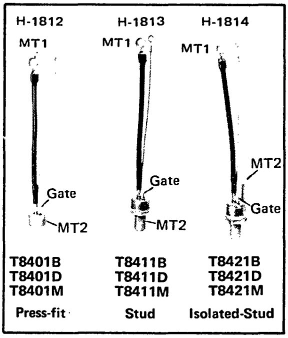
RCA
Solid State Division

Thyristors

T8401 T8411 T8421 Series



60-A Silicon Triacs

For Phase-Control and Load-Switching Applications

Features:

- di/dt Capability = 300 A/µs
- Low On-State Voltage at High Current Levels
- Shorted-Emitter, Center-Gate Design
- Low Thermal Resistance
- Low Switching Losses

Package \ Voltage	200 V	400 V	600 V
Press-fit	T8401B (41029)	T8401D (41030)	T8401M (41031)
Stud	T8411B (41032)	T8411D (41033)	T8411M (41034)
Iso-stud	T8421B (41035)	T8421D (41036)	T8421M (41037)

Numbers in parentheses (e.g. 41029) are former RCA type numbers

RCA T8401, T8411, and T8421 series triacs are gate-controlled, full-wave silicon ac switches. They are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative triggering voltages.

These triacs are intended for control of ac loads in applications such as heating controls motor controls, arc-welding equipment, light dimmers, and power switching systems. They can also be used in air-conditioning and photocopying equipment

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at Frequencies up to 50/60 Hz and with Resistive or Inductive Load.

		T8401B T8411B T8421B	T8401D T8411D T8421D	T8401M T8421M T8421M	
REPETITIVE PEAK OFF-STATE VOLTAGE:●	V_{DROM}				
Gate open, T_J = −40 to 110°C		200	400	600	V
RMS ON-STATE CURRENT (Conduction angle = 360°):	$I_{T(RMS)}$				
Case Temperature					
T_C = 85°C (Press-Fit types)			60		A
80°C (Stud types)			60		A
75°C (Isolated-Stud types)			60		A
For other conditions			See Fig. 3		
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}				
For one cycle of applied principal voltage, T_C as above					
60 Hz (sinusoidal)			600		A
50 Hz (sinusoidal)			500		A
For more than one cycle of applied principal voltage			See Fig. 4		
RATE OF CHANGE OF ON-STATE CURRENT:					
$V_{DM} = V_{DROM}$, I_{GT} = 300 mA, t_r = 0.1 µs (See Fig. 13)	di/dt		300		A/µs
FUSING CURRENT (for Triac Protection):					
T_J = −40 to 110°C, t = 1.25 to 10 ms	I^2t		1800		A^2s
PEAK GATE-TRIGGER CURRENT:■					
For 10 µs max. (See Fig. 7)	I_{GTM}		7		A
GATE POWER DISSIPATION (See Fig. 7):					
Peak (For 10 µs max., $I_{GTM} \leqslant$ 7 A (peak)	P_{GM}		42		W
AVERAGE	$P_{G(AV)}$		0.75		W
TEMPERATURE RANGE:▲					
Storage	T_{stg}		−40 to 150		°C
Operating (Case)	T_C		−40 to 110		°C
TERMINAL TEMPERATURE (During soldering):					
For 10 s max. (terminals and case)	T_T		225		°C
STUD TORQUE:	τ_s				
Recommended			125		in-lb
Maximum (DO NOT EXCEED)			150		in-lb

● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1. ▲ For temperature measurement reference point, see Dimensional Outline.

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ELECTRICAL CHARACTERISTICS *At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperature*

