HA11440A, HA11442A

Color TV Picture IF System

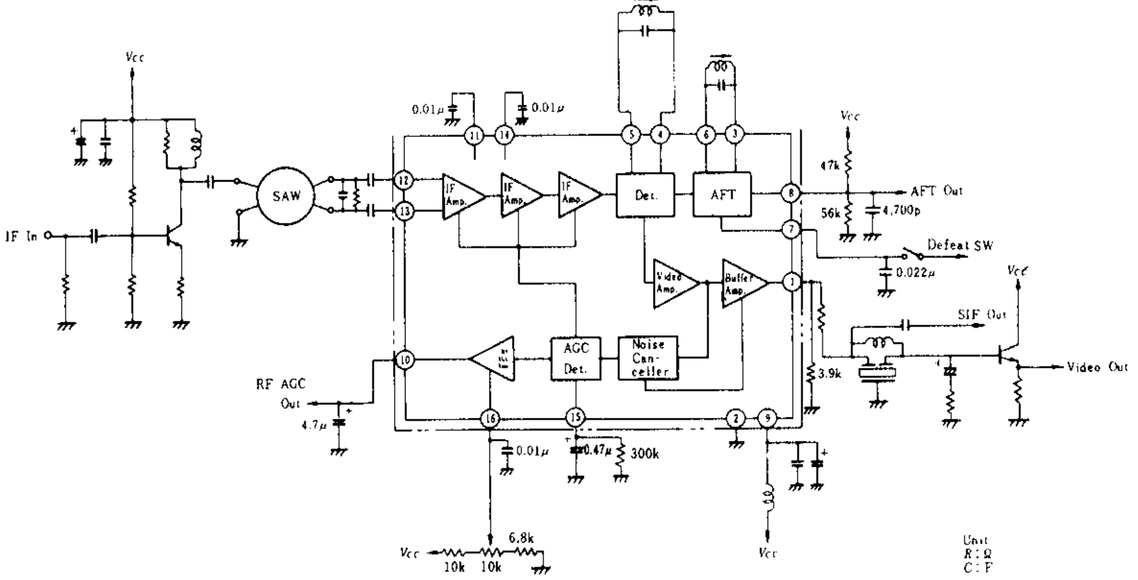
Functions

- PIF (picture intermediate frequency) amplifier
- Quasi-synchronous detector
- AFT with defeat terminal
- Video amplifier
- AGC (automatic gain control) circuit
- Tuner AGC output
- Noise canceller

Features

- Reduced 920-kHz beats and cross-color
- Improved differential gain (DG) and differential phase (DP)
- Minimized external components
- Minimum level of forward AGC output voltage adjusted by external resistors

Block Diagram



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Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit
Supply voltage	V_{CC}	15	V
Mean level of maximum output current at pin 1	I_O	4	mA
Power dissipation (Ta = 65°C)	P_T	745	mW
Operating temperature	T_{opr}	–20 to +65	°C
Storage temperature	T_{stg}	–55 to +125	°C

Electrical Characteristics (Ta = 25°C, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Supply current 1	I_{S1}	27.0	39.0	51.3	mA	$V_{1F} = 0$
Supply current 2	I_{S2}	27.0	40.0	51.3	mA	$V_{1F} =$ 80 dBµ
Input sensitivity	V_{in}	35	40	45	dBµ	The input voltage at which the video output goes down by 1 dB
Maximum input voltage	$V_{in(max)}$	93	98	—	dBµ	The input voltage at which the video output voltage varies by 5%
Video bandwidth	F_C	6.0	7.5	—	MHz	The frequency at which the video output voltage goes down by 3 dB
Video output level	V_{out}	1.98	2.32	2.65	V_{p-p}	m = 0.875
Sync tip voltage	V_{SYNC}	5.20	5.60	5.90	V	
Noise canceller starting voltage	V_{NC}	1.20	1.50	1.80	V	
Differential gain	DG	—	8	12	%	m = 0.875, 5% chroma added, DSB signal inputted
Differential phase	DP	—	2.5	6	deg.	m = 0.875, 5% chroma added, DSB signal inputted
AGC charging time constant	τ_c	—	350	500	µs	Input signal modulated with square wave
AGC disharging time constant	τ_d	—	14	28	ms	Input signal modulated with square wave
Vertical interval distortion	V_{VER}	—	50	100	mV_{p-p}	
Minimum RF AGC voltage	$V_{TR(min)}$	0	0	1.0	V	$V_{1F} =$ 85 dBµ

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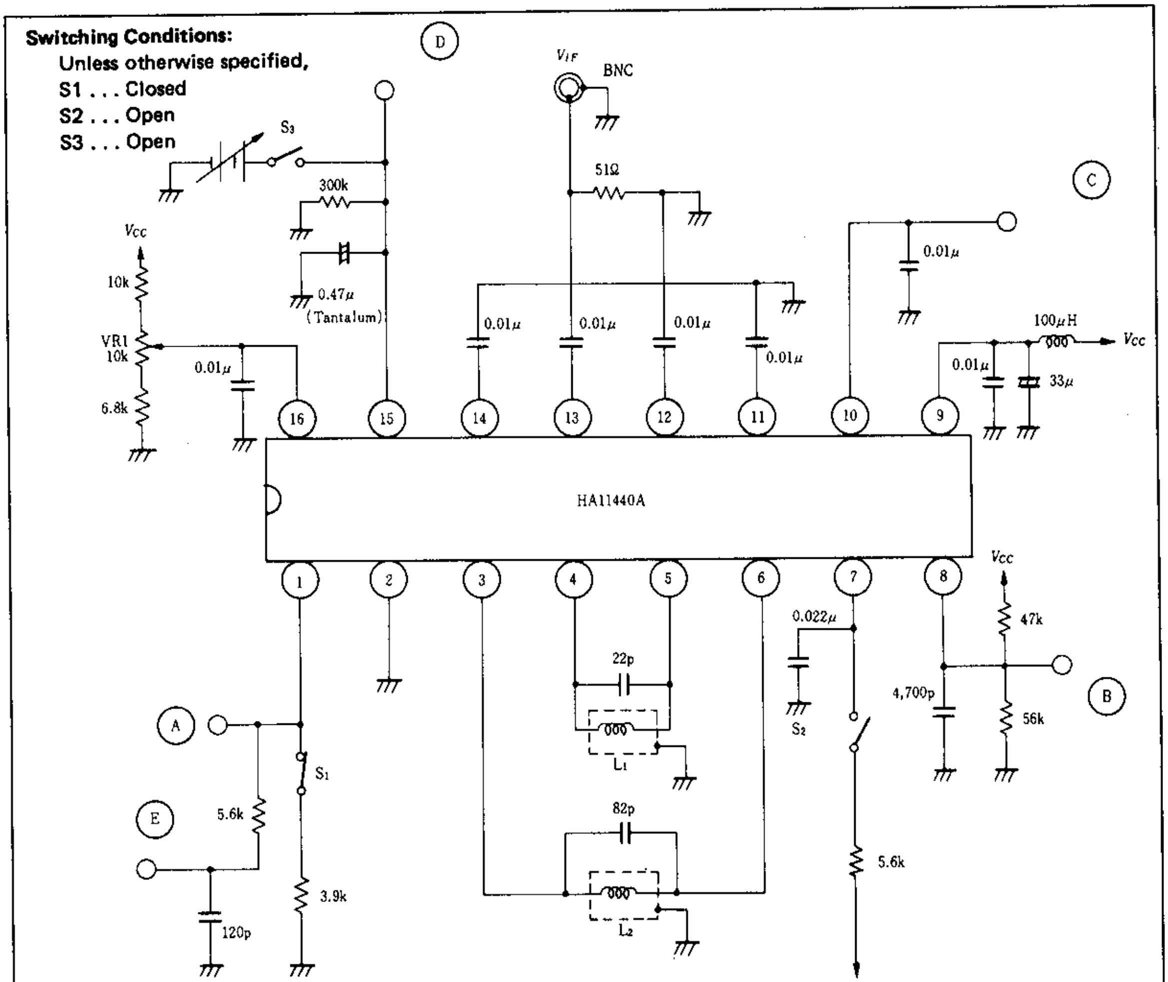
Electrical Characteristics (cont)

