General Purpose Low Noise Bipolar Transistors

V3.00

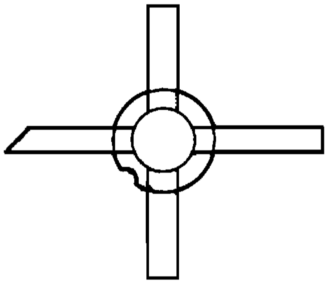
Features

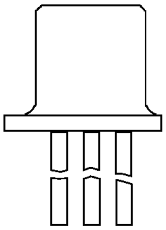
- Low Noise Through 1.5 GHz
- Hermetic Package
- Can Be Screened to JAN, JANTX, JANTXV Levels

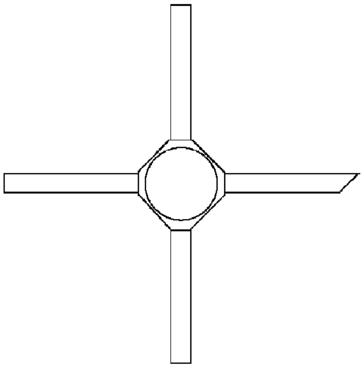
Description

The series of Silicon NPN bipolar transistors are designed for low noise amplifiers in the frequency range of 60 MHz through 2 GHz. These devices are offered in several different families with different f_T, gain and dynamic range characteristics. They are offered in hermetic, RF packages and as chips. Also offered are a family of low power, high f_T oscillator transistors useful in applications up to 3 GHz.

