Nokia Customer Care

Service Manual

RX-51 (Nokia N900; L3&4)

Mobile Terminal

Part No: (Issue 1)

COMPANY CONFIDENTIAL

NOKIA
Care

Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	09/2009	MT	

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IMPORTANT

This document is intended for use by qualified service personnel only.

Warnings and cautions

Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.

ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.

Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.

Company policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Business Group should be notified in writing/e-mail.

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Battery information

Note: A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Li-Ion batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.

Nokia N900; L3&4 Service Manual Structure

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1 — General Information

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Product selection

RX-51 is a quadband EGSM handportable LinuX computer supporting EGSM850/900/1800/1900 and WCDMA 2100/1700/900.

RX-51 is a 3GPP Release 5 terminal supporting WCDMA/HSDPA and GPRS data bearers. For WCDMA 900, 1700/2100, 2100 the maximum speed is PS 384/384 kbps (DL/UL); HSPA maximum speed is 10 Mbps (DL).

For 2G and 2.5G networks, RX-51 is a Class A GPRS, multislot 32, which means a maximum speed of up to 107/64.2 kbps (DL/UL).

RX-51 has Dual Transfer Mode (DTM) support for simultaneous voice and packet data connection in GSM/EDGE networks. The device supports EDGE class A, multislot class 32, with a maximum speed of 296/177.6 kbps (DL/UL), and Bluetooth 2.1 EDR standard. Bluetooth profiles HFP; HSP, A2DP, AVRCP; FTP, OPP are supported.

RX-51 is a LinuX computer with phone functionality, a large 3.5'' WVGA (800 x 480 pixels) display, landscape slider and Qwerty keyboard. The browser is a highly advanced Internet browser based on Mozilla technology, also capable of viewing operator domain XHTML Mobile Profile.

RX-51 has two cameras. The main camera is a 5 Mpix autofocus camera with Carl Zeiss optics and flash. The secondary VGA camera is for video calls.

RX-51 supports messaging with SMS, IM, and VoIP. The device also supports VoIP video calling with an integrated camera up to 640 x 480 pixels (VGA), up to 30 fps.

RX-51 uses LinuX operating system, providing a good platform for compelling 3rd party applications.

Figure 1 View of RX-51

Product features and sales package

Imaging

Main camera:

- Sensor: CMOS, 5 megapixel

- Carl Zeiss Optics: Tessar™ lens
- F number/Aperture: F2.8
- Focal length: 5.2 mm
  31.8 mm (35 mm equiv.)
- Focus range: 10 cm ~ infinity
- Macro focus distance: 10-50 cm

Video:

- Video resolution: up to WVGA at 25 fps
- Audio recording: AAC
- Video clip length: memory limit
- Video file format: .mp4. H.264 (for lower fps)
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: auto
- Zoom: digital 3X

Photo:

- Still image resolutions: up to 5 megapixel: 2592 x 1944
- Still image file format: JPEG/EXIF
- Auto focus
- Auto exposure: center weighted AE
- Image orientation: automatic
- Exposure compensation: +2 ~ -2EV at 0.5 step
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: auto, sports, portrait, close-up, landscape, night, user defined
- Colour tone: normal, sepia, B&W, vivid, negative
- Zoom (digital): up to 3X

Other camera features:

- LED flash and recording indicator
- Front camera, VGA (640 x 480) sensor

Edit

- On device Photo editor

View

- Large 3,5" VGA (800 x 480 pixels) display
- Slideshow from Photos

Share

- Share effortlessly from Photos or after capture via e-mail, Bluetooth or via Internet Services (Flikr or OVI)
- Direct connection to TV via cable
- VoIP video call

Store

- Photoshop Album 3.0 Starter Edition (PC)
- Nokia Lifeblog (mobile & PC)

Music

- Media player:
  - Music playback file formats: MP3/WMA/AAC/M4A/WAV
  - Audio streaming, UPnP music streaming
- Dedicated music keys
- Stereo FM radio (87.5-108MHz)
- Stereo headset WH-205

Media

- Browsing based on Mozilla Technology with Full Flash 9.4 support
- Supported mark-up languages HTML, XHTML, XML / supported protocols HTTP
- Full web browser support (HTML)
- Visual Radio™ support
- Media Player:
  - Video streaming: h.264, mepg4, h.263, wmv in .asf, .avi, .wmv, .3gp, .mov and .mp4 containers
  - Video playback file formats: .mp4, .avi, .wmv; codecs: H.264, MPEG-4, Xvid

Productivity

Messaging:

- E-mail (SMTP, IMAP4, POP3), SMS

Office applications:

- Viewing of email attachments – .pdf

PIM:

- Contacts, calendar, to-do, notes, calculator, clock

Synchronization:

- Support for MS outlook and smartphone synchronization of contacts, calendar and notes
- Data: Calendar, Contacts, To-do, Notes, E-mail
- PC Applications: PC Suite

Call management:

- Call logs, call waiting, call hold, call divert
- VoIP video calling up to 640 x 480 pixels (VGA), up to 30 fps

Connectivity

- WLAN - IEEE802.11 b/g with UPnP support
- Micro USB type B interface with USB 2.0 full speed
- 3.5 mm stereo headphone plug and TV out support (PAL/NTSC)
- Bluetooth wireless technology 2.1 with A2DP stereo audio

Add-on software framework

- Maemo 5, LinuX OS
- Seamless Software Updater (SSU) - Maemo update

Additional technical specifications

- Vibrating alert
- 3GPP Rel 6 compliant
- Speech codecs supported in WCDMA: AMR
- Speech codecs supported in GSM: NB_ AMR/EFR/FR/HR; ILBL; G711, GT29
- WCDMA HSDPA 2100 MHz with simultaneous voice and packet data (PS max speed DL/UL= 10 Mbps/2 Mbps, CS max speed 2 Mbps)
  - WCDMA 900, 1700/2100, 2100, maximum speed PS 384/384 kbps (DL/UL)
  - HSPA maximum speed 10 Mbps (DL)
- Dual Transfer Mode (DTM) support for simultaneous voice and packet data connection in GSM/EDGE networks. Simple class A, multi slot class 32, max speed DL/UL: 296/177.6 kbits/s
- GPRS class A, multi slot class 32 (Max Sum 6), max speed DL/UL= 107/64.2 kbits/s
- EDGE class A, multi slot class 32, maximum speed 296/177.6 kbps (DL/UL)
- A-GPS
- WLAN IEEE 802.11 b/g, WLAN security: WEP, WPA, WPA2
- TCP/IP support
- Capability to serve as data modem via USB connection

Sales package

- Transceiver RX-51
- Nokia High Efficiency charger (AC-10)
- Battery (BL-5J)
- Nokia stereo headset (WH-205)
- Video connectivity cable (CA-75U)
- Micro USB connectivity cable (CA-101)

Mobile enhancements

Table 1 Audio

Enhancement	Type
Music headset	HS-48
Basic headset	HS-41
Stereo headset	WH-205
Wireless headset	BH-905

Enhancement	Type
Bluetooth headset	BH-904
	BH-902
	BH-900
	BH-804
	BH-803
	BH-800
	BH-708
	BH-703
	BH-701
	BH-700
	BH-606
	BH-602
	BH-600
	BH-301
	BH-216
	BH-215
	BH-213
	BH-212
	BH-208
	BH-202
	BH-201
	BH-200
	BH-102
	BH-101
	BH-1XX
Bluetooth stereo headset	BH-905
	BH-903
	BH-605
	BH-604
	BH-504
	BH-501
	BH-214
	BH-103
Wireless stereo gateway	AD-42W

Enhancement	Type
Music headphone	HS-48
	HS-41
	WH-102
	WH-205
Advanced headphone	HS-62
Music speaker	MD-6
Bluetooth speaker	MD-7W
Mini speaker	MD-8
	MD-4

Table 2 Car

Enhancement	Type
Mobile charger	DC-10
Wireless plug-in car handsfree	HF-200
Car kit	CK-100
Multimedia car kit	CK-300

Table 3 Data

Enhancement	Type
Connectivity cable	CA-101
Video connectivity cable	CA-75U
MicroSD card	MAC 16 GB
Charging connectivity cable	CA-126

Table 4 GPS

Enhancement	Type
Wireless GPS module	LD-3W
Bluetooth GPS module	LD-4W

Table 5 Messaging

Enhancement	Type
Digital pen	SU-27W
Wireless keyboard	SU-8W
Stylus	

Table 6 Power

Enhancement	Type
Battery 1320 mAh Li-ion	BL-5J
Travel charger	AC-10
Mobile USB charger	DC-6

Table 7 Carrying

Enhancement	Type
Carrying case	CP-xx

Technical specifications

Transceiver general specifications

Unit	Dimensions (L x W x T) (mm)	Weight (g)	Volume (cm^3)
Transceiver with BL-5J 1320 mAh Li-ion battery back	110.9 x 59.8 x 18	181	113

Main RF characteristics for GSM850/900/1800/1900 and WCDMA 900/1700-2100/2100 phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900, WCDMA VIII (900), WCDMA IV (1700-2100) and WCDMA I (2100)
Rx frequency band	GSM850: 869 - 894 MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA VIII (900): 925 - 960 MHz
	WCDMA IV (1700-2100): 2110 - 2155 MHz
	WCDMA I (2100): 2110 - 2170 MHz
Tx frequency band	GSM850: 824 - 849 MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
	WCDMA VIII (900): 880 - 915 MHz
	WCDMA IV (1700-2100): 1710 - 1755 MHz
	WCDMA I (2100): 1920 - 1980 MHz

Parameter	Unit
Output power	GSM850: +5 ...+32.5 dBm/3.2mW...1.8W
	GSM900: +5 ... +32.5 dBm/3.2mW...1.8W
	GSM1800: +0 ... +29.5 dBm/1.0mW...0.9W
	GSM1900: +0 ... +29.5 dBm/1.0mW...0.9W
	WCDMA VIII (900): -50 ... +22.5 dBm/0.01µW ... 180mW
	WCDMA IV (1700-2100): -50 ... +22 dBm/0.01µW ... 160mW
	WCDMA I (2100): -50 ... +22.5 dBm/0.01µW ... 180mW
EDGE output power	EDGE850: +5 ... +28.5 dBm/3.2mW ... 710mW
	EDGE900: +5 ... +28.5 dBm/3.2mW ... 710mW
	EDGE1800: +0 ... +25.5 dBm/1.0mW ... 360mW
	EDGE1900:+0 ... +25.5 dBm/1.0mW ... 360mW
Number of RF channels	GSM850: 124
	GSM900: 174
	GSM1800: 374
	GSM1900: 299
	WCDMA VIII (900): 152
	WCDMA IV (1700-2100): 210
	WCDMA I (2100): 277
Channel spacing	200 kHz
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16
	WCDMA VIII (900): 75
	WCDMA IV (1700-2100): 75
	WCDMA I (2100): 75

Battery endurance

Battery	Capacity (mAh)	Talk time	Stand-by
BL-5J	1320	Up to 9 h (GSM) Up to 5 h (WCDMA)	Up to 10 days GSM Up to 10 days WCDMA

Charging times

AC-10E
3h 30 min

Environmental conditions

Temperature conditions

Environmental condition	Ambient temperature	Notes
Normal operation	-10ºC...+55ºC	Specifications fulfilled
Reduced performance	-25ºC...-15ºC +55ºC...+70ºC	Operational for shorts periods only
Intermittent operation	-40ºC...-15ºC +70ºC...+85 ºC	Operation not guaranteed but an attempt to operate does not damage the phone.
No operation or storage	<-40ºC...>+85ºC	No storage or operation: an attempt may damage the phone.
Charging allowed	-25ºC...+50ºC	
Long term storage conditions	0ºC...+85ºC	

Humidity

Relative humidity range is 5...95%.

The HW module is not protected against water. Condensed or splashed water might cause malfunction. Any submerge of the phone will cause permanent damage. Long-term high humidity, with condensation, will cause permanent damage because of corrosion.

Vibration

The module should withstand the following vibrations:

- 5 - 10 Hz; +10dB / octave
- 10 - 50 Hz; 5.58 m^2 / s^3 (0.0558 g^2/ Hz)
- 50 - 300 Hz; - 10 dB / octave

ESD strength

Conducted discharge is 8 kV (>10 discharges) and air contact 15 kV (>10 discharges).

The standard for electrostatic discharge is IEC 61000-4-2, and this device fulfils level 4 requirements.

RoHS

This device uses RoHS compliant components and lead-free soldering process.

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2 — Service Tools and Service Concepts

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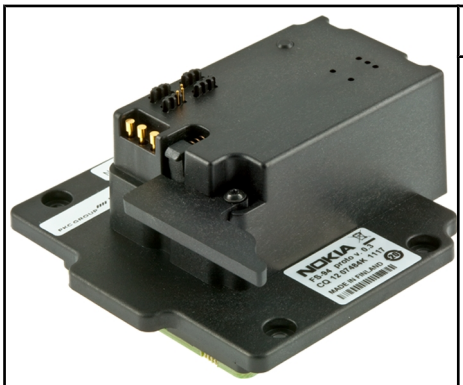
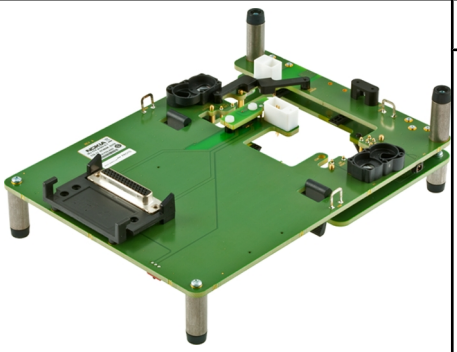
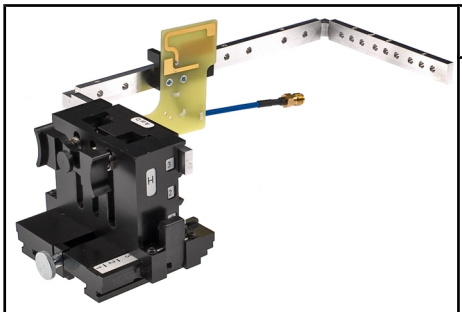
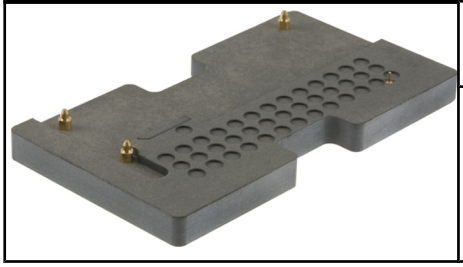
Service tools

Product specific tools

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RX-51. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

<table>
<tr><td rowspan="2">  </td><td>FS-94</td><td>Flash adapter</td><td></td></tr>
<tr><td colspan="3">Flash adapter FS-94 is used for phone testing and flashing. FS-94 is used with the generic flash adapter base SS-60/62 and control unit CU-4 or interface adapter SS-46.
When flashing or system testing the phone, the adapter is attached to replace the phone own battery.
All functions (as well as the calibration voltages, current and the protections for over voltages, over current and voltage polarity), are performed by CU-4.
Flash adapter FS-94 main features:
• VBATT supply interface
• USB / FBUS multiplexed interface to the phone</td></tr>
<tr><td rowspan="2">  </td><td>MJ-174</td><td>Module jig</td><td></td></tr>
<tr><td colspan="3">MJ-174 can be used for flashing as well as for RF, battery and system testing.
MJ-174 main functions:
• CU-4 interface adapter to phone
• FBUS interface to phone
• UI Interface to phone
• WCDMA and GSM RF-interface
All functions are performed in CU-4 e.g. calibration voltages and currents both all protections (over current, over voltage and voltage polarity).
MJ-174 contains following interfaces to phone:
• VBATT interface
• UI interface containing Display connector
• WCDMA and GSM RF interfaces
• Bluetooth RF interface
• Earpiece interface
• IHF speaker interface
• Microphone interface</td></tr>
</table>

	SA-131	RF coupler	
	SA-131 is a generic device for GPS testing. It is used together with SS-62.		
	SS-206	Domesheet alignment jig	
	SS-206 is used for domesheet alignment.		

Using SA-131 GPS RF coupler with RX-51

Use the following basic SA-131 setup for RX-51:

- 1575.520152 MHz
- -110dbm
- 20db fixed RF attenuator

And use the following settings for the SA-131:

- Base setting: 3
- Sledge setting: 3
- Frame setting: D4 left
- GPS Coupler setting: D1
- Direction: Down
- Attenuation for GPS Coupler: 12dbm
- RF Generator output level (e.g. -110dbm + 20dbm fixed attenuation + attenuation for GPS Coupler): -78dbm

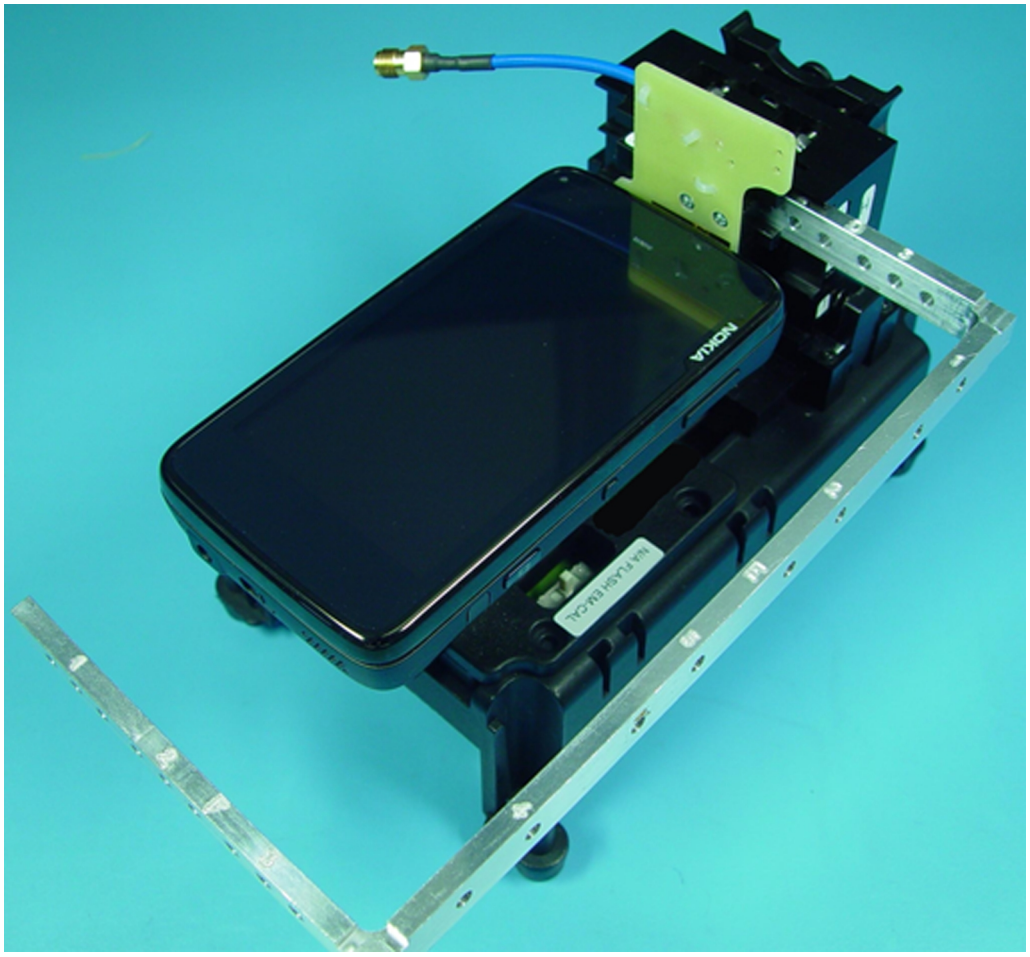


Figure 2 RX-51 setup for SA-131

General tools

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RX-51. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

CU-4

CU-4	Control unit	

CU-4 is a general service tool used with a module jig and/or a flash adapter. It requires an external 12 V power supply.

The unit has the following features:

- software controlled via USB
- EM calibration function
- Forwards FBUS/Flashbus traffic to/from terminal
- Forwards USB traffic to/from terminal
- software controlled BSI values
- regulated VBATT voltage
- 2 x USB2.0 connector (Hub)
- FBUS and USB connections supported

When using CU-4, note the special order of connecting cables and other service equipment:

Instructions

1 Connect a service tool (jig, flash adapter) to CU-4.
2 Connect CU-4 to your PC with a USB cable.
3 Connect supply voltage (12 V)
4 Connect an FBUS cable (if necessary).
5 Start Phoenix service software.

Note: Phoenix enables CU-4 regulators via USB when it is started.

Reconnecting the power supply requires a Phoenix restart.

FLS-5	Flash device	

FLS-5 is a dongle and flash device incorporated into one package, developed specifically for POS use.

Note: FLS-5 can be used as an alternative to PKD-1.

FPS-21

FPS-21	Flash prommer	

FPS-21 sales package:

- FPS-21 prommer
- AC-35 power supply
- CA-31D USB cable

FPS-21 interfaces:

Front

- Service cable connector

  Provides Flashbus, USB and VBAT connections to a mobile device.
- SmartCard socket

  A SmartCard is needed to allow DCT-4 generation mobile device programming.

Rear

- DC power input

  For connecting the external power supply (AC-35).
- Two USB A type ports (USB1/USB3)

  Can be used, for example, for connecting external storage memory devices or mobile devices
- One USB B type device connector (USB2)

  For connecting a PC.
- Phone connector

  Service cable connection for connecting Flashbus/FLA.
- Ethernet RJ45 type socket (LAN)

  For connecting the FPS-21 to LAN.

Inside

- Four SD card memory slots

  For internal storage memory.

  Note: In order to access the SD memory card slots inside FPS-21, the prommer needs to be opened by removing the front panel, rear panel and heatsink from the prommer body.

PK-1	Software protection key	

PK-1 is a hardware protection key with a USB interface. It has the same functionality as the PKD-1 series dongle.

PK-1 is meant for use with a PC that does not have a series interface.

To use this USB dongle for security service functions please register the dongle in the same way as the PKD-1 series dongle.

RJ-230	Soldering jig	

The jig is used for soldering and as a rework jig for the system module. It is made of lead-free rework compatible material.

SB-6	Bluetooth tester	

The SB-6 test box is a generic device to perform Bluetooth bit error rate testing and doing cordless FBUS connection via Bluetooth.

SB-7	WLAN test box	

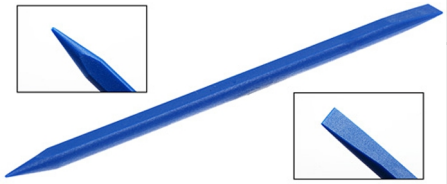
WLAN test requires defined position for the device.

SS-100	Camera removal tool	

The camera removal tool SS-100 is used to remove/attach a camera module from/to the camera socket of the phone PWB.

SS-46	Interface adapter	
SS-46 acts as an interface adapter between the flash adapter and FPS-21.		

SS-62	Generic flash adapter base for BB5	
• generic base for flash adapters and couplers • SS-62 equipped with a clip interlock system • provides standardised interface towards Control Unit • provides RF connection using galvanic connector or coupler • multiplexing between USB and FBUS media, controlled by VUSB		



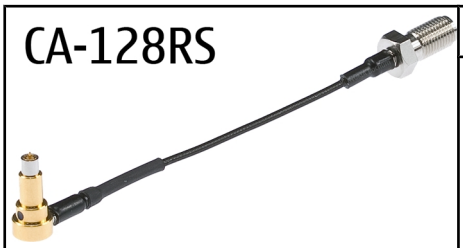
SS-93	Opening tool	
SS-93 is used for opening JAE connectors. **Note:** The SS-93 is included in Nokia Standard Toolkit.		

SX-4	Smart card	
SX-4 is a BB5 security device used to protect critical features in tuning and testing. SX-4 is also needed together with FPS-21 when DCT-4 phones are flashed.		

Cables

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RX-51. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

CA-101	Micro USB cable	
The CA-101 is a USB-to-microUSB data cable that allows connections between the PC and the phone.		



CA-128RS	RF tuning cable	

Product-specific adapter cable for RF tuning.

- **Table 8 Attenuation values**

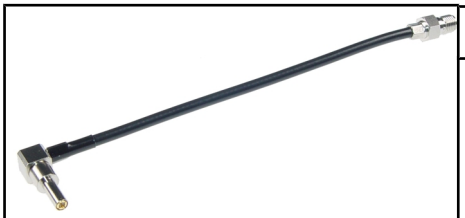
Band	Attenuation Rx/Tx
GSM 850/900	0.2...0.3 dB
GSM 1800/1900	0.3...0.4 dB
WCDMA 900	0.2...0.3 dB
WCDMA 2100 / WCDMA 1700-2100	0.4...0.6 dB

CA-31D	USB cable	

The CA-31D USB cable is used to connect FPS-21 to a PC. It is included in the FPS-21 sales package.

CA-35S	Power cable	

CA-35S is a power cable for connecting, for example, the FPS-21 flash prommer to the Point-Of-Sales (POS) flash adapter.



CA-58RS	RF tuning cable	

Product-specific adapter cable for RF tuning.

- **Table 9 Attenuation values**

Band	Attenuation Rx/Tx
GSM850/GSM900/WCDMA900	0.2...0.3 dB
GSM1800/GSM1900/ WCDMA2100/ WCDMA2100-1700	0.3...0.4 dB
WLAN	0.4...0.6 dB

PCS-1	Power cable	

The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.

XRF-1	RF cable	

The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.

SMA to N-Connector ca. 610 mm.

Attenuation for:

- GSM850/GSM900/WCDMA900: 0.3+-0.1 dB
- GSM1800/GSM1900/WCDMA2100/WCDMA1700-2100: 0.5+-0.1 dB
- WLAN: 0.6+-0.1dB

XRS-6	RF cable	

The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.

SMA to N-Connector approximately 610 mm.

Attenuation for:

- GSM850/GSM900/WCDMA900: 0.3+-0.1 dB
- GSM1800/GSM1900/WCDMA2100/WCDMA1700-2100: 0.5+-0.1 dB
- WLAN: 0.6+-0.1dB

Service concepts

POS (Point of Sale) flash concept

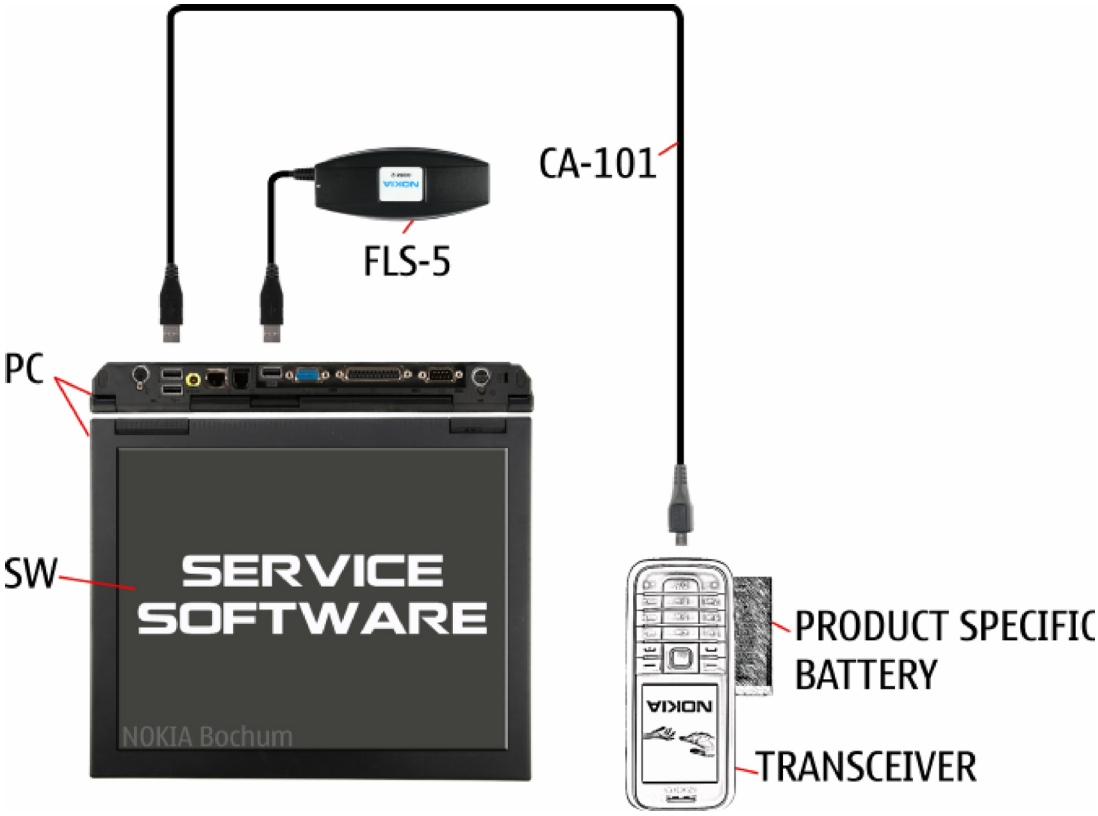


Figure 3 POS flash concept

Type	Description
Product specific tools	
BL-5J	Battery
Other tools	
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
CA-101	Micro USB cable

Flash concept with FPS-21

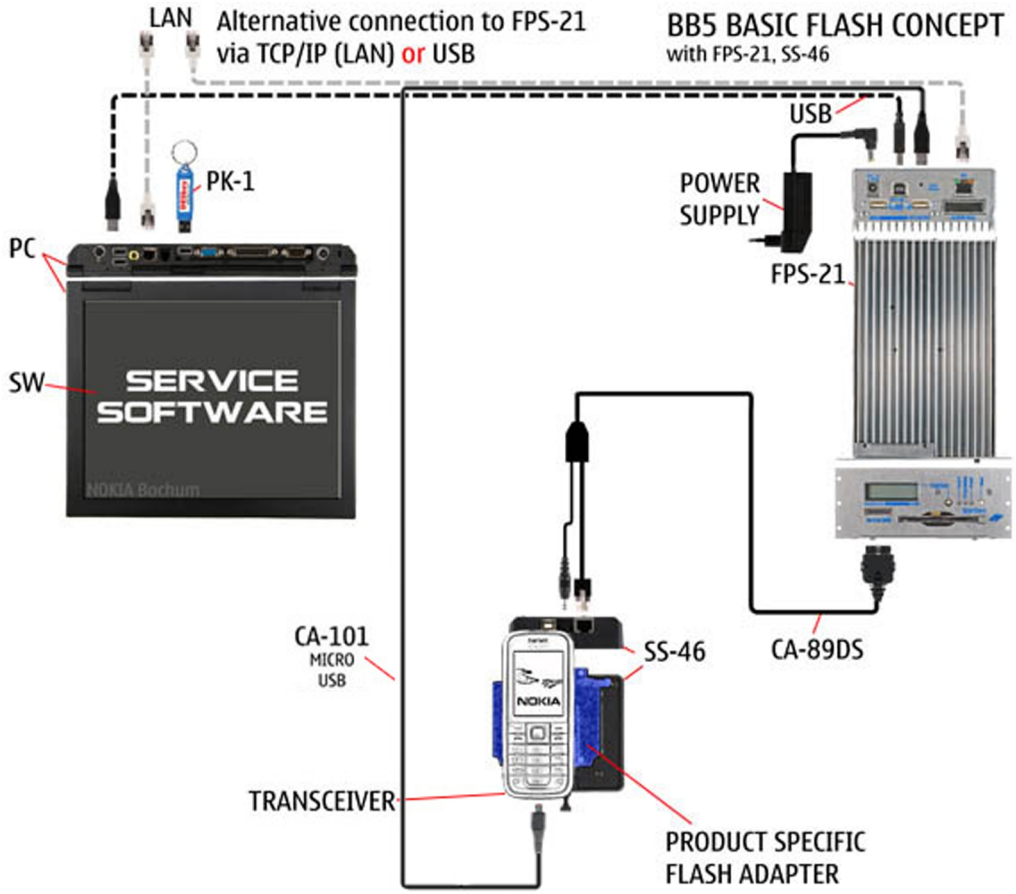


Figure 4 Basic flash concept with FPS-21

Type	Description
Product specific devices	
FS-94	Flash adapter
Other devices	
FPS-21	Flash prommer box
AC-35	Power supply
PK-1	SW security device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
CA-89DS	Service cable
	USB cable
CA-101	Micro USB cable

CU-4 flash concept with FPS-21

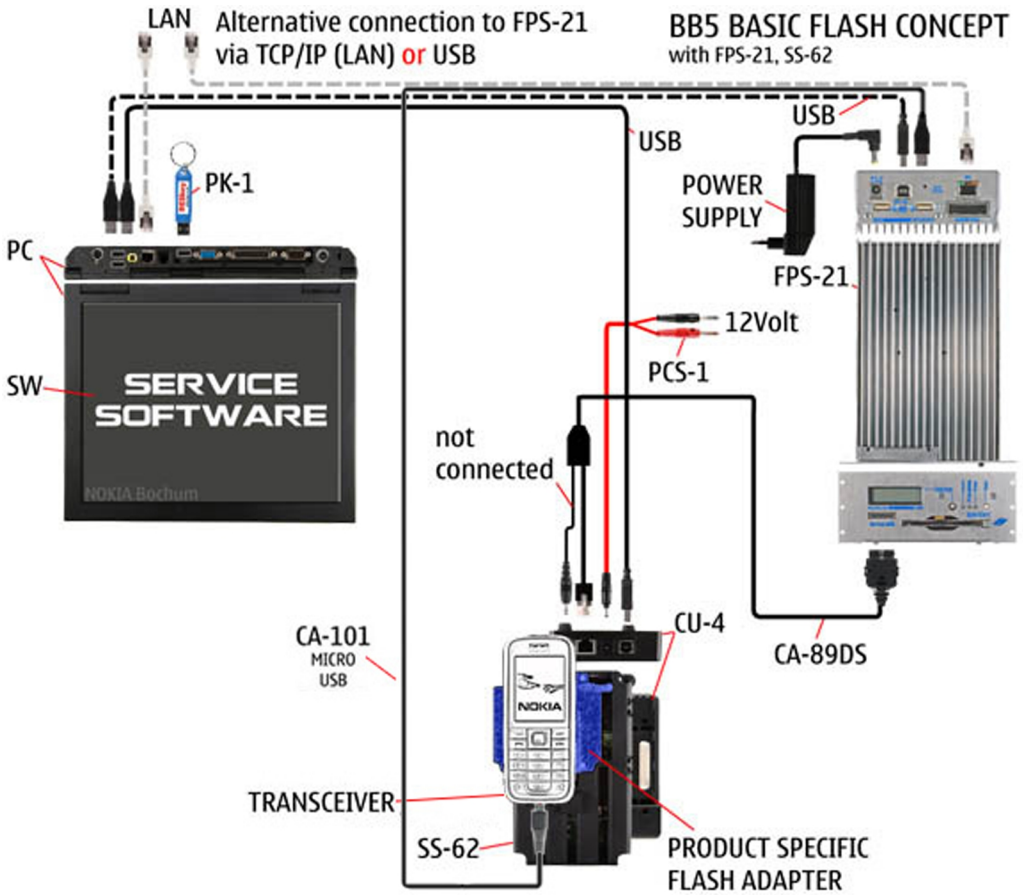


Figure 5 CU-4 flash concept with FPS-21

Type	Description
Product specific devices	
FS-94	Flash adapter
Other devices	
CU-4	Control unit
FPS-21	Flash prommer box
AC-35	Power supply
PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card (for DCT-4 generation mobile device programming)
	PC with Phoenix service software
Cables	
PCS-1	Power cable
CA-89DS	Service cable
	Standard USB cable

Type	Description
	USB cable
CA-101	Micro USB cable

Module jig service concept

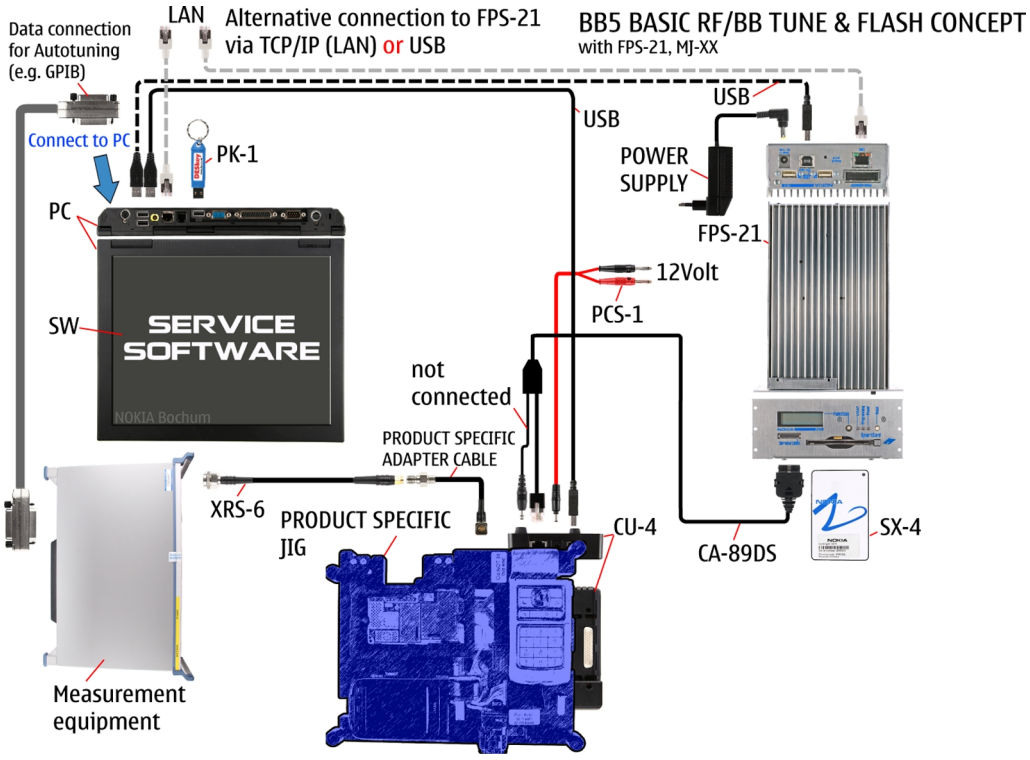


Figure 6 Module jig service concept

Type	Description
Phone specific devices	
MJ-174	Module jig
Other devices	
CU-4	Control unit
FPS-21	Flash prommer box
PK-1	SW security device
SX-4	Smart card
	PC with VPOS and Phoenix service software
	Measurement equipment
Cables	
CA-89DS	Service cable
PCS-1	DC power cable
XRS-6	RF cable

Type	Description
	USB cable
	GPIB control cable

Bluetooth test concept with SB-6

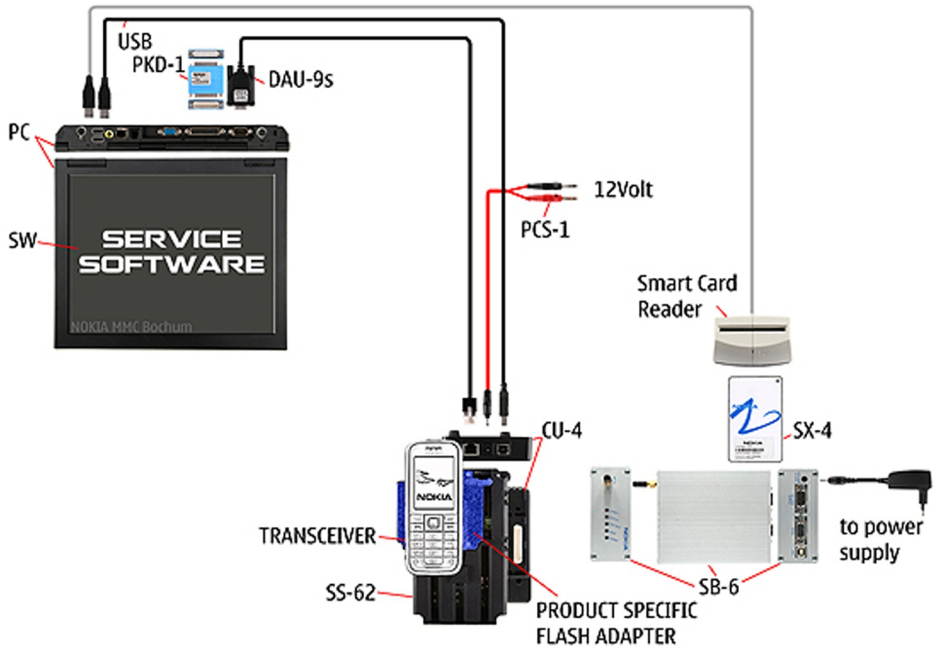


Figure 7 Bluetooth test concept with SB-6

Type	Description
Product specific tools	
FS-94	Flash adapter
Other tools	
CU-4	Control unit
PK-1	SW Security device
SS-62	Generic base adapter
SB-6	BT test box
ACP-8	Charger for SB-6
Cables	
PCS-1	Power cable
DAU-9S	Cable
PCS-1	DC power cable
	Standard USB cable

WLAN functionality testing concept with SB-7

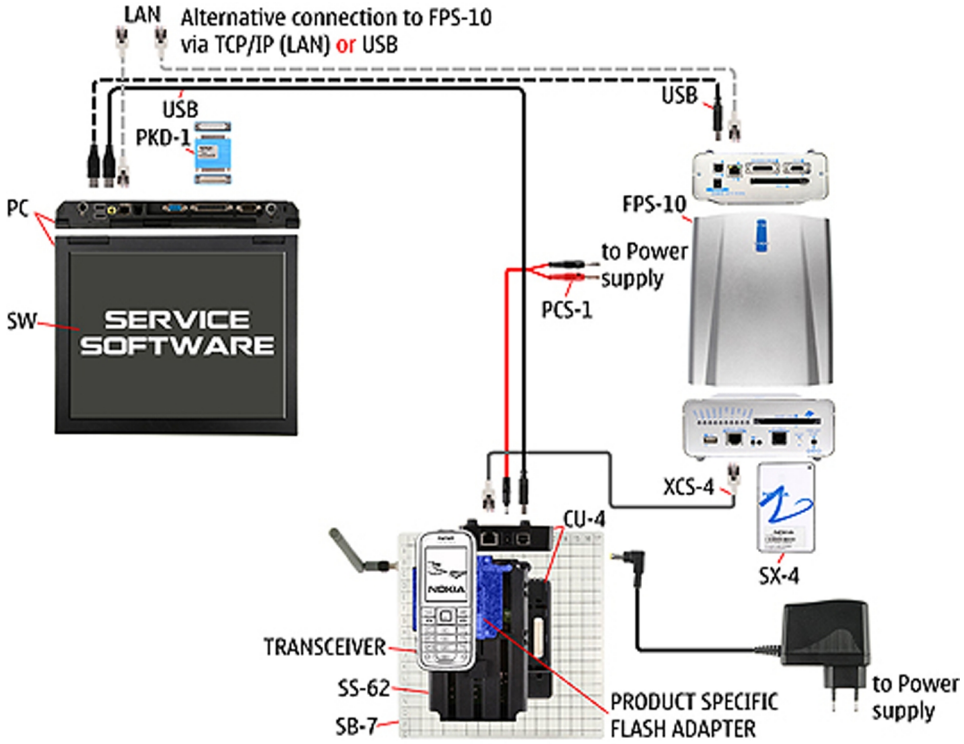


Figure 8 WLAN functionality testing concept with SB-7

Type	Description
Product specific tools	
FS-94	Flash adapter
Other tools	
CU-4	Control unit
PCS-1	DC power cable
PK-1	SW Security device
SS-62	Generic base adapter
Cables	
PCS-1	Power cable
DAU-9S	Cable
	Standard USB cable

Service concept for RF testing and RF/BB tuning

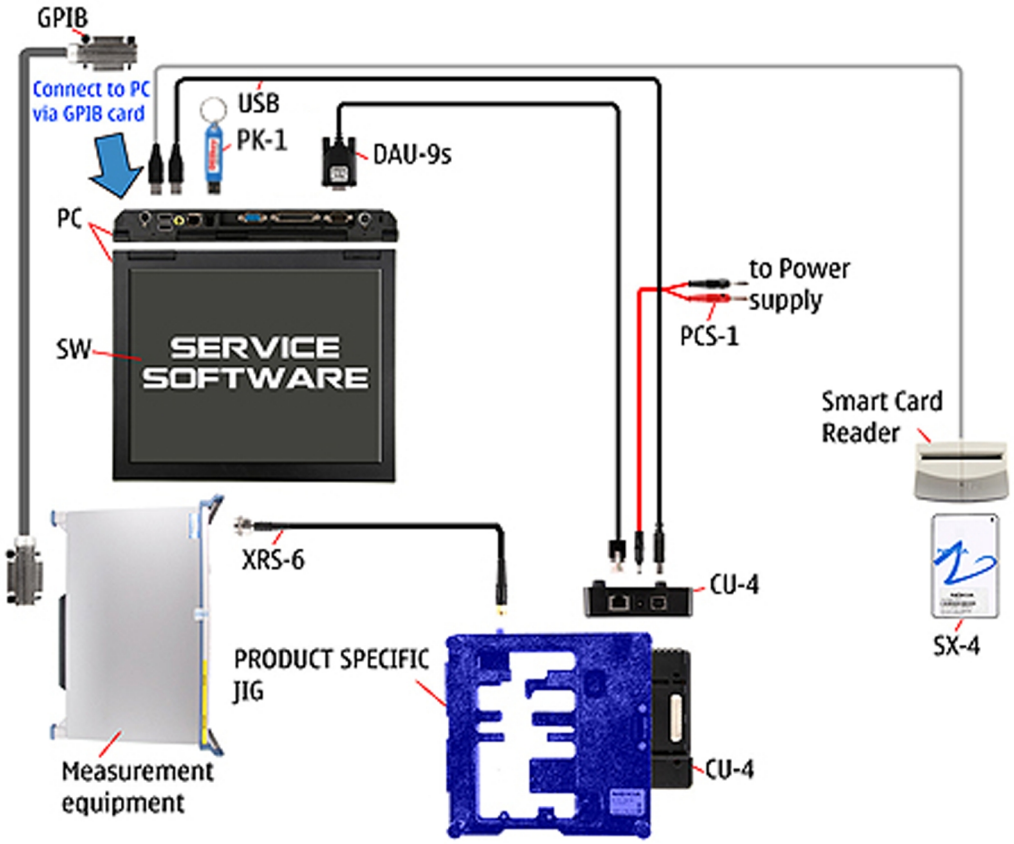


Figure 9 Service concept for RF testing and RF/BB tuning

Type	Description
Product specific devices	
MJ-174	Module jig
Other devices	
CU-4	Control unit
PK-1/PKD-1	SW security device
SX-4	Smart card
	Measurement equipment
	Smart card reader
	PC with Phoenix service software
Cables	
DAU-9S	MBUS cable
PCS-1	DC power cable
XRS-6	RF cable
	GPIB control cable

Type	Description
	USB cable

GPS testing concept with GPS RF coupler

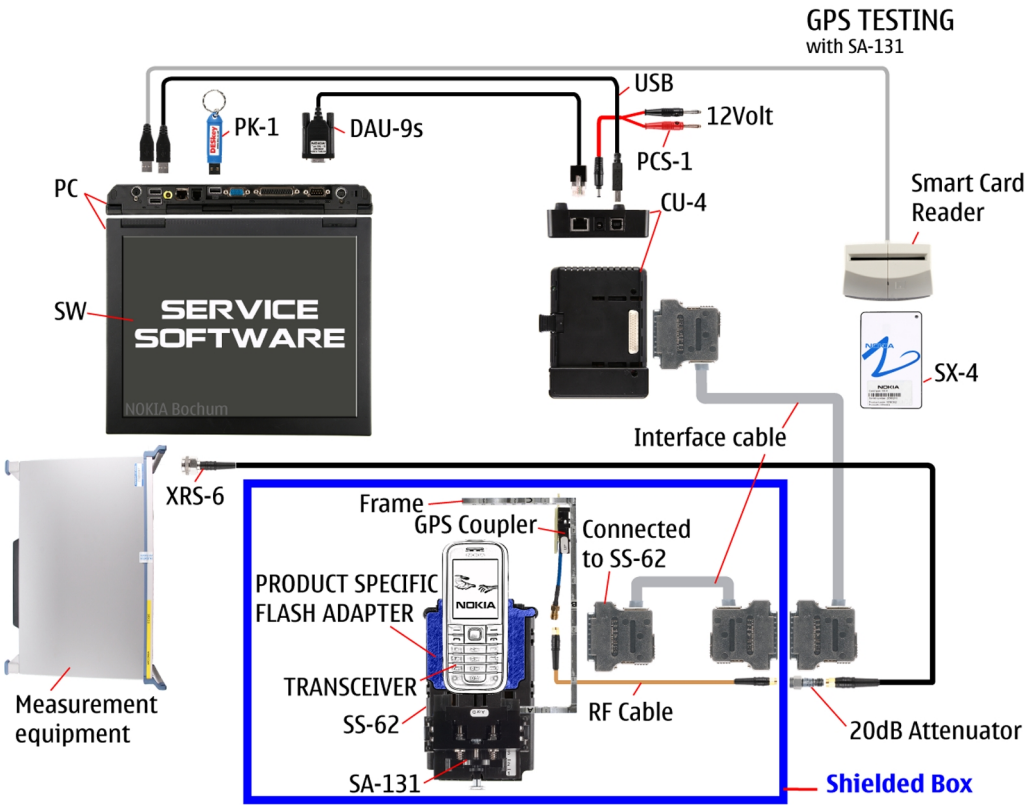


Figure 10 RF testing concept with RF coupler

Type	Description
Product specific devices	
FS-94	Flash adapter
SA-131	GPS RF coupler
Other devices	
CU-4	Control unit
SX-4	Smart card
JXS-1	RF shield box
PK-1	SW security device
SS-62	Flash adapter base
	Smart card reader
	Measurement equipment
	PC with Phoenix service software
Cables	

Type	Description
CA-58RS	RF service cable (product-specific adapter cable)
PCS-1	Power cable
DAU-9S	MBUS cable
XRS-6	RF cable
	20dB attenuator
	Interface cable
	USB cable

3 — BB Troubleshooting

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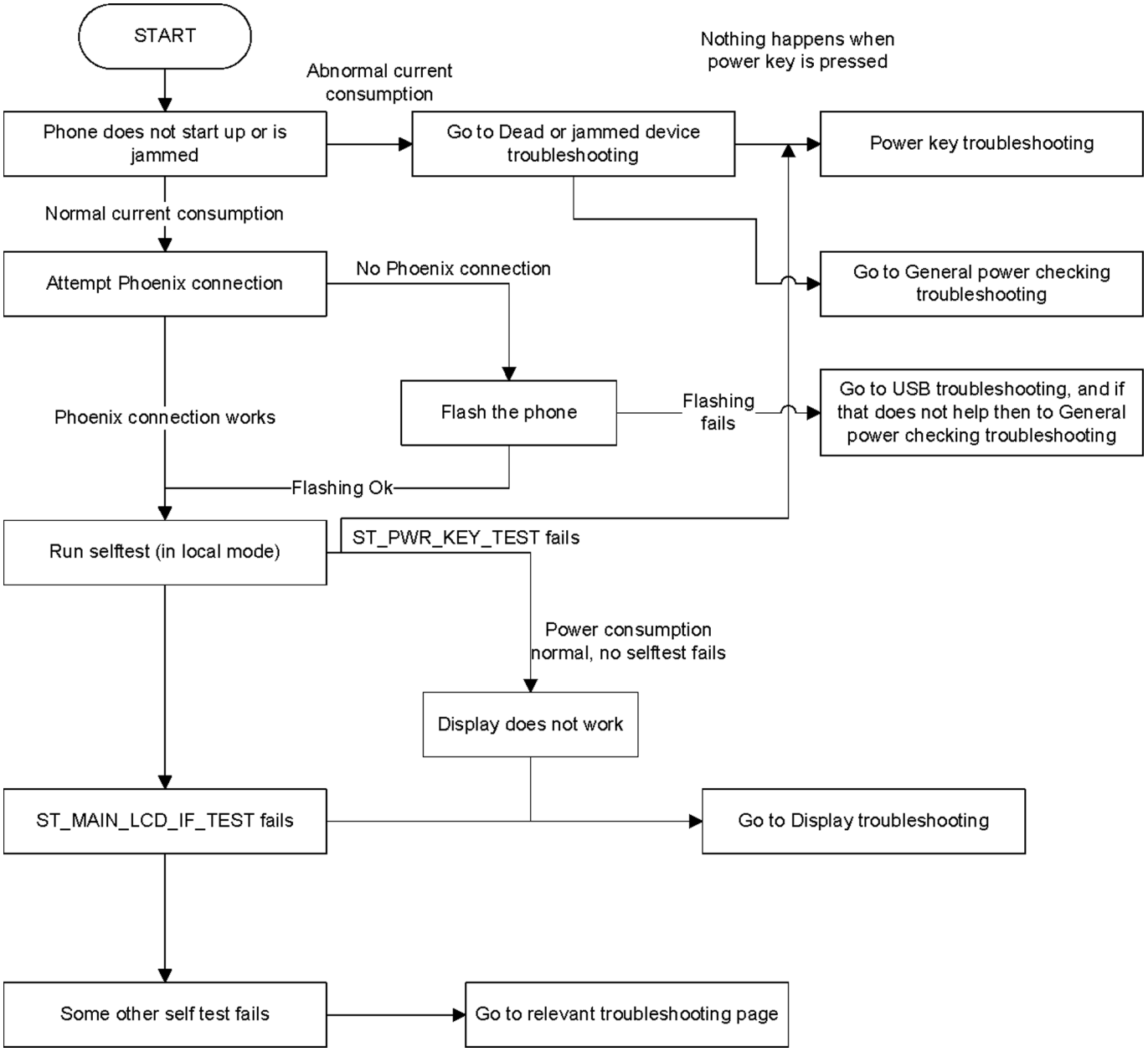
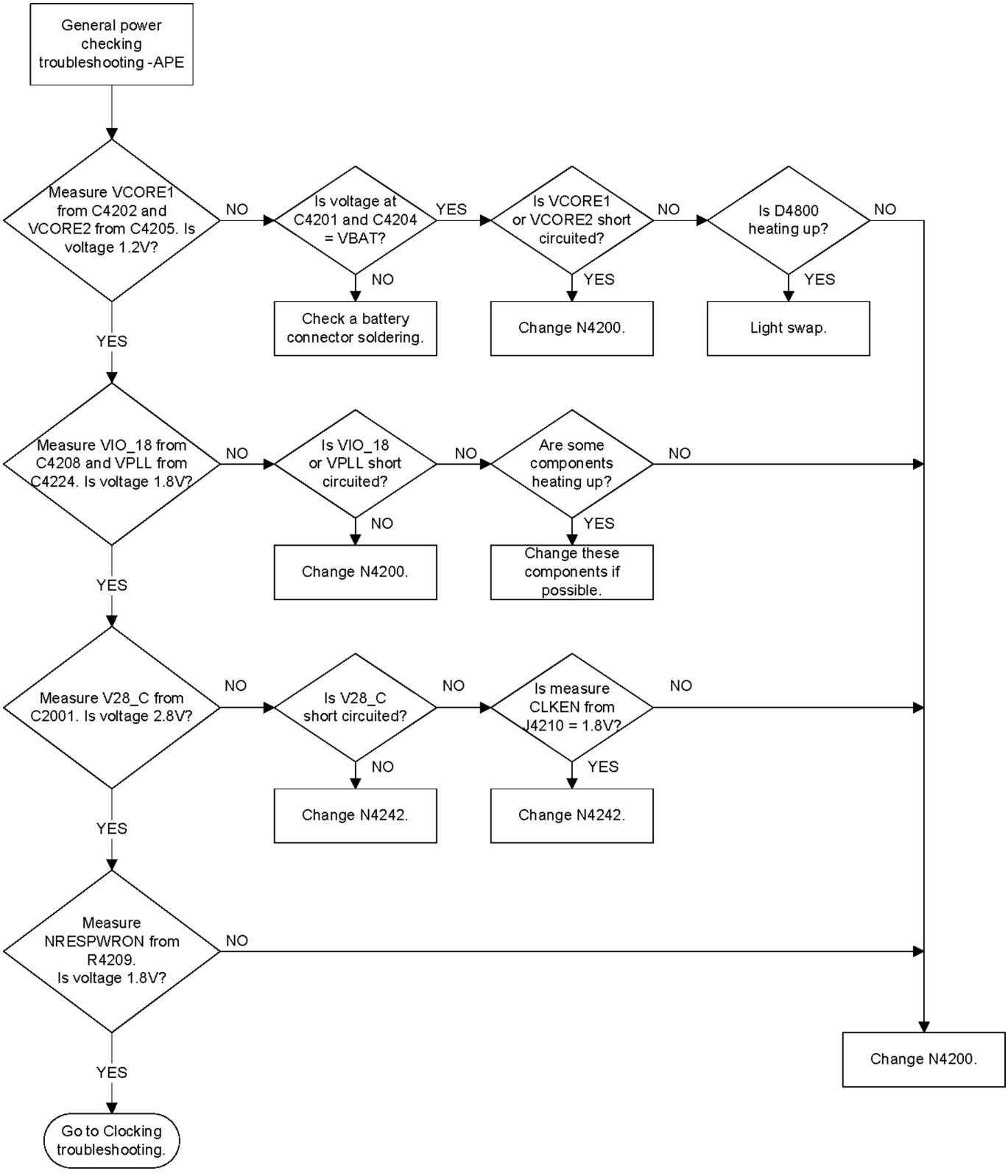
Troubleshooting flow



