INTERNATIONAL RECTIFIER IOR

320PJT & 320PJT-A SERIES

1200 and 1400 Amp I_{TGQ} Gate Turn-Off Hockey Puk SCRs

Major Ratings and Characteristics

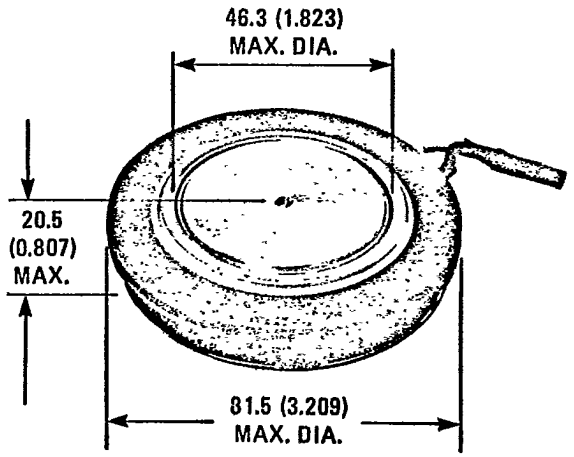
	320PJT200 320PJT250	320PJT200A 320PJT250A	Units
I_{TGQ}	1200	1400	A
$I_{T(RMS)}$	500		A
$I_{T(AV)}$	320		A
@ Max. T_C	80		°C
I_{TSM} @ 50 Hz	4000		A
@ 60 Hz	4200		
I^2t @ 50 Hz	80,000		A^2s
@ 60 Hz	73,000		
I_{GT}	2.0		A
dv/dt	1000		V/μs
di/dt	500		A/μs
t_{gq}	20		μs
T_J	-40 to 125		°C
V_{RRM}, V_{DRM}	2000 to 2500		V

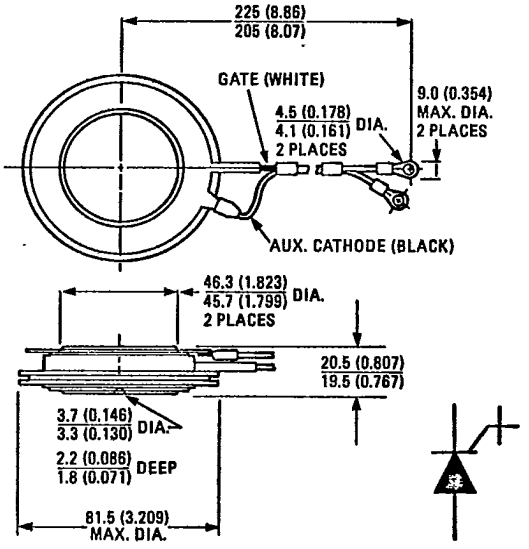
Description/Features

The 320PJT Series of GTO (gate turn-off) thyristors is designed for power control applications such as uninterruptible power supplies (UPS), variable speed ac motor drives, etc. Since they can be turned off by a negative current pulse to the gate, devices in the 320PJT Series allow reductions in overall size, weight, cost and acoustical noise when compared to conventional thyristors that require bulky commutating circuits.

- 320A average current.
- 1200A and 1400A controllable on-state current.
- Maximum turn-off time of 20 μsec.
- Critical dv/dt of 1000 V/μsec.
- Available with maximum repetitive peak off-state voltage (V_{DRM}) to 2500V.

CASE STYLE AND DIMENSIONS





IR Case Style A-38
Dimensions in Millimeters and (Inches)

320PJT & 320PJT-A Series

VOLTAGE RATINGS

Part Number	V_{RRM}, V_{DRM} – Max. Repetitive Peak Reverse and Off-State Voltage (V) ① ②	V_{RSM} – Max. Non-Repetitive Peak Reverse Voltage $t_p \leq 5$ ms (V) ②	V_{DSM} – Max. Non-Repetitive Peak Off-State Voltage $t_p \leq 5$ ms (V) ①
	T_J = -40 to 125°C	T_J = 25 to 125°C	T_J = 25 to 125°C
320PJT200	2000	2200	2200
① 320PJT200A	2000	2200	2200
320PJT250	2500	2750	2500
② 320PJT250A	2500	2750	2500

Peak off-state voltages apply for -2V or more negative gate voltage or for gate-to-cathode resistance = 2 ohms.

Peak reverse voltages apply for zero or negative gate voltage.

