

Silicon Bipolar High f_T Low Noise Microwave Transistors

MP4T645

Features

- f_T to 9 GHz
- Low Noise Figure
- High Associated Gain
- Hermetic and Surface Mount Packages Available
- Can be Screened to JANTX, JANTXV Equivalent Levels
- Industry Standard

Description

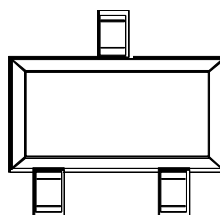
The MP4T645 family of high gain-bandwidth, small signal silicon bipolar transistors is well suited for use in amplifiers to approximately 4 GHz, and in oscillators to approximately 10 GHz. These industry standard transistors feature low noise figure at high collector current, which produces very good associated gain and wide dynamic range. The MP4T645 series transistors are available in a hermetic microstrip package (MP4T64535), in the plastic SOT-23 package (MP4T64533), in chip form (MP4T64500), and in the SOT-143 package (MP4T64539). The MP4T645 series is available in other plastic and hermetic packages as well. The chip and hermetically packaged transistors can be screened to a JANTXV equivalent level.

Applications

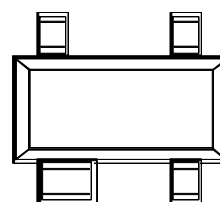
The MP4T645 family of bipolar NPN transistors can be used for low noise, high associated gain, large dynamic range amplifiers up to approximately 4 GHz. These transistors can also be used as preamplifier or driver stages in the same frequency range.

The MP4T645 family of bipolar NPN transistors can also be used for oscillators or VCOs up to approximately 10 GHz. The passivation consists of silicon dioxide, commonly known as thermal oxide, and silicon nitride to produce very low $1/f$ noise in both amplifiers and oscillators.

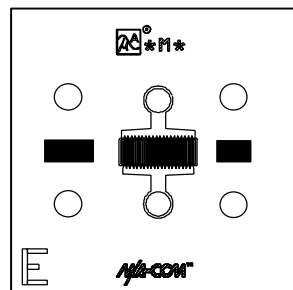
Case Styles



SOT-23



SOT-143



Chip

Micro-X

Specification Subject to Change Without Notice

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Collector-Base Voltage	V_{CBO}	25 V
Collector-Emitter Voltage	V_{CEO}	12 V
Emitter-Base Voltage	V_{EBO}	1.5 V
Collector Current	I_C	65 mA
Junction Operating Temperature	T_j	200°C
Storage Temperature Chip or Ceramic Packages Plastic Packages		-65°C to +200°C -65°C to +125°C
Total Power Dissipation at 25°C Derate Linearly to: +150°C Chip +125°C Plastic Package (SOT-23) +150°C Ceramic Package (Micro-X)		400 mW 200 mW 300 mW

Electrical Specifications @ 25 °C**MP4T645 Series**

Parameter of Test	Condition	Symbol	Units	MP4T64500 Chip	MP4T64535 SOT-23	MP4T64533 Micro-X
Gain Bandwidth Product	$V_{CE} = 8$ volts $I_C = 20$ mA	f_T	GHz	10 typ	8 typ	9 typ
Insertion Power Gain	$V_{CE} = 8$ volts $I_C = 20$ mA $f = 1$ GHz $f = 2$ GHz $f = 4$ GHz	$ S_{21E} ^2$	dB	18 typ 11 min 7 typ	16 typ 10 min	17 typ 10 min 6.5 typ
Noise Figure	$V_{CE} = 8$ volts $I_C = 7$ mA $f = 1$ GHz $f = 2$ GHz	NF	dB	1.7 max 2.0 typ	1.7 max 2.5 typ	1.7 max 2.0 typ
Unilateral Gain	$V_{CE} = 8$ volts $I_C = 7$ mA $f = 1$ GHz $f = 2$ GHz	GTU (max)	dB	18 typ 11 typ	16 typ 10 typ	17 typ 11 typ
Maximum Available Gain	$V_{CE} = 8$ volts $I_C = 10$ mA $f = 2$ GHz $f = 4$ GHz	MAG	dB	14 typ 12 typ	13 typ 10 typ	14 typ 11.5 typ
Power Out at 1 dB Compression	$V_{CE} = 8$ volts $I_C = 10$ mA $f = 1$ GHz $f = 4$ GHz	P_{1dB}	dBm	16 typ 11 typ	16 typ 11 typ	16 typ 11 typ

