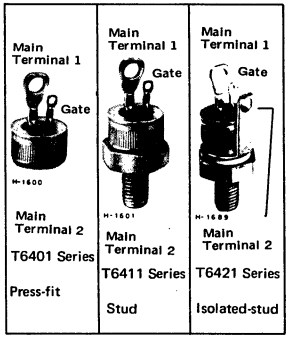
RCA
Solid State
Division

Thyristors

T6401 T6411 T6421 Series



30-A Silicon Triacs

Features:

- di/dt Capability = 100 A/μs
- Shorted-Emitter Center-Gate Design
- Low Switching Losses
- Low On-State Voltage at High Current Levels
- Low Thermal Resistance

Package \ Voltage	200 V Types	400 V Types	600 V Types
Pressfit	T6401B (40660)	T6401D (40661)	T6401M (40671)
Stud	T6411B (40662)	T6411D (40663)	T6411M (40672)
Isolated-Stud	T6421B (40805)	T6421D (40806)	T6421M (40807)

Numbers in parentheses are former RCA type numbers.

These RCA 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 gate 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.

		T6401B T6411B T6421B	T6401D T6411D T6421D	T6401M T6411M T6421M	
REPETITIVE PEAK OFF-STATE VOLTAGE:●					
Gate open, T_J = −50 to 100° C	V_{DROM}	200	400	600	V
RMS ON-STATE CURRENT (Conduction angle = 360°):					
Case temperature	$I_{T(RMS)}$				
T_C = 65° C (Press-fit types)			30		A
= 60° C (Stud types)			30		A
= 55° C (Isolated-stud types)			30		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)			300		A
50 Hz (sinusoidal)			265		A
For more than one cycle of applied principal voltage			See *Fig. 4*		
RATE-OF-CHANGE OF ON-STATE CURRENT:	di/dt				
V_{DM}= V_{DROM}, I_{GT} = 200 mA, t_r = 0.1 μs (See *Fig. 13)*			100		A/μs
FUSING CURRENT (for triac protection):					
T_J = -40 to 100 °C, t = 1.25 to 10 ms	I^2t		450		A^2s
PEAK GATE-TRIGGER CURRENT:■	I_{GTM}				
For 1 μs max., See *Fig. 7*			12		A
GATE POWER DISSIPATION:					
PEAK (For 1 μs max., $I_{GTM} \leq$ 4 A, See *Fig. 7)*	P_{GM}		40		W
AVERAGE	$P_{G(AV)}$		0.75		W
TEMPERATURE RANGE:▲					
Storage	T_{stg}		−65 to 150		°C
Operating (Case)	T_C		−65 to 100		°C
TERMINAL TEMPERATURE (During soldering):	T_T				
For 10 s max. (terminals and case)			225		°C

MAXIMUM RATINGS, *Absolute-Maximum Values:*

For Operation with Sinusoidal Supply Voltage at Frequencies up to 50/60 Hz and with Resistive or Inductive Load.

	T6401B T6411B T6421B	T6401D T6411D T6421D	T6401M T6411M T6421M
STUD TORQUE:			
Recommended		35	in-lb
Maximum (DO NOT EXCEED)		50	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.

