6 – Baseband Description and Troubleshooting

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List of abbreviations

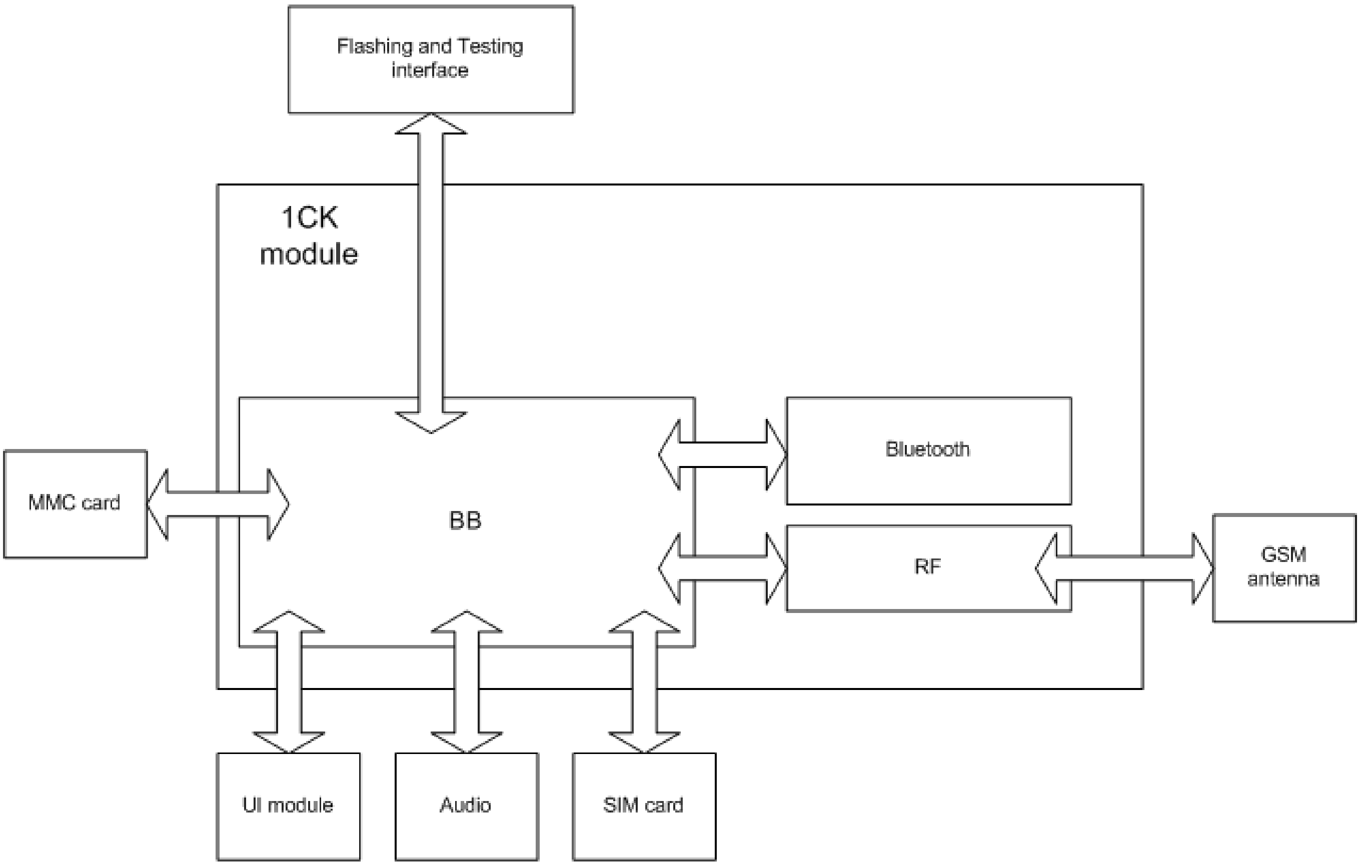
ASIC	Application Specific Integrated Circuit
BB	Baseband
BT	Bluetooth
BSI	Battery Size Indicator
CBus	Control Bus connecting UPP_WD2 with UEM
CPU	Central Processing Unit
DBUS	Data Bus
DSP	Digital Signal Processor
ESD	Electro Static Discharge
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global system mobile
HF	Hands free
HFCM	Handsfree Common
HS	Handset
I/O	Input/Output
IHF	Integrated hands free
LCD	Liquid Crystal Display
LO	Local Oscillator
MCU	Micro Controller Unit
MIC, mic	Microphone
PA	Power Amplifier
PCS	GSM1900
PDA	Pocket Data Application
PLL	Phase Locked Loop

PWB	Printed Wired Board
RFBUS	Control Bus For RF RXReceiver
SDRAM	Synchronous Dynamic Random Access Memory
SIM	Subscriber Identity Module
TX	Transmitter
UEM	Universal Energy Management
UI	User Interface
VCO	Voltage controlled oscillator
VHF	Very High Frequency
VCXO	Voltage Controlled Crystal Oscillator
VGA	Video Graphics Array

1CK System Module Block Diagram

The 1CK system module is the engine board of the RH-47 phone. It includes the base-band and RF functions of the phone and the Bluetooth module, fig. 1 below. External interfaces are drawn as arrows crossing the 1CK border.

Figure 1: 1CK module block diagram



The accessory interface is provided by Bluetooth. Only the headset & charger are galvanic interfaces.

Baseband Technical Summary

The heart of the BB is UPP_WD2, which includes the MCU, DSP and digital control logic. Power is supplied by the UEMK ASIC and a number of discrete regulators. Memory comprises 1x 64Mbit, 1x 128Mbit flash memory devices and 128Mbit SDRAM.

There are two audio transducers (earpiece 8 mm and a MALT speaker 16 mm) and external galvanic headset (DCT4) interface. MALT speaker is also used for handling the ringing tones. The MALT speaker is driven by a discrete audio amplifier.

For data connectivity, there is Bluetooth and an MMC card.

The display is a GD82C type colour display with 66000 Colours and 176x208 pixels with backlighting.

Functional Description

BB description

The BB core is based on UPP_WD2 CPU, which is a PDA version of the DCT4 UPP ASIC. UPP_WD2 takes care of all the signal processing and operation controlling tasks of the phone as well as all PDA tasks.

For power management, there is one main ASIC for controlling charging and supplying power UEM plus some discrete power supplies. The main reset for the system is generated by the UEM.

The interface to the RF and audio sections is also handled by the UEM. This ASIC provides A/D and D/A conversion of the in-phase and quadrature receive and transmit signal paths and also A/D and D/A conversions of received and transmitted audio signals. Data transmission between the UEM and RF and the UPP_WD2 is implemented using different serial connections (CBUS, DBUS, FBUS, MBUS and RFBUS). Digital speech processing is handled by the UPP_WD2 ASIC.

A real time clock function is integrated into the UEM, which utilizes the same 32kHz-clock source as the sleep clock. A rechargeable battery provides backup power to run the RTC when the main battery is removed. Backup time is about 3 hours.

Memory configuration

RH-47 uses two kinds of memories: flash and SDRAM. These memories have their own dedicated bus interfaces to UPP_WD2.

Synchronous DRAM is used as working memory. Interface is a 16-bit wide data and 14-bit address. Memory clocking speed is 104 MHz. The SDRAM size is 128Mbits (8Mx16). SDRAM I/O is 1.8 V and core 2.78 V, both are supplied by UEM regulator VIO. All memory contents are lost, if the supply voltage is switched off.

Multiplexed flash memory interface is used to store the MCU program code and user data. The memory interface is a burst type FLASH with multiplexed address/data bus, running at 40MHz. Both Flash I/O and core voltage are 1.8 V supplied by UEM's VIO.

Energy management

The master of EM control is UEM and with SW this has the main control of the system voltages and operating modes.

Modes of operation

RH-47 employs several hardware & SW controlled operation modes. The main modes are described below.

- NO_SUPPLY mode means that the main battery is not present or its voltage is too low (below UEM master reset threshold) and back-up battery voltage is too low.

- In BACK_UP mode, the main battery is not present or its voltage is too low but back-up battery has sufficient charge in it.

- In PWR_OFF mode, the main battery is present and its voltage is over UEM master reset threshold. All regulators are disabled.
- RESET mode is a synonym for start-up sequence and contains in fact several modes. In this mode, regulators and oscillators are enabled and after they have stabilized system reset is released and PWR_ON mode entered.
- In PWR_ON mode, SW is running and controlling the system.
- SLEEP mode is entered from PWR_ON mode when the system's activity is low (SLEEPX controlled by SW).
- FLASHING mode is for production SW download.

Voltage limits

In the following table, the voltage limits of the system are listed. These are also controlling system states.:

Parameter	Description	Value
V_{MSTR+}	Master reset threshold (rising)	2.1 V (typ.)
V_{MSTR-}	Master reset threshold (falling)	1.9 V (typ.)
V_{COFF+}	Hardware cutoff (rising)	3.1 V (typ.)
V_{COFF-}	Hardware cutoff (falling)	2.8 V (typ.)
V_BU_{COFF+}	Back-up battery cutoff (rising)	2.1 V (typ.)
V_BU_{COFF-}	Back-up battery cutoff (falling)	2.0 V (typ.)
SW_{COFF}	SW cutoff limit (> regulator drop-out limit) MIN!	3.4 V SW changeable

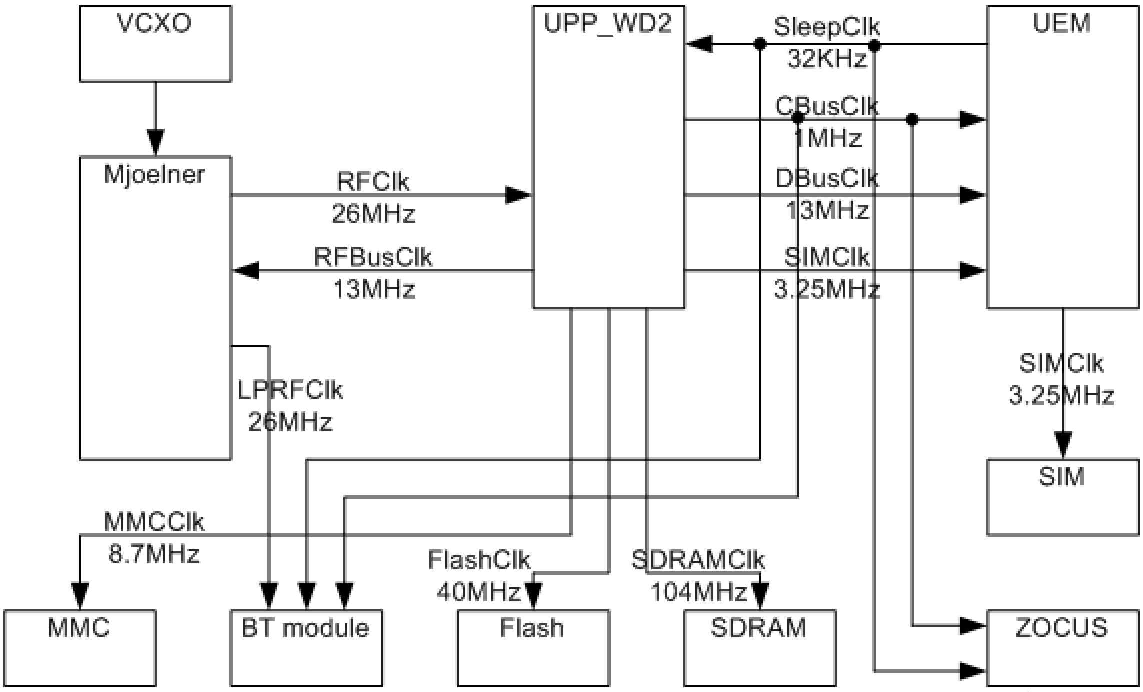
The master reset threshold controls the internal reset of the UEM. If battery voltage is above V_{MSTR}, UEM's charging control logic is alive. In addition, RTC is active and supplied from the main battery. Above V_{MSTR} UEM allows the system to be powered on although this may not succeed due to voltage drops during start-up. SW can also consider battery voltage too low for operation and power down the system.

Clocking scheme

A 26 MHz VCXO is used as system clock generator in GSM. During the system start-up, UEM RC-oscillators generate timing for state machines. All clock signals of the engine are illustrated in following figure.

Bluetooth uses a 26 MHz clock.

Figure 2: RH-47 Clocking.



In SLEEP mode, the VCXO is off. UEM generates low frequency clock signal (32.768 kHz) that is fed to UPP_WD2, Bluetooth and ZOCUS.

UPP_WD2 voltage/clock frequency adjusting

No external clock is available for UPP_WD2 before VCXO starts. As reset is released, the VCXO is running and MCU uses the 26 MHz clock while DSP is in reset. There are three identical DPLL's, for MCU, for DSP and for accessory interfaces which can be controlled independently. The clock for MCU can be up to 104 MHz and 117 MHz is the maximum clock frequency for the DSP. These clock signals are used either directly (SDRAM IF) or divided down for the interfaces (for example, flash IF).

Power distribution, control and reset

All power (except backup battery power) is drawn from the BL-6C Li-Ion battery located in the B-cover. Current flows through ZOCUS current sense the resistor which is used for current measurement by ZOCUS and thus for remaining operating time estimation.

1CK board contains one power ASIC, UEM and discrete regulators needed for generating the different operating voltages. The discrete regulators consist of a step-down DC-DC converter to power UPPWD2 voltage core and a step-up DC-DC converter for display module backlighting. The keyboard backlighting is powered with a discrete driver.

Power-up sequence (reset mode)

RESET mode can be entered in four ways: by inserting the battery or charger, by RTC alarm or by pressing the power key. The VCXO is powered by the UEM. After a 220 ms delay, regulators are configured and UEM enters the PWR_ON mode and system reset PURX is released.

During system start-up, in the RESET state, the regulators are enabled, and each regulator charges the capacitor(s) at the output with the maximum current (short circuit current) it can deliver. This results in battery voltage dropping during start-up. When a battery with voltage level just above the hardware cutoff limit is inserted, the system may not start due to excessive voltage dipping. Dropping below 2.8 V for longer than 5 ms forces the system to PWR_OFF state.

Powering off

Controlled powering off is done when the user requests it by pressing the power-key or when the battery voltage falls too low. Uncontrolled powering off happens when the battery is suddenly removed or if over-temperature condition is detected in regulator block while in RESET mode. In this mode, all UEM's regulators are disabled immediately and discrete regulators are disabled as Vbat supply disappears.

Controlled powering off

For RH-47, powering off is initiated by pressing the power key. After that power off sequence is activated in the UEM and SW. Basically, power key causes a UEM Interrupt to UPP_WD2 and SW sets watchdog time value to zero and as this happens, PURX is forced low and all regulators are disabled. If the battery voltage falls below the very last SW-cutoff level, SW will power off the system by letting the UEM's watchdog elapse. If thermal shutdown limit in UEM regulator block is exceeded, the system is powered off. System reset PURX is forced low.

Uncontrolled powering off

This happens when the battery is suddenly removed. UEM's state machine notices battery removal after battery voltage has been below V_{COFF-} for 5 us and enters the PWR_OFF mode. PURX is set low and all UEM's regulators are disabled.

Watchdogs

There are three watchdogs in the UEM. The first one is for controlling system power-on and power-down sequences. The initial time for this watchdog after reset is 32s and the watchdog can not be disabled. The time can be set using a register. This watchdog is used for powering the system off in a controlled manner. The other one is for security block and is used during IMEI code setting. The third one is a power key watchdog. It is used to power off the system in case SW is stuck and the user presses the power key.

There is also a"soft watchdog" in UPP_WD2. It is used to reset the chip in case software gets stuck for any reason. The Bluetooth module also contains a watchdog.

Charging

Charging control and charge switch is in the UEM. There are two different charging modes: charging empty battery (start-up charge mode), and SW controlled charging.

UEM digital part takes care of charger detection (generates interrupt to UPP_WD2), pulse width modulated charging control (for internal charge switch) and over voltage and current detection. SW using registers controls all these.

Chargers

RH-47 BB supports a standard charger (two wires), chargers ACP-8 and ACP-12, cigarette charger LCH-8 and LCH-12 are supported.

Battery

RH-47 uses a detachable, semi-fixed lithium-Ion BL-6C battery. Nominal voltage is 3.7 V (max charging voltage 4.2 V).

The interface consists of three pins: VBAT, GND and BSI. Pull-down resistor inside the batteries (BSI signal) recognizes the battery types. Voltage level at BSI line is measured using UEM's AD-converter.

Back-up battery and real time clock

Real time clock (RTC), crystal oscillator and back-up battery circuitry reside in the UEM. A register in the UEM controls back-up battery charging. Charging is possible only in the POWER_ON state.

Baseband measurement A/D converter

The UEM contains 11 channels A/D converter, which is used for different baseband measurement purposes. The resolution of A/D converter is 10 bits. Converter uses the CBUS interface clock signal for the conversion. An interrupt is given to the MCU at the end of the measurements. The converter is used for following purposes.

- Battery voltage measurement A/D channel (Internal)
- Charger voltage measurement A/D channel (Internal)
- Charger current measurement A/D channel (Internal)
- Battery temperature measurement A/D channel (External)
- Battery size measurement A/D channel (External)
- LED temperature measurement A/D channel (External)

There is also auxiliary AD converter in the UEM, which is used to monitor RF functions.

ZOCUS

The ZOCUS device is a current sensor used for the battery bar display and for determining whether the phone is in a high current consuming mode. The ZOCUS device measures the voltage drop across a sense resistor in the battery voltage line. This sense resistor is formed from a PWB track and is on an internal layer of the PWB. The nominal value of the sense resistor is 3.3 mohm. ZOCUS reports the current measurement to UPP_WD2 via the Cbus interface.

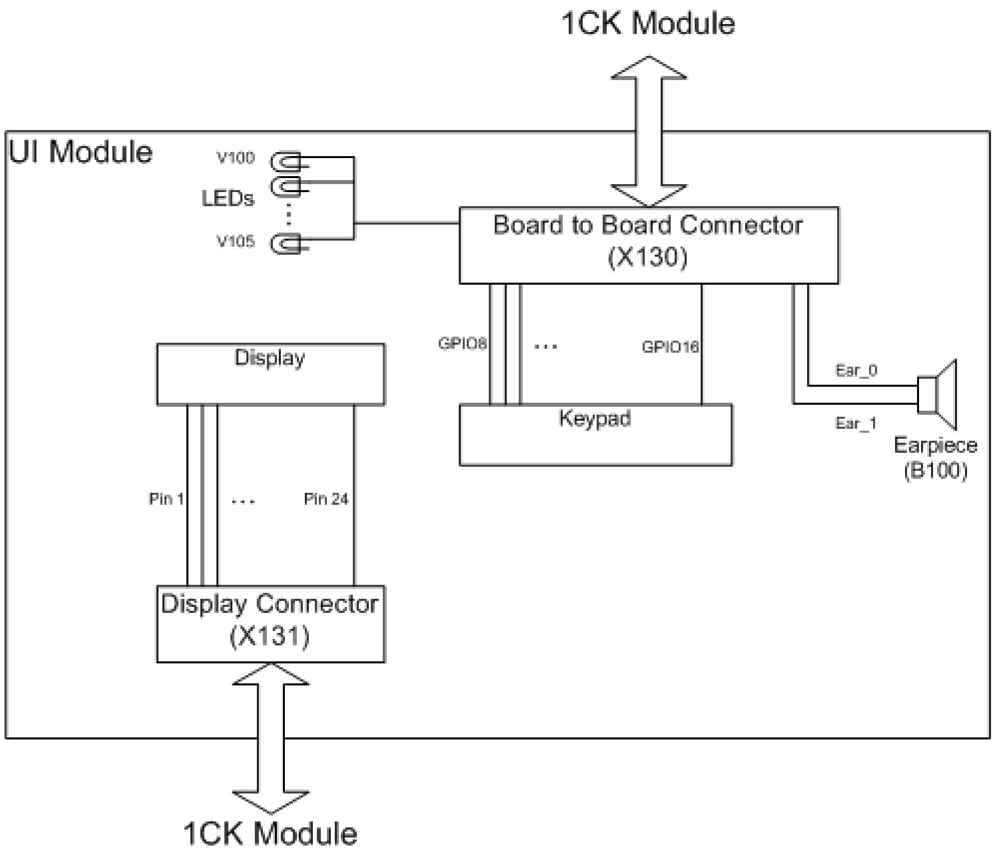
RH-47 BB Features & HW Interfaces

RH-47 BB user interface

UI module interface

The UI module consists of the LCD and keymat. Colour display resolution is 176 x 208 and backlighting is via 6 orange LED's with a lightguide. The display is connected to the 1CK module via an24-pin plug and socket. The keymat is connected to 1CK by 24-pin board-to-board connector. Interface also includes power rails for keypad backlight. The keymat interface uses GPIO pins of UPP_WD2.

Figure 3: UI module block diagram



Bluetooth

Bluetooth provides a fully digital link for communication between a master unit and one or more slave units. The system provides a radio link that offers a high degree of flexibility to support various applications and product scenarios. Data and control interface for a low power RF module is provided. Data rate is regulated between the master and the slave.

SIM interface

The SIM interface is located in two chips (UPP_WD2 and UEM). In UEM, there is only support for one SIM card. The interfaces support both 1.8 V and 3 V SIM cards. Adjustable SIM regulator (1.8V/3.0V) is located in the UEM.