Note: The electrical characteristics of the MP4T64539 (SOT-143) are very similar to those of the MP4T64533 (SOT-23).

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Electrical Specifications @ 25 °C

MP4T645 Series

Parameter	Condition	Symbol	Min	Typical	Max	Units
Collector Cut-off Current	$V_{CB} = 8$ volts $I_E = 0$ μ A	I_{CBO}	—	—	100	nA
Emitter Cut-off Current	$V_{EB} = 1$ volt $I_C = 0$ μ A	I_{EBO}	—	—	1	μ A
Forward Current Gain	$V_{CE} = 8$ volts $I_C = 7$ mA	h_{FE}	30	125	250	—
Collector-Base Junction Capacitance	$V_{CB} = 10$ volts $I_E = 0$ μ A $f = 1$ MHz	C_{CO}	—	0.3	0.6	pF

Typical Scattering Parameters in the Micro-X Package

MP4T64535, $V_{CE} = 8$ Volts, $I_C = 7$ mA

Frequency (MHz)	S_{11E}		S_{21E}		S_{12E}		S_{22E}	
	Mag.	Angle	Mag.	Angle	Mag.	Angle	Mag.	Angle
500	0.583	-114	9.315	116.1	0.052	43.6	0.573	-42.6
1000	0.569	-153	5.399	94.7	0.063	39.0	0.406	-53.0
1500	0.573	-173	3.807	82.0	0.072	40.0	0.357	-57.1
2000	0.587	170	2.980	72.0	0.082	42.5	0.313	-61.8
2500	0.598	159	2.479	62.7	0.092	44.0	0.299	-71.7
3000	0.616	150	2.132	54.8	0.103	45.2	0.304	-78.5
3500	0.645	142	1.935	47.0	0.118	45.5	0.289	-86.5
4000	0.675	132	1.782	38.5	0.130	45.7	0.281	-96.6
4500	0.705	124	1.631	29.6	0.143	45.5	0.292	-105.5
5000	0.749	115	1.538	22.0	0.159	44.5	0.281	-114.1
5500	0.791	106	1.445	14.4	0.176	43.6	0.283	-125.7
6000	0.832	96	1.395	6.1	0.188	42.3	0.306	-135.0

MP4T64535, $V_{CE} = 8$ Volts, $I_C = 10$ mA

Frequency (MHz)	S_{11E}		S_{21E}		S_{12E}		S_{22E}	
	Mag.	Angle	Mag.	Angle	Mag.	Angle	Mag.	Angle
500	0.562	-128	10.477	111.9	0.044	44.5	0.515	-46.2
1000	0.564	-161	5.845	92.1	0.056	44.0	0.358	-53.8
1500	0.575	176	4.088	80.5	0.068	46.5	0.313	-57.2
2000	0.592	166	3.185	70.9	0.080	49.0	0.276	-62.3
2500	0.601	156	2.638	62.0	0.092	49.7	0.268	-71.7
3000	0.618	148	2.266	54.5	0.105	50.1	0.272	-78.3
3500	0.648	139	2.053	46.9	0.122	49.4	0.259	-87.0
4000	0.677	130	1.892	38.6	0.136	48.7	0.253	-96.9
4500	0.706	122	1.734	29.8	0.150	47.9	0.264	-106.0
5000	0.749	113	1.634	22.3	0.167	46.1	0.257	-115.1
5500	0.790	104	1.532	14.8	0.184	44.4	0.259	-126.3
6000	0.831	95	1.482	6.4	0.196	42.6	0.278	-136.0

