MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

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MC1590G

WIDEBAND AMPLIFIER WITH AGC

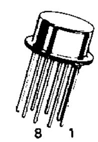
SILICON MONOLITHIC INTEGRATED CIRCUIT

RF/IF/AUDIO AMPLIFIER

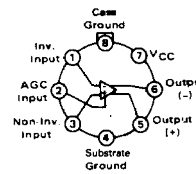
. . . an integrated circuit featuring wide-range AGC for use in RF/IF amplifiers and audio amplifiers over the temperature range, −55 to +125°C.

- High Power Gain — 50 dB Typ at 10 MHz
  45 dB Typ at 60 MHz
  35 dB Typ at 100 MHz
- Wide-Range AGC — 60 dB min, dc to 60 MHz
- Low Reverse Transfer Admittance — <10 μmhos Typ at 60 MHz
- 6.0 to 15-Volt Operation, Single-Polarity Power Supply

PIN CONNECTIONS



G SUFFIX
METAL PACKAGE
CASE 601



MAXIMUM RATINGS (T_A = +25°C unless otherwise noted)

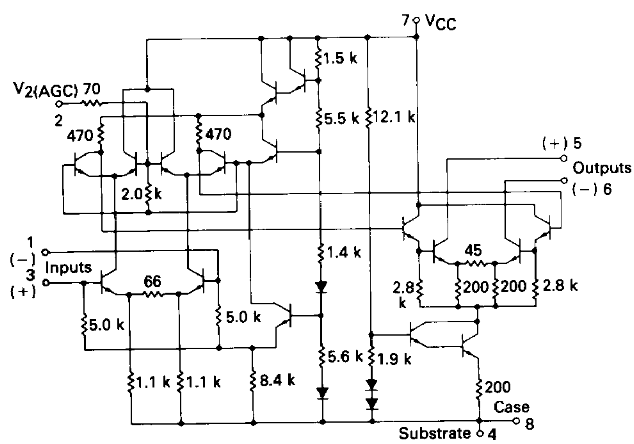
Rating	Symbol*	Value	Unit
Power Supply Voltage	V_{CC}	+18	Vdc
Output Supply	V_O	+18	Vdc
AGC Supply	$V_{2(AGC)}$	V_{CC}	Vdc
Differential Input Voltage	V_I	5.0	Vdc
Operating Temperature Range	T_A	−55 to +125	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Junction Temperature	T_J	+175	°C

ADMITTANCE PARAMETERS
(V_{CC} = +12 Vdc, T_A = +25°C)

Parameter	Symbol	f = MHz Typ		Unit
		30	60	
Single-Ended Input Admittance	g_{11} b_{11}	0.4 1.2	0.6 −3.0	mmhos
Single-Ended Output Admittance	g_{22} b_{22}	0.05 0.5	0.1 1.0	mmhos
Forward Transfer Admittance (Pin 1 to Pin 5)	Y_{21} θ_{21} (Polar)	175 −30	150 −105	mmhos °C
Reverse Transfer Admittance*	g_{12} b_{12}	−0 −5.0	−0 −10	μmhos

*The value of Reverse Transfer Admittance includes the feedback admittance of the test circuit used in the measurement. The total feedback capacitance (including test circuit) is 0.025 pF and is a more practical value for design calculations than the internal feedback of the device alone. (See Figure 10.)

REPRESENTATIVE CIRCUIT SCHEMATIC



Pins 4 and 8 should both be connected to circuit ground.

SCATTERING PARAMETERS (V_{CC} = +12 Vdc, T_A = +25°C, Z_o = 50 Ω)

Parameter	Symbol	f = MHz Typ		Unit
		30	60	
Input Reflection Coefficient	S_{11} θ_{11}	0.95 −7.3	0.93 −16	— °C
Output Reflection Coefficient	S_{22} θ_{22}	0.99 −3.0	0.98 −5.5	— °C
Forward Transmission Coefficient	S_{21} θ_{21}	16.8 128	14.7 64.3	— °C
Reverse Transmission Coefficient	S_{12} θ_{12}	0.00048 84.9	0.00092 79.2	— °C

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ELECTRICAL CHARACTERISTICS (V_{CC} = +12 Vdc, f = 60 MHz, BW = 1.0 MHz, T_A = −55°C to +125°C unless otherwise noted)

