

To all our customers

Regarding the change of names mentioned in the document, such as Hitachi Electric and Hitachi XX, to Renesas Technology Corp.

The semiconductor operations of Mitsubishi Electric and Hitachi were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Hitachi, Hitachi, Ltd., Hitachi Semiconductors, and other Hitachi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Renesas Technology Home Page: <http://www.renesas.com>

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

Cautions

Keep safety first in your circuit designs!

1. Renesas Technology Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.

Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corporation product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corporation or a third party.
2. Renesas Technology Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.

3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor for the latest product information before purchasing a product listed herein.

The information described here may contain technical inaccuracies or typographical errors.

Renesas Technology Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.

Please also pay attention to information published by Renesas Technology Corporation by various means, including the Renesas Technology Corporation Semiconductor home page (<http://www.renesas.com>).

4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corporation is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corporation for further details on these materials or the products contained therein.

HA12181FP

AM Radio Noise Reduction System



ADE-207-171A (Z)

2nd. Edition
June 1997

Functions

- Buffer amp. for audio
- Linear approximate circuit for noise reduction
- IF Amp., detector, audio amp. and AGC circuit for noise detection
- Gate pulse generator

Features

- High noise cancelling capacity: 46 dB typ.
- Less gain loss: $G_v = -0.5$ dB typ.
- Low total harmonic distortion and high signal-to noise ratio: THD = 0.06% typ., S/N = 75 dB typ.
- Operation supply voltage range: 7.0 V to 10 V (8.2 V typ.)
- Less external parts count

Block Diagram

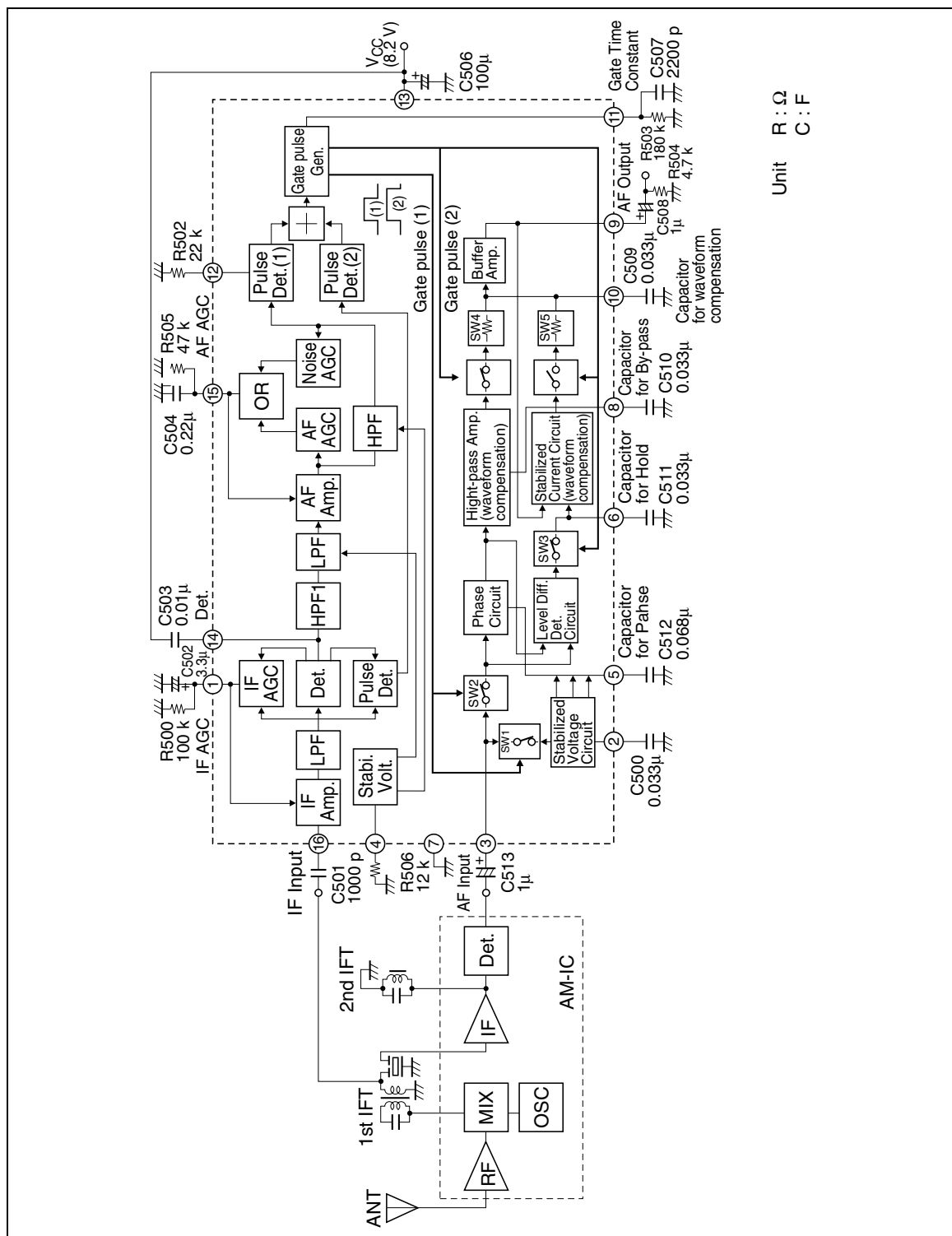


Table of Pin Description and External Parts

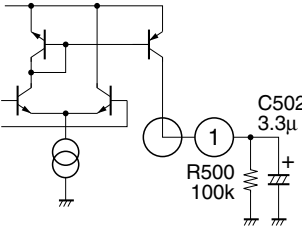
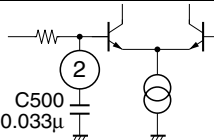
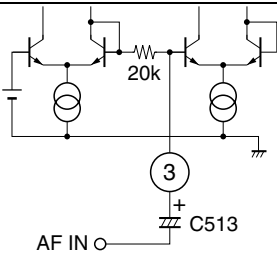
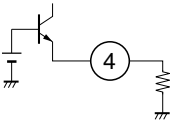
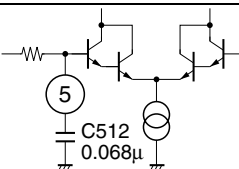
| No. of pin | Name | Function | DC voltage (V) (No input) | Equivalent circuit | External parts | | Influence of External parts | |
|------------|----------|---------------------------------------|---------------------------|---|----------------|-------------------|---|--|
| | | | | | No. | recommended value | Larger than recommended value | Smaller than recommended value |
| 1 | IF AGC | Time constant for IF AGC. | 2.7 |  | R500 C502 | 100 K 3.3 μ | Longer time to stabilize AGC. | Longer distortion of recover. |
| 2 | Bias1 | Bypass for voltage Stabi. | 3.2 |  | C500 | 0.033 μ | — | Increased noise. |
| 3 | AF input | Input of AF. | 3.3 |  | C513 | 1 μ | — | — |
| 4 | Bias2 | Decide the current of filter network. | 1.3 |  | R506 | 12 K | Cut off frequency of L.P.F and H.P.F shifted lower. | Cut off frequency of L.P.F and H.P.F shifted higher. |
| 5 | Phase | Phase circuit | 3.3 |  | C512 | 0.068 μ | Must be used on the recommended value. | |

Table of Pin Description and External Parts (cont)

