CCS Technical Documentation
RH-14 Series Transceivers

Troubleshooting

Contents

Troubleshooting

The first thing to do when a problem is encountered is to carry out a thorough visual check of the module. Make sure that:

- there are no mechanical damages

- the solder joints are OK

Note: Before changing anything, ALL SUPPLY VOLTAGES AND THE SYSTEM CLOCK / SLEEP CLOCK should be checked.

Baseband Troubleshooting

General testing information

There are three different modes for testing and/or repairing the phone. The mode can be selected with suitable resistors connected to BSI- and BTEMP- lines as illustrated in the following table:

Table 1: Phone operating mode

Mode	BSI- resistor	BTEMP resistor	Remarks
Normal	68k	75k	
Local	560_(<1k_)	Whatever	
Test	> 1k	560_(<1k_)	Recommended for baseband testing. Same as local mode, but making a phone call is possible.

If the corresponding resistors are connected, the MCU software automatically enters into the local or test mode when the supply voltage is connected to the phone.

The power can be switched on by:

1. Pressing the power key.

2. Connecting the local/test mode resistors to the BSI/BTEMP lines and connecting the battery voltage to the phone.

3. Connecting a charger.

4. Using the phone's internal functions (real-time clock alarm).

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

Troubleshooting

Note: Most of the baseband repair actions require removing the baseband shield. The shield must not be removed unless separately authorized by the program.

Note: The phone's ESN has to re-written to the UEM, if the UEM is replaced. This can be done only in Central Service.

The baseband troubleshooting instructions include the following topics:

1   Power up

2   Flash programming

3   Audio

   •   Earpiece

   •   Microphone

4   Charging

5   Accessory detection

6   Sleep clock

7   User interface

   •   Display

   •   Lights

   •   MIDI

   •   Vibra

   •   Keyboard

Power-up faults

   Power-up sequence

1   The 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 supply 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

- The core is ready to run but waiting for the PURX release

- Reset releasing

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

2 MCU starts running the Bootstrap Code

- written in stone/ UPP internal ROM

- the program checks if there is any reason for the FDL mode (Flash Down Load)

- If there is an executable code in FLASH and there is no reason for FDL, the MCU starts running the MCU program from FLASH

3 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 following figure, the RF_Clk frequency appears to be lower than 19.44MHz because of a too low oscilloscope sampling frequency (2kS/s).

Figure 1: Power-up sequence
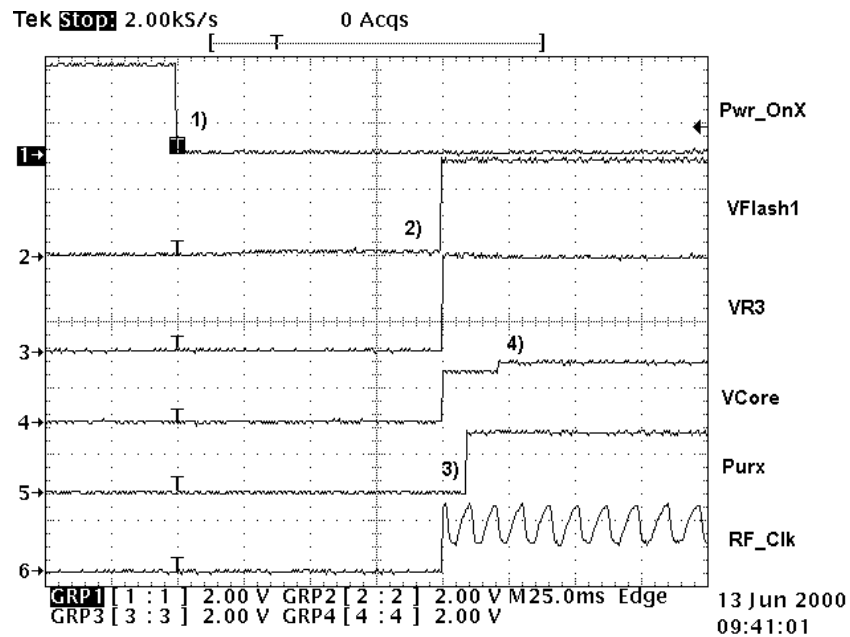
1   Power key pressed

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

   - VFLASH1, Vana, Vcore, Vio, and VR3 goes high

   - VCTCXO enabled by VR3 -> RFClk 19.44 MHz running

2   Purx released

   - Purx released by UEM, UEMINT goes high for 100 ms, SleepX
     goes high, and SleepClk (32 KHz) starts running.

3   Software running

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

   - Cbus (1.08MHz) and Dbus clocks start running

Phone does not start up normally or does not stay on

Note: In the case of power-up faults, it is not possible to force the phone on by disabling the watchdog. Instead, measurements should be taken immediately when the power key is pressed or when the battery voltage is connected to the phone (local / test mode).

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

The Dbus clock (programmable 9.72MHz) is not automatically visible in the test and local modes.

Figure 2: Fault tree, phone does not power up
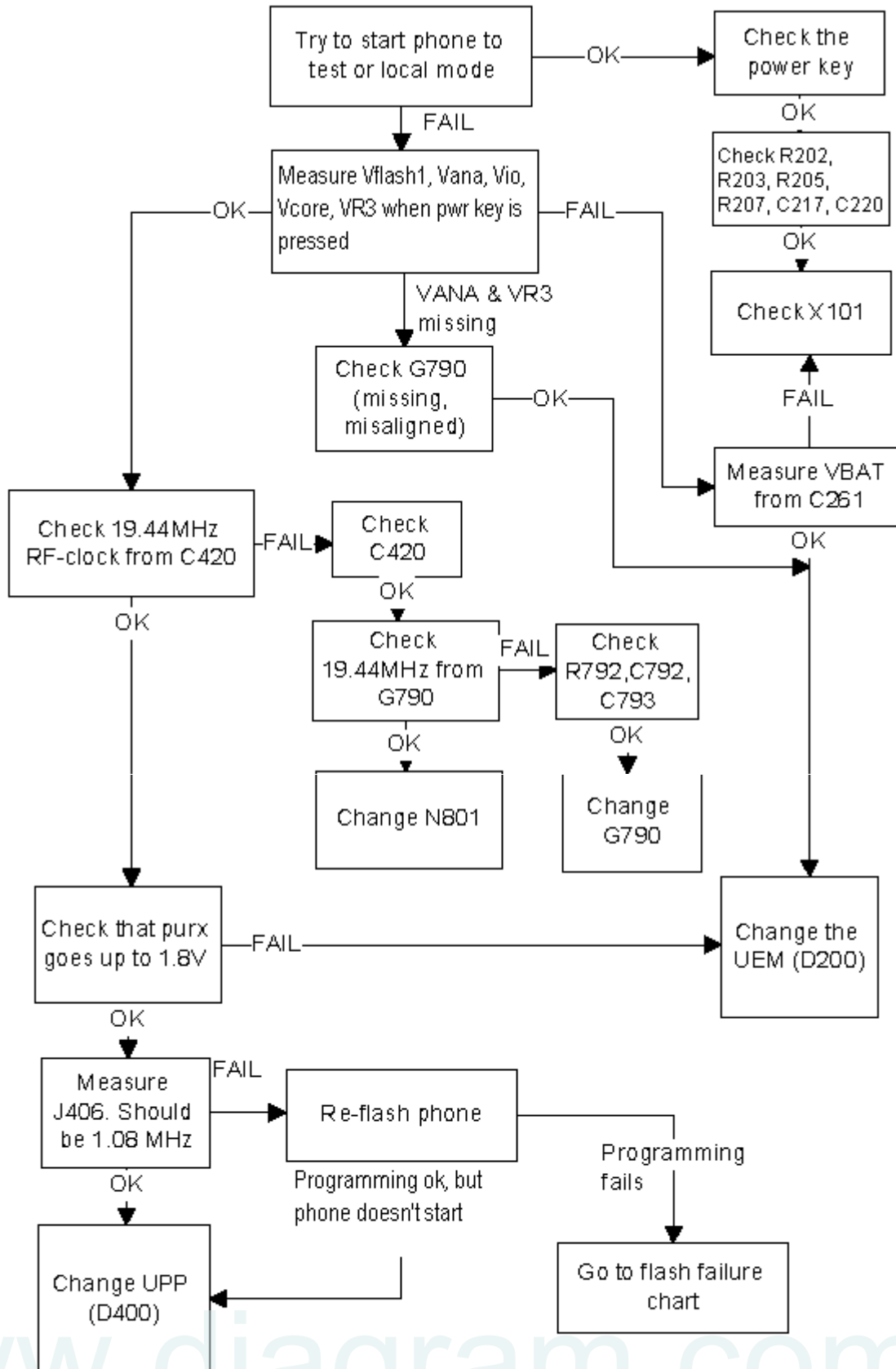
Flash Programming does not work

Flash programming procedure

1   The phone communicates with the prommer via the production test pattern, using the following signals:

   •   FBUSTX (serial data to phone)

   •   FBUSRX (serial data from phone)

   •   MBUS (serial clock for FBUSRX)

   •   VPP (External flashing voltage for speed up flashing)

   •   The BSI line is also used when initializing flashing (battery connector)

2   When the phone is powered (VBAT>3V), the MBUS and FBUSTX lines are pulled up internally by the phone.

3   The prommer sends a command to the UEM, using FBUSRX, to enter the Flash-mode. During the sending of this command, the prommer keeps the BSI line high and MBUS is used as a serial clock.

4   When the Flash-mode command is acknowledged, UEM enters the Flash-mode and releases reset (PURX) to MCU.

5   After reset is released, UPP checks if there is a request for the Bootstrap code (that resides in the UPP ROM).

6   The request for Bootstrap is the MBUS pulled down by the prommer (if the bootstrap is not requested, the bootstrap code jumps to FLASH SW).

7   If the Bootstrap code is requested, UPP enters the Flash-mode and sets FbusTX to '0' as an acknowledgement to the prommer. This is an indication that UPP can run, at least, the fixed Bootstrap code – although it is not able to run the FLASH code. UPP then sends an UPP-ID to the prommer via the FBUSTX line.

8   After the prommer has received the UPP-ID, it sends a corresponding Secondary Boot Code to the phone via FBUSRX. The Secondary Boot Code, when run in UPP, requests UPP to send information to the prommer about the flash type and other HW-related parameters about the device to be flashed.