ELECTRICAL CHARACTERISTICS

At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	LIMITS Min.	LIMITS Typ.	LIMITS Max.	UNITS
Peak Off-State Current:● Gate open, T_J = 100° C, V_{DROM} = Max. rated value	I_{DROM}	–	0.2	4	mA
Maximum On-State Voltage:● For i_T = 100 A (peak), T_C = 25° C	V_{TM}	–	2.1	2.5	V
DC Holding Current:● Gate open, Initial principal current = 150 mA (DC), v_D = 12V: T_C = 25° C	I_{HO}	–	25	60	mA
For other case temperatures			See *Fig. 6*		
Critical Rate-of-Rise of Commutation Voltage:● For v_D = V_{DROM}, $I_{T(RMS)}$ = 30 A, commutating di/dt = 16 A/ms, gate unenergized, (See *Fig. 14*): T_C = 65° C (Press-fit types)	dv/dt	3	20	–	V/μs
= 60° C (Stud types)		3	20	–	
= 55° C (Isolated-stud types)		3	20	–	
Critical Rate-of-Rise of Off-State Voltage:● For v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 100° C: T6401B, T6411B, T6421B	dv/dt	40	200	–	V/μs
T6401D, T6411D, T6421D		25	150	–	
T6401M, T6411M, T6421M		20	100	–	
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}	–	15	50	mA
Mode III- (V_{MT2} negative, V_G negative)		–	20	50	
Mode I- (V_{MT2} positive, V_G negative)		–	30	80	
Mode III+ (V_{MT2} negative, V_G positive)		–	40	80	
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	2.5	V
For other case temperatures			See *Fig. 10*		
For v_D = V_{DROM}, R_L = 125 Ω, T_C = 100° C		0.2	–	–	
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 200 mA, t_r = 0.1 μs, i_T = 45 A (peak), T_C = 25° C (See *Figs. 11 & 15*)	t_{gt}	–	1.7	3	μs
Thermal Resistance, Junction-to-Case: Steady-State Press-fit types	$\theta_{J\text{-}C}$	–	–	0.8	°C/W
Stud		–	–	0.9	
Transient (Press-fit & stud types)			See *Fig. 12*		
Thermal Resistance, Junction-to-Hex (Stud, See Dim. Outline): Steady-State (Isolated-stud types)	$\theta_{J\text{-}IH}$	–	–	1	

● 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.

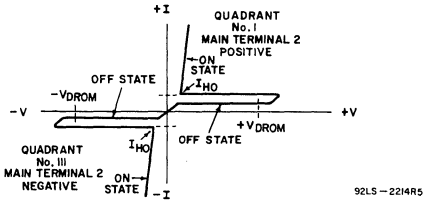


Fig. 1 – Principal voltage-current characteristic.

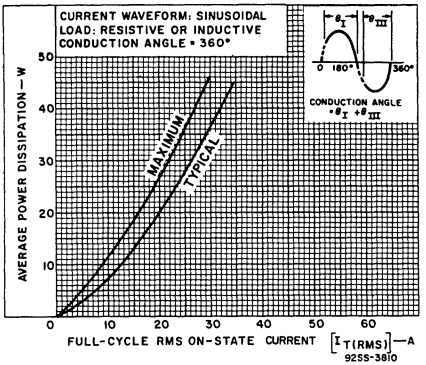


Fig. 2 – Power dissipation vs. on-state current.

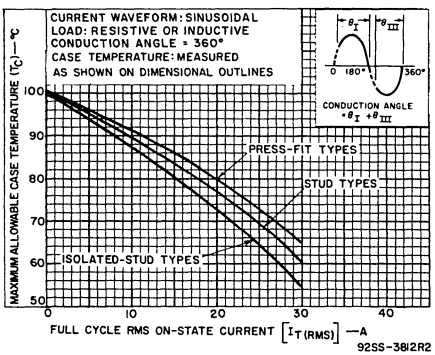


Fig. 3 – Maximum allowable case temperature vs. on-state current.

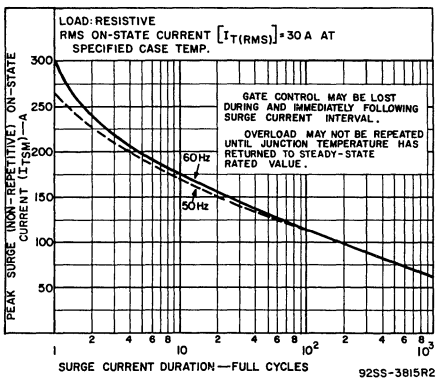


Fig. 4 – Peak surge on-state current vs. surge current duration.

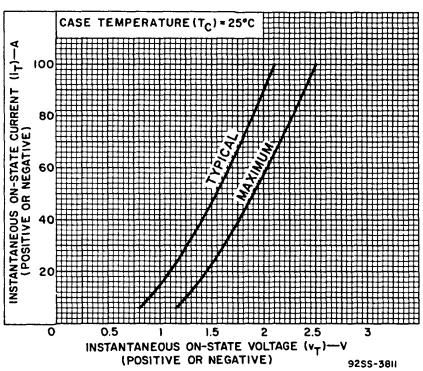


Fig. 5 – On-state current vs. on-state voltage.

