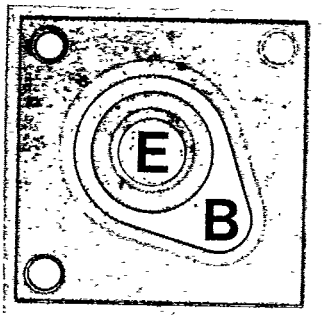
T-29-17

RAYTHEON

Low Level, Low Noise, High Gain Amplifiers

CL NPN



Description

General purpose amplifier for low level, low noise and high gain amplifier applications. The PNP compliment is the GL.

Dimensions

Die Size: 19 x 19 mils
Bonding Pad Size:
Base 3.2 mil Diameter
Emitter 3.2 mil Diameter

Popular Types

2N930/JAN
2N2484/JAN
2N3117

Electrical Characteristics (at 25°C ambient temperature unless otherwise stated)

Parameter	Conditions	2N930JAN			2N2484JAN			Units
		Min	Typ	Max	Min	Typ	Max	
BV_{CEO}	I_C = 10mA, I_B = 0	45	60		60	75		Volts
BV_{CBO}	I_C = 10μA, I_E = 0	60	130		60	150		Volts
BV_{EBO}	I_C = 0, I_E = 10μA	6	9.5		6	9.5		Volts
I_{CEO}	I_B = 0, V_{CE} = 5V		0.01	2		0.01	2	nA
I_{CES}	V_{EB} = 0, V_{CE} = 45V		0.01	2		0.01	5	nA
I_{CES}	V_{EB} = 0, V_{CE} = 45V, T_A = 150°C		0.01	10		0.01	10	μA
I_{CBO}	I_E = 0, V_{CB} = 45V		0.01	10		0.01	10	nA
I_{EBO}	I_C = 0, V_{EB} = 5V		0.01	5		0.01	2	nA
H_{FE}	I_C = 1μA, V_{CE} = 5V				45	200		
H_{FE}	I_C = 10μA, V_{CE} = 5V	100	150	300	200	320	500	
H_{FE}	I_C = 10μA, V_{CE} = 5V, T_A = -55°C	20	80		35	175		
H_{FE}	I_C = 100μA, V_{CE} = 5V				225	450		
H_{FE}	I_C = 500μA, V_{CE} = 5V	150	300		250	510		
H_{FE}	I_C = 1mA, V_{CE} = 5V				250	580		
H_{FE}	I_C = 10mA, V_{CE} = 5V		450	600		650	800	
$h_{fe\ (ac)}$	I_C = 1mA, V_{CE} = 5V, f = 1kHz	150		600	250		900	
h_{fe}	I_C = 500μA, V_{CE} = 5V, f = 30MHz	1.5	2.9	6	2	3.1	7	
$V_{CE(SAT)}$	I_C = 1mA, I_B = 100μA					0.05	0.3	Volts
$V_{CE(SAT)}$	I_C = 10mA, I_B = 500μA		0.1	1				Volts
$V_{BE(on)}$	I_C = 100μA, V_{CE} = 5V				0.5	0.57	0.7	Volts
$V_{BE(SAT)}$	I_C = 10mA, I_B = 500μA	0.6	0.72	1				Volts
C_{ob}	V_{CB} = 5V, I_E = 0		1.9	8		1.9	5	pF
C_{ib}	V_{EB} = 0.5V, I_C = 0					3.9	6	pF
NF	I_C = 10μA, V_{CE} = 5V, f = 100Hz, R_S = 10kΩ		0.5	5		0.5	7.5	dB
NF	I_C = 10μA, V_{CE} = 5V, f = 1kHz, R_S = 10kΩ		0.5	3		0.5	3	dB
NF	I_C = 10μA, V_{CE} = 5V, f = 10kHz, R_S = 10kΩ		0.5	3		0.5	2	dB
NF	I_C = 10μA, V_{CE} = 5V, Bw = 15.7kHz					1.3	3	dB