Characteristic	Fig.	Symbol	Min	Typ	Max	Unit
AGC Range ($V_{2(AGC)}$ = 5.0 V to 7.0 V) ($V_{2(AGC)}$ = 5.0 V to 7.0 V, T_A = 25°C)	24	M_{AGC}	 58 60	 — 68	 — —	dB
Single-Ended Power Gain (T_A = 25°C)	24	G_p	37 40	— 45	— —	dB
Noise Figure (R_s optimized for best NF) (T_A = 25°C)	24	NF	—	6.0	7.0	dB
Output Stage Current (Sum of Pins 5 and 6) (T_A = 25°C)	32	I_O	 3.5 4.0	 — 5.6	 8.0 7.5	mA
Output Current Matching (Magnitude of Difference of Output Currents) ($I_5 - I_6$) (T_A = 25°C)	32	ΔI_O	—	0.7	—	mA
Power Supply Current (V_O = 0 V) (V_O = 0 V, T_A = 25°C)	32	I_{CC}	 — —	 — 14	 20 17	mA
Power Consumption (12 × I_{CC}) (V_I = 0 V) (V_I = 0 V, T_A = 25°C)	—	P_C	 — —	 — 168	 240 204	mW

FIGURE 1 – UNNEUTRALIZED POWER GAIN versus FREQUENCY
(Tuned Amplifier, See Figure 24)

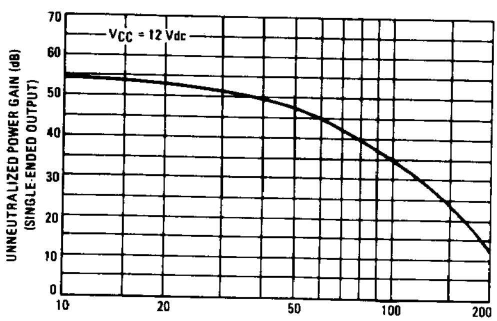
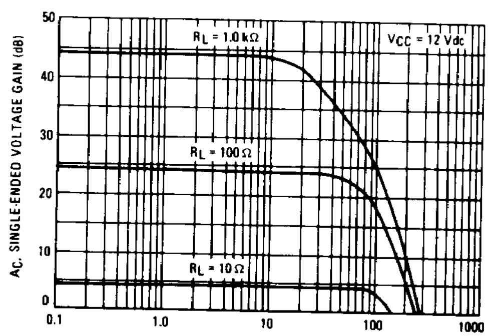


FIGURE 2 – VOLTAGE GAIN versus FREQUENCY
(Video Amplifier, See Figure 26)



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TYPICAL CHARACTERISTICS

($V_{2\,(AGC)}$ = 0, V_{CC} = 12 Vdc, T_A = +25°C unless otherwise noted)

FIGURE 3 – DYNAMIC RANGE: OUTPUT VOLTAGE versus INPUT VOLTAGE (Video Amplifier, See Figure 26)

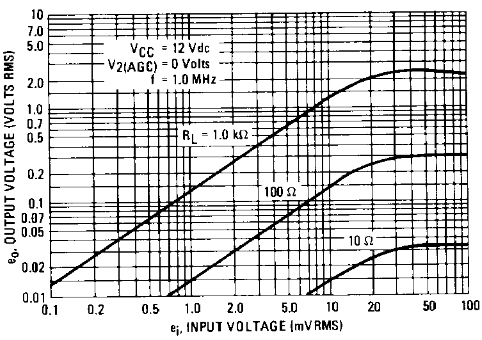


FIGURE 4 – VOLTAGE GAIN versus FREQUENCY (Video Amplifier, See Figure 26)

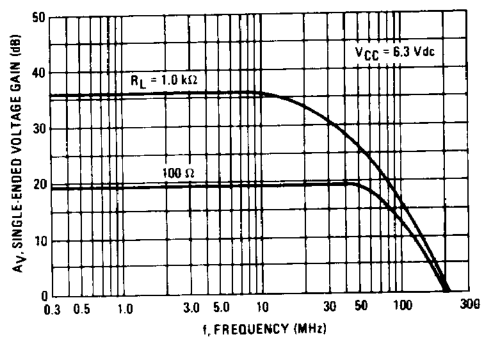


FIGURE 5 – VOLTAGE GAIN AND SUPPLY CURRENT versus SUPPLY VOLTAGE (Video Amplifier, See Figure 26)

