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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



## FM IF IC FOR PAGER

### ■ GENERAL DESCRIPTION

**NJM2294** is a super low current FM IF IC for pagers. It includes almost all functions of the paging IF system. In those functions, the RSSI function can be used for automatic gain control. When the electric field strength is high, the RSSI output signal can control the attenuation of an RF amplifier to improve the received condition.

### ■ PACKAGE OUTLINE



**NJM2294V**

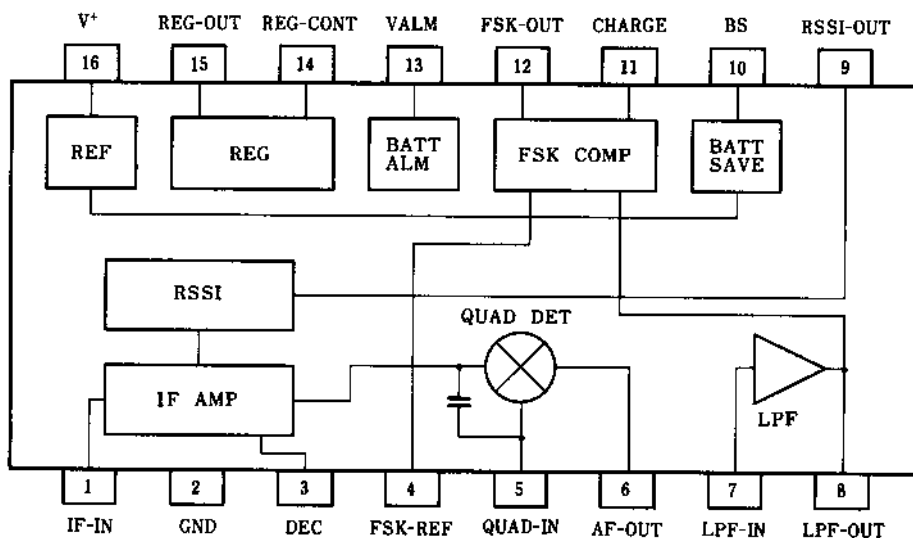
### ■ FEATURES

- Low Operating Voltage ( $V^+=1.1$  to  $4.0V$ )
- Super low Operating Current ( $600\mu A$ ,  $V^+=1.4V$ )
- RSSI (Received Signal Strength Indicator)
- FSK wave shaper
- Battery check alarm function (Alarm Voltage= $1.1V$  typ.)
- Battery saving function
- A high output current voltage regulator with an external transistor ( $V_{reg}=1.0V$  typ.)
- A ceramic discriminator is available.
- Package Outline SSOP16
- Bipolar Technology

### ■ RECOMMENDED OPERATIONAL CONDITION

- Operating Voltage  $V^+$  1.1 to  $4.0V$

### ■ PIN CONFIGURATION



**NJM2294V**

# NJM2294

## ■ ABSOLUTE MAXIMUM RATINGS

( $T_a=25^\circ\text{C}$ )

