IGTH/IGTM/IGTP20N40 IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N40A IGTH/IGTM/IGTP20N50A

File Number **2174**

N-Channel Enhancement-Mode Conductivity-Modulated Power Field-Effect Transistors

20 A, 400 V and 500 V
V_{CE}(on): 2.5 V
T_{fi}: 1 *μs, 0.5 μs*

Features:
- *Low on-state voltage*
- *Fast switching speeds*
- *High input impedance*
- *No anti-parallel diode*

Applications:
- *Power supplies*
- *Motor drives*
- *Protection circuits*

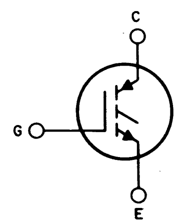
The RCH20N40, RCH20N40A, RCH20N50, RCH20N50A, RCP20N40, RCP20N40A, RCP20N50, RCP20N50A, RCM20N40, RCM20N40A, RCM20N50, RCM20N50A* are n-channel enhancement-mode conductivity-modulated power field-effect transistors designed for high-voltage, low on-dissipation applications such as switching regulators and motor drivers. These types can be operated directly from low-power integrated circuits.

The RCH-types are supplied in the JEDEC TO-218AC plastic package and the RCP-types in the JEDEC TO-220AB plastic package.

The RCM-types are supplied in the JEDEC TO-204AA steel package.

*The RCH and RCP series were formerly RCA Development Type Nos. TA9573XD and TA9573XV, respectively. The RCM series was formerly RCA Development Type No. TA9573XG.

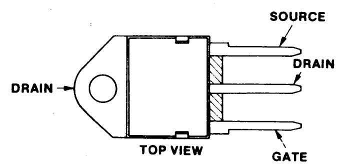
TERMINAL DIAGRAM



92CS-43134

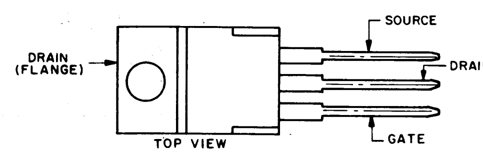
N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATION



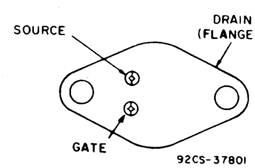
92CS-39967

JEDEC TO-218AC



92CS-39528

JEDEC TO-220AB



92CS-37801

JEDEC TO-204AA

MAXIMUM RATINGS,
Absolute-Maximum Values ($T_C = 25°C$):

	IGTH20N40 IGTH20N40A IGTH20N50 IGTH20N50A	IGTM20N40 IGTM20N40A IGTM20N50 IGTM20N50A	IGTP20N40 IGTP20N40A	IGTP20N50 IGTP20N50A	
COLLECTOR-EMITTER VOLTAGE, V_{CES}	400	500	400	500	V
COLLECTOR-GATE VOLTAGE ($R_{ge} = 1\ M\Omega$), V_{CGR}	400	500	400	500	V
REVERSE COLLECTOR-EMITTER VOLTAGE, V_{CES}(rev)		-5			V
GATE-EMITTER VOLTAGE, V_{GE}		±20			V
COLLECTOR CURRENT, RMS Continuous, I_C		20			A
Pulsed, I_{CM}		35			A
POWER DISSIPATION @ $T_C = 25°$, P_T	100	100	75	75	W
Derate above $T_C = 25°C$	0.8	0.8	0.6	0.6	W/°C
OPERATING AND STORAGE TEMPERATURE, T_j, T_{stg}		-55 to +150			°C

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 4,532,534 4,567,641
4,587,713 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 4,717,679 4,794,432 4,801,986 4,803,533
4,809,045 4,810,665

IGTH/IGTM/IGTP20N40 IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N40A IGTH/IGTM/IGTP20N50A

