

IGTH/IGTM/IGTP20N40
IGTH/IGTM/IGTP20N40A

IGTH/IGTM/IGTP20N50
IGTH/IGTM/IGTP20N50A

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

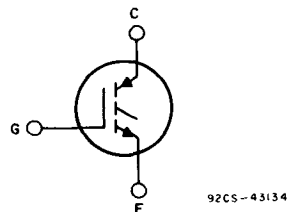
The RCH20N40, RCH20N40A, RCH20N50, RCH20N50A, RCP20N40, RCP20N40A, RCP20N50, RCP20N50A, RCM20N40, RCM20N40A, RCM20N50, RCM20N50A* are n-channel enhancement-mode conductivity-modulated power field-effect transistors designed for high-voltage, low on-dissipation applications such as switching regulators 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.

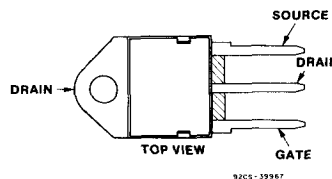
*The RCH and RCP series were formerly RCA Development Type Nos. TA9573XD and TA9573XV, respectively. The RCM series was formerly RCA Development Type No. TA9573XG.

TERMINAL DIAGRAM

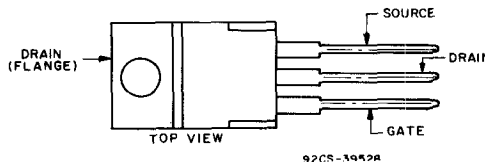


N-CHANNEL ENHANCEMENT MODE

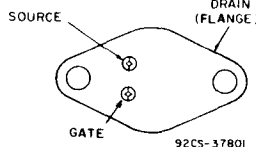
TERMINAL DESIGNATION



JEDEC TO-218AC



JEDEC TO-220AB



JEDEC TO-204AA

MAXIMUM RATINGS,

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

COLLECTOR-EMITTER VOLTAGE, V_{CES}
 COLLECTOR-GATE VOLTAGE ($R_{gs} = 1 M\Omega$), V_{CGR}
 REVERSE COLLECTOR-EMITTER VOLTAGE, $V_{CES(rev)}$..
 GATE-EMITTER VOLTAGE, V_{GE}
 COLLECTOR CURRENT, RMS Continuous, I_C
 Pulsed, I_{CM}
 POWER DISSIPATION @ $T_C = 25^\circ C$
 Derate above $T_C = 25^\circ C$
 OPERATING AND STORAGE TEMPERATURE, T_j, T_{stg}

| IGTH20N40 | IGTM20N40 | IGTP20N40 | IGTP20N50 | |
|------------|------------|-------------|------------|---------------|
| IGTH20N40A | IGTM20N40A | IGTP20N40A | IGTP20N50A | |
| IGTH20N50 | IGTM20N50 | IGTP20N40A | IGTP20N50A | |
| IGTH20N50A | IGTM20N50A | IGTP20N40A | IGTP20N50A | |
| 400 | 500 | 400 | 500 | V |
| 400 | 500 | 400 | 500 | V |
| | | -5 | | V |
| | | ± 20 | | V |
| | | 20 | | A |
| | | 35 | | A |
| 100 | 100 | 75 | 75 | W |
| 0.8 | 0.8 | 0.6 | 0.6 | W/ $^\circ C$ |
| | | -55 to +150 | | $^\circ C$ |

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 ($T_c = 25^\circ\text{C}$) 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} | $V_{CE} = 400\text{ V}$ $V_{CE} = 500\text{ V}$ | — | 250 | — | — | μA |
| | | $T_C = 125^\circ\text{C}$ $V_{CE} = 400\text{ V}$ $V_{CE} = 500\text{ V}$ | — | — | — | — | |
| | | | — | 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 | $V_{CE(CLPI)} = 300\text{ V}$ | — | 50 | — | 50 | |
| Turn-Off Delay Time | $t_d(off)$ | $L = 25\ \mu\text{H}$ | — | 400 | — | 400 | |
| Fall Time | t_f | $T_J = 100^\circ\text{C}$ $V_{GE} = 10\text{ V}$ $R_g = 25\ \Omega$ | Typ. 680 | 1000 | Typ. 680 | 1000 | |
| | | 20N40 20N50 | 400 | 500 | 400 | 500 | |
| Turn-Off Energy Loss per Cycle (off switching dissipation = E_{off} x frequency) | E_{off} | $I_C = 10\text{ A}$ $V_{CE(CLPI)} = 300\text{ V}$ $L = 25\ \mu\text{H}$ $T_J = 100^\circ\text{C}$ $V_{GE} = 10\text{ V}$ $R_g = 25\ \Omega$ | 1810 (typ.) | | | | μJ |
| | 20N40A 20N50A | 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/IGTP20N40 IGTH/IGTM/IGTP20N50
 IGTH/IGTM/IGTP20N40A IGTH/IGTM/IGTP20N50A

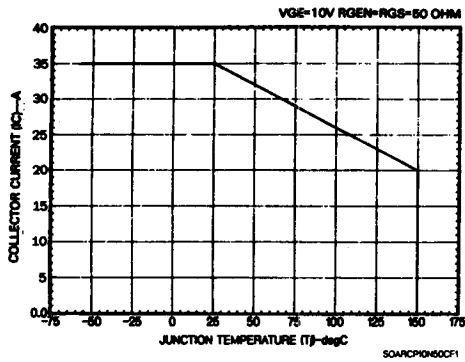


Fig. 1 - Maximum switching current level for all types. $R_{\theta} = 25 \Omega$, $V_{GE} = 0 V$ are the minimum allowable values.

