

RIS HGTP3N60C3D, HGT1S3N60C3D, HGT1S3N60C3DS

Packaging

6A, 600V, UFS Series N-Channel IGBT with Anti-Parallel Hyperfast Diodes

JEDEC TO-220AB

GATE



Features

- 6A, 600V at T_C = 25^oC
- 600V Switching SOA Capability
- Short Circuit Rating
- Low Conduction Loss
- Hyperfast Anti-Parallel Diode

Description

The HGTP3N60C3D, HGT1S3N60C3D, and HGT1S3N60C3DS 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. The IGBT used is the development type TA49113. The diode used in anti-parallel with the IGBT is the development type TA49055.

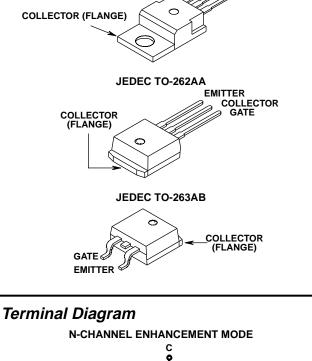
The IGBT is ideal for many high voltage switching applications operating at moderate frequencies where low conduction losses are essential.

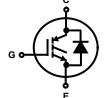
PACKAGING AVAILABILITY

PART NUMBER	PACKAGE	BRAND	
HGTP3N60C3D	TO-220AB	G3N60C3D	
HGT1S3N60C3D	TO-262AA	G3N60C3D	
HGT1S3N60C3DS	TO-263AB	G3N60C3D	

NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-263AB variant in tape and reel, i.e. HGT1S3N60C3DS9A

Formerly Developmental Type TA49119.





HGTP3N60C3D, HGT1S3N60C3D

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

	HGT1S3N60C3DS	UNITS
Collector-Emitter VoltageBV _{CES}	600	V
Collector Current Continuous		
At $T_{C} = 25^{\circ}C$ I _{C25}	6	А
At $T_{C} = 110^{\circ}C$ I_{C110}	3	А
Collector Current Pulsed (Note 1)ICM	24	А
Gate-Emitter Voltage Continuous	±20	V
Gate-Emitter Voltage Pulsed	±30	V
Switching Safe Operating Area at T _J = 150 ^o C, Fig. 14 SSOA	18A at 480V	
Power Dissipation Total at $T_{C} = 25^{\circ}C$ P_{D}	33	W
Power Dissipation Derating T _C > 25 ^o C	0.27	W/ ^o C
Operating and Storage Junction Temperature Range	-40 to 150	°C
Maximum Lead Temperature for SolderingTL	260	°C
Short Circuit Withstand Time (Note 2) at V _{GE} = 10V, Fig 6t _{SC}	8	μs
NOTES:		
1 Populitive Poling: Dulos width limited by maximum junction temperature		

1. Repetitive Rating: Pulse width limited by maximum junction temperature.

V_{CE(PK)} = 360V, T_J = 125^oC, R_{GE} = 82Ω.

