

Customer Care Solutions

NPL-2 Series Cellular Phones

7 – RF Description and Troubleshooting

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RF Description and Troubleshooting

Introduction

The sections below provide instructions how to check, repair and calibrate the RF section of NPL-2 phones.

It is assumed that for tuning and repair the phones are disassembled and tested within a repair jig MJS-52.

The following types of measurements can be done for diagnosis and repair of NPL-2 phone modules:

- RF measurements shall be done using a Spectrum Analyzer together with a high-frequency probe. (Note, that signal will be significantly attenuated). Correct attenuation can be checked using a "good" phone board for example.
- LF (Low frequency) and DC measurements shall be done with a an oscilloscope together with a 10:1 probe.
- For receiver measurements a signal generator with frequencies up to 2000 MHz is required. Most of the radio communication testers like CMD55 or CMU200 can be used as signal generator. The signal generator is connected to the antenna port using the repair jig MJS-52.
- Output level measurements of the transmitter shall be done with a power meter, which is connected to the antenna port using the repair jig MJS-52.

Always make sure that the measurement set-up is calibrated when measuring RF parameters at the antenna port. Remember to include the correct losses of the module repair jig (as stated on MJS-52) and the connecting cable when realigning the phone.

Most RF semiconductors are static discharge sensitive. ESD protection must be used during repair (wrist straps and ESD proof soldering irons).

Mjoelner RF ASIC is moisture sensitive. Therefore, Mjoelner RF ASIC must be in appropriate condition or pre-baked prior to soldering.

RX calibration done via Phoenix software is temperature sensitive because of calibration of the 26 MHz reference oscillator (VCXO). According to Mjoelner specification ambient temperature has to be in a range from 22°C to 36°C.

Apart from key-components described in the following sections there are a lot of discrete components (resistors, inductors and capacitors) for which trouble shooting is done by checking its proper soldering and complete assembly on the PWB. Capacitors and resistors can be checked by means of an ohm-meter, but be aware: in-circuit measurement results have to be evaluated carefully.

Below the following abbreviations can be used interchangeably:

EGSM and EGSM900 to refer to GSM low band.

DCS or PCN or GSM1800 GSM medium band.

PCS and GSM1900 GSM high band.

RF Key Component Placement

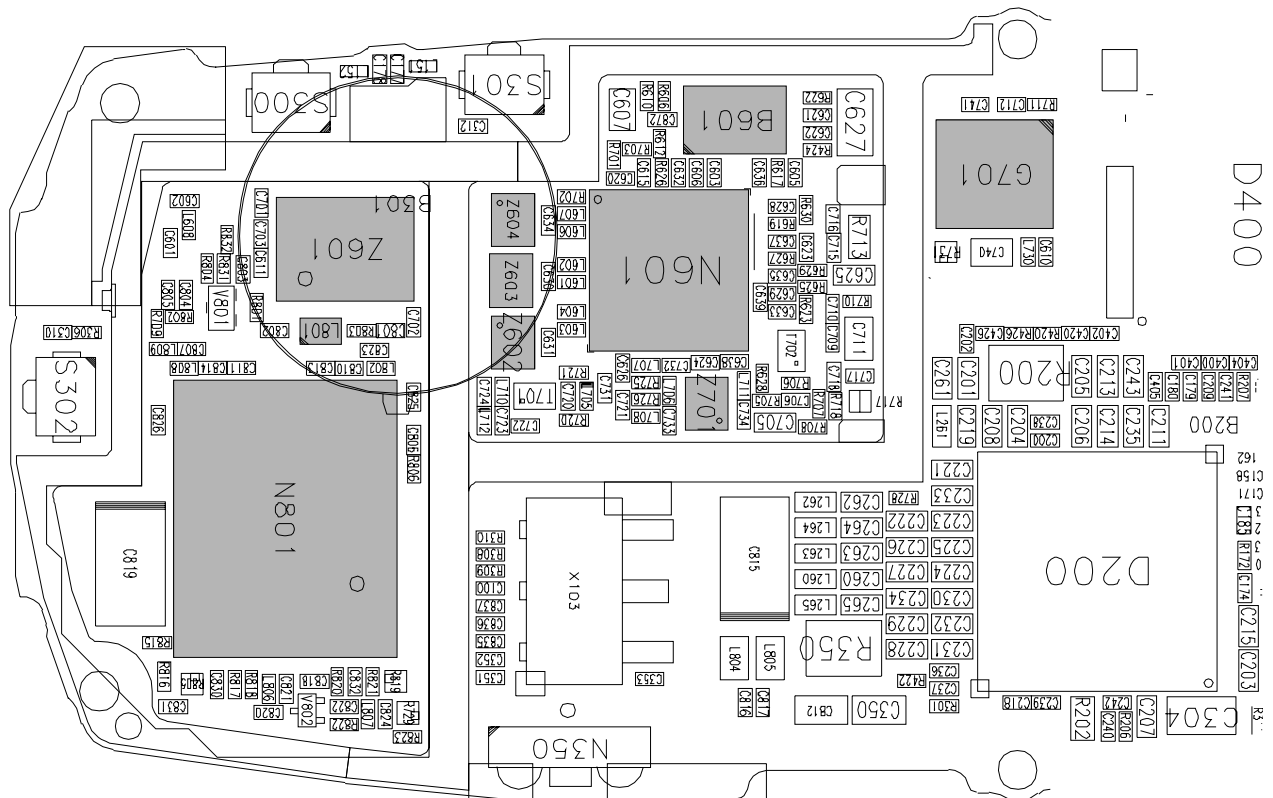


Figure 1: RF key components placement

Position	Component Name	Supplier and Description	Code
N801	TX-PA	Agilent, QCPM8893	4350369
L801	Directional Coupler	Murata, LDC15D190A0010A	4551015
Z601	Antenna Switch Module	Hitachi Metals, SHS-L090	4510385
Z602	SAW1800 RX	Epcos, B7714	4511367
Z603	SAW1900 RX	Epcos, B7720	4511367
Z604	SAW900 RX	Epcos, B7710	4511279
Z701	SAW900 TX	Epcos, B7715	4511311
N601	Mjoelner	Infineon, F3a	4370867
B601	XTAL	NDK	4510337
G701	VCO	FDK, IT016	4350315

RF Measurement Points

The RF power supplies are generated in the UEM and can be measured either in the Mjoelner chamber or in the base band chamber. On the illustration small circles show the locations of the test points.

Receiver Test Points

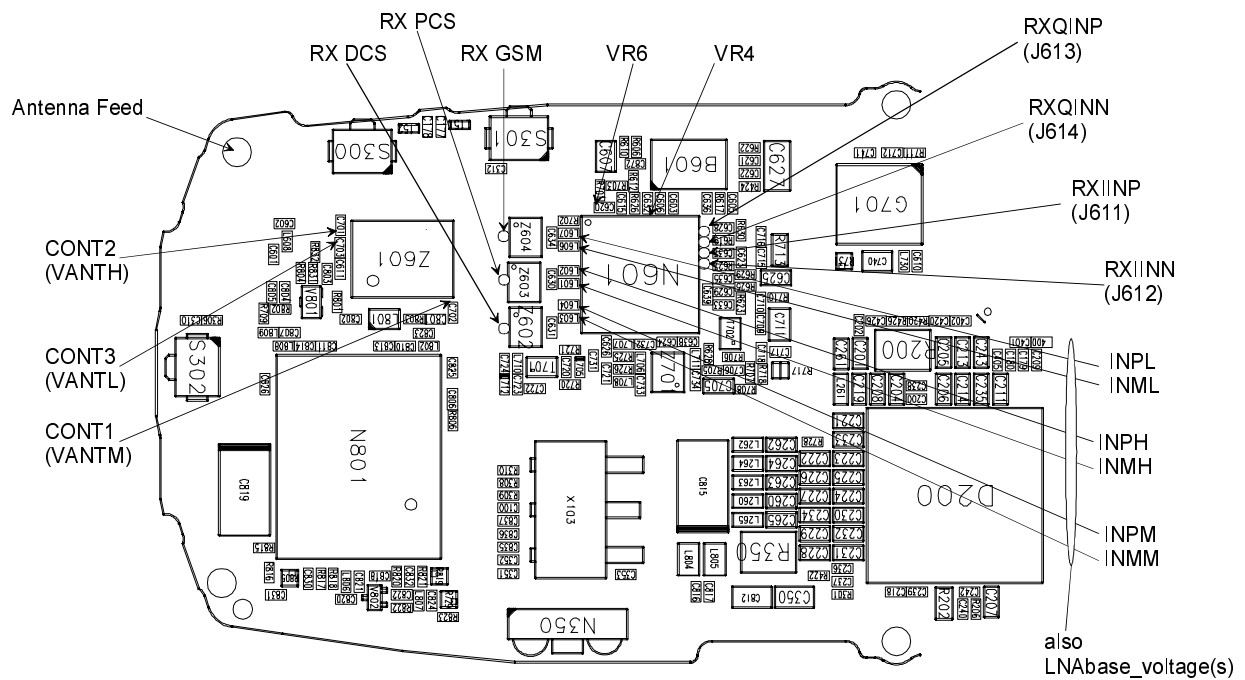


Figure 2: Test points of the receiver

Transmitter Test Points

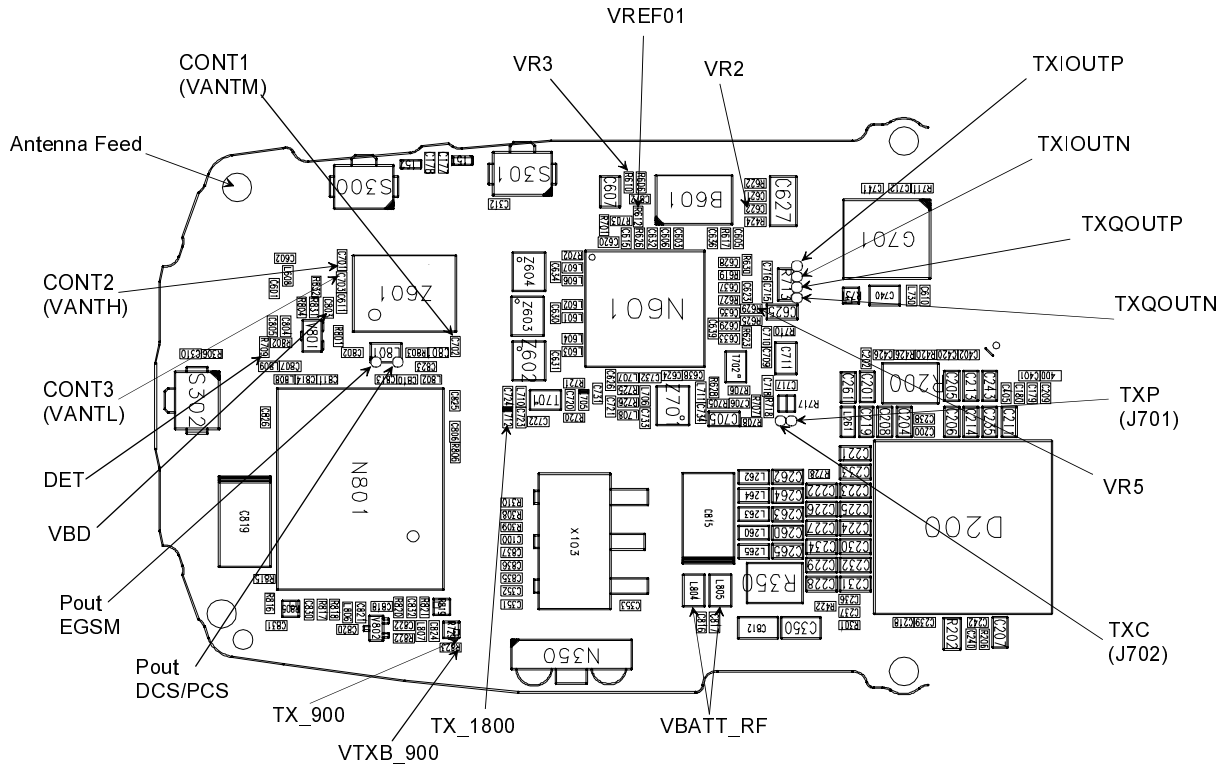


Figure 3: Test points of the transmitter

Synthesizer Test Points

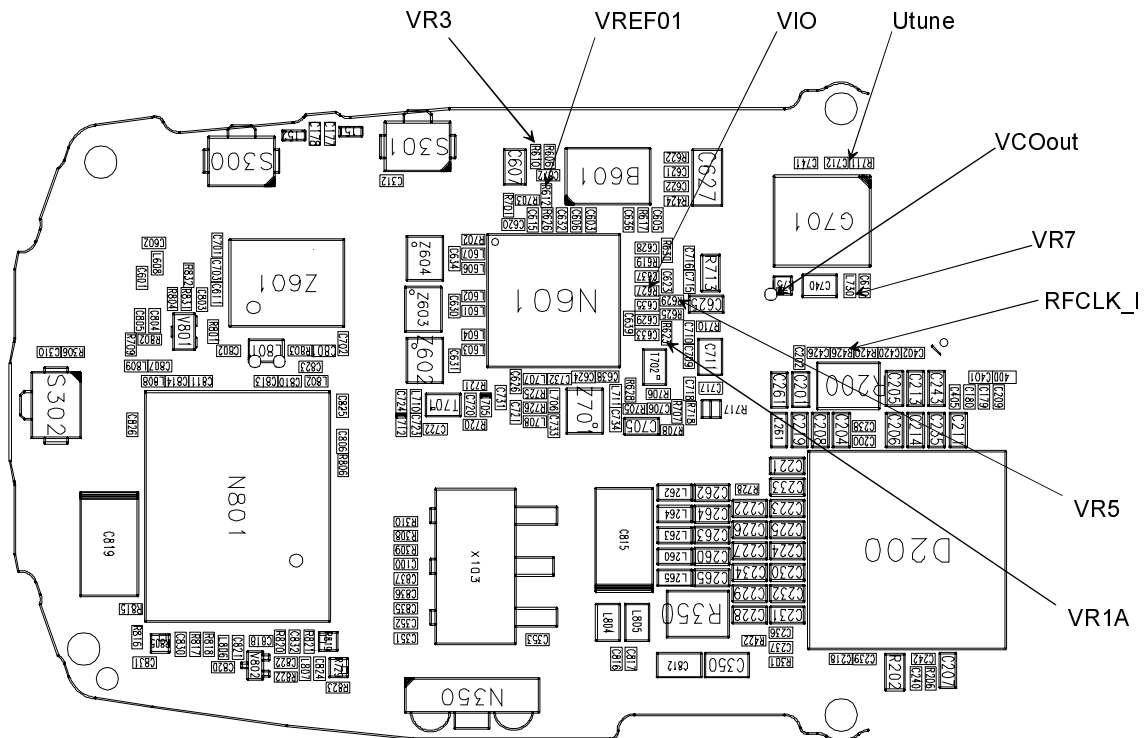


Figure 4: Test points of the synthesizer

RF Implementation in NPL-2

The NPL-2 RF front-end is a triple-band direct conversion transceiver. Using direct conversion, no intermediate frequencies are used for up- or down-conversion.

The VCO oscillates on the double respectively quadruplicate frequency the wanted RX or TX frequency, depending on the band used. The VCO frequency is divided by either 2 or 4 and fed to the mixers (down-conversion) or modulators (up-conversion). Up- or down-conversion is done in one step, directly between RF frequency and base band. All up- and down-conversion takes place in the RF ASIC named Mjoelner (N601).

Mjoelner RF ASIC also contains PLL and LNAs for all used bands. A DC control section is included to power and/or control EGSM TX buffer, detector and antenna switch. The Mjoelner RF ASIC is controlled via a serial bus.

Mjoelner RF ASIC contains an integrated VCXO which uses an external 26 MHz Xtal. No analogue AFC signal is needed. AFC is realized via the serial interface port of Mjoelner.

The UPP is supplied by the 26 MHz reference clock of Mjoelner.

The phone supports HSCSD (High Speed Circuit Switched Data) and GPRS (General Packed Radio Service), meaning multi-slot operation. (This does not require special equipment or procedures in repair situations.)

The following diagrams show the RF frequency scheme and the RF block diagram.

RF Frequency Plan

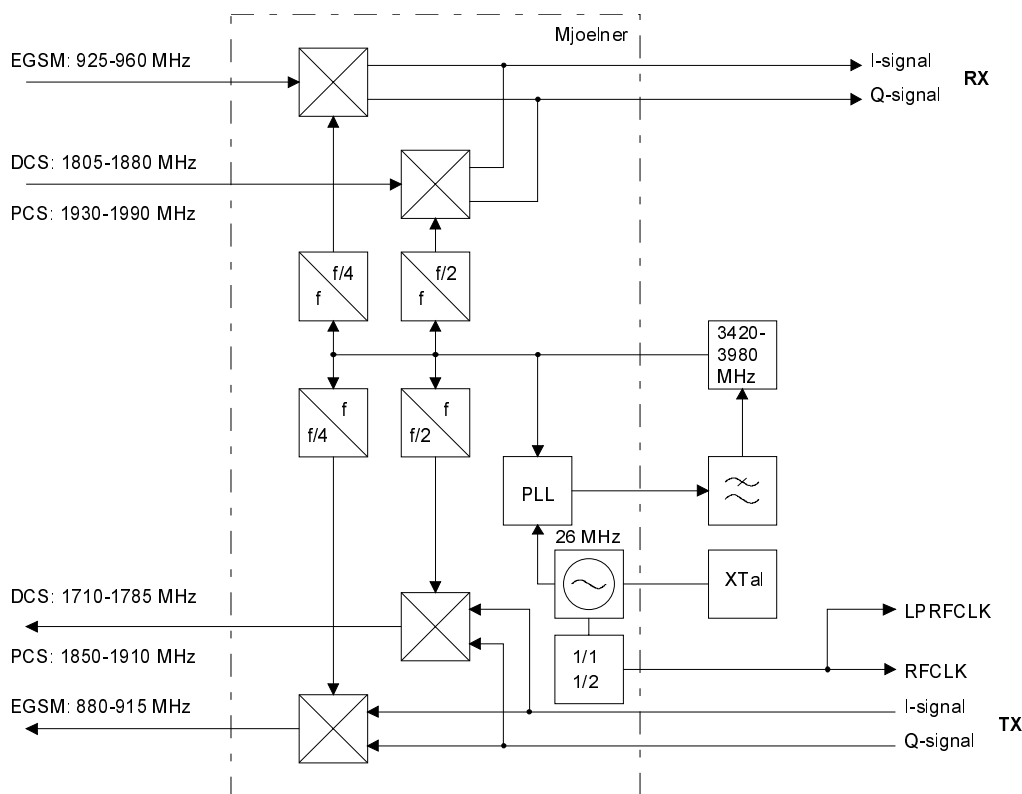
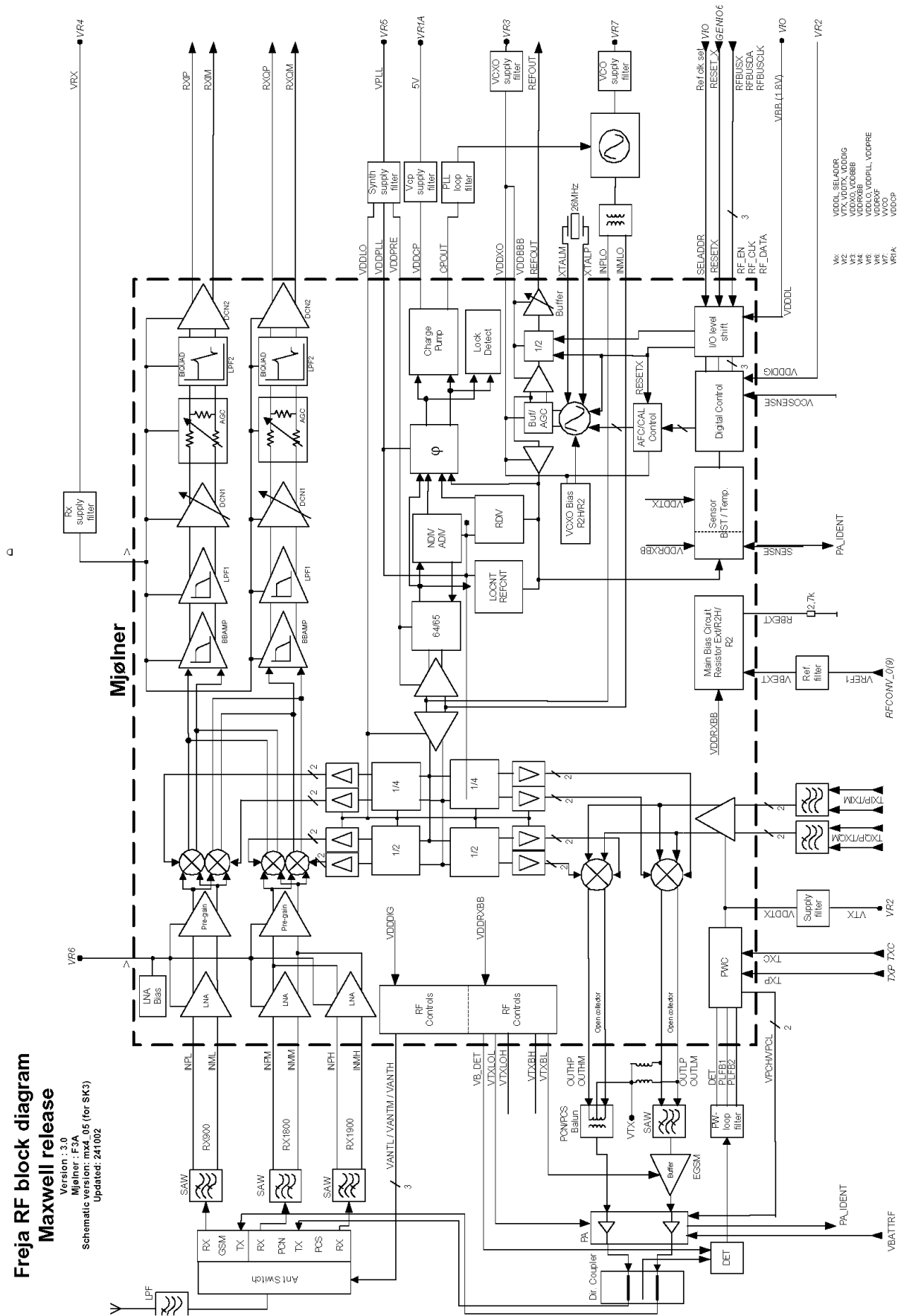


Figure 5: RF frequency plan

RF Block Diagram



Freja RF block diagram
Maxwell release
 Version : 3.0
 Mjølner : F3A
 Schematic version: mx4_05 (for SK3)
 Updated: 241002

Figure 6: RF Block Diagram

RF Power Supply Configuration

All power supplies for the NPL-2 RF Section are generated in the UEM IC (D200). All RF supplies can be checked either in Mjoelner or in BB chamber.

The power supply configuration used is shown in the block diagram below. Values of voltages are given as nominal outputs of UEM. Currents are typical values.

