

T6401, T6411, T6421 Series

File Number 459

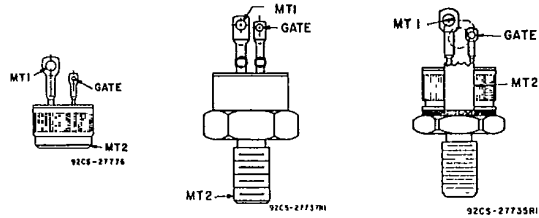
30-A Silicon Triacs

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 SERIES

STUD TYPES
T6411 SERIES

ISOLATED-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.

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.

These triacs are intended for control of ac loads in applica-

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° C (Press-fit types)

= 85° C (Stud types)

= 80° 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 mA, t_r = 0.1 μs (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 μs max., See Fig. 7

GATE POWER DISSIPATION:

PEAK (For 1 μs max., I_{GT} ≤ 4 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 ² t	_____	_____	450	_____	A ² s
I _{GT(M)}	_____	_____	12	_____	A
P _{GM}	_____	_____	40	_____	W
P _{G(AV)}	_____	_____	0.75	_____	W
T _{sig}	_____	_____	-65 to 150	_____	°C
T _C	_____	_____	-65 to 100	_____	°C
T _T	_____	_____	225	_____	°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), $v_D = 12\text{V}$: $T_C = 25^\circ\text{C}$ For other case temperatures	I_{HO}	—	25 See Fig. 6	60	mA
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) $= 85^\circ\text{C}$ (Stud types) $= 80^\circ\text{C}$ (Isolated-stud types)	dv/dt	3	20	—	V/ μs
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 T6401D, T6411D, T6421D T6401M, T6411M, T6421M T6401N, T6411N	dv/dt	40 25 20 10	200 150 100 50	— — — —	V/ μs
DC Gate-Trigger Current: Mode V_{MT2} V_G For $v_D = 12\text{ V (DC)}$, $R_L = 30\ \Omega$, $T_C = 25^\circ\text{C}$ For other case temperatures	I_{GT}	— — — —	15 20 30 40	50 50 80 80	mA
DC Gate-Trigger Voltage: For $v_D = 12\text{ V(DC)}$, $R_L = 30\ \Omega$, $T_C = 25^\circ\text{C}$ For other case temperatures For $v_D = V_{\text{DROM}}$, $R_L = 125\ \Omega$, $T_C = 100^\circ\text{C}$	V_{GT}	— 0.2	1.35 — See Fig. 10	2.5 —	V
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 Stud Transient (Press-fit & stud types)	R_{JC}	— —	— — See Fig. 2	0.8 0.9	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Hex (Stud, See Dim. Outline): Steady-State (Isolated-stud types)	R_{JH}	—	—	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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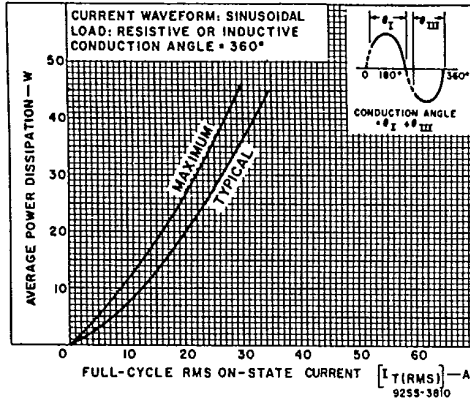


Fig. 1 — Power dissipation vs. on-state current.

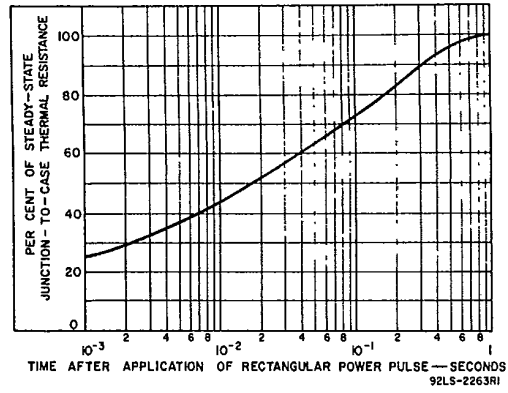


Fig. 2 — Transient junction-to-case thermal resistance vs. time.

