



# LA75503V

## Adjustment Free VIF/SIF Signal Processing IC for PAL TV/VCR

### Overview

The LA75503V is an adjustment free VIF/SIF signal processing IC for PAL TV/VCR.

It supports 38 MHz, 38.9 MHz, and 39.5 MHz as the IF frequencies, as well as PAL sound multi-system (M/N, B/G, I, D/K), and contains an on-chip sound carrier trap and sound carrier BPF. To adjust the VCO circuit, AFT circuit, and sound filter, 4-MHz external crystal or 4-MHz external signal is needed.

### Functions

- VIF amplifier
- VCO adjustment free PLL detection circuit
- Digital AFT circuit
- RF AGC
- Buzz canceller
- Equalizer amplifier
- Internal sound carrier BPF
- Internal sound carrier trap
- PLL-FM detector
- Reference oscillation circuit

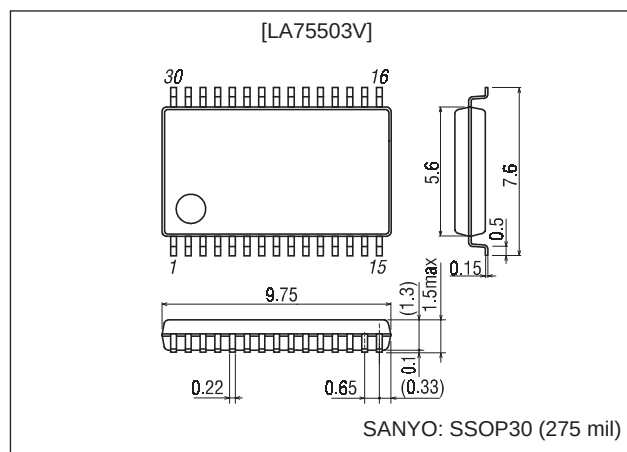
### Features

- Internal VCO adjustment free circuit eliminating need for VCO coil adjustments.
- Internal sound carrier BPF and sound carrier trap enable easy configuration of PAL sound multi-system at low cost.
- Considerably reduces the number of required peripheral parts.
- Use of digital AFT eliminates problem of AFT tolerance.
- Package: SSOP30 (275 mil)

### Package Dimensions

unit: mm

#### 3191A-SSOP30 (275 mil)



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## Specifications

### Maximum Ratings at Ta = 25°C

| Parameter                   | Symbol              | Conditions                                      | Ratings         | Unit |
|-----------------------------|---------------------|-------------------------------------------------|-----------------|------|
| Maximum supply voltage      | V <sub>CC</sub> max |                                                 | 7               | V    |
| Circuit voltage             | V16                 |                                                 | V <sub>CC</sub> | V    |
|                             | V18                 |                                                 | V <sub>CC</sub> | V    |
| Circuit current             | I30                 |                                                 | −1              | mA   |
|                             | I17                 |                                                 | +0.5            | mA   |
|                             | I6                  |                                                 | −10             | mA   |
|                             | I4                  |                                                 | −3              | mA   |
| Allowable power dissipation | Pd max              | Ta ≤ 70°C (*Mounted on a printed circuit board) | 550             | mW   |
| Operating temperature       | Topr                |                                                 | −20 to +70      | °C   |
| Storage temperature         | Tstg                |                                                 | −55 to +150     | °C   |

Note: \* Circuit board dimensions: 65 × 72 × 1.6 mm<sup>3</sup>, material: paper phenol.

### Operating Conditions at Ta = 25°C

| Parameter                  | Symbol             | Conditions | Ratings    | Unit |
|----------------------------|--------------------|------------|------------|------|
| Recommended supply voltage | V <sub>CC</sub>    |            | 5          | V    |
| Operating voltage range    | V <sub>CC</sub> op |            | 4.5 to 5.5 | V    |

