Nokia Customer Care
6255/6255i/6256/6256i (RM-19)
Mobile Terminal

# RF Description and Troubleshooting

 

## Contents Page



  

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# Introduction

When troubleshooting the receiver, first check the RX_AGC PDM value. The AGC value should be close to the typical values in the tables. The RX AGC tries to keep a constant amplitude at the output of the receiver chain; if the AGC value indicates an AGC gain that is substantially higher than normal, the AGC is compensating for extra loss in another component. If the AGC PDM values are normal and there is still a problem, check the actual AGC voltages. RF probing at specific locations in the chain can then help to pinpoint the source of the problem.

Likewise, when troubleshooting the transmitter, first check the measured output power and AGC values, which give an indication of where to start probing.

Although probing points and signal-level information are given for each point in the receiver and transmitter chains, the troubleshooter is not expected to probe each point on every mobile terminal — only the suspected trouble spots.

Absolute power measurements were made with an Agilent (HP) 85024A active high-impedance probe. Other probes can be used (but should be high-impedance so that the measurement does not load the circuit) but may very well have a different gain; therefore, adjust the absolute measurements accordingly. Also, adjust if using a probe attenuator.

Where a range is given for loss, typically the higher loss occurs at the band edges. Probing is not a very accurate method to measure absolute power; therefore, you cannot expect measured results to exactly match the numbers listed.

Power depends on the impedance of the circuit. For example, if a filter has a nominal loss of 5dB, then straightforward probing on the input and output, then subtracting, might not result in 5dB because the input impedance might be different from the output impedance. Most components in the RF section have the same input and output impedance (50ohms), but where this is not the case absolute power is noted in dBm, rather than loss or gain in dB.

When testing the CDMA receiver, it is easier to inject a CW tone into the receiver. The gains and losses are the same for a CW signal as for CDMA.

*Note: After opening the shield lids, always replace them with new lids.*

# Mobile Terminal Components

The mobile terminal includes two PWB boards, the main PWB and the UI PWB.

## Main PWB

Following are the components of the main PWB.

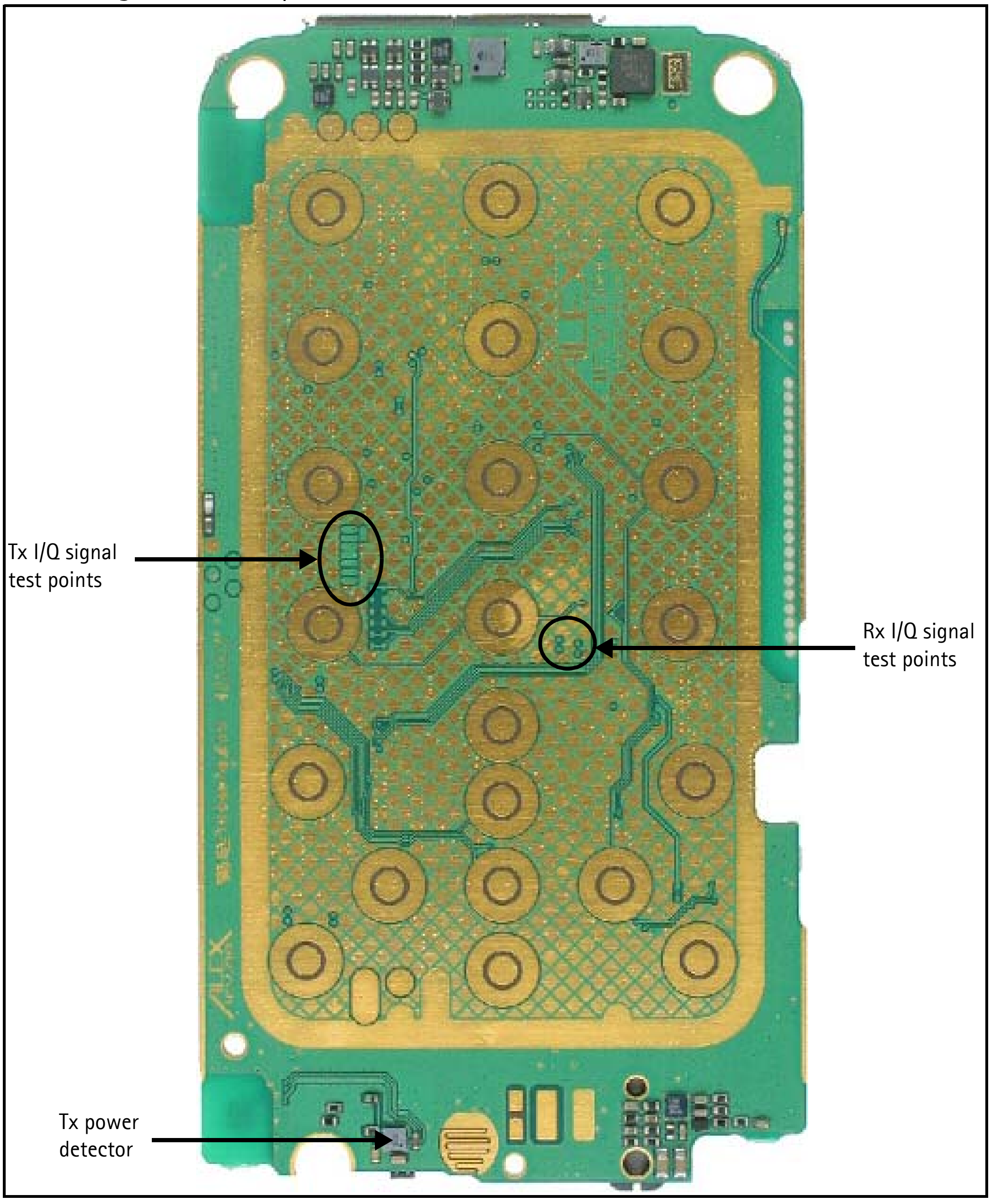



**Figure 1: Main PWB component layout - top**

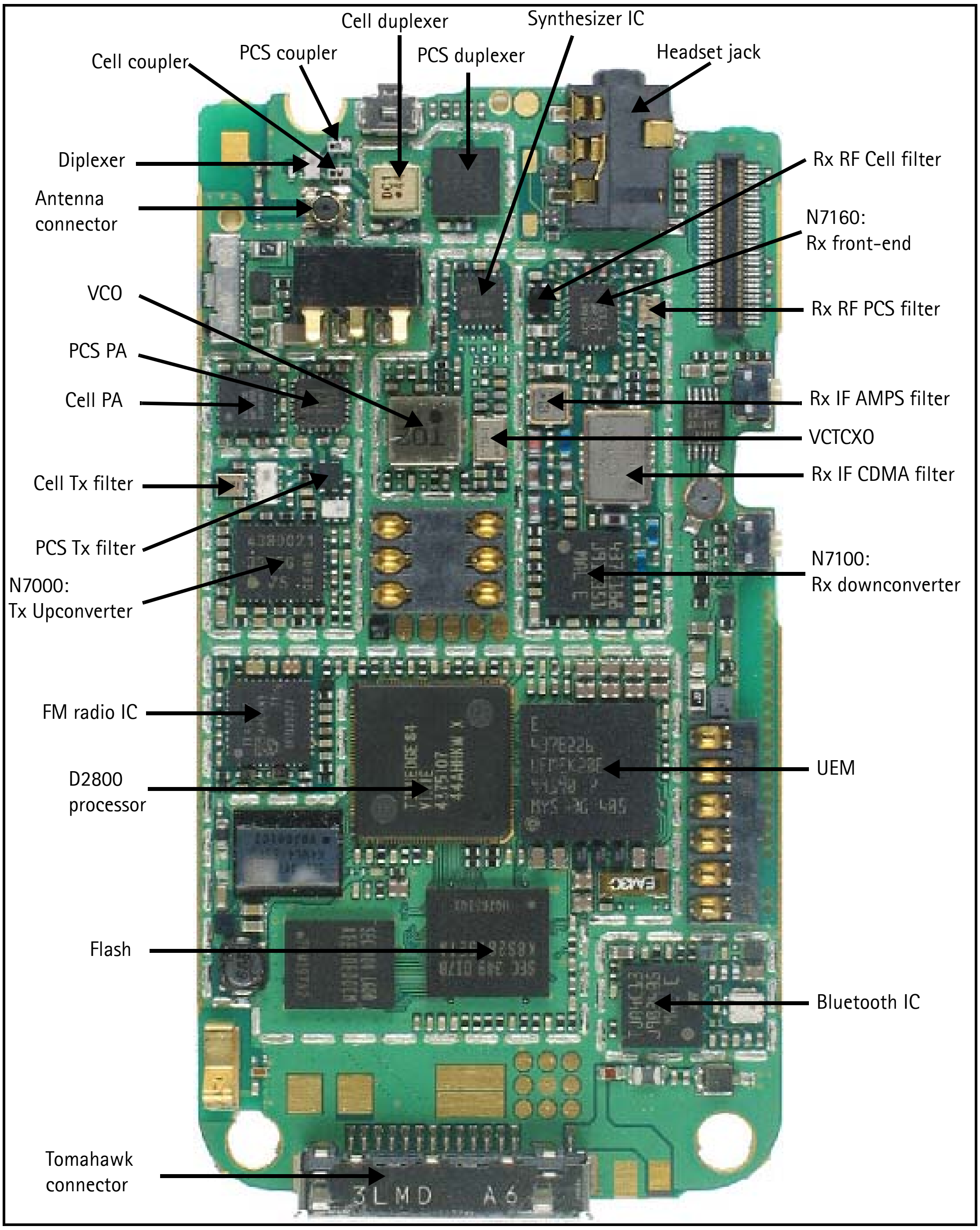



**Figure 2: Main PWB component layout – bottom**

## UI (Secondary) PWB

Following are the components of the UI PWB.


**Figure 3: UI PWB component layout – top**

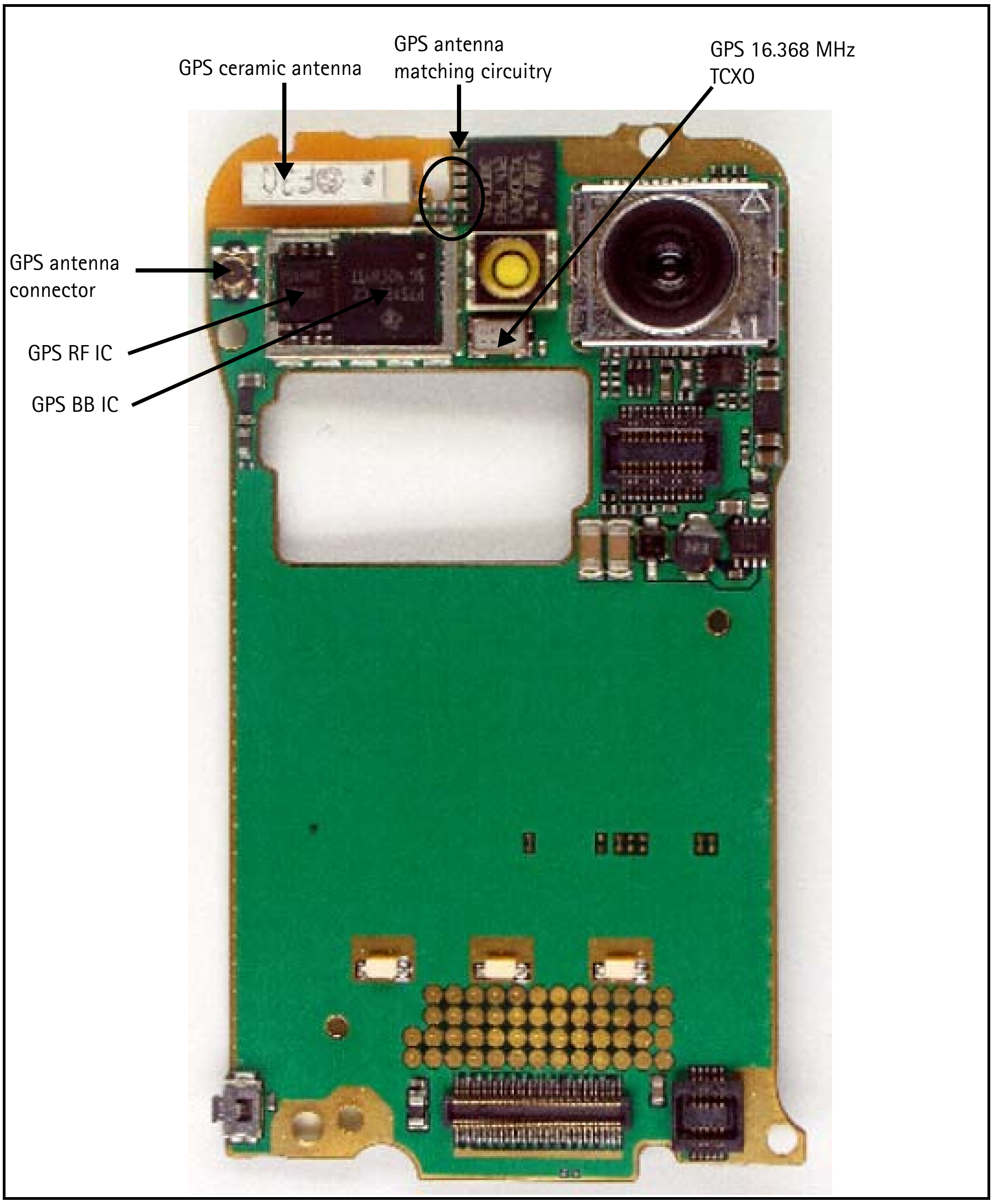



**Figure 4: UI PWB component layout – bottom**

# Preliminary RF Troubleshooting

The following sections identify steps to troubleshoot some common RF issues.

## Mobile Terminal Cannot Make a Call

Verify the following if the mobile terminal cannot make a call:

1. The mobile terminal is in Normal Mode (i.e., the mobile terminal is searching for a signal, net server is on).
2. The Preferred Roaming List (PRL) is loaded into the mobile terminal.
3. The mobile terminal is tuned and has passed tuning. Read the tuning parameters using the **Read Parameters** component in Phoenix. An untuned mobile terminal has all zeros in the tuning file.
4. The call box channel is set for a channel in PRL.
5. The SID is correct and entered into the mobile terminal.
6. The VCTCXO is centered as described in the "VCTCXO Manual Tuning" section on page 54.
7. The transmitter and receiver are working properly in Local Mode. See "Transmitter RF Troubleshooting" on page 11 and "Receiver RF Troubleshooting" on page 31 for detailed information.

## Tx Power Low

Complete the following steps if Tx power is low:

1. Use Phoenix to turn on the transmitter in Local Mode.
2. Perform a visual inspection of the PWB under a microscope to check for the proper placement, rotation, and soldering of components.
3. Look for the presence of a Tx signal on a spectrum analyzer at the correct frequency.
   - If a signal is present but off-frequency, check the synthesizers for proper frequency and amplitude. One of the synthesizers may be unlocked or the VCO has no output signal.
   - If a signal is not present or is present but is low in amplitude, check the probing diagrams to determine where in the chain the fault occurs. (See "Tx RF Test Points - Bottom Side" on page 28.)
4. Ensure that the power supplies to the Tx have the correct voltage. (See "Tx DC Test Points - Bottom Side" on page 25)
5. Ensure that the AGC PDMs are set for the desired Tx power and that the AGC voltages are correct. (See "AMPS Tx Setup" on page 15, "Cell Tx Setup" on page 18, or "PCS Setup" on page 20.)

# Transmitter RF Troubleshooting

Following are the main Tx RF components.

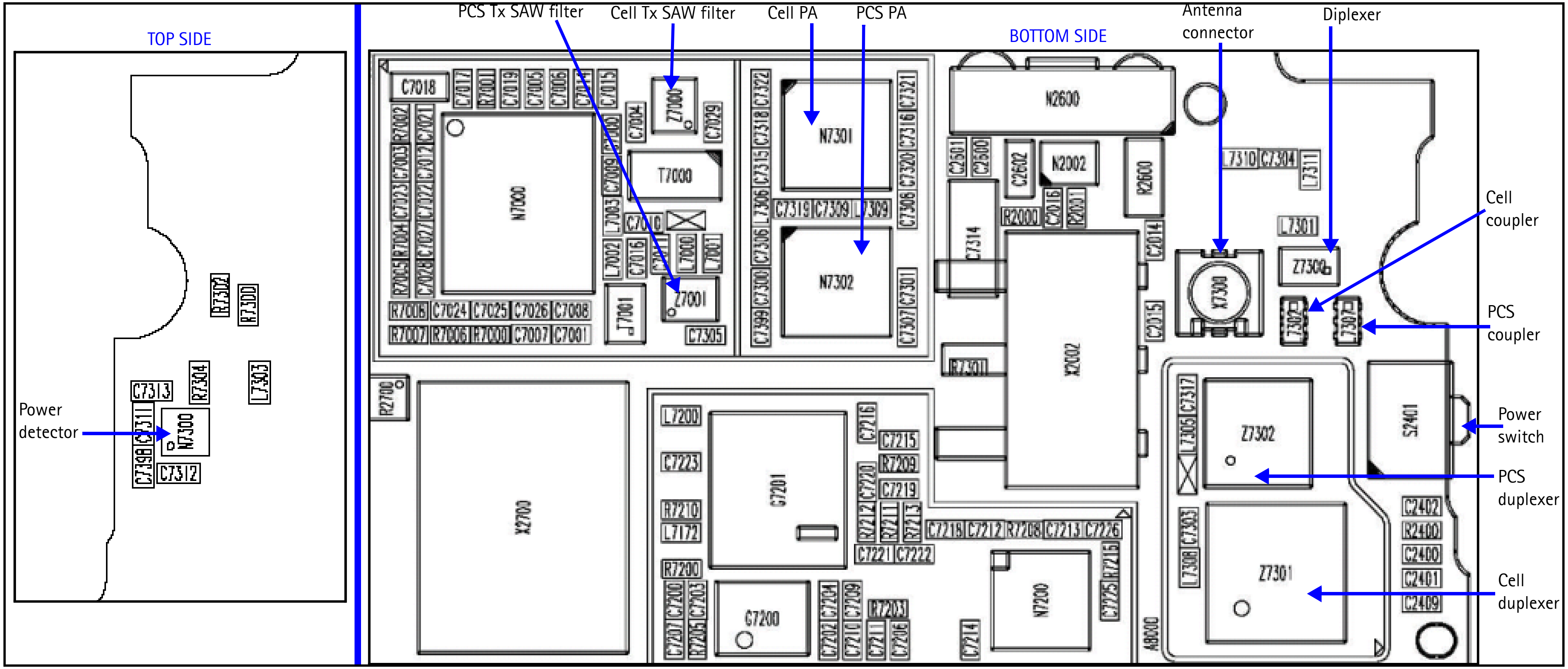



**Figure 5: Main transmitter RF components**

## Transmitter Block Diagram

Following is the block diagram for the Tx RF system.

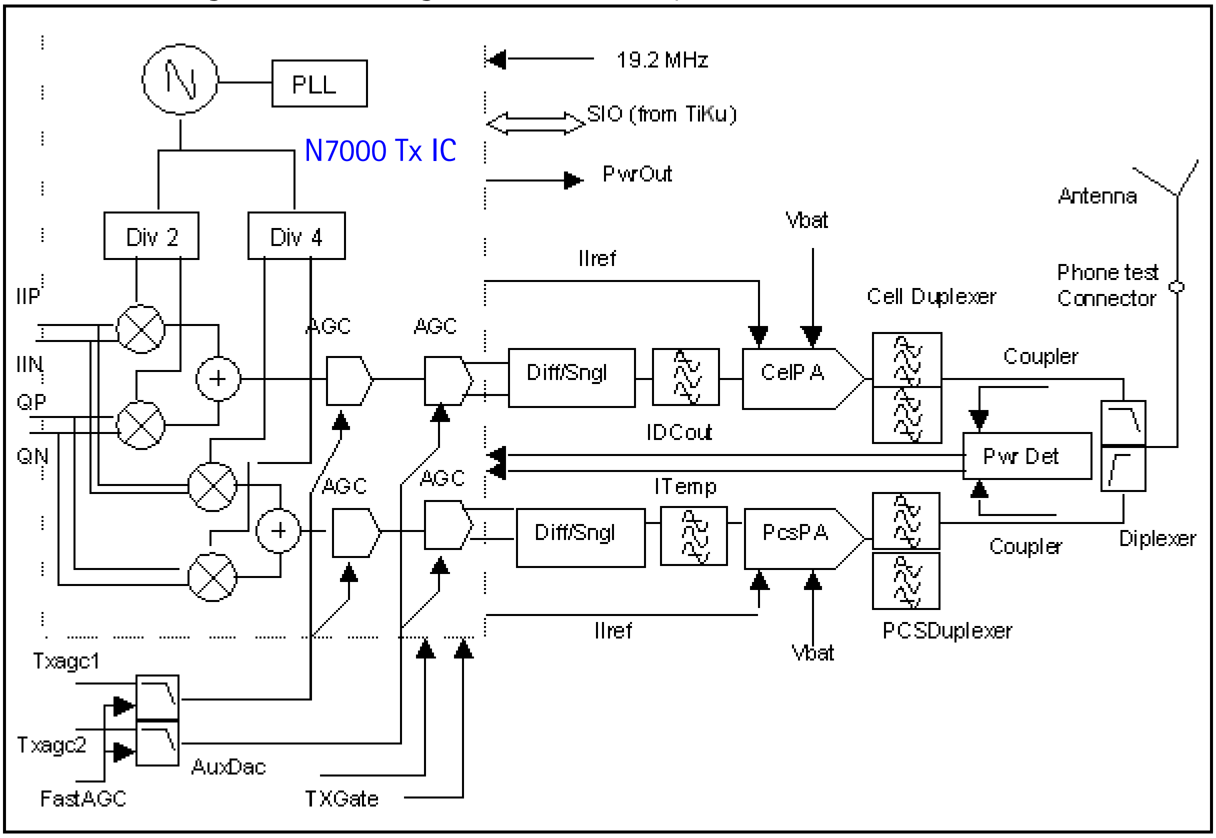



**Figure 6: Tx system block diagram**

## Transmitter Schematics

The following schematics are for general reference only. See the *Schematics* chapter for detailed versions.

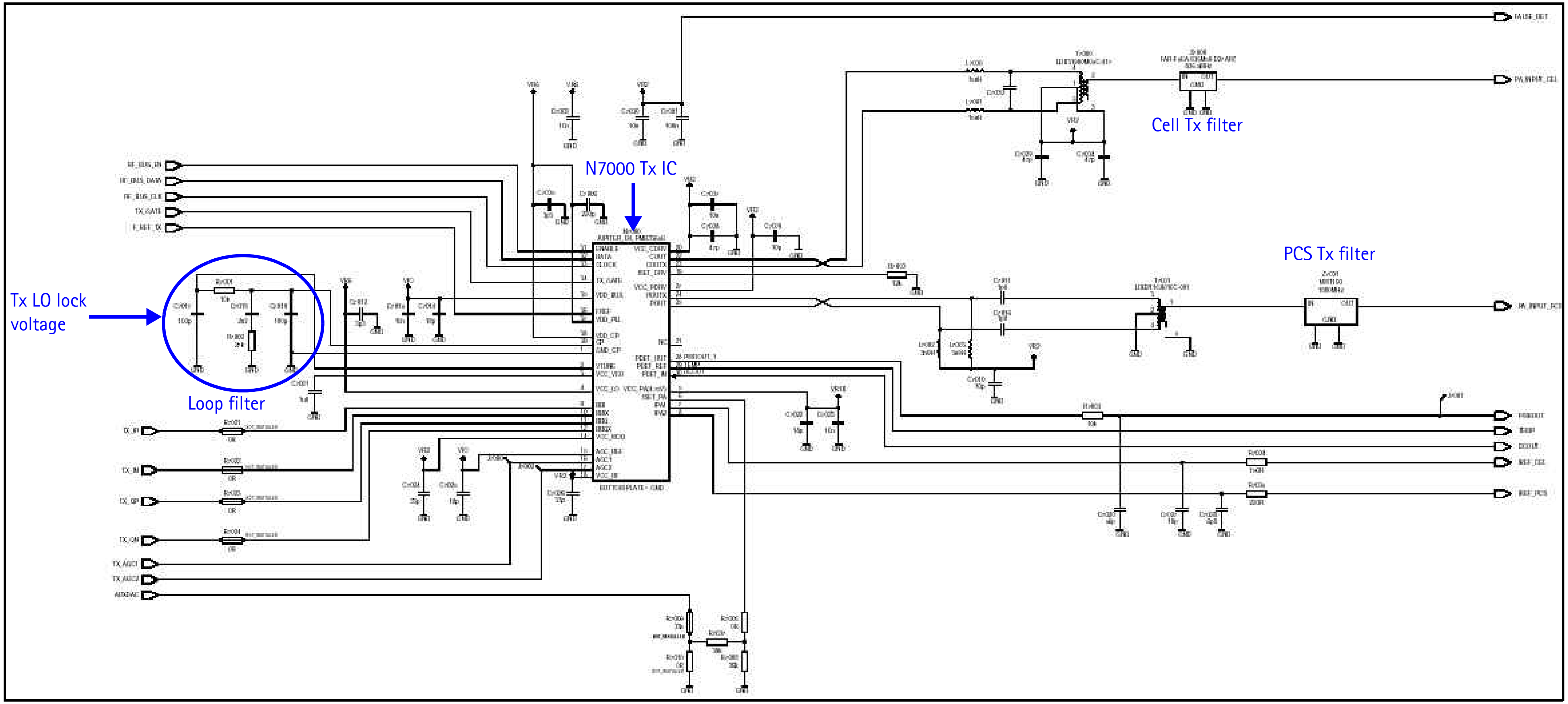



**Figure 7: Transmitter schematic 1**

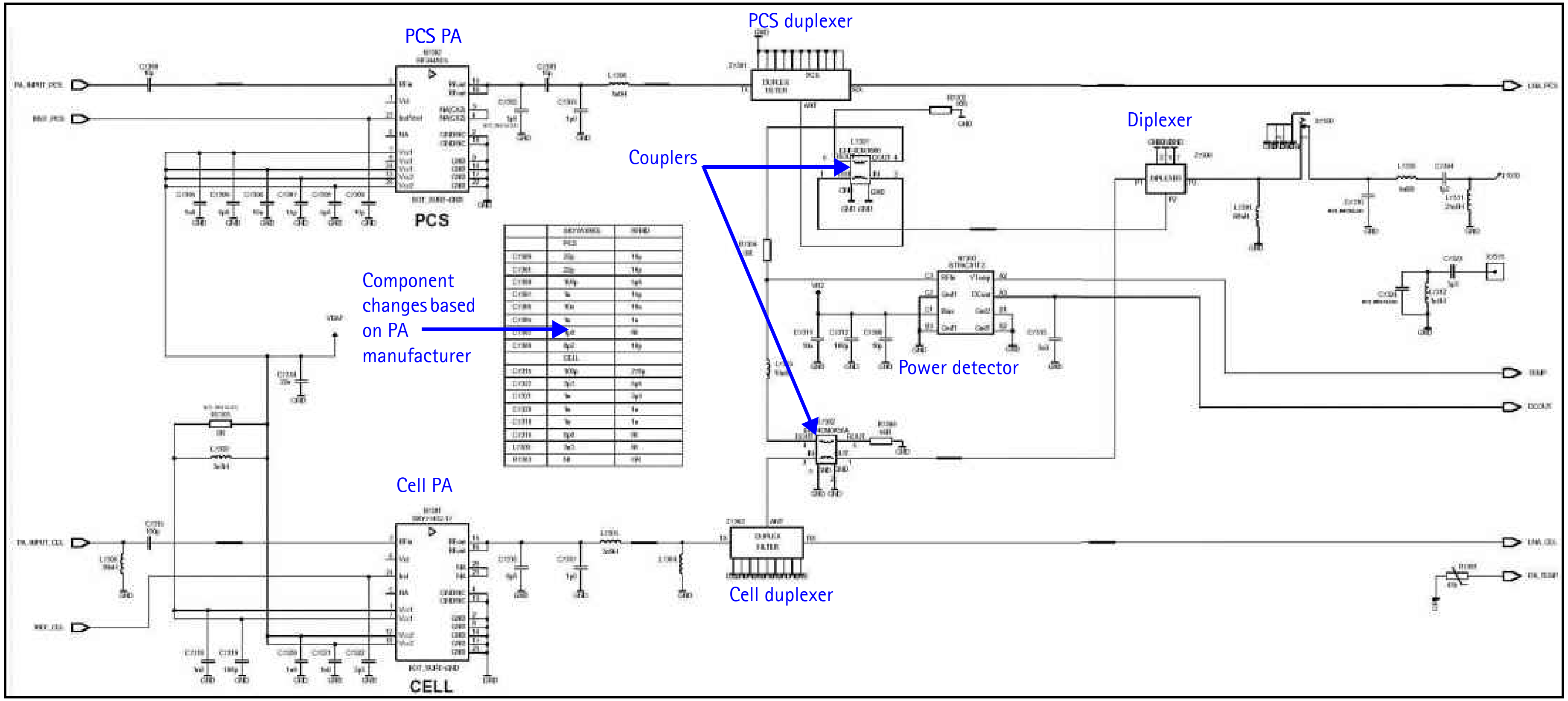



**Figure 8: Transmitter schematic 2**

## Transmitter Troubleshooting Setup

Use the following sets of procedures to troubleshoot the transmitter using Phoenix. Due to the compact layout of the mobile terminal, some of the major test points are not accessible without destroying the shield frames and the EL lamp. For example, duplexers/ diplexer/couplers test points are blocked by the test jig, the PA test points are underneath the shield frame, and the BBIQ points are underneath the EL lamp.

