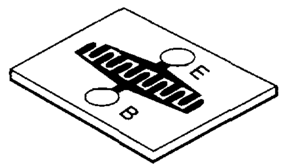
NEC

NPN SILICON GENERAL PURPOSE TRANSISTOR

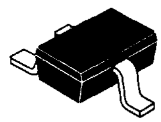
NE734 SERIES

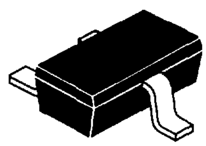
FEATURES

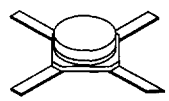
- **LOW NOISE FIGURE:** < 3 dB at 500 MHz
- **HIGH GAIN:** 15 dB at 500 MHz
- **HIGH GAIN BANDWIDTH PRODUCT:** 2 GHz (3 GHz for the NE73435)
- **SMALL COLLECTOR CAPACITANCE:** 1 pF
- **HIGH RELIABILITY METALLIZATION**



00 (CHIP)


30 (SOT 323 STYLE)


33 (SOT 23 STYLE)


35 (MICRO-X)

DESCRIPTION

The NE734 series of NPN silicon general purpose UHF transistors provide the designer with a wide selection of reliable transistors for high speed logic and wide-band low noise amplifier applications. The series uses NEC's highly reliable platinum-silicide, titanium, platinum, and gold metallization system to assure uniform performance and reliability. Besides the chip form (NE73400), several package styles are available. The NE73433 is in the plastic Mini-Mold package designed for high-speed automated assembly operations for large volume hybrid ICs. For applications requiring small size and light weight, the NE73430 is recommended. Forty percent smaller than the SOT 23 version, it is ideal for hand held portable designs. For hybrid MIC applications requiring more performance, the NE73435 is recommended. This device is packaged in the economical metal-ceramic, hermetic Micro-X package.

ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE73400 00 (CHIP)			NE73430 2SC4185 30		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**
f_T	Gain Bandwidth Product at							
	V_{CE} = 10 V, I_C = 10 mA	GHz	1.5	2.0				
	V_{CE} = 10 V, I_C = 5 mA	GHz					2.3	
NF_{MIN}	Minimum Noise Figure[2] at							
	V_{CE} = 10 V, I_C = 3 mA, f = 0.5 GHz	dB		2.1	3.5			
	V_{CE} = 10 V, I_C = 5 mA, f = 0.9 GHz	dB					4.0	
MAG	Maximum Available Gain at							
	V_{CE} = 10 V, I_C = 10 mA, f = 0.5 GHz	dB		21			17	
	f = 1 GHz	dB		16				
$\lvert S_{21E}\rvert^2$	Insertion Power Gain at V_{CE} = 10 V, I_C = 10 mA,							
	f = 0.5 GHz	dB		16				
	f = 1 GHz	dB	8	9			8	
h_{FE}	Forward Current Gain Ratio at							
	V_{CE} = 10 V, I_C = 10 mA		25	100	200			
	V_{CE} = 10 V, I_C = 5 mA					40	100	180
I_{CBO}	Collector Cutoff Current at V_{CB} = 15 V, I_E = 0	µA			0.1			0.1
I_{EBO}	Emitter Cutoff Current at V_{EB} = 2 V, I_C = 0	µA			0.1			
C_{CB}	Collector to Base Capacitance[4] at							
	V_{CB} = 10 V, I_C = 0 mA, f = 1 MHz	pF				1.5		0.75
P_T	Total Power Dissipation	mW						150
R_{TH}	Thermal Resistance (Junction to Case)	°C/W						833

