6 – Troubleshooting Instructions

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Table of Contents

Introduction

This document describes in overview the different hardware error possibilities for the RM-8, RM-47 and RM-48 phone.

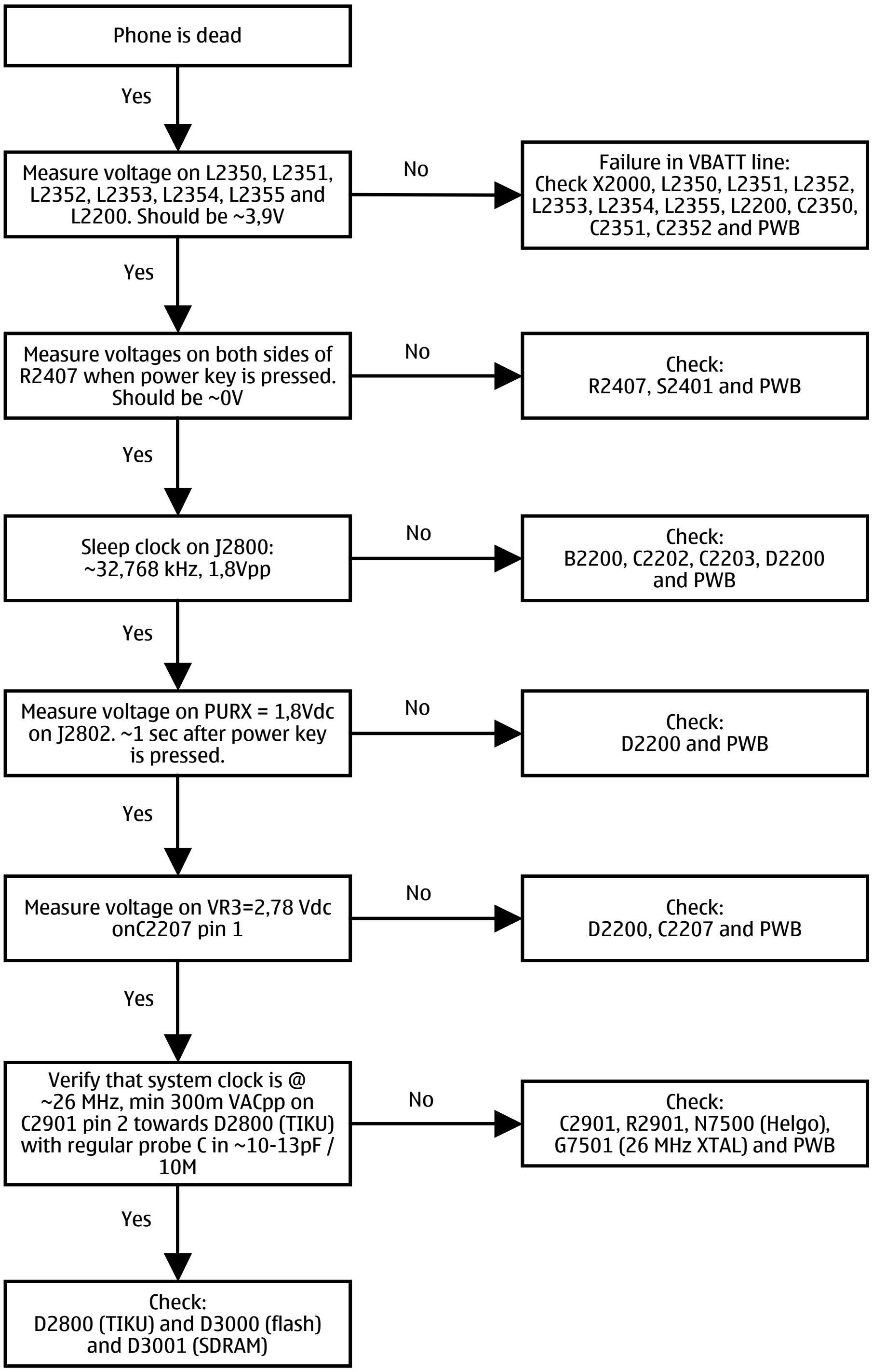
Not every possible hardware error is described in this document, but only those possible to correct.

General Failures

Phone is dead

This means that the phone doesn’t use any current at all when supply is connected and/or power key is pressed. It is assumed that the voltage supplied is 3,9Vdc. UEMEK will prevent any functionality at battery/supply levels below 2,9Vdc and the software will shut the phone down at 3,1Vdc.

Figure 1: Phone is dead



Flash programming doesn't work

The flash programming on RM-8 boards is only possible via the pads on the PWB.

In case of Flash failure in production (FLALI station), problem is most likely related to SMD problems. Possible failures could be short-circuiting of balls under µBGAs (e.g. UEMEK, TIKUEDGE, SDRAM, FLASH), missing or misaligned components.

In flash programming error cases the flash prommer (via Phoenix or Darium) can give some information about the fault. The fault information messages could be:

- Phone doesn't set Flashbus TXD line high after VCC is switch on.
- External RAM test failed.

These errors are some of the most common errors and based on this, a fault finding diagram for flash programming is shown below. Various errors can appear from the prommer when flashing the phone - not all of them can be directly linked to the HW or phone.

Because of the use of uBGA components, it is not possible to verify on the diagram, if there is a short circuit in control and address/data lines on TIKUEDGE, NOR flash or SDRAM.

Figure 2: Flash programming doesn't work

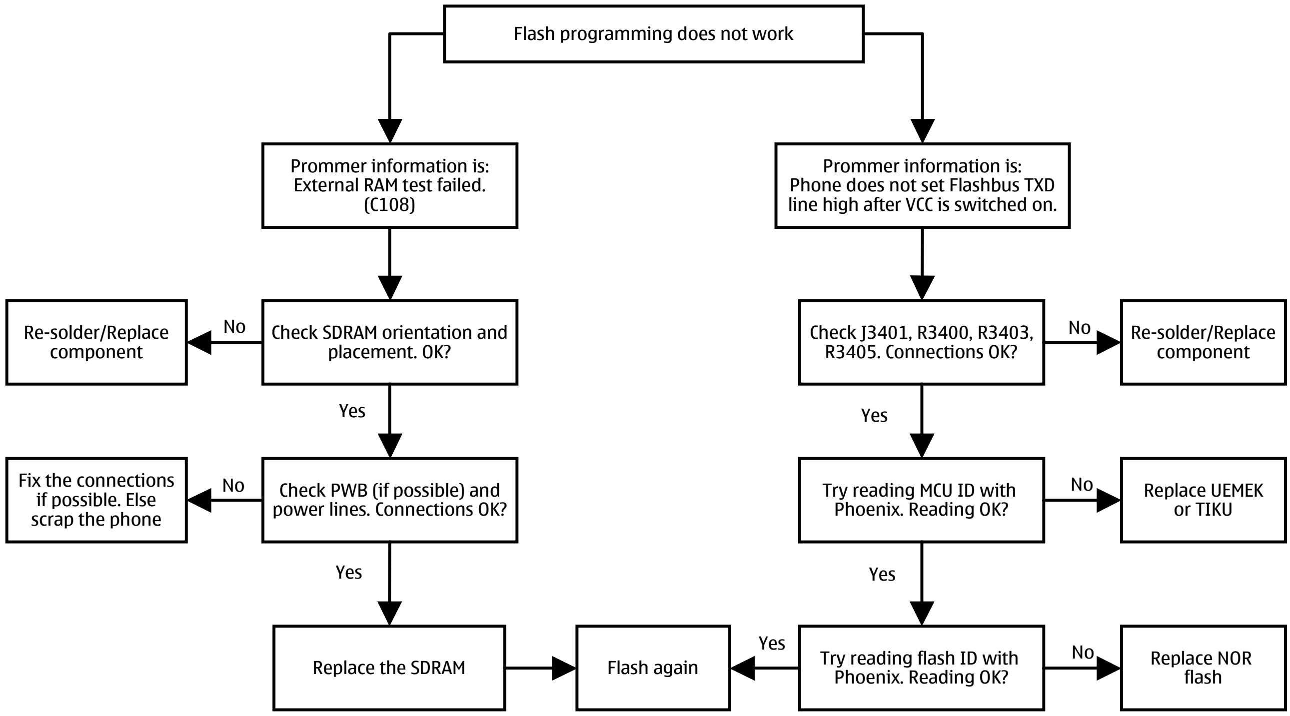
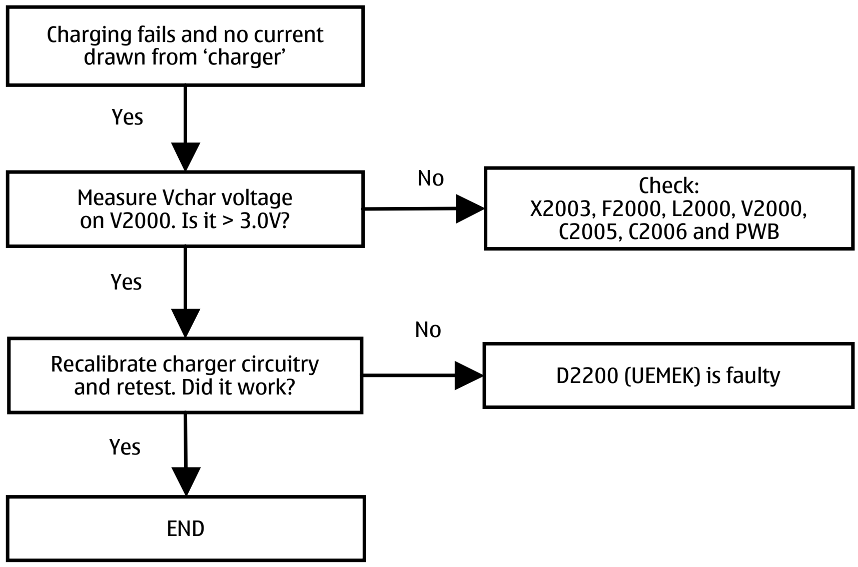
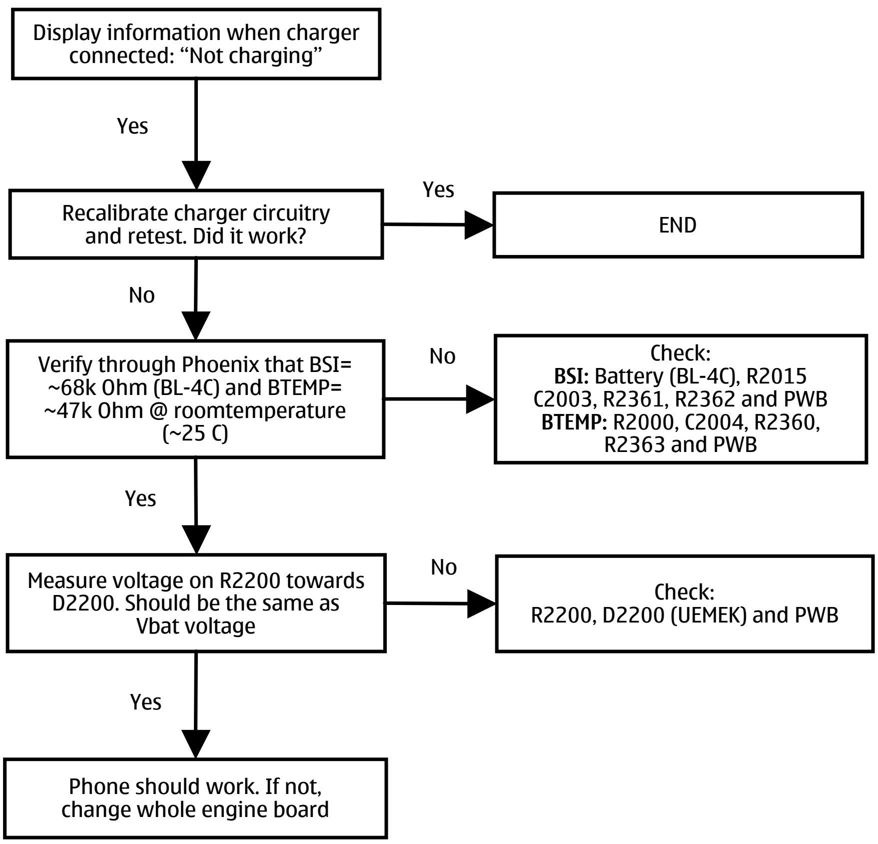


Table 1: Most common error messages

Error	Description	Used signals/components	Points to Check
C101	The Phone does not set Flashbus TXD line high after the startup.	**VBAT, VCORE, VIO, VFLASH1** **BSI and FBUSRX from Prommer to UEMEK** **FBUSTX from TIKU->UEMEK->Prommer (stuck at '0')** **SLEEPX from UEMEK to TIKU**	VBAT at C2228 VCORE at C2222, VIO at C3003 VFLASH1 at R2204 BSI pulse at C2003 when flashing starts FBUSRX at R3403 FBUSTX state at J2812(TIKU)->R3400(UEMEK) SLEEPX at J2801
C102	The Phone does not set Flashbus TXD line low after the line has been high. The Prommer generates this error also when the Phone is not connected to the Prommer.	**PURX, VR3** **RFCLOCK (VCTCX->Helgo->TIKU)** **MBUS From Prommer->UEMEK->TIKU(stuck at '1')** **FBUSTX from TIKU->UEMEK->Prommer(stuck at '1')**	PURX state transition '0' to '1' at J2802 VR3 at C2227 and C7526 RFCLOCK at G7501 and R2901 MBUS pulse train at R3405 FBUSTX state at J2812(TIKU)->R3400(UEMEK)
C103	The Phone MCU has not received the first dummy word correctly from the Prommer after the startup.	**MBUS from Prommer->UEMEK->TIKU(stuck at '0')** FBUSRX from Prommer->UEMEK->TIKU FBUSTX from TIKU->UEMEK->Prommer	MBUS pulse train at R3405 FBUSRX serial data at R3403 FBUSTX state at J2812(TIKU)->R3400(UEMEK)
C107	The Phone MCU can not start Secondary code correctly.	**TIKU**	
A204	The flash manufacturer and device IDs in the existing Algorithm files do not match with the IDs received from the target phone.	**Flash** **Signals between TIKU and Flash**	Prommer SW
A387	The MCU ID in the FIASCO_MCU_ID_INFO block of the MCUSW file does not match with the ID received from the target phone.	TIKU	Prommer SW
C583 C683	The Prommer has not received Phone acknowledge to the message.	Flash and TIKU Signals between TIKU and Flash	
C584 C684	The Phone has generated NAK signal during data block transfer.	Flash and TIKU Signals between TIKU and Flash	
C585 C685	The Phone has not acknowledged data block correctly.	Flash and TIKU Signals between TIKU and Flash	
C586 C686	The erasing status response from the Phone informs about fail.	Flash	

Charging Failure



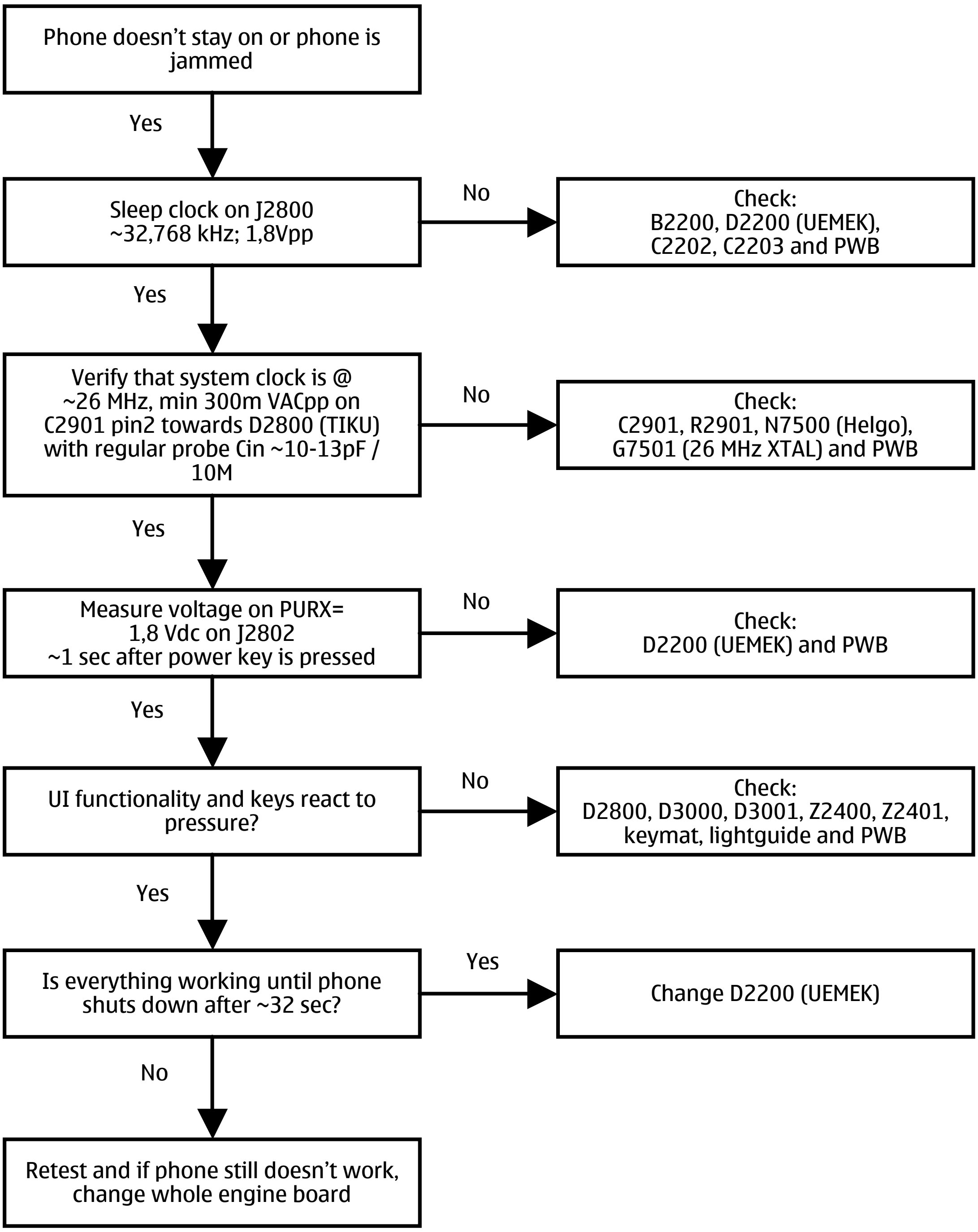


Phone doesn’t stay on, or phone is jammed

If this kind of a failure is presenting itself immediately after FLALI, it is most likely caused by ASICs missing contact with PWB.

If the MCU doesn’t service the watchdog register within the UEMEK, the operations watchdog will run out after approximately 32 seconds. It is not possible to measure this service routine.

Figure 3: Phone doesn’t stay on, or is jammed



Display Information: “Contact Service”

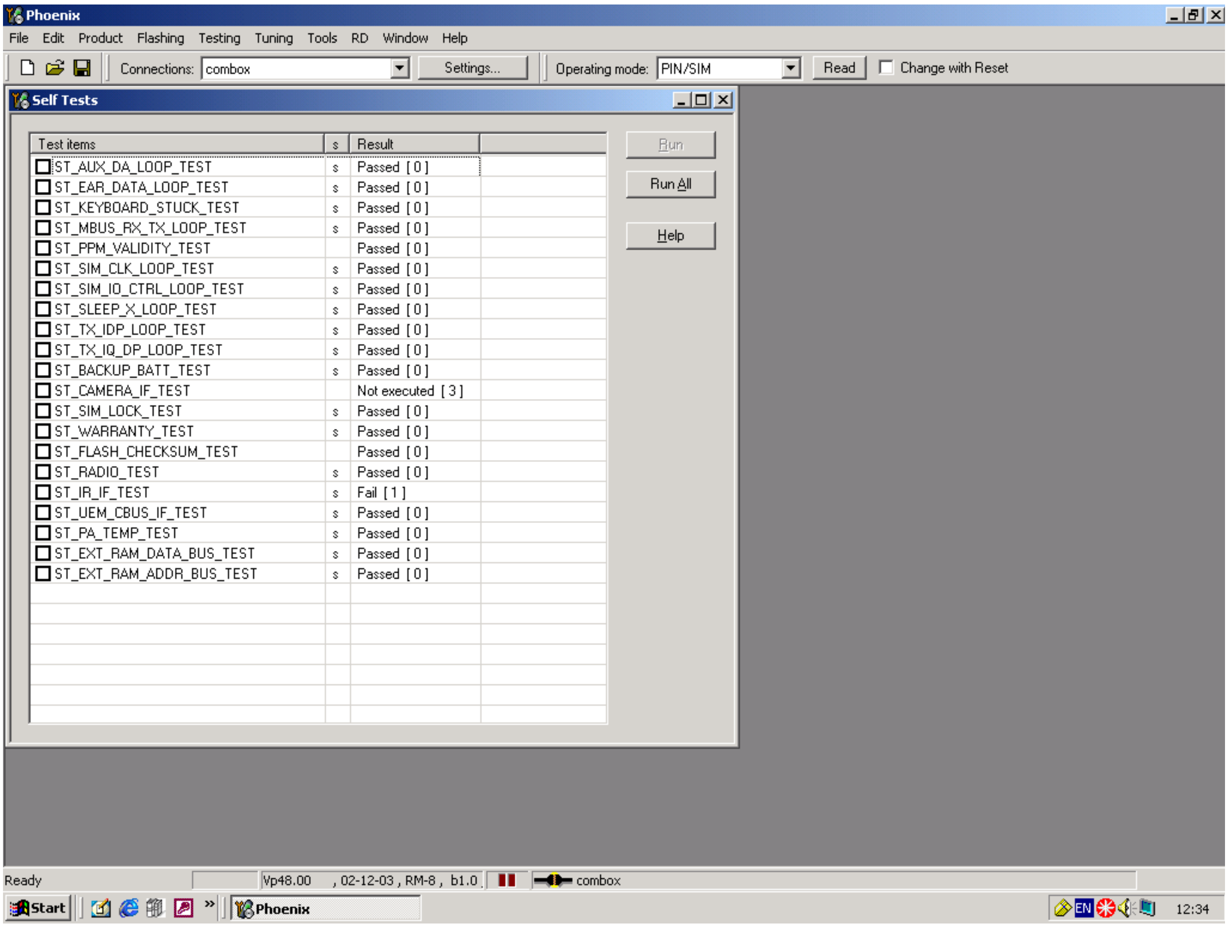
When this error appears in the display it means that one or more of the internal baseband tests has failed. The baseband tests (self tests) are performed each time the phone is powered on. The self tests are divided into those performed while powering up (Start up tests) and the ones that can be executed with a PC using Phoenix (Runtime tests). The following Start-up tests are performed during power up:

AUX DA LOOP TEST
EAR DATA LOOP TEST
KEYBOARD STUCK TEST
MBUS RX TX LOOP TEST
PPM VALIDITY TEST
SIM CLK LOOP TEST
SIM IO CTRL LOOP TEST
SLEEP X LOOP TEST
TX IDP LOOP TEST
TX IQ DP LOOP TEST
BACKUP BATT TEST
CAMERA IF TEST
SIM LOCK TEST
WARRANTY TEST
FLASH CHECKSUM TEST
RADIO TEST
IR IF_TEST
UEM CBUS IF TEST
PA TEMP TEST
EXT RAM DATA BUS TEST
EXT RAM ADDR BUS TEST

If all these self tests are passed, the phone will start up.

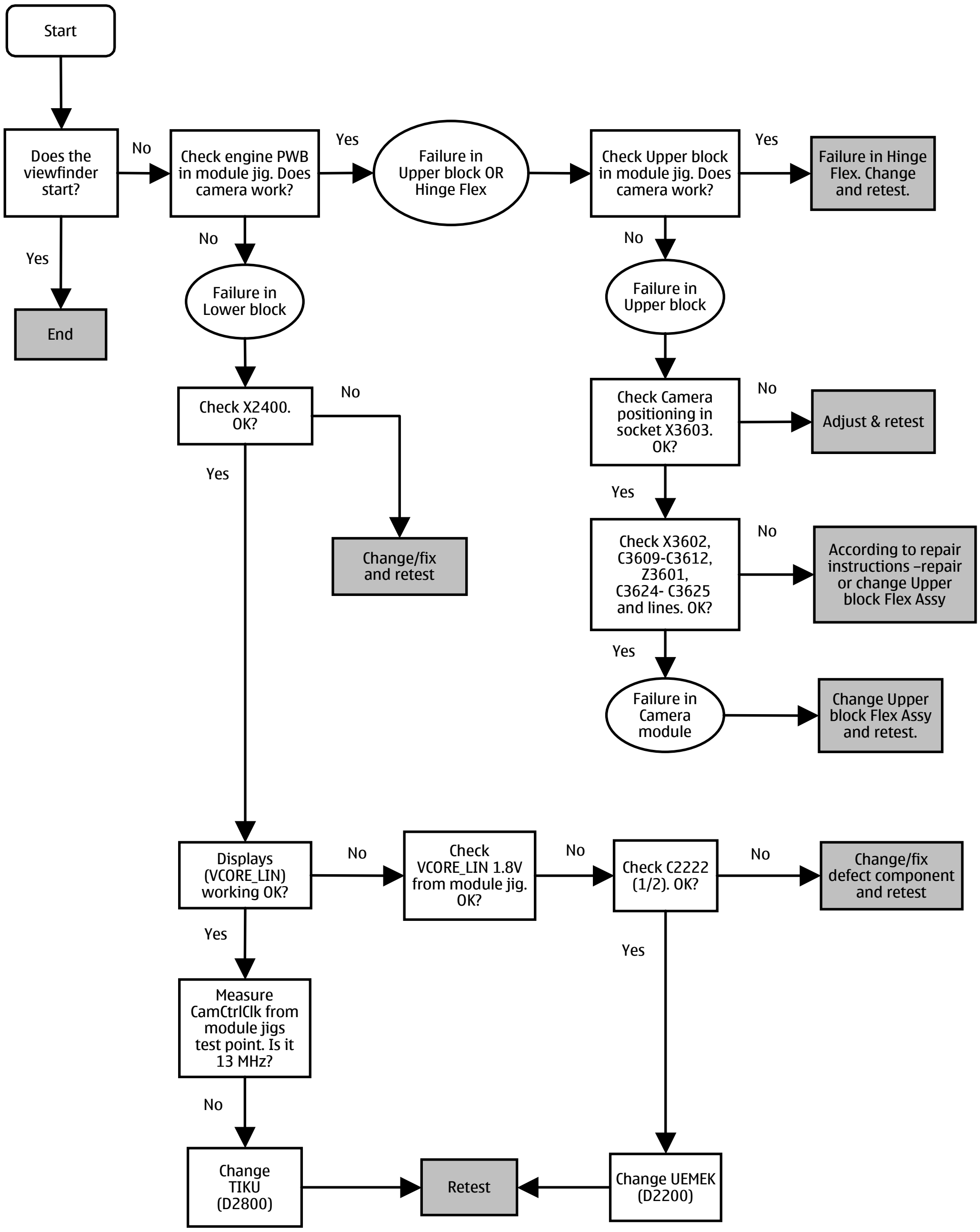
From Phoenix it’s possible to run all the self tests and the additional “Runtime test”. The test cases can be seen below.

Figure 4:Display Information: “Contact Service”

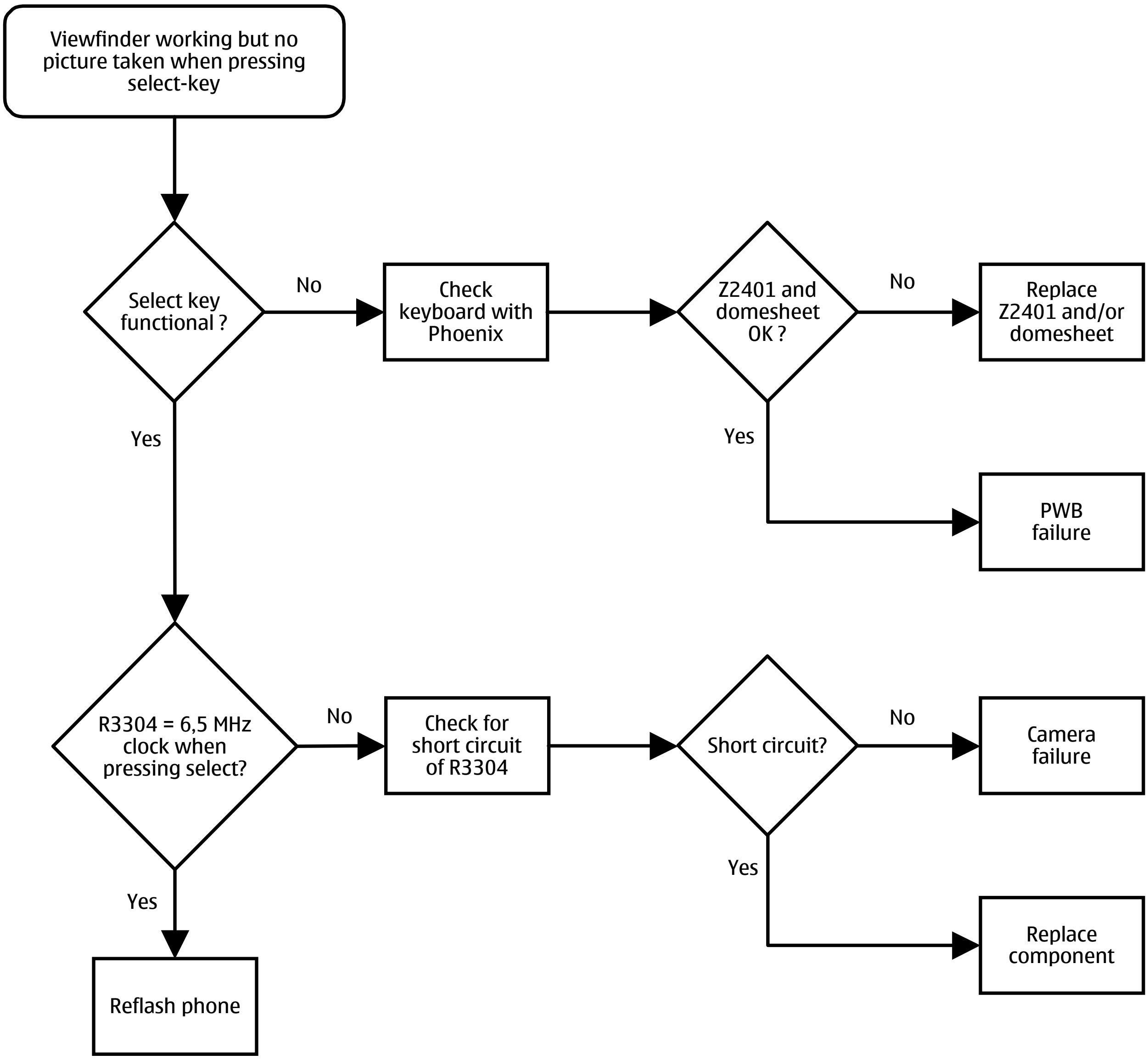


Function Failures

Camera Failure



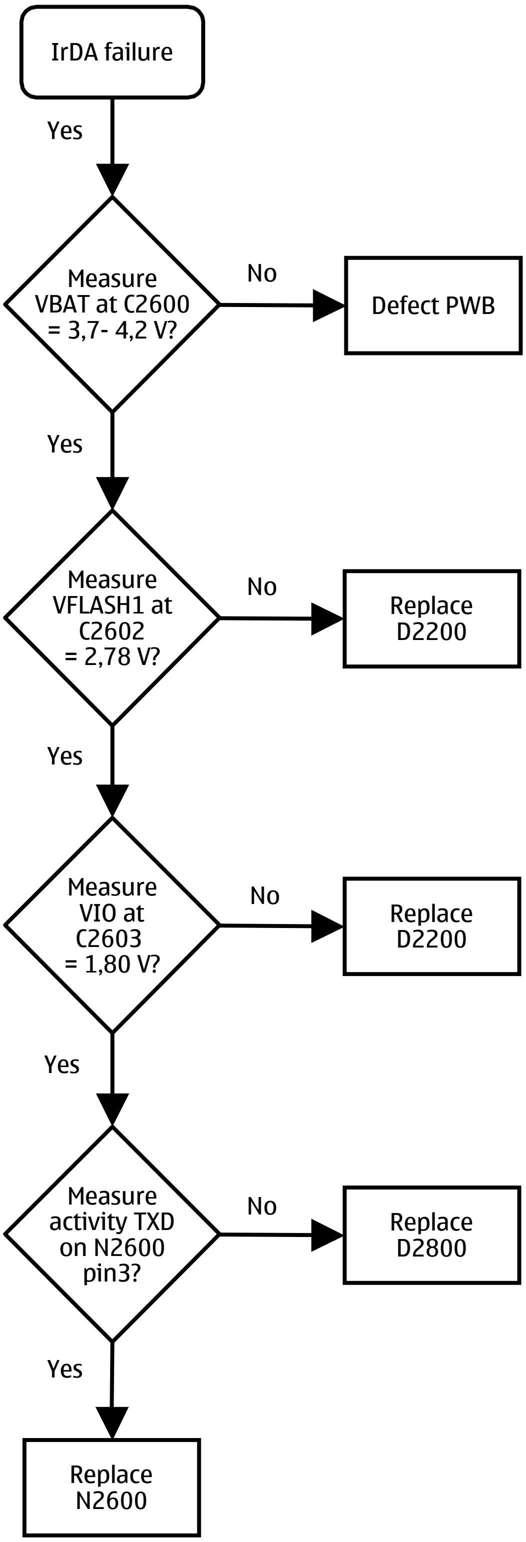
Camera viewfinder failure



FM-radio Failure

The FM-radio troubleshooting guide is in the RF section.

Infrared Communication Failure

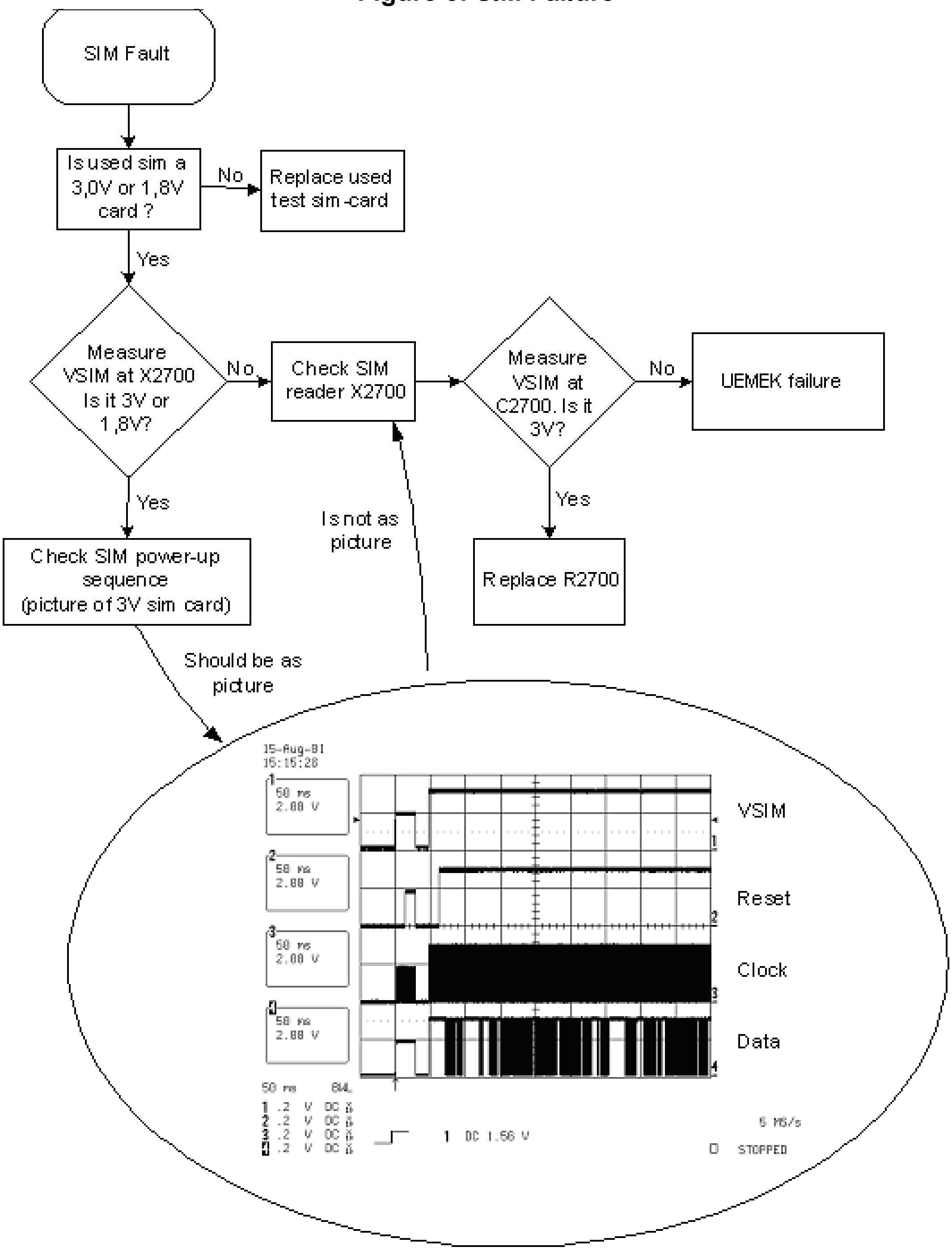


SIM Failure

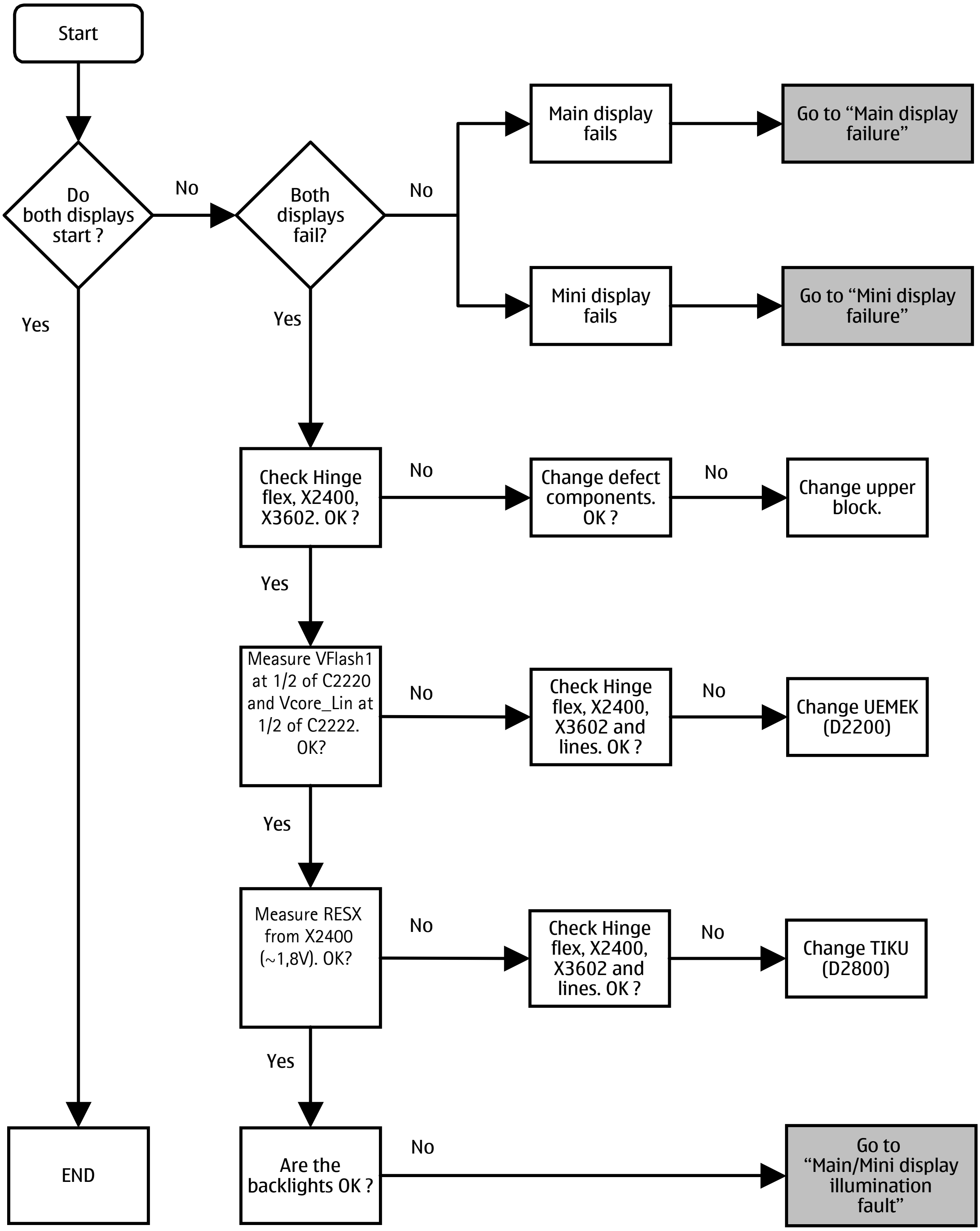
The hardware of the SIM interface from the UEMEK (D2200) to the SIM connector (X2700) can be tested without a SIM card. When the power is switched on, the phone first checks for a 1,8V SIM card and then a 3V SIM card. The phone will try this four times, whereafter it will display "Insert SIM card".

The error ”SIM card rejected” means that the ATR message received from the SIM card is corrupted, e.g. data signal levels are wrong. The first data is always ATR and it is sent from card to phone.

