HGTG30N60A4D



Data Sheet

January 2000 File Number 4830

600V, SMPS Series N-Channel IGBT with Anti-Parallel Hyperfast Diode

The HGTG30N60A4D is a MOS gated high voltage switching devices combining 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 much lower on-state voltage drop varies only moderately between 25°C and 150°C. The IGBT used is the development type TA49343. The diode used in anti-parallel is the development type TA49373.

This IGBT is ideal for many high voltage switching applications operating at high frequencies where low conduction losses are essential. This device has been optimized for high frequency switch mode power supplies.

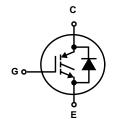
Formerly Developmental Type TA49345.

Ordering Information

PART NUMBER	PACKAGE	BRAND	
HGTG30N60A4D	TO-247	30N60A4D	

NOTE: When ordering, use the entire part number.

Symbol

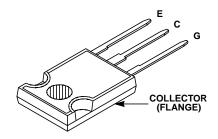


Features

- >100kHz Operation At 390V, 30A
- 200kHz Operation At 390V, 18A
- 600V Switching SOA Capability
- Low Conduction Loss
- Temperature Compensating SABER Model
 www.intersil.com

Packaging

JEDEC STYLE TO-247



INTERSIL CORPORATION IGBT PRODUCT IS COVERED BY ONE OR MORE OF THE FOLLOW	/ING U.S. PATENTS
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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	4,587,713
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 $T_{C} = 25^{\circ}C$, Unless Otherwise Specified

	HGTG30N60A4D,	UNITS
Collector to Emitter VoltageBV _{CES}	600	V
Collector Current Continuous		
At T _C = 25 ^o CI _{C25}	75	А
At T _C = 110 ^o C I _{C110}	60	А
Collector Current Pulsed (Note 1)	240	А
Gate to Emitter Voltage ContinuousV _{GES}	±20	V
Gate to Emitter Voltage Pulsed	±30	V
Switching Safe Operating Area at T _J = 150 ^o C (Figure 2) SSOA	150A at 600V	
Power Dissipation Total at $T_C = 25^{\circ}C$ P_D	463	W
Power Dissipation Derating T _C > 25 ^o C	3.7	W/ ^o C
Operating and Storage Junction Temperature Range	-55 to 150	°C
Maximum Temperature for SolderingTL	260	°C

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.

NOTE:

1. Pulse width limited by maximum junction temperature.

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Collector to Emitter Breakdown Voltage	BV _{CES}	$I_{C} = 250 \mu A, V_{GE} = 0 V$		600	-	-	V
Collector to Emitter Leakage Current	ICES	V _{CE} = 600V	$T_J = 25^{\circ}C$	-	-	250	μΑ
			T _J = 125 ^o C	-	-	2.8	mA
Collector to Emitter Saturation Voltage	V _{CE(SAT)}	I _C = 30A,	$T_J = 25^{\circ}C$	-	1.8	2.6	V
		V _{GE} = 15V	T _J = 125 ⁰ C	-	1.6	2.0	V
Gate to Emitter Threshold Voltage	V _{GE(TH)}	I _C = 250μA, V _{CE}	= 600V	4.5	5.2	7.0	V
Gate to Emitter Leakage Current	I _{GES}	$V_{GE} = \pm 20V$		-	-	±250	nA
Switching SOA	SSOA		$T_J = 150^{\circ}C, R_G = 3\Omega, V_{GE} = 15V,$ L = 100µH, V _{CE} = 600V		-	-	A
Gate to Emitter Plateau Voltage	V _{GEP}	I _C = 30A, V _{CE} =	300V	-	8.5	-	V
On-State Gate Charge	Q _{g(ON)}		V _{GE} = 15V	-	225	270	nC
			-	300	360	nC	
Current Turn-On Delay Time	t _{d(ON)} I	$ \begin{array}{l} \text{IGBT and Diode at } T_{J} = 25^{O}C, \\ \text{I}_{CE} = 30A, \\ \text{V}_{CE} = 390V, \\ \text{V}_{GE} = 15V, \\ \text{R}_{G} = 3\Omega, \\ \text{L} = 200\muH, \\ \text{Test Circuit (Figure 24)} \end{array} $		-	25	-	ns
Current Rise Time	t _{rl}			-	12	-	ns
Current Turn-Off Delay Time	^t d(OFF)I			-	150	-	ns
Current Fall Time	t _{fl}			-	38	-	ns
Turn-On Energy (Note 2)	E _{ON1}			-	280	-	μJ
Turn-On Energy (Note 2)	E _{ON2}			-	600	-	μJ
Turn-Off Energy (Note 3)	E _{OFF}	_		-	240	350	μJ
Current Turn-On Delay Time	t _{d(ON)} I	IGBT and Diode	at T _J = 125 ⁰ C,	-	24	-	ns
Current Rise Time	t _{rl}	I _{CE} = 30A, V _{CE} = 390V, V _G	15\/	-	11	-	ns
Current Turn-Off Delay Time	^t d(OFF)I	$R_{G} = 3\Omega,$	E = 13 v,	-	180	200	ns
Current Fall Time	t _{fl}	L = 200µH,	2.4)	-	58	70	ns
Turn-On Energy (Note 2)	E _{ON1}	Test Circuit (Figure 24)		-	280	-	μJ
Turn-On Energy (Note 2)	E _{ON2}			-	1000	1200	μJ
Turn-Off Energy (Note 3)	E _{OFF}			-	450	750	μJ
Diode Forward Voltage	V _{EC}	I _{EC} = 30A		-	2.2	2.5	V
Diode Reverse Recovery Time	t _{rr}	$I_{EC} = 30A, dI_{EC}/dt = 200A/\mu s$ $I_{EC} = 1A, dI_{EC}/dt = 200A/\mu s$		-	40	55	ns
				-	30	42	ns

