GTC

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2N4199 thru 2N4204

GTC

Designers Data Sheet

REVERSE BLOCKING TRIODE THYRISTOR

. . . fast switching, high-voltage Thyristors especially designed for pulse modulator applications in radar and other similar equipment.

- Guaranteed Limits on All Critical Parameters
- High-Voltage: V_{DRM} = 300 to 800 Volts
- Maximum Turn-On Times Specified – 300 to 400 ns
- Repetitive Pulse Current to 100 Amperes
- Stable Switching Characteristics Over an Operating Temperature Range From -65 to +105°C
- Pulse Repetition Rates as High as 20,000 pps
- Jan Versions Available

SILICON CONTROLLED RECTIFIERS

100 AMPERE PULSE
300 thru 800 VOLTS

Designers Data for "Worst Case" Conditions

The Designers Data Sheets permit the design of most circuits entirely from the information presented. Limit curves – representing boundaries on device characteristics – are given to facilitate "worst case" design.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Reverse Blocking Voltage (1) (T_J = 105°C)	V_{RRM}	50	Volts
*Peak Forward Blocking Voltage (1) 2N4199 (T_C = 105°C) 2N4200 2N4201 2N4202 2N4203 2N4204	V_{DRM}	300 400 500 600 700 800	Volts
Repetitive Peak On-State Current (PW = 3.0 µs, Duty Cycle = 0.6%, T_C = 85°C)	I_{TRM}	100	Amp
Continuous On-State Current (T_C = 65°C)	I_T	5.0	Amp
Current Application Rate (2)	di/dt	5000	A/µs
Peak Forward Gate Power	P_{GFM}	20	Watts
Average Forward Gate Power	$P_{GF(AV)}$	1	Watt
Peak Forward Gate Current	I_{GFM}	5.0	Amp
Peak Gate Voltage – Forward Reverse (3)	V_{GFM} V_{GRM}	10 10	Volts
Operating Junction Temperature Range Blocking State Conducting State	T_J	 -65 to +105 -65 to +200	°C
Storage Temperature Range	T_{stg}	-65 to +200	°C
Stud Torque	–	15	in. lb.

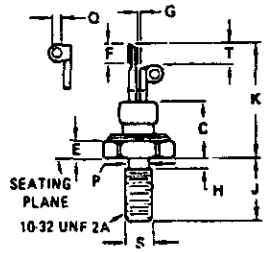
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
*Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

(1) Characterized for unilateral applications where reverse blocking capability is not important. Higher voltage units available upon request. V_{DRM} and V_{RRM} may be applied as a continuous dc voltage for zero or negative gate voltage but positive gate voltage must not be applied concurrently with a negative potential on the anode. When checking blocking capability, do not permit the applied voltage to exceed the rated voltage.
(2) Minimum Gate Trigger Pulse: i_G = 200 mA, PW = 1 µs, t_r = 20 ns.
(3) Do not reverse bias gate during forward conduction if anode current exceeds 10 amperes.

*JEDEC Registered Data

STYLE 1.
PIN 1. CATHODE
2. GATE
STUD – ANODE



DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	12.57	12.83	0.495	0.505
B	10.77	11.10	0.424	0.437
C	–	10.80	–	0.425
D	3.94	4.70	0.155	0.185
E	–	3.56	–	0.140
J	10.16	11.51	0.400	0.453
K	–	21.72	–	0.855
L	–	17.78	–	0.700
N	–	7.11	–	0.280
Q	1.02	1.91	0.040	0.075

