

T6401, T6411, T6421 Series

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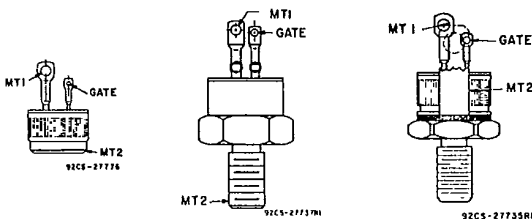
30-A Silicon Triacs

For Power-Switching and Power Control

Features:

- 800V, 125 Deg. C T_J Operating
- High dv/dt and di/dt Capability
- Low Switching Losses
- High Pulse Current Capability
- Low Forward and Reverse Leakage
- Sipos Oxide Glass Multilayer Passivation System
- Advanced Unisurface Construction
- Precise Ion Implanted Diffusion Source

TERMINAL DESIGNATIONS

PRESS-FIT TYPES
T6401 SERIESSTUD TYPES
T6411 SERIESISOLATED-STUD TYPES
T6421 SERIES

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 applica-

tions 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:

REPETITIVE PEAK OFF-STATE VOLTAGE:*

Gate open, $T_J = -50$ to 125°C RMS ON-STATE CURRENT (Conduction angle = 360°):

Case temperature

 $T_C = 90^\circ\text{C}$ (Press-fit types) $= 85^\circ\text{C}$ (Stud types) $= 80^\circ\text{C}$ (Isolated-stud types)

For other conditions

PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:

For one cycle of applied principal voltage

60 Hz (sinusoidal)

50 Hz (sinusoidal)

For more than one cycle of applied principal voltage

RATE-OF-CHANGE OF ON-STATE CURRENT:

 $V_{DM} = V_{DROM}$, $I_{GT} = 200\text{ mA}$, $t_r = 0.1\text{ }\mu\text{s}$ (See Fig. 13)

FUSING CURRENT (for triac protection):

 $T_J = -40$ to 100°C , $t = 1.25$ to 10 ms

PEAK GATE-TRIGGER CURRENT:■

For $1\text{ }\mu\text{s}$ max., See Fig. 7

GATE POWER DISSIPATION:■

PEAK (For $1\text{ }\mu\text{s}$ max., $I_{GTM} \leq 4\text{ A}$, See Fig. 7)

AVERAGE

TEMPERATURE RANGE:▲

Storage

Operating (Case)

TERMINAL TEMPERATURE (During soldering):

For 10 s max. (terminals and case)

STUD TORQUE:

Recommended

Maximum (DO NOT EXCEED)

	T6401B	T6401D	T6401M	T6401N	
	T6411B	T6411D	T6411M	T6411N	
	T6421B	T6421D	T6421M	—	
V_{DROM}	200	400	600	800	V
$I_{T(RMS)}$			30		A
			30		A
			30		A
			See Fig. 3		
I_{TSM}			300		A
			265		A
			See Fig. 4		
di/dt			100		A/ μs
I^2t			450		A ^2s
I_{GTM}			12		A
P_{GM}			40		W
$P_{G(AV)}$			0.75		W
T_{slg}			-65 to 150		$^\circ\text{C}$
T_C			-65 to 100		$^\circ\text{C}$
T_T			225		$^\circ\text{C}$
			35		in-lb
			50		in-lb