Case Styles





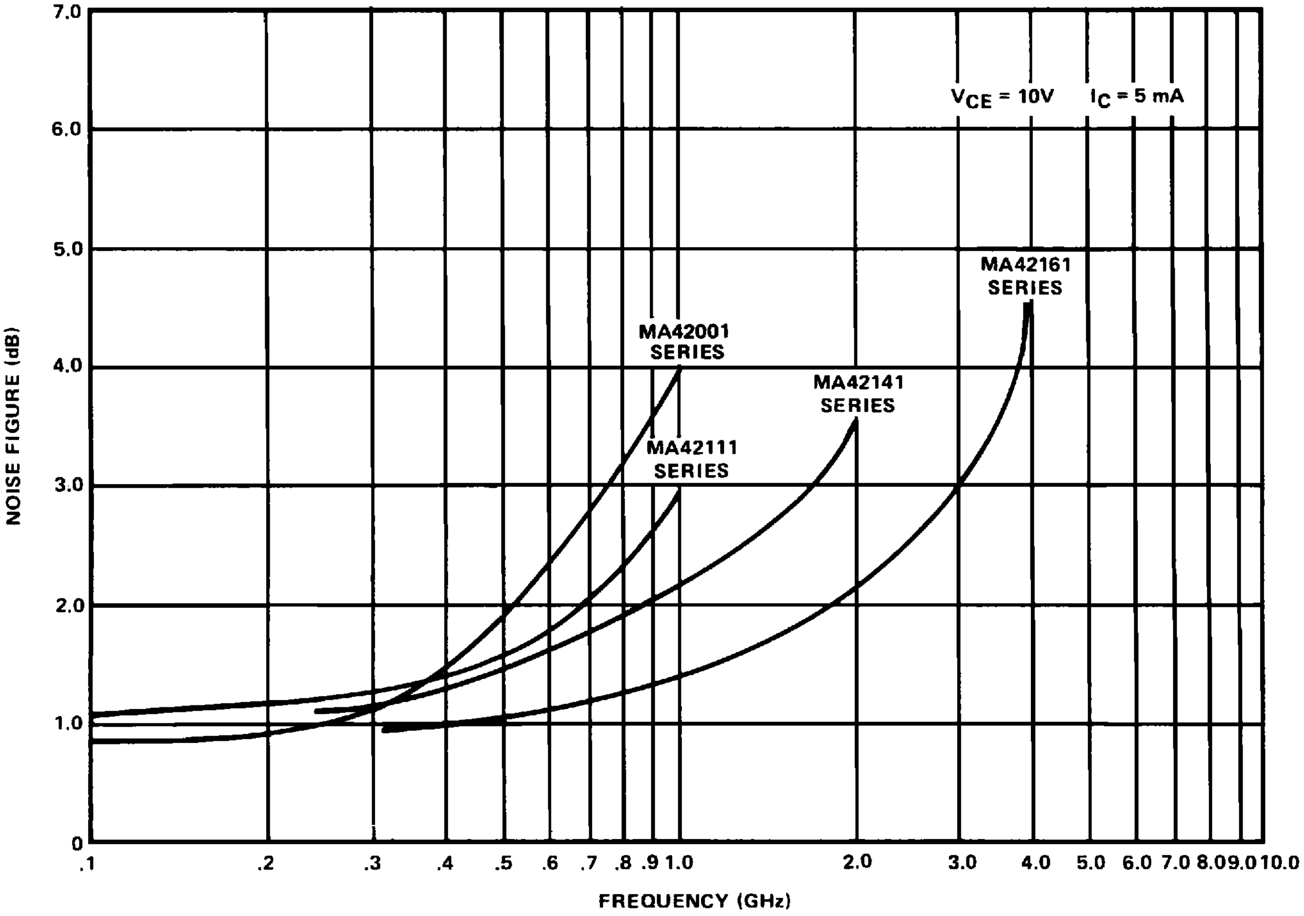


Selection Guide

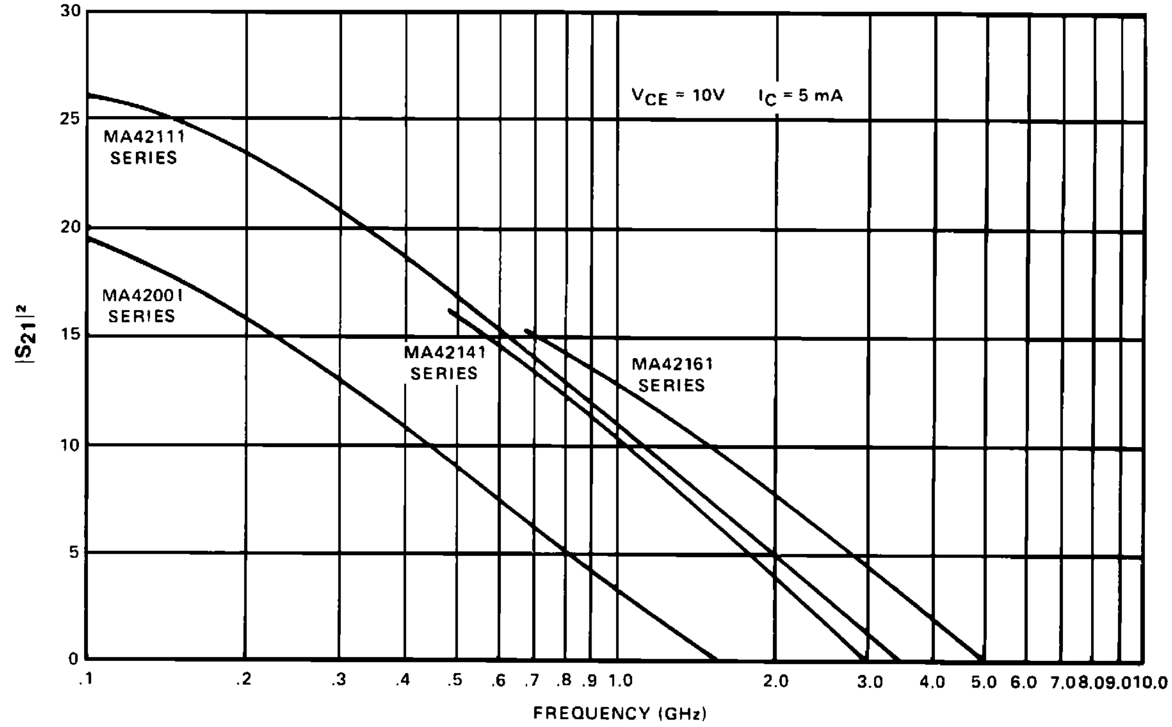
Model No. Series	Nominal f_T (GHz)	Nominal Optimum Noise Figure at Current (mA)	Nominal Current Range	I_C (Max.) (mA)	Useful Frequency Range (MHz)
MA42161	7.0	3	0.5 - 7.0	20	500 - 2500
MA42111	5.5	5	3.0 - 20.0	125	100 - 1500
MA42141	4.5	3	1.0 - 10.0	50	300 - 2000
MA42151	4.5	3	1.0 - 10.0	50	300 - 2000
MA42001	2.5	5	5.0 - 40.0	125	10 - 750
MA42021	1.8	1	1.0 - 3.0	40	10 - 600
MA42051	1.8	2	1.0 - 5.0	50	10 - 600
MA42121	1.5	1	0.9 - 3.0	80	10 - 600
MA42181	2.8	20	10.0 - 60.0	300	10 - 1600

