

# 2N681 & 2N5204 SERIES

## 25 and 35 Amp RMS SCRs

### Major Ratings and Characteristics

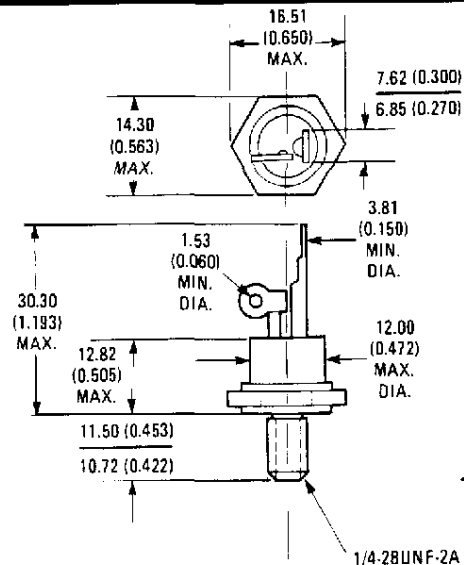
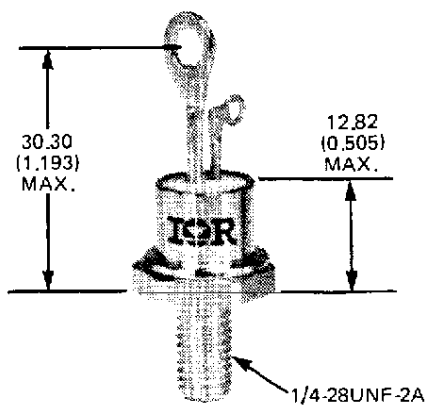
	2N681-92	2N5204-07	Units
$I_T(\text{RMS})$	25	35	A
$I_T(\text{AV})$	16*	22*	A
@ $T_C$	-65 to 65*	-40 to 40	°C
$I_{TSM}$			
@ 50 Hz	145	285	A
@ 60 Hz	150*	300*	
$i_2t$			A <sup>2</sup> s
@ 50 Hz	103	410	
@ 60 Hz	94	375	
$I_{GT}$	40	40	mA
$dv/dt$	—	100*	V/ $\mu$ s
$di/dt$	75–100	100	A/ $\mu$ s
$T_J$	-65 to 125*	-40 to 125*	°C
$V_{RRM}, V_{DRM}$ range	25–800	600–1200	V

\*JEDEC registered value.

### Description/Features

- General purpose stud mounted
- Broad forward and reverse voltage range – through 1200 volts
- Can be supplied to meet stringent military, aerospace and other high-reliability requirements

### CASE STYLE AND DIMENSIONS



Conforms to JEDEC Outline TO-208AA (TO-48)  
Dimensions in Millimeters and (Inches)

**VOLTAGE RATINGS (Applied gate voltage zero or negative)**

Part Numbers	$V_{RRM}, V_{DRM}$ - Max. Repetitive Peak Reverse and Off-State Voltage (V)	$V_{RSM}$ Max. Non Repetitive Peak Reverse Voltage $t_p < 5$ ms (V)
	$T_J = -65^{\circ}C$ to $125^{\circ}C$	$T_J = -65^{\circ}C$ to $125^{\circ}C$
2N681	25*	35*
2N682	50*	75*
2N683	100*	150*
2N685	200*	300*
2N687	300*	400*
2N688	400*	500*
2N689	500*	600*
2N690	600*	720*
2N691	700*	840*
2N692	800*	960*
	$T_J = -40^{\circ}C$ to $125^{\circ}C$	$T_J = -40^{\circ}C$ to $125^{\circ}C$
2N5204	600	720
2N5205	800	960
2N5206	1000	1200
2N5207	1200	1440

