# M61110FP/GP

## Coil-less VIF/SIF

REJ03F0021-0200Z
Rev.2.0
Mar.12.2004

### Description

M61110FP is a semiconductor integrated circuit consisting of VIF/SIF signal processing for CTVs and VCRs.
M61110FP provides low cost and high performance system with the coil-less AFT

### Feature

- Coil-less AFT
- PLL FM demodulation for Audio. No external parts and adjustment. (Target S/N=70dB)
- The PLL-SPLIT system provides good sound sensitivity and reduces buzz.
- Video output is 2.2Vp-p through EQ AMP
- Easy to add Buzz cancel
- Hi speed IF AGC
- Built-in QIF AGC
- Improve over modulation characteristics and Vcc ripple rejection
- Open collector RF AGC output (5-9V available).

### Application

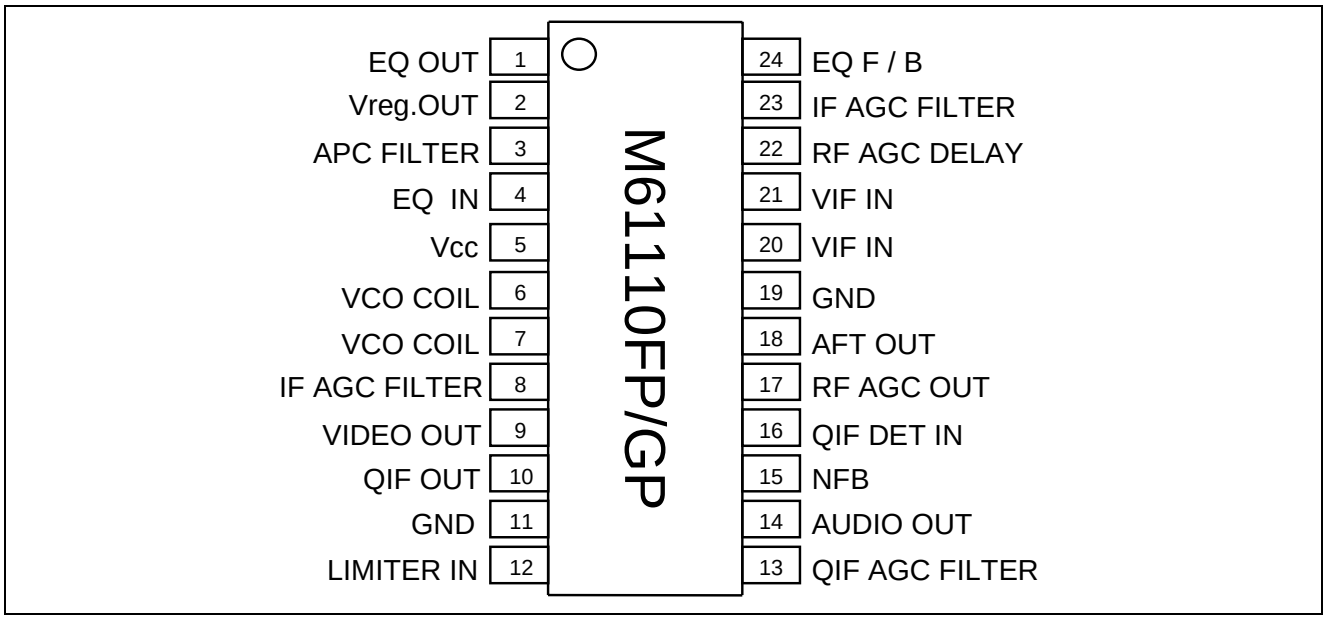
TV set, VCR tuners.

### Recommended Operating Condition (Ta = 25°C, unless otherwise noted)

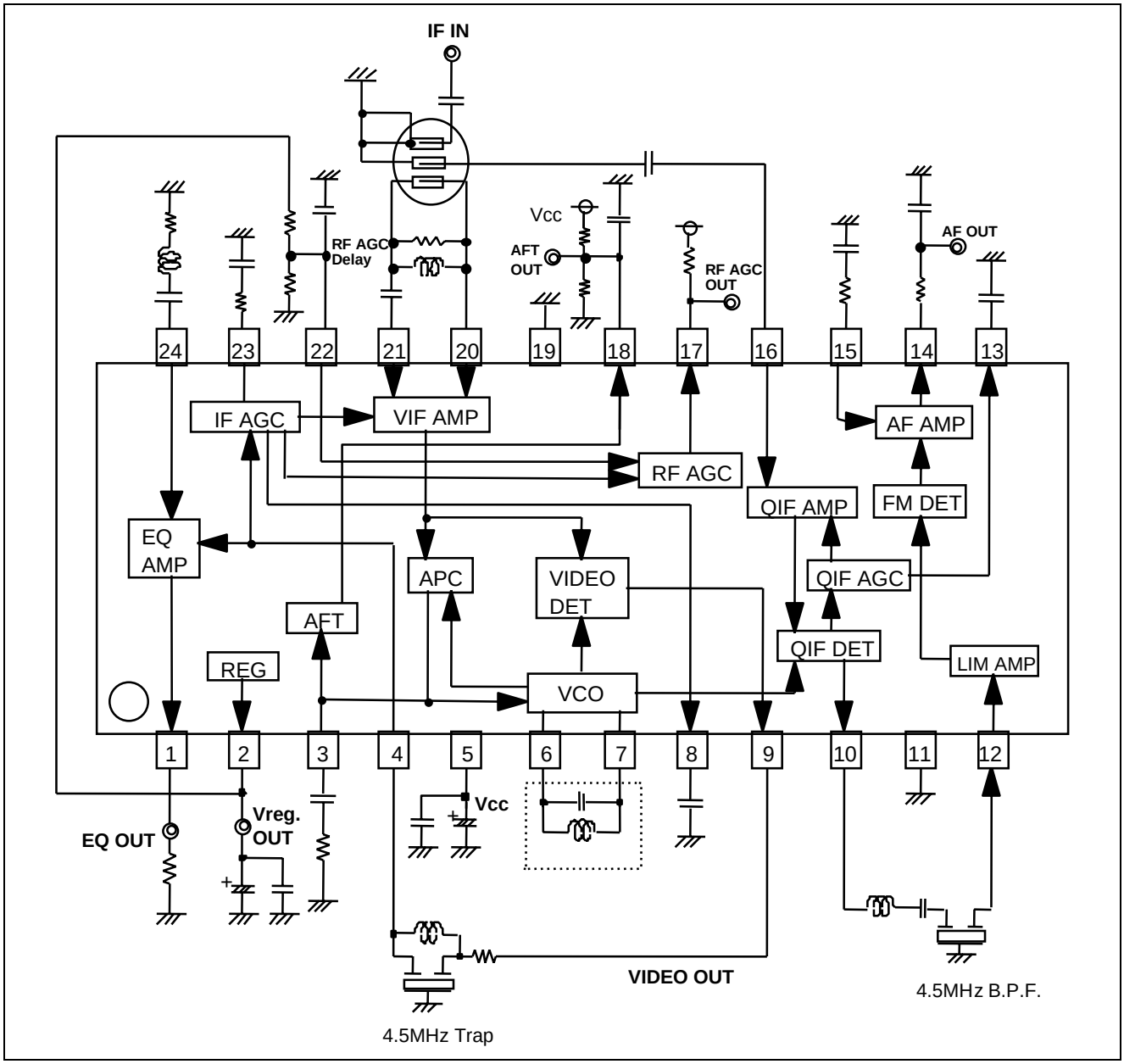
Supply Voltage Range (Vcc).....4.75 to 5.25 V