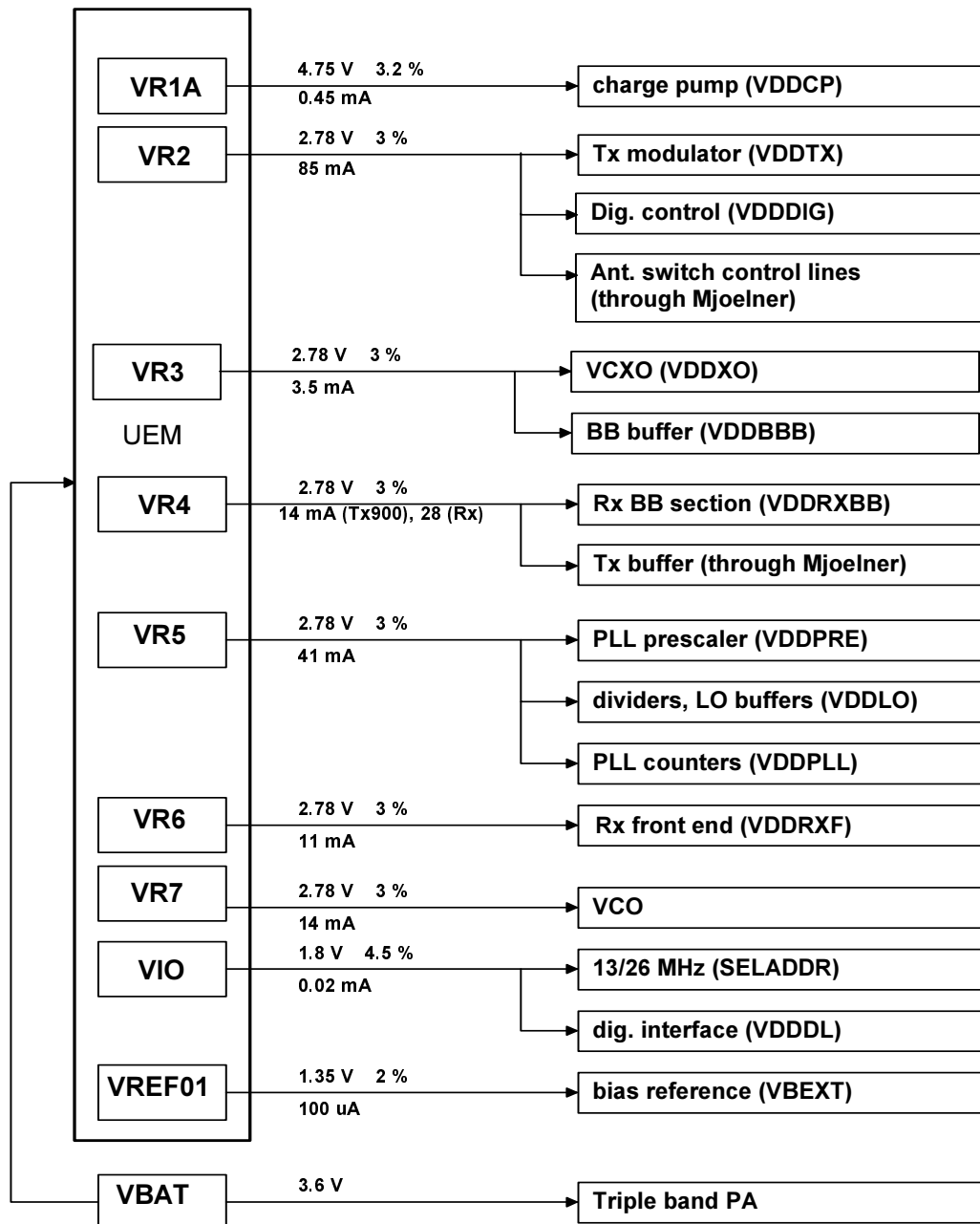


Figure 7: RF Power distribution diagram

Receiver Description and Trouble Shooting

RX Signal Paths

The signal paths of the receiver are shown in following block diagram. Note that the diagram shows EGSM900 receiver (above), GSM1900 receiver (middle) and GSM1800 receiver (below).

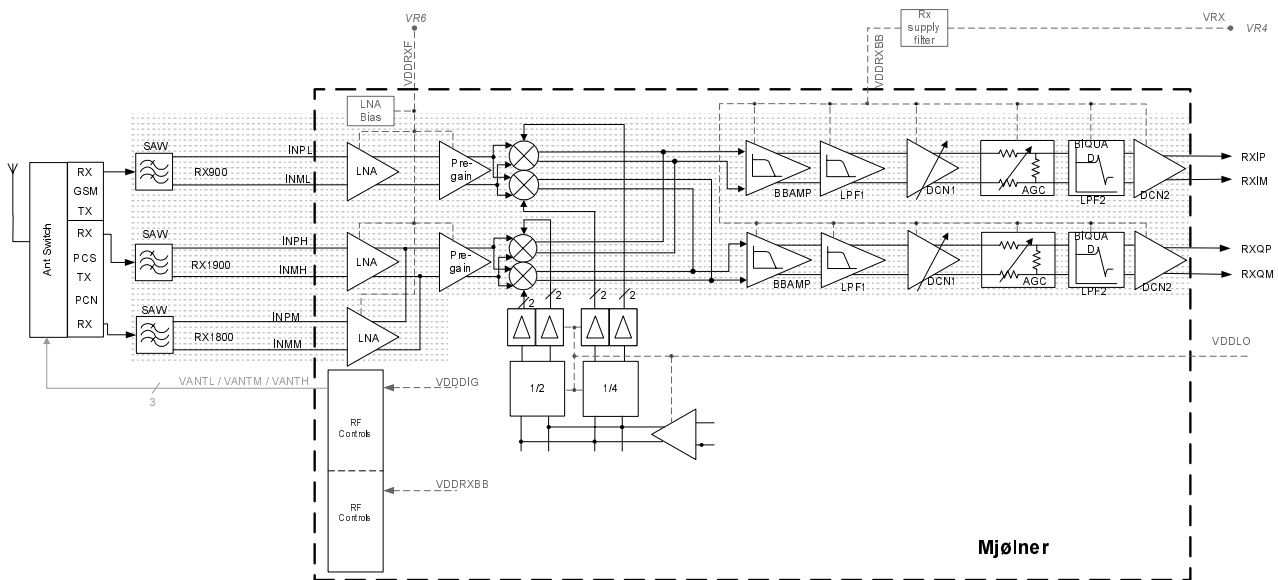


Figure 8: RX signal paths

Antenna Switch (RX/TX Switch)

Signal path of RF: From the antenna-pad (J615) the RF signal is fed through the antenna low pass filter (C601, L608, C602) to the antenna switch (Z601).

The antenna switch has the function of a diplexer which consists of two paths, a GSM900 and a GSM1800/GSM1900. The EGSM900 input signals pass the switch to the GSM_RX output. GSM1800/GSM1900 input signals pass to PCN_RX output or respectively to PCS_RX output, depending on the control signal VANTH (Cont2).

Signal paths:

- GSM900: RX1-GSM output of the antenna switch → EGSM900 SAW filter (Z604).
- GSM1800: RX2-DCS output of the antenna switch → GSM1800 SAW filter (Z602).
- GSM1900: RX3-PCS output of the antenna switch → RX GSM1900 SAW filter (Z603).

The antenna switch including routed lines has following typical insertion losses:

- 1.3dB @ EGSM900
- 1.6dB @ GSM1800
- 1.6dB @ GSM1900.

RX Front-End

The RX front-end includes three SAW filters for (EGSM900 (Z604), GSM1800 (Z602) and GSM1900 (Z603)). They are matched to the corresponding LNA inputs of Mjoelner RF ASIC (N601) with differential matching circuits (LC-type). The SAW filters provide out-of-band blocking immunity. The integrated LNAs provide the front-end gains. Each of the SAW filters has a single-ended input and a balanced output.

The SAW filters have maximum insertion losses of

3.5dB@EGSM900, 4.0dB@GSM1800 and 4.0dB@GSM1900.

RX Paths of Mjoelner RF ASIC

The balanced RX signal is amplified by the integrated LNA and the subsequent pre-gain stage. After amplification the RX signal is down-converted.

The RX paths of Mjoelner RF ASIC consist of following sub units:

- Separate LNAs for each of the three bands: EGSM900, GSM1800 and GSM1900.
- Two PREGAIN amplifiers, one for EGSM900 and one common for GSM1800 and GSM1900.
- Two passive I/Q mixers (MIX), one for EGSM900 and one common for GSM1800 and GSM1900.

The BB signal paths consist of:

- Base band amplifiers (BBAMP1). These amplifiers implement the initial channel filtering.
- Low pass filters (LPF1).
- DC compensation / AGC amplifiers (DCN1). These amplifiers implement gain steps from 0dB to 24dB in 6dB steps.
- Attenuators (AGC). These implement gain steps from -48dB to 0dB in 6dB steps, yielding a total gain range of 72dB together with DCN1.
- Bi-quad filters (LPF2).
- DC compensation amplifiers (DCN2).

The differential base band outputs are internally DC-coupled and are connected directly to the ADC inputs of the RF converter chip. The common mode level is set equal to the VBEXT reference voltage.

Fault Finding Chart of the Receiver

The phone layout has dedicated test points for the analogue differential RX I and Q signals (RXIINP, RXIINN, RXQINP, RXQINN) from Mjoelner RF ASIC to UEM. The BB part is used to measure those signals by means of RSSI reading. It is assumed that correct calibration of RSSI reading has been carried out in production.

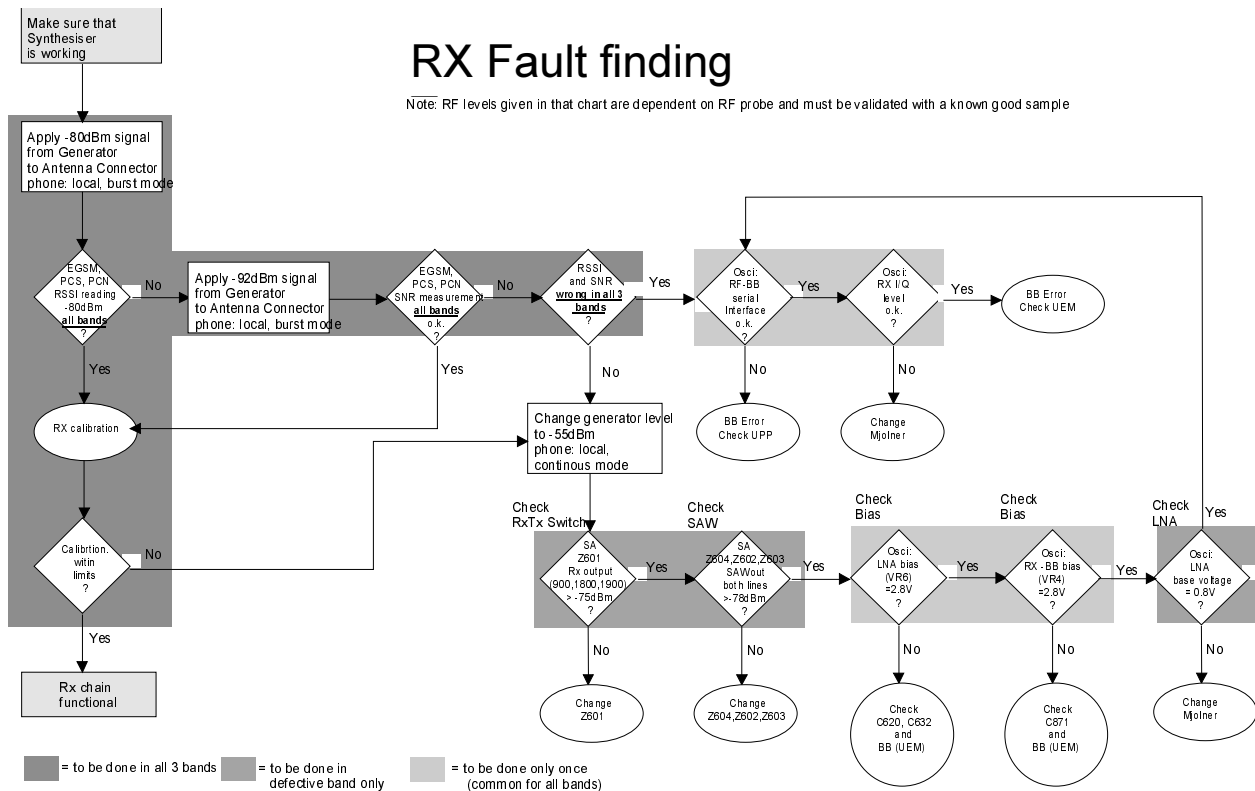
$$RSSI_{reading} [dBm] = 20\log(U_{BB}) + AGC_{calibrated}$$

Therefore, don't calibrate a defective phone before the phone error has been found.

When a defective phone has been calibrated, a possible error in RX front-end might be masked. In that case one can get a reasonable RSSI reading, although the front-end shows excessive losses.

If it is not sure that **incorrect re-calibration** has been made, the following steps shall be done:

- Check if AGC calibration is within limits
- Check if SNR reading is o.k.
Use an Oscilloscope to check levels of "RXIINN" and "RXQINN".



If RX and TX path seem to be faulty it has to be checked if the synthesizer is working. If so, then check the path from the antenna pad J615 to the antenna switch Z601 (see RX fault finding "Check RXTX switch").

General Instructions for RX Trouble Shooting

Connect the phone module to a PC with dongle and DAU-9T cable (RS232) or DKU-5 cable (USB). Follow the instructions below.

Connect the phone to a power supply (DC voltage of 3.6V) and a RF signal generator.

Measuring RX I/Q Signals using RSSI Reading

Start Phoenix Service Software and open FBUS connection.

Select Scan Product Ctrl-R

Wait until phone information is shown in the lower right corner of the screen.

Set operating mode to local mode

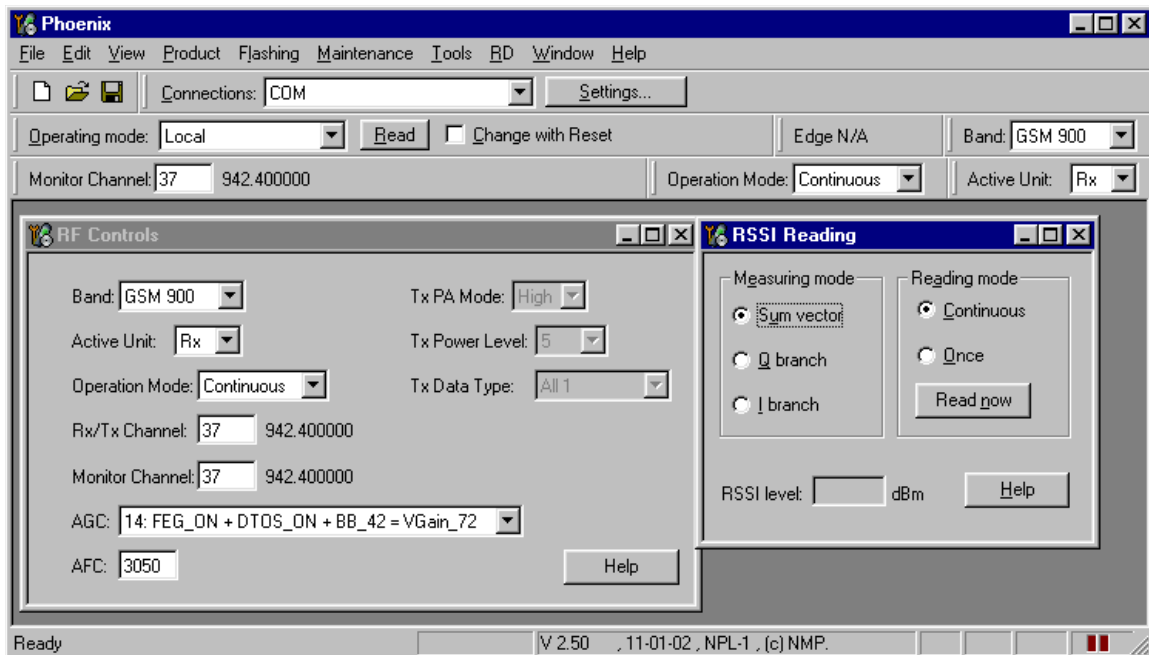
Select Maintenance Alt-M
Testing T
RF Controls F

Wait until the RF Controls window has popped up

Select Band GSM 900 or GSM1800 or GSM1900
Active unit RX
Operation mode **Burst**
RX/TX Channel 37 or 700 or 661

Select Maintenance Alt-M
Testing T
RSSI reading R

The setup should now look like this:



Make the following settings on your signal generator:

1. Frequencies:
 - EGSM: 942.46771 MHz (channel 37 + 67.710kHz offset)
 - GSM1800: 1842.86771 MHz (channel 700 + 67.710kHz offset)
 - GSM1900: 1960.06771 MHz (channel 661 + 67.710kHz offset)

2. RFpower level:

- – **80dBm** at the antenna connector of the phone/test jig (remembering to compensate for the cable and jig attenuation).

In RSSI reading click on Read now.

The resulting RSSI level should be – 80dBm +/- 0.5dB in each band.

Measuring RX Performance using SNR Measurement

Start Phoenix Service Software and open FBUS connection.

Select	Scan Product	Ctrl-R
--------	--------------	--------

Wait until phone information is shown in the lower right corner of the screen.

Set operating mode to local mode.

Select	Maintenance	Alt-M
	Testing	T
	RF Controls	F

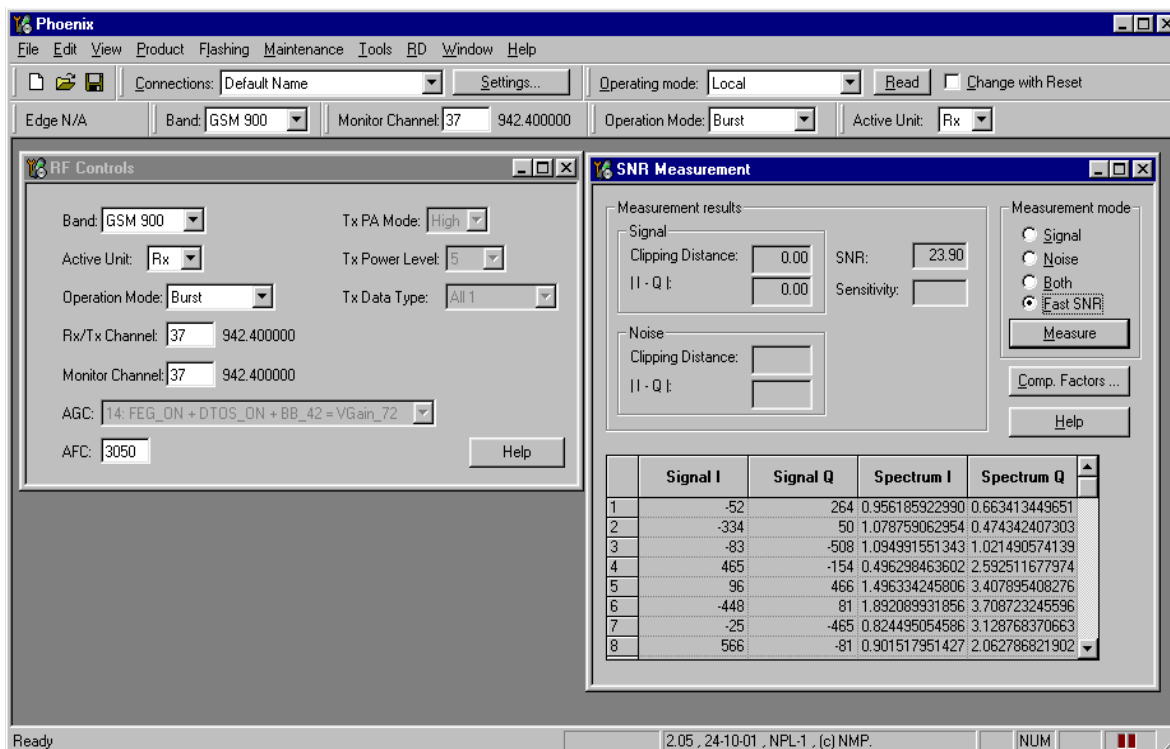
Wait until the RF Controls window has popped up.

Select	Band	GSM 900 or GSM1800 or GSM1900
	Active unit	RX
	Operation mode	Burst
	RX/TX Channel	37 or 700 or 661

Select	Maintenance	Alt-M
	Testing	T
	SNR Measurement	M

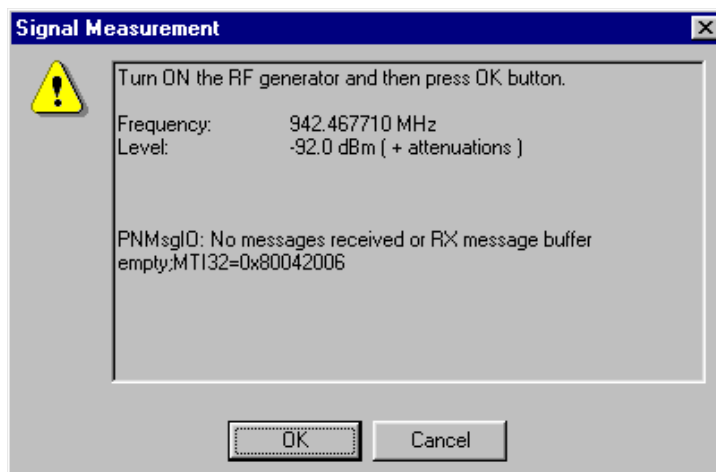
Select	Fast SNR (Radio Button)
--------	-------------------------

The setup should now look like this:



Choose respective band (EGSM900, GSM1800, GSM1900).

Press measure. A window pops up, e.g. for EGSM900 band:



Set the signal generator as shown in the above window, remembering to compensate for the cable and test jig attenuation losses.

Press OK and the window closes.

Read the SNR result. The values should be:

- EGM900 ---->20dB
- GSM1800 ---->18dB
- GSM1900 ---->18dB

Measuring Front-End Power Levels using Spectrum Analyzer

Spectrum Analyzer (SA) level values depend on the probe type and should be validated using a good sample. The levels that are given here are measured using a resistive probe (50Ohm semi-rigid cable).

Start Phoenix Service Software and open FBUS connection.

Select	Scan Product	Ctrl-R
--------	--------------	--------

Wait until phone information is showing in the lower right corner of the screen.

Set operating mode to local mode.

Select	Maintenance	Alt-M
	Testing	T
	RF Controls	F

Wait until the RF Controls window pops up

Select	Band	GSM 900 or GSM1800 or GSM1900
	Active unit	RX
	Operation mode	Continuous
	RX/TX Channel	37 or 700 or 661

Please refer to the fault finding chart for proper levels at different test points.

Measuring Analogue RX I/Q Signals using Oscilloscope

Measuring with an oscilloscope on "RXIINN" or "RXQINN" is recommended only if RSSI reading does not provide enough information. There exist dedicated test points for RX I and Q signals. Input level = -80dBm.

Start Phoenix Service Software and open FBUS connection.

Select	Scan Product	Ctrl-R
--------	--------------	--------

Wait until phone information is showing in the lower right corner of the screen.

Set operating mode to local mode.

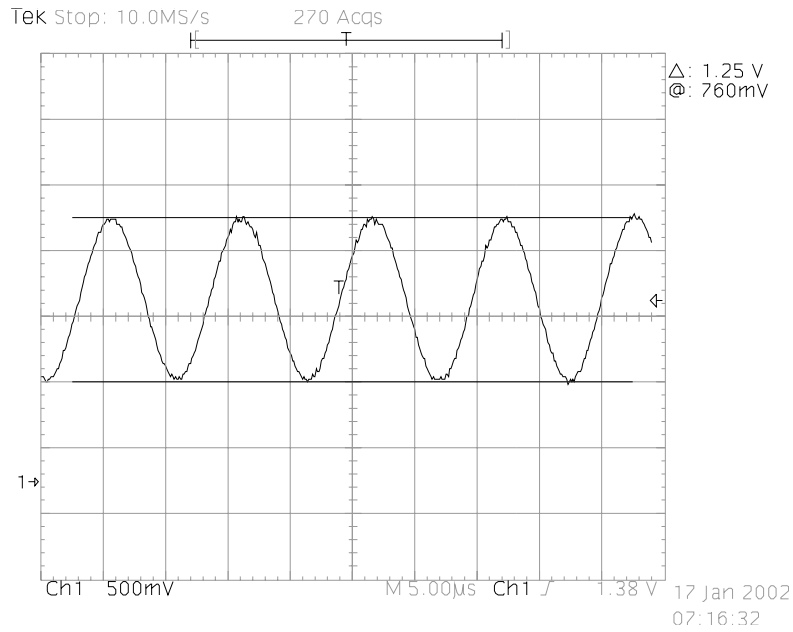
Select	Maintenance	Alt-M
	Testing	T
	RF Controls	F

Wait until the RF Controls window has popped up.

Select	Band	GSM 900 or GSM1800 or GSM1900
	Active unit	RX
	Operation mode	continuous
	RX/TX Channel	37 or 700 or 661
	AGC	14

Following picture should be displayed on an oscilloscope's screen if the EGSM receiver is

working properly:



Signal amplitude	1.25V
DC offset	1.35V
Frequency	67kHz

Transmitter Description and Troubleshooting

TX Signal Paths

For easy error tracking it is important to know the signal paths of the transmitter. The components are grouped in blocks and shown on the diagram below.

Note: that the diagram shows both EGSM900 transmitter (below) and GSM1800/GSM1900 transmitter (above).

