CCS Technical Documentation
RH-40 Series Transceivers

Troubleshooting Instructions

Contents

Transceiver Troubleshooting

First, 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

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

Mode	BSI–resistor	BTEMP resistor	Remarks
Normal	68k	47k	
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 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 BB troubleshooting instructions consist of 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

- Buzzer

- 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 Bootsrap 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).
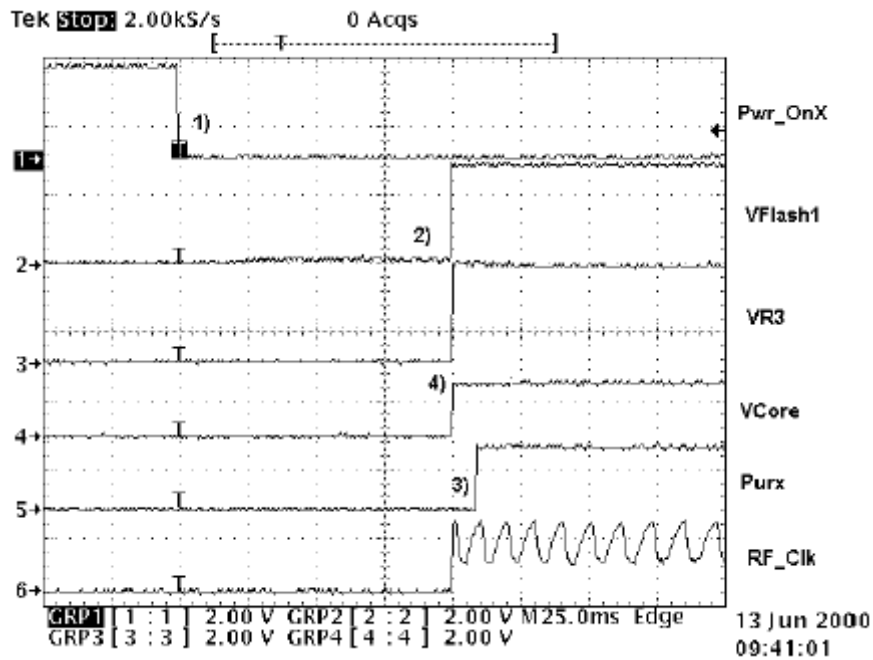
Figure 1: Power up sequence

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 UEM starts feeding SleepClk (32 KHz) to UPP.

Note: The sleepclock starts running in the crystal circuitry (B200) immediately when the battery voltage is supplied.

3   Software running

  • Default value for Vcore is 1.5 volts when the software is running.

  • Cbus (1.08MHz) clock starts running.

Phone does not start up normally or does not stay on

Note: In 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.

```
┌─────────────────────┐                    ┌─────────────────┐
│ Try to start phone  │──────OK──────────▶ │  Check the      │
│ to test or local    │                    │  power key      │
│ mode                │                    └─────────────────┘
└─────────────────────┘                            │
          │ FAIL                                    OK
          ▼                                         ▼
┌─────────────────────┐              ┌─────────────────────┐
│ Measure             │              │ Check R202,         │
│ Vflash1,Vana,Vio,   │──FAIL──────▶ │ R206, R207,         │
│ Vcore,VR3 when pwr  │              │ C220, C240          │
│ key pressed         │              └─────────────────────┘
└─────────────────────┘                         │ OK
   │ OK      │ VANA & VR3                         ▼
   │         │ missing              ┌─────────────────┐
   │         ▼                      │  Check X101     │
   │   ┌─────────────┐              └─────────────────┘
   │   │ Check G790  │                      ▲
   │   │ (missing,   │────OK───┐            │ FAIL
   │   │ misaligned) │         │            │
   │   └─────────────┘         │   ┌──────────────────┐
   │                           └──▶│ Measure VBAT     │
   ▼                               │ from C261        │
┌────────────────────┐            └──────────────────┘
│ Check 19.44MHz     │                    │ OK
│ RF-clock from C420 │──FAIL──▶ ┌────────┐
└────────────────────┘         │ Check  │
          │ OK                 │ C420   │
          │                    └────────┘
          │                        │ OK
          │              ┌──────────────────┐   ┌──────────────┐
          │              │ Check            │   │ Check        │
          │              │ 19.44MHz from    │──FAIL──▶│ R792,C792,   │
          │              │ G790             │   │ C793         │
          │              └──────────────────┘   └──────────────┘
          │                    │ OK                   │ OK
          │              ┌──────────────┐      ┌──────────────┐
          │              │ Change N801  │      │ Change G790  │
          │              └──────────────┘      └──────────────┘
          ▼
┌────────────────────┐                         ┌──────────────────┐
│ Check that purx    │──────FAIL────────────▶  │ Change the       │
│ goes up to 1.8V    │                         │ UEM (D200)       │
└────────────────────┘                         └──────────────────┘
          │ OK
          ▼
┌──────────────────┐   FAIL   ┌──────────────────┐
│ Measure J406.    │─────────▶│ Re-flash phone   │──┐
│ Should be 1.08   │          └──────────────────┘  │ Programming
│ MHz              │            │ Programmng ok,     │ fails
└──────────────────┘            │ but phone doesn't  │
          │ OK                  │ start              ▼
          ▼                     │            ┌──────────────────┐
┌──────────────────┐            │            │ Go to flash      │
│ Change UPP       │◀───────────┘            │ failure chart    │
│ (D400)           │                         └──────────────────┘
└──────────────────┘
```
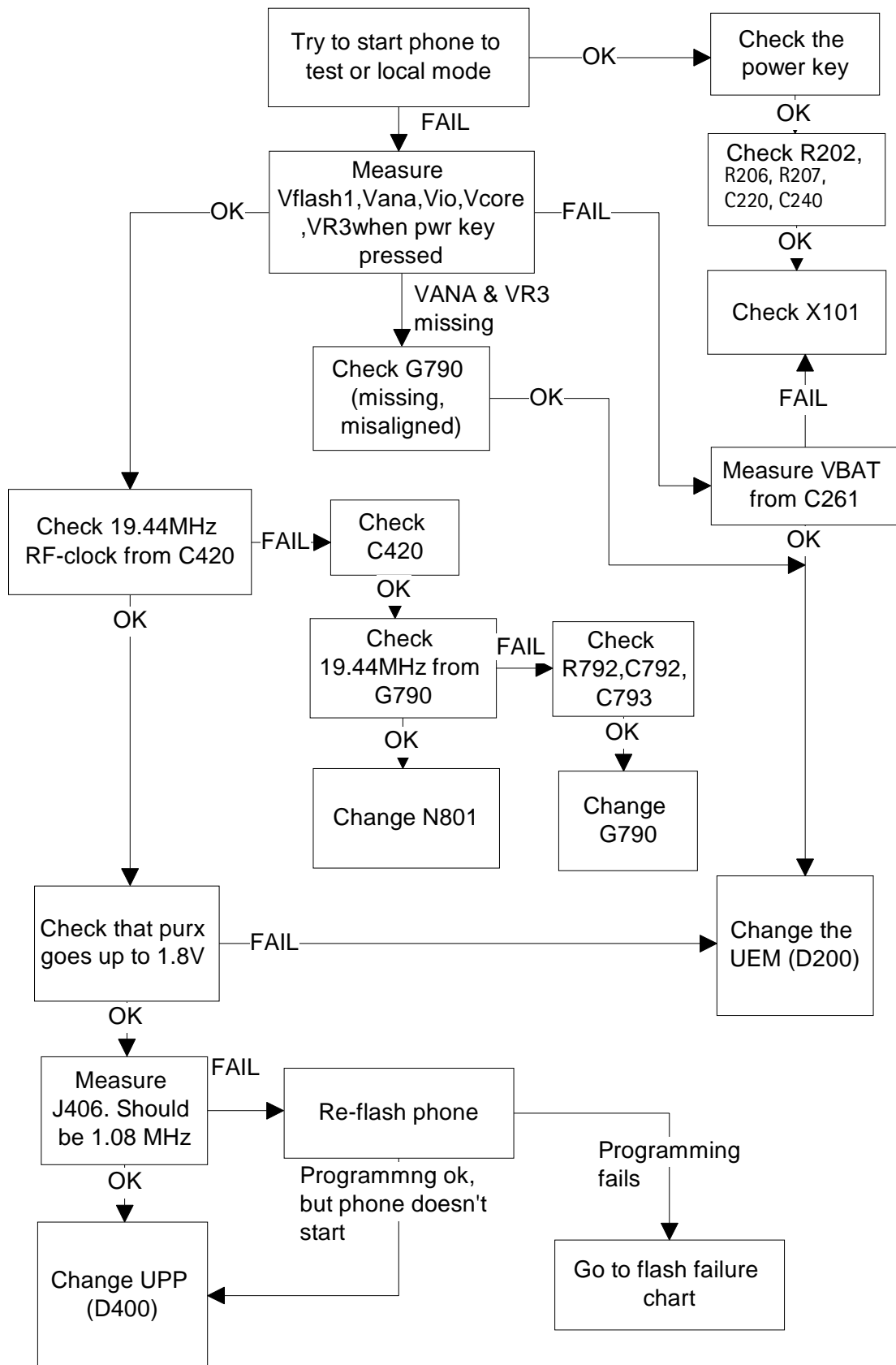
Figure 2: Fault tree, phone does not power up