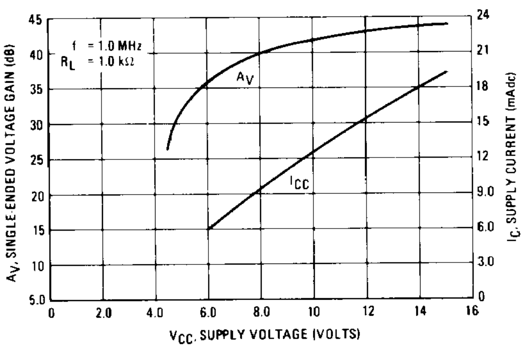


FIGURE 6 – TYPICAL GAIN REDUCTION versus AGC VOLTAGE

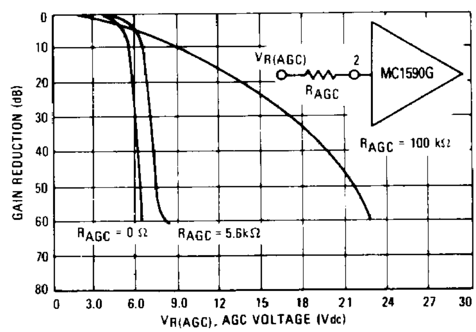


FIGURE 7 – TYPICAL GAIN REDUCTION versus AGC CURRENT

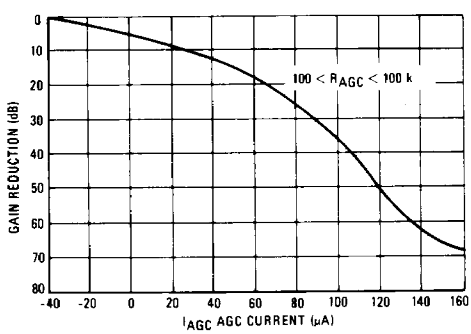
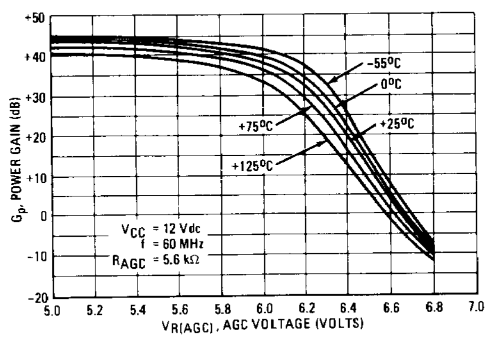


FIGURE 8 – FIXED TUNED POWER GAIN REDUCTION versus TEMPERATURE (See Test Circuit, Figure 24)



TYPICAL CHARACTERISTICS (continued)

FIGURE 9 – POWER GAIN versus SUPPLY VOLTAGE (See Test Circuit, Figure 24)

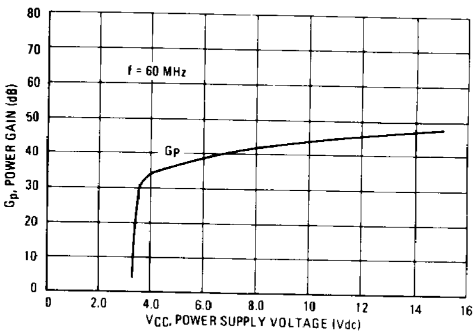


FIGURE 10 – REVERSE TRANSFER ADMITTANCE versus FREQUENCY (See Parameter Table, Page 1)

