Troubleshooting

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Transceiver Troubleshooting

General about testing

Phone operating modes

Phone has three different modes for testing/repairing phone. Modes can be selected with suitable resistors connected to BSI- and BTEMP- lines as following:

Table 1: Mode selection resistors

Mode	BSI- resistor	BTEMP- resistor	Remarks
Normal	68k	47k	
Local	560_ (<1k_)	What ever	
Test	3.3k (> 1k)	560_ (<1k_)	Recommended with baseband testing. Same as local mode, but making a phone call is possible.

The MCU software enters automatically to local or test mode at start-up if corresponding resistors are connected.

Note! Baseband doesn't wake up automatically when the battery voltage is connected (normal mode). Power can be switched on by

- Pressing the power key
- connecting a charger
- RC-alarm function

In the local and test mode the baseband can be controlled through MBUS or FBUS (FBUS is recommended) connections by a Phoenix service software.

Measurement points

Figure 1: UEM regulator's filter capacitors

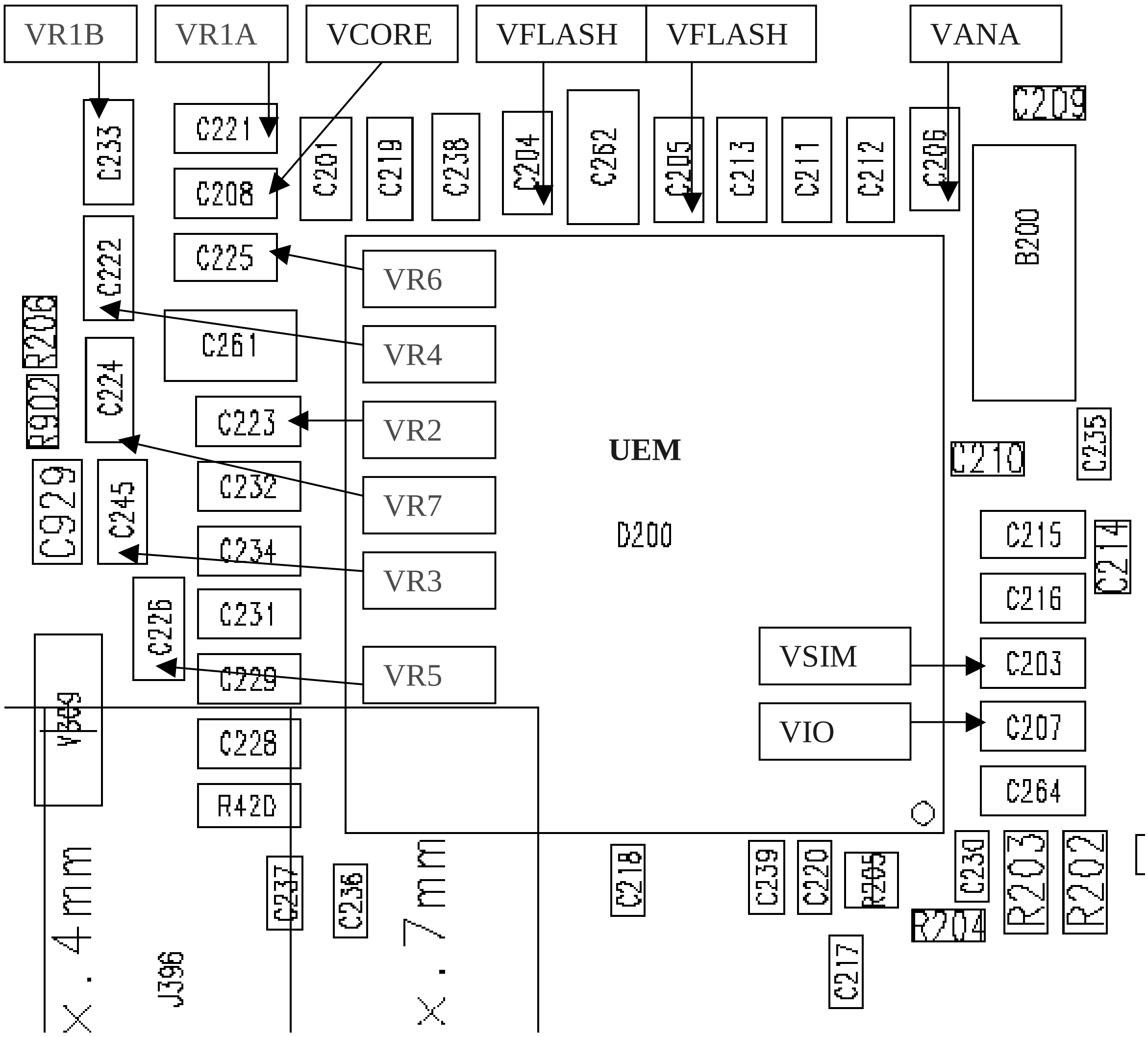
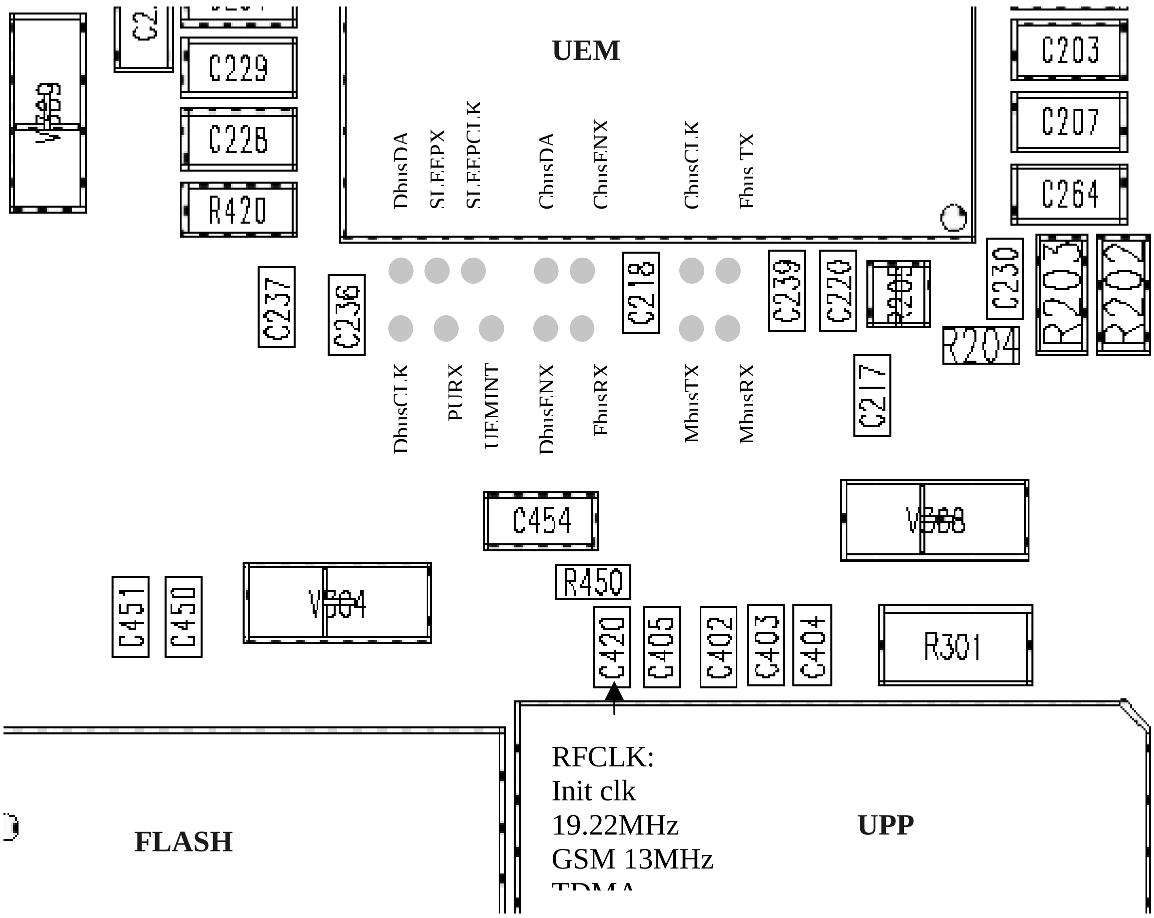


Figure 2: BB testpoints



Baseband Troubleshooting

Note: ESN and IMEI has to re-written to phone If UEM is replaced. This can be done only in Central Service.

The Baseband Troubleshooting instructions consists of the following topics:

- Power up
- Flash programming
- Audio
  - Earpiece
  - Microphone
- Charging
- Accessory detection
- Data cable
- Sleep clock
- User interface
  - Display
  - Lights
  - Buzzer
  - Vibra
  - Keyboard
- Infra red
- Power up faults

Power up sequence

UEM acts as a HW master during start up

- Vbatt limits: 2.1V for internal state machine, 3V triggering whole startup
- Regulator sequencing

- Hw "core" regulators "on": Vio, Vcore, VR3, Vflash1
- These regulators are supplying the processors, memory, chip interfaces and clock source in RF

- Reset releasing delay
  - Supply voltages stabilize to their UEM hw default values
  - RFCLK grows to full swing
  - Core is ready to run but waiting for PURX release

- Reset releasing
  - UPP releases the SLEEPX up to "non sleep" -state to prevent the UEM switching the regulators "OFF"

MCU starts running the Bootsrap Code

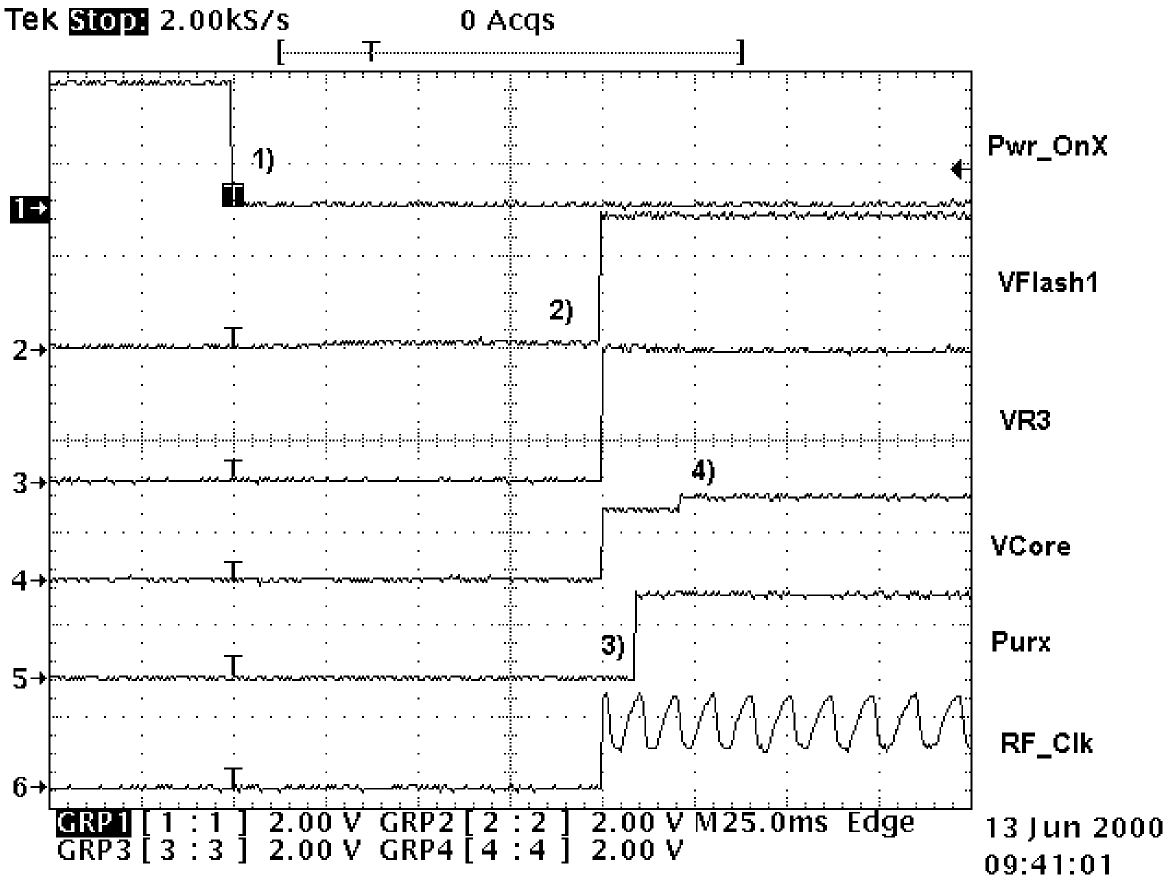
- written in stone/ UPP internal ROM
- the program checks if there exists any reason for FDL mode (Flash Down Load)
- If there exists executable code in FLASH and there exists no reason for FDL, the MCU starts running the MCU program from FLASH.

MCU runs the FLASH MCU code

- the phone initialization, user interfaces, internal blocks etc
- Core regulator voltage setting for required DSP speed
- Initializes the DSP and concerning hw
- Releases DSP reset -> DSP starts running

Note: In the figure below RF_Clk frequency appears to be lower than 19.2MHz because of too low oscilloscope sampling frequency (2kS/s).

Figure 3: Power up sequence



1 Power key pressed

- After 20ms UEM enters RESET MODE if VBAT>Vmstr+

2 2) VFLASH1, Vana, Vcore, Vio and VR3 goes high.

- VCTCXO enabled by VR3 -> RFClk 19.2 MHz running.

3 Purx released

- Purx released by UEM, UEMINT goes high for 100 ms and about 500ms RFCLK will change 13MHz (GSM mode), SleepX goes high and UEM starts feeding SleepClk (32 KHz) to UPP. *NOTE! Sleepclock starts running in crystal circuitry (B200) immediately when battery voltage is supplied*.

4 Software running

- Default value for Vcore is 1.5 volts and if software is running Vcore will rise to 1.8 volts.

- Cbus (1.00MHz/GSM and 1.08MHz/TDMA) clock starts running.

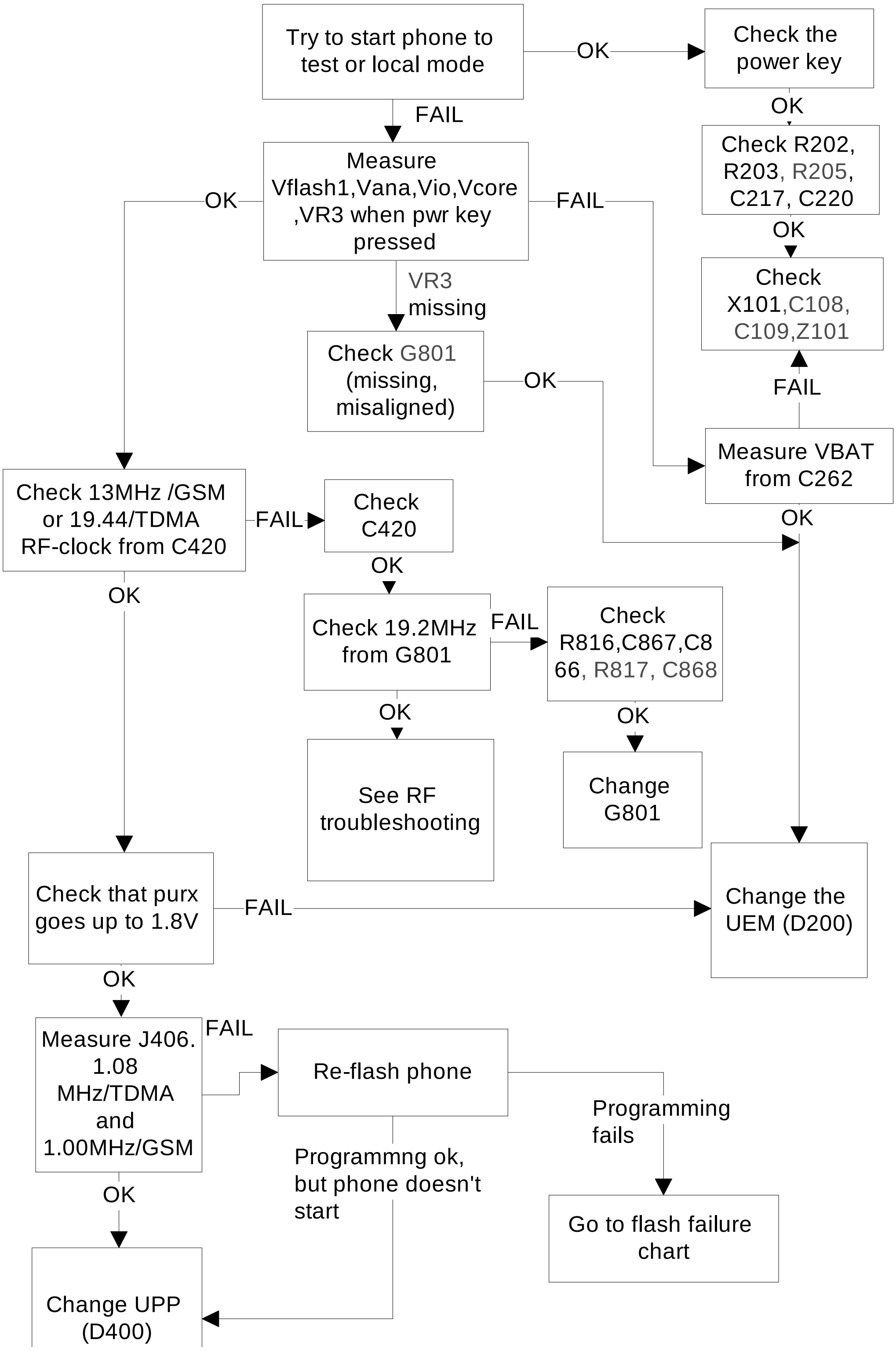
Phone does not start up normally or does not stay on

Note! In case of power up faults, it's not possible to force phone on by disabling watch-dog. Instead, measurements should be done immediately when power key pressed or when battery voltage connected to phone (local/test mode).

The easist way to check if software is running when phone takes abnormal amount of current is to measure cbusclk and Vcore.

Dbus clock (programmable 9.72MHz TDMA, 13MHz GSM) is not automatically visible on test and local mode.

Figure 4: Fault tree, phone does not power up



Flash Programming does not work

Flash programming procedure

- Phone communicates with prommer via production test pattern, using signals:

- FBUSTX(serial data to phone),
- FBUSRX(serial data from phone),
- MBUS(serial clock for FBUSRX)
- VPP(External flashing voltage for speed up flashing)

- Also BSI line is used when initializing flashing(battery connector)
- When phone is powered(VBAT>3V) MBUS and FBUSTX lines are pulled up internally by phone.
- Prommer sends command to UEM, using FBUSRX, to enter Flash-mode. During the sending of this command prommer keeps BSI line high and MBUS is used as a serial clock.
- When Flash-mode command is acknowledged UEM enters Flash-mode and releases reset (PURX) to MCU.
- After reset is released UPP checks if there is a request for Bootstrap code (that resides in UPP ROM).
- Request for Bootstrap is MBUS pulled down by Prommer.(If bootstrap is not requested, bootstrap code jumps to FLASH SW.)
- If Bootstrap code is requested UPP enters Flash-mode and sets FbusTX to '0' as acknowledgement to prommer. This is an indication that UPP can run, at least, the fixed Bootstrap code – although not able to run FLASH code. UPP then sends an UPP-ID to prommer via FBUSTX line.
- After prommer has received UPP-ID it sends corresponding Secondary Boot Code to phone via FBUSRX. Secondary Boot Code, when run in UPP, requests UPP to send information to prommer about flash type and other HW related parameters about the device to be flashed.
- Prommer then sends the Algorithm Code corresponding to the HW parameters and this algorithm, when run in UPP, takes over handling the MCUSW transfer to Flash.
- 12 volts can be supplied to Vpp(by prommer) to speedup flashing.
- FLASH Program includes a package of MCU and DSP software and all default parameters for the phone. The tuning values will be added/rewritten during Flash/Alignment phase.

Flash programming error codes

Error codes can be seen from "FPS-8 Flash" in Phoenix.

Underlined note means that item under consideration is being used first time in flashing sequence.