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 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 table below 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 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: 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 LCH-9 is used, and works with ACP-7 and ACP-8, check that the charge control pin of the system connector is connected to the ground.

```
          ┌─────────────────────┐
          │  Phone doesn't start │
          │      charging        │
          └─────────────────────┘
                     │
                     ▼
    ┌─────────────────────┐        Fail      ┌─────────────────────┐
    │ Connect charger and │ ───────────────▶ │        Check        │
    │    check VCHARIN     │                  │ F100, L100, V100, C105│
    └─────────────────────┘                  └─────────────────────┘
                │  OK                                    │  OK
                ▼                                        ▼
    ┌─────────────────────┐                  ┌─────────────────────┐
    │     Check ICHAR      │                  │   Check bottom      │
    │                      │                  │    connector        │
    └─────────────────────┘                  │      - VIN          │
                │  FAIL                       │  - Charge control pin│
                ▼                             └─────────────────────┘
    ┌─────────────────────┐
    │        Check         │
    │ R202. R206, R207,    │
    │ C201, C202, C220, C240│
    │ and R200             │
    └─────────────────────┘
                │  OK
                ▼
    ┌─────────────────────┐
    │     Change the       │
    │        UEM           │
    └─────────────────────┘
```
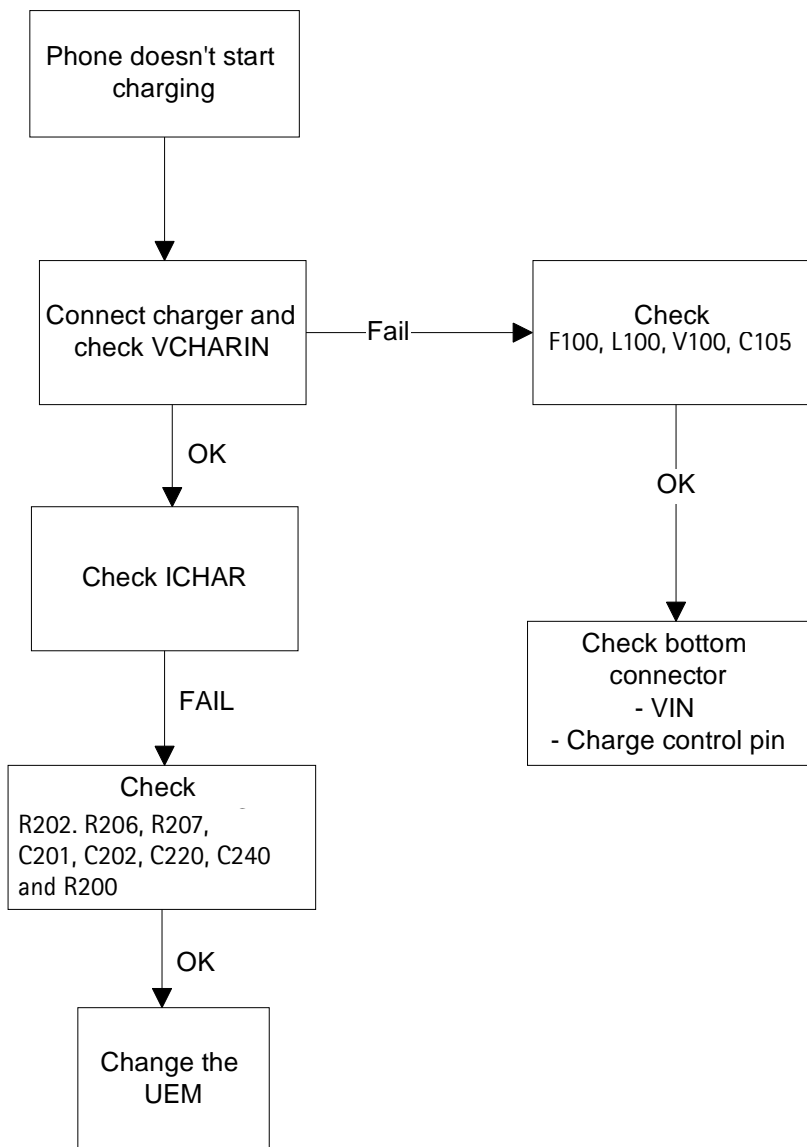
Figure 3: Fault tree, charging

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   In case 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.

In case 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

```
┌──────────────────┐
│  Earpiece doesn't│
│       work       │
└──────────────────┘
         │
         ▼
┌──────────────────┐   Fail    ┌──────────────────┐     OK
│  Run audio-loop  │ ────────▶ │ Feed 1KHz to Xmic│ ──────────┐
│   selftest with  │           │   by JBA-8 and   │           │
│     phoenix      │           │   measure from   │           │
└──────────────────┘           │     earpiece     │           │
         │ OK                   └──────────────────┘           │
         ▼                              │ Fail                 │
┌──────────────────┐                    │                      │
│   Check R157     │ ◀──────────────────┘                      │
└──────────────────┘                                           │
         │ OK                                                   │
         ▼                                                      ▼
┌──────────────────┐                              ┌──────────────────┐
│      Check       │                              │                  │
│     earpiece     │                              │    Change UPP    │
└──────────────────┘                              │                  │
         │ OK                                      └──────────────────┘
         ▼
┌──────────────────┐
│   Change UEM     │
└──────────────────┘
```
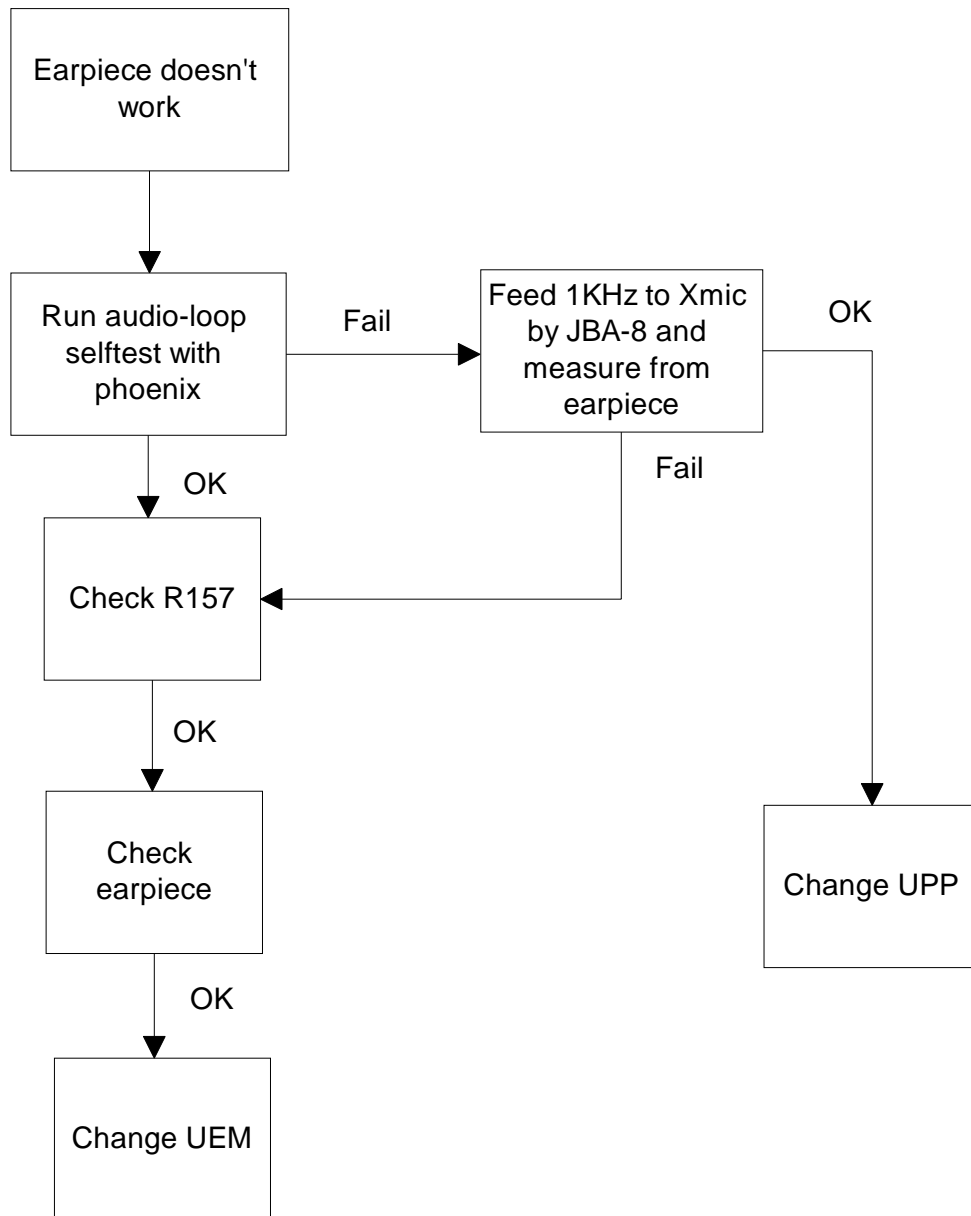
Figure 4: Fault tree, earpiece failure

