3 Volt, Low Current, Low Noise High f_T Silicon Transistor

MA4T6305 Series

V 2.00

Features

- Low Current and Low Voltage Operation
- 1.5 dB Noise Figure at 0.3 - 0.6 mA
- 11 GHz f_T
- Low Cost Plastic Packaging
- Available on Tape and Reel
- Available as Chips

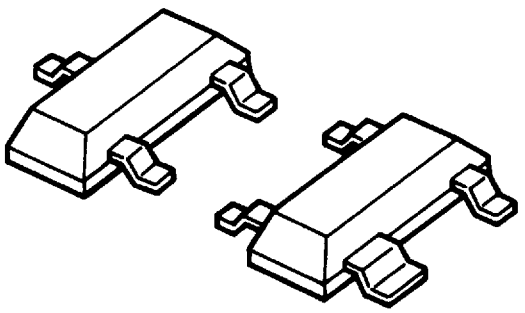
Description

The MA4T6305 series of silicon bipolar NPN transistors provide low noise figure at a bias of 3 volts and very small collector current. These low cost surface mount transistors are well suited for usage in battery operated systems from approximately 500 MHz through 2.5 GHz where good noise figure at the minimum collector current is an important criteria. These transistors will provide good noise figure using only one to two milliwatts DC power.

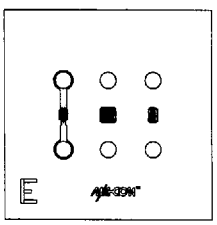
The MA4T6305 series has high f_T (11 GHz) and provides low noise figure at a bias of 3 volts and 0.2 to 1 milliamperes current. Associated gain is 12 dB at 1 GHz. The MA4T6305 also has low phase noise while operating at a low power 3-5 volt battery operated VCO.

The MA4T6305 series is available as a chip (MA4T630500), in the SOT-23 (MA4T630533), the SOT-143 (MA4T630539) and the Micro-X (MA4T630535) package. The surface mount packages are available on tape and reel.

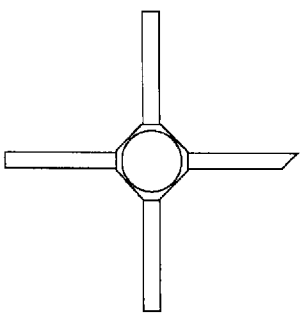
SOT-23



SOT-143



Chip



Micro-X

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Maximum Ratings @ +25°C

Parameter	Symbol	Maximum
Collector-Base Voltage	V_{CBO}	8 V
Collector-Emitter Voltage	V_{CEO}	6 V
Emitter-Base Voltage	V_{EBO}	3 V
Collector Current	I_C	5 mA
Junction Temperature	T_j	200 °C
Storage Temperature Chips or Ceramic Packages Plastic Packages	T_{STG}	 -65°C to +200°C -65°C to +125°C
Power Dissipation	P_D	30 mW[1]

Note: 1. See power derating curves. The thermal resistance of the MA4T630500 chip is 80°C/watt maximum.

Electrical Specifications @ +25°C
MA4T6305 Series

Parameter	Condition	Symbol	Units	MA4T630535 Micro-X	MA4T630533 SOT-23	MA4T630539 SOT-143	MA4T630500 Chip
Gain Bandwidth Product	V_{CE} = 3 V I_C = 1 mA	f_T	GHz	11 typ.	11 typ.	11 typ.	11 typ.
Insertion Power Gain	V_{CE} = 3 V I_C = 3 mA f = 1 GHz f = 2 GHz	$\|S_{21E}\|^2$	dB	 11 min. 7 typ.	 10 min. 6 typ.	 10 min. 6 typ.	 11 min. 7 typ.
Noise Figure	V_{CE} = 3 V I_C = 0.5 mA f = 1 GHz f = 2 GHz	NF	dB	 1.5 max. 2.2 max.	 1.7 max. 2.2 max.	 1.7 max. 2.2 max.	 1.5 max. 2.2 max.
Unilateral Gain	V_{CE} = 3 V I_C = 0.5 mA f = 1 GHz f = 2 GHz	GTU (max)	dB	 14 typ. 9 typ.	 13 typ. 8 typ.	 13 typ. 8 typ.	 14 typ. 9 typ.
Maximum Available Gain	V_{CE} = 3 V I_C = 3 mA f = 1 GHz f = 2 GHz	MAG	dB	 10 typ.	 9 typ.	 9 typ.	 10 typ.
Power Out at 1 dB Compression	V_{CE} = 3 V I_C = 3 mA f = 1 GHz	P_{1dB}	dBm	 -7 typ.	 -7 typ.	 -7 typ.	 -7 typ.
Thermal Resistance	Junction/ Ambient	$R_{TH(J-A)}$	°C/W	600 max.[2]	700 max.[2]	700 max.[2]	80 max.[1]

