

April 1995

### Features

- 10A and 12A, 400V and 500V
- $V_{CE(ON)}$ : 2.5V Max.
- $T_{FI}$ : 1 $\mu$ s, 0.5 $\mu$ s
- Low On-State Voltage
- Fast Switching Speeds
- High Input Impedance
- No Anti-Parallel Diode

### Applications

- Power Supplies
- Motor Drives
- Protection Circuits

### Description

The HGTH12N40C1, HGTH12N40E1, HGTH12N50C1, HGTH12N50E1, HGTP10N40C1, HGTP10N40E1, HGTP10N50C1 and HGTP10N50E1 are n-channel enhancement-mode insulated gate bipolar transistors (IGBTs) designed for high-voltage, low on-dissipation applications such as switching regulators and motor drivers. These types can be operated directly from low-power integrated circuits.

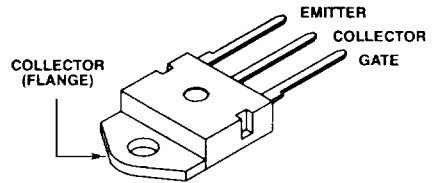
#### PACKAGING AVAILABILITY

PART NUMBER	PACKAGE	BRAND
HGTH12N40C1	TO-218AC	G12N40C1
HGTH12N40E1	TO-218AC	G12N40E1
HGTH12N50C1	TO-218AC	G12N50C1
HGTH12N50E1	TO-218AC	G12N50E1
HGTP10N40C1	TO-220AB	G10N40C1
HGTP10N40E1	TO-220AB	G10N40E1
HGTP10N50C1	TO-220AB	G10N50C1
HGTP10N50E1	TO-220AB	G10N50E1

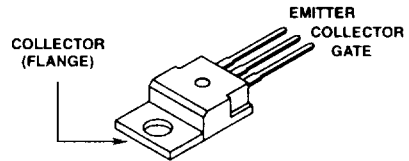
NOTE: When ordering, use the entire part number.

### Packages

HGTH-TYPES JEDEC TO-218AC

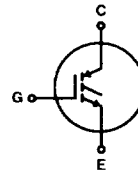


HGTP-TYPES JEDEC TO-220AB



### Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



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

	HGTH12N40C1 HGTH12N40E1	HGTH12N50C1 HGTH12N50E1	HGTP10N40C1 HGTP10N40E1	HGTP10N50C1 HGTP10N50E1	UNITS
Collector-Emitter Voltage	400	500	400	500	V
Collector-Gate Voltage $R_{GE} = 1\text{M}\Omega$	400	500	400	500	V
Reverse Collector-Emitter Voltage	15	15	-5	-5	V
Gate-Emitter Voltage	$\pm 20$	$\pm 20$	$\pm 20$	$\pm 20$	V
Collector Current Continuous	12	12	10	10	A
Collector Current Pulsed	17.5	17.5	17.5	17.5	A
Power Dissipation at $T_C = +25^\circ\text{C}$	75	75	60	60	W
Power Dissipation Derating Above $T_C > +25^\circ\text{C}$	0.6	0.6	0.48	0.48	W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$-55$ to $+150$	$-55$ to $+150$	$-55$ to $+150$	$-55$ to $+150$	$^\circ\text{C}$

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper ESD Handling Procedures  
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**Specifications HGTP10N40C1, 40E1, 50C1, 50E1, HGTH12N40C1, 40E1, 50C1, 50E1**