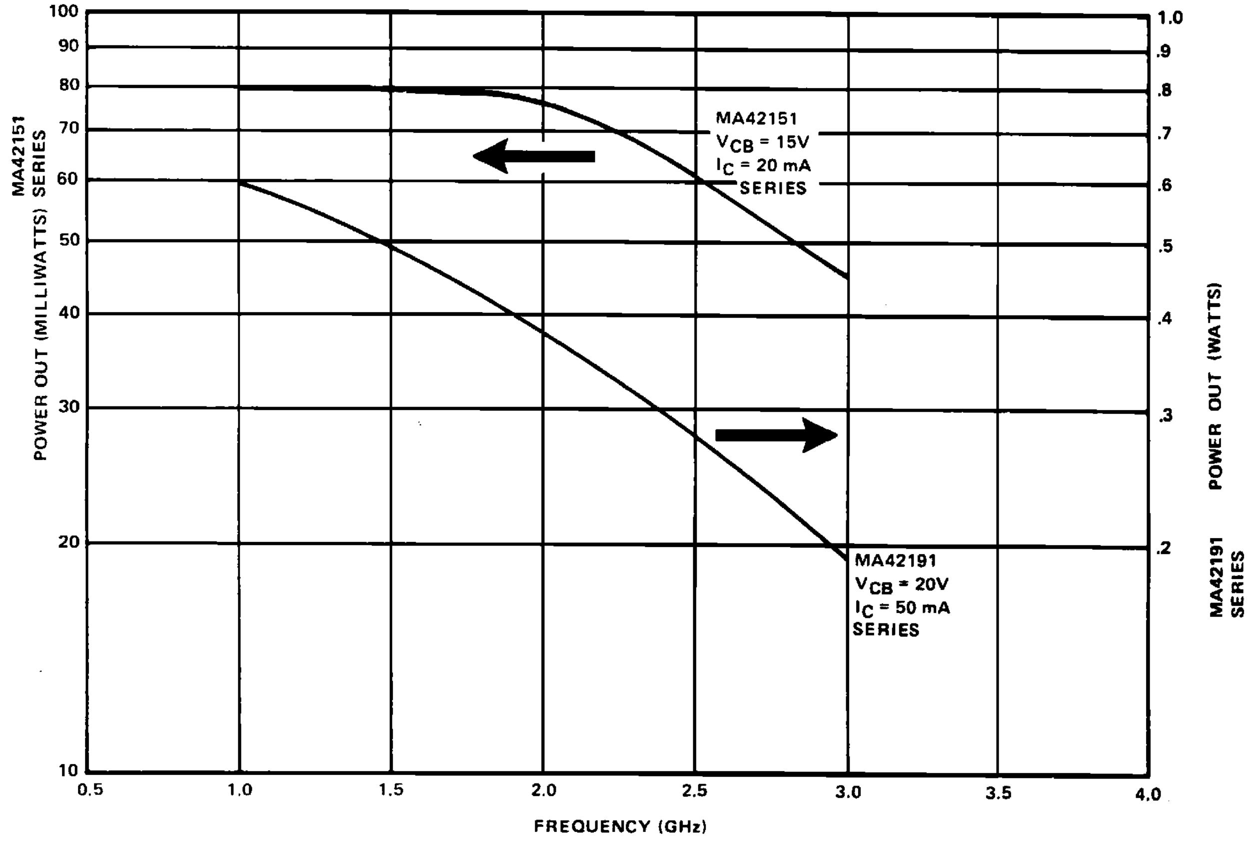
Typical Performance Curves

NOISE FIGURE VS. FREQUENCY



Typical Performance Curves (Cont'd)


$|S_{21}|^2$ VS. FREQUENCY


COMMON-BASE POWER OUT VS. FREQUENCY

MA42161 Series

Description

- Nominal f_T = 7 GHz
- Nominal Current Range = 0.5 to 7 mA
- I_C Max. = 20 mA
- Frequency Range = 500 MHz to 2 GHz

The MA42161 is a low noise silicon planar epitaxial transistor for 0.5 to 2.0 GHz amplifiers. These transistors have typically 14.0 dB gain at 2.0 GHz and nominal noise figure of 2.3 dB at 2.0 GHz. These transistors when housed in case style 511, are useful in low level oscillators from 1-5 GHz.

Absolute Maximum Ratings at 25° C

MA42161 Series

Parameter	Symbol	Unit	Absolute Maximum
Collector-Base Voltage	V_{CBO}	Volts	20
Collector-Emitter Voltage	V_{CEO}	Volts	12
Emitter-Base Voltage	V_{EBO}	Volts	1.5
Collector Current	I_C	mA	20
Junction Operating Temperature	T_j	°C	-65 to +150
Storage Temperature	T_S	°C	-65 to +200
Power Dissipation (Case Style 511)	P_D	mW	250

Specifications @ T_A = 25°C

Model[1,4] Number	Test Frequency (GHz)	Maximum[2] Noise Figure (dB)	Maximum[2] Unilateral Gain (dB)	Nominal[2] $\lvert S_{21E}\rvert^2$ (dB)	Nominal[2] Gain @ Optimum Noise Figure (dB)
MA42161	2.0	2.5	12	8.0	11.0
MA42161	1.0	1.5	18	12.5	15.0

Notes:

1. 1 dB compression point is -5 dBM.
2. Test conditions I_C = 3 mA, V_{CE} = 10 volts.
3. The nominal collector to emitter sustaining voltage is 12 volts; I_C = 1.0 mA.
4. Available in case styles 511 and Micro-X. To order, add package as suffix to the model number i.e., MA42161-511.

