To our customers,

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

EOL Product

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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EOL Product

M52342FP

PLL-Split VIF/SIF IC

REJ03F0165-0201
Rev.2.01
Jan 25, 2008

Description

The M52342FP is IF signal-processing IC for VCRs and TVs. It enables the PLL detection system despite size as small as that of conventional quasi-synchronous VIF/SIF detector, IF/RF AGC, SIF limiter, FM detector, QIF AGC and EQ AMP.

Features

- Video detection output is 2 V_{P-P}. It has built-in EQ AMP.
- The package is a 24-pin flat package, suitable for space saving.
- The video detector uses PLL for full synchronous detection circuit. It produces excellent characteristics of DG, DP, 920 kHz beat, and cross color.
- Dynamic AGC realizes high-speed response with only single filter.
- Video IF and sound IF signal processing are separated from each other. VCO output is used to obtain intercarrier. This PLL-SPLIT method and built-in QIF AGC provide good sound sensitivity and reduces buzz.
- As AFT output voltage uses the APC output voltage, VCO coil is not used.
- Audio FM demodulation uses PLL system, so it has wide frequency range with no external parts and no adjustment.

Application

TV sets, VCR tuners

Recommended Operating Condition

- In case of V_{CC} and Vreg. OUT short
  - Supply voltage range: 4.75 to 5.25 V
  - Recommended supply voltage: 5.0 V
- Incase of Vreg. OUT open
  - Supply voltage range: 8.5 to 12.5 V

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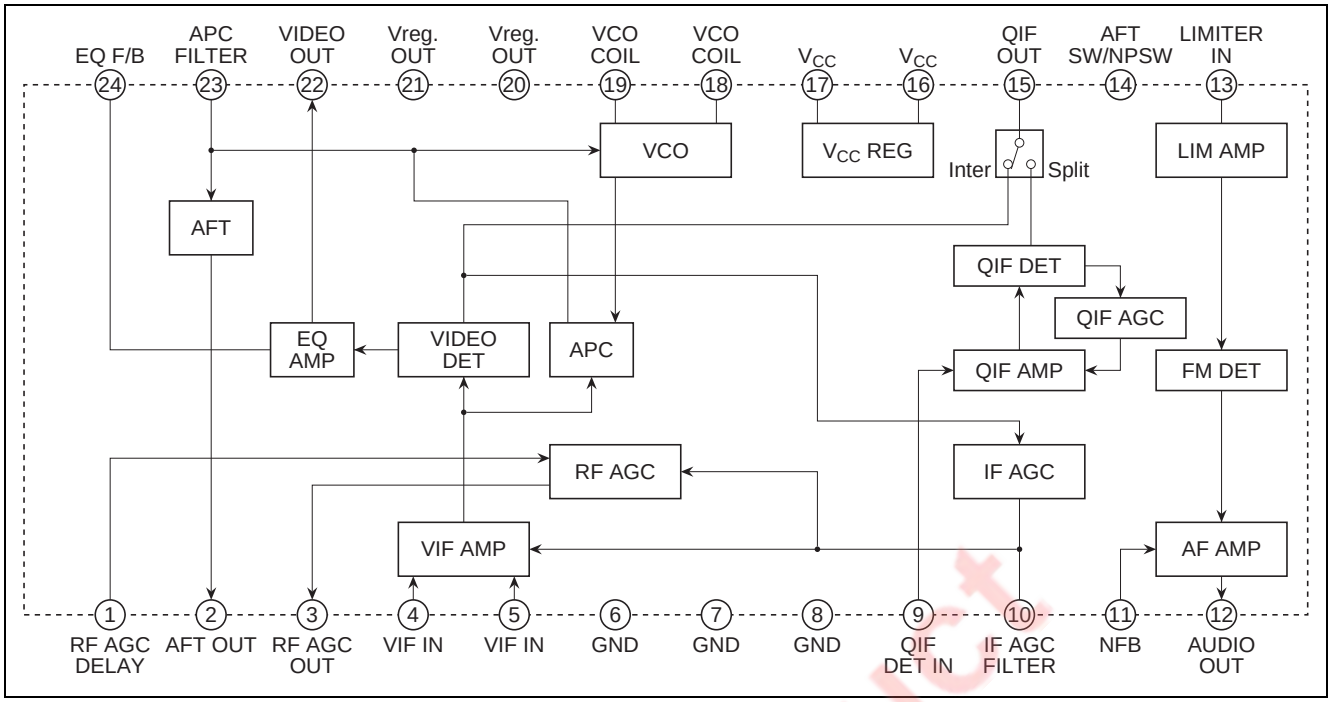
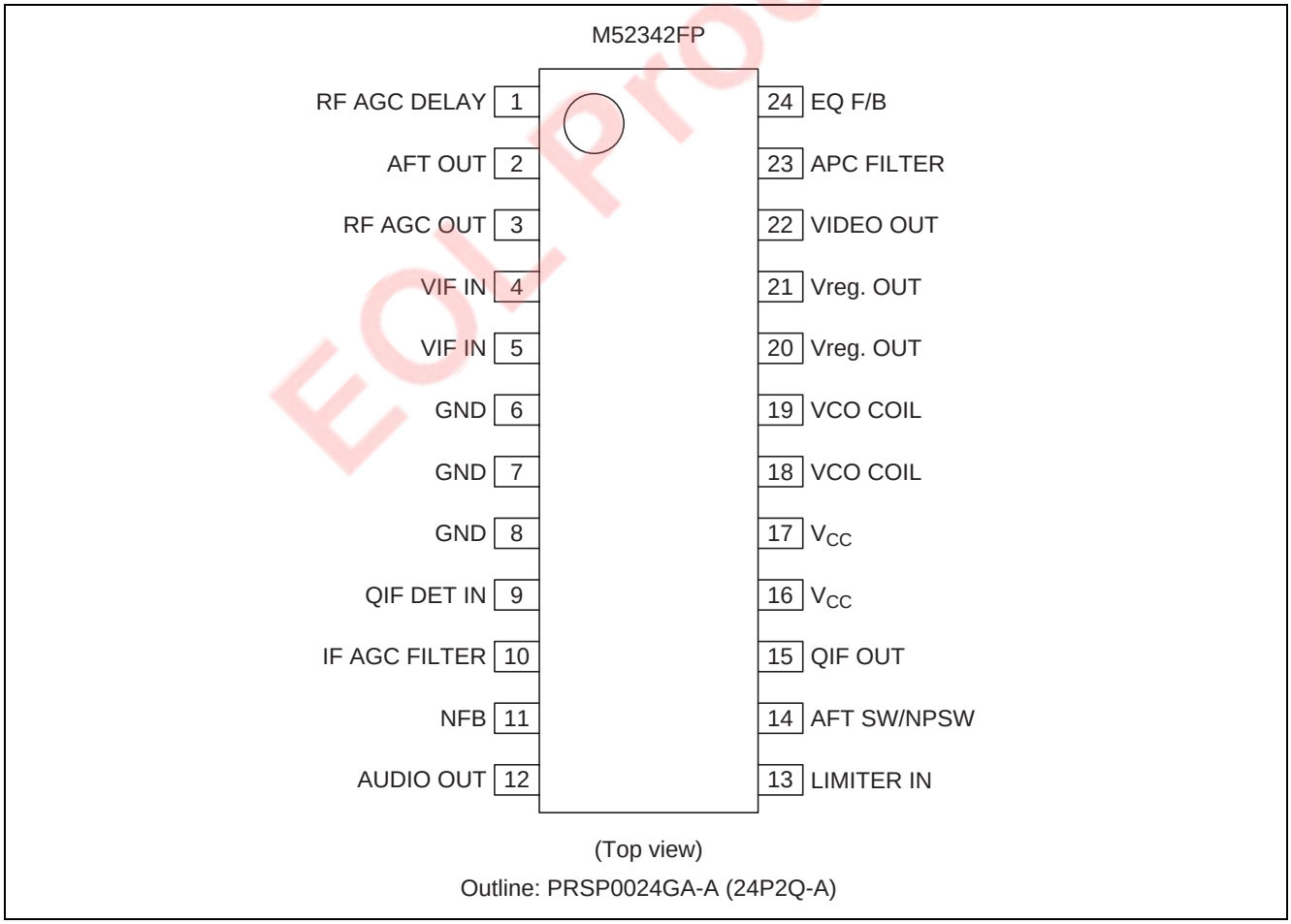
Block Diagram



