efrcom

Nokia Customer Care

Service Manual

RM-675; RM-691 (Nokia C7-00; L3&4)

Mobile Terminal

Part No: (Issue 4)

COMPANY CONFIDENTIAL

NOKIA
Care

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Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	07/2010	MT	
Issue 2	09/2010	MT	Updates have been made to all chapters. A new service tool, SS-250 Display removal tool, has been added to chapter *Service Tools and Service Concepts*.
Issue 3	10/2010	MT	A new section, *EDoF impact on image quality*, has been added to chapter *Camera Module Troubleshooting*. Chapter *Cellular RF Troubleshooting* has been completely updated. Sections *Baseband main troubleshooting*, *Bluetooth and FM radio troubleshooting*, *WLAN auto tuning*, *FMTx troubleshooting*, *NFC troubleshooting* and *Energy management calibration* in chapter *BB Troubleshooting and Manual Tuning Guide* have been updated.
Issue 4	02/2011	MT	Section *Baseband manual tuning guide* in chapter *BB Troubleshooting and Manual Tuning Guide* has been updated with new topics *Certificate restoring* and *Product code change*. Chapter 7, titled *Service information differences between RM-691 and RM-675*, has been added to the manual. The new chapter describes the key hardware differences between the RM-691 and RM-675 variants of the Nokia C7-00.

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IMPORTANT

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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.

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For your safety

QUALIFIED SERVICE

Only qualified personnel may install or repair phone equipment.

ACCESSORIES AND BATTERIES

Use only approved accessories and batteries. Do not connect incompatible products.

CONNECTING TO OTHER DEVICES

When connecting to any other device, read its user's guide for detailed safety instructions. Do not connect incompatible products.

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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.

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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.

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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.

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Nokia C7-00; L3&4 Service Manual Structure

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2 Service Tools and Service Concepts
3 BB Troubleshooting and Manual Tuning Guide
4 Cellular RF Troubleshooting
5 Camera Module Troubleshooting
6 System Module
7 Service information differences between RM-691 and RM-675
Glossary

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1 — General Information

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Product selection

RM-675 is a GSM/HSDPA/WCDMA tri-mode handportable monoblock multimedia computer with a capacitive touch UI, integrated GPS (A-GPS OMA SUPL), WLAN and a TV-out connection. It supports EGSM 850/900/1800/1900 and WCDMA 850/900/1700/1900/2100 bands, and CSD/HSCSD, GPRS/EGPRS and WCDMA/HSDPA data bearers.

For WCDMA the maximum bit rate is up to 384 kbit/s for downlink and 384 kbit/s for uplink with simultaneous CS speech or CS video (max. 64 kbit/s). The HSDPA peak is 3.6 Mbit/s downlink (with limited use cases).

In PS/CS mode, RM-675 supports DTM Class with multi slot class 11 (max. 4 RX + 3TX, sum 5). With EGPRS this means maximum download speed of up to 236.8 kbit/s simultaneously with speech. With GPRS this means maximum download speed of up to 64.2 kbit/s simultaneously with speech.

In PS only mode, RM-675 supports MSC 33 (max. 5 Rx + 4 TX, sum 6) timeslots resulting in maximum download speed of up to 296 kbit/s with EGPRS, and up to 107 kbit/s with GPRS.

RM-675 has a large AMOLED nHD 3.5" (640 x 360 pixels) colour display (active area 43.2 mm x 76.8 mm) with 16 million colors. It also has an 8 megapixel EDOF camera, 2x digital zoom and an integrated dual LED flash. The device supports two-way video calls with two integrated cameras, one on the front and one on the back.

The MMS implementation follows the OMA MMS standard release 1.3. The browser is a highly advanced Internet browser also capable of viewing operator domain XHTML Mobile Profile (MP) content. The device also supports Bluetooth 2.1 EDR standard.

RM-675 uses Symbian ^3 for Nokia devices operating system, and supports the full Web Browser for S60, which brings desktop-like Web browsing experience to mobile devices. It also supports MIDP Java 2.1 , providing a good platform for compelling 3rd party applications.

Figure 1 View of RM-675

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Product features and sales package

Imaging and video

Main camera:

- Sensor: 8 Megapixel EDOF (Extended Depth of Field)
- F number/Aperture: F2.8
- Digital zoom: 2x
- Flash: Integrated dual LED flash

Secondary camera:

- Sensor: VGA (640 x 480 pixels)
- F number/Aperture: F2.8
- Focal length: 1.39 mm

Video:

- Video resolution: 720p (1280 x 720) at 25fps or VGA at 30fps
- Audio recording: AAC (AMR for MMS)
- Video stabilization
- Video clip length: Max. 90 min
- Video file format: .mp4 (default), .3gp (for MMS)
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: Auto, Night
- Colour tone: normal, sepia, B&W, vivid, negative
- Zoom (digital): up to 3x
- Video recording indicator

Photo:

- Aspect ratio: 8MPix (4:1), 6MPix (16:9)
- View finder: full screen view finder
- Still image resolutions: up to 8 megapixel: 3264 x 2448
- Still image file format: JPEG/EXIF
- Auto exposure: center weighted AE
- Image orientation: automatic
- Automatic red eye removal
- Automatic motion blur reduction
- Face tracking
- Exposure compensation: +2 ~ -2EV at 0.5 step
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: auto, portrait, landscape, night, user defined
- Colour tone: normal, sepia, B&W, vivid, negative
- Zoom (digital): up to 2x

Edit

- On device Photo editor and Video editor (manual & automatic)

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View

- 3.5” nHD (640 x 360 pixels) colour display (active area 43.2 mm x 76.8 mm), up to 16M colors, 16:9 aspect ratio
- Digital Ambient Light Sensor (ALS) – used to optimize display/key brightness and power consumption
- Slideshow from Gallery

Share

- Nokia XpressShare - share effortlessly from Gallery or after capture via Email, Bluetooth or MMS
- Direct connection to TV via cable or WLAN (UPnP)
- Video call and video sharing support. (WCDMA services)
- Online Album: Image/Video uploading from Gallery

Print

- Nokia XpressPrint – direct printing via USB (PictBridge), Bluetooth (BPP), and WLAN (UPnP), from memory card or via online printing

Store

- 8 GB internal user memory
- Nokia XpressTransfer – easy to transfer and organize photos and video between your device and a compatible PC
- Nokia Lifeblog (mobile & PC)

Music

- Digital music player: supports MP3/ AAC/ eAAC/ eAAC+/ WMA/ AMR-NB / AMR-WB with playlists, equalizer and album art
- Synchronise music with Microsoft Windows Media Player 10&11
- One click CD ripping, converting and transferring music to your device using Nokia Music Manager
- Stereo FM radio (87.5-108 MHz /76-90 MHz) with Visual Radio™ support
- Bluetooth speakers
- Integrated handsfree speaker

Media

- Full-screen video playback to view downloaded, streamed or recorded video clips
- Supported video formats: MPEG-4 , H.264/AVC, H.263/3GPP, VC-1, Real Video 10, ON2 VP6, Flash video

Productivity

Context management:

- OMA DRM version 2.0
- OTA provisioning & over the air SW update (FOTA)
- Ovi Suite
- Web Browser (OSS), Java ™ MIDP 2.1, XHTML browsing over TCP/IP

Messaging:

- E-mail (SMTP, IMAP4, POP3), MMS, SMS, unified editor
- IM client

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Office applications:

- Viewing of email attachments – .doc, .xls, .ppt, .pdf, .zip
- Mail for Exchange

PIM:

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

Synchronization:

- Local/Remote (using SyncML)
  - Data: Calendar, Contacts, To-do, Notes, E-mail
  - PC Applications: Microsoft Outlook (98, 2000, 2002, 2003), Outlook Express, Lotus Organizer (5.0, 6.0), Lotus Notes (5.0, 6.0)

Call management:

- Call logs, speed dial, voice dialling (with SIND) and voice commands
- Nokia Push to Talk (PoC)

Connectivity

- Integrated GPS (A-GPS OMA SUPL)
- Nokia Maps 3.0, including Friend Finder
- WLAN - IEEE802.11 g/b with UPnP support
- Micro USB interface with USB 2.0 high speed
- Bluetooth wireless technology 2.1 + EDR + A2DP
- FM transmitter
- MicroSD memory card - support up to 32 GB
- Nokia 3.5 mm AV connector
- 2.0 mm DC connector

Add-on software framework

- Symbian ^3 for Nokia devices
- Java: MIDP2.1
- C++ and Java SDKs
- Flash Lite 4.0

Additional technical specifications

- Vibrating alert
- 3GPP Rel 5/6 WCDMA , Rel 4 EGSM compliant
- Speech codecs supported: AMR, NB AMR, WB AMR, FR, EFR
- GPRS/EGPRS Class B, Multi slot class 33
- Dual Transfer Mode (DTM) class A, multi slot class 11
- WCDMA DL 384 kbit/s, UL 384 kbit/s
- HSDPA up to 10.2 Mbps, HSUPA 2 Mbps

Sales package

- Transceiver RM-675
- Charger (AC-15)

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- Battery (BL-5K)
- Music headset (WH-102)
- Connectivity cable (CA-101)
- CD-ROM
- User Guide

Product and module list

Module name	Type code	Notes
System/RF module PWB	3GB	
UI flexi module	3GR	
Flash module	3GU	

Mobile enhancements

Table 1 Audio

Enhancement	Type
Music headset	WH-102
Nokia Wireless Stereo Gateway	AD-42W
Mini speakers	MD-8
	MD-9
Hearing aids	HDA-12
	LPS-5
Wired headsets	WH-102
	WH-205
	WH-502
	WH-700
	WH-701
	WH-800
	WH-900

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Enhancement	Type
Bluetooth headsets	BH-103
	BH-108
	BH-214
	BH-215
	BH-500
	BH-501
	BH-503
	BH-504
	BH-505
	BH-606
	BH-607
	BH-610
	BH-702
	BH-704
	BH-804
	BH-805
	BH-900
	BH-902
	BH-904
	BH-905
Bluetooth speakers	MD-5W
	MD-7W

Table 2 Car

Enhancement	Type
Nokia Universal Mobile Holder	CR-99
	CR-115
Speakerphone	HF-310
	HF-510
Car kit	CK-100
Display car kit	CK-600
Mobile charger	DC-9
	DC-10
	DC-11

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Table 3 Data

Enhancement	Type
Connectivity cable	CA-101
	CA-101D
Micro USB OTG to USB adapter cable	CA-156
MicroSD card	MU-43, 8GB
	MU-44, 16GB
	MU-xx 32GB

Table 4 Messaging

Enhancement	Type
Other multimedia peripherals	SU-33W
Stylus	STYLUS PEN ASSY

Table 5 Power

Enhancement	Type
Battery 1200 mAh Li-ion	BL-5K
Travel charger	AC-6
	AC-8
	AC-10
	AC-15
Multiple charger	DT-600

Technical specifications

Transceiver general specifications

Unit	Dimensions (L x W x T) (mm)	Weight (g)	Volume (cm^3)
Transceiver with BL-5K 1200 mAh Li-ion battery pack	47 x 44 x 5.7	~24.6	~12

