

NS HGTG12N60C3D

24A, 600V, UFS Series N-Channel IGBT with Anti-Parallel Hyperfast Diode

January 1997

Features

- 24A, 600V at T_C = 25°C
- Typical Fall Time 210ns at T_J = 150°C
- · Short Circuit Rating
- · Low Conduction Loss
- · Hyperfast Anti-Parallel Diode

Description

The HGTG12N60C3D is a MOS gated high voltage switching device combining the best features of MOSFETs and bipolar transistors. The device has the high input impedance of a MOS-FET 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 TA49123. The diode used in antiparallel with the IGBT is the development type TA49061.

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

PACKAGING AVAILABILITY

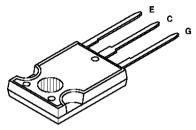
PART NUMBER	PACKAGE	BRAND		
HGTG12N60C3D	TO-247	G12N60C3D		

NOTE: When ordering, use the entire part number.

Formerly Developmental Type TA49117.

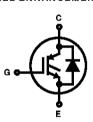
Package





Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



Absolute Maximum Ratings $T_C = 25^{\circ}C$, Unless Otherwise Specified		
	HGTG12N60C3D	UNITS
Collector-Emitter Voltage	600	٧
Collector Current Continuous		
At $T_C = 25^{\circ}C$ I_{C25}	24	Α
At $T_C = 110^{\circ}C$	12	Α
Average Diode Forward Current at 110°C	15	Α
Collector Current Pulsed (Note 1)	96	Α
Gate-Emitter Voltage Continuous	±20	٧
Gate-Emitter Voltage Pulsed	±30	V
Switching Safe Operating Area at T _J = 150°C	24A at 600V	
Power Dissipation Total at T _C = 25°C	1 04	W
Power Dissipation Derating T _C > 25°C	0.83	W/°C
Operating and Storage Junction Temperature Range	-40 to 150	°C
Maximum Lead Temperature for SolderingT _L	260	°C
Short Circuit Withstand Time (Note 2) at V _{GE} = 15V	4	μs
Short Circuit Withstand Time (Note 2) at V _{GE} = 10V	13	μs
NOTE:		

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

	HARRIS	SEMICONDUCTOR	R IGBT PRODU	CT IS COVERED	BY ONE OR MC	ORE OF THE FO	LLOWING U.S. F	PATENTS:
4,3	364,073	4,417,385	4,430,792	4,443,931	4,466, 1 76	4,516,143	4,532,534	4,567,64 1
4,5	587,713	4,598,46 1	4,605,948	4,618,872	4,620,211	4,63 1 ,564	4,639,754	4,639,762
4,6	641,162	4,644,637	4,682,195	4,684,413	4,694,313	4,717,679	4,743,952	4,783,690
4,7	794,432	4,801,986	4,803,533	4,809,045	4,809,047	4,810,665	4,823,176	4,837,606
4,8	360,080	4,883,767	4,888,627	4,890,143	4,901,127	4,904,609	4,933,740	4,963,951
10	169 027							

