

TYPES 2N2913 THRU 2N2920, 2N2915A, 2N2916A, 2N2919A, 2N2920A, 2N2972 THRU 2N2979 DUAL N-P-N SILICON TRANSISTORS



SOLID STATE INC.

46 FARRAND STREET
BLOOMFIELD, NEW JERSEY 07003

www.solidstateinc.com

A BROAD FAMILY OF DUAL TRANSISTORS RECOMMENDED FOR

- Differential Amplifiers
- High-Gain, Low-Noise, Audio Amplifiers
- Transducer Signal-Conditioner Amplifiers
- Low-Level Flip-Flops

*mechanical data

ALL LEADS INSULATED FROM CASE ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED OUTLINE A — TYPES 2N2913 THRU 2N2920, 2N2915A, 2N2916A, 2N2919A, 2N2920A	
ALL LEADS INSULATED FROM CASE ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED OUTLINE B — TYPES 2N2972 THRU 2N2979	

Dimensions without tolerance designate true position. Leads having maximum diameter (0.019") measured in gaging plane 0.054" +0.001" -0.000" below the seating plane of the device shall be within 0.007" of their true position relative to a maximum width tab.

1. COLLECTOR 1
2. BASE 1
3. EMITTER 1
5. EMITTER 2
6. BASE 2
7. COLLECTOR 2

FALLS WITHIN TO-71 DIMENSIONS

1. EMITTER 1
2. BASE 1
3. COLLECTOR 1
5. EMITTER 2
6. BASE 2
7. COLLECTOR 2

quick-selection guide (for details see characteristics on the following pages)

TYPE		MIN $V_{(BR)CEO}$		MIN-MAX h_{FE} ($I_C = 10 \mu A$)		MIN h_{FE1} h_{FE2}		$ V_{BE1} - V_{BE2} $ ($I_C = 100 \mu A$)			$ \Delta V_{BE1} - V_{BE2} \Delta T_A $ ($T_{A(1)} = 25^\circ C, T_{A(2)} = 125^\circ C$)		
OUTLINE A	OUTLINE B	60 V	45 V	60-240	150-600	0.9	0.8	1.5 mV	3 mV	5 mV	0.5 mV	1 mV	2 mV
2N2913	2N2972		•	•									
2N2914	2N2973		•		•								
2N2915	2N2974		•	•		•			•			•	
2N2915A			•	•		•		•			•		
2N2916	2N2975		•		•	•			•			•	
2N2916A			•		•	•		•			•		
2N2917	2N2976		•				•			•			•
2N2918	2N2977		•		•		•			•			•
2N2919	2N2978	•		•		•			•			•	
2N2919A		•		•		•		•			•		
2N2920	2N2979	•			•	•			•			•	
2N2920A		•			•	•		•			•		

*JEDEC registered data. This data sheet contains all applicable registered data in effect at the time of publication.

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*absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

	2N2913 thru 2N2918 2N2915A 2N2916A		2N2972 thru 2N2977		2N2919 2N2919A 2N2920 2N2920A		2N2978 2N2979		UNIT
	EACH TRIODE	TOTAL DEVICE	EACH TRIODE	TOTAL DEVICE	EACH TRIODE	TOTAL DEVICE	EACH TRIODE	TOTAL DEVICE	
Collector-Base Voltage	45		45		60		60		V
Collector-Emitter Voltage (See Note 1)	45		45		60		60		V
Emitter-Base Voltage	6		6		6		6		V
Collector-1 — Collector-2 Voltage	(±200)†				(±200)†				V
Continuous Collector Current	30		30		30		30		mA
Continuous Device Dissipation at (qr below) 25°C Free-Air Temperature (See Note 2)	0.3	0.5	0.25	0.3	0.3	0.5	0.25	0.3	W
Continuous Device Dissipation at (or below) 25°C Case Temperature (See Note 3)	0.75	1.5	0.5	0.75	0.75	1.5	0.5	0.75	W
Storage Temperature Range	-65 to 200		-65 to 200		-65 to 200		-65 to 200		°C
Lead Temperature 1/16 Inch from Case for 60 Seconds	300		300		300		300		°C