Notes: 1. Junction/Heat Sink RTH(J-C)
2. Free Air

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Electrical Specifications @ +25°C
MA4T6305 Series

Parameter	Condition	Symbol	Min	Typical	Max	Unit
Collector Cut-off Current	V_{CB} = 3 V I_E = 0	I_{CBO}	—	—	100	nA
Emitter Cut-off Current	V_{EB} = 1 V I_C = 0	I_{EBO}	—	—	1	µA
Forward Current Gain	V_{CE} = 3 V I_C = 3 mA	h_{FE}	30	100	200	—
Collector-Base Junction Capacitance	V_{CB} = 3 V I_E = 0 f = 1 MHz	C_{OB}	—	0.33	0.45	pF

Typical Noise Parameters in the Micro-X Package
MA4T630535

Frequency GHz	I_C (mA)	NFo (dB)	GA (dB)	Γ_{OPT}		Rn
				Mag	Angle	
2.00	0.2	1.85	2.7	0.76	43.3	82.1
2.00	0.5	1.95	3.6	0.78	43.2	80.3
2.00	1.0	2.17	5.0	0.75	46.7	71.7

Typical Scattering Parameters in the Micro-X Package
MA4T630535
V_{CE} = 3 Volts, I_C = 0.5 mA

Frequency (MHz)	S_{11E}		S_{21E}		S_{12E}		S_{22E}	
	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
500	0.920	-18.2	1.262	150.9	0.078	74.3	0.973	-16.7
1000	0.836	-34.9	1.202	128.9	0.143	60.6	0.902	-31.7
1500	0.734	-49.8	1.154	110.1	0.189	49.3	0.821	-44.1
2000	0.630	-64.4	1.133	93.9	0.228	41.3	0.750	-55.0
2500	0.527	-77.1	1.090	78.9	0.254	33.9	0.684	-65.7
3000	0.423	-85.8	1.042	65.0	0.276	28.8	0.629	-74.1
3500	0.363	-97.1	1.038	54.1	0.294	21.4	0.585	-82.8
4000	0.309	-110.1	1.010	44.9	0.306	18.2	0.551	-90.8
4500	0.243	-122.0	0.971	33.3	0.317	13.2	0.514	-98.4
5000	0.199	-135.1	0.951	25.2	0.324	9.4	0.487	-105.5
5500	0.159	-151.2	0.934	17.5	0.330	6.4	0.467	-113.0
6000	0.135	-163.5	0.920	9.3	0.341	3.3	0.451	-120.6

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Typical Scattering Parameters in the Micro-X Package (Con't)

MA4T630535
V_{CE} = 3 Volts, I_C = 1 mA

Frequency (MHz)	S_{11E} Mag	S_{11E} Angle	S_{21E} Mag	S_{21E} Angle	S_{12E} Mag	S_{12E} Angle	S_{22E} Mag	S_{22E} Angle
500	0.860	-23.1	2.450	147.1	0.075	71.4	0.941	-20.7
1000	0.730	-43.5	2.223	123.8	0.130	57.6	0.823	-36.8
1500	0.589	-60.9	2.017	104.7	0.166	48.1	0.721	-48.4
2000	0.465	-76.7	1.831	88.6	0.198	42.1	0.645	-59.0
2500	0.358	-89.7	1.662	74.1	0.222	36.6	0.584	-67.7
3000	0.260	-98.2	1.492	61.5	0.244	32.6	0.538	-75.3
3500	0.214	-107.8	1.410	51.3	0.264	26.9	0.504	-83.8
4000	0.173	-122.4	1.320	42.2	0.282	24.1	0.480	-91.8
4500	0.121	-137.4	1.238	31.3	0.297	19.7	0.450	-99.7
5000	0.091	-157.9	1.184	23.4	0.311	16.0	0.429	-107.1
5500	0.067	164.0	1.137	15.8	0.323	12.8	0.414	-114.9
6000	0.065	138.5	1.950	7.7	0.337	9.7	0.402	-123.2