CHARACTERISTIC	SYMBOL	LIMITS For All Types Except as Specified			UNITS
		MIN.	TYP.	MAX.	
Peak Off-State Current:• Gate open, V_{DROM} = Max. rated value	I_{DROM}	–	0.4	4	mA
Maximum On-State Voltage:• For i_T = 100 A (peak), T_C = 25°C	v_{TM}	–	1.55	1.8	V
DC Holding Current:• Gate open, Initial principal current = 500 mA (dc) v_D = 12 V, T_C = 25°C	I_{HO}	–	20	60	mA
T_C = −40°C		–	–	85	mA
For other case temperatures		See Fig. 6			
Critical Rate-of-Rise of Commutation Voltage:• For $v_D = V_{DROM}$, $I_{T(RMS)}$ = 60 A, commutating di/dt = 32 A/ms; gate unenergized, (See Fig. 14): T_C = 75°C (Press-fit types)	dv/dt	3	10	–	V/μs
= 65°C (Stud types)		3	10	–	V/μs
= 55°C (Isolated-stud types)		3	10	–	V/μs
Critical Rate-of-Rise of Off-State Voltage:• For $v_D = V_{DROM}$, exponential voltage rise, gate open, T_C = 110°C: T8401B, T8411B, T8421B	dv/dt	50	200	–	V/μs
T8401D, T8411D, T8421D		30	150	–	V/μs
T8401M, T8411M, T8421M		20	100	–	V/μs
DC Gate-Trigger Current:•▪ For v_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C — Mode I+, V_{MT2} positive, V_G positive	I_{GT}	–	20	75	mA
Mode III−, V_{MT2} negative, V_G negative		–	40	75	mA
Mode I−, V_{MT2} positive, V_G negative		–	40	150	mA
Mode III+, V_{MT2} negative, V_G positive		–	100	150	mA
For v_D = 12 V (dc), R_L = 30 Ω, T_C = −40°C — Mode I+, V_{MT2} positive, V_G positive		–	35	150	mA
Mode III−, V_{MT2} negative, V_G negative		–	80	150	mA
Mode I−, V_{MT2} positive, V_G negative		–	100	400	mA
Mode III+, V_{MT2} negative, V_G positive		–	280	400	mA
For other case temperatures		See Figs. 8 & 9			
DC Gate-Trigger Voltage:•▪ For v_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C	V_{GT}	–	1.35	2.8	V
For other case temperatures		See Fig. 10			
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For $v_D = V_{DROM}$, I_{GT} = 300 mA, t_r = 0.1 μs, i_T = 85 A (peak), T_C = 25°C (See Figs. 11 & 15)	t_{gt}	–	1.2	2.5	μs
Thermal Resistance, Junction-to-Case: Steady-State Press-fit types	$R_{\theta JC}$	–	–	0.3	°C/W
Stud types		–	–	0.35	°C/W
Isolated-stud types		–	–	0.4	°C/W
Transient (Press-fit & Stud types)		See Fig. 12			

• For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
▪ For either polarity of gate voltage (V_G) with reference to main terminal 1.

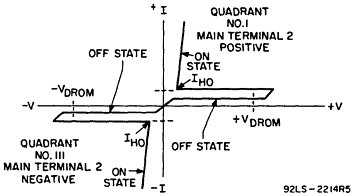


Fig. 1 — Principal voltage-current characteristic.

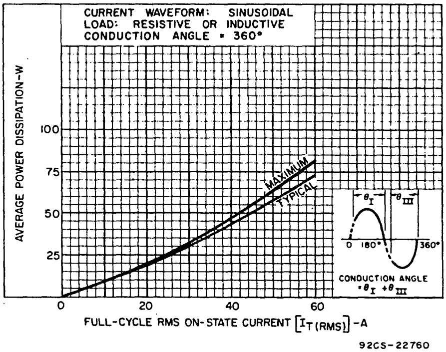


Fig. 2 — Power dissipation vs. on-state current.

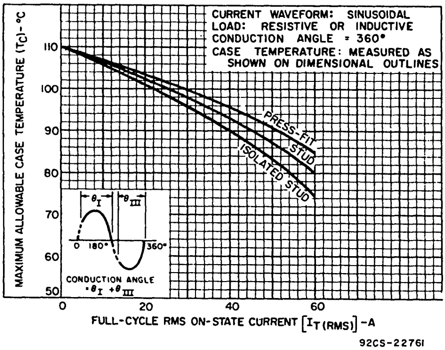


Fig. 3 — Maximum allowable case temperature vs. on-state current.

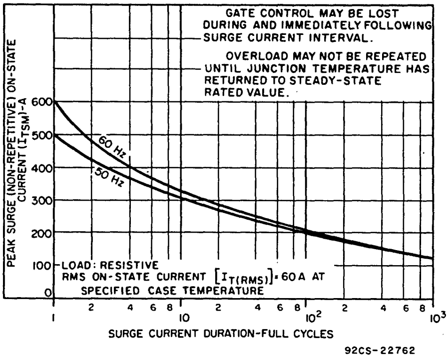


Fig. 4 — Peak surge on-state current vs. surge current duration.

