MITSUBISHI ICs (TV)

M52014SP

TWIN PLL VIF/SIF

DESCRIPTION

The M52014SP is a semiconductor integrated circuit consisting of IF signal processing for color TV sets and VCRs with AV.

It is an effective means to obtain high grade IF system since video and sound signal processings are separated.

FEATURES

● TWIN–PLL detector circuit is adopted.
  • Quasi-parallel SAW filter is used and video IF signal and sound IF signal (including picture carrier) are input separately.
  • A full synchronous detector circuit using PLL is used to detect sound IF signal and a full synchronous detector circuit using its VCO output is used to detect video IF signal.
  • Buzz is reduced since sound IF signal does not have the Nyquist slope characteristics.
  • A full synchronous detector for video signal provides excellent DG, DP, 920kHz beat and cross color characteristics.
● Built-in dynamic AGC circuit
  • Conventional 2-pin IF AGC filter is replaced with 1-pin filter and V sag is reduced and high speed response is obtained.
  • AGC works for each of video IF signal and sound IF signal.
● EQ Amp/Video Mute circuit
  • Video equalizer is built-in. It is optimum for VCRs and color TV sets with video output terminals.

PIN CONFIGURATION (TOP VIEW)

EQ FEED BACK	1	32 } AFT COIL
IF AGC FILTER (P)	2	31
EQ VIDEO OUT	3	30 APS FILTER
RF AGC OUT	4	29 EQ IN
RF AGC DELAY	5	28 AFT OUT
VIF IN {	6	27 VIDEO OUT
	7	26 LOCK FILTER
GND	8	25 VCO Vcc
Vcc	9	24 } VCO COIL
SIF IN {	10	23
	11	22 VCO GND
GND	12	21 LOCK SW
IF AGC FILTER (Q)	13	20 APC FILTER
LIMITTER IN	14	19 } SIF COIL
BIAS	15	18
SIF DET OUT	16	17 AUDIO OUT

M52014SP
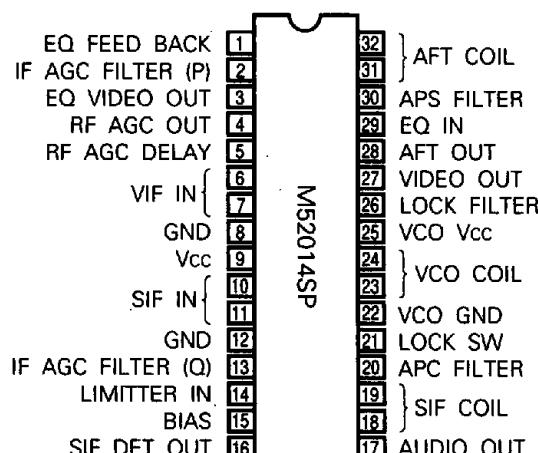
Outline 32P4B

• Video output can be muted by setting EQ Feedback (pin 1) to Low.
● Built-in FM demodulation circuit
 • The quadrature detector circuit for FM detector for sound IF signal has good linearity with a simple coil.

APPLICATION

TV sets, VCR tuners

RECOMMENDED OPERATING CONDITION

Rated supply voltage 9V

BLOCK DIAGRAM

MITSUBISHI ICs (TV)

M52014SP

TWIN PLL VIF/SIF
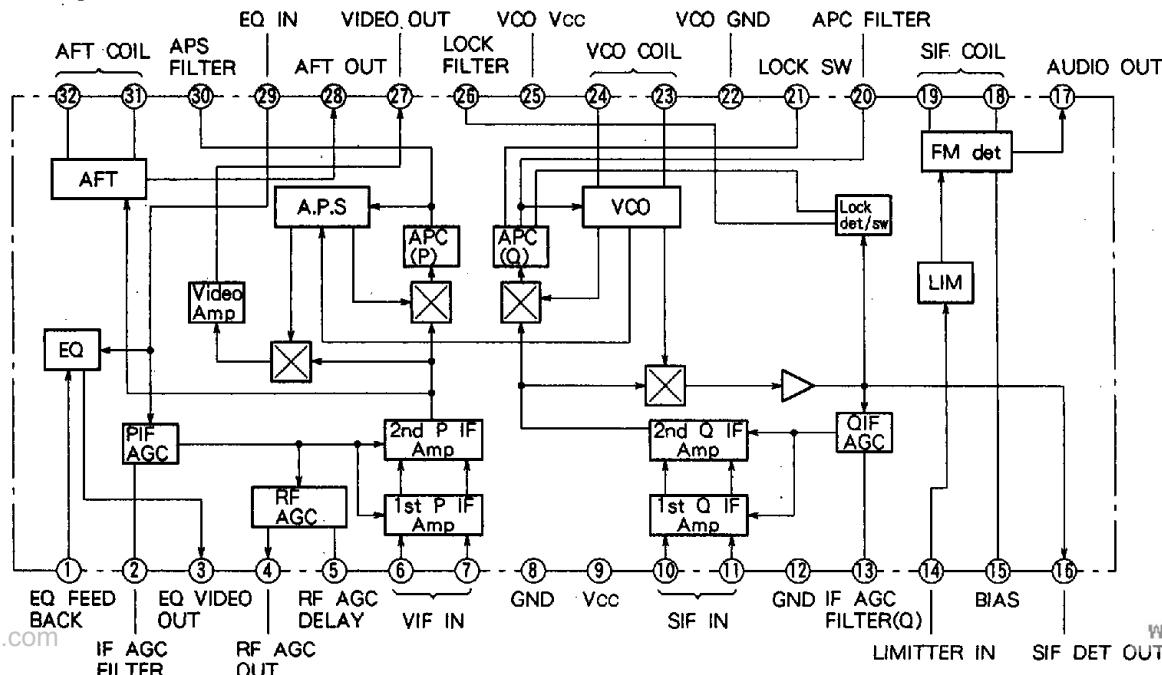
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Ratings	Unit
V_{CC}	Supply voltage	10.8	V
P_d	Power dissipation	1250	mW
T_{opr}	Operating temperature	$-20 \sim 75$	°C
T_{stg}	Storage temperature	$-40 \sim 125$	°C
V_{opr}	Recommended operating supply voltage	9.0	V
–	Electrostatic discharge	± 200	V

