Demodulating at 10.7MHz IF with the NE/SA605/625 AN1996

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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 455kHz 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 10.7MHz. This frequency offers more potential bandwidth than 455kHz, allowing for faster communications.

Since the wavelength at 10.7MHz is much smaller than 455kHz, the demand for a good RF layout and good RF techniques increases. These demands aid in preventing regeneration from occuring 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.

BACKGROUND

If a designer is working with the NE/SA605 for the first time, it is highly recommended that he/she reads AN1994 and AN1995. These two application notes discuss the NE/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. Philips Semiconductors offers an extensive receiver line to meet the growing demands of the wireless market. Table 1 (see end of app note) 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 a NE/SA606, SA607, SA608, or SA626. All of these low voltage receivers are designed to operate at 3V 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 2MHz. However, the SA626 can operate with a standard IF frequency of 10.7MHz and also provide fast RSSI speed. Additionally the SA626 has a power down mode to conserve battery power.

A close look at Table 1 will also show that there are subtle differences between the 3V receivers. The main differences between the NE/SA606, SA607, and SA608 can be seen in the audio and RSSI output structure. Additionally the SA607 and SA608 provide a frequency check pin which can aid in locking in the desired received frequency over temperature.

OBJECTIVE

The objective of this application note is to show that the NE/SA605 can perform well at an IF frequency of 10.7MHz. Since most Philips Semiconductors receiver demo-boards are characterized at RF = 45MHz/IF = 455kHz, 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 = 45MHz/IF = 455kHz vs RF = 45MHz/ IF = 10.7MHz. As we will discuss later, there was minimal degradation in performance.