To minimize effort, check the following in order:

1. Tx power at the RF connector.
2. All Tx DC points.
3. All soldering jig points for the whole Tx chain.
4. UHF LO presence:
   - If the UHF LO is present, check the N7000 output.
   - If the UHF LO is not present, it is a synthesizer problem.
5. If there is no N7000 output:
   a. Change the N7000.
   b. If the problem persists, reflow the duplexers, diplexer, and couplers.
   c. If the problem persists, change the PA.
6. If there are several failed mobile terminals with the same symptoms, it may be necessary to break one to determine the cause.

Use the following sections to set up troubleshooting in Phoenix according to the band you are using:


- "AMPS Tx Setup" on page 15
- "Cell Tx Setup" on page 18
- "PCS Setup" on page 20


### AMPS Tx Setup

Use the following procedures to prepare for AMPS Tx troubleshooting using Phoenix.

1. Connect the RF test connector to a spectrum analyzer.
2. Connect the mobile terminal to the PC via a test jig. (The bottom connector is a USB port.)
3. Connect a power supply to the mobile terminal.
4. Open the **Troubleshooting** menu, and click **Phone Control**.

   The **Phone Control** dialog box appears.

5. Click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode.

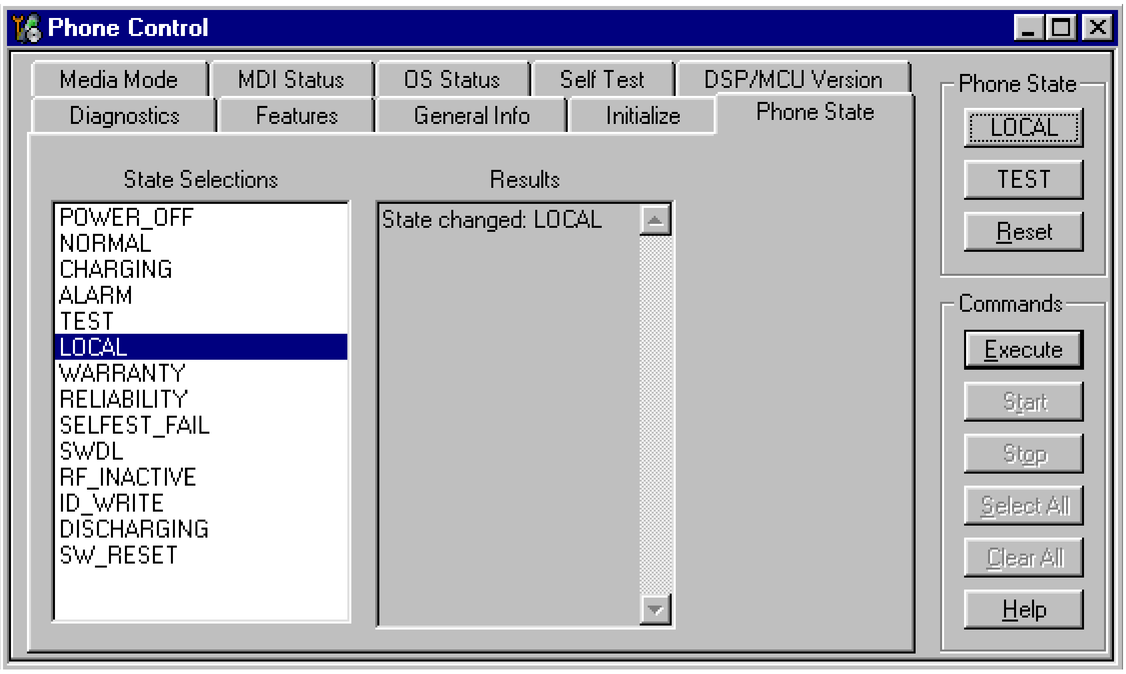



**Figure 9: Phone Control dialog box**

6. Open the **Troubleshooting** menu, point to **AMPS**, and click **AMPS Control**.

   The **AMPS Control** dialog box appears.

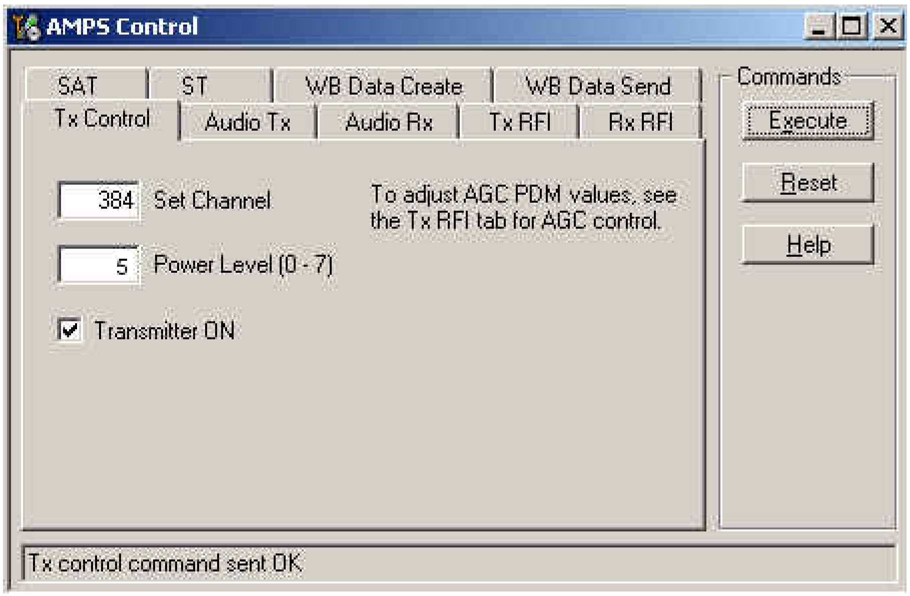



**Figure 10: AMPS Control dialog box**

7. Click the **Tx Control** tab.
8. In the **Set Channel** field, type 384.
9. In the **Power Level** field, type 5.
10. Select the **Transmitter ON** option, and click **Execute**.

11. Configure the spectrum analyzer using the following values:
    - Center Frequency = 836.52 MHz
    - Span = 100 MHz
    - Amplitude = 20 dBm
    - Attenuation = Auto
    - BW = Auto

**Table 1: RF PDM Values at Power Level 5**

| Description/Field | Reference Value |
|---|---|
| AGC1 | -512 |
| AGC2 | -31 |
| AGC3 | -400 |
| Rx IF AGC | -234 |
| AFC | +176 |
| Pout at RF connector | +14dBm |
| Current | 400-500mA |

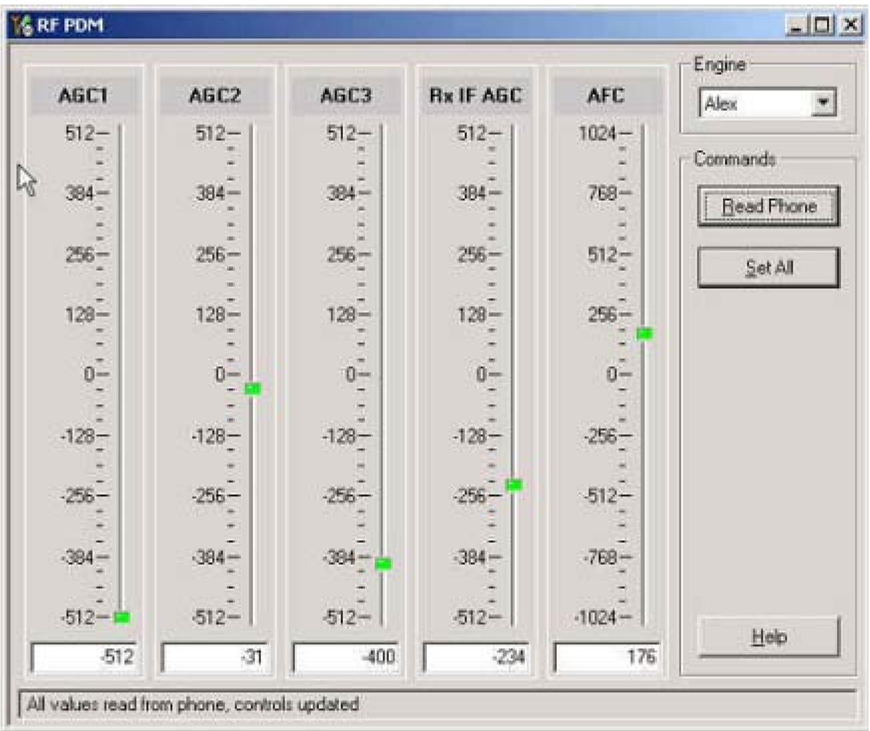



**Figure 11: RF PDM dialog box for AMPS**

12. Click **Read Phone** to update the values.

### Cell Tx Setup

Use the following procedures to prepare for Cell Tx troubleshooting using Phoenix.

1. Connect an RF test connector to a call box.
2. Connect the mobile terminal to the PC via a test jig. (The bottom connector is a USB port.)
3. Connect a power supply to the mobile terminal.
4. On the **Phone Control** dialog box, click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode. (See Figure 9 on page 16.)
5. Open the **Troubleshooting** menu, point to **RF**, and click **RF Main Mode**.

   The **RF Main Mode** dialog box appears.

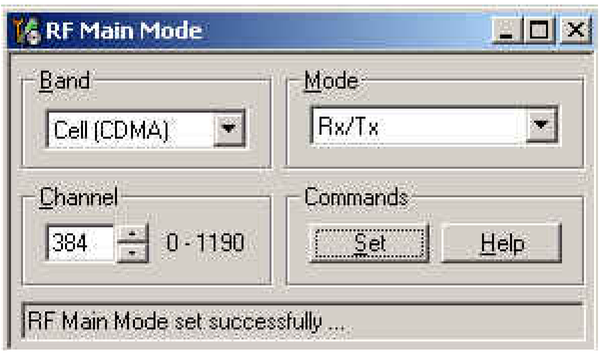



**Figure 12: RF Main Mode dialog box for Cell Mode**

6. Select the following values on the **RF Main Mode** dialog box:
   - **Band** = Cell (CDMA)
   - **Channel** = 384
   - **Mode** = Rx/Tx
7. Click **Set.**

   *Note: Be sure that the "RF Main Mode set successfully" message appears in the status bar.*

8. Open the **Troubleshooting** menu, point to **RF**, and click **CDMA Control**.

The **CDMA Control** dialog box appears.

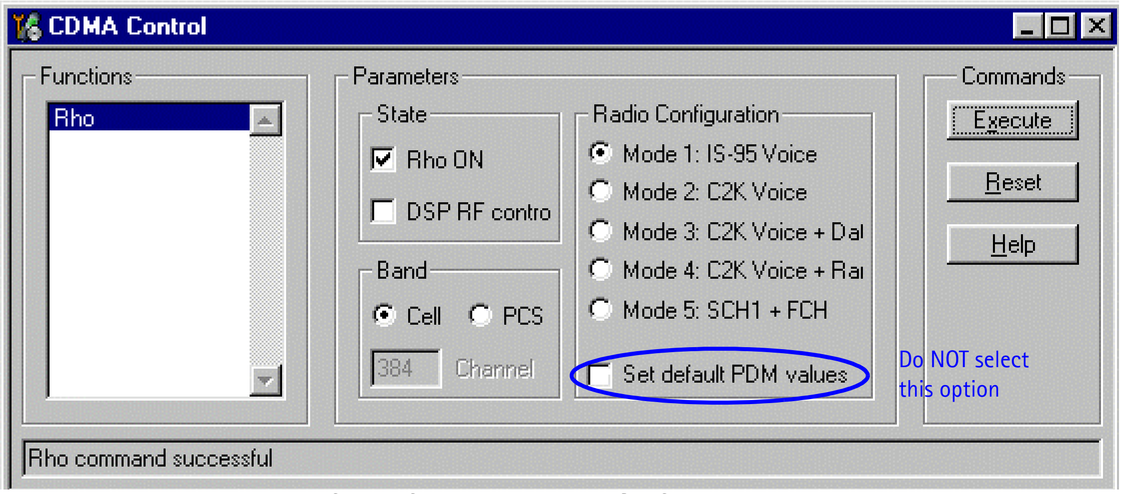



**Figure 13: CDMA Control dialog box for Cell Tx troubleshooting**

9. Select the following values:
   - **State** = Rho ON
   - **Band** = Cell
   - **Radio Configuration** = Mode 1: IS-95 Voice

   *Note: Do NOT select the Set default PDM values option*

10. Click **Execute.**
11. Configure the spectrum analyzer using the following values:
    - Center Frequency = 836.52 MHz
    - Span = 100 MHz
    - Amplitude = 20 dBm
    - Attenuation = Auto
    - BW = Auto

**Table 2: RF PDM Values**

| Description/Field | Reference Value |
|---|---|
| AGC2 | -250 |
| AGC3 | -387 |
| Pout at RF connector | +20dBm |
| Current | 500-600mA |

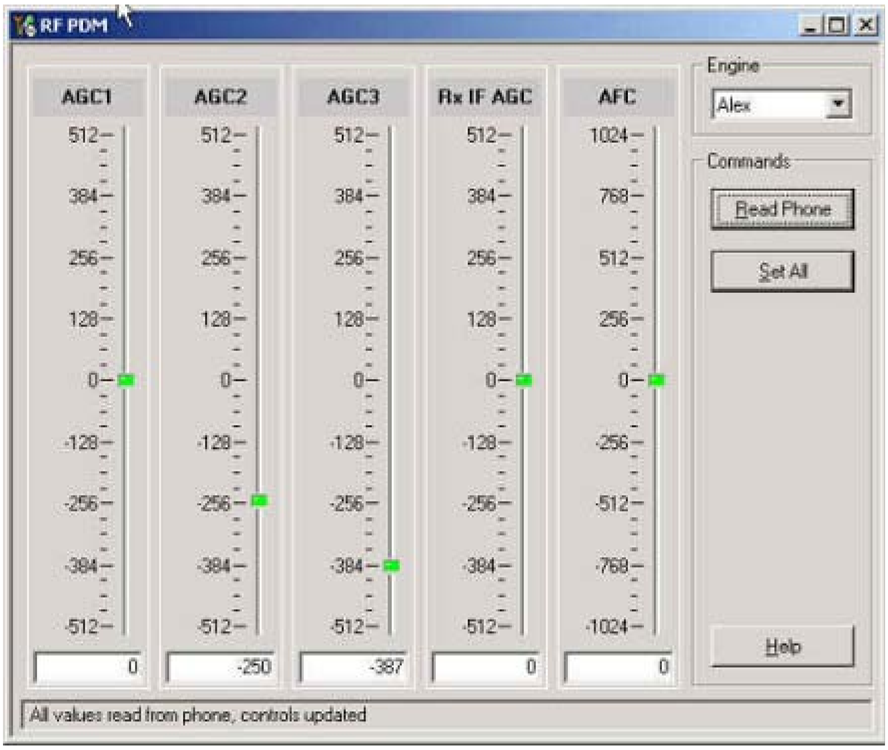



**Figure 14: RF PDM Control dialog box for Cell band**

12. Click **Read Phone** to update the values.

### PCS Setup

Use the following procedures to prepare for PCS Tx troubleshooting using Phoenix.

1. Connect an RF test connector to a call box.
2. Connect the mobile terminal to the PC via a test jig. (The bottom connector is a USB port.)
3. Connect a power supply to the mobile terminal.
4. Open the **Troubleshooting** menu, and point to **Phone Control**.

   The **Phone Control** dialog box appears. (See Figure 9 on page 16.)
5. Click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode.
6. Open the **Troubleshooting** menu, point to **RF**, and click **RF Main Mode**.

   The **RF Main Mode** dialog box appears. (See Figure 12 on page 18.)

7. Select the following values on the **RF Main Mode** dialog box:
   - **Band** = PCS (CDMA)
   - **Channel** = 600
   - **Mode** = Rx/Tx
8. Click **Set.**

   *Note: Be sure that the "RF Main Mode set successfully" message appears in the status bar.*

9. Open the **Troubleshooting** menu, point to **RF**, and click **CDMA Control**.

   The **CDMA Control** dialog box appears. (See Figure 13 on page 19.)
10. Select the following values on the **CDMA Control** dialog box.
    - **State** = Rho ON
    - **Band** = PCS
    - **Radio Configuration** = Mode 1: IS-95 Voice

    *Note: Do NOT select the Set default PDM values option.*

11. Click **Execute.**
12. Open the **Troubleshooting** menu, point to **RF**, and click **PDM Control**.
13. Configure the spectrum analyzer using the following values:
    - Center Frequency = 1880 MHz
    - Span = 100 MHz
    - Amplitude = 20 dBm
    - Attenuation = Auto
    - BW = Auto

**Table 3: RF PDM Values**

| Description/Field | Reference Value |
|---|---|
| AGC2 | -511 |
| AGC3 | -83 |
| Pout at RF connector | +23dBm |
| Current | 700-800mA |

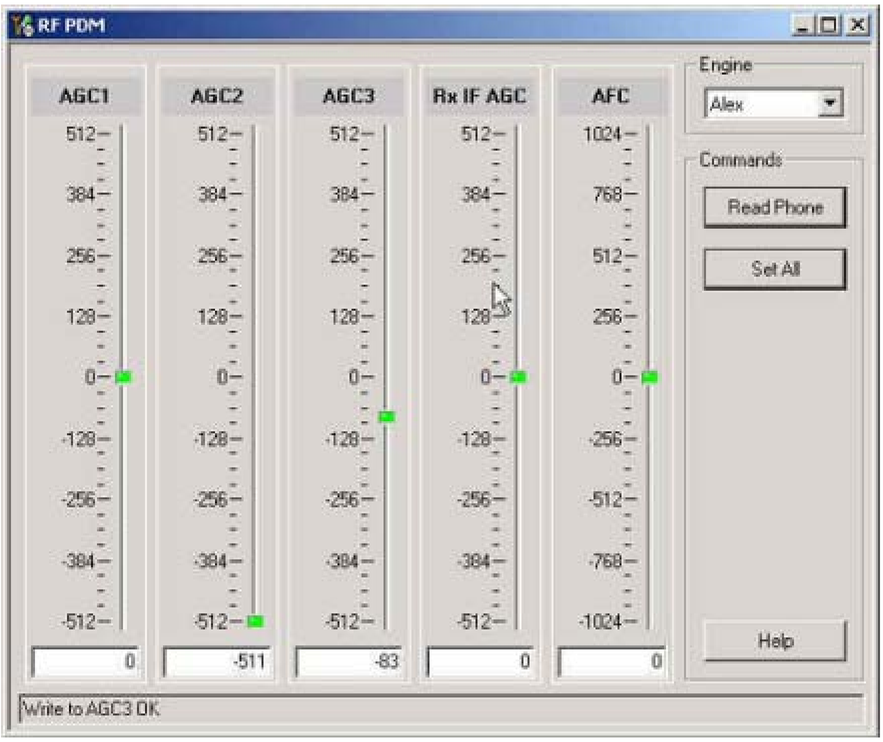



Figure 15: RF PDM Control dialog box for PCS band

14. Click **Read Phone** to update the values.

## Transmitter RF Troubleshooting Procedures

After Phoenix is set up using either the AMPS, Cell, or PCS setup procedures, use the following steps to troubleshoot the transmitter.

1. Using a voltmeter, check to see that all VR2, VR6, and VR1B are on the transmit system. (See "Tx DC Test Points - Bottom Side" on page 25.)
   - If any are missing, look for SMD problems around the N7000 and the UEME.
   - If SMD is good, replace the UEME.
2. Once all DC voltages are present, check the AGC control voltages. (See "AMPS Tx Setup" on page 15, "Cell Tx Setup" on page 18, or "PCS Setup" on page 20.)
   - If the voltages are incorrect, check the SMD around TX_AGC1 and TX_AGC2.
   - If the SMDs are correct, replace the D2800.
3. Using an oscilloscope, check the input modulation BBIQ wave forms at R7021, R7022, R7023, and R7024. They should all be present with an AC swing of about 500mVpp, with an offset of +1.2V.
   - If one or more waveforms are missing, look for SMD problems around these resistors.
   - If the SMD is good, replace the UEM.

4. Use an AAS-10 RF probe to probe the Cell Tx output of the N7000.
    - If there is no RF or low RF, look for SMD everywhere around the N7000.
    - If the SMD is okay, replace the N7000.
5. Probe the PA input.
    - If the level is low, look for an SMD issue on the Tx filter or matching transformer (T7001 or T7002).
    - Reflow or replace the filter as necessary.
6. Probe the PA output.
    - If the RF is missing or low, look for Vbatt voltages and SMD issues on and around the PA.
    - If these are okay, replace the PA.
7. Probe the duplexer output.
    - If the RF is missing or low, reflow or replace the duplexer.
8. Probe the coupler output.
    - If the RF is missing or low, reflow or replace the coupler.
9. Probe the diplexer output.
    - If the RF is missing or low, reflow or replace the diplexer.

**Failed Test: Tx PA Detector**

Use the following steps if you encounter a failed test for the Tx PA detector:

1. Use Phoenix to set the mobile terminal into Local Mode and activate the Tx with default output power.
2. The output power at the RF test connector should be 15dBm +/- 4dB. If not, follow the procedures in the "Transmitter RF Troubleshooting Procedures" section on page 22.
3. Using a voltmeter on DC, probe the detector output at C7313. The voltmeter should read approximately 1.4V. If not, replace N7300. (See page 26 for test point locations and common power and voltage variations.)

### Tx Output Spectrum

Following is the correct output of the mobile terminal on a spectrum analyzer with 100MHz span. Note that if you are using the AAS-10 probe with the mobile terminal connected to the call box, the amplitude should be approximately -7dBm at the antenna test point on the top of the PWB.

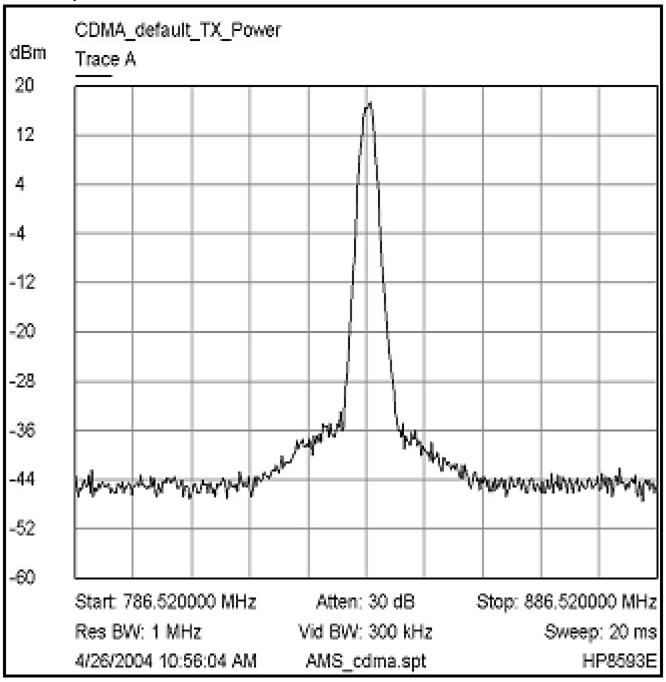



**Figure 16: Correct output spectrum**

Following is an example of *incorrect* output.

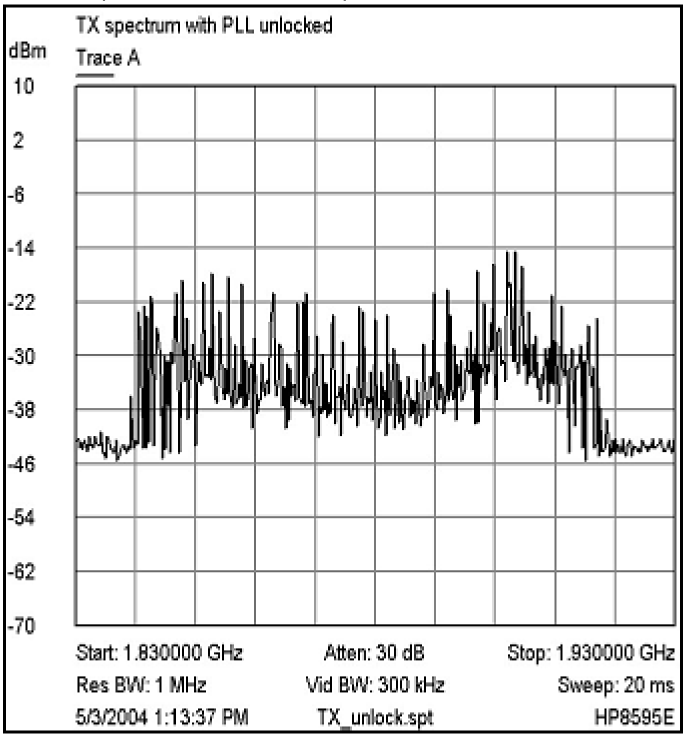



**Figure 17: Incorrect output spectrum**

### Tx DC Test Points – Bottom Side

Following are the Tx DC test points located on the bottom side of the main PWB.