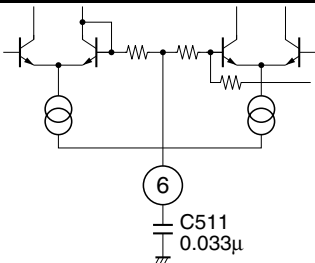
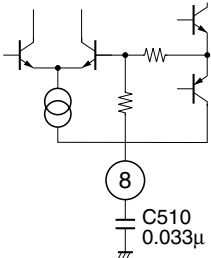
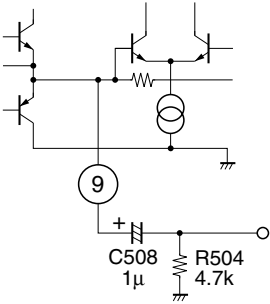
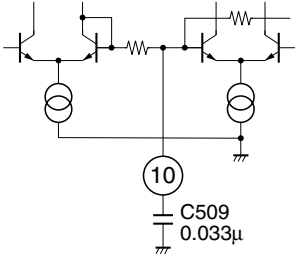
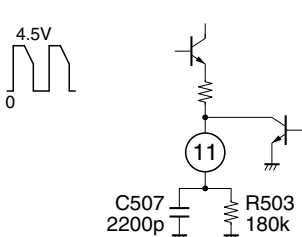
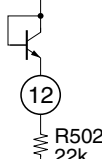
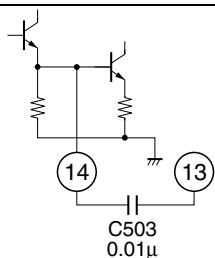
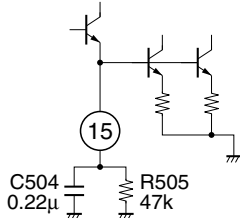
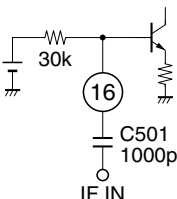
| No. of pin | Name | Function | DC voltage (V) (No input) | Equivalent circuit | External parts | | Influence of External parts | |
|------------|------------|---|---------------------------|---|----------------|-------------------|--|--------------------------------|
| | | | | | No. | recommended value | Larger than recommended value | Smaller than recommended value |
| 6 | Hold | Hold of level difference. | 3.3 |  | C511 | 0.033 μ | Must be used on the recommended value. | |
| 7 | GND | GND | — | — | — | — | — | — |
| 8 | High-Pass. | High-Pass AMP. (Wave-form Compensation) | 3.3 |  | C510 | 0.033 μ | Must be used on the recommended value. | |
| 9 | AF out | Output of AF | 3.3 |  | C508 | 1 μ | Output DC cut | |
| | | | | | R504 | 4.7 K | Output load | |
| 10 | Wave form | Wave-form Compensation | 3.3 |  | C509 | 0.033 μ | Must be used on the recommended value. | |

Table of Pin Description and External Parts (cont)

| No. of pin | Name | Function | DC voltage (V) (No input) | Equivalent circuit | External parts | | Influence of External parts | |
|------------|-----------------|--|---------------------------|---|----------------|---------------------------|---|--|
| | | | | | No. | recom- mended value | Larger than recom- mended value | Smaller than recom- mended value |
| 11 | Gate | Gate pulse generation | 4.5V |  | R503 | 180 K | Gate | Gate |
| | | | | | C507 | 2200 P | pulse width become wider. | pulse width become narrow. |
| 12 | Vth | Determination of noise detection sensitivity | 1.1 |  | R502 | 22 K | Higher noise detection sensitivity. | Lower noise detection sensitivity. |
| 13 | V _{cc} | V _{cc} | 8.2 | — | — | — | — | — |
| 14 | IF Det. | IF AGC detector | 3.3 |  | C503 | 0.01 μ | — | — |
| 15 | AF AGC | Time constant for AF AGC | 0 |  | R505 | 47 K | Longer time to stabilize AGC. | Miss-operation in noise detector. |
| | | | | | C504 | 0.22 μ | | |

HA12181FP

Table of Pin Description and External Parts (cont)

| No. of pin | Name | Function | DC voltage (V) (No input) | Equivalent circuit | External parts | | Influence of External parts | |
|------------|-------|----------|---------------------------|---|----------------|-------------------|-------------------------------|--------------------------------|
| | | | | | No. | recommended value | Larger than recommended value | Smaller than recommended value |
| 16 | IF in | IF input | 1.3 |  | | | IF Input | Coupling |
| | | | | | | | — | Instability |

Absolute Maximum Ratings (Ta = 25°C)

| Item | Symbol | Rating | Unit |
|-----------------------|-----------------|-------------|------|
| Supply voltage | V _{cc} | 16 | V |
| Power dissipation | Pd | 400*1 | mW |
| Operating temperature | Topr | −40 to +85 | °C |
| Storage temperature | Tstg | −55 to +125 | °C |

Note: 1. Value at Ta = 85°C

Electrical Characteristics (Tentative) ($V_{cc} = 8.2\text{ V}$, $T_a = 25^{\circ}\text{C}$, Pin 3 input: $V_{in} = 100\text{ mVrms}$, $f = 1\text{ KHz}$, Pin 16 input: $V_{in} = 74\text{ dB}\mu$, $f_c = 450\text{ KHz}$, $f_m = 1\text{ KHz}$, $m = 30\%$)

| Item | Symbol | Min | Typ | Max | Unit | Test conditions |
|--|------------|-----|------|-----|-------|---|
| Supply current | I_{cc} | — | 11.0 | — | mA | No input signal, IC only |
| Output voltage | V_{out} | 70 | 95 | 120 | mVrms | Pin 3 input only |
| Total harmonic distortion | THD1 | — | 0.06 | 0.3 | % | |
| Signal-to-noise ratio | S/N (1) | 60 | 75 | — | dB | Pin 3 input $V_{in} = 100\text{ mVrms}$ (Reference), $R_g = 10\text{ K}\Omega$ |
| Strong input total harmonic distortion | THD2 | — | 1.0 | 2.5 | % | Pin 3 input $V_{in} = 500\text{ mVrms}$ |
| Recovered output voltage | V_o (AF) | 50 | 78 | 120 | mVrms | Pin 16 input only |
| Recovered output signal-to-noise-ratio | S/N (2) | 35 | 45 | — | dB | |
| Noise suppression ratio | NSR | 35 | 46 | — | dB | Input the waveform below. Pin 3 input $V_{in} = 100\text{ mVrms}$ (Reference) no input sine wave |