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

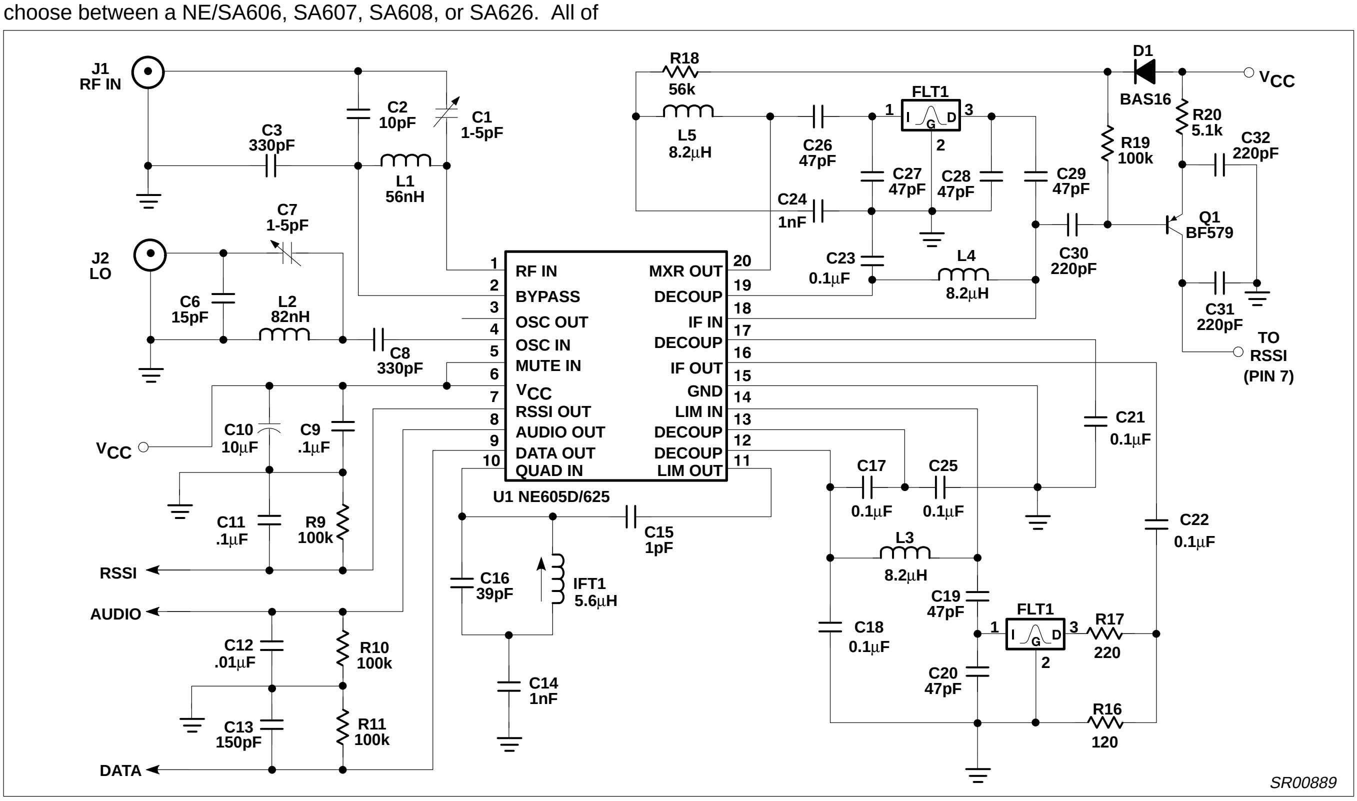

Figure 1. NE/SA605/625 Schematic: RF = 240MHz, LO = 229.3MHz, IF = 10.7MHz

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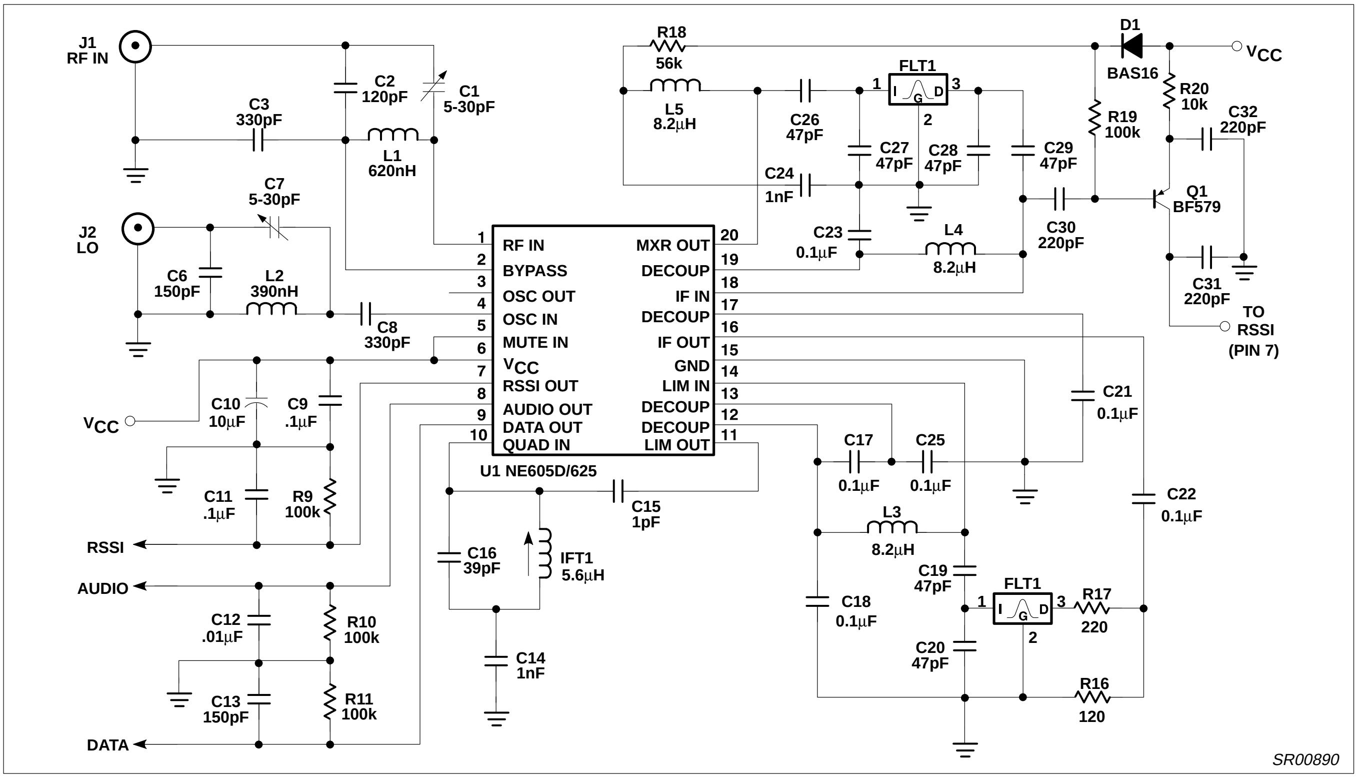

Figure 2. NE/SA605/625 Schematic: RF = 45MHz, LO = 55.7MHz, IF = 10.7MHz

The RF = 240MHz/IF = 10.7MHz demo-board is expected to perform less than the RF = 45MHz/IF = 10.7MHz demo-board 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.

With the new demands for fast RSSI time, Philips Semiconductors has also designed receiver chips with fast RSSI speed: The NE/SA624, NE/SA625 and SA626. The NE/SA625 can also be used in this layout because it is pin-for-pin compatible with the NE/SA605. The RSSI circuitry was the only change done for the NE/SA625, so performance will be similar to the NE/SA605. Performance graphs shown in this application note will reveal the similarities.

For systems requiring low voltage operation, IF=10.7MHz and fast RSSI speed, the SA626 will be the correct choice, however, this application note does not address the performance of the SA626 because the SA626 was not available at this writing.

Board Set-Up and Performance Graphs

Figures 1 and 2 show the NE/SA605/625 schematics for the 240MHz and 45MHz boards, respectively. Listed below are the basic functions of each external components for both Figures 1 and 2.

SO Layout Schematic List

U1- NE/SA605 or NE/SA625
FLT1-10.7MHz ceramic filter Murata SFE10.7MA5-A (280kHz BW)
FLT2-10.7MHz ceramic filter Murata SFE10.7MA5-A (280kHz BW)

Note: 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.

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 NE/SA605/625 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 10.7MHz with IFT1 and C15
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 amp decoupling cap
C22- DC blocking cap
C23- IF amp decoupling cap 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

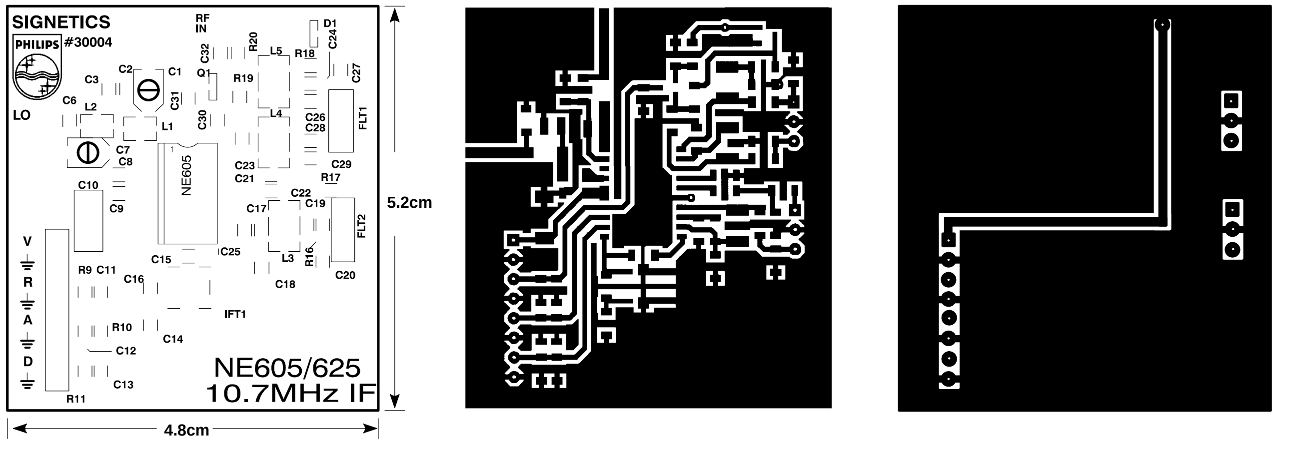

Figure 3. NE/SA605/625 SO Demo-Board Layouts (Not Actual Size)

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- Philips BF579 PNP transistor
IFT1- part of the quad tank circuit

There are minor differences between Figures 1 and 2. The RF and LO tapped-C component values are changed to accommodate for the different RF and LO test frequencies (RF=240MHz and 45MHz and LO = 229.3MHz and 55.7MHz). 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 NE/SA605/625 layout is shown in Figure 3. This layout can be integrated with other systems.