**ELECTRICAL SPECIFICATIONS**

		2N681-92	2N5204-07	Units	Conditions
<b>ON-STATE</b>					
$I_T(RMS)$	Max. RMS on-state current	25	35	A	
$I_T(AV)$	Max. average on-state current	16*	22*	A	180° half sine wave conduction
	@ $T_C =$	-65 to 65*	-40 to 40*	°C	
$I_{TSM}$	Max. peak one cycle, non-repetitive surge current	145	285	A	50 Hz half cycle sine wave or 6 ms rectangular pulse 60 Hz half cycle sine wave or 5 ms rectangular pulse Following any rated load condition, and with rated $V_{RRM}$ applied following surge.
		150*	300*		
		170	340		
		180	355		
$I^2t$	Max. $I^2t$ capability, for fusing	103	410	$A^2s$	$t = 10$ ms $t = 8.3$ ms Rated $V_{RRM}$ applied following surge, initial $T_J = 125^{\circ}C$
		94	375		
$I^2t$	Max. $I^2t$ capability, for individual device fusing	145	580	$A^2s$	$t = 10$ ms $t = 8.3$ ms $V_{RRM} = 0$ following surge, initial $T_J = 125^{\circ}C$ .
		135	530		
$I^2\sqrt{t}$	Max. $I^2\sqrt{t}$ capability, for individual device fusing (1)	1450	5800	$A^2\sqrt{s}$	$t = 0.1$ to $10$ ms initial $T_J \leq 125^{\circ}C$ $V_{RRM}$ following surge = 0.
$V_{TM}$	Max. peak on-state voltage	2*	2.3*	V	$T_J = 25^{\circ}C$ , $I_T(AV) = 16A$ (50A peak) 2N681, $I_T(AV) = 22A$ (70A peak) 2N5204
$I_H$	Max. holding current	20 @ $25^{\circ}C$ †	200* @ $-40^{\circ}C$	mA	Anode supply = 24V, initial $I_T = 1.0A$ .
<b>BLOCKING</b>					
$dv/dt$	Min. critical rate-of-rise of off-state voltage	100†	100*	V/ $\mu s$	$T_J = 125^{\circ}C$ . Exponential to 100% rated $V_{DRM}$ $T_J = 125^{\circ}C$ . Exponential to 67% rated $V_{DRM}$ Gate open circuited.
		250†	250		

\*JEDEC Registered value.

(1)  $I^2t$  for time  $t_x = I^2\sqrt{t} \cdot \sqrt{t_x}$ .