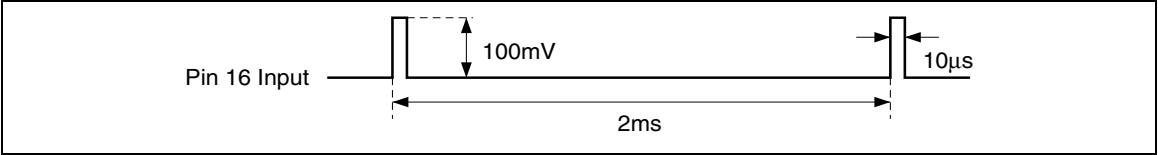
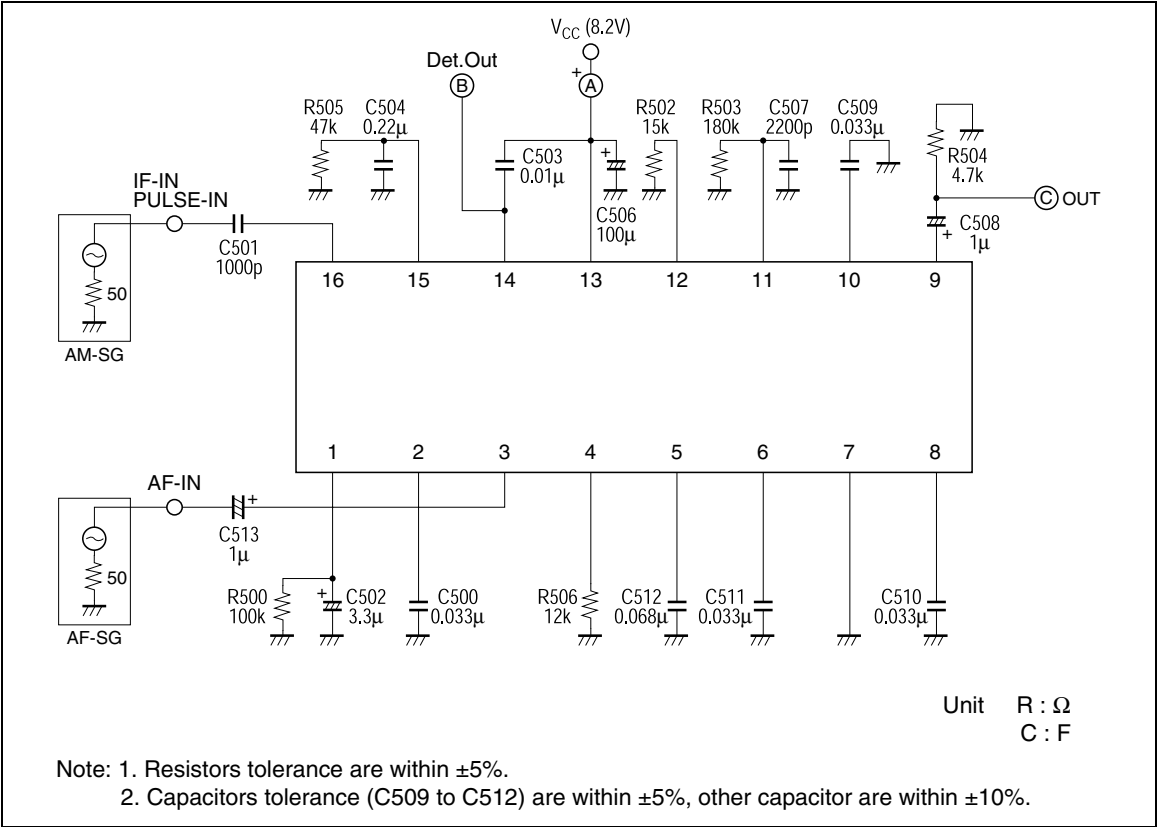


Figure 1 Input Waveform at Measurement of Noise Suppression Ratio

HA12181FP

Test Circuit



Operation Principle

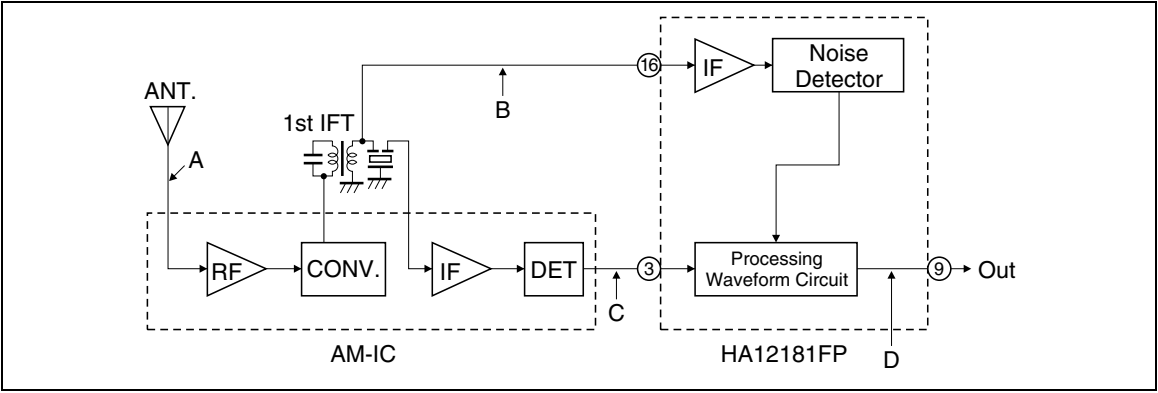


Figure 2 System Block Diagram of AM Radio

A system block diagram of AM Radio using the HA12181FP is shown in Figure 2 and waveforms at each point in the system are illustrated in Figure 3. For AM wave with impulse noise from ANT, the pulse spreads its width each time when the AM wave passes through a selection filter.

The pulse width becomes the order of several hundred microseconds at detector output (Point C).

A radio without a noise canceller produces large noise to the audience. This IC perfectly detects every noise by using the signals from 1st IFT (Point B) in front of the narrow band filter.

The wave process circuit approximates the voltage linearly at the pulse to reduce the noise in the output.

The principle for wave processing follows. Further investigation make it clear that the pulse width of impulse noise is constant (several handred microseconds) and independent of the waveform or waveheight.

Therefore the former and later voltage (V_A , V_B) of the pulse can be found at the same time (T_1) by means of the wave and the delayed one for this time, as shown in the right figure.

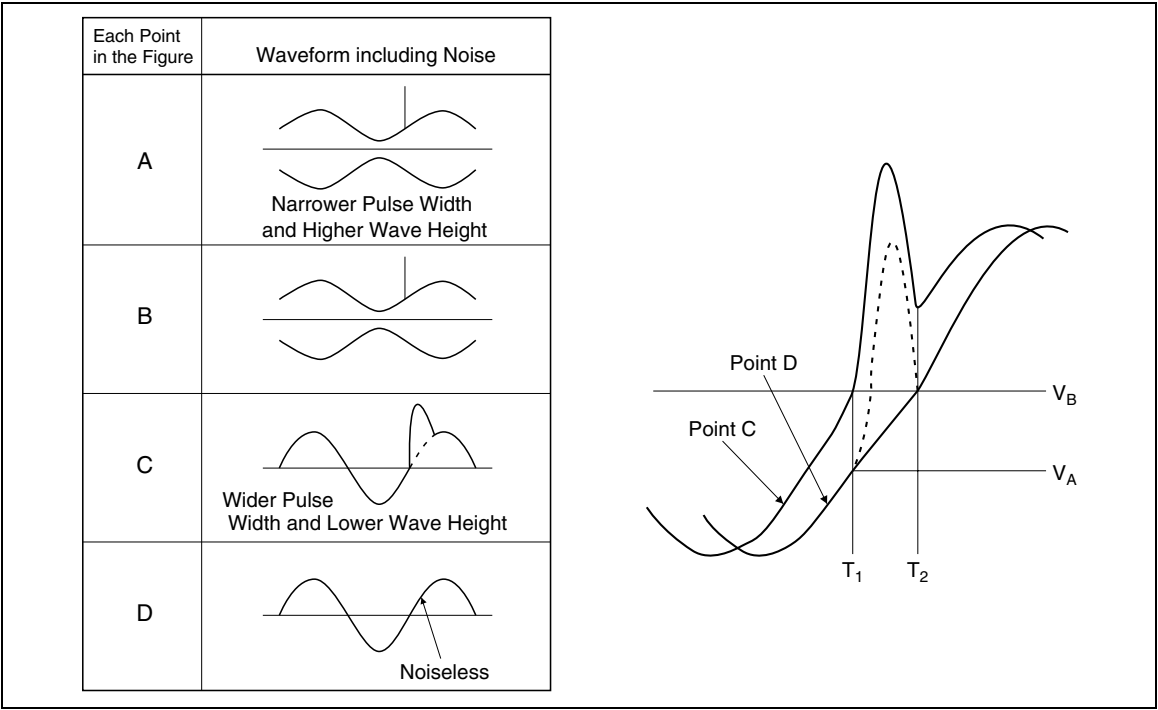


Figure 3 Waveforms at Each Point in the System

In an actual circuit, the differential voltage between input and output of phase shift circuit is changed to the capacitor C511 at pin 6.