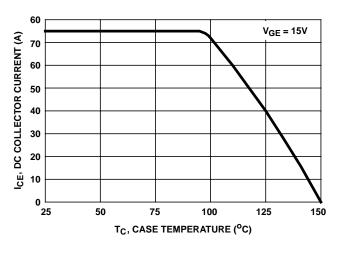
Electrical Specifications $T_J = 25^{\circ}C$, Unless Otherwise Specified (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	ТҮР	MAX	UNITS
Thermal Resistance Junction To Case	$R_{ extsf{ heta}JC}$	IGBT	-	-	0.27	°C/W
		Diode	-	-	0.65	°C/W

NOTES:

- 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 24.
- 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 Curves Unless Otherwise Specified





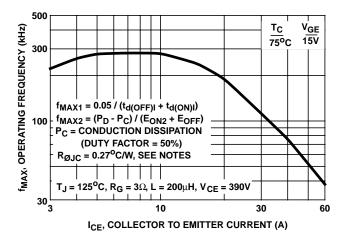


FIGURE 3. OPERATING FREQUENCY vs COLLECTOR TO EMITTER CURRENT

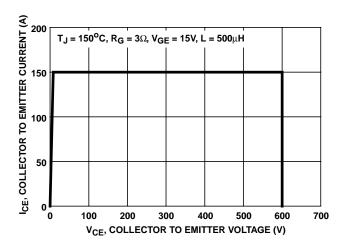


FIGURE 2. MINIMUM SWITCHING SAFE OPERATING AREA

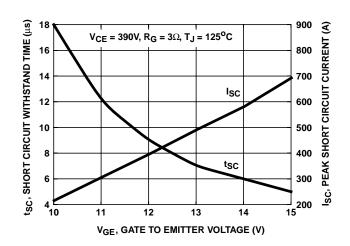


FIGURE 4. SHORT CIRCUIT WITHSTAND TIME

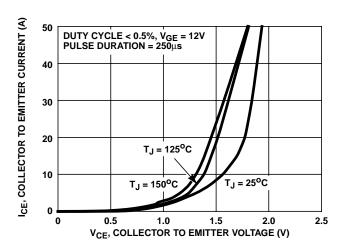


FIGURE 5. COLLECTOR TO EMITTER ON-STATE VOLTAGE

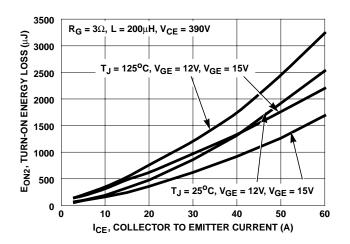


FIGURE 7. TURN-ON ENERGY LOSS vs COLLECTOR TO EMITTER CURRENT

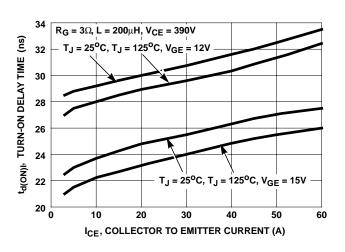


FIGURE 9. TURN-ON DELAY TIME vs COLLECTOR TO EMITTER CURRENT

4