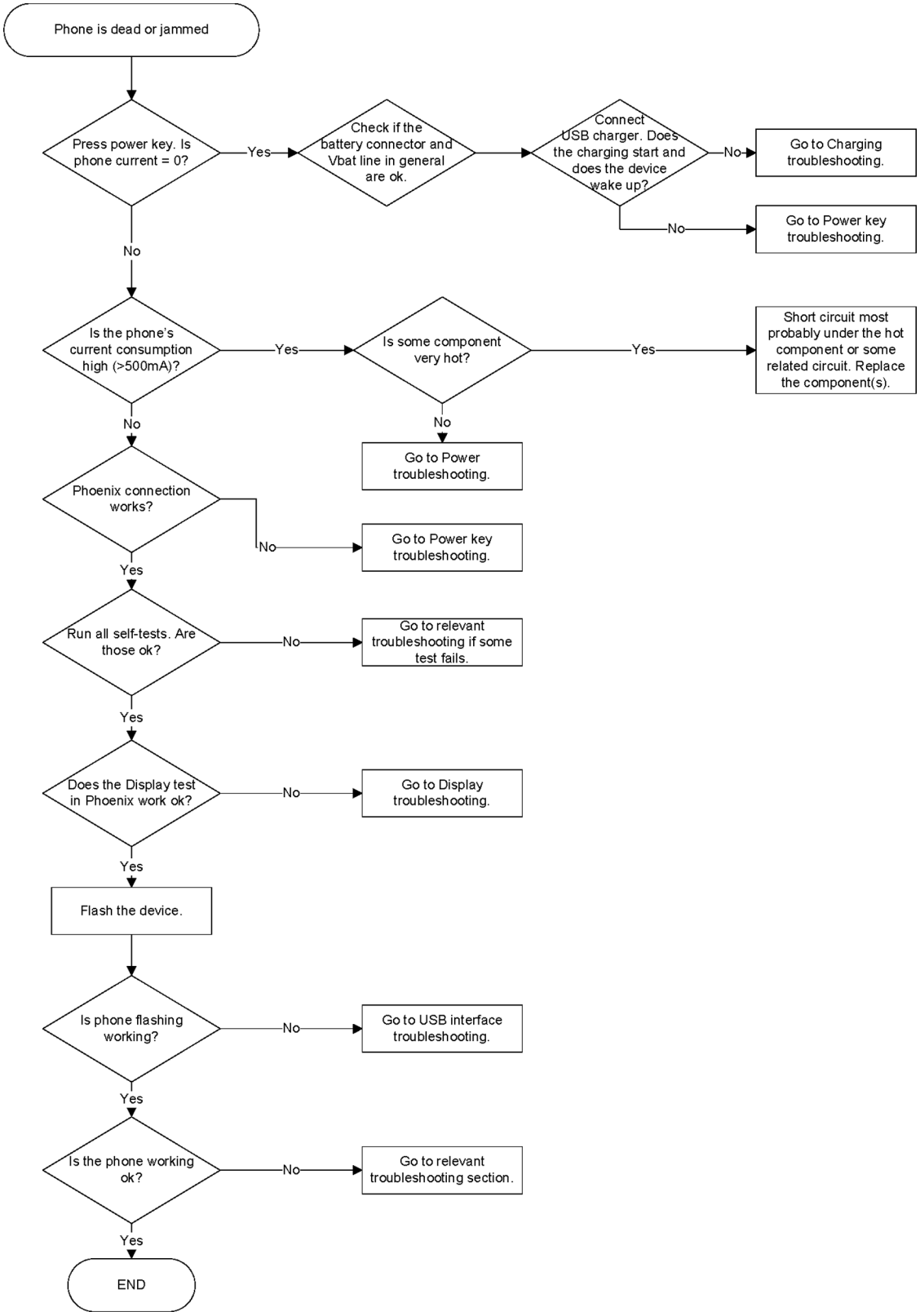
General power checking troubleshooting

Troubleshooting flow



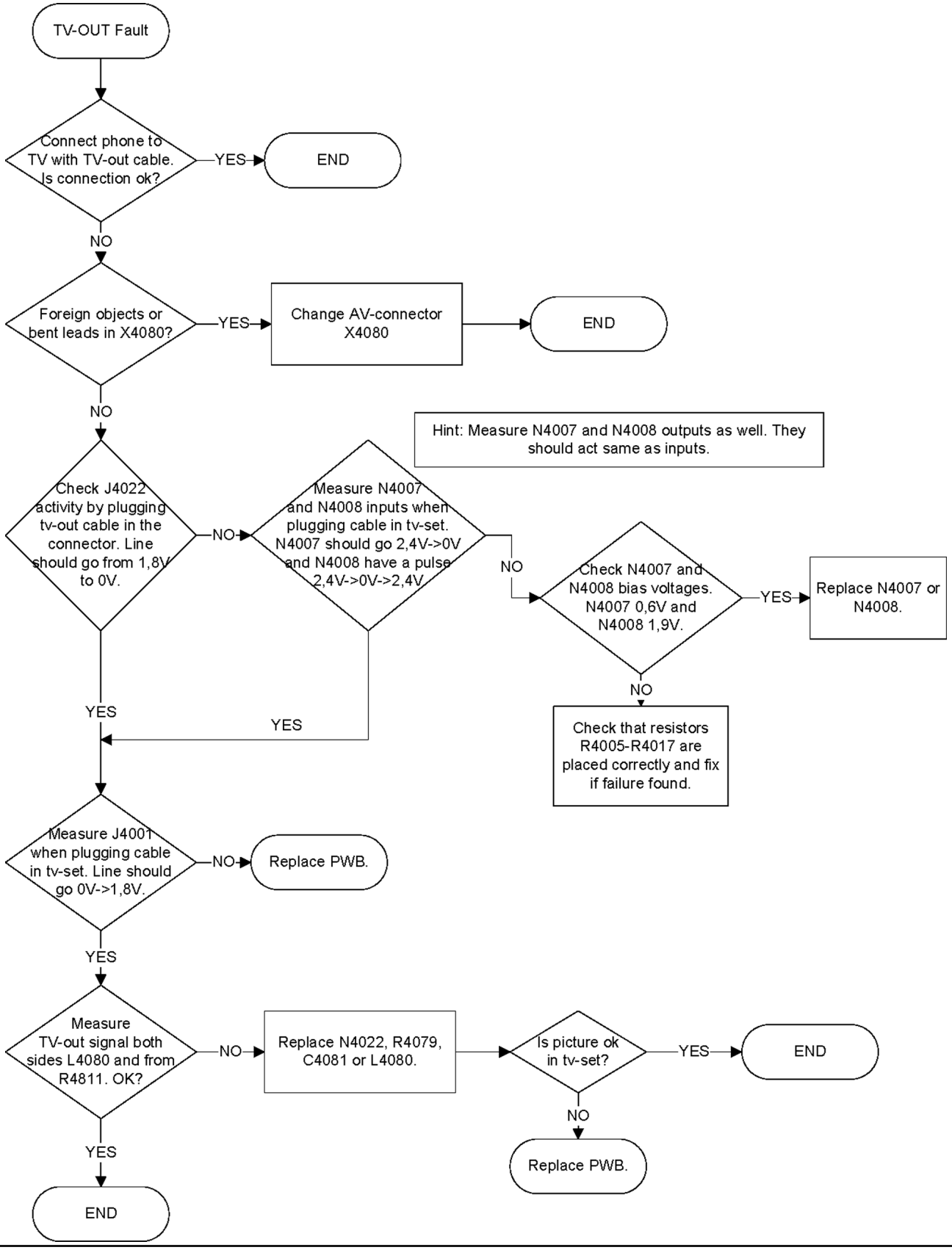
Dead or jammed device troubleshooting

Troubleshooting flow



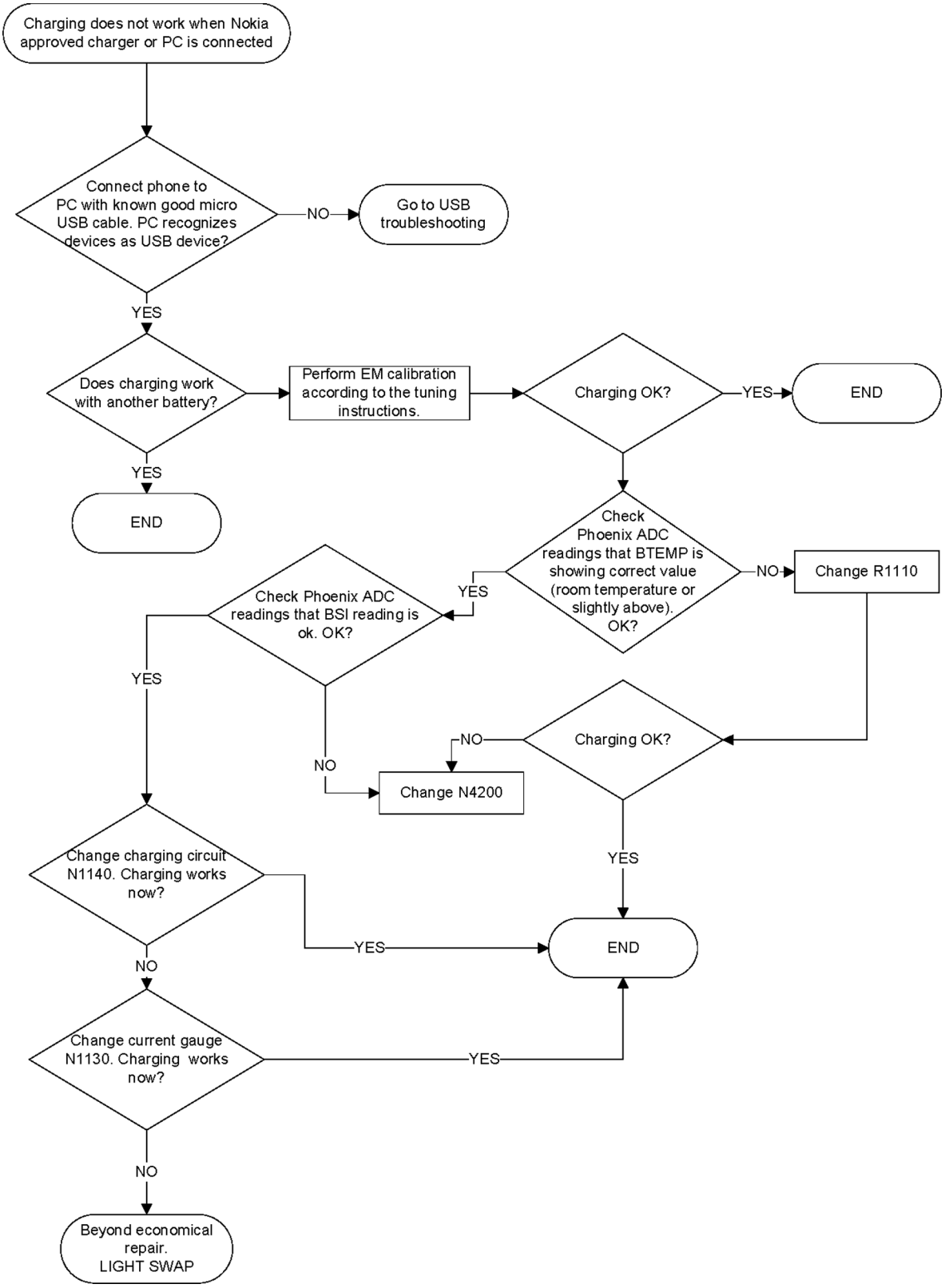
TV-out troubleshooting

Troubleshooting flow



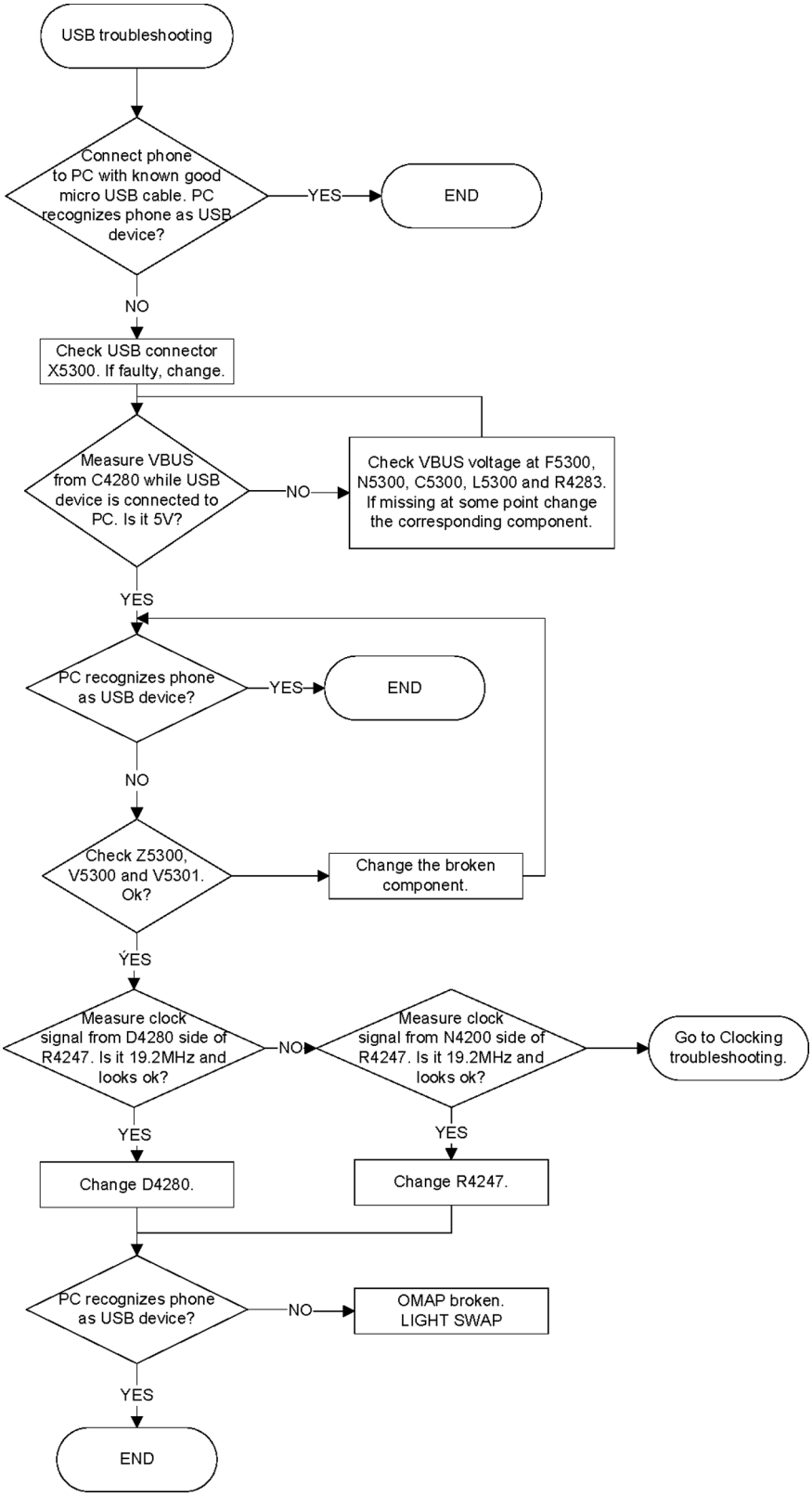
Charging troubleshooting

Troubleshooting flow



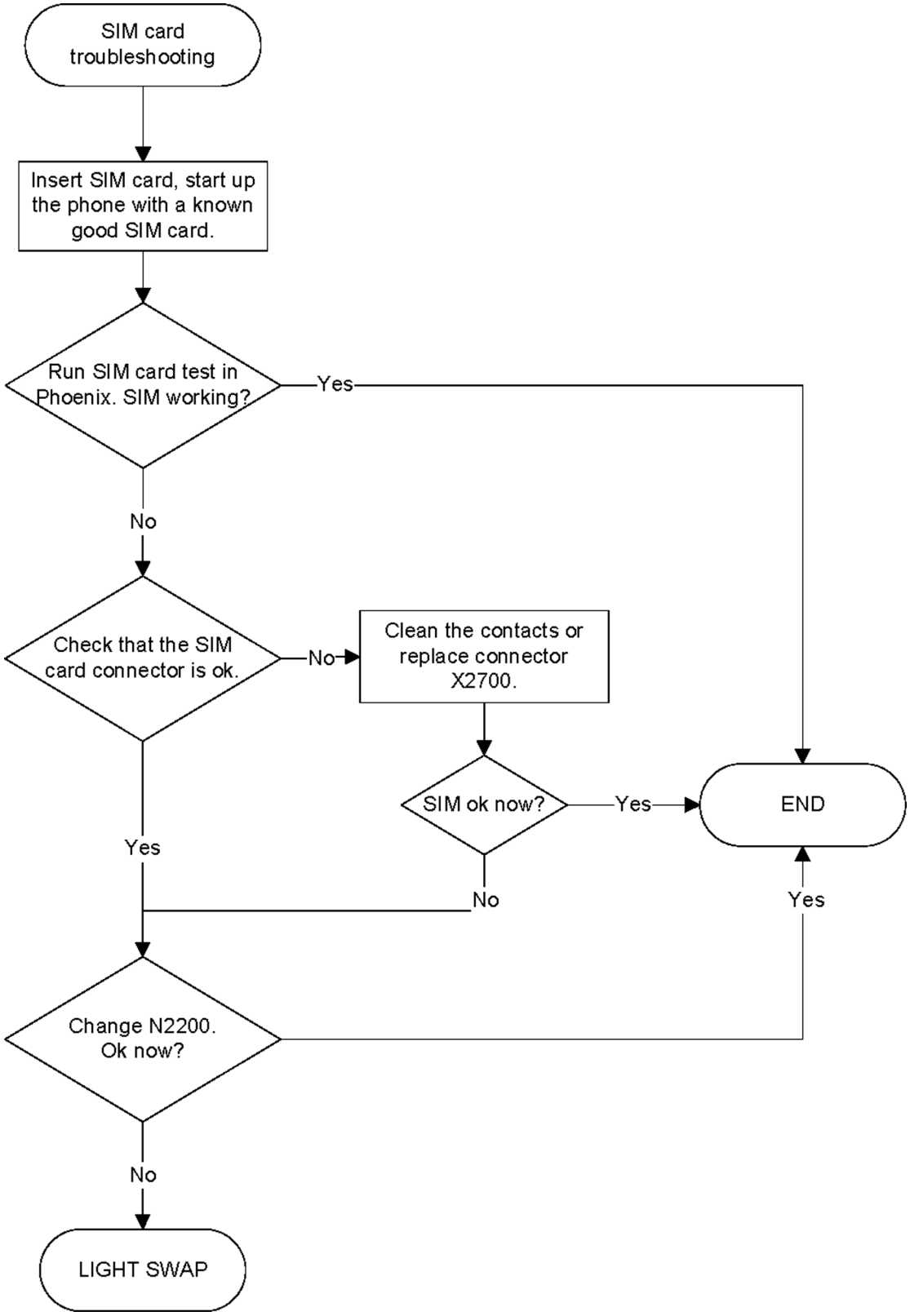
USB troubleshooting

Troubleshooting flow



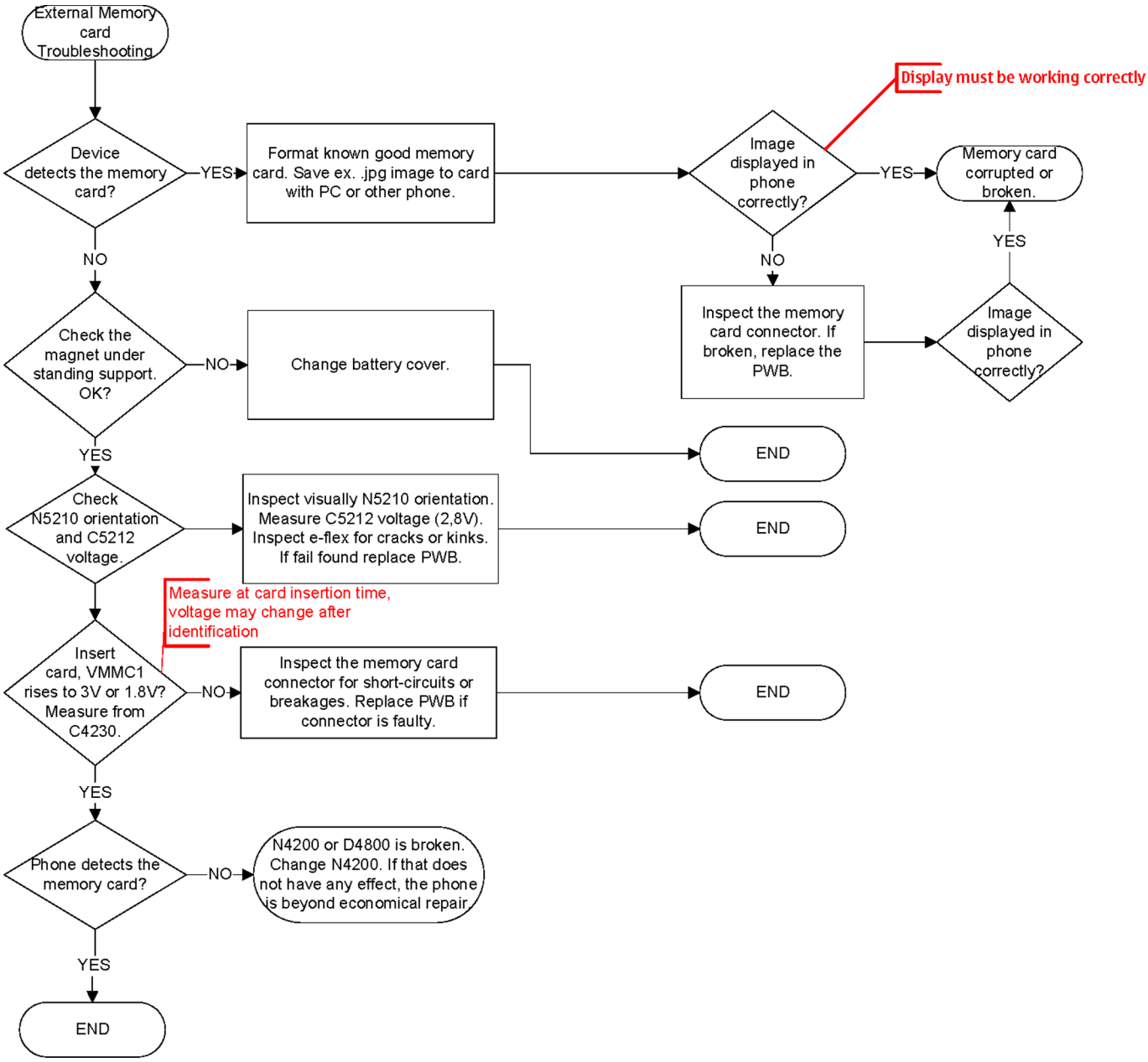
SIM card troubleshooting

Troubleshooting flow

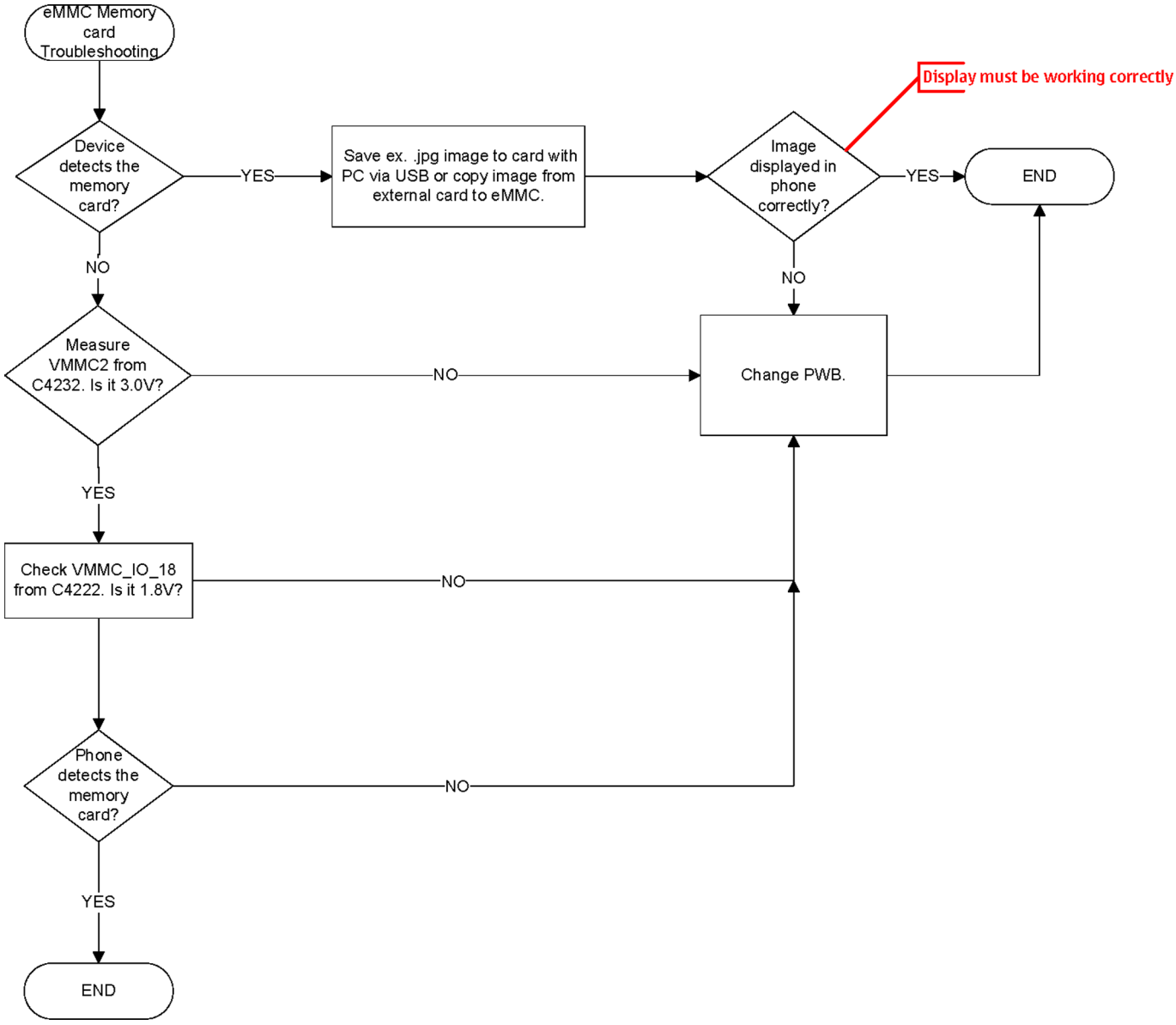


Memory cards troubleshooting

External memory card troubleshooting

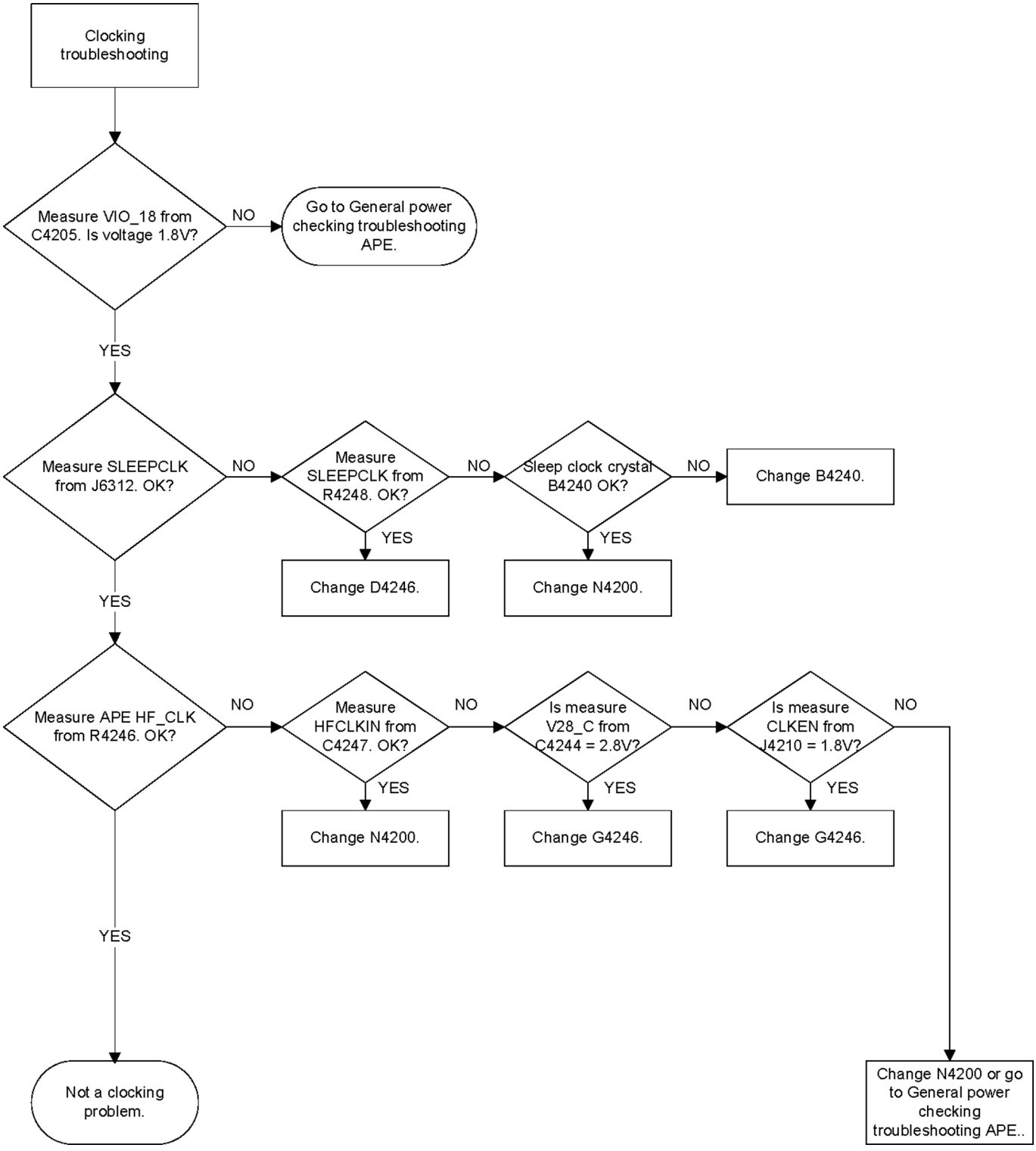


Internal memory card troubleshooting



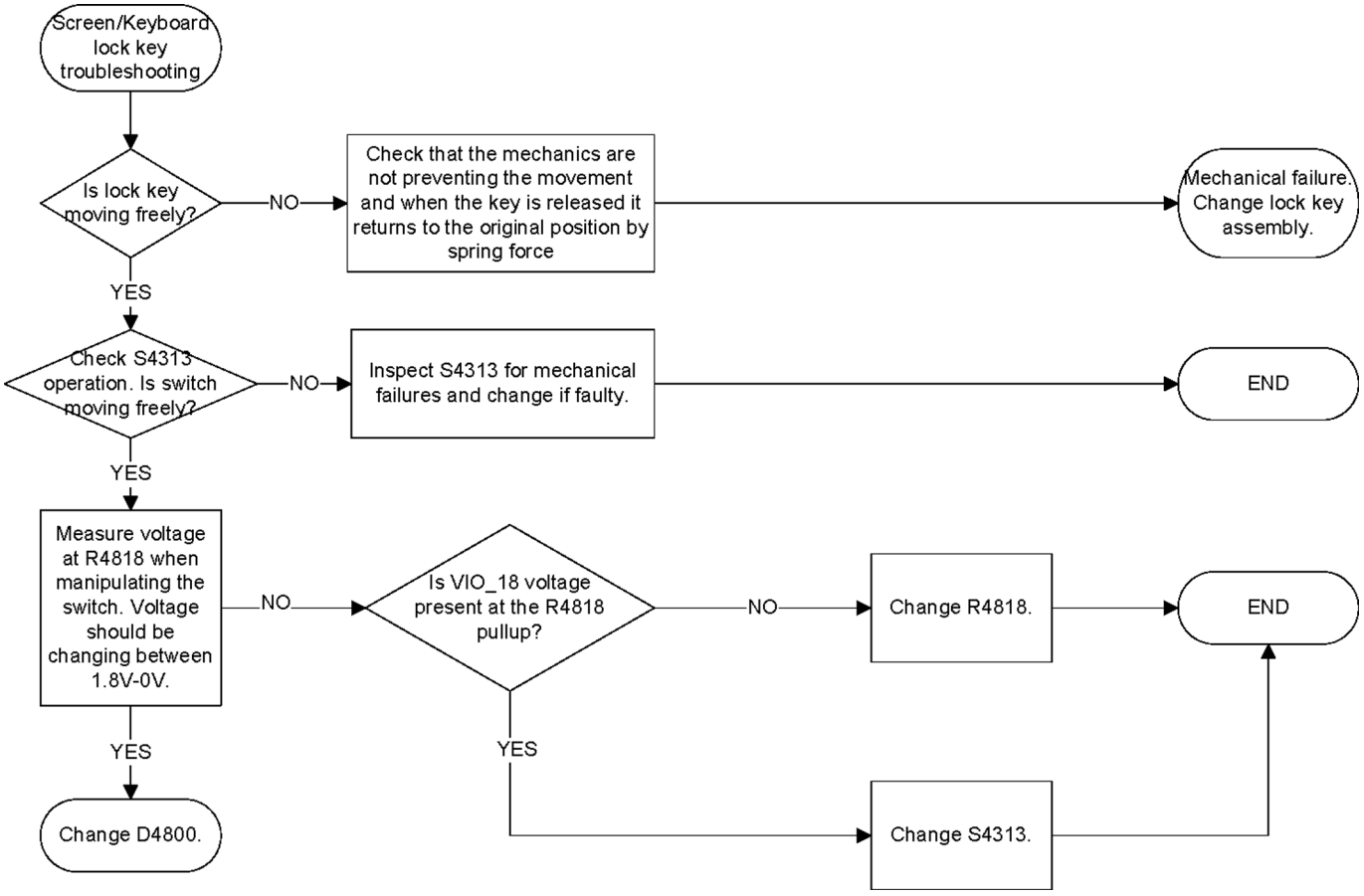
Clocking troubleshooting

Troubleshooting flow



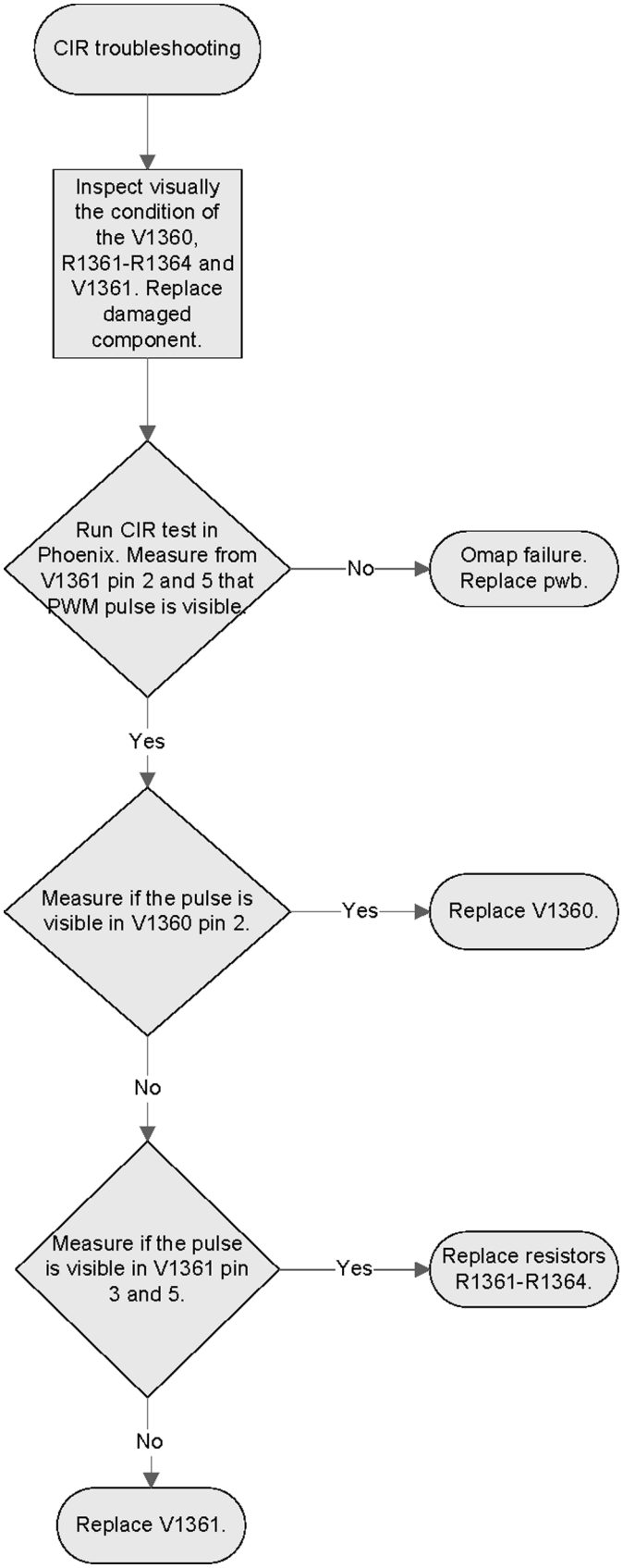
Lock key troubleshooting

Troubleshooting flow



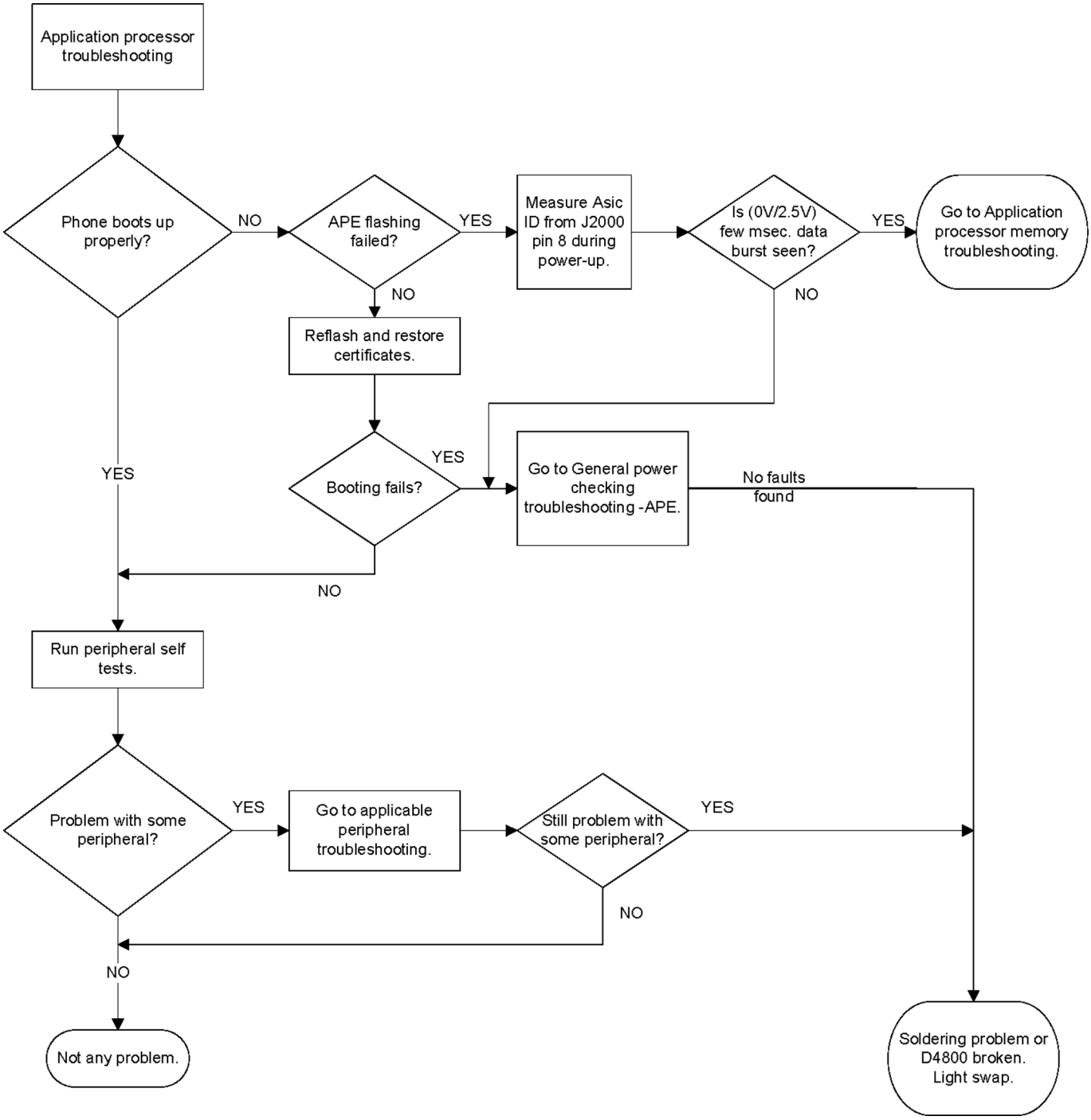
CIR troubleshooting

Troubleshooting flow



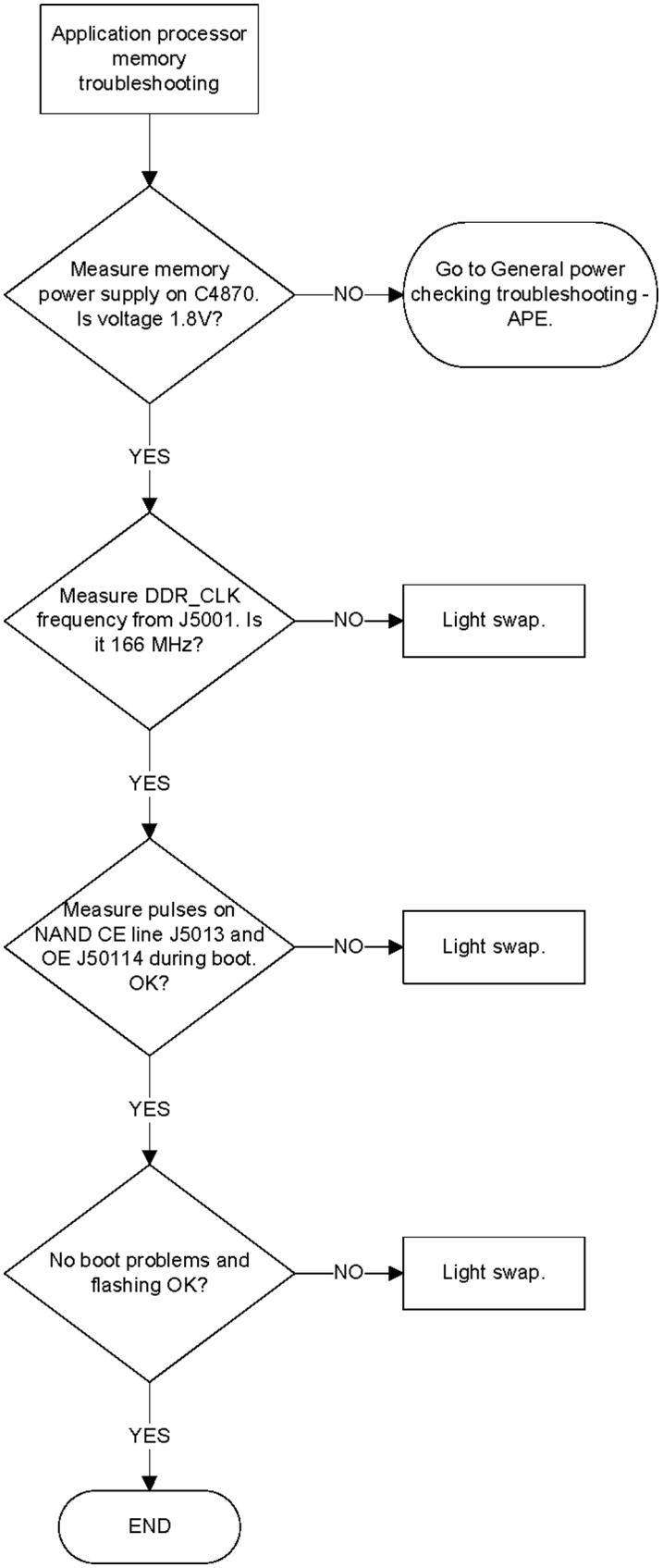
Application processor troubleshooting

Troubleshooting flow



Application processor memory troubleshooting

Troubleshooting flow



Display module troubleshooting

General instructions for display troubleshooting

The first step is to verify with a working display that the fault is not on the display module itself. The display module cannot be repaired.

The second step is to check that the engine is working normally. This can be done by connecting the phone to a docking station and starting Phoenix service software. With the help of Phoenix read the phone information to check that also the application engine is functioning normally (you should be able to read the APE ID).

After these checks proceed to the display troubleshooting flowcharts. Use the Display Test tool in Phoenix to find the detailed fault mode.

Pixel defects

Table 10 Display module troubleshooting cases

Display blank	There is no image on the display. The display looks the same when the phone is on as it does when the phone is off. The backlight can be on in some cases.
Image on the display not correct	Image on the display can be corrupted or a part of the image can be missing. If a part of the image is missing, change the display module. If the image is otherwise corrupted, follow the appropriate troubleshooting diagram.
Backlight dim or not working at all	Backlight LED components are inside the display module. Backlight failure can also be in the connector or in the backlight power source in the main engine of the phone. Backlight is also controlled automatically by the ambient light sensor. This means that in case the display is working (image OK), the backlight is faulty.
Visual defects (pixel)	Pixel defects can be checked by controlling the display with Phoenix. Use both colours, black and white, on a full screen. The display may have some random pixel defects that are acceptable for this type of display. The criteria when pixel defects are regarded as a display failure, resulting in a replacement of the display, are presented the following table.

Table 11 Pixel defects

Bright sub-pixels	(sometimes called on-pixels or stuck-on) are characterized by the appearance of bright/colored pixels in, for example, black full screen picture.

Dark sub-pixels	(sometimes called off-pixels, stuck-off, or black pixels) are characterized by the appearance of dark pixels in white, red, green, or blue full-screen picture.
Combined sub-pixel	defects are characterized by at least two sub-pixels defects (bright or dim) being closer than 5 mm to each other.
Temporal sub-pixels	(sometimes called blinking defects) exhibit temporal variations not related to any steady-state video input. Temporal sub-pixel defects may be intermittent, exhibit a sudden change of state, or be flickering.

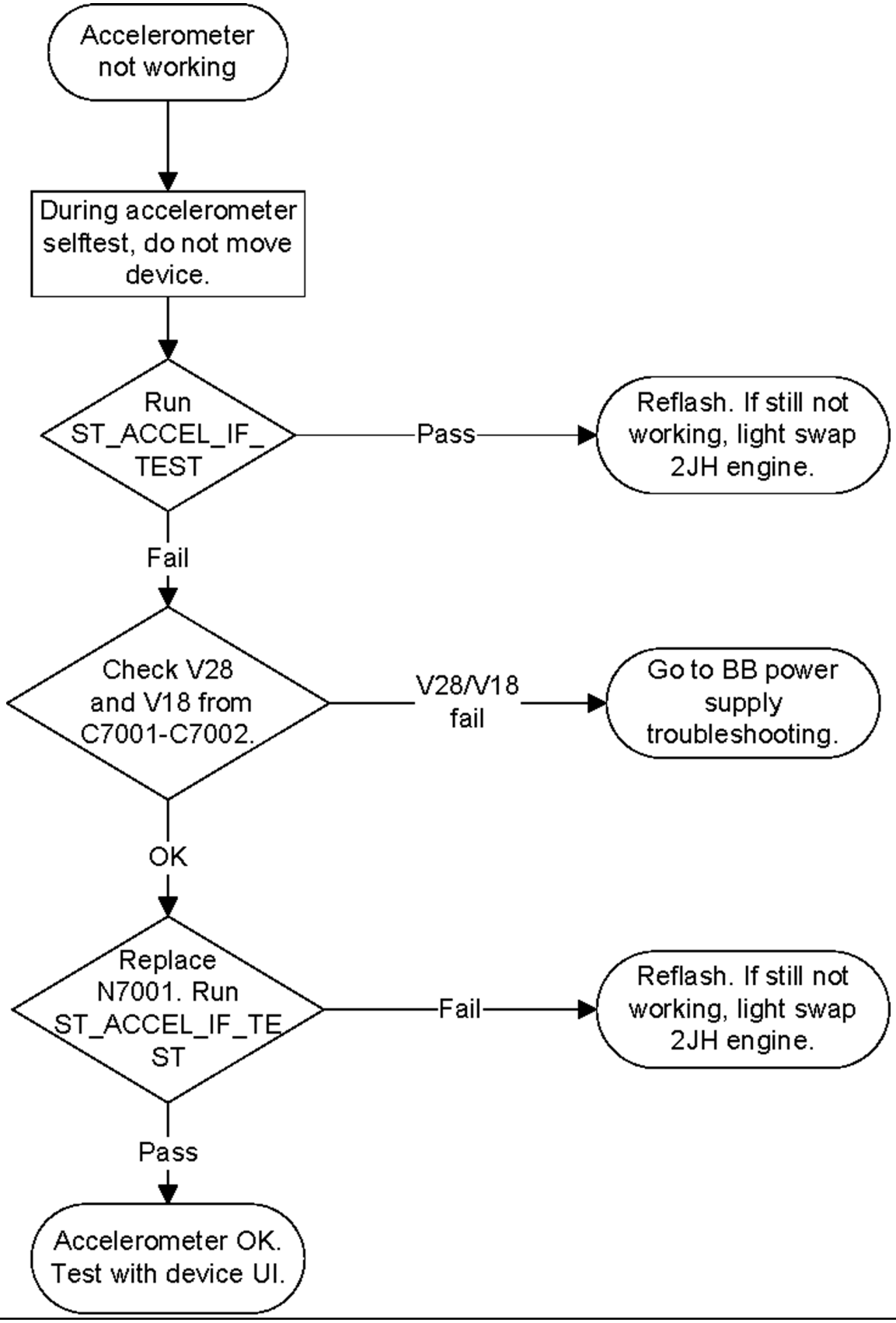
Table 12 Defects table

Item		Bright dot (sub-pixel) defect	Dark dot (sub-pixel) defect	Total
1	Defect counts	Not allowed		
2	Combined sub-pixel defect	Not allowed		
3	Temporal sub-pixel defect	Not allowed		

Note: Blinking pixels are not allowed in normal operating temperatures and light conditions.

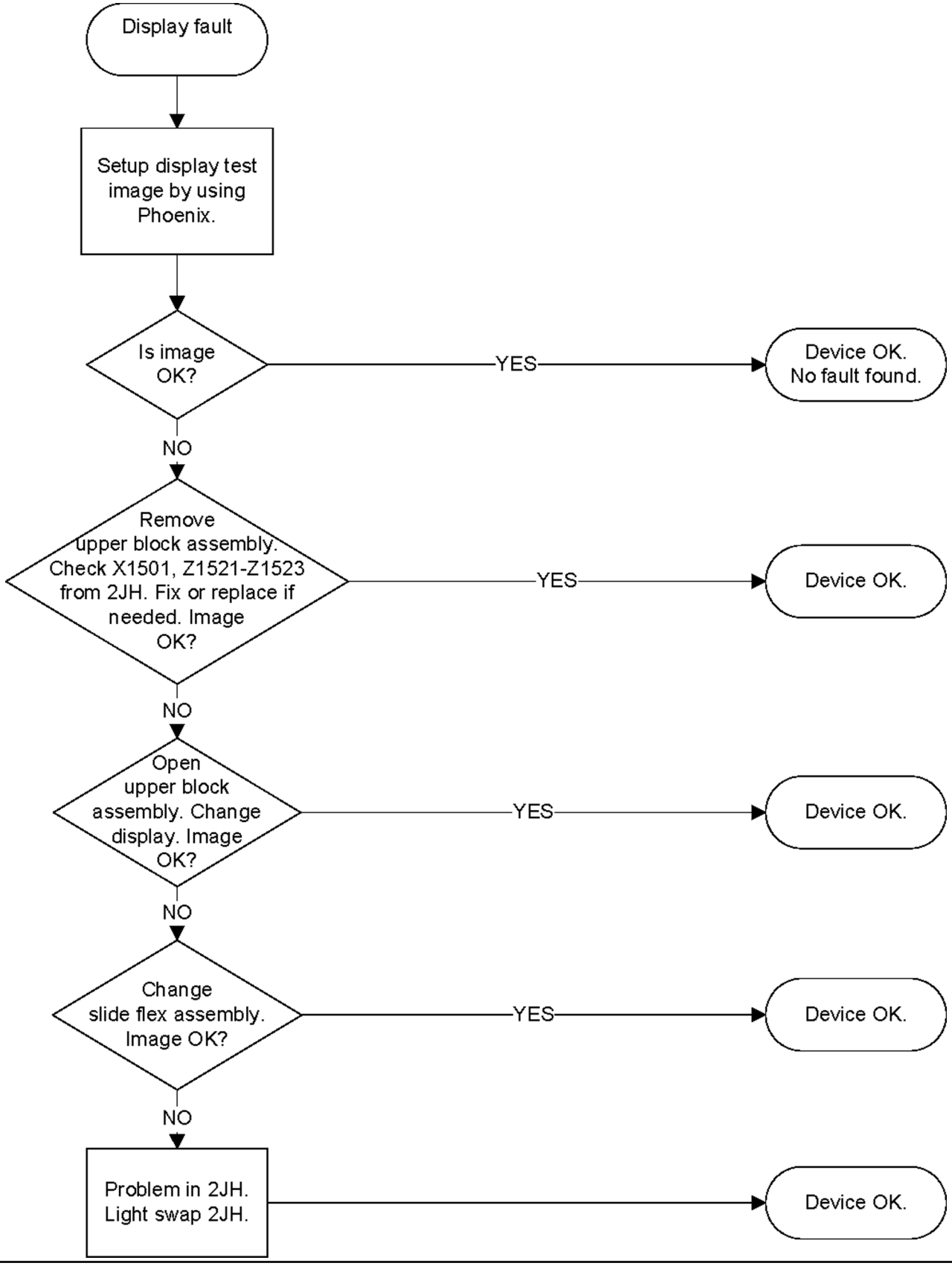
Accelerometer troubleshooting

Troubleshooting flow



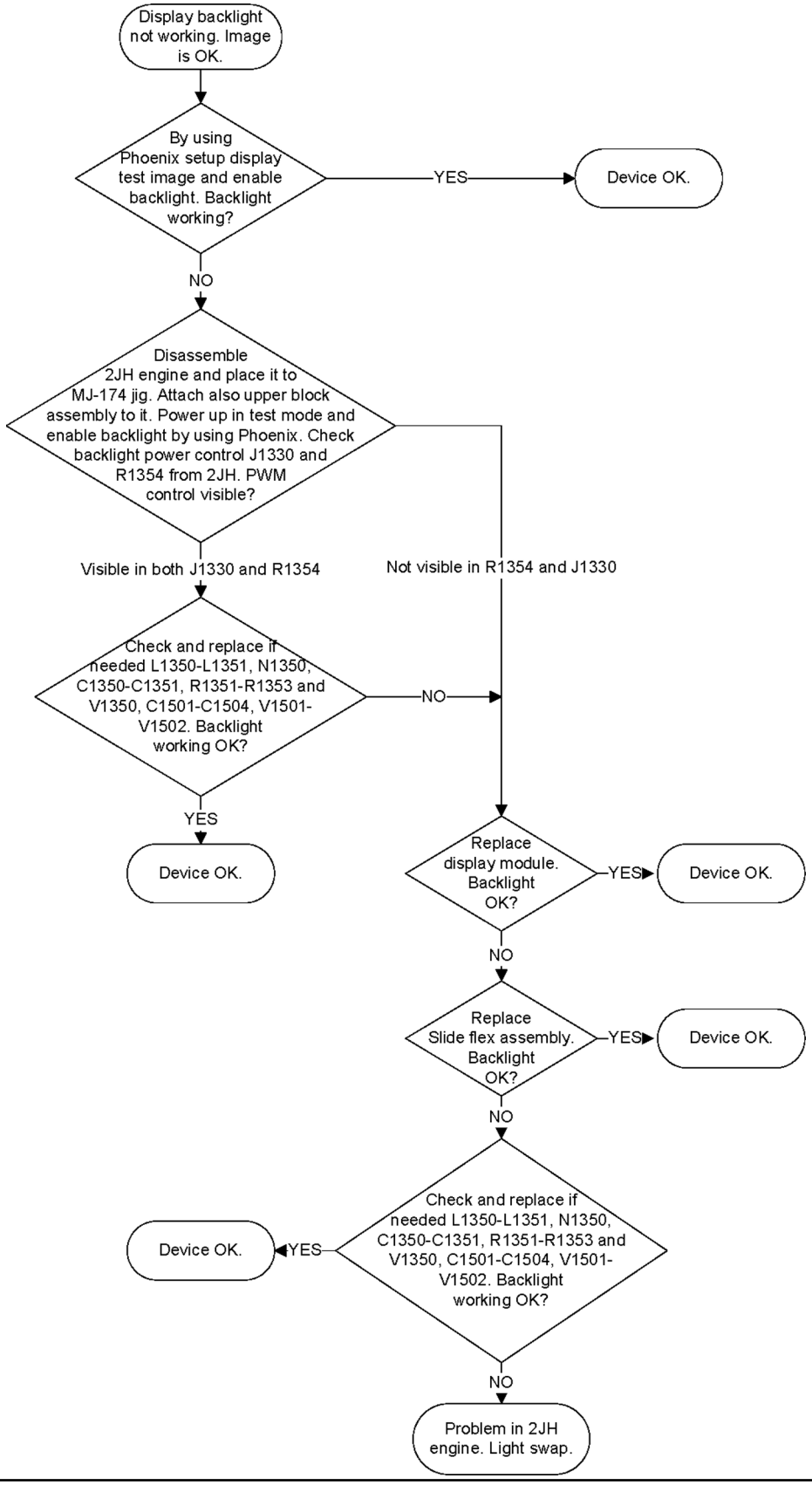
Display troubleshooting

Troubleshooting flow



Display backlight troubleshooting

Troubleshooting flow



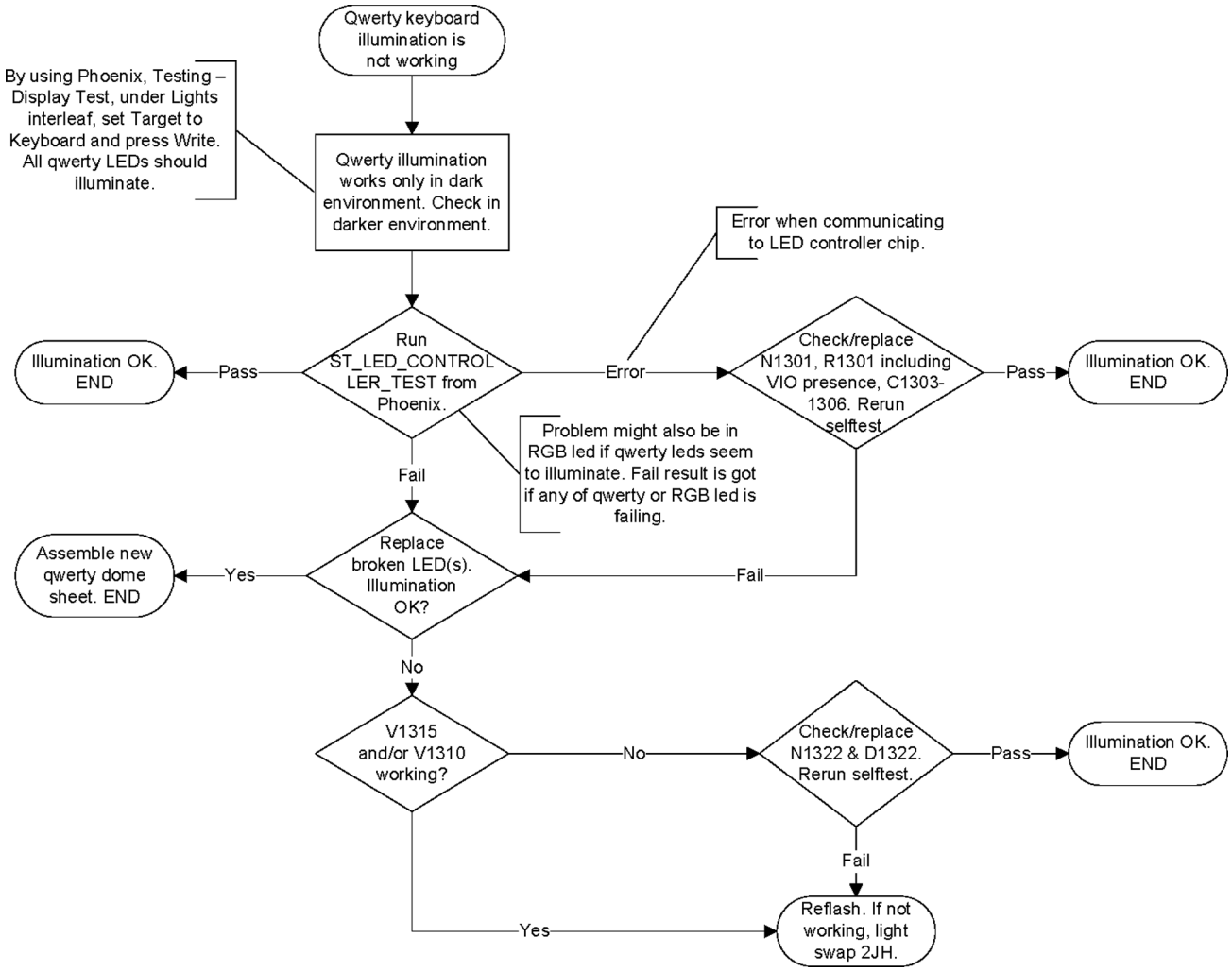
Touch screen troubleshooting

Troubleshooting flow

Illumination troubleshooting

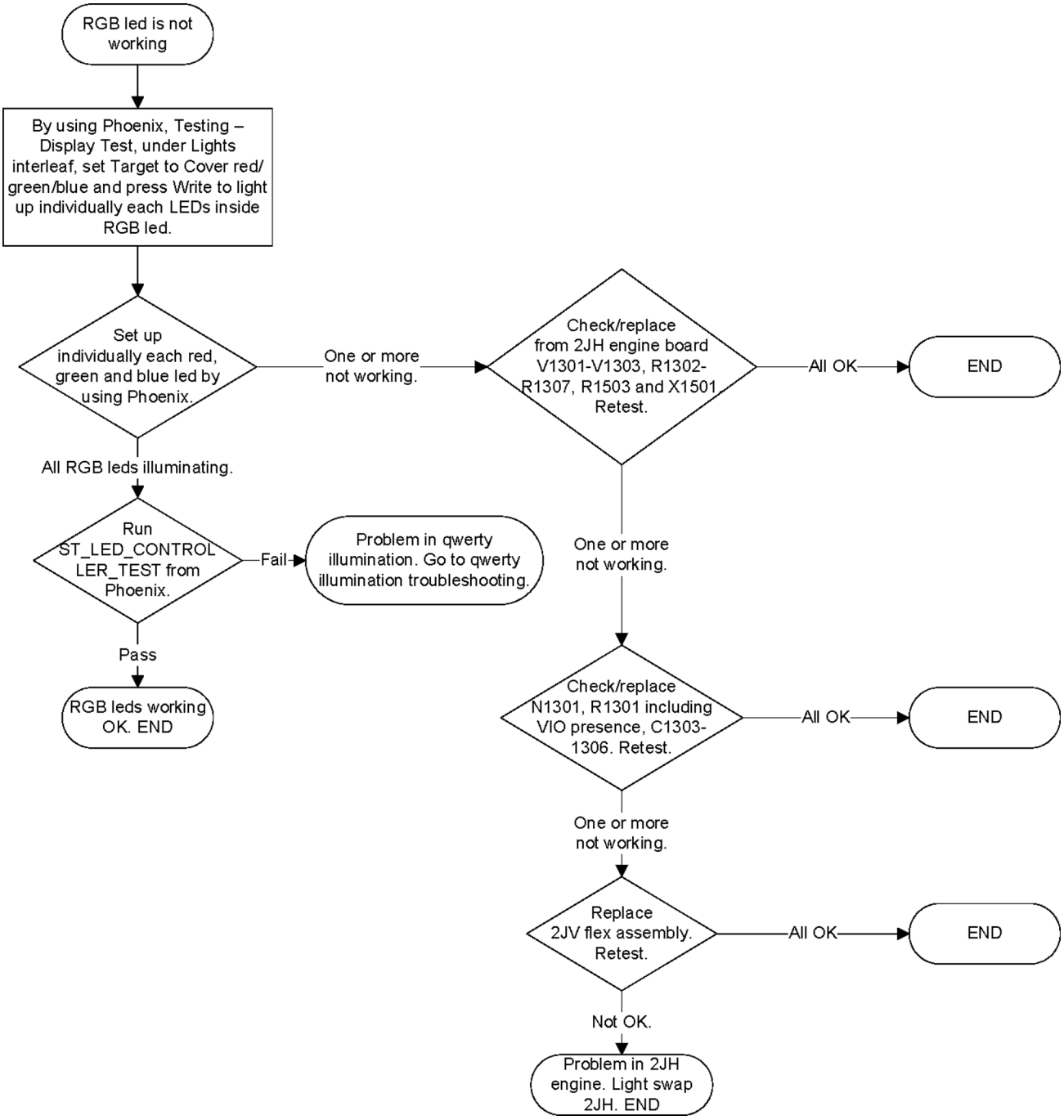
Qwerty keyboard illumination troubleshooting

