AN1996

Demodulating at 10.7 MHz IF with the SA605

Rev. 2 — 28 August 2014 **Application note**

Document information

Info	Content
Keywords	RSSI extender circuit, RSSI dynamic range, SAW filter, quadrature tank, S curve, tapped-C transform matching network.
Abstract	This application note discusses RF circuit techniques and principles that will enhance stable receiver operation. Consideration is given to PCB layout, special circuits, such as, the RSSI extender, and passive component selection. Performance data is provided for specific applications at 240 MHz and 45 MHz RF inputs.

Revision history

Rev	Date	Description
2	20140828	Application note; second release Modifications: • 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.
1	19971023	Application note; intial release

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1. Introduction

The need for high-speed communications is increasing in the market place. To meet these needs, high-performance receivers must demodulate at higher IF frequencies to accommodate for the wider deviations in FM systems.

The standard 455 kHz IF frequency, which is easier to work with, and thus more forgiving in production, no longer satisfies the high-speed communication market. The next higher standard IF frequency is 10.7 MHz. This frequency offers more potential bandwidth than 455 kHz, allowing for faster communications.

Since the wavelength at 10.7 MHz is much smaller than 455 kHz, the demand for a good RF layout and good RF techniques increases. These demands aid in preventing regeneration from occurring in the IF section of the receiver. This application note will discuss some of the RF techniques used to obtain a stable receiver and reveal the excellent performance achieved in the lab.

1.1 Background

If a designer is working with the SA605 for the first time, it is highly recommended that *AN1994* (Ref. 2) and *AN1995* (Ref. 3) be read. These two application notes discuss the SA605 in great detail and provide a good starting point in designing with the chip.

Before starting a design, it is also important to choose the correct part. NXP offers an extensive receiver line to meet the growing demands of the wireless market. Table 1 displays the different types of receivers and their key features. With the aid of this chart, a designer will get a good idea for choosing a chip that best fits their design needs.

If low-voltage receiver parts are required in a design, a designer can choose between SA606 or SA636. These low-voltage receivers are designed to operate at 3 V while still providing high performance to meet the specifications for cellular radio. All of these parts can operate with an IF frequency as high as 2 MHz. However, the SA636 can operate with a standard IF frequency of 10.7 MHz and also provide fast RSSI speed. Additionally the SA636 has a Power-down mode to conserve battery power.

Table 1. FM/IF family overview

Specification	SA602A	SA604A	SA605	SA606	SA636
V_{CC}	4.5 V to 8 V	4.5 V to 8 V	4.5 V to 8 V	2.7 V to 7 V	2.7 V to 5.5 V
I_{CC}	2.4 mA at 6 V	3.3 mA at 6 V	5.7 mA at 6 V	3.5 mA at 3 V	6.5 mA at 3 V
Number of pins	8	16	20	20	20
Packages	SA602AD/01: SO8	SA604AD/01: SO16	SA605D/01: SO20 SA605DK/01: SSOP20	SA606DK/01: SSOP20 SA606DK/02: SSOP20 SA606DK/03: SSOP20	SA636BS: HVQFN20 SA636DK/01: SSOP20
−12 dB SINAD (RF = 45 MHz; IF = 455 kHz); 1 kHz tone; 8 kHz deviation	−120 dBm / 0.22 μV	−120 dBm / 0.22 μV	−120 dBm / 0.22 μV	−117 dBm / 0.31 μV	−112 dBm / 0.54 μV (RF = 240 MHz; IF = 10.7 MHz) 1 kHz tone; ±70 kHz deviation
Process f_t	8 GHz	8 GHz	8 GHz	8 GHz	8 GHz
For lower-cost version and less performance	SA612A	SA614A	SA615	SA616	-
Features	• Audio and data pins • IF bandwidth of 25 MHz • No external matching required for standard 455 kHz IF filter	• Audio and data pins • IF bandwidth of 25 MHz • No external matching required for standard 455 kHz IF filter	• Audio and data pins • IF bandwidth of 25 MHz • No external matching required for standard 455 kHz IF filter	• Low-voltage • Internal RSSI and audio op amps • No external matching required for standard 455 kHz IF filter • IF bandwidth of 2 MHz	• Power-down mode • Low-voltage • Fast RSSI time • IF bandwidth of 25 MHz • Internal RSSI and audio op amps • No external matching required for standard 10.7 MHz IF filter
RSSI output section					
Dynamic range	90 dB	90 dB	90 dB	90 dB	90 dB
Accuracy	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB
455 kHz IF					
Rise time[1]	-	1.4 μs	-	-	-
Fall time[1]	-	21.3 μs	-	-	-
10.7 MHz IF					
Rise time[1]	-	1.5 μs	-	-	1.2 μs
Fall time[1]	-	19.4 μs	-	-	2 μs

Table 1. FM/IF family overview *…continued*

Specification	SA602A	SA604A	SA605	SA606	SA636
Mixer					
Max. conversion power gain (RF = 45 MHz; IF = 455 kHz)	17 dB	-	13 dB	17 dB	13 dB
3rd-order intercept point (input) f1 = 45 MHz; f2 = 45.06 MHz	–13 dB	-	–10 dBm	–9 dBm	–11 dBm (f1 = 240.05 MHz; f2 = 240.35 MHz)
Noise Figure at 45 MHz	5 dB	-	5 dB	6.2 dB	11 dB at 240 MHz
RF input resistance and capacitance at 45 MHz	1.5 kΩ 3 pF	-	4.7 kΩ 3.5 pF	8 kΩ 3 pF	4.7 kΩ 3.5 pF at 240 MHz
Output resistance	1.5 kΩ	-	1.5 kΩ	1.5 kΩ	330 Ω
IF Section					
Total IF gain	-	100 dB	100 dB	100 dB	96 dB (includes –6 dB pad)
Total IF bandwidth	-	25 MHz	25 MHz	2 MHz	25 MHz
IF amplifier					
Input impedance	-	1.6 kΩ	1.6 kΩ	1.5 kΩ	330 Ω
Output impedance	-	1.0 kΩ	1.0 kΩ	330 Ω	330 Ω
Gain	-	40 dB	40 dB	44 dB	44 dB
Bandwidth	-	41 MHz	41 MHz	5.5 MHz	40 MHz
IF limiter					
Input impedance	-	1.6 kΩ	1.6 kΩ	1.5 kΩ	330 Ω
Output impedance[1]	-	330 Ω	330 Ω	330 Ω	330 Ω
Gain	-	60 dB	60 dB	58 dB	58 dB
Bandwidth	-	28 MHz	28 MHz	4.5 MHz	28 MHz

[1] No IF filters in the circuit.