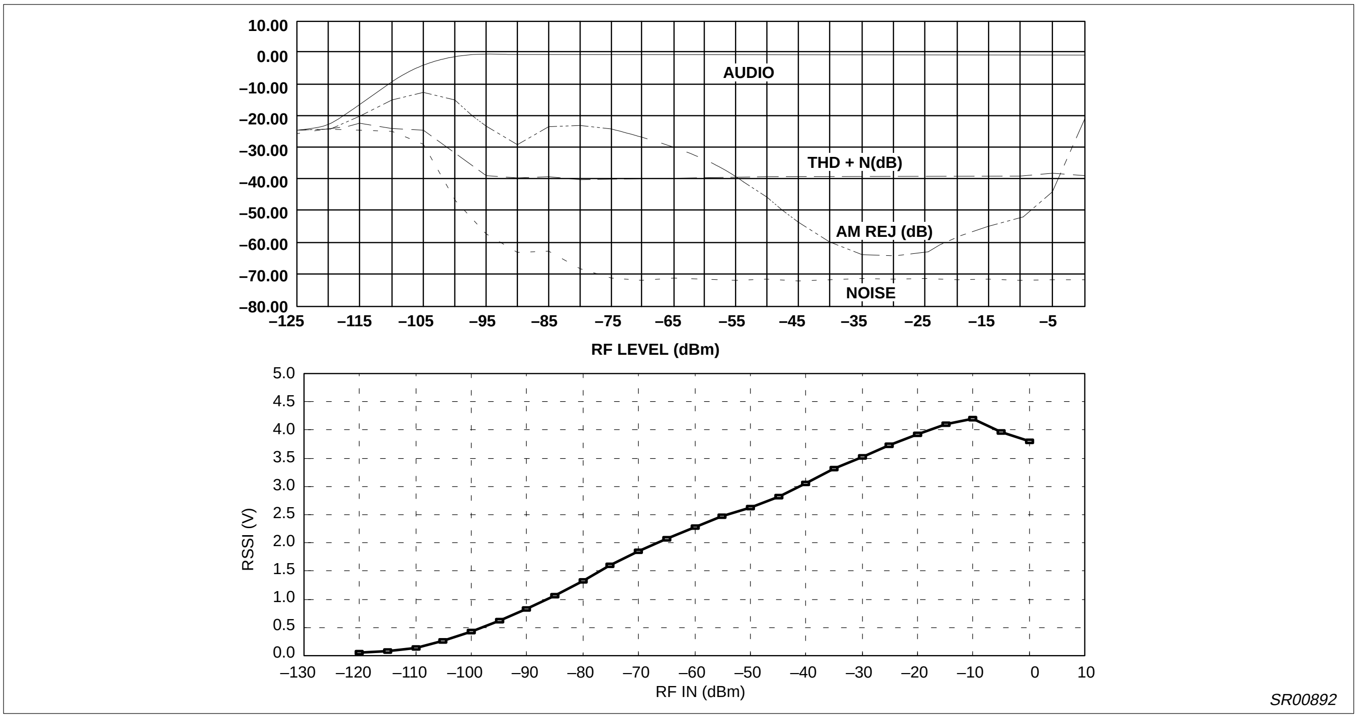

Figure 4. NE/SA625 SO Performance Graphs at 240MHz

Figures 4 through 7 show the performance graphs for the NE/SA605 & NE/SA625 at 240MHz and 45MHz RF inputs. There was no real noticeable difference in performance between a NE/SA605 or NE/SA625 except for AM rejection. The NE/SA605 appears to have a little better AM rejection, but from the end user's point of view, there is no difference between the receiver. All the other measurements were perfect, including SINAD.

RF Input

The NE/SA605/625 board is set up to receive an RF input of 240MHz (see Figure 1). This is achieved by implementing a tapped-C network. The deviation should be set to ±70kHz to achieve ***-110dBm to -112dBm for -12dB SINAD***. However, the deviation can be increased to ±100kHz, depending on the bandwidth of the IF filter and the Q of the quad tank.

