IGTH10N40 IGTM10N40 IGTP10N40
IGTH10N40A IGTM10N40A IGTP10N40A
IGTH10N50 IGTM10N50 IGTP10N50
IGTH10N50A IGTM10N50A IGTP10N50A

File Number **1697**

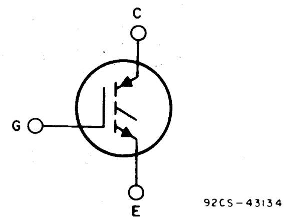
N-Channel Enhancement Mode Conductivity-Modulated Power Field-Effect Transistors

10 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*

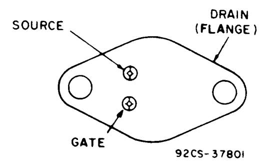
Applications:
- *Power supplies*
- *Motor drives*
- *Protective circuits*

TERMINAL DIAGRAM

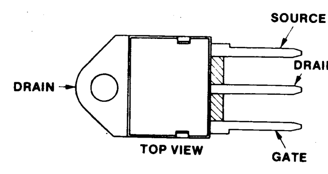


N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATION



JEDEC TO-204AA



JEDEC TO-218AC

The IGTH10N40, IGTH10N40A, IGTH10N50, IGHTH10N50A, IGTP10N40, IGTP10N40A, IGTP10N50, IGTP10N50A, IGTM10N40, IGTM10N40A, IGTM10N50, IGTM10N50A* are n-channel enhancement-mode conductivity-modulated power field-effect transistors (COMFETs) 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 IGTH-types are supplied in the JEDEC TO-218AC plastic package and the IGTP-types in the JEDEC TO-220AB plastic package.

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

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*The IGTH and IGTP series were formerly RCA Development Type Nos. TA9687 and TA9438, respectively. The IGTM series was formerly RCA Development Type No. TA9437.

MAXIMUM RATINGS,

Absolute-Maximum Values (T_C = 25° C):

	IGTH10N40 IGTH10N40A IGTM10N40 IGTM10N40A	IGTH10N50 IGTH10N50A IGTM10N50 IGTM10N50A	IGTP10N40 IGTP10N40A	IGTP10N50 IGTP10N50A	
COLLECTOR-EMITTER VOLTAGE, V_{CES}	400	500	400	500	V
COLLECTOR-GATE VOLTAGE (R_{ge} = 1 MΩ), 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	10				A
Pulsed, I_{CM}	17.5				A
POWER DISSIPATION @ T_C = 25°C, P_T	75	75	60	60	W
Derate above T_C = 25°C	0.6	0.6	0.48	0.48	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					

IGTH10N40 IGTH10N40A IGTH10N50 IGTH10N50A
IGTM10N40 IGTM10N40A IGTM10N50 IGTM10N50A
IGTP10N40 IGTP10N40A IGTP10N50 IGTP10N50A

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

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS IGTH10N40 IGTH10N40A IGTM10N40 IGTM10N40A IGTP10N40 IGTP10N40A		LIMITS IGTH10N50 IGTH10N50A IGTM10N50 IGTM10N50A IGTP10N50 IGTP10N50A		UNITS
			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, 3 (typ.)	2	4.5, 3 (typ.)	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_D = 10 A, V_{GE} = 10 V	—	2.5	—	2.5	V
		I_C = 17.5 A, V_{GE} = 20 V	—	3.2	—	3.2	
Gate-Emitter Plateau Voltage	V_{GEP}	I_C = 5 A, V_{CE} = 10 V	—	6 (typ.)	—	6 (typ.)	V
On-State Gate Charge	$Q_g(on)$	I_C = 5 A, V_{CE} = 10 V	—	19 (typ.)	—	19 (typ.)	nC
Turn-On Delay Time	$t_d(on)$	I_C = 10 A, $V_{CE(CLP)}$ = 300 V, L = 50 µH, T_J = 100°C, V_{GE} = 10 V, R_g = 50 Ω	—	50	—	50	ns
Rise Time	t_r		—	50	—	50	
Turn-Off Delay Time	$t_d(off)$		—	400	—	400	
Fall Time	t_{fi} 10N40 10N50		Typ. 680	1000	Typ. 680	1000	
	10N40A 10N50A		400	500	400	500	
Turn-Off Energy Loss per Cycle (off switching dissipation = E_{off} x frequency)	E_{off} 10N40 10N50	I_C = 10 A, $V_{CE(CLP)}$ = 300 V, L = 50 µH, T_J = 100°C, V_{GE} = 10 V, R_g = 50 Ω	680 (typ.)				µJ
	10N40A 10N50A		400 (typ.)				
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	IGTH/IGTM	—	1.67	—	1.67	°C/W
		IGTP	—	2.083	—	2.083	