PARAMETER	SYMBOL	TEST CON	MIN	TYP	MAX	UNITS	
Collector-Emitter Breakdown Voltage	BV _{CES}	$I_{C} = 250 \mu A, V_{GE} = 0 V$		600	-	-	V
Collector-Emitter Leakage Current	ICES	$V_{CE} = BV_{CES}$	T _C = 25 ^o C	-	-	250	μΑ
		$V_{CE} = BV_{CES}$	T _C = 150 ^o C	-	-	2.0	mA
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	I _C = I _{C110} , V _{GE} = 15V	T _C = 25 ^o C	-	1.65	2.0	V
			T _C = 150 ^o C	-	1.85	2.2	V
Gate-Emitter Threshold Voltage	V _{GE(TH)}	I _C = 250μA, V _{CE} = V _{GE}	T _C = 25 ^o C	3.0	5.5	6.0	V
Gate-Emitter Leakage Current	I _{GES}	$V_{GE} = \pm 25 V$		-	-	±250	nA
Switching SOA	SSOA	$T_{\rm J} = 150^{\rm O} {\rm C}$	V _{CE(PK)} = 480V	18	-	-	A
		$R_{G} = 82\Omega$ $V_{GE} = 15V$ $L = 1mH$	V _{CE(PK)} = 600V	2	-	-	A
Gate-Emitter Plateau Voltage	V _{GEP}	$I_{C} = I_{C110}, V_{CE} = 0.5 \text{ BV}_{CES}$		-	8.3	-	V
On-State Gate Charge	Q _{G(ON)}	IC = IC110, VCE = 0.5 BVCES	V _{GE} = 15V	-	10.8	13.5	nC
			V _{GE} = 20V	-	13.8	17.3	nC
Current Turn-On Delay Time	t _{D(ON)} I	$\begin{array}{l} T_{J} = 150^{0}C \\ I_{CE} = I_{C110} \\ V_{CE(PK)} = 0.8 \; \text{BV}_{CES} \\ V_{GE} = 15V \\ R_{G} = 82\Omega \\ L = 1\text{mH} \end{array}$		-	5	-	ns
Current Rise Time	t _{RI}			-	10	-	ns
Current Turn-Off Delay Time	^t D(OFF)I			-	325	400	ns
Current Fall Time	t _{FI}			-	130	275	ns
Turn-On Energy	E _{ON}	1	-	85	-	μJ	
Turn-Off Energy (Note 3)	E _{OFF}	1	-	245	-	μJ	
Diode Forward Voltage	V _{EC}	I _{EC} = 3A		-	2.0	2.5	V
Diode Reverse Recovery Time	t _{RR}	$I_{EC} = 3A$, $dI_{EC}/dt = 200A/\mu s$		-	22	28	ns
		$I_{EC} = 1A$, $dI_{EC}/dt = 200A/\mu s$		-	17	22	ns
Thermal Resistance	R _{θJC}	IGBT		-	-	3.75	°C/W
		Diode	-	-	3.0	°C/W	

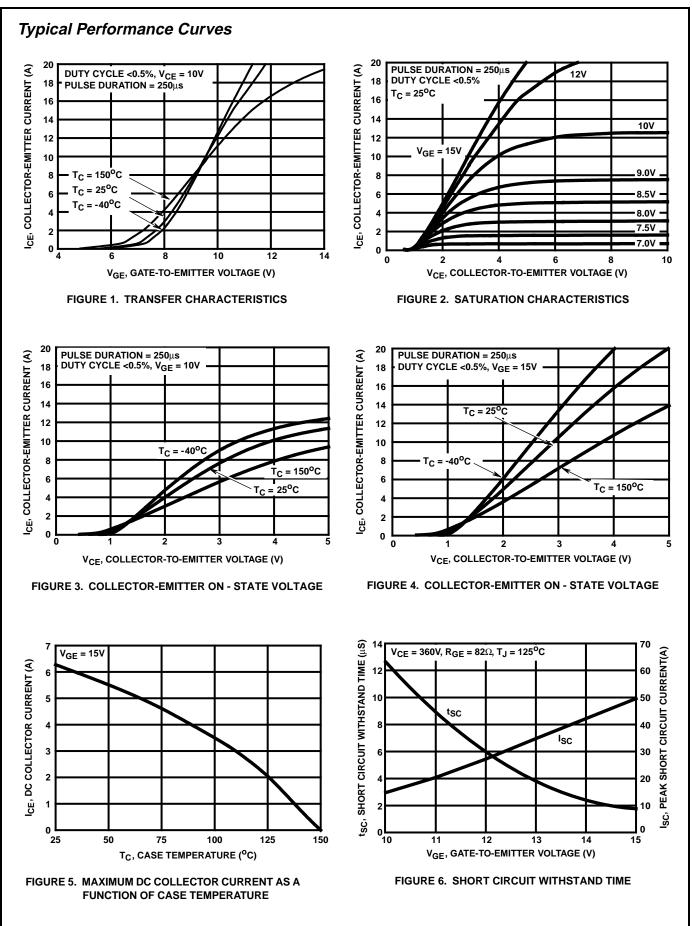
Electrical Specifications $T_{C} = 25^{\circ}C$, Unless Otherwise Specified

