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| SANYO | No. 4842 | LA3460M |
| | | FM NC + MPX Demodulator for Car Stereo Tuners |

Overview

The LA3460M is a high performance car stereo tuner IC that includes an FM noise canceller and a stereo multiplex demodulator.

Functions

[Noise Canceller Block]

- Built-in low- and high-pass filters
- Noise AGC
- Pilot signal compensation function

[Multiplex Block]

- Adjustment-free VCO (456 kHz)
- Level follower type pilot canceller
- SNC (stereo noise control)
- HCC (high cut control)
- Stereo indicator driver
- VCO oscillator stop function

Features

[Noise Canceller Block]

- Improved ignition noise rejection during medium to weak field reception
Adoption of a new noise AGC circuit
Optimized gate time
- High audio quality design with malfunction prevention in the high frequency band and for overmodulated signals
Improved dynamic range low-pass and high-pass filters

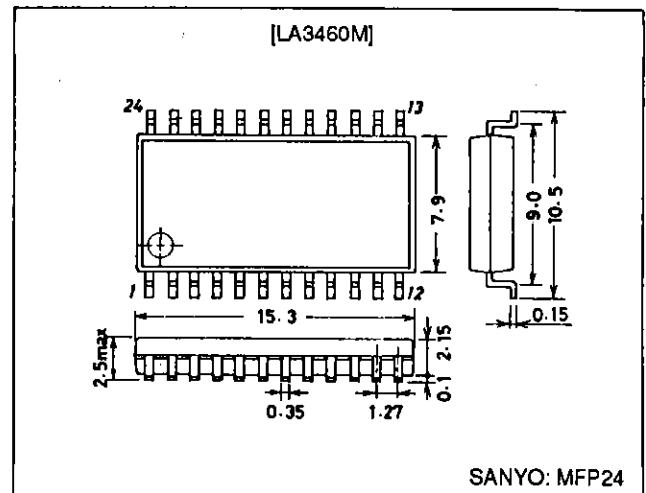
[Multiplex Block]

- High signal-to-noise ratio and low distortion (stereo S/N ratio: 79 dB, THD: 0.1 %)
- Good high frequency band separation (50 dB at 1 kHz and 30 dB at 10 kHz)
- Adoption of a PLL circuit with an adjustment-free VCO (456 kHz ceramic resonator)
- Improved pilot cancellation level (25 to 30 dB) using a new cancellation circuit
- Built-in 114 kHz and 190 kHz anti-birdie filters
- Adoption of new SNC characteristics to reduce multipath noise
- Reduced printed circuit board space requirements due to the adoption of a mini-flat package (MFP-24)

Package Dimensions

unit: mm

3045B-MFP24



Specifications

Maximum Ratings at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------|--------------|--------------------------|-------------|------------------|
| Maximum supply voltage | V_{CC} max | | 10 | V |
| Lamp influx current | I_L max | | 30 | mA |
| Allowable power dissipation | P_d max | $T_a = 85^\circ\text{C}$ | 490 | mW |
| Operating temperature | T_{opr} | | -40 to +85 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -40 to +150 | $^\circ\text{C}$ |

Operating Conditions at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|--------------------------------|-------------|------------|------------|------|
| Recommended supply voltage | V_{CC} | | 8.0 | V |
| Operating supply voltage range | V_{CC} op | | 7.0 to 9.0 | V |

Operating Characteristics

at $T_a = 25^\circ\text{C}$, $V_{CC} = 8.0$ V, $V_i = 300$ mVrms, $f = 1$ kHz, $L + R = 90\%$, pilot = 10% modulation, VSNC (V8) = 3 V, VHCC (V9) = 3 V

