

2N2904, 2N2904A, 2N2904AL 2N2905, 2N2905A, 2N2905AL

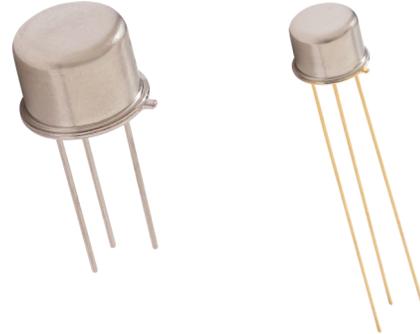


Radiation Hardened PNP Silicon Switching Transistors

Rev. V3

Features

- Qualified to MIL-PRF-19500/290
- Available in JAN, JANTX, JANTXV, JANS and JANSR
- Radiation Tolerant Levels M, D, P, L and R
- TO-39 and TO-5 package styles
- General Purpose Switching and Amplifier Applications



Electrical Specifications @ $T_A = 25^\circ\text{C}$

Parameter	Test Conditions	Symbol	Units	Minimum	Maximum
Off Characteristics:					
Collector - Emitter Breakdown	$I_C = -10 \text{ mA dc}$ 2N2904, 2N2905 2N2904A, 2N2905A 2N2904AL, 2N2905AL	$V_{(BR)CEO}$	V dc	-40 -60 -60	—
Collector - Base Cutoff Current	$V_{CB} = -60 \text{ V dc}$	I_{CBO1}	$\mu\text{A dc}$	—	-10
Collector - Base Cutoff Current	$V_{CB} = -50 \text{ V dc}$ 2N2904, 2N2905 2N2904A, 2N2905A 2N2904AL, 2N2905AL	I_{CBO2}	nA dc	—	-20 -10 -10
Emitter - Base Cutoff Current	$V_{EB} = -5.0 \text{ V dc}$	I_{EBO1}	$\mu\text{A dc}$	—	-10
Emitter - Base Cutoff Current	$V_{EB} = -3.5 \text{ V dc}$	I_{EBO2}	nA dc	—	-50
Collector-Emitter Cutoff Current	2N2904, 2N2905; $V_{CE} = -40\text{V dc}$ 2N2904A, 2N2904AL; $V_{CE} = -60\text{V dc}$ 2N2905A, 2N2905AL; $V_{CE} = -60\text{V dc}$	I_{CES}	$\mu\text{A dc}$		1 1 1

1. Pulse Test: Pulse Width = 300 us, Duty Cycle < 2%.

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Parameter	Test Conditions	Symbol	Units	Minimum	Maximum
On Characteristics:					
Forward Current Transfer Ratio	$V_{CE} = -10 \text{ V dc}$, $I_C = -0.1 \text{ mA dc}$ 2N2904 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	h_{FE1}		20 35 40 75	
Forward Current Transfer Ratio	$V_{CE} = -10 \text{ V dc}$, $I_C = -1.0 \text{ mA dc}$ 2N2904 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	h_{FE2}		25 50 40 100	175 450 175 450
Forward Current Transfer Ratio	$V_{CE} = -10 \text{ V dc}$, $I_C = -10 \text{ mA dc}$ 2N2904 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	h_{FE3}		35 75 40 100	
Forward Current Transfer Ratio	$V_{CE} = -10 \text{ V dc}$, $I_C = -150 \text{ mA dc}$ 2N2904 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	h_{FE4}		40 40 100 100	120 120 300 300
Forward Current Transfer Ratio	$V_{CE} = -10 \text{ V dc}$, $I_C = -500 \text{ mA dc}$ 2N2904 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	h_{FE5}		20 30 40 50	
Collector - Emitter Voltage (Saturated)	$I_C = -150 \text{ mA dc}$, $I_B = -15 \text{ mA dc}$ $I_C = -500 \text{ mA dc}$, $I_B = -50 \text{ mA dc}$	$V_{CE(sat)1}$ $V_{CE(sat)2}$	Vdc	—	-0.4 -1.6
Base - Emitter Voltage (Saturated)	$I_C = -150 \text{ mA dc}$, $I_B = -15 \text{ mA dc}$ $I_C = -500 \text{ mA dc}$, $I_B = -50 \text{ mA dc}$	$V_{BE(sat)1}$ $V_{BE(sat)2}$	Vdc	—	-1.3 -2.6