IGTH10N40 IGTH10N40A IGTH10N50 IGTH10N50A
IGTM10N40 IGTM10N40A IGTM10N50 IGTM10N50A
IGTP10N40 IGTP10N40A IGTP10N50 IGTP10N50A

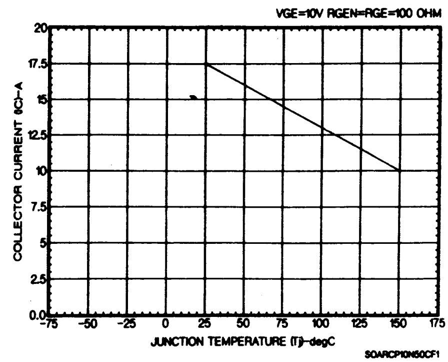


Fig. 1 - Maximum switching current level for all types. $R_g = 50$ Ω, $\overline{V_{GE}} = 0$ V are the minimum allowable values.

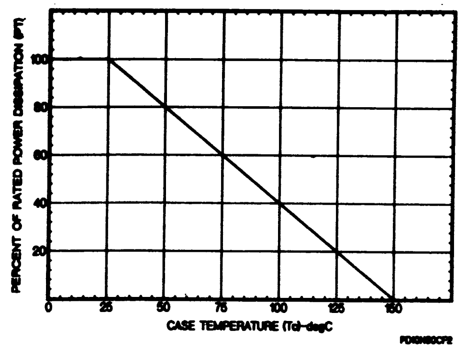


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

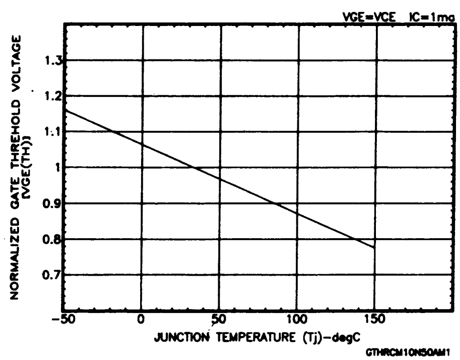


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

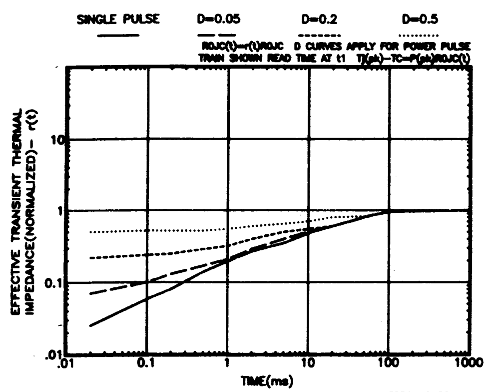


Fig. 4 - Normalized thermal response characteristics for all types.

