HGTH12N40C1D, HGTH12N40E1D, HGTH12N50C1D, HGTH12N50E1D

12A, 400V and 500V N-Channel IGBTs with Anti-Parallel Ultrafast Diodes

April 1995

Features

- **12A, 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 HGTH12N40C1D, HGTH12N40E1D, HGTH12N50C1D, and HGTH12N50E1D 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.

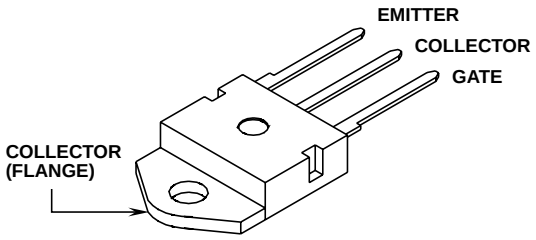
PACKAGING AVAILABILITY

PART NUMBER	PACKAGE	BRAND
HGTH12N40C1D	TO-218AC	G12N40C1D
HGTH12N40E1D	TO-218AC	G12N40E1D
HGTH12N50C1D	TO-218AC	G12N50C1D
HGTH12N50E1D	TO-218AC	G12N50E1D

NOTE: When ordering, use the entire part number

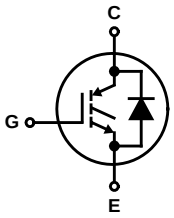
Package

JEDEC TO-218AC



Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



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

	HGTH12N40C1D HGTH12N40E1D	HGTH12N50C1D HGTH12N50E1D	UNITS
Collector-Emitter Voltage . . . . . V_{CES}	400	500	V
Collector-Gate Voltage R_{GE} = 1MΩ . . . . . V_{CGR}	400	500	V
Gate-Emitter Voltage . . . . . V_{GE}	±20	±20	V
Collector Current Continuous . . . . . I_C	12	12	A
Collector Current Pulsed . . . . . I_{CM}	17.5	17.5	A
Power Dissipation Total at $T_C = +25^oC$ . . . . . P_D	75	75	W
Power Dissipation Derating $T_C > +25^oC$	0.6	0.6	$W/^oC$
Operating and Storage Junction Temperature Range . . . . . T_J, T_{STG}	-55 to +150	-55 to +150	^oC

INTERSIL CORPORATION 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							

CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.

File Number **2273.3**

Electrical Specifications $T_C = +25^oC$, Unless Otherwise Specified

PARAMETERS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			HGTH12N40C1D, HGTH12N40E1D		HGTH12N50C1D, HGTH12N50E1D		
			MIN	MAX	MIN	MAX	
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 (Note 9)	-	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_{EC}/dt = 100A/µs	-	100	-	100	ns