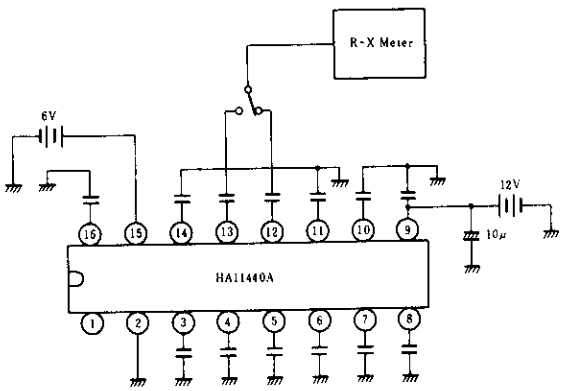
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Maximum RF AGC voltage	$V_{TR(max)}$	11.00	11.70	11.95	V	V_{1F} = 65 dBµ
Signal-to-noise ratio	SN	49	52	—	dB	V_{1F} = 80 dBµ, CW input signal
Noise limited sensitivity	V_{SN}	—	48	52	dB	
PIF input resistance at pin 12	$R_{i\ 12}$	—	1.80	—	kΩ	
PIF input resistance at pin 13	$R_{i\ 13}$	—	1.80	—	kΩ	
PIF input capacitance at pin 12	$C_{i\ 12}$	—	3.0	—	pF	
PIF input capacitance at pin 13	$C_{i\ 13}$	—	3.0	—	pF	
Video output resistance	R_{out}	—	30	—	Ω	
AFT quiescent voltage	V_{M1}	5.25	6.52	7.55	V	No input signal
DC output voltage at AFT	V_{M2}	6.45	6.52	6.59	V	Defeat on
AFT detection sensitivity	µ	—	180	230	kHz/10V	IF sweep signal input
AFT hold range (high)	F_{AH}	1.0	1.8	3.5	MHz	IF sweep signal input
AFT hold range (low)	F_{AL}	–3.5	–1.8	–1.0	MHz	IF sweep signal input
Maximum AFT voltage	$V_{A\ max}$	11.00	11.60	11.95	V	IF sweep signal input
Minimum AFT voltage	$V_{A\ min}$	0.05	0.30	1.00	V	IF sweep signal input
Time constant at AGC lock prevention circuit	τ_L	110	220	440	µs	
Gain attenuation	V_{AT}	0	2	5	dB	RF stage gain of the tuner attenuated
Thermal deviation of delay point	DDL_T	–6	0	6	dB	T_a = –20°C to +65°C
Thermal deviation of video output	DVO_T	–5	0	5	%	T_a = –20°C to +65°C

Test Circuits



Note) Fix AGC (Pin-15) with the stair step input and adjust L1 for minimum sync tip voltage
L1 : Toko 10K Bobbin 0.17φ Enameled Wire 5t
L2 : To ai-Musen No. P2142031

Figure 1 Test Circuit 1



*Unless otherwise specified, Capacitance=0.01μF

Figure 2 Test Circuit 2

In figure 3, measure the 920 kHz beat element in video output signal with a spectrum analizer, then calculate the 920 kHz beat-to-video output signal ratio, and plot the three-signal cross-modulation characteristic while giving the calculated value for the Y axis and P/S for the X axis. 920 kHz beat-to-video output signal = [Video output p-p voltage (dBμ)] - 920 kHz beat (dBμ)]

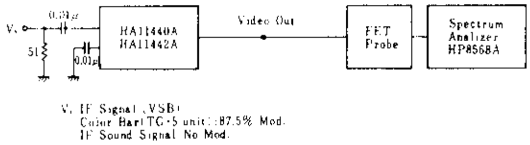


Figure 3 Test Circuit 3—920-kHz Beat

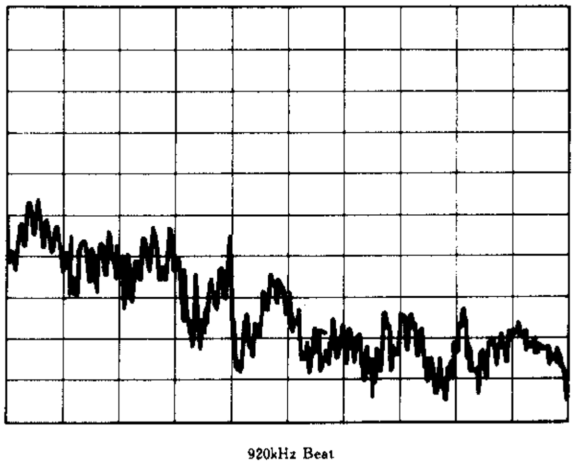
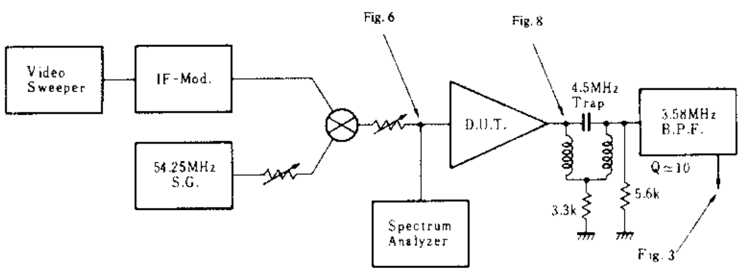


Figure 4 Test Circuit 3—920-kHz Beat Waveform by Spectrum Analyzer



Note) The waveforms at the connection points indicated are shown on the next sheet.

Figure 5 Test Circuit 4

In figure 9, measure the ratio of the 920 kHz video signal chroma element to the 3.58 MHz video signal chroma element at video output, and convert the value into dB.

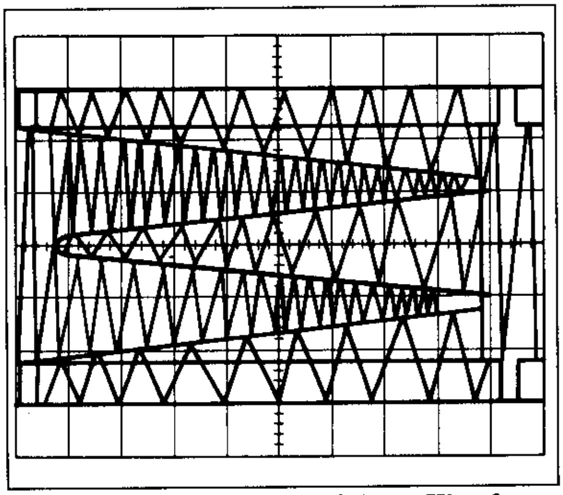


Figure 6 Test Circuit 4—IC Input Waveform (No Sound)

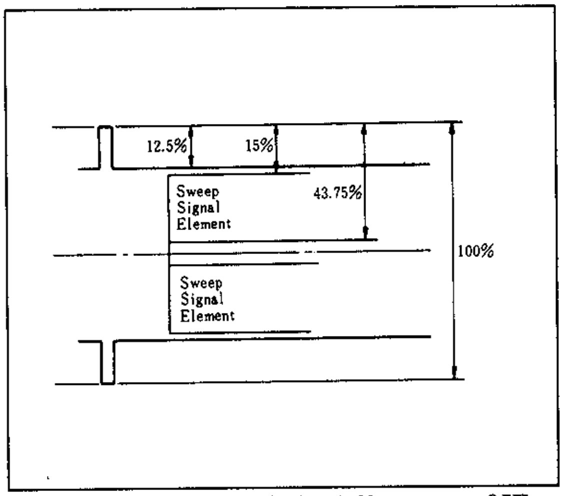


Figure 7 Test Circuit 4—Adjustment of IF Modulation Depth in Figure 6

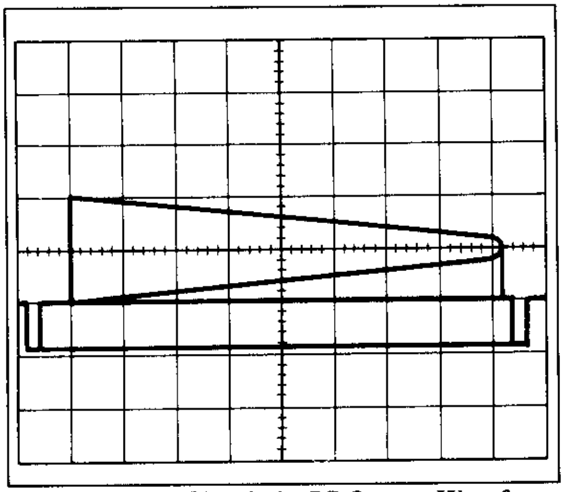


Figure 8 Test Circuit 4—IC Output Waveform (No sound)