### Electrical Characteristics at Ta = 25°C, V<sub>CC</sub> = 5.0 V, fp = 38.9 MHz

| Parameter                        | Symbol | Conditions                     | Ratings |      |      | Unit   |
|----------------------------------|--------|--------------------------------|---------|------|------|--------|
|                                  |        |                                | min     | typ  | max  |        |
| [VIF Block ]                     |        |                                |         |      |      |        |
| Circuit current                  | I17    |                                |         | 64.0 | 73.6 | mA     |
| Maximum RF AGC voltage           | V14H   | Collector load 30 kΩ VC2 = 9 V | 8.5     | 9    | —    | V      |
| Minimum RF AGC voltage           | V14L   |                                |         | 0.3  | 0.7  | V      |
| Input sensitivity                | Vi     |                                | 33      | 39   | 45   | dBμV   |
| AGC range                        | GR     |                                | 58      |      |      | dB     |
| Maximum allowable input          | Vimax  |                                | 92      | 97   |      | dBμV   |
| No-signal video output voltage   | V4     |                                | 3.3     | 3.6  | 3.9  | V      |
| Synchronizing signal tip voltage | V4tip  |                                | 1.0     | 1.3  | 1.6  | V      |
| Video output level               | VO     |                                | 1.7     | 2.0  | 2.3  | Vpp    |
| Video signal-to-noise ratio      | S/N    | B/G                            | 48      | 52   |      | dB     |
| C-S beating                      | IC-S   | P/S = 10 dB                    | 26      | 32   | 38   | dB     |
| Differential gain                | DG     | Vin = 80 dBμ                   |         | 3    | 10   | %      |
| Differential phase               | DP     |                                |         | 2    | 10   | deg    |
| Black noise threshold voltage    | VBTH   |                                |         | 0.7  |      | V      |
| Black noise clamp voltage        | VBCL   |                                |         | 1.8  |      | V      |
| VIF input resistance             | Ri     |                                |         | 2.5  | 3.0  | kΩ     |
| VIF input capacitance            | Ci     |                                |         | 3    | 6    | PF     |
| Maximum AFT voltage              | V13H   |                                | 4.3     | 4.7  | 5.0  | V      |
| Minimum AFT voltage              | V13L   |                                | 0       | 0.2  | 0.7  | V      |
| AFT tolerance 1                  | dfa1   | f = 38.9 MHz                   |         | ±35  | ±70  | kHz    |
| AFT tolerance 2                  | dfa2   | f = 38.0 MHz                   |         | ±35  | ±70  | kHz    |
| AFT tolerance 3                  | dfa3   | f = 39.5 MHz                   |         | ±35  | ±70  | kHz    |
| AFT detection sensitivity        | Sf     | RL = 100 kΩ/100 kΩ             | 40      | 80   | 120  | mV/kHz |
| AFT dead zone                    | fda    |                                |         | 30   | 60   | kHz    |
| APC pull-in range (U)            | fpu    |                                | 1.5     | 2.0  |      | MHz    |
| APC pull-in range (L)            | fpl    |                                | 1.5     | 2.0  |      | MHz    |
| VCO maximum frequency range (U)  | dfu    |                                | 1.5     | 2.0  |      | MHz    |
| VCO maximum frequency range (L)  | dfl    |                                | 1.5     | 2.0  |      | MHz    |
| VCO control sensitivity          | β      |                                | 2.0     | 4.0  | 8.0  | kHz/mV |

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| Parameter                            | Symbol               | Conditions                                       | Ratings |      |     | Unit  |
|--------------------------------------|----------------------|--------------------------------------------------|---------|------|-----|-------|
|                                      |                      |                                                  | min     | typ  | max |       |
| N trap1 (4.75 MHz)                   | NT1                  | wrt 1 MHz                                        | −30     | −35  |     | dB    |
| N trap2 (5.25 MHz)                   | NT2                  | wrt 1 MHz                                        | −19     | −24  |     | dB    |
| BG trap1 (5.75 MHz)                  | BT1                  | wrt 1 MHz                                        | −27     | −32  |     | dB    |
| BG trap2 (6.1 MHz)                   | BT2                  | wrt 1 MHz                                        | −20     | −25  |     | dB    |
| BG trap3 (5.85 MHz)                  | BT3                  | wrt 1 MHz                                        | −27     | −32  |     | dB    |
| I trap1 (6.25 MHz)                   | IT1                  | wrt 1 MHz                                        | −25     | −30  |     | dB    |
| I trap2 (6.8 MHz)                    | IT2                  | wrt 1 MHz                                        | −15     | −20  |     | dB    |
| DK trap1 (6.75 MHz)                  | DT1                  | wrt 1 MHz                                        | −25     | −30  |     | dB    |
| Group delay 1 NTSC (3.0 MHz)         | NGD1                 | wrt 1 MHz                                        | 10      | 40   | 70  | ns    |
| Group delay 1-1 NTSC (3.5 MHz)       | NGD1-1               | wrt 1 MHz                                        | 70      | 120  | 170 | ns    |
| Group delay 2 BG (4 MHz)             | BGD2                 | wrt 1 MHz                                        | 30      | 60   | 90  | ns    |
| Group delay 2-1 BG (4.4 MHz)         | BGD2-1               | wrt 1 MHz                                        | 100     | 150  | 200 | ns    |
| Group delay 3 I (4 MHz)              | IGD3                 | wrt 1 MHz                                        | 0       | 30   | 60  | ns    |
| Group delay 3-1 I (4.4 MHz)          | IGD3-1               | wrt 1 MHz                                        | 30      | 60   | 90  | ns    |
| Group delay 4 DK (4 MHz)             | DGD4                 | wrt 1 MHz                                        | 0       | 15   | 30  | ns    |
| Group delay 4-1 DK (4.4 MHz)         | DGD4-1               | wrt 1 MHz                                        | 0       | 30   | 60  | ns    |
| [1st SIF Block]                      |                      |                                                  |         |      |     |       |
| Conversion gain                      | Vg                   | f <sub>p</sub> = 5.5 MHz, V <sub>i</sub> = 500μV | 26      | 32   | 38  | dB    |
| SIF carrier output level             | So                   | V <sub>i</sub> = 10 mV                           |         | 100  |     | mVrms |
| First SIF maximum input              | Simax                | So ±2 dB                                         |         | 106  |     | dBμV  |
| First SIF input resistance           | Ris                  |                                                  |         | 5.0  | 6.0 | kΩ    |
| First SIF input capacitance          | Cis                  |                                                  |         | 3    | 6   | pF    |
| [SIF Block]                          |                      |                                                  |         |      |     |       |
| Limiting sensitivity                 | V <sub>i</sub> (lim) | f <sub>p</sub> = 5.5 MHz, ΔF = ±30 kHz at 400 Hz | 46      | 52   | 58  | dBμV  |
| FM detector output voltage           | V <sub>o</sub> (FM)  |                                                  | 560     | 700  | 850 | mVrms |
| AM rejection ratio                   | AMR                  | AM = 30% at 400 Hz                               | 50      | 60   |     | dB    |
| Total harmonic distortion            | THD                  | f = 5.5 MHz, ΔF = ±30 kHz                        |         | 0.3  | 1.0 | %     |
| FM detector output S/N               | S/N(FM)              |                                                  | 55      | 60   |     | dB    |
| BPF 3-dB bandwidth                   | BW                   |                                                  |         | ±100 |     | kHz   |
| PAL de-emphasis                      | Pdeem                | f <sub>m</sub> = 3 kHz                           |         | −3   |     | dB    |
| NTSC de-emphasis                     | Ndeem                | f <sub>m</sub> = 2 kHz                           |         | −3   |     | dB    |
| PAL/NT audio voltage gain difference | GD                   |                                                  |         | 6    |     | dB    |
| [Others]                             |                      |                                                  |         |      |     |       |
| 4-MHz level (during external input)  | X4MIN                | Terminated                                       | 86      |      |     | dBμ   |
| SIF system SW threshold voltage      | V10, V11             |                                                  |         | 1.4  |     | V     |
| IF system SW threshold resistance    | V12                  |                                                  |         |      | 270 | kΩ    |
| Split/inter SW                       | V16                  |                                                  |         | 0.5  |     | V     |