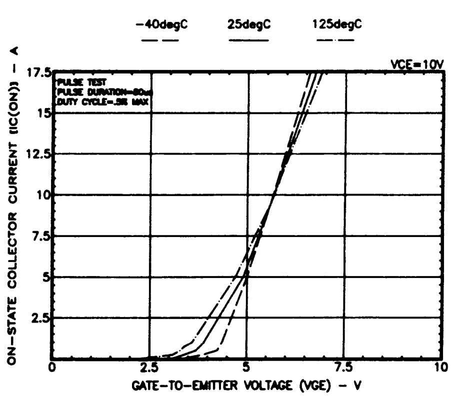


Fig. 5 - Typical transfer characteristics for all types.

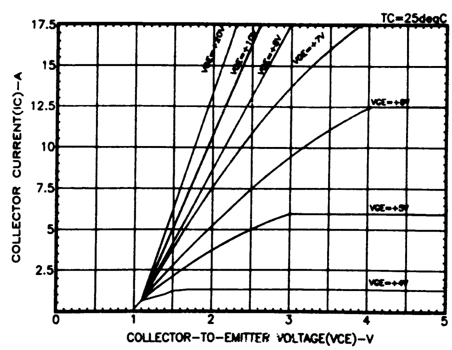


Fig. 6 - Typical saturation characteristics for all types.

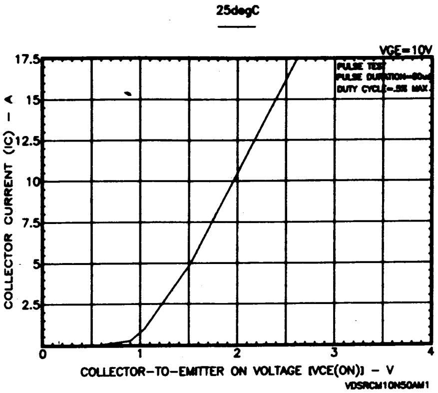


Fig. 7 - Typical collector-to-emitter on-voltage as a function of collector current for all types.

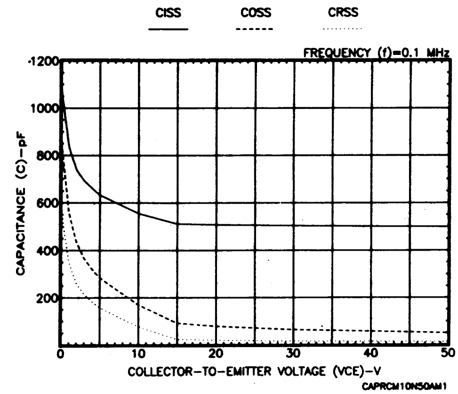


Fig. 8 - Capacitance as a function of collector-to-emitter voltage for all types.

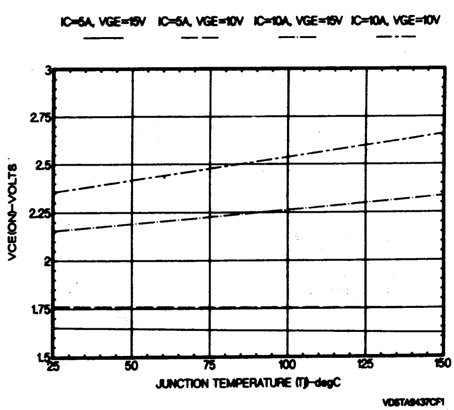


Fig. 9 - Typical $V_{CE}(on)$ *vs. temperature for all types.*

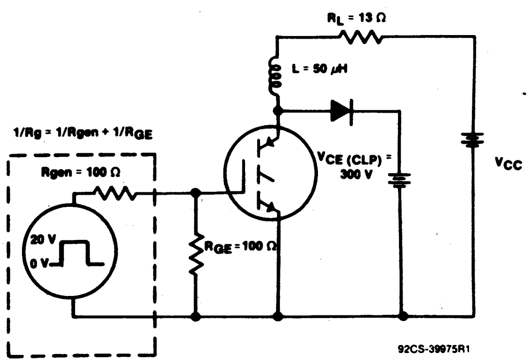


Fig. 10 - Inductive switching test circuit.