1.2 Objective

The objective of this application note is to show that the SA605 can perform well at an IF frequency of 10.7 MHz. Since most NXP Semiconductors receiver demoboards are characterized at RF = 45 MHz/IF = 455 kHz, we decided to continue to characterize at this frequency. This way we could compare how much degradation (for different IFs) there was with a RF = 45 MHz/IF = 455 kHz versus RF = 45 MHz/ IF = 10.7 MHz. As we will discuss later, there was minimal degradation in performance.

We also tested at RF = 240 MHz/IF = 10.7 MHz. The 240 MHz RF is sometimes referred to as the first IF for double conversion receivers. Testing the board at RF = 83.16 MHz (which is also a common first IF for analog cellular radio) and IF = 10.7 MHz was not done because the conversion gain and noise figure does not change that much compared to 45 MHz input. Therefore, we can expect the same type of performance at 83.16 MHz.

The RF = 240 MHz/IF = 10.7 MHz demoboard is expected to perform less than the RF = 45 MHz/IF = 10.7 MHz demoboard because the mixer conversion gain decreases while the noise figure increases. These two parameters will decrease the performance of the receiver as the RF frequency increases.

For systems requiring low voltage operation, IF = 10.7 MHz and fast RSSI speed, the SA636 will be the correct choice.

2. Board setup and performance graphs

Figure 1 and Figure 2 show the SA605 schematics for the 240 MHz and 45 MHz boards, respectively.

Table 2 lists the basic functions of each external component for both Figure 1 and Figure 2.