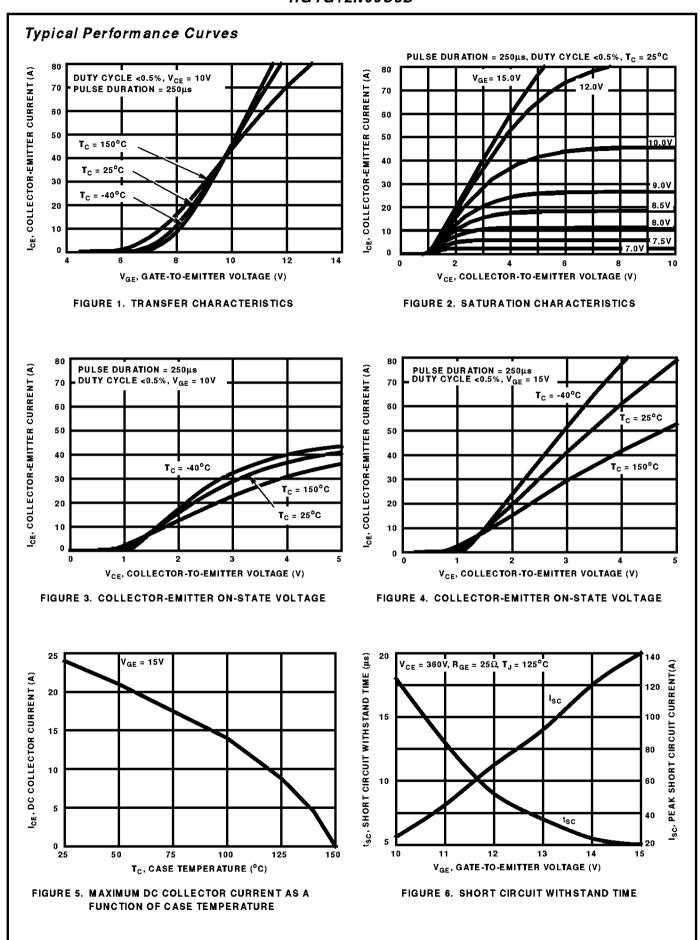
HGTG12N60C3D

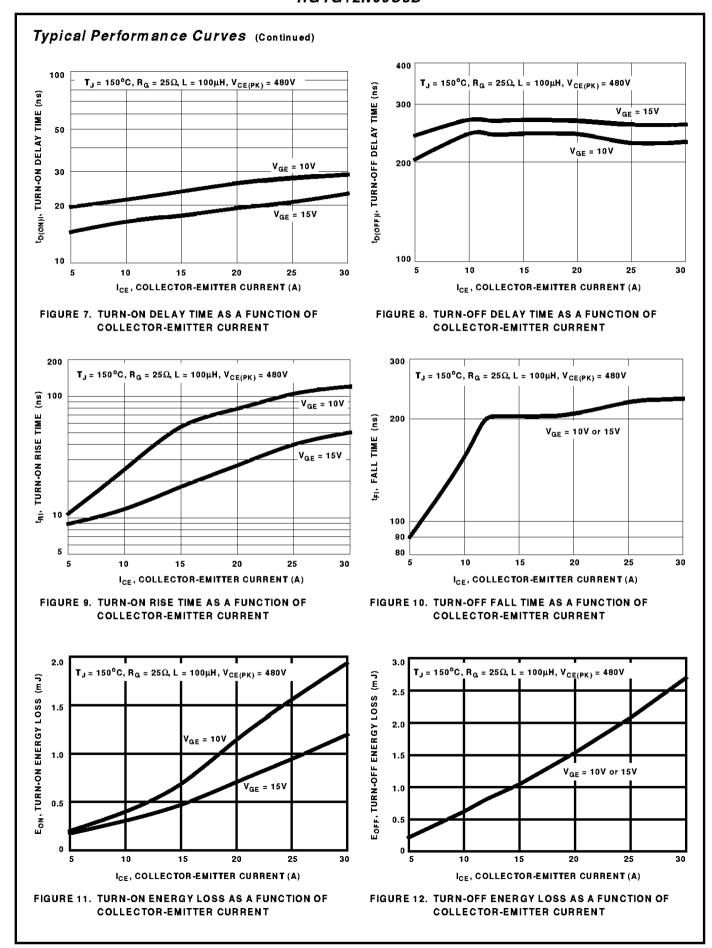
Electrical Specifications $T_C = 25^{\circ}C$, Unless Otherwise Specified