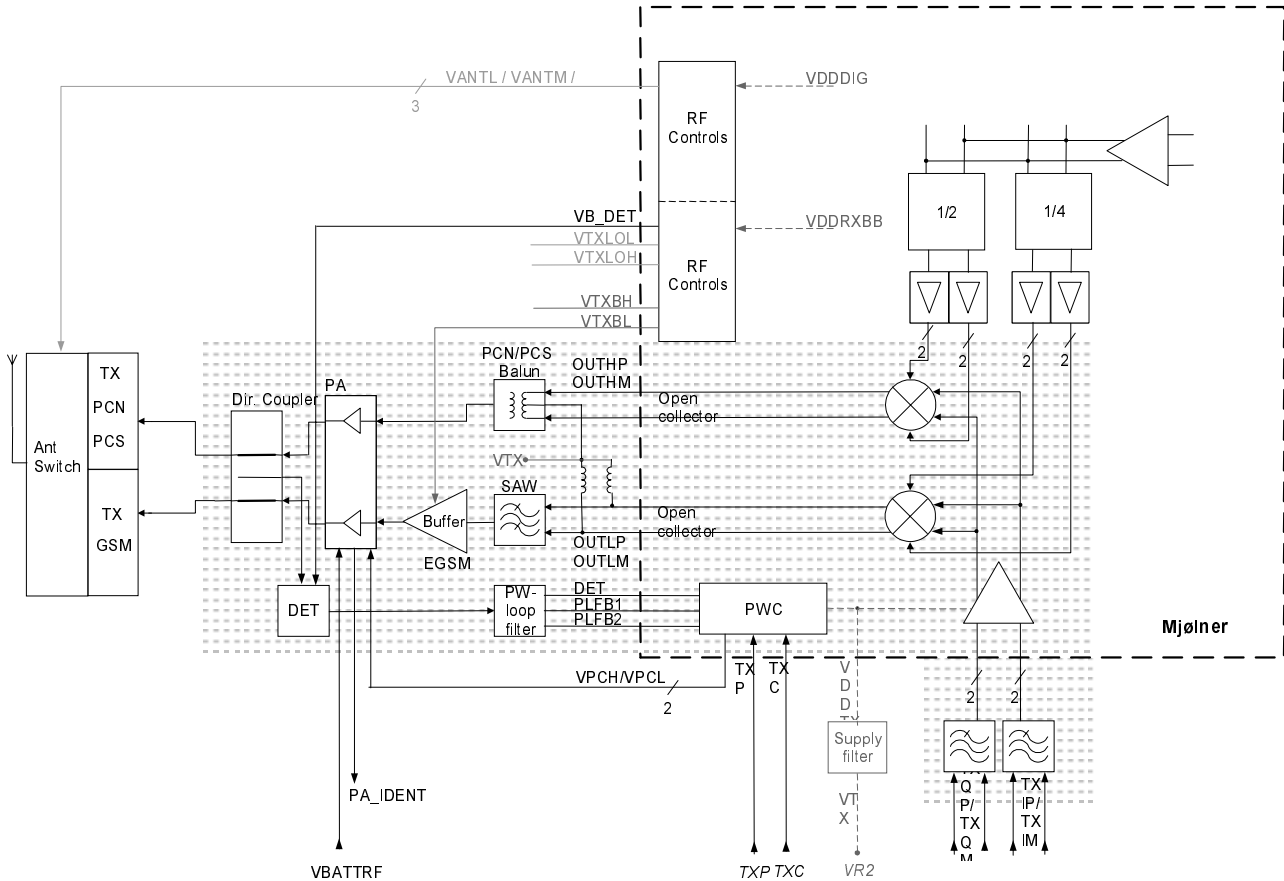


Figure 9: Transmitter signal paths

The balanced TX IQ baseband signals (TXIOUTP, TXIOUTN, TXQOUTP, TXQOUTN, TXQOUTN) are provided by the base band and are fed to the **Mjølnir RF ASIC**. The TX path of the Mjølnir RF ASIC includes mainly two RF modulators for up-conversion of the base band signals, one for EGSM900 and one common for GSM1800/GSM1900. The base band signal is up-converted with the LO signal corresponding to the wanted TX channel. Both RF-TX outputs (900MHz and 1800/1900MHz) of the Mjølnir RF ASIC are delivering balanced signals.

The EGSM900 output signal of the Mjølnir RF ASIC is fed through the EGSM TX SAW filter (balanced to single ended), a 3dB pad, and the 900MHz buffer to the EGSM input of the **power amplifier (PA)**.

The GSM1800/1900 output signal of the Mjoelner RF ASIC is fed through the TX balun (T701) (balanced to single ended), and a 3dB pad to the GSM1800/1900 input of the **power amplifier (PA)**.

The Triband PA has maximum output power of approx. 35dBm at 900MHz and 33dBm at 1800/1900MHz. DC-power supply is delivered directly from the battery connectors.

The RF output power is controlled by the power control loop. From the output of the PA both signal are going through the dual directional coupler (one of the power control loop components) to the **antenna switch**.

Antenna Switch (TX/RX switch)

The antenna switch operates as a diplexer for the RX and TX signals. Moreover, it suppresses the TX harmonics generated by the PA. The antenna switch is controlled by the Mjoelner RF ASIC using the control signals CONT1, CONT2 and CONT3.

The following table shows the possible different states.

CONT1 [Volt]	CONT2 [Volt]	CONT3 [Volt]	EGSM RX	DCS RX	PCS RX	EGSM TX	DCS/PCS TX
0	0	0	X				
0	0	0		X			
0	0	2.7				X	
0	2.7	0			X		X
2.7	2.7	0					X

To switch the TX-DCS/PCS path both signals cont1 and cont2 are activated. This increases the isolation from the TX-DCS/PCS path to the RX-DCS path and reduces the RF-power that is fed back to Mjoelner.

General Instructions for TX Troubleshooting

Apply a RF cable to the test jig to allow the transmitted signal to act as normal. The RF cable should be connected to the measurement equipment (GSM test equipment, power meter, spectrum analyzer, or similar).

Be sure to use at least a 10dB attenuator, otherwise the results may be incorrect.

- 1 Connect PC with Phoenix to phone module
- 2 Provide the phone with power supply (3.6V).
- 3 Start Phoenix Service Software and open FBUS connection.
- 4 Select Scan Product Ctrl-R
and wait until phone information is shown in the lower right corner of the screen.

Follow the instructions as given below.

EGSM900 TX Trouble Shooting

General Instructions for EGSM900 TX Trouble shooting

Start the preparations as described in section "General Instructions for TX Trouble shooting".

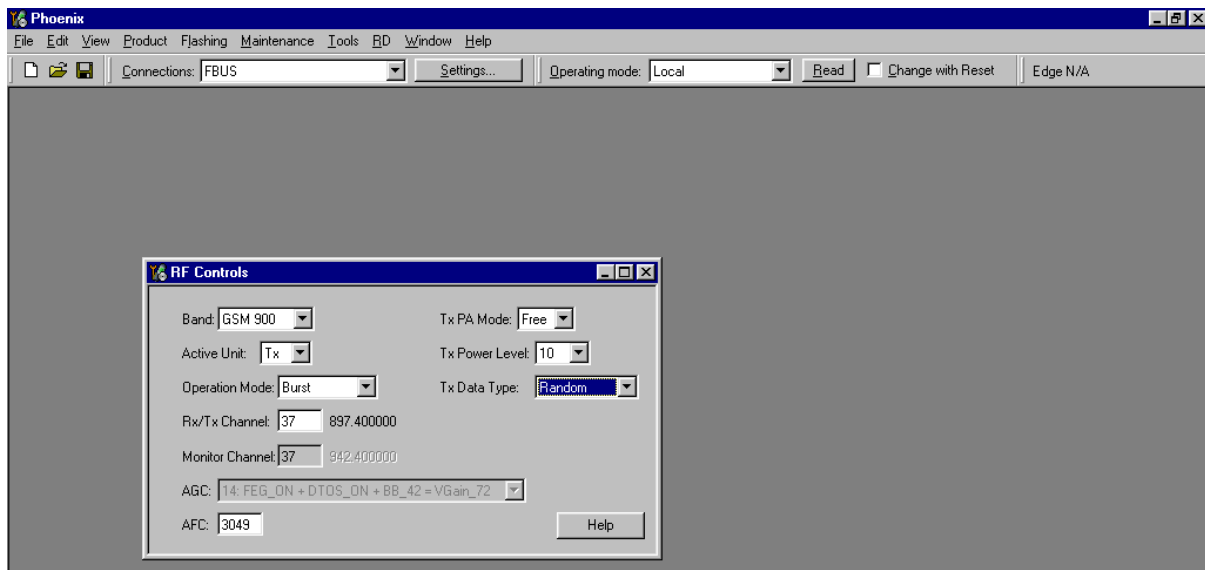
Set operating mode to local mode.

Select Maintenance Testing RF Controls

Wait until the RF Controls window has popped up

Select	Band	GSM 900
	Active unit	TX
	Operation mode	Burst
	RX/TX Channel	37
	TX PA Mode	Free
	TX Power Level	10
	TX Data Type	Random

The setup should now look like this:



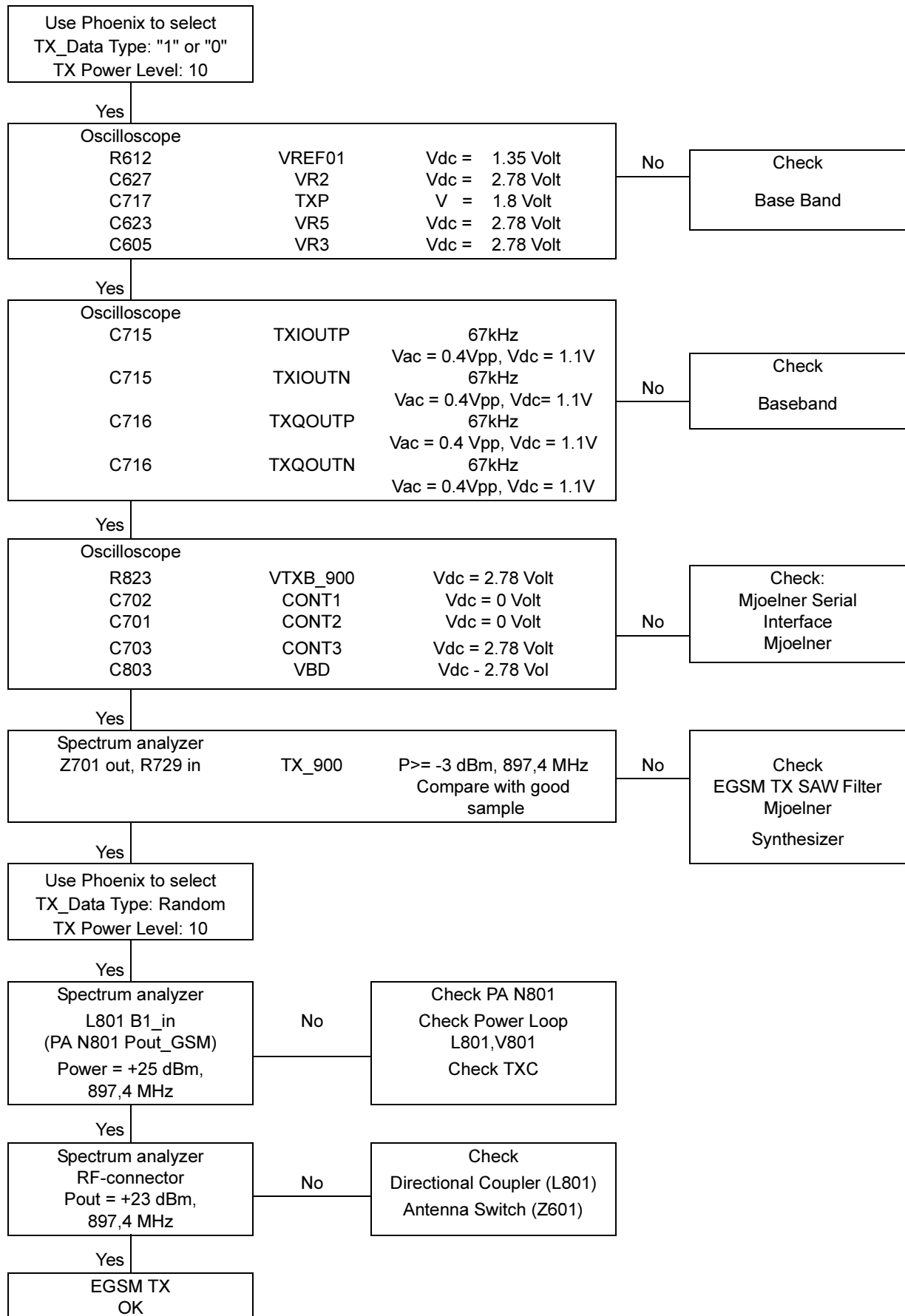
Now the measurement equipment should detect the following output signal of the phone:

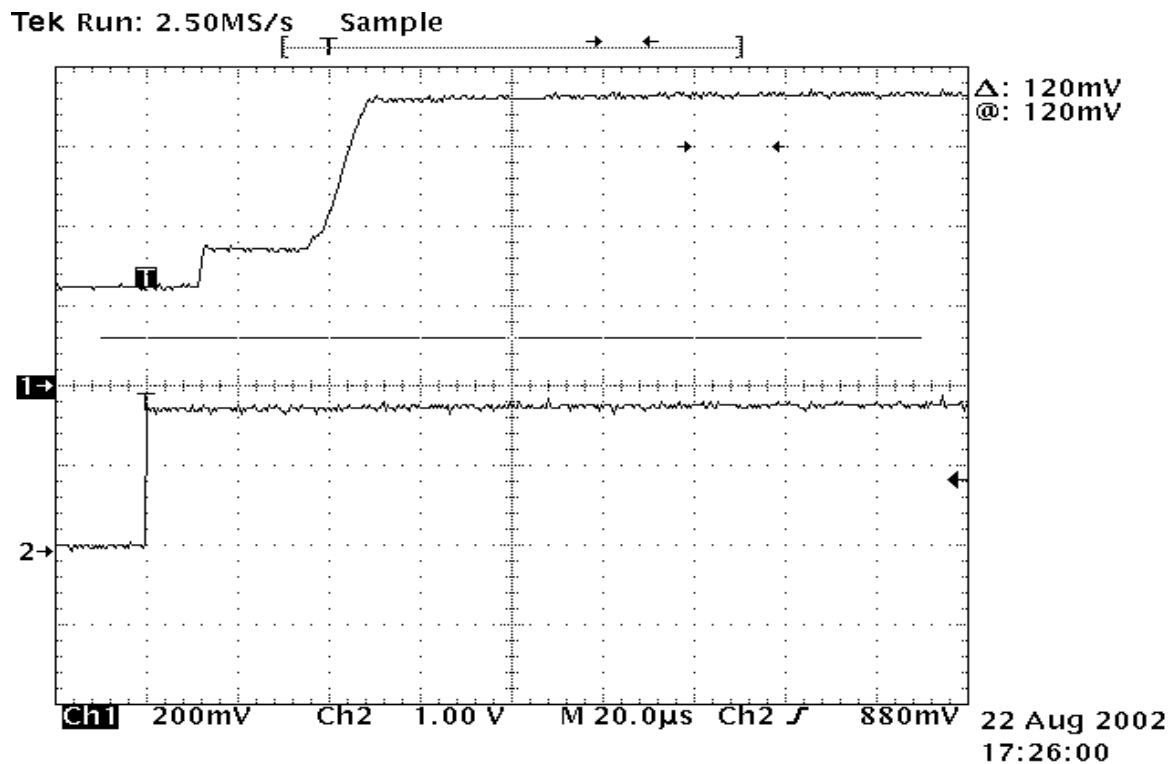
$$P_{out} = +23\text{dBm @ } 897.4\text{MHz}$$

If this is not the case, then go to the fault finding chart.

Fault Finding Chart for EGSM900 Transmitter

In the following, the TXP signal is used as a trigger-signal. For this purpose a TXP test point is provided on the PWP, refer to figure 3.





GSM1800 TX Trouble Shooting

Setup for GSM1800 TX Trouble shooting

Start the preparations as described in section "General Instructions for TX Trouble shooting".

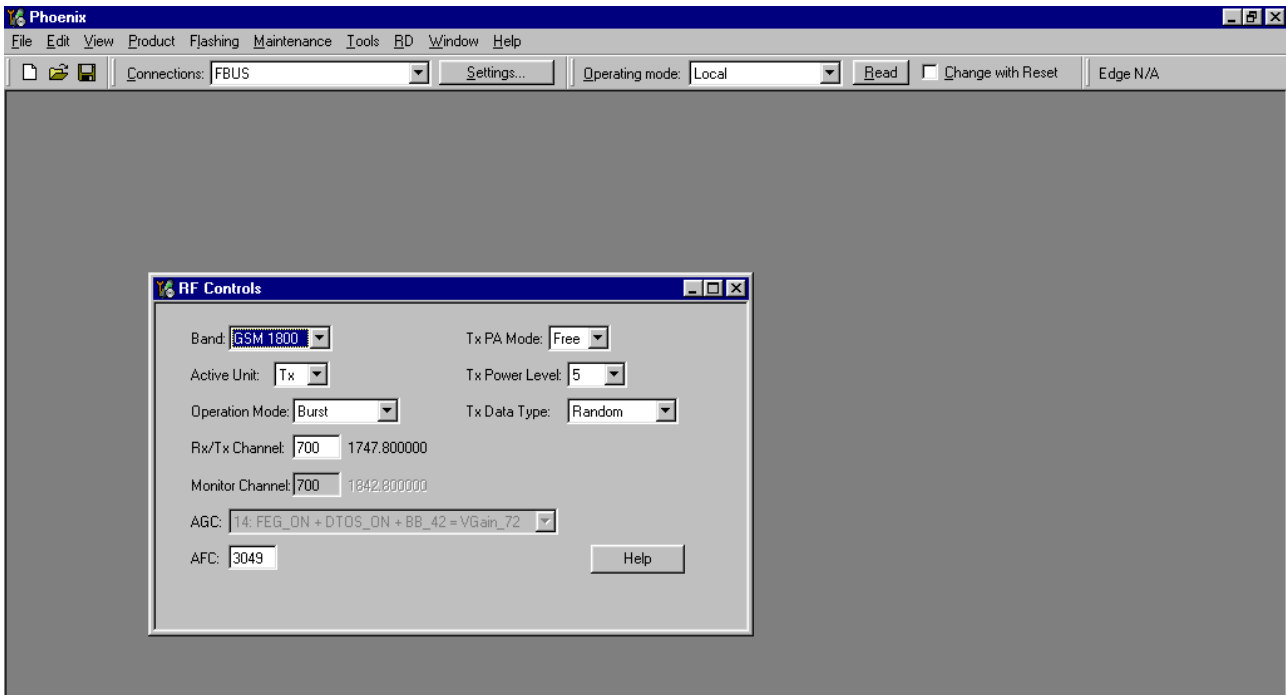
Set operating mode to local mode.

Select Maintenance Testing RF Controls

Wait until the RF Controls window pops up.

Select	Band	GSM 1800
	Active unit	TX
	Operation mode	Burst
	RX/TX Channel	700
	TX PA Mode	Free
	TX Power Level	5
	TX Data Type	Random

The setup should now look like this:



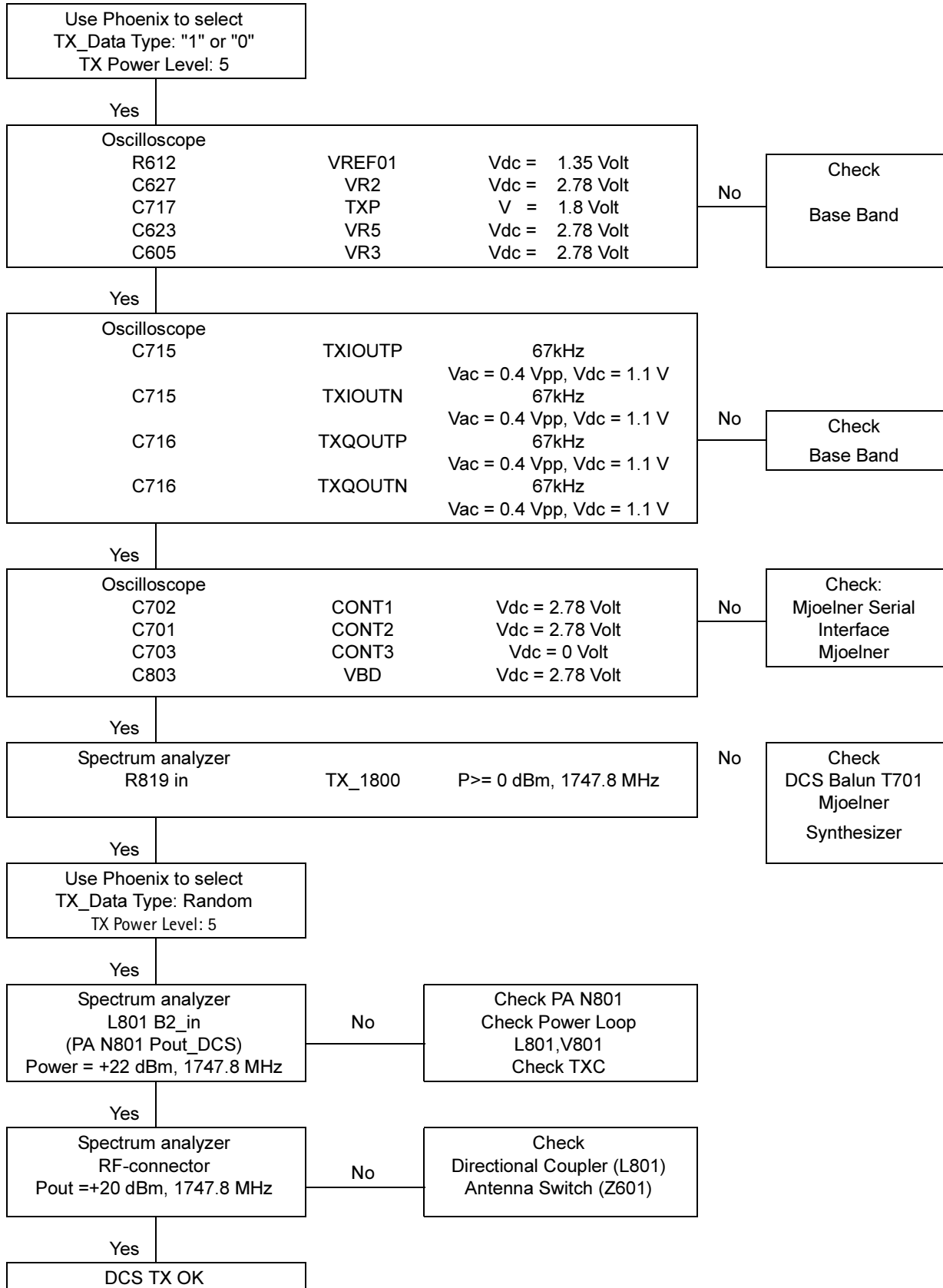
Now the measurement equipment should detect the following output signal of the phone.

$$P_{out} = +20dBm @ 1747.8MHz$$

If this is not the case, then go to the fault finding chart.

Fault finding chart for GSM1800 transmitter

In the following, the TXP signal is used as a trigger-signal. For this purpose a TXP test point is provided on the PWP, refer to figure 3.



GSM1900 TX Trouble Shooting

Setup for GSM1900 TX Trouble shooting

Start the preparations as described in section "General Instructions for TX Trouble shooting".