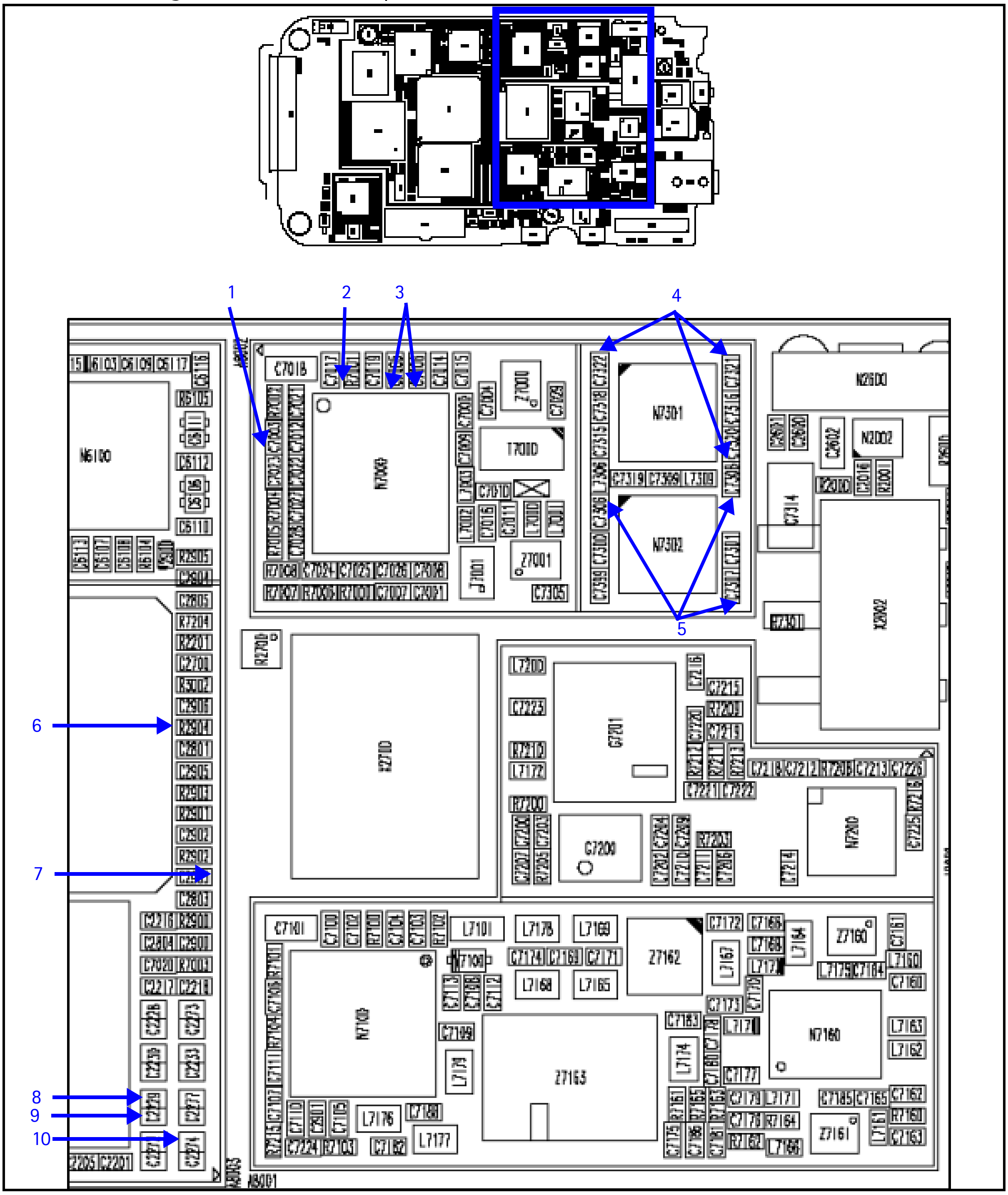



**Figure 18: Tx DC test points on the bottom side of the main PWB**

Table 4 shows the values for the test points in Figure 18.

**Table 4: Tx DC Test Point Description and Values – Main PWB – Bottom Side**

| Test Point | Description | Values |
|---|---|---|
| 1 | Tx UHF LO | Lock voltage: ~1.2V |
| 2 | VR6 | 2.8V |
| 3 | Vbatt Cell* | |
| 4 | Vbatt PCS* | |
| 5 | VR1B | 4.8V |
| 6 | AGC1 | 0.1V to 1.8V |
| 7 | AGC2 | 0.1V to 1.8V |
| 8 | VR6 | 2.8V |
| 9 | VR2 | 2.8V |
| 10 | VR1B | 4.8V |

*Vbatt also appears at the outputs of the PAs.

### Tx DC and RF Test Points – Top Side

Following are the Tx DC and RF test points located on the top side of the main PWB.

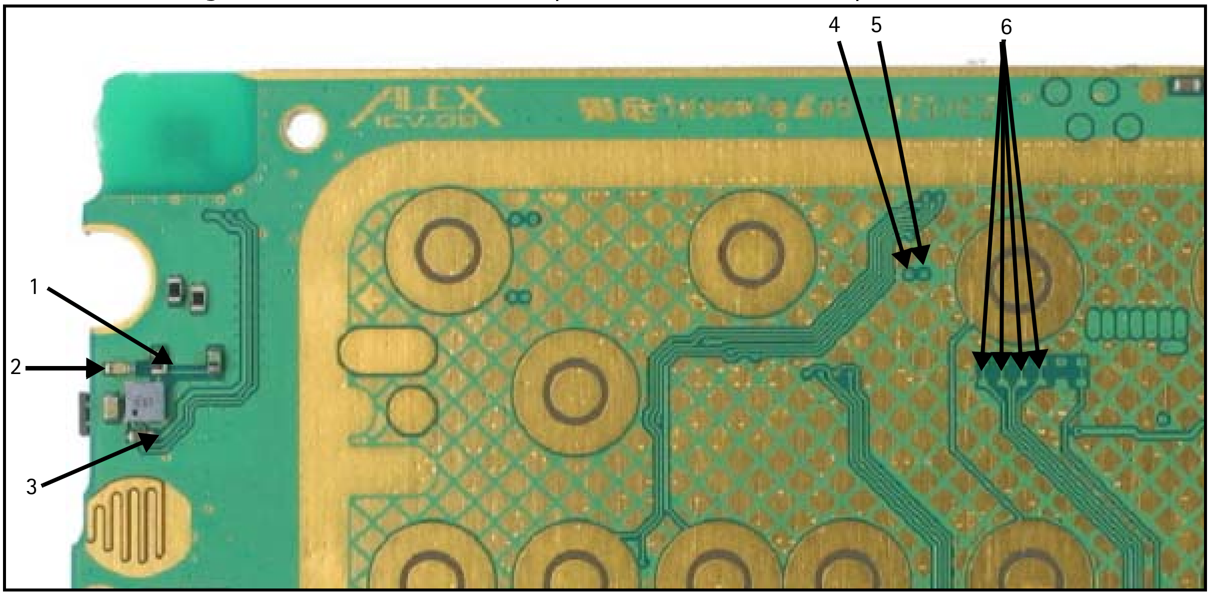



**Figure 19: Tx DC and RF test points on the top side of the main PWB**

Table 5 shows the values for the test points in Figure 19.

**Table 5: Tx DC Test Point Description and Values - Main PWB - Top Side**

| Test Point | Description | Values |
|---|---|---|
| 1 | Power detector input | AMPS: -5dBm at 836.25MHz<br>Cell: -3dBm at 836.25MHz<br>PCS: -6dBm at 1880MHz |
| 2 | Power detector output | AMPS/Cell:<br>1.9V at <5dBm<br>1.8V at 15dBm<br>1.2V at 25dBm<br><br>PCS:<br>1.9V at <5dBm<br>1.8V at 15dBm<br>1.3V at 25dBm |
| 3 | Power detector VR2 | 2.8V |
| 4 | AGC2 | 0.1V to 1.8V |
| 5 | AGC1 | 0.1V to 1.8V |
| 6 | Tx IQ in | ~1.2V<br>With oscilloscope:<br>Approximately 500 mV p-p with +1.2V offset |

### Tx RF Test Points – Bottom Side

Figure 20 shows the Tx RF test points located on the bottom side of the main PWB.

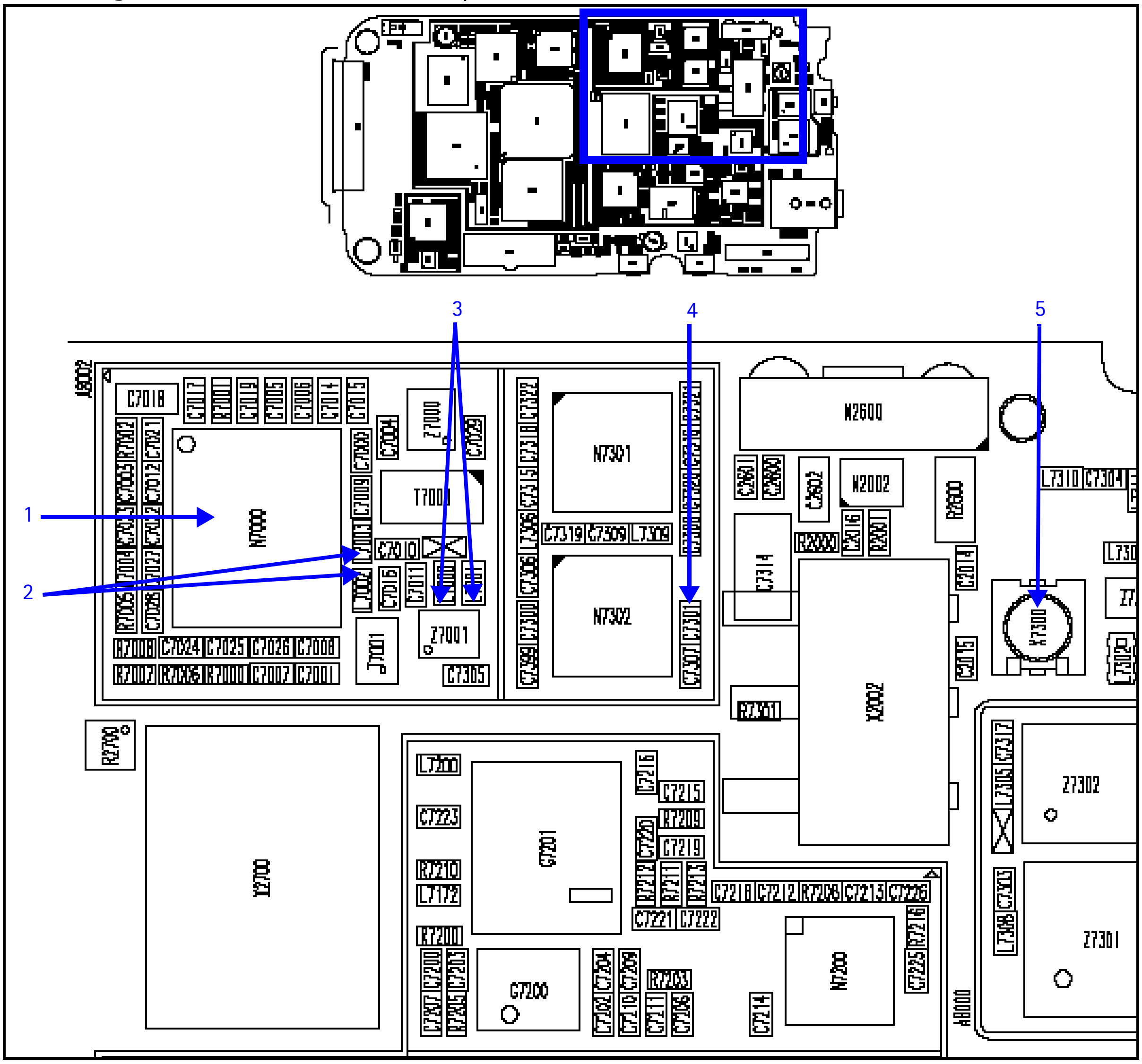



**Figure 20: Tx DC and RF test points on the bottom side of the main PWB**

Table 6 shows the values for the test points in Figure 20. These values are based on a PCS frequency of 1880MHz and an AMPS/Cell frequency of 836.25MHz.

**Table 6: Tx RF Test Point Descriptions and Values – Main PWB – Bottom Side**

| Test Point | Description | Values |
|---|---|---|
| 1 | Tx UHF LO | Cell: 3346.08MHz -57dBm<br>PCS: 3760MHz -54dBm |
| 2 | PCS N7000 out | -15dBm |
| 3 | Cell N7000 out | Cell: -8dBm<br>AMPS: -15dBm |

Table 6: Tx RF Test Point Descriptions and Values – Main PWB – Bottom Side (Continued)

| Test Point | Description | Values |
|---|---|---|
| 4 | PCS PA out | 11dBm |
| 5 | RF out | AMPS: +14dBm<br>Cell: +20dBm<br>PCS: +20dBm |

## RF Power Supply DC Test Points – Bottom Side

Following are the RF power supply DC test points located on the bottom side of the main PWB.

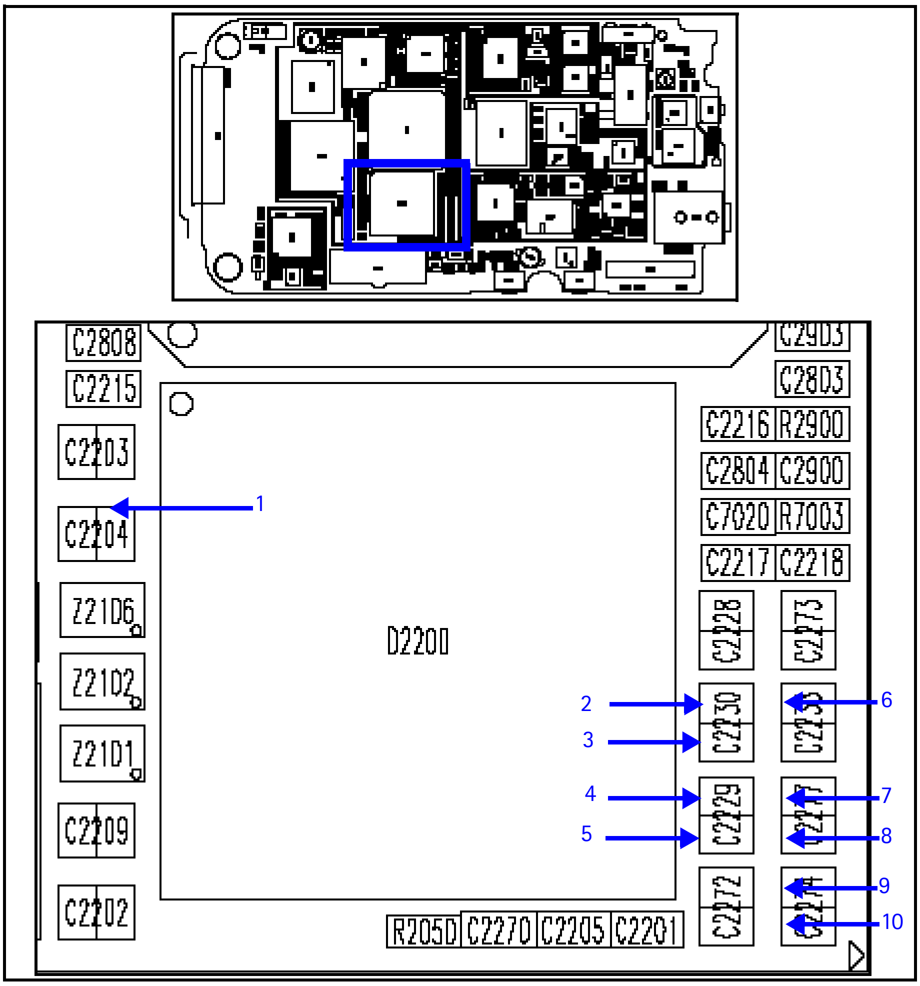



Figure 21: RF power supply DC test points on the bottom side of the main PWB

Table 7 shows the values for the test points in Figure 21.

**Table 7: RF Power Supply DC Test Points (Main PWB - Bottom Side)**

| Probe Point | Description | Value |
|---|---|---|
| 1 | VIO | 1.8V |
| 2 | VrefRF1 | 1.4V (Tx) |
| 3 | VR7 | 2.8V (Rx) |
| 4 | VR6 | 2.8V (Tx) |
| 5 | VR2 | 2.8V (Tx) |
| 6 | VR3 | 2.8V (Synthesizer) |
| 7 | VR5 | 2.8V (Rx) |
| 8 | VR4 | 2.8V (Rx) |
| 9 | VR1A | 4.7V (Synthesizer) |
| 10 | VR1B | 4.7V (Tx) |

## Receiver RF Troubleshooting

The heart of the receiver is the N7160 Rx IC, which contains two LNAs and mixers. The other components are passive. There are two RF SAW filters for the Cell and PCS bands. In addition, there are two additional IF filters, an IF SAW for CDMA and an IF Crystal for AMPS. The back-end of the receiver consists of the N7100 IC, which handles the VGA and IQ demodulator functions.

## Receiver Block Diagram

Following is the Rx system block diagram.

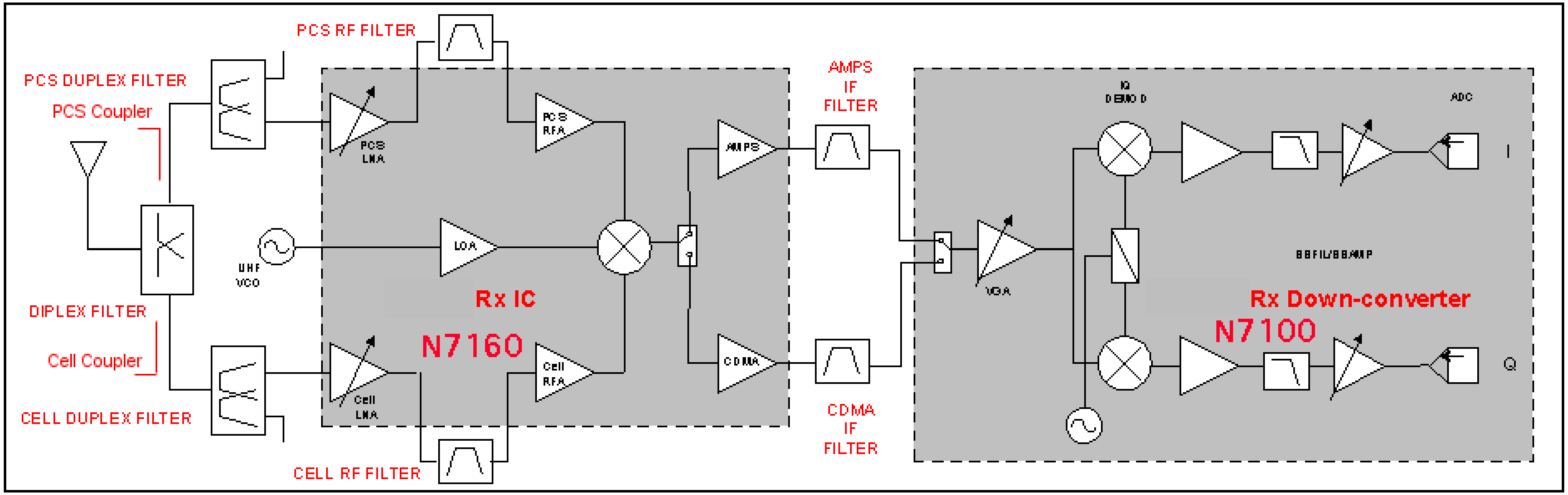



Figure 22: Receiver system block diagram

## Receiver Schematics

The following schematics are for general reference only. See the *Schematics* chapter for detailed versions.

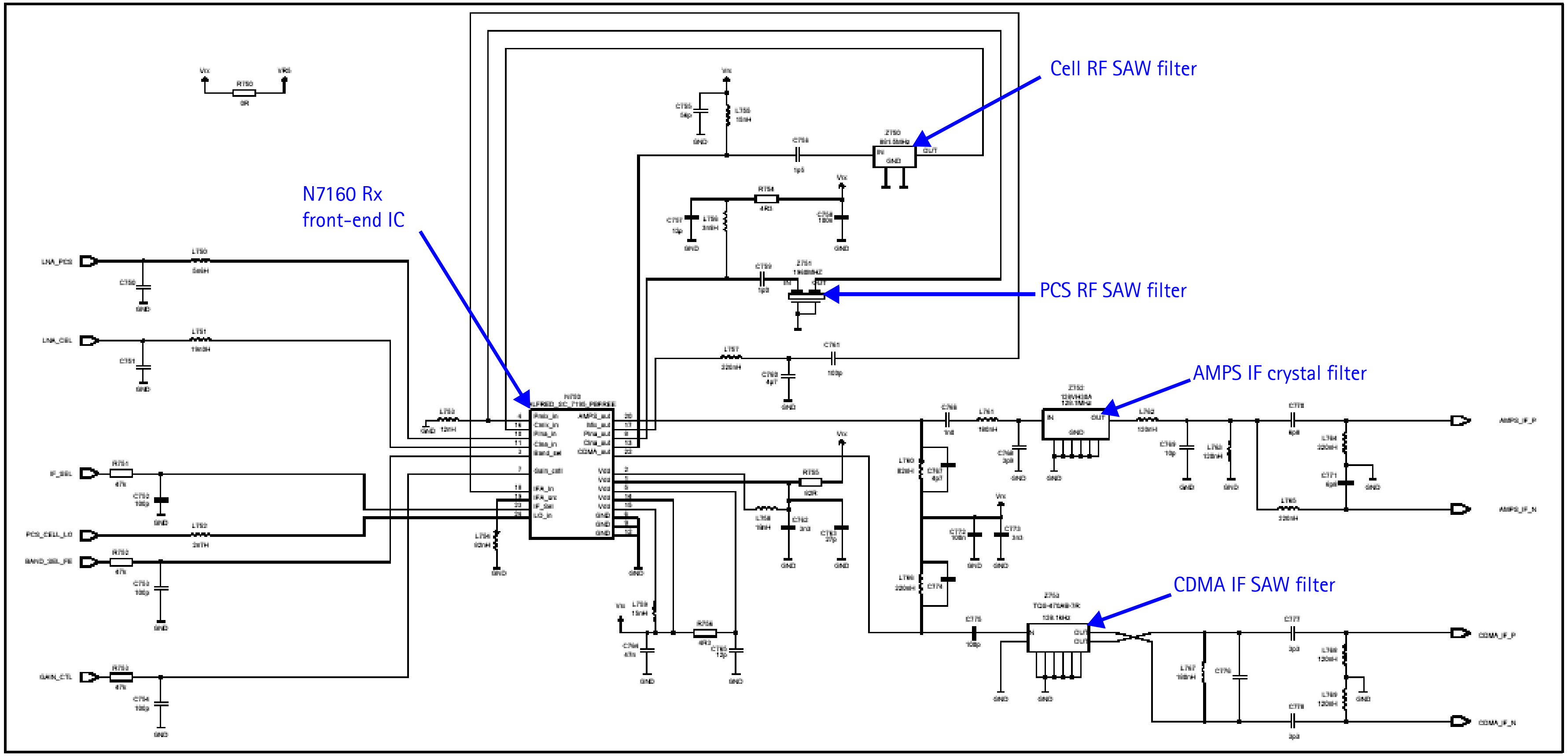



**Figure 23: Receiver schematics – 1**

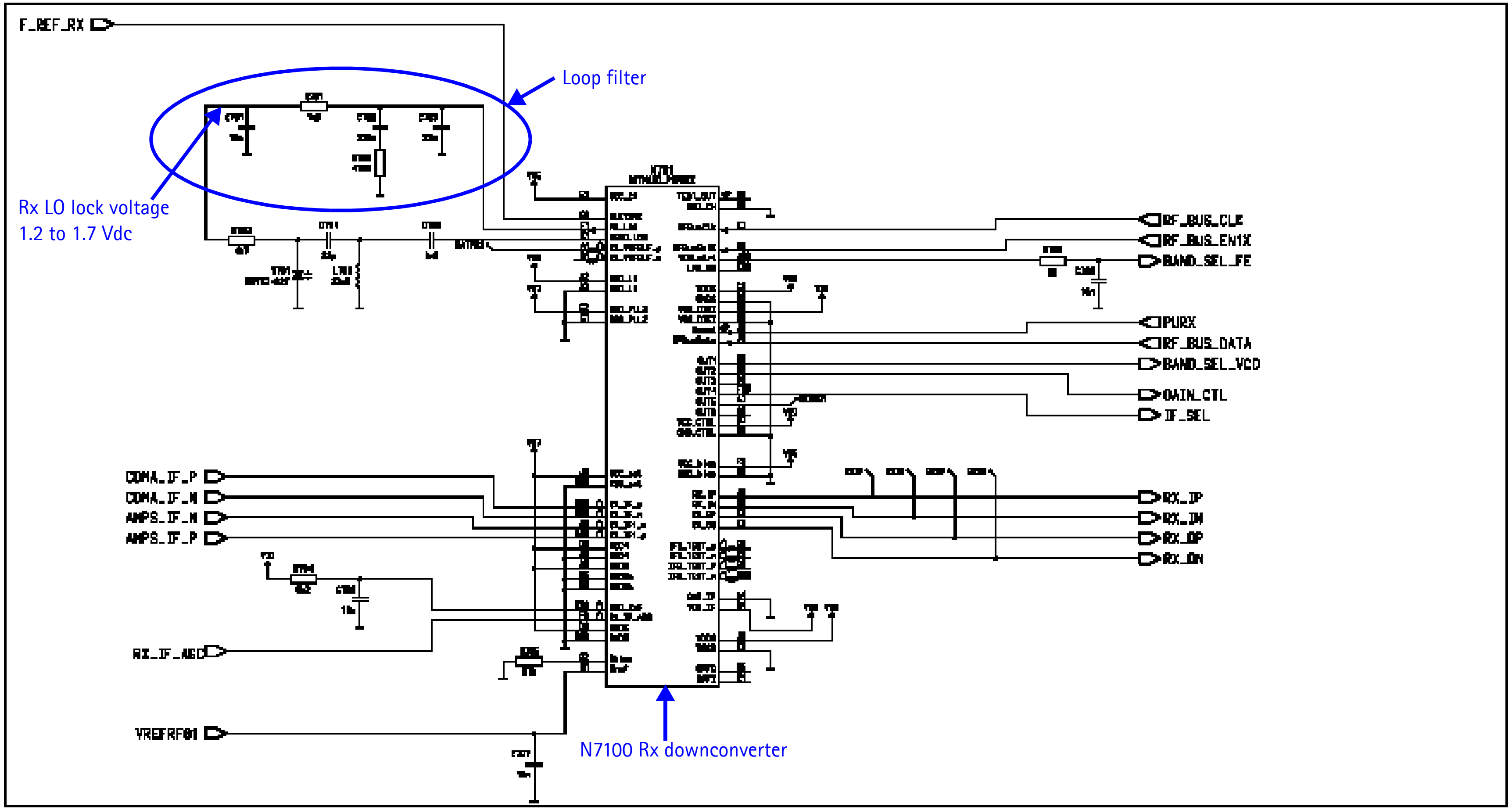



**Figure 24: Receiver schematic – 2**

## RF AGC Status

When configuring the values on the **RF AGC Status** dialog box, note the following:

- The RF AGC status functionality only works in Call Mode.
- In the **PLL Lock Status** area, bright green indicates a locked PLL and dark green indicates an unlocked PLL.
- In the **Baseband Type** field, ensure that the correct baseband is selected (Tiku BB 4.5).
- Clicking the **Stop Updating** button allows you to toggle between the **Update Every 2 Seconds** and **Stop Updating** functions.