Table 2: Flash programming error codes

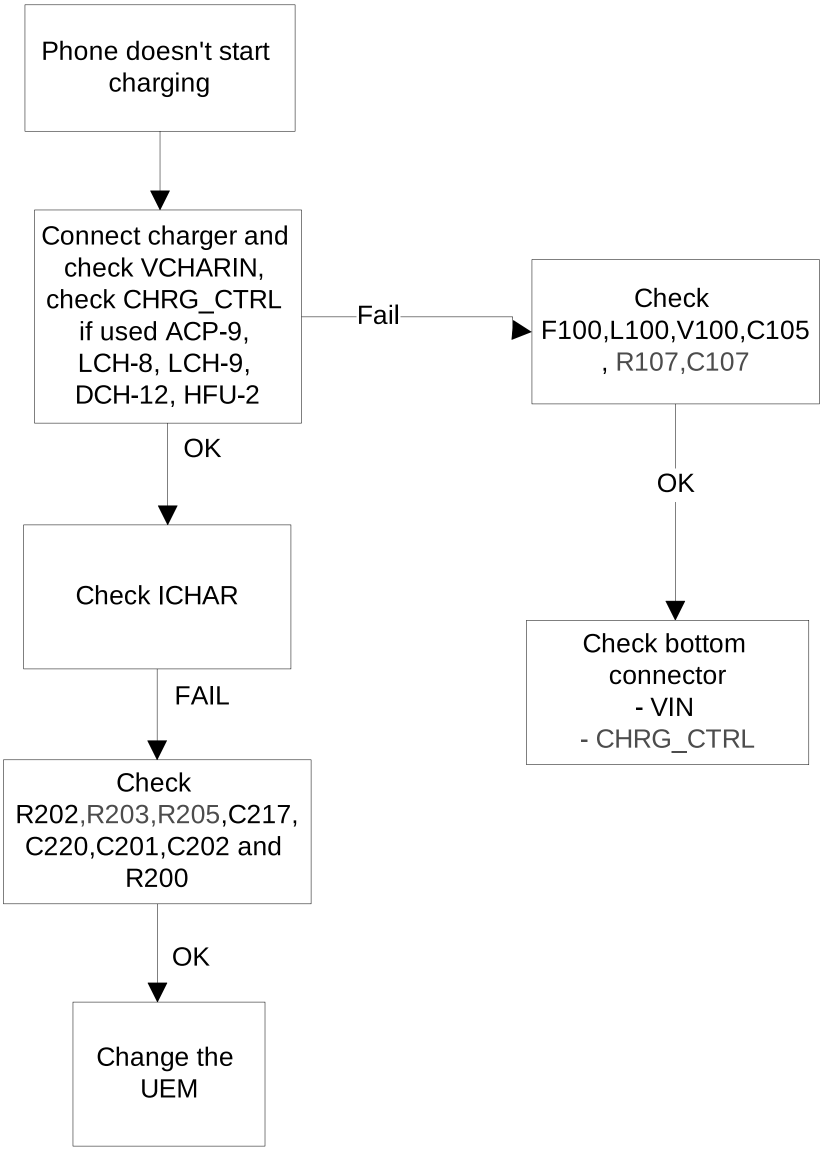
Error	Description	Not working properly
C101	"The Phone does not set FbusTx line high after the startup."	Vbatt Vflash1 Vcore VIO BSI and FbusRX from prommer to UEM. FbusTx from UPP->UEM->Prommer(SA0)
C102	"The Phone does not set FbusTx line low after the line has been high. The Prommer generates this error also when the Phone is not connected to the Prommer."	PURX(also to Safari) VR3 Rfclock(VCTCXO->Safari->UPP) Mbus from Prommer->UEM->UPP(MbusRx)(SA1) FbusTx from UPP->UEM->Prommer(SA1)
C103	"Boot serial line fail."	Mbus from Prommer->UEM->UPP(MbusRx)(SA0) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C104	"MCU ID message sending failed in the Phone."	FbusTx from UPP->UEM->Prommer
C105	"The Phone has not received Secondary boot codes length bytes correctly."	Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C106	"The Phone has not received Secondary code bytes correctly."	Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C107	"The Phone MCU can not start Secondary code correctly."	UPP
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 UPP-Flash
A387	"The MCU ID in the MCUSW	UPP
C601	"The prommer has detected that Vpp voltage level has dropped below the limit"	Vpp from prommer - >Flash
C383 C583 C683	"The Prommer has not received Phone acknowledge to the message." (C383-during algorithm download to target phone) (C583-during erasing) (C683-during programming)	Flash UPP Signals between UPP-Flash

C384 C584 C684	"The Phone has generated NAK signal during data block transfer." (C384-during algorithm download to target phone) (C584-during erasing) (C684-during programming)	Flash UPP Signals between UPP-Flash
C585 C685	Data block handling timeout" (C585-during erasing) (C685-during programming)	Flash UPP Signals between UPP-Flash
C586 C686	"The status response from the Phone informs about fail." (C586-during erasing) (C686-during programming)	Flash

Charging

Note: Charging voltage and current can be checked by connecting phone to service software and reading ad- converter values of vchar and ichar.

Figure 5: Fault tree, charging



Audio failures

In case of audio failures there are three possibilities to check audio lines.

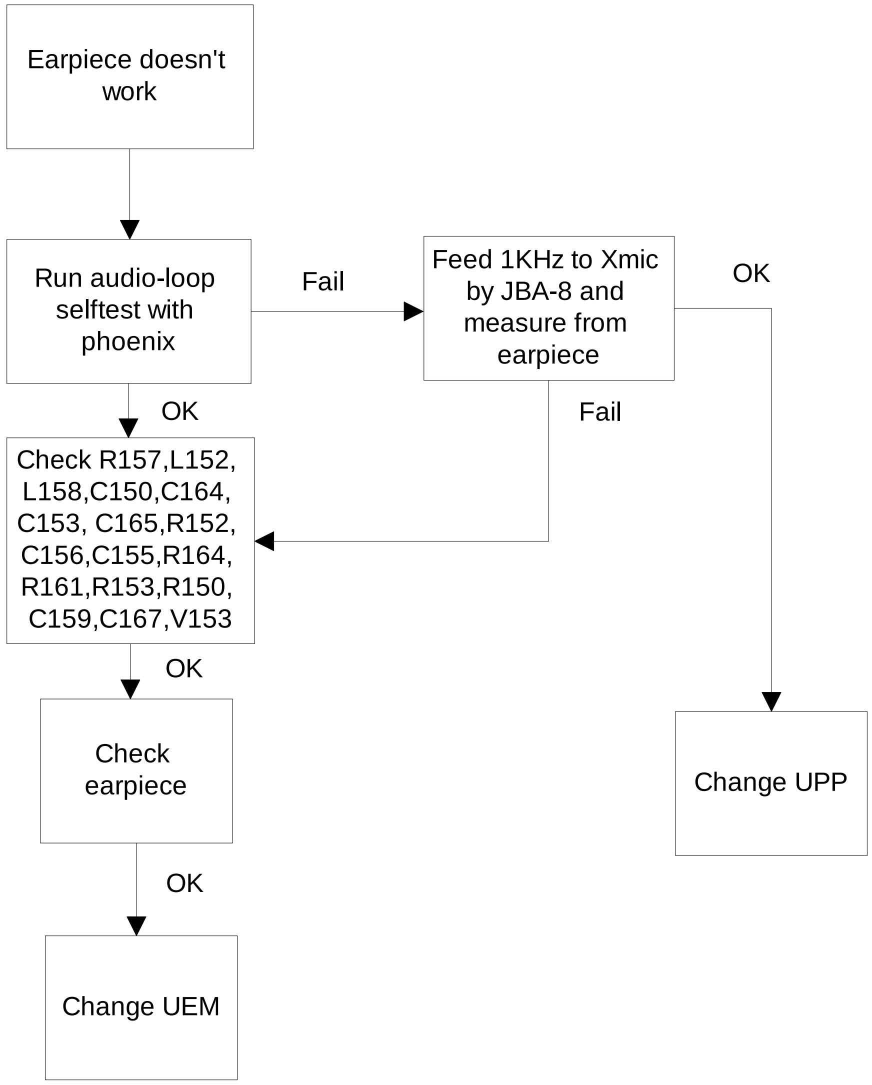
1. Make a phone call against tester and check audios.
2. In case of earpiece/XMIC fail: Feed 1Khz signal to XMIC line and measure signal from earpiece line. Audio test box JBA-8 is needed. Audio loop (*Audio test/Ext In Hp Out*) must be switched on by Phoenix service software. This loop will connect audios only through UEM. In this case UPP is not used.

3 In case of internal microphone/XEAR fail: Feed tone to microphone and measure signal from XEAR line. Audio test box JBA-8 is needed. Audio loop (*Audio test/Hp In Ext Out*) must be switched on by Phoenix service software. This loop will connect audios only through UEM. In this case UPP is not used.

4 Run audio- loop selftest with Phoenix (*BB Self tests/ST_EAR_DATA_LOOP_TEST*). This loop will test the eardata/micdata lines between UPP and UEM.

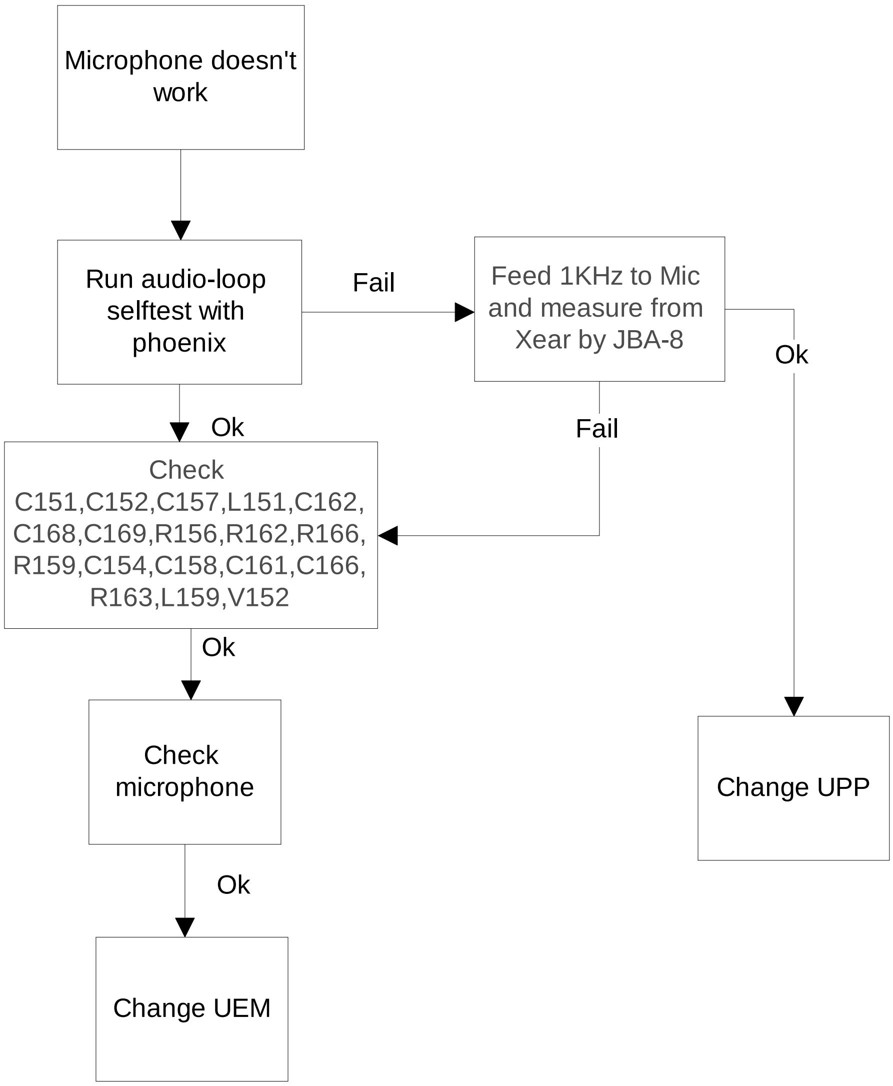
Earpiece or external microphone line does not work

Figure 6: Fault tree, earpiece fail



.Microphone or XEAR line does not work

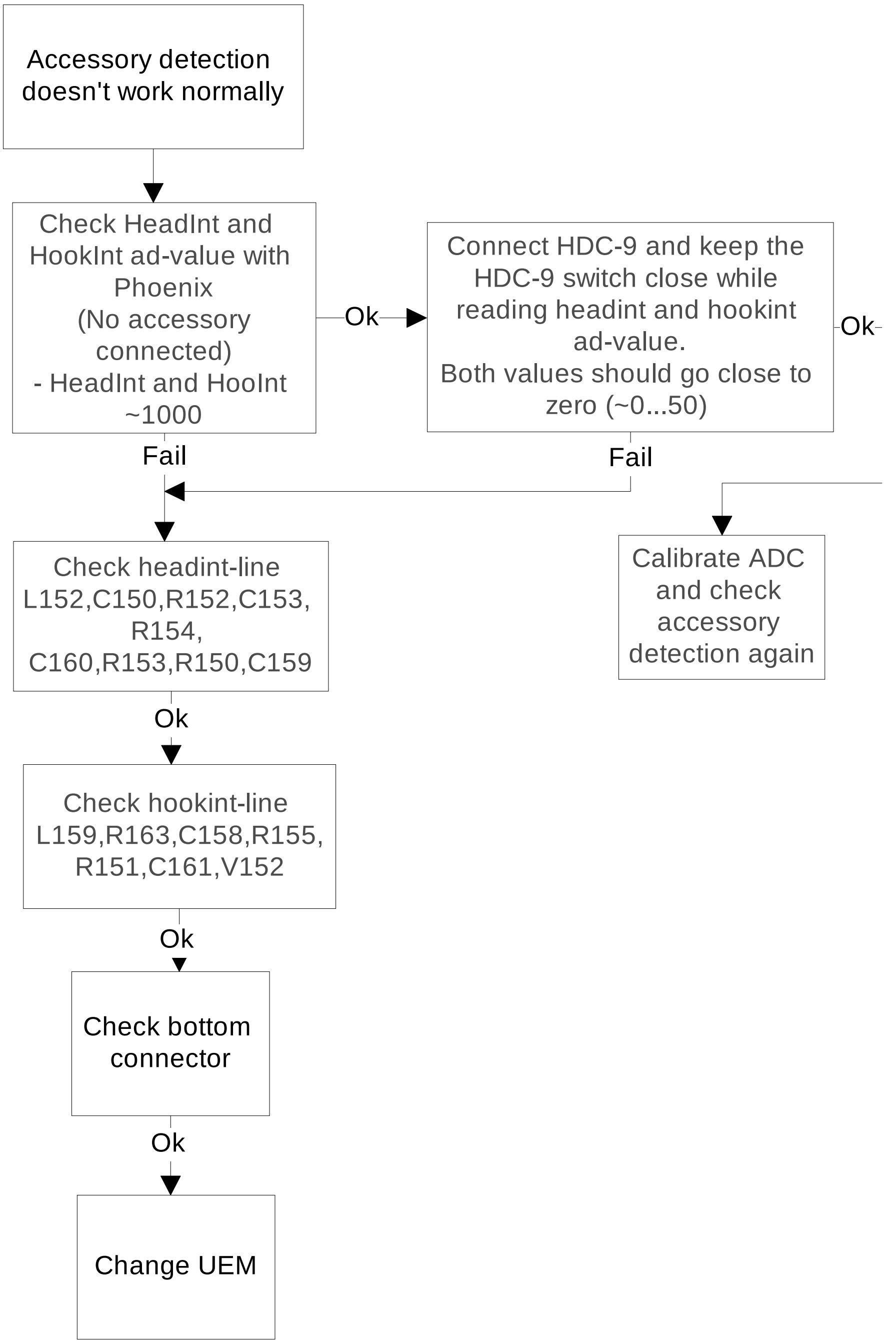
Figure 7: Fault tree, microphone fail



Accessory detection

- - Start phone to normal mode when checking accessory detection.
- - Ad- converter value of headint and hookint - lines can be checked with Phoenix ADC-reading.
- - When headset HDC-9 connected and headset push button is held down, head-int- value should be between 10 and 50 and hookint- value between 0-30.

Figure 8: Fault tree, accessory detection

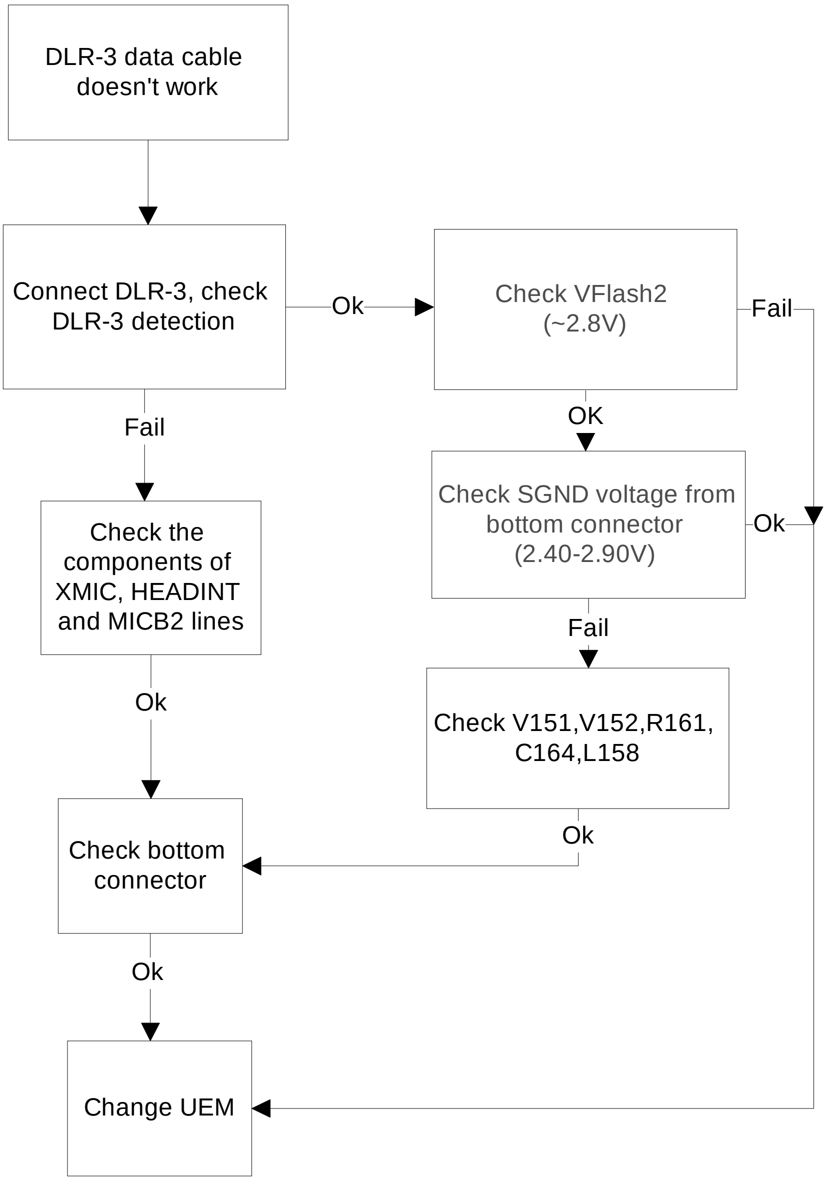


Power supply for data cable

DLR-3 needs power supply for data transfering. SGND will supply 2.8V to DLR-3.

- Start phone to normal mode when checking DLR-3 detection

Figure 9: Fault tree, data cable.