The data communication between the card and the phone is asynchronous half duplex. The clock supplied to the card is 3.25 MHz. The data baud rate is SIM card clock frequency divided by 372 (by default), 64, 32 or 16.

MMC interface

The MMC interface consists of a block in UPP_WD2 plus a level shifting device and an EMC protection ASIP. The MMC interface comprises 3 lines -clock, data and command. The interface runs at 8.66 MHz. The level shifting device also incorporates a 2.85V regulator to power the MMC card.

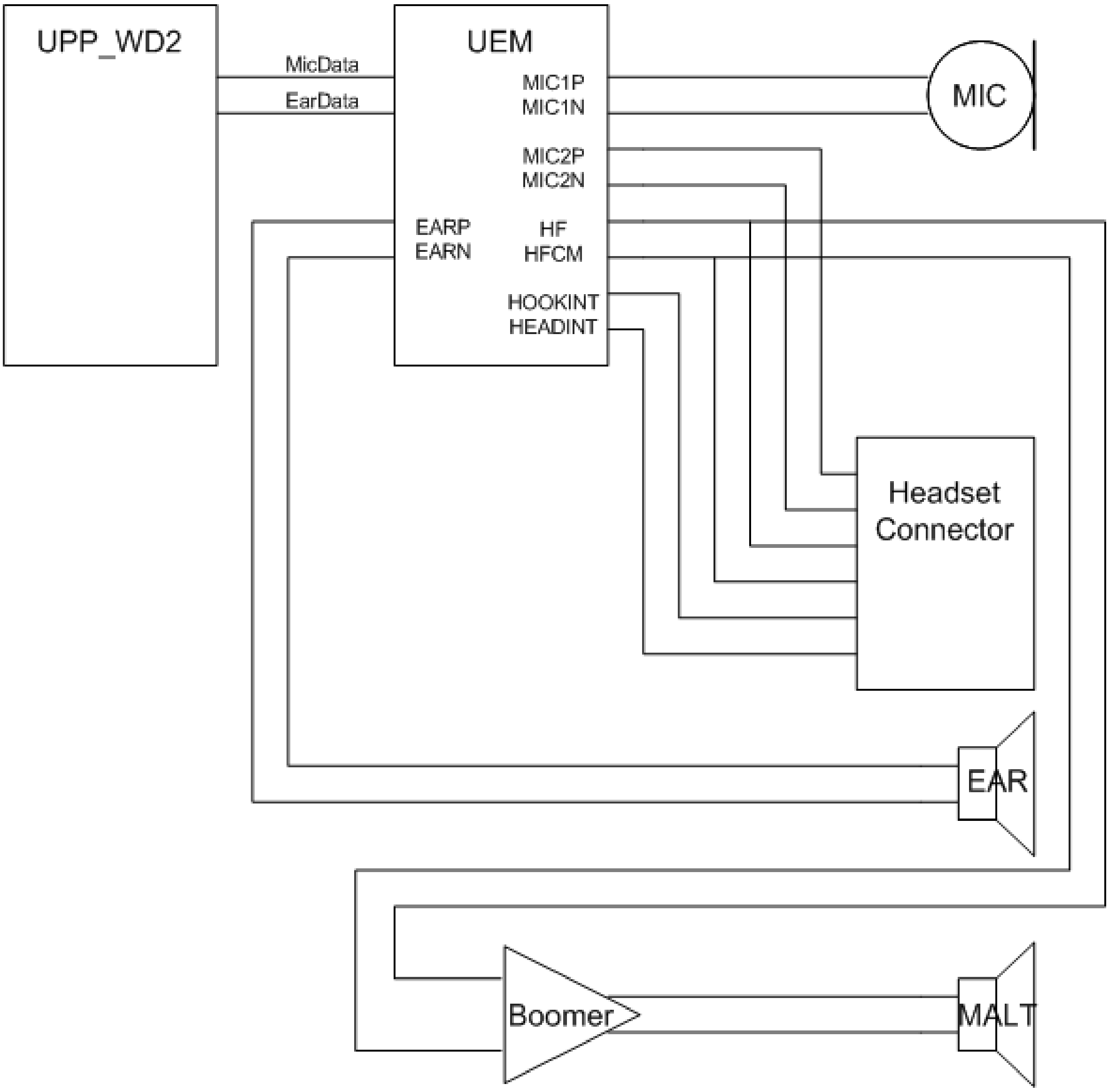
Use only multimedia cards (MMC) with this device. Other memory cards, such as Secure Digital (SD) cards, do not fit in the MMC card slot and are not compatible with this device.

Using an incompatible memory card may damage the memory card as well as device, and data stored on the incompatible card may be corrupted.

RH-47 audio concept

RH-47 audio includes earpiece, microphone, and headset connector and MALT speaker. Audio is based on ASIC's UPP_WD2, UEM and a discrete amplifier for the handsfree speaker.

Figure 4: RH-47 Audio Blocks



Between UPP_WD2 and UEM the audio signals are transferred in digital format using signals MICDATA and EARDATA. The headset output of UEM is also fed to boomer, that is, the MALT speaker and the headset share the same output lines from UEM. Ringing tones and warning/info tones are produced with the MALT speaker also.

Earpiece

The earpiece used in RH-47 is an 8-mm Pico earpiece. It has 32Ω continuous impedance and continuous power 8 mWatt. It is driven by differential signals from the UEM (EARP & EARN). It makes contact with the PWB via spring contacts.

Microphone

The microphone capsule for RH-47 is an EMC microphone. It has sensitivity of 42db nominal. Contacts are done by springs.

Two inputs are used from the UEM: one for the normal internal microphone and a second for the headset. The third microphone input is not used, so it is connected to ground via capacitors. Microphone bias block in the UEM generates bias voltages for handportable and handsfree/headset microphones. For both microphone bias outputs (MICB1 & MICB2), the minimum output voltage is 2.0 Volts and maximum output current is 600 µA. Microphone bias block also includes a low pass filter for the reference voltage used as an input for the MICB1&2 amplifiers.

Audio amplifier and MALT speaker

The speaker used in RH-47 is a 16mm 8Ω speaker. It can handle 0.2 Watts nominal power and peak power 0.3 Watts. The component is housed in the B-cover and connects to the PWB via spring contacts.

HF and HFCM lines of UEM are use to drive the amplifier.

Power amplifier is a differential opamp. The differential output drives the MALT speaker. The amplifier load impedance is 8 ohm.

The outputs go into a high impedance state when powered down. The amplifier can be enabled and shut down using a GENIO line from UPP_WD2.

SW controls IHF and earpiece volume via UEM. Gain setting can be done in 2 dB steps, from –40 to +6 dB. Output sound pressure level of the MALT speaker is controlled by SW (CBus is used for controlling).

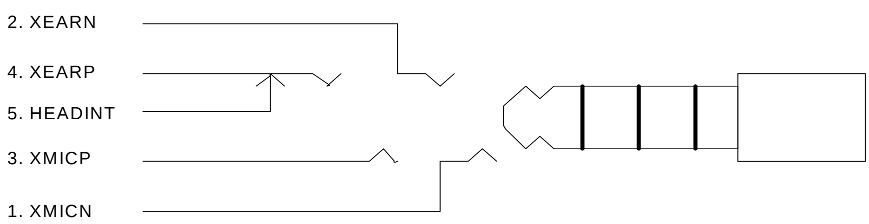
The schematic around the amplifier is presented in RH-47 schematics. The schematic shows all the filtering needed and also protection components against ESD and EMC.

The supply voltage for the amplifier is taken directly from the battery voltage.

External audio interface

In RH-47, there is headset connector which is a fully differential 4–wire connection.

Figure 5: External Audio Connector



The handsfree (HF) driver in the UEM is meant for a headset. In RH-47, the output is driven in fully differential mode. In the fully differential mode, the HF pin is the negative output and HFCM pin is the positive output. The gain of the handsfree driver in the differential mode is 6 dB. The earpiece (EARP, EARN) and headset (HF, HFCM) signals are multiplexed so that the outputs can not be used simultaneously. The HF and HFCM amplifiers include a transient suppression circuitry.

The plug opens a mechanical switch inside the connector between HF and HeadInt lines. The HeadInt line is pulled up to 2.7V by internal resistor when the switch is open. When the plug is not inserted, the voltage in the HeadInt line is <0.8 V caused by internal pull down resistor in the HF line.

Flashing

SW download in service is implemented by custom tools and SW, kindly refer to *Service Software Instructions* and *Service Tools* sections of the manual.

Testing interfaces

Testing interface electrical specifications

Pin	Name	Dir	Parameter	Min	Typ	Max	Unit	Notes
1	MBUS	<->	Vol	0	0.2	0.3*VFlash1	V	
			Vil (From Prommer)	0	0.2	0.3*VFlash1	V	
			Voh	0.7*VFlash1	2.7	0.7*VFlash1	V	
			Vih(From Prommer)	0.7*VFlash1	2.7	VFlash1	V	
2	FBusTx	->	Vol	0	2.7	0.3*VFlash1	V	
			Voh	0.7*VFlash1	2.7	VFlash1	V	
3	FBusRx	<-	Vil (From Prommer)	0	2.7	0.3*VFlash1	V	
			Vih(FromPrommer)	1.89	2.7	VFlash1	V	
			Abs. Max. Voltage to Test Pad Referenced to GND	-0.3V		3.0	V	Absolute Max Voltage limits to MBUS/ FBUS
4	VPP		To Phone	0 / 2.8 / 12 +/- 3%	V	Prommer Select	4	VPP
4	VPP		To Phone	0 / 2.8 / 12 +/- 3%	V	Prommer Select	4	VPP
5	GND				0		V	VBAT GROUND

**Note: VFlash1 is 2.78 +/- 3%*

Electrical Specifications for power supply interface in product testing

Pin	Name	Min	Typ	Max	Unit	Notes
1	VBAT	0	3.6	5.1	V	
2	BSI	0	2.78	VFlash1	V	Internal pullup
3	GND	0			V	

Note: VAna & VFlash1 = 2.78 +/-3%

Extreme voltages

Lithium-Ion battery BL-6C:

- Nominal voltage is 3.7V
- Lower extreme voltage is 2.8V (cut off voltage)
- Higher extreme voltage is 4.2V (charging high limit voltage)

Temperature conditions

Specifications are met within the range of –10C to +55C ambient temperature. Reduced operation between [-30] and [+60]. Storage temperature range is of –40C to +85C.

Humidity and water resistance

Relative humidity range is 5 ... 95%. Condensed or dripping water may cause intermittent malfunctions. Protection against dripping water have to be implemented in (enclosure) mechanics. Continuous dampness causes permanent damage to the module.

Introduction to RH-47 Baseband Troubleshooting

This document is a guide for localizing and repairing electrical faults in the RH-47 device. First there is a brief guide for fault localizing. Then fault repairing is divided into troubleshooting paths.

Before any service operation, you must be familiar with the RH-47 product and module level architecture. You have to be also familiar with the RH-47 specific service tools such as the Phoenix service software, flashing tools and software.

General guidelines for RH-47 troubleshooting

Tools needed for troubleshooting

- Service tools (as listed at service tools chapter in this service manual)
- Laboratory power supply with current indicator
- Oscilloscope
- Digital multimeter

General guidelines

If the device cannot be turned on by any means, see “dead device” troubleshooting.

Current consumption (missing consumption) gives an idea whether the device is able to start up.

Dropping supply voltage or very large current consumption indicates a short circuit.

Check whether the connection with Phoenix works and what can be discovered with Phoenix (ADC-readings, baseband self-test, BB-calibrations etc.).

If “CONTACT SERVICE” is shown on the display, check baseband self-tests with Phoenix.

Check visually display and rocker faults.

Force phone to LOCAL mode and make keyboard test with phoenix.

Check that the board-to-board connector is OK, and connectors make good contacts.

If there is a liquid damage, stop repairing!

If the fault is not obvious and Phoenix connection is OK, flash the phone before disassembling.

Disassemble phone: try to locate failed module.

When located, check the failed module visually:

- Mechanical damages?
- Solder joints OK?

Continue with specific troubleshooting procedure for the module:

- If there is an obvious fault, repair it before reflashing the device.
- Flash first if a fault is not obvious.
- If flashing is not working go to flashing troubleshooting.

Due to CSP packages, short circuits or broken solder joints are not easily seen. If the examined signal seems to be continuously low or high level, then measure for possible short circuit to ground (signal low) or to supply voltage (signal high). Note that if a problem is not found from any visible contact/component, it can be under CSPs where the signal is connected.

Care must be taken when assembling and disassembling the transceiver. Failure to do this may result in unnecessary damage to the device.

Nominal current consumption

NOTE: service tools need some amount of current to work.

The following current consumption values are measured from a complete RH-47.

Vbatt = 3.6V

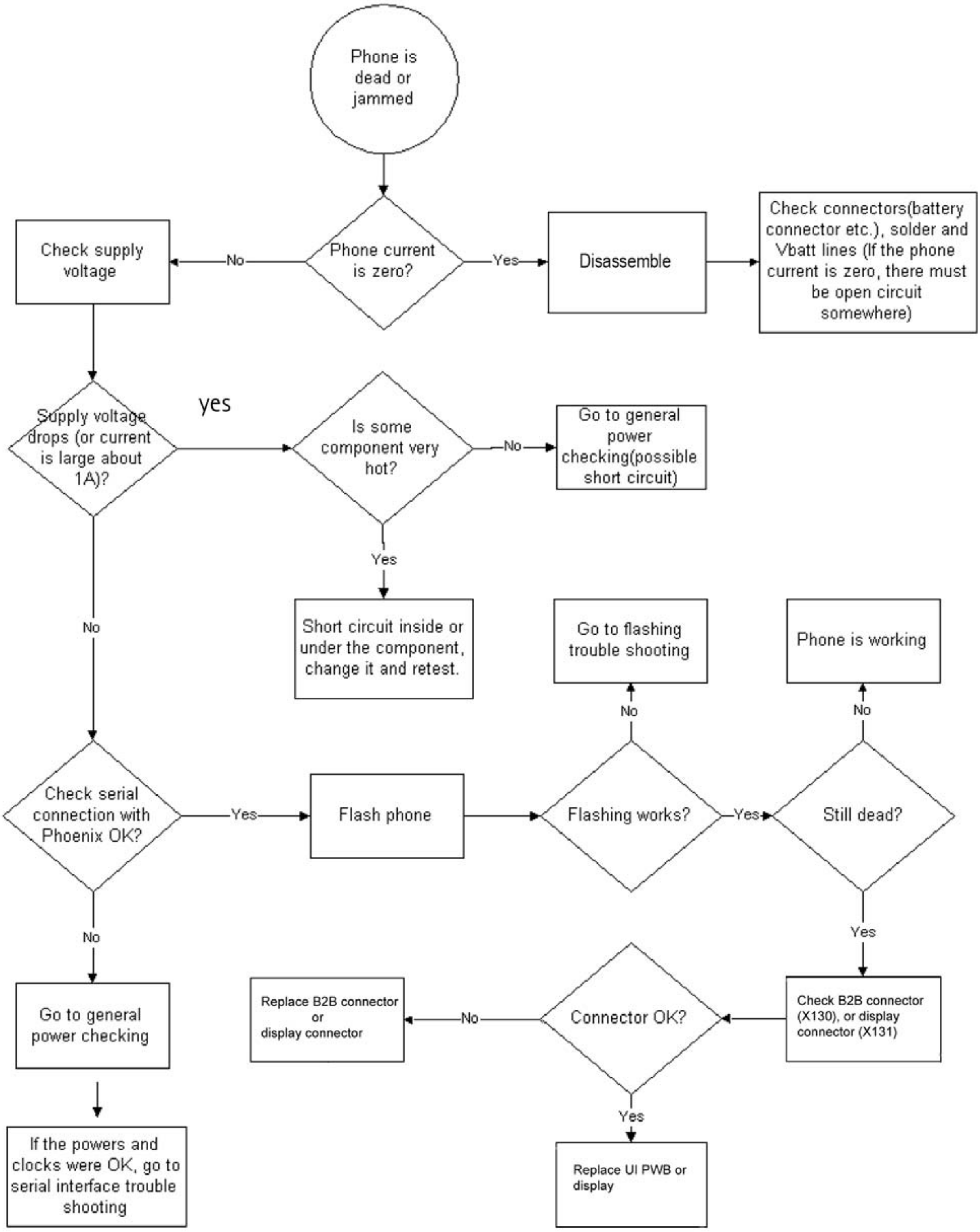
Measured nominal currents are drawn from the main battery.

Measurements have been made with a current probe connected to an oscilloscope.

Operating mode	Current consumption
Idle	4.5-5mA
Local	50-55mA
Normal (display and keyb.LEDs on)	100-130mA
2W audio call	290mA

Troubleshooting Paths

Dead or jammed device



Partially damaged device

If the device is working, but some functionality is missing, try to localize where the problems is and see relevant part of this manual. For example, if audio is not working, see "Audio Troubleshooting", if charging is not working see "Charging troubleshooting".

Most common symptoms reported by customer

This chapter describes the most common symptoms reported by customers when the device is brought in for service. Some tips where the trouble can be found are also given. When troubleshooting, use these tips and follow the given troubleshooting path.

Most common symptoms for audio problems

"Earpiece sound is missing"
"Handsfree sound is missing"
"Headset is not recognized"
"Microphone is not working"
"Volume cannot be adjusted"
"Ringing tones does not work"
"Audio volume too low"

See audio troubleshooting.

Most common symptoms for Bluetooth problems

"Bluetooth does not work or connection cannot be established"

Follow the Bluetooth troubleshooting guide lines gave relevant chapters.

Symptoms related to energy management

"Phone does not stay on"
"Charging is not working"
"Time is lost during battery change"
"Charging takes too long"
"Operating time is very short"

See relevant part of energy management troubleshooting

Problems related to UI module:

"UI-module keypad is not working"
"Rocker is not working"
"Backlight is dim"
"Backlight not even"
"Backlight is blinking"
"Keypad or display backlight is not working"
"Display related problems"

See UI module troubleshooting.

Most common RF related symptoms:

"Call cannot be made"
"Phone does not find signal"
"Call is often dropped"
See RF troubleshooting

ASIC is changed

ASIC's can be changed only at a defined service level.

Exchanged Component	IMEI re-writing	EM calibration	RF tuning
D190 - UEM	YES	NO	NO
D311 - Flash 1	YES	YES	YES
D312 - Flash 2	NO	NO	NO
D310 - SDRAM	NO	NO	NO
D100 - UPP	NO	NO	NO
N430 - BT MCM	NO	NO	NO

Test points

Test Point	Signal	Test point	Signal	Test point	Signal
J109	UEMInt	J204	AUXD	J476	SIMRST (SIM reader)
J170	RFCLK_I	J206	SLEEPX	J477	VSIM
J190	EARDATA	J260	VDD VCORE regulator	J487	MMCDATA
J191	MICDATA	J311	FLASH CE (D311)	J488	MMCGND
J192	SIMIODAI	J312	FLASH CE (D312)	J490	MMCCLK
J193	SIMCLKI	J334	Shutdown Audio PA	J492	VMMC
J194	SIMIOCTRL	J390	Current sense resistor	J493	MMCGND
J195	MBUSTX	J391	Current sense resistor	J495	MMCCMD
J196	MBUSRX	J392	Current sense resistor	J497	MMCGND
J197	FBUSTXI	J393	Current sense resistor		
J198	FBUSRXI	J470	SIMGND		
J199	RFCONVCLK	J471	SIMDATA (EMIF)		
J200	RXID	J472	SIMCLK (EMIF)		
J201	RXQD	J473	SIMRST (EMIF)		
J202	TXID	J474	SIMDATA (SIM reader)		
J203	TXQD	J475	SIMCLK (SIM reader)		

Note! For test point locations, see Appendix A.

