

IGTH/IGTM/IGTP20N40
IGTH/IGTM/IGTP20N40A

IGTH/IGTM/IGTP20N50
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 μ s, 0.5 μ s**Features:**

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

Applications:

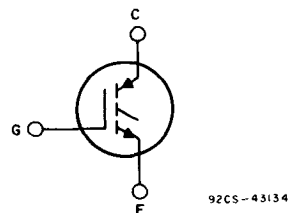
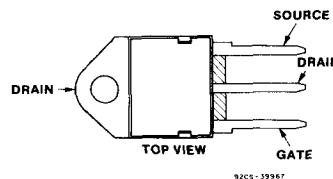
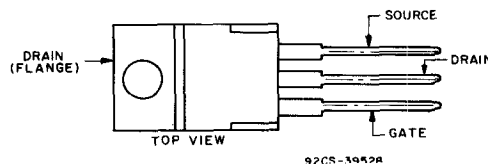
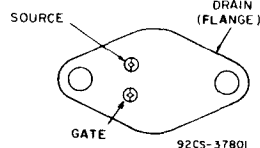
- Power supplies
- Motor drives
- Protection circuits

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**N-CHANNEL ENHANCEMENT MODE****TERMINAL DESIGNATION****JEDEC TO-218AC****JEDEC TO-220AB****JEDEC TO-204AA****MAXIMUM RATINGS,**

Absolute-Maximum Values ($T_C = 25^\circ\text{C}$):

	IGTH20N40	IGTM20N40	IGTP20N40	IGTP20N50	
	IGTH20N40A	IGTM20N40A	IGTP20N40A	IGTP20N50A	
COLLECTOR-EMITTER VOLTAGE, V_{CES}	400	500	400	500	V
COLLECTOR-GATE VOLTAGE ($R_{gs} = 1\text{ M}\Omega$), 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 @ $T_C = 25^\circ\text{C}$, P_T	100	100	75	75	W
Derate above $T_C = 25^\circ\text{C}$	0.8	0.8	0.6	0.6	W/ $^\circ\text{C}$
OPERATING AND STORAGE TEMPERATURE, T_j , T_{stg}			-55 to +150		$^\circ\text{C}$

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/IGTP20N40A
IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N50A
ELECTRICAL CHARACTERISTICS, At Case Temperature ($T_C = 25^\circ\text{C}$) unless otherwise specified

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

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IGTH/IGTM/IGTP20N50
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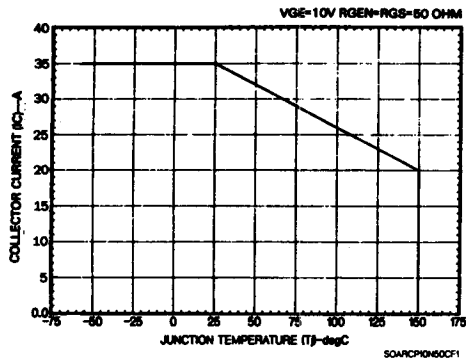


Fig. 1 - Maximum switching current level for all types. $R_g = 25 \Omega$, $V_{GE} = 0 \text{ V}$ are the minimum allowable values.