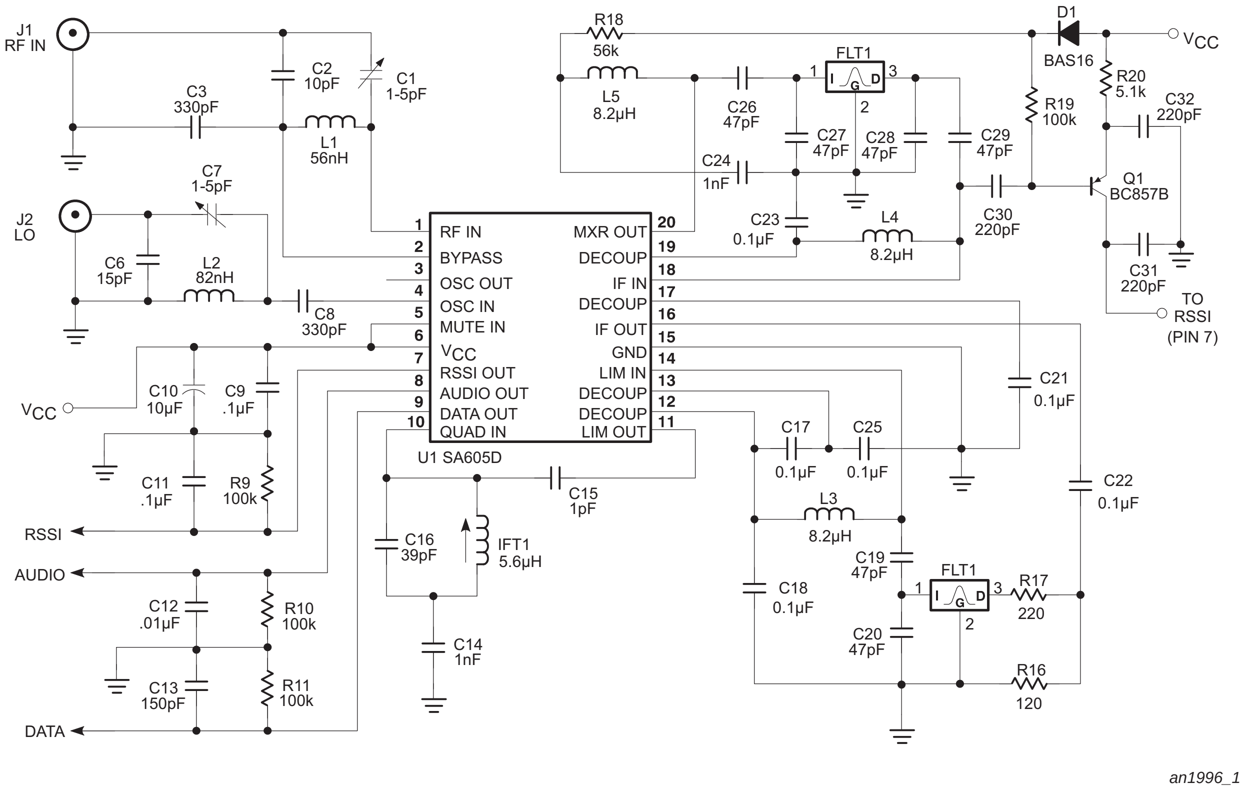

Fig 1. SA605 schematic: RF = 240 MHz, LO = 229.3 MHz, IF = 10.7 MHz

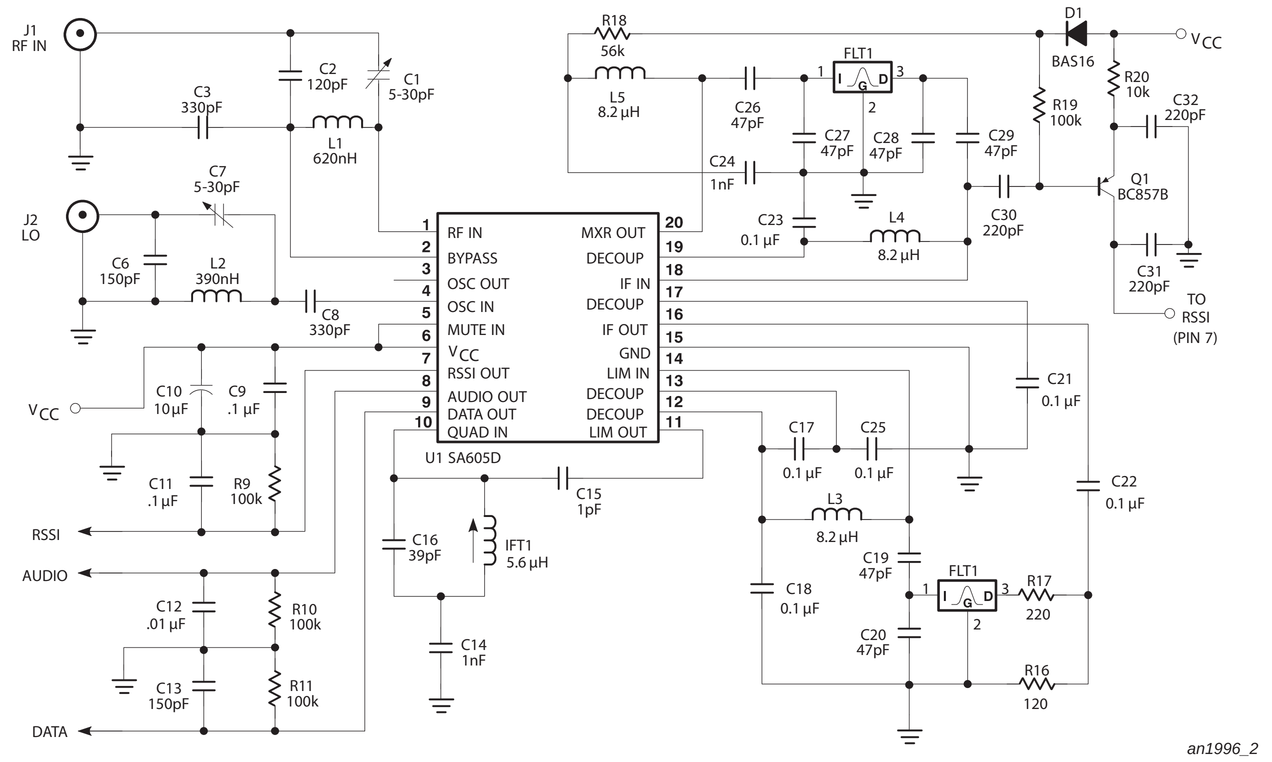

Fig 2. SA605 schematic: RF = 45 MHz, LO = 55.7 MHz, IF = 10.7 MHz

Table 2. SO layout schematic component list

Component	Description
U1	SA605D/01
FLT1	10.7 MHz ceramic filter Murata SFE10.7MA5-A (280 kHz bandwidth)[1]
FLT2	10.7 MHz ceramic filter Murata SFE10.7MA5-A (280 kHz bandwidth)[1]
C1	part of the tapped-C network to match the front-end mixer
C2	part of the tapped-C network to match the front-end mixer
C3	used as an AC short to Pin 2 and to provide a DC block for L1, which prevents the upsetting of the DC biasing on Pin 1
C6	part of the tapped-C network to match the LO input
C7	part of the tapped-C network to match the LO input
C8	DC blocking capacitor
C9	supply bypassing
C10	supply bypassing (this value can be reduced if the SA605 is used with a battery)
C11	used as a filter, cap value can be adjusted when higher RSSI speed is preferred over lower RSSI ripple
C12	used as a filter
C13	used as a filter
C14	used to AC ground the quad tank
C15	used to provide the 90° phase shift to the phase detector
C16	quad tank component to resonant at 10.7 MHz with IFT1 and C15

Table 2. SO layout schematic component list *…continued*

Component	Description
C17	IF limiter decoupling capacitor
C18	DC block for L3 which prevents the upsetting of the DC biasing on Pin 14
C19	part of the tapped-C network for FLT2
C20	part of the tapped-C network for FLT2
C21	IF amplifier decoupling capacitor
C22	DC blocking capacitor
C23	IF amplifier decoupling capacitor and DC block for L3 which prevents the upsetting of the DC biasing on Pin 14
C24	provides DC block for L5 which prevents the upsetting of the DC biasing on Pin 20
C25	IF limiter decoupling capacitor
C26	part of the tapped-C network for FLT1
C27	part of the tapped-C network for FLT1
C28	part of the tapped-C network for FLT1
C29	part of the tapped-C network for FLT1
R9	used to convert the current into the RSSI voltage
R10	converts the audio current to a voltage
R11	converts the data current to a voltage
R16	used to kill some of the IF signal for stability purposes
R17	used in conjunction with R16 for a matching network for FLT2
L1	part of the tapped-C network to match the front-end mixer
L2	part of the tapped-C network to match the front-end mixer
L3	part of the tapped-C network to match the input of FLT2
L4	part of the tapped-C network to match the input of FLT1
L5	part of the tapped-C network to match the input of FLT1
RSSI extender circuit	
R18	provides bias regulation, the gain will stay constant over varying V_{CC}
R19	for biasing, buffer RF DC voltage
R20	provides the DC bias, RSSI gain (when R20 increases, RSSI gain decreases)
C30	DC blocking capacitor which connects the ceramic filter's output to the PNP transistor's input
C31	decoupling capacitor, and should be removed for measuring RSSI systems speed
C32	peak detector charge capacitor
D1	diode to stabilize the bias current
Q1	NXP BC857B PNP transistor
IFT1	part of the quad tank circuit

[1] If a designer wants to use different IF bandwidth filters than the ones used in this application note, the quad tank's S-curve may need to be adjusted to accommodate the new bandwidth.

There are minor differences between Figure 1 and Figure 2. The RF and LO tapped-C component values are changed to accommodate for the different RF and LO test frequencies (RF = 240 MHz and 45 MHz and LO = 229.3 MHz and 55.7 MHz). The other difference is the value of R20. This resistor value was changed to optimize the RSSI curve's linearity (see RSSI extender section in this application note for further details).

The recommended SA605 layout is shown in Figure 3. This layout can be integrated with other systems.