Electrical Specifications @ 25° C

MA42161 Series

Parameter	Condition	Symbol	Min.	Typical	Max.	Unit
Collector Cut-off Current	V_{CB} = 10 V I_E = 0 µA	I_{CBO}	—	—	200	nA
Emitter Cut-off Current	V_{EB} = 1 V I_C = 0 µA	I_{EBO}	—	—	1.0	µA
Forward Current Gain	V_{CE} = 10 V I_C = 5 mA	H_{FE}	50	80	250	—
Collector-Base Junction Capacitance	V_{CB} = 5 V f = 1 MHz	C_{OB}	—	1.0	1.2	pF

MA42141 Series

Description

- Nominal f_T = 4.5 GHz
- Nominal Current Range = 1 to 10 mA
- I_C Max. = 50 mA
- Frequency Range = 300 MHz to 2.0 GHz
- Geometry = 63

The MA42141 NPN silicon planar transistor features excellent high frequency current gain at medium current levels.

The MA42141 series has low noise figures from the frequency range of 0.5 to 2 GHz. These transistors are useful in RF amplifiers and low level oscillators from 100 MHz to 2 GHz.

Absolute Maximum Ratings at 25° C

MA42141 Series

Parameter	Symbol	Unit	Absolute Maximum
Collector-Base Voltage	V_{CBO}	Volts	27
Collector-Emitter Voltage	V_{CEO}	Volts	20
Emitter-Base Voltage	V_{EBO}	Volts	3
Collector Current	I_C	mA	50
Junction Operating Temperature	T_j	°C	-65 to +150
Storage Temperature	T_S	°C	-65 to +200
Power Dissipation	P_D	mW	
Case Style 509			400
Case Style 510			700
Case Style 511			700

Specifications @ T_A = 25°C

Model[1] Number	Test Frequency (GHz)	Maximum[2] Noise Figure (dB)	Maximum Unilateral Gain (dB)	Nominal BV_{ebo} (Volts)
MA42141	1.00	2.5	17	1.5

Notes:

1. MA42141 is available in case styles 509, 510 and 511. To order, add the case style as a suffix to the basic model number, i.e.: MA42141-510.
2. The collector current = 5 mA.

Electrical Specifications at 25° C

MA42141 Series

Parameter	Condition	Symbol	Min.	Typical	Max.	Unit
Collector Cut-off Current	V_{CB} = 10 V I_E = 0 μA	I_{CBO}	—	—	200	nA
Emitter Cut-off Current	V_{EB} = 1 V I_C = 0 μA	I_{EBO}	—	—	1.0	μA
Forward Current Gain	V_{CE} = 10 V I_C = 5 mA	H_{FE}	20	80	200	—
Collector-Base Junction Capacitance	V_{CB} = 5 V f = 1 MHz	C_{OB}	—	0.8	1.0	pF

MA42111 Series

Description

- Nominal f_T = 5.5 GHz
- Nominal Current Range = 3 to 50 mA
- I_C Max. = 125 mA
- Frequency Range = 100 MHz to 1.5 GHz

The MA42111 series of silicon NPN bipolar transistors is designed to give low noise figure and wide dynamic range. They can be used as low power oscillators to 4 GHz.

Absolute Maximum Ratings @ 25° C

MA42111 Series

Parameter	Symbol	Unit	Absolute Maximum
Collector-Base Voltage	V_{CBO}	Volts	20
Collector-Emitter Voltage	V_{CEO}	Volts	15
Emitter-Base Voltage	V_{EBO}	Volts	2.5
Collector Current	I_C	mA	125
Junction Operating Temperature	T_j	°C	-65 to +150
Storage Temperature	T_S	°C	-65 to +200
Power Dissipation	P_D	mW	
Case Style 509			450
Case Style 510			1200
Case Style 511			750

Specifications @ T_A = 25°C

Model Number	Case Style	Test Frequency (MHz)	Maximum[1] Noise Figure (dB @ mA)	Maximum[2] Unilateral Gain (dB)	Minimum[3] $\|S_{21E}\|^2$	Nominal Gain @ Opt. NF (dB)
MA42111-509	509	450	1.5	14	13.0	13
MA42111-510	510	450	1.5	17	15.5	15
MA42111-511	511	450	1.5	19	16.0	15

Notes:

1. The maximum noise figure is measured as follows:
   V_{CE} = 10 volts
   I_C = 5 mA
   Frequency = 450 MHz.
2. For the maximum unilateral gain, 1 dB compression point is equal to 0 dBm.
3. Minimum $|S_{21}E|^2$ is: V_{CE} = 10 volts, I_C = 20 mA, and the frequency = 450 MHz.
4. The maximum collector cutoff current is 10 µA, where V_{CB} = 10 volts.