*electrical characteristics at 25°C free-air temperature (unless otherwise noted)

individual triode characteristics (see note 4)

PARAMETER	TEST CONDITIONS	2N2913 2N2915 2N2915A 2N2917 2N2972 2N2974 2N2976	2N2914 2N2916 2N2916A 2N2918 2N2973 2N2975 2N2977	2N2919 2N2919A 2N2978		2N2920 2N2920A 2N2979		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
V _{(BR)CBO} Collector-Base Breakdown Voltage	I _C = 10 μA, I _E = 0	45		45		60		V
V _{(BR)CEO} Collector-Emitter Breakdown Voltage	I _C = 10 mA, I _B = 0, See Note 5	45		45		60		V
V _{(BR)EBO} Emitter-Base Breakdown Voltage	I _E = 10 μA, I _C = 0	6		6		6		V
I _{CBO} Collector Cutoff Current	V _{CB} = 45 V, I _E = 0		10		10		2	nA
	V _{CB} = 45 V, I _E = 0, T _A = 150°C		10		10		10	μA
I _{CEO} Collector Cutoff Current	V _{CE} = 5 V, I _B = 0		2		2		2	nA
I _{EBO} Emitter Cutoff Current	V _{EB} = 5 V, I _C = 0		2		2		2	nA
h _{FE} Static Forward Current Transfer Ratio	V _{CE} = 5 V, I _C = 10 μA	60	240	150	600	60	240	150 600
	V _{CE} = 5 V, I _C = 100 μA	100		225		100		225
	V _{CE} = 5 V, I _C = 1 mA	150		300		150		300
	V _{CE} = 5 V, I _C = 10 μA, T _A = -55°C	15		30 (40)†		15		40
V _{BE} Base-Emitter Voltage	V _{CE} = 5 V, I _C = 100 μA		0.7		0.7		0.7	V
V _{CE(sat)} Collector-Emitter Saturation Voltage	I _B = 100 μA, I _C = 1 mA		0.35		0.35		0.35	V

- NOTES: 1. These values apply when the base-emitter diode is open-circuited.
2. Derate linearly to 200°C free-air temperature at the following rates: 1.72 mW/°C for each triode and 2.86 mW/°C for total device (2N2913 thru 2N2920, 2N2915A, 2N2916A, 2N2919A, 2N2920A); 1.43 mW/°C for each triode and 1.72 mW/°C for total device (2N2972 thru 2N2979).
3. Derate linearly to 200°C case temperature at the following rates: 4.3 mW/°C for each triode and 8.6 mW/°C for total device (2N2913 thru 2N2920, 2N2915A, 2N2916A, 2N2919A, 2N2920A); 2.96 mW/°C for each triode and 4.3 mW/°C for total device (2N2972 thru 2N2979).
4. The terminals of the triode not under test are open-circuited for the measurement of these characteristics.
5. This parameter must be measured using pulse techniques. t_W = 300 μs, duty cycle ≤ 1%.

†JEDEC registered data

‡These values apply to types 2N2915A, 2N2916A, 2N2919A, and 2N2920A only.

‡This value applies to type 2N2916A only.

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*electrical characteristics at 25°C free-air temperature (continued)

individual triode characteristics (see note 4)