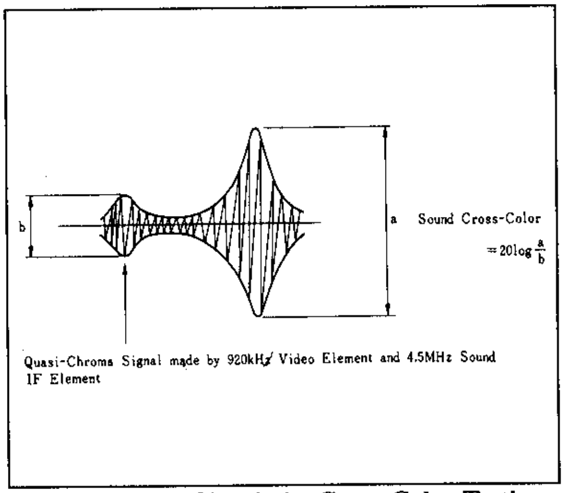


Figure 9 Test Circuit 4—Cross-Color Testing Procedure

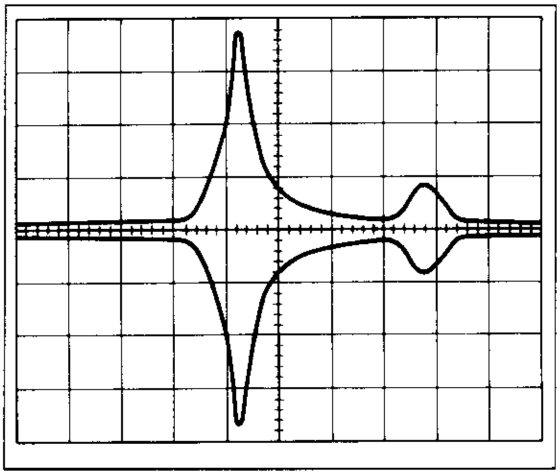


Figure 10 Output Test Circuit 4—Output Waveform at Band Pass Filter (P/S = 10 dB)

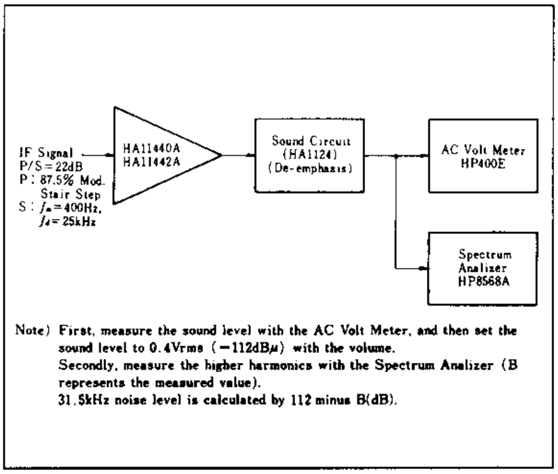


Figure 11 Test Circuit 5—31.5-kHz Noise in Sound Signal

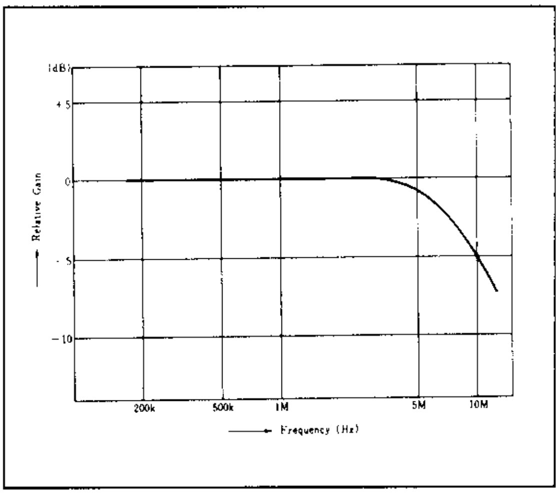


Figure 12 Relative Gain vs. Frequency

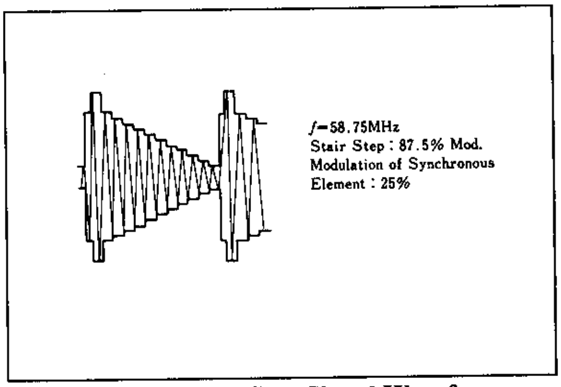


Figure 13 Stair Step Signal Waveforms (Without Chroma Signal)

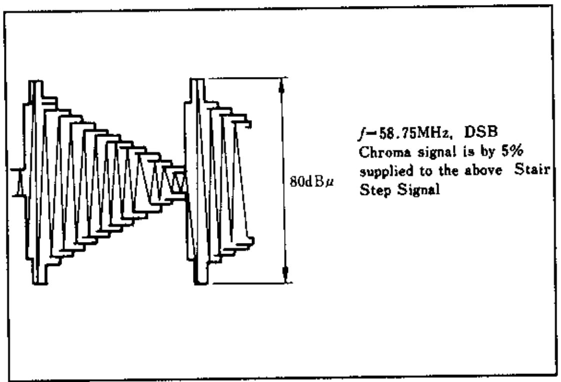


Figure 14 Stair Step Signal Waveforms (With Chroma Signal)

