6(a) – Baseband Troubleshooting and Manual Tuning Guide

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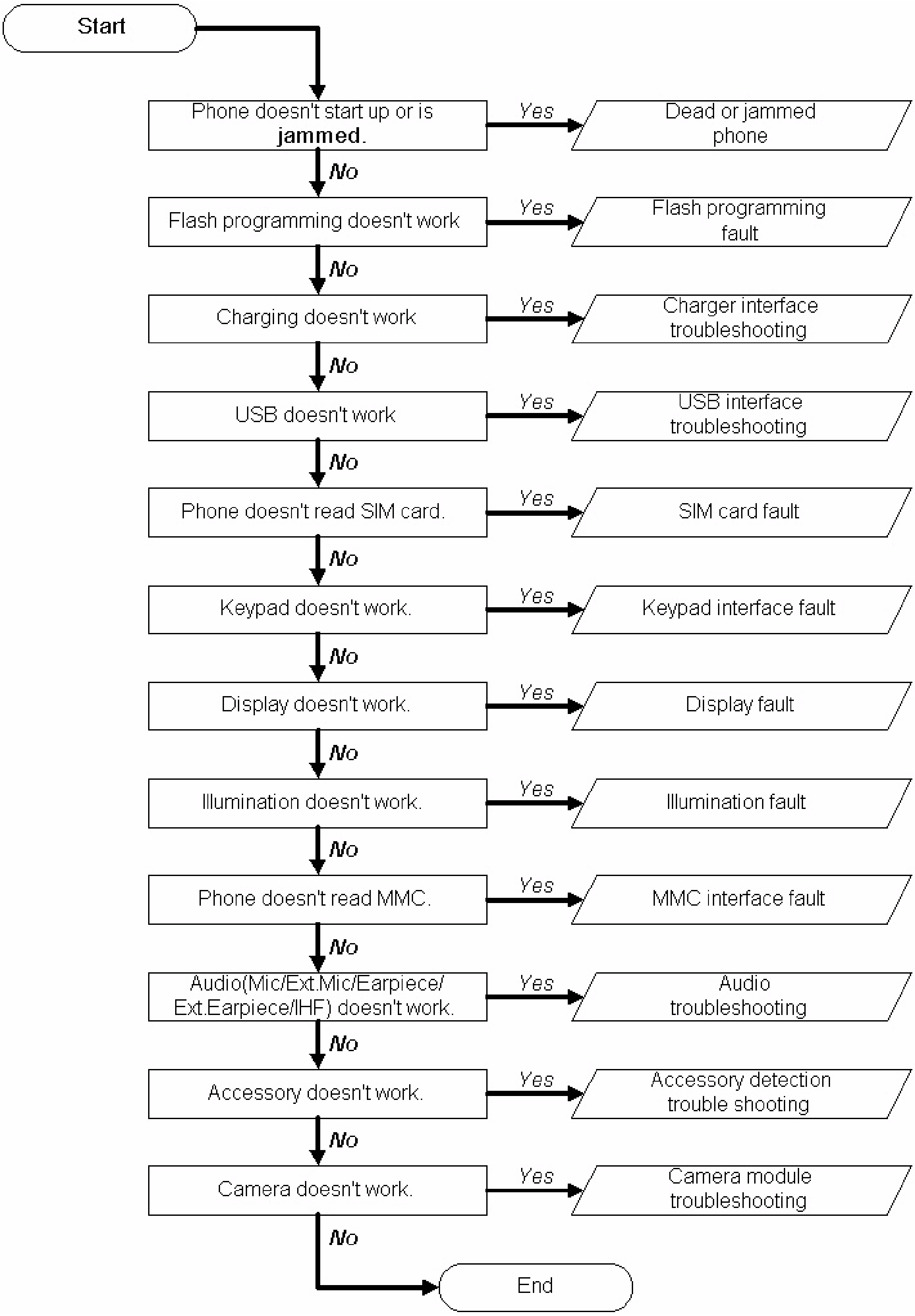
Baseband troubleshooting

This document is intended to be a guide for localising and repairing electrical faults in the RH-51/52, RH-67/68 device. The fault repairing is divided into troubleshooting paths.

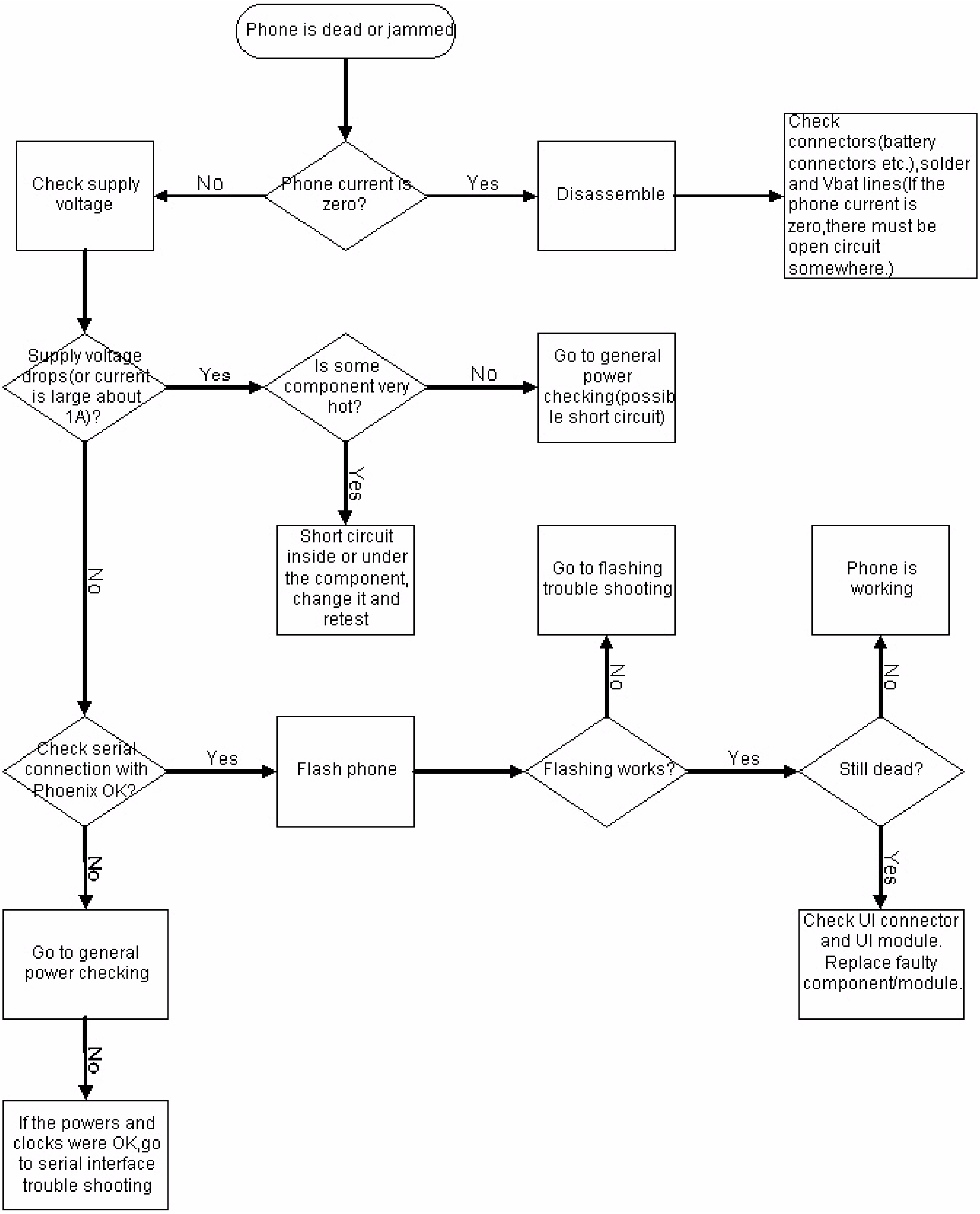
The following diagrams describe baseband troubleshooting.

Figure 1: Main troubleshooting diagram



Dead or jammed phone

Figure 2: Phone is jammed or dead



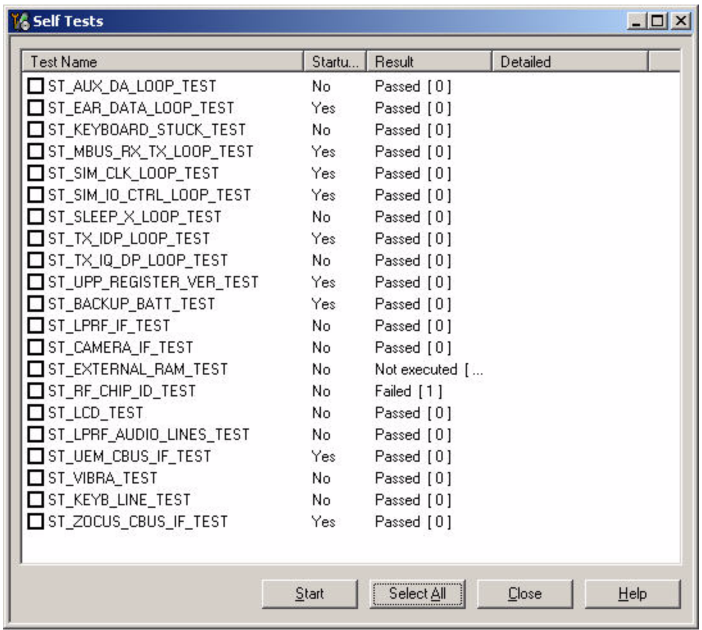
BB selftest tools

"Selftest failed. Contact service." on display.

This fault means that the software is able to run and thus the watchdog of UEME can be served. Selftest functions are executed when the phone is powered on, and if one or more selftest functions fail, the message "Selftest failed. Contact Service." is shown on the display.

The MCU selftest case 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 tests and the items included are as follows:

Figure 3: BB selftest items



Flash programming fault

Following is the troubleshooting flow chart of flash programming.

"C101Boot timeoutl" written in the flow chart refers to the Phoenix error message that is shown when there are problems on phone flash programming using FPS-8.

Figure 4: Flashing troubleshooting 1

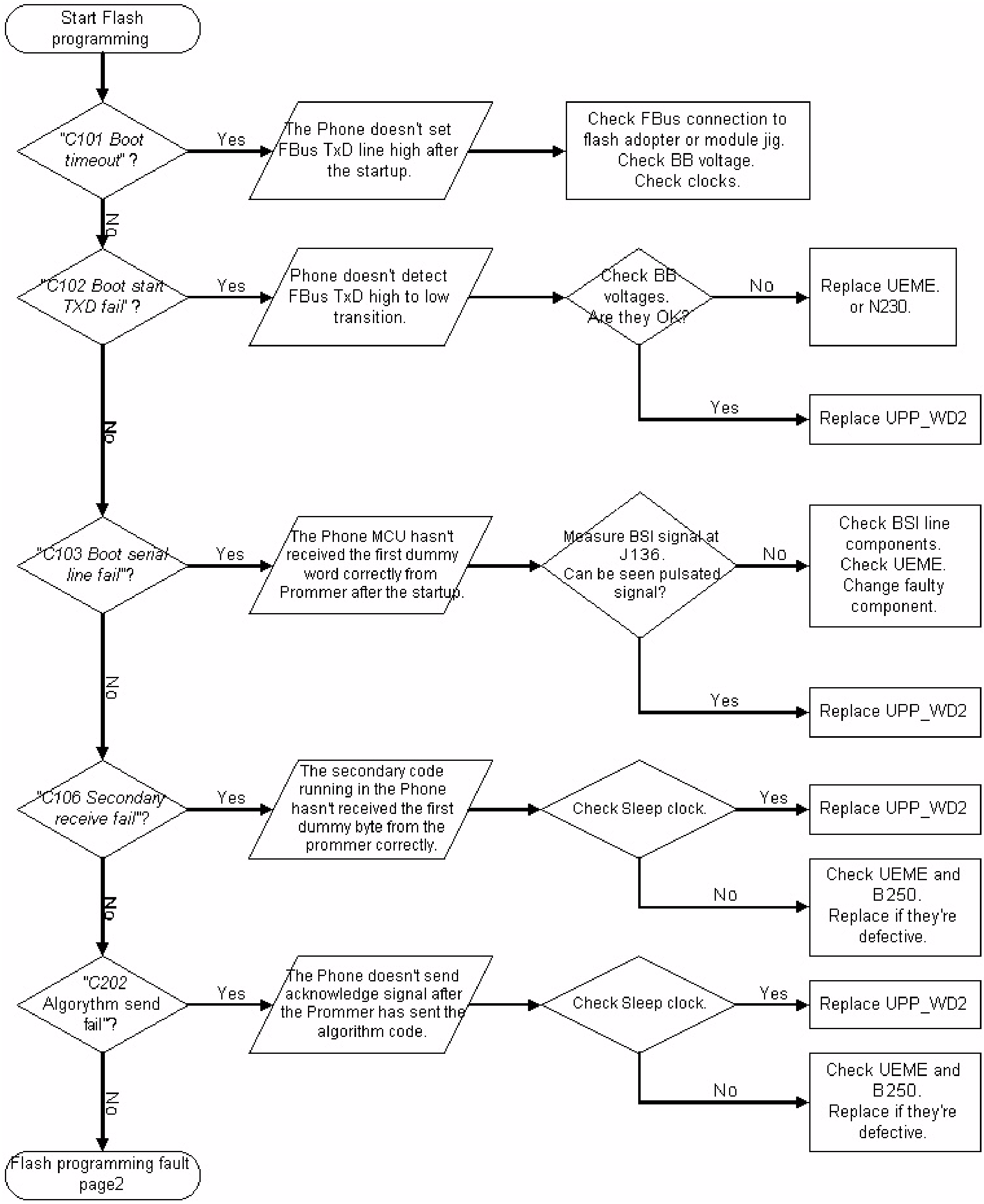
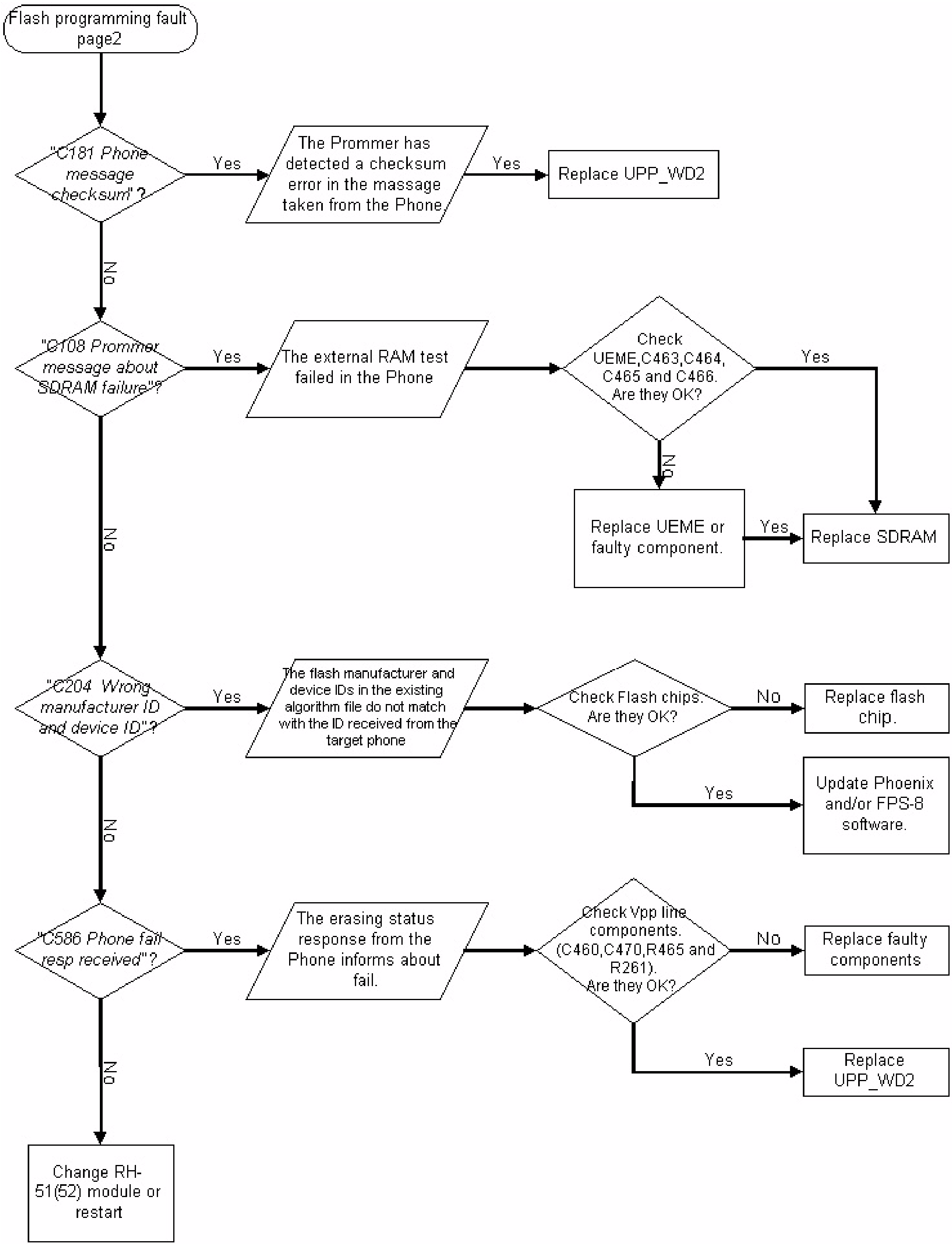


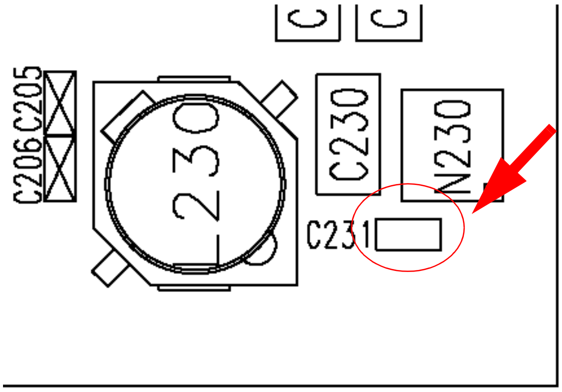
Figure 5: Flashing troubleshooting 2



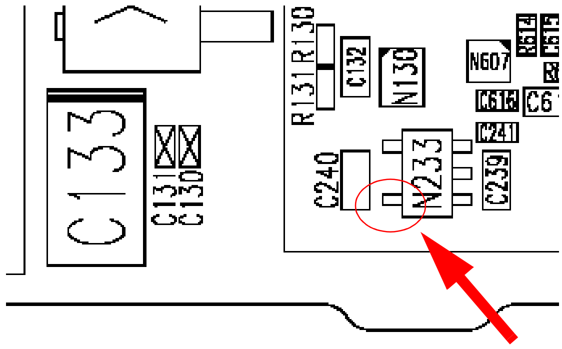
General power checking

Test points for regulators

VCOREA (LM2608/N230: 1.5V output)
Test point: C231 near by BT shield



VLCD (MAS9161/N233: 2.5V output)
Test point: N233 pin or C240 near.



