Microwave Transistors

MICROWAVE OPERATION ADVANTAGES AND RELIABILITY

Fairchild microwave transistors are NPN planar epitaxial transistors designed for both amplifier and oscillator applications covering the range .5GHz to 5.0GHz. The high f_{MAX} of these devices assures best possible performance and highest maximum available gain at L, S, and C band frequencies.

Fairchild step recovery diodes allow for extension of the oscillator capability into the X band range.

The planar process assures volume reproducibility with minimum lot to lot variation allowing for high volume production of microwave circuits and components.

MICROWAVE DEVICE SELECTION GUIDE

Device	Package	Typical f_{MAX} GHz	Typical M.A.G. 1 GHz	2 GHz	3 GHz	Oscillator P_O/Frequency (GHz)
MT1038	TO-46 (CC)	2.8	9	3		1W @ 1
MT1038A	TO-46	2.8	9	3		1W @ 1
MT1039	TO-46	2.8	9	3		.8W @ 1
MT1050	CE Coax	3.6	11	5		.25W @ 1
MT1060	TO-46	4.0	12	6		80mW @ 2
MT1060A	TO-46	4.0	13	6		100mW @ 2
MT1061	TO-72	4.5		6		See Data
MT1061A	TO-72	5.0	14	6		Sheet for
MT1062	TO-50	4.5	13	6.5	3.5	Amplifier
MT1063	CD Channel	SEE	DATA	SHEET		G_{PE} & N.F.
MT3833	TO-50		13	6.5	3.5	100mW @ 2
MT3834	TO-50		12	6		75mW @ 2
MT1070	CE Coax	6		9	5	20mW @ 2.5
MT1115	CE Coax	6		9.5	6	45mW @ 3
MT1116	CE Coax	6		12	9	20mW @ 4 90mW @ 3

OSCILLATOR PERFORMANCE

Frequency (GHz)	Output Power 10W	5W	2W	1W	.5W	250mW	100mW	50mW	25mW
.5	X	X	MT1038A	MT1039	MT1039	MT1060A	MT1060	MT1060	MT1060
1.0		X	X	MT1038/A	MT1039	MT1060/A	MT1060	MT1060	MT1060
1.5			X	X	MT1038A	MT1039	MT1060	MT1060	MT1060
2.0				X	X	MT1050	MT3833	MT3834	MT3834
2.5					X	X	MT1050	MT1070	MT1070
3.0						X	MT1116	MT1115	MT1070
3.5							X	MT1116	MT1115
4.0								X	MT1116
5.0	X being developed							X	

AMPLIFIER CHARACTERISTICS

Frequency (GHz)	Maximum Available Gain (db)* 18	15	12	9	6.5	3
.5	MT1060 MT1061	MT1038 MT1039				
1.0			MT1060 MT1061	MT1038/A		
2.0				MT1070	MT1060 MT1062 MT1050	MT1038
3.0				MT1116	MT1070	MT1050 MT1062
4.0					MT1116	MT1115
5.0						MT1116

MICROWAVE TRANSISTORS NUMERICAL INDEX

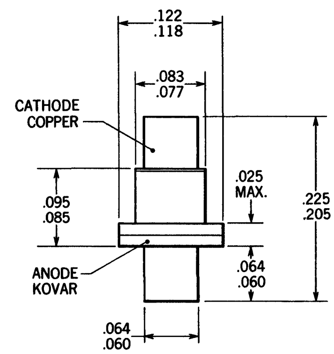
FGC1001

STEP RECOVERY DIODE

FOR MICROWAVE HARMONIC GENERATION

GENERAL DESCRIPTION — The Fairchild FGC1001 Step Recovery Diode is a silicon epitaxial passivated mesa device designed to enhance minority carrier storage in the forward direction and to force picosecond cessation of the reverse conduction current. This very fast transition time makes this Step Recovery Diode useful for harmonic generation, time delay and pulse sharpening.

PHYSICAL DIMENSIONS



ABSOLUTE MAXIMUM RATINGS (Note 1)

Thermal Resistance (Junction to Case)	75°C/W
Operation Temperature Range	−65°C to +175°C
Storage Temperature Range	−65°C to +175°C
RF Input Power ($T_A = 25°C$)	400 mW

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
t_t	Transition Time		70	100	ps	$I_F = 10$ mA	$V_R = 10$ V
τ	Lifetime	6	14		ns	$I_F = 10$ mA	$I_R = 6.0$ mA
C_O	Capacitance		0.9	1.3	pF	$V_R = 0$ V	f = 1.0 MHz
BV	Breakdown Voltage	20	25		Volts	$I_R = 10\ \mu A$	
I_R	Leakage Current		1.0	100	nA	$V_R = 10$ V	
I_F	Forward Current	75	200		mA	$V_F = 1.0$ V	

NOTES:
(1) The maximum ratings are limiting values above which life or satisfactory performance may be impaired.

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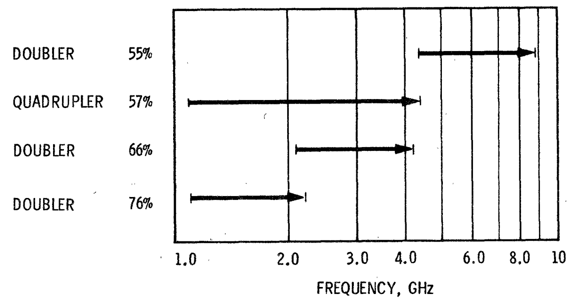
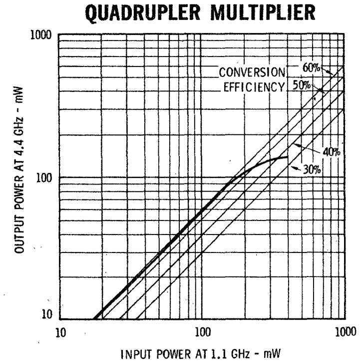
A SUMMARY OF TYPICAL MULTIPLIER EFFICIENCIES

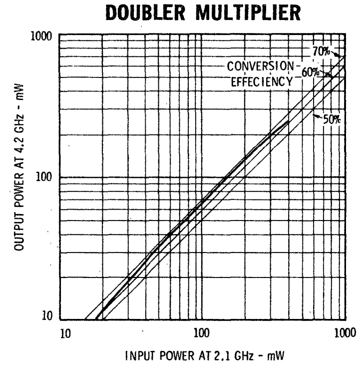


TYPICAL PERFORMANCE CURVES

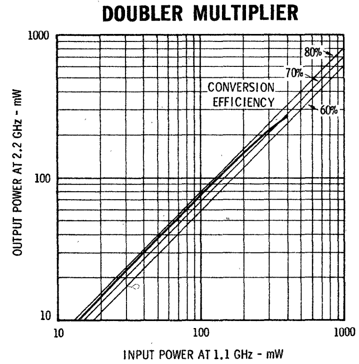
**1.1 TO 4.4 GHz
QUADRUPLER MULTIPLIER**