3

ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE73433 2SC2759 33			NE73435 2SC2148 35		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**
f_T	Gain Bandwidth Product at							
	V_{CE} = 10 V, I_C = 10 mA	GHz	1.5	2.0		1.5	3.0	
	V_{CE} = 10 V, I_C = 5 mA	GHz						
NF_{MIN}	Minimum Noise Figure[2] at							
	V_{CE} = 10 V, I_C = 3 mA, f = 0.5 GHz	dB		3.0	4.0		2.1	3.5
MAG	Maximum Available Gain[3] at							
	V_{CE} = 10 V, I_C = 10 mA, f = 0.5 GHz	dB		17			18	
	f = 1 GHz	dB					13	
$\lvert S_{21E}\rvert^2$	Insertion Power Gain at V_{CE} = 10 V, I_C = 10 mA,							
	f = 0.5 GHz	dB		13			16	
	f = 1 GHz	dB		8		8	9	
h_{FE}	Forward Current Gain Ratio at							
	V_{CE} = 10 V, I_C = 10 mA		25	100	200	25	100	200
	V_{CE} = 10 V, I_C = 5 mA							
I_{CBO}	Collector Cutoff Current at V_{CB} = 15 V, I_E = 0	µA			0.1			0.1
I_{EBO}	Emitter Cutoff Current at V_{EB} = 2 V, I_C = 0	µA						0.1
C_{CB}	Collector to Base Capacitance[4] at							
	V_{CB} = 10 V, I_C = 0 mA, f = 1 MHz	pF		1	1.5		.55	1.5
P_T	Total Power Dissipation	mW			200			250
R_{TH}	Thermal Resistance (Junction to Ambient)	°C/W			625			550

Notes:
1. Electronic Industrial Association of Japan.
2. Input and output are tuned for optimum noise figures.
3. Maximum Available Gain (MAG) is calculated

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When $K \leq 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

4. C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	30
V_{CEO}	Collector to Emitter Voltage	V	14
V_{EBO}	Emitter to Base Voltage	V	3
I_C	Collector Current	mA	50
T_J	Junction Temperature	°C	200[2]
T_{STG}	Storage Temperature	°C	-65 to +200[3]

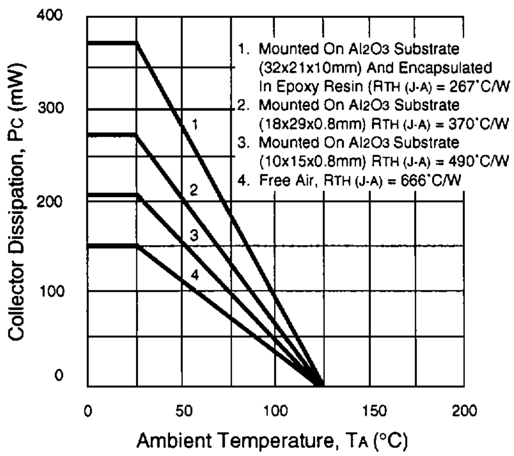
Notes:
1. Operation in excess of any one of these parameters may result in permanent damage.
2. Maximum Junction Temperature for the NE73430 and NE73433 is 150°C.
3. Maximum Storage Temperature for the NE73430, NE73433 and the NE73435 Grade D is 150°C.

NE73435
TYPICAL NOISE PARAMETERS (T_A = 25°C)

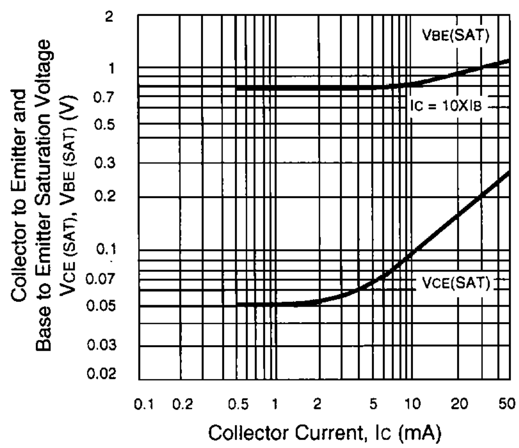
FREQ. (MHz)	NF_{OPT} (dB)	G_A (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50
V_{CE} = 10 V, I_C = 3 mA					
500	2.0	16.1	0.30	80	0.63
1000	3.1	11.2	0.43	126	0.33
1500	4.2	9.2	0.54	168	0.19
2000	5.1	7.1	0.56	178	0.20
V_{CE} = 10 V, I_C = 15 mA					
500	3.3	17.5	0.34	120	0.36
1000	4.7	13.5	0.47	168	0.27
1500	6.5	10.8	0.67	-174	0.13
2000	7.4	9.2	0.64	-163	0.46