Pin Arrangement



(Top view)

Outline: PRSP0024GA-A (24P2Q-A)

EOL Product

Absolute Maximum Ratings

(Ta = 25°C, surge protection capacitance 200 pF resistance 0 Ω, unless otherwise noted)

Item	Symbol	Ratings	Unit	Condition
Supply voltage1	V_{CC}	13.2	V	V_{CC} and Vreg. OUT is not connected to each other.
Supply voltage Vreg. OUT	Vreg. OUT	6.0	V	V_{CC} and Vreg. OUT is not connected to each other.
Power dissipation	Pd	1524	mW	
Operating temperature	Topr	−20 to +75	°C	
Storage temperature	Tstg	−40 to +150	°C	
Surge voltage resistance	Surge	200	V	

Ambient Operating Condition

(Ta = 25°C, unless otherwise noted)

Supply Voltage	Supply Voltage Range	Recommended Supply Voltage
In case of V_{CC} and Vreg. OUT short	4.75 to 5.25 V	5.0 V
In case of Vreg. OUT open	8.5 to 12.5 V	

Electrical Characteristics

(V_{CC} = 5 V, Ta = 25°C, unless otherwise noted)

Item	Symbol	Test Circuit	Test Point	Input Point	Input SG	Limits			Unit	Test Conditions			
										External Power Supply			Switches set to position 1 unless otherwise indicated
						Min.	Typ.	Max.		V7	V8	V12	
VIF section													
Circuit current1 V_{CC} = 5 V	I_{CC1}	1	A	VIF IN	SG1	33	46	59	mA			5	V_{CC} = 5 V SW17 = 1, SW14 = 2
Circuit current2 V_{CC} = 12 V	I_{CC2}	1	A	VIF IN	SG1	33	46	59	mA			5	V_{CC} = 12 V SW14 = SW17 = 2
Vreg voltage	V_{CC2}	1	TP17	—	—	4.60	4.95	5.30	V			5	V_{CC} = 12 V SW7 = 2
Video output DC voltage	V18	1	TP18A	—	—	3.2	3.5	3.8	V		0		SW8 = 2
Video output voltage	V_O det	1	TP18A	VIF IN	SG1	1.8	2.1	2.4	V_{P-P}				
Video S/N	Video S/N	1	TP18B	VIF IN	SG2	51	56	—	dB				SW18 = 2
Video band width	BW	1	TP18A	VIF IN	SG3	7.0	9.0	—	MHz		Variable		SW8 = 2
Input sensitivity	VIN MIN	1	TP18A	VIF IN	SG4	—	48	52	dBμ				

EOL Product

(V_{CC} = 5 V, Ta = 25°C, unless otherwise noted)

Item	Symbol	Test Circuit	Test Point	Input Point	Input SG	Limits			Unit	Test Conditions			
										External Power Supply			Switches set to position 1 unless otherwise indicated
						Min.	Typ.	Max.		V7	V8	V12	
Maximum allowable input	VIN MAX	1	TP18A	VIF IN	SG5	101	105	—	dBμ				
AGC control range input	GR	—	—	—	—	50	57	—	dB				
IF AGC voltage	V8	1	TP8	VIF IN	SG6	2.9	3.2	3.5	V				
Maximum IF AGC voltage	V8H	1	TP8	—	—	4.0	4.4	—	V				
Minimum IF AGC voltage	V8L	1	TP8	VIF IN	SG7	2.2	2.4	2.6	V				
Maximum RF AGC voltage	V3H	1	TP3	VIF IN	SG6	4.2	4.7	—	V				
						8.0	8.9	—					(V_{CC} = 9 V)
						11.0	11.9	—					(V_{CC} = 12 V)
Minimum RF AGC voltage	V3L	1	TP3	VIF IN	SG7	—	0.1	0.5	V				
						—	0.2	0.7					(V_{CC} = 9 V)
						—	0.2	0.7					(V_{CC} = 12 V)
RF AGC operation voltage	V3	1	TP3	VIF IN	SG8	89	92	95	dBμ				
Capture range U	CL-U	1	TP18A	VIF IN	SG9	1.0	1.7	—	MHz				
Capture range L	CL-L	1	TP18A	VIF IN	SG9	1.8	2.4	—	MHz				
Capture range T	CL-T	1	—	—	—	3.1	4.1	—	MHz				
AFT sensitivity		1	TP2	VIF IN	SG10	20	30	60	mV/kHz			3.3	
AFT maximum voltage	V2H	1	TP2	VIF IN	SG10	3.85	4.15	—	V			3.3	
						7.7	8.1	—					(V_{CC} = 9 V)
						10.7	11.1	—					(V_{CC} = 12 V)
AFT minimum voltage	V2L	1	TP2	VIF IN	SG10	—	0.7	1.2	V			3.3	
						—	0.7	1.2					(V_{CC} = 9 V)
						—	0.7	1.2					(V_{CC} = 12 V)
AFT defeat1	AFT def1	1	TP2	VIF IN	SG10	2.2	2.5	2.8	V			1.65	
						4.1	4.5	4.9					(V_{CC} = 9 V)
						5.5	6.0	6.5					(V_{CC} = 12 V)
AFT defeat2	AFT def2	1	TP2	VIF IN	SG10	2.2	2.5	2.8	V			4.6	
						4.1	4.5	4.9					(V_{CC} = 9 V)
						5.5	6.0	6.5					(V_{CC} = 12 V)
Inter modulation	IM	1	TP18A	VIF IN	SG11	35	40	—	dB		Variable		SW8 = 2

