

FEATURES

- ULTRA-LINEAR BROAD-BAND AMPLIFIER
- LOW DISTORTION AT HIGH POWER

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V _{CB0}	Collector to Base Voltage	V	35
V _{CE0}	Collector to Emitter Voltage	V	18*
V _{EB0}	Emitter to Base Voltage	V	3
I _c	Collector Current	mA	250
T _J	Junction Temperature	°C	200
T _{STG}	Storage Temperature	°C	-65 to +200

*Typical V_{CER} = 35 V for R ≤ 300 Ω

DESCRIPTION AND APPLICATIONS

The NE221 is an NPN silicon, bipolar transistor series, designed especially for wide-band, low distortion amplifiers at UHF. The series has excellent power capabilities for oscillators (up to 1 GHz) and, CATV and MATV linear amplifiers. The NE22120 features NEC's high-reliability platinum/silicide, titanium, platinum, and gold metallized chips in the molded stripline 20 package. This combination yields excellent economy and performance with the utmost in reliability and ruggedness.

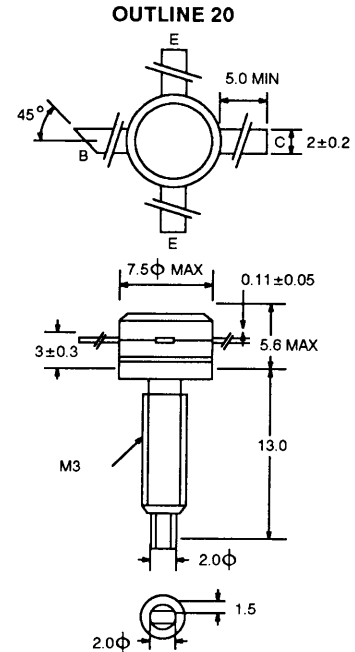
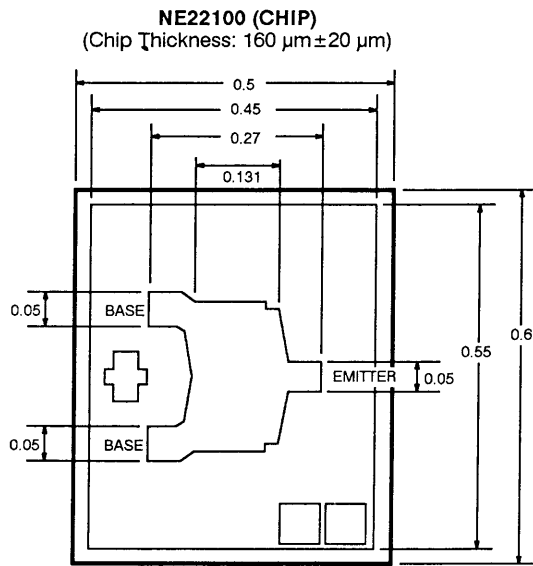
PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE		NE22120 2SC2065 20			
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
f _r	Gain Bandwidth Product at V _{CE} = 10 V, I _c = 80 mA	GHz	2.8	3.2	
S _{21E} ²	Insertion Power Gain at V _{CE} = 10 V, I _c = 80 mA, f = 0.5 GHz f = 1 GHz	dB dB		11 5.5	
MAG	Maximum Available Gain ² at V _{CE} = 10 V, I _c = 80 mA, f = 0.5 GHz f = 1 GHz	dB dB	13.5	14.5 9	
IM ₂₊	Second Order Intermodulation Product at V _{CE} = 10 V, I _c = 80 mA, V _o = 110 dBμV/75 Ω, f ₁ = 90 MHz, f ₂ = 90 MHz, f = f ₁ + f ₂	dB		-59	
IM ₂₋	Second Order Intermodulation Product at V _{CE} = 10 V, I _c = 80 mA, V _o = 110 dBμV/75 Ω, f ₁ = 190 MHz, f ₂ = 90 MHz, f = f ₁ - f ₂	dB		-63	
IM ₃	Third Order Intermodulation Product at V _{CE} = 10 V, I _c = 80 mA, V _o = 110 dBμV/75 Ω, f ₁ = 190 MHz, f ₂ = 200 MHz, f = 2f ₁ - f ₂	dB	-75	-78	

Notes:

1. Electronic Industrial Association of Japan.
2. $MAG = |S_{21E}|^2 \cdot \frac{1}{1 - |S_{11E}|^2} \cdot \frac{1}{1 - |S_{22E}|^2}$

OUTLINE DIMENSIONS (Units in mm)



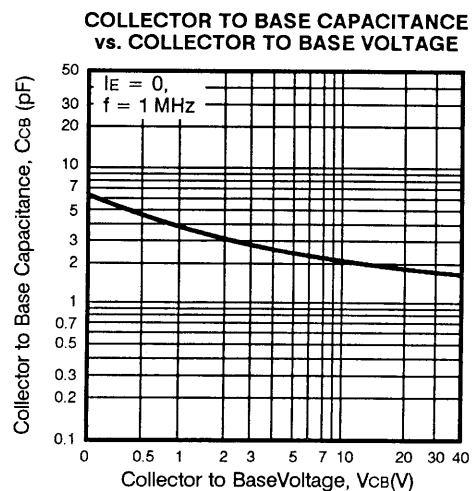
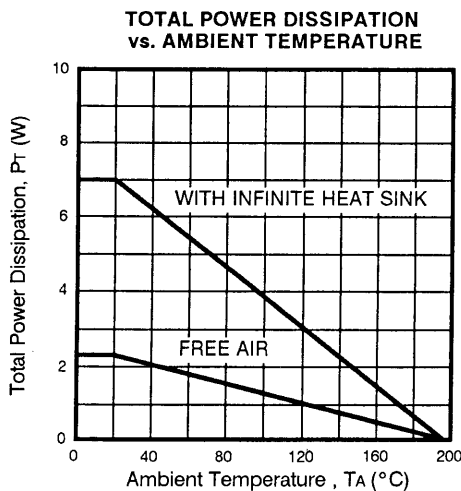
ELECTRICAL CHARACTERISTICS (TA = 25°C)

PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE				NE22120 2SC2065 20		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	
IcBO	Collector Cutoff Current at Vcb = 20 V, Ie = 0	μA			10	
IeBO	Emitter Cutoff Current at Veb = 2 V, Ic = 0	μA			10	
hFE	Forward Current Gain at Vce = 10 V, Ic = 80 mA (pulsed)		20	100	200	
Ccb	Collector to Base Capacitance ² at Vcb = 10 V, Ie = 0, f = 1 MHz	pF		2	3	
RθJC	Thermal Resistance (Junction-to-Case)	°C/W			25	
P _T	Total Power Dissipation (Tc = 25°)	W			7	

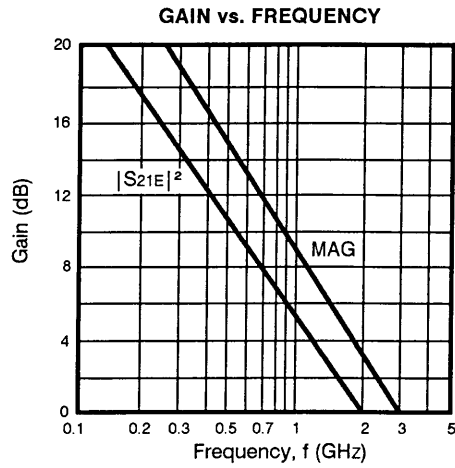
Notes:

1. Electronic Industrial Association of Japan.
2. Ccb measurement employs a three terminal capacitance bridge incorporating a guard circuit. The emitter shall be connected to the guard terminal.

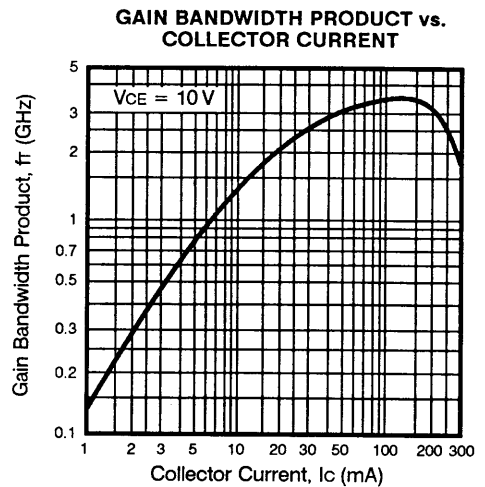
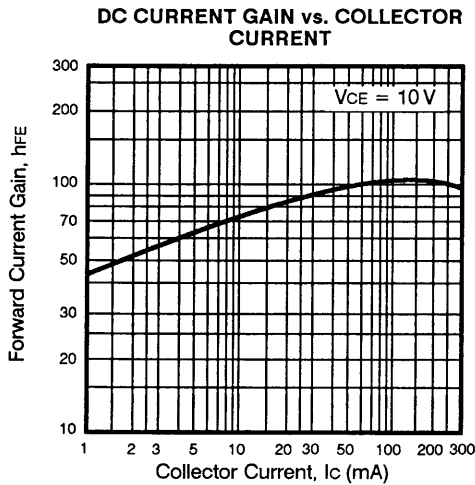
TYPICAL THERMAL AND CAPACITANCE CHARACTERISTICS



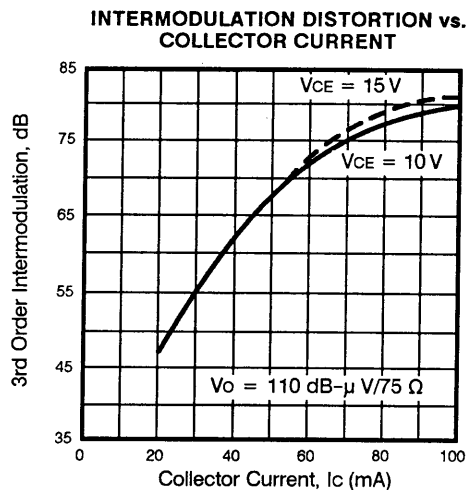
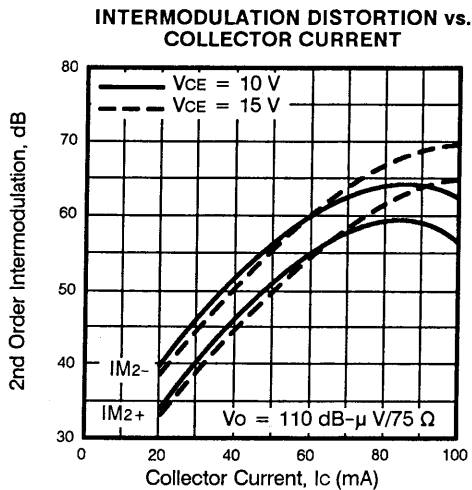
TYPICAL GAIN CHARACTERISTICS



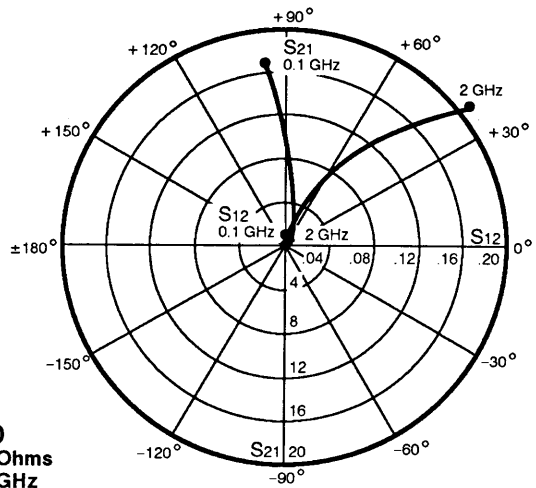
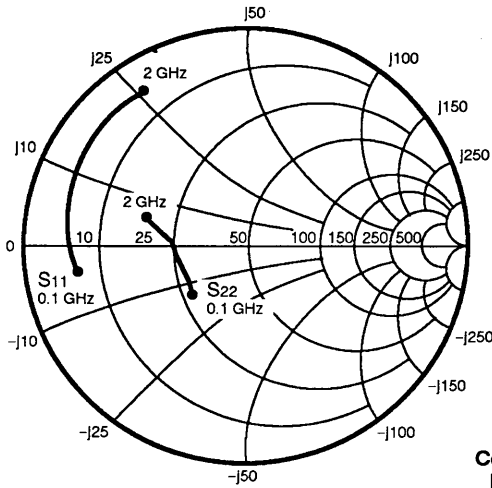
TYPICAL PERFORMANCE CHARACTERISTICS (TA=25°C)