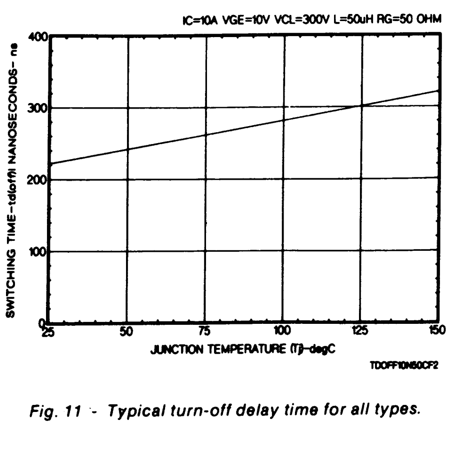


Fig. 11 - Typical turn-off delay time for all types.

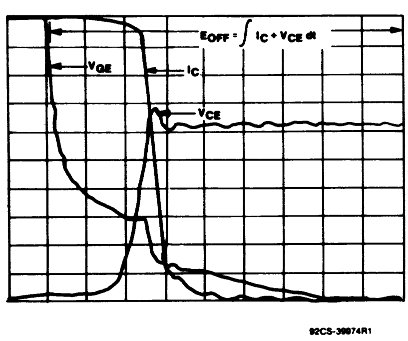


Fig. 12 - Typical inductive switching waveforms.

IGTH10N40 IGTH10N40A IGTH10N50 IGTH10N50A
IGTM10N40 IGTM10N40A IGTM10N50 IGTM10N50A
IGTP10N40 IGTP10N40A IGTP10N50 IGTP10N50A

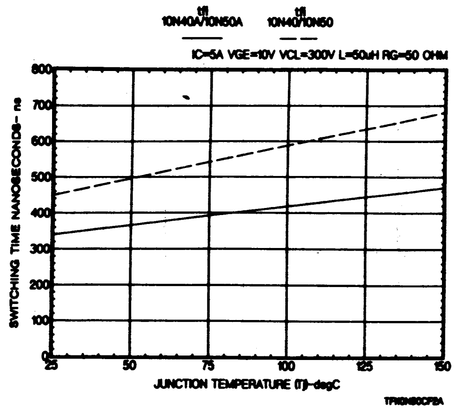


Fig. 13 - Typical fall time for all types (I_C = 5 A).

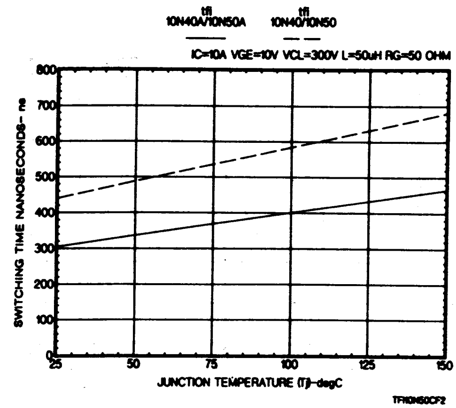


Fig. 14 - Typical fall time for all types (I_C = 10 A).

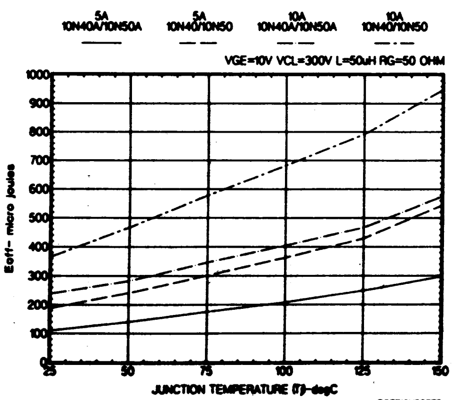
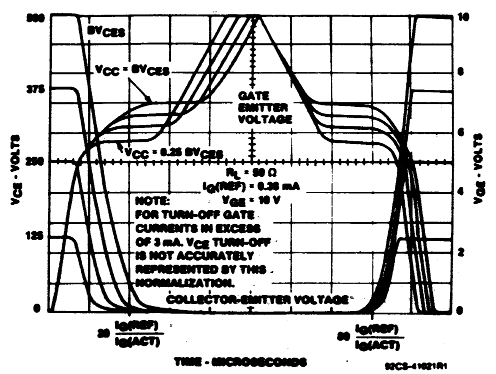