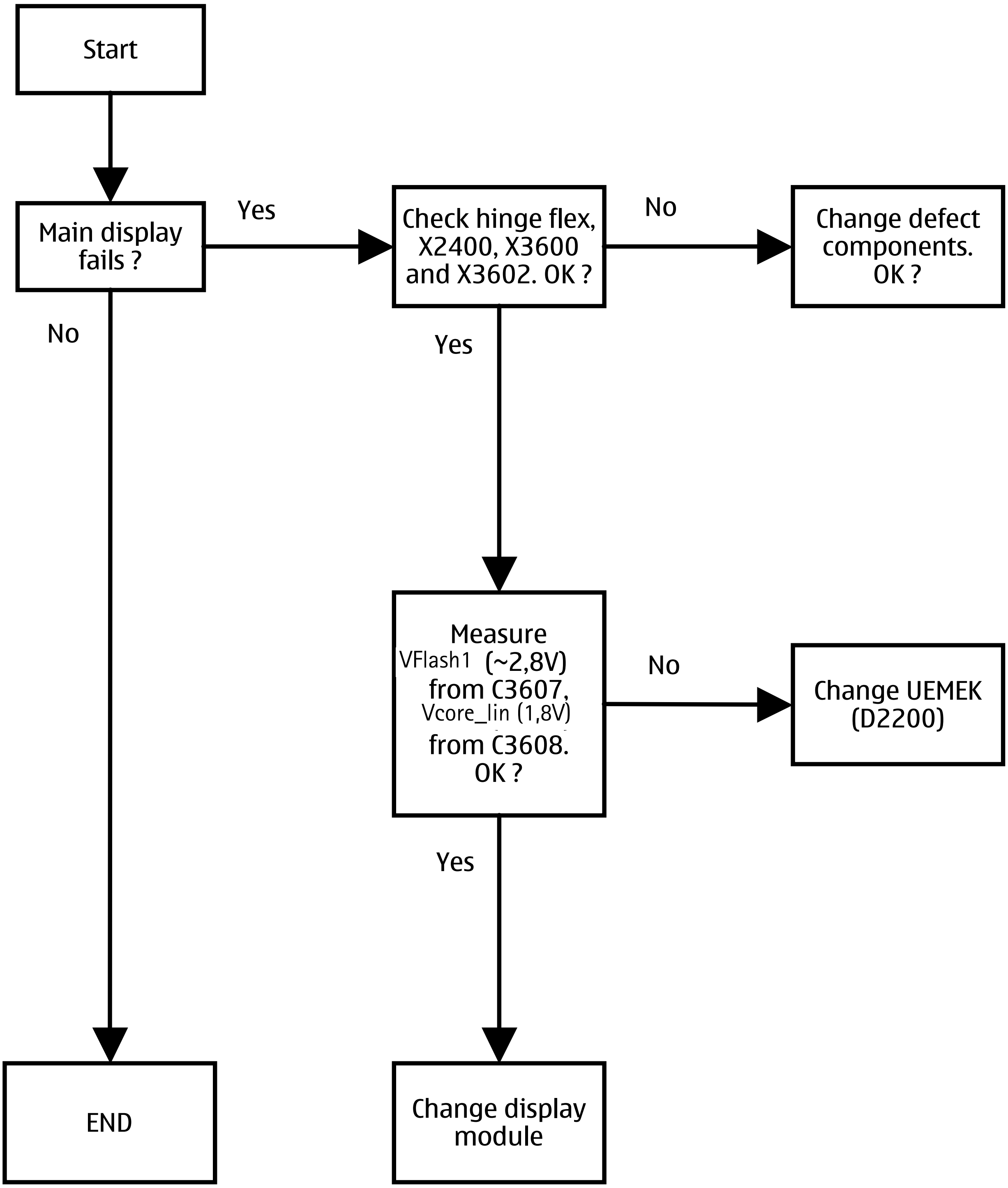
Figure 5: SIM Failure



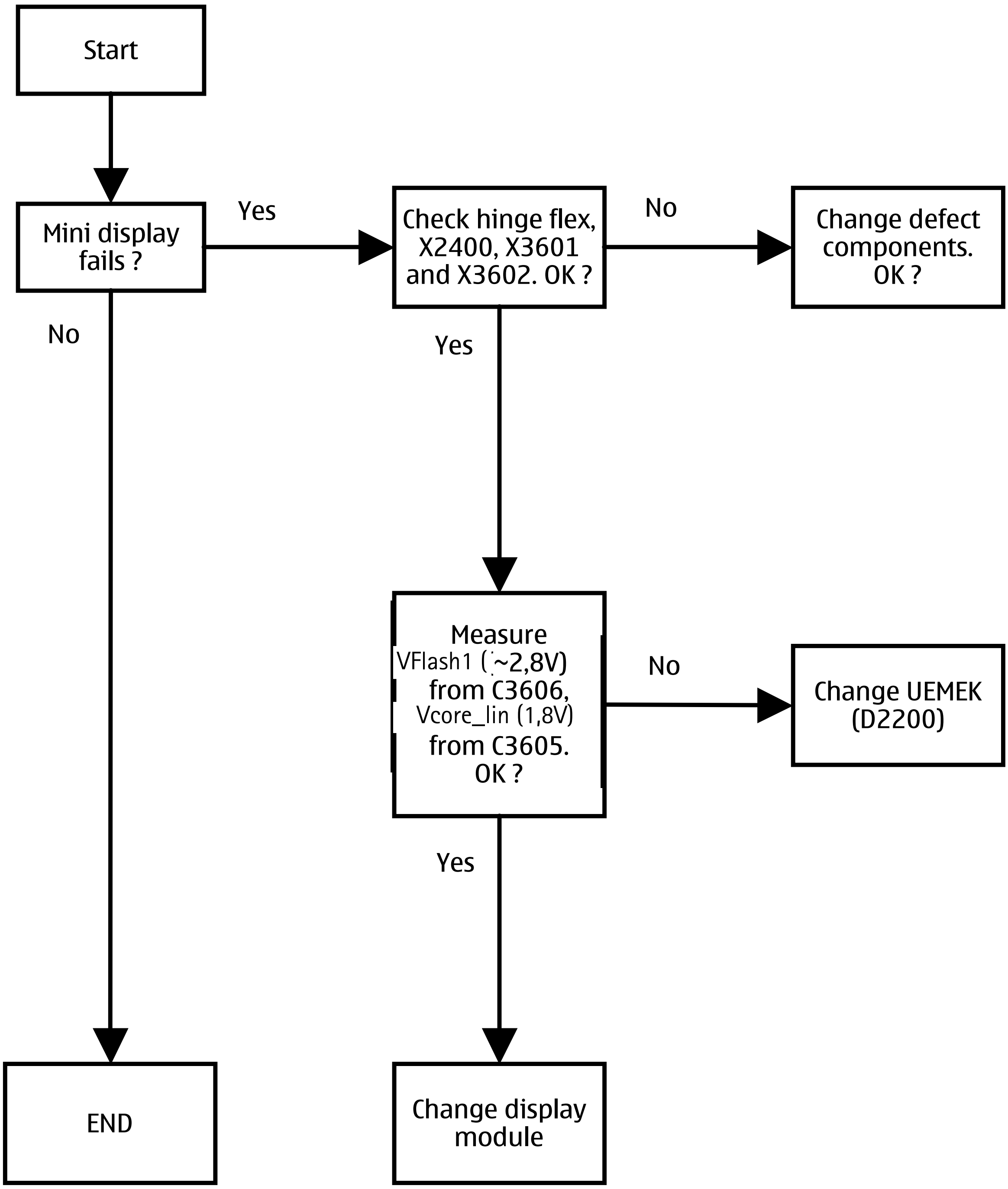
Display Failure



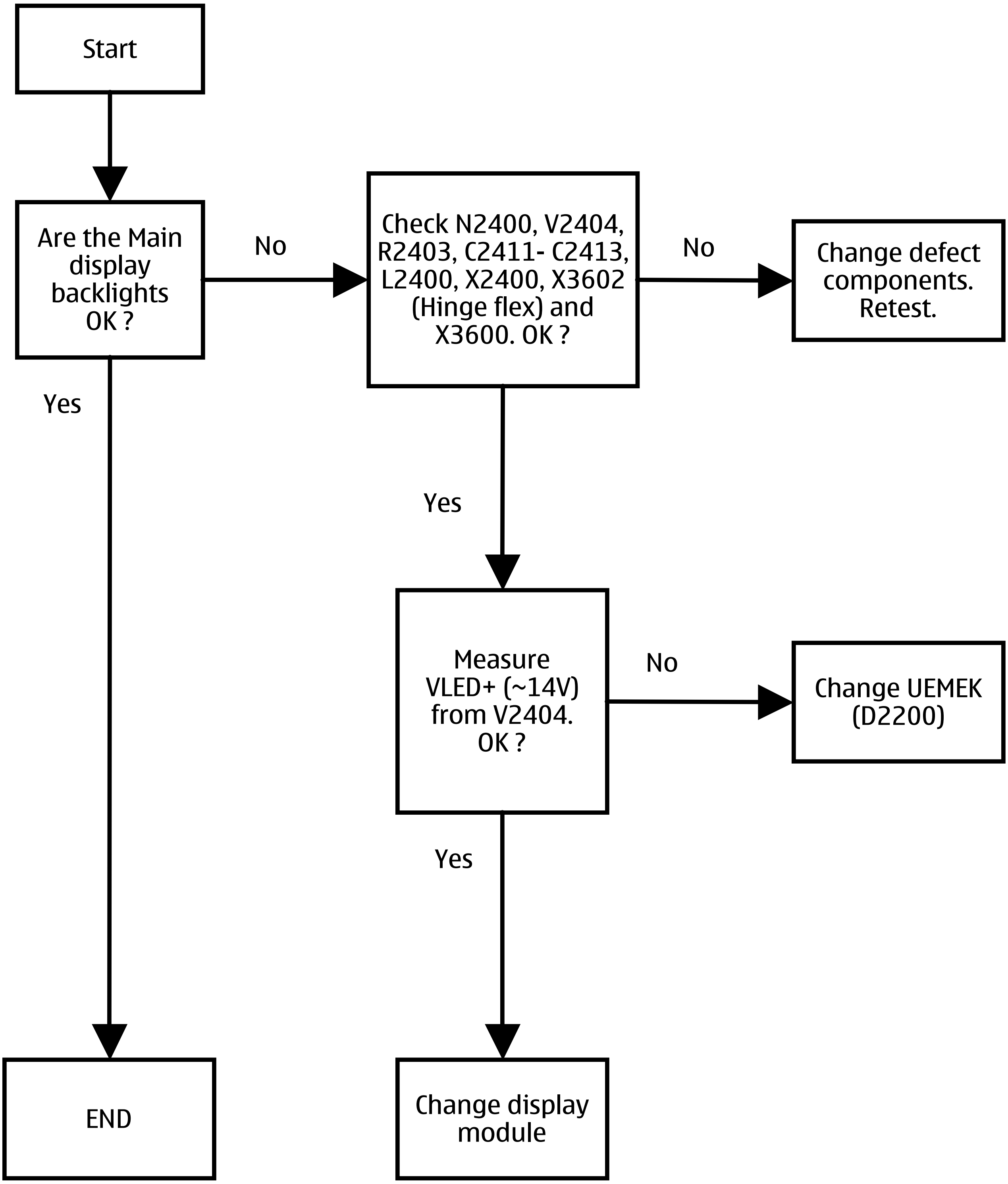
Main display failure



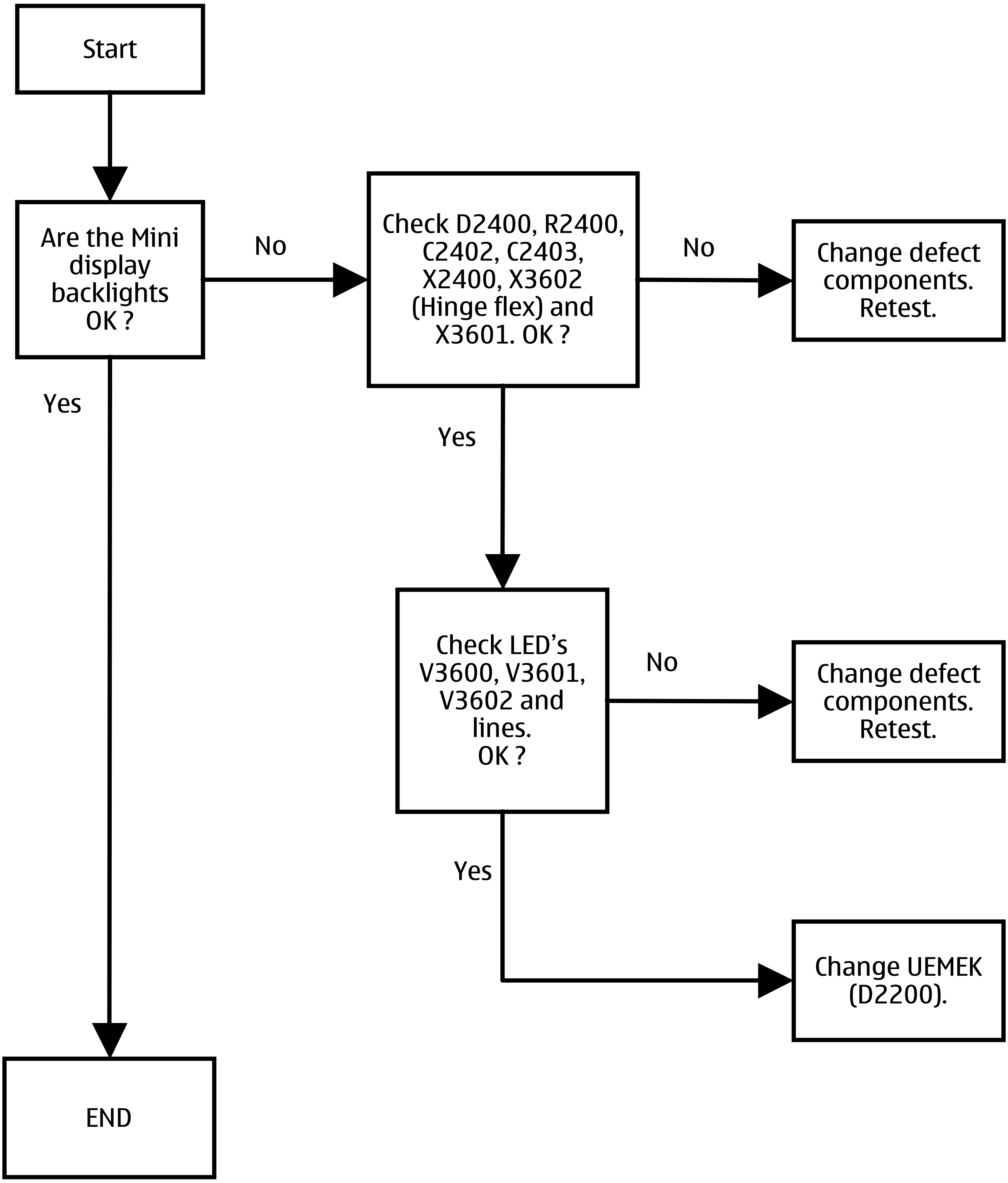
Mini display failure



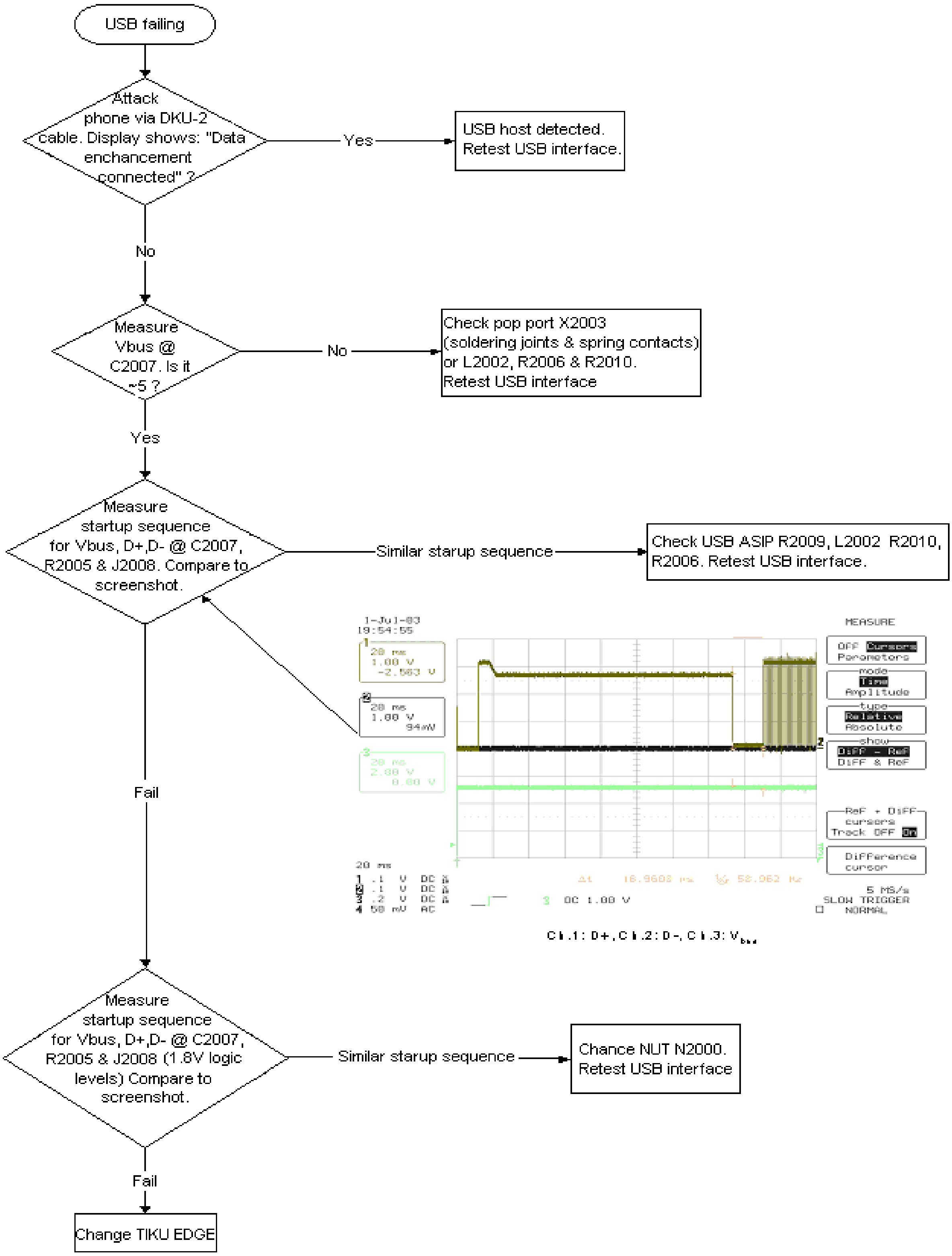
Main display illumination fault



Mini display illumination fault

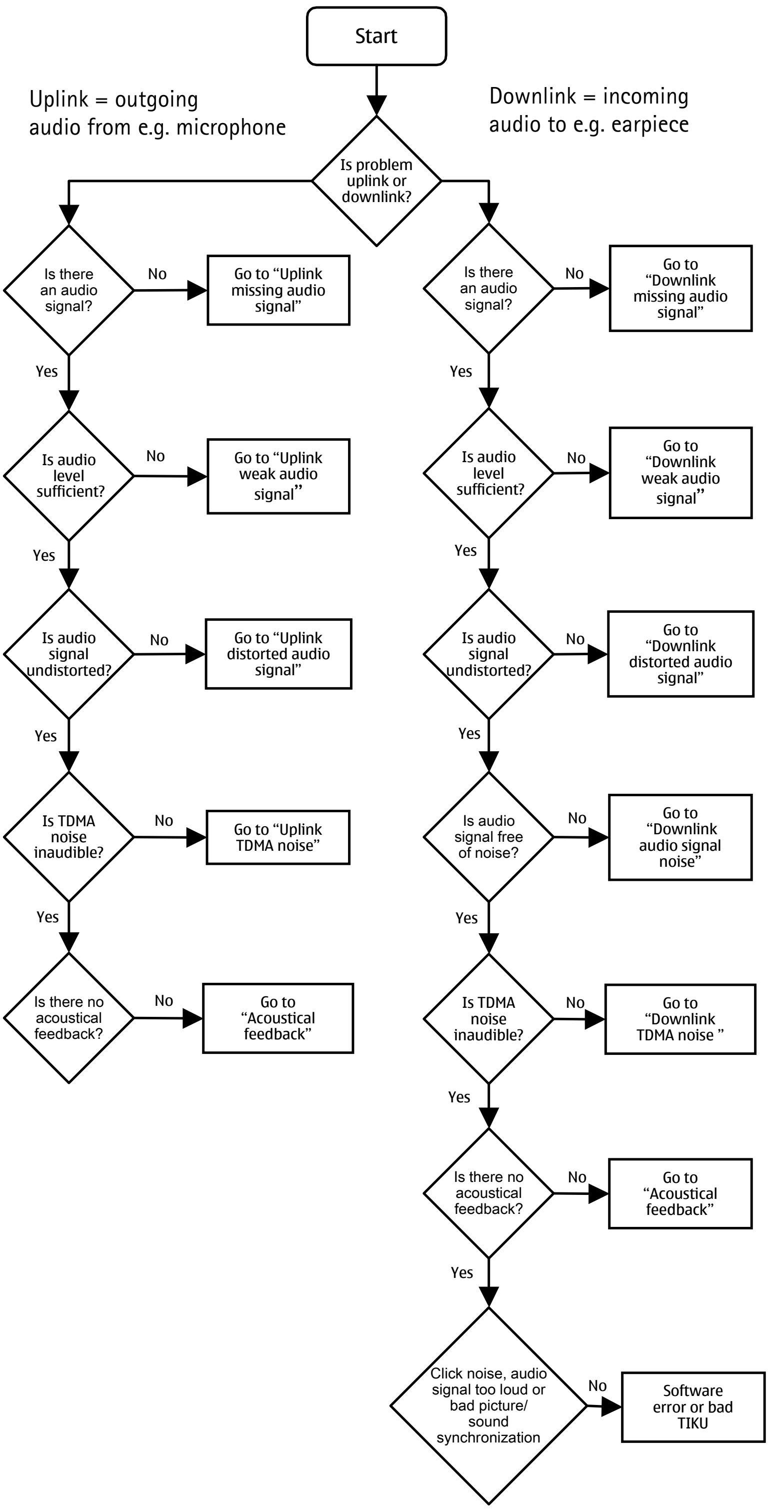


USB Data Transmission Failure



Audio Failure

Uplink or downlink failure



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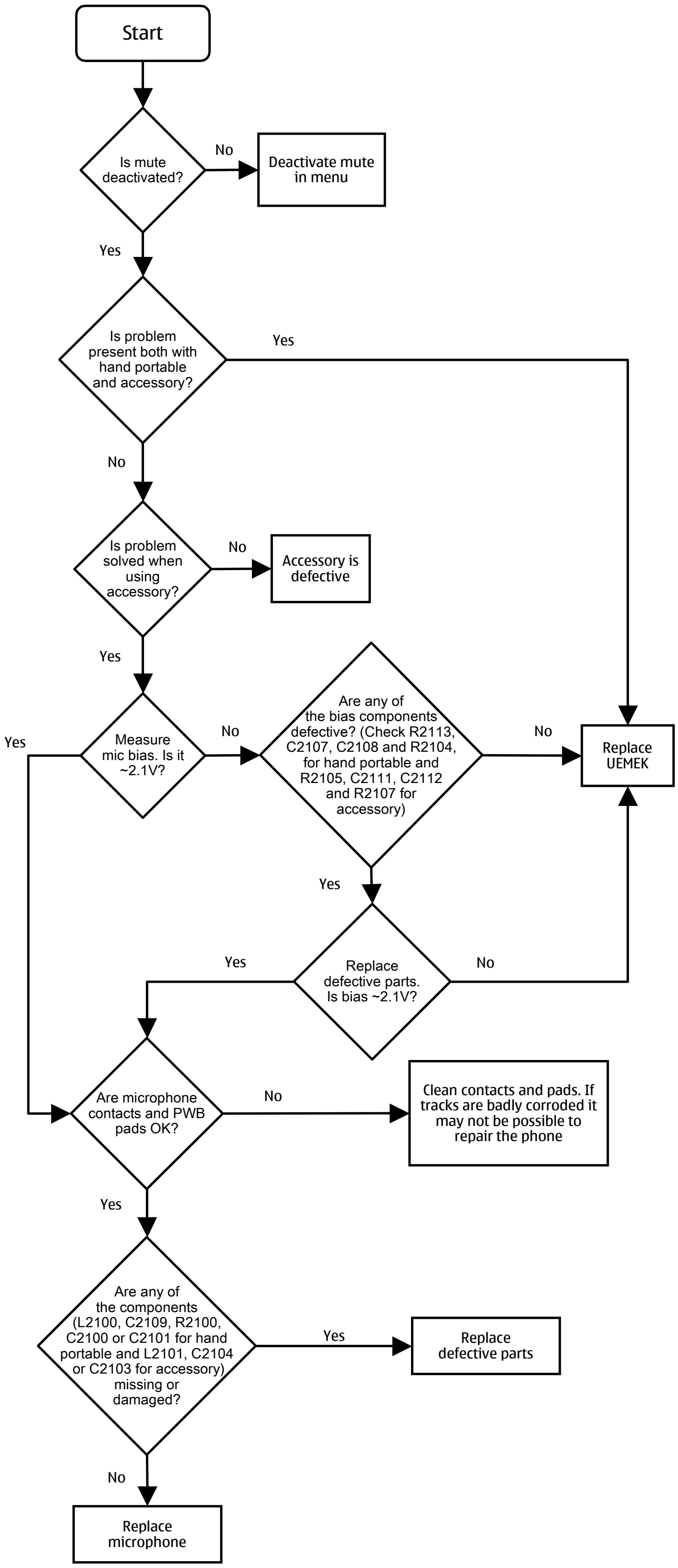
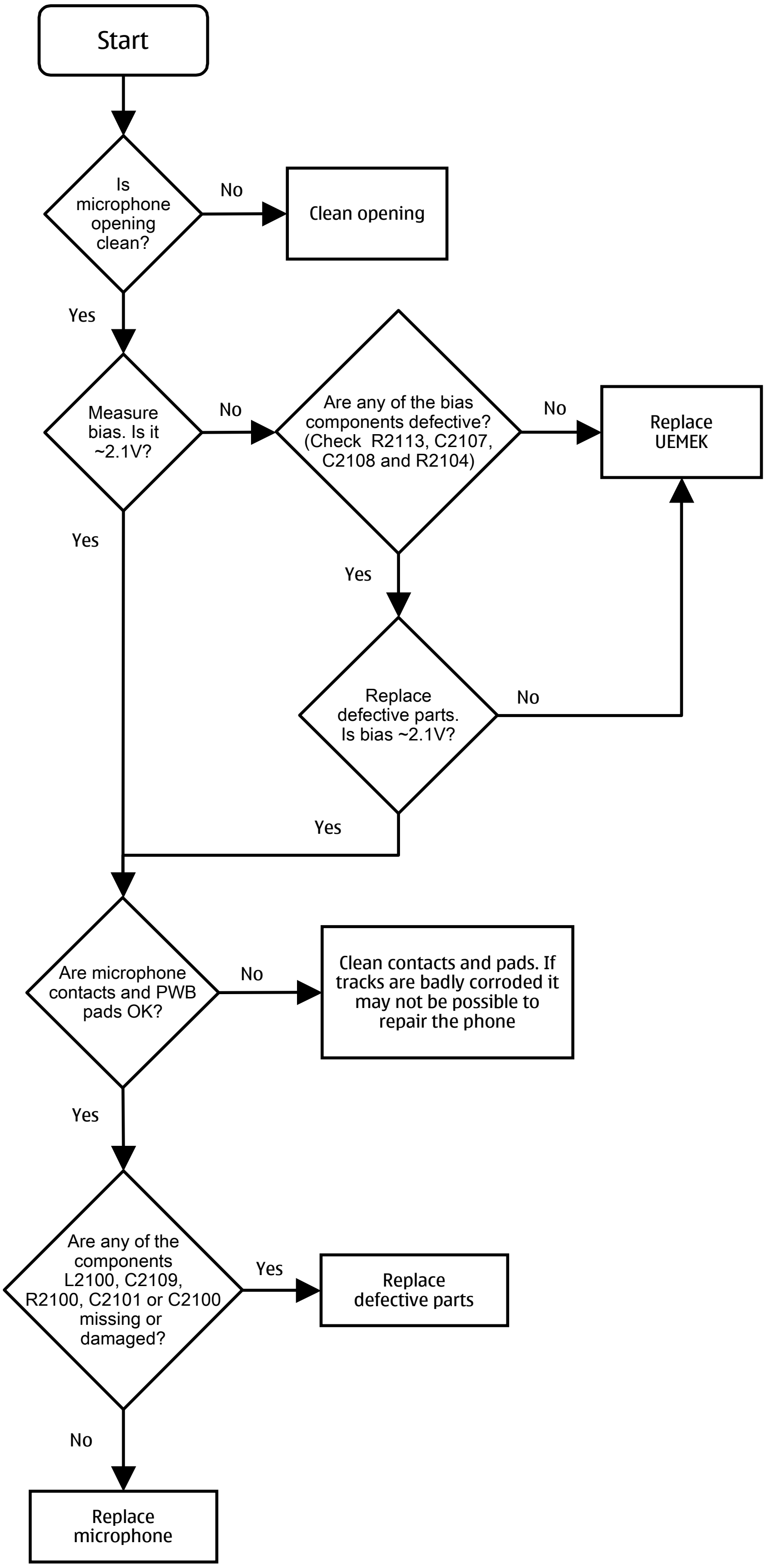
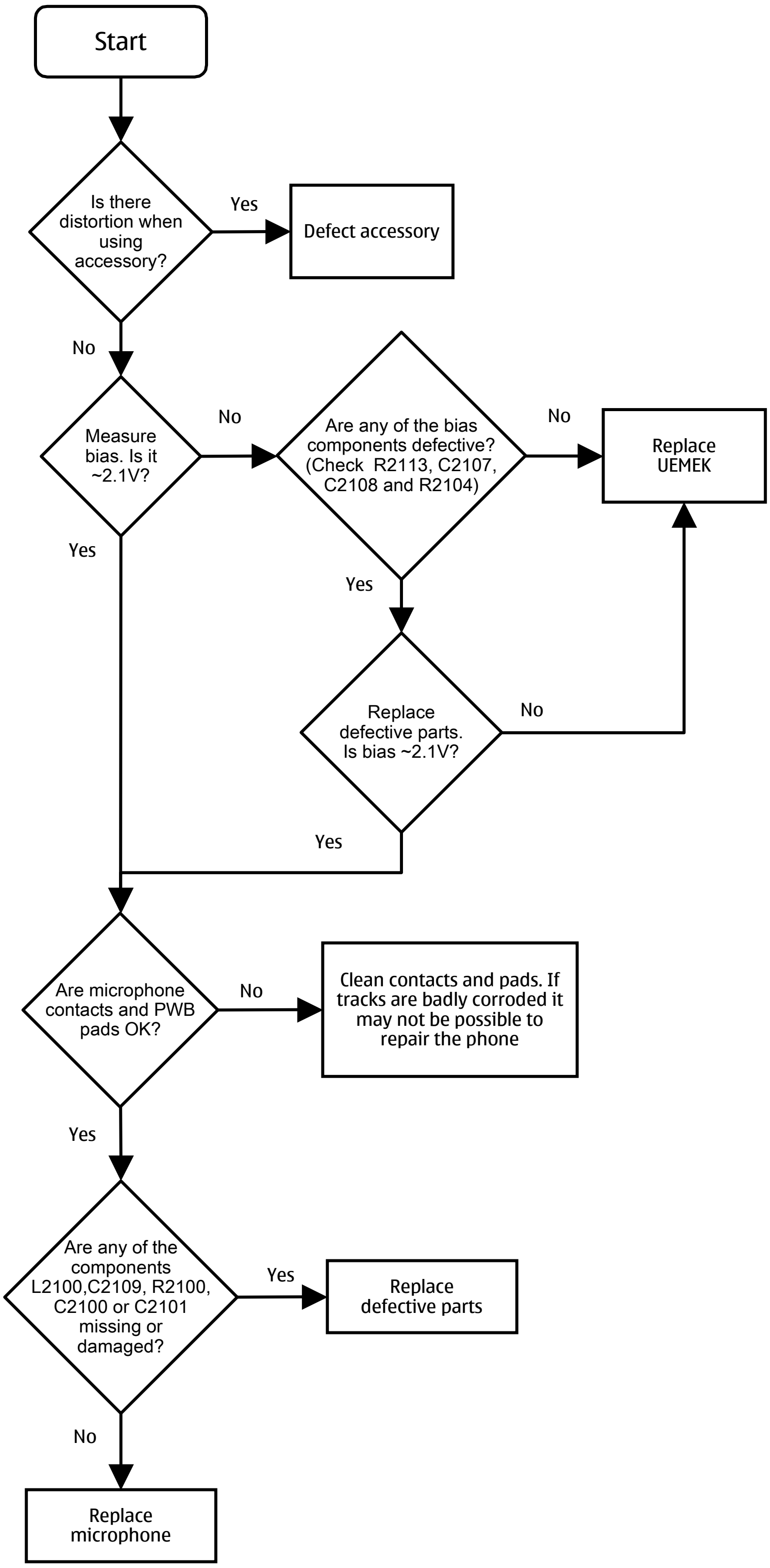
Uplink missing audio signal