*For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.■For either polarity to 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			UNITS
		For All Types Unless Otherwise Specified			
		Min.	Typ.	Max.	
Peak Off-State Current:* Gate open, $T_J = 125^\circ\text{C}$, $V_{\text{DROM}} = \text{Max. rated value}$	I_{DROM}	—	0.2	4	mA
Maximum On-State Voltage:* For $I_T = 100\text{ A (peak)}$, $T_C = 25^\circ\text{C}$	V_{TM}	—	2.1	2.5	V
DC Holding Current:* Gate open, Initial principal current = 150 mA (DC), $v_D = 12\text{V}$: $T_C = 25^\circ\text{C}$	I_{HO}	—	25	60	mA
			See Fig. 6		
Critical Rate-of-Rise of Commutation Voltage:* For $v_D = V_{\text{DROM}}$, $I_{\text{T(RMS)}} = 30\text{ A}$, commutating $di/dt = 16\text{ A/ms}$, gate unenergized (See Fig. 14): $T_C = 90^\circ\text{C}$ (Press-fit types)	dv/dt	3	20	—	V/ μs
$= 85^\circ\text{C}$ (Stud types)		3	20	—	
$= 80^\circ\text{C}$ (Isolated-stud types)		3	20	—	
Critical Rate-of-Rise of Off-State Voltage:* For $v_D = V_{\text{DROM}}$, exponential voltage rise, gate open, $T_C = 125^\circ\text{C}$: T6401B, T6411B, T6421B	dv/dt	40	200	—	V/ μs
T6401D, T6411D, T6421D		25	150	—	
T6401M, T6411M, T6421M		20	100	—	
T6401N, T6411N		10	50	—	
DC Gate-Trigger Current:*** Mode V_{MT2} V_G For $v_D = 12\text{ V (DC)}$, $R_L = 30\ \Omega$, $T_C = 25^\circ\text{C}$	I_{GT}	— — — — —	15 20 30 40 40	50 50 80 80 80	mA
For other case temperatures			See Figs. 8 & 9		
DC Gate-Trigger Voltage:*** For $v_D = 12\text{ V (DC)}$, $R_L = 30\ \Omega$, $T_C = 25^\circ\text{C}$	V_{GT}	— 0.2	1.35 See Fig. 10 —	2.5 —	V
For $v_D = V_{\text{DROM}}$, $R_L = 125\ \Omega$, $T_C = 100^\circ\text{C}$					
Gate-Controlled Turn-On Time: (Delay Time = Rise Time) For $v_D = V_{\text{DROM}}$, $I_{\text{GT}} = 200\text{ mA}$, $t_r = 0.1\ \mu\text{s}$, $i_T = 45\text{ A (peak)}$, $T_C = 25^\circ\text{C}$ (See Figs. 7 & 12)	t_{gt}	—	1.7	3	μs
Thermal Resistance, Junction-to-Case: Steady-State Press-fit types	R_{JJC}	—	—	0.8	$^\circ\text{C/W}$
Stud		—	—	0.9	
Transient (Press-fit & stud types)		See Fig. 2			
Thermal Resistance, Junction-to-Hex (Stud, See Dim. Outline): Steady-State (Isolated-stud types)	R_{JHH}	—	—	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.

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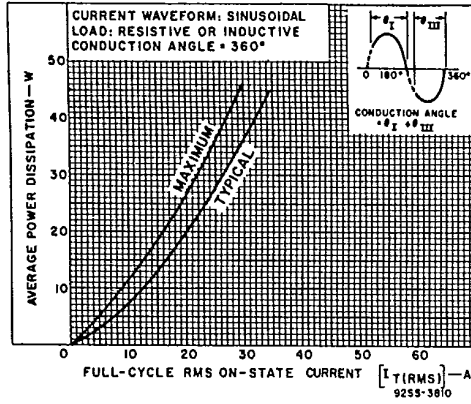


Fig. 1 — Power dissipation vs. on-state current.

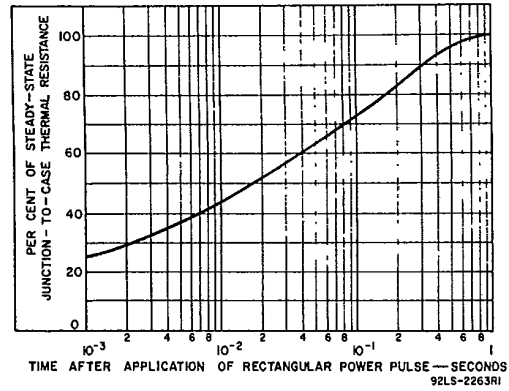


Fig. 2 — Transient junction-to-case thermal resistance vs. time.

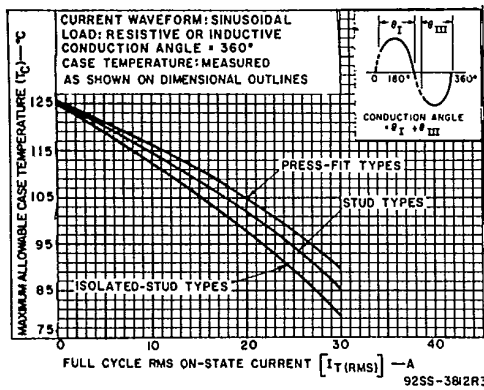


Fig. 3 — Maximum allowable case temperature vs. on-state current.

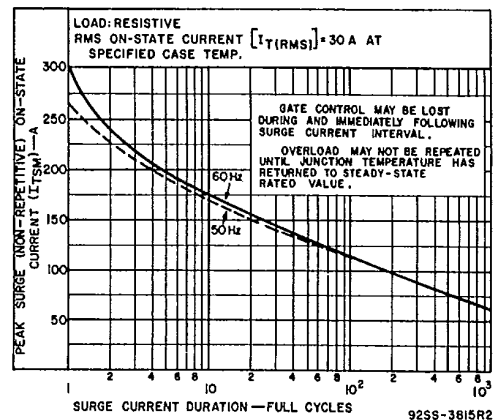


Fig. 4 — Peak surge on-state current vs. surge current duration.