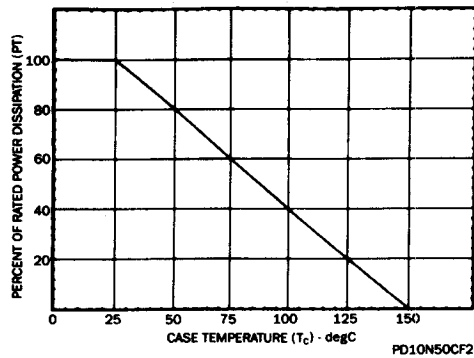


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

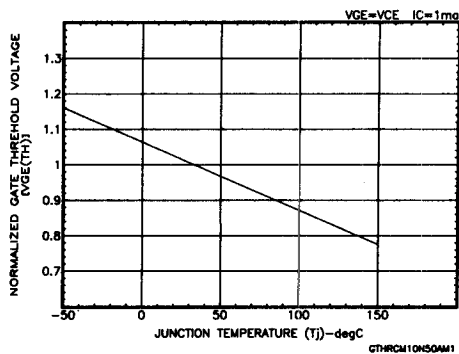


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

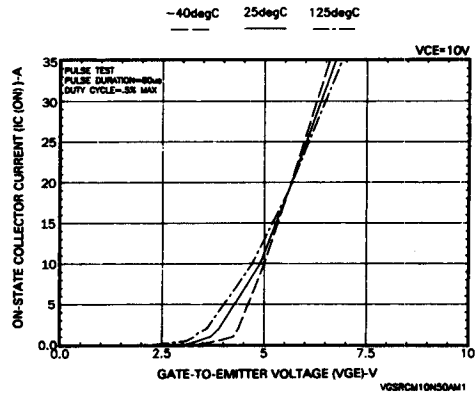


Fig. 4 - Typical transfer characteristics for all types.

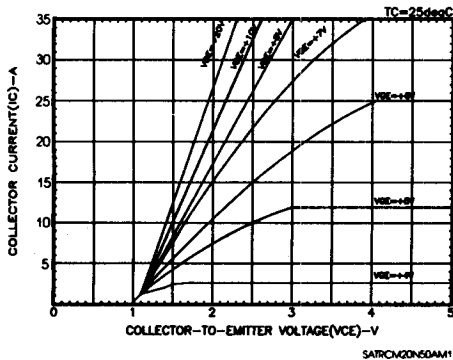


Fig. 5 - Typical saturation characteristics for all types.

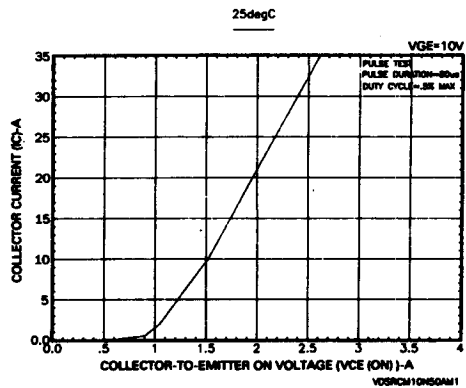


Fig. 6 - Typical collector-to-emitter on-voltage as a function of collector current for all types.

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

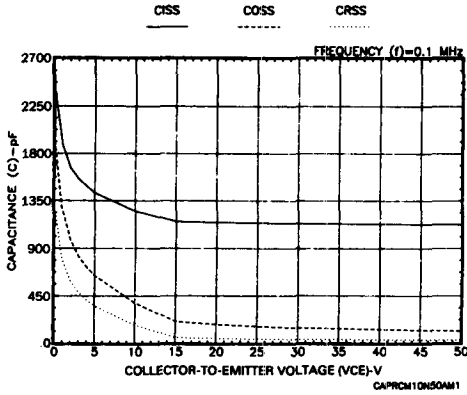


Fig. 7 - Capacitance as a function of collector-to-emitter voltage for all types.

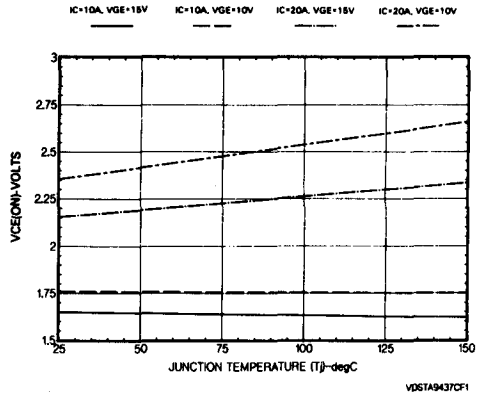


Fig. 8 - Typical VCE (on) vs. temperature for all types.