ELECTRICAL SPECIFICATIONS

		320PJT200 320PJT250	320PJT200A 320PJT250A	Units	Conditions
	ON-STATE				
$I_{T(RMS)}$	Nominal RMS on-state current	500		A	
$I_{T(AV)}$	Max. average on-state current	320		A	180° half sine wave conduction.
	@ Max. T_C	80		°C	
I_{TGQ}	Max. controllable peak on-state current	1200	1400	A	T_J = 125°C, V_{DM} = 0.5 V_{DRM}, G_{GQ} = 5, C_S = 3 μF. Note: $V_S \leq$ 1000V @ T_J = 25°C and $V_S \leq$ 900V @ T_J = 125°C. (V_S is the voltage spike which appears on the dynamic on-state voltage trace during fall time.) ③
I_{TSM}	Max. peak one cycle, non-repetitive surge current	4000		A	50 Hz half cycle sine wave or 6 ms rectangular pulse. Following any rated load condition, and with rated V_{RRM} applied following surge. SCR turned fully on.
		4200			60 Hz half cycle sine wave or 5 ms rectangular pulse
I^2t	Max. I^2t capability for fusing	80,000		A^2s	t = 10 ms. Rated V_{RRM} applied following surge, initial $T_J \leq$ 125°C.
		73,000			t = 8.3 ms
V_{TM}	Max. peak on-state voltage	3.23		V	T_J = 25°C, $I_{T(AV)}$ = 320A (1000A peak) and I_G = 4A
I_L	Typical latching current	30		A	T_J = 25°C
I_H	Typical holding current	30		A	T_J = 25°C
	BLOCKING				
dv/dt	Min. critical rate-of-rise of off-state voltage	1000		V/μs	Gate voltage = -2V, Gate-to-cathode resistance = 2Ω. T_J = 125°C, V_D = 0.5 V_{DRM}
		300			
I_{DM} & I_{RM}	Max. peak off-state and reverse current	100		mA	T_J = 125°C, V_{DM} = rated V_{DRM}. Peak off-state current applies for -2V or more negative gate voltage or for gate-to-cathode resistance = 2Ω.
	SWITCHING				
di/dt	Max. repetitive rate-of-rise of turned-on current	500		A/μs	$di_G/dt \geq$ 10A/μs, + $I_{GM} \geq$ 15A, $V_D \leq$ 0.5 V_{DRM}, $I_{TM} \leq$ 1200A (320PJT200 & 250), $I_{TM} \leq$ 1400A (320PJT200A & 250A).
t_d	Max. delay time	5		μs	T_J = 125°C, V_D = 0.5 V_{DRM}, + I_{GM} = 15A, di_G/dt = 10A/μs, I_T = 1200A (320PJT200, 250), I_T = 1400A (320PJT200A, 250A).
t_{gt}	Max. turn-on time	10		μs	t_{gt} is measured from the instant at which i_G = 0.1 I_{GM} to the instant at which v_D = 0.1 V_D with resistive load. T_J = 125°C, V_D = 0.5 V_{DRM}, = + I_{GM} = 15A, di_G/dt = 10 A/μs, I_T = 1200A (320PJT200 & 250), I_T = 1400A (320PJT200A & 250A).

③ $G_{GQ} = \frac{I_T}{\text{applied } I_{GQ}}$ = forced turn-off gain.

ELECTRICAL SPECIFICATIONS (Continued)

		320PJT200 320PJT250	320PJT200A 320PJT250A	Units	Conditions
	SWITCHING (Continued)				
t_{on}	Min. permissible on-time	20		μs	t_{on} is the time necessary to ensure that all cathode islands are in conduction. T_J = 125°C, V_D = 0.5 V_{DRM}, I_{GM} = 15A, di_G/dt = 10 A/μs, I_T = 1200A (320PJT200 & 250), I_T = 1400A (320PJT200A & 250A).
t_{gq}	Max. gate-controlled turn-off time	20		μs	t_{gq} is measured from the instant at which i_G = 0.1 I_{GQ} to the instant at which i_T = 0.1 I_{TGQ} with resistive load. T_J = 125°C, V_D = 0.5 V_{DRM}, di_G/dt = 60 A/μs, V_{GK} = -18V, I_T = 1200A (320PJT200 & 250), I_T = 1400A (320PJT200A & 250A).
t_f	Typical fall time	1.0		μs	t_f is measured from the instant at which i_T = 0.9 I_{TGQ} to the instant at which i_T = 0.1 I_{TGQ} with resistive load. T_J = 125°C, V_D = 0.5 V_{DRM}, di_G/dt = 60 A/μs, V_{GK} = -18V, I_T = 1200A (320PJT200 & 250), I_T = 1400A (320PJT200A & 250A).
t_{off}	Min. permissible off-time	85		μs	t_{off} is measured from the instant at which the turn-off pulse is applied to the gate to the earliest instant at which the GTO can be retriggered. T_J = 125°C, V_D = 0.5 V_{DRM}, di_G/dt = 60 A/μs, V_{GK} = -18V, I_T = 1200A (320PJT200 & 250), I_T = 1400A (320PJT250A & 250A).
Q_{CQ}	Typical gate turn-off charge	2200	2500	μC	T_J = 125°C, V_D = 0.5 V_{DRM}, di_G/dt = 60 A/μs, V_{GK} = -18V, I_T = 1200A (320PJT200 & 250), I_T = 1400A (320PJT200A & 250A).
	TRIGGERING				
$P_{GF(AV)}$	Max. average forward gate power	30		W	
P_{GRM}	Max. peak reverse gate power	18,000		W	$t_p \leqslant 5$ μs — Forward gate power is produced by positive gate current, reverse gate power is produced by negative gate current.
$P_{GR(AV)}$	Max. average reverse gate power	80		W	
$+I_{GM}$	Max. peak positive gate current	100		A	$t_p \leqslant 100$ μs. Positive gate current may not be applied during reverse recovery interval.
$-I_{GM}$	Max. peak negative gate current	50		mA	T_J = 125°C, $-V_{GM}$ = rated $-V_{GRM}$. SCR blocking.
$-V_{GRM}$	Max. repetitive peak negative gate voltage	20		V	SCR blocking.
I_{GT}	Max. required DC gate current to trigger	4.6		A	T_C = -40°C — Max. required gate trigger current (or voltage) is the lowest value which will trigger all units with +12 volts anode-to-cathode and I_T = 50A after triggering.
		2.0			T_C = 25°C
		0.5			T_C = 125°C
V_{GT}	Max. required DC gate voltage to trigger	1.25		V	T_C = -40°C
		1.0			T_C = 25°C