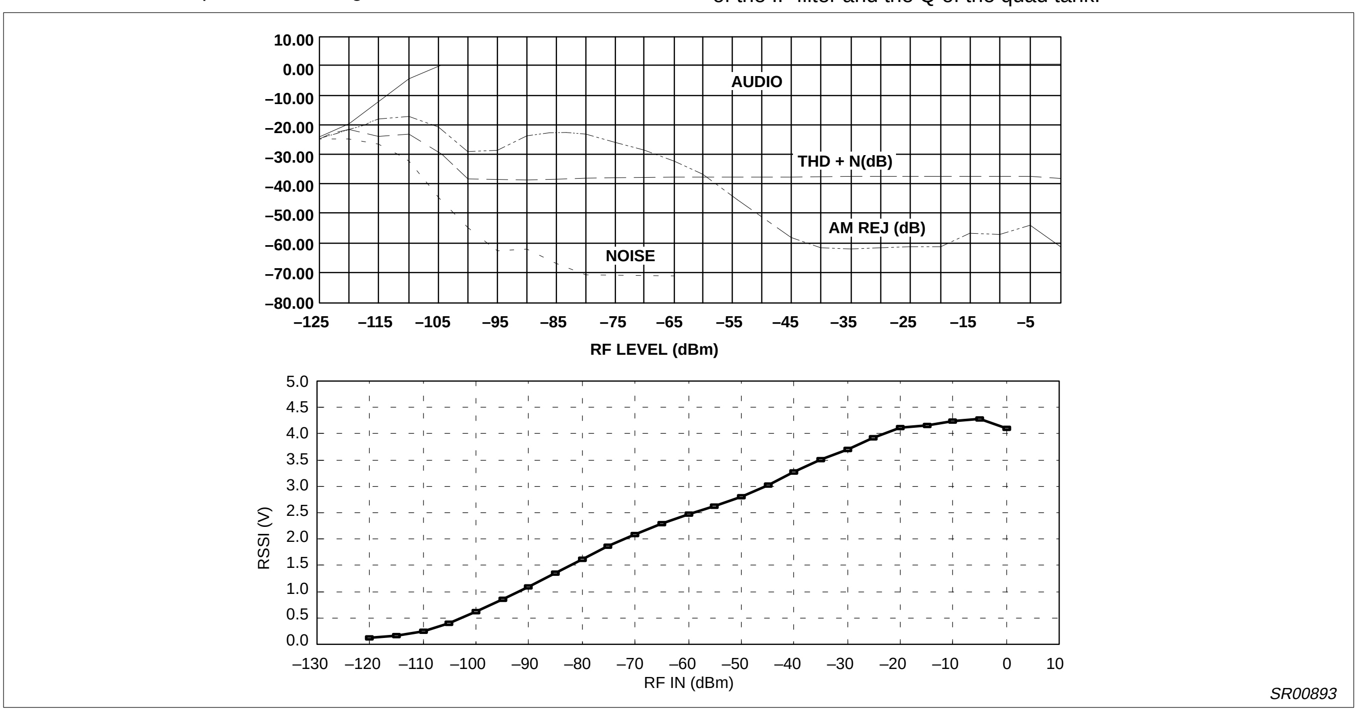

Figure 5. NE/SA625 SO Performance Graphs at 45MHz

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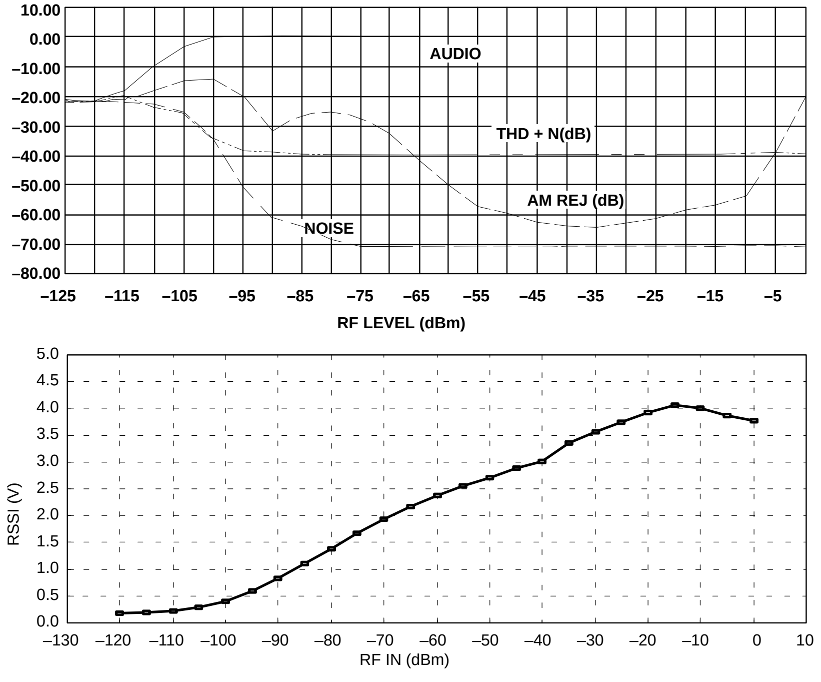


Figure 6. NE/SA605SO Performance Graphs at 240MHz

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

close to achieving performance similar to our standard 455kHz 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 NE/SA605/625 demo-board from Philips Semiconductors its set up will be for an RF input frequency of 240MHz.* 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.

LO Input

The LO frequency should be 229.3MHz for the RF = 240MHz demo-board and have a drive level of -10dBm to 0dBm (this also applies for the RF = 45MHz and LO = 55.7MHz). 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 10kΩ 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 NE/SA605/625. 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.

10.7MHz Ceramic Filters

The input and output impedance of the 10.7MHz ceramic IF filters are 330Ω. The NE/SA605/625's input and output impedances are roughly 1.5KΩ. 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 8 shows the values chosen for the network.