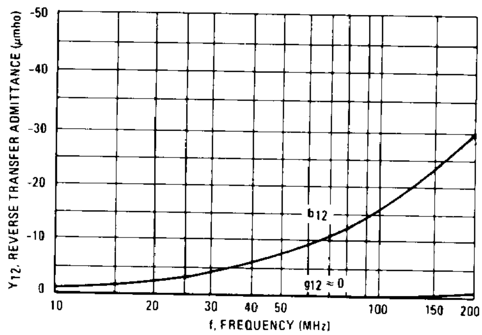


FIGURE 11 – NOISE FIGURE versus FREQUENCY

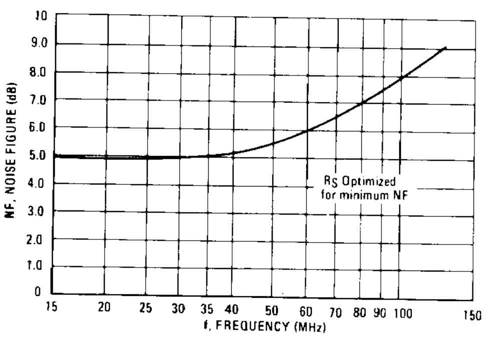


FIGURE 12 – NOISE FIGURE versus SOURCE RESISTANCE

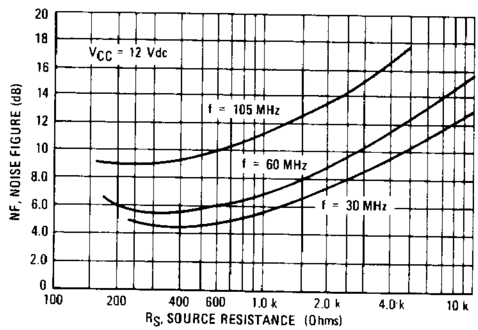
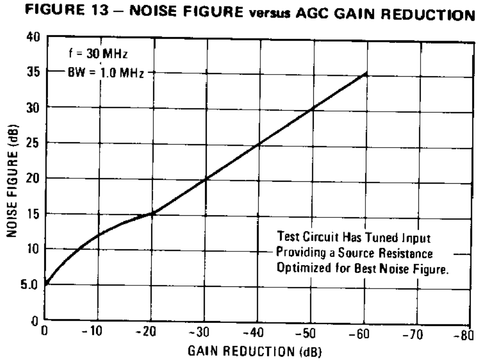


FIGURE 13 – NOISE FIGURE versus AGC GAIN REDUCTION



TYPICAL CHARACTERISTICS (continued)

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FIGURE 14 – SINGLE-ENDED OUTPUT ADMITTANCE

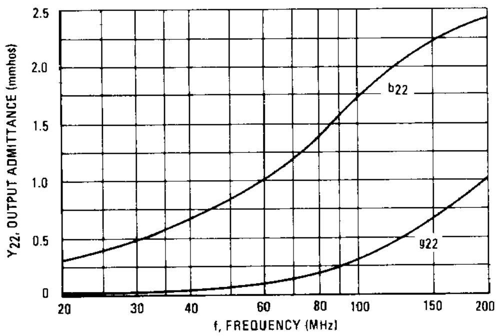


FIGURE 15 – SINGLE-ENDED INPUT ADMITTANCE

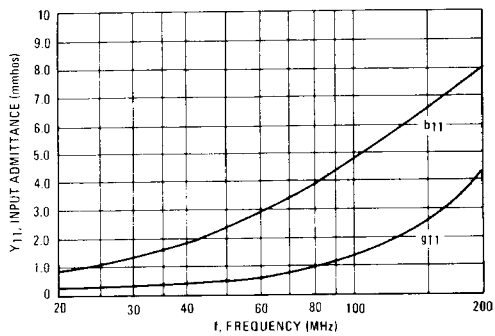


FIGURE 16 – HARMONIC DISTORTION versus AGC GAIN REDUCTION FOR AM CARRIER (For Test Circuit, See Figure 17)

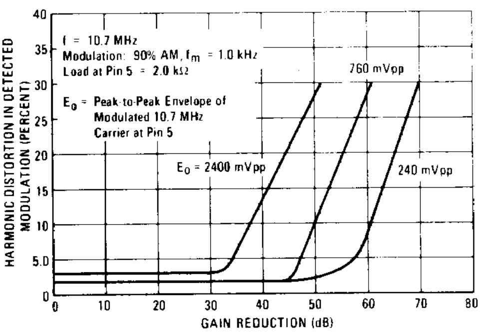
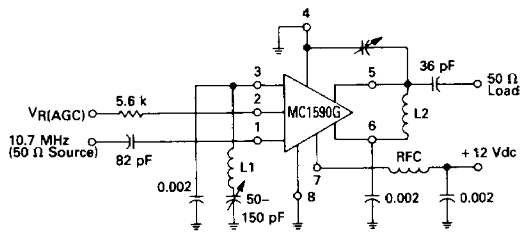


FIGURE 17 — 10.7 MHz AMPLIFIER
Gain ≈ 55 dB, BW ≈ 100 kHz



L1 = 24 Turns, No. 22 AWG Wire on a T12-44 Micro Metal Toroid Core (~124 pF)
L2 = 20 Turns, No. 22 AWG Wire on a T12-44 Micro Metal Toroid Core (~100 pF)