Electrical Specifications @ 25° C

MA42111 Series

Parameter	Condition	Symbol	Min.	Typical	Max.	Unit
Collector Cut-off Current	V_{CB} = 10 V I_E = 0 µA	I_{CBO}	—	10	100	nA
Emitter Cut-off Current	V_{EB} = 1 V I_C = 0 µA	I_{EBO}	—	—	1.0	µA
Forward Current Gain	V_{CE} = 15 V I_C = 5 mA	H_{FE}	20	120	300	—
Collector-Base Junction Capacitance	V_{CB} = 5 V f = 1 MHz	C_{OB}	—	1.0	1.2	pF

MA42001-509 and 2N6665-509

Description

- Nominal f_T = 2.5 GHz
- Nominal Current Range = 5 to 40 mA
- I_C Max. = 125 mA
- Frequency Range = 10 MHz to 750 GHz

This series of NPN silicon bipolar transistors is designed to provide low noise figures at frequencies from 10 to 750 MHz. These transistors have flat noise figures from ~2 to 20 mA collector current. This series is recommended for applications such as IF and RF amplifiers from 10 to 750 MHz where wider dynamic range is required.

Absolute Maximum Ratings @ 25° C MA42001 Series

Parameter	Symbol	Unit	Absolute Maximum
Collector-Base Voltage	V_{CBO}	Volts	20
Collector-Emitter Voltage	V_{CEO}	Volts	15
Emitter-Base Voltage	V_{EBO}	Volts	2.5
Collector Current	I_C	mA	125
Junction Operating Temperature	T_j	°C	-65 to +150
Storage Temperature	T_S	°C	-65 to +200
Power Dissipation	P_D	mW	
Case Style 509			450
Case Style 510			1200
Case Style 511			750

Specifications @ T_A = 25°C

Model Number	Case Style	Test Frequency (MHz)	Maximum[1] Noise Figure (dB @ mA)	Maximum[2] Unilateral Gain (dB)	Maximum[4] cbo (nA)	Minimum[2] BV_{cbo} (Volts)	Minimum[3] BV_{ebo} (Volts)
2N6665-509	509	60	1.0 @ 5.0	28	10	20	2.5
MA42001-509	509	60	1.0 @ 5.0	28	10	20	2.5

Notes:

1. V_{CE} = 10 Volts.
2. Collector current = 10 µA.
3. I_E = 10µA maximum.

MA42021 and 2N Series

Description

- Nominal f_T = 1.8 GHz
- Nominal Current Range = 1 to 5 mA
- I_C Max = 50 mA
- Frequency = 10 MHz to 600 MHz

This series of NPN silicon planar transistors, packaged in the 509 case style are useful for low noise, high gain amplifiers from 10 to 600 MHz. All these transistors have gold metallization resulting in a rugged, highly reliable transistor.

Specifications @ T_A=25°C

Model[1] Number	Test Frequency (MHz)	Maximum[4] Noise Figure (dB @ mA)	Maximum Unilateral Gain (dB)	Minimum[5] Bv_{cbo} (Volts)	Minimum[6] Bv_{ebo} (Volts)
MA42021	60	1.6 @ 1.5	23	30	2.5
2N5031	450	2.5 @ 1.0	10	30	2.5
2N3570	450	2.5 @ 1.5	10	30	2.5
2N3953	450	3.0 @ 1.0	10	30	2.5
2N5032	450	3.0 @ 1.0	10	30	2.5
2N3880	450	3.5 @ 1.5	10	30	2.5
2N3839	450	3.9 @ 1.5	10	30	2.5
2N3571	450	4.0 @ 2.0	10	30	2.5
2N5054	450	4.0 @ 2.0	10	30	2.5
2N3683	450	4.5 @ 1.5	10	30	2.5
2N2857*	450	4.5 @ 1.5	10	30	2.5
2N5179	450	4.5 @ 2.0	10	30	2.5
2N5053	450	5.0 @ 2.0	10	30	2.5
2N3572	450	6.0 @ 2.0	10	30	2.5

* This transistor can be screened to JAN level screening.