THERMAL-MECHANICAL SPECIFICATIONS

T_J	Junction operating temperature range	-40 to 125	°C	
T_{stg}	Storage temperature range	-40 to 125	°C	
R_{thJC}	Max. internal thermal resistance, junction-to-case	0.035	deg. C/W	DC operation; double side cooled, mounting force = 11750N (2650 lbf).
R_{thCS}	Thermal resistance, one pole piece to one heat dissipator	0.02	deg. C/W	Mounting surface smooth, flat and greased.
F	Mounting force Min.	10,600 (2400)	N (lbf)	
	Max.	12,900 (2900)		
wt	Approximate weight	360 (12.7)	g (oz.)	
	Case Style	IR: A-38		

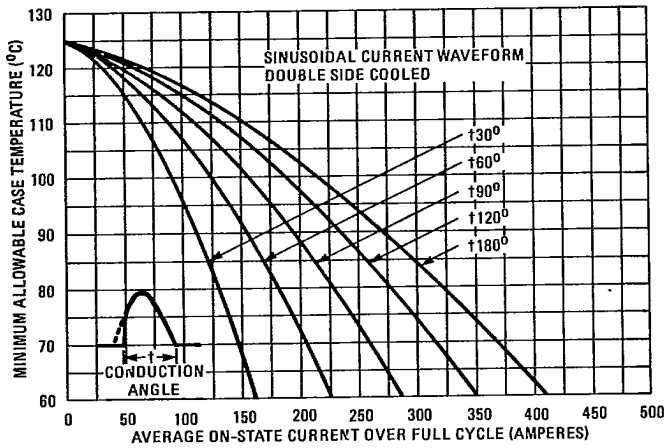


Fig. 1 — Maximum Allowable Case Temperature Vs. Average On-State Current (Sinusoidal Current Waveform), All Devices

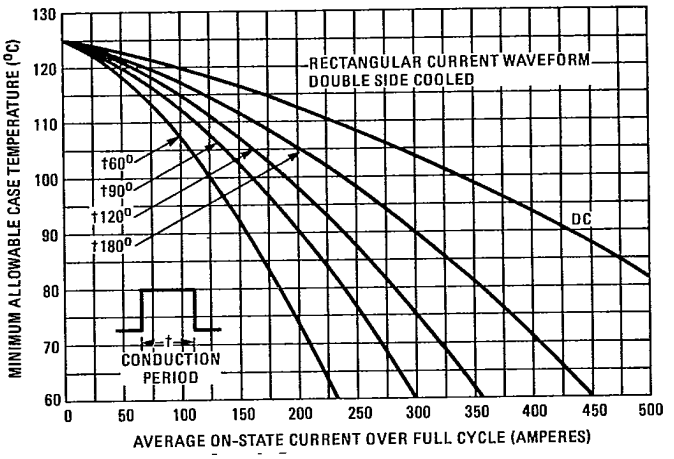


Fig. 2 — Maximum Allowable Case Temperature Vs. Average On-State Current (Rectangular Current Waveform), All Devices

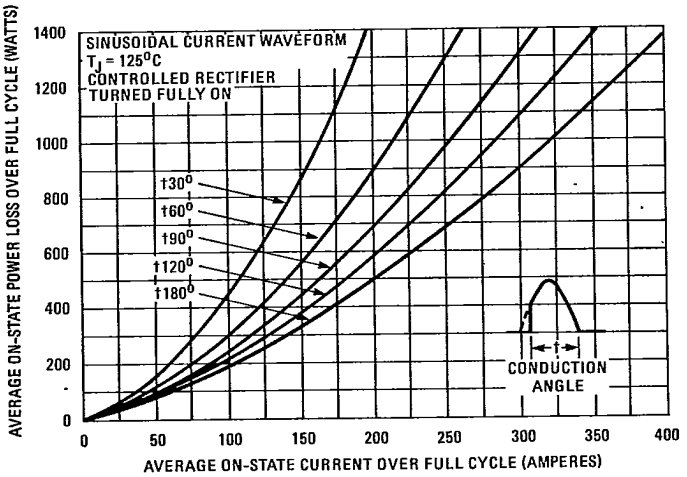


Fig. 3 — Maximum Low-Level On-State Power Loss Vs. Average On-State Current (Sinusoidal Current Waveform), All Devices

