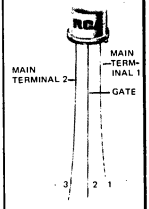
RCA Solid State Division

Thyristors

T2300 T2302 T2310 T2312 Series

T2310 Series
T2312 Series

H-1468



T2300 Series
T2302 Series

H-1380V1

2.5-A Sensitive-Gate Silicon Triacs

For Low-Power Phase-Control and Load-Switching Applications

Features:

- **Very High Gate Sensitivity**
  3 mA max. for T2300 and T2310 series
  10 mA max. for T2302 and T2312 series
- **3-Lead Package for Printed Circuit Board Applications**
- **Shorted Emitter Design**

Voltage / Package	100 V Types	200 V Types	400 V Types
Mod. TO-5	T2300A (40525)	T2300B (40526)	T2300D (40527)
Mod. TO-5	T2302A (40528)	T2302B (40529)	T2302D (40530)
TO-5 with Radiator	T2310A (40531)	T2310B (40532)	T2310D (40533)
TO-5 with Radiator	T2312A (40534)	T2312B (40535)	T2312D (40536)

Numbers in parentheses are former RCA type numbers.

RCA T2300-, T2302-, T2310-, and T2312-series triacs are gate-controlled full-wave ac silicon switches. They are designed to switch from a blocking state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

The T2302 series has higher dv/dt capability and higher gate trigger current requirements than the T2300 series. The gate sensitivity of these triacs permits the use of economical transistorized and IC control circuits and enhances their use in low-power phase control and load-switching applications.

The T2300 series has rms on-state current ratings of 2.5 amperes at a case temperature of +60°C while the T2302 series has the same ratings at a case temperature of +70°C.

The repetitive peak off-state voltage rating for T2300A and T2302A is 100 volts; for T2300B and T2302B, 200 volts; and for T2300D and T2302D, 400 volts.

The T2310 and T2312 series are the same as the T2300 and T2302 series, respectively, but have factory-attached heat-radiators and are intended for printed-circuit-board applications.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

For Operation with 50/60-Hz, Sinusoidal Supply Voltage and Resistive or Inductive Load

REPETITIVE PEAK OFF-STATE VOLTAGE♦ (Gate Open):	V_{DROM}		
T_J = −40°C to +90°C: T2300A, T2310A		100	V
T2300B, T2310B		200	V
T2300D, T2310D		400	V
T_J = −40°C to +100°C: T2302A, T2312A		100	V
T2302B, T2312B		200	V
T2302D, T2312D		400	V
RMS ON-STATE CURRENT (Conduction Angle = 360°):	I_T (RMS)		
T_C = 60°C: T2300 series		2.5	A
T_C = 70°C: T2302 series		2.5	A
T_A = 25°C: T2300 series		0.35	A
T2302 series		0.40	A
For other conditions		See Figs. 2, 3, 4 & 5	
For heat-radiator types		See Figs. 6 & 7	
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}		
For one full cycle of applied principal voltage, T_C as above			
60 Hz sinusoidal		25	A
50 Hz sinusoidal		21	A
For more than one full cycle of applied voltage		See Fig. 8	
RATE OF CHANGE OF ON-STATE CURRENT:			
V_{DM} = V_{DROM}, I_{GT} = 50 mA, t_r = 0.1 μs (See Fig. 19)	di/dt	100	A/μs
FUSING CURRENT (for Triac Protection):			
T_J = −65 to 100°C, t = 1.25 to 10 ms	I^2t	3	A^2s

MAXIMUM RATINGS (Cont'd.).

PEAK GATE-TRIGGER CURRENT♦:	I_{GTM}		
For 1 μs max.		0.5	A
GATE POWER DISSIPATION♦:			
Peak (For 1 μs max.)	P_{GM}	10	W
Average: T_C = 60°C	$P_{G(AV)}$	0.15	W
T_A = 25°C		0.05	W
TEMPERATURE RANGE‡:			
Storage		−40 to +150	°C
Operating (case): T2300 Series		−40 to +90	°C
T2302 Series		−40 to +100	°C
T2310, T2312 Series (From −40°C) Upper limits		See Figs. 6 & 7	
LEAD TEMPERATURE:			
During soldering, terminal temperature at a distance ≥ 1/6 in. (1.58 mm) from the case for 10 s		225	°C

♦ 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 information on the reference point of temperature measurement see *Dimensional Outlines.*

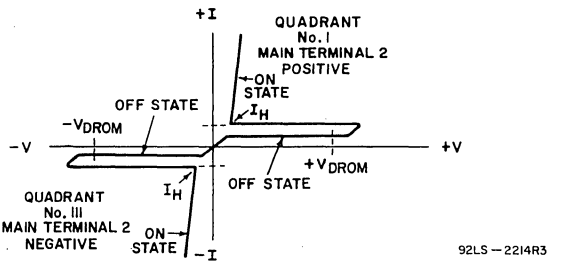


Fig. 1 — Principal voltage-current characteristics.