TYPICAL INTERMODULATION DISTORTION CHARACTERISTICS



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE22120
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 100 mA)

S-MAGN AND ANGLES:

V_{CE} = 10 V, I_C = 50 mA
FREQUENCY (MHz)

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.77	-169	14.58	96	.01	44	.29	-112
500	.83	168	2.93	66	.05	57	.25	-158
1000	.83	152	1.46	40	.10	56	.34	-167
1500	.83	137	.97	19	.14	46	.43	-176
2000	.84	124	.74	5	.20	40	.52	172

V_{CE} = 10 V, I_C = 100 mA

100	.78	-172	16.22	94	.01	55	.34	-137
500	.82	167	3.21	67	.06	62	.33	-175
1000	.83	152	1.60	42	.10	56	.38	177
1500	.83	137	1.08	22	.15	46	.43	172
2000	.83	124	.83	7	.21	39	.49	163

V_{CE} = 15 V, I_C = 50 mA

100	.76	-167	15.39	97	.01	55	.27	-107
500	.81	168	3.10	66	.05	57	.23	-154
1000	.83	153	1.54	41	.10	54	.31	-164
1500	.83	138	1.03	19	.14	46	.41	-173
2000	.83	125	.78	4	.19	40	.50	175

V_{CE} = 15 V, I_C = 100 mA

100	.76	-170	16.99	95	.01	54	.31	-133
500	.81	168	3.35	67	.06	60	.29	-172
1000	.82	152	1.68	43	.10	56	.34	180
1500	.82	138	1.13	22	.15	45	.40	175
2000	.82	125	.87	7	.20	38	.47	167





NPN MEDIUM POWER OSCILLATOR TRANSISTOR

NE243 SERIES

FEATURES

- HIGH OSCILLATOR POWER OUTPUT:
630 mW TYP at 7.5 GHz
- FREQUENCY USE TO 10 GHz
- LOW AM/FM NOISE
- HIGH RELIABILITY

DESCRIPTION AND APPLICATIONS

The NE243 NPN series transistor is designed for oscillator applications to 10 GHz. Reliable operation is assured by NEC's gold, platinum and titanium metallization system. The NE243 series is available as a chip or in hermetically sealed packages.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE24300 00 (CHIP)		NE243187 NE243188 87,88		NE243287 NE243288 87,88		NE243499 99	
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MIN	TYP	MIN	TYP	MIN	TYP
P _{osc}	Oscillator Power Output at V _{CE} = 12 V, f = 7.5 GHz, I _c = 80 mA I _c = 120 mA I _c = 200 mA	mW mW mW		150		150		320		630
S ₂₁ ²	Insertion Power Gain at V _{CC} = 8 V, f = 1 GHz, I _c = 50 mA I _c = 100 mA I _c = 200 mA	dB dB dB	4.3		4.3		4		3.5	

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

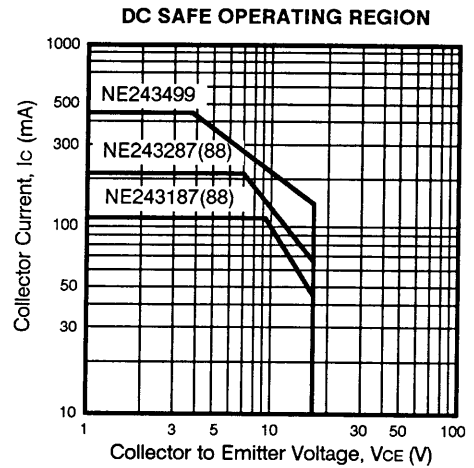
PART NUMBER PACKAGE OUTLINE			NE24300 00 (CHIP)			NE243187 NE243188 87,88			NE243287 NE243288 87,88			NE243499 99		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I _{CBO}	Collector Cutoff Current at V _{CB} = 15 V, I _E = 0	μA			0.25			0.25			0.5			1
I _{EBO}	Emitter Cutoff Current at V _{EB} = 1 V, I _C = 0	μA			1			1			2			4
h _{FE}	Forward Current Gain at V _{CE} = 8 V, I _c = 50 mA I _c = 100 mA I _c = 200 mA		20		200	20		200	20		200	20		200
C _{OB}	Output Capacitance at V _{CB} = 10 V, I _E = 0	pF		0.30			0.65	1		0.95	1.5		2.9	4
R _{TH}	Thermal Resistance (Junction-to-Case)	°C/W		45			45			30				18
P _T	Total Power Dissipation	W		2.75			2.75			5.5				9.7

ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
VCBO	Collector to Base Voltage	V	25
VEBO	Emitter to Base Voltage	V	1.5
VCEO	Collector to Emitter Voltage	V	16
VCER*	Collector to Emitter Voltage	V	25
Ic	Collector Current		
	NE24300	mA	110
	NE243187, NE243188	mA	110
	NE243287, NE243288	mA	220
	NE243499	mA	440
TJ	Junction Temperature	°C	200
TSTG	Storage Temperature	°C	-65 to +200

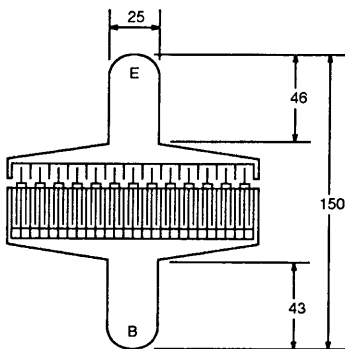
*RBE = 300 Ω

TYPICAL DEVICE CHARACTERISTICS (TA = 25°C)



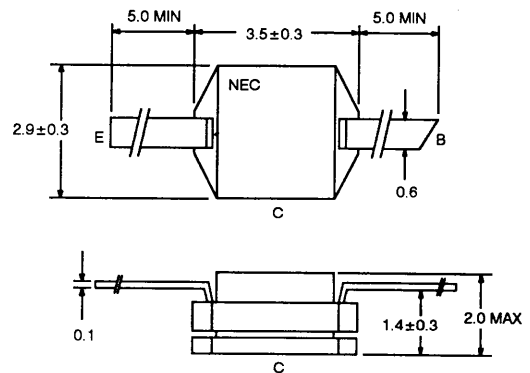
OUTLINE DIMENSIONS (Units in mm)