EOL Product

(V_{CC} = 5 V, Ta = 25°C, unless otherwise noted)

Item	Symbol	Test Circuit	Test Point	Input Point	Input SG	Limits			Unit	Test Conditions			
										External Power Supply			Switches set to position 1 unless otherwise indicated
						Min.	Typ.	Max.		V7	V8	V12	
Differential gain	DG	1	TP18A	VIF IN	SG12	—	2	5	%				
Differential phase	DP	1	TP18A	VIF IN	SG12	—	2	5	deg				
Sync. tip level	V18 SYNC	1	TP18A	VIF IN	SG2	0.85	1.15	1.45	V				
VIF input resister	RINV	2	TP4	—	—	—	1.2	—	kΩ				
VIF input capacitance	CINV	2	TP4	—	—	—	5	—	pF				
SIF section													
QIF output1	QIF1	1	TP13	VIF IN QIF IN	SG2 SG13	94	100	106	dBμ				
QIF output2	QIF2	1	TP13	VIF IN QIF IN	SG2 SG14	94	100	106	dBμ				
SIF detection output	V_{OS}	1	TP13	VIF IN	SG15	94	100	106	dBμ	0		5	SW7 = 2
AF output DC voltage	V1	1	TP10	SIF IN	SG20	1.6	2.2	2.8	V			5	
AF output (4.5 MHz)	VOAF1	1	TP10	SIF IN	SG16	400	560	800	mVrms			5	
AF output (5.5 MHz)	VOAF2	1	TP10	SIF IN	SG21	320	450	630	mVrms			0	
AF output distortion (4.5 MHz)	THD AF1	1	TP10	SIF IN	SG16	—	0.2	0.9	%			5	
AF output distortion (5.5 MHz)	THD AF2	1	TP10	SIF IN	SG21	—	0.2	0.9	%			0	
Limiting sensitivity (4.5 MHz)	LIM1	1	TP10	SIF IN	SG17 SG19	—	42	55	dBμ			5	
Limiting sensitivity (5.5 MHz)	LIM2	1	TP10	SIF IN	SG22 SG24	—	42	55	dBμ			0	
AM rejection (4.5 MHz)	AMR1	1	TP10	SIF IN	SG18	55	62	—	dB			5	
AM rejection (5.5 MHz)	AMR2	1	TP10	SIF IN	SG23	55	64	—	dB			0	
AF S/N (4.5 MHz)	AF S/N1	1	TP10	SIF IN	SG20	55	62	—	dB			5	
AF S/N (5.5 MHz)	AF S/N2	1	TP10	SIF IN	SG25	55	64	—	dB			0	

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(V_{CC} = 5 V, Ta = 25°C, unless otherwise noted)

Item	Symbol	Test Circuit	Test Point	Input Point	Input SG	Limits			Unit	Test Conditions			
										External Power Supply			Switches set to position 1 unless otherwise indicated
						Min.	Typ.	Max.		V7	V8	V12	
SIF input resistance	RINS	2	TP7	—	—	—	1.5	—	kΩ				
SIF input capacitance	CINS	2	TP7	—	—	—	4	—	pF				
Control section													
QIF control	C_{QIF}	1	TP7	—	—	—	0.7	1.0	V	Variable			SW7 = 2

Pin 14 Voltage Control

Pin 14 Voltage (V)		AF	AFT
0 to 2.3	0 to 0.6	PAL	NORMAL
	1.0 to 2.3		DEFEAT
2.7 to 5.0	2.7 to 4.0	NTSC	NORMAL
	4.4 to 5.0		DEFEAT

Electrical Characteristics Test Method

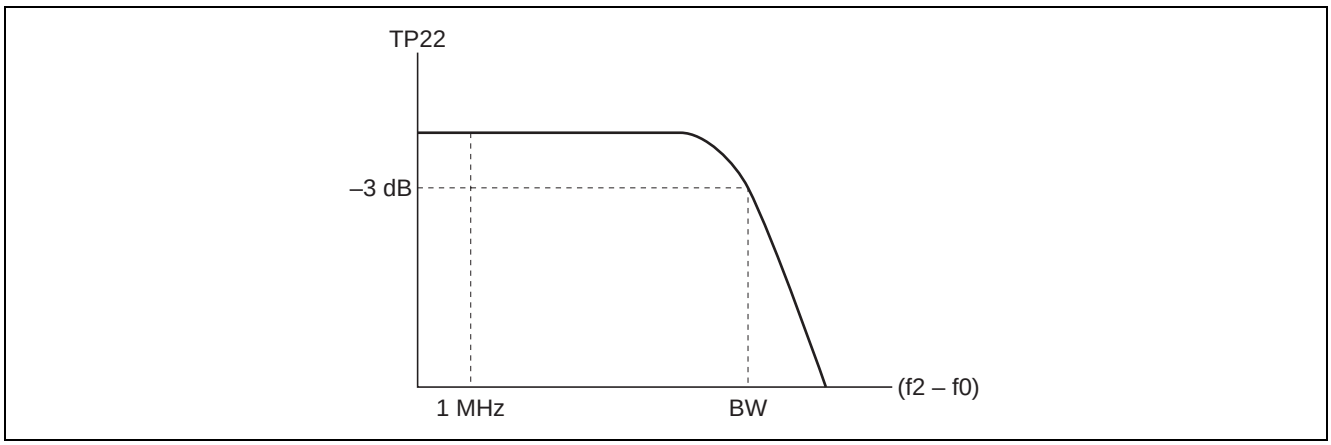
Video S/N

Input SG2 into VIF IN and measure the video out (Pin 22) noise in r.m.s at TP22B through a 5 MHz (–3 dB) L.P.F.

