HGTP10N40C1D, HGTP10N40E1D, HGTP10N50C1D, HGTP10N50E1D

HARRIS SEMICONDUCTOR

10A, 400V and 500V N-Channel IGBTs with Anti-Parallel Ultrafast Diodes

April 1995

Features

- 10A, 400V and 500V
- $V_{CE(ON)}$: 2.5V Max.
- T_{FALL}: 1μs, 0.5μs
- Low On-State Voltage
- Fast Switching Speeds
- High Input Impedance
- Anti-Parallel Diode

Applications

- Power Supplies
- Motor Drives
- Protective Circuits

Description

The HGTP10N40C1D, HGTP10N40E1D, HGTP10N50C1D, and HGTP10N50E1D 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. They feature a discrete anti-parallel diode that shunts current around the IGBT in the reverse direction without introducing carriers into the depletion region. These types can be operated directly from low power integrated circuits.

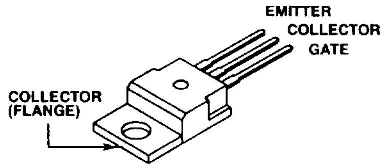
PACKAGING AVAILABILITY

PART NUMBER	PACKAGE	BRAND
HGTP10N40C1D	TO-220AB	10N40C1D
HGTP10N40E1D	TO-220AB	10N40E1D
HGTP10N50C1D	TO-220AB	10N50C1D
HGTP10N50E1D	TO-220AB	10N50E1D

NOTE: When ordering, use the entire part number.

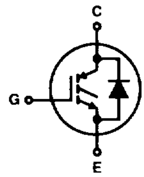
Package

JEDEC TO-220AB



Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



Absolute Maximum Ratings $T_C = +25^oC$, Unless Otherwise Specified

		HGTP10N40C1D HGTP10N40E1D	HGTP10N50C1D HGTP10N50E1D	UNITS
Collector-Emitter Voltage	V_{CES}	400	500	V
Collector-Gate Voltage $R_{GE} = 1M\Omega$	V_{CGR}	400	500	V
Gate-Emitter Voltage	V_{GE}	±20	±20	V
Collector Current Continuous at $T_C = +25^oC$	I_{C25}	17.5	17.5	A
at $T_C = +90^oC$	I_{C90}	10	10	
Power Dissipation Total at $T_C = +25^oC$	P_D	75	75	W
Power Dissipation Derating $T_C > +25^oC$		0.6	0.6	W/°C
Operating and Storage Junction Temperature Range	T_J, T_{STG}	-55 to +150	-55 to +150	°C

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper ESD Handling Procedures.

File Number 2405.5

Electrical Specifications T_C = +25°C, Unless Otherwise Specified

PARAMETERS	SYMBOL	TEST CONDITIONS	LIMITS HGTP10N40C1D, HGTP10N40E1D MIN	MAX	HGTP10N50C1D, HGTP10N50E1D MIN	MAX	UNITS
Collector-Emitter Breakdown Voltage	BV_{CES}	I_C = 1mA, V_{GE} = 0	400	-	500	-	V
Gate Threshold Voltage	$V_{GE(TH)}$	$V_{GE} = V_{CE}$, I_C = 1mA	2.0	4.5	2.0	4.5	V
Zero Gate Voltage Collector Current	I_{CES}	V_{CE} = 400V, T_C = +25°C	-	250	-	-	μA
		V_{CE} = 500V, T_C = +25°C	-	-	-	250	μA
		V_{CE} = 400V, T_C = +125°C	-	1000	-	-	μA
		V_{CE} = 500V, T_C = +125°C	-	-	-	1000	μA
Gate-Emitter Leakage Current	I_{GES}	V_{GE} = ±20V, V_{CE} = 0	-	100	-	100	nA
Collector-Emitter On Voltage	$V_{CE(ON)}$	I_C = 10A, V_{GE} = 10V	-	2.5	-	2.5	V
		I_C = 17.5A, V_{GE} = 20V	-	3.2	-	3.2	V
Gate-Emitter Plateau Voltage	V_{GEP}	I_C = 5A, V_{CE} = 10V	-	6 (Typ)	-	6 (Typ)	V
On-State Gate Charge	$Q_{G(ON)}$	I_C = 5A, V_{CE} = 10V	-	19 (Typ)	-	19 (Typ)	nC
Turn-On Delay Time	$t_{D(ON)I}$	I_C = 10A, $V_{CE(CLP)}$ = 300V, L = 50μH, T_J = +100°C, V_{GE} = 10V, R_G = 50Ω	-	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}						
40E1D, 50E1D			680 (Typ)	1000	680 (Typ)	1000	ns
40C1D, 50C1D			400 (Typ)	500	400 (Typ)	500	ns
Turn-Off Energy Loss per Cycle (Off Switching Dissipation = W_{OFF} x Frequency)	W_{OFF}	I_C = 10A, $V_{CE(CLP)}$ = 300V, L = 50μH, T_J = +100°C, V_{GE} = 10V, R_G = 50Ω					
40E1D, 50E1D			1810 (Typ)				μJ
40C1D, 50C1D			1070 (Typ)				μJ
Thermal Resistance Junction-to-Case	$R_{\theta JC}$		-	1.67	-	1.67	°C/W
Diode Forward Voltage	V_{EC}	I_{EC} = 10A	-	2	-	2	V
Diode Reverse Recovery Time	t_{RR}	I_{EC} = 10A, di/dt = 100A/μs	-	100	-	100	ns