At the time of T_1 , when the switch turns to the noise processing mode (the switch positions in Figure 4 are inverted), the voltage difference ($V_A - V_B$) is held in C511.

C509 at pin 10 is changed by the differential voltage between the held voltage and the output voltage at pin 9 (V_A): $V_A - (V_A - V_B) = V_B$.

As the initial voltage of C509 is equal to the output voltage (VA) before the switch change, the voltage between terminals of C509 is changed from VA to VB.

The waveform which change up to C509 becomes the output, because the voltage of C509 appears at pin 9 through the buffer.

The changed up waveform of C509 is almost linearly approximated because of the constant current change by the feedback from the output at pin 9.

At the time of T2 when the awitches change to the normal mode (the switch position in Figure 4), the output recovers smoothly as the voltage of C509 is VB.

However the unmatched wave delay time due to the pulse width or the phase circuit and the offset of circuit make a slight step difference on the waveform at the moment of switch change.

LPF, consisting of R1 and C509 make it smooth.

The frequency characteristics, which is deteriorated by LPF in the normalmode, is compensated so that it might become flat. C509 and C510 should have the same capacity, and the tolerance must be within $\pm 5\%$.

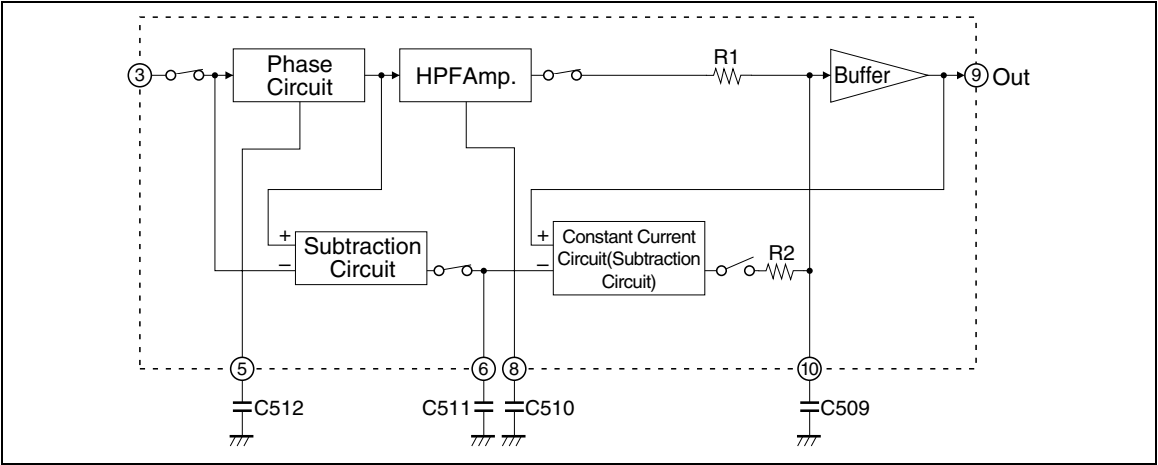
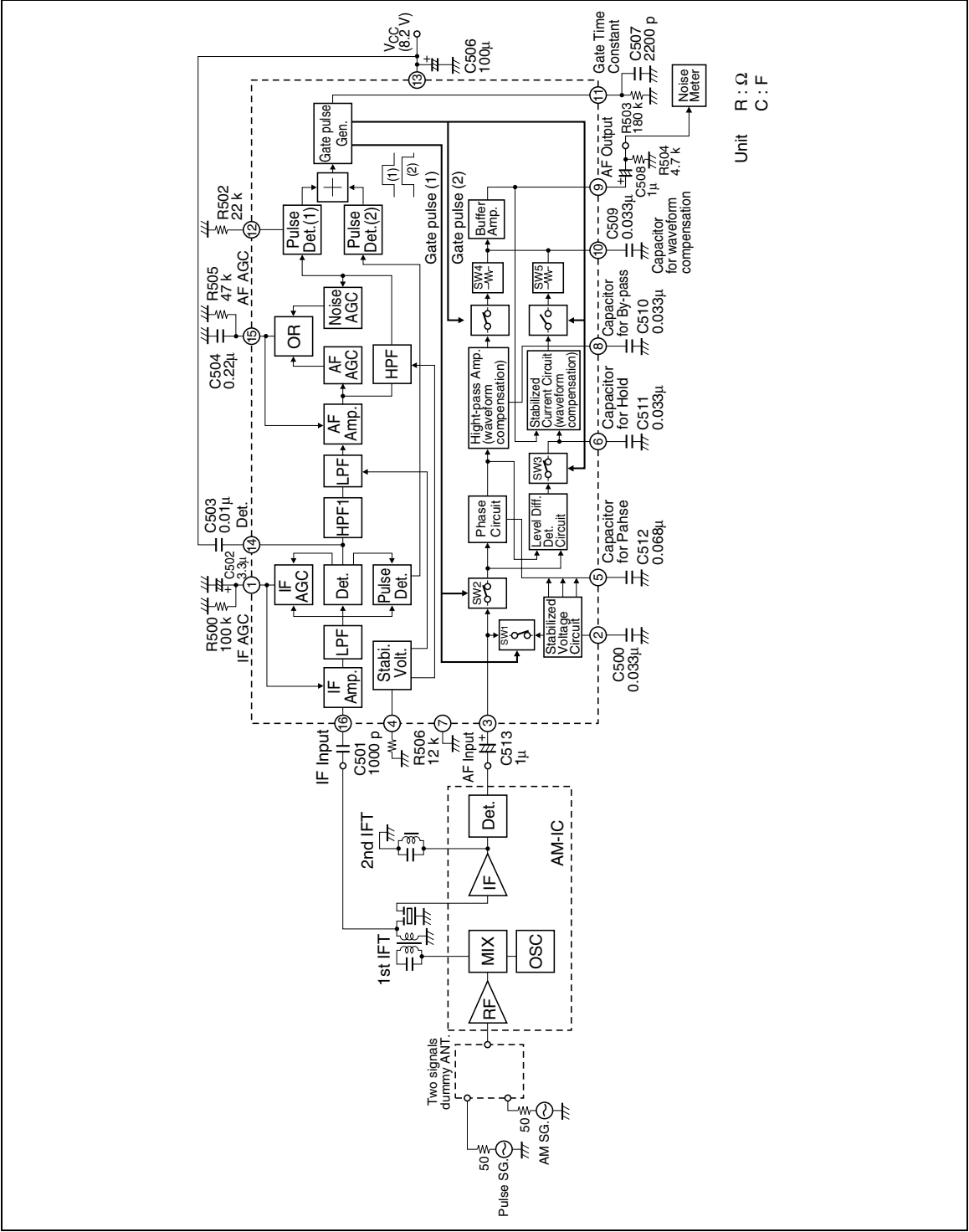
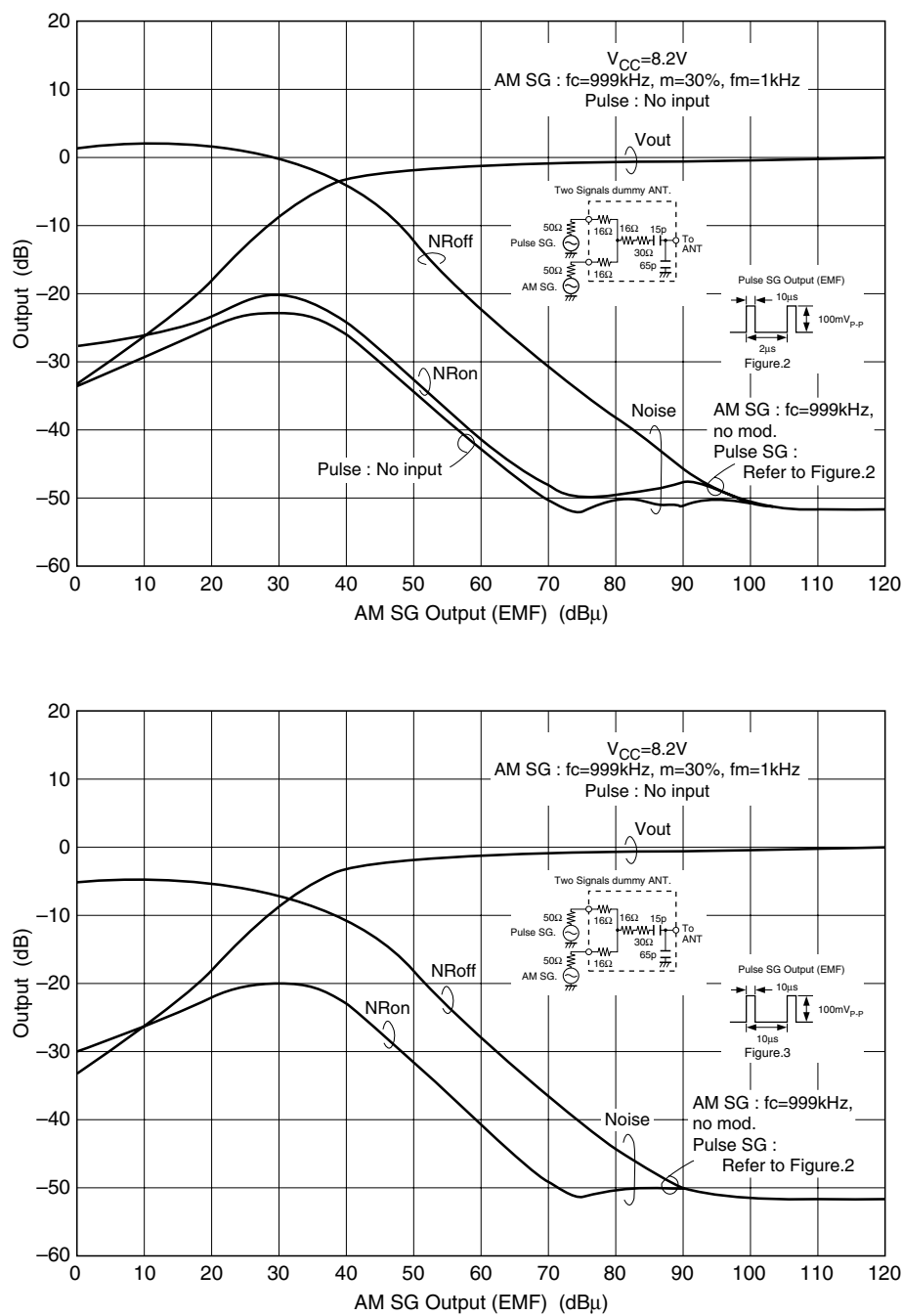


