POWER TRANSISTORS
5 Amp, 80V, Planar, NPN

JAN, JANTX, & JANTXV 2N2880
JAN, JANTX, & JANTXV 2N3749

FEATURES
- Meets MIL-S-19500/315
- Collector-Base Voltage: 110V
- Fast Switching: t_r, t_f = 300nSec max
- Low Saturation Voltage: 0.25V max @ 1A

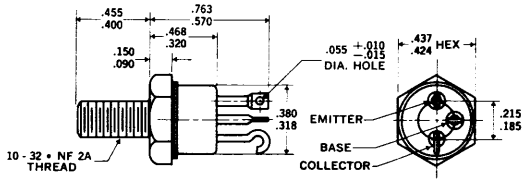
DESCRIPTION
Unitrode power transistors provide a unique combination of low saturation voltage, high gain and fast switching. They are ideally suited for power supply, pulse amplifier and similar high efficiency power switching applications.

ABSOLUTE MAXIMUM RATINGS

	JAN, JANTX, JANTXV 2N2880 2N3749
Collector-Base Voltage, V_{CBO}	110V
Collector-Emitter Voltage, V_{CEO}	80V
Emitter-Base Voltage, V_{EBO}	8V
D.C. Collector Current, I_C	5A
Power Dissipation	
25°C Ambient	2W
100°C Case	30W
Operating and Storage Temperature Range	−65°C to +200°C

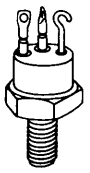
MECHANICAL SPECIFICATIONS

JAN, JANTX, & JANTXV 2N2880

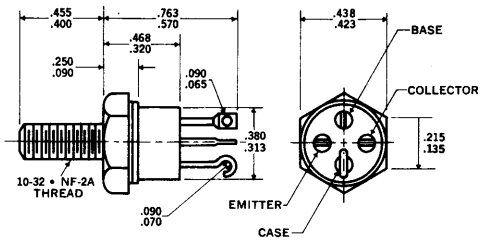


Dimensions in inches.

TO-59

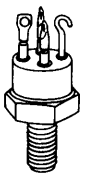


JAN, JANTX, & JANTXV 2N3749



Dimensions in inches.

TO-111



UNITRODE

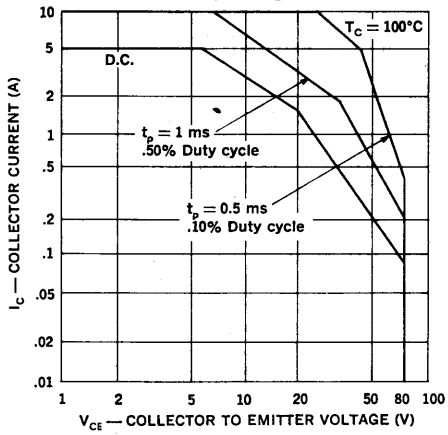
ELECTRICAL SPECIFICATIONS (at 25°C unless noted)