ELECTRICAL CHARACTERISTICS (Ta = 25°C, Vcc = 9V unless otherwise noted)

Symbol	Parameter	Test point	VIF	QIF	SIF	V2	V5	V13	V26	1	2	3	4	5	6	7	Notes	Min.	Typ.	Max.	Unit
Icc	Circuit current	A	–	–	–	–	–	–	–	2	1	1	1	1	1	1		37.1	53.0	68.9	mA
V_{27}	Video detector output DC voltage 1	TP9	–	–	–	–	–	–	–	1	1	3	3	1	1	1		3.00	3.75	4.50	V
V_3	Video detector output DC voltage 2	TP1	–	–	–	–	–	–	–	1	1	3	3	1	1	1		4.32	5.40	6.48	V
V_{odet1}	Video detector output1	TP9	SG1	SG1	–	–	–	–	–	1	1	1	1	1	1	1		1.08	1.45	1.81	V_{P-P}
V_{odet2}	Video detector output2	TP1	SG1	SG1	–	–	–	–	–	1	1	1	1	1	1	1		1.35	1.80	2.70	V_{P-P}
P/N	Video S/N	TP10	SG2	SG2	–	–	–	–	–	1	1	1	1	1	1	2	Note1	45.0	51.0	–	dB
BW	Video frequency characteristics	TP9	SG3	SG3	–	–	–	–	–	1	1	1	1	1	1	1	Note2	5.0	6.0	–	MHz
Vin(min)	Input sensitivity	TP9	SG4	SG4	–	–	–	–	–	1	1	1	1	1	1	1	Note3	–	45	53	dB μ
Vin(max)	Maximum allowable input	TP9	SG5	SG5	–	–	–	–	–	1	1	1	1	1	1	1	Note4	100	106	–	dB μ
GR	AGC control range	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Note5	50.0	61.0	–	dB
V_{2H}	VIF AGC maximum voltage	TP11	–	–	–	–	–	–	–	1	1	1	1	1	1	1		6.8	8.6	–	V
$V_{2(90dB\mu)}$	VIF AGC voltage	TP11	SG2	SG2	–	–	–	–	–	1	1	1	1	1	1	1		3.4	4.65	5.9	V
V_{2L}	VIF AGC minimum voltage	TP11	SG7	SG7	–	–	–	–	–	1	1	1	1	1	1	1		2.3	3.0	4.0	V
V_{28}	AFT output voltage	TP8	–	–	–	–	–	–	–	1	1	3	3	1	1	1		2.0	4.2	6.5	V
μ	AFT detector sensitivity	TP8	SG10	SG10	–	–	–	–	–	1	1	1	1	1	1	1	Note6	40.0	58.0	75.0	mV/kHz
V_{28H}	AFT maximum voltage	TP8	SG10	SG10	–	–	–	–	–	1	1	1	1	1	1	1	Note7	8.0	8.7	–	V
V_{28L}	AFT minimum voltage	TP8	SG10	SG10	–	–	–	–	–	1	1	1	1	1	1	1	Note8	–	0.3	1.0	V
V_{4H}	RF AGC maximum voltage	TP2	SG2	SG2	–	2	–	–	–	1	1	1	1	1	1	1		7.7	8.2	–	V
V_{4L}	RF AGC minimum voltage	TP2	SG2	SG2	–	–	–	–	–	1	1	1	1	1	1	1		–	0.1	1.0	V
V_{2L}	Lock detector threshold voltage	TP6	–	–	–	5	–	5	Variable	1	1	2	2	2	2	1	Note9	3.2	3.6	4.0	V
DG	DG	TP9	SG16	SG16	–	–	–	–	–	1	1	1	1	1	1	1	Note10	–	4	8	%
DP	DP	TP9	SG16	SG16	–	–	–	–	–	1	1	1	1	1	1	1	Note10	–	2	5	deg.
V_{16}	QIF detector output DC voltage	TP3	–	–	–	–	–	–	–	1	1	3	3	1	1	1		3.0	3.75	4.5	V
V_{odet3}	QIF detector output	TP3	SG1	SG1	–	–	–	–	–	1	1	1	1	1	1	1		1.08	1.45	1.81	V_{P-P}
Q BW	QIF detector output frequency characteristics	TP3	SG3	SG3	–	–	–	–	–	1	1	1	1	1	1	1	Note11	5.0	6.0	–	MHz
V_{Qmin}	QIF detector output input sensitivity	TP3	SG4	SG4	–	–	–	–	–	1	1	1	1	1	1	1	Note12	–	45	53	dB μ
V_{Qmax}	QIF detector output maximum allowable input	TP3	SG5	SG5	–	–	–	–	–	1	1	1	1	1	1	1	Note13	100	106	–	dB μ
CL–U1	Capture range (U–1)	TP9	SG11	SG11	–	–	–	–	–	1	1	1	1	1	1	1	Note14	0.5	0.8	–	MHz
CL–L1	Capture range (L–1)	TP9	SG11	SG11	–	–	–	–	–	1	1	1	1	1	1	1	Note15	0.8	1.7	–	MHz
CL–T1	Capture range (T–1)	TP9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Note16	2.0	2.5	–	MHz
CL–U2	Capture range (U–2)	TP9	SG11	SG11	–	–	–	–	–	1	1	1	1	2	1	1	Note14	0.3	0.5	0.8	MHz
CL–L2	Capture range (L–2)	TP9	SG11	SG11	–	–	–	–	–	1	1	1	1	2	1	1	Note15	1.05	1.50	1.95	MHz
V_{26}	Minimum voltage at pin ㉖	TP6	–	–	–	5	–	5	Variable	1	1	2	2	2	2	1	Note17	–	0.2	0.6	V
EQBW	EQ output frequency characteristics	TP1	SG3	SG3	–	–	–	–	–	1	1	1	1	1	1	1	Note18	4	6	–	MHz
IM	Intermodulation	TP9	SG15	SG15	–	Variable	–	–	–	1	1	2	1	1	1	1	Note19	35	50	–	dB
V_{SYNC}	EQ output sync tip level	TP1	SG2	SG2	–	–	–	–	–	1	1	1	1	1	1	1		3.0	3.5	4.0	V
VIF SECTION																					
fvT	VCO frequency temperature drift	TP7	–	–	–	–	–	–	–	1	1	3	3	1	1	1	Note20	-0.1	0.3	0.4	MHz
Δfsw	VCO frequency sw ON drift	TP7	–	–	–	–	–	–	–	1	1	3	3	1	1	1	Note21	-0.1	0.05	0.15	MHz
$R_{IN}(P)$	PIF input resistance	–	90dBμ	–	–	–	–	–	–	–	–	–	–	–	–	–	Test circuit	1.08	1.35	1.60	kΩ
$C_{IN}(P)$	PIF input capacitance	–	90dBμ	–	–	–	–	–	–	–	–	–	–	–	–	–	Test circuit	2.7	4.0	5.2	pF
$R_{IN}(Q)$	QIF input resistance	–	–	90dBμ	–	–	–	–	–	–	–	–	–	–	–	–	Test circuit	1.08	1.35	1.60	kΩ
$C_{IN}(Q)$	QIF input capacitance	–	–	90dBμ	–	–	–	–	–	–	–	–	–	–	–	–	Test circuit	2.7	4.0	5.2	pF

