

MC1590G

RF/IF/AUDIO AMPLIFIER

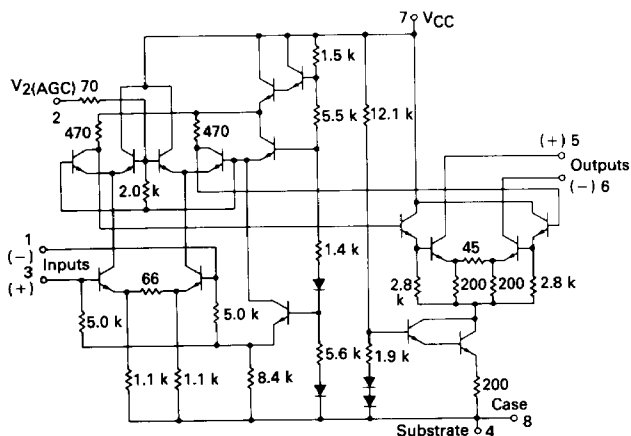
... an integrated circuit featuring wide-range AGC for use in RF/IF amplifiers and audio amplifiers over the temperature range, -55 to +125°C.

- 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 μ mhos Typ at 60 MHz
- 6.0 to 15-Volt Operation, Single-Polarity Power Supply

MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol*	Value	Unit
Power Supply Voltage	V_{CC}	+18	Vdc
Output Supply	V_O	+18	Vdc
AGC Supply	$V_2(\text{AGC})$	V_{CC}	Vdc
Differential Input Voltage	V_I	5.0	Vdc
Operating Temperature Range	T_A	-55 to +125	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-65 to +150	$^\circ\text{C}$
Junction Temperature	T_J	+175	$^\circ\text{C}$

REPRESENTATIVE CIRCUIT SCHEMATIC

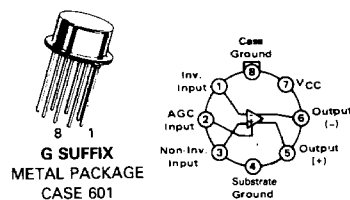


Pins 4 and 8 should both be connected to circuit ground.

WIDEBAND AMPLIFIER WITH AGC

SILICON MONOLITHIC INTEGRATED CIRCUIT

PIN CONNECTIONS



ADMITTANCE PARAMETERS ($V_{CC} = +12 \text{ Vdc}$, $T_A = +25^\circ\text{C}$)

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 $^\circ\text{C}$
Reverse Transfer Admittance*	g_{12} b_{12}	-0 -5.0	-0 -10	μ mhos

*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.)

SCATTERING PARAMETERS ($V_{CC} = +12 \text{ Vdc}$, $T_A = +25^\circ\text{C}$, $Z_0 = 50 \Omega$)

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

MC1590G

ELECTRICAL CHARACTERISTICS ($V_{CC} = +12 \text{ Vdc}$, $f = 60 \text{ MHz}$, $BW = 1.0 \text{ MHz}$, $T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$ unless otherwise noted)

Characteristic	Fig.	Symbol	Min	Typ	Max	Unit
AGC Range ($V_2(\text{AGC}) = 5.0 \text{ V}$ to 7.0 V) ($V_2(\text{AGC}) = 5.0 \text{ V}$ to 7.0 V , $T_A = 25^\circ\text{C}$)	24	M_{AGC}	58 60	— 68	— —	dB
Single-Ended Power Gain ($T_A = 25^\circ\text{C}$)	24	G_p	37 40	— 45	— —	dB
Noise Figure (R_s optimized for best NF) ($T_A = 25^\circ\text{C}$)	24	NF	—	6.0	7.0	dB
Output Stage Current (Sum of Pins 5 and 6) ($T_A = 25^\circ\text{C}$)	32	I_O	3.5 4.0	— 5.6	8.0 7.5	mA
Output Current Matching (Magnitude of Difference of Output Currents) ($I_5 - I_6$) ($T_A = 25^\circ\text{C}$)	32	ΔI_O	—	0.7	—	mA
Power Supply Current ($V_O = 0 \text{ V}$) ($V_O = 0 \text{ V}$, $T_A = 25^\circ\text{C}$)	32	I_{CC}	— —	— 14	20 17	mA
Power Consumption ($12 \times I_{CC}$) ($V_I = 0 \text{ V}$) ($V_I = 0 \text{ V}$, $T_A = 25^\circ\text{C}$)	—	P_C	— —	— 168	240 204	mW