Notes:

1. This series of NPN silicon planar transistors is packaged in case style 509.
2. Maximum collector cutoff current is 10 μA, where V_{CB} = 15 volts.
3. The nominal current transfer ratio is 120 where V_{CE} = 1 volt, and I_C = 3 mA.
4. V_{CE} = 6 volts.
5. I_C = 1 μA.
6. I_E = 10 μA.

MA42051 Series

Description

- Nominal f_T = 1.8 GHz
- Nominal Current Range = 1 to 5 mA
- I_C Max. = 40 mA
- Frequency Range = 10 MHz to 600 GHz

The MA42051 series of NPN silicon planar transistors will give high gain and low noise figure characteristics in VHF amplifier applications. This transistor is recommended for low power oscillators from 100 MHz to 1 GHz.

Absolute Maximum Ratings @ 25° C

MA42051 Series

Parameter	Symbol	Unit	Absolute Maximum
Collector-Base Voltage	V_{CBO}	Volts	20
Collector-Emitter Voltage	V_{CEO}	Volts	15
Emitter-Base Voltage	V_{EBO}	Volts	2.5
Collector Current	I_C	mA	40
Junction Operating Temperature	T_j	°C	-65 to +150
Storage Temperature	T_S	°C	-65 to +200
Power Dissipation	P_D	mW	
Case Style 509			300
Case Style 510			450
Case Style 511			350

Specifications @ T_A=25°C

Model[1] Number	Test Frequency (MHz)	Maximum[3] Noise Figure (dB @ mA)	Maximum[4] Unilateral Gain (dB)	Minimum[5] Bv_{cbo} (Volts)	Minimum[3] Bv_{ebo} (Volts)
MA42051	450	2.2 @ 3.0	18	20	2.5

Notes:

1. MA42051 is available in the 509, 510, 511 case styles. When ordering, specify the desired case style as a suffix to the basic mode number, i.e., MA42051-510.
2. V_{CC} = 8 Volts
3. I_E = 10 μA.
4. V_{CE} = 8 Volts; I_C = 3 mA; Nominal current transfer ratio = 75.
5. V_{CB} = 10 Volts; Maximum collector current = 40 mA.

MA42121 Series

Description

- Nominal f_T = 1.5 GHz
- Nominal Current Range = 0.4 to 3 mA
- I_C Max. = 80 mA
- Frequency = 100 to 600 MHz

This series of NPN epitaxial silicon planar transistors is designed for 100 MHz to 1 GHz amplifiers and low power oscillators up to 4 GHz. The MA42121 has the maximum frequency of oscillation of 4.2 GHz. Two case styles are offered, case style 508 for low power oscillator applications and case style 509 for small signal IF and RF amplifiers.

Maximum Ratings @ 25° C

MA42121 Series

Parameter	Symbol	Unit	Absolute Maximum
Collector-Base Voltage	V_{CBO}	Volts	30
Collector-Emitter Voltage	V_{CEO}	Volts	30
Emitter-Base Voltage	V_{EBO}	Volts	4.0
Collector Current	I_C	mA	80
Junction Operating Temperature	T_j	°C	-65 to +150
Storage Temperature	T_S	°C	-65 to +200
Power Dissipation	P_D	W	
Case Style 508			1.0
Case Style 509			0.5

Specifications @ T_A = 25°C

Model[1] Number	Case[1] Style	Maximum[2] Unilateral Gain Gu(dB)	Minimum[4] Gain Bandwidth f_T (GHz)	Maximum[4] Available Gain GA(dB)	Maximum[3,5] Frequency Oscillation (GHz)
MA42121	508	13	1.3	12.8	4.2

Notes:

1. Available in case styles 508 and 509. When ordering, specify the package, by adding the case style as a suffix to the basic model number, i.e MA42121-508.
2. The test frequency is 450 MHz.
3. V_{CE} = 10 volts, I_C = 20 mA, Frequency = 500 MHz.
4. V_{CE} = 10 volts, I_C = 20 mA, Frequency = 1 GHz.
5. The maximum frequency of oscillation is calculated from S-parameters, Fmax is the frequency at which the extrapolated Ga (max) is 0 dB.
6. I_C = 10 μA, I_E = 0.

MA42151 and MA42191 Series

Description

- Nominal f_T = 4.5 GHz
- Nominal Current Range = 1 to 10 mA
- I_C Max. = 100 mA
- Frequency = 300 MHz to 2.0 GHz

These NPN planar transistors are characterized for local oscillator use in to 1.0 to 3.0 GHz range. The MA42151 when mounted in a common base package (case style 510) exhibits a typical Fmax of 9.5 GHz at 20 mA collector current. The MA42191 in case style 510 exhibits a typical Fmax of 6.0 GHz at 50 mA collector current. This transistor is also available in the hermetically sealed case style 511 stripline package.

