

**Nokia Customer Care
2255 (RM-97)
Mobile Terminal**

**RF Description and
Troubleshooting**

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Mobile Terminal Components

Figure 1 illustrates the main components of the 2255.

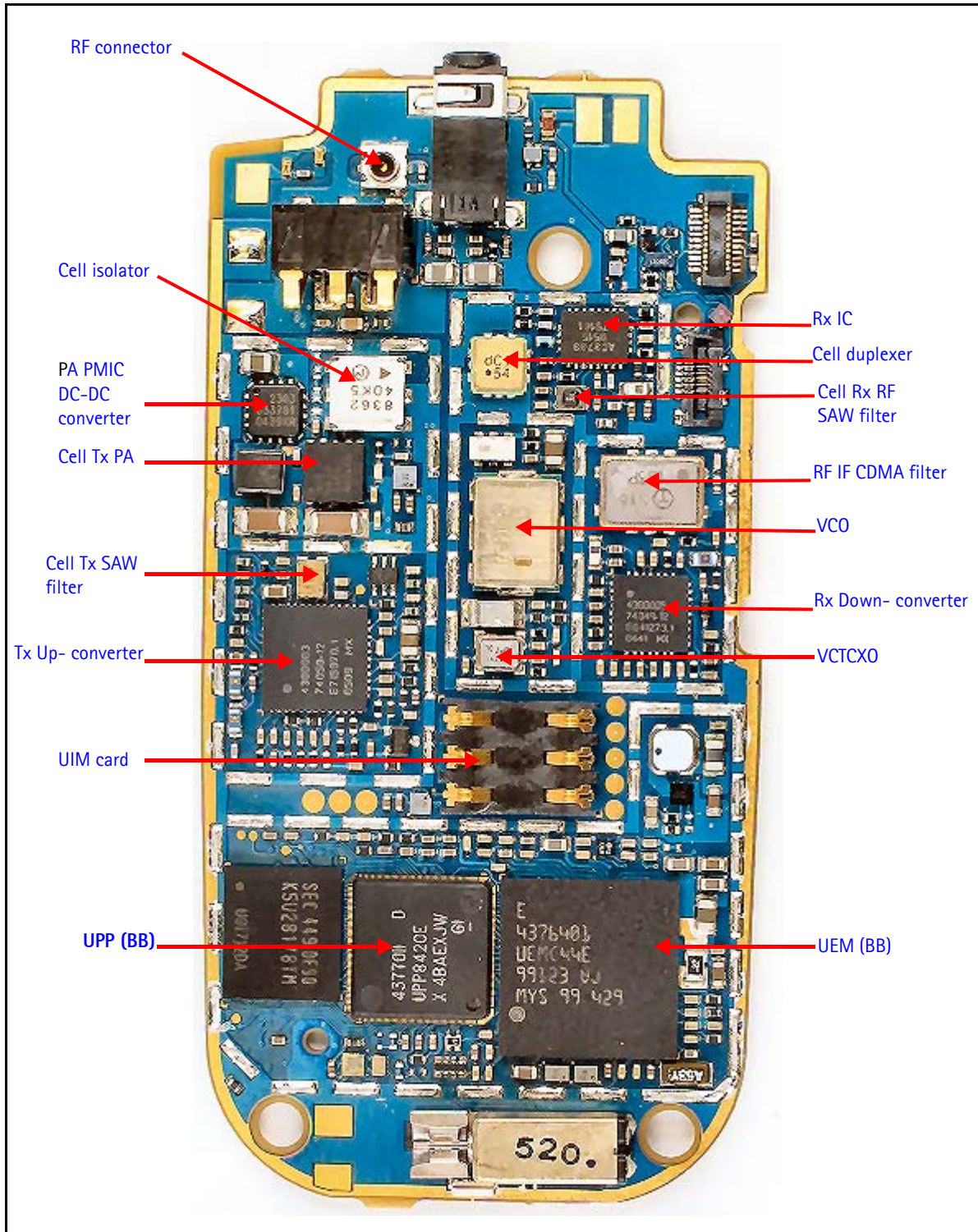


Figure 1: Component layout (bottom)

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 **Batch Tune** 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 34.
7. The transmitter and receiver are working properly in Local Mode. See "Transmitter Troubleshooting" on page 8 and "Receiver Troubleshooting" on page 16 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.)
4. Ensure that the power supplies to the Tx have the correct voltage.
5. Ensure that the AGC PDMs are set for the desired Tx power and that the AGC voltages are correct.

Transmitter Block Diagram

Following is the block diagram for the Tx RF system. I

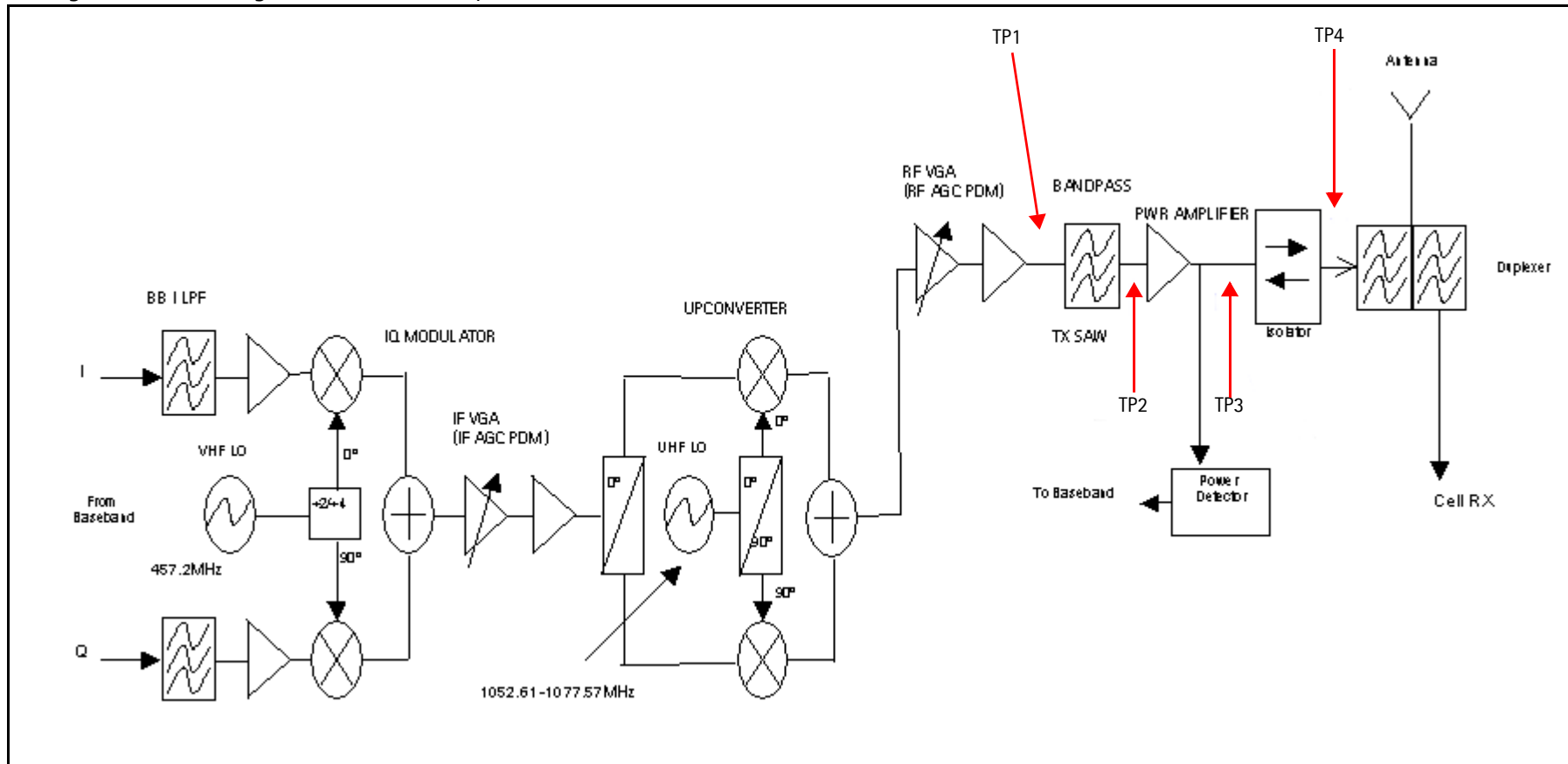
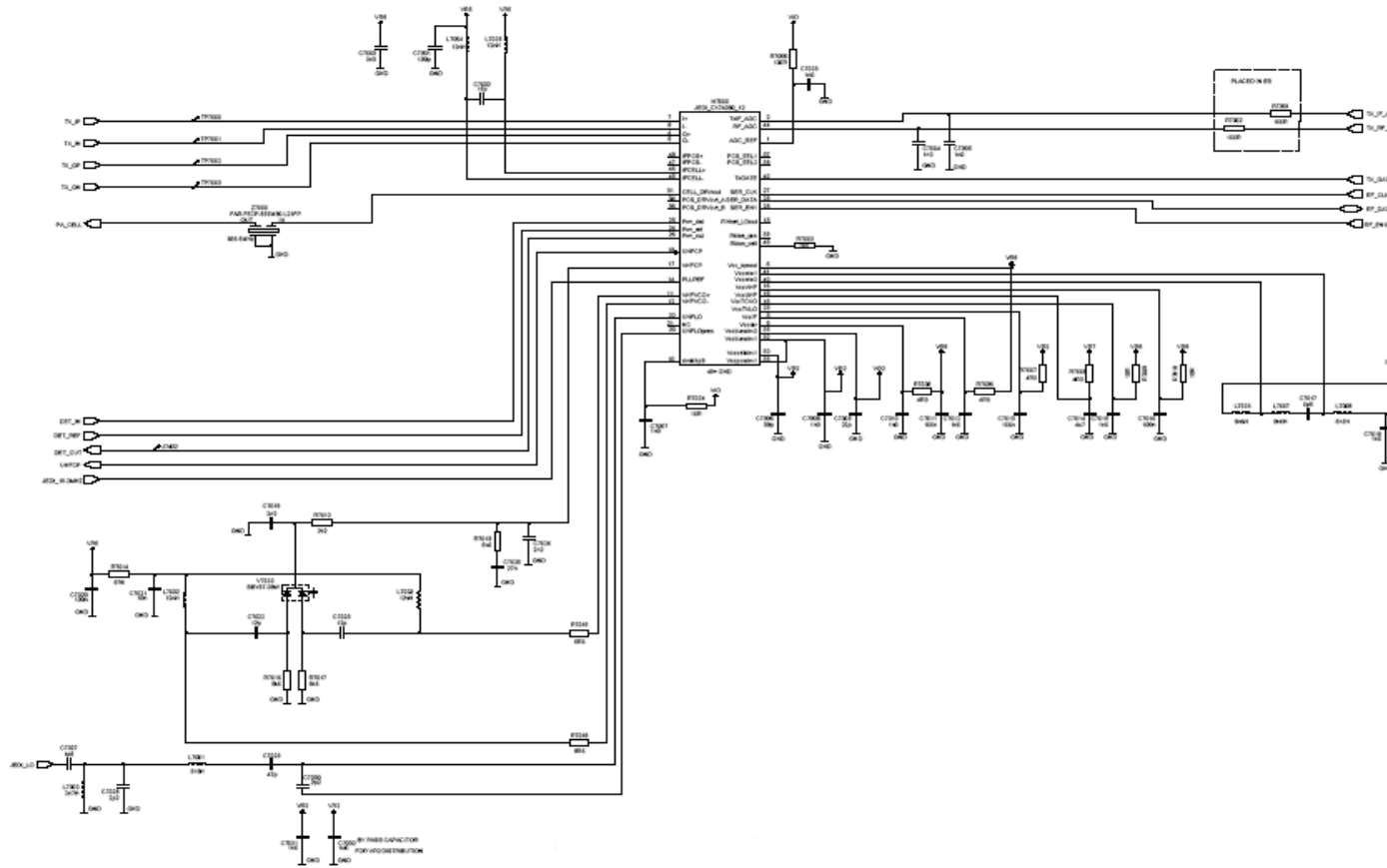


Figure 2: Tx system block diagram

Transmitter Schematics

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



Transmitter Troubleshooting

CELL Tx Setup

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

1. Connect RF test connector to a call box.
2. Connect the phone to a PC via the bottom connector, and connect a power supply.
3. Open the **Troubleshooting** menu, and click **Phone Control**.

The **Phone Control** dialog box appears.

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

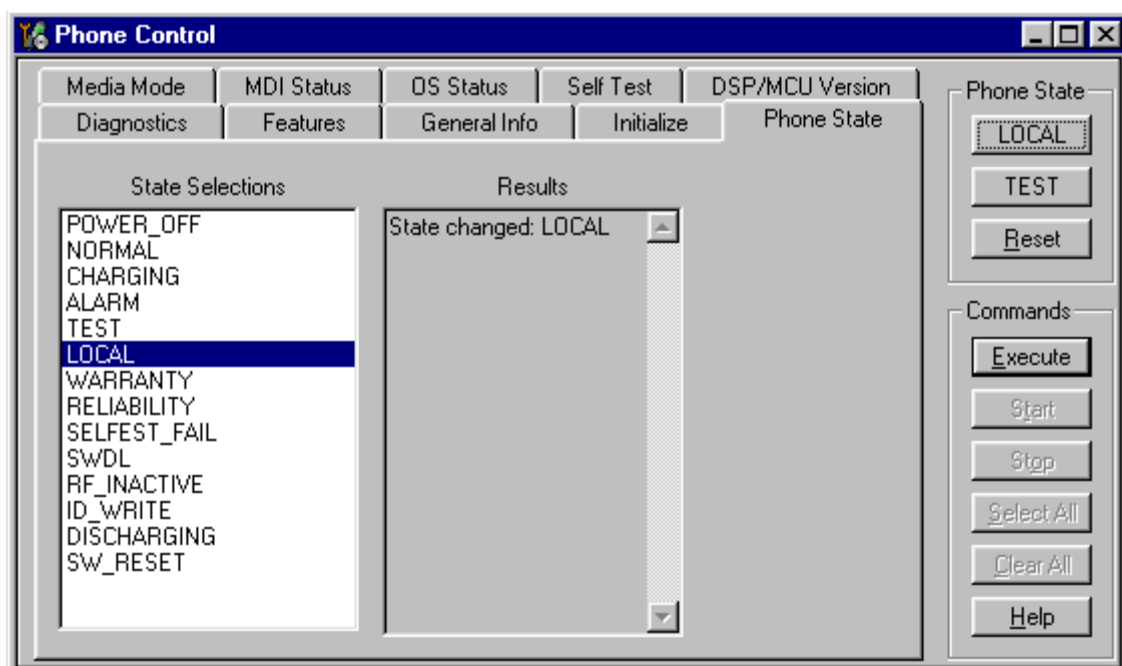


Figure 5: Phone Control dialog box

5. Open the **Troubleshooting** menu, point to **RF**, and click **CDMA Control**. The **RF Main Mode** dialog box appears.
6. Select the following values on the **RF Main Mode** dialog box:
 - **Band** = Cell (CDMA)
 - **Channel** = 384
 - **Mode** = Rx/Tx

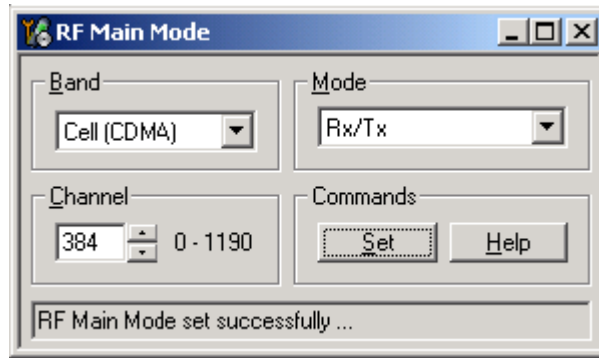


Figure 6: RF Main Mode dialog box

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.

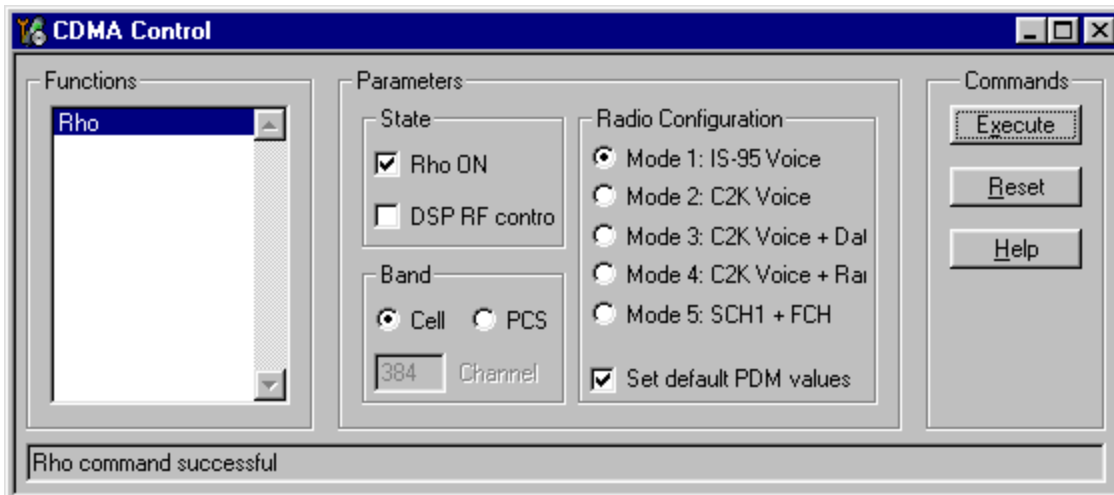


Figure 7: CDMA Control dialog box for Cell Tx troubleshooting

9. Select the following values on the **CDMA Control** dialog box.

- **State** = Rho ON
- **Band** = Cell
- **Radio Configuration** = Mode 1: IS-95 Voice
- Select the **Set default PDM values** check box.