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

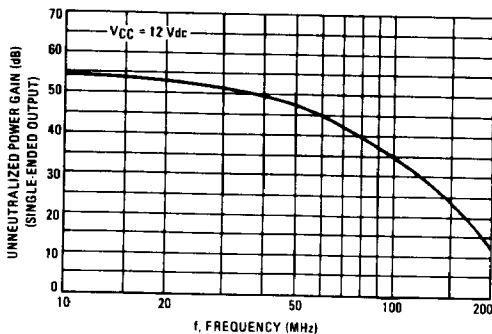
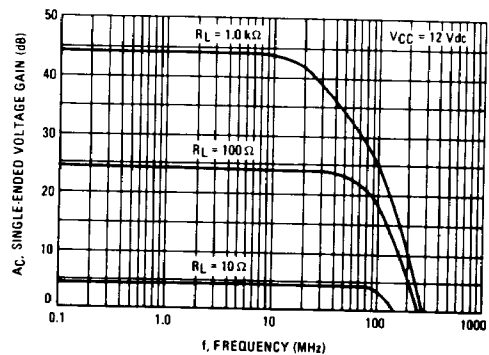


FIGURE 2 — VOLTAGE GAIN versus FREQUENCY
(Video Amplifier, See Figure 26)



MC1590G

TYPICAL CHARACTERISTICS

($V_2(AGC) = 0$, $V_{CC} = 12$ Vdc, $T_A = +25^\circ\text{C}$ unless otherwise noted)

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

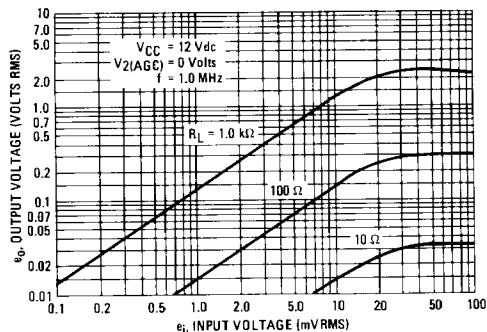


FIGURE 4 – VOLTAGE GAIN versus FREQUENCY (Video Amplifier, See Figure 26)

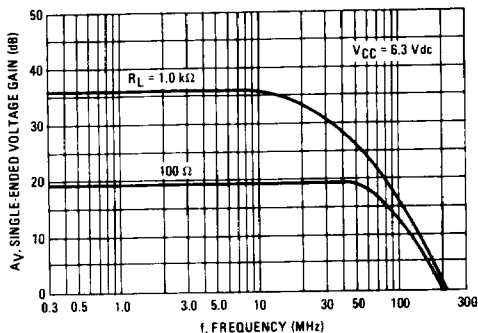


FIGURE 5 – VOLTAGE GAIN AND SUPPLY CURRENT versus SUPPLY VOLTAGE (Video Amplifier, See Figure 26)

