



**PNP SWITCHING SILICON TRANSISTOR**  
**Qualified per MIL-PRF-19500/290**

*Qualified Levels:*  
 JAN, JANTX, JANTXV  
 and JANS

**DESCRIPTION**

This family of 2N2904AL and 2N2905AL switching transistors are military qualified up to the JANS level for high-reliability applications. These devices are also available in a TO-39 package. Microsemi also offers numerous other transistor products to meet higher and lower power ratings with various switching speed requirements in both through-hole and surface-mount packages.

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**FEATURES**

- JEDEC registered 2N2904 through 2N2905 series.
- JAN, JANTX, JANTXV, and JANS qualifications are available per MIL-PRF-19500/290. (See [part nomenclature](#) for all available options.)
- RoHS compliant versions available (commercial grade only).

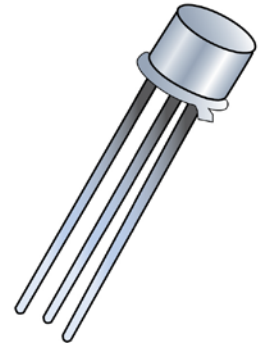
**APPLICATIONS / BENEFITS**

- General purpose transistors for high speed switching applications.
- Military and other high-reliability applications.

**MAXIMUM RATINGS**

Parameters / Test Conditions	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	V
Collector-Base Voltage	$V_{CBO}$	60	V
Emitter-Base Voltage	$V_{EBO}$	5.0	V
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	195	$^{\circ}C/W$
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	50	$^{\circ}C/W$
Collector Current	$I_C$	600	mA
Total Power Dissipation	$P_T$	0.8 3.0	W
		@ $T_A = +25^{\circ}C$ <sup>(1)</sup> @ $T_C = +25^{\circ}C$ <sup>(2)</sup>	
Operating & Storage Junction Temperature Range	$T_J$ and $T_{stg}$	-65 to +200	$^{\circ}C$

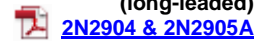
- Notes:**
1. For derating, see [figures 1 and 2](#).
  2. For thermal impedance, see [figures 3 and 4](#).



**TO-5 Package**

Also available in:

**TO-39 (TO-205AD) package**  
 (long-leaded)



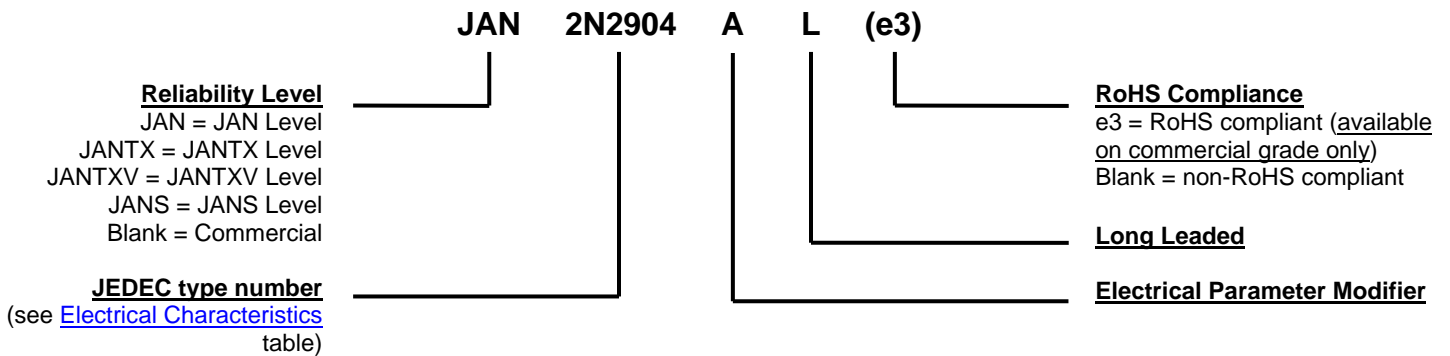
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**MECHANICAL and PACKAGING**

- CASE: Hermetically sealed, kovar base, nickel cap.
- TERMINALS: Tin/lead plate or RoHS compliant matte/tin (commercial grade only) over nickel.
- MARKING: Part number, date code, manufacturer's ID.
- POLARITY: PNP (see package outline).
- WEIGHT: Approximately 1.14 grams.
- See [Package Dimensions](#) on last page.