9   The 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.

10 12 volts can be supplied to Vpp (by the prommer) to speed up flashing.

11 The 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 the Flash/Alignment phase.

Flash programming error codes

The various error codes can be seen from the "FPS-8 Flash" in Phoenix.

The underlined text in the following table means that the item under consideration is being used for the first time in the flashing sequence.

Error	Description	Not working properly
C101	"The Phone does not set FbusTx line high after the star-tup."	Vflash1 VBatt BSI and FbusRX from prommer to UEM. FbusTx from UPP->UEM->Prom-mer(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)(SA0) FbusTx from UPP->UEM->Prom-mer(SA1) BSI and FbusRX from prommer to UEM.
C103	"Boot serial line fail."	Mbus from Prommer->UEM->UPP(MbusRx)(SA1) 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 cor-rectly."	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 cor-rectly."	UPP
C586	"The erasing status response from the Phone informs about fail."	Flash
C686	"The programming status response from the Phone informs about fail."	Flash
Cx81	"The Prommer has detected a checksum error in the mes-sage, which it has received from the Phone."	FbusTx from UPP->UEM->Prommer

Cx82	"The Prommer has detected a wrong ID byte in the message, which it has received from the Phone."	FbusTx from UPP->UEM->Prommer
A204	"The flash manufacturer and device IDs in the existing Algorithm files do not match with the IDs received from the target phone."	Flash UPP VIO/VANA? Signals between UPP-Flash
Cx83	"The Prommer has not received Phone acknowledge to the message."	Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP
Cx84	"The Phone has generated NAK signal during data block transfer."	FbusTx from UPP->UEM->Prommer
Cx85	"Data block handling timeout"	
Cx87	"Wrong MCU ID."	RFClock UPP(Vcore)
Startup for flashing	Required startup for flashing	Vflash1 VBatt

Charging

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

If charging fails when the ACP-9 or the LCH-9 is used, but works with ACP-7, ACP-8, and LCH-8, check that the charge control pin of the system connector is connected to the ground.

Figure 3: Fault tree, charging
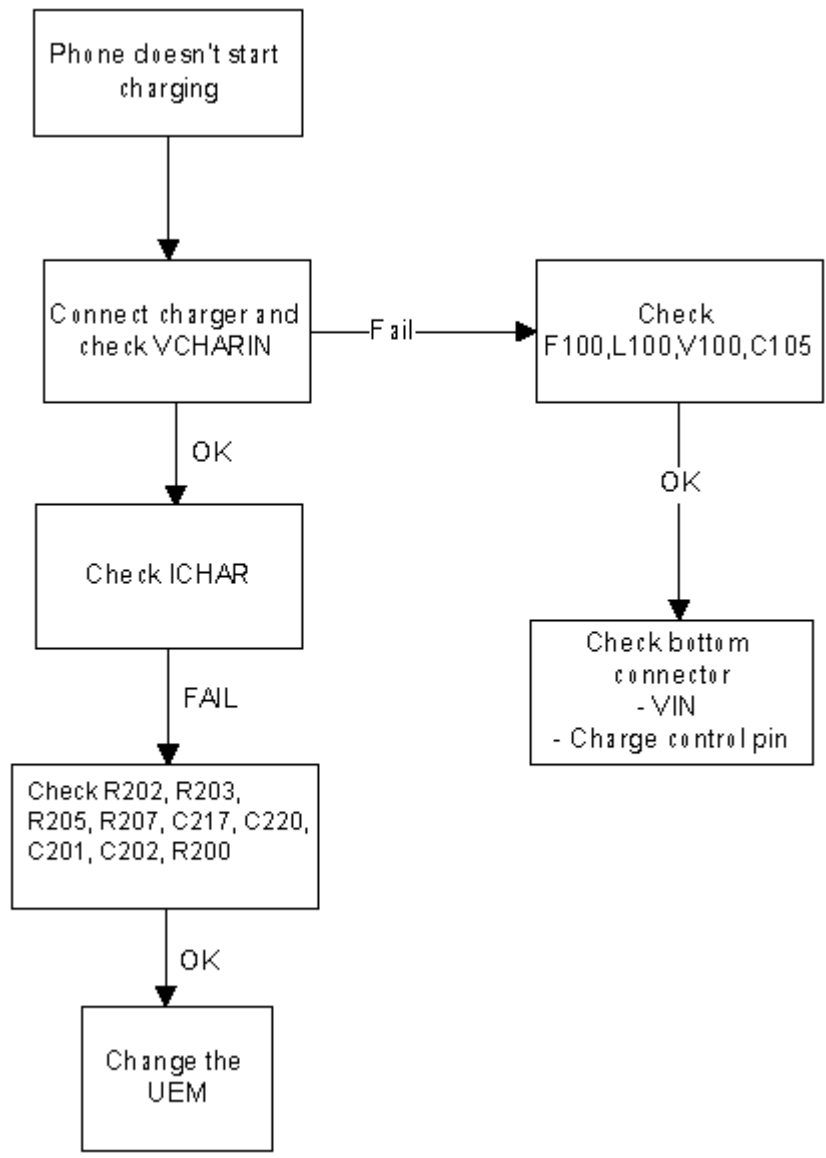
Audio failures

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

1   Make a phone call against tester and check audios.

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

If the internal microphone/XEAR fails: Feed the tone to the microphone and measure the signal from the XEAR line. The Audio test box JBA-8 is needed. The Audio loop (*Audio test/Hp In Ext Out*) must be switched on by the Phoenix service software. This loop will connect audios only through the UEM. In this case, the

UPP is not used.

3   Run the audio-loop self-test with Phoenix (*BB Self Tests/
    ST_EAR_DATA_LOOP_TEST*). This loop will test the ear-data/mic-data lines
    between the UPP and the UEM.

Earpiece or external microphone line does not work

Figure 4: Fault tree, earpiece failure
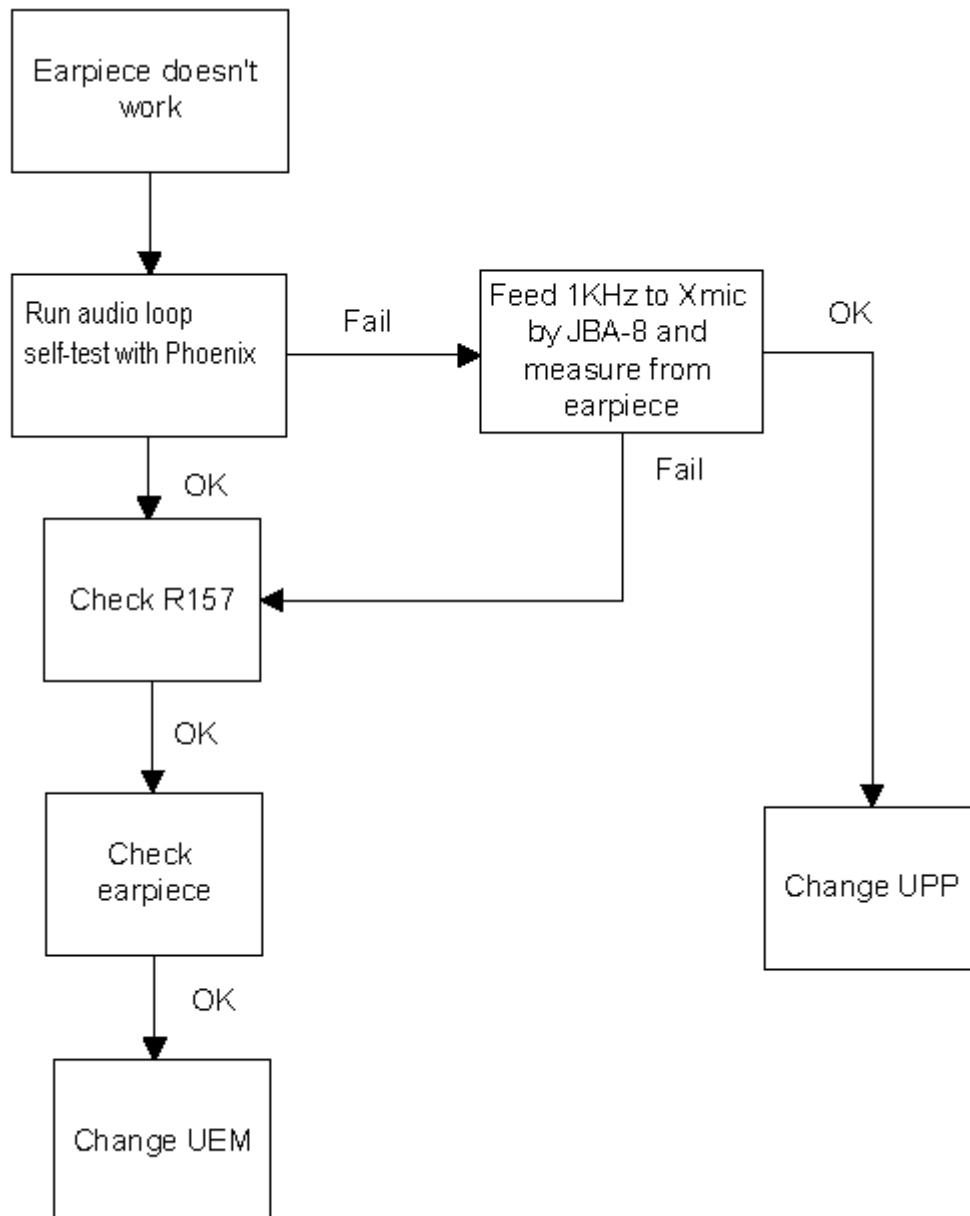
Microphone or XEAR line does not work