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ELECTRICAL CHARACTERISTICS (cont.)

Symbol	Parameter	Test point	Input			External power supply (V)				Switch setting							Notes	Limits			Unit
			VIF	QIF	SIF	V2	V5	V13	V26	1	2	3	4	5	6	7		Min.	Typ.	Max.	
SIF SECTION																					
V17	AF output DC voltage	TP4	–	–	–	–	–	–	–	1	1	3	3	1	1	1		3.6	4.6	5.6	V
VOAF(MAX)	Maximum AF output	TP4	–	–	SG17	–	–	–	–	1	1	3	3	1	1	1		247	330	412	mVrms
THD AF	AF output distortion	TP4	–	–	SG21	–	–	–	–	1	1	3	3	1	1	1		–	0.5	1.5	%
VIN(LIM)	Input limiting sensitivity	TP4	–	–	SG18	–	–	–	–	1	1	3	3	1	1	1	Note22	–	37	45	dBμ
AMR	AMR	TP4	–	–	SG19	–	–	–	–	1	1	3	3	1	1		Note23	48.0	58.0	–	dB
S/N	AF S/N	TP4	–	–	SG20	–	–	–	–	1	1	3	3	1	1	1	Note24	45.0	60.0	–	dB
V15	15 pin voltage	TP12	–	–	–	–	–	–	–	1	1	3	3	1	1	1		4.5	5.0	5.5	V

ELECTRICAL CHARACTERISTICS TEST METHOD

Note 1

a. The noise appearing at pin 27 is determined by measuring the r.m.s. voltage at TP10 through low pass filter (–3dB at 5MHz).

b. P/N = 20 log {Vodet1(VP-P) × 0.7 ÷ noise(Vrms)}, where Vodet1 denotes video detector output 1.

Note 2

a. Set SG3 and measure the amplitude of 1MHz at TP9 and let it be V1.

b. Decrease frequency f2 until amplitude of (f1 – f2) at TP9 reaches 3dB smaller than V1. Then, read the frequency.

c. BW = 58.75 – f2(MHz)

Note 3

a. Decrease the SG4 level until the detector output of 27 pin reaches 3dB smaller than Vodet1 and let the level be input sensitivity.

Note 4

a. Increase the SG5 level until the detector output of 27 pin reaches 3dB smaller than Vodet1 and let the level be maximum allowable input.

Note 5

a. AGC control range is defined as follows:

GR = Maximum allowable input – Input sensitivity(dB)

Note 6

a. Measure difference of frequency between 3V and 6V of DC voltage at TP8 and let it be Δf.

b. AFT detector sensitivity μ is defined as follows:

$$\mu = \frac{3000(mV)}{\Delta f(kHz)} \ [mV/kHz]$$

Note 7

a. Let maximum DC voltage in the figure on the right be V28H.
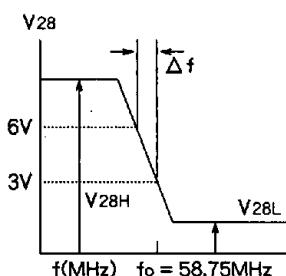
Note 8

a. Let minimum DC voltage in the figure on the right be V28L.

Note 9

a. Set voltage of V26 to 3V and observe TP6.

b. Increase the voltage of V26 and let V26 at which voltage at TP6 is 1V be V26TH.

Note 10

a. Modulated waves of SG16 is generated by 87.5% video modulation of the 10-step waves shown in the figure on the right.

b. At TP9, measure DG and DP with vectorscope.
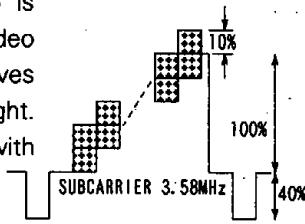
Note 11

a. First set SG3 and measure the amplitude of 1MHz at TP3 and let it be V1.

b. Decrease frequency f2 until the amplitude of (f1 – f2) reaches 3dB smaller than V1. Then, read the frequency.

c. QBW = 58.75 – f2 (MHz)

Note 12

a. Decrease the SG4 level and let the level at which detector output of 16 pin is 3dB smaller than Vodet3 be input sensitivity.

Note 13

a. Increase the SG5 level and let the level at which detector output of 16 pin is 3dB smaller than Vodet3 be maximum allowable input.

Note 14

a. Input SG11 in QIF IN and increase the frequency until VCO lock is released.

b. Decrease the frequency of SG11 and let the frequency at which VCO locks again be fu (MHz).

c. Capture range (U) = fu – 58.75(MHz)

Note 15

a. Input SG11 in QIF IN and decrease the frequency until VCO lock is released.

b. Increase the frequency of SG11 and let the frequency at which VCO locks again be f_L (MHz).

c. Capture range (L) = $58.75 - f_L$ (MHz)

## Note 16

a. $(CL - T1) = (CL - U1) - (CL - L1)$

Note 17

a. Let minimum voltage at TP6 in Note 9 be V_{26}.