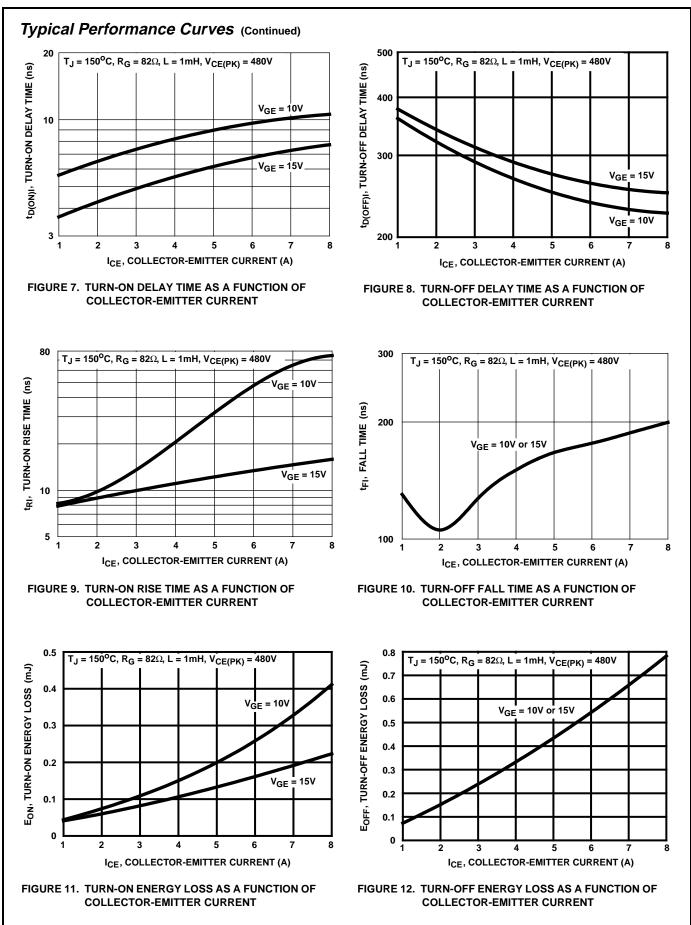
NOTE:

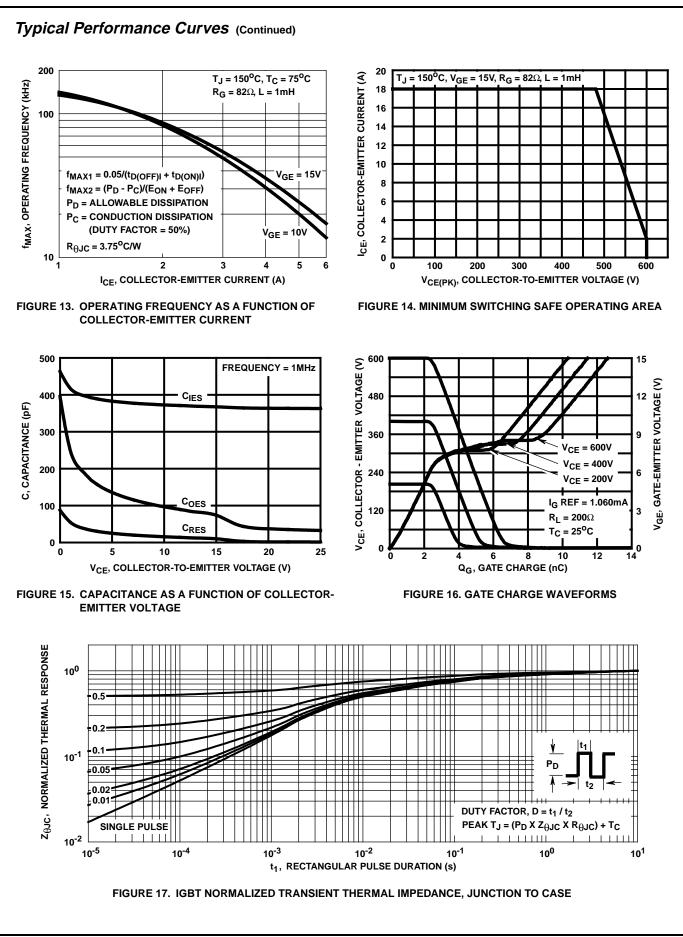
3. Turn-Off Energy Loss (E_{OFF}) is defined as the integral of the instantaneous power loss starting at the trailing edge of the input pulse and ending at the point where the collector current equals zero (I_{CE} = 0A). The HGTP3N60C3D, HGT1S3N60C3D, and HGT1S3N60C3DS were tested per JEDEC standard No. 24-1 Method for Measurement of Power Device Turn-Off Switching Loss. This test method produces the true total Turn-Off Energy Loss. Turn-On losses include diode losses.