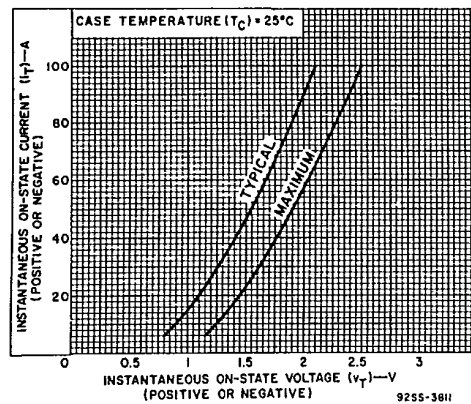


Fig. 5 — On-state current vs. on-state voltage.

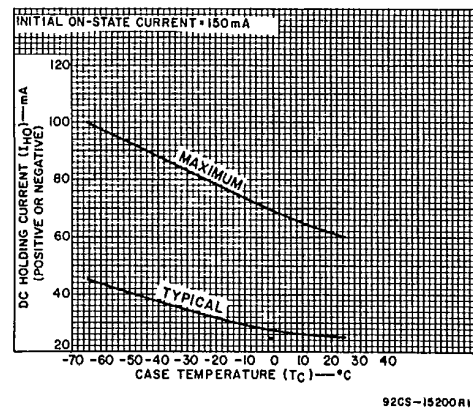


Fig. 6 — DC holding current vs. case temperature.

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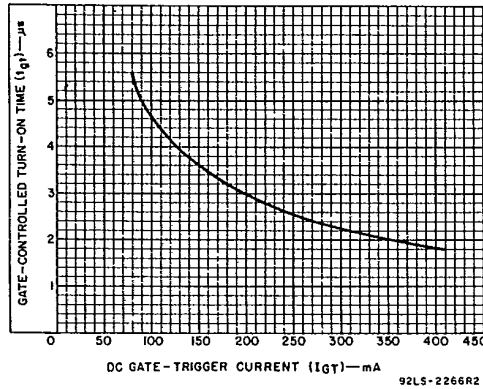


Fig. 7 — Turn-on time vs. gate trigger current.

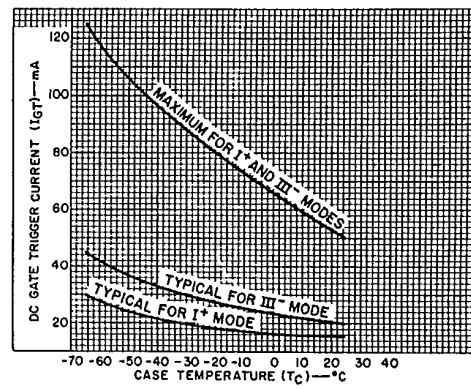


Fig. 8 — DC gate-trigger current vs. case temperature (I* and III* modes).

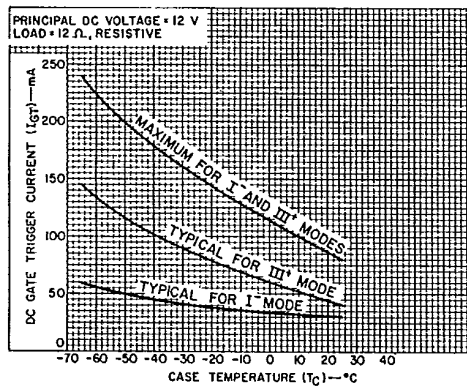


Fig. 9 — DC gate-trigger current vs. case temperature (I* and III* modes).

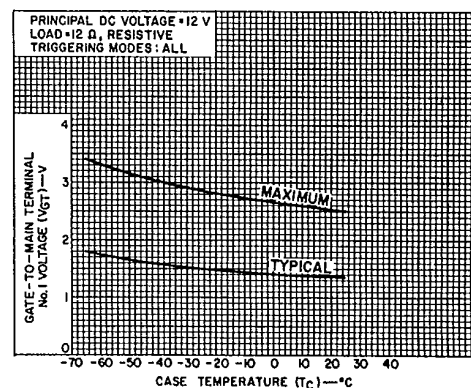


Fig. 10 — DC gate-trigger voltage vs. case temperature.