CASE 63-03

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2N4199 thru 2N4204

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic		Fig. No.	Symbol	Min	Max	Unit
*Peak Forward and Reverse Blocking Current (Rated V_{DRM} and V_{RRM}, T_C = 105°C, gate open)		17	I_{DRM} I_{RRM}	– –	2.0 2.0	mA
Gate Trigger Current (Continuous dc) (Anode Voltage = 7.0 Vdc, R_L = 100 ohms, T_C = 25°C) * (Anode Voltage = 7.0 Vdc, R_L = 100 ohms, T_C = -65°C)		14	I_{GT}	 – –	 50 100	mA
Gate Trigger Voltage (Continuous dc) * (Anode Voltage = rated V_{DRM}, R_L = 100 ohms, T_C = 105°C) (Anode Voltage = 7.0 Vdc, R_L = 100 ohms, T_C = 25°C) * (Anode Voltage = 7.0 Vdc, R_L = 100 ohms, T_C = -65°C)		12	V_{GT}	 0.2 – –	 – 1.5 2.0	Volts
*Holding Current (Anode Voltage = 7.0 Vdc, gate open, T_C = 105°C)		18	i_H	 3.0	 –	mA
*Forward "On" Voltage (I_{TM} = 5 Adc, PW = 1.0 ms max, Duty cycle ≤ 1%)		8	V_{TM}	–		Volts
*Dynamic Forward "On" Voltage (0.5 μs after 50% decay point on dynamic forward voltage waveform.) Forward Current: 30 A pulse Gate Pulse: at 200 mA, PW = 1.0 μs, t_r = 20 ns		7	V_{TM}	–	25	Volts
*Turn-On Time (2) I_{TM} = 30A						ns
Delay Time	All types	1, 9	t_d	–	200	
Rise Time	2N4199 and 2N4200	1, 11	t_r	–	200	
	2N4201			–	150	
	2N4202			–	130	
	2N4203 and 2N4204			–	100	
*Pulse Turn-Off Time Test Conditions: PFN discharge; Forward Current = 30 A pulse; Reverse Current = 5.0 A, T_C = 85°C, dv/dt = 250 V/μs to Rated V_{DRM}; Reverse anode voltage during turn-off interval = 0 V; Reverse gate bias during turn-off interval = 6.0 V.		2, 13	t_q	–	20	μs
*Forward Voltage Application Rate (Linear Rise of Voltage) (T_C = 105°C, gate open, V_D = Rated V_{DRM})		16	dv/dt	250	–	V/μs

*V_{DRM} for all types can be applied on a continuous dc basis without incurring damage. Ratings apply for zero or negative gate voltage. When checking forward or reverse blocking capability, these devices should not be tested with a constant current source in a manner that the voltage applied exceeds the rated blocking voltage. Other voltage units available upon request.

TEST CIRCUITS

FIGURE 1 – TURN-ON TIME

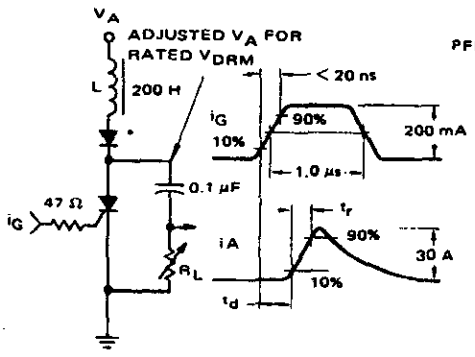
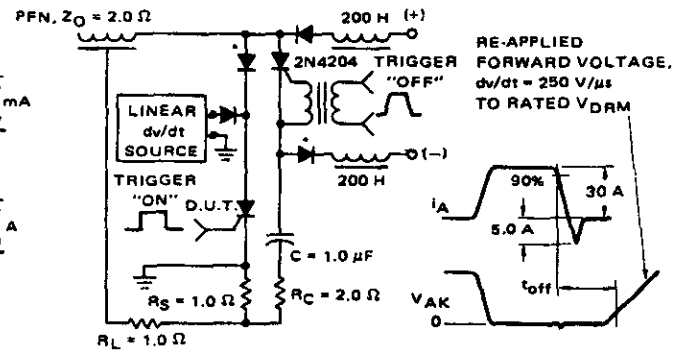


FIGURE 2 – TURN-OFF TIME



*Two 1N4937 fast-recovery diodes in series each shunted by a 180 kΩ resistor.