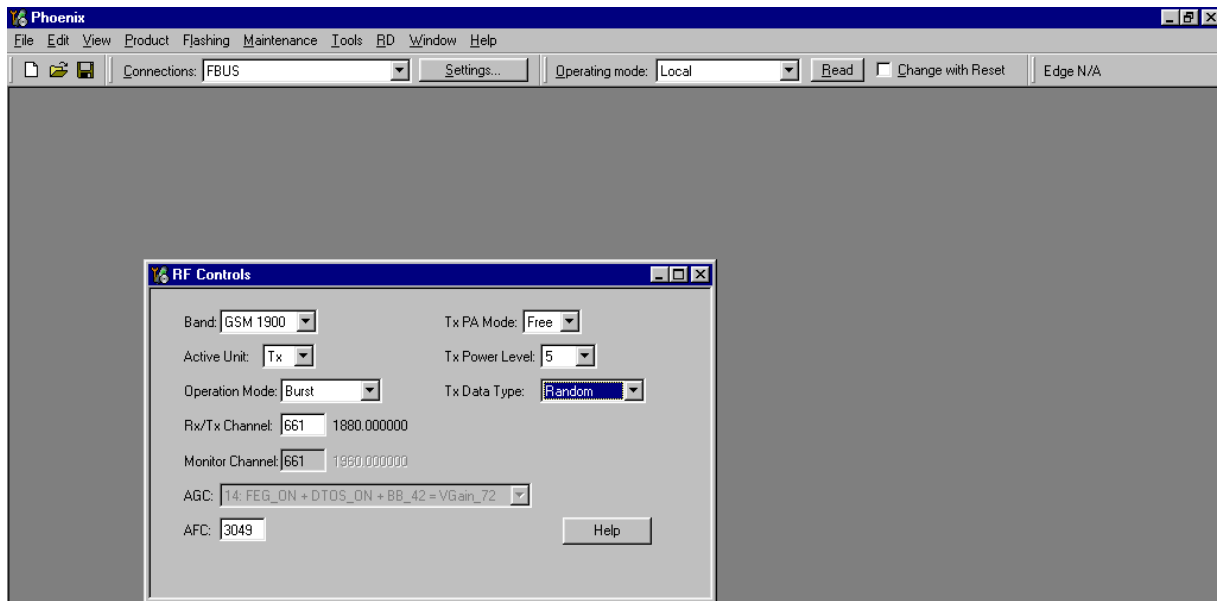
Set operating mode to local mode.

Select Maintenance Testing RF Controls

Wait until the RF Controls window pops up

Select	Band	GSM 1900
	Active unit	TX
	Operation mode	Burst
	RX/TX Channel	661
	TX PA Mode	Free
	TX Power Level	5
	TX Data Type	Random

The setup should now look like this:



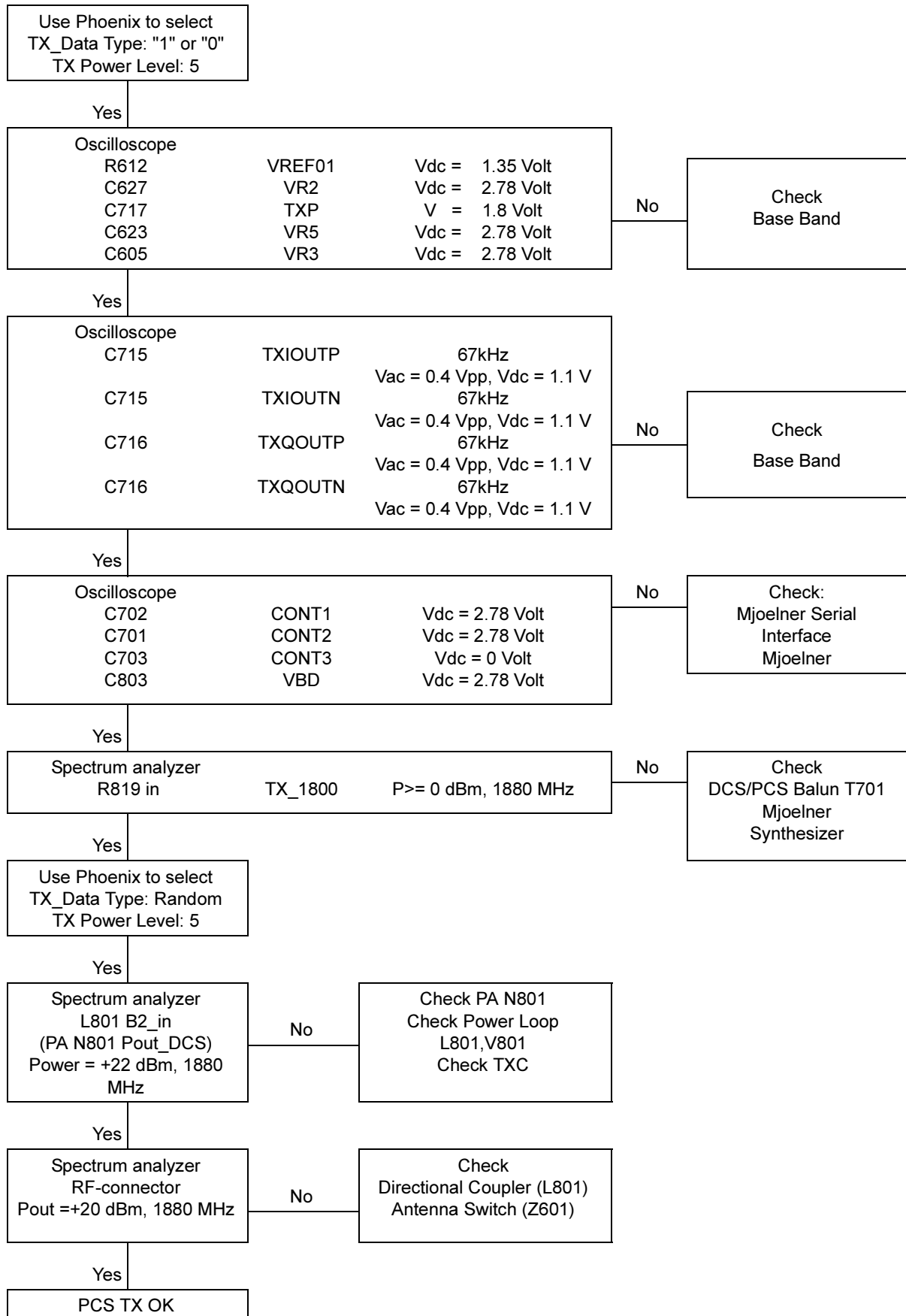
Now the measurement equipment should detect the following output signal of the phone.

$$P_{out} = +20dBm @ 1880MHz$$

If this is not the case, then go to the fault finding chart.

Fault finding chart for GSM1900 transmitter

In the following, the TXP signal is used as a trigger-signal. For this purpose a TXP test point is provided on the PWP, refer to figure 3.



Synthesizer Description and Trouble Shooting

One PLL synthesizer is generating all the required frequencies of the 3 bands for RX and TX. The VCO frequency is divided by 2 or by 4 in Mjoelner depending on the active band.

26 MHz Reference Oscillator (VCXO)

The VCXO is integrated in the Mjoelner RF-ASIC (N601). The only external component is the 26 MHz crystal (B601).

The reference oscillator has two functions:

- Reference frequency for the PLL synthesizer.
- System clock for BB (RfClk_I = 26 MHz).

For an error free initial synchronization, the 26MHz frequency of the VCXO must be accurate enough. Therefore, a VCXO-calibration value is written via the serial Bus into the RefOSCCAL register of Mjoelner and an additional bit in the RefOSCCntI register of the Mjoelner. That is necessary for the rough calibration of the VCXO

The VCXO is fine tuned by programming the AFC value via the serial bus of Mjoelner. The necessary AFC value is written into the RefOSCAFC register in Mjoelner.

VCO

The VCO is able to generate frequencies in the range of 3420MHz to 3980MHz when the PLL is working properly. The frequency of the VCO signal is divided by 2 or by 4 in Mjoelner RF-ASIC. This allows the generation of all the frequencies in the EGSM900, GSM1800 and GSM1900 bands both RX and TX.

The output frequency of the VCO is controlled by a DC voltage (V_c) of the PLL loop filter. The valid range of V_c is 0.7V– 3.8V when the PLL is in the steady state. The typical tuning sensitivity is 240MHz/V. Even if the PLL is not working properly (V_c outside the valid range) a frequency at the output of the VCO can be detected, between 3GHz and 4GHz (if the VCO itself is ok).

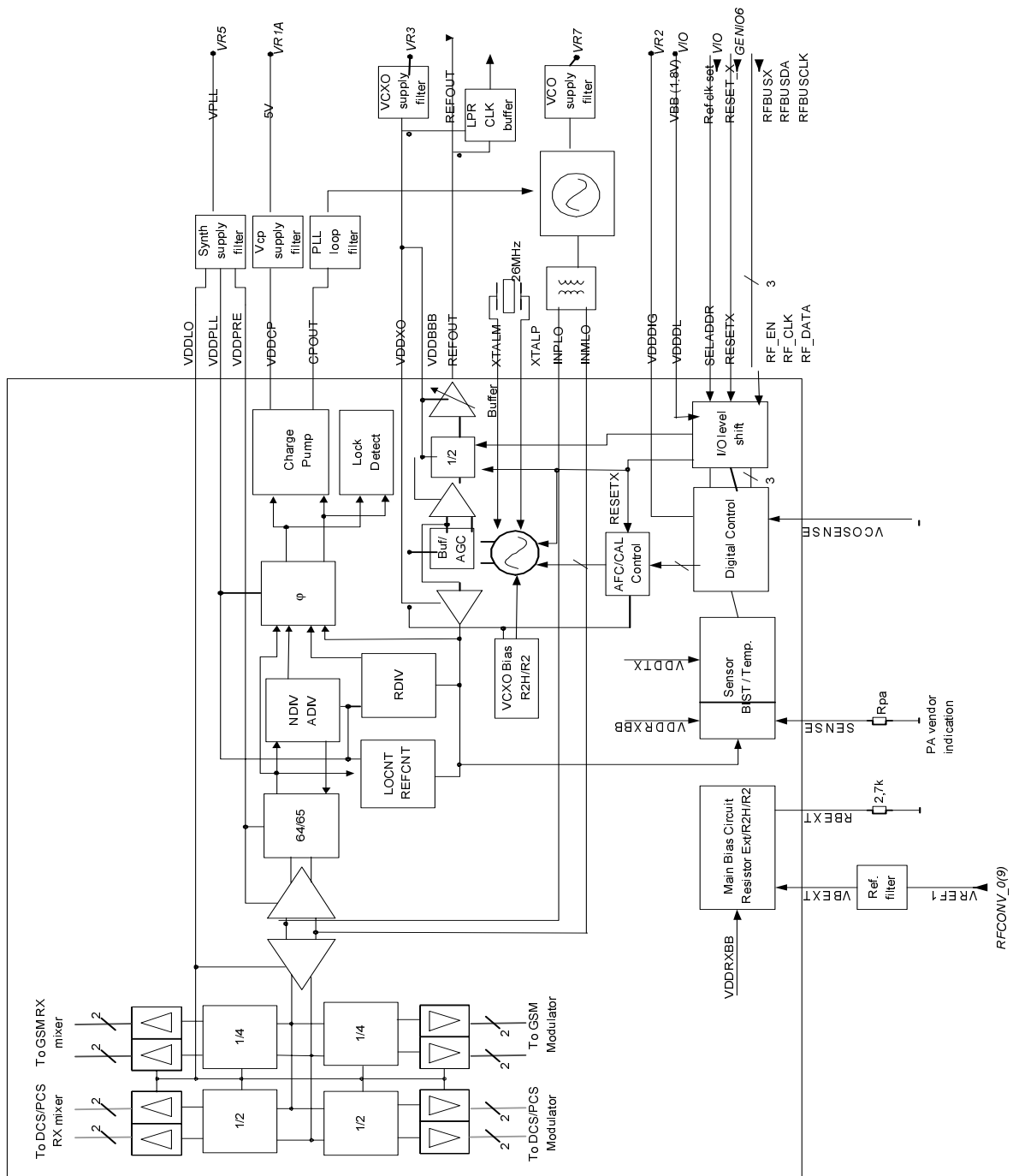


Figure 10: PLL Block Diagram

General instructions for Synthesizer trouble shooting

Connect the phone to a PC with DAU-9T cable (RS232) or DKU-5 cable (USB). The PC must have Phoenix Service Software and dongle installed.

Then follow the instructions below.

Check Synthesizer Operation

Start Phoenix Service Software and open FBUS connection.

Select Scan Product Ctrl-R

Wait until phone information is shown in the lower right corner of the screen.

Set operating mode to local mode.

Start RF Control window:

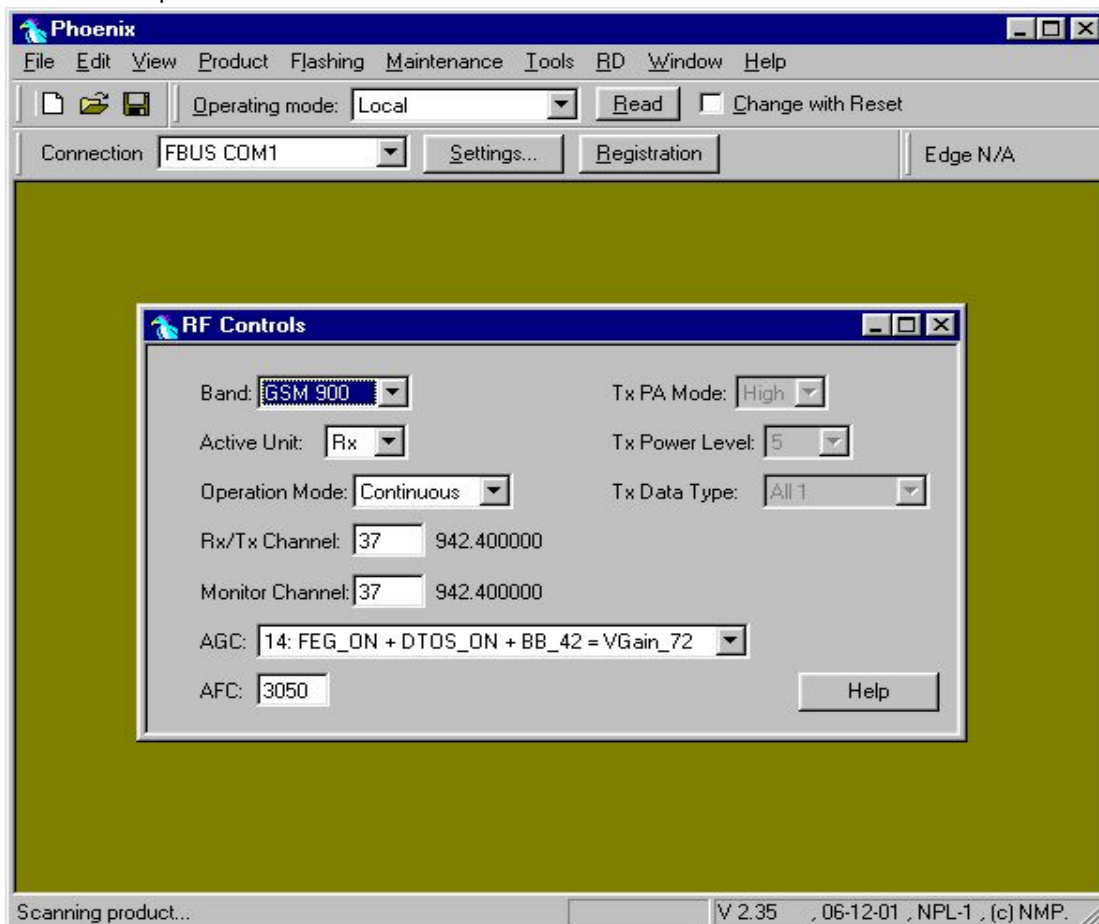
Select Maintenance Alt-M
Tuning T
RF Controls F

Wait until the RF Controls window has popped up.

Set the synthesizer to the following mode:

Select Band GSM 900
Active unit RX
Operation mode Continuous
RX/TX Channel 37

The setup should now look like this:



The frequency of 3769.6MHz at the output of the VCO (G701) has to be measured with a resistive probe and a spectrum analyzer.

The tuning voltage can easily be measured at the Vc input of the VCO (C712). The tuning voltage should be $2.3V_{DC} \dots 2.8V_{DC}$ at $f_{VCO} = 3769.6\text{MHz}$. The (tuning sensitivity of the VCO is typically 240MHz/V).

If this is not the case, please refer to section "Fault finding chart for PLL Synthesizer" below.

Fault Finding Chart for PLL Synthesizer

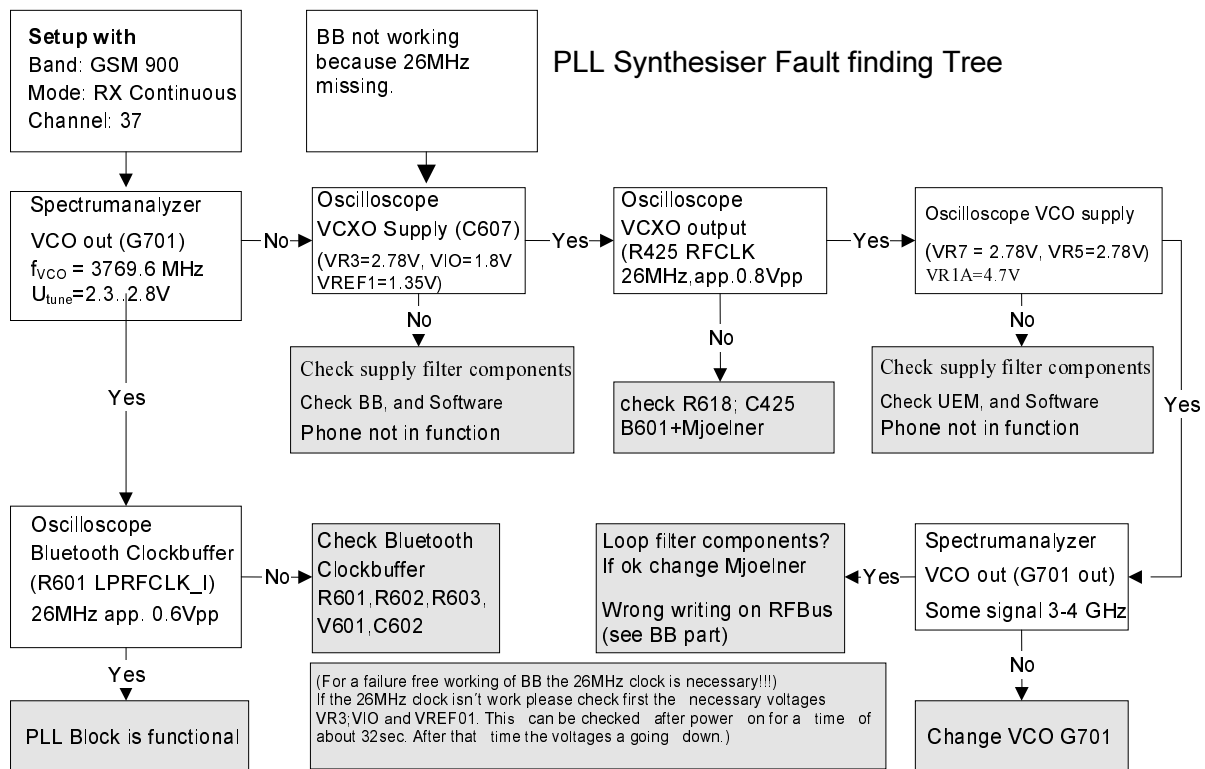


Figure 11: PLL Sythesizer Fault Finding Chart

It is important to note that the power supply of the VCXO (VR3) is only switched off in the so-called 'Deep Sleep Mode' and the power supply of the VCO (G701 VR7) is switched off in so-called 'Sleep Mode'.

RF Tuning Instructions

Setup for RF Tuning

- Provide the phone with power supply (nominal voltage is 3.7V).
- Connect the phone to a PC with DAU-9T cable (RS232) or DKU-5 cable (USB).
- Start Phoenix Service Software (dongle required).
- Open FBUS connection.
- Select: File Alt-F
 Scan Product P
 Shortcut: Ctrl-R

Wait until phone information is shown in the lower right corner of the screen.

RF Tuning after Repairs

The following tunings have to be performed after repairs:

- Repairs in the TX part will require "TX Power Level Tuning". When components around the modulator area are replaced (RF path from UEM via Mjoelner to RF PA) have been done, "TX IQ Tuning" is additionally required.
- In general repairs in the RX front-end or the PLL unit always require "RX Calibration" and "RX Band Filter Calibration".
- If Mjoelner was changed all calibrations mentioned above have to be done.

RX Calibration

The **RX Calibration** has to be performed to determine the gains at different gain settings of the front-end and Mjoelner. The calibration must be done in all three bands.

RX Calibration requires an external signal generator. Most of the radio communication testers like CMD55 or CMU200 can be used also as a signal generator, generating a continuous RF signal with defined levels and frequencies.

RX Calibration in EGSM900 combines two alignments: VCXO calibration and AGC calibration. Calibration of GSM1800 and GSM1900 band only determines the AGC values.

The **VCXO calibration** detects a calibration value for VCXO control, an AFC initial value and 3 AFC-slope coefficients. The VCXO calibration ensures the function of an initial synchronization (before location update is done) when the phone has been set in Normal Mode. For an error free initial synchronization, the 26MHz frequency of the VCXO must be accurate enough. Therefore, a **VCXO cal** value is written into the RefOSCCAL register of the Mjoelner.

During VCXO-calibration, the **VCXO cal** value is changed by a DSP-algorithm until a synchronization is possible. This means that the VCXO oscillates at 26 MHz with a sufficient minimum frequency error.

To further minimize the frequency error, an initial **AFC value** is determined by the DSP and written into RefOSCAFC register of the Mjoelner.

Additionally the DSP algorithm determines three AFC slope coefficients **Slope C1, C2, C3** during VCXO calibration. One AFC slope value is not sufficient for Mjoelner, because the AFC slope is a non-linear function versus time.

The **AGC-calibration** detects the gain values of the RX chain. The AGC is looped by the RF LNA, which can be switched either on or off (gain difference between on and off state is nominally 30dB) and the BB gain which is controlled by 15 gain steps RSSI0 to RSSI14 each having a graduation of 6dB. The LNA is off at steps RSSI0 to RSSI4.

AGC-calibration detects the gain at the two gain steps RSSI4 and RSSI7. All other steps are calculated.

A value **RF_TEMP**, which represents the RF hardware temperature, is determined during RX Calibration. This temperature value is used by DSP for RSSI reporting correction in Normal Mode of the phone. It is not displayed while calibrating.

The RX calibration is only valid if the results are within certain limits. For the most recent limits refer to the production limits of FLALI and FINUI testers.

If the results are not within these limits, the RX chain is faulty.

RX Calibration EGSM900

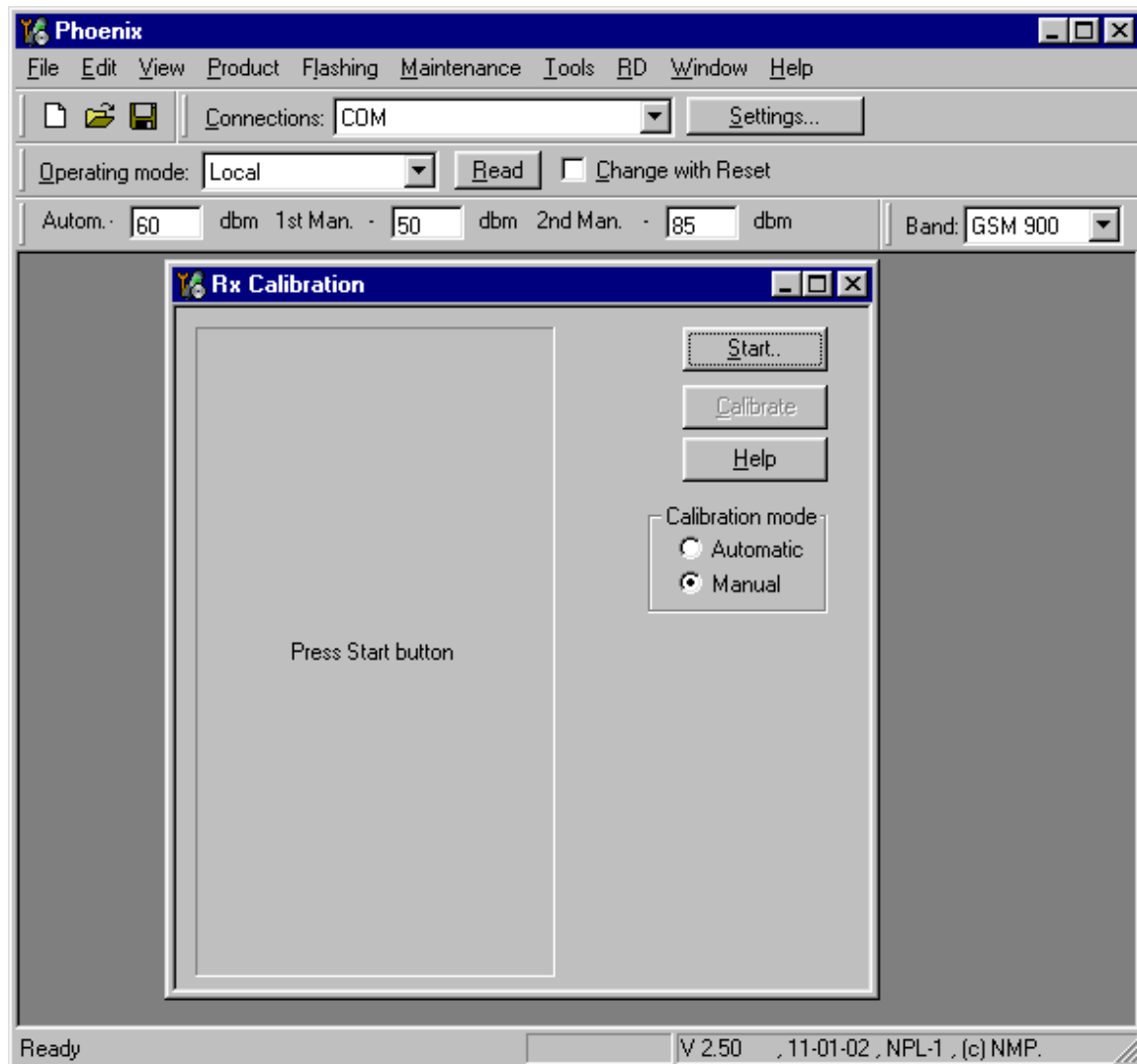
Set operating mode to local mode.