† Typical

**ELECTRICAL SPECIFICATIONS (Continued)**

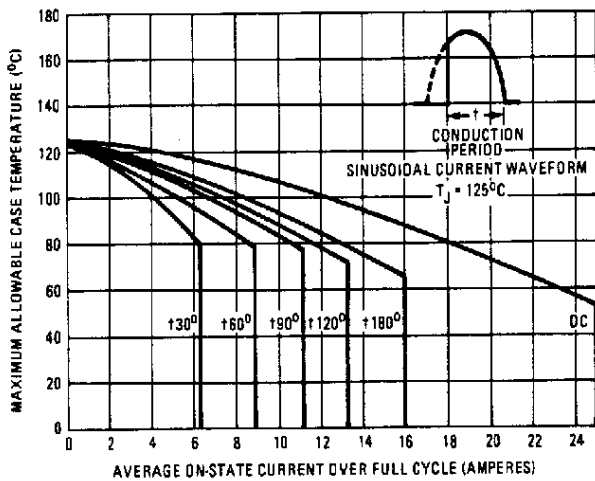
		2N681-92	2N5204-07	Units	Conditions			
<b>BLOCKING (Continued)</b>								
$I_{R(-)}$ & $I_{D(-)}$ Max. reverse and off-state current $V_{RRM}$ & $V_{DRM} = 5V$	$I_{R(AV)}$ & $I_{D(AV)}$ (Average Values)	$I_{RM}$ & $I_{DM}$ (Peak Values)	$I_{RM}$ & $I_{DM}$ (Peak Values)	mA	$T_J = 125^{\circ}C$ , gate open circuited.			
						25 to 150V	6.5*	—
						200 & 250V	6.0*	—
						300V	5.0*	—
						400V	4.0*	—
						500V	3.0*	—
						600V	2.5*	3.3*
						700V	2.25*	—
						800V	2.0*	2.5*
						1000V	—	2.0*
1200V	—	1.7*						
<b>SWITCHING</b>								
$t_d$	Typical delay time	1	1	$\mu s$	$T_C = 25^{\circ}C$ , $V_{DM} =$ rated $V_{DRM}$ , $I_{TM} = 10A$ dc resistive circuit. Gate pulse: 10V, 40 $\Omega$ source, $t_p = 6 \mu s$ , $t_r = 0.1 \mu s$ .			
di/dt	Max. non-repetitive rate of rise of turned-on current $V_{DM} = 25$ to 600V	100	—	$A/\mu s$	$T_C = 125^{\circ}C$ , $V_{DM} =$ rated $V_{DRM}$ , $I_{TM} = 2 \times di/dt$ . Gate pulse: 20V, 15 $\Omega$ , $t_p = 6 \mu s$ , $t_r = 0.1 \mu s$ max. Per JEDEC standard RS-397, 5.2.2.6.			
		= 700 to 800V	75			—		
		—	—			100		
<b>TRIGGERING</b>								
$P_{GM}$	Max. peak gate power	5*	60*	W	$t_p \leq 5$ ms for 2N681 series; $t_p \leq 500 \mu s$ for 2N5204 series.			
$P_{G(AV)}$	Max. average gate power	0.5*	0.5*	W				
$+I_{GM}$	Max. peak positive gate current	2*	2	A				
$+V_{GM}$	Max. peak positive gate voltage	10*	—	V				
$-V_{GM}$	Max. peak negative gate voltage	5*	5*	V				
$I_{GT}$	Max. required DC gate current to trigger	80*	80*	mA	$T_C =$ min. rated value. Max. required gate trigger current is the lowest value which will trigger all units with +6V anode-to-cathode. $T_C = 25^{\circ}C$ $T_C = 125^{\circ}C$ $T_C = 25^{\circ}C$ +6V anode-to-cathode			
		40	40					
		18.5	20					
		Typical DC gate current to trigger	30			30		
$V_{GT}$	Max. required DC gate voltage to trigger	3*	3*	V	$T_C = -65^{\circ}C$ . Max. required gate trigger voltage is the lowest value which will trigger all units with +6V anode-to-cathode. $T_C = 25^{\circ}C$ $T_C = 25^{\circ}C$ +6V anode-to-cathode			
		2	2					
		Typical DC gate voltage to trigger	1.5			1.5		
$V_{GD}$	Max. DC gate voltage not to trigger	0.25*	0.25*	V	$T_C = 125^{\circ}C$ . Max. gate voltage not to trigger is the maximum value which will not trigger any unit with rated $V_{DRM}$ anode-to-cathode.			

**THERMAL-MECHANICAL SPECIFICATIONS**

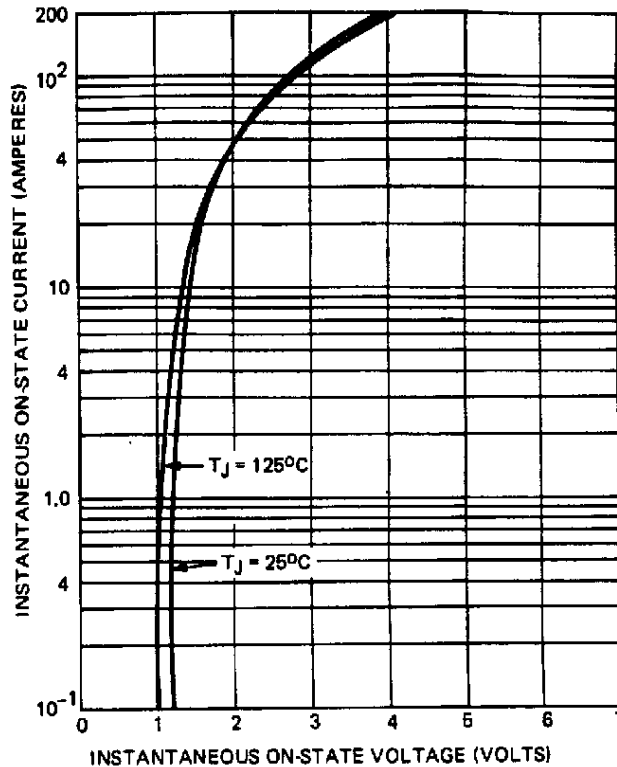
		2N681-92	2N5204-07	Units	Conditions		
$T_J$	Operating junction temperature range	-65° to 125°	-40° to 125°	°C			
$T_{stg}$	Storage temperature range	-65° to 125°	-40° to 125°	°C			
$R_{thJC}$	Max. internal thermal resistance, junction to case	1.5	1.5*	deg. C/W	DC operation		
$R_{thCS}$	Thermal resistance, case to sink	0.35	0.35	deg. C/W	Mounting surface smooth, flat and greased.		
Mounting torque to nut $\pm 10\%$		20.(27.5)		lbf · in.	Lubricated threads (non-lubricated threads).		
		0.23(.32)		kgf · m			
		2.3(3.1)		N·m			
		to device		25		lbf · in.	Lubricated threads.
				0.29		kgf · m	
				2.8		N·m	
wt	Approximate weight	14(0.49)	14 (0.5)	g (oz.)			
Case Style		TO-208AA (TO-48)					