**PART NOMENCLATURE**

**SYMBOLS & DEFINITIONS**

Symbol	Definition
$C_{obo}$	Common-base open-circuit output capacitance.
$I_{CEO}$	Collector cutoff current, base open.
$I_{CEX}$	Collector cutoff current, circuit between base and emitter.
$I_{EBO}$	Emitter cutoff current, collector open.
$h_{FE}$	Common-emitter static forward current transfer ratio.
$V_{CEO}$	Collector-emitter voltage, base open.
$V_{CBO}$	Collector-emitter voltage, emitter open.
$V_{EBO}$	Emitter-base voltage, collector open.

**ELECTRICAL CHARACTERISTICS @  $T_A = +25\text{ }^\circ\text{C}$ , unless otherwise noted**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Current $I_C = 10\text{ mA}$	$V_{(BR)CEO}$	60		V
Collector-Emitter Cutoff Voltage $V_{CE} = 60\text{ V}$	$I_{CES}$		1.0	$\mu\text{A}$
Collector-Base Cutoff Current $V_{CB} = 60\text{ V}$ All Types	$I_{CBO1}$		10	$\mu\text{A}$
$V_{CB} = 50\text{ V}$ 2N2904AL, 2N2905AL	$I_{CBO2}$		10	nA
$V_{CB} = 50\text{ V @ } T_A = +150\text{ }^\circ\text{C}$ 2N2904AL, 2N2905AL	$I_{CBO3}$		10	$\mu\text{A}$
Collector-Base Cutoff Current $V_{CB} = 50\text{ V}$	$I_{CBO}$		10	nA
$V_{CB} = 60\text{ V}$			10	$\mu\text{A}$
Emitter-Base Cutoff Current $V_{EB} = 3.5\text{ V}$	$I_{EBO}$		50	nA
$V_{EB} = 5.0\text{ V}$			10	$\mu\text{A}$

<b>ON CHARACTERISTICS <sup>(1)</sup></b>				
Forward-Current Transfer Ratio $I_C = 0.1\text{ mA}, V_{CE} = 10\text{ V}$	2N2904AL 2N2905AL	$h_{FE}$	40 75	
$I_C = 1.0\text{ mA}, V_{CE} = 10\text{ V}$	2N2904AL 2N2905AL		40 100	175 450
$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$	2N2904AL 2N2905AL		40 100	
$I_C = 150\text{ mA}, V_{CE} = 10\text{ V}$	2N2904AL 2N2905AL		40 100	120 300
$I_C = 500\text{ mA}, V_{CE} = 10\text{ V}$	2N2904AL 2N2905AL		40 50	
Collector-Emitter Saturation Voltage $I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$		$V_{CE(sat)}$		0.4 1.6 V
Base-Emitter Saturation Voltage $I_C = 150\text{ mA}, I_B = 15\text{ mA}$ $I_C = 500\text{ mA}, I_B = 50\text{ mA}$		$V_{BE(sat)}$		1.3 2.6 V

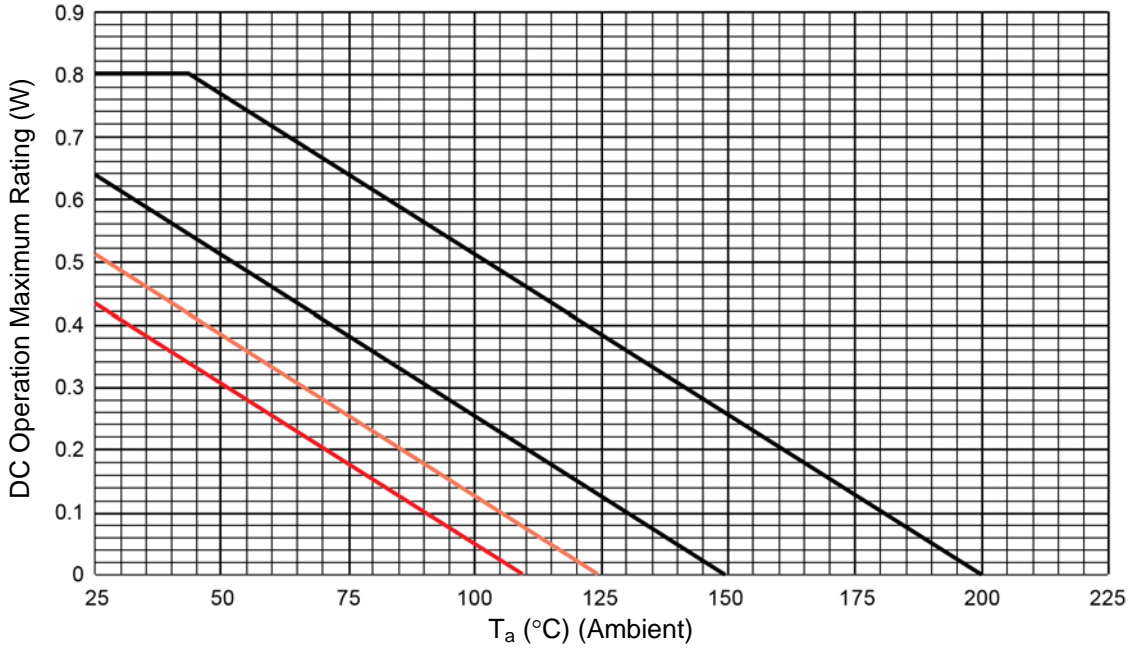
(1) Pulse Test: Pulse Width = 300  $\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