## System Switching

- SIF system switch

The SIF system is switched by setting pins A (pin 13) and B (pin 14) to GND or OPEN.

| A    | B    | B/G | I | D/K | M/N | FM DET LEVEL | De-emphasis |
|------|------|-----|---|-----|-----|--------------|-------------|
| GND  | GND  |     |   |     | O   | 6 dB         | 75 $\mu$ s  |
| GND  | OPEN |     |   | O   |     | 0 dB         | 50 $\mu$ s  |
| OPEN | GND  |     | O |     |     | 0 dB         | 50 $\mu$ s  |
| OPEN | OPEN | O   |   |     |     | 0 dB         | 50 $\mu$ s  |

Note: "O" indicates that the system is selected.

- IF system switch

38.9 MHz is selected as the IF frequency by leaving pin 15 (crystal oscillation) open. 38 MHz is selected by adding 220 k $\Omega$  between pin 15 and GND. This device can also select 39.5 MHz operation by adding a 220 k $\Omega$  resistor between pin 15 and V<sub>CC</sub>.

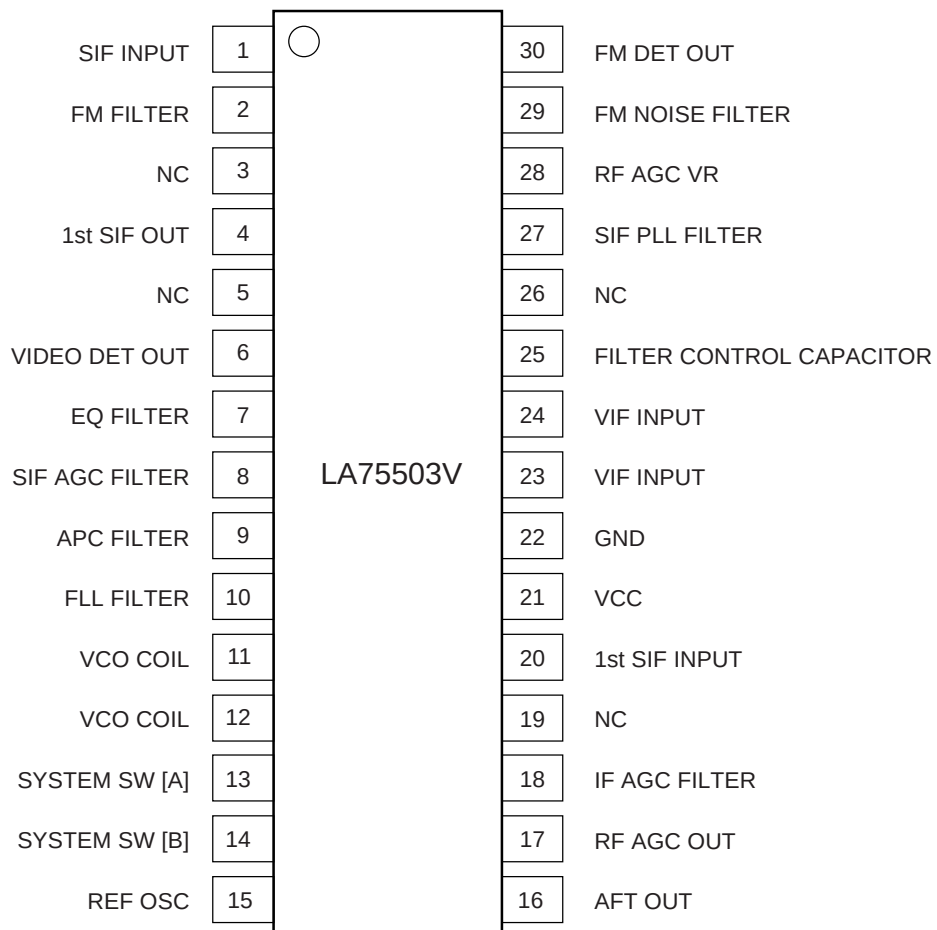
- Split/inter carrier switch

Inter carrier is selected by setting the first SIF input (pin 20) to GND.