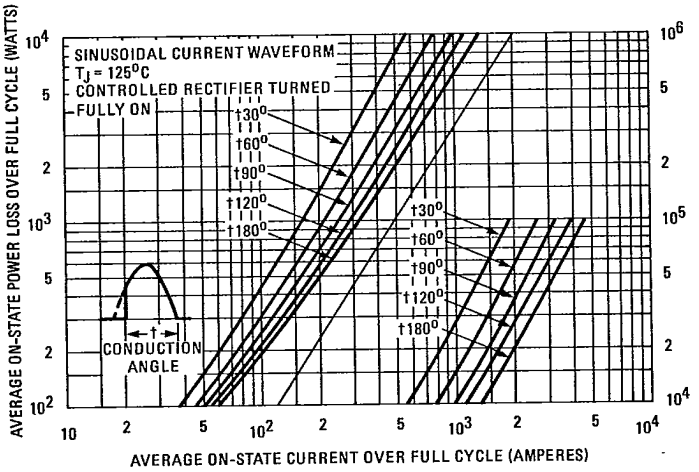


Fig. 4 — Maximum High-Level On-State Power Loss Vs. Average On-State Current (Sinusoidal Current Waveform), All Devices

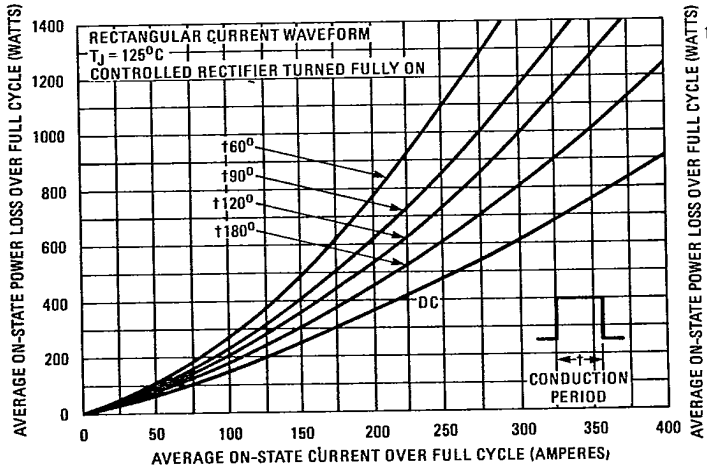


Fig. 5 — Maximum Low-Level On-State Power Loss Vs. Average On-State Current (Rectangular Current Waveform), All Devices

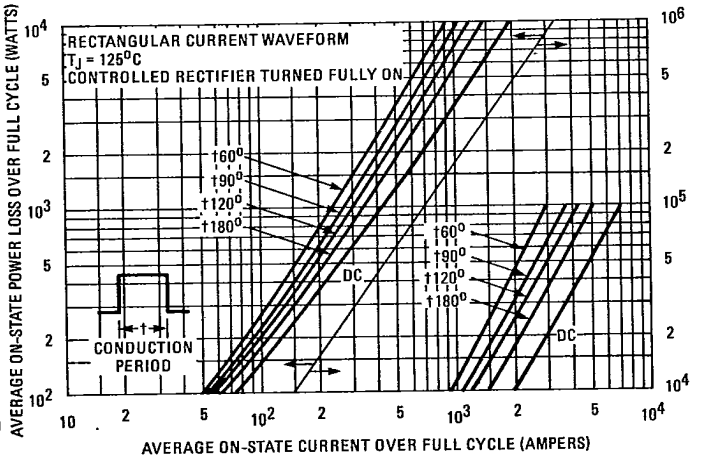


Fig. 6 — Maximum High-Level On-State Power Loss Vs. Average On-State Current (Rectangular Current Waveform), All Devices

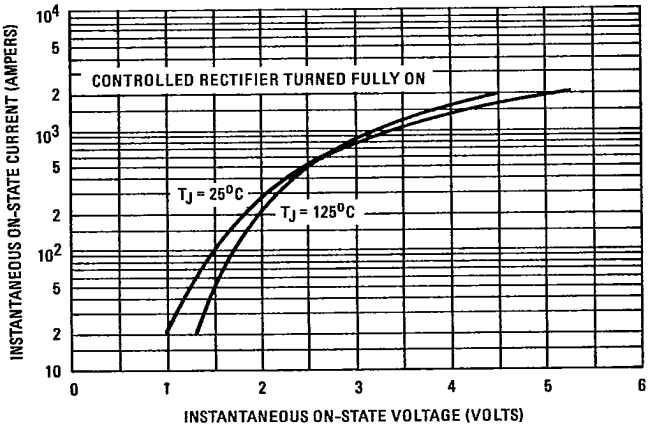


Fig. 7 — Maximum Instantaneous On-State Voltage Vs. Instantaneous On-State Current, All Devices