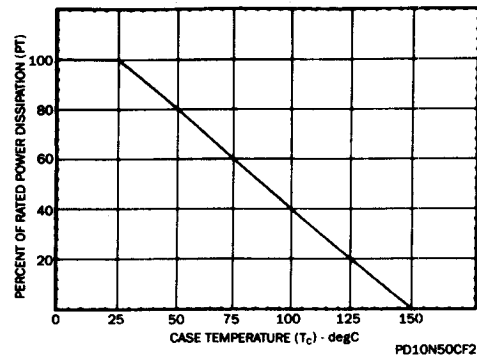


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

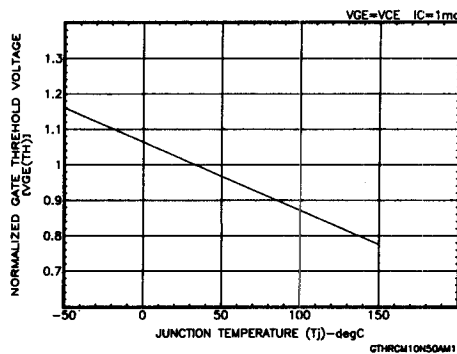


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

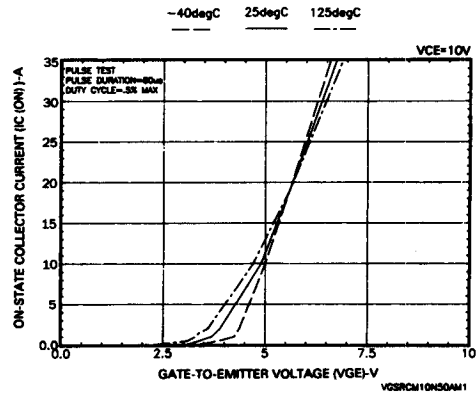


Fig. 4 - Typical transfer characteristics for all types.

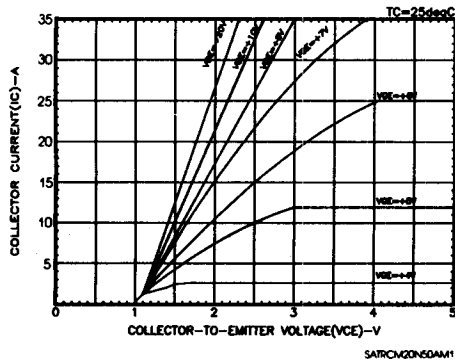


Fig. 5 - Typical saturation characteristics for all types.

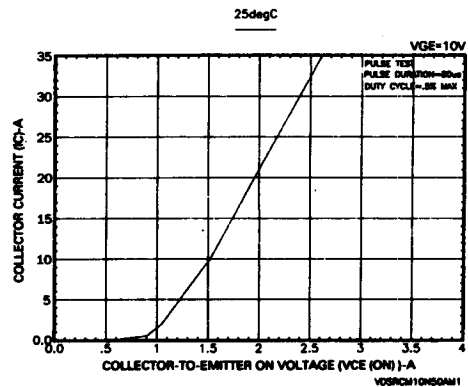


Fig. 6 - Typical collector-to-emitter on-voltage as a function of collector current for all types.

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IGTH/IGTM/IGTP20N50 IGTH/IGTM/IGTP20N50A

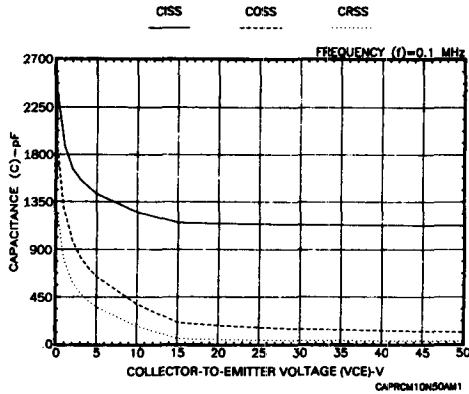


Fig. 7 - Capacitance as a function of collector-to-emitter voltage for all types.

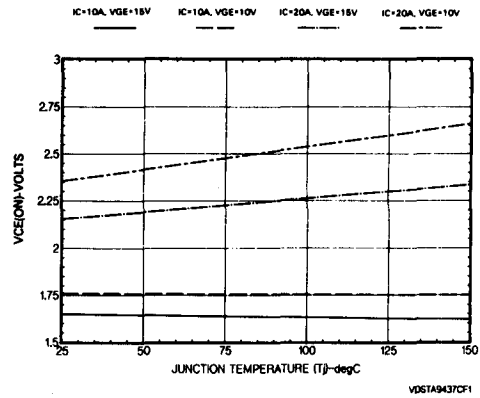


Fig. 8 - Typical $V_{CE(on)}$ vs. temperature for all types.

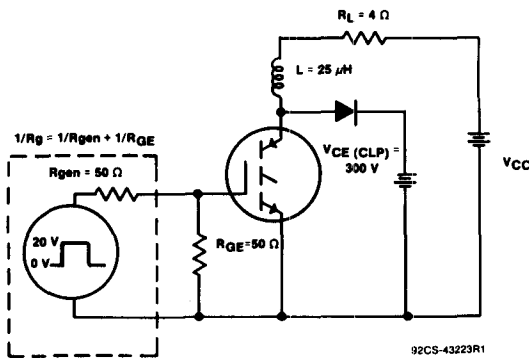


Fig. 9 - Inductive switching test circuit.