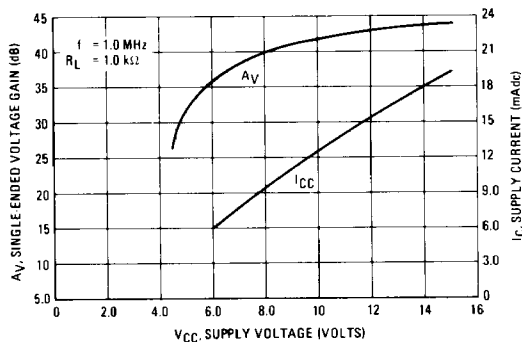


FIGURE 6 – TYPICAL GAIN REDUCTION versus AGC VOLTAGE

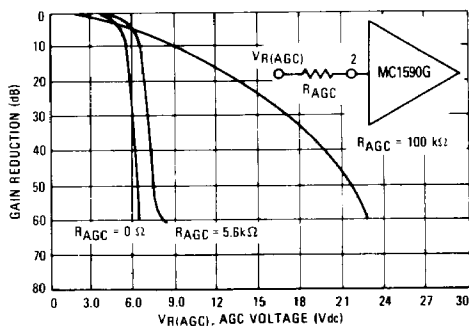


FIGURE 7 – TYPICAL GAIN REDUCTION versus AGC CURRENT

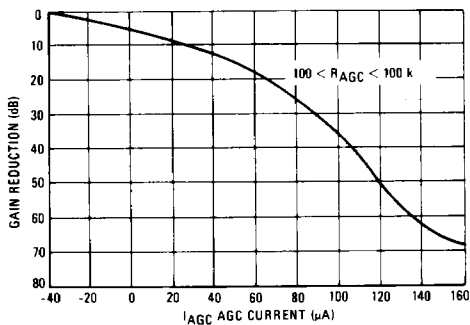
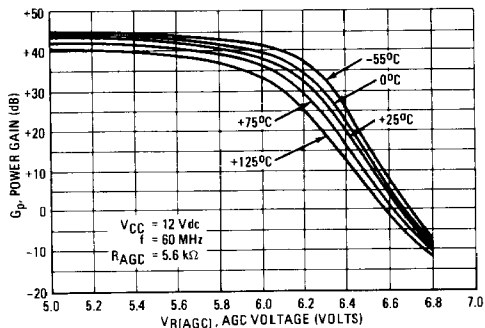


FIGURE 8 – FIXED TUNED POWER GAIN REDUCTION versus TEMPERATURE (See Test Circuit, Figure 24)



TYPICAL CHARACTERISTICS (continued)

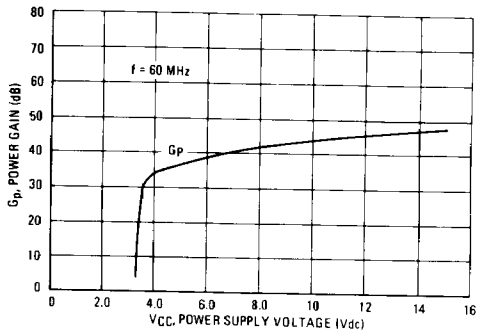
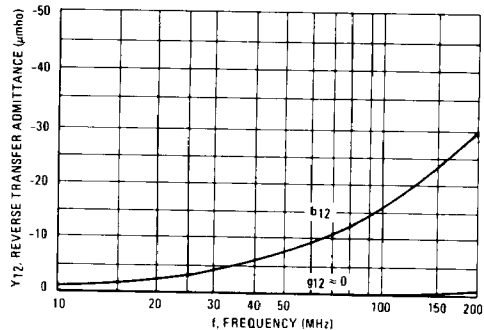
FIGURE 9 – POWER GAIN versus SUPPLY VOLTAGE
(See Test Circuit, Figure 24)FIGURE 10 – REVERSE TRANSFER ADMITTANCE versus FREQUENCY
(See Parameter Table, Page 1)