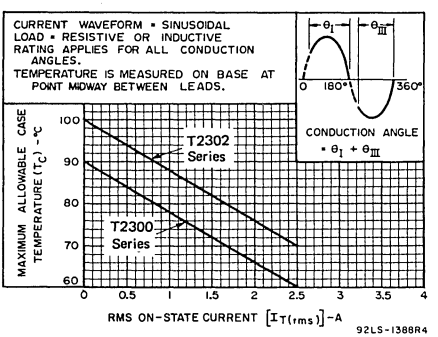


Fig. 2 — Conduction rating chart (case temperature) for T2300 and T2302 series.

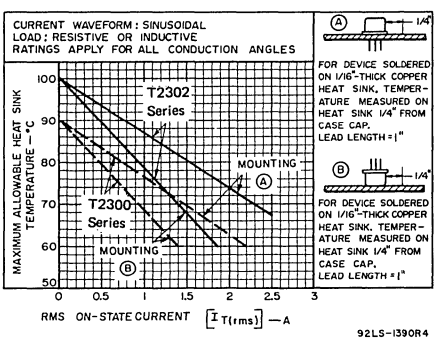


Fig. 3 — Conduction characteristics as a function of mounting method for T2300 and T2302 series.

ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	SYMBOL	LIMITS T2300 Series T2310 Series MIN.	TYP.	MAX	LIMITS T2302 Series T2312 Series MIN.	TYP.	MAX	UNITS
Peak Off-State Current: ♦ Gate Open and V_{DROM} = Max. rated value								
At T_j = +100° C	I_{DROM}	–	–	–	–	0.2	0.75	mA
At T_j = +90° C		–	0.2	0.75	–	–	–	
Maximum On-State Voltage: ♦ For i_T = 10 A (peak) and T_C = 25° C	V_{TM}	–	1.7	2.2	–	1.7	2.2	V
DC Holding Current: ♦ Gate Open, Initial principal current = 150 mA (DC), V_D = 12								
At T_C = 25° C	I_{HO}	–	2	5	–	6.5	15	mA
For other case temperatures		See Fig. 14			See Fig. 15			
Critical Rate of Rise of Commutation Voltage: ♦ For V_D = V_{DROM}, $I_{T(RMS)}$ = 2.5 A, commutating di/dt = 0.95 A/μs, gate unenergized, (See Fig. 20),	dv/dt							
T_C = 100°C		–	–	–	0.5	–	–	V/μs
T_C = 90°C		0.5	–	–	–	–	–	V/μs
Critical Rate-of-Rise of Off-State Voltage: ♦ **For V_D = V_{DROM}**, exponential voltage rise, and gate open	dv/dt							V/μs
At T_C = +100° C		–	–	–	6	10	–	
At T_C = +90° C		3	5	–	–	–	–	
DC Gate-Trigger Current: ♦† For V_D = 12 V (DC), R_L = 30 Ω, and T_C = 25° C — Mode 1+: V_{MT2} positive, V_G positive	I_{GT}	–	1	3	–	3.5	10	mA
Mode 111−: V_{MT2} negative, V_G negative		–	1	3	–	3.5	10	
Mode 1−: V_{MT2} positive, V_G negative		–	2	3	–	7	10	
Mode 111+: V_{MT2} negative, V_G positive		–	2	3	–	7	10	
For other case temperatures		See Fig. 12			See Fig. 13			
DC Gate-Trigger Voltage: ♦† For V_D = 12 V (DC) and R_L = 30 Ω								
At T_C = 25° C	V_{GT}	–	1	2.2	–	1	2.2	V
For other case temperatures		See Fig. 11			See Fig. 11			
For v_D = V_{DROM} and R_L = 125 Ω								
At T_C = 100° C		–	–	–	0.15	–	–	
At T_C = +90° C		0.15	–	–	–	–	–	
Thermal Resistance, Junction-to-Case: Steady-State	$R_{\theta JC}$	8.5 (max.) (T2300 series)			8.5 (max.) (T2302 series)			°C/W

♦ 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.