TEST	SYMBOL	MIN.	MAX.	UNITS	/315 Sub group	MIL - STD - 750 METHOD	MIL - STD - 750 TEST CONDITIONS
Visual and Mechanical	—	—	—		A-1	2071	See Mechanical Data
Collector-Base Voltage	BV_{CBO}	110	—	Vdc	A-2	3001	$I_C = 10\mu Adc$, Cond. D
Collector-Emitter Voltage (1.)	BV_{CEO}	80	—	Vdc	A-2	3011	$I_C = 0.1Adc$, Cond. D
Emitter-Base Voltage	BV_{EBO}	8	—	Vdc	A-2	3026	$I_E = 10\mu Adc$, Cond. D
Collector-Emitter Cutoff Current	I_{CEO}	—	100	μAdc	A-2	3041	$V_{CE} = 60Vdc$, Cond. D
Collector-Emitter Cutoff Current	I_{CEX}	—	10	μAdc	A-2	3041	$V_{CE} = 110Vdc$, $V_{EB} = 0.5Vdc$, Cond. A
Collector-Base Cutoff Current	I_{CBO}	—	0.4	μAdc	A-2	3036	$V_{CB} = 80Vdc$, Cond. D
Emitter-Base Cutoff Current	I_{EBO}	—	0.4	μAdc	A-2	3061	$V_{EB} = 6Vdc$, Cond. D
D.C. Current Gain (1.)	h_{FE}	40	—	—	A-3	3076	$I_C = 50mAdc$, $V_{CE} = 5Vdc$
D.C. Current Gain (1.)	h_{FE}	40	120	—	A-3	3076	$I_C = 1Adc$, $V_{CE} = 5Vdc$
D.C. Current Gain (1.)	h_{FE}	15	—	—	A-3	3076	$I_C = 5Adc$, $V_{CE} = 5Vdc$
Collector Saturation Voltage (1.)	$V_{CE(sat)}$	—	0.25	Vdc	A-3	3071	$I_C = 1Adc$, $I_B = 0.1Adc$
Collector Saturation Voltage (1.)	$V_{CE(sat)}$	—	2	Vdc	A-3	3071	$I_C = 5Adc$, $I_B = 0.5Adc$
Base Saturation Voltage (1.)	$V_{BE(sat)}$	—	1.2	Vdc	A-3	3066	$I_C = 1Adc$, $I_B = 0.1Adc$
Base On-Voltage (1.)	$V_{BE(on)}$	—	1.2	Vdc	A-3	3066	$I_C = 1Adc$, $V_{CE} = 2Vdc$
A.C. Current Gain	h_{FE}	40	120	—	A-4	3206	$I_C = 50mAdc$, $V_{CE} = 5Vdc$, $f = 1KHz$
Gain-Bandwidth Product	f_T	20	120	MHz	A-4	3306	$I_C = 1Adc$, $V_{CE} = 10Vdc$, $f = 10MHz$
Output Capacitance	C_{ob}	—	150	pf	A-4	3236	$V_{CB} = 10Vdc$, $I_E = 0$, $f = 1MHz$
Switching Parameters							
Delay Time	t_d	—	60	ns	A-4	—	See Switching Speed Circuit
Rise Time	t_r	—	300	ns	A-4	—	
Storage Time	t_s	—	1.7	μs	A-4	—	
Fall Time	t_f	—	300	ns	A-4	—	
Thermal Resistance	θ_{JC}	—	3.33	°C/W	C-1	3151	
100°C							
Forward-Biased Second Breakdown	$I_{S/B}$	5	—	Adc	B-5	3051	$V_{CE} = 6Vdc$, t= 60Sec, $T_C = 100°C$
Forward-Biased Second Breakdown	$I_{S/B}$	80	—	mAdc	B-5	3051	$V_{CE} = 80Vdc$, t = 60Sec, $T_C = 100°C$
Clamped Reverse-Biased Second Breakdown	$E_{S/B}$	12.5	—	mj	B-7	—	$I_C = 5A$, L = 1mH, $V_{Clamp} = 110V$, $T_C = 100°C$
Unclamped Revers -Biased Second Breakdown	$E_{S/B}$	12.5	—	mj	B-6	3053	$I_C = 5A$, L = 1mH Base Open
Unclamped Reverse-Biased Second Breakdown	$E_{S/B}$	12.8	—	mj	B-6	3053	$I_C = 1.6A$, L = 10mH Base Open
150°C							
Collector-Emitter Cutoff Current	I_{CEX}	—	50	μA	A-5	3041	$V_{CE} = 80Vdc$, $V_{EB} = 0.5Vdc$ Cond. A, $T_A = 150°C$
—65°C							
D.C. Current Gain (1.)	h_{FE}	15	—	—	A-5	3076	$I_C = 1Adc$, $V_{CE} = 5Vdc$ $T_A = -65°C$

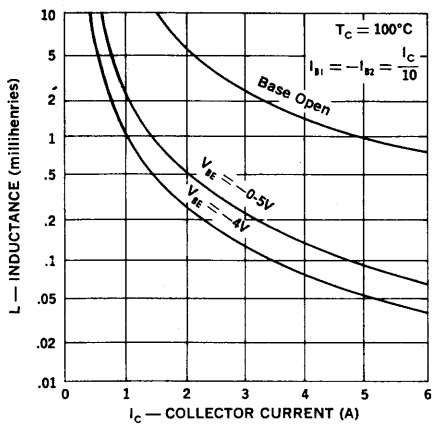
Note 1. Pulse Width = 300μSec, duty cycle ⩽ 2%