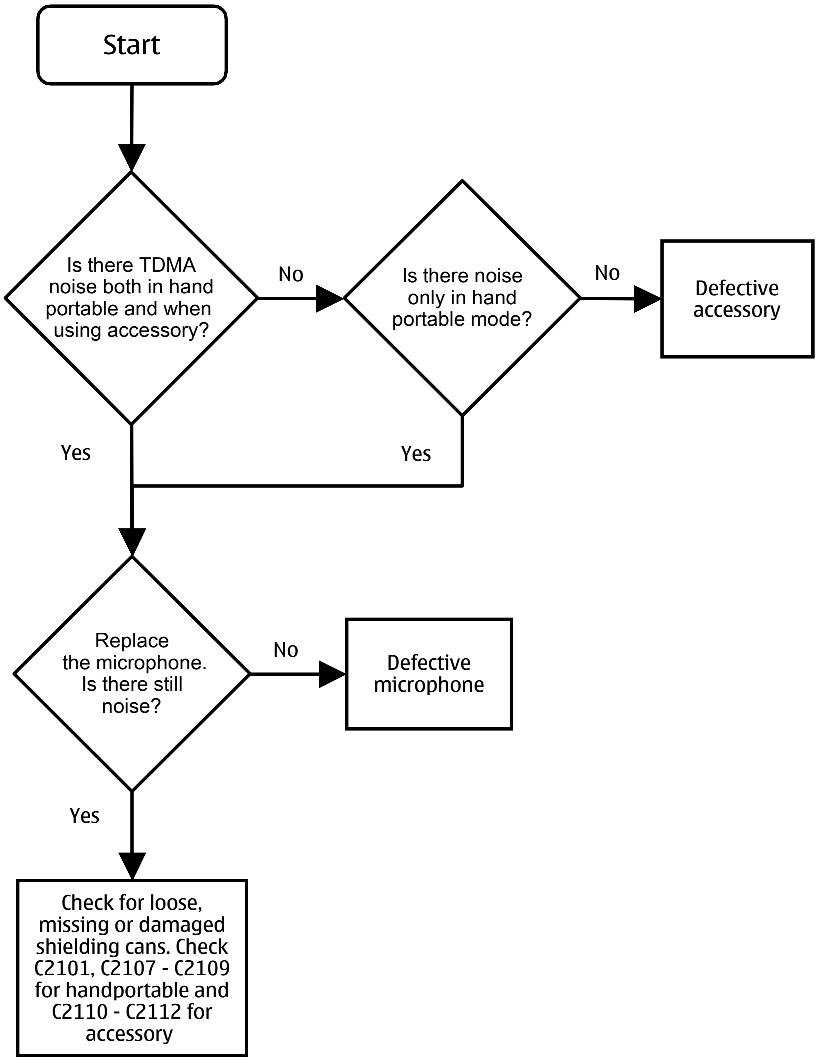
Uplink weak audio signal



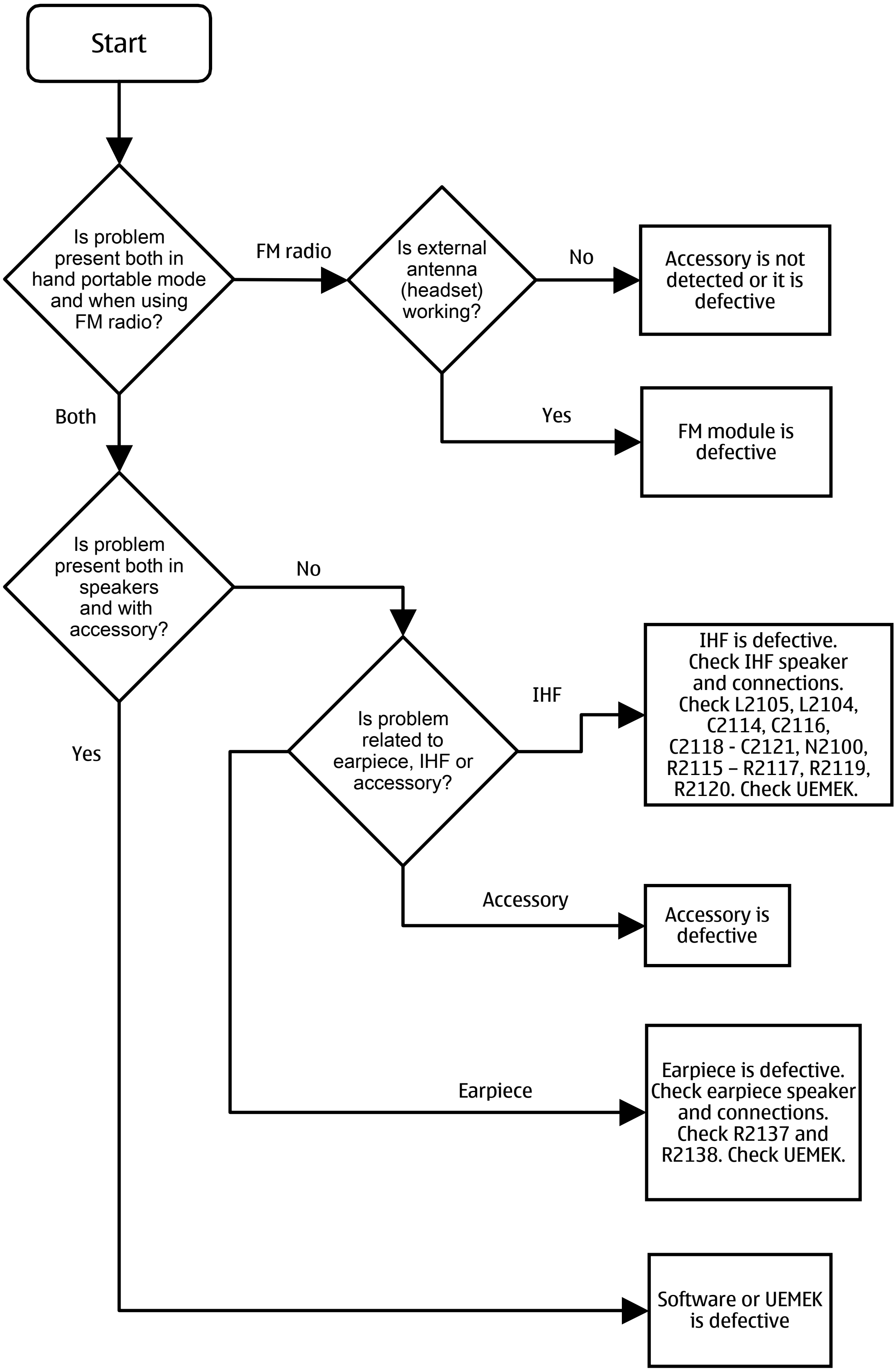
Uplink distorted audio signal



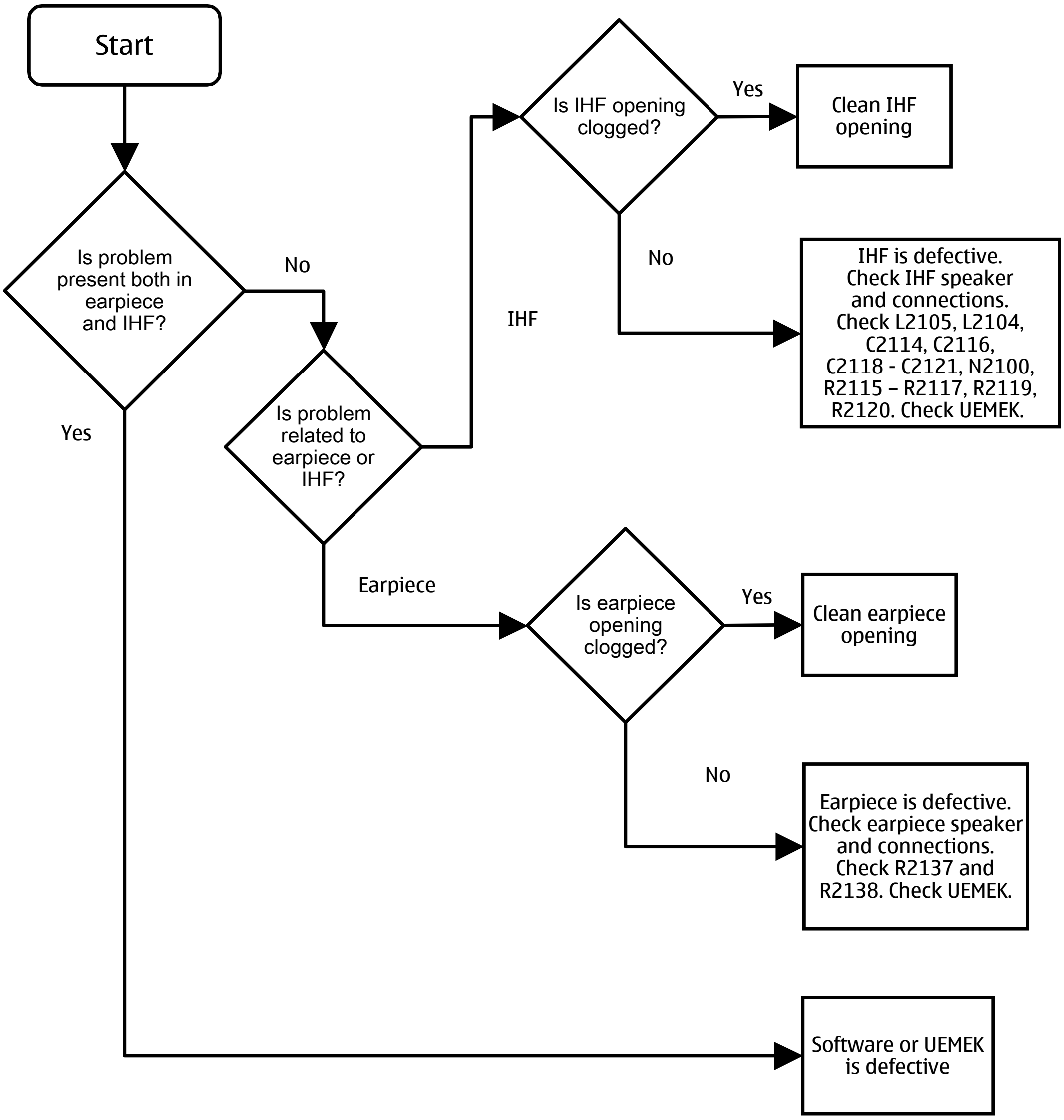
Uplink TDMA noise



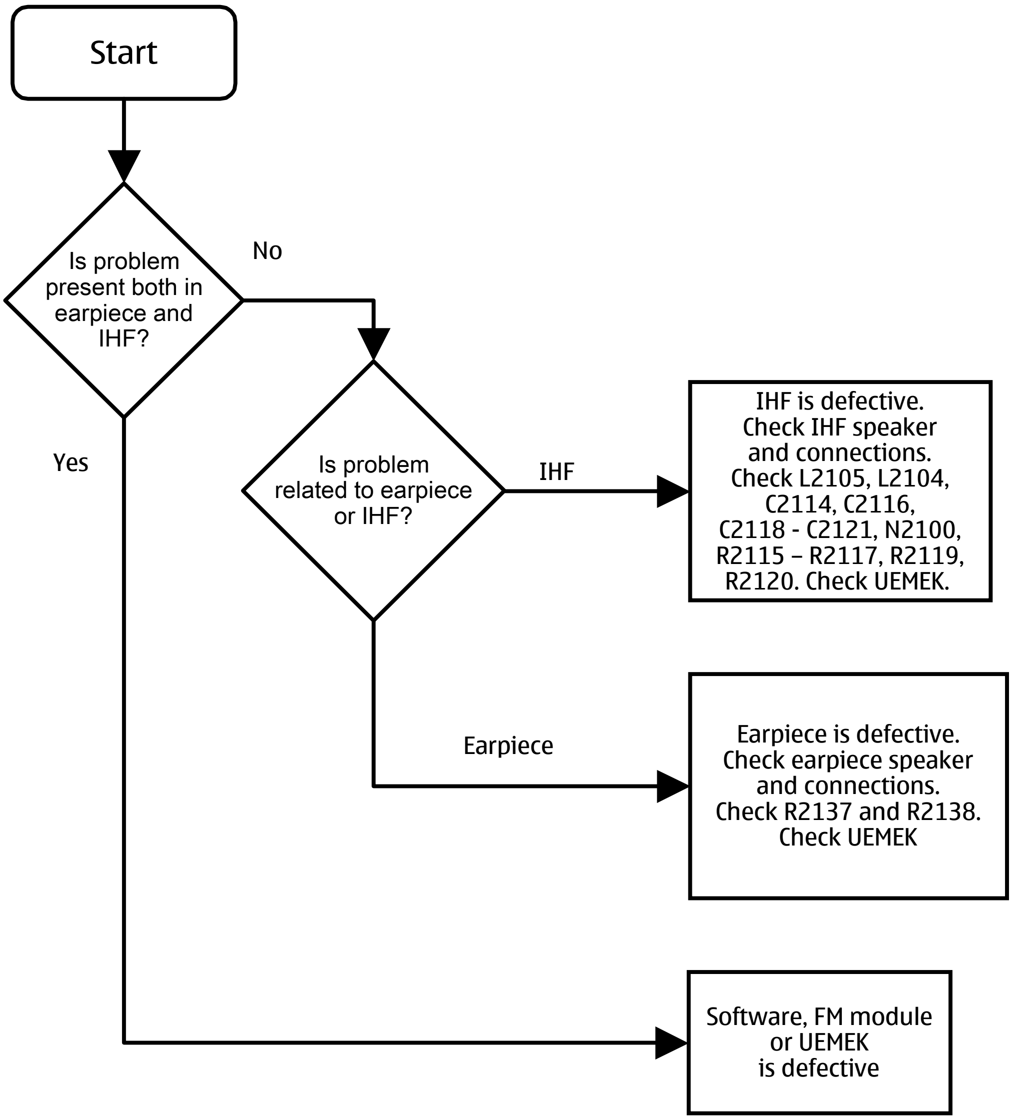
Downlink missing audio signal



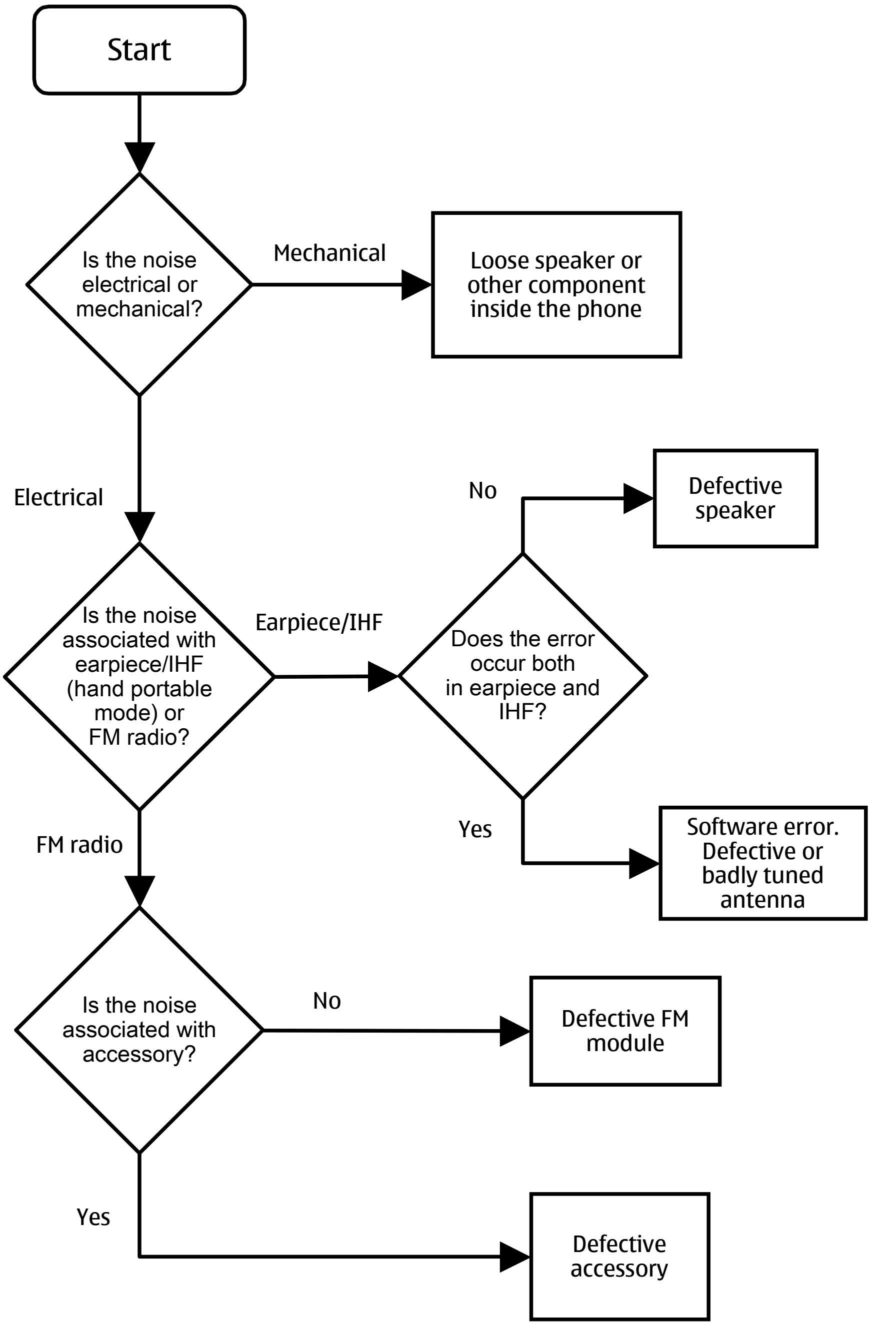
Downlink weak audio signal



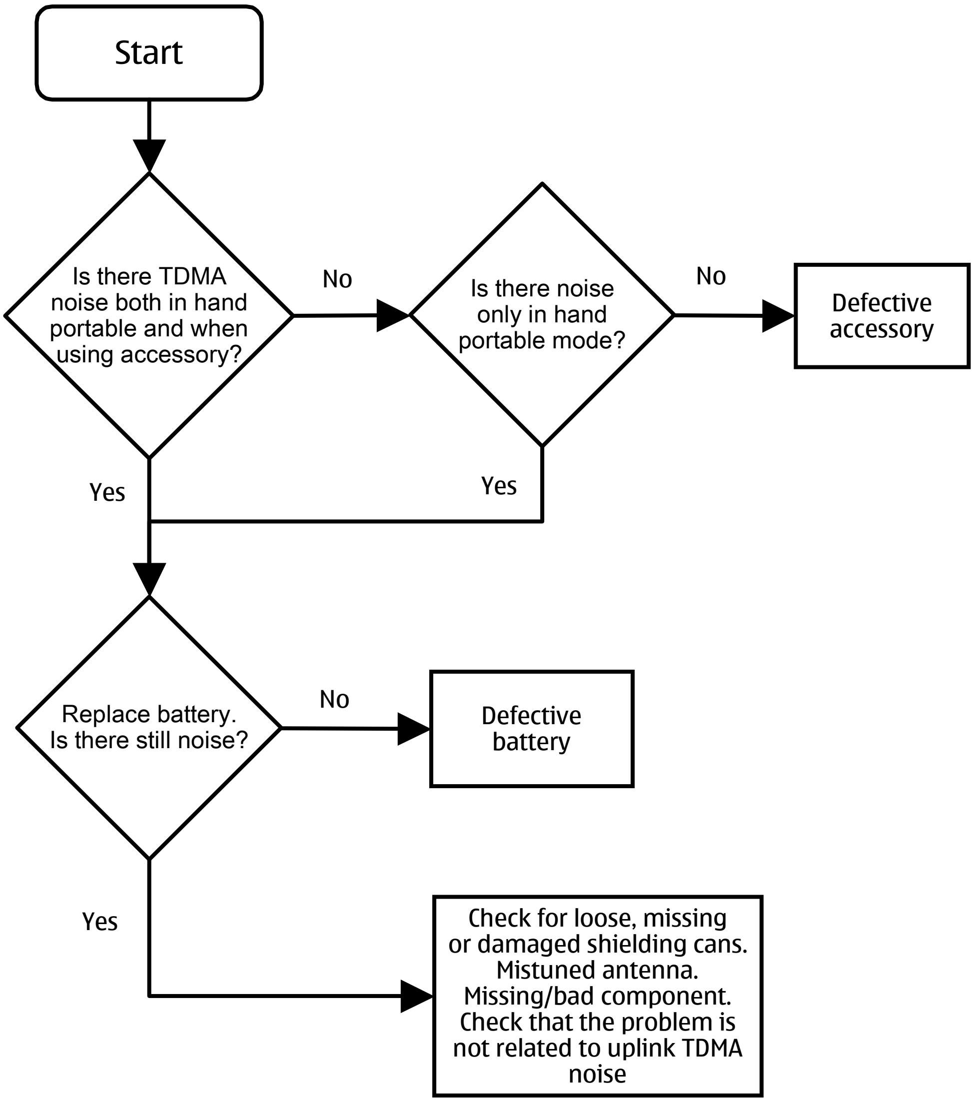
Downlink distorted audio signal



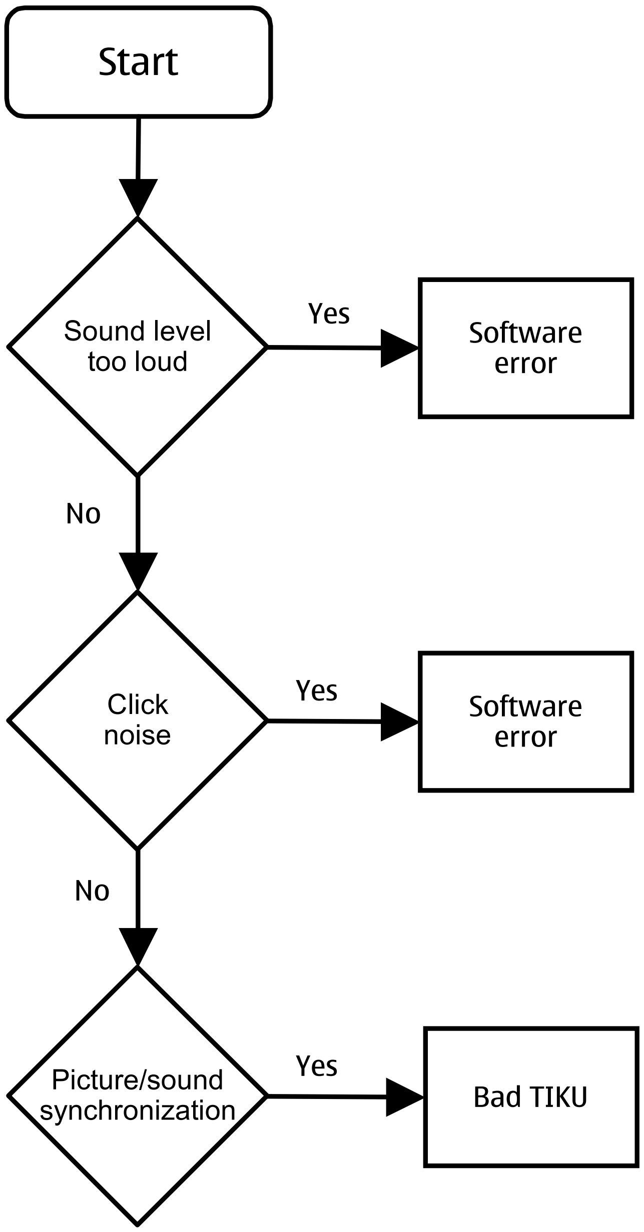
Downlink noise in audio signal



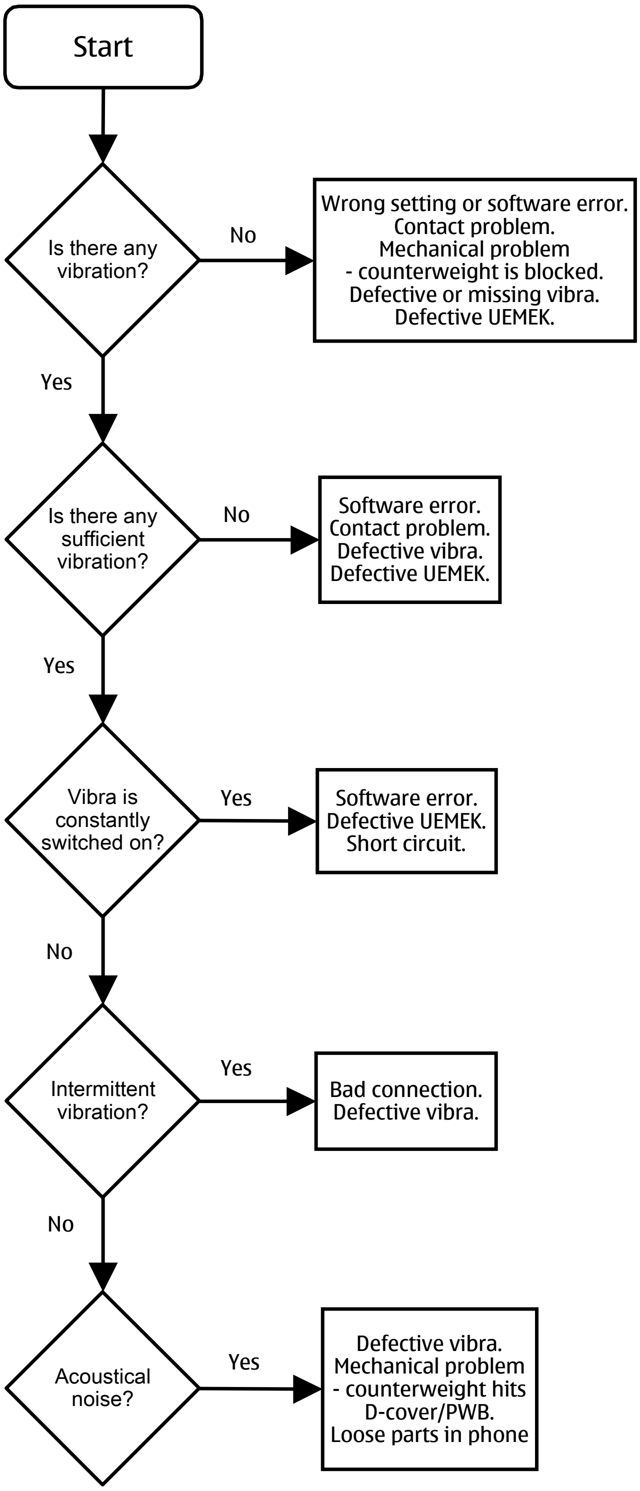
Downlink TDMA noise



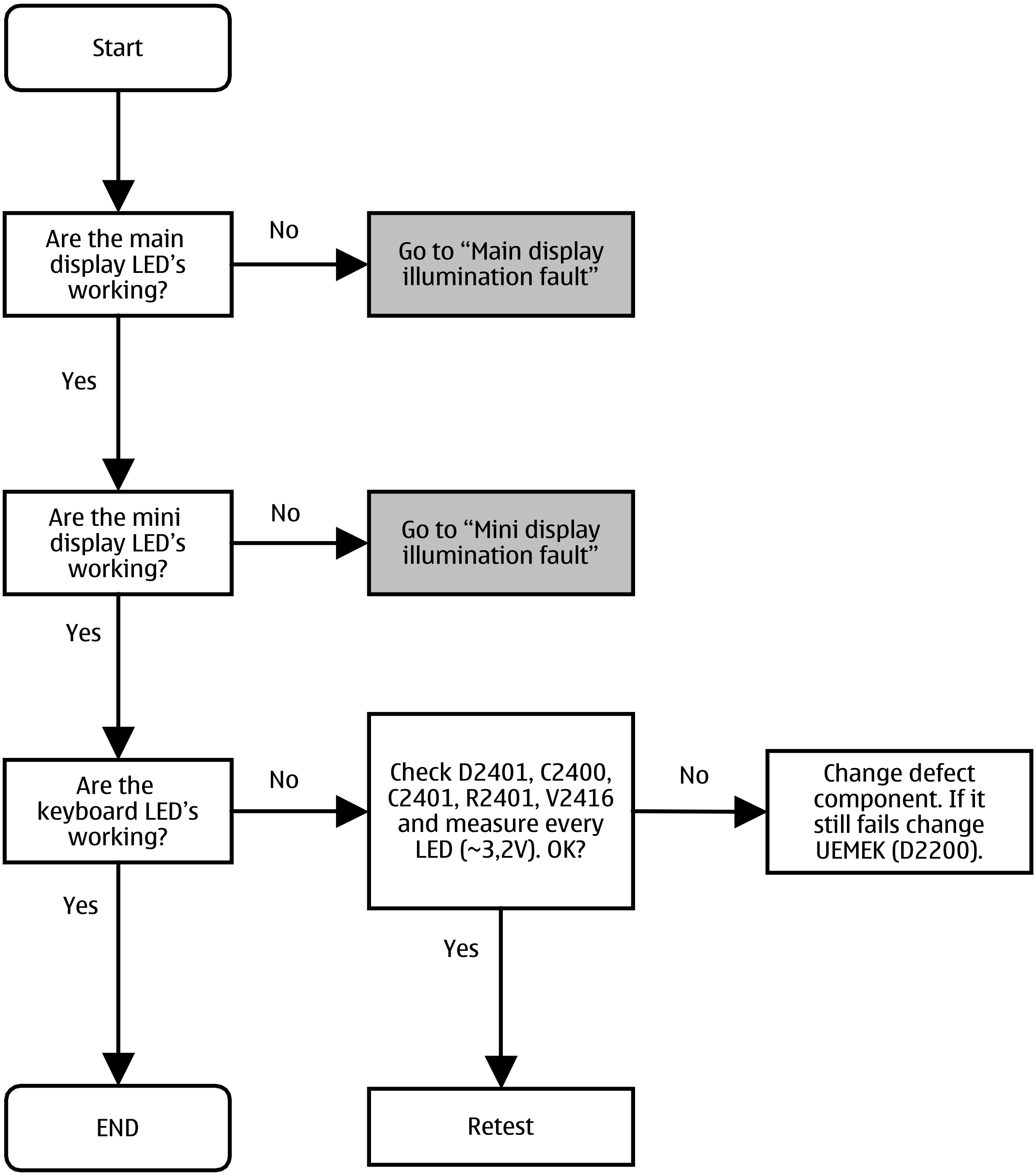
Various noise problems



Vibra errors

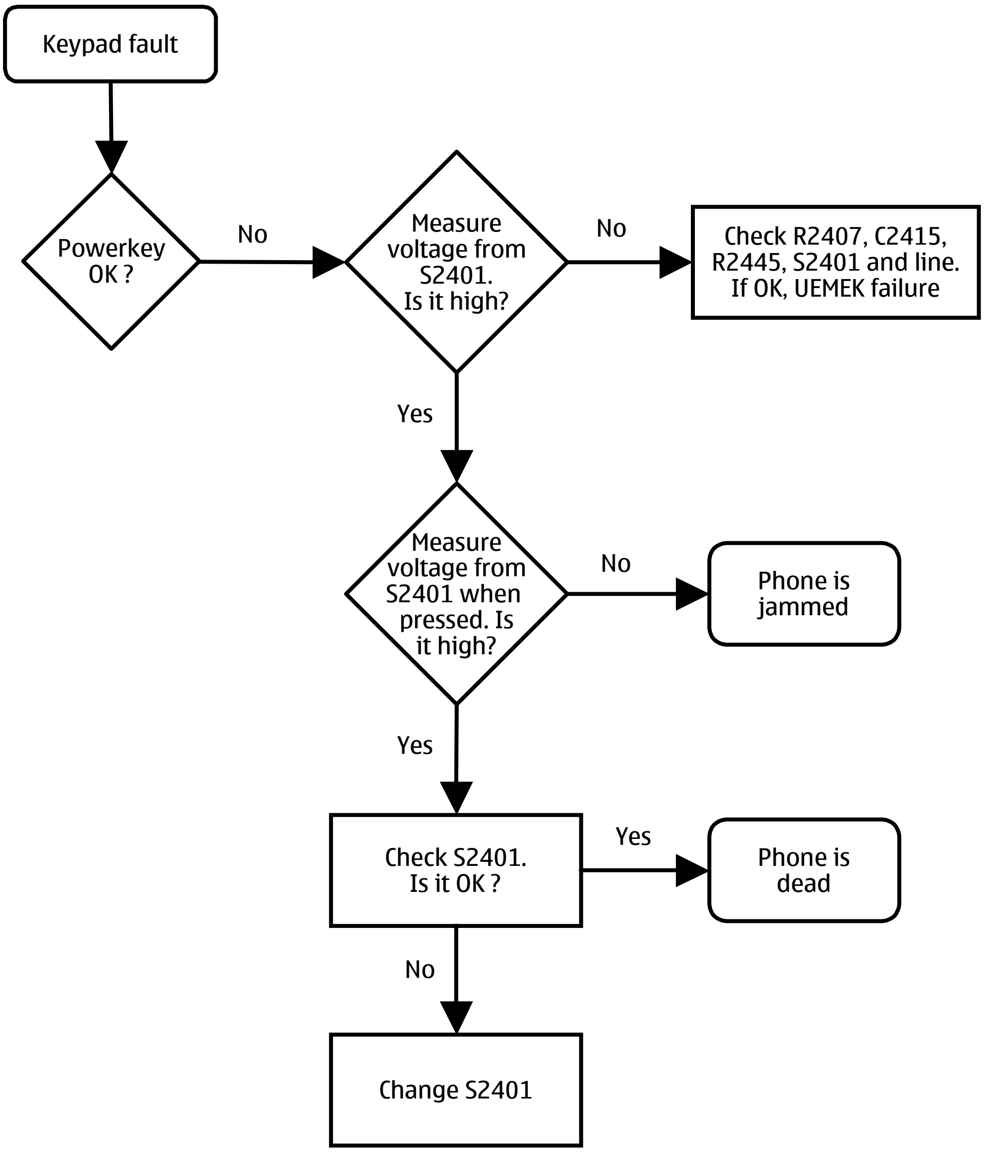


BackLight Failure

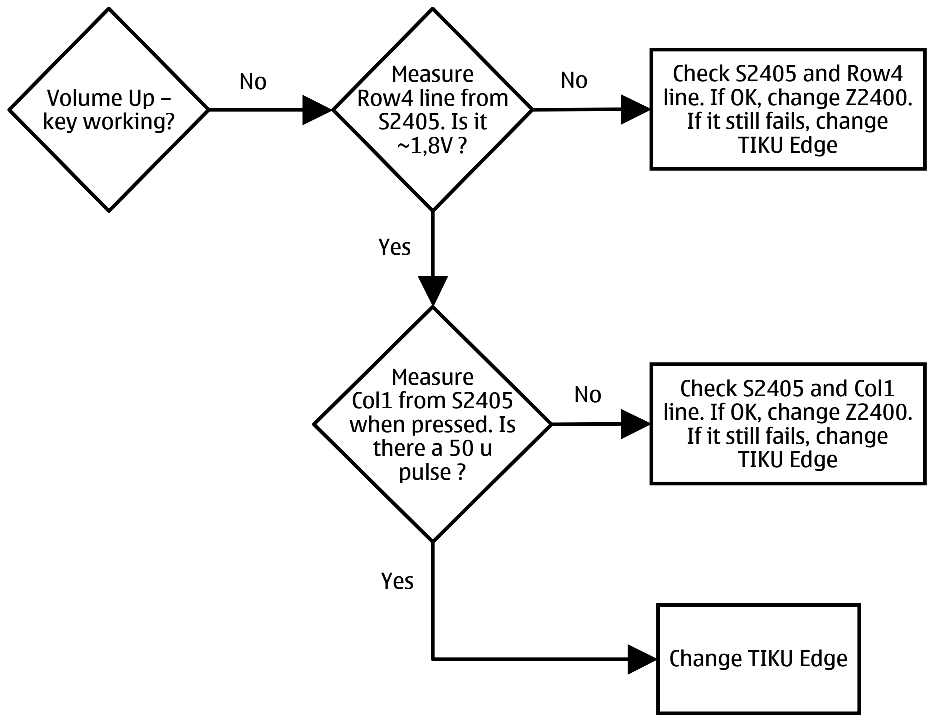


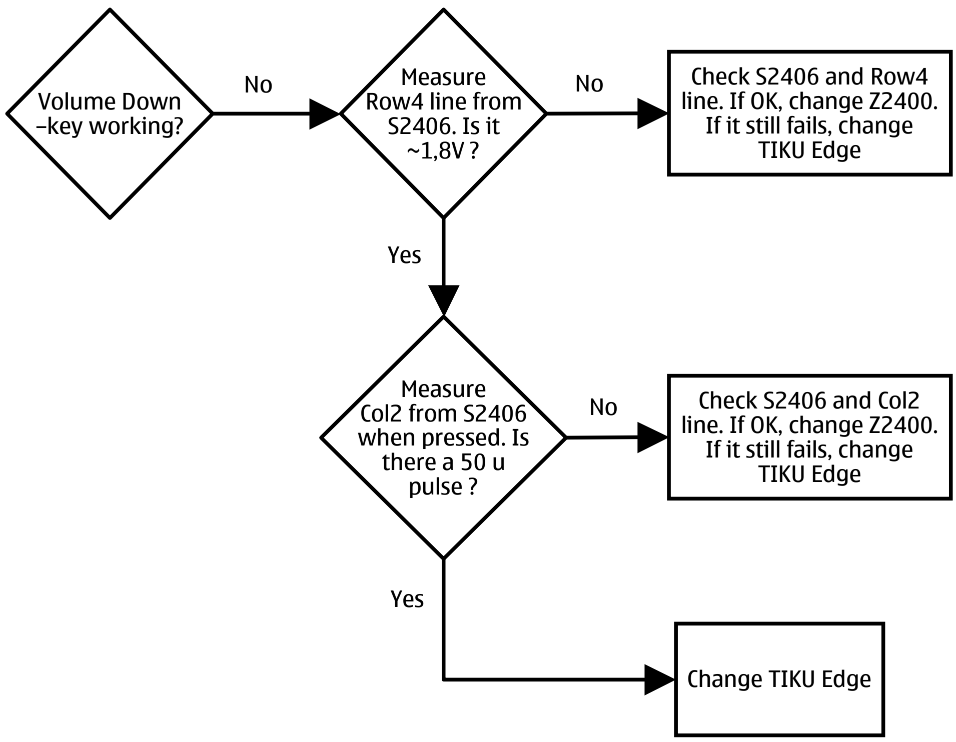
Key Failure

Power Key Failure

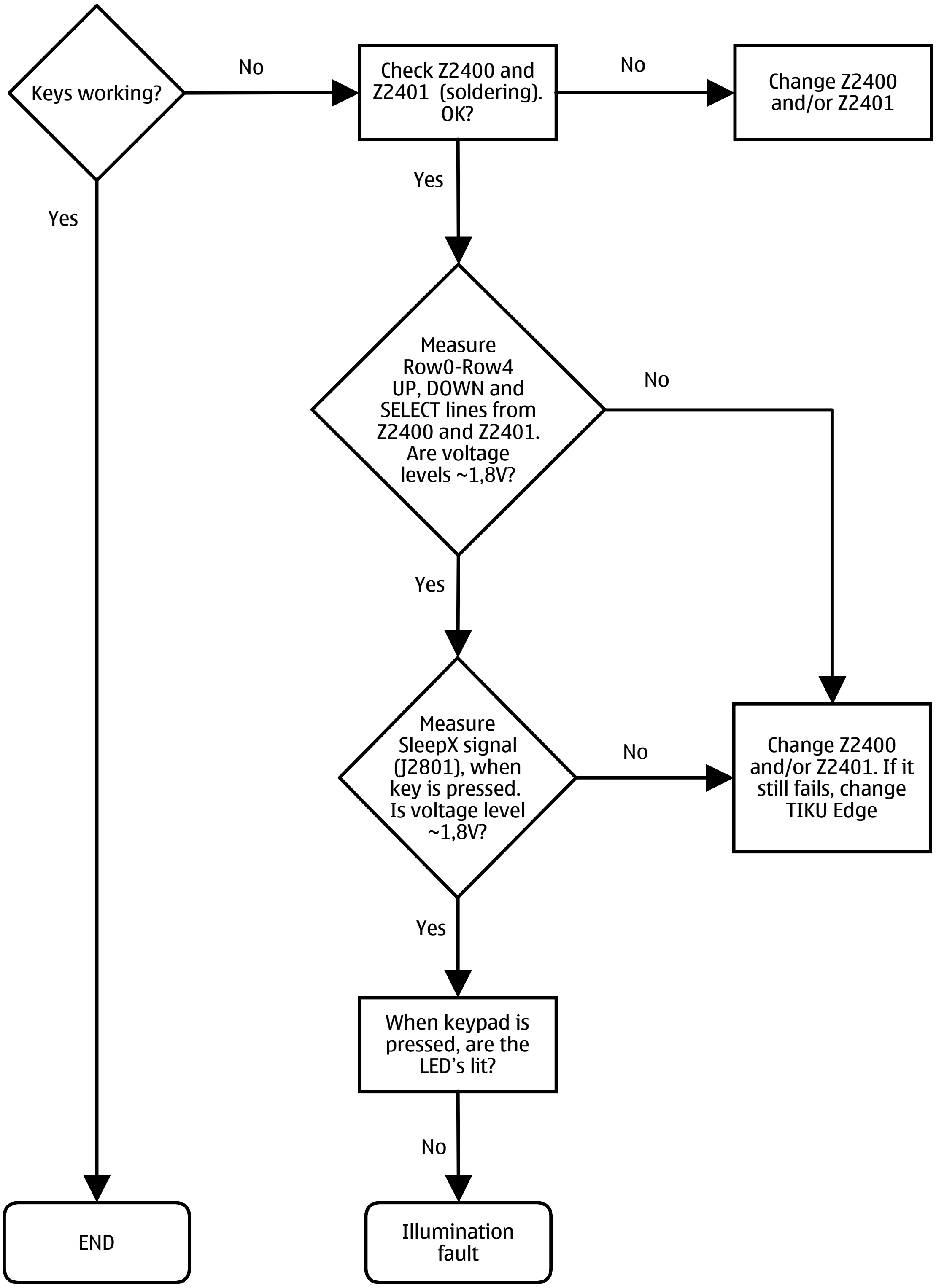


Volume key failure





Keypad failure



RF Troubleshooting

Measurements should be done using spectrum analyzer with high-frequency high-impedance passive probe (LO-/reference frequencies and RF power levels) and oscilloscope with a 10:1 probe (DC-voltages and low frequency signals).

The RF-section is build around one RF-ASIC (HELGO N7500). For easier troubleshooting, this RF troubleshooting document is divided into sections.

Before changing HELGO, please check following things: Supply voltages are OK and serial communication is coming from baseband to HELGO.

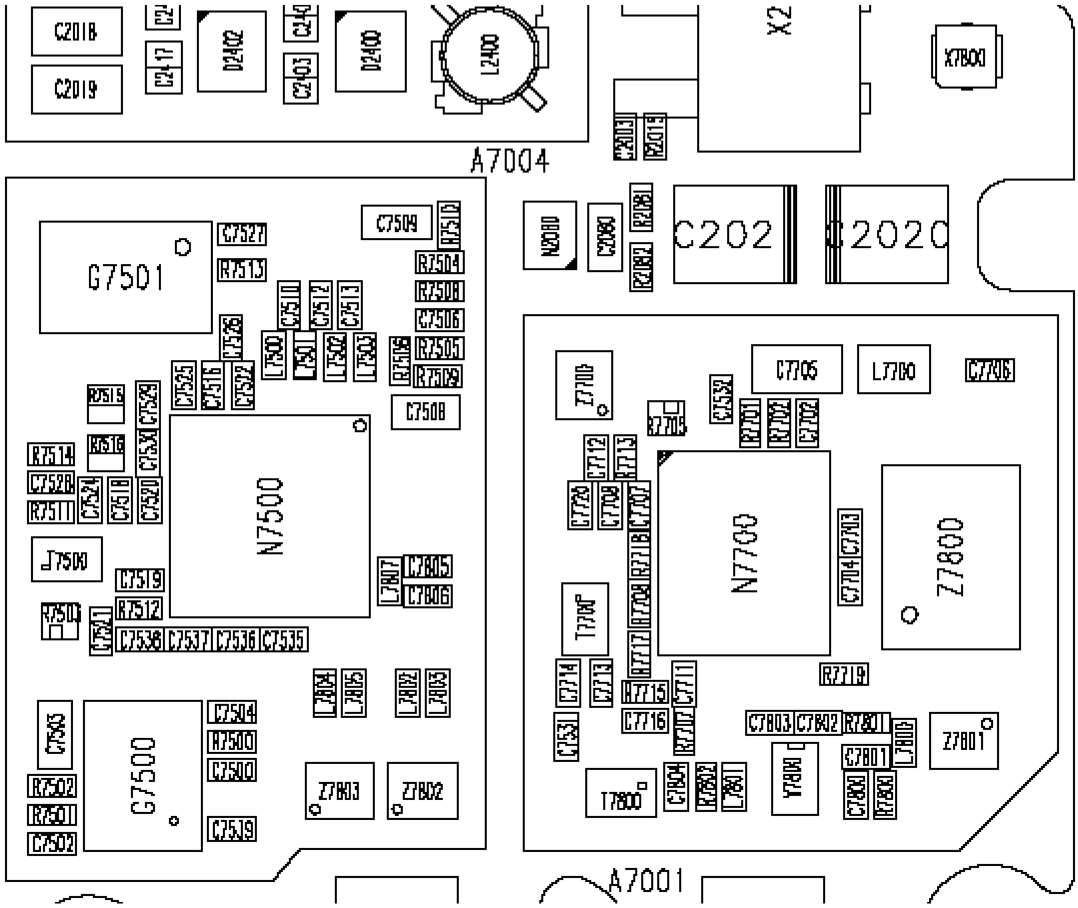
Please note that the grounding of the PA module is directly below PA-module so it is difficult to check or change. Most RF semiconductors are static discharge sensitive. So ESD protection must be taken care of during repair (ground straps and ESD soldering irons). HELGO and PA are moisture sensitive; so parts must be pre-baked prior to soldering.This does not apply to parts taken directly out of a moisture barrier bag.

Apart from key components described in this document here are a lot of discrete components (resistors, inductors and capacitors) which troubleshooting is done by checking soldering of the component is done properly (for factory repairs checking if it is missing from PWB). Capacitors can be checked for shortening and resistors for value by means of an ohmmeter, but be aware in-circuit measurements should be evaluated carefully.

Please be aware that all measured voltages or RF levels in this document are rough figures. Especially RF levels vary due to different measuring equipment or different grounding of the used probe. When using RF probe a good way is to use metallic tweezers to connect probe ground to PWB ground as close to measurement point as possible.