UEME internal regulators
Test points: VIO 1.8V at C282
VANA 2.78V at C278
VFLASH1 2.78V at C279

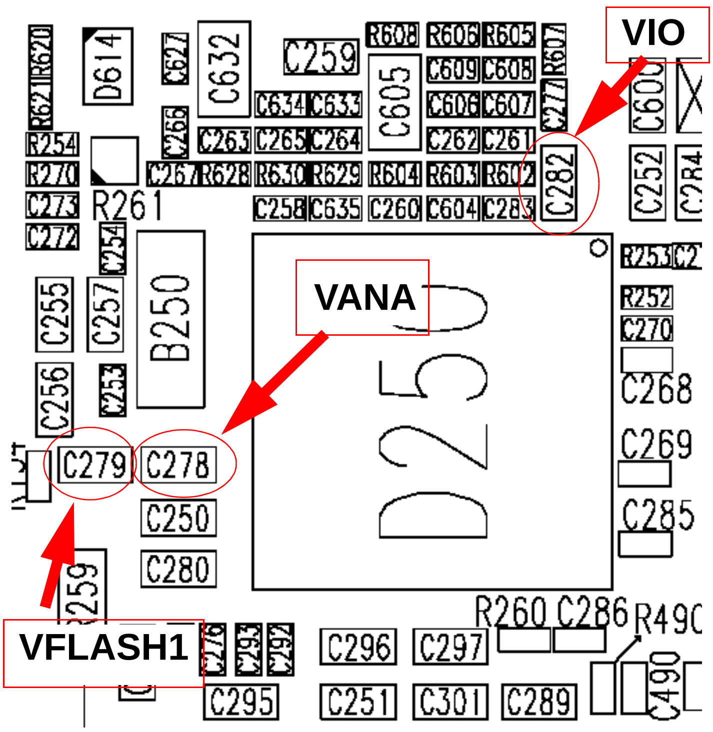
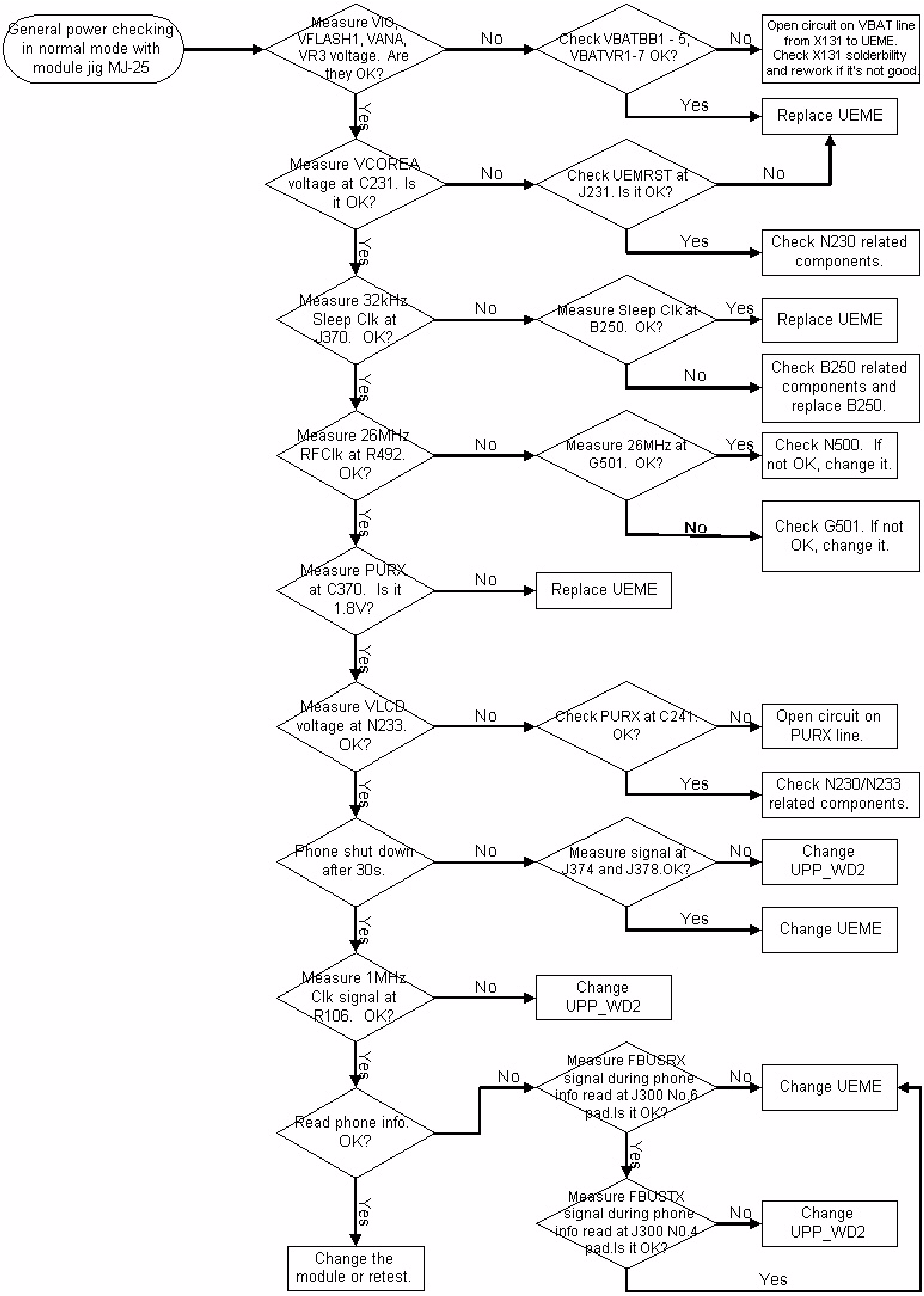


Figure 6: General power check



Baseband serial interface troubleshooting

CBUS

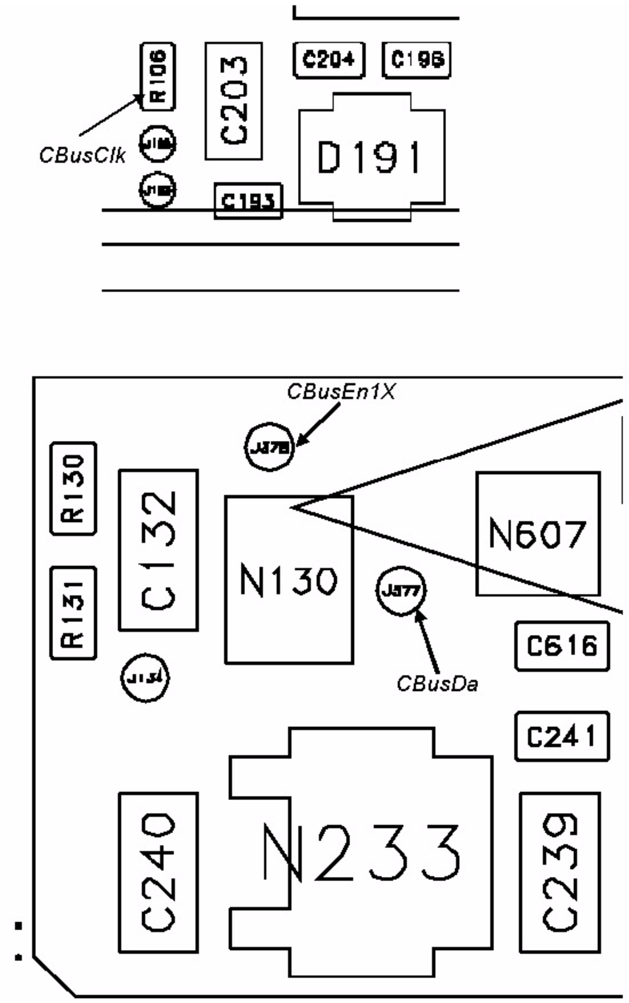
CBUS is a three-wire serial interface between the main baseband components. The bus consists of data, clock and bus_enable signals. In RH-51/52, RH-67/68 the bus is connected between UPP_WD2, UEME and ZOCUS. UPP_WD2 takes care of controlling the traffic on the bus.

If the interface is faulty from the UPP_WD2's end, the phone does not boot properly as powering configurations do not work. Traffic on the bus can be monitored at the following test point and pins.

- CBusClk UPP_WD2 side of R106 pin
- CBusEN1X J378 Pad
- CBusDA J377 Pad

The pads and pin are shown below.

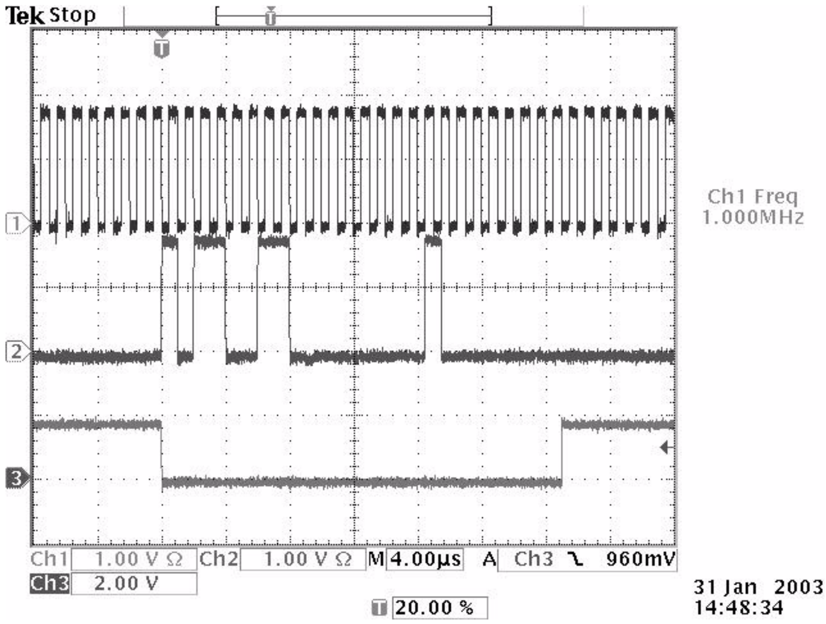
Figure 7: CBUS test points



The CBUS traffic is shown in the figure below (read command to ZOCUS, LM3820, N130).

CBusCLk is connected to Ch1, CBusDa to CH2 and CBusEnx to Ch3.

Figure 8: CBUS waveform



If you are able to get the phone to boot up and can reach Phoenix BB selftest it is possible to test the functionality of each component attached to CBus. Use:

- ST_UEM_CBUS_IF_TEST to test the UEME Cbus interface
- ST_ZOCUS_CBUS_IF_TEST to test the ZOCUS Cbus interface

If an error is found testing any of the above components you should replace or re-solder the failed component.

FBUS

FBUS is a two-wire RX and TX interface between UPP_WD2 and flash/test interface. The bus goes through UEME, which adjusts the voltage levels to suit UPP_WD2. The interface voltage level on the phone flash/test pad pattern is 2.7V 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 the MBUS interface in the case of a failure in the FBUS interface. Flashing is not possible if there is a problem in the FBUS interface.

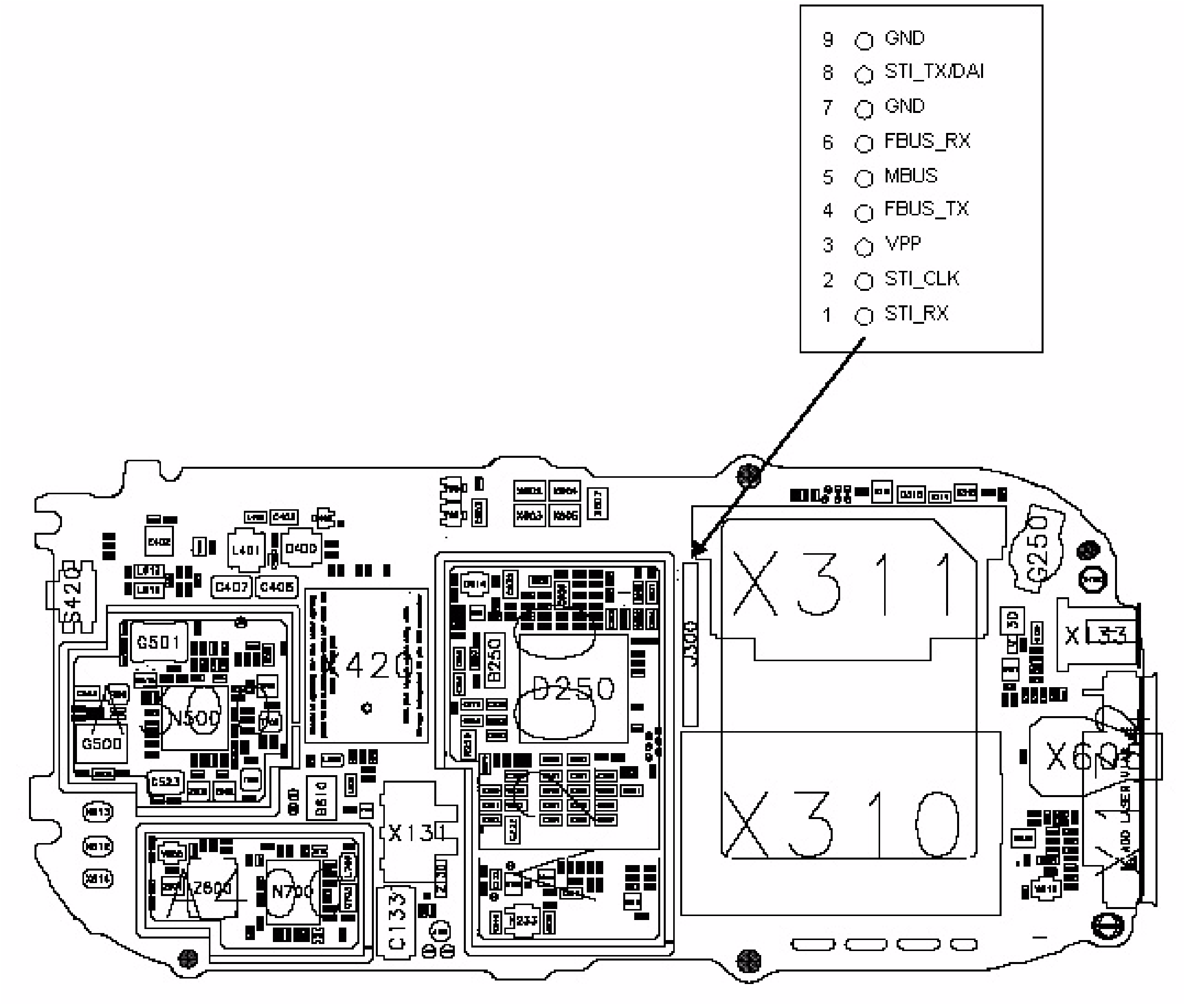
Fbus signals can be seen at flashing test pads and the pad layout is shown in the following figure.

