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

File Number **2174**

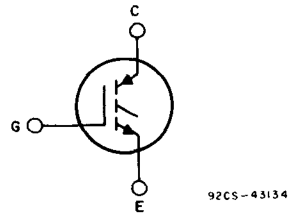
N-Channel Enhancement-Mode Conductivity-Modulated Power Field-Effect Transistors

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*

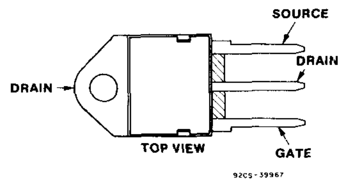
Applications:
- *Power supplies*
- *Motor drives*
- *Protection circuits*

TERMINAL DIAGRAM

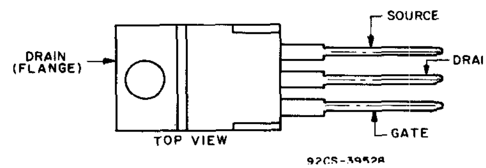


N-CHANNEL ENHANCEMENT MODE

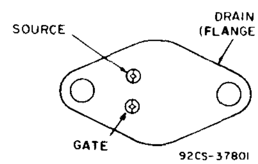
TERMINAL DESIGNATION



JEDEC TO-218AC



JEDEC TO-220AB



JEDEC TO-204AA

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.

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 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		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	1810 (typ.)				μJ
	20N40A 20N50A	T_J = 100° C 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	

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

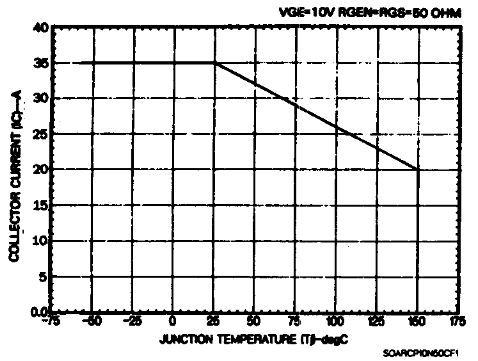


Fig. 1 - Maximum switching current level for all types. R_g = 25 Ω, V_{GE} = 0 V are the minimum allowable values.

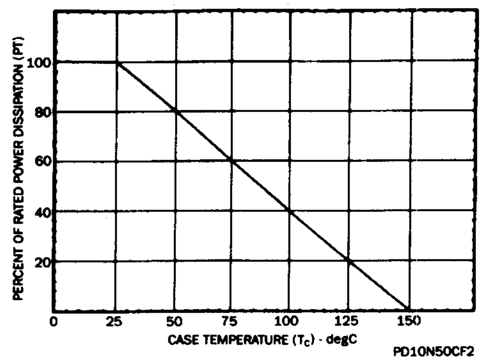


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

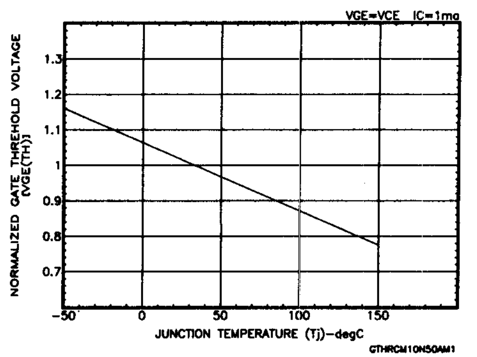


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

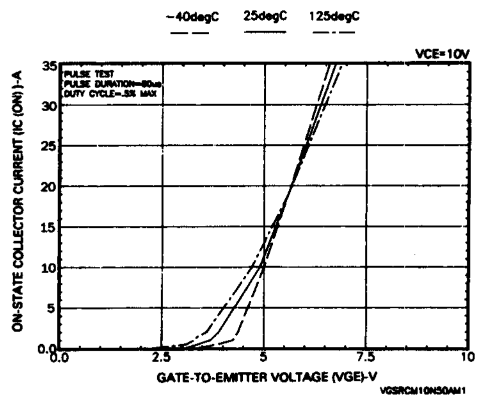


Fig. 4 - Typical transfer characteristics for all types.