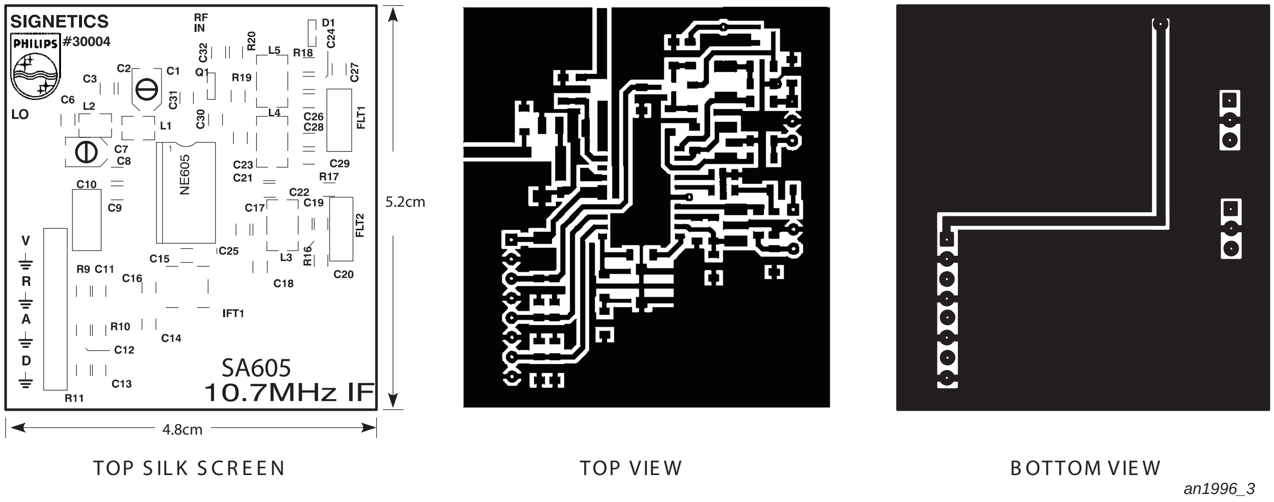

Fig 3. SA605 SO demoboard layouts (not actual size)

Figure 4 and Figure 5 show the performance graphs for the SA605 at 240 MHz and 45 MHz RF inputs.

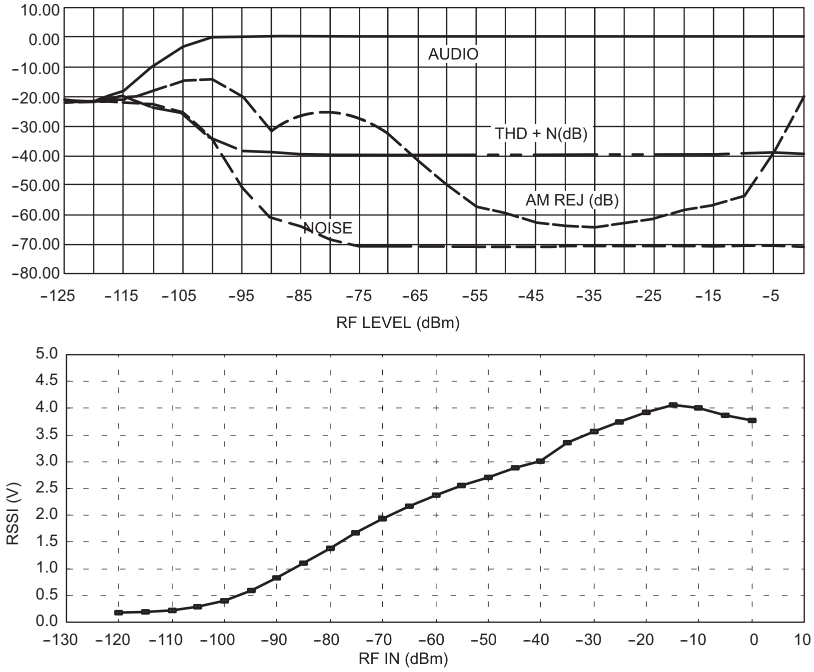

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Fig 4. SA605 SO performance graphs at 240 MHz

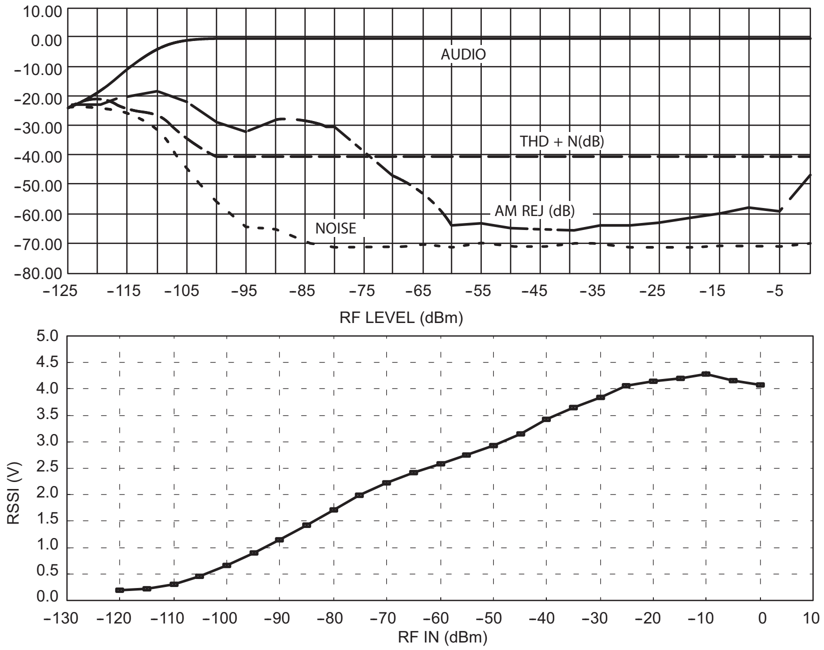

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Fig 5. SA605 SO performance graphs at 45 MHz

3. RF input

The SA605 board is set up to receive an RF input of 240 MHz (see Figure 1). This is achieved by implementing a tapped-C network. The deviation should be set to ±70 kHz to achieve –110 dBm to –112 dBm for –12 dB SINAD. However, the deviation can be increased to ±100 kHz, depending on the bandwidth of the IF filter and the Q of the quad tank.

Because we wanted to test the board at 45 MHz, we changed the values of the tapped-C network for the RF and LO ports (see Figure 2). We found that a –116 dBm to –118 dBm for –12 dB SINAD could be achieved. With these results, we were pretty close to achieving performance similar to our standard 455 kHz IF board.

A designer can also make similar RF and LO component changes if he/she needs to evaluate the board at a different RF frequency. **It should be noted that if a designer purchases a stuffed SA605 demoboard from NXP Semiconductors, its setup will be for an RF input frequency of 240 MHz.** *AN1994* will aid the designer in calculating the tapped-C values for other desired frequencies, while *AN1995* will be of value for making S11 bench measurements. Just remember that the input impedance will differ for different RF frequencies.