## Sound Trap

The trapping point of the sound trap is set approximately 250 kHz above the SIF center frequency of each mode to improve the video S/N. Therefore, design using split specifications is preferable.

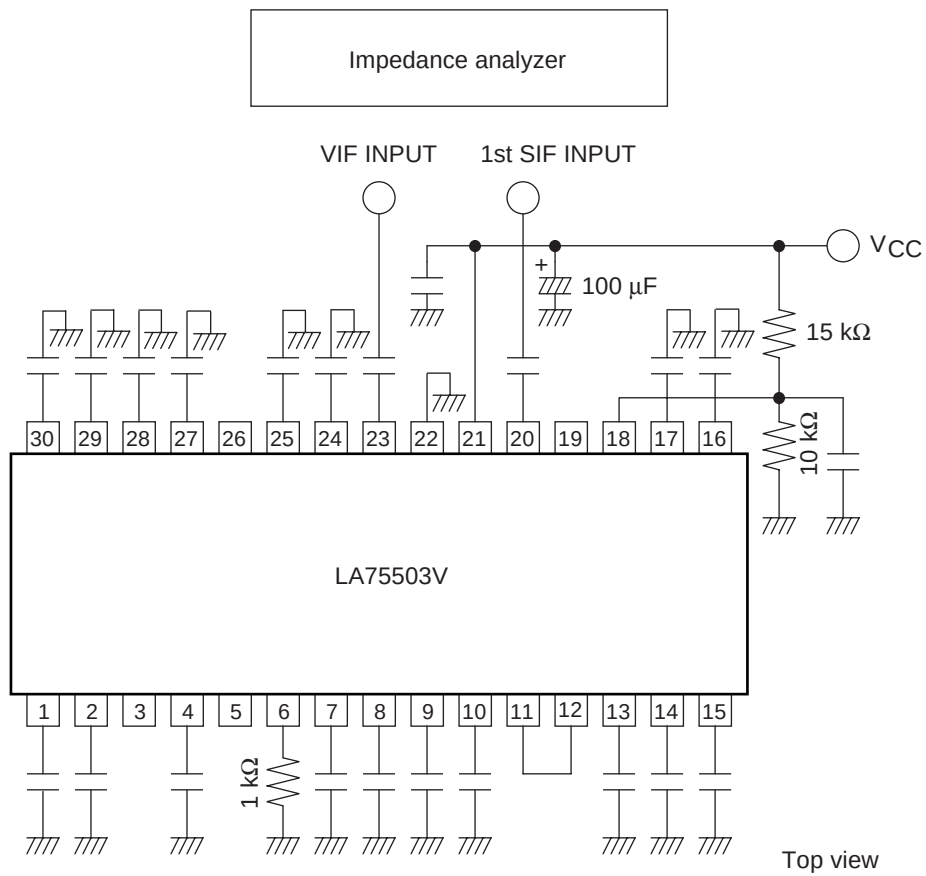
## Pin Assignment



Top view

# Test Circuit

Input Impedance Measuring Circuit (VIF, First SIF input impedance)



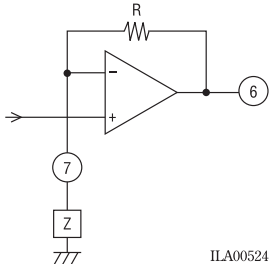
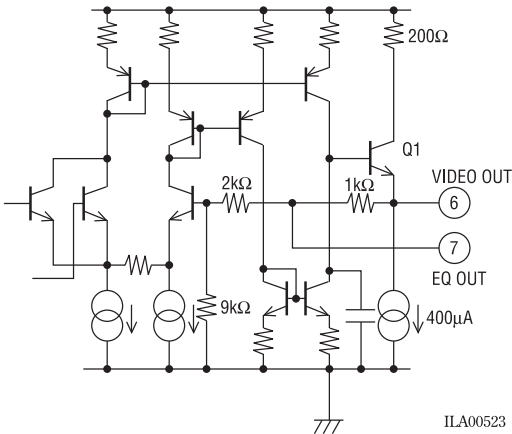
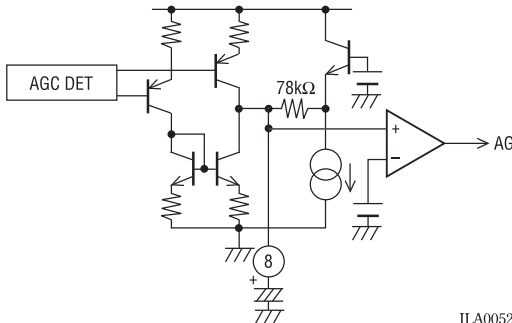
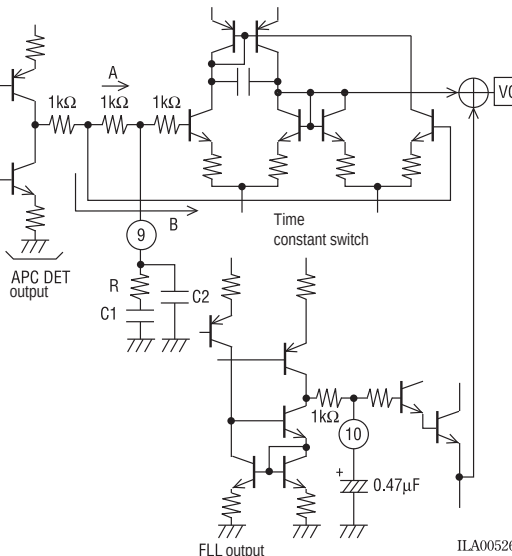
\*: 0.01  $\mu$ F in case of unspecified capacitor