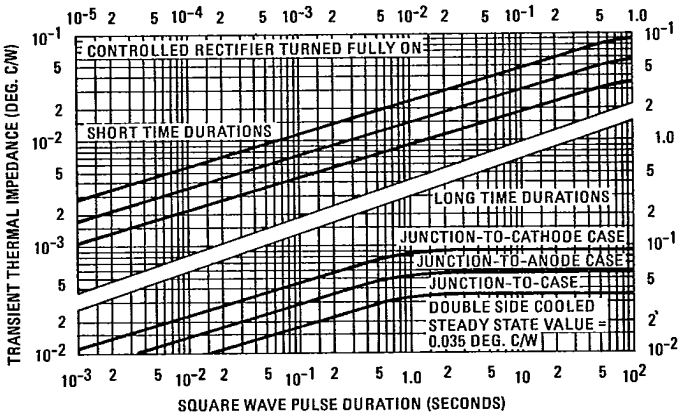


Fig. 8 — Maximum Transient Thermal Impedance Vs. Square Wave Pulse Duration, All Devices

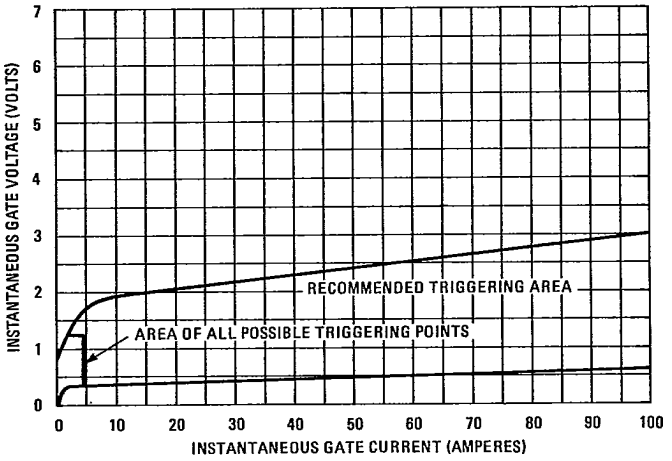


Fig. 9 — Gate Characteristics, All Devices

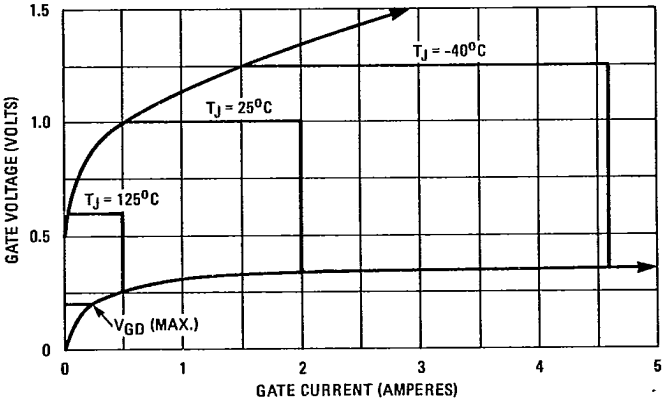


Fig. 9a — Areas of All Possible Triggering Points, All Devices

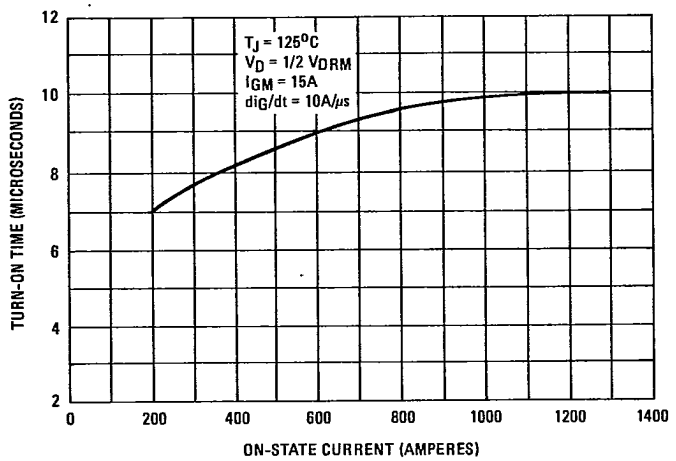


Fig. 10 — Turn-On Time Vs. On-State Current, All Devices

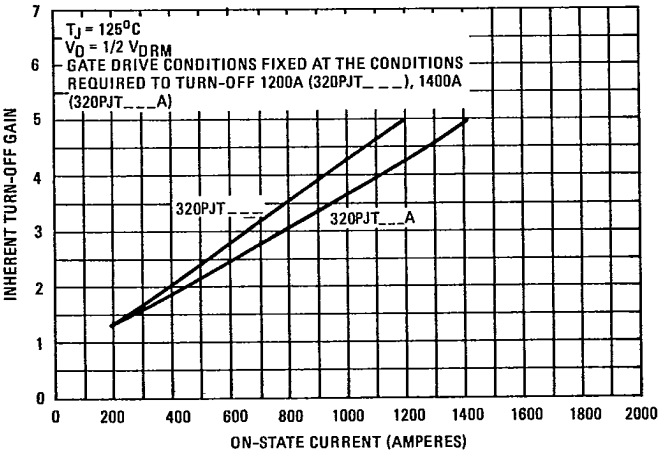


Fig. 11 — Typical Inherent Turn-Off Gain Vs. Instantaneous On-State Current, All Devices