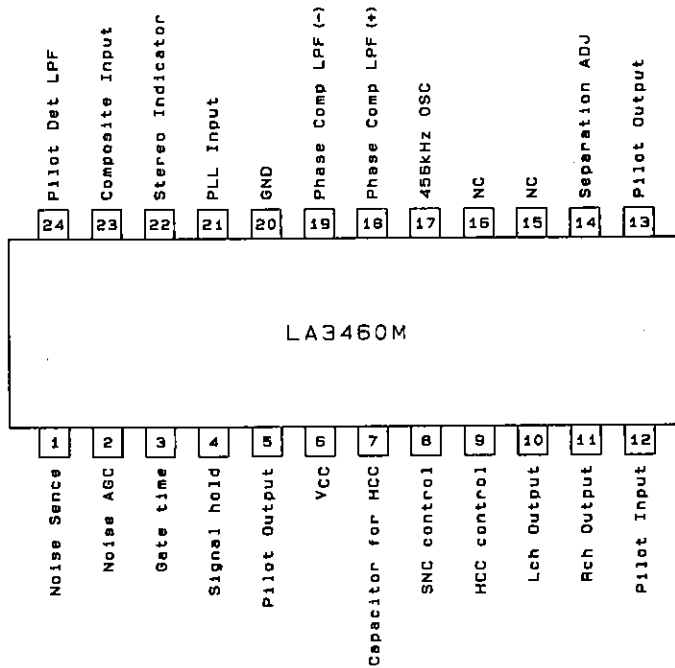
| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---------------------------|-----------|---|-------|-------|------|---------------|
| Quiescent current | I_{CCQ} | No input | 15 | 25 | 35 | mA |
| Channel separation | SEP | | 30 | 50 | | dB |
| Total harmonic distortion | THD | MONO | | 0.06 | 0.5 | % |
| Lamp lit level | V_L | Pilot signal | 4.0 | 7.3 | 13.0 | mVrms |
| Lamp hysteresis | hy | | | 3.0 | 6.0 | dB |
| Demodulator output | V_O | MONO | 260 | 330 | 410 | mVrms |
| S/N ratio | S/N | $R_g = 0 \Omega$, MONO | 70 | 85 | | dB |
| Channel balance | CB | MONO $20 \times \log(L/R)$ | -1.0 | 0 | +1.0 | dB |
| Pilot cancellation | PC | 30 mVrms pilot signal | 10 | 26 | | dB |
| Gate time | tgate | 1 μs 100 mVp-o, pulse input, $f = 1$ kHz | | 30 | 60 | μs |
| Noise sensitivity | S_N | 1 μs pulse input, $f = 1$ kHz | | 30 | 60 | mVp-o |
| SNC | SNC (1) | $V = 1.2$ V, separation L \rightarrow R | 30 | 50 | | dB |
| | SNC (2) | $V = 0.6$ V, separation L \rightarrow R | 6.0 | 8.5 | 11.0 | dB |
| | SNC (3) | $V = 0.1$ V, separation L \rightarrow R | | 0.5 | 2.0 | dB |
| HCC | HCC (1) | $V = 1.2$ V, $f = 10$ kHz, left output | -1.0 | 0 | +1.0 | dB |
| | HCC (2) | $V = 0.6$ V, $f = 10$ kHz, left output | -8.0 | -5.0 | -2.0 | dB |
| | HCC (3) | $V = 0.1$ V, $f = 10$ kHz, left output | -14.0 | -10.0 | -6.0 | dB |

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Pin Functions

| Pin No. | Function | Description |
|---------|----------------------------|----------------------------------|
| 1 | Noise sensitivity | Noises sensitivity adjustment |
| 2 | Noise AGC | |
| 3 | Gate time | |
| 4 | Hold circuit | |
| 5 | Pilot output | |
| 6 | V _{CC} | V _{CC} = +8.0 V |
| 7 | HCC capacitor | High cut filter |
| 8 | SNC control | |
| 9 | HCC control | |
| 10 | Left channel output | |
| 11 | Right channel output | |
| 12 | Pilot canceller input | |
| 13 | Pilot canceller output | |
| 14 | Separation adjustment | |
| 15 | NC | |
| 16 | NC | |
| 17 | 456 kHz oscillator circuit | Ceramic resonator |
| 18 | Phase comparator L.P.F (+) | Phase comparator low-pass filter |
| 19 | Phase comparator L.P.F (-) | Phase comparator low-pass filter |
| 20 | GND | |
| 21 | PLL input | PLL input |
| 22 | Stereo indicator | Active low |
| 23 | Composite input | Composite signal input |
| 24 | Pilot detector lpf | |

