

April 1995

### Features

- 15A and 20A, 400V and 500V
- $V_{CE(ON)}$  2.5V
- $T_{FI}$  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 HGTH20N40C1, HGTH20N40E1, HGTH20N50C1, HGTH20N50E1, HGTP15N40C1, HGTP15N40E1, HGTP15N50C1 and HGTP15N50E1 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.

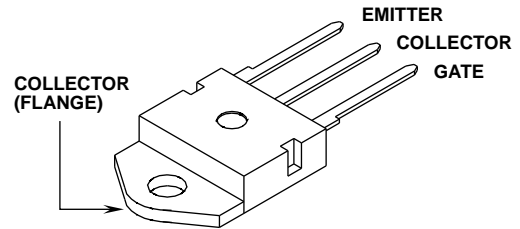
#### PACKAGING AVAILABILITY

PART NUMBER	PACKAGE	BRAND
HGTH20N40C1	TO-218AC	G20N40C1
HGTH20N40E1	TO-218AC	G20N40E1
HGTH20N50C1	TO-218AC	G20N50C1
HGTH20N50E1	TO-218AC	G20N50E1
HGTP15N40C1	TO-220AB	G15N40C1
HGTP15N40E1	TO-220AB	G15N40E1
HGTP15N50C1	TO-220AB	G15N50C1
HGTP15N50E1	TO-220AB	G15N50E1

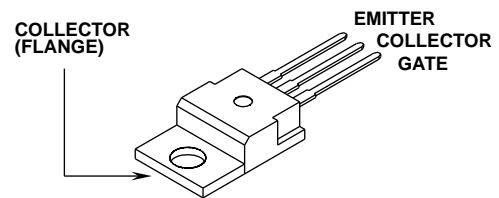
NOTE: When ordering, use the entire part number.

### Packages

#### HGTH-TYPES JEDEC TO-218AC

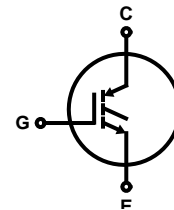


#### HGTP-TYPES JEDEC TO-220AB



### Terminal Diagram

#### N-CHANNEL ENHANCEMENT MODE



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

	HGTH20N40C1 HGTH20N40E1	HGTH20N50C1 HGTH20N50E1	HGTP15N40C1 HGTP15N40E1	HGTP15N50C1 HGTP15N50E1	UNITS
Collector-Emitter Voltage..... $V_{CES}$	400	500	400	500	V
Collector-Gate Voltage $R_{GE} = 1M\Omega$ ..... $V_{CGR}$	400	500	400	500	V
Reverse Collector-Emitter Voltage..... $V_{CES}(rev.)$	-5	-5	-5	-5	V
Gate-Emitter Voltage..... $V_{GE}$	$\pm 20$	$\pm 20$	$\pm 20$	$\pm 20$	V
Collector Current Continuous..... $I_C$	20	20	15	15	A
Collector Current Pulsed..... $I_{CM}$	35	35	35	35	A
Power Dissipation at $T_C = +25^\circ\text{C}$ ..... $P_D$	100	100	75	75	W
Power Dissipation Derating $T_C > +25^\circ\text{C}$ .....	0.8	0.8	0.6	0.6	W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range... $T_J, T_{STG}$	-55 to +150	-55 to +150	-55 to +150	-55 to +150	$^\circ\text{C}$