$$S/N = 20 \log \left(\frac{0.7 \bullet Vo\ det}{NOISE} \right) \quad (dB)$$

BW Video Band Width

1. Measure the 1 MHz component level of EQ output TP22A with a spectrum analyzer when SG3 (f2 = 57.75 MHz) is input into VIF IN. At that time, measure the voltage at TP10 with SW10, set to position 2, and then fix V10 at that voltage.
2. Reduce f2 and measure the value of (f2 – f0) when the (f2 – f0) component level reaches –3 dB from the 1 MHz component level as shown below.



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VIN MIN Input Sensitivity

Input SG4 (Vi = 90 dBμ) into VIF IN, and then gradually reduce Vi and measure the input level when the 20 kHz component of EQ output TP22A reaches –3 dB from V_O det level.

VIN MAX Maximum Allowable Input

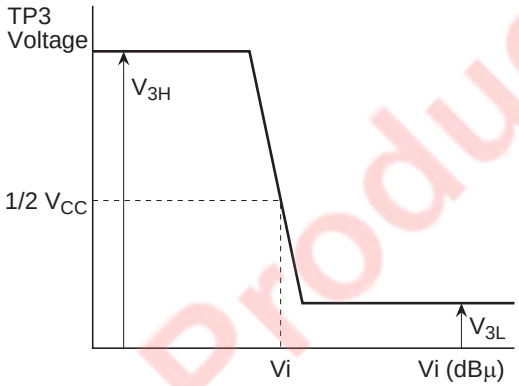
1. Input SG5 (Vi = 90 dBμ) into VIF IN, and measure the level of the 20 kHz component of EQ output.
2. Gradually increase the Vi of SG and measure the input level when the output reaches –3 dB.

GR AGC Control Range

GR = VIN MAX – VIN MIN (dB)

V3 RF AGC Operating Voltage

Input SG8 into VIF IN, and gradually reduce Vi and then measure the input level when RF AGC output TP3 reaches 1/2 V_{CC}, as shown below.



CL-U Capture Range

1. Increase the frequency of SG9 until the VCO is out of locked-oscillation.
2. Decrease the frequency of SG9 and measure the frequency fU when the VCO locks.

CL-U = fU – 58.75 (MHz)

CL-L Capture Range

1. Decrease the frequency of SG9 until the VCO is out of locked-oscillation.
2. Increase the frequency of SG9 and measure the frequency fL when the VCO locks.

CL-L = 58.75 – fL (MHz)

CL-T Capture Range

CL-T = CL-U + CL-L (MHz)

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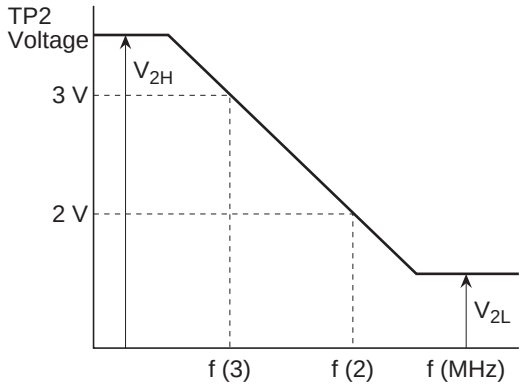
μAFT Sensitivity, V_{2H} Maximum AFT Voltage, V_{2L} Minimum AFT Voltage

1. Input SG10 into VIF IN, and set the frequency of SG10 so that the voltage of AFT output TP2 is 3 V. This frequency is named f (3).
2. Set the frequency of SG10 so that the AFT output voltage is 2 V. This frequency is named f (2).
3. In the graph, maximum and minimum DC voltage are V_{2H} and V_{2L}, respectively.



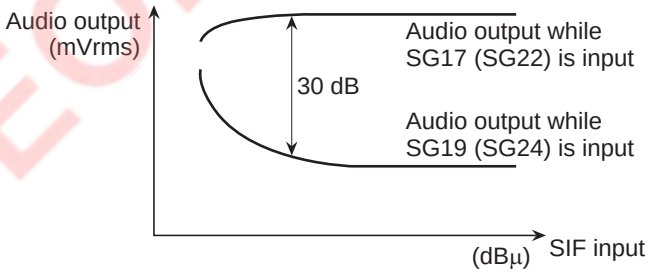
$$\mu = \frac{1000\ (mV)}{f\ (2) - f\ (3)\ (kHz)} \quad (mV/kHz)$$

IM Intermodulation

1. Input SG11 into VIF IN, and measure EQ output TP22A with an oscilloscope.
2. Adjust AGC filter voltage V10 so that the minimum DC level of the output waveform is 1.0 V.
3. At this time, measure, TP22A with a spectrum analyzer.
   The intermodulation is defined as a difference between 920 kHz and 3.58 MHz frequency components.

LIM Limiting Sensitivity

1. Input SG17 (SG22) into SIF input, and measure the 400 Hz component level of AF output TP12.
2. Input SG19 (SG24) into SIF input, and measure the 400 Hz component level of AF output TP12.
3. The input limiting sensitivity is defined as the input level when a difference between each 400 Hz components of audio output (TP12) is 30 dB, as shown below.



AMR AM Rejection

1. Input SG18 (SG23) into SIF input, and measure the output level of AF output TP12. This level is named VAM.
2. AMR is;

$$AMR = 20 \log \left(\frac{VoAF\ (mVrms)}{VAM\ (mVrms)} \right) \quad (dB)$$

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AF S/N

1. Input SG19 (SG24) into SIF input, and measure the output noise level of AF output TP1. This level is named VN.
2. S/N is;

$$S/N = 20 \log \left(\frac{VoAF\ (mVrms)}{VN\ (mVrms)} \right) \quad (dB)$$

C_{QIF} QIF Control

Lower the voltage of V9, and measure the voltage of V9 when DC voltage of TP15 begins to change.