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C = 25° C) unless otherwise specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RCH20N40 RCM20N40 RCP20N40	RCH20N40A RCM20N40A RCP20N40A	RCH20N50 RCM20N50 RCP20N50	RCH20N50A RCM20N50A RCP20N50A	
			Min.	Max.	Min.	Max.	
Collector-Emitter Breakdown Voltage	BV_{CES}	I_C = 1 mA V_{GE} = 0	400	—	500	—	V
Gate Threshold Voltage	$V_{GE}(th)$	$V_{GE} = V_{CE}$ I_C = 1 mA	2	4.5	2	4.5	V
Zero-Gate Voltage Collector Current	I_{CES}	V_{CE} = 400 V V_{CE} = 500 V	— —	250 —	— —	— 250	μA
		T_C = 125°C V_{CE} = 400 V V_{CE} = 500 V	— — —	— 1000 —	— — —	— — 1000	
Gate-Emitter Leakage Current	I_{GES}	V_{GE} = ±20 V V_{CE} = 0	—	100	—	100	nA
Reverse Collector-Emitter Leakage Current	I_{CE}	R_{GE} = 0 Ω V_{EC} = 5 V	—	-5	—	-5	mA
Collector-Emitter On Voltage	$V_{CE}(on)$	I_C = 20 A V_{GE} = 10 V	—	2.5	—	2.5	V
		I_C = 35 A V_{GE} = 20 V	—	3.2	—	3.2	
Gate-Emitter Plateau Voltage	V_{GEP}	I_C = 10 A V_{CE} = 10 V	—	6 (typ.)	—	6 (typ.)	V
On-State Gate Charge	$Q_g(on)$	I_C = 10 A V_{CE} = 10 V	—	33 (typ.)	—	33 (typ.)	nC
Turn-On Delay Time	$t_d(on)$	I_C = 20 A	—	50	—	50	ns
Rise Time	t_r	$V_{CE(CLP)}$ = 300 V	—	50	—	50	
Turn-Off Delay Time	$t_d(off)$	L = 25 μH	—	400	—	400	
Fall Time	t_{fi} 20N40 20N50	T_J = 100°C V_{GE} = 10 V R_g = 25 Ω	Typ. 680	1000	Typ. 680	1000	
	20N40A 20N50A		400	500	400	500	
Turn-Off Energy Loss per Cycle (off switching dissipation = E_{off} x frequency)	E_{off} 20N40 20N50	I_C =10 A $V_{CE(CLP)}$ = 300 V L = 25 μH T_J = 100°C	1810 (typ.)				μJ
	20N40A 20N50A	V_{GE} = 10 V R_g = 25 Ω	1070 (typ.)				
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	IGTH/IGTM	—	1.25	—	1.25	°C/W
		IGTP	—	1.67	—	1.67	

IGTH/IGTM/IGTP20N40 IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N40A IGTH/IGTM/IGTP20N50A

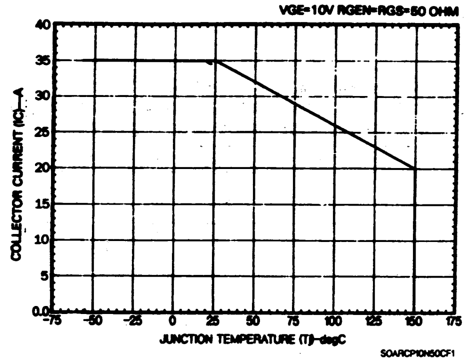


Fig. 1 - Maximum switching current level for all types. R_g = 25 Ω, V_{GE} = 0 V are the minimum allowable values.