Select	Maintenance	Alt-M
	Tuning	T
	RX Calibration	C

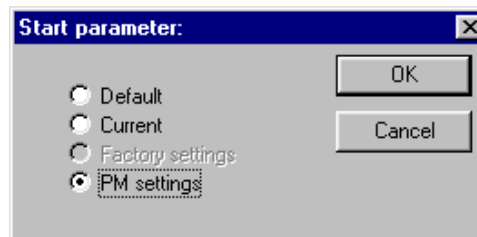
Wait until the RX Calibration window has popped up.

Select	Band	GSM 900
	Autom.-	60 dBm
	1st Man.-	50 dBm
	2nd Man.-	85 dBm

The setup should now look like this:



Select Automatic, press Start and a new window pops up:



Select PM settings, press OK and the window closes.

Now it is possible to press the **Calibrate** button in the RX Calibration window.

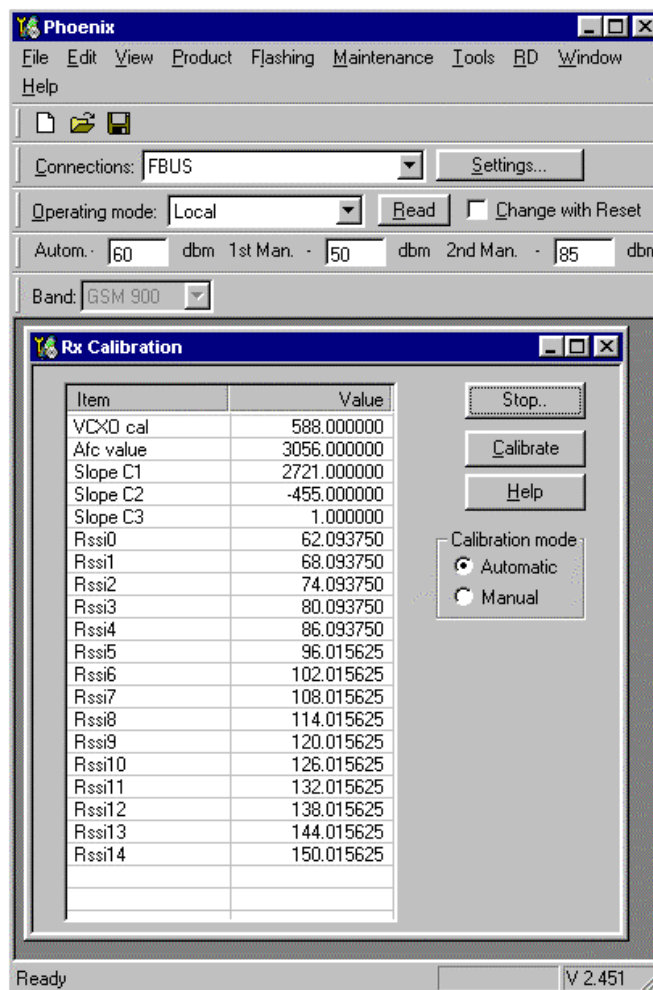
Press Calibrate and a window pops up:



Connect an external signal generator to the RF connector of the phone and compensate for external RF cable losses. Set the generator as shown in window above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure that continuous mode is switched on and modulation switched off.

Press OK and the window closes.

A typical result will look like this:



The results must be compared with the following limits:

Value	Typical	Limit min.	Limit max.
VCXO cal	568	128	767
AFC value	3162	3062	3262
Slope C1	2760	1500	3500
Slope C2	-480	-700	-300
Slope C3	1	0	1
Rssi 3	79	77	82
Rssi 6	102	100	105

For production testing a more sophisticated check of the C1 and C2 values is performed according to the following formulas:

- 1 $1312 < C2 * 0.311 + C1 * 0.395 + \text{Afc value} < 4383$
- 2 $1312 < C2 * 0.407 - C1 * 0.451 + \text{Afc value} < 4383$
- 3 $1 / [-C2 * 3.60e-5 + C1 * 1.99e-5] < 83$
- 4 $1 / [C2 * 3.15e-5 + C1 * 1.99e-5] < 83$

If C1 or C2 are outside the limits in the table above, but inside the limits calculated with the four formulas, the calibration was successful anyhow.

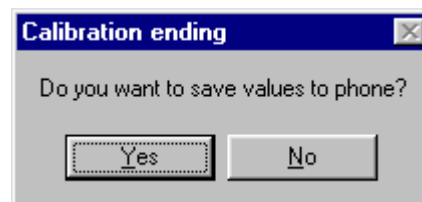
If Rssi 2 and Rssi 6 are within the limits, all other Rssi values are valid, too.

GSM900 receiver part has to be checked

If the whole calibration fails, the GSM900 receiver chain or the synthesizer part (including VCXO) might be defective.

If one of the values VCXO cal, AFC value, C1, C2 or C3 fails and Rssi 4 and Rssi 7 are within the limits, the crystal B601 or the RF ASIC N601 might be defective.

Press Stop in the RX Calibration window and a new window pops up:



Press Yes and the EGSM RX Calibration is finished.

RX Calibration GSM1800

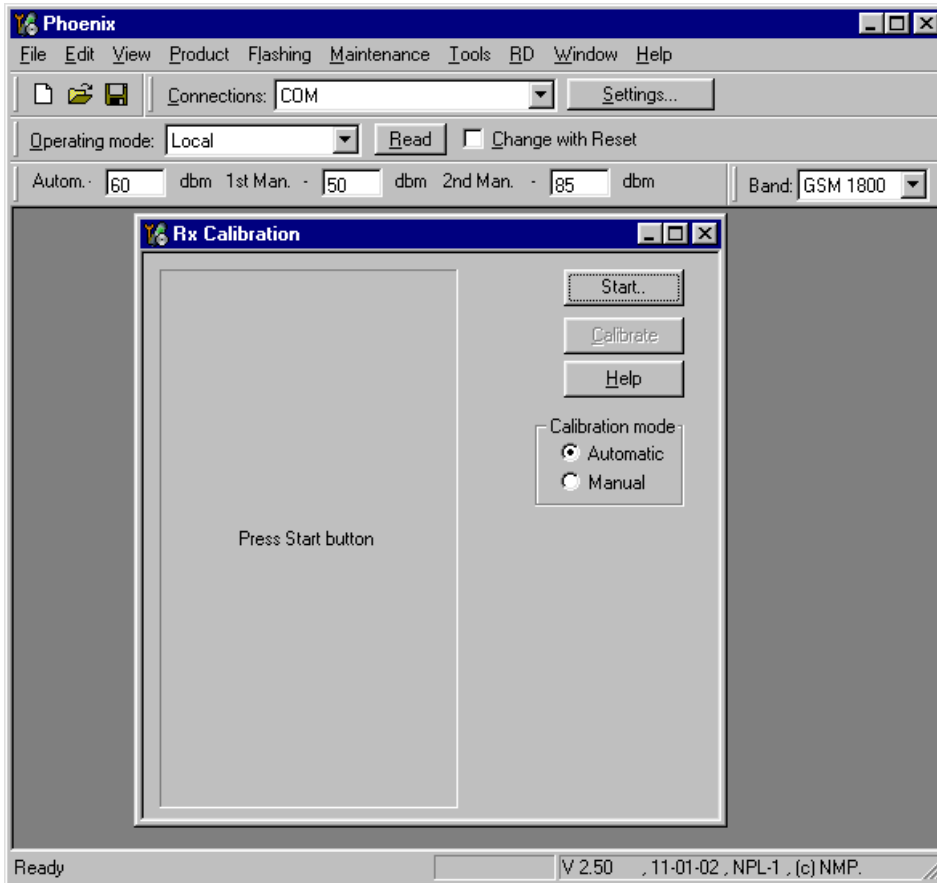
Set operating mode to local mode.

Select	Maintenance	Alt-M
	Tuning	T
	RX Calibration	C

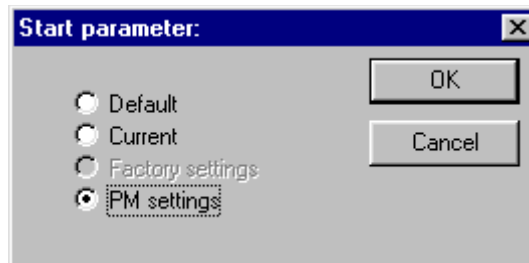
Wait until the RX Calibration window pops up.

Select	Band	GSM 1800
	Autom.-	60dBm
	1 st Man.-	50dBm
	2 nd Man.-	85dBm

The setup should now look like this:



Select Automatic, press Start and a new window pops up:



Select PM settings, press OK and the window closes.

Now it is possible to press the calibrate button in the RX Calibration window.

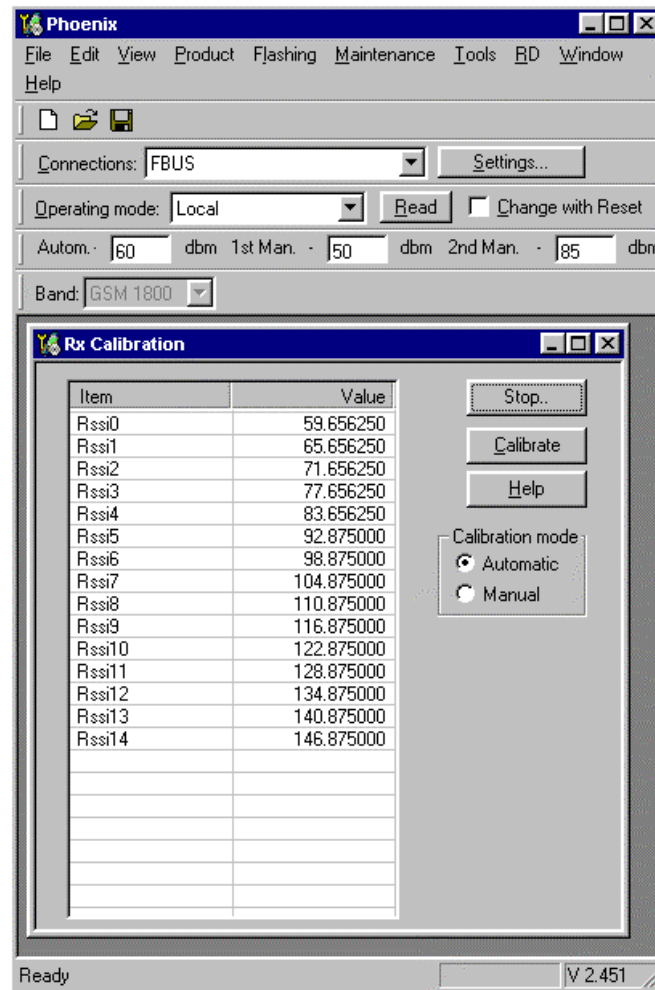
Press Calibrate and a window pops up:



Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window, above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

Press OK and the window closes.

A typical result will look like this:

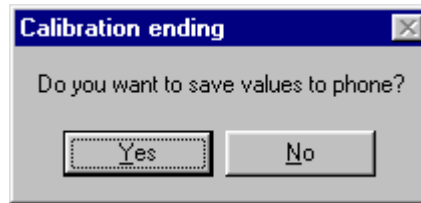


The results must be compared with the following limits:

Value	Typical	Limit min.	Limit max.
Rssi 3	76	74	79
Rssi 6	99	96	103

If Rssi 3 and Rssi 6 are within the limits, all other Rssi values are valid, too. If not, continue according to the instructions of RX fault finding flow chart.

Press Stop in the RX Calibration window and a new window pops up:



Press Yes and the GSM1800 RX Calibration is finished.

RX Calibration GSM1900

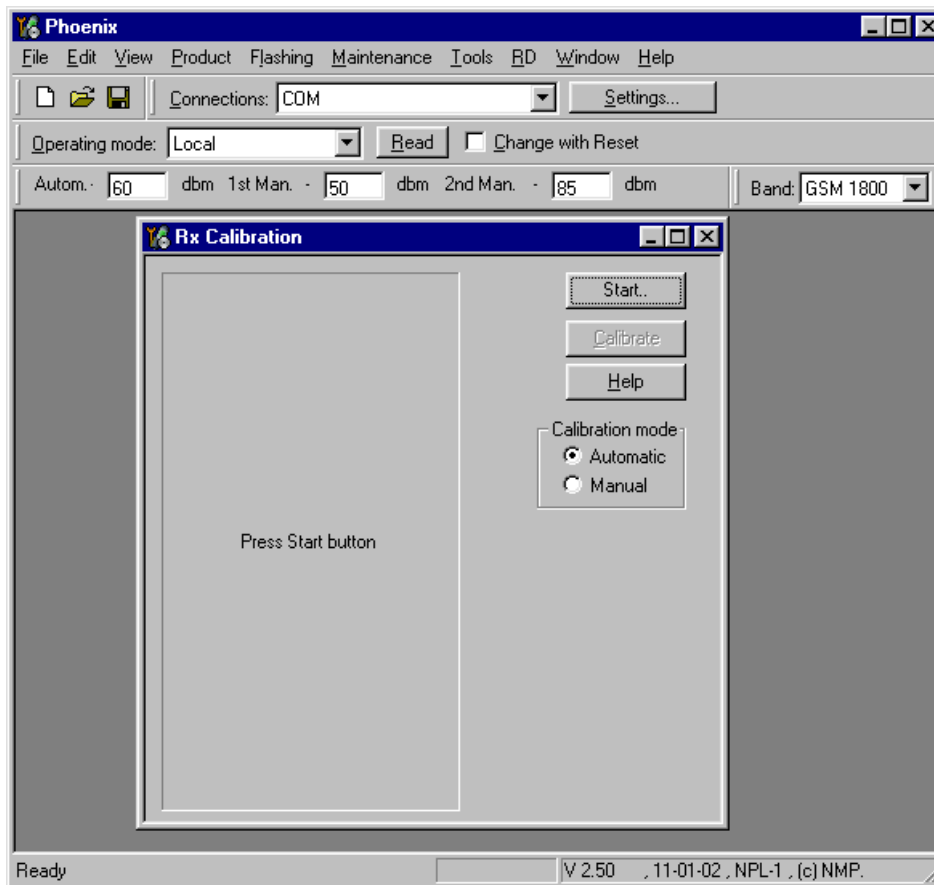
Set operating mode to local mode.

Select	Maintenance	Alt-M
	Tuning	T
	RX Calibration	C

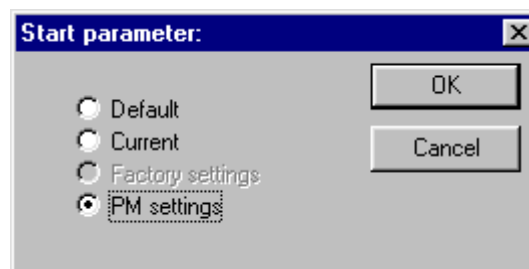
Wait until the RX Calibration window pops up.

Select	Band	GSM 1900
	Autom.-	60dBm
	1 st Man.-	50dBm
	2 nd Man.-	85dBm

The setup should now look like this:



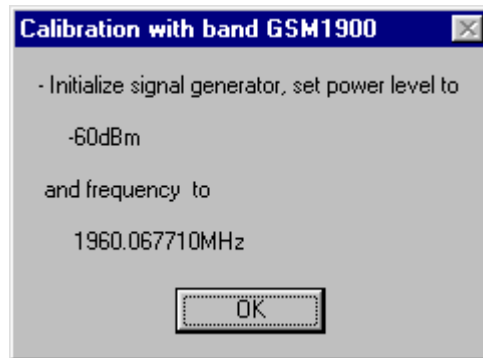
Select Automatic, press Start and a new window pops up:



Select PM settings, press OK and the window closes.

Now it is possible to press the calibrate button in the RX Calibration window.

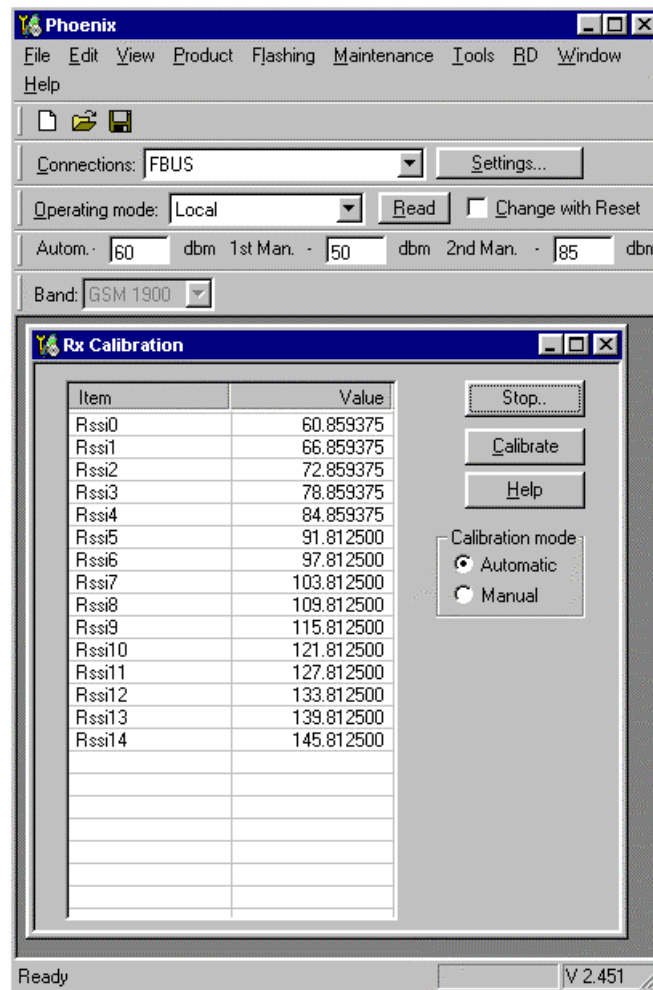
Press Calibrate and a window pops up:



Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

Press ok and the window closes.

A typical result will look like this:

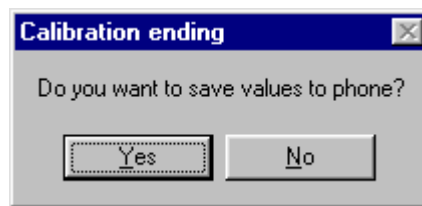


The results must be compared with the following limits:

Value	Typical	Limit min.	Limit max.
Rssi 3	78	76	81
Rssi 6	98	96	101

If Rssi 3 and Rssi 6 are within the limits, all other Rssi values are valid, too. If not, continue according to the instructions of RX Fault finding flow chart.

Press Stop in the RX Calibration window and a new window pops up:



Press Yes and the GSM1900 RX Calibration is finished.

RX Band Filter Response Compensation

This alignment is necessary to compensate the frequency response of the RX band filters (SAW filters).

RX Band Filter Response EGSM900

Set operating mode to local mode.

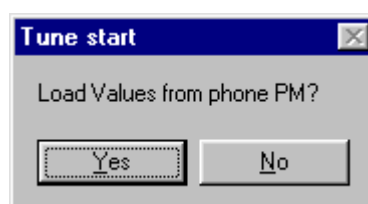
Select Maintenance Alt-M
 Tuning T
 RF Controls F

Wait until the RF Controls window pops up.

Select Band GSM 900

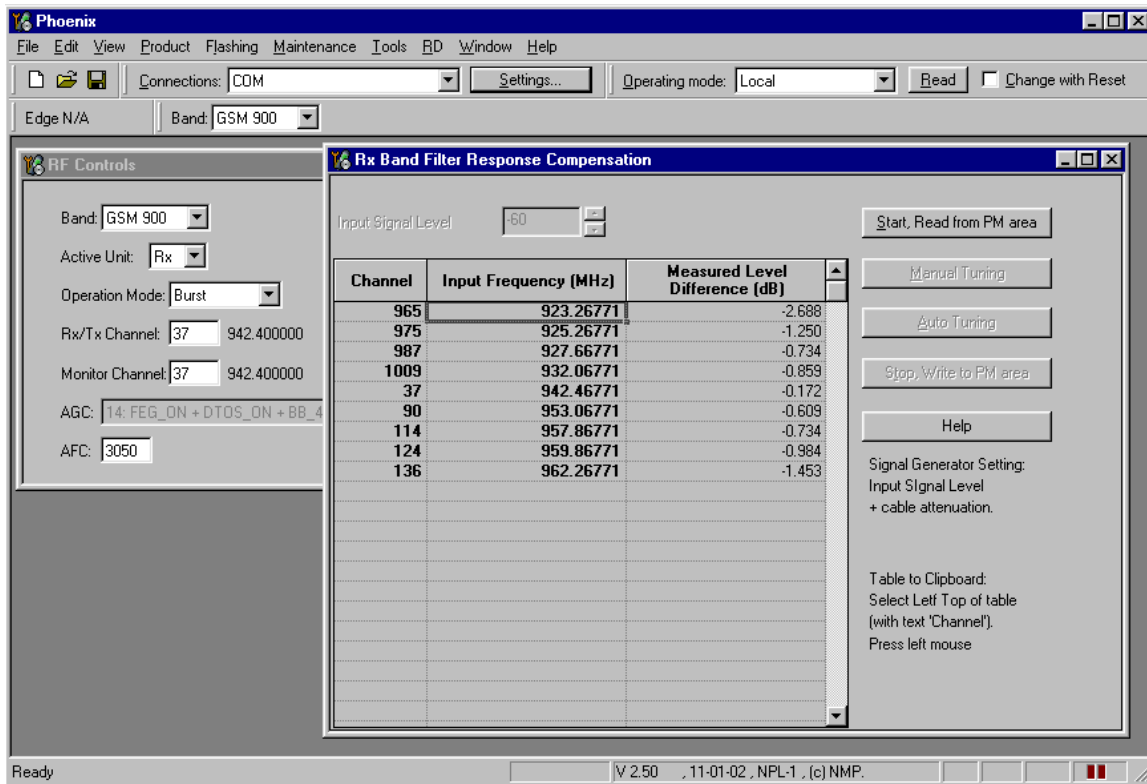
Select Maintenance Alt-M
 Tuning T
 RX Band Filter B
 Response Compensation

A window pops up:



Select Yes and the RX Band Filter Response Compensation window pops up.

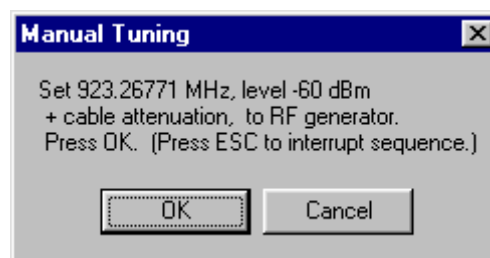
The setup should now look like this:



Select Input Signal Level -60dBm

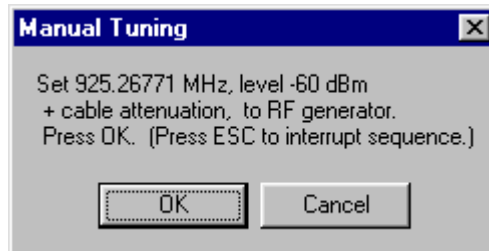
Manual Tuning

Press Manual Tuning and a window pops up:



Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window, above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

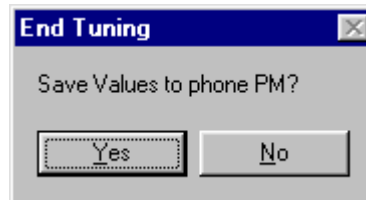
Press OK and a new window pops up:



Set the generator as shown in the window above.