Note 18

a. First set SG3 and measure the amplitude of 1MHz at TP1 and let it be V1.

b. Decrease frequency f_2 until the amplitude of $(f_1 - f_2)$ at TP1 reaches 3dB smaller than V1. Then, read the frequency.

c. EQBW = $58.75 - f_2$ (MHz)

Note 19

a. Observe TP9 with oscilloscope, and adjust the V2 voltage so that minimum level of detector output waveform will come to 2V.

b. Observe TP9 with spectrum analyzer and let the ratio of the 920kHz level to the 3.58MHz level be intermodulation.

Note 20

a. Let VCO frequency when Ta = 25°C be f_{VT-0}.

b. Measure VCO frequency when Ta is changed from –20 to +75°C, and let the difference with f_{VT-0} be f_{VT}.
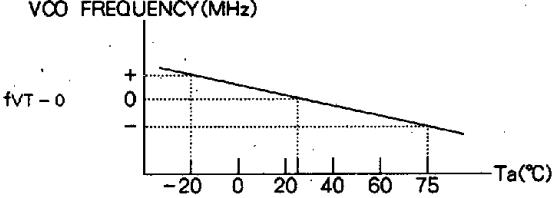
VCO FREQUENCY (MHz)

Note 21

a. Let VCO frequency at TP7 after 3 minutes after turning SW1 ON be f_1 (MHz).

b. Let VCO frequency at TP7 after 1 minute after turning SW1 ON be f_2 (MHz).

c. $\Delta f_{SW} = f_2 - f_1$ (MHz)

Note 22

a. Set SG18 to 80 dBμ and input it in SIF IN.

b. Decrease the SG18 output level until the detector output of TP4 reaches 3dB smaller than $V_{OAF(MAX)}$.

c. The level of SG18 at this time is defined as input limiting sensitivity.

Note 23

a. Measure output voltage at TP4 and let it be V_{AM}.

b. AMR is defined as follows:

Note 24

a. Measure output voltage at TP4 and let it be V_N.

b. AF S/N is defined as follows:

$$S/N = 20 \log (V_{OAF(MAX)}(mVrms) / V_N(mVrms)) (dB)$$

Note 25

a. Amplitude level af all AM modulated waves shall be the peak level of modulated waves.

b. When signal is input simultaneously to PIN IN and QIF IN, phase difference between them shall be 0_{deg}.

c. The following is used for the mixer.
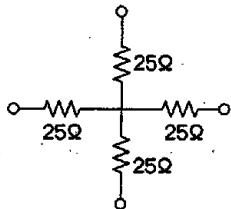
d. With VCO coil, QIF AGC 0V and non-input condition, adjust free run frequency to 58.75MHz.

e. For measurements of VCO frequency (items No. 37 and 38), Mitsubishi's standard jig shall be used.