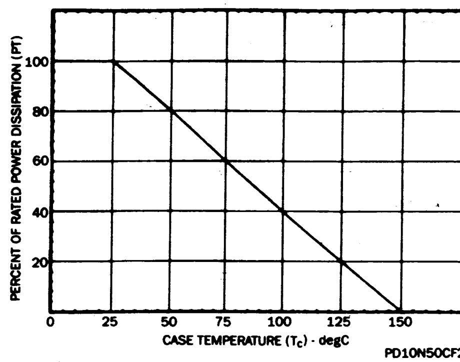


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

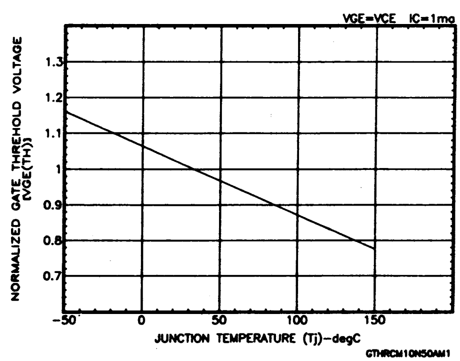


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

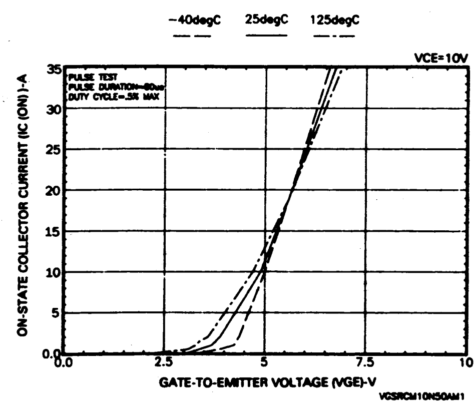


Fig. 4 - Typical transfer characteristics for all types.

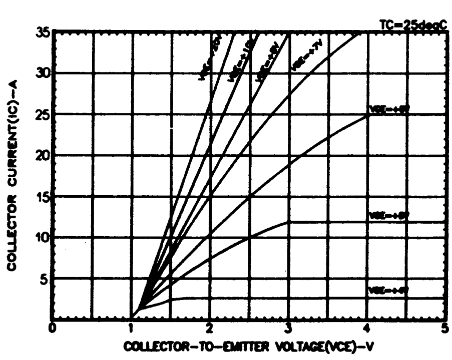


Fig. 5 - Typical saturation characteristics for all types.

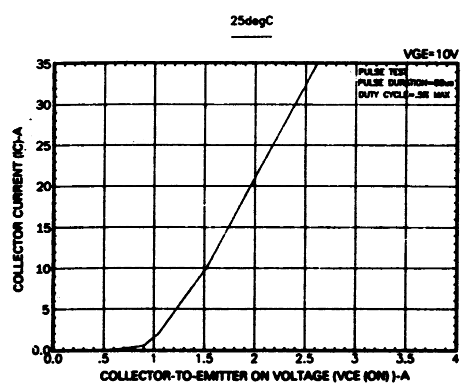


Fig. 6 - Typical collector-to-emitter on-voltage as a function of collector current for all types.

IGTH/IGTM/IGTP20N40 IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N40A IGTH/IGTM/IGTP20N50A

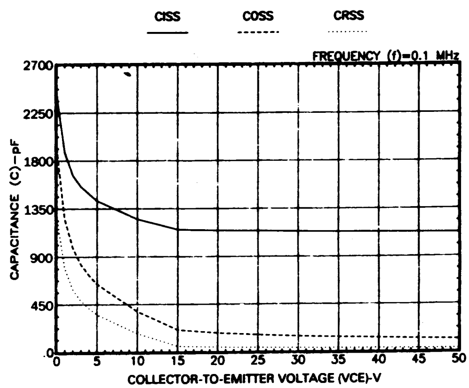


Fig. 7 - Capacitance as a function of collector-to-emitter voltage for all types.

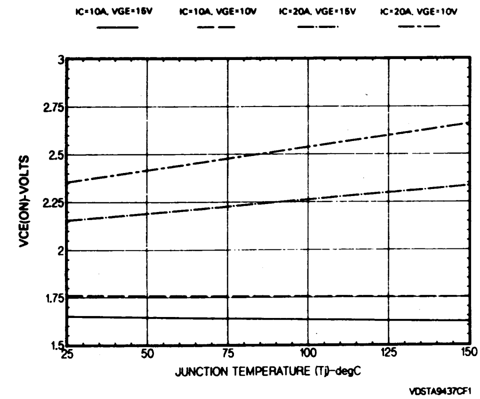


Fig. 8 - Typical V_{CE} (on) vs. temperature for all types.

