MC1350P

MONOLITHIC IF AMPLIFIER

. . . an integrated circuit featuring wide range AGC for use as an IF amplifier in radio and TV over the temperature range 0 to +75°C. The MC1352 is similar in design but has a keyed-AGC amplifier as an integral part of the same chip.

- Power Gain – 50 dB typ at 45 MHz,
  – 48 dB typ at 58 MHz
- AGC Range – 60 dB min, dc to 45 MHz
- Nearly Constant Input and Output Admittance Over the Entire AGC Range
- y_{21} Constant (-3.0 dB) to 90 MHz
- Low Reverse Transfer Admittance – << 1.0 µmho typ
- 12-Volt Operation, Single-Polarity Power Supply

IF AMPLIFIER

MONOLITHIC SILICON INTEGRATED CIRCUIT

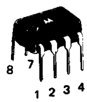
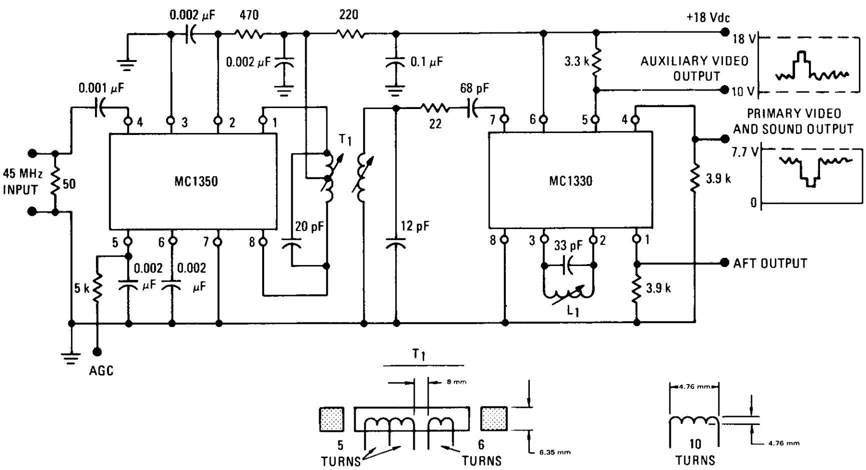


FIGURE 1 – TYPICAL MC1350 VIDEO IF AMPLIFIER and MC1330 LOW-LEVEL VIDEO DETECTOR CIRCUIT



All windings # 0.25 mm ⌀ tinned nylon acetate wire tuned with Arnold Type TH slugs.

L_1 wound with # 0.40 mm ⌀ tinned nylon acetate wire tuned by distorting winding.

MC 1350 P (continued)

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

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+	+18	Vdc
Output Supply Voltage	V_1, V_8	+18	Vdc
AGC Supply Voltage	V_{AGC}	V^+	Vdc
Differential Input Voltage	V_{in}	5.0	Vdc
Power Dissipation (Package Limitation) Plastic Package Derate above 25°C	P_D	 625 5.0	 mW mW/°C
Operating Temperature Range	T_A	0 to +75	°C

ELECTRICAL CHARACTERISTICS (V^+ = +12 Vdc; T_A = +25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
AGC Range, 45 MHz (5.0 V to 7.0 V) (Figure 1)		60	68	–	dB
Power Gain (Pin 5 grounded via a 5.1 kΩ resistor) f = 58 MHz, BW = 4.5 MHz } See Figure 5 f = 45 MHz, BW = 4.5 MHz } f = 10.7 MHz, BW = 350 kHz } See Figure 6 f = 455 kHz, BW = 20 kHz }	A_p	 – 46 – –	 48 50 58 62	 – – – –	dB
Maximum Differential Voltage Swing 0 dB AGC -30 dB AGC	V_o	 – –	 20 8.0	 – –	V_{p-p}
Output Stage Current (Pins 1 and 8)	$I_1 + I_8$	–	5.6	–	mA
Total Supply Current (Pins 1, 2 and 8)	I_S	–	14	17	mAdc
Power Dissipation	P_D	–	168	204	mW

DESIGN PARAMETERS, Typical Values (V+ = +12 Vdc, T_A = +25°C unless otherwise noted)