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

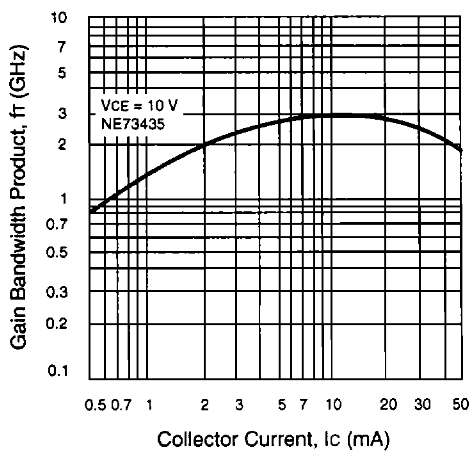
NE73433
DC POWER DERATING CURVES



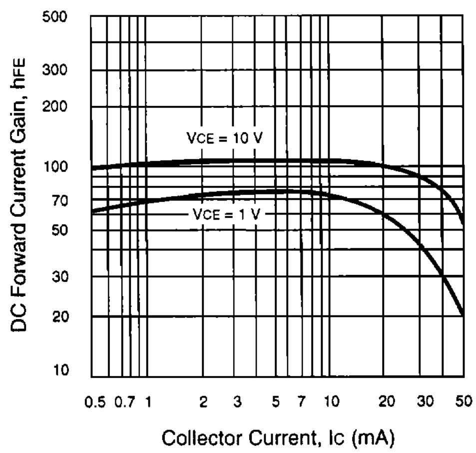
SATURATION VOLTAGE vs.
COLLECTOR CURRENT



GAIN BANDWIDTH PRODUCT
vs. COLLECTOR CURRENT

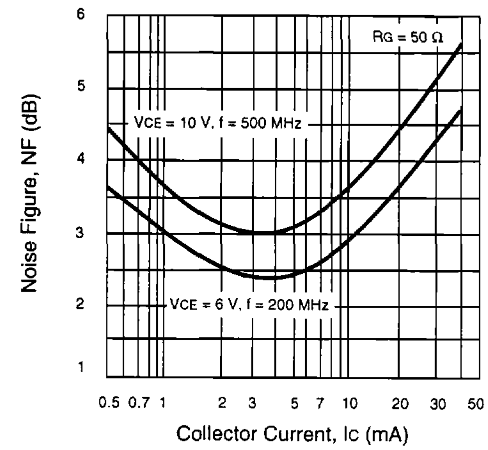


DC CURRENT GAIN
vs. COLLECTOR CURRENT

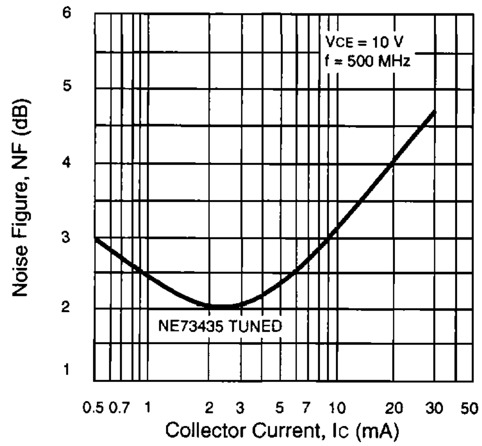


TYPICAL PERFORMANCE CURVES (TA = 25°C)