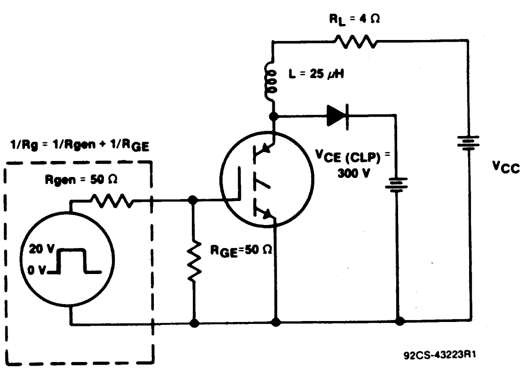


Fig. 9 - Inductive switching test circuit.

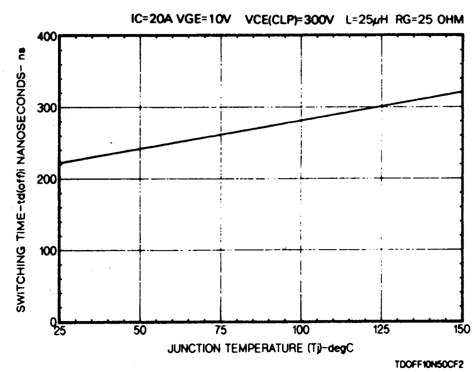


Fig. 10 - Typical turn-off delay time for all types.

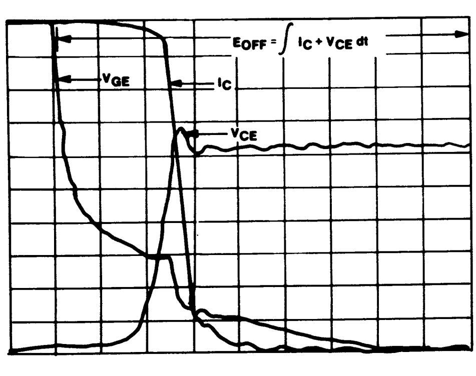


Fig. 11 - Typical inductive switching waveforms.

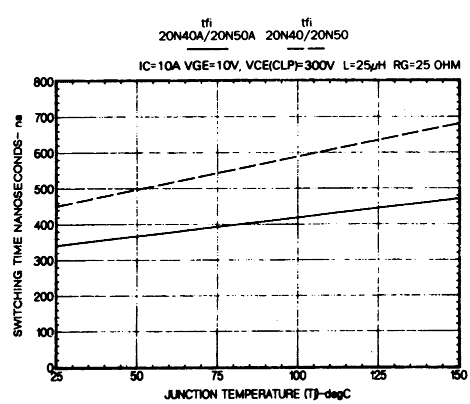


Fig. 12 - Typical fall time for all types.

IGTH/IGTM/IGTP20N40 IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N40A IGTH/IGTM/IGTP20N50A

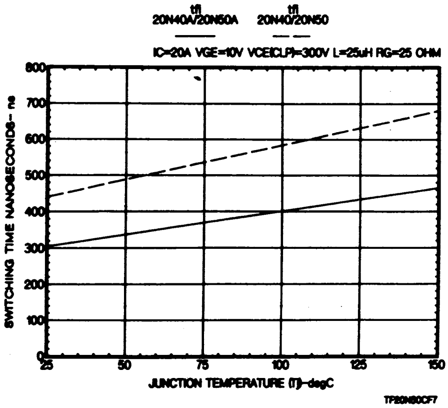


Fig. 13 - Typical fall time for all types (I_C = 20 A).