# Specifications HGTP15N40C1, 40E1, 50C1, 50E1, HGTH20N40C1, 40E1, 50C1, 50E1

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

PARAMETERS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS	
			HGTH20N40C1, E1, HGTP15N40C1, E1		HGTH20N50C1, E1, HGTP15N50C1, 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	2.0	4.5	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	
Reverse Collector-Emitter Leakage Current	$I_{CE}$	$R_{GE} = 0\Omega, V_{EC} = 5\text{V}$	-	-5	-	-5	mA	
Collector-Emitter on Voltage	$V_{CE(ON)}$	$I_C = 20\text{A}, V_{GE} = 10\text{V}$	-	2.5	-	2.5	V	
		$I_C = 35\text{A}, V_{GE} = 20\text{V}$	-	3.2	-	3.2	V	
Gate-Emitter Plateau Voltage	$V_{GEP}$	$I_C = 10\text{A}, V_{CE} = 10\text{V}$	-	6 (Typ)	-	6 (Typ)	V	
On-State Gate Charge	$Q_{G(ON)}$	$I_C = 10\text{A}, V_{CE} = 10\text{V}$	-	33 (Typ)	-	33 (Typ)	nC	
Turn-On Delay Time	$t_{D(ON)I}$	$I_C = 20\text{A}, V_{CE(CLIP)} = 300\text{V},$ $L = 25\mu\text{H}, T_J = +100^\circ\text{C},$ $V_{GE} = 10\text{V}, R_G = 25\Omega$	-	50	-	50	ns	
Rise Time	$t_{RI}$		-	50	-	50	ns	
Turn-Off Delay Time	$t_{D(OFF)I}$		-	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 = $W_{OFF} \times \text{Frequency}$ )	$W_{OFF}$	$I_C = 10\text{A}, V_{CE(CLIP)} = 300\text{V},$ $L = 25\mu\text{H}, T_J = +100^\circ\text{C},$ $V_{GE} = 10\text{V}, R_G = 25\Omega$	1810 (Typ)				$\mu\text{J}$	
			1070 (Typ)				$\mu\text{J}$	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	HGTH, HGTM	-	1.25	-	1.25	$^\circ\text{C/W}$	
		HGTP	-	1.67	-	1.67	$^\circ\text{C/W}$	