The Note in The System Setup

M52342FP has 2 power supply pins of V_{CC} (pin 16, 17) and Vreg. OUT (pin 20, 21) . V_{CC} is for AFT output, RF AGC output circuits and 5 V regulated power circuit and Vreg. OUT is for the other circuit blocks.

In case M52342FP is used together with other ICs like VIF operating at more than 5 V, the same supply voltage as that of connected ICs is applied to V_{CC} and Vreg. OUT is opened. The other circuit blocks, connected to Vreg. OUT are powered by internal 5 V regulated power supply.

In case the connecting ICs are operated at 5 V, 5 V is supplied to both V_{CC} and Vreg. OUT.

Logic Table

		AF	AFT
10 k “H”	20 k “H”	NTSC	DEFEAT
	20 k “L”		NORMAL
10 k “L”	20 k “H”	PAL	DEFEAT
	20 k “L”		NORMAL

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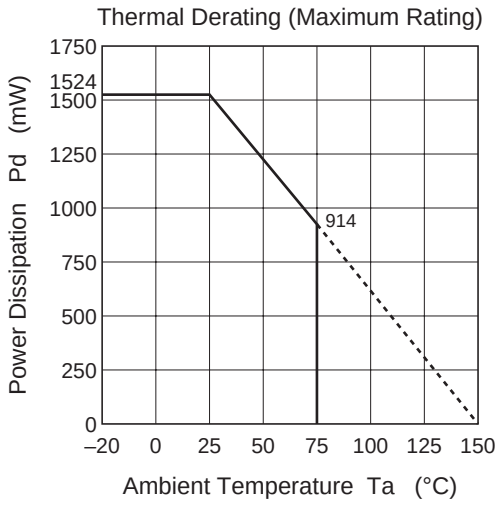
Input Signal

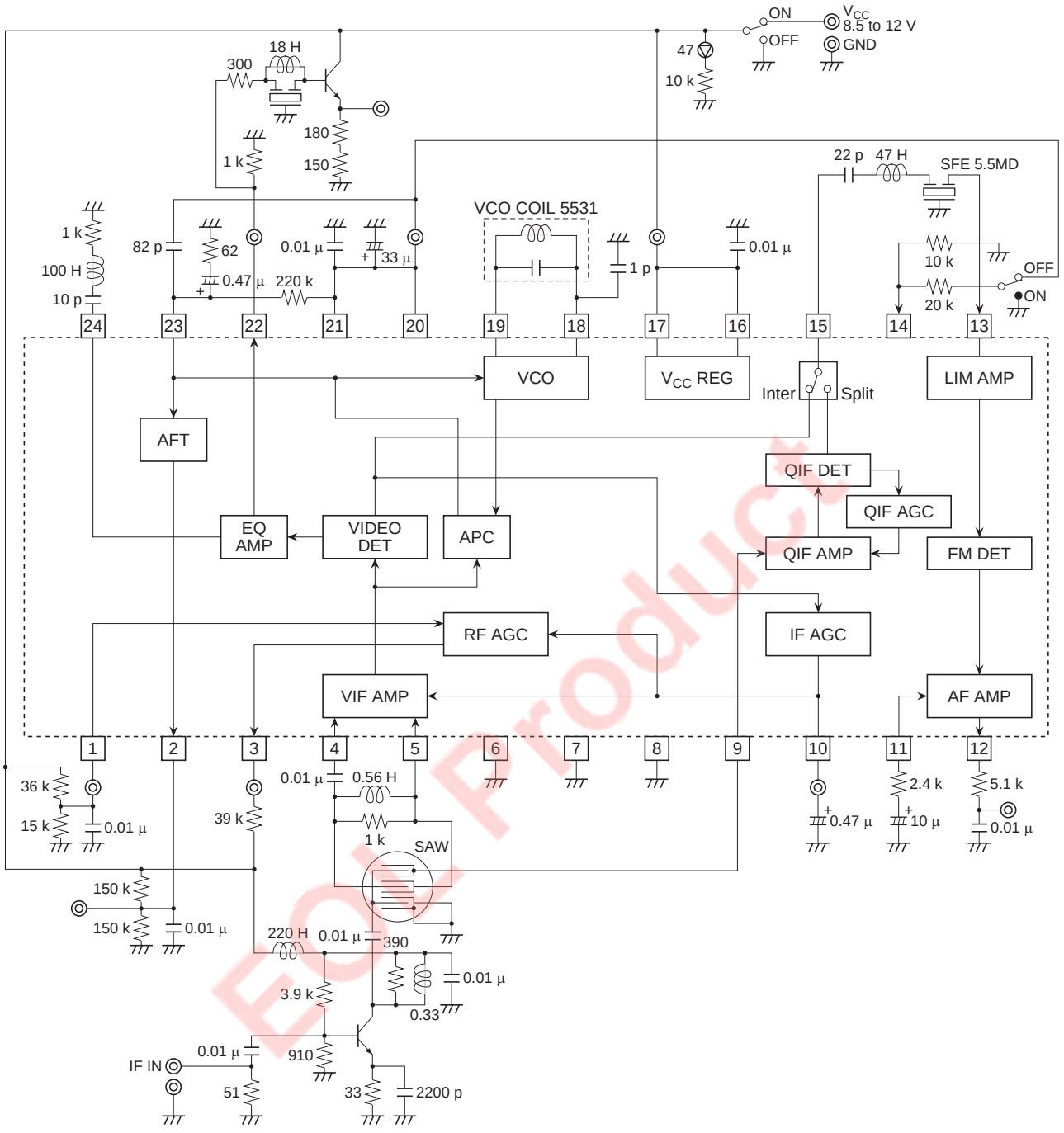
SG No.	Signals (50 Ω Termination)
1	f_0 = 58.75 MHz AM 20 kHz 77.8% 90 dBμ
2	f_0 = 58.75 MHz 90 dBμ CW
3	f_1 = 58.75 MHz 90 dBμ CW (Mixed signal) f_2 = Frequency variable 70 dBμ CW (Mixed signal)
4	f_0 = 58.75 MHz AM 20 kHz 77.8% level variable
5	f_0 = 58.75 MHz AM 20 kHz 14.0% level variable
6	f_0 = 58.75 MHz 80 dBμ CW
7	f_0 = 58.75 MHz 110 dBμ CW
8	f_0 = 58.75 MHz CW level variable
9	f_0 = variable AM 20 kHz 77.8% 90dBμ
10	f_0 = variable 90dBμ CW
11	f_1 = 58.75 MHz 90 dBμ CW (Mixed signal) f_2 = 55.17 MHz 80 dBμ CW (Mixed signal) f_3 = 54.25 MHz 80 dBμ CW (Mixed signal)
12	f_0 = 58.75 MHz 87.5% TV modulation ten-step waveform Sync tip level 90 dBμ
13	f_1 = 54.25 MHz 95 dBμ CW
14	f_1 = 54.25 MHz 75 dBμ CW
15	f_1 = 58.75 MHz 90 dBμ CW (Mixed signal) f_2 = 54.25 MHz 70 dBμ CW (Mixed signal)
16	f_0 = 4.5 MHz 90 dBμ FM 400 Hz ± 25 kHz dev
17	f_0 = 4.5 MHz FM 400 Hz ± 25 kHz dev level variable
18	f_0 = 4.5 MHz 90 dBμ AM 400 Hz 30%
19	f_0 = 4.5 MHz 90dBμ CW
20	f_0 = 4.5 MHz CW level variable
21	f_0 = 5.5 MHz 90dBμ FM 400 Hz ± 50 kHz dev
22	f_0 = 5.5 MHz FM 400 Hz ± 50 kHz dev level variable
23	f_0 = 5.5 MHz 90 dBμ AM 400 Hz 30%
24	f_0 = 5.5 MHz 90dBμ CW
25	f_0 = 5.5 MHz CW level variable