Figure 5: Fault tree, microphone failure
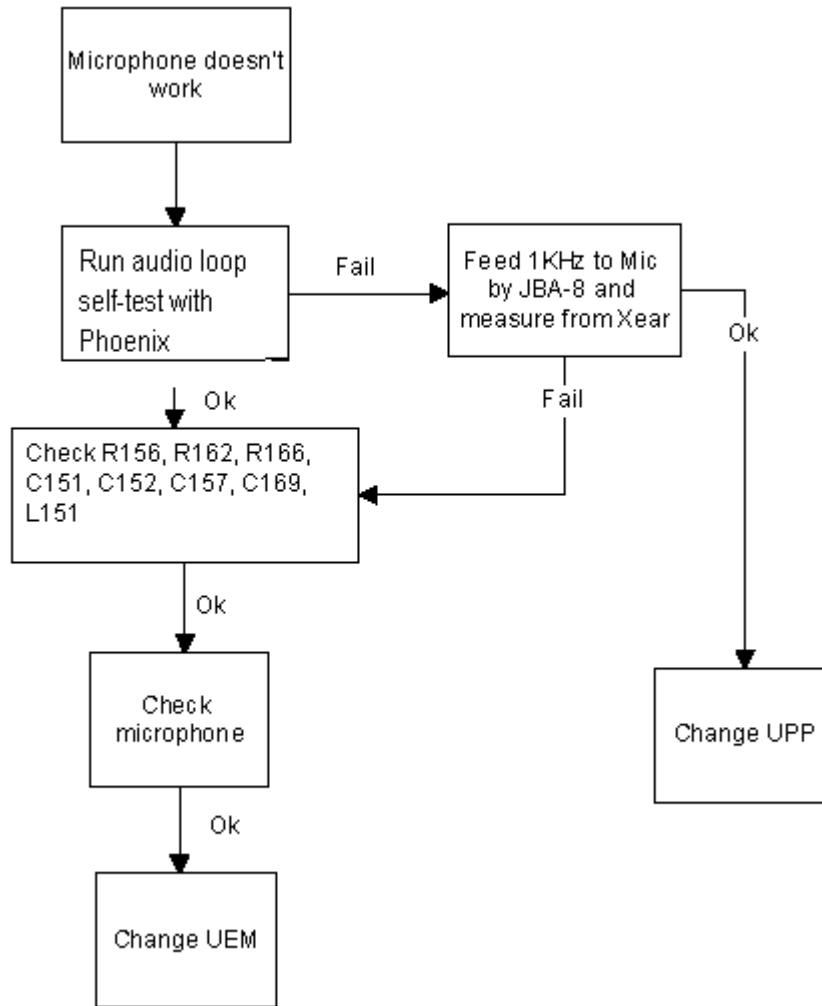
Accessory detection

1   Start the phone in the normal mode when checking for accessory detection.

2   The Ad-converter value of the hookint-line can be checked with the Xmic switch on an MJ-8 test jig. Changes normally from high to low when no accessory is connected.

3   When the headset HDC-5 is connected, the hookint-value should be between 600 and 800.

Figure 6: Fault tree, accessory detection
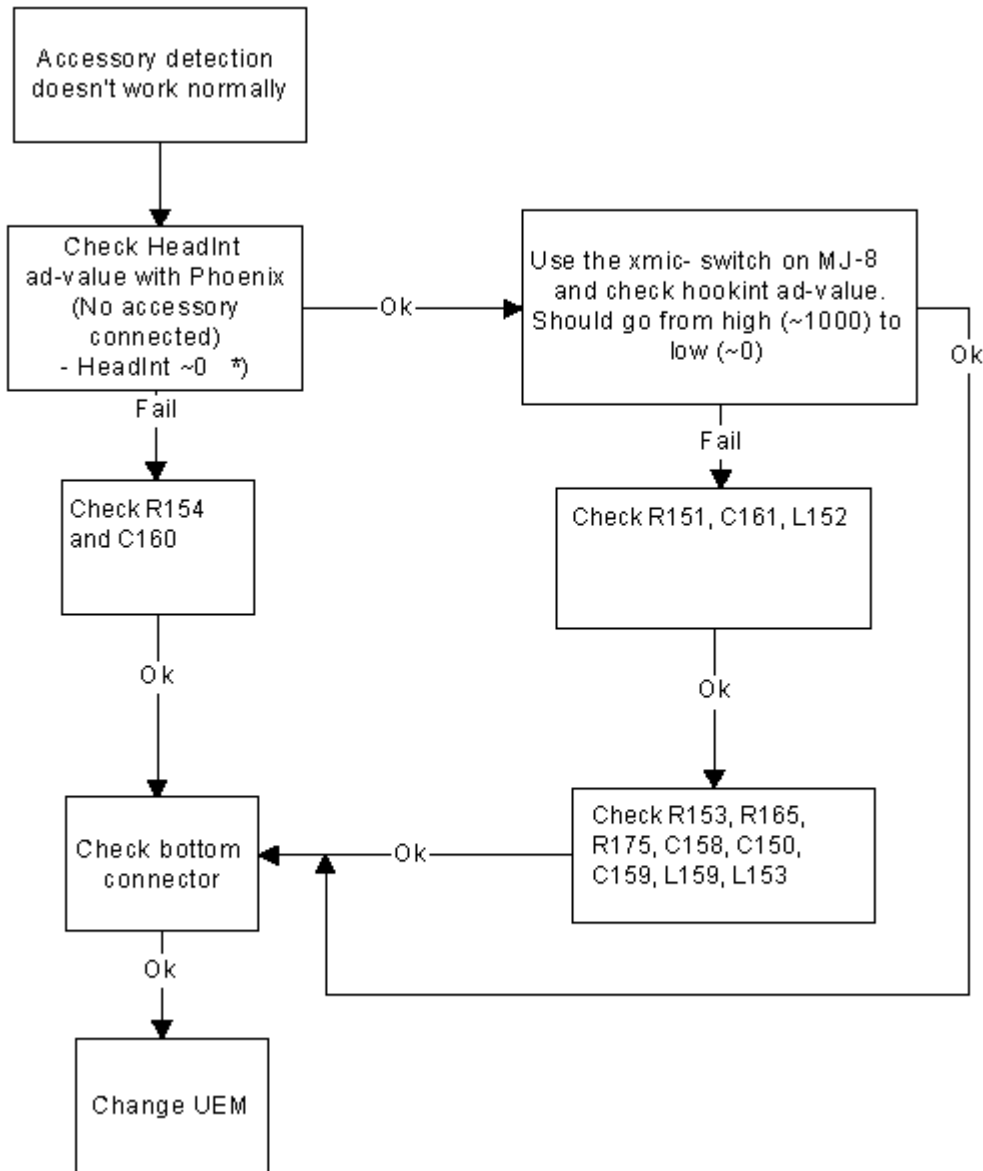
Sleep Clock

Missing/nonfunctional 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 7: Fault tree, sleep clock
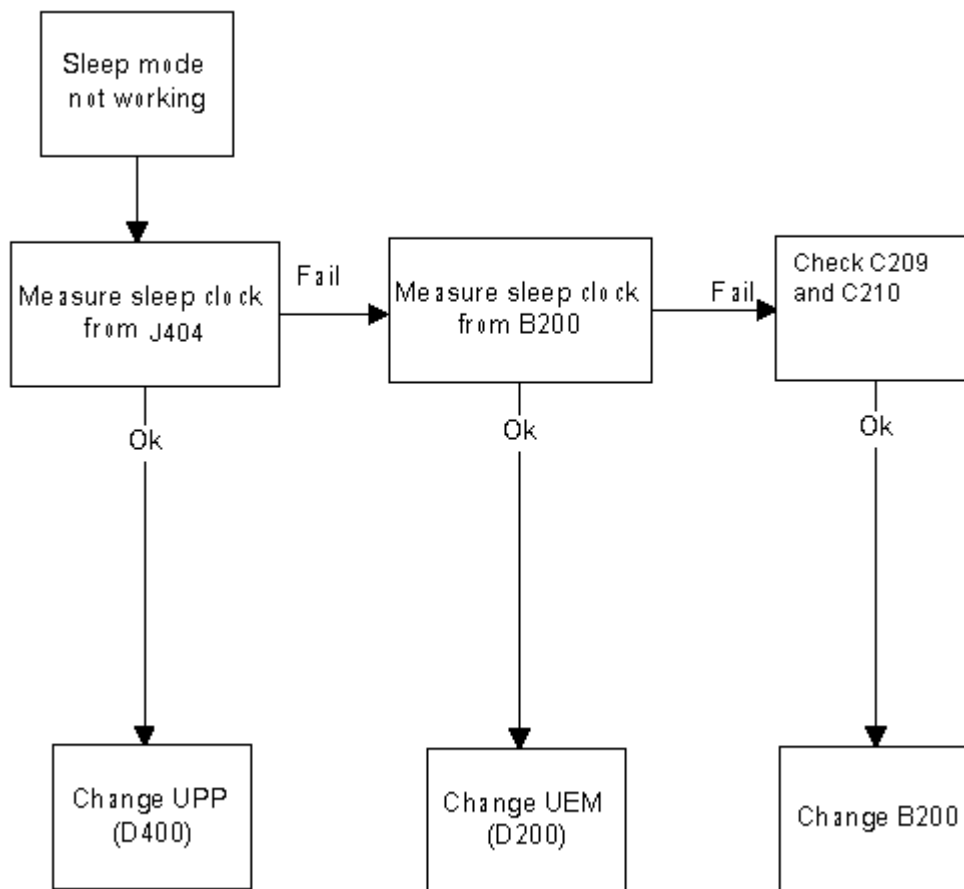
User Interface

Display/Keyboard lights do not work

Figure 8: Fault tree, Display/Keyboard lights
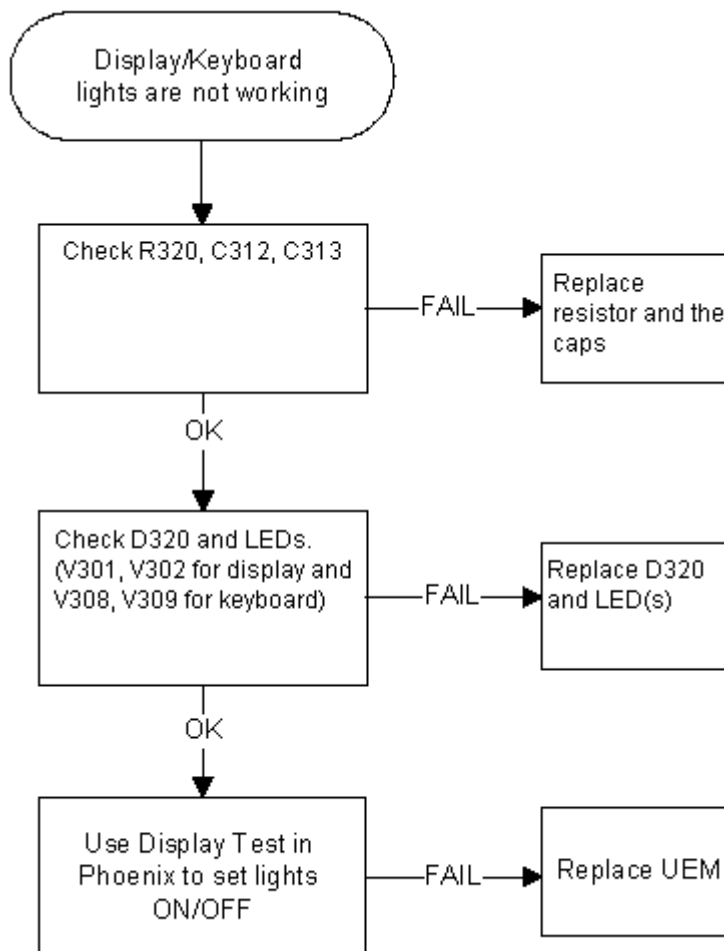
Display does not work