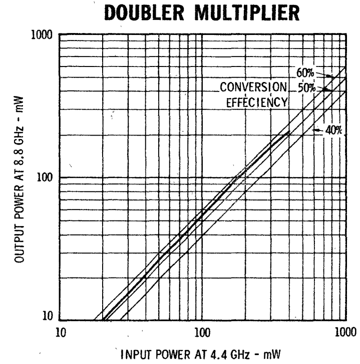
**2.1 TO 4.2 GHz
DOUBLER MULTIPLIER**



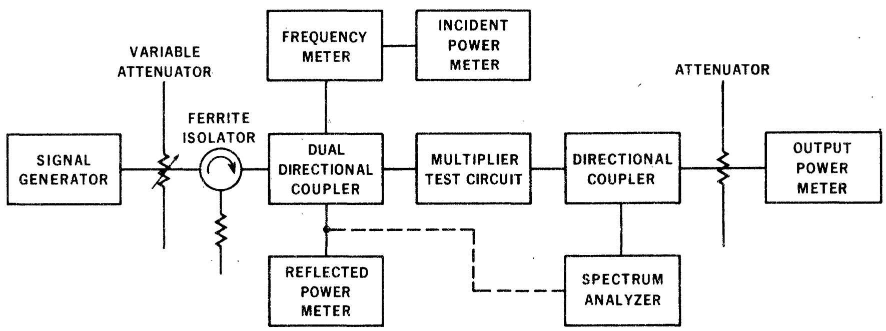
**1.1 TO 2.2 GHz
DOUBLER MULTIPLIER**



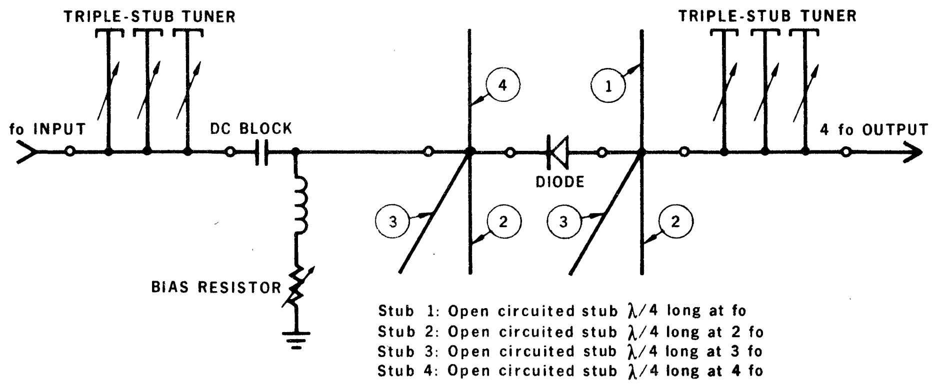
**4.4 TO 8.8 GHz
DOUBLER MULTIPLIER**



HARMONIC GENERATION TEST EQUIPMENT SET-UP



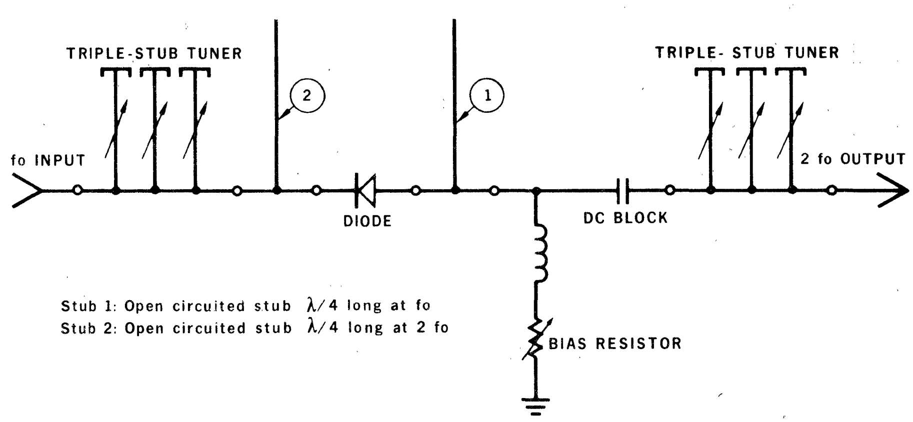
SCHEMATIC DIAGRAM OF QUADRUPLER TEST CIRCUIT



The quadrupler test circuit may be described in the following manner. The stubs 1, 2, 3 and 4 should be set so that they are approximately one quarter wavelength long at the fundamental, second, third and fourth harmonics respectively. These shunt stubs will then act as simple filter circuits at the quarter wavelength frequencies. Stub 1 will prevent the input frequency from entering the output circuit, while stub 4 will prevent the output frequency from entering the input circuit. Stubs 2 and 3 will prevent the second and third harmonics from entering either the input or output circuits and will allow substantial currents to flow through the diode at these frequencies. This latter characteristic approximately fulfills the condition for idler circuits. The physical location of the stubs should be as close to the diode as possible.

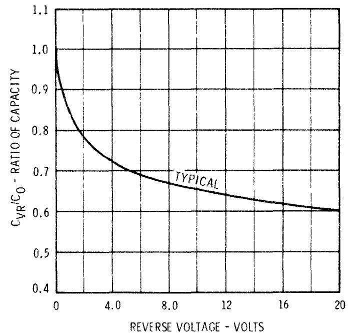
The input triple stub tuner is used to match the diode at the fundamental frequency to the input circuit while the output triple stub tuner is used to match the diode at the fourth harmonic to the output circuit. The bias resistor will affect the impedance and operating point of the diode. Iterative adjustment of the bias resistor and input and output tuners is necessary for optimum conversion efficiency.

SCHEMATIC DIAGRAM OF DOUBLER TEST CIRCUIT

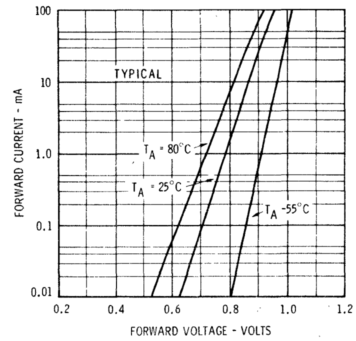


The doubler test circuit is similar to the quadrupler test circuit. Since there are no intermediate harmonic frequencies, the doubler test circuit and tuning procedure is much simpler than the quadrupler test circuit. In all other respects to doubler it operates in a similar manner to the quadrupler.

RATIO OF CAPACITY AT REVERSE VOLTAGE TO ZERO VOLTAGE VERSUS REVERSE VOLTAGE



FORWARD CURRENT VERSUS FORWARD VOLTAGE



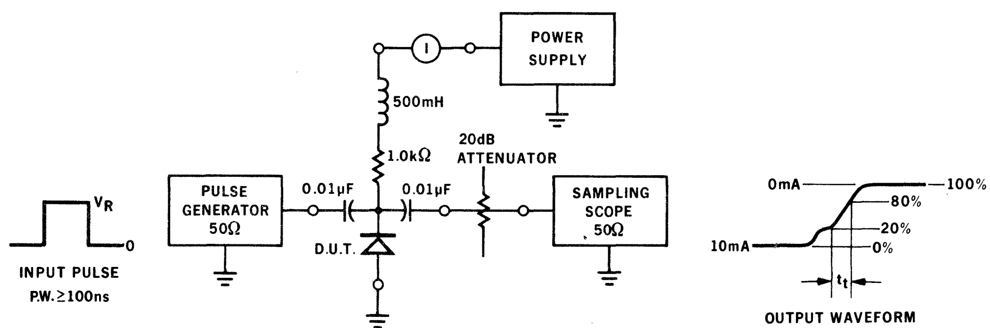


Figure 1 shows the test circuit and waveform diagrams for measuring the transition time. The forward current is adjusted to 10 mA. The reverse voltage is adjusted to 10 V using a pulse generator having a rise time of less than 1.0 ns. The transition time, t_t, is measured between the 20% and 80% points in the falling edge of the forward current waveform.

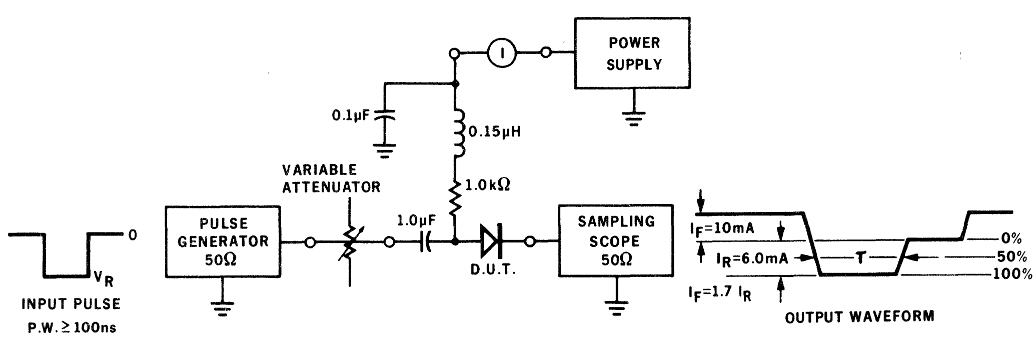


Figure 2 shows the test circuit and waveform diagrams for measuring the effective minority carrier lifetime. The forward current is adjusted to 10 mA. The reverse current is adjusted to 6.0 mA using a pulse generator having a rise time of less than 1.0 ns. The lifetime is measured between the 50% points on the reverse current pulse.

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MT1038 • MT1038A • MT1039 • MT1050

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION: These transistors are NPN silicon planar epitaxial transistors, designed primarily for large signal microwave applications. The high gain bandwidth products plus low $r_b'C_c$ time constants make the MT1038, MT1038A, and MT1039 usable to 1500 MHz; and the MT1050 usable to 2.5 GHz.
The MT1038A is offered in a TO-46 header with an internal heatsink that allows HIGHER POWER DISSIPATION at ELEVATED case temperatures. The MT1050 is offered in a coaxial package that enhances UHF and L-band amplifier stability, and increases oscillator efficiency to 2.5 GHz.