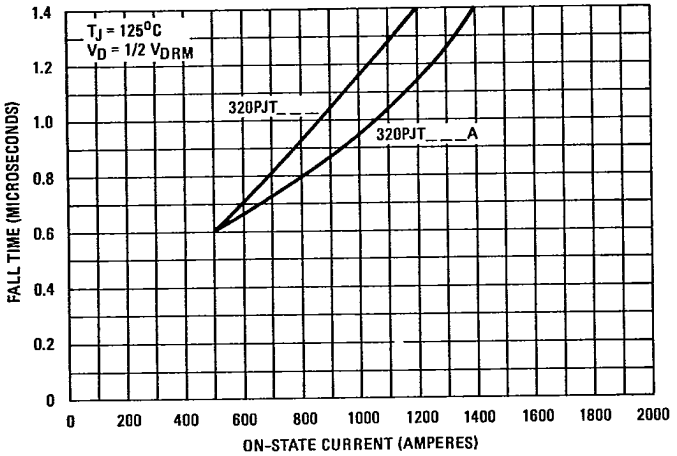


Fig. 12 — Typical Fall Time Vs. On-State Current, All Devices

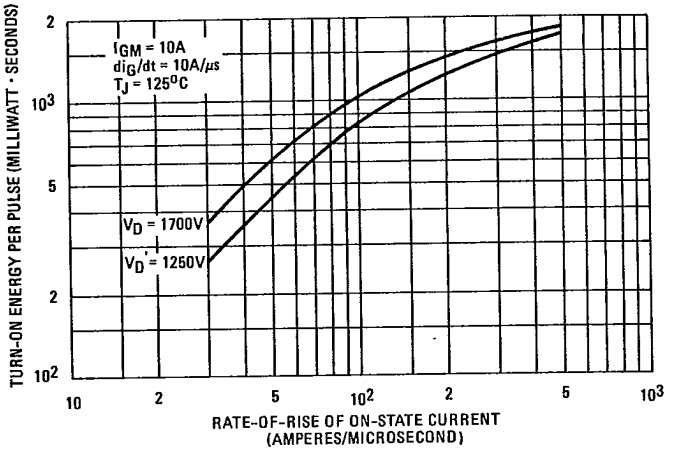


Fig. 13 — Maximum Turn-On Energy Per Pulse Vs. Rate-of-Rise of On-State Current, All Devices

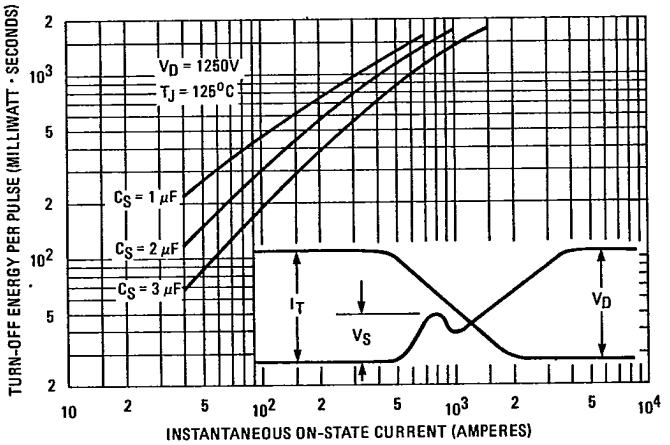


Fig. 14 — Maximum Turn-Off Energy Per Pulse Vs. On-State Current, All Devices

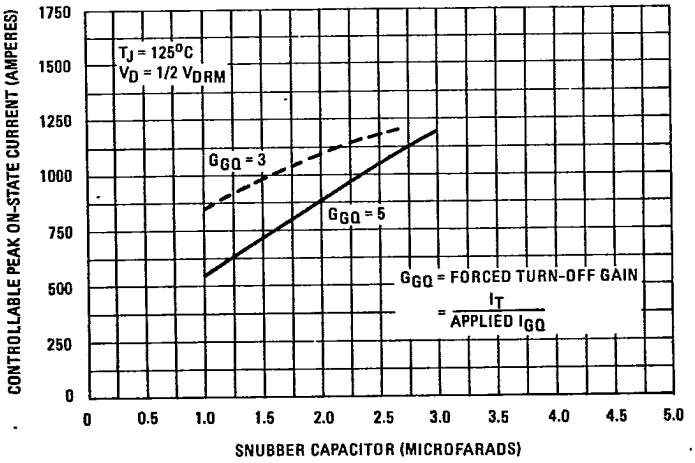


Fig. 15 — Maximum Controllable Peak On-State Current Vs. Snubber Capacitor Value, 320PJT200 & 320PJT250