4. LO input

The LO frequency should be 229.3 MHz for the RF = 240 MHz demoboard and have a drive level of –10 dBm to 0 dBm (this also applies for the RF = 45 MHz and LO = 55.7 MHz). The drive level is important to achieve maximum conversion gain. The LO input also has a matched tapped-C network for efficiency purposes which makes for good RF practices.

If a designer wanted to change the matching network to inject a different LO frequency, he/she could follow the steps in *AN1994* and assume that the input impedance is around 10 kΩ for low frequency inputs. The main goal is to get maximum voltage transfer from the signal generator to the inductor.

An external oscillator circuit was used to provide greater flexibility in choosing different RF and LO frequencies; however, an on-board oscillator can be used with the SA605. New high frequency fundamental crystals, now entering the market, can also be used for high LO frequency requirements. Most receiver systems, however, will use a synthesizer to drive the LO port.

5. 10.7 MHz ceramic filters

The input and output impedance of the 10.7 MHz ceramic IF filters are 330 Ω. The SA605 input and output impedances are roughly 1.5 kΩ. Therefore, a matching circuit had to be implemented to obtain maximum voltage transfer. Tapped-C networks were used to match the filters input and output impedance. But in this case, we decided to go with non-tuning elements to reduce set-up time. Figure 6 shows the values chosen for the network.

Although our total deviation is 140 kHz, we used 280 kHz IF bandwidth filters to maximize for fast RSSI speed. The SINAD performance difference between using 180 kHz bandwidth filter versus 280 kHz band shaping filter was insignificant.

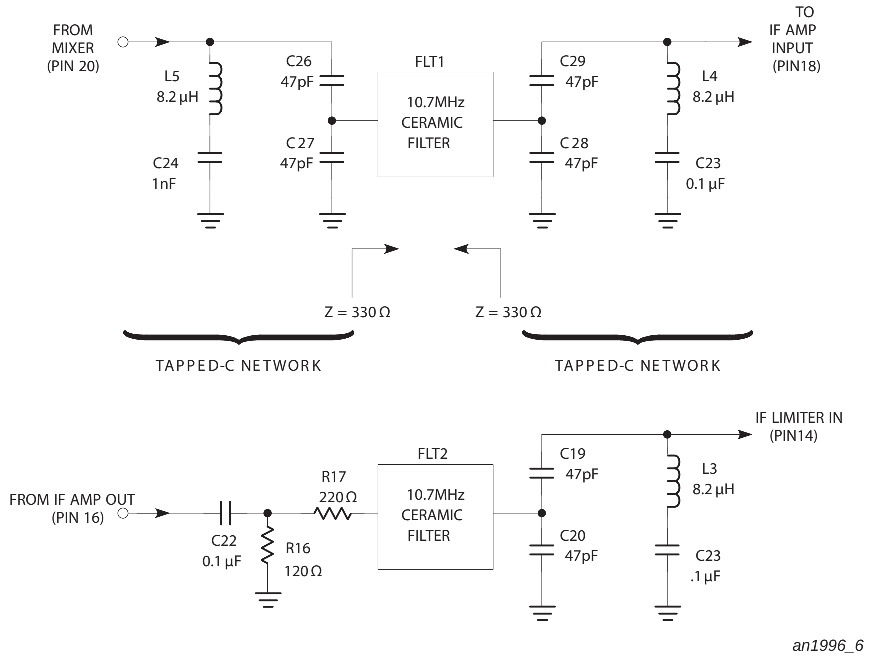


Fig 6. Matching configuration for FLT1 and FLT2

6. Stabilizing the IF section from regeneration

Because the gain in the IF section is 100 dB and the wavelength for 10.7 MHz is small, the hardest design phase of this project was to stabilize the IF section.

The steps below show the methods used to obtain a stable layout.

1. The total IF section (IF amp and limiter) gain is 100 dB, which makes it difficult to stabilize the chip at 10.7 MHz. Therefore, a 120 Ω resistor (R16 of Figure 1) was used to kill some of the IF gain to obtain a stable system.

   Remark: Expect AM rejection performance to degrade as you decrease the IF gain externally.
2. Since the tapped-C inductors for FLT1 and FLT2 are not shielded, it is important not to place them too close to one another. Magnetic coupling will occur and may increase the probability of regeneration.
3. It was also found that if the IF limiter bypass capacitors do not have the same physical ground, the stability worsens. Referring to Figure 1, the IF limiter bypass capacitors (C17, C25) are connected to assure a common ground.
4. The positioning of ground feedthroughs are vital. A designer should put feedthroughs near the IF bypass capacitors ground points. In addition, feedthroughs are needed underneath the chip. Other strategic locations are important for feedthroughs where insufficient grounding occurs.
5. Shielding should be used after the best possible stability is achieved. The SA605 demoboard is stable, so shielding was not used. However, if put into a bigger system, shielding should be used to keep out unwanted RF frequencies. As a special note, if a good shield is used, it can increase the R16 resistor value such that there is less IF gain to kill to achieve stability. This means the RSSI dynamic range is improved. So if a designer does not want to implement the RSSI extender circuit, but is still concerned with SINAD and RSSI range, he/she can experiment with R16 and shielding because there is a correlation between them (see RSSI extender section in this application note for more information). In addition, AM rejection performance will improve due to the greater availability of the total IF gain.

The key to stabilizing the IF section is to kill the gain. This was done with a resistor (R16 in Figure 6) to ground. All the other methods mentioned above are secondary compared to this step. Lowering the value of this resistor reduces the gain and the increasing resistor value kills less gain. For our particular layout, 120 Ω was chosen to obtain a stable board, but we were careful not to kill too much gain. One of the downfalls of killing too much gain is that the SINAD reading will become worse and the RSSI dynamic range is reduced.

7. RSSI dynamic range

There are two main factors which determine the RSSI dynamic range:

- How stable is the board?
- How much gain is killed externally?

If the board is unstable, a high RSSI voltage reading will occur at the bottom end of the curve. If too much gain is taken away, the upper half of the curve is flattened. Thus the dynamic range can be affected. Figure 7 shows how the linear range can be decreased under the conditions mentioned above.

