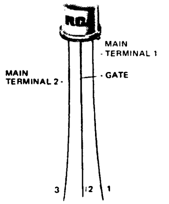
RCA
Solid State Division

Thyristors
T2304 T2305 Series



Modified JEDEC TO-5

400-Hz, 0.5-A Sensitive-Gate Silicon Triacs

For Control-Systems Application in Airborne and Ground-Support Type Equipment

Features:

- **High gate sensitivity, I_{GT} = 10/40 mA max.**
- **di/dt capability = 100 A/μs**
- **Commutating dv/dt capability characterized at 400 Hz**
- **Shorted-Emitter Design**

Package \ Voltage	200 V Types	400 V Types
Modified TO-5	T2304B (40769)	T2304D (40770)
Modified TO-5	T2305B (40771)	T2305D (40772)

Numbers in parentheses are former RCA type numbers.

RCA T2304- and T2305-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 gate triggering voltages.

These triacs are intended for operation up to 400 Hz with resistive or inductive loads and nominal line voltages of 115 and 208 V RMS sine wave and repetitive peak off-stage voltages of 200 V and 400 V.

The high gate sensitivity of these triacs permits the use of economical transistorized or integrated control circuits and enhances their use in low-power phase control and load-switching applications.

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at Frequencies up to 400 Hz and with Resistive or Inductive Load.

		T2304B T2305B	T2304D T2305D	
REPETITIVE PEAK OFF-STATE VOLTAGE:*				
Gate open, T_J = -50 to 100°C	V_{DROM}	200	400	V
RMS ON-STATE CURRENT (Conduction angle = 360°):	$I_{T(RMS)}$			
Case temperature (T_C) = 90°C		0.5		A
Ambient temperature (T_A) = 25°C, without heat sink		0.4		A
For other conditions		*See Figs. 3 & 4*		
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}			
For one cycle of applied principal voltage, T_C = 90°C				
400 Hz (sinusoidal)		50		A
60 Hz (sinusoidal)		25		A
50 Hz (sinusoidal)		21		A
For more than one cycle of applied principal voltage		*See Fig. 5*		
RATE-OF-CHANGE OF ON-STATE CURRENT:	di/dt			
$V_{DM} = V_{DROM}$, I_{GT} = 60 mA, t_r = 0.1 μs (*See Fig. 14*)		100		A/μs
FUSING CURRENT (for triac protection):				
T_J = -50 to 100°C, t = 1.25 to 10 ms	I^2t	2		A^2s
PEAK GATE-TRIGGER CURRENT:■	I_{GTM}			
For 1 μs (max.) (*See Fig. 10*)		1		A
GATE POWER DISSIPATION:				
PEAK (For 1 μs max., (*See Fig. 10*)	P_{GM}	10		W
AVERAGE (At T_C = 60°C)	$P_{G(AV)}$	0.15		W
(At T_A = 25°C, without heat sink)	$P_{G(AV)}$	0.05		W
TEMPERATURE RANGE:▲				
Storage	T_{stg}	-50 to 150		°C
Operating (Case)	T_C	-50 to 100		°C
LEAD TEMPERATURE (During soldering):				
At distances ≥ 1/16 in. (1.58 mm) from the case for 10 s max.	T_L	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 temperature measurement reference point, see Dimensional Outline.