**ELECTRICAL CHARACTERISTICS @  $T_A = +25\text{ }^\circ\text{C}$ , unless otherwise noted (continued)**
**DYNAMIC CHARACTERISTICS**

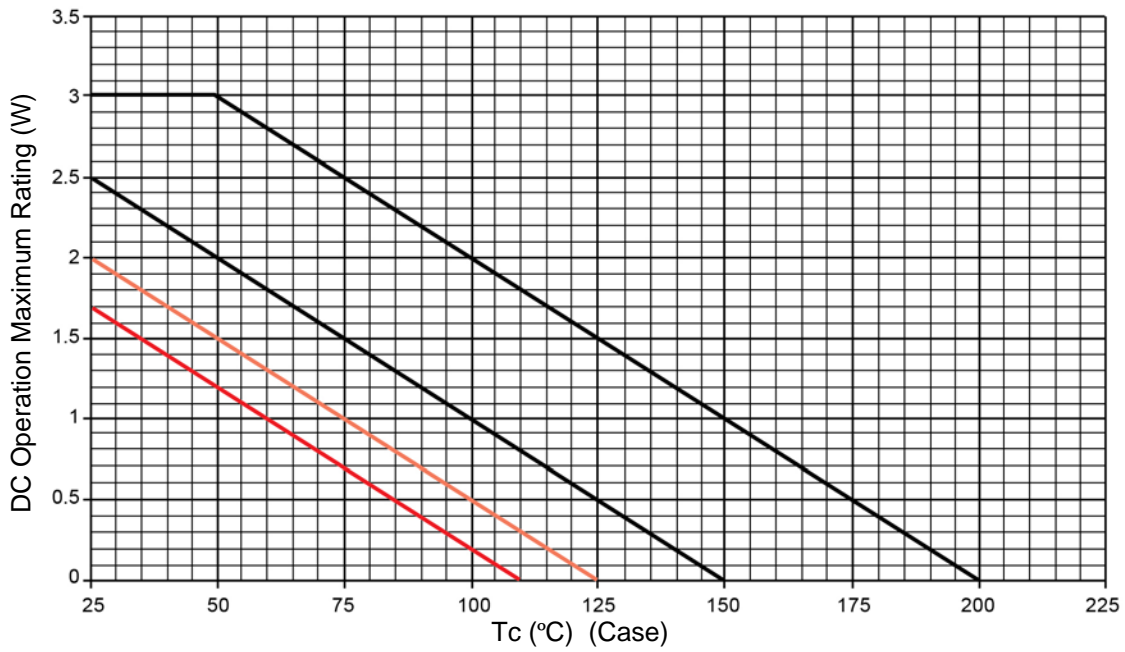
Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Small-Signal Short-Circuit Forward-Current Transfer Ratio $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ kHz}$	$h_{fe}$		100	
Small-Signal Short-Circuit Forward-Current Transfer Ratio $I_C = 50\text{ mA}$ , $V_{CE} = 20\text{ V}$ , $f = 100\text{ MHz}$	$ h_{fe} $		2.0	
Output Capacitance $V_{CB} = 10\text{ V}$ , $I_E = 0$ , $100\text{ kHz} \leq f \leq 1.0\text{ MHz}$	$C_{obo}$		8.0	pF
Input Capacitance $V_{EB} = 2.0\text{ V}$ , $I_C = 0$ , $100\text{ kHz} \leq f \leq 1.0\text{ MHz}$	$C_{ibo}$		30	pF