Troubleshooting flow



RGB LED troubleshooting

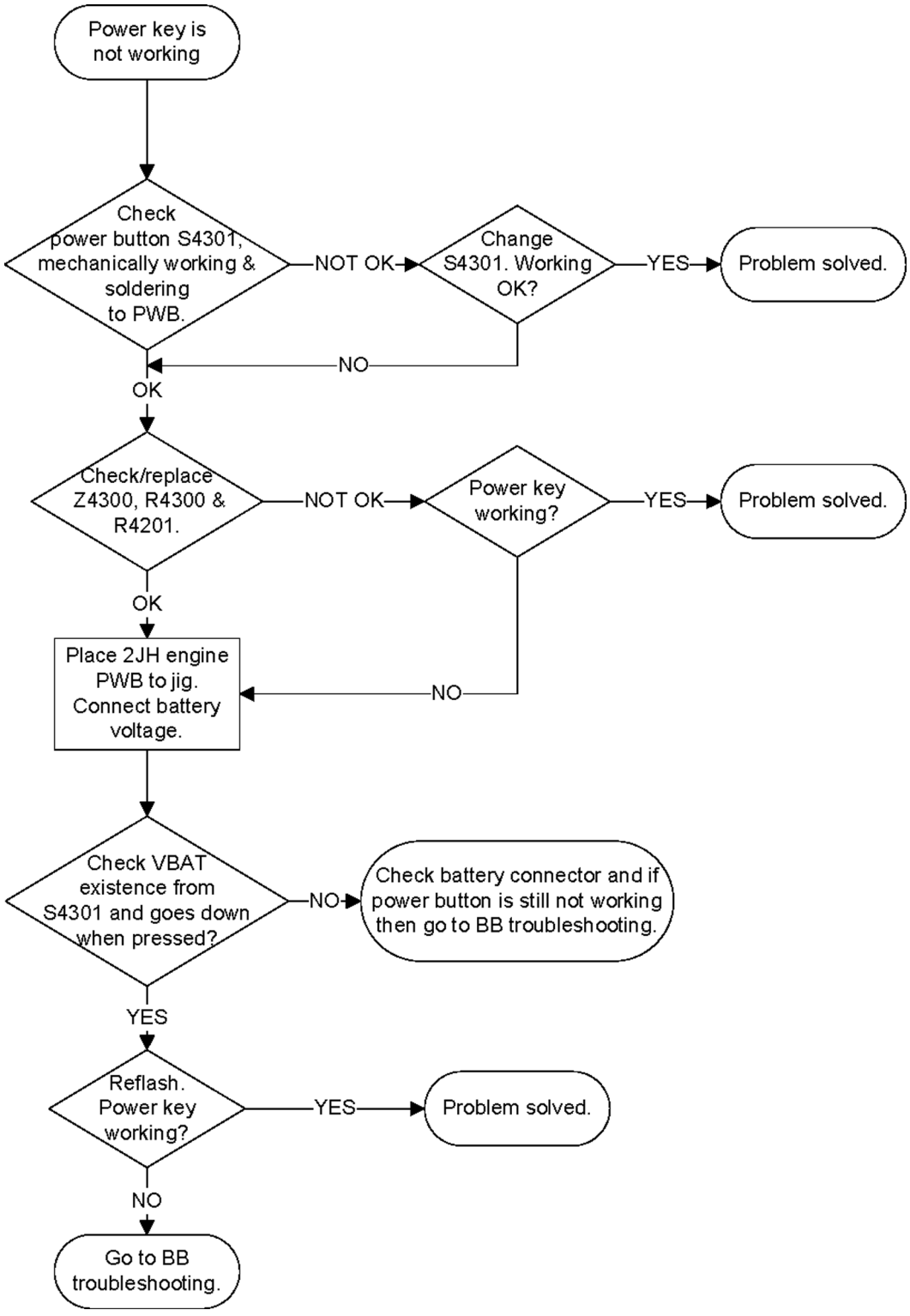
Troubleshooting flow



Keyboard troubleshooting

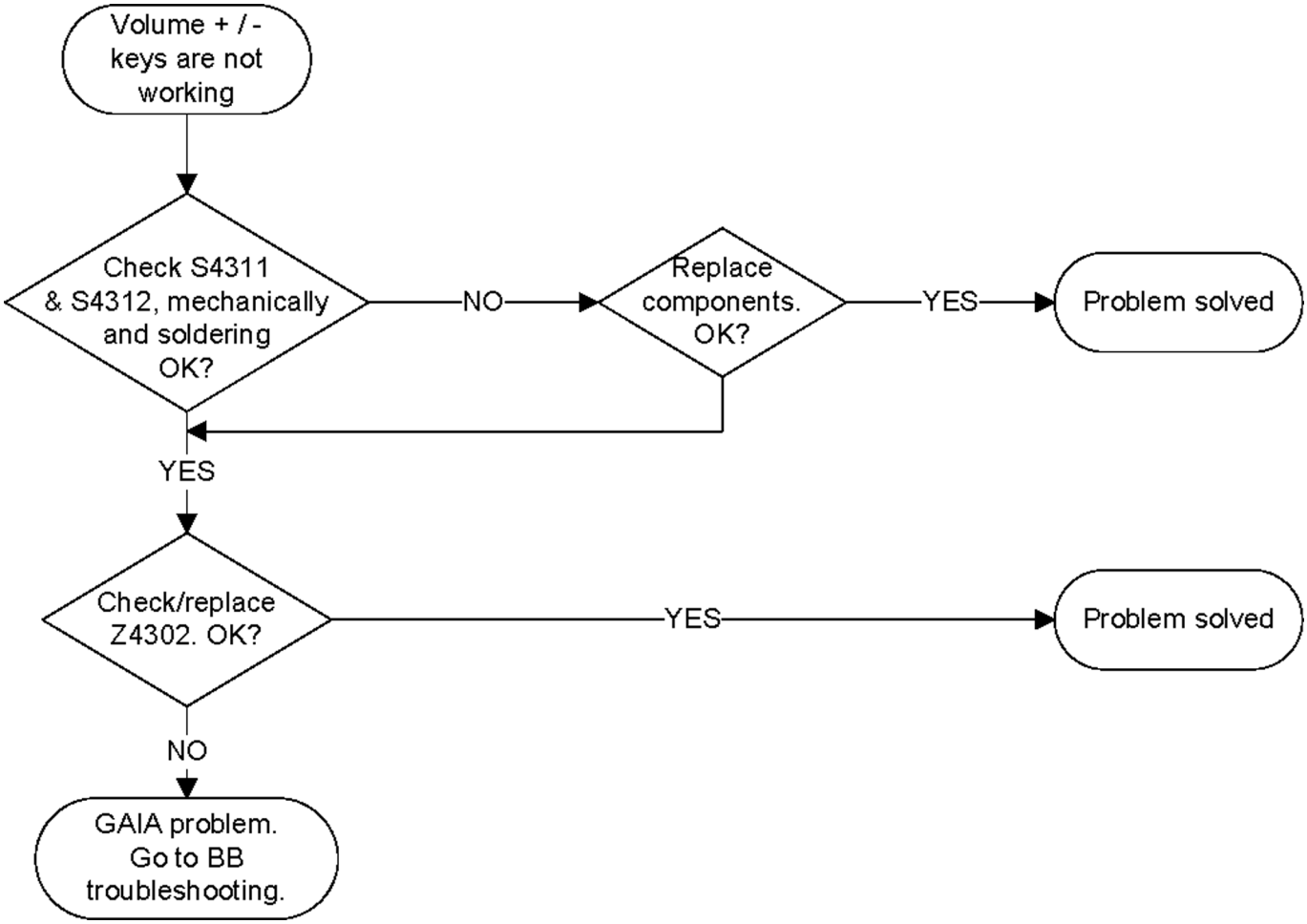
Power key troubleshooting

Troubleshooting flow



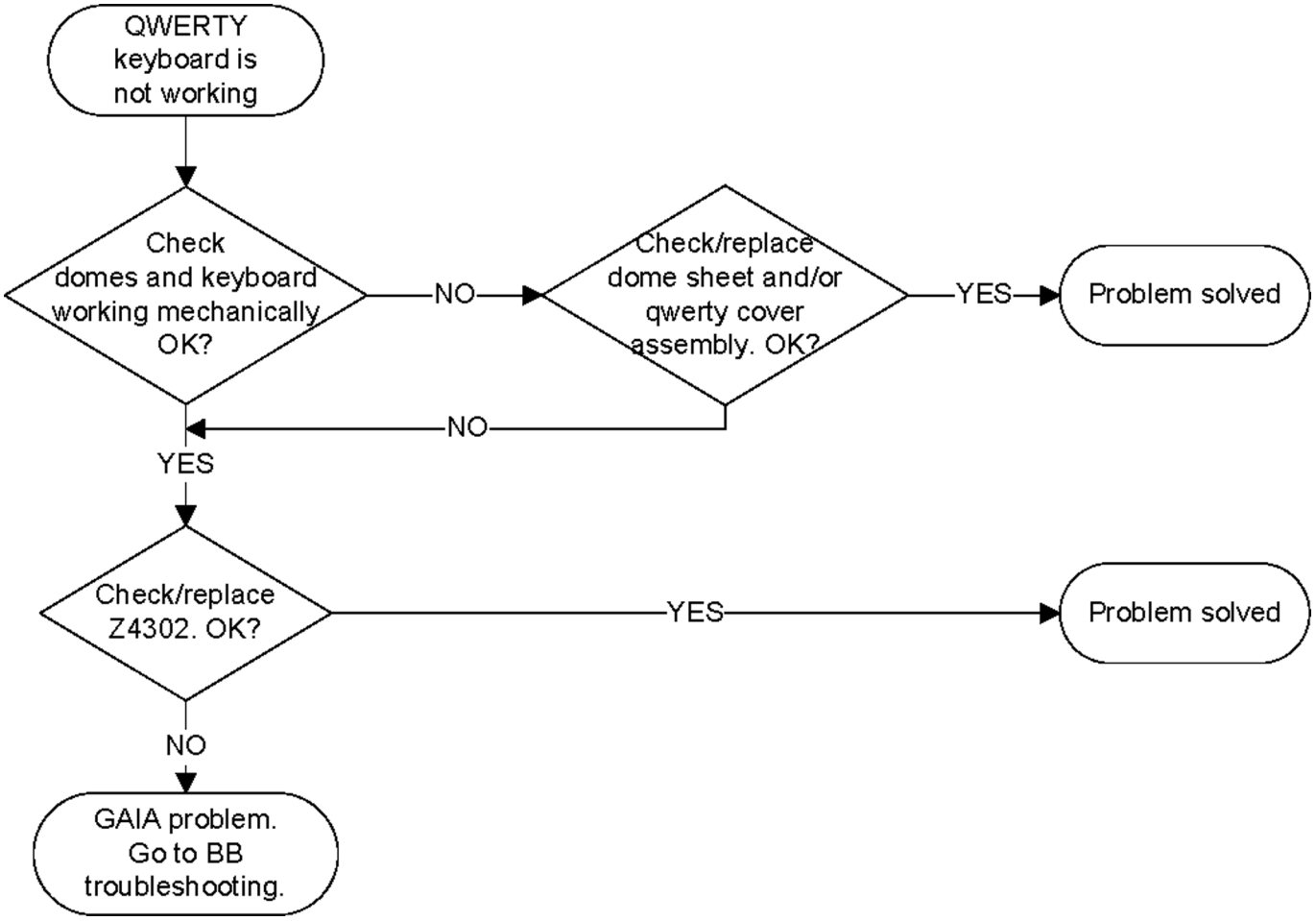
Volume keys troubleshooting

Troubleshooting flow



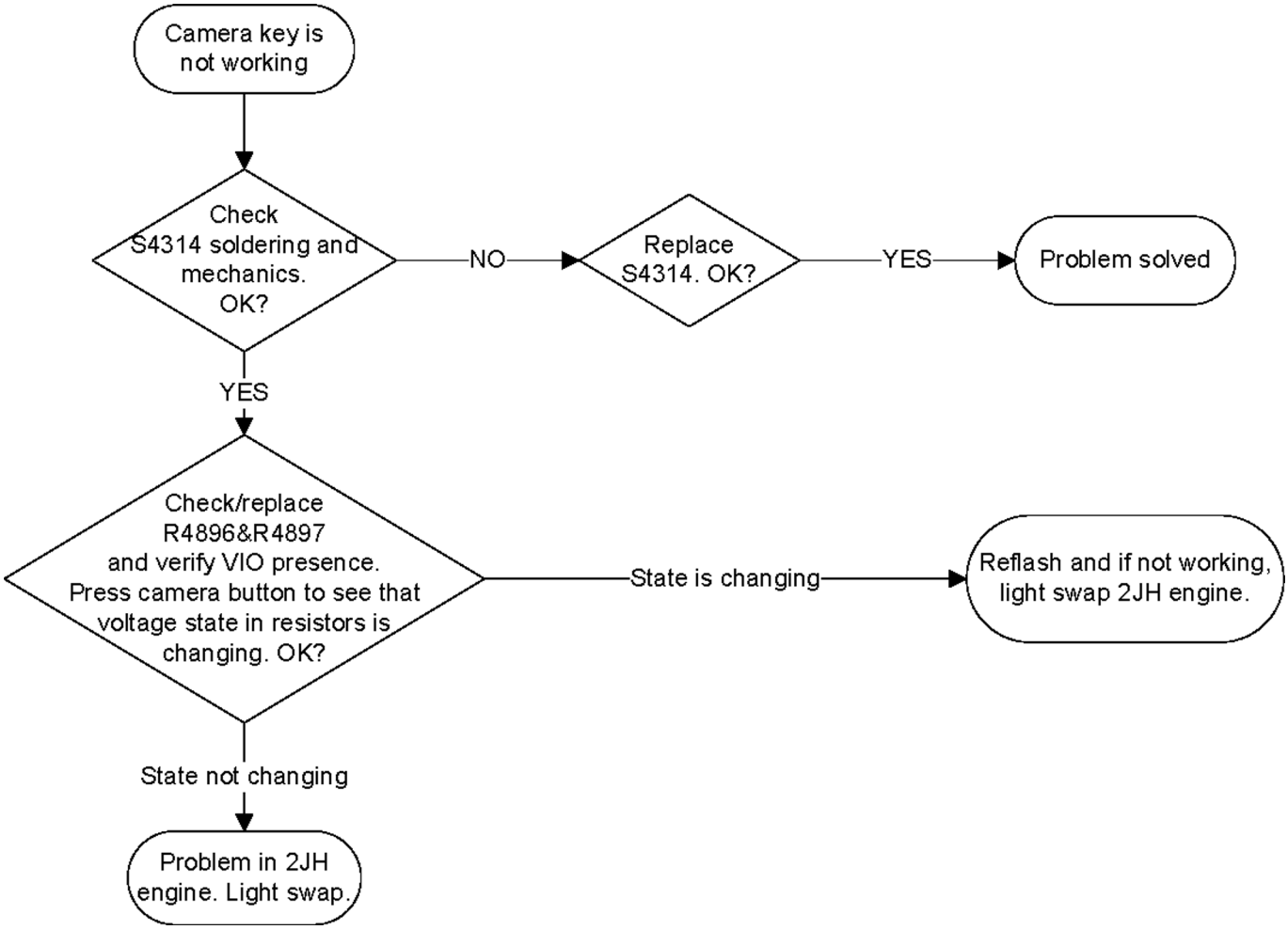
Keyboard troubleshooting

Troubleshooting flow



Camera key troubleshooting

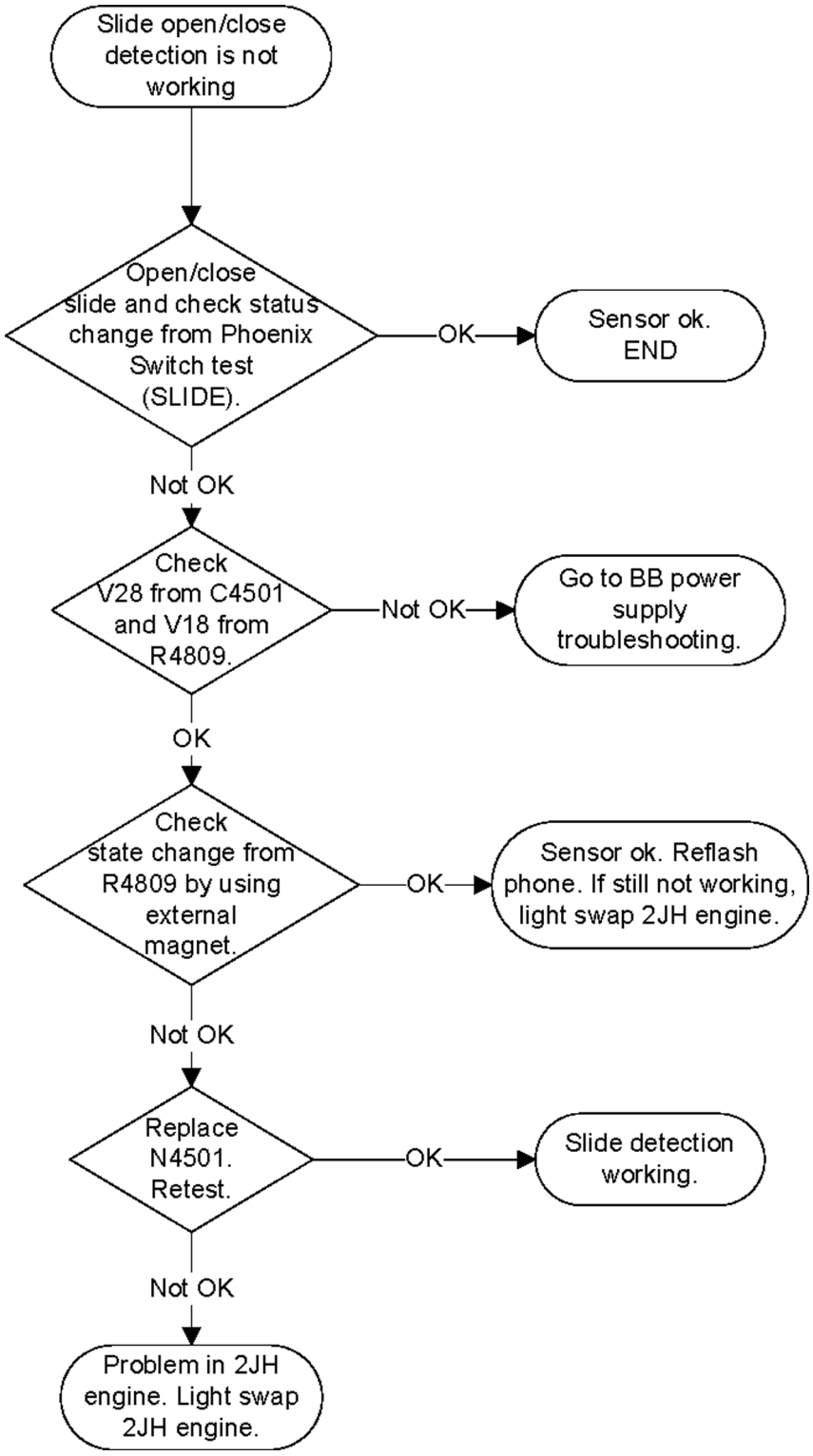
Troubleshooting flow



Sensors troubleshooting

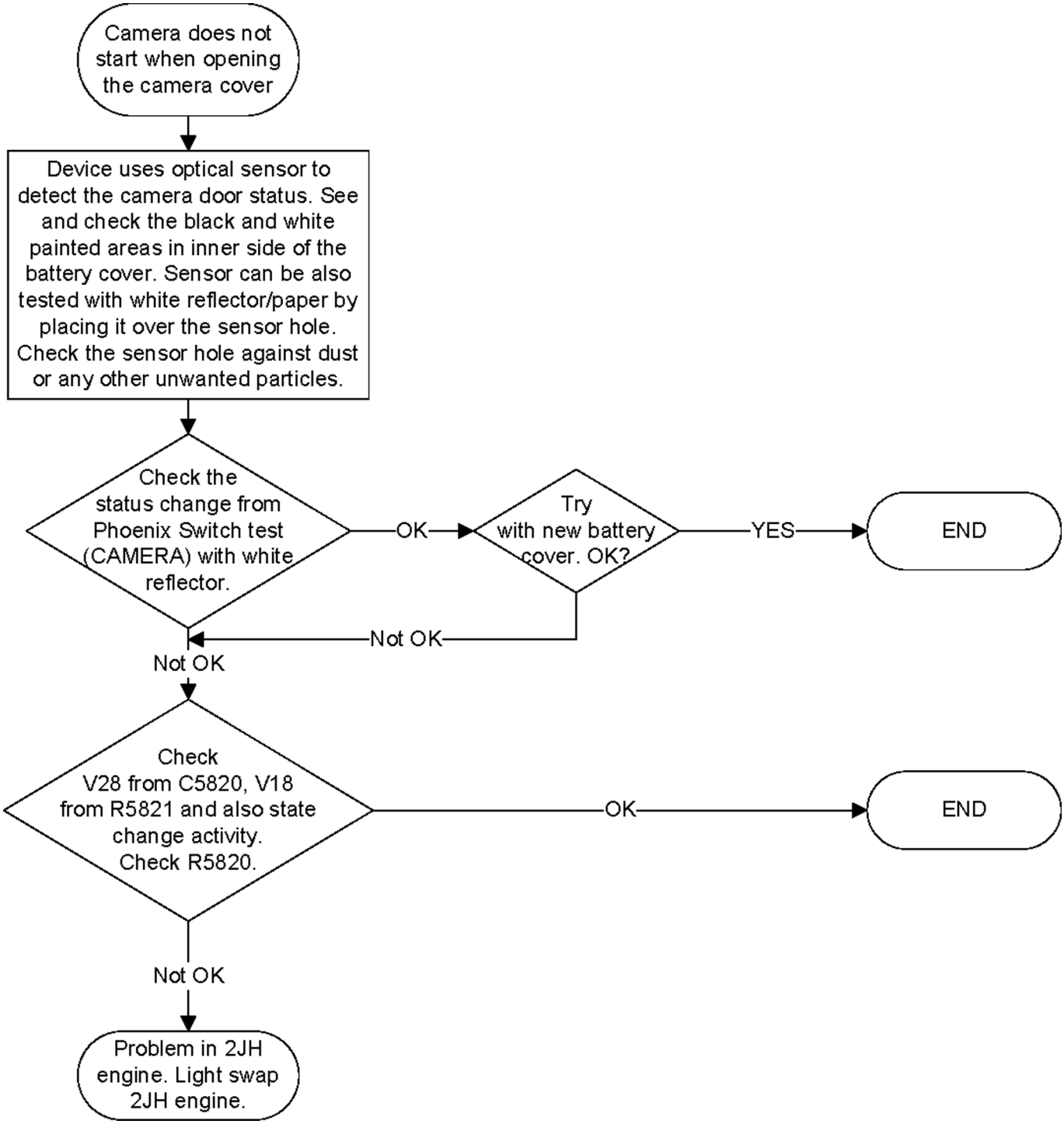
Slide detection troubleshooting

Troubleshooting flow



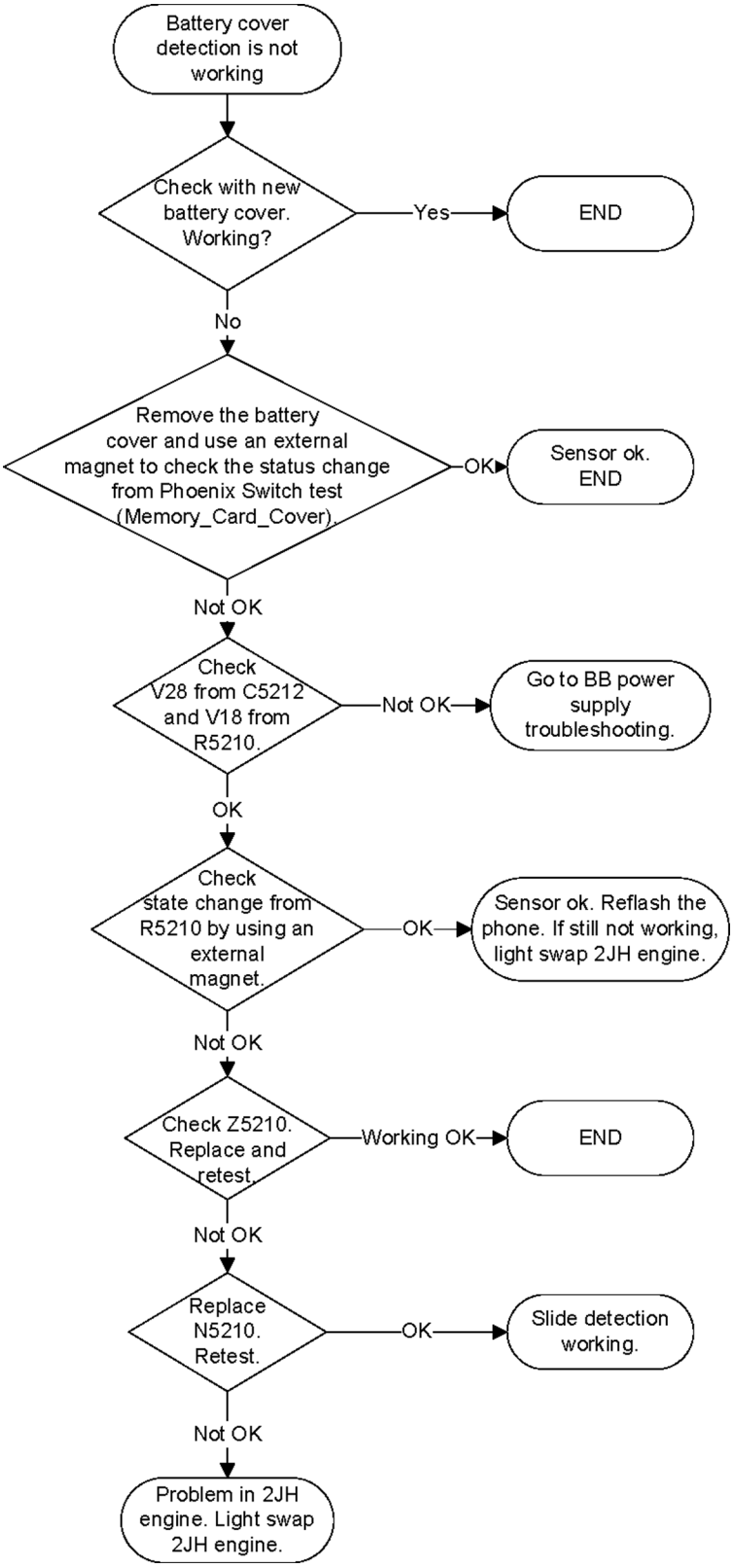
Camera cover troubleshooting

Troubleshooting flow



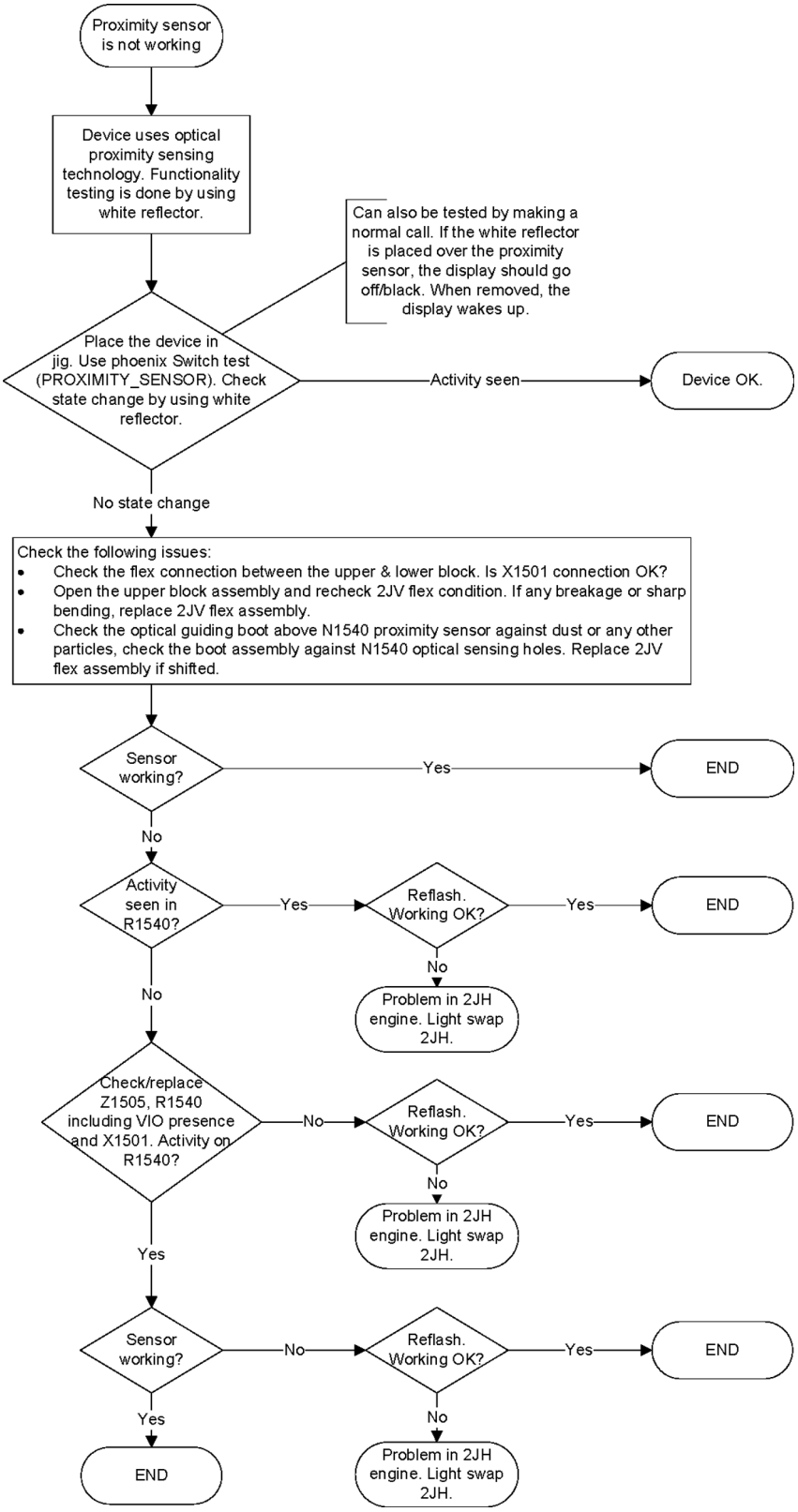
Battery cover detection troubleshooting

Troubleshooting flow



Proximity sensor troubleshooting

Troubleshooting flow



Audio troubleshooting

Audio troubleshooting test instructions

Single-ended external earpiece and differential internal earpiece outputs can be measured either with a single-ended or a differential probe.

When measuring with a single-ended probe each output is measured against the ground.

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 2 kHz.

The input signal for each loop test can be either single-ended or differential. Exception to this is a digital microphone which needs input signal from an external sound source (laptop speaker) to playback, eg. 1 kHz sine wave from 5 cm distance.

Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- Current probe (Internal handsfree DPMA output measurement)
- Phoenix service software
- Battery voltage 3.7V
- Sound source (laptop speaker or B&K type 4231 calibrator)

Test procedure

Audio can be tested using the Phoenix audio routings option. Three different audio loop paths can be activated:

- External headset mic to earpiece
- External headset mic to IHF mono
- Internal digital microphone to headset

Each audio loop sets routing from the specified input to the specified output enabling a quick in-out test. Loop path gains are fixed and they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

Phoenix audio loop tests and test results

The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7V.

Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

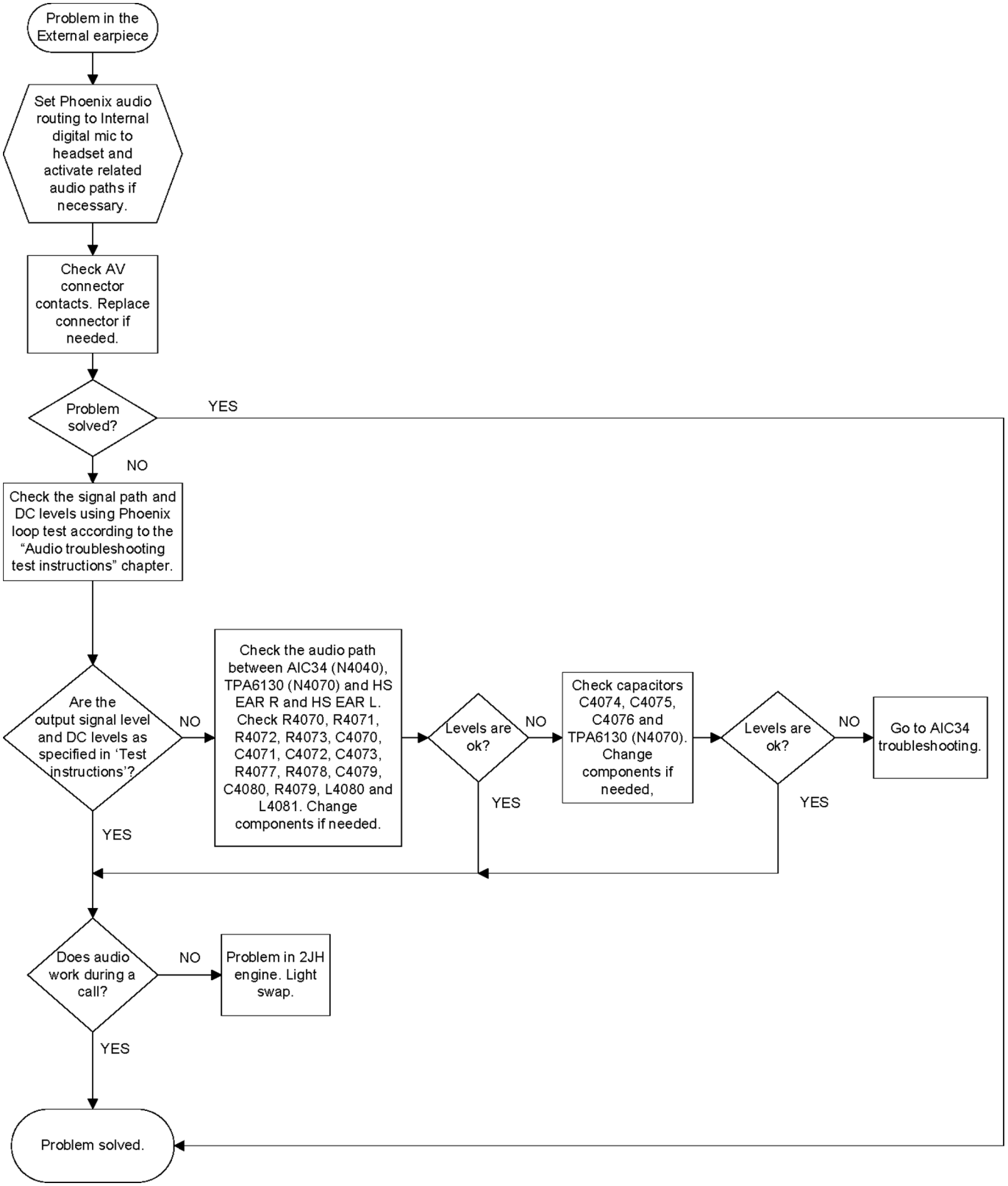
The gain values presented in the table apply for a differential output vs. single-ended/differential input.

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Output DC level [V]	Output voltage [mVp-p]
External headset mic to earpiece	HS_MIC & GND	EAR 1 & GND	0	300	1.35	300
		EAR 0 & GND				

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Output DC level [V]	Output voltage [mVp-p]
External headset mic to IHF mono	HS_MIC & GND	L4855 & L4856	10	200		630
		L4857 & L4858				
Internal digital microphone to headset	Acoustical Input, 1kHz sine wave	HS_L & GND	NA	94 dBSPL		70
		HS_R & GND				

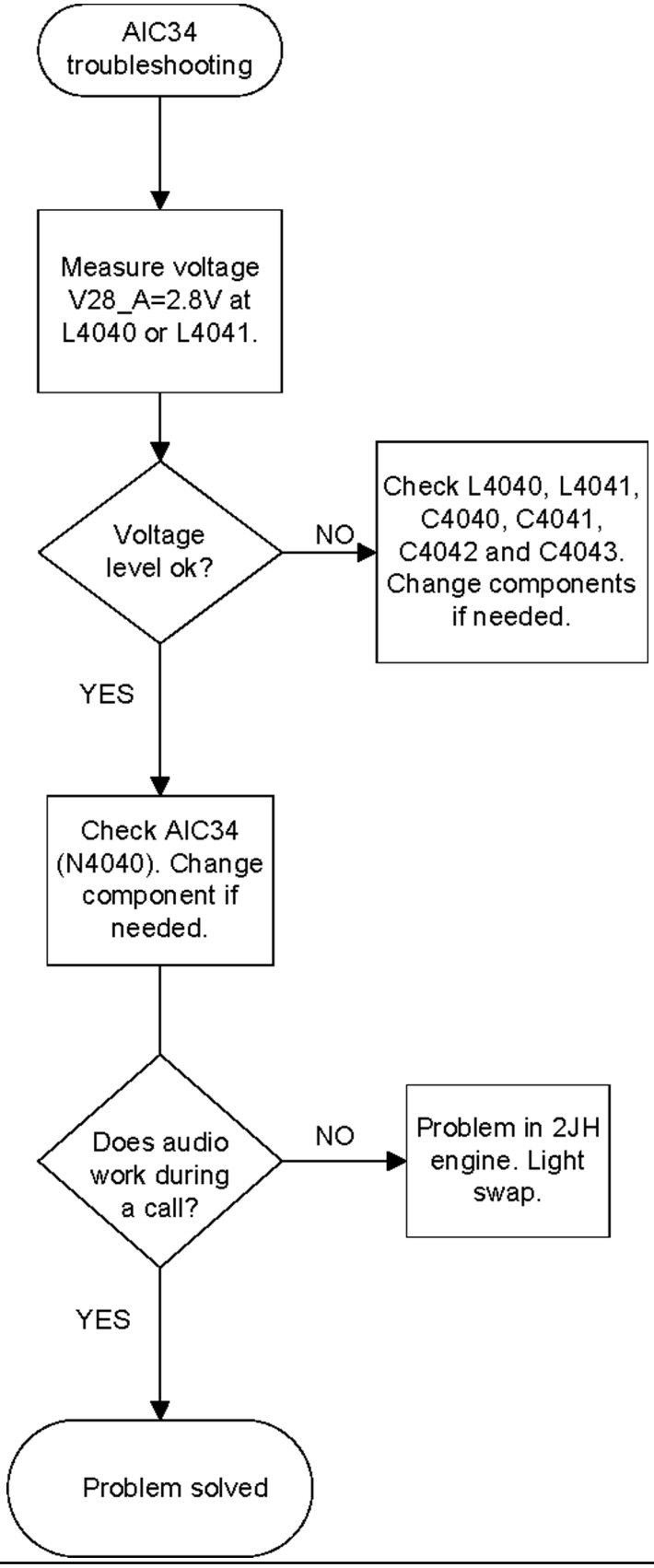
External earpiece troubleshooting

Troubleshooting flow



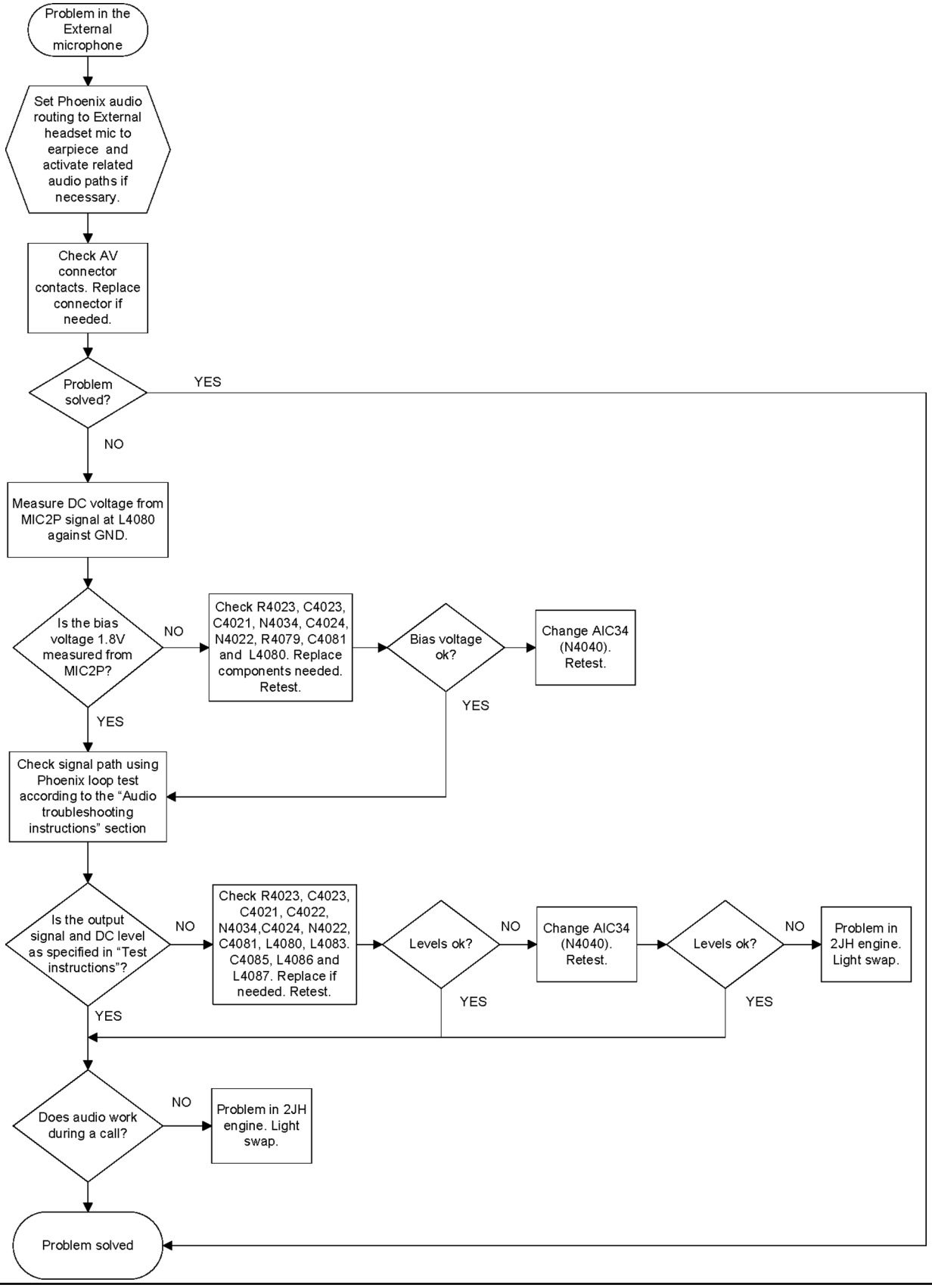
AIC34 troubleshooting

Troubleshooting flow



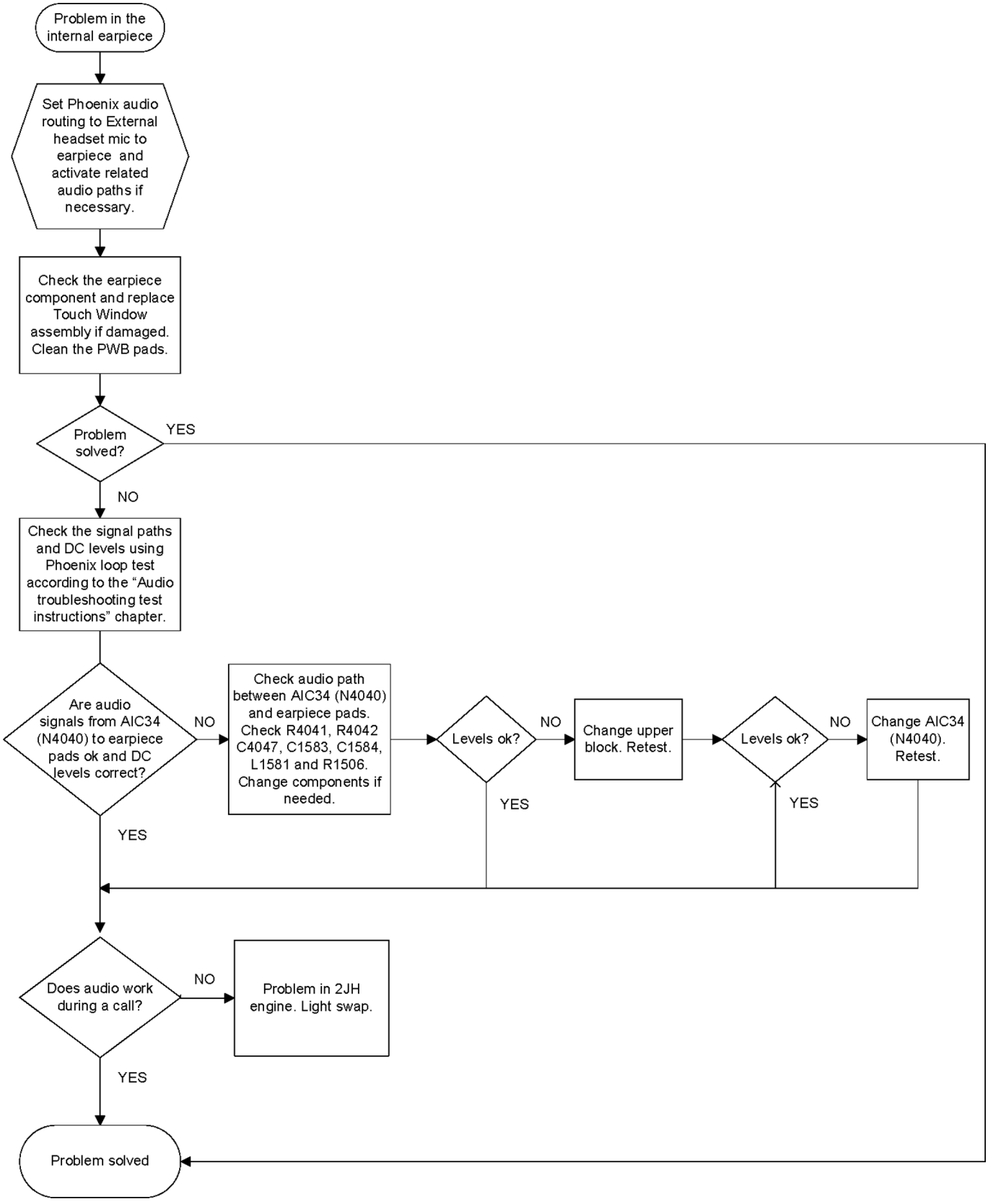
External microphone troubleshooting

Troubleshooting flow



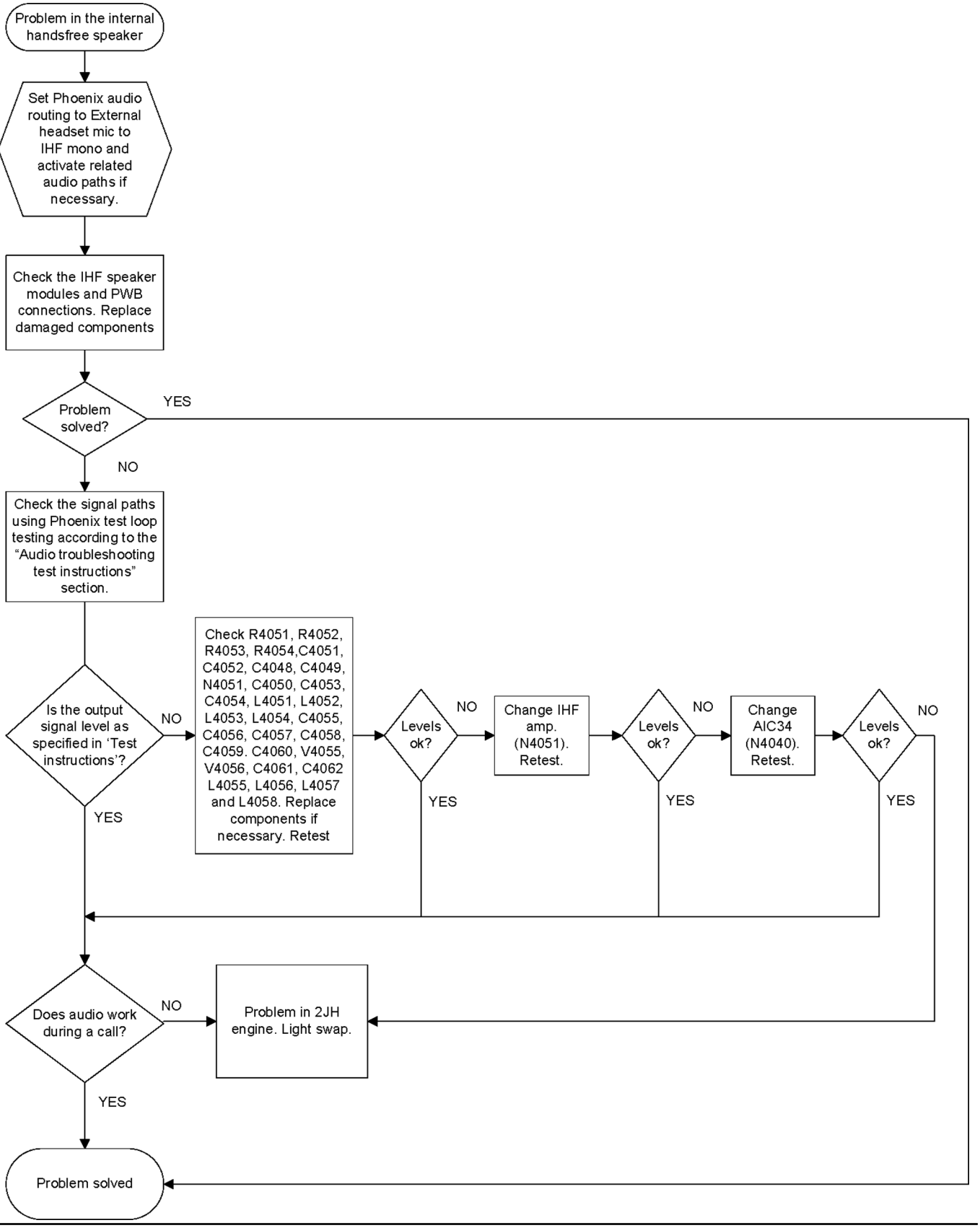
Internal earpiece troubleshooting

Troubleshooting flow



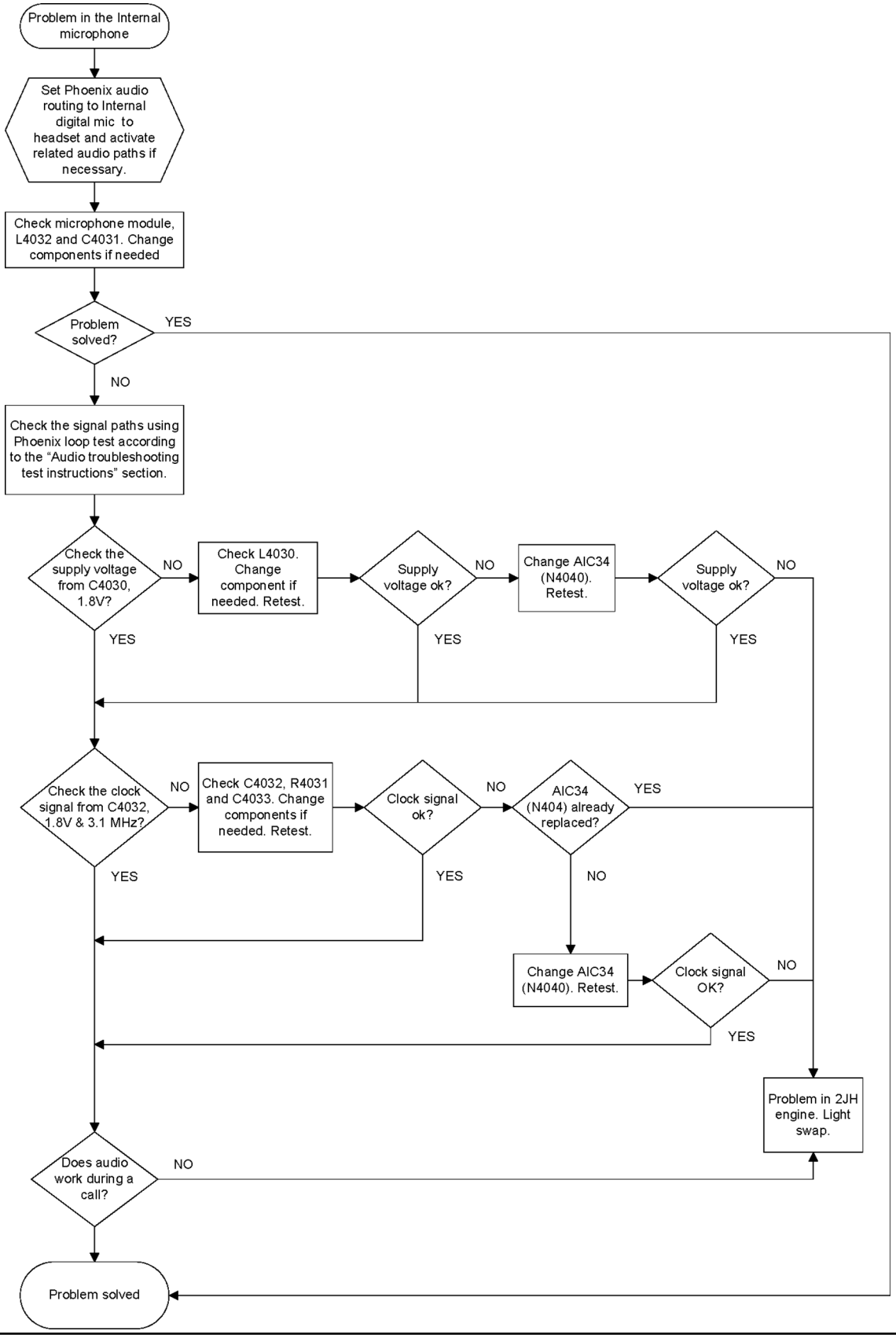
Internal handsfree speaker troubleshooting

Troubleshooting flow



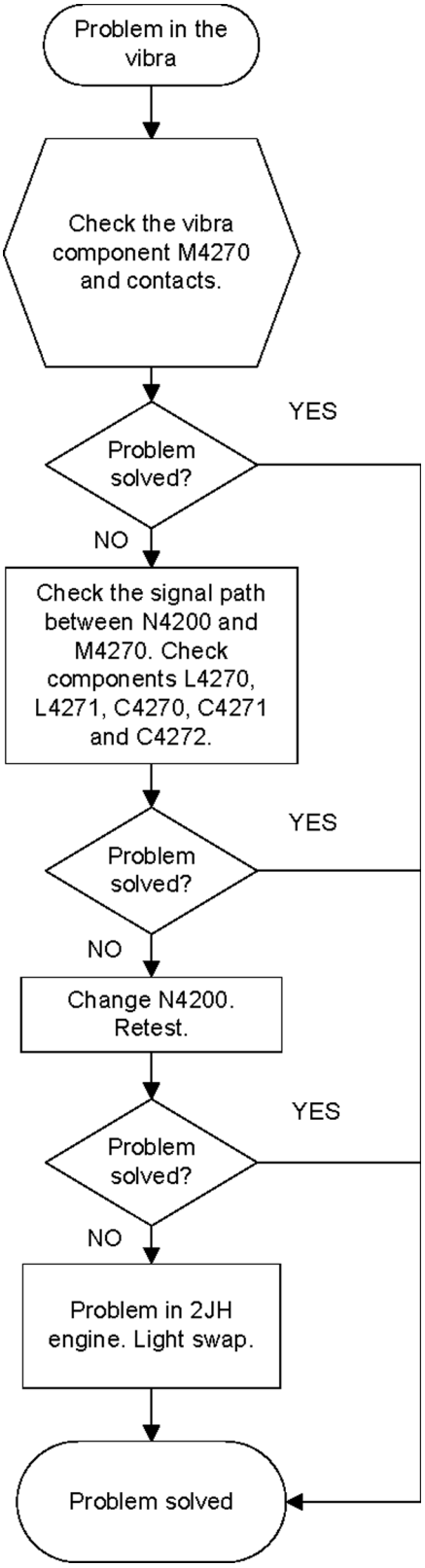
Internal microphone troubleshooting

Troubleshooting flow



Vibra troubleshooting

Troubleshooting flow



ALS technical description and troubleshooting

Ambient Light Sensor

Ambient Light Sensor

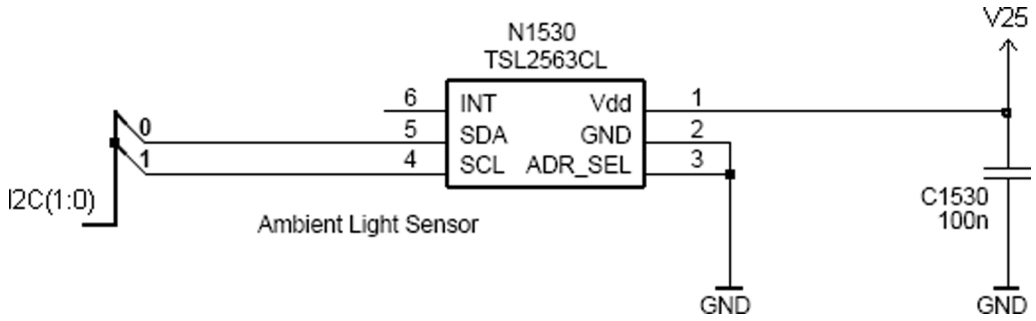


Figure 11 Ambient Light Sensor

Ambient Light Sensor consists of the following components:

- Ambient Light Sensor (ALS)

  ALS is a digital I2C interface component, having two channels with different spectral sensitivities. When combined, the component responds to illuminance similar as human eye.
- Vdd Filtering capacitor C1530

Ambient Light Sensor information is used to control keypad and display brightness of the phone.

Keyboard backlight is turned OFF when it is not needed. Display brightness is dimmed when environment lighting is dark.