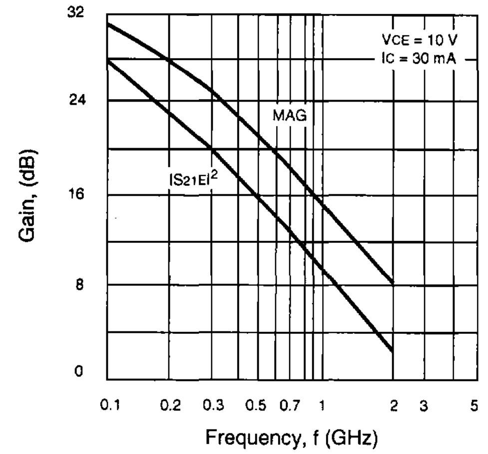
NE73433
NOISE FIGURE vs.
COLLECTOR CURRENT



NE73435
NOISE FIGURE vs.
COLLECTOR CURRENT



NE73435
GAIN vs. FREQUENCY



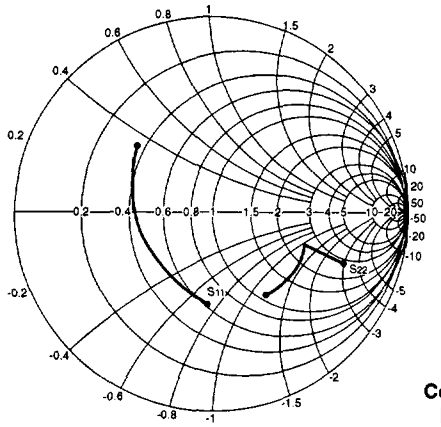
3

ORDERING INFORMATION

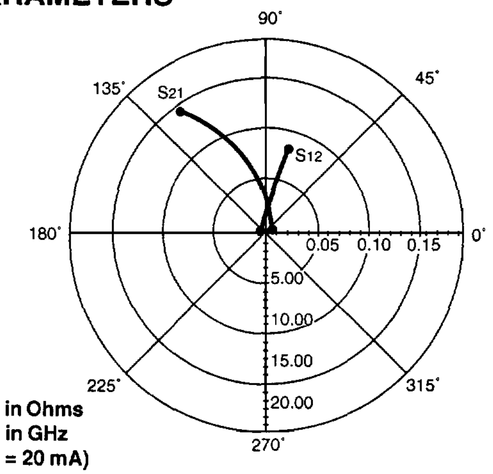
PART NUMBER	QUANTITY	PACKAGING
NE73400	100	Waffle Package
NE73430-T1	3000	Tape & Reel
NE73433-T1B	3000	Tape & Reel
NE73435	1	ESD Bag

Note:
1. Embossed tape 12 mm wide.

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)



NE73433

V_{CE} = 10 V, I_C = 5 mA

FREQUENCY (MHz)	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG	K	MAG[1] (dB)
100	0.72	-53	11.71	143	0.02	68	0.89	-17	0.21	27.7
200	0.57	-88	8.26	120	0.03	57	0.72	-22	0.66	24.4
500	0.43	-144	4.04	90	0.07	59	0.57	-25	0.93	17.6
1000	0.42	-178	2.17	65	0.11	62	0.55	-33	1.11	10.9
1500	0.44	159	1.55	50	0.17	67	0.52	-45	1.02	8.7
2000	0.49	142	1.23	35	0.22	67	0.51	-60	0.94	7.5

V_{CE} = 10 V, I_C = 10 mA

FREQUENCY (MHz)	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG	K	MAG[1] (dB)
100	0.57	-71	15.59	132	0.02	66	0.80	-20	0.40	28.9
200	0.44	-109	9.93	110	0.02	57	0.62	-21	1.23	24.1
500	0.39	-157	4.42	86	0.07	68	0.53	-23	0.95	18.0
1000	0.40	175	2.31	63	0.11	67	0.52	-31	1.13	11.0
1500	0.44	156	1.65	48	0.17	70	0.49	-43	1.02	9.0
2000	0.49	138	1.30	33	0.22	69	0.49	-59	0.93	7.7