\*JEDEC Registered value.

**2N681 Series**



**Fig. 1 – Maximum Allowable Case Temperature Vs. Average On-State Current, 2N681 Series**



**Fig. 2 – Maximum On-State Voltage Vs. Current, 2N681 Series**

2N681 Series

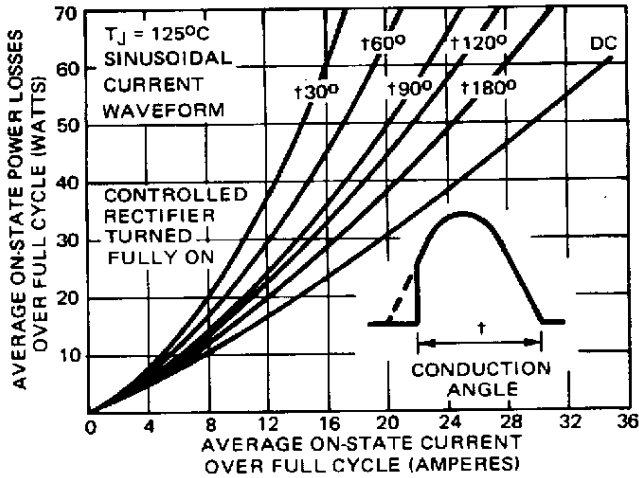


Fig. 3 – Maximum Low Level On-State Power Loss Vs. Current (Sinusoidal Current Waveform), 2N681 Series

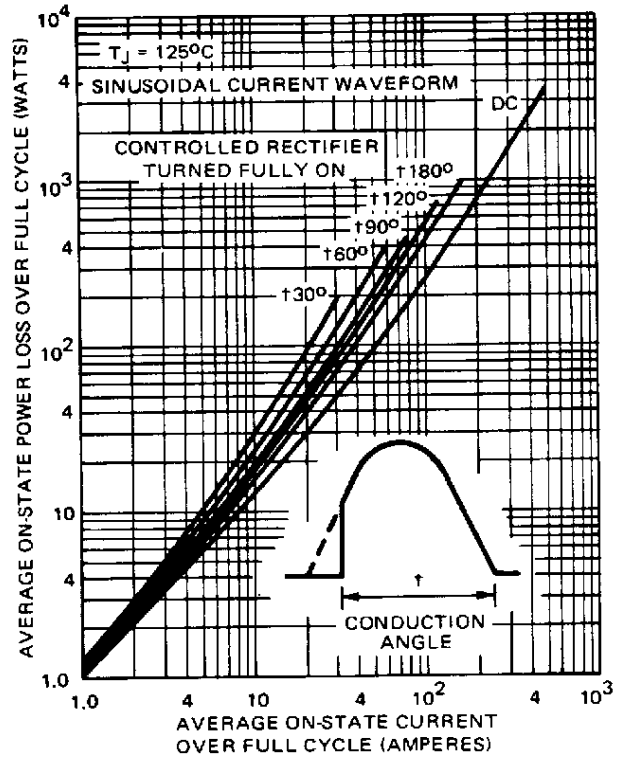


Fig. 4 – Maximum High Level On-State Power Loss Vs. Current (Sinusoidal Current Waveform), 2N681 Series