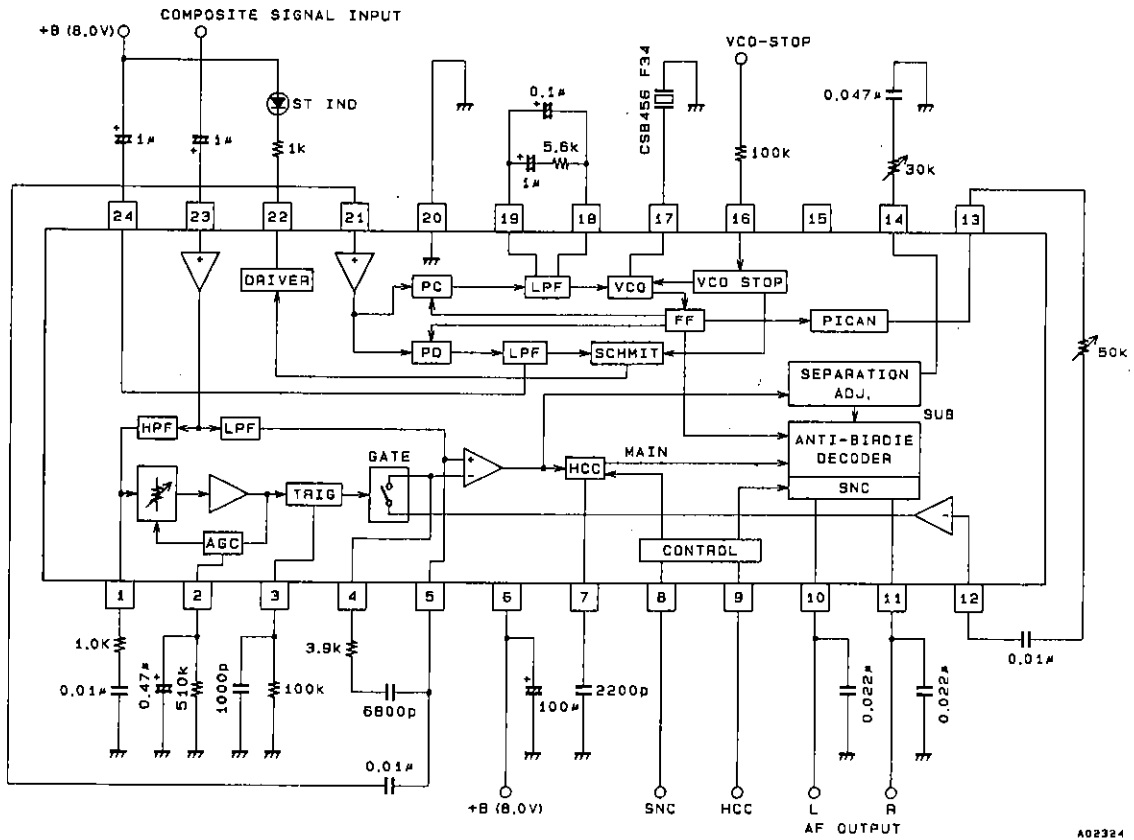
Pin Assignment



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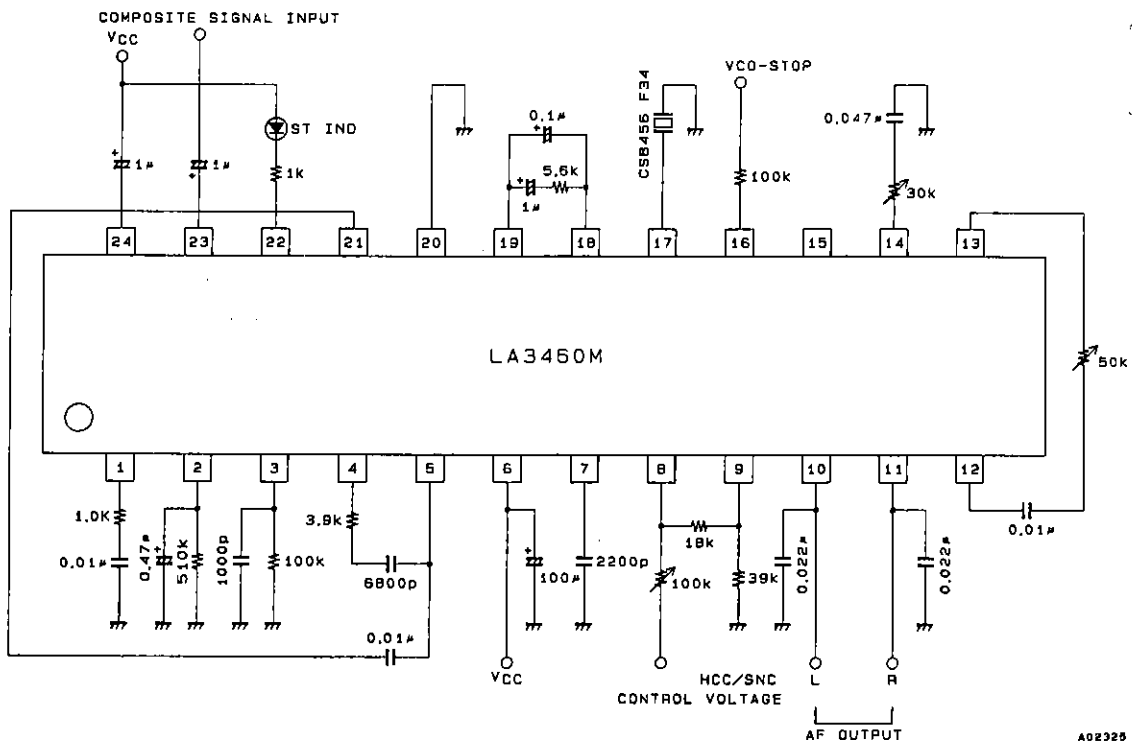
Equivalent Circuit Block Diagram



A02324

Unit (resistance: Ω, capacitance: F)

Sample Application Circuit



A02325

Unit (resistance: Ω, capacitance: F)

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Pin Functions

[NC]

Unit (resistance: Ω, capacitance: F)

| Pin | Function | Internal equivalent circuit | Remarks |
|--------|---|-----------------------------|---|
| 23 | Noise canceller input | | The input impedance is about 50 kΩ. |
| 1 2 | Noise canceller AGC sensitivity adjustments | | After setting up medium field (about 50 dBμ) reception with the noise sensitivity setting pin (pin 1), set up weak field (20 to 30 dBμ) reception with the AGC adjustment pin (pin 2). |
| 3 | Monostable multivibrator time constant | | Set this time constant so that the gate time is about 30 μs. Increasing the gate time improves the noise exclusion efficiency. However, care is required since the apparent distortion due to multipath or overmodulation will increase. |