IV

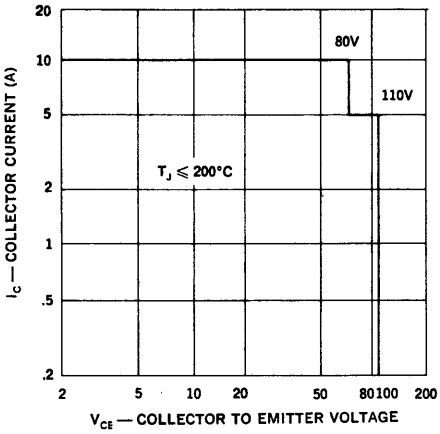
Forward Bias
Safe Operating Area



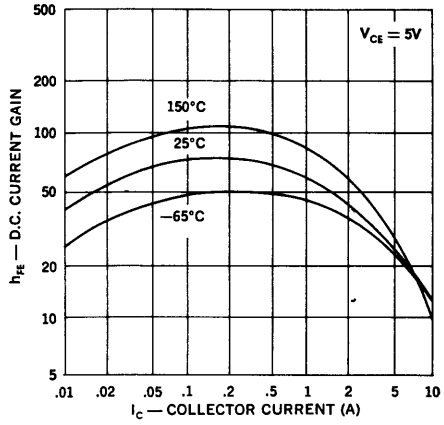
Unclamped Reverse Bias
Second Breakdown



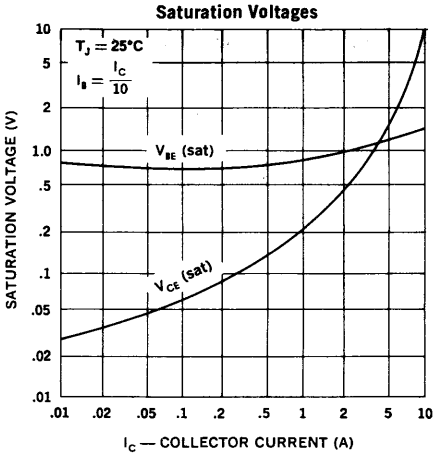
Reverse Bias
Safe Operating Area
Clamped Inductive Switching



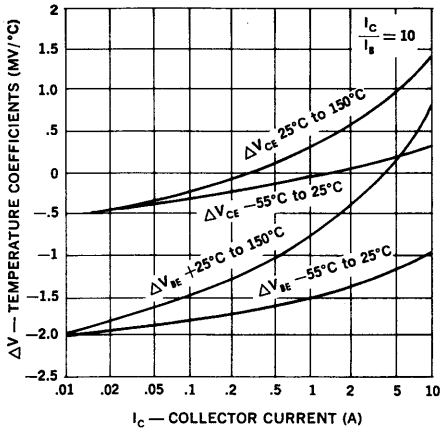
D.C. Current Gain
2N2880-2N3749



Saturation Voltages



Saturation Voltage
Temperature Coefficients



2N3749

POWER TRANSISTORS
5 Amp, 150V, Planar NPN

2N5487 2N5488 5487-1 5487-3 5488-1 5488-3

FEATURES
- Collector-Base Voltage: up to 150V
- D.C. Collector Current: 5A
- Peak Collector Current: 10A
- Fast Switching
- Low Saturation Voltage
- High Gain

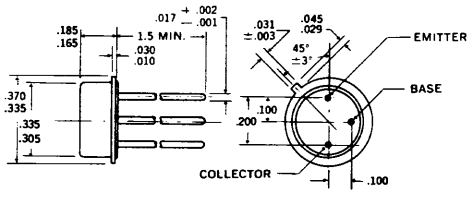
DESCRIPTION
Unitrode power transistors provide a unique combination of low saturation voltage, high gain and fast switching. They are ideally suited for power supply pulse amplifier and similar high efficiency power switching applications.

ABSOLUTE MAXIMUM RATINGS

	2N5487 5487-1 5487-3	2N5488 5488-1 5488-3
Collector-Base Voltage, V_{CBO}	120V	150V
Collector-Emitter Voltage, V_{CER}	120V	150V
Emitter-Base Voltage, V_{EBO}	8V	8V
D.C. Collector Current, I_C	5A	10A
Peak Collector Current, I_C	10A	10A
Power Dissipation		
25°C Ambient	1.25W	1.25W
100°C Case	15W	15W
Operating and Storage Temperature Range	−65°C to 200°C	

MECHANICAL SPECIFICATIONS

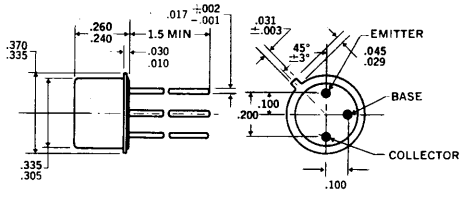
2N5487 2N5488



Dimensions in inches.