- **HIGH GAIN - - BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$**
- **HIGH f_{max}**
- **LOW - - PARASITIC, COAXIAL PACKAGE (MT1050)**
- **GUARANTEED OSCILLATOR POWER TO 2 GHz**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures (MT1038, MT1038A, MT1039, MT1050)

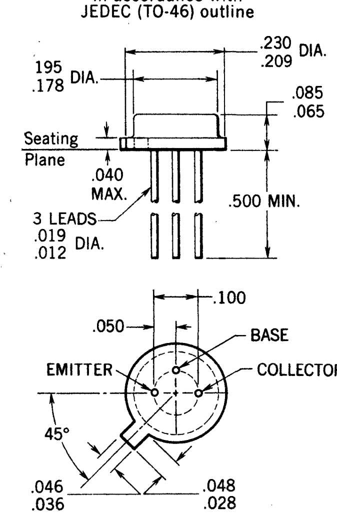
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	175°C

Maximum Power Dissipation	**MT1038**	**MT1038A**	**MT1039**	**MT1050**
Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.5W		1.5W	
at 75°C Case Temperature (Notes 2 and 4)		2.0W		
at 75°C Case Temperature (Notes 2 and 5)				2.0W
at 25°C Ambient Temperature (Notes 2 and 3)	0.3W	0.3W	0.3W	0.3W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 6)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	250 mA

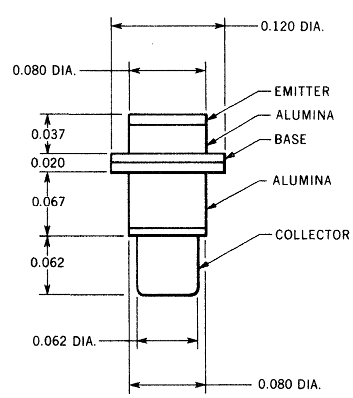
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold-plated KOVAR
Collector internally connected to case
Package weight is 0.36 gram

MT1038 • MT1039

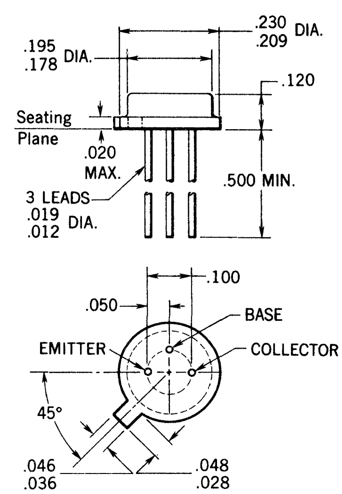
PHYSICAL DIMENSIONS



NOTES:
All dimensions in inches
Emitter and base connections are gold-plated KOVAR
Collector is internally connected to copper stud

MT1050

PHYSICAL DIMENSIONS
similar to
JEDEC (TO-46) outline



NOTES:
All dimensions in inches
Leads are gold-plated KOVAR
Collector internally connected to case

MT1038A

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HIGH FREQUENCY CHARACTERISTICS

SYMBOL	CHARACTERISTICS	MT1038 MT1038A			MT1039			MT1050			UNITS	TEST CONDITIONS	
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
f_t	Gain Bandwidth Product	.95	1.1		.95	1.1		.95	1.1		GHz	10V	50 mA
$r_b'C_c$	Base-Collector Time Constant		5.5	6.5		5.5	6.5				ps	10V	20 mA
									3.5	4.5	ps	10V	30 mA
f_{max}	Maximum Frequency of Oscillation	2.5	2.8		2.5	2.8		3.0	3.6		GHz	10V	50 mA
MAG	Maximum Available Gain (f = 1 GHz)		9			9			11		dB	10V	50 mA
MAG	Maximum Available Gain (f = 2 GHz)		3			3			5		dB	10V	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MT1038 MT1038A			MT-1039			MT1050			UNITS	TEST CONDITIONS	
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
h_{FE}	DC Pulse Current Gain (Note 7)	20	40	120	20	40	120	20	40	120		$I_C = 10$ mA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage (pulsed, Note 7)		0.2	0.5		0.2	0.5		0.2	0.5	Volts	$I_C = 250$ mA	$I_B = 25$ mA
$V_{BCE(sat)}$	Base Saturation Voltage (pulsed, Note 7)		0.89	0.95		0.89	0.95		0.89	0.95	Volts	$I_C = 100$ mA	$I_B = 50$ mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	9.5	11		9.5	11		9.5	11			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{ob}	Output Capacitance		4	6.0		4	6		4	6	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{TE}	Emitter Transition Capacitance		8	12		8	12		8	12	pF	$V_{EB} = +0.5$ V	$I_C = 0$
I_{CBO}	Collector Cutoff Current			0.5			0.5			0.5	μA	$V_{CB} = 10$ V	$I_E = 0$
I_{CBO} (150°C)	Collector Cutoff Current			1.0			1.0			1.0	μA	$V_{CB} = 10$ V $T_A = +150$°C	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	30	40		30	40		30	40		Volts	$I_C = 100$ μA	$I_E = 0$
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage (Notes 6 and 7)	15	17.5		15	17.5		15	17.5		Volts	$I_C = 10$ mA pulsed	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	4.5		4.0	4.5		4.0	4.5		Volts	$I_E = 100$ μA	$I_C = 0$
P_o	Oscillator Power Out (f = 1.0 GHz)	1.0	1.1								Watts	$I_C = 167$ mA	$V_{CB} = 15$V
P_o	Oscillator Power Out (f = 1.0 GHz)				0.8	0.9					Watts	$I_C = 150$ mA	$V_{CB} = 15$V
P_o	Oscillator Power Out (f = 2.0 GHz)							0.2	0.25		Watts	$I_C = 133$ mA	$V_{CB} = 15$V

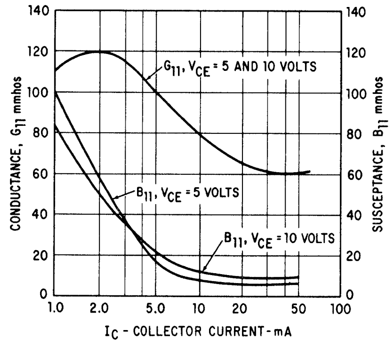
NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 100°C/Watt (derating factor of 10mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 75°C/Watt (derating factor of 13.3 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(5) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 50°C/Watt (derating factor of 20 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(6) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4.
(7) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(8) I_C is adjusted between 75 mA and 133 mA for optimum power output.

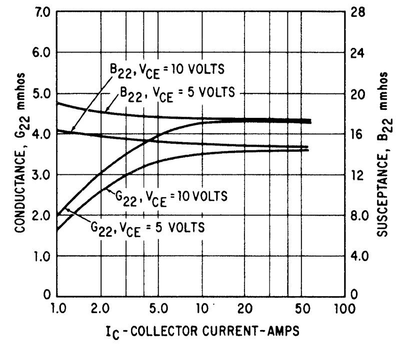
AMPLIFIER CHARACTERISTICS

Y PARAMETERS VERSUS COLLECTOR CURRENT — 500 MHz COMMON EMITTER

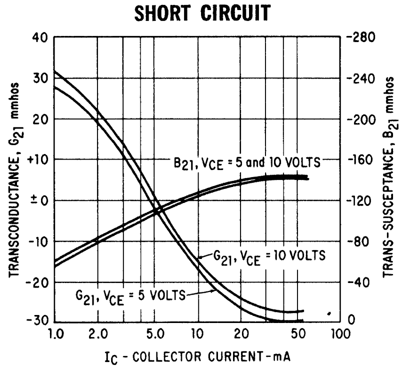
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



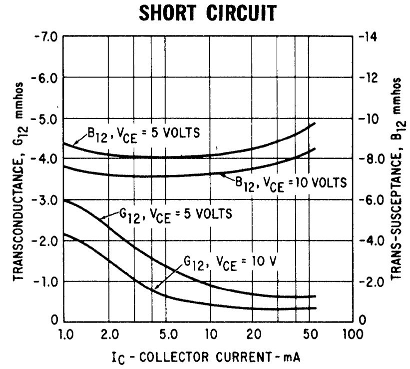
Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT



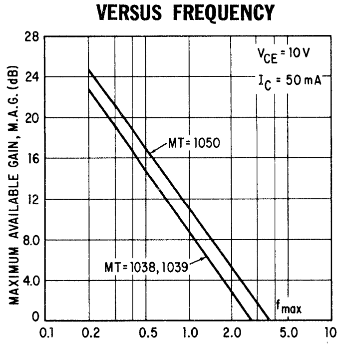
Y_{21E}, FORWARD TRANSFER ADMITTANCE, OUTPUT SHORT CIRCUIT



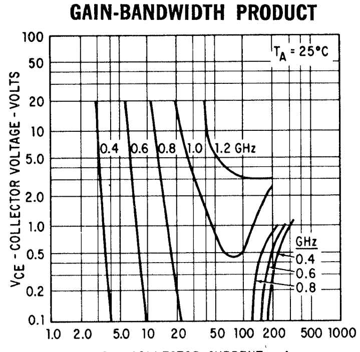
Y_{12E}, REVERSE TRANSFER ADMITTANCE, INPUT SHORT CIRCUIT



MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY



CONTOURS OF CONSTANT GAIN-BANDWIDTH PRODUCT

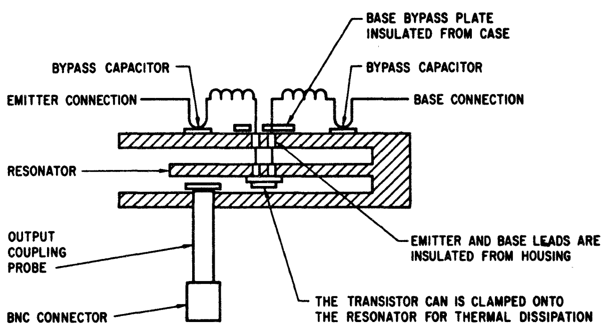


OSCILLATOR CHARACTERISTICS

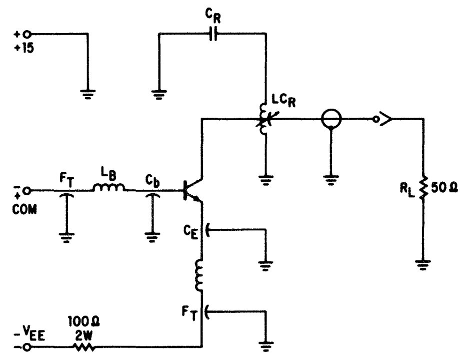
1 GHz OSCILLATOR CAPABILITY

PRODUCT	MIN. P_o	TYP. P_o	CONVERSION EFFICIENCY
MT1038	1.0 W	1.1 W	40%
MT1038A	1.0 W	1.1 W	40%
MT1039	0.8 W	0.9 W	35%

1 GHz TEST OSCILLATOR



1 GHz TEST CIRCUIT RF GROUNDED BASE



L_E is 10 turns of N 26AWG on ⅛" mandril loose wound.