Main RF characteristics for GSM850/900/1800/1900 and WCDMA VIII/V/IV/II/I phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900, WCDMA VIII (900), WCDMA V (850), WCDMA IV (1700/2100), WCDMA II (1900) and WCDMA I (2100)

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Parameter	Unit
Rx frequency band	GSM850: 869 - 894MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA VIII (900): 925 - 960 MHz
	WCDMA V (850): 869 - 894 MHz
	WCDMA IV (1700/2100): 2110 - 2155 MHz
	WCDMA II (1900): 1930 - 1990 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 V (850): 824 - 849 MHz
	WCDMA IV (1700/2100): 1710 - 1755 MHz
	WCDMA II (1900): 1850 - 1910 MHz
	WCDMA I (2100): 1920 - 1980 MHz
Output power	GSM850: +5 ...+33 dBm/3.2 mW ... 2 W
	GSM900: +5 ... +33 dBm/3.2 mW ... 2 W
	GSM1800: +0 ... +30 dBm/1.0 mW ... 1 W
	GSM1900: +0 ... +30 dBm/1.0 mW ... 1 W
	WCDMA VIII (900): -50 ... +24 dBm/0.01 µW ... 251 mW
	WCDMA V (850): -50 ... +24 dBm/0.01 µW ... 251 mW
	WCDMA IV (1700/2100): -50 ... +24 dBm/0.01 µW ... 251 mW
	WCDMA II (1900): -50 ... +21 dBm/0.01 µW ... 126 mW
	WCDMA I (2100): -50 ... +24 dBm/0.01 µW ... 251 mW
EDGE output power	EDGE850: +5 ... +29dBm/3.2mW ... 794mW
	EDGE900: +5 ... +29dBm/3.2mW ... 794mW
	EDGE1800: +0 ... +26dBm/1.0mW ... 400mW
	EDGE1900:+0 ... +26dBm/1.0mW ... 400mW

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Parameter	Unit
Number of RF channels	GSM850: 124
	GSM900: 174
	GSM1800: 374
	GSM1900: 299
	WCDMA VIII (900): 152
	WCDMA V (850): 108
	WCDMA IV (1700/2100): 211
	WCDMA II (1900): 289
	WCDMA I (2100): 277
Channel spacing	200 kHz (WCDMA II, IV and V 100/200 kHz)
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16
	WCDMA VIII (900): 75
	WCDMA V (850): 75
	WCDMA IV (1700/2100): 75
	WCDMA II (1900): 75
	WCDMA I (2100): 75

Battery endurance

Battery	Capacity (mAh)	Talk time	Stand-by	Music playback	Video playback H.264 720p 30fps
BL-5K	1200	TBA	TBA	TBA	TBA

Environmental conditions

Temperature conditions

Environmental condition	Ambient temperature	Notes
Normal operation	-15ºC...+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.

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Environmental condition	Ambient temperature	Notes
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 submersion 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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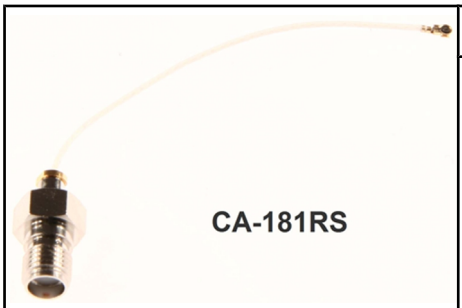
Service tools

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 RM-675; RM-691. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.



CA-181RS	RF tuning cable	

CA-181RS is a product-specific adapter cable for RF tuning with the module jig.

MJ-277	Module jig	

MJ-277 is meant for troubleshooting, testing, tuning and flashing on the engine level (CU-4 supported).

The jig includes an RF interface for GSM, WCDMA, WLAN and Bluetooth. In addition, it has the following features:

- Provides mechanical interface with the engine module
- Provides galvanic connection to all needed test pads in module
- Multiplexing between USB and FBUS media, controlled by Vusb
- MMC interface
- Duplicated SIM connector
- Connector for control unit
- Access for AV- and USB connectors
- CA-181RS cable is used together with this jig for RF testing
-

Attenuation values for galvanic RF connection MJ-277

Band	Default f/ MHz RX	Att. RX	Default f/ MHz TX	Att. TX
GSM 850	881.6	0.30	836.6	0.29
GSM 900	942.4	0.33	897.4	0.31
GSM 1800	1842.8	0.40	1747.8	0.38
GSM 1900	1960.0	0.44	1880.0	0.41
WCDMA I	2140.0	0.52	1950.0	0.44
WCDMA II	1960.0	0.44	1880.0	0.41
WCDMA IV	2140.0	0.52	1740.0	0.38
WCDMA V	880.0	0.30	835.0	0.29
WCDMA VIII	942.6	0.33	897.6	0.31
WLAN	2442.0	5.0	2442.0	5.0

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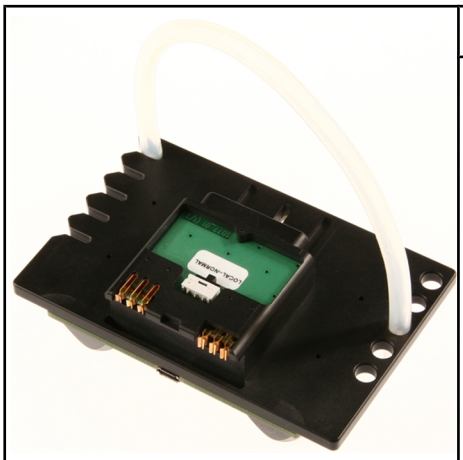
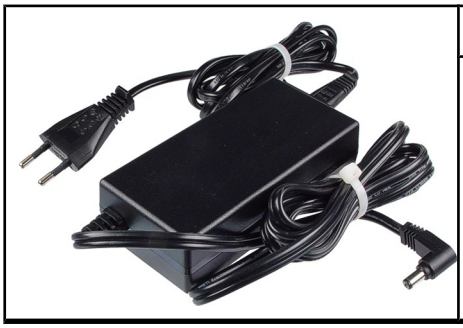
	SD-77	Dummy battery	
	SD-77 is designed to support mass SW flashing which enables local mode while connecting the phone. This dummy battery can be used with Nokia battery types BL-5K, BV-4D, BL-4D, BP-4L.		
	SS-231	RF coaxial cable tool	
	SS-231 is an RF coaxial cable tool designed to remove/connect the RF coaxial cable from the RF connector on PWB. This tool can also be used for the RF connection between CA-181RS and module jig for RF tuning.		
	SS-250	Display removal tool	
	SS-250 is used for removing the display from the chassis assembly.		

General tools

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-675; RM-691. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

	AC-35	Power supply	
	Universal power supply for FPS-21; included in the FPS-21 sales package. Input 100V...230V 50Hz...60Hz, output voltage of 12 V and output current up to 3 A.		

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ACF-8	Universal power supply	
The ACF-8 universal power supply is used to power FLS-5.		

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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.

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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 PK-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.

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	JXS-1	RF shield box	
	Because the WCDMA network disturbs the RX side testing of the WCDMA phone and the Tx signal of the WCDMA phone can severely disturb the WCDMA network, a shield box is needed in all testing, tuning and fault finding which requires WCDMA RF signal. The shield box is not an active device, it contains only passive filtering components for RF attenuation.		
	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.		
	SB-6	Bluetooth test and interface box (sales package)	
	The SB-6 test box is a generic service device used to perform Bluetooth bit error rate (BER) testing, and establishing cordless FBUS connection via Bluetooth. An ACP-8x charger is needed for BER testing and an AXS-4 cable in case of cordless interface usage testing . Sales package includes: • SB-6 test box • Installation and warranty information		
	SB-7	WLAN test box	
	WLAN test requires defined position for the device.		

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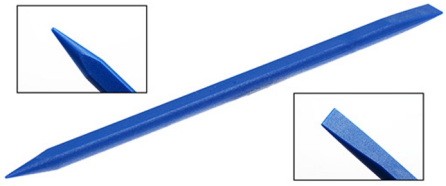
	SRT-6	Opening tool	
	SRT-6 is used to open phone covers. **Note:** The SRT-6 is included in the Nokia Standard Toolkit.		
	SS-210	Camera removal tool	
	The camera removal tool SS-210 is used to remove/attach the camera module from/to the socket.		
SS-46 	SS-46	Interface adapter	
	SS-46 acts as an interface 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 • 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.		

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	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 RM-675; RM-691. 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-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.		

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CA-89DS	Cable	
Provides VBAT and Flashbus connections to mobile device programming adapters.		

DAU-9S	MBUS cable	
The MBUS cable DAU-9S has a modular connector and is used, for example, between the PC's serial port and module jigs, flash adapters or docking station adapters. **Note:** Docking station adapters valid for DCT4 products.		

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.		

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	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: • GSM850/900: 0.3+-0.1 dB • GSM1800/1900: 0.5+-0.1 dB • WCDMA/WLAN: 0.6+-0.1dB		

Installation instructions for CA-181RS

You need the following equipment in installing the CA-181RS:

- RF connector tool SS-231
- Engine module
- Module jig MJ-277

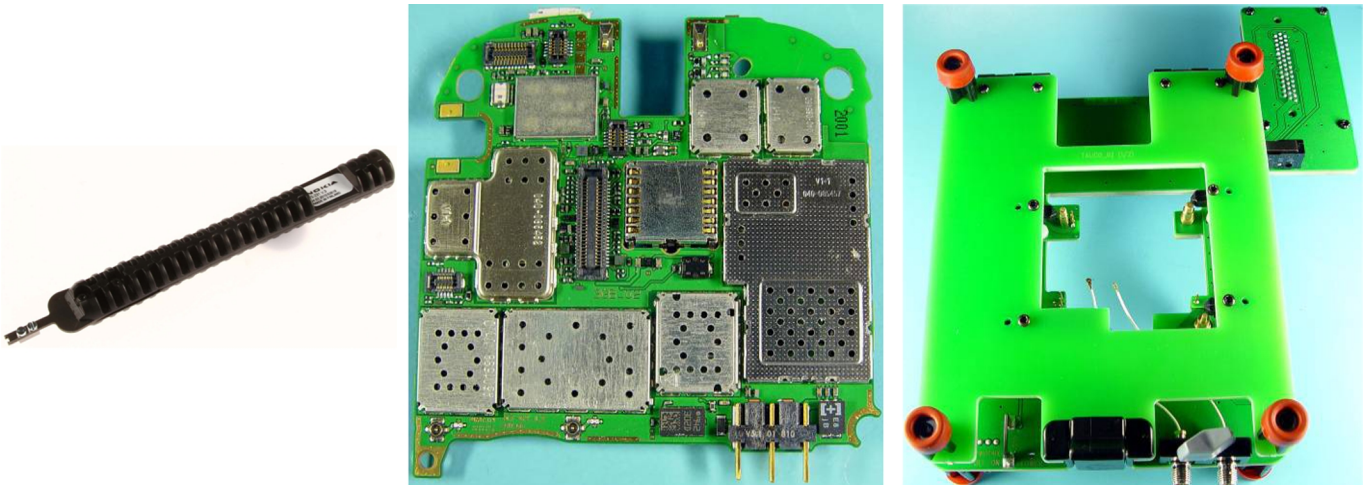

Figure 2 RF connector tool SS-231, engine module and module jig MJ-277

1 Open the frame of MJ-277 module jig.

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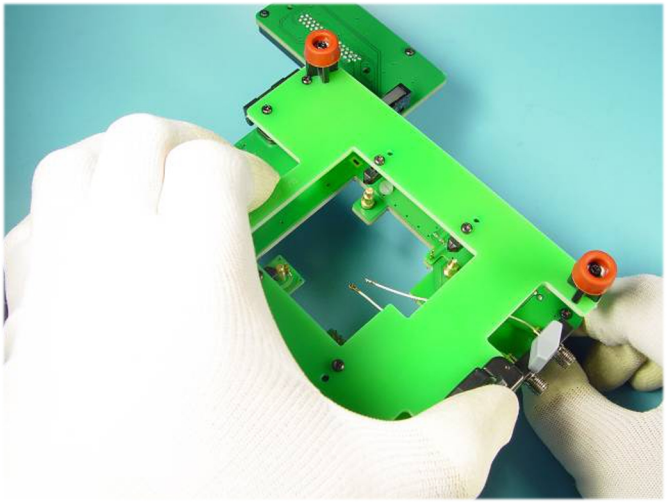
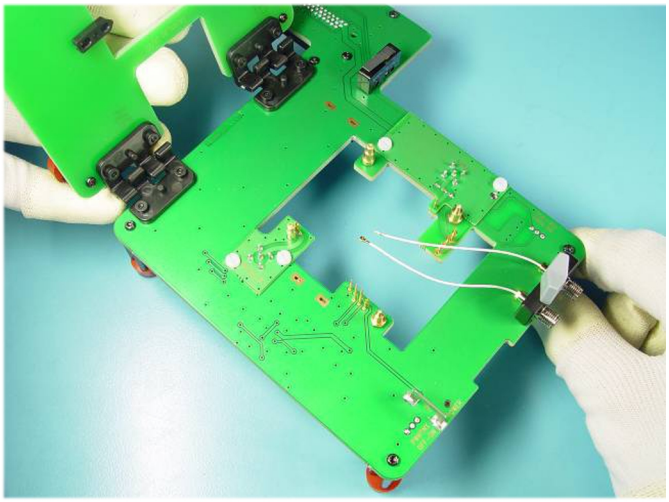
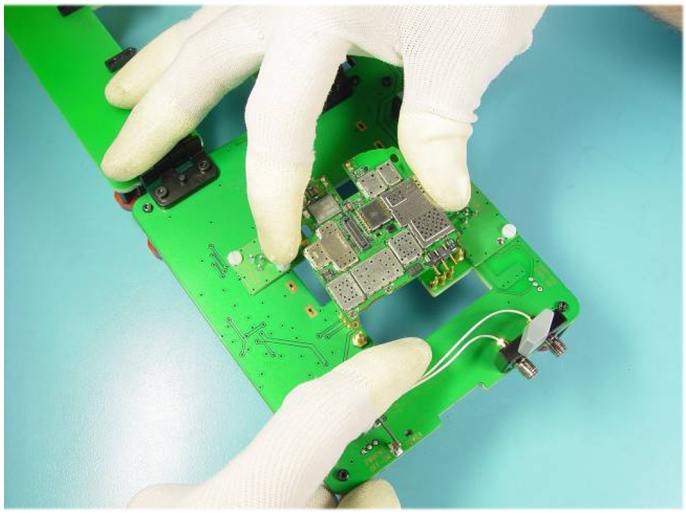
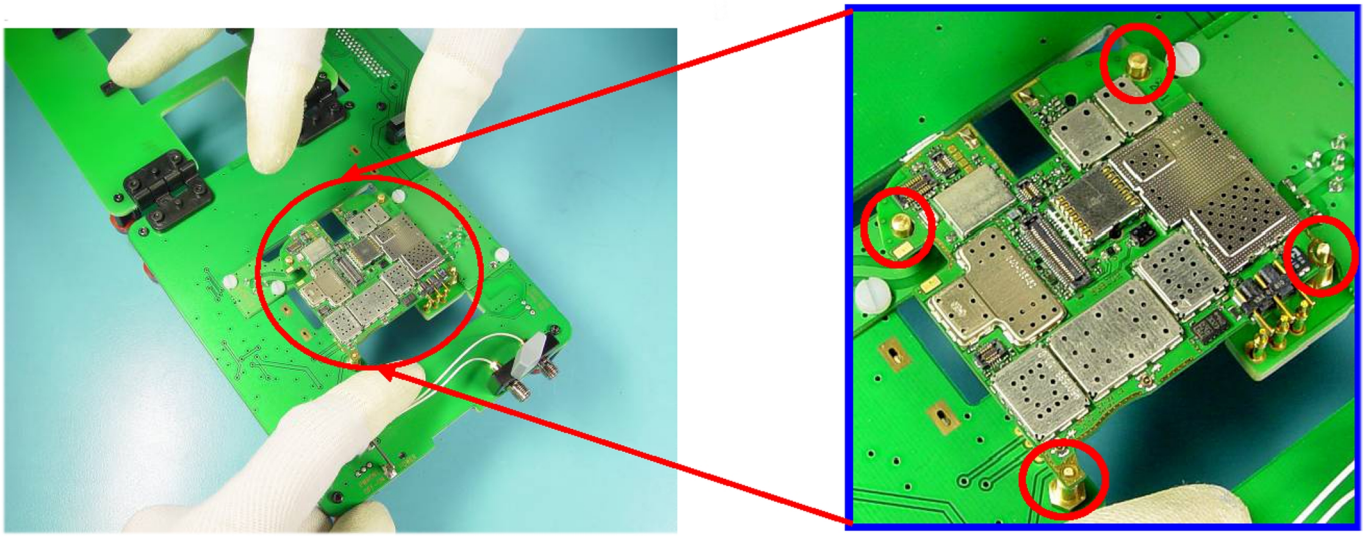




2 Insert the engine module.



Take care of the right alignment according to the guiding pins.



Note the position of the CA-181RS RF cables.

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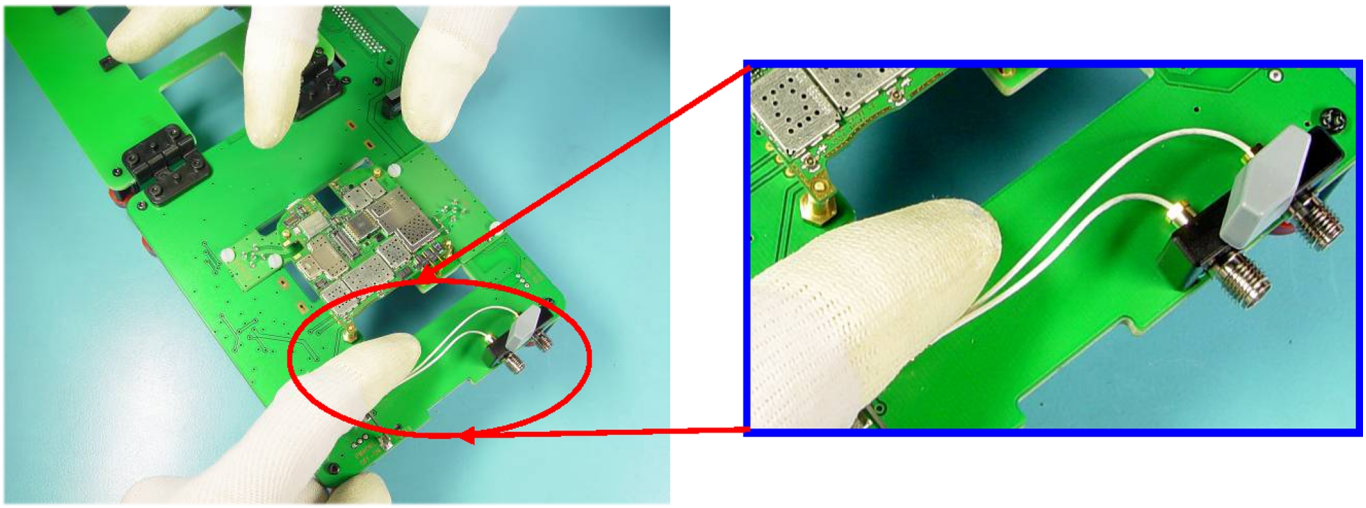

3 Insert the first RF cable plug into the predefined location of the RF connector assembly tool SS-231.

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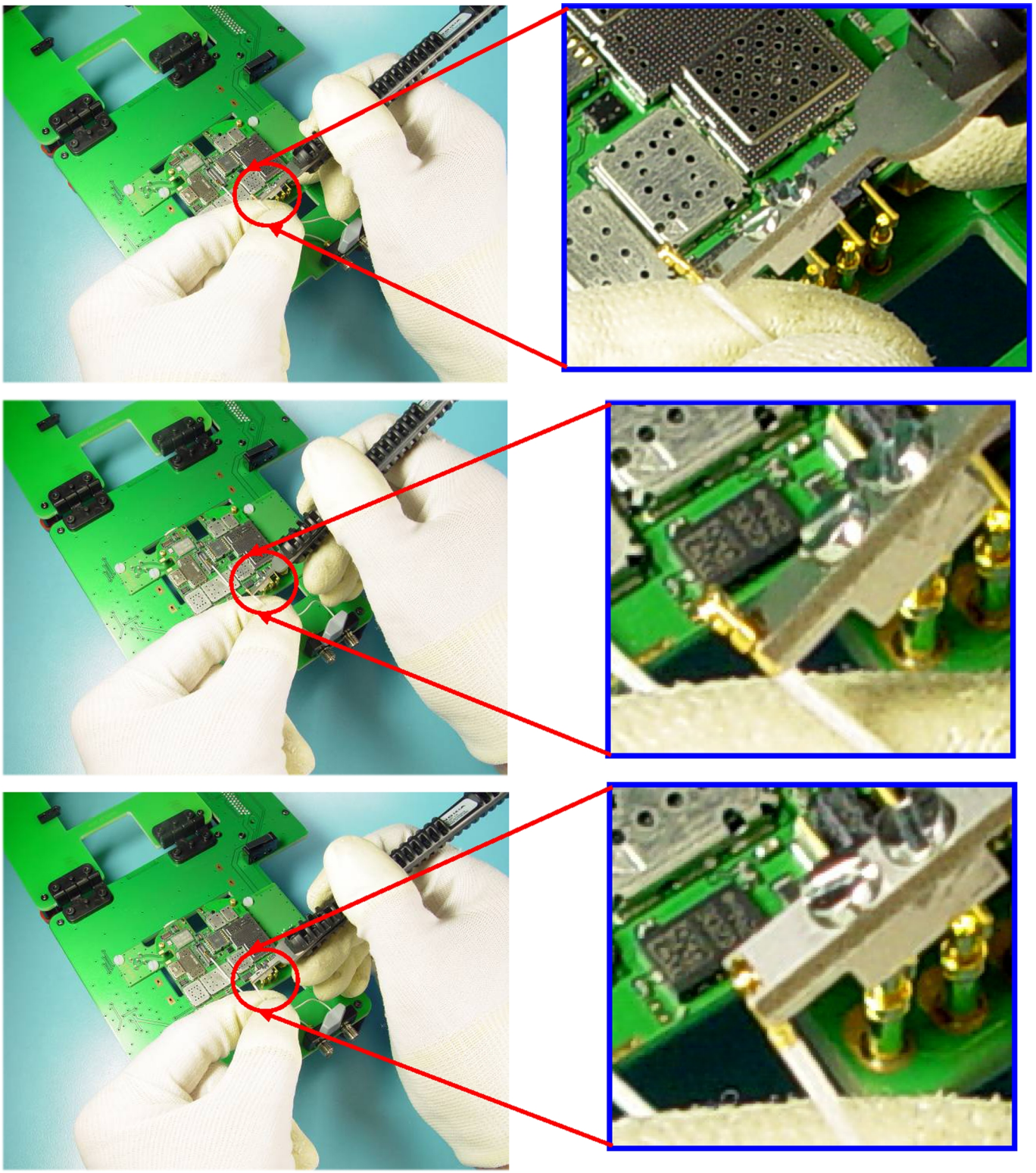