INPUT SIGNAL

SG NO.	Signals (50Ω termination)
SG1	f_0=58.75MHz V_i=90dBμ, 77.78%AM(87.5% video modulation equivalent)fm=20KHz
SG2	f_0 = 58.75MHz V_i = 90dBμ
SG3	f_1 = 58.75MHz V_i = 90dBμ / f_2 = 57.75MHz V_i = 70dBμ mixed signal
SG4	f_0=58.75MHz. V_i=Variable fm=20KHz 77.78%AM
SG5	f_0=58.75MHz V_i=Variable fm=20KHz 16%AM
SG6	f_0 = 58.75MHz V_i = 80dBμ
SG7	f_0 = 58.75MHz V_i = 110dBμ
SG8	f_0 = 54.25MHz V_i = 100dBμ
SG9	f_0 = 54.25MHz V_i = 80dBμ
SG10	f_0 = 58.75MHz ± 5MHz V_i = 90dBμ
SG11	f_0=58.75MHz±5MHz V_i=90dBμ fm=20KHz 77.78%AM
SG12	f_1 = 58.75MHz V_i = 90dBμ / f_2 = 58.25MHz V_i = 60dBμ ⎤ mixed signal
SG13	f_1 = 58.75MHz V_i = 90dBμ / f_2 = 55.75MHz V_i = 60dBμ ⎤ mixed signal
SG14	f_1 = 58.75MHz V_i = 90dBμ / f_2 = 54.75MHz V_i = 60dBμ ⎤ mixed signal
SG15	f_1 = 58.75MHz V_i = 90dBμ / f_2 = 55.17MHz V_i = 70dBμ ⎤ / f_3 = 54.25MHz V_i = 70dBμ ⎤ mixed signal
SG16	f_0=58.75MHz standard 10-step wave modulation m=87.5% video modulation, sync tip level 90dBμ
SG17	f_0=4.5MHz±25KHz dev V_i=100dBμ fm=400Hz
SG18	f_0=4.5MHz±25KHz dev V_i=Variable fm=400Hz
SG19	f_0 = 4.5MHz V_i = 100dBμ 30% AM fm= 400Hz
SG20	f_0 = 4.5MHz V_i = 100dBμ
SG21	f_0=4.5MHz±7.5KHz dev V_i=100dBμ fm=400Hz
SG22	f_0=58.75MHz standard 10-step wave modulation m=110% video modulation, sync tip level 90dBμ
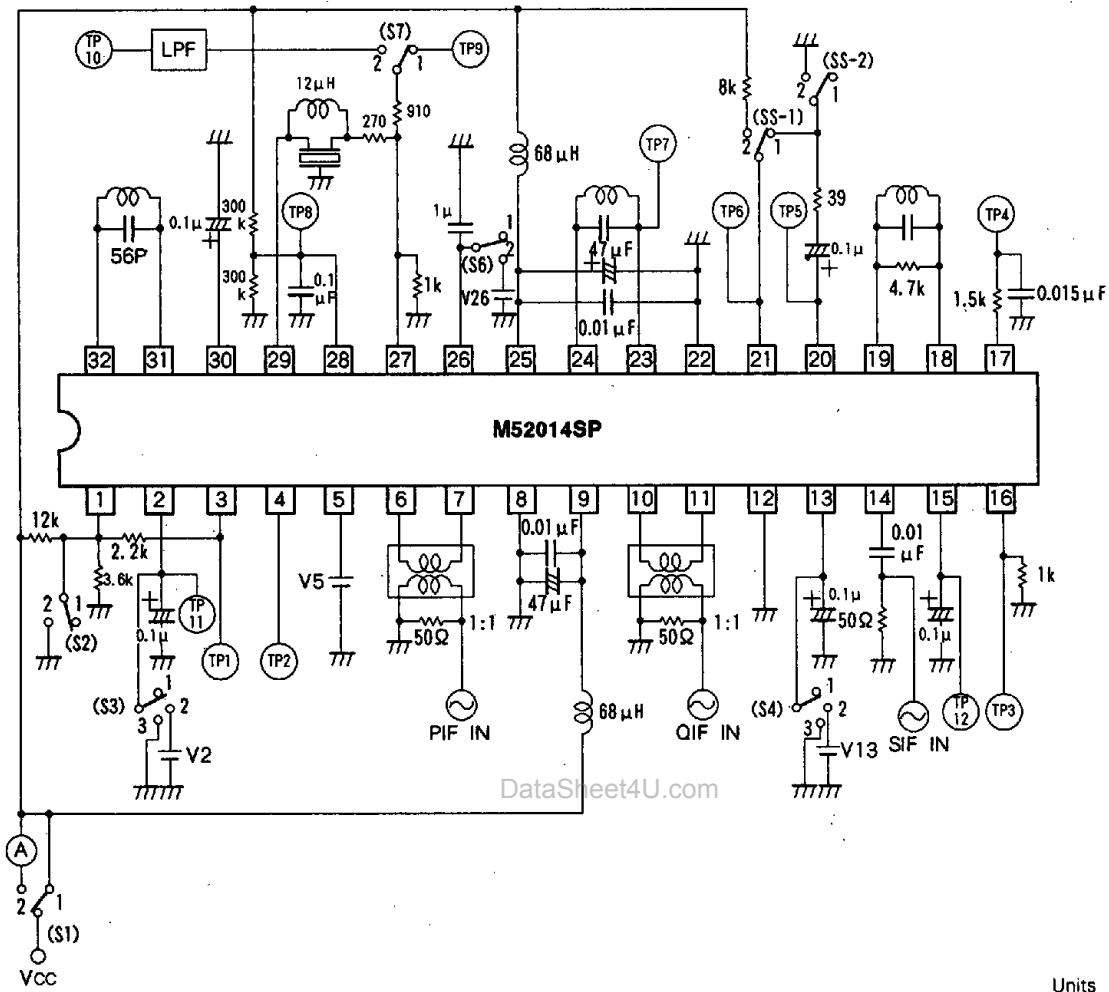
TEST CIRCUIT 1

Units Resistance: Ω

Capacitance: F

TEST CIRCUIT 2
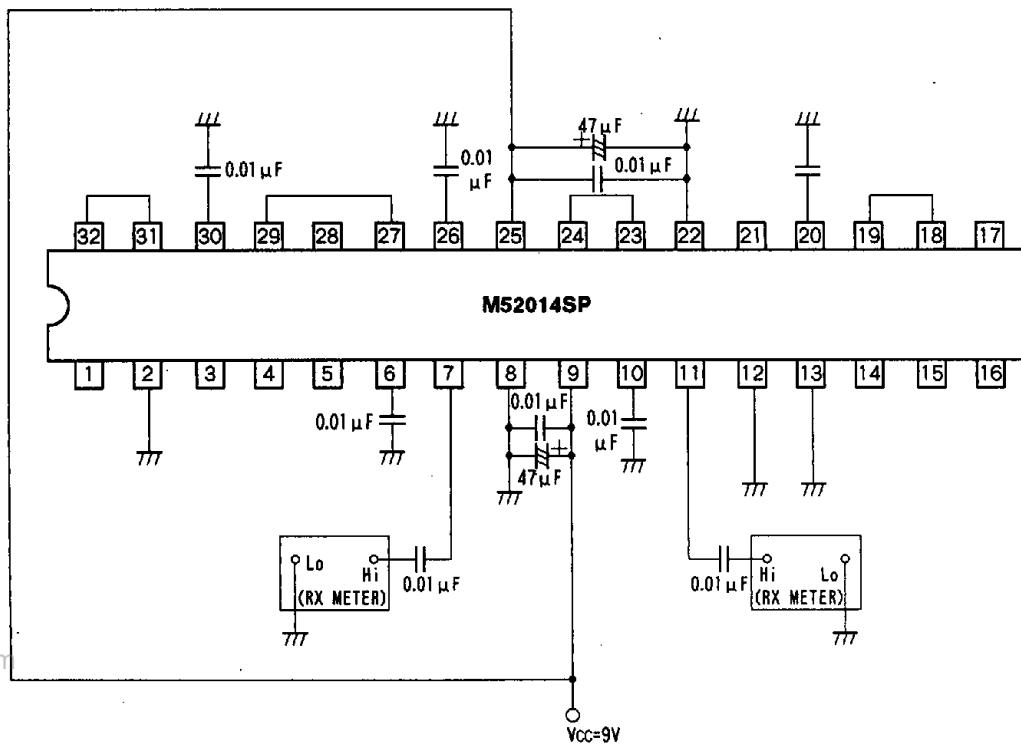
Units Resistance: Ω

Capacitance: F

TYPICAL CHARACTERISTICS

THERMAL DERATING (MAXIMUM RATING)