Figure 9: Fault tree, Display does not work
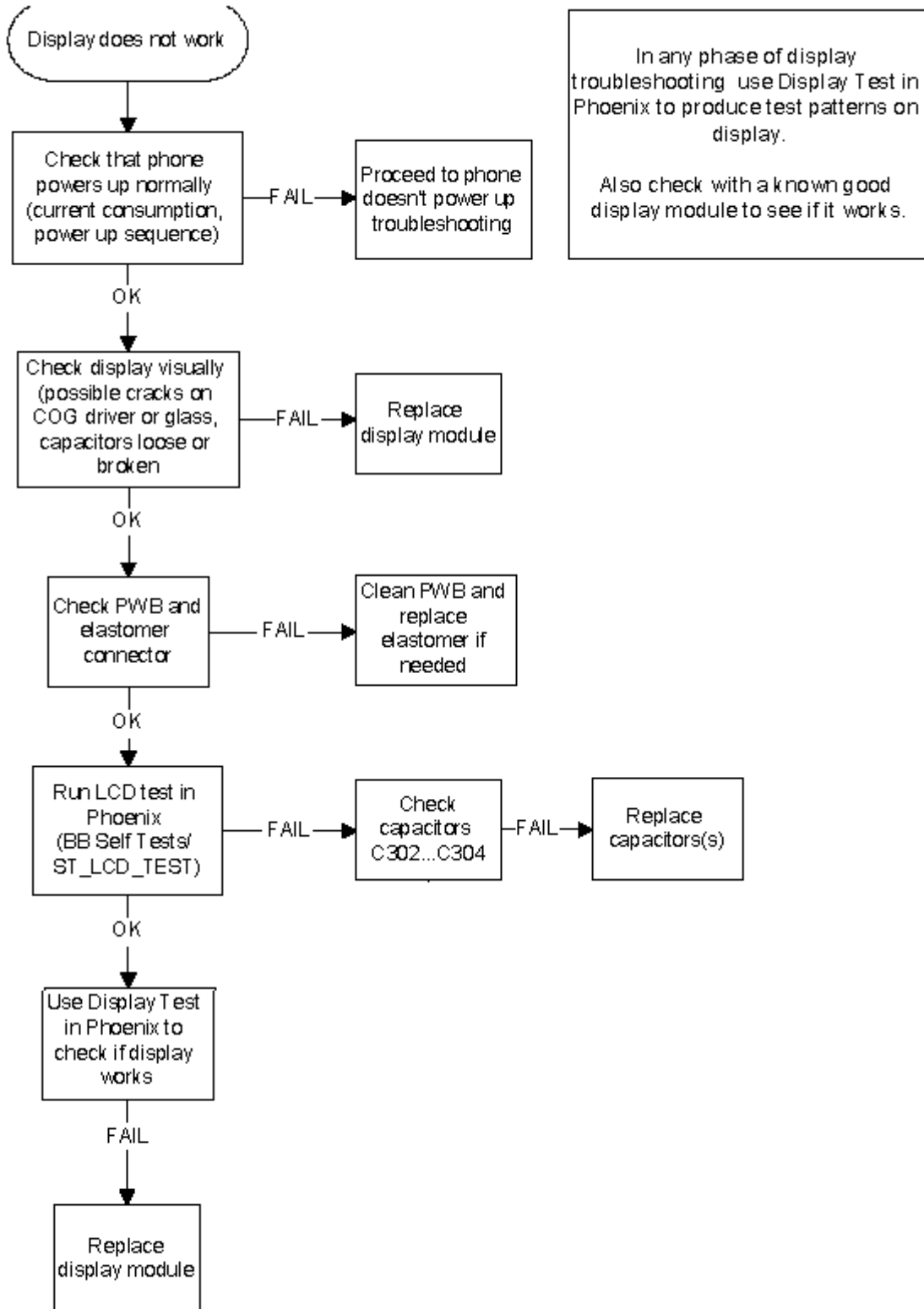
MIDI does not work

Check speaker B180 and the following components: N180, R100, R181, R182, R183, R184, C183, C180, C184, C181, C182, C179, L180, and L181

- No sound: Try using a known good SALT speaker instead. If there is still no sound, change the UEM (D200)

- Weak sound: Use the Audio test in Phoenix to set the SALT speaker parameters (frequency, strength). If it does not affect the sound level, change the SALT speaker.

Vibra does not work

Check spring connectors and C307 and C308.

- No vibration: Try using a known good vibra instead. If there is still no vibration, change the UEM (D200)

- Weak vibration: Use the Vibra test in Phoenix to set the vibra's parameters (frequency, duty cycle). If it does not affect the magnitude of the vibration, change the vibra.

Keyboard does not work

Check that there is no dirt between the dome sheet and the PWB. If the keyboard still does not operate normally, try to use the Keyboard test in Phoenix to see if the pressed key is identified. If it is not identified, change the UPP (D400).

Receiver Troubleshooting

General Instructions for RX troubleshooting

Start the Phoenix software and use it to start the required RX mode of the mobile phone. The troubleshooting flowchart is divided into three steps: (1) general checking, (2) local checking, and (3) RX–chain checking. Always use an RF cable connected from an external RF connector to the analyzer via (RF power) attenuator. This is important to protect the analyzer against excessive RF power and to prevent leakage of undesired RF power into the cellular frequencies.

1 Start the Phoenix software and select the TX mode under *Testing* (AMPS, DAMPS, or TDMA1900).

2 It is useful to select the mid channel (383 for AMPS/DAMPS or 1000 for TDMA1900) and the power level 2.

Note: Before changing ASICs or filters, all solderings and missing components must be checked visually. After any possible component changes, the phone must be tuned with the Phoenix autotune SW.

Path of the received signal

Block level description of the receiver:

(Antenna/ext RF) – Diplexer – Duplexer – Low Noise Amplifier (LNA) – RX band filter – First mixer – 135.54 MHz RX IF filter – IF-amplifier – second mixer – 14 kHz low-pass filter – adjustable IQ amplifier – Baseband.

Fault–finding charts for receiver chain

AMPS

Figure 10: Fault tree, AMPS
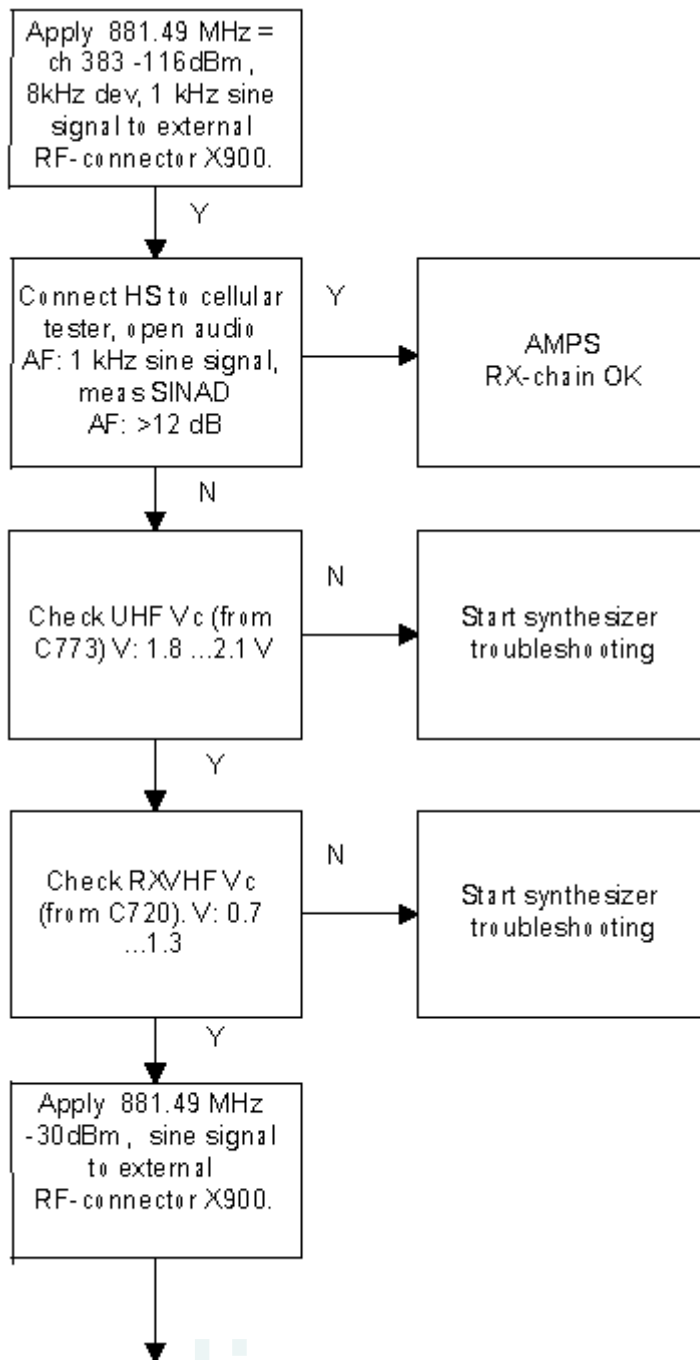
Check input level
at diplexer (Z907)
input. → N → Change EXT RF
Connector

Note!

Check all soldering and components
in antenna circuit before changing

↓ Y

Check input level at
duplex filter. You can
also check level at
diplexer output → N → Change diplexer Z906

Note!