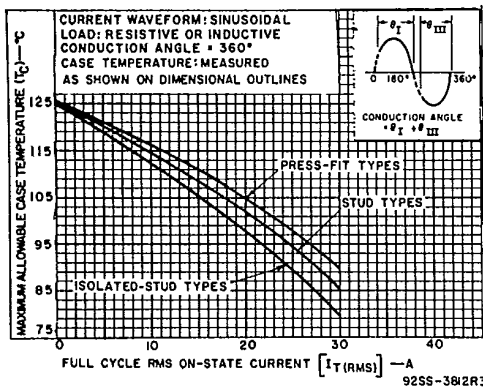


Fig. 3 — Maximum allowable case temperature vs. on-state current.

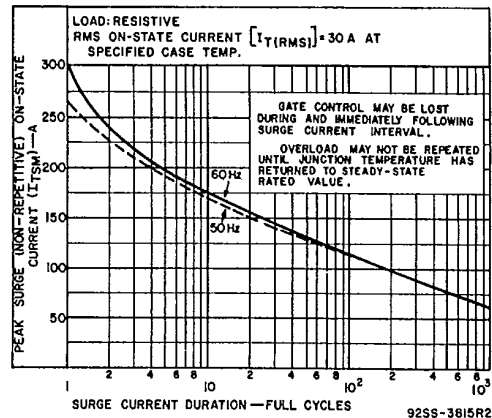


Fig. 4 — Peak surge on-state current vs. surge current duration.

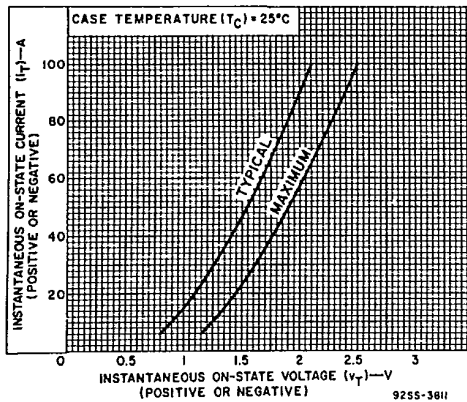


Fig. 5 — On-state current vs. on-state voltage.

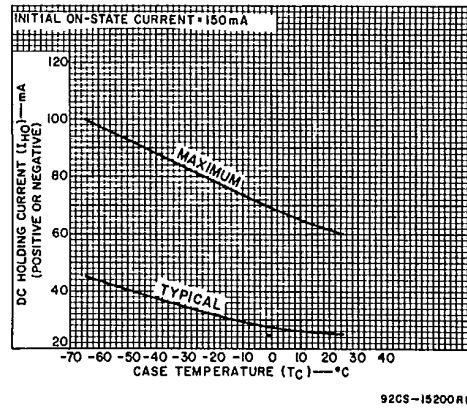


Fig. 6 — DC holding current vs. case temperature.

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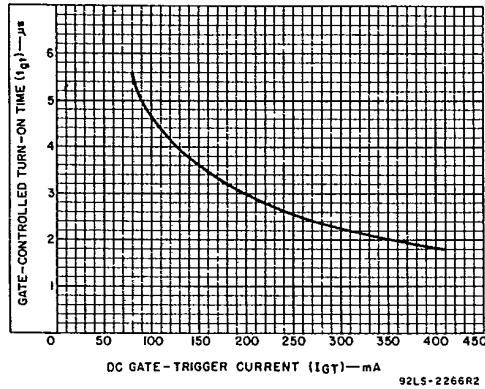


Fig. 7 — Turn-on time vs. gate trigger current.

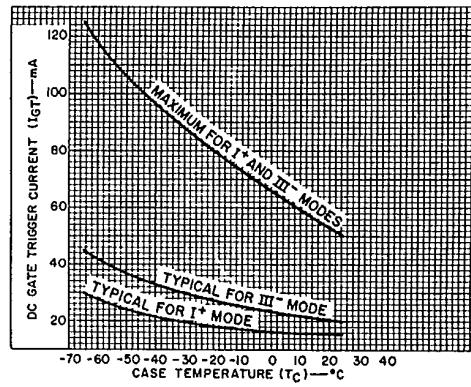


Fig. 8 — DC gate-trigger current vs. case temperature (I* and III* modes).