4 Connect the RF cable plug to the corresponding RF connector on the engine module.

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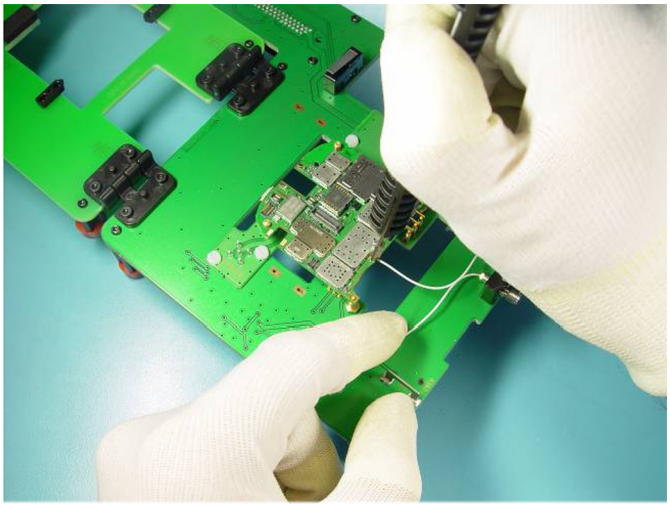
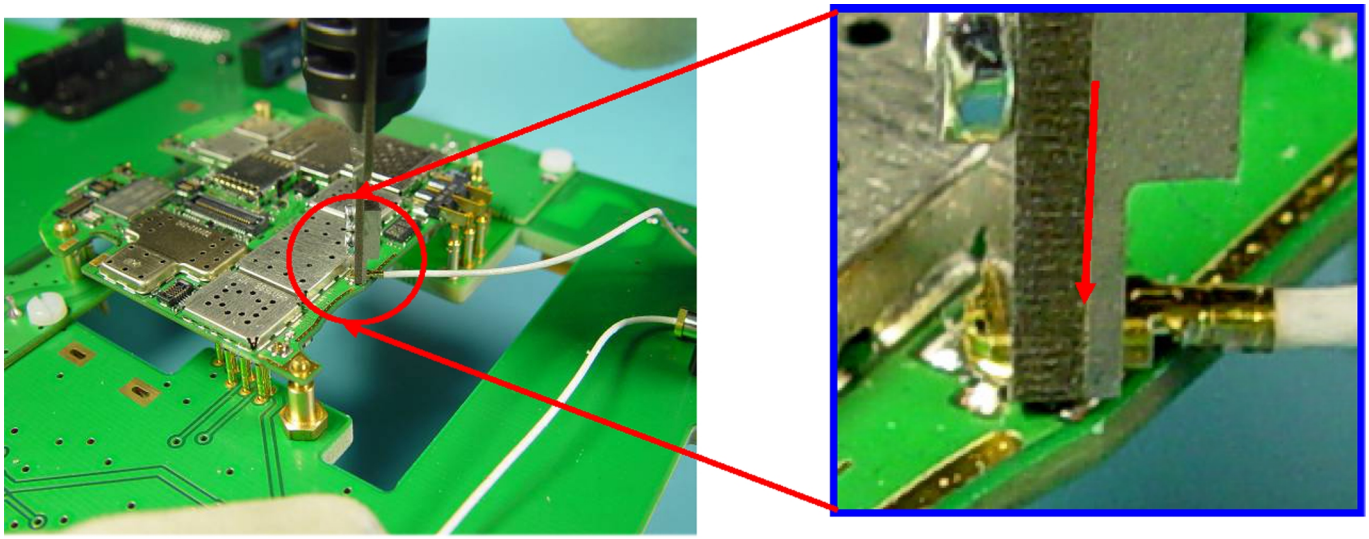


5 Carefully press down the RF connector tool.



6 Do the same procedure with the second RF cable as well.

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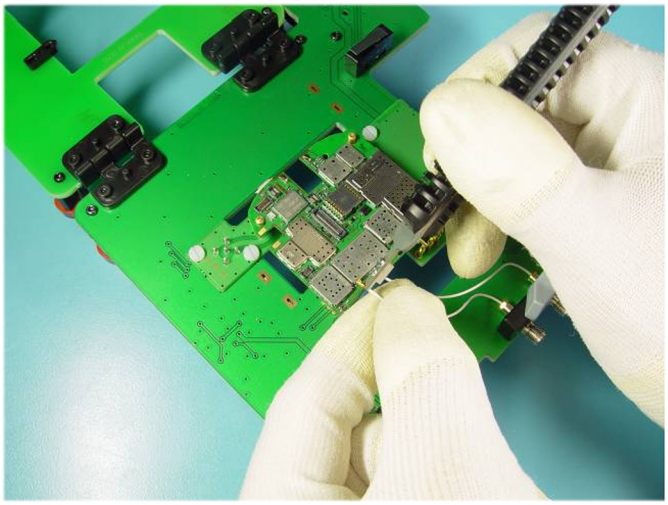