Figure 4 Waveform Processing Circuit

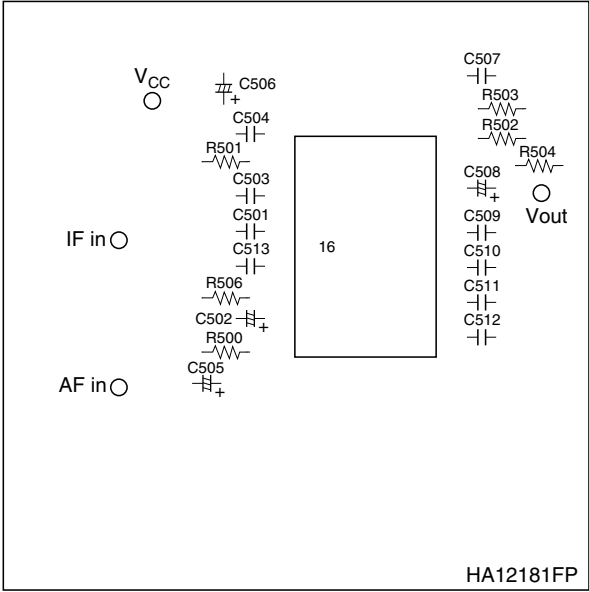
Evaluation Circuit for Noise Reduction Effect