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CL Single Transistors

Product Type	Pkg.	Electrical Parameters @ 25°C Ambient Temperature										
		BV_{CBO} Min @ 10μA	BV_{CEO} Min @ 10mA	BV_{EBO} Min @ 10μA	H_{FE} @ I_C/V_{CE}		$V_{CE(SAT)}$ @ I_C/I_B		ft MHz Min	C_{ob} pF Max	NF	
					Min/Max	mA/V	Volts Max	mA/mA			dB Max	kHz
2N757AJ	TO-18	75	60	6	18/40	1/5	1.0	10/1	60	6	24	1.0
2N759AJ	TO-18	75	60	8	36/90	1/5	1.0	10/1	60	6	24	1.0
2N760A	TO-18	60	60	8	76/333	1/5	1.0	10/1		8		
2N760AJ	TO-18	75	60	8	76/333	1/5	1.0	10/1	60	6	24	1.0
2N929	TO-18	45	45	5	60/350	1/5	1.0	10/0.5	30	8	4	15.7
2N929A	TO-18	60	45	6	60/350	1/5	0.5	10/0.5	45	6	4	15.7
2N929J	TO-18	60	45	6	40/120	0.01/5	1.0	10/0.5	45	8	3	1.0
2N930	TO-18	45	45	5	100/300	0.01/5	1.0	10/0.5	30	8	3	15.7
2N930J,TX,V	TO-18	60	45	6	100/300	0.01/5	1.0	10/0.5	45	8	3	1.0
2N930A	TO-18	60	45	6	100/300	0.01/5	0.5	10/0.5	45	6	3	15.7
2N930B	TO-18	60	45	6	100/300	0.01/5	0.5	10/0.5	45	6	3	15.7
2N2483	TO-18	60	60	6	40/120	0.01/5	0.35	1/0.1	60	6	4	15.7
2N2484	TO-18	60	60	6	100/500	0.01/5	0.35	1/.1	60	6	3	15.7
2N2484J,TX,V	TO-18	60	60	6	200/500	0.01/5	0.3	1/0.1	60	5	3	15.7
2N2509	TO-18	125	80	7	25/-	0.01/5	1.0	5/0.5	45	6	7	1.0
2N2510	TO-18	100	65	7	150/500	10/5	1.0	5/0.5	45	6	4	1.0
2N2511	TO-18	80	50	7	240/750	10/5	1.0	5/0.5	45	6	4	1.0
2N2586	TO-18	60	45	6	120/360	0.01/5	0.5	10/0.5	45	7	3	1.0
2N3117	TO-18	60	60	6	250/500	0.01/5	0.35	1/0.1	60	4 5	1	1.0
2N4104	TO-18	60	60	10	400/800	0.01/5	0.3	1/.1	90	4.5	1	1.0

CL Dual Transistors

Product Type	Pkg.	Electrical Properties @ 25°C Ambient Temperature											
		BV_{CBO} Min @ 10μA	BV_{CEO} Min @ 10mA	BV_{EBO} Min @ 10μA	H_{FE} @ I_C/V_{CE}		Matching		$V_{CE(SAT)}$ @ I_C/I_B		$V_{CE(SAT)}$ @ I_C/I_B		ft MHz Min	C_{ob} pF Max
					Min/Max	mA/V	H_{FE} %	V_{VE} mV	Volts Max	mA/mA	Volts Max	mA/mA		
2N2453	TO-75	60	30	7	150/600	1/5	10	3	1.0	5/0.5	0.9	5/0.5	60	8
2N2639	TO-77	45	45	5	50/300	0.01/5	10	5	1.0	10/0.5	1.0	10/0.5	80	8
2N2639J,TX,V	TO-77	45	45	5	50/150	0.01/5	10	5	1.0	10/0.5	1.0	10/0.5	32	8
2N2640	TO-77	45	45	5	50/300	0.01/5	20	10	1.0	10/0.5	1.0	10/0.5	80	8
2N2641	TO-77	45	45	5	50/300	0.01/5			1.0	10/0.5	1.0	10/0.5	80	8
2N2642	TO-77	45	45	5	100/300	0.01/5	10	5	1.0	10/0.5	1.0	10/0.5	80	8
2N2642J,TX,V	TO-77	45	45	5	100/300	0.01/5	10	5	1.0	10/0.5	1.0	10/0.5	32	8
2N2643	TO-77	45	45	5	100/300	0.01/5	20	10	1.0	10/0.5	1.0	10/0.5	80	8
2N2644	TO-77	45	45	5	100/300	0.01/5			1.0	10/0.5	1.0	10/0.5	80	8
2N2903	TO-75	60	30	7	125/625	1/5	20	10	1.0	5/0.5	0.9	5/0.5	60	8
2N2903A	TO-77	60	30	7	125/625	1/5	20	5	1.0	5/0.5	0.9	5/0.5	60	8
2N2913	TO-75	45	45	6	60/240	0.01/5			0.35	1/0.1			60	6
2N2914	TO-75	45	45	6	150/600	0.01/5			0.35	1/0.1			60	6
2N2915	TO-75	45	45	6	60/240	0.01/5	10	3	0.35	1/0.1			60	6
2N2915A	TO-75	45	45	6	60/240	0.01/5	10	1.5	0.35	1/0.1			60	6
2N2916	TO-75	45	45	6	150/600	0.01/5	10	3	0.35	1/0.1			60	6
2N2916A	TO-75	45	45	6	150/600	0.01/5	10	1.5	0.35	1/0.1			60	6
2N2917	TO-75	45	45	6	60/240	0.01/5	20	5	0.35	1/0.1			60	6
2N2918	TO-75	45	45	6	150/600	0.01/5	20	10	0.35	1/0.1			60	6
2N2919	TO-75	60	60	6	60/240	0.01/5	10	3	0.35	1/0.1			60	6