MA4T630535
V_{CE} = 3 Volts, I_C = 3 mA

Frequency (MHz)	S_{11E} Mag	S_{11E} Angle	S_{21E} Mag	S_{21E} Angle	S_{12E} Mag	S_{12E} Angle	S_{22E} Mag	S_{22E} Angle
500	0.637	-39.0	5.402	135.5	0.062	66.8	0.841	-26.9
1000	0.421	-67.6	4.140	107.6	0.101	57.3	0.672	-39.8
1500	0.282	-86.2	3.161	89.2	0.130	52.5	0.583	-47.2
2000	0.196	-105.3	2.562	75.5	0.160	48.4	0.534	-55.7
2500	0.134	-125.3	2.159	63.6	0.186	44.2	0.496	-62.8
3000	0.081	-151.7	1.843	53.3	0.209	40.4	0.469	-69.5
3500	0.069	164.7	1.676	44.6	0.232	35.4	0.449	-77.8
4000	0.076	150.3	1.532	36.2	0.252	32.4	0.439	-85.5
4500	0.092	118.6	1.422	26.3	0.270	28.3	0.419	-93.6
5000	0.119	99.9	1.339	19.0	0.286	24.4	0.403	-100.9
5500	0.149	84.2	1.272	11.7	0.303	20.9	0.393	-108.7
6000	0.176	74.3	1.220	3.9	0.318	17.9	0.386	-116.9

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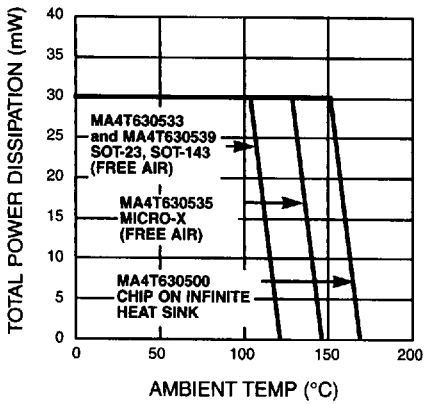
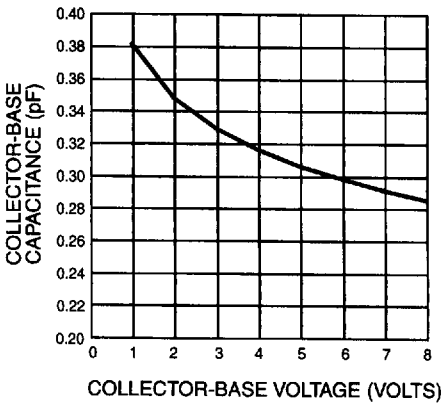
Typical Performance Curves

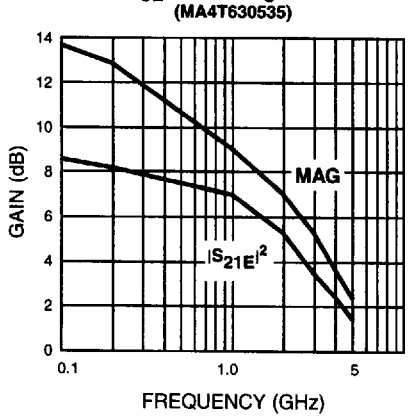
POWER DERATING CURVES



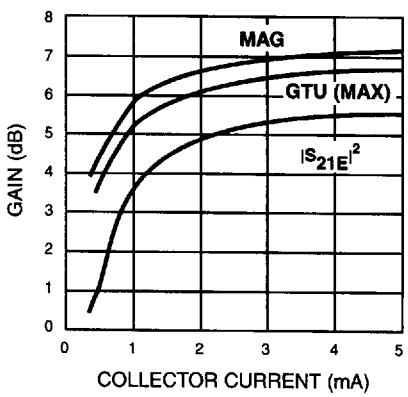
COLLECTOR-BASE CAPACITANCE (C_{OB}) vs COLLECTOR-BASE VOLTAGE (MA4T630535)