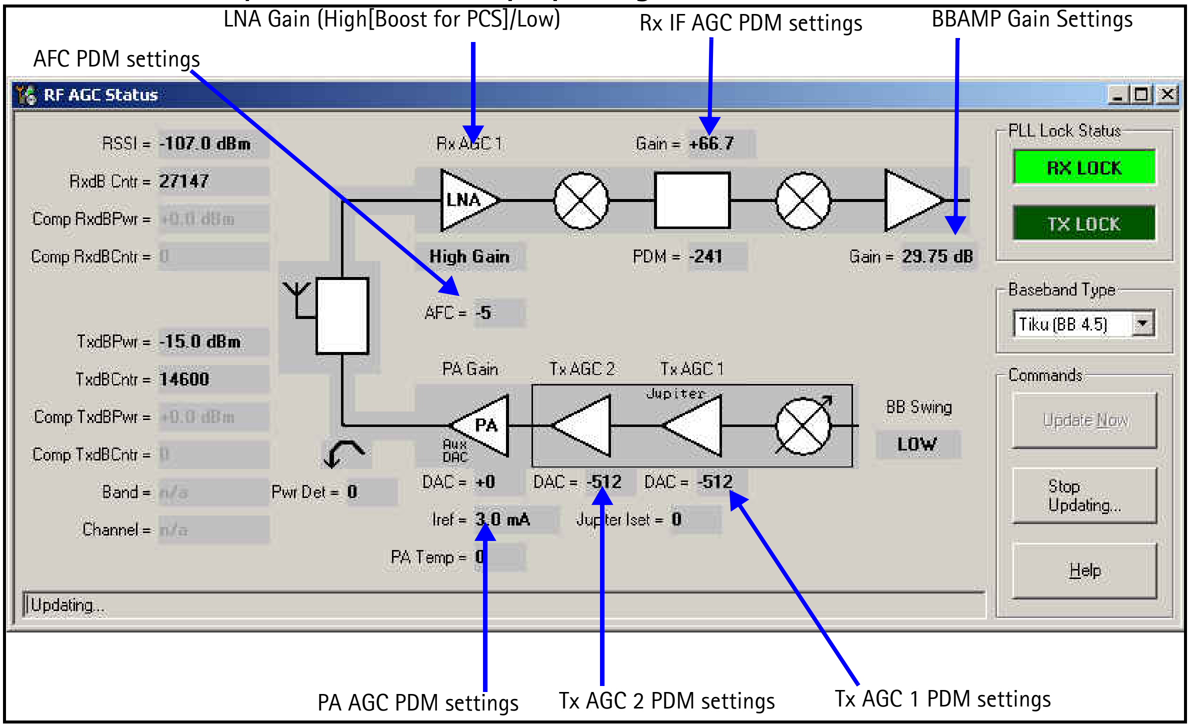



**Figure 25: RF AGC Status dialog box**

## Turning on the Rx Path

Use the following steps to turn on the Rx path using Phoenix.

1. On the **Phone Control** dialog box, click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode.

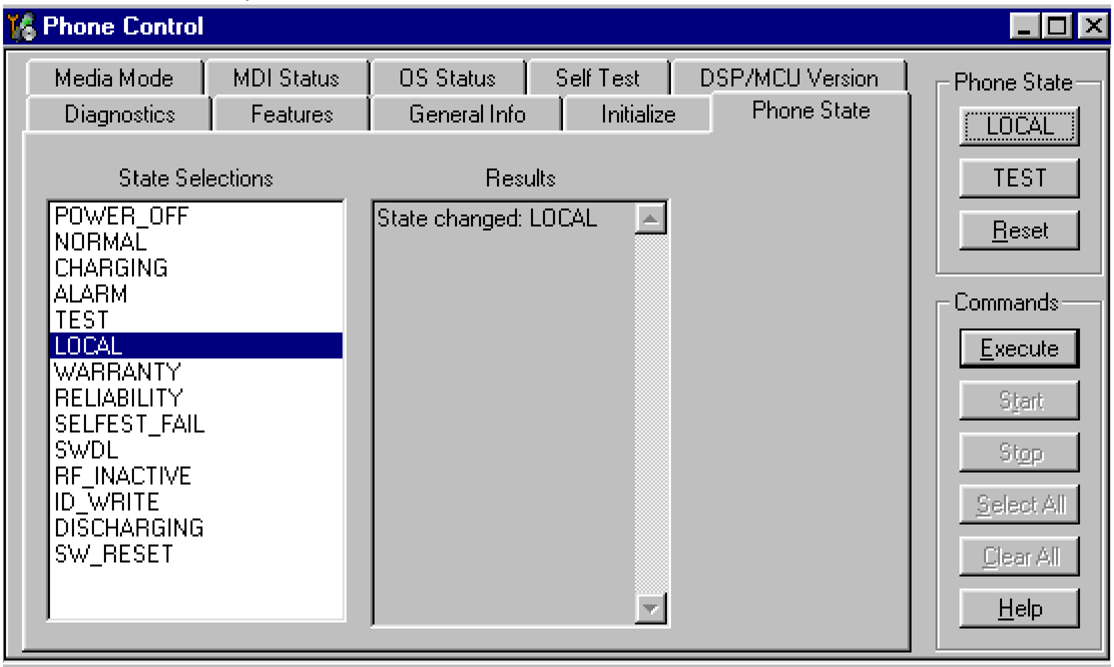



**Figure 26: Phone Control dialog box**

2. Click the **Execute** button.

3. Depending on the band, use the applicable settings from the table below on the **RF Main Mode** dialog box.

**Table 8: RF Main Mode Dialog Box Settings**

| Band | Mode | Channel |
|---|---|---|
| AMPS | Rx = 881.52 MHz | 384 |
| Cell | Rx = 881.52 MHz | 384 |
| PCS | Rx = 1960 MHz | 600 |

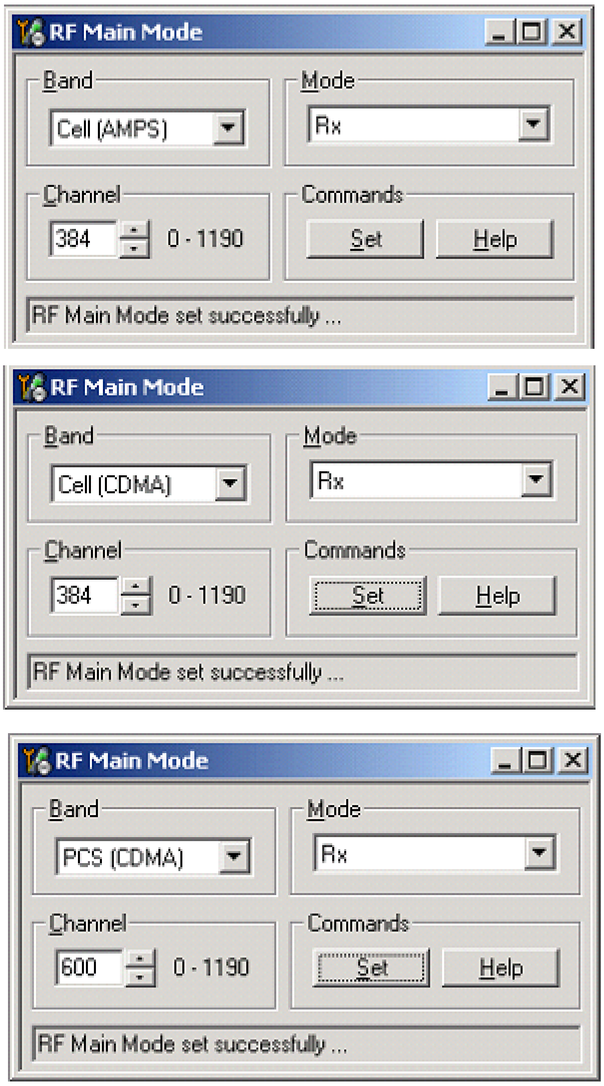



**Figure 27: RF Main Mode dialog box for AMPS (top), Cell (middle), and PCS (bottom)**

## Switching the Rx Gain States

Use the **RF Gen I/O** dialog box to switch the gain state (Hi and Lo) for CDMA and AMPS modes.

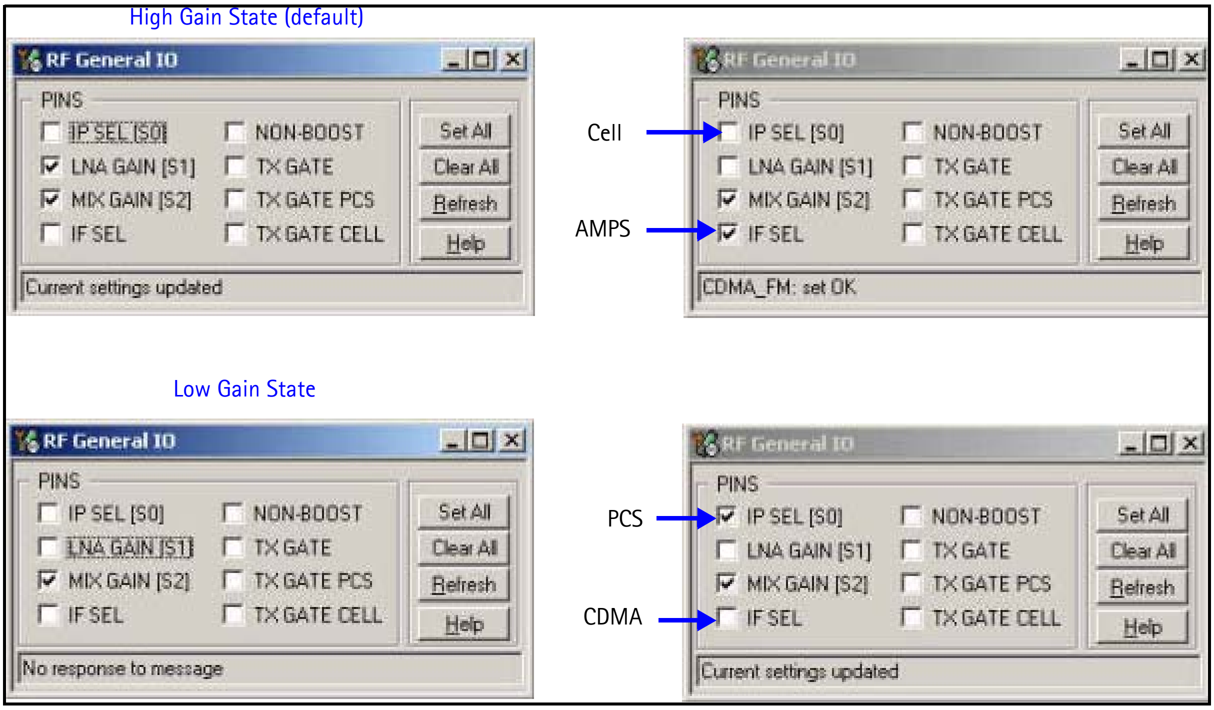



**Figure 28: RF Gen I/O dialog box**

### Checking AMPS from RF to IQ

Use the following steps to check the AMPS receiver functionality from RF to IQ output.

1. Start Phoenix in Local Mode with only the Rx path turned on.
2. Inject a –75dBm CW signal of 881.53MHz (i.e. 10kHz offset from 881.52MHz) into the RF.
3. Measure a 10kHz tone on the analyzer. You should see a typical -20Bm IQ tone for AMPS.

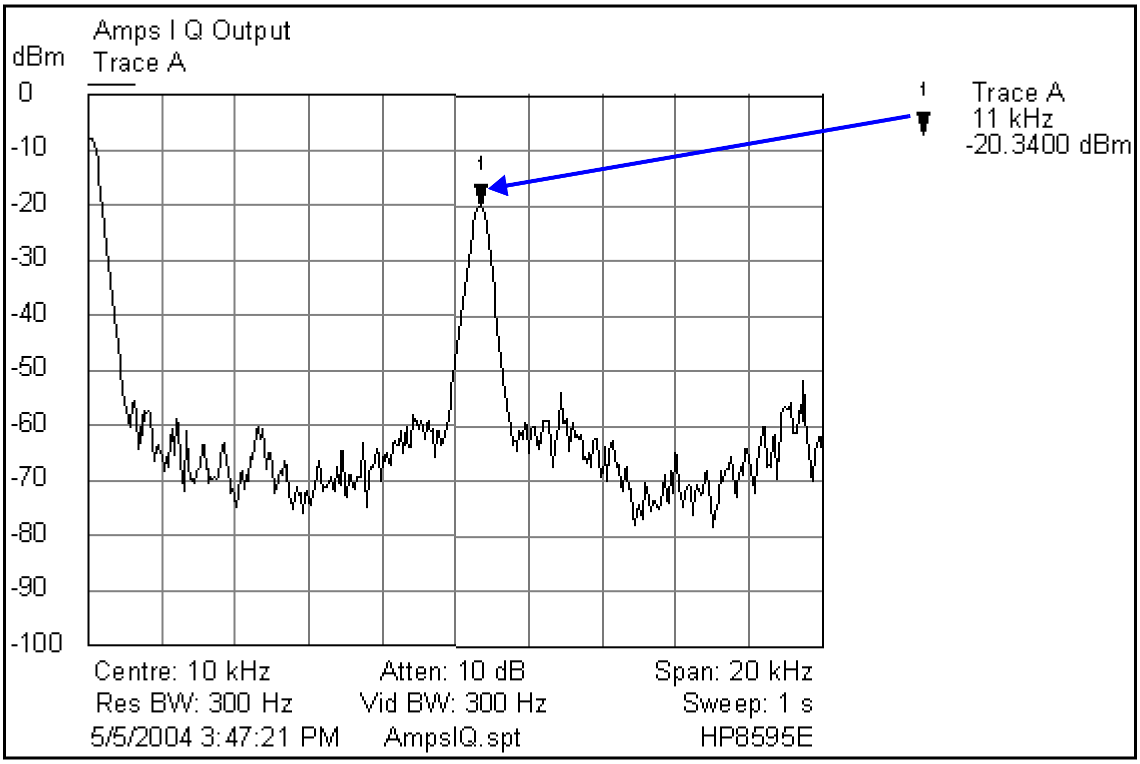



**Figure 29: Receiver IQ Level on AMPS band**

Figure 30 shows the AMPS spectrum and the test points located on the top side of the main PWB. All four test points should be approximately equal. *WARNING: Direct current is present on these test points.*

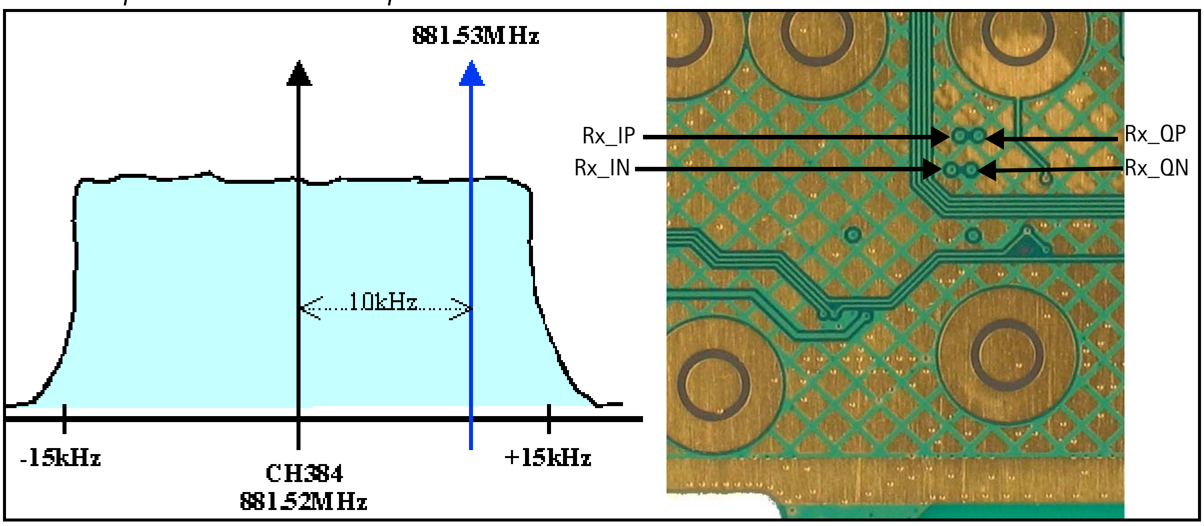



**Figure 30: AMPS spectrum and the test points on the top side of the main PWB**

## Checking Cell Receiver from RF to IQ

Use the following values to check the Cell receiver functionality RF to IQ output.

1. Start Phoenix in Local Mode with only the Rx path turned on.
2. Inject a –75dBm CW signal of 881.82MHz (i.e. 300kHz offset from 881.52MHz or 10 channels away).

3. Measure a 300kHz tone on the analyzer. You should see a typical -21dBm IQ tone for CDMA Cell.

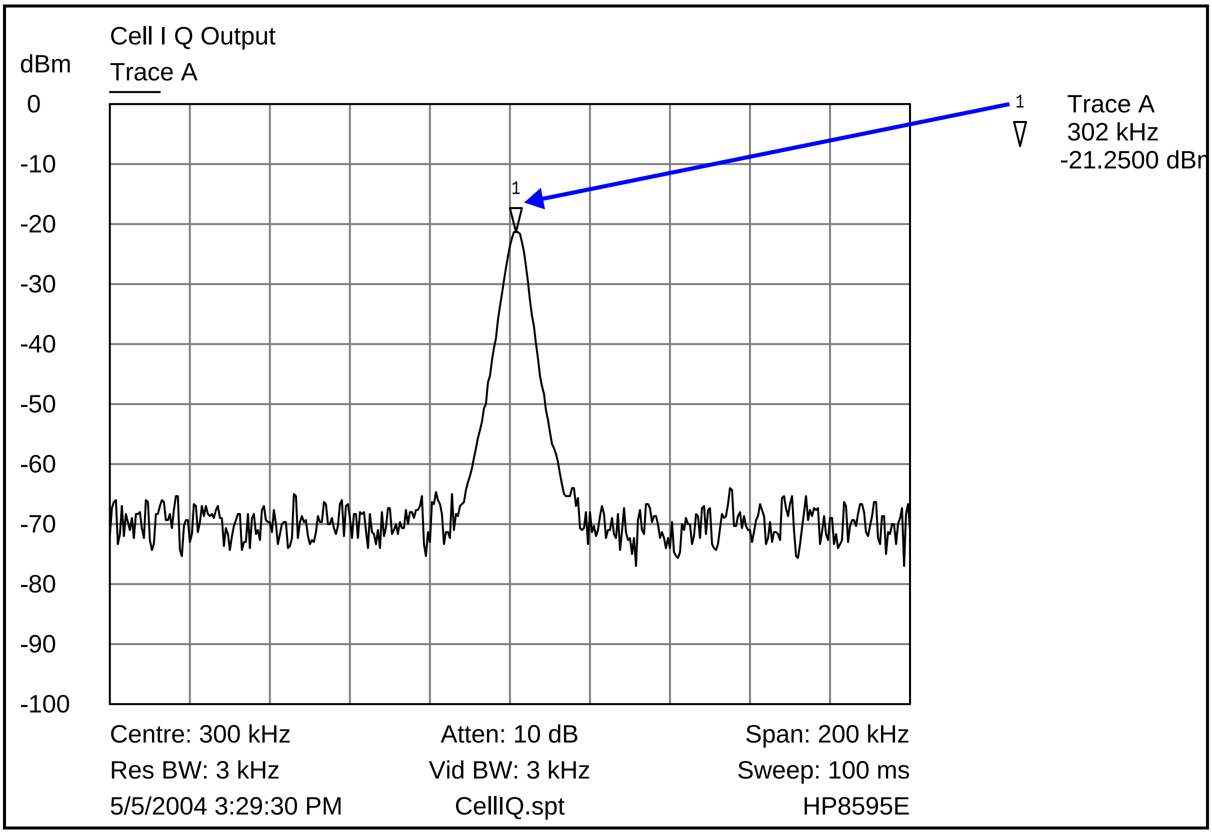



**Figure 31: Receiver IQ level on Cell band**

Figure 32 shows the Cell spectrum and the test points located on the top side of the main PWB. All four test points should be approximately equal. *WARNING: Direct current is present on these test points.*

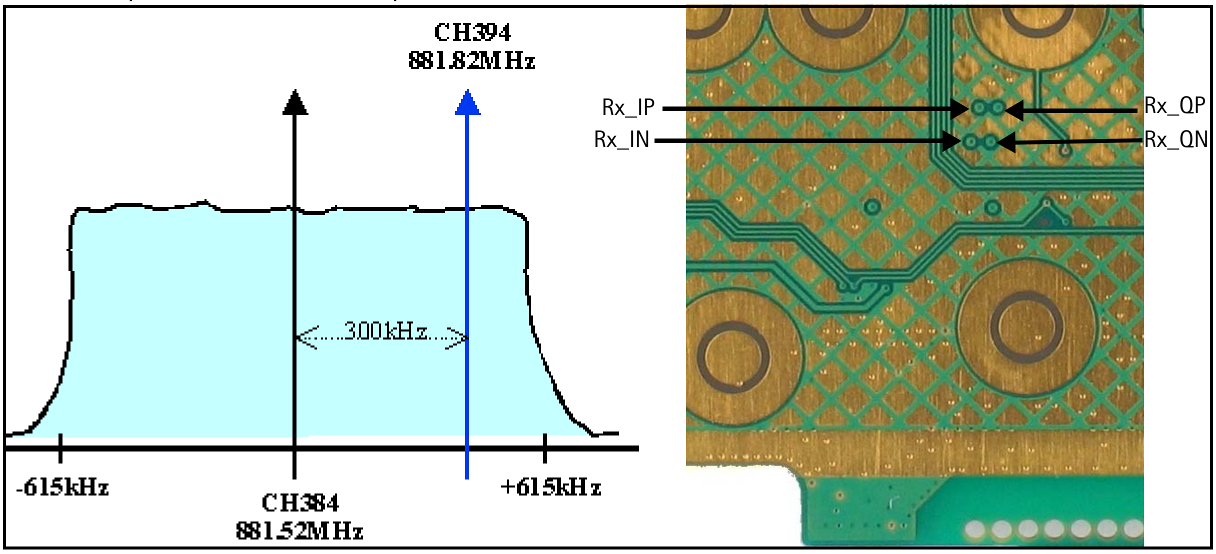



**Figure 32: Cell spectrum and test points on the top side of the main PWB**

### Checking PCS Receiver from RF to IQ

Use the following values to check the PCS receiver functionality from RF to IQ output.

1. Start Phoenix in Local Mode with only the Rx path turned on.
2. Inject a –75dBm CW signal of 1960.5MHz (i.e. 500kHz offset from 1960MHz or 10 channels away).
3. Measure a 500kHz tone on the analyzer. (If a 300kHz tone works but a 500kHz tone does not, the problem is in the BB filter, possibly not set by Phoenix.) You should see a typical -22dBm IQ tone for CDMA PCS.

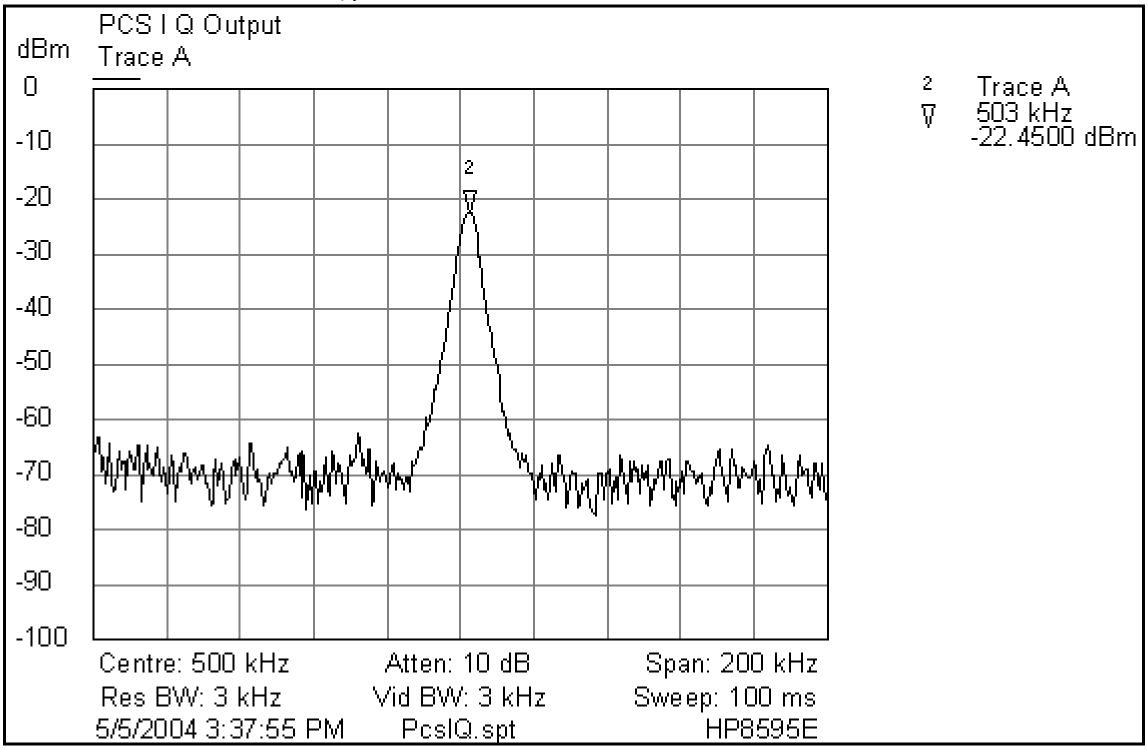



**Figure 33: Receiver IQ Level on PCS Band**

Figure 33 shows the PCS spectrum and the test points located on the top side of the main PWB. All four test points should be approximately equal. *WARNING: Direct current is present on these test points.*

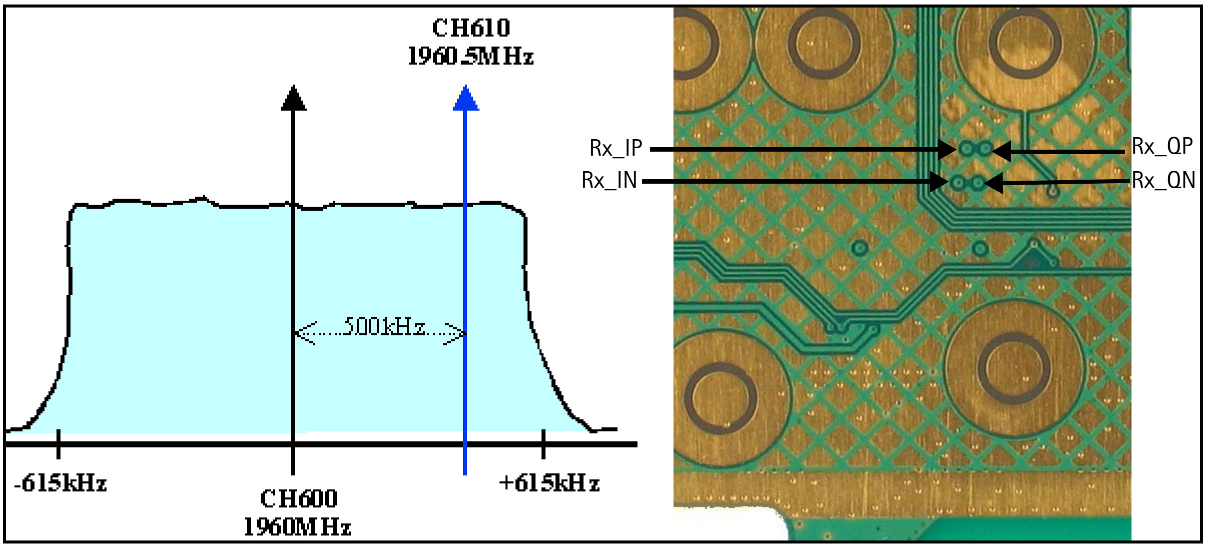



Figure 34: PCS spectrum and the test points on the top side of the main PWB

## Receiver Diagnostic Signal Tracing

Use the following steps to trace the receiver signal.

1. Inject an external signal source of –25dBm to the RF input. An Agilent call box 8960 is recommended.
2. Press the Call Setup button, press the Active Cell soft button, and select CW.
3. Inject a CW signal for PCS (1960MHz) or Cell/AMPS (881.52MHz) at a fixed -25dBm power level.
4. Use an AAS-10 probe to take measurements. Signal levels are approximate, and accuracy may be +/- 2dB or more depending on the position and grounding of the probe.