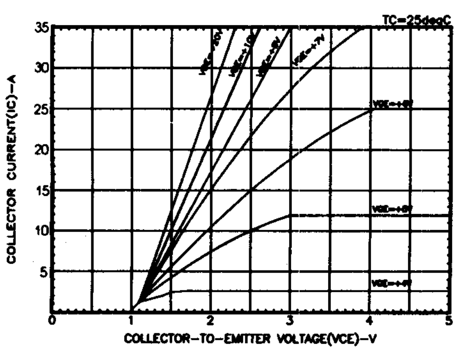


Fig. 5 - Typical saturation characteristics for all types.

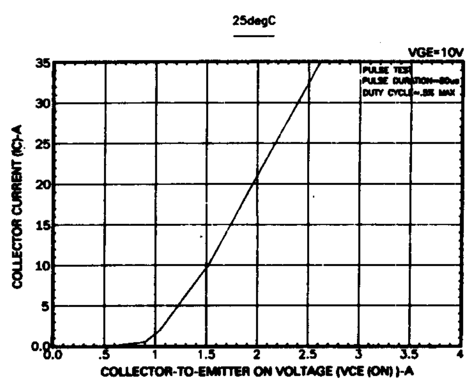


Fig. 6 - Typical collector-to-emitter on-voltage as a function of collector current for all types.

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

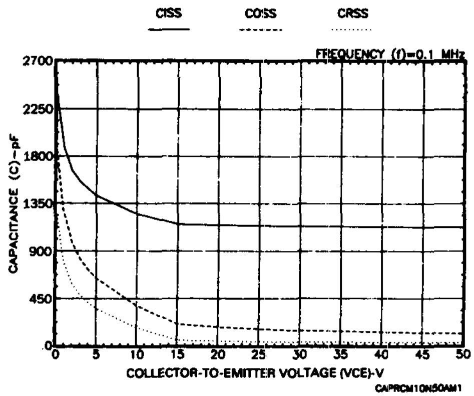


Fig. 7 - Capacitance as a function of collector-to-emitter voltage for all types.

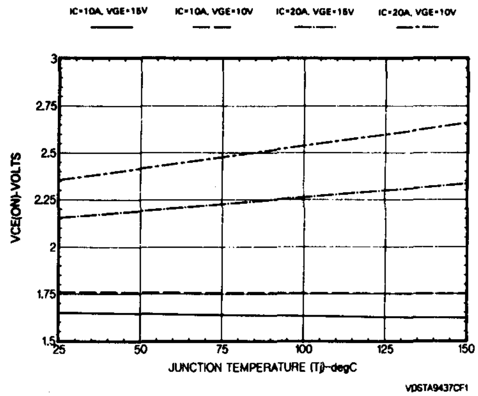


Fig. 8 - Typical V_{CE} (on) vs. temperature for all types

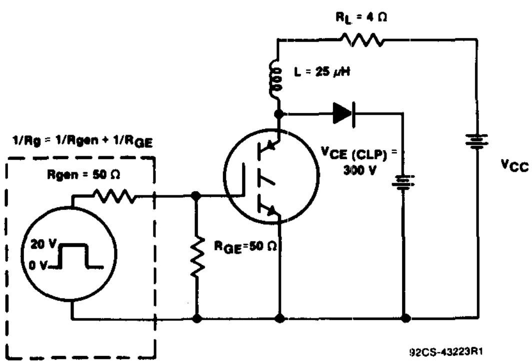


Fig. 9 - Inductive switching test circuit.

