com
- Related Literature
- TB334 “Guidelines for Soldering Surface Mount Components to PC Boards”

Description

The HGTP2N120CN and HGT1S2N120CN are Non-Punch Through (NPT) IGBT designs. They are new members of the MOS gated high voltage switching IGBT family. IGBTs combine the best features of MOSFETs and bipolar transistors. This device has the high input impedance of a MOSFET and the low on-state conduction loss of a bipolar transistor.

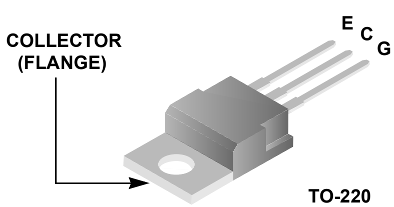
The IGBT is ideal for many high voltage switching applications operating at moderate frequencies where low conduction losses are essential, such as: AC and DC motor controls, power supplies and drivers for solenoids, relays and contactors.

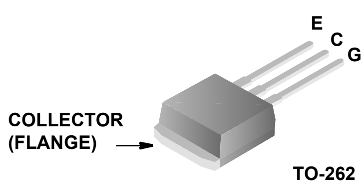
Formerly Developmental Type TA49313

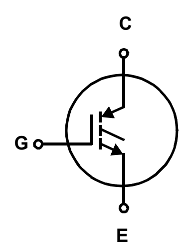
Ordering Informations

Part Number	Package	Brand
HGTP2N120CN	TO-220AB	2N120CN
HGT1S2N120CN	TO-262	2N120CN

Note: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-263AB and TO-252AA variant in tape and reel, e.g., HGT1S2N120CNS9A.







FAIRCHILD SEMICONDUCTOR 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	

Absolute Maximum Ratings $T_C = 25°C$, Unless Otherwise Specified

Symbol	Parameter	HGTP2N120CN HGT1S2N120CN	Units
BV_{CES}	Collector to Emitter Voltage	1200	V
 I_{C25} I_{C110}	Collector Current Continuous At $T_C = 25°C$ At $T_C = 110°C$	 13 7	 A A
I_{CM}	Collector Current Pulsed (Note 1)	20	A
V_{GES}	Gate to Emitter Voltage Continuous	±20	V
V_{GEM}	Gate to Emitter Voltage Pulsed	±30	V
SSOA	Switching SOA Operating Area at $T_J = 150°C$ (Figure 2)	13A at 1200V	
P_D	Power Dissipation Total at $T_C = 25°C$	104	W
	Power Dissipation Derating $T_C > 25°C$	0.83	W/°C
E_{AV}	Forward Voltage Avalanche Energy (Note 2)	18	mJ
t_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°C
 T_L T_{PKG}	Maximum Lead Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10s Package Body for 10s, see Tech Brief 334	 300 260	 °C °C
t_{SC}	Short Circuit Withstand Time (Note 3) at $V_{GE} = 15V$	8	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. Pulse width limited by maximum junction temperature.
2. $I_{CE} = 3A$, $L = 4mH$
3. $V_{CE(PK)} = 840V$, $T_J = 125°C$, $R_G = 51\Omega$.

Electrical Characteristics $T_C = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
BV_{CES}	Collector to Emitter Breakdown Voltage	$I_C = 250\mu A$, $V_{GE} = 0V$		1200	-	-	V
BV_{ECS}	Emitter to Collector Breakdown Voltage	$I_C = 10mA$, $V_{GE} = 0V$		15	-	-	V
I_{CES}	Collector to Emitter Leakage Current	$V_{CE} = 1200V$	$T_J = 25°C$	-	-	100	µA
			$T_J = 125°C$	-	100	-	µA
			$T_J = 150°C$	-	-	1.0	mA
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 2.6A$, $V_{GE} = 15V$	$T_J = 25°C$	-	2.05	2.40	V
			$T_J = 150°C$	-	2.75	3.50	V
$V_{GE(TH)}$	Gate to Emitter Threshold Voltage	$I_C = 45\mu A$, $V_{CE} = V_{GE}$		6.4	6.7	-	V
I_{GES}	Gate to Emitter Leakage Current	$V_{GE} = \pm 20V$		-	-	±250	nA
SSOA	Switching SOA	$T_J = 150°C$, $R_G = 51\Omega$, $V_{GE} = 15V$ $L = 5mH$, $V_{CE(PK)} = 1200V$		13	-	-	A
V_{GEP}	Gate to Emitter Plateau Voltage	$I_C = 2.6A$, $V_{CE} = 600V$		-	10.2	-	V
$Q_{g(ON)}$	On-State Gate Charge	$I_C = 2.6A$, $V_{CE} = 600V$	$V_{GE} = 15V$	-	30	36	nC
			$V_{GE} = 20V$	-	36	43	nC