Parameter	Symbol	Frequency				Unit
		455 kHz	10.7 MHz	45 MHz	58 MHz	
Single-Ended Input Admittance	g_{11} b_{11}	0.31 0.022	0.36 0.50	0.39 2.30	0.5 2.75	mmhos
Input Admittance Variations with AGC (0 to 60 dB)	Δg_{11} Δb_{11}	– –	– –	60 0	– –	µmhos
Differential Output Admittance	g_{22} b_{22}	4.0 3.0	4.4 110	30 390	60 510	µmhos
Output Admittance Variations with AGC (0 to 60 dB)	Δg_{22} Δb_{22}	– –	– –	4.0 90	– –	µmhos
Reverse Transfer Admittance (Magnitude)	$\|y_{12}\|$	<<1.0	<<1.0	<<1.0	<<1.0	µmho
Forward Transfer Admittance Magnitude Angle (0 dB AGC) Angle (-30 dB AGC)	 $\|y_{21}\|$ $\angle y_{21}$ $\angle y_{21}$	 160 -5.0 -3.0	 160 -20 -18	 200 -80 -69	 180 -105 -90	 mmhos degrees degrees
Single-Ended Input Capacitance	C_{in}	7.2	7.2	7.4	7.6	pF
Differential Output Capacitance	C_o	1.2	1.2	1.3	1.6	pF

FIGURE 2 – TYPICAL GAIN REDUCTION
(Figures 5 and 6)

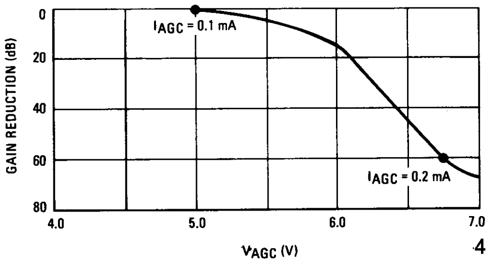
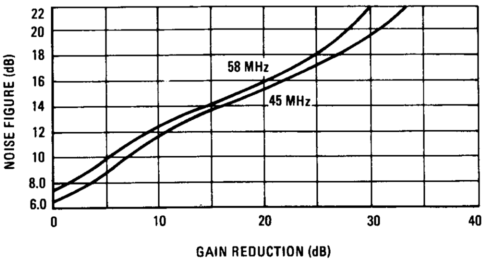


FIGURE 3 – NOISE FIGURE
(Figure 5)



GENERAL OPERATING INFORMATION

The input amplifiers (Q1 and Q2) operate at constant emitter currents so that input impedance remains independent of AGC action. Input signals may be applied single-ended or differentially (for ac) with identical results. Terminals 4 and 6 may be driven from a transformer, but a dc path from either terminal to ground is not permitted.

AGC action occurs as a result of an increasing voltage on the base of Q4 and Q5 causing these transistors to conduct more heavily thereby shunting signal current from the interstage amplifiers Q3 and Q6. The output amplifiers are supplied from an active current source to maintain constant quiescent bias thereby holding output admittance nearly constant. Collector voltage for the output amplifier must be supplied through a center-tapped tuning coil to Pins 1 and 8. The 12-volt supply (V^+) at Pin 2 may be used for this purpose, but output admittance remains more nearly constant if a separate 15-volt supply (V^{++}) is used, because the base voltage on the output amplifier varies with AGC bias.

FIGURE 4 – CIRCUIT SCHEMATIC

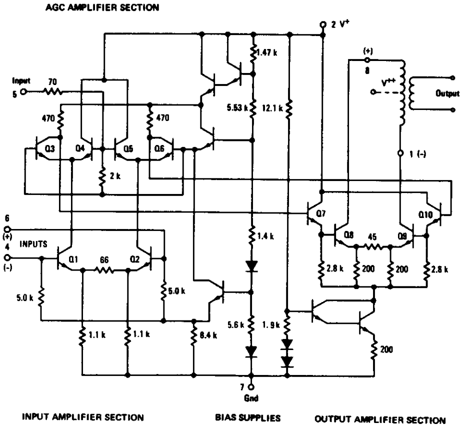
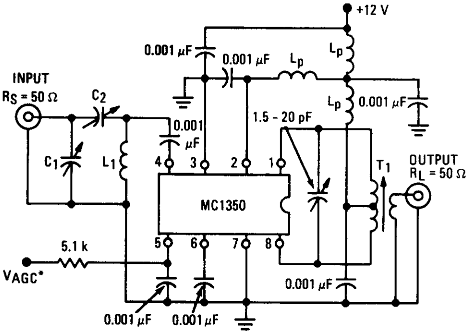


FIGURE 5 – POWER GAIN, AGC and NOISE FIGURE TEST CIRCUIT (45 MHz and 58 MHz)

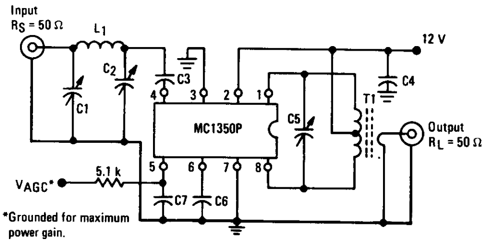


*Connect to ground for maximum power gain test.
All power-supply chokes (L_p), are self-resonate at input frequency. $L_p \geq 20\ k\Omega$
See Figure 10 for frequency response curve.