C_b is Base bypass parallel plate capacitor using 1 mil mylar tape.

C_E is variable capacitor 8-10 pF, Johanson #2950.

FT is Ceramic feed through capacitor, 470 pF, Allen Bradley #FU-60.

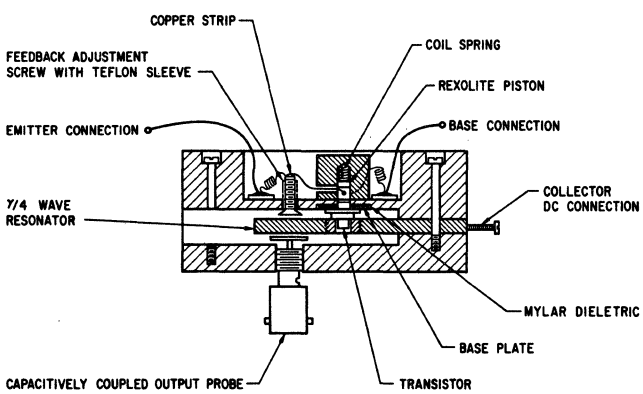
L_B is a 72Ω, ½ W carbon resistor, with 1 inch leads.

C_R-LC_R = Effect of ¼ wave resonator.

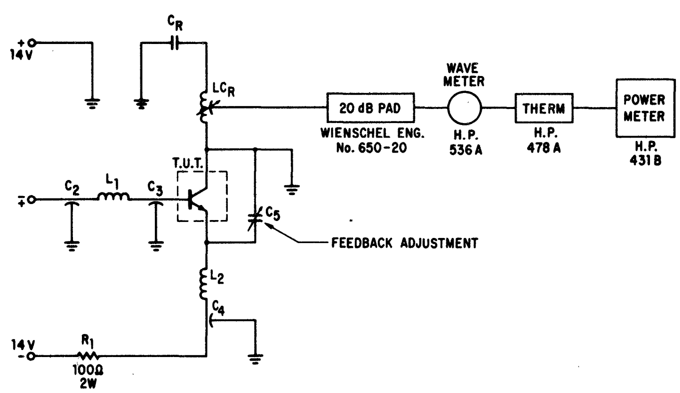
2 GHz OSCILLATOR CAPABILITY

PRODUCT	MIN. P_o	TYP. P_o	CONVERSION EFFICIENCY
MT1050	200 mW	250 mW	10%

2 GHz TEST OSCILLATOR



2 GHz TEST OSCILLATOR RF GROUNDED BASE



C_2-C_4 = 470 pF, Allen Bradley #FU60, ceramic feed thru capacitors paralleled with 500 pF uncapsulated ceramic disc capacitors.
C_3 = Base bypass capacitor (parallel plate capacitor using 1 mil. mylar tape).
C_R-LC_R = Effect of γ/4 resonator.
C_5 = Effect of E to C feedback adjustment screw.
L_1 = 6 turns #28 wire, loose wound ⅛" dia.
R_1 = External current limiting resistor.

MT1060/MT1060A • MT1061/MT1061A • MT1063

NPN MICROWAVE AMPLIFIER OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

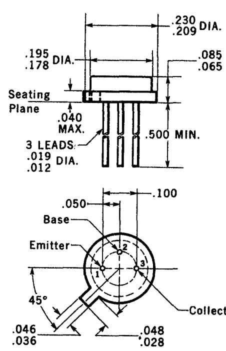
GENERAL DESCRIPTION — These transistors are NPN Silicon planar epitaxial transistor, designed for microwave service. The high gain-bandwidth products plus low $r_b'C_c$ time constants make the MT-1060, MT-1060A useful to 4 GHz while the MT-1061, MT-1061A have maximum frequency of oscillation to 5 GHz. Three packages are offered, the TO-46 outline for low-power oscillator applications, the TO-72 outline for small signal UHF amplifiers and a special package for hybrid integrated circuit use (MT-1063).

- **HIGH GAIN-BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$**
- **HIGH f_{max}**
- **LOW NOISE FIGURE**
- **SPECIAL PACKAGE FOR HYBRID I.C.'s (MT-1063)**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures				
Storage Temperature			−65°C to +200°C	
Operating Junction Temperature				+175°C
Maximum Power Dissipation (Note 2)		**MT-1060/1060A**	**MT-1061/1061A**	**MT-1063**
		Note 3	Note 4	Note 5
Total Dissipation at 25°C Case Temperature		1.0 W	0.5 W	0.2 W
		Note 3	Note 4	
at 25°C Ambient Temperature		0.3 W	0.25 W	
				Note 5
at 25°C Mounting Surface Temperature				0.15 W
Maximum Voltages and Current				
V_{CBO}	Collector to Base Voltage			30 Volts
V_{CES}	Collector to Emitter Voltage			30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 6)			14 Volts
V_{EBO}	Emitter to Base Voltage			4.0 Volts
I_C	Continuous Collector Current			80 mA

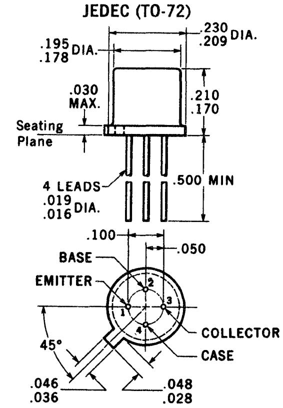
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES:
All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case
Package weight is 0.35 gram

MT1060 • MT1060A

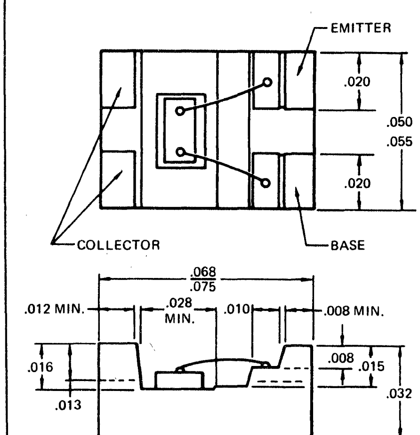
PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-72)



NOTES:
All dimensions in inches
Leads are gold-plated kovar
All transistor elements isolated from case
Package weight is 0.47 gram

MT1061 • MT1061A

PHYSICAL DIMENSIONS



INDICATES METALIZATION
The transistor is protected by epoxy covering

MT1063

Notes on page 2

*Planar is a patented Fairchild process.

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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

HIGH FREQUENCY CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	TYPE	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
f_T	Gain Bandwidth Product	MT-1060A	1.3	1.5		GHz	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1060	1.0	1.3		GHz	f = 500 MHz
		MT-1061A	1.3	1.5		GHz	
		MT-1061	1.0	1.3		GHz	
$r_b'C_c$	Base-Collector Time Constant	MT-1060A		3.5	4.5	ps	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1060		3.5	4.5	ps	f = 79.8 MHz
		MT-1061A		2.5	3.5	ps	
		MT-1061		2.5	3.5	ps	
f_{max}	Maximum Frequency of Oscillation	MT-1060A	3.4	4.2		GHz	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1060	3.0	3.8		GHz	
		MT-1061A	3.8	4.9		GHz	
		MT-1061	3.4	4.6		GHz	
MAG	Maximum Available Gain at f = 1 GHz	MT-1060A		12.8		dB	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1061A		13.8		dB	
MAG	Maximum Available Gain at f = 2 GHz	MT-1060A		6.4		dB	$V_{CE} = 10$ V, $I_C = 20$ mA
		MT-1061A		7.8		dB	
NF	Noise Figure f = 450 MHz, $R_S = 50\,\Omega$	MT-1061A		2.3	3.0	dB	$V_{CE} \approx 10$ V, $I_C = 1.5$ mA
		MT-1061		2.7	3.5	dB	
G_{pe}	Neutralized Power Gain f = 450 MHz, $R_g = 50\,\Omega$,	MT-1061A	15.0	17.0		dB	$V_{CE} \approx 10$ V, $I_C = 1.5$ mA
	20 MHz BW	MT-1061	12.5	14.5		dB	