Electrical Characteristics T_C = 25°C unless otherwise noted **(Continued)**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$t_{d(ON)I}$	Current Trun-On Delay Time	IGBT and Diode at T_J = 25°C I_{CE} = 2.6A V_{CE} = 960V V_{GE} = 15V R_G = 51Ω L = 5mH Test Circuit (Figure 18)	-	25	30	ns
t_{rI}	Current Rise Time		-	11	15	ns
$t_{d(OFF)I}$	Curent Turn-Off Delay Time		-	205	220	ns
t_{fI}	Current Fall Time		-	260	320	ns
E_{ON1}	Turn-On Energy (Note 4)		-	96	-	µJ
E_{ON2}	Turn-On Energy (Note 4)		-	425	590	µJ
E_{OFF}	Turn-Off Energy (Note 5)		-	355	390	µJ
$t_{d(ON)I}$	Curent Turn-On Delay Time	IGBT and Diode at T_J = 150°C I_{CE} = 2.6A V_{CE} = 960V V_{GE} = 15V R_G = 51Ω L = 5mH Test Circuit (Figure 18)	-	21	25	ns
t_{rI}	Current Rise Time		-	11	15	ns
$t_{d(OFF)I}$	Curent Turn-Off Delay Time		-	225	240	ns
t_{fI}	Current Fall Time		-	360	420	ns
E_{ON1}	Turn-On Energy (Note 4)		-	96	-	µJ
E_{ON2}	Turn-On Energy (Note 4)		-	800	1100	µJ
E_{OFF}	Turn-Off Energy (Note 5)		-	530	580	µJ
$R_{\theta JC}$	Thermal Resistance Junction to Case		-	-	1.20	°C/W

Notes:

4. Values for two Turn-On loss conditions are shown for the convenience of the circuit designer. E_{ON1} is the turn-on loss of the IGBT only. E_{ON2} is the turn-on loss when a typical diode is used in the test circuit and the diode is at the same T_J as the IGBT. The diode type is specified in Figure 18.

5. 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} = 0A). All devices were 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.