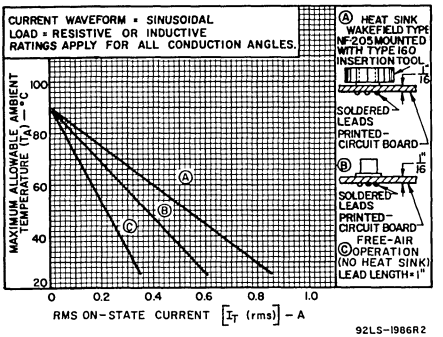


Fig. 4 — Conduction rating chart (ambient temperature) for T2300 series.

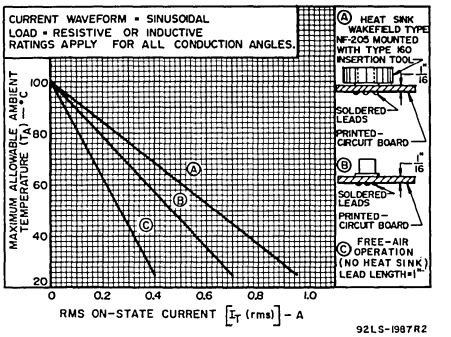


Fig. 5 — Conduction rating chart (ambient temperature) for T2302 series.

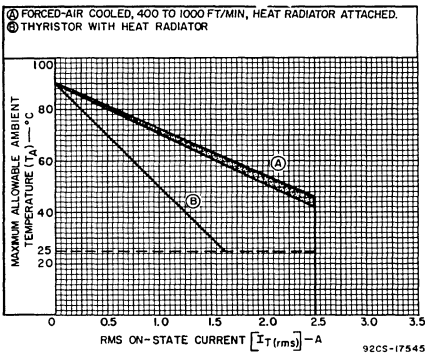


Fig. 6 — Conduction rating chart (ambient temperature) for T2310 series.

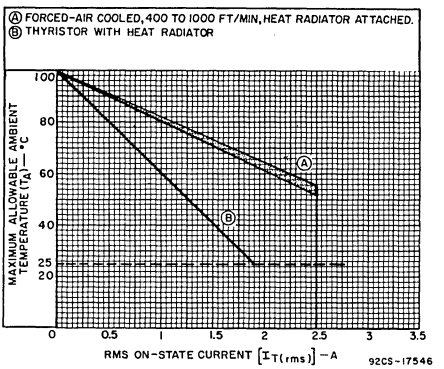


Fig. 7 — Conduction rating chart (ambient temperature) for T2312 series.

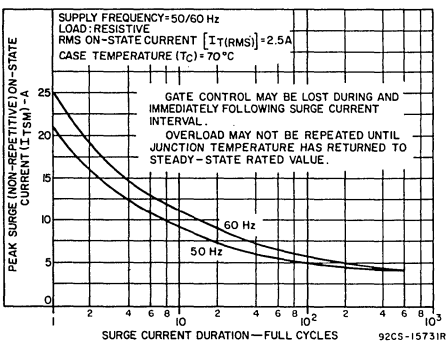


Fig. 8 — Peak surge on-state current vs. surge-current duration for all types.

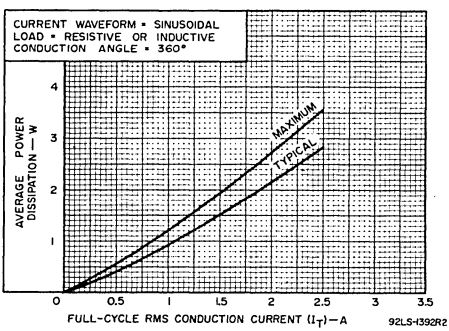


Fig. 9 — Power dissipation curves for all types.

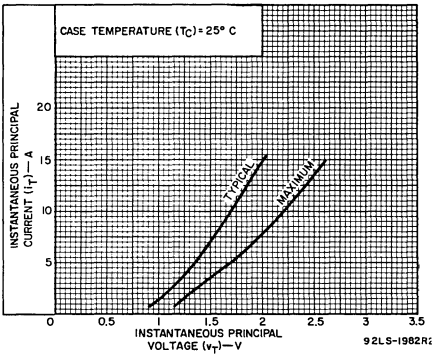


Fig. 10 — On-state characteristics for either direction of principal current for all types.

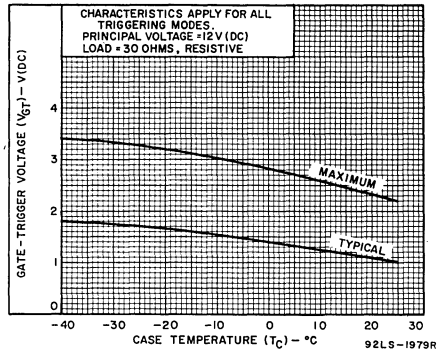


Fig. 11 — DC Gate-trigger voltage characteristics for all types.