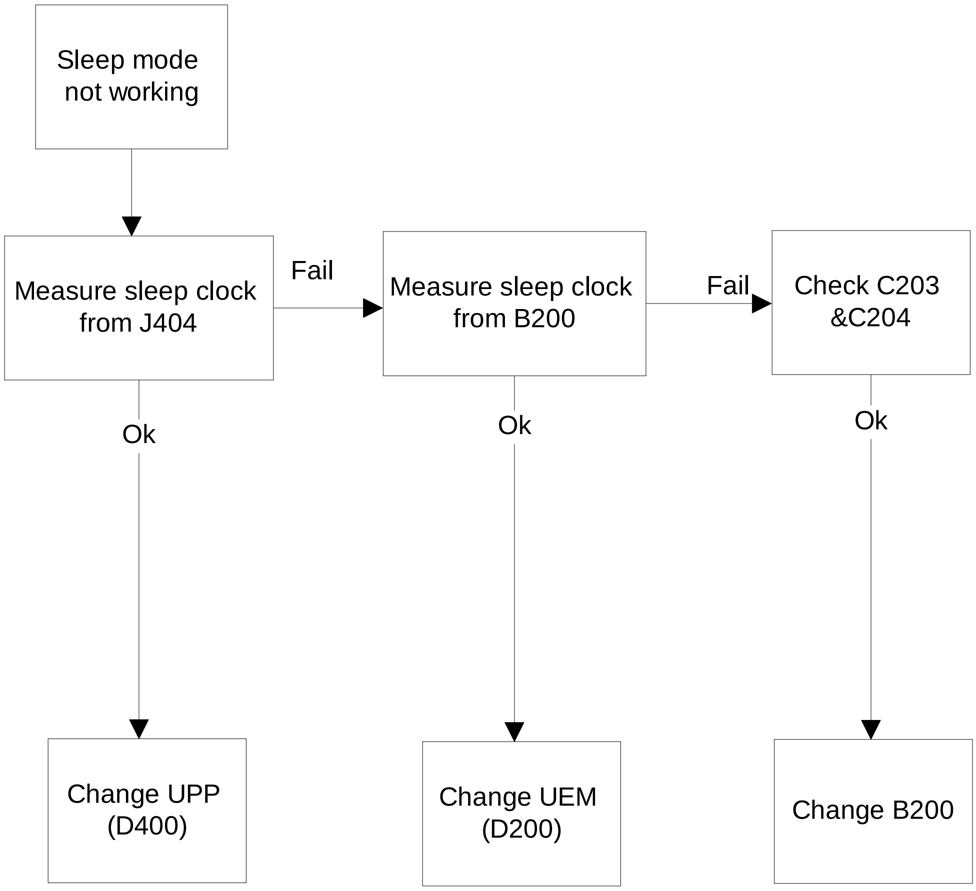
Sleep Clock

Missing/non-functional sleep clock causes

- Entering sleep mode fails (higher current consumption -> shorter standby time)
- Baseband self tests cannot be run

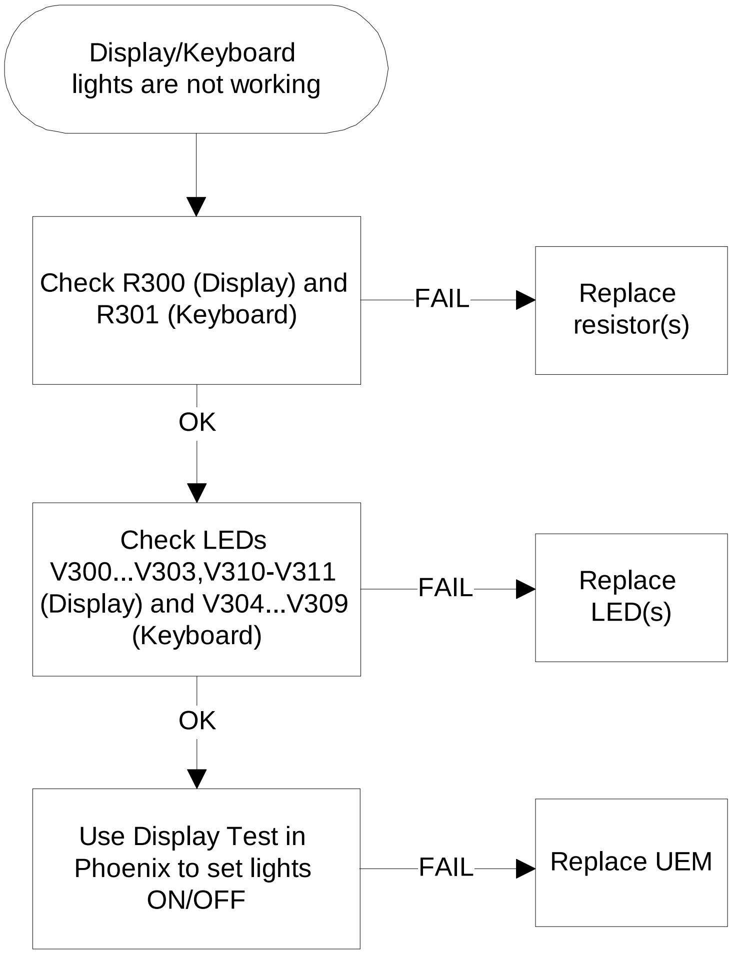
- Phone clock (on display) does not function properly

Figure 10: Fault tree, sleep clock



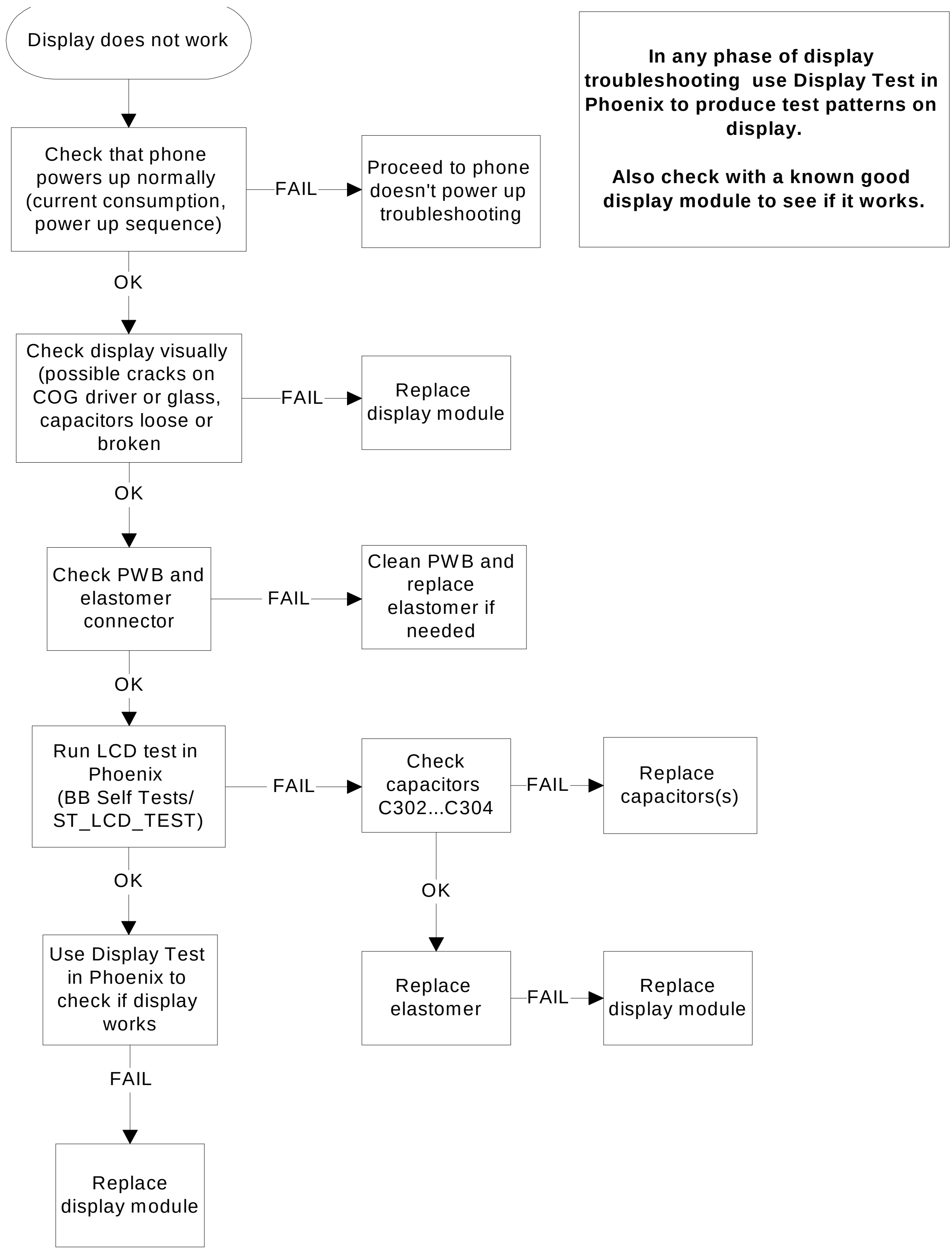
Display/Keyboard lights do not work

Figure 11: Fault tree, Display/Keyboard lights



Display does not work

Figure 12: Fault tree, display



Buzzer does not work

Check spring connectors and C306.

No sound: Try using known good buzzer instead. If still no sound ->change UEM(D200)

Weak sound: Use Audio test in Phoenix to set buzzer parameters(frequency, strength). If it doesn't effect to the sound level ->change buzzer.

Vibra does not work

Check spring connectors and C307.

No vibration: Try using known good vibra instead. If still no vibration -> change UEM(D200)

Weak vibration: Use Vibra test in Phoenix to set vibra parameters(frequency, duty cycle). If it doesn't effect to the magnitude of vibration ->change vibra.

Keyboard does not work

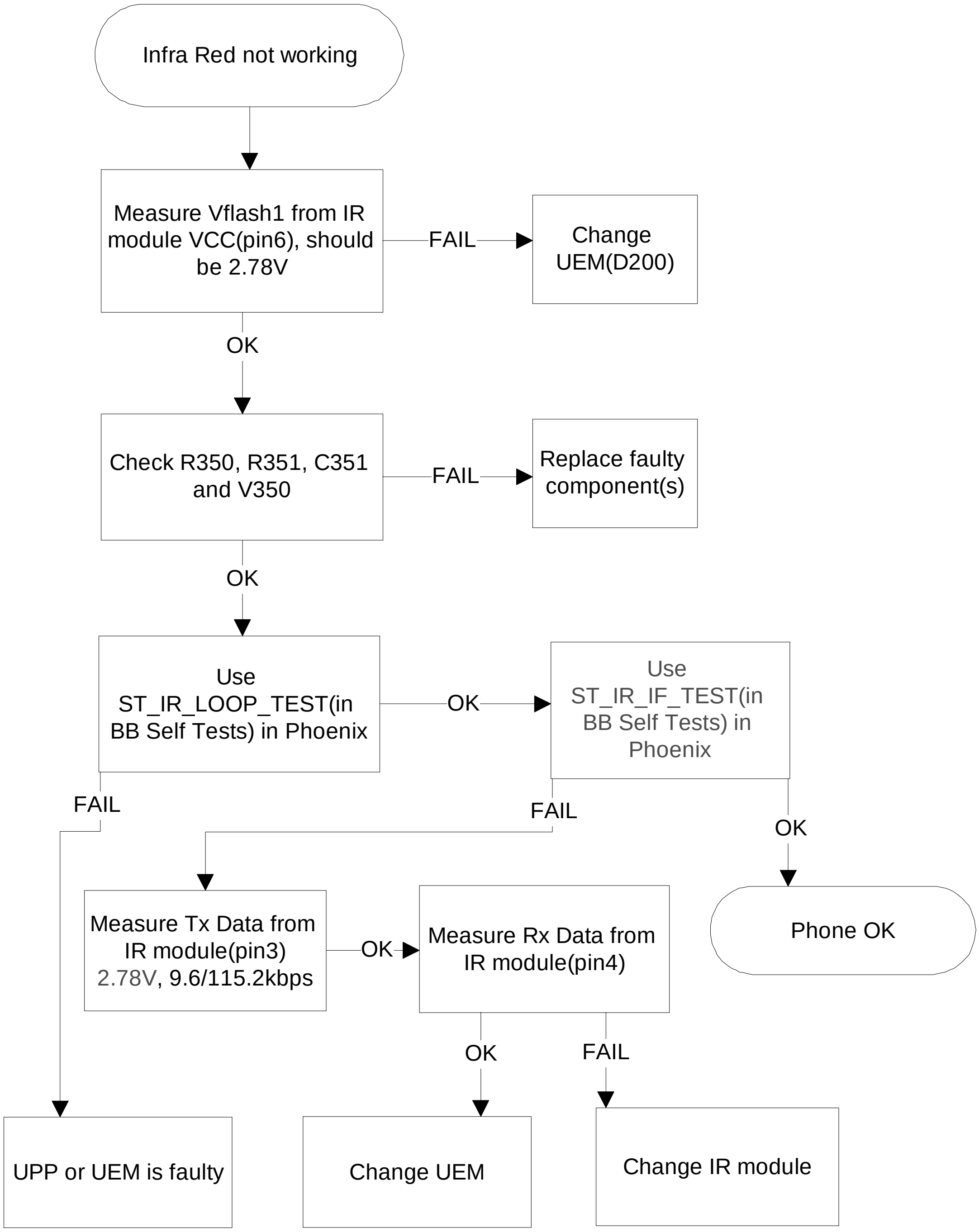
Check that there is no dirt between the dome sheet and the PWB and also check that Z300 is properly soldered and the cornner mark is located in the right place. If the keyboard still doesn't operate normally -> try to use Keyboard test in Phoenix to see if the pressed key is identified. If not ->change UPP(D400), then if this does not help, also change the Z300.

SIM does not work

Check SIM reader's spring connectors, C390 (VSIM 3.0V) and R388. If SIM still does not work then probably the UEM or the UPP is broken -> change first one component and check the phone.

Infrared does not work

Figure 13: Fault tree, infra red



RF Troubleshooting

Introduction

Measurements should be done using spectrum analyzer and high-frequency probe (Local and reference frequencies and RF-power levels in intermediate stages of chain). Oscilloscope is used to measure DC-voltages and low frequency signals. Multimeter is also useful measurement equipment in faultfinding. Also cellular tester is needed in order to perform tests mentioned in this document.

External RF connector is implemented to design improving reliability of the measurement results and should be in use when it is reasonable.

RF-section is mainly build around of SAFARI GTE3.2 IC (N801). The RF block has separate external filters, UHF and VHF synthesizer, Power Amplifier, front-end and up converter circuit for both frequency band.

To simplifying troubleshooting, this RF troubleshooting document is divides into three bigger sections: Receiver-, Transmitter and Synthesizer parts. The tolerance is specified for critical signals/voltages.

Before changing single ASICS or components, please check the following things:

1. The soldering and alignment marks of the ASICS

2. Supply voltages and control signals are OK

The PA-module is static discharge sensitive! So ESD protection must be used when dealing with PA-IC (ground straps and ESD soldering irons). The PA is also moisture sensitive components and it is important to follow additional information about handling the component. So it is recommended to wear EDS protected clothes and shoes whenever handling radio module unit! Also wrist-grounding strap should be used.

The shield lid must be always replaced with new one after it is opened. Plate bands under shield lid could be cut but always bend plate ends downwards after repairing. Plate ends should NOT touch shield lid after lid is installed. Note also that there are no short circuits caused by plate ends on PWB.

Abbreviations in fault finding charts

BB	Base band
BPF	Band pass filter
f:	Frequency of signal (measured with spectrum analyzer)
HB	High band
LB	Low band
LO	Local Oscillator
P:	Power of signal in decibels (dB) (measured with spectrum analyzer)
PA	Power Amplifier
PWB	Printed Wiring Board

PWRDET	Power detector module
PLL	Phase Locked Loop
RF	Radio Frequency
RX	Receiver
T:	Time between pulses
TX	Transmitter
U/C	Up converter (mixer and driver in same package)
UHF	Ultra High Frequency
V:	Voltage of signal (measured with oscilloscope)
VCO	Voltage controlled oscillator
VHF	Very High Frequency
AF:	Audio Frequency

Receiver

General instructions for RX troubleshooting

Receiver troubleshooting is divided into three sections:

- General checking

- Local oscillator checking

- RX Chain checking

Faultfinding charts are represented for each band and more detailed troubleshooting instructions are included. Please note that before changing ASICs or filters, all solderings and missing components must be checked visually. After any possible component changes phone must be re-tuned using Phoenix autotune procedure. Signal levels are not shown in the flowcharts below because of the figures apply with specific measurement probes. It is useful to compare the results against the reference phones.

Equipment needed for receiver troubleshooting:

- Signal generator up to 2 GHz

- Oscilloscope with 10x passive probe

- Spectrum analyzer and active probe without attenuation block or passive probe (Please note that the signal levels mentioned in the RX troubleshooting have been measured with an active probe.)

- PC with Phoenix SW AM version

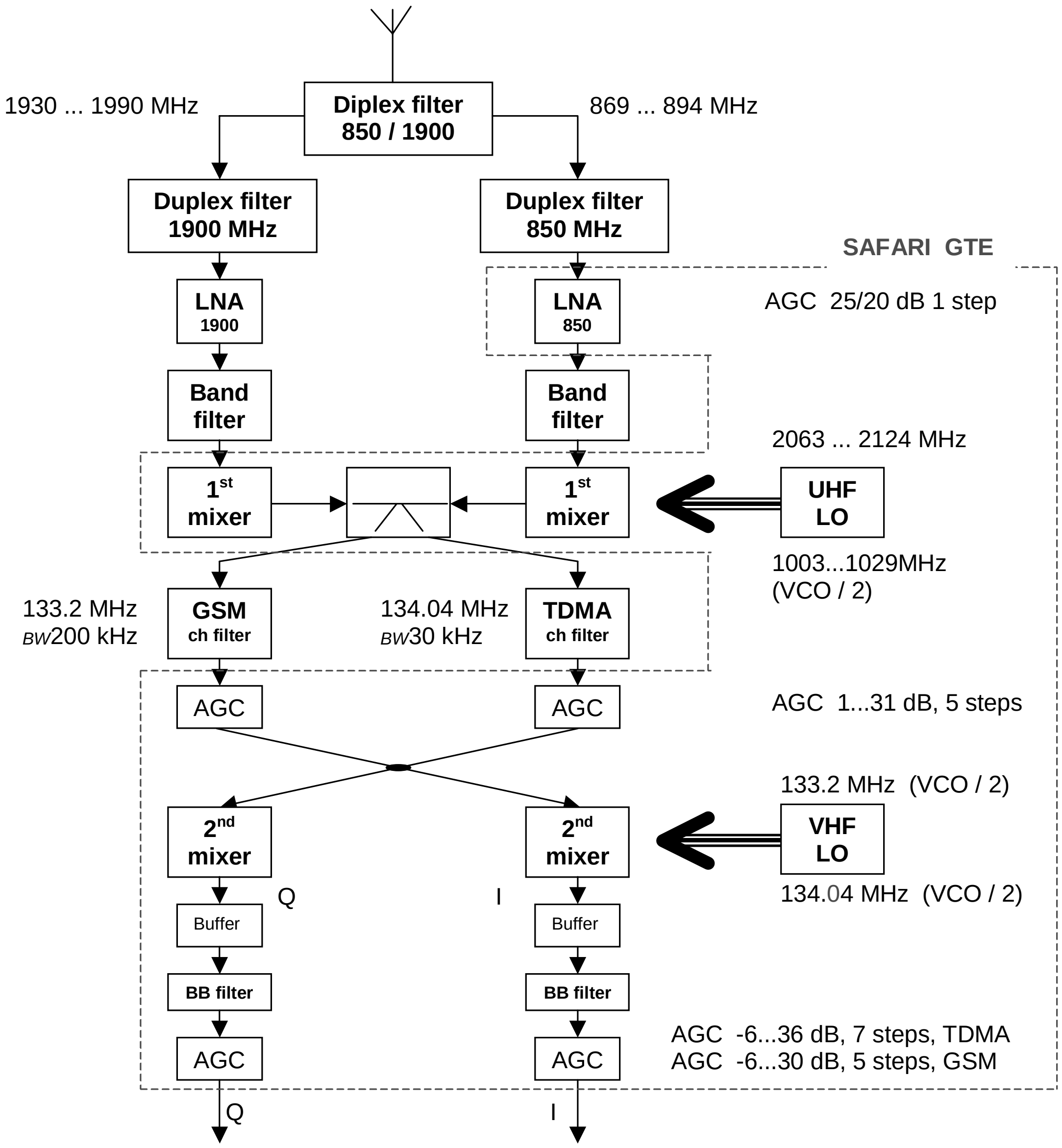
Optional equipment:

- SINAD meter or audio analyzer for AMPS measurement

- Radio communication test set

Path of the received signal

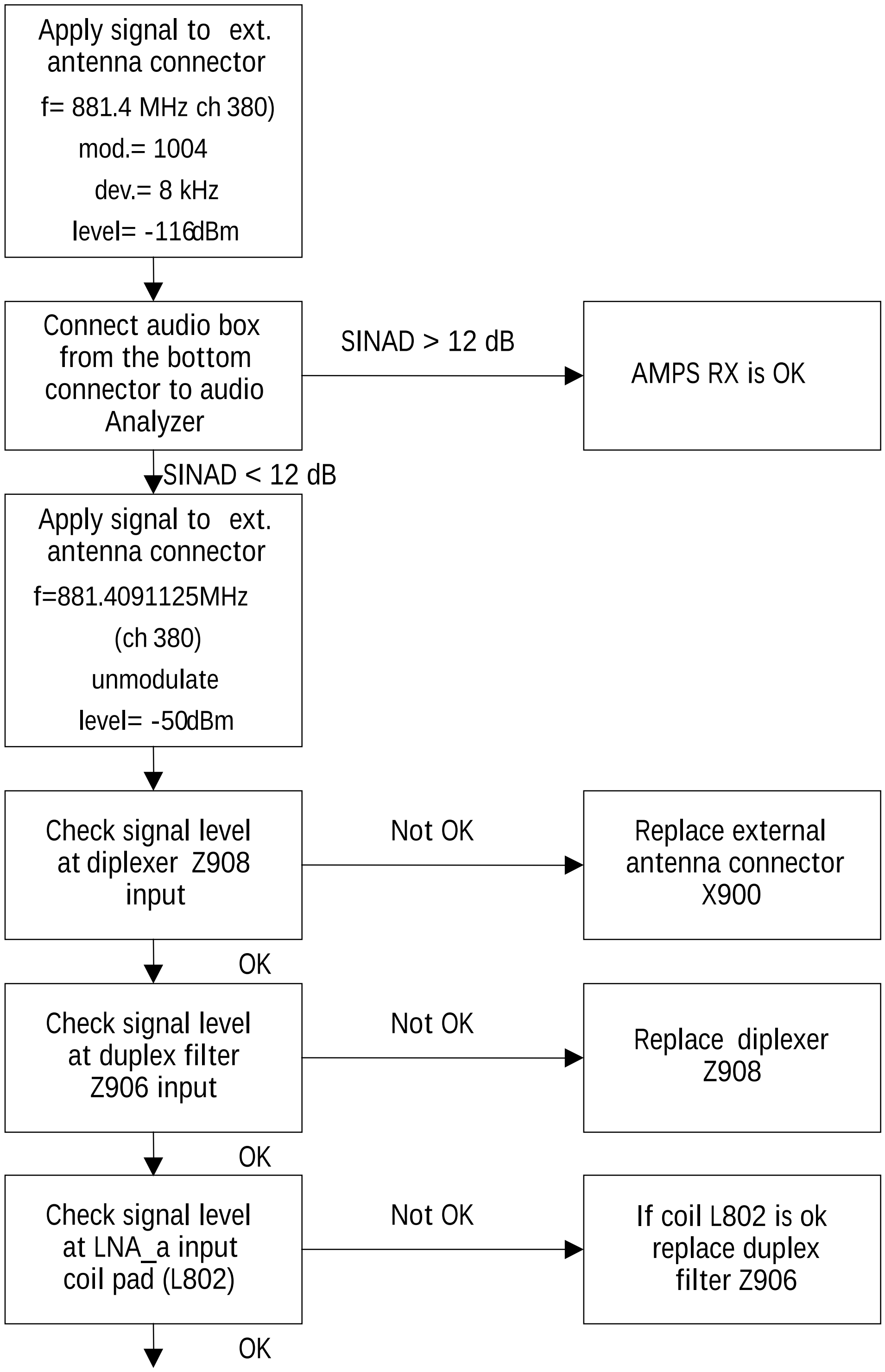
Block level description of the receiver:



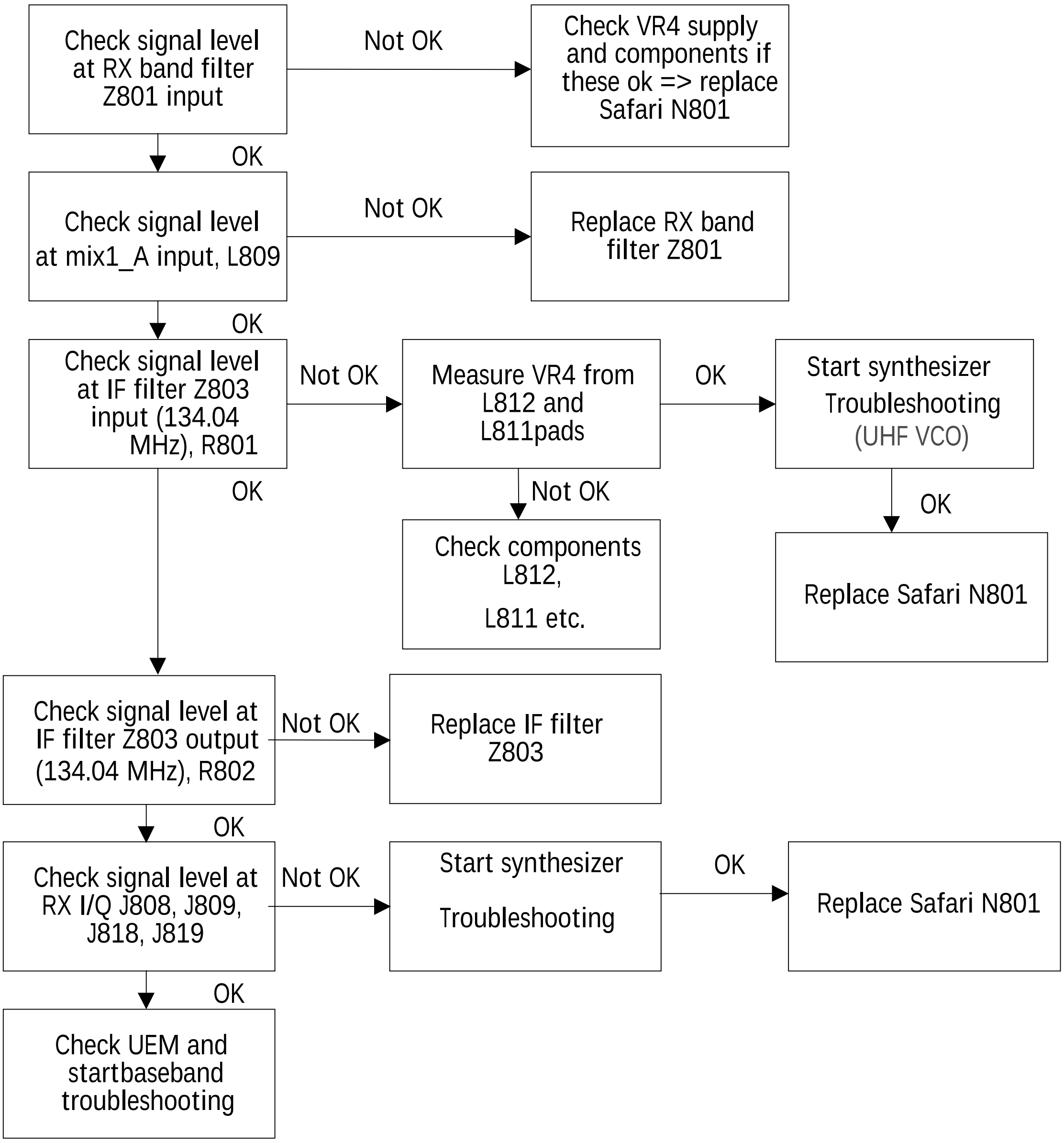
Receiver Block Diagram

AMPS

Fault finding chart

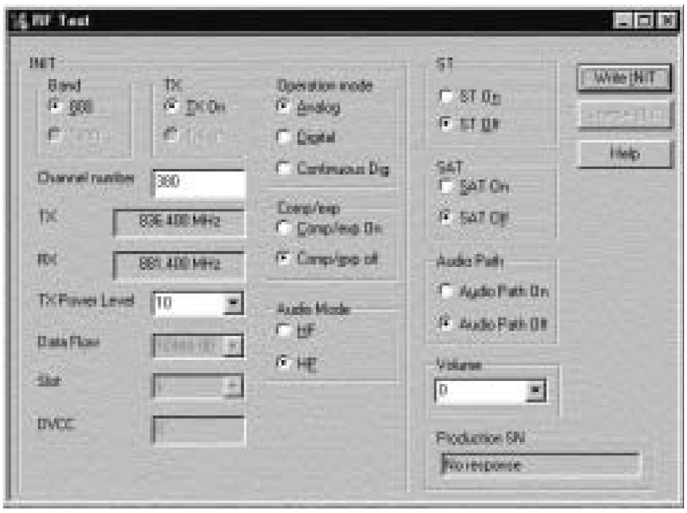


Step 1. General checking

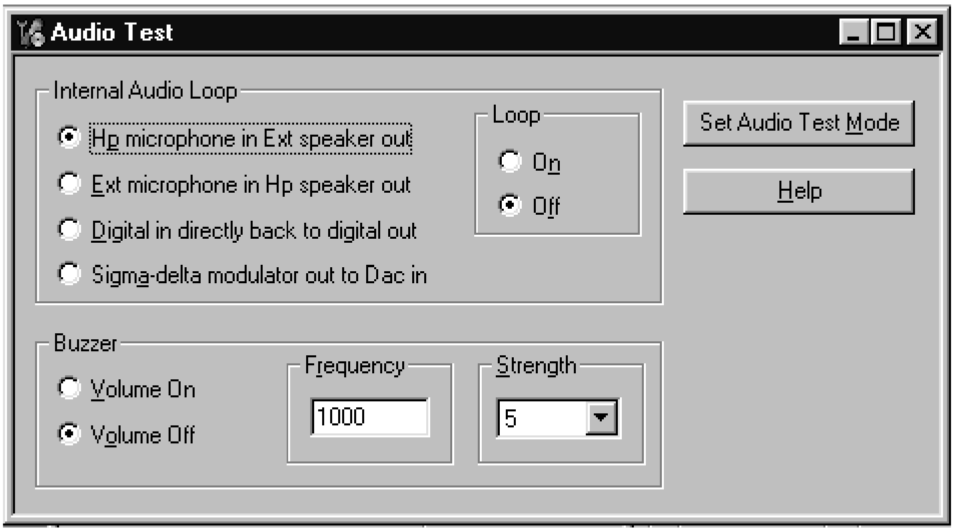


Audio test

Please use Phoenix RF-control to set phone to the correct operating mode.



Enable audio using Phoenix software (maintenance -> testing -> audio test mode -> set audio test mode). See picture below.



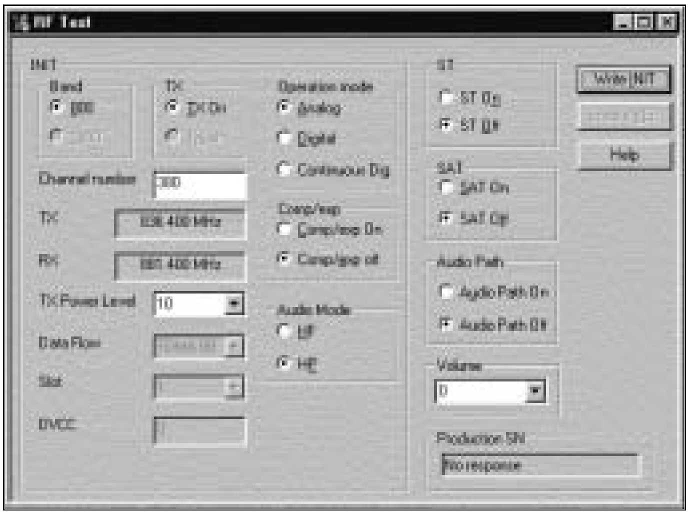
Step 2. Local oscillator checking

Carrying out this step VCO signal of 1st and 2nd mixers can be checked. 2nd mixer RX VHF VCO frequency is constant 268.08 MHz but for the 1st mixer UHF VCO frequency depends on the channel. The UHF VCO frequencies for the 1st mixer are:

Channel 991:	2006.16 MHz
Channel 380:	2030.88 MHz
Channel 799:	2056.02 MHz

1) Set signal generator frequency to 881.4091125 and level to -80 dBm.

2) Set phone to TDMA mode and select RF Test UI in Phoenix (Maintenance => Testing => RF Test).



3) Make sure that signal generator allows phone TX power going to its output. Use low power level, for example 10. Set channel to 380 and select "Write Init".

4) Set spectrum analyzer settings as following:

- Center frequency: 268.08 MHz, Span: 200 kHz
- RBW: 3 kHz, reference level: 0 dBm

5) Connect spectrum analyzer probe on the inductor L818 and record RX VHF VCO signal level and frequency. Signal level should be around -25 dBm and frequency 268.08 MHz.

6) Set spectrum analyzer settings as following:

- Center frequency: 2030.88 MHz, Span: 200 kHz
- RBW: 3 kHz, reference level: 10 dBm

7) Connect spectrum analyzer probe to VCO output pad and record UHF VCO signal level and frequency. Signal level should be around -5 dBm and frequency 2030.88 MHz.

8) Repeat measurement for channels 991 and 799.

Step 3. RX chain checking

1) Set signal generator frequency to 881.4091125 and level to -50 dBm.

2) Set phone to TDMA mode and select RF Test UI in Phoenix (Maintenance => Testing => RF Test).

3) Make sure that signal generator allows phone TX power going to its output. Use low

power level, for example 10. Set channel to 380 and press "Write Init".

4) Connect oscilloscope probe to one of the RX I/Q test points on PWB (all four testpoints J808, J809, J818 and J819 are located behind display)

5) Check that there is a clean signal in each test points.

6) Decrease signal level slowly down to -115 dBm and make sure that AGC keeps signal in visible (This can be noticed by looking at the RX I/Q voltage during signal level change).

7) Measure and record the frequency and peak-to-peak voltage of RX I/Q signal from each test points. Voltage should be around 100 mVp-p and frequency 6.5 kHz +/- 3 kHz.

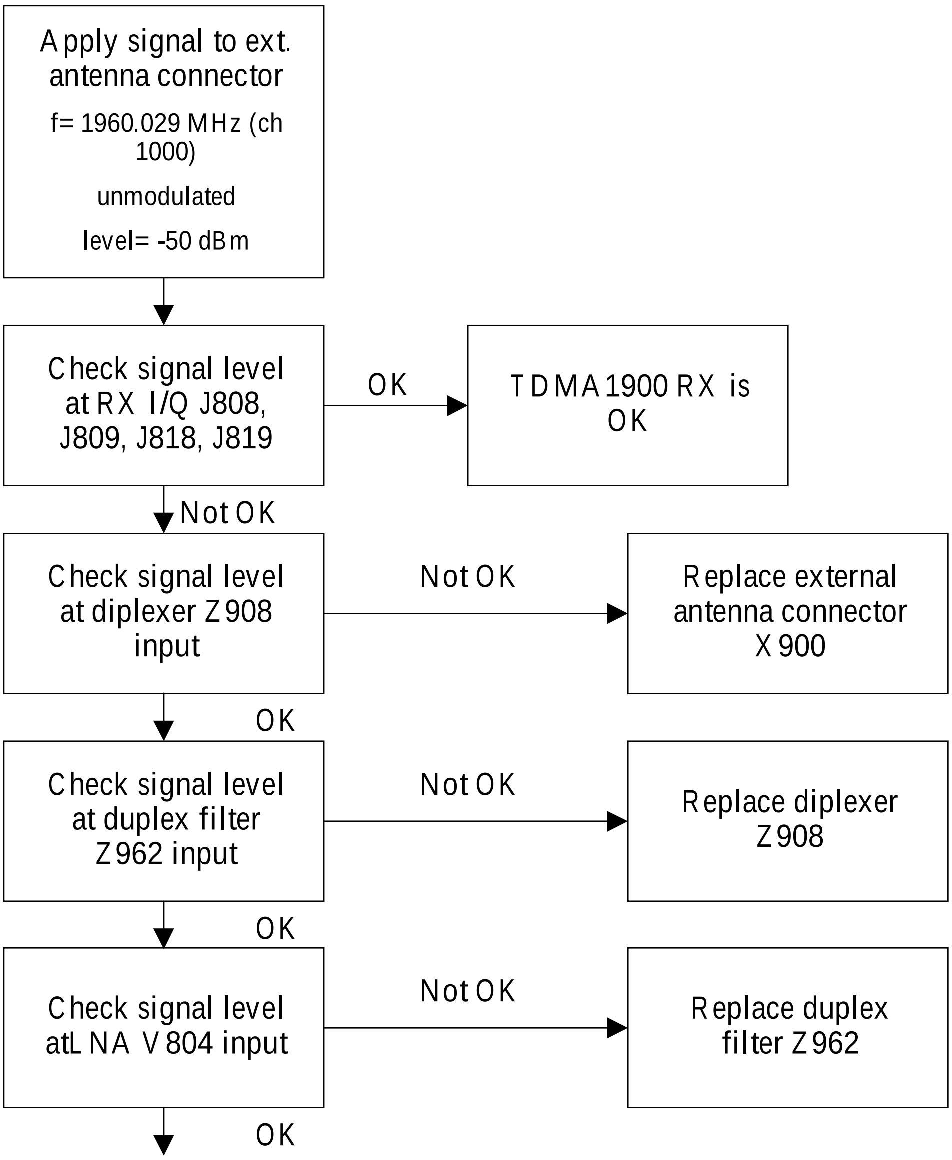
TDMA800

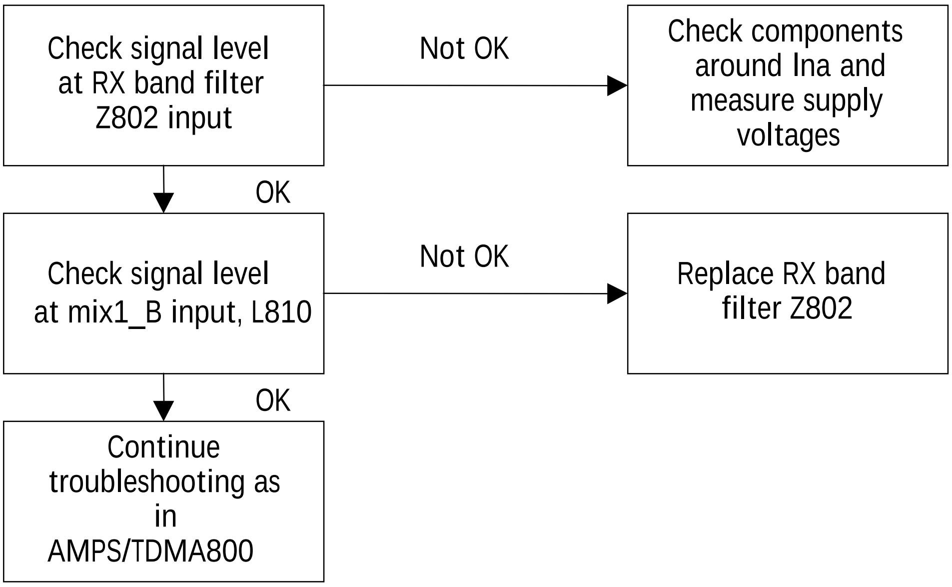
Since there is same physical signal path for both analog (AMPS) and digital mode (TDMA) in lower band there is no need for additional troubleshooting in digital mode. If digital mode in lower band is not working properly start analog mode troubleshooting.

TDMA1900

Only path from external RF connector to IF needs to be checked if AMPS/TDMA800 RX chain is OK. After down conversion (from RF to 134.04 MHz IF) both lower and upper band use same signal path.

Fault finding chart





Step 1. Local oscillator checking

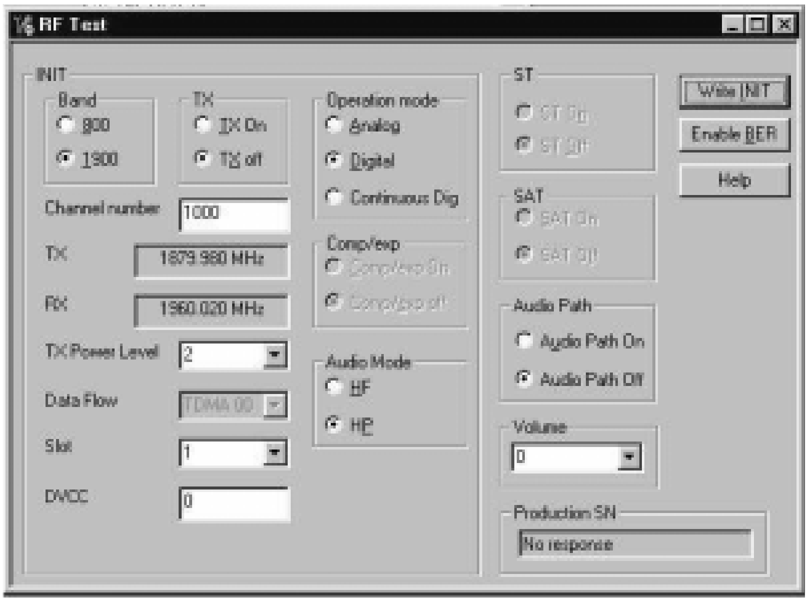
Carrying out this step VCO signal of 1st and 2nd mixers can be checked. 2nd mixer RX VHF VCO frequency is constant 268.08 MHz but for the 1st mixer UHF VCO frequency depends on the channel. The UHF VCO frequencies for the 1st mixer are:

Channel 2:	2064.12 MHz
Channel 1000:	2094.06 MHz
Channel 1998:	2124.00 MHz

1) Set signal generator frequency to 1960.0230375 MHz and level to -80 dBm.

2) Set phone to TDMA mode and select RF Test UI in Phoenix (Maintenance => Testing

=> RF Test).



3) Set channel to 1000 and press "Write Init".

4) Set spectrum analyzer settings as following:

- Center frequency: 268.08 MHz, Span: 200 kHz
- RBW: 3 kHz, reference level: 0 dBm

5) Connect spectrum analyzer probe on the inductor L818 and record RX VHF VCO signal level and frequency. Signal level should be around -25 dBm and frequency 268.08 MHz.