Rated Supply Voltage (Vcc).....5.0 V

### Pin configuration

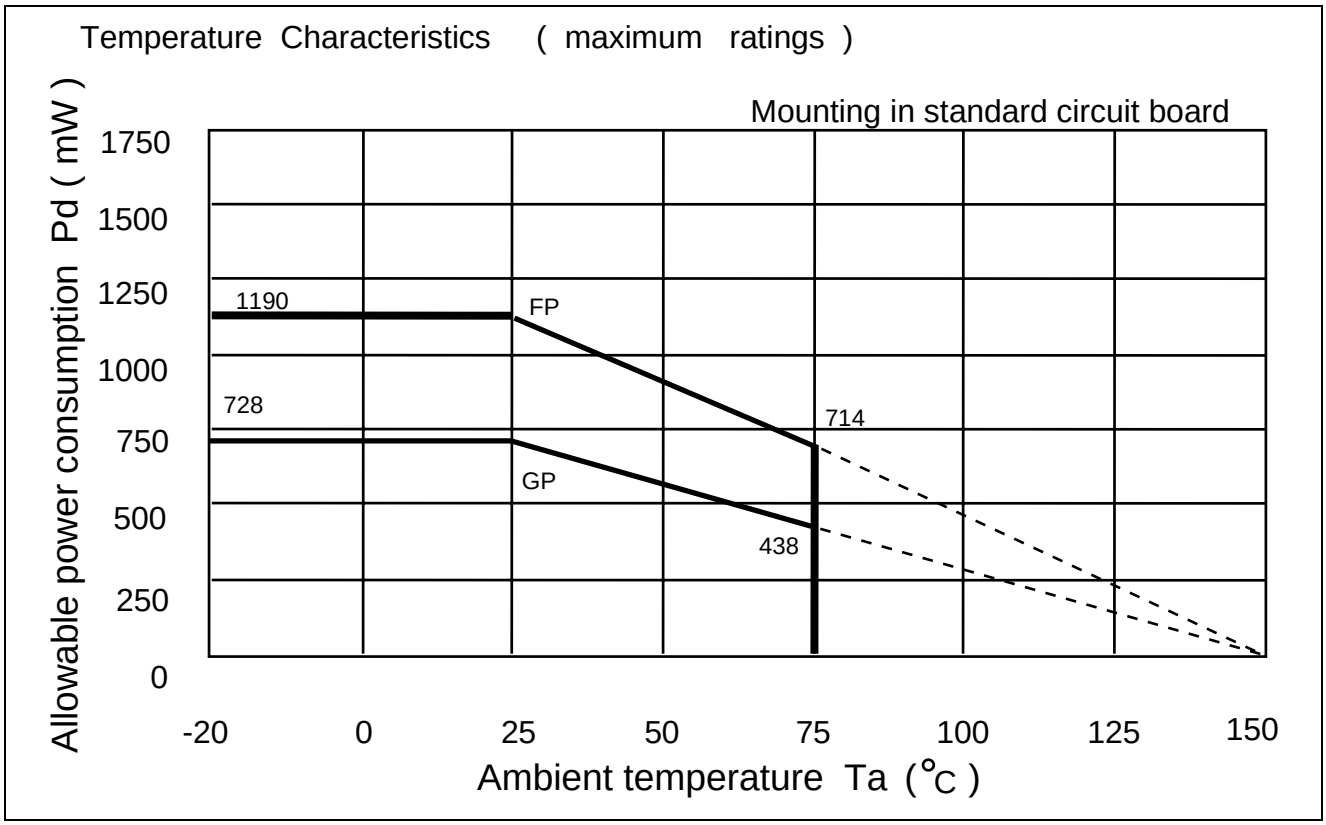


## Block diagram and peripheral circuit



**Absolute maximum ratings** (Ta = 25°C, unless otherwise noted)

| Parameter | Symbol | Ratings | Unit | Note |
|---|---|---|---|---|
| Supply Voltage | Vcc | 6.0 | V | |
| Power Consumption | Pd | 1190(FP), 728(GP) | mW | |
| Operating Temperature | Topr | –20 to +75 | °C | |
| Storage Temperature | Tstg | –40 to +150 | °C | |