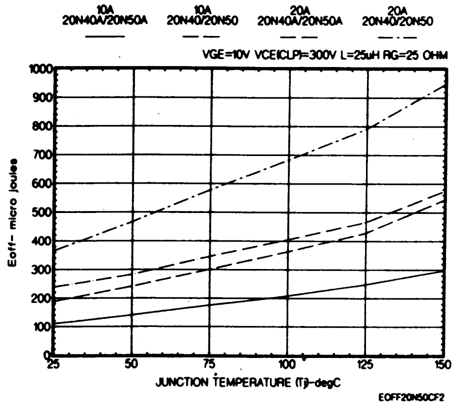
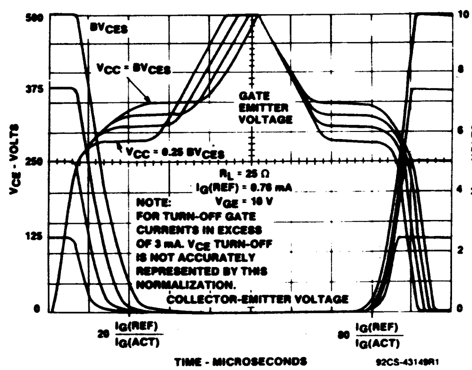


Fig. 14 - Typical clamped inductive turn-off switching loss/cycle.



Refer to RCA application notes AN-7254 and AN-7260 on the use of normalized switching waveforms.

Fig. 15 - Normalized switching waveforms at constant gate current.

File Number **2271**

IGTH20N40D, IGTH20N40AD, IGTH20N50D, IGTH20N50AD

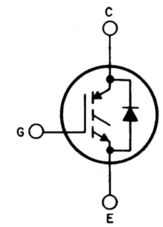
N-Channel Enhancement-Mode Insulated Gate Bipolar Transistors (IGBTs) With Anti-Parallel Ultra-Fast Diode

20 A, 400 V and 500 V
V_{CE}(on): 2.5 V Maximum
T_{fall}: 1 μs, 0.5 μs

Features:
- *Low on-state voltage*
- *Fast switching speeds*
- *High input impedance*
- *Anti-parallel diode*

Applications:
- *Power supplies*
- *Motor drives*
- *Protective circuits*

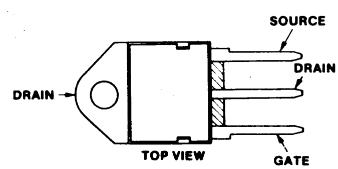
N-CHANNEL ENHANCEMENT MODE



TERMINAL DIAGRAM

The IGTH20N40D, IGTH20N40AD, IGTH20N50D, and IGTH20N50AD are n-channel enhancement-mode conductivity modulated field-effect 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. They are supplied in the JEDEC TO-218AC plastic package and are fabricated using the TA9573 and TA9616 dies.

TERMINAL DESIGNATION



JEDEC TO-218AC

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C = 25° C):*

		IGTH20N40D IGTH20N40AD	IGTH20N50D IGTH20N50AD	
COLLECTOR-EMITTER VOLTAGE	V_{CES}	400	500	V
COLLECTOR-GATE VOLTAGE (R_{ge} = 1 MΩ)	V_{CGR}	400	500	V
GATE-EMITTER VOLTAGE	V_{GE}	±20		V
COLLECTOR CURRENT, RMS Continuous	I_C	20		A
Pulsed	I_{CM}	35		A
POWER DISSIPATION at T_C = 25° C	P_T	100		W
Derate above T_C = 25° C		0.8		W/°C
OPERATING AND STORAGE TEMPERATURE	T_J, T_S	-55 to +150		°C

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	4,532,534	4,567,641
4,587,713	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	4,717,679	4,794,432	4,801,986	4,803,533
4,809,045	4,810,665					

IGTH20N40D, IGTH20N40AD, IGTH20N50D, IGTH20N50AD

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C = 25° C) unless otherwise specified