6) Set spectrum analyzer settings as following:

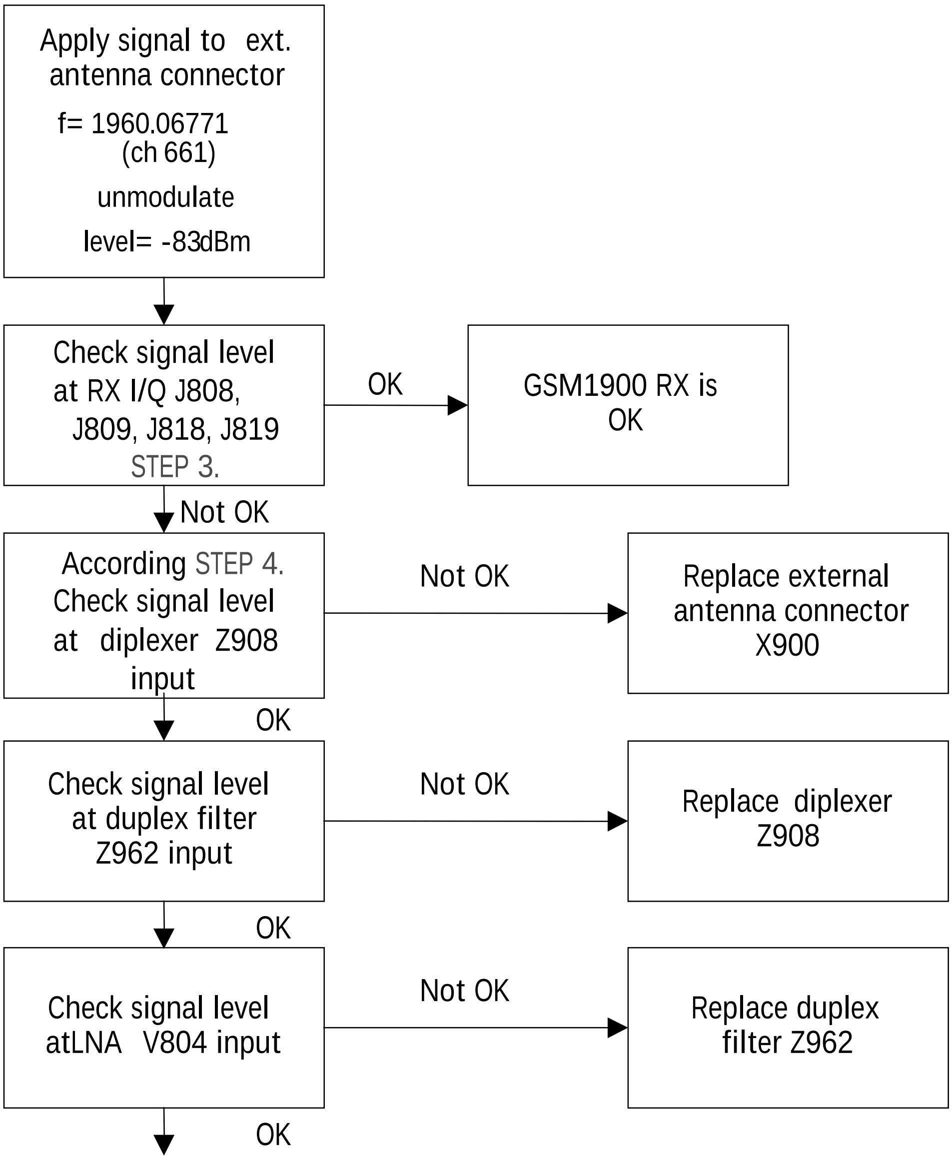
- Center frequency: 2094.06 MHz, Span: 200 kHz
- RBW: 3 kHz, reference level: 10 dBm

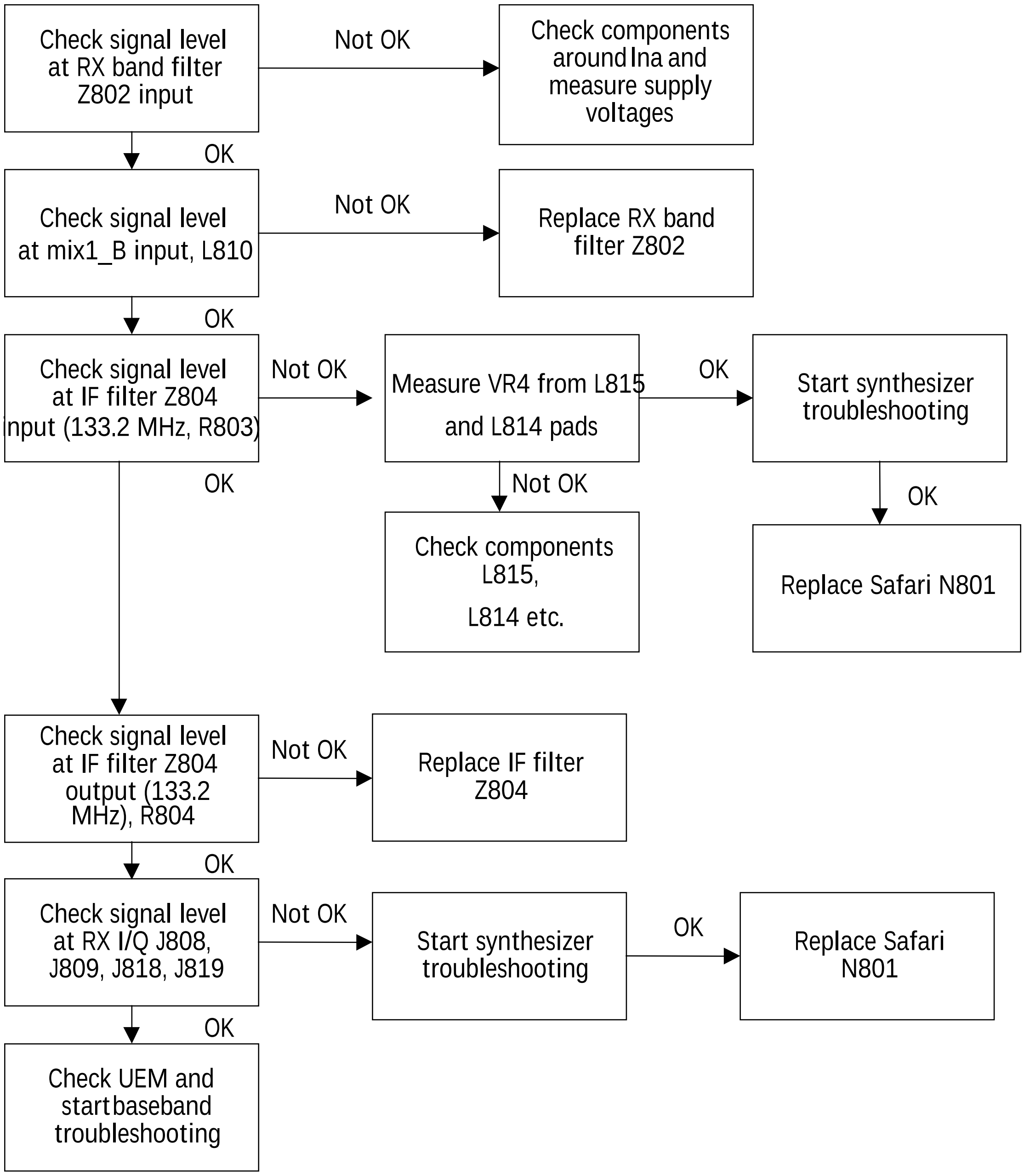
7) Connect spectrum analyzer probe to testpoint J813 and record UHF VCO signal level and frequency. Signal level should be around -5 dBm and frequency 2094.06 MHz.

8) Repeat measurement for channels 2 and 1998.

GSM1900

Fault finding chart


Apply signal to ext. antenna connector
f= 1960.06771
(ch 661)
unmodulate
level= -83dBm
Check signal level at RX I/Q J808, J809, J818, J819
STEP 3.
OK
GSM1900 RX is OK
Not OK
According STEP 4. Check signal level at diplexer Z908 input
Not OK
Replace external antenna connector X900
OK
Check signal level at duplex filter Z962 input
Not OK
Replace diplexer Z908
OK
Check signal level atLNA V804 input
Not OK
Replace duplex filter Z962
OK



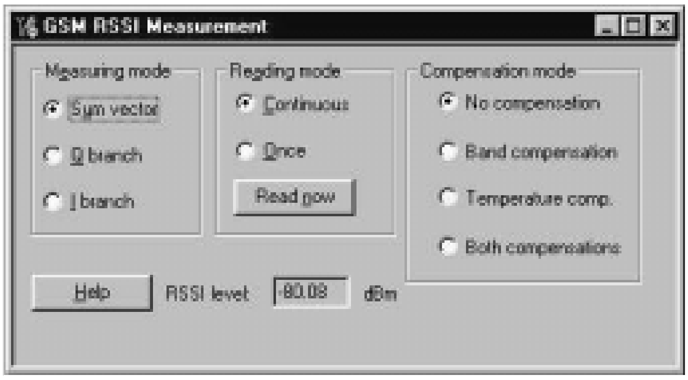
Step 1. General checking

The fastest way to get overview of RX status is to measure RSSI (Received Signal Strength Indicator) level. This can be done by using signal generator and Phoenix. Note that this is useful only if the phone has been calibrated when it was OK and the malfunction have occured after tunings.

1) Set signal generator frequency to 1960.06771 MHz and level to -80 dBm.

2) Select RSSI measurement UI in Phoenix (maintenance => GSM RSSI Meas).

3) Set Band to GSM1900 and Rx/Tx channel to 661



If the cable losses are calibrated correctly the RSSI reading should give reasonable result (-80 dBm +/- 2 dB). Please note that RSSI result is valid only if there has not been RX calibration attempts for the faulty phone. If the RSSI level is several dB's lower go to Step 2 (Local oscillator checking).

Step 2. Local oscillator checking

Carrying out this step VCO signal of 1st and 2nd mixers can be checked. 2nd mixer RX VHF VCO frequency is constant 266.4 MHz but for the 1st mixer UHF VCO frequency depends on the channel. The UHF VCO frequencies for the 1st mixer are:

Channel 512:	2063.4 MHz
Channel 661:	2093.2 MHz
Channel 810:	2123.0 MHz

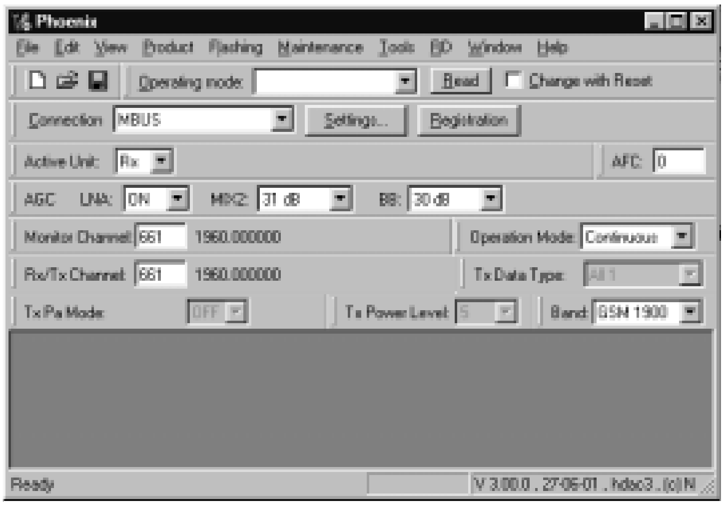
1) Set phone receiver to continuous mode using Phoenix.

2) Set spectrum analyzer settings as following:

- Center frequency: 266.4 MHz, Span: 200 kHz
- RBW: 3 kHz, reference level: 0 dBm

3) Connect spectrum analyzer probe on the inductor L818 and record RX VHF VCO signal

level and frequency. The result should be like in the picture below:

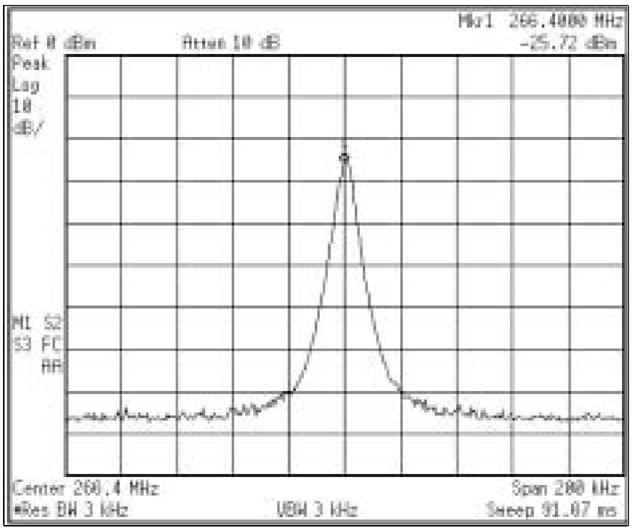


2) Set spectrum analyzer settings as following:

- Center frequency: 266.4 MHz, Span: 200 kHz

- RBW: 3 kHz, reference level: 0 dBm

3) Connect spectrum analyzer probe on the inductor L818 and record RX VHF VCO signal level and frequency. The result should be like in the picture below:



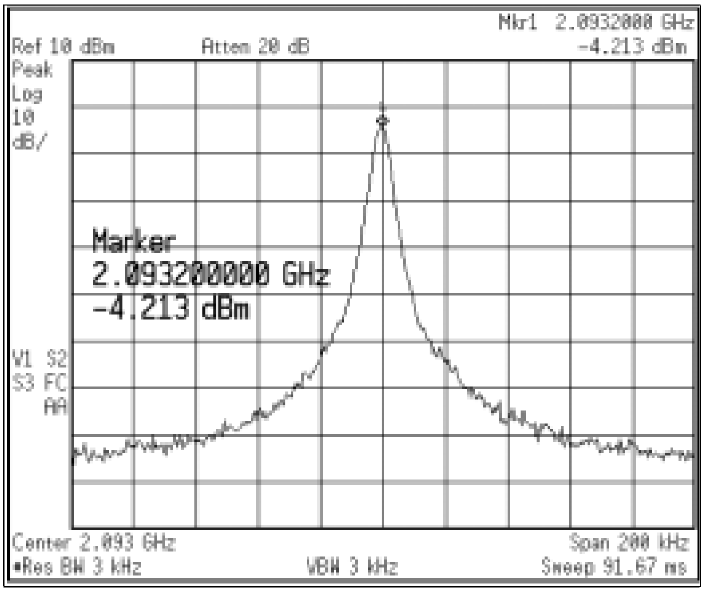
4) Set Rx/Tx channel to 661 using Phoenix.

5) Set spectrum analyzer settings as following:

- Center frequency: 2093.2 MHz, Span: 200 kHz

- RBW: 3 kHz, reference level: 10 dBm

6) Connect spectrum analyzer probe to testpoint J813 and record UHF VCO signal level and frequency. The result should be like in the picture below:

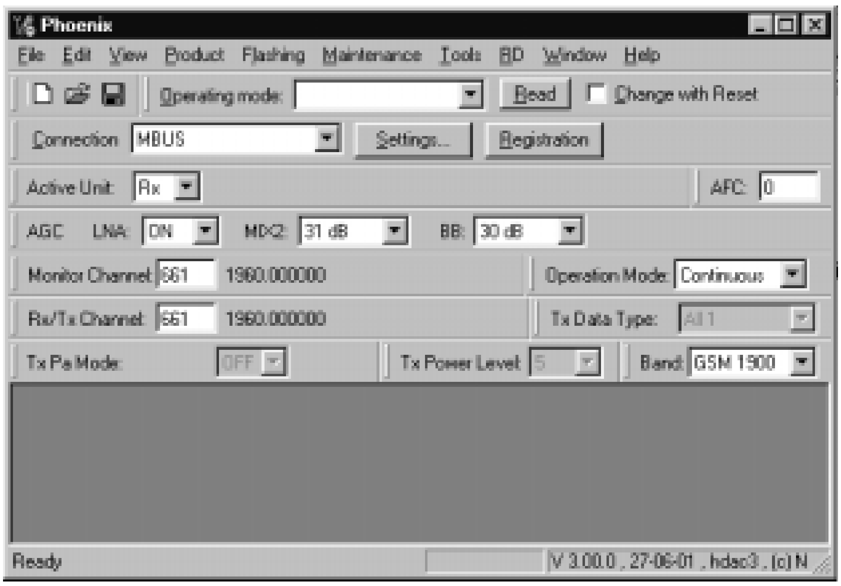


7) Repeat measurement for channels 512 and 810.

Step 3. RX chain checking

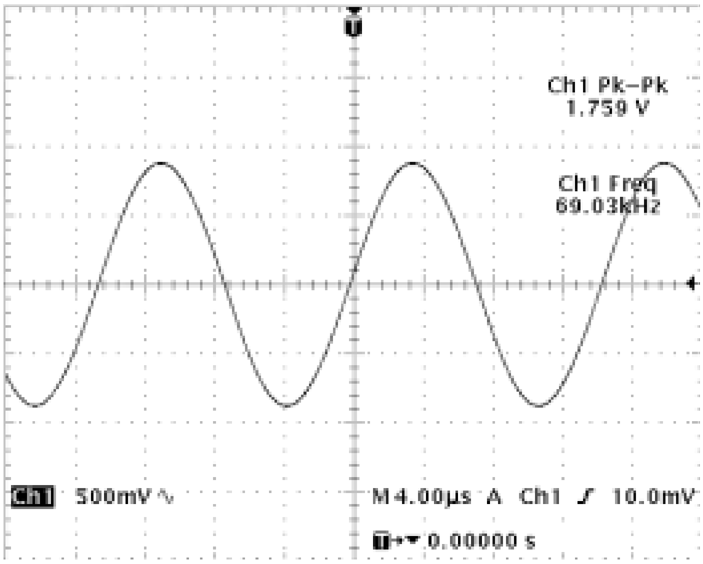
1) Set signal generator frequency to 1960.06771 MHz and level to -83 dBm.

2) Set phone receiver to continuous mode with full gain using Phoenix.



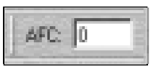
3) Connect oscilloscope probe to one of the RX I/Q test points on PWB (all four testpoints J808, J809, J818 and J819 are located behind display)

4) Measure frequency and peak-to-peak voltage of RX I/Q signal from each test points. Signal should look like in the picture below:

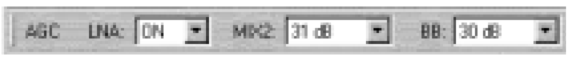


- If only one or two testpoints shows correct signal and rest of the testpoints are either deaf or signal is very small, the fault is probably due to Safari ASIC.

- If the signal amplitude is correct but its frequency is something else than 67.71 kHz +/- 3 kHz, you may try to change AFC value (-1024...1023) and see does it have effect to the frequency. Frequency should be tuned to target value with the AFC value of +/- 100.



- If the signal amplitude and frequency in all testpoints is correct and signal amplitude changes when the LNA, MIX2 and BB gains are changed, RX chain is OK.



- If the signal amplitude in all testpoints is too low (< 1 Vp-p), you have to continue with RX front-end measurements.

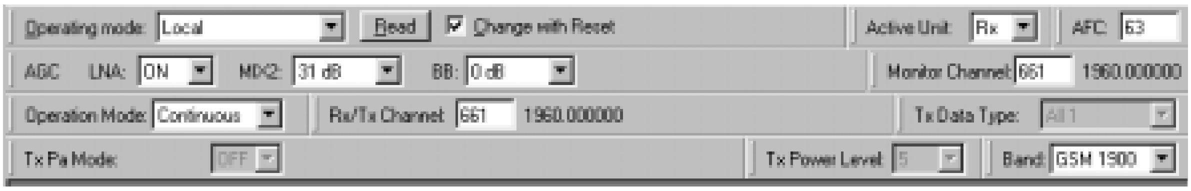
1) Set signal generator frequency to 1960.06771 MHz and level to -60 dBm.

2) Set spectrum analyzer settings as following:

- Center frequency: 133.2 MHz, Span: 200 kHz

- RBW: 3 kHz, reference level: -20 dBm

3) Set phone receiver to continuous mode with the following gain settings using Phoenix (see picture of controls in step 3).



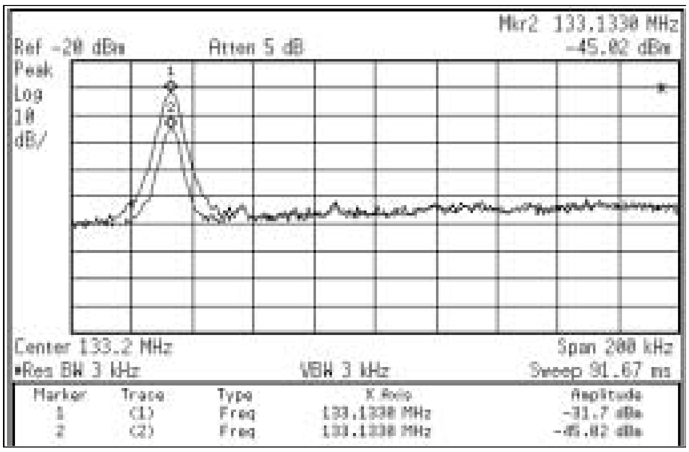
4) Connect spectrum analyzer probe to the output of GSM IF filter (at the one end of R804) and record the level.