## Electrical Characteristics (Vcc=5V, Ta=25°C, unless otherwise noted)

VIF Section

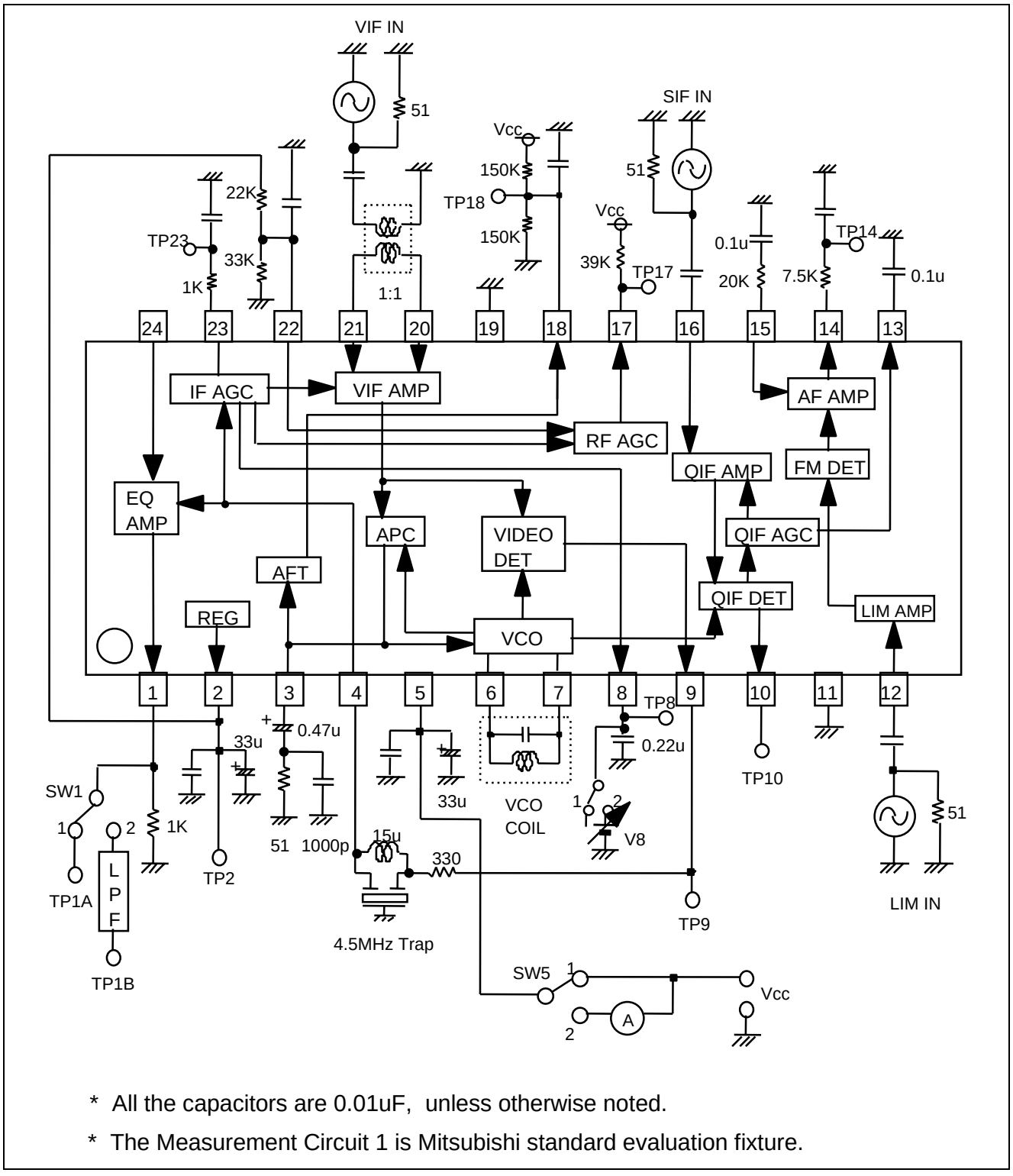
| No. | Parameter | Symbol | Test Circuit | Test Point | Input Point | Input SG | Measurement switches set to position 1 unless otherwise noted | Limits Min | Limits Typ | Limits Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Circuit Current | Icc | 1 | A | — | — | SW5 = 2 | 40 | 50 | 60 | mA | |
| 2 | Vreg. Output Voltage | Vreg. | 1 | TP2 | — | — | | 3.2 | 3.5 | 3.8 | V | |
| 3 | Video Output Voltage 9 | Vo det9 | 1 | TP9 | VIF IN | SG1 | | 0.85 | 1.1 | 1.35 | Vp-p | |
| 4 | Video Output Voltage 1 | Vo det | 1 | TP1A | VIF IN | SG1 | | 1.85 | 2.2 | 2.55 | Vp-p | |
| 5 | Video S/N | Video S/N | 1 | TP1B | VIF IN | SG2 | SW1 = 2 | 51 | 56 | — | dB | 1 |
| 6 | Video Band Width | BW | 1 | TP1A | VIF IN | SG3 | SW8 = 2<br>V8 = Variable | 5.0 | 7.0 | — | MHz | 2 |
| 7 | Input Sensitivity | VIN MIN | 1 | TP1A | VIF IN | SG4 | | — | 48 | 52 | dBμ | 3 |
| 8 | Maximum Allowable | VIN MAX | 1 | TP1A | VIF IN | SG5 | | 104 | 110 | — | dBμ | 4 |
| 9 | AGC Control Range Input | GR | — | — | — | — | | 55 | 62 | — | dB | 5 |
| 10 | IF AGC Voltage 1 | V8 | 1 | TP8 | VIF IN | SG6 | | 2.8 | 3.1 | 3.4 | V | |
| 11 | IF AGC Voltage 2 | V23 | 1 | TP23 | VIF IN | SG6 | | 2.8 | 3.1 | 3.4 | V | |
| 12 | Maximum RF AGC | V17H | 1 | TP17 | VIF IN | SG6 | | 4.5 | 4.9 | — | V | |
| 13 | Minimum RF AGC | V17L | 1 | TP17 | VIF IN | SG7 | | — | 0.1 | 0.5 | V | |
| 14 | RF AGC Delay Point | V17 | 1 | TP17 | VIF IN | SG8 | | 86 | 89 | 92 | dBμ | 6 |
| 15 | Capture Range U | CR-U | 1 | TP1A | VIF IN | SG9 | | 1.0 | 1.5 | — | MHz | 7 |
| 16 | Capture Range L | CR-L | 1 | TP1A | VIF IN | SG9 | | 1.1 | 1.6 | — | MHz | 8 |
| 17 | Capture Range T | CR-T | — | — | — | — | | 2.3 | 3.1 | — | MHz | 9 |
| 18 | AFT Sensitivity | μ | 1 | TP18 | VIF IN | SG10 | | 22 | 32 | 44 | mV/kHz | 10 |
| 19 | AFT Minimum Voltage | V18H | 1 | TP18 | VIF IN | SG10 | | 4.4 | 4.8 | — | V | 10 |
| 20 | AFT Maximum Voltage | V18L | 1 | TP18 | VIF IN | SG10 | | — | 0.1 | 0.5 | V | 10 |
| 21 | AFT defeat | AFT def | 1 | TP18 | VIF IN | — | | 2.2 | 2.5 | 2.8 | V | |
| 22 | Inter Modulation | IM | 1 | TP1A | VIF IN | SG11 | SW8 = 2<br>V8 = Variable | 35 | 40 | — | dB | 11 |
| 23 | Differential Gain | DG | 1 | TP1A | VIF IN | SG12 | | — | 2 | 5 | % | |
| 24 | Differential Phase | DP | 1 | TP1A | VIF IN | SG12 | | — | 2 | 5 | deg | |

## **Electrical Characteristics** (Vcc=5V, Ta=25°C, unless otherwise noted)

SIF Section

| No. | Parameter | Symbol | Test Circuit | Test Point | Input Point | Input SG | Measurement switches set to position 1 unless otherwise noted | Limits Min | Limits Typ | Limits Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | QIF det OUT1 | QIF1 | 1 | TP10 | VIF IN<br>QIF IN | SG2<br>SG13 | | 94 | 100 | 106 | dBµ | |
| 26 | QIF det OUT2 | QIF2 | 1 | TP10 | VIF IN<br>QIF IN | SG2<br>SG14 | | 94 | 100 | 106 | dBµ | |
| 27 | AF Output | VoAF | 1 | TP14 | SIF IN | SG16 | | 400 | 600 | 880 | mVrms | |
| 28 | AFOutput Distortion | THD AF | 1 | TP14 | SIF IN | SG16 | | — | 0.2 | 0.9 | % | |
| 29 | Limiting Sensitivity | LIM | 1 | TP14 | SIF IN | SG17 | | — | 42 | 55 | dBµ | 12 |
| 30 | AM Rejection | AMR | 1 | TP14 | SIF IN | SG18 | | 61 | 68 | — | dB | 13 |
| 31 | AF S/N | AF S/N | 1 | TP14 | SIF IN | SG19 | | 63 | 70 | — | dB | 14 |

## Measurement Circuit Diagram




* All the capacitors are 0.01uF, unless otherwise noted.

* The Measurement Circuit 1 is Mitsubishi standard evaluation fixture.