**SWITCHING CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-On Time	$t_{on}$		45	ns
Turn-Off Time	$t_{off}$		300	ns

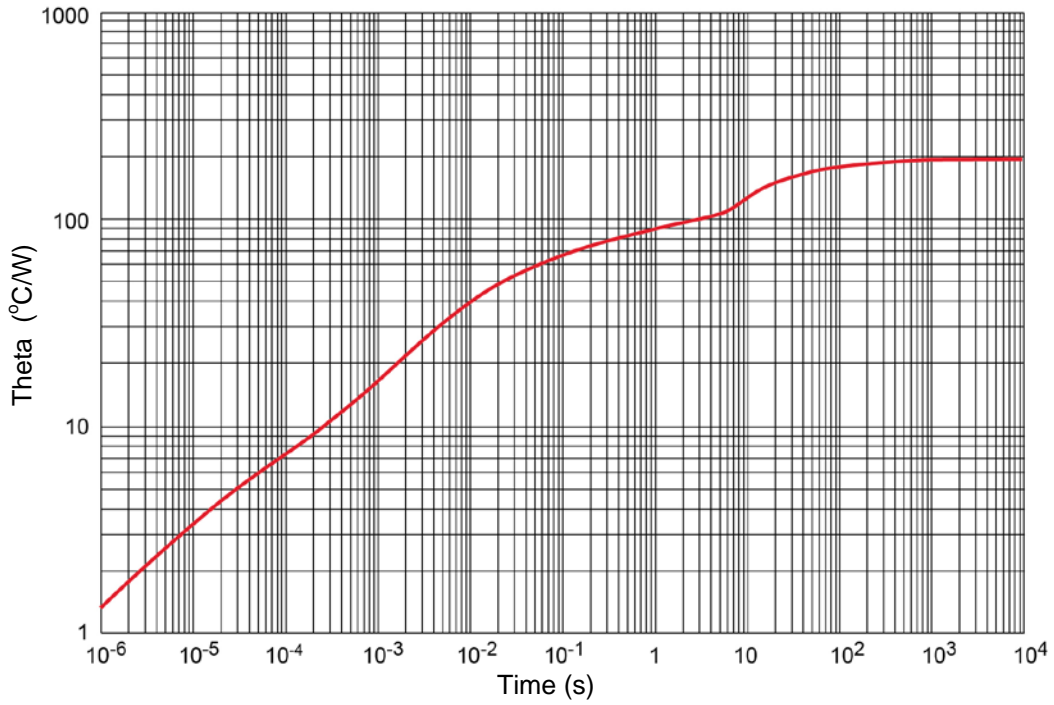
**GRAPHS**


**FIGURE 1**  
Derating (R<sub>θJA</sub>) PCB



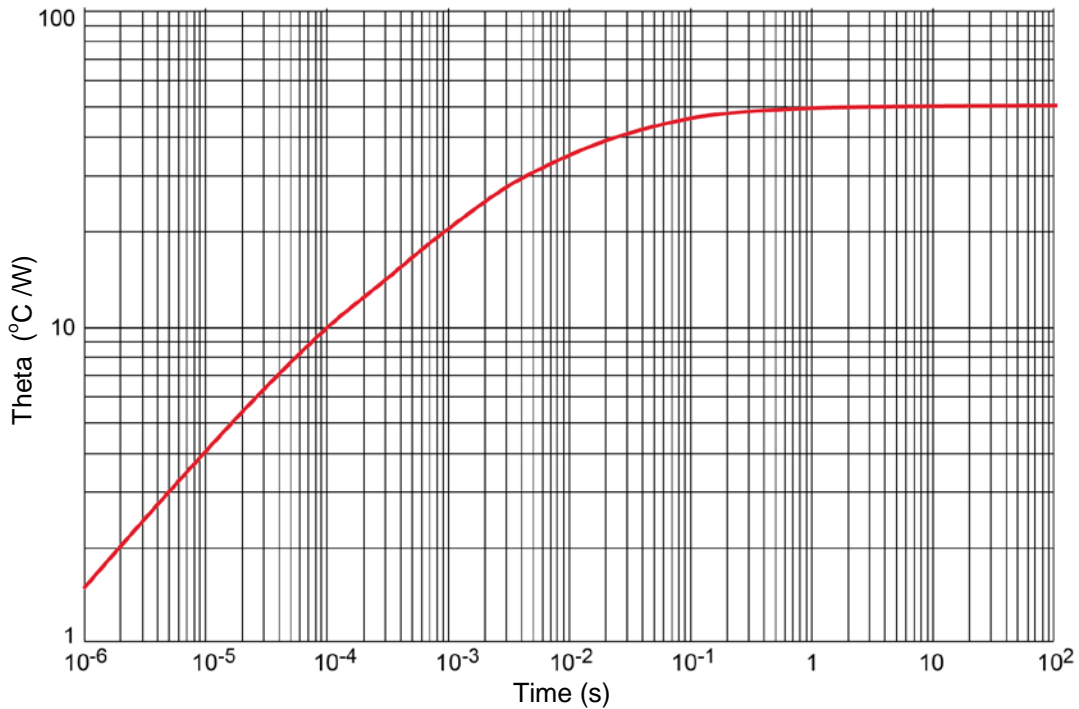
**FIGURE 2**  
Derating (R<sub>θJA</sub>) PCB

GRAPHS (continued)



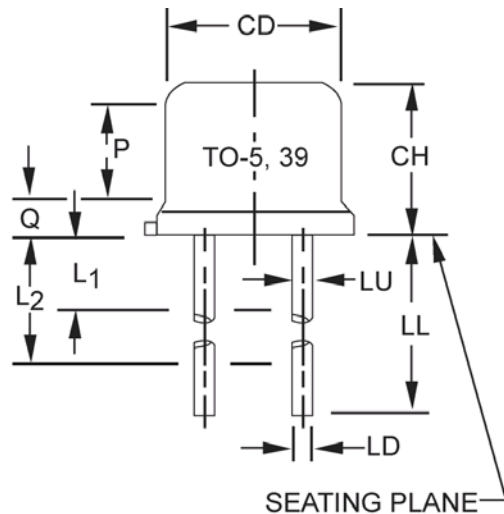
**FIGURE 3**

Thermal impedance graph ( $R_{\theta JA}$ )



**FIGURE 4**

Thermal impedance graph ( $R_{\theta JA}$ )

**PACKAGE DIMENSIONS**


Symbol	Dimensions				Note
	Inch		Millimeters		
	Min	Max	Min	Max	
<b>CD</b>	0.305	0.335	7.75	8.51	
<b>CH</b>	0.240	0.260	6.10	6.60	
<b>HD</b>	0.335	0.370	8.51	9.40	
<b>LC</b>	0.200 TP		5.08 TP		6
<b>LD</b>	0.016	0.021	0.41	0.53	7, 8
<b>LL</b>	0.500	0.750	12.70	19.05	7, 8, 12
<b>LU</b>	0.016	0.019	0.41	0.48	7, 8
<b>L1</b>		0.050		1.27	7, 8
<b>L2</b>	0.250		6.35		7, 8
<b>P</b>	0.100		2.54		
<b>Q</b>		0.050		1.27	5
<b>TL</b>	0.029	0.045	0.74	1.14	4
<b>TW</b>	0.028	0.034	0.71	0.86	3
<b>r</b>		0.010		0.25	10
<b>α</b>	45° TP		45° TP		6

**NOTES:**

- Dimensions are in inches.
- Millimeters are given for general information only.
- Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
- Dimension TL measured from maximum HD.
- Body contour optional within zone defined by HD, CD, and Q.
- Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -.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.
- Dimension LU applies between L1 and L2. Dimension LD applies between L2 and LL minimum. Diameter is uncontrolled in L1 and beyond LL minimum.
- All three leads.
- The collector shall be internally connected to the case.
- Dimension r (radius) applies to both inside corners of tab.
- In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.
- For "L" suffix devices, dimension LL is 1.50 (38.10 mm) minimum, 1.75 (44.45 mm) maximum.
- Lead 1 = emitter, lead 2 = base, lead 3 = collector.

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