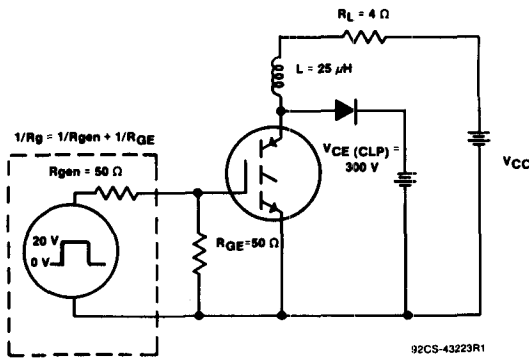


Fig. 9 - Inductive switching test circuit.

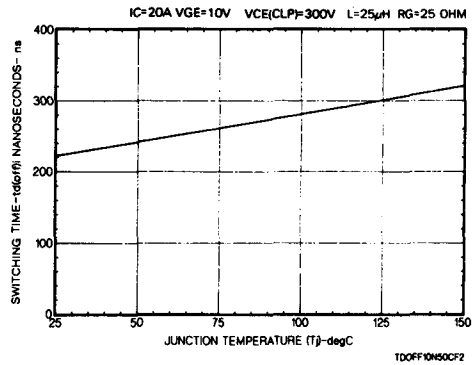


Fig. 10 - Typical turn-off delay time for all types.

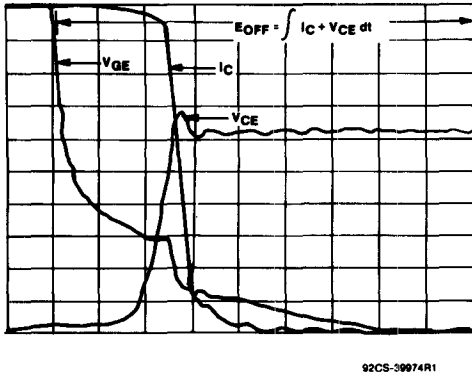


Fig. 11 - Typical inductive switching waveforms.

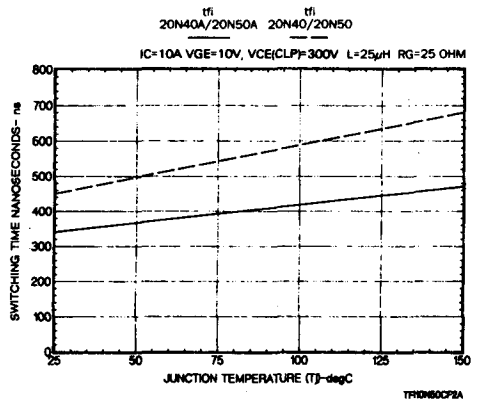


Fig. 12 - Typical fall time for all types.

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

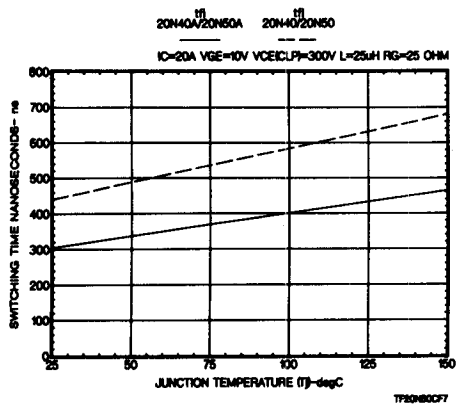


Fig. 13 - Typical fall time for all types ($I_c = 20$ A).

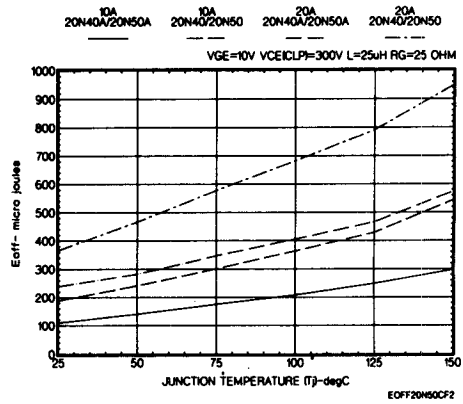
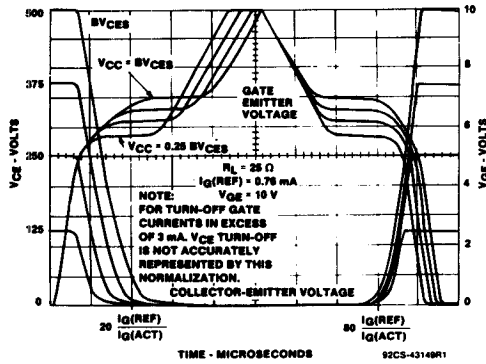


Fig. 14 - Typical clamped inductive turn-off switching loss/cycle.



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.