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

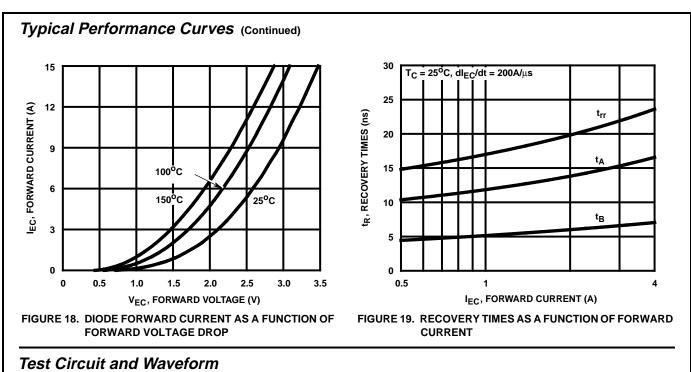
4,364,073	4,417,385	4,430,792	4,443,931	4,466,176	4,516,143	4,532,534	4,567,641
4,587,713	4,598,461	4,605,948	4,618,872	4,620,211	4,631,564	4,639,754	4,639,762
4,641,162	4,644,637	4,682,195	4,684,413	4,694,313	4,717,679	4,743,952	4,783,690
4,794,432	4,801,986	4,803,533	4,809,045	4,809,047	4,810,665	4,823,176	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

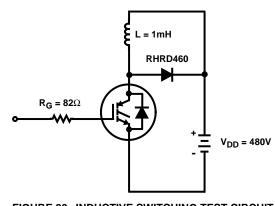


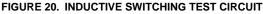


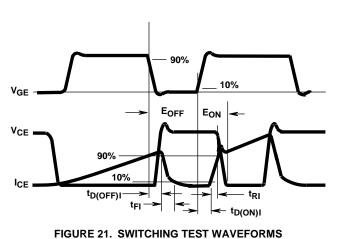


HGTP3N60C3D, HGT1S3N60C3D, HGT1S3N60C3DS









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 21.

Device turn-off delay can establish an additional frequency limiting condition for an application other than T_{JMAX} . $t_{D(OFF)I}$ 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 $P_D = (T_{JMAX} - T_C)/R_{\theta JC}$. 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 21. 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 during turn-off. All tail losses are included in the calculation for E_{OFF} ; i.e. the collector current equals zero ($I_{CE} = 0$).

Handling Precautions for IGBTs

Insulated Gate Bipolar Transistors are susceptible to gateinsulation 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:

- 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.

ECCOSORBD[™] is a Trademark of Emerson and Cumming, Inc.

- 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.

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