Microphone or XEAR line does not work
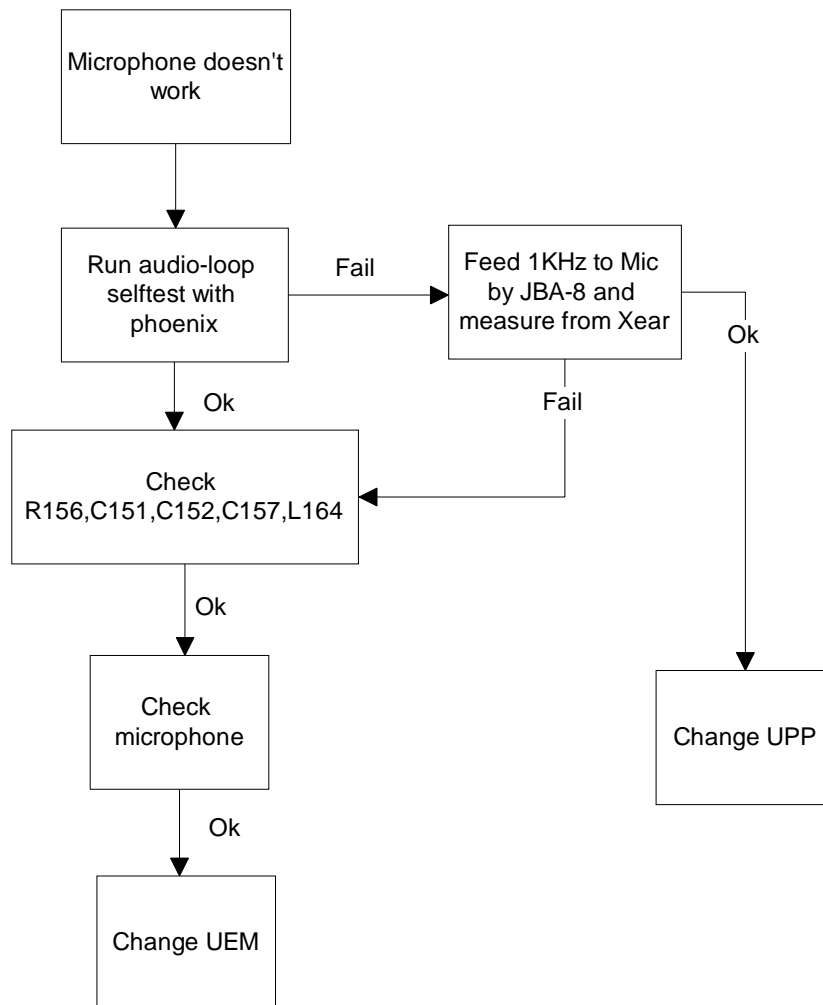
Figure 5: Fault tree, microphone failure

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 MJS-18 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.
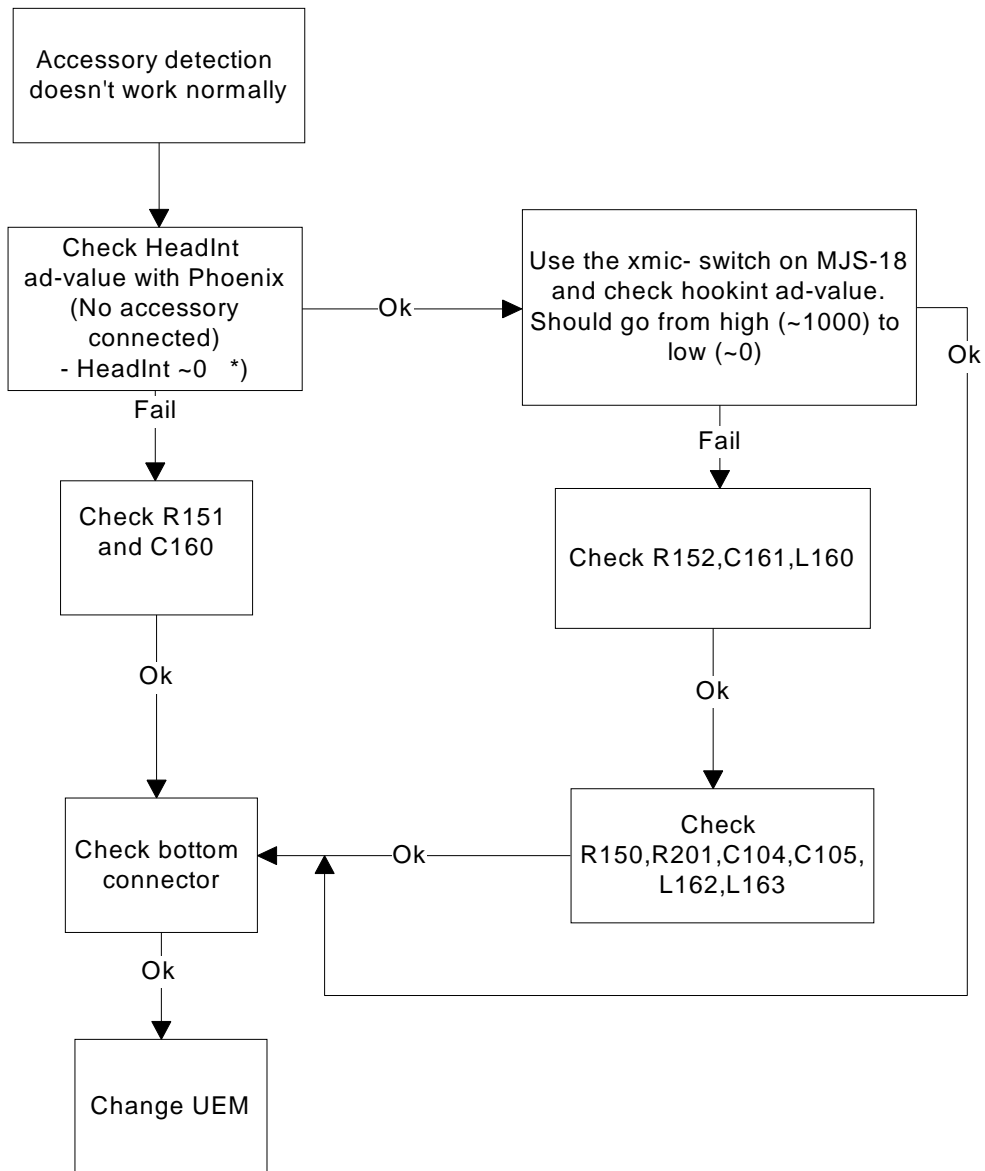
Figure 6: Fault tree, accessory detection