## Pin Functions

| Pin No. | Pin         | Pin Function                                                                                                                                                                                                                                                                                                                                                                  | Internal Circuit |
|---------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 1       | SIF INPUT   | Inputs the SIF signal from the first SIF output.<br>Set the input level to 90 dB $\mu$ V or lower because of the dynamic range of the internal filter.                                                                                                                                                                                                                        | <p>ILA00519</p>  |
| 2       | FM FILTER   | This is the FM feedback filter pin. It is composed of a C and R filters.<br>1 $\mu$ F is normally used as the capacitance.<br>If the capacitance is a low value, the audio output level is small at low frequencies.<br>Moreover, the audio output level can be made smaller by increasing the resistance connected in series.<br>Use a resistance of 3 k $\Omega$ or higher. | <p>ILA00520</p>  |
| 3       | NC          | Not connected                                                                                                                                                                                                                                                                                                                                                                 |                  |
| 4       | 1st SIF OUT | This is the first SIF output.<br>In case of inter carrier, the chroma carrier is bigger than split carrier applications, so that it is recommended to connect a filter externally.<br><br>Filter example<br><p>ILA00522</p>                                                                                                                                                   | <p>ILA00521</p>  |

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| Pin No. | Pin                      | Pin Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Internal Circuit                                                                     |
|---------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 5       | NC                       | Not connected                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                      |
| 6<br>7  | VIDEO-OUT<br>EQ-OUT      | <p>Pin 6 is the video output pin.</p> <p>The EQ amplifier can be thought of as shown below.</p>  <p>Therefore, the peak gain of the EQ amplifier is determined by <math>A_v = 1 + R/Z</math>.</p> <p>However, note that the LA75503V being an IC with <math>V_{CC} = 5\text{ V}</math>, setting too large an amplitude causes distortion in the <math>V_{CC}</math> side. Use so that the white level is 4 V or less.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |
| 8       | SIF AGC FILTER           | <p>Pin 8 is the SIF AGC filter pin.</p> <p>Use this pin with a capacitance between 0.01 <math>\mu\text{F}</math> and 0.1 <math>\mu\text{F}</math>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| 9<br>10 | APC FILTER<br>FLL FILTER | <p>Pin 9 is the PLL detector APC filter pin.</p> <p>Normally the following are used:</p> <p><math>R = 330\ \Omega</math></p> <p><math>C1 = 0.47\ \mu\text{F}</math> to <math>1\ \mu\text{F}</math></p> <p><math>C2 = 100\ \text{pF}</math></p> <p><math>C1 = 1\ \mu\text{F}</math> is effective for the overmodulation characteristics.</p> <p>When the PLL is locked, the signal passes via the path marked A in the figure, and when PLL is unlocked and in weak signal, the signal passes via the path marked B in the figure. The PLL loop gain can thus be switched in this manner.</p> <p>Pin 10 is a VCO automatic control FLL filter pin.</p> <p>Since it operates always on a small current, using a larger capacitance results in a slower response.</p> <p>Normally, a capacitance between 0.47 <math>\mu\text{F}</math> and 1 <math>\mu\text{F}</math> is used.</p> <p>Moreover, the control range for this pin is between about 3 V to 4.7 V. Since this range is determined when adjusting the VCO tank circuit, set the design center of L and C of VCO so that the voltage of pin 10 is 3.6 V.</p> |  |