L_1 @ 45 MHz = 7 1/4 Turns on a 6.35 mm Ø coil form.
@ 58 MHz = 6 Turns on a 6.35 mm Ø coil form
T_1 Primary Winding = 18 Turns on a 6.35 mm Ø coil form, center-tapped
Secondary Winding = 2 Turns centered over Primary Winding @ 45 MHz
= 1 Turn @ 58 MHz
Slug = Arnold TH Material 12.70 mm Long

	45 MHz		58 MHz	
L_1	0.4 µH	Q ≥ 100	0.3 µH	Q ≥ 100
T_1	1.3-3.4 µH	Q ≥ 100 @ 2 µH	1.2-3.8 µH	Q ≥ 100 @ 2 µH
C_1	50 - 160 pF		8 - 60 pF	
C_2	8 - 60 pF		3 - 35 pF	

FIGURE 6 – POWER GAIN and AGC TEST CIRCUIT (455 kHz and 10.7 MHz)



*Grounded for maximum power gain.

Note 1. Primary: 120 µH (center-tapped)
Q_u = 140 at 455 kHz
Primary: Secondary turns ratio ≈ 13

Note 2. Primary: 6.0 µH
Primary winding = 24 turns 0.12 mm (close-wound on 6.35 mm Ø form)
Core = Arnold Type TH or equiv.
Secondary winding = 1-1/2 turns 0.12 mm, 6.35 mm Ø (wound over center-tap)

Component	Frequency	
	455 kHz	10.7 MHz
C1	–	80–450 pF
C2	–	5.0–80 pF
C3	0.05 µF	0.001 µF
C4	0.05 µF	0.05 µF
C5	0.001 µF	36 pF
C6	0.05 µF	0.05 µF
C7	0.05 µF	0.05 µF
L1	–	4.6 µH
T1	Note 1	Note 2

TYPICAL CHARACTERISTICS

($V^+ = 12$ V, $T_A = +25^oC$)

FIGURE 7 – SINGLE-ENDED INPUT ADMITTANCE

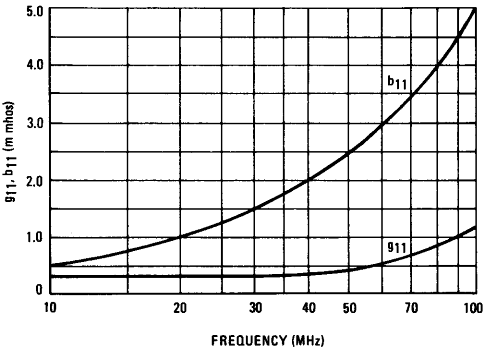


FIGURE 8 – FORWARD TRANSFER ADMITTANCE

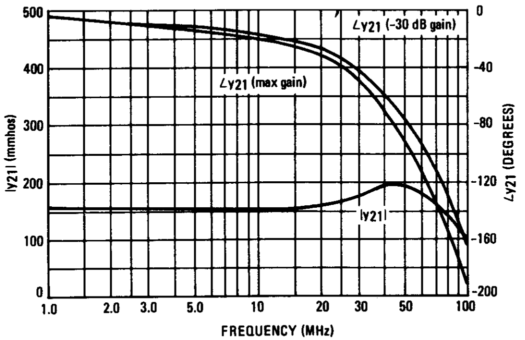


FIGURE 9 – DIFFERENTIAL OUTPUT ADMITTANCE

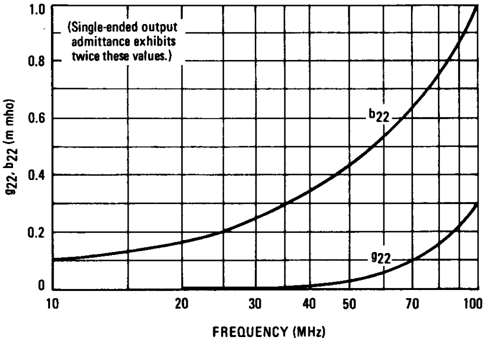


FIGURE 10 – TEST CIRCUIT RESPONSE CURVE (45 and 58 MHz)