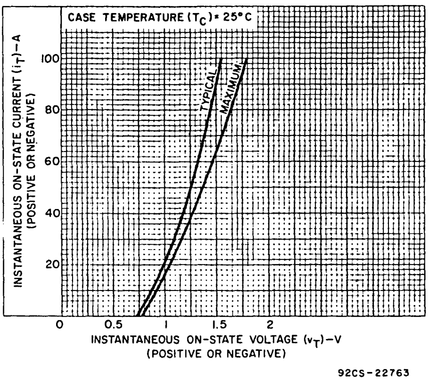


Fig. 5 — On-state current vs. on-state voltage.

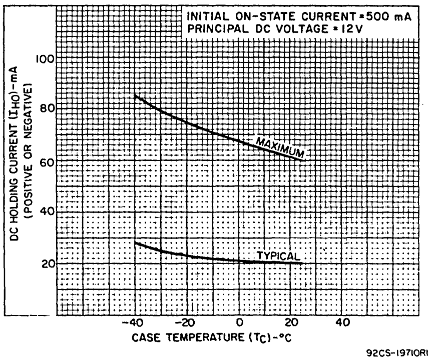


Fig. 6 — DC holding current vs. case temperature.

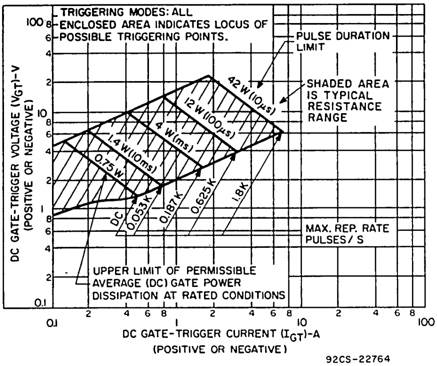


Fig. 7 — Gate-trigger characteristic and limiting conditions for determination of permissible gate-trigger pulses.

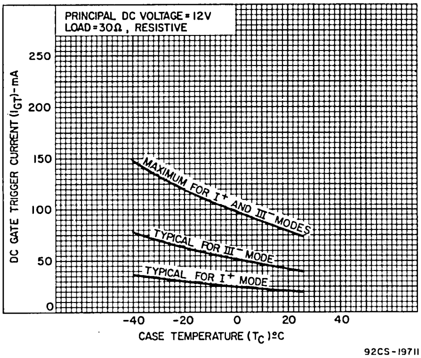


Fig. 8 — DC gate-trigger current vs. case temperature (I^+ and III^- modes).

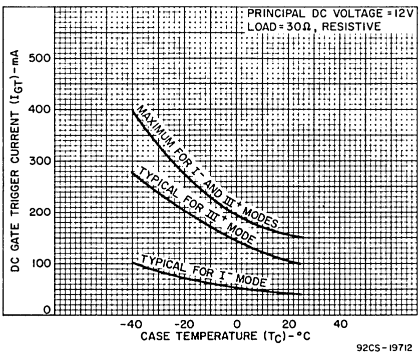


Fig. 9 — DC gate-trigger current vs. case temperature (I^- and III^+ modes).

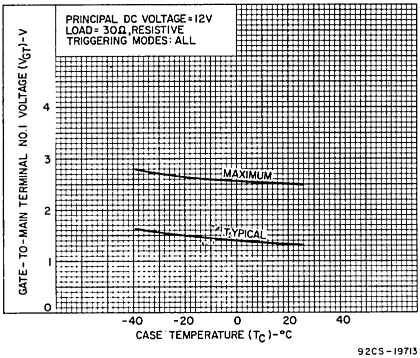


Fig. 10 — DC gate-trigger voltage vs. case temperature.

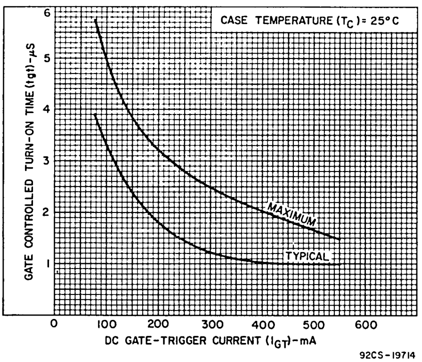


Fig. 11 — Turn on time vs. gate-trigger current.