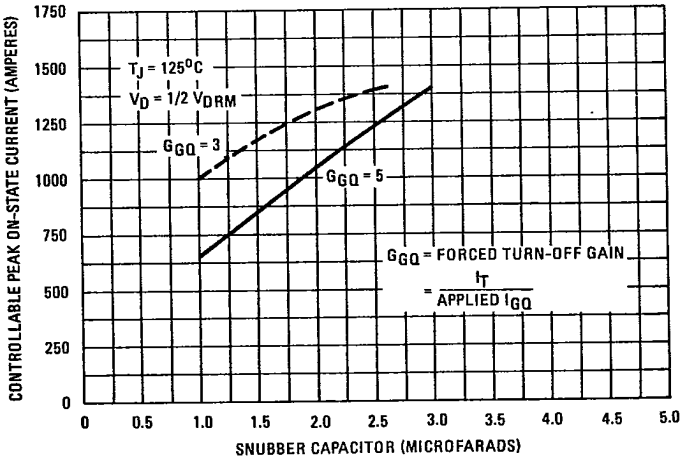


Fig. 16 — Maximum Controllable Peak On-State Current Vs. Snubber Capacitor Value, 320PJT200A & 320PJT250A

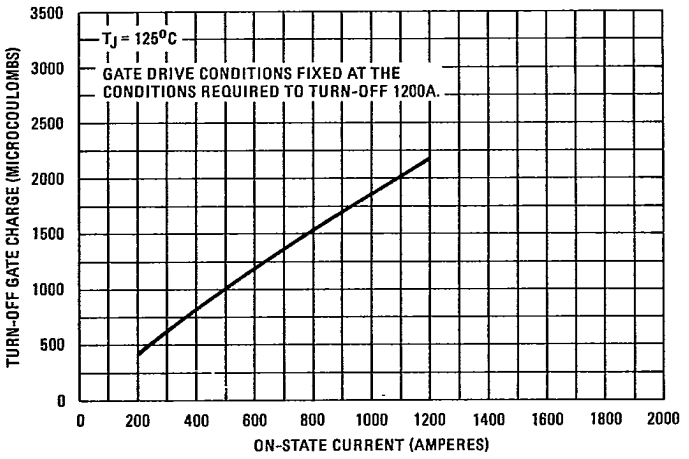


Fig. 17 — Typical Turn-Off Gate Charge Vs. On-State Current, 320PJT200 & 320PJT250

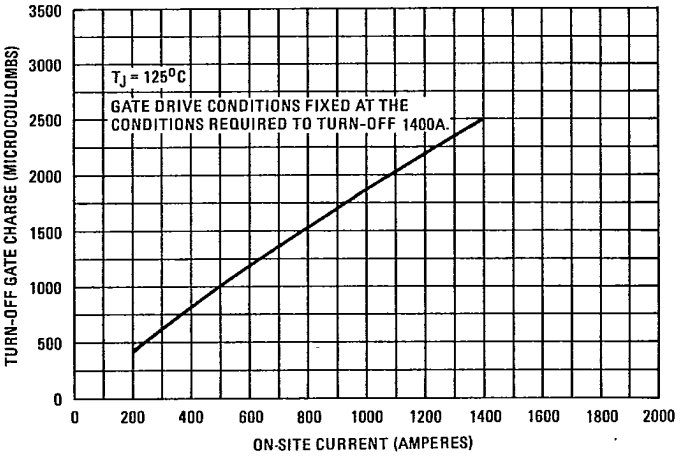


Fig. 18 — Typical Turn-Off Gate Charge Vs. On-State Current, 320PJT200A & 320PJT250A

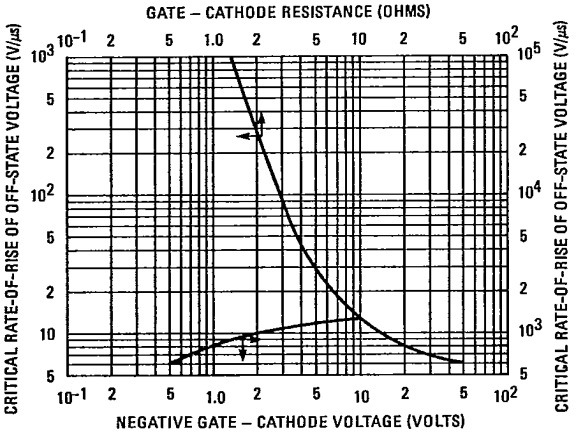


Fig. 19 — Minimum Critical Rate-of-Rise of Off-State Voltage Vs. Negative Gate-Cathode Voltage and Vs. Gate-Cathode Resistance, All Devices