GAIN vs FREQUENCY AT V_{CE} = 3 V AND I_C = 1 MA (MA4T630535)

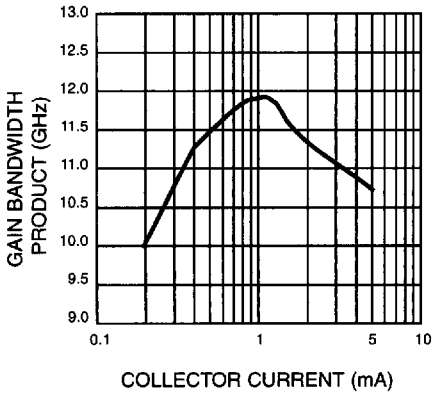


GAIN VS COLLECTOR CURRENT AT 3 GHz AND V_{CE} = 3 V (MA4T630535)

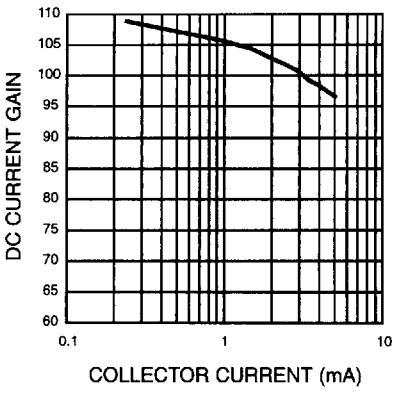


Typical Performance Curves (Con't)

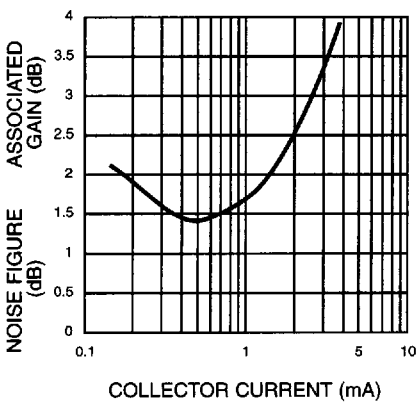
GAIN BANDWIDTH PRODUCT (f_T) vs COLLECTOR CURRENT AT V_{CE} = 3 V (MA4T630535)



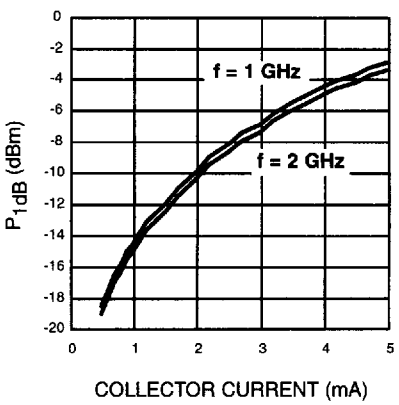
DC CURRENT GAIN (h_{FE}) vs COLLECTOR CURRENT AT V_{CE} = 3 V (MA4T630535)



NOISE FIGURE AND ASSOCIATED GAIN AT 1 GHz AT V_{CE} = 3 V vs COLLECTOR CURRENT (MA4T630535)



NOMINAL OUTPUT POWER AT THE 1 dB COMPRESSION POINT vs COLLECTOR CURRENT, V_{CE} = 3 V (MA4T630535)



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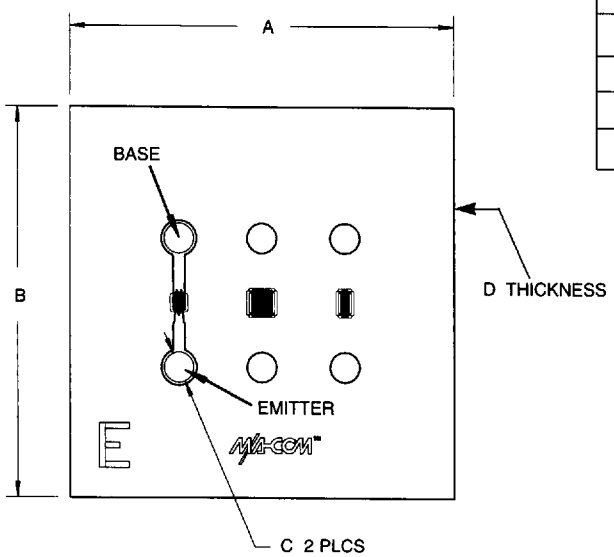
Case Styles