### Receiver DC Test Points

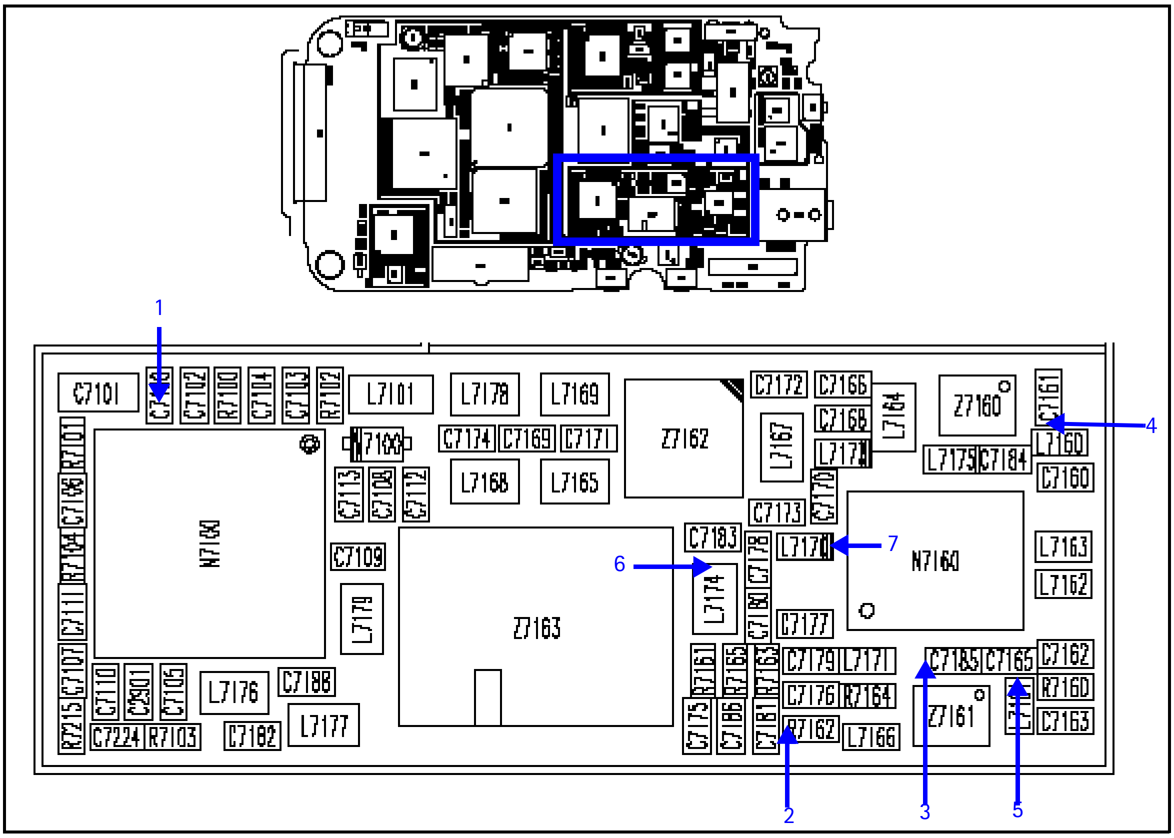



**Figure 35: Receiver DC troubleshooting test points on the bottom side of the main PWB**

Table 9 includes the descriptions and values for the Rx DC test points from Figure 35.

**Table 9: Receiver DC Test Point Values**

| Test Point | Description | Value |
|---|---|---|
| 1 | Rx LO lock voltage | 1.2 to 1.7 Vdc |
| 2 | LO Vdd | 2.6 VDC LO Amp supply lines for Cell and PCS |
| 3 | RFA Vdd | 2.8 VDC RF Amp Vdd supply line for Cell band |
| 4 | C_LNA Vdd | 2.8 VDC external VDd supply line for Cell LNA |
| 5 | P_LNA Vdd | 2.8 VDC external Vdd supply line for PCS LNA |
| 6 | IFA Vdd | 2.8 VDC IF Amp Vdd supply line for CDMA and AMPS IFs |
| 7 | IFA Vdd | 2.8 VDC IF Amp Vdd supply line for CDMA and AMPS IFs |

### Receiver RF Test Points

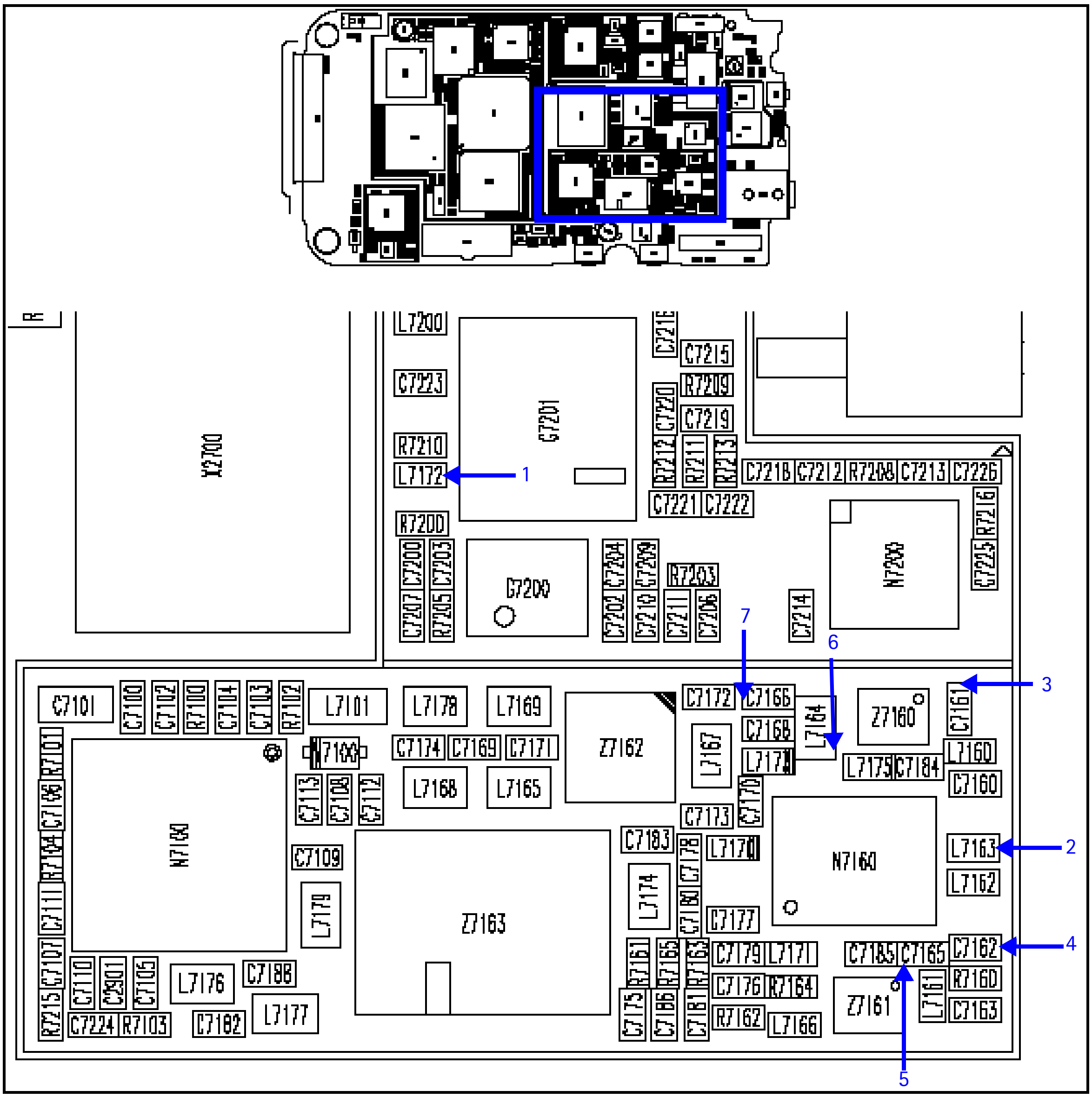



Figure 36: Rx RF test points on the bottom side of the main PWB

Table 10 includes the descriptions and values for the Rx RF test points from Figure 36.

Table 10: Receiver RF Test Point Values

| Test Point | Description | Value |
|---|---|---|
| 1 | PCS_CEL_LO (from VCO) | Cell: 1009.62MHz at -15dBm<br>PCS: 2088.1MHz at -17dBm |
| 2 | Cell channel 384 (from duplexer) | 881.52MHz at -33dBm |
| 3 | Cell channel 384 (to RF SAW) | High gain: 881.52MHz at -21dBm<br>Low gain: 881.52MHz at -36dBm |
| 4 | PCS channel 600 (from duplexer) | 1960MHz at -46dBm |

Table 10: Receiver RF Test Point Values (Continued)

| Test Point | Description | Value |
|---|---|---|
| 5 | PCS channel 600 (to RF SAW) | High gain: 1960MHz at -32dBm<br>Low gain: 1960MHz at -49dBm |
| 6 | IF MIX OUT (from N7160) | High gain: 128.1MHz at -21dBm<br>Low gain: 128.1MHz at -34dBm |
| 7 | IFA_IN (to N7160) | High gain: 128.1MHz at -18dBm<br>Low gain: 128.1MHz at -34dBm |

## Receiver IF Test Points

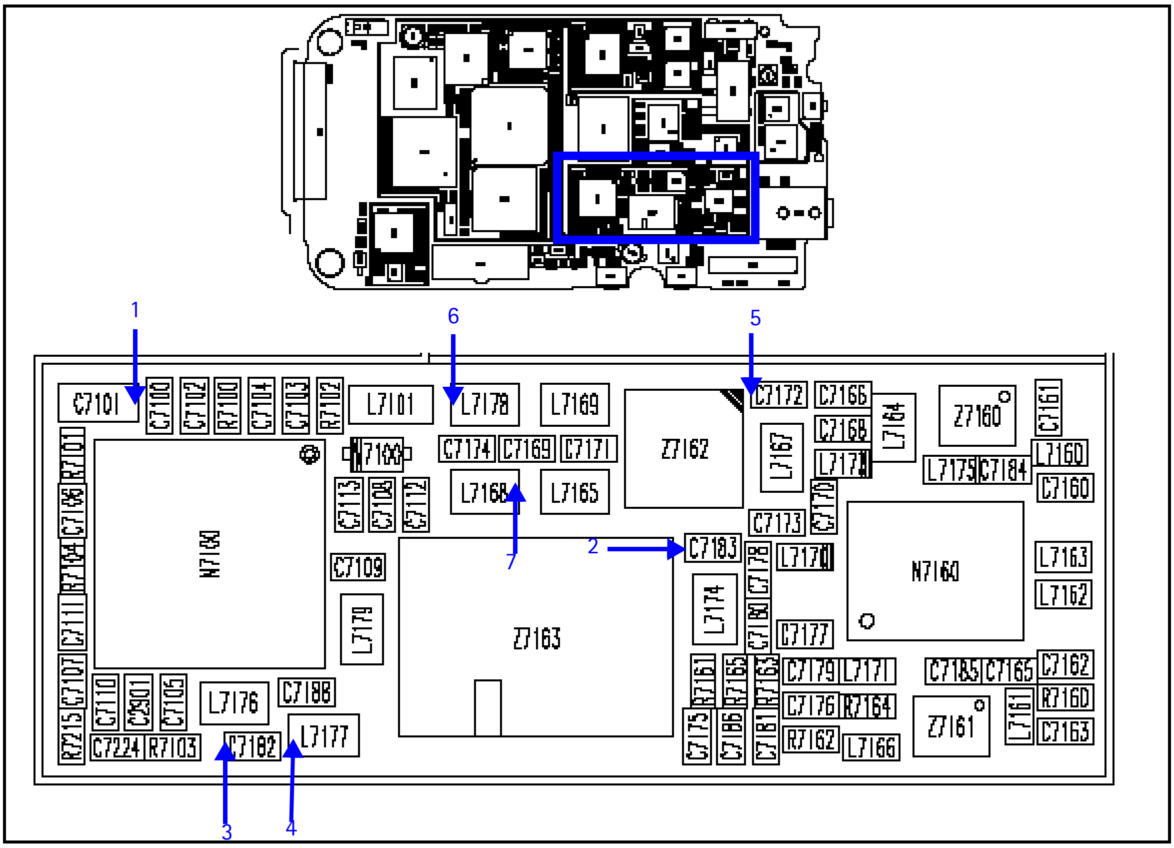



Figure 37: Receiver IF test points on the bottom side of the main PWB

Table 11 includes the descriptions and values for Rx IF test points from Figure 37.

Table 11: Receiver IF Test Point Values

| Test Point | Description | Value |
|---|---|---|
| 1 | Rx VHF LO | 256.2MHz at -70dBm |
| 2 | CDMA IF (to SAW) 128.1MHz | High gain: Cell channel 384 at -9dBm<br>Low gain: Cell channel 384 at -25dBm<br>High gain: PCS channel 600 at -8dBm<br>Low gain: PCS channel 600 at -24dBm |

Table 11: Receiver IF Test Point Values (Continued)

| Test Point | Description | Value |
|---|---|---|
| 3 | CDMA_IF_P (to the N7100) 128.1MHz | Cell high gain: -29dBm<br>Cell low gain: -45dBm<br>PCS high gain: -29dBm<br>PCS low gain: -45dBm |
| 4 | CDMA_IF_N | Cell high gain: -29dBm<br>Cell low gain: -45dBm<br>PCS high gain: -29dBm<br>PCS low gain: -45dBm |
| 5 | AMPS IF (to MCF) 128.1MHz | High gain: Cell channel 384 at -19dBm<br>Low gain: Cell channel 384 at -35dBm |
| 6 | AMPS_IF_N (to the N7100) 128.1MHz | Cell high gain: -28dBm<br>Cell low gain: -44dBm |
| 7 | AMPS_IF_P | Cell high gain: -28dBm<br>Cell low gain: -44dBm |

## Receiver Logic Input Voltages

Figure 38 shows the receiver logic input voltages.

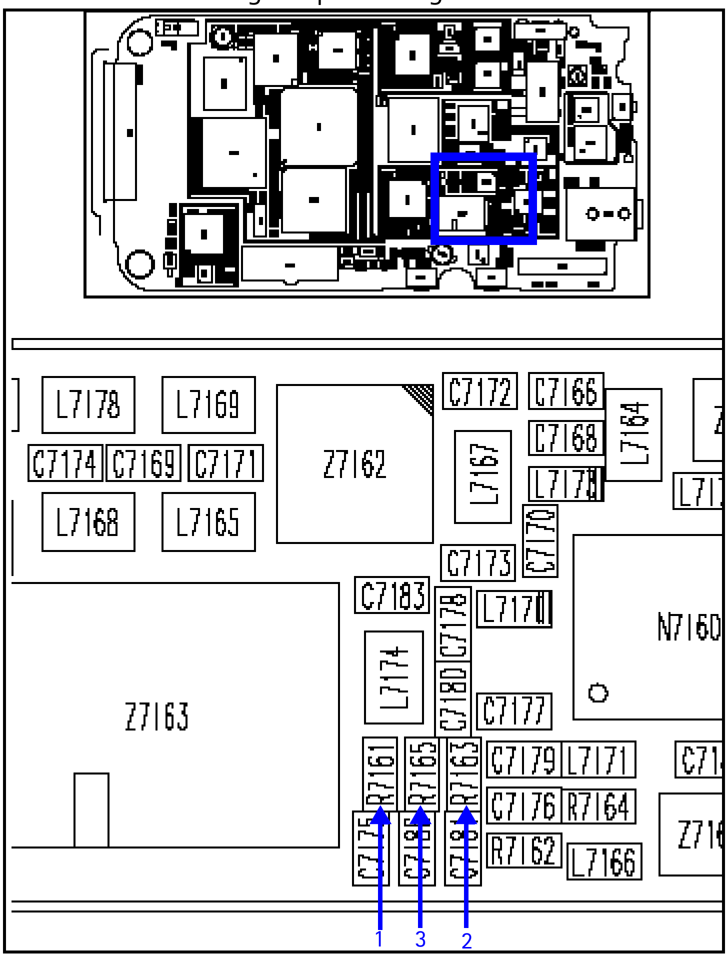



Figure 38: Receiver logic input voltage test points

Table 12 includes the measure logic levels for the N7160.

**Table 12: Rx Front-end (N7160) Logic Levels**

| Mode | Logic Input Voltages | | |
|---|---|---|---|
| | IF_SEL | BAND | GAIN_CTL |
| AMPS High Gain | 2.8 V | 0.1 V | 2.8 V |
| AMPS Low Gain | 2.8 V | 0.1 V | 0 V |
| Cell CDMA High Gain | 0 V | 0.1 V | 2.8 V |
| Cell CDMA Low Gain | 0 V | 0.1 V | 0 V |
| PCS CDMA High Gain | 0 V | 2.7 V | 2.8 V |
| PCS CDMA Low Gain | 0 V | 2.7 V | 0 V |

If the logic levels are significantly off (+/- 0.2V), replace the N7160 and re-measure. If the voltages are still out of specifications, refer to the *Baseband Troubleshooting* chapter.

## N7160 Receiver Overview

Keep the following points in mind regarding the N7160 receiver:

- There is a separate LNA for 800MHz (Cell and AMPS) and 1900MHz (PCS).
- There is a separate RFA (inside N7160) for 800MHz (Cell and AMPS) and 1900MHz (PCS).
- After the RFA, there is a mixer, and then the signals are separated by CDMA (Cell and PCS) and AMPS.

  For example, if there is no IF frequency (128.1MHz) check both Cell and PCS. If only one has 128.1MHz at L753, ensure that IF_SEL is working. If it is, then replace the N750 due to a bad RFA.

  If Cell and AMPS are working but PCS is not, look at the band select line and the PCS LNA before replacing the N7160.

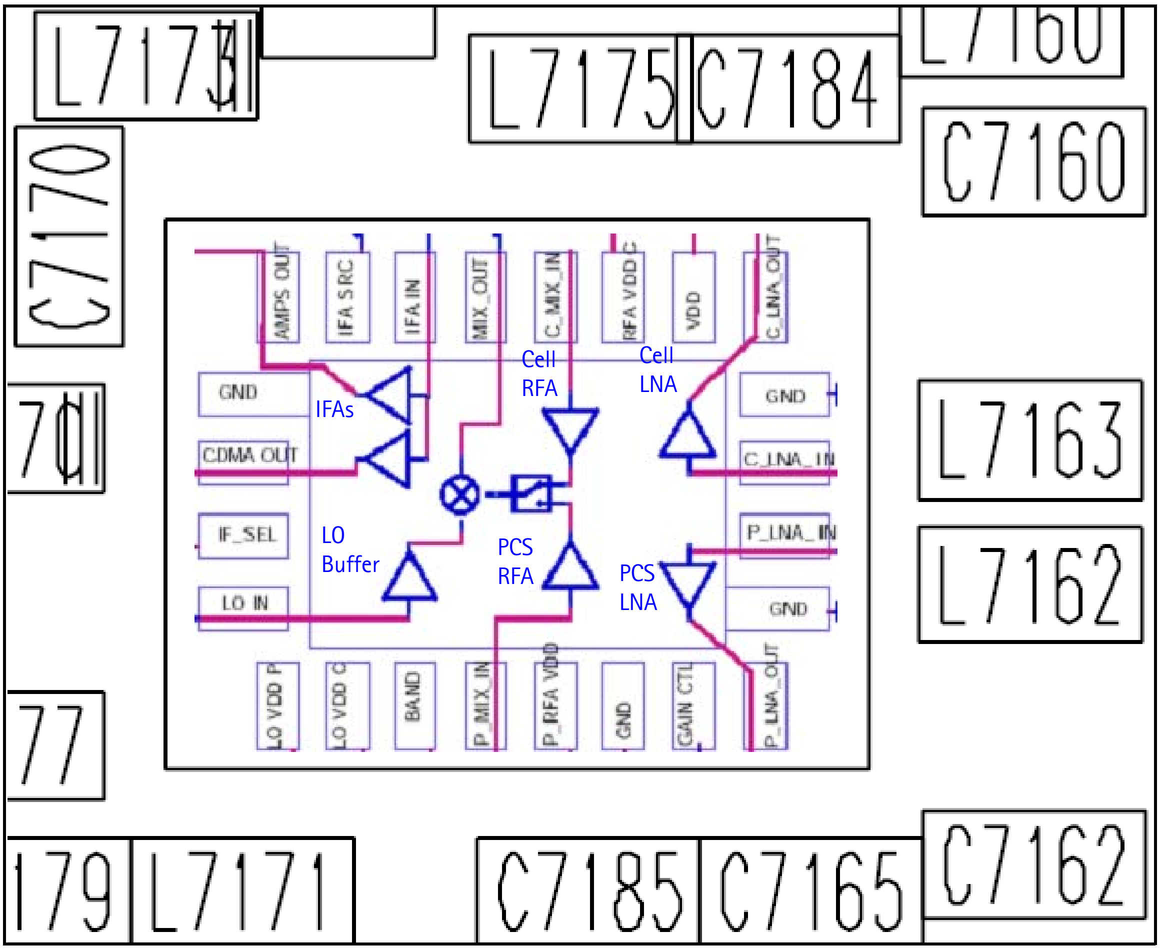



**Figure 39: N7160 receiver**

There are two common explanations for an N7160 failure consisting of high current in Local Mode with just the Rx turned on:

- No presence of an LO signal
- Input impedance drop is shorting out one of the DC supply pins to the chip

**IMPORTANT: You must check for both conditions before replacing the chip.** If you have no LO signal, refer to "UHF Synthesizer" on page 56. If you have a significant supply voltage drop on one of the supply pins, then replace the N7160.

**Table 13: N7160 Conditions and Supply Currents**

| Condition: Local Mode, Set Rx Only in RF Main Mode | Supply Current (From Power Supply) |
|---|---|
| Good mobile terminal | 100mA |
| No UHF LO signal present | 254mA |
| Pin 13 shorted | 255mA |

## Synthesizer Troubleshooting

Faulty synthesizers can cause both Rx and Tx failures during tuning, in addition to the VCTCXO tuning. However, first check for the presence of various LO signals and their proper levels. If everything fails, it may be necessary to check the reference clock (19.2MHz) which is needed for the mobile terminal to power up. The 19.2MHz signal is also important because the D2800 processor is sensitive enough to pick up a very weak 19.2MHz clock, resulting in intermittent problems such as a constant mobile terminal reset.

Following are the synthesizers used in the mobile terminal:

- Dual-band UHF (1009.62MHz for channel 384 in Cell and AMPS bands, and 2088.1MHz for channel 600 in PCS band) with a separate LMX2310 PLL IC
- Rx VHF (256.2MHz for Cell, AMPS, and PCS) with PLL inside the N7100 IC
- Tx UHF (3296.16MHz~3395.88 for Cell and AMPS, 3700~3819.9MHz for PCS) with PLL inside the N7000 IC

## Synthesizer Block Diagram

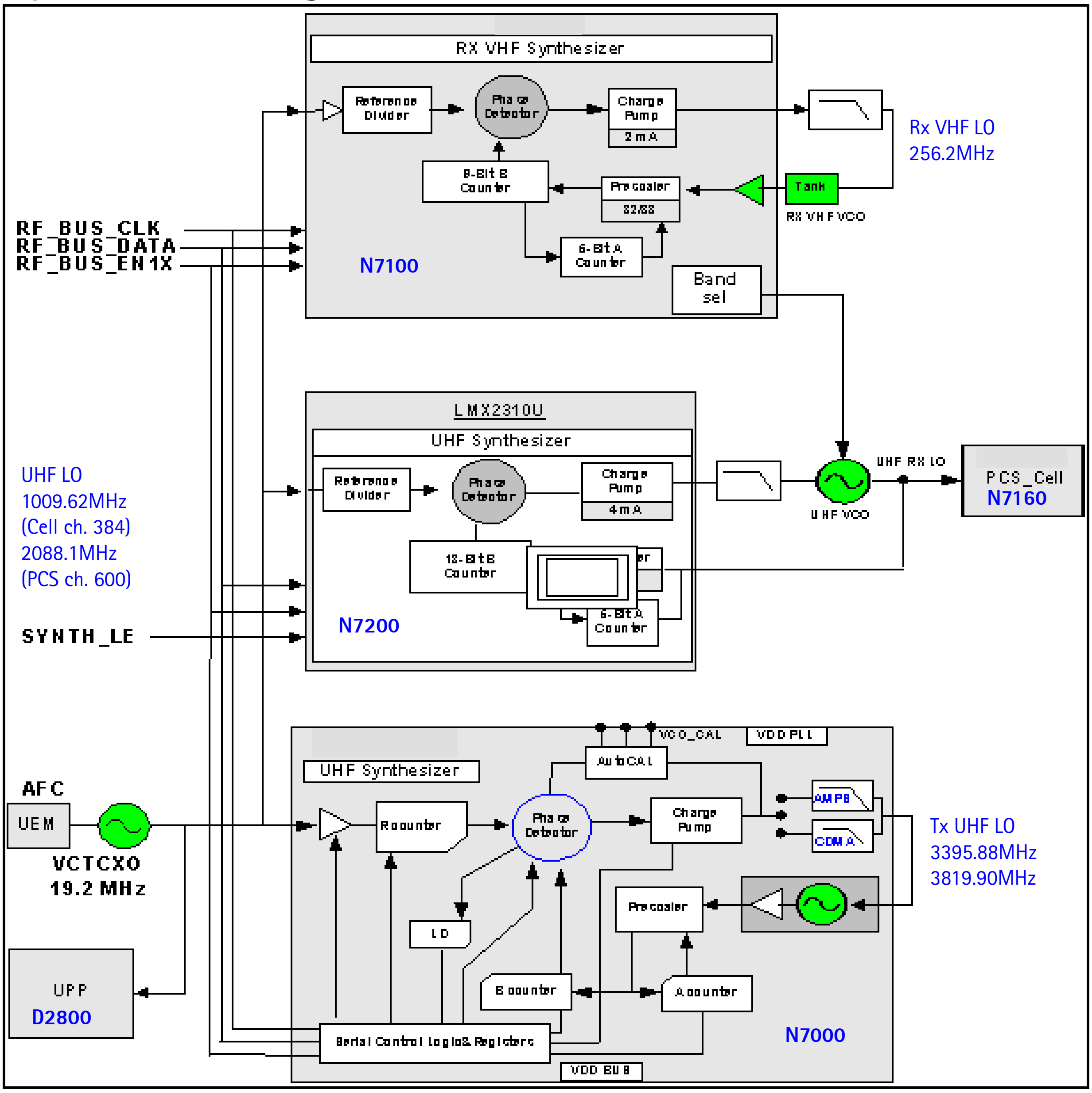



Figure 40: Synthesizer block diagram

## Synthesizer Schematics

The following schematics are for general reference only. See the *Schematics* chapter for detailed versions.