Ambient Light Sensor is calibrated in production and can be re-tuned in service points though not recommended unless calibration coefficient are lost for some reason

ALS troubleshooting

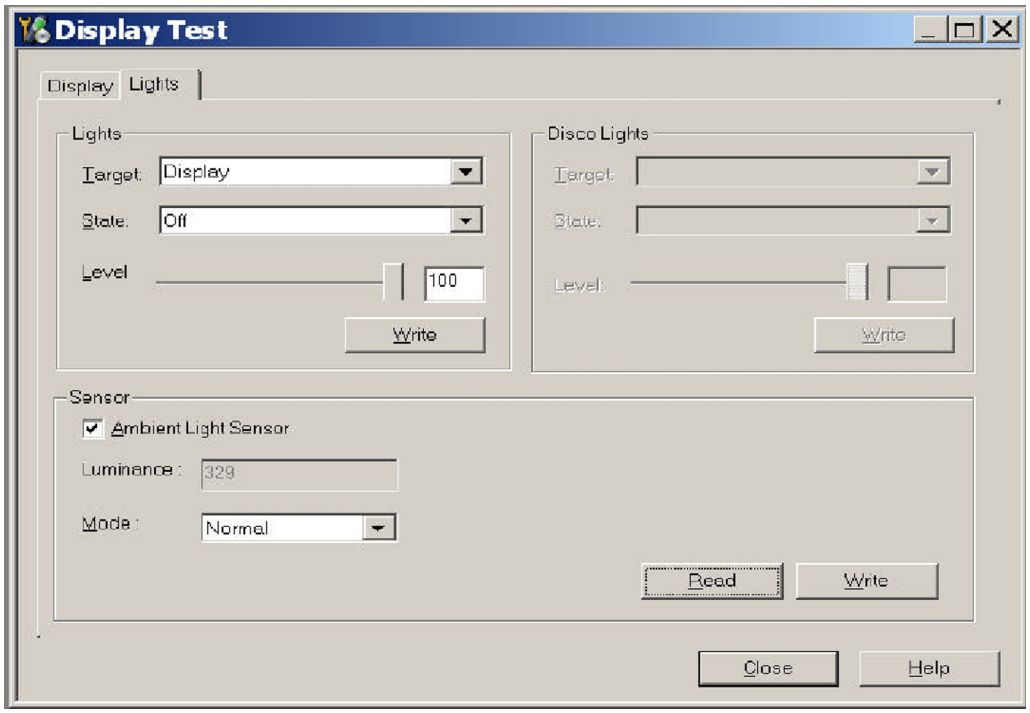
Context

Functionality check:

Steps

1. Connect phone to Phoenix and set the phone (e.g. on the table) so that the amount of ambient light seen by ALS is as stable as possible.
2. Start Phoenix
3. Choose **File -> Scan product**
4. Choose **Testing -> Display Test**
5. Open the **Lights** tab, check Ambient Light Sensor check box, click **Read**, cover the sensor and click **Read** again. When covered, Luminance reading should be less than after clicking **Read** without covering the sensor.

6. If component doesn't give any reading or reading doesn't change when sensor is/is not covered, replace the part.



Note: After replacing the ALS. If calibration values of the new sensor are lost or for some other reason, ALS re-tuning is required (see instructions later in this document).

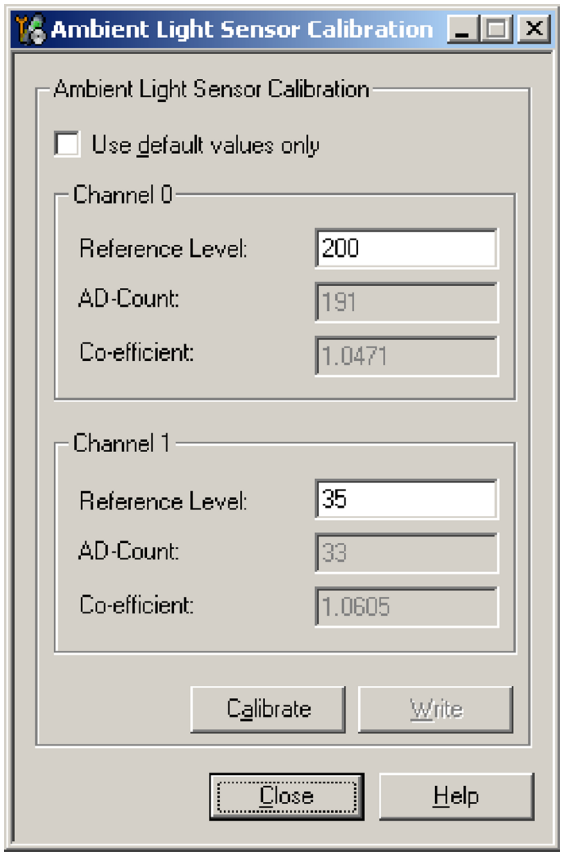
When doing the ALS calibration procedure, it is required to have a reference phone, which includes calibrated ALS. ALS re-tuning instructions show why the reference phone is needed.

Re-tuning ALS

Steps

1. Connect reference phone to Phoenix and set the phone (e.g. on the table) so that the amount of ambient light seen by ALS is as stable as possible.
2. Start Phoenix.
3. Choose **File→Scan Product.**

4. Choose **Tuning -> Ambient Light Sensor Calibration**. You should see the following window:



5. Read AD-count values for Channel 0 and Channel 1 by click **Read** button and write them down.
6. Repeat 1-5 for the phone to be calibrated and make sure the phone to be calibrated is located in the same place as reference phone was when luminance reading was taken.
7. Calculate co-efficient from reference phone and phone to be calibrated AD-count values by division: Co-efficient = AD-count(reference phone) / AD-count(phone to be calibrated), write down the calculated co-efficient values.
8. -> Iterate by changing Channel 0 and Channel 1 (reference level) values (remove cross from 'Use default values only'). After writing some value to Channel 0 and Channel 1 (reference value), calibrate button must be pressed. Stop iterating when Co-efficient is equal to Co-efficient calculated in step 7. Note that decimal numbers should be used in the iteration in order to achieve enough precision (e.g. 200.2455)
9. After having same Co-efficient value in "Co-efficient" textbox as the calculated value, make sure that ambient light values (read using **Testing → Display Test → "Luminance"** textbox) are almost the same in reference phone and calibrated phone. Remember that illuminance readings for reference and calibrated phones must be done in the same ambient light conditions. If illuminance values differs a lot (difference max. +- 10%), repeat whole ALS re-tuning procedure.
10. To end the calibration, click Close.

Bluetooth and FM radio troubleshooting

Introduction to Bluetooth/FM radio troubleshooting

Bluetooth/WLAN antenna

The BT RF signal is routed from BTFMRDS2.2 through the WLAN module to the shared WLAN/BT antenna in the phone's B-cover. Check the antenna pin contacts with Bluetooth/WLAN antenna.

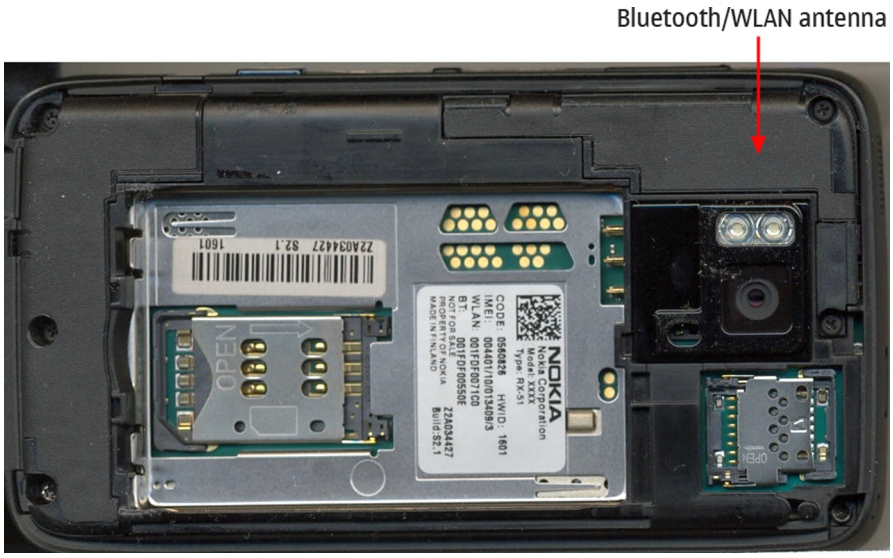


Figure 12 Bluetooth/WLAN antenna

Introduction to Bluetooth/FM radio troubleshooting

The Bluetooth and FM radio are combined in the same ASIC, so both features are checked when troubleshooting.

The following problems can occur with the Bluetooth and FM radio hardware:

Symptom	Problem	Repair solution
Unable to switch on Bluetooth on phone user interface	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs or SMD components	Replacement of Bluetooth/ FM ASIC/module
Able to send data file to another Bluetooth device, but unable to hear audio through functional Bluetooth headset	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs	Replacement of Bluetooth/ FM ASIC/module
Able to switch on Bluetooth on phone user interface, but unable to detect other Bluetooth devices	Open circuit solder joints or antenna pins not making contact with Bluetooth/WLAN antenna	Repair or replace Bluetooth/ WLAN antenna
Able to turn on FM radio and Bluetooth on phone user interface, but unable to detect local FM radio stations with Nokia headset inserted	Open circuit solder joints or detached component in FM antenna circuit Check antenna pin contacts with Bluetooth/WLAN antenna	Repair components or replace Bluetooth/WLAN antenna module
Able to perform scans to detect local FM radio stations with functional Nokia headset inserted, but unable to hear FM audio through headset	Open circuit solder joints or detached component in FM audio path between Bluetooth/ FM ASIC and headset	Repair of FM audio circuit

Users may experience the following problems resulting in functional phones being returned to the repair centre:

Symptom	Problem	Repair solution
Bluetooth feature does not operate as desired with another Bluetooth device	Bluetooth Profile implemented in Bluetooth accessory not supported in Nokia phone	Use Bluetooth accessory with Bluetooth profiles supported by phone
Poor FM radio reception (unable to detect many radio stations)	Nokia headset not being used	Use Nokia headset

Test coverage

The tests listed in the table below should be performed to verify whether the Bluetooth and FM receiver and transmitter are functional. The use of Self Tests are described in section *BT and FM Self Tests in Phoenix*

Test	Test Coverage	Repair solution
Blueooth Self Test: ST_LPRF_IF_TEST	Bluetooth-FM ASIC UART interface (controls Bluetooth and FM receiver and transmitter)	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Self Test: ST_BT_WAKEUP_TEST	Bluetooth ASIC interrupt control interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Self Test: ST_LPRF_AUDIO_LINES_TEST	Bluetooth ASIC PCM interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Functional Test: BER test with BT-Box or functional test with other Bluetooth device	Bluetooth antenna circuit	Repair of Bluetooth antenna circuit (including RF filter or WLAN switch if fitted)
FM Radio Self Test: ST_RADIO_TEST	FM Radio I2C interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
FM Radio Functional Test: Perform scan for local radio stations and check station list displayed on phone	FM receiver antenna circuit	Repair of FM antenna circuit (between BTHFM ASIC and headset connector)
FM Radio Functional Test: Listen to local radio station	FM receiver audio circuit	Repair of FM receiver audio circuit (between BTHFM ASIC and headset connector)

The self tests run from Phoenix software are used for fault diagnosis.

If Phoenix software is not available the functional tests with phone accessories are sufficient to verify the functionality Bluetooth and FM radio receiver and transmitter.

Bluetooth/FM radio component layout and test points

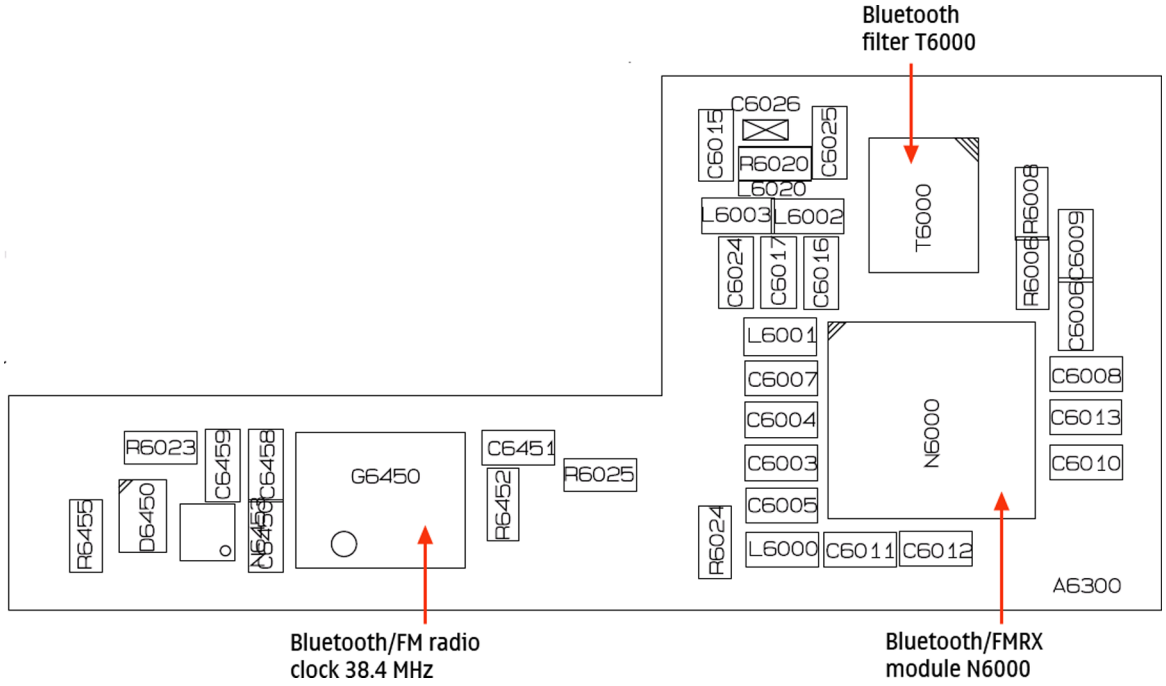


Figure 13 BT/FM component layout

The Bluetooth antenna is product specific (antenna integrated into phone B cover). On phones with WLAN, the Bluetooth RF signal is routed through a WLAN front-end module and a shared Bluetooth / WLAN antenna is used. The FM RF signal is routed through a product specific FM antenna matching circuit to the phone headset connector. The FM radio audio signal is routed to the headset connector through the BB ASIC shared by the phone audio functions.

Bluetooth BER test

Prerequisites

JBT-9, or SB-6 Bluetooth test box (BT-box) is required to perform a BER test. If a BT-box not available Bluetooth functionality can be checked by transferring a file to another Bluetooth phone.

Steps

1. Connect data cable to phone.
2. Start *Phoenix* service software.
3. Choose **File → Scan Product**.
4. Choose **Testing → Bluetooth LOCALS** .
5. Locate the BT-box serial number (12 digits) found in the type label on the back of the JBT-9, or SB-6 Bluetooth test box.
6. In the Bluetooth *LOCALS* window, write the 12-digit serial number on the *Counterpart BT Device Address* line.
7. Place the BT-box near (within 10 cm) of the phone and click **Start BER Test**.

Bluetooth and FM radio self tests in Phoenix

Prerequisites

A flash adapter (or phone data cable) connected to a PC with Phoenix service software is required.

Steps

1. Place the phone in the flash adapter or connect data cable to phone.
2. Start *Phoenix* service software.
3. Choose **File→Scan Product.**
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth and FM radio related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**
   - **ST_RADIO_TEST**
7. To run the tests, click **Start**.

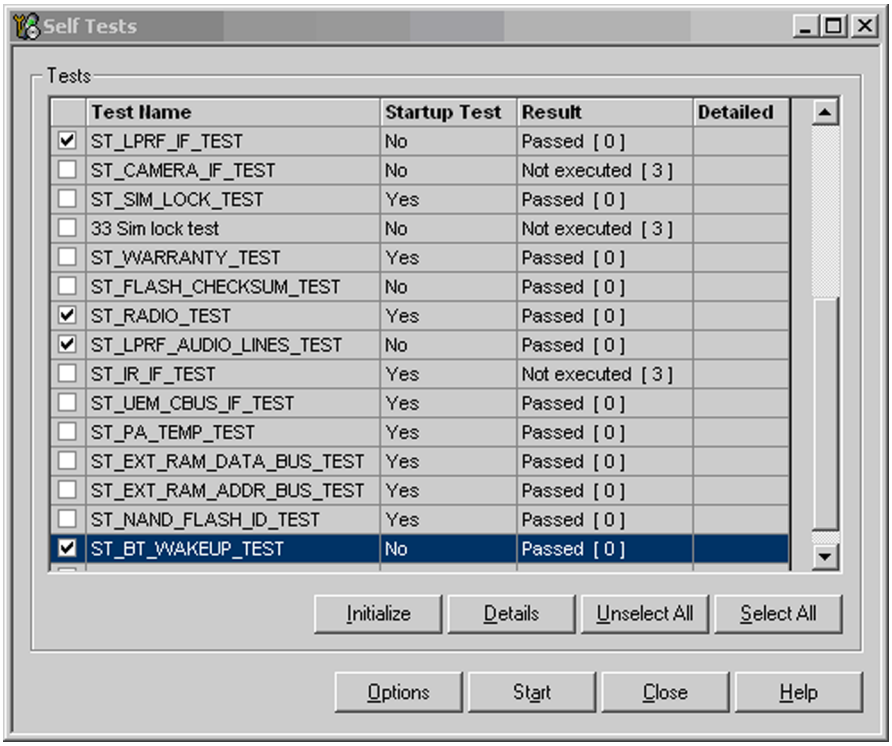
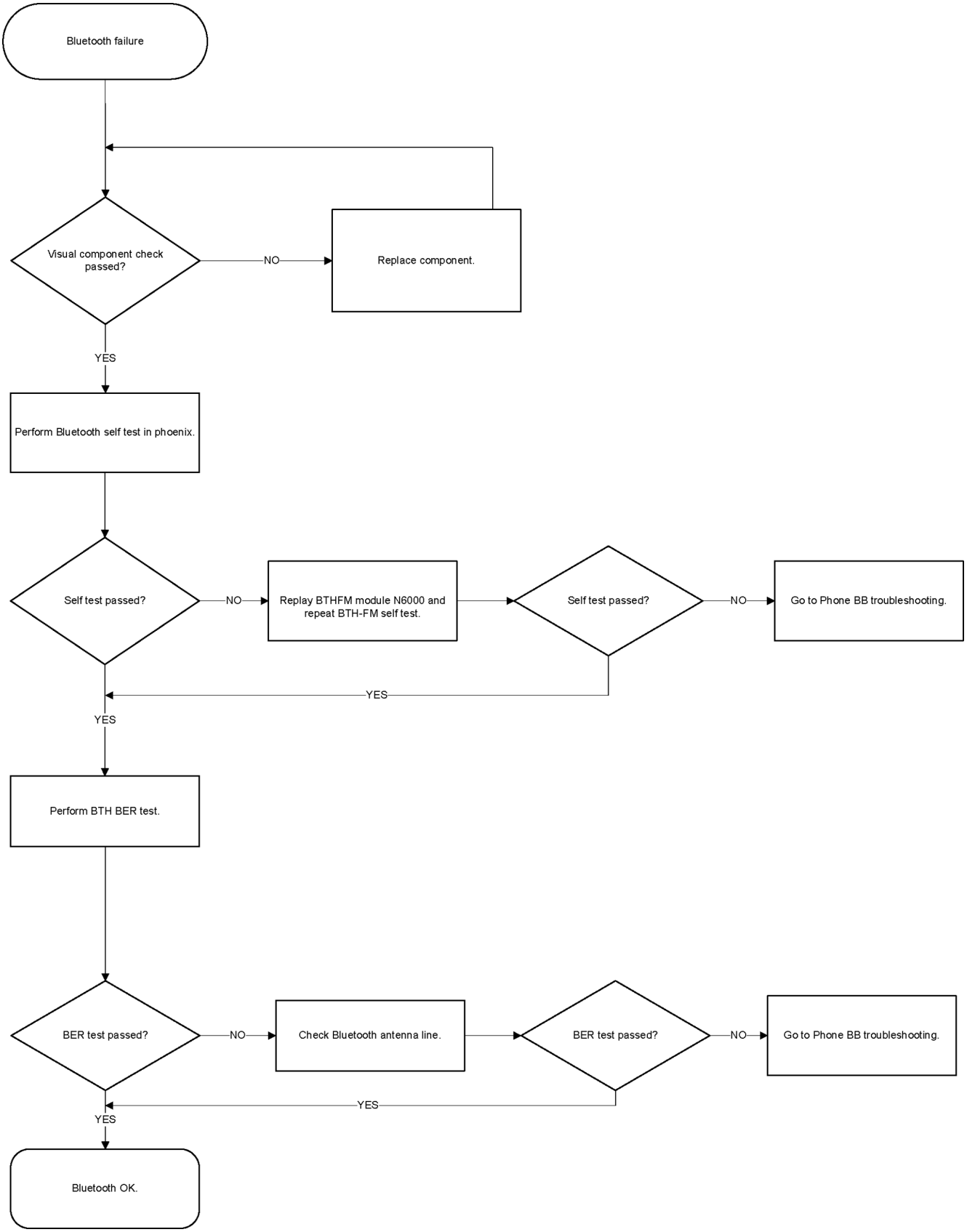


Figure 14 Bluetooth and FM radio self tests in *Phoenix*

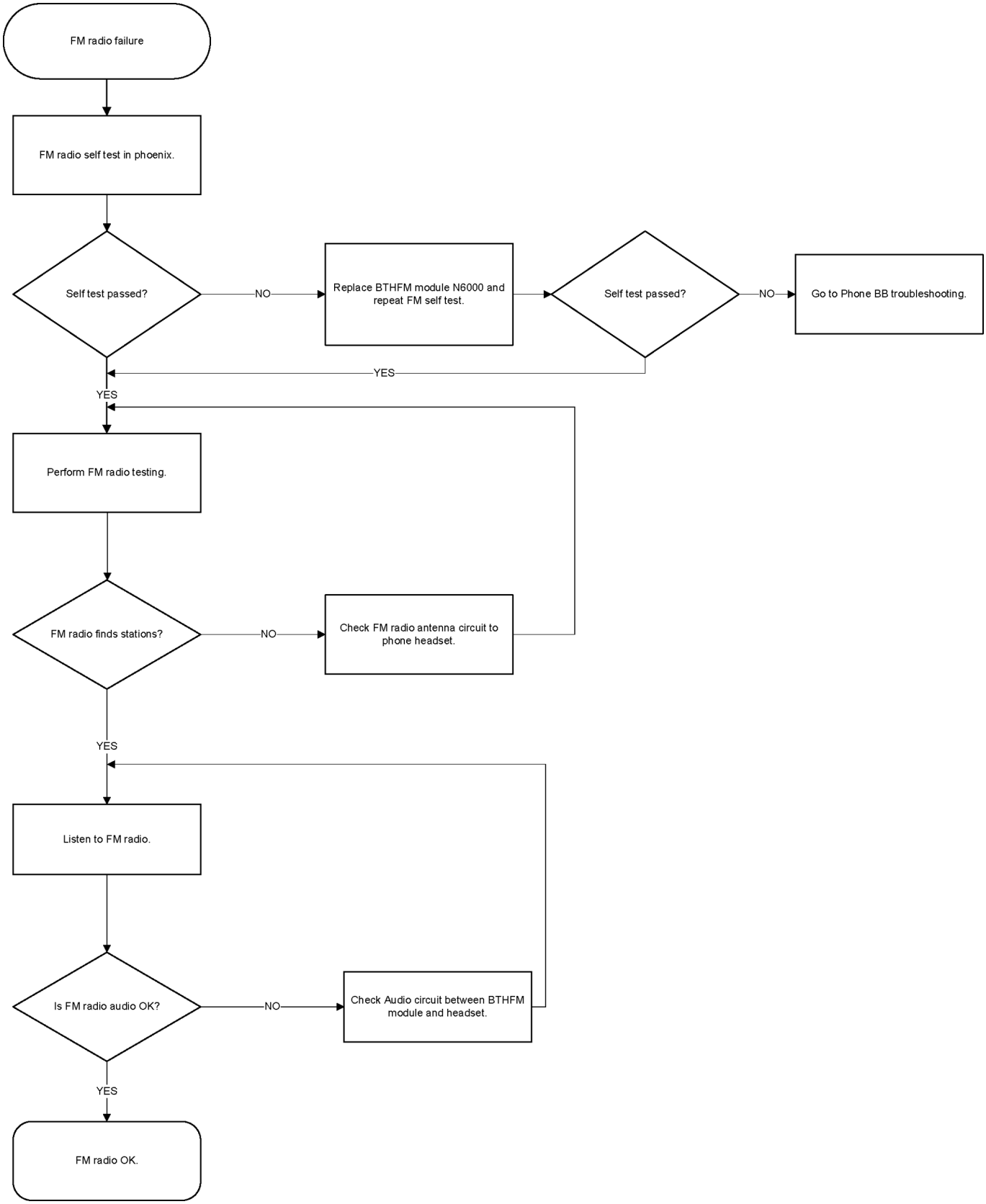
Bluetooth troubleshooting

Troubleshooting flow



FM radio troubleshooting

Troubleshooting flow



FM radio testing

Steps

1. Set signal generator parameters:
   - FM modulation on
   - Frequency 100MHz
   - FM deviation 22kHz
   - Modulation frequency 1kHz
   - RF level should be varied during the test to obtain good audio signal quality
   - Connect suitable antenna to signal generator

     Note: You may alternately use a known good FM radio broadcast as a test signal.
2. Attach the Nokia headset to the phone's AV connector.
3. Use Scroll button to autotune to the radio frequency.
4. Set volume to suitable level.
5. Check audio quality with a headset.

GPS troubleshooting

GPS layout and basic test points

The GPS components are located on the top side of the PWB. Satellite signals are picked up by the GPS antenna in the B-cover. The signal is then routed through a filter before being processed by the GPS5350 receiver ASIC.

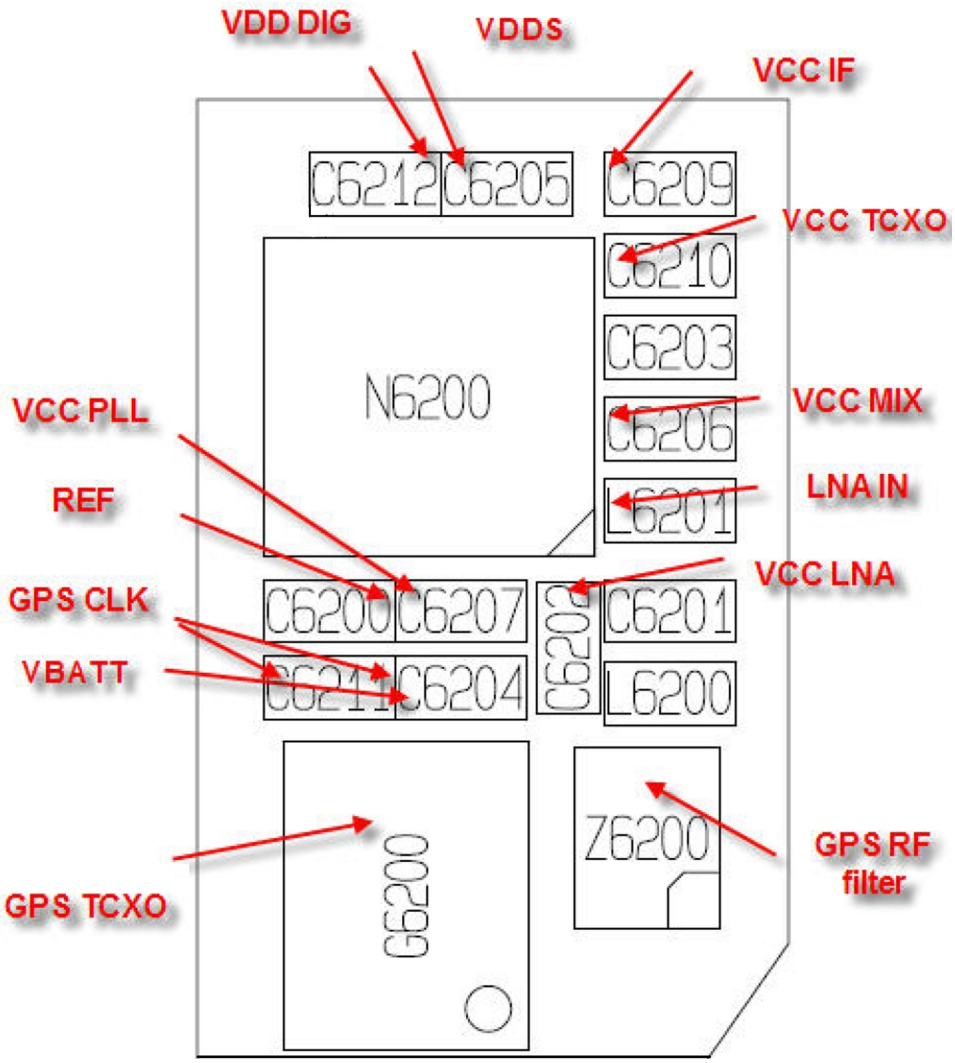


Figure 15 GPS layout and basic test points

GPS settings for Phoenix

Quick Test window

This test will perform 3 tests in one: Self test, Oscillator Test and CW Test and will provide a Pass/Fail Response for each. The HW Self Test confirms basic communication with the GPS ASIC. The oscillator test confirms the frequency accuracy of the GPS TCXO against the Ref_Clk. The CW Test confirms end-to-end connectivity between the GPS antenna and the GPS ASIC. It also contains a receive button.

Before this test is performed a known good phone should be tested in order to calibrate the setup. The signal level of the Signal Generator should be adjusted so a reading of SNR 35 dB is achieved with the reference unit. A good starting point is to set up the signal generator to -50 dBm.

These checks are part of GPS failure troubleshooting (page 3–57).

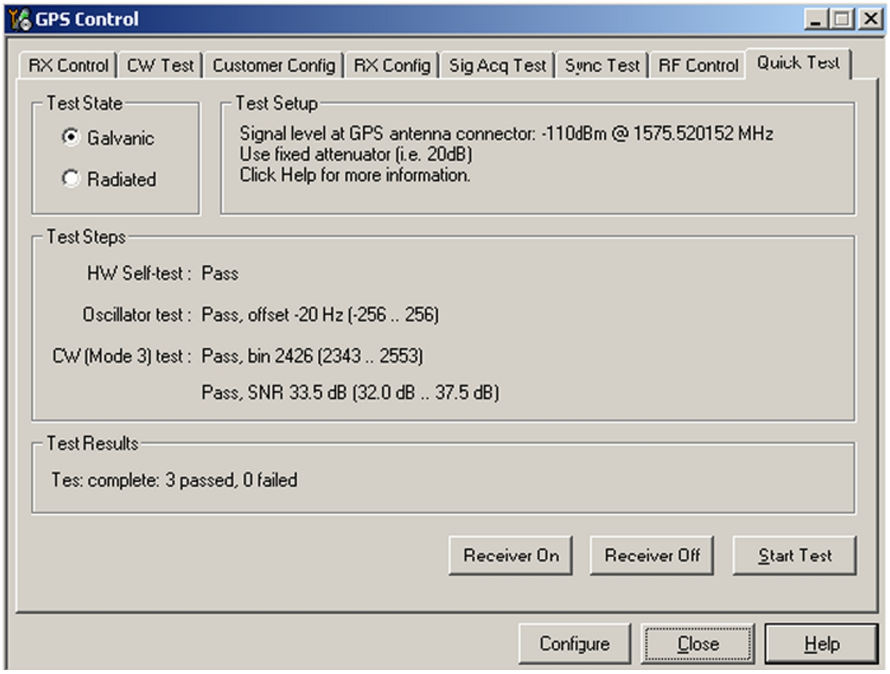


Figure 16 GPS Quick Test window

GPS control

Prerequisites

A flash adapter with RF coupler connected to a PC with Phoenix service software is required. The GPS signal should be connected to the RF coupler. Calibrate the signal level with a known good phone. Signal level will be high (approx -45dBm) because it is a leakage connection.

Context

Use the following to test GPS using Phoenix.

Steps

1. Place phone to Flash Adaptor.
2. Start Phoenix service software.
3. From the **File** menu, select **Scan Product** and check that the correct product version is displayed.

4. From the **Testing** menu, select **GPS Control**. This opens up *GPS Control* dialogue box, as shown in the figure below, and enables the GPS.

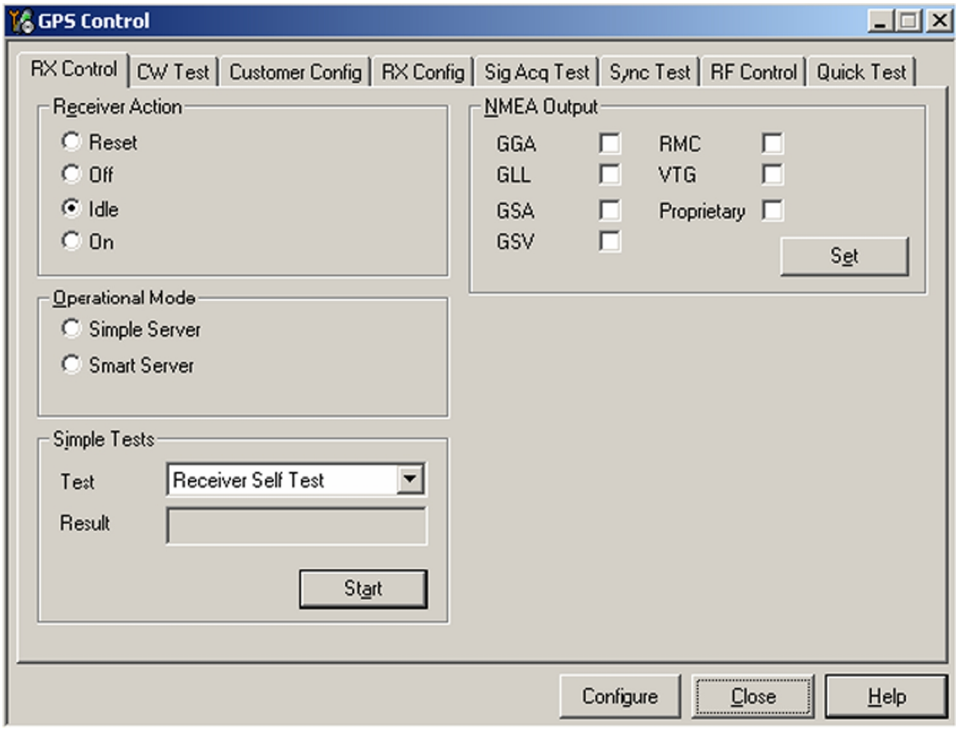


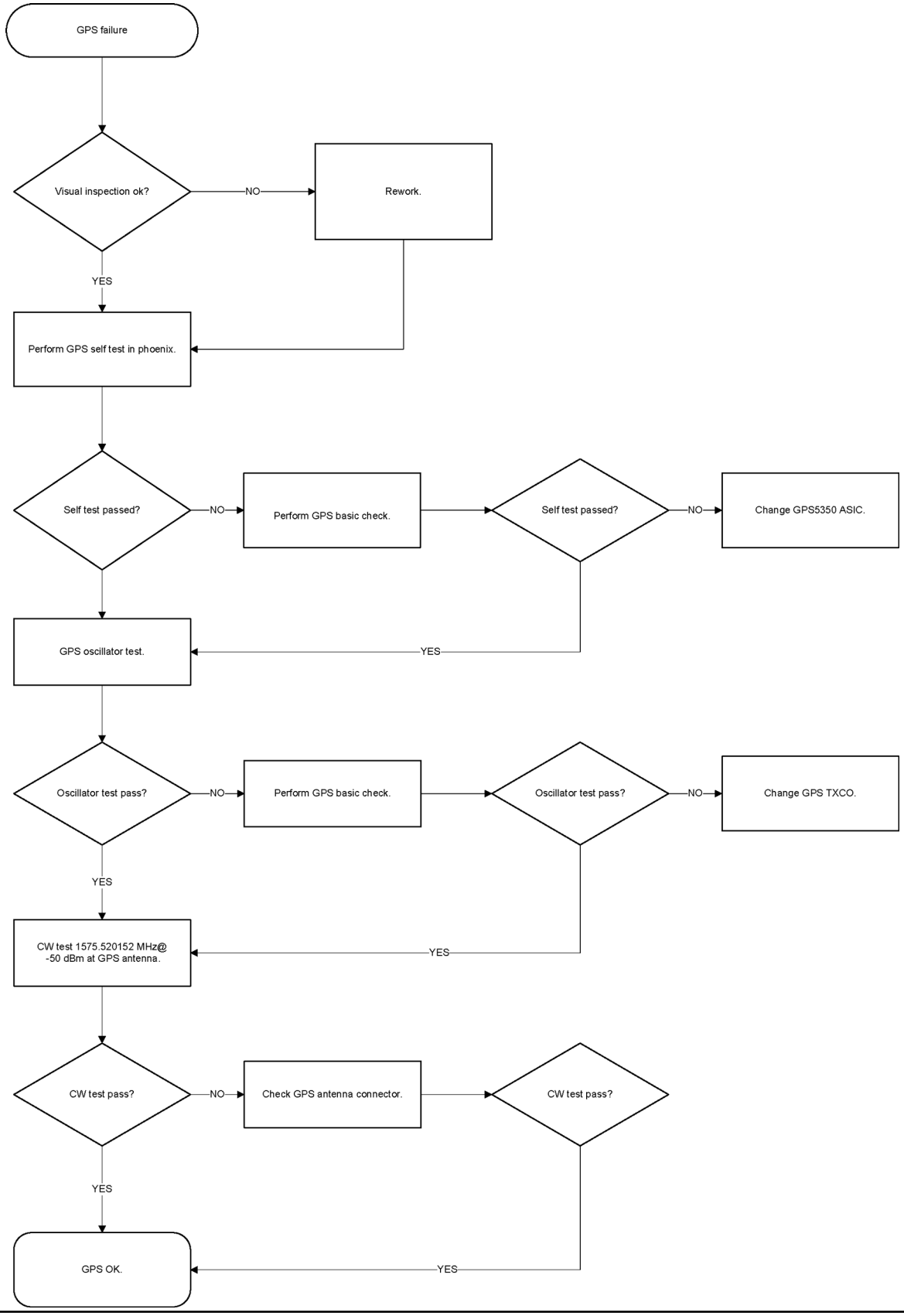
Figure 17 GPS Control dialogue box

Select **Idle** to confirm the GPS is enabled and is in idle mode; at this point all clocks should be present, GPS_En_Reset & SleepX should be high, and Vdd_Dig, Vcc_TCXO & Vcc_PLL/VCO will be present.

Receiver On turns on all RF sections of the ASIC and so all LDOs will be on.

GPS failure troubleshooting

Troubleshooting flow



WLAN troubleshooting

WLAN functional description

The Size 4 WLAN module is designed for use with a single antenna shared between itself and a co-located BT device. The WLAN SW is downloaded from the host engine when the WLAN is turned on over the dedicated SPI interface. BT and WLAN have their own 38,4MHz TCXO.

WLAN settings for Phoenix

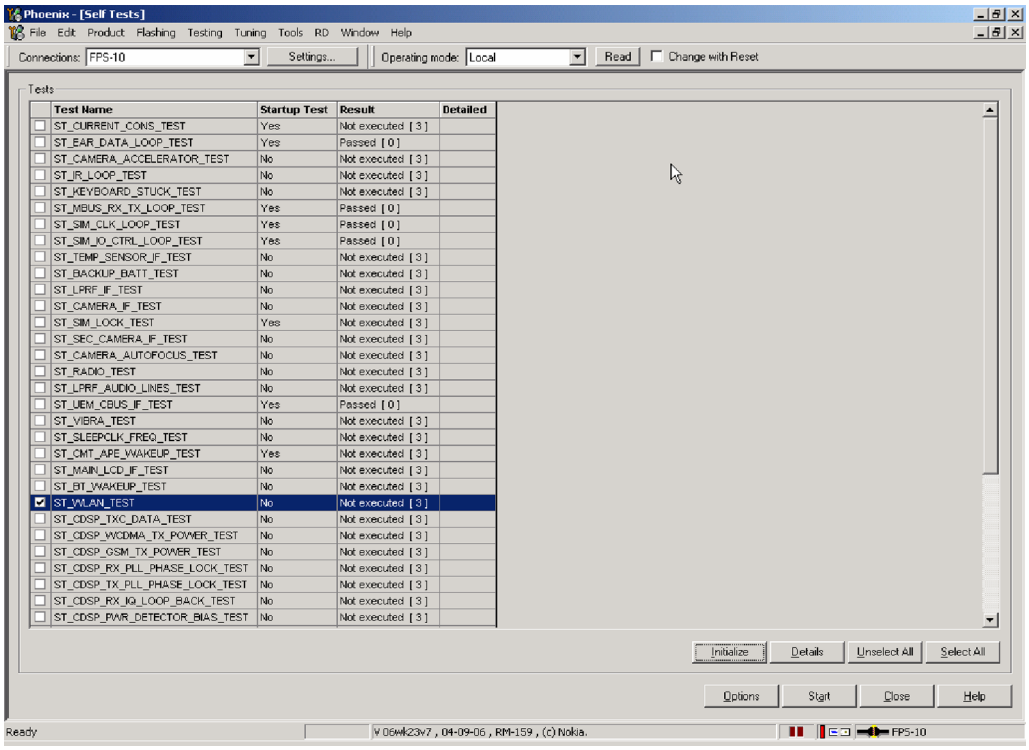
Use the following to test WLAN using Phoenix:

1 Set phone into Local Mode .

2 From the **File** menu, select **Scan Product** and check that the correct product version is displayed

3 From the **Testing** menu, select **Self Test**. This opens up a Self Test dialogue box, as shown below.

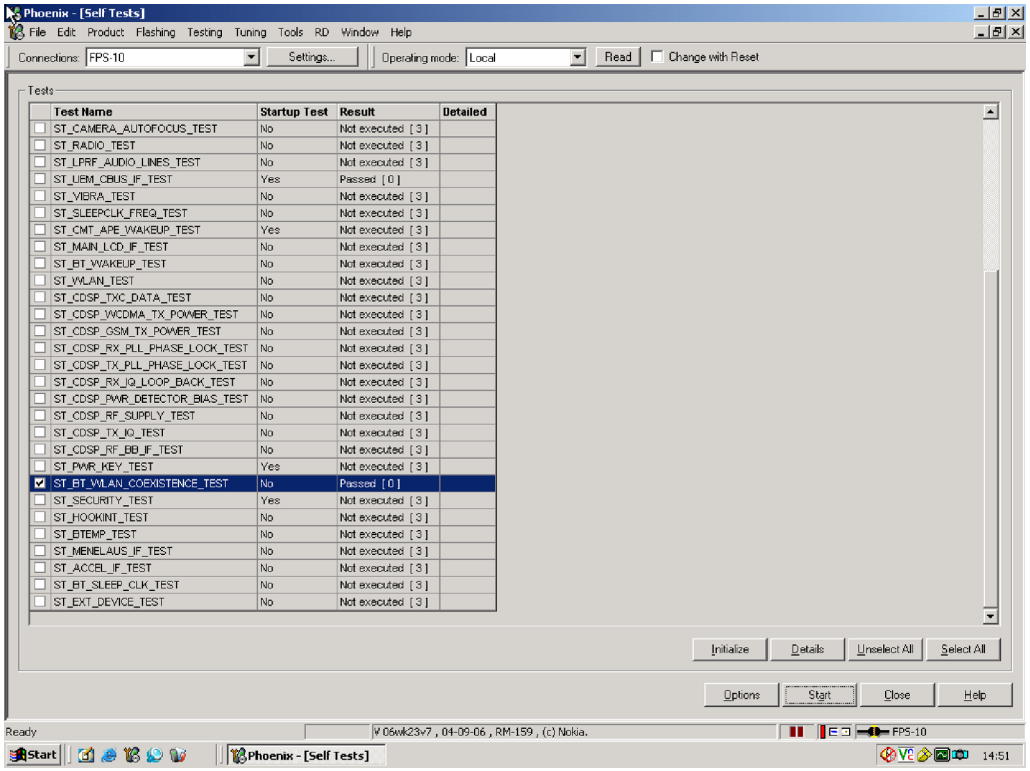
Select the **ST_WLAN_TEST** check box as shown and then select **Start** button. The test turns on the WLAN, sets up the SPI interface and then downloads the WLAN firmware into the WLAN module. During the download the WLAN acknowledges the data blocks and so the self test is a good way to confirm that the WLAN module is communicating with the Host. The result column will change to **Passed** after a few seconds if operating properly.



In addition, a test of the WLAN to BTH interface can be done by selecting the **ST_BT_WLAN_COEXISTENCE_TEST** check box and selecting Start button.

This test verifies that the WLAN to BTH co-existence interface signals are properly connected and there are no open circuit or shorts on the four interface signals.

The co-existence interface comprises BTH Txconfig, BTH RF Active, BTH Priority, and BTH Frequency.



In summary these two Self tests provide a simple means of ensuring the Host engine is able to communicate with the WLAN module and check the interface to BTH. More detailed WLAN performance test is covered in WLAN functional test section.

WLAN functional tests

On/Off test

Prerequisites

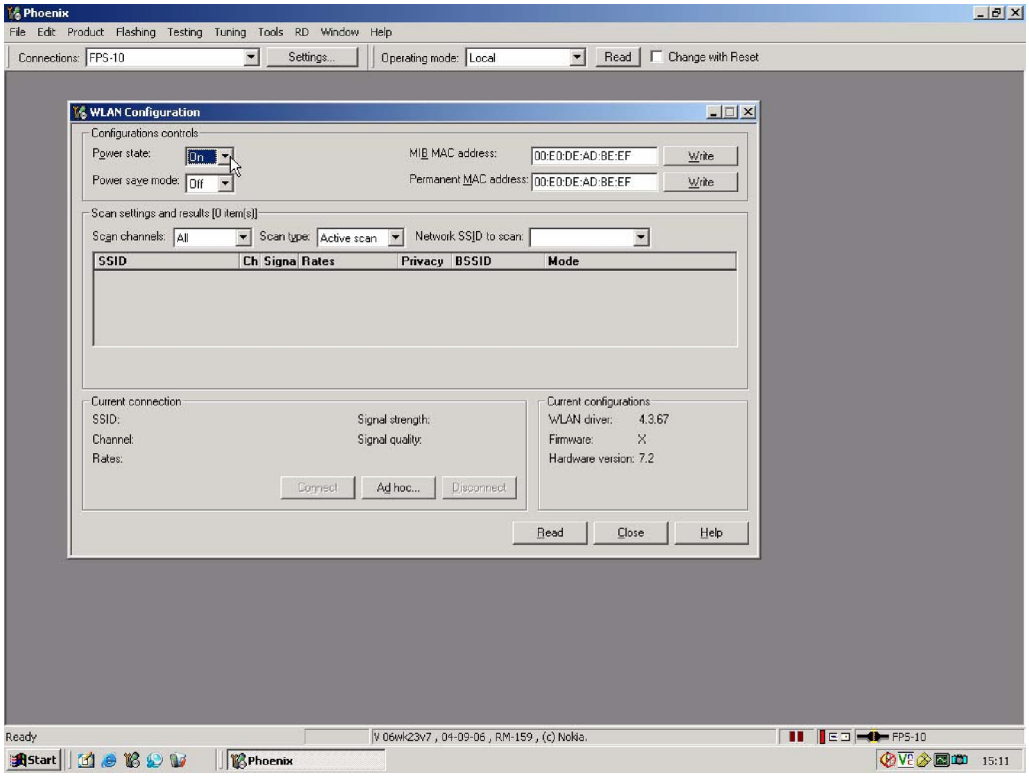
A flash adapter connected to a PC with Phoenix service software is required.

From the testing toolbar select **WLAN Configuration** option. This opens the WLAN configuration dialogue box below. Selecting the Power state option button (as indicated), the WLAN can be turned ON and OFF:

1 With Power State set to OFF, measure the dc power supply current consumption of the flash adaptor.

2 Next return the Power state to ON and re-measure the dc power supply current of the flash adaptor.

The difference between the currents in (1) and (2) should be between 190 to 220mA. When WLAN is ON, the firmware has been downloaded and the WLAN module is in the receive state. When OFF WLAN is powered down.



TX tests

Prerequisites

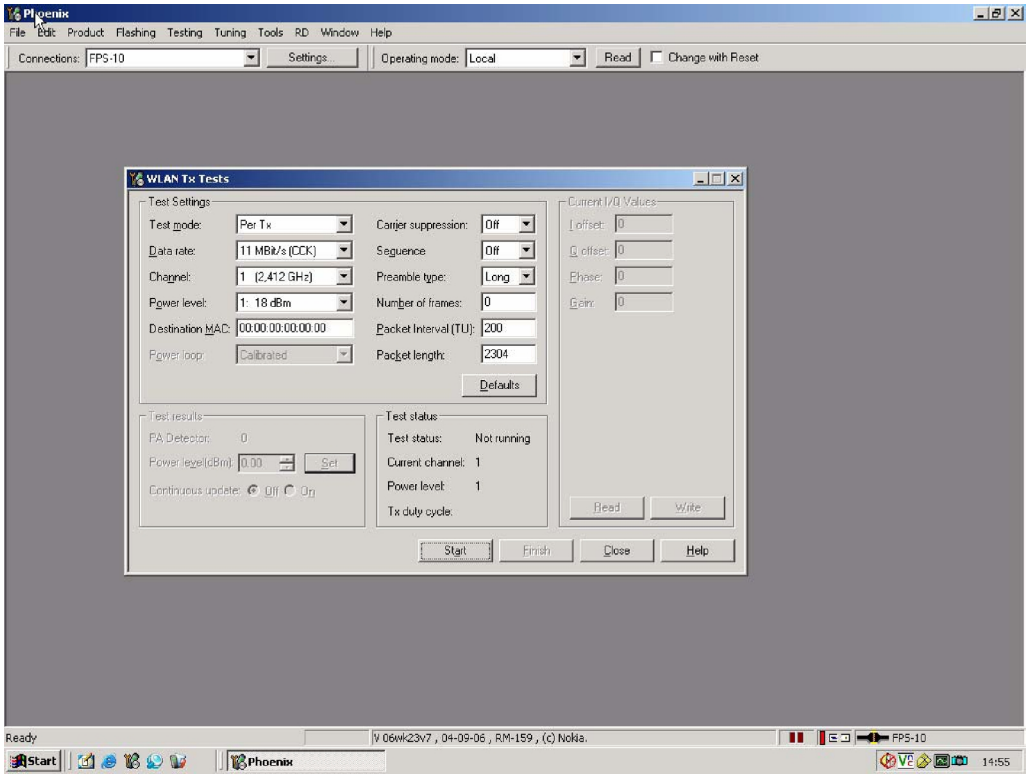
Connect complete phone assembly with battery cover to a PC with Phoenix service software using a USB data cable.

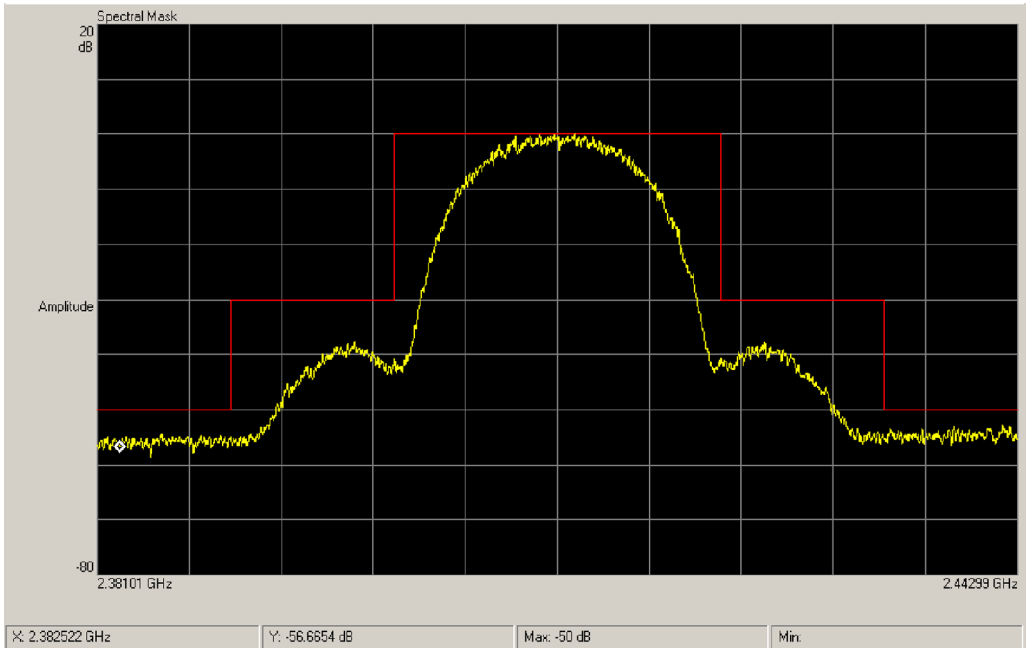
From the testing toolbar select WLAN Tx Test option shown below. This test can be used to verify TX configuration and functionality. The default settings are sufficient for testing the TX operation, although other channels and data rates are equally suitable. To start the test, select the Start option button:

1 Monitor the WLAN TX spectrum on a Spectrum analyser. (When making a radiated test ensure that other WLAN devices are not transmitting as these may be detected as well, confusing the result). A typical 11MBPS TX spectrum is shown in figure below.

2 To finish the test select the Finish option button.

The difference between the two readings should be approximately 150mA and measures the transmit current in 11MBPS, 802.11b mode of operation.





RX Tests

Prerequisites

Connect complete phone assembly with battery cover to a PC with Phoenix service software using a USB data cable.

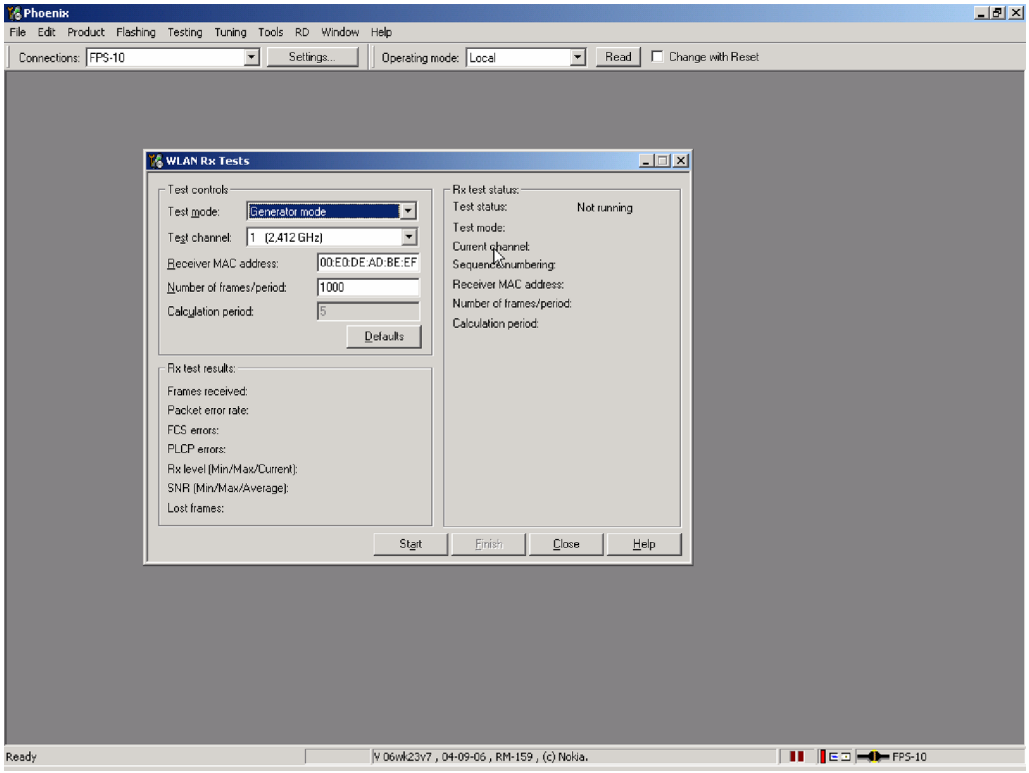
There are different options available for testing the Rx path. The simplest is to use the WLAN to report Rx packets when operating in an area where there is an active WLAN network. Simply starting an Rx test will show the number of packets detected by the WLAN module as it monitors the network. However, it does require a properly configured WLAN network.

From the testing toolbar select WLAN Rx Test option shown below. This test can be used to verify Rx configuration and functionality.

To start the test, select the Start option button.

As the WLAN monitors an active WLAN network, the Rx test results window will update and show the number of Frames received, as well as the Packer error rate.

Monitoring the detected frames is a simple method to verify the WLAN antenna and receiver path is working properly.



WLAN auto tuning

In case of WLAN ASIC change, RF power auto tuning is needed. Connect WLAN RF test connector to CMU200 input using proper RF cable. Start Phoenix WLAN autotune window. Check the settings and verify your PC communicates with CMU200 via GPIB.

Auto tuning procedure

1 Start tuning by pressing **Tune**.

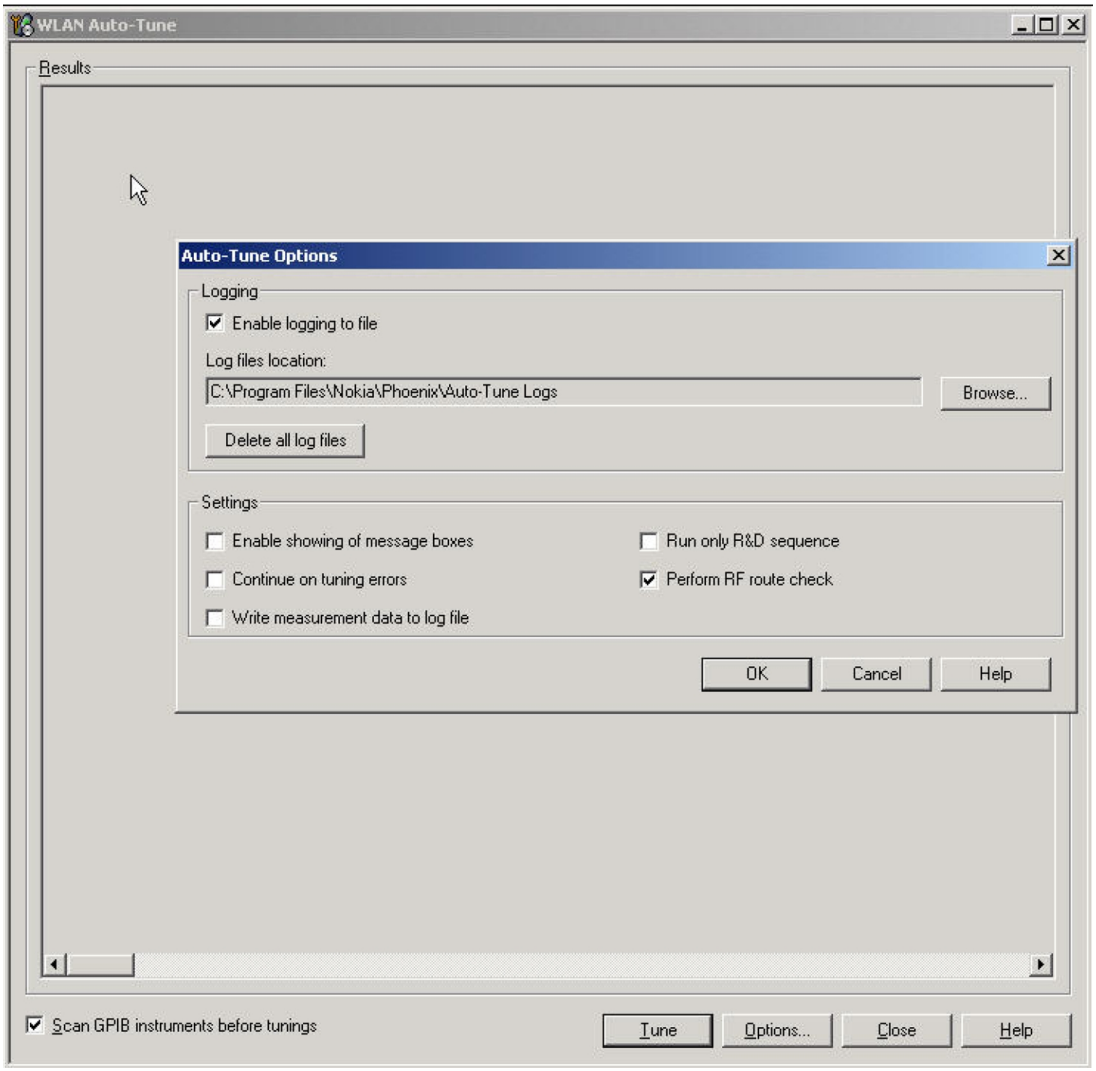


Figure 18 WLAN auto tune settings

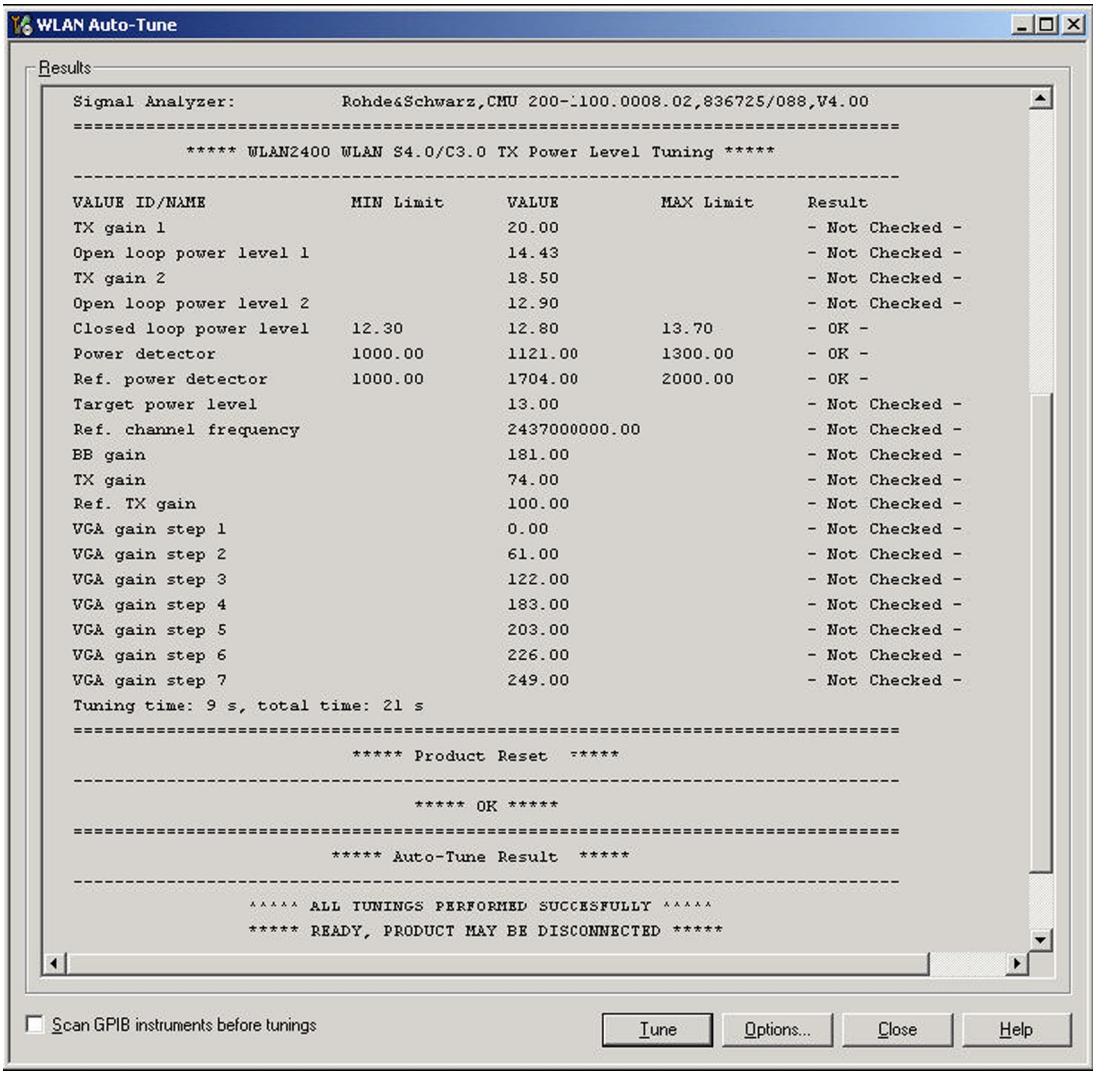


Figure 19 WLAN auto tune results

FMTx2.1 troubleshooting

General

The handset uses an antenna that is integrated to the B-cover. The connection to the half loop antenna is exposed by disassembling the phone and removing the PWB.