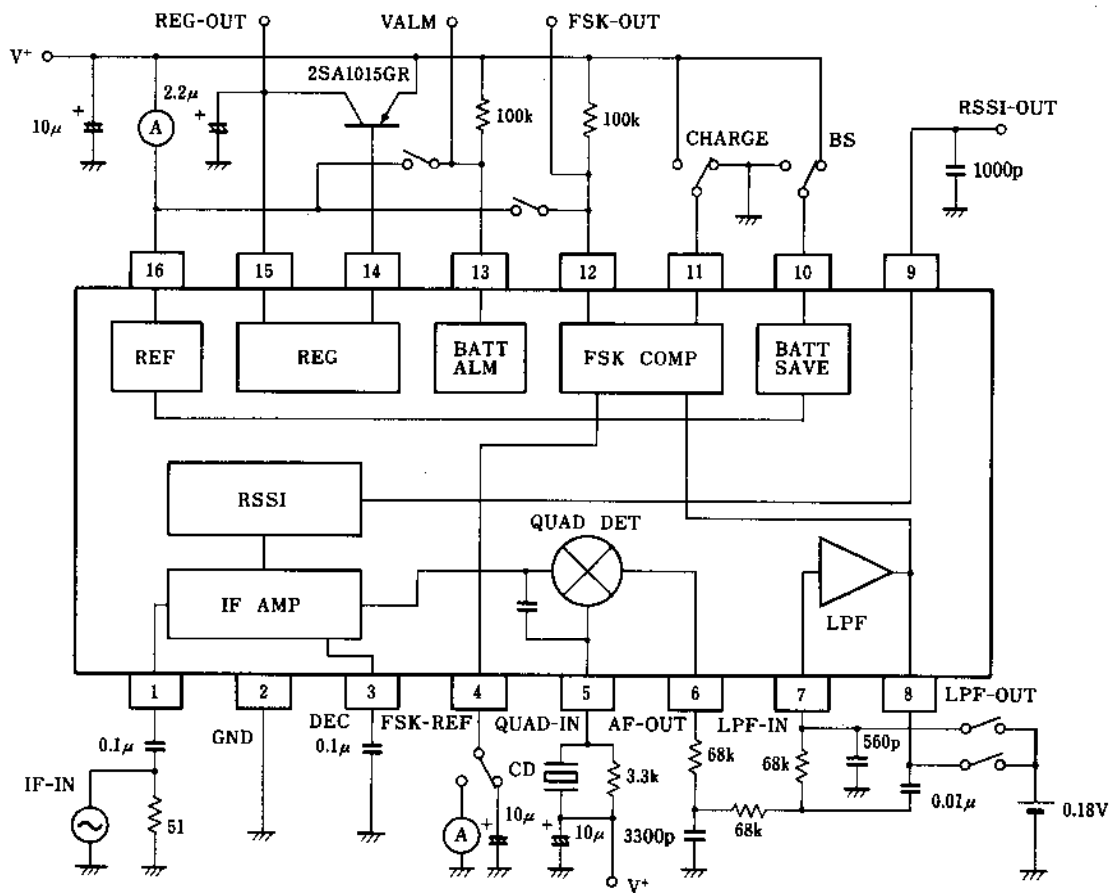
| PARAMETER                   | SYMBOL    | RATINGS     | UNIT             |
|-----------------------------|-----------|-------------|------------------|
| Supply Voltage              | $V_+$     | 5           | V                |
| Power Dissipation           | $P_D$     | 300         | mW               |
| Operating Temperature Range | $T_{opr}$ | -20 to +75  | $^\circ\text{C}$ |
| Storage Temperature Range   | $T_{stg}$ | -40 to +125 | $^\circ\text{C}$ |

## ■ ELECTRICAL CHARACTERISTICS

( $V^+=14\text{V}$ ,  $f_i=455\text{kHz}$ ,  $f_{mod}=600\text{Hz}$ ,  $f_{dev}=\pm 4\text{kHz}$ ,  $T_a=25^\circ\text{C}$ )