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

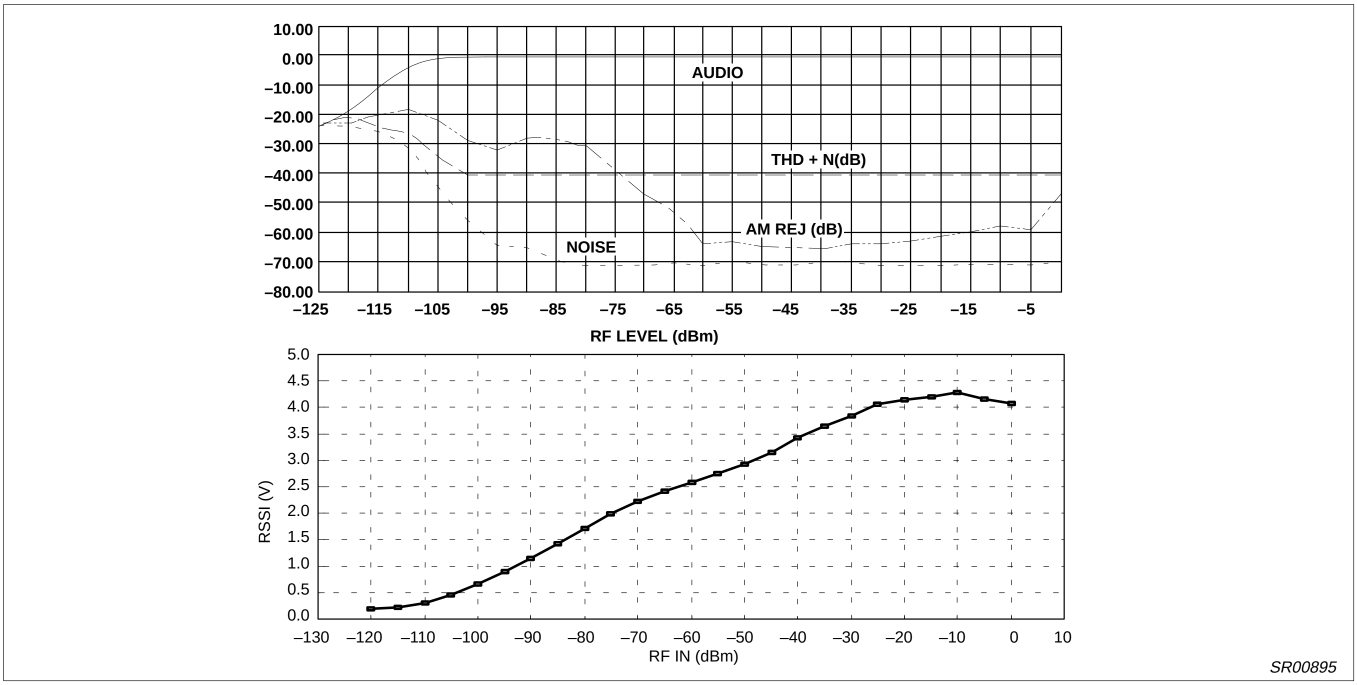


Figure 7. NE/SA605 SO Performance Graphs at 45MHz

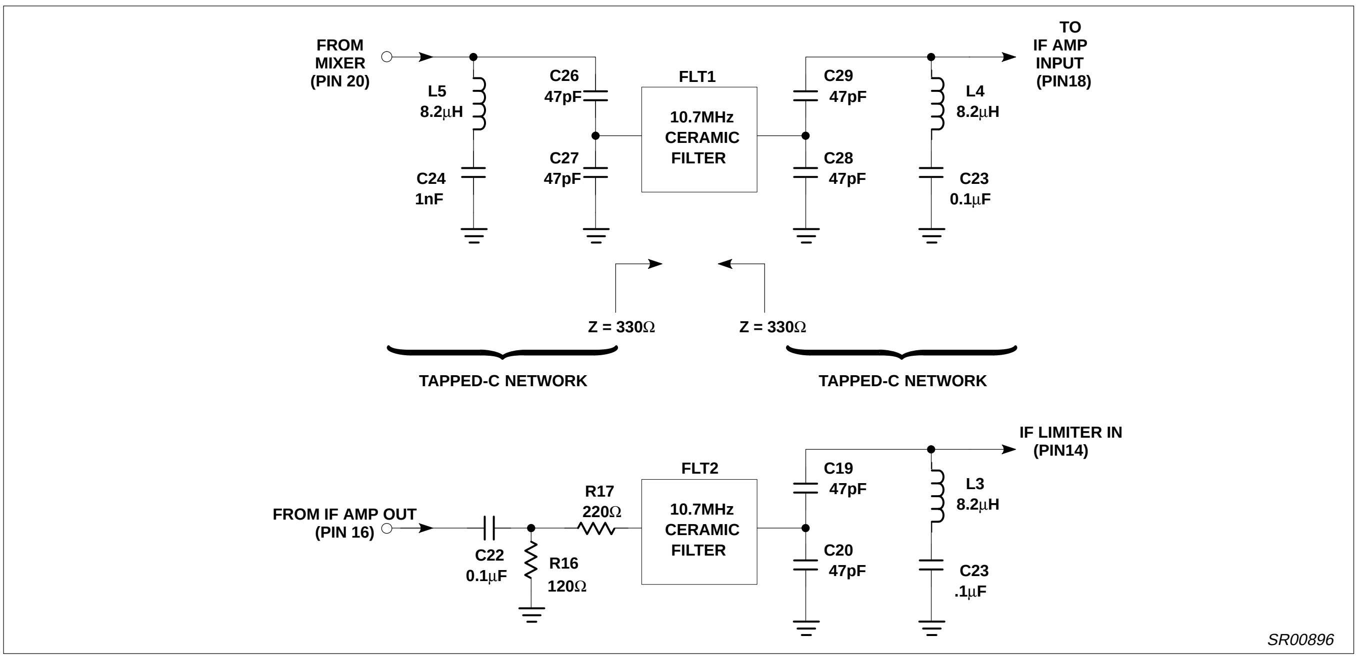


Figure 8. Matching Configuration for FLT1 and FLT2

Stabilizing the IF Section From Regeneration

Because the gain in the IF section is 100dB and the wavelength for 10.7MHz 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 100dB which makes it difficult to stabilize the chip at 10.7MHz. Therefore, a 120Ω (R16 of Figure 1) resistor was used to kill some of the IF gain to obtain a stable system. (NOTE: 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 NE/SA605/625 demo-board 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 8) 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, 120Ω 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.

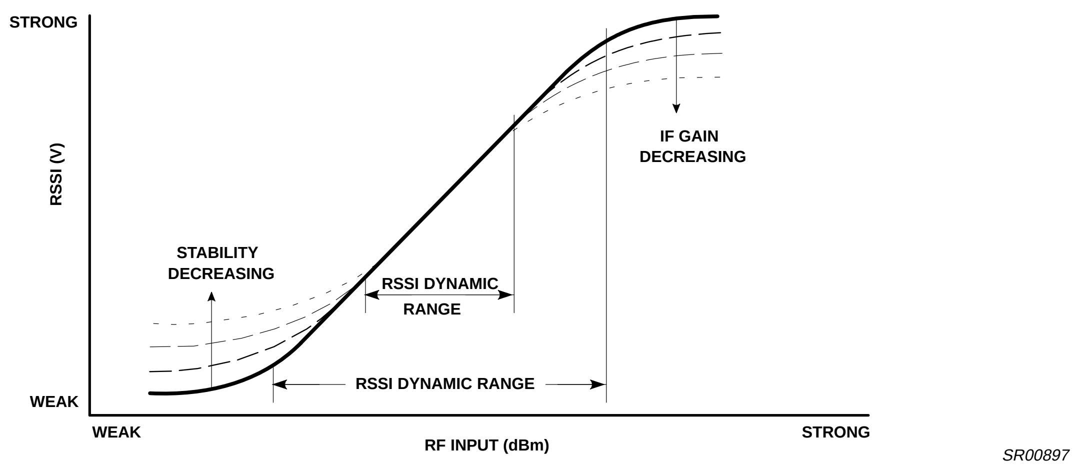
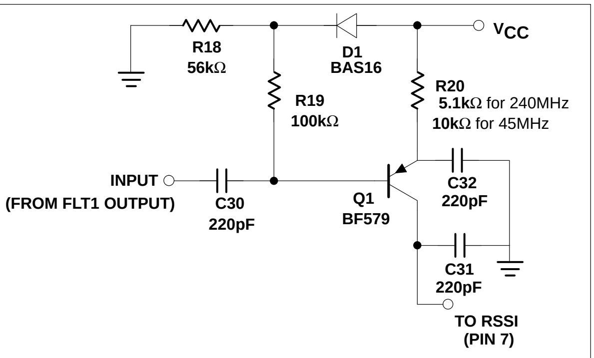


Figure 9. RSSI Dynamic Range



RSSI EXTENDER COMPONENT LIST AND EXPLANATION

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–de-coupling capacitor
C32–peak detector charge capacitor
D1–diode to prevent improper current flow
Q1–Philips BF579 PNP transistor

SR00898

Figure 10. External RSSI Extender Circuit

RSSI Dynamic Range

There are two main factors which determine the RSSI dynamic range. These two factors are 1.) how stable is the board, and 2.) 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 9 shows how the linear range can be decreased under the conditions mentioned above.

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.

RSSI Extender Circuit

The RSSI extender circuit increases the upper dynamic range roughly about 20-30dB for the 240MHz demo-board. The NE/SA605/625 demo-board has 90-100dB of linear dynamic range when the RSSI modification is used.

Referring to Figure 10, 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.

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 240MHz to 45MHz, 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.

Quad Tank

The quad tank is tuned for 10.7MHz ($F=1/2\pi\sqrt{LC}$). Figure 1 shows the values used (C14,C15, C16, IFT1) and Figure 11 shows the S-curve. The linear portion of the S-curve is roughly 200kHz. Therefore, it is a good circuit for a total deviation of 140kHz. It is possible to deviate at 200kHz, but this does not leave much room for part tolerances.

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.