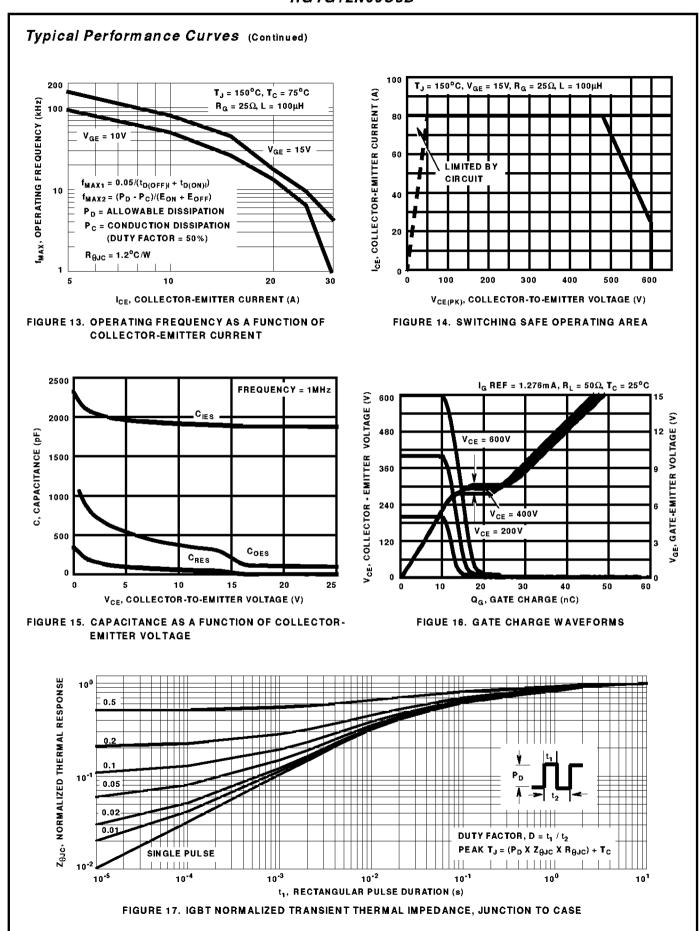
				LIMITS			
PARAMETER	ETER SYMBOL TEST CONDITIONS		MIN	TYP	MAX	UNITS	
Collector-Emitter Breakdown Voltage	BV _{CES}	$I_C = 250 \mu A, V_{GE} = 0 V$		600	-	-	٧
Emitter-Collector Breakdown Voltage	BV _{ECS}	I _C = 10mA, V _{GE} =	= 0 V	15	25	-	٧
Collector-Emitter Leakage Current	I _{CES}	V _{CE} = BV _{CES}	$T_C = 25^{\circ}C$	-	-	250	μΑ
		V _{CE} = BV _{CES}	T _C = 1 50°C	-	-	2.0	mA
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	$I_{C} = I_{C110},$ $V_{GE} = 15V$	$T_C = 25^{\circ}C$	-	1.65	2.0	٧
			$T_{\rm C} = 150^{\rm o}{\rm C}$	-	1.85	2.2	٧
		$I_C = 15A$, $V_{GE} = 15V$	$T_C = 25^{\circ}C$	-	1.80	2.2	٧
			$T_C = 150^{\circ}C$	-	2.0	2.4	٧
Gate-Emitter Threshold Voltage	V _{GE(TH)}	$\begin{split} I_C &= 250 \mu A, \\ V_{CE} &= V_{GE} \end{split}$	$T_C = 25^{\circ}C$	3.0	5.0	6.0	٧
Gate-Emitter Leakage Current	I _{GES}	V _{GE} = ±20V		-	-	±100	nA
Switching SOA	SSOA	$\begin{split} T_J &= 150^{o}C, \\ V_{GE} &= 15V, \\ R_G &= 25\Omega, \\ L &= 100 \mu H \end{split}$	V _{CE(PK)} = 480V	80	-	-	Α
			$V_{CE(PK)} = 600V$	24	-	-	Α
Gate-Emitter Plateau Voltage	V_{GEP}	$I_{C} = I_{C110}, V_{CE} = 0.5 \text{ BV}_{CES}$		-	7.6	-	٧
On-State Gate Charge	Q _{G(ON)}	$I_{C} = I_{C110},$ $V_{CE} = 0.5 \text{ BV}_{CES}$	V _{GE} = 15V	-	48	55	пC
			V _{GE} = 20V	-	62	71	пС
Current Tum-On Delay Time	t _{D(ON)} I	$\begin{array}{l} T_{J} = 150^{o}C, \\ I_{CE} = I_{C110}, \\ V_{CE(PK)} = 0.8 \; BV_{CES}, \\ V_{GE} = 15V, \\ R_{G} = 25\Omega, \\ L = 100\mu H \end{array}$		-	14	-	ns
Current Rise Time	t _{RI}			-	16	-	ns
Current Tum-Off Delay Time	t _{D(OFF)} I			-	270	400	ns
Current Fall Time	t _{FI}			-	210	275	ns
Turn-On Energy	E _{ON}	1	-	380	-	μJ	
Turn-Off Energy (Note 3)	E _{OFF}	1	-	900	-	μJ	
Diode Forward Voltage	V _{EC}	I _{EC} = 12A		-	1.7	2.0	٧
Diode Reverse Recovery Time	t _{rr}	$I_{EC} = 12A$, $dI_{EC}/dt = 100A/\mu s$		-	34	42	ns
		$I_{EC} = 1.0A$, $dI_{EC}/dt = 100A/\mu s$		-	30	37	ns
Thermal Resistance	$R_{ heta JC}$	IGBT	IGBT		-	1.2	°C/W
		Diode		-	-	1.5	°C/W