NE24300 (CHIP)

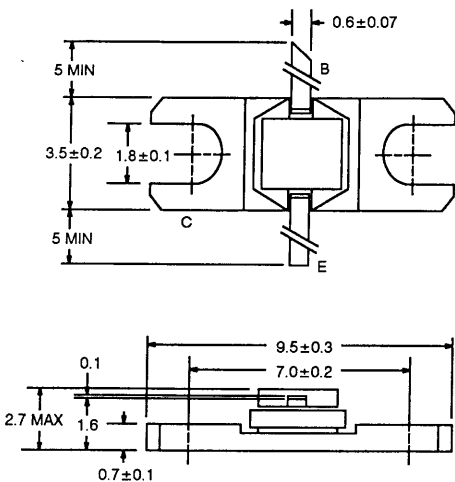


Die Size: 350 x 350 μm
Die Thickness: 110 to 160 μm

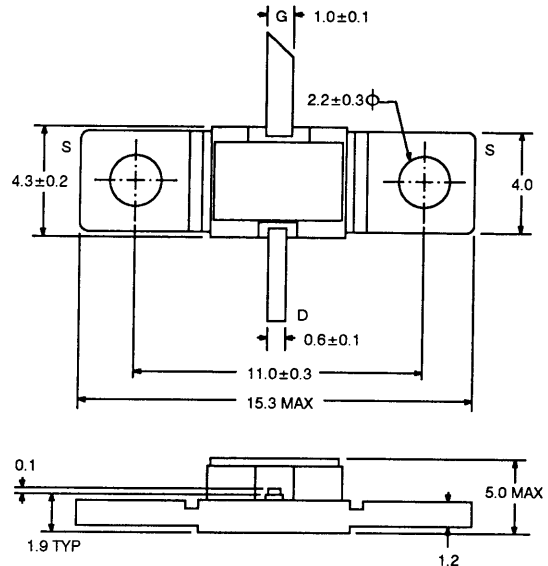
OUTLINE 87



OUTLINE 88

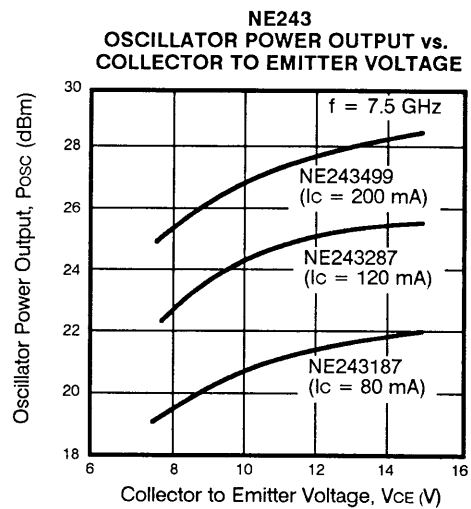
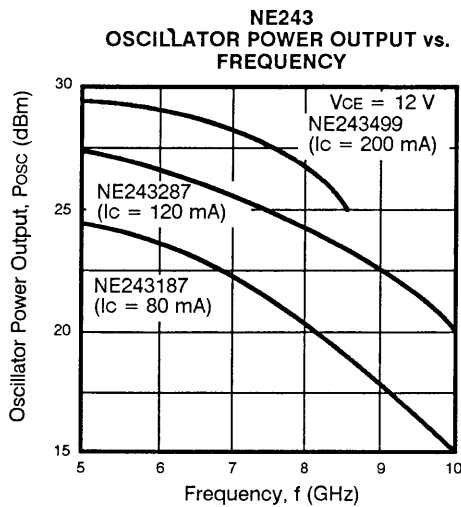


OUTLINE 99



NE243 SERIES

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)



NE243187 COMMON COLLECTOR* SCATTERING PARAMETERS

S-MAGN AND ANGLES:
VCE = 12 V, IC = 80 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
2000	.92	-75	1.70	-53	.46	27	.78	118
3000	.85	-109	1.51	-76	.61	2	.69	89
4000	.81	-140	1.35	-97	.72	-24	.58	64
5000	.77	-171	1.21	-118	.79	-46	.50	39
6000	.72	161	1.06	-137	.83	-68	.42	16
7000	.69	130	.91	-157	.86	-89	.36	-2
8000	.65	105	.83	-175	.87	-115	.30	-20
9000	.68	74	.72	162	.85	-137	.26	-33
10000	.68	44	.60	143	.77	-163	.22	-27

*S₁₁ is base to collector, S₂₂ is emitter to collector.

NE243287 COMMON COLLECTOR* SCATTERING PARAMETERS

S-MAGN AND ANGLES:
VCE = 12 V, IC = 120 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
2000	.97	-91	1.60	-59	.44	22	.72	129
3000	.96	-126	1.36	-82	.56	-3	.58	110
4000	.97	-156	1.16	-103	.62	-29	.45	99
5000	.98	175	.97	-124	.65	-50	.35	93
6000	.96	150	.80	-144	.62	-71	.30	96
7000	.92	127	.69	-159	.64	-92	.28	98
8000	.95	108	.60	-178	.62	-113	.31	99
9000	.97	81	.49	158	.57	-136	.37	89
10000	.96	54	.39	138	.54	-159	.43	75

*S₁₁ is base to collector, S₂₂ is emitter to collector.

NE243188 COMMON COLLECTOR* SCATTERING PARAMETERS

S-MAGN AND ANGLES:
VCE = 12 V, IC = 80 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
2000	.91	-73	1.65	-50	.47	28	.72	120
3000	.83	-104	1.47	-72	.64	6	.65	93
4000	.77	-133	1.30	-91	.74	-20	.55	67
5000	.71	-159	1.17	-108	.81	-40	.49	42
6000	.65	176	1.02	-127	.85	-62	.43	18
7000	.59	148	.92	-145	.89	-81	.40	-2
8000	.51	123	.82	-164	.87	-105	.35	-27
9000	.53	94	.75	178	.88	-127	.32	-46
10000	.53	60	.67	156	.85	-151	.26	-62

*S₁₁ is base to collector, S₂₂ is emitter to collector.