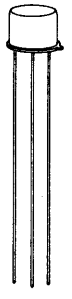
Pancake TO-5

5487-1 5488-1



Dimensions in inches.

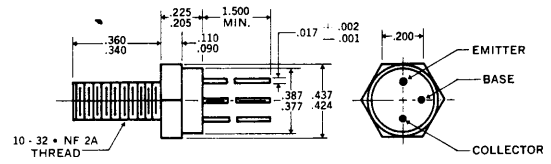
TO-5



UNITRODE

MECHANICAL SPECIFICATIONS

5487-3 5488-3



Dimensions in inches.

Low Profile
7/16 Hex

IV

ELECTRICAL SPECIFICATIONS (at 25°C unless noted)†

Test	Symbol	2N5487 Min.	2N5487 Max.	2N5488 Min.	2N5488 Max.	Units	Test Conditions
D.C. Current Gain (Note 3)	h_{FE}	100	300	40	120	—	$I_C = 1A, V_{CE} = 2V$
D.C. Current Gain	h_{FE}	80		35		—	$I_C = 50mA, V_{CE} = 2V$
D.C. Current Gain (Note 3)	h_{FE}	25		15		—	$I_C = 5A, V_{CE} = 5V$
Collector Saturation Voltage (Note 3)	V_{CE} (sat)		0.25		0.25	V	$I_C = 1A, I_B = 100mA$
Collector Saturation Voltage (Note 3)	V_{CE} (sat)		1.0		1.0	V	$I_C = 5A, I_B = 500mA$
Base Saturation Voltage (Note 3)	V_{BE} (sat)		1.2		1.2	V	$I_C = 1A, I_B = 100mA$
Base Saturation Voltage (Note 3)	V_{BE} (sat)		1.8		1.8	V	$I_C = 5A, I_B = 500mA$
Collector-Emitter Breakdown Voltage (Note 3)	BV_{CER}	120		150		V	$I_C = 10mA, R_{BE} = 10$ ohms
Collector-Emitter Breakdown Voltage (Note 3)	BV_{CEO}	80		100		V	$I_C = 100mA, I_B = 0$
Emitter-Base Breakdown Voltage	BV_{EBO}	8		8		V	$I_E = 10\mu A, I_C = 0$
Collector Cutoff Current	I_{CES}		0.1			μA	$V_{CE} = 80V, R_{BE} = 0$
Collector Cutoff Current	I_{CES}				0.1	μA	$V_{CE} = 100V, R_{BE} = 0$
Collector Cutoff Current	I_{CES}		10			μA	$V_{CE} = 120V, R_{BE} = 0$
Collector Cutoff Current	I_{CES}				10	μA	$V_{CE} = 150V, R_{BE} = 0$
Collector Cutoff Current, 150°C	I_{CES}		50			μA	$V_{CE} = 80V, R_{BE} = 0$
Collector Cutoff Current, 150°C	I_{CES}				50	μA	$V_{CE} = 100V, R_{BE} = 0$
Collector Capacitance	C_{ob}		75		75	pf	$V_{CB} = 10V, I_E = 0$
A.C. Current Gain	h_{fe}	4		4			$I_C = 200mA, V_{CE} = 5V, f = 10MHz$
Switching Speeds Turn-on Time	t_{on}		125		125	ns	$I_C = 1A$ 2N5487 See Fig. 1
Switching Speeds Turn-off Time	t_{off}		450		550	ns	$I_C = 1A$ 2N5488 See Fig. 2

Notes:
1. **The device may be switched between maximum rated collector current and maximum rated collector-emitter voltage along a resistive load line provided the switching time is less than 10 microseconds. Switching at low speed through regions of high instantaneous power dissipation may cause second breakdown to occur, with consequent damage to the device.**
2. **Steady state limits based on a maximum junction temperature of 200°C. High pulse power dissipation may cause second breakdown. Consult the factory on high power, low duty cycle application.**
3. **Pulse length = 300 μs; duty cycle $\leqslant$2%.**

†All values in this table are JEDEC registered.