MBUS

MBUS is a two-wire RX and TX interface between UPP_WD2 and UEME. From UEME the interface continues to flash/test interface as one-wire interface. UEME 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 UEME can be tested with Phoenix (ST_MBUS_RX_TX_LOOP_TEST). Flashing is not possible if there is a problem in MBUS. The MBUS signal can also be seen at flashing test pads and the pad layout is shown in the following figure.

Figure 9: Flash interface layout (FBUS/MBUS test pads layout)



Charger interface troubleshooting

Figure 10: Not charging on display

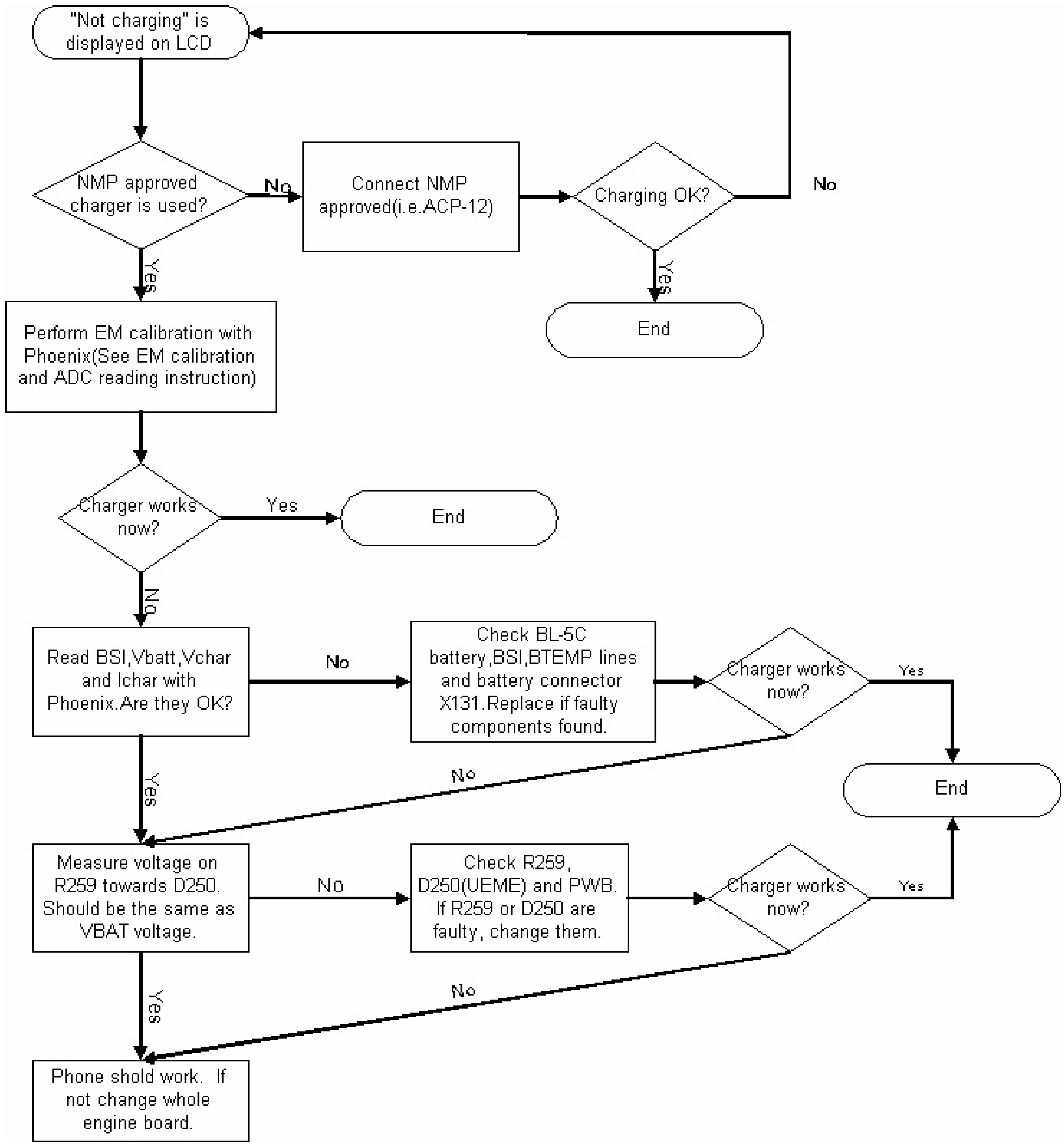
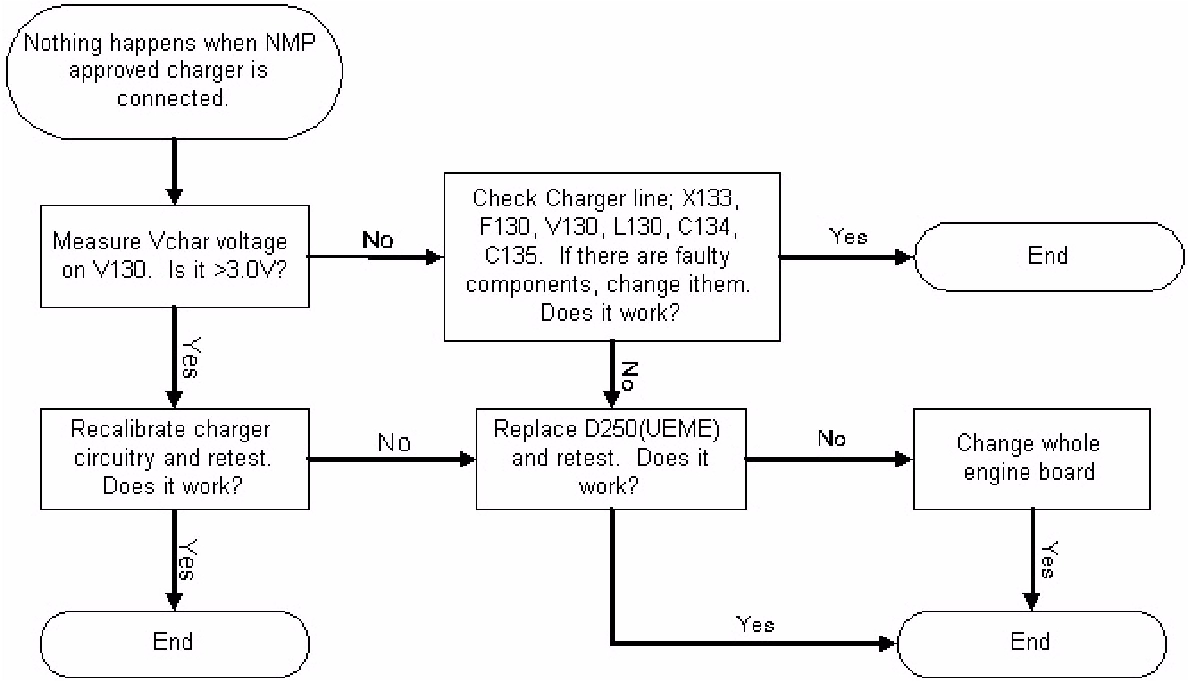


Figure 11: Nothing happens when charging



Energy management calibration

EM calibrations should be carried out in JBV-1 docking station attached to DA-2 docking station adapter.

Power to JBV-1 should be supplied from an external DC power supply.

JBV-1 input voltages: nominal + 12 VDC, maximum +16VDC

On the JBV-1, the A/D converter, BSI, BTEMP, battery voltage (VBAT), charger voltage (VCHAR), charger current (ICHAR) and battery current (IBAT) are calibrated. For detailed information and instructions, see energy management calibration instructions in the service manual.

Troubleshooting tips

ADC-offset over limits

Inspect the BSI line, connectors (hotbar and board to board connector) and components in it (capacitor C272, ASIP R135, pull-up resistor R252). If these are OK, change UEME.

BSI gain over limits

Inspect the BSI line, connectors (hotbar and board to board connector) and components in it (capacitor C272, ASIP R135, pull-up resistor R252). If these are OK, change UEME.

Vbatt offset and gain

Inspect Vbatt lines and components in it.

VCHAR over limits

Inspect components that are connected to VCHAR line: filtering capacitors C134, C135, TVS V130, L130 and fuse F130. If those are OK, change UEM.

ICHAR over limits

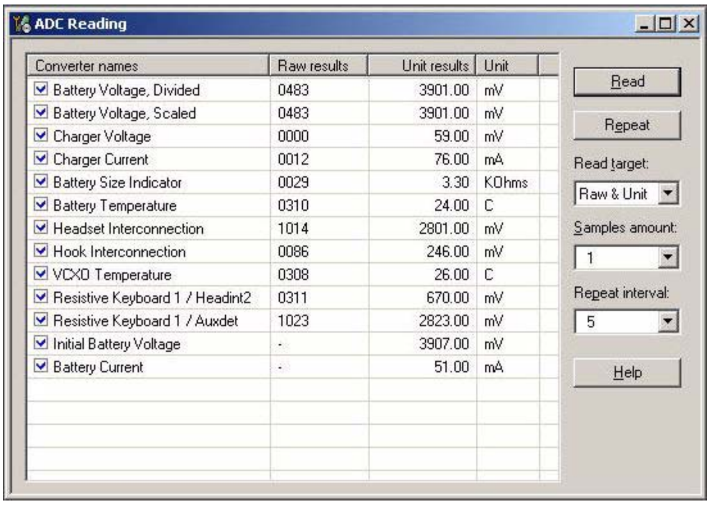
Inspect components that are connected to VCHAR line: filtering capacitors C134, C135, TVS V130, L130 and fuse F130. If those are OK, first change the current sense resistor R259, if calibration is still not successful, change UEME.

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

ADC reading

Divided and scaled battery voltage, battery current, charger voltage, charger current and BSI values can be read by this tool. Read values a few times before you can be sure that results are accurate.

Figure 12: ADC reading view



Maximum tolerances:

Reading	Check point	Tolerance
Vbatt SCAL	4.2V	±25mV
Vchar	8.4V	±40mV
Ichar	500mA	±20mV
BSI	75k (BL-5C)	±1.3kohm
Btemp	273K (47k)	±5K

Backup battery

Symptom of backup battery fault is:

Real Time Clock loses the correct time during short battery removal.

The same symptom can also be seen when the backup battery is empty. About 30 minutes is needed to fully charge the backup battery in the device.

NOTE: The backup battery is charged only 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 the backup battery is OK.

Measure the voltage of the backup battery.

- Normal operation when the voltage is > 2.0V.
- Fully charged when the voltage is about 3.2V.

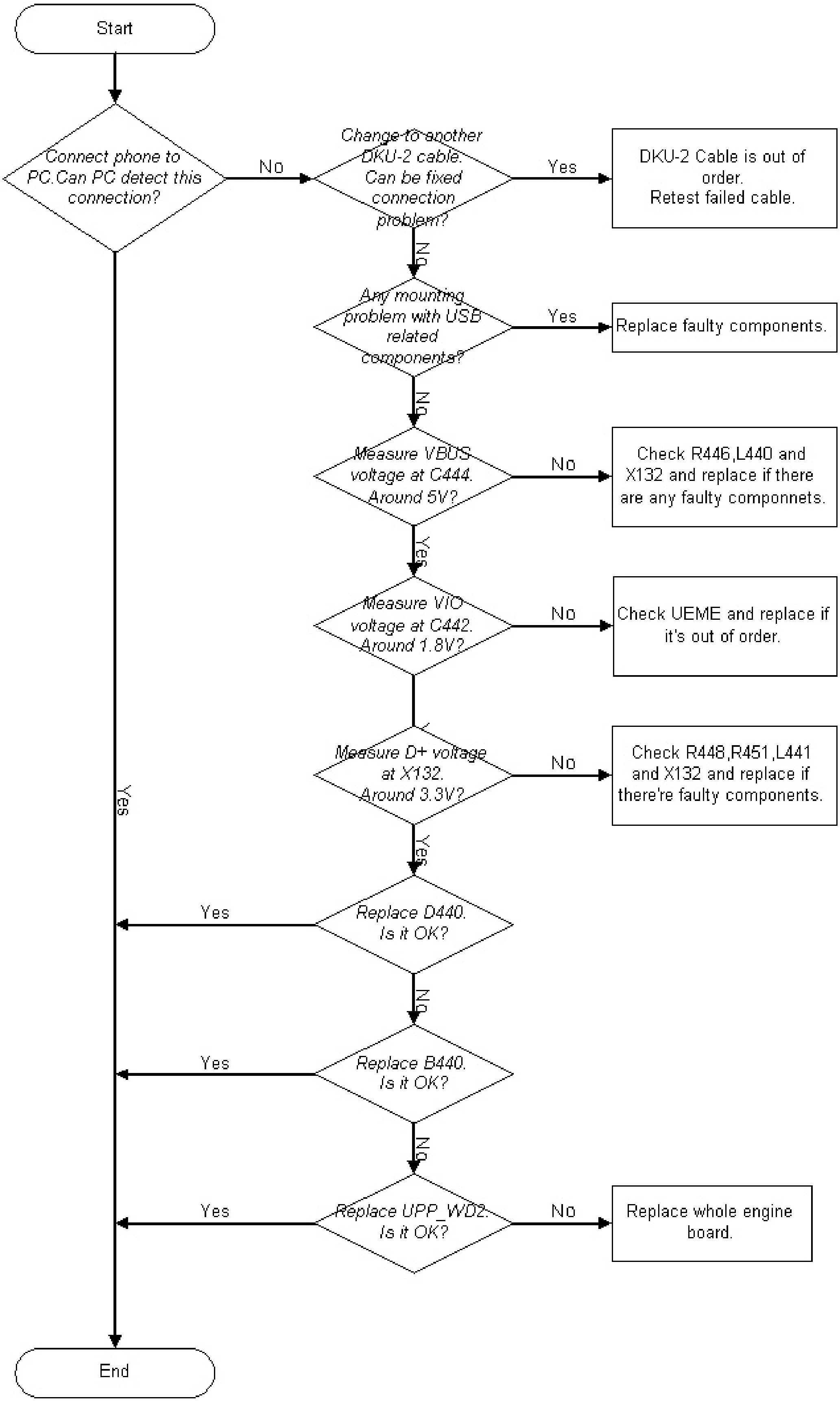
Enable the backup battery charging (start to charge the main battery or boot the device to LOCAL or TEST mode).

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

When the voltage is over 2.0V for sure, check the backup battery with Phoenix.

USB interface troubleshooting

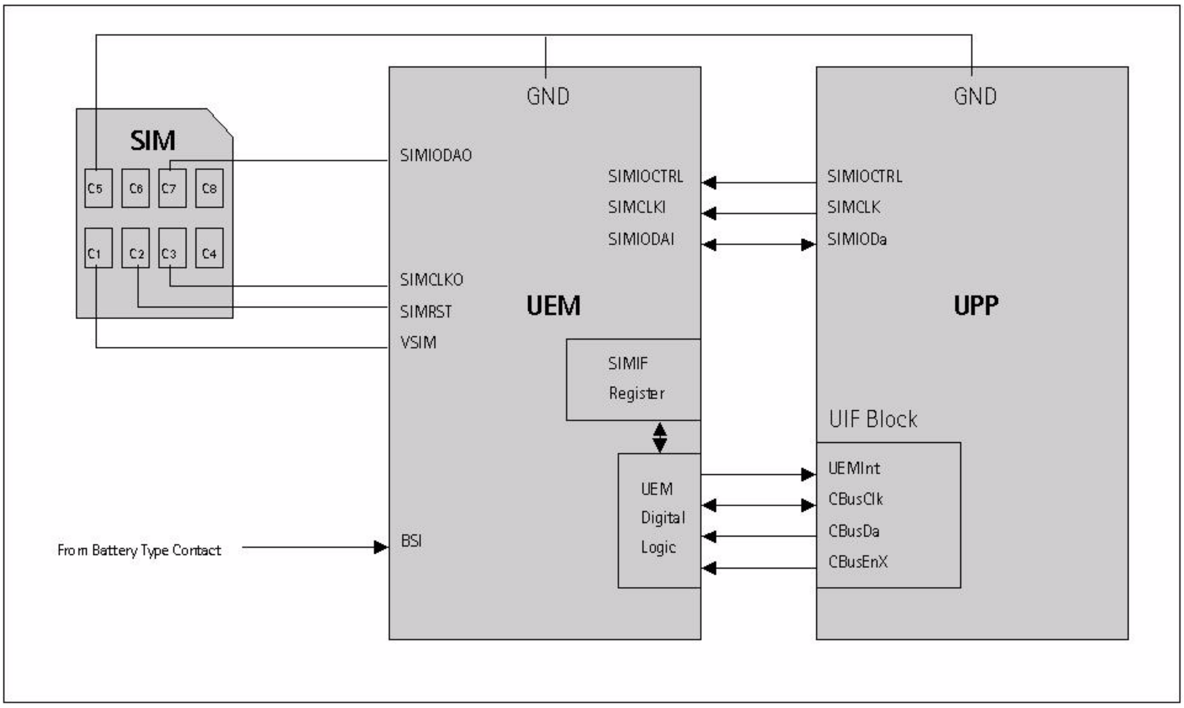
Figure 13: USB interface troubleshooting



SIM card fault

The whole SIM interface is located in two chips; UPP_WD2 and UEME. UEME contains the SIM interface logic level shifting. UPP_WD2 provides SIMClk through UEME to the SIM. The SIM interface supports both 3V and 1.8V SIMs. There is an EMIF component (3 lines EMI filter) between the SIM card and the UEME which isn't shown in the figure below.