Press OK and a new window pops up. Continue with the sequence until the calibration is finalized on all of the 9 channels.

Press Stop, Write to PM Area (In the RX Band Filter Response Compensation window) and a window pops up:



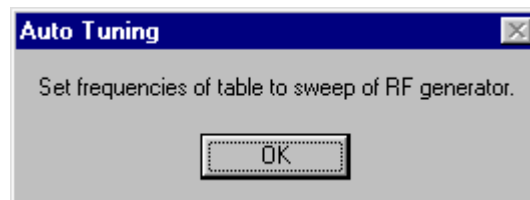
Press Yes and the EGSM RX Band Filter Response Compensation is finished.

Auto Tuning

A faster and more convenient method for Band Filter Calibration can be performed by clicking on "Auto Tuning". This requires a Signal Generator that can be pre-programmed to sweep through user defined frequencies.

Program the signal generator according to the list of frequencies that is shown in the window's column "Input Frequency (MHz)".

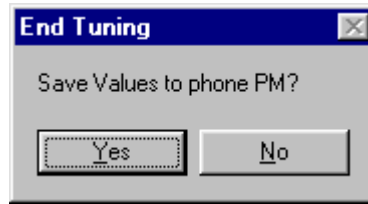
Press Auto Tuning and a window pops up:



Connect an external signal generator to the RF connector of the phone and the signal generator will generate the pre-programmed frequencies after pressing: OK.

Press Stop, Write to PM Area (In the RX Band Filter Response Compensation window) and

a window pops up:



Press Yes and the EGSM RX Band Filter Response Compensation is finished.

Limits

Regarding the limits, the value of N4 is given below. Concerning the other filter frequencies please refer to Appendix A where all FLALI testcases are listed together with the limits.

Value	Typical	Limit min.	Limit max.
N4	0	-0.3	0.3

RX Band Filter Response GSM1800

Set operating mode to local mode.

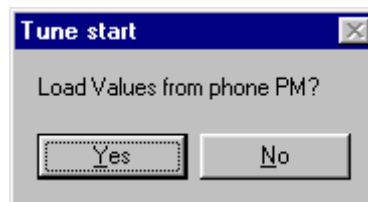
Select Maintenance Tuning RF Controls Alt-M T F

Wait until the RF Controls window has popped up

Select Band GSM 1800

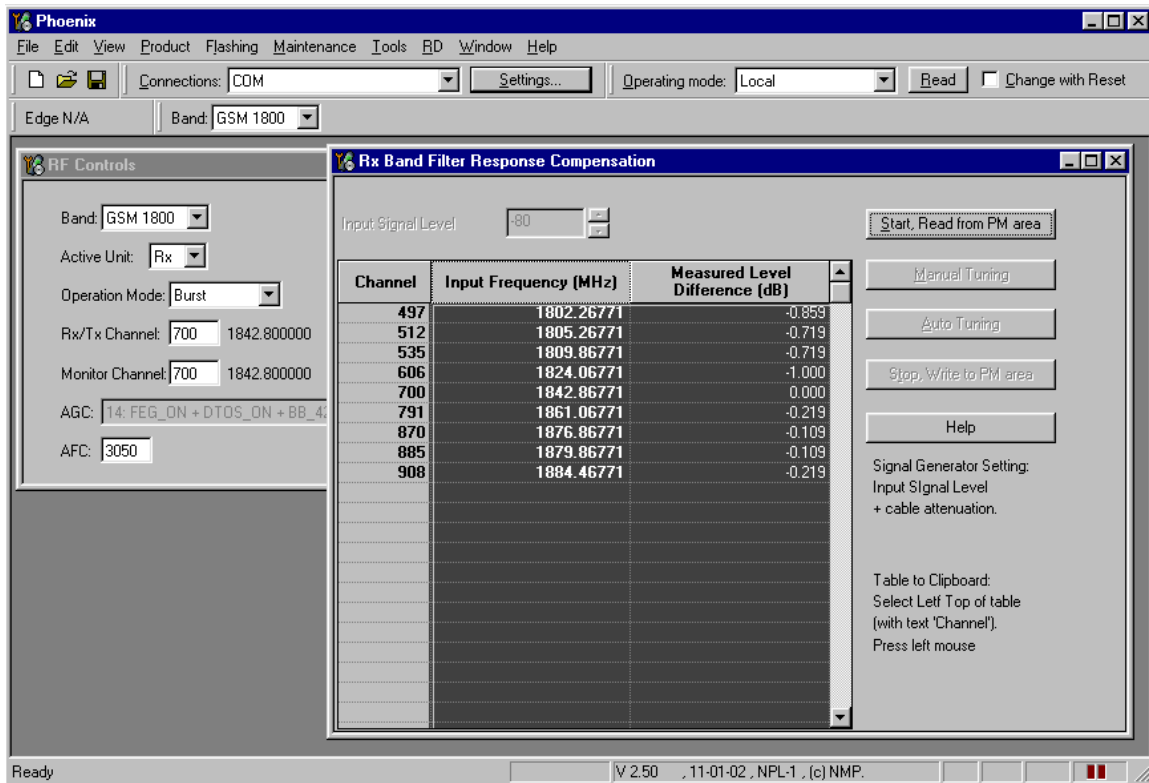
Select Maintenance Tuning RX Band Filter Response Compensation Alt-M T B

The following window pops up:



Select Yes and the RX Band Filter Response Compensation window pops up.

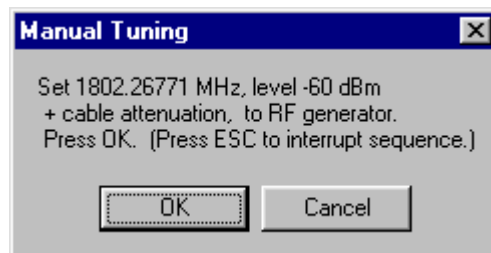
The setup should now look like this:



Select Input Signal Level -60dBm

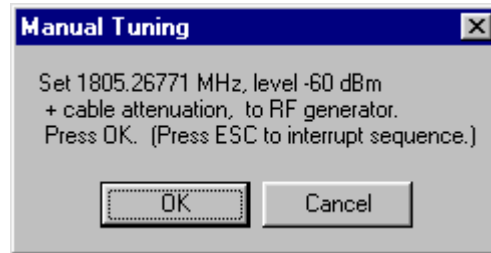
Manual Tuning

Press Manual Tuning and a window pops up:



Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

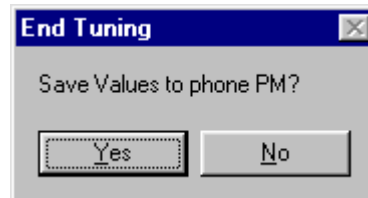
Press OK and a new window pops up:



Set the generator as shown in the window above.

Press OK and a new window pops up. Repeat this sequence until the calibration is finalized on all of the 9 channels.

Press Stop, Write to PM Area (In the RX Band Filter Response Compensation window) and a window pops up:



Press Yes and the GSM1800 RX Band Filter Response Compensation is finished.

Auto Tuning

A faster and more convenient method for Band Filter Calibration can be performed by clicking on "Auto Tuning". This requires a Signal Generator that can be pre-programmed to sweep through user defined frequencies.

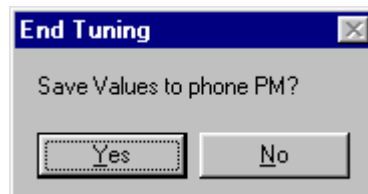
Program the signal generator according to the list of frequencies that is shown in the window's column "Input Frequency (MHz)".

Press Auto Tuning and a window pops up:



Connect an external signal generator to the RF connector of the phone and the signal generator will generate the pre-programmed frequencies after pressing OK.

Press Stop, Write to PM Area (In the RX Band Filter Response Compensation window) and a window pops up:



Press Yes and the EGSM RX Band Filter Response Compensation is finished.

Limits

Regarding limits the value for N4 is given below. Concerning the other filter frequencies please refer to Appendix A where all FLALI testcases are listed together with the limits.

Value	Typical	Limit min.	Limit max.
N4	0	-0.3	0.3

RX Band Filter Response GSM1900

Set operating mode to local mode

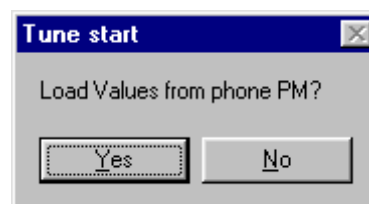
Select Maintenance Alt-M
Tuning T
RF Controls F

Wait until the RF Controls window pops up

Select Band GSM 1900

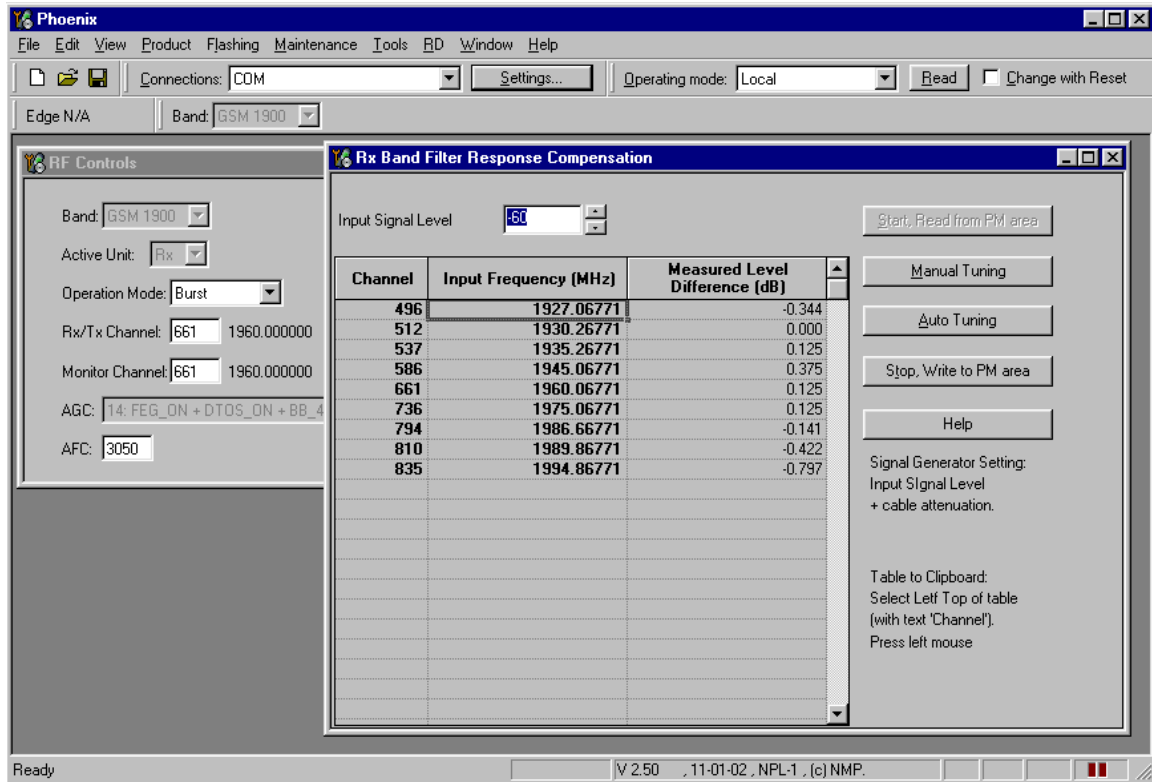
Select Maintenance Alt-M
Tuning T
RX Band Filter B
Response Compensation

A window pops up:



Select Yes and the RX Band Filter Response Compensation window pops up.

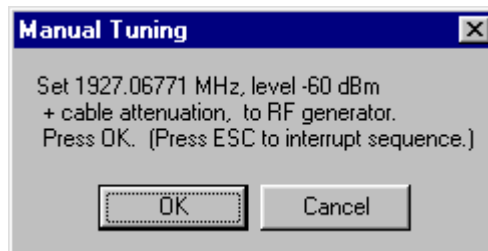
The setup should now look like this:



Select Input Signal Level -60dBm

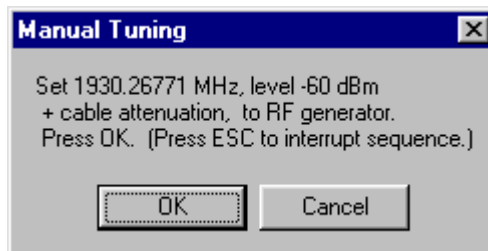
Manual Tuning

Press Manual Tuning and a window pops up:



Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

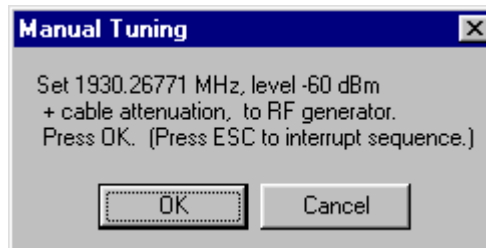
Press OK and a new window pops up:



Set the generator as shown in the window above.

Press OK and a new window pops up. Continue the sequence until the calibration is finalized on all 9 channels.

Press Stop, Write to PM Area (In the RX Band Filter Response Compensation window) and a window pops up:



Press Yes and the GSM1900 RX Band Filter Response Compensation is finished.

Auto Tuning

A faster and more convenient method for Band Filter Calibration can be performed by clicking on "Auto Tuning". This requires a signal Generator that can be pre-programmed to sweep through user defined frequencies.

Program the signal generator according to the list of frequencies that is visible in the window's column "Input Frequency (MHz)".

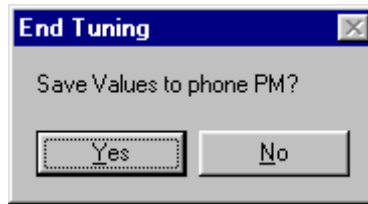
Press Auto Tuning and a window pops up:



Connect an external signal generator to the RF connector of the phone and the signal generator will generate the programmed frequencies after pressing OK.

Press Stop, Write to PM Area (In the RX Band Filter Response Compensation window) and

a window pops up:



Press Yes and the EGSM RX Band Filter Response Compensation is finished.

Limits

Regarding the limits, the value of N4 is given below. Concerning the other filter frequencies please refer to Appendix A where all FLALI testcases are listed together with the limits.

Value	Typical	Limit min.	Limit max.
N4	0	-0.3	0.3

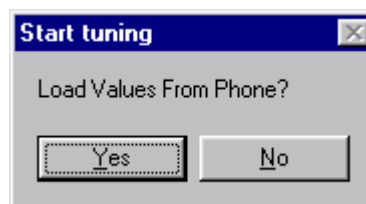
RX Channel Select Filter Calibration

In the following the calibration of the Base Band filter inside Mjoelner is described. It is performed by internally measuring of a prototype filter. For this reason the calibration is done only once, and not separately in 3 bands.

Set operating mode to local mode

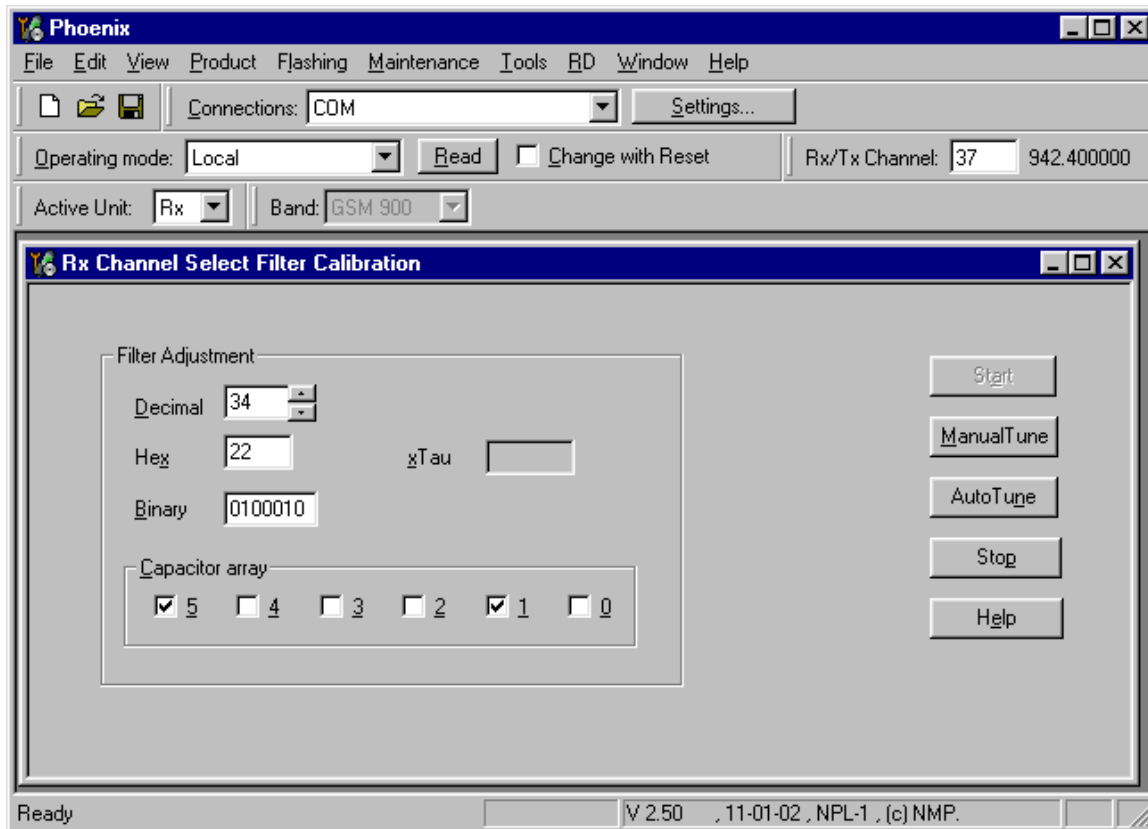
Select Maintenance Alt-M
 Tuning T
 RX Channel Select H
 filter Calibration

A window pops up:



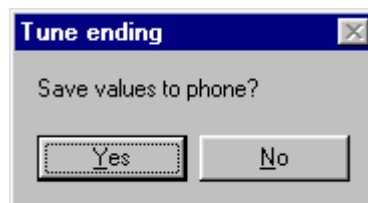
Select Yes and the RX Channel Select Filter Calibration window pops up.

The setup should now look like this:



Press Auto Tune and the optimal values are found.

Press Stop and a new window pops up:



Press Yes and the RX Channel Select Filter Calibration is finished.

Limits of the GTR value = Filter adjustment value in "decimal" format:

Value	Typical	Limit min.	Limit max.
GTR	34	28	40

RX AM Suppression – not needed

The HDG13 RFIC Mjoelner does not require any tuning of AM suppression.

TX Power Level Tuning

This tuning must be done in all three bands.

Note: TX Power Tuning must be done with a peak power meter, e.g. Anritsu model ML2408A with Anritsu Peak Power Sensor MA2442A and a suitable attenuator.

The use of the built-in power meter of GSM testers is likely to cause larger errors than the use of a dedicated power meter and might cause miss tuning so that the phone might be not compliant with the GSM specifications.

Set power supply voltage Vcc=3.6V!

TX Power Level Tuning EGSM900

Set operating mode to local mode.

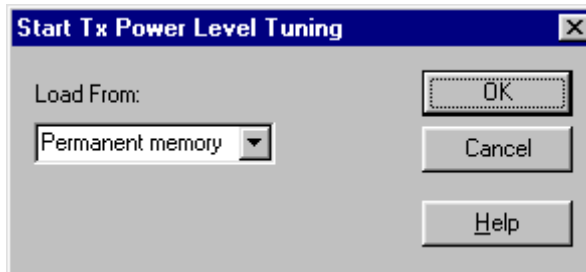
Select Maintenance
Tuning TX Power Level Tuning

Wait until the TX Power Level Tuning window has popped up.

Connect a **calibrated** power meter to the RF connector of the phone.

Select Band GSM 900
Active Unit TX

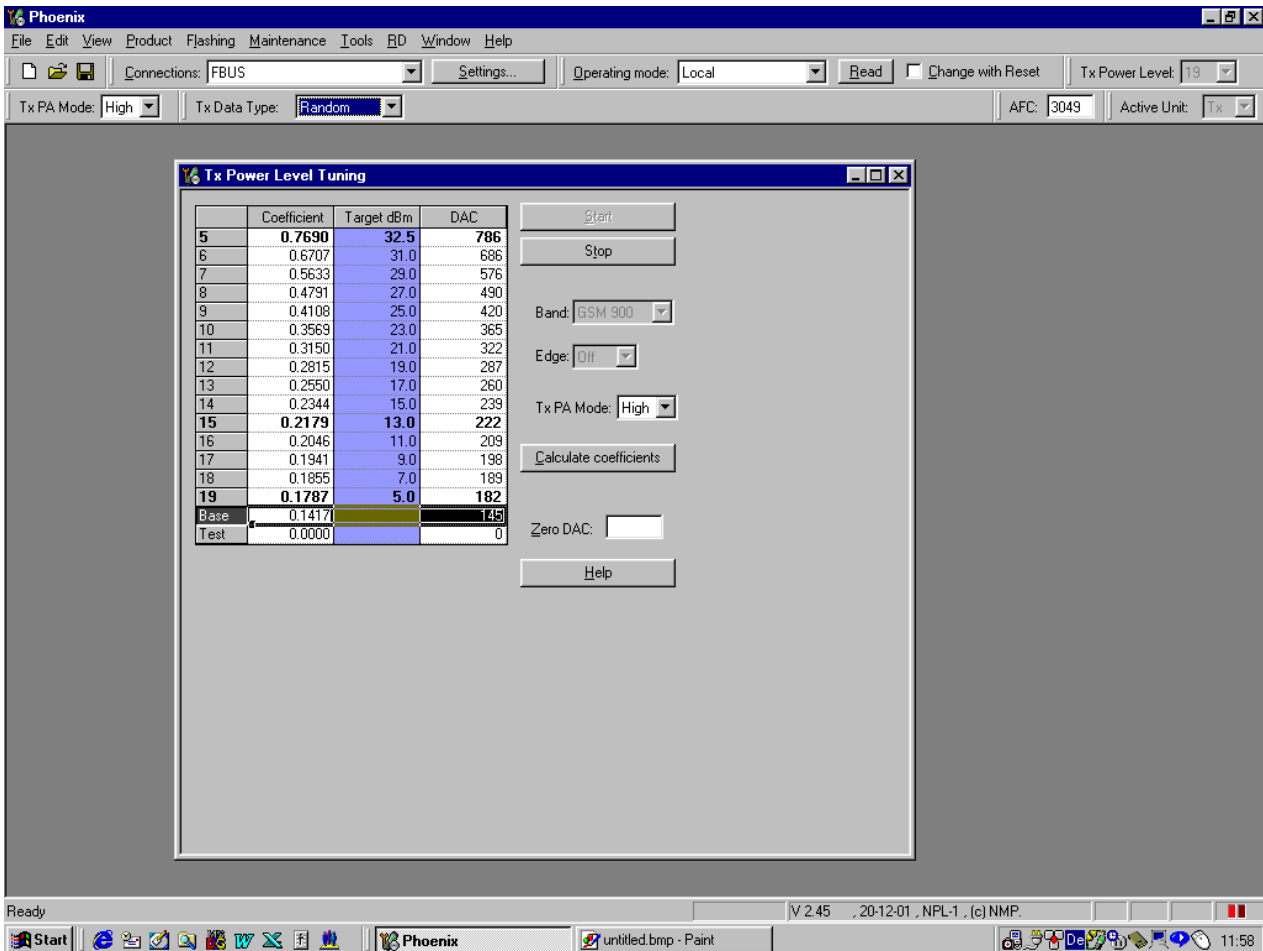
Press Start and a window pops up:



Select Permanent memory, press OK and the window closes.

Select TX Data Type Random

The setup should now look like this:



Select TX PA Mode High

Tune Base level to -27 dBm.

Adjust DAC Values for Power Level 5 (32.5 dBm), 15 (13 dBm) and 19 (5 dBm) according to the target values. The power levels may differ from the target power levels mentioned in Phoenix.