APPLICATION EXAMPLE 1

Units Resistance: Ω
Capacitance: F

APPLICATION EXAMPLE 2

$$f_P = 39.5MHz$$
$$f_{S1} = 33.5MHz$$
$$f_{S2} = 32.95MHz$$

Units Resistance: Ω
Capacitance: F

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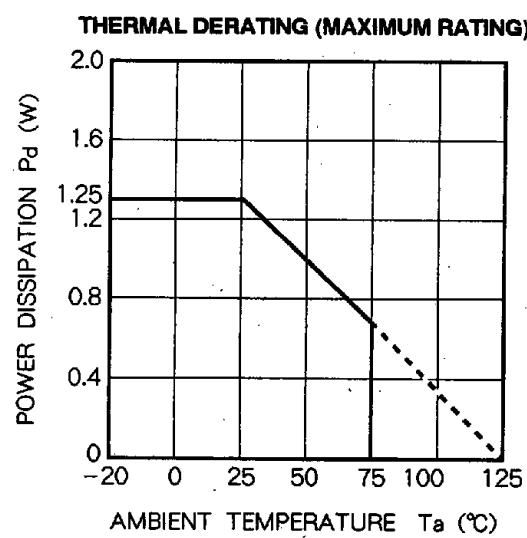
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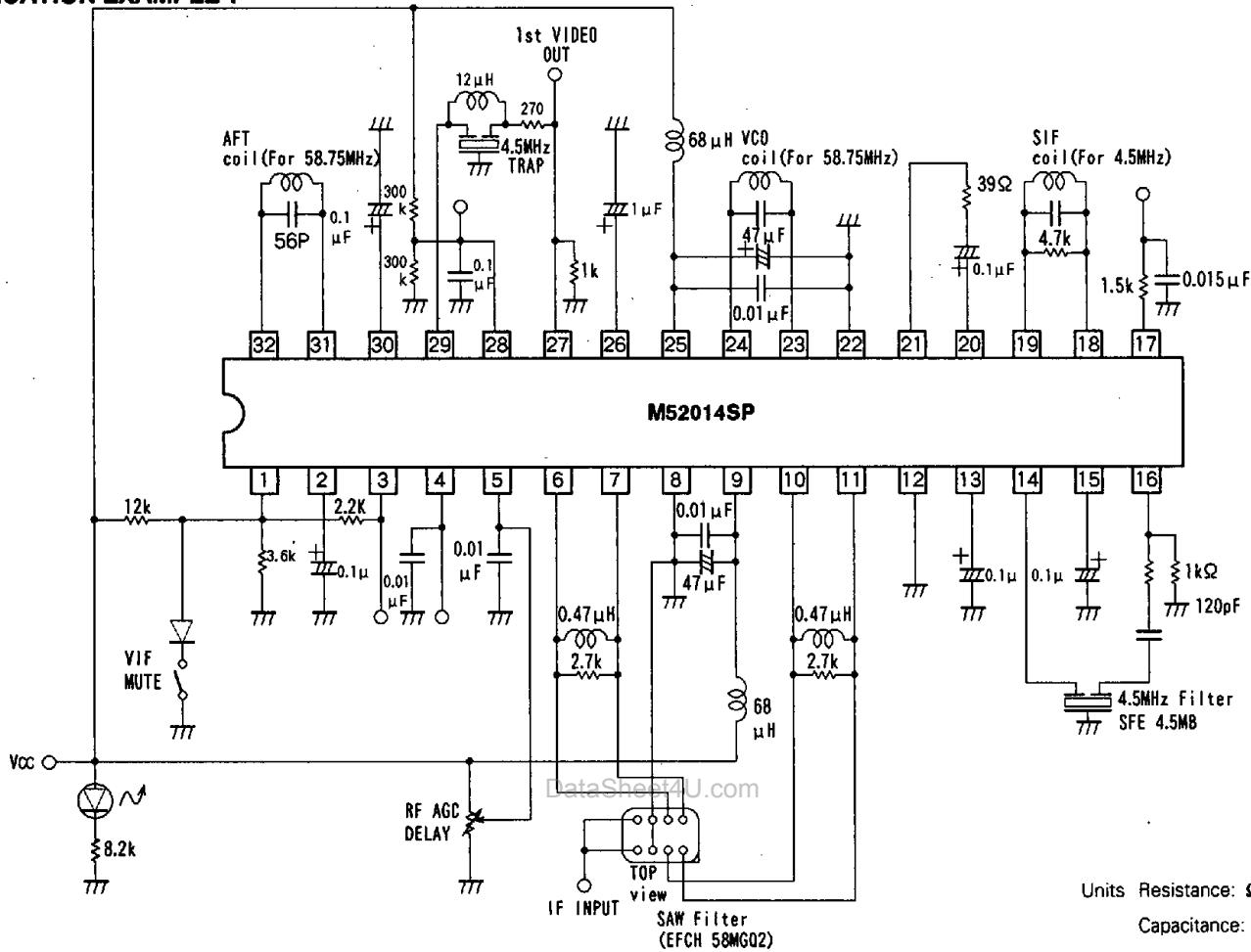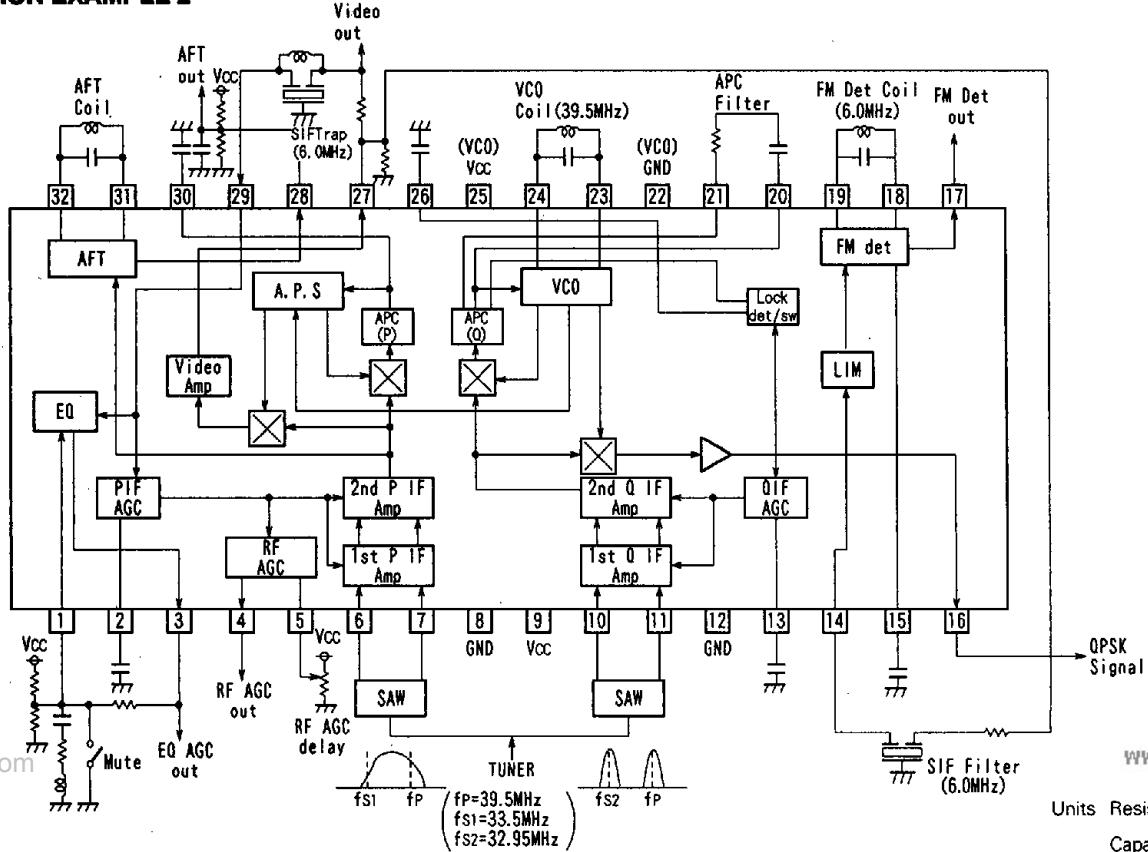
DESCRIPTION OF PIN