Figure 14: UPP_WD2 and UEME SIM connections



The SIM power up/down sequence is generated in the UEME. This means that the UEME generates the RST signal to the SIM. The card detection is taken from the BSI signal, which detects the removal of the battery. A comparator inside UEME monitors the BSI signal. The threshold voltage is calculated from the battery size specifications.

First, the SW attempts to power up the SIM with 1.8V. If this does not succeed, power up is repeated with VSIM switched to 3V.

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

Figure 15: SIM power up waveform

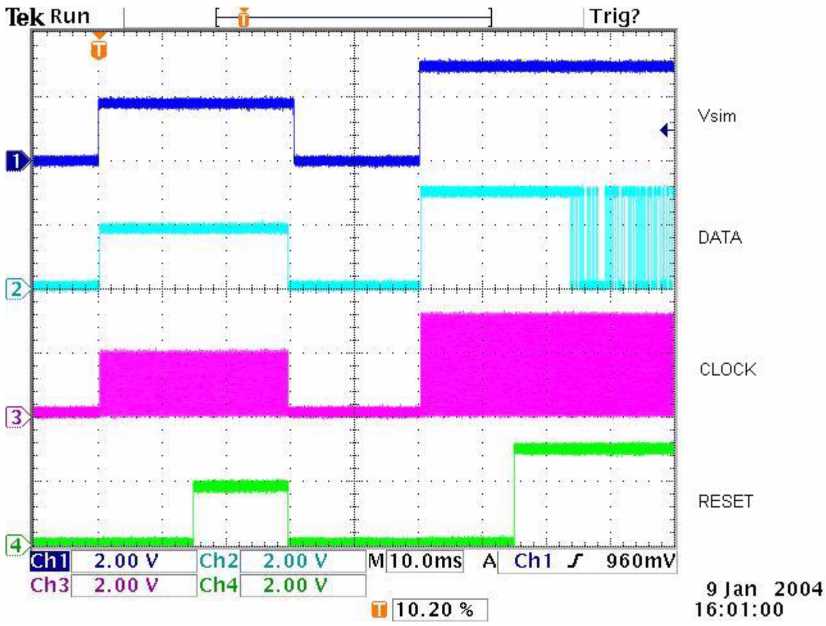
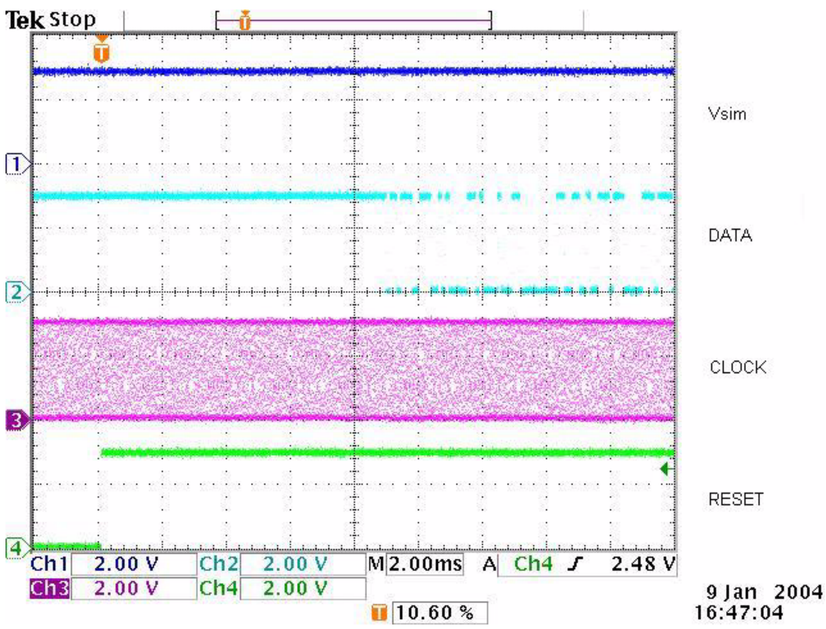
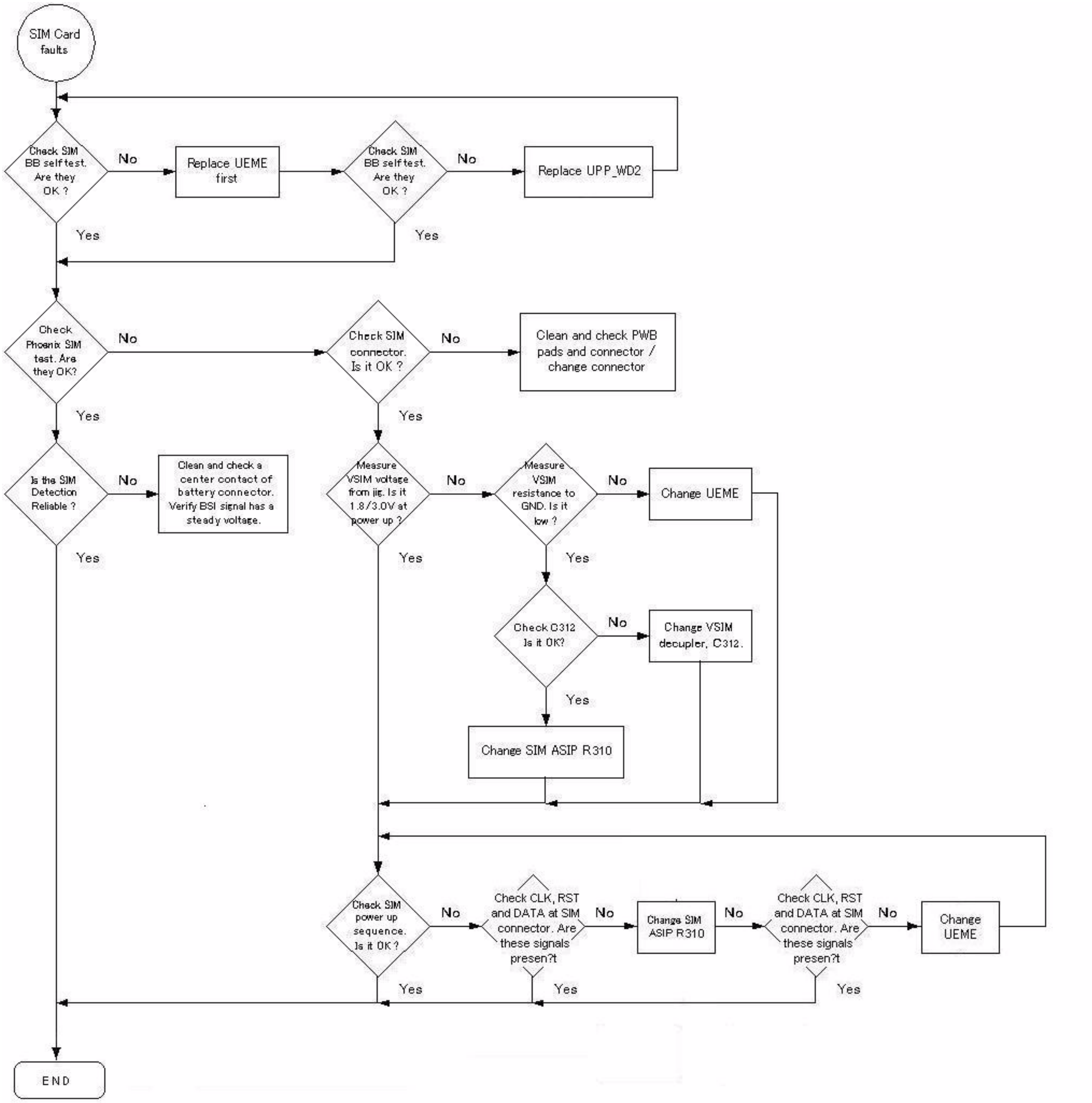


Figure 16: SIM answer to reset waveform



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

Figure 17: Insert SIM card troubleshooting



Keypad interface fault

Figure 18: Keypad troubleshooting 1

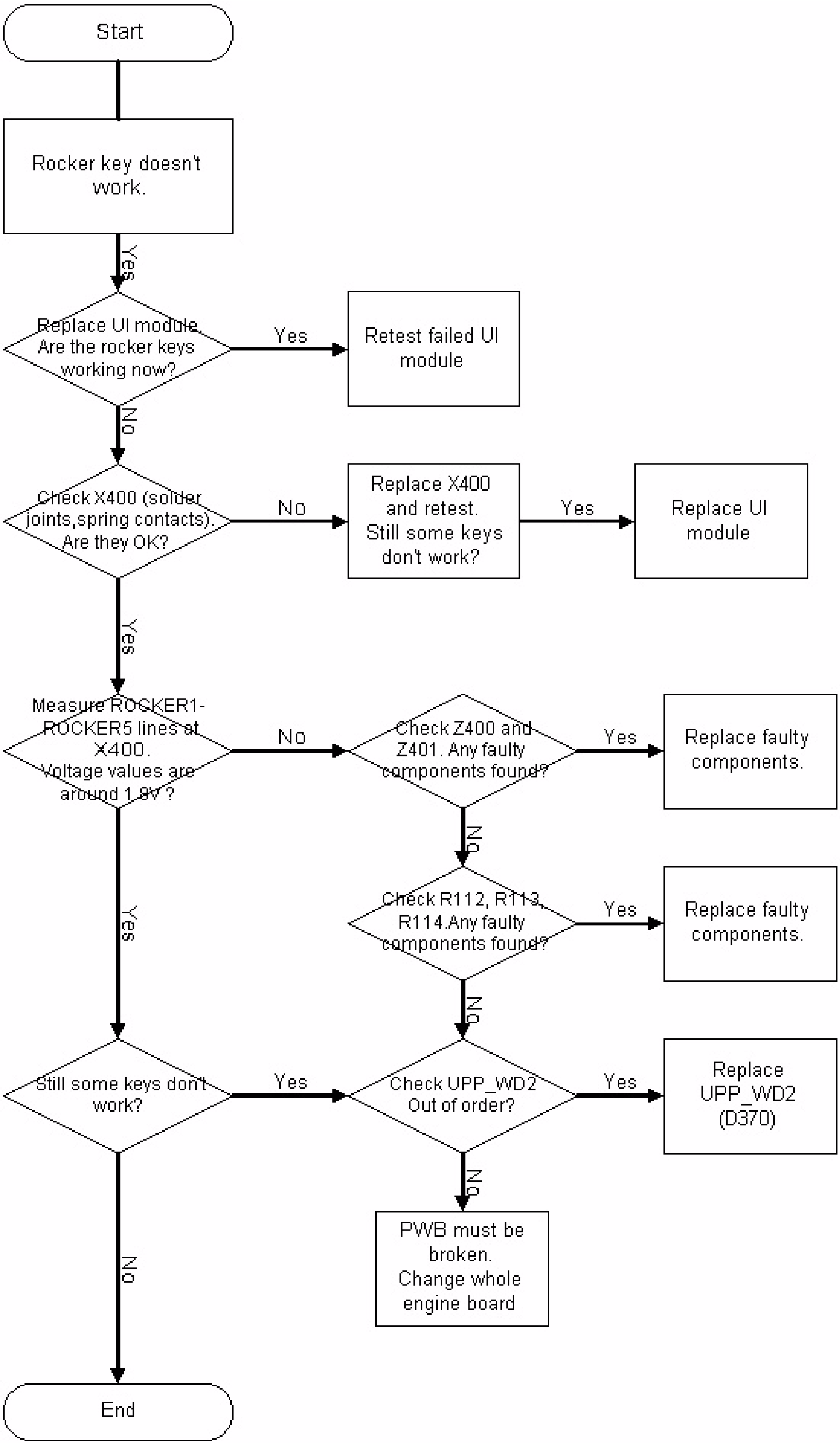
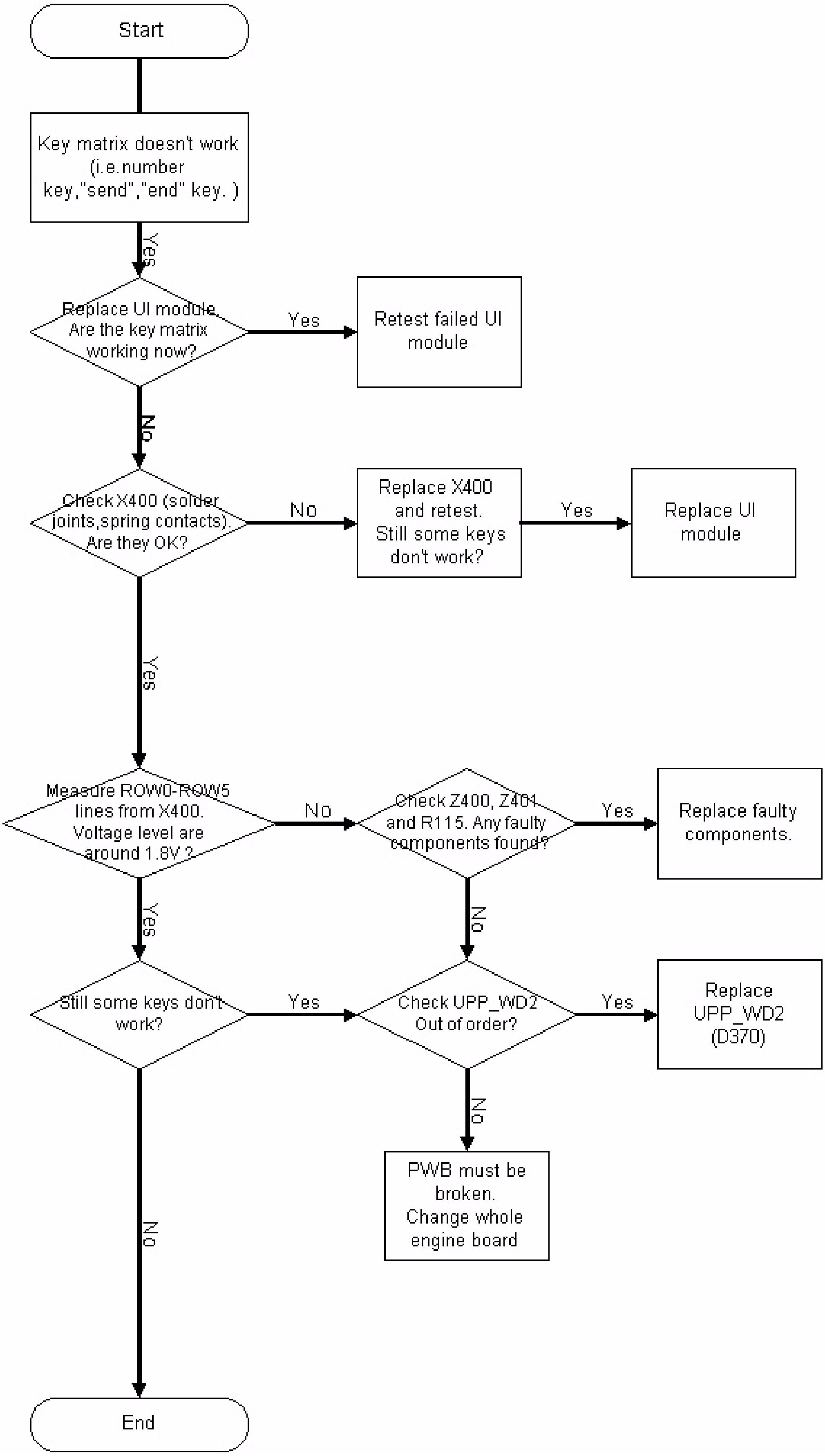
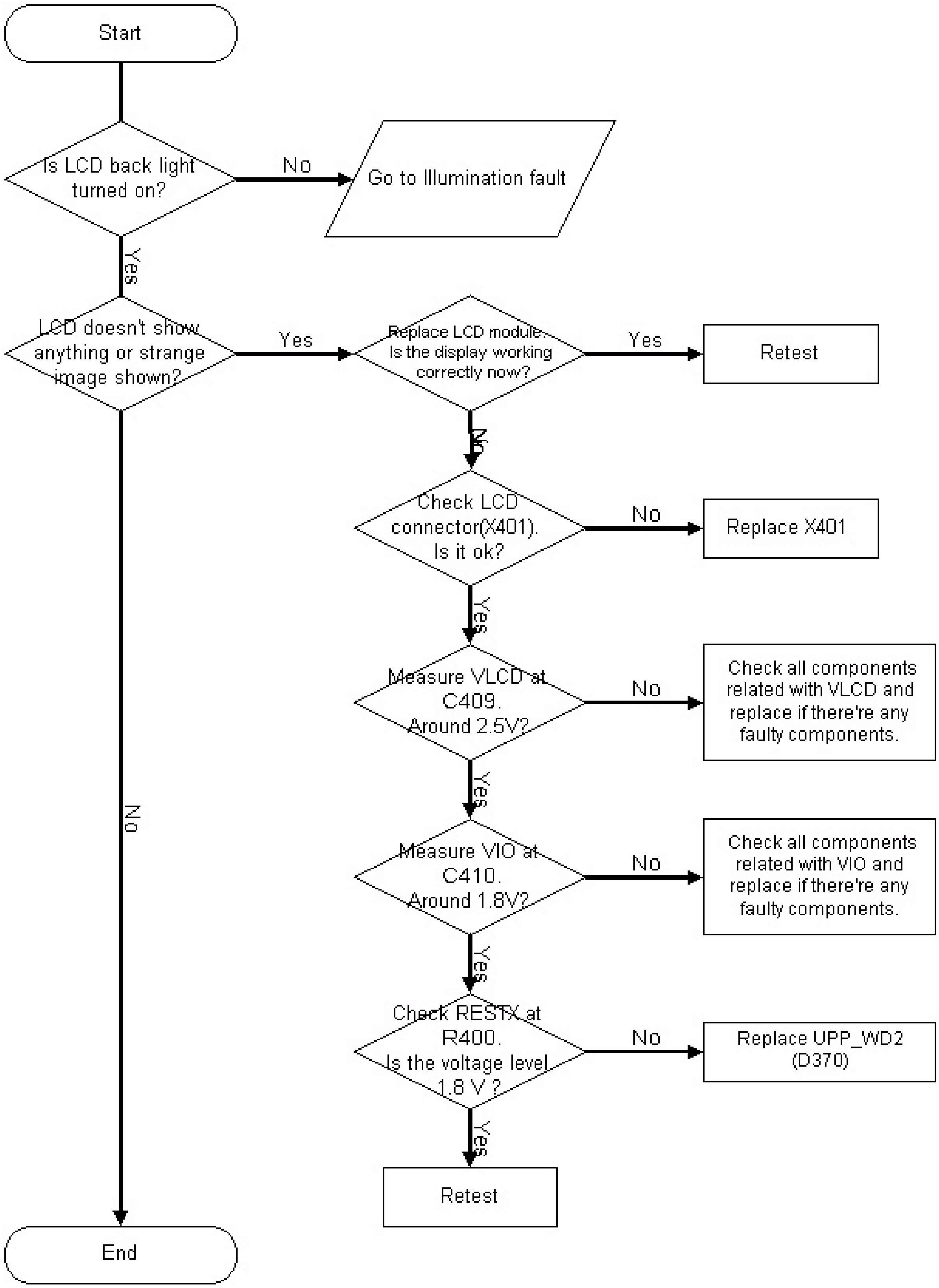