Check all soldering and discrete
components of front end

↓ Y

Check input level at
LNA input (J800). → N → Change duplex filter
(Z906)

↓ Y

Check RF level at
RX800 band filter
input. → N → Change SAFARI
(N801)
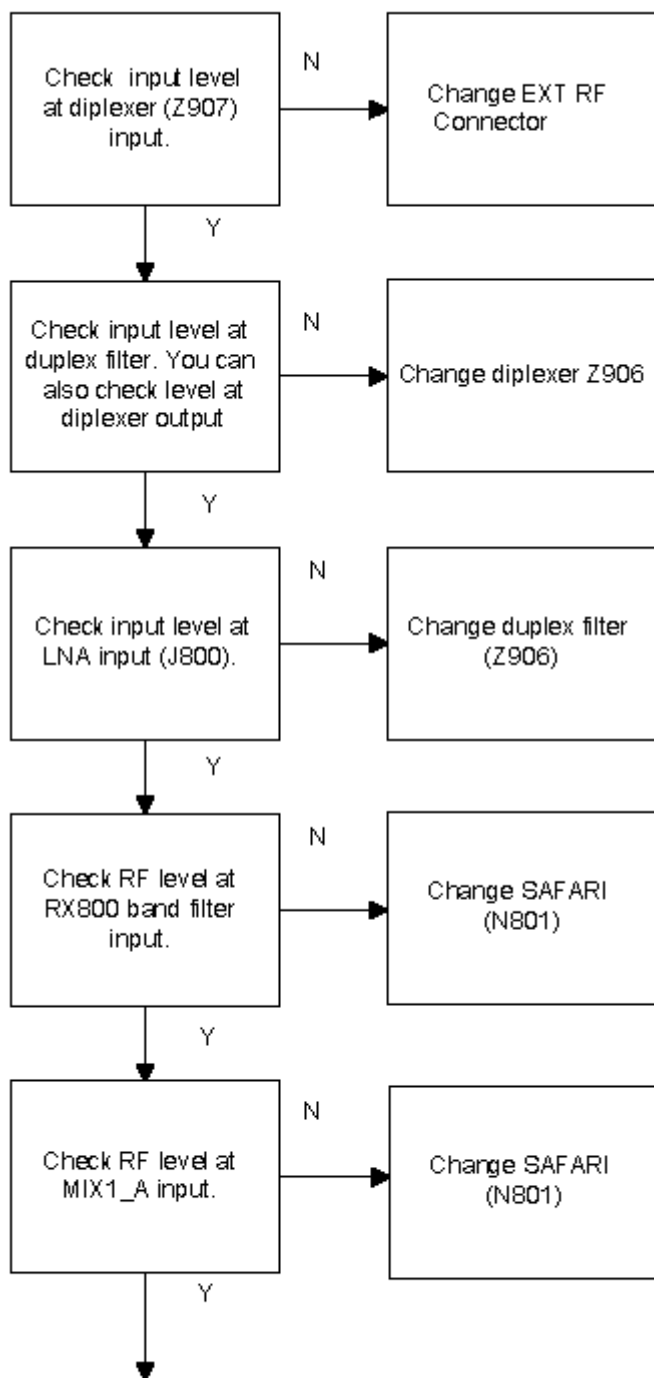
Note!

Check all solderings and discrete
components around SAFARI before
changing

↓ Y

Check RF level at
MIX1_A input. → N → Change SAFARI
(N801)

Note!

From the begin to MIX_1A input
you should see strong RF signal
level at 881.49 MHz. Exact level
is difficult to define here because
variable impedances in RX path.
Also used probe type affects to
the results.

↓ Y

```
┌─────────────────────┐    N    ┌─────────────────────┐    N    ┌─────────────────────┐
│ Check  RF level at RX│────────▶│ Check RF level at J751│───────▶│  Start synthesizer  │
│ IF filter input at   │         │ and J752 at 2034.06  │         │    troubleshoot     │
│ 135.54 MHz           │         │ MHz                  │         │                     │
└─────────────────────┘         └─────────────────────┘         └─────────────────────┘
           │ Y                              │ Y
           │                                ▼
           │                     ┌─────────────────────┐         Note !
           │                     │  Change SAFARI       │         Check all discrete components and
           │                     │  (N801)              │         voltages around SAFARI
           │                     └─────────────────────┘
           ▼
┌─────────────────────┐    N    ┌─────────────────────┐
│ Check  RF level at RX│────────▶│ Change RX IF filter  │
│ IF filter output at  │         │ (Z830)               │
│ 135.54 MHz           │         │                      │
└─────────────────────┘         └─────────────────────┘
           │ Y
           ▼
┌─────────────────────┐    N    ┌─────────────────────┐    N    ┌─────────────────────┐
│ Check  RX I and Q    │────────▶│ Check RF level by    │───────▶│  Start synthesizer  │
│ signals at I: J801(+),│        │ L730 without having  │         │    troubleshoot     │
│ J803(-) and Q:       │         │ electrical contact at│         │                     │
│ J804(+), J802(-)     │         │ 271.08 MHz           │         │                     │
└─────────────────────┘         └─────────────────────┘         └─────────────────────┘
           │ Y                              │ Y
           │                                ▼
           │                     ┌─────────────────────┐
           │                     │  Change SAFARI       │
           │                     │  (N801)              │
           │                     └─────────────────────┘
           ▼
┌─────────────────────┐
│ Check UEM and start  │
│ baseband troubleshoot│
└─────────────────────┘
```

TDMA800

Since the same physical signal path is used for both analog and digital modes at the lower band, there is no need for additional troubleshooting in the digital mode. So if the digital mode at the lower band is not working properly, start the analog mode trouble-shooting.

TDMA1900 (only dualband)

Only EXT RF connector –> 1st IF needs separate troubleshoot at upper band. After down conversion (RF –> 135.54 MHz), both lower and upper band use the same signal path.

Figure 11: Fault tree, TDMA1900 troubleshooting

Check input level of diplexer (Z907) — N → Change EXT RF connector

Note!

Check all soldering and components in antenna circuit before changing

Check input level of duplex filter (Z962) — N → Change diplexer (Z907)

Note!

Check all soldering and discrete components of front end

Check RF level at LNA input (at duplex filter RX output port) — N → Change duplex filter (Z962)

Note!

Before replacing SAFARI, check all the solderings and components around V850

Check RF level at RX1900 band filter (Z850) input — N → Check voltage at C854 out (V850 in). V: about 2.7V → Change SAFARI (N801)

Table 2: Flash programming error codes

Error	Description	Not working properly
C101	"The Phone does not set FbusTx line high after the start-up."	Vflash1 VBatt 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)(SA0) FbusTx from UPP->UEM->Prommer(SA1) BSI and FbusRX from prommer to UEM.
C103	"Boot serial line fail."	Mbus from Prommer->UEM->UPP(MbusRx)(SA1) 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
C586	"The erasing status response from the Phone informs about fail."	Flash
C686	"The programming status response from the Phone informs about fail."	Flash
Cx81	"The Prommer has detected a checksum error in the message, which it has received from the Phone."	FbusTx from UPP->UEM->Prommer
Cx82	"The Prommer has detected a wrong ID byte in the message, which it has received from the Phone."	FbusTx from UPP->UEM->Prommer
A204 Cx83 Cx84 Cx85	"The flash manufacturer and device IDs in the existing Algorithm files do not match with the IDs received from the target phone." "The Prommer has not received Phone acknowledge to the message." "The Phone has generated NAK signal during data block transfer." "Data block handling timeout"	Flash UPP VIO/VANA? Signals between UPP-Flash Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
Cx87	"Wrong MCU ID."	RFClock UPP(Vcore)
Startup for flashing	Required startup for flashing	Vflash1 VBatt

Transmitter fault–finding

General instructions for TX troubleshooting

Always use RF cable connected from external RF connector to analyzer via (rf-power) attenuator. This is important to protect analyzer against excessive rf-power and not to let leak unwanted rf-power to the cellular frequencies.

Start Phoenix software and select TX mode under testing (AMPS, DAMPS, or TDMA1900). 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 autotune SW.

Path of the transmitted signal

AMPS/DAMPS

UEM TX I/Q DA-converters -> I/Q modulator and Digital gain step amplifier (Safari) -> IF-BPF -> Upconverter+driver -> BPF -> PA -> Coupler (Power detector) -> Duplex-filter -> Diplexer -> EXT RF-connector -> Antenna

TDMA1900 (ONLY DUALBANDER)

UEM TX I/Q DA-converters -> I/Q modulator and Digital gain step amplifier (Safari) -> IF-BPF -> Upconverter + driver (Safari) ->Balun -> BPF -> PA->Coupler (Power detector) -> Duplex-filter -> Diplexer -> EXT RF-connector -> Antenna

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 analyze input, and measure RF level. Notice insertion loss of the cable and attenuations.

AMPS, PL2, CH383

Visual check of TX block
- PA and up converter
- TX SAW
- Duplex filter
- Passive components

OK

Check LO-signal (1017.03 MHz)@up converter and TX VHF (361.08 MHz)@N750 → NO → Start synth troubleshooting

OK

Check supply voltage
- VR2
- VBATTRF
- VR5
- IPA1
- TXP1
→ NO → Check UEM and UPP (Baseband)

OK

Check TXi/q signals Test points J901...J904 → NO → Check UEM (Baseband)

OK

Check TX IF input power (180.54 MHz) @ up converter IF : -20 dBm +3 /-6 dB → NO → Change SAFARI

OK

Check TX RF (836.49 MHz) output power and @ up converter RF : 0 dBm +/- 6dB → NO → Change up converter

OK

```
              ┌──────────────────┐   NO    ┌──────────────────┐
              │ Check TX SAW     │────────▶│ Change TX SAW    │
              │ input and output │         │ filter Z905      │
              │ power            │         │                  │
              │ IL: -3 dB        │         │                  │
              └──────────────────┘         └──────────────────┘
                       │ OK
                       ▼
              ┌──────────────────┐   NO    ┌──────────────────┐
              │ Is Itot 700...800│────────▶│ Change PA N901   │
              │ mA? Check PA     │         │                  │
              │ output power and │         │                  │
              │ gain.            │         │                  │
              │ Output power: ~28│         │                  │
              │ dBm              │         │                  │
              │ Gain: ~30 dB     │         │                  │
              └──────────────────┘         └──────────────────┘
                       │ OK
                       ▼
              ┌──────────────────┐   NO    ┌──────────────────┐
              │ Check PWRDET N930│────────▶│ Change PWRDET    │
              │ insertion loss   │         │ N930             │
              │ IL<0.3 dB        │         │                  │
              └──────────────────┘         └──────────────────┘
                       │ OK
                       ▼
              ┌──────────────────┐   NO    ┌──────────────────┐
              │ Check duplexer   │────────▶│ Change Z906 or   │
              │ Z906, diplexer   │         │ Z907 or RF       │
              │ Z907 and RF      │         │ connector        │
              │ connector X900   │         │                  │
              │ insertion loss   │         │                  │
              │ Dupl IL ~2.2 dB  │         │                  │
              │ Dipl ~0.35 dB    │         │                  │
              │ RF conn ~0.1 dB  │         │                  │
              └──────────────────┘         └──────────────────┘
                       │ OK
                       ▼
              ┌──────────────────┐
              │ Start Power      │
              │ control          │
              │ troubleshooting  │
              └──────────────────┘
```

TDMA800

The transmitter chain is exactly the same as AMPS mode, with the exception of the IPA current. Therefore it is important that AMPS has no faults.