Sleep Clock

Missing/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.

```
┌─────────────────┐
│   Sleep mode    │
│   not working   │
└─────────────────┘
         │
         ▼
┌─────────────────┐  Fail  ┌─────────────────┐  Fail  ┌─────────────────┐
│ Measure sleep   │──────▶ │ Measure sleep   │──────▶ │  Check C203     │
│ clock from J204 │        │ clock from B200 │        │  &C204          │
└─────────────────┘        └─────────────────┘        └─────────────────┘
         │ Ok                      │ Ok                       │ Ok
         │                         │                          │
         ▼                         ▼                          ▼
┌─────────────────┐        ┌─────────────────┐        ┌─────────────────┐
│  Change UPP     │        │  Change UEM     │        │  Change B200    │
│  (D400)         │        │  (D200)         │        │                 │
└─────────────────┘        └─────────────────┘        └─────────────────┘
```
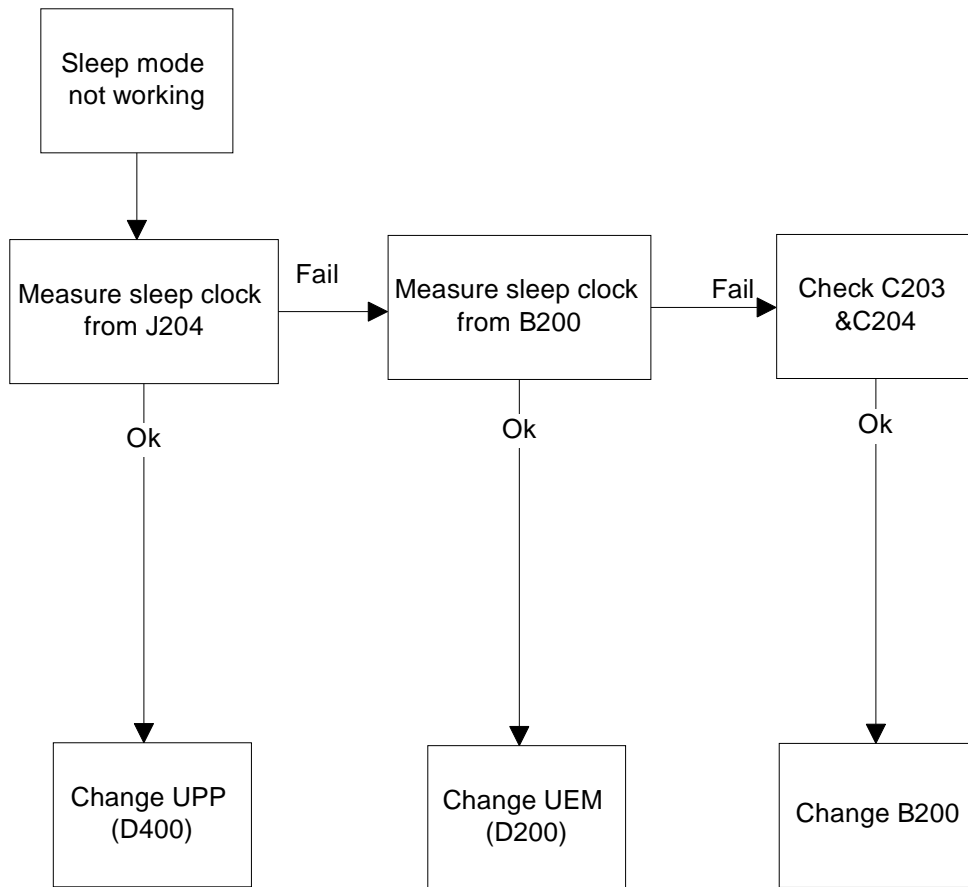
Figure 7: Fault tree, sleep clock

Display/Keyboard lights do not work

```
        ┌─────────────────────┐
        │   Display/Keyboard   │
        │ lights are not working│
        └─────────────────────┘
                  │
                  ▼
  ┌──────────────────────┐        ┌──────────────┐
  │ Check R300 (Display) │  FAIL  │   Replace    │
  │  and R301 (Keyboard) ├───────▶│ resistor(s)  │
  └──────────────────────┘        └──────────────┘
              │ OK
              ▼
  ┌──────────────────────┐        ┌──────────────┐
  │     Check LEDs       │  FAIL  │   Replace    │
  │ V300...V303 (Display)├───────▶│   LED(s)     │
  │and V304...V309(Keyboard)      └──────────────┘
  └──────────────────────┘
              │ OK
              ▼
  ┌──────────────────────┐        ┌──────────────┐
  │  Use Display Test in │  FAIL  │ Replace UEM  │
  │ Phoenix to set lights├───────▶│              │
  │       ON/OFF         │        └──────────────┘
  └──────────────────────┘
```
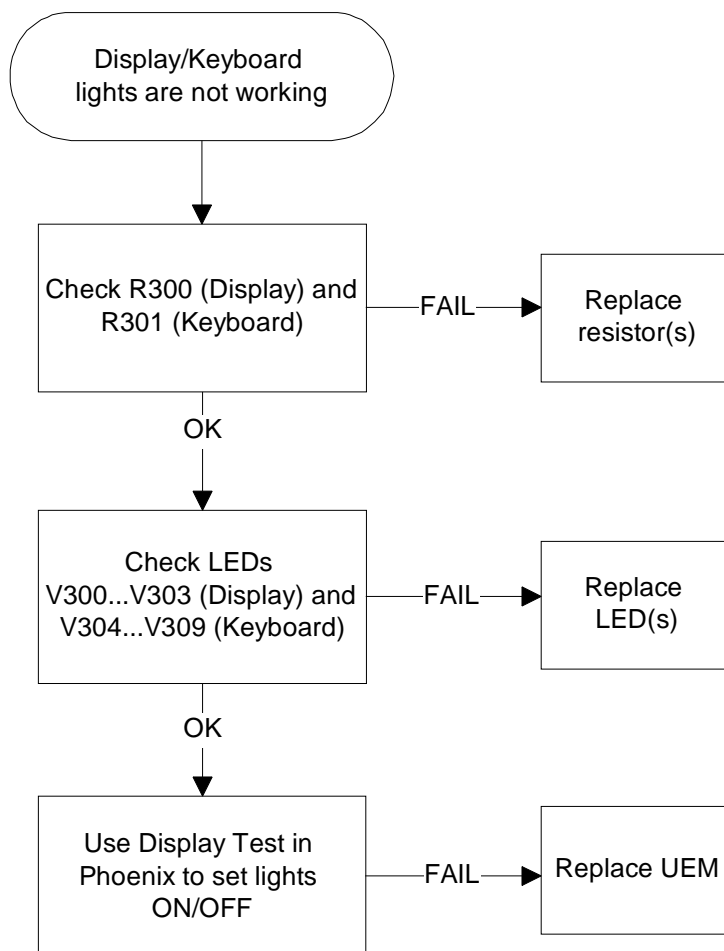
Figure 8: Fault tree, Display/Keyboard lights

Display does not work

```
        ╭─────────────────────╮
        │ Display does not work │
        ╰─────────────────────╯
                  │
                  ▼
        ┌─────────────────┐           ┌──────────────────┐
        │ Check that phone │           │ Proceed to phone │
        │ powers up normally│──FAIL──▶ │ doesn't power up │
        │(current consumption,│         │ troubleshooting  │
        │ power up sequence)│           └──────────────────┘
        └─────────────────┘
                  │ OK
                  ▼
        ┌─────────────────┐           ┌──────────────────┐
        │ Check display   │           │                  │
        │ visually (possible│          │ Replace          │
        │ cracks on COG   │──FAIL──▶   │ display module   │
        │ driver or glass,│           │                  │
        │ capacitors loose│           └──────────────────┘
        │ or broken)      │
        └─────────────────┘
                  │ OK
                  ▼
        ┌─────────────────┐           ┌──────────────────┐
        │                 │           │ Clean PWB and    │
        │ Check PWB and   │           │ replace          │
        │ elastomer       │──FAIL──▶  │ elastomer if     │
        │ connector       │           │ needed           │
        └─────────────────┘           └──────────────────┘
                  │ OK
                  ▼
        ┌─────────────────┐  FAIL  ┌──────────┐  FAIL  ┌────────────┐
        │ Run LCD test in │─────▶  │ Check    │─────▶  │ Replace    │
        │ Phoenix         │        │ capacitors│        │ capacitors(s)│
        │ (BB Self Tests/ │        │ C302...C304│       └────────────┘
        │ ST_LCD_TEST)    │        └──────────┘
        └─────────────────┘             │ OK
                  │ OK                   ▼
                  ▼                ┌──────────┐  FAIL  ┌────────────┐
        ┌─────────────────┐       │ Replace  │─────▶  │ Replace    │
        │ Use Display Test │      │ elastomer│        │ display module│
        │ in Phoenix to   │       └──────────┘        └────────────┘
        │ check if display│
        │ works           │
        └─────────────────┘
                  │ FAIL
                  ▼
        ┌─────────────────┐
        │ Replace         │
        │ display module  │
        └─────────────────┘
```

In any phase of display troubleshooting use Display Test in Phoenix to produce test patterns on display.