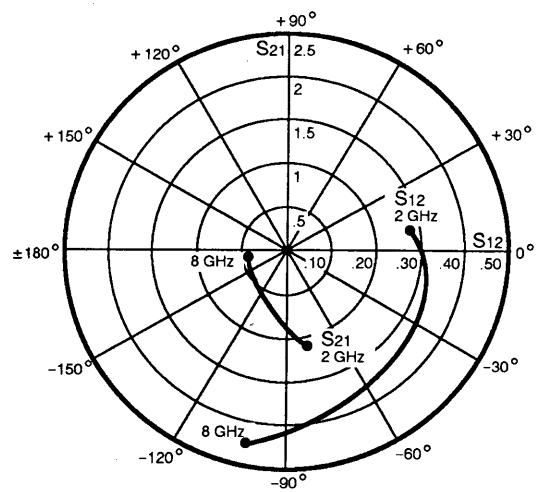
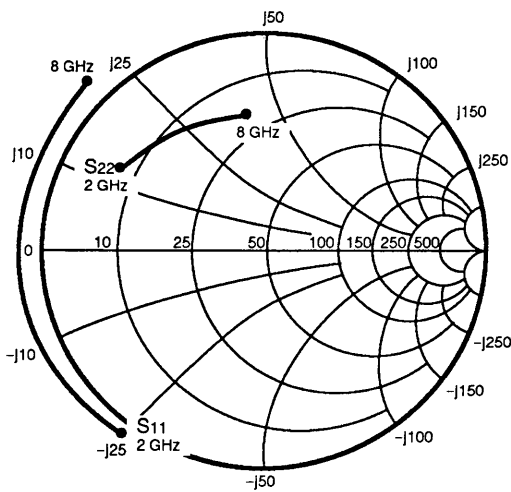
NE243288 COMMON COLLECTOR* SCATTERING PARAMETERS

S-MAGN AND ANGLES:
VCE = 12 V, IC = 120 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
2000	.97	-90	1.54	-56	.45	25	.69	132
3000	.96	-120	1.31	-77	.57	2	.55	116
4000	.96	-146	1.11	-95	.64	-22	.42	104
5000	.95	-169	.95	-112	.67	-42	.33	98
6000	.94	171	.81	-130	.68	-62	.25	96
7000	.91	151	.70	-145	.66	-79	.24	96
8000	.89	134	.61	-164	.65	-100	.23	97
9000	.92	112	.54	179	.64	-120	.30	87
10000	.97	87	.49	157	.63	-142	.36	71

*S₁₁ is base to collector, S₂₂ is emitter to collector.

NE243499 COMMON COLLECTOR* SCATTERING PARAMETERS



S-MAGN AND ANGLES:
VCE = 12 V, IC = 200 mA

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
2000	1.04	-125	1.12	-76	.29	8	.72	150
3000	1.06	-151	.84	-97	.32	-11	.67	143
4000	1.08	-170	.67	-114	.34	-33	.66	137
5000	1.10	173	.57	-130	.35	-48	.65	128
6000	1.08	159	.49	-145	.36	-67	.63	118
7000	1.03	146	.45	-159	.39	-82	.62	106
8000	1.06	134	.47	-175	.45	-103	.61	93

*S₁₁ is base to collector, S₂₂ is emitter to collector.





NPN MEDIUM POWER MICROWAVE TRANSISTOR

NE24600
NE24615
NE24620

FEATURES

- **EXCELLENT IM DISTORTION CHARACTERISTICS AT HIGH OUTPUT LEVELS:**
NE24615 IM₂ = -56 dB, IM₃ = -64
NE24620 IM₂ = -63 dB, IM₃ = -72
@ V_o = 120 dBμ V/75 Ω
- **HIGH GAIN**
- **SUITABLE FOR CATV TRUNK LINE AMPLIFIERS**
- **HIGH RELIABILITY METALLIZATION**

DESCRIPTION AND APPLICATIONS

The NE246 is an NPN transistor designed for broadband VHF and UHF amplifier applications. The intermodulation distortion and noise figure of the NE246 are low at high output levels; therefore, the transistor is well suited for use as a linear amplifier. A proprietary process is used to form the emitter ballast resistance which prevents current concentration. Reliable operation is assured by NEC's Pt-Si/Ti/Pt/Au metallization process. The NE246 is available as a chip or in hermetically sealed packages.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER EIAJ REGISTERED NUMBER PACKAGE OUTLINE			NE24600 ¹ 00 (CHIP)			NE24615 2SC2952 15			NE24620 2SC2953 20		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f _r	Gain Bandwidth Product at V _{CE} = 10 V, I _c = 60 mA V _{CE} = 15 V, I _c = 100 mA	GHz GHz		4.5		2.8				4.5	
S _{21E} ²	Insertion Power Gain at V _{CE} = 10 V, I _c = 60 mA, f = 0.5 GHz V _{CE} = 15 V, I _c = 100 mA, f = 0.5 GHz	dB dB		13.5		8.5	10		12	13.5	
MAG	Maximum Available Gain at V _{CE} = 10 V, I _c = 60 mA, f = 0.5 GHz f = 1 GHz V _{CE} = 15 V, I _c = 100 mA, f = 0.5 GHz f = 1 GHz	dB dB dB dB		17 11			11 5			17 11	
NF	Noise Figure at V _{CE} = 10 V, I _c = 60 mA, f = 1 GHz V _{CE} = 15 V, I _c = 80 mA, f = 1 GHz	dB dB		4		3.5				4	
IM ₂	Second Order Intermodulation Product, V _o = 120 dBμ V/75 Ω f ₁ = 100 MHz f ₂ = 90 MHz f = f ₁ + f ₂ V _{CE} = 10 V, I _c = 60 mA V _{CE} = 15 V, I _c = 80 mA	dB dB		-63			-56			-63	
IM ₃	Third Order Intermodulation Product, V _o = 120 dBμ V/75 Ω f ₁ = 200 MHz f ₂ = 190 MHz f = 2f ₁ - f ₂ V _{CE} = 10 V, I _c = 100 mA V _{CE} = 15 V, I _c = 120 mA	dB dB		-72			-64			-72	