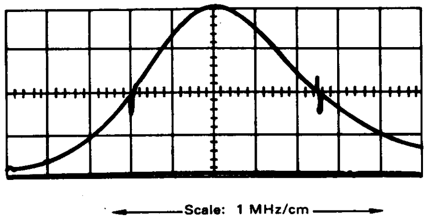
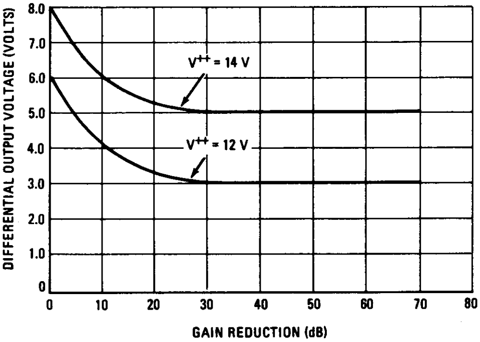
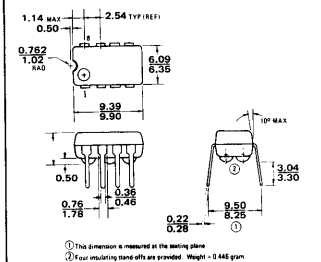


FIGURE 11 – DIFFERENTIAL OUTPUT VOLTAGE





PLASTIC PACKAGE
CASE 626
Dimensions in millimeters

For additional information see "A High-Performance Monolithic IF Amplifier Incorporating Electronic Gain Control", by W. R. Davis and J. E. Solomon, IEEE Journal on Solid State Circuits, December 1968.

MC1352
MC1353

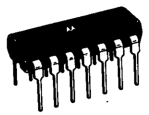
TV VIDEO IF AMPLIFIER WITH AGC AND KEYER CIRCUIT

. . . a monolithic IF amplifier with a complete gated wide-range AGC system for use as the 1st and 2nd IF stages and AGC keyer and amplifier in color or monochrome TV receivers.

- Power Gain at 45 MHz, 52 dB typ
- Extremely Low Reverse-Transfer Admittance – << 1.0 μmho typ
- Nearly Constant Input and Output Admittance Over AGC Range
- Single-Polarity Power-Supply Operation
- High-Gain Gated AGC System for Either Positive or Negative-Going Video Signals
- Control Signal Available for Delayed AGC of Tuner
- Two Complementary Devices – MC1352 and MC1353 – Offer Opposite Tuner AGC Polarity

TV VIDEO IF AMPLIFIER WITH AGC AND KEYER CIRCUIT

MONOLITHIC SILICON INTEGRATED CIRCUIT



P SUFFIX
PLASTIC PACKAGE
CASE 646
TO-116

PQ SUFFIX
PLASTIC PACKAGE
CASE 647

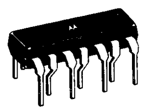
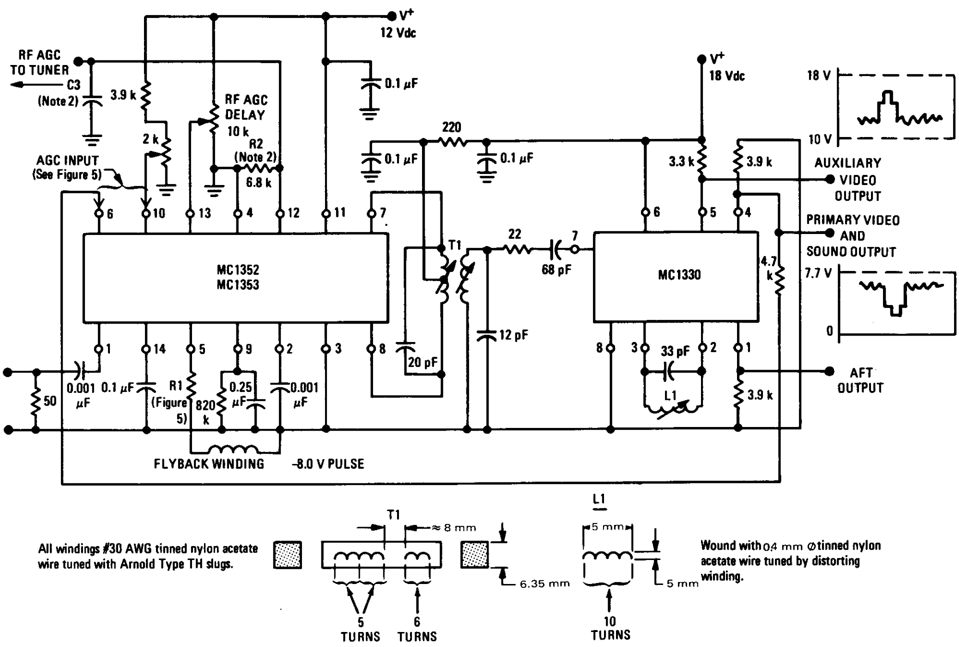


FIGURE 1 – TYPICAL VIDEO IF AMPLIFIER APPLICATION



MAXIMUM RATINGS (Voltages referenced to pin 4, ground; T_A = +25°C unless otherwise noted)

Rating	Value	Unit
Power Supply (Pin 11)	+18	Vdc
Output Supply (Pins 7 and 8)	+18	Vdc
Signal Input Voltage (Pin 1 or 2, other pin ac grounded)	10	V_{p-p}
AGC Input Voltage (Pin 6 or 10, other pin ac grounded)	+6.0	Vdc
Gating Voltage, Pin 5	+10, -20	Vdc
Power Dissipation Derate above T_A = +25°C	625 5.0	mW mW/°C
Operating Temperature Range	0 to +70	°C
Storage Temperature Range	-55 to +150	°C

Maximum Ratings as defined in MIL-S-19500, Appendix A.