FIGURE 11 – NOISE FIGURE versus FREQUENCY

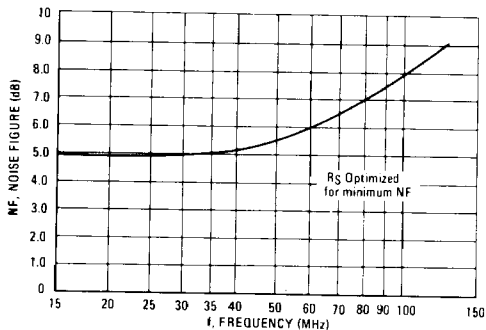


FIGURE 12 – NOISE FIGURE versus SOURCE RESISTANCE

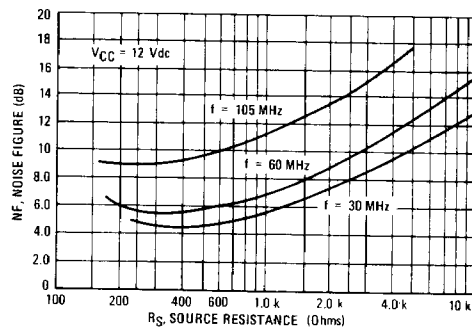
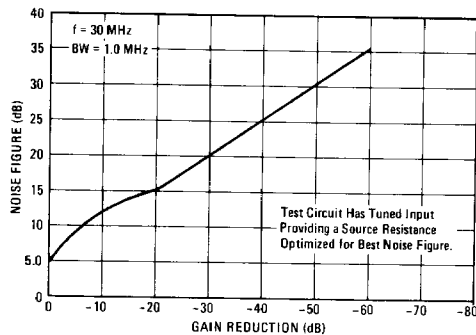
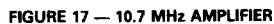
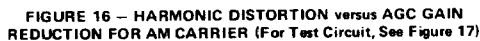


FIGURE 13 – NOISE FIGURE versus AGC GAIN REDUCTION



2

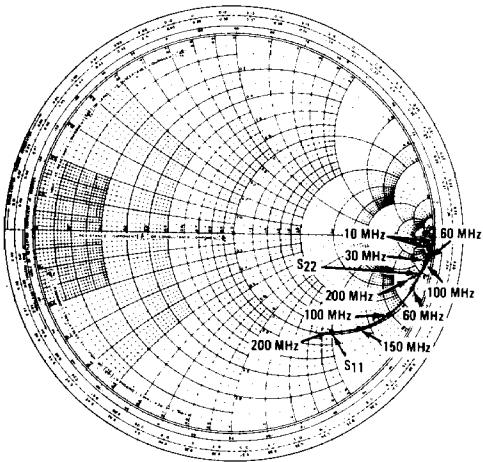
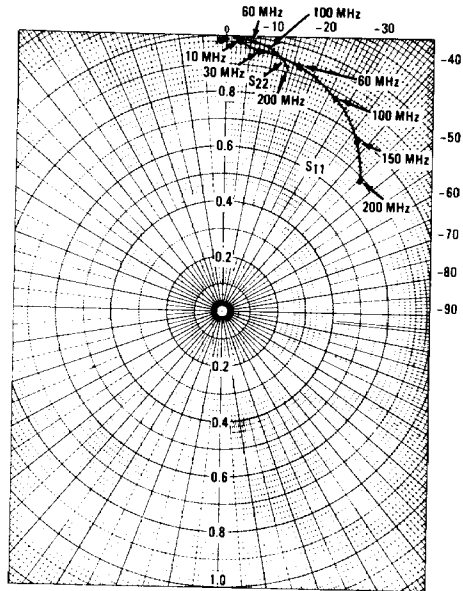
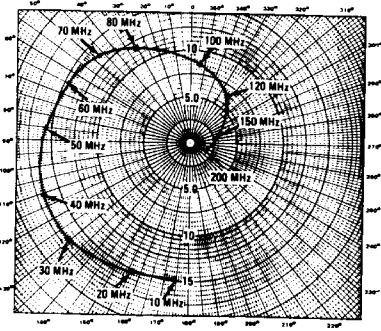
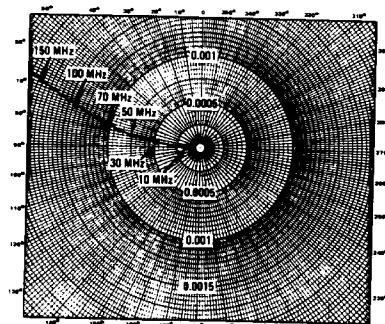
FIGURE 14 – SINGLE-ENDED OUTPUT ADMITTANCE