V_{CE} = 10 V, I_C = 20 mA

FREQUENCY (MHz)	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG	K	MAG[1] (dB)
100	0.47	-93	18.06	122	0.02	69	0.72	-20	0.51	29.6
200	0.38	-130	10.35	103	0.02	56	0.58	-19	1.34	23.7
500	0.38	-167	4.39	82	0.06	75	0.51	-18	1.15	16.3
1000	0.42	171	2.27	60	0.12	69	0.52	-28	1.03	11.7
1500	0.46	153	1.61	46	0.17	72	0.51	-41	0.97	9.8
2000	0.52	137	1.26	31	0.23	70	0.49	-58	0.87	7.4

V_{CE} = 10 V, I_C = 30 mA

FREQUENCY (MHz)	S11 MAG	S11 ANG	S21 MAG	S21 ANG	S12 MAG	S12 ANG	S22 MAG	S22 ANG	K	MAG[1] (dB)
100	0.43	-111	16.72	116	0.02	82	0.70	-19	0.53	29.2
200	0.39	-144	9.20	99	0.02	54	0.60	-16	1.41	22.8
500	0.41	-173	3.85	79	0.06	73	0.56	-17	1.13	15.9
1000	0.46	167	1.99	58	0.11	72	0.57	-28	1.07	11.0
1500	0.51	149	1.41	43	0.17	77	0.55	-42	0.92	9.2
2000	0.57	133	1.10	29	0.23	73	0.53	-60	0.82	6.8

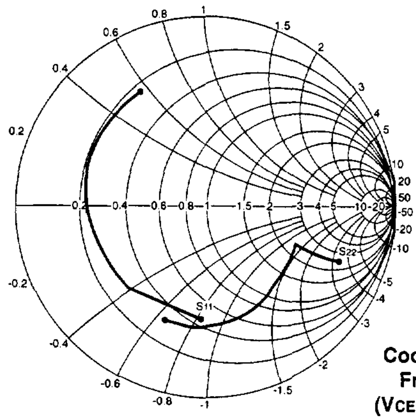
Note:

1. Gain Calculation:

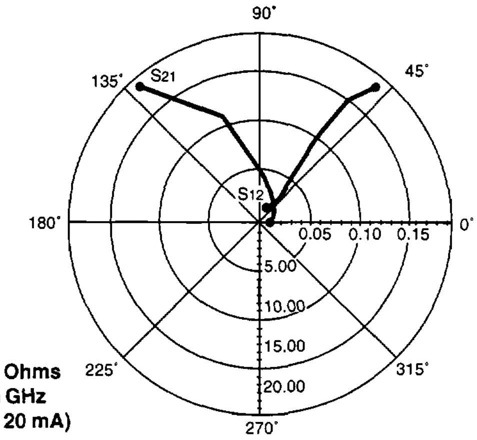
$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When $K \leq 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)



NE73435

V_{CE} = 10 V, I_C = 3 mA

FREQUENCY (MHz)	S_{11} MAG	S_{11} ANG	S_{21} MAG	S_{21} ANG	S_{12} MAG	S_{12} ANG	S_{22} MAG	S_{22} ANG	K	MAG[1] (dB)
100	0.861	-28.4	6.880	157.0	0.026	70.5	0.960	-11.1	0.19	24.2
200	0.810	-55.0	6.206	139.8	0.047	56.9	0.865	-19.2	0.28	21.2
500	0.676	-115.5	4.323	104.1	0.070	37.3	0.689	-29.0	0.50	17.9
1000	0.616	-156.0	2.494	74.4	0.085	30.5	0.612	-38.3	0.84	14.7
1500	0.607	-175.1	1.709	55.6	0.095	32.2	0.612	-49.8	1.05	11.2
2000	0.610	171.3	1.317	39.0	0.107	32.2	0.616	-62.2	1.16	8.5
2500	0.613	160.0	1.071	25.3	0.118	33.9	0.632	-74.0	1.20	6.9
3000	0.618	149.5	0.896	13.0	0.132	33.5	0.649	-87.3	1.19	5.7
4000	0.630	128.9	0.647	-8.4	0.170	33.7	0.657	-112.9	1.20	3.1