FIGURE 18 – Y_{21}, FORWARD TRANSFER ADMITTANCE RECTANGULAR FORM

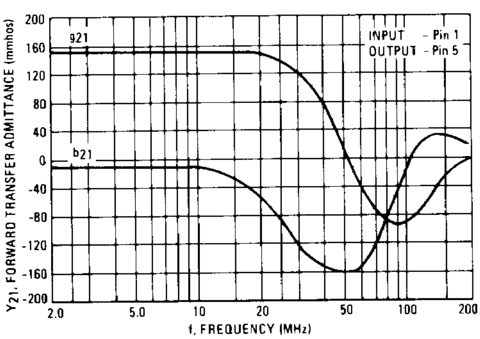
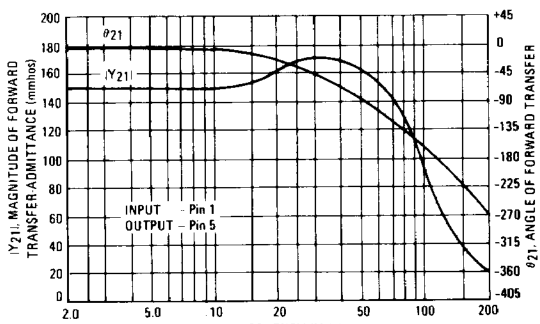


FIGURE 19 — Y_{21}, FORWARD TRANSFER ADMITTANCE POLAR FORM



TYPICAL CHARACTERISTICS (continued)

FIGURE 20 – S_{11} AND S_{22}, INPUT AND OUTPUT REFLECTION COEFFICIENT

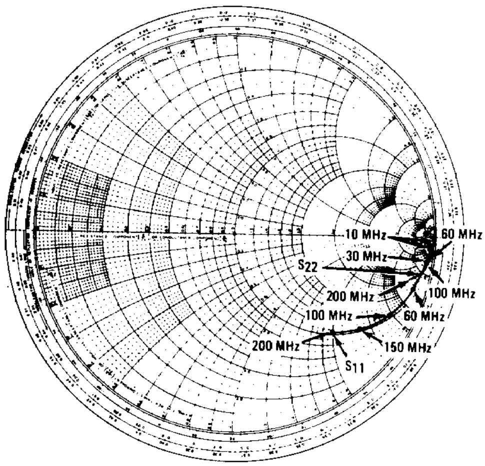


FIGURE 21 – S_{11} AND S_{22}, INPUT AND OUTPUT REFLECTION COEFFICIENT

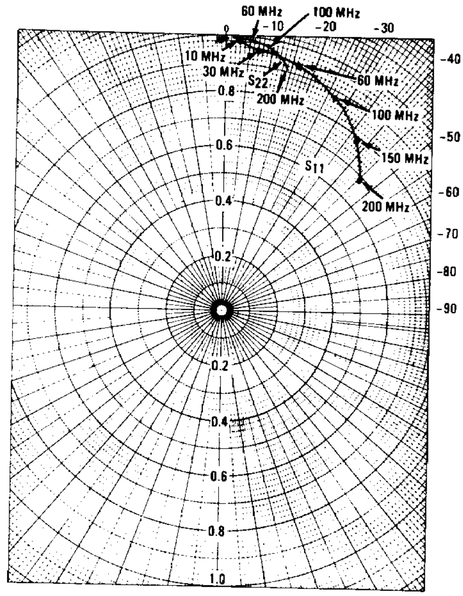


FIGURE 22 – S_{21}, FORWARD TRANSMISSION COEFFICIENT (GAIN)

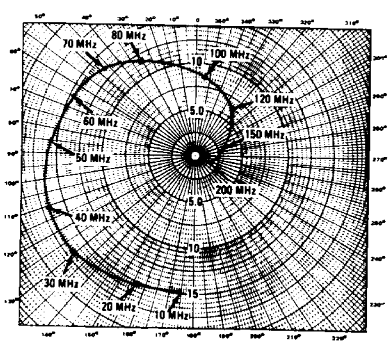
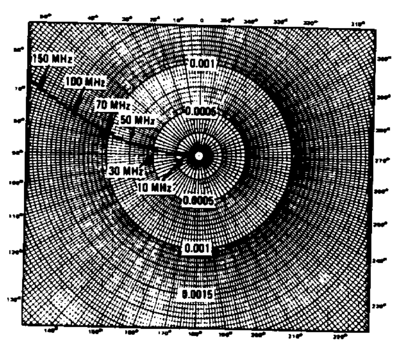