5) Connect spectrum analyzer probe to the input of GSM IF filter (at the one end of R803) and record the level.

- If the IF signal levels are according to the picture below and local oscillators are OK (see step 2 Local oscillator checking) but RX I/Q signal is not correct (see step 3 to check RX I/Q signal) the problem is probably due too malfunction of either 2nd mixer or AGC blocks inside Safari. Please note that these levels are measured with active probe.

- If the IF signal level is correct at the filter input but not at the output side the filter shall be replaced with new one.

- If the IF signal level is not correct at the filter input side and the local oscillators are OK, inductors L814 and L815 shall be checked, too. If they are OK and there is a signal at the input of 1st mixer, the problem is probably due to faulty 1st mixer inside Safari.



LNA gain step function can be checked by measuring signal level at L803 and turning ON and OFF the LNA using Phoenix. The gain should change by 20...25 dB.

Transmitter

General instructions for TX troubleshooting

Always use an RF-cable connected from an external RF-connector to analyzer via (rf-power) attenuator. This is important to protect analyzer against excessive RF-power and not allow leakage of undesired RF-power into RF-power into cellular frequencies.

AMPS/TDMA

Start Phoenix-software and select TX mode under testing (AMPS, DAMPS or TDMA1900). It is useful to select mid channel (383 for AMPS/DAMPS or 1000 for TDMA1900) and power level 2. Select random data for digital mode of operation.

After any component change tune the phone with Phoenix auto tune SW.

GSM1900

Start Phoenix-software and select GSM RF Control, PL0, Ch661 and TX data type random.

Path of the transmitted signal

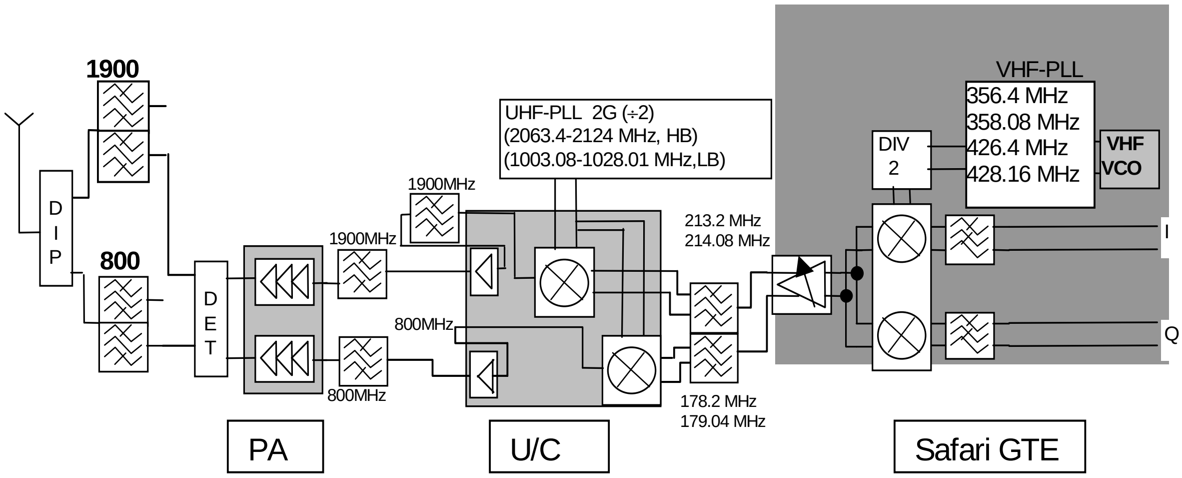
AMPS/DAMPS

UEM TX I/Q DA-converters -> I/Q modulator and Digital gain step amplifier (SAFARI) -> Dual TX IF-BPF -> Up converter (mixer -> C904 -> driver) -> BPF -> PA -> Power detector -> Duplex-filter -> Diplexer -> EXT RF-connector -> Antenna

TDMA1900, GSM1900

UEM TX I/Q DA-converters -> I/Q modulator and Digital gain step amplifier (SAFARI) -> Dual TX IF-BPF -> Up converter (Mixer -> BPF -> Driver) -> BPF -> PA -> Power detector -> Duplex-filter -> Diplexer -> EXT RF-connector -> Antenna

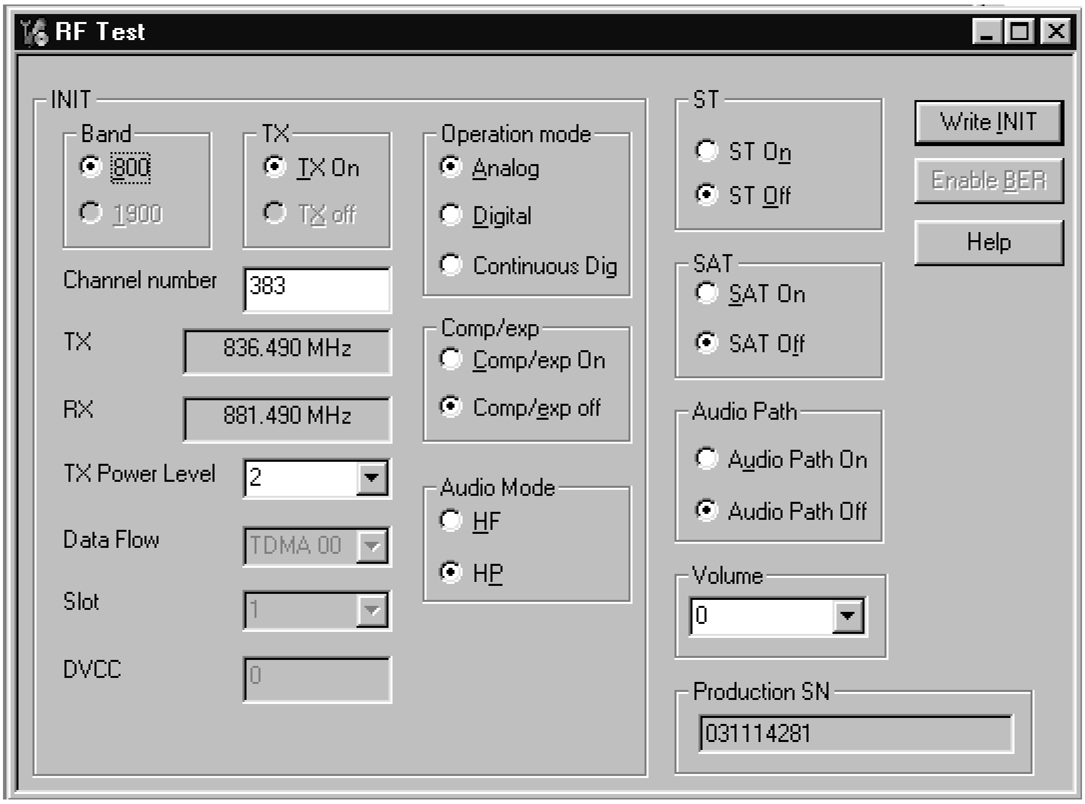
The power detection and power control circuit belongs under power control part of this guide.

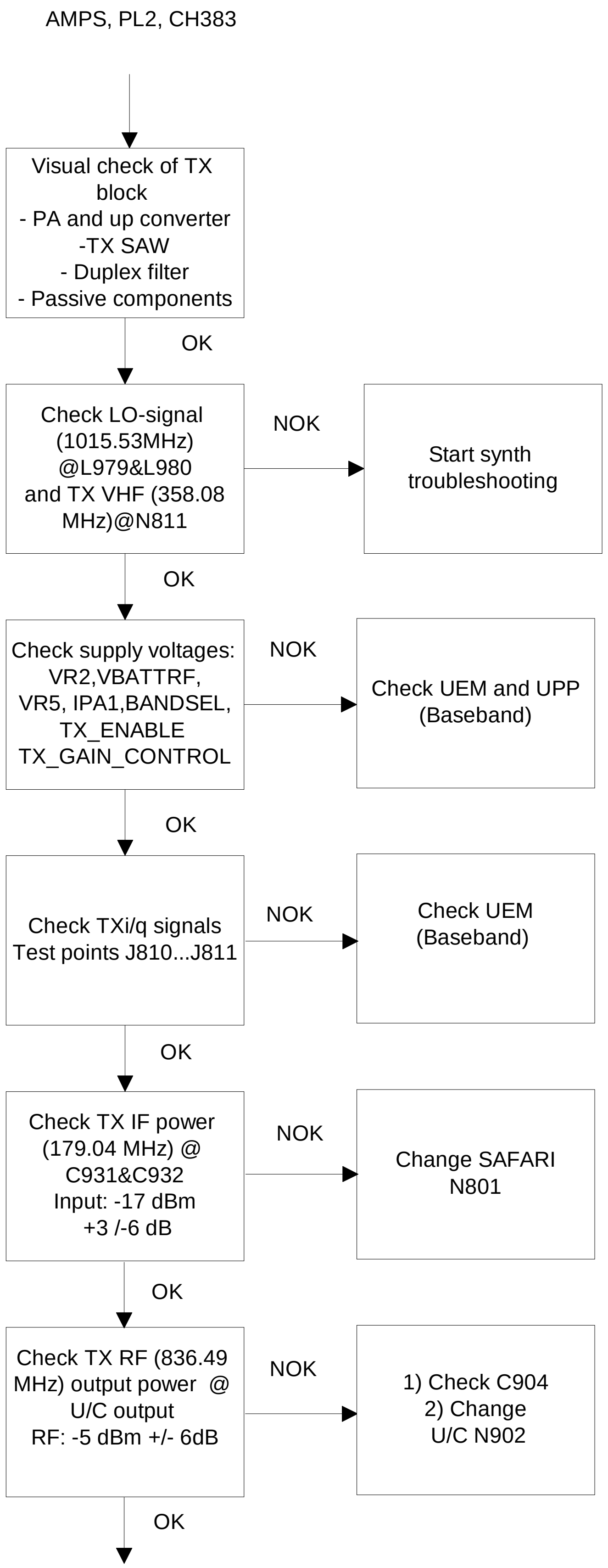


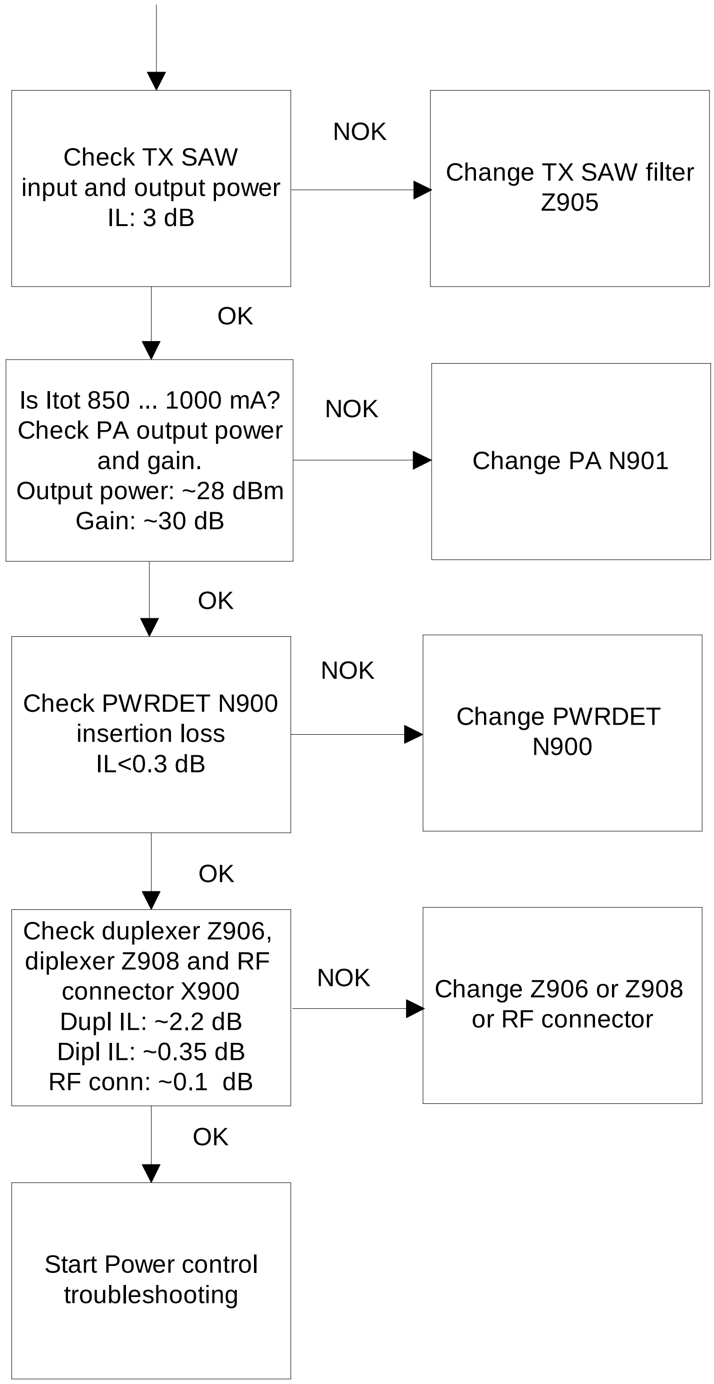
Fault finding charts for transmitter

AMPS

Start Phoenix-software and set phone to the Analog mode. Set channel 383 and Power level 2. Connect RF-cable to Ext RF connector and connect cable to Spectrum analyzer input and measure RF level. Please notice insertion loss of the cable and attenuations.


RF Test
INIT
Band
800
1900
TX
TX On
TX off
Operation mode
Analog
Digital
Continuous Dig
Channel number
383
TX
836.490 MHz
RX
881.490 MHz
Comp/exp
Comp/exp On
Comp/exp off
TX Power Level
2
Audio Mode
HF
HP
Data Flow
TDMA 00
Slot
1
DVCC
0
ST
ST On
ST Off
SAT
SAT On
SAT Off
Audio Path
Audio Path On
Audio Path Off
Volume
0
Production SN
031114281
Write INIT
Enable BER
Help


AMPS, PL2, CH383
Visual check of TX block
- PA and up converter
-TX SAW
- Duplex filter
- Passive components
OK
Check LO-signal (1015.53MHz) @L979&L980 and TX VHF (358.08 MHz)@N811
NOK
Start synth troubleshooting
OK
Check supply voltages: VR2,VBATTRF, VR5, IPA1,BANDSEL, TX_ENABLE TX_GAIN_CONTROL
NOK
Check UEM and UPP (Baseband)
OK
Check TXi/q signals Test points J810...J811
NOK
Check UEM (Baseband)
OK
Check TX IF power (179.04 MHz) @ C931&C932 Input: -17 dBm +3 /-6 dB
NOK
Change SAFARI N801
OK
Check TX RF (836.49 MHz) output power @ U/C output RF: -5 dBm +/- 6dB
NOK
1) Check C904
2) Change U/C N902
OK



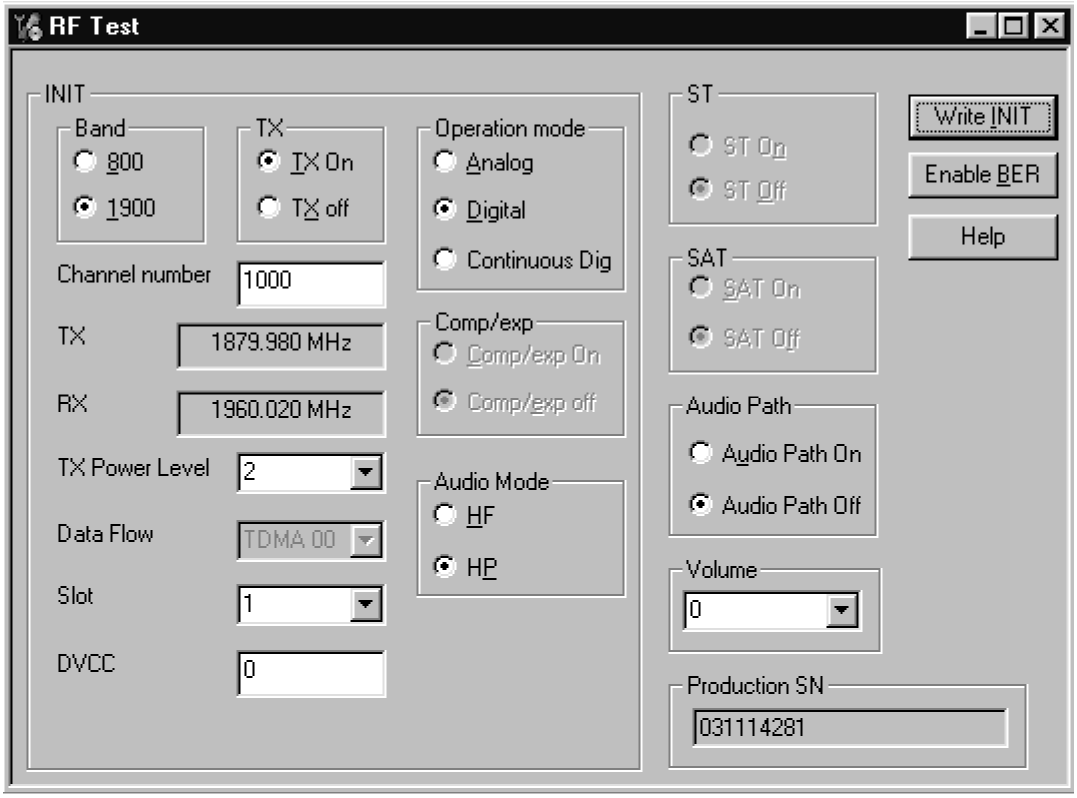
TDMA800

The transmitter chain is exactly same as the AMPS-mode, except for the IPA current, and thus it is important that the AMPS have no faults.

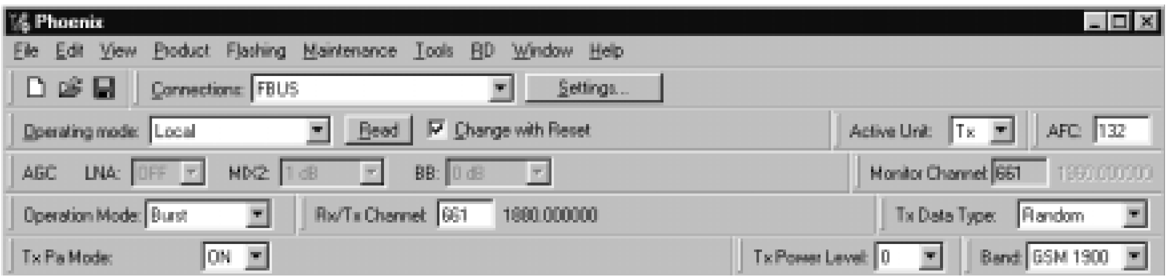
TDMA1900, GSM1900

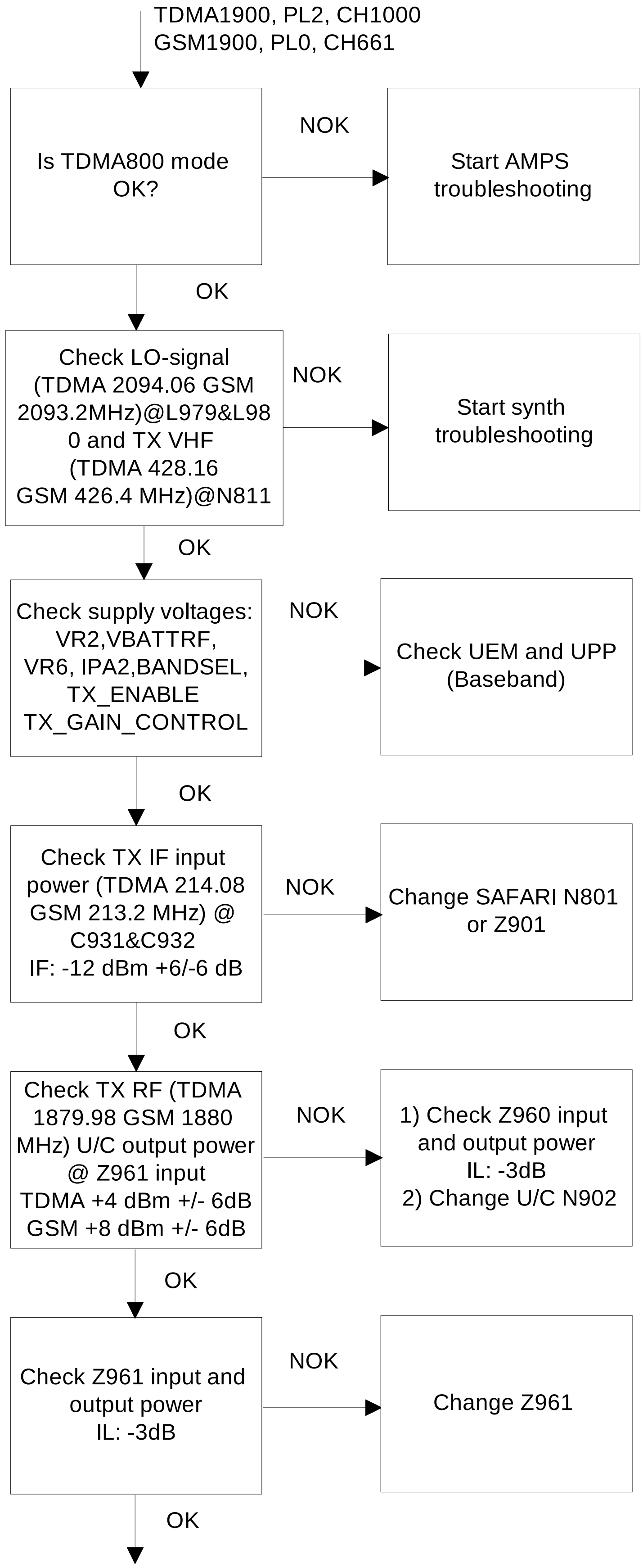
TDMA1900 and GSM1900 mode and DAMPS mode have a common RF modulator and thus it is important that DAMPS mode have no faults.