Typical Performance Curves

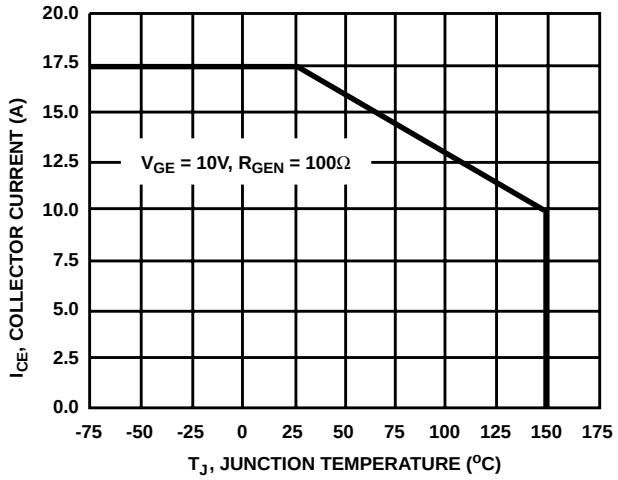


FIGURE 1. MAX. SWITCHING CURRENT LEVEL. R_G = 50Ω, V_{GE} = 0V ARE THE MIN. ALLOWABLE VALUES

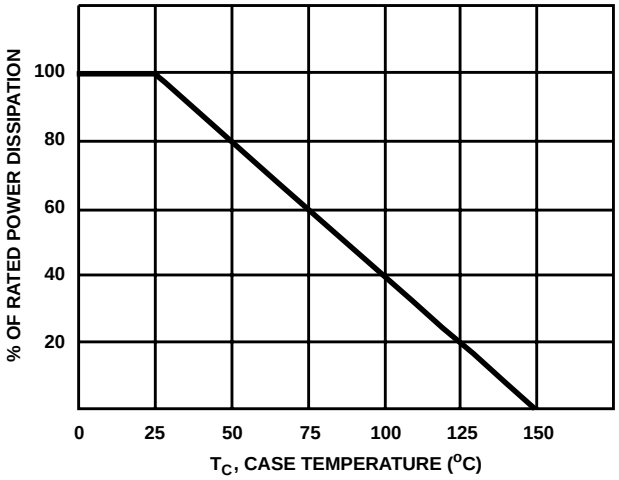


FIGURE 2. POWER DISSIPATION vs TEMPERATURE DERATING CURVE

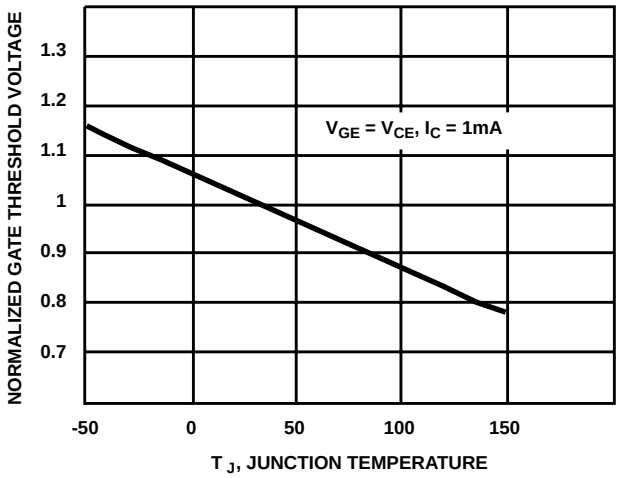


FIGURE 3. TYPICAL NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

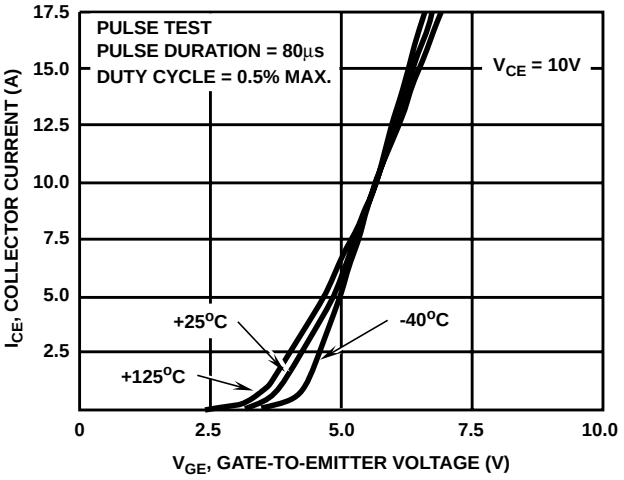


FIGURE 4. TYPICAL TRANSFER CHARACTERISTICS

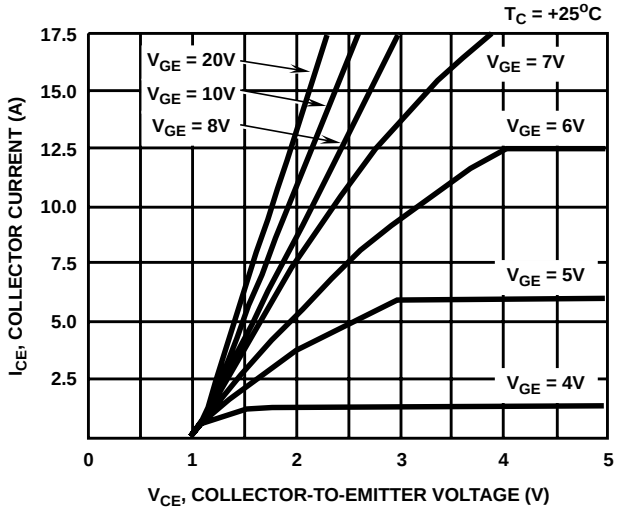


FIGURE 5. TYPICAL SATURATION CHARACTERISTICS

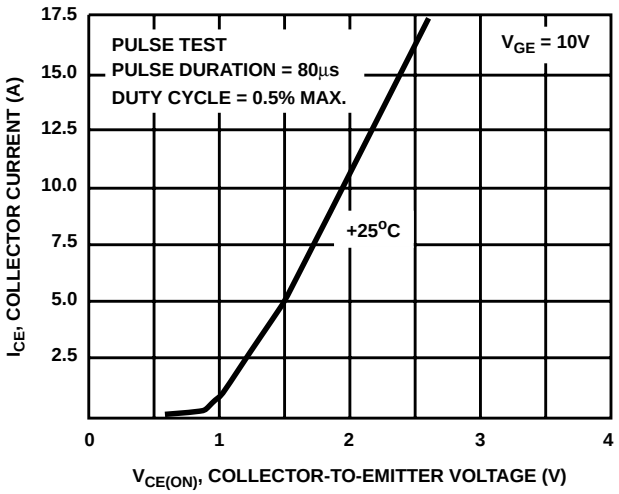


FIGURE 6. TYPICAL COLLECTOR-TO-EMITTER ON VOLTAGE vs COLLECTOR CURRENT

Typical Performance Curves (Continued)