| PARAMETER                                     | SYMBOL               | TEST CIRCUIT | TEST CONDITION                          | MIN. | TYP. | MAX. | UNIT               |
|---|----------------------|--------------|---|------|------|------|--------------------|
| No signal Operating Current                   | $I_{CCQ}$            | 11           | $V_I=0$ , 10pin= $V^+$                  | -    | 600  | 900  | $\mu\text{A}$      |
| Battery saving Operating Current              | $I_{CCS}$            | 12           | $V_I=0$ , 10pin=GND                     | -    | 0    | 5    | $\mu\text{A}$      |
| IF amplifier input resistance                 | $R_{IN}$             | -            |   | -    | 2    | -    | k $\Omega$         |
| S / N 1                                       | S / N 1              | 1            | $V_I=60\text{dB}\mu\text{EMF}$          | -    | 62   | -    | dB                 |
| S / N 2                                       | S / N 2              | 1            | $V_I=25\text{dB}\mu\text{EMF}$          | -    | 35   | -    | dB                 |
| -3dB limiting sensitivity                     | $V_{IN}(\text{lim})$ | 1            |   | -    | 22   | 27   | dB $\mu\text{EMF}$ |
| Demodulated output level                      | $V_{OD}$             | 1            | $V_I=60\text{dB}\mu\text{EMF}$          | 30   | 46   | 65   | mVrms              |
| AM rejection ratio                            | AMR                  | 1            | $V_I=60\text{dB}\mu\text{EMF}$ , AM=30% | -    | 50   | -    | dB                 |
| Duty ratio of wave shaped output              | DR                   | 2            | $V_I=60\text{dB}\mu\text{EMF}$          | 40   | 50   | 60   | %                  |
| RSSI output voltage                           | $V_{RSSI}$           | 10           | $V_I=80\text{dB}\mu\text{EMF}$          | 0.48 | 0.62 | 0.76 | V                  |
| RSSI output resistance                        | $R_{RSSI}$           | -            |   | -    | 62   | -    | k $\Omega$         |
| Quick charge / discharge current              | $I_{ch}$             | 13           | 4pin=GND, 8pin=0.18V                    | 35   | 65   | 110  | $\mu\text{A}$      |
| Alarm voltage                                 | $V_{alm}$            | 3            |   | 1.05 | 1.10 | 1.15 | V                  |
| Regulator output voltage                      | $V_{reg}$            | 8            | $R_L=430\Omega$                         | 0.95 | 1.00 | 1.05 | V                  |
| Low level output voltage of VALM terminal     | $V_{almL}$           | 4            | $I_L=100\mu\text{A}$                    | -    | 0.1  | 0.4  | V                  |
| High level leak current of VALM terminal      | $I_{almH}$           | 5            |   | -    | 0    | 2    | $\mu\text{A}$      |
| Low level output voltage of FSK-OUT terminal  | $V_{fskL}$           | 6            | $I_L=100\mu\text{A}$                    | -    | 0.1  | 0.4  | V                  |
| High level leak current of FSK-OUT terminal   | $I_{fskH}$           | 7            |   | -    | 0    | 2    | $\mu\text{A}$      |
| Low level output voltage of REG-CONT terminal | $V_{regL}$           | 9            | $I_L=100\mu\text{A}$                    | -    | -    | 0.6  | V                  |