Absolute Maximum Ratings @ 25° C MA42151 and MA42191 Series

Parameter	Symbol	Unit	MA42151	MA42191
Collector-Base Voltage	V_{CBO}	Volts	27	30
Collector-Emitter Voltage	V_{CEO}	Volts	25	20
Emitter-Base Voltage	V_{EBO}	Volts	1.5	3.5
Collector Current	I_C	mA	50	300
Junction Operating Temperature	T_j	°C	-65 to +150	-65 to +150
Storage Temperature	T_S	°C	-65 to +200	-65 to +200
Power Dissipation (Case Style 510)	P_D	mW	700	30

Specifications @ T_A = 25°C

Model[1] Number	Minimum[2] $B_{V_{cbo}}$ (Volts)	Minimum[3] $B_{V_{ebo}}$ (Volts)	Minimum[4] $B_{V_{ceo}}$ (Volts)	Collector Current (mA)	Nominal Current Transfer Ratio (H_{FE})
MA42151	27	1.5	20	50	60
MA42191	30	3.5	25	300	40

Notes:
1. The standard case style for the MA42151 and MA42191 is case style 510. The MA42151 is also available in the hermetically sealed 511 stripline package; to order, add the case style as a suffix to the basic model number, i.e. MA42151-511.
2. I_C = 10 µA for MA42151; I_C = 100 µA for MA42191.
3. I_E = 10 µA.
4. I_C = 500 µA.

MA42181-510

Description

- Nominal fT = 2.8 GHz
- Nominal Current Range = 10 to 60 mA
- IC Max. = 300 mA
- Frequency Range = 10 MHz to 1 GHz

The MA42181 transistor is designed for wide dynamic range amplifier applications from 100 MHz to 1 GHz. Other applications include second stage high dynamic range amplifiers and low level oscillators.

Absolute Maximum Ratings @ 25° C

MA42181-510

Parameter	Symbol	Unit	Absolute Maximum
Collector-Base Voltage	V_{CBO}	Volts	30
Collector-Emitter Voltage	V_{CEO}	Volts	25
Emitter-Base Voltage	V_{EBO}	Volts	35
Collector Current	I_C	mA	300
Junction Operating Temperature	T_j	°C	-65 to +150
Storage Temperature	T_S	°C	-65 to +200
Power Dissipation Case Style 510	P_D	W	3.0

Specifications @ T_A = 25°C

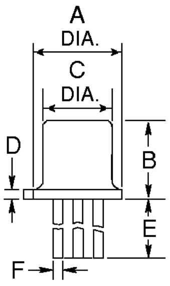
Model Number	Case Style	Minimum[1] Bv_{cbo} (Volts)	Minimum[2] Bv_{EBO} (Volts)	Minimum[3] Bv_{CEO} (Volts)	Compression Point (P_{1dB})	Maximum[8] Unilateral Gain(dB) (GHz)
MA42181-510	510	30	3.5	25	+25	8.4

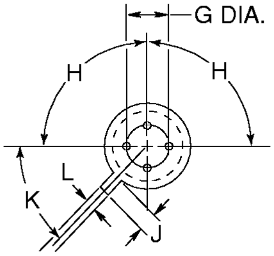
Notes:

1. I_C = 100 µA
2. I_E = 10 µA.
3. I_C = 100 µA.
4. Nominal current transfer ratio is 60; V_{CE} = 15 Volts; I_C = 100 mA.
5. V_{CE} = 15 Volts; I_C = 60 mA; ZG = ZL = 500 Ohms; Frequency = 1 GHz.
6. The nominal $|S_{21E}|^2$ is 2.0 dB; V_{CE} = 15 Volts; I_C = 60 mA; Frequency = 2 GHz.
7. The nominal gain at optimum noise figure is 14.5 dB; V_{CE} = 15 Volts; I_C = 60 mA; Frequency = 1 GHz.
8. V_{CE} = 15 Volts; I_C = 60 mA; Frequency = 1 GHz.