10. Click **Execute**.

11. At this point you should be able to measure Tx Pout at the RF connector. The cell band Tx Pout = 0 to 2 dBm. If you do not see these values, set the AGC PDM for 25 dBm and probe the Tx path to figure out where in the path the fault occurs.

12. Open the **Troubleshooting** menu, point to **RF**, and click **PDM Control**.

The RF PDM Control dialog box appears.

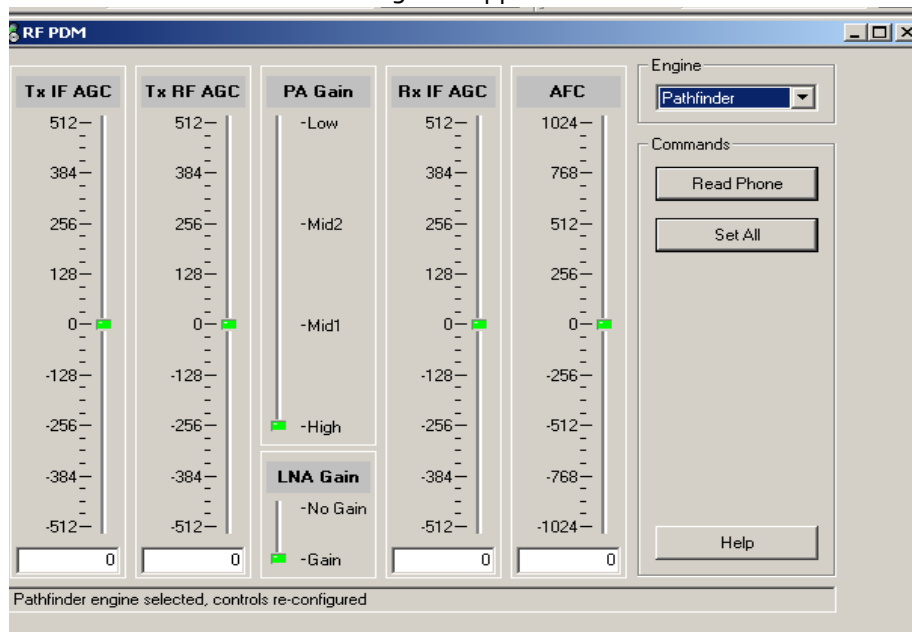


Figure 8: RF PDM Control dialog box for Cell troubleshooting

13. Click **Read Phone** to update the values.
14. Configure the spectrum analyzer using the following values:
 - Center Frequency = 836.52 MHz
 - Span = 100 MHz
 - Amplitude = 20 dBm
 - Attenuation = Auto
 - BW = Auto

Adjust the following PDM field values on the RF PDM dialog box:

- Set PA Gain State to High
- Adjust Tx RF AGC PDM to around -250
- Adjust Tx IF AGC PDM to around -250
- Set Output level to +23dBm on CH-384 and monitor the current between 590mA and 660mA.

Failed Test: Tx PA Detector

1. Use Phoenix to set the phone in Local Mode, and activate the Tx with default output power. The output power at the RF test connector should read 9 dBm +/- 4 dB.
2. Use a voltmeter on DC, and probe the detector output at C813. The voltmeter should read approximately 1.4 V. If not, replace the detector (N803).

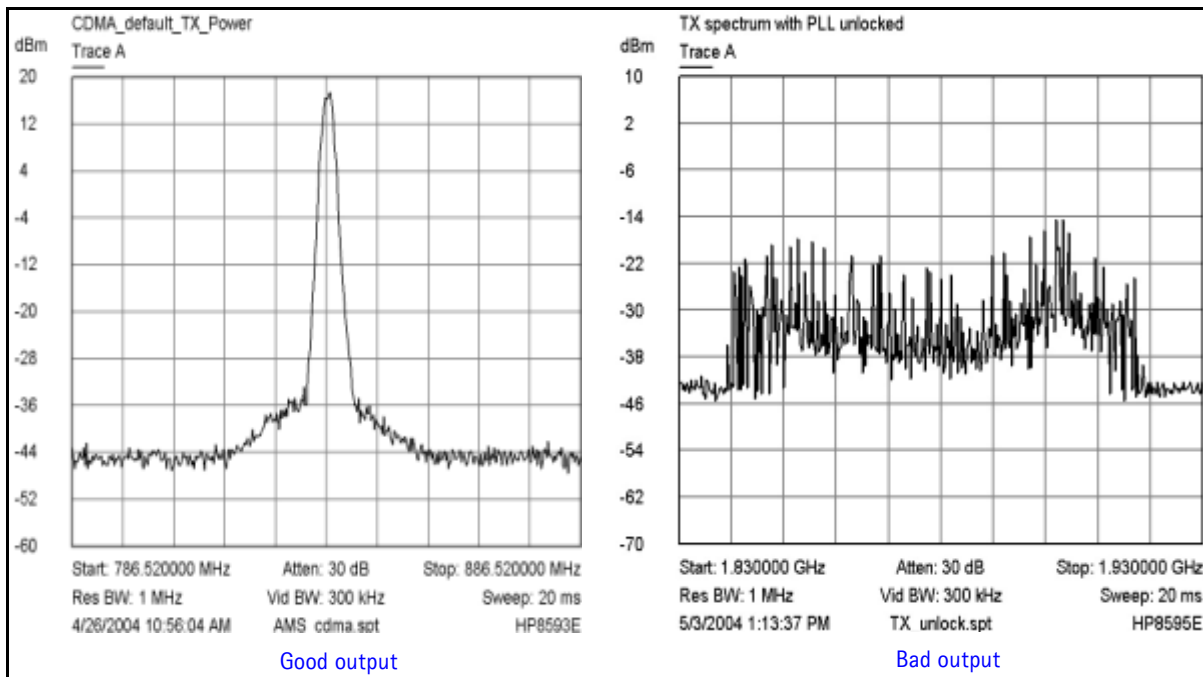


Figure 9: The output of the mobile terminal on a spectrum analyzer should look like the figure on the left

If using the AAS-10 probe with the phone connected to the call box, the amplitude should be approximately -7 dBm at the antenna test point on the top of the PWB.

Tx RF Test Points

Figure 10 and Figure 11 are the transmitter DC/RF test points. See Table 1 on page 14 for test point descriptions and values.

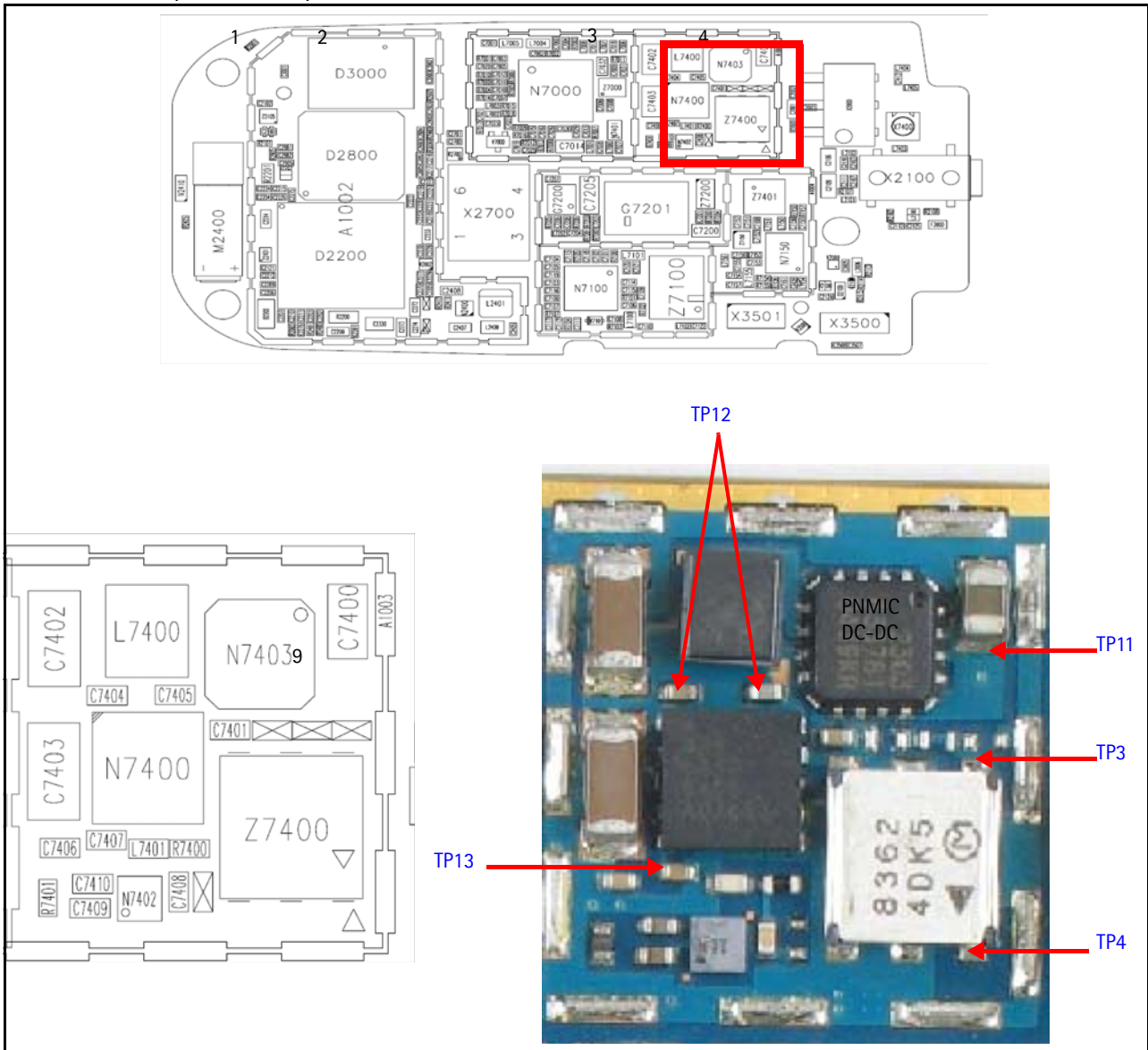


Figure 10: Tx DC/RF test points - PA section

Following are the Tx DC/RF test points for the N7000 Tx Section

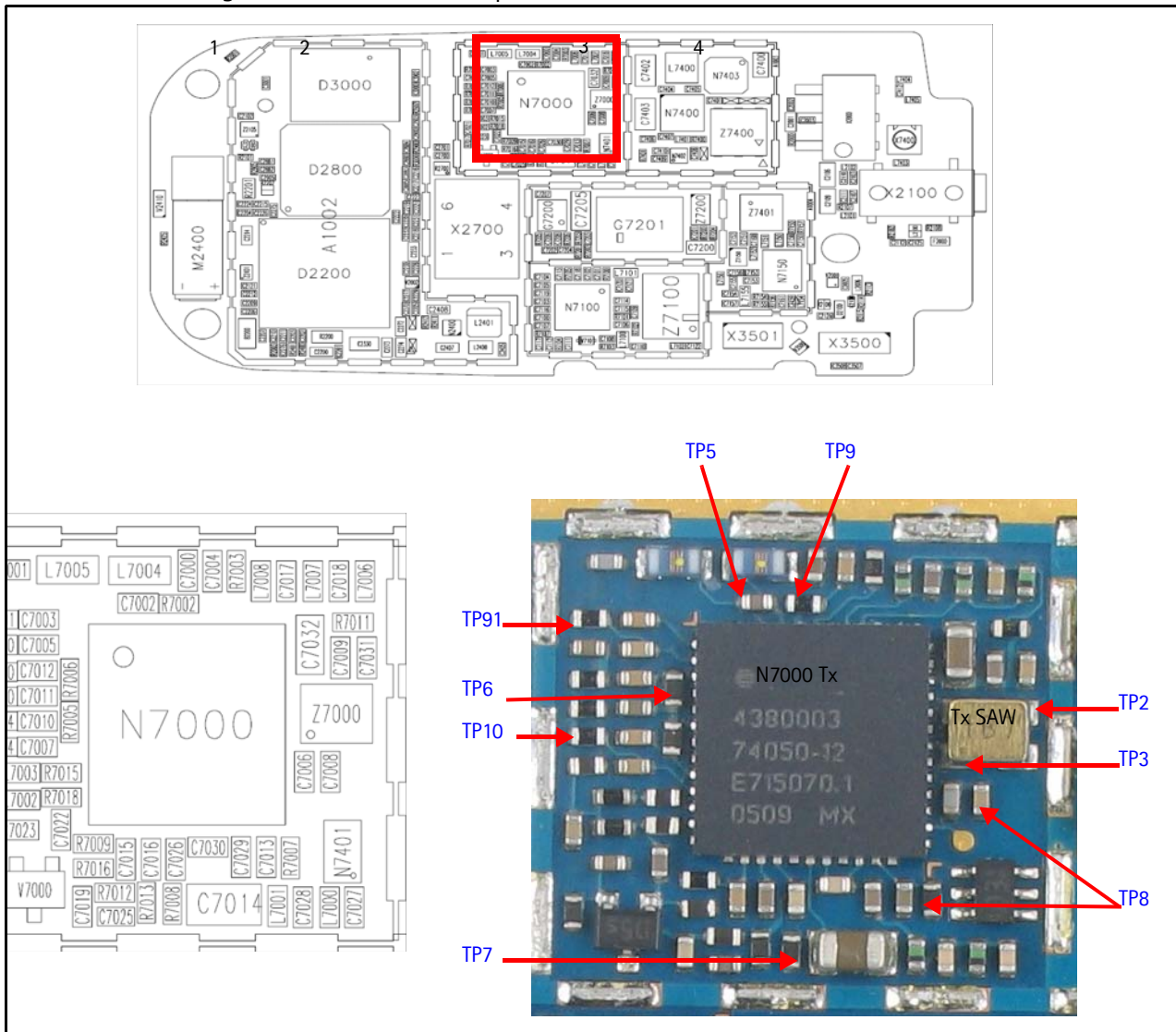


Figure 11: Tx DC/RF test points - N7000 section

Table 1 shows the Tx DC/RF test points to probe (see Figure 10 and Figure 11) when troubleshooting the cell transmitter path. It is recommended that you follow the steps in order.

Table 1: Tx DC test points

Test Point	FUnction	Typical Value/ Frequency HP85024A	Typical Value/ Frequency Prod Probe	Comments
TP1 Z7000 pin 1	N7000 - Out	-40 dBm/ 1MHz 836.52MHz	-13.2dBm/ 836.52MHz	Output of N7000 Driver, Input to Tx SAW Filter
TP2 Z7000 pin 3	PA - In	-26 dBm/ 1MHz 836.52MHz	-15.4 dBm/ 836.52MHz	Output of Tx SAW, Input to PA
TP3 Z7400 In	PA - Out	5.0 dBm/ 1MHz 836.52MHz	18.3 dBm/ 836.52MHz	Input to Isolator
TP4 Z7400 Out	Iso - Out	2.5 dBm/ 1MHz 836.52MHz	10.3 dBm/ 836.52MHz	Output of Isolator, Input to Duplexer
TP5 C7002	IF - Out	-29 dBm/ 1MHz 228.6MHz	-24 dBm/ 228.6MHz	Tx IF probing point at IF filter
TP6	VR5	2.75V dc		VHF VCO/PLL, IQ modulator supply from UEM
TP7	VR7	2.75V dc		UHF PLL supply from UEM
TP8	VR2	2.75V dc		Mixer, driver, and IF supply from UEM
TP9 R7002 TP91 R7001	VAGC-RF VAGC-IF	0.2 to 1.8V dc		Tx AGC control voltage from UPP. 0.2V = Max Gain 1.8V = Min Gain
TP10	VIO-Tx	1.8V		Supply for digital circuits from UEM
TP11	VBAT	3.2V dc		Battery voltage (nominal voltage 3.7V dc)
TP12	VCC	3.1V dc (High Gain)		Main PA supply voltage from PMIC. Lgain=0.8V, Mgain=1.25V, Hgain=Vbat
TP13 C7407	VG/Vref	4.6V dc (Enable)		PA gate voltage (Enable/ Disable). Disable=0V

Tx AGC Tuning

Tx power versus IF/RF PDM can be verified against FlaLi specification limits. Make sure that the PA is set in high gain mode (GenIO bits 10, 13, and 12 are set to H).