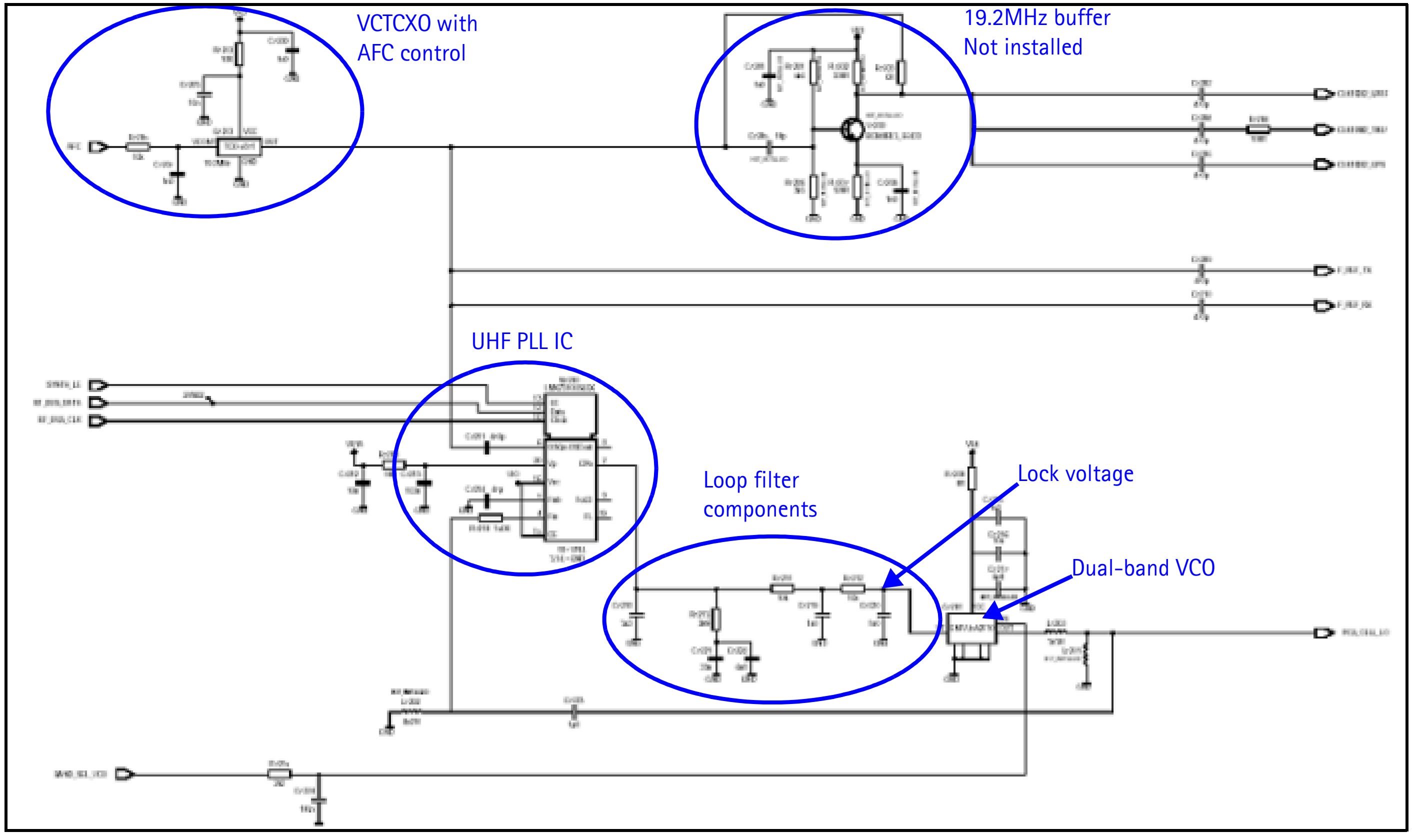



**Figure 41: Synthesizer schematic**

## Synthesizer Troubleshooting Setup

Use the following steps to troubleshoot the synthesizer using Phoenix:

1. On the **Phone Control** dialog box, click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode.

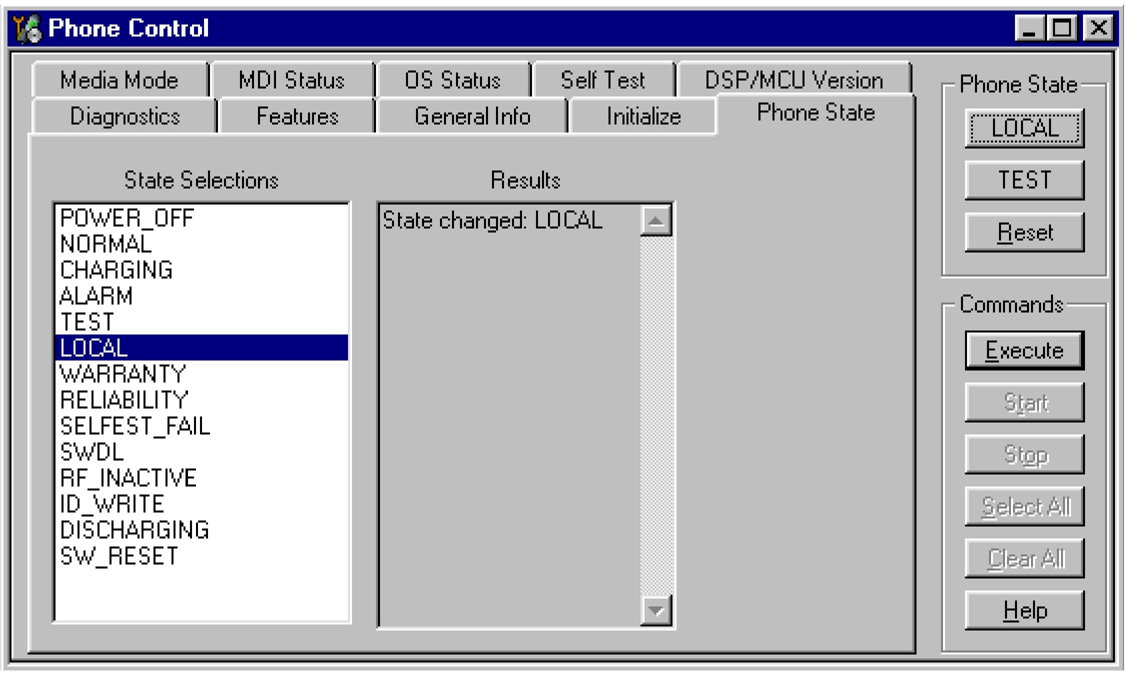



**Figure 42: Phone Control dialog box**

2. Select the following values on the **RF Main Mode** dialog box:.

**Table 14: RF Main Mode Dialog Box Settings**

| Synthesizer | Band | Mode | Channel |
|---|---|---|---|
| UHF | Cell | Rx/Tx | 384 |
| | PCS | Rx/Tx | 600 |
| Rx VHF | (one band is enough) | Rx | |
| Tx VHF | Cell | Rx/Tx | 384 |
| | PCS | Rx/Tx | 600 |

### Incorrect PLL Frequencies

Following are some possible causes for incorrect PLL frequencies:

- Power supplies to PLL portion
- Control line to VCO
- Loop filter or resonator components missing or incorrectly installed
- 19.2MHz reference clock missing or low
- Component failure (PLL IC, N7100, N7000, VCO, or VCTCXO)

## VCTCXO Troubleshooting

Without 19.2MHz, the mobile terminal does not power up. This signal goes to the N7100, N7000, D2800, and the UHF PLL. Check the test points in Figure 43 for the presence of the 19.2MHz signal.

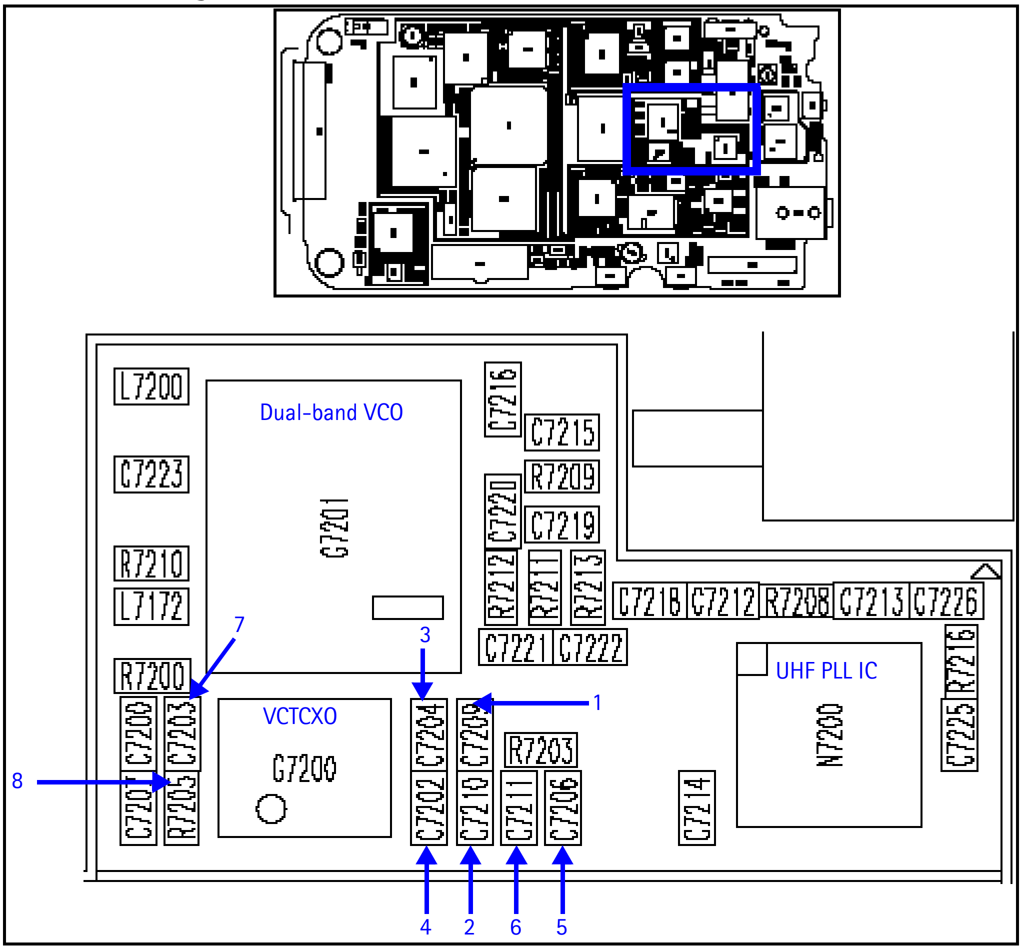



**Figure 43: VCTCXO test point output values**

Table 15 includes the descriptions and values for VCTCXO test points from Figure 43.

**Table 15: VCTCXO Test Point Output Values**

| Test Point | Description | Value |
|---|---|---|
| 1 | F_REF_TX, clock reference to the N7000 | ~ -9dBm |
| 2 | F_REF_RX, clock reference to the N7100 | ~ -9dBm |
| 3 | CLK19M2_TIKU, clock reference to Tiku | ~ -9dBm, and ~2 dB less on the other side of R7204 (located adjacent to the D2800) |
| 4 | CLK19M2_LPRF, clock reference to the Bluetooth subsystem | ~ -9dBm |
| 5 | CLK19M2_GPS, clock reference to the GPS subsystem | ~ -9dBm |
| 6 | OSC IN to UHF PLL | |

Table 15: VCTCXO Test Point Output Values (Continued)

| Test Point | Description | Value |
|---|---|---|
| 7 | If you do not see the VCTCXO signal at test points 1-5, check the voltage at VR3 | 2.8V |
| 8 | AFC voltage | 1 to 3 Volts (adjustable with the AFC slider on the RF PDM Control in Phoenix)<br>1.2V for PDM 0<br>0V for PDM -1024<br>2.4V for PDM 1024 |
| N/A | If an AFC voltage is missing, check the UEM. | |

### VCTCXO Manual Tuning

The VCTCXO can be manually tuned to verify when a mobile terminal is tuned incorrectly or if mobile terminal cannot make a call. Monitor the RF signal at the mobile terminal's output.

1. On the **Phone Control** dialog box, click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode. (See Figure 9 on page 16 for an example of the **Phone Control** dialog box.)
2. Click the **Execute** button.
3. On the **AMPS Control** dialog box, set the **Set Channel** field to 384, the **Power Level** field to 5, and select the **Transmitter ON** check box. (See Figure 10 on page 16 for an example of the **AMPS Control** dialog box.)
4. Click the **Rx RFI** tab, make sure the **AFC Control** check box is cleared, and click **Execute**.
5. The frequency accuracy of the VCTCXO can be measured using an HP8960 callbox in AMPS mode or a spectrum analyzer at the output of the transmit chain.
   - If using a spectrum analyzer, set the center frequency to 836.52MHz and the span to 2MHz initially. Establish a marker at 836.52Mhz.
   - If using an HP8960, set the callbox System Type to AMPS, and set the ACC channel to 384. Use the Frequency Stability measurement to center the VCTCXO (minimum Frequency Error).
6. Use the RF PDM component to adjust the AFC to center the VCTCXO. The tuning range is approximately +/-10kHz.
7. Adjust the AFC so that the output signal is within +/-150MHz. If using a spectrum analyzer, narrow the span to 1kHz or less.
8. Replace the UEM if the VCTCXO does not tune correctly.

## AFC Voltage Troubleshooting

Use the following steps to monitor the AFC voltage.

1. In Phoenix, open the **RF PDM** dialog box.

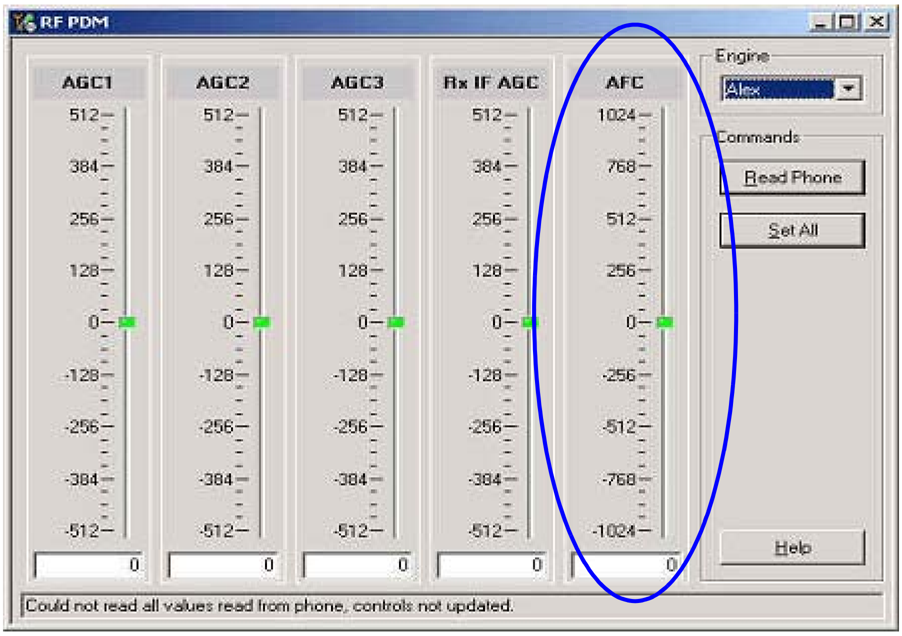



**Figure 44: RF PDM dialog box for AFC troubleshooting**

Figure 45 shows a partial schematic of the R7205.

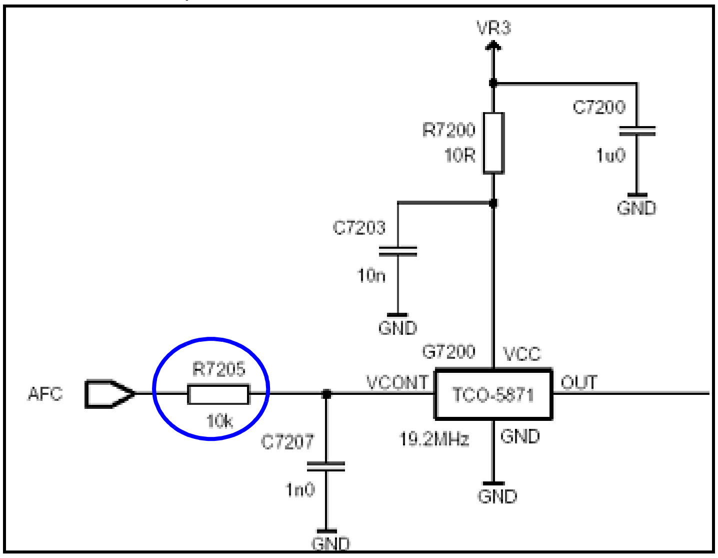



**Figure 45: Partial schematic showing the R7205**

2. Measure the DC voltage at R7205. The following typical voltages are shown in Figure 46.

- 1 = AFC PDM[-1024]=0V
- 2 = AFC PDM[0]=1.2V
- 3 = AFC PDM[1024]=2.4V

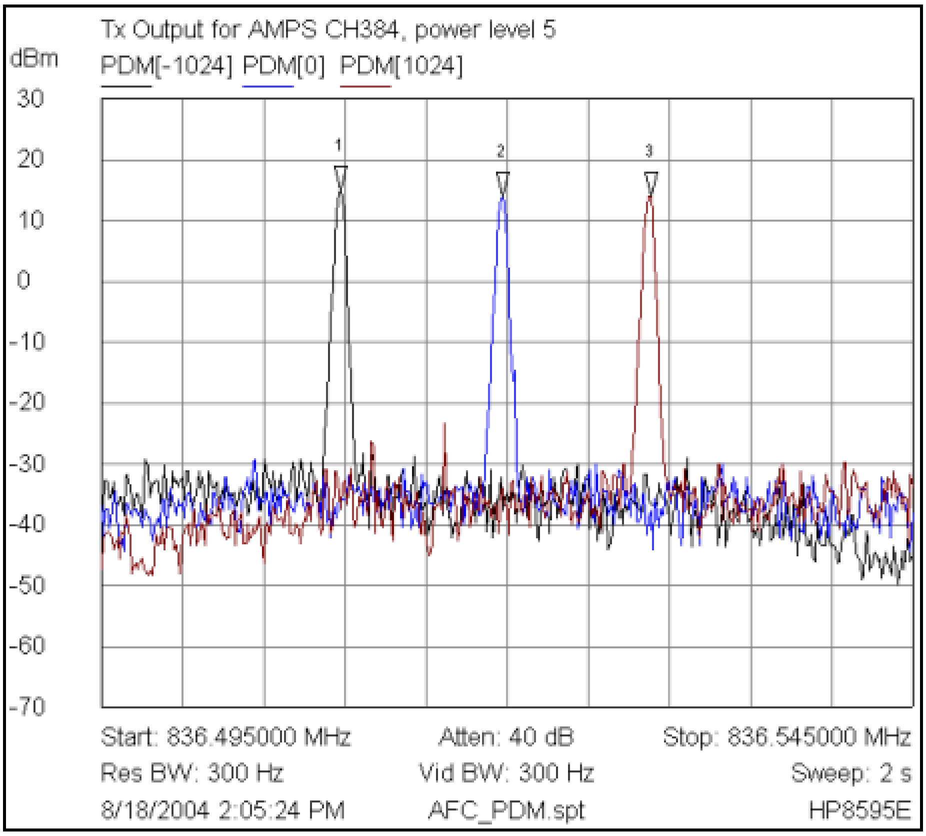



**Figure 46: Tx Output for AMPS channel 384, power level 5**

## UHF Synthesizer

The UHF LO frequency varies with the channel and can be calculated using the Frequency Calculator dialog box in the Phoenix RF component. Use the following steps to troubleshoot the UHF LO frequency.

1. Ensure that the LO is locked. Set a channel and check the output of the UHF LO at L7200 within a very narrow span of 100KHz. The LO must be virtually immobile.
2. Measure the nominal UHF LO signal levels (see "UHF Synthesizer Test Points" on page 57).
3. If you do not see the presence of any LOs, check the DC voltages at the following:
    - R7209, VR4, supply line for VCO IC and PLL IC = 2.76VDC
4. If the frequency of the LO is not correct, check the DC voltages at the following:
    - R7208, VR1A, supply line for PLL charge pump = 4.76VDC
5. Ensure that the lock voltage at C7220 is between 1V and 3V.
6. Check the RF return at R7210.
    - **TX UHF LO (Cell/AMPS)** = Tx frequency x 4
    - **TX UHF LO (PCS)** = Tx frequency x 2

### UHF Synthesizer Test Points

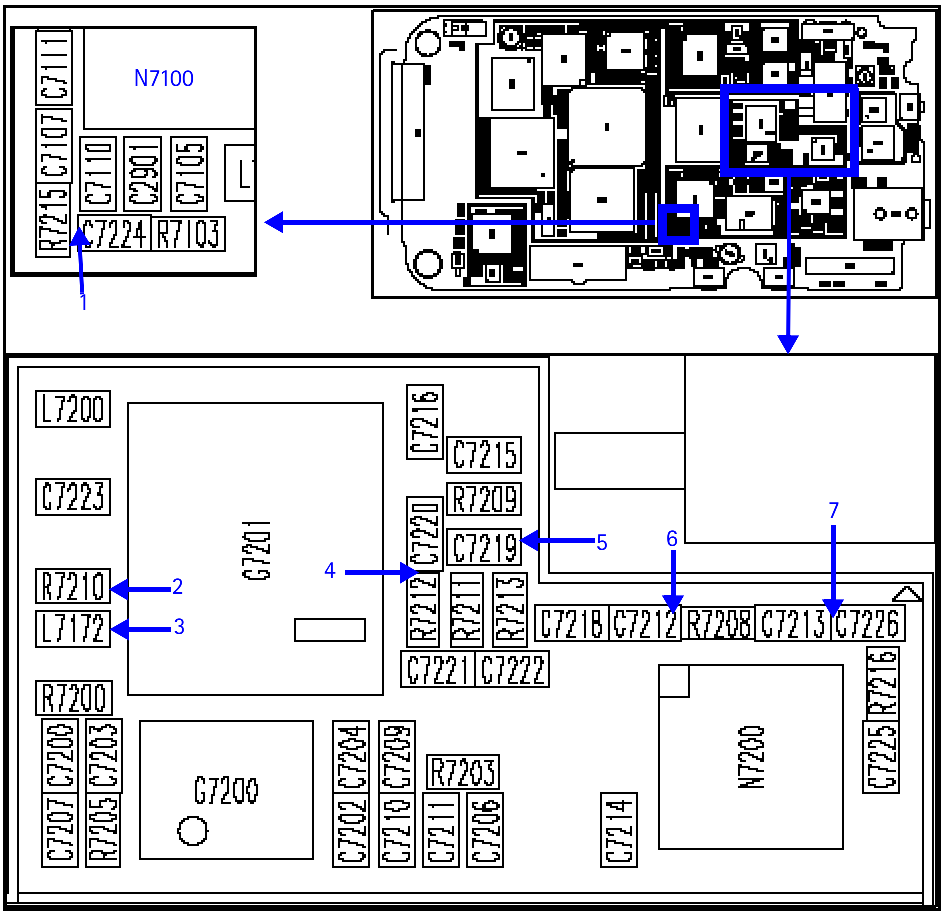



**Figure 47: UHF synthesizer layout**

Table 16 shows the description for each component in Figure 47.

**Table 16: UHF Synthesizer Layout Components**

| Test Point | Description | Value |
|---|---|---|
| 1 | BAND_SEL_VCO | Cell = 0Vdc<br>PCS = 2.8Vdc |
| 2 | PCS_CEL-LO return to UHF PLL | Cell: -11dBm<br>PCS: -18dBm |
| 3 | PCS_CEL_LO input to the N7160 | Cell channel 384: 1009.62MHz > -15dBm<br>PCS channel 600: 2088.1MHz > -17dBm |
| 4 | Lock voltage | DC between 0.8 and 3.4V, S/B 1.2V at the center frequency |
| 5 | VR4 | 2.8V |
| 6 | VR1A | 4.8V |
| 7 | VPLL | 2.8V |

## Rx VHF LO (N7100) Schematic

Following are the main layout components on a partial view of the Rx VHF schematic. See the *Schematics* chapter for detailed versions.

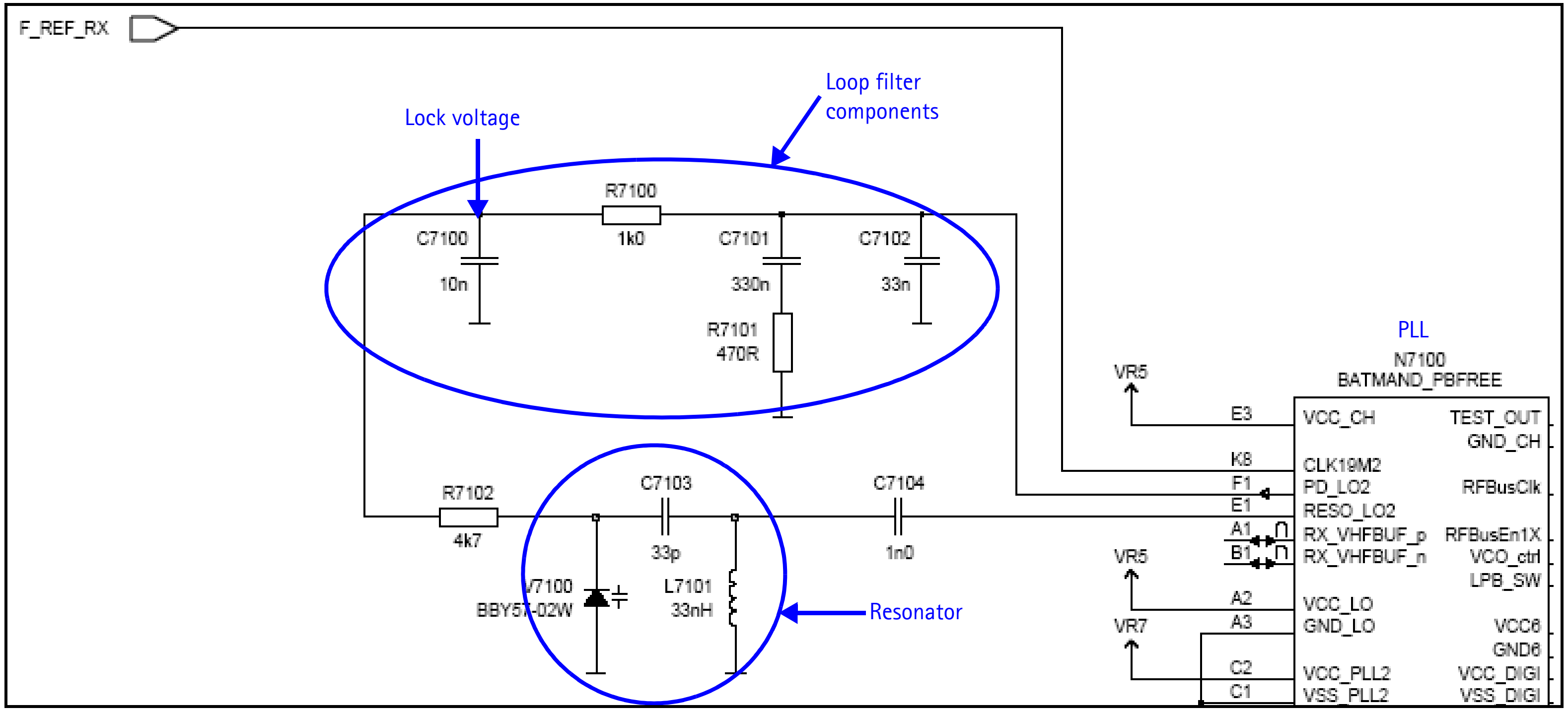



**Figure 48: Rx VHF schematic, partial view**

## Rx VHF LO Troubleshooting

The VHF LO operates at a fixed frequency of 256.2MHz. It is the second LO for down-conversion to I and Q for baseband processing. Use the following steps to troubleshoot the VHF LO.

1. Monitor the test point at C710. Ensure that a locked and stable 256.2MHz with amplitude ~ –60dBm is present on the spectrum analyzer (or, with a high impedance probe, ~ -2dBm at C7104).
2. Monitor the control voltage at C7100. The control voltage at a locked state must be between 1.2 and 1.7 Vdc for the proper operation of the VHF LO.