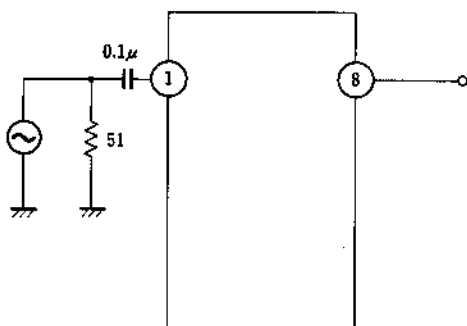
## ■ TEST CIRCUIT



C D : Ceramic Discriminator, 455kHz

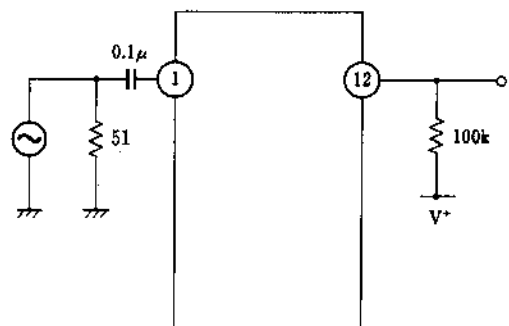
### Test Circuit 1

S/N1, S/N2,  $V_{IN}$  (lim),  $V_{OD}$ , AMR



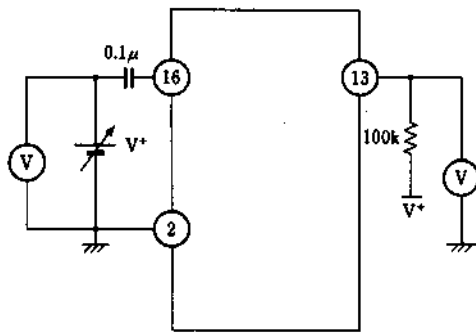
### Test Circuit 2

DR



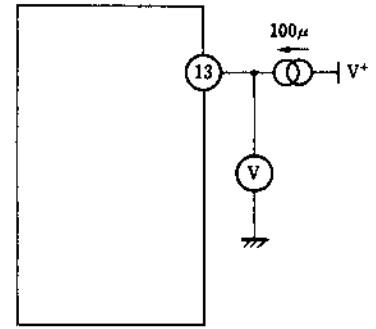
**Test Circuit 3**

Valm



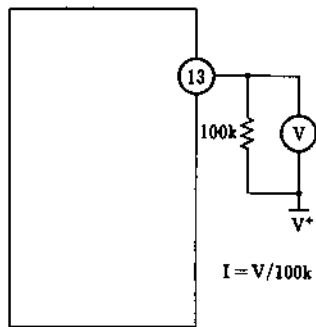
**Test Circuit 4**

ValmL



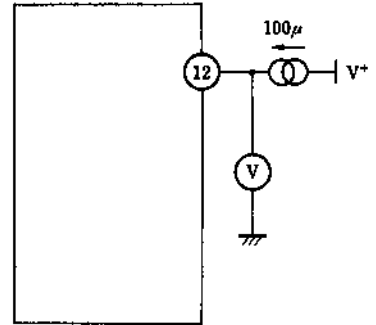
**Test Circuit 5**

IalmH



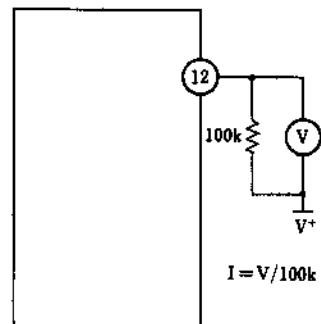
**Test Circuit 6**

VfiskL



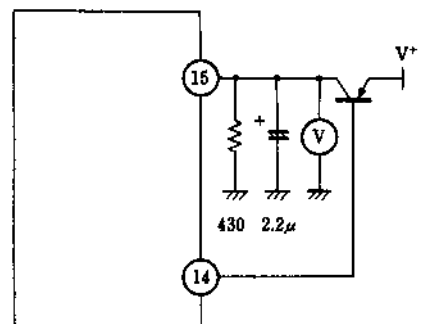
**Test Circuit 7**

IfskH



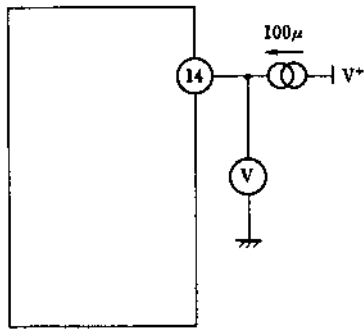
**Test Circuit 8**

Vreg



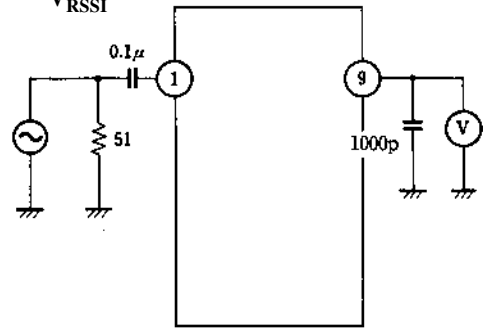
**Test Circuit 9**

$V_{regL}$



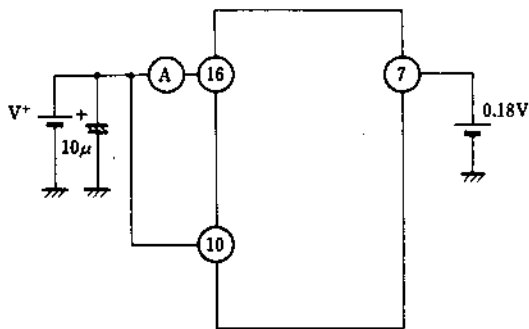
**Test Circuit 10**

$V_{RSSI}$



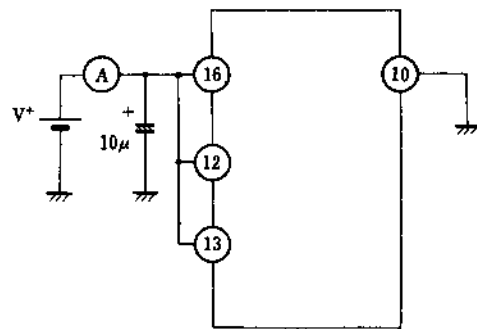
**Test Circuit 11**

$I_{ccq}$



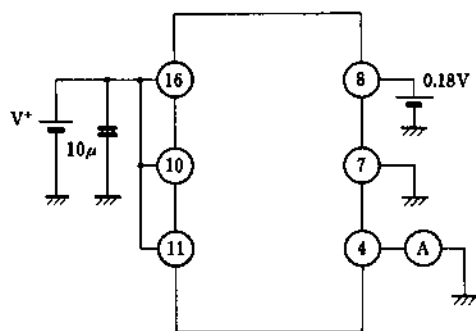
**Test Circuit 12**

$I_{ccs}$



**Test Circuit 13**

$I_{ch}$



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## ■ TERMINAL FUNCTION

| PIN NO. | SYMBOL   | FUNCTION  | EQUIVALENT CIRCUIT |
|---------|----------|---|--------------------|
| 1       | IF-IN    | An IF amplifier input.<br>Typical input impedance is 2kΩ.   |                    |
| 3       | DEC      | A Decoupling terminal which is connected with a decoupling capacitor.   |                    |
| 2       | GND      | Ground  |                    |
| 5       | QUAD-IN  | An input terminal of a quadrature detection circuit.<br>This terminal will be connect with a ceramic discriminator. |                    |
| 9       | RSSI OUT | An RSSI Output.<br>This voltage level is in logarithmic proportion to the input signal level.                       |                    |