The half loop antenna requires two connection points, signal C-clip (X6189) and ground (PWB opening in the another end of the FMTX antenna). It is important to check these connection points for damage or dirt since the performance of the FMTx 2.1 implementation will be severely impaired if these connections are not in good condition.

FMTx 2.1 component layout

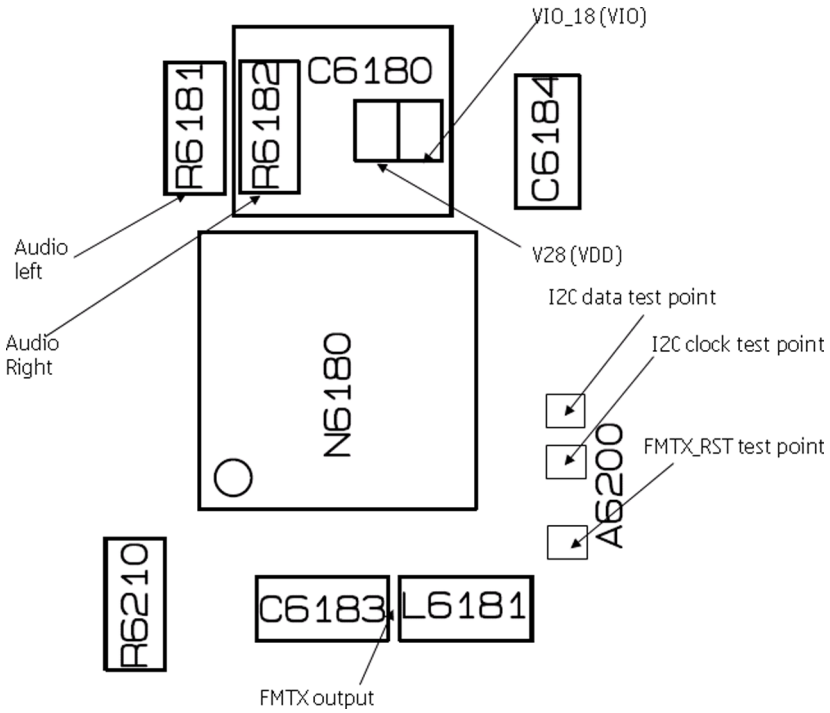


Figure 20 FMTx 2.1 Component References and Location

The main component of the FMTx 2.1 solution is the Si4713 low power transmitter device (N6180).

Specific digital and power supply test points

Using access to signals figure as a reference it can be seen that supplies to the Si4713 device VIO 2/2 C6180 and VDD 1/2 C6180 can be accessed easily. The FMTx 2.1 solution utilises a QFN package. This type of package lends itself well to analysis of signals on the various pins of the device.

VIO & VDD

VIO should be in the range 1.5 to 3.6 Volts.

VDD should be in the range 2.7 to 5.5 Volts.

_RST

Also, the _RST signal to the device can be monitored through test pin J6185. This is an active low signal and should only be asserted during power up.

FMTx2.1 specific RF test points

TXO

FMTX output power can be measured from capacitor C6183 and probe access can be obtained easily. Using a high impedance probe and a spectrum analyser it would be possible to examine the TXO output power and check that the transmitter is outputting a signal.

Specific clock test points

RCLK

Test point J6183 is the RCLK (Reference Clock) input to the device. This is typically 32.768KHz and is driven from the sleep clock from the base band. When measuring this clock frequency, it may be seen to vary by as much as +/- 120 ~ 200ppm. The device can only typically tolerate +/- 20ppm in order to maintain transmit frequency accuracy. To overcome this, the software driver for the device calculates what the actual sleep clock (RCLK) frequency is and periodically programs the device with this frequency.

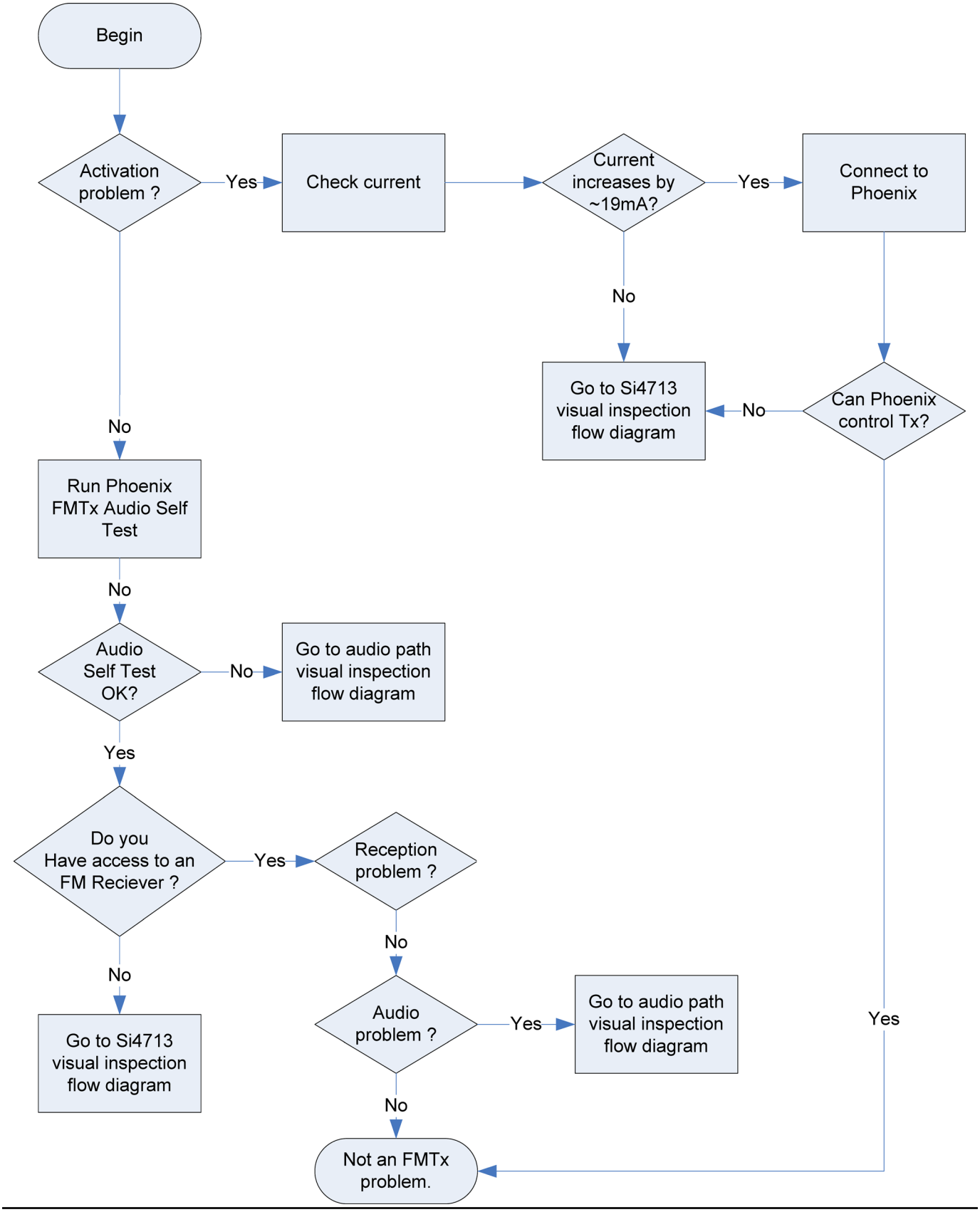
The device then internally adjusts its dividers in order to maintain the required output frequency. Using this method it is possible to reduce the effective ppm of the reference clock down to +/- 14ppm over the full operating temperature range of -15 to +50 degrees Centigrade.

General visual inspection guidelines

- If the handset has the FMTx antenna in the B-cover then check the condition of the antenna springs and trace.
- Check that the Si4713 device is placed correctly on the PWB and that there are no obvious signs of damage.
- Check the surrounding components and ensure correct placement on the PWB and that there is no visual damage. Check that there are no missing components.

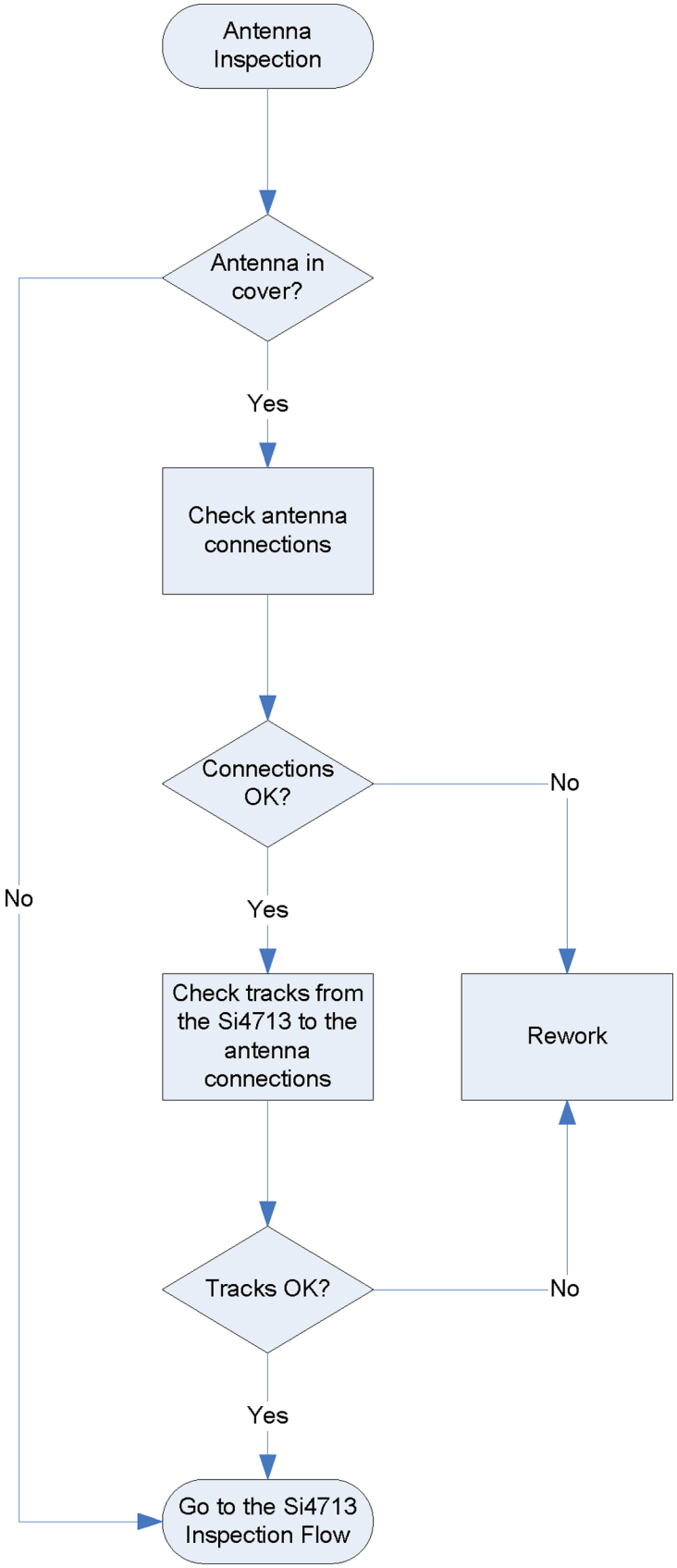
FMTx2.1 troubleshooting

Troubleshooting flow



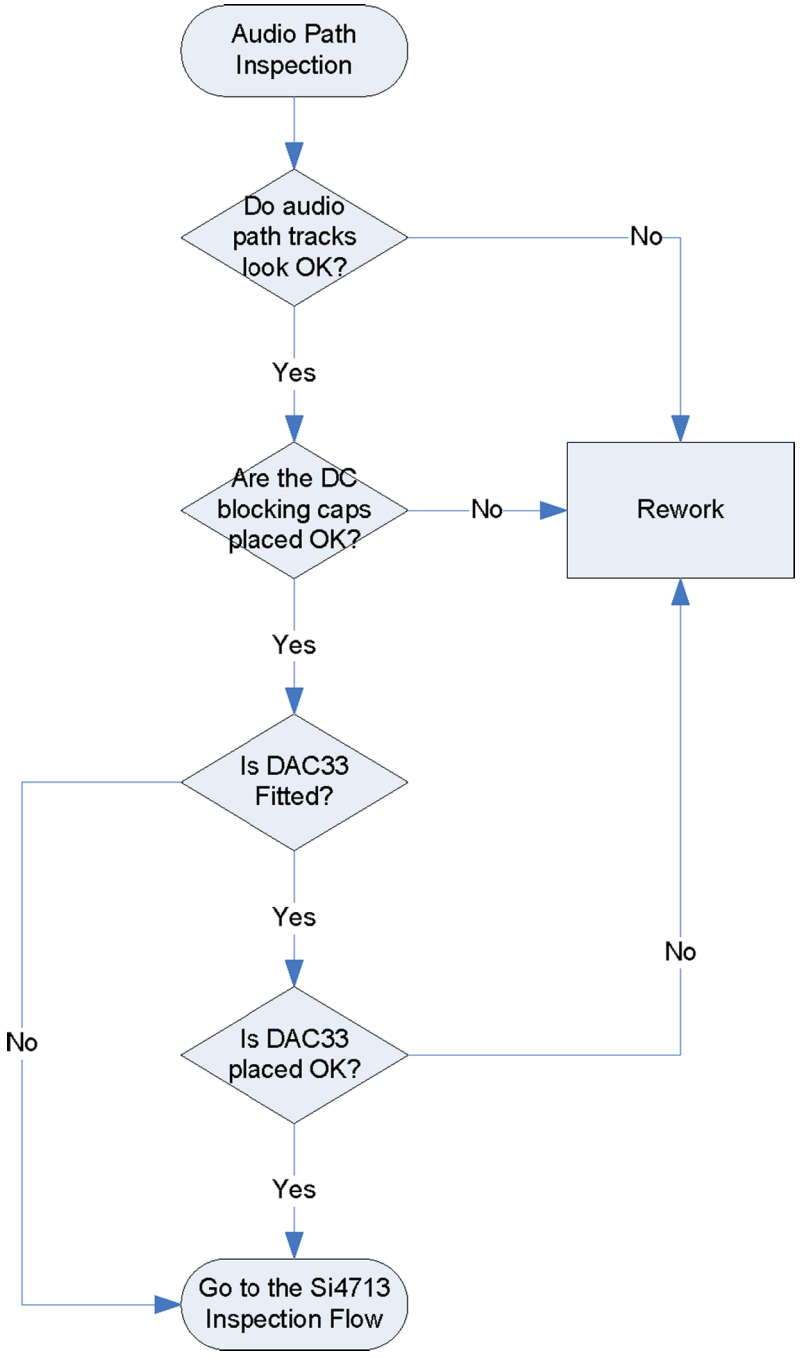
FMTx2.1 antenna visual inspection troubleshooting

Troubleshooting flow



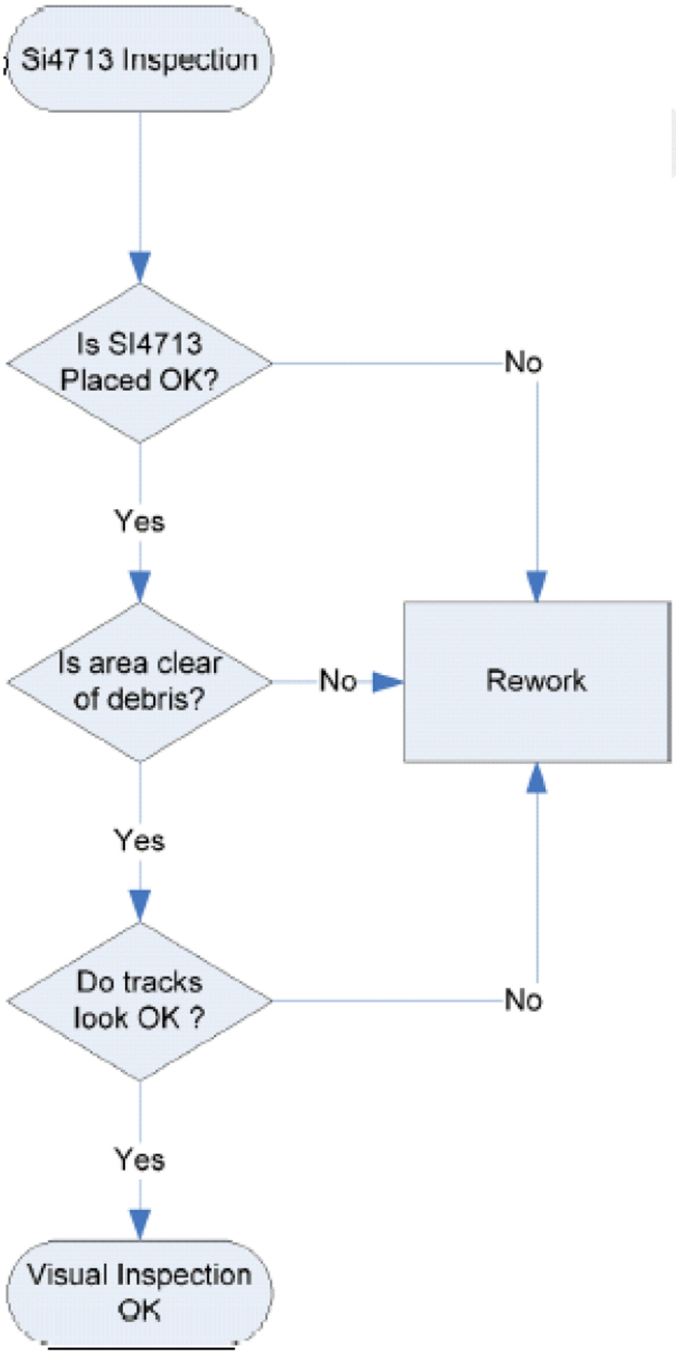
FMTx2.1 audio path visual inspection troubleshooting

Troubleshooting flow



FMTx2.1 Si4713 visual inspection troubleshooting

Troubleshooting flow



Checking validity of signals

Please refer to **Access to signals** figure as a reference. Generally all power supply levels and clocks willbe consistent. Signals on the analogue audio input pins (R6181 and R6182) will be dependant on the audio content being injected to the device. During the audio self test (initiated from Phoenix) it is possible to monitor these pins and check that the DSP generated 1KHz tones can be seen at some point during the test. Check that the signals are clean and that no obvious distortion can be seen such as clipping of the signals.

Typical maximum swing of these tones will be ~636mV peak to peak. The maximum swing may vary between Nokia handsets but for the FMTx 2.1 implementation, the swing should not be greater than the aforementioned value.

FMTx2.1 troubleshooting faults

Possible faults

Expected fault reports relating to the FMTx 2.1 implementation may consist of one or more of the following;

1 No left audio
2 No right audio
3 No audio
4 Can't start FMTx
5 Can't locate FM transmission on an FM receiver or no FM transmission
6 Distortion on audio
7 Poor reception on FM receiver
8 No RDS information

Initial fault analysis

Where possible, attempt to reproduce and verify the reported fault. Intermittent problems are likely to be due to bad connections or broken components/solder joints. Any faults relating to poor FM transmitter performance or frequent failure to locate usable frequencies when performing a scan are likely to be due to some kind of antenna issues.

In handsets that utilise an antenna solution in a removable cover it is likely that the connecting interface pins are either damaged, dirty or that the cover fits poorly perhaps due to broken tabs/latching lugs. Poor audio fault reports may also be due to the above antenna issues.

Phoenix PC tool

Setting Up Phoenix

Required equipment:

- A Deskey security dongle for Phoenix to run.
- The latest version of Phoenix that has the FMTx 2.1 GUI installed on a PC (version 2007.21.000.27897 or greater).
- A jig suitable for the handset.
- A cable to connect the jig/handset to the PC. Run Phoenix and select the FMTx panel.

Using the FMTx panel to drive the FMTx 2.1 features

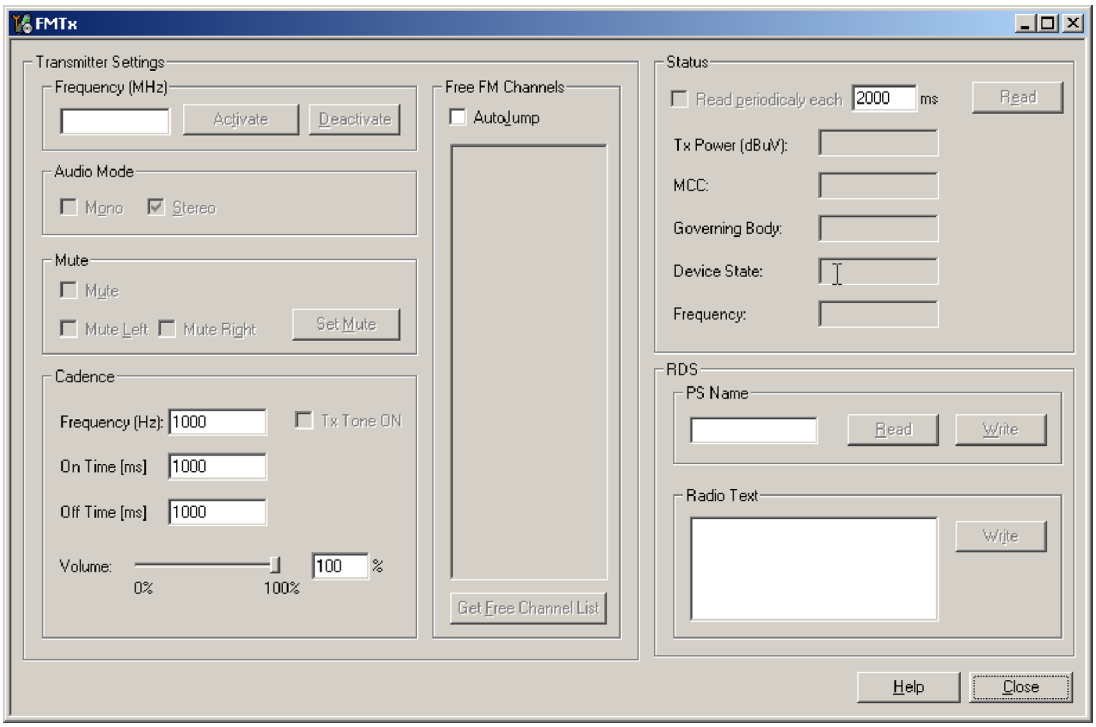


Figure 21 FMTx panel before connection to the handset

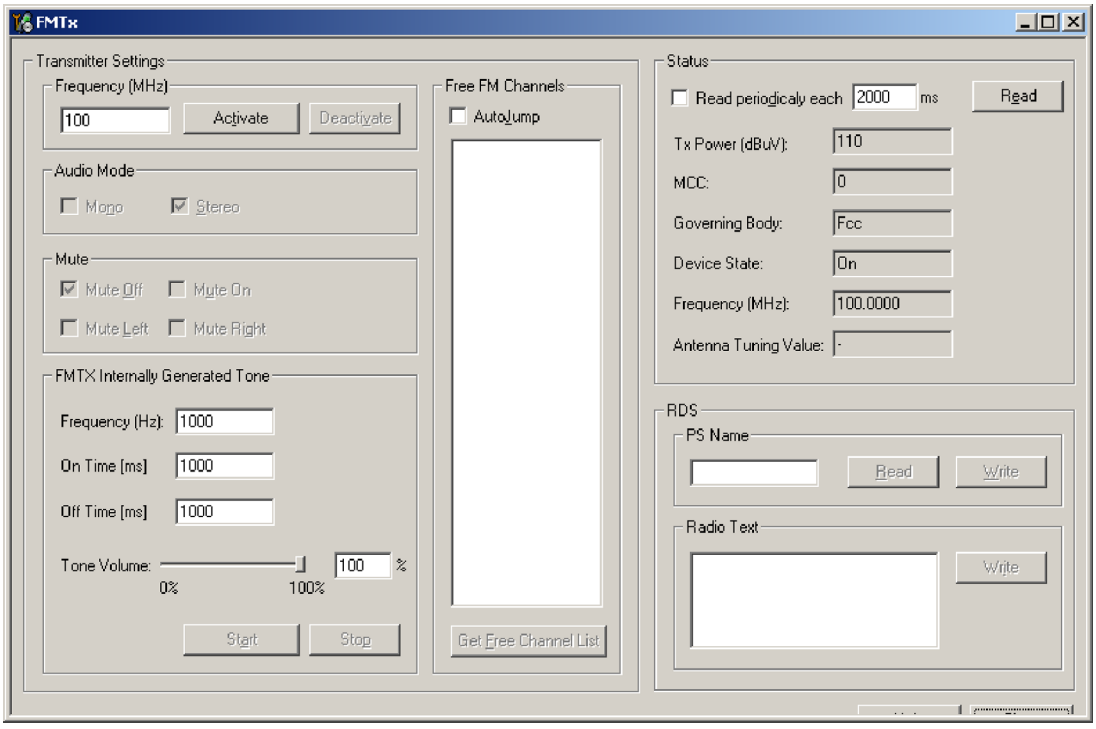


Figure 22 FMTx panel after connection to the handset

Typing in a valid FM transmitter frequency and clicking on 'Activate' will turn on the FMTx feature and will begin transmitting the carrier on the selected frequency. Note: Unless this carrier signal is modulated with some audio (either via the music player or a DSP or Si4713 generated tone) then all that will be heard if an

FM receiver is tuned to the same frequency would be silence. After approximately 10 seconds of silence the handset should begin to 'chirp' periodically with a short 1Khz tone that repeats every 5 seconds. This indicates that there is no audio input and reminds the user that the feature is on.

The Phoenix FMTx 2.1 panel can be used to control the following features;

- Set the FM frequency to transmit on (88.1 to 107.9MHz).
- Select Stereo or Mono mode (generally all Nokia handsets will only use stereo)
- Mute both left and right audio channels.
- Mute only the left or the right audio channels.
- Allow an internal tone to be generated and transmitted from the Si4713 device. The audio frequency of this tone can be selected along with the on/off time and the volume of the tone. Selecting 0 (zero) in either the on or off time will produce a continuous tone.
- Obtain a list of suitable 'quiet or free' channels. This effectively performs an RSSI (RPS) scan to locate quiet channels to transmit on. If the 'AutoJump' tick box is checked then this list will be transmitted to the FM receiver to allow the handset to perform AF jumps. This is dependent on the Nokia handset and if the FM receiver is RDS capable. The use of AF feature allows an RDS capable FM receiver to follow the transmissions of the FM transmitter automatically.
- FMTx 2.1 status panel. This provides information on the state of the FMTx feature. This can be polled by Phoenix at regular intervals defined by the user when the 'Read periodically each…' check box is checked. The status can otherwise be read at any point by clicking on the 'Read' button. The MCC value is the 'Mobile Country Code' and provided the phone is registered on a network will provide the code pertaining to the country in which it resides. The antenna tuning value is a good indicator of the state of the antenna and the other components connected to the TXO pin. For RX-51 the tuning values should be in the range 0 – 80. Any value outside of this range will indicate some problem with the components connected to the TXO pin (including the antenna). In the case of a removable antenna, the cause of the out of range value is like to be because of a poor antenna connection. This might be because of broken or dirty connections between the handset and the cover in which the antenna is fitted.
- The RDS panel can be used to set the PS name and/or to enter a Radio Text (RT) string. If access to an FM receiver is available that supports RDS then these strings can be observed on the display of the FM receiver.

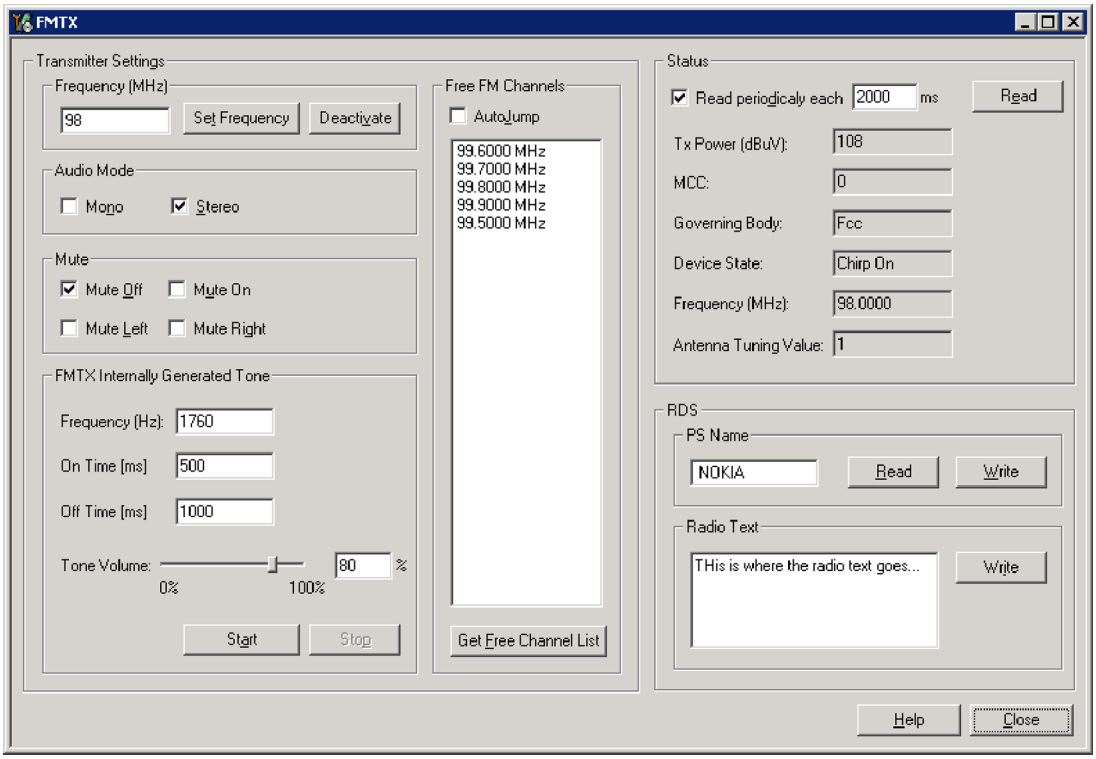


Figure 23 FMTx panel in action

Using the audio self test

The audio self test can be used to quickly determine if the left and right audio paths are intact.

The left and right audio connectivity self test process performs the following steps:

1 Measure and store silence.

2 Inject 1KHz tone (left or right) to give 75KHz deviation. Measure and store.

3 Inject same tone on both left and right analogue audio inputs. Measure and store. Compare result from (2) with result from (1). If the delta is NOT more than a specified threshold level then fail. This would indicate that the selected channel is open circuit. If an over deviation indication is detected on (2), then the audio channels must be shorted together. This is a fail condition. For (3), a returned value of zero is expected. This indicates that there is an over deviation condition which in turn indicates that the 'other' audio input channel is connected correctly.

If on (3) there is no over deviation response, then the 'other' channel must be open circuit at some point in the audio path. This is a fail condition.

The table shows the truth table for the left and right audio self test.

Table 13 Left and right audio self test truth table

LEFT	RIGHT	ASQ Condition	Comment
0	0	0	SILENCE
1	0	0	OPEN/SHORT
1	0	1	OK
1	0	2	SHORT
0	1	X	Don't Care
0	1	X	Don't Care

LEFT	RIGHT	ASQ Condition	Comment
0	1	X	Don't Care
1	1	0	ALL OPEN/SHORT
1	1	1	OPEN
1	1	2	OK

Using the auto tune panel

The Auto Tune panel should only be used if one or more of the following components have been changed:

- The Si4713 device.
- The Inductor connected to the TXO pin 4.
- The inline resistor connected to the TXO pin 4 (if fitted).
- The ESD diode package connected to the TXO pin 4 (if fitted).

This procedure follows the alignment that is done in the factory to ensure that the FMTx 2.1 solution is aligned to provide the correct Tx output power for the relevant legislations such as FCC and ETSI.

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4 — Cellular RF troubleshooting

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Table of Contents

List of Figures

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General RF troubleshooting

Introduction to RF troubleshooting

Most RF semiconductors are static discharge sensitive

ESD protection must be applied during repair (ground straps and ESD soldering irons).

Measuring equipment

All measurements should be done using:

- An oscilloscope for low frequency and DC measurements. Recommended probe: 10:1, 10Mohm//8pF.
- A radio communication tester including RF generator and spectrum analyser, for example Rohde & Schwarz CMU200. (Alternatively a spectrum analyser and an RF generator can be used. Some tests in this guide are not possible to perform if this solution is chosen).

  Note: A mobile phone WCDMA transmitter should never be tested with full TX power (it is only possible to perform the measurements in a good RF-shielded room). Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.

  Note: All communication Test Set Screen dumps are from CMU200. Other testers are different.

  Note: All measurements with an RF coupler should be performed in an RF-shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, testing at frequencies of nearby base stations should be avoided.

Level of repair

The scope of this guideline is to verify functionality of the cellular RF block without removing RF shield.

Cellular RF test points

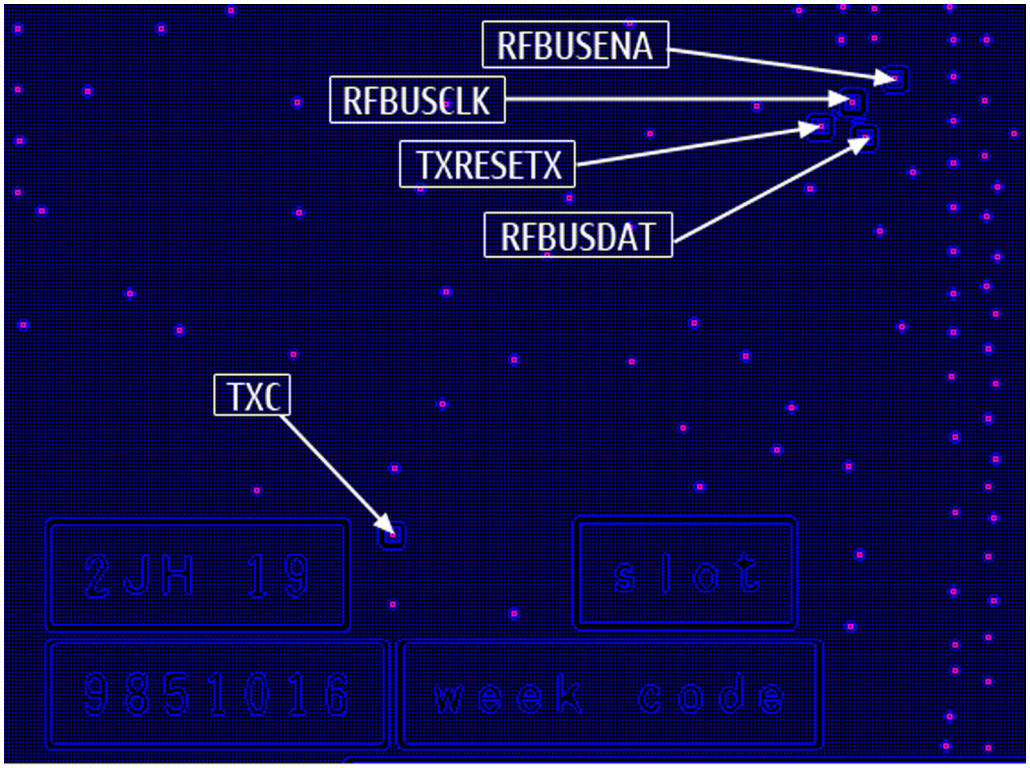


Figure 24 Cellular RF test points 1

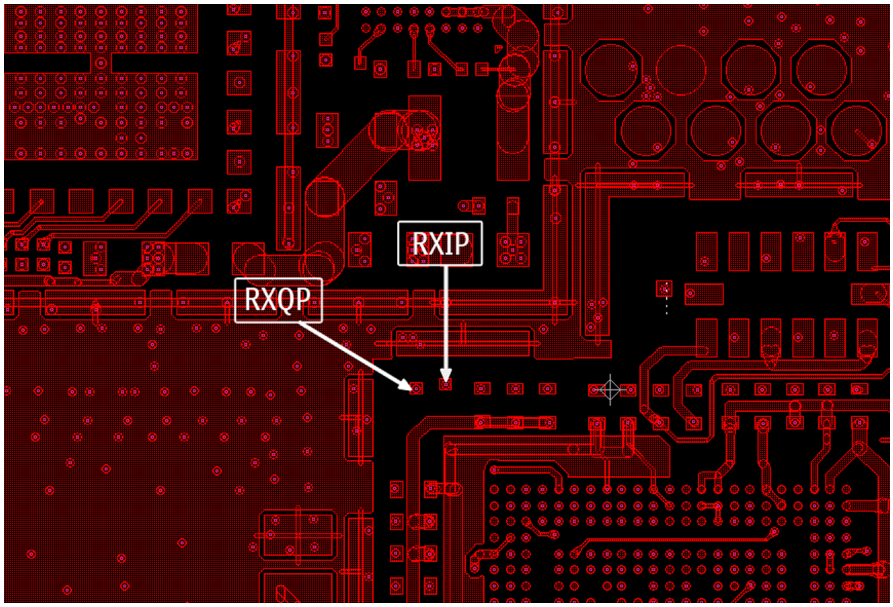


Figure 25 Cellular RF test points 2

Auto tuning

Introduction to RF tunings

RF tuning is always performed with the help of a product-specific module jig, never with an RF coupler. Using an RF coupler in the tuning phase will cause a complete mistuning of the RF part.

Cable and adapter losses

RF cables and adapters have some losses. They have to be taken into account when the phone is tuned. As all RF losses are frequency dependent, the user has to act very carefully and understand the measurement setup. For RF attenuations of the module jig and RF cable, please refer to the Service Tools section.

Auto tuning

This phone can be tuned automatically.

Auto tuning is designed to align the phone's RF part easier and faster. It performs calibrations, tunings and measurements of RX and TX. The results are displayed and logged in a result file, if initiated.

Hardware set up

For hardware requirements for auto tuning, please refer to *Service concept for RF testing and RF/BB tuning* in section 'Service Tools and Service Concepts'.

Phoenix preparations

Install the phone specific data package, for example *Nokia_firmware_RX-51_EUROPE_10.014_v41.0.exe*. This defines phone specific settings.

Auto tuning procedure

1 Make sure the phone (in the jig) is connected to the equipment. Otherwise some menus will not be shown in Phoenix.

2 To go to autotune, select **Tuning (Alt-U)→Auto-Tune (Alt-A)** from the menu.

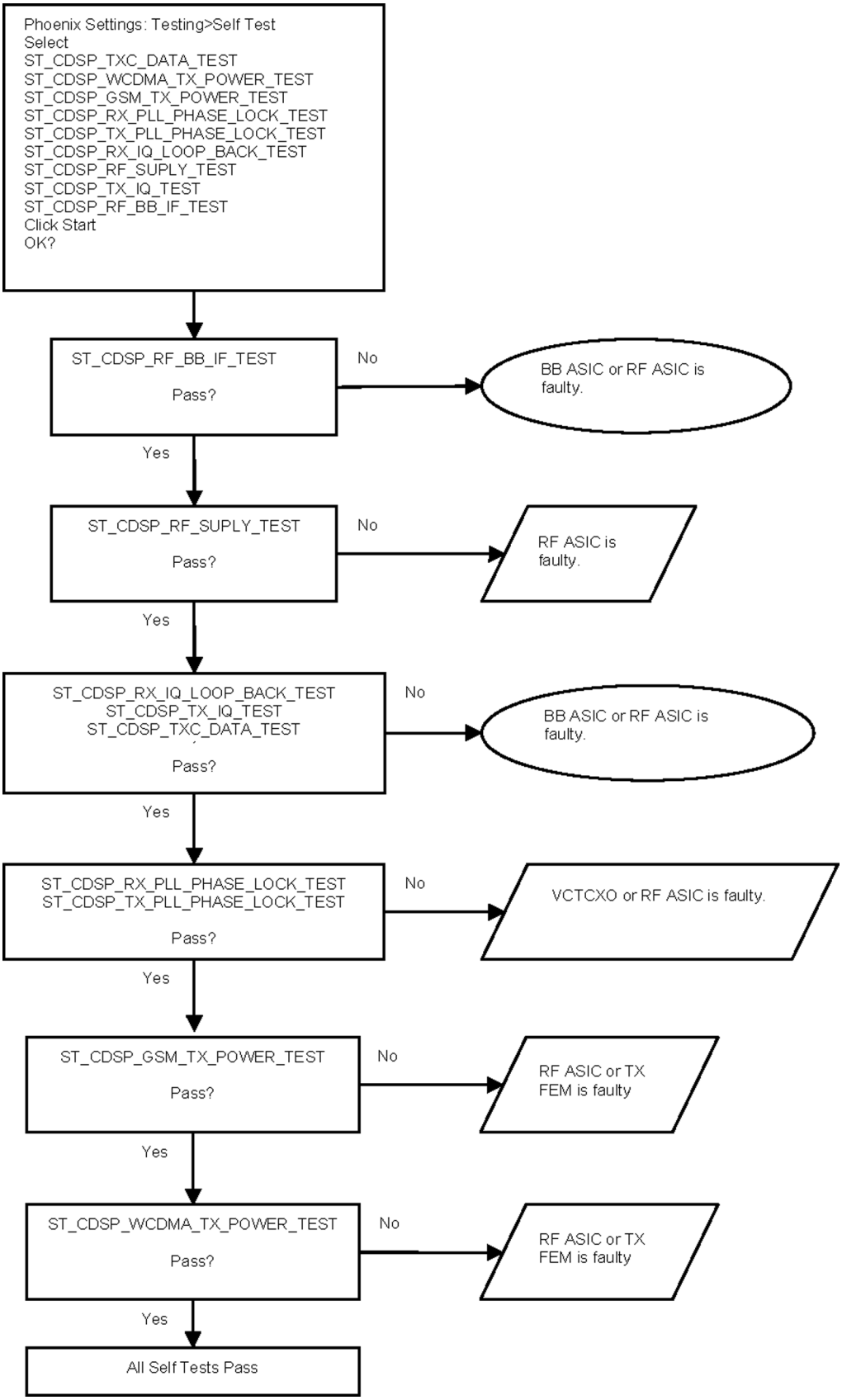
3 Start autotuning by clicking the *Tune* button.

Self test troubleshooting

Self test troubleshooting

Troubleshooting flow

Note: Self tests are recommended to be made when phone is in jig and 50 Ohm load is connected to RF connector. Otherwise powertests may fail depending on antenna load.



Receiver troubleshooting

Introduction to receiver (RX) troubleshooting

RX can be tested by making a phone call or in local mode. For the local mode testing, use Phoenix service software.

The main RX troubleshooting measurement is RSSI reading. This test measures the signal strength of the received signal. For GSM RSSI measurements, see *GSM RX chain activation for manual measurements/GSM RSSI measurement*. For a similar test in WCDMA mode, see *WCDMA RSSI measurement*.

GSM RX chain activation for manual measurements/GSM RSSI measurement

Prerequisites

Make the following settings in Phoenix service software:

Setting	GSM850	GSM900	GSM1800	GSM1900
Phoenix Channel	190	37	700	661
Signal generator to antenna connector	881.66771MHz	942.46771MHz	1842.86771MHz	1960.06771MHz
	(67.71kHz offset)	(67.71kHz offset)	(67.71kHz offset)	(67.71kHz offset)
	at -60dBm	at -60dBm	at -60dBm	at -60dBm

Steps

1. Set the phone to local mode.
2. Activate RSSI reading in Phoenix (**Testing→GSM→RSSI reading**)

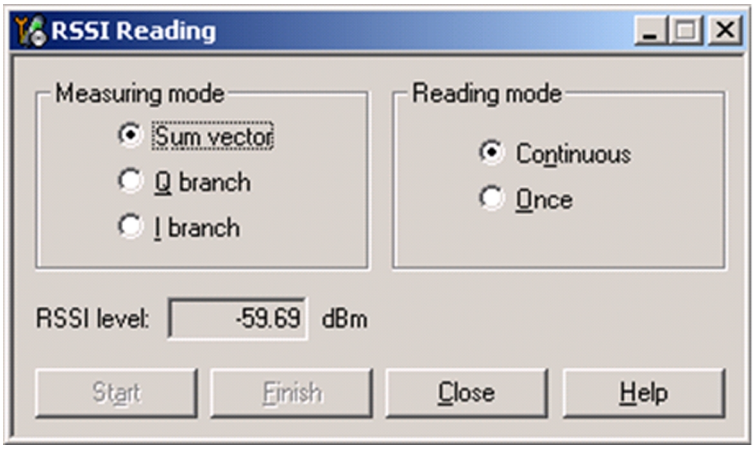


Figure 26 Phoenix GSM RSSI reading window

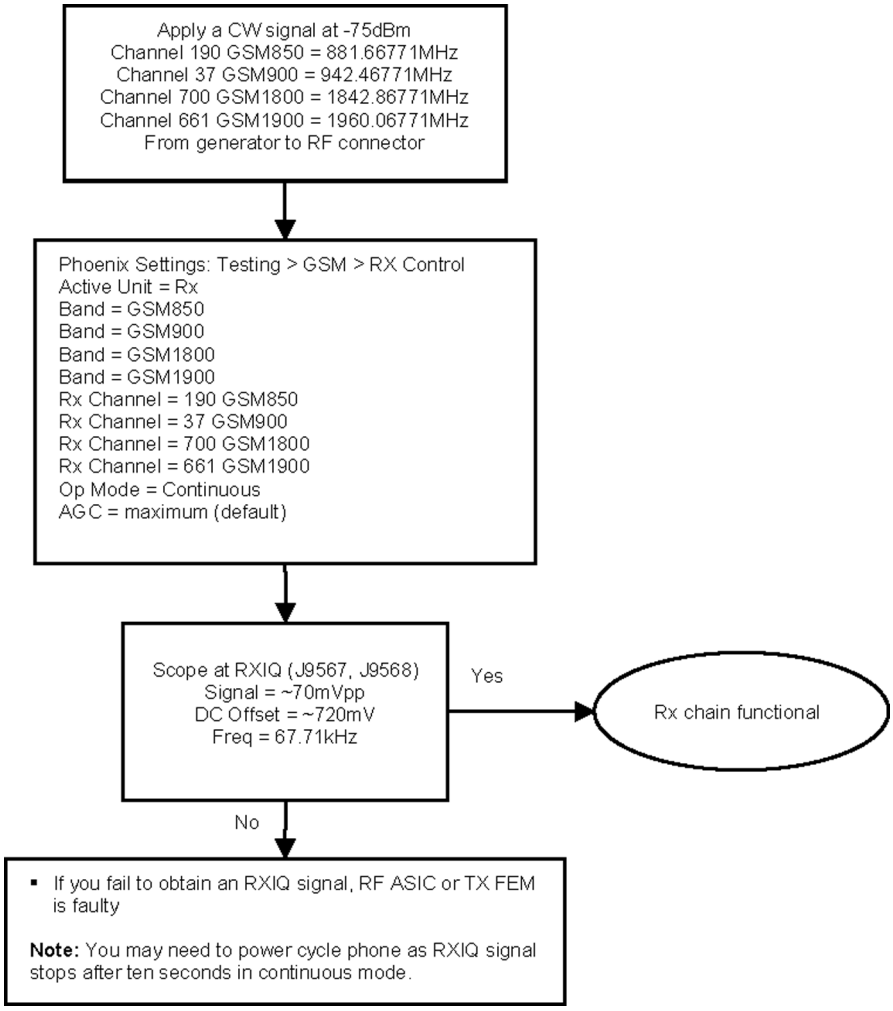
Results

The reading should reflect the level of the signal generator (-losses) +/- 5 dB.

When varying the level in the range -30 to -102 dBm the reading should then follow within +/-5 dB.

GSM receiver troubleshooting flowchart

Troubleshooting flow



WCDMA RX chain activation for manual measurement

Steps

1. Via Phoenix Testing menu, choose **WCDMA/RX Control**.
2. In the RX control window, make the following settings:

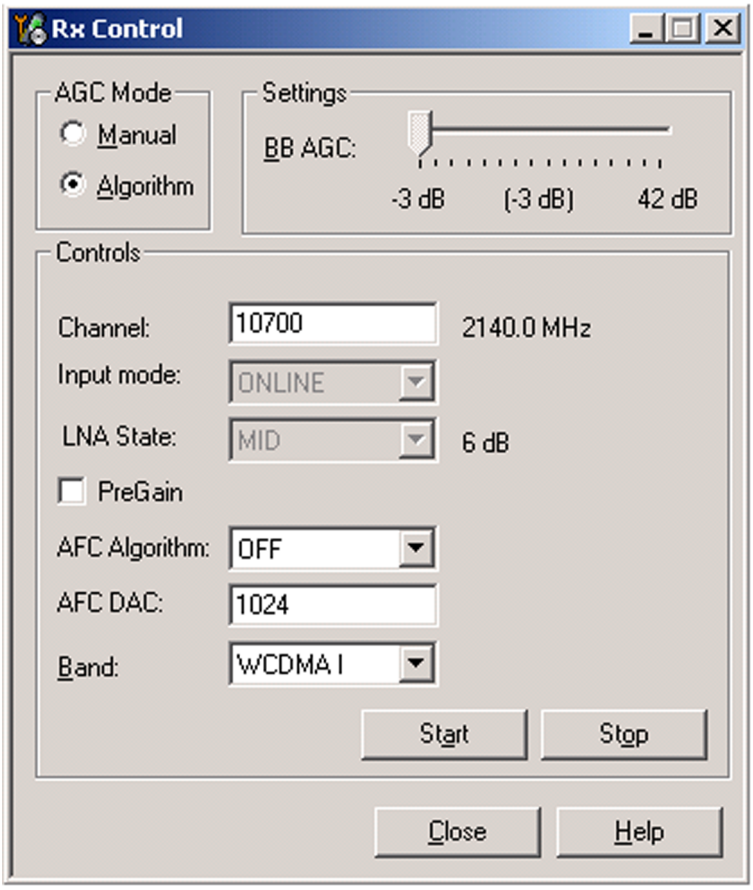


Figure 27 Phoenix WCDMA RX Control window

Note: Channel for band WCDMA I 10700, IV 1637, VIII 3012

3. Click **Start** to activate the settings.

   If the settings are changed later on (for example, change of channel) you have to click **Stop** and **Start** again.

   Note: Clicking **Stop** also disables TX control if it was active.

WCDMA RSSI measurement

Prerequisites

WCDMA RX must be activated before RSSI can be measured. For instructions, please refer to WCDMA RX chain activation. Connect signal generator to RF connector and use appropriate frequency for each channel (2141MHz for channel 10700 WCDMA band I, WCDMA modulation).

Steps

1. Set the following RF generator settings:

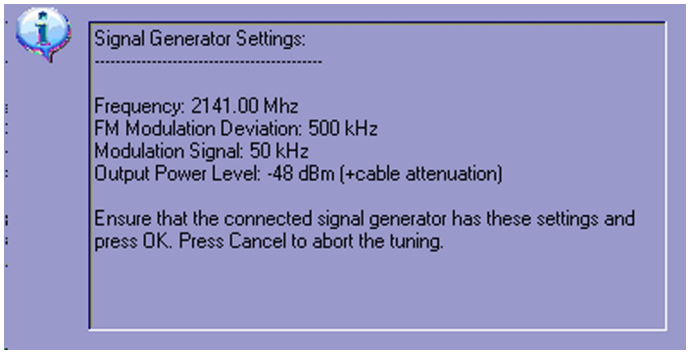


Figure 28 WCDMA RX generator settings

Note: Frequency for band WCDMA I 2141.0MHz, IV 2133.4MHz, VIII 943.4MHz

2. From the Phoenix testing menu, select **WCDMA→RX Power measurement**
3. In the RX power measurement window, make the following settings:

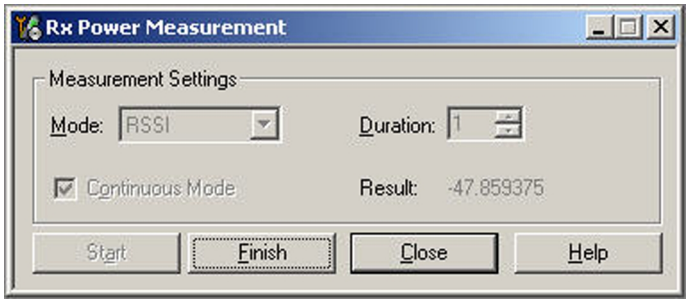


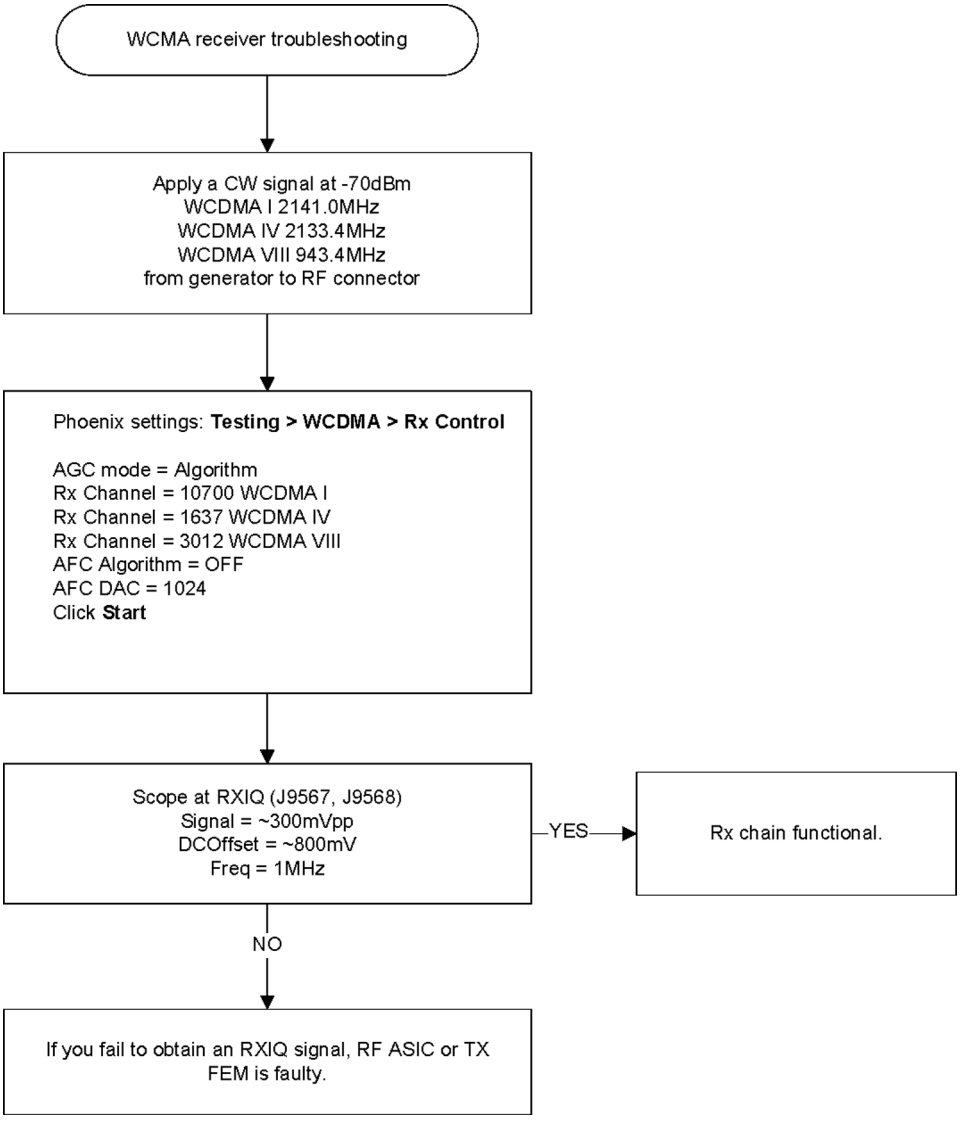
Figure 29 Phoenix WCDMA RX power measurement window

4. Click **Start** to perform the measurement.

Note: WCDMA RSSI measurement is accurate only with WCDMA modulated signal.

WCDMA receiver troubleshooting flowchart

Troubleshooting flow



Transmitter troubleshooting

General instructions for transmitter (TX) troubleshooting

Please note the following before performing transmitter tests:

- TX troubleshooting requires TX operation.
- Do not transmit on frequencies that are in use.
- The transmitter can be controlled in local mode for diagnostic purposes.
- The most useful Phoenix tool for GSM transmitter testing is “RF Controls”, in WCDMA transmitter testing the best tool is “TX Control”.
- Remember that re-tuning is not a fix! Phones are tuned correctly in production.

Note: Never activate the GSM or WCDMA transmitter without a proper antenna load. Always connect a 50 Ω load to the RF connector (antenna, RF-measurement equipment or at least a 2 W dummy load); otherwise the GSM or WCDMA Power amplifier (PA) may be damaged.