CHARACTERISTIC		TEST CONDITIONS	LIMITS IGTH20N40D IGTH20N40AD MIN.	MAX.	IGTH20N50D IGTH20N50AD MIN.	MAX.	UNITS
Collector-Emitter Breakdown Voltage	BV_{CES}	I_C = 1 mA, V_{GE} = 0	400	—	500	—	V
Gate Threshold Voltage	$V_{GE}(th)$	V_{GE} = V_{CE}, I_C = 1 mA	2	4.5	2	4.5	V
Zero-Gate Voltage Collector Current	I_{CES}	V_{CE} = 400 V	—	250	—	—	μA
		V_{CE} = 500 V	—	—	—	250	
		T_C = 125° C	—	—	—	—	
		V_{CE} = 400 V	—	1000	—	—	
		V_{CE} = 500 V	—	—	—	1000	
Gate-Emitter Leakage Current	I_{GES}	V_{GE} = ±20 V, V_{CE} = 0	—	100	—	100	nA
Collector-Emitter On-Voltage	$V_{CE}(on)$	I_C = 20 A, V_{GE} = 10 V	—	2.5	—	2.5	V
		I_C = 35 A, V_{GE} = 20 V	—	3.2	—	3.2	V
Gate-Emitter Plateau Voltage	V_{GEP}	I_C = 10 A, V_{CE} = 10 V	—	6 (typ)	—	6 (typ)	V
On-State Gate Charge	$Q_G(on)$	I_C = 10 A, V_{CE} = 10 V	—	33(typ)	—	33(typ)	nC
Turn-On Delay Time	$t_d(on)$	I_C = 20 A, $V_{CE}(clp)$ = 300 V, L = 25 μH, T_J = 100° C, V_{GE} = 10 V, R_g = 25 Ω	—	50	—	50	ns
Rise Time	t_r		—	50	—	50	ns
Turn-Off Delay Time	$t_d(off)$		—	400	—	400	ns
Fall Time 20N40D 20N50D	t_{fi}		TYP 680	1000	TYP 680	1000	ns
20N40AD 20N50AD			TYP 400	500	TYP 400	500	ns
Turn-Off Energy Loss per Cycle (off switching dissipation = E_{off} x frequency) 20N40D 20N50D	E_{off}	I_C = 20 A, $V_{CE}(clp)$ = 300 V, L = 25 μH, T_J = 100° C, V_{GE} = 10 V, R_g = 25 Ω	1810 (typ)				μJ
20N40AD 20N50AD			1070 (typ)				μJ
Thermal Resistance Junction-to-Case	$R\theta_{JC}$		—	1.25	—	1.25	°C/W
Diode Forward Voltage	V_{EC}	I_{EC} = 20 A	—	2	—	2	V
Diode Reverse Recovery Time	T_{rr}	I_{EC} = 20 A, di/dt = 100 A/μs	—	100	—	100	ns

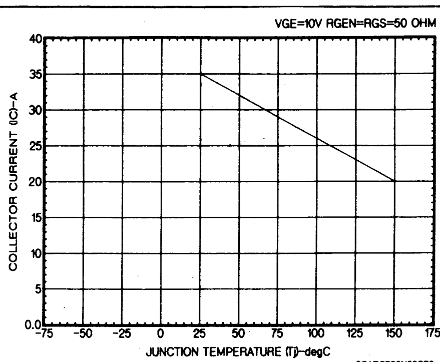


Fig. 1 - Maximum switching current level for all types. Minimum allowable values are R_g = 50 Ω, V_{GE} = 0 V.

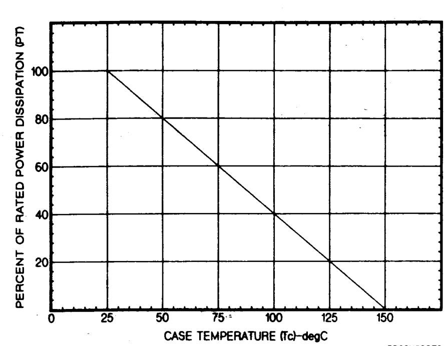


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

IGTH20N40D, IGTH20N40AD, IGTH20N50D, IGTH20N50AD

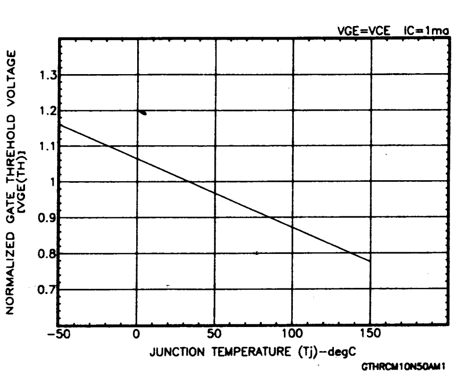


Fig. 3 - Typical normalized gate-threshold voltage as a function of junction temperature for all types.