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MT-1060 MT-1061 MIN.	TYP.	MAX.	MT-1060A MT-1061A MT-1063 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	40	100	40	70	150		$I_C = 500\,\mu A$	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 7)		0.30	0.38		0.25	0.35	Volts	$I_C = 80$ mA	$I_B = 8.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 7)		0.95	0.98		0.93	0.96	Volts	$I_C = 40$ mA	$I_B = 20$ mA
BV_{CBO}	Collector to Base Breakdown Voltage	30	35		30	35		Volts	$I_C = 10\,\mu A$	$I_E = 0$
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage (Note 6)	14	16.5		14	16.5		Volts	$I_C = 1.0$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	5.0		4.0	5.0		Volts	$I_E = 100\,\mu A$	$I_C = 0$
I_{CBO}	Collector Cutoff Current		0.01	500		0.01	500	nA	$V_{CB} = 10$ V	$I_E = 0$
I_{CBO}(150°C)	Collector Cutoff Current		0.01	50		0.01	50	μA	$V_{CB} = 10$ V	$I_E = 0$
C_{cb}	Collector to Base Capacitance		1.0	1.4		0.85	1.0	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{cb}	Collector to Base Capacitance				(MT-1063)	1.2	1.33	pF	$V_{CB} = 10$ V	$I_E = 0$
C_{eb}	Emitter to Base Capacitance		1.5	3.0		1.5	3.0	pF	$V_{EB} = +0.5$ V	$I_C = 0$
$\lvert h_{fe} \rvert$	Magnitude of High Frequency Current Gain, f = 500 MHz	2.0	2.6		2.6	3.0			$V_{CE} = 10$ V	$I_C = 20$ mA

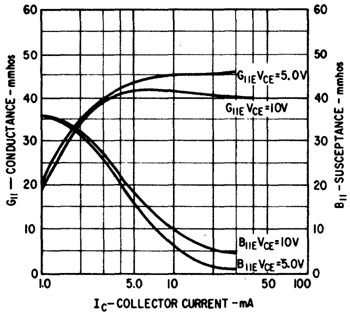
NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.7 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2 mW/°C).
(4) These ratings give a maximum junction temperature of 175°C and a junction to case thermal resistance of 300°C/Watt (derating factor of 3.3 mW/°C); junction to ambient thermal resistance of 600°C/Watt (derating factor of 1.7 mW/°C).
(5) These ratings give a maximum junction temperature of 175°C and a junction to case thermal resistance of 750°C/Watt (derating factor of 1.3 mW/°C); junction to mounting surface of 1000°C/Watt (derating factor of 1 mW/°C).
(6) Rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(7) Pulse Conditions: length = 300 μs; duty cycle = 1.0%.

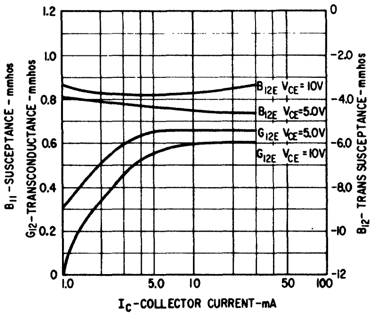
TYPICAL COMMON EMITTER "Y" PARAMETERS VERSUS COLLECTOR CURRENT

MT1060 • MT1060A (f = 500 MHz)

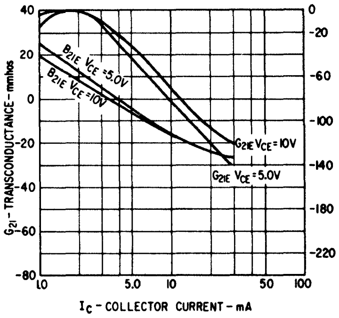
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



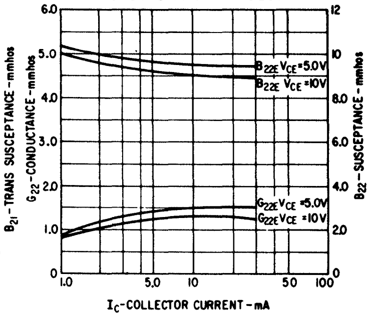
Y_{12E}, REVERSE TRANSADMITTANCE, INPUT SHORT CIRCUIT



Y_{21E}, FORWARD TRANSADMITTANCE, OUTPUT SHORT CIRCUIT

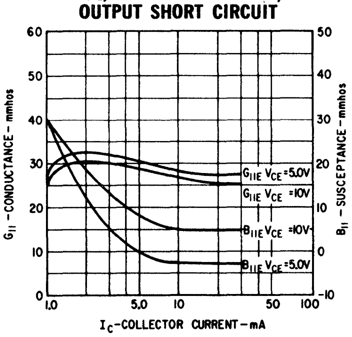


Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT

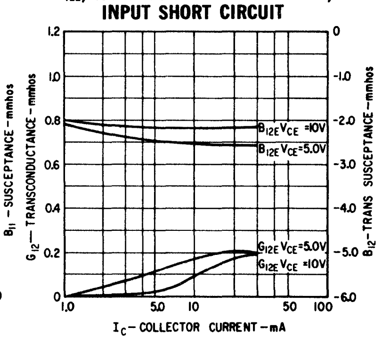


MT1061 • MT1061A (f = 500 MHz)

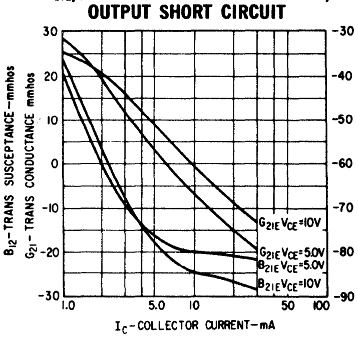
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



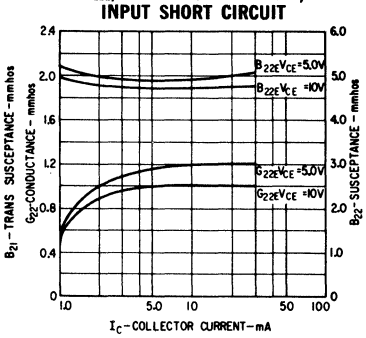
Y_{12E}, REVERSE TRANSADMITTANCE, INPUT SHORT CIRCUIT



Y_{21E}, FORWARD TRANSADMITTANCE, OUTPUT SHORT CIRCUIT

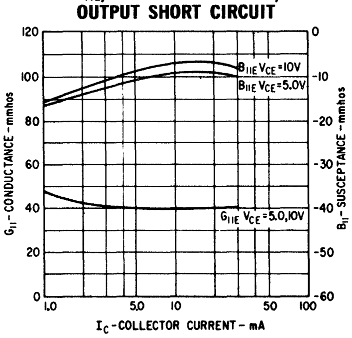


Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT

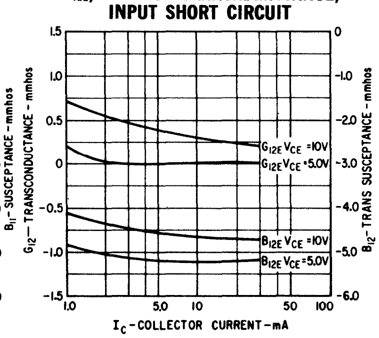


MT1061 • MT1061A (f = 1.0 GHz)