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Typical Scattering Parameters in the Micro-X Package (Cont'd)

MP4T64535, $V_{CE} = 8$ Volts, $I_C = 20$ mA

Frequency (MHz)	Mag. S_{11E} Angle	Mag. S_{21E} Angle	Mag. S_{12E} Angle	Mag S_{22E} Angle
500	0.536 -154	11.788 104.0	0.033 49.8	0.390 -46.8
1000	0.565 -177	6.309 87.5	0.046 55.7	0.284 -53.2
1500	0.579 170	4.350 77.0	0.062 57.7	0.270 -54.6
2000	0.592 160	3.368 68.6	0.077 59.3	0.237 -57.5
2500	0.612 151	2.798 60.1	0.093 58.0	0.226 -70.0
3000	0.630 142	2.390 52.6	0.108 56.5	0.243 -77.2
3500	0.660 134	2.156 45.4	0.126 54.4	0.231 -84.4
4000	0.691 125	1.984 37.2	0.141 52.6	0.223 -95.8
4500	0.719 117	1.809 28.4	0.155 50.9	0.240 -105.2
5000	0.760 109	1.697 21.3	0.173 48.5	0.229 -112.6
5500	0.803 101	1.594 13.8	0.192 46.0	0.229 -112.3
6000	0.844 92	1.540 6.0	0.210 44.2	0.258 -136.2

Typical Scattering Parameters in the SOT-23 Package

MP4T64533, $V_{CE} = 8$ Volts, $I_C = 7$ mA

Frequency (MHz)	Mag. S_{11E} Angle	Mag. S_{21E} Angle	Mag. S_{12E} Angle	Mag S_{22E} Angle
500	0.421 -95	7.378 126.4	0.062 77.9	0.519 -36.3
1000	0.257 -149	4.384 118.9	0.100 97.9	0.402 -36.9
1500	0.232 -176	3.082 123.3	0.140 116.2	0.368 -39.6
2000	0.238 157	2.408 129.2	0.183 130.9	0.354 -44.7
2500	0.256 140	2.005 136.3	0.224 145.7	0.346 -51.6
3000	0.279 126	1.734 143.2	0.274 160.8	0.339 -58.8
3500	0.310 116	1.498 153.3	0.308 172.0	0.331 -68.5
4000	0.338 106	1.367 163.5	0.350 173.6	0.320 -80.1
4500	0.359 97	1.284 173.8	0.402 161.0	0.327 -90.6

MP4T64533, $V_{CE} = 8$ Volts, $I_C = 10$ mA

Frequency (MHz)	Mag. S_{11E} Angle	Mag. S_{21E} Angle	Mag. S_{12E} Angle	Mag S_{22E} Angle
500	0.299 -116	8.385 119.4	0.057 82.1	0.451 -33.9
1000	0.216 -161	4.558 116.9	0.099 102.3	0.354 -33.2
1500	0.215 172	3.185 122.7	0.142 119.5	0.332 -37.7
2000	0.230 151	2.487 129.0	0.188 132.9	0.332 -44.0
2500	0.247 134	2.064 136.4	0.230 146.9	0.332 -50.1
3000	0.267 123	1.783 143.8	0.281 161.5	0.322 -56.1
3500	0.299 114	1.548 153.9	0.315 172.5	0.310 -66.4
4000	0.328 104	1.410 164.0	0.357 173.6	0.299 -79.2
4500	0.352 96	1.320 174.5	0.408 161.3	0.310 -90.1