Also check with a known good display module to see if it works.

Figure 9: Fault tree, Display does not work

Buzzer does not work

Check spring connectors and C306.

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

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

Keyboard does not work

Check that there is no dirt between the dome sheet and the PWB. Check EMI/ESD filter Z301 that all lines come through. If not, change Z301. 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.

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

```
┌─────────────────────────┐
│ Apply 881.49 MHz =      │
│ ch 383 -116dBm ,        │
│ 8kHz dev, 1 kHz sine    │
│ to external             │
│ RF-connector X900.      │
└─────────────────────────┘
            │ Y
            ▼
┌─────────────────────────┐   Y    ┌──────────────────────┐
│ Connect HS to cellular  │───────▶│                      │
│ tester, open            │        │   AMPS               │
│ AF: 1 kHz sine      ,   │        │   RX-chain OK        │
│    meas SINAD           │        │                      │
│ AF: >12 dB              │        │                      │
└─────────────────────────┘        └──────────────────────┘
            │ N
            ▼
┌─────────────────────────┐   N    ┌──────────────────────┐
│ Check UHF Vc (from      │───────▶│  Start               │
│ C773) V: 1.8 ...2.1 V   │        │  troubleshooting     │
│                         │        │                      │
└─────────────────────────┘        └──────────────────────┘
            │ Y
            ▼
┌─────────────────────────┐   N    ┌──────────────────────┐
│ Check RXVHF Vc          │───────▶│  Start               │
│ (from C720). V: 0.7     │        │  troubleshooting     │
│ ...1.3                  │        │                      │
└─────────────────────────┘        └──────────────────────┘
            │ Y
            ▼
┌─────────────────────────┐
│ Apply 881.49 MHz        │
│ -30dBm ,  sine signal   │
│ external                │
│ RF-connector X900.      │
└─────────────────────────┘
            │
            ▼
```

```
┌─────────────────┐              ┌─────────────────┐     Note!
│ Check input level│     N        │                 │
│ at diplexer (Z907)│────────────▶│ Change EXT RF   │     Check all soldering and components
│ input.           │              │   Connector     │     in antenna circuit before changing
└─────────────────┘              └─────────────────┘
         │ Y
         ▼
┌─────────────────┐              ┌─────────────────┐     Note!
│ Check input level│     N        │                 │
│ at duplex filter.│────────────▶│ Change diplexer Z907│   Check all soldering and discrete
│                  │              │                 │     components of frontend.
└─────────────────┘              └─────────────────┘
         │ Y
         ▼
┌─────────────────┐              ┌─────────────────┐
│ Check input level│     N        │ Change duplex filter│
│ at LNA input.    │────────────▶│     (Z906)      │
│                  │              │                 │
└─────────────────┘              └─────────────────┘
         │ Y
         ▼
┌─────────────────┐              ┌─────────────────┐     Note!
│ Check RF level at│     N        │ Change Safari   │
│ RX800 band filter│────────────▶│    (N801)       │     Check all solderings and discrete
│ input.           │              │                 │     copmponents around Safari
└─────────────────┘              └─────────────────┘     before changing
         │ Y
         ▼
┌─────────────────┐              ┌─────────────────┐
│ Check RF level at│     N        │ Change Safari   │
│ MIX1Ain P/N.     │────────────▶│    (N801)       │
│                  │              │                 │
└─────────────────┘              └─────────────────┘
         │ Y
         ▼
```
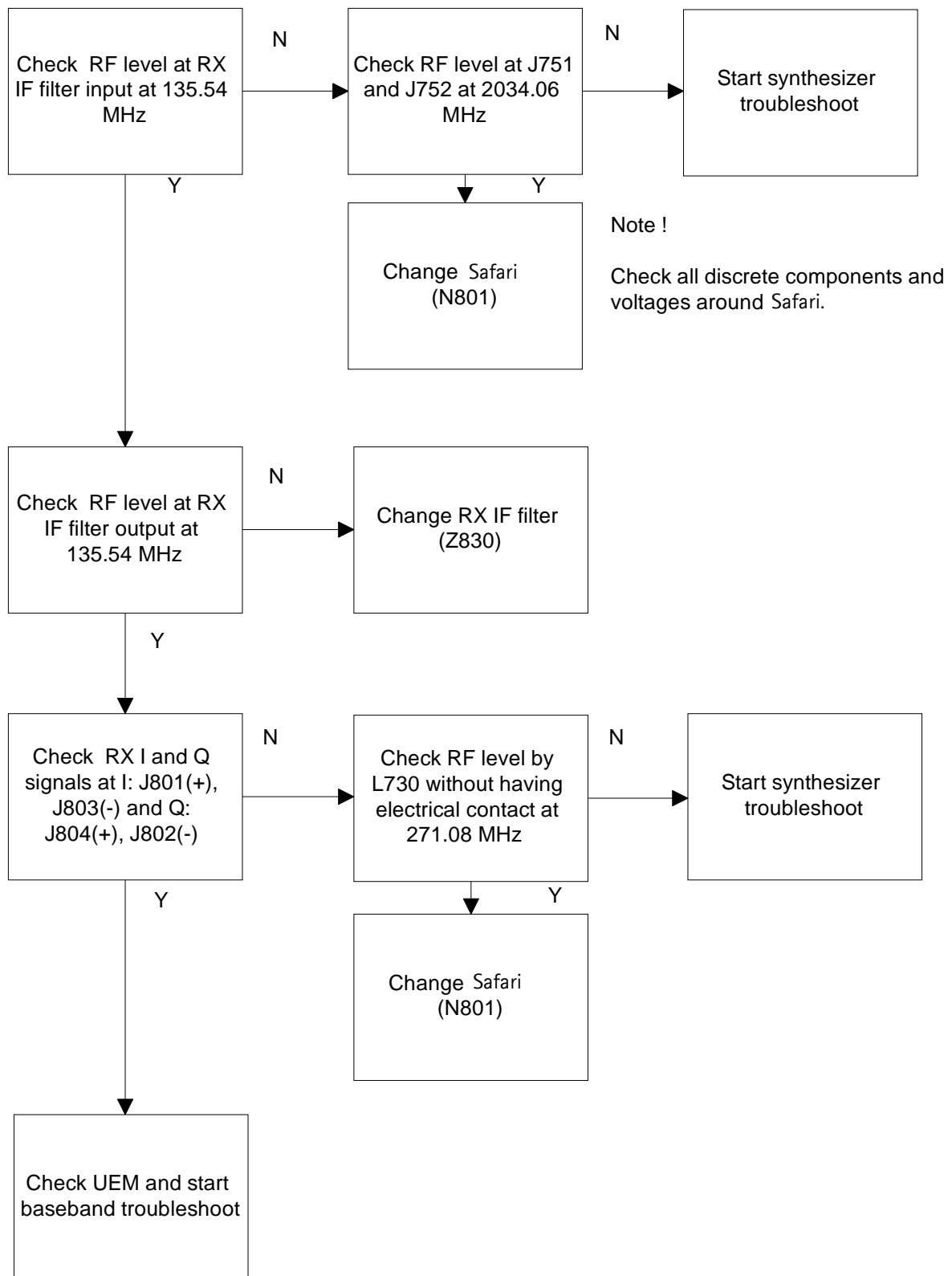
Figure 10: Fault tree. AMPS

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 troubleshooting.

Transmitter Troubleshooting

General instructions for TX troubleshooting

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

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

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

Note: After any component change, tune the phone with the 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 (Safari) -> Balun->BPF -> PA -> Coupler (Power detector) -> Duplex-filter -> Diplexer -> EXT RF-connector -> Antenna

Fault-finding charts for the transmitter

AMPS

1 Start the Phoenix-software and set the phone to the analog mode by using RF Test UI.

2 Set the channel to 383 and the power level to 2.

3 Connect the RF-cable to the Ext RF connector.

4 Connect the cable to the Spectrum analyzer input.

5 Measure the RF level.

Note: Insertion loss of the cable and attenuations.