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SWITCHING CHARACTERISTICS

FIGURE 9 – DELAY TIME

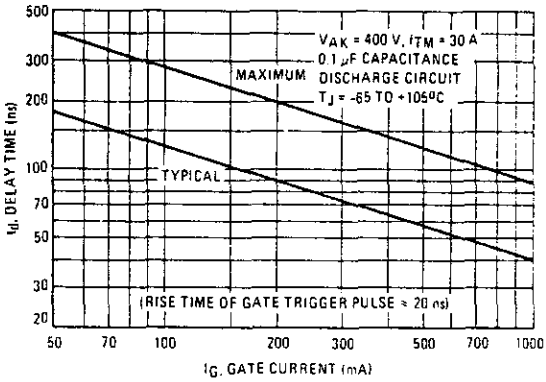


FIGURE 11 – CURRENT RISE TIME

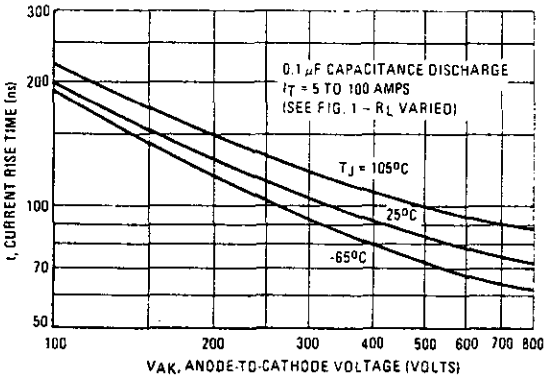
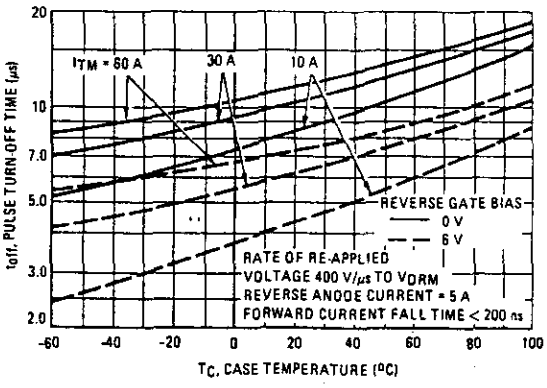


FIGURE 13 – TYPICAL TURN-OFF TIME



TRIGGERING CHARACTERISTICS

FIGURE 10 – TYPICAL PULSE TRIGGER CHARGE/CURRENT

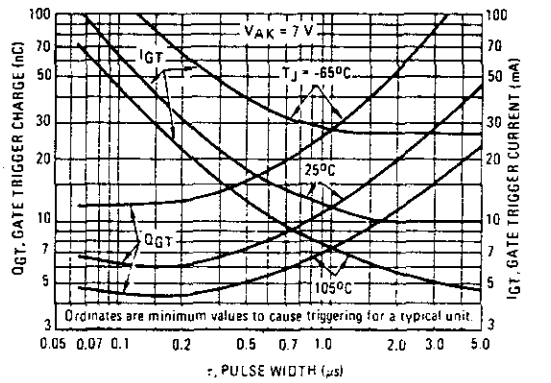


FIGURE 12 – DC GATE TRIGGER VOLTAGE

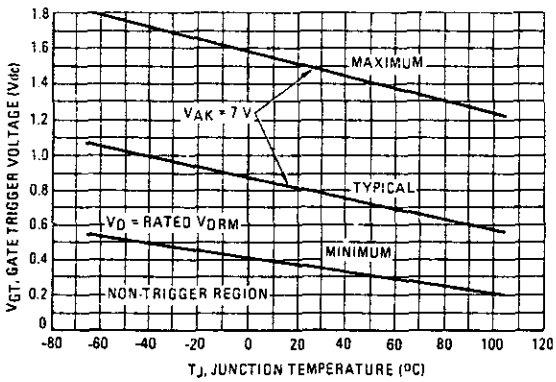


FIGURE 14 – DC GATE TRIGGER CURRENT

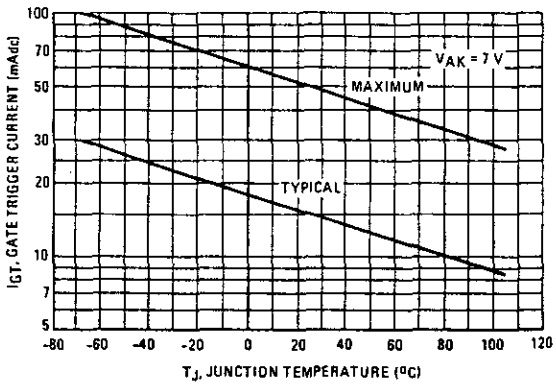


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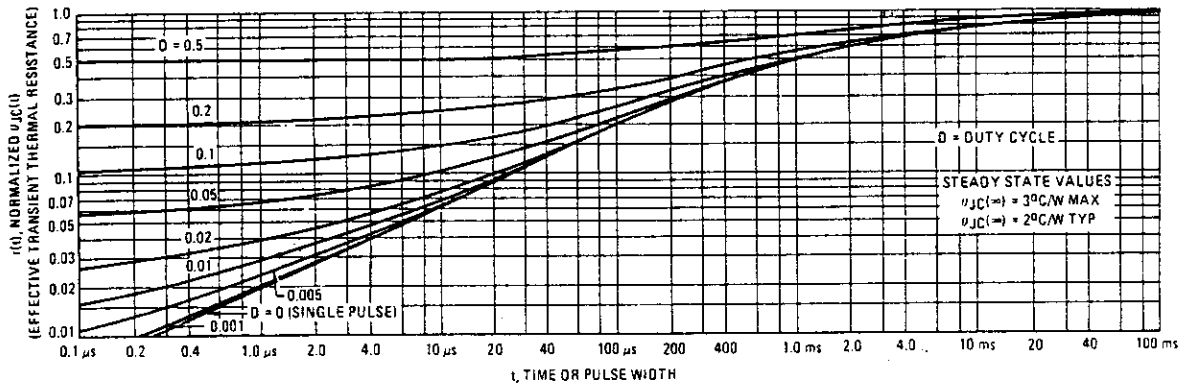
FIGURE 6 – NORMALIZED EFFECTIVE TRANSIENT THERMAL RESISTANCE