Note:

1. RF characteristics are measured in #20 package.

ELECTRICAL CHARACTERISTICS (TA = 25°C)

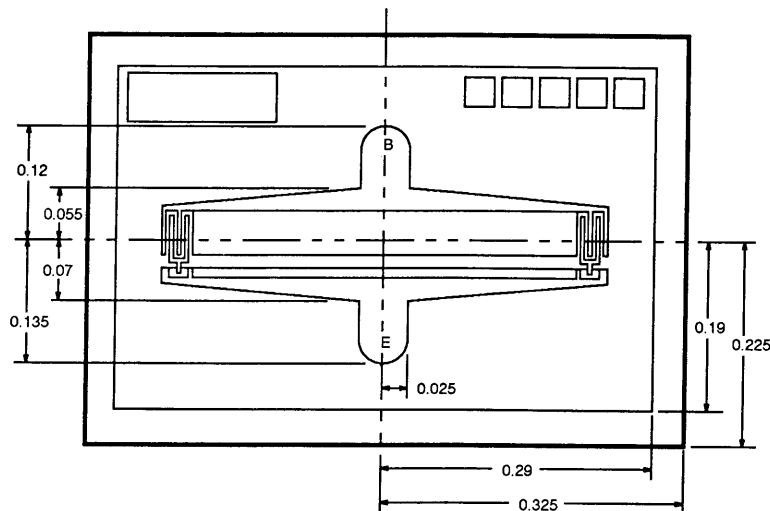
PART NUMBER EIAJ REGISTERED NUMBER PACKAGE OUTLINE			NE24600 00 (CHIP)			NE24615 2SC2952 15			NE24620 2SC2953 20		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
ICBO	Collector Cutoff Current at VCB = 20 V, IE = 0	μA			10			10			10
IEBO	Emitter Cutoff Current at VEB = 2 V, IC = 0	μA			10			10			10
hFE	Forward Current Gain at VCE = 10 V, IC = 80 mA (pulsed)		30	80	200	30	80	200	30	80	200
CCB	Collector-Base Capacitance at VCB = 10 V, IE = 0 mA, f = 1 MHz	pF		1.8	2.5		1.8	2.5		1.8	2.5

ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
VCBO	Collector to Base Voltage	V	30
VCEO	Collector to Emitter Voltage	V	20
VEBO	Emitter to Base Voltage	V	3
IC	Collector Current	mA	250
TJ	Junction Temperature	°C	200
TSTG	Storage Temperature	°C	-65 to +200
RTH (J-C)	Thermal Resistance	°C/W	25
PT	Total Power Dissipation	W	5

OUTLINE DIMENSIONS (Units in mm)

NE24600 (CHIP)

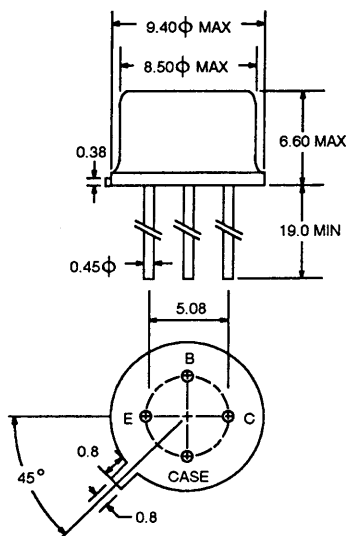


Die Thickness: .110 to .160 mm

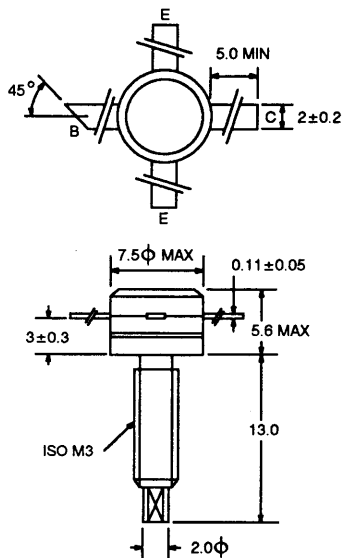


OUTLINE DIMENSIONS (Units in mm)

OUTLINE 15
(TO-33)

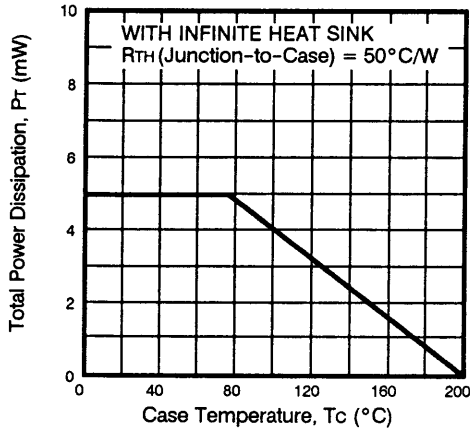


OUTLINE 20

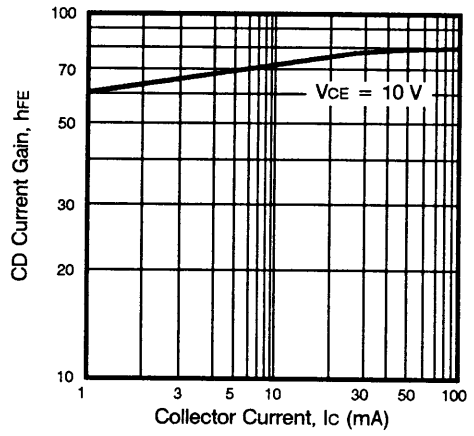


TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)