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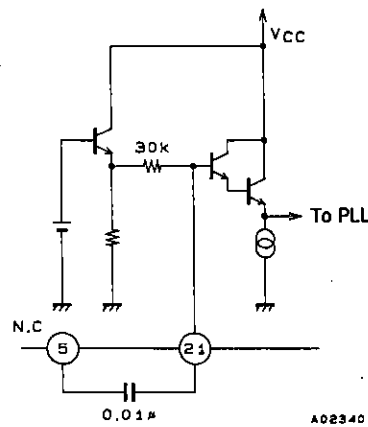
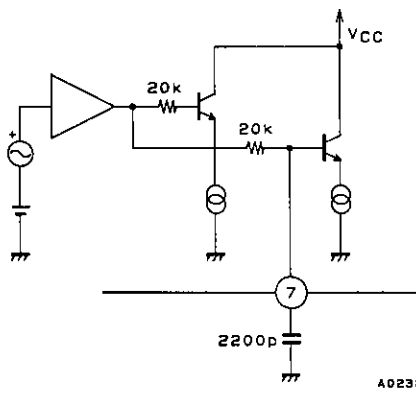
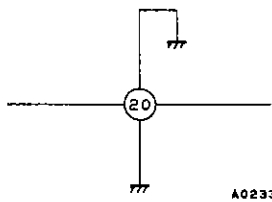
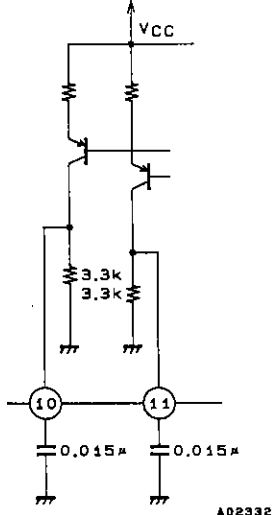
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| Pin | Function | Internal equivalent circuit | Remarks |
|--------|------------------------------|---|---|
| 4 5 | Memory circuit connection | <p>The diagram shows an internal equivalent circuit for pins 4 and 5. Pin 21 is connected to pin 5 through a 0.01 μF capacitor. Pin 5 is connected to pin 4 through a 6800 pF capacitor and a 3.9 kΩ resistor. The circuit includes a differential amplifier and a gate circuit, with a VCC supply and an LPF (Low Pass Filter) block. The reference number A02328 is located at the bottom right of the diagram.</p> | Memory circuit used during noise canceller operation |
| 12 | Pilot canceller signal input | <p>The diagram shows an internal equivalent circuit for pin 12. Pin 12 is connected to pin 13 through a 0.01 μF capacitor and a 50 kΩ resistor. The circuit includes a differential amplifier with a 20 kΩ resistor connected to pin 12, a 10 kΩ resistor to ground, and a 6.7 kΩ resistor to ground. A VCC supply is also shown. The reference number A02333 is located at the bottom right of the diagram.</p> | The pilot signal level requires adjustment due to variations in the IF output level and other parameters. |

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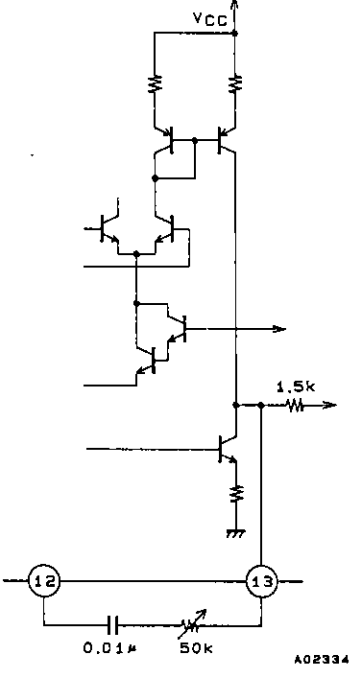
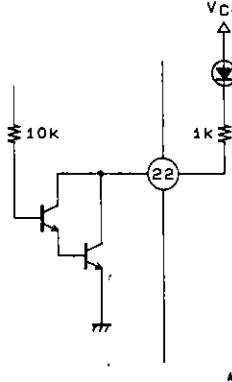
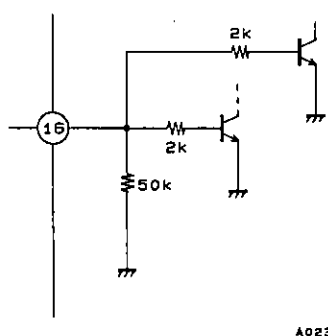
[MPX]

| Pin | Function | Internal equivalent circuit | Remarks |
|----------|---|--|--|
| 21 | Pilot input |  <p style="text-align: right;">A02340</p> | Pin 21 is the PLL circuit input. |
| 7 | HCC capacitor |  <p style="text-align: right;">A02328</p> | The HCC frequency characteristics are determined by the value of the external capacitor connected to this pin. |
| 20 | N.C. MPX GND |  <p style="text-align: right;">A02338</p> | Noise canceller and MPX circuit ground |
| 10 11 | MPX output (left) MPX output (right) |  <p style="text-align: right;">A02332</p> | |