| 6       | AF-OUT   | An FM demodulated signal output.  |                    |

## ■ TERMINAL FUNCTION

| PIN NO. | SYMBOL  | FUNCTION  | EQUIVALENT CIRCUIT |
|---------|---------|---|--------------------|
| 7       | LPF-IN  | An input terminal of a low pass filter.<br>This terminal is biased from the AF-OUT terminal (6pin) through an external RC filter. |                    |
| 8       | LPF-OUT | An output terminal of a low pass filter.  |                    |
| 4       | FSK-REF | A Reference input terminal of a wave shaping comparator.<br>This terminal is connected with an external capacitor.                |                    |
| 12      | FSK-OUT | An output terminal of a wave shaping circuit. The Wave shaped signal inverted for the LPF output comes out.                       |                    |
| 10      | BS      | A Control terminal of a battery saving circuit.<br>H : This circuit is OFF.<br>L : This circuit is ON.                            |                    |



# NJM2294

## ■ TERMINAL FUNCTION

| PIN NO. | SYMBOL   | FUNCTION   | EQUIVALENT CIRCUIT |
|---------|----------|--|--------------------|
| 11      | CHARGE   | A Control terminal of a quick charge / discharge circuit.<br>H : This circuit is ON.<br>L : This circuit is OFF. |                    |
| 13      | VALM     | An output terminal of the alarm signal.<br>When $V^+$ drops down to 1.1V, this output becomes high.              |                    |
| 14      | REG CONT | A Control terminal of an external PNP transistor used for the regulator.   |                    |
| 15      | REG-OUT  | A Monitoring terminal of the regulator.  |                    |
| 16      | $V^+$    | Supply voltage   |                    |

## ■ FSK WAVE SHAPING FUNCTION

When the demodulated FSK signal is weak or noisy, the micro computer may fail to read data.