Fig. 15 - Typical clamped inductive turn-off switching loss/cycle.



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

Fig. 16 - Normalized switching waveforms at constant gate current.

File Number **2273**

IGTH10N40D, IGTH10N40AD, IGTH10N50D, IGTH10N50AD

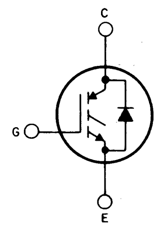
N-Channel Enhancement-Mode Insulated Gate Bipolar Transistors (IGBTs) With Anti-Parallel Ultra-Fast Diode

10 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

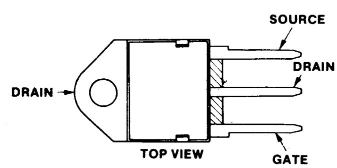


92CS-43516

TERMINAL DIAGRAM

The IGTH10N40D, IGTH10N40AD, IGTH10N50D, and IGTH10N50AD 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):*

		IGTH10N40D IGTH10N40AD	IGTH10N50D IGTH10N50AD	
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	10		A
Pulsed	I_{CM}	17.5		A
POWER DISSIPATION at T_C = 25° C	P_T	75		W
Derate above T_C = 25° C		0.6		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					

IGTH10N40D, IGTH10N40AD, IGTH10N50D, IGTH10N50AD

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

CHARACTERISTIC		TEST CONDITIONS	LIMITS				UNITS
			IGTH10N40D IGTH10N40AD		IGTH10N50D IGTH10N50AD		
			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	—	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 = 10 A, V_{GE} = 10 V	—	2.5	—	2.5	V
		I_C = 17.5 A, V_{GE} = 20 V	—	3.2	—	3.2	V
Gate-Emitter Plateau Voltage	V_{GEP}	I_C = 5 A, V_{CE} = 10 V	—	6 (typ)	—	6 (typ)	V
On-State Gate Charge	$Q_G(on)$	I_C = 5 A, V_{CE} = 10 V	—	19(typ)	—	19(typ)	nC
Turn-On Delay Time	$t_d(on)$	I_C = 10 A, $V_{CE}(clp)$ = 300 V, L = 50 μH, T_J = 100° C, V_{GE} = 10 V, R_g = 50 Ω	—	50	—	50	ns
Rise Time	t_r		—	50	—	50	ns
Turn-Off Delay Time	$t_d(off)$		—	400	—	400	ns
Fall Time	t_{fi} 10N40D 10N50D		TYP 680	1000	TYP 680	1000	ns
	10N40AD 10N50AD		TYP 400	500	TYP 400	500	ns
Turn-Off Energy Loss per Cycle (off switching dissipation = E_{off} x frequency)	E_{off} 10N40D 20N50D	I_C = 10 A, $V_{CE}(clp)$ = 300 V, L = 50 μH, T_J = 100° C, V_{GE} = 10 V, R_g = 50 Ω	1810 (typ)				μJ
	10N40AD 10N50AD		1070 (typ)				μJ
Thermal Resistance Junction-to-Case	$R\theta_{JC}$		—	1.67	—	1.67	° C/W
Diode Forward Voltage	V_{EC}	I_{EC} = 10 A	—	2	—	2	V
Diode Reverse Recovery Time	T_{rr}	I_{EC} = 10 A, di/dt = 100 A/μs	—	100	—	100	ns