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| Pin | Function | Internal equivalent circuit | Remarks |
|-----|------------------------------|--|---|
| 13 | Pilot canceller signal input |  <p style="text-align: right;">A02334</p> | Pin 13 is the pilot canceller signal input. |
| 22 | Stereo Indicator |  <p style="text-align: right;">A02341</p> | Stereo indicator This is an active-low signal. |
| 16 | OSC-stop |  <p style="text-align: right;">A02336</p> | |

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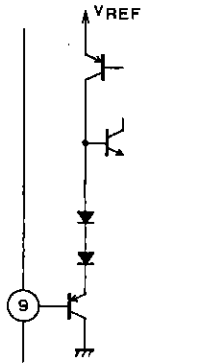
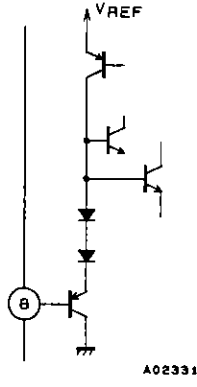
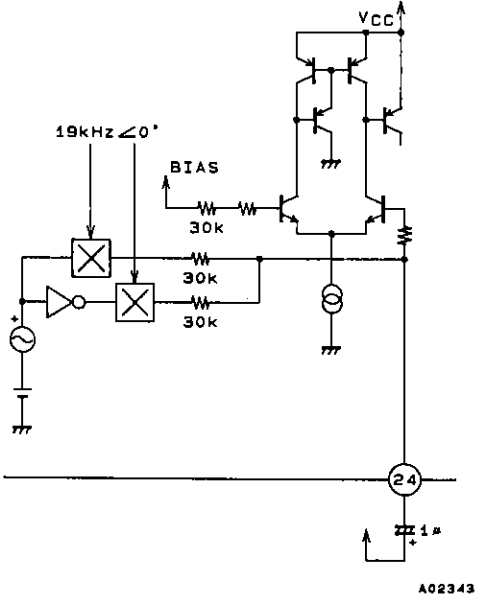
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| Pin | Function | Internal equivalent circuit | Remarks |
|----------|-----------------------|--|---|
| 14 | Separation adjustment | <p style="text-align: right; font-size: small;">A02335</p> | <p>The trimmer connected at this pin is used to adjust the sub-decoder input level. (The output level in mono (main) mode is not affected.)</p> |
| 17 | VCO | <p style="text-align: right; font-size: small;">A02337</p> | <p>The oscillator frequency is 456 kHz.</p> |
| 18 19 | Phase comparator | <p style="text-align: right; font-size: small;">A02338</p> | |

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| Pin | Function | Internal equivalent circuit | Remarks |
|-----|-------------------|---|---|
| 9 | HCC control input |  <p style="text-align: center;">A02330</p> | |
| 8 | SNC control input |  <p style="text-align: center;">A02331</p> | <p>The sub-output is controlled by an input between 0 and 1 V.</p> |
| 24 | Pilot detector |  <p style="text-align: center;">A02343</p> | <p>The circuit is forced to mono by the insertion of a 1 MΩ resistor between pin 24 and V_{CC}.</p> |

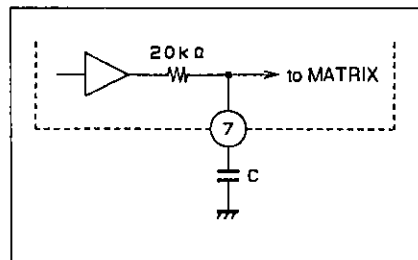
Usage Notes

1. Noise Canceller Block

- The noise canceller input (pin 23) has an input impedance of about 50 kΩ. Carefully consider low-area frequency characteristics when determining the value of the coupling capacitor. In an application circuit that uses a 1 μF capacitor, f_c will be about 3 Hz.
- Pins 1 and 2 are used to set the noise detector sensitivity and the noise AGC level. Setting up these values is easier if the noise sensitivity is set with pin 1 for a medium field strength (an antenna input of about 50 dBμ) first, and then the AGC is adjusted with pin 2 for a weak field strength (20 to 30 dBμ). A point that requires caution is that although the AGC action is improved if the noise detector sensitivity is increased, the weak field sensitivity will, inversely, be lowered.
- The time constant of the monostable multivibrator (pin 3) will be about 30 μs when C is 0.001 μF and R is 100 kΩ. The noise exclusion efficiency increases if the gate time is increased. However, distortion due to multipath and overmodulation is increased.