RF Key Component Placement

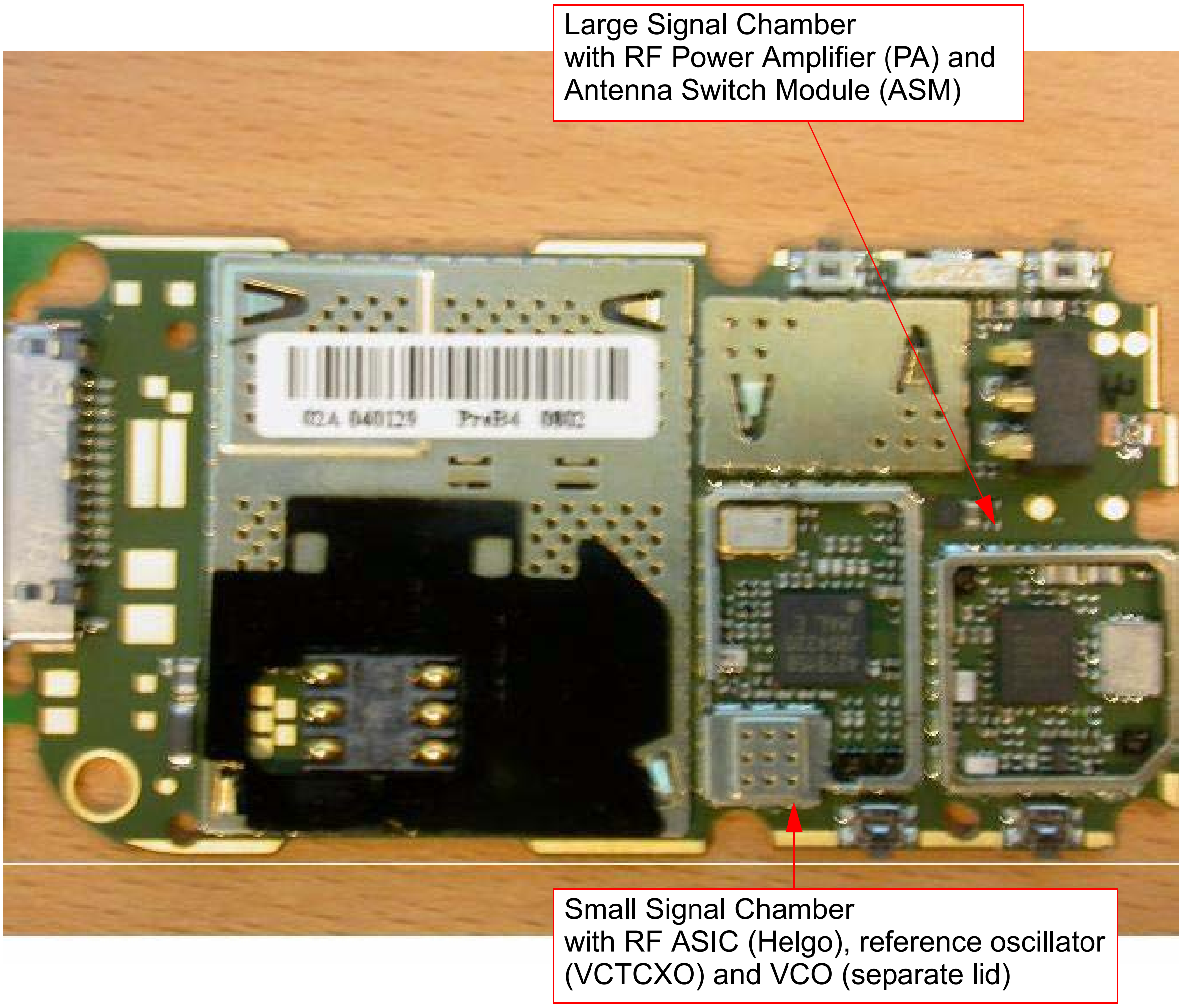
Figure 1:



RF test points

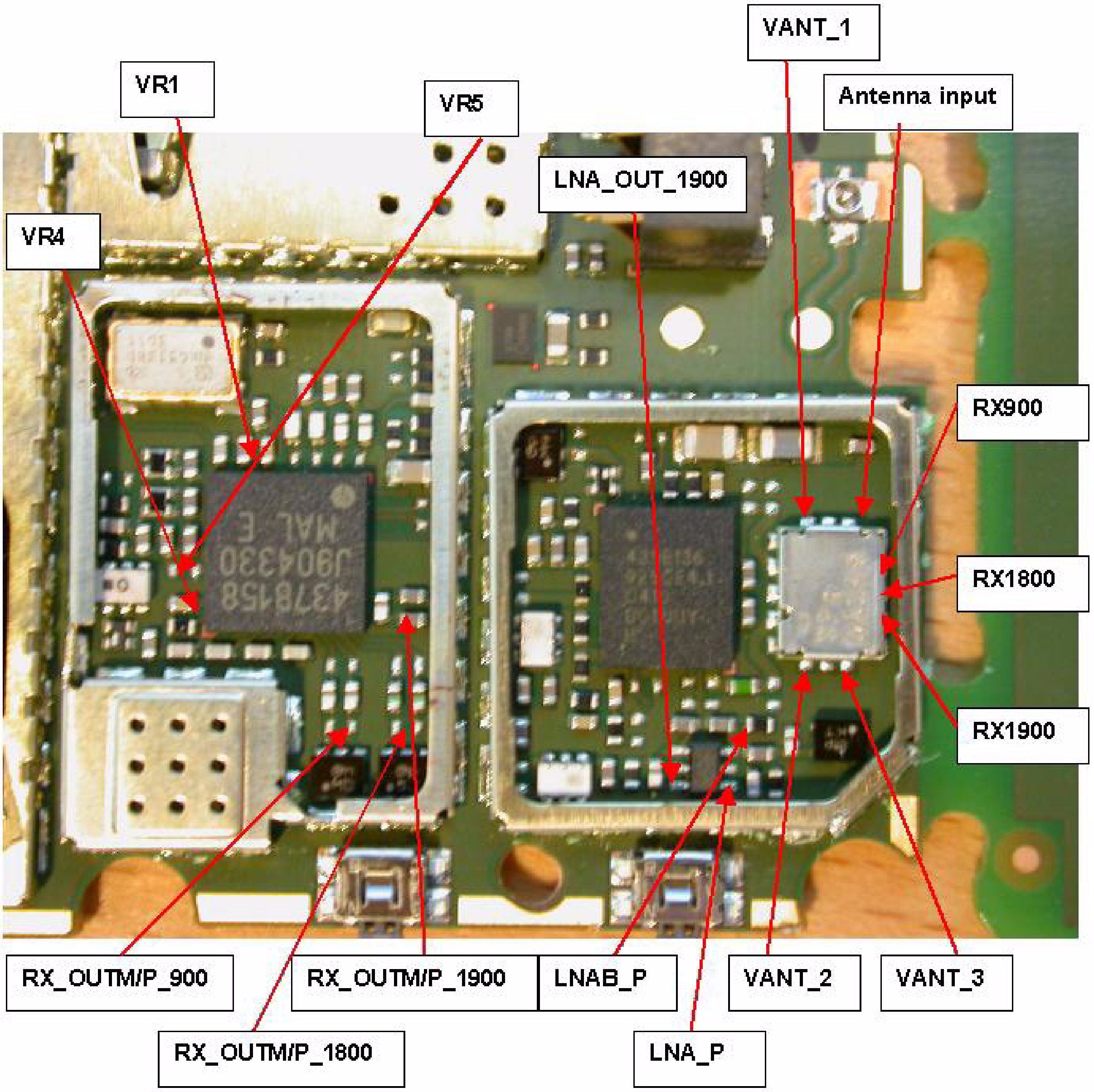
The RF power supplies are generated in the UEMEK and can be measured either in the Small Signal Chamber or in the Base Band Chamber. On the drawings below small points show the locations of the test points.

Figure 2: Picture of the assembled PWB with chamber



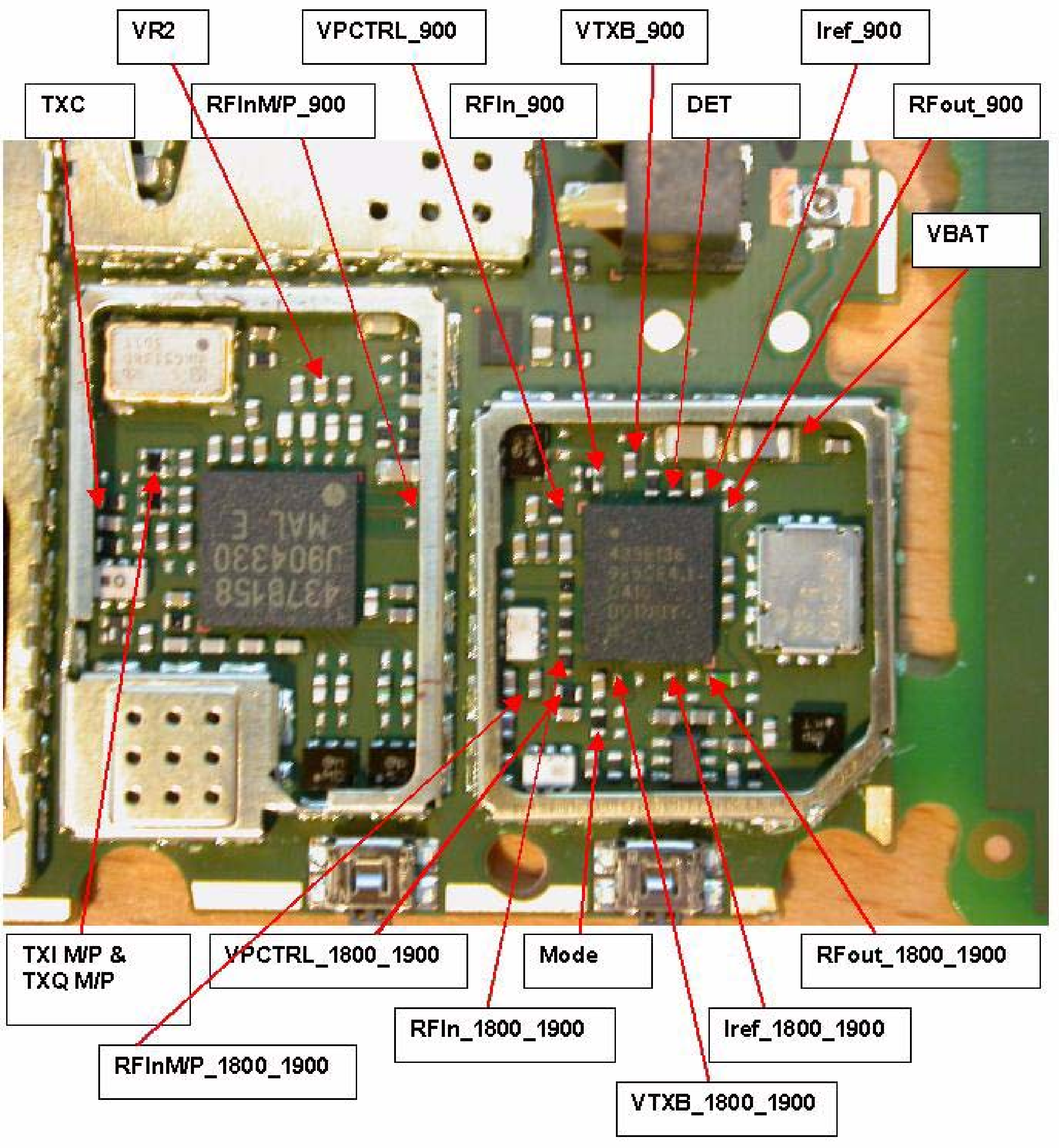
Receiver

Figure 3: Test points of the receiver



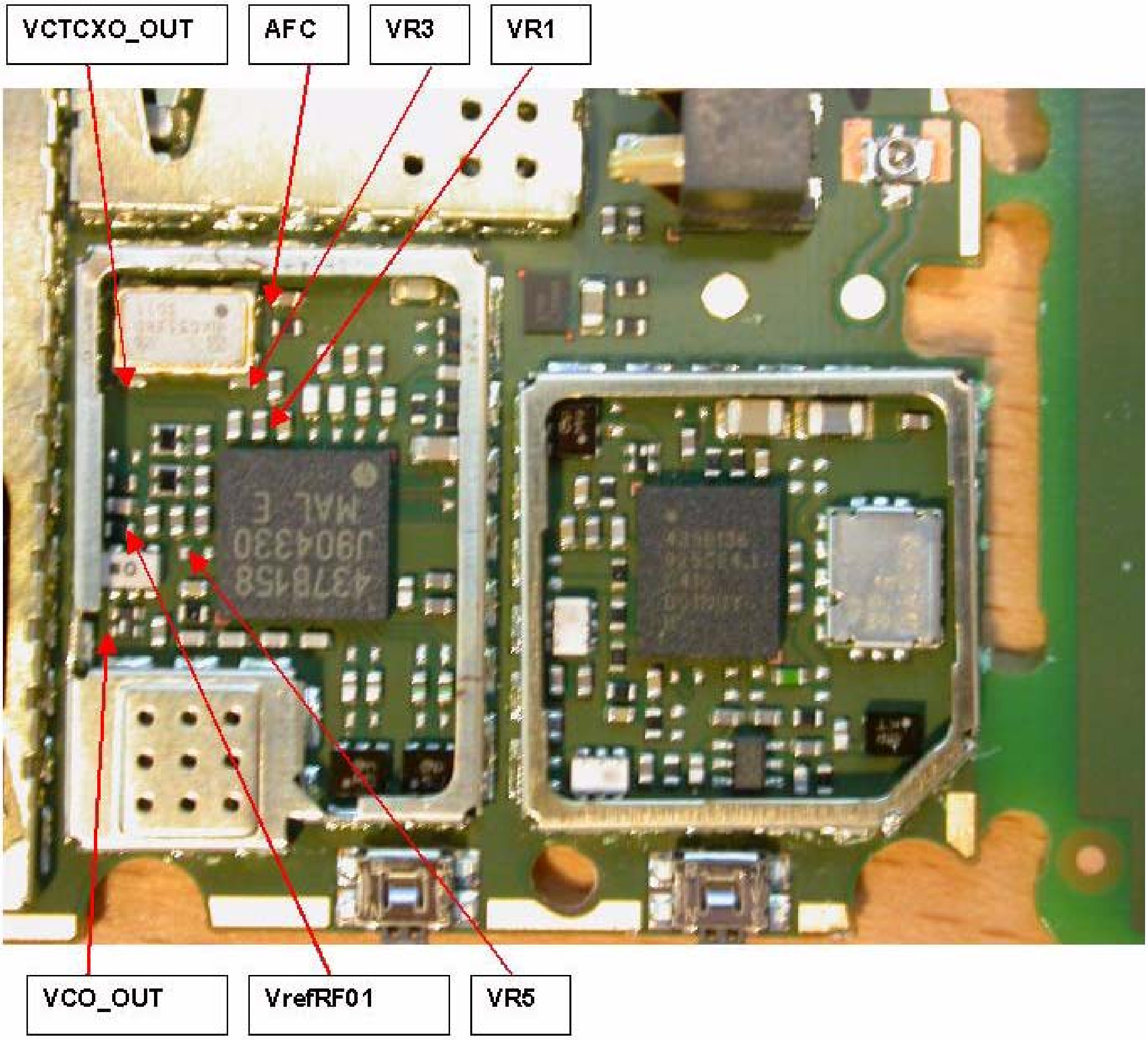
Transmitter

Figure 4: Test points of the transmitter



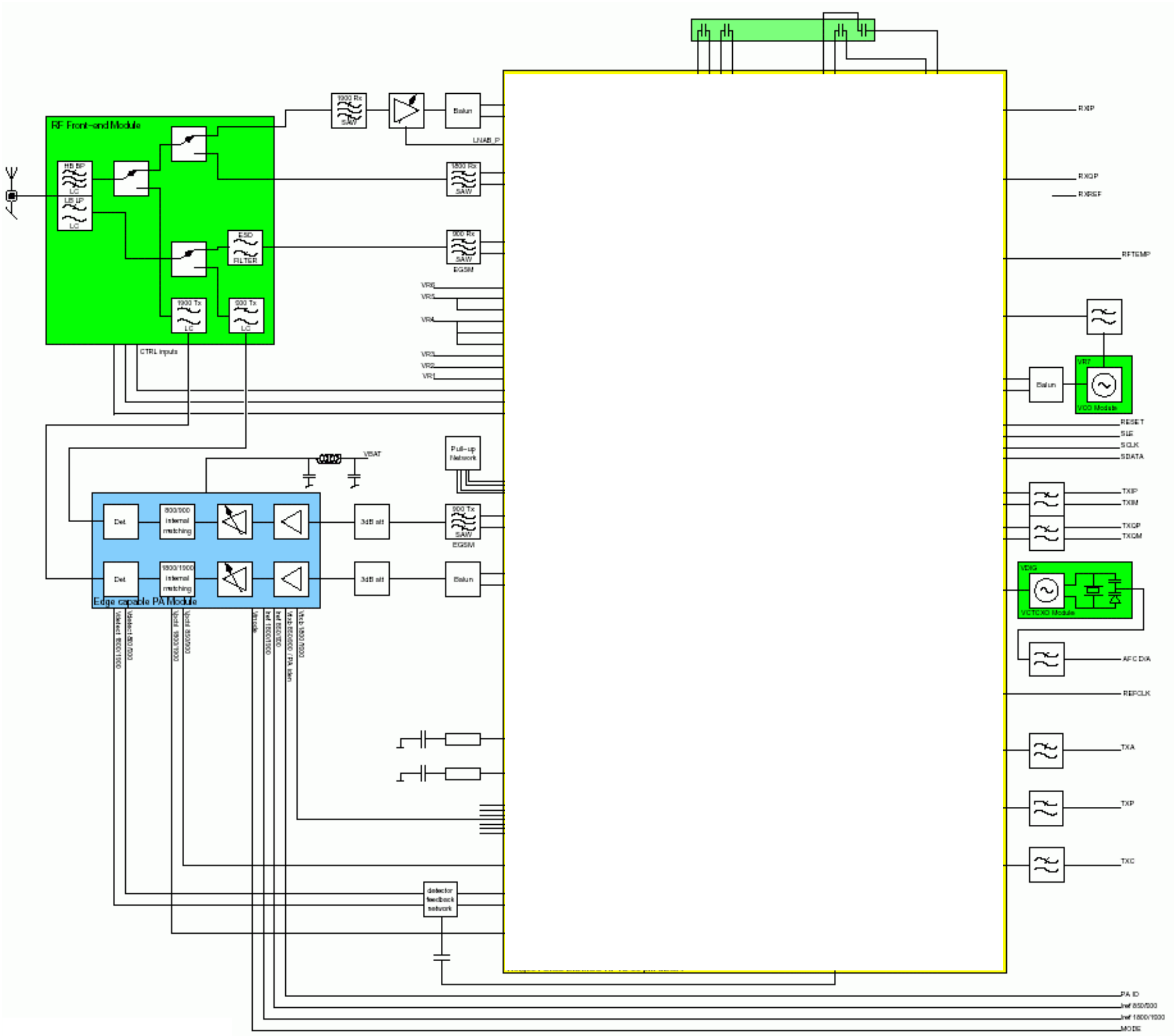
Synthesizer

Figure 5: Test points of the synthesizer



RF in General

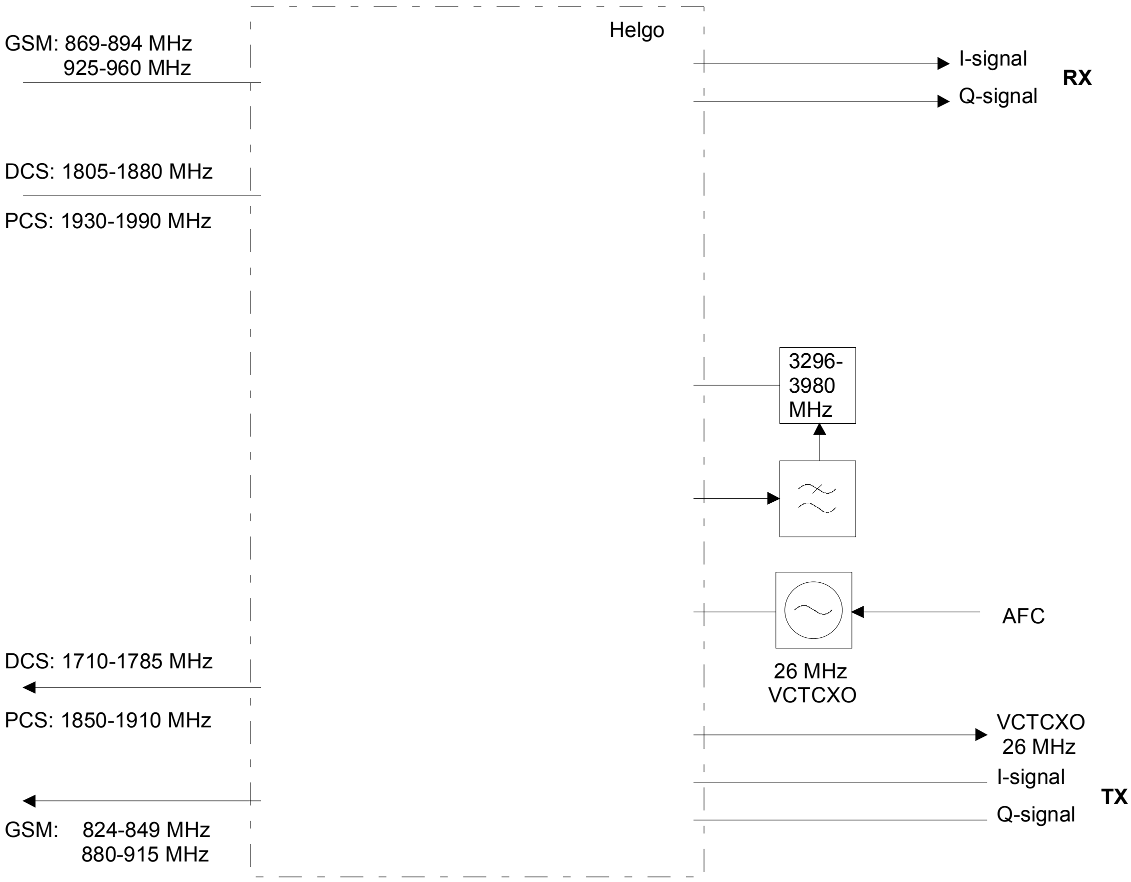
Figure 6: RF block diagram



RF block diagram consisting of:

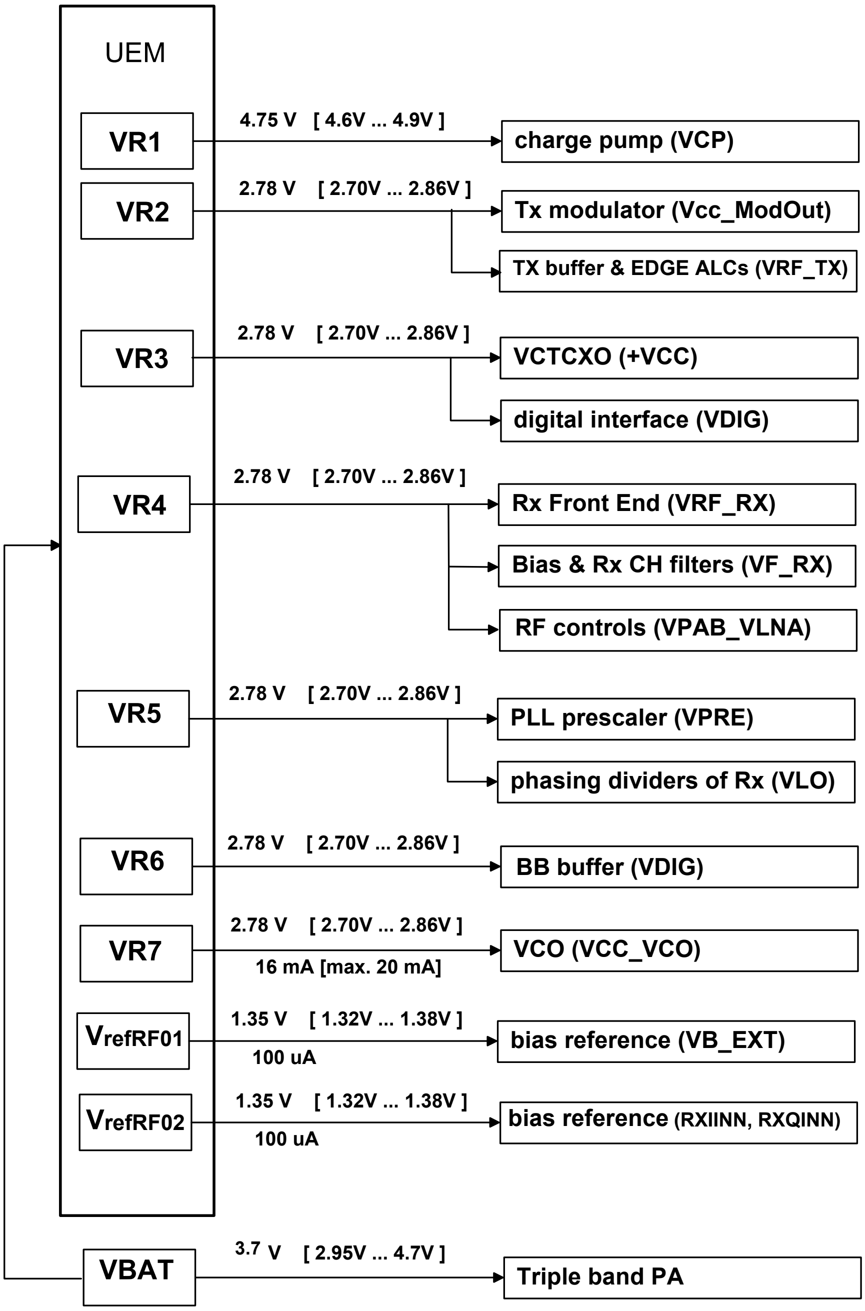
- RF front-end module
- Power amplifier module
- RF ASIC
- VCTCXO module
- VCO module

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



RF Power Supply Configuration

Figure 7:



General Specifications of Transceiver

Parameter	Unit
Cellular System	GSM850/900, GSM1800, GSM1900
Modulation schemes	GMSK, 8-PSK
RX Frequency Band	GSM850:824 … 849 MHz GSM900:925 … 960 MHz GSM1800:1805 ... 1880 MHz GSM1900:1930 … 1990 MHz
TX Frequency Band	GSM850:869 … 894 MHz GSM900:880 … 915 MHz GSM1800:1710 ... 1785 MHz GSM1900:1850 … 1910 MHz
Output Power GMSK	GSM850:+5 … +33 dBm (3.2 mW … 2 W) GSM900:+5 … +33 dBm (3.2 mW … 2 W) GSM1800:+0 … +30 dBm (1.0 mW … 1 W) GSM1900:+0 … +30 dBm (1.0 mW … 1 W)
Output Power 8-PSK	GSM850:+5 … 27 dBm (3.2 mW … 0.5 W) GSM900:+5 … 27 dBm (3.2 mW … 0.5 W) GSM1800:+0 … 26 dBm (1.0 mW … 0.4 W) GSM1900:+0 … 26 dBm (1.0 mW … 0.4 W)
Duplex Spacing	GSM850:45 MHz GSM 900:45 MHz GSM 1800:95 MHz GSM 1900:80 MHz
Number of RF Channels	GSM 850:124 GSM 900:174 GSM 1800:374 GSM1900:299
Channel Spacing	200 kHz (each band)
Number of TX Power Levels GMSK	EGSM:15 GSM 900:15 GSM 1800:16 GSM 1900:16
Number of TX Power Levels 8-PSK	GSM 850:12 GSM 900:12 GSM 1800:14 GSM 1900:14

Sensitivity, static channel (+25°C)	EGSM:-102 dBm GSM 900:-102 dBm GSM 1800:-102 dBm GSM 1900:-102 dBm
Frequency Error, static channel	< 0.1 ppm
RMS Phase Error	< 5.0 °
Peak Phase Error	< 20.0 °
EVM, 8- PSK	9 %
Peak EVM, 8- PSK	30 %

Receiver Verification and Troubleshooting

General instructions for RX Troubleshooting

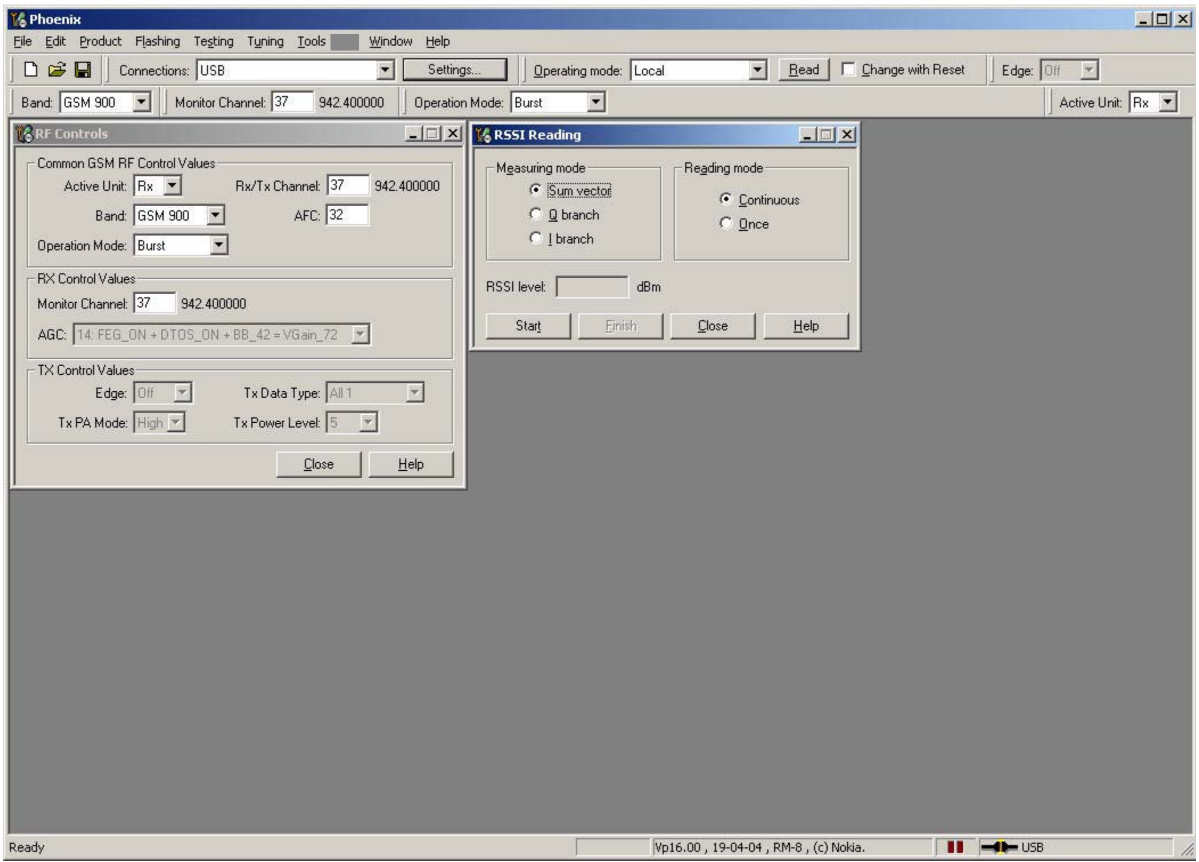
- Connect the phone to a PC, which has Phoenix Service Software and a dongle installed, using either Repair jig and DAU-9S cable (RS232) or DKU-2 cable (USB).
- Connect the phone to a power supply (DC voltage: 4.0V, max. current: 3A) and an RF signal generator. Switch the phone on.
- Start Phoenix Service Software and open FBUS or USB connection. FBUS connection is available only with DAU-9S cable (contact via test pads on phone board) and USB connection is available only with DKU-2 cable (contact via bottom connector of the phone).
- Select Scan Product (Ctrl-R)
- Wait until phone information (RM-8) is shown in the lower right corner of the screen.
- Follow the instructions in Measuring RX I/Q Signals using RSSI Reading.

Measuring RX I/Q Signals using RSSI Reading

- Start Phoenix Service Software and open FBUS or USB connection.
- Select → Scan Product (Ctrl-R)
- Wait until phone information is shown in the lower right corner of the screen.
- Then set operating mode to local mode.
- Select → Testing → RF Controls.
- Select → Band → GSM 850 or GSM 900 or GSM 1800 or GSM 1900.
- Select Active unit → RX.
- Select Operation mode → Burst.
- Select RX/TX Channel → 190 or 37 or 700 or 661.
- Select → Testing → RSSI reading.

In the RSSI Reading window the “measuring mode” shall be set on **Sum vector** and the “reading mode” on **Continuous**.

The setup should now look like this:



Make the following settings on your signal generator:

- Frequency:

GSM 850: 881.66771 MHz (channel 190 + 67.710 kHz offset)

GSM 900: 942.46771 MHz (channel 37 + 67.710 kHz offset)

GSM 1800: 1842.86771 MHz (channel 700 + 67.710 kHz offset)

GSM 1900: 1960.06771 MHz (channel 661 + 67.710 kHz offset)

- RF power level: 60 dBm @ the antenna connector of the phone/ test jig (Remembering to compensate for the cable and jig attenuation).
- Click on “Start” in RSSI reading window.

The resulting RSSI level shall be – 60 dBm +/– 1 dB in each band.

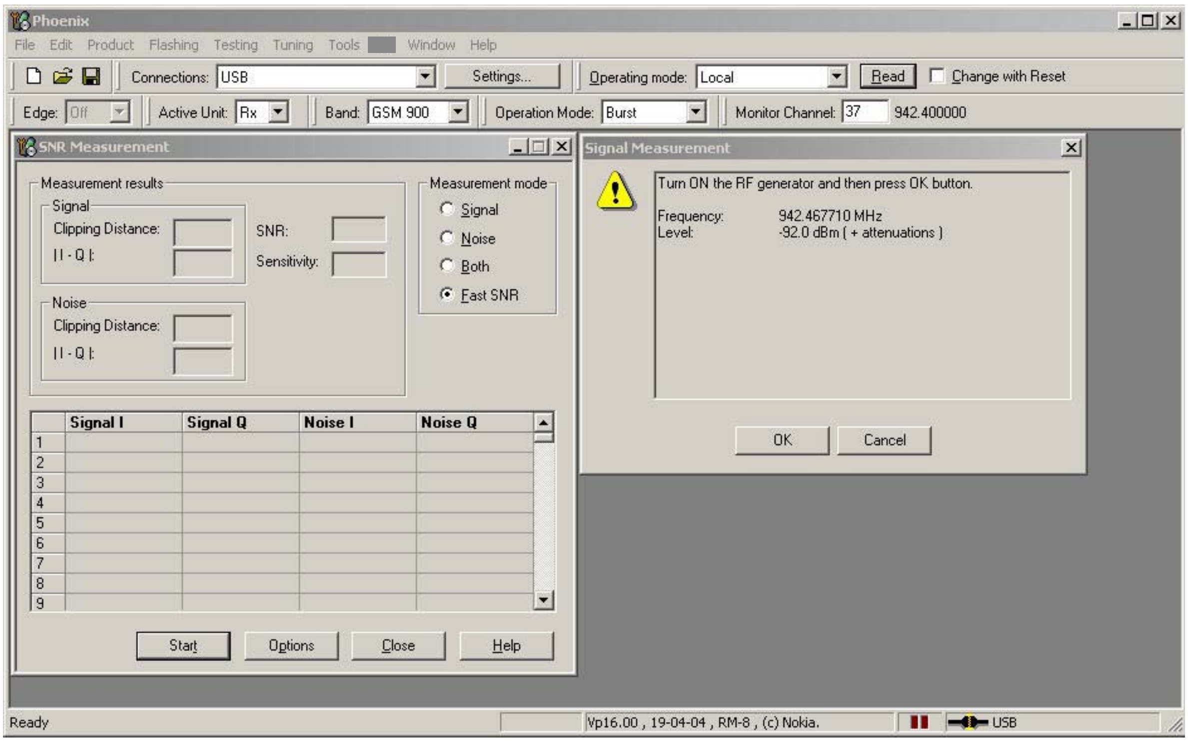
Measuring RX Performance using SNR Measurement

- Start Phoenix Service Software and open FBUS or USB 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 → Testing → RF Controls.
- Select → Band → GSM 850 or GSM 900 or GSM 1800 or GSM 1900.
- Active unit → RX.
- Operation mode →Burst.
- RX/TX Channel → 190 or 37 or 700 or 661.
- Select → Testing → SNR Measurement.
- Select → Measurement mode → Fast SNR (Radio Button).
- Press → Start.

The window “Signal Measurement” pops up informing on frequency and power level of the signal generator to be set.

The setup should now look like this:



- Set frequency and output level of the signal generator.
- Press “ok” and the window will close.
- Read the SNR results.
- Choose the remaining GSM bands and measure according to the procedure described above.
- The values shall exceed:

GSM 850: > 20 dB

GSM 900: > 20 dB

GSM 1800:	> 18 dB
GSM 1900:	> 18 dB

Note! SNR measurement may fail due to unwanted radio interference (blocking signals). This can be avoided by keeping the phone in shielded case during measurement. Try also measuring on different channels before taking any further actions.

Measuring Front-End Power Levels using Spectrum Analyzer

- Start Phoenix Service Software and open FBUS or USB 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 → Testing → RF Controls.
- Select → Band → GSM 850 or GSM 900 or GSM 1800 or GSM 1900.
- Active unit → RX.
- Operation mode → **Continuous.**
- RX/TX Channel → 190 or 37 or 700 or 661.
- Set the frequency and the output level of the signal generator.

Spectrum Analyzer (SA) level values depend on the probe type and shall be verified by a properly working phone sample.

Measuring Analogue RX I/Q Signals using Oscilloscope

There are no test pads for RX I/Q signals so they cannot be measured.

Fault Finding Chart of the Receiver

During fault finding, the RX calibration procedure is used to find out, whether all bands are affected (error in common part of the RX chain) or only one band (error in a RX part of the failed band). The calibration procedure is explained in chapter RX calibration.

Take care not to save to phone memory calibration values that are out of limits. Find the error first and repair it. 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, following steps shall be done:

- Read the AGC calibration values from phone (don’t calibrate) and check if they are OK.
- Check if RSSI reading is OK.

If both AGC and RSSI are ok, there are no excessive losses in RX chain. If both RX and TX path seem to be faulty it has to be checked if the synthesizer is working.

Figure 8: Receiver troubleshooting 1 and 2

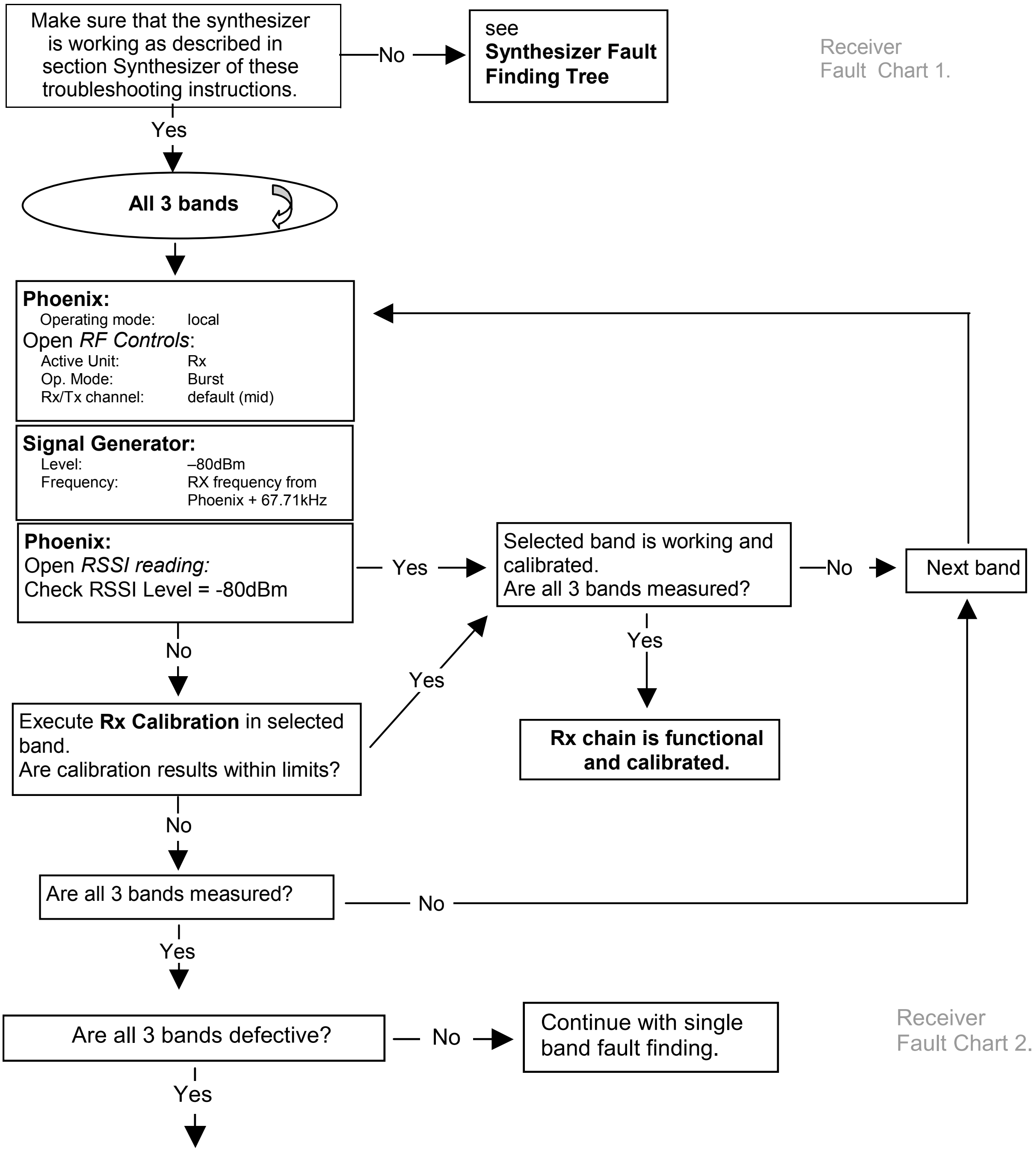


Figure 9: Receiver troubleshooting 3, 4, 5 and 6

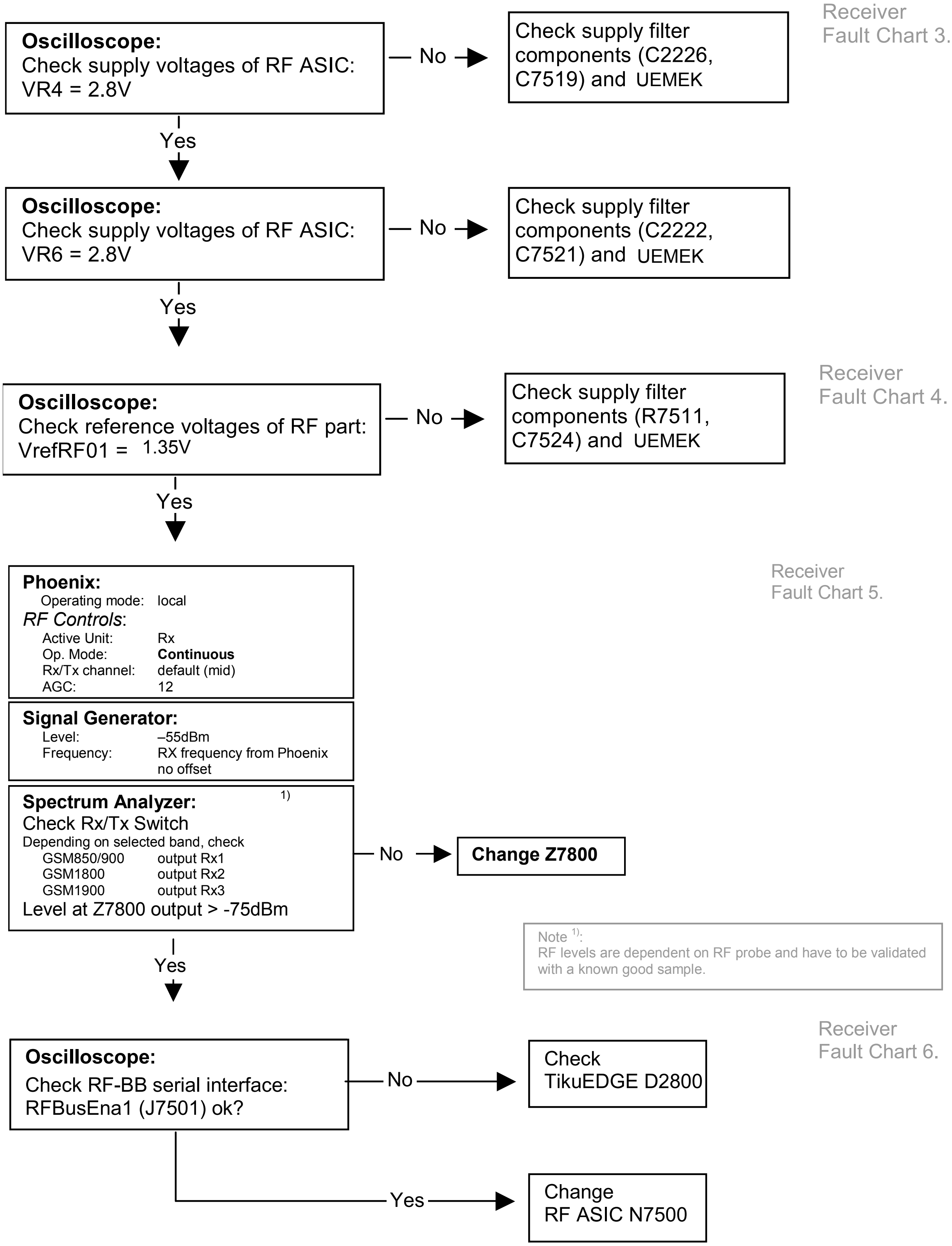


Figure 10: Single band troubleshooting (receiver troubleshooting 7 and8)

Single band fault finding
Select faulty band in Phoenix and continue measurements on dedicated Rx part.