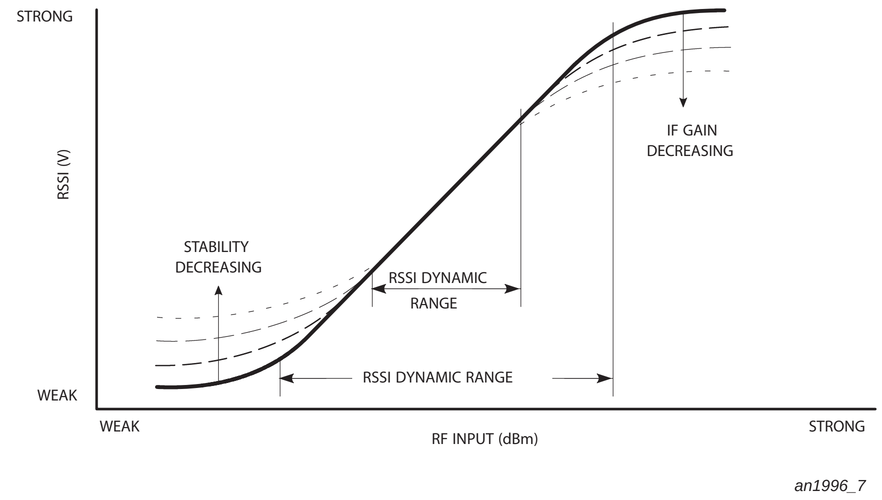


Fig 7. RSSI dynamic range

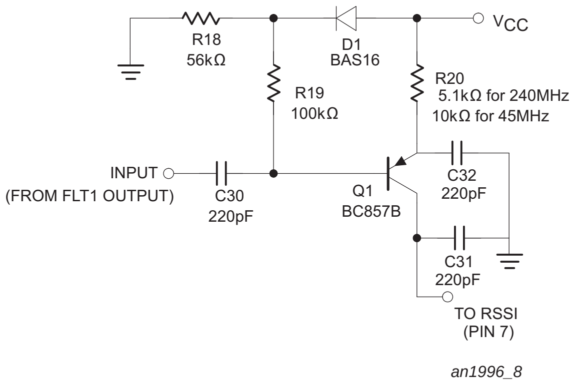
It is important to choose the appropriate resistor to kill enough gain to get stability but not too much gain to affect the upper RSSI curve dynamic range. Because we had to kill some IF gain to achieve good board stability and good SINAD readings, our RSSI overall dynamic range was reduced on the upper end of the curve.

Because SINAD and the RSSI dynamic range are two important parameters for most of our customers, we decided to add an ‘RSSI extender’ modification to the board to get the best of both worlds. Together with the RSSI external modification and the ‘stability resistor’, we can now achieve excellent SINAD readings and maintain a wide RSSI dynamic range.

8. RSSI extender circuit

The RSSI extender circuit increases the upper dynamic range roughly about 20 dB to 30 dB for the 240 MHz demoboard. The SA605 demoboard has 90 dB to 100 dB of linear dynamic range when the RSSI modification is used.

Referring to Figure 8, one can see that one transistor is used with a few external components. The IF input signal to the PNP transistor is tapped after the ceramic filter to ensure a clean IF signal. The circuit then senses the strength of the signal and converts it to current, which is then summed together with the RSSI output of the chip.



R18 — provides bias regulation, the gain will stay constant over varying V_{CC}

R19 — for biasing, buffer RF DC voltage

R20 — provides the DC bias, RSSI gain (when R20 increases, RSSI gain decreases)

C30 — DC blocking capacitor that connects the ceramic filter's output to the PNP transistor's input

C31 — decoupling capacitor

C32 — peak detector charge capacitor

D1 — diode to prevent improper current flow

Q1 — NXP BC857B PNP transistor

Fig 8. External RSSI extender circuit

The PNP transistor stage has to be biased as a class B amplifier. The circuit provides two functions. It is a DC amplifier and an RF detector. The gain of the RSSI extender can be controlled by R20 and R9 (Gain = R9 / R20). Adjusting R20 is preferable because it controls the upper half of the RSSI curve, whereas adjusting R9 shifts the whole RSSI curve.

If a different RF frequency is supplied to the mixer input, it is important to set the external RSSI gain accordingly. When the RF input was changed from 240 MHz to 45 MHz, the conversion gain of the mixer increased. Therefore, the earlier gain settings for the RSSI extender was too much. A lower gain setting had to be implemented such that a smoother transition would occur.

9. Quad tank

The quad tank is tuned for 10.7 MHz ($f = 1/2\pi\sqrt{LC}$). Figure 1 shows the values used (C14,C15, C16, IFT1) and Figure 9 shows the S-curve. The linear portion of the S-curve is roughly 200 kHz. Therefore, it is a good circuit for a total deviation of 140 kHz. It is possible to deviate at 200 kHz, but this does not leave much room for part tolerances.

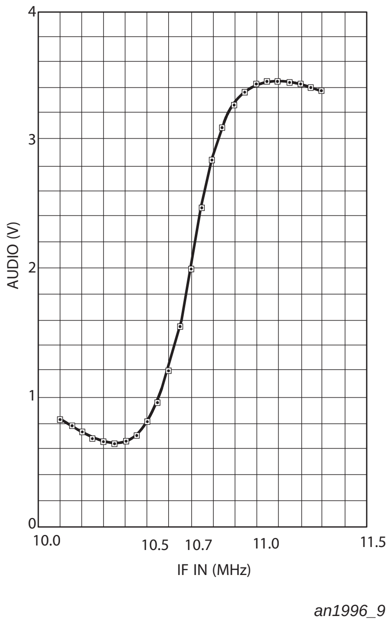


Fig 9. 10.7 MHz quad tank S-curve

If more deviation is needed, a designer can lower the S-curve with a parallel resistor connected to the quadrature tank. A designer should play with different value resistors and plot the S-curve to pick the best value for the design. To key in on the resistor value with minimum effort, a designer can put a potentiometer in parallel with the quad tank and tune it for best distortion. Then the designer can use fixed value resistors that are close to the potentiometer's value.

Fixed quad tank component values can be used to eliminate tuning, but a designer must allow for part tolerances and temperature considerations. For better performance over temperature, a resonator/discriminator can be used. Thus, no tuning is required for the quad tank section, which will save on production costs.

10. RSSI system speed

The RSSI rise and fall times are important in applications that use pulsed RF in their design. The way we define the speed is how fast the RSSI voltage can travel up and down the RSSI curve. Figure 10 shows a representation of this. Five different pulsed RF levels were tested to get a good representation of the RSSI speed. One can predict that the stronger the pulsed signal, the higher the RSSI voltage and the longer it will take for the fall time to occur. Generally speaking, the rise time is determined by how long it takes to charge up an internal capacitor. The fall time depends on how long it takes to discharge this capacitor.