Table 2: Tx AGC Tuning Steps

Tx Tuning AGC Step	Target Power	Low Limit	High Limit
Tx AGC (0)	-46	-55	-37
Tx AGC (1)	-24	-34	-14
Tx AGC (2)	-15	-25	-6
Tx AGC (3)	-4.5	-14	5
Tx AGC (4)	2.5	-7	12
Tx AGC (5)	6	-3	15
Tx AGC (6)	15	6	24
Tx AGC (7)*	25	21	27

*Not an actual FlaLi tuning PDM. PDM produces approx. 25 dBm at the antenna connector.

Receiver Troubleshooting

Following is the Rx system block diagram.

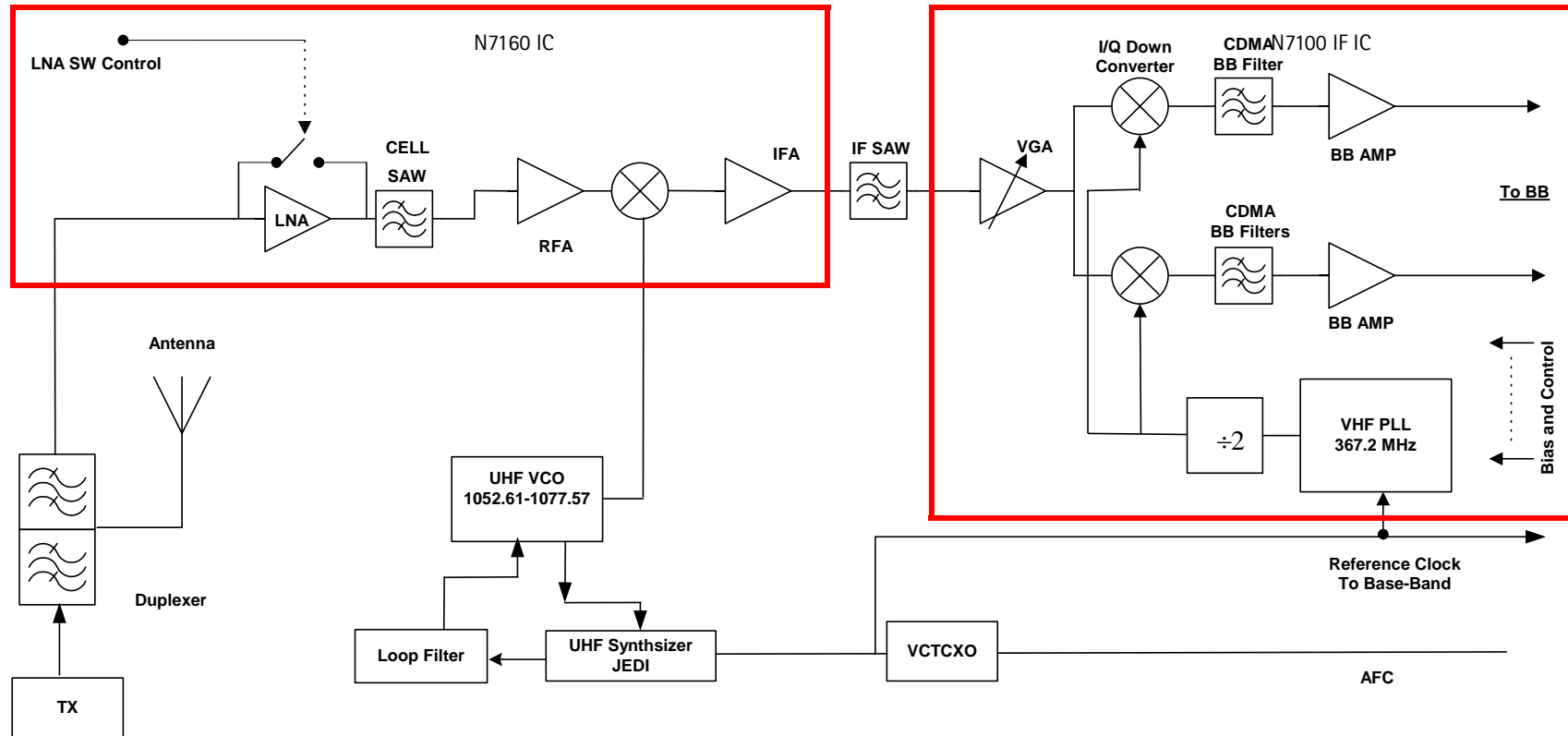


Figure 12: Receiver system block diagram

Receiver Schematics

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

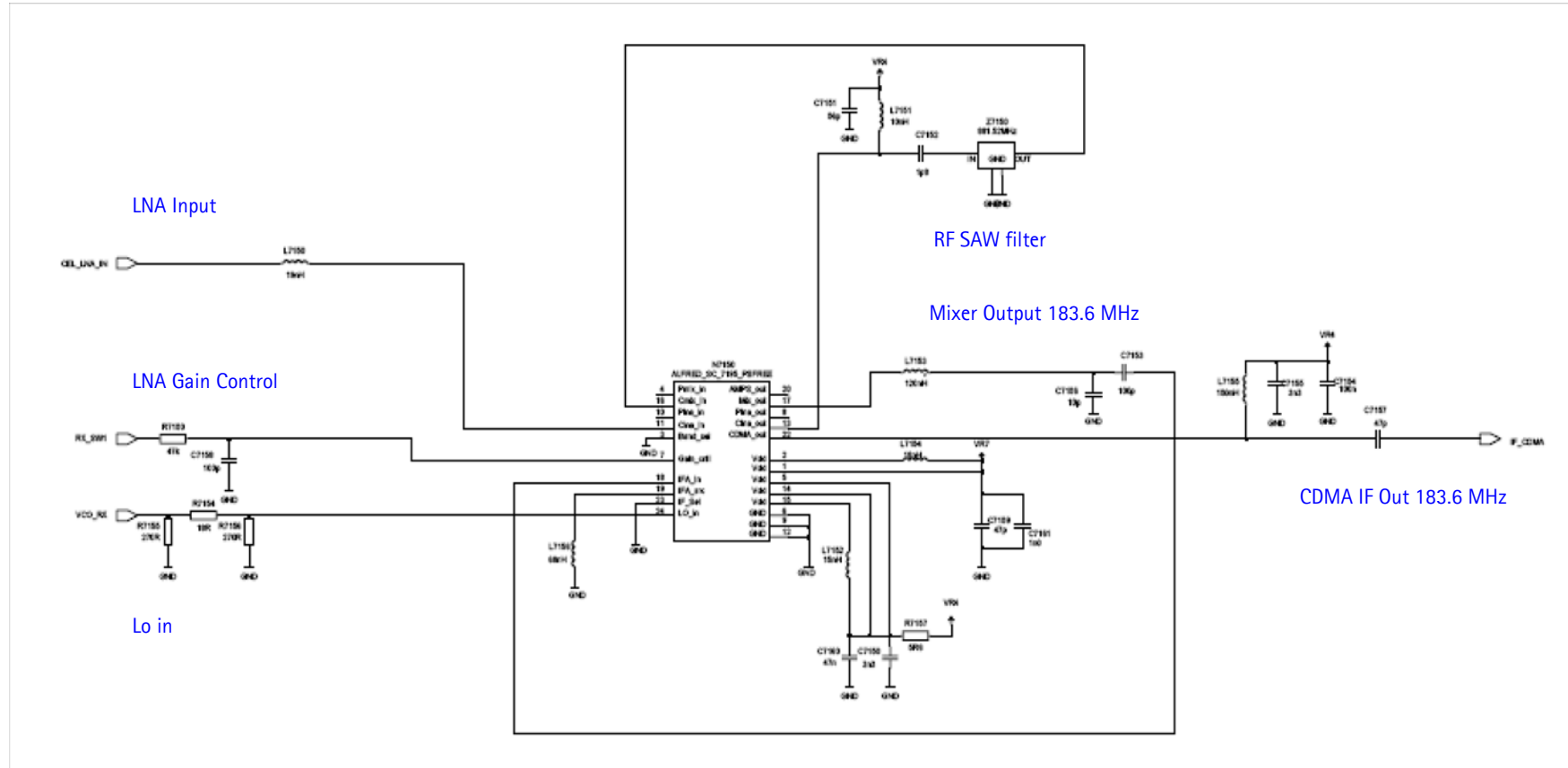


Figure 13: Receiver schematic 1

Turning on the Rx Path

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

1. Turn on Receiver Only in CDMA mode.
2. On the **Phone Control** dialog box, click the **LOCAL** button in the **Phone State** area to put the phone into Local Mode.

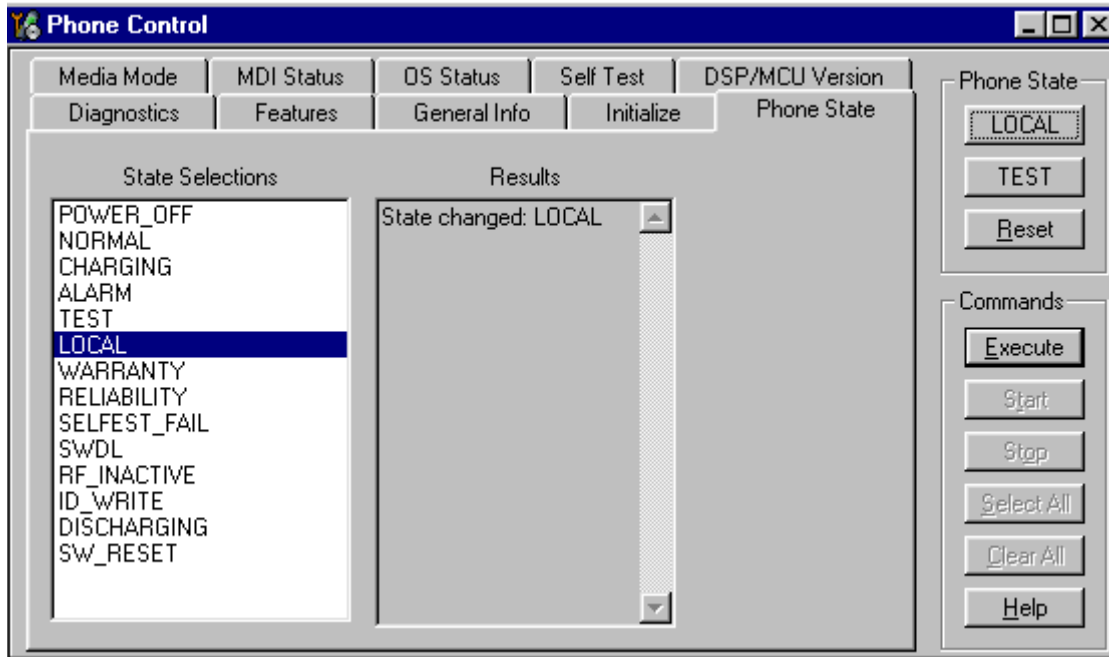


Figure 15: Phone Control dialog box

3. Click **Execute**.
4. On the **RF Main Mode** dialog box select the following values:
 - **Band** = Cell (CDMA)
 - **Channel** = 384
 - **Mode** = Rx/Tx
5. Click **Set**.

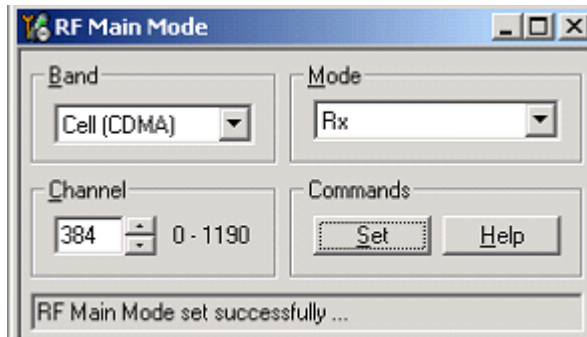


Figure 16: RF Main Mode dialog box for Cell Mode

Note: Be sure that the “RF Main Mode set successfully” message appears in the status bar

Switching the Rx Gain, IF, and IP States

Use the **RF Gen I/O** dialog box to switch the gain state (Hi and Lo) for CDMA mode. Select the desired state, and click **Refresh**.

- Lo Gain Mode: Move the green square to **No Gain**.
- High Gain Mode: Move the green square to **Gain**.

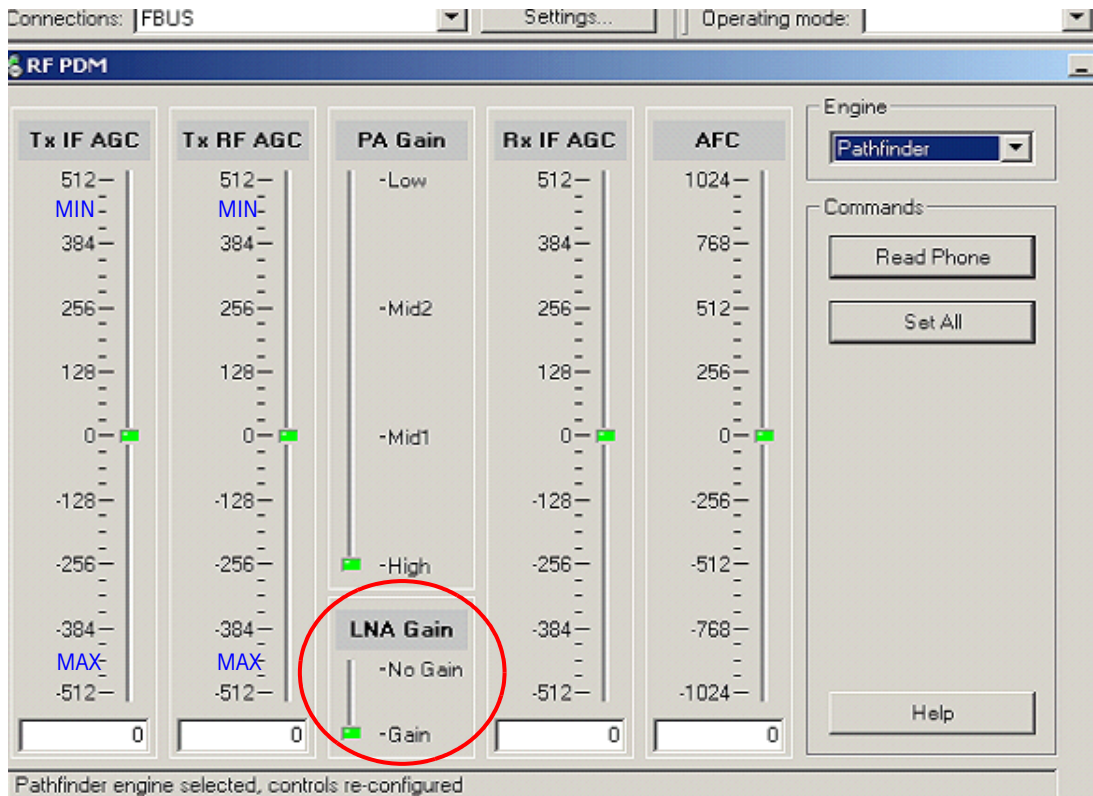


Figure 17: RF Main Mode dialog box for Cell Switching Rx Gain States

Receiver Troubleshooting

Use Phoenix to perform the following steps for troubleshooting the receiver. Together with the VCO frequency and level verification, this test should be the first test for a non-working receiver. This test verifies the entire receiver chain, from input connector to baseband output.

1. Inject a CW signal 881.82MHz or 881.22MHz (CH-384 offset by 300KHz) at a fixed -75dBm power level, If you don't have Signal Generator, use the CALL BOX in AMPS mode on Channel 374 or 394 (10 channels away from Channel 384).
2. Open the **Phone Control** dialog box.