GSM transmitter troubleshooting

Steps

1. Set the phone to local mode.
2. Activate RF controls in Phoenix (**Testing→GSM→Rf Controls**).
   Make settings as shown in the figure:

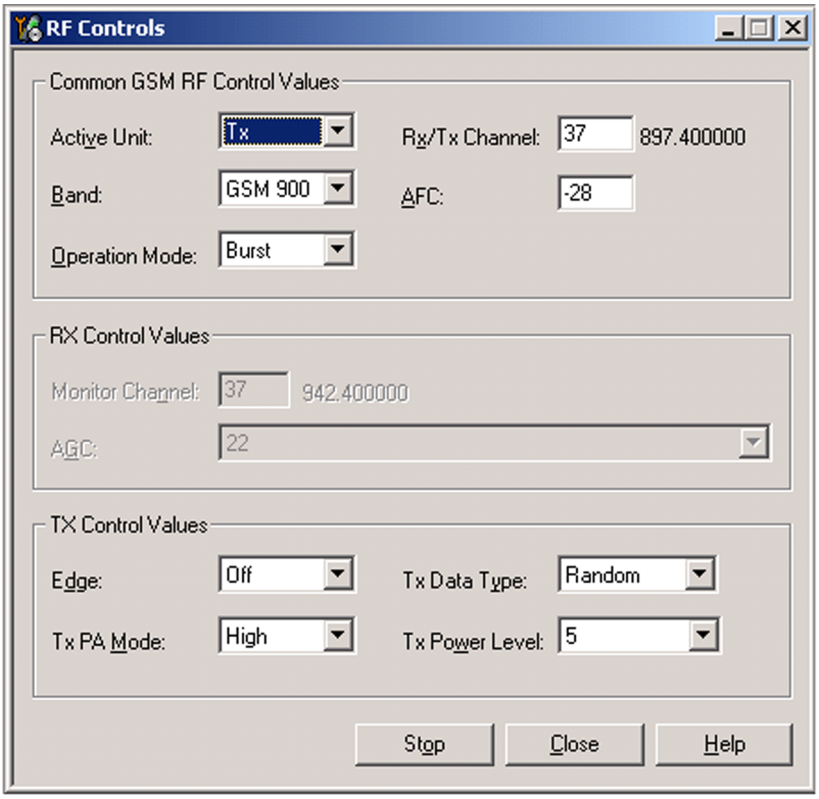
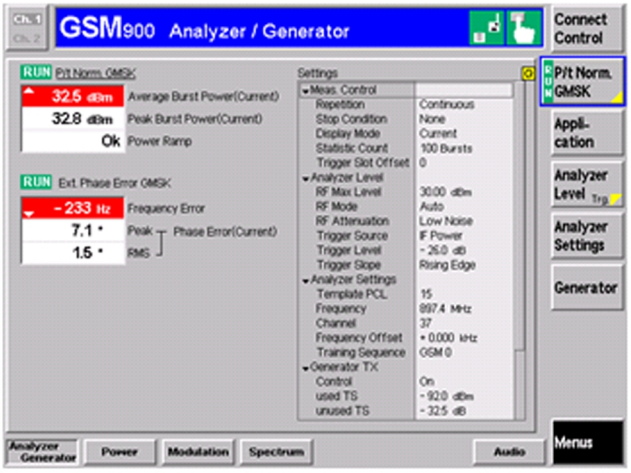


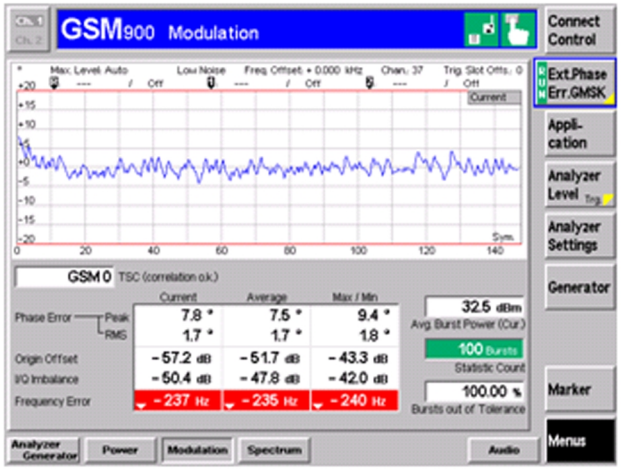
Figure 30 Phoenix GSM RF controls window

3. Check the basic TX parameters (i.e. power, phase error, modulation and switching spectrum), using a communication analyser (for example CMU200).

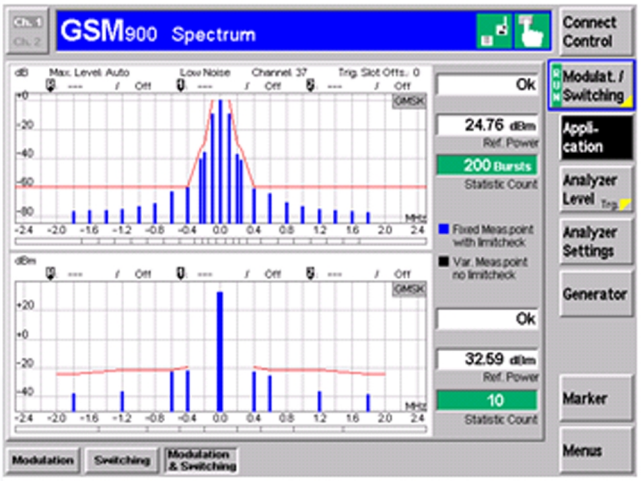
Analyser settings



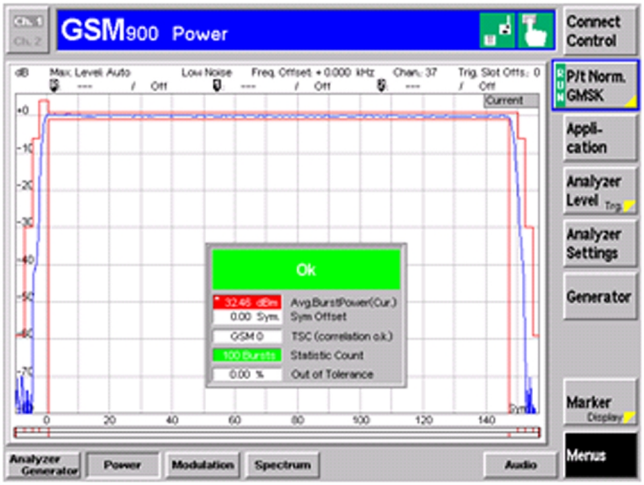
Phase error



Modulation/Switching spectrum



Power/Burst GSM/GPRS (GMSK)



Power/Burst - EDGE (8PSK)

4. Change power level (RF controls) and make sure the power reading follows accordingly.

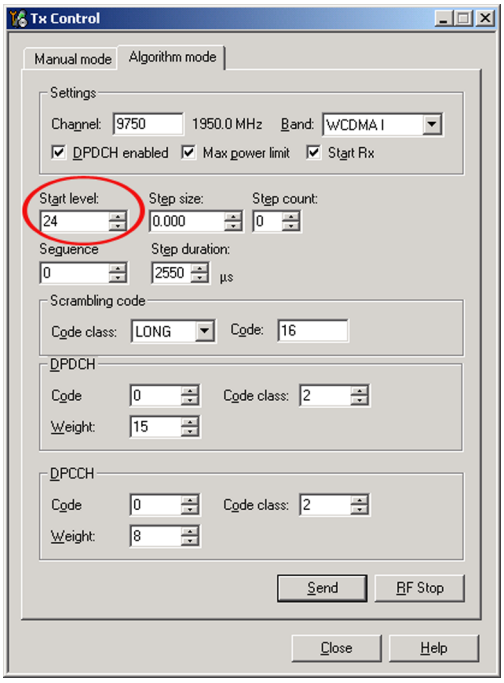
Next actions

If you want to troubleshoot the other bands, change band with RF controls and set the communication analyser accordingly.

WCDMA transmitter troubleshooting

Steps

1. Set the phone to local mode.
2. In Phoenix, select **Testing→WCDMA→TX control** .
3. In the TX control window, make settings as in the picture:

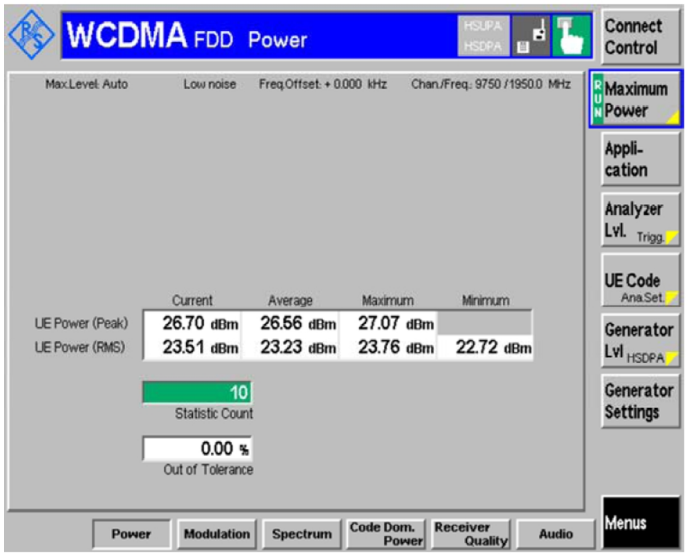


Note: For WCDMA TX channels: band I 9750, IV 1412, VIII 2787

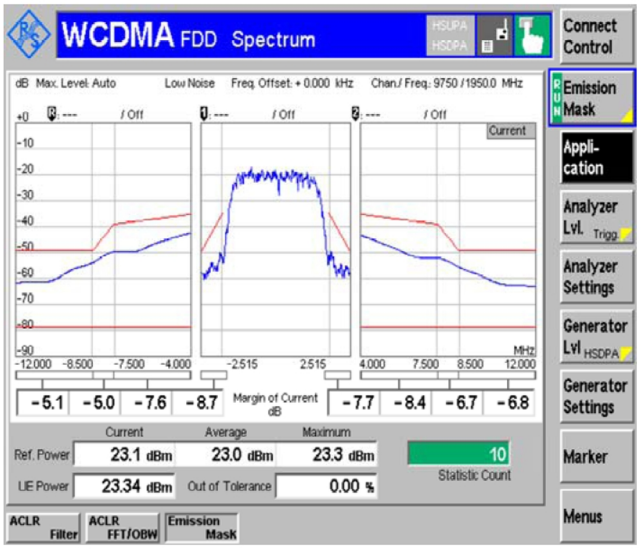
4. Click **Send** to enable the settings and activate TX.

   If settings are changed (eg. new channel), you have to click **RF Stop** and **Send** again.
5. Check the basic TX parameters using a communication analyzer (for example CMU200).

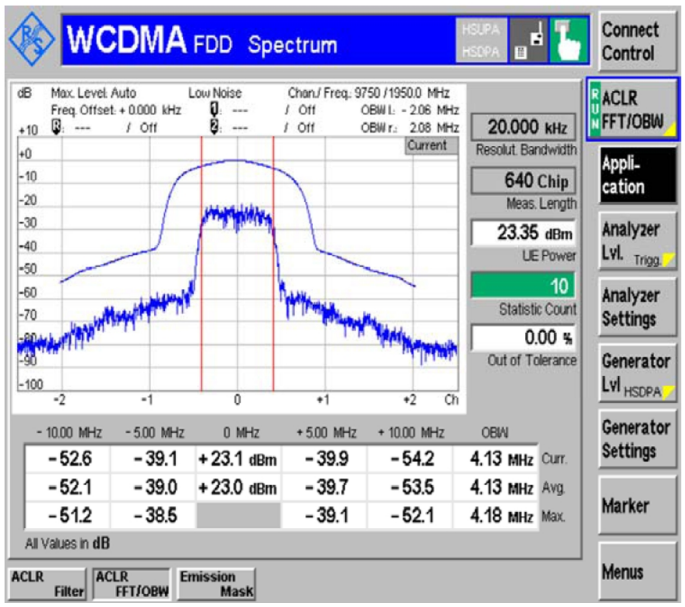
Power



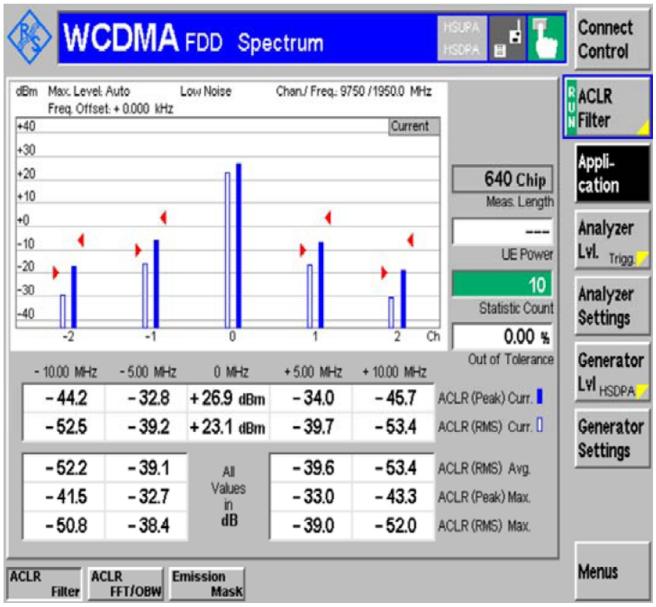
Spectrum - Emission Mask



Spectrum - ACLR (FFT/OBW)



Spectrum - ACLR (Filter)



Next actions

If you want to troubleshoot the other bands, change band with RF controls and set the communication analyser accordingly.

Antenna

Antenna troubleshooting

Antenna contacts, visual check

In the main antenna there is one feed and two GND contacts. Check that the GND and feed pads take proper contact to the C-clips on the main PWB. The antenna contact pads (3 pcs) are shown in the figure below.

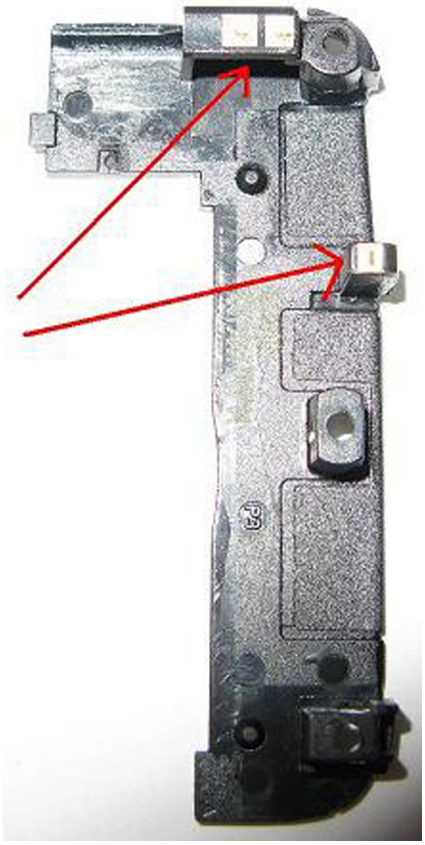


Figure 31 Antenna contacts

5 — Camera Module Troubleshooting

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Introduction to camera module troubleshooting

Background, tools and terminology

Faults or complaints in camera operation can be roughly categorised into three subgroups:

1 Camera is not functional at all; no image can be taken.

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

3 Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded, or customer complains about image quality.

Image quality is very hard to measure quantitatively, and even comparative measurements are difficult (comparing two images) to do, if the difference is small. Especially if the user is not satisfied with his/her device's image quality, and tells, for example, that the images are not sharp, it is fairly difficult to accurately test the device and get an exact figure which would tell whether the device is functioning properly.

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training or experience of a correctly operating reference device may be 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 images in bad conditions. Therefore the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference. Experience helps significantly in analysing image quality.

Terms

Autofocus	Camera module contains lens movement mechanics for focus adjustment. Autofocus enables camera to take sharp images of objects positioned between 10cm to infinity. During AF the viewfinder image will be momentarily blurred as the camera searches for the right focus setting.
Digital zoom	Digital zoom is done by first cropping the image by the zoom ratio and then upscaling it to the output resolution. This will decrease the image quality especially with high zoom ratios.
Dynamic range	Camera's ability to capture details in dark and bright areas of the scene simultaneously.
Exposure time	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 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	Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image.
ND-filter	Neutral density filter is a filter which is used in very bright conditions to reduce the amount of light hitting the sensor. The filter is built into the camera module and applied automatically when needed.
Noise	Variation of response between pixels with same level of input illumination.
Resolution	Usually the amount of pixels in the camera sensor. In some occasions the term resolution is used for describing the sharpness of the images.

Sensitivity	Camera module's sensitivity to light. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film.
Sharpness	Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance.
Shutter	The electronic shutter is used when short exposure times are needed and in video. When the mechanical shutter is used a black sheet will cover the lens after the exposure.

The effect of image taking conditions on image quality

There are some factors, which may cause poor image quality, if not taken into account by the end user when shooting images, and thus may result in complaints. The items listed are normal to camera operation and are not a reason for changing the camera module.

Autofocus

When the camera is focusing a lens is moved inside the module to give the sharpest possible image. This camera module is specified to operate satisfactorily from 10 cm to infinite distance of scene objects. Trying to photograph objects closer than 10 cm is likely to result in a blurred out of focus image. The lack of sharpness is first visible in full resolution images. Images taken very close to the subject, a limited depth of focus will be visible, that is the upper or lower parts of the image may be out of focus. This is normal; do not change the camera module.

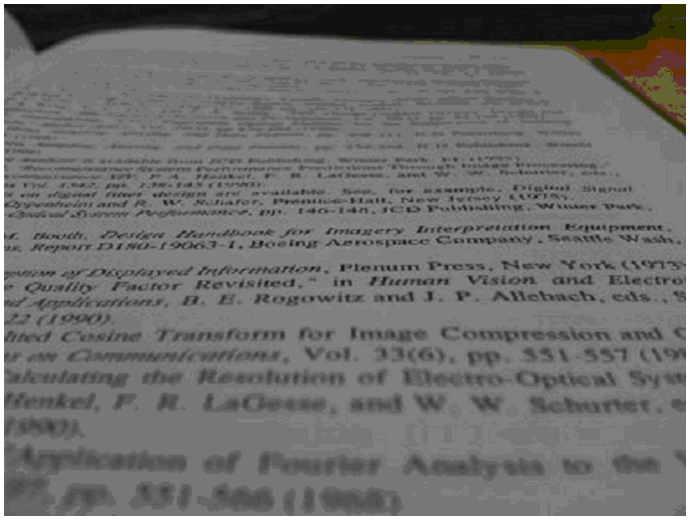


Figure 32 Only center part of image is in focus due to limited depth of focus

The amount of light available

In dim conditions camera runs out of sensitivity. The exposure time is long (especially in the night mode) and the risk of getting shaken (= blurred) images increases. In addition, image noise level grows. The maximum exposure time in the night mode is ¼ seconds. Therefore, images need to be taken with extreme care and by supporting the phone when the amount of light reflected from the target is low. Because of the longer exposure time and larger gain value, noise level increases in low light conditions. Sometimes blurring may even occur in daytime, if the image is taken very carelessly. See the figure below for an example. This is normal; do not change the camera module.

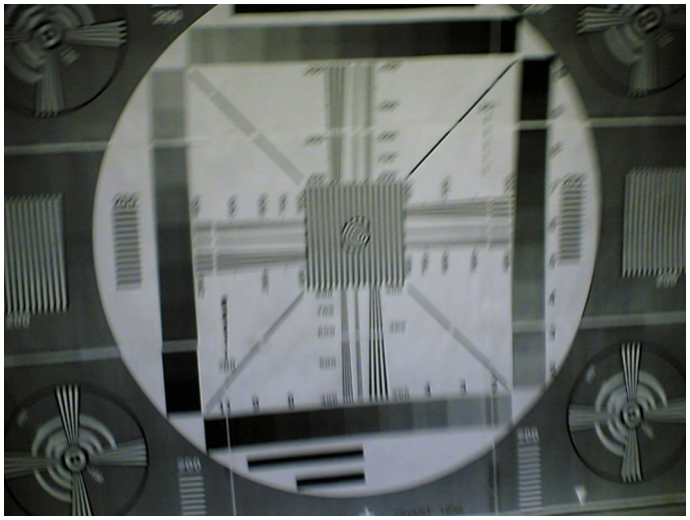


Figure 33 Blurring caused by shaking hands

Movement in bright light

If an image is taken of moving objects or if the device is used in a moving vehicle, object 'skewing' or 'tilting' may occur. This phenomenon is fundamental to most CMOS camera types, and may happen when using the electronic shutter. The movement of camera or object sometimes cause blurring indoors or in dim lighting conditions because of long exposure time. This is normal; do not change the camera module.

Figure 34 Near objects get skewed when taking images from a moving vehicle

Temperature

High temperatures inside the mobile phone cause more noise to appear in images. For example, in +70 degrees (Celsius), the noise level may be very high, and it further grows if the conditions are dim. If the phone processor has been heavily loaded for a long time before taking an image, the phone might have considerably higher temperature inside than in the surrounding environment. This is also normal to camera operation; do not change the camera module.

Figure 35 Noisy image taken in +70 degrees Celsius

Phone display

If the display contrast is set too dark, the image quality degrades: the images may be very dark depending on the setting. If the display contrast is set too bright, image contrast appears bad and "faint". This problem is solved by setting the display contrast correctly. This is normal behaviour; do not change the camera module.

Basic rules of photography (especially shooting against light)

Because of dynamic range limitations, taking images against bright light might cause either saturated image or the actual target appear too dark. In practice, this means that when taking an image indoors and having, for example, a window behind the object, the result is usually poor. This is normal behaviour; do not change the camera module.

Figure 36 Image taken against light

Flicker

In some occasions a bright fluorescent light may cause flicker in the viewfinder and captured image. This phenomenon may also be a result, if images are taken indoors under the mismatch of 50/60 Hz electricity network frequency. The electricity frequency used is automatically detected by the camera module. In some very few countries, both 50 and 60 Hz networks are present and thus probability for the phenomenon increases. Flickering occurs also under high artificial illumination level. Flickering only occurs when the rolling shutter is used. This is normal behaviour; do not change the camera module.

Figure 37 Flicker in an image; object illuminated by strong fluorescent light

Bright light outside of image view

Especially the sun can cause clearly visible lens glare phenomenon and poor contrast in images. This happens because of undesired reflections inside the camera optics. Generally this kind of reflections are common in all optical systems. This is normal behaviour; do not change the camera module.

Figure 38 A lens reflection effect caused by sunshine

Examples of good quality images

Figure 39 Good image taken indoors

Figure 40 Good image taken outdoors

Image quality analysis

Possible faults in image quality

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

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

In addition, there are many other kinds of possibilities for bad image quality, but those are ruled out from the scope of this document since the probability of their appearance is small.

Testing for dust in camera module

Symptoms and diagnosis

For detecting these kinds of problems, take an image of a uniform white surface and analyse it in full resolution. A good quality PC monitor is preferred for analysis. Search carefully, since finding these defects is not always easy. Figure "Effects of dust on optical path" is an example image containing easily detectable dust problems.

When taking a white image, use uniformly lightened white paper or white wall. One possibility is to use uniform light but in this case make sure that the camera image is not flickering when taking the test image. In case flickering happens, try to reduce illumination level. Use JPEG image format for analysing, and set the image quality parameter to ‘High Quality’.

Black spots in an image are caused by dirt particles trapped inside the optical system. Clearly visible and sharp edged black dots in an image are typically dust particles on the image sensor. These spots are searched for in the manufacturing phase, but it is possible that the camera body cavity contains a particle, which may move onto the image sensor active surface, for example, 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 the problem is present when the service technician analyses the phone.

If a dust particle is lying on the infrared filter surface on either side, they are hard to locate because they are out of focus, and appear in the image as large, grayish and fading-edge 'blobs'. Sometimes they are invisible to the eye, and thus the user probably does not notice them at all. However, it is possible that a larger particle disturbs the user, causing need for service.

Figure 41 Effects of dust on 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. The dust gasket between the window and lens should prevent any particles from getting into the cavity after the manufacturing phase.

If dust particles are found on the sensor, this is classified as a manufacturing error of the module and the camera should be replaced. Any particles inside the cavity between the protection window and lens have most probably been trapped there in the assembly phase at a Nokia factory. Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean 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 camera image sharpness

Symptoms and diagnosis

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

1 The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.
2 The camera module has failed to focus correctly, producing a blurred image.
3 User has tried to take pictures in too dark conditions and images are blurred due to handshake or movement. This is not a cause to replace camera module.
4 There is dirt between the protection window and the camera lens.
5 The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

A quantitative analysis of sharpness is very difficult to conduct in any other environment than optics laboratory. Therefore, subjective analysis should be used.

If no visible defects (items 1-4) are found, a couple of test images should be taken. Generally, a well-illuminated typical indoor scene, such as the one in Figure "Good image taken indoors", can be used as a target. The main considerations are:

- The camera module has to be given time to focus correctly. Correct focusing is normally indicated with a flashing icon or green bracket in the viewfinder. During focusing, the image in the viewfinder moves slightly back and fourth, this is normal and shows that the lens unit is moving. During the movement a faint sound can be heard from the camera head.
- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

There are several conditions in which AF operation is challenging for the camera module, i.e. failing from time to time. These include:

- Low light scenes and night mode
- Scenes with low contrast
- Fast-moving objects

AF operation is disabled on purpose in "night", "landscape", and "sports" modes.

When using these modes the lens is set to a predermined focal position ans isn't moved during use.

In "video" mode autofocus can be done before video recording is started and after recording starts the focus is fixed to that specific focus range.

Under low light and night mode the AF function is slower than under good light, it may even fail to find correct focus position. Low contrast scenes or fast moving objects may also slow down or cause AF to fail. This is normal operation, and is not a cause to replace camera.

The operation of AF can be tested by taking images of objects at different distances. Good distances are 20 cm, 60 cm and infinity (>3 m). Any LED or xenon flashes should not be used while taking the images.

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

If the differences are noticeable at a glance and also if the one under investigation is significantly inferior, the module might have a faulty lens. In this case, the module should be changed. Always re-check the resolution after changing the camera module. If a different module produces a clearly noticeable quality gap,

the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module. As references Figure "Good image taken indoors" and Figure "Good image taken outdoors" can be used. Another possibility is to use a service point comparison phone, if available.

Effects of dirty or defective camera lens protection window

The following series of images demonstrates the effects of fingerprints on the camera protection window.

Note: The effects of any dirt in images can vary very much; it may be difficult to judge if the window has been dirty when some image has been taken or if something else has been wrong. That is why the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

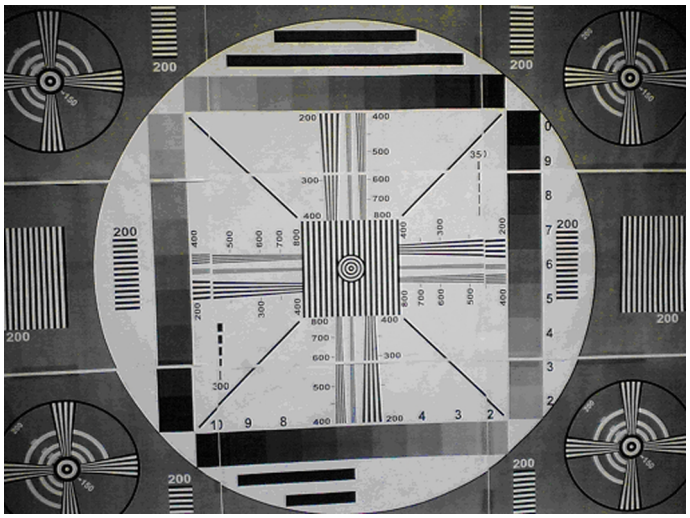


Figure 42 Image taken with clear protection window

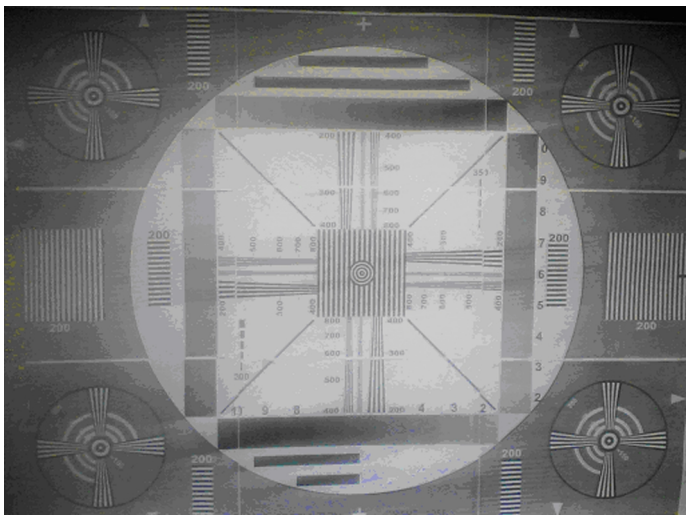


Figure 43 Image taken with greasy protection window

Bright point light sources might cause images that have flares around the light source if the protection window is dirty. A smeared fingerprint may be hard to see on the protective window but if will affect the image quality. These flares can be avoided by cleaning the window with a suitable cloth.

Figure 44 Image of point light sources taken with a clean protective window

Figure 45 Image of point light sources taken with a dirty (finger print) protective window

Faulty pixels in images

Faulty pixels are pixels that do not respond to light in the same way as the pixels around them. There are three main types of faulty pixels, dead, stuck and hot pixels.

Dead pixels are always black or significantly darker than their surrounding. Dead pixels appear as black spots in all lightning conditions. Camera modules producing images with dead pixels that are clearly noticeable should be replaced.

If the pixel remains always saturated to its maximum value it is stuck. Stuck pixels may appear as red, green, blue or white spots in all lightning conditions. Camera modules producing images with one or more stuck pixels should be replaced.

Hot pixels are pixels that easily saturate in dim light conditions. It is normal to get a lot of noise and hot pixels in night conditions or otherwise dark conditions. The hot pixels should disappear when the ambient light is increased, but may still appear in darker areas of an otherwise well illuminated scene.

When examining an image for defect pixels, test images should be viewed as 100% enlargements on a PC monitor.

Figure 46 Enlargement of a hot pixel

Flash photography problems

Use of flash device may affect the image in many ways.

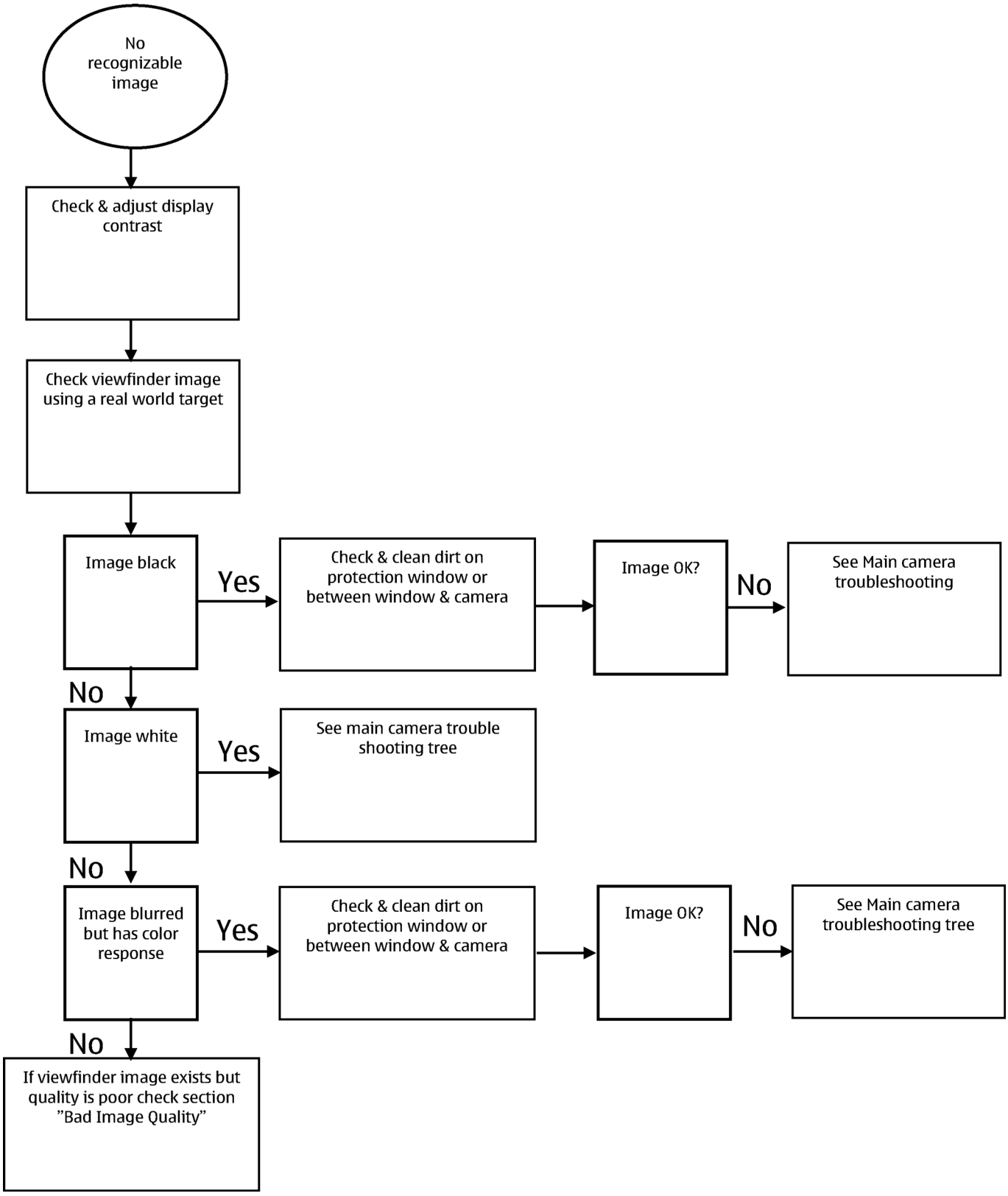
- White balance errors. The image may get a wrong tone due to mixing of flash colour temperature and ambient lightning. This is unwanted but normal feature.
- Dust reflections. Dust or water drops in front of the flash unit may reflect strongly to the camera sensor. See the following figure.

Figure 47 Light from the flash has reflected on particles in front of the camera

Main (back) camera troubleshooting flowcharts

No recognizable viewfinder image

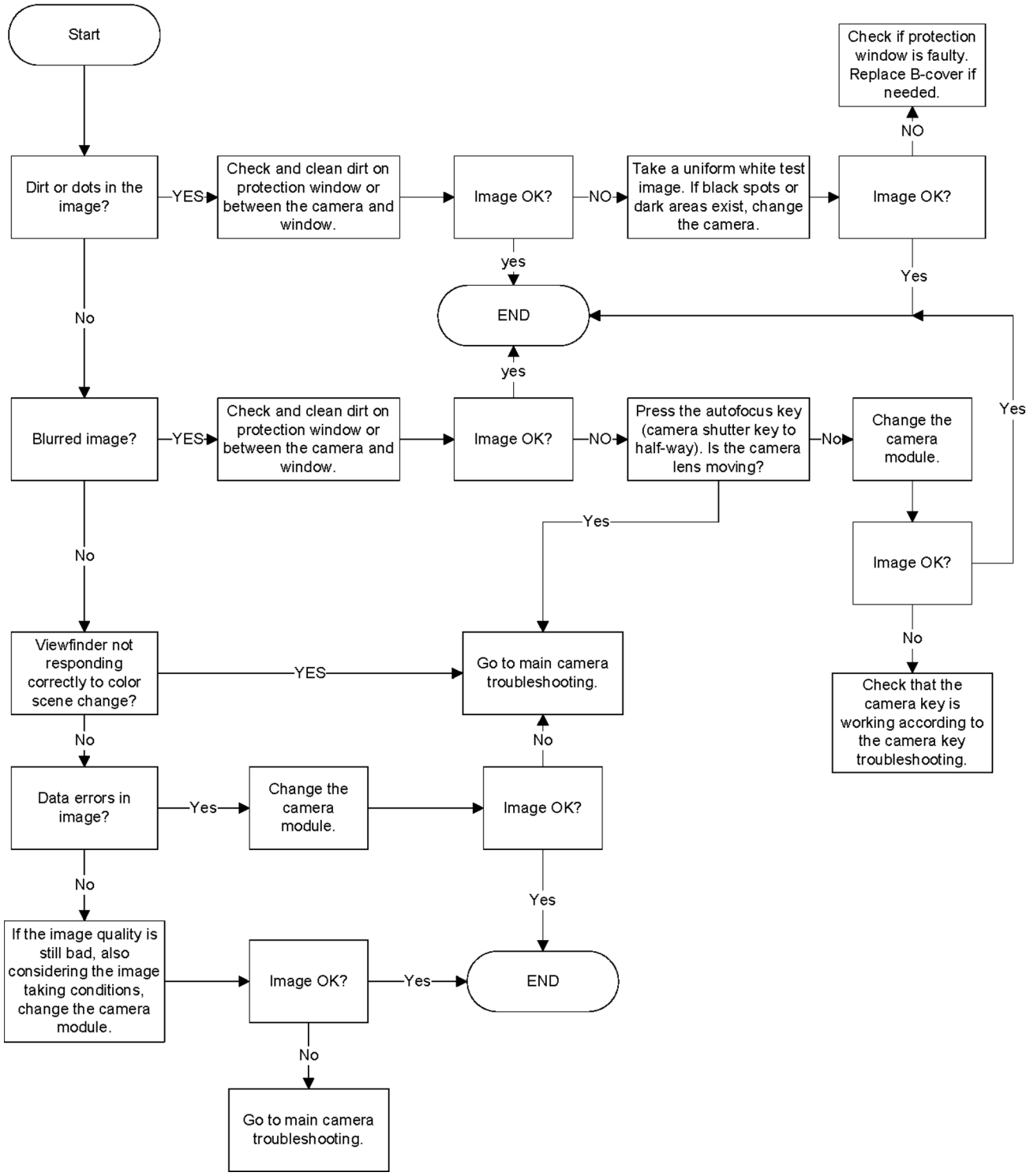
Troubleshooting flow



Bad image quality troubleshooting

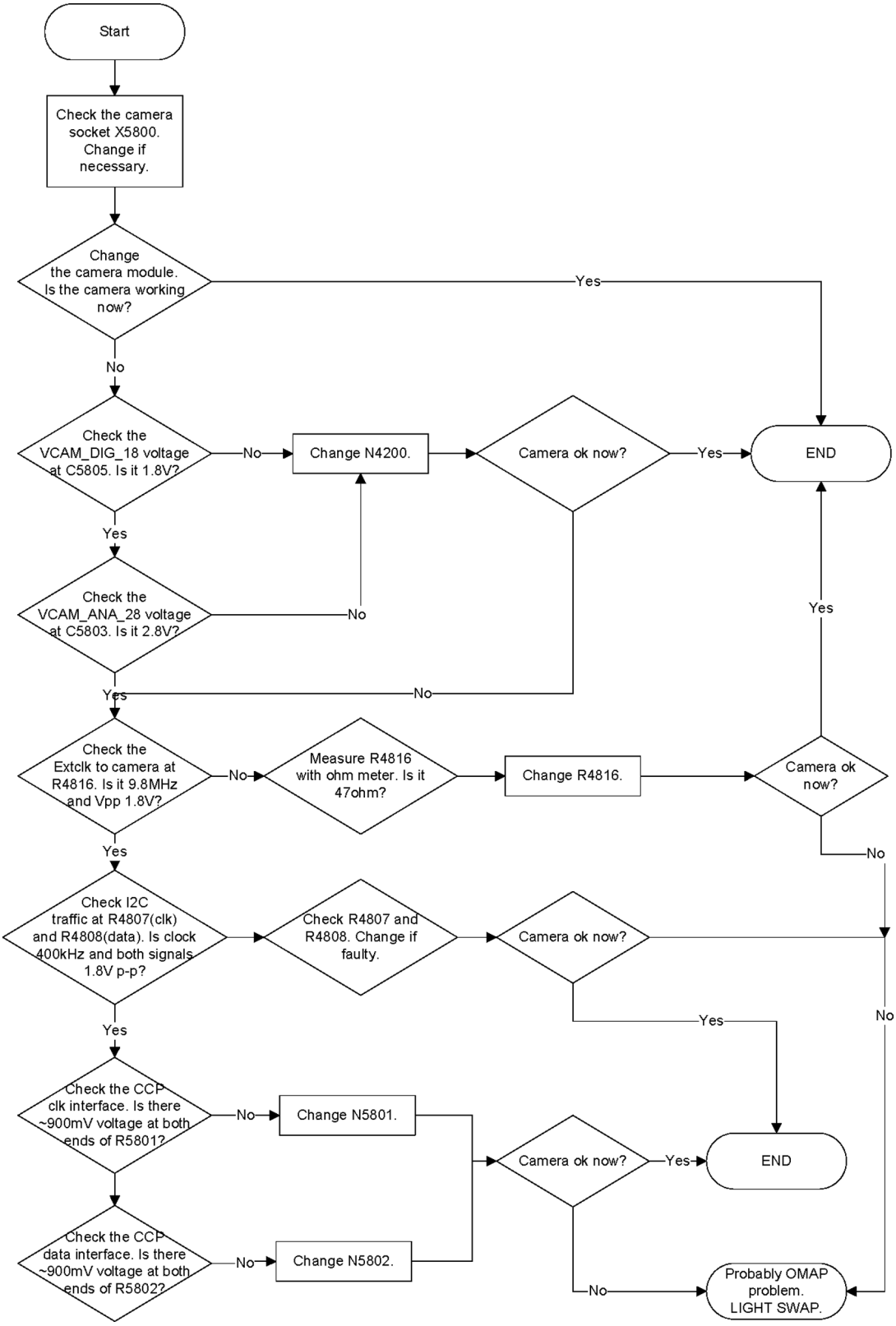
Troubleshooting flow

Before starting check the effects of image taking conditions on the image quality from the previous chapter!



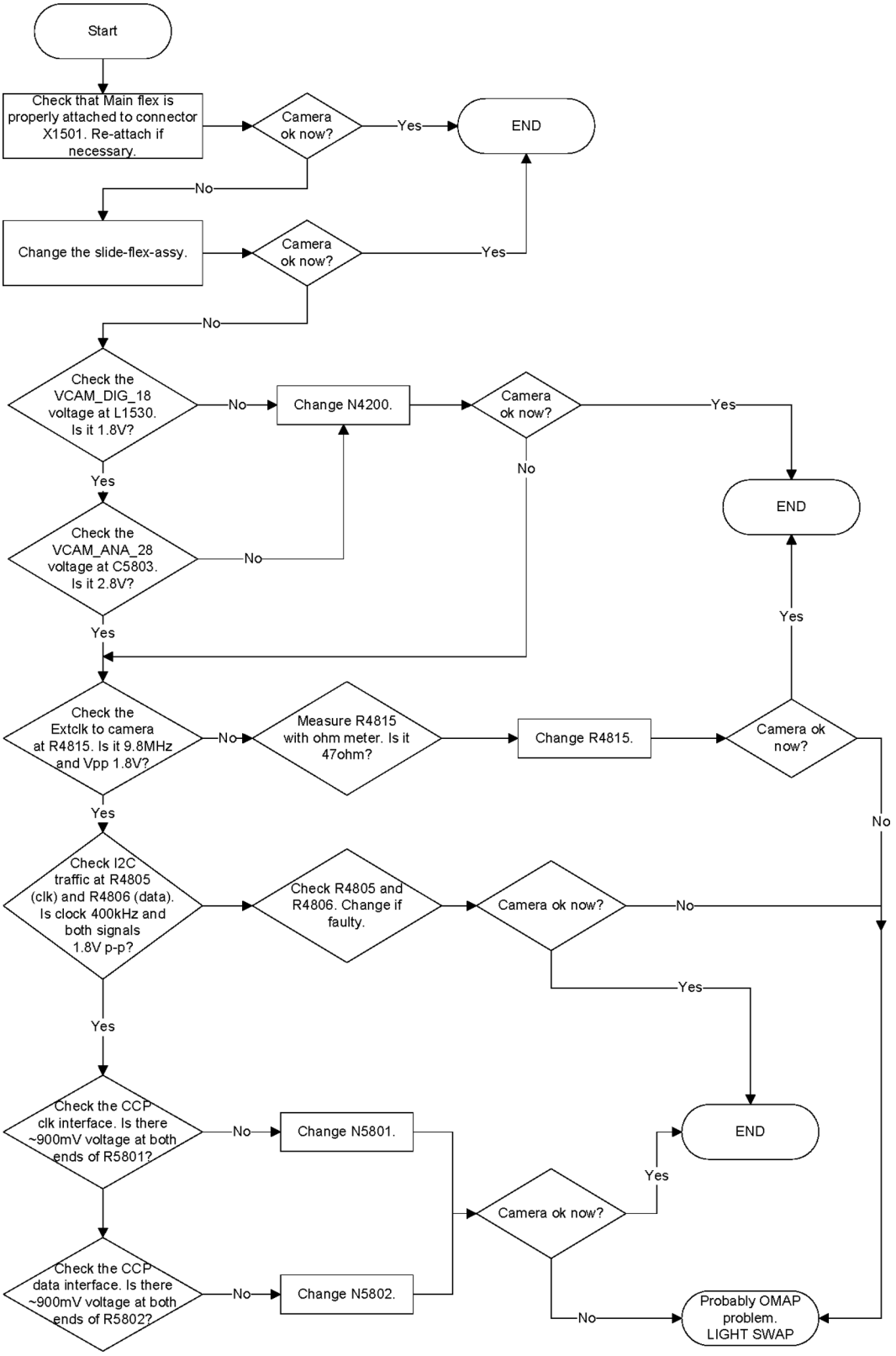
Main camera troubleshooting

Troubleshooting flow



Secondary (front) camera troubleshooting

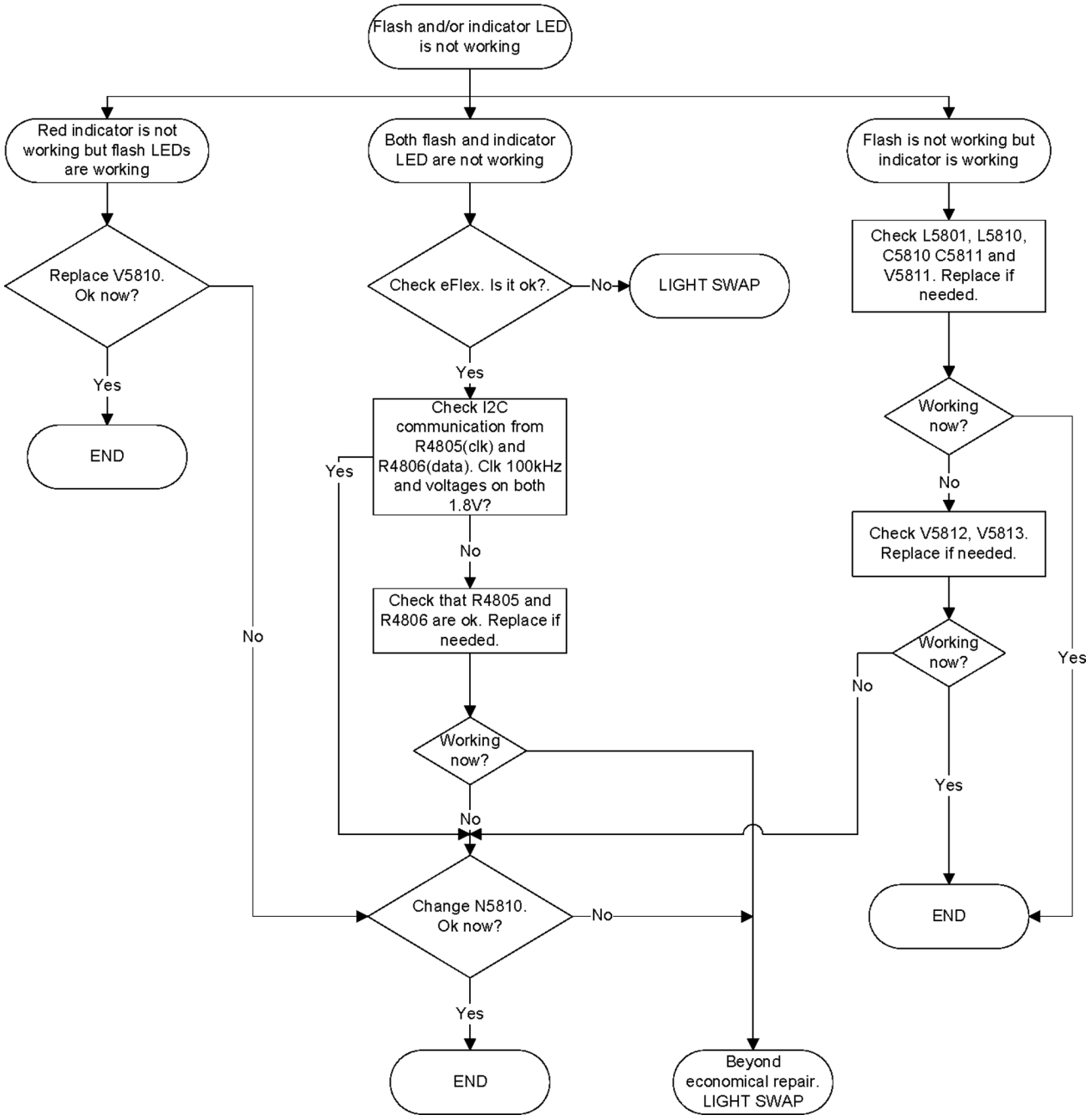
Troubleshooting flow



Flash troubleshooting

Troubleshooting flow

NOTE: Before checking flash functionality, make sure that the main camera is working properly.



6 — System Module

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Introduction

Phone description

The device consists of two main mechanical blocks. The lower block holds the main PWB with most of the electrical components. The upper block is basically the main flex that is connected to the main PWB with a board-to-board connector. The upper block has the display, touch screen, ambient light sensor, secondary camera, proximity sensor, RGB indication LED and earpiece.

Functional description

Baseband can be divided into two larger blocks. The application engine (APE) side runs with Linux operating system which is controlled by OMAP3430 application processor. Most of the peripherals are connected to that. Also OMAP controls the other major baseband block, the cellular engine side (CMT). The application engine has 2Gbit of NAND flash and 2Gbit of SDRAM. Memory is stacked on top of the application processor.

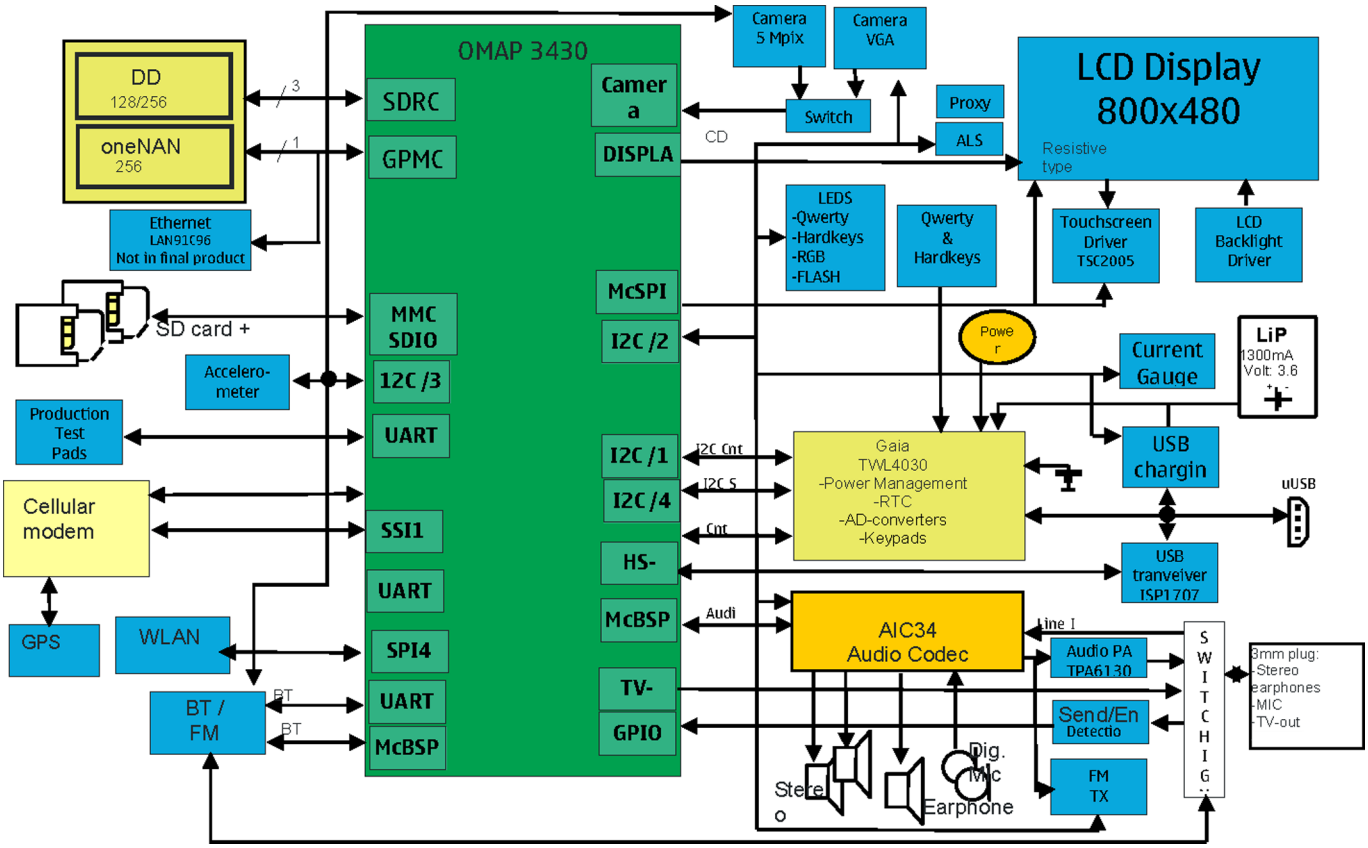


Figure 48 System level block diagram

Main components

Function	Description	Item ref
Application engine	OMAP3430	D4800
Application engine EM ASIC	GAIA	D4200
APE memory	Combo 2G DDR/2G M3	D5000
Cellular engine	RapuYama	D2800

Function	Description	Item ref
Cellular EM ASIC	Gazoo/Pearl	N2200
CMT memory	Combo 128M NOR/128M M3	D3000
USB transceiver	ISP1707 HS USB transceiver	D4280
FM-radio with RDS	BTHFMRDS2.2D discrete Bluetooth	N6000
Bluetooth		
WLAN	WLAN Cost4	N6300
GPS	GPS5350_ROM3.0	N6200
USB charger	BQ21450	N1140
Keyboard + RGB led driver	Lysti 9-channel LED driver	N1301
Touch screen controller	TSC2005	N1510
RF ASIC	Vapaus 5.1	N7500
GSM PA	850/900/1800/1900	N7520
WCDMA PA	I/IV/VIII	N7540
Oscillator	VCTCXO 38.4MHZ	G7500
	TCXO 19.2 MHz	G4246
	TCXO 38.4 MHz	G6450
	TCXO 16.368	G6200
Sleep clock	Crystal 32.768kHz	B2200 B4240
MicroSD reader		X5210
SIM card reader		X2700
eMMC	32 GB eMMC	D5200
FM transmitter	SI4713	N6150
Display backlight driver	TK65604	N1350
Accelerometer	3-axis accelerometer	N7001
Audio codec	AIC34 dual audio codec	N4040
Consumer IR transmitter	CIR LED	V1360
Ambient light sensor	Digital ambient light sensor	N1530 (main flex)
Display connector	3.5” wide VGA display	X1521 (main flex)
Main camera connector	5Mpix CMOS camera with electronic shutter	X5800

Function	Description	Item ref
Front camera	VGA SMD camera	N1550 (main flex)

Energy management

Battery and charging

Battery

Supported battery type is BL-5J.

Battery connector

Blade battery connector type.

- VBAT (Battery voltage)
- BSI (Battery size indication)
- GND (Battery ground)

Charging

Dead battery charging

Weak battery

This phone is charged through the micro USB connector. The phone supports dedicated, host or hub chargers. Charging is controlled by energy management, and external components are needed to protect the baseband module against EMC, reverse polarity and transient frequency deviation. USB charging circuit consists of USB charging chip BQ24150 and USB transceiver ISP1707. USB wall charger is detected with ISP1707 USB transceiver. It can directly control BQ24150 to 500mA charging mode.

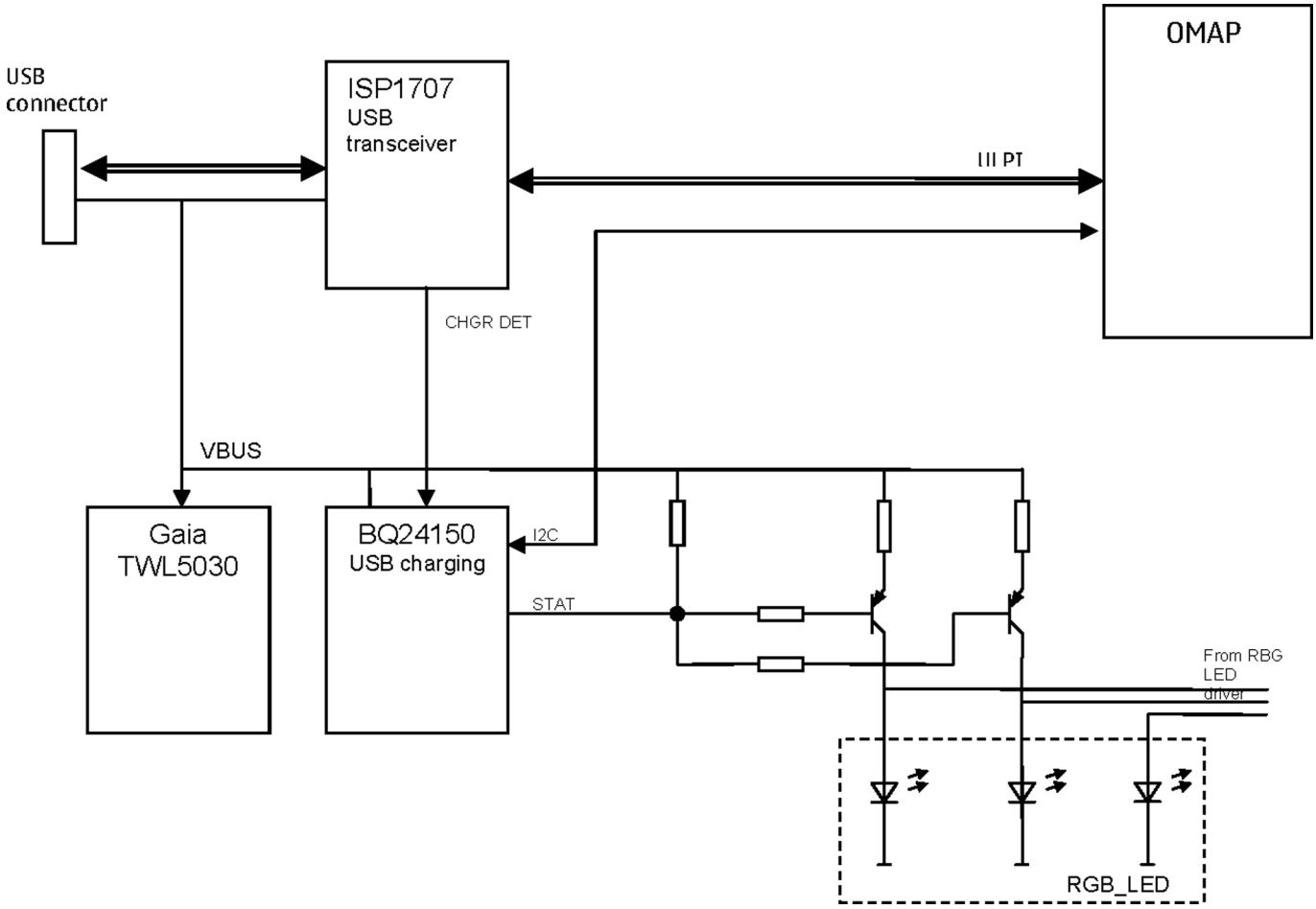


Figure 49 Charging circuitry

USB charging circuit BQ24150 starts charging with 100mA immediately after USB cable is connected. ISP1707 can control charging current to 500mA if a wall charger is detected. RBG LED indicates charging.

When Gaia wake up level is reached it wakes up OMAP3 and detects used charger immediately. During this, CellMo is kept to reset state. If a wall charger is detected a device can be booted immediately, otherwise a battery is charged in low power mode until a bootable level is reached.

If a USB cable is connected before a battery, charging is not started. The USB cable and battery must then be removed before charging is started.

A device starts charging with 100mA if a battery level is under 3.5V but a cold flashing is prevented with low battery, this ensures that there are no reset loops. Rom code has a 3 sec timeout for USB enumeration.

Backup battery

When the main battery is not attached, APE side EM ASIC goes in backup mode using back-up battery that supplies voltage to RTC in EM ASIC. CMT side does not have its own backup battery.

Normal and extreme voltages

Energy management is mainly handled by the APE side EM ASIC called Gaia. It supplies most of the power supplies on APE side together with few external regulators. CMT side energy management is handled by Gazoo EM ASIC. It powers the CMT processor, cellular RF, SIM card and GPS.

In the table below normal and extreme voltages are shown when a BL-5J battery is used.