For Product

Typical Characteristics



Typical Application Example (for 38.9 MHz Split)



Note: In case the other components are connected to the GND area nearby the VCO coil, a leakage interference to them should be considered.
The bypass capacitors of 33 µF and 0.01 µF are grounded as close as possible to the GND pins (pin 6, 7, 8) so as to minimize the interference.

Units R: Ω
C: F

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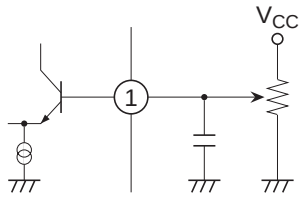
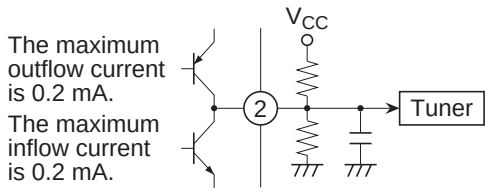
Pin Description

Pin 1 (RF AGC DELAY)



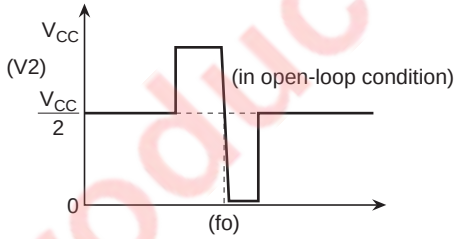
An applied voltage to the pin 1 is for changing a RF AGC delay point.

Pin 2 (AFT OUT)

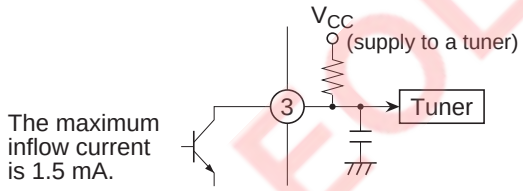


Since an AFT output is provided by a high impedance source, the detection sensitivity can be set by an external resistor.
The muting operation will be on in following two cases;

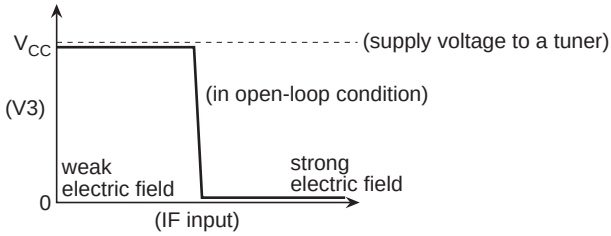
1) the APC is out of locking,
2) the video output becomes small enough in a weak electric field.



Pin 3 (RF AGC OUT)

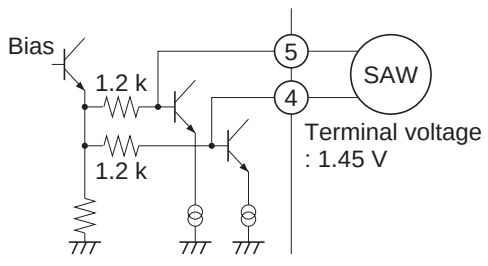


A current mode output is available in the reverse AGC operation.
The fluctuation of a bottom voltage is made small by loading higher impedance for a deep saturation.



Note: Connecting a nonpolarity capacitor of 1 μF between pin1 and pin3 improves AGC operating speed. In that case, the capacitors between pin1/pin3 and ground should be removed.

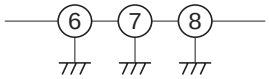
Pin 4, Pin 5 (VIF IN)



It should be designed considering careful impedance matching with the SAW filter.

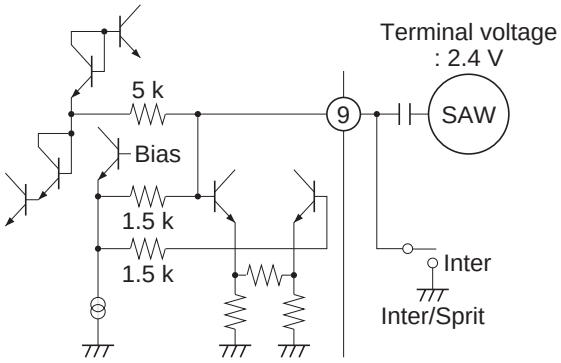
EOL Product

Pin 6, Pin 7, Pin 8 (GND)



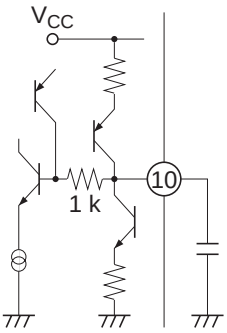
They are all groung pins.