AMPS, PL2, CH383

Visual check of TX

-PA
-TX SAW
- Duplex filter
- Passive components

OK

Start syntheziser
troubleshooting

OK

Check supply voltage
- VR2
- VBATTRF
- VR5
- IPA1

NOK → Check UEM and UPP
(Baseband)

OK

Check TXi/q signals
Test points J901...J904

NOK → Check UEM
(Baseband)

OK

Check Z960 input and
output power
out:-20dBm+3/-6dB
IL:2dB

NOK → Change Safari
or Z960

OK

Check TX RF (836.49
MHz) output power
from balun T961
input RF:0dBm+/-6dI

NOK → Change Safari

OK

```
                    ┌─────────────────┐   NOK   ┌─────────────────────┐
                    │  Check TX SAW   │────────▶│ Change TX SAW filter│
                    │ input and output│         │        Z905         │
                    │     power       │         │                     │
                    │   IL: -3 dB     │         │   Z905 or I961      │
                    └─────────────────┘         └─────────────────────┘
                             │ OK
                             ▼
                    ┌─────────────────┐   NOK   ┌─────────────────────┐
                    │ Is Itot 700...900 mA?│     │                     │
                    │ Check PA output power│────▶│   Change PA N901    │
                    │    and gain.    │         │                     │
                    │ Output power: ~28│        │                     │
                    │      dBm        │         │                     │
                    │   Gain: ~30 d   │         │                     │
                    └─────────────────┘         └─────────────────────┘
                             │ OK
                             ▼
                    ┌─────────────────┐   NOK   ┌─────────────────────┐
                    │ Check PWRDET N930│───────▶│  Change PWRDET      │
                    │  insertion loss │         │       N930          │
                    │   IL< 0.3 dB    │         │                     │
                    └─────────────────┘         └─────────────────────┘
                             │ OK
                             ▼
                    ┌─────────────────┐   NOK   ┌─────────────────────┐
                    │ Check duplexer Z906,│      │                     │
                    │ diplexer Z907 and RF│─────▶│ Change Z906 or Z907 │
                    │  connector X900 │         │   or RF connector   │
                    │  insertion loss │         │                     │
                    │  Dupl IL ~2.2 dB│         │                     │
                    │  Dipl ~0.35 dB  │         │                     │
                    │  RF conn ~0.1   │         │                     │
                    └─────────────────┘         └─────────────────────┘
                             │ OK
                             ▼
                    ┌─────────────────┐
                    │ Start Power control│
                    │  troubleshooting │
                    │                 │
                    └─────────────────┘
```
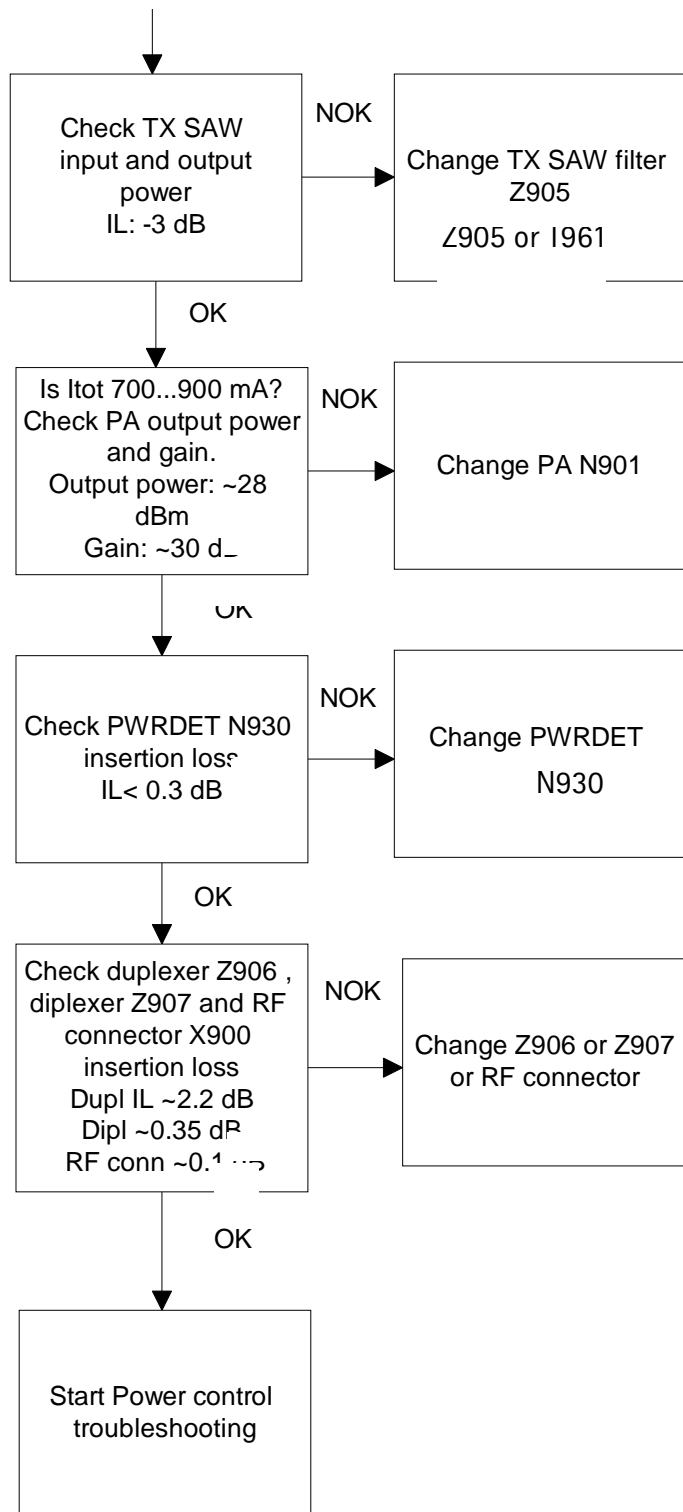
Figure 11: Fault tree. Transmitter troubleshooting

TDMA800

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

*Power control loo*p

Basically, the power detection is done with the Power detector module and power control is done inside the Safari. Power detection is basically similar for both bands, except that both bands have their own coupler.
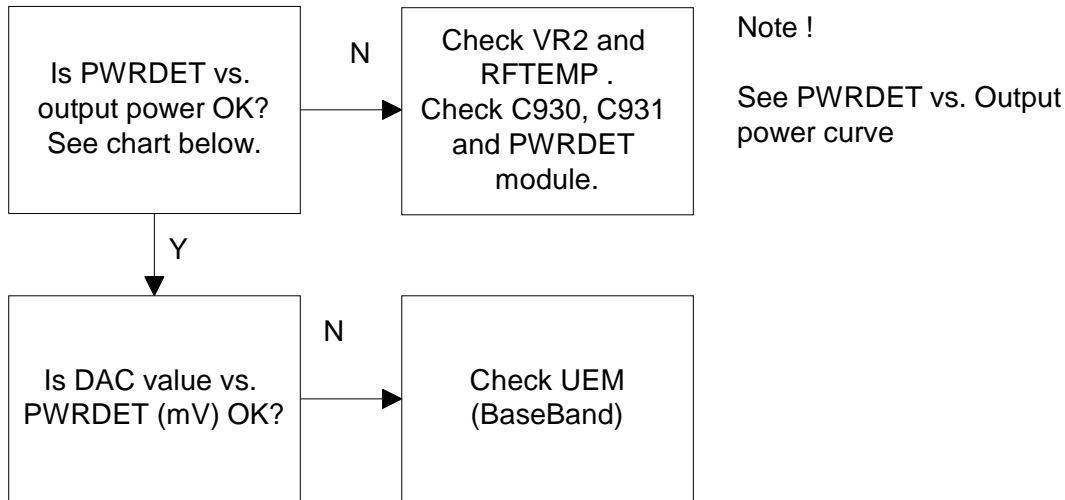
```
┌────────────────────┐   N   ┌────────────────────┐     Note !
│  Is PWRDET vs.     │─────▶ │  Check VR2 and     │
│  output power OK?  │       │  RFTEMP .          │     See PWRDET vs. Output
│  See chart below.  │       │  Check C930, C931  │     power curve
└────────────────────┘       │  and PWRDET        │
         │                   │  module.           │
         │ Y                 └────────────────────┘
         ▼
┌────────────────────┐   N   ┌────────────────────┐
│  Is DAC value vs.  │─────▶ │  Check UEM         │
│  PWRDET (mV) OK?   │       │  (BaseBand)        │
└────────────────────┘       └────────────────────┘
```