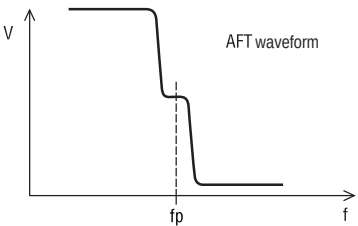
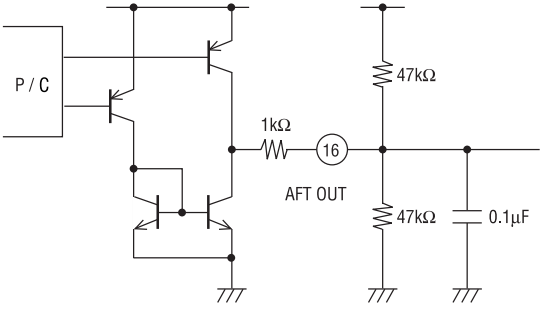
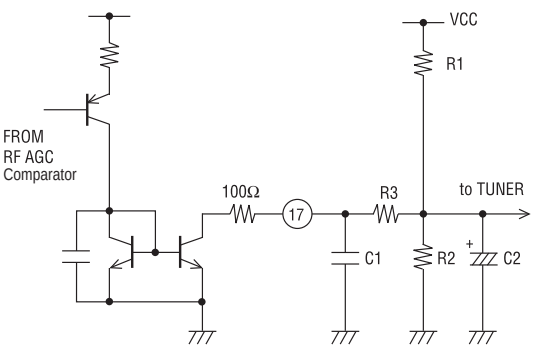
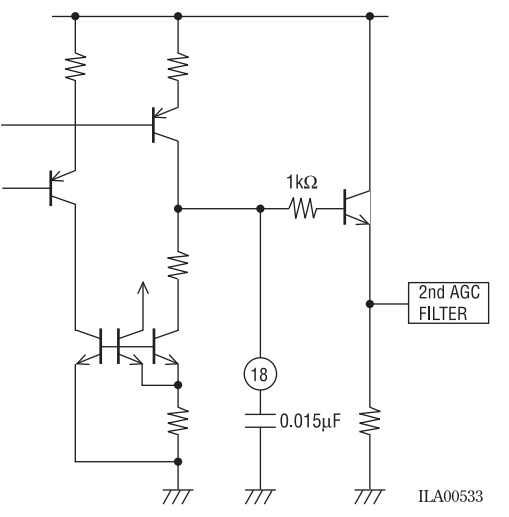
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| Pin No.  | Pin       | Pin Function                                                                                                                                                                                                                                                                                                                                                                                        | Internal Circuit |
|----------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 11<br>12 | VCO COIL  | <p>This is the VCO tank circuit for the PLL detector.</p> <p>Use a tuning capacitance of 24 pF.</p> <p>Use L and C specifications that are accurate to <math>\pm 2\%</math>. Also, design the L and C values so that the voltage of pin 10 is 3.6 V when PLL is locked while using the IF center frequency.</p>                                                                                     |                  |
| 13<br>14 | SYSTEM SW | <p>This is the system switch pin.</p> <p>The transistor turns ON when the pin voltage from the circuit becomes approx. 1.4 V.</p>                                                                                                                                                                                                                                                                   |                  |
| 15       | REF OSC   | <p>This pin can be used both as the crystal resonator pin and IF switch.</p> <p>The 38-MHz mode is selected by inserting 220 kΩ between pin 15 and GND, the 38.9 MHz mode by leaving the pin open, and the 39.5-MHz mode by inserting 220 kΩ between pin 15 and V<sub>CC</sub>.</p> <p>4-MHz input is possible from this pin.</p> <p>In the case of 4-MHz external input, input 86 dBμ or more.</p> |                  |

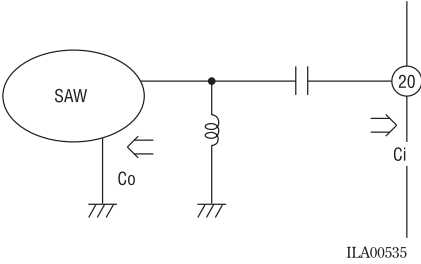
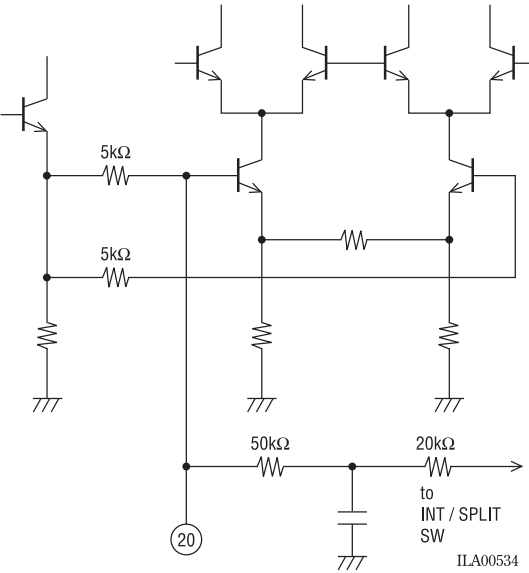
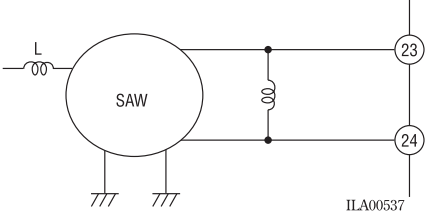
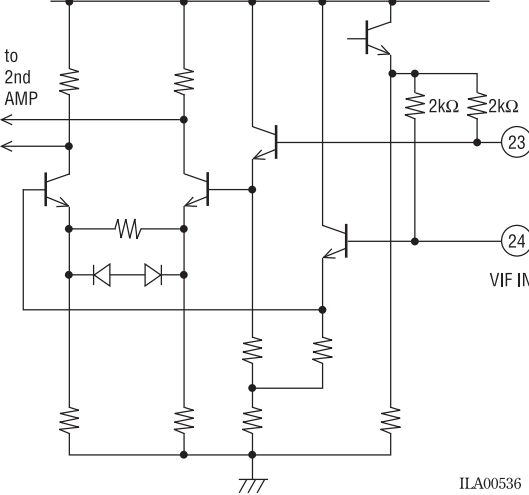
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| Pin No. | Pin           | Pin Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Internal Circuit                                                                                     |
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| 16      | AFT OUT       | <p>Pin 16 is the AFT output pin.</p> <p>Use external resistors of 47 k<math>\Omega</math> and a filter capacitance 0.1 <math>\mu</math>F.</p> <p>The AFT circuit generates the AFT voltage by comparing the signal obtained by dividing the 4-MHz reference frequency with the signal obtained by dividing VCO.</p> <p>Since it uses a digital phase comparator, a dead zone exists in the AFT center.</p>  <p>ILA00531</p> |  <p>ILA00530</p>   |
| 17      | RF AGC OUT    | <p>Pin 17 is the RF AGC output.</p> <p>RF AGC max is determined by R1 and R2.</p> <p>RF AGC min is determined by R3 and R4.</p> <p>Capacitor C1 prevents oscillation and capacitor C2 is the RF AGC filter.</p> <p>Normally 30 k<math>\Omega</math> is used for R1, but if the tuner's F/E transistor is GaAs, the gate's impedance is lower, so use approx. 10 k<math>\Omega</math>.</p>                                                                                                                    |  <p>ILA00532</p>  |
| 18      | IF AGC FILTER | <p>Pin 18 is the IF AGC filter pin.</p> <p>Normally, 0.01 <math>\mu</math>F to 0.02 <math>\mu</math>F polyester film capacitor is used.</p> <p>Determine the impedance based on H-SAG and AGC speed.</p>                                                                                                                                                                                                                                                                                                     |  <p>ILA00533</p> |
| 19      | NC            | Not connected                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                      |