Pin 9 (QIF DET IN)

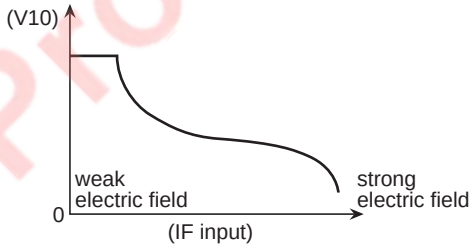


The input impedance is 1.5 kΩ.
In the intercarrier system application, the intercarrier output is available in pin 15 by connecting pin 9 to ground.

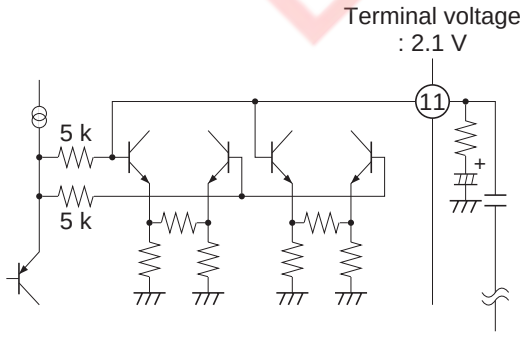
Pin 10 (IF AGC FILTER)



In spite of the 1-pin filter configuration, 2-pin filter characteristics are available by utilizing the dynamic AGC circuit.



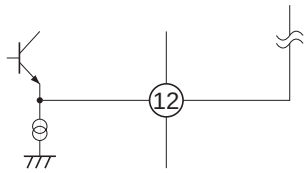
Pin 11 (NFB)



The FM detector can respond to several kinds of SIF signals without an adjustment and external components by adopting the PLL technique.
It also is in compliance with the multi-SIF by selecting an appropriate deemphasis and audio output amplifier using the pin 14 switch.
The capacitor between pin 11 and 12, which fixes the deemphasis characteristics, can be determined considering the combination of an equivalent resistance of the IC and this capacitor itself.

EOL Product

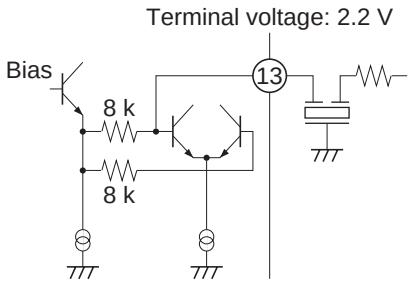
Pin 12 (AUDIO OUT)



Terminal voltage: 2.2 V

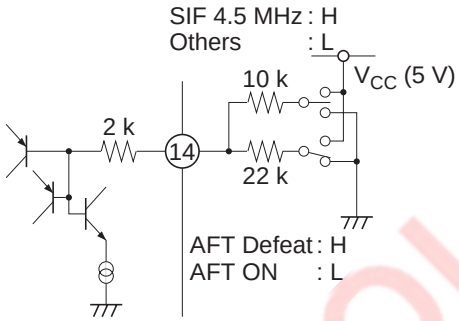
In the 4.5 MHz application, the internal voltage gain is increased by 6-dB in comparison with the other applications and then the signals are delivered through an emitter follower.

Pin 13 (LIMITER IN)



The input impedance is 8 kΩ.

Pin 14 (AFT SW/NPSW)

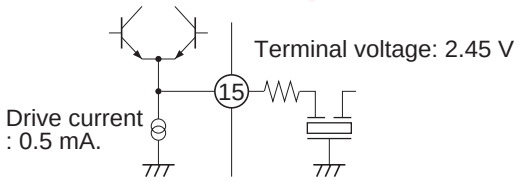


It works as a switch by connecting the resistor to 5 V (High) or GND (Low), alternately.

10k	20k	AF AMP	AFT	Pin 14 Applied Voltage
H	H	4.5 MHz	Defeat	4.4 to 5.0 V
H	L	4.5 MHz	Normal	2.7 to 4.0 V
L	H	Other	Defeat	1.0 to 2.3 V
L	L	Other	Normal	0 to 0.6 V

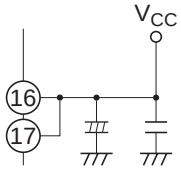
The terminal voltage is set by the external resistors because of an open base input.

Pin 15 (QIF OUT)



In both the split and intercarrier system, the carrier signal to SIF provided from pin 15 through an emitter follower.

Pin 16, Pin 17 (V_{CC})



The recommended supply voltage is 5 V or 9 to 12 V.
In the case of 5 V supply, these pins should be tied to pin 20 and pin 21.
In the case of 9 to 12 V supply, a regulated output of 5 V are available in pin 20 and pin 21.

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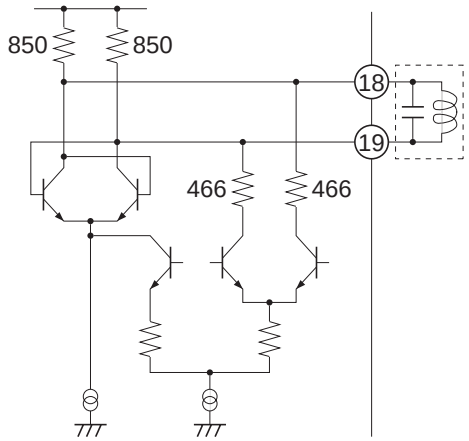
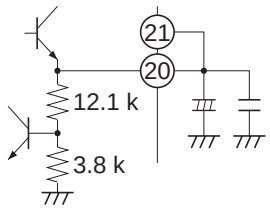
Pin 18, Pin 19 (VCO COIL)



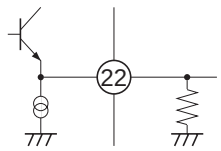
Connecting a tuning coil and capacitor to these pins enables an oscillation.
The tuning capacitor of about 30 pF is recommended.
The oscillation frequency is tuned in f0.
In the actual adjustment, the coil is tuned so that the AFT voltage is reached to $V_{CC}/2$ with f0 as an input.
The printed pattern around these pins should be designed carefully to prevent an pull-in error of VCO, caused by the laekage interference from the large signal level oscillator to adjacent pins.
The interconnection also should be designed as short as possible.

Pin 20, Pin 21 (Vreg. OUT)



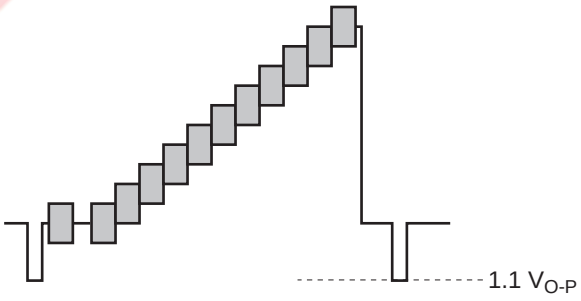
It is a regulated 5 V output which has current drive capability of approximately 15 mA.

