TYPES 2N2913 THRU 2N2920, 2N2915A, 2N2916A, 2N2919A, 2N2920A,
2N2972 THRU 2N2979

DUAL N-P-N SILICON TRANSISTORS

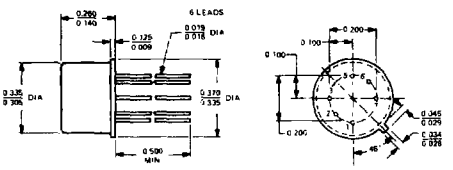
BULLETIN NO. DL-S 6911165, MARCH 1969

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



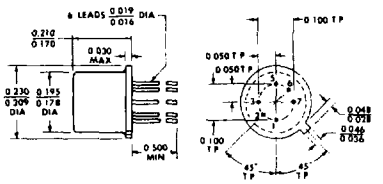
ALL DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE SPECIFIED

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

OUTLINE A — **TYPES 2N2913 THRU 2N2920, 2N2915A, 2N2916A, 2N2919A, 2N2920A**

ALL LEADS INSULATED FROM CASE



FALLS WITHIN TO-71 DIMENSIONS

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

ALL DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE SPECIFIED

OUTLINE B — **TYPES 2N2972 THRU 2N2979**

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

TYPE		MIN $V_{(BR)CEO}$		MIN-MAX h_{FE} (I_C = 10 μA)		MIN $\frac{h_{FE1}}{h_{FE2}}$		$\lvert V_{BE1}-V_{BE2}\rvert$ (I_C = 100 μA)			$\lvert\Delta V_{BE1}-V_{BE2}\rvert/\Delta T_A$ (T_{A1} = 25°C, T_{A2} = 125°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.

USES CHIP N11

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

*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 (or 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	MIN	MAX	
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	I_C = 10 μA, I_E = 0		45		45		60		60		V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	I_C = 10 mA, I_B = 0,	See Note 5	45		45		60		60		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	I_E = 10 μA, I_C = 0		6		6		6		6		V
I_{CBO}	Collector Cutoff Current	V_{CB} = 45 V, I_E = 0			10		10		2		2	nA
		V_{CB} = 45 V, I_E = 0,	T_A = 150°C		10		10		10		10	μA
I_{CEO}	Collector Cutoff Current	V_{CE} = 5 V, I_B = 0			2		2		2		2	nA
I_{EBO}	Emitter Cutoff Current	V_{EB} = 5 V, I_C = 0			2		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		0.7	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_B = 100 μA, I_C = 1 mA			0.35		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.

TEXAS INSTRUMENTS
INCORPORATED
POST OFFICE BOX 5012 • DALLAS, TEXAS 75222

*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 V, I_C = 1 mA, f = 1 kHz	25	32	25	32	Ω
h_{ob}	Small-Signal Common-Base Output Admittance	V_{CB} = 5 V, I_C = 1 mA, f = 1 kHz		1		1	μmho
$\lvert h_{fe} \rvert$	Small-Signal Common-Emitter Forward Current Transfer Ratio	V_{CE} = 5 V, I_C = 0.5 mA, f = 20 MHz	3		3	8	
C_{obo}	Common-Base Open-Circuit Output Capacitance	V_{CB} = 5 V, I_E = 0, f = 140 kHz to 1 MHz		6		6	pF
C_{ibo}	Common-Base Open-Circuit Input Capacitance	V_{EB} = 0.5 V, I_C = 0, f = 140 kHz to 1 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	
$\frac{h_{FE1}}{h_{FE2}}$	Static Forward-Current-Gain Balance Ratio	V_{CE} = 5 V, I_C = 100 μA, See Note 6	0.9	1	0.9	1	0.8	1	
		V_{CE} = 5 V, I_C = 100 μA to 1 mA, T_A = -55°C to 125°C, See Note 6			0.85	1			
$\lvert V_{BE1} - V_{BE2} \rvert$	Base-Emitter-Voltage Differential	V_{CE} = 5 V, I_C = 100 μA		3		1.5		5	mV
		V_{CE} = 5 V, I_C = 10 μA to 1 mA		5		2		10	
$\lvert \Delta(V_{BE1} - V_{BE2})_{\Delta T_A} \rvert$	Base-Emitter-Voltage-Differential Change With Temperature	V_{CE} = 5 V, I_C = 100 μA, $T_{A(1)}$ = 25°C, $T_{A(2)}$ = -55°C		0.8		0.4		1.6	mV
		V_{CE} = 5 V, I_C = 100 μA, $T_{A(1)}$ = 25°C, $T_{A(2)}$ = 125°C		1		0.5		2	