V_{CE} = 10 V, I_C = 5 mA

FREQUENCY (MHz)	S_{11} MAG	S_{11} ANG	S_{21} MAG	S_{21} ANG	S_{12} MAG	S_{12} ANG	S_{22} MAG	S_{22} ANG	K	MAG[1] (dB)
100	0.798	-39.0	10.428	151.6	0.025	66.2	0.923	-14.4	0.22	26.2
200	0.733	-74.2	8.974	131.4	0.040	52.9	0.788	-22.4	0.31	23.5
500	0.628	-134.4	5.214	96.8	0.056	37.4	0.613	-28.4	0.62	19.7
1000	0.603	-166.4	2.797	70.8	0.073	37.1	0.563	-36.6	0.94	15.8
1500	0.605	178.1	1.893	53.1	0.088	39.9	0.572	-47.9	1.09	11.5
2000	0.613	166.2	1.442	37.6	0.102	39.9	0.582	-60.5	1.16	9.1
2500	0.621	155.9	1.161	24.2	0.117	41.0	0.604	-72.5	1.15	7.6
3000	0.628	146.0	0.967	12.0	0.133	40.6	0.628	-85.9	1.10	6.7
4000	0.644	126.0	0.690	-9.3	0.176	39.2	0.639	-111.8	1.09	4.1

V_{CE} = 10 V, I_C = 10 mA

FREQUENCY (MHz)	S_{11} MAG	S_{11} ANG	S_{21} MAG	S_{21} ANG	S_{12} MAG	S_{12} ANG	S_{22} MAG	S_{22} ANG	K	MAG[1] (dB)
100	0.687	-62.0	16.892	142.1	0.020	59.4	0.846	-19.1	0.26	29.3
200	0.635	-106.6	12.598	118.5	0.031	48.8	0.677	-24.6	0.40	26.1
500	0.603	-153.4	5.959	89.6	0.042	42.9	0.541	-25.9	0.81	21.5
1000	0.607	-175.8	3.063	67.1	0.061	47.2	0.521	-33.7	1.07	15.4
1500	0.621	171.8	2.039	50.5	0.080	48.7	0.541	-45.3	1.12	12.0
2000	0.633	161.4	1.532	35.2	0.096	48.3	0.559	-58.0	1.14	9.8
2500	0.646	151.8	1.220	22.4	0.112	48.3	0.586	-70.7	1.10	8.4
3000	0.652	142.4	1.009	10.4	0.132	47.9	0.612	-84.2	1.02	8.0
4000	0.672	122.6	0.712	-10.1	0.182	44.2	0.627	-111.0	0.96	5.9

V_{CE} = 10 V, I_C = 20 mA

FREQUENCY (MHz)	S_{11} MAG	S_{11} ANG	S_{21} MAG	S_{21} ANG	S_{12} MAG	S_{12} ANG	S_{22} MAG	S_{22} ANG	K	MAG[1] (dB)
100	0.584	-94.8	22.708	130.8	0.015	57.7	0.761	-21.6	0.32	31.8
200	0.594	-134.2	14.233	108.5	0.023	48.1	0.599	-23.0	0.55	27.9
500	0.613	-165.6	6.118	84.3	0.034	51.7	0.515	-22.0	0.95	22.6
1000	0.632	178.2	3.061	63.8	0.054	53.6	0.517	-30.8	1.13	15.3
1500	0.650	167.5	2.014	47.5	0.072	55.5	0.545	-43.4	1.14	12.2
2000	0.666	157.8	1.506	32.9	0.089	55.1	0.564	-56.8	1.12	10.2
2500	0.678	148.5	1.190	20.3	0.108	56.1	0.594	-69.8	1.02	9.6
3000	0.686	139.0	0.976	8.7	0.132	55.3	0.621	-83.9	0.91	8.7
4000	0.699	119.3	0.682	-11.2	0.190	49.2	0.634	-111.2	0.86	5.6