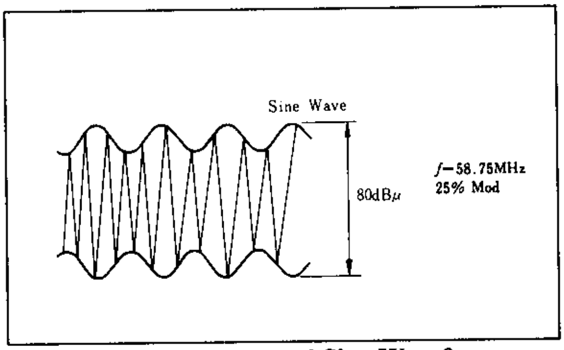


Figure 15 Modulated Sine Waveforms

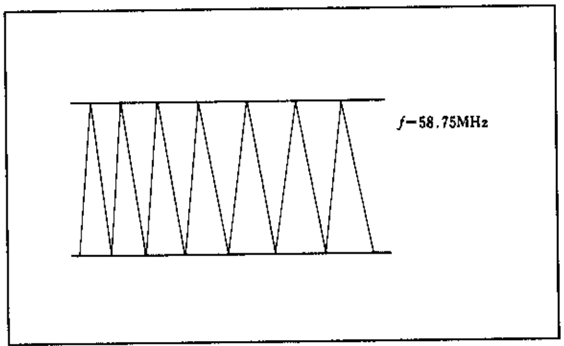


Figure 16 Non-Modulated Sine Waveforms

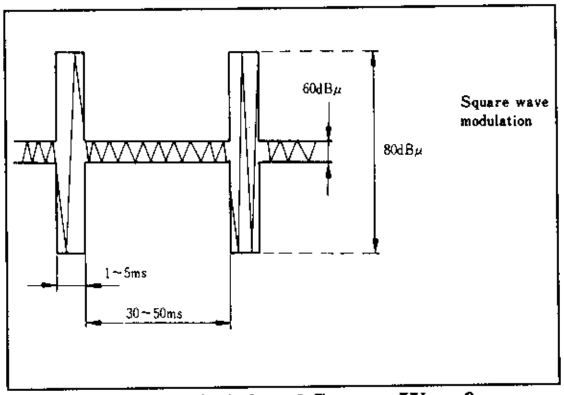


Figure 17 Modulated Square Waveform

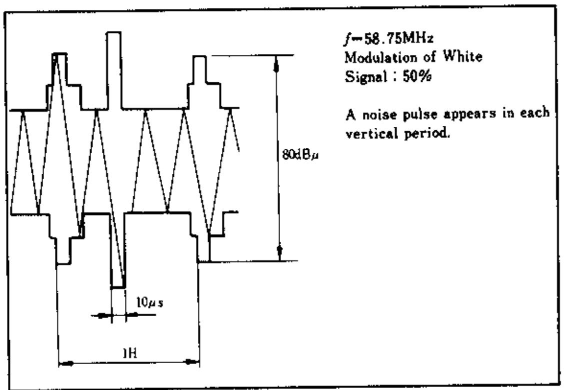


Figure 18 Noise Signal Waveform

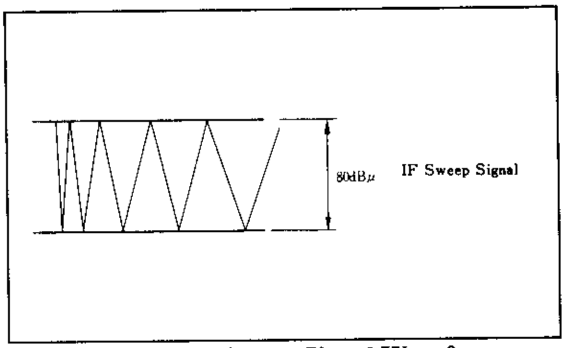


Figure 19 IF Sweep Signal Waveforms

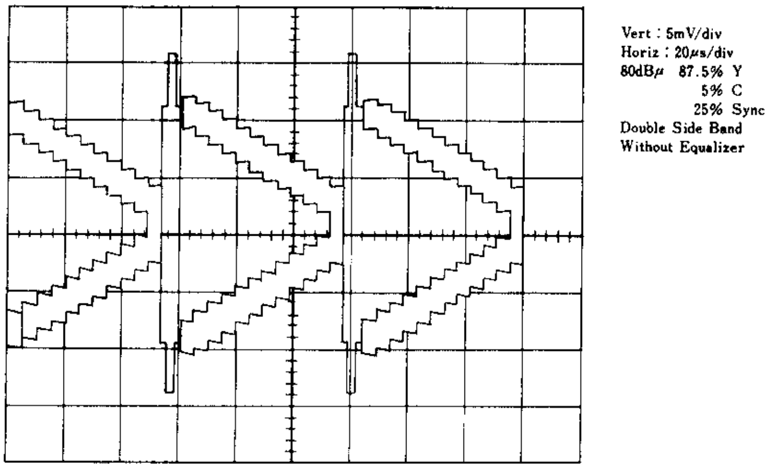


Figure 20 Input Signal Waveform

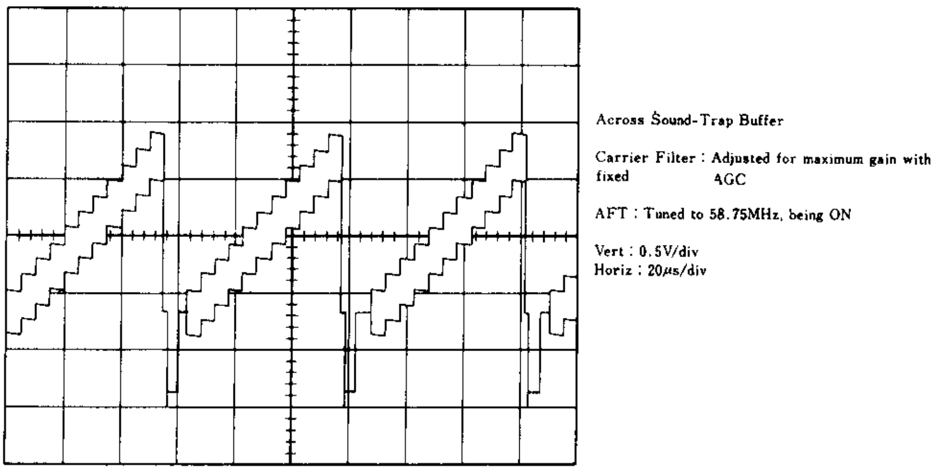


Figure 21 Video Output Waveform

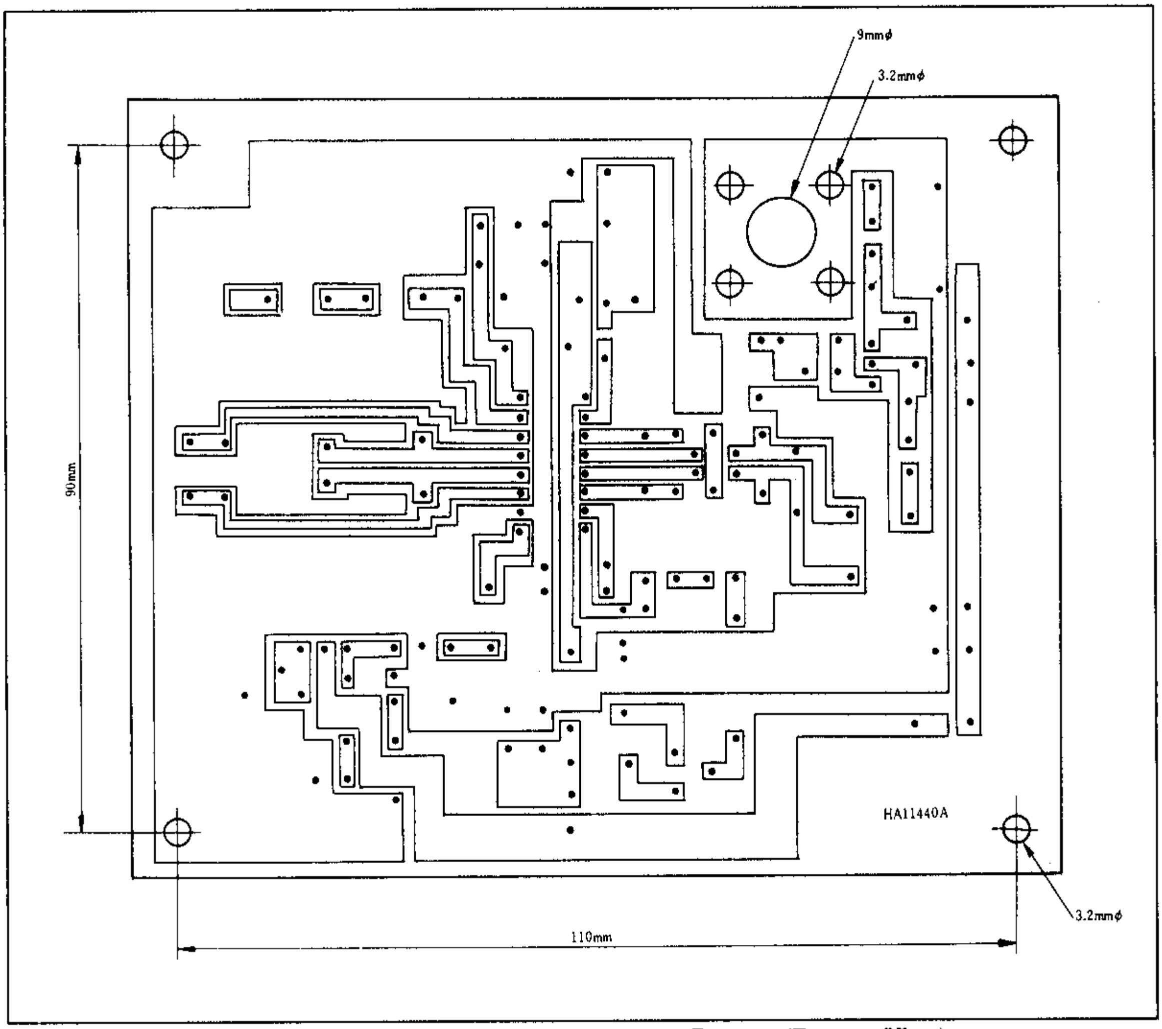


Figure 22 Printed Circuit Board Layout Pattern (Bottom View)