Typical Performance Characteristics

Figure 1. DC Collector Current vs Case Temperature

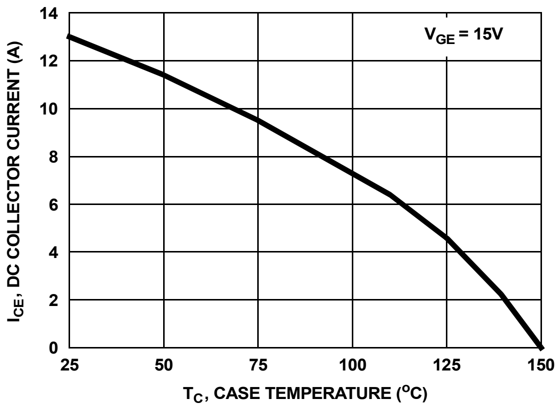


Figure 2. Minimum Switching Safe Operating Area

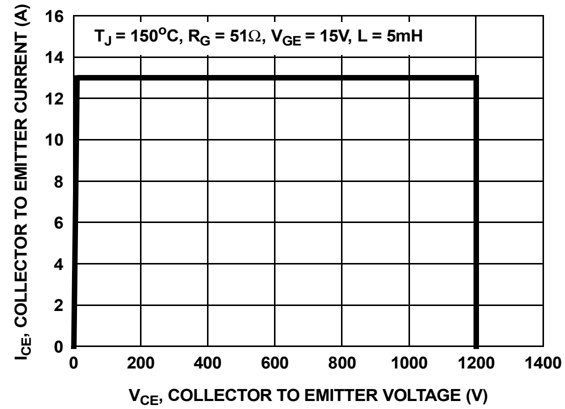


Figure 3. Operating Frequency vs Collector to Emitter Currentl

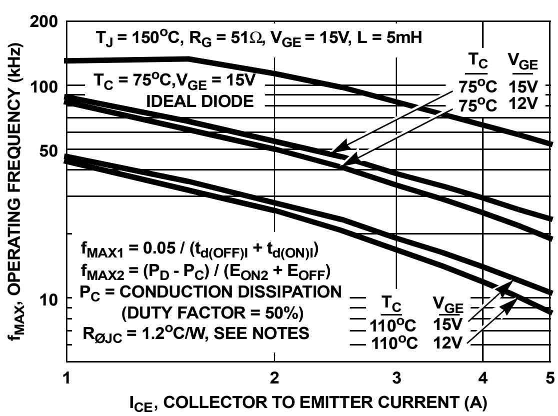


Figure 4. Short Circuit Withstand Time

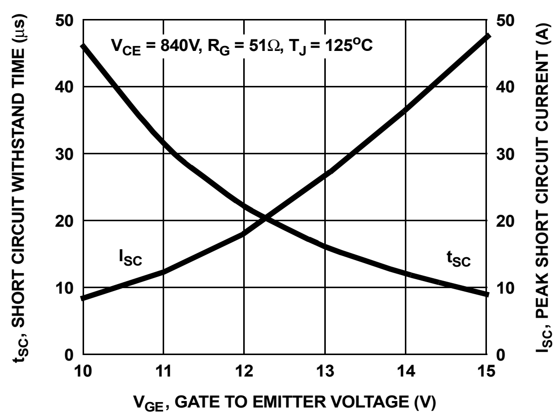


Figure 5. Collector to Emitter On-State Voltage

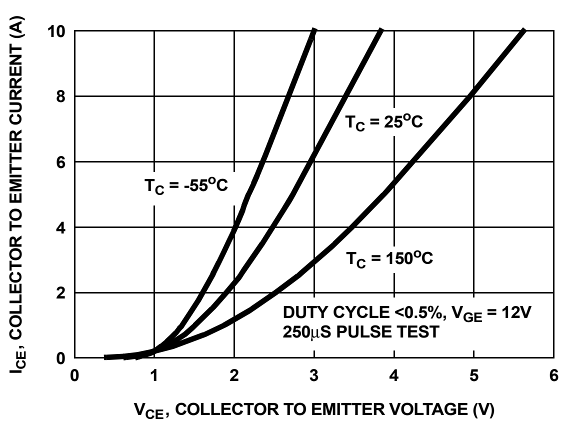
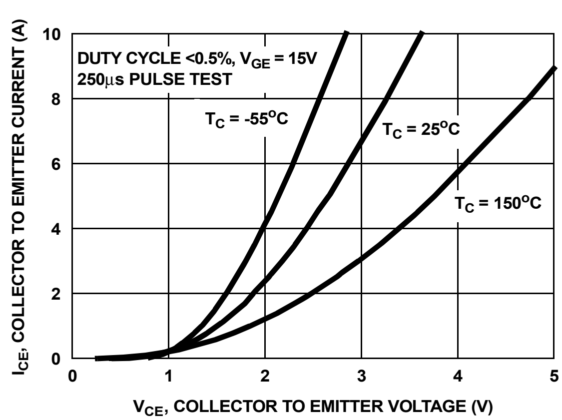


Figure 6. Collector to Emitter On-State Voltage



Typical Performance Characteristics (Continued)