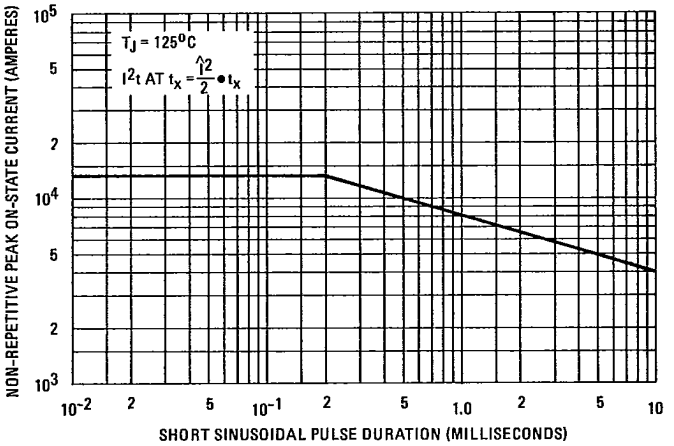
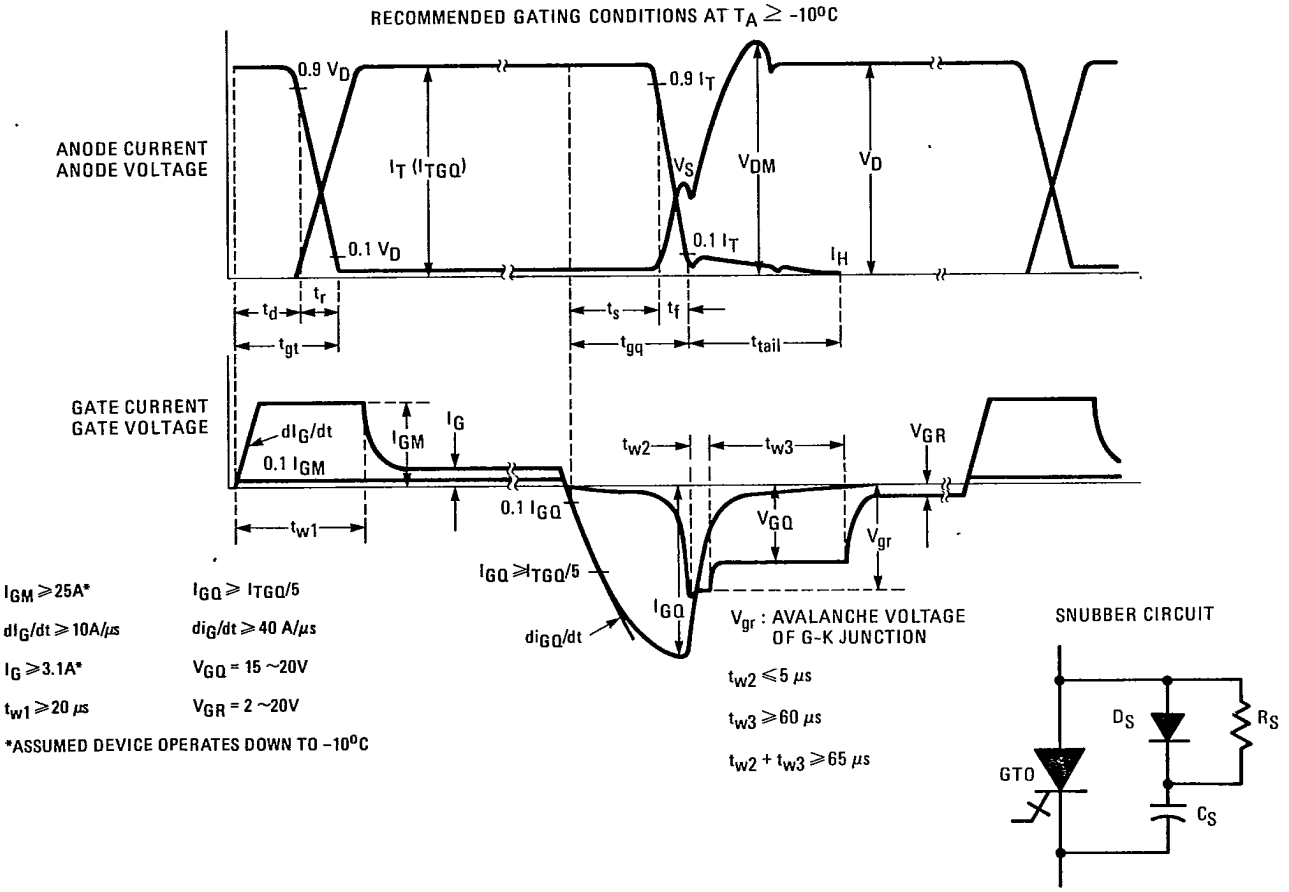


Fig. 20 — Non-Repetitive Peak On-State Current Vs. Sinusoidal Pulse Duration, All Devices

RECOMMENDED GATING CONDITIONS AT $T_A \geq -10^0C$



$I_{GM} \geq 25A^*$ $I_{GQ} \geq I_{TGQ}/5$

$dI_G/dt \geq 10A/\mu s$ $di_G/dt \geq 40\ A/\mu s$

$I_G \geq 3.1A^*$ $V_{GQ} = 15 \sim 20V$

$t_{w1} \geq 20\ \mu s$ $V_{GR} = 2 \sim 20V$

*ASSUMED DEVICE OPERATES DOWN TO -10^0C

V_{gr} : AVALANCHE VOLTAGE OF G-K JUNCTION

$t_{w2} \leq 5\ \mu s$

$t_{w3} \geq 60\ \mu s$

$t_{w2} + t_{w3} \geq 65\ \mu s$

SNUBBER CIRCUIT

SNUBBER CAPACITOR Cs (μF)	SNUBBER RESISTOR Rs (Ω)	MINIMUM ON-TIME (μs)
3.0	20	150
	10	90
2.0	20	100
	10	60
1.0	20	50
	10	30

Fig. 21 — Recommended Gating Conditions