"CONTACT SERVICE" on display

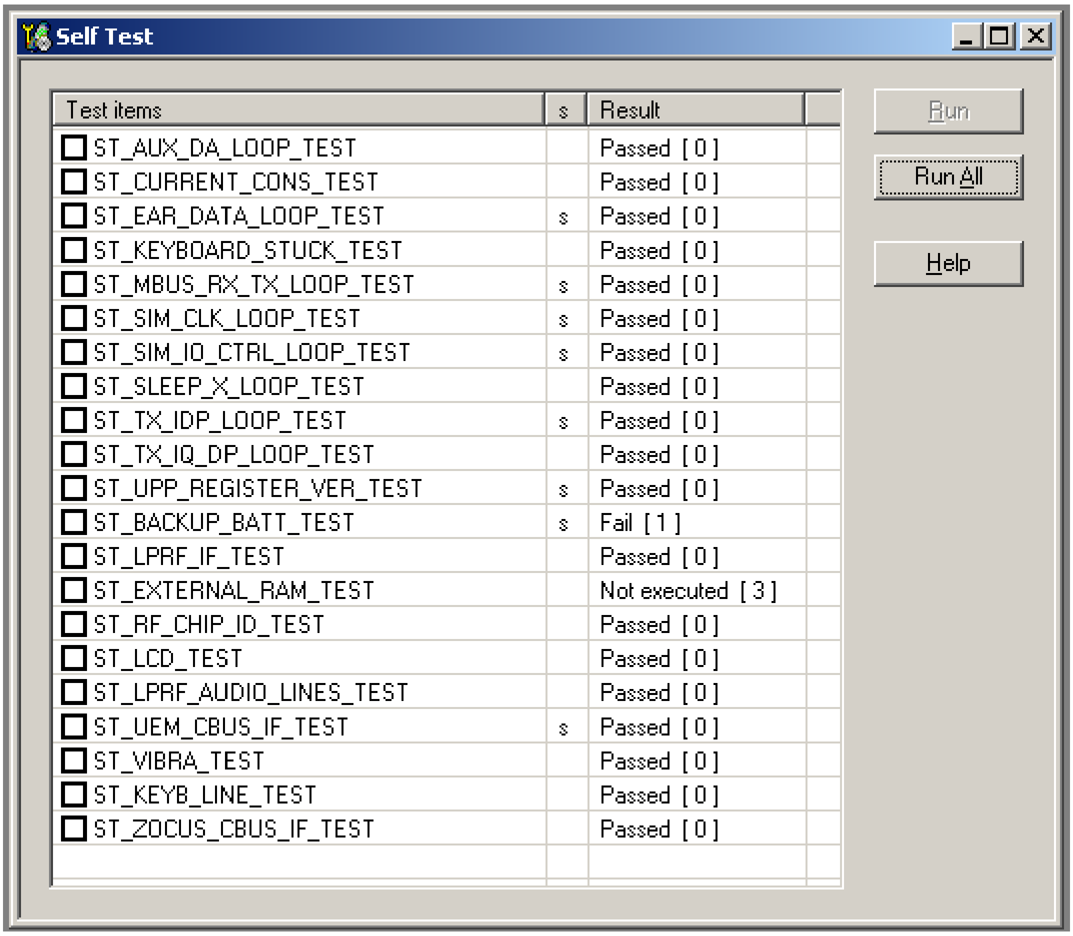
CONTACT SERVICE on display (self-tests by Phoenix)

Display information: **"Contact Service"**

This fault means that software is able to run and thus the watchdog of UEM can be served.

Self-test functions are executed when the phone is powered on and if one or more self-test functions fail, the message "Contact Service" is shown on the display.

MCU self-test cases can be split into two categories: The ones that are executed during power up and the ones that are executed only with a PC connected. These test and items included are as follows:

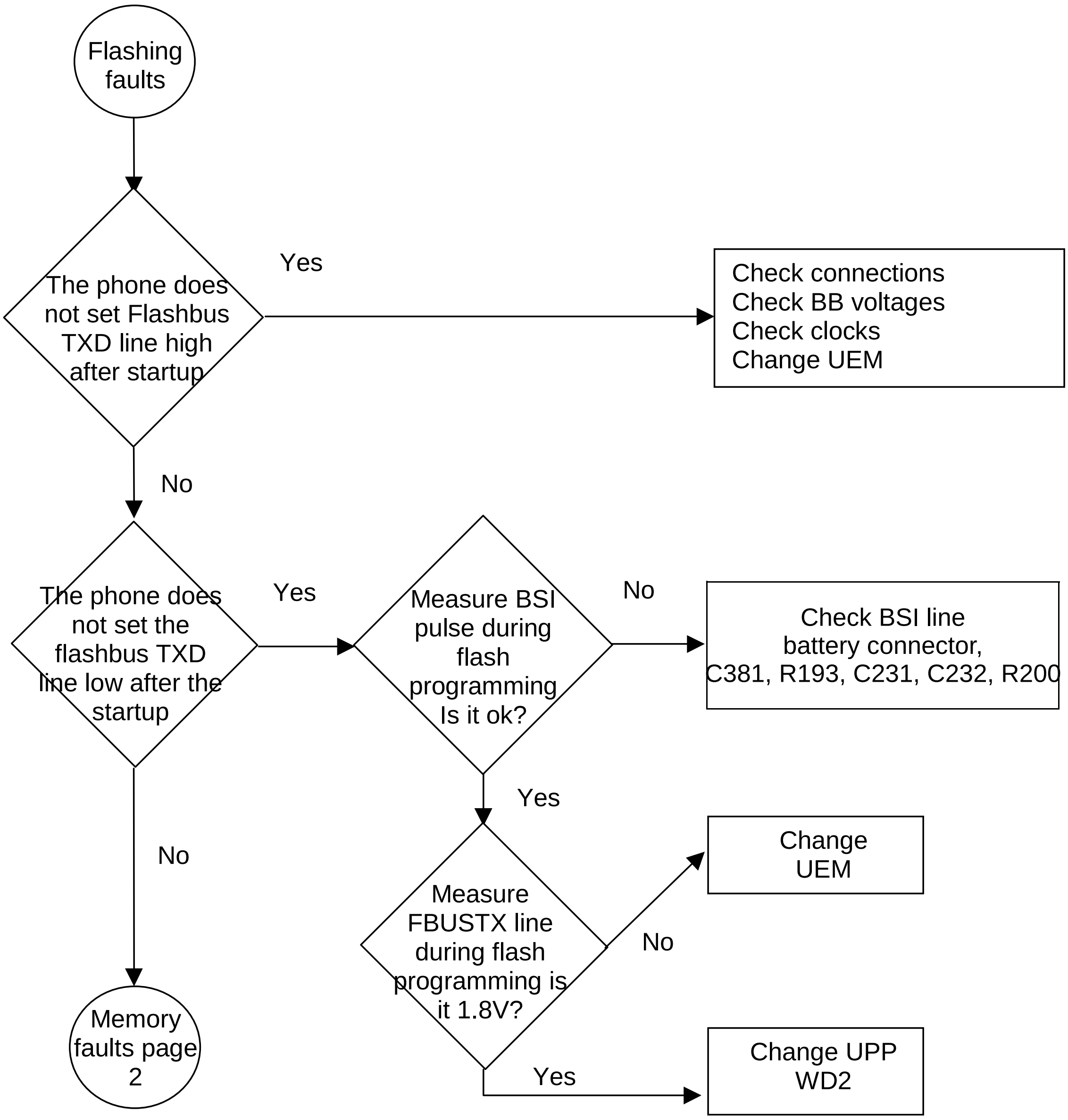


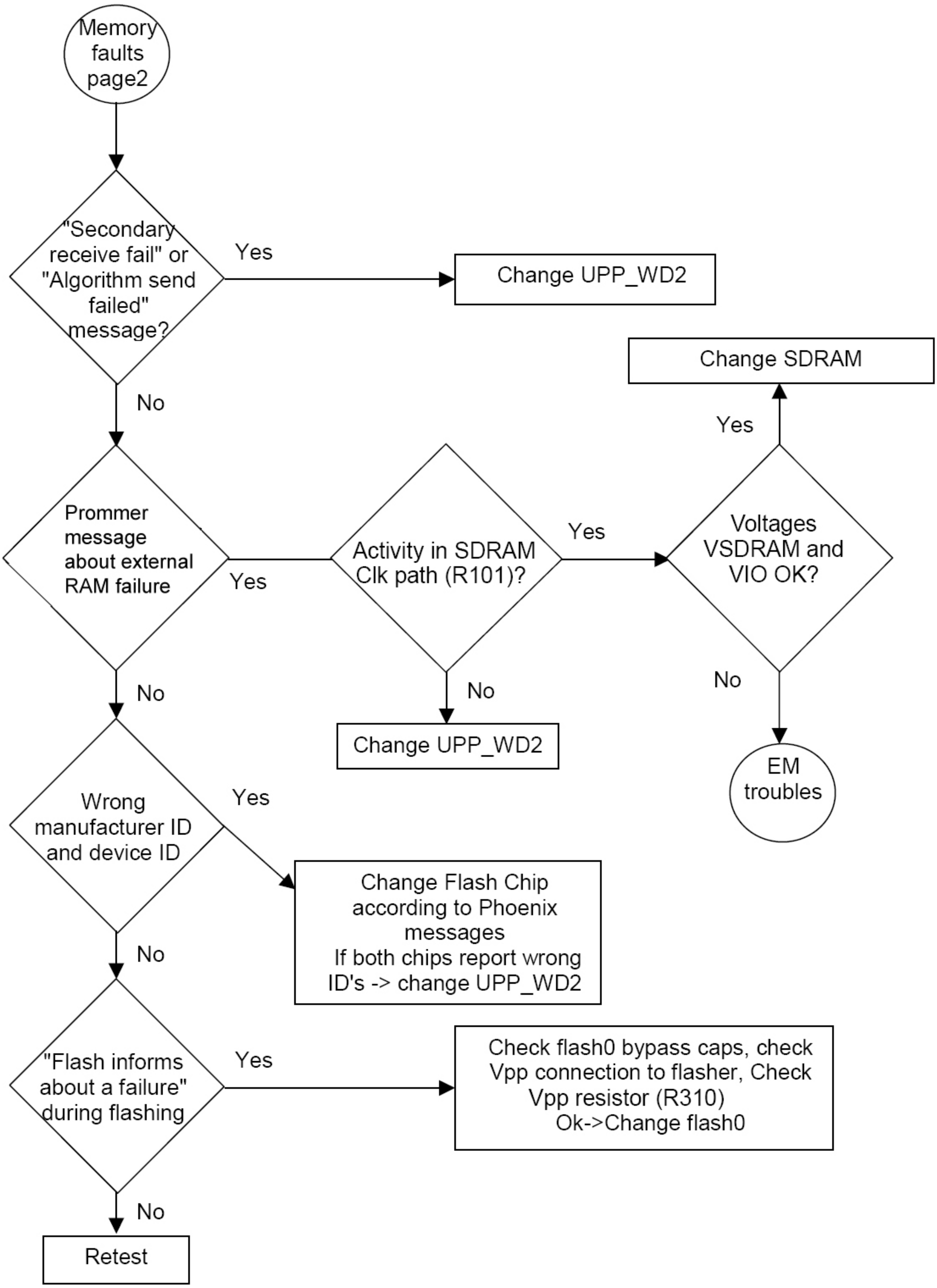
If some of the self-tests failed, see relevant chapter in this troubleshooting document.

1CK Baseband HW Subarea Troubleshooting

Flashing troubleshooting

RH-47 has two memory components installed on the main PWB. The best indication of which one is causing problems can be obtained by flashing the device. It has to be kept in mind that the two flashes are interfaced with UPP WD2 ASIC that might itself have some problems. The necessary steps are described below. Phoenix error messages during flashing greatly help on defining what is wrong. To be able to flash the device, most device BB area components must function properly.




Memory faults page2
"Secondary receive fail" or "Algorithm send failed" message?
Yes
Change UPP_WD2
No
Prommer message about external RAM failure
Yes
Activity in SDRAM Clk path (R101)?
Yes
Voltages VSDRAM and VIO OK?
Yes
Change SDRAM
No
EM troubles
No
Change UPP_WD2
No
Wrong manufacturer ID and device ID
Yes
Change Flash Chip according to Phoenix messages
If both chips report wrong ID's -> change UPP_WD2
No
"Flash informs about a failure" during flashing
Yes
Check flash0 bypass caps, check Vpp connection to flasher, Check Vpp resistor (R310)
Ok->Change flash0
No
Retest

Energy management troubleshooting

Device does not stay on

If the device is switched off without any visible reason, there may be problems in the following areas:

- UEM watchdog problem (WD is not updated by SW)
- BSI line problem (BSI line is floating => contact failure)
- Battery line problem
- Soldering problem

The most likely reason is UEM WD (watchdog), which turns the device off after about 32 seconds if SW is jammed.

This may caused by SW problem, UPP_WD2 problem (Not server by SW), UEM or memory malfunctions.

The following tests are recommended:

- General power checking
- Clocks
- Memory testing
- Serial Interface

If there is something wrong in the BSI line, the device seems to be dead after the power key is pressed. However, the regulators of the device are on a few seconds before the power down.

This mode can easily be detected from the current consumption of the device. After a few seconds the current consumption drops almost to 0 mA.

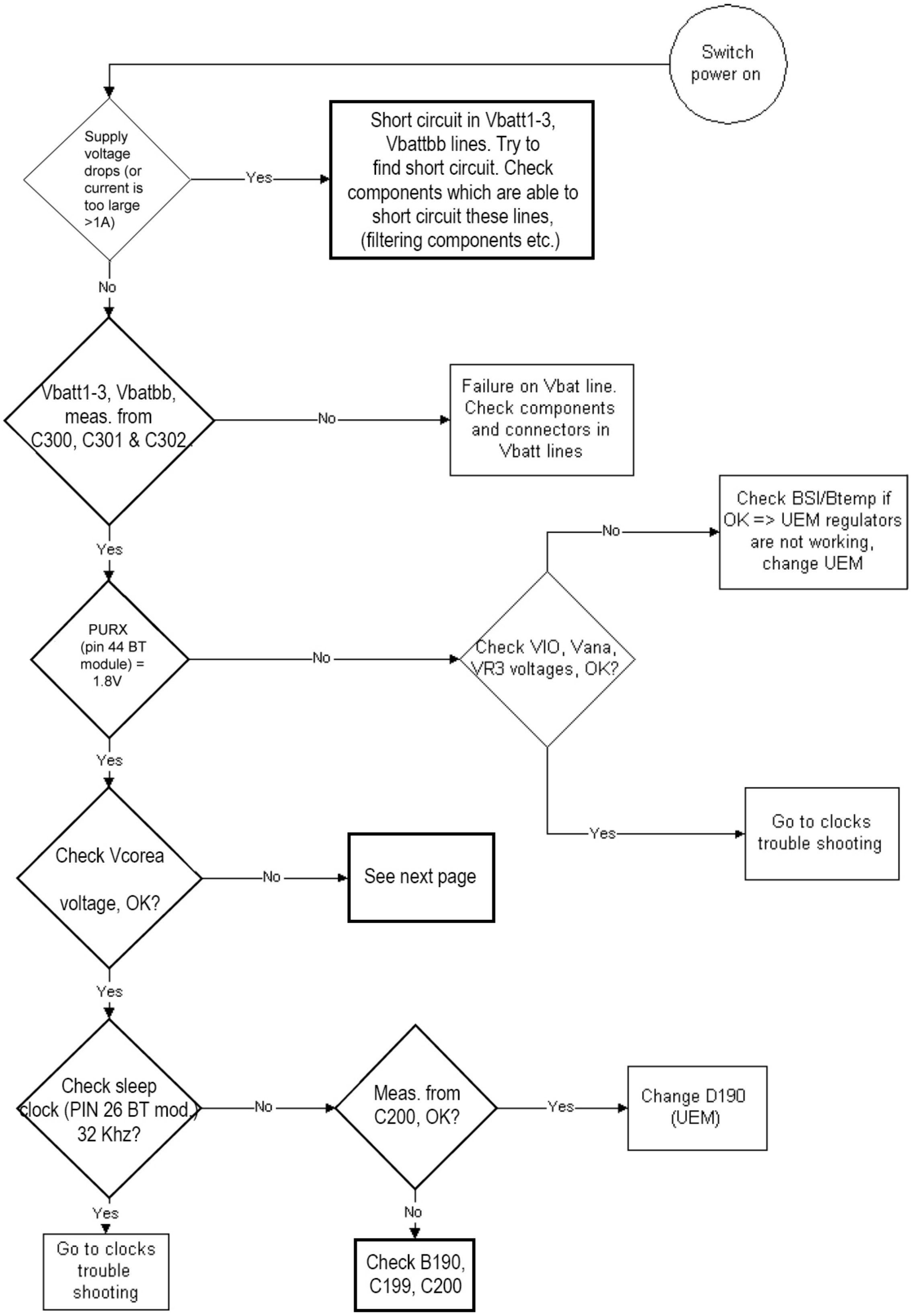
In this case, check component or soldering:

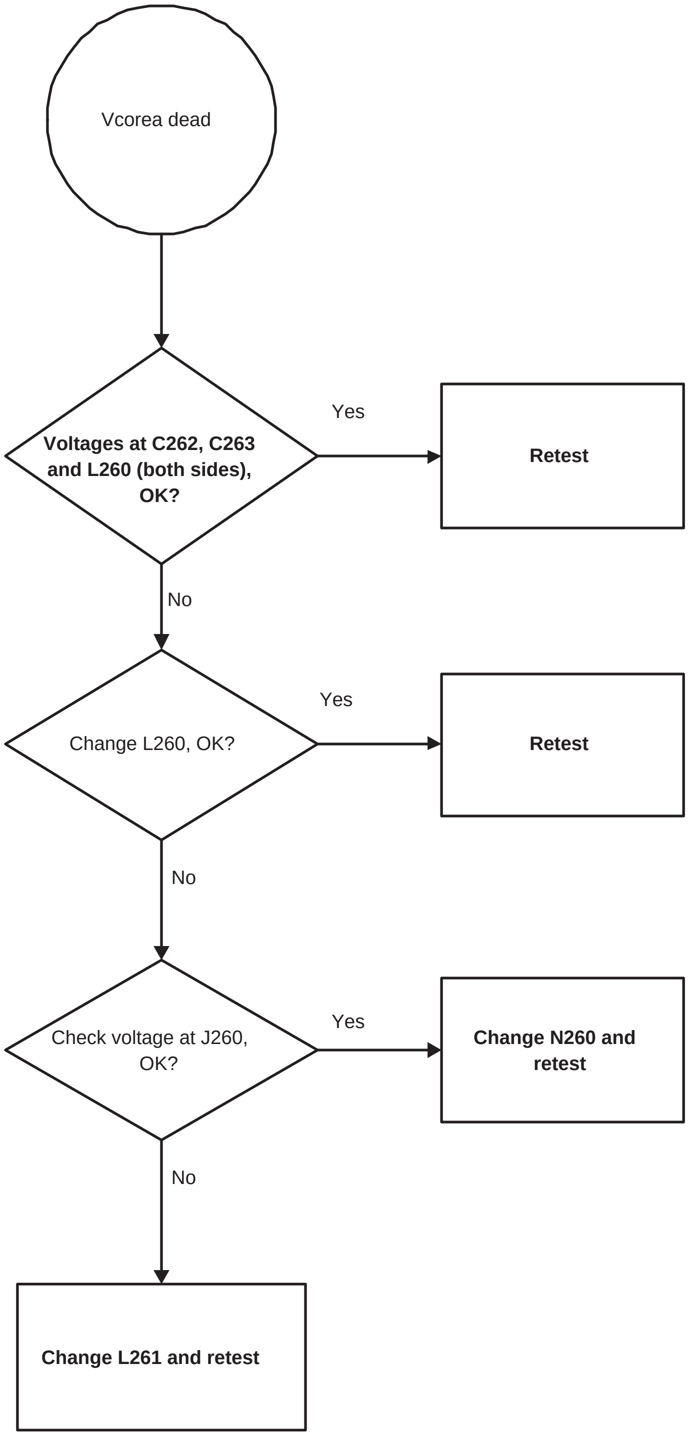
- Battery connector X382
  EMI-filter R381
  UEM D190 (pin number C2)

If phone boots to TEST or LOCAL mode with normal battery, BSI is short circuited to ground. Check EMI-filter and filtering capacitors, which are located in the BSI.

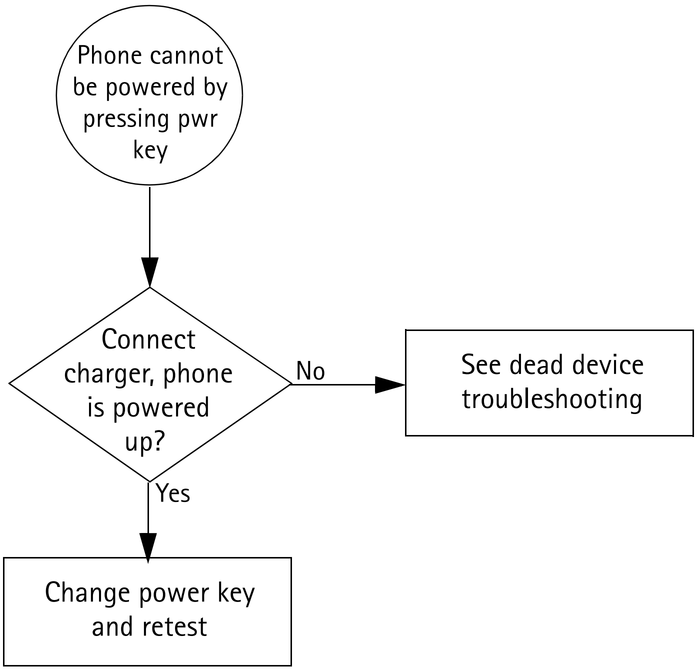
General power checking

Use service tool SF-20. Battery voltage should be at least 3.6V. After phone disassembly, use module jig MJ-21.