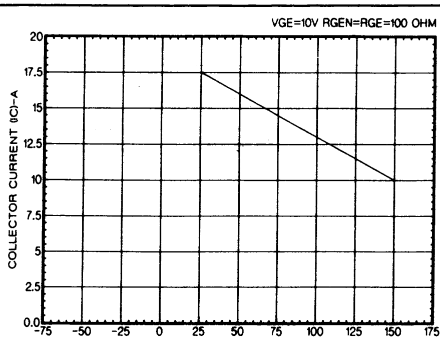


Fig. 1 - Maximum switching current level for all types. Minimum allowable values are R_g = 50 Ω, V_{GE} = 0 V.

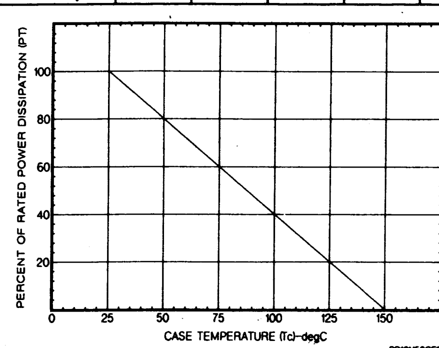


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

IGTH10N40D, IGTH10N40AD, IGTH10N50D, IGTH10N50AD

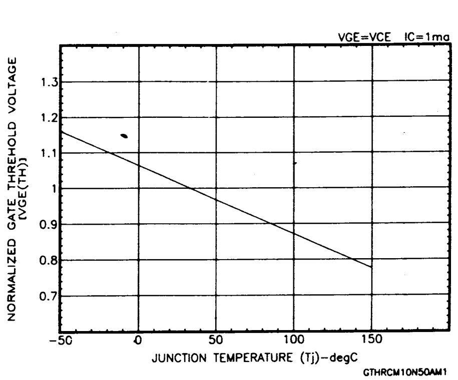


Fig. 3 - Typical normalized gate-threshold voltage as a function of junction temperature for all types.

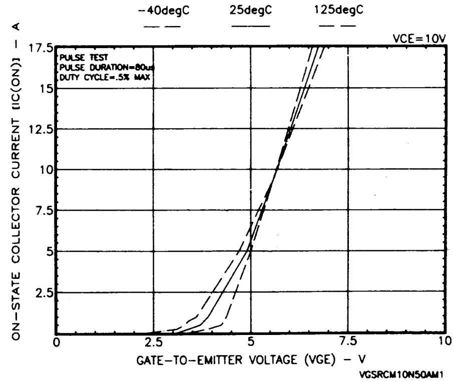


Fig. 4 - Typical transfer characteristics for all types.

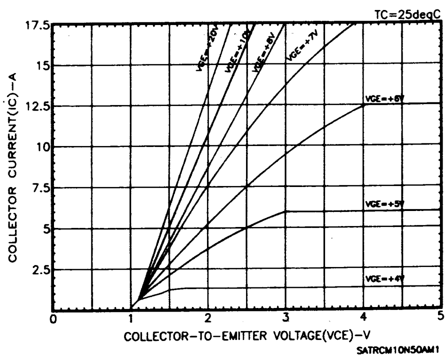


Fig. 5 - Typical saturation characteristics for all types.

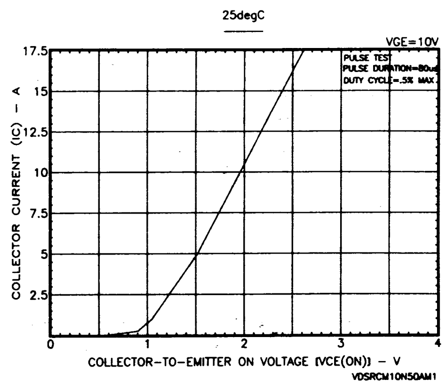


Fig. 6 - Typical collector-to-emitter on-voltage as a function of collector current for all types.