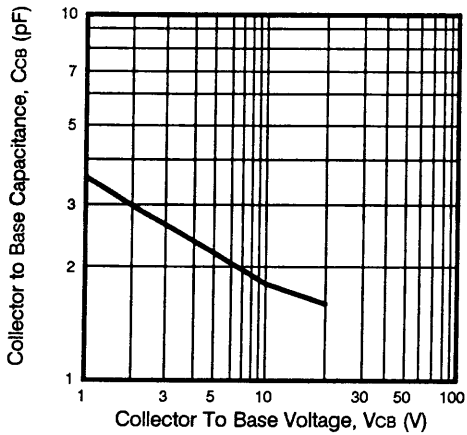
NE246
DC POWER DERATING CURVES



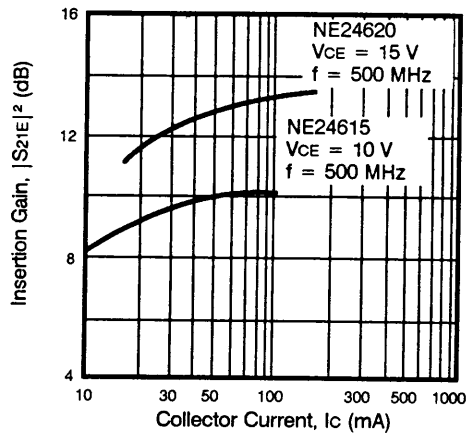
NE24615 AND NE24620
DC CURRENT GAIN vs.
COLLECTOR CURRENT



NE24615 AND NE24620
COLLECTOR CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE



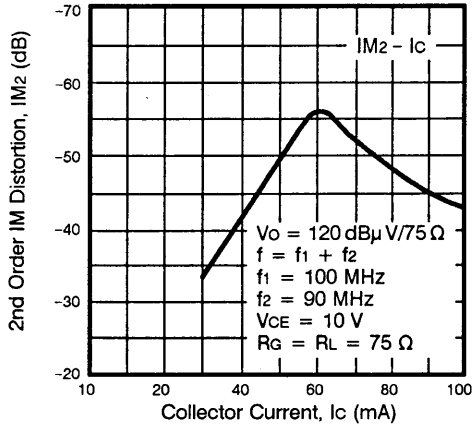
NE24615 AND NE24620
FORWARD INSERTION GAIN vs.
COLLECTOR CURRENT



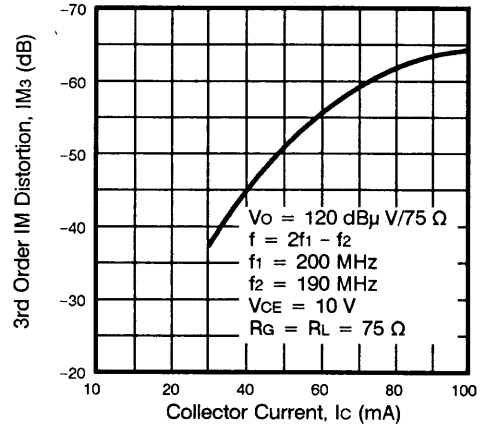
2

TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

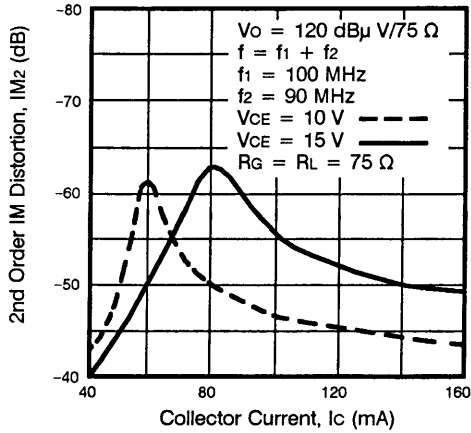
NE24615
SECOND ORDER IM DISTORTION vs.
COLLECTOR CURRENT



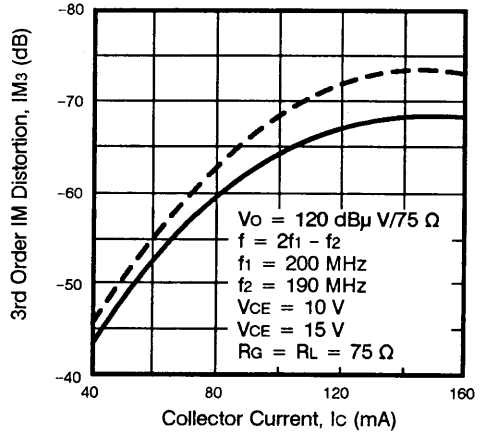
NE24615
THIRD ORDER IM DISTORTION vs.
COLLECTOR CURRENT



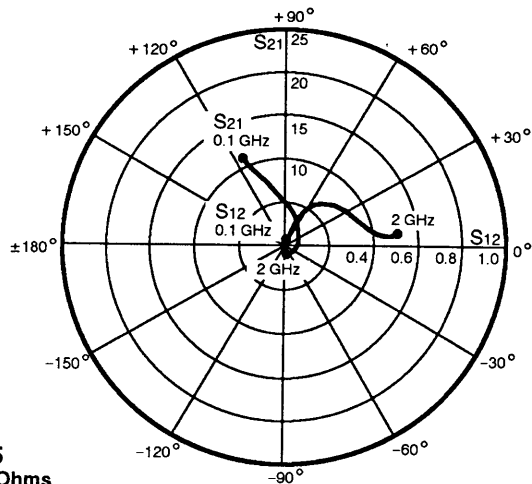
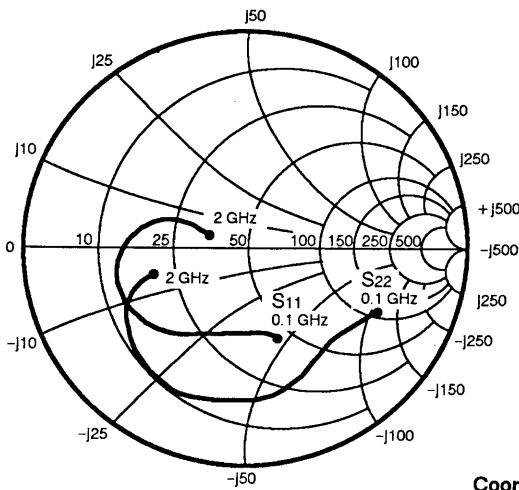
NE24620
SECOND ORDER IM DISTORTION vs.
COLLECTOR CURRENT



NE24620
THIRD ORDER IM DISTORTION vs.
COLLECTOR CURRENT



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE24615
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