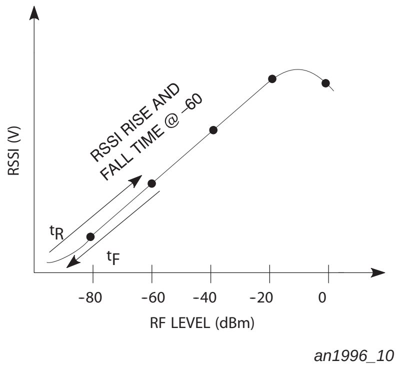


Fig 10. RSSI curve with pulsed RF levels

It is also important to understand that there are two types of RSSI speeds. The first type is the RSSI **chip** speed and the second is the RSSI **system** speed. The RSSI **chip** speed will be faster than the **system** speed. The bandwidth of the external filters and other external parts can slow down the RSSI system speed dramatically.

Figure 11 shows the bench setup for the RSSI system speed measurements. The pulsed RF was set for 10 kHz and the RSSI output was monitored with a digital oscilloscope. Figure 12 shows how the rise and fall times were measured on the oscilloscope.

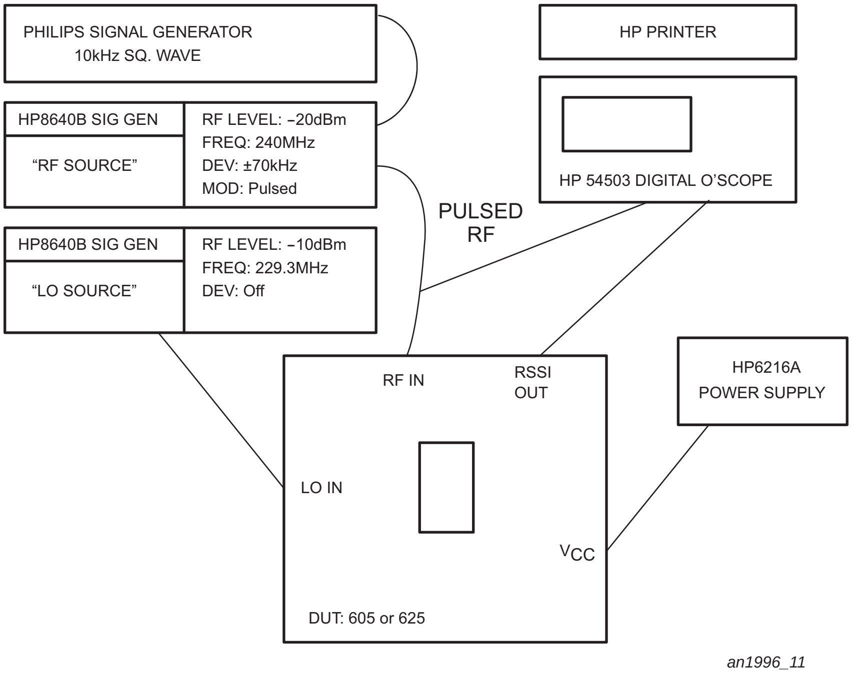


Fig 11. RSSI speed setup

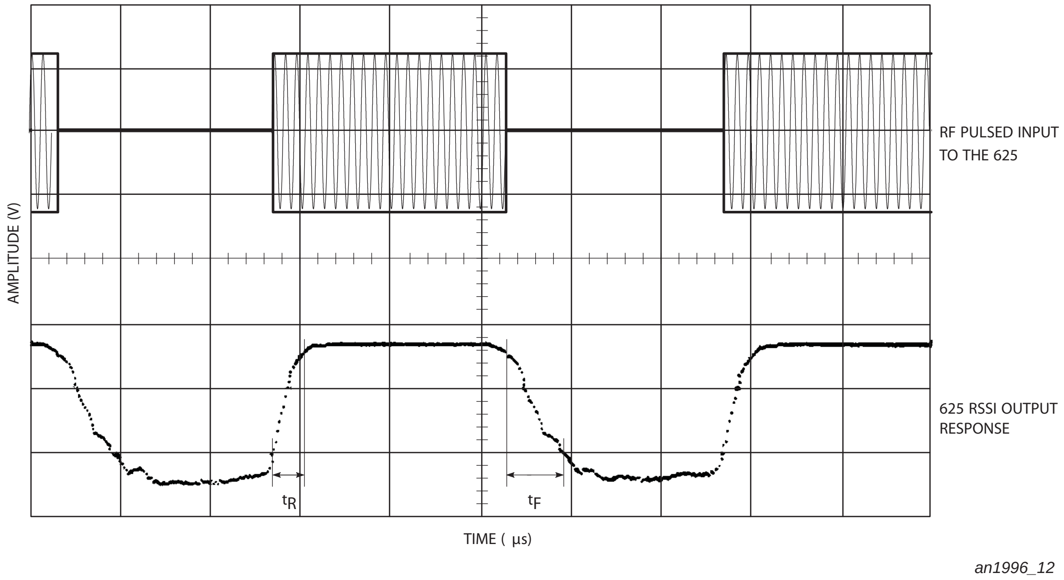


Fig 12. Oscilloscope display of RSSI system rise and fall times

The modifications done on the SA605 board are shown in Figure 13. The RSSI caps C11 and C31 were eliminated, and the RSSI resistor values were changed. We wanted to see how much time was saved by using a smaller RSSI resistor value.

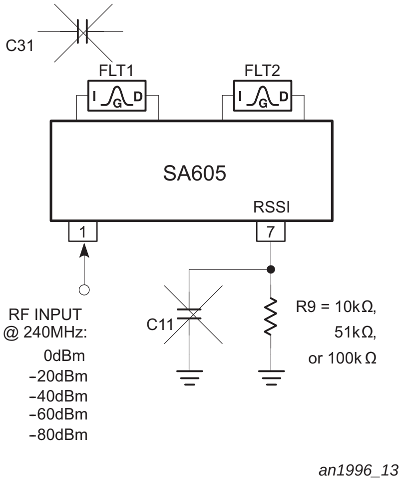


Fig 13. SA605 RSSI test circuit configuration

The RSSI system speed for the 240 MHz SA605 demo board is shown in Figure 14. Again, the only modification was that the RSSI caps (C11 and C31) were taken out and the RSSI resistor value (R9) was varied. For different RF levels, the speed seems to vary slightly, but this is expected. The higher the RSSI voltage, the longer it will take to come back down the RSSI curve for the fall time.