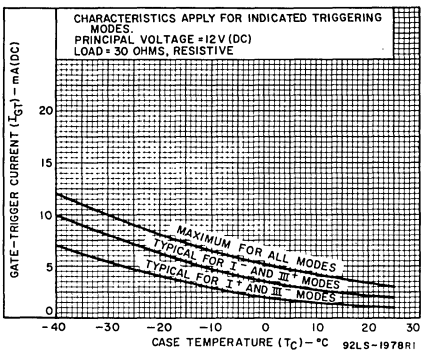


Fig. 12 — DC gate-trigger current characteristics for T2300 and T2310 series.

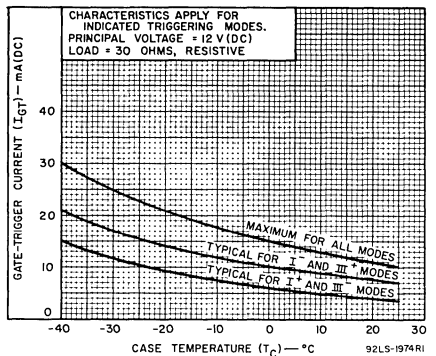


Fig. 13 — DC gate-trigger current characteristics for T2302 and T2312 series.

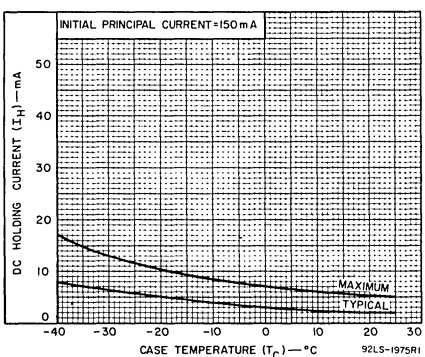


Fig. 14 — DC holding current characteristics for either direction of principal current for T2300 and T2310 series.

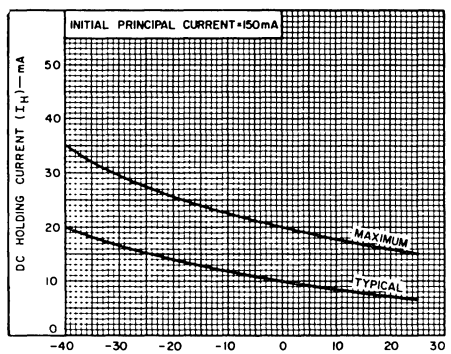


Fig. 15 — DC holding current characteristics for either direction of prinicpal current for T2302 and T2312 series.

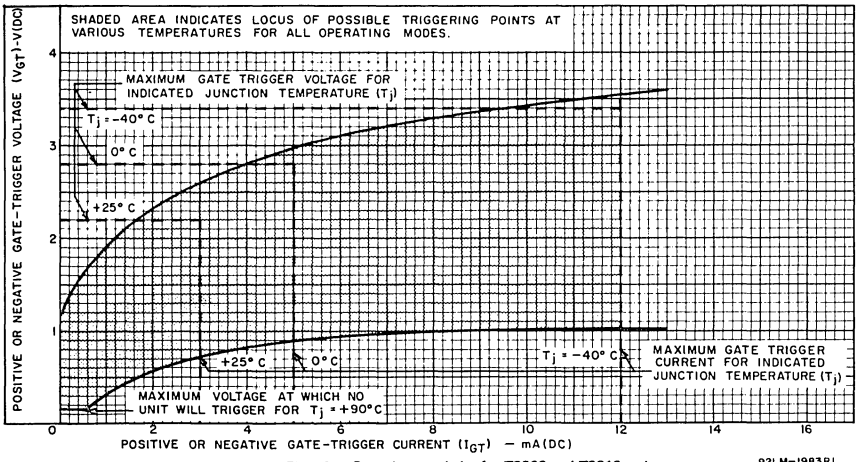


Fig. 16 — Gate characteristics for T2300 and T2310 series.