PARAMETER	TEST CONDITIONS	2N2913 thru 2N2920 2N2972 thru 2N2979		2N2915A 2N2916A 2N2919A 2N2920A		UNIT
		MIN	MAX	MIN	MAX	
h_{ib} Small-Signal Common-Base Input Impedance	$V_{CB} = 5 \text{ V}$, $I_C = 1 \text{ mA}$, $f = 1 \text{ kHz}$	25	32	25	32	Ω
h_{ob} Small-Signal Common-Base Output Admittance	$V_{CB} = 5 \text{ V}$, $I_C = 1 \text{ mA}$, $f = 1 \text{ kHz}$	1		1		μmho
$ h_{fe} $ Small-Signal Common-Emitter Forward Current Transfer Ratio	$V_{CE} = 5 \text{ V}$, $I_C = 0.5 \text{ mA}$, $f = 20 \text{ MHz}$	3		3	8	
C_{obo} Common-Base Open-Circuit Output Capacitance	$V_{CB} = 5 \text{ V}$, $I_E = 0$, $f = 140 \text{ kHz to } 1 \text{ MHz}$	6		6		pF
C_{ibo} Common-Base Open-Circuit Input Capacitance	$V_{EB} = 0.5 \text{ V}$, $I_C = 0$, $f = 140 \text{ kHz to } 1 \text{ MHz}$			10		pF

triode matching characteristics

PARAMETER	TEST CONDITIONS	2N2915 2N2916 2N2919 2N2920 2N2974 2N2975 2N2978 2N2979		2N2915A 2N2916A 2N2919A 2N2920A		2N2917 2N2918 2N2976 2N2977		UNIT		
		MIN	MAX	MIN	MAX	MIN	MAX			
h_{FE1} h_{FE2}	Static Forward-Current-Gain Balance Ratio	$V_{CE} = 5 \text{ V}, I_C = 100 \mu\text{A}$, See Note 6		0.9	1	0.9	1	0.8	1	
		$V_{CE} = 5 \text{ V}, I_C = 100 \mu\text{A to } 1 \text{ mA}$, $T_A = -55^\circ\text{C to } 125^\circ\text{C}$, See Note 6				0.85	1			
$ V_{BE1} - V_{BE2} $	Base-Emitter-Voltage Differential	$V_{CE} = 5 \text{ V}, I_C = 100 \mu\text{A}$		3		1.5		5		mV
		$V_{CE} = 5 \text{ V}, I_C = 10 \mu\text{A to } 1 \text{ mA}$		5		2		10		
$ \Delta V_{BE1} - V_{BE2} _{\Delta T_A}$	Base-Emitter-Voltage-Differential Change With Temperature	$V_{CE} = 5 \text{ V}, I_C = 100 \mu\text{A}$, $T_{A(1)} = 25^\circ\text{C}, T_{A(2)} = -55^\circ\text{C}$		0.8		0.4		1.6		mV
		$V_{CE} = 5 \text{ V}, I_C = 100 \mu\text{A}$, $T_{A(1)} = 25^\circ\text{C}, T_{A(2)} = 125^\circ\text{C}$		1		0.5		2		

*operating characteristics at 25°C free-air temperature

individual triode characteristics (see note 4)

PARAMETER	TEST CONDITIONS	2N2913	2N2919A	2N2914	2N2920A	UNIT
		2N2915	2N2972	2N2916	2N2973	
		2N2915A	2N2974	2N2916A	2N2975	
		2N2917	2N2976	2N2918	2N2977	
		2N2919	2N2978	2N2920	2N2979	
		MAX		MAX		
F Average Noise Figure	V _{CE} = 5 V, I _C = 10 μA, R _G = 10 kΩ, f = 1 kHz, Noise bandwidth = 200 Hz	4		3		dB
	V _{CE} = 5 V, I _C = 10 μA, R _G = 10 kΩ, Noise bandwidth = 15.7 kHz, See Note 7	4		3		

NOTES: 4. The terminals of the triode not under test are open-circuited for the measurement of these characteristics.

6. The lower of the two h_{FE} readings is taken as h_{FE1} .

7. This parameter is measured in an amplifier with response down 3 dB at 10 Hz and 10 kHz and a high-frequency rolloff of 6 dB/octave.