TDMA1900 (only dualband)

TDMA1900 mode and DAMPS mode have a common RF modulator, making it important that the DAMPS mode has no faults.

TDMA 1900, PL2, CH1000

```
                    │
                    ▼
         ┌──────────────────┐    NO    ┌──────────────────┐
         │  Is TDMA800 mode │─────────▶│   Start AMPS     │
         │       OK?        │          │  troubleshooting │
         └──────────────────┘          └──────────────────┘
                    │ OK
                    ▼
         ┌──────────────────┐    NO    ┌──────────────────┐
         │ Check LO-signal  │─────────▶│   Start synth    │
         │ (2079.78 MHz)@T775│         │ troubleshooting  │
         │ and TX VHF (363.6 │         │                  │
         │   MHz)@N750      │          │                  │
         └──────────────────┘          └──────────────────┘
                    │ OK
                    ▼
         ┌──────────────────┐    NO    ┌──────────────────┐
         │Check supply voltage│───────▶│  Check UEM and UPP│
         │    - VR2         │          │    (Baseband)    │
         │    - VBATTRF     │          │                  │
         │    - VR6         │          │                  │
         │    - IPA2        │          │                  │
         │    - TXP2        │          │                  │
         └──────────────────┘          └──────────────────┘
                    │ OK
                    ▼
         ┌──────────────────┐    NO    ┌──────────────────┐
         │ Check TX IF input│─────────▶│  Change SAFARI or│
         │ power (181.80 MHz) @│        │      Z960        │
         │      Z960        │          │                  │
         │ IF: -20 dBm +3 /-6 dB│       │                  │
         └──────────────────┘          └──────────────────┘
                    │ OK
                    ▼
         ┌──────────────────┐    NO    ┌──────────────────┐
         │  Check TX RF     │─────────▶│  Change SAFARI   │
         │ (1879.98 MHz) output│        │                  │
         │ power @T960 input │         │                  │
         │ RF: 0 dBm +/- 6dB │         │                  │
         └──────────────────┘          └──────────────────┘
                    │ OK
                    ▼
         ┌──────────────────┐    NO    ┌──────────────────┐
         │ Check Z961 input and│──────▶│   Change Z961    │
         │   output power   │          │                  │
         │    IL: -3dB      │          │                  │
         └──────────────────┘          └──────────────────┘
                    │ OK
                    ▼
```
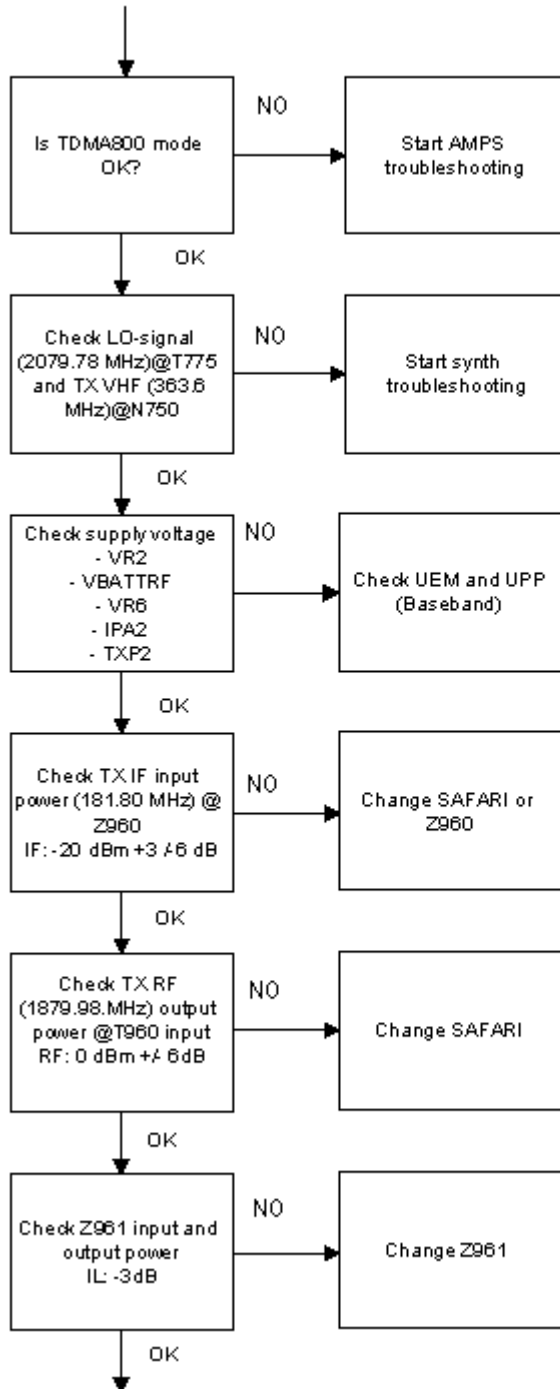
Power control loop

Basically power detection is done with the Power detector module and power control is done inside Safari. Power detection is basically similar for both bands, except both bands have individual couplers.

```
┌─────────────────────┐         ┌─────────────────────┐       Note !
│                     │    N    │   Check VR2 and     │
│  Is PWRDET vs.      │────────▶│   RFTEMP .          │       See PWRDET vs. Output
│  output power OK?   │         │  Check C930, C931   │       power curve
│  See chart below.   │         │  and PWRDET         │
│                     │         │  module.            │
└─────────────────────┘         └─────────────────────┘
           │
           │ Y
           ▼
┌─────────────────────┐    N    ┌─────────────────────┐
│                     │         │                     │
│  Is DAC value vs.   │────────▶│   Check UEM         │
│  PWRDET (mV) OK?    │         │   (BaseBand)        │
│                     │         │                     │
└─────────────────────┘         └─────────────────────┘
```
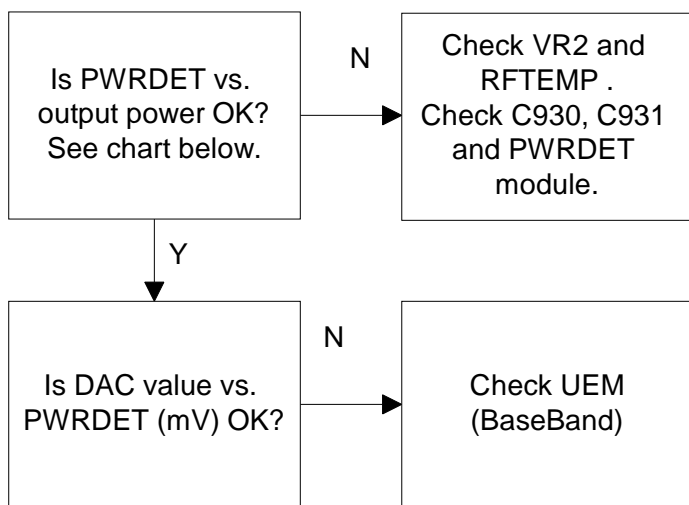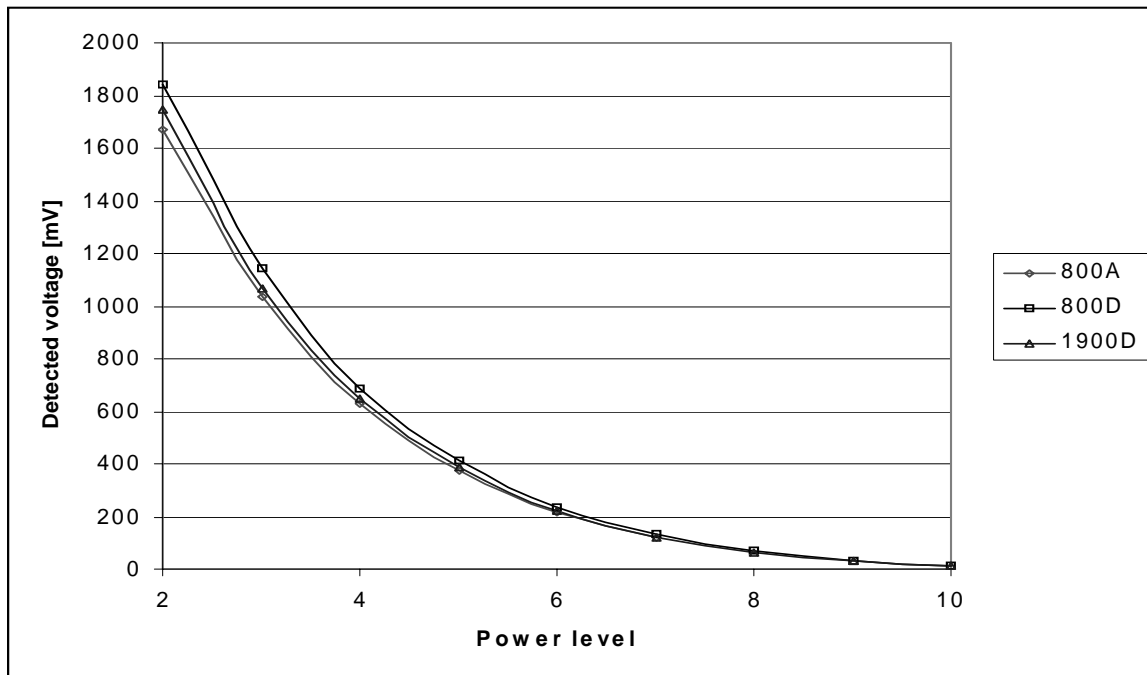
Detected voltages are described in the next table and diagram.