Make sure that the output power for Power Level 5 is equal or lower than 1dB below the saturation output power. Determine the saturation power by setting the DAC Value to its maximum, for example, adjust the DAC Value to 32.3dBm for Power Level 5 if the saturation output power is only 33.3dBm.

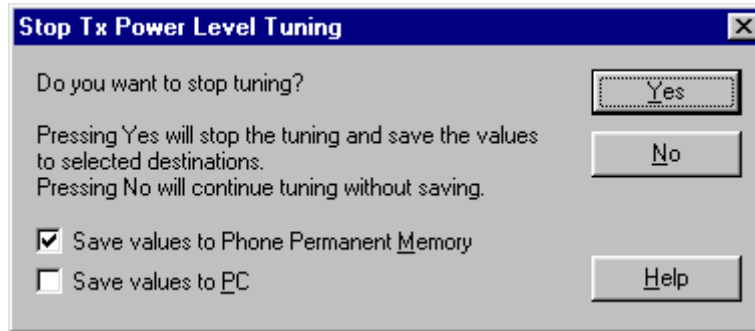
Press calculate, check if all levels match the target values, correct if necessary.

Select TX PA Mode Low

Adjust DAC Values for Power Level 7, 15 and 19 according to the target values.

Press calculate, check if all levels match the target values, correct if necessary.

Press Stop and a window pops up:



Select 'Save values to Phone Permanent Memory'

Press Yes and the EGSM TX Power Level Tuning is finished.

TX Power Level Tuning GSM1800

Set operating mode to local mode

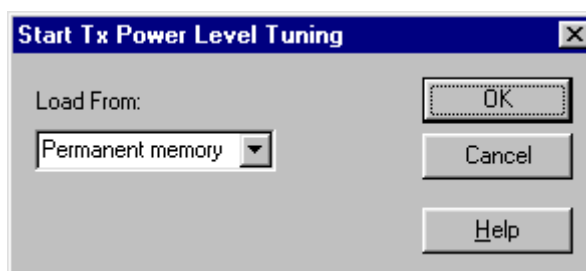
Select Maintenance
Tuning
TX Power Level Tuning

Wait until the TX Power Level Tuning window has popped up.

Connect a **calibrated** power meter to the RF connector of the phone.

Select Band GSM 1800
Active Unit TX

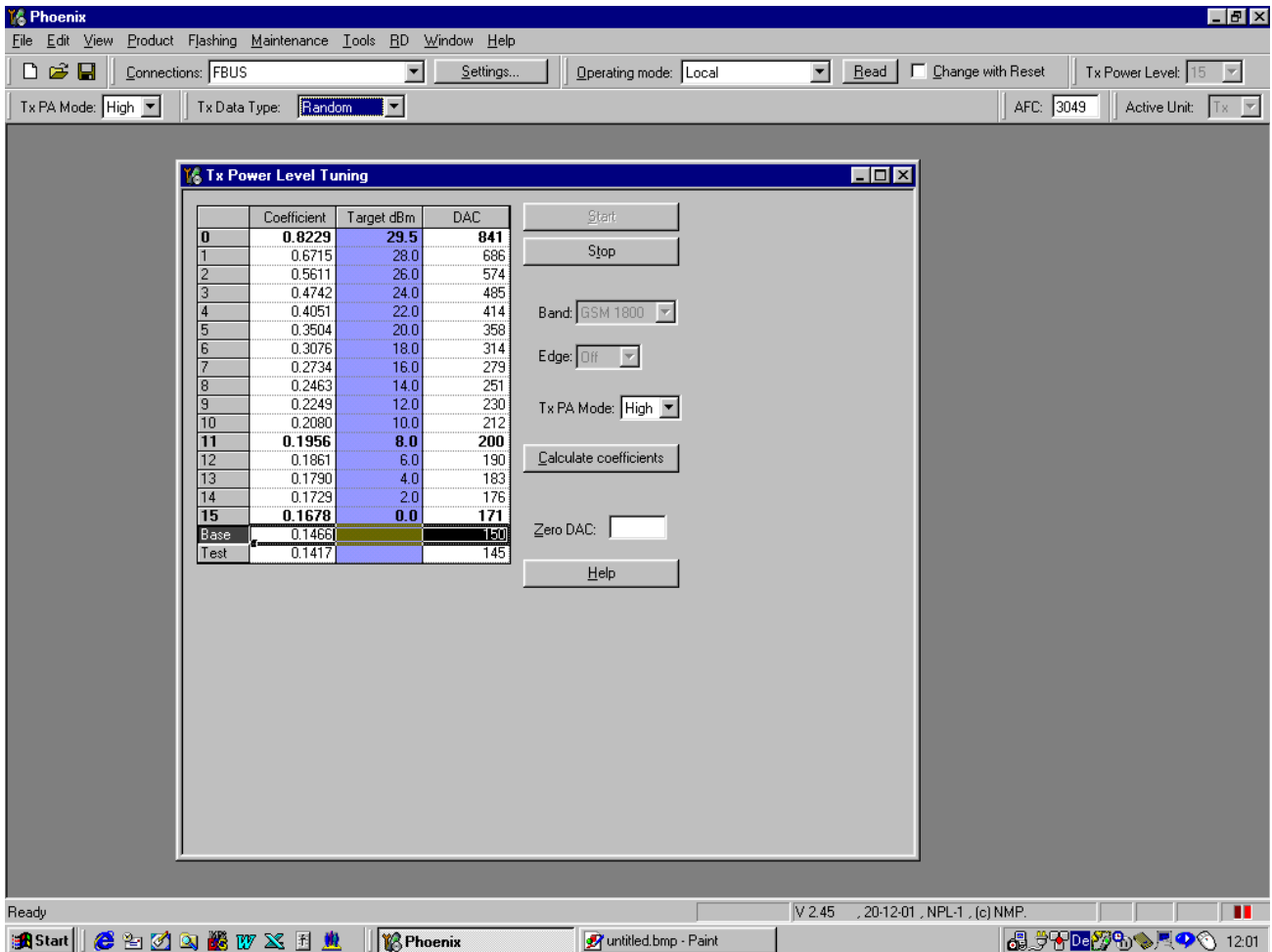
Press Start and a window pops up:



Select Permanent memory, press OK and the window closes.

Select TX Data Type Random

The setup should now look like this:



Select TX PA Mode High

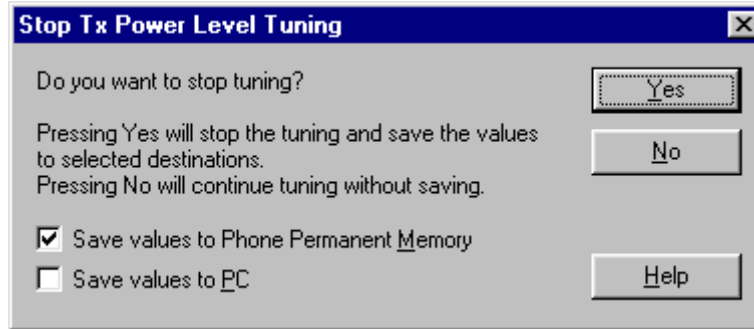
Tune Base level to -27dBm.

Adjust DAC Values for Power Level 0 (30dBm), 11 (8dBm) and 15 (0dBm). The Power levels may differ from the target levels mentioned.

Make sure that the output power for Power Level 0 is equal or lower than 1dB below the saturation output power. Determine the saturation power by setting the DAC Value to its maximum, for example, adjust the DAC Value to 29.7dBm for Power Level 0 if the saturation output power is only 30.7dBm.

Press calculate, check if all levels match the target values, correct if necessary.

Press Stop and a window pops up:



Select **Save values to Phone Permanent Memory**

Press Yes and the GSM1800 TX Power Level Tuning is finished.

TX Power Level Tuning GSM1900 (PCS)

Set operating mode to local mode.

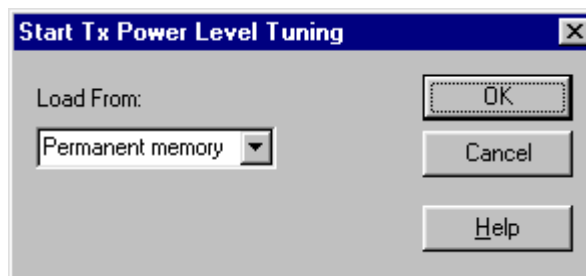
Select **Maintenance Tuning TX Power Level Tuning**

Wait until the TX Power Level Tuning window pops up.

Connect a **calibrated** power meter to the RF connector of the phone.

Select **Band GSM 1900**
Active Unit TX

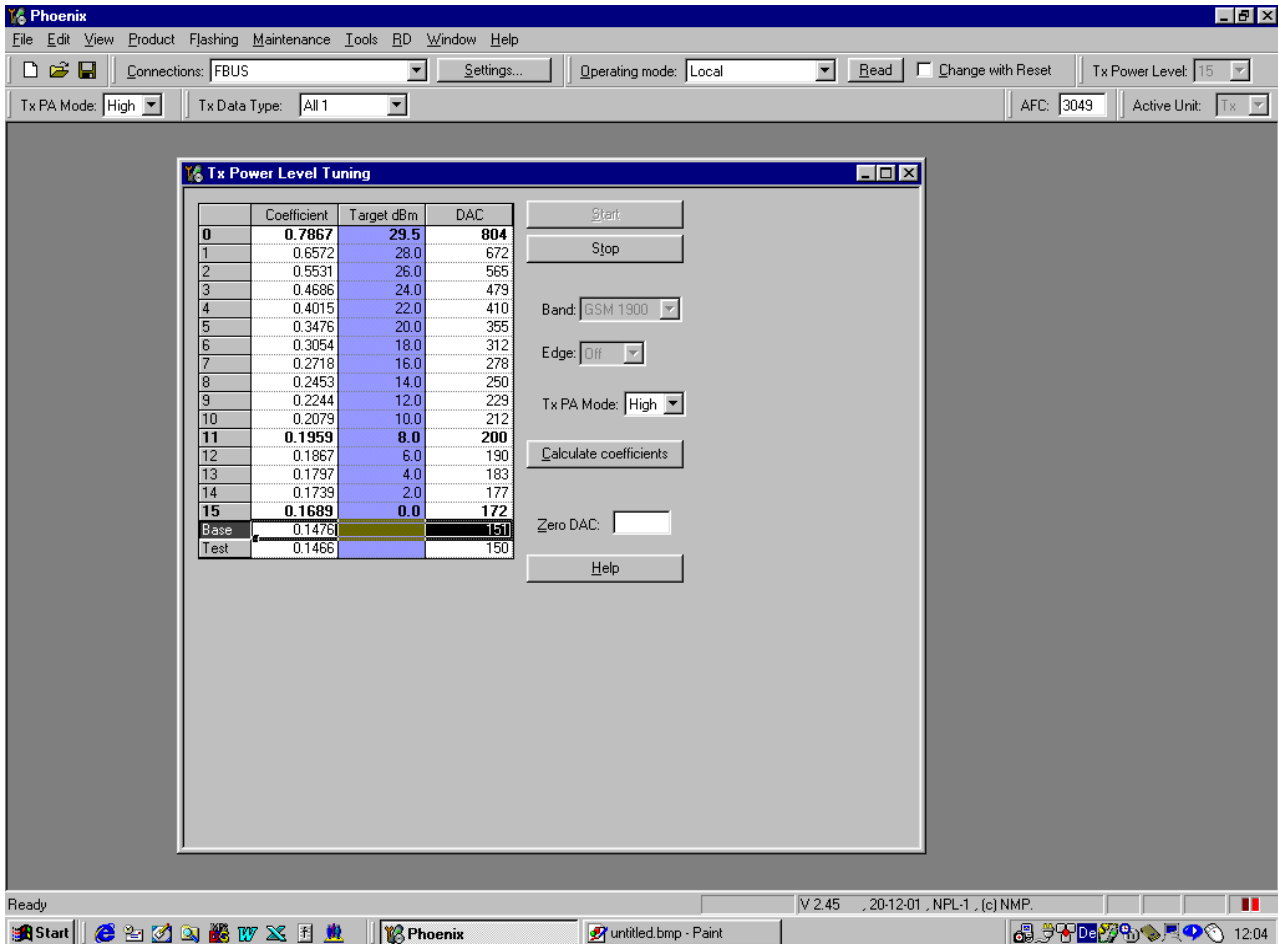
Press Start and a window pops up:



Select Permanent memory, press OK and the window closes.

Select **TX Data Type Random**

The setup should now look like this:



Select TX PA Mode High

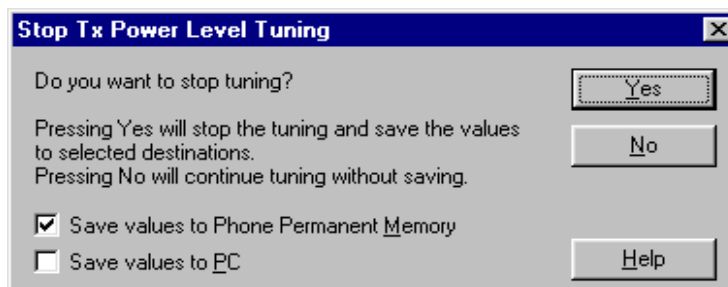
Tune Base level to -27dBm.

Adjust DAC Values for Power Level 0 (30dBm), 11 (8dBm) and 15 (0dBm). The Power levels may differ from the target power levels mentioned in Phoenix.

Make sure that the output power for Power Level 0 is equal or lower than 1dB below the saturation output power. Determine the saturation power by setting the DAC Value to its maximum, for example, adjust the DAC Value to 29.7dBm for Power Level 0 if the saturation output power is only 30.7dBm.

Press calculate, check if all levels match the target values, correct if necessary.

Press Stop and a window pops up:



Select Save values to Phone Permanent Memory.

Press Yes and the GSM1900 TX Power Level Tuning is finished.

TX I/Q Tuning

This tuning must be performed in all three bands.

TX I/Q Tuning GSM900

Caution: If you use a spectrum analyzer make sure that the external attenuation between phone and spectrum analyzer is high enough that the input of the analyzer can't be destroyed, 20 to 30dB is recommended. Adjust the reference level offset according to the insertion loss between the phone and the spectrum analyzer.

Note: During TX I/Q Tuning in EGSM900 band, an additional calibration value for the battery voltage A/D converter is taken. Therefore it is important to set the operating voltage to 3.6V for this alignment.

PC/Phone operation:

Set operating mode to Local Mode.

Set supply voltage to 3.6V.

```
Select      Maintenance      Alt-M
              Tuning          T
                    TX IQ Tuning      I
```

Wait until the TX IQ Tuning window pops up.

```
Select      Maintenance      Alt-M
              Tuning          T
                    RF Controls      F
```

Wait until the RF Controls window pops up.

Connect a Spectrum Analyzer or GSM tester with the option 'Narrow Spectrum' to the antenna pads of the phone.

If a spectrum analyzer is used, make the following settings.

	EGSM/EGSM900
Center Frequency	897.4 MHz
Frequency Span	300 kHz
Resolution Bandwidth	3kHz
Video Bandwidth	3kHz
Sweep Time	3 sec.
Sweep Type	Clear/Write

	EGSM/EGSM900
Detector Type	Max Peak
Reference level	35 dBm
Marker 1	897.33229 MHz
Marker 2	897.4 MHz
Marker 3	897.46771 MHz

Select in the RF Controls Window:

Select Band GSM 900
 Active Unit TX
 Operation Mode Burst
 RX/TX Channel 37
 TX PA Mode Free
 TX Data Type All1

Select in the TX IQ Tuning Window:

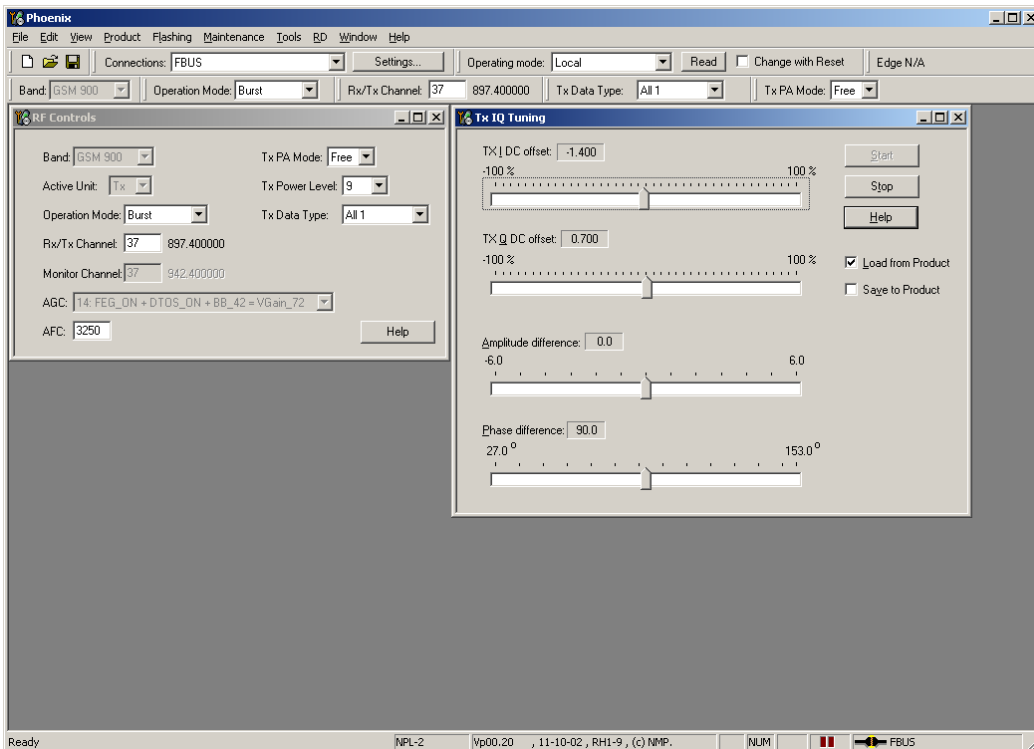
Select Load from Product

Press Start

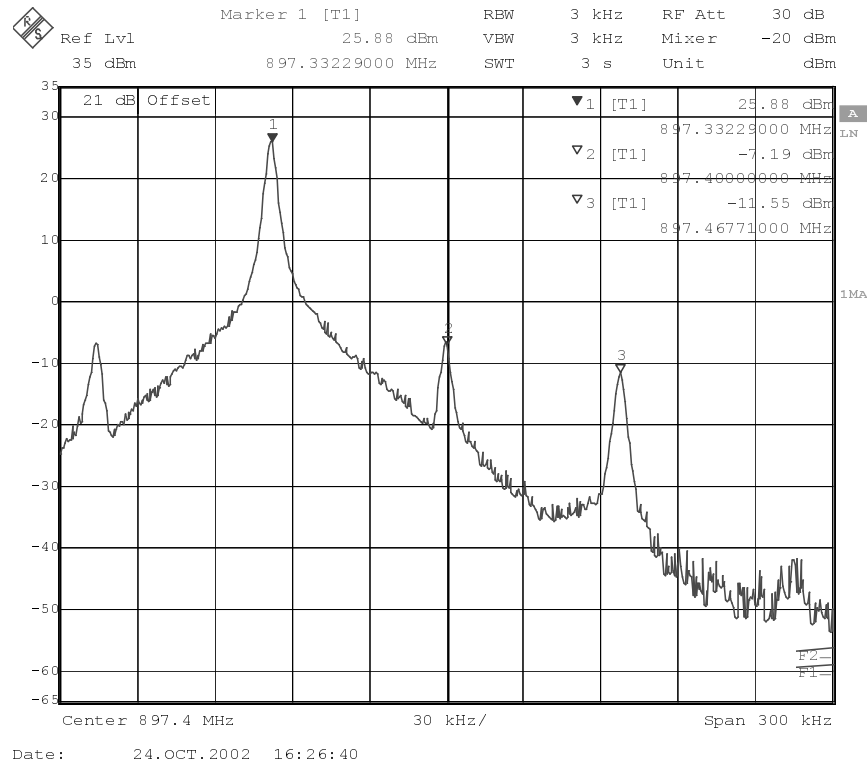
Select again in the RF Controls Window:

Select TX Power Level 9

The setup should now look like this:



The Spectrum Analyzer now shows a plot like this:

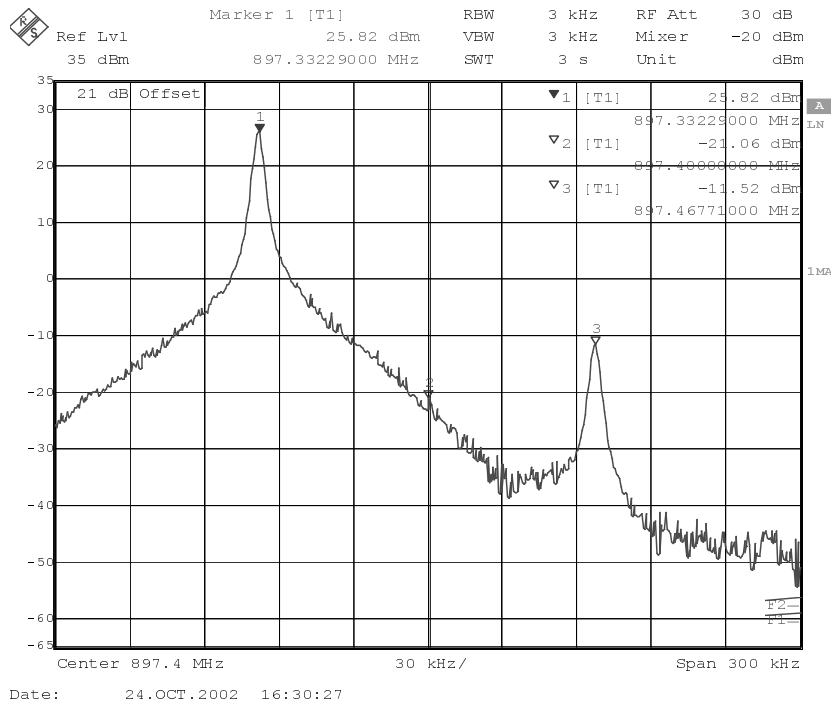


The purpose of this alignment is to tune the carrier signal (at marker 2) and the +67kHz signal (at marker 3) to a minimum level.

Use the variables 'TX I DC offset' and 'TX Q DC offset' to adjust the carrier signal to a minimum level (marker 2). Tuning can be performed by using arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 2 and the peak levels at marker 1 must exceed 40dB.

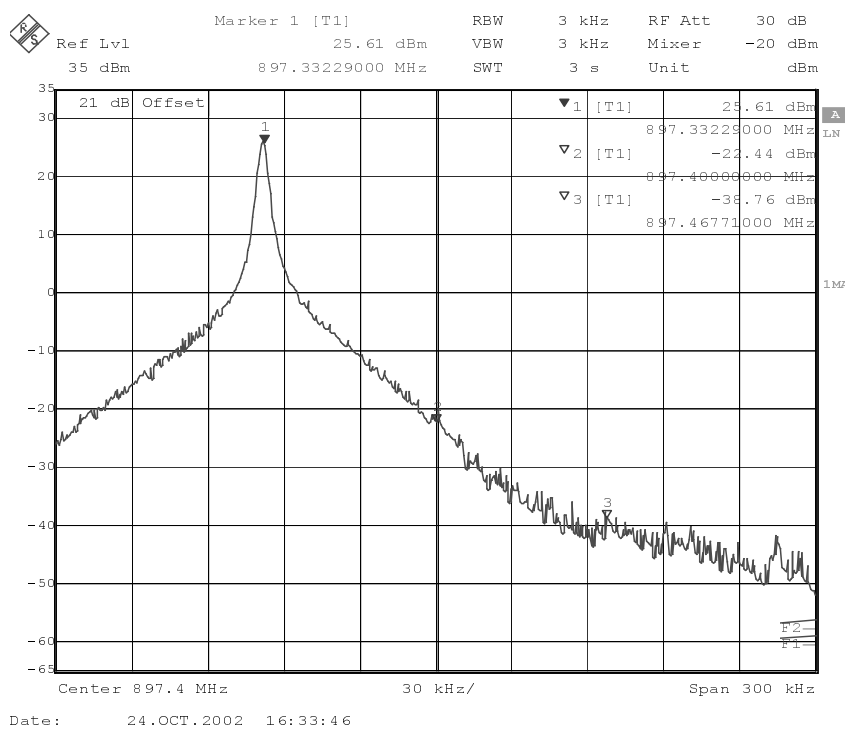
The Spectrum Analyzer now shows a plot like this:



Use the variables 'Amplitude difference' and 'Phase difference' to adjust the +67kHz signal to a minimum level (Marker 3). Tuning can be performed by using the arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 3 and the peak level at marker 1 must exceed 40dB.