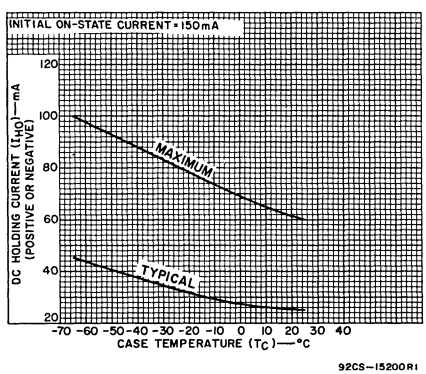


Fig. 6 – DC holding current vs. case temperature.

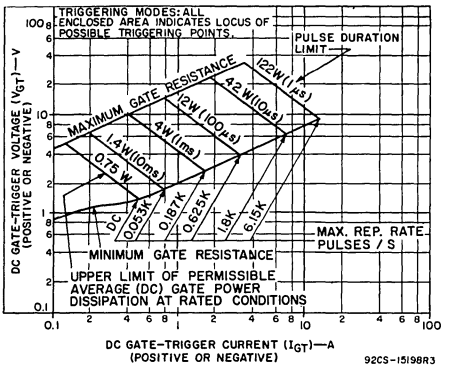


Fig. 7 – Gate trigger characteristics and limiting conditions for determination of permissible gate trigger pulses.

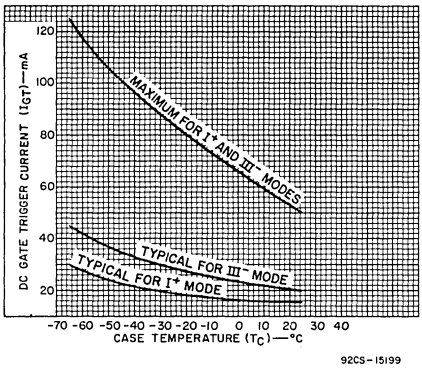


Fig. 8 – DC gate-trigger current vs. case temperature (I^+ & III^- modes).

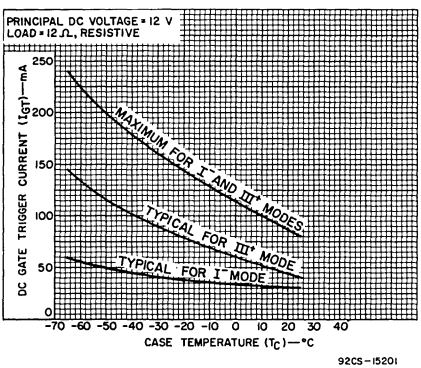


Fig. 9 – DC gate-trigger current vs. case temperature (I^- & III^+ modes).

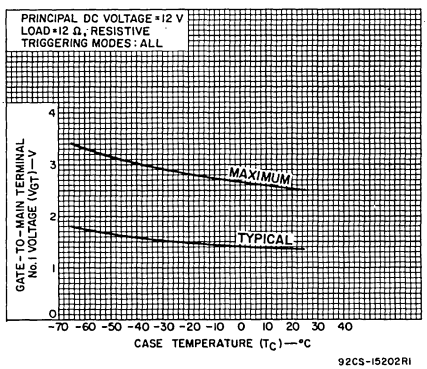


Fig. 10 – DC gate-trigger voltage vs. case temperature.

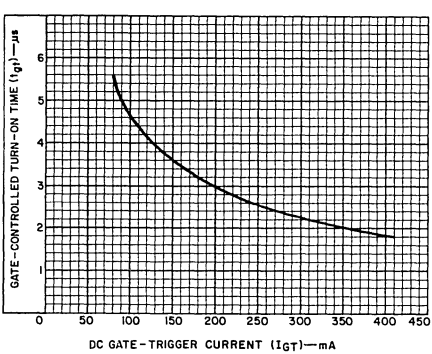


Fig. 11 – Turn-on time vs. gate trigger current.