FIGURE 23 – S_{12}, REVERSE TRANSMISSION COEFFICIENT (FEEDBACK)



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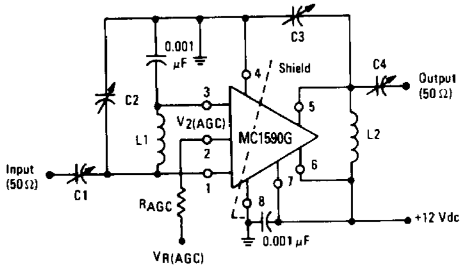
TYPICAL APPLICATIONS

FIGURE 24 — 60 MHz POWER GAIN TEST CIRCUIT



L1 = 7 Turns, #20 AWG Wire, 5/16″ Dia., 5/8″ Long
L2 = 6 Turns, #14 AWG Wire, 9/16″ Dia., 3/4″ Long
C1,C2,C3 = (1-30) pF
C4 = (1-10) pF

FIGURE 25 — PROCEDURE FOR SETUP USING FIGURE 24

Test	e_{in}	V2(AGC)	RAGC(kΩ)
MAGC	2.23 mV (−40dBm)	5-7 V	0
Gp	1.0 mV (−47dBm)	≤5.0 V	5.6
NF	1.0 mV (−47dBm)	≤5.0 V	5.6

FIGURE 26 – VIDEO AMPLIFIER

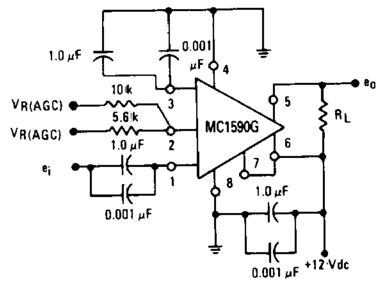
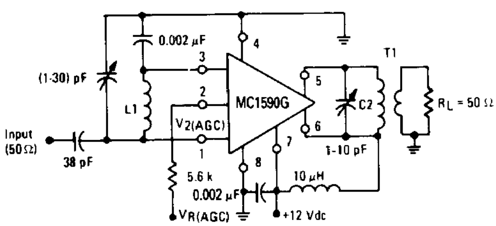
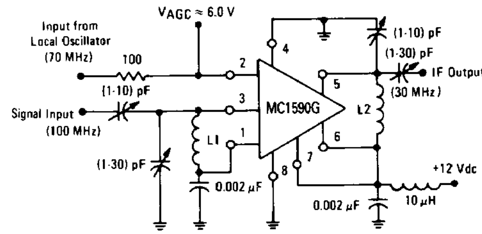


FIGURE 27 — 30 MHz AMPLIFIER (Power Gain = 50 dB, BW ≈ 1.0 MHz)



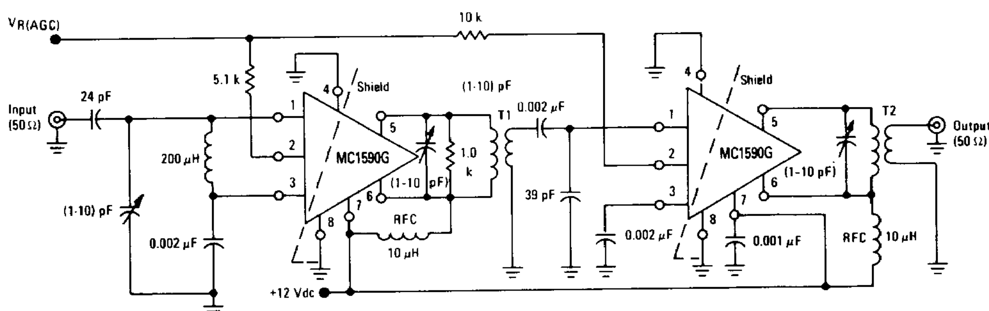
L1 = 12 Turns #22 AWG Wire on a Toroid Core, (T37-6 Micro Metal or Equiv)
T1: Primary = 17 Turns #20 AWG Wire on a Toroid Core, (T44-6 Micro Metal or Equiv)
Secondary = 2 Turns #20 AWG Wire