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins	Description of function
① ③	EQ FEED BACK EQ VIDEO OUT	(With no signal) 5.4V		Frequency characteristics can be given to video output at pin ③ by feedbacking it to pin ①. They can also be used as an amplifier with fixed gain by varying external constant. EQ video output at pin ③ can be muted by setting pin ① to Low.
②	IF AGC FILTER (P)	—		Peak AGC is made by IF AC filter pin on (P) side. Input and output current in ordinary electric field is around 15μA in charging, 200μA max., and 500μA in discharging. Resistor of 910KΩ or more can be connected between this pin and GND externally.
④	RF AGC OUT	0.1~8.2V		RF AGC is for reverse output. Circuit operates by current. Input and output current is 200μA.

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DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins	Description of function
⑤	RF AGC DELAY	—		Differential bias and delay point can be varied by variable external resistor.
⑥ ⑦	VIF IN	2.2V		IF input on (P) side. Be sure to input same signal to pins ⑥ and ⑦.
⑧	VIF GND	—	—	GND for VIF section.
⑨	Vcc	9V	—	Power supply for VIF and SIF sections.
⑩ ⑪	SIF IN	2.2V		IF input on (Q) side. Be sure to input same signal to pin ⑩ and ⑪.
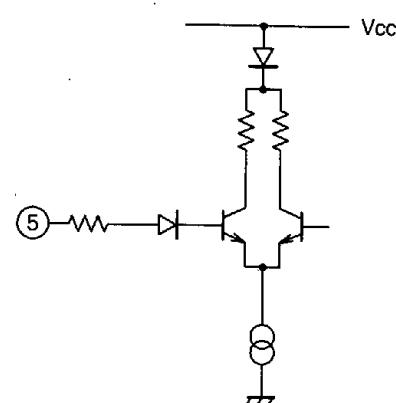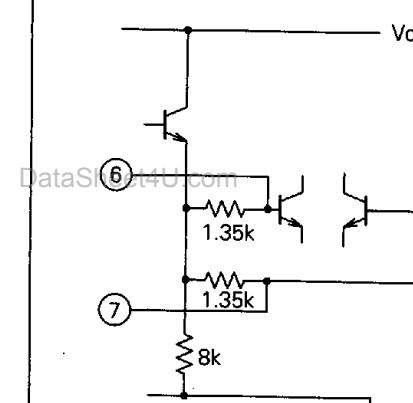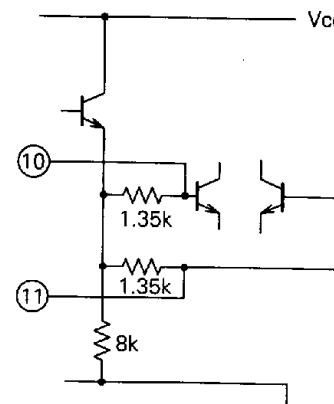
DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins	Description of function
⑫	SIF GND	———	———	———
⑬	IF AGC FILTER (Q)	———		IF AGC filter pin on (Q) side similar to pin ②.
⑭	LIMITTER IN	2.3V		Input pin for intercarrier.
⑮	BIAS	5.0V		Bias pin for sound output. (pin ⑰)
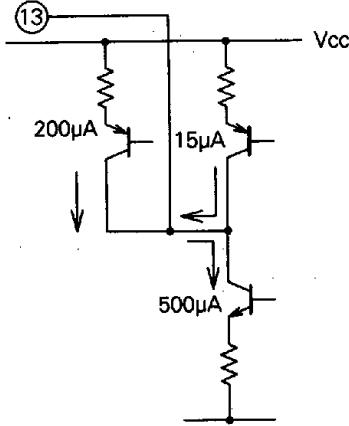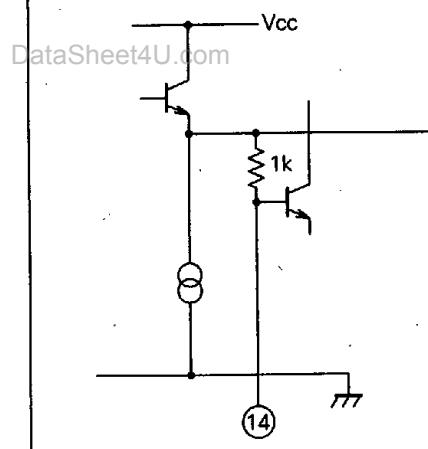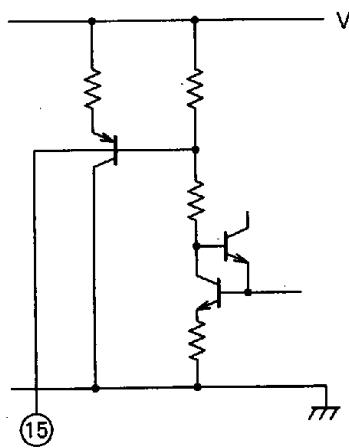
DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins	Description of function
⑯	SIF DET OUT	(With no signal) 3.75V		Detector output pin on (Q) side. It is driven by adding 1KΩ resistor externally. Current of around 1mA is flowed inside.
⑰	AUDIO OUT	4.6V		Output pin after sound FM detection. Current of around 500μA is flowed inside.
⑱ ⑲	SIF COIL	5.1V		It is a pin for sound FM detector coil. At 4.5MHz and 25kHz dev., output will be around 330mV r.m.s by inserting 4.7KΩ dumping resistor.