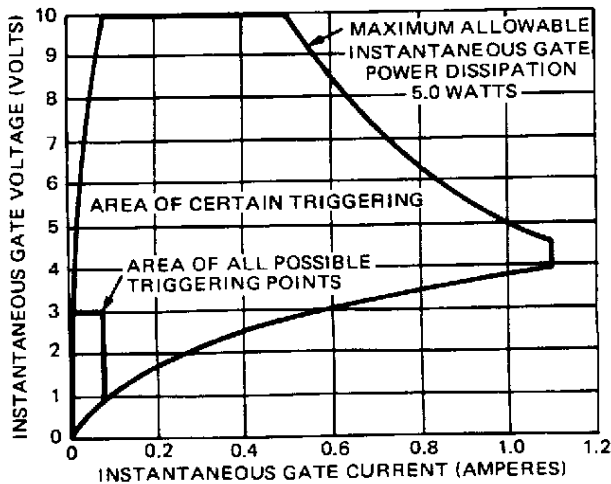


Fig. 5 – Gate Characteristics, 2N681 Series

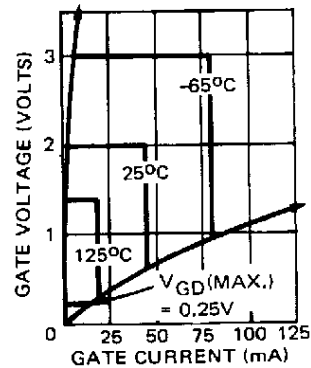


Fig. 5A – Area of All Possible Triggering Points Vs. Temperature 2N681 Series

2N681 Series

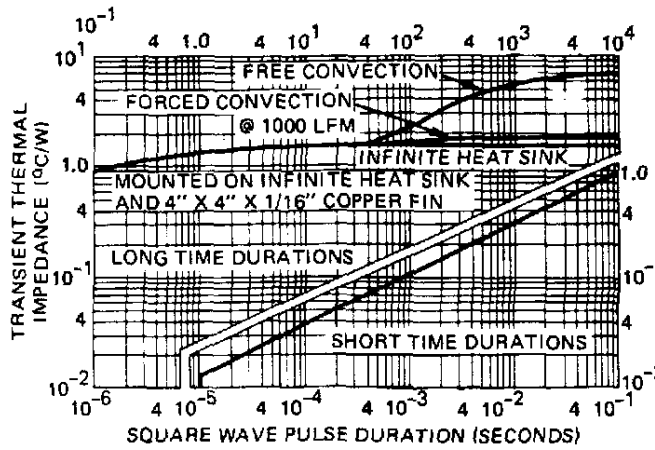


Fig. 6 – Maximum Transient Thermal Impedance, Junction to Case, Vs. Pulse Duration, 2N681 Series

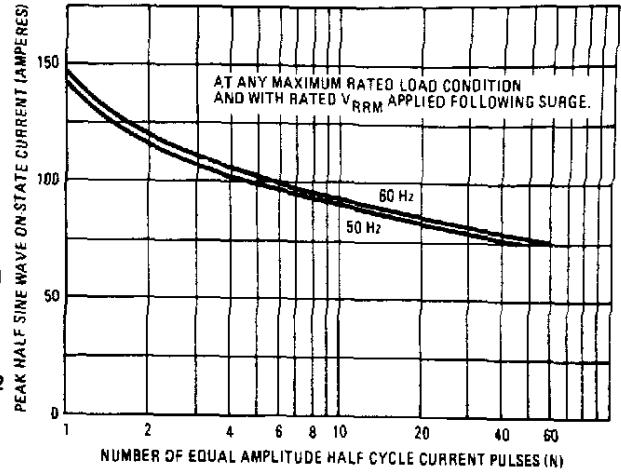


Fig. 7 – Maximum Non-Repetitive Surge Current, Vs. Number of Current Pulses, 2N681 Series