Vcorea dead
Voltages at C262, C263 and L260 (both sides), OK?
Yes
Retest
No
Change L260, OK?
Yes
Retest
No
Check voltage at J260, OK?
Yes
Change N260 and retest
No
Change L261 and retest

Power key troubleshooting

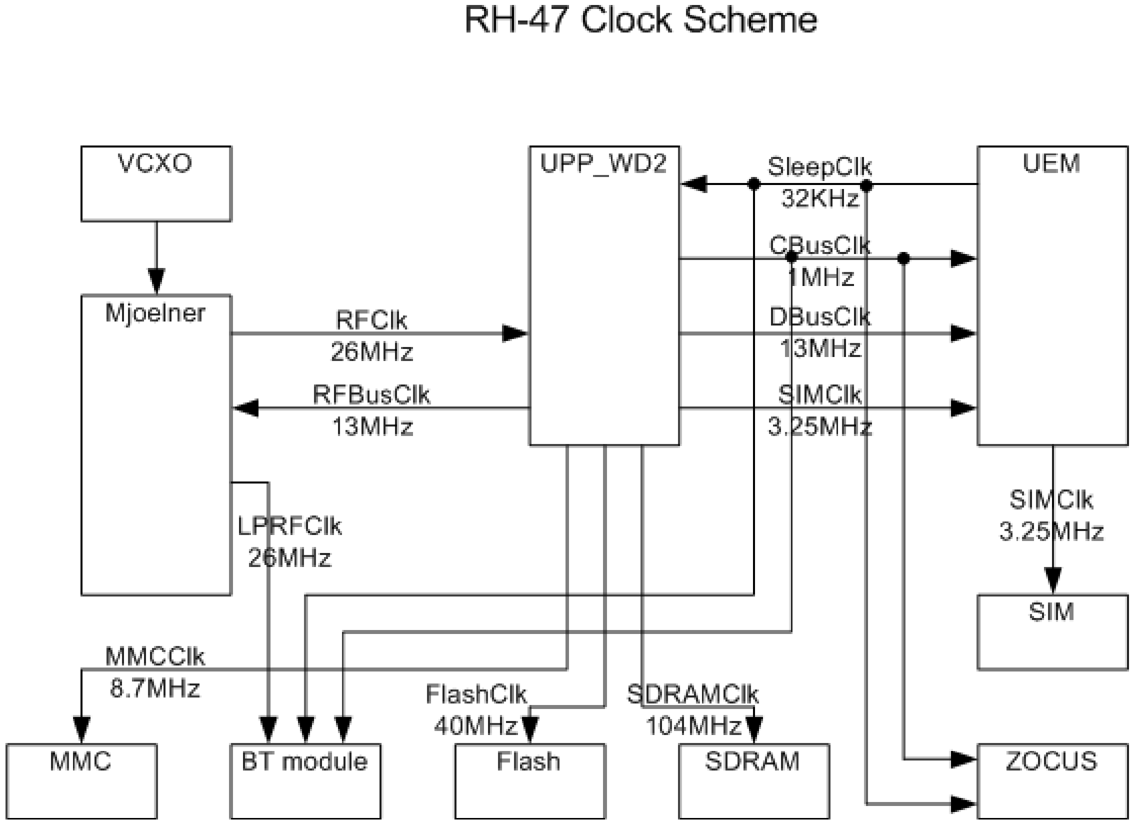


Clocks troubleshooting

Clocks include the following:

- RF-clock
- DBUS, CBUS clocks
- Flash and SDRAM clocks
- Sleep clock
- Bluetooth clock
- SIM clock
- MMC clock

The main clock signal for the baseband is generated from the voltage controlled by crystal oscillator VCXO. This 26 MHz triangle wave clock signal is supplied to OSC_IN pin of Mjoelner and out to UPPWD2. Inside UPPWD2 the clock frequency is divided into 13 MHz and then fed to RFBusClk.



In SLEEP mode the VCXO is off. UEM generates low frequency clock signal (32.768 kHz) that is fed to UPP_WD2, Bluetooth and ZOCUS.

When the flashing of the device does not succeed, but powering is OK, follow these instructions.

Note: The absence of clocks may indicate that the device (put phone to LOCAL mode when the sleep is not allowed or press buttons so that phone is not in sleep mode) is in sleep mode. Make sure that the device is not in sleep during clocks measuring.

IMPORTANT: Clock signals have to be measured with 1MΩ (or greater) probes!

Measure signal from J170. This should be 26Mhz clock signal. See Figure 2, “RFClk” on the next page. For more information, see RF Troubleshooting.

Check that the crystal oscillator (B190) is oscillating at 32.768kHz frequency. If not, change B190. If OK, measure sleepclk from PIN 26 BT module. Frequency should be the same 32.678kHz (see Figure 6, “Sleep clock,” on page 34 below.) If not, change UEM.

Figure 6: Sleep clock

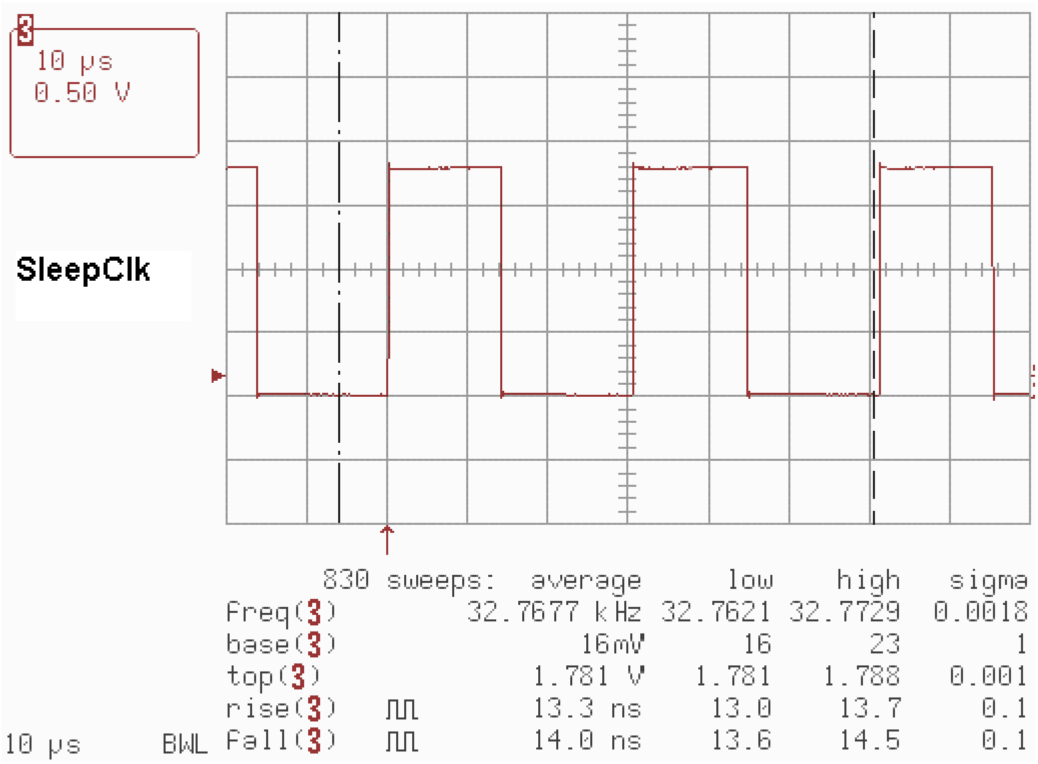
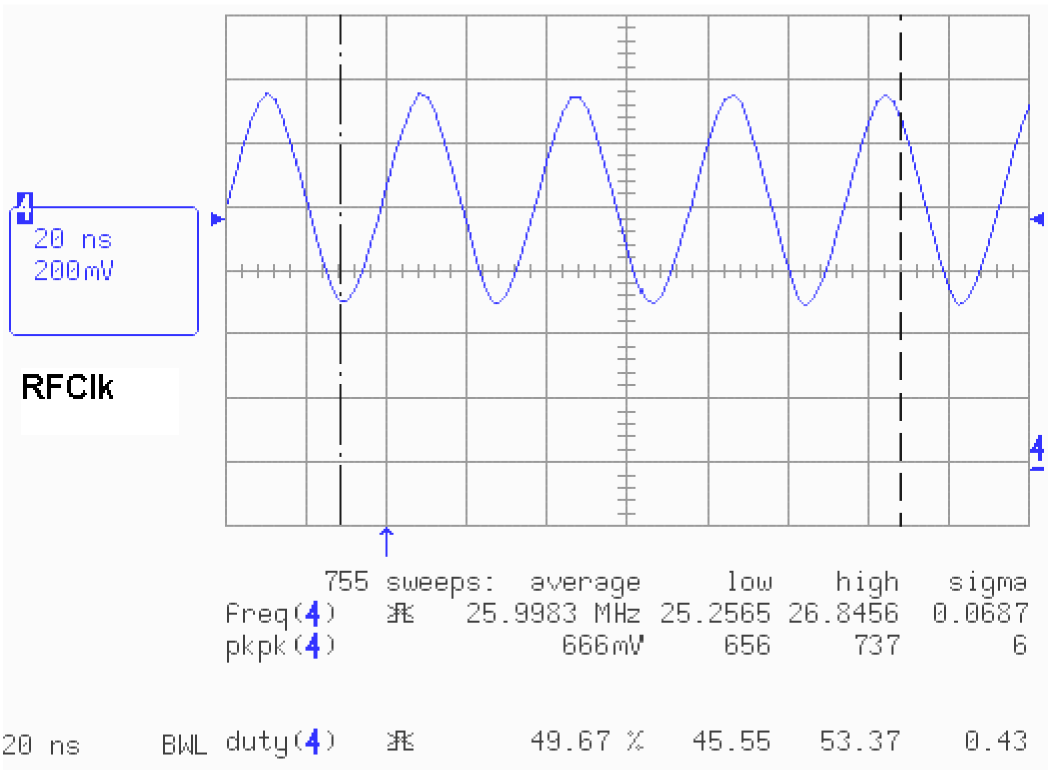


Figure 7: RFClk



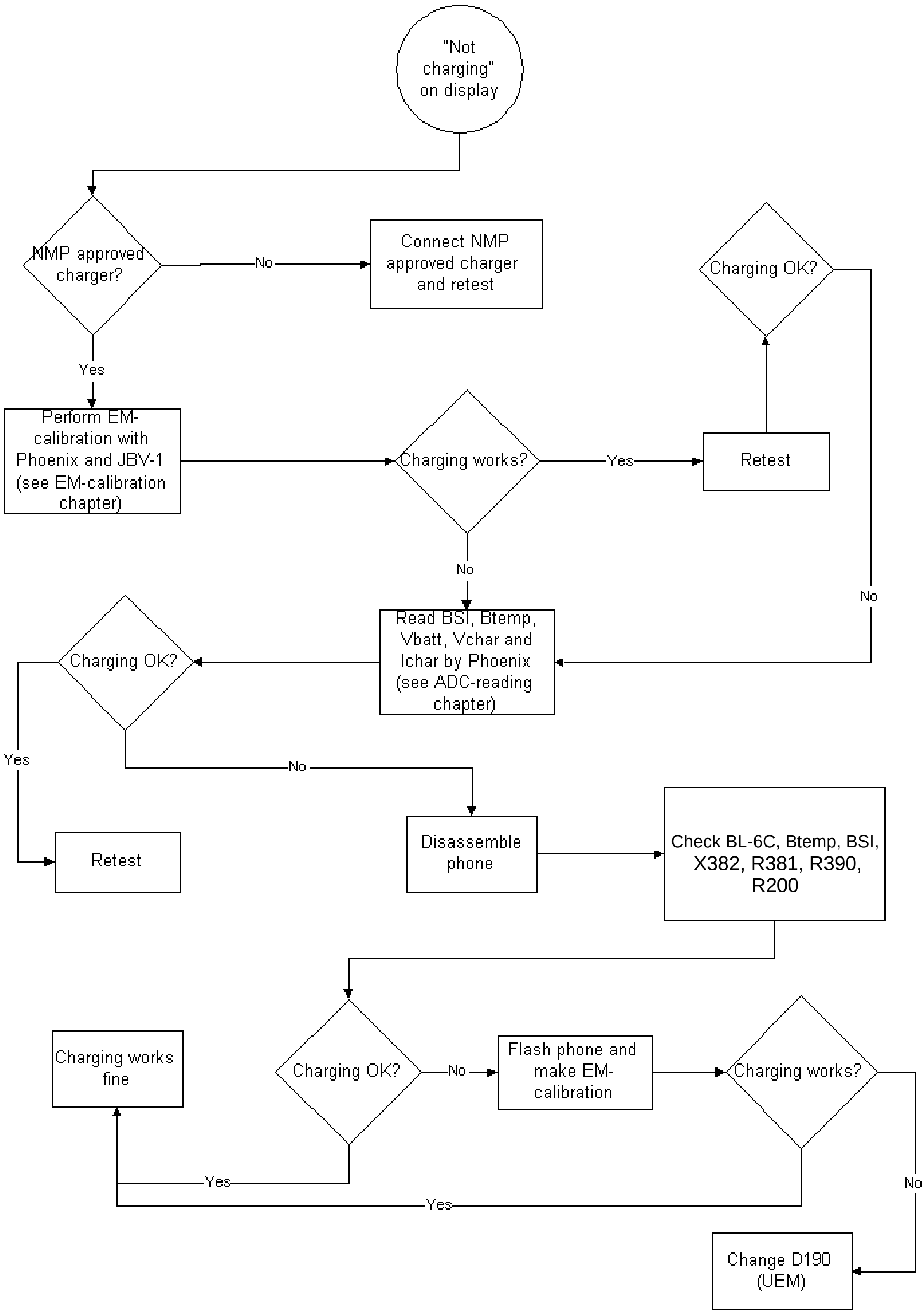
Charging checking

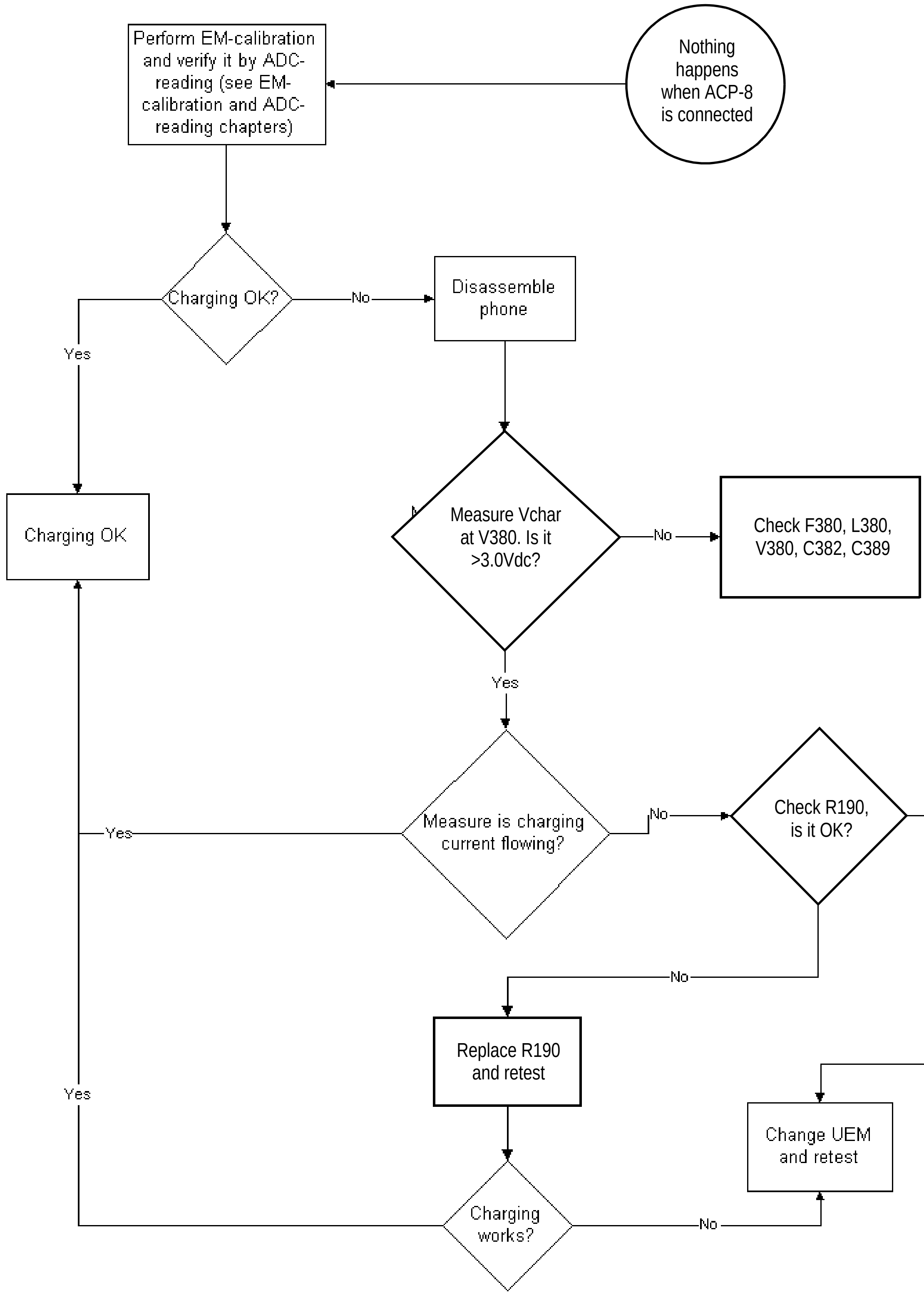
Use the BL6-C battery and JBV-1 calibration set to test charging. (NOTE: power supply cannot be charged if it not has a current sinking capability.) When you are charging a totally empty battery, remember that start-up charging might take a bit longer than normally. During this time the display is blank.

If charger is not of NMP approved type and its current and voltage are not within NMP charger window, software does not start charging and there is "NOT CHARGING" on the display. Voltage should be between 5.3V - 9.5V and current between 200mA – 900mA

Remove and reconnect battery and charger a few times before you start to measure the device. This check ensures that the fault really exists (refer to "Charging troubleshooting").

Figure 8: Charging troubleshooting




Perform EM-calibration and verify it by ADC-reading (see EM-calibration and ADC-reading chapters)
Nothing happens when ACP-8 is connected
Charging OK?
No
Disassemble phone
Yes
Charging OK
Measure Vchar at V380. Is it >3.0Vdc?
No
Check F380, L380, V380, C382, C389
Yes
Measure is charging current flowing?
Yes
No
Check R190, is it OK?
No
Yes
Replace R190 and retest
Yes
Change UEM and retest
Charging works?
No

Energy management calibration

During energy management calibration, A/D-converter, BSI, Btemp, battery voltage, charger voltage and charger current are calibrated.

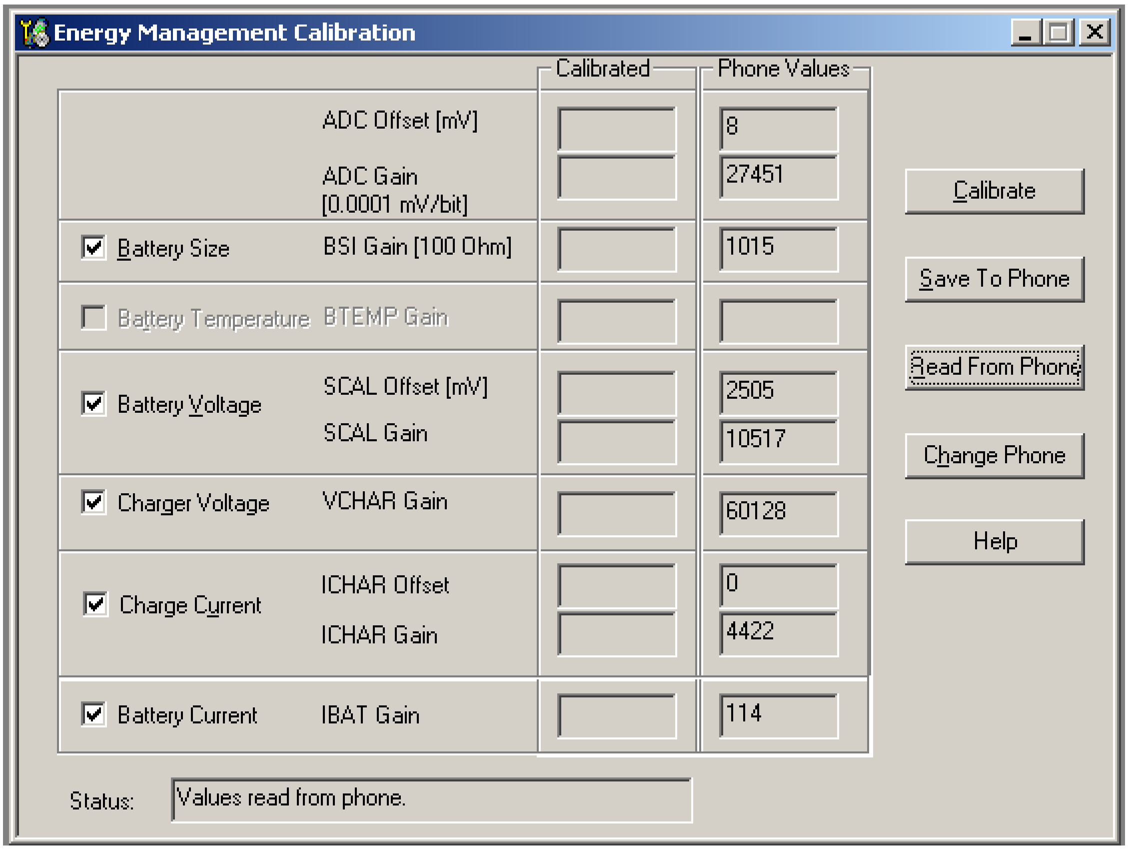


Table 1: Limits for calculated calibration

Channel	Low	High
ADC Offset	-50	50
ADC Gain	26000	29500
BSI Gain	860	1180
Vbatt Offset	2400	2600
Vbatt Gain	10000	11000
Vchar	57000	63000
Ichar	3600	5000

ADC-offset over limits:
Inspect the BSI line and components (R381, R200, pull-up resistor R193). If these are OK, change UEM.