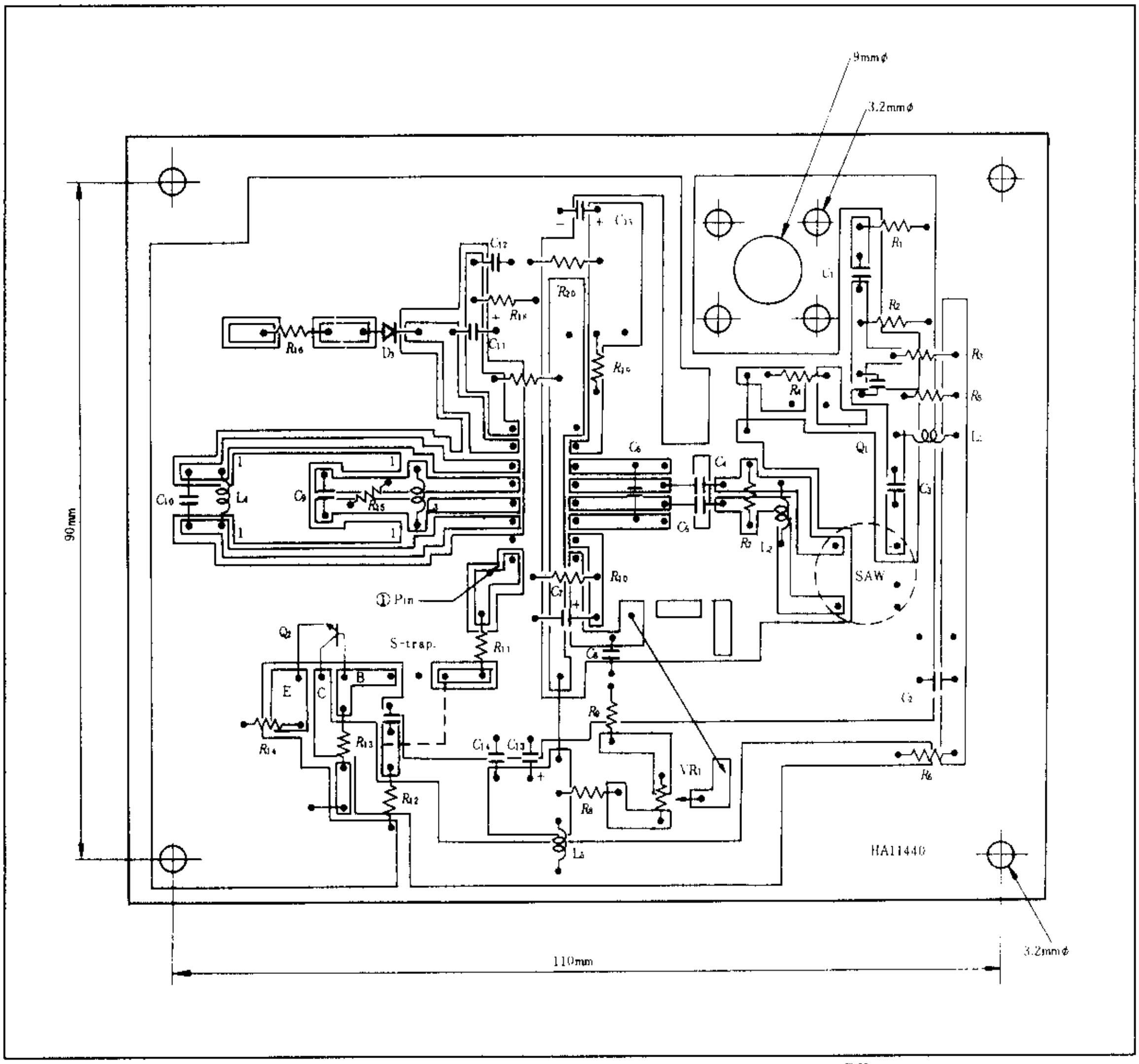


Figure 23 Printed Circuit Board Layout Pattern (Top View)