Figure 19: Keypad troubleshooting 2



Display fault

Figure 20: Display troubleshooting



Illumination fault (display/keyboard backlight)

Figure 21: Illumination troubleshooting 1

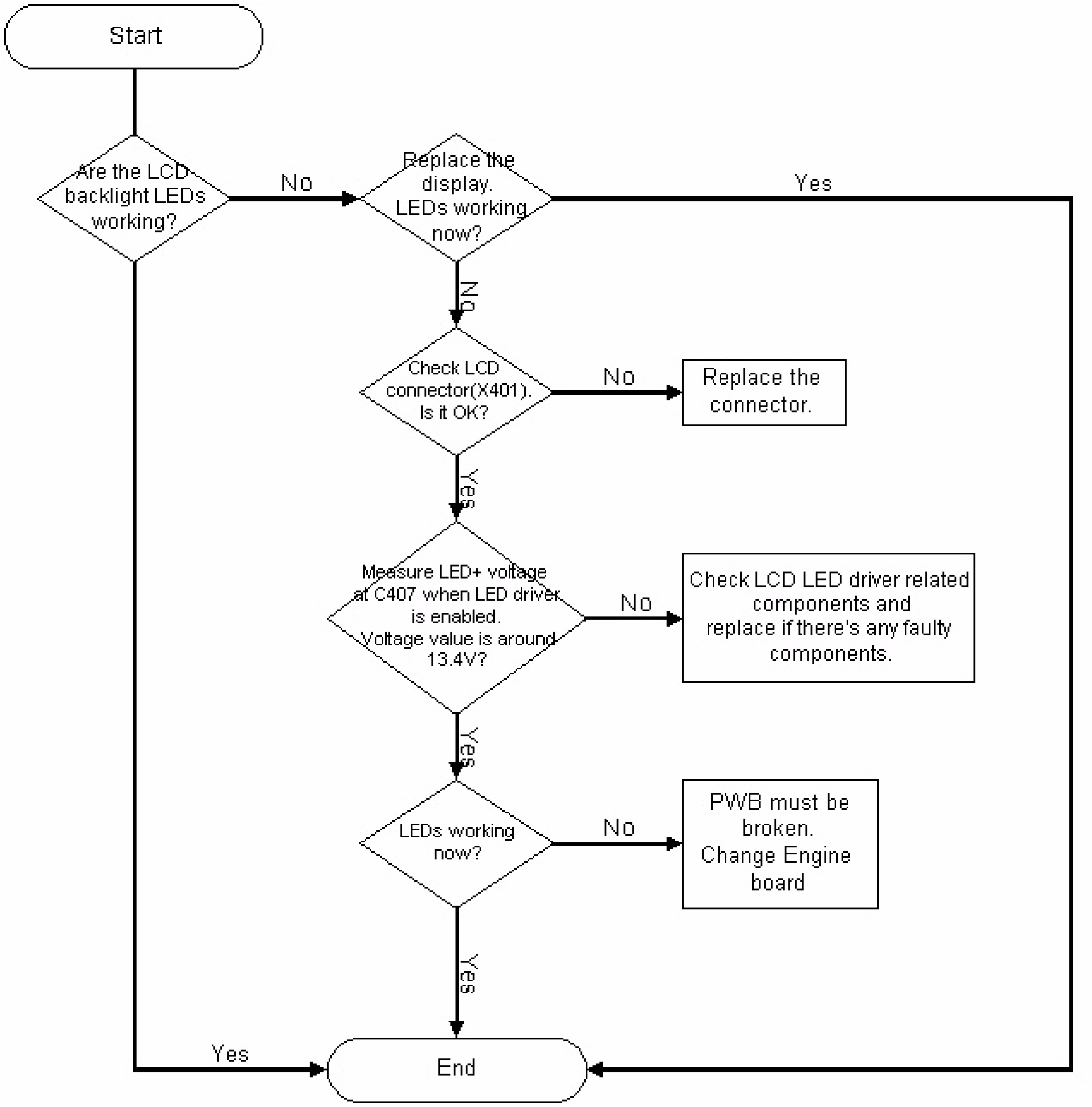
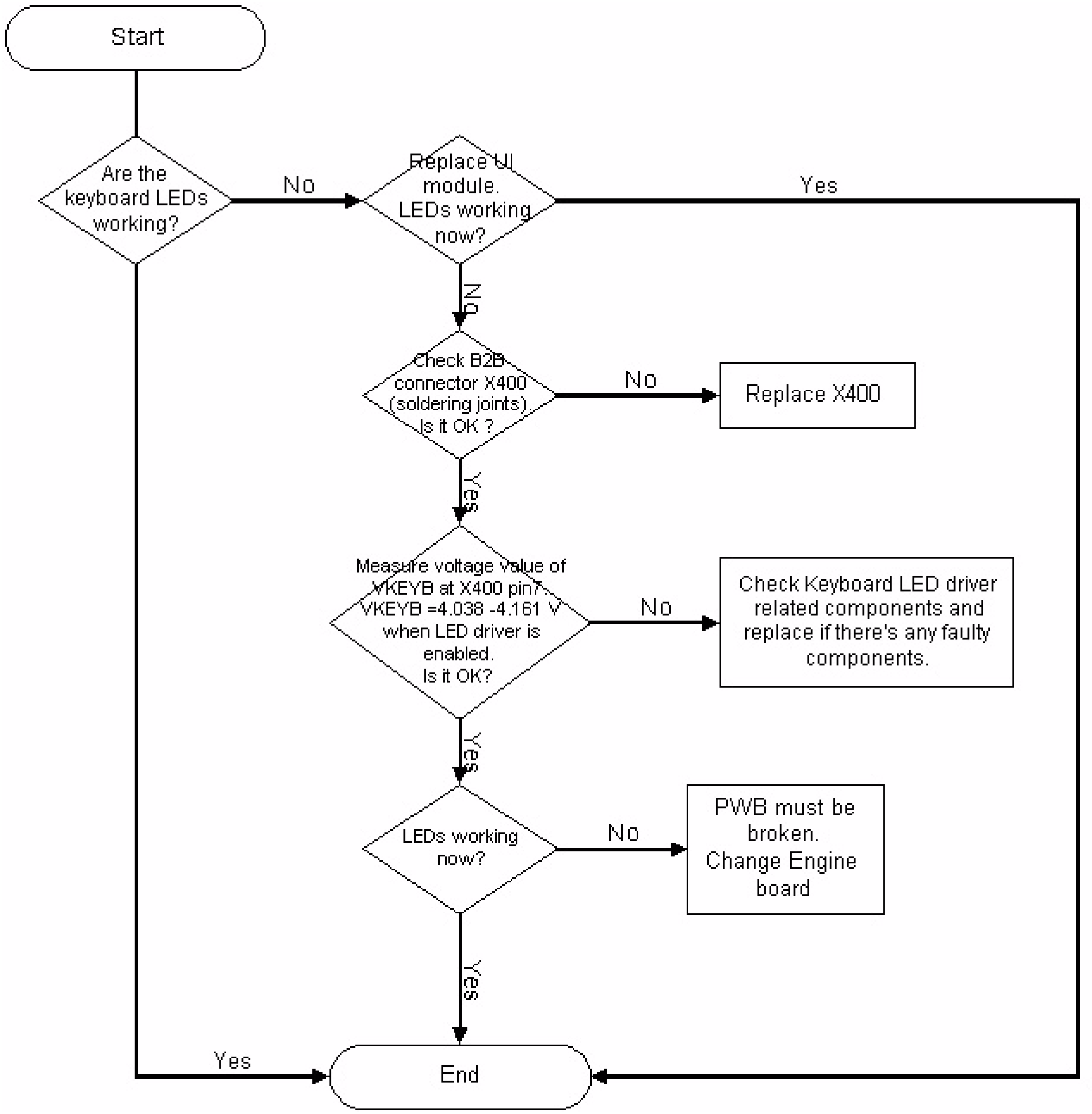


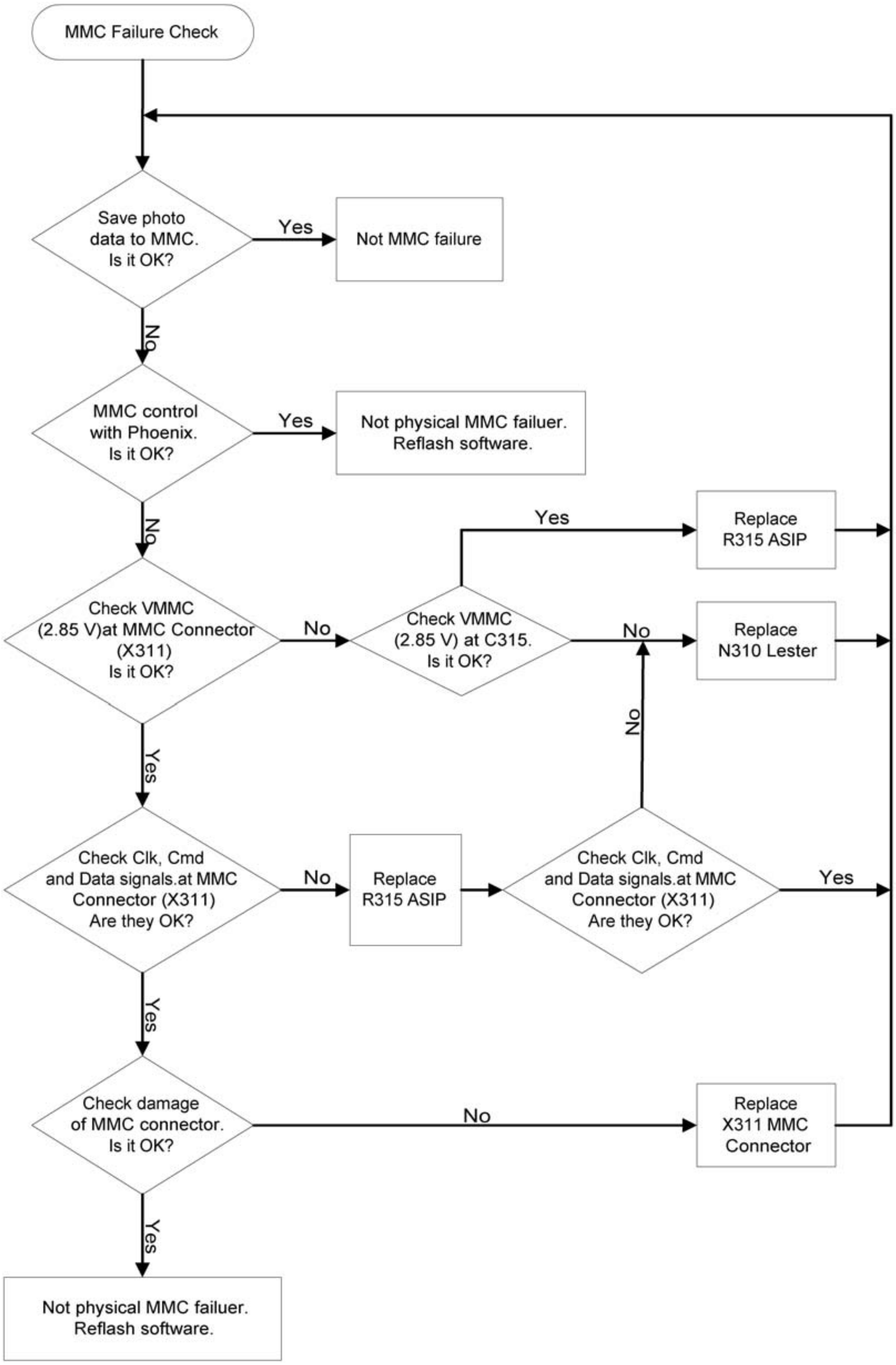
Figure 22: Illumination troubleshooting 2



MMC interface fault

Use with known working MMC to save the photo test. Target devices to replace are N310 Lester, R315 ASIP and X311 MMC connector. The MMC card itself might be broken, it should be checked as well.

