AN1991

Audio decibel level detector with meter driver

Rev. 2.1 — 20 March 2015 Application note

Document information

Info	Content
Keywords	SA604A, LM358, RSSI, cellular radio
Abstract	The SA604A can provide a logarithmic response proportional to the input signal level over an 80 dB range up to a 15 MHz operating frequency. This application note describes a technique that optimizes this useful function within the audio band.

Revision history

Rev	Date	Description
v.2.1	20150320	Updated Figure 1
v.2	20121029	application note; second release • The format of this application note has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • All references to “SA604” are replaced with “SA604A” • All references to “SA532” are replaced with “LM358”
v.1	19970820	first release

Contact information

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1. Introduction

Although the SA604A was designed as an RF device intended for the cellular radio market, it has features that permit other design configurations. One of these features is the Received Signal Strength Indicator (RSSI). In a cellular radio, this function is necessary for continuous monitoring of the received signal strength by the radio's microcomputer. This circuit provides a logarithmic response proportional to the input signal level. The SA604A can provide this logarithmic response over an 80 dB range up to a 15 MHz operating frequency. This application note describes a technique that optimizes this useful function within the audio band.

2. Audio level indicator circuit

A sensitive audio level indicator circuit can be constructed using two integrated circuits, the SA604A and LM358. This circuit draws very little power (less than 5 mA with a single 6 V power supply), making it ideal for portable battery operated equipment. The small size and low power consumption belie the 80 dB dynamic range and 10.5 μV sensitivity.

The RSSI function requires a DC output voltage that is proportional to the log10 of the input signal level, thus a standard 0 V to 5 V voltmeter can be linearly calibrated in decibels over a single 80 dB range. The entire circuit is composed of nine capacitors and two resistors along with the two ICs. No tuning or calibration is required in a manufacturing setting.

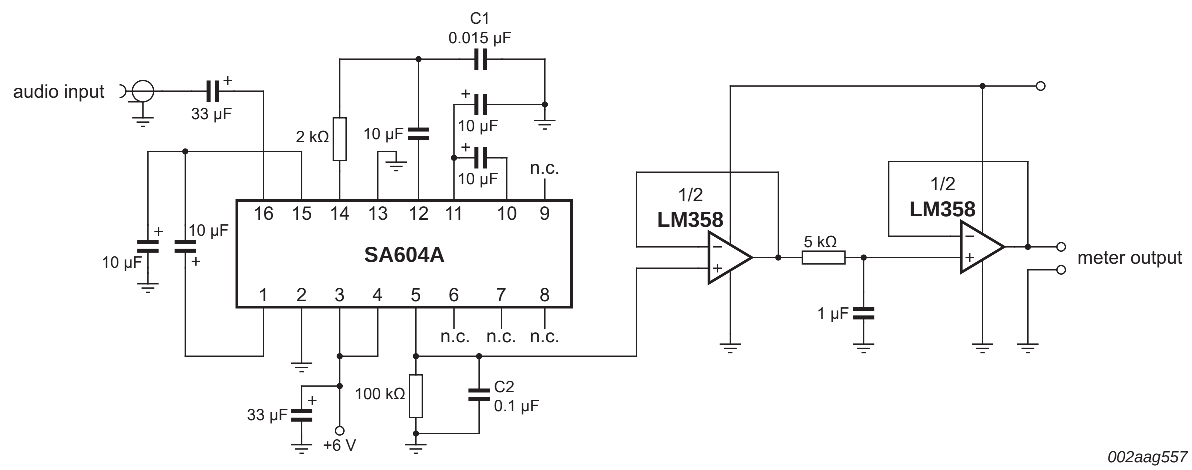
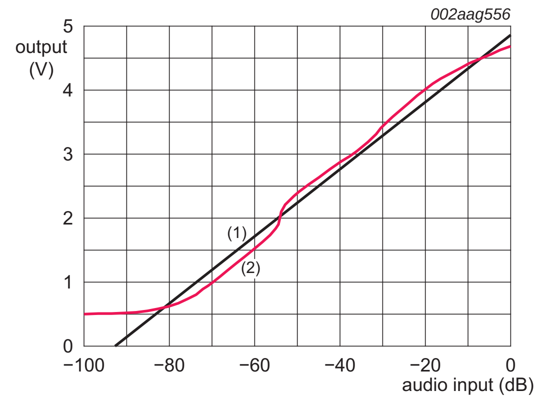


Fig 1. Audio level indicator circuit using SA604A and LM358

Figure 2 shows that the circuit is within 1.5 dB tolerance over the 80 dB range for audio frequencies from 100 Hz to 10 kHz. Higher audio levels can be measured by placing an attenuator ahead of the input capacitor. The input impedance is high (about 50 kΩ), so lower impedance terminations (50 Ω or 600 Ω) will not be affected by the input impedance. If very accurate tracking is required (<0.5 dB accuracy), a 40 dB or 50 dB segment can be ‘selected’. A range switch can then be added with appropriate attenuators if more than 40 dB or 50 dB dynamic range is required.



0 dB = 300 mV (peak-to-peak)

V_{CC} = 6 V

(1) Ideal slope.

(2) Measured slope.

Fig 2. Audio input versus output

There are two amplifier sections in the SA604A with two and three stages in the first and second sections, respectively. Each stage outputs a sample current to a summing circuit. The summing circuit has a current mirror, which appears at pin 5. This current is proportional to the log10 of the input audio signal. A voltage is dropped across the 100 kΩ resistor by the current, and a 0.1 μF capacitor is used to bypass and filter the output signal. The LM358 op amp is used as a buffer and meter driver, although a digital voltmeter could replace both the op amp and the meter shown. The rest of the capacitors are used for power supply and amplifier input bypassing.

The RC circuit between pin 14 and pin 12 forms a low-pass filter which can be adjusted by changing the value of C1. Raising the capacitance will lower the cut-off frequency and also lower the zero signal output resting voltage (about 0.6 V). Lowering the capacitance value will have the opposite effect with some reduction in dynamic range, but will raise the frequency response. The 2 kΩ resistor value provides the near-ideal interstage loss for maximum RSSI linearity. C2 can also be changed. The trade-offs here are between output damping and ripple. Most analog and digital metering methods will tend to cancel the effects of small or moderate ripple voltages through integration, but high ripple voltages should be avoided.

A second op amp is used with an optional second filter. This filter has the advantage of low impedance signal source by virtue of the first op amp. Again, a trade-off exists between meter damping and ripple attenuation. If very low ripple and low damping are both required, a more complex active low-pass filter should be constructed.

Some applications of this circuit include:

- Portable acoustic analyzer
- Microphone tester
- Audio spectrum analyzer
- VU meters
- S-meter for direct conversion radio receiver
- Audio dynamic range testers
- Audio analyzers (THD, noise, separation, response, etc.)

3. Abbreviations

Table 1. Abbreviations

Acronym	Description
IC	Integrated Circuit
RC	Resistor-Capacitor
RSSI	Received Signal Strength Indicator
THD	Total Harmonic Distortion
VU	Volume Units

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5. Contents

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