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ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	SYMBOL	LIMITS						UNITS
		T2304 Series			T2305 Series			
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak Off-State Current:♦ Gate open, T_J = 100°C, V_{DROM} = Max. rated value	I_{DROM}	-	0.2	0.75	-	0.2	0.75	mA
Maximum On-State Voltage:♦ For i_T = 10 A (peak), 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 V, T_C = 25°C	I_{HO}	-	7	15	-	15	30	mA
For other case temperatures		See Figs. 8 & 9						
Critical Rate-of-Rise of Commutation Voltage:♦ For v_D = V_{DROM}, $I_{T(RMS)}$ = 0.5 A, commutating di/dt = 1.8 A/ms, gate unenergized, T_C = 90°C (See Fig. 15)	dv/dt	1	4	-	1	4	-	V/µs
Critical Rate-of-Rise of Off-Stage Voltage:♦ For v_D = V_{DROM}, exponentail voltage rise, gate open, T_C = 100°C	dv/dt	10	100	-	10	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}	-	3.5	10	-	5	25	mA
Mode III⁻: V_{MT2} negative, V_G negative		-	3.5	10	-	5	25	mA
Mode I⁻: V_{MT2} positive, V_G negative		-	7	10	-	10	40	mA
Mode III⁺: V_{MT2} negative, V_G positive		-	7	10	-	10	40	mA
For other case temperatures		See Figs. 11 & 12						
DC Gate-Trigger Voltage:♦† For v_D = 12 V (DC), R_L = 30Ω, T_C = 25°C	V_{GT}	-	1	2.2	-	1	2.2	V
For other case temperatures		See Fig. 13						
For v_D = V_{DROM}, R_L = 125Ω, T_C = 100°C		0.15	-	-	0.15	-	-	V
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 60 mA, t_r = 0.1 µs, i_T = 10 A (peak), T_C = 25°C (See Fig. 16)	t_{gt}	-	1.8	-	2.5	1.8	2.5	µs
Thermal Resistance, Junction-to-Case:	θ_{J-C}	-	-	8.5	-	-	8.5	°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.

The following data are applicable to all triacs except as noted.

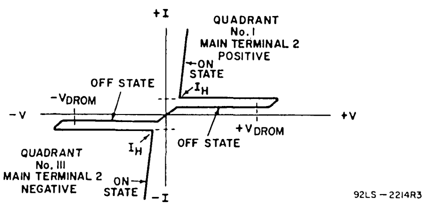


Fig. 1 — Principal voltage-current characteristic.

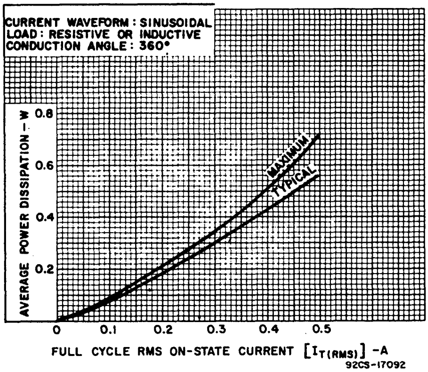


Fig. 2 — Power dissipation vs. on-state current.

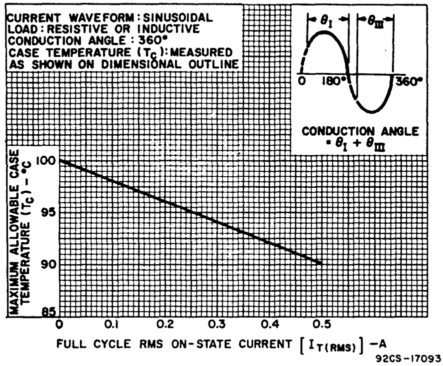


Fig. 3 — Maximum allowable case temperature vs. on-state current.

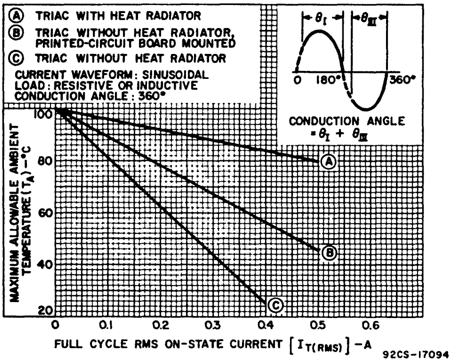


Fig. 4 — Maximum allowable ambient temperature vs. on-state current for the package/mounting options of these triacs.