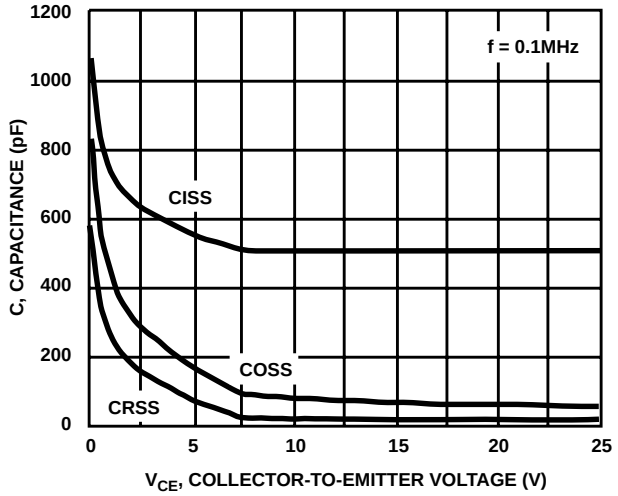


FIGURE 7. CAPACITANCE vs COLLECTOR-TO-EMITTER VOLTAGE

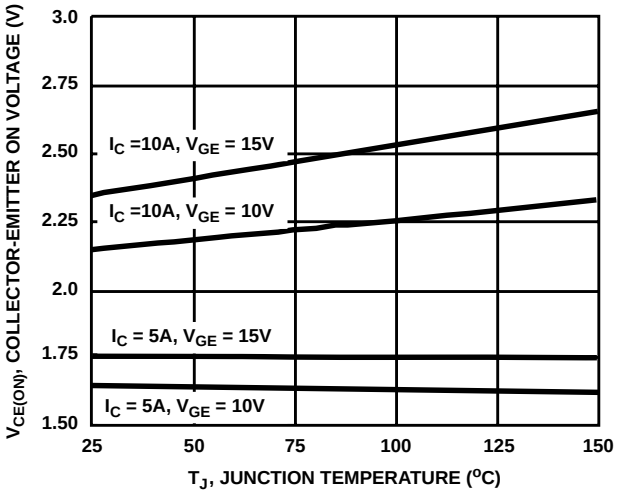


FIGURE 8. TYPICAL $V_{CE(ON)}$ vs TEMPERATURE

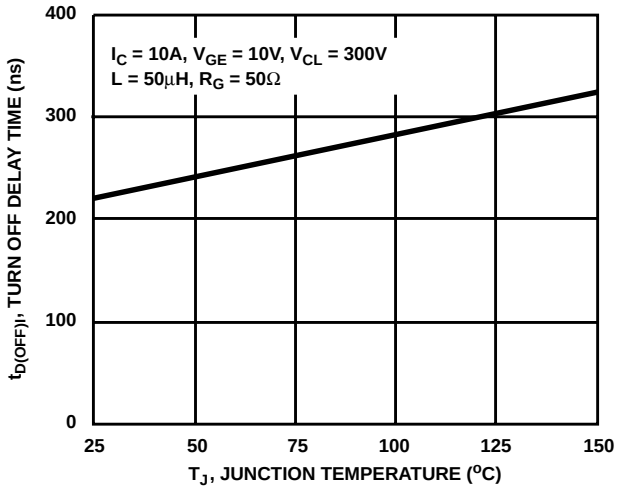


FIGURE 9. TYPICAL TURN-OFF DELAY TIME

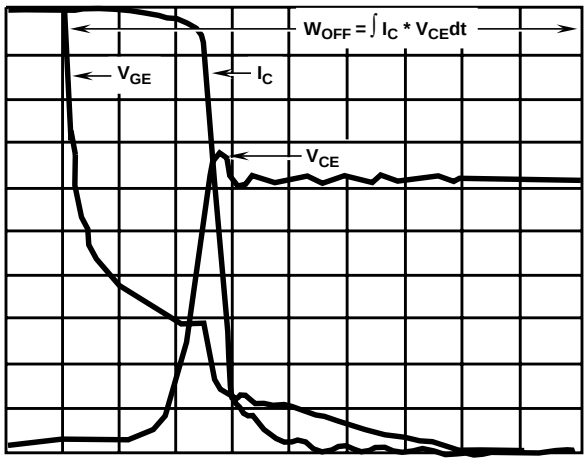


FIGURE 10. TYPICAL INDUCTIVE SWITCHING WAVEFORMS

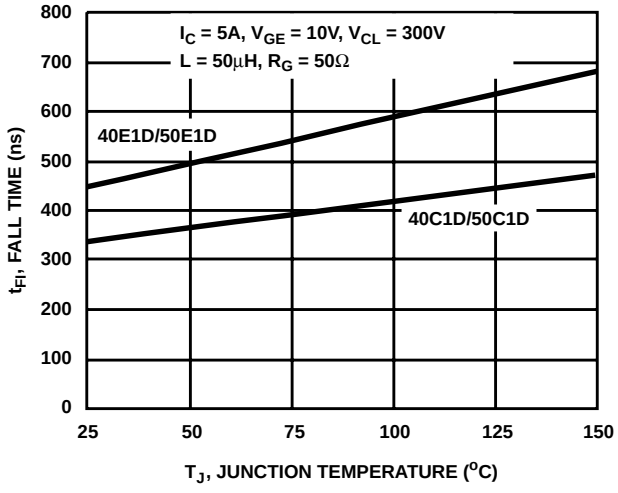