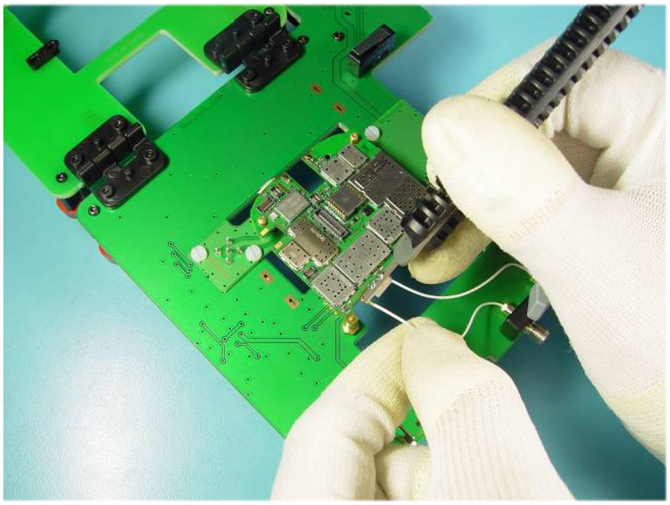

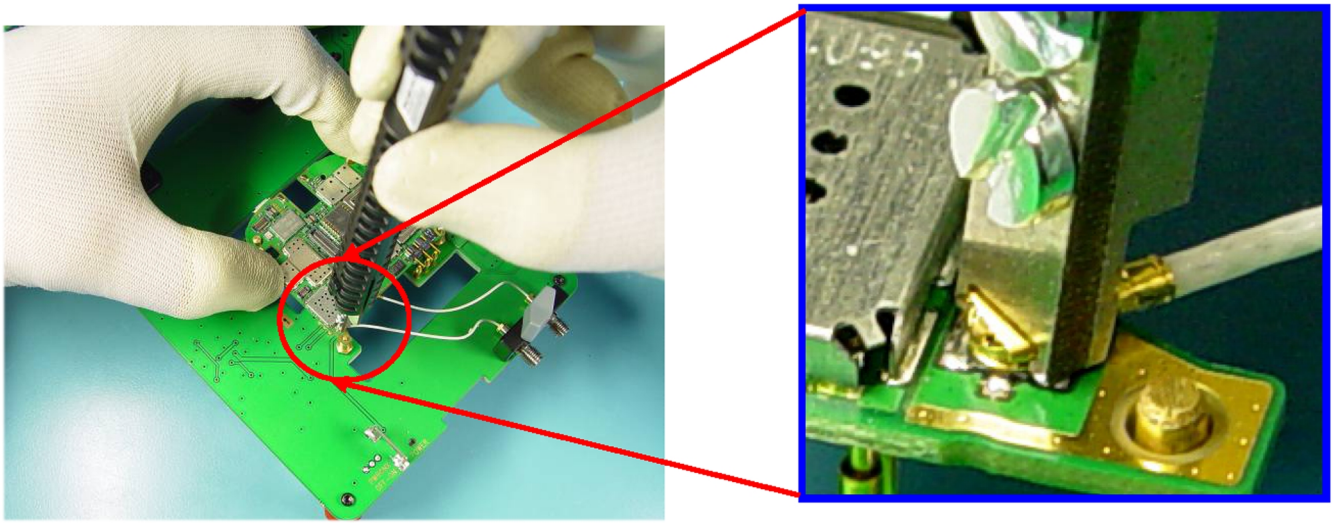

7 Take care of the cables during closing of the frame.

8 Close the module jig.

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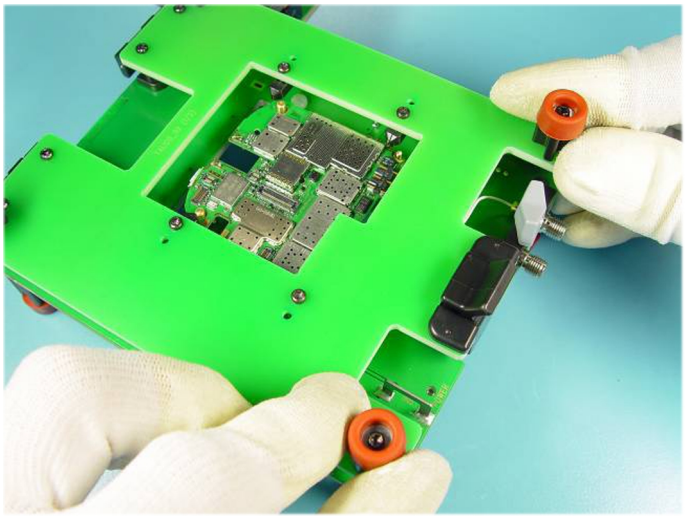
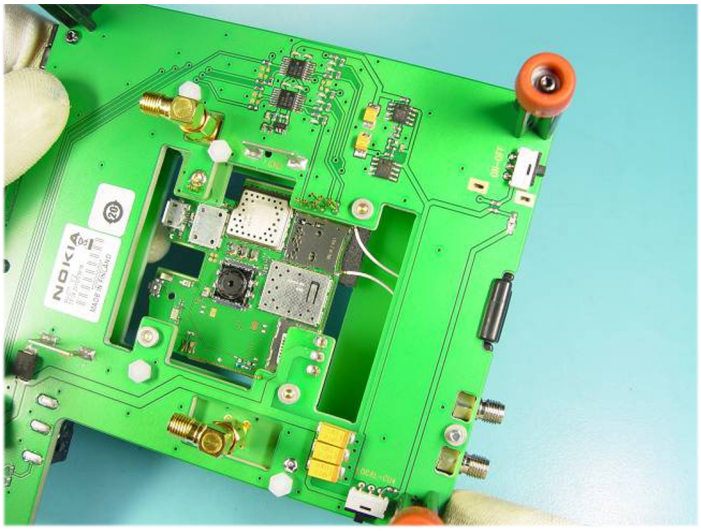
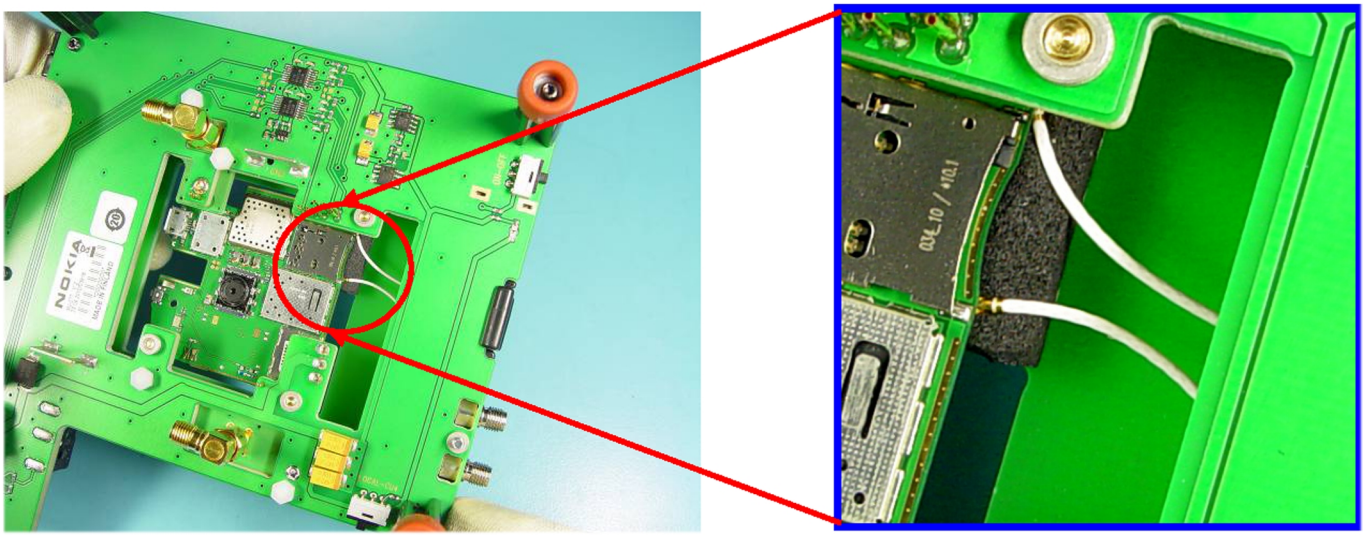


9 Turn around the module jig and check that the RF cables are in the right position on the gasket.





10 To remove the RF cable, insert SS-231 to the RF cable connector plug.

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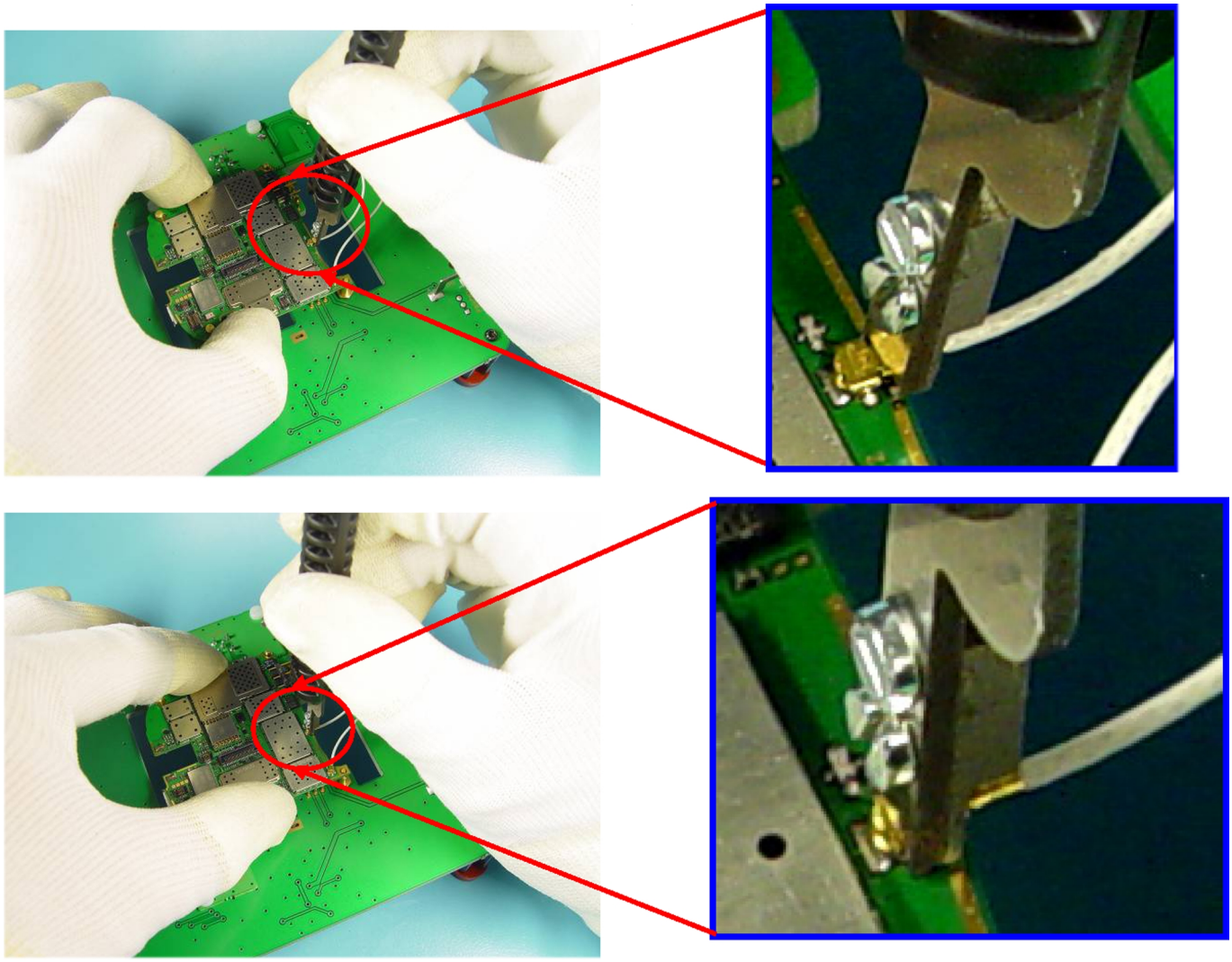
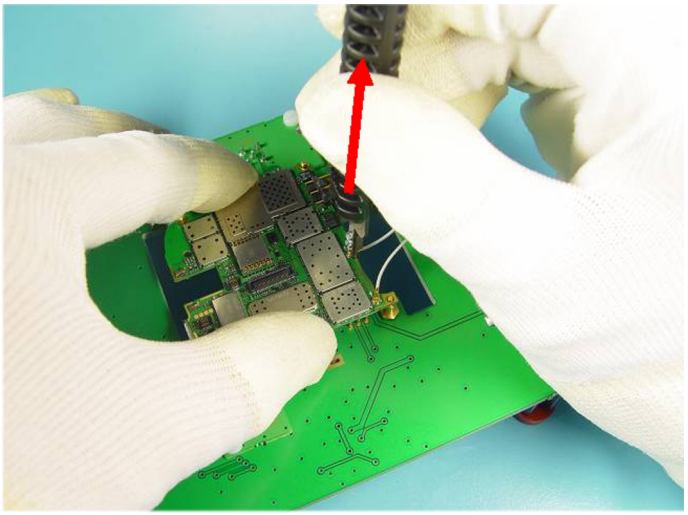


11 To open the connection, lift SS-231 up vertically.



Note: The RF connection is very fragile. Please handle it very carefully to prevent any damaging of the RF connectors.

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Service concepts

POS (Point of Sale) flash concept

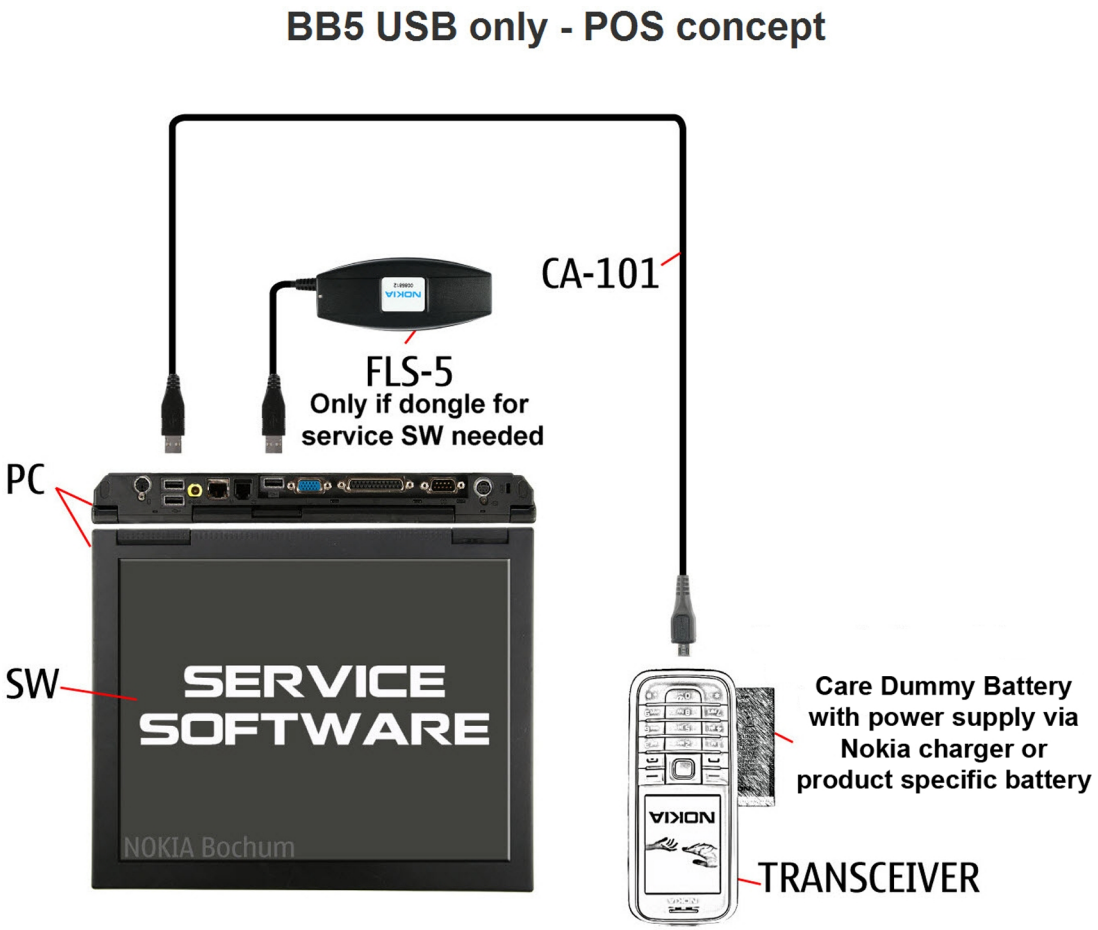

Figure 3 POS flash concept

Type	Description
Product specific tools	
SD-77	Care dummy battery
Other tools	
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
CA-101	Micro USB cable