*JEDEC registered data

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TYPICAL MATCHING CHARACTERISTICS†

FOR TYPES 2N2915, 2N2915A, 2N2916, 2N2916A, 2N2919, 2N2919A, 2N2920, 2N2920A, 2N2974, 2N2975, 2N2978, 2N2979

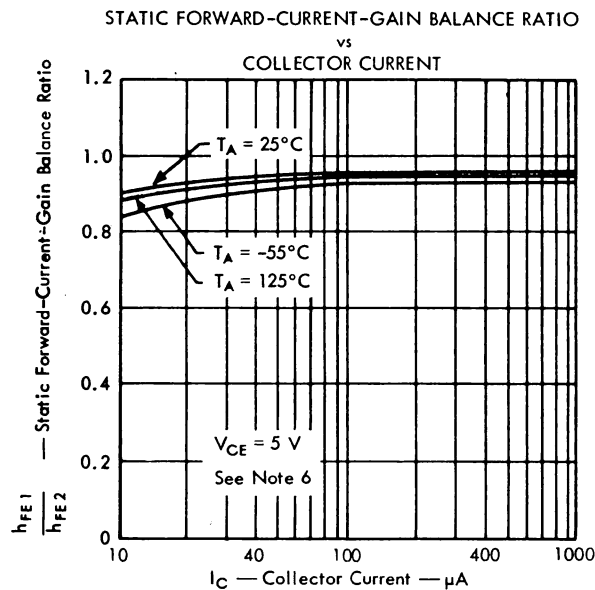


FIGURE 1

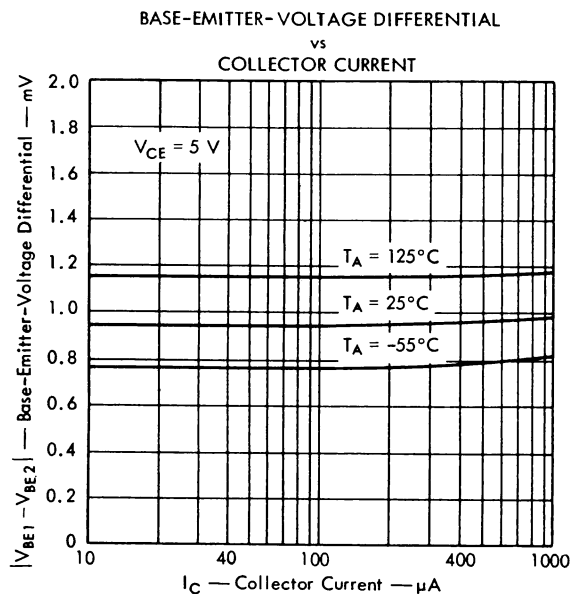


FIGURE 2

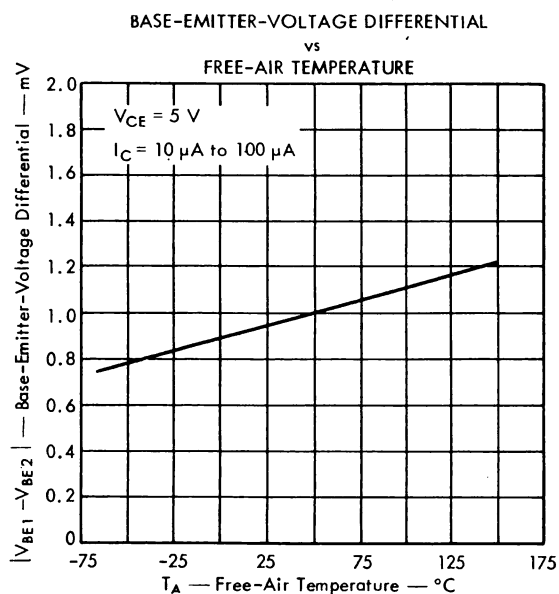


FIGURE 3

NOTE 6: The lower of the two h_{FE} readings is taken as h_{FE1} .

†These curves represent the average behavior of groups of dual transistors. Unlike normal single-triode characteristics, matching characteristics of dual transistors may differ considerably in behavior from the typical. For example, a minority of devices have been observed with smaller V_{BE} mismatch at 150°C than at -65°C , as opposed to the average behavior as shown in figures 2 and 3.