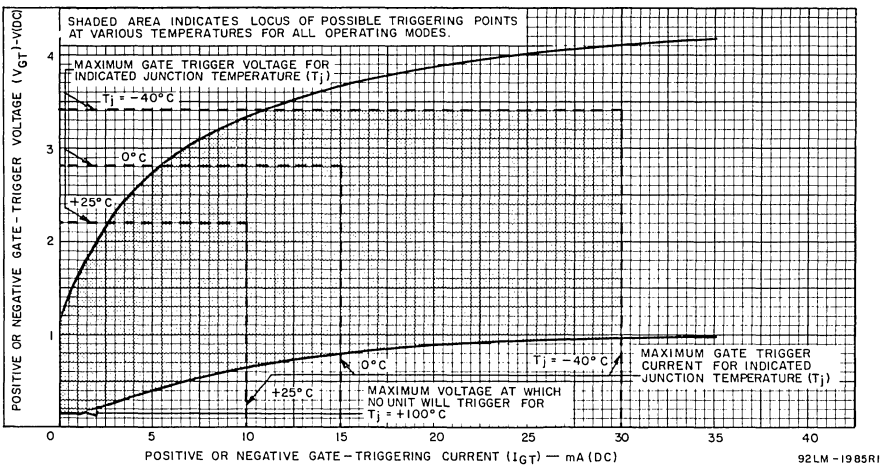


Fig. 17 — Gate characteristics for T2302 and T2312 series.

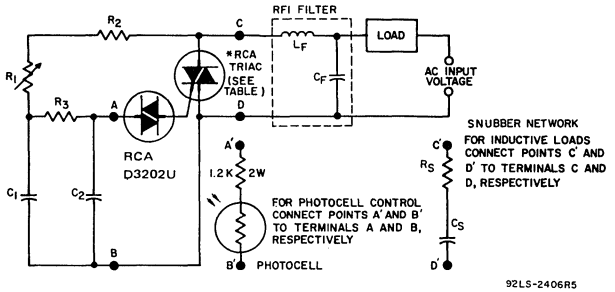
TERMINAL CONNECTIONS

For T2300 and T2302 series

Lead No. 1 — Main terminal 1
Lead No. 2 — Gate
Case, Lead No. 3 — Main terminal 2

For T2310 and T2312 series

Lead No. 1 — Main terminal 1
Lead No. 2 — Gate
Heat Rad., Lead No. 3 — Main terminal 2



NOTE: For incandescent lamp loads which produce burnout current surges with I^2t values greater than 2.5 ampere^2 seconds, connect a 10-ohm resistor of appropriate wattage rating in series with the load. The appropriate wattage rating can be determined as follows:

$$\text{Power Rating of 10-ohm Resistor} = 10 \times (\text{rms load current})^2$$

AC INPUT VOLTAGE	C_1	C_2	R_1	R_2	R_3	RFI FILTER L_F* (typ.)	RFI FILTER C_F* (typ.)	SNUBBER NETWORK C_S	SNUBBER NETWORK R_S	RCA TYPES
120V 60Hz	0.1μF 200V	0.1μF 100V	100KΩ ½W	2.2KΩ ½W	15KΩ ½W	100μH	0.1μF 200V	0.068μF 200V	2.2KΩ ½W	T2300B,T2310B T2302B,T2312B
240V 60Hz	0.1μF 400V	0.1μF 100V	250KΩ 1W	3.3KΩ ½W	15KΩ ½W	200μH	0.1μF 400V	0.075μF 400V	2.5KΩ ½W	T2300D,T2302D T2310D,T2312D

*Typical values for lamp dimming circuits

Fig. 18 – Typical phase-control circuit for lamp dimming, heat controls, and universal motor speed controls.

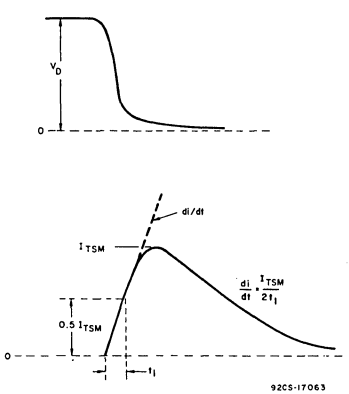


Fig. 19– Rate of change of on-state current with time (defining di/dt).

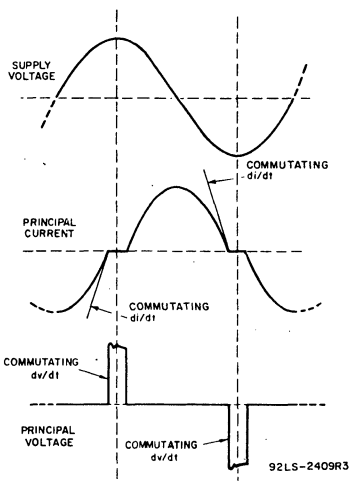


Fig. 20– Relationship between supply voltage and principle current (inductive load) showing reference points for definition of commutating voltage (dv/dt).