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

PARAMETERS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS	
			HGTH12N40C1, E1, HGTP10N40C1, E1		HGTH12N50C1, E1, HGTP10N50C1, E1			
			MIN	MAX	MIN	MAX		
Collector-Emitter Breakdown Voltage	$BV_{CES}$	$I_C = 1\text{mA}, V_{GE} = 0$	400	-	500	-	V	
Gate Threshold Voltage	$V_{GE(TH)}$	$V_{GE} = V_{CE}, I_C = 1\text{mA}$	2.0	4.5 3 (Typ)	2.0	4.5 3 (Typ)	V	
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 400\text{V}, T_C = +25^\circ\text{C}$	-	250	-	-	$\mu\text{A}$	
		$V_{CE} = 500\text{V}, T_C = +25^\circ\text{C}$	-	-	-	250	$\mu\text{A}$	
		$V_{CE} = 400\text{V}, T_C = +125^\circ\text{C}$	-	1000	-	-	$\mu\text{A}$	
		$V_{CE} = 500\text{V}, T_C = +125^\circ\text{C}$	-	-	-	1000	$\mu\text{A}$	
Gate-Emitter Leakage Current	$I_{GES}$	$V_{GE} = \pm 20\text{V}, V_{CE} = 0$	-	100	-	100	nA	
Collector-Emitter on Voltage	$V_{CE(ON)}$	$I_C = 10\text{A}, V_{GE} = 10\text{V}$	-	2.5	-	2.5	V	
		$I_C = 17.5\text{A}, V_{GE} = 20\text{V}$	-	3.2	-	3.2	V	
Gate-Emitter Plateau Voltage	$V_{GEP}$	$I_C = 5\text{A}, V_{CE} = 10\text{V}$	-	6 (Typ)	-	6 (Typ)	V	
On-State Gate Charge	$Q_{G(ON)}$	$I_C = 5\text{A}, V_{CE} = 10\text{V}$	-	19 (Typ)	-	19 (Typ)	nC	
Turn-On Delay Time	$t_{D(ON)}$	$I_C = 10\text{A}, V_{CE(CL P)} = 300\text{V},$ $L = 50\mu\text{H}, T_J = +100^\circ\text{C},$ $V_{GE} = 10\text{V}, R_G = 50\Omega$	-	50	-	50	ns	
Rise Time	$t_{RI}$		-	50	-	50	ns	
Turn-Off Delay Time	$t_{D(OFF)}$		-	400	-	400	ns	
Fall Time	$t_{FI}$		40E1, 50E1	680 (Typ)	1000	680 (Typ)	1000	ns
			40C1, 50C1	400	500	400	500	ns
Turn-Off Energy Loss per Cycle (Off Switching Dissipation = $W_{OFF} \times \text{Frequency}$ )	$W_{OFF}$	$I_C = 10\text{A}, V_{CE(CL P)} = 300\text{V},$ $L = 50\mu\text{H}, T_J = +100^\circ\text{C},$ $V_{GE} = 10\text{V}, R_G = 50\Omega$	680 (Typ)				$\mu\text{J}$	
			400 (Typ)				$\mu\text{J}$	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	HGTH, HGTM	-	1.67	-	1.67	$^\circ\text{C/W}$	
		HGTP	-	2.083	-	2.083	$^\circ\text{C/W}$	