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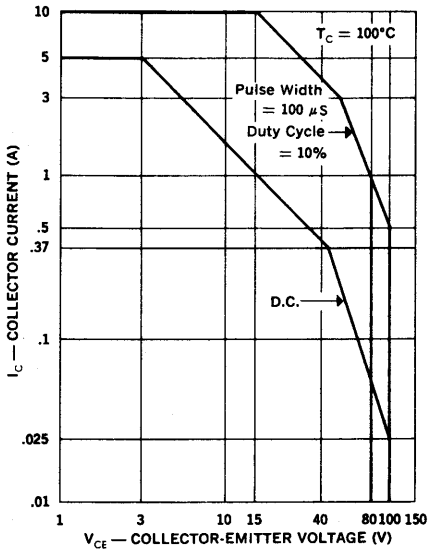
Maximum Safe Operating Area



Switching Speed Circuit

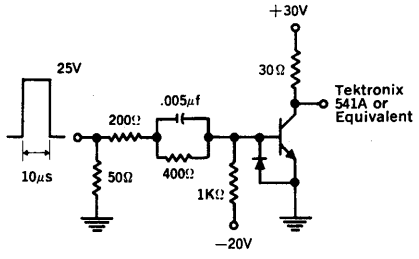


Figure 1

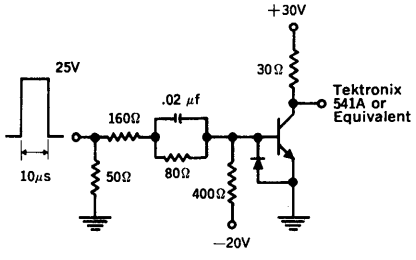


Figure 2

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TWX (710) 326-6509 • TELEX 95-1064

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SCRs
.8 Amp RMS, Plastic

FEATURES
- Voltage Ratings: to 400V
- Forward Current: 0.8A RMS
- Surge Current: 6A, 8ms
- Gate Sensitivity: 200μa max.
- Planar Passivated Process
- TO-92 Plastic Package

DESCRIPTION
This plastic series features very fast switching performance, low forward voltage drop and a high degree of reliability and parameter stability. All units are fully planar passivated and are packaged in a rugged TO-92 case, constructed from a special epoxy compound that features excellent moisture resistance providing stable performance under high humidity conditions and good thermal transfer characteristics.

TYPICAL APPLICATIONS

Lamp Driving	Process Controls	Remote Controls
Relay Driving	Pressure Controls	High Current SCR Driving
Relay Replacement	Display Systems	Timers
Alarm Systems	Touch Switches	Temperature Controls
Counters	and many other current sensing and control applications.	

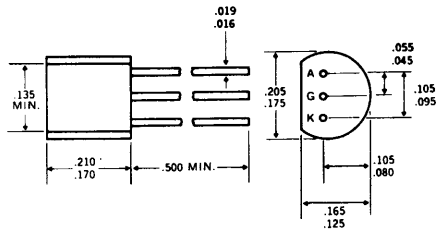
ABSOLUTE MAXIMUM RATINGS

	2N6564	2N6565
Repetitive Peak Off-State Voltage, V_{DRM}	300V	400V
Repetitive Peak Reverse Voltage, V_{RRM}	300V	400V
On-State Current, $I_{T(RMS)}$ @ T_C = 70°C	0.8A	
Peak One Cycle Surge (Non-Rep.) On-State Current, I_{TSM}	6A	
Peak Gate Current, I_{GM}	1.0A	
Peak Gate Power, P_{GM}	1W	
Average Gate Power $P_{G(AV)}$	0.01W	
Reverse Gate Voltage, V_{GR}	6V	
Storage Temperature Range	−65°C to +150°C	
Operating Temperature Range	−65°C to +125°C	

X

MECHANICAL SPECIFICATIONS

2N6564-2N6565



Dimensions in inches.

TO92

UNITRODE

ELECTRICAL SPECIFICATIONS (at 25°C unless noted, R_{GK} = 1000 ohms)