BSI Gain over limits:
Inspect the BSI line and components (R381, R200, pull-up resistor R193). If these are OK, change UEM.

Vbatt offset and Gain:
Inspect Vbatt lines and component in it.

Vchar over limits:
Inspect components which are connected to Vchar line: F380, L380 and V380.

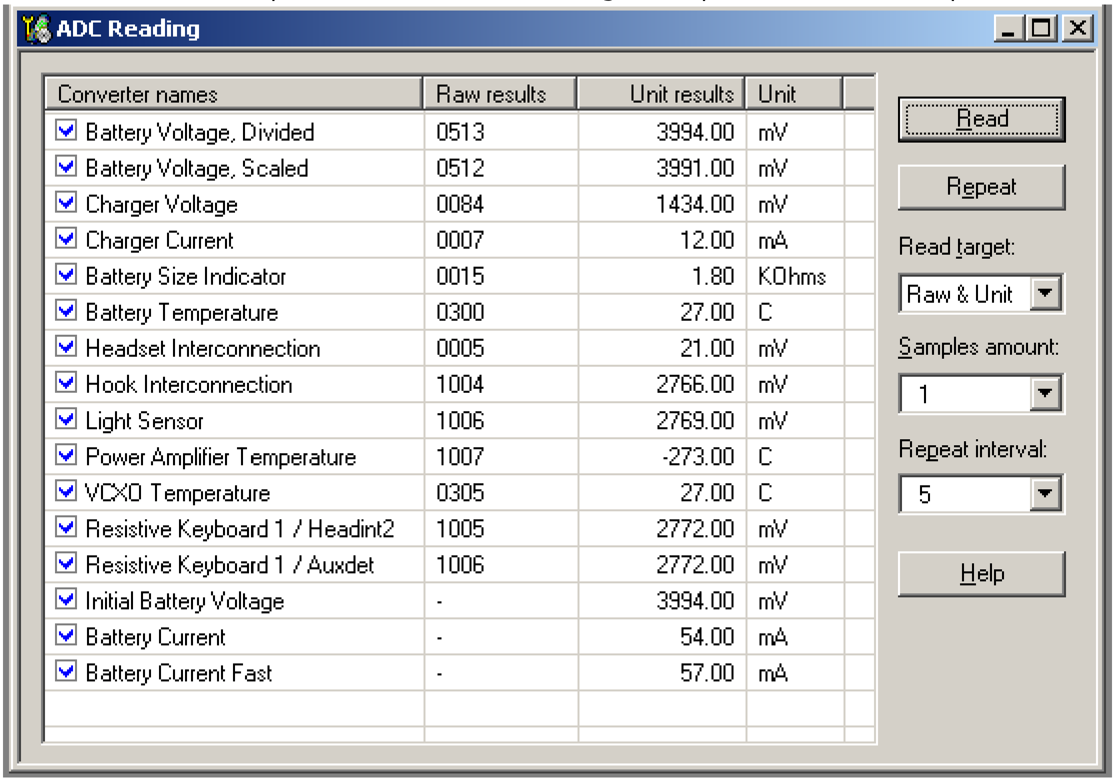
Ichar over limits:
Inspect components which are connected to Vchar line. If those are OK, first change current sense resistor (R190). If calibration is still not successful, change UEM.

Calibration can be checked by using ADC-readings. Known voltages, currents and resistances are fed and read by ADC-readings, read values and known values can be compared.

ADC-reading

Divided and Scaled Battery Voltage, Charger Voltage, Charger Current, BSI and Btemp values can be read by this tool. Read values a few times before you can be sure that the results are accurate.

NOTE: If Vbatt Scaled and Divided unit results are different, default calibration values are used. In this case perform EM calibration to get full performance of the phone.



Backup battery

A symptom of a backup battery fault is that the real time clock loses the correct time during short main battery removal.

The same symptom can also be seen when the backup battery is empty. About 5 hours is needed to fully charge the backup battery in the device. NOTE: Backup battery is charged only at the same time with main battery charging or when the device is in LOCAL or TEST mode.

Always check the backup battery visually for any leakage or any other visual defect.

Check that the backup battery is correctly mounted in the device before closing the cover.

Check with Phoenix that backup battery is OK.

Measure the voltage of backup battery:

- Normal operation when the voltage is > 2.0V
- Fully charged when the voltage is about 3.2V (because of large internal impedance voltage will not stay above 3.0V a long time after charging is disabled)

Enable backup battery charging (start to charge main battery or boot device to LOCAL or TEST mode).

Measure voltage of backup battery during charging. It should arise, if it is not 3.2V, yet.

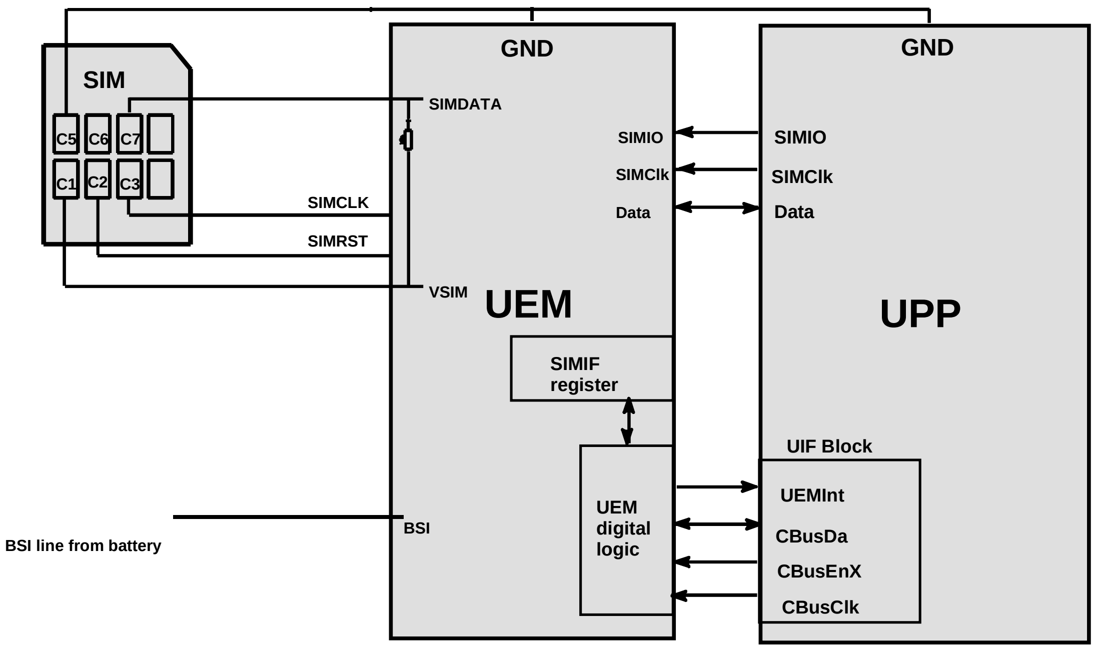
When the voltage is over 2.0V for sure, check backup battery with Phoenix.
-> If not OK, then D190 is faulty.

Ensure that the RTC is running.

SIM card

The whole SIM interface is located in two chips UPP_WD2 and UEM. UEM contains the SIM interface logic level shifting. UPP provides SIMClk through UEM to the SIM. SIM interface supports both 3 V and 1.8 V SIMs.

UPP & UEM SIM connections



The SIM power up/down sequence is generated in the UEM. This means that the UEM generates the RST signal to the SIM. Also the SIMCardDet signal is connected to the UEM. The card detection is taken from the BSI signal, which detects the removal of the battery. The monitoring of the BSI signal is done by a comparator inside the UEM. The threshold voltage is calculated from the battery size specifications.

The SIM interface is powered up when the SIMCardDet signal indicates "card in". This signal is derived from the BSI signal. SW tries first to power up the SIM with 1.8 V. If this does not succeed, power up is repeated with VSIM switched to 3 V.

The data communication between the card and the phone is asynchronous half duplex. The clock supplied to the card is in GSM system 1.083 MHz or 3.25 MHz. The data baudrate is SIM card clock frequency divided by 372 (by default), 64, 32 or 16.

Figure 9: SIM power-up sequence

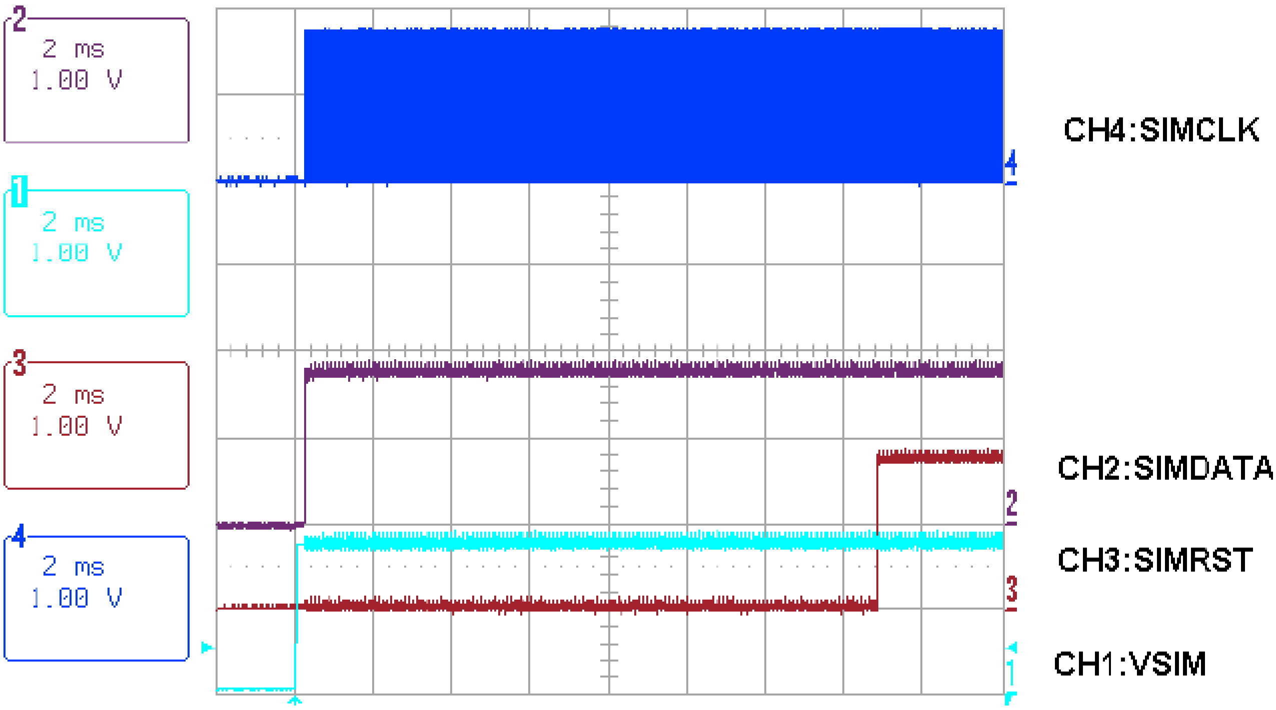
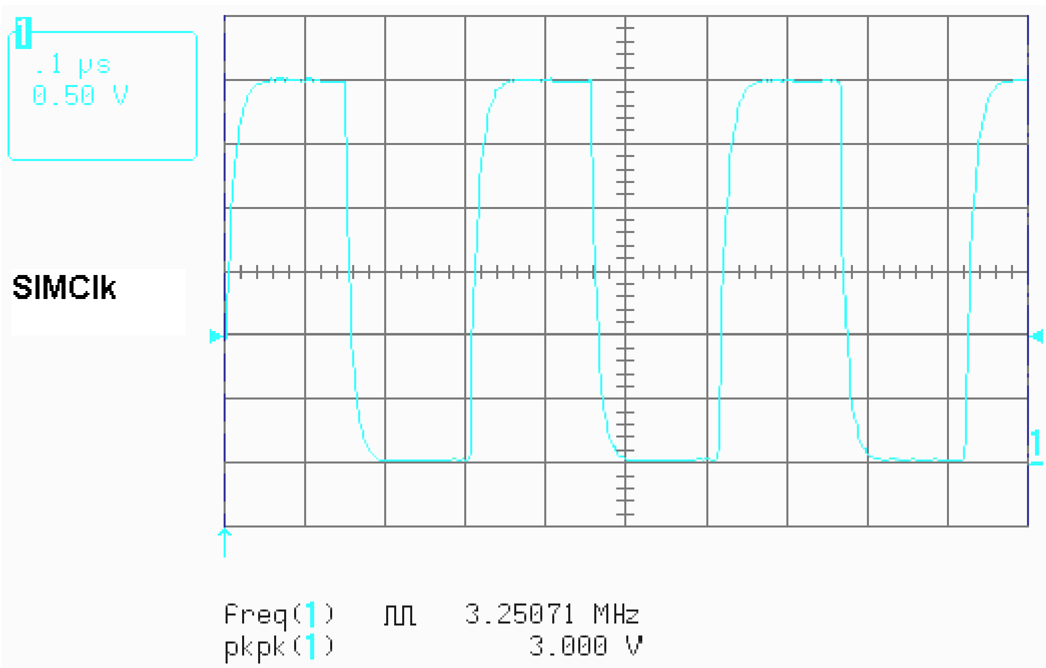
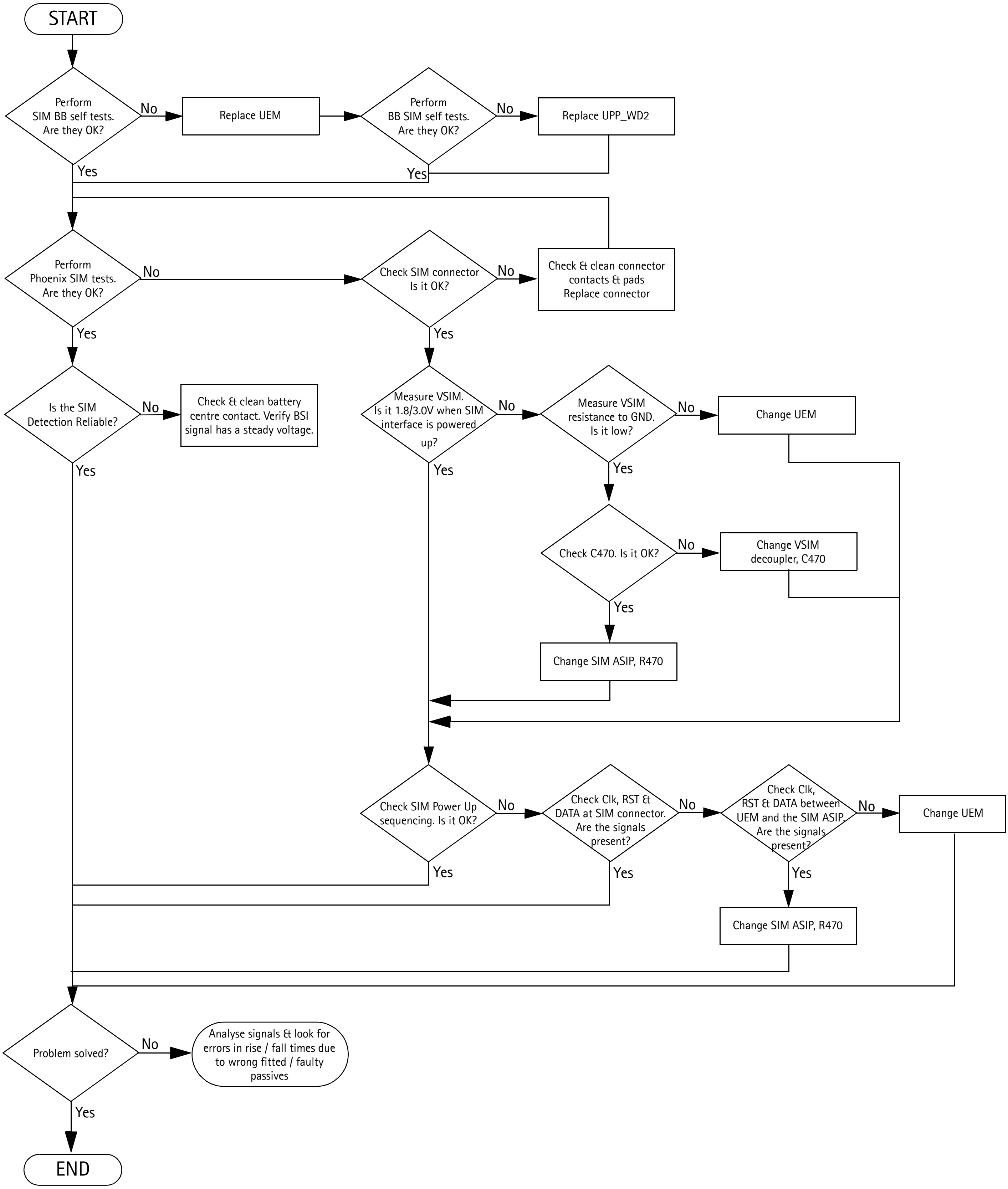


Figure 10: SIM Clk 3.25MHz.



Remember to check the two Phoenix test cases before changing UPP!