ELECTRICAL CHARACTERISTICS (V+ = +12 Vdc, Voltages referenced to pin 4, ground T_A = +25°C unless otherwise noted)

Characteristic	Min	Typ	Max	Unit
AGC Range	–	75	–	dB
Power Gain				dB
f = 35 MHz or 45 MHz	–	52	–	
f = 58 MHz	–	50	–	
Maximum Differential Output Voltage Swing				V_{p-p}
0 dB AGC	–	16.8	–	
-30 dB AGC	–	8.4	–	
Voltage Range for RF-AGC at Pin 12				Vdc
Maximum	–	7.0	–	
Minimum	–	0.2	–	
IF Gain Change Over RF-AGC Range	–	10	–	dB
Output Stage Current ($I_7 + I_8$)	–	5.7	–	mAdc
Total Supply Current ($I_7 + I_8 + I_{11}$)	–	27	31	mAdc
Total Power Dissipation	–	325	370	mW

DESIGN PARAMETERS, TYPICAL VALUES (V+ = 12 Vdc, T_A = +25°C unless otherwise noted)

Parameters	Symbol	f = 35 MHz	f = 45 MHz	f = 58 MHz	Unit
Single-Ended Input Admittance	g_{11} b_{11}	0.55 2.25	0.70 2.80	1.1 3.75	mmhos
Input Admittance Variations with AGC (0 to 60 dB)	Δg_{11} Δb_{11}	50 0	60 0	– –	µmhos
Differential Output Admittance	g_{22} b_{22}	20 430	40 570	75 780	µmhos
Output Admittance Variations with AGC (0 to 60 dB)	Δg_{22} Δb_{22}	3.0 80	4.0 100	– –	µmhos
Reverse Transfer Admittance	$\lvert y_{12} \rvert$	<<1.0	<<1.0	<<1.0	µmho
Forward Transfer Admittance					
Magnitude	$\lvert y_{12} \rvert$	260	240	210	mmhos
Angle (0 dB AGC)	$\angle y_{21}$	-73	-100	-135	degrees
Angle (-30 dB AGC)	$\angle y_{21}$	-52	-72	-96	
Single-Ended Input Capacitance		9.5	10	10.5	pF
Differential Output Capacitance		2.0	2.0	2.5	pF

FIGURE 2 - CIRCUIT SCHEMATIC

KEYER AND AGC AMPLIFIER

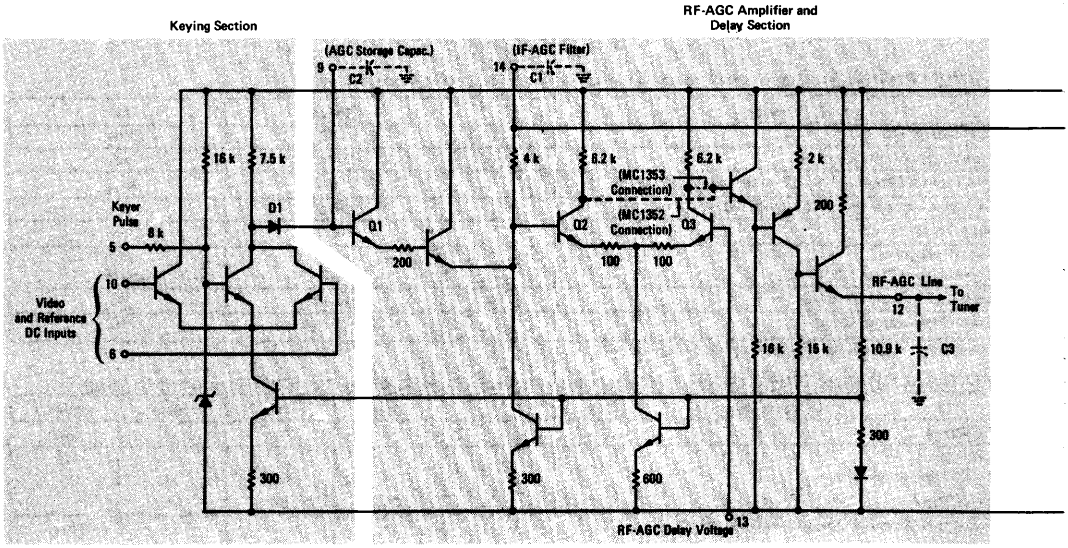
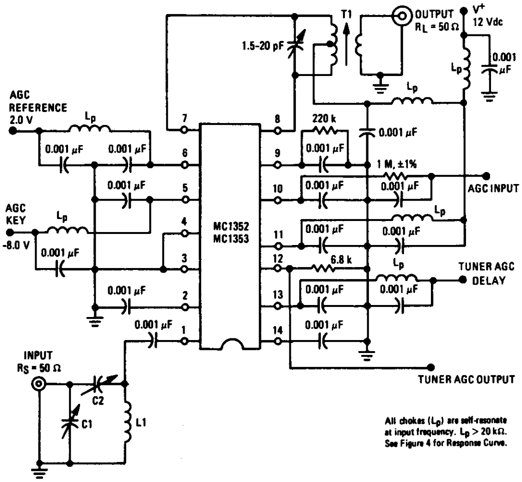