Case Styles

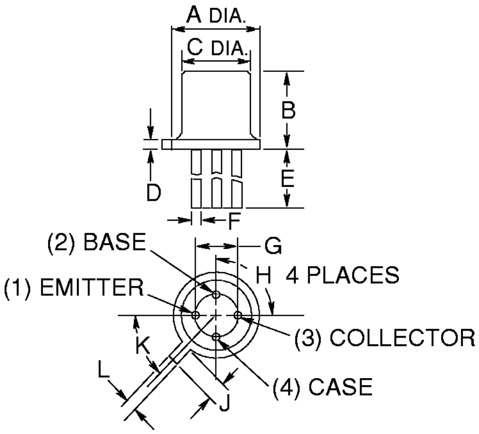
Case Style 508





DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	0.209	0.230	5,31	5,84
B	0.065	0.085	1,65	2,16
C	0.178	0.195	4,52	4,95
D	—	0.030	—	0,76
E	0.500	—	12,70	—
F	0.016	0.021	0,41	0,53
G	0.090	0.110	2,29	2,75
H	89°	91°	89°	91°
J	0.028	0.048	0,71	1,22
K	43°	47°	43°	47°
L	0.036	0.046	0,91	1,17

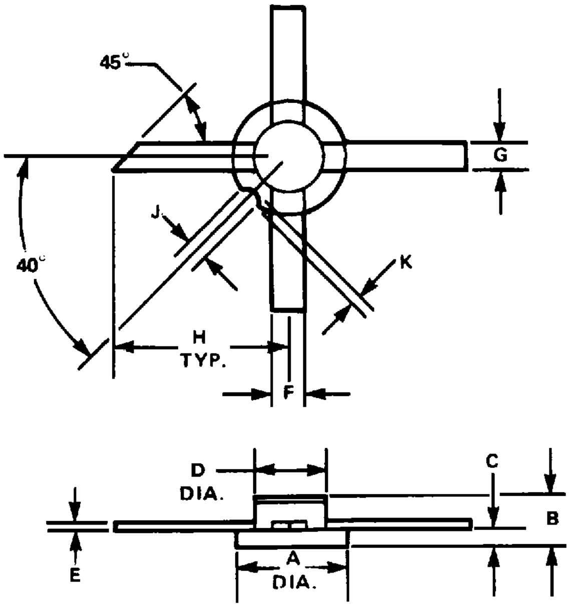
Case Style 509



DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	0.209	0.230	5.31	5,84
B	0.170	0.210	4,32	5.33
C	0.178	0.195	4,52	4,95
D	—	0.020	—	0,51
E	0.500	—	12,70	—
F	0.016	0.019	0,41	0,48
G	0.090	0.110	2,29	2,79
H	89°	91°	89°	91°
J	0.028	0.048	0,71	1,22
K	43°	47°	43°	47°
L	0.036	0.046	0,91	1,17

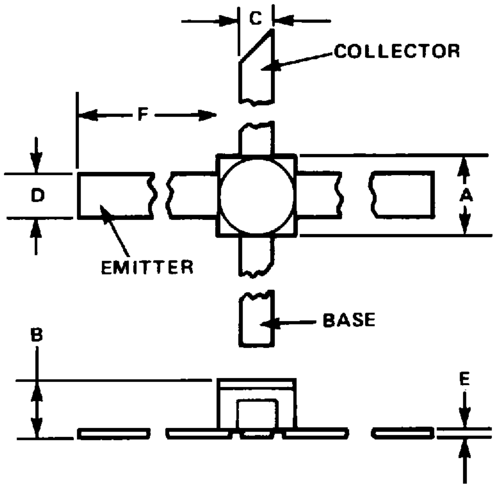
Case Styles (Cont'd)

Case Style 510



DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	0.195	0.215	4 95	5 46
B	0.043	0.063	1,09	1,60
C	0.016	0.024	0,41	0,61
D	0.129	0.141	3,28	3,58
E	0.0015	0.0045	0,04	0,11
F	0.054	0.066	1,37	1,68
G	0.024	0.036	0,61	0,91
H	0.279	0.321	7,09	8,15
J	0.030 REF.		0,76 REF.	
K	0.150 REF.		0,38 REF.	

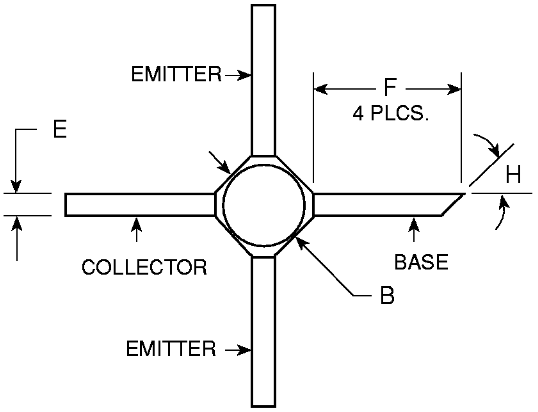
Case Style 511



DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	0.095	0.105	2,41	2,68
B	—	0.050	—	1,27
C	0.016	0.024	0,41	0,61
D	0.036	0.044	0,91	1,12
E	0.002	0.006	0,05	0,15
F	0 190	0.260	4,83	6,60

Case Styles (Cont'd)

Micro-X
Case Style 1139



DIM.	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS 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°