FORWARD "ON" VOLTAGE DATA

FIGURE 7 – TYPICAL DYNAMIC FORWARD "ON" VOLTAGE

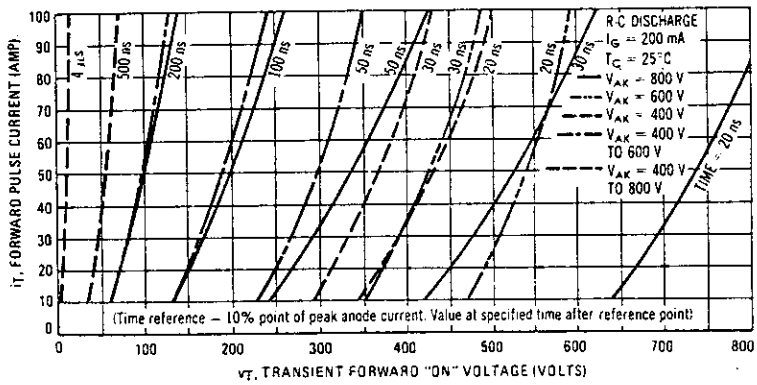
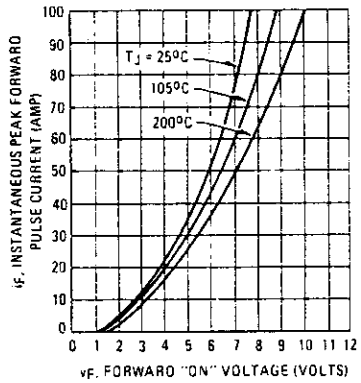


FIGURE 8 – MAXIMUM STEADY-STATE



DESIGN NOTE CONTINUED

$$\Delta T(t_4) = [\,1000\,[0.0205 + (1 - 5.25 \cdot 10^{-3})\,0.27 + 5.25 \cdot 10^{-3} - 0.27] + 700\,[(1 - 7.75 \cdot 10^{-3})\,0.27 + 7.75 \cdot 10^{-3} - 0.27]\,]\,3 = 93.51^{\circ}C$$

$$\Delta T(t_5) = [\,1000\,[0.032 + (1 - 5.25 \cdot 10^{-3})\,0.27 + 5.25 \cdot 10^{-3} - 0.27 - 0.0205] + 700\,[0.025 + (1 - 7.75 \cdot 10^{-3})\,0.27 + 7.75 \cdot 10^{-3} - 0.27]\,]\,3 = 105.6^{\circ}C$$

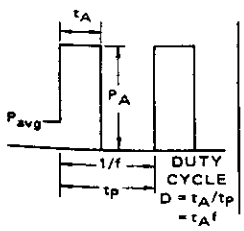


FIGURE A – SIMPLE MODEL

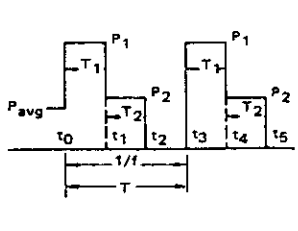


FIGURE B – MORE ACCURATE MODEL

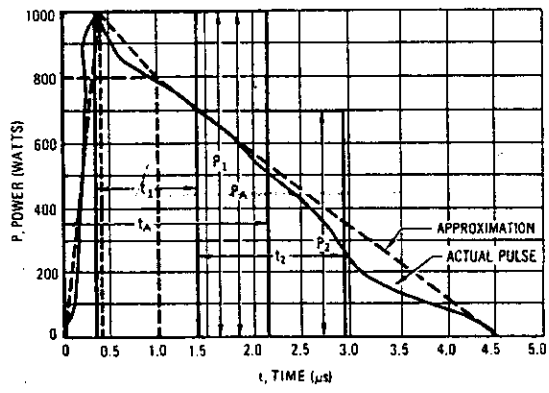


FIGURE C – AN ACTUAL TRANSIENT POWER PULSE