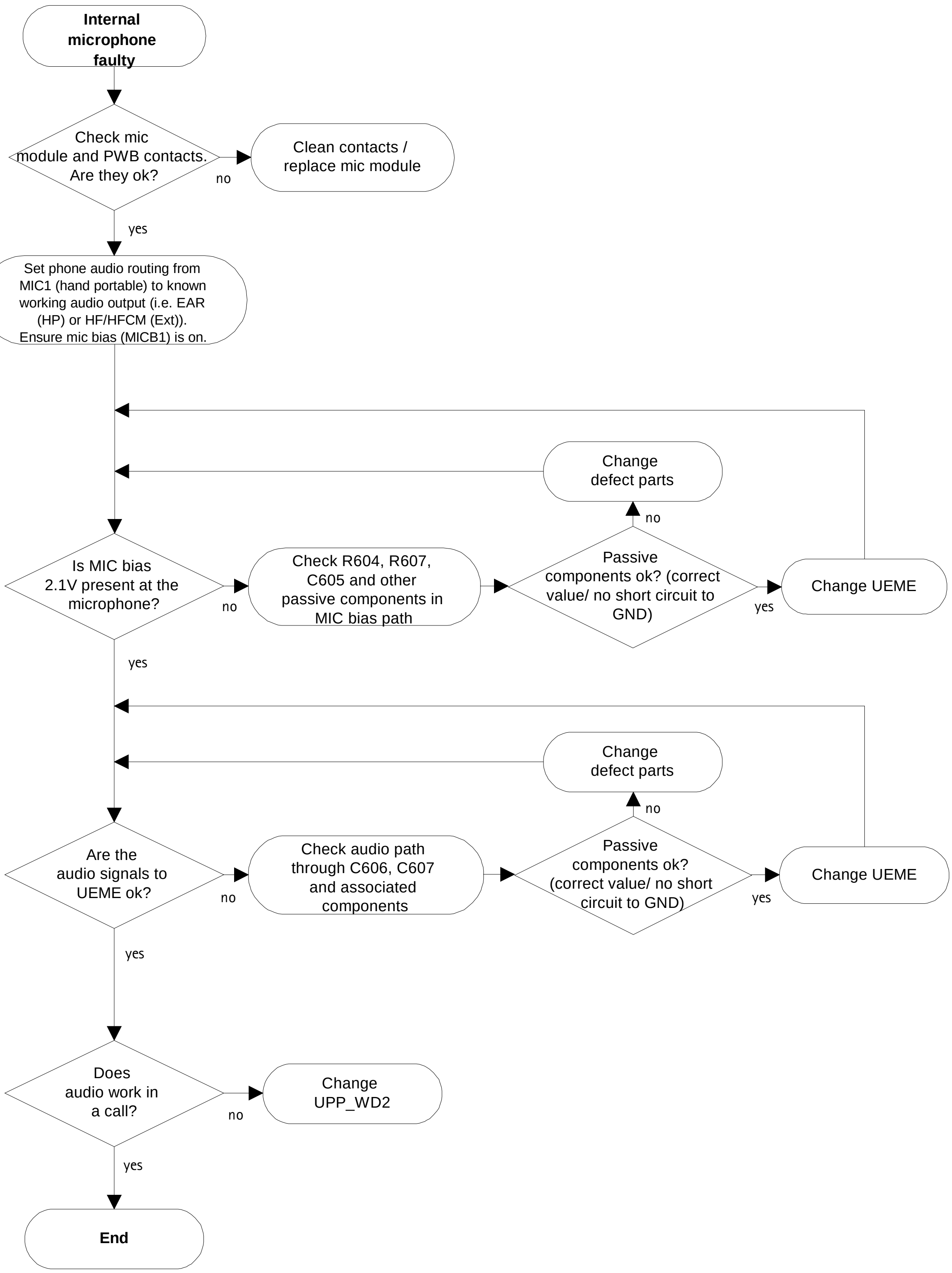
Figure 23: MMC troubleshooting



Audio troubleshooting

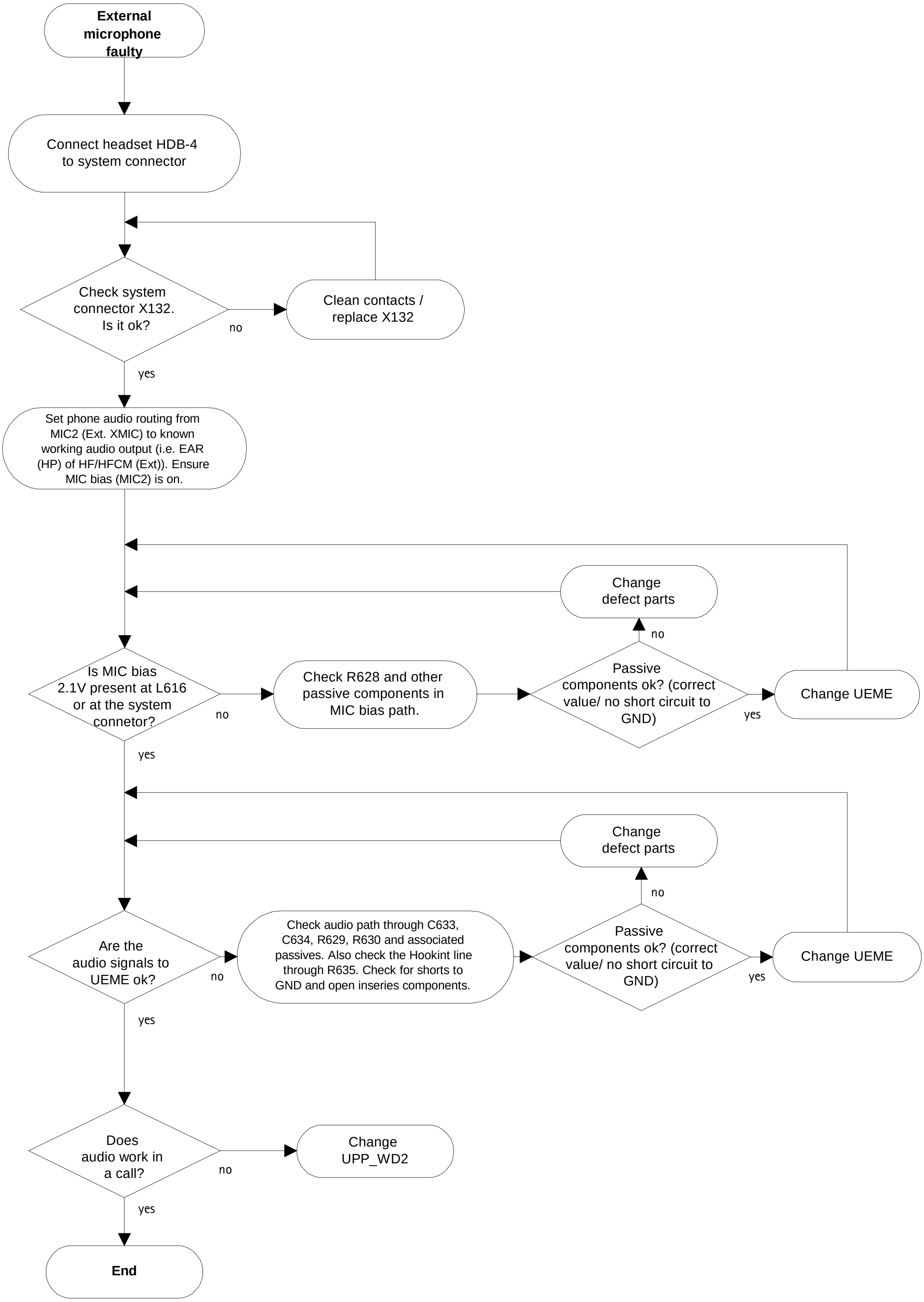
Internal microphone

Figure 24: Internal microphone troubleshooting



External microphone

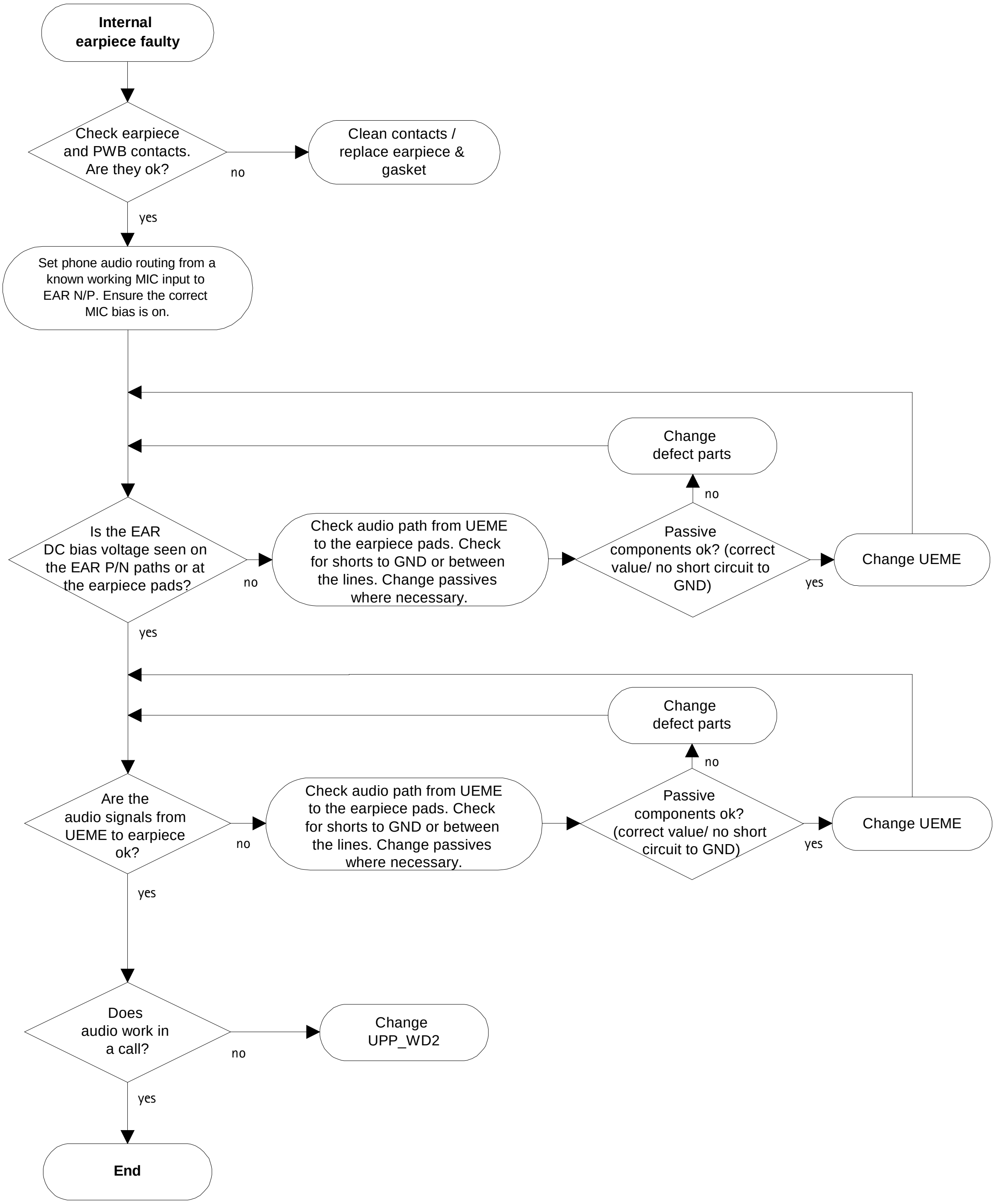
Figure 25: External microphone troubleshooting



Internal earpiece

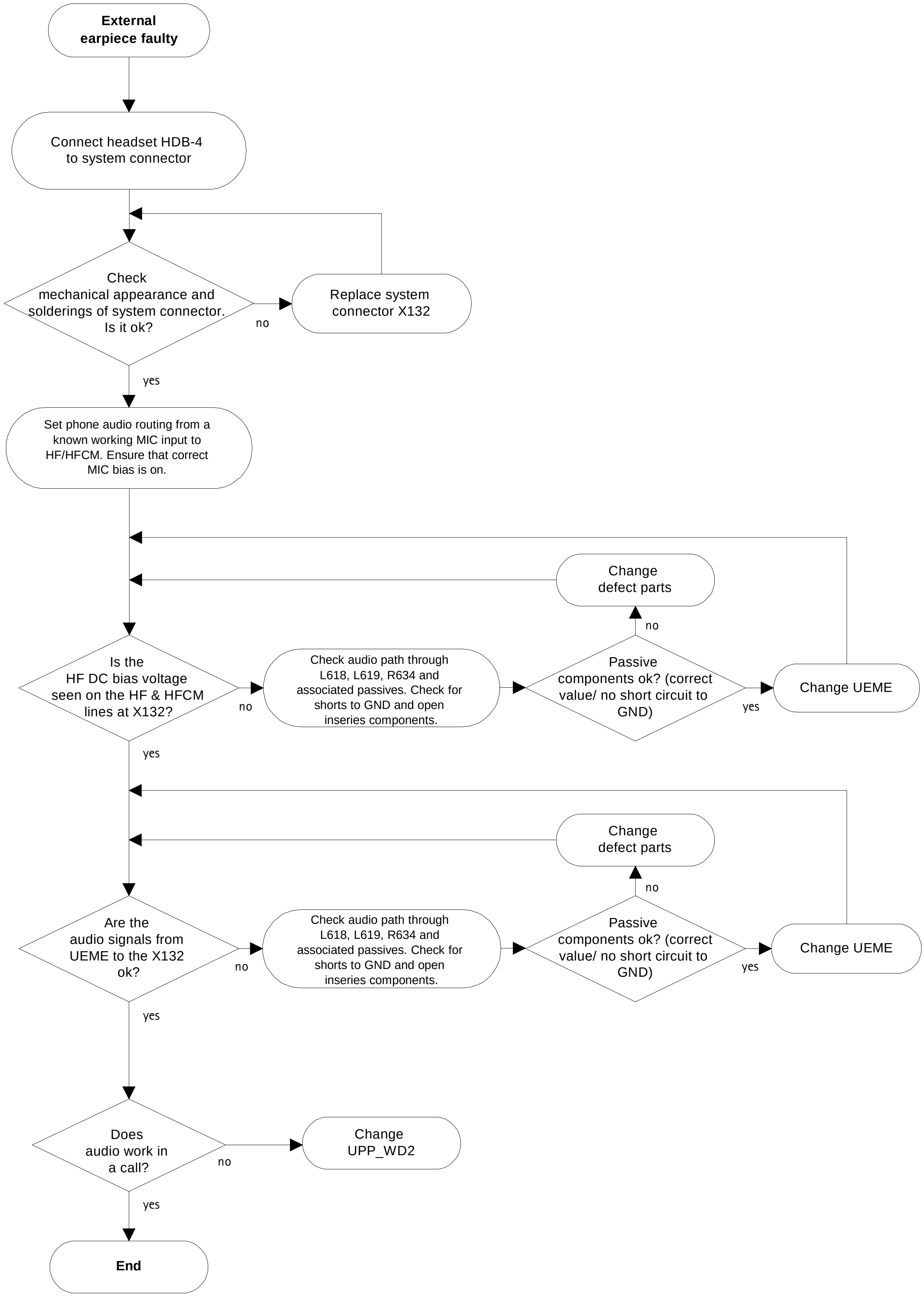
Check that holes are not coated.