Figure 7. Turn-On Energy Loss vs Collector to Emitter Current

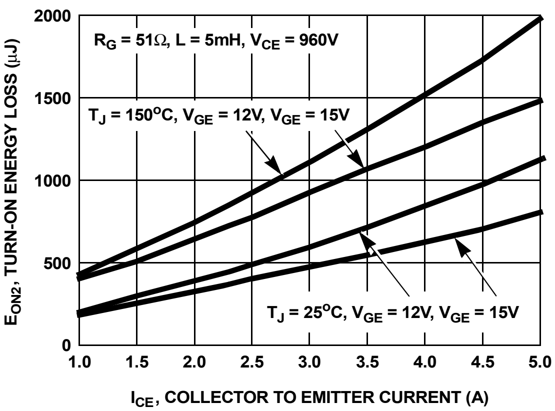


Figure 8. Turn-Off Energy Loss vs Collector to Emitter Current

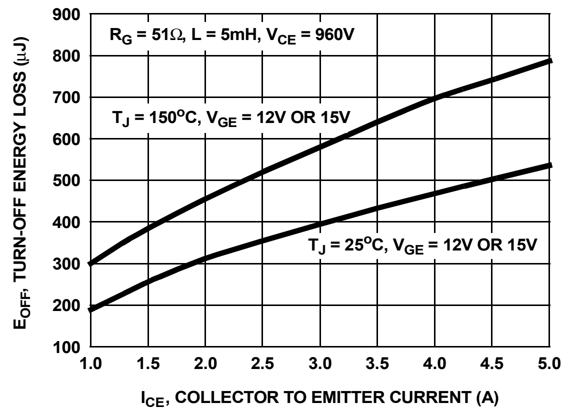


Figure 9. Turn_On Delay Time vs Collector to Emitter Current

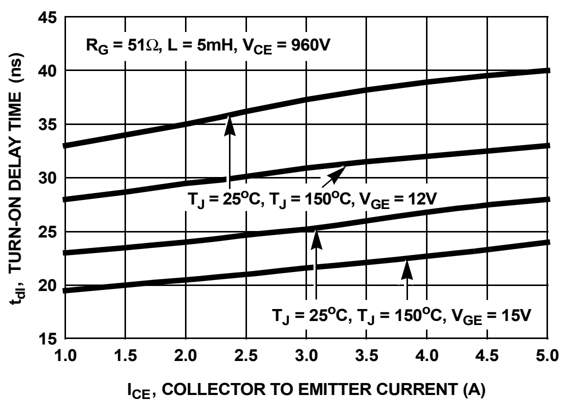


Figure 10. Turn-On Rise Time vs Collector to Emitter Current

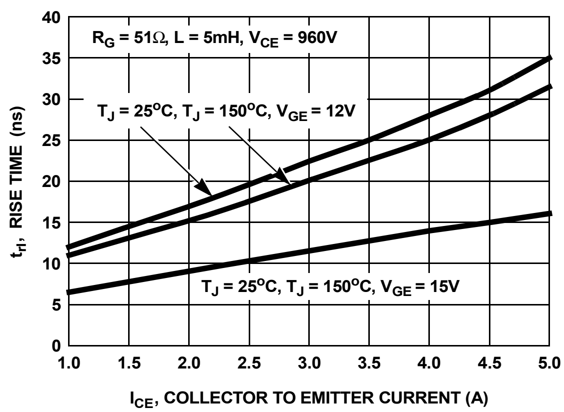


Figure 11. Turn-Off Delay Time vs Collector to Emitter Current

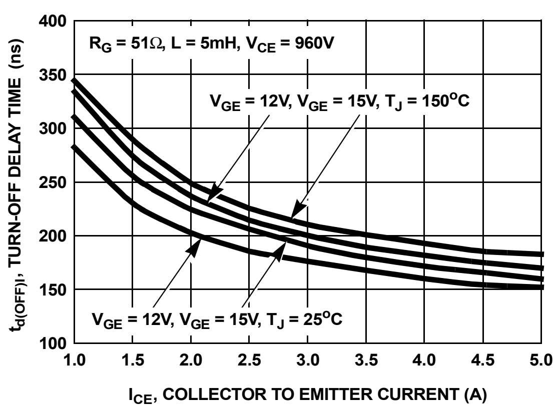
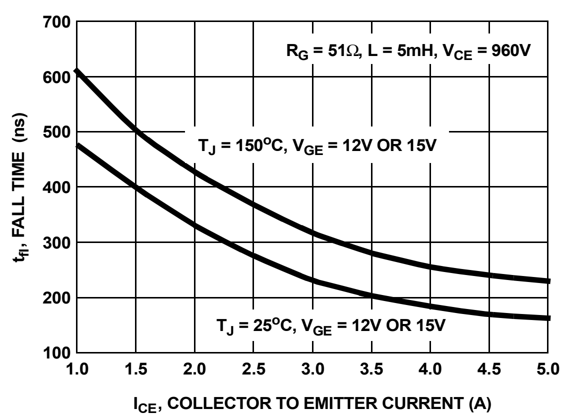


Figure 12. Fall Time vs Collector to Emitter Current



Typical Performance Characteristics (Continued)