FIGURE 3 – POWER GAIN, AGC AND NOISE TEST CIRCUIT



All chokes (L_p) are self-resonate at input frequency. L_p > 20 kΩ.
See Figure 4 for Response Curve.

	35 and 45 MHz		58 MHz	
L1	0.4 µH	Q > 100	0.3 µH	Q > 100
T1	1.3-3.4 µH	Q > 100 @ 2 µH	1.2-3.8 µH	Q > 100 @ 2 µH
C1	48-100 pF		40-80 pF	
C2	8-60 pF		12-45 pF	

L1 and T1 = #26 AWG Tinned Nylon Acetate Wire.

L1 @ 35 or 45 MHz : 7-1/4 Turns on a 6.35 mm coil form
58 MHz : 6 Turns on a 6.35 mm coil form
T1 @ Primary Winding : 18 Turns on a 1/4" coil form
Secondary Winding : 2 Turns Wound Evenly over Primary Winding for 35 or 45 MHz and 1 Turn for 58 MHz
Slug : Arnold TH Material 12.7 mm long

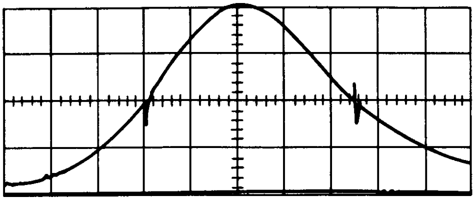
GENERAL OPERATING INFORMATION

Each device, MC1352 and MC1353, consists of an AGC section and an IF signal amplifier (Figure 2) subdivided into different functions as indicated by the illustration.

A gating pulse, a reference level, and a composite video signal are required for proper operation of the AGC section. Either positive or negative-going video may be used; necessary connections and signal levels are shown in Figure 1. The essential difference is that the video is fed into Pin 10 and the AGC reference level is applied to Pin 6 for a video signal with positive-going sync while the input connections are reversed for negative-going sync.

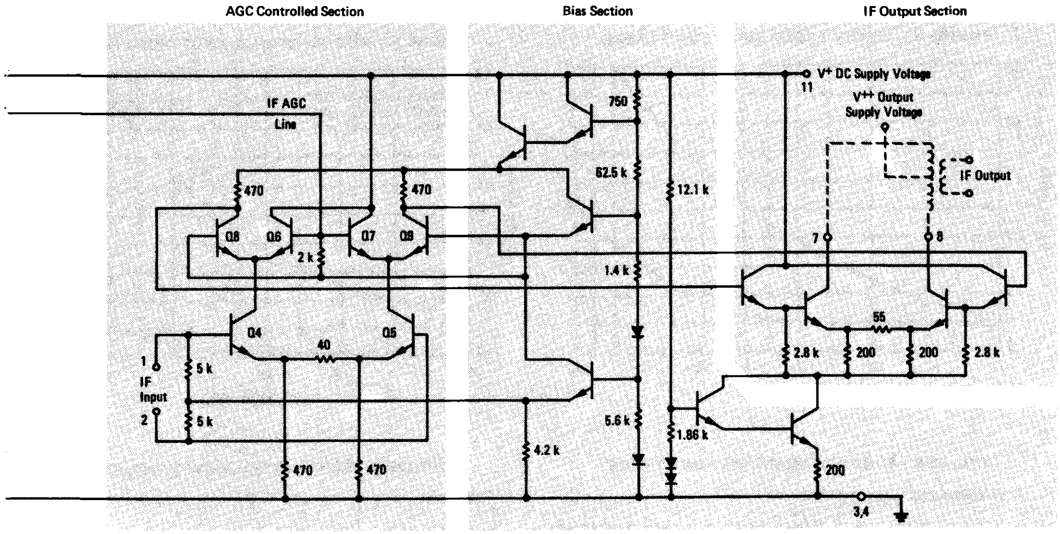
The action of the gating section is such that the proper voltage,