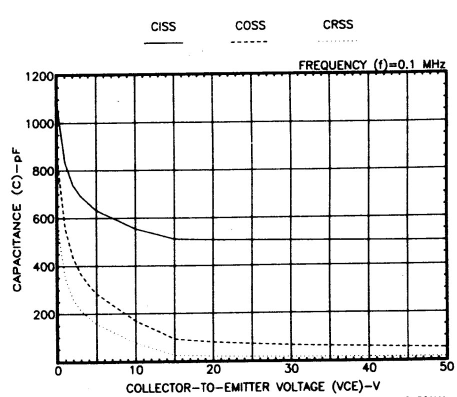


Fig. 7 - Capacitance as a function of collector-to-emitter voltage for all types.

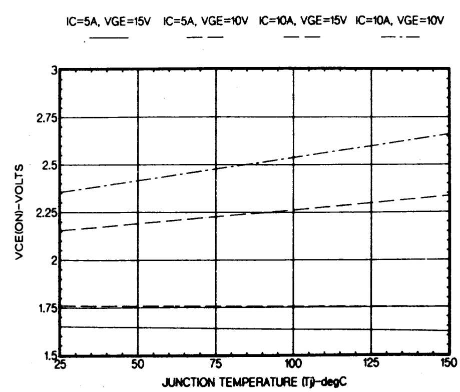


Fig. 8 - Typical $V_{CE}(on)$ vs. temperature for all types.

IGTH10N40D, IGTH10N40AD, IGTH10N50D, IGTH10N50AD

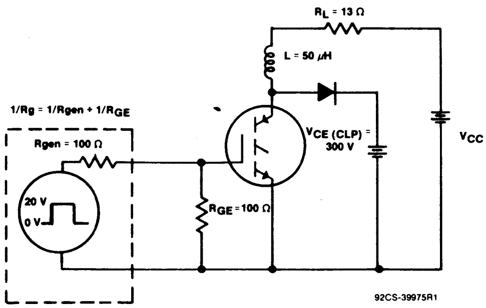


Fig. 9 - Inductive switching test circuit.

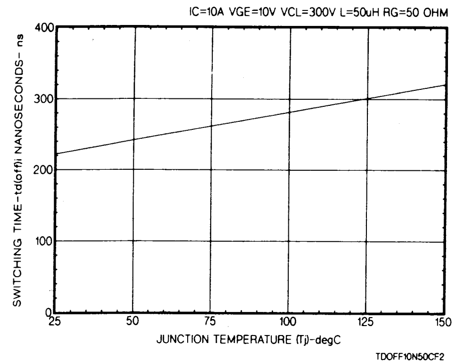


Fig. 10 - Typical turn-off delay time for all types.

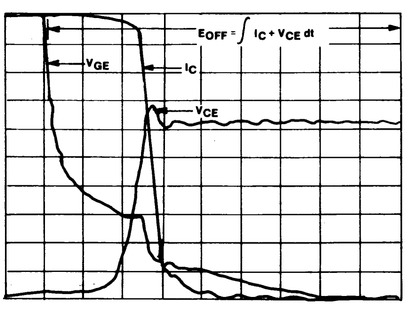


Fig. 11 - Typical inductive switching waveforms.

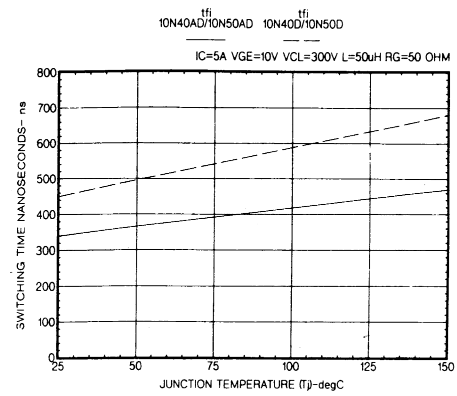


Fig. 12 - Typical fall time for all types ($I_C = 5\ A$).