"Insert SIM Card" in device display, although the card is inserted



Audio troubleshooting

Figure 11: Internal earpiece

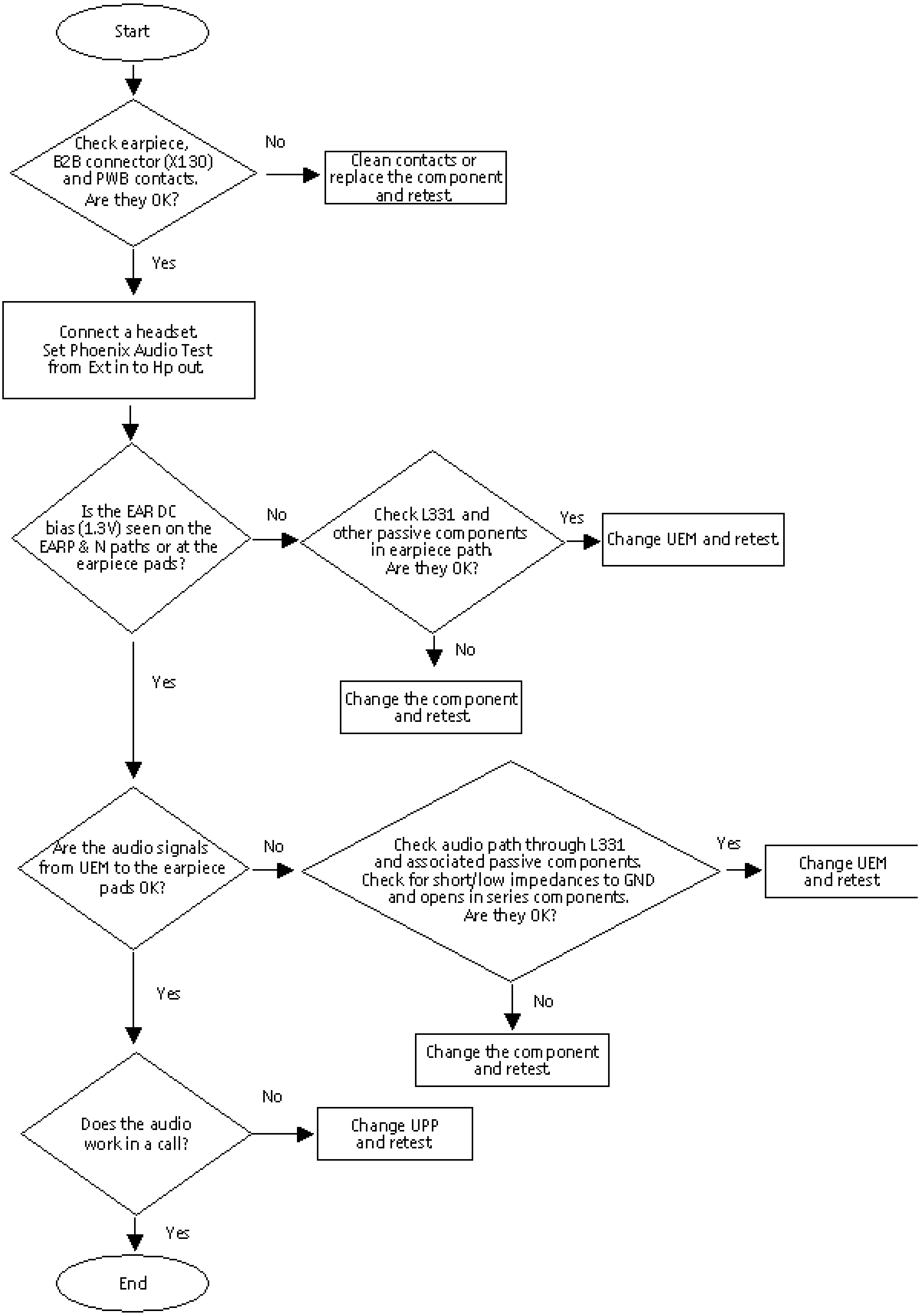


Figure 12: Internal MIC

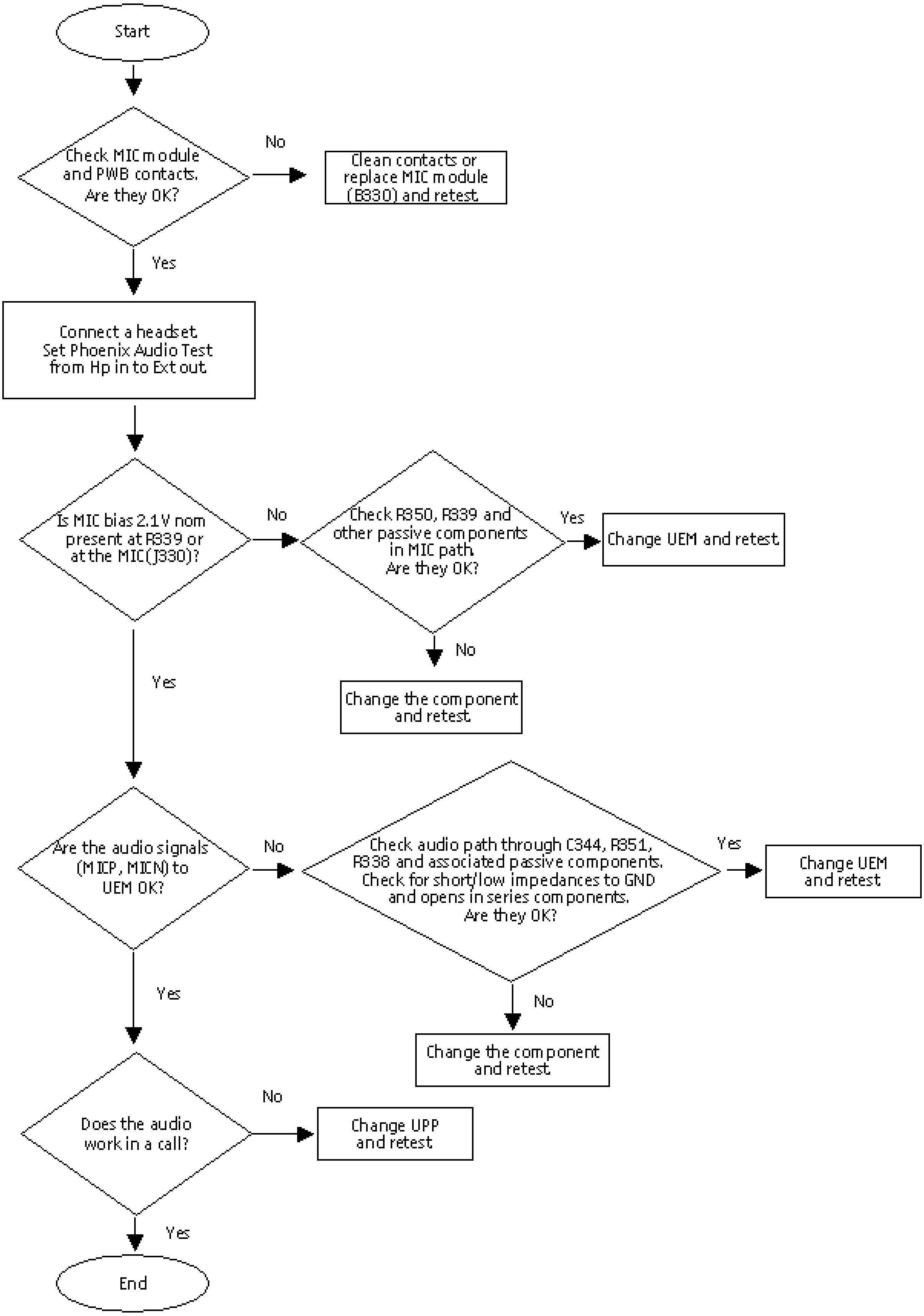


Figure 13: External earpiece

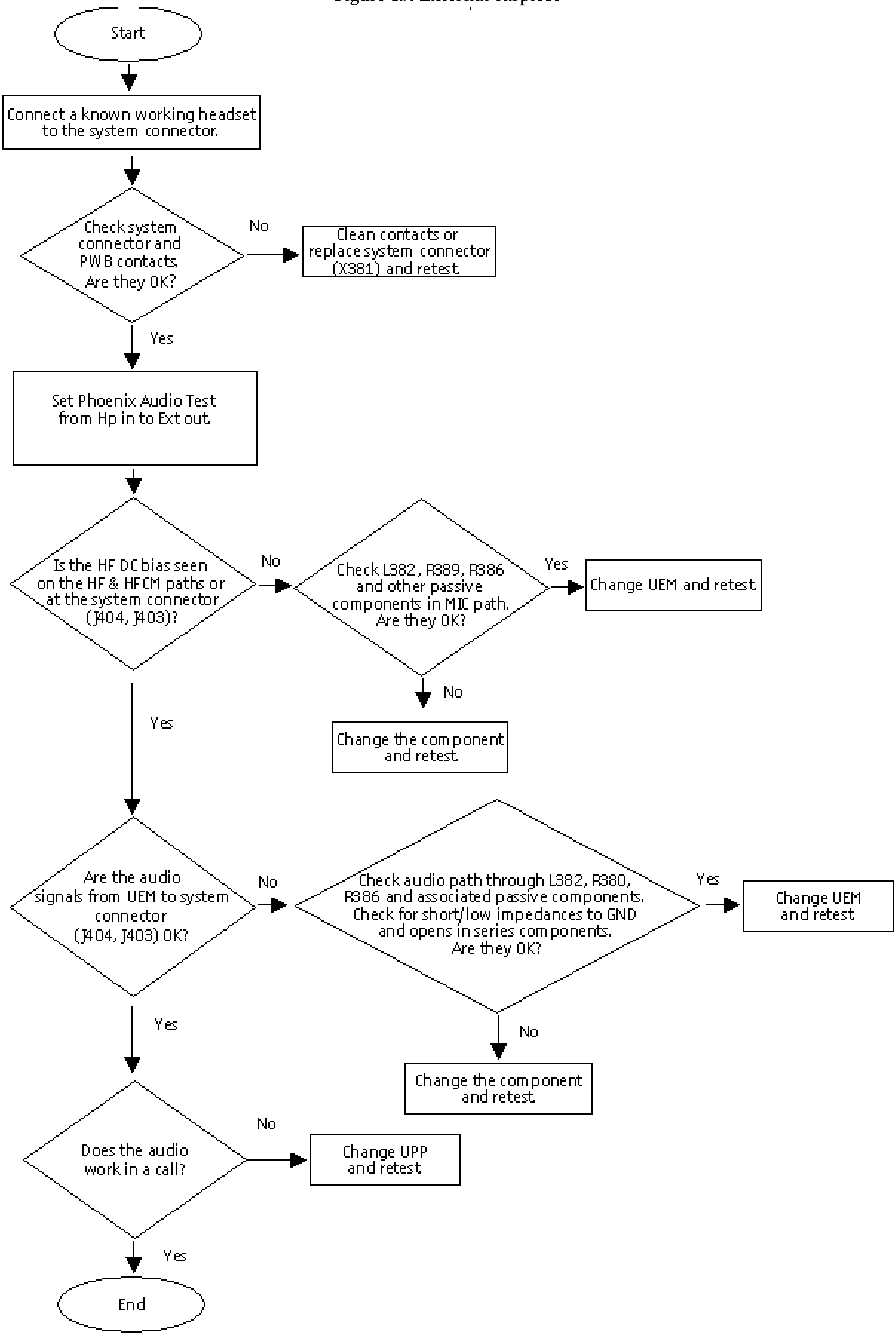


Figure 14: External MIC

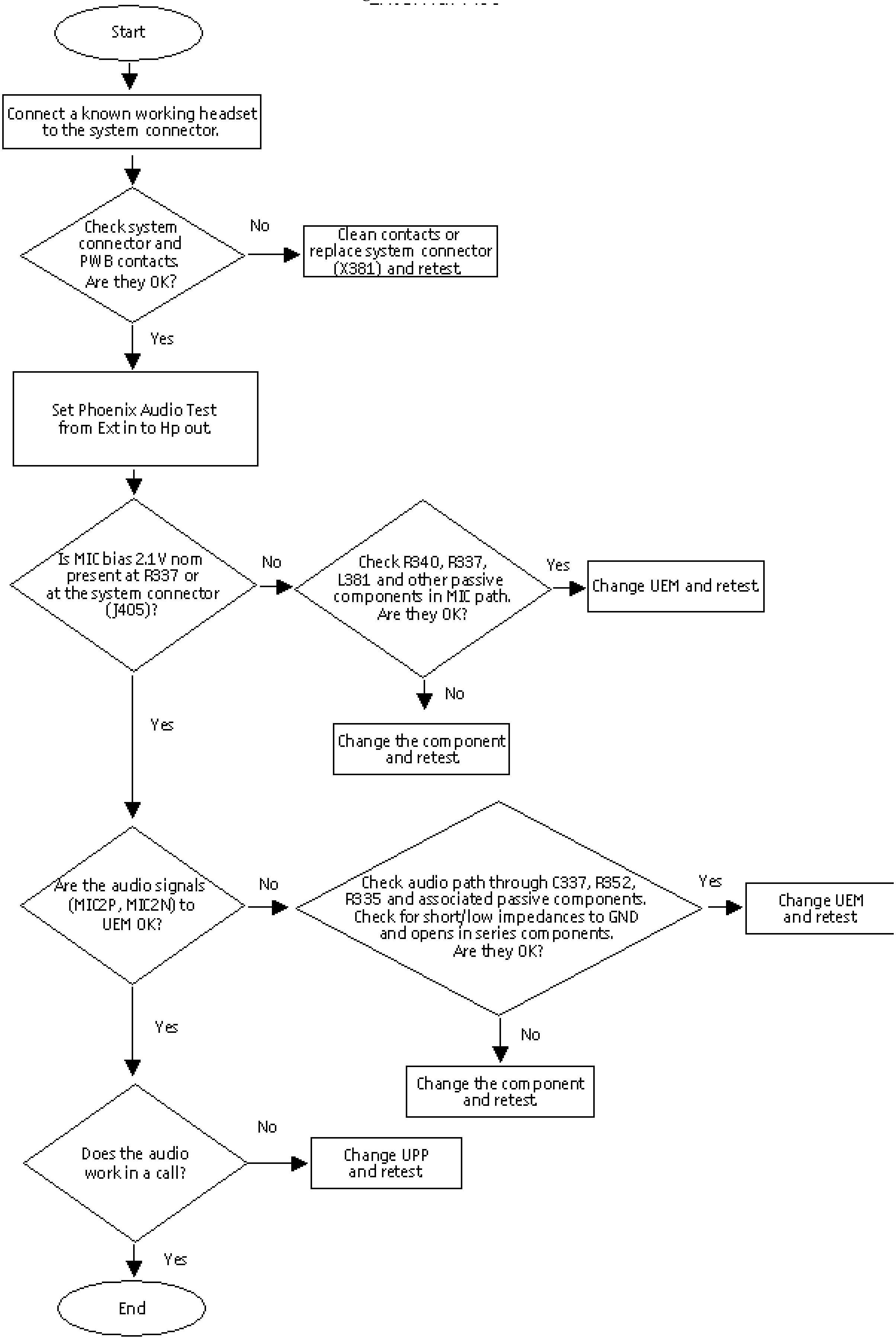


Figure 15: Internal MALT speaker

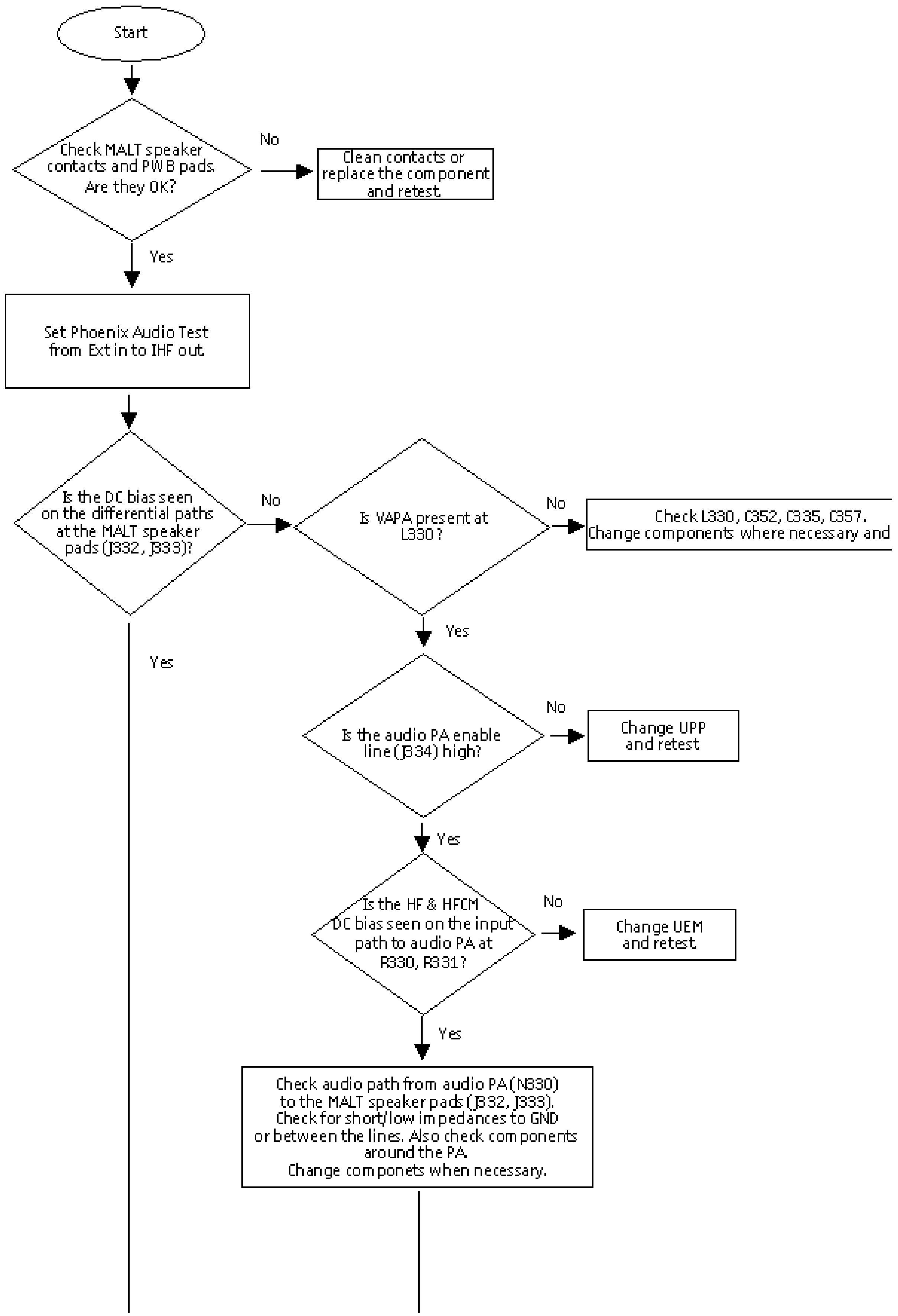


Figure 16: Internal MALT speaker (2)

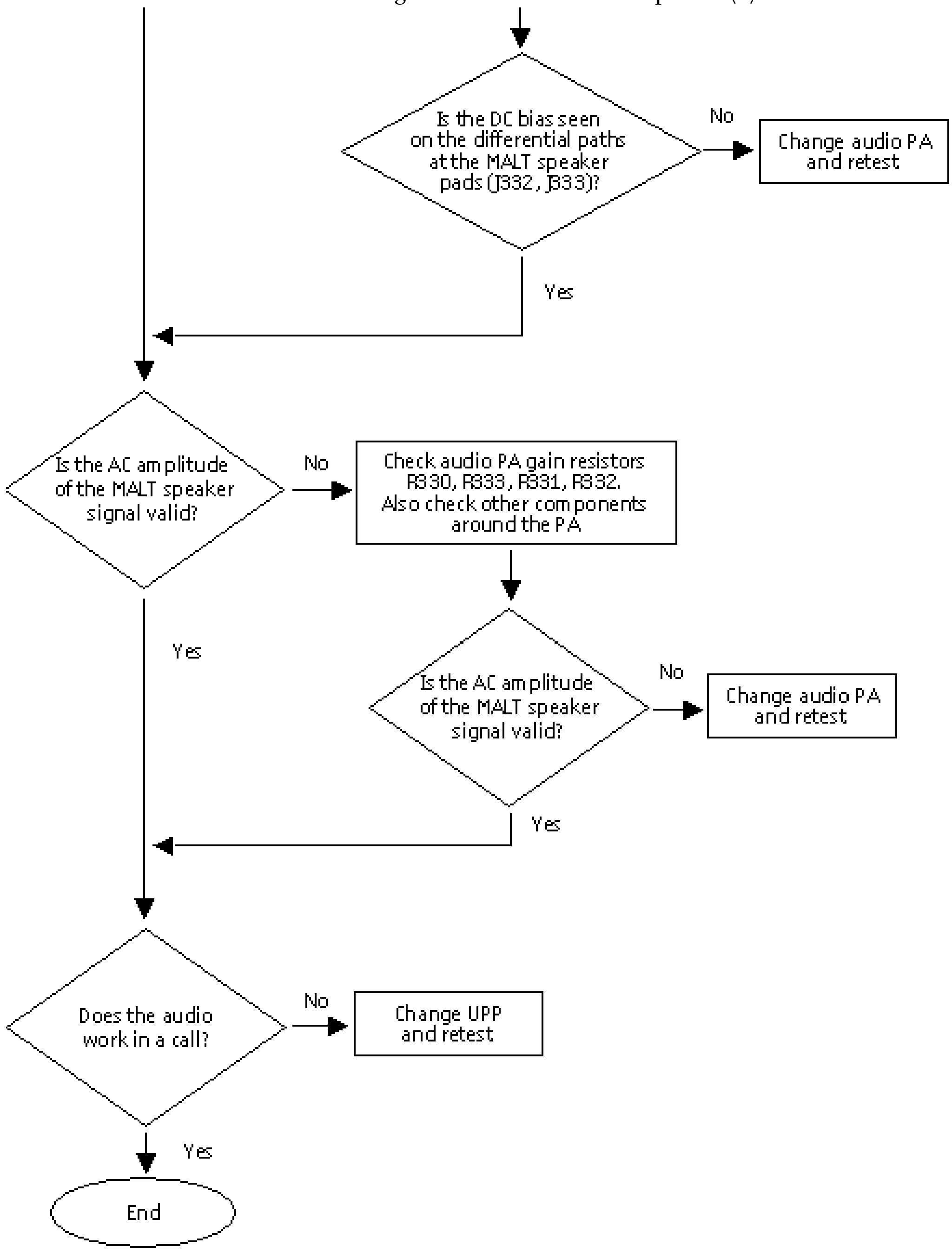
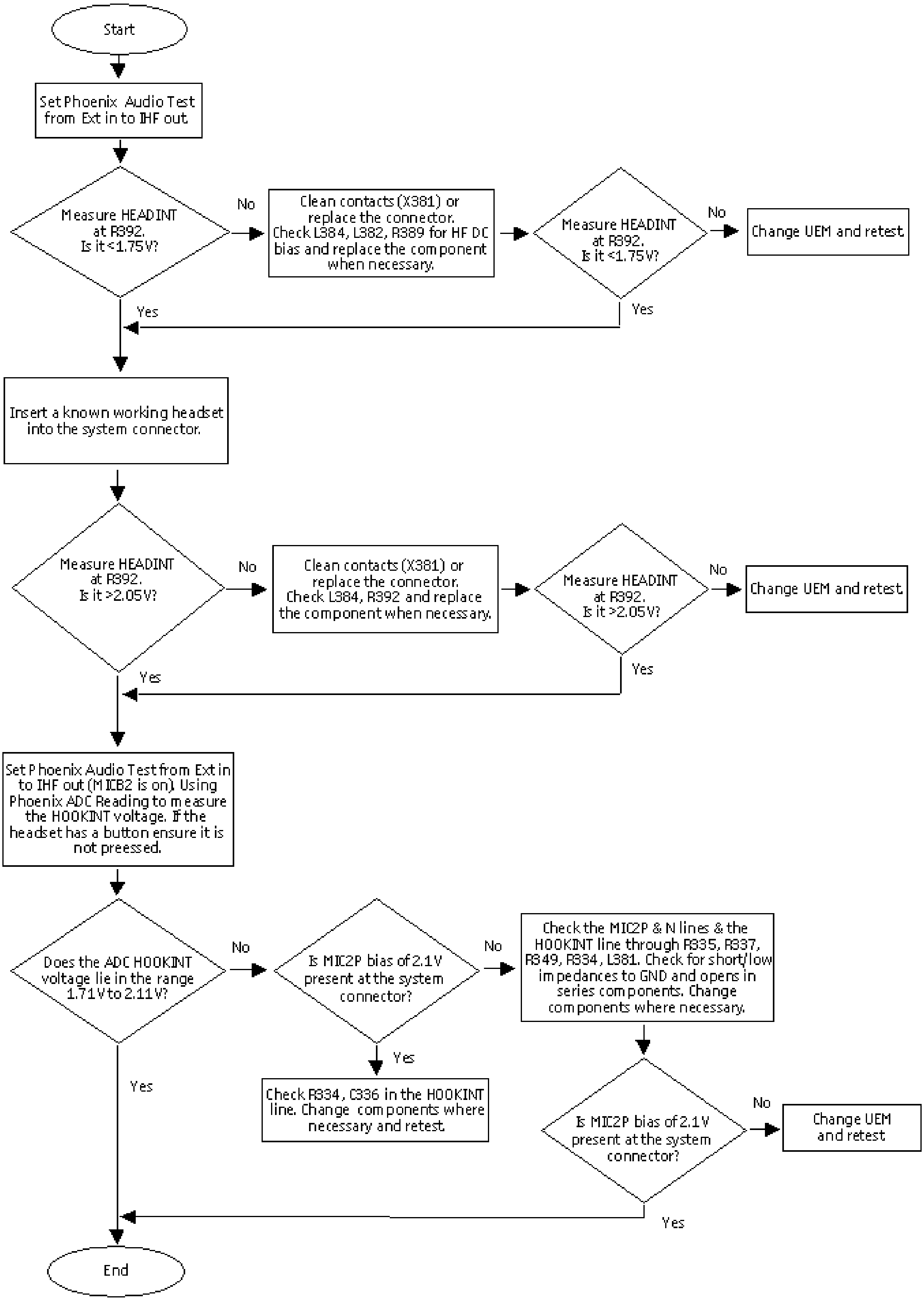


Figure 17: Accessory detection



Memory troubleshooting

Most memory related errors are found through flashing the device; flashing the device is therefore recommended before any of the steps described in this chapter. Check flashing troubleshooting section first!