Receiver
Fault Chart 7.

Phoenix:
Open *SNR Measurement:*
Meas. Mode: Fast SNR
Press *Start*.

Signal Generator:
Level: –92dBm
Frequency: RX frequency from Phoenix

Phoenix:
SNR measurement ok?
(SNR > 18dB)

Yes →

Front-end is ok.

Phoenix:
Operating mode: local
RF Controls:
Active Unit: Rx
Op. Mode: **Continuous**
Rx/Tx channel: default (mid)
AGC: 12

Signal Generator:
Level: –55dBm
Frequency: RX frequency from Phoenix
no offset

Continue with Receiver Fault Chart 6.

No ↓

Receiver
Fault Chart 8.

Phoenix:
Operating mode: local
RF Controls:
Active Unit: Rx
Op. Mode: **Continuous**
Rx/Tx channel: default (mid)
AGC: 12

Signal Generator:
Level: –55dBm
Frequency: RX frequency from Phoenix
(no offset)

Spectrum Analyzer: 1)
Center Freq: RX frequency from Phoenix
RBW: 20kHz

Check Rx SAW filter of selected band:
GSM850/900 Z7803
output both lines > -80dBm
GSM1800 Z7802
output both lines > -80dBm
GSM1900 Z7801
single output > -74dBm

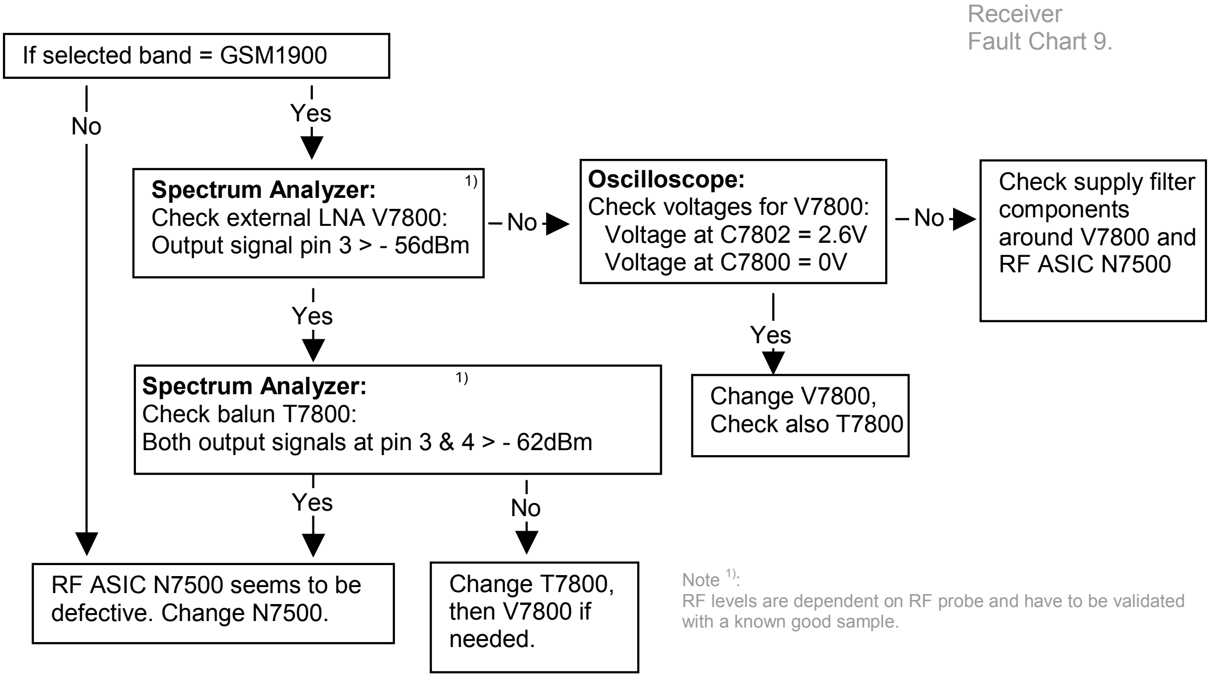
No →

Change Rx SAW filter
(Z7801, Z7802, Z7803)
depending on selected band

Yes ↓

Note 1):
RF levels are dependent on RF probe and have to be validated with a known good sample.

Figure 11: Receiver troubleshooting 9



RX Signal Paths

Antenna Switch (RX/TX Switch)

RF signal is fed directly from the lower block antenna connector (X7800) to the antenna switch (Z7800). This switch has the function of a diplexer, which consists of two combined paths (low pass/high pass filter combination), a GSM850/900 and a GSM1800/1900 path. The GSM 850/900 input signals pass the switch to Rx1 output. GSM 1800 input signal passes the switch to Rx2 output and GSM 1900 to Rx3 output, depending on the control signals VANT_1, VANT_2 and VANT_3.

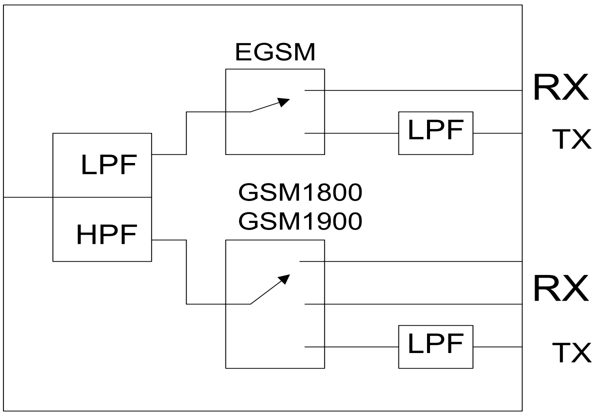
Signal paths from the antenna switch to the band filters:

- GSM 850/900:RX1 → GSM850 SAW filter (Z7803) → GSM900 SAW filter (Z7803)
- GSM1800: RX2 → GSM1800 SAW filter (Z7802)
- GSM1900: RX3 → GSM1900 SAW filter (Z7801)

The antenna switch has following typical insertion losses in Rx-mode from its input to output ports:

- GSM 850/900: 1.0 dB
- GSM 1800: 1.3 dB
- GSM 1900: 1.3 dB

Figure 12: Block diagram of antenna switch



Input port (antenna) is on the left side and output ports (Rx/Tx) are on the right side.

RX front-end

The RX front-end includes three SAW filters GSM 850/900 (US/EU), GSM1800 and GSM1900 to provide the wanted out-of-band blocking immunity. GSM 850/900 and GSM 1800 filters have unbalanced (single-ended) inputs and balanced outputs. The outputs are matched to the corresponding LNA inputs of the RF ASIC (N7500) with differential matching network (LC-type). GSM 1900 band filter has unbalanced input and output. Output of the filter is fed to external LNA (V7800), which improves the noise figure of the receiver. Unbalanced output signal of the LNA is converted to balanced signal with BALUN (T7800) and the balanced signal is then matched to RF ASIC input with a differential matching network (LC-type).

The SAW filters have approximately 2.5 to 3.2 dB insertion losses.

The LNA for the GSM 1900 band provides a gain of approximately 17 to 20 dB.

RX paths of RF ASIC

The balanced GSM 850/900 and GSM 1800 RX signals are amplified by integrated LNA's, there is one LNA for the lower bands and one for the higher band. The GSM 1900 signal is fed to the pre-gain stage also used for the GSM 1800 signal. After amplification the RX signals are down-converted.

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

- Separate LNAs for each of the bands: GSM 850/900, and GSM1800.
- Two PRE-GAIN amplifiers, one for GSM 850/900 and one for GSM1800/1900.
- Two passive I/Q mixers (MIX), one for GSM 850/900 and one for GSM1800/1900.

Transmitter

General Instructions for Transmitter Troubleshooting

- Connect the phone to a PC, which has Phoenix Service Software and a dongle installed, using either Repair jig and DAU-9S (RS232) cable or DKU-2 cable (USB).
- Connect the phone to a power supply (DC voltage of **3.9V**) and switch the phone on. The value of the DC voltage of 3.9V at the phone battery connector is crucial.
- Attention: When repairing or tuning transmitter use external DC supply with at least 3A current capability.
- Connect an RF cable between the test jig and the measurement equipment (GSM test equipment, power meter, spectrum analyzer, or similar).
- Make use of an adequate attenuator at the input of your measurement equipment (10dB to 20dB are recommended for a spectrum analyzer or a power meter). Additionally, a DC block is recommended. Assure not to overload or destroy the equipment.
- Start Phoenix Service Software and open USB connection (FBUS if DAU 9S and repair jig used):
- Select → Scan Product (Ctrl-R) and wait until phone information is shown in the lower right corner of the screen.
- Follow the instructions in the chapter Transmitter troubleshooting.

Transmitter troubleshooting

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 a controlled by the RF ASIC using the control signals VANT1, VANT2 and VANT3.

The table below shows the possible different switching states. To switch the TX -GSM 1800/

VANT2 VC1 [Volt]	VANT3 VC2 [Volt]	VANT1 VC3 [Volt]	Rx1 GSM 850/900 Rx	Rx2 GSM 1800 Rx	Rx3 GSM 1900 Rx	TX_IN_ EGSM Tx1 GSM 850/900 Tx	TX_IN_ DCS Tx2 GSM 1800/1900 Tx
0	0	0	X				
0	0	0		X			
0	2.7 (0, 850)	2.7				X	
0	2.7	0			X		
2.7	2.7	0					X

1900 path both signals VANT2 and VANT3 have to be activated. This increases the isolation from the TX-GSM 1800/1900 path to the RX-GSM 1800 path and reduces the feed back of RF-power to the RF ASIC.

GSM850 Transmitter

GSM850 chapter is valid only for the RM-9. Start the preparations as described in chapter 8.1 (General instruction for the transmitter troubleshooting).

General Instructions for GSM850 TX Troubleshooting

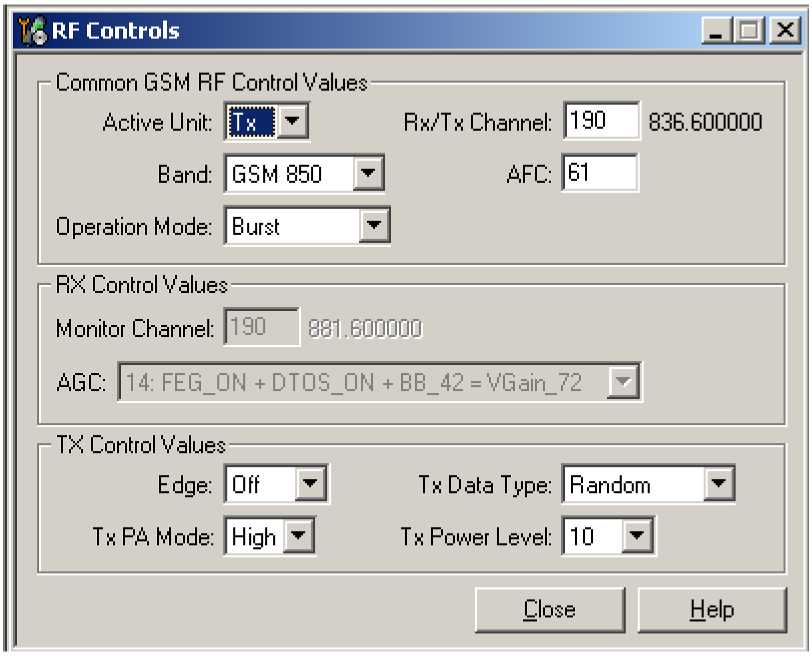
GMSK:

First, select operating mode to local mode. Then, select → Testing → RF Controls.

In the popped up window:

- Select → Band → GSM 850.
- Active unit → TX.
- Operation mode → Burst.
- RX/TX Channel → 190.
- TX Power Level → 10.
- TX Data Type → Random.

The Phoenix window should now look like this:



Now the measurement setup, which has been built according to the chapter 8.1, should detect the following output signal of the phone.

P_{out} = +23dBm @ 836.6 MHz

If this is not the case, then go to the next chapter 8.3.2.1 GMSK for the troubleshooting.

Start the preparations as described in chapter 8.1.

EDGE:

First, select operation mode to the local. Then, select → Testing → RF control.

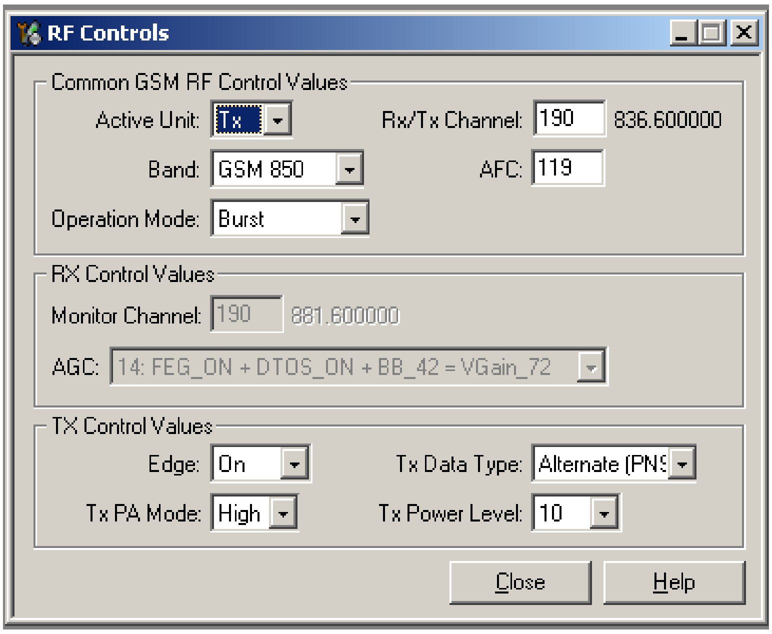
In the popup window these values are common:

- Active unit → TX
- Band → 850
- Operation mode → Burst
- RX/TX Channel → 190

In the popup window TX control values:

- EDGE → ON
- Tx data type → Alternate
- TX PA mode → High
- TX Power level → 10

The Phoenix window should now look like this:



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

P_{out} = +24 dBm @ 836.6 MHz

If this is not the case, then go to the next chapter 8.3.2.2 EDGE for the troubleshooting.

Start the preparations as described in chapter General Instructions for Transmitter Troubleshooting.

Fault Finding Chart for GSM850 Transmitter

In following, it is assumed that the TXP signal is used as trigger-signal. For that a TXP test point is provided.

Figure 13: GSM850 troubleshooting, GMSK

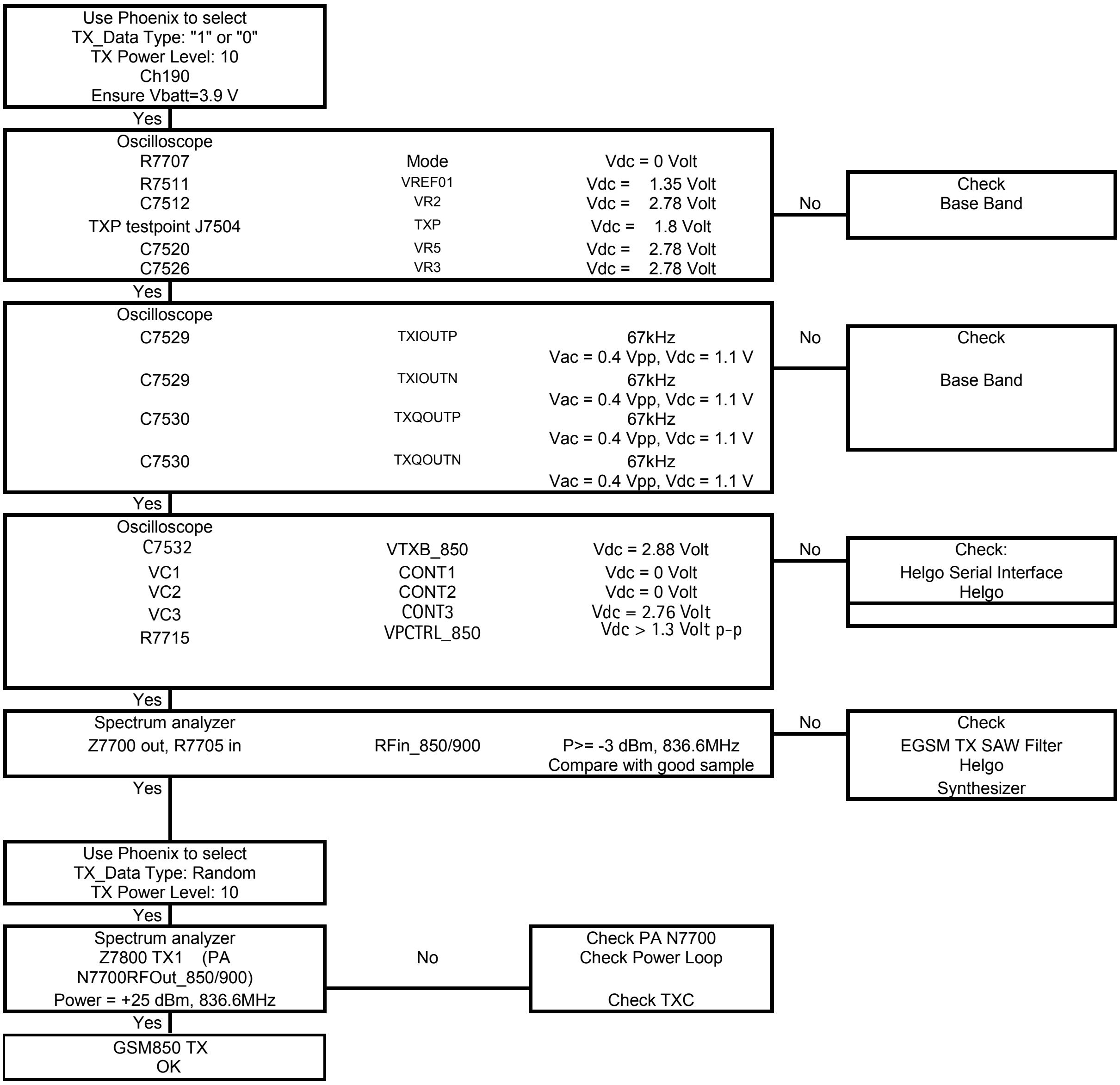
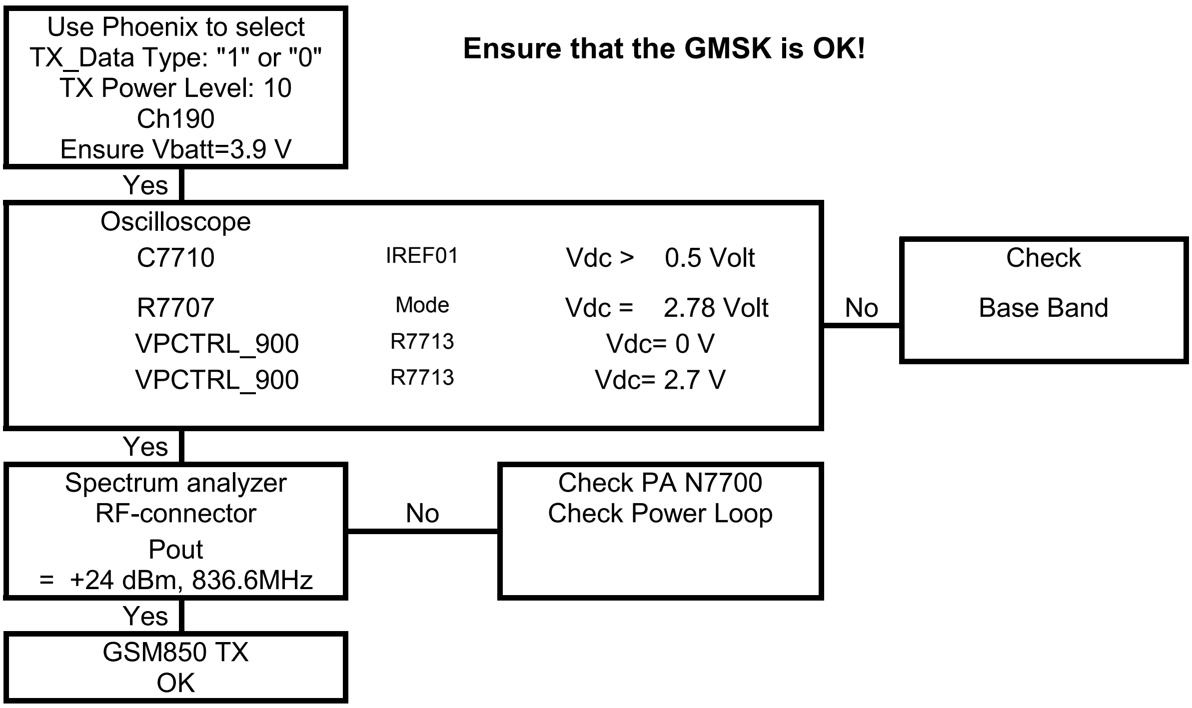


Figure 14:GSM850 troubleshooting, EDGE



GSM900 Transmitter

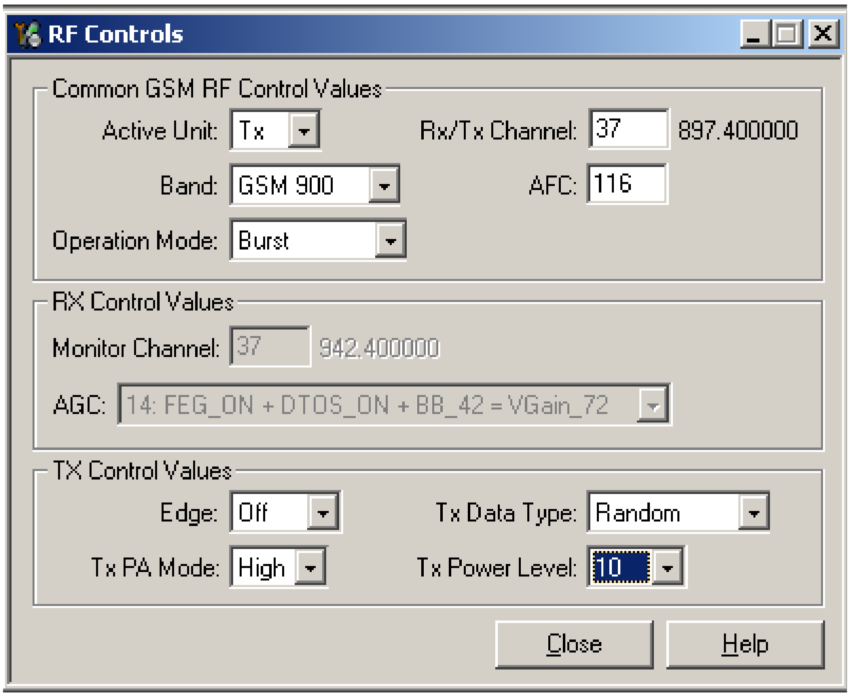
GSM900 chapter is valid for the RM-8 (EU variant).

General Instructions for GSM TX Troubleshooting

GMSK:

- Set the operating mode to the local mode.
- Select → Testing → RF Controls.
- Wait until the RF Controls window is popped up.
- Select → Band → GSM 900, Active unit → TX, Operation mode → Burst, RX/TX Channel → 37, TX Power Level → 10 and 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} = +23dBm @ 897.4 MHz

If this is not the case, then go to the next chapter 8.4.2.1 GMSK for troubleshooting.

EDGE:

- Select operation mode to the local.
- Select → Testing → RF control.

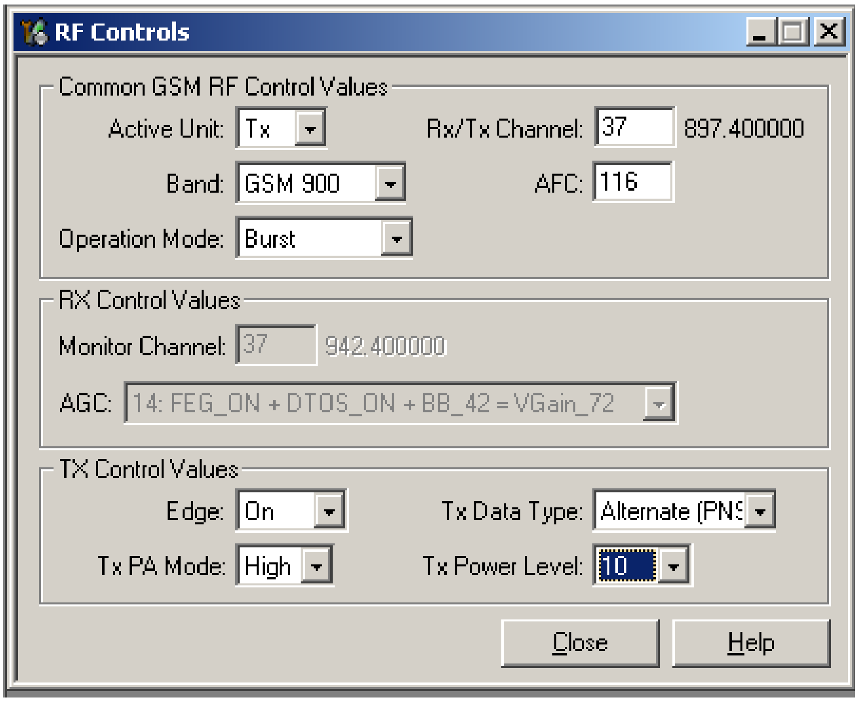
In the popup window common values:

- Active unit → TX
- Band → 900
- Operation mode → Burst
- RX/TX Channel → 37

In the popup window TX control values:

- EDGE → ON
- Tx data type → Alternate
- TX PA mode → High
- TX Power level → 10

The setup should now look like this:



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

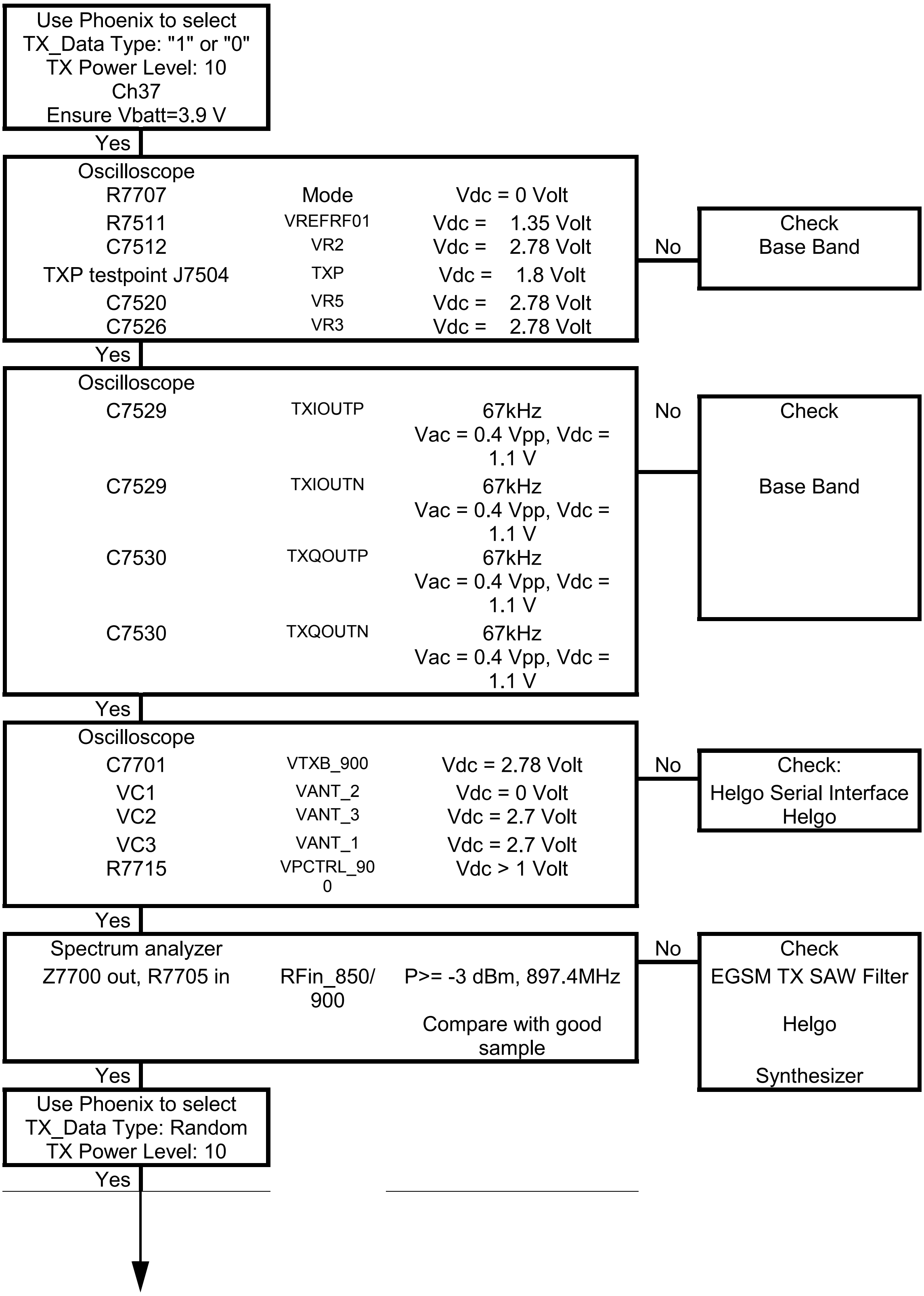
P_{out} = +24 dBm @ 897.4 MHz

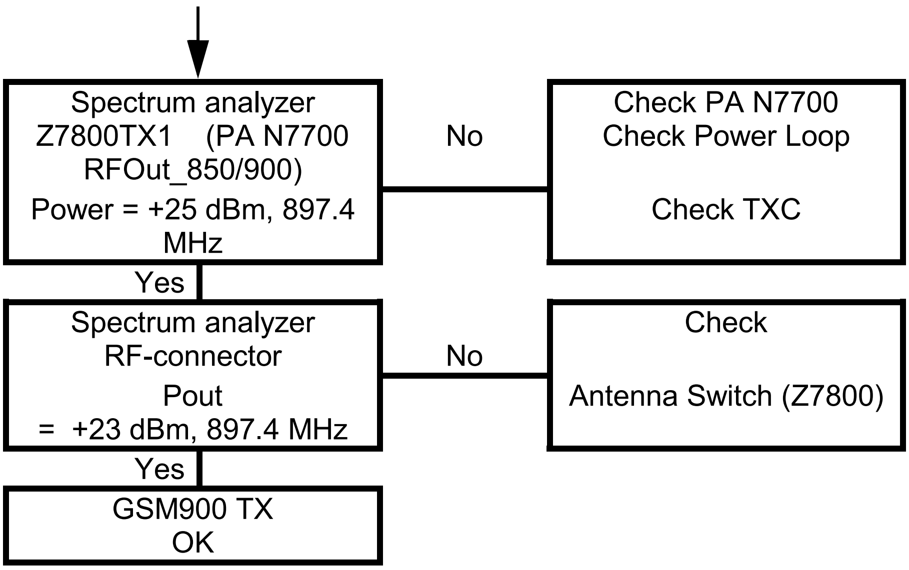
If this is not the case, then go to the next chapter 8.4.2.2 EDGE for the troubleshooting.

Fault Finding Chart for GSM900 Transmitter

In following, it is assumed that the TXP signal is used as trigger-signal. For that a TXP test point is provided.

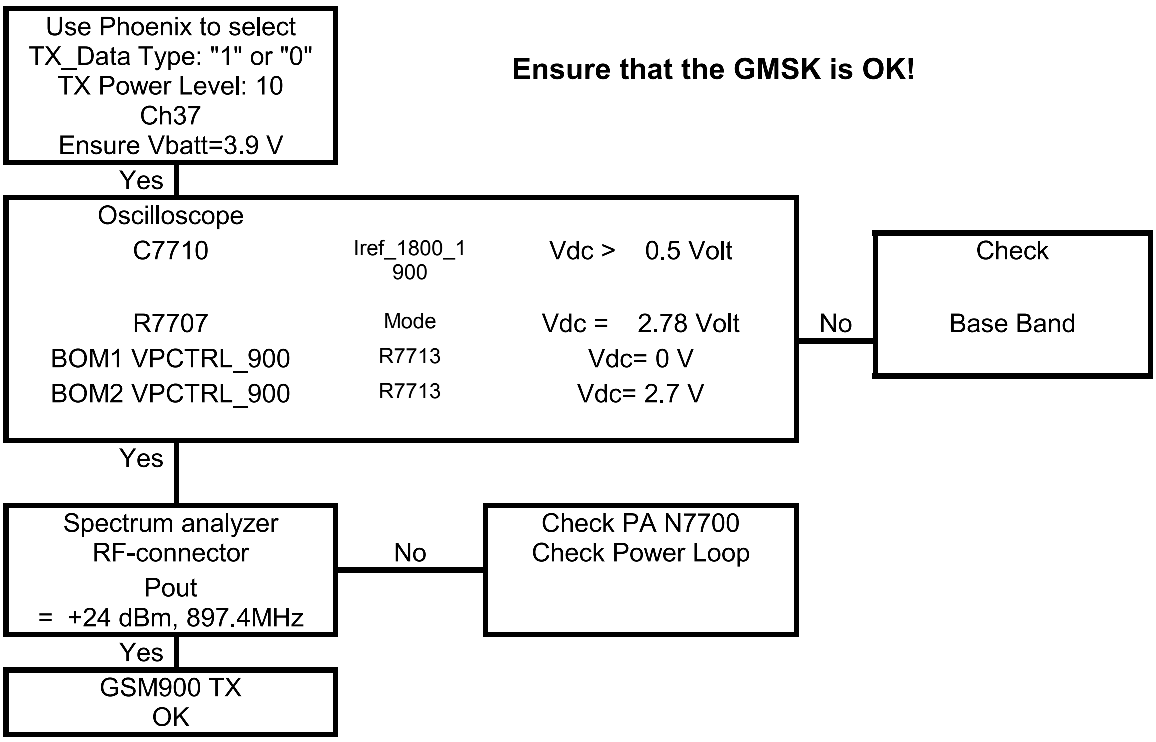
Figure 15:GSM900 troubleshooting, GMSK





EDGE:

Figure 16: GSM900 troubleshooting, EDGE



GSM1800 Transmitter

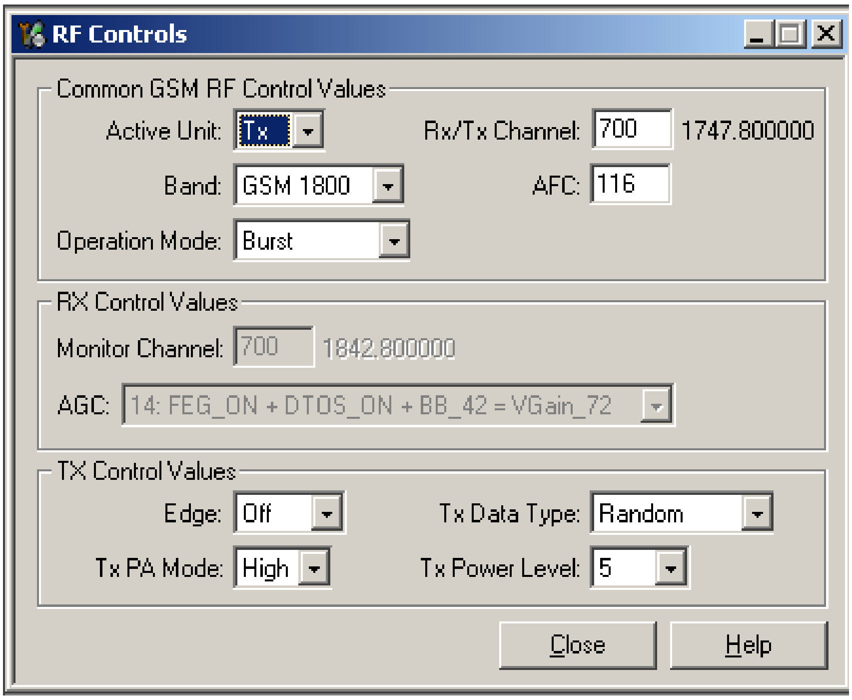
General instructions for GSM1800 TX Troubleshooting

Start the preparations as described in chapter “General Instructions for Transmitter Trouble-shooting”.

GMSK:

- Set the operating mode to local mode.
- Select → Testing → RF Controls and wait until the RF Controls window is popped up.
- Select → Band → GSM 1800, Active unit → TX, Operation mode → Burst, RX/TX Channel → 700, TX Power Level → 5 and 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} = +23dBm @ 1747.8 MHz

If this is not the case, then go to the chapter Fault finding for GSM1800 transmitter and GMSK for troubleshooting.

EDGE:

- Select operation mode to the local.
- Select → Testing → RF control.

In the popup window common values:

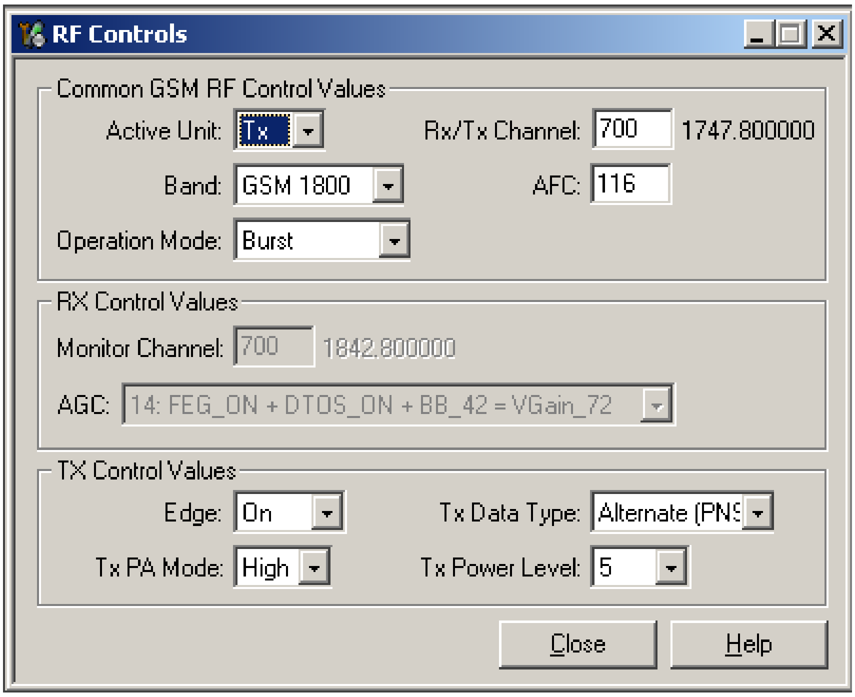
- Active unit → TX
- Band → 1800

- Operation mode → Burst
- RX/TX Channel → 700

In the popup window TX control values:

- EDGE → ON
- Tx data type → Alternate
- TX PA mode → High
- TX Power level → 5

The setup should now look like this:



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

P_{out} = +21 dBm @ 1747.8 MHz

If this is not the case, then go to the next chapter 8.5.2.2 for Troubleshooting.

Fault finding chart for GSM1800 transmitter

It is assumed that the TXP signal is used as a trigger-signal and a TXP test point is provided in the following chart.