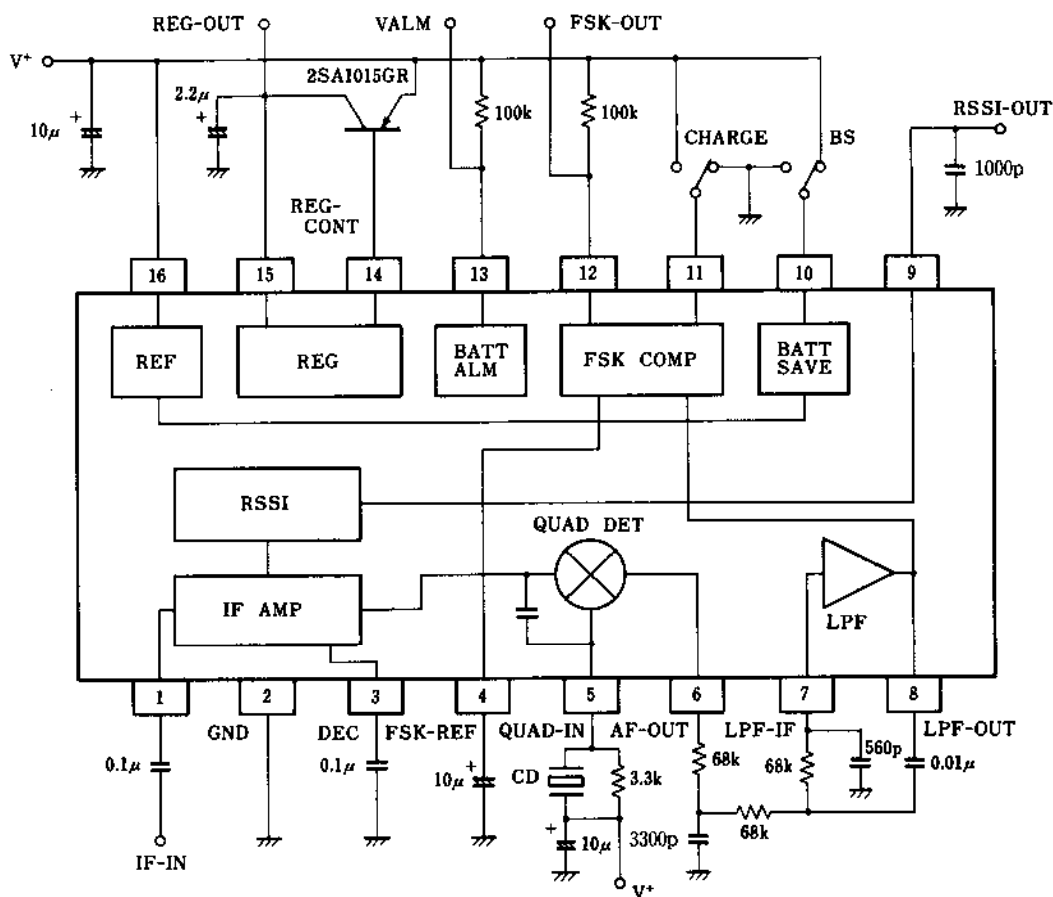
The wave shaping circuit (comparator) will change those signals to the correct logical signal to prevent the readerror.

## ■ QUICK CHARGE / DISCHARGE FUNCTION

The DC voltage of the FSK-REF terminal is equal to that of the demodulated FSK signal. When the battery saving state turns into the ordinary state, the FSK-REF terminal voltage will be late to come up to the reference voltage by the time constant of an external capacitor and an internal resistor, and the wave shaped data may be failed. This circuit will charge/ discharge the external capacitor quickly to prevent the error.

When the DC level of the FM demodulated output changes in the operation mode of this function, the FSK-REF terminal voltage follows to the FSK demodulated output DC voltage, and the FSK output duty ratio can be constant.

## ■ APPLICATION CIRCUIT



C D : Ceramic Discriminator, 455kHz

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