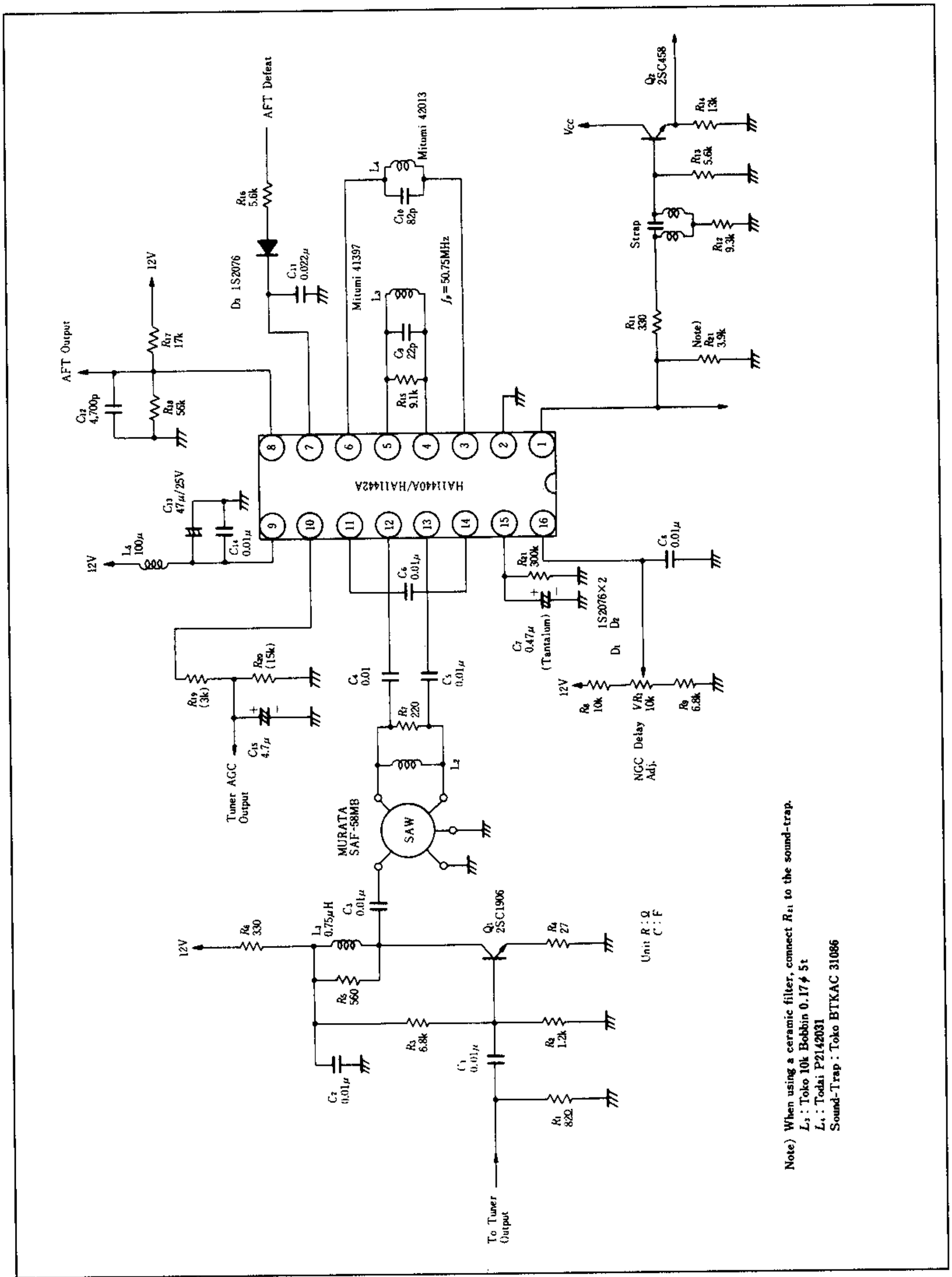


Figure 24 Typical Applications

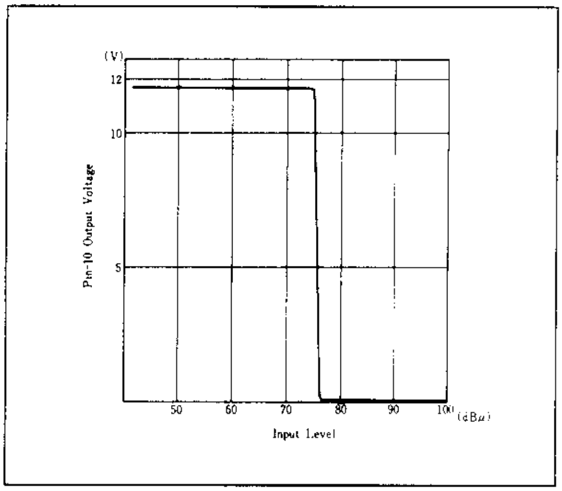


Figure 25 Pin 10 Output Voltage vs. Input Level

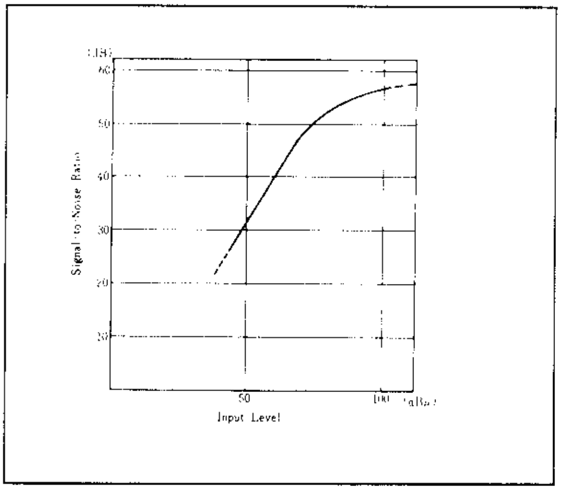


Figure 26 Signal-to-Noise Ratio vs. Input Level

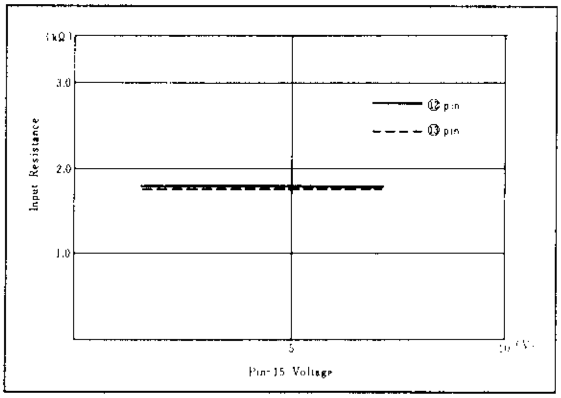


Figure 27 Input Resistance vs. Pin 15 Voltage

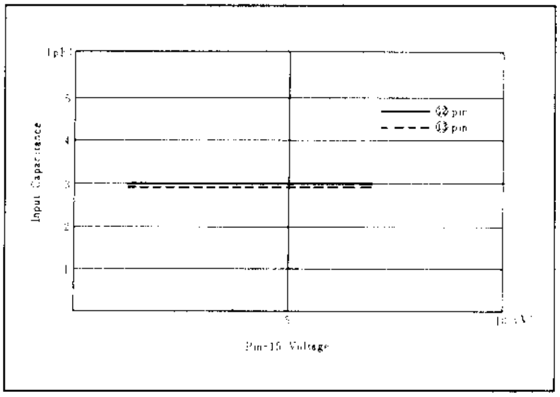


Figure 28 Iput Capacitance vs. Pin 15 Voltage

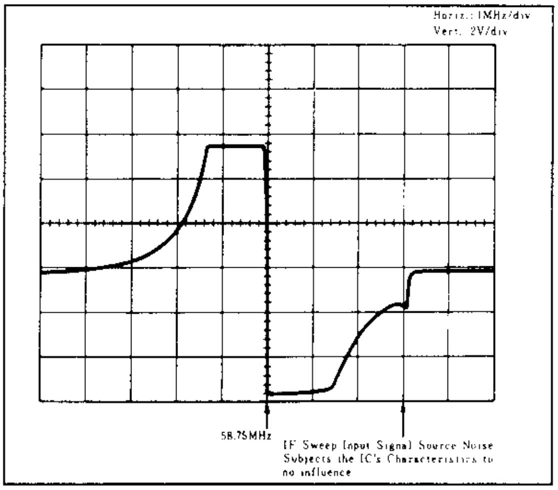


Figure 29 AFT Characteristics

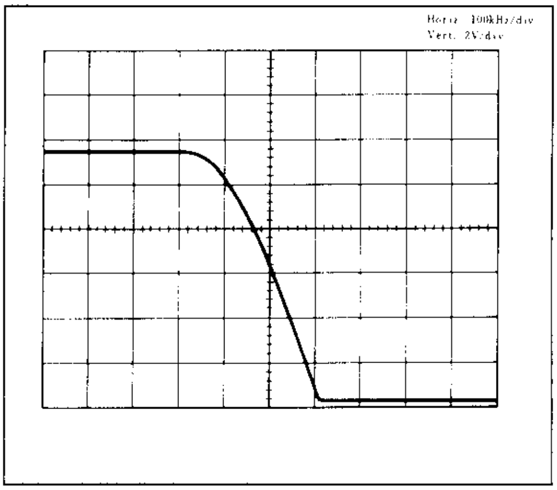


Figure 30 AFT Detection Sensitivity

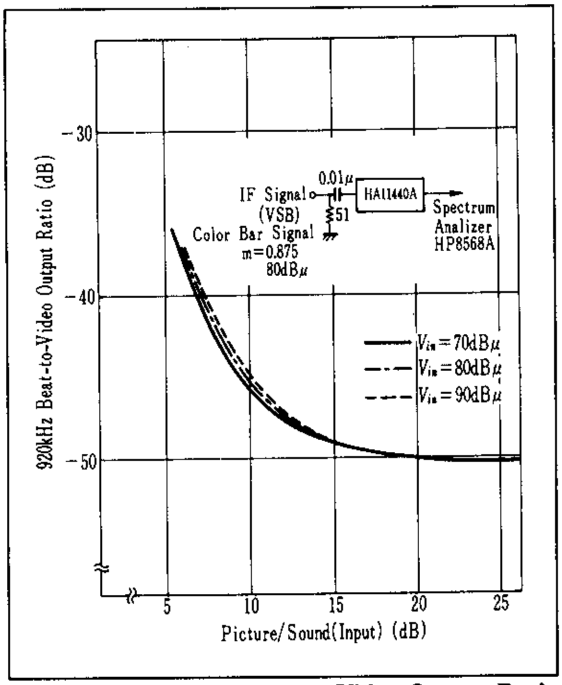


Figure 31 920 kHz Beat-to-Video Output Ratio vs. Picture/Sound

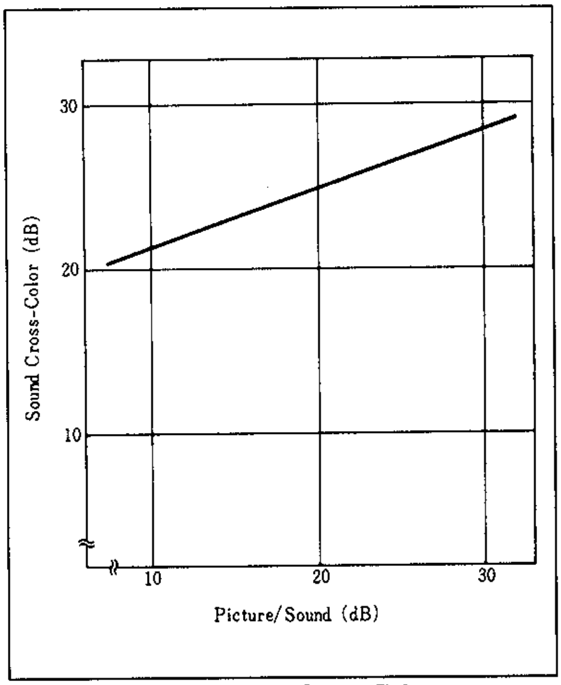


Figure 32 Sound Cross-Color vs. Picture/Sound

Quiescent Current (I_{S1})

Measure the current at pin 9, with S1 open.

Consumption Current (I_{S2})

Measure the current at pin 9, with S1 open, 80 dBμ input signal at pin 1.

Input Sensitivity (V_{in})

Measure on point E with synchroscope. The input sensitivity is defined as the input voltage level at which the video output voltage at pin 1 goes down by 1 dB as shown in figure 33.

Maximum Input ($V_{in\ max}$)

Defined as the VIF level at which the video output amplitude at pin 1 exceeds ±5%.

Video Bandwidth (F_C)

With S3 closed, adjust VG so that the output voltage level at pin 1 is approximately in the middle of the carrier zero level and the sync tip voltage level. Then, with the modulated frequency varied, measure thr voltage at point E at which the frequency goes down by 3 dB, as shown in figure 34.

Video Output Level (V_{out})

Measure output peak-to-peak voltage at point A, as shown in figure 35.

Sync Tip Voltage (V_{SYNC})

Use a synchroscope to measure the sync tip level of the video output voltage at point A, as shown in figure 36.

Noise Canceller Starting Voltage (V_{NC})

Defined as the ouptut voltage at point A when the influence in AGC by noise disappears in the waveform at point A. See figures 37 and 38.