FIGURE 28 – 100 MHz MIXER



L1 = 5 Turns, #16 AWG Wire, 1/4″ ID, 5/8″ Long
L2 = 16 Turns, #20 AWG Wire on a Toroid Core, (T44-6 Micro Metal or Equiv)

FIGURE 29 – TWO-STAGE 60 MHz IF AMPLIFIER (Power Gain ≈ 80 dB, BW ≈ 1.5 MHz)



T1: Primary Winding = 15 Turns, #22 AWG Wire, 1/4″ ID Air Core
Secondary Winding = 4 Turns, #22 AWG Wire,
Coefficient of Coupling ≈ 1.0

T2: Primary Winding = 10 Turns, #22 AWG Wire, 1/4″ ID Air Core
Secondary Winding = 2 Turns, #22 AWG Wire,
Coefficient of Coupling ≈ 1.0

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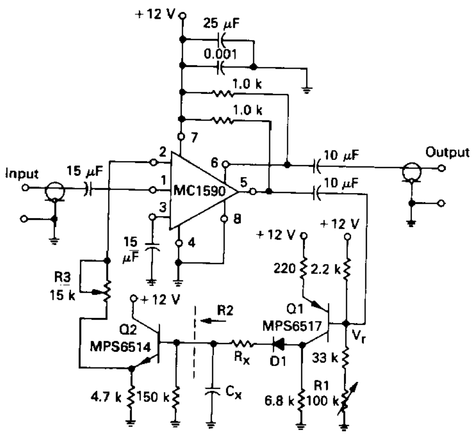
TYPICAL APPLICATIONS (continued)

FIGURE 30 – SPEECH COMPRESSOR



DESCRIPTION OF SPEECH COMPRESSOR

The amplifier drives the base of a PNP MPS6517 operating common-emitter with a voltage gain of approximately 20. The control R1 varies the quiescent Q point of this transistor so that varying amounts of signal exceed the level V_r. Diode D1 rectifies the positive peaks of Q1's output only when these peaks are greater than $V_r \approx 7.0$ Volts. The resulting output is filtered by C_X, R_X.

R_X controls the charging time constant or attack time. C_X is involved in both charge and discharge. R2 (the 150 kΩ and input resistance of the emitter-follower Q2) controls the decay time. Making the decay long and attack short is accomplished by making R_X small and R2 large. (A Darlington emitter-follower may be needed if extremely slow decay times are required.)

The emitter-follower Q2 drives the AGC Pin 2 of the MC1590G and reduces the gain. R3 controls the slope of signal compression. The following graph (Figure 31) details performance with R3 set to 15 kΩ.

FIGURE 31 – OUTPUT VOLTAGE versus INPUT VOLTAGE

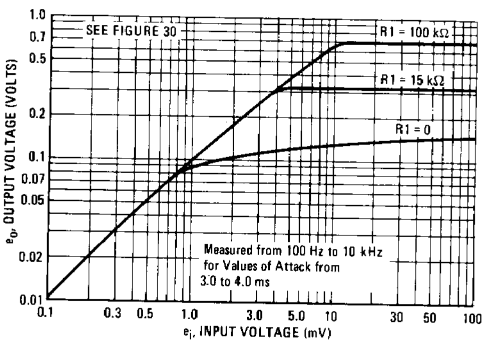


TABLE 1 — DISTORTION versus FREQUENCY

FREQUENCY	DISTORTION		DISTORTION	
	10 mV e_i	100 mV e_i	10 mV e_i	100 mV e_i
100 Hz	3.5%	12%	15%	27%
300 Hz	2%	10%	6%	20%
1.0 kHz	1.5%	8%	3%	9%
10 kHz	1.5%	8%	1%	3%
100 kHz	1.5%	8%	1%	3%
	Notes 1 and 2		Notes 3 and 4	

Note: (1) Decay = 300 ms
Attack = 20 ms
(2) C_X = 7.5 µF
R_X = 0 (Short)
(3) Decay = 20 ms
Attack = 3 ms
(4) C_X = 0.68 µF
R_X = 1.5 kΩ

FIGURE 32 – OUTPUT CURRENT, CURRENT MATCH AND I_{CC} FIXTURE