TYPICAL DETECTED VOLTAGES AT POWER LEVELS PL2…PL10 FOR DUALBANDER

800A				800D				1900D		
	Pout	TXPWRDET			Pout	TXPWRDET			Pout	TXPWRDET
PL	dBm	dac	mV		dBm	dac	mV		dBm	dac	mV
2	26.5	633	1671		27.3	696	1839		27.3	662	1746
3	22.5	393	1038		23.3	433	1142		23.3	405	1069
4	18.5	237	625		19.3	261	688		19.3	245	648
5	14.5	141	372		15.3	155	410		15.3	147	387
6	10.5	82	215		11.3	90	237		11.3	84	222
7	6.5	46	120		7.3	50	132		7.3	46	122
8	-	-	-		3.3	27	70		3.3	24	64
9	-	-	-		-0.7	13	33		-0.7	11	30
10	-	-	-		-4.7	5	12		-4.7	5	12

NOTE: DAC VALUES MAY VARY ABOUT +/- 20%
NOTE: TXPWRDET is difference between TX on burst and off burst.

TYPICAL DETECTED VOLTAGES AT POWER LEVELS PL2..PL10 FOR SINGLE BANDER

800A				800D		
	Pout	TXPWRDET		Pout	TXPWRDET	
PL	dBm	dac	mV	dBm	dac	mV
2	25.5	559	1475	27.3	671	1771
3	21.5	388	1023	23.3	465	1228
4	17.5	234	618	19.3	281	742
5	13.5	140	371	15.3	168	445
6	9.5	81	215	11.3	98	258
7	5.5	45	120	7.3	54	144
8	-	-	-	3.3	31	82
9	-	-	-	-0.7	15	40
10	-	-	-	-4.7	5	14

NOTE: DAC VALUES MAY VARY ABOUT +/- 20%
NOTE: TXPWRDET is difference between TX on burst and off burst.
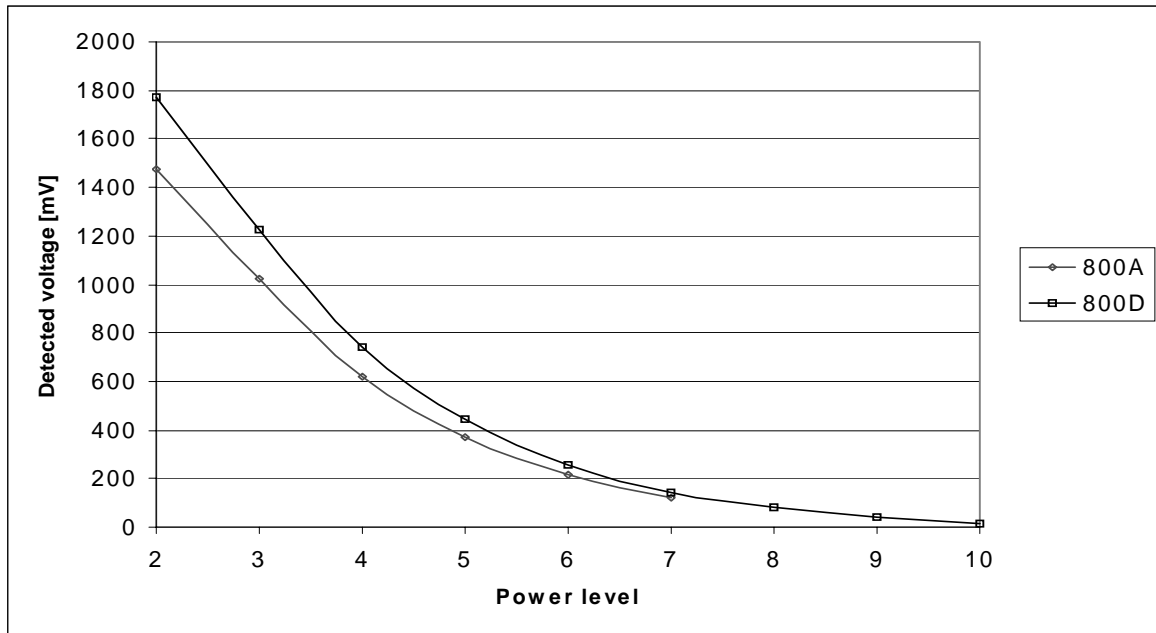
Synthesizer fault-finding

There are four oscillators generating the needed frequencies for the RF section:
19.44 MHz reference oscillator, 2GHz UHF VCO, TX VHF cascade amplifier VCO, and
RX VHF VCO integrated in Safari. RX VHF frequency is fixed at 271.08 MHz and TX VHF
has two fixed frequencies: 361.08 MHz for lowband and 363.6 MHz for upper band. The
VCO operating frequencies are controlled by the Safari PLL circuit. All locals are locked to
stable 19.44MHz reference oscillator.

The frequency range for 2GHz UHF VCO is 2009.1 ... 2125.53 MHz. The output frequency
range for the lower band is from 2009.1 to 2059.02 MHz. In upper band, the output fre-
quency range from the UHF VCO is from 2031.81 MHz to 2125.53 MHz.

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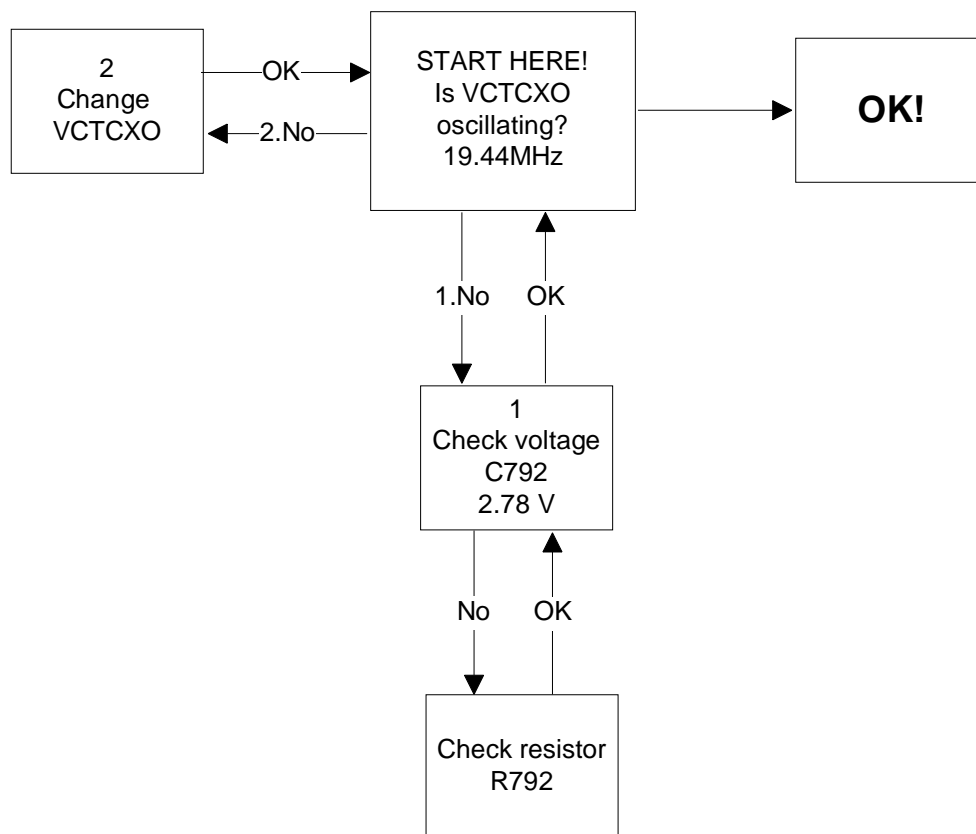are running correctly.

19.44 MHz reference oscillator

The 19.44 MHz oscillator frequency (G790) is controlled by UEM. This 19.44 MHz signal
is connected to Safari, PLL-circuits, and from Safari to UPP.

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

Baseband also needs a reference signal where it can generate the necessary clock signals
and VCTCXO output signal is also buffered and connected to UPP.