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BB5 USB only – Basic flash concept L3

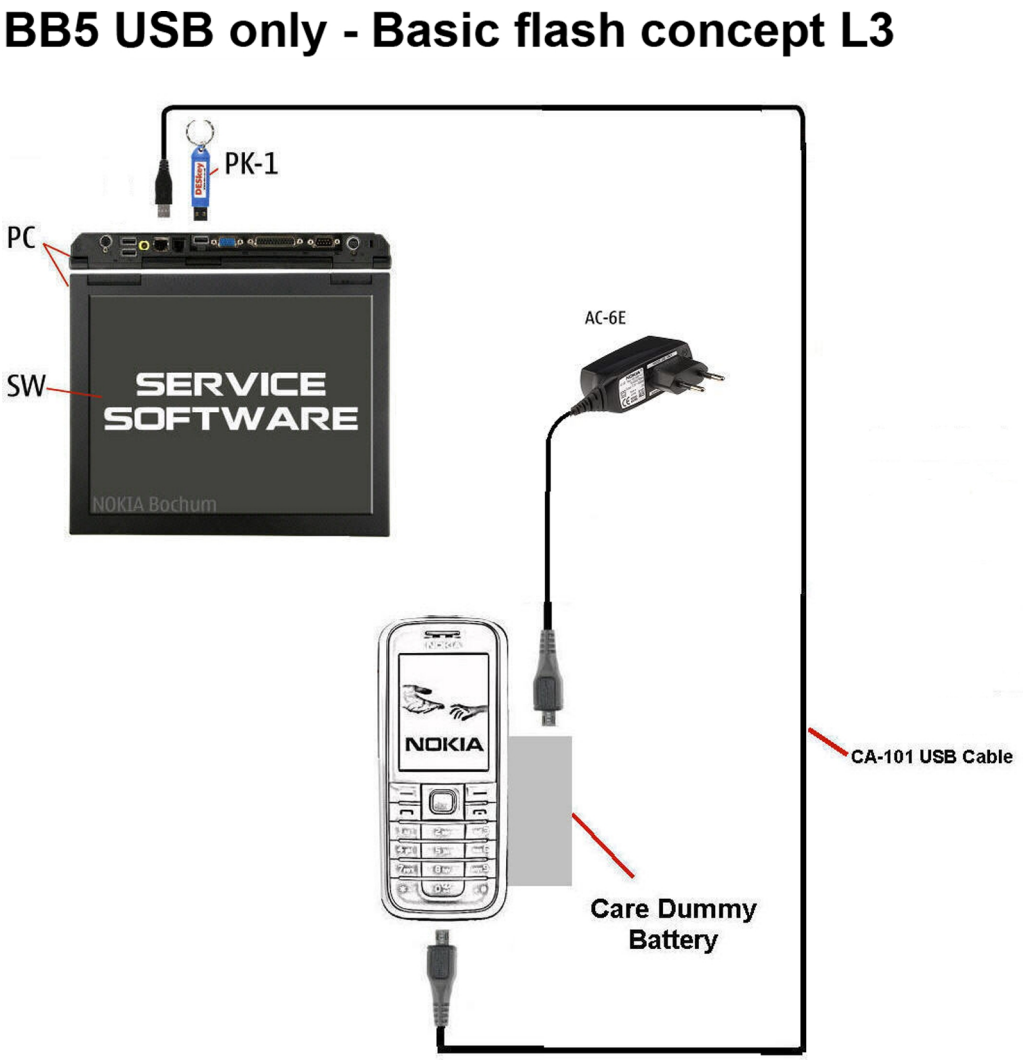

Figure 4 BB5 USB only – Basic flash concept L3

Type	Description
Product specific devices	
SD-77	Care dummy battery
Other devices	
PK-1	SW security device
	PC with Phoenix service software
Cables	
CA-101	Micro USB cable

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Level 3 concept for flashing, certificate restore and product code change option 3

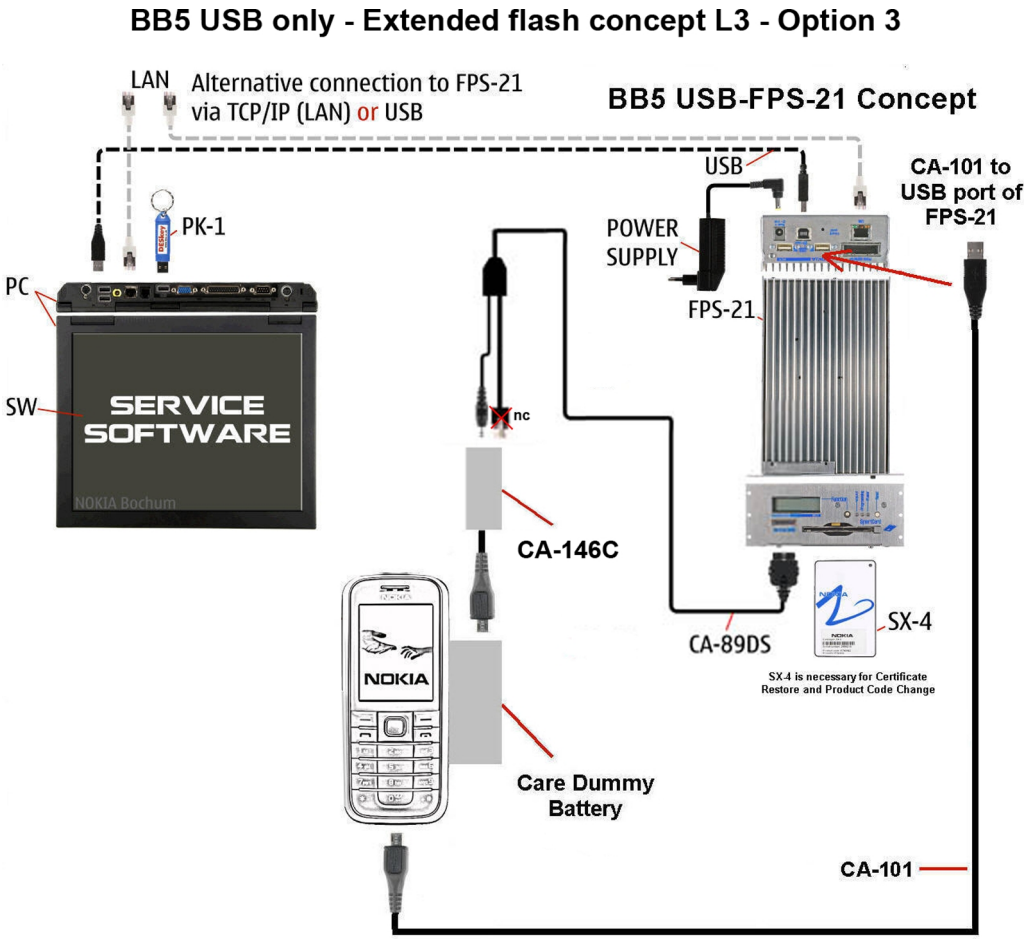

Figure 5 Level 3 concept for flashing, certificate restore and product code change

Type	Description
Product specific devices	
SD-77	Care dummy battery
Other devices	
CA-146C	Power conversion adapter
FPS-21	Flash prommer box
AC-35	Power supply
PK-1	SW security device
SX-4	Smart card (for DCT-4 generation mobile device programming)
	PC with Phoenix service software
Cables	
CA-101	Micro USB cable
CA-89DS	Service cable

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Module jig service concept

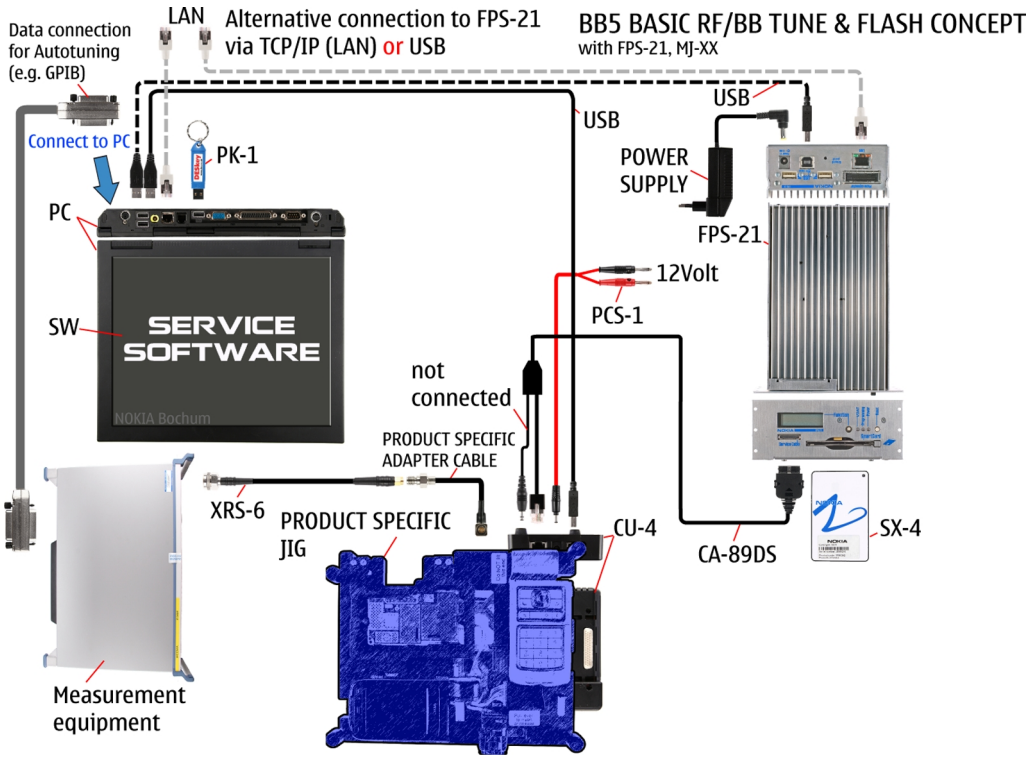

Figure 6 Module jig service concept

Type	Description
Phone specific devices	
MJ-277	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
	USB cable
	GPIB control cable