**Input Signal**

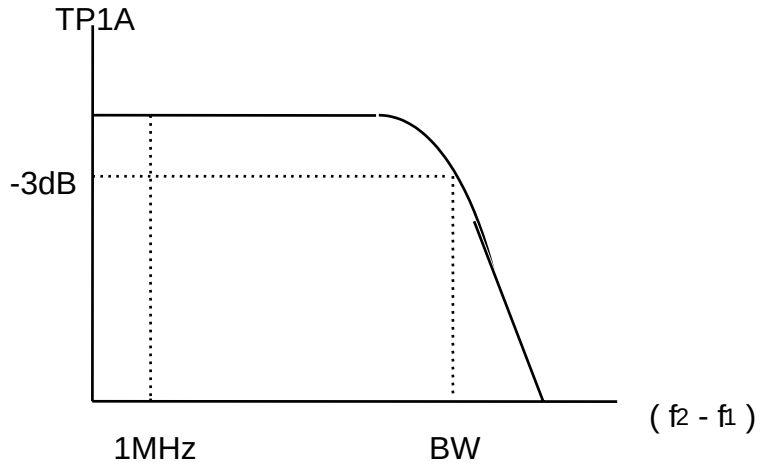
| SG | 50 Ω Termination |
|---|---|
| 1 | f0 = 45.75MHz AM 20kHz 77.8% 90dBμ |
| 2 | f0 = 45.75MHz 90dBμ CW |
| 3 | f1 = 45.75MHz 90dBμ CW<br>f2 = Frequency Variable 70dBμ } CW Mixed Signal |
| 4 | f0 = 45.75MHz AM 20kHz 77.8% Level Variable |
| 5 | f0 = 45.75MHz AM 20kHz 14.0% Level Variable |
| 6 | f0 = 45.75MHz 80dBμ CW |
| 7 | f0 = 45.75MHz 110dBμ CW |
| 8 | f0 = 45.75MHz Level Variable CW |
| 9 | f0 = Frequency Variable AM 20kHz 77.8% 90dBμ |
| 10 | f0 = Frequency Variable 90dBμ CW |
| 11 | f1 = 45.75MHz 90dBμ CW<br>f2 = 42.17MHz 80dBμ CW } Mixed Signal<br>f3 = 41.25MHz 80dBμ CW |
| 12 | f0 = 45.75MHz 87.5% TV modulation 10stair-steps waveform<br>Sync Tip Level 90dBμ |
| 13 | f1 = 41.25MHz 95dBμ CW |
| 14 | f1 = 41.25MHz 75dBμ CW |
| 15 | f1 = 45.75MHz 90dBμ CW<br>f2 = 41.25MHz 70dBμ CW } Mixed Signal |
| 16 | f0 = 4.5MHz 90dBμ FM 400Hz +/–25kHzdev |
| 17 | f0 = 4.5MHz Level Variable FM 400Hz +/–25kHzdev |
| 18 | f0 = 4.5MHz 90dBμ AM 400Hz 30% |
| 19 | f0 = 4.5MHz 90dBμ CW |
| 20 | f0 = 4.5MHz Level Variable CW |

## Notes

1. Video S/N
   Input SG2 to VIF IN and measure the video out (Pin 1) noise in r.m.s. at TP1B through a 5MHz (–3dB) L.P.F.

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

2. Video Band Width : BW
   1. Measure the 1MHz component level of Video output TP1A with a spectrum analyzer when SG3 ($f_2$ = 44.75MHz) is input to VIF IN. At that time, measure the voltage at TP8 with SW8, set to position 2, and then fix V8 at that voltage.
   2. Reduce $f_2$ and measure the value of ($f_2$-$f_1$) when the ($f_2$-$f_1$) component level reaches –3dB from the 1MHz component level as shown below.



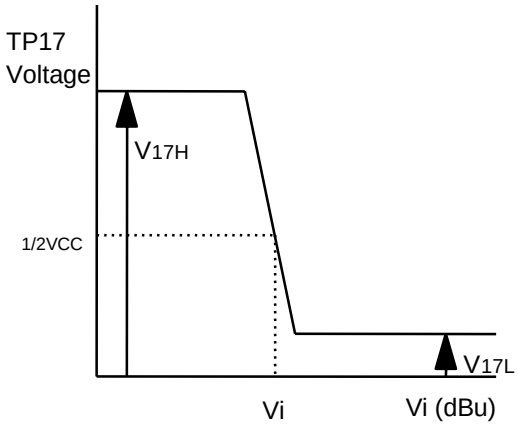

3. Input Sensitivity : VIN MIN
   Input SG4 (Vi = 90dBμ) to VIF IN , and then gradually reduce Vi and measure the input level when the 20kHz component of Video output TP1A reaches –3dB from Vo det level.

4. Maximum Allowable Input : VIN MAX
   1. Input SG5 (Vi = 90dBμ) to VIF IN , and measure the level of the 20kHz component of Video output.
   2. Gradually increase the Vi of SG and measure the input level when the output reaches –3dB.

5. AGC Control Range: GR

   GR = VIN MAX – VIN MIN [dB]

6. RF AGC Operating Voltage: V17
   Input SG8 to VIF IN and gradually reduce Vi and then measure the input level when RF AGC output TP17 reaches 1/2Vcc, as shown below.




7. Capture range: CR-U
   1. Increase the frequency of SG9 until the VCO is out of locked-oscillation.
   2. And decrease the frequency of SG9 and measure the frequency fU when the VCO is locked.

   CR-U = fU – 45.75 [MHz]

8. Capture range: CR-L
   1. Decrease the frequency of SG9 until the VCO is out of locked-oscillation.
   2. And increase the frequency of SG9 and measure the frequency fL when the VCO is locked.

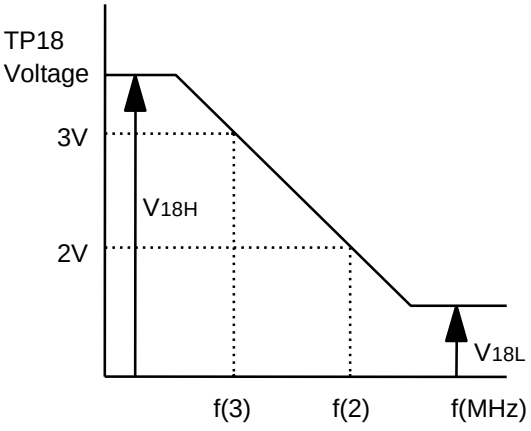
   CR-L = 45.75 – fL [MHz]

9. Capture range: CR-T

   CR-T = CR-U + CR-L [MHz]

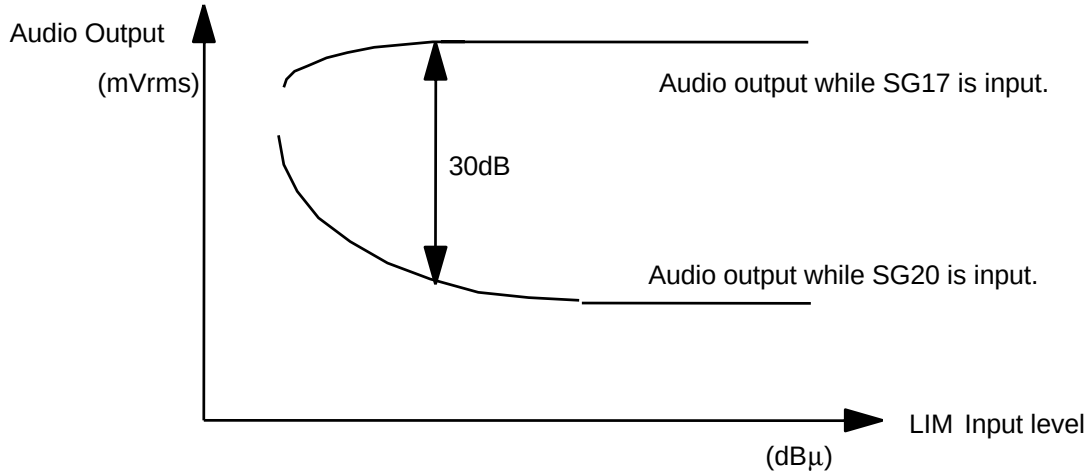
10. AFT sensitivity : μ, Maximum AFT voltage : $V_{18H}$ , Minimum AFT voltage : V18L
    1. Input SG10 to VIF IN, and set the frequency of SG10 so that the voltage of AFT output TP18 is 3[V] . This frequency is named f(3).
    2. Set the frequency of SG10 so that the AFT output voltage is 2[V].
       This frequency is named f(2).
    3. IN the graph shown below, maximum and minimum DC voltage are $V_{18H}$ and $V_{18L}$ , respectively.