Table 14 Nominal voltages

Voltage	Voltage [V]	Notes
Battery voltage	4.2	Maximum voltage
Cutoff voltage (SW)	3.2	EM SW controlled
Cutoff voltage (HW)	2.7	Gaia EM ASIC controlled
Backup battery voltage	3.2	Typical voltage. Capacity 15uAh.

Power key and system power-up

After inserting the main battery, regulators started by HW are enabled. SW checks if there is some reason to keep the power on. If not, the system is set to power off state by watchdog.

Power-up can be caused by the following reasons:

- Power key is pressed
- Charger is connected
- RTC alarm occurs
- MBUS wakeup

APE engine is the master that handles the device start-up. After the APE side is up it can release the CMT side from reset state.

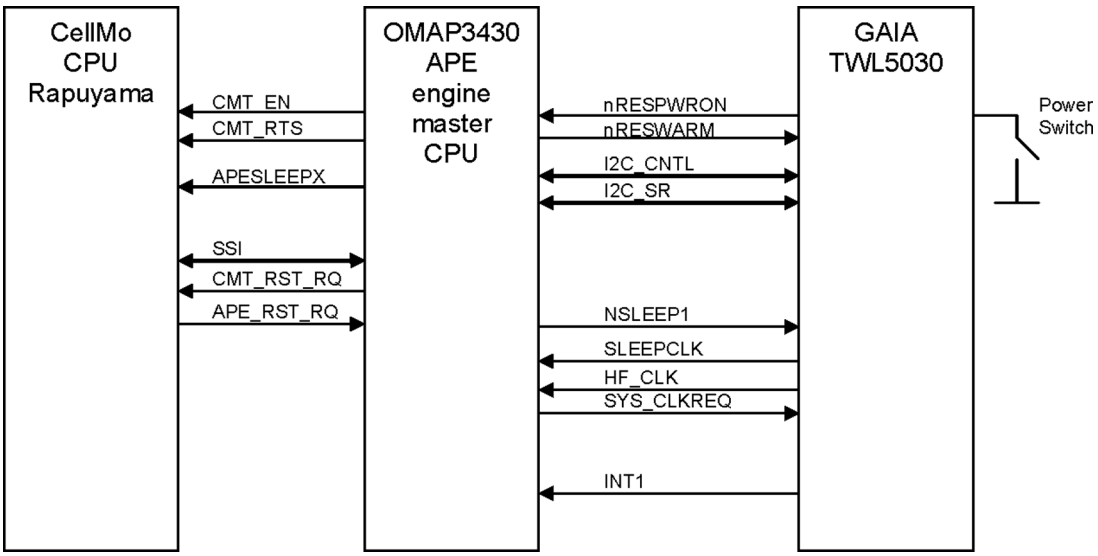
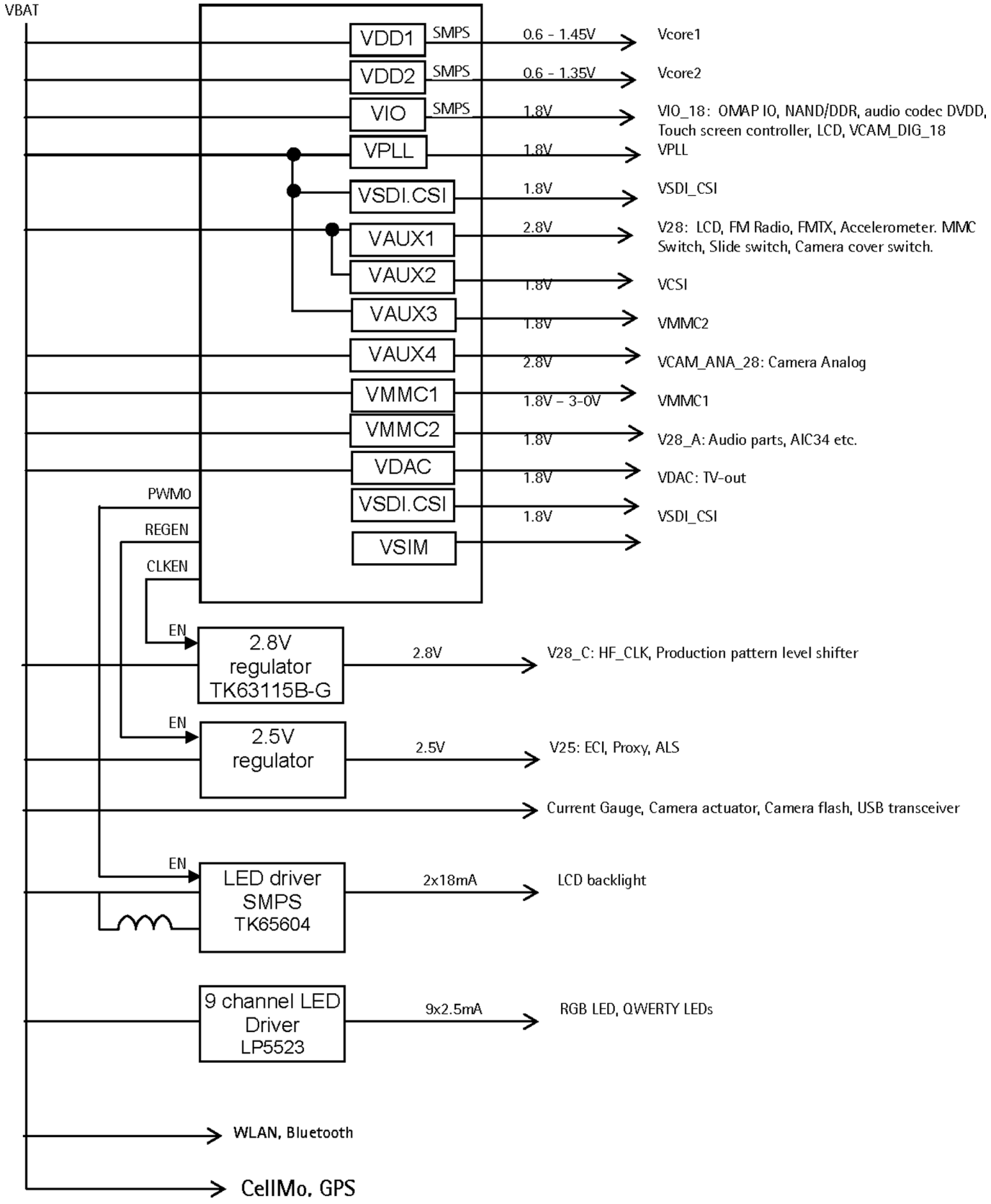


Figure 50 APE and CMT control signals and interfaces

Power distribution



Clocking scheme

RX-51 has two different clocking schemes. Both APE and CMT side have their own clocking system.

Two main clocks are provided for the APE system: 19.2 MHz clock produced by a crystal oscillator for Gaia and OMAP3, and 32.768 kHz sleep clock produced by Gaia with an external crystal for sleeping functionality. OMAP3 has internal PLLs which then create clock signals for other peripheral devices/interfaces like USB and RS MMC, LCD and memories.

WLAN and BT have independent BTSYSCLK which is generated by VCTCXO. They can request btsysclk independently, which enables sleeping/wakening even though OMAP is sleeping or woken up.

32k Sleep Clock is always powered on after start-up. Sleep clock is used for low-power operation.

There are two main clocks in the CellMo system: 38.4 MHz RF clock produced by VCTCXO in RF section and 32.768 kHz sleep clock produced by the EM ASIC Gazoo with an external crystal. RF clock is generated only when VCTCXO is powered on by the EM ASIC regulator. The regulator itself is activated by SleepX signal from RAPUYAMA. When both CPUs of RAPUYAMA are in sleep, RF clock is stopped. RAPUYAMA has internal PLL that creates clock signals for other peripheral devices/interfaces, such as SIM, I2C and memories.

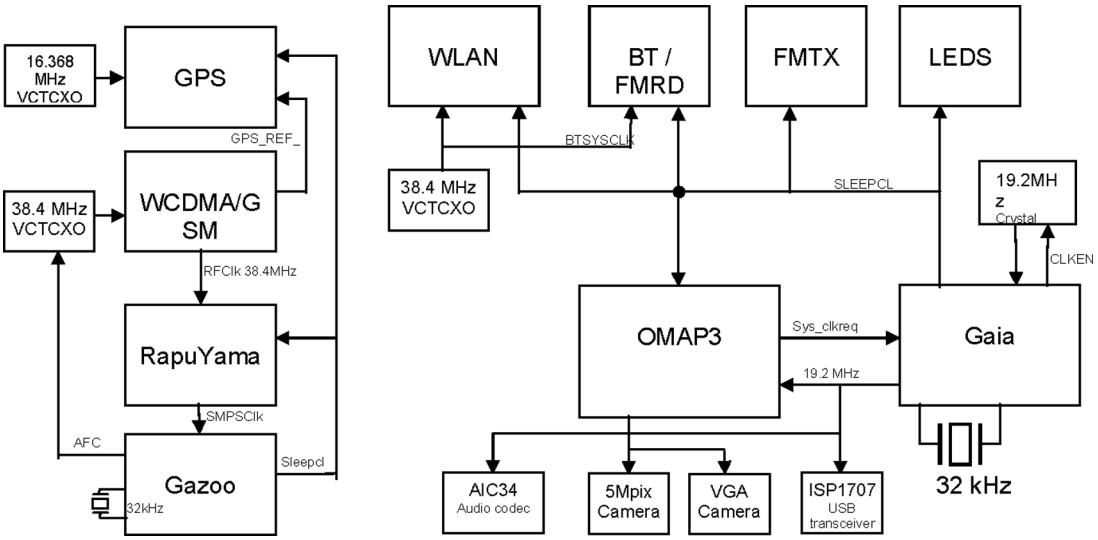


Figure 51 Clocking scheme

Bluetooth and FM RDS radio module

Bluetooth and FM radio receiver are provided by the same ASIC (Broadcom BCM2048). The device supports Bluetooth operation and FM radio rececption in both European and USA bands. The UART interface allows the device to communicate with the phone baseband engine using Bluetooth HCI commands. Commands to the FM radio can also be sent over the I2C interface.

When Bluetooth is switched on, the phone user interface the BT_RESETX line is toggled to reset the Bluetooth device, and commands are sent over the UART interface to configure the device. If UART communication fails (due to a hardware fault) it will not be possible to switch on Bluetooth from the phone user interface.

The device has two clock signals: BTSYSCLK (19.2MHz, 26.0MHz, or 38.4MHz supported) and SLEEP_CLK (32.768kHz). The SLEEP_CLK is supplied all the time the phone is switched on. To maximise the phone standby time, it is only necessary to provide a BTSYSCLK signal when Bluetooth activity occurs, such as sending Bluetooth data to another device, or checking periodically if there are any other Bluetooth devices attempting to communicate with it. At other times when the Bluetooth device is in standby mode or the FM radio is switched on it is only necessary to provide a SLEEP_CLK signal. The Bluetooth-FM ASIC is powered directly from the phone battery voltage line (VBAT). An internal regulator is enabled when Bluetooth or FM radio is switched on.

Bluetooth audio signals are sent to and from the device using a PCM and UART interface. The Bluetooth RF signal is routed via a buried track to the Bluetooth antenna on the side of the PWB. An RF filter is needed between the Bluetooth antenna and Bluetooth ASIC to prevent interference to and from the celluar phone antenna. Phones that have both Bluetooth and WLAN use a shared antenna, as both services occupy the 2.4GHz ISM frequency band. The co-existence signaling interface between Bluetooth and WLAN ASICs controls the RF activity in the shared frequency band.

The audio signal from the FM radio is routed via the phone Audio ASIC to the phone headset or loudspeaker. The external wired headset is also used as an Antenna for the FM radio. The FM radio receiver RF signal is routed from the ASIC via a buried track to an impedance matching circuit placed near the headset connector.

The following block diagram shows how Bluetooth-FM is connected to the host engine.

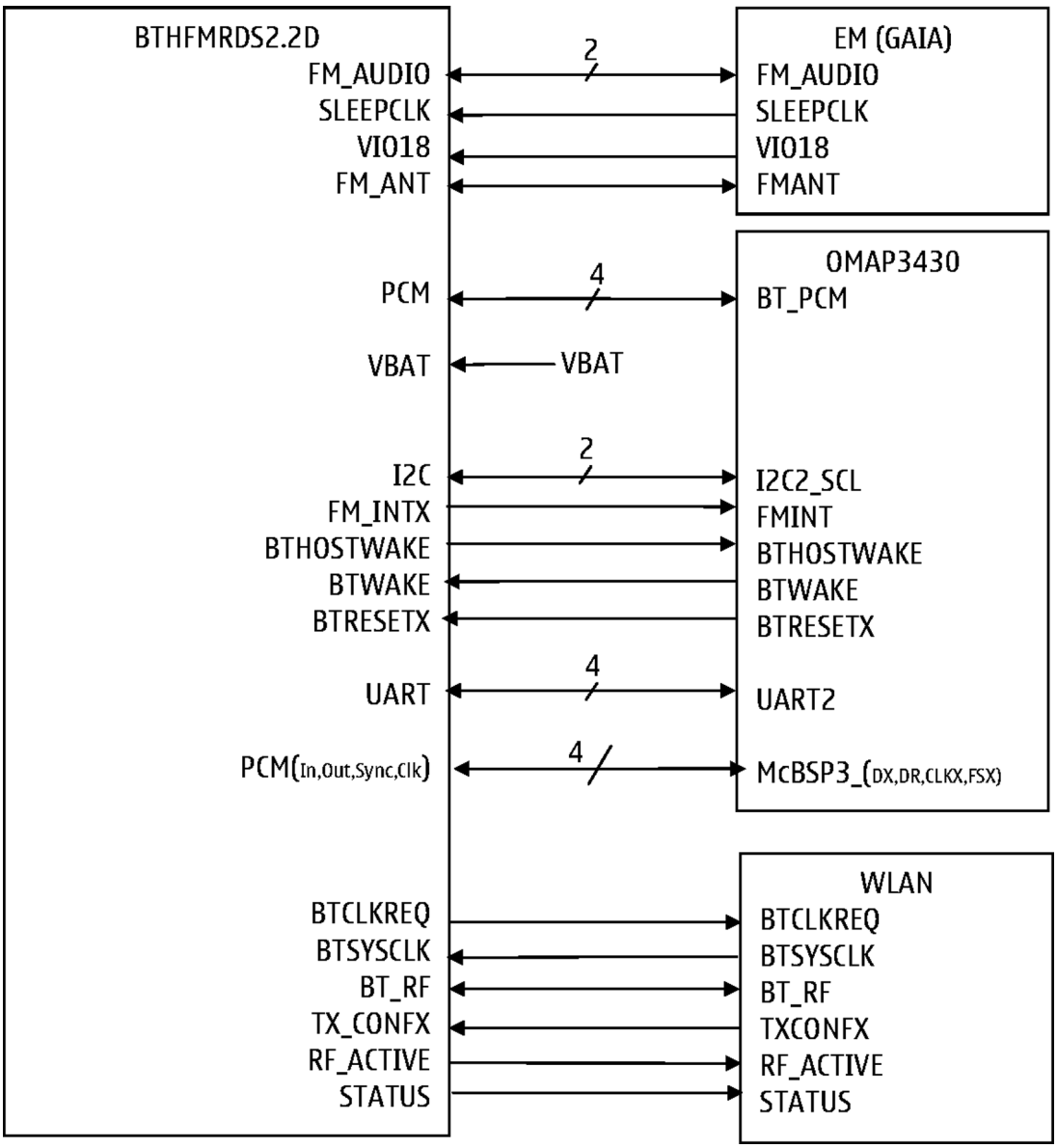


Figure 52 Bluetooth and FM radio block diagram

GPS module

RX-51 supports GPSCost4.0 release. GPS module is connected to cellular engine via I2C interface and GenIO control signals. GPS clock configuration includes dedicated GPS TCXO and reference clock from Vapaus.

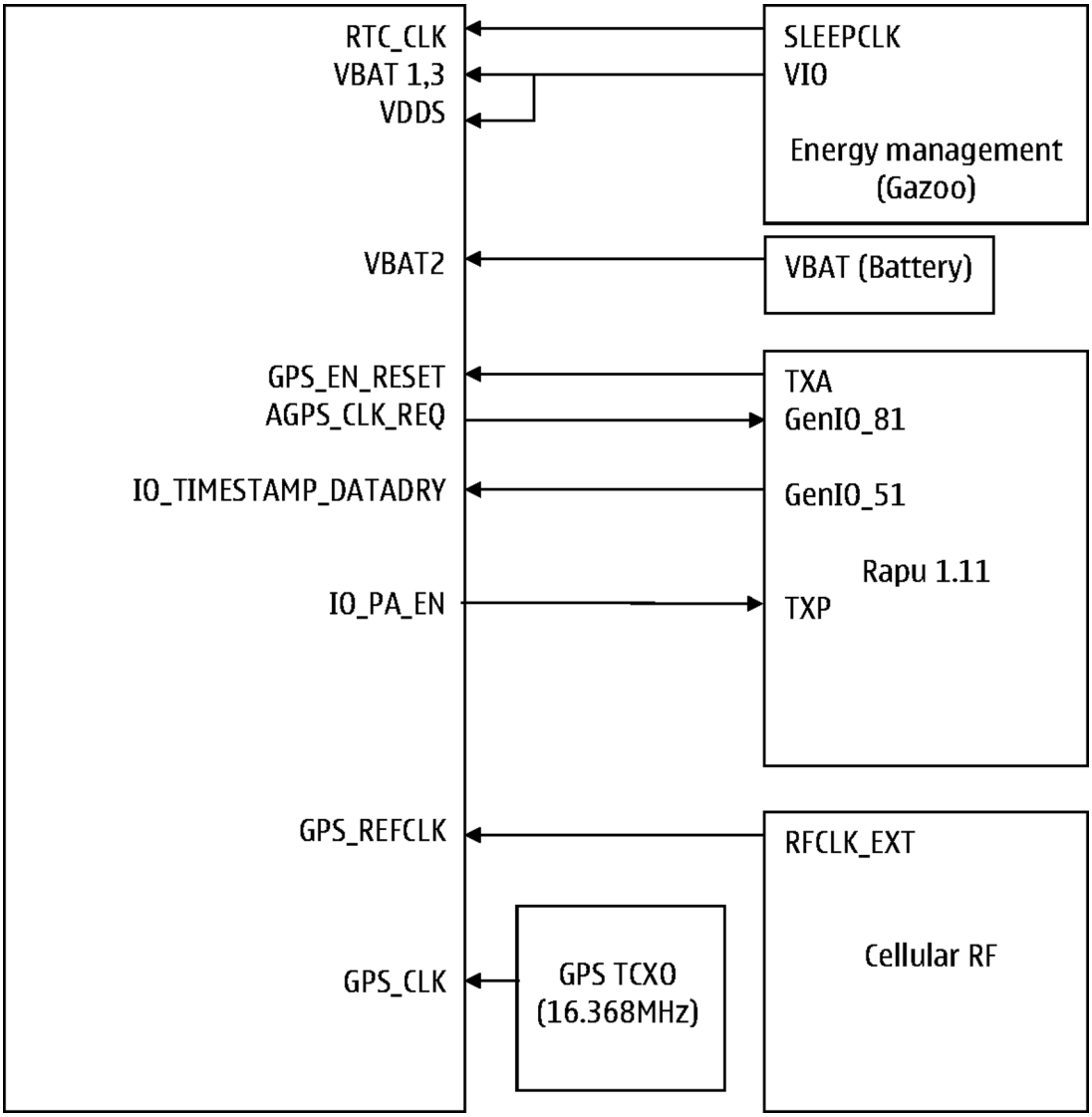


Figure 53 GPS module block diagram

WLAN module

WLAN module of RX-51 supports WLANSize4.0 release. WLAN module is configured as OMAP engine SPI slave. WLAN and Bluetooth co-existence is supported via BTH-WLAN interface. WLANSize4.0 has a reference clock of external oscillator 38.4MHz and it is shared with Bluetooth.

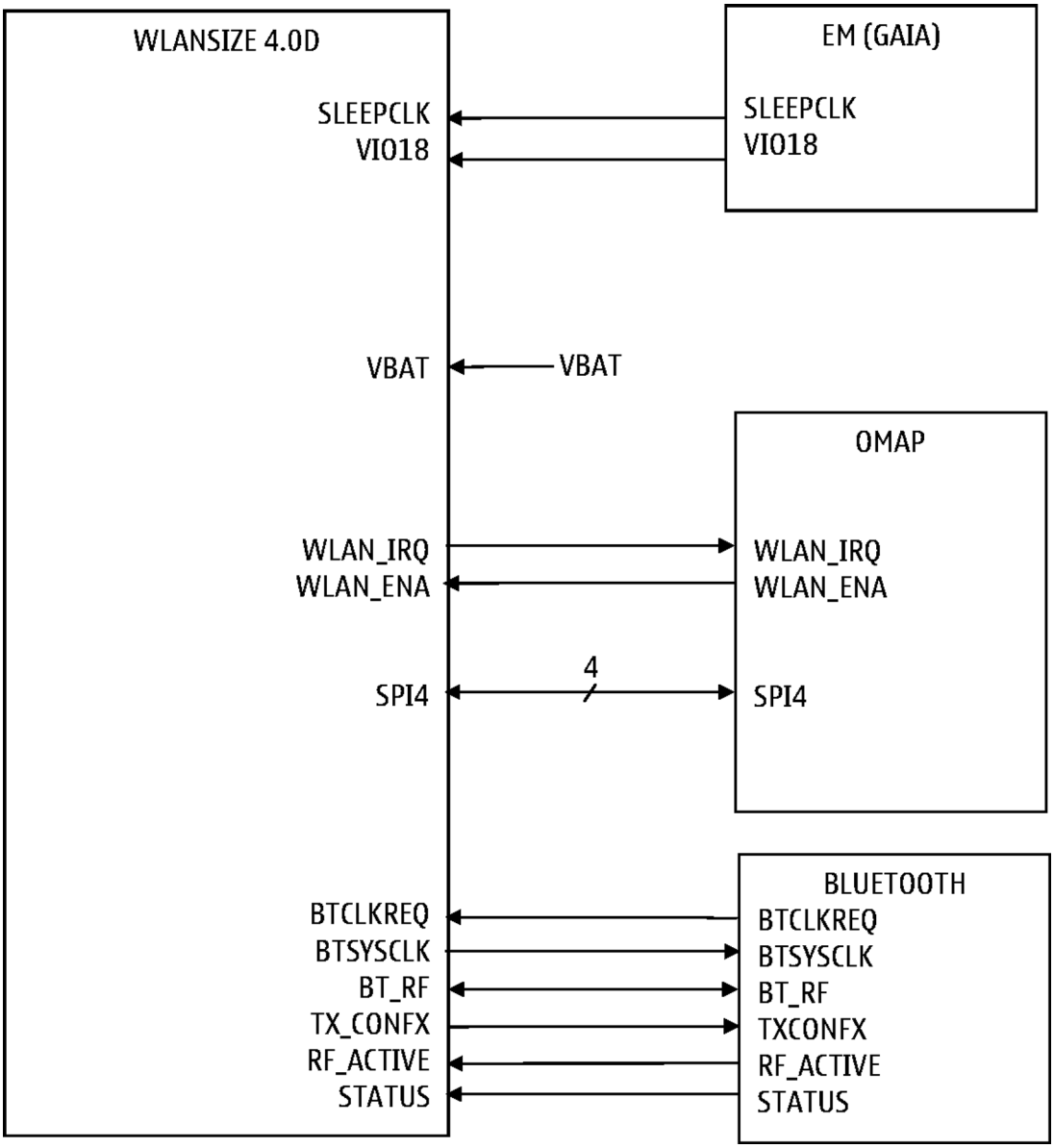


Figure 54 WLAN module block diagram

FM transmitter module

The FM transmitter module Si4713 is controlled by I2C from OMAP with left and right analog audio input from the audio circuitry.

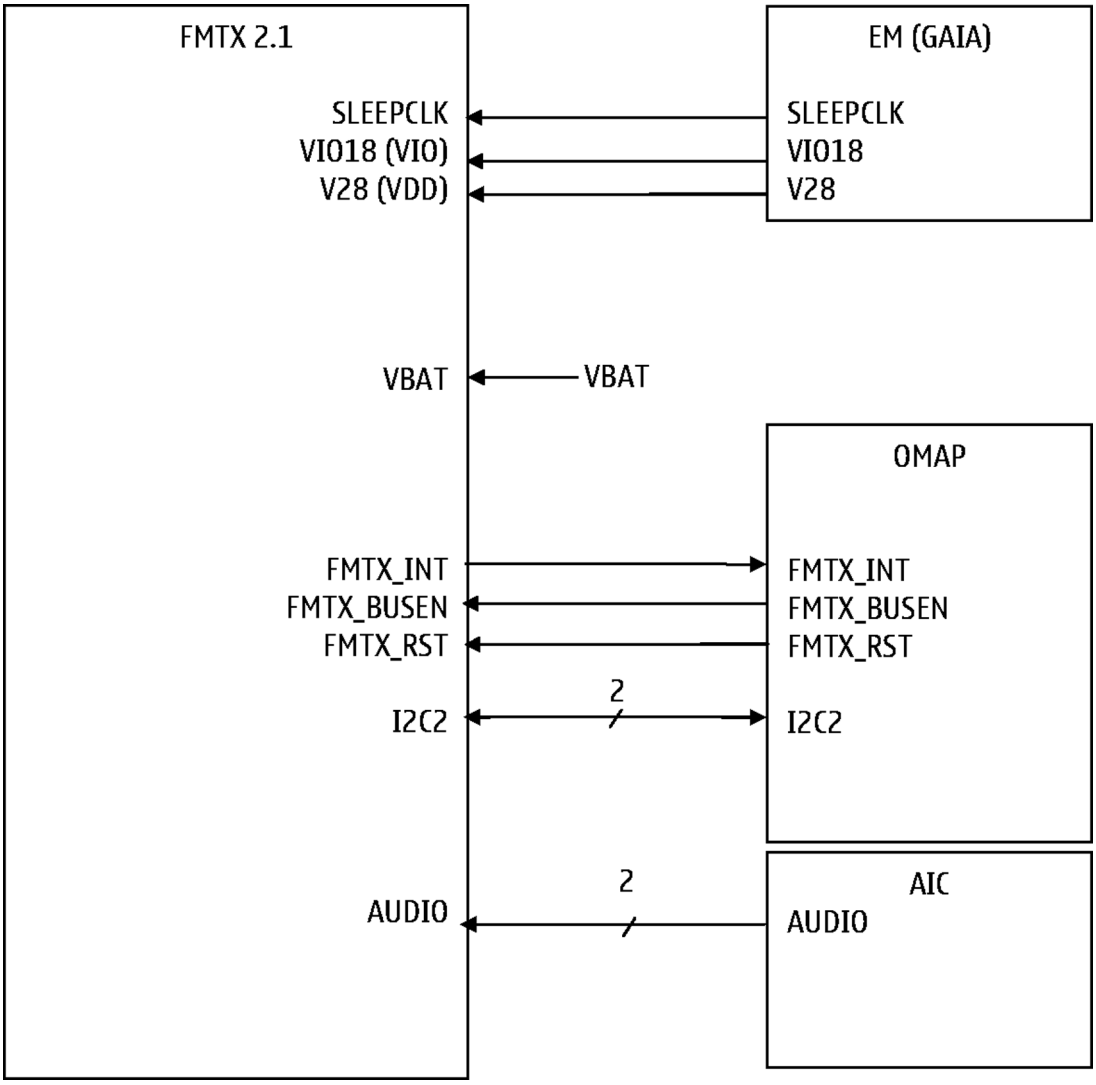


Figure 55 FM transmitter

High-speed USB

High-speed USB

The device can transmit and receive USB data at high-speed (480 Mbit/s), full-speed (12 Mbit/s) and low-speed (1.5Mbit/s). The external interface is the micro-B connector X5300. The interface between USB transceiver and micro-B receptacle is the standard USB interface specified in the Universal Serial Bus specification Rev. 2.0. The interface from the transceiver to OMAP is standard ULPI interface.

Memory card interfaces

There are two memory card interfaces. One for internal mass memory called eMMC and one for hot swappable microSD card. Both are standard MMC/SD interfaces. Both interfaces use 48 MHz clock. MicroSD uses 4 datalines and eMMC uses 8 datalines.

Both cards are protected against sudden battery removal with a magnetic sensor that recognizes the removal of battery cover. When the battery cover is removed, the sensor sends an interrupt to OMAP and both memory cards are powered down. This also enables hot swapping for microSD card.

I2C buses

There are 4 I2C-buses in the APE side. Two I2C-buses are reserved for communication between OMAP and its EM ASIC. The other two are used to control different peripheral devices.

Table 15 I2C bus configurations

Component	I2C bus	Comment
TWL5030	I2C_1	Gaia
BQ27200	I2C_2	Current Gauge
BQ24150	I2C_2	USB charging
ADP1653	I2C_2	Camera Flash
Acme Lite	I2C_2	Camera B
LP5523	I2C_2	LED driver
SI4713	I2C_2	FM TX
TSL2563	I2C_2	Ambient light sensor
AIC34	I2C_2	Audio codec
TPA6130	I2C_2	Headphone PA
FM_RX	I2C_3	FM RX
BCM2048	I2C_3	Accelerometer
Stingray 5Mpix Camera	I2C_3	Main camera

User interface

Display module

The display is a 3.5” 800 x 480 transflective LTPS LCD display which supports 16 million colours. The display interface is a differential serial interface called CDP. It has a differential clock and two differential data lines. It uses LoSSi as a control interface. The display has two operating modes. Normal and a sleep mode. The display module is connected to the main flex with a board-to-board connector. The display is backlit with 6 LEDs and a separate backlight driver is used to power the LEDs as two series of 3.

The display also has content adaptive backlight control. It means that backlight can be increased or decreased from a wanted value based on the content on the screen thus saving in power consumption.

Touch screen

The main input method for the user interface is a resistive touch screen. The touch screen is connected with a flex connector to the display module flex. There are 4 lines coming from the touch window, two for X-axis and two for Y-axis to the touch screen controller which converts the analog voltages from the touch screen to digital values that are then interpreted as coordinates on the screen by SW. The touch screen controller is connected to OMAP via standard SPI interface.

Keyboard

The main text input method is a 3-row qwerty keyboard. Keyboad is wired to Gaia’s keyboard matrix as rows and columns. While pressing a key a certain row and column are activated and SW then interprets that as the key that is marked on the keyboard.

There are also a few keys/switches that are not in the keyboard matrix but are instead connected to OMAP's GPIO pins. These are side keys that are volume/zoom keys and dual action camera key, where the first stage is used for auto focus function and when the key is pressed completely it acts as a shutter key.

Cameras

RX-51 camera concept has two cameras. A 5 megapixel main camera for still and video imaging and a VGA resolution front camera for video calls. Both cameras use dedicated CCP2 differential camera interface. OMAP has only one CCP2 port so the CCP-lines are multiplexed with switches.

The device has also a camera flash located directly beside the main camera, providing better image quality in darker environments. The flash has a built-in red indicator that is used as a privacy indicator. The red led is lit during video recording and it is also used to indicate image capture with the main camera.

Illumination

The Qwerty keyboard is backlit with 6 LEDs. The power supply for the LEDs is called Lysti which is a 9-channel LED controller. It also controls and supplies the RGB LED in the upper block. It can control all 9-channels individually.

Sensors

The device has several sensors.

Battery cover sensor

Battery cover sensor is a hall sensor that recognizes magnet that is inside the battery cover. It is used to protect memory cards from battery removal. It also enables hot swapping of the memory card.

Slide sensor

Slide sensor is an MR sensor which also uses magnets for state switching. In this device it is used to detect the slide movement that reveals the qwerty keyboard.

Camera door sensor

Camera door has an optical sensor that detects when it is opened. It is used to automatically open the camera application when the main camera is revealed. Its operation is based on detecting the reflecting IR light from its transmitter to its receiver.

Proximity sensor

Proximity sensor is basically the same kind of optical sensor as the camera door sensor but its operating range is slightly longer. It is used to lock the touch screen when the device is near the head during phone calls so that there are no accidental touch interactions from the cheek etc.

Accelerometer

The device also employs a 3D-accelerometer that can detect acceleration on all 3 axis. It is used for example to detect the device's position when images are taken with camera or to turn the UI with certain applications.

Ambient light sensor (ALS)

Ambient light sensor is used to detect surrounding light levels. Its readings are used to adjust keyboard light and display backlight levels. So in bright surroundings the keyboard is turned off and display is made brighter for better readability, and in dark the display is dimmed and keyboard lights are turned on.

TV-out interface

This device has an analog composite TV-out feature. TV-out signal is received straight from the OMAP's dedicated TV-out output. It is then routed via a switch to an AV-connector. There it can be transferred to the TV with a composite cable with a 3.5 mm plug.

Consumer infrared transmitter (CIR)

The device also has an infrared transmitter that can be used as a remote control. It is made by using a high power IR LED. Transmissions are made with GPIO that is modulated with the right frequency.

Audio concept

Audio HW architecture

The device audio hardware is built around AIC34 audio codec. AIC34 contains two individual audio codecs which are improved versions of AIC33 codec. AIC34 codec partitions are named A and B, which are referenced in this document as AIC34_A and AIC34_B. OMAP is connected to AIC34_A. AIC34_B is used to amplify earpiece signal and to provide bias voltage for AV-interface microphone. There are no digital or analog audio connections inside AIC34 between partitions A and B, so the partitions are connected using external signal routing.

The top level audio architecture and audio hardware block diagrams are presented in the figures below.

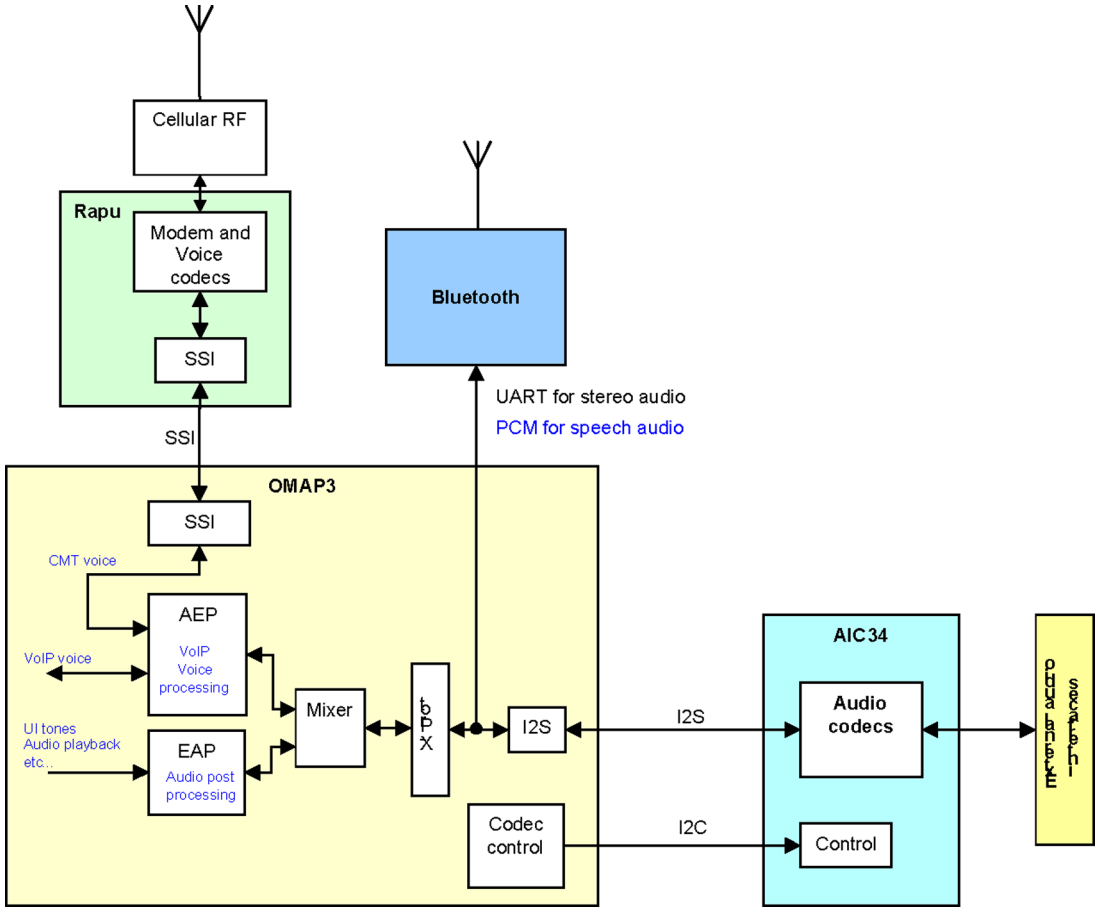


Figure 56 Top level audio architecture

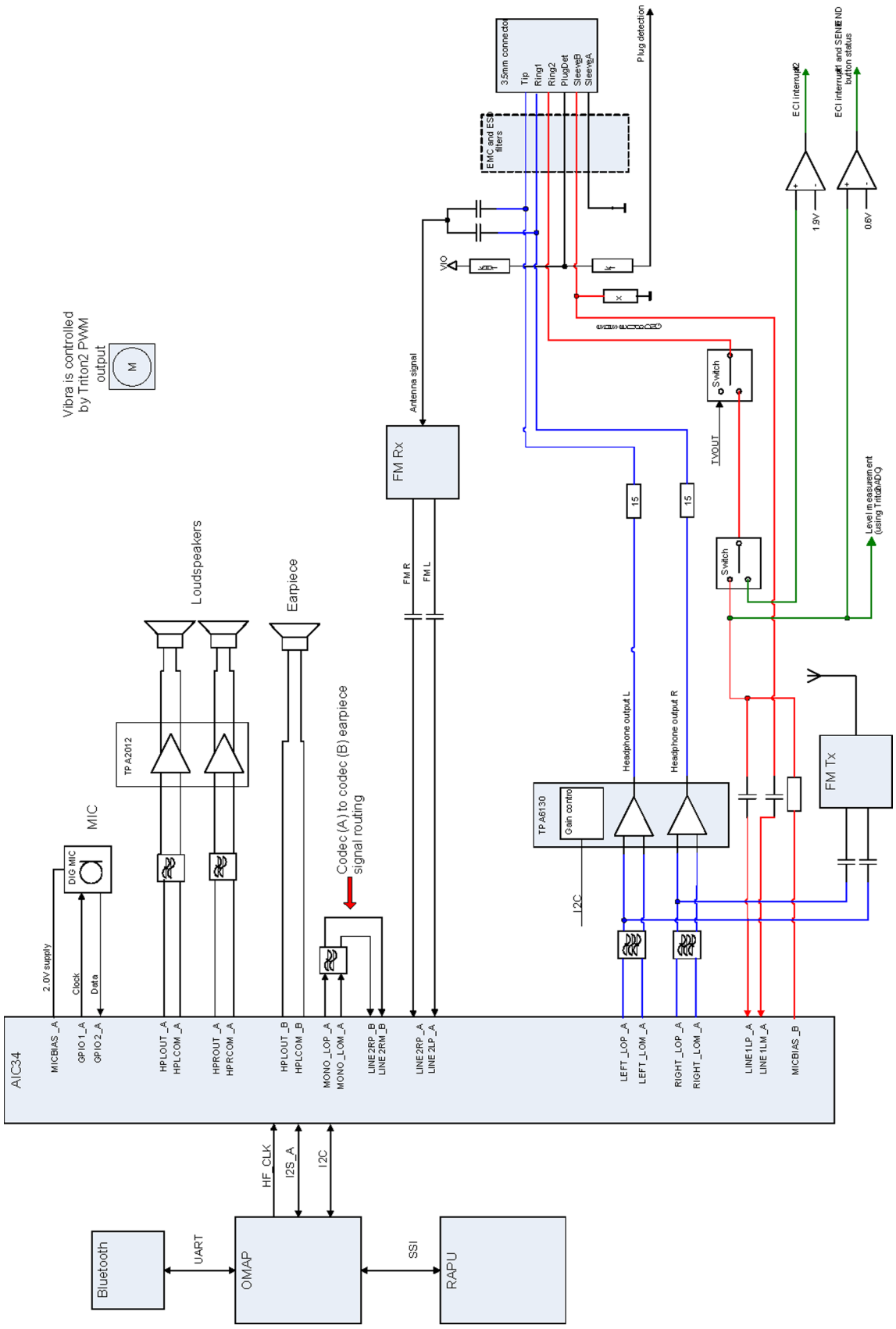


Figure 57 Audio HW block diagram

Cellular RF technical description

RF block diagram

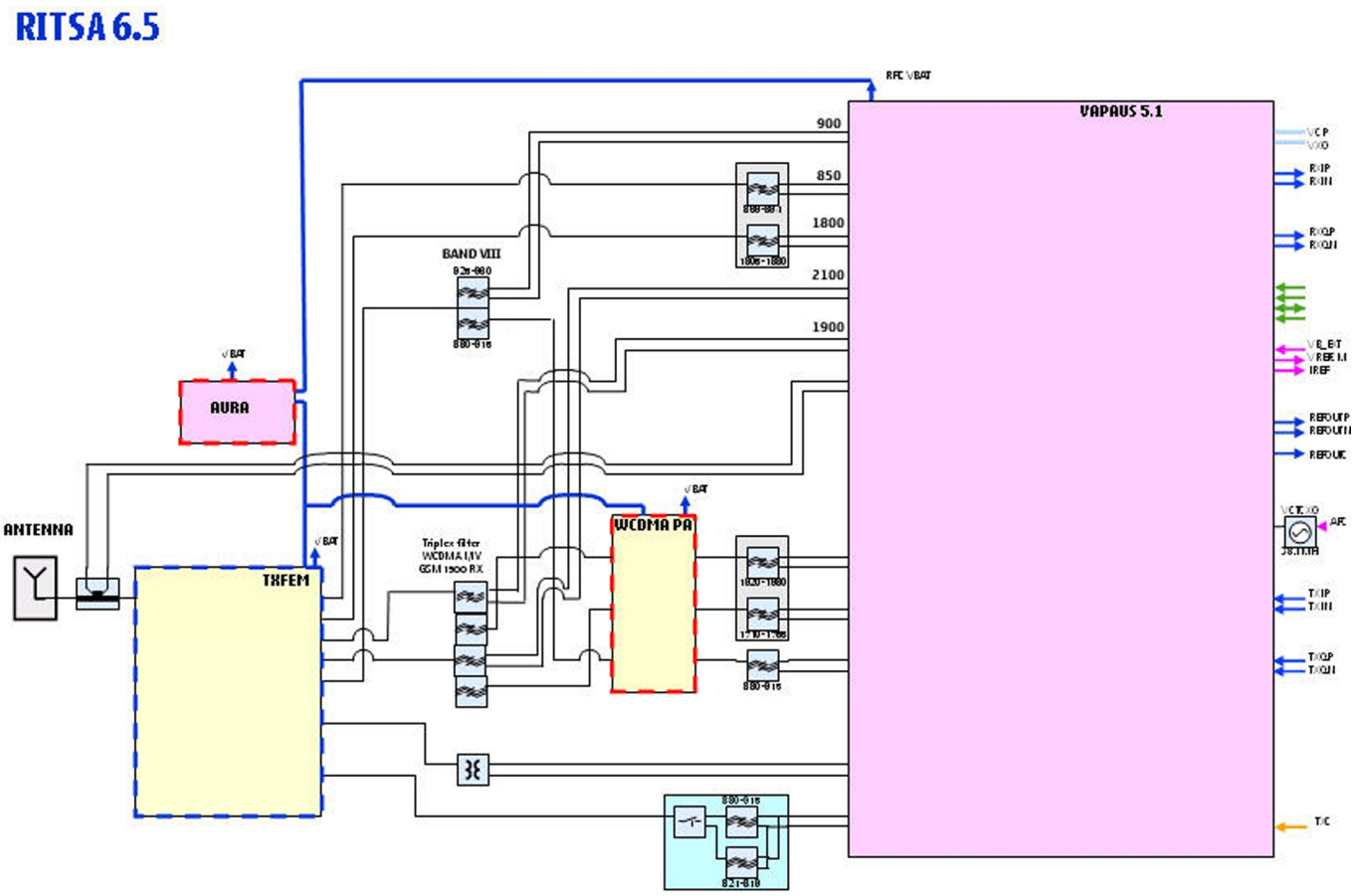


Figure 58 Cellular RF block diagram RX-51 using RF ASIC N7500

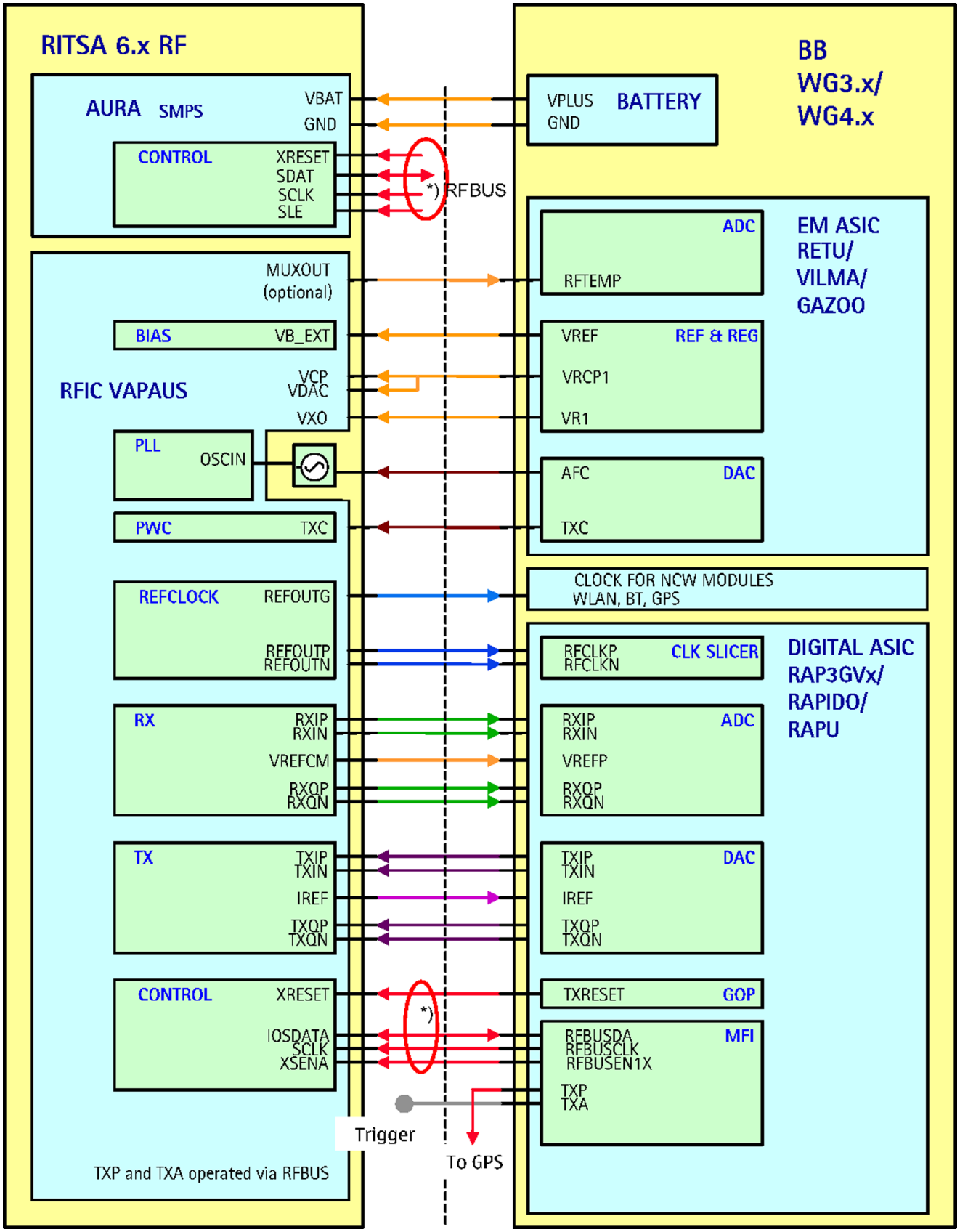


Figure 59 Cellular RF-BB interface

The RF block diagram uses RF ASIC N7500 that performs the RF back-end functions of receive and transmit function of the cellular transceiver.

Receiver (RX)

An analogue signal is received by the phone's antenna. The signal is converted to a digital signal and is then transferred further to the baseband (eg. to the earpiece).

The receiver functions are implemented in the RF ASIC.

Signals with different frequencies take different paths, therefore being handled by different components. The principle of GSM and WCDMA is the same.

Transmitter (TX)

The digital baseband signal (eg. from the microphone) is converted to an analogue signal, which is then amplified and transmitted from the antenna. The frequency of this signal can be tuned to match the bandwith of the system in use (eg. GSM900).

The transmitter functions are implemented in the RF ASIC.

Even though the GSM and WCDMA signals are sent via different components, the principles of the transmission is the same.

Frequency mappings

GSM850 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
128	824.2	869.2	3296.8	3476.8	170	832.6	877.6	3330.4	3510.4	212	841.0	886.0	3364.0	3544.0
129	824.4	869.4	3297.6	3477.6	171	832.8	877.8	3331.2	3511.2	213	841.2	886.2	3364.8	3544.8
130	824.6	869.6	3298.4	3478.4	172	833.0	878.0	3332.0	3512.0	214	841.4	886.4	3365.6	3545.6
131	824.8	869.8	3299.2	3479.2	173	833.2	878.2	3332.8	3512.8	215	841.6	886.6	3366.4	3546.4
132	825.0	870.0	3300.0	3480.0	174	833.4	878.4	3333.6	3513.6	216	841.8	886.8	3367.2	3547.2
133	825.2	870.2	3300.8	3480.8	175	833.6	878.6	3334.4	3514.4	217	842.0	887.0	3368.0	3548.0
134	825.4	870.4	3301.6	3481.6	176	833.8	878.8	3335.2	3515.2	218	842.2	887.2	3368.8	3548.8
135	825.6	870.6	3302.4	3482.4	177	834.0	879.0	3336.0	3516.0	219	842.4	887.4	3369.6	3549.6
136	825.8	870.8	3303.2	3483.2	178	834.2	879.2	3336.8	3516.8	220	842.6	887.6	3370.4	3550.4
137	826.0	871.0	3304.0	3484.0	179	834.4	879.4	3337.6	3517.6	221	842.8	887.8	3371.2	3551.2
138	826.2	871.2	3304.8	3484.8	180	834.6	879.6	3338.4	3518.4	222	843.0	888.0	3372.0	3552.0
139	826.4	871.4	3305.6	3485.6	181	834.8	879.8	3339.2	3519.2	223	843.2	888.2	3372.8	3552.8
140	826.6	871.6	3306.4	3486.4	182	835.0	880.0	3340.0	3520.0	224	843.4	888.4	3373.6	3553.6
141	826.8	871.8	3307.2	3487.2	183	835.2	880.2	3340.8	3520.8	225	843.6	888.6	3374.4	3554.4
142	827.0	872.0	3308.0	3488.0	184	835.4	880.4	3341.6	3521.6	226	843.8	888.8	3375.2	3555.2
143	827.2	872.2	3308.8	3488.8	185	835.6	880.6	3342.4	3522.4	227	844.0	889.0	3376.0	3556.0
144	827.4	872.4	3309.6	3489.6	186	835.8	880.8	3343.2	3523.2	228	844.2	889.2	3376.8	3556.8
145	827.6	872.6	3310.4	3490.4	187	836.0	881.0	3344.0	3524.0	229	844.4	889.4	3377.6	3557.6
146	827.8	872.8	3311.2	3491.2	188	836.2	881.2	3344.8	3524.8	230	844.6	889.6	3378.4	3558.4
147	828.0	873.0	3312.0	3492.0	189	836.4	881.4	3345.6	3525.6	231	844.8	889.8	3379.2	3559.2
148	828.2	873.2	3312.8	3492.8	190	836.6	881.6	3346.4	3526.4	232	845.0	890.0	3380.0	3560.0
149	828.4	873.4	3313.6	3493.6	191	836.8	881.8	3347.2	3527.2	233	845.2	890.2	3380.8	3560.8
150	828.6	873.6	3314.4	3494.4	192	837.0	882.0	3348.0	3528.0	234	845.4	890.4	3381.6	3561.6
151	828.8	873.8	3315.2	3495.2	193	837.2	882.2	3348.8	3528.8	235	845.6	890.6	3382.4	3562.4
152	829.0	874.0	3316.0	3496.0	194	837.4	882.4	3349.6	3529.6	236	845.8	890.8	3383.2	3563.2
153	829.2	874.2	3316.8	3496.8	195	837.6	882.6	3350.4	3530.4	237	846.0	891.0	3384.0	3564.0
154	829.4	874.4	3317.6	3497.6	196	837.8	882.8	3351.2	3531.2	238	846.2	891.2	3384.8	3564.8
155	829.6	874.6	3318.4	3498.4	197	838.0	883.0	3352.0	3532.0	239	846.4	891.4	3385.6	3565.6
156	829.8	874.8	3319.2	3499.2	198	838.2	883.2	3352.8	3532.8	240	846.6	891.6	3386.4	3566.4
157	830.0	875.0	3320.0	3500.0	199	838.4	883.4	3353.6	3533.6	241	846.8	891.8	3387.2	3567.2
158	830.2	875.2	3320.8	3500.8	200	838.6	883.6	3354.4	3534.4	242	847.0	892.0	3388.0	3568.0
159	830.4	875.4	3321.6	3501.6	201	838.8	883.8	3355.2	3535.2	243	847.2	892.2	3388.8	3568.8
160	830.6	875.6	3322.4	3502.4	202	839.0	884.0	3356.0	3536.0	244	847.4	892.4	3389.6	3569.6
161	830.8	875.8	3323.2	3503.2	203	839.2	884.2	3356.8	3536.8	245	847.6	892.6	3390.4	3570.4
162	831.0	876.0	3324.0	3504.0	204	839.4	884.4	3357.6	3537.6	246	847.8	892.8	3391.2	3571.2
163	831.2	876.2	3324.8	3504.8	205	839.6	884.6	3358.4	3538.4	247	848.0	893.0	3392.0	3572.0
164	831.4	876.4	3325.6	3505.6	206	839.8	884.8	3359.2	3539.2	248	848.2	893.2	3392.8	3572.8
165	831.6	876.6	3326.4	3506.4	207	840.0	885.0	3360.0	3540.0	249	848.4	893.4	3393.6	3573.6
166	831.8	876.8	3327.2	3507.2	208	840.2	885.2	3360.8	3540.8	250	848.6	893.6	3394.4	3574.4
167	832.0	877.0	3328.0	3508.0	209	840.4	885.4	3361.6	3541.6	251	848.8	893.8	3395.2	3575.2

EGSM900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3714,4	18	893,6	938,6	3574,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3715,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3716,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3717,6	22	894,4	939,4	3577,6	3757,6	84	906,8	951,8	3627,2	3807,2
997	884,6	929,6	3538,4	3718,4	23	894,6	939,6	3578,4	3758,4	85	907,0	952,0	3628,0	3808,0
998	884,8	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	86	907,2	952,2	3628,8	3808,8
999	885,0	930,0	3540,0	3720,0	25	895,0	940,0	3580,0	3760,0	87	907,4	952,4	3629,6	3809,6
1000	885,2	930,2	3540,8	3720,8	26	895,2	940,2	3580,8	3760,8	88	907,6	952,6	3630,4	3810,4
1001	885,4	930,4	3541,6	3721,6	27	895,4	940,4	3581,6	3761,6	89	907,8	952,8	3631,2	3811,2
1002	885,6	930,6	3542,4	3722,4	28	895,6	940,6	3582,4	3762,4	90	908,0	953,0	3632,0	3812,0
1003	885,8	930,8	3543,2	3723,2	29	895,8	940,8	3583,2	3763,2	91	908,2	953,2	3632,8	3812,8
1004	886,0	931,0	3544,0	3724,0	30	896,0	941,0	3584,0	3764,0	92	908,4	953,4	3633,6	3813,6
1005	886,2	931,2	3544,8	3724,8	31	896,2	941,2	3584,8	3764,8	93	908,6	953,6	3634,4	3814,4
1006	886,4	931,4	3545,6	3725,6	32	896,4	941,4	3585,6	3765,6	94	908,8	953,8	3635,2	3815,2
1007	886,6	931,6	3546,4	3726,4	33	896,6	941,6	3586,4	3766,4	95	909,0	954,0	3636,0	3816,0
1008	886,8	931,8	3547,2	3727,2	34	896,8	941,8	3587,2	3767,2	96	909,2	954,2	3636,8	3816,8
1009	887,0	932,0	3548,0	3728,0	35	897,0	942,0	3588,0	3768,0	97	909,4	954,4	3637,6	3817,6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3600,8	3780,8	113	912,6	957,6	3650,4	3830,4
					52	900,4	945,4	3601,6	3781,6	114	912,8	957,8	3651,2	3831,2
					53	900,6	945,6	3602,4	3782,4	115	913,0	958,0	3652,0	3832,0
					54	900,8	945,8	3603,2	3783,2	116	913,2	958,2	3652,8	3832,8
					55	901,0	946,0	3604,0	3784,0	117	913,4	958,4	3653,6	3833,6
					56	901,2	946,2	3604,8	3784,8	118	913,6	958,6	3654,4	3834,4
					57	901,4	946,4	3605,6	3785,6	119	913,8	958,8	3655,2	3835,2
					58	901,6	946,6	3606,4	3786,4	120	914,0	959,0	3656,0	3836,0
					59	901,8	946,8	3607,2	3787,2	121	914,2	959,2	3656,8	3836,8
					60	902,0	947,0	3608,0	3788,0	122	914,4	959,4	3657,6	3837,6
					61	902,2	947,2	3608,8	3788,8	123	914,6	959,6	3658,4	3838,4
					62	902,4	947,4	3609,6	3789,6	124	914,8	959,8	3659,2	3839,2