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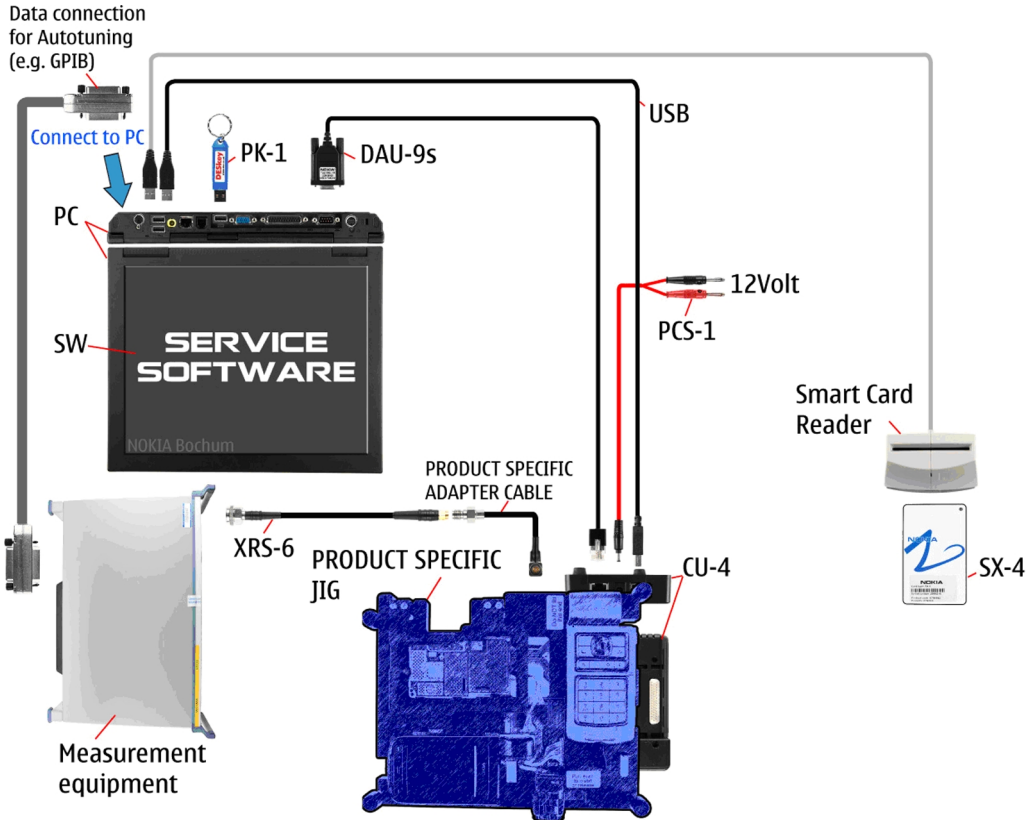
BB/RF tuning concept with module jig



Type	Description
Product specific tools	
MJ-277	Module jig
Other tools	
CU-4	Control unit
PK-1	SW security device
SX-4	Smart card
	PC with Phoenix service software
	Smart card reader
Cables	
DAU-9S	MBUS cable
PCS-1	Power cable
XRS-6	RF cable
	USB cable

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Bluetooth testing concept with SB-6

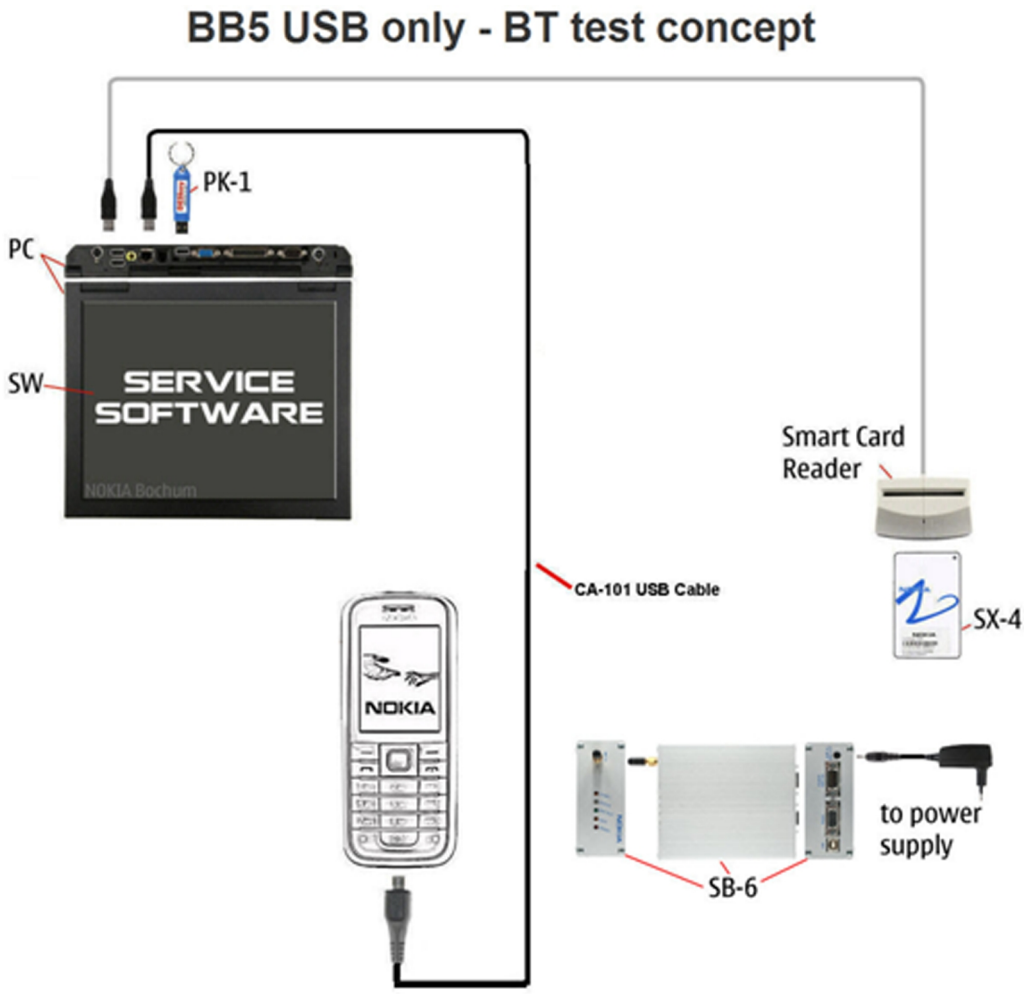

Figure 7 Bluetooth testing concept with SB-6

Type	Description
Product specific devices	
BL-5K	Battery
Other devices	
PK-1	SW security device
SX-4	Smart card
SB-6	Bluetooth test and interface box
	Smart card reader
	PC with Phoenix service software
Cables	
CA-101	Micro USB cable

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WLAN functionality testing concept with SB-7

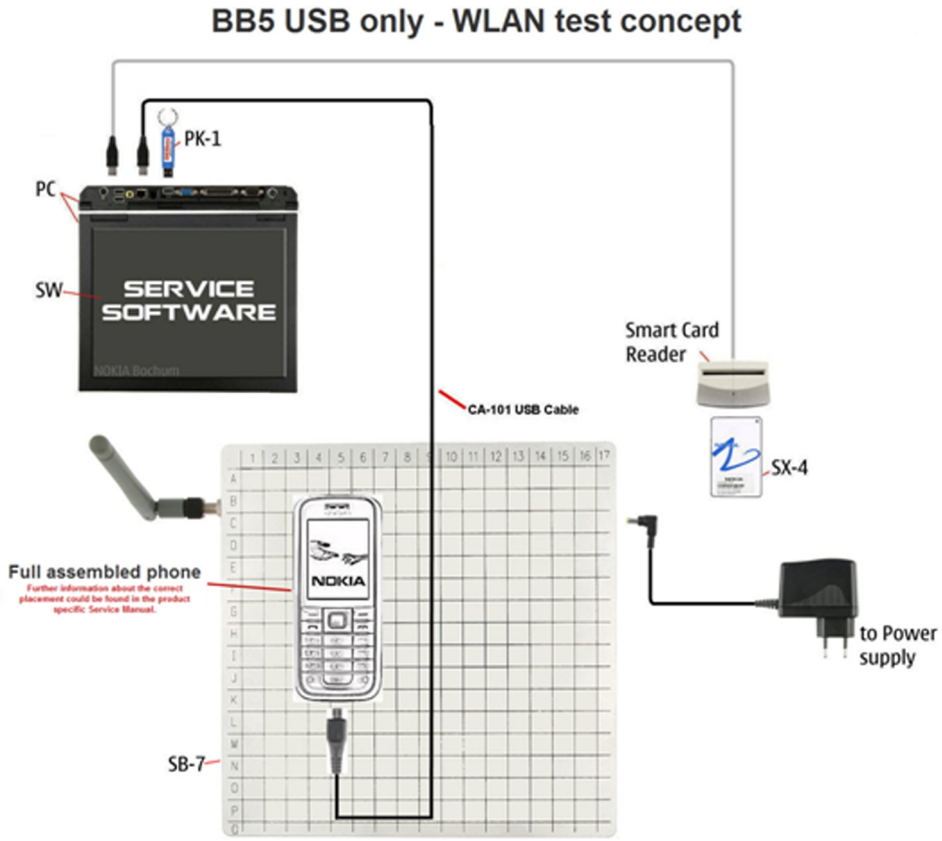

Figure 8 WLAN functionality testing concept with SB-7

Type	Description
Product specific tools	
BL-5K	Battery
Other tools	
SX-4	Smart card
PK-1	SW Security device **Note:** PK-1 can be used instead of PKD-1.
Cables	
CA-101	Micro USB cable

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3 — BB Troubleshooting and Manual Tuning Guide

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Baseband main troubleshooting

Context

Always start the troubleshooting procedure by running the Phoenix self tests. If a test fails, please follow the diagrams below. If the phone is dead and you cannot perform the self tests, go to *Dead or jammed device troubleshooting*.