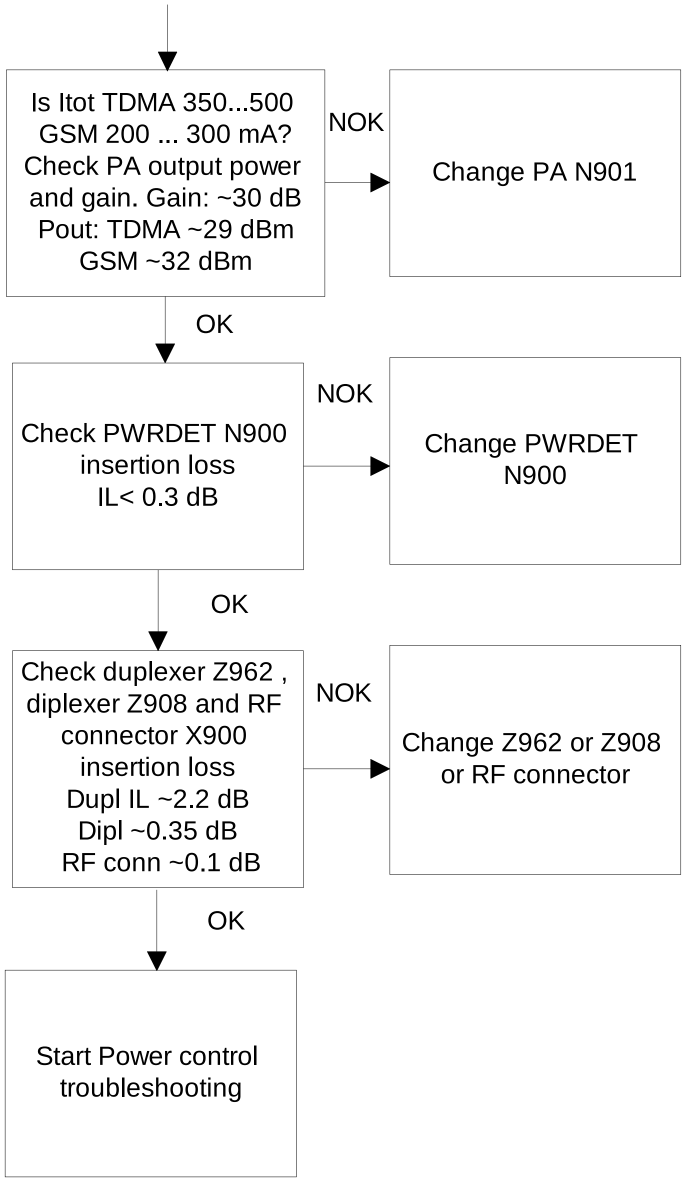
TDMA1900:



GSM1900:

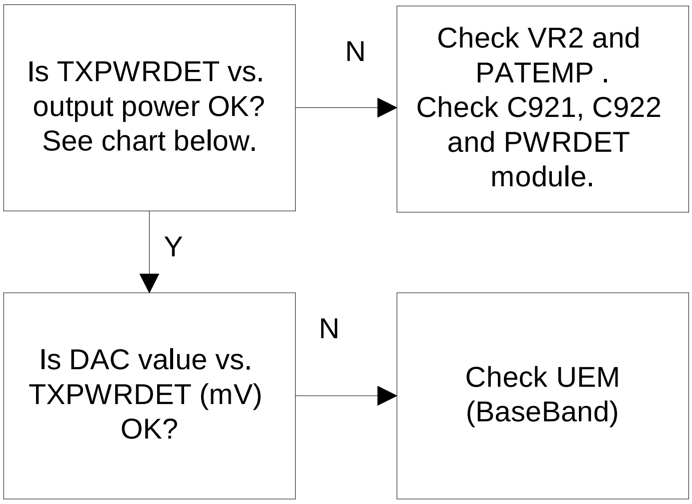



TDMA1900, PL2, CH1000
GSM1900, PL0, CH661
Is TDMA800 mode OK?
NOK
Start AMPS troubleshooting
OK
Check LO-signal (TDMA 2094.06 GSM 2093.2MHz)@L979&L980 and TX VHF (TDMA 428.16 GSM 426.4 MHz)@N811
NOK
Start synth troubleshooting
OK
Check supply voltages: VR2,VBATTRF, VR6, IPA2,BANDSEL, TX_ENABLE TX_GAIN_CONTROL
NOK
Check UEM and UPP (Baseband)
OK
Check TX IF input power (TDMA 214.08 GSM 213.2 MHz) @ C931&C932 IF: -12 dBm +6/-6 dB
NOK
Change SAFARI N801 or Z901
OK
Check TX RF (TDMA 1879.98 GSM 1880 MHz) U/C output power @ Z961 input TDMA +4 dBm +/- 6dB GSM +8 dBm +/- 6dB
NOK
1) Check Z960 input and output power IL: -3dB
2) Change U/C N902
OK
Check Z961 input and output power IL: -3dB
NOK
Change Z961
OK



Power control loop

Basically, the power detection is done with Power detector module and power control is done inside SAFARI. Power detection is similar for both bands, except both bands have own coupler.



Note !

See TXPWRDET vs. Output power curve

The detected voltages are illustrated in the following table and diagram.

AMPS AND TDMA

Table 3: Typical detected voltages at power levels PL2...PL10

800A					800D					1900D	
	Pout	TXPWRDET			Pout	TXPWRDET			Pout	TXPWRDET	
PL	dBm	dac	mV		dBm	dac	mV		dBm	dac	mV
2	25.7	440			27.3				27.3	503	
3	23.3	320			23.3				23.3	304	
4	19.3	190			19.3				19.3	182	
5	15.3	110			15.3				15.3	105	
6	11.1	60			11.1				11.1	57	
7	7.0	33			7.0				7.0	30	
8	-	-	-		-3.0	18			3.0	15	
9	-	-	-		-1.0	8			-1.0	6	
10	-	-	-		-5.0	3			-5.0	2	

GSM1900

Table 4: Typical detected voltages at power levels PL0...PL15

	850				1900		
	Pout	TXPWRDET			Pout	TXPWRDET, U_value	
PL	dBm	dac	mV		dBm	dac	mV
0					29.5	660	
1					28	556	
2					26	436	
3					24	343	
4					22	364	
5					20	203	
6					18	158	
7					16	118	
8					14	91	
9					12	66	
10					10	50	
11					8	35	
12					6	27	
13					4	18	
14					2	13	
15					0	9	

Note: DAC VALUES MAY VARY ABOUT +/- 20%

Note: TXPWRDET is difference between TX on burst and off burst.

Synthesizers

There are five oscillators generating the needed frequencies for RF-section. 19.2 MHz reference oscillator, 2GHz UHF VCO, TX VHF cascade amplifier VCO both RX VHF VCO and BB VHF integrated in Safari. RX VHF frequency is 268.08 MHz in TDMA and 266.4 MHz in GSM and TX VHF has three fixed frequencies, 358.08 MHz for lowband and 426.4 MHz in GSM and 428.16 MHz in TDMA upper band. VCO's operating frequencies are controlled by PLL-circuit of SAFARI. All locals are locked to stable 19.2 MHz reference oscillator.

The frequency range for 2GHz UHF VCO is: 2006.16 ... 2124 MHz. The output frequency range for the lower band is from 2006.16 to 2056.02 MHz. In TDMA upper band the output frequency range from the UHF VCO is from 2064.12 MHz to 2124 MHz and GSM 2063.40 ... 2123 MHz.

BB-PLL frequencies are in TDMA 77.76 MHz and in GSM 78 MHz

It is practical way to check out synthesizer status by measuring control voltage of the VCO from Integrator capacitor. If voltage is stable and reasonable, local oscillators are running correctly.

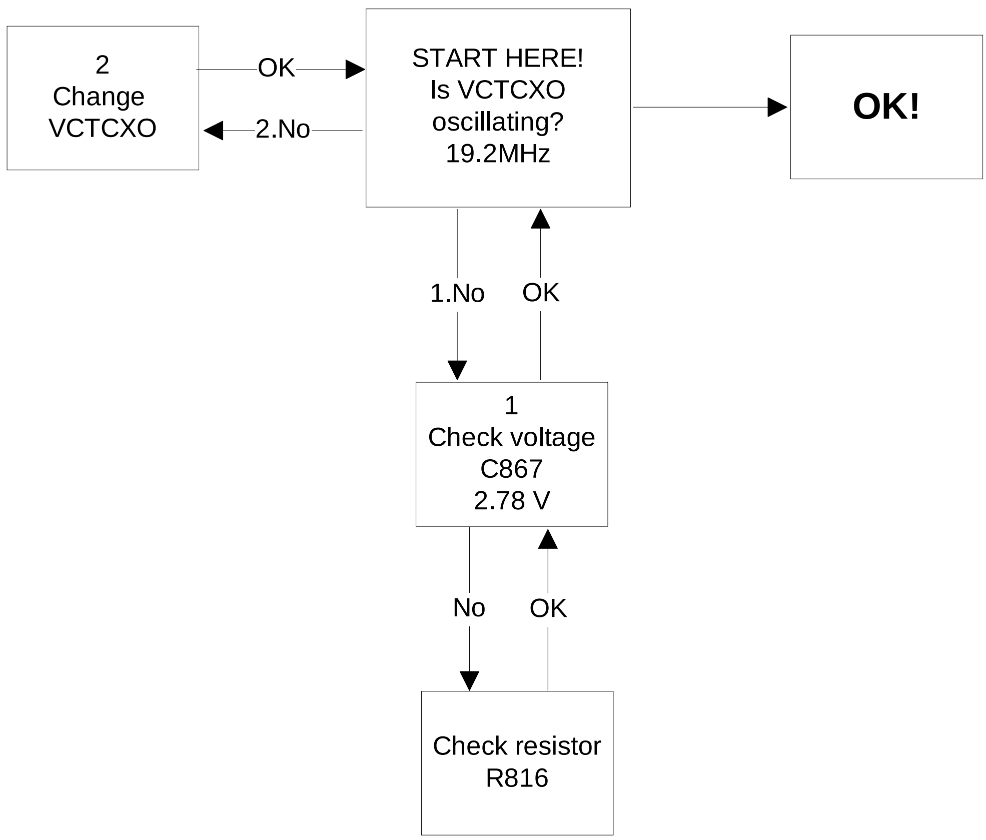
19.2 MHz reference oscillator

The 19.2 MHz oscillator frequency (G801) is controlled by UEM. This 19.2 MHz signal is connected thru SAFARI to PLL-circuits.

All synthesizers use divided VCTCXO signal as a reference signal for Phase locked loop to provide correct LO-frequency.

BB-PLL provides to the BB needed clock signals.

Fault finding chart for 19.2 MHz oscillator



RX VHF VCO

The RX VHF VCO signal is used to generate receiver Intermediate frequency. RX VHF VCO has two fixed frequencies: TDMA 268.08 MHz, GSM 266.4 MHz. Operating frequency is locked in Phase locked Loop.

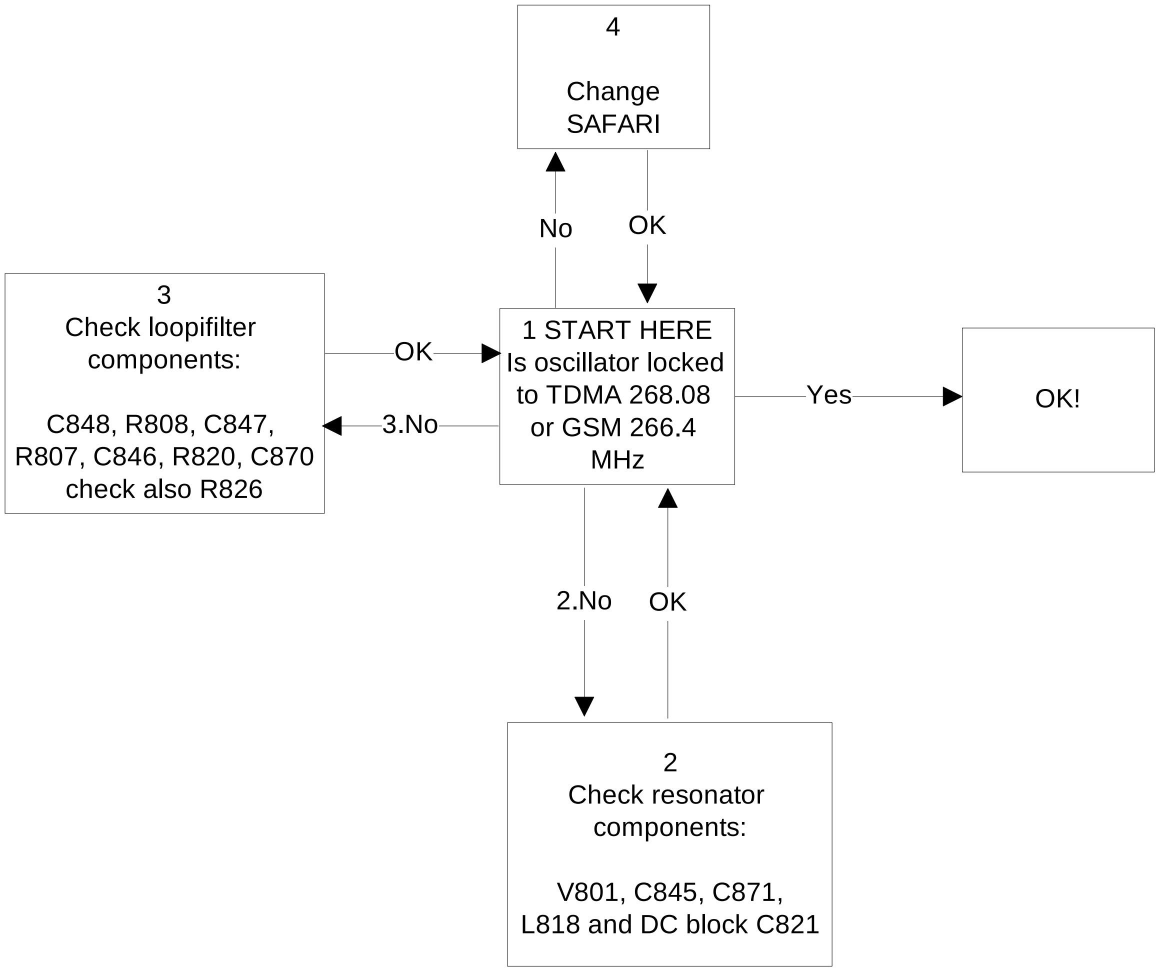
RX VHF VCO output signal is fed to SAFARI. Inside the SAFARI signal is divided for Phase detector and RX parts. Before I/Q-modulator frequency is divided by 2.

Fault finding chart for RX VHF VCO

Measure oscillator frequency over L818 coil. Don't connect probe to pads!

AMPS, CH383 -> RX VHF frequency 268.08 MHz

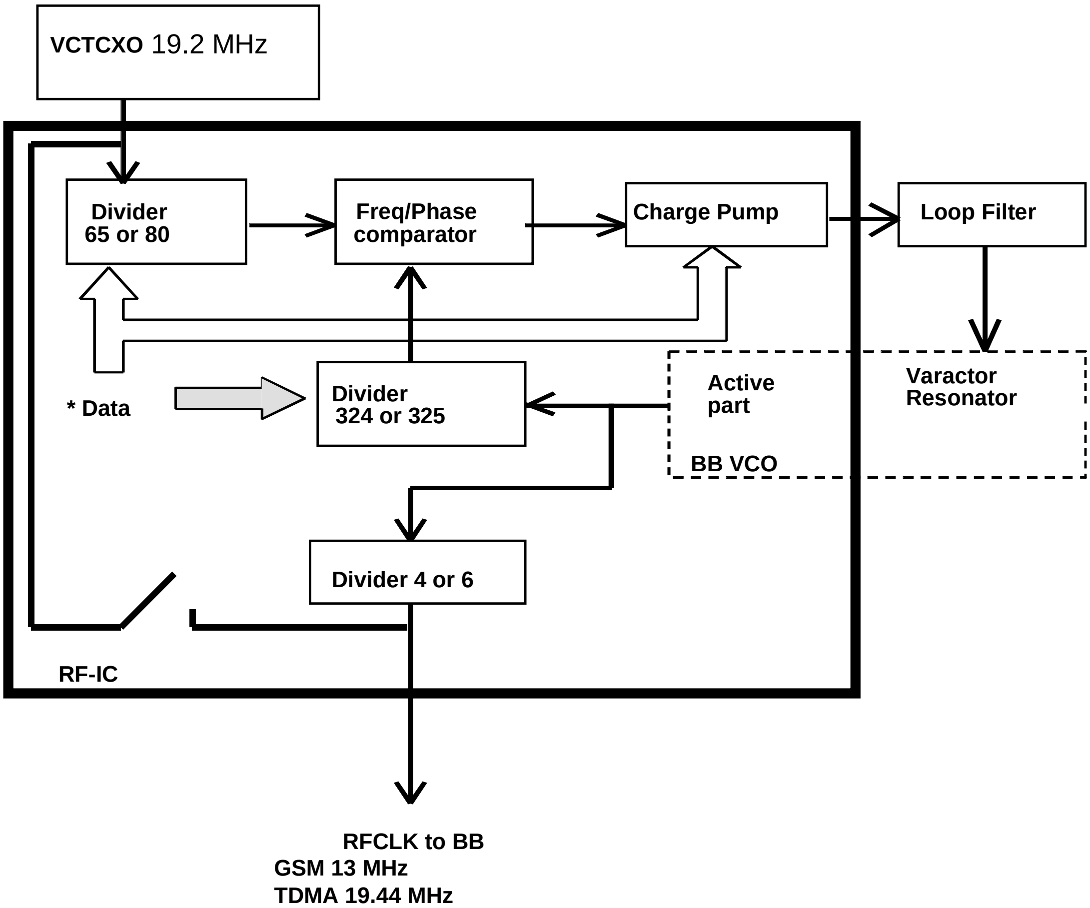
GSM1900, CH661 -> TX VHF frequency 266.4 MHz



BB PLL

The BB PLL generates RF clock to base band. It has two fixed frequencies 77.76 MHz in

TDMA mode and 78 MHz in GSM mode. Next picture shows BB PLL working.