Fault–finding chart for 19.44 MHz oscillator

```
┌──────────┐  OK →   ┌──────────────┐              ┌──────────┐
│    2     │────────→│ START HERE!  │──────────────→│          │
│  Change  │         │  Is VCTCXO   │              │   OK!    │
│  VCTCXO  │←─2.No───│ oscillating? │              │          │
└──────────┘         │   19.44MHz   │              └──────────┘
                     └──────────────┘
                       │        ▲
                      1.No      OK
                       ▼        │
                     ┌──────────────┐
                     │      1       │
                     │ Check voltage│
                     │    C792      │
                     │   2.78 V     │
                     └──────────────┘
                       │        ▲
                       No       OK
                       ▼        │
                     ┌──────────────┐
                     │ Check resistor│
                     │    R792      │
                     └──────────────┘
```
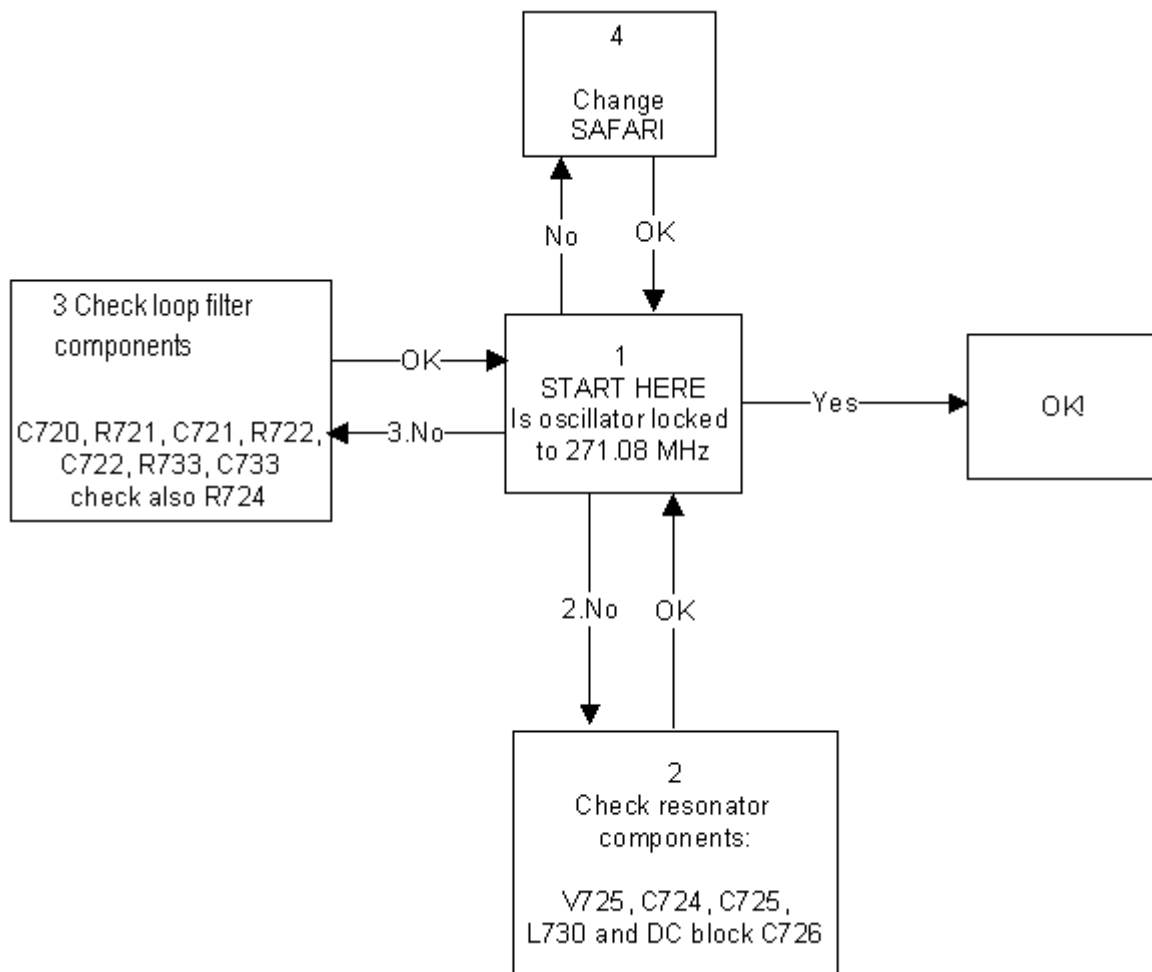
RX VHF VCO

The RX VHF VCO signal is used to generate receiver Intermediate frequency. RX VHF VCO has one fixed frequency (271.08 MHz). Operating frequency is locked in Phase-locked loop.

RX VHF VCO output signal is fed to Safari. The inside of the Safari signal is divided into the 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 L730 coil. Don´t connect probe to pads!

AMPS, CH383

TX VHF VCO

The TX VHF VCO signal is used to generate transmitter Intermediate frequency. TX VHF VCO has two fixed frequencies (361.08 MHz for lower band and 363.6 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 361.08 MHz
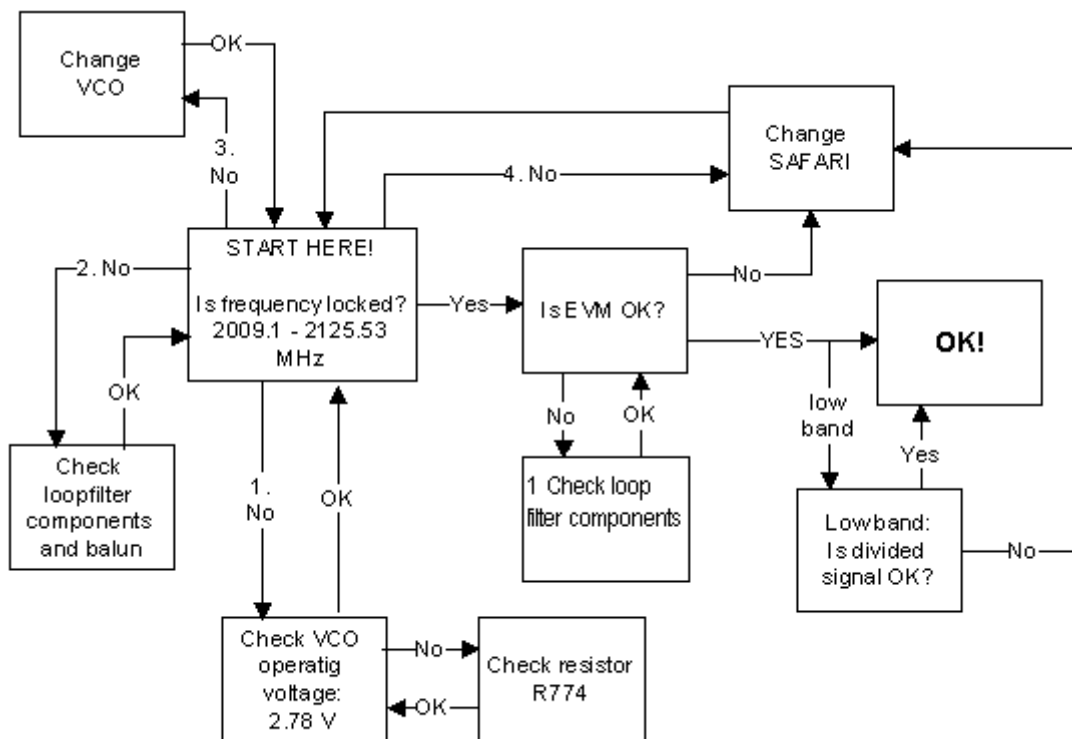
TDMA1900, CH1000   -> TX VHF frequency 363.6 MHz
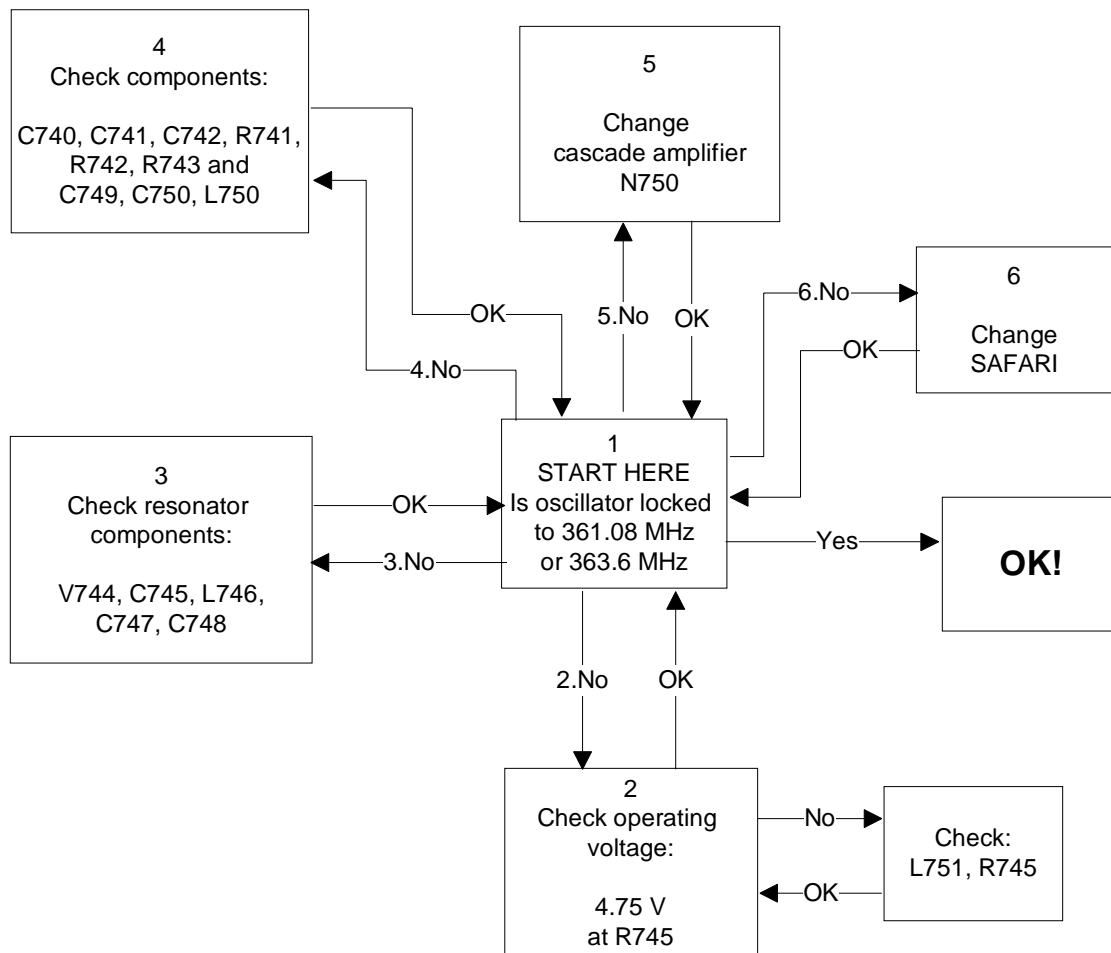
UHF Synthesizer

The UHF Synthesizer consists of an external 2GHz UHF VCO, loop filter and an integrated PLL in the Safari RF IC. Safari T 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 2009.1MHz to 2125.53 MHz.

In the upper band (TDMA1900), 2 GHz synthesizer frequency is fed straight to mixers. In the lower band (AMPS and TDMA800), 2 GHZ UHF VCO frequency signal is first divided by two 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 the PLL circuit inside Safari.

Fault–finding chart for UHF Synthesizer

```
Change VCO ──OK──┐
       │         │
    3. No         │
       │         │
       ▼         ▼
  ──2.No──  START HERE!  ──Yes──  Is EVM OK?  ──No──  Change SAFARI
       │    Is frequency locked?          │                    ▲
       │    2009.1 - 2125.53      ──YES──> OK!                 │
    OK │        MHz              │                             │
       ▼         │              low band                       │
  Check      1.  OK            No   OK    Yes                   │
  loopfilter  No  │             │   ▲      │                    │
  components   │  │             ▼   │    Lowband:              │
  and balun    ▼  │       1 Check loop   Is divided  ──No──────┘
               Check VCO  filter         signal OK?
               operatig   components
               voltage:  ──No──  Check resistor
               2.78 V   ──OK──   R774
```

4. No ─── Change SAFARI