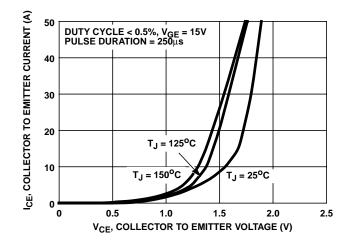


FIGURE 6. COLLECTOR TO EMITTER ON-STATE VOLTAGE

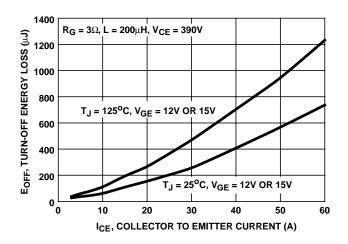
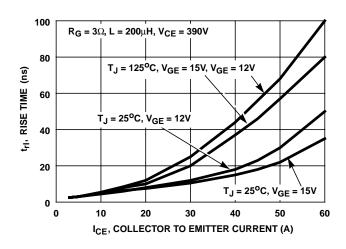
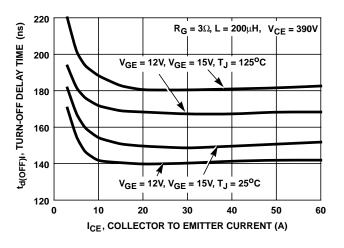


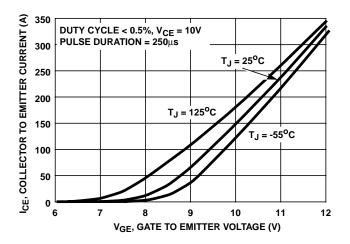
FIGURE 8. TURN-OFF ENERGY LOSS vs COLLECTOR TO EMITTER CURRENT



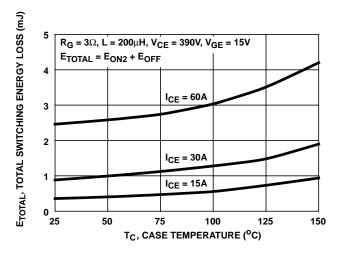




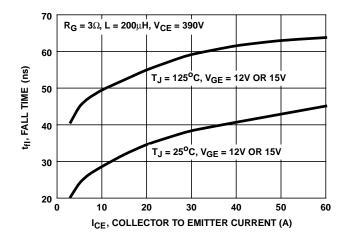


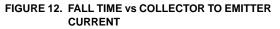


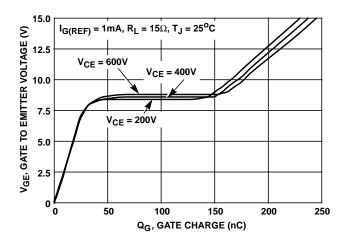




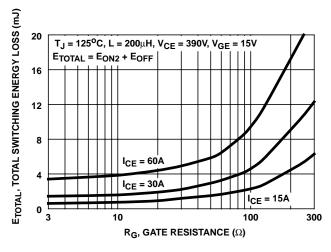




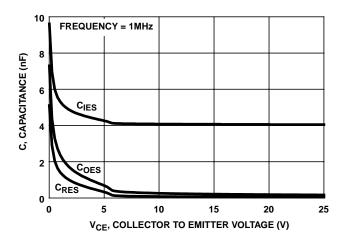


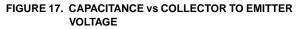












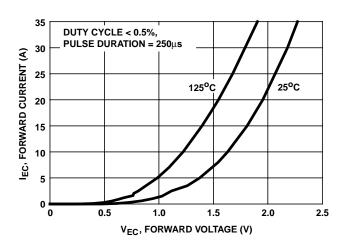


FIGURE 19. DIODE FORWARD CURRENT vs FORWARD VOLTAGE DROP

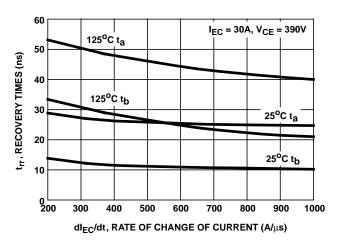


FIGURE 21. RECOVERY TIMES vs RATE OF CHANGE OF CURRENT

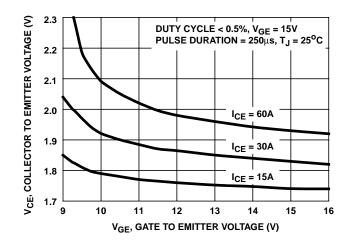


FIGURE 18. COLLECTOR TO EMITTER ON-STATE VOLTAGE vs GATE TO EMITTER VOLTAGE

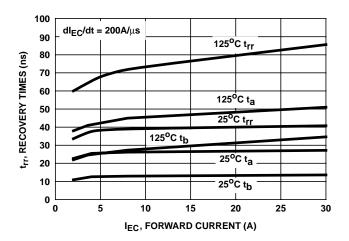
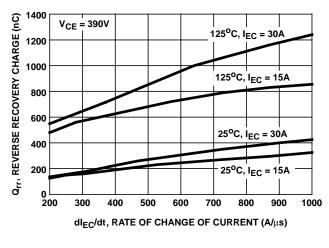