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



11. Inter modulation: IM
    1. Input SG11 to VIF IN, and measure video output TP9 with an oscilloscope.
    2. Adjust AGC filter voltage V8 so that the minimum DC level of the output waveform is 1.5V.
    3. At that time, measure TP1A with a spectrum analyzer .
       The inter modulation is defined as a difference between 0.92MHz and 3.58 MHz frequency components.

12. Limiting Sensitivity: LIM
    1. Input SG17 to LIM IN, and measure the 400Hz component level of AF output TP14.
    2. Input SG20 to LIM IN, and measure the noise level of AF output TP14 .
    3. The input limiting sensitivity is defined as the input level when the difference between each 400Hz components of audio output (TP14) is 30dB, as shown below.




13. AM Rejection: AMR
    1. Input SG18 to LIM IN, and measure the output level of Audio output (TP14).
       This level is named VAM.
    2. AMR is;

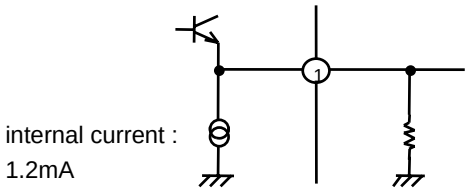
$$AMR = 20\log\left(\frac{VoAF\ (mVrms)}{VAM\ (mVrms)}\right) \quad [dB]$$

14. AF S/N: AF S/N
    1. Input SG19 to LIM IN, and measure the output noise level of Audio output (TP14).
       This level is named VN.
    2. S/N is;

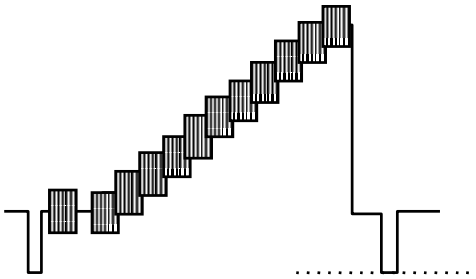
$$S/N = 20\log\left(\frac{VoAF\ (mVrms)}{VN\ (mVrms)}\right) \quad [dB]$$

## Pin peripheral circuit explanation

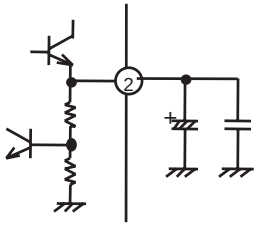
*Pin 1 (EQ OUT)




EQ output amplitude is positive 2.2Vp-p in case of 87.5% video modulation.

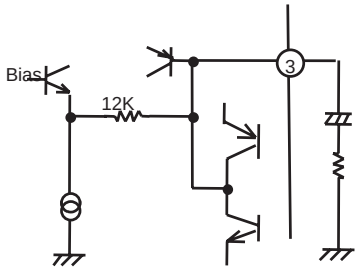



*Pin 2 (Vreg.OUT)

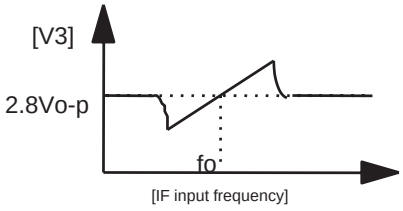


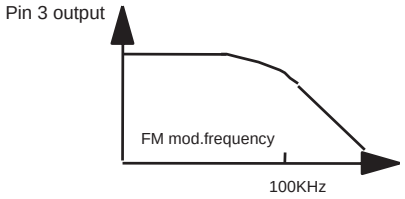

It is a regulated 3.5V output which has current drive capability of approximately 1mA.

*Pin3 (APC FILTER)

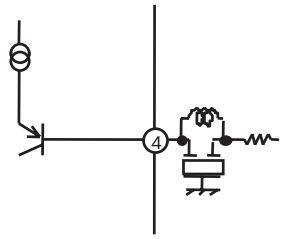



In the locked state, the cut-off frequency of the filter is adjusted effectively by an external resistor so that it will be in the range of around 30 to 200kHz.
In case the cut-off frequency is lower, the pull-in speed becomes slow. On the other hand, a higher cut-off frequency widen the pull-in range 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.



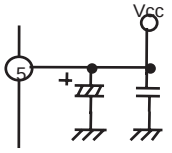



*PIN 4 (EQ IN)



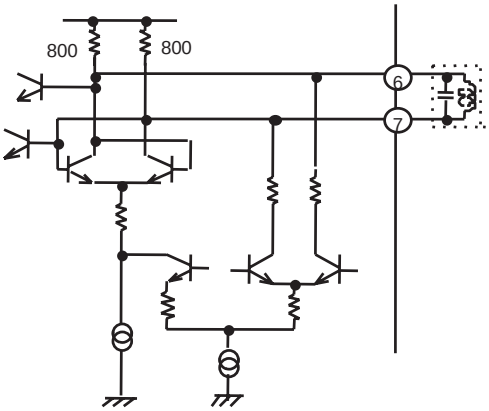

The input is open base.
If DC information is not input to pin9, IF AGC dose not work normally.
Please pay attention.

*PIN 5 (Vcc)



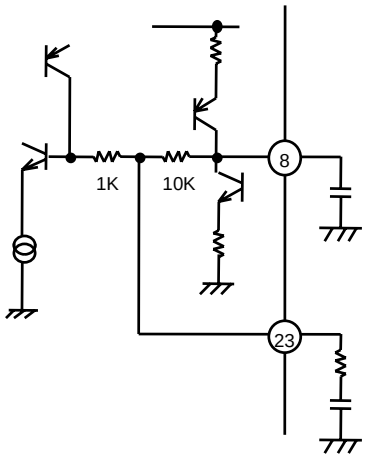

It is Vcc pin. (only one Vcc pin in this IC)

*PIN 6, PIN 7 (VCO COIL)

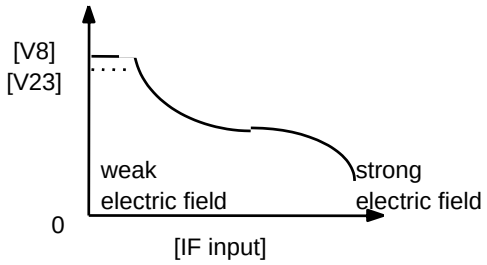



Connecting a tuning coil and capacitor to these pins enables an oscillation. The oscillation frequency is tuned in 'fo' .In the actual adjustment, the coil is tuned so that the AFT voltage reaches to Vcc/2 with 'fo' as an input.
The printed pattern around these pins should be designed carefully to prevent an pull-in error of VCO,
caused by the leakage interference from the large signal level oscillator to adjacent pins. The interconnection
should be designed as short as possible.
In case the printed pattern has the interference problem, a capacitor of about 1pF is connected between pin6 or pin7 and GND so as to cancel the interference and keep enough pull-in range even in a low input level.