NOTE:

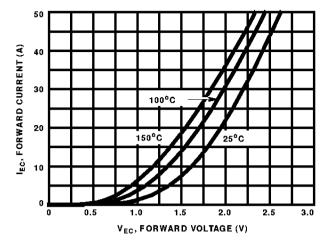
^{3.} Turn-Off Energy Loss (E_{OFF}) is defined as the integral of the instantaneous power loss starting at the trailing edge of the input pulse, and ending at the point where the collector current equals zero (I_{CE} = 0A). The HGTG12N60C3D was tested per JEDEC Standard No. 24-1 Method for Measurement 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 (Continued)



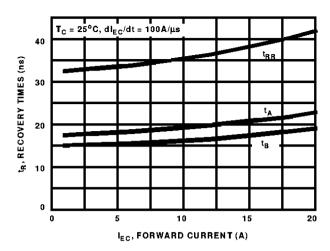


FIGURE 18. DIODE FORWARD CURRENT AS A FUNCTION OF FORWARD VOLTAGE DROP

FIGURE 19. RECOVERY TIMES AS A FUNCTION OF FORWARD CURRENT

Test Circuit and Waveform

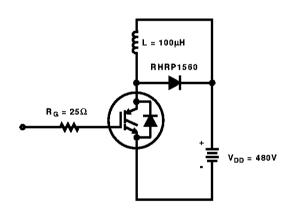


FIGURE 20. INDUCTIVE SWITCHING TEST CIRCUIT

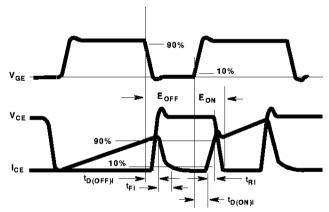


FIGURE 21. SWITCHING TEST WAVEFORMS

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} . $t_{\text{D(OFF)I}}$ 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 $P_D = (T_{JMAX} - T_C)/(P_{0JC})$. 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 $P_C = (V_{CF} \times I_{CF})/2$.

 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 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:

- 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.
- 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.
- Devices should never be inserted into or removed from circuits with power on.
- 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.
- 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.

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

All Harris Semiconductor products are manufactured, assembled and tested under ISO9000 quality systems certification.

Harris Semiconductor products are sold by description only. Harris Semiconductor reserves the right to make changes in circuit design and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that data sheets are current before placing orders. Information furnished by Harris is believed to be accurate and reliable. However, no responsibility is assumed by Harris or its subsidiaries for its use; nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Harris or its subsidiaries.

Sales Office Headquarters

For general information regarding Harris Semiconductor and its products, call 1-800-4-HARRIS

UNITED STATES

Harris Semiconductor P. O. Box 883, Mail Stop 53-210 Melbourne, FL 32902 TEL: 1-800-442-7747

(407) 729-4984 FAX: (407) 729-5321

EUROPE

Harris Semiconductor Mercure Center 100, Rue de la Fusee 1130 Brussels, Belgium TEL: (32) 2.724.2111 FAX: (32) 2.724.22.05

ASIA

Harris Semiconductor PTE Ltd. No. 1 Tannery Road Cencon 1, #09-01 Singapore 1334 TEL: (65) 748-4200 FAX: (65) 748-0400