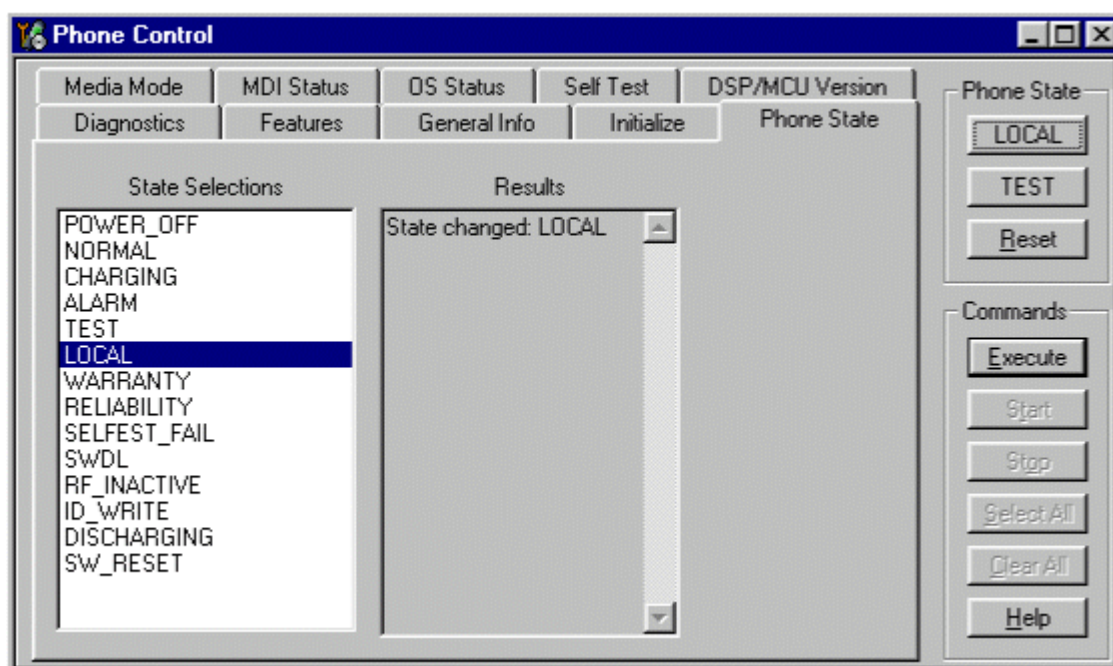


Figure 18: Phone Control dialog box for Rx IF troubleshooting

3. Click the **LOCAL** button in the **Phone State** area to put the mobile terminal into Local Mode.
4. Select the following values on the **RF Main Mode** dialog box:
 - **Band** = Cell (CDMA)
 - **Channel** = 384
 - **Mode** = Rx

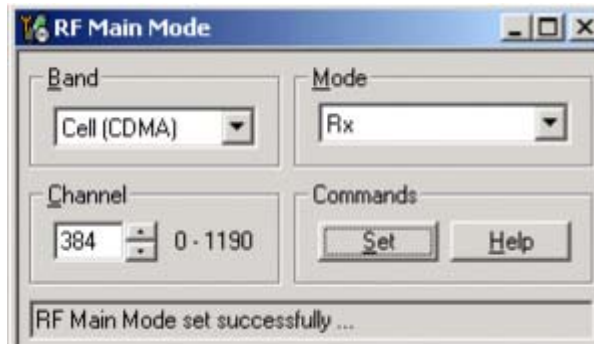


Figure 19: RF Main Mode dialog box for Rx IF troubleshooting

5. Click **Set**.

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

6. Use a Spectrum analyzer to test TP3 (I+,I-, Q+, Q-), Set the S.A to 300KHz Center Frequency, 200KHz SPAN and +10dBm Reference level
7. For the 1st 2 tests in the table below (Tp1,Tp2), inject CW signal at 881.52 MHz (CH-384) at a fix -25dBm Power level (Same as in the RF tests).
8. Using Phoenix, set the Receiver to Rx mode, High Gain, Ch-384, same as in the RF section.

Receiver RF Troubleshooting Test Points

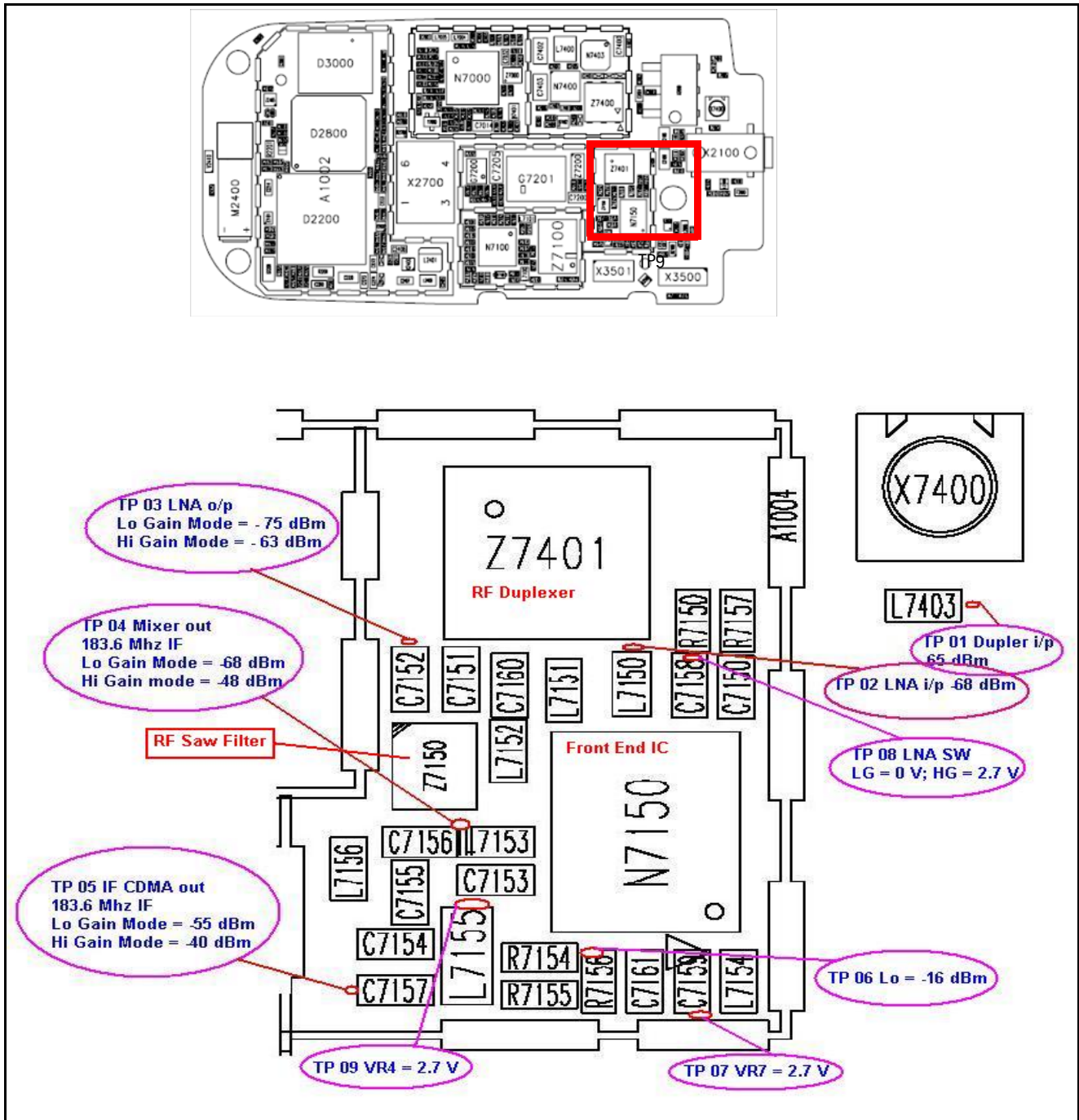


Figure 20: Receiver Rx troubleshooting test points

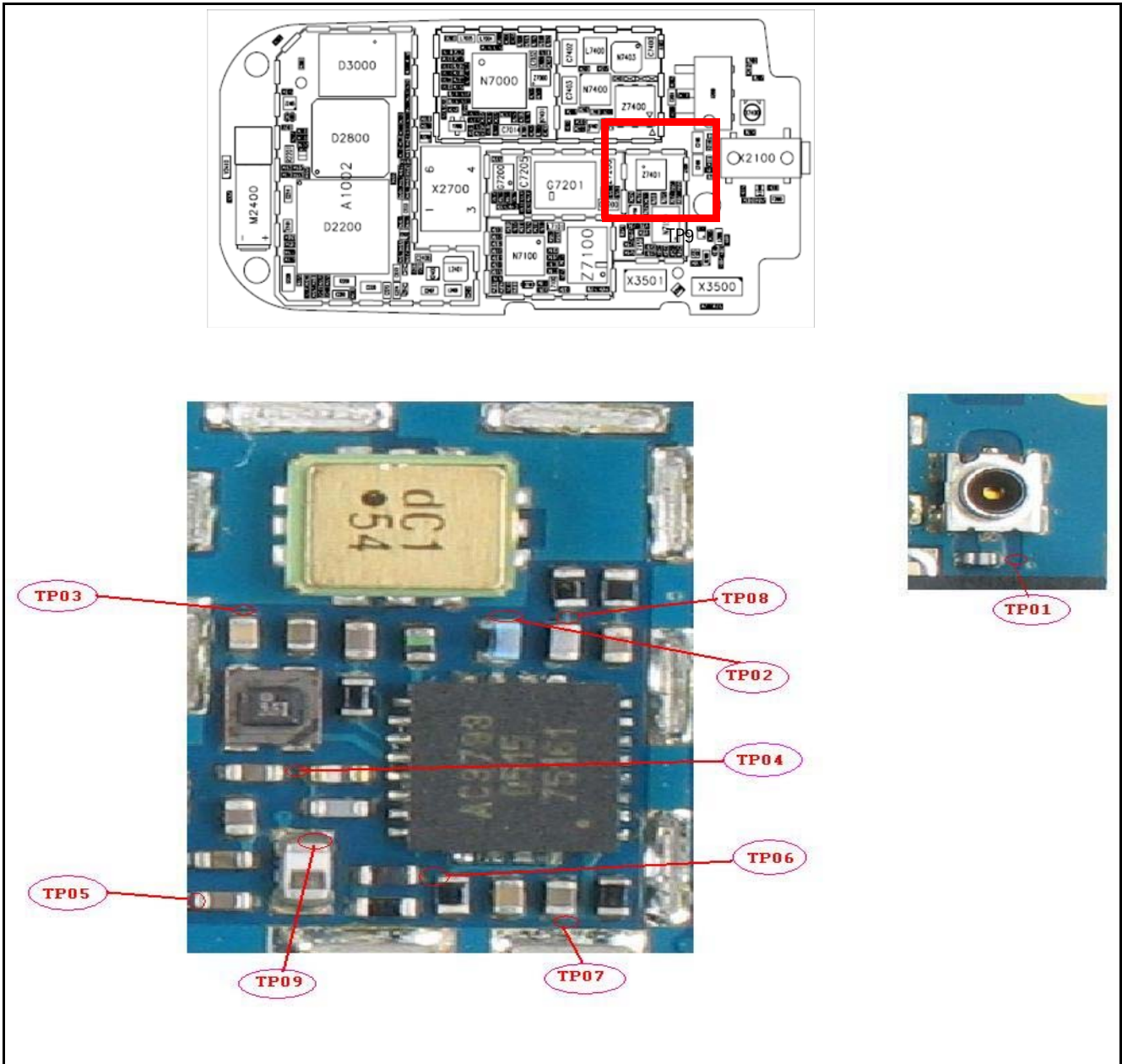


Figure 21: Receiver Rx troubleshooting test points

Receiver IF Troubleshooting Test Points

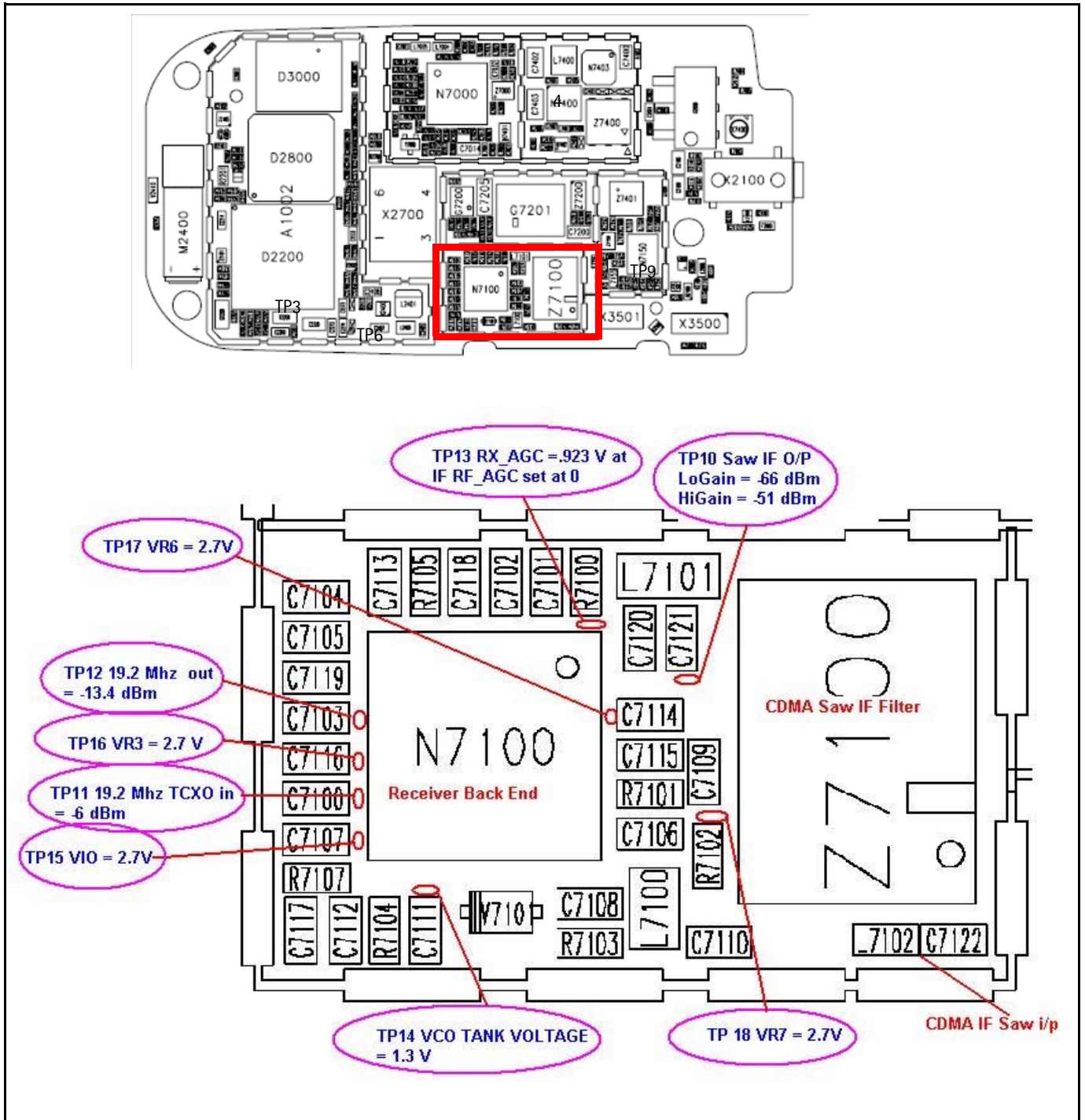


Figure 22: Receiver IF troubleshooting test points

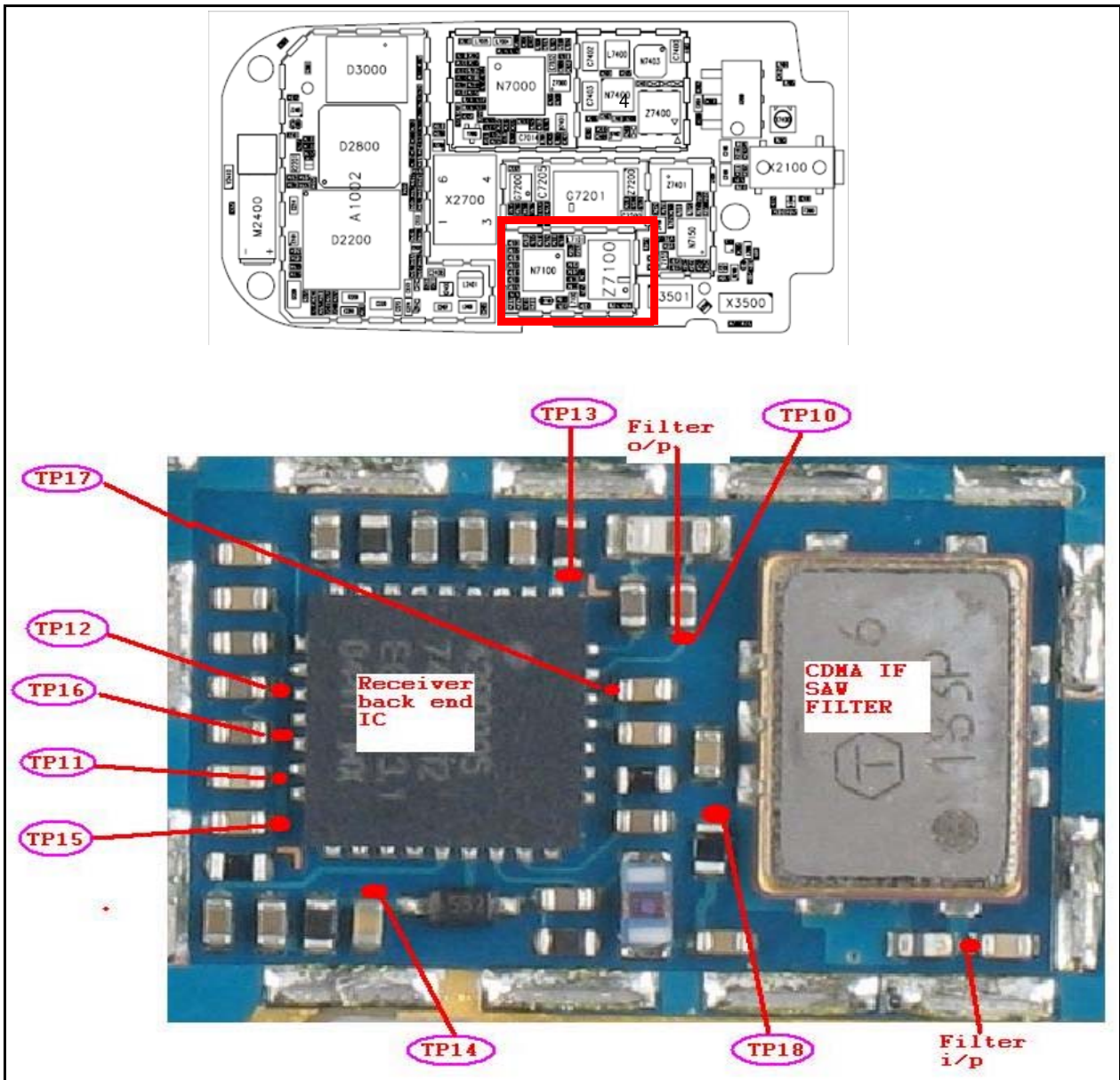


Figure 23: Receiver IF troubleshooting test points

Cell Receiver Check from RF to IQ

Use the following values to check the CDMA Cell Rx 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 for Cell 881.82MHz or 881.22 (CH-384 offset by 300kHz from 881.52MHz or 10 channels away).
3. Measure a 300kHz tuning on the analyzer. You should see a typical -21dBm IQ tuning for CDMA Cell.