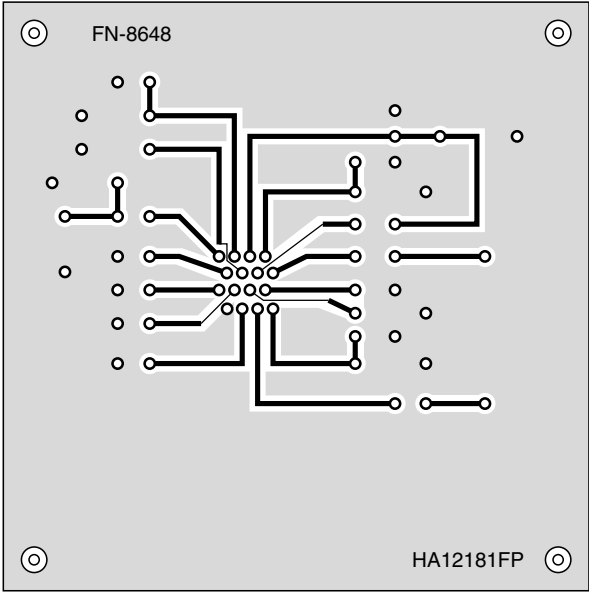
Example of Noise Reduction Effect



PC Board Layout Pattern

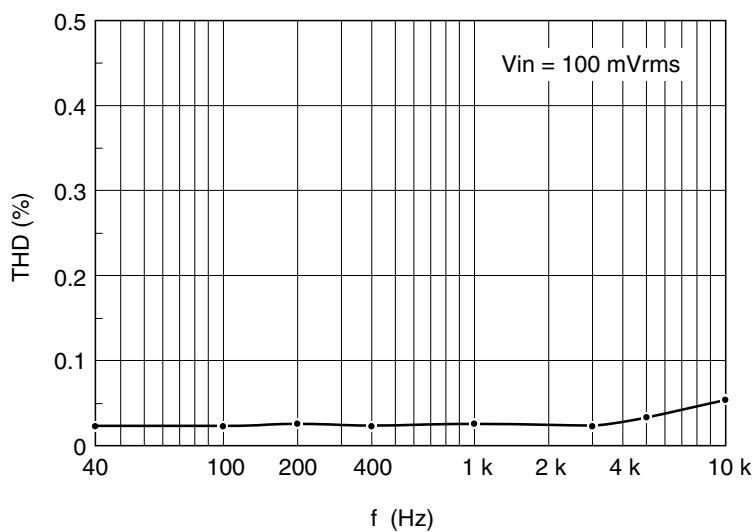
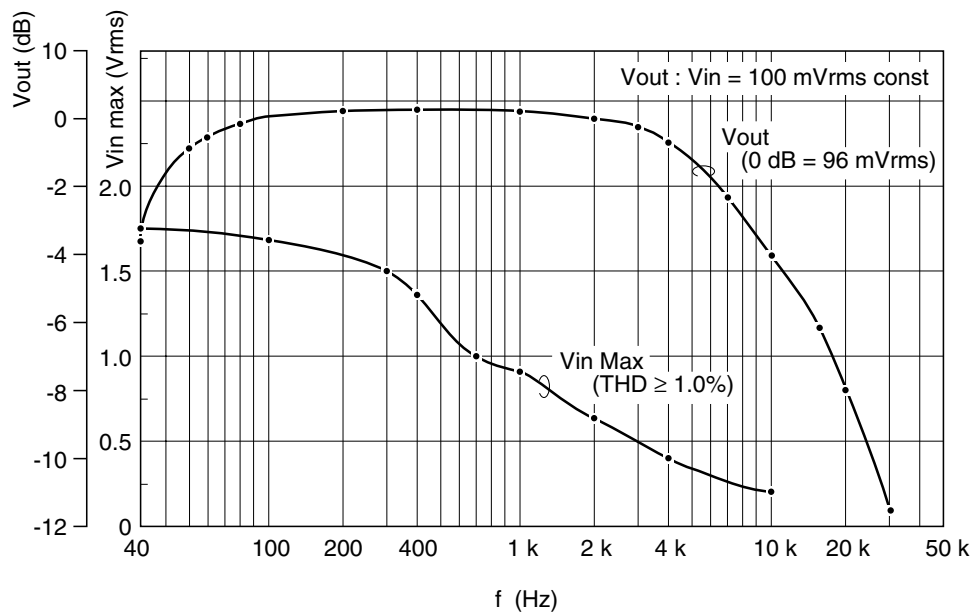


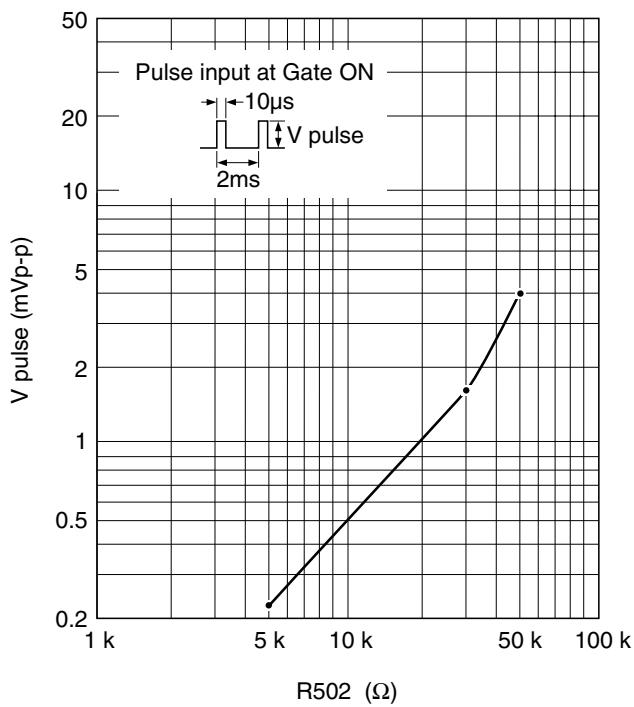
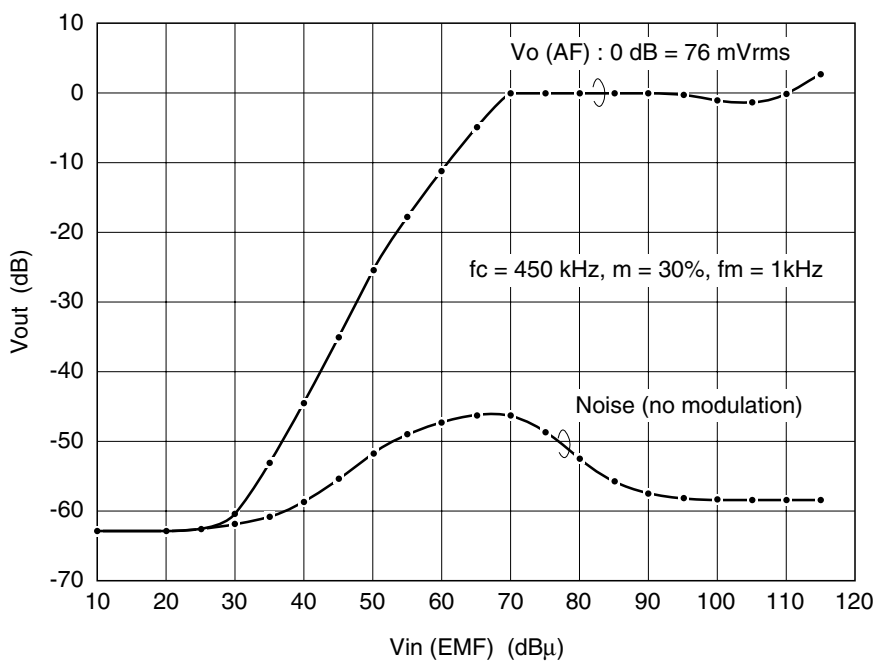
(Top view)