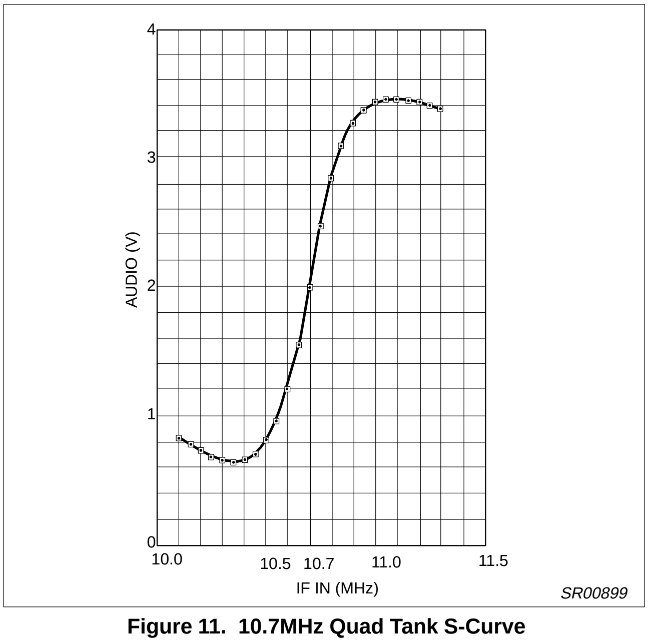


Figure 11. 10.7MHz Quad Tank S-Curve

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 12 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.

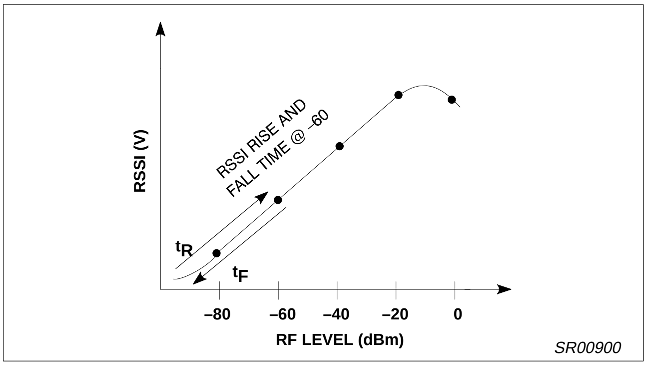


Figure 12. RSSI Cuve with Pulsed RF Levels

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 13 shows the bench set up for the RSSI system speed measurements. The pulsed RF was set for 10kHz and and the RSSI output was monitored with a digital oscilloscope. Figure 14 shows how the rise and fall times were measured on the oscilloscope.

The modifications done on the NE/SA625 board are shown in Figure 15. 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.

The RSSI system speed for the 240MHz NE/SA625 demo board is shown in Figure 16. 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.

Looking more closely at Figure 16, one can note that the 0dBm input level has a faster fall time than the -20dBm level. This occurs because of the limited dynamic range of the test equipment. The equipment does not have sufficient on/off range, so at 0dBm the 'off' mode is actually still on. Therefore, you don't get a true reading.

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

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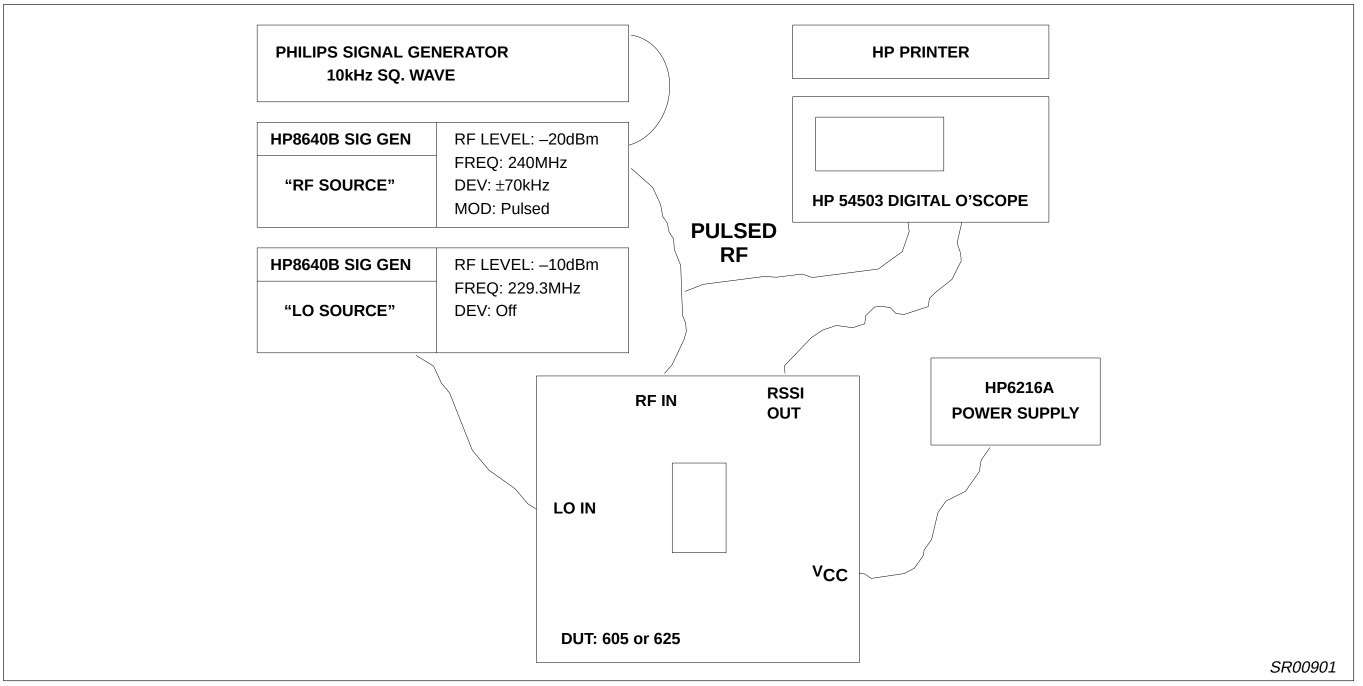

Figure 13. RSSI Speed Set-Up

QUESTION AND ANSWER SECTION

Q. What should the audio level at Pin 8 be?

A. The audio level is at 580mV$_{P-P}$ 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 tanks "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.

Q. Am I required to use the 10µF supply capacitor?

A. No, a smaller value can be used. The 10µF 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.

Q. Can I use different IF filters for my required bandwidth specifications?

A. Yes, you can order different IF filters with different bandwidths. Some of the standard manufacturers have 180kHz, 230kHz, and 280kHz bandwidths for 10.7MHz ceramic filters. Just be sure that the quad tank "S-curve" is linear for your required bandwidth. The NE/SA605/625 demo-board has a 200kHz linearity for the quad tank. So ±70kHz 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.

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

A. 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 10.7MHz 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 NE/SA605/625 demo board.

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

Q. If the system RSSI time is dependent on the external components used, like the IF filters, then what is the difference in using the NE/SA605 vs the NE/SA625?