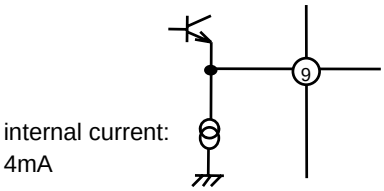
## *PIN 8, PIN 23 (IF AGC FILTER)



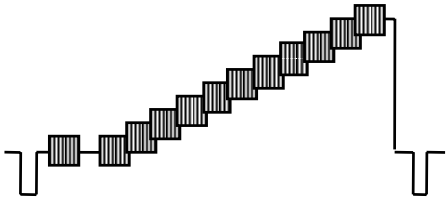

2-pins filter characteristics are available by utilizing the dynamic AGC circuit .
And AGC speed can be changed, if pin23 on the external resistor is variable.



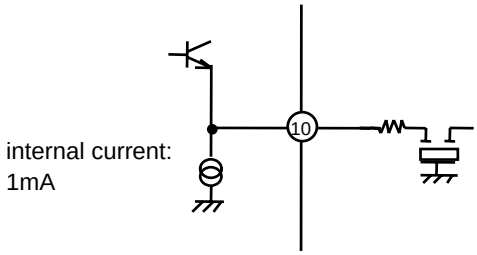

## *PIN 9 (VIDEO OUT)




Video output amplitude is positive 1.1Vp-p in case of 87.5% video modulation.

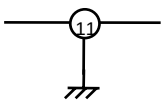


## *PIN 10 (QIF OUT)



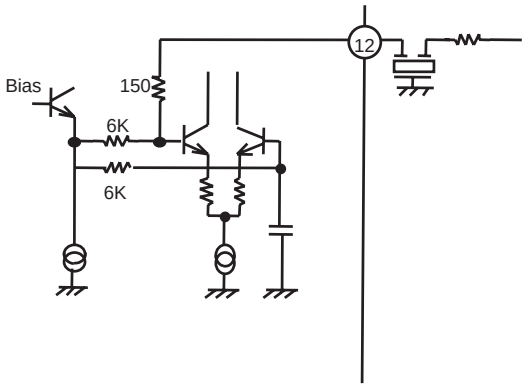

In the split carrier system, the carrier signal to SIF is provided from pin10 through the emitter follower.
And please open this pin, when it is used in the inter carrier system.

## *PIN 11 (GND)



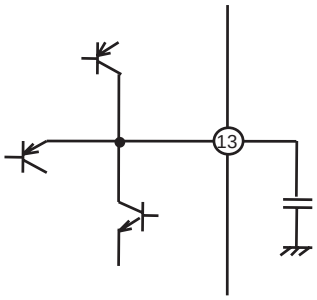

This is GND of the SIF part .

## *PIN 12 (LIMITER IN)



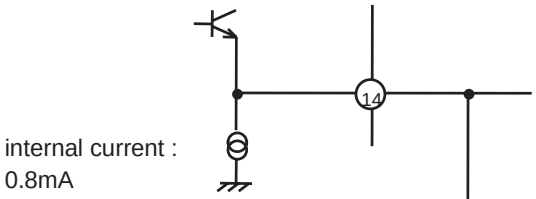

The input impedance is 6.15KΩ.

## *PIN 13 (QIF AGC FILTER)



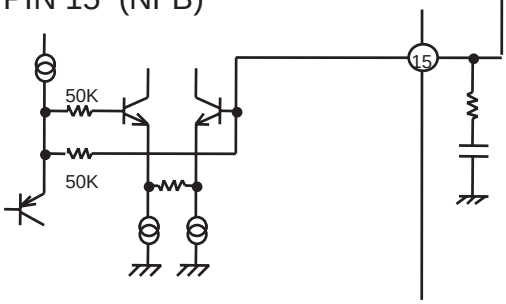

AGC speed can be changed by this pin's external capacity.

## *PIN 14 (AUDIO OUT)



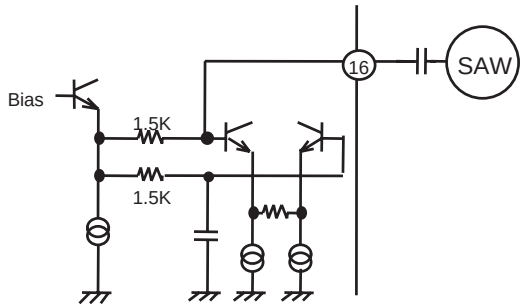

The FM detector can respond to SIF signals without an adjustment and external components by adopting the PLL technique. The capacitor between pin14 and pin15, which fixes the de-emphasis characteristics, can be determined considering the combination of an equivalent resistance of the IC and this capacitor itself.

## *PIN 15 (NFB)



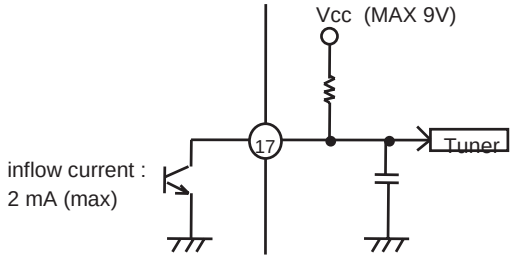

Frequency response of audio output is decided with external capacitor value of pin15.
And audio output level can be made it small when it connected external capacitor to pin15 and resistance in series.

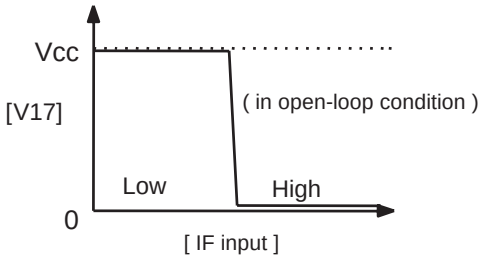
## *PIN 16 (QIF DET IN)




The input impedance is 1.5KΩ.

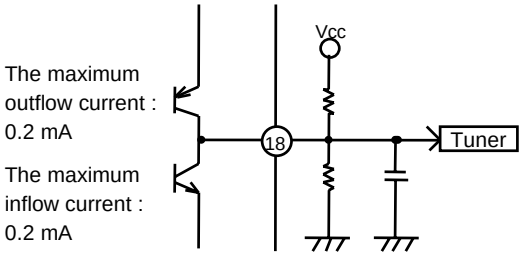
## *PIN 17 (RF AGC OUT)



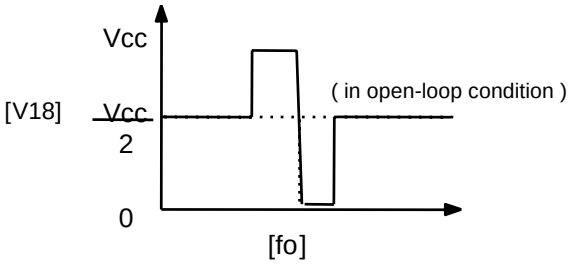




Connecting a non-polarity capacitor of 1uF between pin17 to pin22 improves AGC operating speed.
In that case, the capacitors between pin17 and pin22 to ground should be removed.
It is possible for Pin17 to connect to Vcc with 9V.