Figure 24 shows the Cell spectrum with an inject tone at -75dBm , as well as the IQ output test points. Note that DC is present on the IQ output test points, and all test points should be approximately equal.

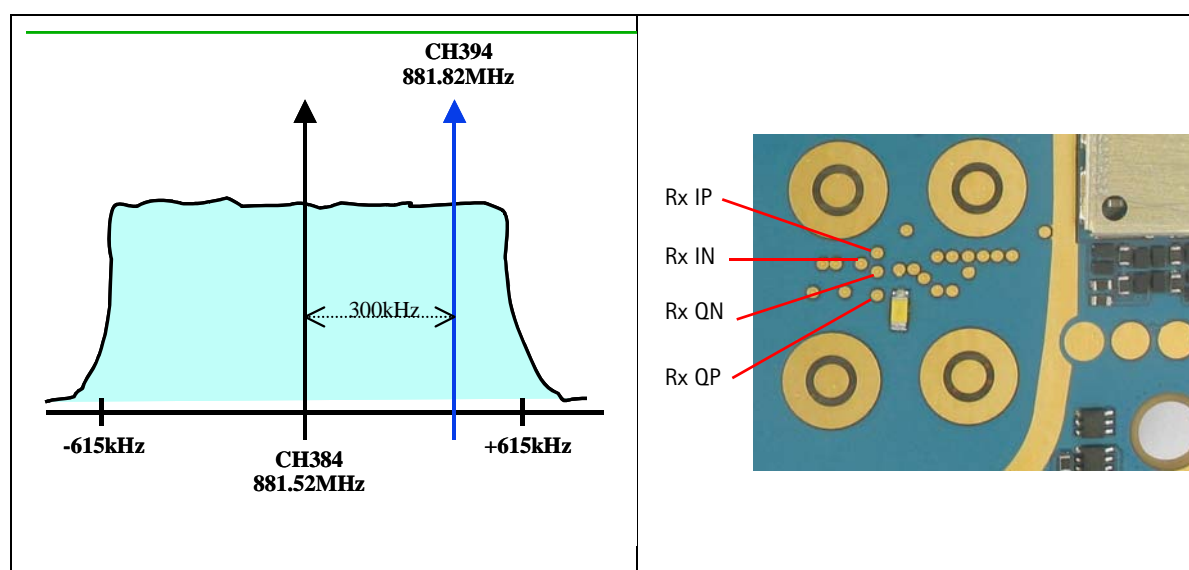


Figure 24: Cell spectrum (left) and IQ output test points (right)

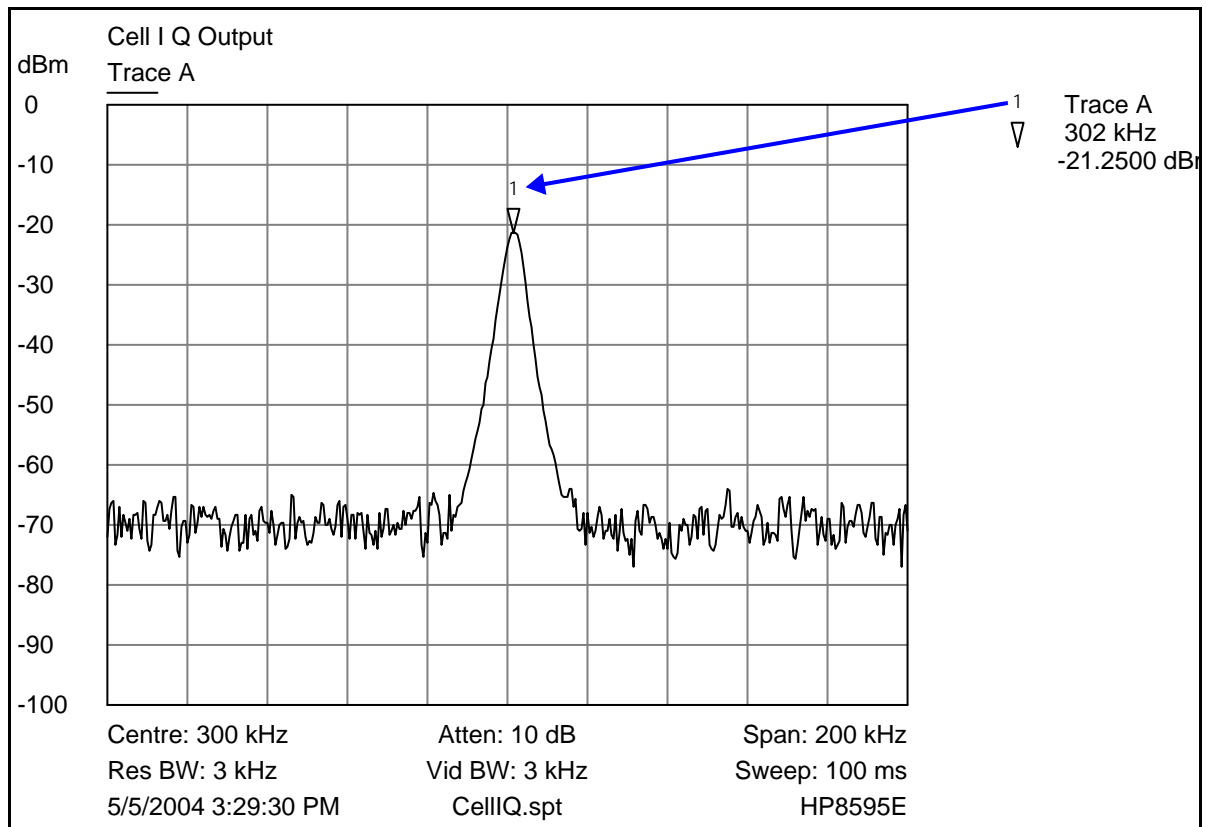


Figure 25: Receiver IQ level on CDMA Cell band

Receiver Diagnostic using Signal Tracing and Call Box

Use the following steps to trace a receiver signal. Refer to diagrams above.

1. Inject an external signal source of -25dBm into 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.

Inject a CW signal for Cell 881.82MHz or 881.22 (CH-384 offset by 300KHz) at a fixed -75dBm power level.

Rx Front-End IC (N7150) DC Troubleshooting

There are two common explanations for an N7150 failure consisting of high current in Local Mode with just the Rx turned on:

- No presence of an LO signal
- Input impedance drop 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 N7150.

Table 3: N7150 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. The following synthesizers are used in the 2255:

- UHF (CELL) PLL inside N7000 IC.
- Tx VHF (457.2MHz) with PLL in N7000 IC.
- Rx VHF (367.2MHz) with PLL in N7100 IC.

Synthesizer Block Diagram

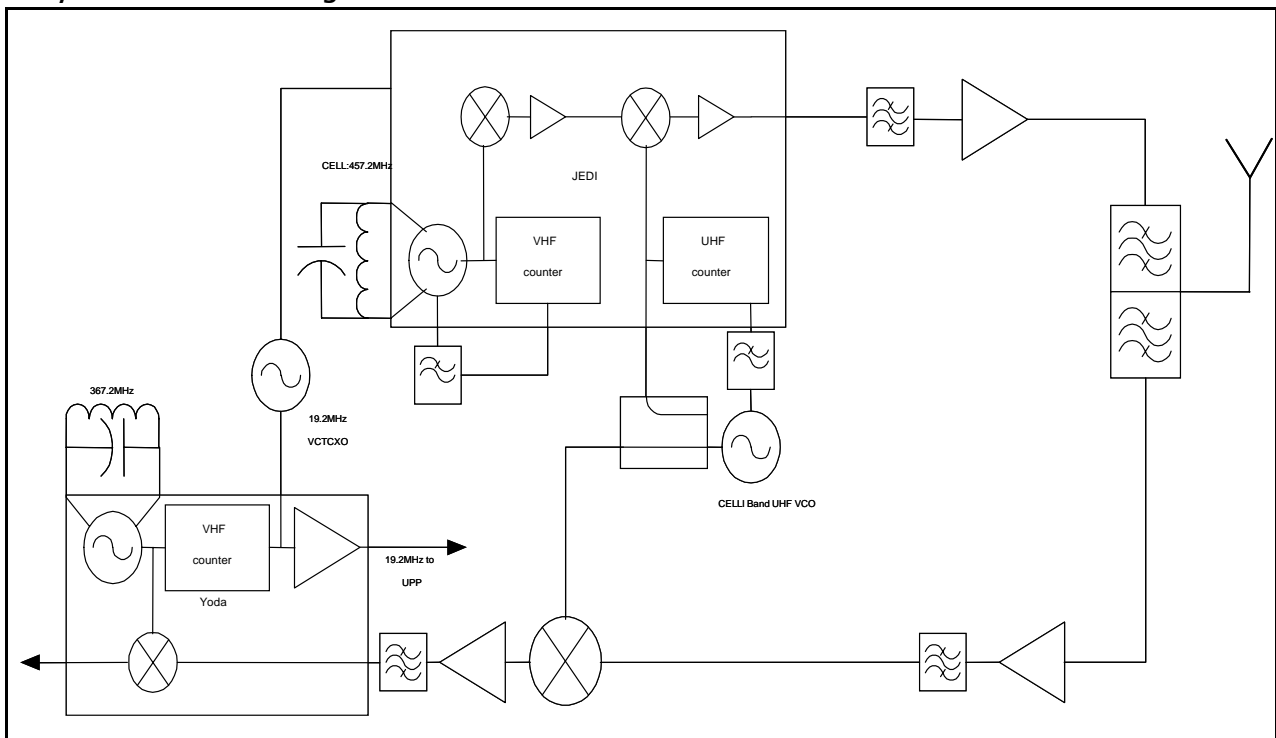


Figure 26: Synthesizer block diagram

Synthesizer Schematic

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

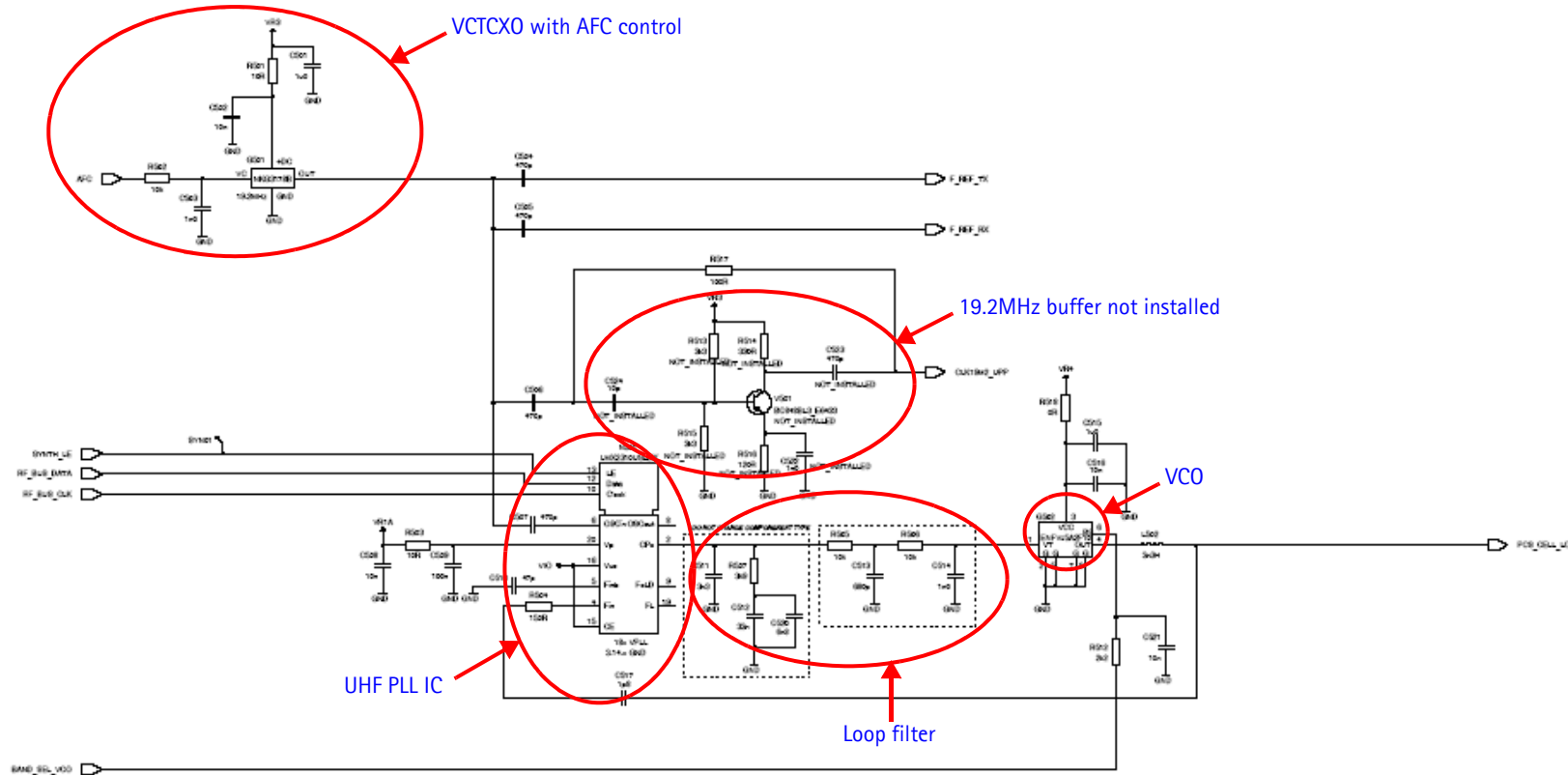


Figure 27: Synthesizer schematic

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 phone into Local Mode.

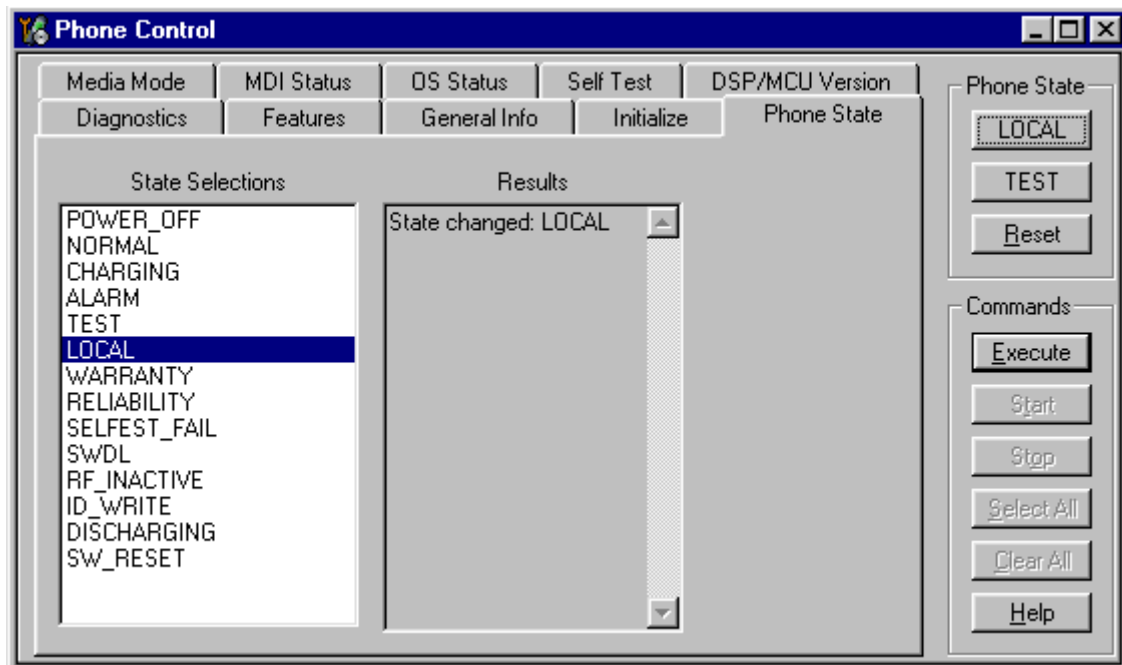
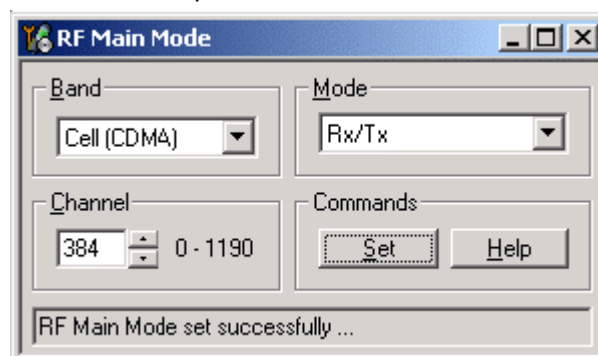


Figure 28: Phone Control dialog box

2. Use the following settings for the **Band**, **Channel**, and **Mode** fields on the **RF Main Mode** dialog box:
 - UHF: Use the Rx/Tx mode and channel 384 in Cell band. This allows you to check power in both the Rx and Tx circuits.
 - Rx VHF: Use the Rx mode. One band is enough.
 - Tx VHF: Use the Rx/Tx mode in Cell band.