**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
4,969,027							

Typical Performance Curves

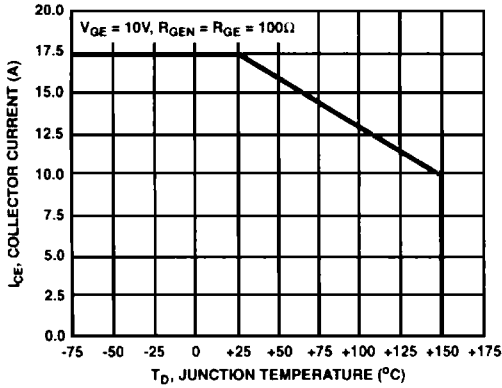


FIGURE 1. MAX. SWITCHING CURRENT LEVEL.  $R_G = 50\Omega$ ,  $V_{GE} = 0V$  ARE THE MIN. ALLOWABLE VALUES

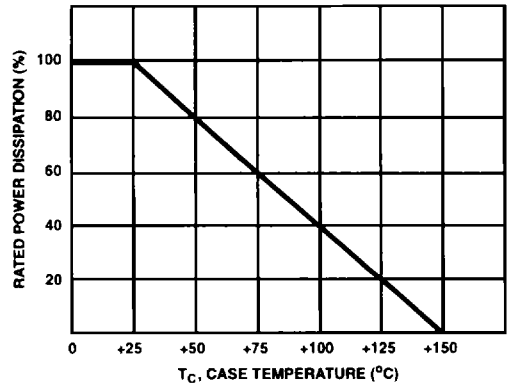


FIGURE 2. POWER DISSIPATION vs TEMPERATURE DERATING CURVE

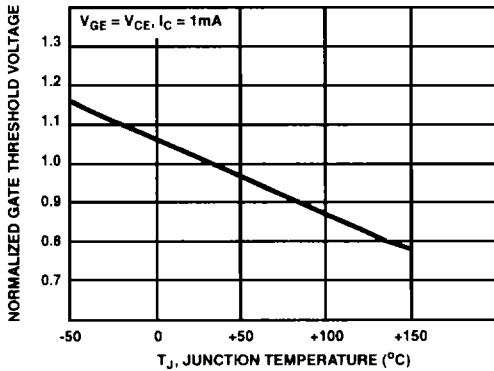


FIGURE 3. TYPICAL NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

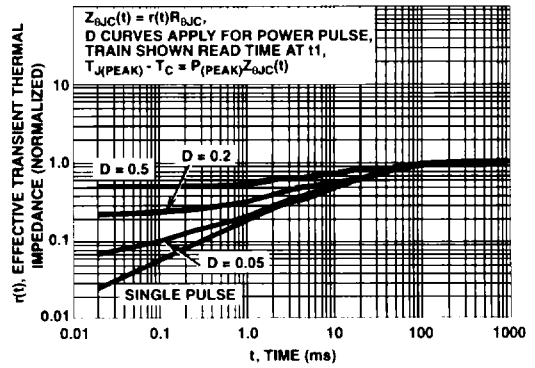


FIGURE 4. NORMALIZED THERMAL RESPONSE CHARACTERISTICS

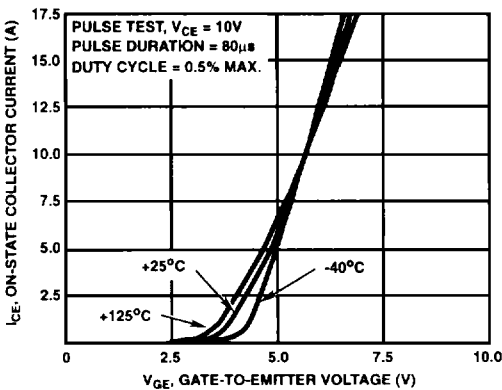


FIGURE 5. TYPICAL TRANSFER CHARACTERISTICS

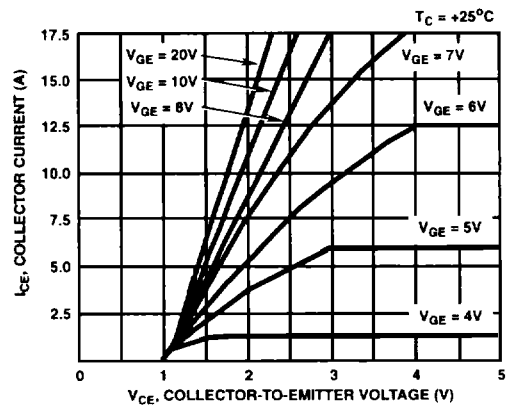


FIGURE 6. TYPICAL SATURATION CHARACTERISTICS

Typical Performance Curves (Continued)