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| Pin No.  | Pin             | Pin Function                                                                                                                                                                                                                                                                                                                                                                                       | Internal Circuit                                                                     |
|----------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 20       | 1st SIF INPUT   | <p>Pin 20 can be used both as the First SIF IN and inter/split switch pins.</p> <p>In the case of inter carrier, connect pin 20 to GND.</p> <p>When a sound saw filter is added, the matching loss can be decreased by inserting L to neutralize the IC input capacitance and saw filter output capacitance.</p>  |    |
| 21       | V <sub>CC</sub> | Connect the decoupling capacitor as close as possible.                                                                                                                                                                                                                                                                                                                                             |                                                                                      |
| 22       | GND             |                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                      |
| 23<br>24 | VIF INPUT       | <p>Pins 23 and 24 are VIF input pins.</p> <p>To reduce the loss of signal through a saw filter, input registers are set to 2 kΩ.</p> <p>VIF amplifier has three capacitive coupling amplifiers, direct connection from a saw filter is available.</p>                                                           |  |

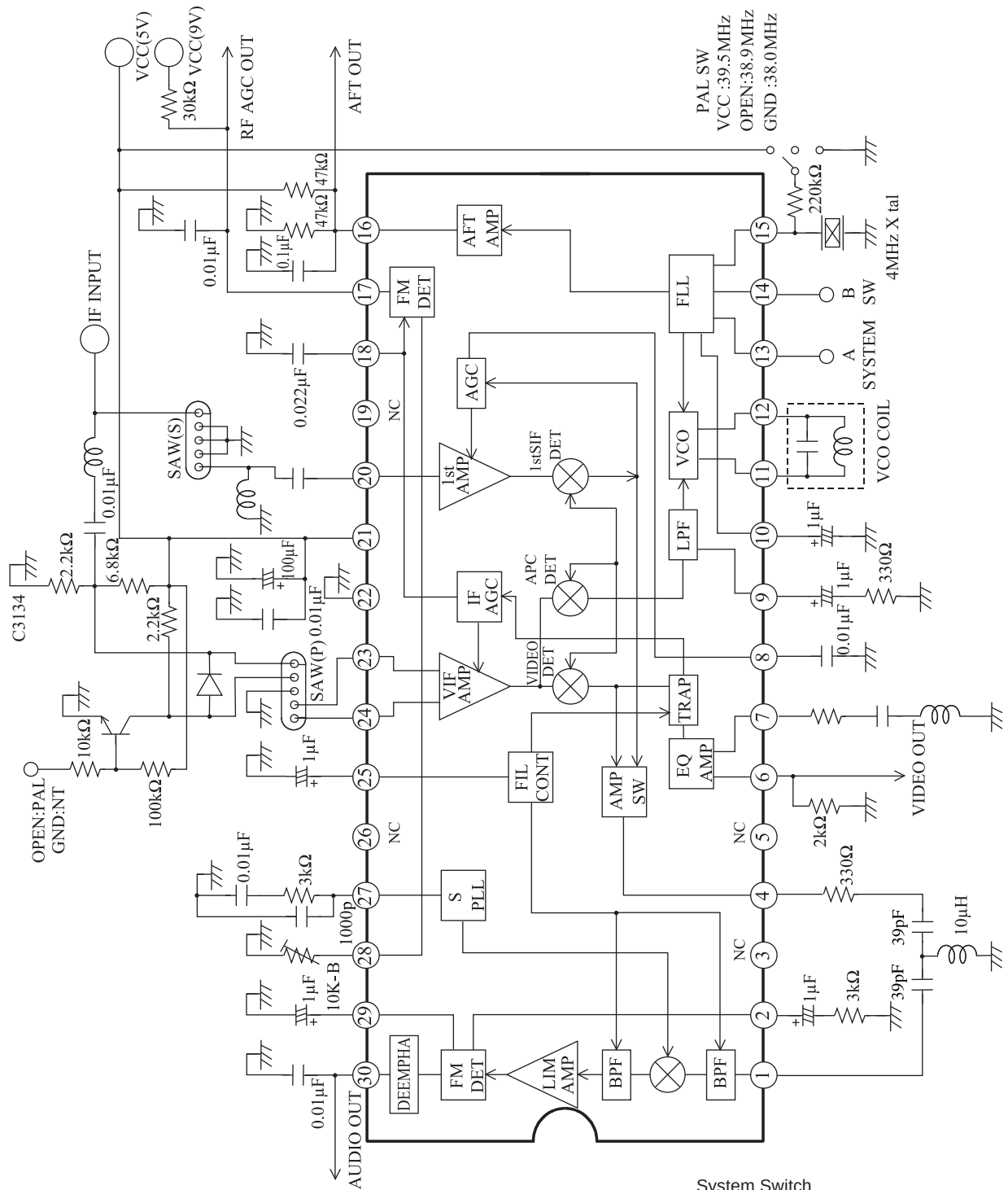
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| Pin No. | Pin        | Pin Function                                                                                                                                                                                                           | Internal Circuit |
|---------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 28      | RF AGC VR  | Pin 28 is the RF AGC VR pin.<br>When this pin is connected to GND, no signal is appeared on pin 6 and pin 30.                                                                                                          | <p>ILA00541</p>  |
| 29      | FM FILTER  | Pin 29 is the FM filter pin.<br>Use a capacitance between 0.01 $\mu$ F and 1 $\mu$ F.                                                                                                                                  | <p>ILA00542</p>  |
| 30      | FM DET OUT | Pin 30 is the FM output pin.<br>The built-in differential amplifier determines and switches the de-emphasis resistance value.<br>PAL: $5\text{ k} \times 0.01\mu\text{F}$<br>NT: $7.5\text{ k} \times 0.01\mu\text{F}$ | <p>ILA00543</p>  |