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CL Dual Transistors (Cont'd)

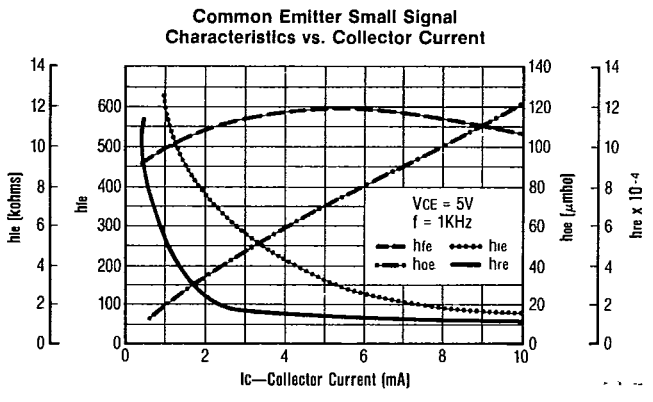
Product Type	Pkg.	Electrical Properties @ 25°C Ambient Temperature											
		BV_{CBO} Min @ 10μA	BV_{CEO} Min @ 10mA	BV_{EBO} Min @ 10μA	H_{FE} @ I_C/V_{CE}		Matching		$V_{CE(SAT)}$ @ I_C/I_B		$V_{CE(SAT)}$ @ I_C/I_B		f_t MHz Min	C_{ob} pF Max
					Min/Max	mA/V	H_{FE} %	V_{VE} mV	Volts Max	mA/mA	Volts Max	mA/mA		
2N2919J,TX,V	TO-77	70	60	6	60/240	0.01/5	10	3	0.3	1/0.1			60	5
2N2919A	TO-75	60	60	6	60/240	0.01/5	10	1.5	0.35	1/0.1			60	6
2N2920	TO-75	60	60	6	150/600	0.01/5	10	3	0.35	1/0.1			60	6
2N2920J,TX,V	TO-77	70	60	6	175/600	0.01/5	10	3	0.3	1/0.1	1.0	1/0.1	60	5
2N2920A	TO-75	60	60	6	150/600	0.01/5	10	1.5	0.35	1/0.1			60	6
2N2936	TO-75	60	55	5	100/300	0.01/5	10	5	0.3	2/0.2			30	8
2N2937	TO-75	60	55	5	100/300	0.01/5			0.3	2/0.2			30	8
SP930F	TO-89	45	45	5	100/300	0.01/5			1.0	10/0.5			30	8
SP2916F	TO-89	45	45	6	150/600	0.01/5	10	3	0.35	1/0.1			60	6
SP2919F	TO-89	60	60	6	60/240	0.01/5	10	3	0.35	1/0.1			60	6
SP2978F	TO-89	60	60	6	60/240	0.01/5	10	3	0.35	1/0.1			60	6
SP2453AF	TO-89	80	50	7	150/600	1/5	10	3	1.0	5/0.5	0.9	5/0.5	60	4
SP2484F	TO-89	60	60	6	100/500	0.1/5			0.35	1/0.1			60	6
SP2639F	TO-89	45	45	5	50/300	0.01/5	10	5	1.0	10/0.5	1.0	10/0.5	80	8
SP2642F	TO-89	45	45	5	100/300	0.01/5	10	5	1.0	10/0.5	1.0	10/0.5	80	8
SP2915F	TO-89	45	45	6	60/240	0.01/5	10	3	0.35	1/0.1			60	6