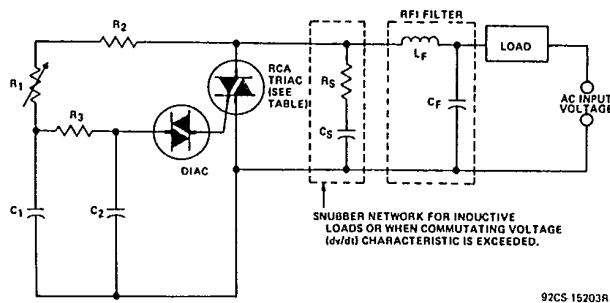


Fig. 11 — Typical phase-control circuit for lamp dimming, heat control, and universal-motor speed control.

AC INPUT VOLTAGE	120V 60Hz	240V 60Hz	240V 50Hz
C1	0.1μF 200V	0.1μF 400V	0.1μF 400V
C2	0.1μF 100V	0.1μF 100V	0.1μF 100V
R1	100KΩ 1/2W	200KΩ 1W	250KΩ 1W
R2	2.2KΩ 1/2W	3.3KΩ 1/2W	3.3KΩ 1/2W
R3	18KΩ 1/2W	18KΩ 1/2W	18KΩ 1/2W
SNUBBER NETWORK	Cs	0.1μF 400V	0.1μF 400V
	Rs	100Ω 1/2W	100Ω 1/2W
RFI FILTER	Cf*	0.1μF 400V	0.1μF 400V
	Lf*	100μH	200μH
RCA TRIACS	T6401B	T6401D	T6401D
	T6411B	T6411D	T6411D
	T6421B	T6421D	T6421D

*Typical values for lamp dimming circuits.

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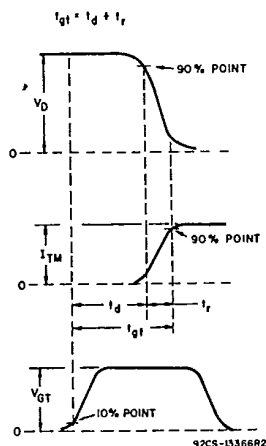


Fig. 12 — Relationship between off-state voltage, on-state current, and gate-trigger voltage showing reference points for definition of turn-on time (t_{gt}).

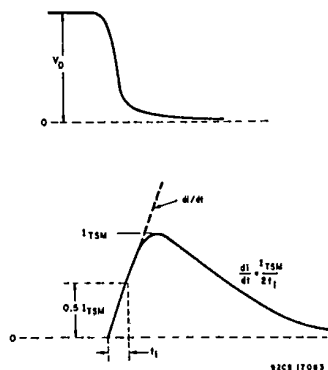


Fig. 13 — Rate of change of on-state current with time (defining di/dt).

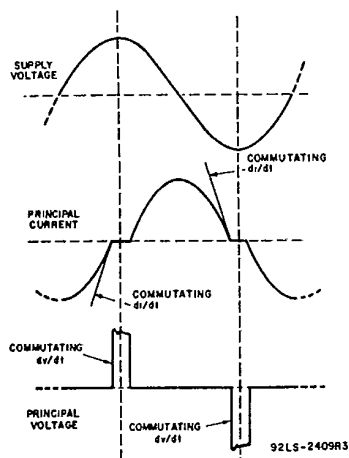


Fig. 14 — Relationship between supply voltage and principle current (inductive load) showing reference points for definition of commutating voltage (dv/dt).

MOUNTING CONSIDERATIONS

Mounting of press-fit package types depends upon an interference fit between the thyristor case and the heat sink. As the thyristor is forced into the heat-sink hole, metal from the heat sink flows into the knurl voids of the thyristor case. The resultant close contact between the heat sink and the thyristor case assures low thermal and electrical resistances.

A recommended mounting method shows press-fit knurl and heat-sink hole dimensions. If these dimensions are maintained, a "worst-case" condition of 0.0085 in. (0.2159 mm) interference fit will allow press-fit insertion below the maximum allowable insertion force of 800 pounds. A slight chamfer in the heat-sink hole will help center and guide the press-fit package properly into the heat sink. The insertion tool should be a hollow shaft having an inner diameter of 0.380 ± 0.010 in. (9.65 ± 0.254 mm) and an outer diameter of 0.500 in. (12.70 mm). These dimensions provide sufficient clearance for the leads and assure that no direct force will be applied to the glass seal of the thyristor.

The press-fit package is not restricted to a single mounting arrangement; direct soldering and the use of epoxy adhesives have been successfully employed. The press-fit case is tin-plated to facilitate direct soldering to the heat sink. A 60-40 solder should be used and heat should be applied only long enough to allow the solder to flow freely.