The Spectrum Analyzer now shows a plot like this:



Compare the results in the TX IQ Tuning Window with the limits below:

Value	Typical	Limit min.	Limit max.
TX I DC offset	0.1	-6	6
TX Q DC offset	0	-6	6
Amplitude difference	0	-1	1
Phase difference	87.5	80	100

Select in the TX IQ Tuning Window:

Select Save to Product

Press Stop

and the values are stored in the phone. The GSM900 TX IQ Tuning is now finished.

Note: The optimum values for "TX I and Q Offset" and "Amplitude and Phase Difference" vary from phone to phone.

TX I/Q Tuning GSM1800

Caution: If you use a spectrum analyzer make sure that the external attenuation between phone and spectrum analyzer is high enough that the input of the analyzer can't be destroyed, 20 to 30dB is recommended. Adjust the reference level offset according to the insertion loss between the phone and the spectrum analyzer.

PC/Phone operation:

Set operating mode to Local Mode.

Select Maintenance Tuning TX IQ Tuning Alt-M
T
I

Wait until the TX IQ Tuning window has popped up.

Select Maintenance Tuning RF Controls Alt-M
T
F

Wait until the RF Controls window has popped up.

Connect a Spectrum Analyzer or GSM tester with the option 'Narrow Spectrum' to the RF connector of the phone.

If a spectrum analyzer is used, make the following settings.

	GSM1800
Center Frequency	1747.8MHz
Frequency Span	300 kHz
Resolution Bandwidth	3 kHz
Video Bandwidth	3 kHz

Sweep Time	3 sec.
Sweep Type	Clear/Write
Detector Type	Max Peak
Reference level	35 dBm
Marker 1	1747.73229 MHz
Marker 2	1747.8 MHz
Marker 3	1747.86771 MHz

Select in the RF Controls Window:

Select Band GSM 1800
 Active Unit TX
 Operation Mode Burst
 RX/TX Channel 700
 TX PA Mode Free
 TX Data Type All1

Select in the TX IQ Tuning Window:

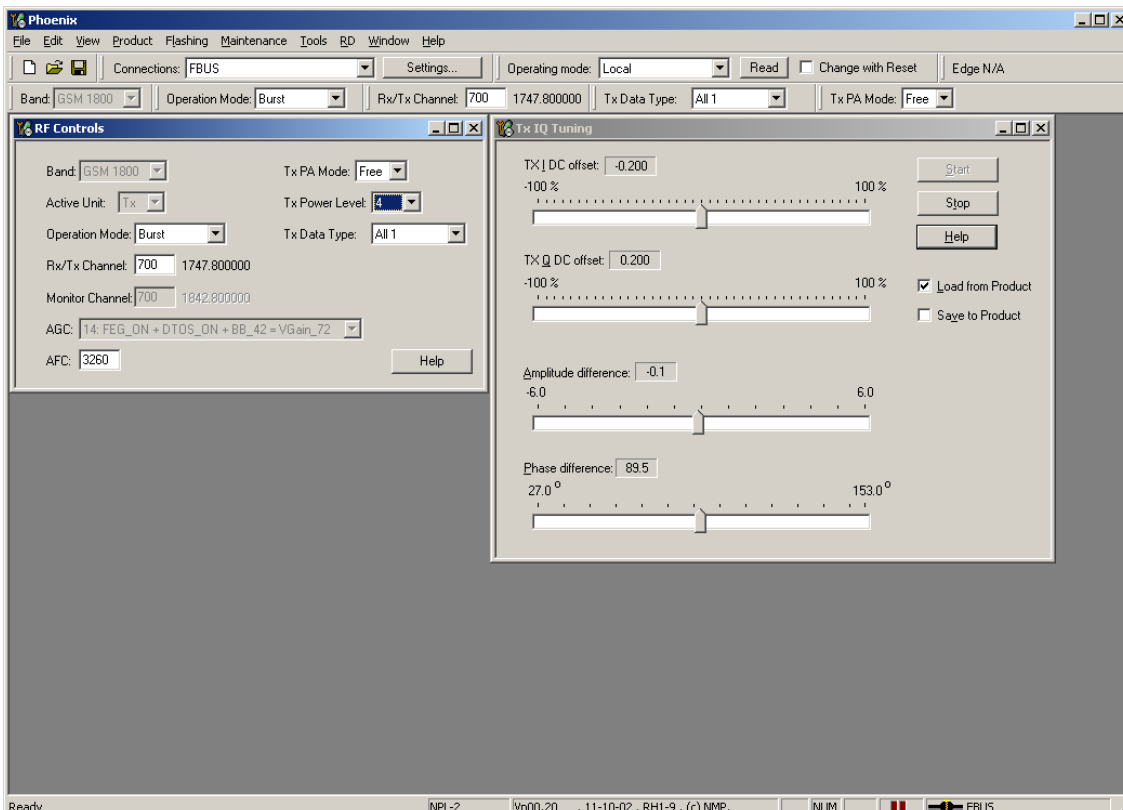
Select Load from Product

Press Start

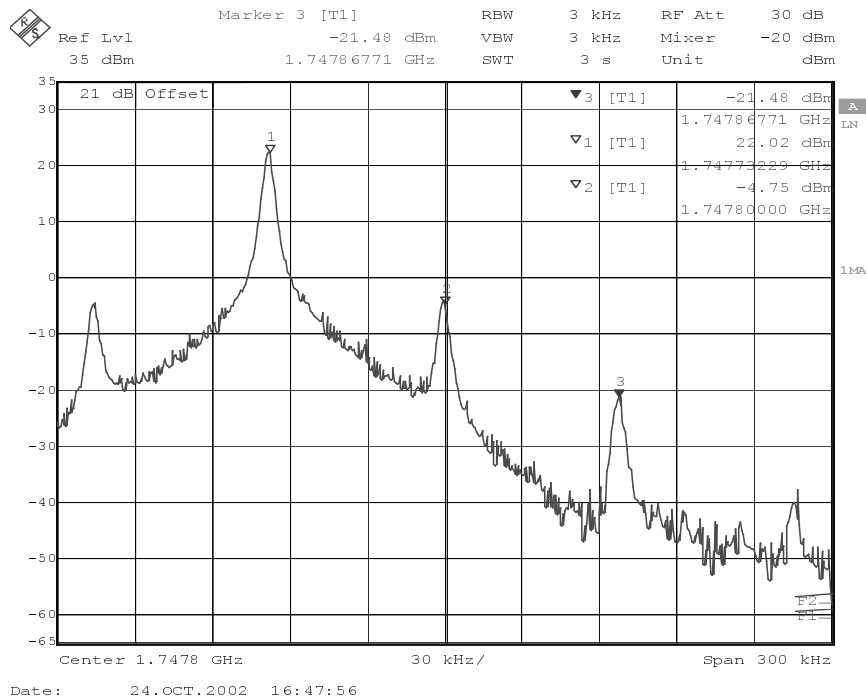
Select again in the RF Controls Window:

Select TX Power Level 4

The setup should now look like this:



The Spectrum Analyzer now shows a plot like this:

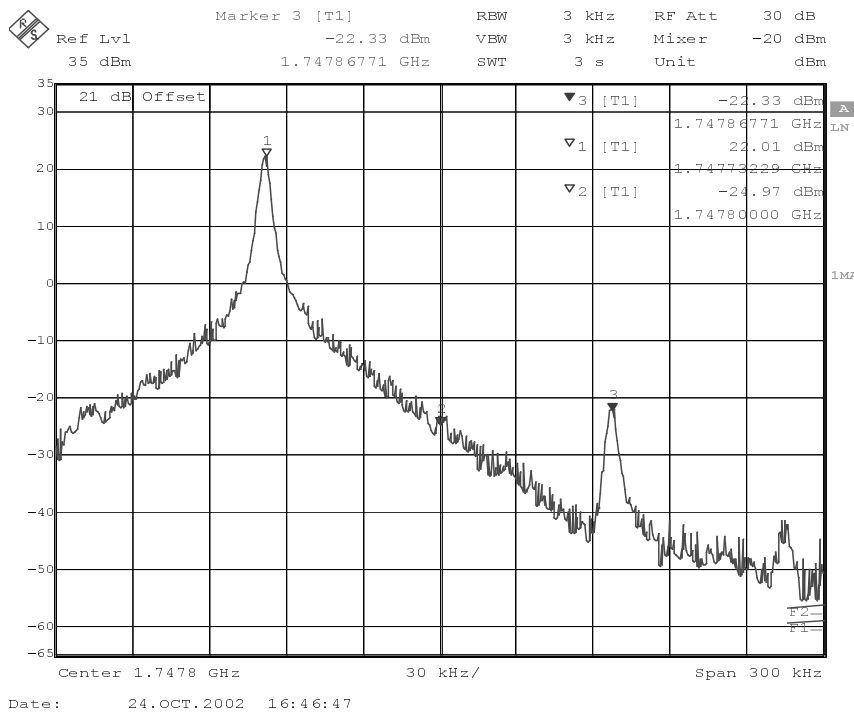


The purpose of this alignment is to tune the carrier signal (at marker 2) and the +67kHz signal (at marker 3) to a minimum level.

Use the variables 'TX I DC offset' and 'TX Q DC offset' to adjust the carrier signal to a minimum level (Marker 2). Tuning is possible by using arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive but even possible.

After tuning to the minimum the level difference between marker 2 and the peak levels at marker 1 must exceed 40dB.

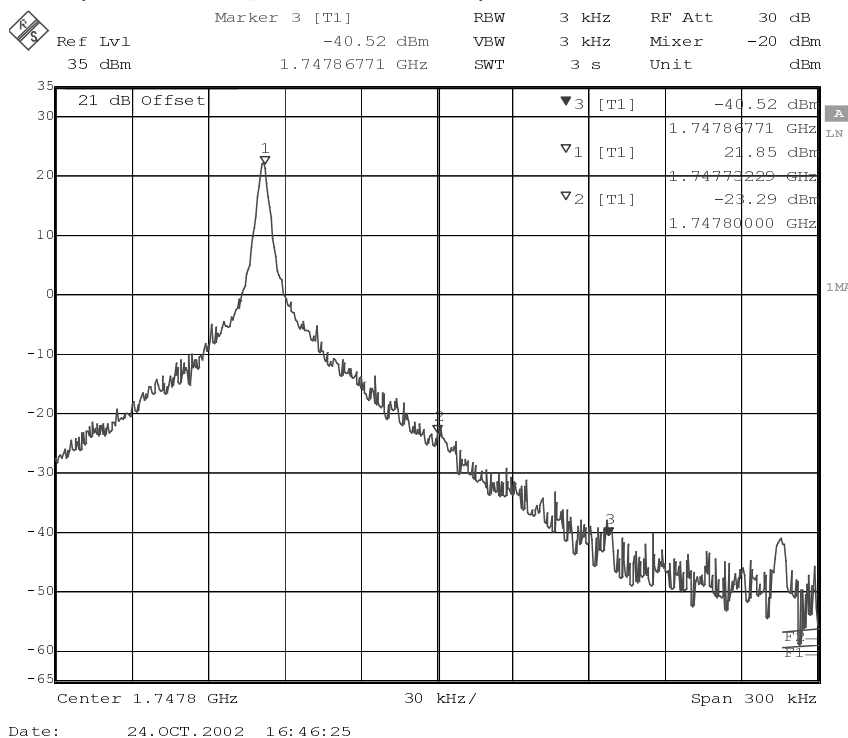
The Spectrum Analyzer now shows a plot like this:



Use the variables 'Amplitude difference' and 'Phase difference' to adjust the +67kHz signal to a minimum level (Marker 3). Tuning can be performed by using the arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 3 and the peak level at marker 1 must exceed 40dB.

The Spectrum Analyzer now shows a plot like this:



Compare the results in the TX IQ Tuning Window with the limits below:

Value	Typical	Limit min.	Limit max.
TX I DC offset	0.1	-6	6
TX Q DC offset	-0.1	-6	6
Amplitude difference	-0.1	-1	1
Phase difference	89.5	80	100

Select in the TX IQ Tuning Window:

Select Save to Product

Press Stop

and the values are stored in the phone. The GSM1800 TX IQ Tuning is now finished.

Note: The optimum values for "TX I and Q Offset" and "Amplitude and Phase Difference" vary from phone to phone.

TX I/Q Tuning GSM1900

Caution: If you use a spectrum analyzer make sure that the external attenuation between phone and spectrum analyzer is high enough that the input of the analyzer can't be destroyed, 20 to 30dB is recommended. Adjust the reference level offset according to the insertion loss between the phone and the spectrum analyzer.

PC/Phone operation:

Set operating mode to local mode

```

Select           Maintenance           Alt-M
                  Tuning                T
                  TX IQ Tuning          I
  
```

Wait until the TX IQ Tuning window has popped up.

```

Select           Maintenance           Alt-M
                  Tuning                T
                  RF Controls           F
  
```

Wait until the RF Controls window has popped up.

Connect a Spectrum Analyzer or GSM tester with the option 'Narrow Spectrum' to the RF connector of the phone.

If a spectrum analyzer is used, make the following settings.

	GSM1900
Center Frequency	1880MHz
Frequency Span	300 kHz
Resolution Bandwidth	3 kHz
Video Bandwidth	3 kHz

Sweep Time	3 sek.
Sweep Type	Clear/Write
Detector Type	Max Peak
Reference level	35 dBm
Marker 1	1879.93229 MHz
Marker 2	1880 MHz
Marker 3	1880.06771 MHz

Select in the RF Controls Window:

Select Band GSM 1900
 Active Unit TX
 Operation Mode Burst
 RX/TX Channel 661
 TX PA Mode Free
 TX Data Type All 1

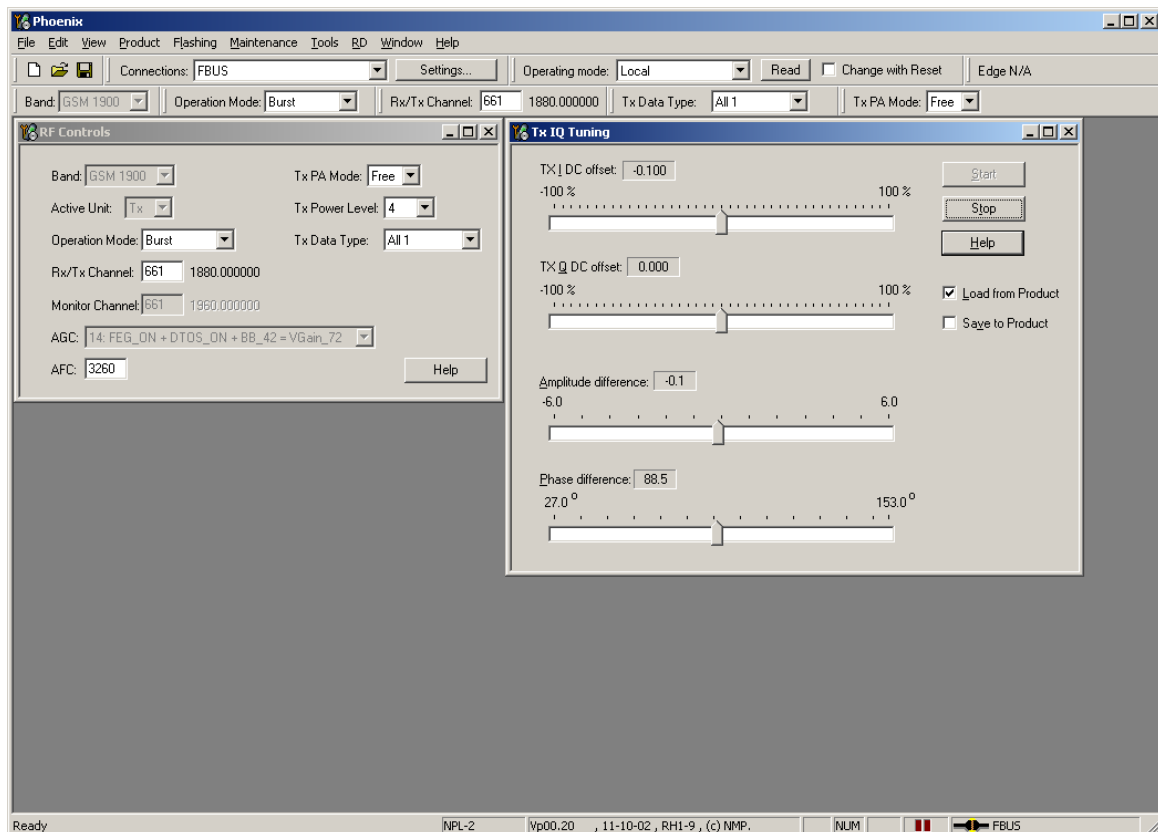
Select in the TX IQ Tuning Window:

Select Load from Product
 Press Start

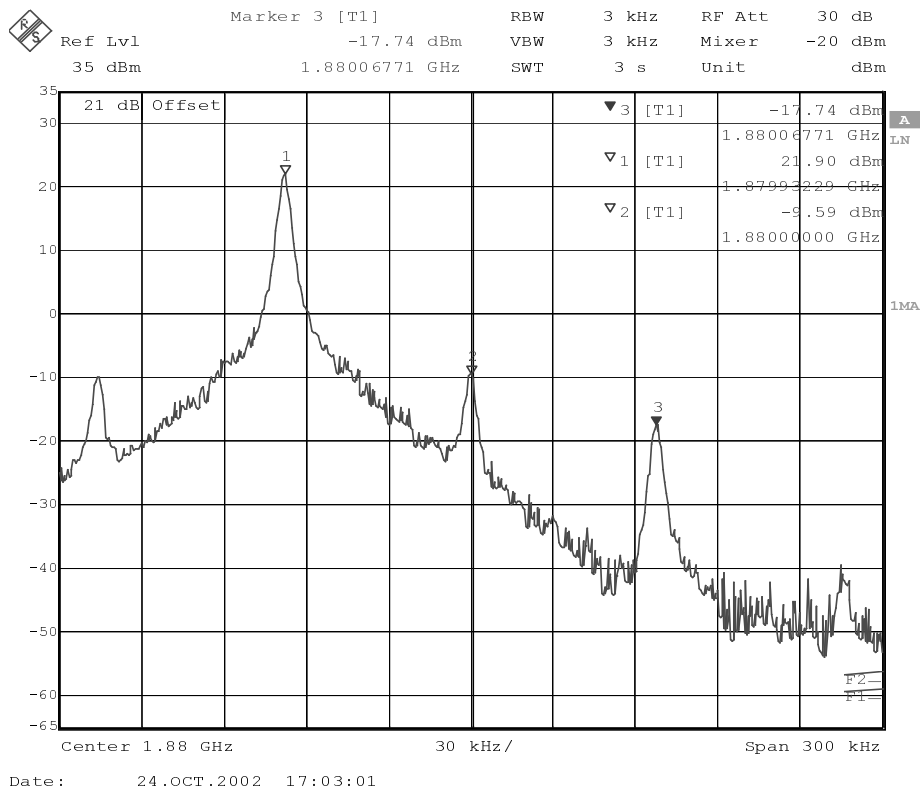
Select again in the RF Controls Window:

Select TX Power Level 4

The setup should now look like this:



The Spectrum Analyzer now shows a plot like this:

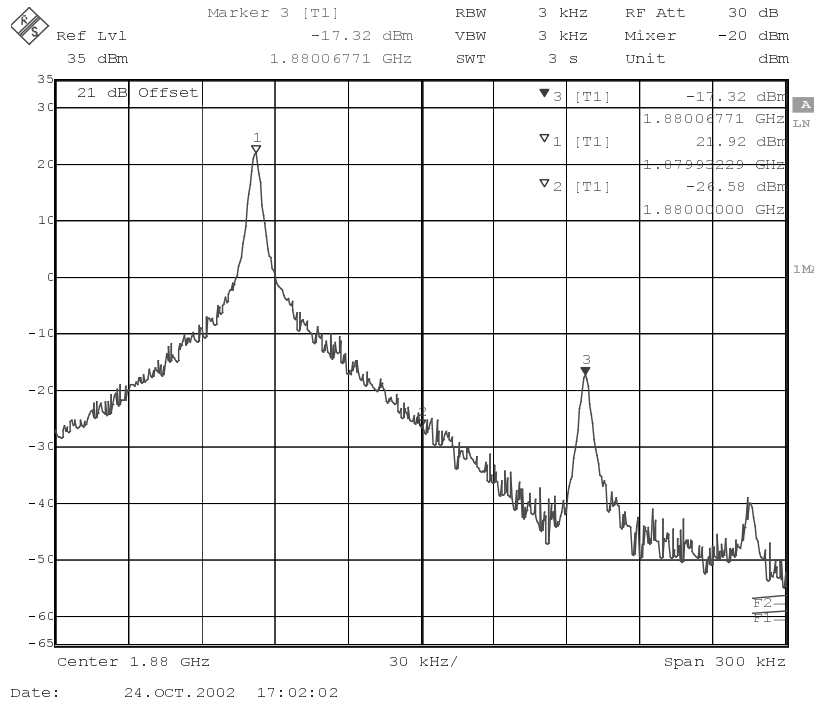


The purpose of this alignment is to tune the carrier signal (at marker 2) and the +67kHz signal (at marker 3) to a minimum level.

Use the variables 'TX I DC offset' and 'TX Q DC offset' to adjust the carrier signal to a minimum level (marker 2). Tuning can be performed by using arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 2 and the peak levels at marker 1 must exceed 40dB.

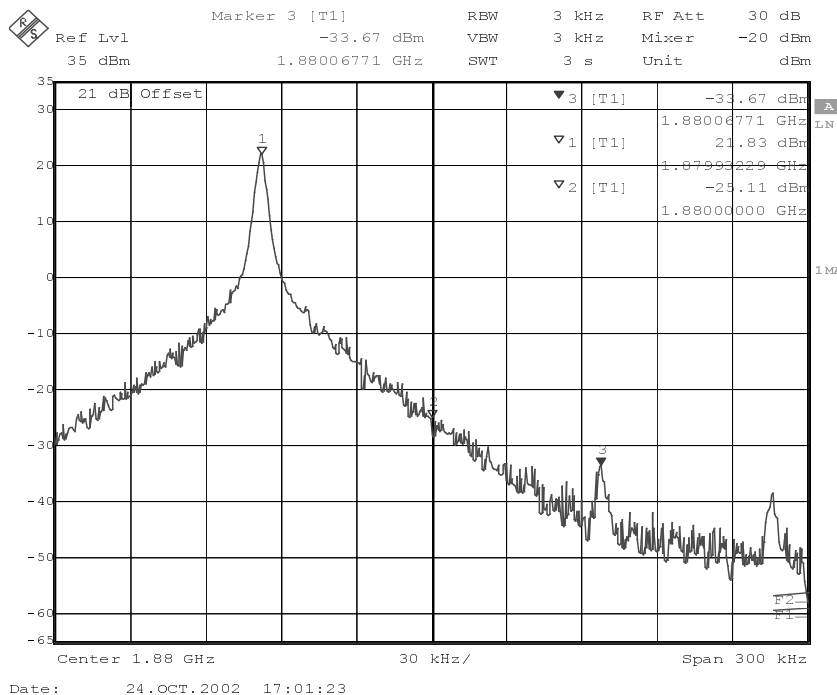
The Spectrum Analyzer now shows a plot like this:



Use the variables 'Amplitude difference' and 'Phase difference' to adjust the +67kHz signal to a minimum level (Marker 3). Tuning can be performed by using the arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 3 and the peak level at marker 1 must exceed 40dB.

The Spectrum Analyzer now shows a plot like this:



Compare the results in the TX IQ Tuning Window with the limits below:

Value	Typical	Limit min.	Limit max.
TX I DC offset	0.2	-6	6
TX Q DC offset	-0.1	-6	6
Amplitude difference	0	-1	1
Phase difference	89.0	80	100

Select in the TX IQ Tuning Window:

Select Save to Product

Press Stop

and the values are stored in the phone. The GSM1900 TX IQ Tuning is now finished.

Note: The optimum values for "TX I and Q Offset" and "Amplitude and Phase Difference" vary from phone to phone.

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