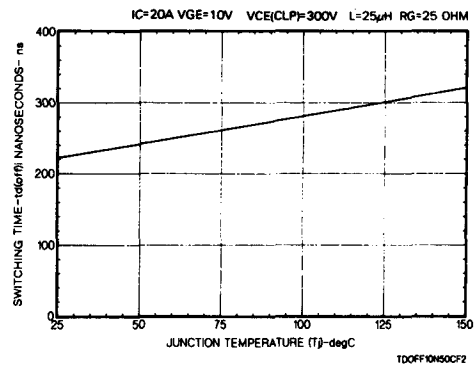


Fig. 10 - Typical turn-off delay time for all types.

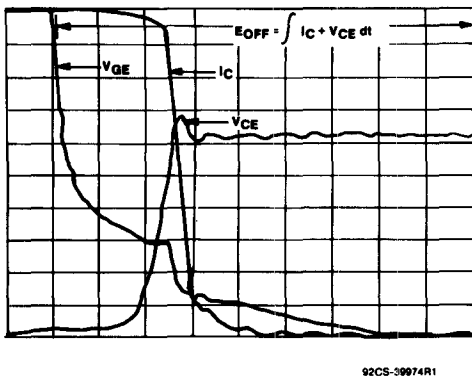


Fig. 11 - Typical inductive switching waveforms.

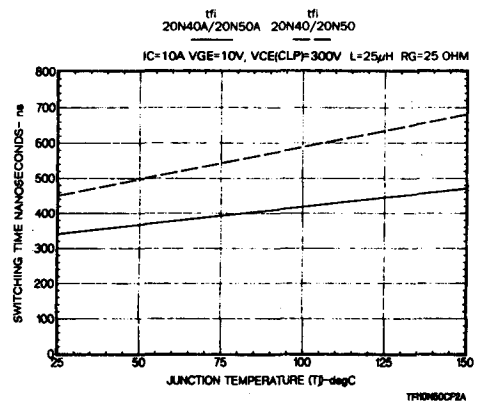


Fig. 12 - Typical fall time for all types.

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IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N50A

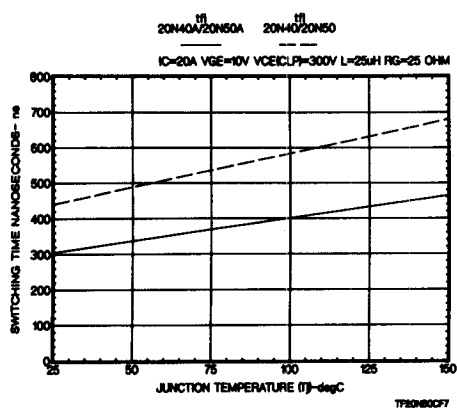


Fig. 13 - Typical fall time for all types ($I_C = 20 A$).

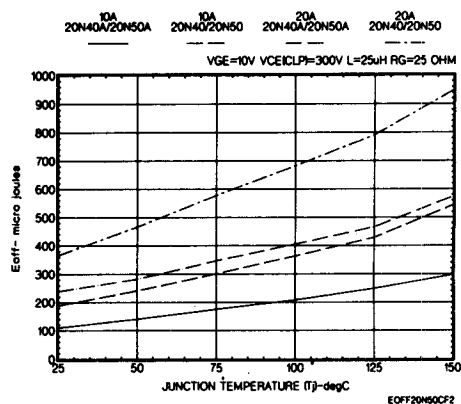
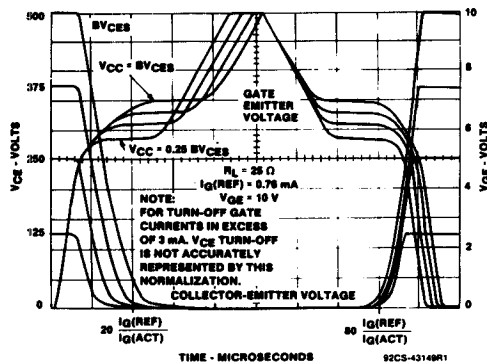


Fig. 14 - Typical clamped inductive turn-off switching loss/cycle.



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.