2N5204 Series

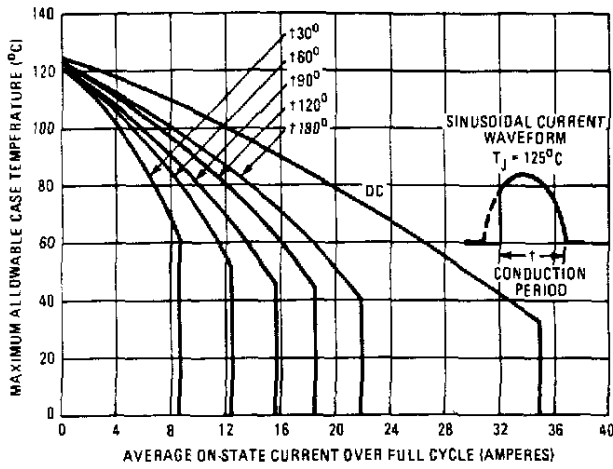


Fig. 8 – Maximum Allowable Case Temperature Vs. Average On-State Current (Sinusoidal Current Waveform), 2N5204 Series

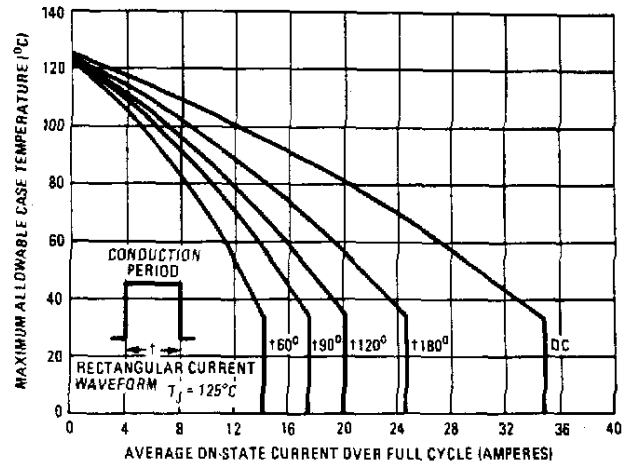
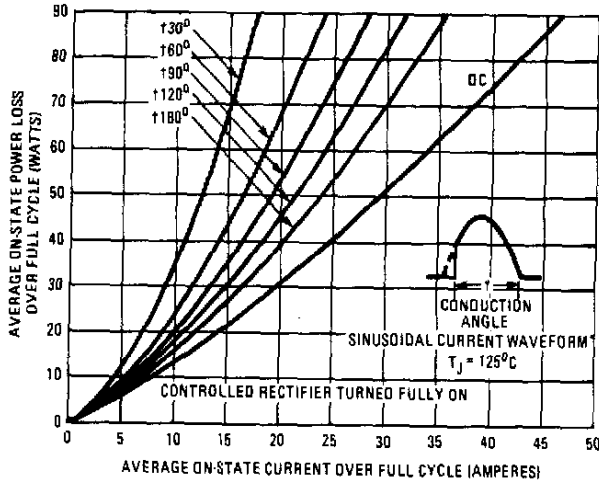
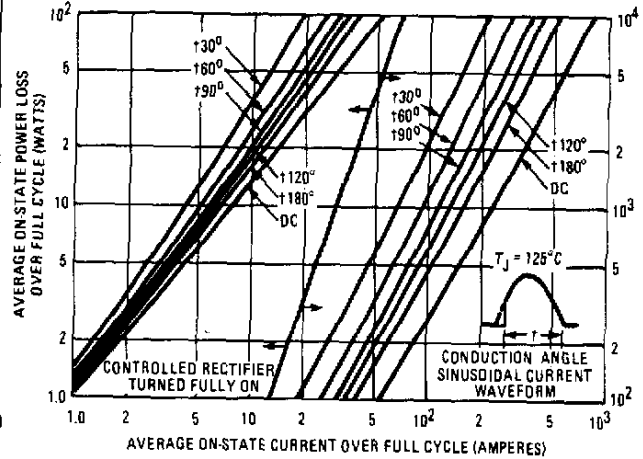


Fig. 9 – Maximum Allowable Case Temperature Vs. Average On-State Current (Rectangular Current Waveform), 2N5204 Series