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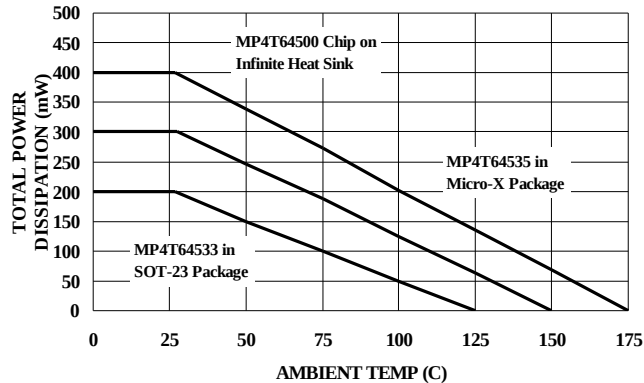
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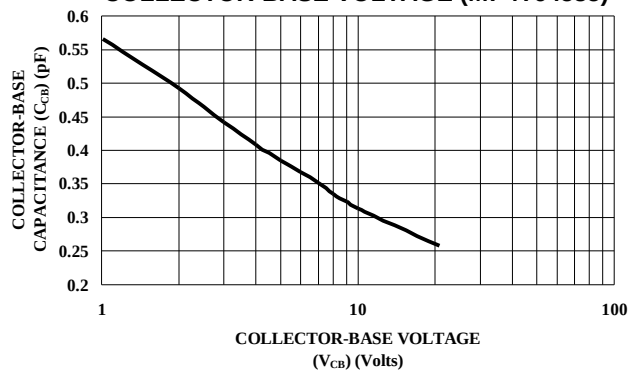
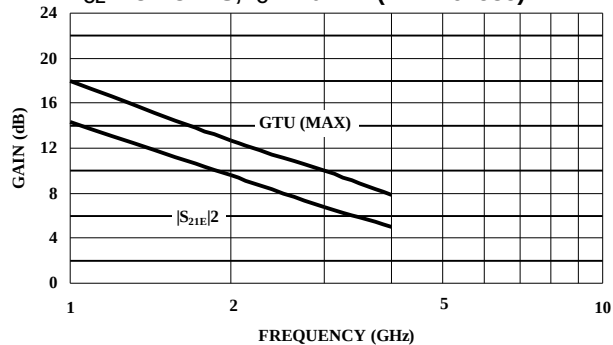
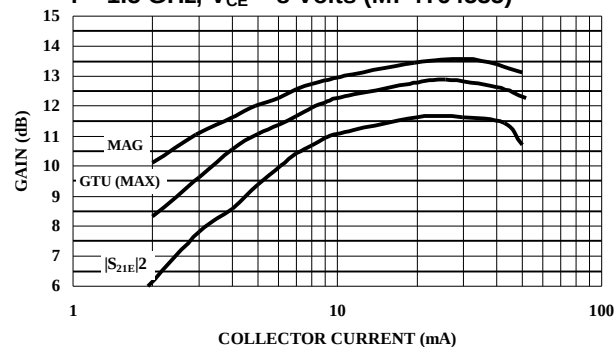
MP4T645 Series

Typical Performance Curves

NOMINAL POWER DERATING CURVES



NOMINAL COLLECTOR-BASE CAPACITANCE vs COLLECTOR-BASE VOLTAGE (MP4T64535)

NOMINAL GAIN vs FREQUENCY at V_{CE} = 8 VOLTS, I_C = 10 mA (MP4T64535)NOMINAL GAIN vs COLLECTOR CURRENT at f = 1.5 GHz, V_{CE} = 8 Volts (MP4T64535)