## Sample Application Circuit



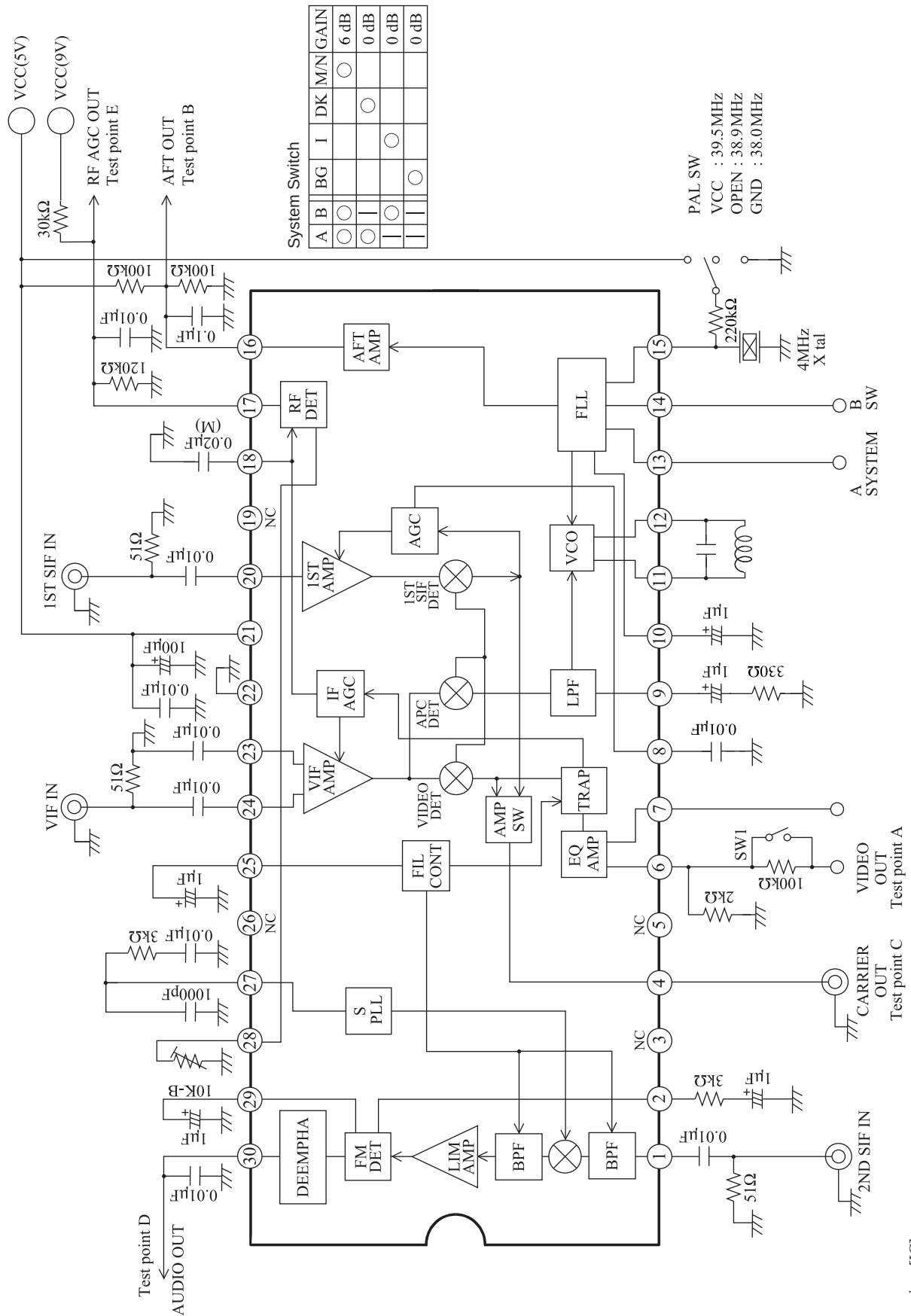
System Switch

| A | B | BG | I | DK | MN | GAIN |
|---|---|----|---|----|----|------|
| 0 | 0 |    |   |    | ○  | 6 dB |
| 0 | 1 |    |   | ○  |    | 0 dB |
| 1 | 0 |    | ○ |    |    | 0 dB |
| 1 | 1 | ○  |   |    |    | 0 dB |

1: OPEN

0: GND

## Test Circuit



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