CL Quad Transistors

Product Type	Pkg.	Electrical Properties @ 25°C Ambient Temperature							f_t MHz Min	C_{ob} pF Max	NF	
		BV_{CBO} Min @ 10μA	BV_{CEO} Min @ 10mA	BV_{EBO} Min @ 10μA	H_{FE} @ I_C/V_{CE}		$V_{CE(SAT)}$ @ I_C/I_B				dB Max	kHz
					Min/Max	mA/V	Volts Max	mA/mA				
SP930QD	TO-116	45	45	5	100/300	0.01/5	1.0	10/0.5	30	8	3	15.7
SP930QDB	TO-116	45	45	5	100/300	0.01/5	1.0	10/0.5	30	8	3	15.7
SP930QF	TO-86	45	45	5	100/300	0.01/5	1.0	10/0.5	30	8	3	15.7
SP2484QD	TO-116	60	60	6	100/500	0.01/5	0.35	1/0.1	60	6	3	15.7
SP2484QDB	TO-116	60	60	6	100/500	0.01/5	0.35	1/0.1	60	6	3	15.7
SP2484QF	TO-86	60	60	6	100/500	0.01/5	0.35	1/0.1	60	6	3	15.7

QD = Quad Dip (Ceramic); QDB = Quad Dip (Plastic); QF = Flatpak

Typical Performance Characteristics



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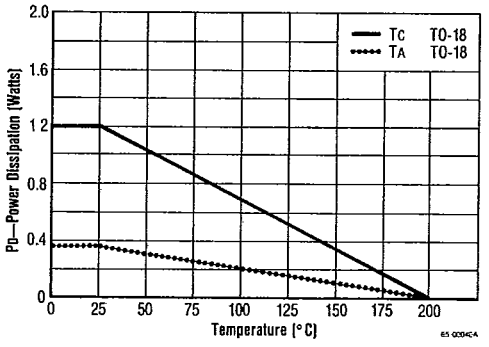
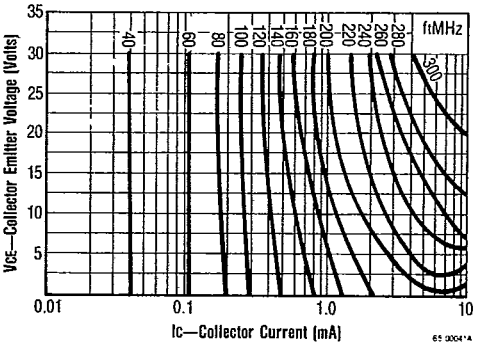
Typical Performance Characteristics (continued)

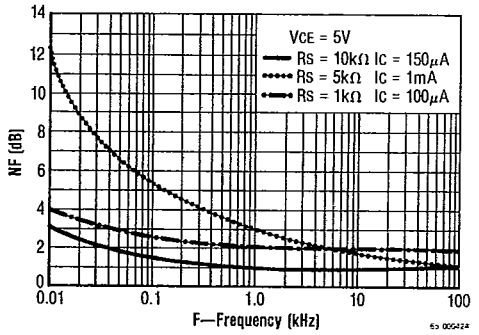
Power Derating Curves



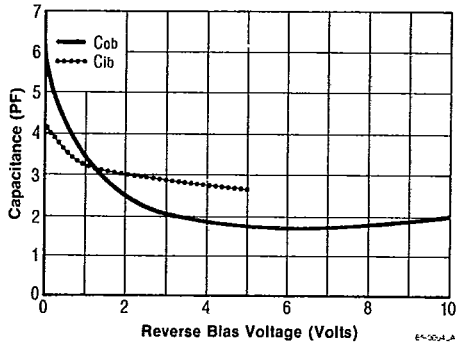
ft—Constant Gain Bandwidth Products Contours