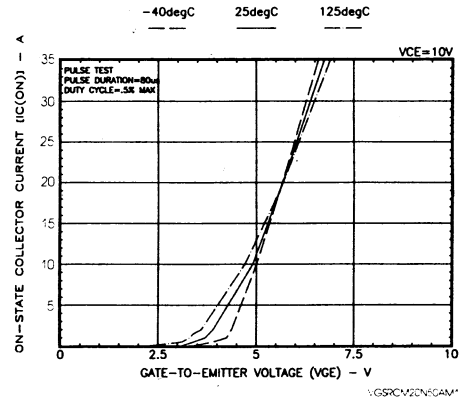


Fig. 4 - Typical transfer characteristics for all types.

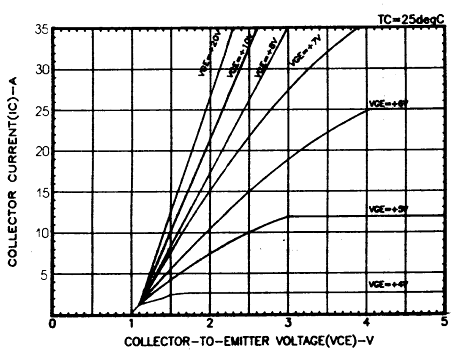


Fig. 5 - Typical saturation characteristics for all types.

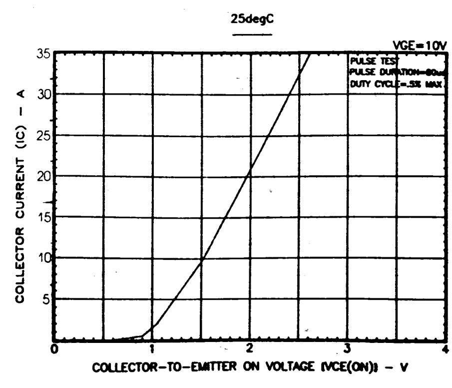


Fig. 6 - Typical collector-to-emitter on-voltage as a function of collector current for all types.

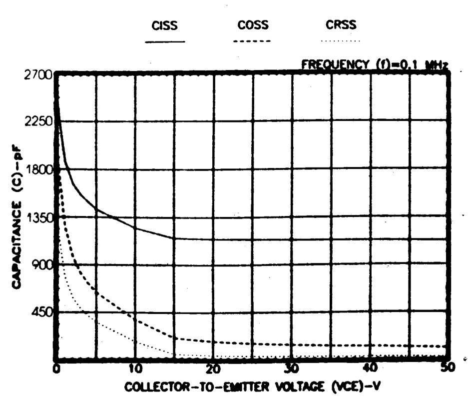


Fig. 7 - Capacitance as a function of collector-to-emitter voltage for all types.

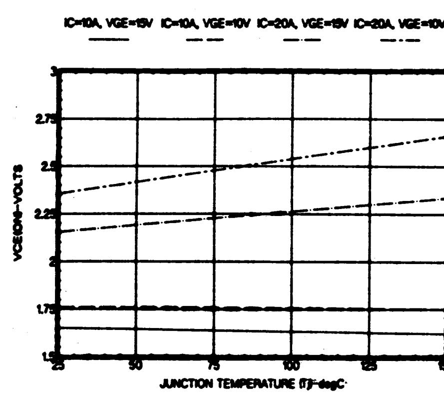


Fig. 8 - Typical V_{CE}(on) vs. temperature for all types.