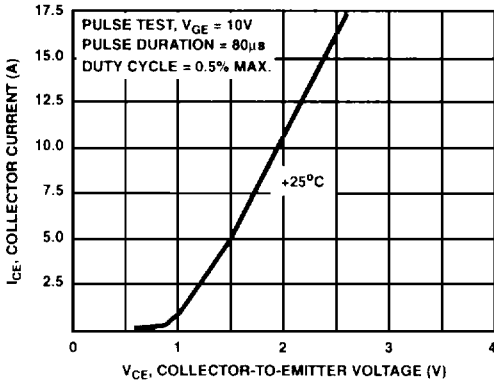


FIGURE 7. TYPICAL COLLECTOR-TO-EMITTER VOLTAGE vs COLLECTOR CURRENT

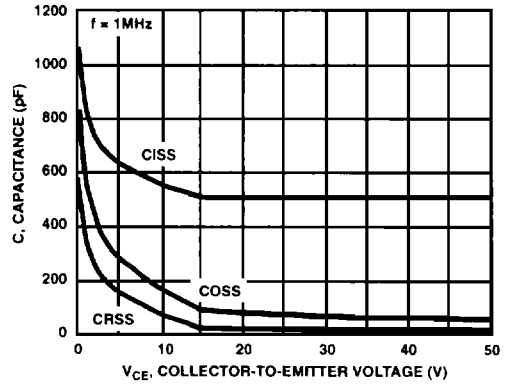


FIGURE 8. CAPACITANCE vs COLLECTOR-TO-EMITTER VOLTAGE

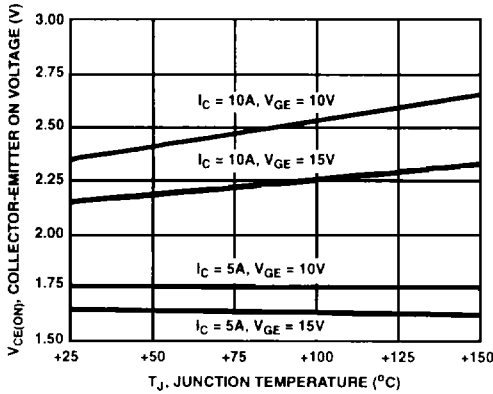


FIGURE 9. TYPICAL  $V_{CE(ON)}$  vs TEMPERATURE

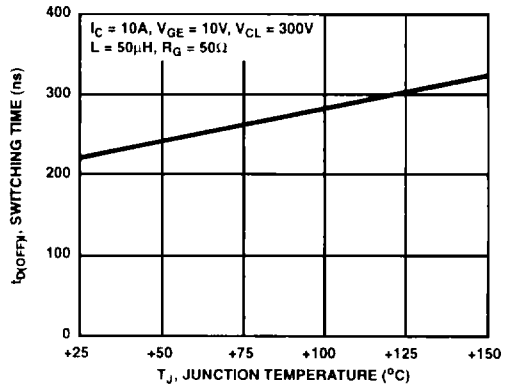


FIGURE 10. TYPICAL TURN-OFF DELAY TIME

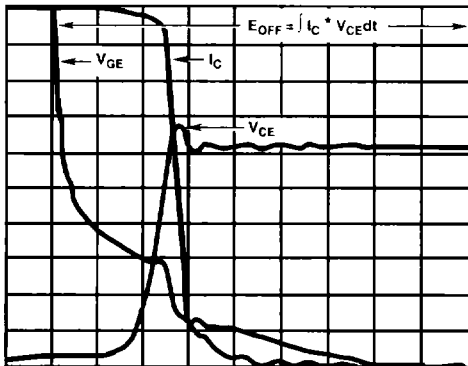


FIGURE 11. TYPICAL INDUCTIVE SWITCHING WAVEFORMS

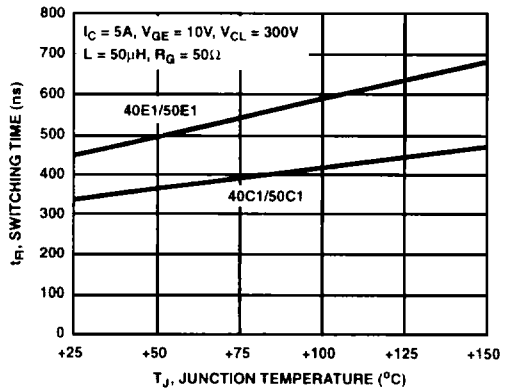


FIGURE 12. TYPICAL FALL TIME ( $I_C = 5A$ )

Typical Performance Curves (Continued)

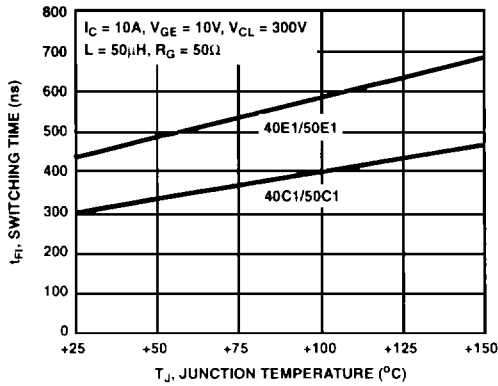


FIGURE 13. TYPICAL FALL TIME ( $I_C = 10A$ )

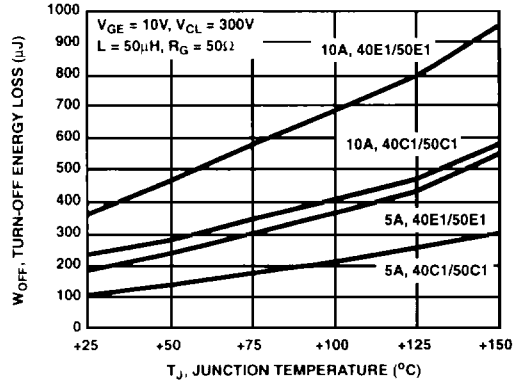


FIGURE 14. TYPICAL CLAMPED INDUCTIVE TURN-OFF SWITCHING LOSS/CYCLE

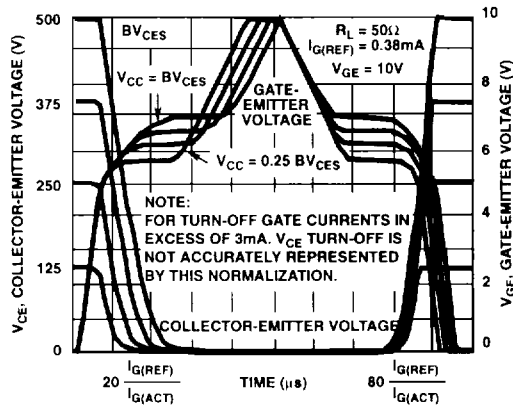


FIGURE 15. NORMALIZED SWITCHING WAVEFORMS AT CONSTANT GATE CURRENT

Test Circuit

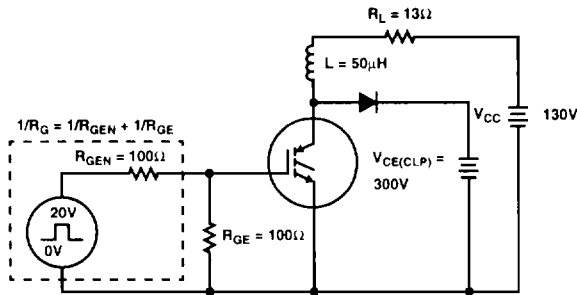


FIGURE 16. INDUCTIVE SWITCHING TEST CIRCUIT