**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

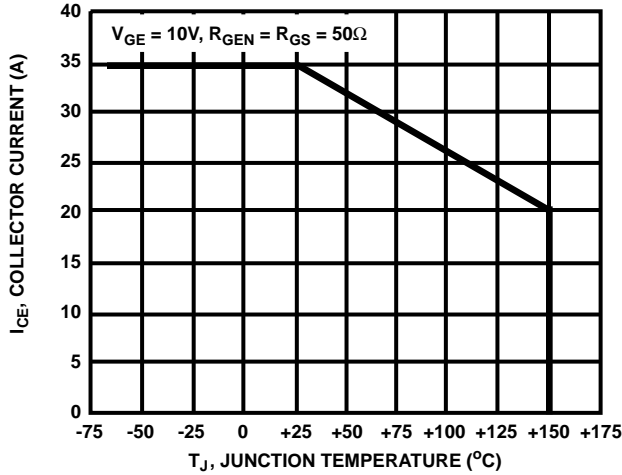


FIGURE 1. MAX. SWITCHING CURRENT LEVEL.  $R_G = 25\Omega$ ,  $V_{GE} = 0V$  ARE THE MIN. ALLOWABLE VALUES

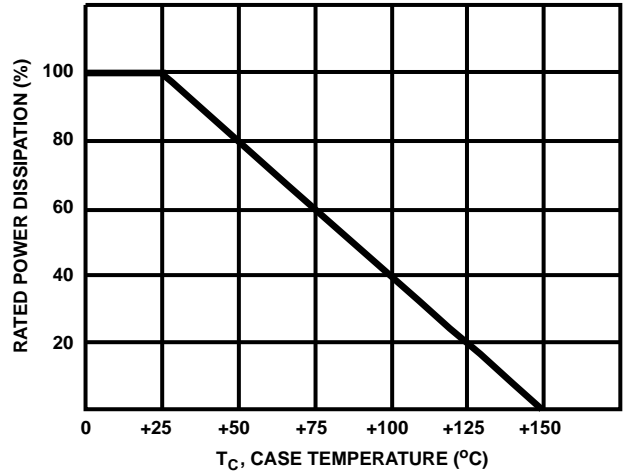


FIGURE 2. POWER DISSIPATION vs TEMPERATURE DERATING CURVE

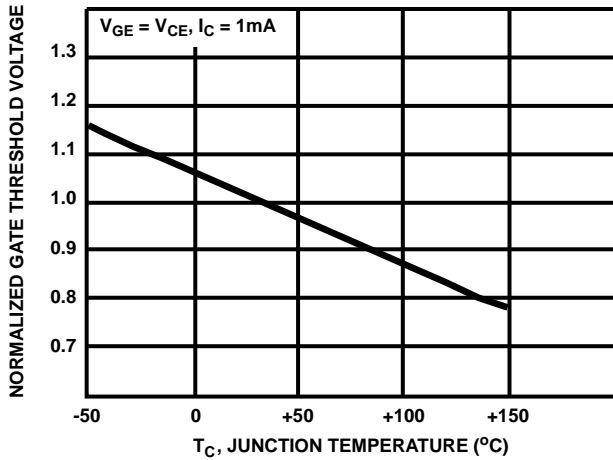


FIGURE 3. TYPICAL NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

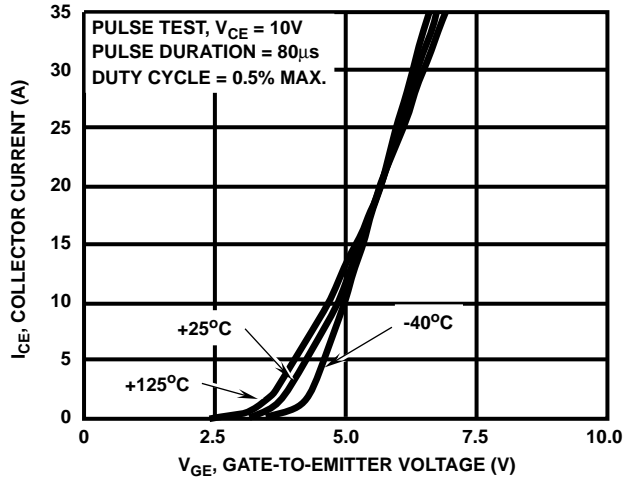


FIGURE 4. TYPICAL TRANSFER CHARACTERISTICS

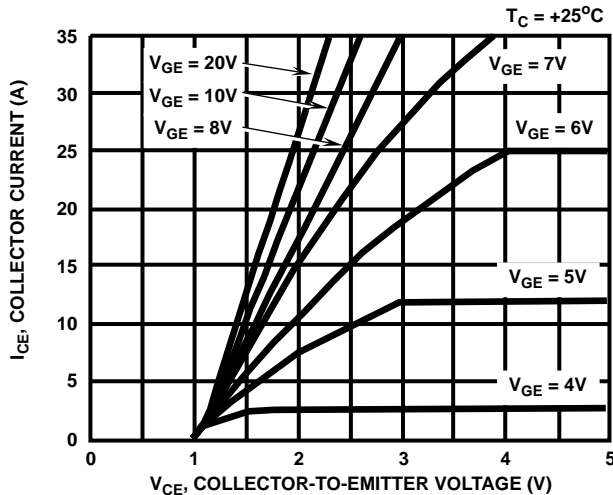


FIGURE 5. TYPICAL SATURATION CHARACTERISTICS

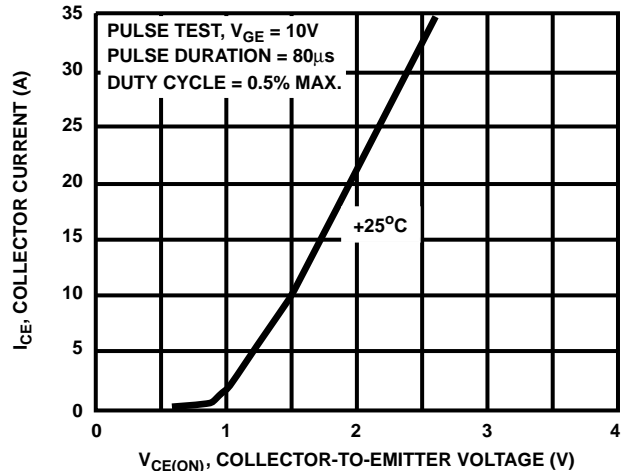


FIGURE 6. TYPICAL COLLECTOR-TO-EMITTER ON-VOLTAGE vs COLLECTOR CURRENT

Typical Performance Curves (Continued)