3. Click **Set**.

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

4. Read register templates N7000 (0) bits 10 and 11 for the UHF and Tx VHF lock condition

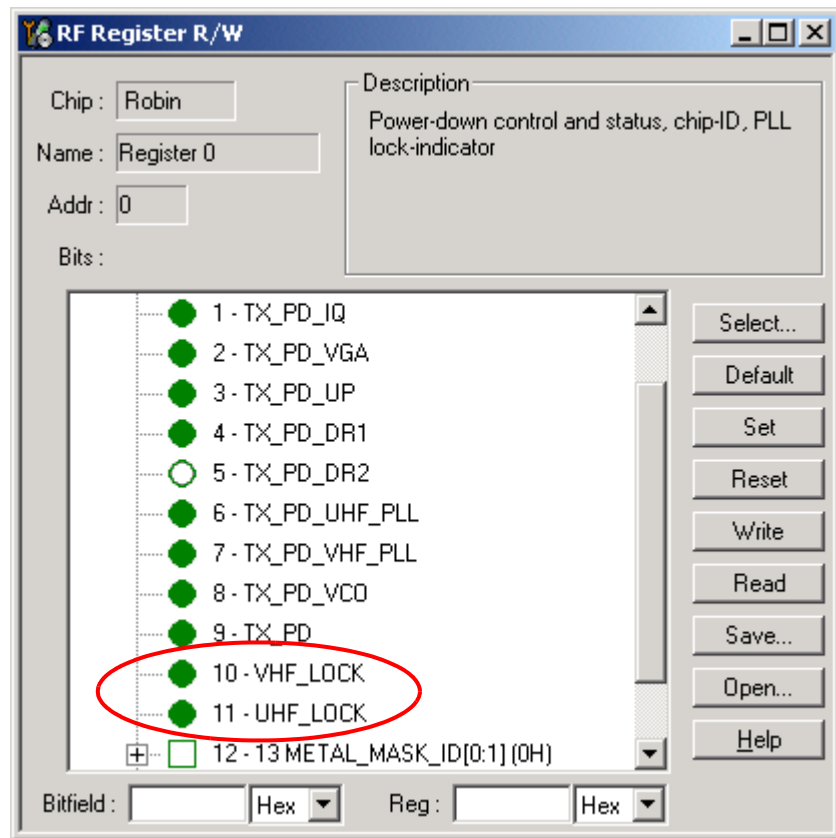


Figure 29: RF Register R/W dialog box for synthesizer setup

5. Read register templates N7100 (0) bit 11 for the Rx VHF lock condition.

19.2 MHz VCTCXO Reference Clock

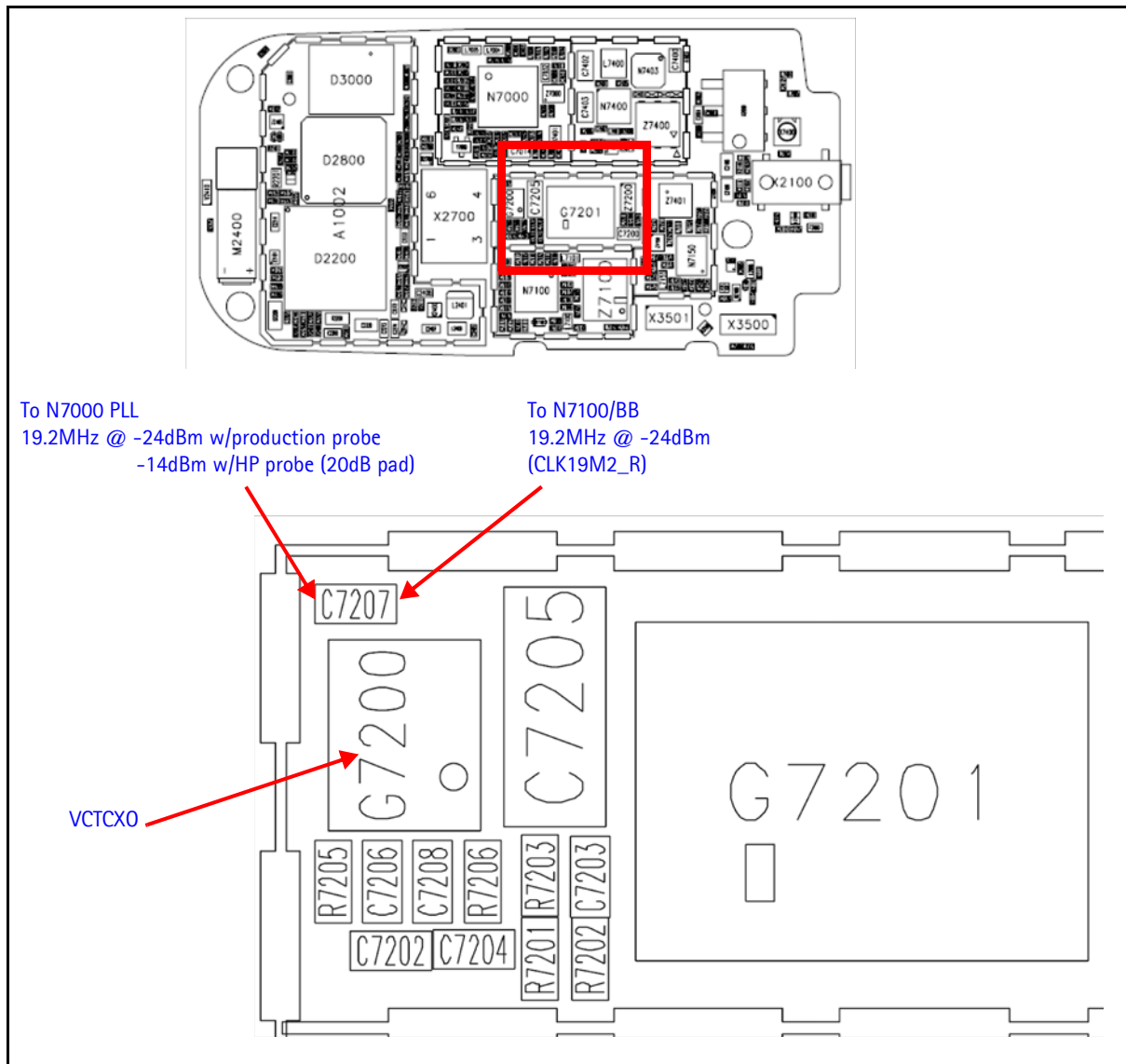


Figure 30: 19.2 MHz VCTCXO Reference clock

VCTCXO Manual Tuning

1. The VCTCXO can be manually tuned to verify failed tuned phones, or to verify if a phone cannot make a call. This can be done with the phone in Local Mode and generating a CW signal. The frequency accuracy of the VCTCXO can be measured using an HP8960 callbox in AMPS mode, an HP4406 Tx tester, or a spectrum analyzer (preferably using a lab system 10MHz source as equipment reference). Replace the VCTCXO if the VCTCXO AFC DAC value does not meet the tuning requirements after tuning.

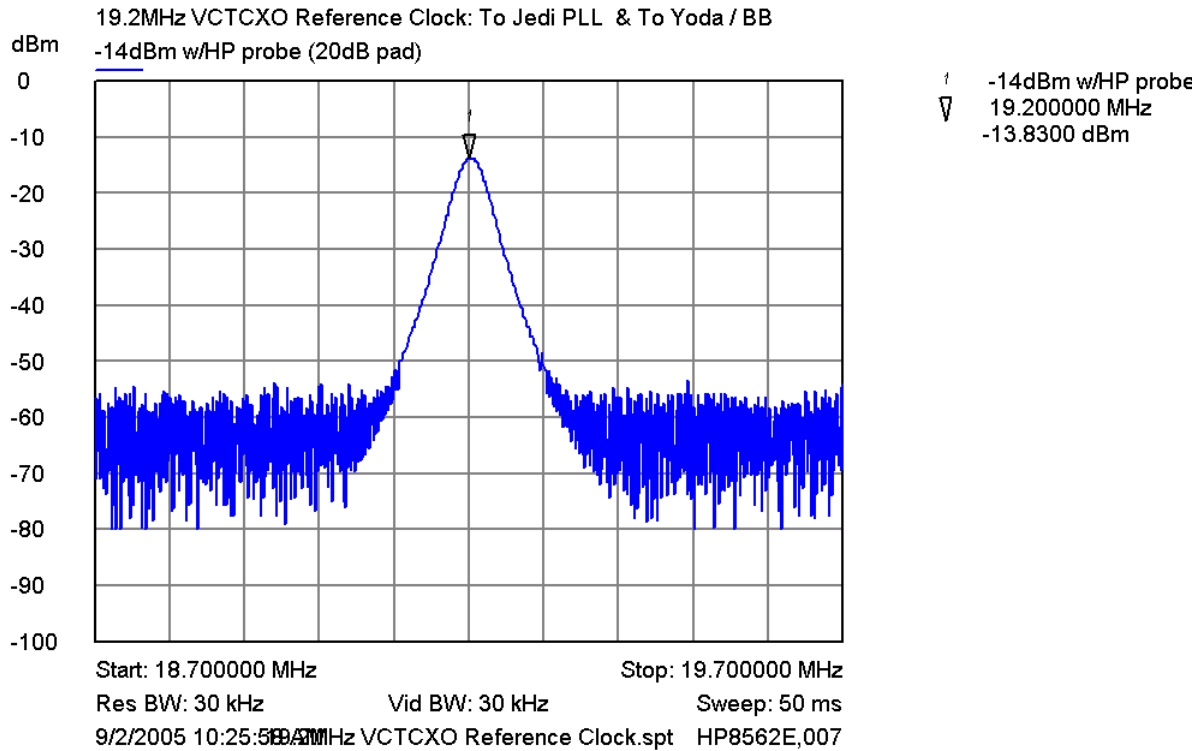


Figure 31: 19.2 MHz VCTCXO reference clock

Use the following steps to set up a CW signal:

1. Open the **Phone Control** dialog box.

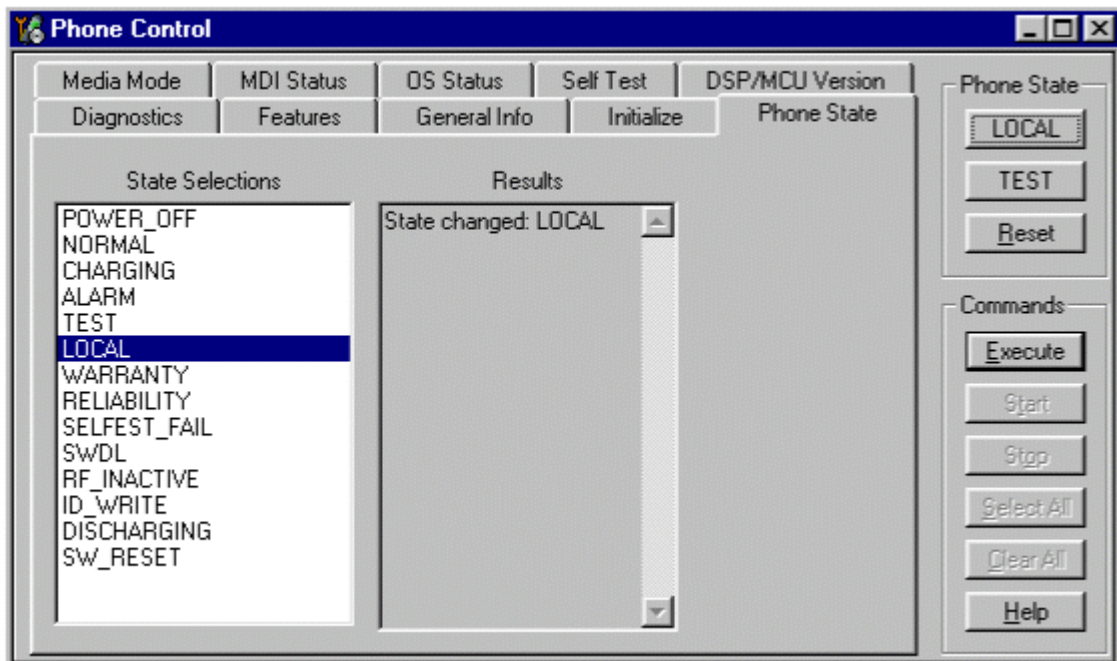


Figure 32: Phone Control dialog box for VCTCXO troubleshooting

2. Click the **LOCAL** button in the **Phone State** area to put the phone into Local Mode.
3. Select the following values on the **RF Main Mode** dialog box:
 - **Band** = Cell (CDMA)
 - **Channel** = 384
 - **Mode** = Rx/Tx

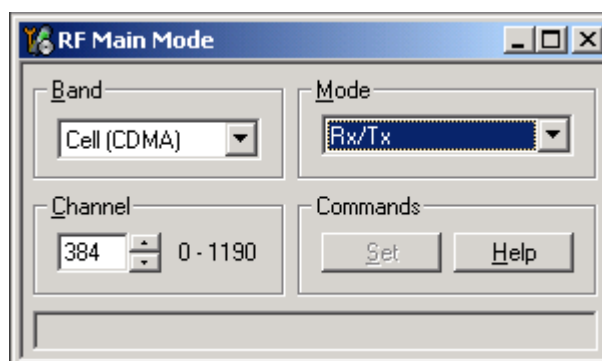


Figure 33: RF Main Mode dialog box for VCTCXO troubleshooting

4. *Do not* use CDMA control to turn on Rho.
5. Open the **BB General I/O** dialog box to set the CW signal.

6. Type 10, 13, 12, and 8 in the fields in the **PIN #** column.

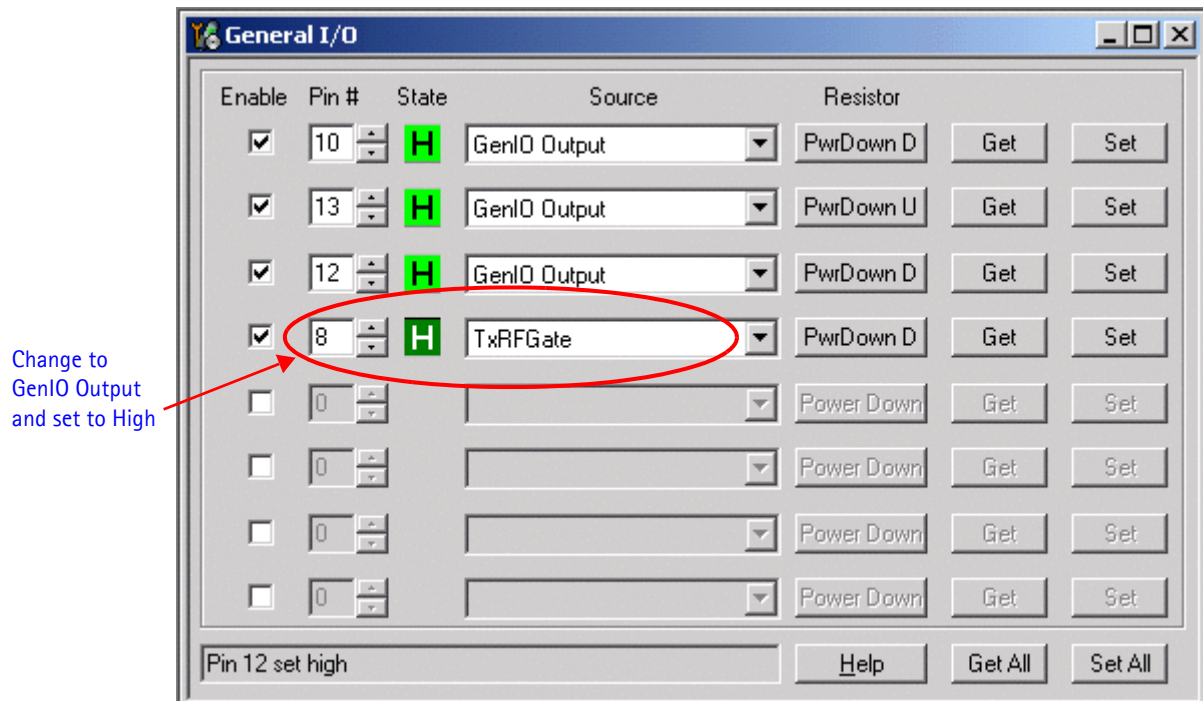


Figure 34: General I/O dialog box for VCTCXO tuning

7. Click the **Get All** button.
8. Change the value for Pin 8 in the **Source** column to GenIO Output.
9. Ensure that all of the pins have a value of H in the **State** column. (Click the L values to change them to H values.)
10. The next step depends on the type of measurement equipment you are using:
 - HP4406 or a spectrum analyzer: Set the center frequency to 836.52MHz and the span to 2MHz. Also, establish a marker at 836.52MHz.
 - HP8960: Set the callbox state to AMPS, and set the channel to 384. Use the Frequency Accuracy measurement to center the VCTCXO.
11. Adjust the AFC value to center the VCTCXO on the **RF PDM** dialog box. The tuning range is approximately +/- 10kHz.