Figure 12: Fault tree: Power control loop

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

800A				800D		
	Pout	TXPWRDET		Pout	TXPWRDET	
PL	dBm	dac	mV	dBm	dac	Mv
2	24.5	577	1600	27.3	772	1919
3	21.0	413	1145	23.3	504	1250
4	17.5	308	851	19.3	358	815
5	13.5	222	615	15.3	251	448
6	9.5	172	478	11.3	192	271
7	5.5	142	387	7.3	150	152
8	–	–	–	3.3	125	81
9	–	–	–	–0.7	110	43
§0	–	–	–	–4.7	102	20

Note: DAC values may vary about +- 20%

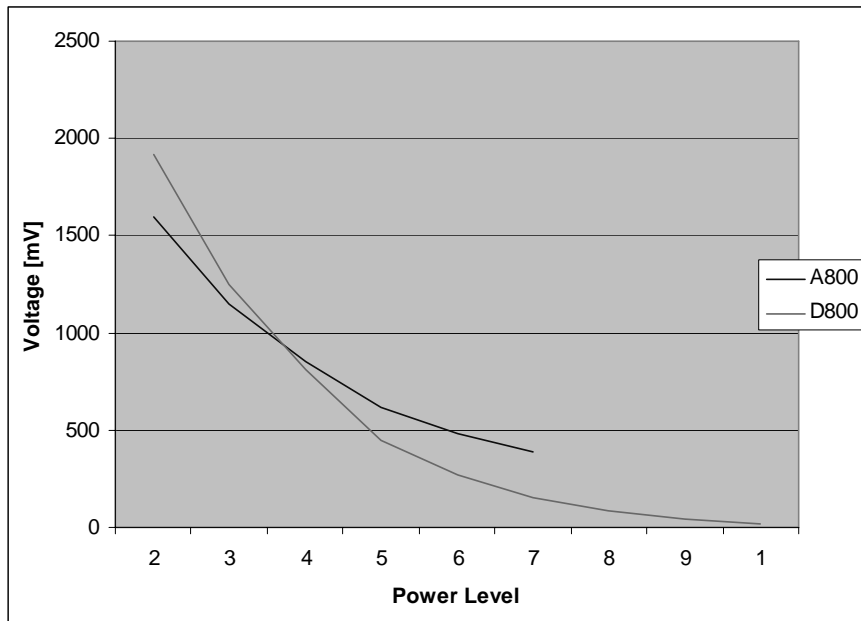*Note: TXPWRDET is the difference between TX on burst and off burst.*

Figure 13: Detected voltage limits

Synthesizer Troubleshooting

There are four oscillators generating the needed frequencies for RF-section. 19.44 MHz VCTCXO is used as a refence signal oscillatorreference oscillator, 2GHz UHF VCO with loop filter circuit is used for RX and TX channel selection, TX VHF and RF VHF are for TX modulator and 2nd RX mixer locals generation.

The VHF synthesizers are integrated in Safari, but have external VCO coils and loop filters. RX VHF frequency is fixed 271.08 MHz and TX VHF is fixed to 271.08 MHz . 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 2009.16 to 2059.02MHz. In upper band the output frequency range from the UHF VCO is from 2031.78MHz to 2125.53MHz.

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.

19.44 MHz reference oscillator

The VCTCXO oscillator frequency (G790) is controlled by UEM. This output 19.44 MHz signal is connected to Safari. It is used as a reference signal in Safari and also fed out as buffered clock signal to UPP. All synthesizers use divided 19.44 MHz signal as a reference signal for Phase locked loop to provide correct LO-frequency.
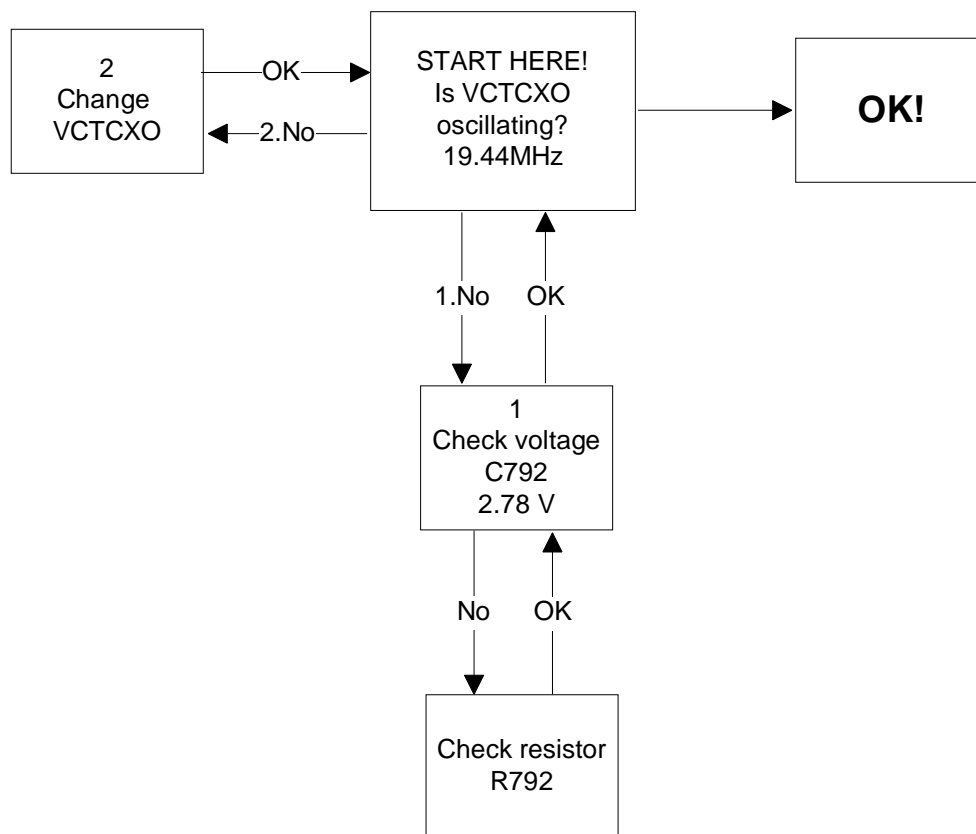
```
┌─────────────┐   OK→   ┌──────────────┐         ┌──────────────┐
│      2      │────────→│ START HERE!  │────────→│              │
│   Change    │         │  Is VCTCXO   │         │     OK!      │
│   VCTCXO    │←─2.No───│ oscillating? │         │              │
└─────────────┘         │   19.44MHz   │         └──────────────┘
                        └──────────────┘
                          │          ↑
                        1.No        OK
                          ↓          │
                        ┌──────────────┐
                        │      1       │
                        │ Check voltage│
                        │     C792     │
                        │    2.78 V    │
                        └──────────────┘
                          │          ↑
                          No        OK
                          ↓          │
                        ┌──────────────┐
                        │ Check resistor│
                        │     R792     │
                        │              │
                        └──────────────┘
```

Figure 14: Fault tree: 19.44 MHz oscillator

RX VHF

The RX VHF signal is used to generate receiver Intermediate frequency. RX VHF has one fixed frequency 271.08 MHz. Operating frequency is locked in Phase locked Loop.