Figure 17: GSM1800 transmitter troubleshooting, GMSK

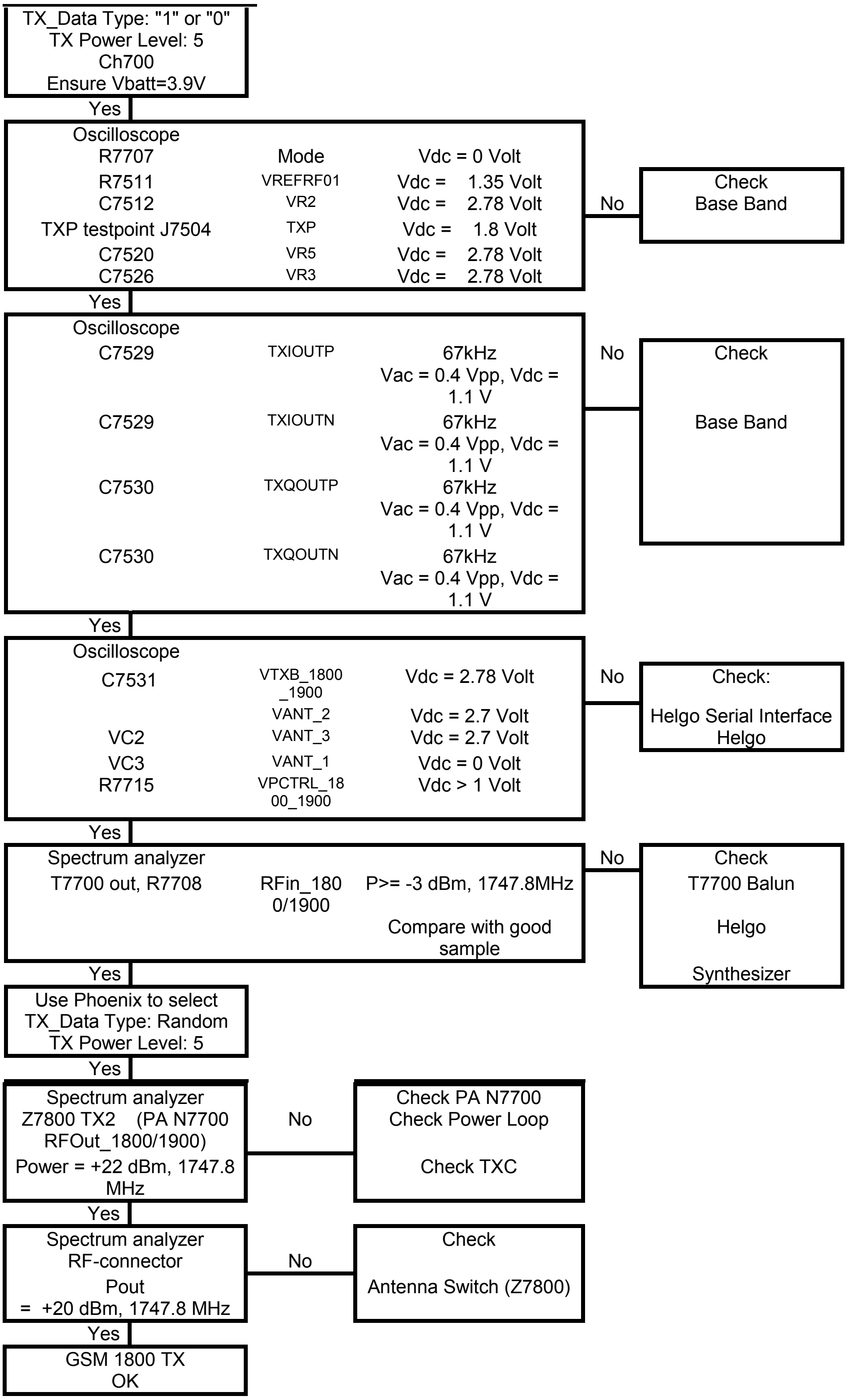
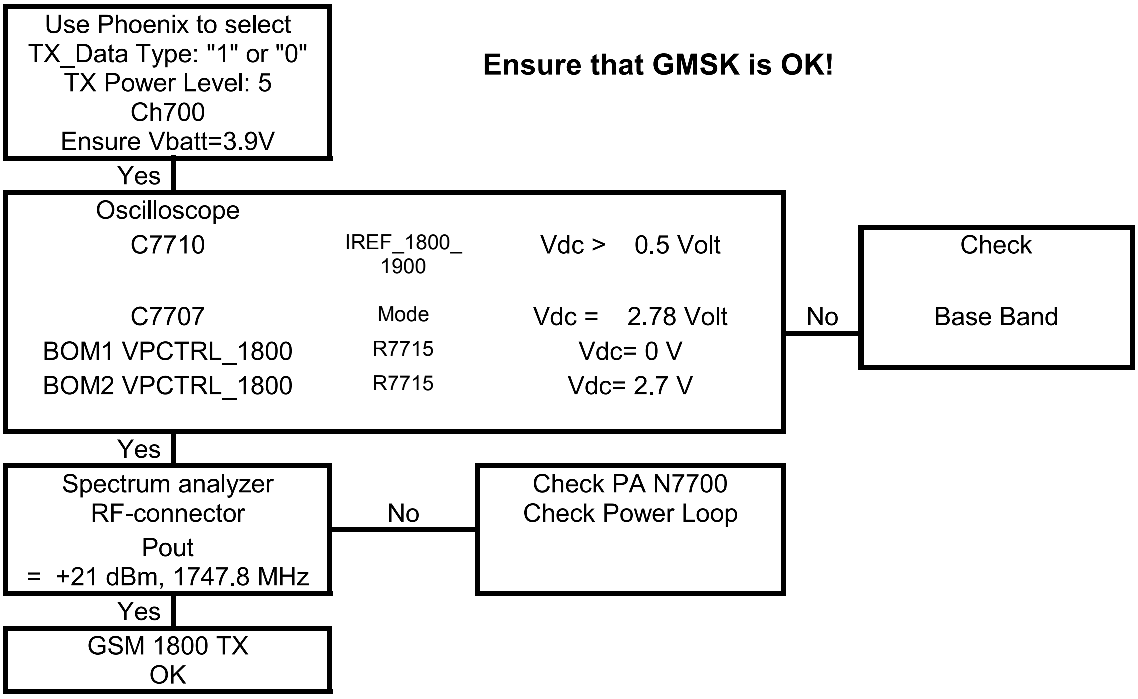


Figure 18: GSM1800 transmitter troubleshooting, EDGE



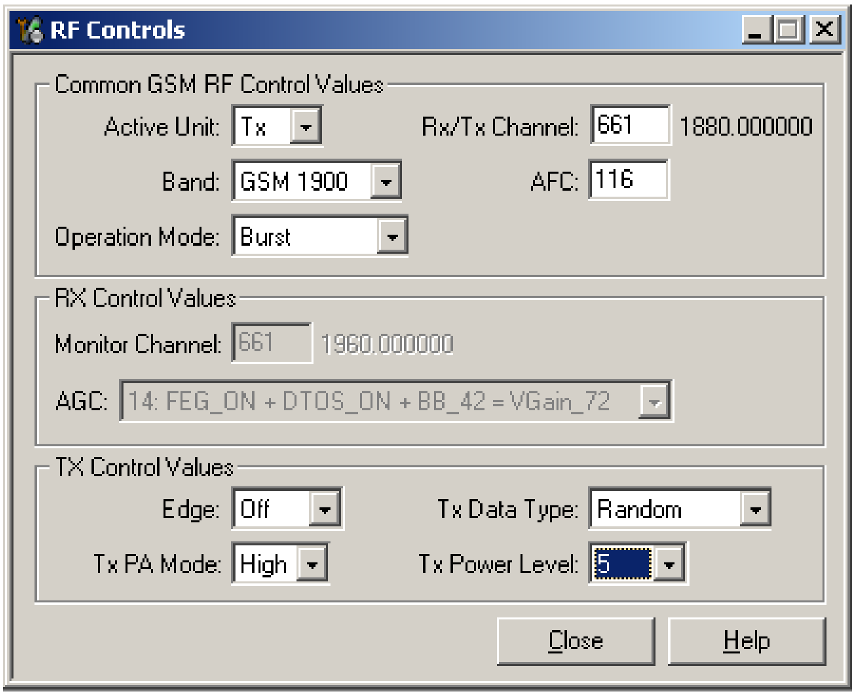
GSM1900 Transmitter

General instructions for GSM1900 TX Troubleshooting

GMSK:

- Set the operating mode to local mode.
- Select → Testing → RF Controls
- Wait until the RF Controls window is popped up
- Select → Band → GSM 1900, Active unit → TX, Operation mode → Burst, RX/TX Channel → 661, 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} = +23dBm @ 1880 MHz

If this is not the case, then go to the chapter Fault finding chart for GSM1900 transmitter, GMSK troubleshooting.

EDGE:

- Select operation mode to the local.
- Select → Testing → RF control

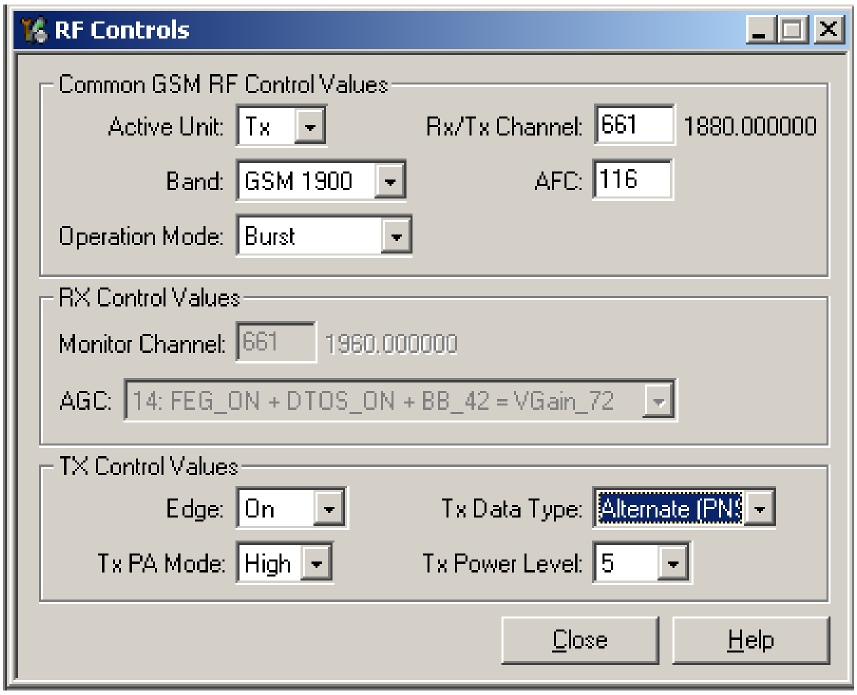
In the popup window common values:

- Active unit → TX
- Band → 1900
- Operation mode → Burst
- RX/TX Channel → 661

In the popup window TX control values:

- EDGE → ON
- Tx data type → Alternate
- TX PA mode → High
- TX Power level → 5

The setup should now look like this:



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

P_{out} = +21 dBm @ 1880 MHz

If this is not the case, then go to the next chapter 8.6.2.2 EDGE for the troubleshooting.

Fault finding chart for GSM1900 transmitter

In the following, it is assumed that the TXP signal is used as trigger-signal. For that a TXP test point is provided.

Figure 19: GSM1900 transmitter troubleshooting, GMSK

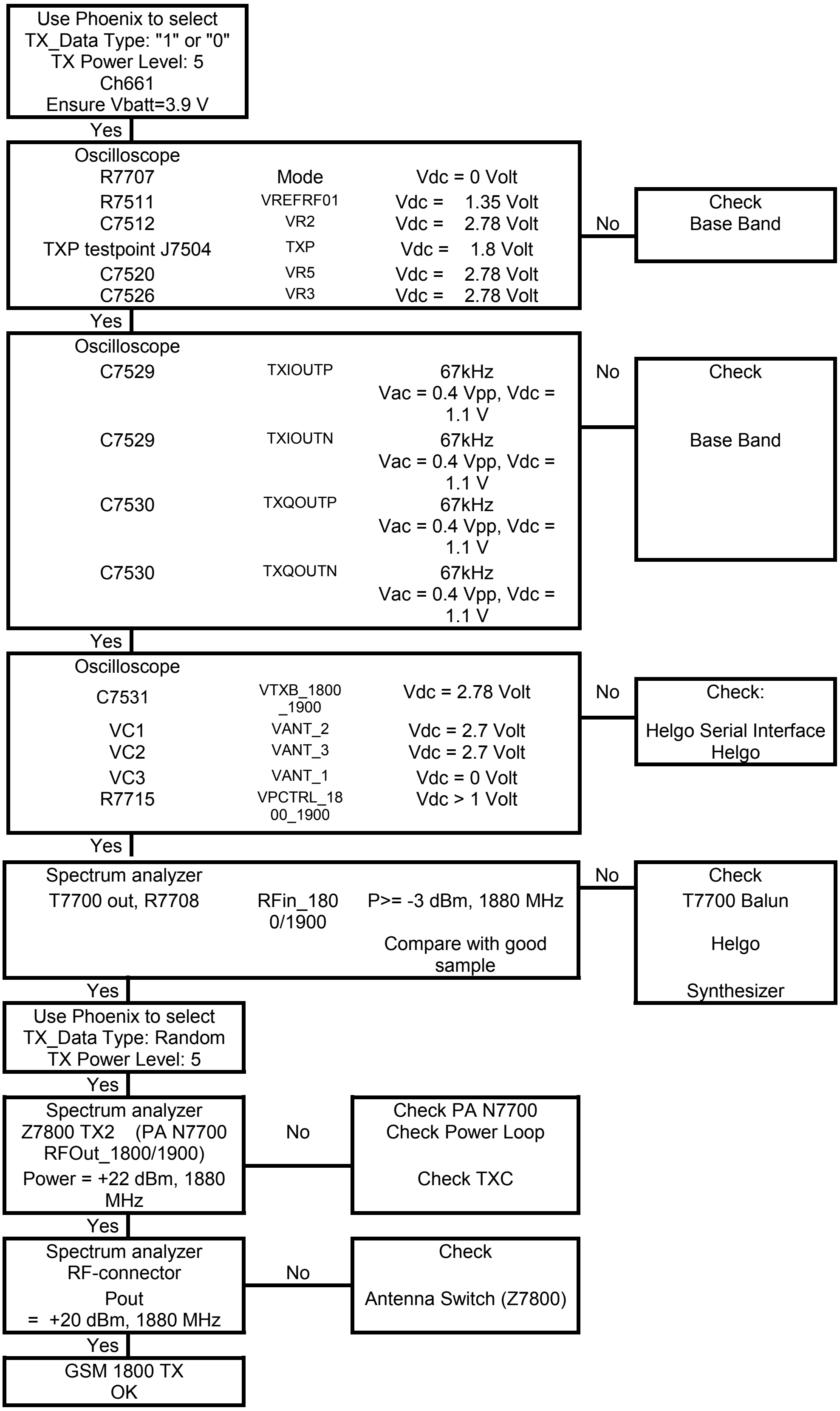
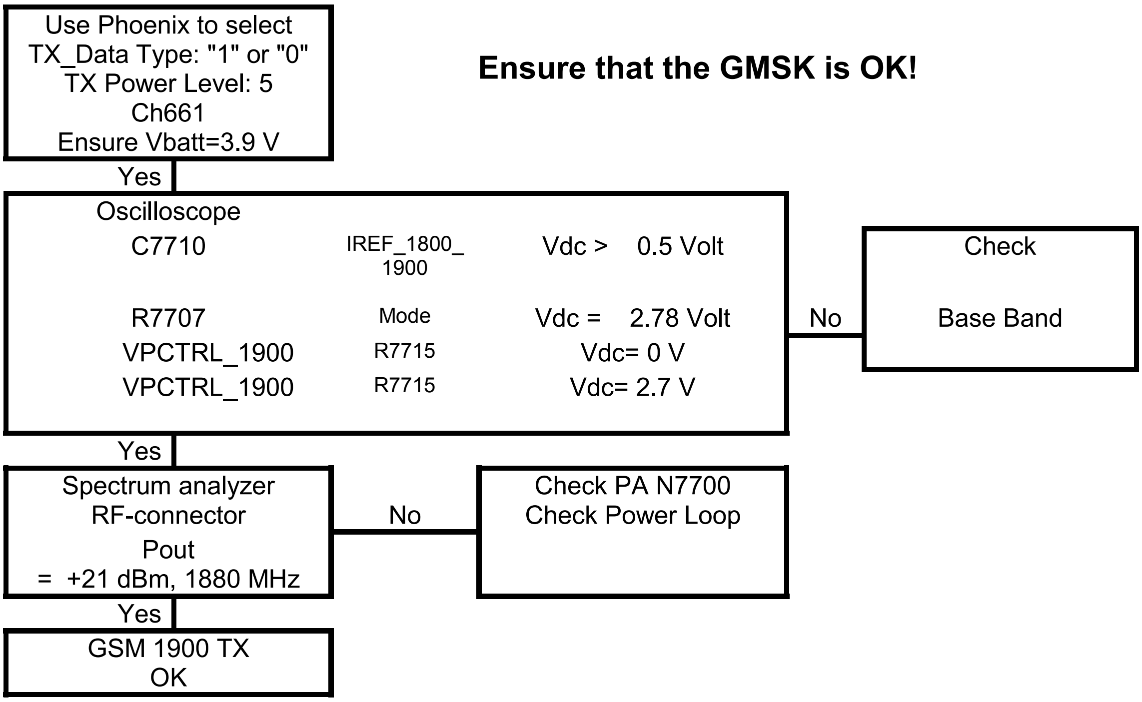


Figure 20: GSM1900 transmitter troubleshooting, EDGE



Synthesizer

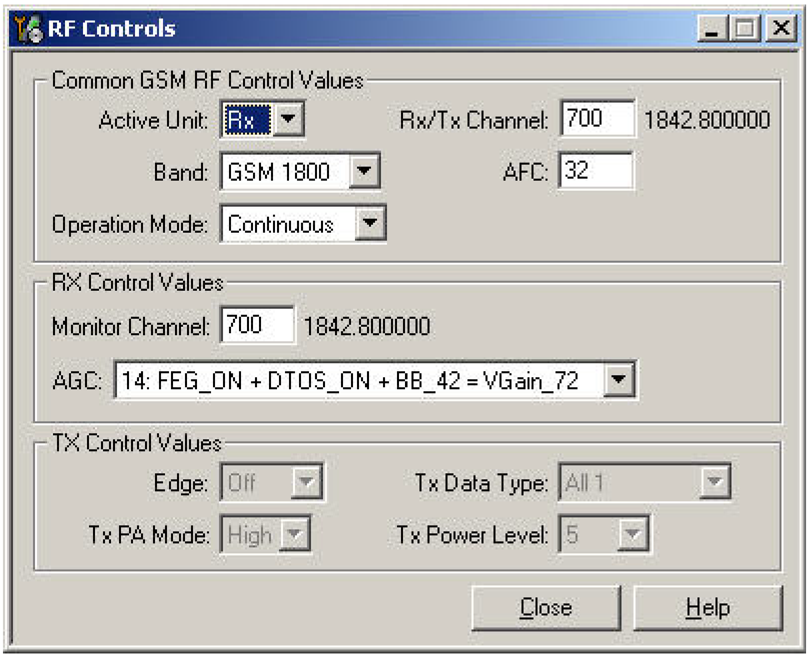
Synthesizer operation check

- Start Phoenix Service Software and open FBUS or USB connection. FBUS connection is available only with DAU-9S cable (contact via test pads on phone board) and USB connection is available only with DKU-2 cable (contact via bottom connector of the phone).
- Select “Scan Product” (Ctrl-R or in menu File - Scan Product).
- Wait until phone information is shown in the lower right corner of the screen.
- Set operating mode to local.
- Open window “RF Controls” (menu Testing - RF Controls)

Set the synthesizer to the following mode:

- Select → Band → GSM 1800
- Active unit → Rx
- Operation mode → **Continuous**
- Rx/Tx Channel → 700

The setup should now look like this:



To measure the supply voltage VR7, the tuning voltage Vc and the output frequency $f_{VCO;}$ see Figure: Test points of the synthesizer.

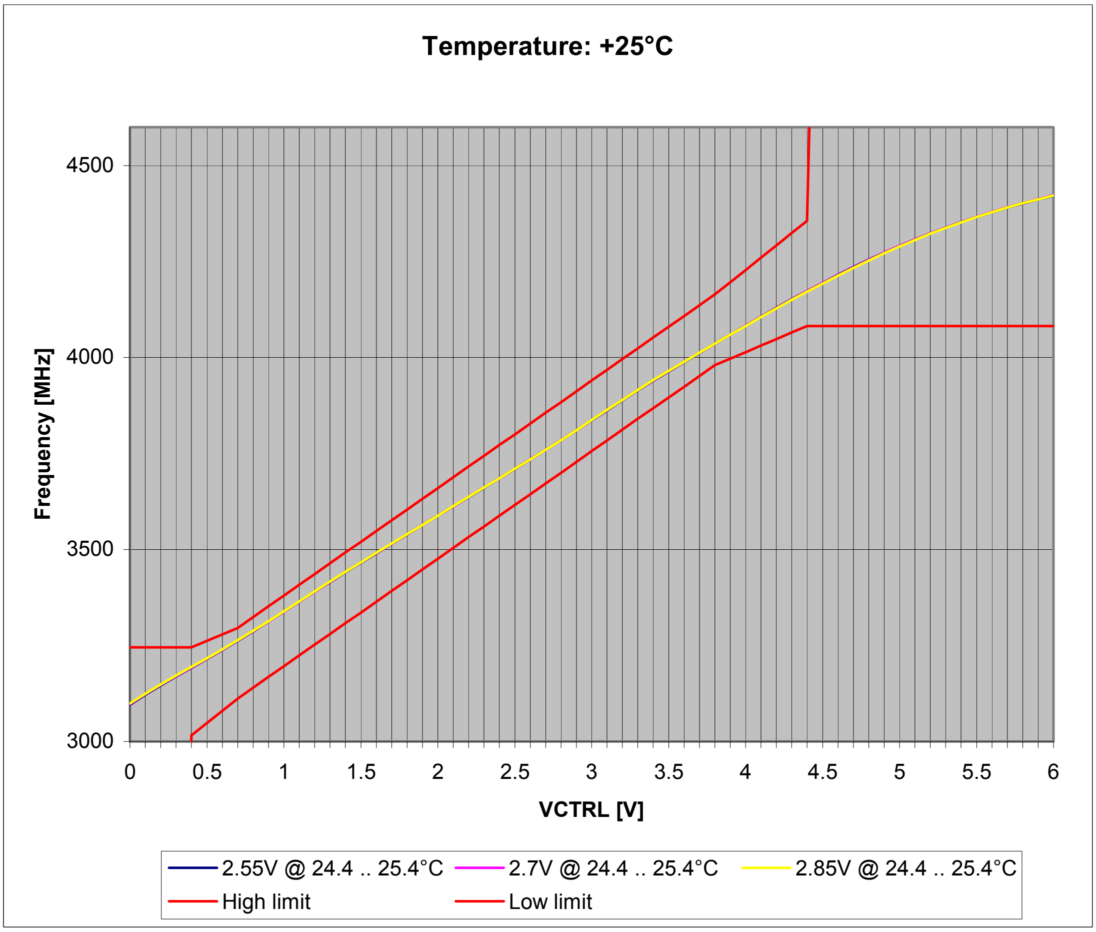
The VCO frequency is twice the Rx frequency in the GSM1800 band:

f_{VCO} = 2 * f_{RX} = 2 * 1842.8 MHz = **3685.6 MHz**. The VCO frequency shall be measured at VCO output, before or after the 2 dB resistor net attenuator (R7503).

The tuning voltage should be **2.1V_{DC} .. 2.6V_{DC}** at f_{VCO} = 3685.6MHz.

The tuning sensitivity of the VCO is typically 250MHz/V. The typical relation of VCO frequency and tuning voltage is shown in the following diagram:

Figure 1: Typical frequency tuning curve for the Matsushita VCO



If the frequency or the tuning voltage have other values than given in Figure: Typical frequency tuning curve for the Matsushita VCO, then go to chapter ..

Reference Oscillator 26 MHz (VCTCXO)

The reference oscillator is implemented as Voltage Controlled Temperature Compensated Crystal Oscillator (VCTCXO) module. The component (G7501) is located in the Small Signal chamber.

The reference oscillator has two functions:

- 26 MHz Reference frequency for the PLL synthesizer.
- 13 MHz System clock for BB (26 MHz VCTCXO signal is divided by 2 in Helgo RF ASIC N7500, 13 MHz output named REFOUT).

For an error free initial synchronization, the 26MHz frequency of the reference oscillator must be accurate enough. Therefore, an analog voltage with signal name AFC tunes the oscillator. The AFC voltage is calculated using the values “AFC value” and “AFC slope”, which are determined during Rx calibration of the low band.

Voltage Controlled Oscillator (VCO)

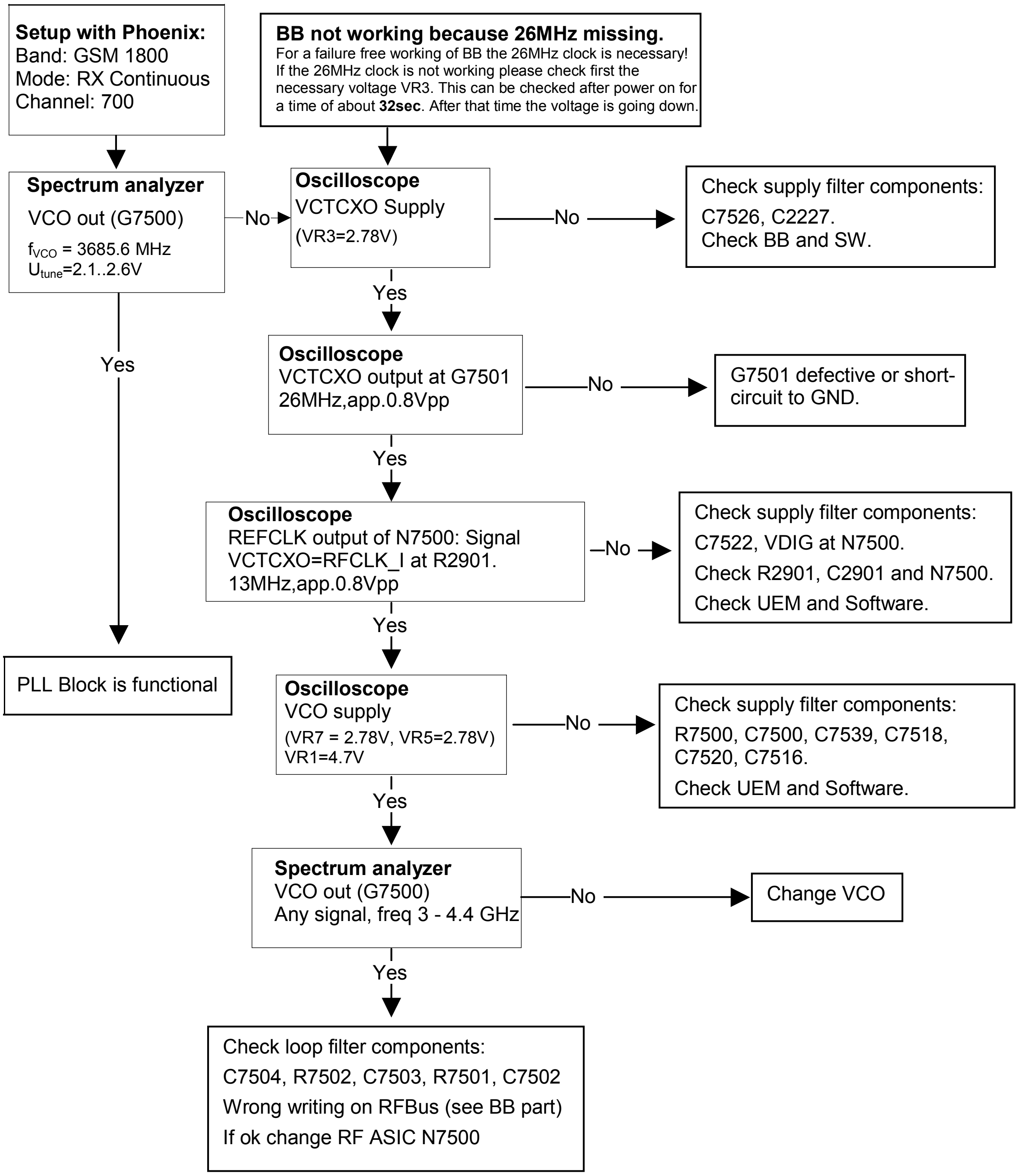
The VCO is able to generate frequencies in the range of 3296MHz to 3980MHz when the PLL is working properly. The frequency of the VCO is divided by 2 for GSM1800 and GSM1900 operation and by 4 for GSM850 and GSM900 operation. The division is done in RF ASIC and it allows the generation of all the frequencies in the GSM850, GSM900, GSM1800 and GSM1900 bands, both RX and TX range.

The output frequency of the VCO is controlled by a DC voltage (Vc) of the PLL loop filter. The valid range of Vc is 0.7V– 3.8V when the PLL is in steady state. The typical tuning sensitivity is 250MHz/V.

Even if the PLL is not working properly (Vc outside the valid range), a frequency at the output of the VCO can be detected between 3 GHz and 4.4 GHz (if the VCO itself is ok and the supply voltage VR7 = 2.78V is available).

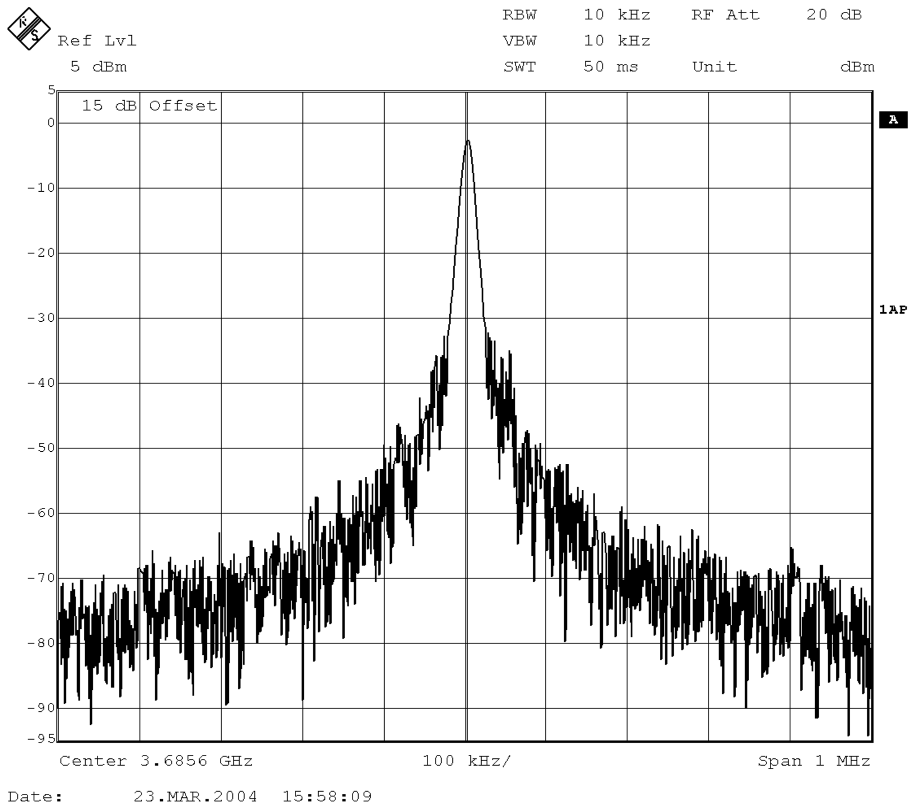
The VCO (G7500) is located under a separate fixed shield in Small Signal chamber.

Figure 2: Troubleshooting the PLL Synthesizer



It is important to note that the power supply VR3 of the VCTCXO is only switched off in the so-called ‘Deep Sleep Mode’ and the power supply VR7 of the VCO is switched off in so-called ‘Sleep Mode’.

Figure 3: VCO output, 1800 band, RX on, continuous output



Frequencies

Table 1: TX, RX and VCO frequency ranges

Band		Carrier Frequency	Divider used	VCO Frequency
GSM 850	Tx	824.2 - 848.8 MHz	4	3296.8 – 3395.2 MHz
	Rx	869.2 – 893.8 MHz	4	3476.8 – 3575.2 MHz
E-GSM900	Tx	880.2 – 914.8 MHz	4	3520.8 – 3659.2 MHz
	Rx	925.2 – 959.8 MHz	4	3700.2 – 3839.2 MHz
DCS 1800	Tx	1710.2 – 1784.8 MHz	2	3420.4 – 3569.6 MHz
	Rx	1805.2 – 1879.8 MHz	2	3610.4 – 3759.6 MHz
PCS 1900	Tx	1850.2 – 1909.8 MHz	2	3700.4 – 3819.6 MHz
	Rx	1930.2 – 1989.8 MHz	2	3860.4 – 3979.6 MHz

TX, RX and VCO frequencies for particular channel can be calculated from equations in these tables:

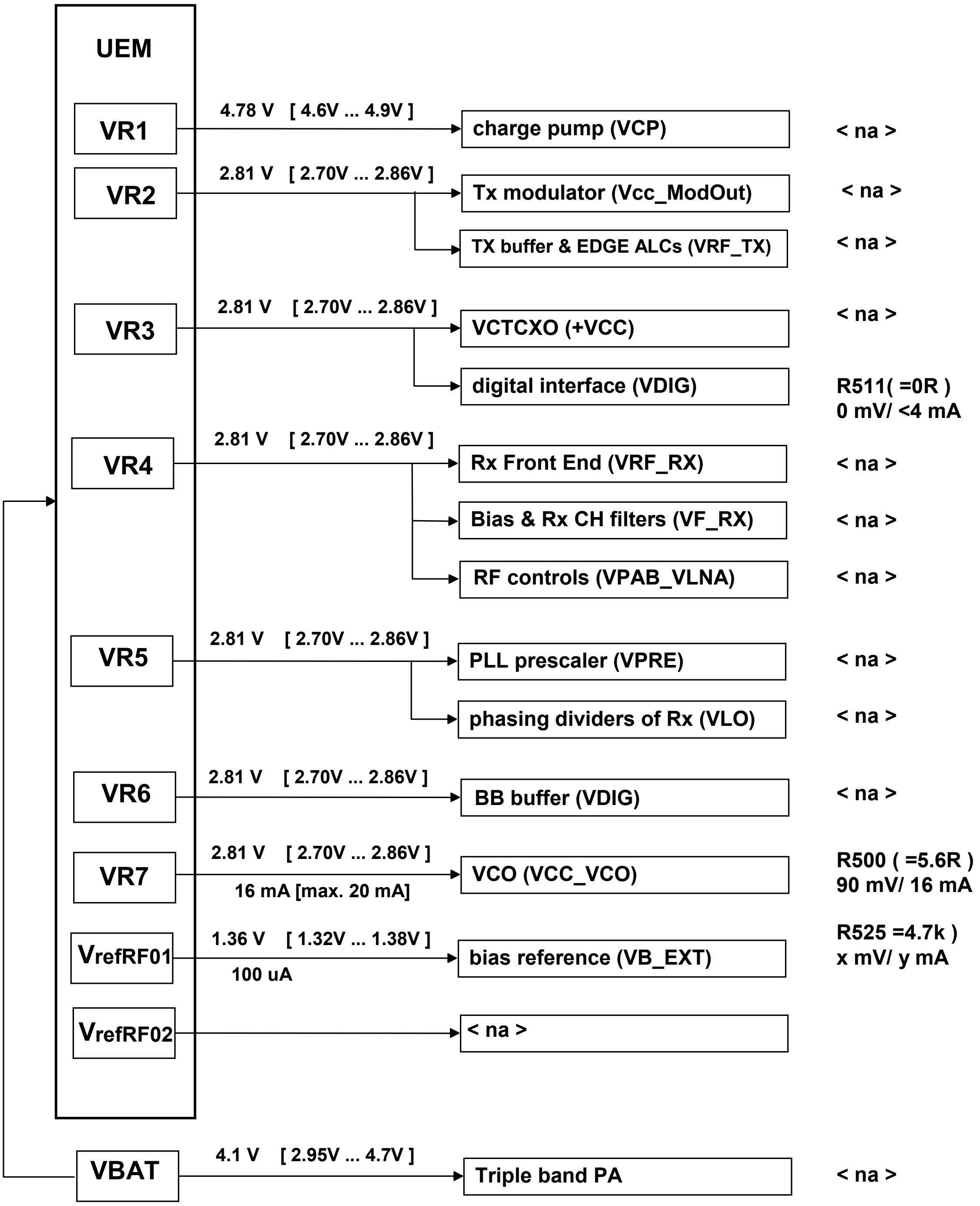
System	Channel number	TX frequency	RX frequency	Unit
GSM850	128 ≤ n ≤ 251	f = **824.2 + 0.2*(n-128)**	f = **869.2 + 0.2*(n-128)**	MHz
E-GSM 900	0 ≤ n ≤ 124	f = **890 + 0.2*n**	f = **935 + 0.2*n**	MHz
	975 ≤ n ≤1023	f = **890 + 0.2*(n-1024)**	f = **935 + 0.2*(n-1024)**	MHz
DCS1800	512 ≤ n ≤ 885	f = **1710.2 + 0.2*(n-512)**	f = **1805.2 + 0.2*(n-512)**	MHz
PCS1900	512 ≤ n ≤ 810	f = **1850.2 + 0.2*(n-512)**	f = **1930.2 + 0.2*(n-512)**	MHz

System	Channel number	VCO frequency on TX	VCO frequency on RX	Unit
GSM850	128 ≤ n ≤ 251	f = [**824.2 + 0.2*(n-128)]***4	f = [**869.2 + 0.2*(n-128)**]*4	MHz
E-GSM 900	0 ≤ n ≤ 124	f = (**890 + 0.2*n**)*4	f = (**935 + 0.2*n**)*4	MHz
	975 ≤ n ≤1023	f = [**890 + 0.2*(n-1024)**]*4	f = [**935 + 0.2*(n-1024)**]*4	MHz
DCS1800	512 ≤ n ≤ 885	f = [**1710.2 + 0.2*(n-512)**]*2	f = [**1805.2 + 0.2*(n-512)**]*2	MHz
PCS1900	512 ≤ n ≤ 810	f = [**1850.2 + 0.2*(n-512)**]*2	f = [**1930.2 + 0.2*(n-512)**]*2	MHz

DC Supply Current Check

For a quick check of DC power supplies refer to the diagram below. Voltage drops are measured at the respective resistors pads. Note, that not all currents can be checked in such a way, see the marking “na” (not applicable) in the diagram.

Figure 4: Checking the DC supply current



Phoenix Tuning

General instructions for tuning:

- Connect the phone to a PC, which has Phoenix Service Software and a dongle installed, using either Repair jig and DAU-9S (RS232) cable or DAU-9T cable (RS232) or DKU-5 cable (USB).
- Connect the phone to a power supply (DC voltage of 4.0V, min. current of 3A) and switch the phone on.
- 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”.

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 component replacements around the modulator area (RF path from UEMK via RF ASIC to RF PA) have been done, "TX IQ Tuning" is additionally required.
- In general repairs in the RX front-end always require "RX Calibration" and “Rx Band Filter Calibration” for **all three bands**.
- Repairs in the PLL circuit always require "RX Calibration" of the low band.

If the RF ASIC was replaced all calibrations mentioned above have to be done.

Semi-automatic Calibrations & Measurements - step by step: RX/TX and GSM-Bands

RX Calibration

The **RX Calibration** has to be performed to determine gains at different gain settings in the RF ASIC. The calibration must be done in **all three bands:** GSM 850/900, GSM 1800, GSM 1900.

RX Calibration requires an external RF signal generator. Most of the radio communication testers like CMD 55 or CMU 200 can be used also as RF signal generators, generating continuous RF signals (CW signal) with defined levels and frequencies.

Rx Calibration GSM850 or GSM900

- RM-8 (EU- variant) has to be calibrated on GSM 900.
- RM-9 (US- variant) has to be calibrated on GSM 850.

Open the window “Rx Calibration” in Phoenix Service Software as follows:

- Select → Tuning (Alt-U)
- Select → Rx calibration (Alt-C)

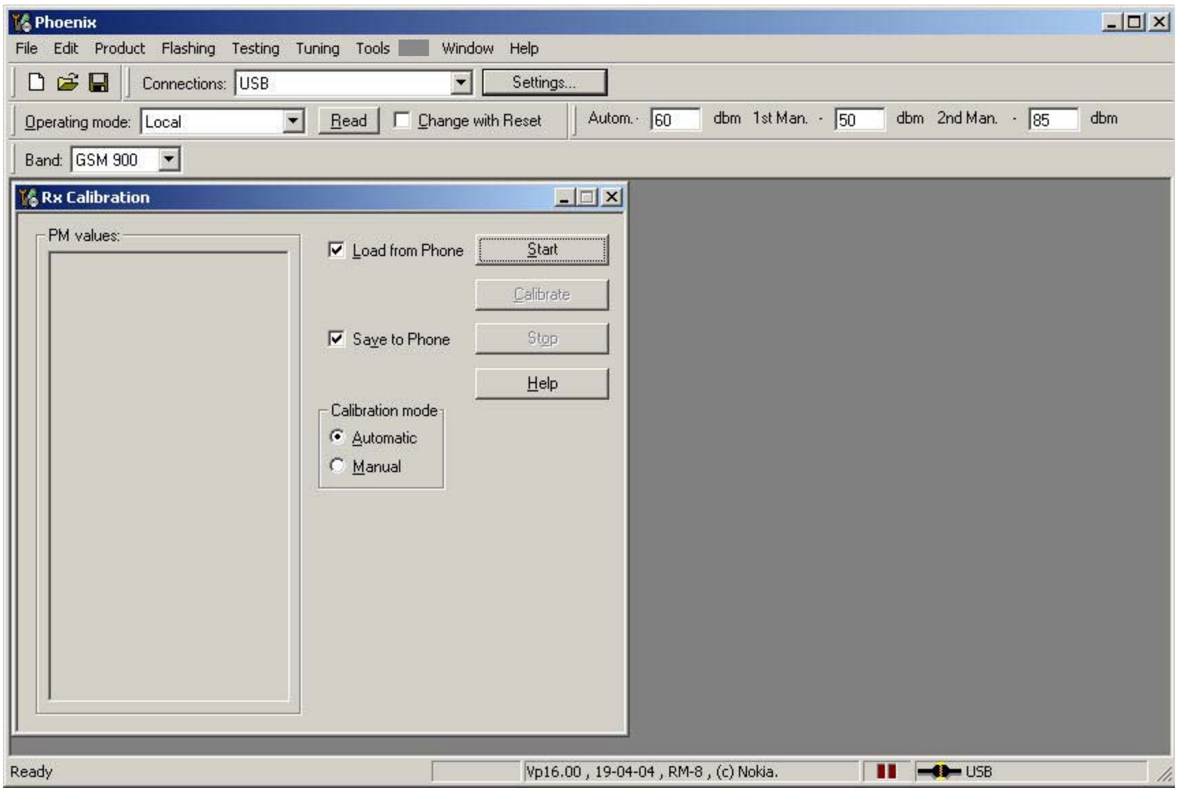
The necessary band selection is made by Phoenix automatically in the low band.

The following power levels shall be displayed in the headline:

- Automatic Calibration mode -60 [dBm]
- 1st Manual Calibration mode -50 [dBm]
- 2nd Manual Calibration mode -85 [dBm]

First, connect an RF signal generator to the antenna port of the test jig. Second, select “Calibration mode” to Automatic.