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

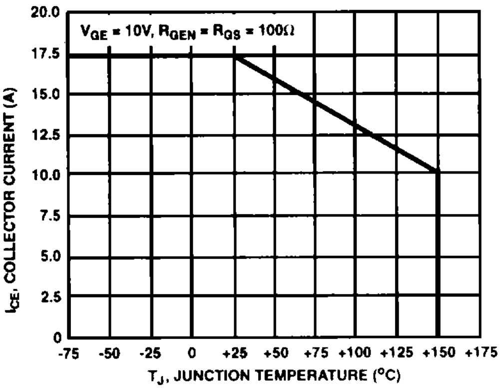


FIGURE 1. MAX. SWITCHING CURRENT LEVEL. R_G = 50Ω, V_{GE} = 0V ARE THE MIN. ALLOWABLE VALUES

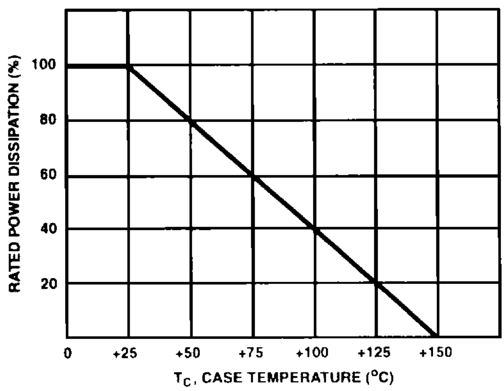


FIGURE 2. POWER DISSIPATION vs TEMPERATURE DERATING CURVE

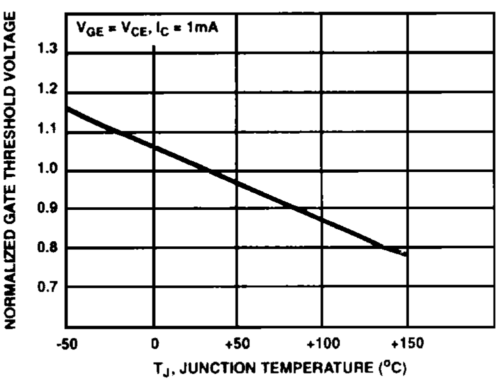


FIGURE 3. TYPICAL NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

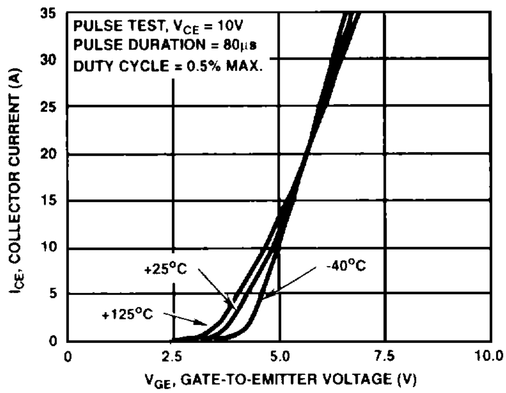


FIGURE 4. TYPICAL TRANSFER CHARACTERISTICS

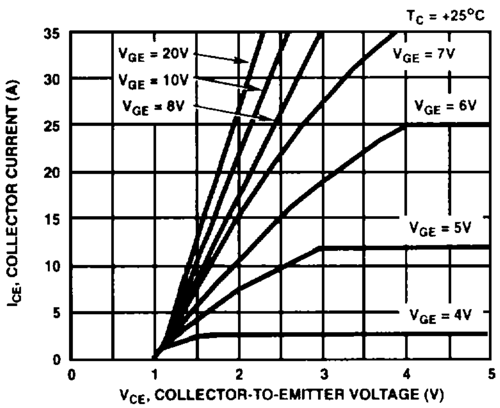


FIGURE 5. TYPICAL SATURATION CHARACTERISTICS