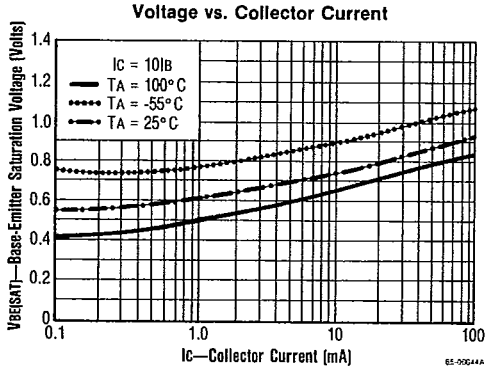
Noise Figure vs. Frequency



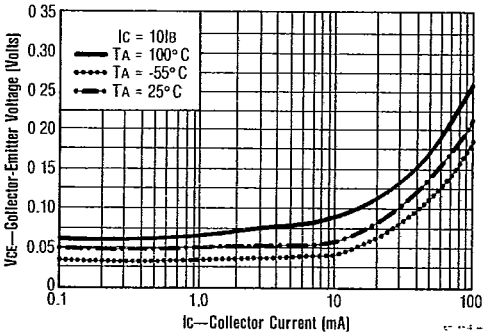
Output and Input Capacitance vs. Reverse Bias Voltage



Base-Emitter Saturation Voltage vs. Collector Current



Collector-Emitter Saturation Voltage vs Collector Current



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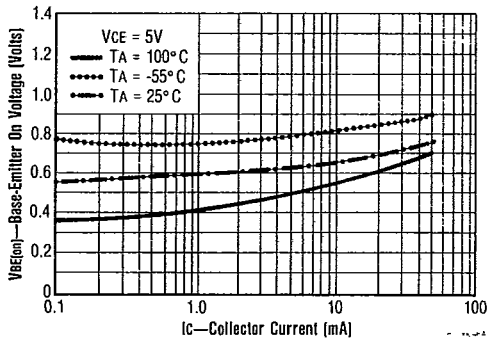
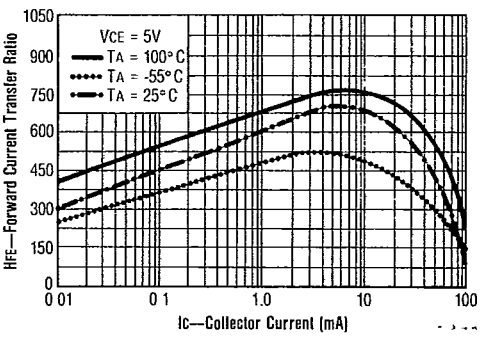
Typical Performance Characteristics (continued)

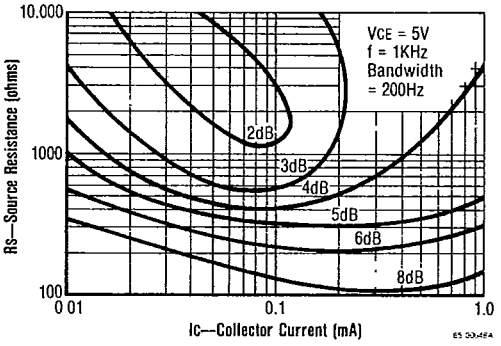
Base-Emitter On Voltage vs. Collector Current



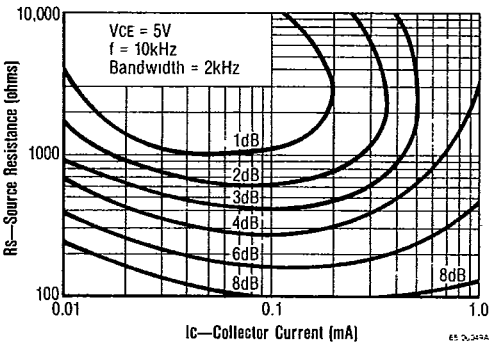
Forward Current Transfer Ratio vs. Collector Current