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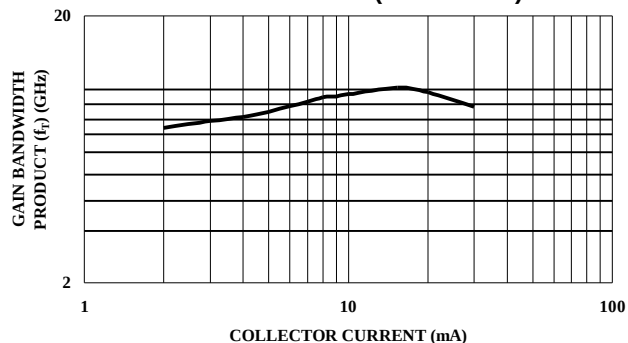
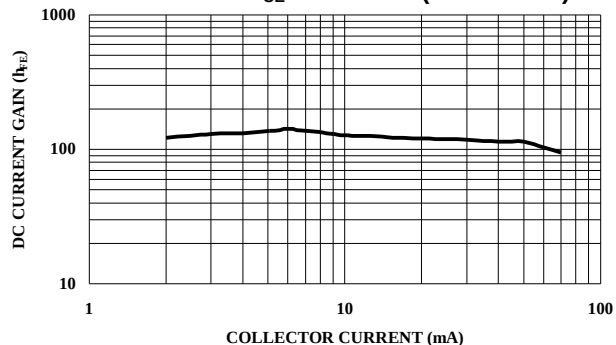
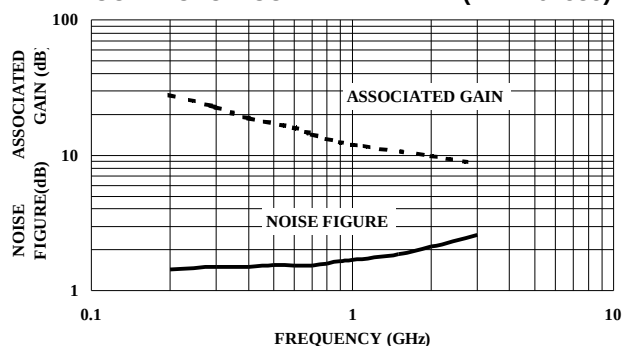
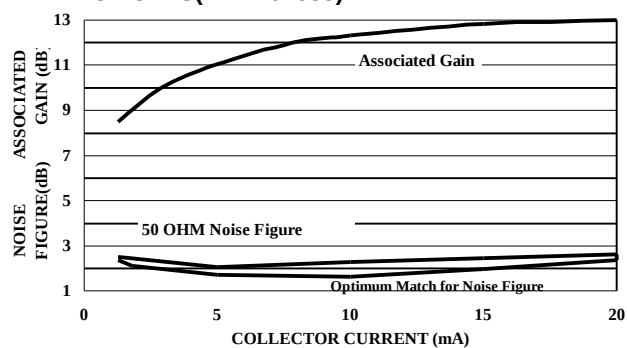
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Typical Performance Curves (Cont'd)

NOMINAL GAIN BANDWIDTH PRODUCT vs COLLECTOR CURRENT (MP4T64535)

NOMINAL DC CURRENT GAIN vs COLLECTOR CURRENT at $V_{CE} = 8$ VOLTS (MP4T64535)NOMINAL NOISE FIGURE and ASSOCIATED GAIN vs FREQUENCY at $V_{CE} = 8$ VOLTS, COLLECTOR CURRENT = 7 mA (MP4T64535)NOMINAL NOISE FIGURE and ASSOCIATED GAIN vs COLLECTOR CURRENT at $f = 1$ GHz and $V_{CE} = 8$ VOLTS (MP4T64535)