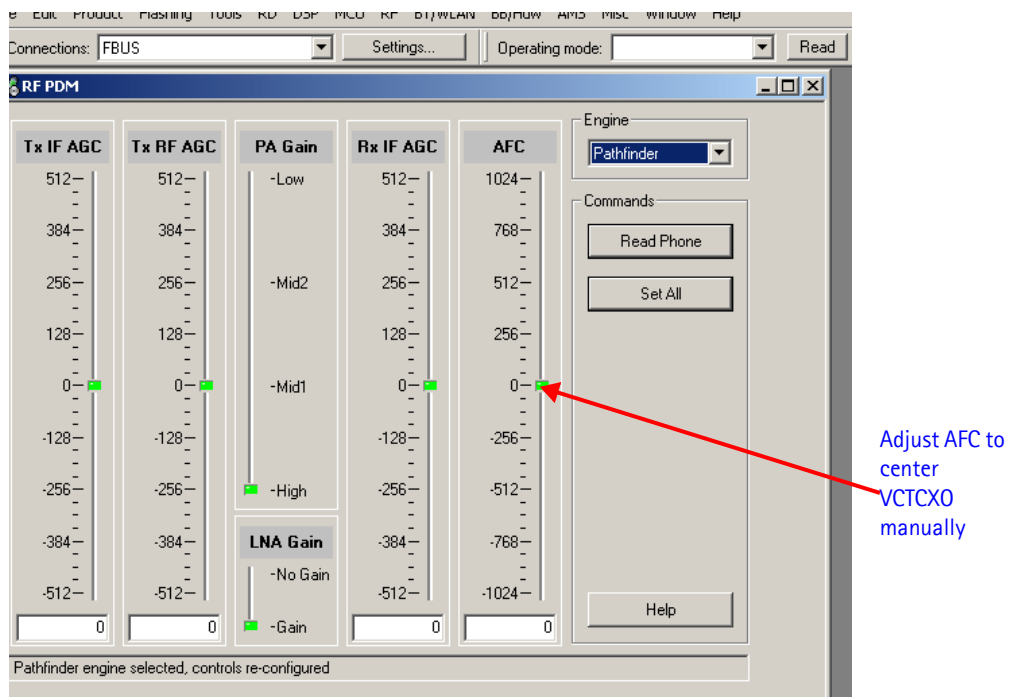


Figure 35: Manually adjusting the AFC to center VCTCXO

12. Adjust the AFC value so that the output signal is within +/- 100Hz. If you are using an HP4406 or a spectrum analyzer, narrow the span to 1kHz or less.
13. If the VCTCXO does not tune, replace the UEM.

UHF Synthesizer Test Points

Figure 36 shows the UHF Synthesizer layout.

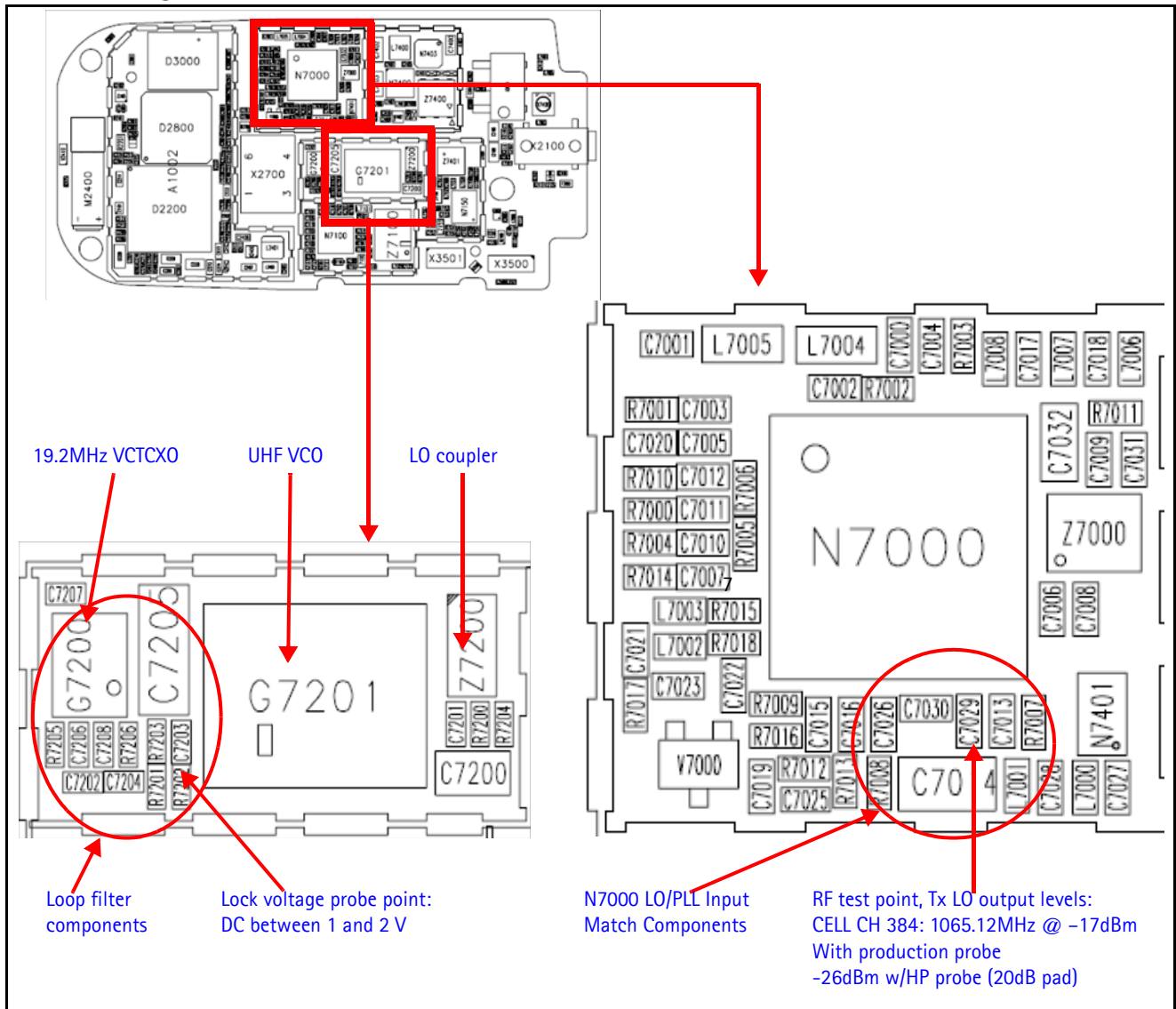


Figure 36: UHF Synthesizer test points

UHF Synthesizer Schematic

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

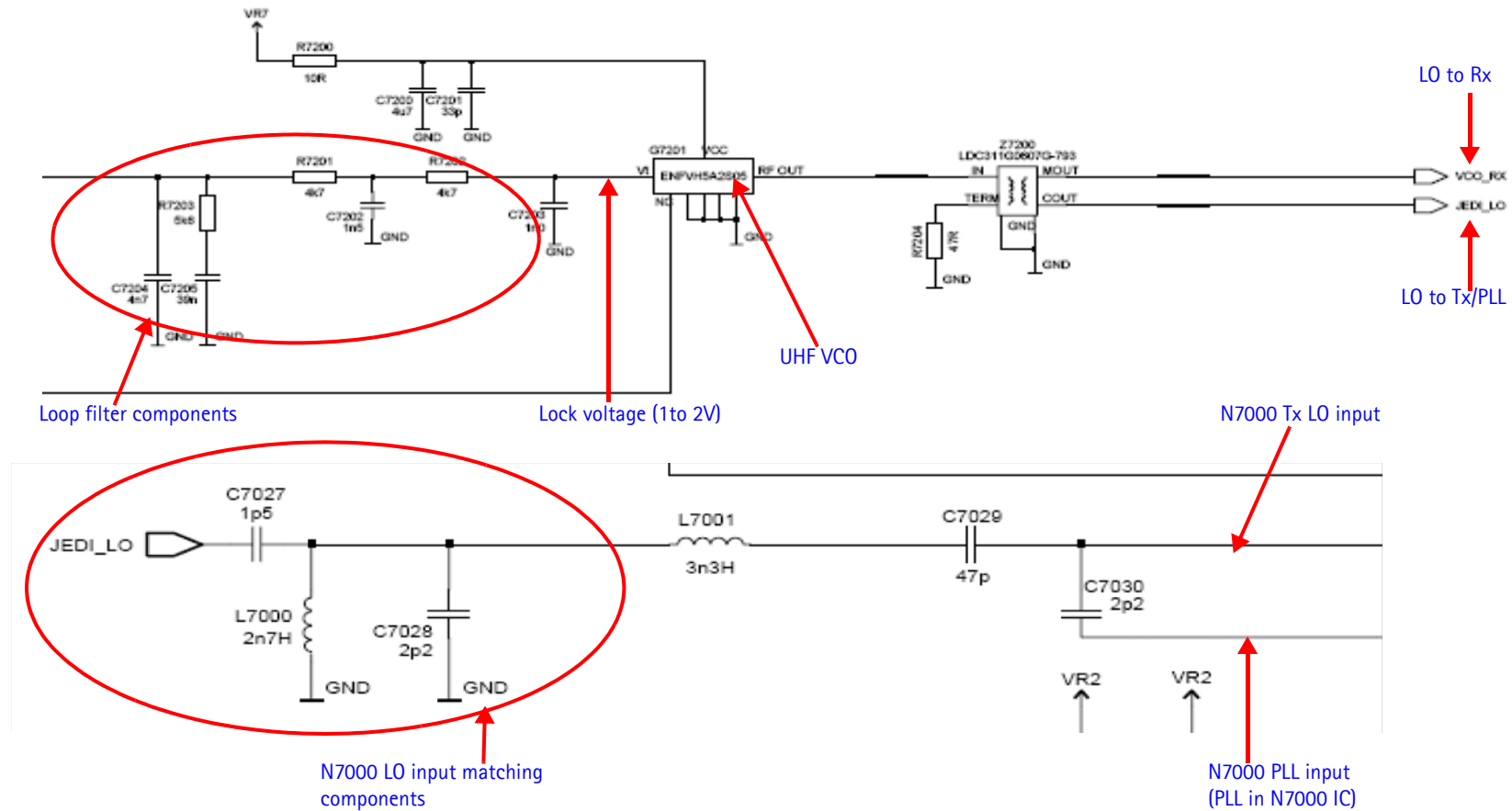


Figure 37: UHF synthesizer schematic

Incorrect UHF Frequency

Following are possible causes for incorrect UHF frequencies:

- Power supplies to PLL N7000 missing or low (VR7)
- Loop filter components missing or incorrectly installed
- Matching components to N7000 TxLO/PLL input missing or incorrectly installed
- 19.2MHz reference clock missing or low
- Programming is incorrect
- Component failure (VCO or PLL portion of N7000)

Rx VHF

Figure 38 shows the Rx VHF test points layout.