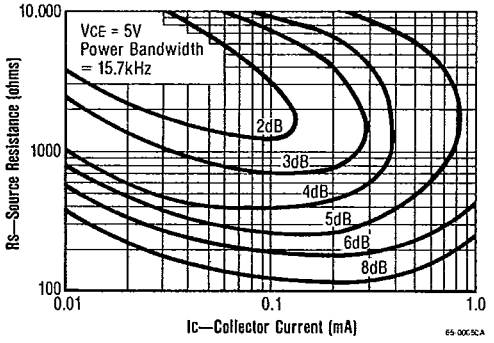
Contours of Constant Narrow Band Noise Figure



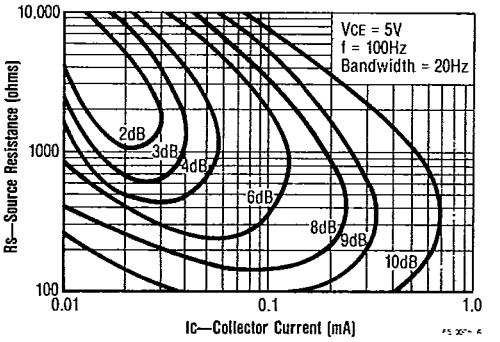
Contours of Constant Narrow Band Noise Figure



Wide Band Constant Noise Figure Contours



Contours of Constant Narrow Band Noise Figure



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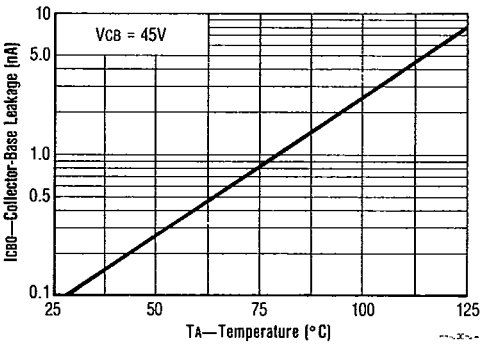
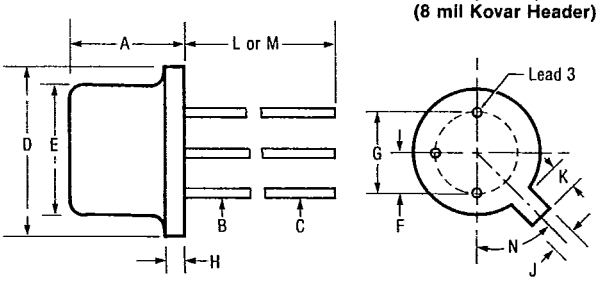
Typical Performance Characteristics (continued)

Collector-Base Leakage Current vs. Temperature



Packaging Information

In accordance with JEDEC (TO-18) outline (8 mil Kovar Header)



Notes: Lead No. 3 internally connected to case
Can material is nickel.

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	.170	210	4.31	5.33
B	.016	.019	.41	48
C	.016	.021	.41	.53
D	.209	.230	5.30	5 84
E	.178	.195	4.52	4.95
F	.050BSC		1 27BSC	
G	.100BSC		2.54BSC	
H		.030		.76
J	.036	.046	.91	1.16
K	.028	.048	.71	1.21
L	.500		12.70	
M	1.500		38.10	
N	45° BSC		45° BSC	

Low Level, Low Noise High Gain Amplifiers

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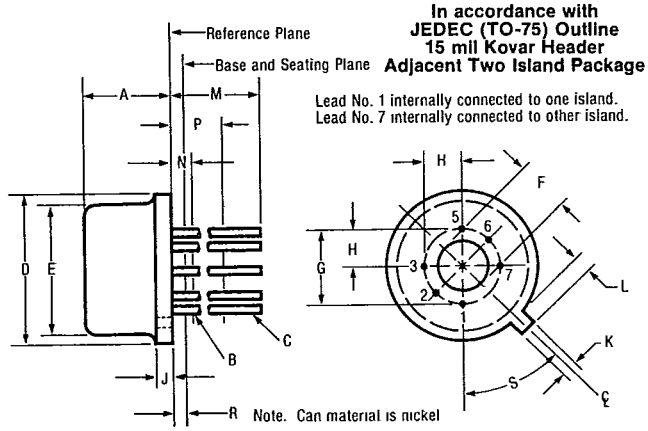
Packaging Information (continued)