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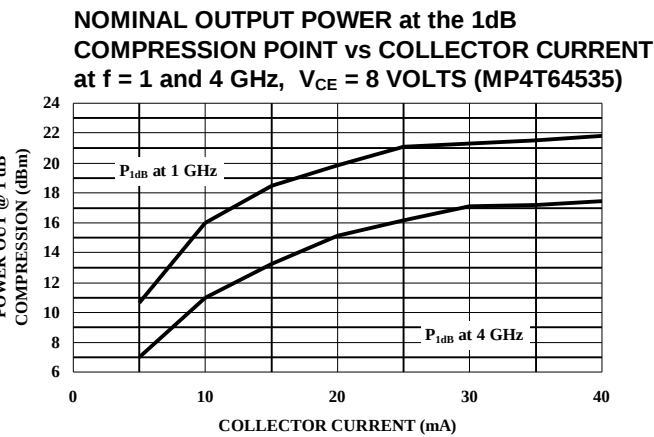
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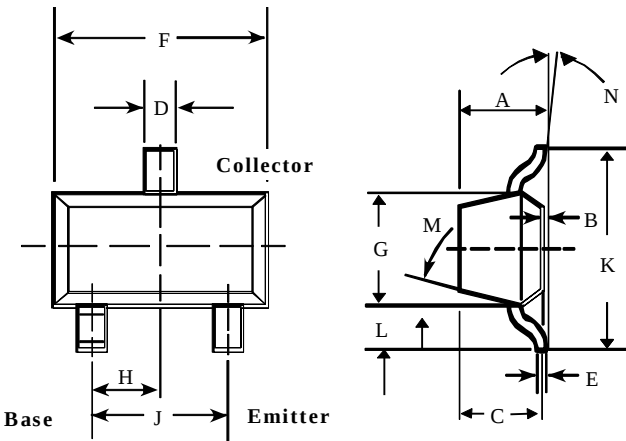
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Typical Performance Curves (Cont'd)



Case Styles

MP4T64533
SOT-23



MP4T64533

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

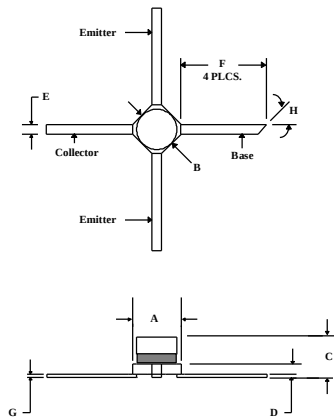
DIM.	GRADIENT
M	10° max. ¹
N	2° . . . 30°

NOTE:
1. Applicable on all sides

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Case Styles (Cont'd)

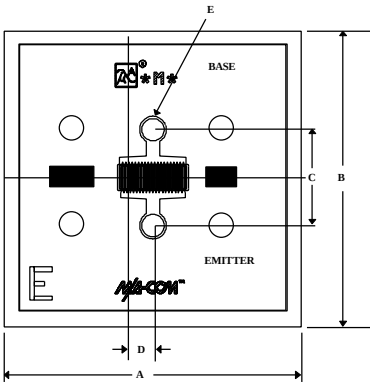
MP4T64535 Micro-X



MP4T64535

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	0.46	0.56
F	0.150	—	3.81	—
G	0.003	0.006	0.08	0.15
H	45°		45°	

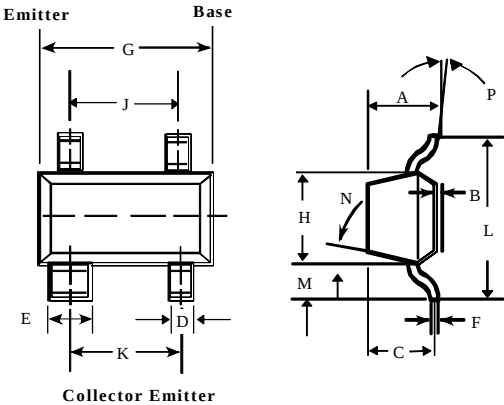
MP4T64500
Case Style 00 (Chip)



MP4T64500

DIM.	INCHES	MILLIMETERS
A	0.013	0.325
B	0.013	0.325
C	0.004	0.110
D	0.0005	0.013
E (Dia.)	0.0012	0.030
F (chip thickness)	0.0045	0.114

MP4T64539
Case Style SOT-143



MP4T64539

DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	—	0.044	—	1.10
B	—	0.004	—	0.10
C	—	0.040	—	1.00
D	0.013	0.020	0.35	0.50
E	0.030	0.035	0.75	0.90
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	0.040 typical		1.70 typical	
L	—	0.103	—	2.60
M	—	0.024	—	0.60

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

NOTE:
1. Applicable on all sides