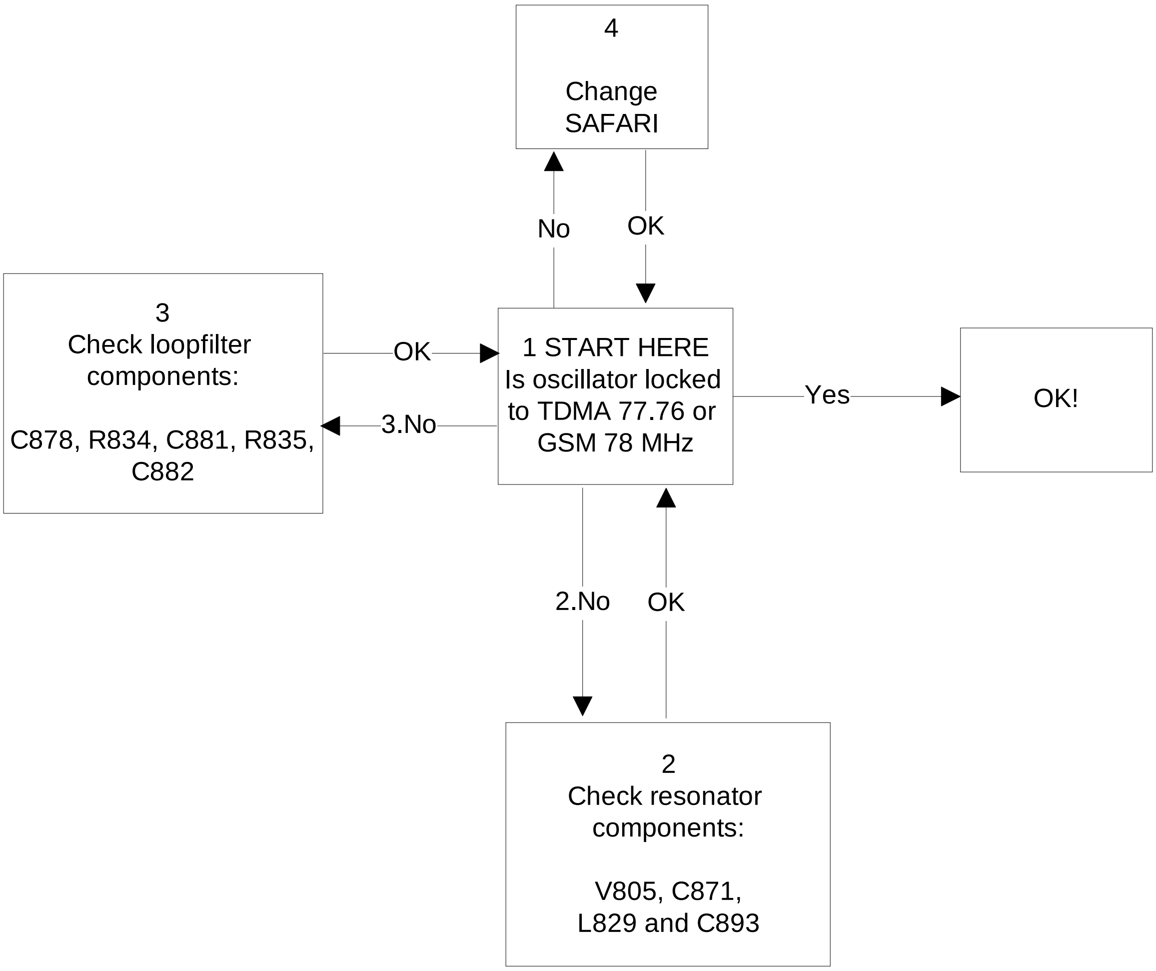
*Data are related to vctcxo frequency and mode selections.

Fault finding chart for BB PLL

Measure oscillator frequency over L829 coil. Don’t connect probe to pads!

TDMA -> BB PLL frequency 77.76 MHz

GSM-> BB PLL frequency 78 MHz



TX VHF VCO

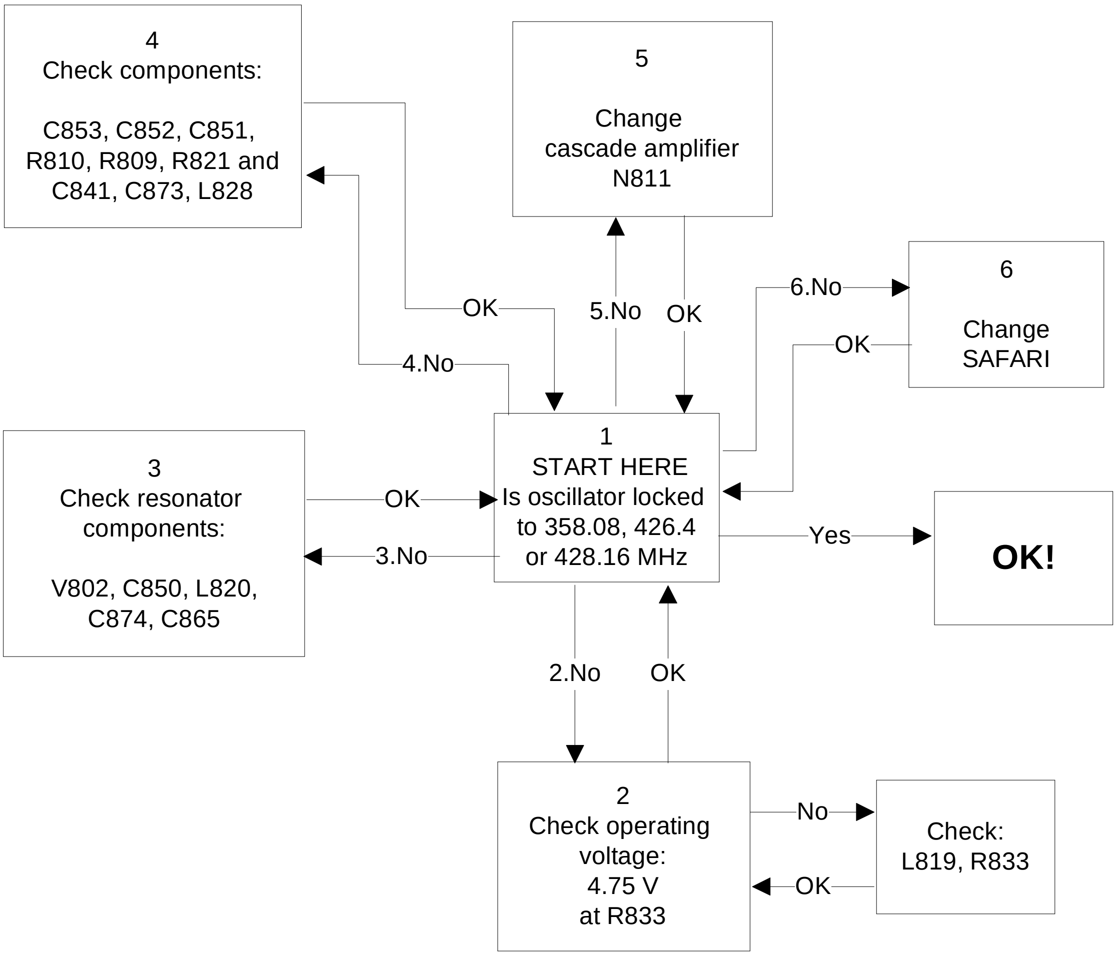
The TX VHF VCO signal is used to generate transmitter Intermediate frequency. TX VHF VCO has three fixed frequencies 358.08 MHz for lower band and TDMA 428.16 MHz and GSM 426.4 MHz for upper band. Operating frequency is locked in Phase locked Loop and frequency is divided by two before modulator.

Fault finding chart for TX VHF VCO

AMPS, CH383 -> TX VHF frequency 358.08 MHz

TDMA1900, CH1000-> TX VHF frequency 428.16 MHz

GSM1900, CH661 -> TX VHF frequency 426.4 MHz

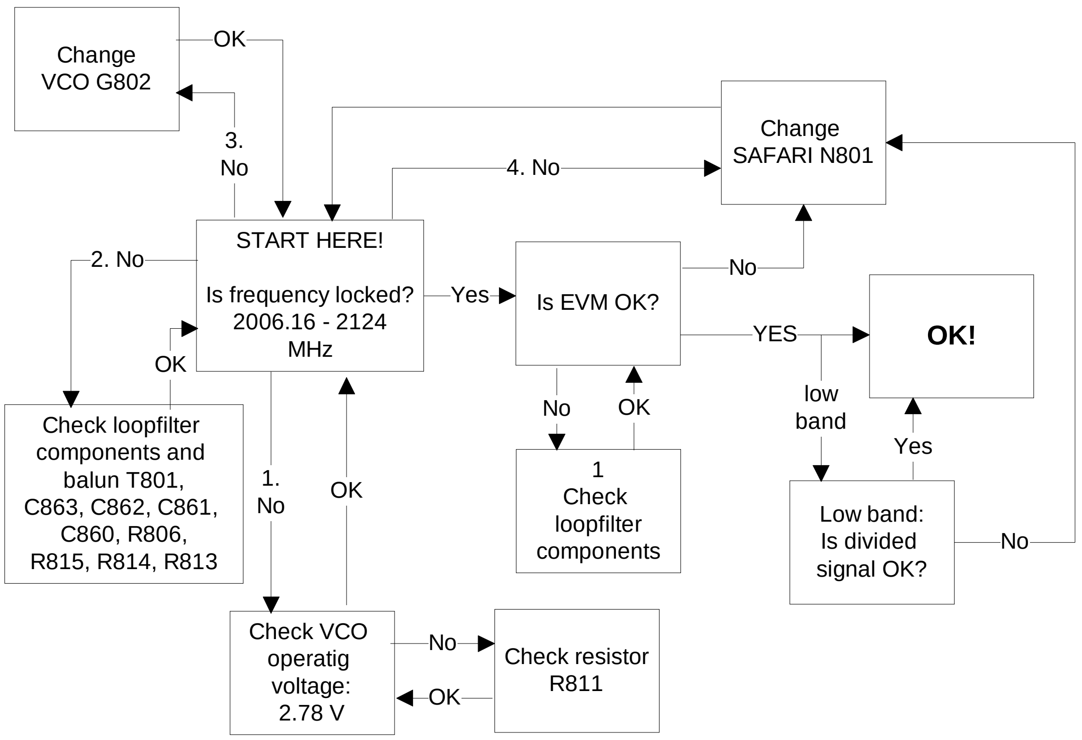


UHF SYNTHESIZER

The UHF synthesizer consists of a external 2GHz UHF VCO, loop filter and integrated PLL in Safari RF-IC. Safari GTE IC contains stages like counters, prescaler, divider by two, phase and frequency comparator and a charge pump circuit which allows two operational modes analog and digital. The UHF VCO Oscillation frequency is from 2006.16 MHz to 2124 MHz

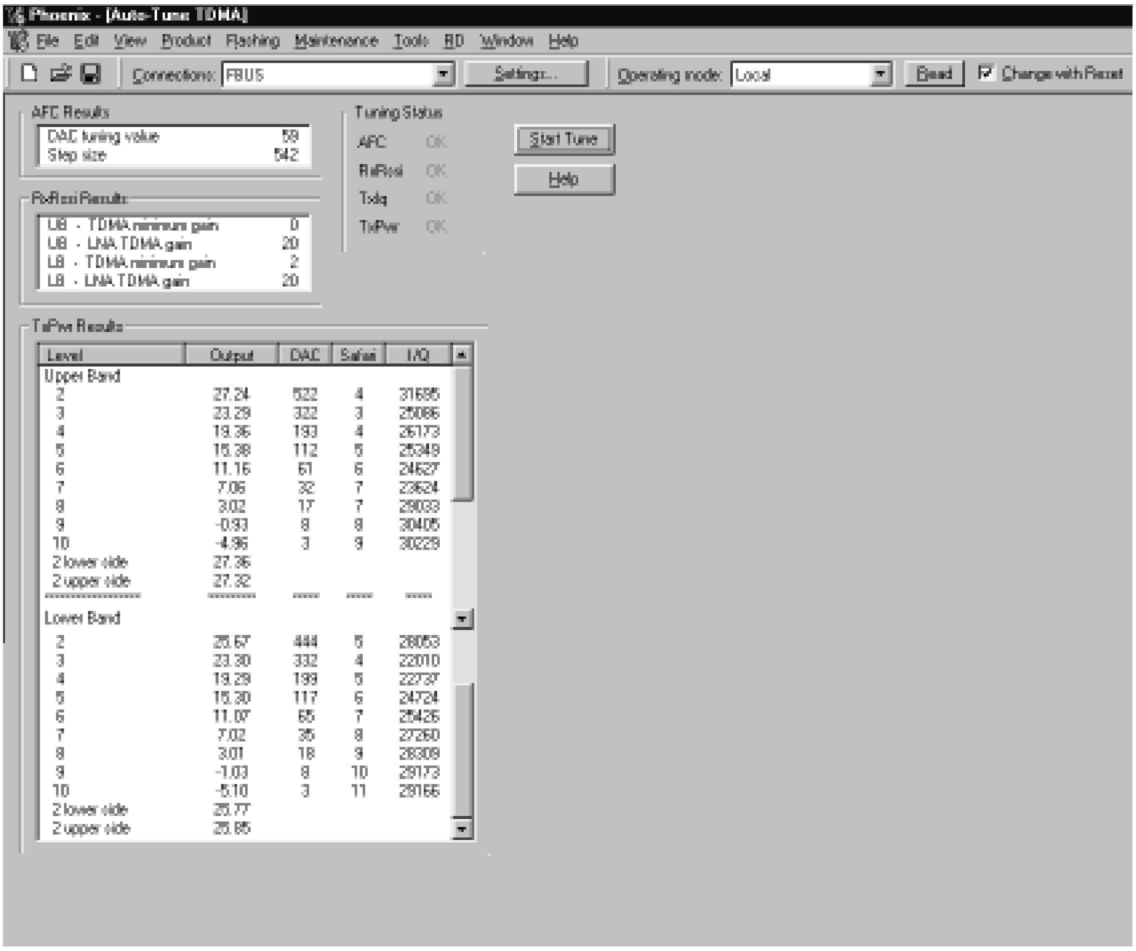
In upper band (TDMA1900 &GSM1900) 2 GHz synthesizer frequency is fed straight to mixers. In lower band case (AMPS & TDMA800) 2 GHZ UHF VCO frequency signal is first divided by 2 inside SAFARI and then that divided signal is fed to mixers. The output frequency of the VCO depends on the DC-control voltage which is controlled by PLL-circuit inside SAFARI.

Fault finding chart for UHF SYNTHESIZER



Description of NPM-2NX RF Auto-tune Tuning

TDMA RF tunings



TDMA RX tunings

AFC tuning

- Purpose of the tuning is to correct phone frequency error
- If AFC tuning fails it might be due to:
  - Problems with lower band signal path, synthesizer etc.
  - If AFC DAC tuning value or step size is too low or high it might be due to faulty VCTCXO component.
- (UEM)
- (UPP)

RX LP and AMP2 filter tunings

- Tuning results are only visible after unsuccessful tuning with auto-tune procedure
- This tuning has done simultanously with AFC-tuning

If LP and AMP2 filter tuníngs fail it might be due to:

- Problems with lower band signal path (synthetizer etc.)
- VCTCXO component can be broken
- Safari can be broken or solder joints

UB RX AGC tuning

- UB TDMA minimum gain (around 0 dB), measured when lna is switched off
- UB LNA gain step, measured when lna is switched on. Result is gain difference between lna on and off (around 20 dB)
- If UB TDMA minimum gain is lower than -2 further analysis is needed. Result 32752 means that the signal doesn't go through RX chain at all or it has a lot of attenuation.

If it fails there can be following problems:

- Rx chain is totally deaf or some gain is missing, start receiver troubleshooting

LB RX AGC tuning

- LB TDMA minimum gain (around 2 dB), measured when lna is switched off
- LB LNA gain step, measured when lna is switched on. Result is gain difference between lna on and off (around 20 dB)
- If LB TDMA minimum gain is lower than -2 dB, further analysis is needed. Result 32752 means that the signal doesn't go through RX chain at all or it has a lot of attenuation.

If it fails there can be following problems:

- Rx chain is totally deaf or some gain is missing, start receiver troubleshooting

TDMA TX tunings

If some TX tunings fails, start always TX troubleshooting!

TX IQ (TxIq)

- Purpose of the tuning is to tune DC offset and phase offset so low as possible (test limit –40 dBc)

If tuning fails there can be following problems:

- UEM or Safari
- Too low output power

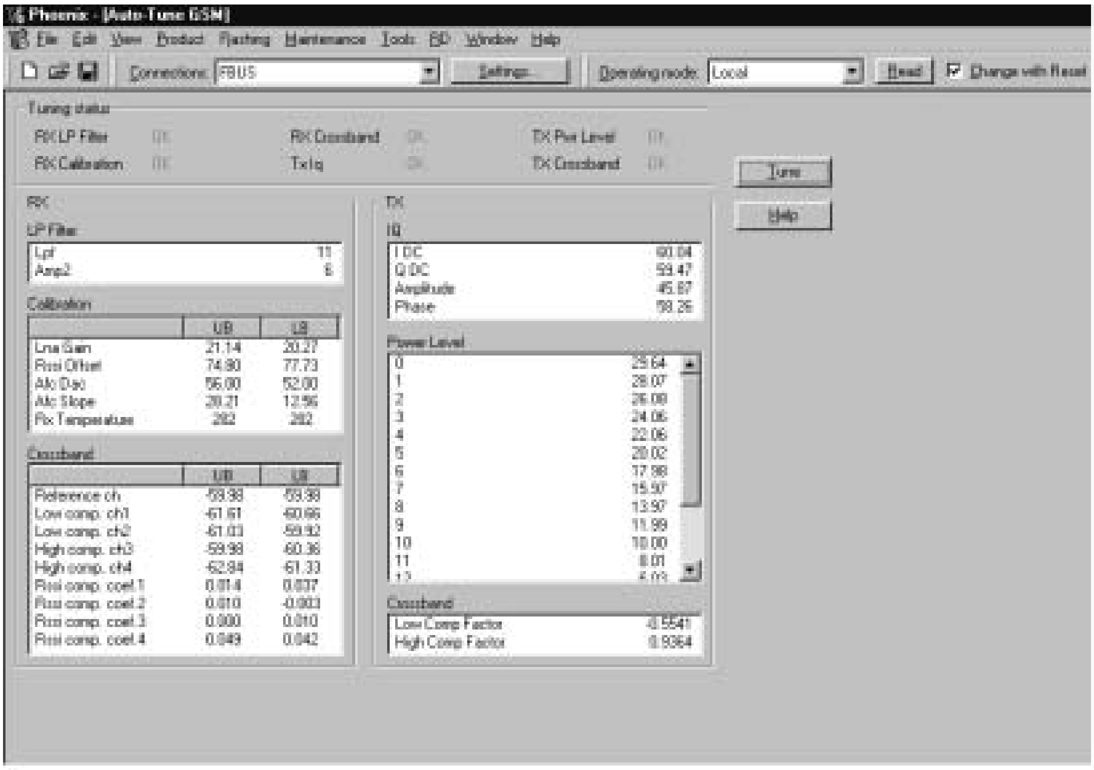
TX power levels and crossband (TxPwr)

- Purpose of this tuning is to tune all power levels (PL2 – PL10)
- TX crossband:
  - Low band: Purpose to tune ch991 and ch799 equals to mid (ch383) channel power
  - Upper band: Purpose to tune ch2 and ch1998 equals to mid (ch1000) channel power
  - Crossband tuning is done only with PL2

If tuning fails there can be following problems:

- Broken component: PA, Safari, up converter, some filters
- Missing components

GSM RF tunings



GSM RX tunings

LP and AMP2 filters tunings

- This is done using Safari internal loop. No external signal is needed

If it fails there can be following problems:

- Safari problem

GSM AFC tuning

- Purpose of the tuning is to correct phone frequency error

If AFC tuníng fails it might be due to:

- Problems with upper band signal path (synthesizer etc.)
- VCTCXO component can be broken
- (UEM)
- (UPP)

GSM UB LNA GAIN AND RSSI OFFSET

- UB GSM reference gain (around 74 dB), measured when lna is switched off
- UB LNA gain step, measured when lna is switched on. Result is gain difference between lna on and off (around 21 dB)

If it fails there can be following problems:

- Rx chain is totally deaf or some gain is missing, start receiver troubleshooting

GSM LB LNA GAIN AND RSSI OFFSET

- UB GSM reference gain (around 77 dB), measured when lna is switched off
- UB LNA gain step, measured when lna is switched on. Result is gain difference between lna on and off (around 20 dB)

If it fails there can be following problems:

- Rx chain is totally deaf or some gain is missing, start receiver troubleshooting

RX temperature calibration

- NTC resistor calibration in ambient temperature

If NTC temperature fails it might be due to:

- Faulty NTC resistor or pull up resistor
- faulty UEM
- wrong ambient temperature (phone is too hot or cold)

GSM RX CROSS BAND CALIBRATION

- Purpose of the calibration is to compensate gain ripple due to rx-filters over the band
- This is done in UB and LB

If it fails response over the band can be totally bad and there can be following problems:

- Please check that all components are ok and in place around rx-parts
- Please check that filters are ok

GSM TX tunings

If some TX tuning fails, start always TX troubleshooting!

TX IQ

- Purpose of this tuning is tune DC offset and phase offset so low as possible
  - Typical values Amplitude: -45 to –55 dBc and Phase: –50 to – 60 dBc

If tuning fails there can be following problems:

- UEM or Safari
- Too low output power

TX Power levels

- Purpose of this tuning is tune all power levels (PL0 – PL15)

If tuning fails there can be following problems:

- Broken components: PA, Safari, up converter, some filters
- Missing components

TX crossband

- Purpose to tune ch512 and ch810 equals to mid (ch661) channel power
  - Typical values
    - Low Comp Factor –0.5 to –1.5
    - High Comp Factor 0.5 to 2