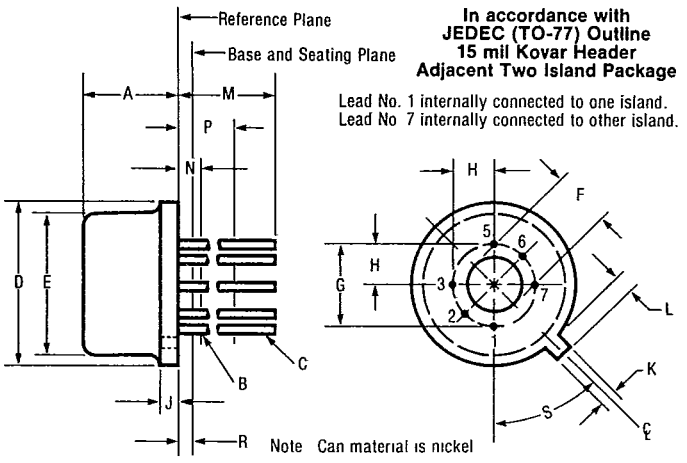


In accordance with JEDEC (TO-75) Outline 15 mil Kovar Header Adjacent Two Island Package

Lead No. 1 internally connected to one island.
Lead No. 7 internally connected to other island.

Note. Can material is nickel

Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0 240	0 260	6.10	6 60
B	0 016	0.019	0.41	0.48
C	0.016	0.021	0.41	0 53
D	0 335	0.370	8 51	9.40
E	0 305	0.335	7.75	8 51
F	0.120	0 160	3.05	4 06
G	0 200 BSC		5.08 BSC	
H	0.100 BSC		2.54 BSC	
J	0.009	0.041	0 23	1 04
K	0 028	0 034	0 71	0 86
L	0 029	0.045	0.74	1 14
M	0.500	0 750	12.70	19 05
N		0.050		1 27
P	0.250		6 35	
R	0 010	0 045	0 25	1.14
S	45° C BSC		45° C BSC	

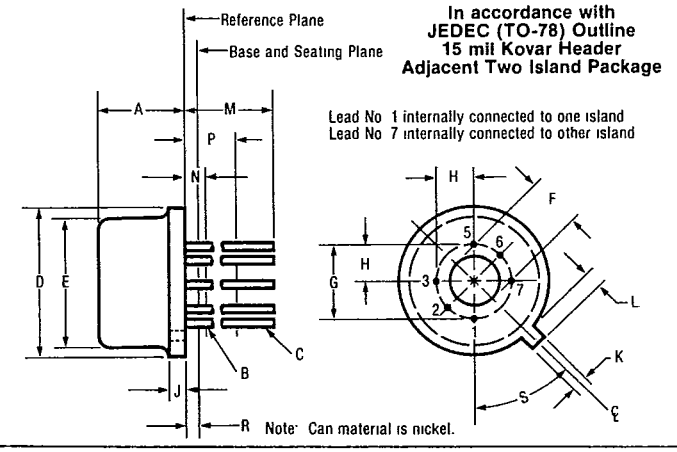


In accordance with JEDEC (TO-77) Outline 15 mil Kovar Header Adjacent Two Island Package

Lead No. 1 internally connected to one island.
Lead No 7 internally connected to other island.