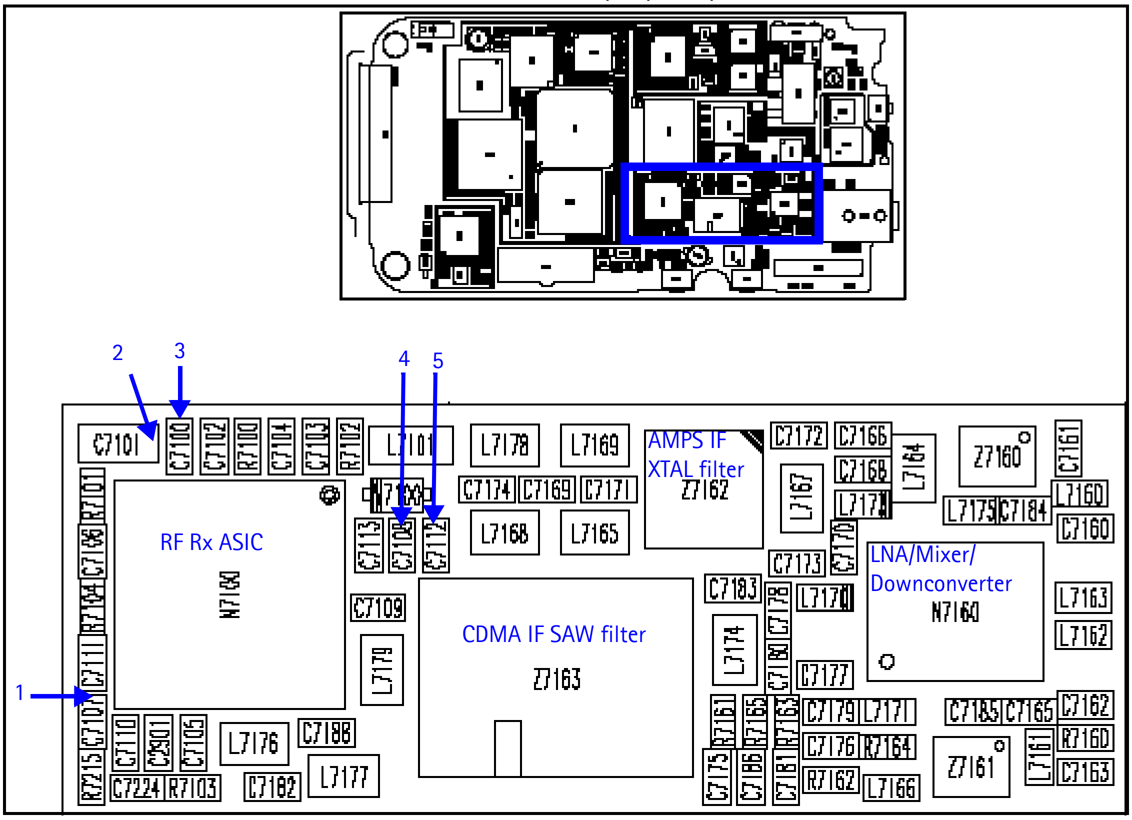



**Figure 49: Rx VHF LO test points**

Table 17 shows the description for each component in Figure 49.

**Table 17: Rx VHF Layout Components**

| Test Point | Description | Value |
|---|---|---|
| 1 | VIO | 1.8V |
| 2 | Rx LO 256.2MHz | -60 to -65dBm |
| 3 | Rx LO lock voltage | 1.2 to 1.7Vdc |
| 4 | VR7 | 2.8V |
| 5 | VR5 | 2.8V |

## Tx UHF LO (N7000) Schematic

The following partial schematic is for general reference only. See the *Schematics* chapter for complete detailed versions.

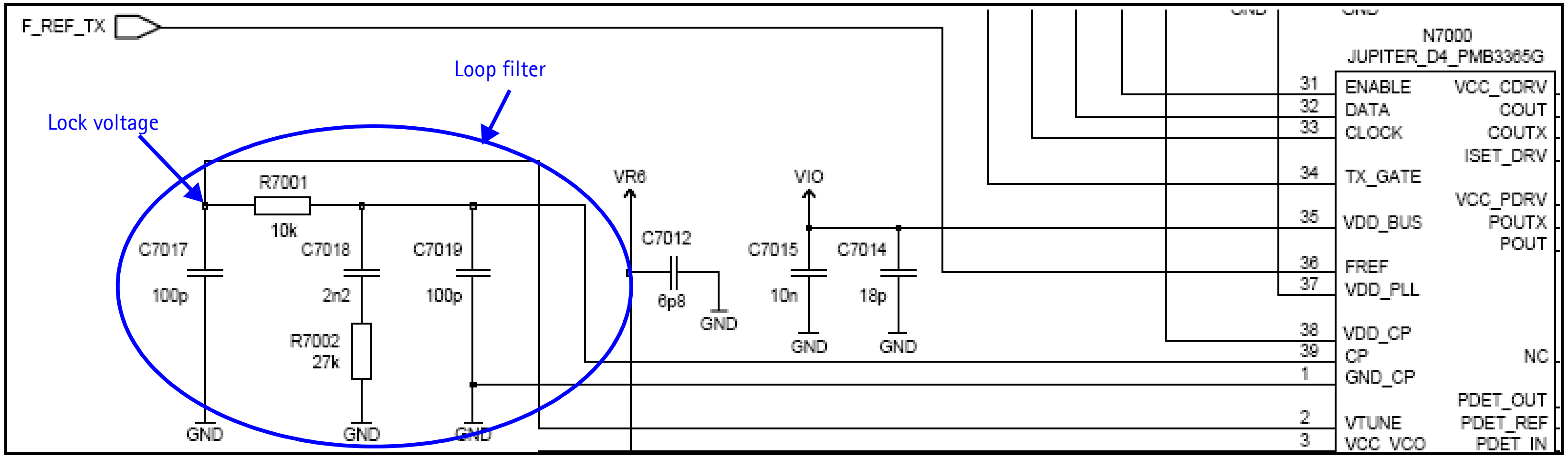



**Figure 50: Tx UHF LO (N7000) schematic**

## Tx UHF LO (N7000) Troubleshooting

There are two fixed LOs, 3296.16~3395.88MHz for cell band and 3700~3819.90MHz for PCS band. This is the only LO for up-conversion. Be sure to monitor the control voltage at R7001. When the N7000 LO is locked, this control voltage should be between 1.2 and 1.8Vdc.

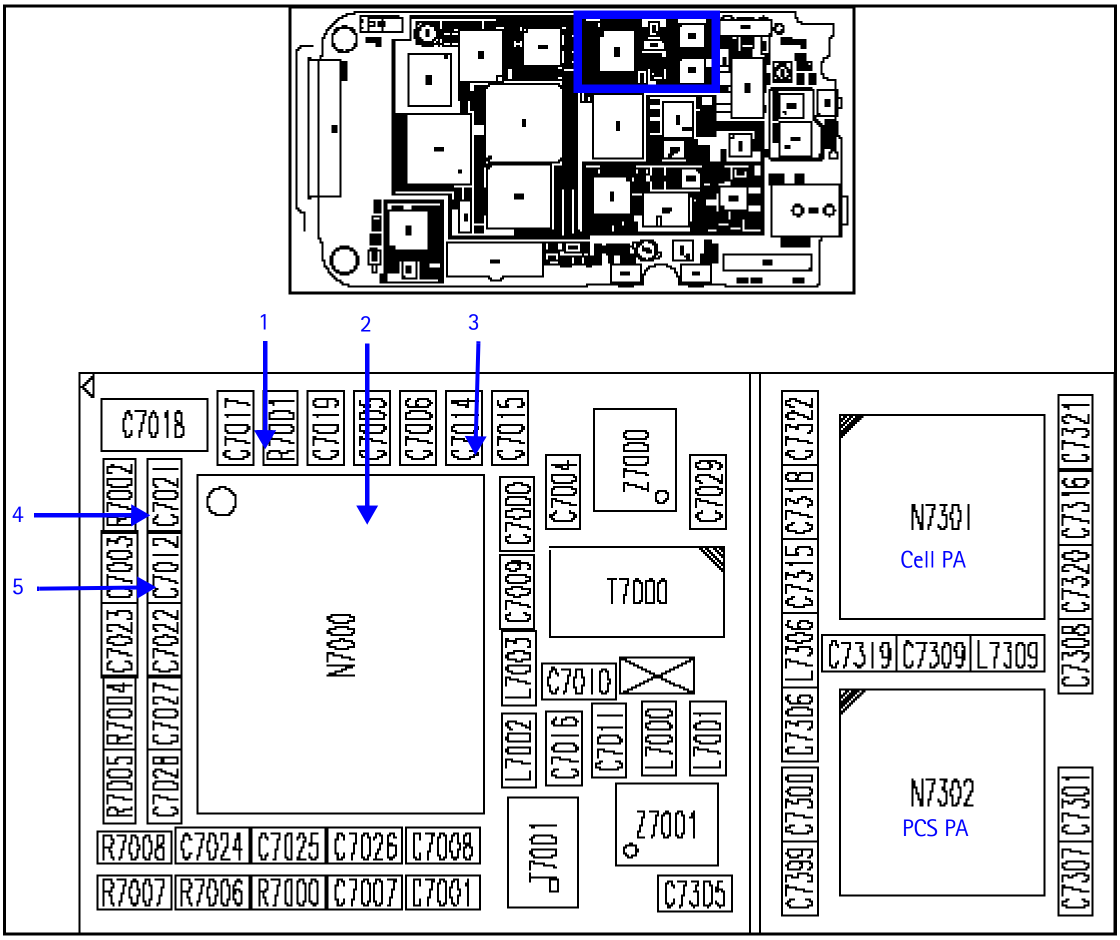



**Figure 51: Tx UHF LO layout and test points**

Table 18 shows the description for each component in Figure 51.

**Table 18: Tx UHF Test Point Values**

| Test Point | Description | Value |
|---|---|---|
| 1 | Lock voltage | DC between 1.2 and 1.8V |
| 2 | N7000: Measure voltage by probing the top of the chip. | Cell channel 384: 3346.08MHz, -55 to -65dBm<br>PCS channel 600: 3760MHz, -54 to -65dBm |
| 3 | VIO | 1.8V |
| 4 | Vcc_Vco | 2.3V |
| 5 | VR6 | 2.8V |

# GPS Troubleshooting

## GPS RF Block Diagram

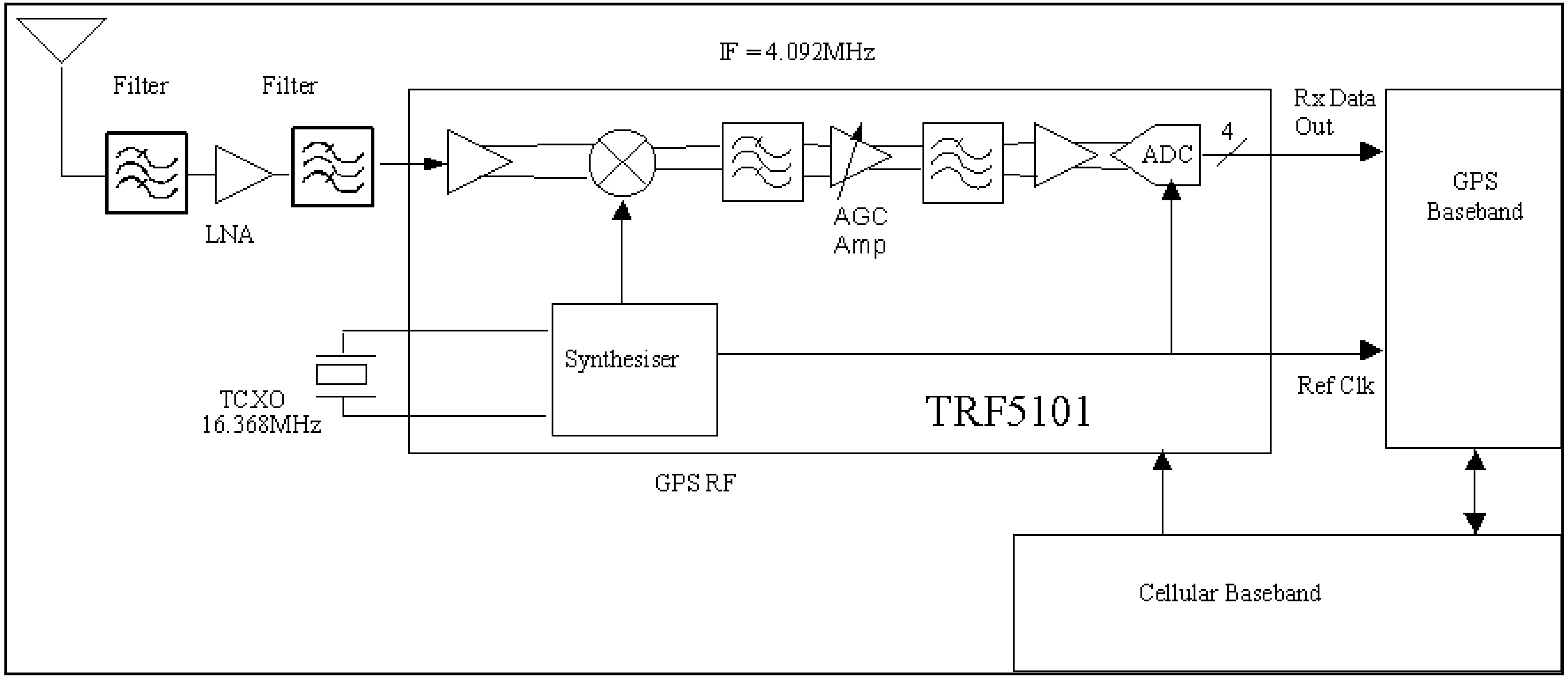



Figure 52: GPS block diagram

## GPS RF Schematic

The following schematic is for general reference only. See the *Schematics* chapter for a detailed version.

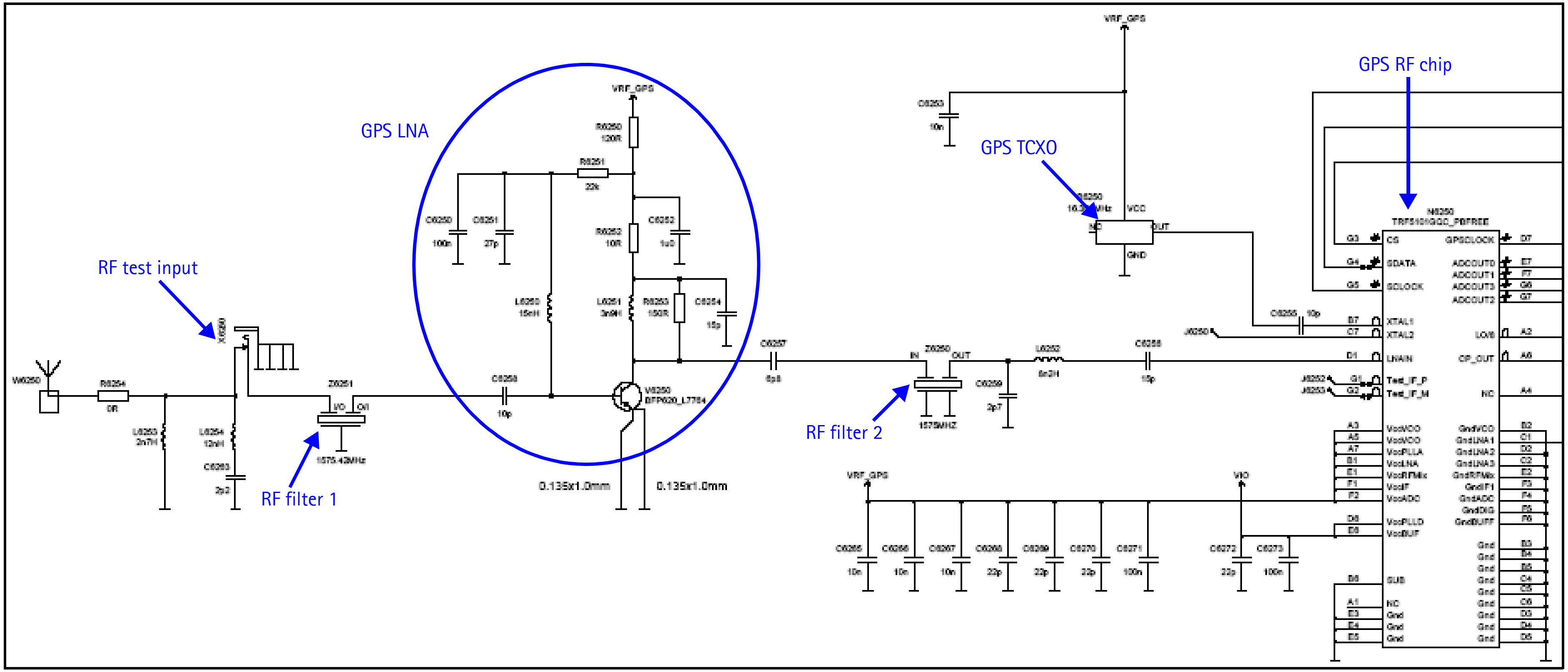



**Figure 53: GPS RF schematic**

## GPS Troubleshooting Setup

Use the following steps to set up GPS signal using Phoenix.

1. On the **Phone Control** dialog box, click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode. (See Figure 9 on page 16 for an example of the **Phone Control** dialog box.)
2. Click the **Execute** button.
3. Inject a -110dBm tone at 1575.52MHz at the GPS connector (X6250) with a signal generator or call box.

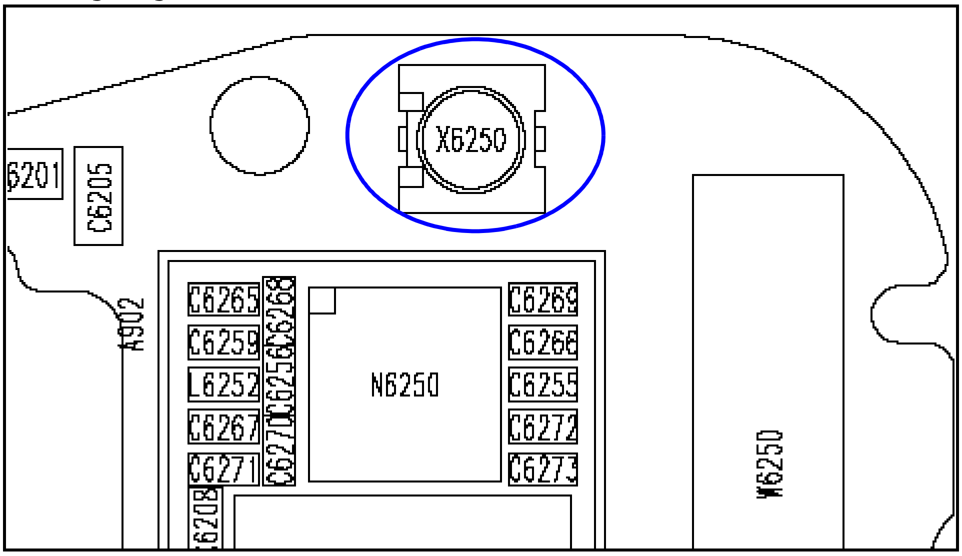



**Figure 54: X6250 on the bottom side of the UI PWB**

4. Open the **Troubleshooting** menu, and click **GPS Testing**.

   The **GPS Control** dialog box appears.

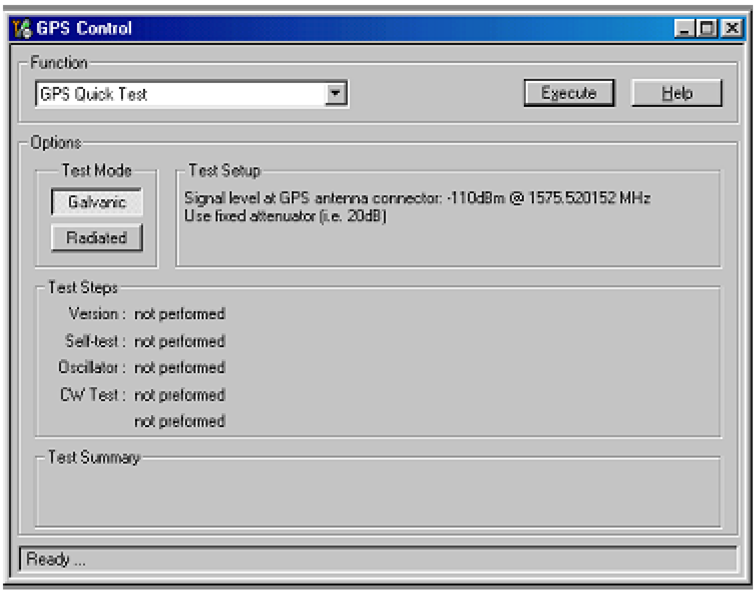



**Figure 55: GPS Control dialog box**

5. In the **Test Mode** field, ensure that **Galvanic** is selected.
6. Click **Execute**.

**Self Test Failure**

If the test fails, repeat steps 1—6. If the test fails again, continue with the following self-test failure troubleshooting:

1. Verify the DC voltages at VRF_GPS and VIO_GPS. ("GPS DC Test Points" on page 66 for test point locations and values.)
2. Inspect all GPS circuit elements around the GPS BB chip (N6200).
3. If the elements pass a visual inspection, replace the N6200.

**Oscillator Failure**

1. Inspect all GPS circuit elements around the GPS RF chip (N6250).
2. If the elements pass a visual inspection, replace the GPS TCXO (B6250).

**CW Test Failure**

1. Check that the signal generator is on and sourcing a signal to the GPS RF input port (X6250).
2. Inspect all GPS RF circuit elements.
3. Probe the GPS RF test points on page 69.
4. If the elements pass a visual inspection and the RF is good, replace the GPS RF IC (N6250).

**GPS RF Troubleshooting**

Use the following steps to trouble shoot the GPS receiver.

1. On the **GPS Control** dialog box, select **On**.

2. Click **Execute**.

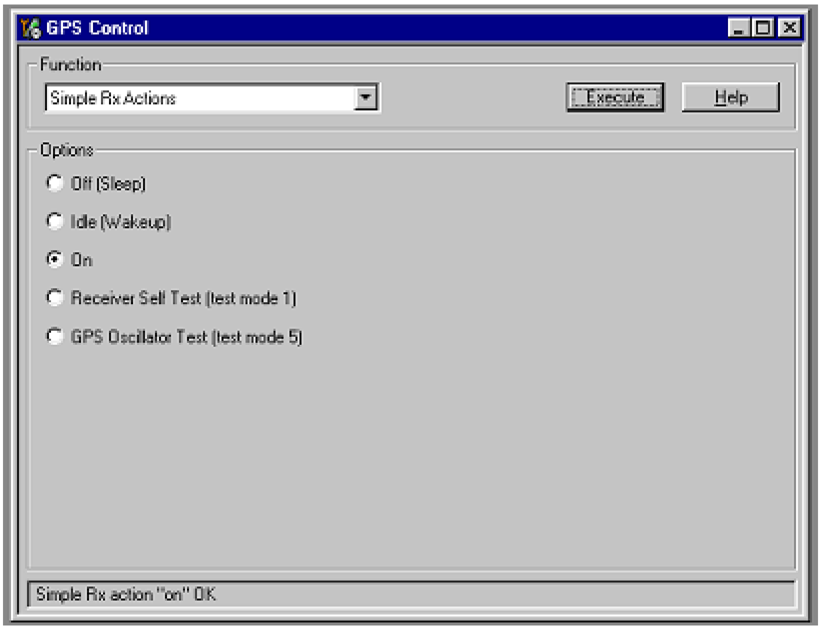



**Figure 56: Turning on the GPS receiver on the GPS Control dialog box**

3. Inject a -50dBm tone at 1575.52MHz at the GPS connector (X6250) with a signal generator or a call box. (See Figure 54.)

### GPS DC Test Points

Measure the following test points with an AAS-10B probe and spectrum analyzer set at center frequency 1575.25MHz (span = 500kHz), or with a voltmeter as required.

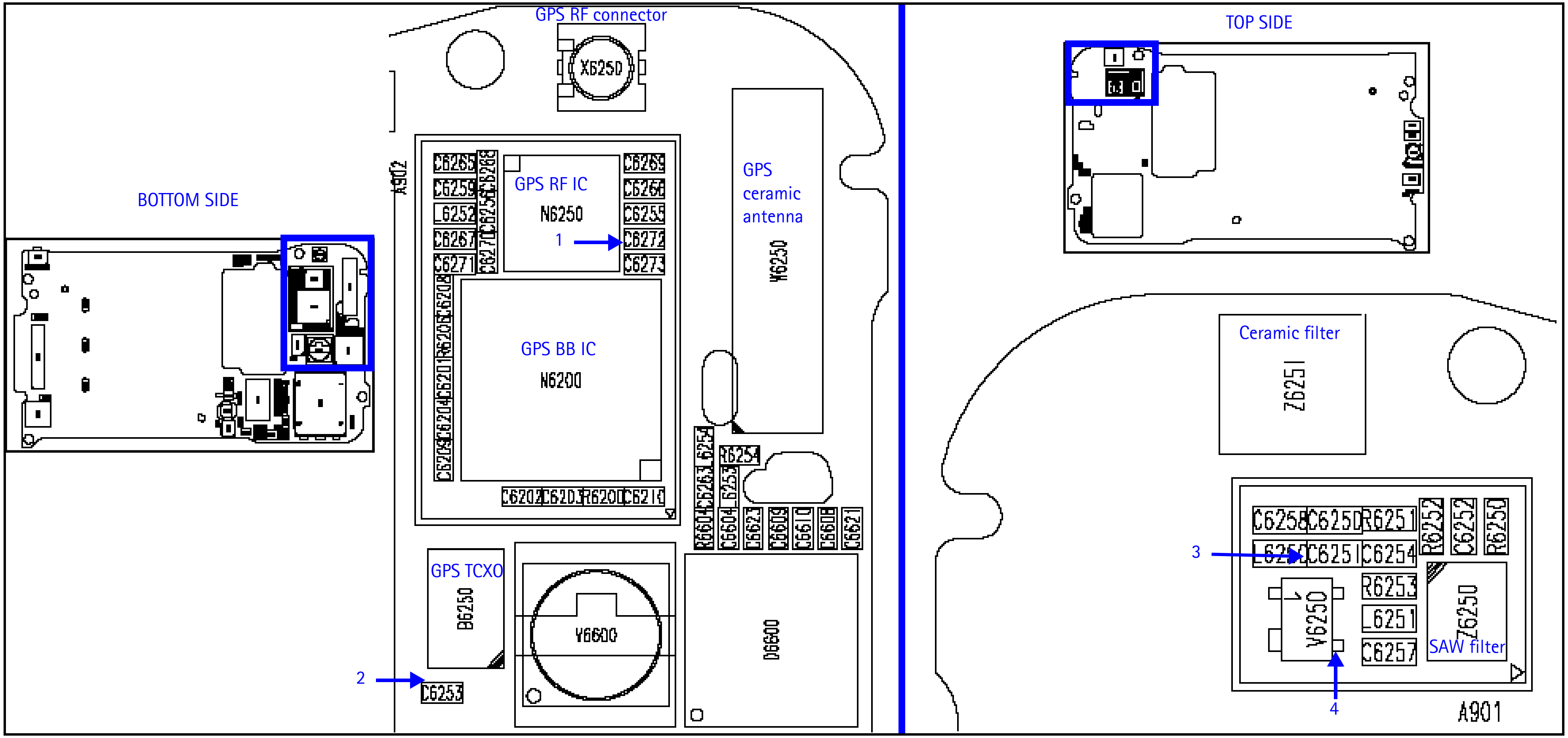



Figure 57: GPS DC probe points on the bottom side (left) and top side (right) of the UI PWB

Table 19 shows the values for the GPS DC test points in Figure 57.