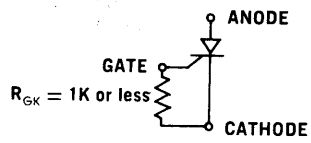
Test	Symbol	Min.	Typical	Max.	Units	Test Conditions
Off-State Current	I_{DRM}	—	0.1	1.0	μA	V_{DRM} = Rating
		—	—	100	μA	V_{DRM} = Rating, T = 125°C*
Reverse Current	I_{RRM}	—	0.1	1.0	μA	V_{RRM} = Rating
		—	—	100	μA	V_{RRM} = Rating, T = 125°C*
Gate Trigger Current	I_{GT}	—	—	200	μA	V_D = 6V, R_L = 100 ohms
		—	—	350	μA	V_D = 6V, R_L = 100 ohms, T = −65°C*
Gate Trigger Voltage	V_{GT}	—	0.6	0.8	V	V_D = 6V, R_L = 100 ohms
		—	—	1.2	V	V_D = 6V, R_L = 100 ohms, T = −65°C*
		0.1	—	—	V	V_D = Rating, R_L = 100 ohms, T = 125°C*
Peak On-State Voltage	V_{TM}	—	1.0	1.7	V	I_{TM} = 1.2 Amp Pulse*
Holding Current	I_H	—	0.7	5.0	mA	V_D = 6V, T = 25°C
		—	—	10.0	mA	V_D = 6V, T = −65°C*
Critical Rate of Rise — Off-State Voltage	dv/dt	—	75	—	V/μs	V_D = Rating
Turn-on Time	t_{on}	—	0.5	1.5	μs	I_G = 10mA, I_T = 1A, V_D = Rating*
Circuit Commutated Turn-off Time	t_q	—	15	—	μs	I_T = I_R = 1A

Note: Blocking voltage ratings apply over the full operating temperature range, provided the gate is connected to the cathode through a resistor, 1000 ohms or smaller, or other adequate bias is used.

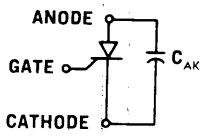
*Indicates JEDEC Registered data.

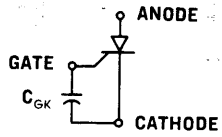
DESIGN CONSIDERATIONS

1. The 2N6564 Series SCRs are guaranteed to block their rated voltage over the rated operating temperature when a resistance of 1000 ohms or less is connected from gate to cathode as shown.



2. In cases where the SCR may be subjected to fast rising anode voltages a capacitor can be connected between anode or gate and cathode as shown, to serve as protection against dv/dt firing.





SCRs
1.0 Amp RMS, Plastic
800V

2N6681
2N6682
2N6683
2N6684
2N6685

FEATURES:
- Forward Current: 1.0A RMS
- Voltage Ratings: to 800V
- High Surge Current: 15A, 8mS
- Gate Sensitivity: 30μA Typical
- Hard Glass Passivated Junction
- Economical TO-92 Package

TYPICAL APPLICATIONS:
Ground fault interrupters
Photo flash circuits
Ignition/Ignitor circuits
Relay drivers
Relay replacement
Gate drivers for high current SCRs
Lamp driving
Off-line appliance controls

DESCRIPTION:
This plastic PNPN device is rated at 1.0 Amp RMS maximum on-state current, with rated voltages up to 800 volts. All units in this series offer full hard glass passivation with sensitivity especially targeted for good transient immunity. Supplied in an economical TO-92 package, this device is well suited for many high volume applications.

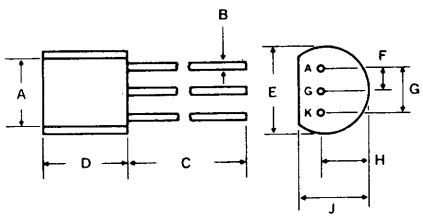
MAXIMUM RATINGS

	2N6681	2N6682	2N6683	2N6684	2N6685
Repetitive Peak Off-State Voltage, V_{DRM}	100V	200V	400V	600V	800V
Repetitive Peak Reverse Voltage, V_{RRM}	100V	200V	400V	600V	800V
On-State Current, I_T RMS At 60°C Case, 180° Conduction Sinewave			1.0A		
Surge (Non-Rep.) On-State Current, I_{TSM}			15A		
Peak Gate Current, I_{GM}			1.0A		
Peak Gate Power, P_{GM}			1W		
Average Gate Power P_G (AV.)			0.01W		
Reverse Gate Voltage, V_{GR}			6V		
Storage Temperature Range			−55°C to +150°C		
Operating Temperature Range (2N6681-2N6683)			−55°C to +110°C		
Operating Temperature Range (2N6684-2N6685)			−55°C to + 85°C		