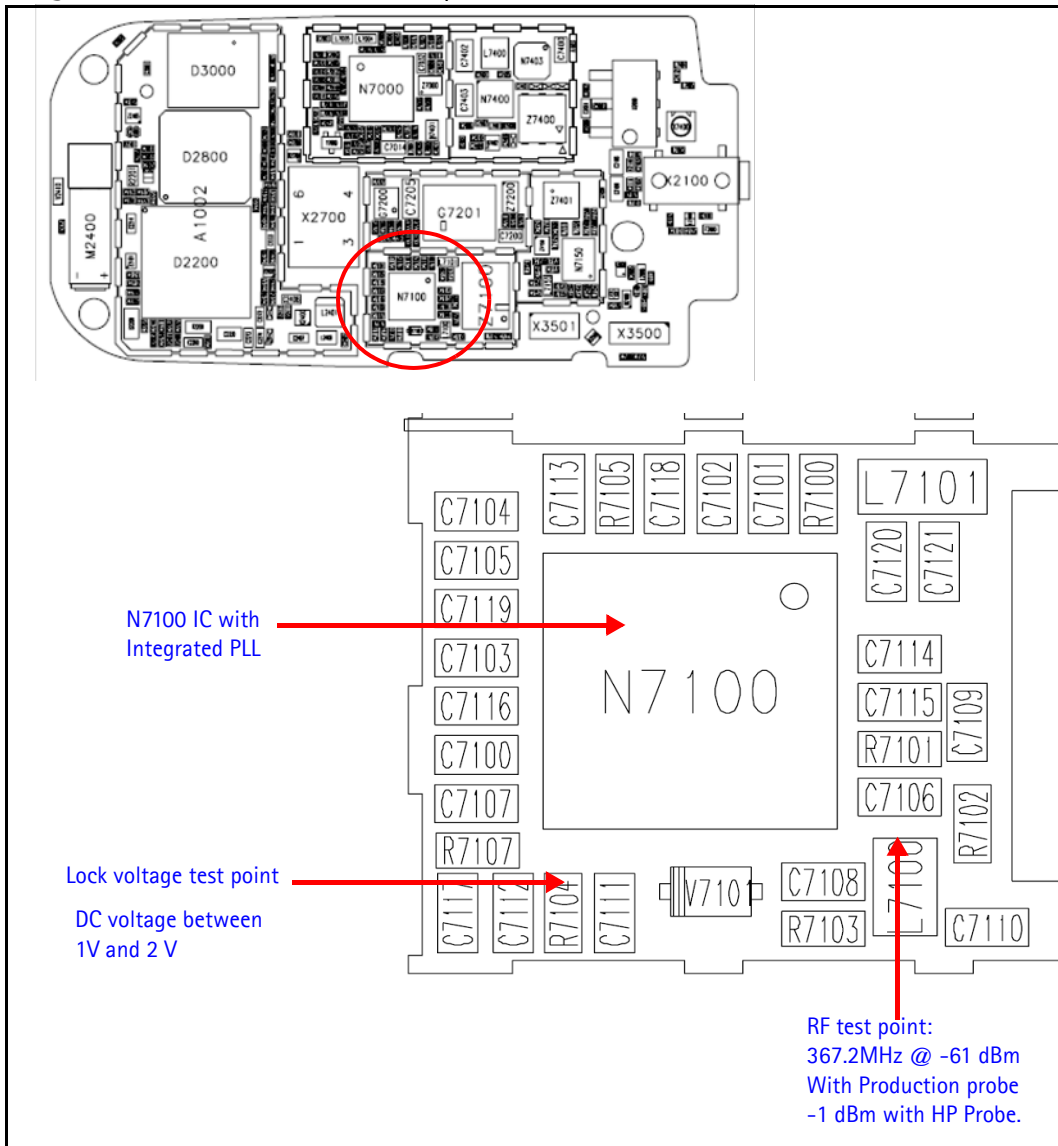


Figure 38: Rx VHF test points

Rx VHF Schematic

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

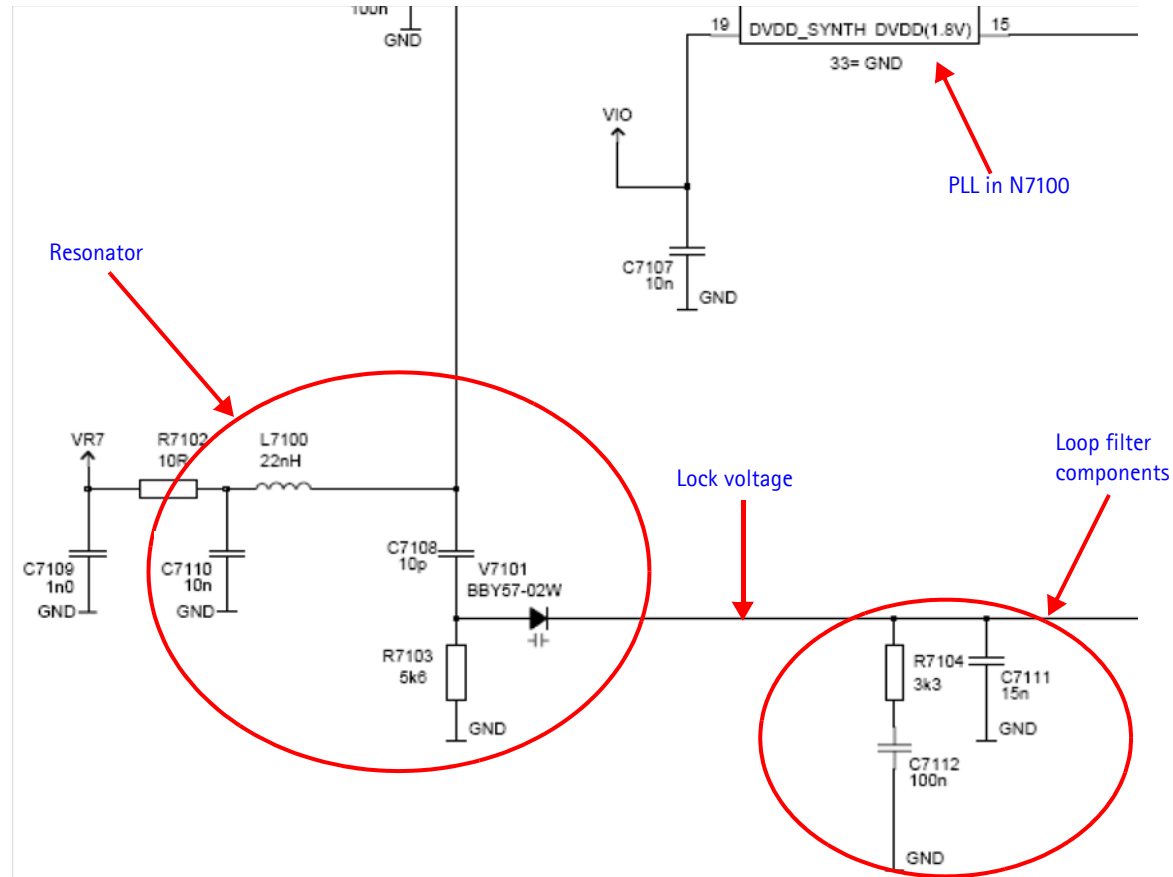


Figure 39: Rx VHF schematic

Incorrect Rx VHF Frequency

Following are possible causes for incorrect Rx VHF frequencies:

- Power supplies to PLL portion of IC N7100 missing or low (VR7)
- Loop filter or resonator components missing or incorrectly installed
- 19.2MHz reference clock missing or low
- Programming is incorrect

Tx VHF

Figure 38 shows the Tx VHF test points layout

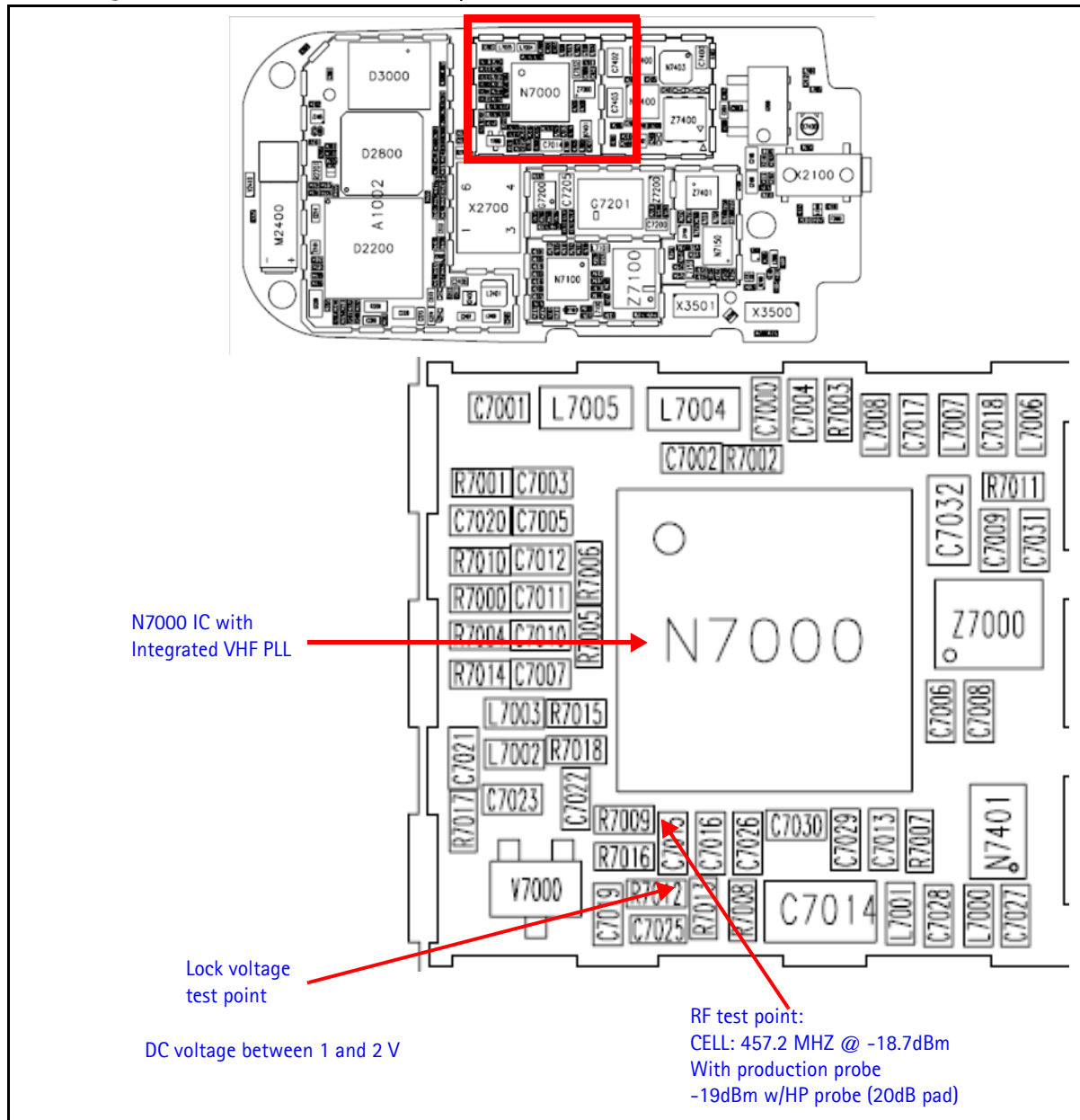


Figure 40: Tx VHF test points

Tx VHF Schematic

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

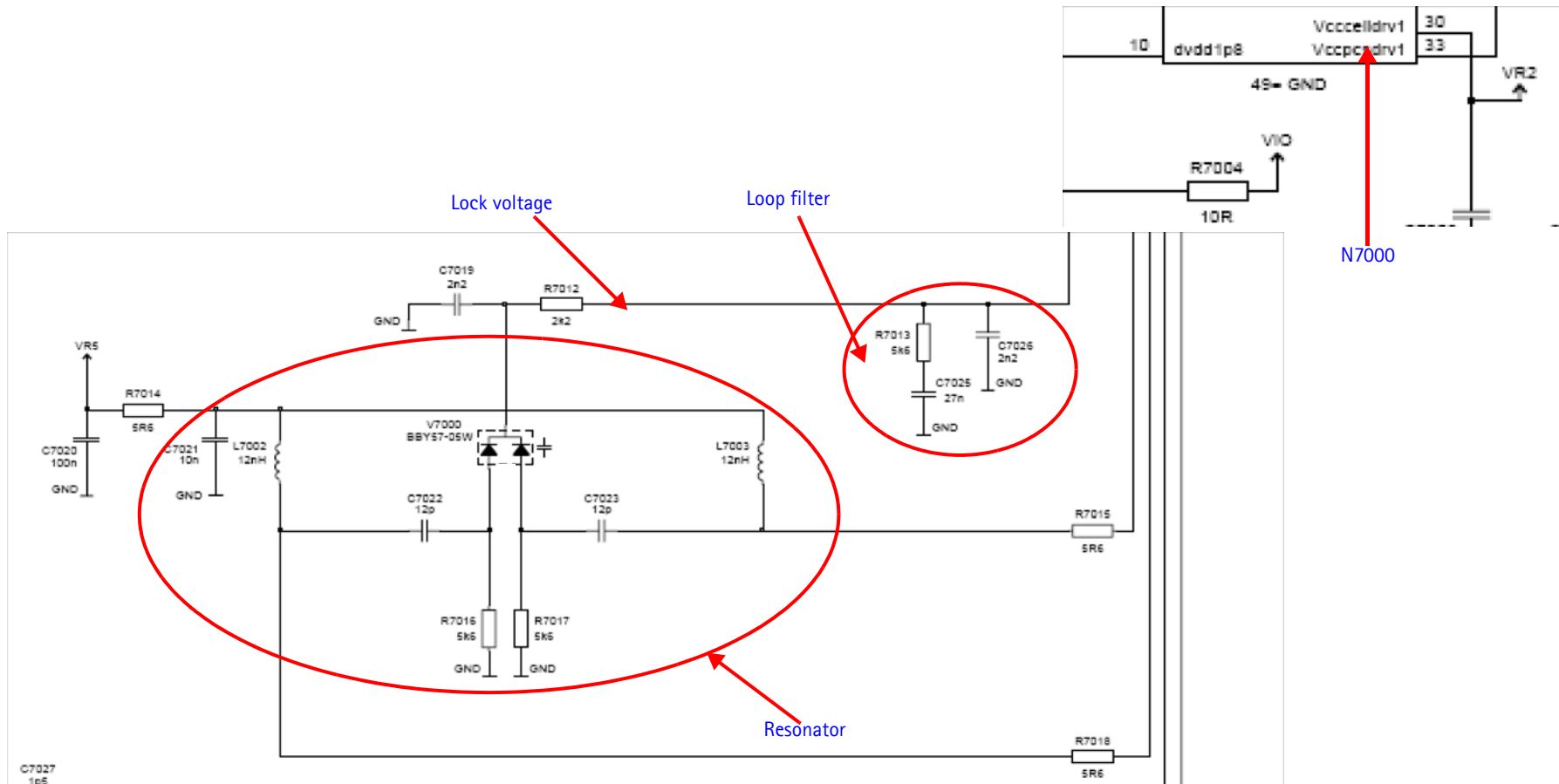


Figure 41: Tx VHF schematic

Incorrect Tx VHF Frequency

Following are possible causes for incorrect Tx VHF frequencies:

- Power supplies to PLL portion of IC N7000 missing or low (VR5)
- Loop filter or resonator components missing or incorrectly installed
- 19.2MHz reference clock missing or low
- Programming is incorrect
- Component failure (N7000 IC)

FM Radio Troubleshooting

Figure 42 shows the FM Radio layout. FM Radio circuits are located on the top of the PWB.

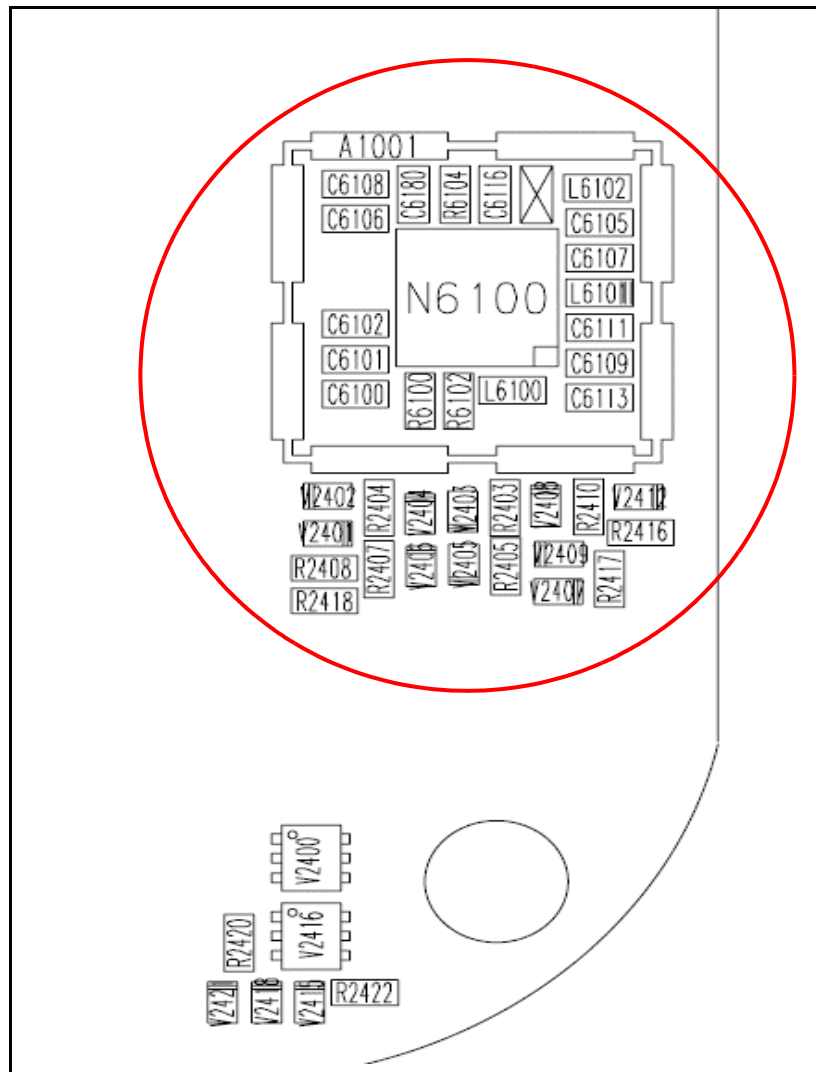


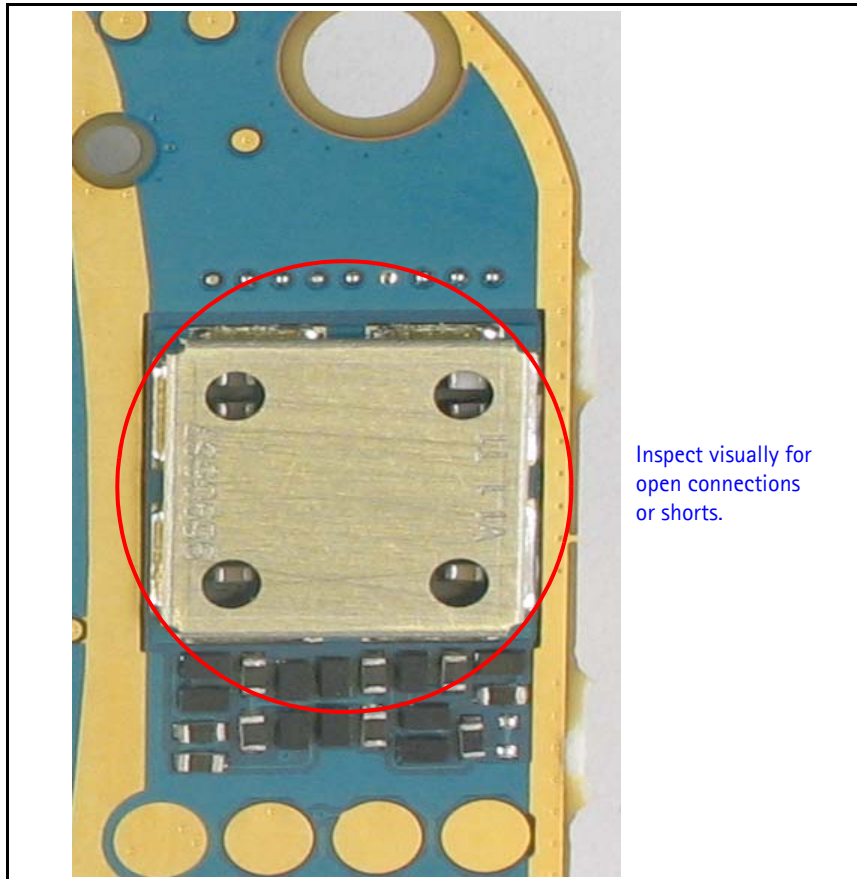
Figure 42: FM Radio layout

FM Radio Troubleshooting Setup

Use the following steps to troubleshoot the FM radio while using universal headset to the UHJ connector.

1. Connect the universal headset (HS-9) to the UHJ connector (top connector).
2. Select the **Menu > Media > Radio** from the mobile terminal user interface.
3. Set a local radio channel by selecting "Automatic tuning" from the Radio menu and scanning up and down by pressing the "Up" and "Down" key respectively.
4. Listen for sound coming from the headset.

- If a signal is present the radio is functioning properly.
- If no channel can be found or no static/sound inspect all FM radio baseband and audio circuits. Refer to the "Audio" section of the Baseband Description and Troubleshooting chapter for more information.



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