There are however a few memory related errors that cannot be found through flashing.

- SDRAM(D310) partially damaged. This can mean that the SDRAM component itself is partially damaged and all the memory locations cannot be successfully read or there is a soldering problem somewhere either under UPP or SDRAM. There is a BB self-test for testing SDRAM component quite thoroughly, but the problem is that if SDRAM does not function properly one may not be able to run those tests as SDRAM is used during the device boot and self-test cannot be run if the device has not booted.

- DEVICE may inform about being "out of memory " more often than it should

- Flash1 (D312) is partially/totally damaged. During flashing the manufacturer, device and revision IDs are read, but flashing is done based on IDs of the flash0 (D311). This means that one cannot see any error messages displayed on the Phoenix window during flashing, if flash1 is failing. IDs are however displayed on the Phoenix window and successful read of flash1 IDs can be checked from there.

Serial interface troubleshooting

CBUS

CBUS is a three wire serial interface between the main baseband components. The bus consists of data, clock and bus_enable signals. In RH-47, the bus is connected from UPP WD2 to ZOCUS, UEM and LPRF. UPP_WD2 takes care of controlling the traffic on the bus.

If the interface is faulty from the UPP WD2's end, the phone will not boot properly as powering configurations do not work. Traffic on the bus can be monitored from three pins on the BT module: pins 34, 35 and 36.

If however you are able to get the phone to boot up and can reach Phoenix BB self-tests it is possible to test the functionality of each component attached to Cbus.

Use:

ST_ZOCUS_CBUS_IF_TEST to test AEM Cbus interface

ST_UEM_CBUS_IF_TEST to test UEM Cbus interface

ST_LPRF_IF_TEST to test Bluetooth Cbus interface

If an error is found testing any of the above components, you should replace the failing component.

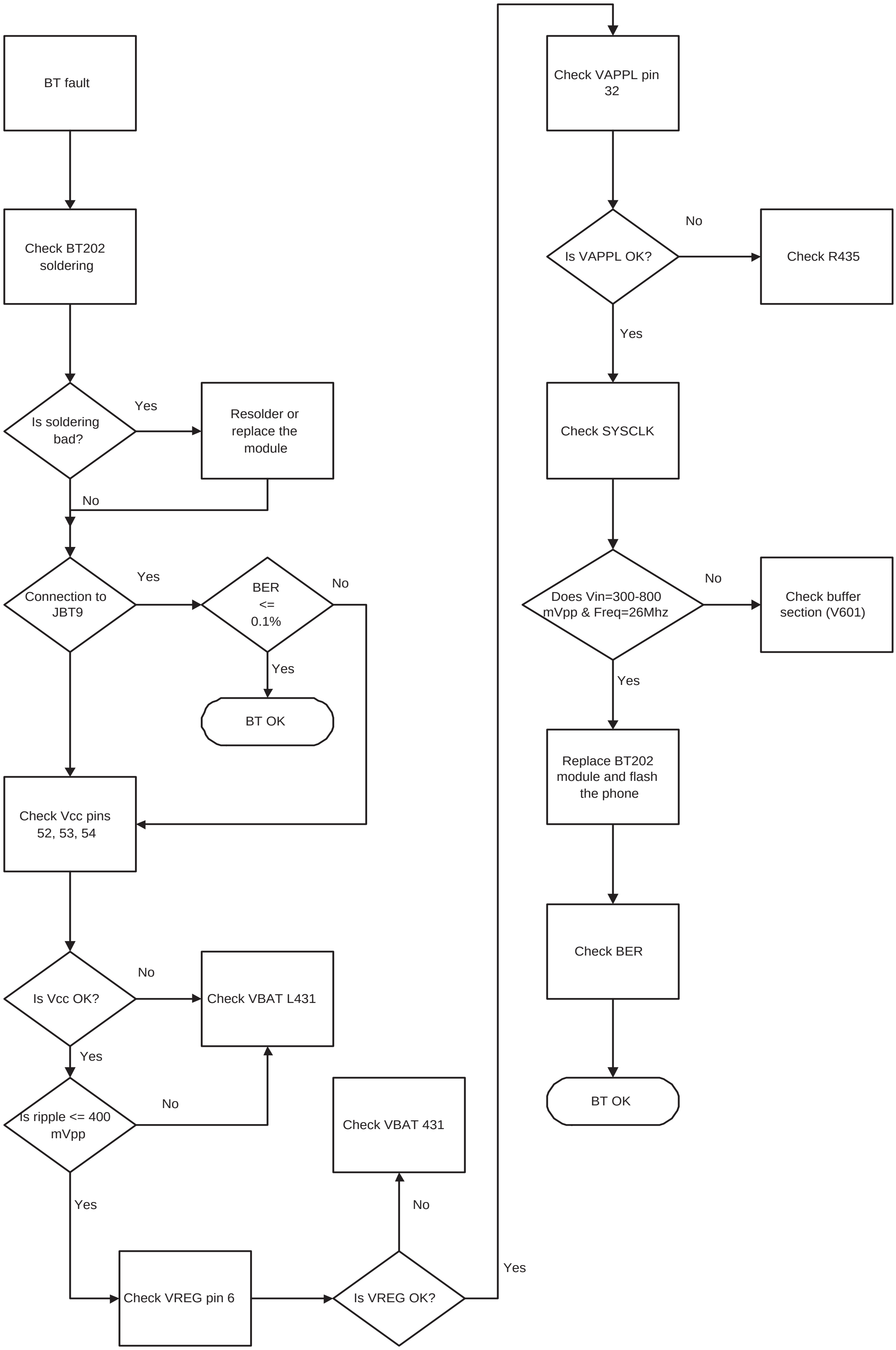
FBUS

FBUS is a two wire RX and TX interface between UPP and flash/test interface. The bus goes through UEM which adjusts the voltage levels to suit UPP_WD2. The interface voltage level on the phone flash/test pad pattern is 2.78V and on the UPP WD2 end it is 1.8V. The functionality of this interface should not affect the device boot into NORMAL, LOCAL or TEST modes. Phoenix tests can be performed through MBUS interface in the case of a failure in FBUS interface. Flashing is not possible, if there is a problem in FBUS.

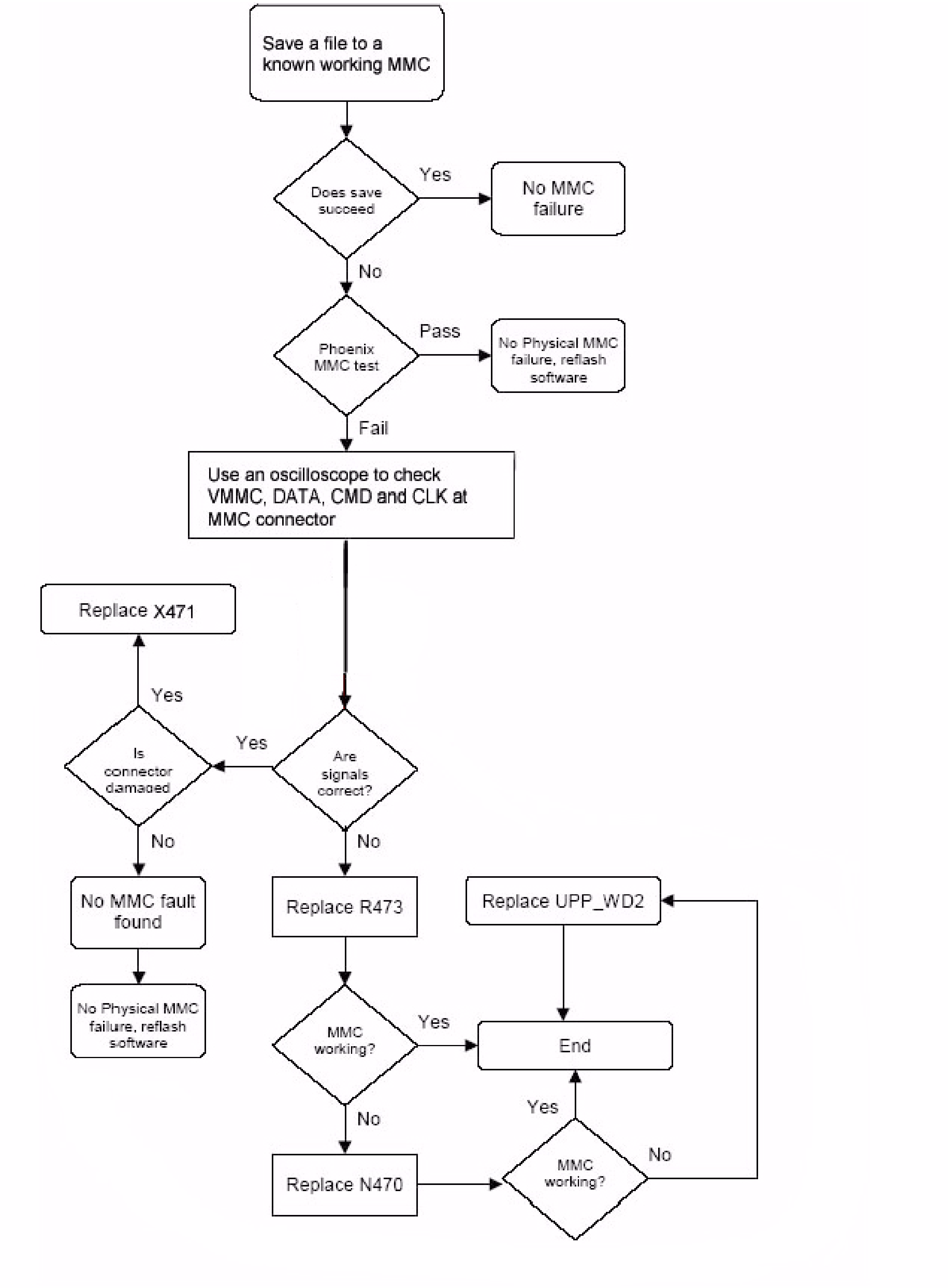
MBUS

MBUS is a two wire RX and TX interface between UPP and UEM. From UEM the interface continues to flash/test interface as a one wire interface. UEM also adjusts the voltage levels. The interface voltage level on the phone flash/test pad pattern is 2.78V and on the UPP WD2 end it is 1.8V. MBUS traffic between UPP WD2 and UEM can be tested with Phoenix (ST_MBUS_RX_TX_LOOP_TEST). Flashing is not possible, if there is a problem in MBUS.

Bluetooth troubleshooting



MMC troubleshooting

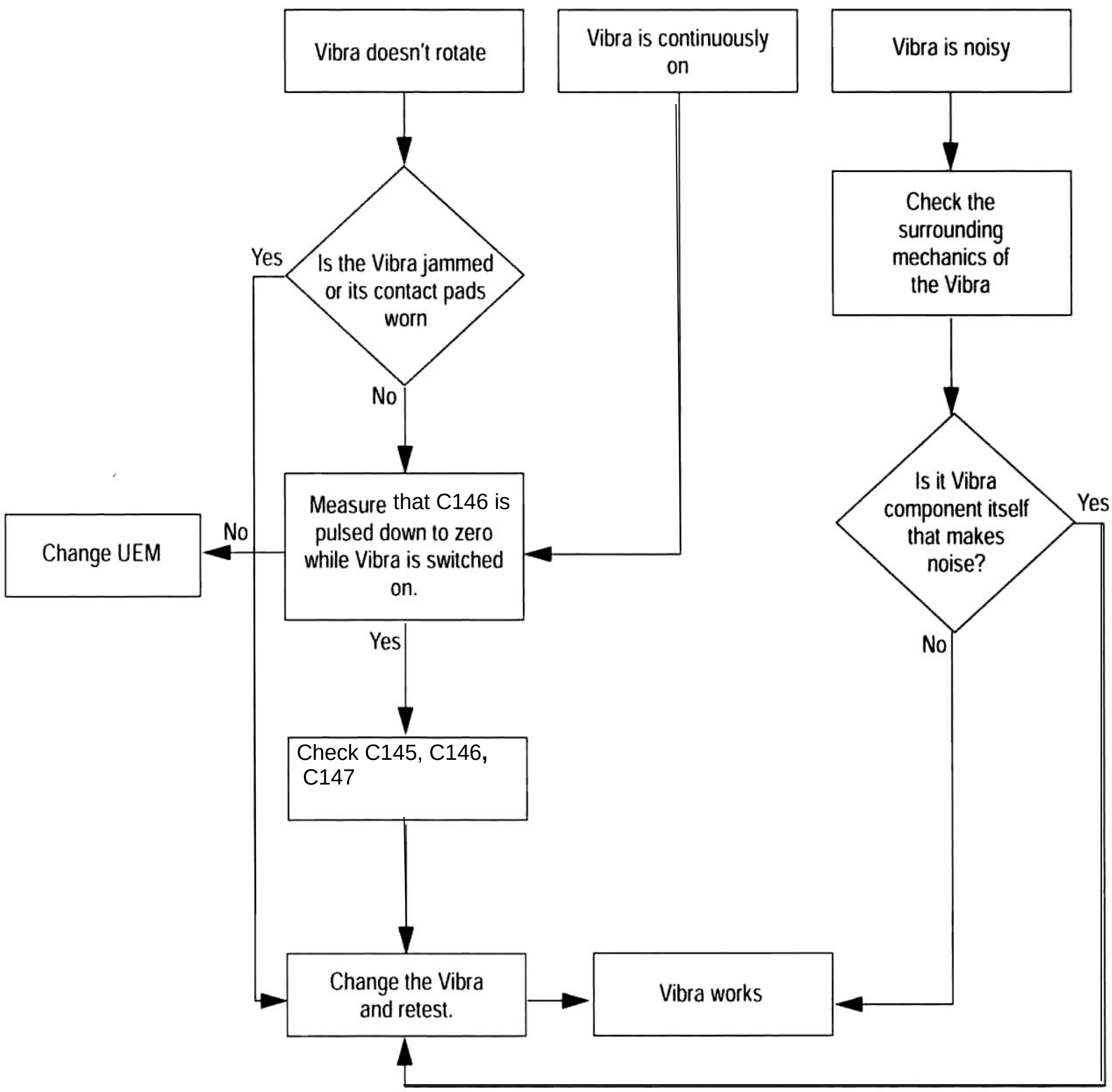


Vibra

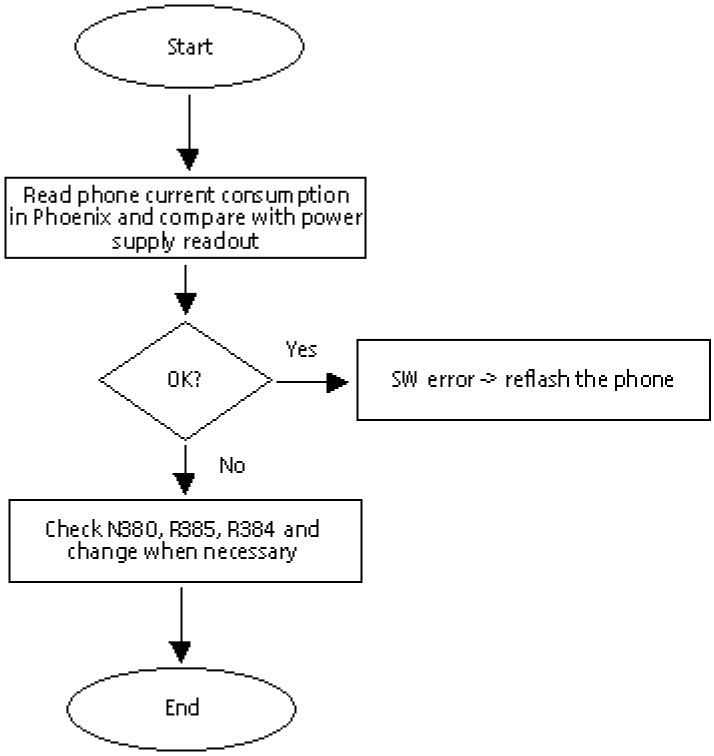
There may be three kinds of problems with the vibra:

- It does not rotate.
- It is noisy.
- it is continuously on.

Noisiness is usually caused by the contact of the rotating mass with surrounding mechanics.



ZOCUS


Start
Read phone current consumption in Phoenix and compare with power supply readout
OK?
Yes
SW error -> reflash the phone
No
Check N380, R385, R384 and change when necessary
End

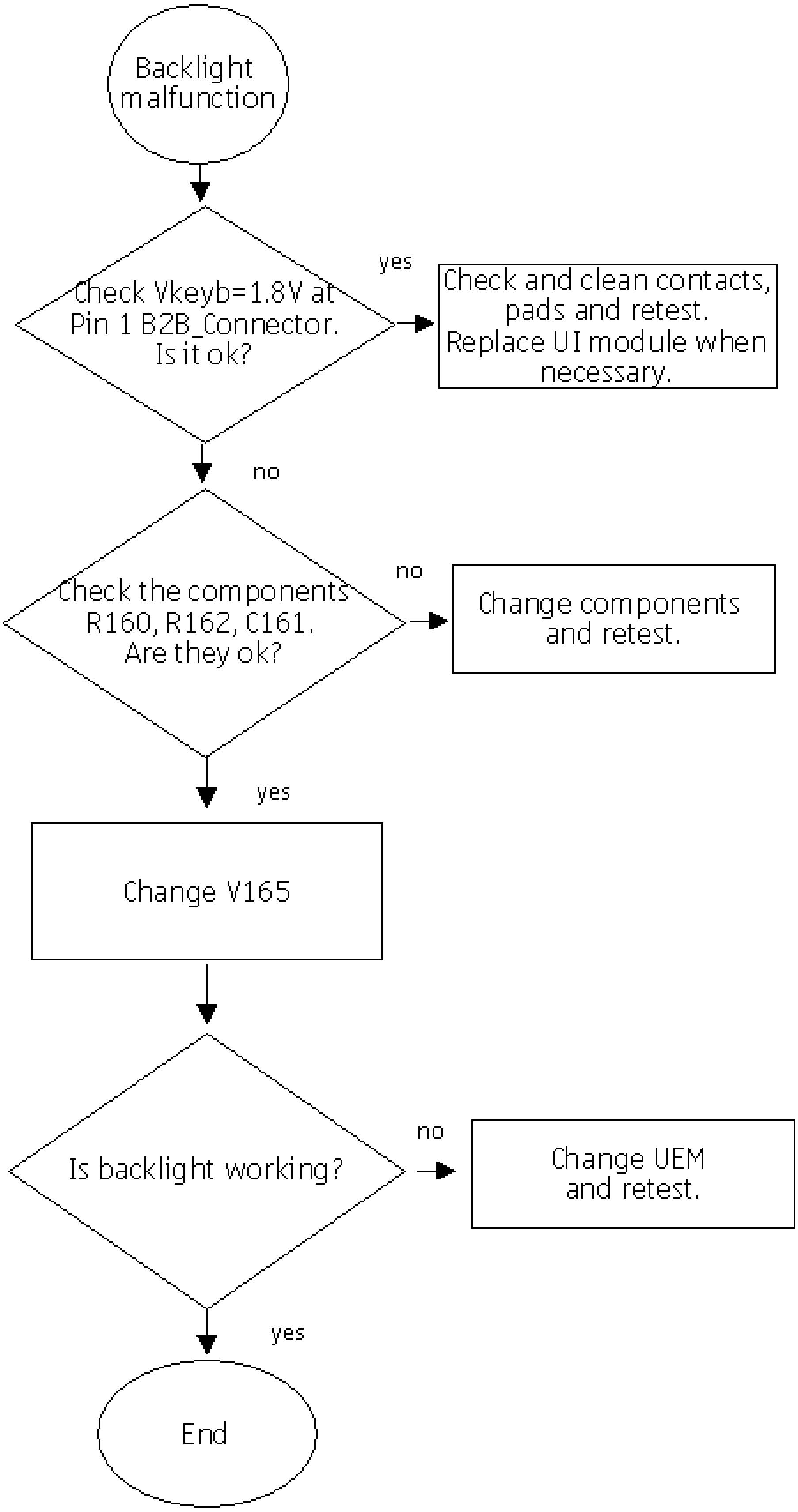
UI Module Troubleshooting

This section describes the troubleshooting of the UI module

If the problem is in the display or in the keymat PWB, the entire UI module must be replaced. However, the earpiece alone may be replaced (see audio troubleshooting).