Figure 26: Internal earpiece troubleshooting



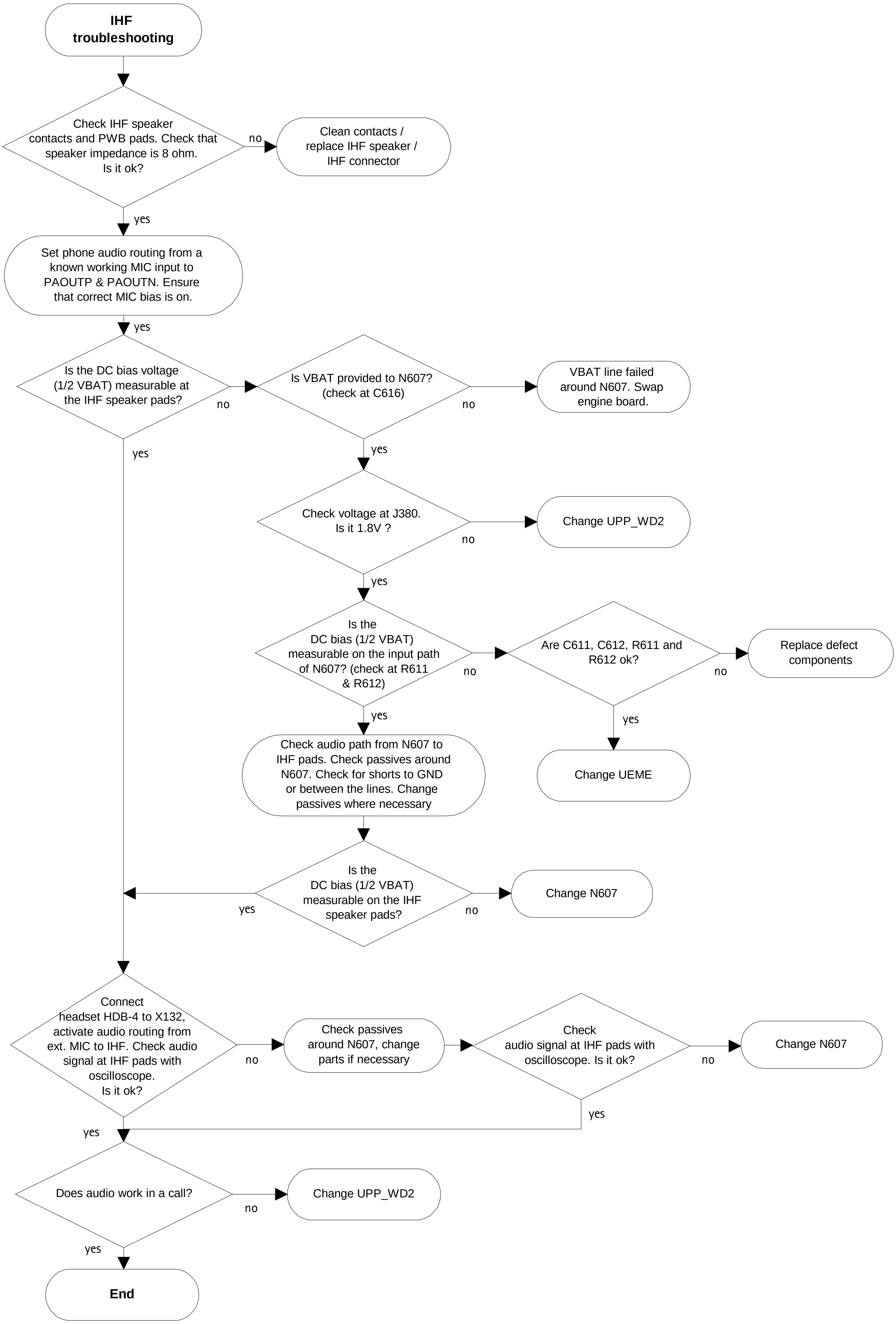
External earpiece

Figure 27: External earpiece troubleshooting



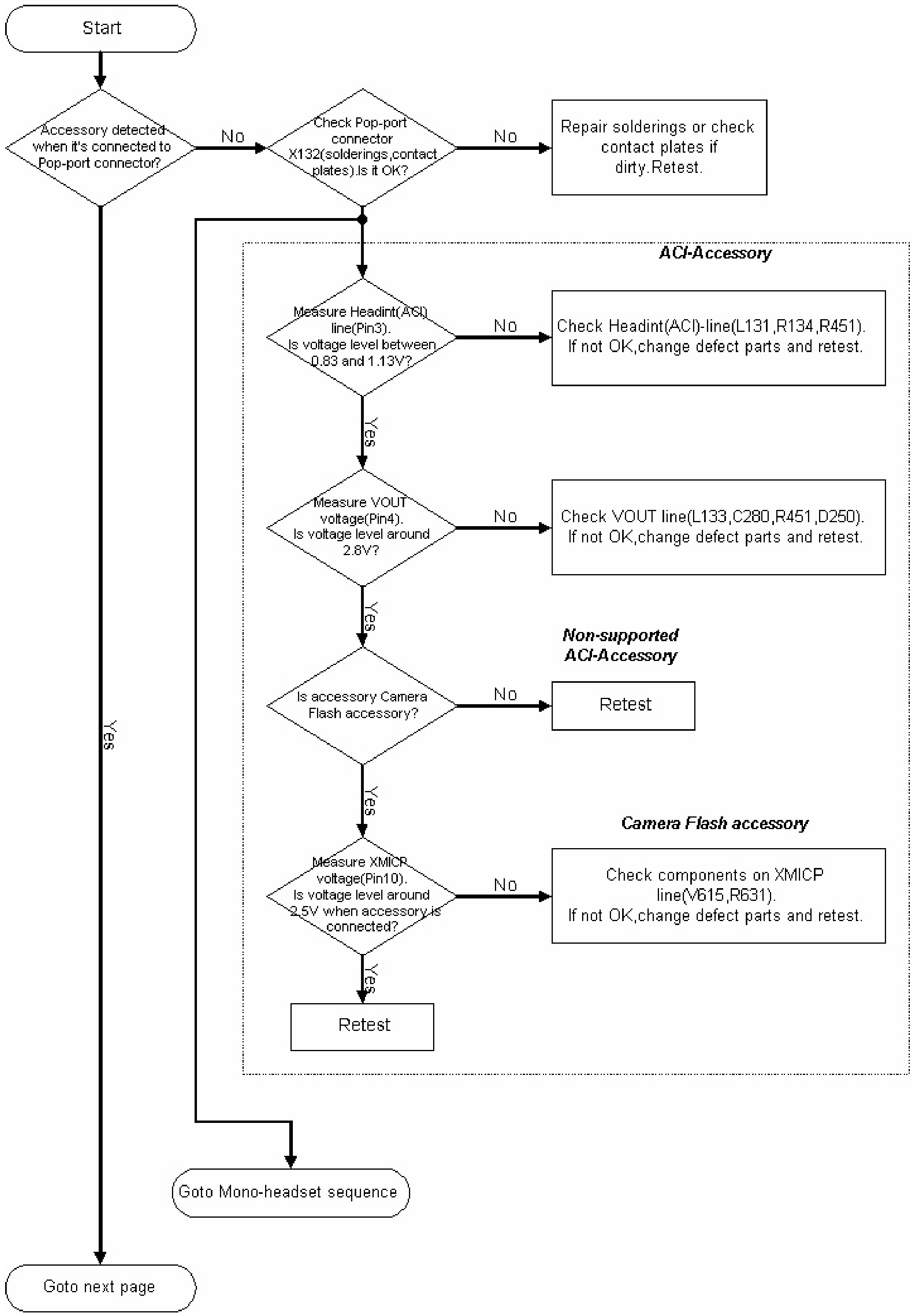
IHF

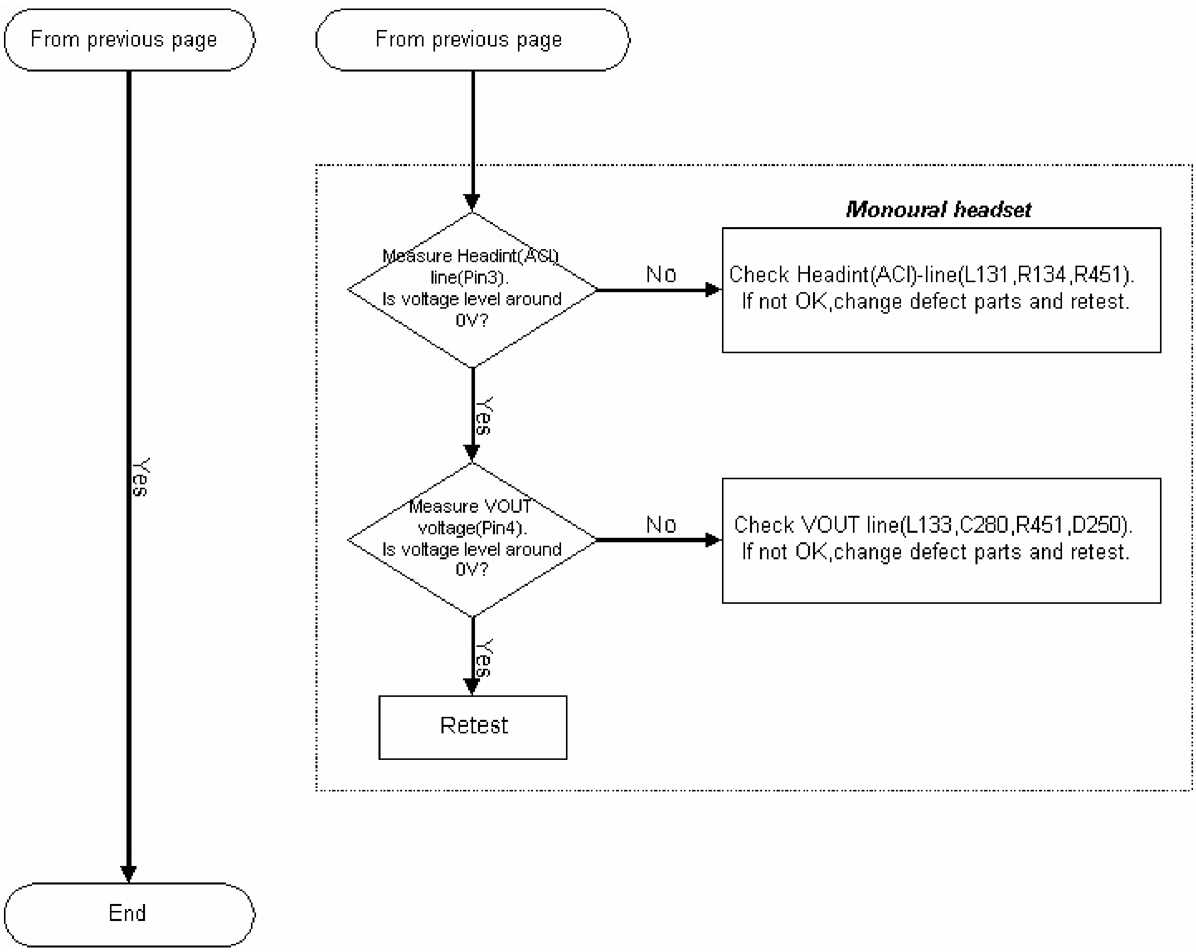
Figure 28: IHF troubleshooting



Accessory detection troubleshooting

Figure 29: Accessory detection troubleshooting




From previous page
From previous page
Monoural headset
Measure Headint(ACI) line(Pin3). Is voltage level around 0V?
No
Check Headint(ACI)-line(L131,R134,R451). If not OK,change defect parts and retest.
Yes
Yes
Measure VOUT voltage(Pin4). Is voltage level around 0V?
No
Check VOUT line(L133,C280,R451,D250). If not OK,change defect parts and retest.
Yes
Retest
End

Camera module troubleshooting

A fault associated to camera operation can be roughly categorized to three subgroups:

43 Camera is not functional at all, no image can be obtained.

44 Images can be taken but there is nothing recognizable in them.

45 Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded.

Image quality is very hard to measure quantitatively, and even comparative measurements are difficult (comparing two images) if the difference is small. Especially, if the user is not satisfied with his/her device's image quality, and tells e.g. that the images are not sharp, it is very difficult to test the device and get an exact figure which then would tell if the device is OK or not.

Most often, subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training and a correctly operating reference device maybe needed in order to detect what actually is wrong, or is there anything wrong at all. It is easy for the user to take bad looking images in bad conditions; thus the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known to be good device as a reference. Experience significantly helps in analysing image quality.

Terms

Dynamic range: The camera's ability to capture details in dark and bright areas of the scene simultaneously.

Exposure time: The camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to the light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically, i.e. there is no mechanical moving parts like in film cameras.

Flicker: A phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in image.

Noise: Variation of response between pixels with the same level of input illumination. See e.g. Figure "Noisy image taken in +70deg" for an example of a noisy image.

Image taking condition effect on image quality

This chapter lists some of the factors, which may cause poor image quality if not taken into account, and thus result in complaints from customers.

Several issues affect the image quality and will need to be taken into account when shooting pictures; the listed items are normal to camera operation.

Distance to target

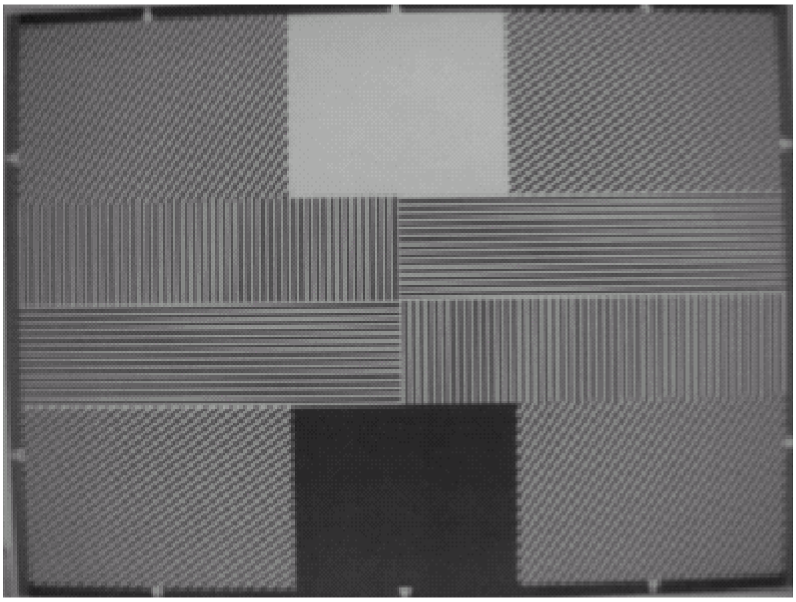
The lens in the module is specified to operate satisfactorily from 40 cm to infinite distance of scene objects. In practice, the operation is such that close objects may be noticed to get more blurred when distance to them is shortened from 40 cm. Lack of sharpness will be first visible in full resolution (1Mpixel) images. If observing just the viewfinder, even very close objects may seem to appear sharp.

Sharpness of picture edges

The lens performance degrades in image edges, and generally the image is sharpest in the center part. Particularly this applies to distant objects (> 1 meter).

See the following figure.

Figure 30: Sharpness of picture is worse in edges than in center



Geometrical distortion

The camera lens will cause some amount of so called barrel distortion in images. In practice, this appears as bending of straight objects in edges of the image.

See the figure below. Note geometrical barrel distortion in background for example (wall in the background).

Amount of light available

In dim conditions the camera runs out of sensitivity. Exposure time is long (especially in night mode) and the risk of getting shaken images grows. Image noise level grows. The maximum exposure time in night mode is approximately ¼ seconds, so images need to be taken with extreme care when the amount of light reflected from the target is low.

Figure 31: Shaking hands caused blurring of this image. Note geometrical barrel disortion in background.

Movement in bright light

If pictures of moving objects are taken or if the device is used in a moving car, object 'skewing' or 'tilting' will occur. This phenomenon is fundamental to most CMOS cameras, and can not be helped. Movement of camera or object will usually cause blurring in inside or dim lighting conditions due to long exposure time.

Figure 32: Near objects in image get skewed when shooting from a moving car

Temperature

High temperatures inside the mobile phone will cause more noise to appear in images, e.g. in +70°C the noise level may be very high, and it further grows if the conditions are dim. This is also normal to camera operation. (See the following figure.)

Figure 33: Noisy image taken in +70deg

Display

If the display contrast is set too dark, the image quality degrades quite much: the images may be very dark, naturally depending on the setting. This flaw is easily cured by setting the display contrast to correct value.

Basic rules of photography, especially shooting against light

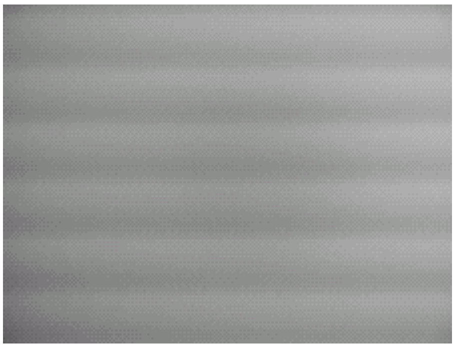
Electronic image sensors typically have a much lower dynamic range than films. In practice, this means that when taking a picture inside e.g. having a window behind the object, will produce poor results.

Figure 34: Image which has been taken "against the light". The actual object (a squirrel) can't be seen well

Flicker

In some rare occasions a very bright fluorescent light may cause flicker to be seen in the viewfinder image.

Figure 35: Flicker in image of white uniform object illuminated by strong fluorescent light



Bright light outside of image view

Especially sun causes clearly visible 'halo' effects and poor contrast in images. This happens due to unwanted reflections inside camera optics.

Figure 36: A lens reflection effect caused by sun shining above the scene

Figure 37: A good quality picture taken indoors

Note: The camera module as a component is not a repairable part, i.e. components in the module may not be changed. Cleaning dust from the front face is the only allowable operation.

Image quality analysis

Possible faults in image quality

When checking for possible errors in camera functionality, knowing what error is suspected will significantly help the testing by narrowing down the amount of test cases. The following types of image quality problems may be expected to appear (in order of appearance probability):

- Dust (black spots)
- Lack of sharpness
- Bit errors

In addition, there are many other kinds of possibilities for getting bad image quality, but those are ruled out from the scope of this document since probability of their appearance is going to be minimized by production testing.

Testing for dust

For detecting this kind of problems, take an image of uniform white surface and analyse it in full resolution; search carefully – finding these defects is not always easy. See the following figure.

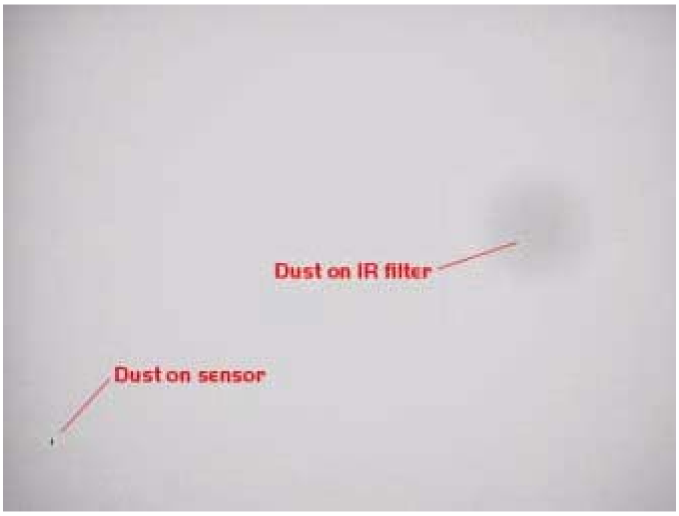
Effects of dust in the optical path are an example of image containing easily detectable dust problems.

Black spots in image are caused by dirt particles trapped into the optical system: clearly visible and sharp edged black dots in image are typically dust particles on the image sensor.

These spots are searched for in the manufacturing phase, but it is possible that the lens holder cavity contains a particle, which may move onto the image sensor active surface, e.g. when the phone is dropped. Thus, it is also possible that the problem will disappear before the phone is brought to service. The camera should be replaced if it has been in some phase verified that the problem has been present.

If dust particles are located on infrared filter surface on either side, they are much harder to locate because they will be out of focus, and appear in image as large, greyish and fading-edge 'blobs'. Sometimes they will be very hard to find, and thus the user probably will not notice them at all since they do no harm. But it is possible that a larger particle disturbs the user, causing need for service.

Figure 38: Effects of dust in optical path



If large dust particles get trapped on top of the lens surface in the cavity between camera window and lens, they will cause image blurring and poor contrast (see also item 'sharpness'). The seal between the window and lens should prevent any particles from getting into the cavity after manufacturing phase.

If dust particles are found on the sensor or are suspected to be inside the camera module, this is classified as a manufacturing error of the module and thus the camera should be replaced. The particles inside the cavity between window and lens have most probably been trapped there in the assembly phase in the factory. It is of course also possible that the user has disassembled the device and caused the problem. However, in most cases it should be possible to remove the particle(s) by using compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial.

Always check the image sharpness after removing dust.

Testing for sharpness

If pictures taken with a device are claimed to be blurry, there are four possible sources for the claim:

- The user has tried to take pictures in too dark conditions and images are blurred due to handshake or movement. No need to replace camera module.
- There is dirt between the back window and camera lens.
  The back window is defective. Window should be changed.
- Back window is visibly scratched, broken or dirty.
- Camera lens is misfocused.