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

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.45	-68	11.74	115	.04	75	.72	-27
500	.49	-128	3.57	67	.19	66	.69	-69
1000	.55	-176	2.00	17	.34	36	.68	-124
1500	.37	159	1.17	-12	.39	18	.52	-154
2000	.13	138	.91	-24	.52	8	.38	-162

V_{CE} = 10 V, I_C = 60 mA

100	.35	-59	13.82	108	.04	81	.63	-30
500	.49	-118	3.98	67	.21	67	.64	-77
1000	.53	-173	2.12	20	.36	32	.57	-134
1500	.36	162	1.27	-6	.40	14	.41	-159
2000	.08	130	1.08	-19	.54	4	.28	-156

V_{CE} = 10 V, I_C = 100 mA

100	.35	-57	14.12	107	.04	80	.61	-31
500	.49	-118	4.00	67	.21	65	.62	-79
1000	.53	-173	2.12	20	.36	31	.55	-137
1500	.35	161	1.28	-5	.41	13	.39	-161
2000	.05	119	1.11	-18	.55	3	.25	-154

V_{CE} = 15 V, I_C = 20 mA

100	.50	-66	11.83	116	.04	75	.74	-27
500	.49	-127	3.61	67	.18	66	.70	-67
1000	.54	-174	2.05	18	.34	37	.69	-122
1500	.37	161	1.20	-12	.39	17	.54	-152
2000	.13	141	.92	-25	.51	8	.40	-161

V_{CE} = 15 V, I_C = 60 mA

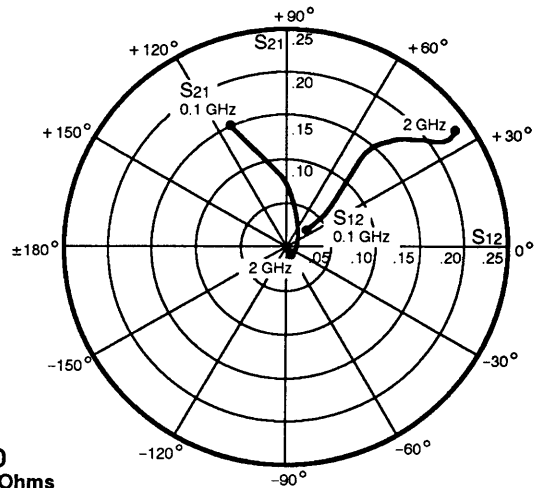
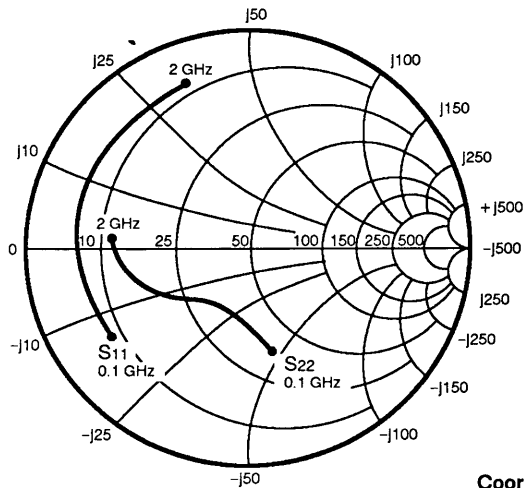
100	.38	-58	13.87	109	.04	78	.64	-30
500	.50	-117	4.02	68	.21	67	.65	-75
1000	.54	-172	2.17	20	.36	32	.58	-132
1500	.35	163	1.30	-6	.40	15	.42	-157
2000	.06	142	1.10	-21	.53	3	.30	-152

V_{CE} = 15 V, I_C = 100 mA

100	.37	-57	14.16	108	.04	78	.62	-30
500	.50	-116	4.05	68	.21	66	.63	-77
1000	.53	-172	2.17	21	.36	31	.56	-134
1500	.35	163	1.31	-5	.40	14	.40	-159
2000	.04	131	1.13	-20	.55	2	.27	-149



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE24620
Coordinates in Ohms
Frequency in GHz
(V_{CE} = 10 V, I_C = 20 mA)

S-MAGN AND ANGLES:

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

FREQUENCY (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	.71	-144	15.60	112	.04	37	.50	-73
500	.79	172	3.49	68	.05	38	.26	-124
1000	.78	151	1.77	41	.08	46	.34	-142
1500	.81	137	1.16	19	.13	48	.43	-157
2000	.81	121	.89	4	.19	41	.52	-170

V_{CE} = 10 V, I_C = 60 mA

100	.72	-159	19.13	108	.02	39	.47	-98
500	.77	168	4.13	70	.05	52	.32	-157
1000	.77	149	2.11	46	.10	52	.35	-171
1500	.78	135	1.43	26	.15	47	.40	-179
2000	.78	120	1.13	11	.20	38	.45	175

V_{CE} = 10 V, I_C = 100 mA

100	.72	-163	19.94	106	.02	44	.47	-106
500	.77	168	4.26	70	.06	54	.35	-163
1000	.77	149	2.18	47	.10	53	.37	-177
1500	.78	134	1.48	28	.15	47	.41	175
2000	.77	119	1.18	12	.21	35	.45	170

V_{CE} = 15 V, I_C = 20 mA

100	.72	-143	15.98	112	.03	36	.51	-71
500	.78	172	3.59	68	.05	40	.26	-121
1000	.78	151	1.81	42	.08	48	.34	-141
1500	.80	136	1.20	20	.13	49	.42	-156
2000	.81	121	.91	5	.19	41	.52	-169

V_{CE} = 15 V, I_C = 60 mA

100	.71	-158	19.61	108	.02	42	.47	-97
500	.77	169	4.25	70	.05	52	.32	-156
1000	.77	149	2.16	46	.10	52	.34	-170
1500	.78	135	1.47	26	.15	47	.39	-178
2000	.78	120	1.16	11	.20	38	.45	176

V_{CE} = 15 V, I_C = 100 mA

100	.72	-162	20.57	106	.02	44	.47	-104
500	.77	168	4.39	70	.05	56	.34	-163
1000	.77	149	2.24	48	.10	54	.37	-176
1500	.78	134	1.53	28	.15	47	.40	176
2000	.77	120	1.21	13	.21	36	.44	171