The setup should now look like this:



Press **Start:** The current calibration values are loaded from the phone memory and displayed in the window as “PM values”.

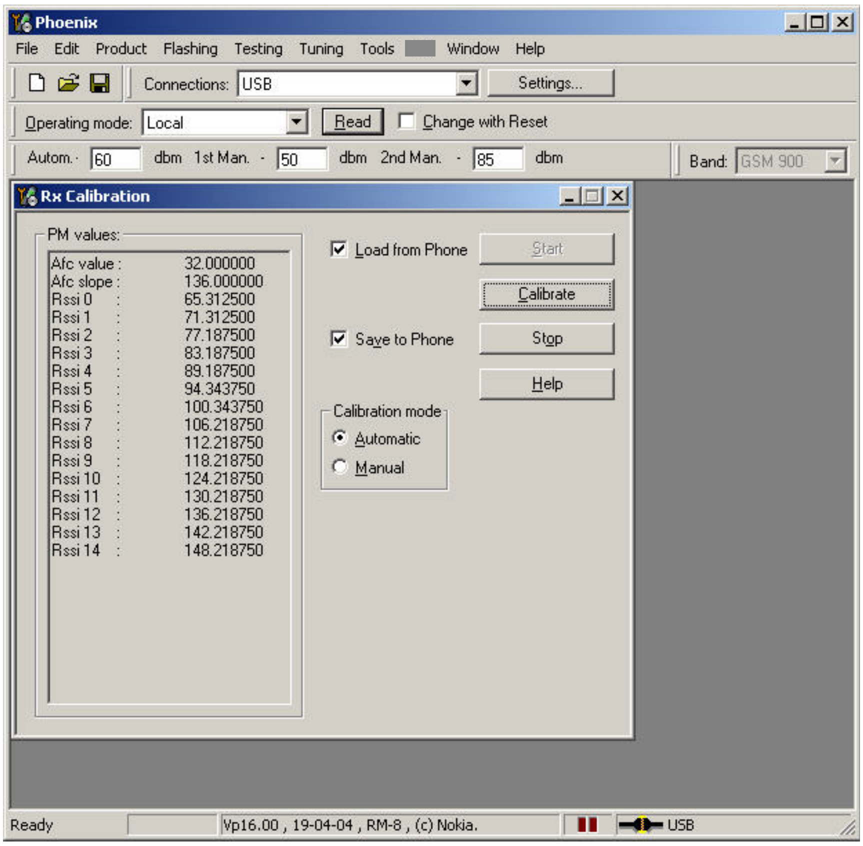
Press the **Calibrate** button and a window pops up, instructing you to set the frequency and output power of the RF signal generator:

- Power Level: -60 dBm
- Frequency: 881.667110 MHz (GSM 850) or 942.467110 MHz (GSM 900)
- Compensate for external RF cable and test jig losses.

If a radio communication tester (CMD 55, CMU 200, HP 8960, MT 8801) is used, assure that “continuous mode” is switched on and “modulation” switched off.

Press **OK** and the calibration will be executed.

Typical calibration values will look like this:



The results shall be in following limits:

Calibration value / Test case	Typical	Low limit	High limit
AFC value / check AFC_VALUE [DAC]	53	-350	+350
AFC Slope / check AFC_SLOPE [DAC]	128	90	165
Rssi 0 / Check RX GSM xxx Gain A 1 [dB]	65	59	71
Rssi 2 / Check RX GSM xxx Gain A 3 [dB]	77	71	83

GSM xxx means the selected band: GSM 850 / 900 / 1800 / 1900

Rx Calibration GSM1800 and GSM1900

Both bands are available in all variants of the triple band phones described herein. Thus, the calibration must **always be done for both bands**, GSM1800 and GSM1900.

Open the window “Rx Calibration” in Phoenix Service Software as follows:

- Select → Tuning (Alt-U)
- Select → Rx calibration (Alt-C)

- Select → Band → GSM 1800 or GSM 1900

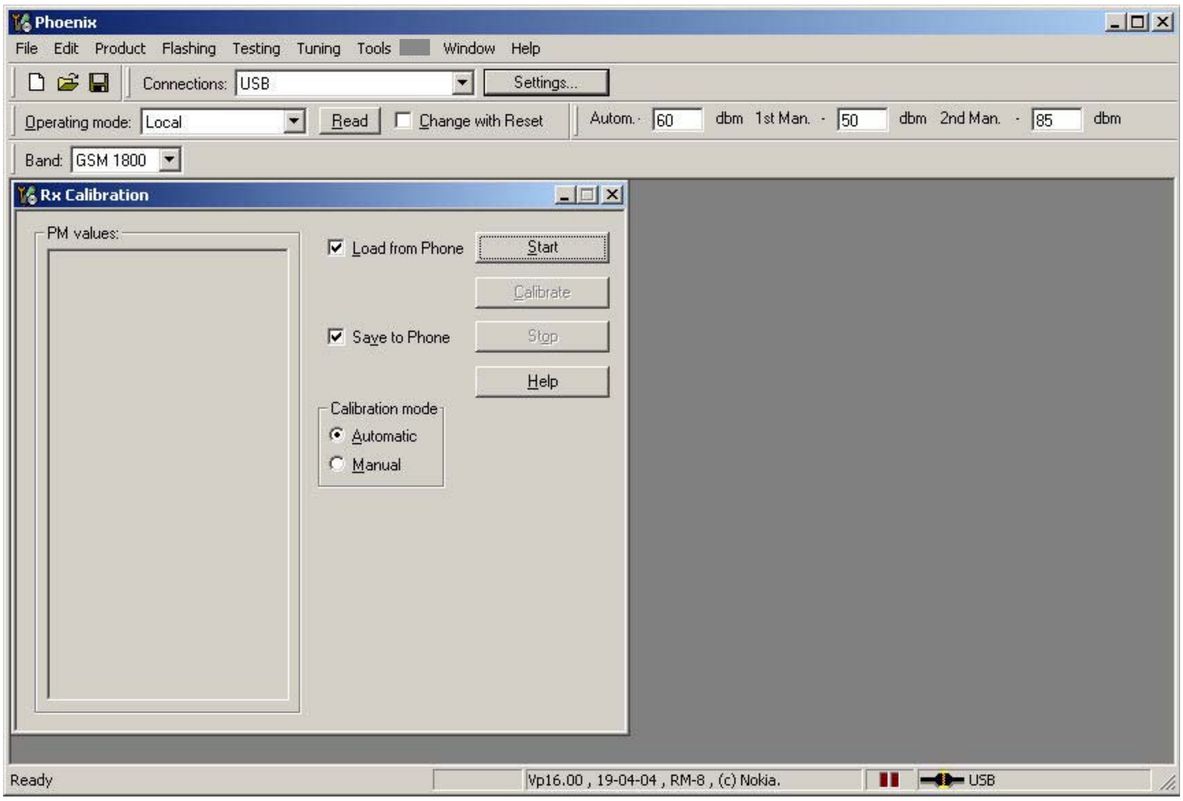
The following power levels shall be displayed in the headline:

- Automatic Calibration mode -60 [dBm]
- 1st Manual Calibration mode -50 [dBm]
- 2nd Manual Calibration mode -85 [dBm]

Connect an RF signal generator to the antenna port of the test jig.

Select “Calibration mode” to Automatic.

The setup should now look like this:



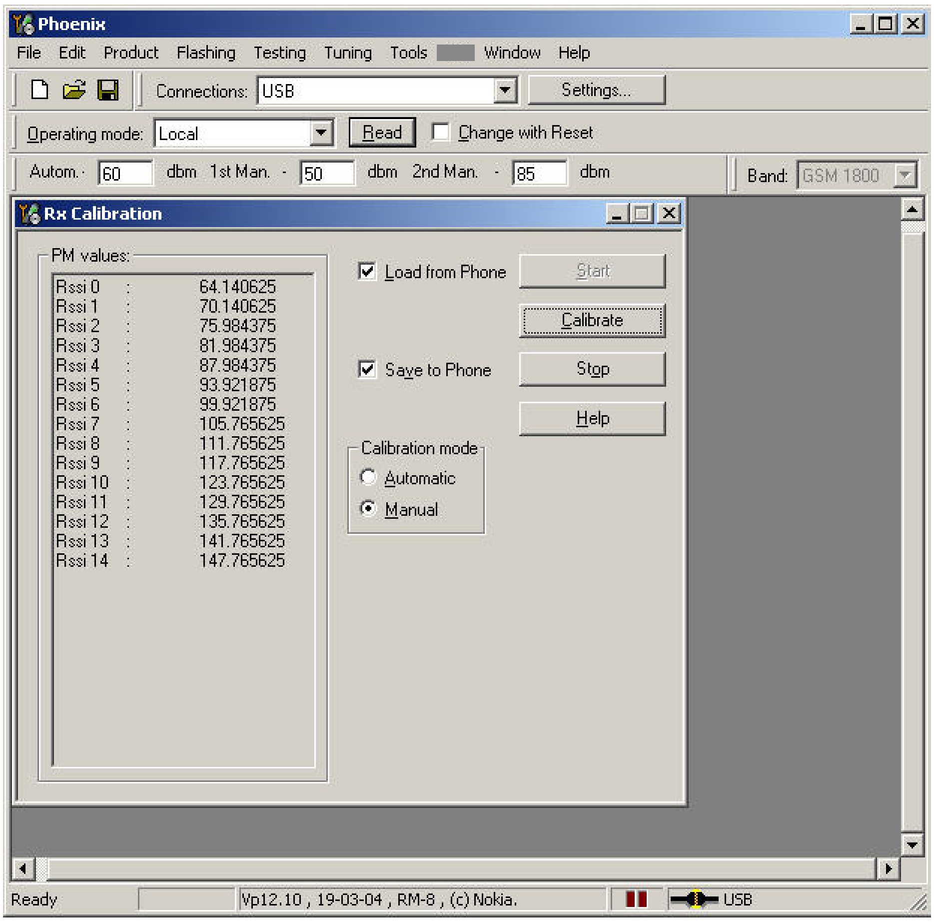
Press the **Calibrate** button and a window pops up, instructing you to set the frequency and output power of the RF signal generator:

- Power Level: -60 dBm
- Frequency: 1842.867110 MHz (GSM 1800) or 1960.067110 MHz (GSM1 900)

Compensate for external RF cable and test jig losses. If a radio communication tester (CMD55, CMU200, HP 8960, MT8801) is used, assure that “continuous mode” is switched on and “modulation” switched off.

Press **OK** and the calibration will be executed.

A typical result will look like this:



The results shall be in these limits:

Calibration value / Test case	Typical	Low limit	High limit
Rssi 0 / Check RX GSM xxx Gain A 1 [dB]	65	59	71
Rssi 2 / Check RX GSM xxx Gain A 3 [dB]	77	71	83

GSM xxx means the selected band: GSM 850 / 900 / 1800 / 1900.

RX Band Filter Response Compensation

This alignment is necessary to compensate the frequency response of the RX band filters. Rx Band Filter Response Calibration has to be done for all bands. Tuning procedure is identical for all bands; GSM 900 band filter tuning is shown here. The limits are valid for all GSM bands.

Manual Tuning

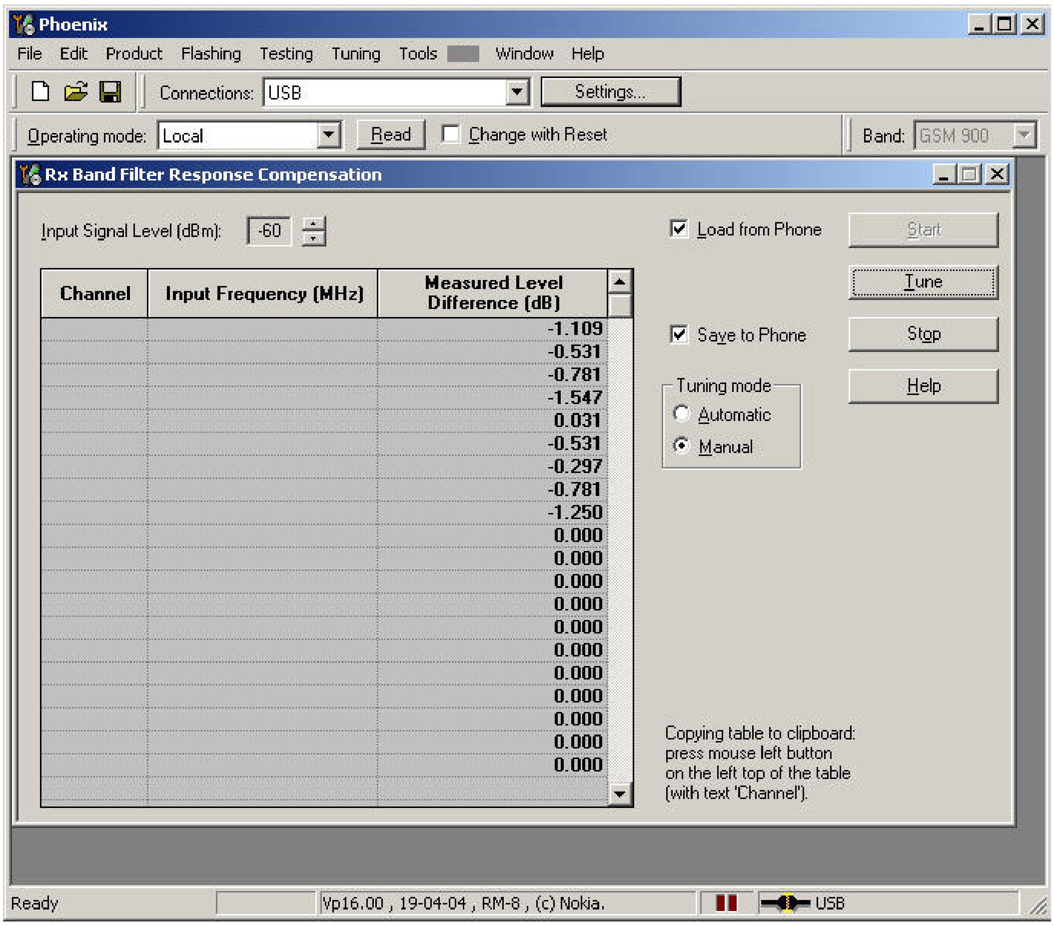
Open the window “Rx Band Filter Response Compensation” in Phoenix Service Software as follows:

- Select → Tuning (Alt-U)
- Select → Rx Band Filter Response Compensation (Alt-C)

The necessary band selection is made by Phoenix automatically in the low band.

Press Start and the current “Level Differences (dB)” are loaded from the phone memory and displayed on the “Rx Band Filter Response Compensation” window.

The setup should now look like this:



Connect an RF signal generator to the antenna port of the test jig.

If a radio communication tester (CMD 55, CMU 200, HP 8960, MT 8801) is used, assure that "continuous mode” is switched on and “modulation” switched off.

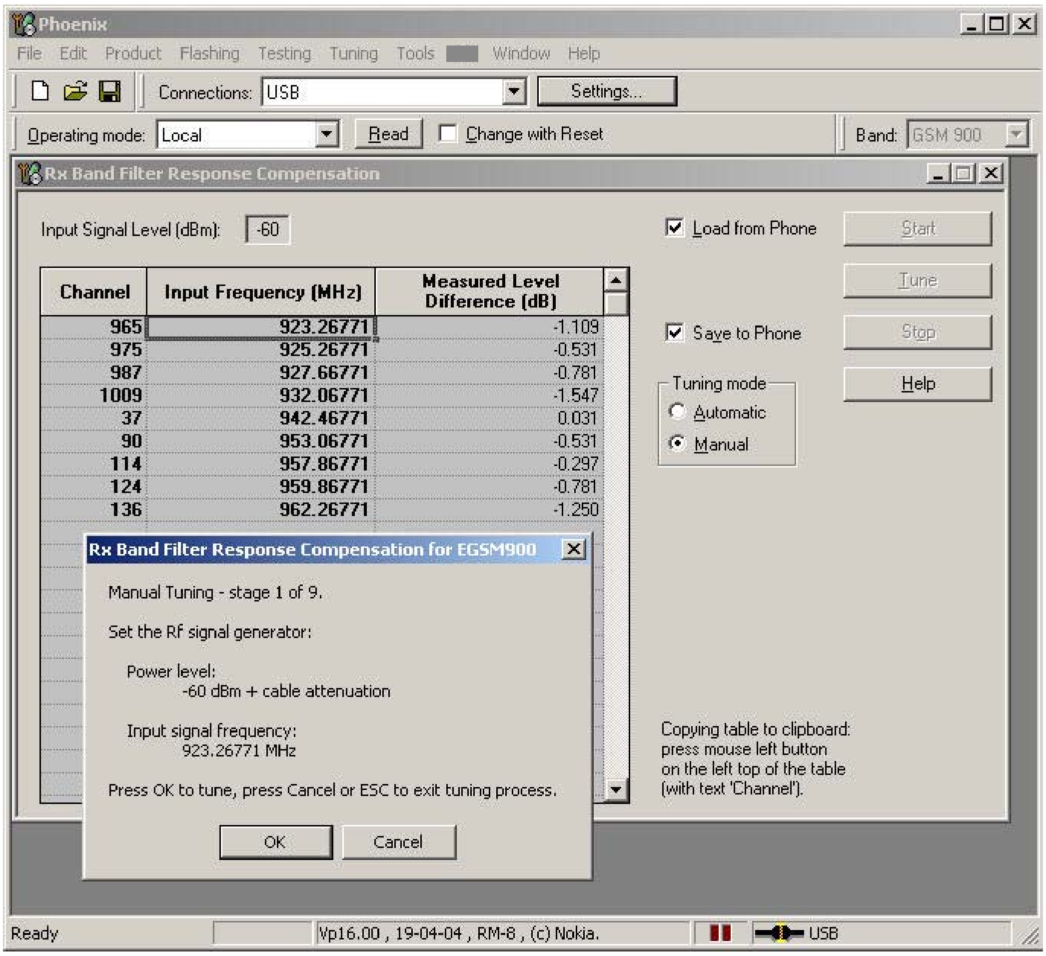
Compensate for external RF cable and test jig losses.

- Press **Tune** in Phoenix.
- Adjust the “Input signal Level (dBm)” field to -60 [dBm] on the “Rx Band Filter Response Compensation” window.

Set the RF source as indicated in the pop- up window:

- Power Level: -60 dBm
- Frequency: 923.267710 MHz
- Press **OK**.

The setup should now look like this:



- Follow the instructions for power level and signal frequency input for the remaining “Manual Tuning” stages 2 to 9 as indicated on the pop-up window.
- Press **OK** after each step.
- Press **Stop** to finalize the tuning.

Auto Tuning

A faster and more comfortable method for Band Filter Calibration is automatic tuning. This requires an RF signal generator that can be:

- Internally programmed for sweeping or
- Externally controlled by a PC and a SW-program, e.g. HP Vee: Rx_AGC+Bandfilter_Cal.vee.

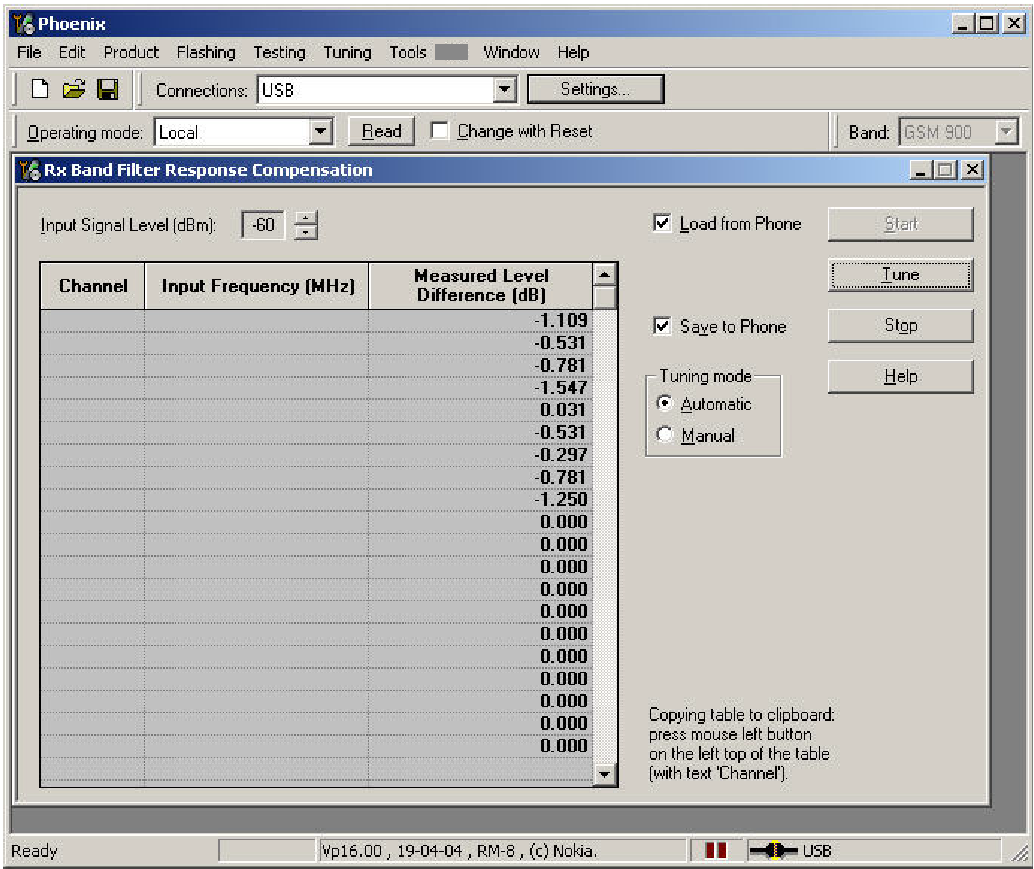
Open the window “Rx Band Filter Response Compensation” in Phoenix Service Software as follows:

- Select → Tuning (Alt-U)
- Select → Rx Band Filter Response Compensation (Alt-C)

The necessary band selection is made by Phoenix automatically in the low band.

- Select **automatic** in the “Tuning mode” in the “Rx Band Filter Response Compensation” window.
- Press **Start** and the current “Level Differences (dB)” are loaded from the phone memory and displayed on the “Rx Band Filter Response Compensation” window.

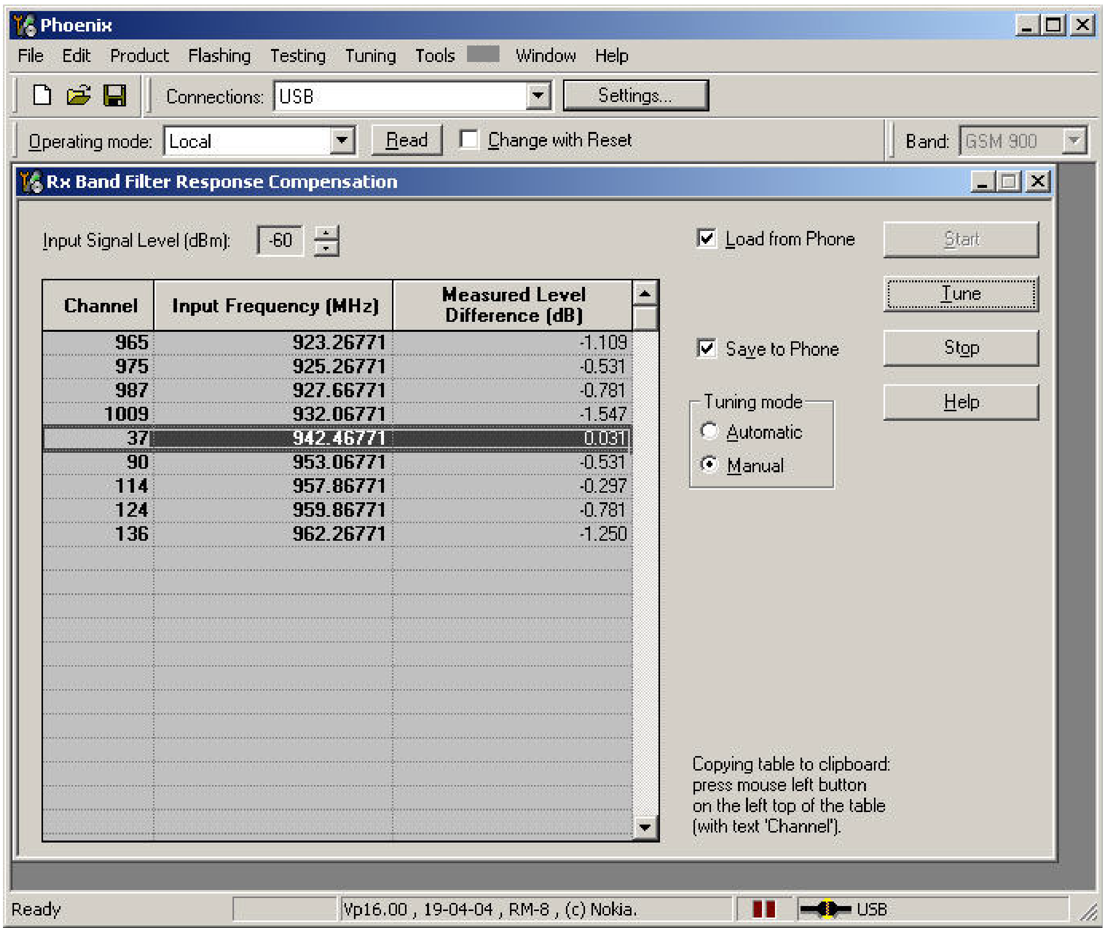
The setup should now look like this:



- Adjust the “Input signal Level (dBm)” field on the “Rx Band Filter Response Compensation” window to **-60 [dBm].**
- Press **Tune** in Phoenix.
- Set the RF signal generator to -60 dBm and program it according to the list of frequencies that is shown in the pop- up window “ Rx Band Filter Response Compensation for GSM 900”.
- Connect the RF signal generator to the antenna port of the test jig respectively the phone.
- Compensate for external RF cable and test jig losses.
- Press **OK**.
- Press **Stop** to finish.

Limits

The typical value of the “Measured Level Difference (dB)” on channel 37 (middle of band) shall be approximately 0 dB.

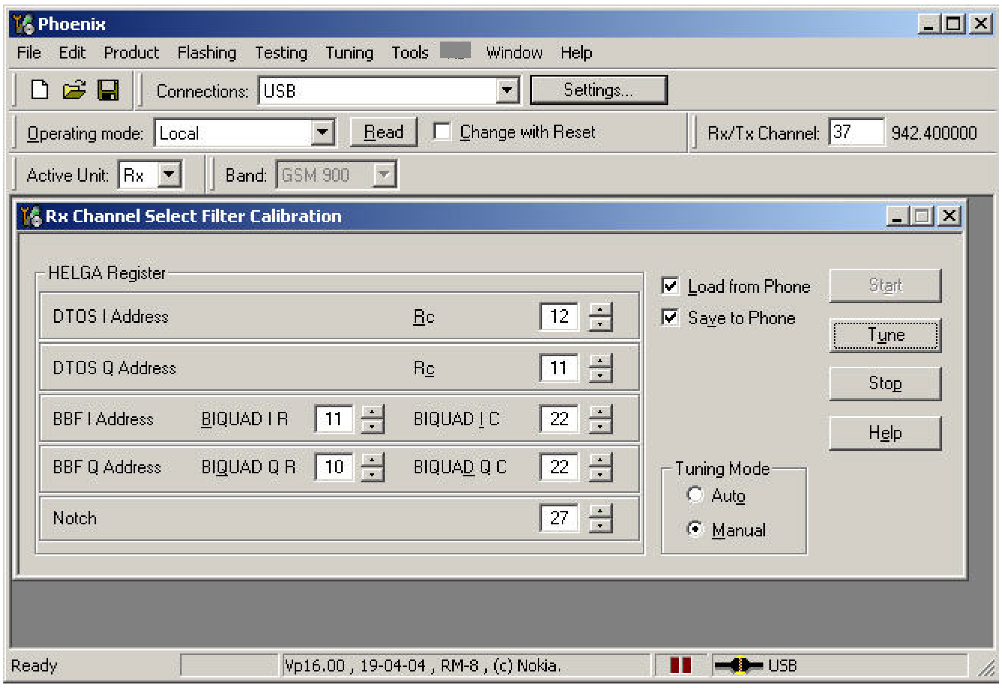


RX Channel Select Filter Calibration

Rx Channel Select Filter is a base band filter inside RF ASIC. There is an internal calibration routine for calibrating the channel filter and it is done without external RF signal. The Channel select filter is common part for all bands and **it shall be calibrated only in one band**.

- Set operating mode to local mode.
- Select → Tuning (Alt-U)
- Select → Rx Channel Select Filter Calibration (Alt-H)

The setup should now look like this:



Select **Auto** in the “Tuning mode” in the “Rx Channel Select Filter Calibration” window.

Press **Tune** and the optimal values are found.

Press **Stop**, the values are saved to the phone and the calibration has finished.

The results shall be in following limits:

Calibration value / Test case	Typical	Low limit	High limit
DTOS I Address Rc / check rx baseband filter DTOS_I [DAC]	21	-6	+37
DTOS Q Address Rc / check rx baseband filter DTOS_Q [DAC]	21	-6	+37
BBF I Address BIQUAD I R / check rx baseband filter BIQUAD_IR [DAC]	21	-6	+37
BBF I Address BIQUAD I C / check rx baseband filter BIQUAD_IC [DAC]	21	-6	+37
BBF Q Address BIQUAD Q R / check rx baseband filter BIQUAD_QR [DAC]	21	-6	+37
BBF Q Address BIQUAD Q C / check rx baseband filter BIQUAD_QC [DAC]	21	-6	+37
Notch / check rx baseband filter NOTCH [DAC]	21	-6	+37

TX Power Level Tuning

RM-8 and RM-9 supports GMSK and EDGE mode for the Power amplifier.
Therefore the Power level tuning must be carried out for both modes in each band.It is strongly recommended to use **Phoenix Autotune** capability.

The functionality of Phoenix Autotune is described in 11.3 Fully automatic Calibration, Tuning & Measurement by Phoenix. Nevertheless manual tuning is described below.

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.

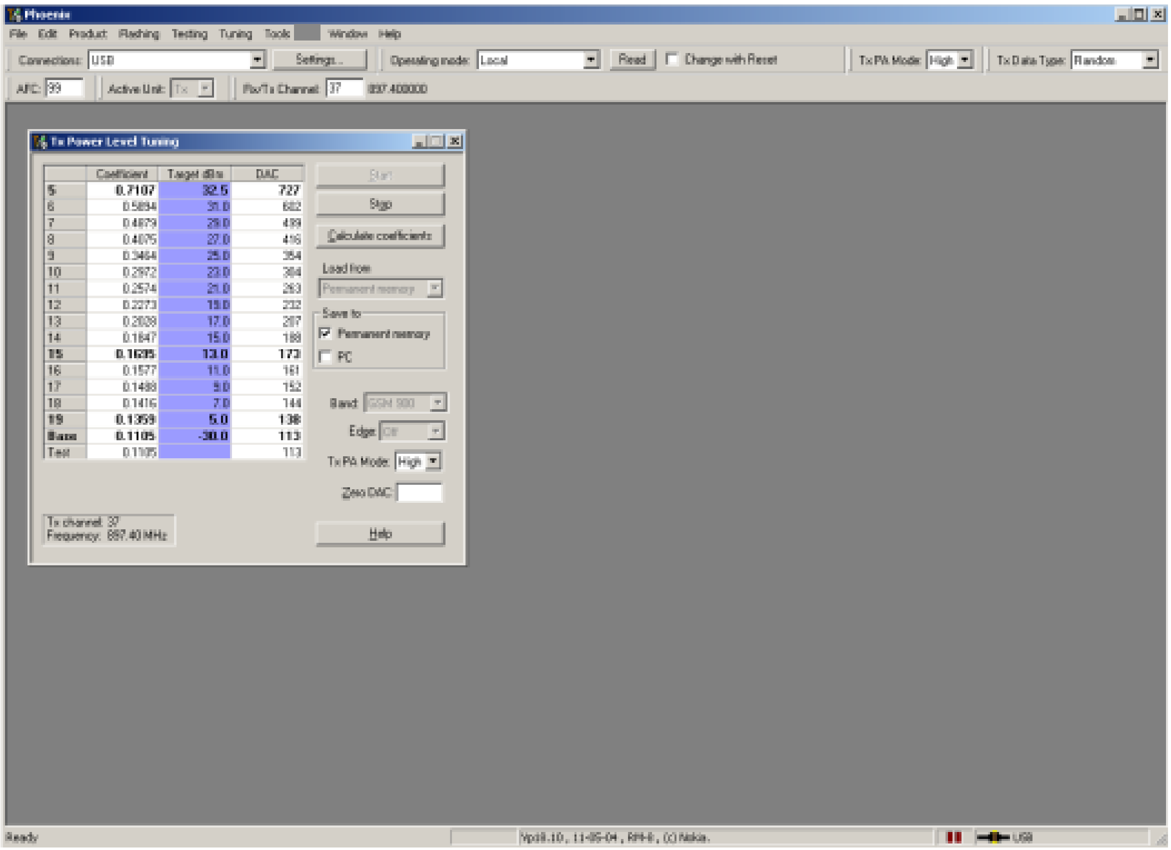
Set power supply voltage Vcc=3.9V!

Tx Power Level Tuning GSM850, GSM900, GSM 1800 and GSM 1900 in GMSK mode

Tuning of GSM850, GSM900, GSM 1800 and GSM 1900 work in the same manner, only the band settings are different.

- Start Phoenix Service Software and open USB (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 → Tuning → TX Power Level Tuning
- Wait until the TX Power Level Tuning window is popped up.
- Connect a **calibrated** power meter to the RF connector of the phone.
- Select →Load from → Permanent memory
- Select → Band → For example GSM900
- Set Edge Off.

Press Start and a window pops up:



- Select → TX Data Type → Random
- Select → TX PA Mode → High

Adjust DAC Values in TX PA mode ‘High’ for **bold** power levels according to target values:

Table 2: GSM850, GSM900

Power level	Target power		Power level	Target power
5	32.5 dBm		13	17 dBm
6	31 dBm		14	15 dBm
7	29 dBm		15	13 dBm
8	27 dBm		16	11 dBm
9	25 dBm		17	9 dBm
10	23 dBm		18	7 dBm
11	21 dBm		19	5 dBm
12	19 dBm		Base	-27 dBm

Table 3: GSM1800, GSM 1900

Power level	Target power		Power level	Target power
0	29.5 dBm (30.5dBm for GSM1900)		9	12 dBm
1	28 dBm		10	10 dBm
2	26 dBm		11	8 dBm
3	24 dBm		12	6 dBm
4	22 dBm		13	4 dBm
5	20 dBm		14	2 dBm
6	18 dBm		15	0 dBm
7	16 dBm		Base	-27 dBm
8	14 dBm			

The power levels may differ from the target power levels mentioned in Phoenix.

Make sure that the output power for maximum Power Level 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 coefficients

Check if all levels match the target values, correct if necessary.

- - Select → Save to → Permanent memory
- - Press Stop

TX Power Level Tuning is finished!

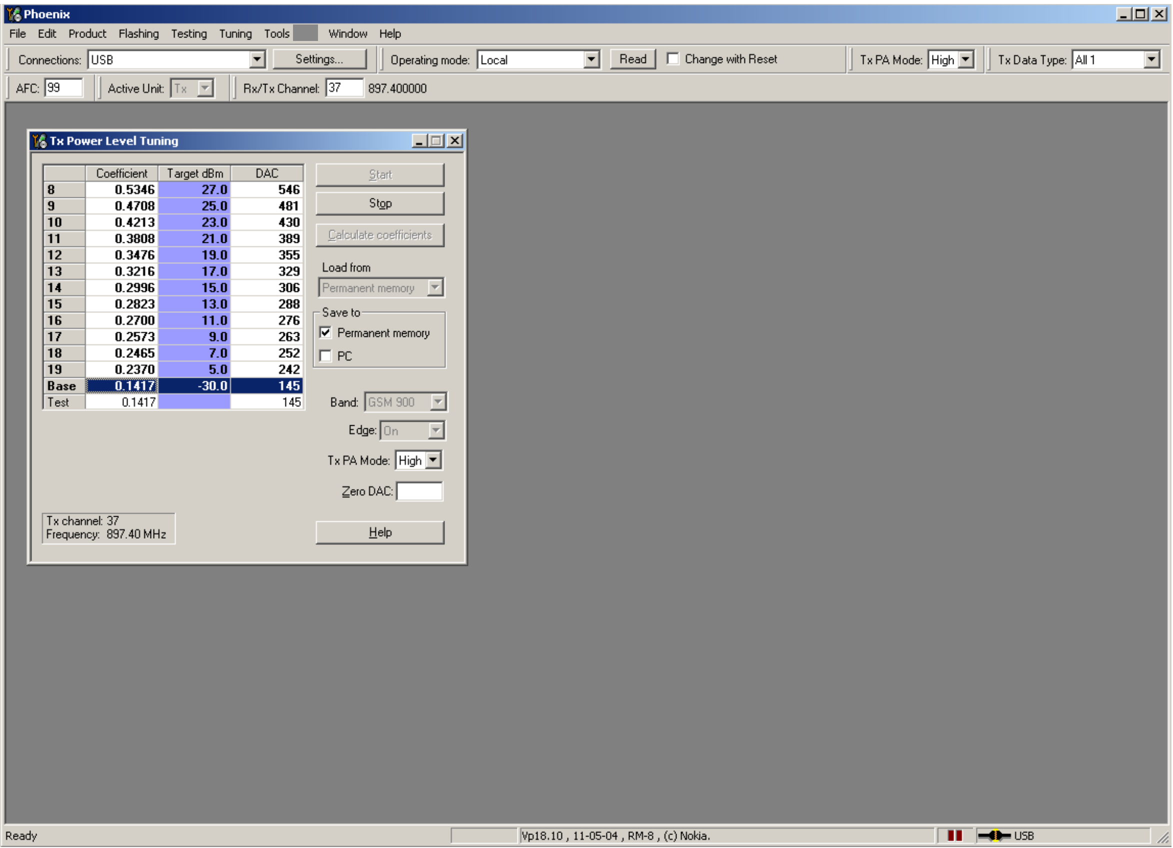
Tx Power Level Tuning GSM850, GSM900, GSM1800 and GSM1900 in EDGE mode

Tuning of GSM850, GSM900, GSM 1800 and GSM 1900 work in the same manner, only band settings are different.

- Start Phoenix Service Software and open USB (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 → Tuning → TX Power Level Tuning
- Wait until the TX Power Level Tuning window is popped up.
- Connect a **calibrated** power meter to the RF connector of the phone.
- Select → Load from → Permanent memory

- Select →Band → For example GSM900
- Set Edge On.

Press Start and a window pops up:



- Select →TX Data Type → **All1**
- Select →TX PA Mode → High

Adjust DAC Values in TX PA mode ‘High’ for all power levels according to the target values:

Table 4: EGPRS850, EGPRS900

Power level	Target power		Power level	Target power
8	27.9 dBm		16	12.4 dBm
9	26.4 dBm		17	10.4 dBm
10	24.4 dBm		18	8.4 dBm
11	22.4 dBm		19	6.4 dBm
12	20.4 dBm		Base	-17 dBm
13	18.4 dBm			
14	16.4 dBm			
15	14.4 dBm			

Table 5: EGPRS1800, EGPRS1900

Power level	Target power		Power level	Target power
2	26.4 dBm		10	11.4 dBm
3	24.9 dBm		11	9.4 dBm
4	23.4 dBm		12	7.4 dBm
5	21.4 dBm		13	5.4 dBm
6	19.4 dBm		14	3.4 dBm
7	17.4 dBm		15	1.4 dBm
8	15.4 dBm		Base	-17 dBm
9	13.4 dBm			

The power levels may differ from the target power levels mentioned in Phoenix.

Make sure that the output power for maximum Power Level 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 27 dBm for Power Level 8 if the saturation output power is only 28 dBm.

- Press → Calculate coefficients

Check if all levels match the target values, correct if necessary.

- Select → Save to → Permanent memory
- Press Stop

TX Power Level Tuning is finished!

TX I/Q Tuning

This tuning must be performed in all three bands in GMSK or EDGE mode.

The tuning is carried out exactly the same way in each band and is therefore described only once.

- Set supply voltage to 3.9V.
- Start Phoenix Service Software and open USB (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 →Tuning → TX IQ Tuning
- Wait until the TX IQ Tuning window is popped up.