Quantitative analysis of sharpness is very difficult to conduct in other than optics laboratory environment. Thus subjective analysis should be used.

If no visible defects (items 2-4) can be found, a couple of test images should be taken and checked. Generally, a well illuminated typical indoor office scene, such as the one in Figure "A good quality picture taken indoors", can be used as a target.

The main considerations are:

Amount of light: 300 – 600 lux (bright office lighting) is sufficient.

The scene should contain e.g. small objects for checking sharpness and distance to them should be in order of 1 – 2 meters

If possible, compare the image to another image of the same scene, taken by different device.

The taken images should be analysed on PC screen at 100% scaling simultaneously with reference image. Pay attention to the computer display settings; at least 65000 colors (16bit) have to be used. 256 (8-bit) color setting is not sufficient, and true color (24bit, 16 million colors) or 32 bit (full color) setting is recommended.

If there appears to be a clearly noticeable difference between the reference image and the test images, the module might have misfocused lens. In this case, the module should be changed. Always re-check the resolution after changing the camera. If a different module produces the same result, the fault is probably in the camera window. Check the window by looking through it when replacing the module.

Bit errors

Bit errors are defects in image caused by data transmission error between the camera and phone baseband. This type of error is expected to be rare since usually missing bits will cause a hardware failure message. Bit errors can be typically seen in images taken of any object, and they should be most visible in full Mega pixel resolution images.

Viewfinder images may not contain the errors at all due to lower bit rate used in this mode.

A good practice is to use uniform white test target.

The errors will be clearly visible as colorful sharp dots or lines in camera Mega pixel images.

Camera hardware failure troubleshooting flow

If camera related hardware is faulty, follow the troubleshooting sequence below.

Figure 39: Camera HW troubleshooting

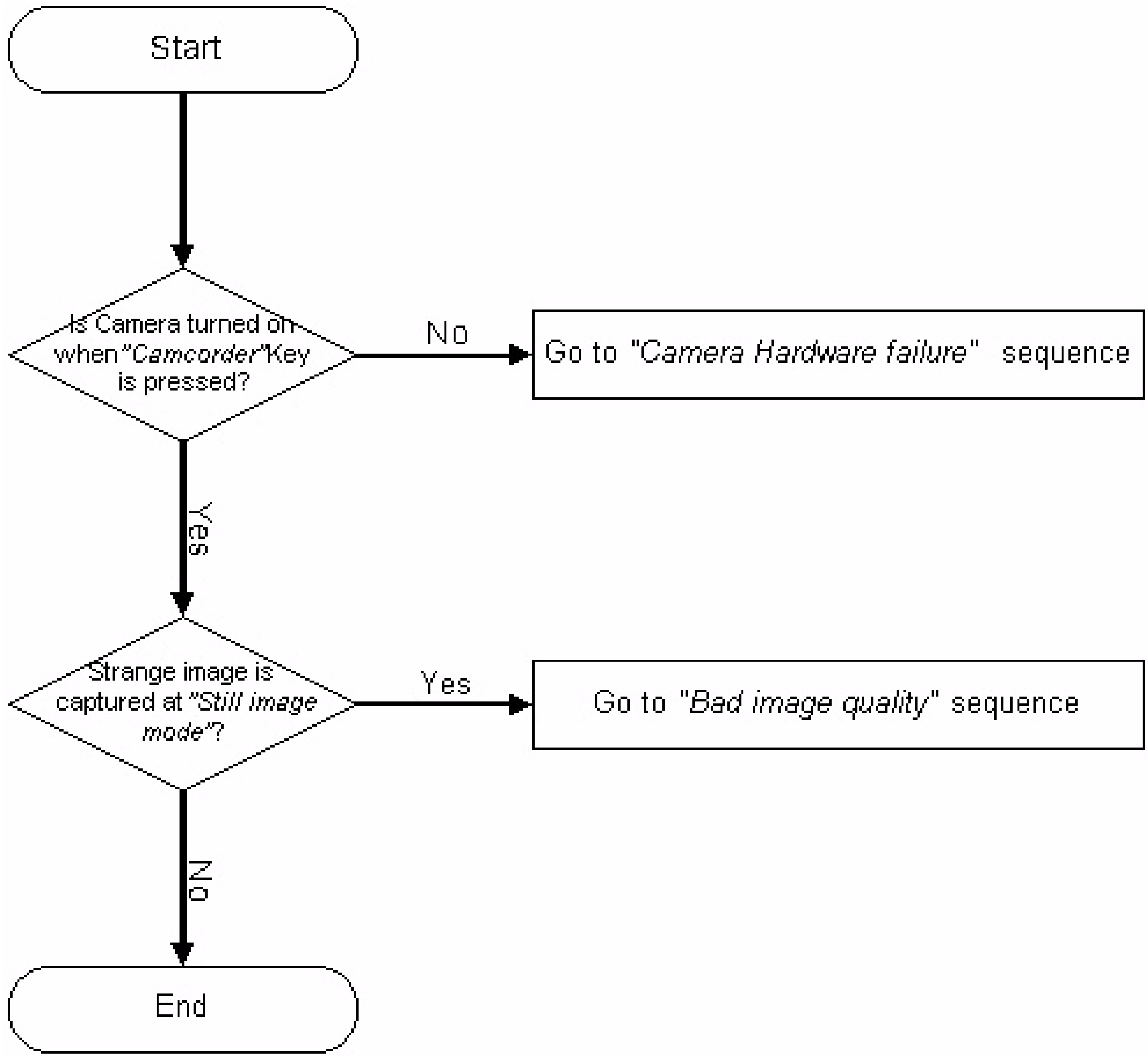
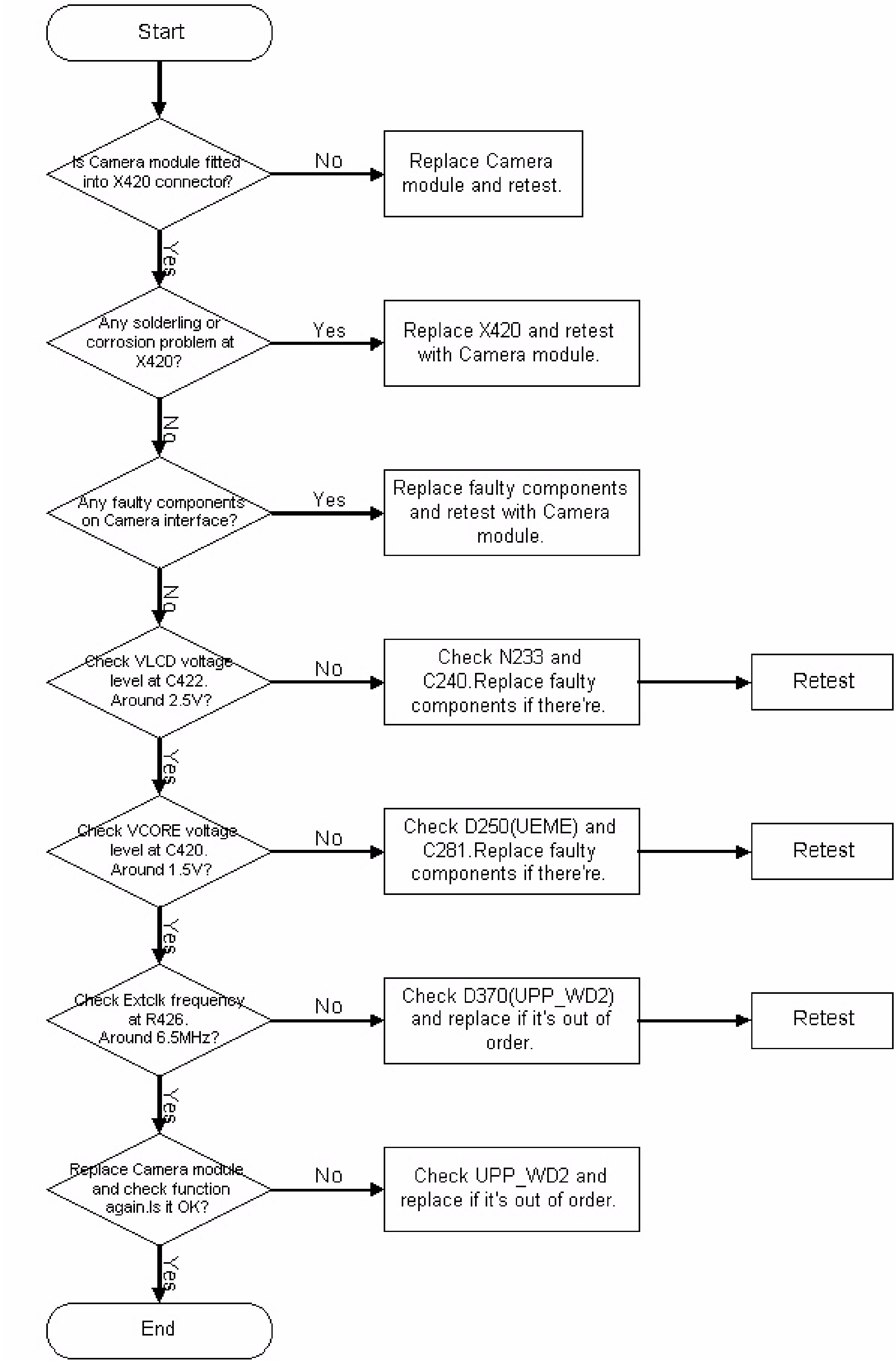
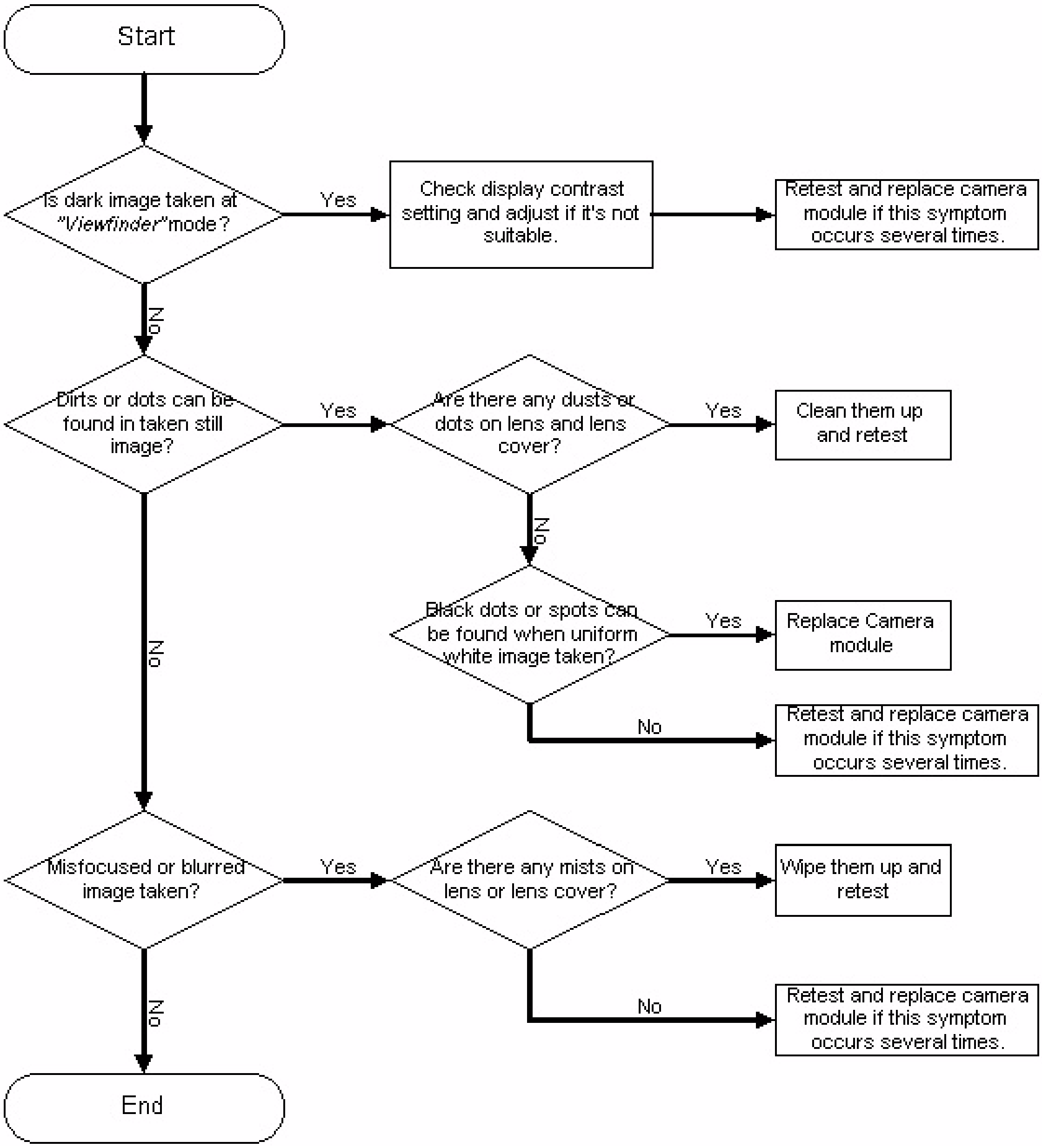


Figure 40: Hardware failure troubleshooting



Bad image quality

Figure 41: Bad image quality troubleshooting



Baseband tuning operation

Energy managment calibration is always required when the following components are changed.

- charging related components
- ZOCUS (N130) and related components
- UEME (D250) and related components
- BSI related components

Energy management calibration

EM (Energy Management) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (i.e. battery voltage, BSI, charger voltage, charger current).

This is to get accurate conversion result of AD converter.

HW setup

"JBV-1 service concept" is needed.

An external power supply is needed.

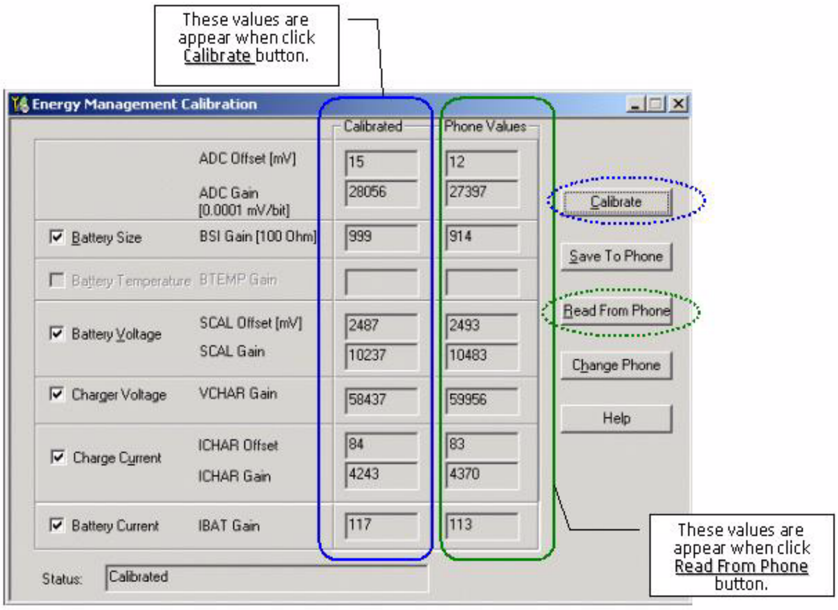
The RH-51/52, RH-67/68 phone must be connected to JBV-1 (docking station) with DA-18 (docking station adapter).

- Connect SCB-3 (DC-DC cable) between JBV-1 and charger connector of phone for charger channel calibration.
- Supply 11-16V DC from an external power supply to JBV-1 to power up phone.

Phoenix SW setup

- Start Phoenix service software.
- Select FBUS connection.
- Choose Main -> Choose product-> RH-51, -52, -67 or -68.
- Choose Tuning -> Energy Management Calibration.

Figure 42: EM calibration window



Calibration procedure with JBV-1

Select "Read from phone" to show the current values in the phone memory, and then check that the communication with the phone works.

Select "JBV-1 used" check box.

Select the item(s) you try to calibrate.

Note: ADC has to be calibrated before other item(s). If the ADC value is correct or you calibrate ADC and other items at the same time, that's OK.

Select "Calibrate".

Calibration is carried out automatically regarding the calibration item(s) that you selected.

The candidate of the new calibration values is shown in the "calculated" field. If the new calibration values seem to be reasonable (please refer to the calibration value limit table), select "Write to PM" to store the new calibration value in the phone permanent memory.

Select "Read from phone" and confirm that the new calibration values are stored in the phone memory correctly. If not, please try to store by selecting "Write to PM" again.

Close the Energy Management Calibration widow.

Parameter	Min.	Max.
ADC Gain	26500	28500
ADC Offset	-50	50
BSI Gain	950	1100
VBAT Gain	10000	11000
VBAT Offset	2300	2900
VCHAR Gain	58000	62000
ICHAR Gain	3750	4650
ICHAR Offset	0	150
IBAT Gain	50	160

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