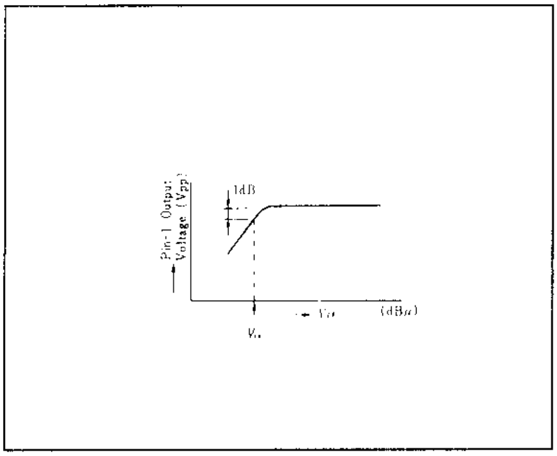


Figure 33 Video Output Voltage at Pin 1

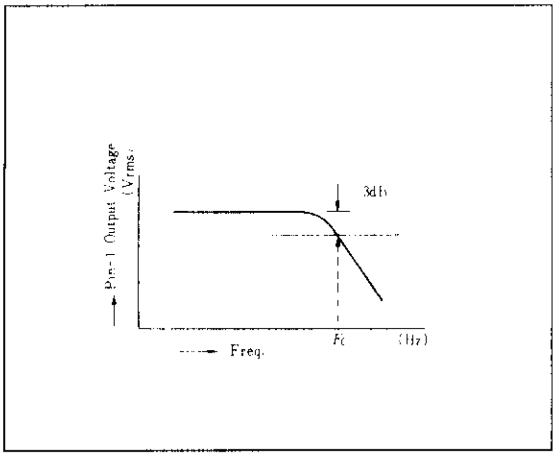


Figure 34 Point E Voltage Measurement

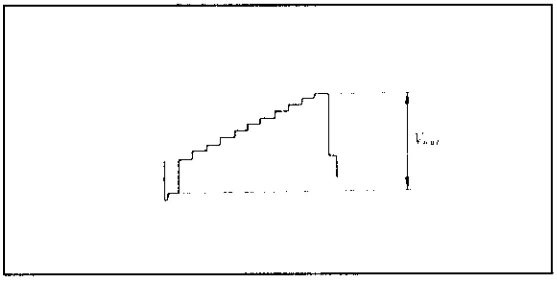


Figure 35 Video Output Level

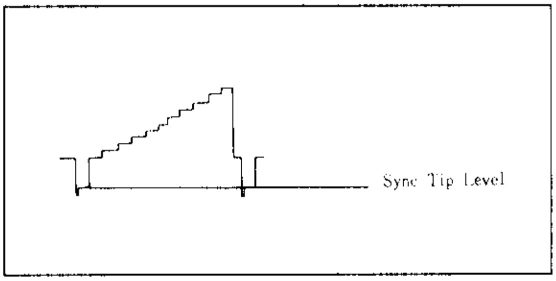


Figure 36 Sync Tip Voltage

Differential Gain (DG) and Differential Phase (DP)

Connect a vectorscope to point A before measuring, as in figure 39.

AGC Charging Time Constant (τ_c) and AGC Discharging Time Constant (τ_d)

Measure the waveform at point D by synchroscope. See figure 40.

Minimum RF AGC Voltage ($V_{TR\ min}$) and Maximum RF AGC Voltage ($V_{TR\ max}$)

Adjust VR1 for 75 dBµ of the delay point and measure the voltage at point C. See figure 41.

Signal to Noise Ratio (SN)

Connect an AC voltmeter to point A and measure the noise voltage, as shown in figure 42.

$S/N = 20 \log 3000/V_N$ where V_N (mV) is the value the voltmeter reads.

Noise Limited Sensitivity (V_{SN})

Defined as the input voltage at which S/N is 30 dB.

PIF Input Resitance at Pin 12 and 13 (R_{i12}, R_{i13})

Measure with an R-X meter, with frequency adjusted to 58.75 MHz.

PIF Input Capacitance at Pin 12 and 13 (C_{i12}, C_{i13})

Measure with an R-X meter, with frequency adjusted to 58.75 MHz.

Video Output Resistance (R_{out})

Measure output voltage V_O at point A with S1 open.Then, connecting 1 kΩ to point A, measure output voltage V_O' with S1 open.

$R_{out} = 1000 \times (V_O/V_O' - 1)$

AFT Quiescent Voltage (VM1)

No input signal. S3 closed. V_G = 6 V. Measure the voltage at point B.

DC Output Voltage at AFT (VM2)

S2 closed. Defeat on. Measure the voltage at point B.

AFT Detection Sensitivity (µ), AFT Hold Range High (F_{AM}), AFT Hold Range Low (F_{AL}), Maximum AFT Voltage ($V_{A\ max}$), Minimum AFT Voltage ($V_{A\ min}$)

With S3 closed, adjust V_G so that the minimum output voltage level at point A goes to the same level as the sync tip. (See figure 43.) Then measure the output voltage at point B. (See figure 44.)

Time Constant at AGC Lock Prevention Circuit (τ_L)

Increase the noise level to operate the noise canceller. Extend the noise width gradually and measure the noise width at which the noise canceller stops operating.

Gain Attenuation (V_{AT})

Attenuate the RF stage gain of the tuner. Adjust VR1 for 75 dBµ of the delay point. See figure 45.

Vertical Interval Distortion (V_{VER})

Measure the vertical interval distortion at point A, as in figure 46.