FIGURE 4 – TEST CIRCUIT RESPONSE CURVE (45 and 58 MHz)



Scale: 1 MHz/cm

IF AMPLIFIER



V_C, is maintained across the external capacitor, C2, for a particular video level and dc reference setting. The voltage V_C, is the result of the charge delivered through D1 and the charge drained by Q1. The charge delivered occurs during the time of the gating pulse, and its magnitude is determined by the amplitude of the video signal relative to the dc reference level. The voltage V_C is delivered via the IF-AGC amplifier and applied to the variable gain stage of the IF signal amplifier and is also applied to the RF-AGC amplifier, where it is compared to the fixed RF-AGC delay voltage reference by the differential amplifier, Q2 and Q3. The following stages amplify the output signal of either Q2 for MC1352, or Q3 for MC1353 and shift the dc levels causing the RF-AGC voltage to vary (positive-going for MC1352 or negative-going for MC1353).

The input amplifiers (Q4 and Q5) operate at constant emitter currents so that input impedance remains independent of AGC action. Input signals may be applied single-ended or differentially (for ac). Terminals 1 and 2 may be driven from a transformer, but a dc path from either terminal to ground is not permitted.

AGC action occurs as a result of an increasing voltage on the base of Q6 and Q7 causing those transistors to conduct more heavily thereby shunting signal current from the interstage amplifiers Q8 and Q9. The output amplifiers are fed from an active current source to maintain constant quiescent bias thereby holding output admittance nearly constant.

NOTES:

1. The 12-V supply must have a low ac impedance to prevent low-frequency instability in the RF-AGC loop. This can be achieved by a 12-V zener diode and a large decoupling capacitor. (5 μF).

2. Choices of C1, C2 and C3 depend somewhat on the set designers' preference concerning AGC stability versus AGC recovery speed. Typical values are C1 = 0.1 μF, C2 = 0.25 μF, C3 = 10 μF.

3. To set a fixed IF-AGC operating point (e.g., for receiver alignment) connect a 22 kΩ resistor from pin 9 to pin 11 to give minimum gain, then bias pin 14 to give the correct operating point using a 200 kΩ variable resistor to ground.

4. Although the unit will normally be operating with a very high power gain, the pin configuration has been carefully chosen so that shielding between input and output terminals will not normally be necessary even when a standard socket is used.

FIGURE 5 – TYPICAL AGC APPLICATION CHART

Video Polarity	Pin 6 Voltage	Pin 10 Voltage	Pin 5 R1 (Ω)
Negative-Going Sync.	5.5 / 2.0 / 0	Adj. 1.0–4.0 Vdc Nom 2.0 V	0
Positive-Going Sync.	Adj. 1.0–8.0 Vdc Nom 4.5 V	4.5 / 0	3.9 k

TYPICAL CHARACTERISTICS

(V^+ = +12 Vdc, T_A = +25°C unless otherwise noted)