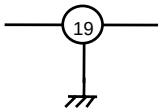
## *PIN 18 (AFT OUT)




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 locked
2) the video output becomes small enough in a low input level.

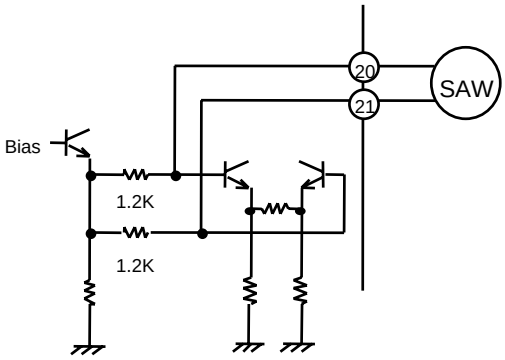


*PIN 19 (GND)



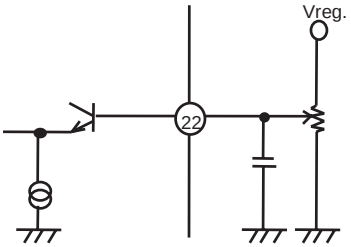

This is GND other than SIF part.

*PIN 20, PIN 21 (VIF IN)



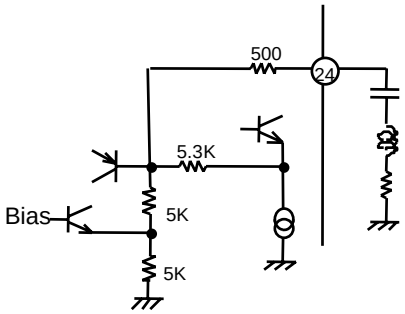

It should be designed carefully for impedance matching with the SAW filter.

*PIN 22 (RF AGC DELAY)

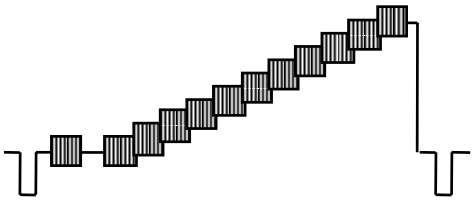



The applied voltage to the pin22 is for changing RF AGC delay point .

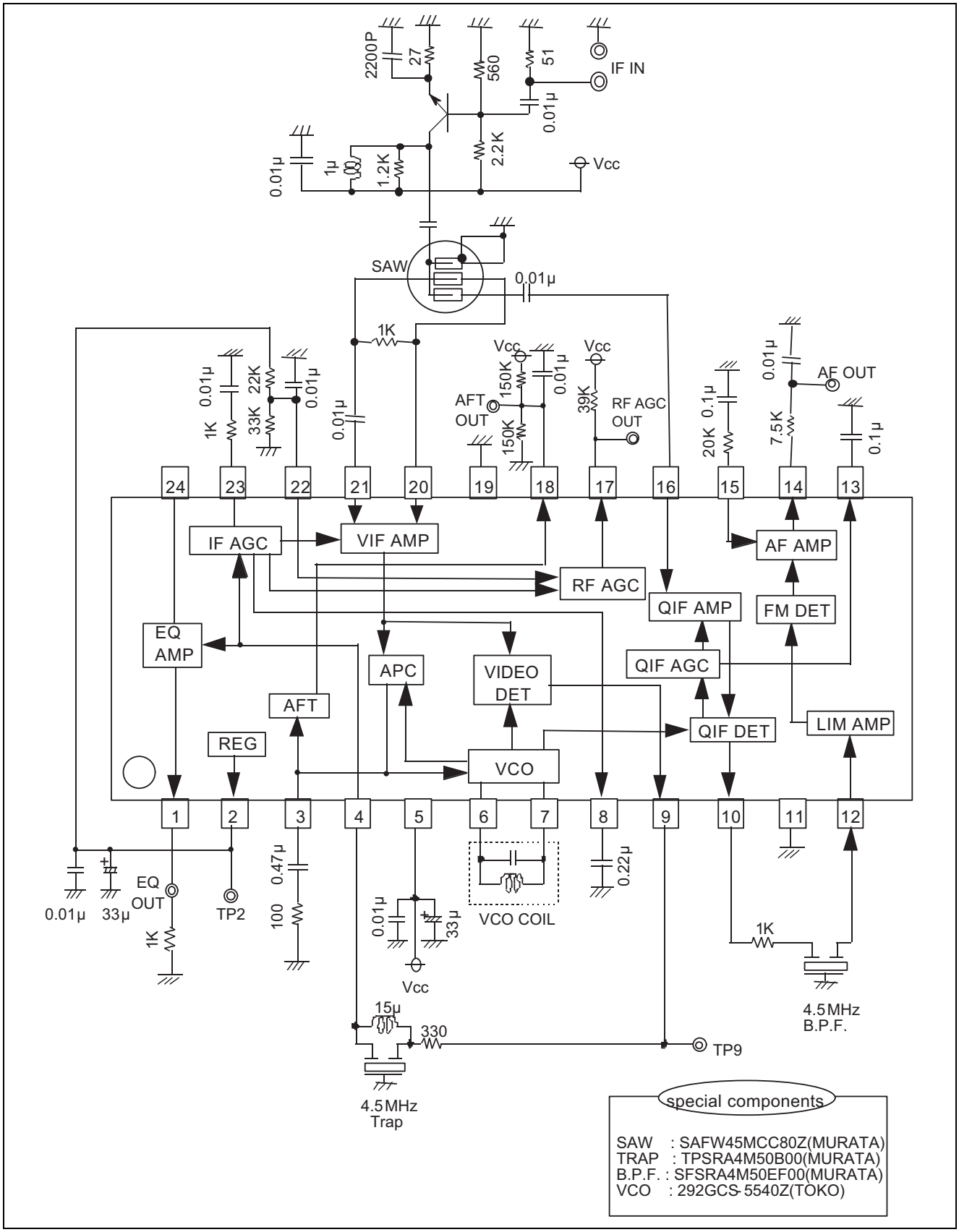
*PIN 24 (EQ F/B)