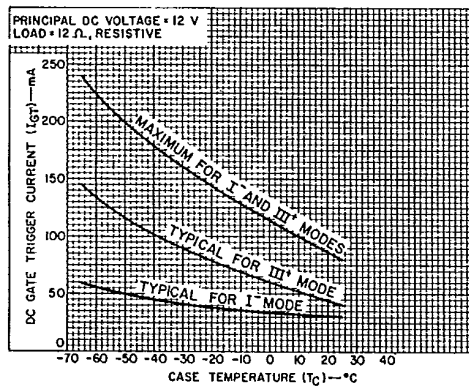


Fig. 9 — DC gate-trigger current vs. case temperature (I* and III* modes).

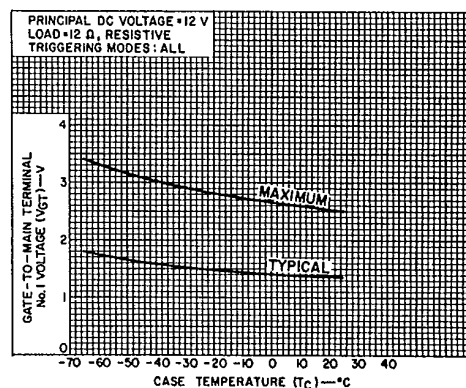


Fig. 10 — DC gate-trigger voltage vs. case temperature.

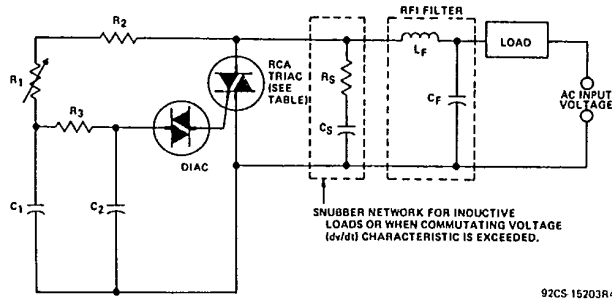


Fig. 11 — Typical phase-control circuit for lamp dimming, heat control, and universal-motor speed control.

AC INPUT VOLTAGE	120V 60Hz	240V 60Hz	240V 50Hz
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	18kΩ 1/2W	18kΩ 1/2W	18kΩ 1/2W
SNUBBER NETWORK	C _S	0.1μF 200V	0.1μF 400V
	R _S	100Ω 1/2W	100Ω 1/2W
RFI FILTER	C _F *	0.1μF 200V	0.1μF 400V
	L _F *	100μH	200μH
RCA TRIACS	T6401B T6411B T6421B	T6401D T6411D T6421D	T6401D T6411D T6421D

*Typical values for lamp dimming circuits.

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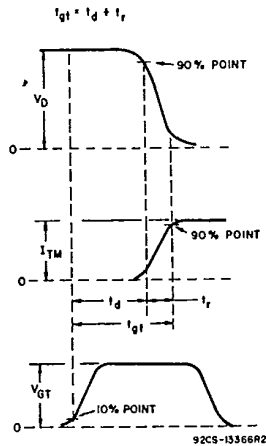


Fig. 12 — Relationship between off-state voltage, on-state current, and gate-trigger voltage showing reference points for definition of turn-on time (t_{gt}).

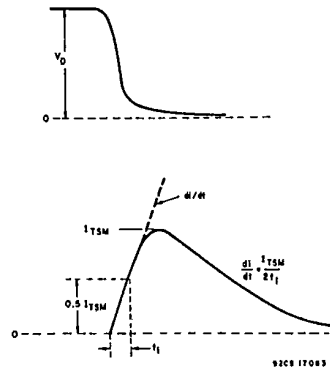


Fig. 13 — Rate of change of on-state current with time (defining di/dt).

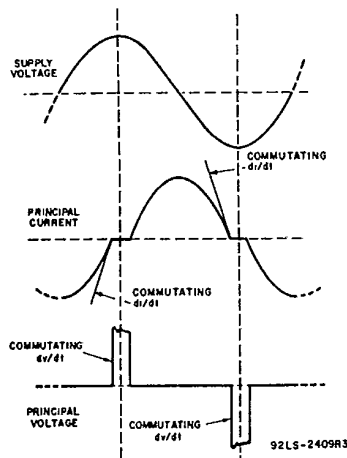


Fig. 14 — Relationship between supply voltage and principle current (inductive load) showing reference points for definition of commutating voltage (dv/dt).

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.