FIGURE 11. TYPICAL FALL TIME (I_C = 5A)

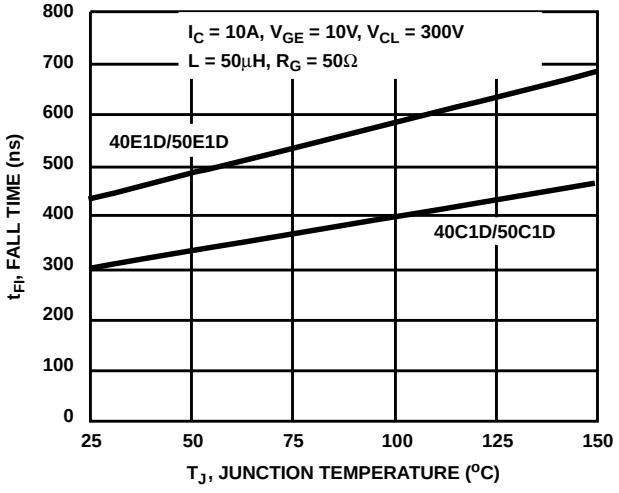


FIGURE 12. TYPICAL FALL TIME (I_C = 10A)

Typical Performance Curves (Continued)

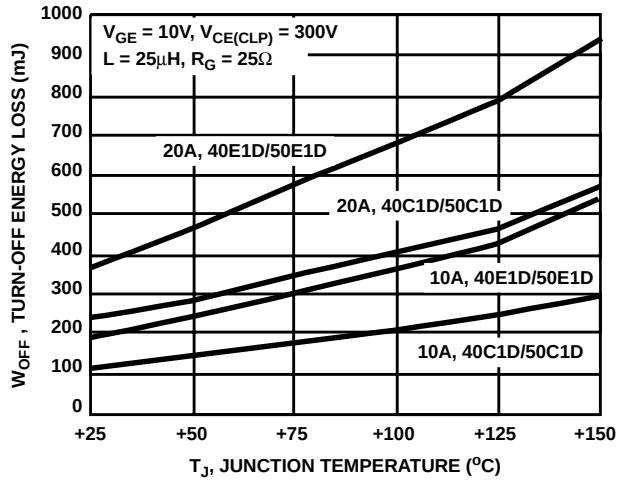


FIGURE 13. TYPICAL CLAMPED INDUCTIVE TURN-OFF SWITCHING LOSS/CYCLE

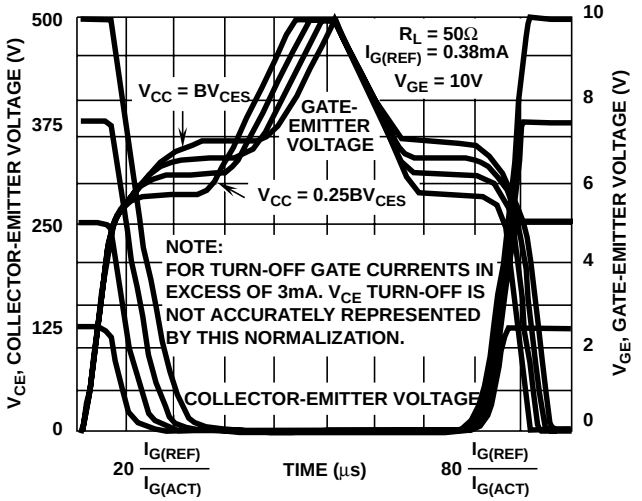


FIGURE 14. NORMALIZED SWITCHING WAVEFORMS AT CONSTANT GATE CURRENT (REFER TO APPLICATION NOTES AN7254 AND AN7260)