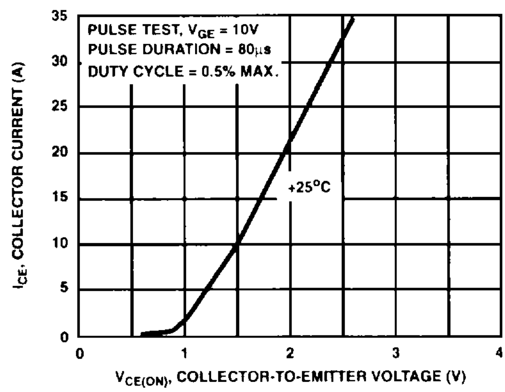


FIGURE 6. TYPICAL COLLECTOR-TO-EMITTER ON-VOLTAGE vs COLLECTOR CURRENT

Typical Performance Curves (Continued)

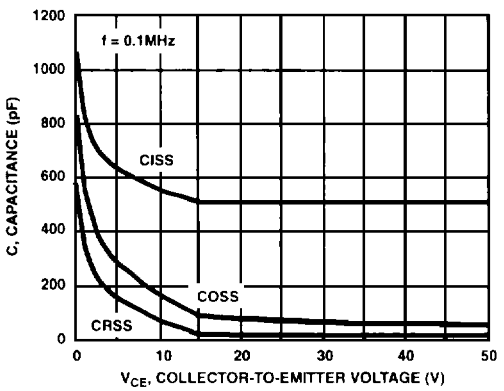


FIGURE 7. CAPACITANCE vs COLLECTOR-TO-EMITTER VOLTAGE

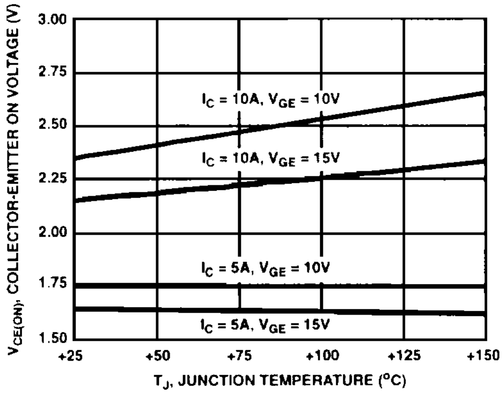


FIGURE 8. TYPICAL $V_{CE(ON)}$ vs TEMPERATURE

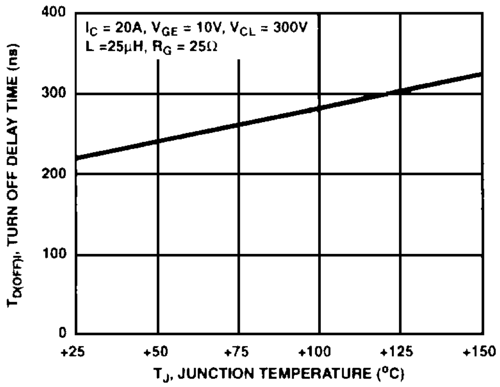


FIGURE 9. TYPICAL TURN-OFF DELAY TIME

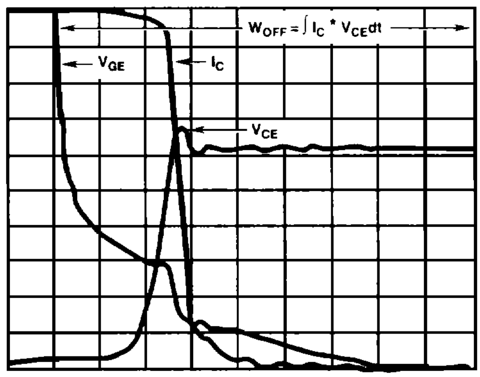


FIGURE 10. TYPICAL INDUCTIVE SWITCHING WAVEFORMS

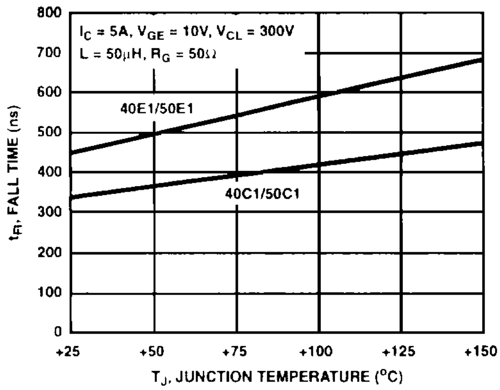


FIGURE 11. TYPICAL FALL TIME (I_C = 5A)