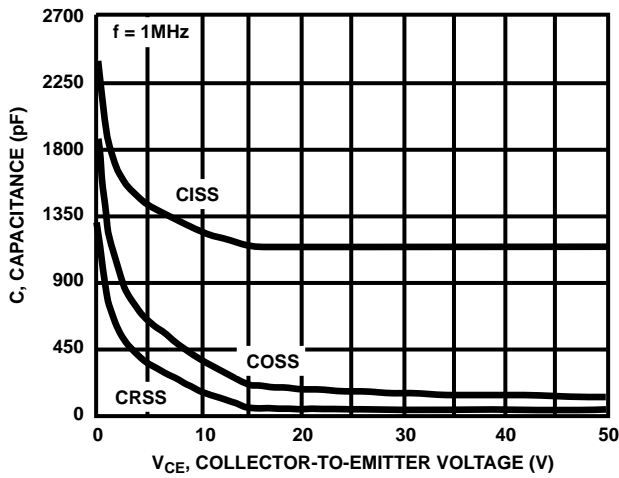


FIGURE 7. CAPACITANCE vs COLLECTOR-TO-EMITTER VOLTAGE

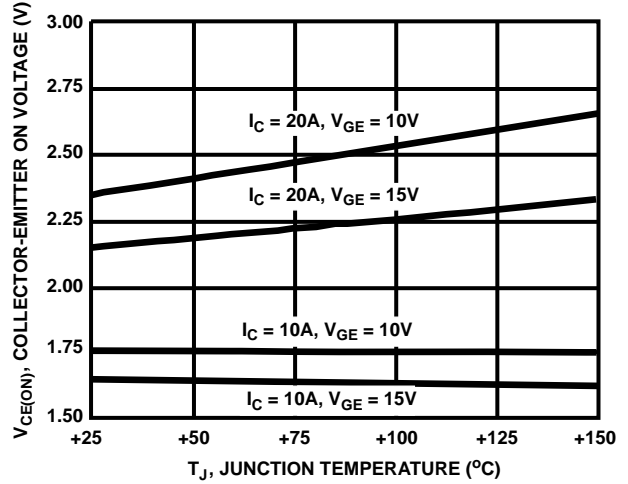


FIGURE 8. TYPICAL  $V_{CE(ON)}$  vs TEMPERATURE

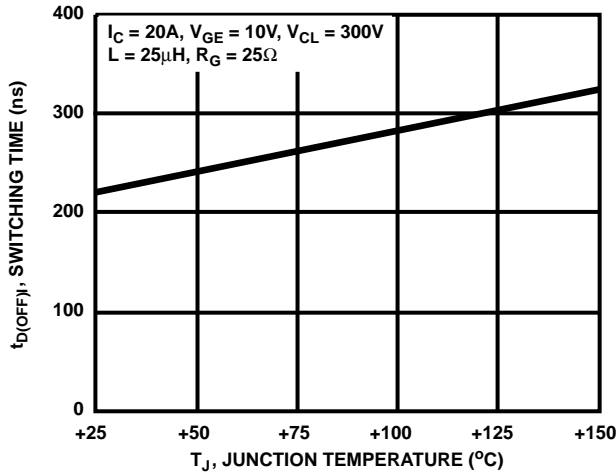


FIGURE 9. TYPICAL TURN-OFF DELAY TIME

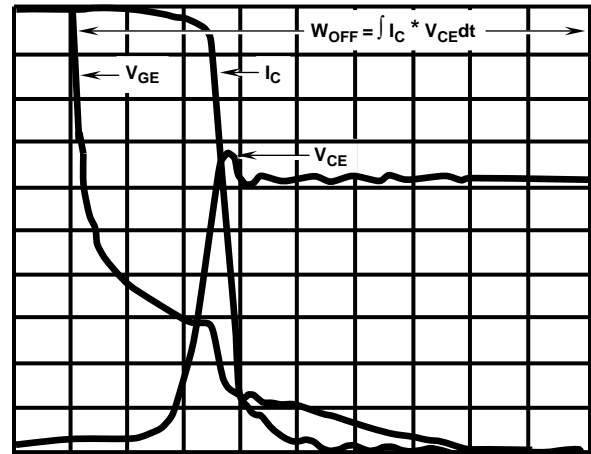


FIGURE 10. TYPICAL INDUCTIVE SWITCHING WAVEFORMS

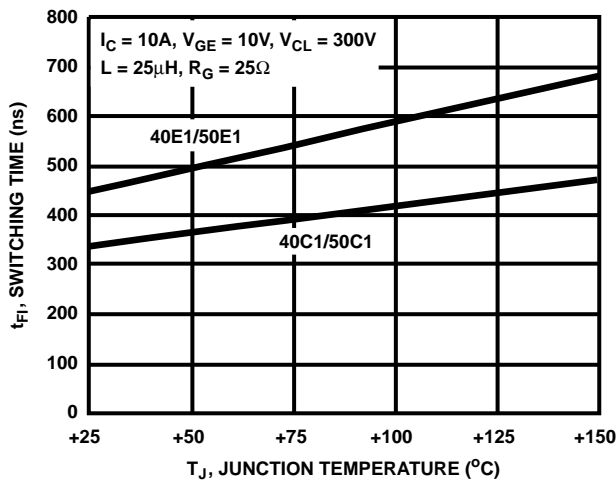


FIGURE 11. TYPICAL FALL TIME ( $I_C = 10A$ )