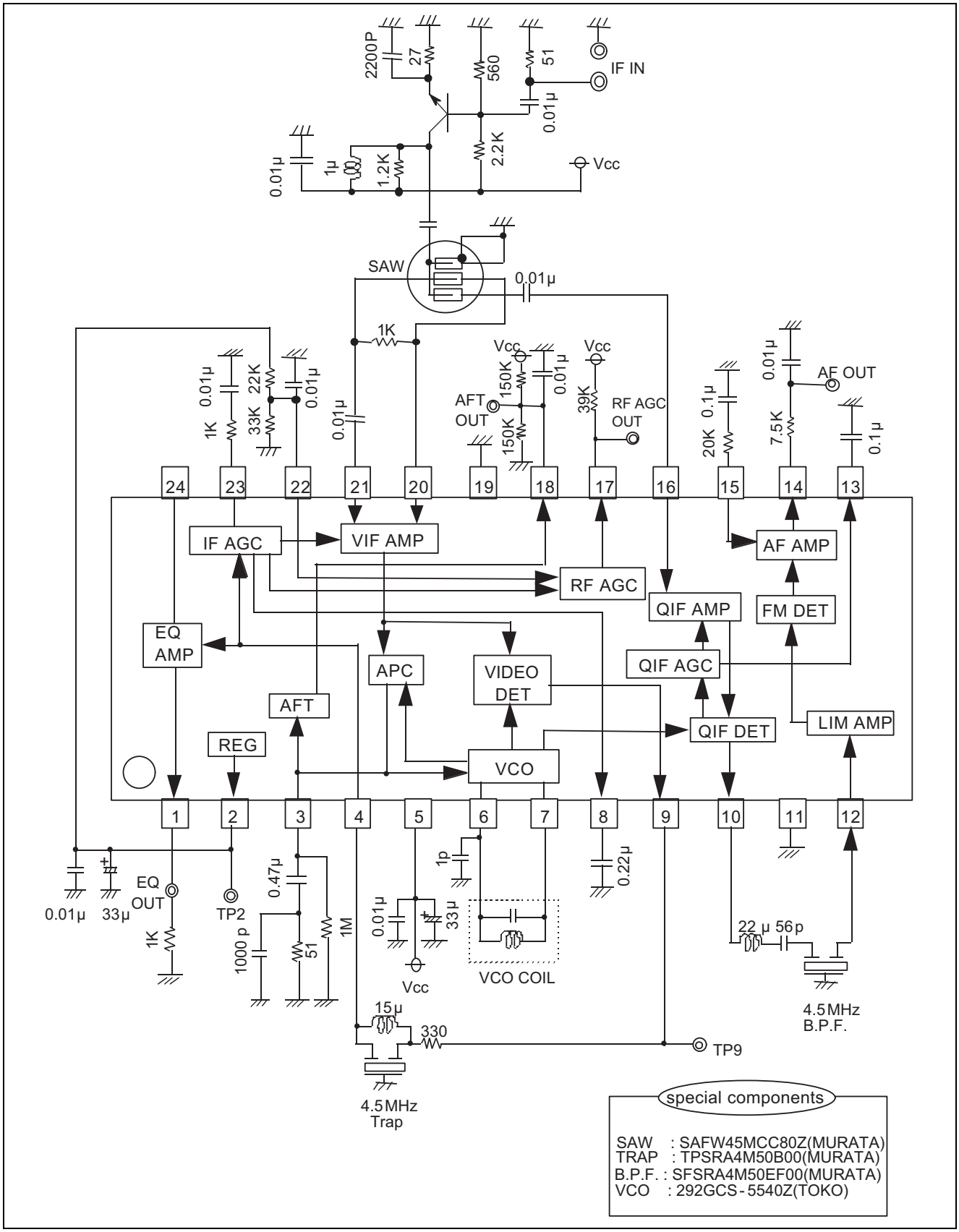

Both the external coil and capacitor determine the frequency response of EQ output .
The series connected resistor is for damping.



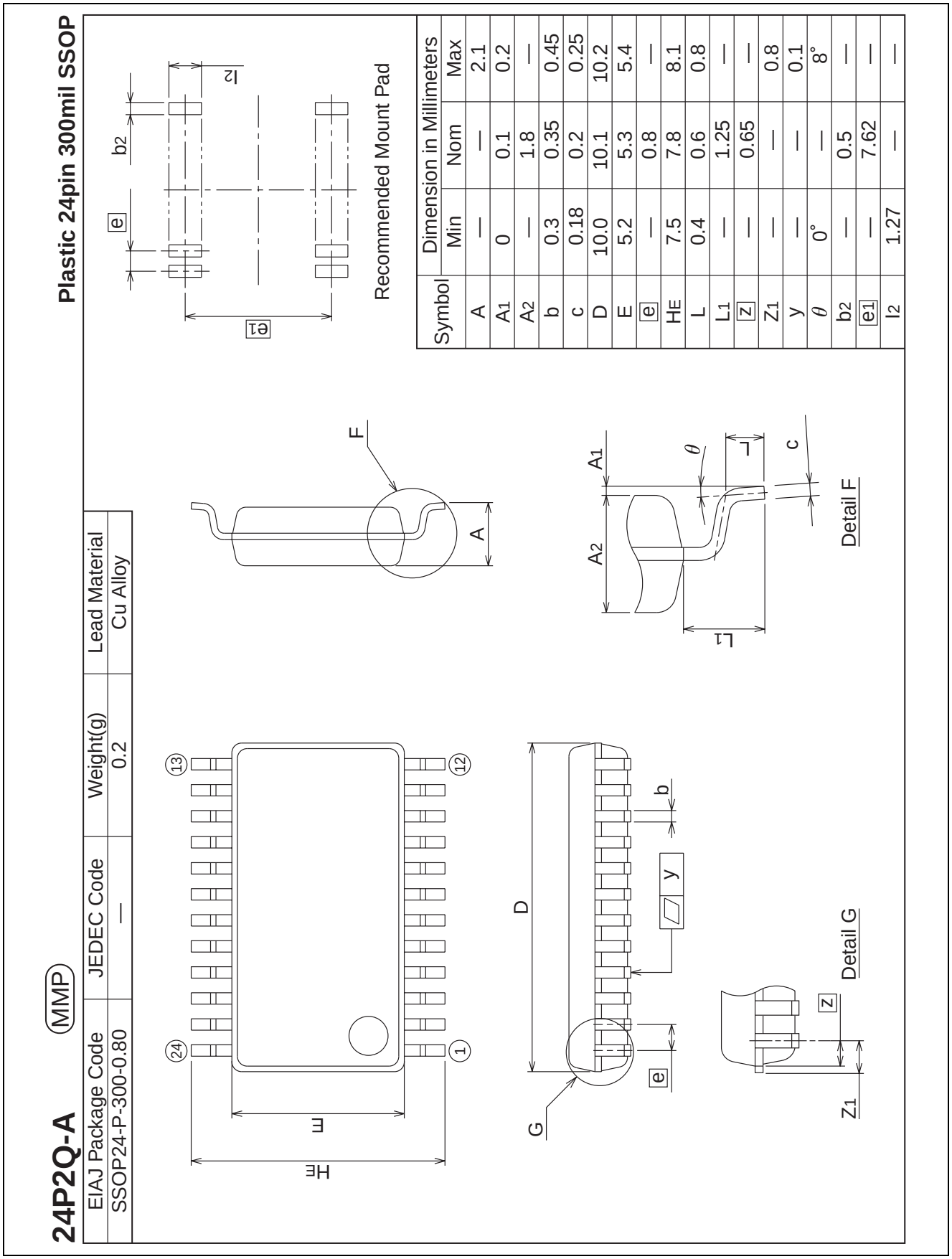
## Application Example 1



## Application Example 2



## Detailed Diagram Of Package Outline



Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan



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**Renesas Technology America, Inc.**
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Dornacher Str. 3, D-85622 Feldkirchen, Germany
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**Renesas Technology Taiwan Co., Ltd.**
FL 10, #99, Fu-Hsing N. Rd., Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

**Renesas Technology (Shanghai) Co., Ltd.**
26/F., Ruijin Building, No.205 Maoming Road (S), Shanghai 200020, China
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

**Renesas Technology Singapore Pte. Ltd.**
1, Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001



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