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins	Description of function
20	APC FILTER	4.5V		It outputs voltage for phase difference between input signal and VCO output. It is connected with pin 21 through lag-lead filter.
21	LOCK SW	(When locked) 0.2V		It outputs judgment for PLL locking to IF signal. The judgment is output by switching time constant of APC loop filter.
22	VCO GND	——	——	It is GND pin for VCO section.
23 24	VCO COIL	8.1V		It is a connector pin for VCO coil. Capture range is varied depending on the capacity of coil connected.
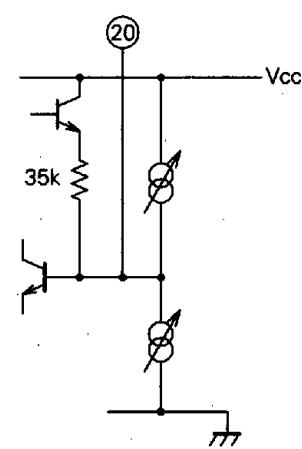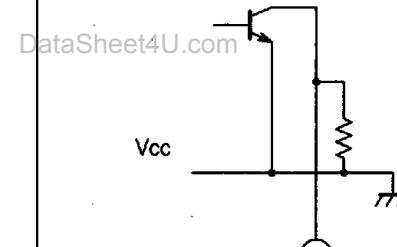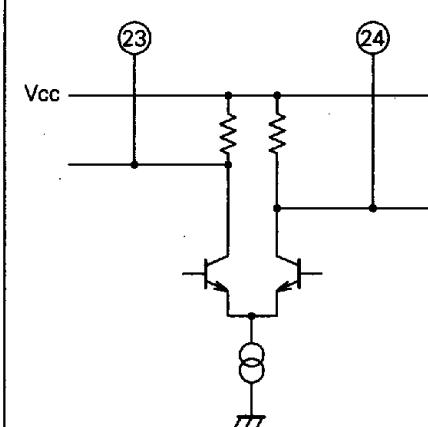
DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins	Description of function
㉕	VCO Vcc	9V	————	Power supply for VCO section.
㉖	LOCK FILTER	(With no signal) 3.75V		Low pass filter consists of external capacitor of pin ㉖ and internal resistor.
㉗	VIDEO OUT	(With no signal) 3.75V		Detector output pin on (P) side. It is driven by adding 1KΩ resistor externally. Current of around 1mA is flowed inside.
㉘	AFT OUT	(With no signal) 4.2V		External resistor is added and AFT waveform is output. Detector sensitivity can be varied by changing the external resistor.

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DESCRIPTION OF PIN (cont.)
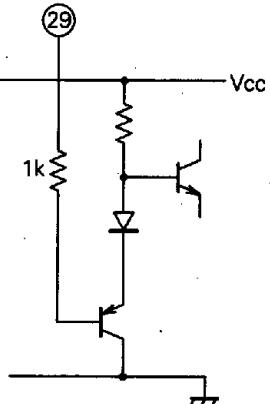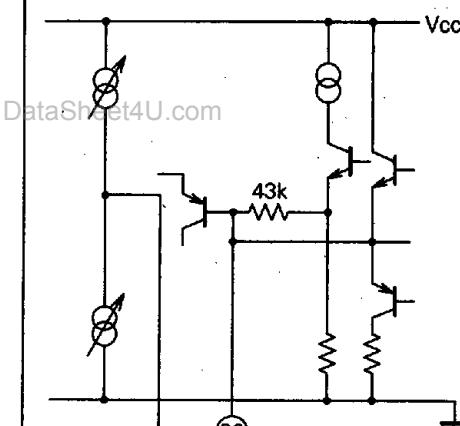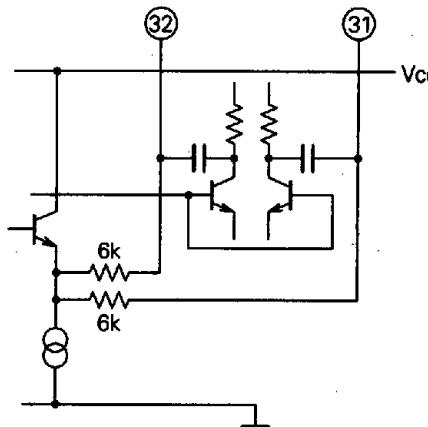
Pin No.	Name	Voltage and wave information	Peripheral circuit of pins	Description of function
29	EQ IN	—		Output pin for EQ amplifier. It is also used as an input pin for (P) IF AGC.
30	APS FILTER	(With no signal) 4.8V		It outputs voltage for phase difference between VCO output locked on Q side and IF input signal.
31 32	AFT COIL	3.7V		It is a connector pin for AFT coil. Set tuning point by adding a coil.