2. MPX Block

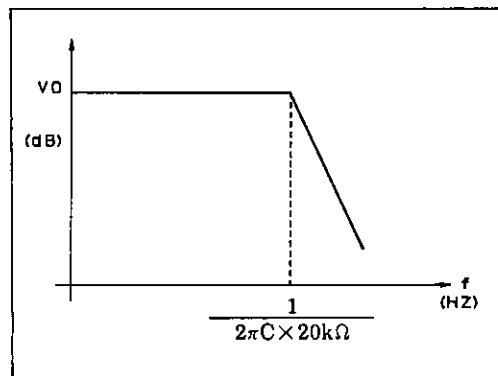
- HCC (high cut control) frequency characteristics (pin 7)



A02344

$$f_c = \frac{1}{2\pi \times C \times 20k\Omega} \text{ [Hz]}$$

The value of the external capacitor connected to pin 7 determines the output signal frequency characteristics during HCC control.

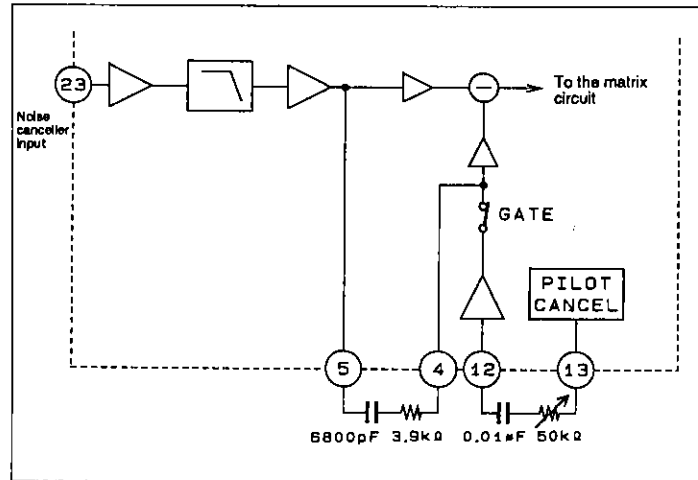


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- Pilot canceller adjustment (pins 12 and 13)

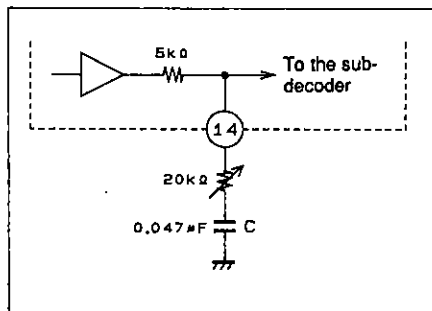
The pin 13 pilot canceller signal waveform is a 19 kHz signal that does not include the third harmonic component, as shown in the figure below. There is no need for a capacitor between pin 13 and ground, since this signal has the same phase as the pilot signal. Since it does not include a third harmonic component, good pilot cancellation in the left and right channel outputs can be obtained by adjusting the variable resistor.



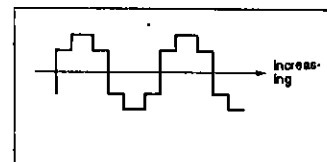
A02345

- Separation adjustment (pin 14)

The separation is adjusted by varying the sub-decoder input level with the variable resistor connected to pin 14. When the variable resistor is changed, only the sub-demodulation level is changed, and the mono (main) output level is not changed. The decoder high band separation will not be degraded in the sub-signal frequency band (23 to 53 kHz) if the value of the external capacitor C is made sufficiently small relative to the impedance of the variable resistor.



A02347



A02348

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