*operating characteristics at 25°C free-air temperature

individual triode characteristics (see note 4)

PARAMETER	TEST CONDITIONS	2N2913 2N2915 2N2915A 2N2917 2N2919 2N2919A 2N2972 2N2974 2N2976 2N2978	2N2914 2N2916 2N2916A 2N2918 2N2920 2N2920A 2N2973 2N2975 2N2977 2N2979	UNIT
		MAX	MAX	
$\overline{F}$ 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

TYPICAL MATCHING CHARACTERISTICS†

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

STATIC FORWARD-CURRENT-GAIN BALANCE RATIO
vs
COLLECTOR CURRENT

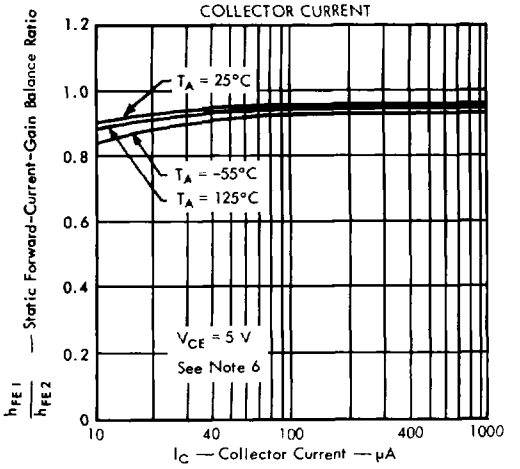


FIGURE 1

BASE-EMITTER-VOLTAGE DIFFERENTIAL
vs
COLLECTOR CURRENT

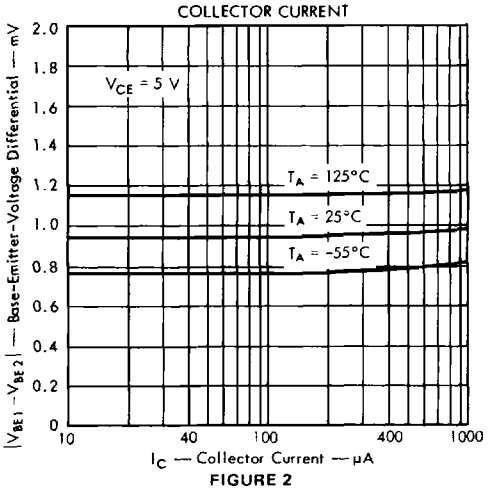


FIGURE 2

BASE-EMITTER-VOLTAGE DIFFERENTIAL
vs
FREE-AIR TEMPERATURE

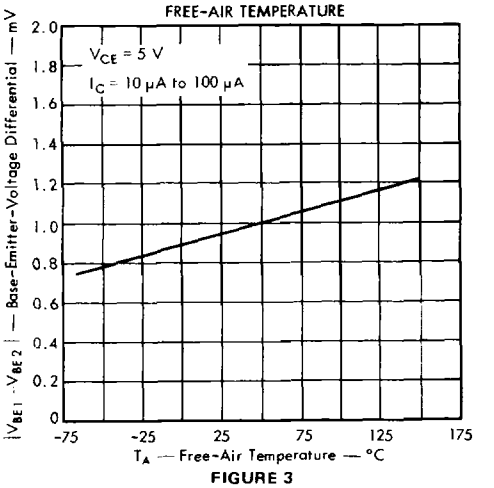


FIGURE 3

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.

TEXAS INSTRUMENTS
INCORPORATED
POST OFFICE BOX 5012 • DALLAS, TEXAS 75222