GSM1800 frequencies

Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	793	1766.4	1861.4	3532.8	3722.8
513	1710.4	1805.4	3420.8	3610.8	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	794	1766.6	1861.6	3533.2	3723.2
514	1710.6	1805.6	3421.2	3611.2	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	795	1766.8	1861.8	3533.6	3723.6
515	1710.8	1805.8	3421.6	3611.6	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	796	1767.0	1862.0	3534.0	3724.0
516	1711.0	1806.0	3422.0	3612.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	797	1767.2	1862.2	3534.4	3724.4
517	1711.2	1806.2	3422.4	3612.4	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	798	1767.4	1862.4	3534.8	3724.8
518	1711.4	1806.4	3422.8	3612.8	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	799	1767.6	1862.6	3535.2	3725.2
519	1711.6	1806.6	3423.2	3613.2	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	800	1767.8	1862.8	3535.6	3725.6
520	1711.8	1806.8	3423.6	3613.6	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	801	1768.0	1863.0	3536.0	3726.0
521	1712.0	1807.0	3424.0	3614.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	802	1768.2	1863.2	3536.4	3726.4
522	1712.2	1807.2	3424.4	3614.4	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	803	1768.4	1863.4	3536.8	3726.8
523	1712.4	1807.4	3424.8	3614.8	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	804	1768.6	1863.6	3537.2	3727.2
524	1712.6	1807.6	3425.2	3615.2	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	805	1768.8	1863.8	3537.6	3727.6
525	1712.8	1807.8	3425.6	3615.6	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	806	1769.0	1864.0	3538.0	3728.0
526	1713.0	1808.0	3426.0	3616.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	807	1769.2	1864.2	3538.4	3728.4
527	1713.2	1808.2	3426.4	3616.4	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	808	1769.4	1864.4	3538.8	3728.8
528	1713.4	1808.4	3426.8	3616.8	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	809	1769.6	1864.6	3539.2	3729.2
529	1713.6	1808.6	3427.2	3617.2	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	810	1769.8	1864.8	3539.6	3729.6
530	1713.8	1808.8	3427.6	3617.6	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	811	1770.0	1865.0	3540.0	3730.0
531	1714.0	1809.0	3428.0	3618.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	812	1770.2	1865.2	3540.4	3730.4
532	1714.2	1809.2	3428.4	3618.4	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	813	1770.4	1865.4	3540.8	3730.8
533	1714.4	1809.4	3428.8	3618.8	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	814	1770.6	1865.6	3541.2	3731.2
534	1714.6	1809.6	3429.2	3619.2	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	815	1770.8	1865.8	3541.6	3731.6
535	1714.8	1809.8	3429.6	3619.6	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	816	1771.0	1866.0	3542.0	3732.0
536	1715.0	1810.0	3430.0	3620.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	817	1771.2	1866.2	3542.4	3732.4
537	1715.2	1810.2	3430.4	3620.4	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	818	1771.4	1866.4	3542.8	3732.8
538	1715.4	1810.4	3430.8	3620.8	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	819	1771.6	1866.6	3543.2	3733.2
539	1715.6	1810.6	3431.2	3621.2	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	820	1771.8	1866.8	3543.6	3733.6
540	1715.8	1810.8	3431.6	3621.6	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	821	1772.0	1867.0	3544.0	3734.0
541	1716.0	1811.0	3432.0	3622.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	822	1772.2	1867.2	3544.4	3734.4
542	1716.2	1811.2	3432.4	3622.4	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	823	1772.4	1867.4	3544.8	3734.8
543	1716.4	1811.4	3432.8	3622.8	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	824	1772.6	1867.6	3545.2	3735.2
544	1716.6	1811.6	3433.2	3623.2	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	825	1772.8	1867.8	3545.6	3735.6
545	1716.8	1811.8	3433.6	3623.6	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	826	1773.0	1868.0	3546.0	3736.0
546	1717.0	1812.0	3434.0	3624.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	827	1773.2	1868.2	3546.4	3736.4
547	1717.2	1812.2	3434.4	3624.4	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	828	1773.4	1868.4	3546.8	3736.8
548	1717.4	1812.4	3434.8	3624.8	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	829	1773.6	1868.6	3547.2	3737.2
549	1717.6	1812.6	3435.2	3625.2	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	830	1773.8	1868.8	3547.6	3737.6
550	1717.8	1812.8	3435.6	3625.6	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	831	1774.0	1869.0	3548.0	3738.0
551	1718.0	1813.0	3436.0	3626.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	832	1774.2	1869.2	3548.4	3738.4
552	1718.2	1813.2	3436.4	3626.4	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	833	1774.4	1869.4	3548.8	3738.8
553	1718.4	1813.4	3436.8	3626.8	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	834	1774.6	1869.6	3549.2	3739.2
554	1718.6	1813.6	3437.2	3627.2	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	835	1774.8	1869.8	3549.6	3739.6
555	1718.8	1813.8	3437.6	3627.6	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	836	1775.0	1870.0	3550.0	3740.0
556	1719.0	1814.0	3438.0	3628.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	837	1775.2	1870.2	3550.4	3740.4
557	1719.2	1814.2	3438.4	3628.4	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	838	1775.4	1870.4	3550.8	3740.8
558	1719.4	1814.4	3438.8	3628.8	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	839	1775.6	1870.6	3551.2	3741.2
559	1719.6	1814.6	3439.2	3629.2	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	840	1775.8	1870.8	3551.6	3741.6
560	1719.8	1814.8	3439.6	3629.6	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	841	1776.0	1871.0	3552.0	3742.0
561	1720.0	1815.0	3440.0	3630.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	842	1776.2	1871.2	3552.4	3742.4
562	1720.2	1815.2	3440.4	3630.4	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	843	1776.4	1871.4	3552.8	3742.8
563	1720.4	1815.4	3440.8	3630.8	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	844	1776.6	1871.6	3553.2	3743.2
564	1720.6	1815.6	3441.2	3631.2	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	845	1776.8	1871.8	3553.6	3743.6
565	1720.8	1815.8	3441.6	3631.6	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	846	1777.0	1872.0	3554.0	3744.0
566	1721.0	1816.0	3442.0	3632.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	847	1777.2	1872.2	3554.4	3744.4
567	1721.2	1816.2	3442.4	3632.4	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	848	1777.4	1872.4	3554.8	3744.8
568	1721.4	1816.4	3442.8	3632.8	662	1740.2	1835.2	3480.4	3670.4	756	1759.0	1854.0	3518.0	3708.0	849	1777.6	1872.6	3555.2	3745.2
569	1721.6	1816.6	3443.2	3633.2	663	1740.4	1835.4	3480.8	3670.8	757	1759.2	1854.2	3518.4	3708.4	850	1777.8	1872.8	3555.6	3745.6
570	1721.8	1816.8	3443.6	3633.6	664	1740.6	1835.6	3481.2	3671.2	758	1759.4	1854.4	3518.8	3708.8	851	1778.0	1873.0	3556.0	3746.0
571	1722.0	1817.0	3444.0	3634.0	665	1740.8	1835.8	3481.6	3671.6	759	1759.6	1854.6	3519.2	3709.2	852	1778.2	1873.2	3556.4	3746.4
572	1722.2	1817.2	3444.4	3634.4	666	1741.0	1836.0	3482.0	3672.0	760	1759.8	1854.8	3519.6	3709.6	853	1778.4	1873.4	3556.8	3746.8
573	1722.4	1817.4	3444.8	3634.8	667	1741.2	1836.2	3482.4	3672.4	761	1760.0	1855.0	3520.0	3710.0	854	1778.6	1873.6	3557.2	3747.2
574	1722.6	1817.6	3445.2	3635.2	668	1741.4	1836.4	3482.8	3672.8	762	1760.2	1855.2	3520.4	3710.4	855	1778.8	1873.8	3557.6	3747.6
575	1722.8	1817.8	3445.6	3635.6	669	1741.6	1836.6	3483.2	3673.2	763	1760.4	1855.4	3520.8	3710.8	856	1779.0	1874.0	3558.0	3748.0
576	1723.0	1818.0	3446.0	3636.0	670	1741.8	1836.8	3483.6	3673.6	764	1760.6	1855.6	3521.2	3711.2	857	1779.2	1874.2	3558.4	3748.4
577	1723.2	1818.2	3446.4	3636.4	671	1742.0	1837.0	3484.0	3674.0	765	1760.8	1855.8	3521.6	3711.6	858	1779.4	1874.4	3558.8	3748.8
578	1723.4	1818.4	3446.8	3636.8	672	1742.2	1837.2	3484.4	3674.4	766	1761.0	1856.0	3522.0	3712.0	859	1779.6	1874.6	3559.2	3749.2
579	1723.6	1818.6	3447.2	3637.2	673	1742.4	1837.4	3484.8	3674.8	767	1761.2	1856.2	3522.4	3712.4	860	1779.8	1874.8	3559.6	3749.6
580	1723.8	1818.8	3447.6	3637.6	674	1742.6	1837.6	3485.2	3675.2	768	1761.4	1856.4	3522.8	3712.8	861	1780.0	1875.0	3560.0	3750.0
581	1724.0	1819.0	3448.0	3638.0	675	1742.8	1837.8	3485.6	3675.6	769	1761.6	1856.6	3523.2	3713.2	862	1780.2	1875.2	3560.4	3750.4
582	1724.2	1819.2	3448.4	3638.4	676	1743.0	1838.0	3486.0	3676.0	770	1761.8	1856.8	3523.6	3713.6	863	1780.4	1875.4	3560.8	3750.8
583	1724.4	1819.4	3448.8	3638.8	677	1743.2	1838.2	3486.4	3676.4	771	1762.0	1857.0	3524.0	3714.0	864	1780.6	1875.6	3561.2	3751.2
584	1724.6	1819.6	3449.2	3639.2	678	1743.4	1838.4	3486.8	3676.8	772	1762.2	1857.2	3524.4	3714.4	865	1780.8	1875.8	3561.6	3751.6
585	1724.8	1819.8	3449.6	3639.6	679	1743.6	1838.6	3487.2	3677.2	773	1762.4	1857.4	3524.8	3714.8	866	1781.0	1876.0	3562.0	3752.0
586	1725.0	1820.0	3450.0	3640.0	680	1743.8	1838.8	3487.6	3677.6	774	1762.6	1857.6	3525.2	3715.2	867	1781.2	1876.2	3562.4	3752.4
587	1725.2	1820.2	3450.4	3640.4	681	1744.0	1839.0	3488.0	3678.0	775	1762.8	1857.8	3525.6	3715.6	868	1781.4	1876.4	3562.8	3752.8
588	1725.4	1820.4	3450.8	3640.8	682	1744.2	1839.2	3488.4	3678.4	776	1763.0	1858.0	3526.0	3716.0	869	1781.6	1876.6	3563.2	3753.2
589	1725.6	1820.6	3451.2	3641.2	683	1744.4	1839.4	3488.8	3678.8	777	1763.2	1858.2	3526.4	3716.4	870	1781.8	1876.8	3563.6	3753.6
590	1725.8	1820.8	3451.6	3641.6	684	1744.6	1839.6	3489.2	3679.2	778	1763.4	1858.4	3526.8	3716.8	871	1782.0	1877.0	3564.0	3754.0
591	1726.0	1821.0	3452.0	3642.0	685	1744.8	1839.8	3489.6	3679.6	779	1763.6	1858.6	3527.2	3717.2	872	1782.2	1877.2	3564.4	3754.4
592	1726.2	1821.2	3452.4	3642.4	686	1745.0	1840.0	3490.0	3680.0	780	1763.8	1858.8	3527.6	3717.6	873	1782.4	1877.4	3564.8	3754.8
593	1726.4	1821.4	3452.8	3642.8	687	1745.2	1840.2	3490.4	3680.4	781	1764.0	1859.0	3528.0	3718.0	874	1782.6	1877.6	3565.2	3755.2
594	1726.6	1821.6	3453.2	3643.2	688	1745.4	1840.4	3490.8	3680.8	782	1764.2	1859.2	3528.4	3718.4	875	1782.8	1877.8	3565.6	3755.6
595	1726.8	1821.8	3453.6	3643.6	689	1745.6	1840.6	3491.2	3681.2	783	1764.4	1859.4	3528.8	3718.8	876	1783.0	1878.0	3566.0	3756.0
596	1727.0	1822.0	3454.0	3644.0	690	1745.8	1840.8	3491.6	3681.6	784	1764.6	1859.6	3529.2	3719.2	877	1783.2	1878.2	3566.4	3756.4
597	1727.2	1822.2	3454.4	3644.4	691	1746.0	1841.0	3492.0	3682.0	785	1764.8	1859.8	3529.6	3719.6	878	1783.4	1878.4	3566.8	3756.8
598	1727.4	1822.4	3454.8	3644.8	692	1746.2	1841.2	3492.4	3682.4	786	1765.0	1860.0	3530.0	3720.0	879	1783.6	1878.6	3567.2	3757.2
599	1727.6	1822.6	3455.2	3645.2	693	1746.4	1841.4	3492.8	3682.8	787	1765.2	1860.2	3530.4	3720.4	880	1783.8	1878.8	3567.6	3757.6
600	1727.8	1822.8	3455.6	3645.6	694	1746.6	1841.6	3493.2	3683.2	788	1765.4	1860.4	3530.8	3720.8	881	1784.0	1879.0	3568.0	3758.0
601	1728.0	1823.0	3456.0	3646.0	695	1746.8	1841.8	3493.6	3683.6	789	1765.6	1860.6	3531.2	3721.2	882	1784.2	1879.2	3568.4	3758.4
602	1728.2	1823.2	3456.4	3646.4	696	1747.0	1842.0	3494.0	3684.0	790	1765.8	1860.8	3531.6	3721.6	883	1784.4	1879.4	3568.8	3758.8
603	1728.4	1823.4	3456.8	3646.8	697	1747.2	1842.2	3494.4	3684.4	791	1766.0	1861.0	3532.0	3722.0	884	1784.6	1879.6	3569.2	3759.2
604	1728.6	1823.6	3457.2	3647.2	698	1747.4	1842.4	3494.8	3684.8	792	1766.2	1861.2	3532.4	3722.4	885	1784.8	1879.8	3569.6	3759.6
605	1728.8	1823.8	3457.6	3647.6	699	1747.6	1842.6	3495.2	3685.2										

GSM1900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6	794	1906,6	1986,6	3813,2	3973,2
513	1850,4	1930,4	3700,8	3860,8	607	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0	795	1906,8	1986,8	3813,6	3973,6
514	1850,6	1930,6	3701,2	3861,2	608	1869,4	1949,4	3738,8	3898,8	702	1888,2	1968,2	3776,4	3936,4	796	1907,0	1987,0	3814,0	3974,0
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8	797	1907,2	1987,2	3814,4	3974,4
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2	798	1907,4	1987,4	3814,8	3974,8
517	1851,2	1931,2	3702,4	3862,4	611	1870,0	1950,0	3740,0	3900,0	705	1888,8	1968,8	3777,6	3937,6	799	1907,6	1987,6	3815,2	3975,2
518	1851,4	1931,4	3702,8	3862,8	612	1870,2	1950,2	3740,4	3900,4	706	1889,0	1969,0	3778,0	3938,0	800	1907,8	1987,8	3815,6	3975,6
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4	801	1908,0	1988,0	3816,0	3976,0
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8	802	1908,2	1988,2	3816,4	3976,4
521	1852,0	1932,0	3704,0	3864,0	615	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2	803	1908,4	1988,4	3816,8	3976,8
522	1852,2	1932,2	3704,4	3864,4	616	1871,0	1951,0	3742,0	3902,0	710	1889,8	1969,8	3779,6	3939,6	804	1908,6	1988,6	3817,2	3977,2
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0	805	1908,8	1988,8	3817,6	3977,6
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4	806	1909,0	1989,0	3818,0	3978,0
525	1852,8	1932,8	3705,6	3865,6	619	1871,6	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8	807	1909,2	1989,2	3818,4	3978,4
526	1853,0	1933,0	3706,0	3866,0	620	1871,8	1951,8	3743,6	3903,6	714	1890,6	1970,6	3781,2	3941,2	808	1909,4	1989,4	3818,8	3978,8
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6	809	1909,6	1989,6	3819,2	3979,2
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0	810	1909,8	1989,8	3819,6	3979,6
529	1853,6	1933,6	3707,2	3867,2	623	1872,4	1952,4	3744,8	3904,8	717	1891,2	1971,2	3782,4	3942,4					
530	1853,8	1933,8	3707,6	3867,6	624	1872,6	1952,6	3745,2	3905,2	718	1891,4	1971,4	3782,8	3942,8					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
533	1854,4	1934,4	3708,8	3868,8	627	1873,2	1953,2	3746,4	3906,4	721	1892,0	1972,0	3784,0	3944,0					
534	1854,6	1934,6	3709,2	3869,2	628	1873,4	1953,4	3746,8	3906,8	722	1892,2	1972,2	3784,4	3944,4					
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
537	1855,2	1935,2	3710,4	3870,4	631	1874,0	1954,0	3748,0	3908,0	725	1892,8	1972,8	3785,6	3945,6					
538	1855,4	1935,4	3710,8	3870,8	632	1874,2	1954,2	3748,4	3908,4	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
541	1856,0	1936,0	3712,0	3872,0	635	1874,8	1954,8	3749,6	3909,6	729	1893,6	1973,6	3787,2	3947,2					
542	1856,2	1936,2	3712,4	3872,4	636	1875,0	1955,0	3750,0	3910,0	730	1893,8	1973,8	3787,6	3947,6					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1856,8	1936,8	3713,6	3873,6	639	1875,6	1955,6	3751,2	3911,2	733	1894,4	1974,4	3788,8	3948,8					
546	1857,0	1937,0	3714,0	3874,0	640	1875,8	1955,8	3751,6	3911,6	734	1894,6	1974,6	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
549	1857,6	1937,6	3715,2	3875,2	643	1876,4	1956,4	3752,8	3912,8	737	1895,2	1975,2	3790,4	3950,4					
550	1857,8	1937,8	3715,6	3875,6	644	1876,6	1956,6	3753,2	3913,2	738	1895,4	1975,4	3790,8	3950,8					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
553	1858,4	1938,4	3716,8	3876,8	647	1877,2	1957,2	3754,4	3914,4	741	1896,0	1976,0	3792,0	3952,0					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,4					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
557	1859,2	1939,2	3718,4	3878,4	651	1878,0	1958,0	3756,0	3916,0	745	1896,8	1976,8	3793,6	3953,6					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3794,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
561	1860,0	1940,0	3720,0	3880,0	655	1878,8	1958,8	3757,6	3917,6	749	1897,6	1977,6	3795,2	3955,2					
562	1860,2	1940,2	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
565	1860,8	1940,8	3721,6	3881,6	659	1879,6	1959,6	3759,2	3919,2	753	1898,4	1978,4	3796,8	3956,8					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568	1861,4	1941,4	3722,8	3882,8	662	1880,2	1960,2	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
569	1861,6	1941,6	3723,2	3883,2	663	1880,4	1960,4	3760,8	3920,8	757	1899,2	1979,2	3798,4	3958,4					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
572	1862,2	1942,2	3724,4	3884,4	666	1881,0	1961,0	3762,0	3922,0	760	1899,8	1979,8	3799,6	3959,6					
573	1862,4	1942,4	3724,8	3884,8	667	1881,2	1961,2	3762,4	3922,4	761	1900,0	1980,0	3800,0	3960,0					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
576	1863,0	1943,0	3726,0	3886,0	670	1881,8	1961,8	3763,6	3923,6	764	1900,6	1980,6	3801,2	3961,2					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3924,0	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
580	1863,8	1943,8	3727,6	3887,6	674	1882,6	1962,6	3765,2	3925,2	768	1901,4	1981,4	3802,8	3962,8					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
584	1864,6	1944,6	3729,2	3889,2	678	1883,4	1963,4	3766,8	3926,8	772	1902,2	1982,2	3804,4	3964,4					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865,2	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	775	1902,8	1982,8	3805,6	3965,6					
588	1865,4	1945,4	3730,8	3890,8	682	1884,2	1964,2	3768,4	3928,4	776	1903,0	1983,0	3806,0	3966,0					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866,0	1946,0	3732,0	3892,0	685	1884,8	1964,8	3769,6	3929,6	779	1903,6	1983,6	3807,2	3967,2					
592	1866,2	1946,2	3732,4	3892,4	686	1885,0	1965,0	3770,0	3930,0	780	1903,8	1983,8	3807,6	3967,6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1866,8	1946,8	3733,6	3893,6	689	1885,6	1965,6	3771,2	3931,2	783	1904,4	1984,4	3808,8	3968,8					
596	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771,6	3931,6	784	1904,6	1984,6	3809,2	3969,2					
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					
599	1867,6	1947,6	3735,2	3895,2	693	1886,4	1966,4	3772,8	3932,8	787	1905,2	1985,2	3810,4	3970,4					
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790	1905,8	1985,8	3811,6	3971,6					
603	1868,4	1948,4	3736,8	3896,8	697	1887,2	1967,2	3774,4	3934,4	791	1906,0	1986,0	3812,0	3972,0					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986,2	3812,4	3972,4					
605	1868,8	1948,8	3737,6	3897,6	699	1887,6	1967,6	3775,2	3935,2	793	1906,4	1986,4	3812,8	3972,8					

WCDMA 2100 Rx frequencies

Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX
10562	2112.4	4224.8	10625	2125	4250	10688	2137.6	4275.2	10751	2150.2	4300.4	10814	2162.8	4325.6
10563	2112.6	4225.2	10626	2125.2	4250.4	10689	2137.8	4275.6	10752	2150.4	4300.8	10815	2163	4326
10564	2112.8	4225.6	10627	2125.4	4250.8	10690	2138	4276	10753	2150.6	4301.2	10816	2163.2	4326.4
10565	2113	4226	10628	2125.6	4251.2	10691	2138.2	4276.4	10754	2150.8	4301.6	10817	2163.4	4326.8
10566	2113.2	4226.4	10629	2125.8	4251.6	10692	2138.4	4276.8	10755	2151	4302	10818	2163.6	4327.2
10567	2113.4	4226.8	10630	2126	4252	10693	2138.6	4277.2	10756	2151.2	4302.4	10819	2163.8	4327.6
10568	2113.6	4227.2	10631	2126.2	4252.4	10694	2138.8	4277.6	10757	2151.4	4302.8	10820	2164	4328
10569	2113.8	4227.6	10632	2126.4	4252.8	10695	2139	4278	10758	2151.6	4303.2	10821	2164.2	4328.4
10570	2114	4228	10633	2126.6	4253.2	10696	2139.2	4278.4	10759	2151.8	4303.6	10822	2164.4	4328.8
10571	2114.2	4228.4	10634	2126.8	4253.6	10697	2139.4	4278.8	10760	2152	4304	10823	2164.6	4329.2
10572	2114.4	4228.8	10635	2127	4254	10698	2139.6	4279.2	10761	2152.2	4304.4	10824	2164.8	4329.6
10573	2114.6	4229.2	10636	2127.2	4254.4	10699	2139.8	4279.6	10762	2152.4	4304.8	10825	2165	4330
10574	2114.8	4229.6	10637	2127.4	4254.8	10700	2140	4280	10763	2152.6	4305.2	10826	2165.2	4330.4
10575	2115	4230	10638	2127.6	4255.2	10701	2140.2	4280.4	10764	2152.8	4305.6	10827	2165.4	4330.8
10576	2115.2	4230.4	10639	2127.8	4255.6	10702	2140.4	4280.8	10765	2153	4306	10828	2165.6	4331.2
10577	2115.4	4230.8	10640	2128	4256	10703	2140.6	4281.2	10766	2153.2	4306.4	10829	2165.8	4331.6
10578	2115.6	4231.2	10641	2128.2	4256.4	10704	2140.8	4281.6	10767	2153.4	4306.8	10830	2166	4332
10579	2115.8	4231.6	10642	2128.4	4256.8	10705	2141	4282	10768	2153.6	4307.2	10831	2166.2	4332.4
10580	2116	4232	10643	2128.6	4257.2	10706	2141.2	4282.4	10769	2153.8	4307.6	10832	2166.4	4332.8
10581	2116.2	4232.4	10644	2128.8	4257.6	10707	2141.4	4282.8	10770	2154	4308	10833	2166.6	4333.2
10582	2116.4	4232.8	10645	2129	4258	10708	2141.6	4283.2	10771	2154.2	4308.4	10834	2166.8	4333.6
10583	2116.6	4233.2	10646	2129.2	4258.4	10709	2141.8	4283.6	10772	2154.4	4308.8	10835	2167	4334
10584	2116.8	4233.6	10647	2129.4	4258.8	10710	2142	4284	10773	2154.6	4309.2	10836	2167.2	4334.4
10585	2117	4234	10648	2129.6	4259.2	10711	2142.2	4284.4	10774	2154.8	4309.6	10837	2167.4	4334.8
10586	2117.2	4234.4	10649	2129.8	4259.6	10712	2142.4	4284.8	10775	2155	4310	10838	2167.6	4335.2
10587	2117.4	4234.8	10650	2130	4260	10713	2142.6	4285.2	10776	2155.2	4310.4			
10588	2117.6	4235.2	10651	2130.2	4260.4	10714	2142.8	4285.6	10777	2155.4	4310.8			
10589	2117.8	4235.6	10652	2130.4	4260.8	10715	2143	4286	10778	2155.6	4311.2			
10590	2118	4236	10653	2130.6	4261.2	10716	2143.2	4286.4	10779	2155.8	4311.6			
10591	2118.2	4236.4	10654	2130.8	4261.6	10717	2143.4	4286.8	10780	2156	4312			
10592	2118.4	4236.8	10655	2131	4262	10718	2143.6	4287.2	10781	2156.2	4312.4			
10593	2118.6	4237.2	10656	2131.2	4262.4	10719	2143.8	4287.6	10782	2156.4	4312.8			
10594	2118.8	4237.6	10657	2131.4	4262.8	10720	2144	4288	10783	2156.6	4313.2			
10595	2119	4238	10658	2131.6	4263.2	10721	2144.2	4288.4	10784	2156.8	4313.6			
10596	2119.2	4238.4	10659	2131.8	4263.6	10722	2144.4	4288.8	10785	2157	4314			
10597	2119.4	4238.8	10660	2132	4264	10723	2144.6	4289.2	10786	2157.2	4314.4			
10598	2119.6	4239.2	10661	2132.2	4264.4	10724	2144.8	4289.6	10787	2157.4	4314.8			
10599	2119.8	4239.6	10662	2132.4	4264.8	10725	2145	4290	10788	2157.6	4315.2			
10600	2120	4240	10663	2132.6	4265.2	10726	2145.2	4290.4	10789	2157.8	4315.6			
10601	2120.2	4240.4	10664	2132.8	4265.6	10727	2145.4	4290.8	10790	2158	4316			
10602	2120.4	4240.8	10665	2133	4266	10728	2145.6	4291.2	10791	2158.2	4316.4			
10603	2120.6	4241.2	10666	2133.2	4266.4	10729	2145.8	4291.6	10792	2158.4	4316.8			
10604	2120.8	4241.6	10667	2133.4	4266.8	10730	2146	4292	10793	2158.6	4317.2			
10605	2121	4242	10668	2133.6	4267.2	10731	2146.2	4292.4	10794	2158.8	4317.6			
10606	2121.2	4242.4	10669	2133.8	4267.6	10732	2146.4	4292.8	10795	2159	4318			
10607	2121.4	4242.8	10670	2134	4268	10733	2146.6	4293.2	10796	2159.2	4318.4			
10608	2121.6	4243.2	10671	2134.2	4268.4	10734	2146.8	4293.6	10797	2159.4	4318.8			
10609	2121.8	4243.6	10672	2134.4	4268.8	10735	2147	4294	10798	2159.6	4319.2			
10610	2122	4244	10673	2134.6	4269.2	10736	2147.2	4294.4	10799	2159.8	4319.6			
10611	2122.2	4244.4	10674	2134.8	4269.6	10737	2147.4	4294.8	10800	2160	4320			
10612	2122.4	4244.8	10675	2135	4270	10738	2147.6	4295.2	10801	2160.2	4320.4			
10613	2122.6	4245.2	10676	2135.2	4270.4	10739	2147.8	4295.6	10802	2160.4	4320.8			
10614	2122.8	4245.6	10677	2135.4	4270.8	10740	2148	4296	10803	2160.6	4321.2			
10615	2123	4246	10678	2135.6	4271.2	10741	2148.2	4296.4	10804	2160.8	4321.6			
10616	2123.2	4246.4	10679	2135.8	4271.6	10742	2148.4	4296.8	10805	2161	4322			
10617	2123.4	4246.8	10680	2136	4272	10743	2148.6	4297.2	10806	2161.2	4322.4			
10618	2123.6	4247.2	10681	2136.2	4272.4	10744	2148.8	4297.6	10807	2161.4	4322.8			
10619	2123.8	4247.6	10682	2136.4	4272.8	10745	2149	4298	10808	2161.6	4323.2			
10620	2124	4248	10683	2136.6	4273.2	10746	2149.2	4298.4	10809	2161.8	4323.6			
10621	2124.2	4248.4	10684	2136.8	4273.6	10747	2149.4	4298.8	10810	2162	4324			
10622	2124.4	4248.8	10685	2137	4274	10748	2149.6	4299.2	10811	2162.2	4324.4			
10623	2124.6	4249.2	10686	2137.2	4274.4	10749	2149.8	4299.6	10812	2162.4	4324.8			
10624	2124.8	4249.6	10687	2137.4	4274.8	10750	2150	4300	10813	2162.6	4325.2			

WCDMA 2100 Tx frequencies

Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx
9612	1922.4	3844.8	9671	1934.2	3868.4	9730	1946	3892	9789	1957.8	3915.6	9848	1969.6	3939.2
9613	1922.6	3845.2	9672	1934.4	3868.8	9731	1946.2	3892.4	9790	1958	3916	9849	1969.8	3939.6
9614	1922.8	3845.6	9673	1934.6	3869.2	9732	1946.4	3892.8	9791	1958.2	3916.4	9850	1970	3940
9615	1923	3846	9674	1934.8	3869.6	9733	1946.6	3893.2	9792	1958.4	3916.8	9851	1970.2	3940.4
9616	1923.2	3846.4	9675	1935	3870	9734	1946.8	3893.6	9793	1958.6	3917.2	9852	1970.4	3940.8
9617	1923.4	3846.8	9676	1935.2	3870.4	9735	1947	3894	9794	1958.8	3917.6	9853	1970.6	3941.2
9618	1923.6	3847.2	9677	1935.4	3870.8	9736	1947.2	3894.4	9795	1959	3918	9854	1970.8	3941.6
9619	1923.8	3847.6	9678	1935.6	3871.2	9737	1947.4	3894.8	9796	1959.2	3918.4	9855	1971	3942
9620	1924	3848	9679	1935.8	3871.6	9738	1947.6	3895.2	9797	1959.4	3918.8	9856	1971.2	3942.4
9621	1924.2	3848.4	9680	1936	3872	9739	1947.8	3895.6	9798	1959.6	3919.2	9857	1971.4	3942.8
9622	1924.4	3848.8	9681	1936.2	3872.4	9740	1948	3896	9799	1959.8	3919.6	9858	1971.6	3943.2
9623	1924.6	3849.2	9682	1936.4	3872.8	9741	1948.2	3896.4	9800	1960	3920	9859	1971.8	3943.6
9624	1924.8	3849.6	9683	1936.6	3873.2	9742	1948.4	3896.8	9801	1960.2	3920.4	9860	1972	3944
9625	1925	3850	9684	1936.8	3873.6	9743	1948.6	3897.2	9802	1960.4	3920.8	9861	1972.2	3944.4
9626	1925.2	3850.4	9685	1937	3874	9744	1948.8	3897.6	9803	1960.6	3921.2	9862	1972.4	3944.8
9627	1925.4	3850.8	9686	1937.2	3874.4	9745	1949	3898	9804	1960.8	3921.6	9863	1972.6	3945.2
9628	1925.6	3851.2	9687	1937.4	3874.8	9746	1949.2	3898.4	9805	1961	3922	9864	1972.8	3945.6
9629	1925.8	3851.6	9688	1937.6	3875.2	9747	1949.4	3898.8	9806	1961.2	3922.4	9865	1973	3946
9630	1926	3852	9689	1937.8	3875.6	9748	1949.6	3899.2	9807	1961.4	3922.8	9866	1973.2	3946.4
9631	1926.2	3852.4	9690	1938	3876	9749	1949.8	3899.6	9808	1961.6	3923.2	9867	1973.4	3946.8
9632	1926.4	3852.8	9691	1938.2	3876.4	9750	1950	3900	9809	1961.8	3923.6	9868	1973.6	3947.2
9633	1926.6	3853.2	9692	1938.4	3876.8	9751	1950.2	3900.4	9810	1962	3924	9869	1973.8	3947.6
9634	1926.8	3853.6	9693	1938.6	3877.2	9752	1950.4	3900.8	9811	1962.2	3924.4	9870	1974	3948
9635	1927	3854	9694	1938.8	3877.6	9753	1950.6	3901.2	9812	1962.4	3924.8	9871	1974.2	3948.4
9636	1927.2	3854.4	9695	1939	3878	9754	1950.8	3901.6	9813	1962.6	3925.2	9872	1974.4	3948.8
9637	1927.4	3854.8	9696	1939.2	3878.4	9755	1951	3902	9814	1962.8	3925.6	9873	1974.6	3949.2
9638	1927.6	3855.2	9697	1939.4	3878.8	9756	1951.2	3902.4	9815	1963	3926	9874	1974.8	3949.6
9639	1927.8	3855.6	9698	1939.6	3879.2	9757	1951.4	3902.8	9816	1963.2	3926.4	9875	1975	3950
9640	1928	3856	9699	1939.8	3879.6	9758	1951.6	3903.2	9817	1963.4	3926.8	9876	1975.2	3950.4
9641	1928.2	3856.4	9700	1940	3880	9759	1951.8	3903.6	9818	1963.6	3927.2	9877	1975.4	3950.8
9642	1928.4	3856.8	9701	1940.2	3880.4	9760	1952	3904	9819	1963.8	3927.6	9878	1975.6	3951.2
9643	1928.6	3857.2	9702	1940.4	3880.8	9761	1952.2	3904.4	9820	1964	3928	9879	1975.8	3951.6
9644	1928.8	3857.6	9703	1940.6	3881.2	9762	1952.4	3904.8	9821	1964.2	3928.4	9880	1976	3952
9645	1929	3858	9704	1940.8	3881.6	9763	1952.6	3905.2	9822	1964.4	3928.8	9881	1976.2	3952.4
9646	1929.2	3858.4	9705	1941	3882	9764	1952.8	3905.6	9823	1964.6	3929.2	9882	1976.4	3952.8
9647	1929.4	3858.8	9706	1941.2	3882.4	9765	1953	3906	9824	1964.8	3929.6	9883	1976.6	3953.2
9648	1929.6	3859.2	9707	1941.4	3882.8	9766	1953.2	3906.4	9825	1965	3930	9884	1976.8	3953.6
9649	1929.8	3859.6	9708	1941.6	3883.2	9767	1953.4	3906.8	9826	1965.2	3930.4	9885	1977	3954
9650	1930	3860	9709	1941.8	3883.6	9768	1953.6	3907.2	9827	1965.4	3930.8	9886	1977.2	3954.4
9651	1930.2	3860.4	9710	1942	3884	9769	1953.8	3907.6	9828	1965.6	3931.2	9887	1977.4	3954.8
9652	1930.4	3860.8	9711	1942.2	3884.4	9770	1954	3908	9829	1965.8	3931.6	9888	1977.6	3955.2
9653	1930.6	3861.2	9712	1942.4	3884.8	9771	1954.2	3908.4	9830	1966	3932			
9654	1930.8	3861.6	9713	1942.6	3885.2	9772	1954.4	3908.8	9831	1966.2	3932.4			
9655	1931	3862	9714	1942.8	3885.6	9773	1954.6	3909.2	9832	1966.4	3932.8			
9656	1931.2	3862.4	9715	1943	3886	9774	1954.8	3909.6	9833	1966.6	3933.2			
9657	1931.4	3862.8	9716	1943.2	3886.4	9775	1955	3910	9834	1966.8	3933.6			
9658	1931.6	3863.2	9717	1943.4	3886.8	9776	1955.2	3910.4	9835	1967	3934			
9659	1931.8	3863.6	9718	1943.6	3887.2	9777	1955.4	3910.8	9836	1967.2	3934.4			
9660	1932	3864	9719	1943.8	3887.6	9778	1955.6	3911.2	9837	1967.4	3934.8			
9661	1932.2	3864.4	9720	1944	3888	9779	1955.8	3911.6	9838	1967.6	3935.2			
9662	1932.4	3864.8	9721	1944.2	3888.4	9780	1956	3912	9839	1967.8	3935.6			
9663	1932.6	3865.2	9722	1944.4	3888.8	9781	1956.2	3912.4	9840	1968	3936			
9664	1932.8	3865.6	9723	1944.6	3889.2	9782	1956.4	3912.8	9841	1968.2	3936.4			
9665	1933	3866	9724	1944.8	3889.6	9783	1956.6	3913.2	9842	1968.4	3936.8			
9666	1933.2	3866.4	9725	1945	3890	9784	1956.8	3913.6	9843	1968.6	3937.2			
9667	1933.4	3866.8	9726	1945.2	3890.4	9785	1957	3914	9844	1968.8	3937.6			
9668	1933.6	3867.2	9727	1945.4	3890.8	9786	1957.2	3914.4	9845	1969	3938			
9669	1933.8	3867.6	9728	1945.6	3891.2	9787	1957.4	3914.8	9846	1969.2	3938.4			
9670	1934	3868	9729	1945.8	3891.6	9788	1957.6	3915.2	9847	1969.4	3938.8			

WCDMA IV (1700) frequencies

TX CH	RX CH	TX (MHz)	RX (MHz)	TX VCO (MHz)	RX VCO (MHz)
1312	1537	1712.4	2112.4	3424.8	4224.8
1313	1538	1712.6	2112.6	3425.2	4225.2
1314	1539	1712.8	2112.8	3425.6	4225.6
1315	1540	1713.0	2113.0	3426.0	4226.0
1316	1541	1713.2	2113.2	3426.4	4226.4
1317	1542	1713.4	2113.4	3426.8	4226.8
1318	1543	1713.6	2113.6	3427.2	4227.2
1319	1544	1713.8	2113.8	3427.6	4227.6
1320	1545	1714.0	2114.0	3428.0	4228.0
1321	1546	1714.2	2114.2	3428.4	4228.4
1322	1547	1714.4	2114.4	3428.8	4228.8
1323	1548	1714.6	2114.6	3429.2	4229.2
1324	1549	1714.8	2114.8	3429.6	4229.6
1325	1550	1715.0	2115.0	3430.0	4230.0
1326	1551	1715.2	2115.2	3430.4	4230.4
1327	1552	1715.4	2115.4	3430.8	4230.8
1328	1553	1715.6	2115.6	3431.2	4231.2
1329	1554	1715.8	2115.8	3431.6	4231.6
1330	1555	1716.0	2116.0	3432.0	4232.0
1331	1556	1716.2	2116.2	3432.4	4232.4
1332	1557	1716.4	2116.4	3432.8	4232.8
1333	1558	1716.6	2116.6	3433.2	4233.2
1334	1559	1716.8	2116.8	3433.6	4233.6
1335	1560	1717.0	2117.0	3434.0	4234.0
1336	1561	1717.2	2117.2	3434.4	4234.4
1337	1562	1717.4	2117.4	3434.8	4234.8
1338	1563	1717.6	2117.6	3435.2	4235.2
1339	1564	1717.8	2117.8	3435.6	4235.6
1340	1565	1718.0	2118.0	3436.0	4236.0
1341	1566	1718.2	2118.2	3436.4	4236.4
1342	1567	1718.4	2118.4	3436.8	4236.8
1343	1568	1718.6	2118.6	3437.2	4237.2
1344	1569	1718.8	2118.8	3437.6	4237.6
1345	1570	1719.0	2119.0	3438.0	4238.0
1346	1571	1719.2	2119.2	3438.4	4238.4
1347	1572	1719.4	2119.4	3438.8	4238.8
1348	1573	1719.6	2119.6	3439.2	4239.2
1349	1574	1719.8	2119.8	3439.6	4239.6
1350	1575	1720.0	2120.0	3440.0	4240.0
1351	1576	1720.2	2120.2	3440.4	4240.4
1352	1577	1720.4	2120.4	3440.8	4240.8
1353	1578	1720.6	2120.6	3441.2	4241.2
1354	1579	1720.8	2120.8	3441.6	4241.6
1355	1580	1721.0	2121.0	3442.0	4242.0
1356	1581	1721.2	2121.2	3442.4	4242.4
1357	1582	1721.4	2121.4	3442.8	4242.8
1358	1583	1721.6	2121.6	3443.2	4243.2
1359	1584	1721.8	2121.8	3443.6	4243.6
1360	1585	1722.0	2122.0	3444.0	4244.0
1361	1586	1722.2	2122.2	3444.4	4244.4
1362	1587	1722.4	2122.4	3444.8	4244.8
1363	1588	1722.6	2122.6	3445.2	4245.2
1364	1589	1722.8	2122.8	3445.6	4245.6
1365	1590	1723.0	2123.0	3446.0	4246.0
1366	1591	1723.2	2123.2	3446.4	4246.4
1367	1592	1723.4	2123.4	3446.8	4246.8
1368	1593	1723.6	2123.6	3447.2	4247.2
1369	1594	1723.8	2123.8	3447.6	4247.6
1370	1595	1724.0	2124.0	3448.0	4248.0
1371	1596	1724.2	2124.2	3448.4	4248.4
1372	1597	1724.4	2124.4	3448.8	4248.8
1373	1598	1724.6	2124.6	3449.2	4249.2
1374	1599	1724.8	2124.8	3449.6	4249.6
1375	1600	1725.0	2125.0	3450.0	4250.0
1376	1601	1725.2	2125.2	3450.4	4250.4
1377	1602	1725.4	2125.4	3450.8	4250.8
1378	1603	1725.6	2125.6	3451.2	4251.2
1379	1604	1725.8	2125.8	3451.6	4251.6
1380	1605	1726.0	2126.0	3452.0	4252.0
1381	1606	1726.2	2126.2	3452.4	4252.4
1382	1607	1726.4	2126.4	3452.8	4252.8
1383	1608	1726.6	2126.6	3453.2	4253.2
1384	1609	1726.8	2126.8	3453.6	4253.6
1385	1610	1727.0	2127.0	3454.0	4254.0
1386	1611	1727.2	2127.2	3454.4	4254.4
1387	1612	1727.4	2127.4	3454.8	4254.8
1388	1613	1727.6	2127.6	3455.2	4255.2
1389	1614	1727.8	2127.8	3455.6	4255.6
1390	1615	1728.0	2128.0	3456.0	4256.0
1391	1616	1728.2	2128.2	3456.4	4256.4
1392	1617	1728.4	2128.4	3456.8	4256.8
1393	1618	1728.6	2128.6	3457.2	4257.2
1394	1619	1728.8	2128.8	3457.6	4257.6
1395	1620	1729.0	2129.0	3458.0	4258.0
1396	1621	1729.2	2129.2	3458.4	4258.4
1397	1622	1729.4	2129.4	3458.8	4258.8
1398	1623	1729.6	2129.6	3459.2	4259.2
1399	1624	1729.8	2129.8	3459.6	4259.6
1400	1625	1730.0	2130.0	3460.0	4260.0
1401	1626	1730.2	2130.2	3460.4	4260.4
1402	1627	1730.4	2130.4	3460.8	4260.8
1403	1628	1730.6	2130.6	3461.2	4261.2
1404	1629	1730.8	2130.8	3461.6	4261.6
1405	1630	1731.0	2131.0	3462.0	4262.0
1406	1631	1731.2	2131.2	3462.4	4262.4
1407	1632	1731.4	2131.4	3462.8	4262.8
1408	1633	1731.6	2131.6	3463.2	4263.2
1409	1634	1731.8	2131.8	3463.6	4263.6
1410	1635	1732.0	2132.0	3464.0	4264.0
1411	1636	1732.2	2132.2	3464.4	4264.4
1412	1637	1732.4	2132.4	3464.8	4264.8
1413	1638	1732.6	2132.6	3465.2	4265.2
1414	1639	1732.8	2132.8	3465.6	4265.6
1415	1640	1733.0	2133.0	3466.0	4266.0
1416	1641	1733.2	2133.2	3466.4	4266.4
1417	1642	1733.4	2133.4	3466.8	4266.8
1418	1643	1733.6	2133.6	3467.2	4267.2
1419	1644	1733.8	2133.8	3467.6	4267.6
1420	1645	1734.0	2134.0	3468.0	4268.0
1421	1646	1734.2	2134.2	3468.4	4268.4
1422	1647	1734.4	2134.4	3468.8	4268.8
1423	1648	1734.6	2134.6	3469.2	4269.2
1424	1649	1734.8	2134.8	3469.6	4269.6
1425	1650	1735.0	2135.0	3470.0	4270.0
1426	1651	1735.2	2135.2	3470.4	4270.4
1427	1652	1735.4	2135.4	3470.8	4270.8
1428	1653	1735.6	2135.6	3471.2	4271.2
1429	1654	1735.8	2135.8	3471.6	4271.6
1430	1655	1736.0	2136.0	3472.0	4272.0
1431	1656	1736.2	2136.2	3472.4	4272.4
1432	1657	1736.4	2136.4	3472.8	4272.8
1433	1658	1736.6	2136.6	3473.2	4273.2
1434	1659	1736.8	2136.8	3473.6	4273.6
1435	1660	1737.0	2137.0	3474.0	4274.0
1436	1661	1737.2	2137.2	3474.4	4274.4
1437	1662	1737.4	2137.4	3474.8	4274.8
1438	1663	1737.6	2137.6	3475.2	4275.2
1439	1664	1737.8	2137.8	3475.6	4275.6
1440	1665	1738.0	2138.0	3476.0	4276.0
1441	1666	1738.2	2138.2	3476.4	4276.4
1442	1667	1738.4	2138.4	3476.8	4276.8
1443	1668	1738.6	2138.6	3477.2	4277.2
1444	1669	1738.8	2138.8	3477.6	4277.6
1445	1670	1739.0	2139.0	3478.0	4278.0
1446	1671	1739.2	2139.2	3478.4	4278.4
1447	1672	1739.4	2139.4	3478.8	4278.8
1448	1673	1739.6	2139.6	3479.2	4279.2
1449	1674	1739.8	2139.8	3479.6	4279.6
1450	1675	1740.0	2140.0	3480.0	4280.0
1451	1676	1740.2	2140.2	3480.4	4280.4
1452	1677	1740.4	2140.4	3480.8	4280.8
1453	1678	1740.6	2140.6	3481.2	4281.2
1454	1679	1740.8	2140.8	3481.6	4281.6
1455	1680	1741.0	2141.0	3482.0	4282.0
1456	1681	1741.2	2141.2	3482.4	4282.4
1457	1682	1741.4	2141.4	3482.8	4282.8
1458	1683	1741.6	2141.6	3483.2	4283.2
1459	1684	1741.8	2141.8	3483.6	4283.6
1460	1685	1742.0	2142.0	3484.0	4284.0
1461	1686	1742.2	2142.2	3484.4	4284.4
1462	1687	1742.4	2142.4	3484.8	4284.8
1463	1688	1742.6	2142.6	3485.2	4285.2
1464	1689	1742.8	2142.8	3485.6	4285.6
1465	1690	1743.0	2143.0	3486.0	4286.0
1466	1691	1743.2	2143.2	3486.4	4286.4
1467	1692	1743.4	2143.4	3486.8	4286.8
1468	1693	1743.6	2143.6	3487.2	4287.2
1469	1694	1743.8	2143.8	3487.6	4287.6
1470	1695	1744.0	2144.0	3488.0	4288.0
1471	1696	1744.2	2144.2	3488.4	4288.4
1472	1697	1744.4	2144.4	3488.8	4288.8
1473	1698	1744.6	2144.6	3489.2	4289.2
1474	1699	1744.8	2144.8	3489.6	4289.6
1475	1700	1745.0	2145.0	3490.0	4290.0
1476	1701	1745.2	2145.2	3490.4	4290.4
1477	1702	1745.4	2145.4	3490.8	4290.8
1478	1703	1745.6	2145.6	3491.2	4291.2
1479	1704	1745.8	2145.8	3491.6	4291.6
1480	1705	1746.0	2146.0	3492.0	4292.0
1481	1706	1746.2	2146.2	3492.4	4292.4
1482	1707	1746.4	2146.4	3492.8	4292.8
1483	1708	1746.6	2146.6	3493.2	4293.2
1484	1709	1746.8	2146.8	3493.6	4293.6
1485	1710	1747.0	2147.0	3494.0	4294.0
1486	1711	1747.2	2147.2	3494.4	4294.4
1487	1712	1747.4	2147.4	3494.8	4294.8
1488	1713	1747.6	2147.6	3495.2	4295.2
1489	1714	1747.8	2147.8	3495.6	4295.6
1490	1715	1748.0	2148.0	3496.0	4296.0
1491	1716	1748.2	2148.2	3496.4	4296.4
1492	1717	1748.4	2148.4	3496.8	4296.8
1493	1718	1748.6	2148.6	3497.2	4297.2
1494	1719	1748.8	2148.8	3497.6	4297.6
1495	1720	1749.0	2149.0	3498.0	4298.0
1496	1721	1749.2	2149.2	3498.4	4298.4
1497	1722	1749.4	2149.4	3498.8	4298.8
1498	1723	1749.6	2149.6	3499.2	4299.2
1499	1724	1749.8	2149.8	3499.6	4299.6
1500	1725	1750.0	2150.0	3500.0	4300.0
1501	1726	1750.2	2150.2	3500.4	4300.4
1502	1727	1750.4	2150.4	3500.8	4300.8
1503	1728	1750.6	2150.6	3501.2	4301.2
1504	1729	1750.8	2150.8	3501.6	4301.6
1505	1730	1751.0	2151.0	3502.0	4302.0
1506	1731	1751.2	2151.2	3502.4	4302.4
1507	1732	1751.4	2151.4	3502.8	4302.8
1508	1733	1751.6	2151.6	3503.2	4303.2
1509	1734	1751.8	2151.8	3503.6	4303.6
1510	1735	1752.0	2152.0	3504.0	4304.0
1511	1736	1752.2	2152.2	3504.4	4304.4
1512	1737	1752.4	2152.4	3504.8	4304.8
1513	1738	1752.6	2152.6	3505.2	4305.2
1662	1887	1712.5	2112.5	3425.0	4225.0
1687	1912	1717.5	2117.5	3435.0	4235.0
1712	1937	1722.5	2122.5	3445.0	4245.0
1737	1962	1727.5	2127.5	3455.0	4255.0
1762	1987	1732.5	2132.5	3465.0	4265.0
1787	2012	1737.5	2137.5	3475.0	4275.0
1812	2037	1742.5	2142.5	3485.0	4285.0
1837	2062	1747.5	2147.5	3495.0	4295.0
1862	2087	1752.5	2152.5	3505.0	4305.0

WCDMA VIII (900) frequencies

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2712	882,4	3529,6	2937	927,4	3709,6
2713	882,6	3530,4	2938	927,6	3710,4
2714	882,8	3531,2	2939	927,8	3711,2
2715	883	3532	2940	928	3712
2716	883,2	3532,8	2941	928,2	3712,8
2717	883,4	3533,6	2942	928,4	3713,6
2718	883,6	3534,4	2943	928,6	3714,4
2719	883,8	3535,2	2944	928,8	3715,2
2720	884	3536	2945	929	3716
2721	884,2	3536,8	2946	929,2	3716,8
2722	884,4	3537,6	2947	929,4	3717,6
2723	884,6	3538,4	2948	929,6	3718,4
2724	884,8	3539,2	2949	929,8	3719,2
2725	885	3540	2950	930	3720
2726	885,2	3540,8	2951	930,2	3720,8
2727	885,4	3541,6	2952	930,4	3721,6
2728	885,6	3542,4	2953	930,6	3722,4
2729	885,8	3543,2	2954	930,8	3723,2
2730	886	3544	2955	931	3724
2731	886,2	3544,8	2956	931,2	3724,8
2732	886,4	3545,6	2957	931,4	3725,6
2733	886,6	3546,4	2958	931,6	3726,4
2734	886,8	3547,2	2959	931,8	3727,2
2735	887	3548	2960	932	3728
2736	887,2	3548,8	2961	932,2	3728,8
2737	887,4	3549,6	2962	932,4	3729,6
2738	887,6	3550,4	2963	932,6	3730,4
2739	887,8	3551,2	2964	932,8	3731,2
2740	888	3552	2965	933	3732
2741	888,2	3552,8	2966	933,2	3732,8
2742	888,4	3553,6	2967	933,4	3733,6
2743	888,6	3554,4	2968	933,6	3734,4
2744	888,8	3555,2	2969	933,8	3735,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2745	889	3556	2970	934	3736
2746	889,2	3556,8	2971	934,2	3736,8
2747	889,4	3557,6	2972	934,4	3737,6
2748	889,6	3558,4	2973	934,6	3738,4
2749	889,8	3559,2	2974	934,8	3739,2
2750	890	3560	2975	935	3740
2751	890,2	3560,8	2976	935,2	3740,8
2752	890,4	3561,6	2977	935,4	3741,6
2753	890,6	3562,4	2978	935,6	3742,4
2754	890,8	3563,2	2979	935,8	3743,2
2755	891	3564	2980	936	3744
2756	891,2	3564,8	2981	936,2	3744,8
2757	891,4	3565,6	2982	936,4	3745,6
2758	891,6	3566,4	2983	936,6	3746,4
2759	891,8	3567,2	2984	936,8	3747,2
2760	892	3568	2985	937	3748
2761	892,2	3568,8	2986	937,2	3748,8
2762	892,4	3569,6	2987	937,4	3749,6
2763	892,6	3570,4	2988	937,6	3750,4
2764	892,8	3571,2	2989	937,8	3751,2
2765	893	3572	2990	938	3752
2766	893,2	3572,8	2991	938,2	3752,8
2767	893,4	3573,6	2992	938,4	3753,6
2768	893,6	3574,4	2993	938,6	3754,4
2769	893,8	3575,2	2994	938,8	3755,2
2770	894	3576	2995	939	3756
2771	894,2	3576,8	2996	939,2	3756,8
2772	894,4	3577,6	2997	939,4	3757,6
2773	894,6	3578,4	2998	939,6	3758,4
2774	894,8	3579,2	2999	939,8	3759,2
2775	895	3580	3000	940	3760
2776	895,2	3580,8	3001	940,2	3760,8
2777	895,4	3581,6	3002	940,4	3761,6
2778	895,6	3582,4	3003	940,6	3762,4
2779	895,8	3583,2	3004	940,8	3763,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2780	896	3584	3005	941	3764
2781	896,2	3584,8	3006	941,2	3764,8
2782	896,4	3585,6	3007	941,4	3765,6
2783	896,6	3586,4	3008	941,6	3766,4
2784	896,8	3587,2	3009	941,8	3767,2
2785	897	3588	3010	942	3768
2786	897,2	3588,8	3011	942,2	3768,8
2787	897,4	3589,6	3012	942,4	3769,6
2788	897,6	3590,4	3013	942,6	3770,4
2789	897,8	3591,2	3014	942,8	3771,2
2790	898	3592	3015	943	3772
2791	898,2	3592,8	3016	943,2	3772,8
2792	898,4	3593,6	3017	943,4	3773,6
2793	898,6	3594,4	3018	943,6	3774,4
2794	898,8	3595,2	3019	943,8	3775,2
2795	899	3596	3020	944	3776
2796	899,2	3596,8	3021	944,2	3776,8
2797	899,4	3597,6	3022	944,4	3777,6
2798	899,6	3598,4	3023	944,6	3778,4
2799	899,8	3599,2	3024	944,8	3779,2
2800	900	3600	3025	945	3780
2801	900,2	3600,8	3026	945,2	3780,8
2802	900,4	3601,6	3027	945,4	3781,6
2803	900,6	3602,4	3028	945,6	3782,4
2804	900,8	3603,2	3029	945,8	3783,2
2805	901	3604	3030	946	3784
2806	901,2	3604,8	3031	946,2	3784,8
2807	901,4	3605,6	3032	946,4	3785,6
2808	901,6	3606,4	3033	946,6	3786,4
2809	901,8	3607,2	3034	946,8	3787,2
2810	902	3608	3035	947	3788
2811	902,2	3608,8	3036	947,2	3788,8
2812	902,4	3609,6	3037	947,4	3789,6
2813	902,6	3610,4	3038	947,6	3790,4
2814	902,8	3611,2	3039	947,8	3791,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2815	903	3612	3040	948	3792
2816	903,2	3612,8	3041	948,2	3792,8
2817	903,4	3613,6	3042	948,4	3793,6
2818	903,6	3614,4	3043	948,6	3794,4
2819	903,8	3615,2	3044	948,8	3795,2
2820	904	3616	3045	949	3796
2821	904,2	3616,8	3046	949,2	3796,8
2822	904,4	3617,6	3047	949,4	3797,6
2823	904,6	3618,4	3048	949,6	3798,4
2824	904,8	3619,2	3049	949,8	3799,2
2825	905	3620	3050	950	3800
2826	905,2	3620,8	3051	950,2	3800,8
2827	905,4	3621,6	3052	950,4	3801,6
2828	905,6	3622,4	3053	950,6	3802,4
2829	905,8	3623,2	3054	950,8	3803,2
2830	906	3624	3055	951	3804
2831	906,2	3624,8	3056	951,2	3804,8
2832	906,4	3625,6	3057	951,4	3805,6
2833	906,6	3626,4	3058	951,6	3806,4
2834	906,8	3627,2	3059	951,8	3807,2
2835	907	3628	3060	952	3808
2836	907,2	3628,8	3061	952,2	3808,8
2837	907,4	3629,6	3062	952,4	3809,6
2838	907,6	3630,4	3063	952,6	3810,4
2839	907,8	3631,2	3064	952,8	3811,2
2840	908	3632	3065	953	3812
2841	908,2	3632,8	3066	953,2	3812,8
2842	908,4	3633,6	3067	953,4	3813,6
2843	908,6	3634,4	3068	953,6	3814,4
2844	908,8	3635,2	3069	953,8	3815,2
2845	909	3636	3070	954	3816
2846	909,2	3636,8	3071	954,2	3816,8
2847	909,4	3637,6	3072	954,4	3817,6
2848	909,6	3638,4	3073	954,6	3818,4
2849	909,8	3639,2	3074	954,8	3819,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2850	910	3640	3075	955	3820
2851	910,2	3640,8	3076	955,2	3820,8
2852	910,4	3641,6	3077	955,4	3821,6
2853	910,6	3642,4	3078	955,6	3822,4
2854	910,8	3643,2	3079	955,8	3823,2
2855	911	3644	3080	956	3824
2856	911,2	3644,8	3081	956,2	3824,8
2857	911,4	3645,6	3082	956,4	3825,6
2858	911,6	3646,4	3083	956,6	3826,4
2859	911,8	3647,2	3084	956,8	3827,2
2860	912	3648	3085	957	3828
2861	912,2	3648,8	3086	957,2	3828,8
2862	912,4	3649,6	3087	957,4	3829,6
2863	912,6	3650,4	3088	957,6	3830,4

Glossary

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A/D-converter	Analogue-to-digital converter
ACI	Accessory Control Interface
ADC	Analogue-to-digital converter
ADSP	Application DPS (expected to run high level tasks)
AGC	Automatic gain control (maintains volume)
ALS	Ambient light sensor
AMSL	After Market Service Leader
ARM	Advanced RISC Machines
ARPU	Average revenue per user (per month or per year)
ASIC	Application Specific Integrated Circuit
ASIP	Application Specific Interface Protector
B2B	Board to board, connector between PWB and UI board
BA	Board Assembly
BB	Baseband
BC02	Bluetooth module made by CSR
BIQUAD	Bi-quadratic (type of filter function)
BSI	Battery Size Indicator
BT	Bluetooth
CBus	MCU controlled serial bus connected to UPP_WD2, UEME and Zocus
CCP	Compact Camera Port
CDMA	Code division multiple access
CDSP	Cellular DSP (expected to run at low levels)
CLDC	Connected limited device configuration
CMOS	Complimentary metal-oxide semiconductor circuit (low power consumption)
COF	Chip on Foil
COG	Chip on Glass
CPU	Central Processing Unit
CSD	Circuit-switched data
CSR	Cambridge silicon radio
CSTN	Colour Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analogue converter
DAC	Digital-to-analogue converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo

DCT-4	Digital Core Technology
DMA	Direct memory access
DP	Data Package
DPLL	Digital Phase Locked Loop
DSP	Digital Signal Processor
DTM	Dual Transfer Mode
DtoS	Differential to Single ended
EDGE	Enhanced data rates for global/GSM evolution
EGSM	Extended GSM
EM	Energy management
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
ESD	Electrostatic discharge
FCI	Functional cover interface
FM	Frequency Modulation
FPS	Flash Programming Tool
FR	Full rate
FSTN	Film compensated super twisted nematic
GMSK	Gaussian Minimum Shift Keying
GND	Ground, conductive mass
GPIB	General-purpose interface bus
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global System for Mobile communication
HSDPA	High-speed downlink packet access
HF	Hands free
HFCM	Handsfree Common
HS	Handset
HSCSD	High speed circuit switched data (data transmission connection faster than GSM)
HW	Hardware
I/O	Input/Output
IBAT	Battery current
IC	Integrated circuit
ICHAR	Charger current
IF	Interface
IHF	Integrated hands free
IMEI	International Mobile Equipment Identity

IR	Infrared
IrDA	Infrared Data Association
ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out
LED	Light-emitting diode
LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
MP3	Compressed audio file format developed by Moving Picture Experts Group
MTP	Multipoint-to-point connection
NFC	Near field communication
NTC	Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor
OMA	Object management architecture
OMAP	Operations, maintenance, and administration part
Opamp	Operational Amplifier
PA	Power amplifier
PCM	Pulse Code Modulation
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x and BB5
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board

PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RDS	Radio Data Service
RF	Radio Frequency
RF PopPort™	Reduced function PopPort™ interface
RFBUS	Serial control Bus For RF
RSK	Right Soft Key
RS-MMC	Reduced size Multimedia Card
RSS	Web content Syndication Format
RSSI	Receiving signal strength indicator
RST	Reset Switch
RTC	Real Time Clock (provides date and time)
RX	Radio Receiver
SARAM	Single Access RAM
SAW filter	Surface Acoustic Wave filter
SDRAM	Synchronous Dynamic Random Access Memory
SID	Security ID
SIM	Subscriber Identity Module
SMPS	Switched Mode Power Supply
SNR	Signal-to-noise ratio
SPR	Standard Product requirements
SRAM	Static random access memory
STI	Serial Trace Interface
SW	Software
SWIM	Subscriber/Wallet Identification Module
TCP/IP	Transmission control protocol/Internet protocol
TCXO	Temperature controlled Oscillator
Tiku	Finnish for Chip, Successor of the UPP
TX	Radio Transmitter
UART	Universal asynchronous receiver/transmitter
UEME	Universal Energy Management chip (Enhanced version)
UEMEK	See UEME
UI	User Interface
UPnP	Universal Plug and Play
UPP	Universal Phone Processor
UPP_WD2	Communicator version of DCT4 system ASIC

USB	Universal Serial Bus
VBAT	Battery voltage
VCHAR	Charger voltage
VCO	Voltage controlled oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VCXO	Voltage Controlled Crystal Oscillator
VF	View Finder
Vp-p	Peak-to-peak voltage
VSIM	SIM voltage
WAP	Wireless application protocol
WCDMA	Wideband code division multiple access
WD	Watchdog
WLAN	Wireless local area network
XHTML	Extensible hypertext markup language
Zocus	Current sensor (used to monitor the current flow to and from the battery)

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