IGTH20N40D, IGTH20N40AD, IGTH20N50D, IGTH20N50AD

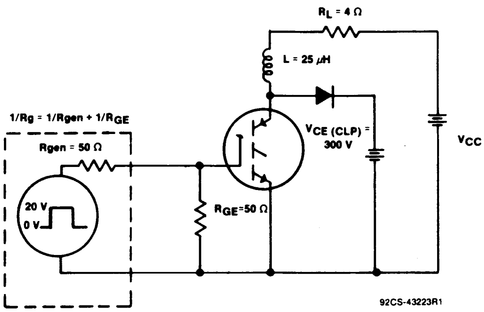


Fig. 9 - Inductive switching test circuit.

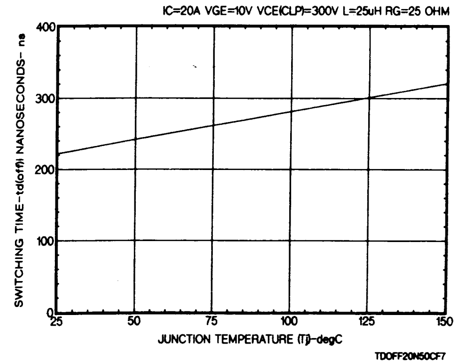


Fig. 10 - Typical turn-off delay time for all types.

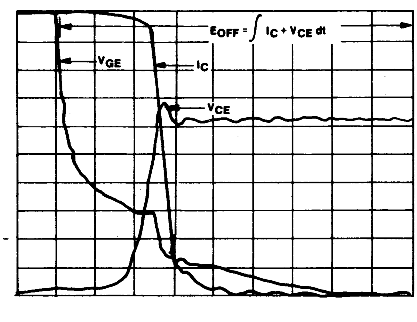


Fig. 11 - Typical inductive switching waveforms.

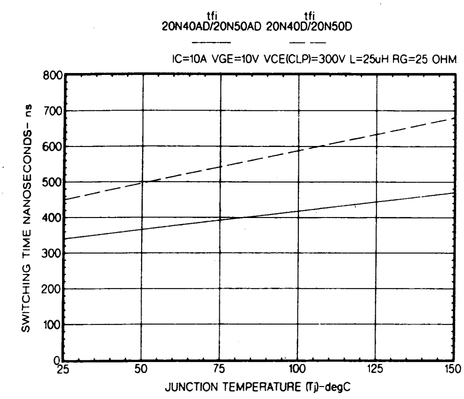


Fig. 12 - Typical fall time for all types ($I_C = 10$ A).

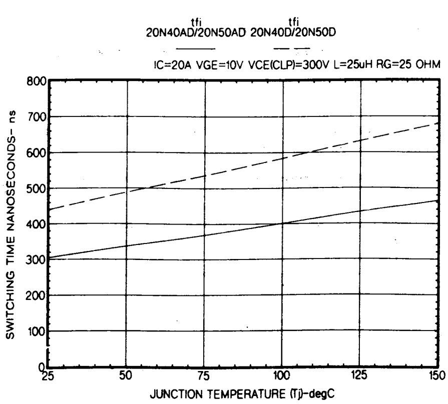


Fig. 13 - Typical fall time for all types ($I_C = 20$ A).

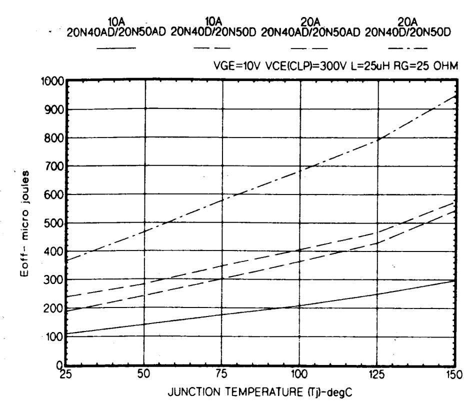


Fig. 14 - Typical clamped inductive turn-off switching loss/cycle.