Note:

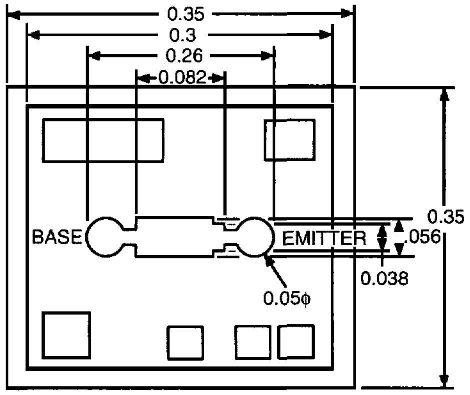
1. Gain Calculation:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When $K \le 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

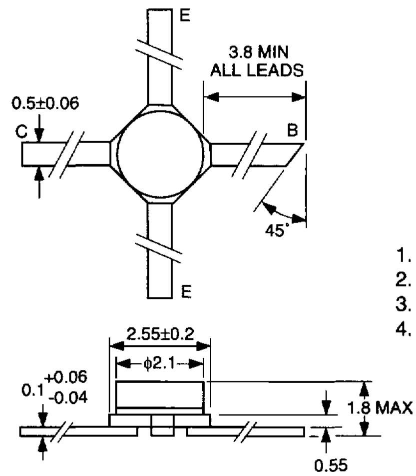
MAG = Maximum Available Gain   MSG = Maximum Stable Gain

OUTLINE DIMENSIONS (Units in mm)

NE73400 (CHIP)
Chip Thickness: 160 μm TYP



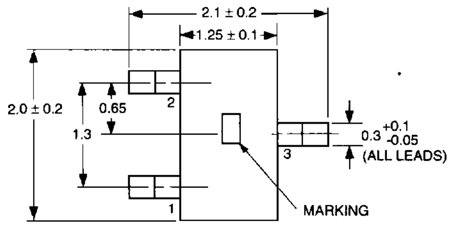
PACKAGE OUTLINE 35
(MICRO-X)

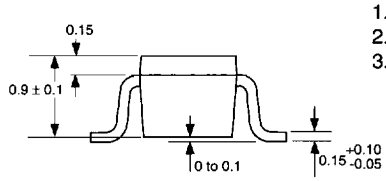


1. Collector
2. Emitter
3. Base
4. Emitter

OUTLINE DIMENSIONS (Units in mm)

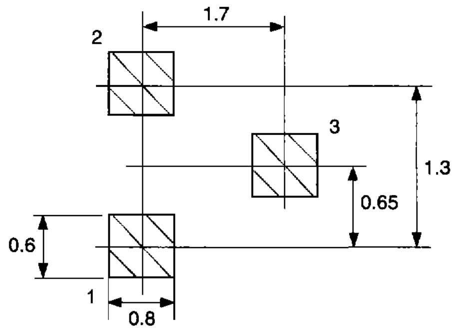
OUTLINE 30
(SOT-323)



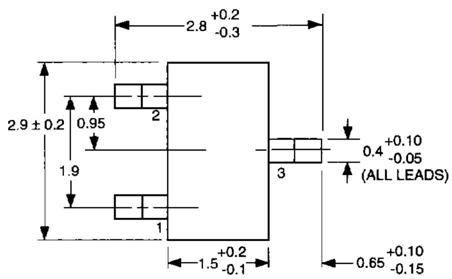


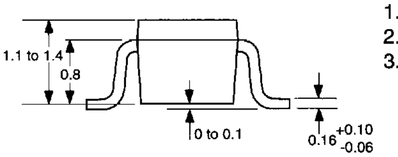
1. Emitter
2. Base
3. Collector

PACKAGE OUTLINE 30
RECOMMENDED P.C.B. LAYOUT



PACKAGE OUTLINE 33
(SOT-23)





1. Emitter
2. Base
3. Collector

PACKAGE OUTLINE 33
RECOMMENDED P.C.B. LAYOUT