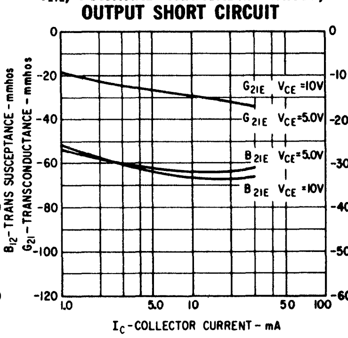
Y_{11E}, INPUT ADMITTANCE, OUTPUT SHORT CIRCUIT



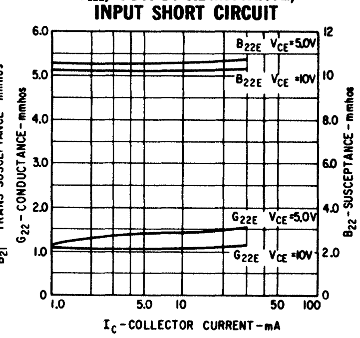
Y_{12E}, REVERSE TRANSADMITTANCE, INPUT SHORT CIRCUIT



Y_{21E}, FORWARD TRANSADMITTANCE, OUTPUT SHORT CIRCUIT



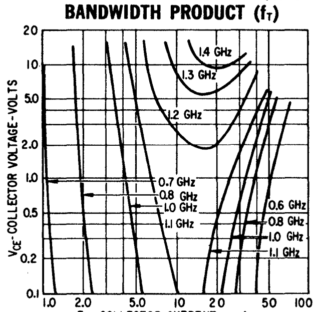
Y_{22E}, OUTPUT ADMITTANCE, INPUT SHORT CIRCUIT



TYPICAL ELECTRICAL CHARACTERISTICS

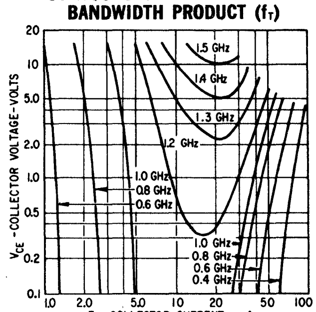
MT1060

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



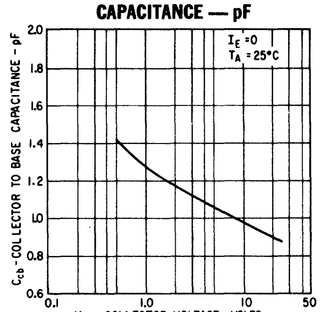
MT1061A

CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



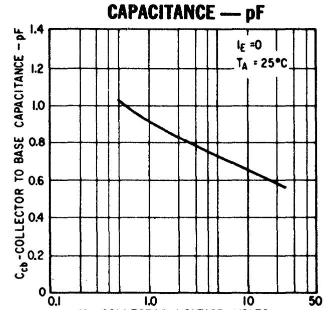
MT1060 • MT1060A

COLLECTOR TO BASE CAPACITANCE — pF



MT1061 • MT1061A

COLLECTOR TO BASE CAPACITANCE — pF

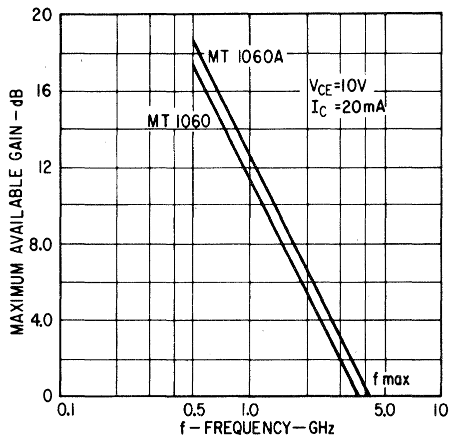


AMPLIFIER CHARACTERISTICS

MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY

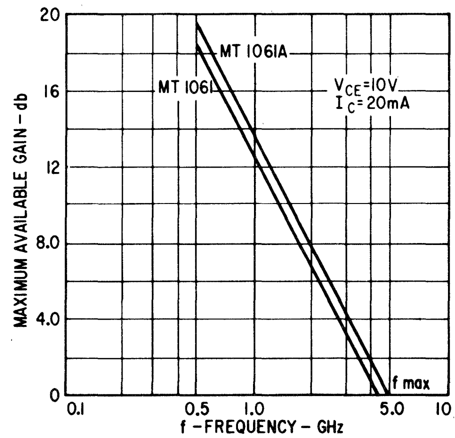
MT1060 • MT1060A

MAXIMUM AVAILABLE GAIN — dB



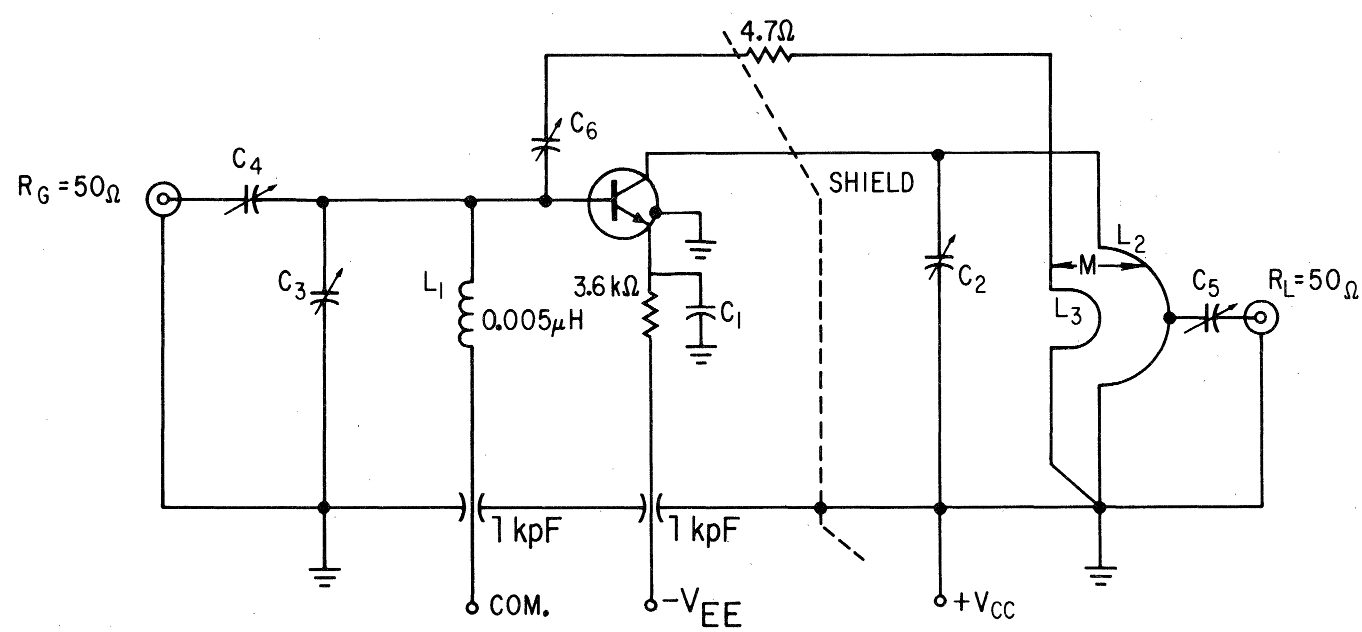
MT1061 • MT1061A

MAXIMUM AVAILABLE GAIN — dB



MT1061 • MT1061A

POWER GAIN AND NOISE FIGURE TEST CIRCUIT (f = 450 MHz)



NOTE: Bandwidth ≥ 20 MHz (Set C_5)
C_1—Uncapsulated Disc Ceramic Capacitor > 500 pF
C_2, C_3, C_4, C_5, C_6 = 0.8—10 pF
L_2 IT #22 tinned wire ½" dia. tap ¾ up from ground
L_3 IT #22 tinned wire 5/16" dia.

MT1062

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPE

SILICON PLANAR* EPITAXIAL TRANSISTOR

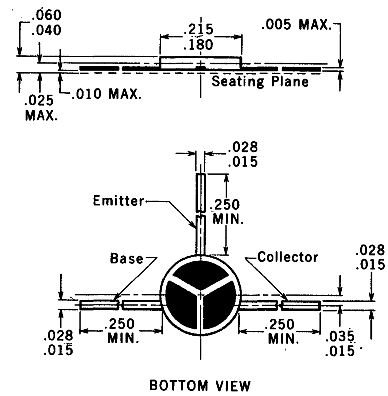
GENERAL DESCRIPTION — The MT1062 is a Silicon Planar* Epitaxial Transistor intended for Microwave oscillator and amplifier applications to 3.5 GHz. These units feature good high-frequency current gain which yields gain-bandwidth products (f_T) of typically 1.5 GHz. Co-Planer lead construction of the TO-50 package makes this device ideal for stripline amplifier applications.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature		−65°C to +200°C
Operating Junction Temperature		175°C Maximum
Lead Temperature (Soldering, 60 second time limit)		300°C Maximum
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature		1.0 Watt
at 25°C Free Air Temperature		0.3 Watt
Maximum Voltages and Current		
V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage	14 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	80 mA

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-50) outline



NOTES: All dimensions in inches
Leads are gold plated Kovar
Base material is ceramic and is 10 mils thick
Package weight is 0.126 grams
Emitter internally tied to case for common emitter operation

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain	40	75	185		$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage		0.27	0.35	Volts	$I_C = 80$ mA	$I_B = 8.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage		0.93	0.96	Volts	$I_C = 40$ mA	$I_B = 20$ mA
h_{fe}	High Frequency Current Gain (f = 500 MHz)	2.6	3.0			$I_C = 20$ mA	$V_{CE} = 10$ V
C_{cb}	Collector Base Capacitance		1.0	1.33	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter Base Capacitance		2.0	3.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		0.01	50	nA	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}(125°C)	Collector Cutoff Current		0.3	1.0	μA	$I_E = 0$	$V_{CB} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 10$ μA	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	14	17.5		Volts	$I_C = 1.0$ mA	$I_B = 0$
I_{EBO}	Emitter Cutoff Current		20	100	μA	$I_C = 0$	$V_{EB} = 4.0$ V
f_T	Gain-Bandwidth Product	1.3	1.5		GHz	$I_C = 20$ mA	$V_{CE} = 10$ V
$r_b'C_c$	Base Collector Time Constant (f = 79.8 MHz)			3.5	ps	$I_C = 20$ mA	$V_{CE} = 10$ V

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).

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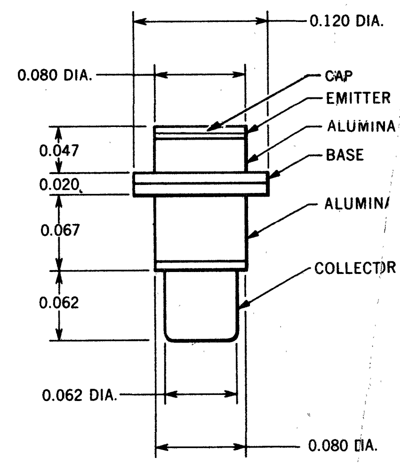
MT1070

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPE

SILICON PLANAR* EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION — The MT1070 is a Silicon Planar* Epitaxial Transistor featuring a coaxial package that provides very low inter-electrode capacitance, very low lead inductance and high emitter-to-collector isolation. This device is ideally suited for small signal amplifier and oscillator applications to 3.5 GHz.