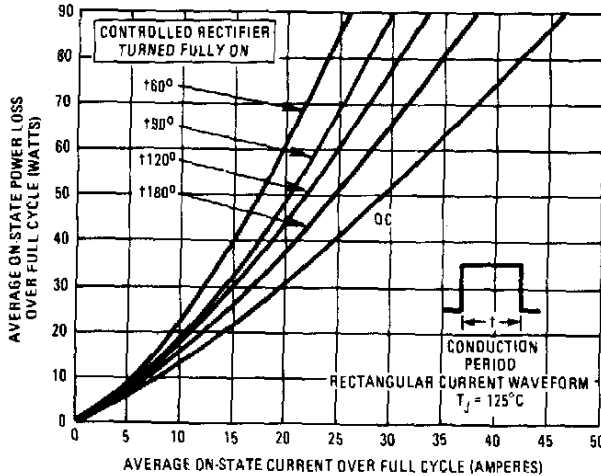
2N5204 Series



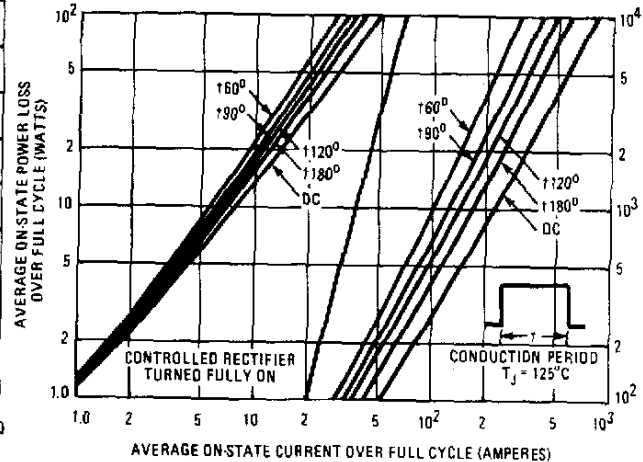
**Fig. 10 – Maximum Low-Level On-State Power Loss Vs. Average On-State Current (Sinusoidal Current Waveform), 2N5204 Series**



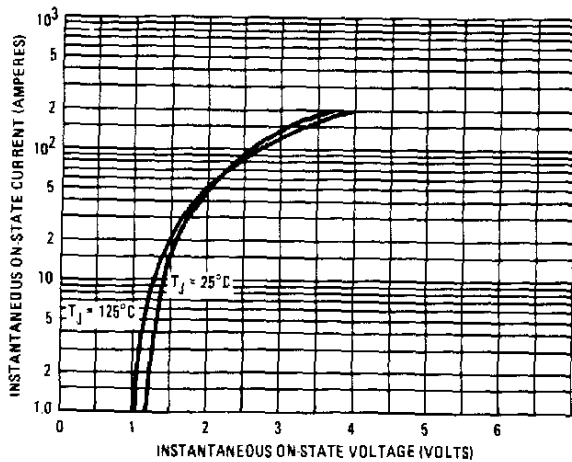
**Fig. 11 – Maximum High-Level On-State Power Loss Vs. Average On-State Current (Sinusoidal Current Waveform), 2N5204 Series**



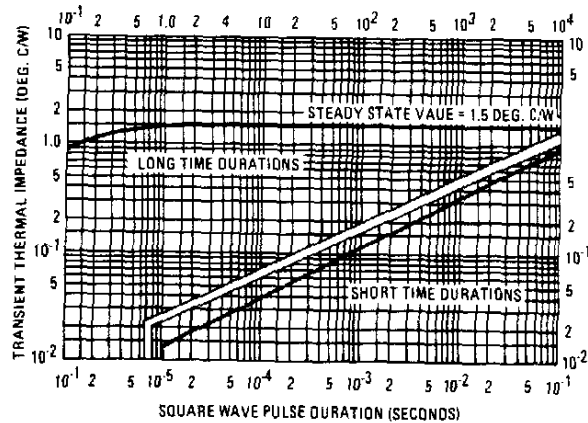
**Fig. 12 – Maximum Low-Level On-State Power Loss Vs. Average On-State Current (Rectangular Current Waveform), 2N5204 Series**



**Fig. 13 – Maximum High-Level On-State Power Loss Vs. Average On-State Current (Rectangular Current Waveform), 2N5204 Series**



**Fig. 14 – Maximum Instantaneous On-State Voltage Vs. Instantaneous On-State Current, 2N5204 Series**



**Fig. 15 – Maximum Transient Thermal Resistance, Junction to Case, Vs. Pulse Duration, 2N5204 Series**