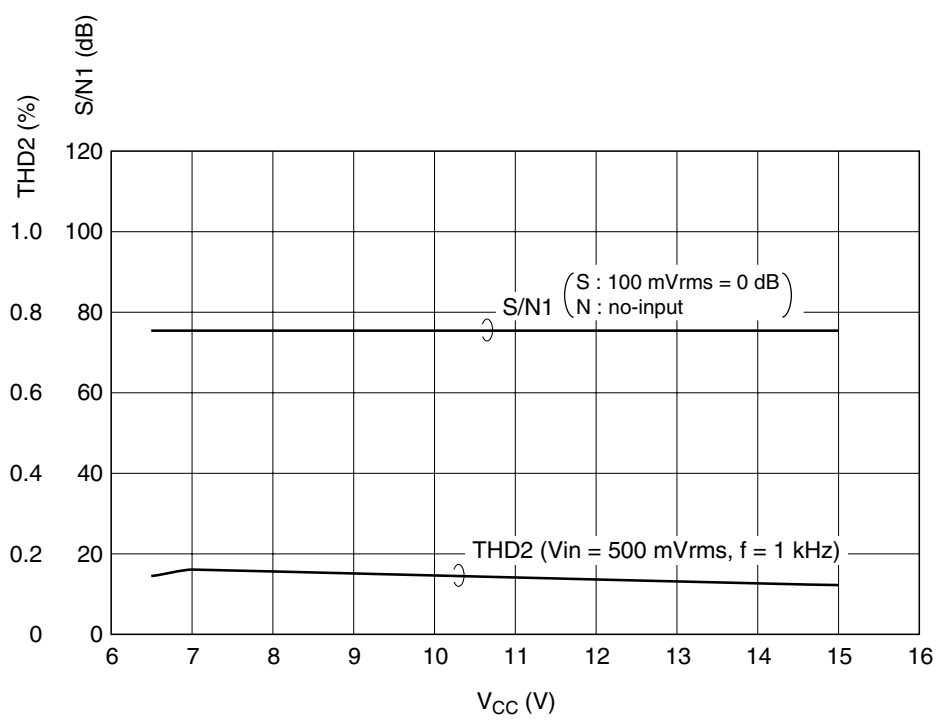
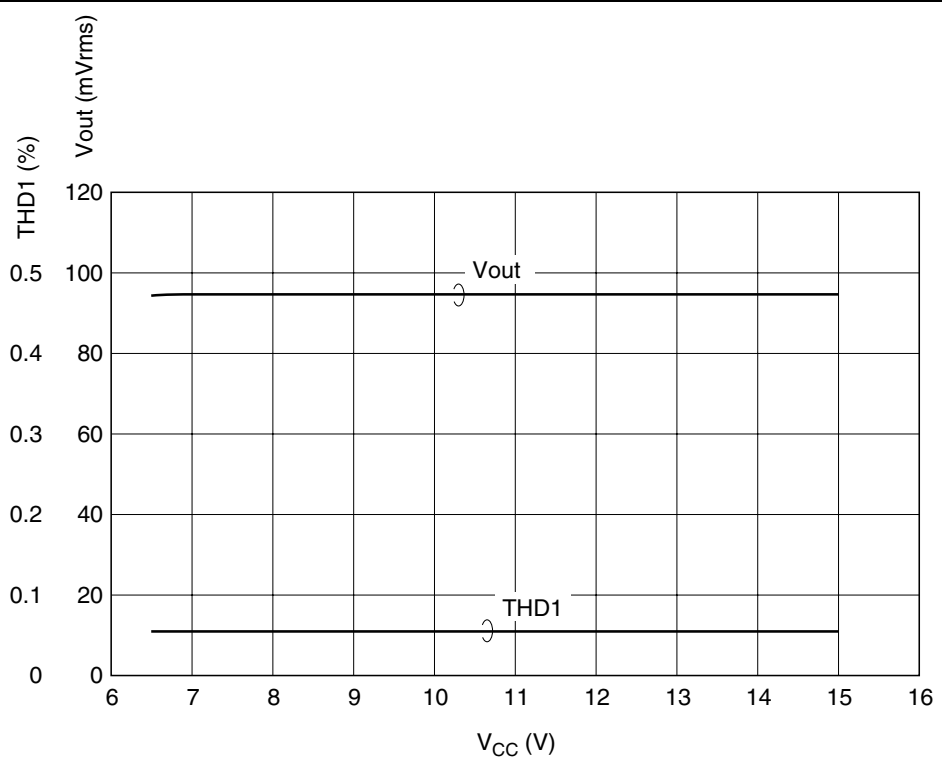


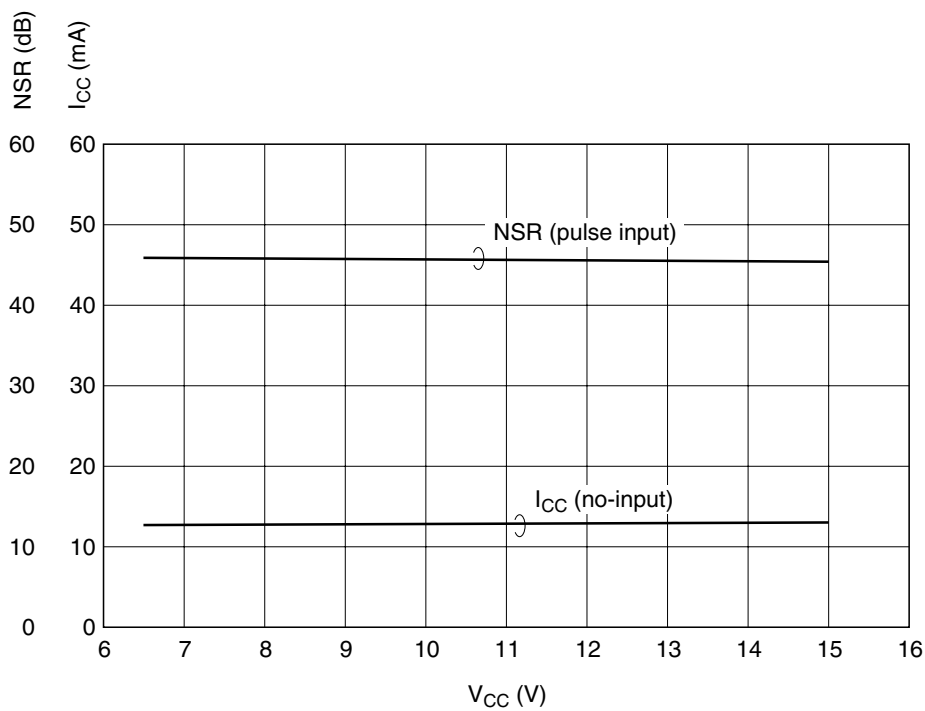
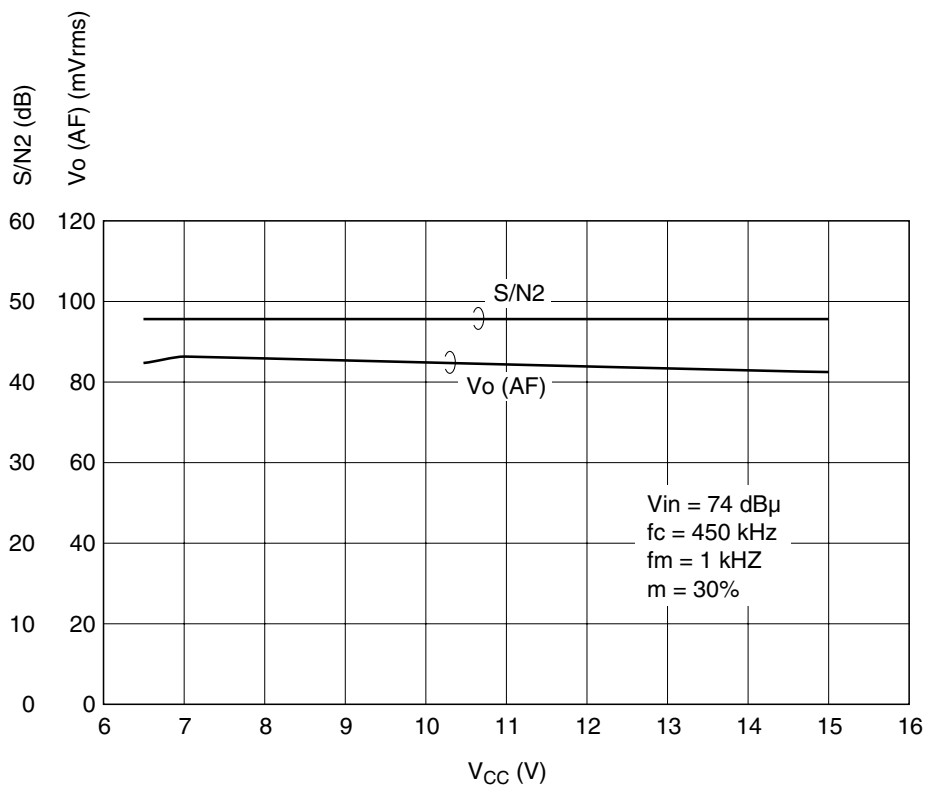
(Bottom view)