PHYSICAL DIMENSIONS



NOTES:
All dimensions in inches
Emitter and base connections are gold-plated KOVAR
Collector is internally connected to copper stud

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	175°C
Lead Temperatures (Soldering, 60 second time limit)	300°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.5 W
at 25°C Mounting Surface Temperature	1.0 W

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage	14 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	80 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain	40	45	185		$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
$V_{CE(sat)}$	Collector Saturation Voltage (Pulsed)		0.27	0.35	Volts	$I_C = 80$ mA	$I_B = 8.0$ mA
$V_{BE(sat)}$	Base Saturation Voltage (Pulsed)		0.93	0.96	Volts	$I_C = 40$ mA	$I_B = 20$ mA
h_{fe}	High Frequency Current Gain (f = 500 MHz)	2.6	3.0			$I_C = 20$ mA	$V_{CE} = 10$ V
C_{cb}	Collector Base Capacitance		0.90	1.0	pF	$I_E = 0$	$V_{CB} = 10$ V
C_{eb}	Emitter Base Capacitance		2.0	3.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CBO}	Collector Cutoff Current		0.01	50	nA	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}(125°C)	Collector Cutoff Current		0.3	1.0	μA	$I_E = 0$	$V_{CB} = 10$ V
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 10\ \mu$A	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	14	17.5		Volts	$I_C = 1.0$ mA	$I_B = 0$
I_{EBO}	Emitter Cutoff Current		20	100	μA	$I_C = 0$	$V_{EB} = 4.0$ V
F_T	Gain-Bandwidth Product	1.3	1.5		GHz	$I_C = 20$ mA	$V_{CE} = 10$ V
$r_b'C_c$	Base Collector Time Constant (f = 79.8 MHz)			2.5	ps	$I_C = 20$ mA	$V_{CE} = 10$ V

*Planar is a patented Fairchild process.

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to mounting surface of 500°C/Watt (derating factor of 2.0 mW/°C).

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MT1115 • MT1116

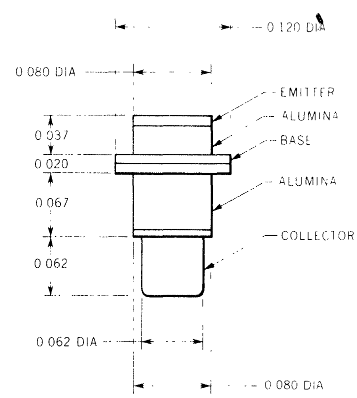
NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — The MT-1115 and MT-1116 are NPN planar epitaxial transistors designed for S-band and C-band oscillator applications. These transistors are tested to guarantee 90 mW minimum of output power for MT-1116, and 45 mW for MT-1115 while operating at about 20% efficiency.

- **GUARANTEED MINIMUM OSCILLATOR POWER OUT AT 3.0 GHz**
- **HIGH GAIN BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$ . . . 2.5 ps MAX**
- **HIGH f_{max} . . . . TYP. OF 8.0 GHz FOR MT-1116**
- **COAXIAL STRUCTURE**

PHYSICAL DIMENSIONS



NOTES:
All dimensions in inches
Emitter and base connections are gold-plated KOVAR
Collector is internally connected to copper stud

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+175°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 Watt
at 25°C Ambient Temperature	0.2 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	28 Volts
V_{CES}	Collector to Emitter Voltage	28 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	12 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	80 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MT-1115 MIN.	TYP.	MAX.	MT-1116 MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	45	155	20	45	155		$I_C = 500\ \mu A$	$V_{CE} = 5.0\ V$
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.27	0.38		0.27	0.38	Volts	$I_C = 80\ mA$	$I_B = 8\ mA$
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.93	0.98		0.93	0.98	Volts	$I_C = 40\ mA$	$I_B = 20\ mA$
h_{fe}	High Frequency Current Gain (f = 500 MHz)	3.0	3.6		3.0	4.0			$I_C = 20\ mA$	$V_{CE} = 10\ V$
C_{cb}	Collector to Base Capacitance		0.7	0.8		0.7	0.8	pF	$V_{CB} = 10\ V$	$I_E = 0$
C_{eb}	Emitter to Base Capacitance		1.7	2.0		1.7	2.0	pF	$V_{EB} = +0.5\ V$	$I_C = 0$
I_{CBO}	Collector Cutoff Current		0.01	10		0.01	10	nA	$V_{CB} = 10\ V$	$I_E = 0$
$I_{CBO}(150°C)$	Collector Cutoff Current		10	50		10	50	nA	$V_{CB} = 10\ V$	$I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	28	32		28	32		Volts	$I_C = 10\ \mu A$	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 4)	12	15		12	15		Volts	$I_C = 1.0\ mA$	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	4.75		4.0	4.75		Volts	$I_E = 100\ \mu A$	$I_C = 0$
P_o	Oscillator Power Out (f = 3.0 GHz)				90	100		mW	$V_{CB} = 12\ V$	$I_C \leq 45\ mA$
P_o	Oscillator Power Out (f = 3.0 GHz)	45	60					mW	$V_{CB} = 12\ V$	$I_C \leq 50\ mA$
$r_b'C_c$	Collector to Base Time Constant (f = 79.8 MHz)		2.0	2.5		1.5	2.5	ps	$I_C = 20\ mA$	$V_{CB} = 10\ V$

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to ambient thermal resistance of 750°C/Watt (derating factor of 1.33 mW/°C).
(4) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

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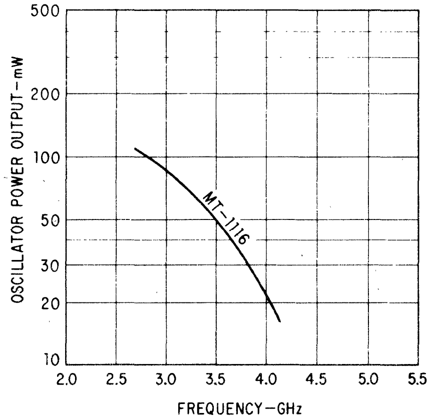
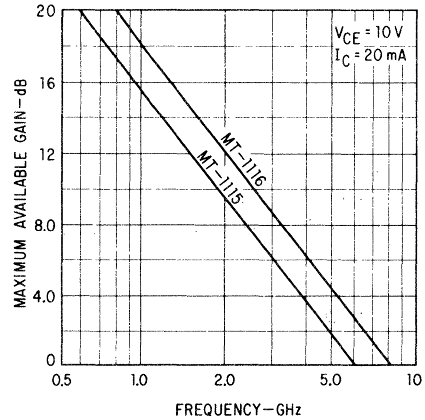
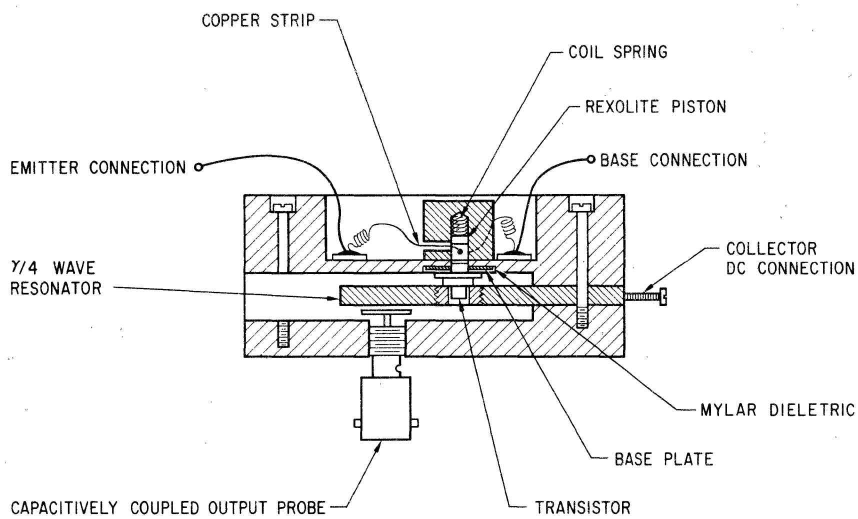
OSCILLATOR POWER OUTPUT VERSUS FREQUENCY

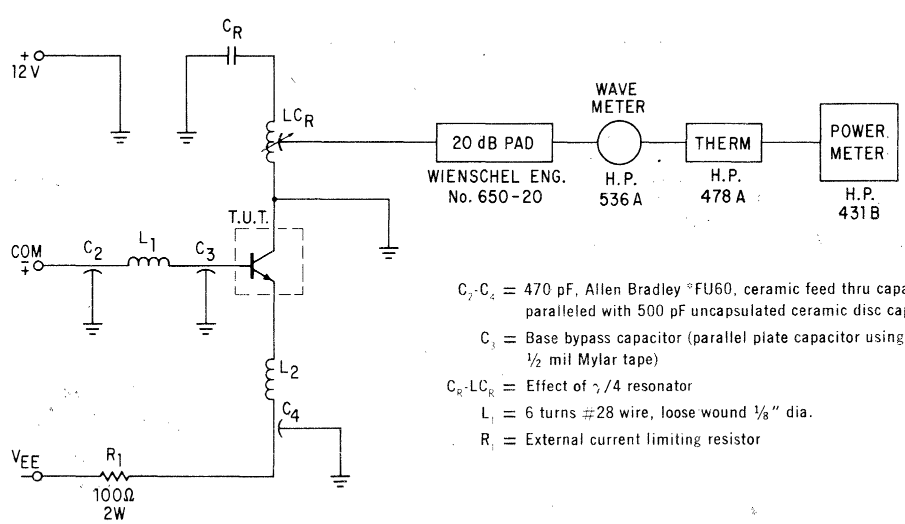


TYPICAL MAXIMUM AVAILABLE GAIN VERSUS FREQUENCY



3.0 GHz TEST CIRCUIT





C_2-C_4 = 470 pF, Allen Bradley *FU60, ceramic feed thru capacitors paralleled with 500 pF uncapsulated ceramic disc capacitors

C_3 = Base bypass capacitor (parallel plate capacitor using ½ mil Mylar tape)

C_R-LC_R = Effect of $\lambda/4$ resonator

L_1 = 6 turns #28 wire, loose wound ⅛" dia.