**Table 19: GPS DC Test Point Values**

| Test Point | Description | Value |
|---|---|---|
| 1 | VIO | 1.8V |
| 2 | VRF_GPS | 2.8V |
| 3 | LNA base | 0.8V |
| 4 | LNA Vcc | 1.5V |

## GPS RF Test Points

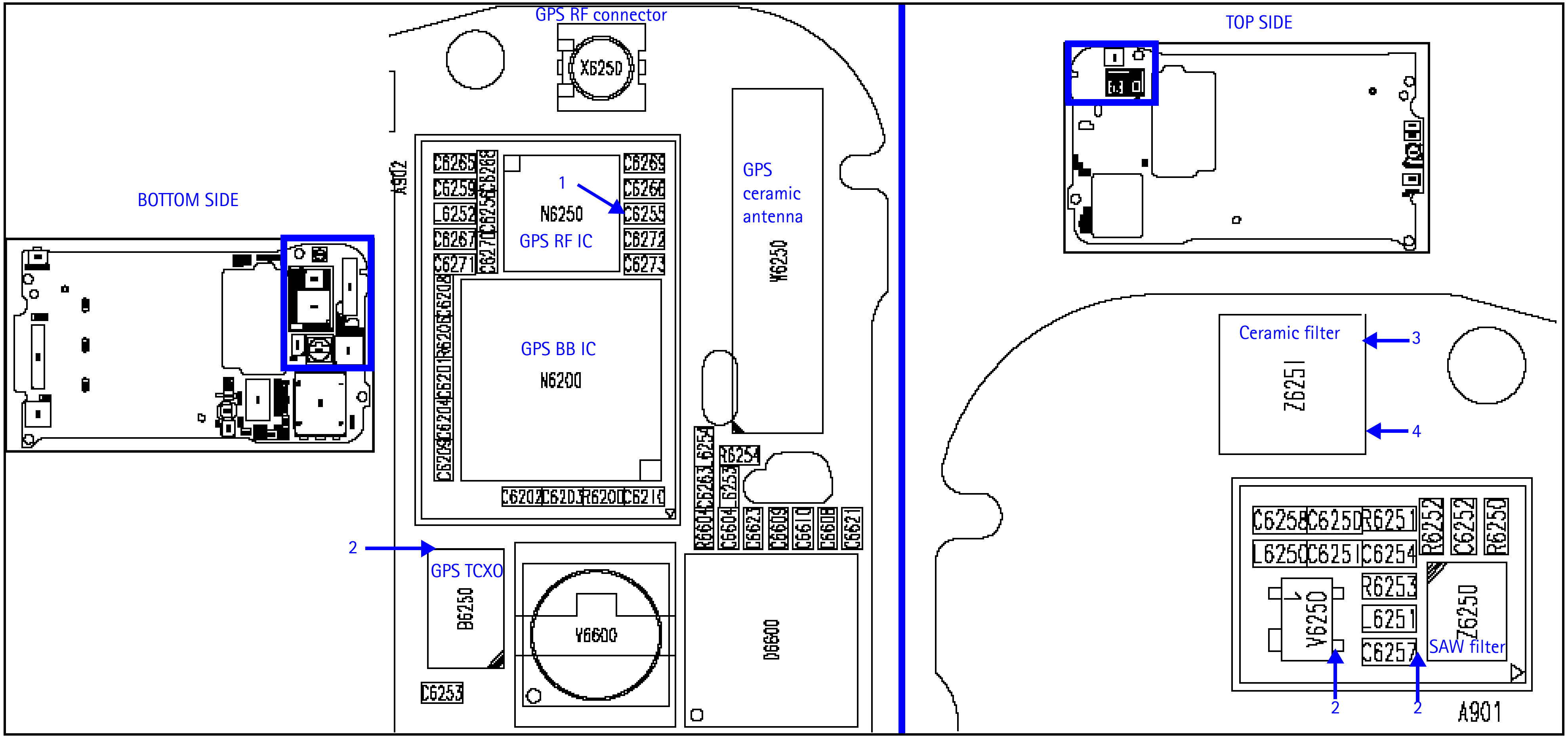



Figure 58: GPS RF probe points on the top side of the UI PWB

Table 20 shows the values for the GPS RF test points in Figure 58. All points are 1575.52MHz, except TCXO.

**Table 20: GPS RF Test Point Values**

| Test Point | Description | Value |
|---|---|---|
| 1 | GPS TCXO | 16.368MHz = -19dBm |
| 2 | GPS TCXO | 16.368MHz = -4dBm |
| 3 | First RF filter input | -62dBm |
| 4 | First RF filter output | -65Dbm |
| 5 | LNA out | -48dBm |
| 6 | Second RF filter input | -48dBm |

# FM Radio Troubleshooting

## FM Radio Schematic

The following schematic is for general reference only. See the *Schematics* chapter for a detailed version.

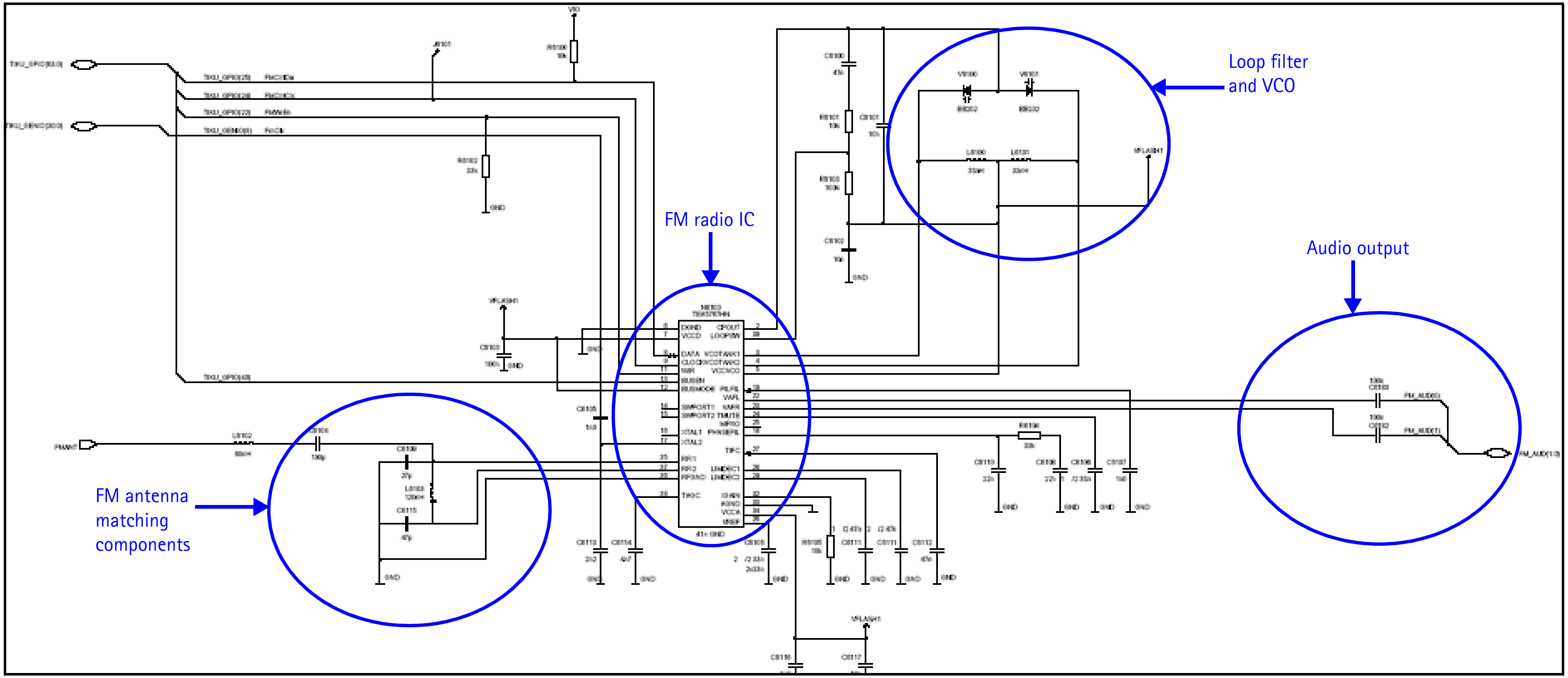



**Figure 59: FM radio schematic**

## FM Radio Troubleshooting Setup

Use the following steps to troubleshoot the FM radio while using a Pop-port headset.

1. Connect the Pop-port headset (HDS-3) to the Pop-port connector (bottom connector).
2. Select the **Menu** > **Media** > **Radio** from the mobile terminal user interface.
3. In an FM radio broadcast coverage area, set a local radio channel by scanning automatically using the **Automatic tuning** option. (Scanning up and down the channels by pressing the “Up” and “Down” key respectively).
4. If no channel could be found, inspect all the components in the FM radio circuitry.
   - If the circuits pass a visual inspection, check the existence of the LO (by radiative pickup) near the VCO of the FM Radio IC.
   - If no LO is found, replace the FM radio IC.
5. Listen for sound out of the headset.
   - If there is a signal present, continue to step 6.
   - If there is no static sound present, inspect all FM Radio circuits on the PCB and refer to the “Audio” section of the *Baseband Description and Troubleshooting* chapter for more information.
6. Disconnect the Pop-port headset and connect the universal headset to the UHJ (top connector).
7. With the universal headset connected, repeat steps 1—5.
   - If there is a signal present, the FM Radio is working properly.
   - If there is no static sound present, refer to the “Audio” section of the *Baseband Description and Troubleshooting* chapter for more information.

### FM Radio Part Layouts and Probe Points

Use the following values when probing the LO near the VCO of the FM radio IC (N6100). See Figure 61 for the location of the N6100.

**Table 21: FM Radio Test Point Values**

| Description | Value |
|---|---|
| LO frequency | (Rx frequency + IF frequency) x 2 |
| IF frequency | 225kHz |

For example, if the Rx frequency is 87.5 and the IF frequency is 225kHz, the LO equals 175.45MHz [(87.5+0.225)*2 = 175.45MHz].

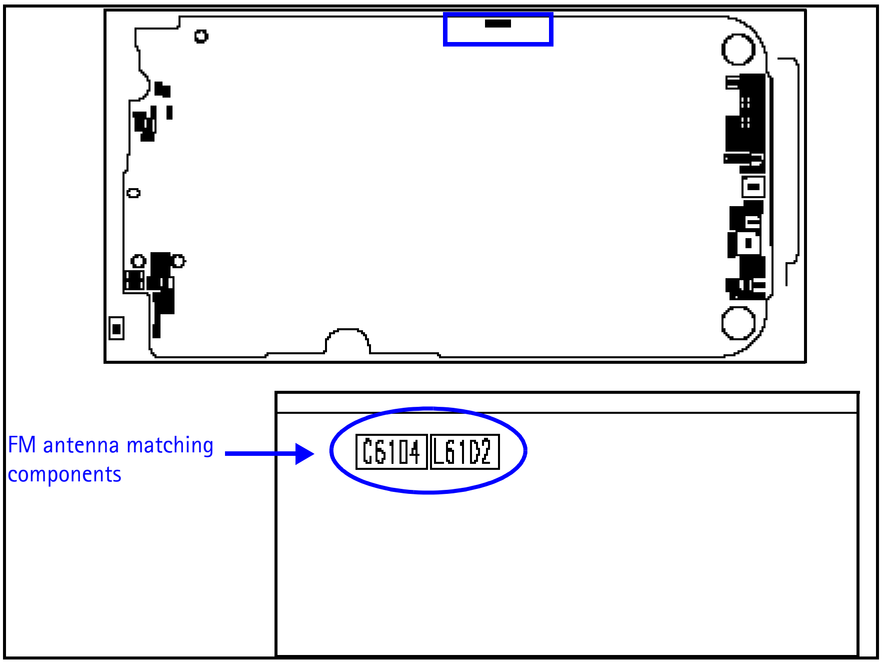



Figure 60: FM radio parts on the top side of the main PWB

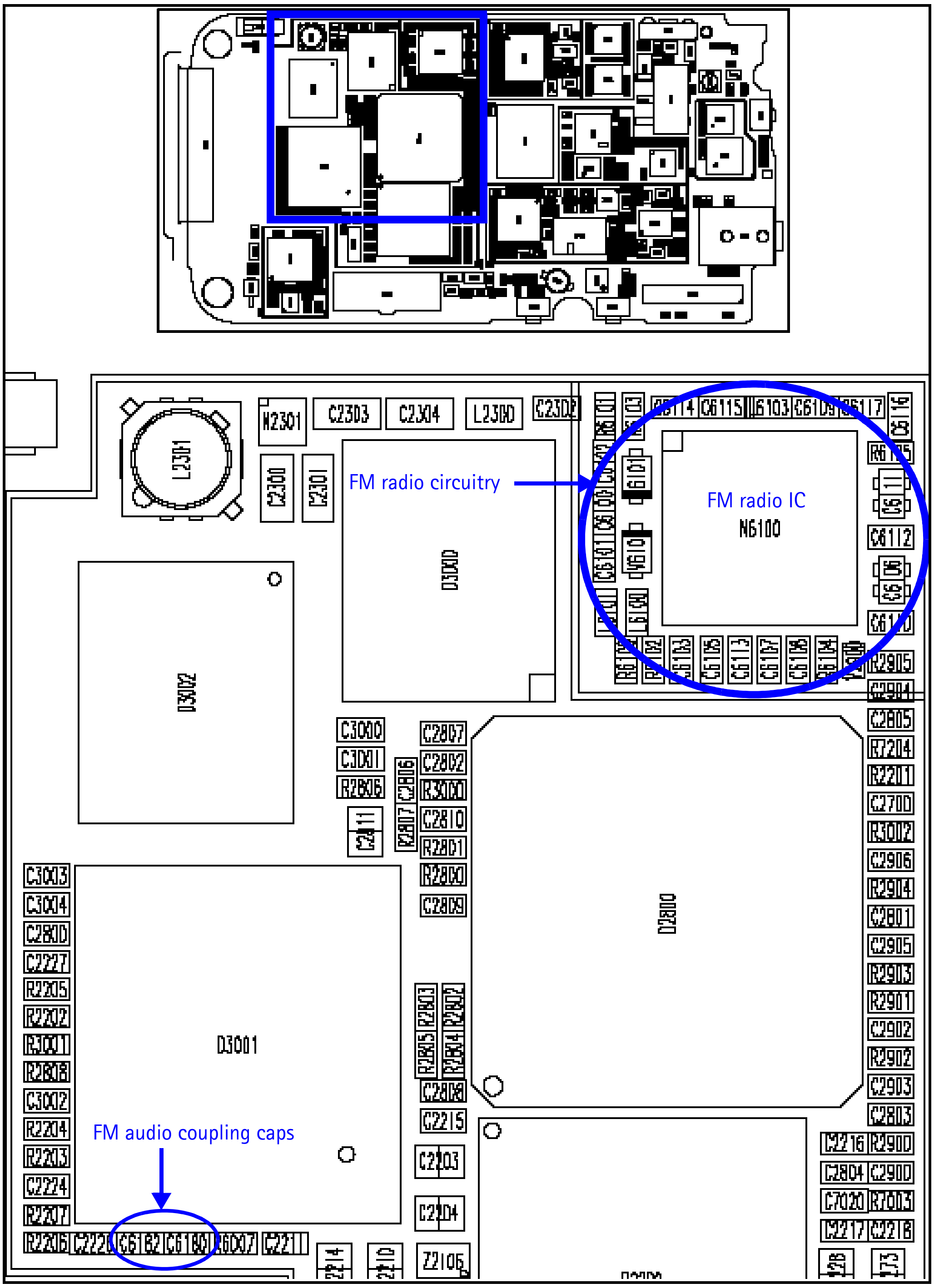



Figure 61: FM radio parts on the bottom side of the main PWB

# Bluetooth Troubleshooting

## Bluetooth Schematic

The following schematic is for general reference only. See the *Schematics* chapter for a detailed version.

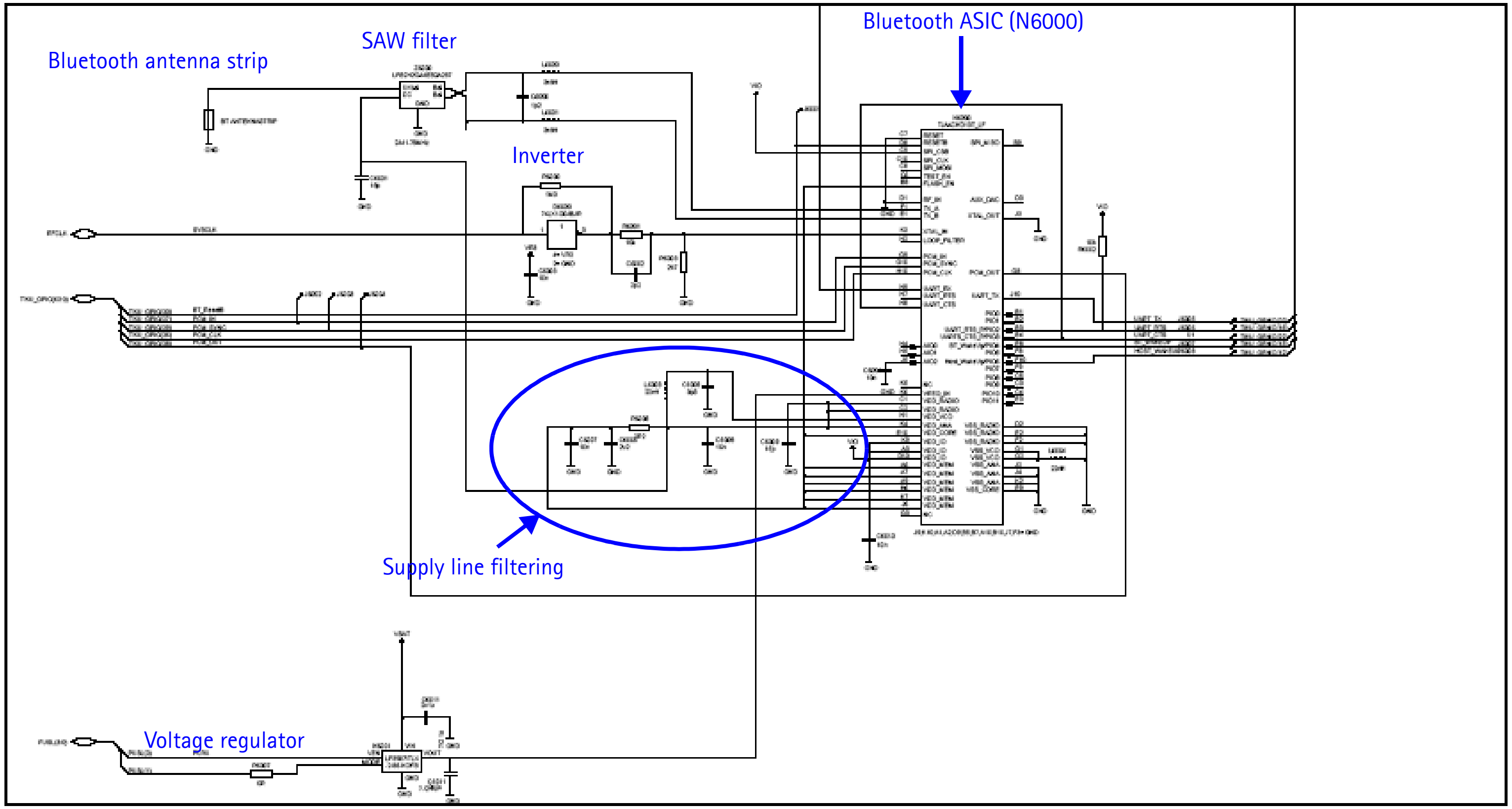



**Figure 62: Bluetooth schematic**

## Bluetooth Troubleshooting Setup

Use the following steps to troubleshoot the BC02 Bluetooth Control component in Phoenix:

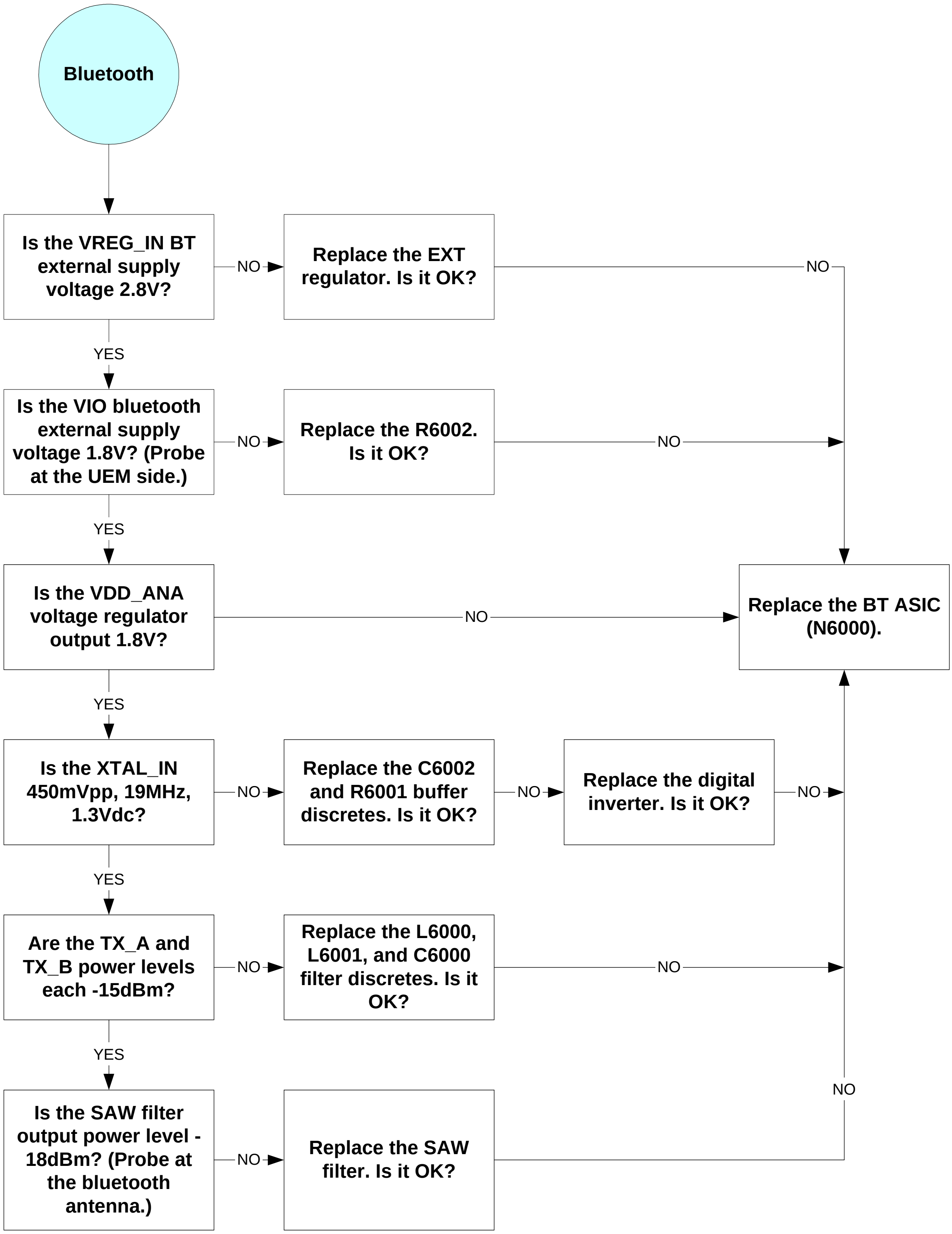
1. On the **Bluetooth Control** dialog box, select the **Tests** tab.
2. In the **PRBS9** list, choose **TX Data 1**.
3. For easy power measurement, choose "TX Simple" – 62.5kHz FM.
4. Click on "Options" button.
5. Set Internal gain = 52
6. Set Tx-Rx Frequency = 2440MHz

**Table 22: Bluetooth Spectrum Analyzer Settings**

| Description | Value |
|---|---|
| RBW | 500kHz |
| VBW | 500kHz |
| Center | 2440MHz |
| Span | 20MHz |

## Bluetooth Troubleshooting Flowchart



## Bluetooth DC and RF Test Points

Figure 63 shows the bluetooth DC and RF test points on the bottom side of the main PWB.

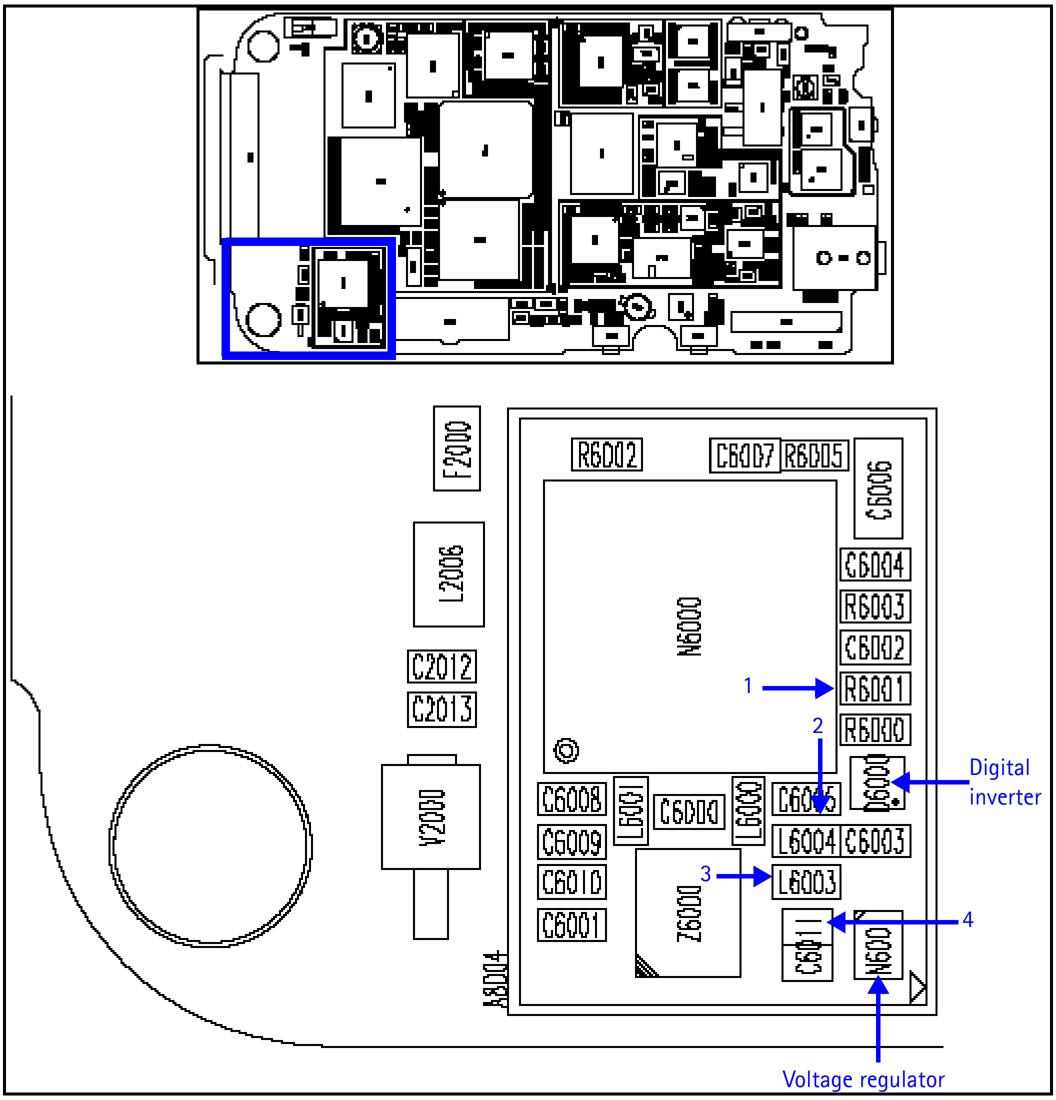



Figure 63: Bluetooth DC and RF test points on the bottom side of the main PWB

Table 23 shows the values associated with the bluetooth test points in Figure 63.

Table 23: Bluetooth DC and RF Test Point Values

| Test Point | Description | Value |
|---|---|---|
| 1 | XTAL_IN | 19MHz, 450mVp-p/1.3V |
| 2 | VDD_VCO | 1.8V |
| 3 | VDD_ANA | 1.8V |
| 4 | VREG_IN | 2.8V |