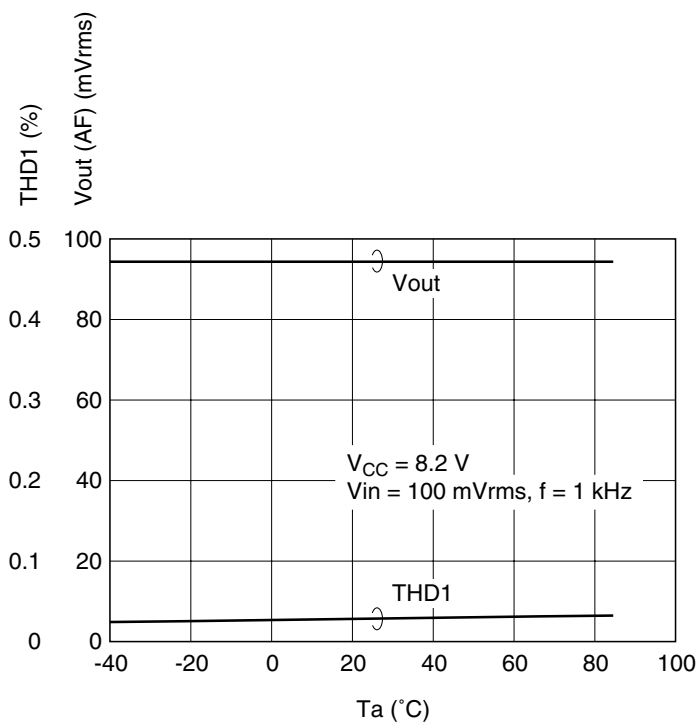
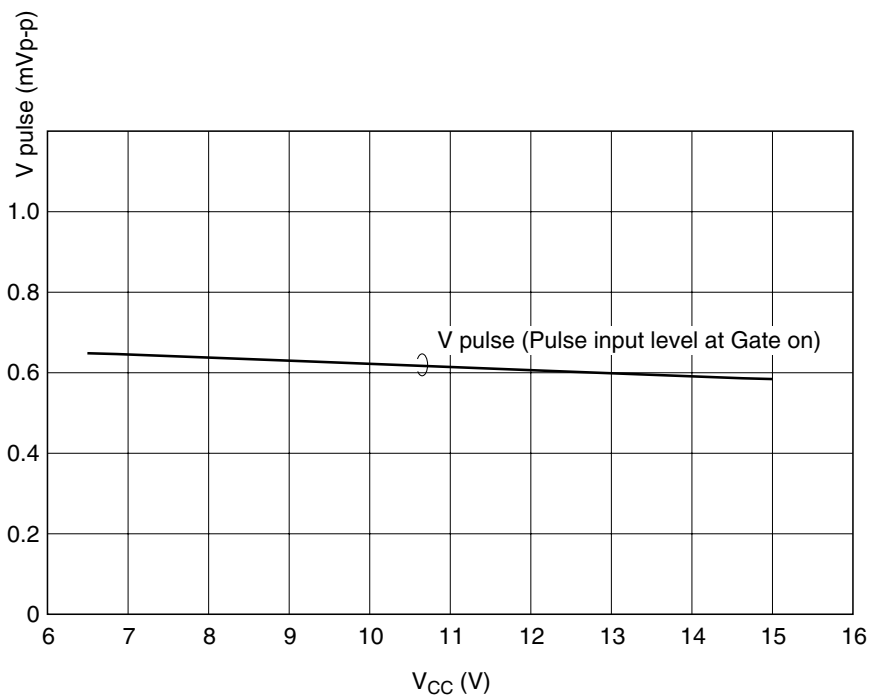
Main Characteristics

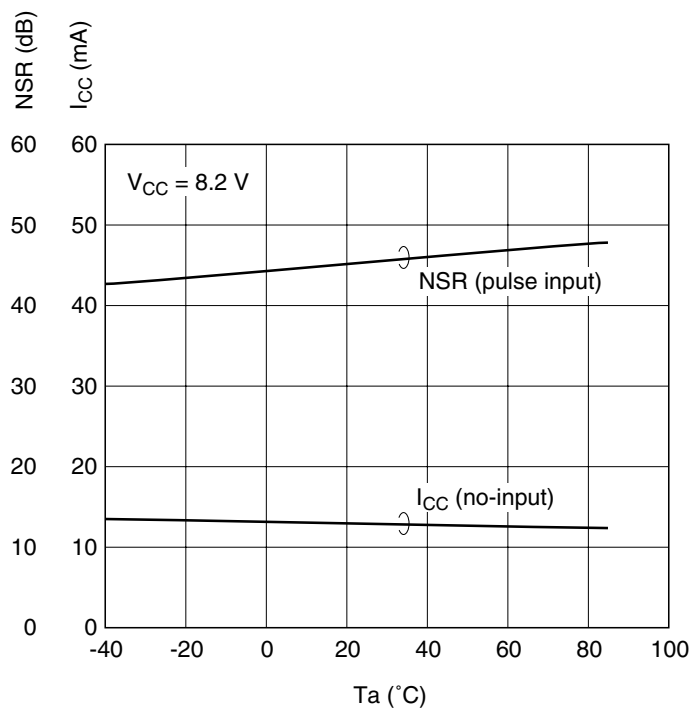








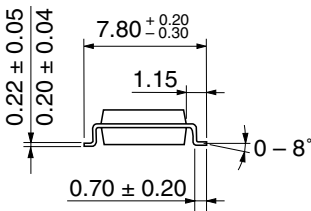
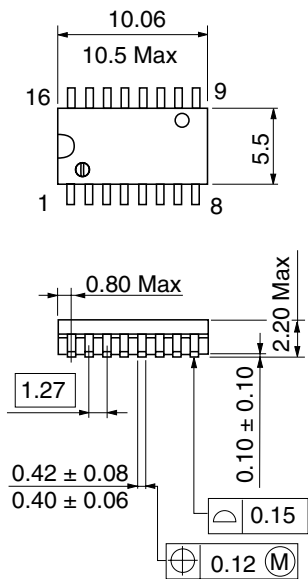




HA12181FP

Package Dimensions

Unit: mm



| | |
|--------------|------------|
| Hitachi Code | FP-16DA |
| JEDEC Code | — |
| EIAJ Code | SC-530-16C |
| Weight | 0.24 g |

Disclaimer

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

Sales Offices

HITACHI

Hitachi, Ltd.

Semiconductor & Integrated Circuits.

Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

| | | | |
|-----|--------------|---|---|
| URL | NorthAmerica | : | http://semiconductor.hitachi.com/ |
| | Europe | : | http://www.hitachi-eu.com/hel/ecg |
| | Asia | : | http://sicapac.hitachi-asia.com |
| | Japan | : | http://www.hitachi.co.jp/Sicd/indx.htm |

For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose, CA 95134
Tel: <1> (408) 433-1990
Fax: <1> (408) 433-0223

Hitachi Europe GmbH
Electronic Components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 585160

Hitachi Asia Ltd.
Hitachi Tower
16 Collyer Quay #20-00,
Singapore 049318
Tel: <65>-538-6533/538-8577
Fax: <65>-538-6933/538-3877
URL: <http://www.hitachi.com.sg>

Hitachi Asia Ltd.
(Taipei Branch Office)
4/F, No. 167, Tun Hwa North Road,
Hung-Kuo Building,
Taipei (105), Taiwan
Tel: <886>-(2)-2718-3666
Fax: <886>-(2)-2718-8180
Telex: 23222 HAS-TP
URL: <http://www.hitachi.com.tw>

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon,
Hong Kong
Tel: <852>-(2)-735-9218
Fax: <852>-(2)-730-0281
URL: <http://www.hitachi.com.hk>

Copyright © Hitachi, Ltd., 2000. All rights reserved. Printed in Japan.
Colophon 2.0