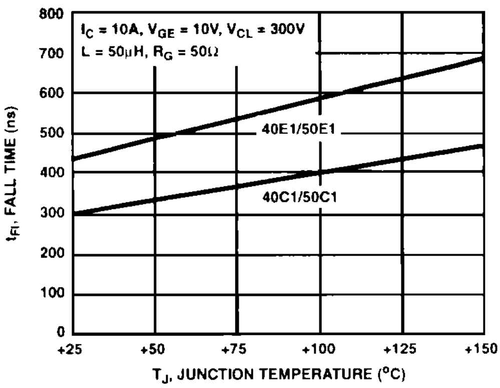


FIGURE 12. TYPICAL FALL TIME (I_C = 10A)

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IGBTs

Typical Performance Curves (Continued)

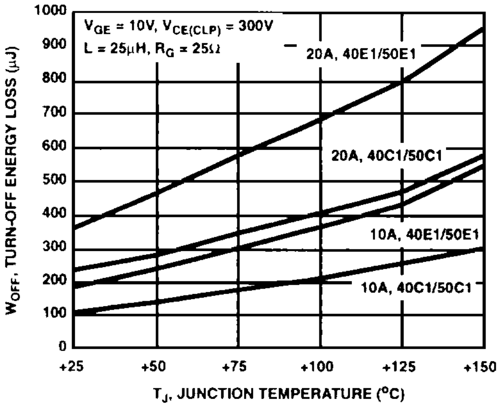

FIGURE 13. TYPICAL CLAMPED INDUCTIVE TURN-OFF SWITCHING LOSS/CYCLE

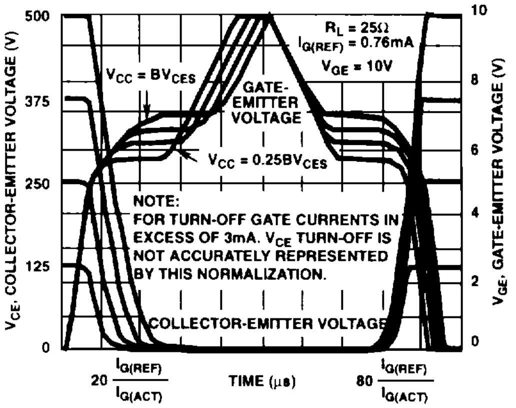

FIGURE 14. NORMALIZED SWITCHING WAVEFORMS AT CONSTANT GATE CURRENT. (REFER TO APPLICATION NOTES AN7254 AND AN7260)

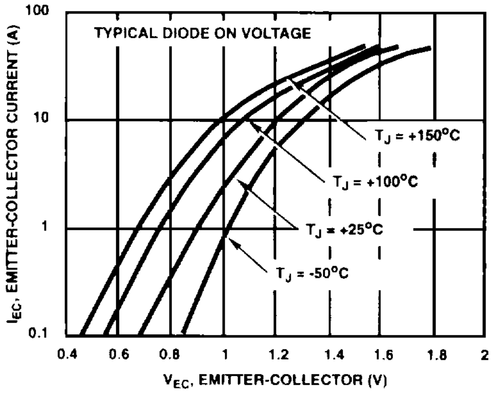

FIGURE 15. TYPICAL DIODE EMITTER-TO-COLLECTOR VOLTAGE vs CURRENT FOR ALL TYPES

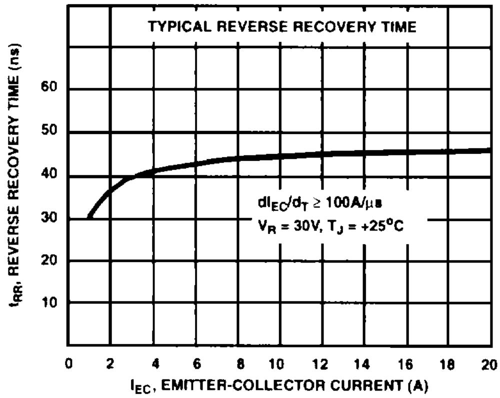

FIGURE 16. TYPICAL DIODE REVERSE-RECOVERY TIME FOR ALL TYPES

Test Circuit

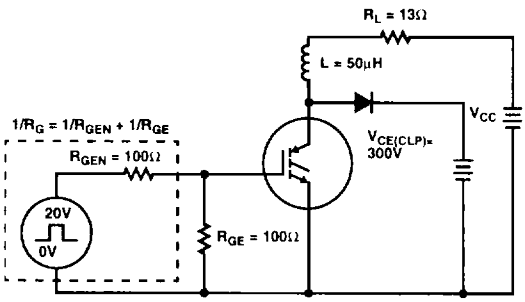

FIGURE 17. INDUCTIVE SWITCHING TEST CIRCUIT