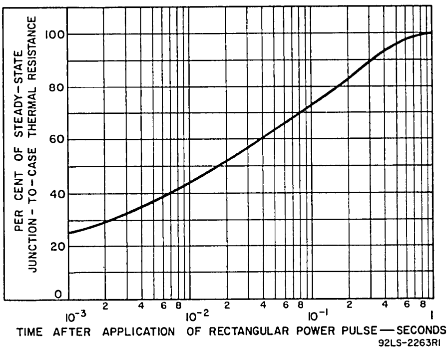
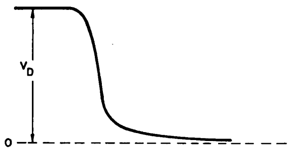


Fig. 12 — Transient junction-to-case thermal resistance vs. time.



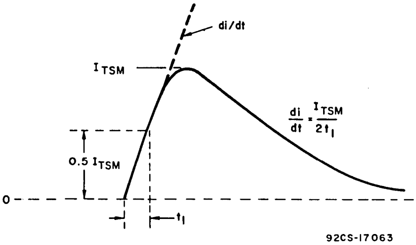


Fig. 13 — Rate-of-change of on-state current with time (defining di/dt).

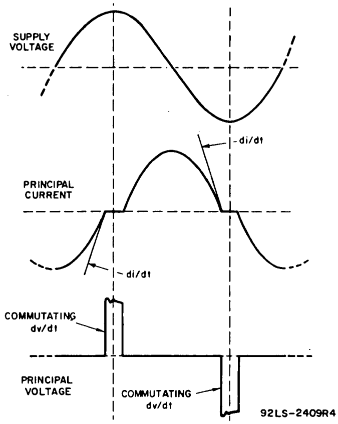


Fig. 14 — Relationship between supply voltage and principal current (inductive load) showing reference points for definition of commutating voltage (dv/dt).

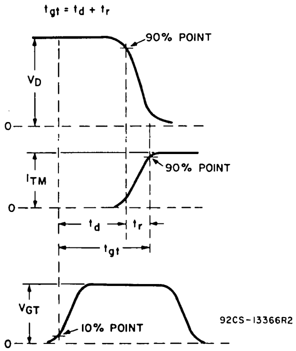


Fig. 15 — Relationship between off-state voltage, on-state current, and gate-trigger voltage showing reference points for definition of turn-on time (t_{gt}).

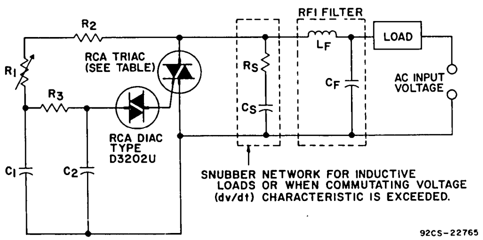


Fig. 16 — Typical phase-control circuit for lamp dimming, heat control, and universal-motor speed control.

TERMINAL CONNECTIONS FOR ALL TYPES

No. 1 — Gate
No. 2 — Main Terminal 1
Case, No. 3 — Main Terminal 2

WARNING: The ceramic of the isolated stud package contains beryllium oxide. Do not crush, grind, or abrade this part because the dust resulting from such action may be hazardous if inhaled, Disposal should be by burial.

AC INPUT VOLTAGE		120 V 60 Hz	240 V 60 Hz	240 V 50 Hz
C_1		0.1 µF 200 V	0.1 µF 400 V	0.1 µF 400 V
C_2		0.1 µF 100 V	0.1 µF 100 V	0.1 µF 100 V
R_1		100 kΩ ½ W	200 kΩ ½ W	250 kΩ ½ W
R_2		2.2KΩ 1/2W	3.3KΩ 1/2W	3.3KΩ 1/2W
R_3		15 kΩ ½ W	15 kΩ ½ W	15 kΩ ½ W
SNUBBER NETWORK FOR 60 A (RMS)• INDUCTIVE LOAD	C_S	0.18 0.22 µF 200 V	0.18 0.22 µF 400 V	0.18 0.22 µF 400 V
	R_S	330 390 Ω ½ W	330 390 Ω ½ W	330 390 Ω ½ W
RFI FILTER	C_F•	0.1 µF 200 V	0.1 µF 400 V	0.1 µF 400 V
	L_F•	100 µH	200 µH	200 µH
RCA TRIACS		T8401B T8411B T8421B	T8401D T8411D T8421D	T8401D T8411D T8421D

• For other RMS Current values refer to RCA Application Note AN-4745.

• Typical values for Lamp dimming circuits.