Figure 13. Transfer Characteristic

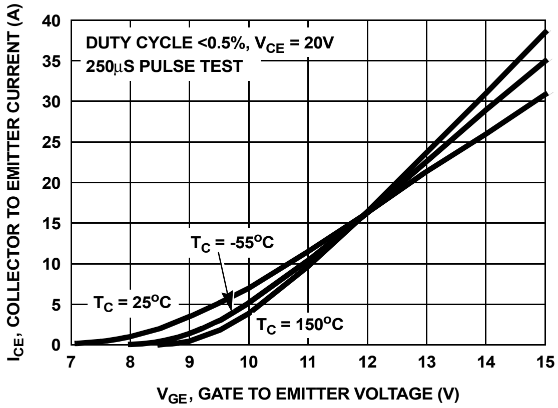


Figure 14. Gate Charge Waveforms

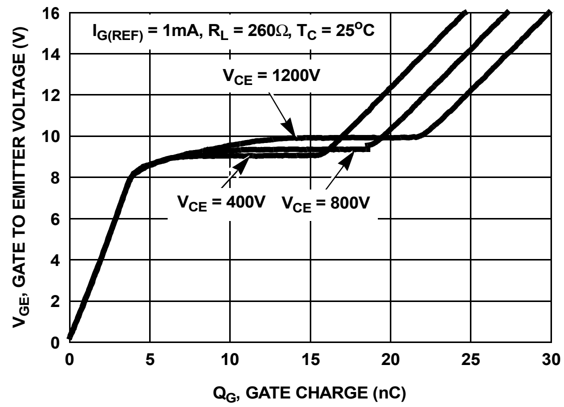


Figure 15. Capacitance vs Collector to Emitter

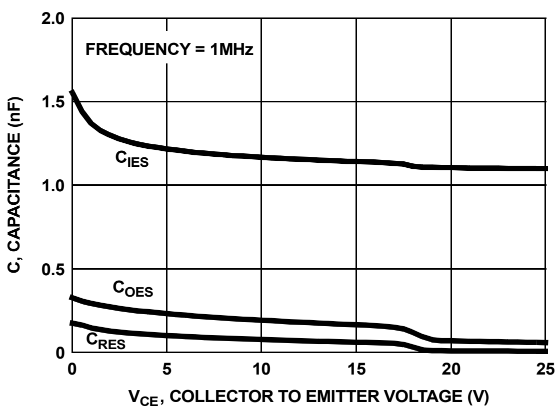


Figure 16. Collector to Emitter On-Sate Voltage

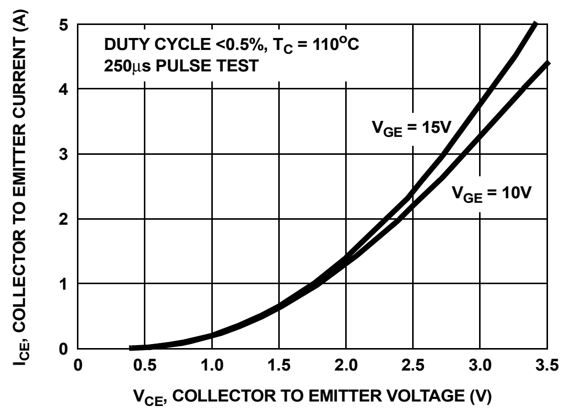
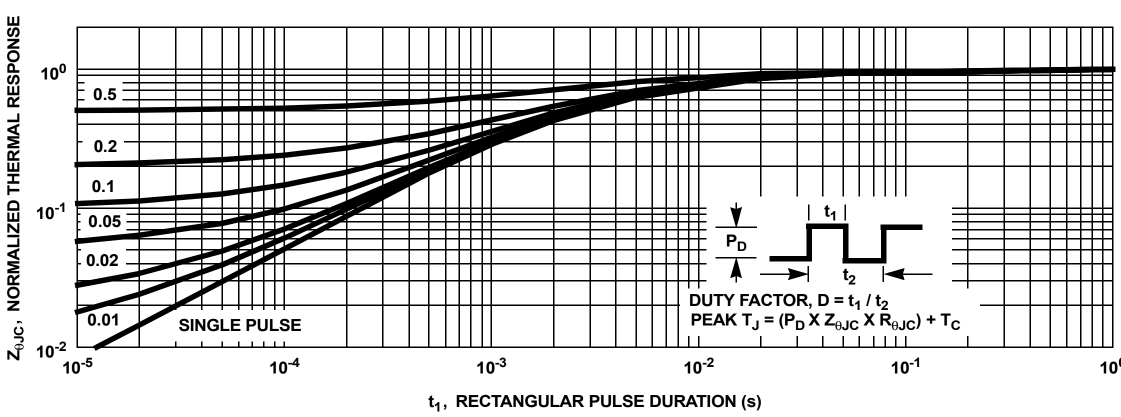


Figure 17. Normalized Transient Thermal Response, Junction to Case



Test Circuit and Waveforms (Continued)

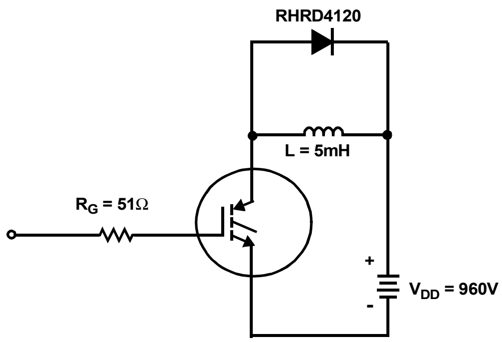


Figure 18. Inductive Switching Test Circuit

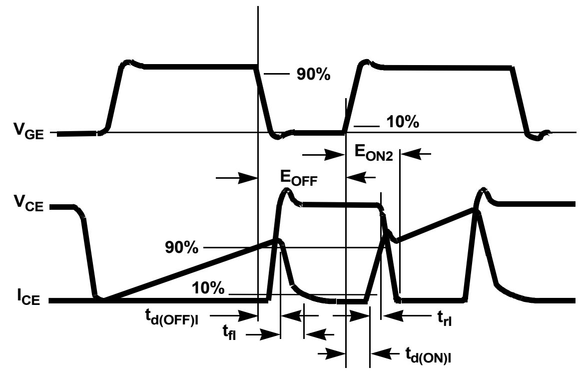


Figure 19. Switching Test Waveforms

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 "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** - 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 3) 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 5, 6, 7, 8, 9 and 11. The operating frequency plot (Figure 3) 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 turn-off 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 $f_{MAX2} = (P_D - P_C)/(E_{OFF} + E_{ON2})$. 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 3) and the conduction losses (P_C) are approximated by $P_C = (V_{CE} \times I_{CE})/2$.

E_{ON2} and E_{OFF} are defined in the switching waveforms shown in Figure 19. E_{ON2} 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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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.

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Datasheet Identification	Product Status	Definition
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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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