X

MECHANICAL SPECIFICATIONS

2N6681-5 SERIES



	inches	millimeters
A	.135 MIN.	3.43 MIN.
B	.019 - .016	.48 - .41
D	.210 - .170	5.33 - 4.32
C	.500 MIN.	12.7 MIN.
E	.205 - .175	5.21 - 4.45
J	.165 - .125	4.19 - 3.18
F	.055 - .045	1.40 - 1.14
G	.105 - .095	2.67 - 2.41
H	.105 - .080	2.67 - 2.03

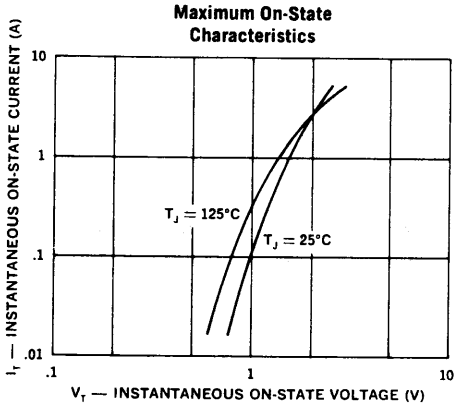
TO-92

ELECTRICAL SPECIFICATIONS (at 25°C unless noted)

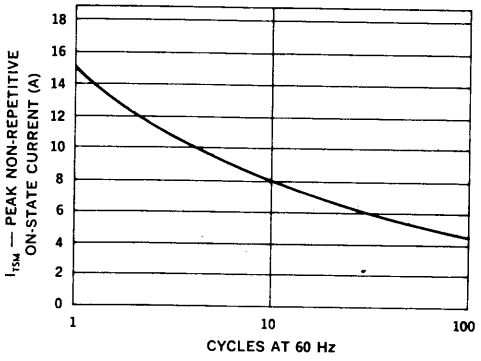
Test	Symbol	Min.	Typical	Max.	Units	Test Conditions
Off-State Current	I_{DRM}	—	—	100	μA	V_{DRM} = Rating, R_{GK} = 1K, T* = 110°C
Reverse Current	I_{RRM}	—	—	100	μA	V_{RRM} = Rating, R_{GK} = 1K, T* = 110°C
Gate Trigger Current	I_{GT}	—	30	200	μA	V_D = 6V, R_{GS} = 10K
Gate Trigger Voltage	V_{GT}	—	0.6	0.8	V	V_D = 6V, R_{GS} = 100Ω
		—	—	1.2	V	V_D = 6V, R_{GS} = 100Ω, T = −55°C
		0.1	—	—	V	V_D = 6V, R_{GS} = 100Ω, T = 125°C
Peak On-State Voltage	V_{TM}	—	—	1.5	V	I_{TM} = 1 Amp Pulse
Holding Current	I_{HX}	—	0.7	5.0	mA	R_{GK} = 1K, T = 25°C
		—	—	10.0	mA	R_{GK} = 1K, T = −55°C
Critical Rate of Rise — Off-State Voltage	dv/dt	—	20	—	V/μs	V_D = Rating, R_{GK} = 1K, T = 100°C

*For 2N6684, 2N6685 T = 90°C

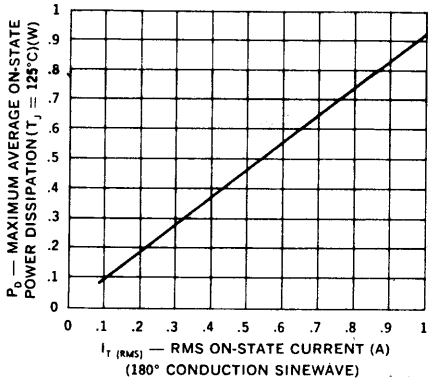
Maximum On-State Characteristics



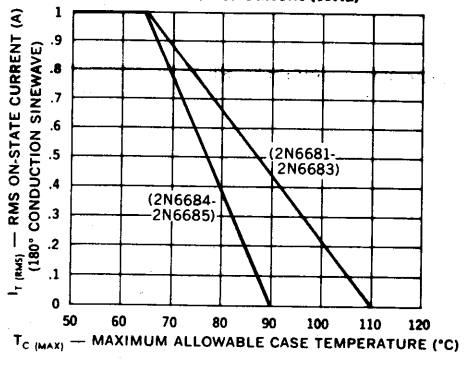
Maximum Allowable Non-Repetitive Peak On-State Current Following Rated Load Conditions



Maximum On-State Power Dissipation (60Hz)



Maximum Allowable Case Temperature vs. On-State Current (60Hz)



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