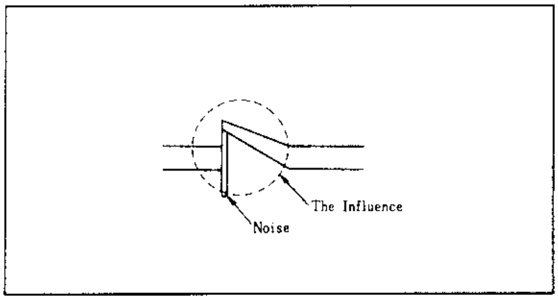


Figure 37 Noise Canceller

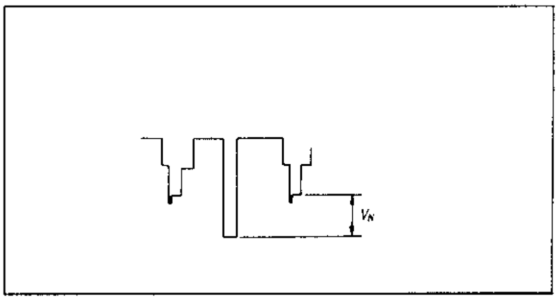


Figure 38 Noise Canceller Starting Voltage Waveform

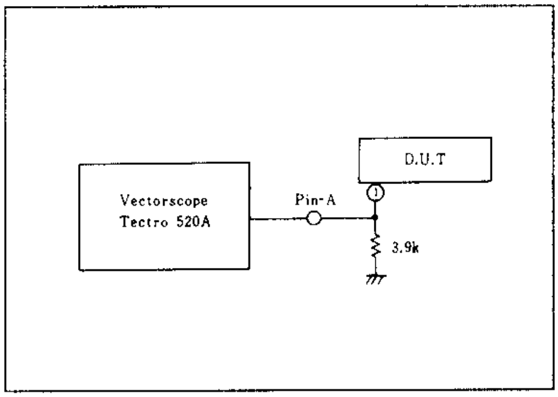


Figure 39 Point A to Vectorscope Connection

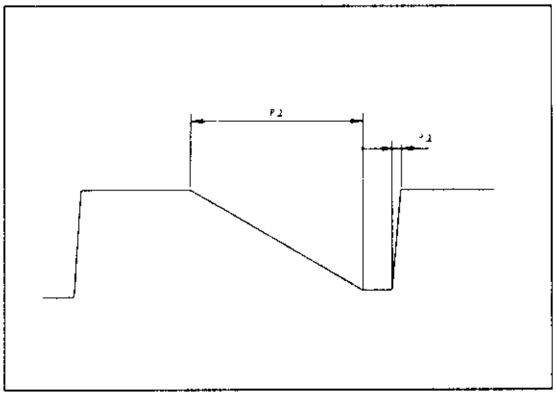


Figure 40 AGC Charging and Discharging Time Constant

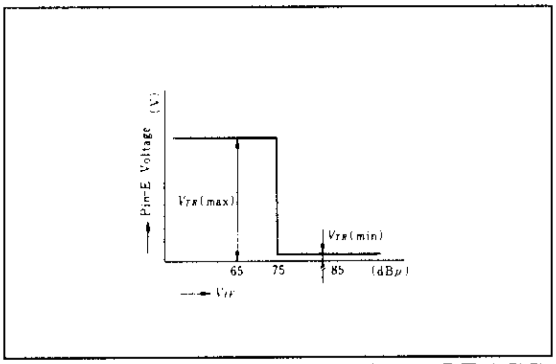


Figure 41 Minimum and Maximum RF AGC Voltage RF AGC Voltage

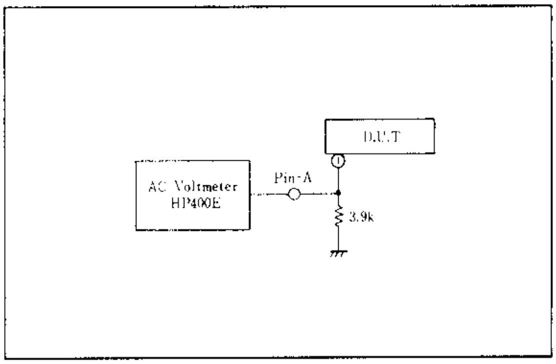


Figure 42 Signal to Noise Ratio

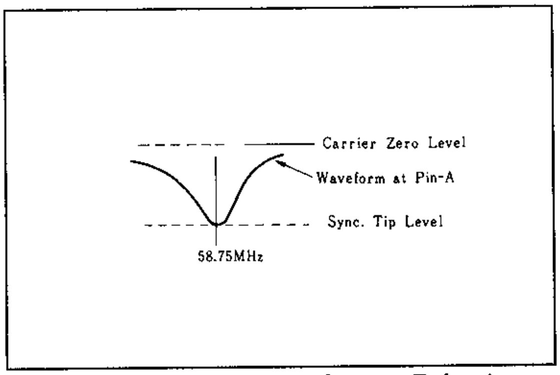


Figure 43 AFT Waveform at Point A

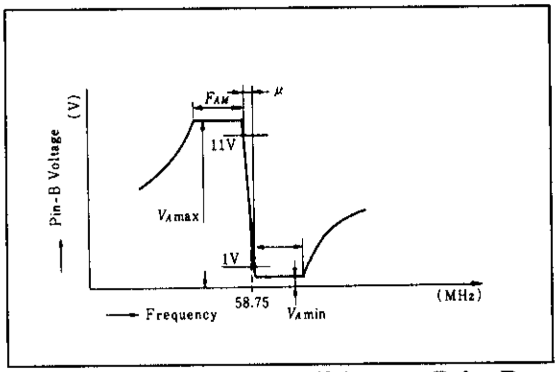


Figure 44 AFT Output Voltage at Point B

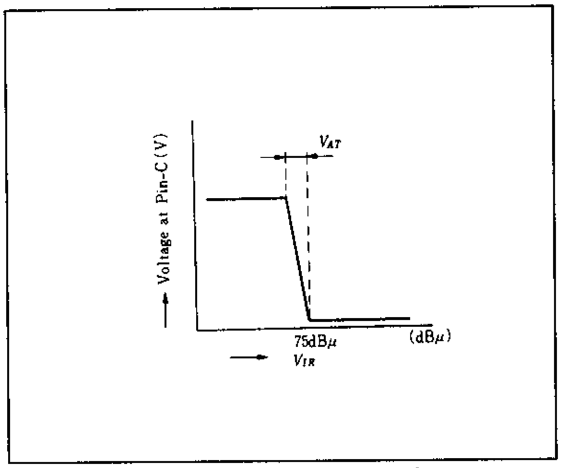


Figure 45 Gain Attenuation

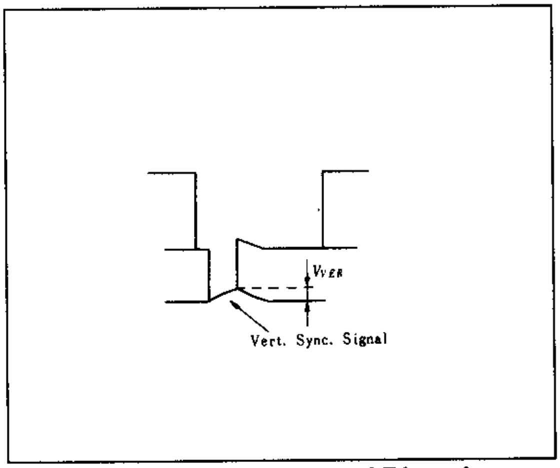


Figure 46 Vertical Interval Distortion

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External Components

Part No.	Recommended Value	Connected Pins
R_1	82 Ω	—
R_2	1.2 kΩ	
R_3	6.8 kΩ	
R_4	27 Ω	
R_5	560 Ω	
R_6	330 Ω	
C_1	0.01 pF	
C_2	0.01 pF	
C_3	0.01 pF	
L_1	0.75 µH	
Q_1	2 SC 1906	
R_1	220 Ω	12, 13
L_2	0.47 µH	
C_4	0.01 µF	12, 13
C_5	0.01 µF	
C_6	0.01 µF	11, 14
C_7	0.47 µ (tantalum)	15
R_{21}	300 k	
R_8	10 kΩ	16
R_9	6.8 kΩ	
C_8	0.1 pF	
VR_1	10 k (B curve)	

Part No.	Recommended Value	Connected Pins
R_{11}	330 Ω	1
R_{12}	4.3 kΩ	
R_{13}	5.6 kΩ	
R_{14}	3 kΩ	
S trap		
Q_2	2 SC 458	
(R_{21})	(3.9 k)	
R_{15}	9.1 kΩ	4, 5
C_9	22 pF	
L_3		
R_{16}	5.6 kΩ	7
D_3	1 S 2076	
C_{11}	0.022 µF (ML)	
R_{17}	47 kΩ	8
R_{18}	56 kΩ	
C_{12}	4700 pF	
C_{17}	4.7 µ/25 V	9
C_{18}	0.01 pF	
L_{12}	100 µF	
R_{19}	(3 k)	10
R_{20}	(15 k)	
C_{15}	(4.7 µ/16 V)	

External Components

$R_1 – R_6$, $C_1 – C_3$, L_1, Q_1

Pre-amp for compensation of power loss caused by SAW (surface acoustic wave) filter application. The circuit constant is determined in the circuit with Murata SAF-58MB (SAW filter). When using another SAW filter, adjust L1 and R5 to match.

R_7, L_2

For matching the SAW filter and IC. Since the input resistance (1.8 KΩ typ) and input capacitance (3.0 pF typ) of the IC are high enough, matching with the SAW filter is easily done by changing the values of R2 and L2. However, when the input impedance of the SAW filter is high, unnecessary external signals such as carrier filter output (pin 14 and 15), video output (pin 1), and so on impair the weak electrical field characteristics. Use of the SAW filter with lower impedance (below 200 Ω) stabilizes weak electrical field characteristics. A SAW filter with 14 – 18 dB P/S is recommended.

C_4, C_5

Coupling capacitance between the SAW filter and IC.

C_6

Capacitance for low pass and DC feedback terminal of IF amp. Internal resistance is set at 6 kΩ (min 4.2 kΩ). The following connection is also possible (see figure 47).

C_7, R_{21}

Capacitance for low pass at IF AGC. If smaller capacitance is applied, high AGC response is obtained, but vertical period distortion and sync tip sag are impaired. A tantalum capacitor with high temperature characteristic is recommended.

R_8, R_9, C_8, VR_1

External circuit for determining delayed AGC switching level.

$R_{11} – R_{14}$, S trap, Q_2, (R_{21})

Buffer amp between sound trap and video output. When a ceramic filter is applied, R21 is connected to pin 1 and functions as DC load. Unless R21 is connected, differential gain characteristic, differential phase characteristic, 920 kHz beat, cross color, etc. deteriorate. Sound trap: Toko BTKAC31086.

R_{15}, C_9, L_3

Phase shift circuit. The circuit constant is determined to get the best differential phase characterisitic, (Q = 35). If the value of Q (transistor) of the tank circuit or that of R15 (damping resistor) is changed, load resistance between pins 4 and 5 is changed and the carrier filter output voltage between pins 4 and 5 is lowered. As a result, differential gain and differential phase characteristics are impaired. L3: Toko 10 k Bobin, 0.17 ø enamel wire, number of turns = 5 T

R_{16}, D_3, C_{11}

R16, D3: Prevent excessive current, and protect IC

C11: Bypasses unnecessary current

When pin 7 (AFT defeat pin) voltage is fixed within the range of 3 V and VCC, operation of AFT circuit is discontinued, and AFT output (pin 8) is fixed to the center point.

R_{17}, R_{18}, C_{12}

AFT load resistance

C_{13}, C_{14}, L_{15}

Filter capacitance at power source

R_{19}, R_{20}, C_{15}

Determine RF AGC time constant. The internal circuits of pin 10 are shown in figures 48 and 49. Determine pin 10 load and time constant according to automatic gain control characteristic of the tuner (refer to the maximum output current).

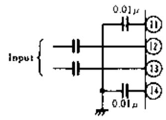

Figure 47 Connection for Low Pass and DC Feedback Terminal of IF Amp

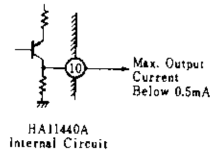

Figure 48 HA11440A Internal Circuit

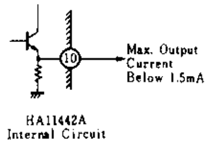

Figure 49 HA11442A Internal Circuit