R_1 = External current limiting resistor

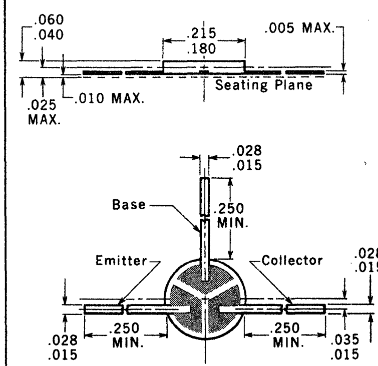
MT3833 • MT3834

NPN MICROWAVE AMPLIFIER, OSCILLATOR TYPES

SILICON PLANAR* EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION — The MT3833 and MT3834 are Silicon Planar Epitaxial Transistors intended for microwave oscillator and amplifier applications. These units feature good high frequency current gain plus low $r_b'C_c$ time constants making the MT3833 usable to 5.0 GHz, and the MT3834 usable to 4.5 GHz. Co-Planar lead construction of the TO-50 package makes these devices ideal for stripline oscillator and amplifier applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-50) outline



BOTTOM VIEW

NOTES: All dimensions in inches
Leads are gold plated Kovar
Base material is ceramic and is 10 mils thick
Package weight is 0.126 grams
Base internally tied to case
for common base operation

FEATURES:
- **HIGH GAIN-BANDWIDTH PRODUCT**
- **LOW $r_b'C_c$**
- **HIGH f_{max}**
- **CO-PLANAR PACKAGE**
- **GUARANTEED OSCILLATOR POWER AT 2.0 GHz**

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Storage Temperature		−65°C to +200°C
Operating Junction Temperature		+175°C
Lead Temperature (Soldering, 60 second time limit)		+300°C
Maximum Power Dissipation (Notes 2 and 3)		
Total Dissipation at 25°C Case Temperature		1.0 Watt
at 25°C Free Air Temperature		0.3 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Continuous Collector Current	100 mA

HIGH FREQUENCY CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MT3833 MIN.	MT3833 TYP.	MT3833 MAX.	MT3834 MIN.	MT3834 TYP.	MT3834 MAX.	UNITS	TEST CONDITIONS	
f_T	Gain Bandwidth Product	1.0	1.5		1.0	1.3		GHz	$I_C = 30$ mA $f = 500$ MHz	$V_{CE} = 12$ V
$r_b'C_c$	Base Collector Time Constant		2.5	3.5		2.7	3.5	ps	$I_C = 30$ mA $f = 79.8$ MHz	$V_{CB} = 12$ V
f_{max}	Maximum Frequency of Oscillation (Note 6)		5.0			4.5		GHz	$I_C = 30$ mA	$V_{CC} = 12$ V
P_o	Oscillator Power Out (See test circuit)	100	120		75	90		mW	$I_C = 30$ mA $f = 2.0$ GHz	$V_{CB} = 12$ V
MAG	Maximum Available Gain		8.0			7.0		dB	$I_C = 30$ mA $f = 2.0$ GHz	$V_{CC} = 12$ V

Additional Electrical Characteristics on Page 2

*Planar is a patented Fairchild process.

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications inolving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 175°C and junction to case thermal resistance of 150°C/Watt (derating factor of 6.67 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(6) Calculated from: $f_{max} = \sqrt{\dfrac{f_T}{8 \pi r_b' C_c}}$

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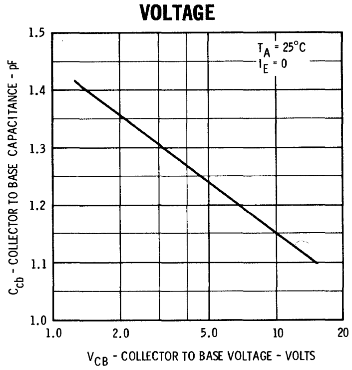
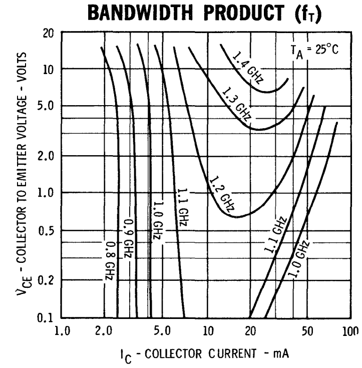
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

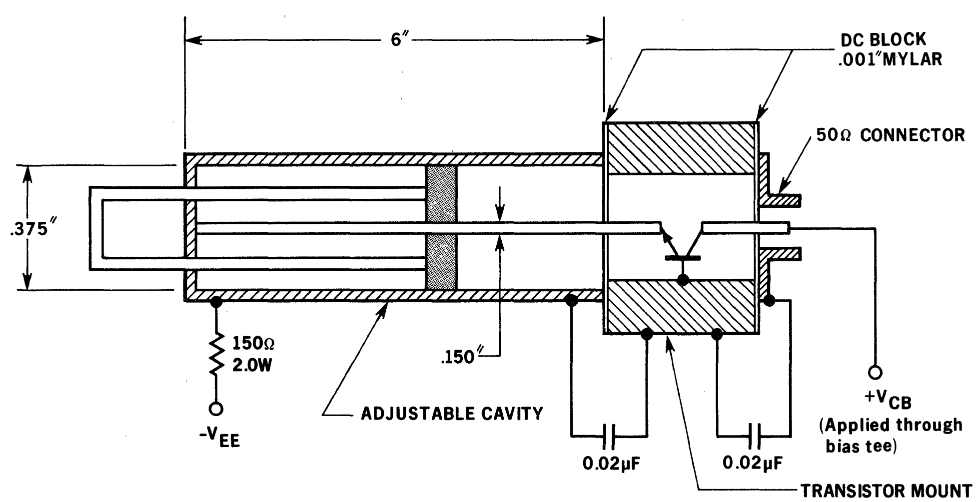
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	20	40			$I_C = 30$ mA	$V_{CE} = 12$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.34	0.38	Volts	$I_C = 80$ mA	$I_B = 8.0$ mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.94	0.98	Volts	$I_C = 40$ mA	$I_B = 20$ mA
h_{fe}	High Frequency Current Gain (f = 500 MHz)	2.0				$I_C = 30$ mA	$V_{CE} = 12$ V
C_{cb}	Collector to Base Capacitance		1.1	1.33	pF	$I_E = 0$	$V_{CB} = 12$ V
C_{eb}	Emitter to Base Capacitance		2.0	3.0	pF	$I_C = 0$	$V_{EB} = 0.5$ V
I_{CES}	Collector Cutoff Current			20	nA	$V_{BE} = 0$	$V_{CE} = 12$ V
I_{CES}(100°C)	Collector Cutoff Current			20	μA	$V_{BE} = 0$	$V_{CE} = 12$ V
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	$I_C = 10$ μA	$I_E = 0$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15	17.5		Volts	$I_C = 2.0$ mA	$I_B = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0	5.0		Volts	$I_E = 100$ μA	$I_C = 0$
I_{EBO}	Emitter Cutoff Current			10	μA	$I_C = 0$	$V_{EB} = 3.0$ V

COLLECTOR TO BASE CAPACITANCE VERSUS COLLECTOR TO BASE VOLTAGE

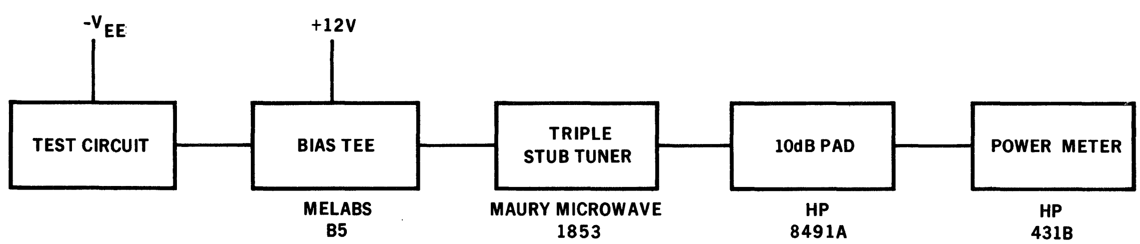


CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)





2.0 GHz OSCILLATOR TEST CIRCUIT



OSCILLATOR POWER MEASUREMENT