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Electrical Specifications ($T_A = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Units	Minimum	Maximum
Collector-Base Cutoff Current	$T_A = +150^\circ\text{C}$ $V_{CB} = -50\text{ V dc}$ 2N2904, 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	I_{CB03}	$\mu\text{A dc}$		-20 -10 -10
Small-Signal Short-Circuit, Forward Current Transfer Ratio	$T_A = -55^\circ\text{C}$ $V_{CE} = -10\text{ V dc}$, $I_C = -1.0\text{ mA dc}$ 2N2904 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	h_{fe6}		15 30 20 50	—
Parameter	Test Conditions	Symbol	Units	Minimum	Maximum
Dynamic Characteristics:					
Small-Signal Short-Circuit Forward Current Transfer Ratio	$V_{CE} = -20\text{ V dc}$, $I_C = -50\text{ mA dc}$, $f = 100\text{ MHz}$	$ h_{fe} $		2.0	
Small-Signal Short-Circuit, Forward Current Transfer Ratio	$V_{CE} = -10\text{ V dc}$, $I_C = -1\text{ mA dc}$, $f = 1\text{ kHz}$ 2N2904 2N2905 2N2904A, 2N2904AL 2N2905A, 2N2905AL	h_{fe}		25 50 40 100	—
Open Circuit Output Capacitance	$V_{CB} = -10\text{ V dc}$, $I_E = 0$, $100\text{ kHz} \leq f \leq 1\text{ MHz}$	C_{obo}	μF	—	8
Input Capacitance (Output Open-circuited)	$V_{EB} = -2.0\text{ V dc}$, $I_C = 0$, $100\text{ kHz} \leq f \leq 1\text{ MHz}$	C_{ibo}			30
Switching Characteristics:					
Turn-On Time	(See figure 6 of MIL-PRF-19500/291)	t_{on}	ns	—	45
Turn-Off Time	(See Figure 7 of MIL-PRF-19500/291)	t_{on}	ns	—	300

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Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ unless otherwise specified)

Ratings	Symbol	Value
Collector - Emitter Voltage 2N2904, 2N2905 2N2904A, L; 2N2905A, L	V_{CEO}	-40 V dc -60 V dc
Collector - Base Voltage	V_{CBO}	-60 V dc
Emitter - Base Voltage	V_{EBO}	-5.0 V dc
Collector Current	I_C	-600 mA dc
Total Power Dissipation @ $T_A = +25^\circ\text{C}$	$P_T(1)$	0.8 W
Total Power Dissipation @ $T_C = +25^\circ\text{C}$	$P_T(2)$	3.0 W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}^{(1)(2)}$	195°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}^{(1)(2)}$	50°C/W
Operating & Storage Temperature Range	T_J, T_{STG}	-65°C to +200°C

Notes: (1) For derating, see figure 2 and figure 3 of MIL-PRF-19500/290
(2) For thermal impedance, see figure 4 and figure 5 of MIL-PRF-19500/290

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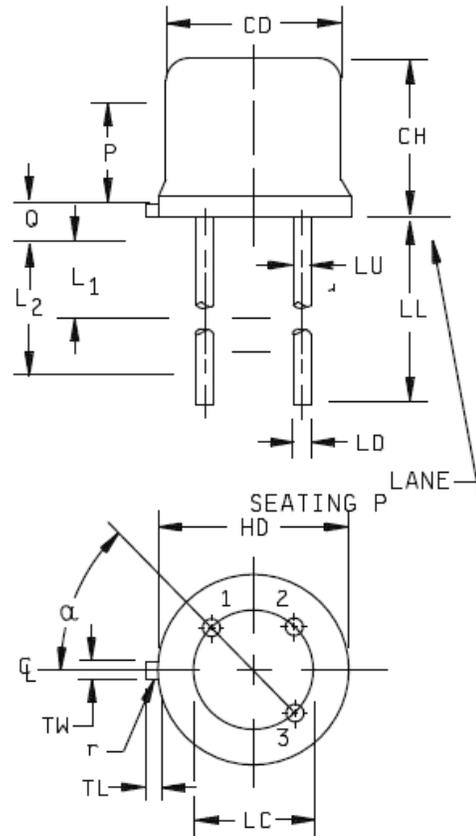


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Outline Drawing (TO-39)

Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.019	0.41	0.48	7, 8
LL	.500	.750	12.70	19.05	7, 8, 12
LU	.016	.019	0.41	0.48	7, 8
L1		.050		1.27	7, 8
L2	.250		6.35		7, 8
P	.100		2.54		
Q		.050		1.27	5
TL	.029	.045	0.74	1.14	4
TW	.028	.034	0.71	0.86	3
r		.010		0.25	10
α	45° TP		45° TP		6



NOTES:

1. Dimension are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001, -.000 inch (1.37 +0.03, -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
7. Dimension LU applies between L1 and L2. Dimension LD applies between L2 and L minimum. Diameter is uncontrolled in L1 and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
12. For "L" suffix devices, dimension LL is 1.50 (38.10 mm) minimum, 1.75 (44.45 mm) maximum.
13. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

FIGURE 1. Physical dimensions (similar to TO-39).

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