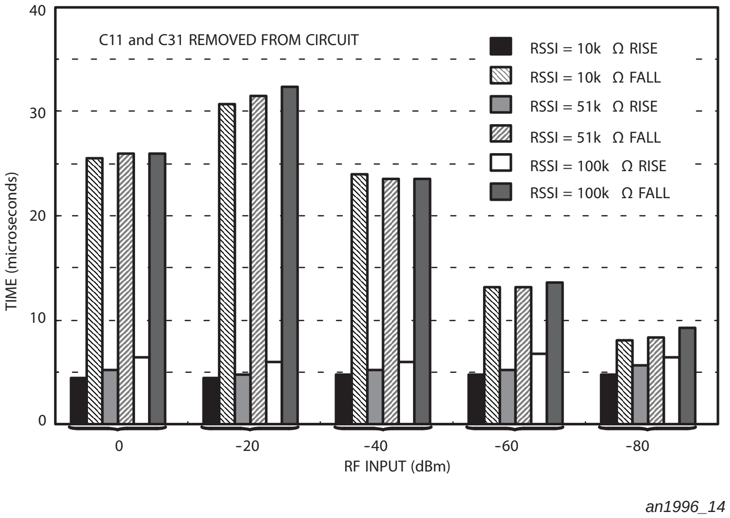


Fig 14. RSSI systems rise and fall time with different RSSI resistor values

Looking more closely at Figure 14, one can note that the 0 dBm input level has a faster fall time than the –20 dBm level. This occurs because of the limited dynamic range of the test equipment. The equipment does not have sufficient on/off range, so at 0 dBm the 'off' mode is actually still on. Therefore, you do not get a true reading.

At 0 dBm the RSSI voltage is lower than –20 dBm. The reason why this happens is because the RSSI linearity range stops at –10 dBm. When the RF input drive is too high (for example, 0 dBm), the mixer conversion gain decreases, which causes the RSSI voltage to drop.

11. Questions and answers

Question: What should the audio level at Pin 8 be?

Answer: The audio level is at 580 mV (peak-to-peak) looking directly at the audio output pin and does not include a C-message filter. However, the audio output level will depend on two factors: the ‘Q’ of the quadrature tank and the deviation used. The higher the quad tank’s ‘Q’, the larger the audio level. Additionally, the more deviation applied, the larger the audio output. But the audio output will be limited to a certain point.

Question: Am I required to use the 10 μF supply capacitor?

Answer: No, a smaller value can be used. The 10 μF capacitor is a suggested value for evaluation purposes. Most of the time a power supply is used to evaluate our demo boards. If the supply is noisy, it will degrade the receiver performance. We have found that a lower value capacitor can be used when the receiver is powered by a battery. But it is probably safer to stay at a reasonable capacitor size.

Question: Can I use different IF filters for my required bandwidth specifications?

Answer: Yes, you can order different IF filters with different bandwidths. Some of the standard manufacturers have 180 kHz, 230 kHz, and 280 kHz bandwidths for 10.7 MHz ceramic filters. Just be sure that the quad tank ‘S-curve’ is linear for your required bandwidth. The SA605 demoboard has a 200 kHz linearity for the quad tank. So ±70 kHz deviation is perfect.

We have also found that even though the IF filter’s bandwidth might be more than our requirements, it does not really degrade overall receiver performance. But to follow good engineering practices, a designer should order filters that are closest to their requirements. Going with wider bandwidth filters will give you better RSSI system speed.

Question: I want to use part of your demo board for my digital receiver project. Can you recommend a good 10.7 MHz filter with accurate 10.7 MHz center frequency which can provide minimum phase delay?

Answer: At the present time, I only know of one manufacturer that is working on a filter to meet digital receiver requirements. Murata has a surface mount 10.7 MHz filter. The number is FX-6502 (SFECA 10.7). It was specifically designed for Japanese digital cordless phones. You can adapt these filters to our SA605 demoboard.

We also used these filters in our layout and got similar SINAD and RSSI system speed performance compared to the standard 10.7 MHz filters (280 kHz bandwidth). I believe the difference between the filters will be apparent for digital demodulation schemes.

Question: Why does the AM rejection performance look better on the SA605, 455 kHz IF board than the SA605 10.7 MHz IF demoboard?

Answer: For the 455 kHz IF demoboard there is more IF gain available compared to the 10.7 MHz IF board. Recall that for the 10.7 MHz IF board, some of the IF gain was killed externally for stability reasons. Since the IF gain helps improve AM rejection performance, by killing IF gain, AM rejection is decreased.

Question: The SA605 10.7 MHz IF demoboard is made for the SO package. Can I use your SSOP package and expect the same level of performance?

Answer: We have not done a SSOP layout yet. But if the same techniques are used, I am sure the SSOP package will work. The SA636DK demoboard is available in SSOP package.

Question: I tried to duplicate your RSSI system reading measurements using your demoboard and I get slower times. What am I doing wrong?

Answer: The RSSI system speed measurements are very tricky. Make sure your cable lengths are not too long. I have found that when making microsecond measurements, lab setup is of utmost importance. Also, make sure the RSSI caps (C11 and C31) are removed from the circuit.

Also be sure that the bandwidth of your IF filters is not slowing down the RSSI system speed (Cf: section on RSSI system speed).

Question: I am going to use your design in my NTT cordless digital phone. Can you recommend a 240.05 MHz filter?

Answer: Murata SF2055A 240.050 MHz SAW filter is a filter you can use for your application.

12. Abbreviations

Table 3. Abbreviations

Acronym	Description
AM	Amplitude Modulation
FM	Frequency Modulation
IF	Intermediate Frequency
LC	inductor-capacitor network
LO	Local Oscillator
NTT	Nippon Telegraph and Telephone
PNP	bipolar transistor with P-type emitter and collector and an N-type base
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
SINAD	Signal-to-Noise And Distortion ratio

13. References

[1] **SA605, “High performance low power mixer FM IF system” —** Product data sheet; NXP Semiconductors; www.nxp.com/documents/data_sheet/SA605.pdf

[2] **AN1994, “Reviewing key areas when designing with the SA605” —** Application note; NXP Semiconductors; www.nxp.com/documents/application_note/AN1994.pdf

[3] **AN1995, “Evaluating the SA605 SO and SSOP demoboard” —** Application note; NXP Semiconductors; www.nxp.com/documents/application_note/AN1995.pdf

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