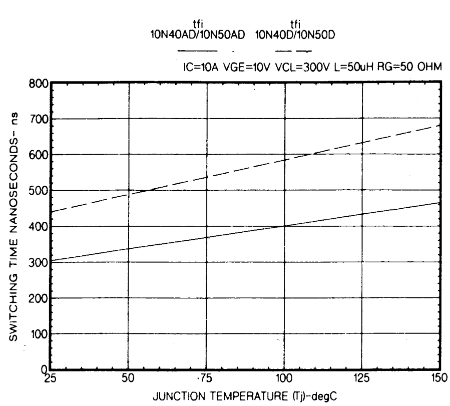


Fig. 13 - Typical fall time for all types ($I_C = 10\ A$).

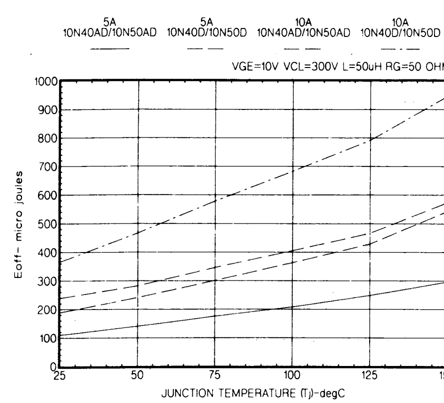


Fig. 14 - Typical clamped inductive turn-off switching loss/cycle.

IGTH10N40D, IGTH10N40AD, IGTH10N50D, IGTH10N50AD

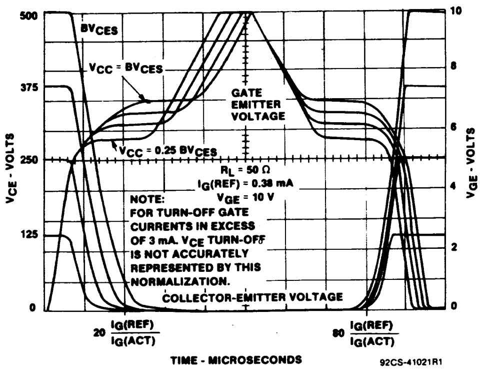


Fig. 15 - Normalized switching waveforms at constant gate current. (Refer to RCA application notes AN7254 and AN7260.)

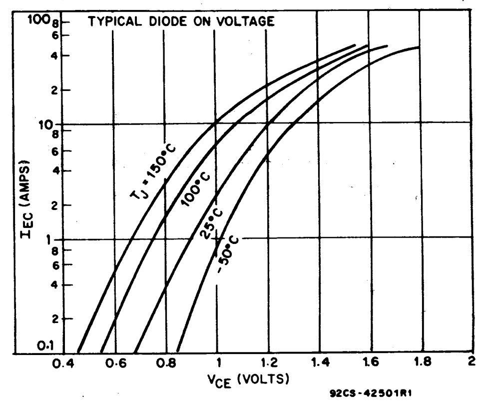


Fig. 16 - Typical diode collector-to-emitter voltage vs. current for all types.

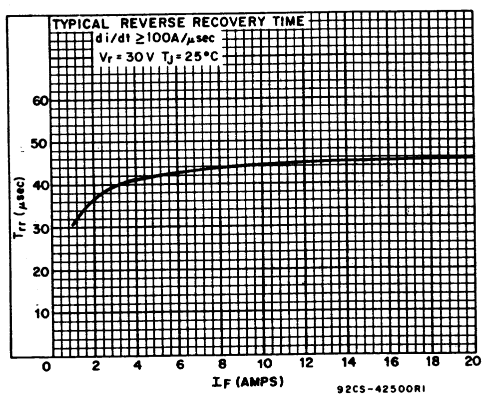


Fig. 17 - Typical diode reverse-recovery time for all types.