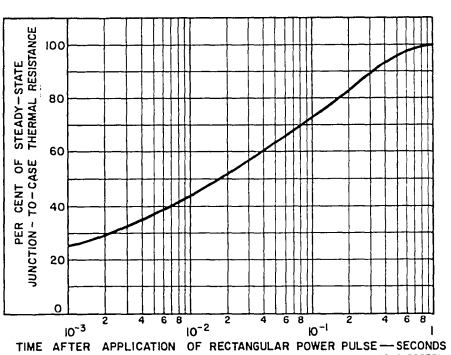


Fig. 12 – Transient junction-to-case thermal resistance vs. time.

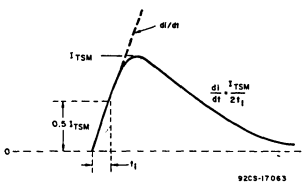


Fig. 13 – Rate of change of on-state current with time (defining di/dt).

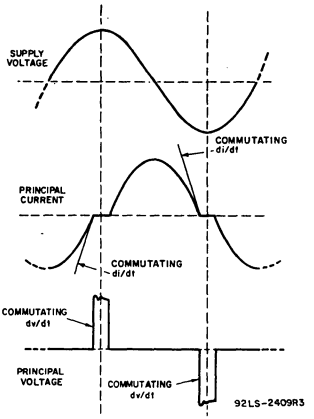


Fig. 14 – Relationship between supply voltage and principle current (inductive load) showing reference points for definition of commutating voltage (dv/dt).

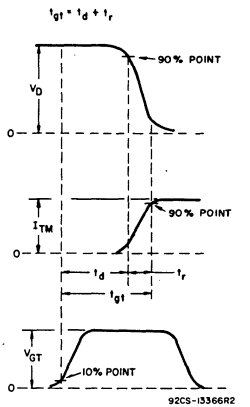


Fig. 15 – Relationship between off-state voltage, on-state current, and gate-trigger voltage showing reference points for definition of turn-on time (t_{gt}).

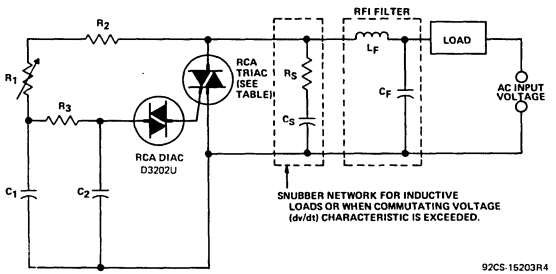


Fig. 16 – Typical phase-control circuit for lamp dimming, heat control, and universal-motor speed control.

AC INPUT VOLTAGE		120V 60Hz	240V 60Hz	240V 50Hz
C_1		0.1μF 200V	0.1μF 400V	0.1μF 400V
C_2		0.1μF 100V	0.1μF 100V	0.1μF 100V
R_1		100KΩ 1/2W	200KΩ 1W	250KΩ 1W
R_2		2.2KΩ 1/2W	3.3KΩ 1/2W	3.3KΩ 1/2W
R_3		15KΩ 1/2W	15KΩ 1/2W	15KΩ 1/2W
SNUBBER NETWORK	C_S	0.1μF 200V	0.1μF 400V	0.1μF 400V
	R_S	100Ω 1/2W	100Ω 1/2W	100Ω 1/2W
RFI FILTER	C_F*	0.1μF 200V	0.1μF 400V	0.1μF 400V
	L_F*	100μH	200μH	200μH
RCA TRIACS		T6401B T6411B T6421B	T6401D T6411D T6421D	T6401D T6411D T6421D

*Typical values for lamp dimming circuits.

WARNING:
The RCA isolated-stud package thyristors should be handled with care. The ceramic portion of these thyristors contains BERYLLIUM OXIDE as a major ingredient. Do not crush, grind, or abrade these portions of the thyristors because the dust resulting from such action may be hazardous if inhaled.

TERMINAL CONNECTIONS

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