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

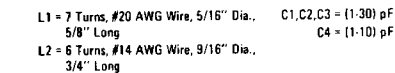


TYPICAL CHARACTERISTICS (continued)

FIGURE 20 — S_{11} AND S_{22} , INPUT AND OUTPUT REFLECTION COEFFICIENTFIGURE 21 — S_{11} AND S_{22} , INPUT AND OUTPUT REFLECTION COEFFICIENTFIGURE 22 — S_{21} , FORWARD TRANSMISSION COEFFICIENT (GAIN)FIGURE 23 — S_{12} , REVERSE TRANSMISSION COEFFICIENT (FEEDBACK)

2

FIGURE 24 — 60 MHz POWER GAIN TEST CIRCUIT



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

Test	ϕ_{in}	V2(AGC)	RAGC(k Ω)
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

[illegible]

L2 = 16 Turns, #20 AWG Wire on a Toroid Core (T44-6 Micro Metal or Equiv)

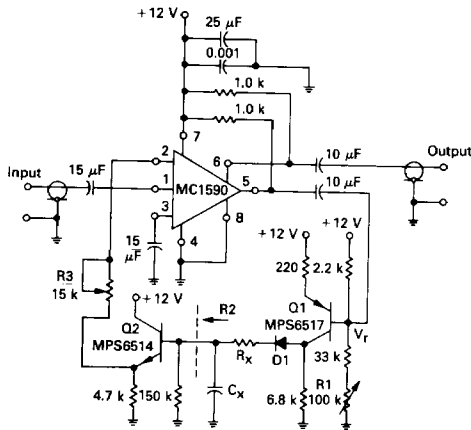
The diagram shows a two-stage active filter circuit. The first stage is a low-pass filter with an input impedance of 50 Ω. It uses an MC1590G op-amp configured with a feedback network consisting of a 1.0 kΩ resistor and a 10 μH inductor (labeled RFC). The input network includes a 24 pF capacitor and a 200 μH inductor. The second stage is a high-pass filter with an output impedance of 50 Ω. It also uses an MC1590G op-amp with a feedback network of a 1.0 kΩ resistor and a 10 μH inductor (labeled RFC). The input network of the second stage includes a 39 pF capacitor and a 0.002 μF capacitor. Both op-amps are powered by a +12 Vdc supply and have their non-inverting inputs grounded. The circuit is shielded, with a 10 kΩ resistor connected to the shield at the input and a 10 μH inductor connected to the shield at the output.

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

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_T . Diode D1 rectifies the positive peaks of Q1's output only when these peaks are greater than $V_T = 7.0$ 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 k Ω) 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 k Ω .

FIGURE 31 – OUTPUT VOLTAGE versus INPUT VOLTAGE

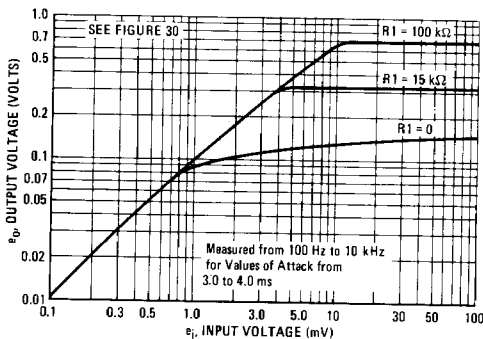


TABLE 1 — DISTORTION versus FREQUENCY

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%

Note: (1) Decay = 300 ms
Attack = 20 ms
(2) $C_x = 7.5 \mu F$
 $R_x = 0$ (Short)
(3) Decay = 20 ms
Attack = 3 ms
(4) $C_x = 0.68 \mu F$
 $R_x = 1.5 k\Omega$

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