RX VHF PLL output signal is integrated in Safari. There are only four external components, VCO coil L730 and loop filter components C740, C741 and R741.
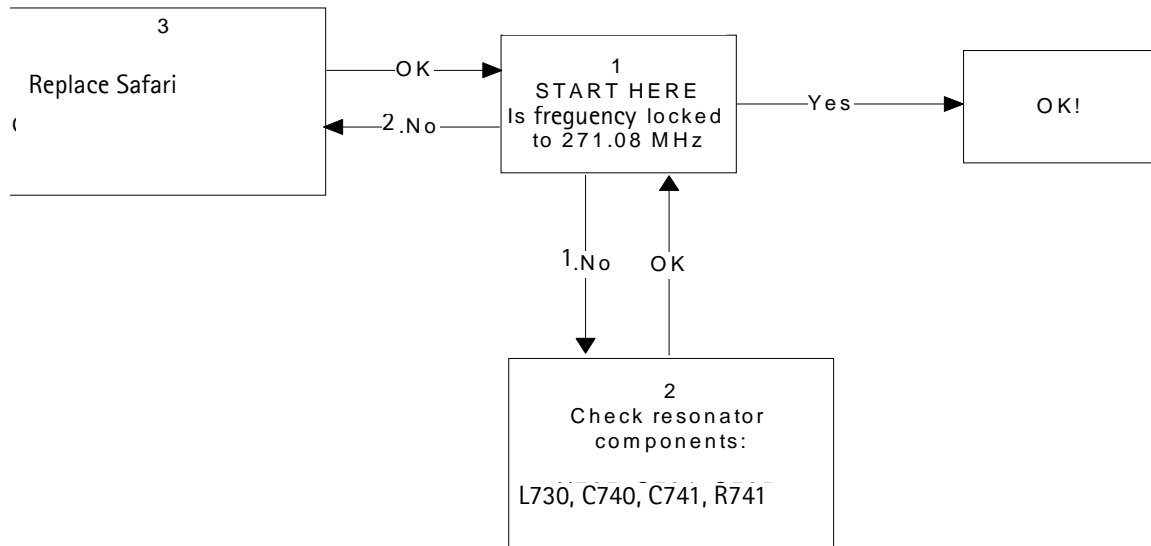
Fault–finding chart for RX VHF VCO

```
  ┌──────────────────────┐              ┌──────────────────────┐                ┌──────────────────┐
  │          3           │──── OK ────▶ │          1           │                │                  │
  │                      │              │     START HERE        │──── Yes ────▶ │      OK!          │
  │    Replace Safari     │◀── 2.No ──── │  Is frequency locked  │                │                  │
  │    (                  │              │   to 271.08 MHz       │                └──────────────────┘
  └──────────────────────┘              └──────────────────────┘
                                            │          ▲
                                          1.No        OK
                                            │          │
                                            ▼          │
                                   ┌──────────────────────┐
                                   │          2           │
                                   │   Check resonator     │
                                   │   components:         │
                                   │                      │
                                   │  L730, C740, C741, R741 │
                                   └──────────────────────┘
```

Figure 15: Fault tree: RX VHF

TX VHF

The TX VHF signal is used to generate transmitter Intermediate frequency. TX VHF VCO has one fixed frequency 361.08. Operating frequency is locked in Phase locked loop. TX VHF VCO output signal is divided by 2 and fed to the modulator.
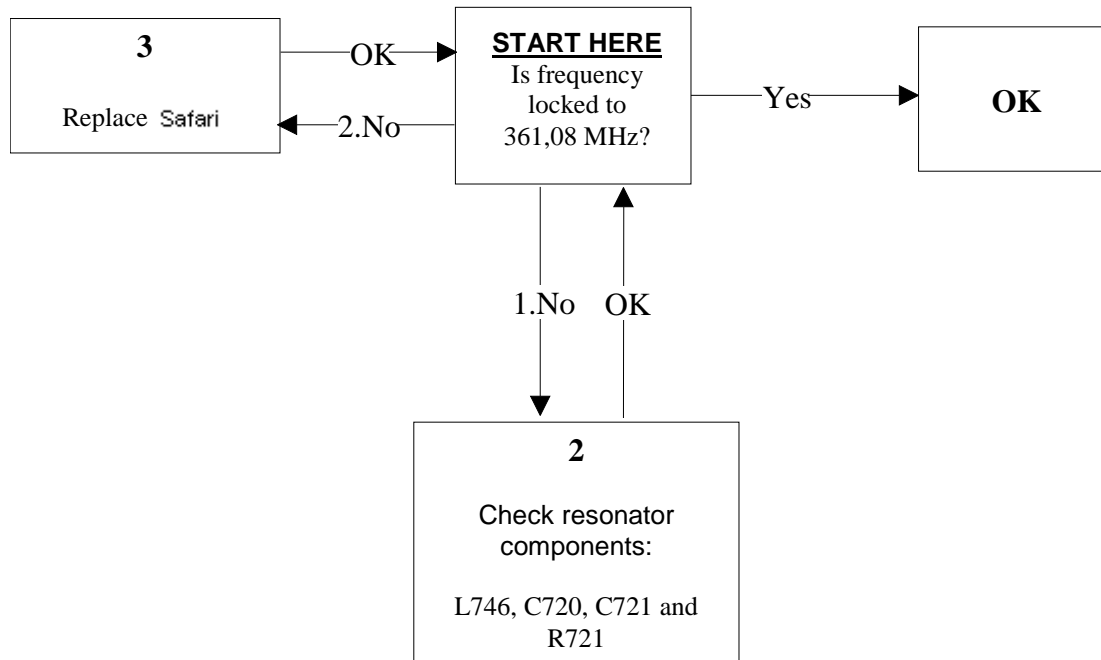
```
  ┌──────────────────────┐              ┌──────────────────────┐                ┌──────────────────┐
  │          3           │──── OK ────▶ │     START HERE        │                │                  │
  │                      │              │    Is frequency       │──── Yes ────▶ │       OK          │
  │    Replace Safari     │◀── 2.No ──── │    locked to          │                │                  │
  │                      │              │    361,08 MHz?        │                └──────────────────┘
  └──────────────────────┘              └──────────────────────┘
                                            │          ▲
                                          1.No        OK
                                            │          │
                                            ▼          │
                                   ┌──────────────────────┐
                                   │          2           │
                                   │   Check resonator     │
                                   │   components:         │
                                   │                      │
                                   │  L746, C720, C721 and │
                                   │        R721           │
                                   └──────────────────────┘
```

Figure 16: Fault tree: TX VHF

UHF Synthesizer

The UHF VCO signal is used for RF channel selection. This signal is fed as a local signal for 1st mixer of RX–path and for upconverter of TX–path. When operating on lower band the VCO signal is divided by 2 before feeding. This synthesizer is used for channel selection in all modes and both bands.

The UHF synthesizer consists of an external 2GHz VCO module with loop filter components and integrated PLL parts in Safari. Integrated charge pump circuit allows analog and digital operation modes. The VCO Oscillation frequency is from 2009.1 to 2125.53 MHz. The output frequency of the VCO module depends on the DC–control voltage which is controlled by PLL–circuit inside Safari.
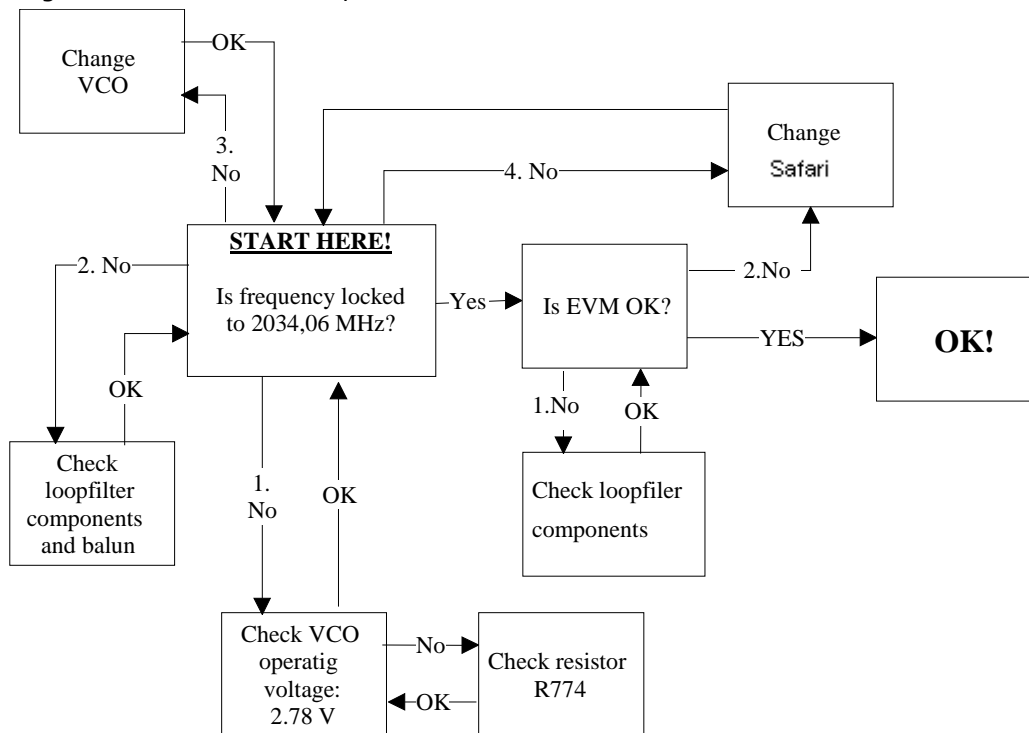
Figure 17: Fault tree: UHF Synthesizer