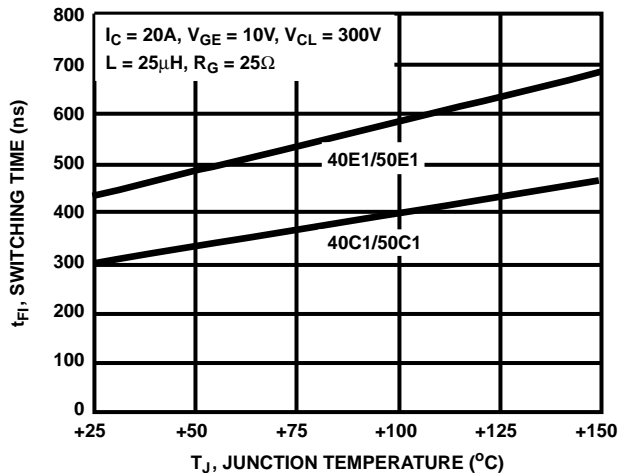


FIGURE 12. TYPICAL FALL TIME ( $I_C = 20A$ )

Typical Performance Curves (Continued)

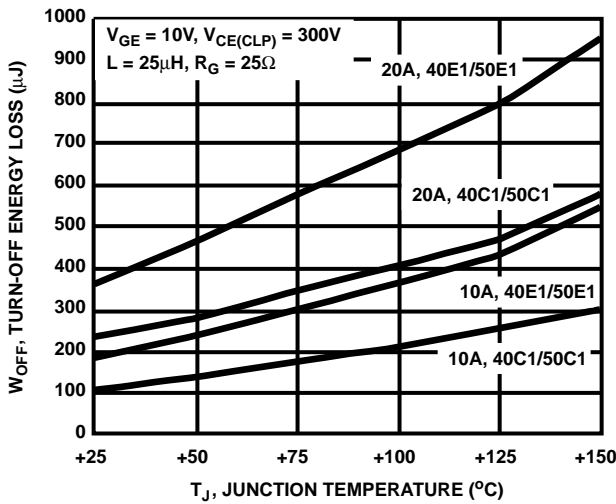


FIGURE 13. TYPICAL CLAMPED INDUCTIVE TURN-OFF SWITCHING LOSS/CYCLE

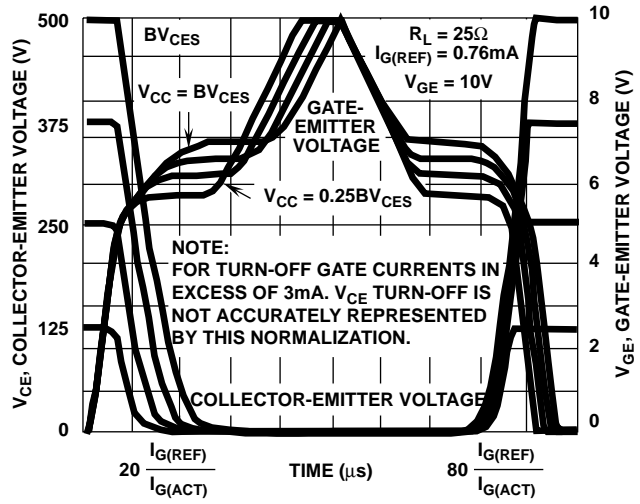


FIGURE 14. NORMALIZED SWITCHING WAVEFORMS AT CONSTANT GATE CURRENT. (REFER TO APPLICATION NOTES AN7254 AND AN7260 ON THE USE OF NORMALIZED SWITCHING WAVEFORMS)

Test Circuit

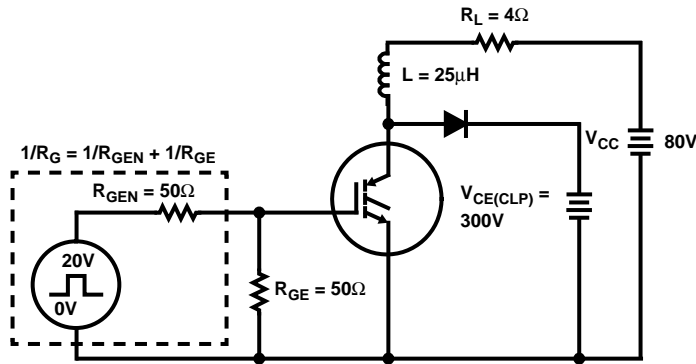


FIGURE 15. INDUCTIVE SWITCHING TEST CIRCUIT