A. The difference comes in the fall time for high IF frequencies. You are correct that for IFs like 455kHz, there is probably little delta difference because the filter's bandwidth prohibits the speed dramatically. However, for 10.7MHz IFs, there will be a difference in the fall time between the chips because the bandwidths are much wider. Therefore, the chips will play a role in the RSSI system speed. The chip difference in RSSI speed will depend on your overall system configuration.

Q. Why does the AM rejection performance look better on the NE/SA605, 455kHz IF board than the NE/SA605/625 10.7MHz IF demo-board?

A. For the 455kHz IF demo-board there is more IF gain available compared to the 10.7MHz IF board. Recall that for the 10.7MHz 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.

Q. The NE/SA605/625 10.7MHz IF demo-board is made for the SO package. Can I use your SSOP package and expect the same level of performance?

A. We have not done a SSOP layout yet. But if the same techniques are used, I am sure the SSOP package will work. The SA626 demo-board will be done in SSOP, and probably be available in the future.

Q. I tried to duplicate your RSSI system reading measurements using your demo-board and I get slower times. What am I doing wrong?

A. 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 set-up 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).

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

A. Murata SX-4896 (SAMAFC 240.05) is a filter you can use for your application.

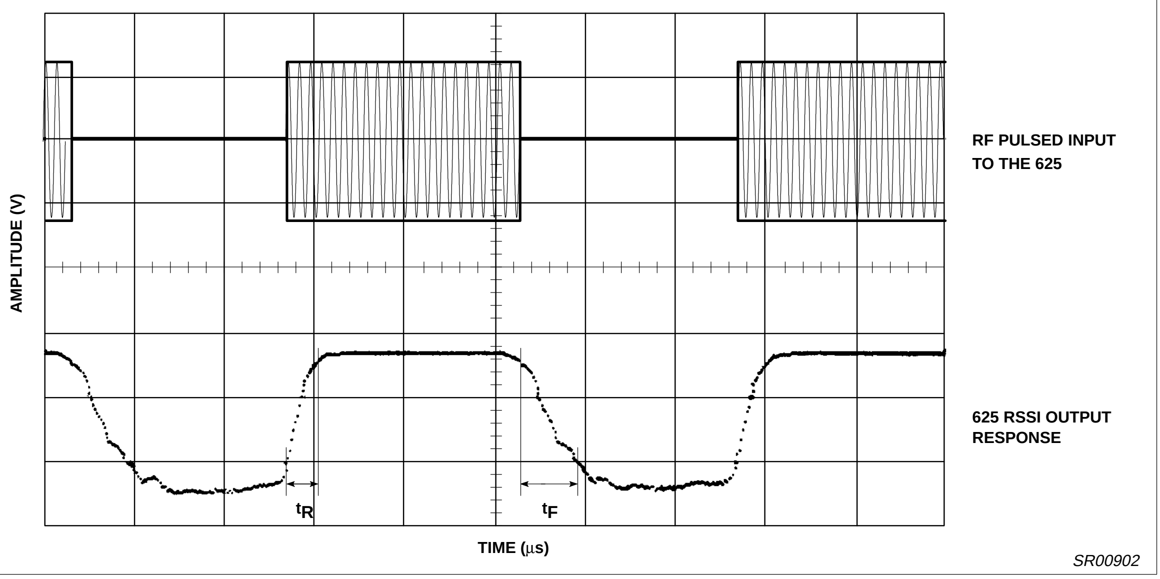

Figure 14. Oscilloscope Display of RSSI System Rise and Fall Time

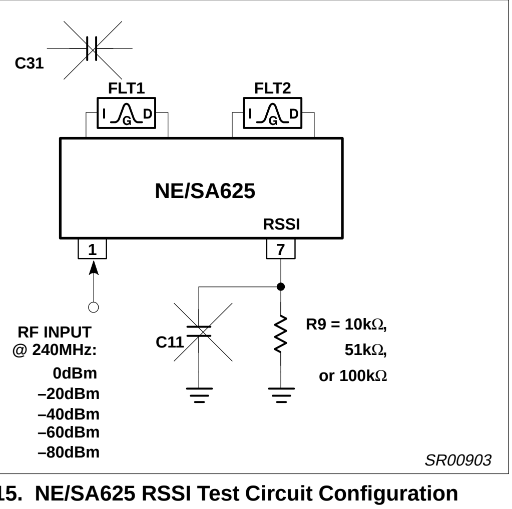

Figure 15. NE/SA625 RSSI Test Circuit Configuration

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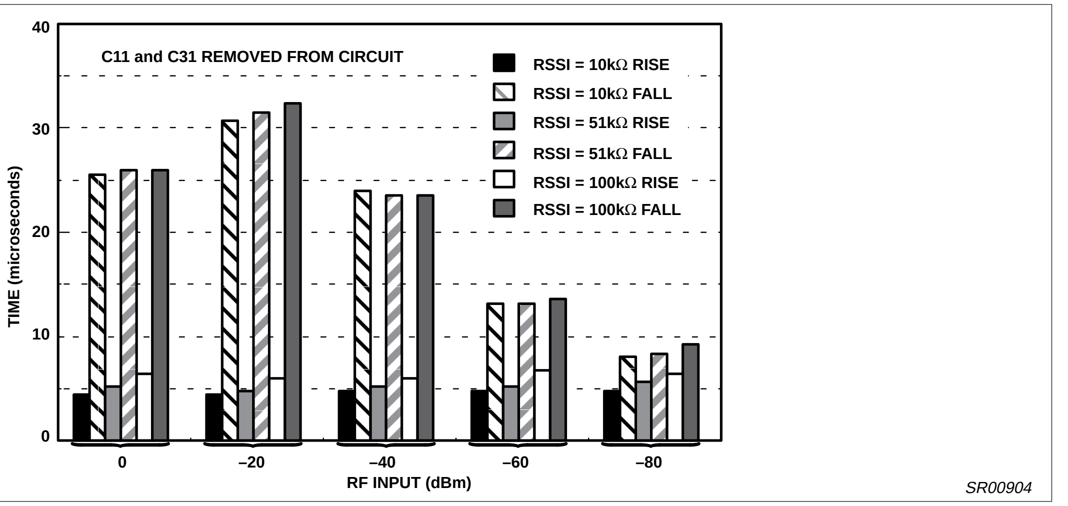