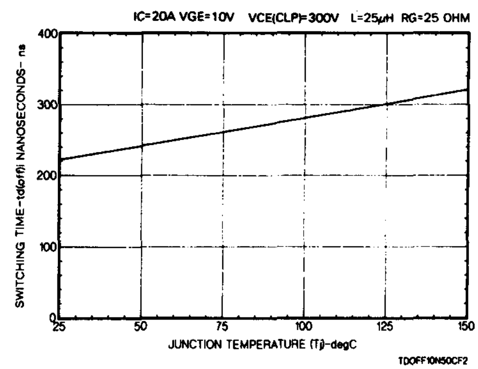


Fig. 10 - Typical turn-off delay time for all types.

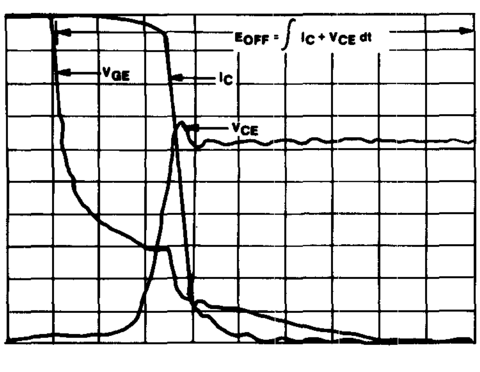


Fig. 11 - Typical inductive switching waveforms.

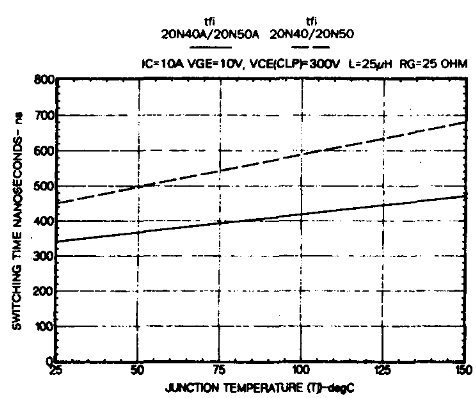


Fig. 12 - Typical fall time for all types.

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

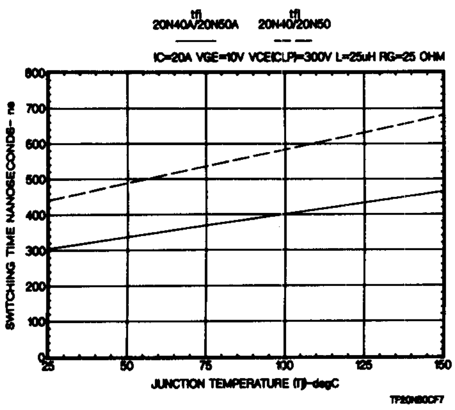


Fig. 13 - Typical fall time for all types (I_C = 20 A).

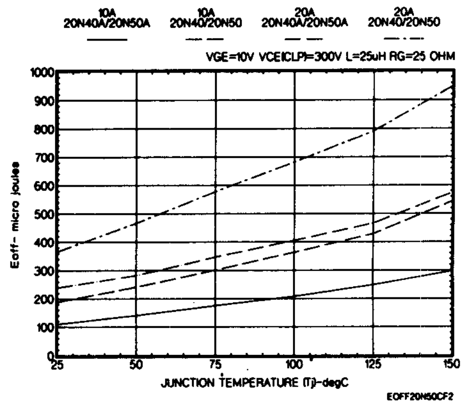
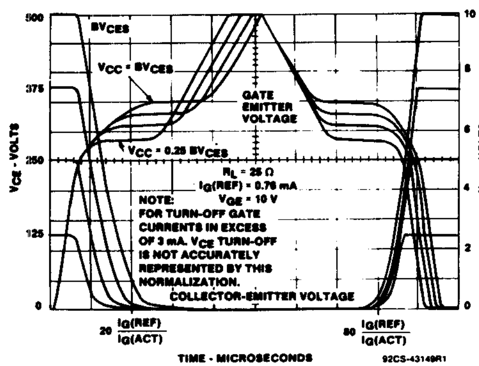


Fig. 14 - Typical clamped inductive turn-off switching loss/cycle.



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.