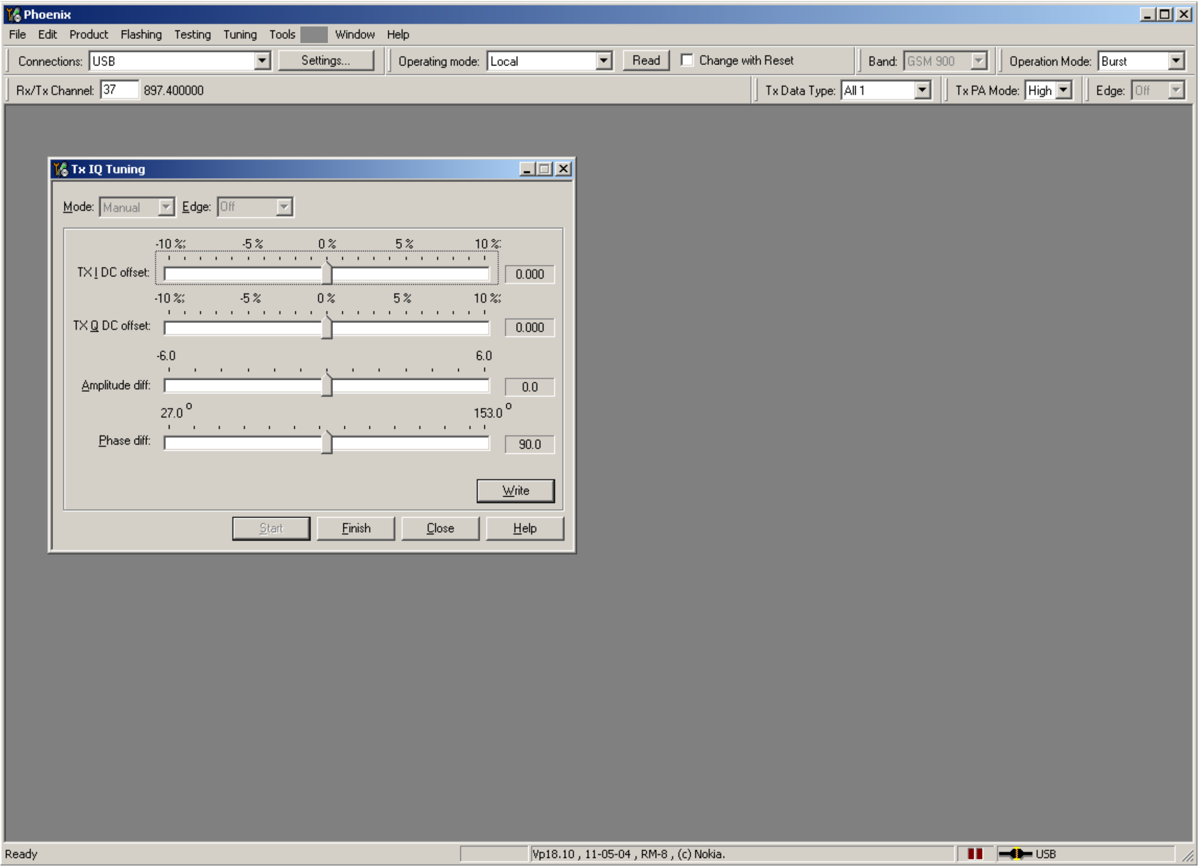
Connect a Spectrum Analyzer or GSM tester with the option 'Narrow Spectrum' to the antenna pads of the phone.

If a spectrum analyzer is used, make the following settings, adjust Center frequency and Markers according to bands.

	GSM900
Center Frequency	897.4 MHz
Frequency Span	300 kHz
Resolution Bandwidth	3kHz
Video Bandwidth	3kHz
Sweep Time	3 sec.
Sweep Type	Clear/Write
Detector Type	Max Peak
Reference level	35 dBm
Marker 1	897.33229 MHz
Marker 2	897.4 MHz
Marker 3	897.46771 MHz

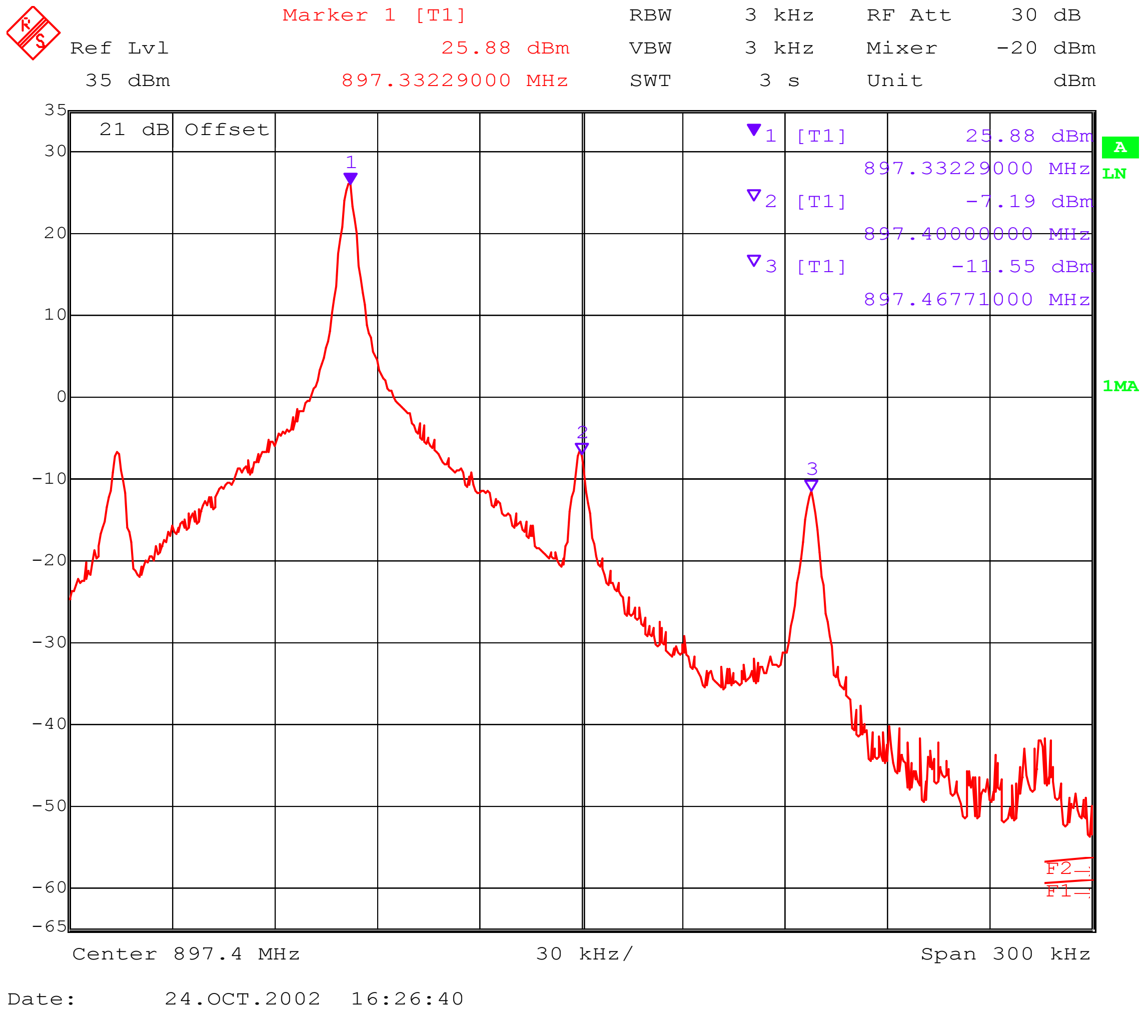
- Select → Load from → Permanent memory
- Select → Band → For example GSM900
- Set Edge On/Off.

Press Start and a window pops up:



- Select →TX Data Type → All 1

The Spectrum Analyzer now shows a plot like this:

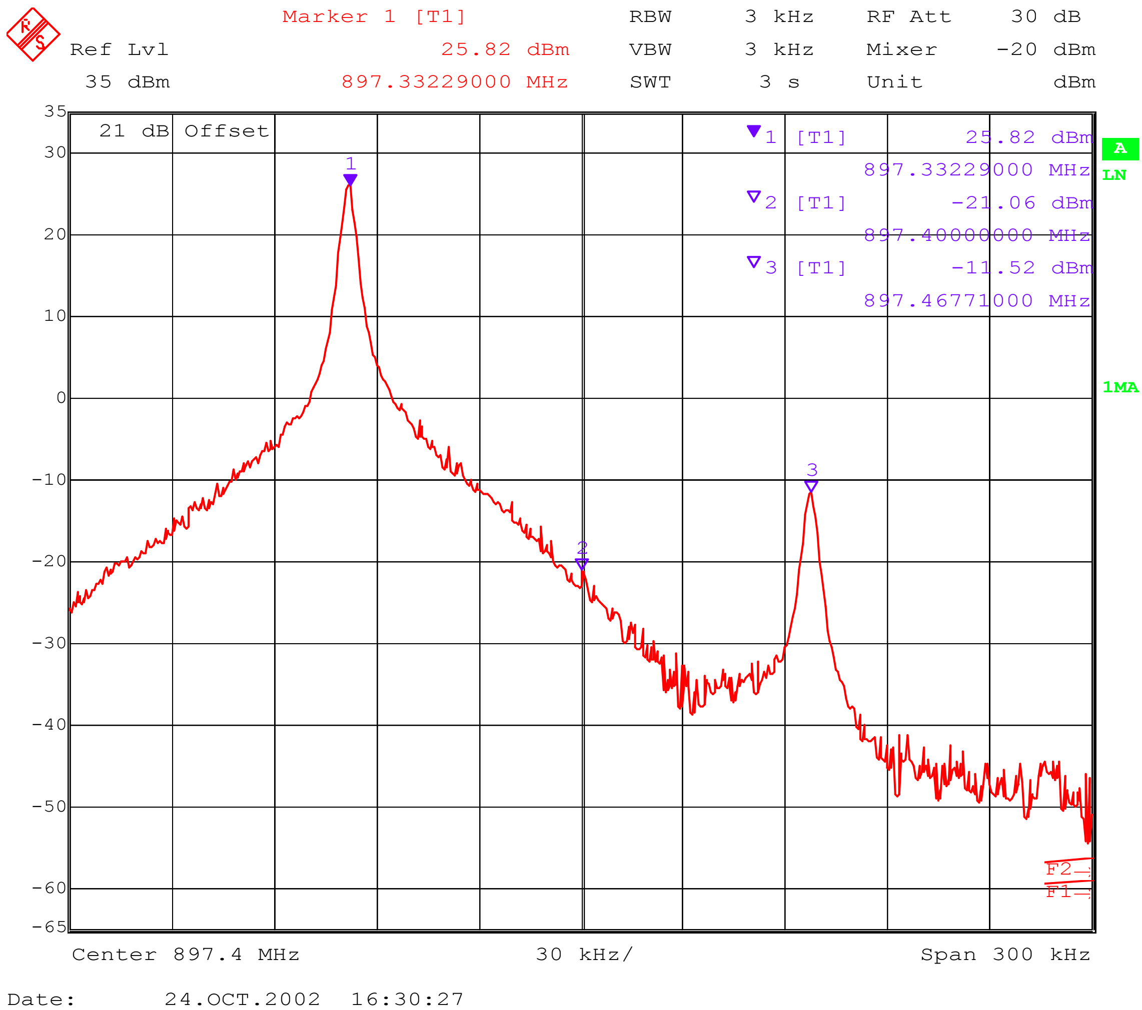


The purpose of this alignment is to tune the carrier signal (at marker 2) and the +67kHz signal (at marker 3) to a minimum level.

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.

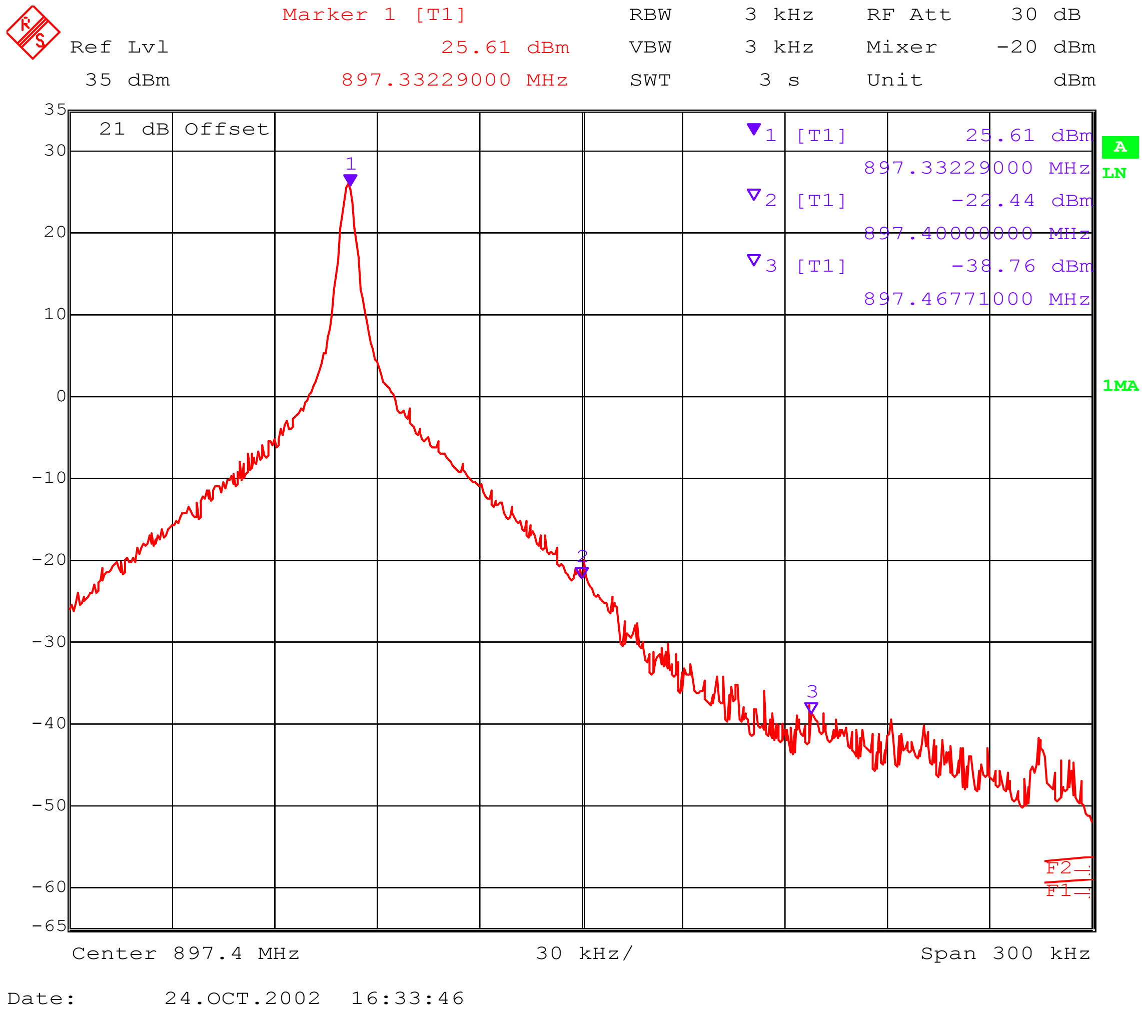
The Spectrum Analyzer now shows a plot like this:



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	-6	6
TX Q DC offset	0	-6	6
Amplitude difference	0	-1	1
Phase difference	90	80	100

- Select → Write
- Press Finish

The values are stored to 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

Note! Compensation of cable and jig losses is only possible with a CS-dongle.

Fully automatic Calibration, Tuning & Measurement by Phoenix “Auto-Tune”

Auto-tune is designed to align the phone' s RF part easier and faster, it calibrates, tunes and measures the following for RM-8 and RM-9:

- Rx channel select filter calibration
- Rx calibration
- RX band filter response compensation
- RX Dtos balance calibration
- Rx AM suppression
- Tx power level tuning
- Tx I/Q tuning

and saves the results in a log-file, if wanted.

Preparations for Phoenix

Copy the ini-file: autotune_RM-8.ini, autotune_RM-9.ini to the root directory of Phoenix. Follow the general instructions for tuning in chapter 11. Phoenix tuning.

Compensation of cable and jig loses

Measure the losses of the feeding cable(s) between the phone and the Radio Communication Tester respective the network consisting of RF generator and Signal Analyzer. The set up of the measurement equipment and its cabling are shown in the HELP-program “Environment”.

- Follow the path: Tuning → Auto-Tune → Help → Environment

Note: Only the proposed measurement equipment listed in “Environment” is supported.

Selection of measurement equipment:

- one Tx and one Rx measurement equipment each from the Tx and Rx lists or
- one from the Rx/Tx list (only Rohde & Schwarz CMU 200 currently supported)

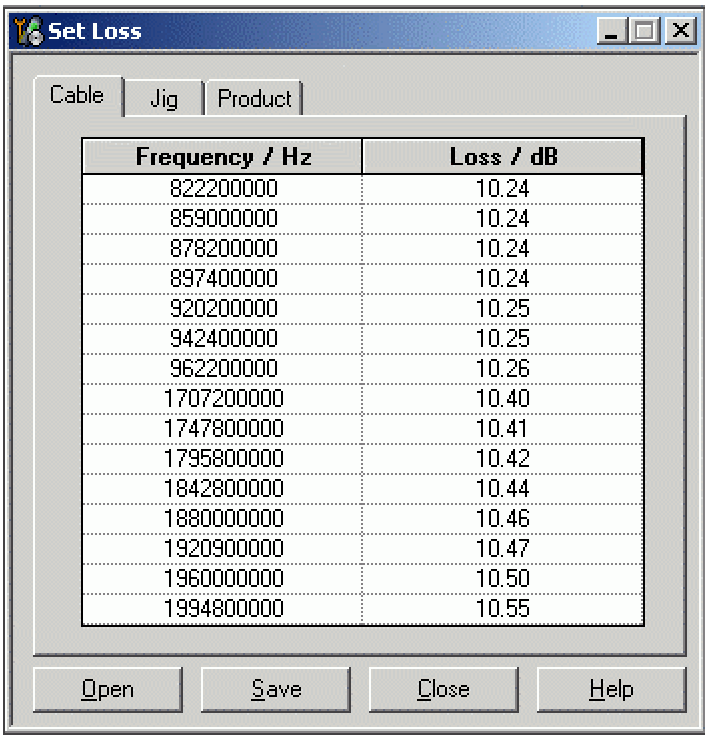
No mixing of equipment from the lists [Rx/Tx] and [Tx or Rx] allowed. This means the use of CMU 200 allows no other measurement equipment !

The discrete frequencies for loss determinations are defined in the sub-program “set loss”.

- Select → Tuning (Alt-U)
- Set loss (Alt-O)

The window “Set loss” pops- up with the register card “Cable”.

Edit the column “Loss/dB”:.



Frequency / Hz	Loss / dB
822200000	10.24
859000000	10.24
878200000	10.24
897400000	10.24
920200000	10.25
942400000	10.25
962200000	10.26
1707200000	10.40
1747800000	10.41
1795800000	10.42
1842800000	10.44
1880000000	10.46
1920900000	10.47
1960000000	10.50
1994800000	10.55

Click on the register card “Jig”.

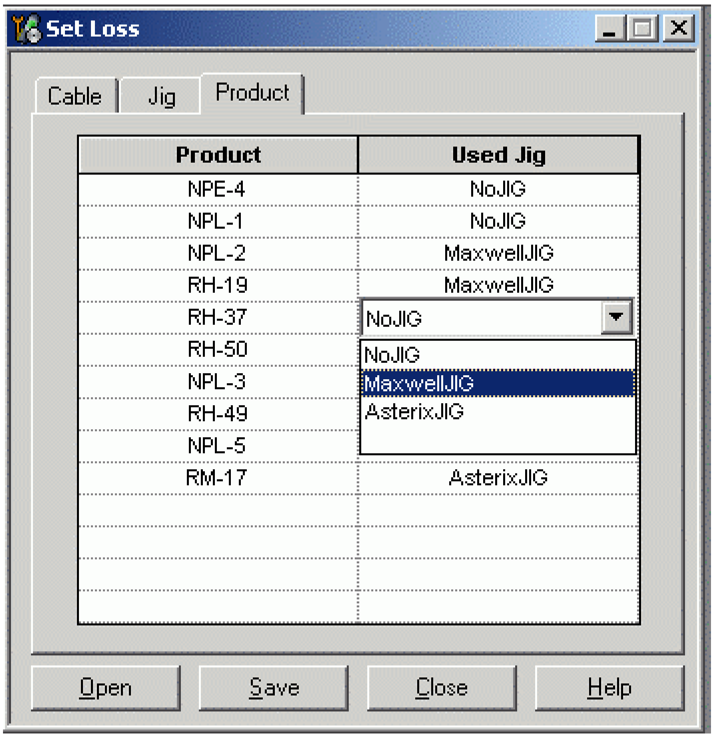
New jigs can be defined by their names and losses versus frequency (button: Add).

3 jigs are pre-defined:

- NoJig (attenuation 0 (null) versus frequencies) has to be selected, if the phone is connected with RF cable.
- Maxwell Jig
- Asterix Jig

Click on the register card “Product” and select in the row RM-8 respectively RM-9 the type of “used jig” by double clicking of the field on the right (no jig=NoJIG).

A window pops up with the names of jigs defined:



- Select a jig to be used.
- Press save.

GPIB interface

The GPIB card shall be labeled by National Instruments or at least compatible with their products.

Drivers must be installed and card "accepted" by Phoenix. The following procedure has to be made once for "acceptance":

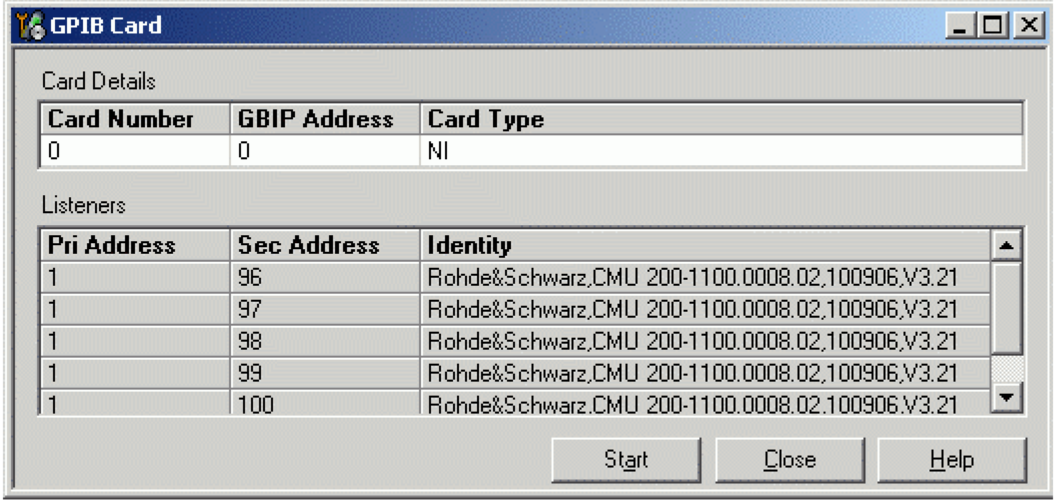
- Select → Tools (Alt-T)
- Options (Alt-O)
- GPIB card (Alt-G)

The window "GPIB Card" pops up.

- Select → Card Type: NI

Press **Start** and wait until the "listeners" are identified, then press **Close**.

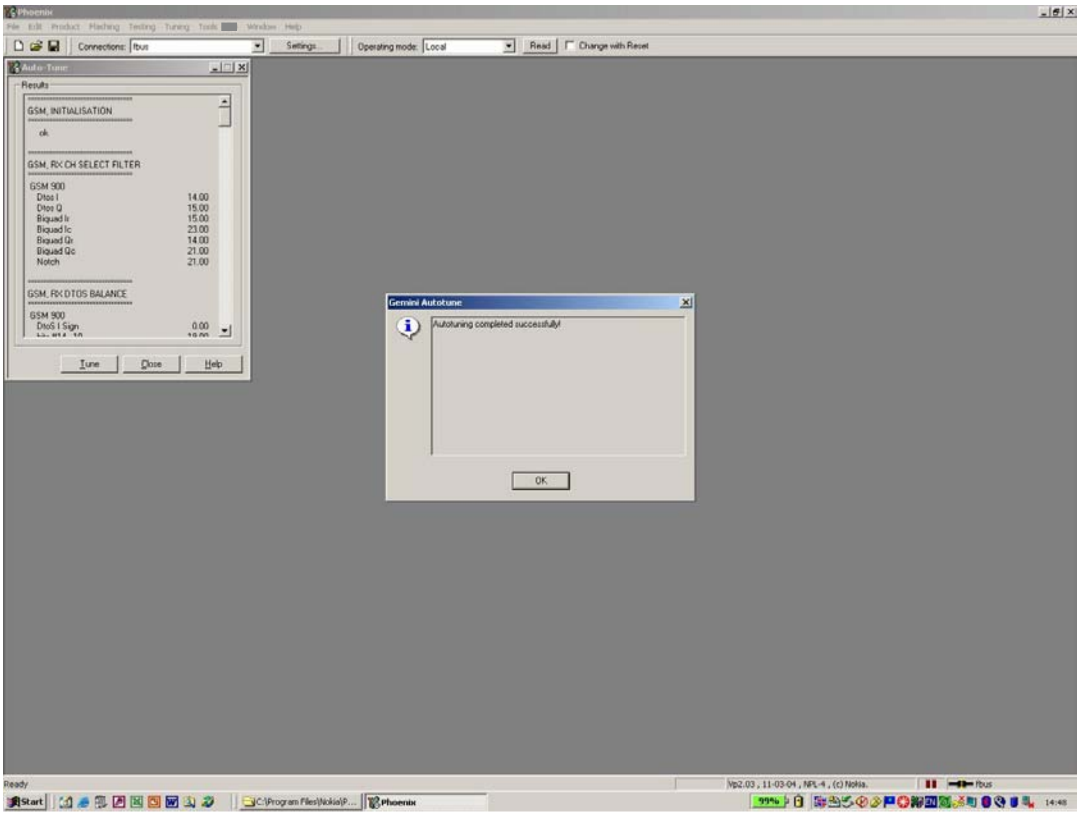
The set up should now look like this:



Automatic tuning procedure

- Select → Tuning (Alt-U)
- Auto-Tune (Alt-A)
- Tune (Alt-T)

The Auto-Tune results are displayed as follows:



and they are logged in a result- file, if initiated according to chapter Log file.

To enable the creation of a log file to save the calibration, tuning and measurement results edit the command of the “autotune_RM-8.ini” file as follows:

Row 8: Logging **1**

The additional path for the logging file can be defined in row 9. Delete the character “;” at the beginning of the row to enable the command. Otherwise the log-files will be written to the directory\text-file:

```
Phoenix\Products\RM-8\autotune_results_yymmdd_hhmmss.txt
```

The file gets an explicit time stamp for identification and sorting:

yy=year, mm=month, dd=day   hh=hour, mm=minute, ss=second

For RM-9 the corresponding notes are valid.

FM-radio troubleshooting (RM-8 only)

Notes to FM-Radio Troubleshooting:

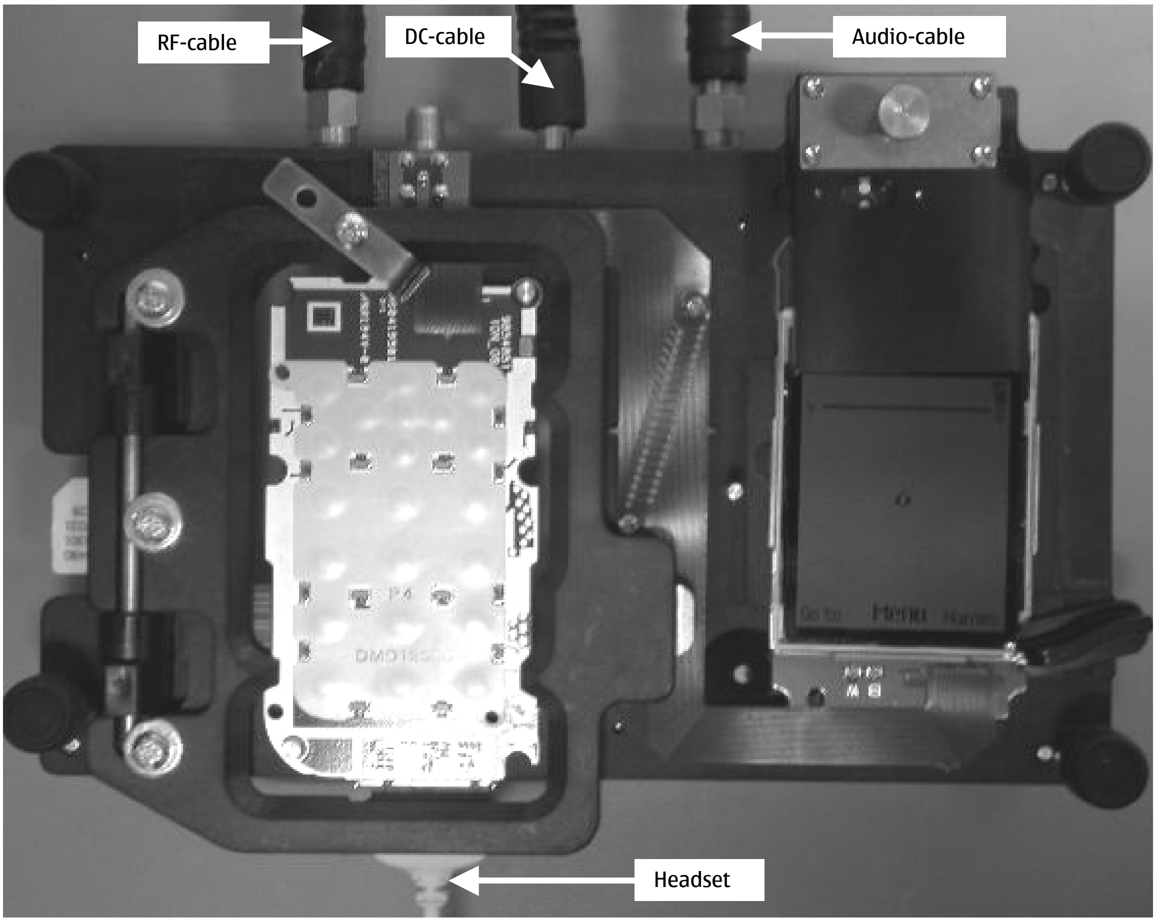
Use 1MHz 1X probe when measuring audio and clock signals with oscilloscope

Use active RF probe when measuring frequencies with spectrum analyzer

Use Module Jig and connect audio test cable to audio output and connect RF generator to FM input and force “Tomahawk Stereo Headset” on FM Radio Test Phoenix.

RF Test signal parameters:

- Amplitude, A, -67dBm
- Carrier frequency, f_c, 98.000MHz
- Deviation, Δf, 75 kHz
- Modulating frequency, f_m, 1.000kHz (RF generator internal)
- FM Stereo, Mode R=L, Pilot state ON



FM-Radio Troubleshooting

Figure 5: FM-Radio troubleshooting flowchart

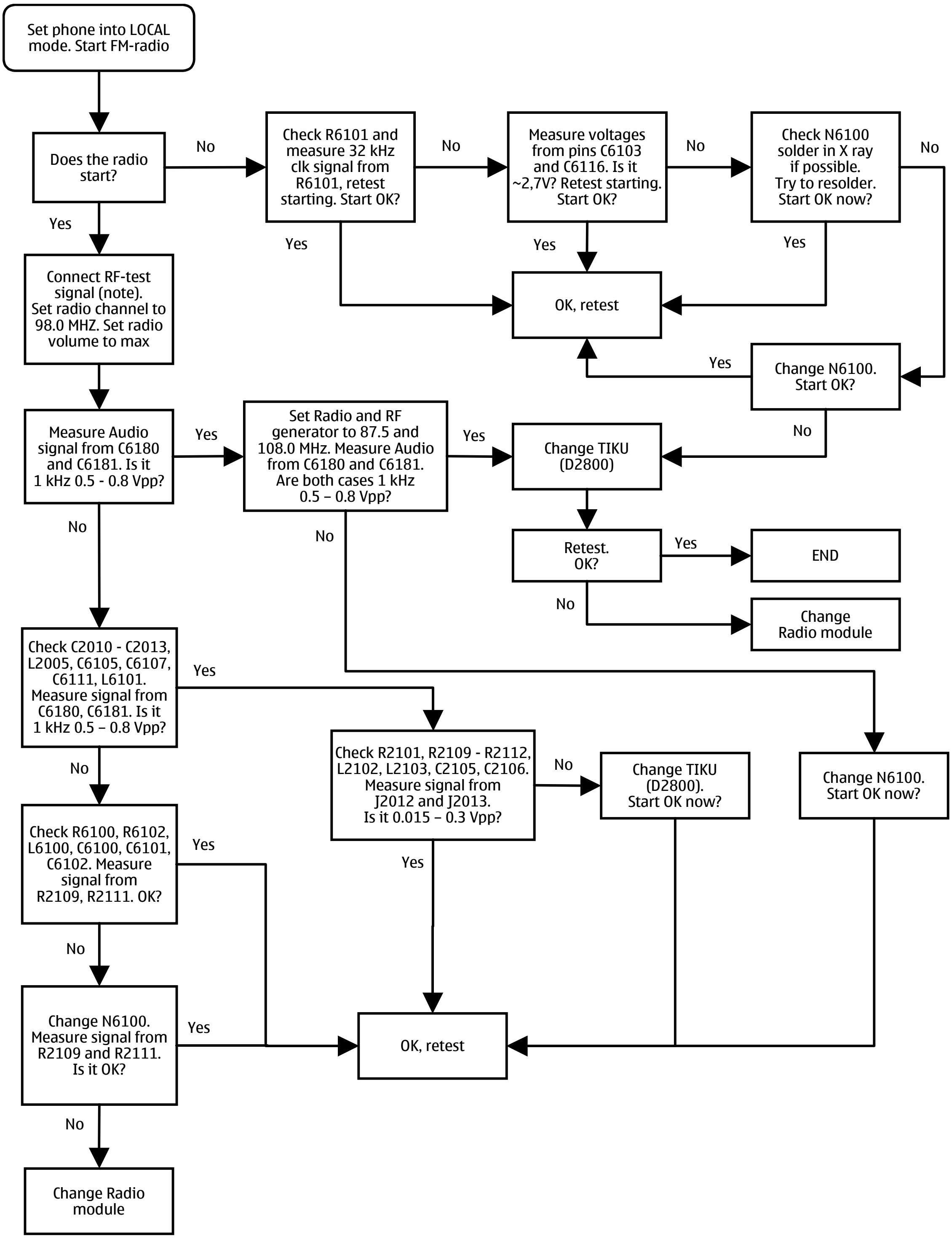


Figure 6:

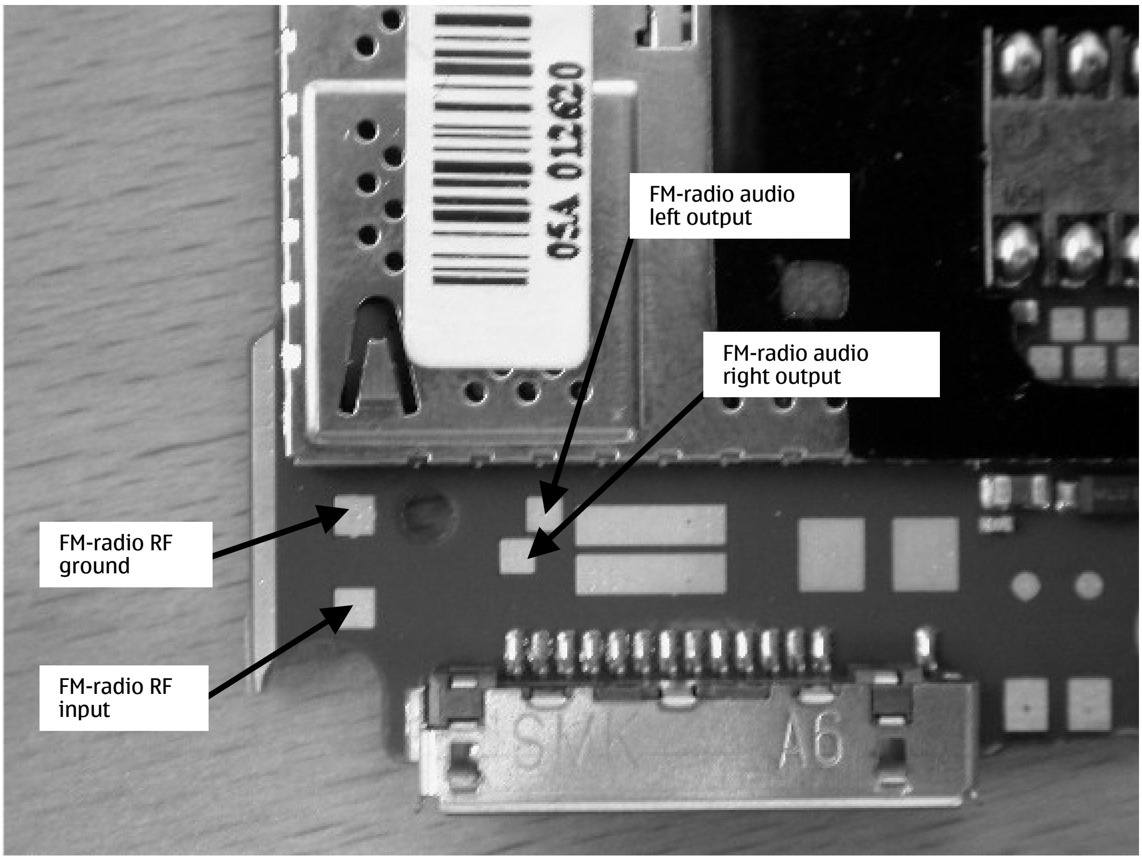

FM-radio audio left output
FM-radio audio right output
FM-radio RF ground
FM-radio RF input
05A 012620
SMK A6

Figure 7: FM-clock signal measured from resistor R6101

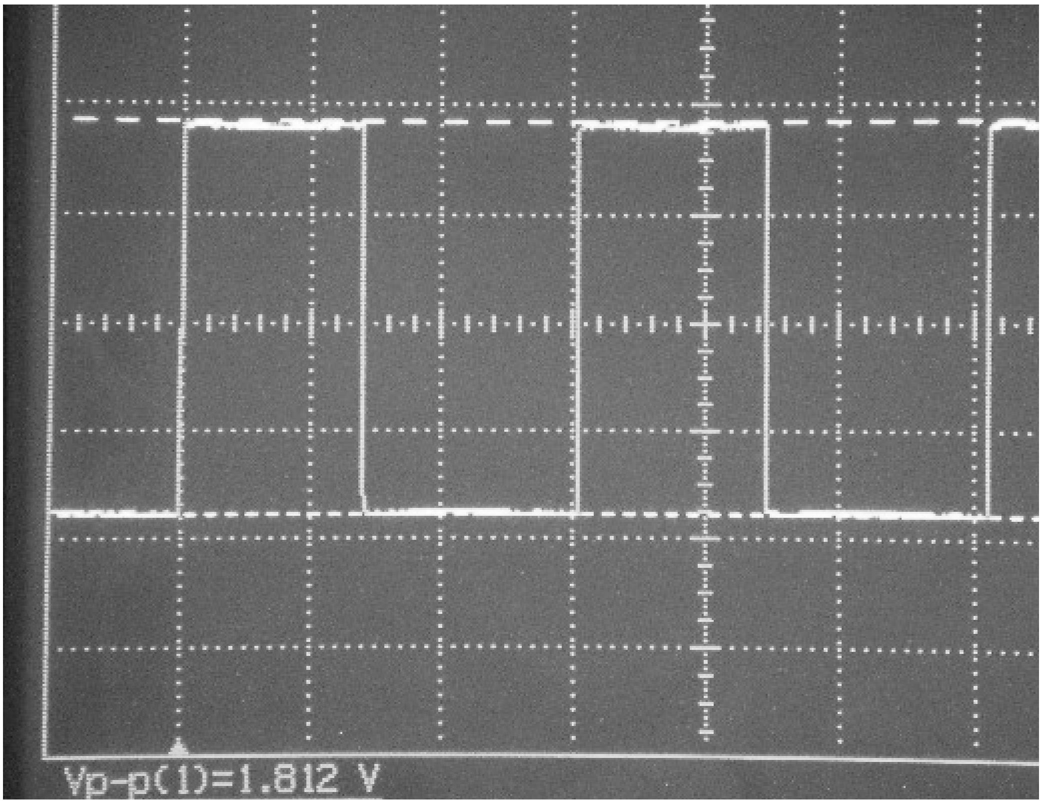


Figure 8: FM-radio audio signal measured from testpoints J2012 and 2013

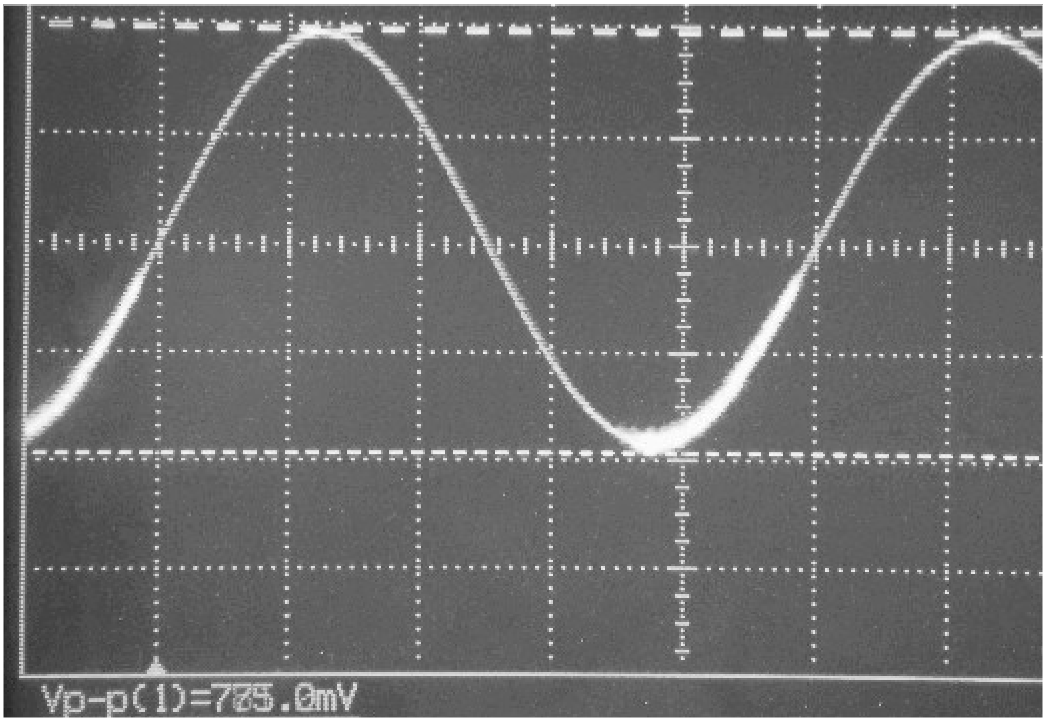


Figure 9: FM-radio output signal (1kHz) measured from C6180 and C6181