Note Can material is nickel

Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.165	0 260	4.19	6 60
B	0 016	0 019	0 41	0 48
C	0 016	0.021	0.41	0 53
D	0 335	0.370	8 51	9 40
E	0 305	0.335	7 75	8 51
F	0.120	0.160	3.05	4 06
G	0 200 BSC		5 08 BSC	
H	0 100 BSC		2 54 BSC	
J	0.009	0.041	0 23	1 04
K	0 028	0.034	0 71	0 86
L	0 029	0 045	0 74	1 14
M	0.500	0 750	12.70	19 05
N		0 050		1.27
P	0 250		6 35	
R	0 010	0 045	0.25	1 14
S	45° C BSC		45° C BSC	



In accordance with JEDEC (TO-78) Outline 15 mil Kovar Header Adjacent Two Island Package

Lead No 1 internally connected to one island
Lead No 7 internally connected to other island

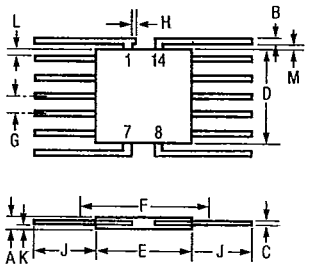
Note: Can material is nickel.

Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	0 165	0.185	4.19	4 70
B	0.016	0.019	0 41	0.48
C	0 016	0 021	0.41	0 53
D	0 335	0 370	8 51	9 40
E	0 305	0.335	7.75	8 51
F	0 120	0.160	3 05	4 06
G	0 200BSC		5 08BSC	
H	0 100BSC		2.54BSC	
J	0 009	0 041	0.23	1 04
K	0 028	0.034	0.71	0 86
L	0.029	0 045	0.74	1.14
M	0.500	0.750	12 70	19 05
N		0 050		1.27
P	0.250		6 35	
R	0.010	0 045	0 25	1.14
S	45° BSC		45° BSC	

Low Level, Low Noise High Gain Amplifiers

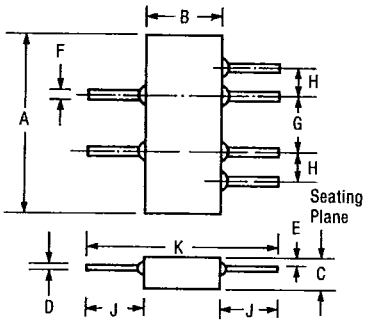
Packaging Information (Continued)

In accordance with JEDEC (TO-86) Outline 14 Lead Flatpak



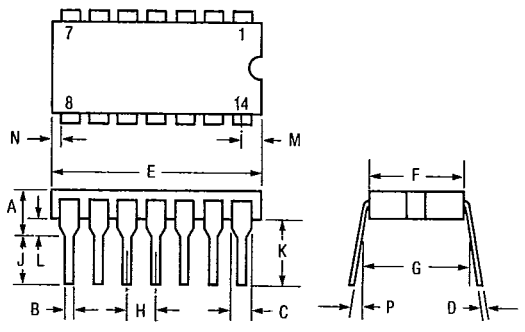
Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	0.030	0.070	0.76	1.77
B	0.010	0.019	0.25	0.48
C	0.003	0.006	0.08	0.15
D	0.240	0.275	6.10	6.98
E	0.240	0.260	6.10	6 60
F		0 290		7 37
G	0.050BSC		1.27BSC	
H	0.008	0.015	0.20	0 38
J	0.070		1.78	
K	0.005	0.035	0 13	0.89
L	0.005		0.13	
M	0.004		0.10	

In accordance with JEDEC (TO-89) Outline 6 Lead Flatpak



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	0.240	0.290	6.10	7.36
B	0.115	0.160	2.92	3.81
C	0.030	0.080	0.76	2.03
D	0.003	0.006	0.08	0 15
E	0.005	0 035	0.13	0.89
F	0.010	0.019	0 25	0.48
G	0.100BSC		2.54BSC	
H	0.050BSC		1.27BSC	
J	0.070	0.250	1.78	6.35
K	0.260	0.650	6.60	16.51

Similar to JEDEC (TO-116) Outline 14 Lead Ceramic Dual-in-Line



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		200		5 08
B	.014	.023	0 36	0 58
C	.030	.070	0.76	1 78
D	.008	015	0 20	0 38
E		785		19 94
F	220	.310	5 59	7 87
G	.290	.320	7.37	8 13
H	.100BSC		2.54BSC	
J	125	200	3 18	5.08
K	.150		3 81	
L	015	060	0.38	1.52
M		.098		2 49
N	.005		0.13	
P	0°	15°	0°	15°

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