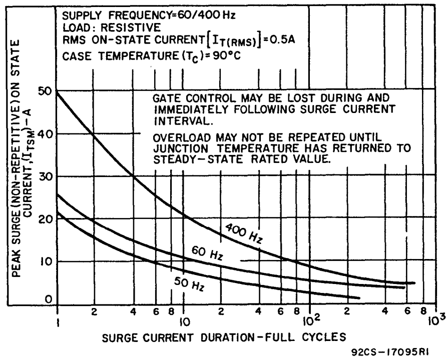


Fig. 5 — Peak surge on-stage current vs. surge-current duration.

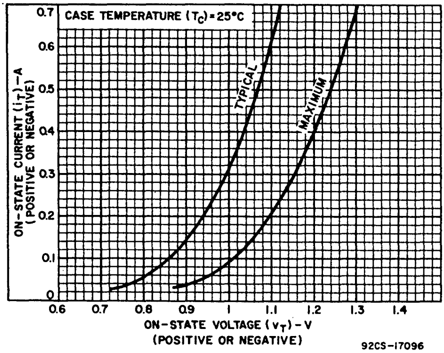


Fig. 6 — On-state current vs. on-state voltage (steady-state condition).

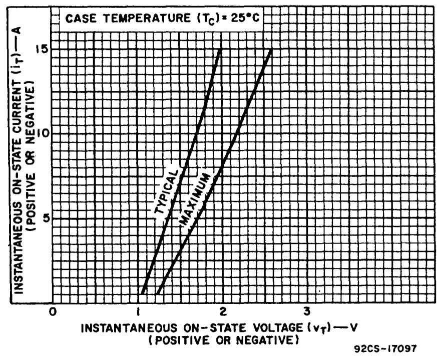


Fig. 7 — On-state current vs. on-state voltage (surge condition).

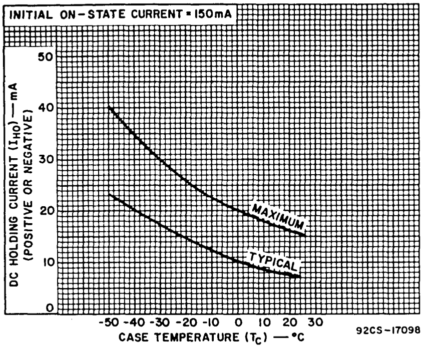


Fig. 8 — DC holding current vs. case temperature for T2304 series.

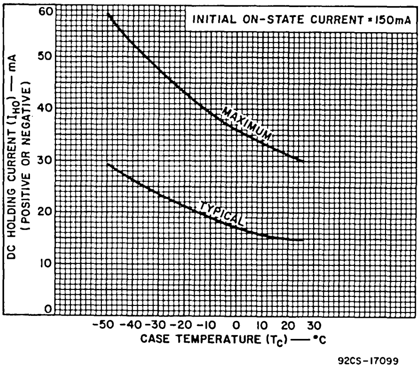


Fig. 9 — DC holding current vs. case temperature for T2305 series.

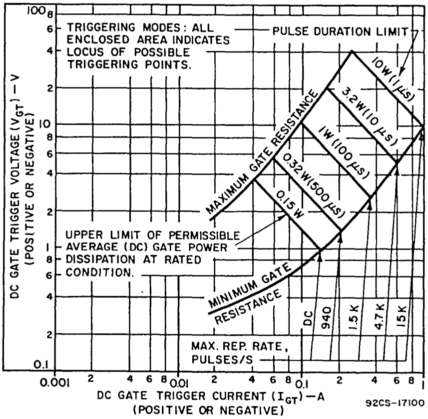


Fig. 10 — Gate trigger characteristics and limiting conditions for determination of permissible gate trigger pulses.

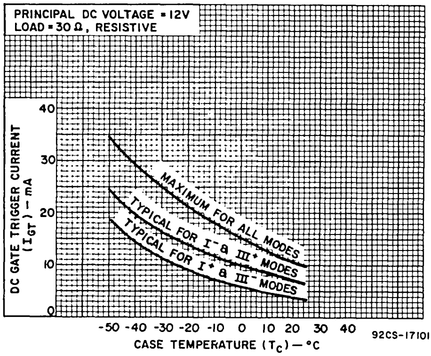


Fig. 11 — DC gate-trigger current vs. case temperature for T2304 series.