FIGURE 20. RECOVERY TIMES vs FORWARD CURRENT





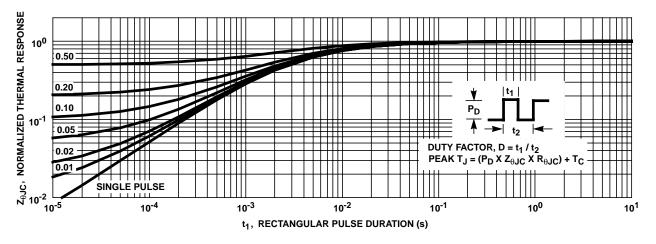


FIGURE 23. IGBT NORMALIZED TRANSIENT THERMAL RESPONSE, JUNCTION TO CASE

Test Circuit and Waveforms

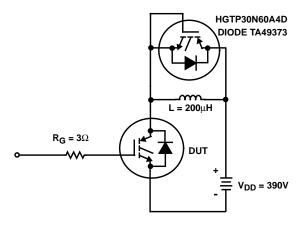


FIGURE 24. INDUCTIVE SWITCHING TEST CIRCUIT

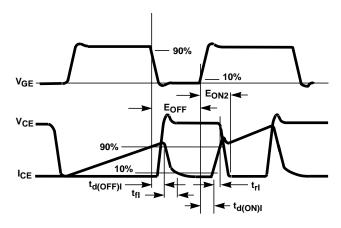


FIGURE 25. SWITCHING TEST WAVEFORMS

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.
- 3. Tips of soldering irons should be grounded.
- 4. 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 opencircuited 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.

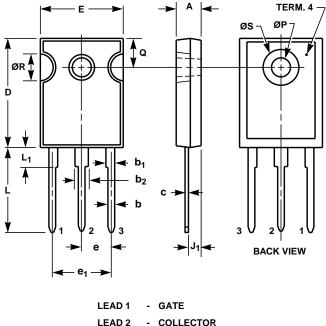
 f_{MAX1} is defined by $f_{MAX1} = 0.05/(t_{d(OFF)I} + t_{d(ON)I})$. Deadtime (the denominator) has been arbitrarily held to 10% of the on-state time for a 50% duty factor. Other definitions are possible. $t_{d(OFF)I}$ and $t_{d(ON)I}$ are defined in Figure 25. Device turn-off delay can establish an 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 25. 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 ($I_{CE} = 0$).

TO-247

3 LEAD JEDEC STYLE TO-247 PLASTIC PACKAGE



LEAD 2	-	COLLECTOR
LEAD 3	-	EMITTER
TERM. 4	-	COLLECTOR

	INCHES MILLIMETERS				
SYMBOL	MIN	MAX	MIN	MAX	NOTES
A	0.180	0.190	4.58	4.82	-
b	0.046	0.051	1.17	1.29	2, 3
b ₁	0.060	0.070	1.53	1.77	1, 2
b ₂	0.095	0.105	2.42	2.66	1, 2
С	0.020	0.026	0.51	0.66	1, 2, 3
D	0.800	0.820	20.32	20.82	-
E	0.605	0.625	15.37	15.87	-
е	0.219 TYP		5.56 TYP		4
e ₁	0.438 BSC		11.12 BSC		4
J ₁	0.090	0.105	2.29	2.66	5
L	0.620	0.640	15.75	16.25	-
L ₁	0.145	0.155	3.69	3.93	1
ØP	0.138	0.144	3.51	3.65	-
Q	0.210	0.220	5.34	5.58	-
ØR	0.195	0.205	4.96	5.20	-
ØS	0.260	0.270	6.61	6.85	-
NOTES:			1	1	

1. Lead dimension and finish uncontrolled in L1.

2. Lead dimension (without solder).

3. Add typically 0.002 inches (0.05mm) for solder coating.

4. Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.

5. Position of lead to be measured 0.100 inches (2.54mm) from bottom of dimension D.

6. Controlling dimension: Inch.

7. Revision 1 dated 1-93.

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Sales Office Headquarters

NORTH AMERICA Intersil Corporation P. O. Box 883, Mail Stop 53-204 Melbourne, FL 32902 TEL: (321) 724-7000 FAX: (321) 724-7240

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9