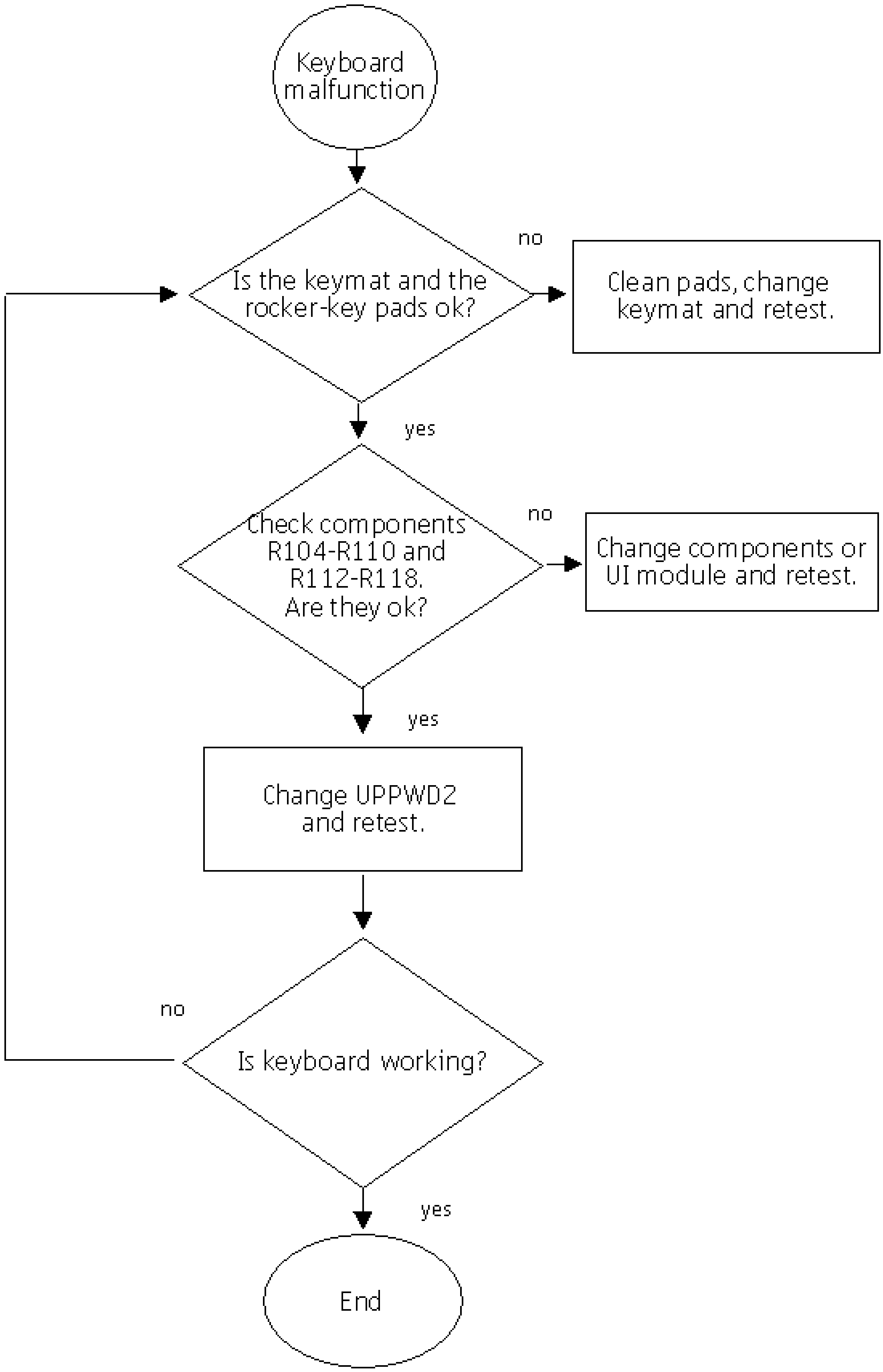
Keymat backlight

If the keymat backlight is not functioning and the backlight driver voltage is generated correctly on the 1CK module, then the problem is either in the connector or in the UI module. Note that it is possible that one LED is dead while all others are working.

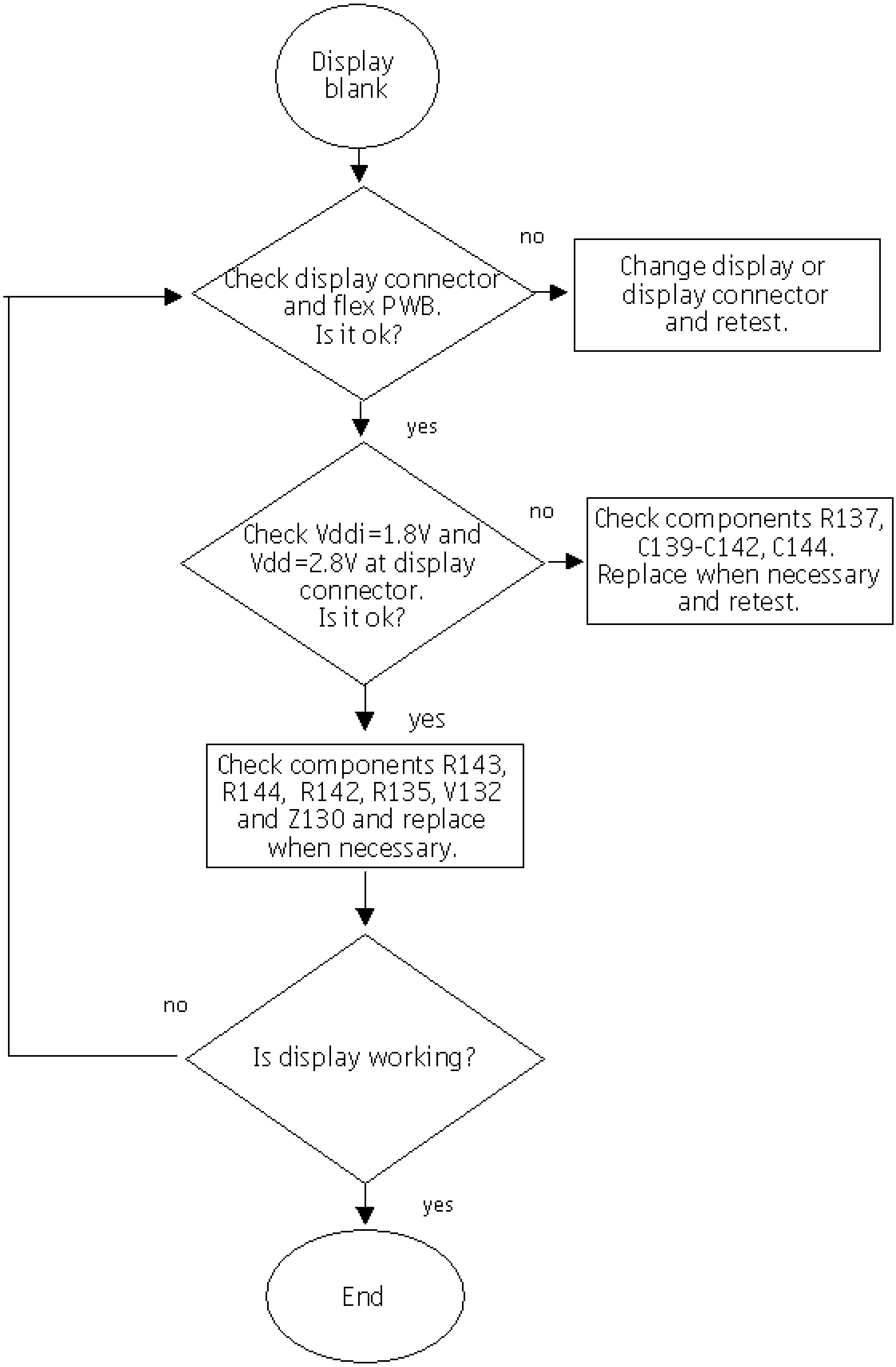


Keyboard problem

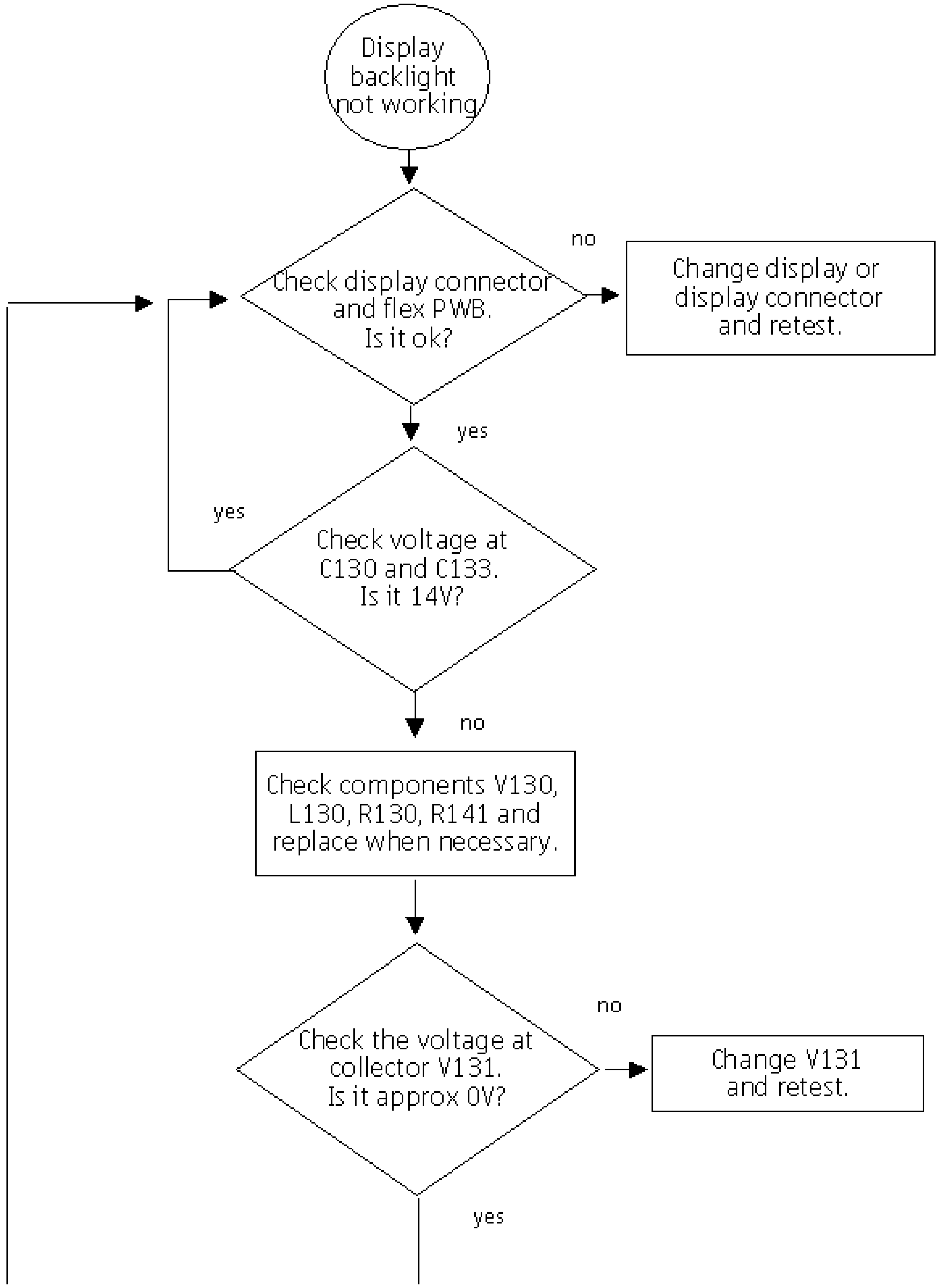
If the keyboard does not work, follow the troubleshooting chart below:

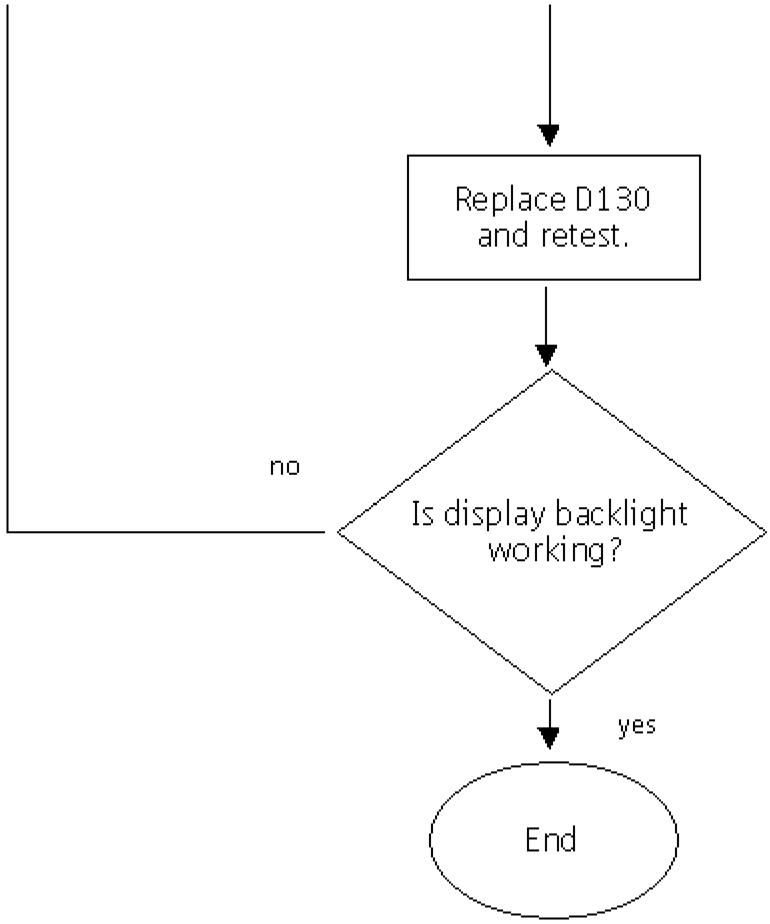


Display blank



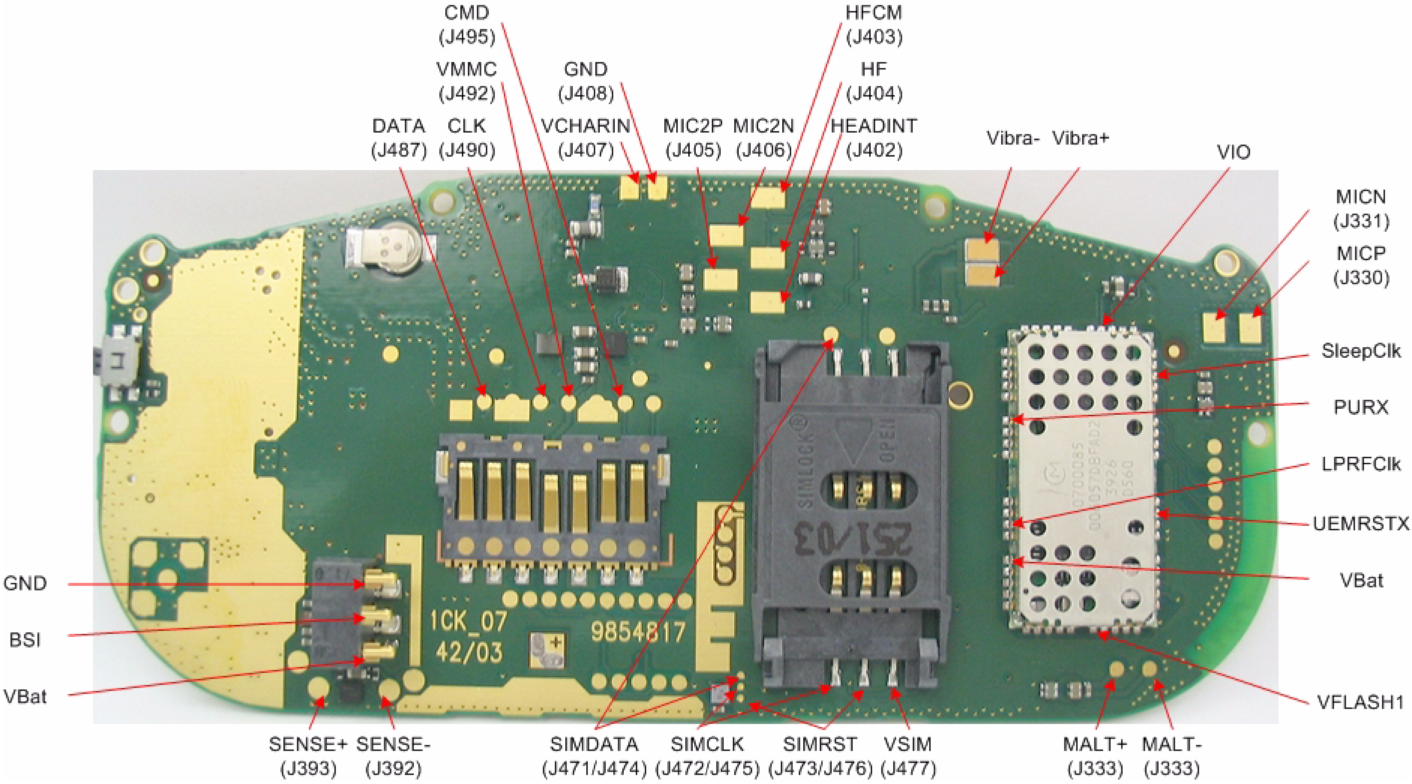
Backlight does not turn on



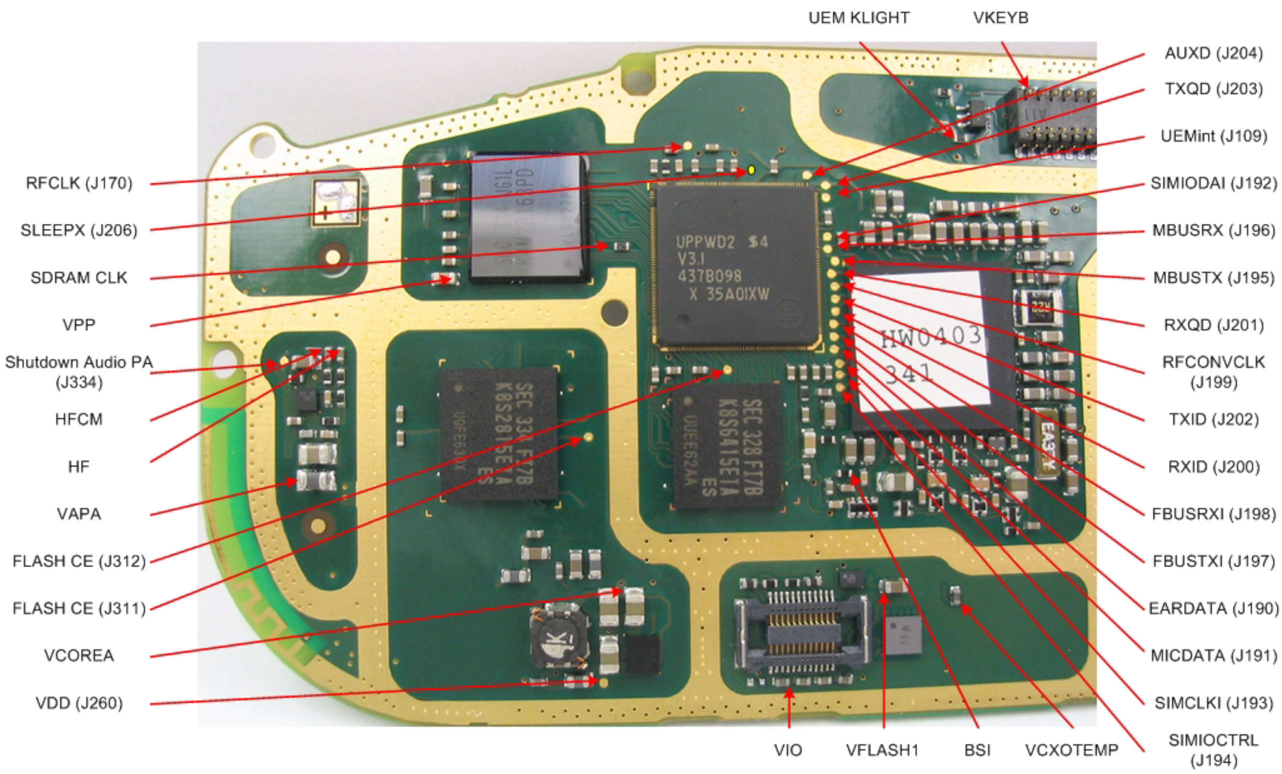

Replace D130
and retest.
no
Is display backlight
working?
yes
End

Appendix A

Test points - Bottom



Test points - Top



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