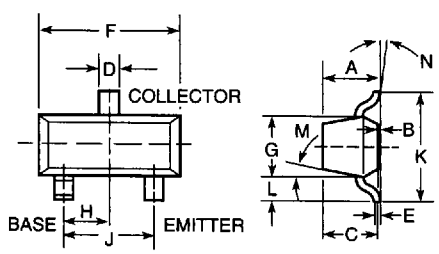
Chip — MA4T630500
Case Style 1166



MA4T630500

DIM.	INCHES (Nominal)	MM (Nominal)
A	0.013	0.35
B	0.013	0.35
C	0.0012	0.030
D	0.0045	0.11

SOT-23 – MA4T630533



MA4T630533

DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	—	0.044	—	1.12
B	—	0.004	—	0.10
C	—	0.040	—	1.00
D	0.013	0.020	0.35	0.50
E	0.003	0.006	0.08	0.15
F	0.110	0.119	2.80	3.00
G	0.047	0.056	1.20	1.40
H	0.037 typical		0.95 typical	
J	0.075 typical		1.90 typical	
K		0.103		2.60
L		0.024		0.60

DIM.	GRADIENT
M	10° max.1
N	2°...30°

Note:
1. Applicable on all sides

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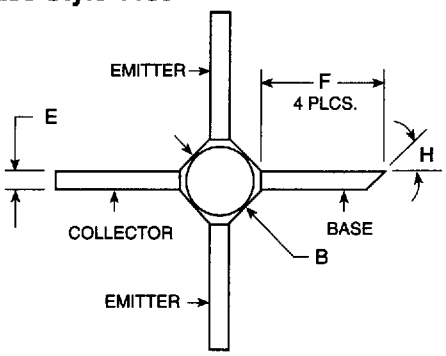
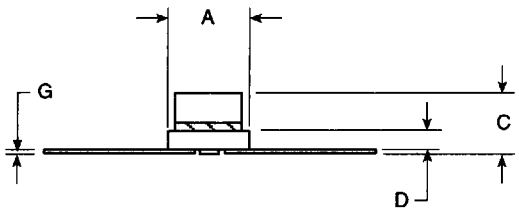
Case Styles (Con't)

Micro-X — MA4T630535
Case Style 1139

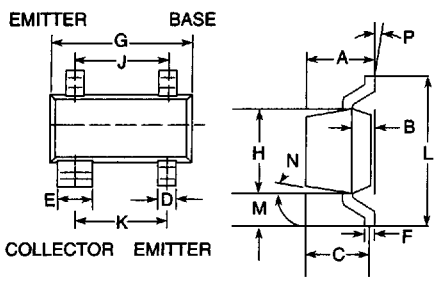




MA4T630535

DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	0.092	0.108	2.34	2.74
B	0.079	0.087	2.01	2.21
C	—	0.070	—	1.78
D	0.019	0.025	0.48	0.64
E	0.018	0.022	0.046	0.56
F	0.150	—	3.81	—
G	0.003	0.006	0.08	0.15
H	45°		45°	

SOT-143 — MA4T630539



MA4T630539

DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	—	0.044	—	1.10
B	—	0.044	—	1.10
C	—	0.040	—	1.00
D	0.030	0.035	0.75	0.90
E	0.013	0.020	0.35	0.50
F	0.003	0.006	0.08	0.15
G	0.110	0.119	2.80	3.00
H	0.047	0.056	1.20	1.40
J	0.075 TYPICAL		1.90 TYPICAL	
K	0.075 TYPICAL		1.90 TYPICAL	
L	—	0.103	—	2.6
M	—	0.024	—	0.6

DIM.	GRADIENT
N	10° max.[1]
P	2°...30°

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