Pin 22 (VIDEO OUT)



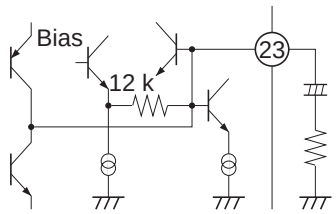
Internal driving current: 3 mA

An output amplitude is positive 2 V_{P-P} in the case of 87.5% video modulation.

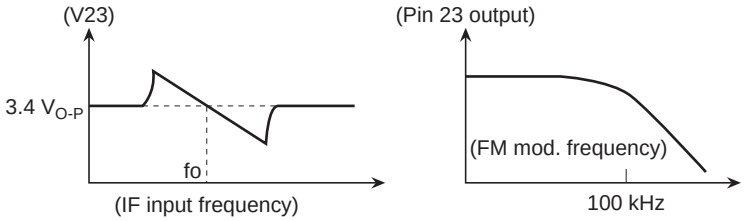


EOL Product

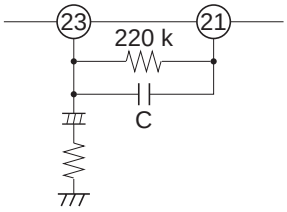
Pin 23 (APC FILTER)



In the locked state, the cut-off frequency of the filter is adjusted effectively by an external resistor so that it will be in the range of around 30 to 200 kHz.
In case the cut-off frequency is lower, the pull-in speed becomes slow. On the other hand, a higher cut-off frequency widen the pull-in range and band width, which results in a degradation in the S/N ratio. So, in the actual TV system design, the appropriate constant should be chosen for getting desirable performance considering above conditions.



In the application, an offset between AFT center frequency and VCO free-running frequency, can be improved by connecting a 220 kΩ resistor to V_{CC} supply (pin 21).



A buzz noise also decreases by connecting a capacitor from pin 23 to V_{CC} (pin 21) or GND. This effect utilizes the signal interference on the printed circuit board. So, the determination that which connection is effective, to V_{CC} or GND, is done by a cut and try method.
The capacitor of less than 680 pF, which depends on Q of VCO coil, is recommended to prevent an APC pull-in range from narrowing.
Taking it into consideration in the actual TV set design.

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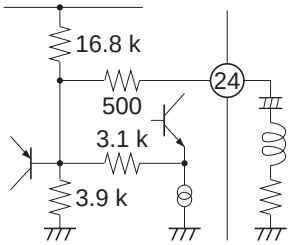
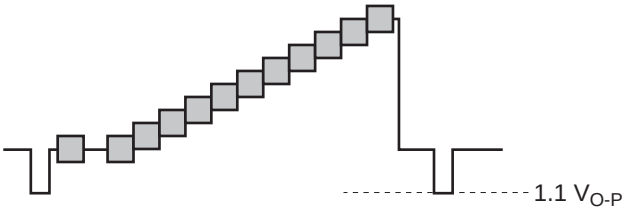
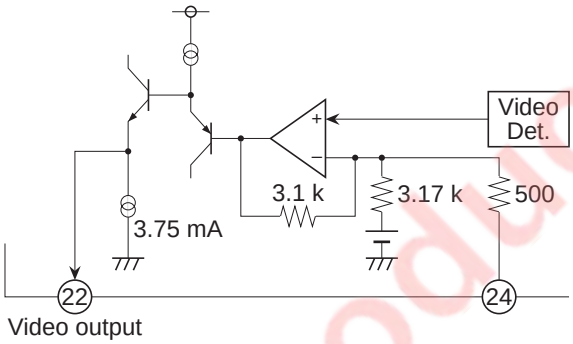
Pin 24 (EQ F/B)



Both the external coil and capacitor determine the frequency response of EQ output.
The series connected resistor is for damping.



In the intercarrier system, the following phenomenon should be considered;
a strong equalization (EQ) enlarge the sound carrier output from pin 22, because the EQ is applied before an audio trap.
In that case, the next two solutions are recommended;
decrease in S level of SAW, avoiding to peak a sound carrier in EQ.

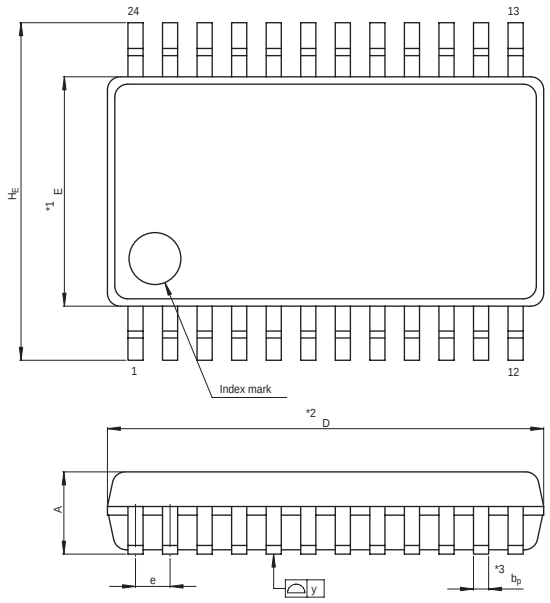


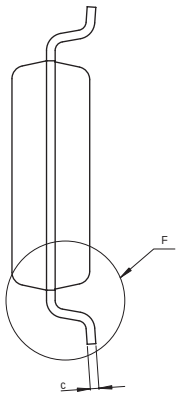
Circuit Diagram of EQ Amp.

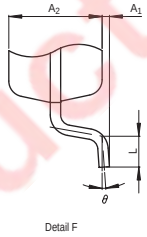
EOL Product

Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SSOP24-5.3x10.1-0.80	PRSP0024GA-A	24P2Q-A	0.2g







NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	10.0	10.1	10.2
E	5.2	5.3	5.4
A_2	—	1.8	—
A	—	—	2.1
A_1	0	0.1	0.2
b_p	0.3	0.35	0.45
c	0.18	0.2	0.25
θ	0°	—	8°
H_E	7.5	7.8	8.1
e	0.65	0.8	0.95
y	—	—	0.10
L	0.4	0.6	0.8

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