Figure 16. RSSI Systems Rise and Fall Time with Different RSSI Resistor Values

Demodulating at 10.7MHz IF with the NE/SA605/625 AN1996

Table 1. FM/IF Family Overview

		NE602A/604A		NE605	SA606	SA607	SA608	NE624	NE625	SA626	NE627
V_{CC}		4.5–8V	4.5–8V	4.5–8V	2.7–7V	2.7–7V	2.7–7V	4.5-8.0V	4.5-8.0V	2.7–5.5V	4.5-8.0V
I_{CC}		2.4mA@6V	3.3mA @ 6V	5.7mA @ 6V	3.5mA @ 3V	3.5mA @ 3V	3.5mA @ 3V	3.4mA @ 6V	5.8mA @ 6V	6.5mA @ 3V	5.8mA @ 6V
Number of Pins		8	16	20	20	20	20	16	20	20	20
Packages NE: 0 to +70°C SA: –40 to +85°C N: Plastic DIP D: Plastic SO FE: Ceramic DIP DK: SSOP		NE602AN NE602AD NE602AFE SA602AN SA602AD SA602AFE	NE604AN NE604AD SA604AN SA604AD	NE605N NE605D NE605DK SA605N SA605D SA605DK	SA606N SA606D SA606DK	SA607N SA607D SA607DK	SA608N SA608D SA608DK	NE624N NE624D SA624N SA624D	NE625N NE625D NE625DK SA625N SA625D SA625DK	SA626D SA626DK	NE627N NE627D NE627DK SA627N SA627D SA627DK
–12dB SINAD (RF = 45MHz), IF = 455kHz) 1kHz Tone, 8kHz Dev.		–120dBm / .22uV		–120dBm / .22uV	–117dBm / .31uV	–117dBm / .31uV	–117dBm / .31uV	–120dBm / .22uV	–120dBm / .22uV	–112dBm / .54uV (RF = 240MHz) (IF = 10.7MHz) 1kHz Tone, +/–70kHz Dev.	–120dBm / .22uV
Process f_t		8GHz		8GHz	8GHz	8GHz	8GHz	8GHz	8GHz	8GHz	8GHz
For lower cost version and less performance		612A & 614A		615	616	617	—	—	—	—	—
Features		– Audio & Data pins – IF BW of 25MHz – No external matching required for standard 455kHz IF filter		– Audio & Data pins – IF BW of 25MHz – No external matching required for standard 455kHz IF filter	– Low voltage – Internal RSSI and audio op amps – No external matching required for standard 455kHz IF filter – IF BW of 2MHz	– Freq check pin – Low voltage – Internal RSSI and audio op amps – Unity gain RSSI output – No external matching required for standard 455kHz IF filter – IF BW of 2MHz	– Freq check pin – Low voltage – Internal RSSI and audio op amps – Unity gain audio output – No external matching required for standard 455kHz IF filter – IF BW of 2MHz	– Fast RSSI Time – Pin-to-Pin compatible with 604A – No external matching required for standard 455kHz IF filter	– Fast RSSI Time – Pin-to-Pin compatible with 605 – No external matching required for standard 455kHz IF filter	– Power down mode – Low voltage – Fast RSSI Time – IF BW of 25MHz – Internal RSSI & audio op amps – No external matching required for standard 10.7MHz IF filter	– Fast RSSI Time – Freq check pin – IF BW of 25MHz – Internal RSSI & audio op amps – No external matching required for standard 455kHz IF filter
RSSI OUTPUT SECTION: Dynamic Range		90dB		90dB	90dB	90dB	90dB	90dB	90dB	90dB	90dB
Accuracy		+/–1.5dB		+/–1.5dB	+/–1.5dB	+/–1.5dB	+/–1.5dB	+/–1.5dB	+/–1.5dB	+/–1.5dB	+/–1.5dB
455kHz IF	**Rise * Time**	—	1.4us	—	—	—	—	1.1us	1.2us	—	1us
	Fall * Time	—	21.3us	—	—	—	—	1.3us	2.1us	—	1.7us
10.7MHz IF	**Rise * Time**	—	1.5us	—	—	—	—	1.2us	1.2us	1.2us	0.9us
	Fall * Time	—	19.4us	—	—	—	—	1.6us	2us	2us	1.4us

***NOTE: No IF filters in the circuit**

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Table 1. (cont.) FM/IF Family Overview

Section	Block	Parameter	NE602A/604A		NE605	NE606	SA607	SA608	NE624	NE625	SA626	NE627
MIXER		Max. Conversion Power Gain (RF = 45MHz; IF = 455kHz)	17dB	—	13dB	17dB	17dB	17dB	—	13dB	13dB	13dB
MIXER		3rd Order Intercept Point (Input) f1 = 45MHz f2 = 45.06MHz	–13dB	—	–10dBm	–9dBm	–9dBm	–9dBm	—	–10dBm	–11dBm f1 = 240.05 f2 = 240.35	–10dBm
MIXER		Noise Figure @45MHz	5dB	—	5dB	6.2dB	6.2dB	6.2dB	—	5dB	11dB @ 240MHz	5dB
MIXER		RF Input Resistance and Capacitance @45MHz	1.5k 3pF	—	4.7k 3.5pF	8k 3pF	8k 3pF	8k 3pF	—	4.7k 3.5pF	4.7k 3.5pF @ 240MHz	4.7k 3.5pF
MIXER		Output Resistance	1.5k	—	1.5k	1.5k	1.5k	1.5k	—	1.5k	330	1.5k
IF SECTION	IF AMP	Input Impedance	—	1.6k	1.6k	1.5k	1.5k	1.5k	1.6k	1.6k	330	1.5k
IF SECTION	IF AMP	Output Impedance	—	1.0k	1.0k	330	330	330	1.0k	1.0k	330	1.0k
IF SECTION	IF AMP	Gain	—	40dB	40dB	44dB	44dB	44dB	40dB	40dB	44dB	40dB
IF SECTION	IF AMP	BW	—	41MHz	41MHz	5.5MHz	5.5MHz	5.5MHz	41MHz	41MHz	40MHz	40MHz
IF SECTION	IF LIMITER	Input Impedance	—	1.6k	1.6k	1.5k	1.5k	1.5k	1.6k	1.6k	330	1.5k
IF SECTION	IF LIMITER	Output * Impedance	—	330	330	330	330	330	330	330	330	330
IF SECTION	IF LIMITER	Gain	—	60dB	60dB	58dB	58dB	58dB	40dB	60dB	58dB	60dB
IF SECTION	IF LIMITER	BW	—	28MHz	28MHz	4.5MHz	4.5MHz	4.5MHz	28MHz	28MHz	28MHz	28MHz
IF SECTION		Total IF Gain	—	100dB	100dB	100dB	100dB	100dB	100dB	100dB	96dB (includes –6dB pad)	100dB
IF SECTION		Total IF BW	—	25MHz	25MHz	2MHz	2MHz	2MHz	25MHz	25MHz	25MHz	25MHz

NOTE: *Not designed to drive a matched load

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