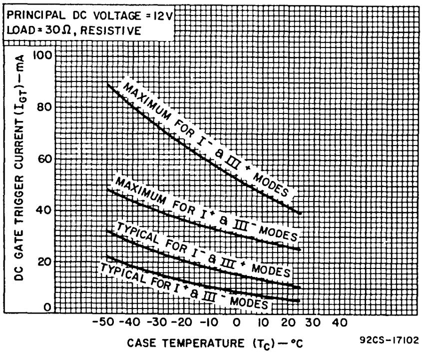


Fig. 12 — DC gate-trigger current vs. case temperature for T2305 series.

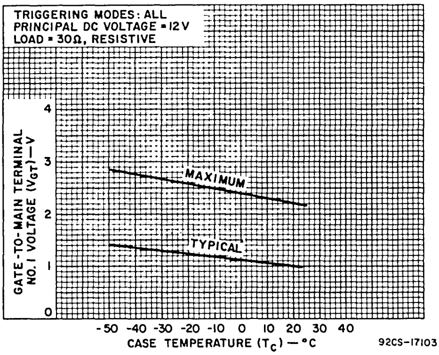


Fig. 13 — DC gate-trigger voltage vs. case temperature.

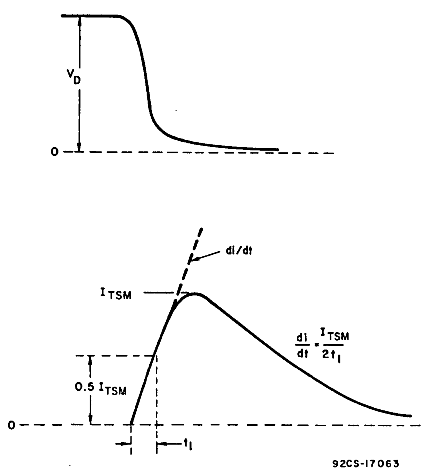


Fig. 14 — Rate-of-change of on-state current with time (defining di/dt).

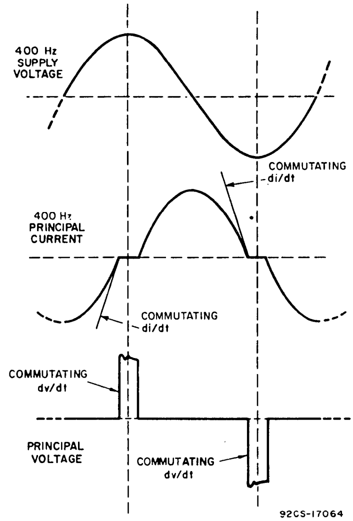


Fig. 15 — Relationship between supply voltage and principal current (inductive load) showing reference points for definition of commutating voltage (dv/dt).

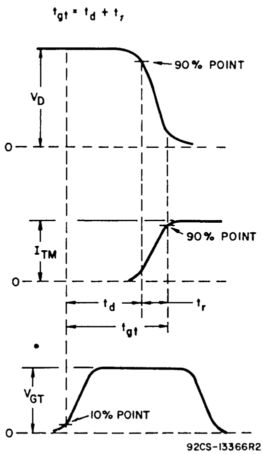
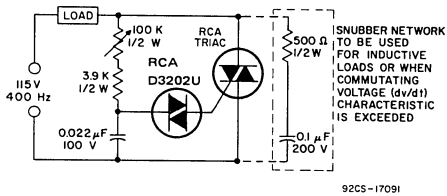


Fig. 16 — Relationship between off-state voltage, on-state current, and gate-trigger voltage showing reference points for definition of turn-on time (t_{gt}).



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 power rating in series with the load. This rating can be determined as follows:

Power Rating of 10-ohm Resistor = 10 (rms load current)^2

Fig. 17 — Typical phase-control circuit for operation at 400 Hz.

TERMINAL CONNECTIONS

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