FIGURE 6 – SINGLE-ENDED INPUT ADMITTANCE

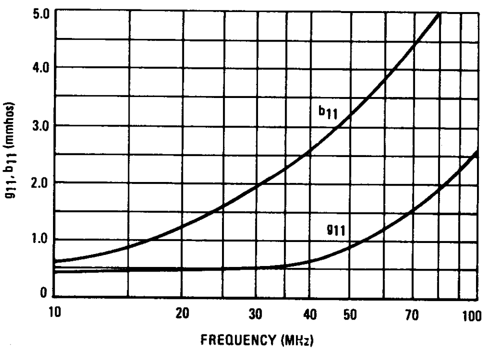


FIGURE 7 – DIFFERENTIAL OUTPUT ADMITTANCE

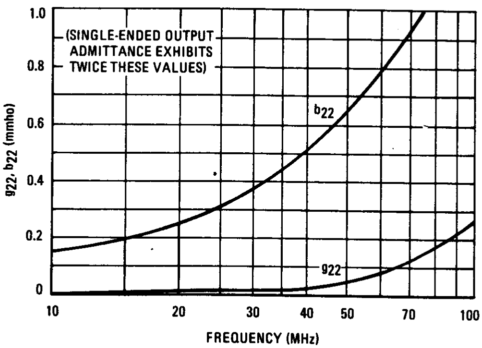


FIGURE 8 – FORWARD TRANSFER ADMITTANCE

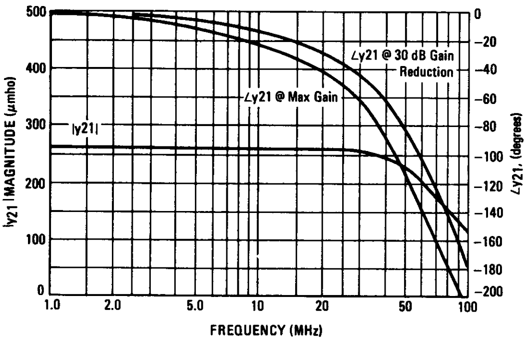


FIGURE 9 – DIFFERENTIAL OUTPUT VOLTAGE

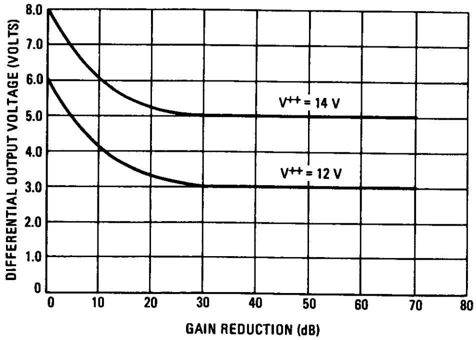


FIGURE 10 – MC1352 AGC CHARACTERISTICS

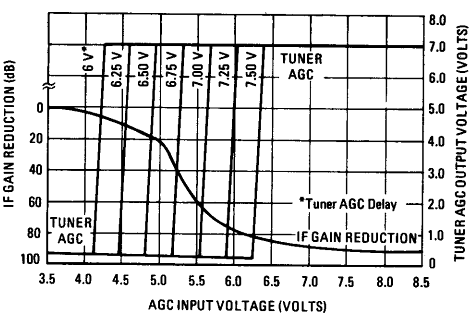
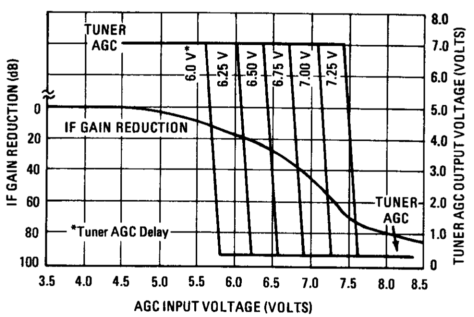


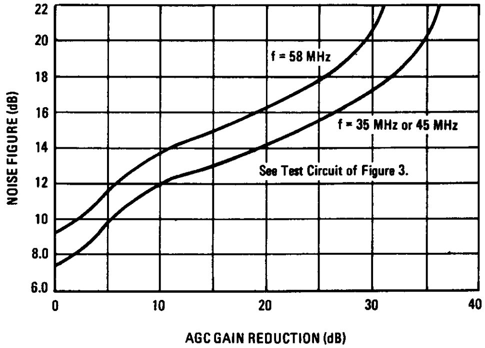
FIGURE 11 – MC1353 AGC CHARACTERISTICS



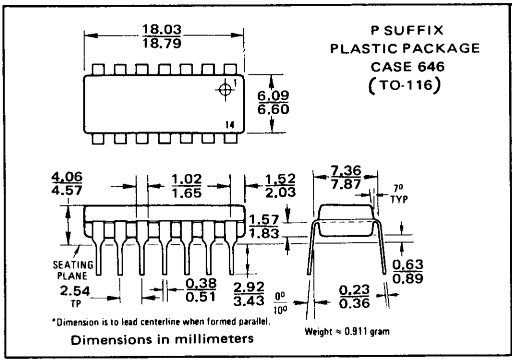
TYPICAL CHARACTERISTICS (continued)

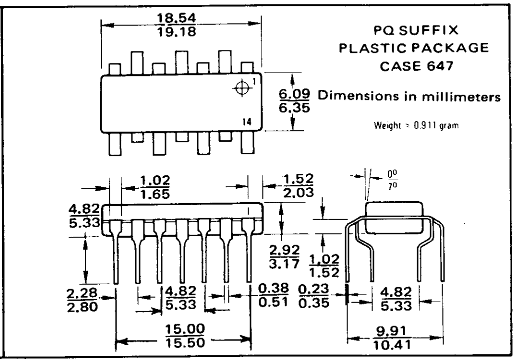
(V^+ = +12 Vdc, T_A = +25°C unless otherwise noted)

FIGURE 12 – TYPICAL NOISE FIGURE



OUTLINE DIMENSIONS





For additional information see "A High-Performance Monolithic IF Amplifier Incorporating Electronic Gain Control", by W. R. Davis and J. E. Solomon, IEEE Journal on Solid State Circuits, December 1968.