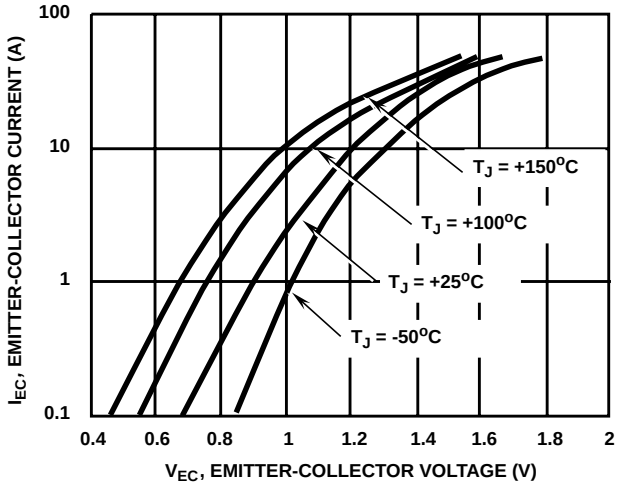


FIGURE 15. TYPICAL DIODE EMITTER-TO-COLLECTOR VOLTAGE vs CURRENT

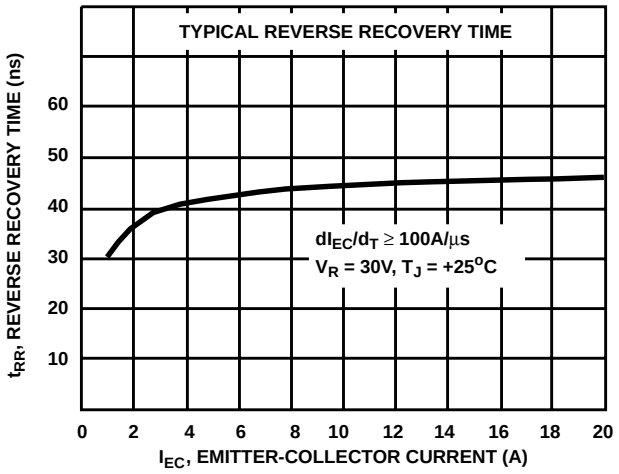


FIGURE 16. TYPICAL DIODE REVERSE RECOVERY TIME

Test Circuit

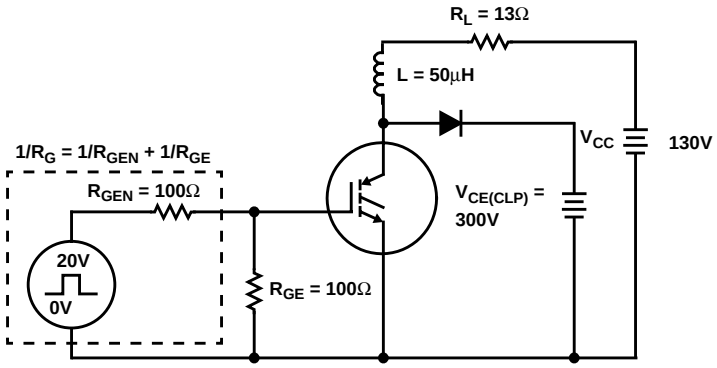


FIGURE 17. INDUCTIVE SWITCHING TEST CIRCUIT

All Intersil semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.

For information regarding Intersil Corporation and its products, see web site **http://www.intersil.com**

Sales Office Headquarters

NORTH AMERICA
Intersil Corporation
P. O. Box 883, Mail Stop 53-204
Melbourne, FL 32902
TEL: (407) 724-7000
FAX: (407) 724-7240

EUROPE
Intersil SA
Mercure Center
100, Rue de la Fusee
1130 Brussels, Belgium
TEL: (32) 2.724.2111
FAX: (32) 2.724.22.05

ASIA
Intersil (Taiwan) Ltd.
Taiwan Limited
7F-6, No. 101 Fu Hsing North Road
Taipei, Taiwan
Republic of China
TEL: (886) 2 2716 9310
FAX: (886) 2 2715 3029