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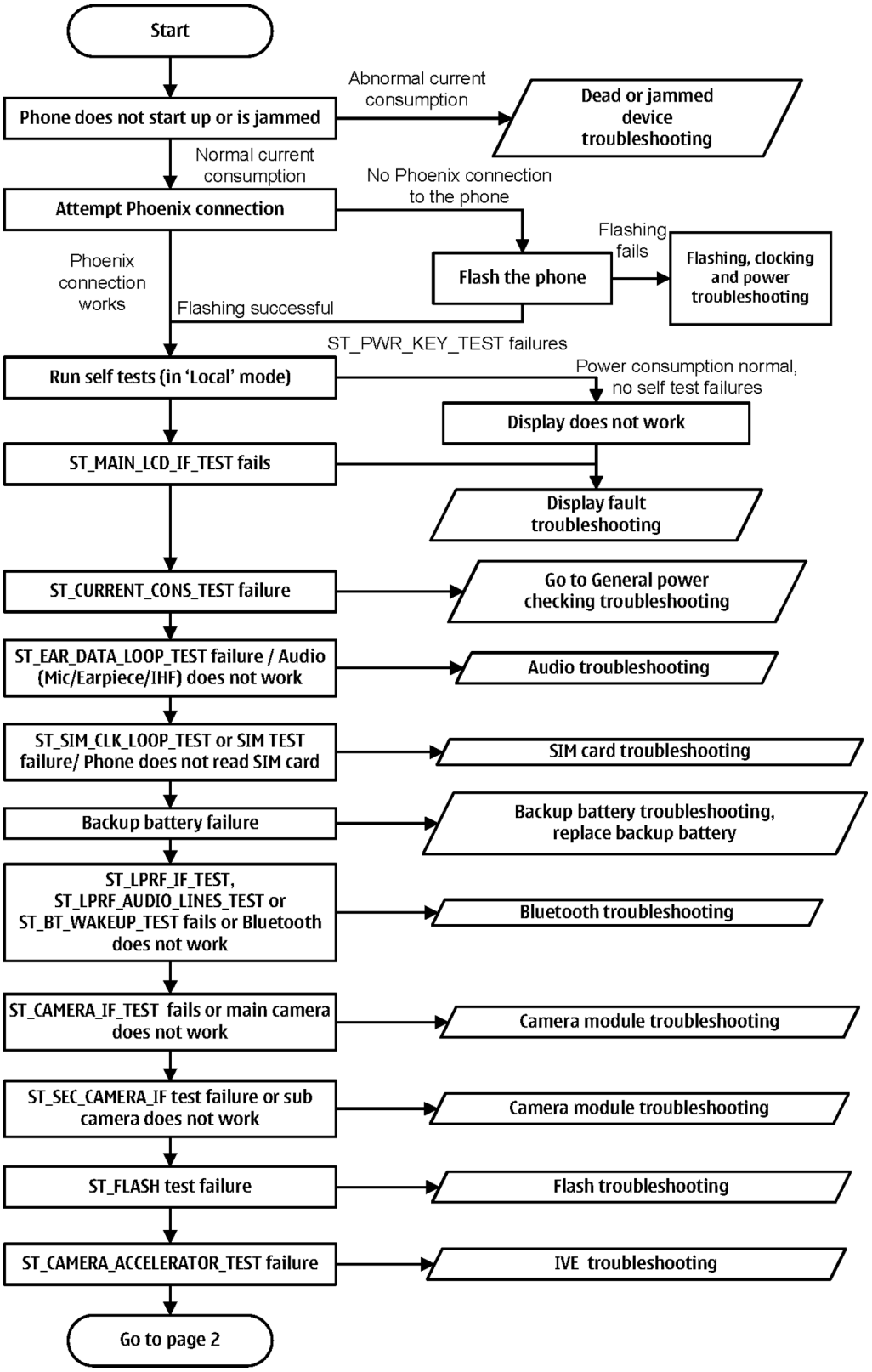
Troubleshooting flow - Page 1 of 3



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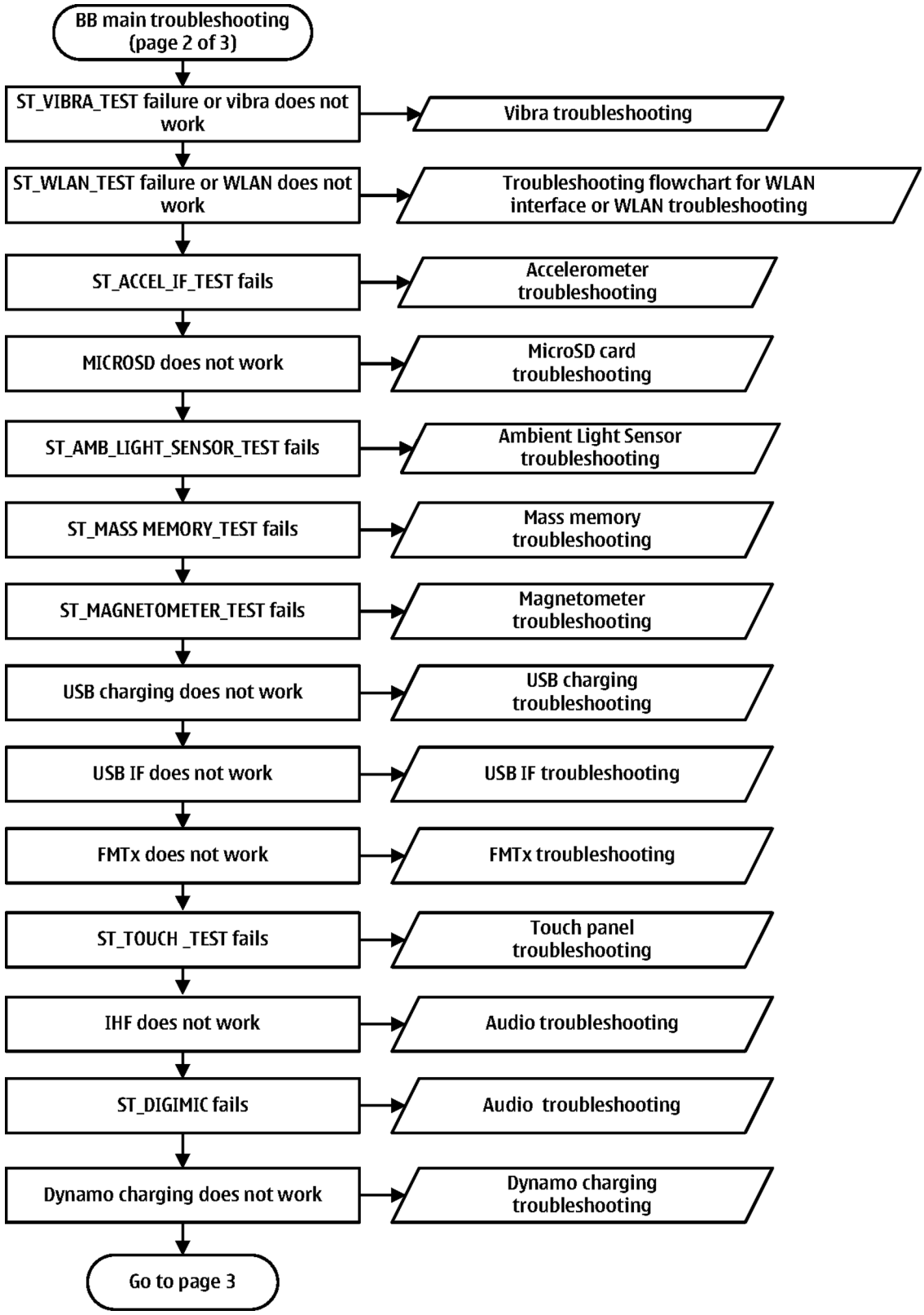
Troubleshooting flow - Page 2 of 3



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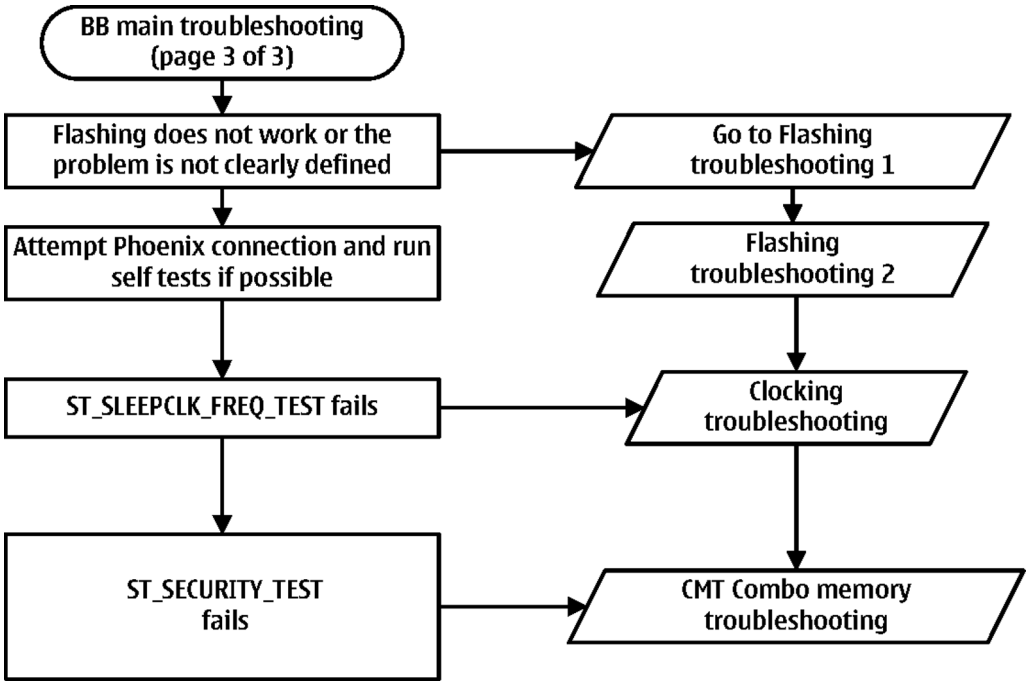
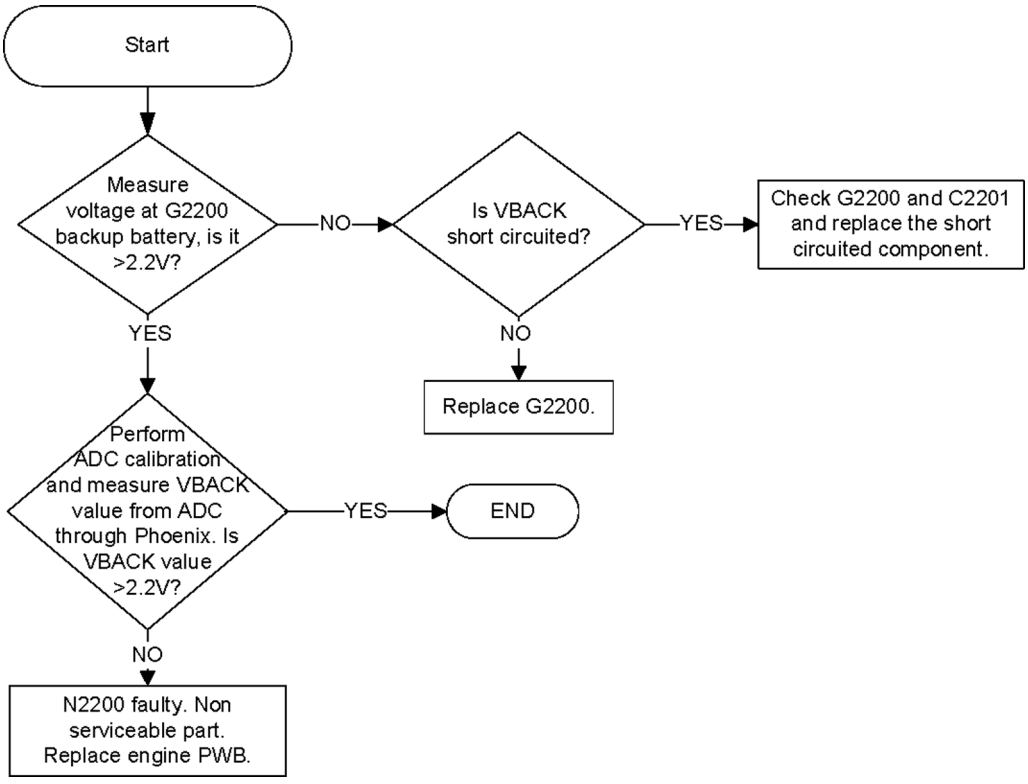
Troubleshooting flow - Page 3 of 3



Power and charging troubleshooting

Backup battery troubleshooting

Troubleshooting flow



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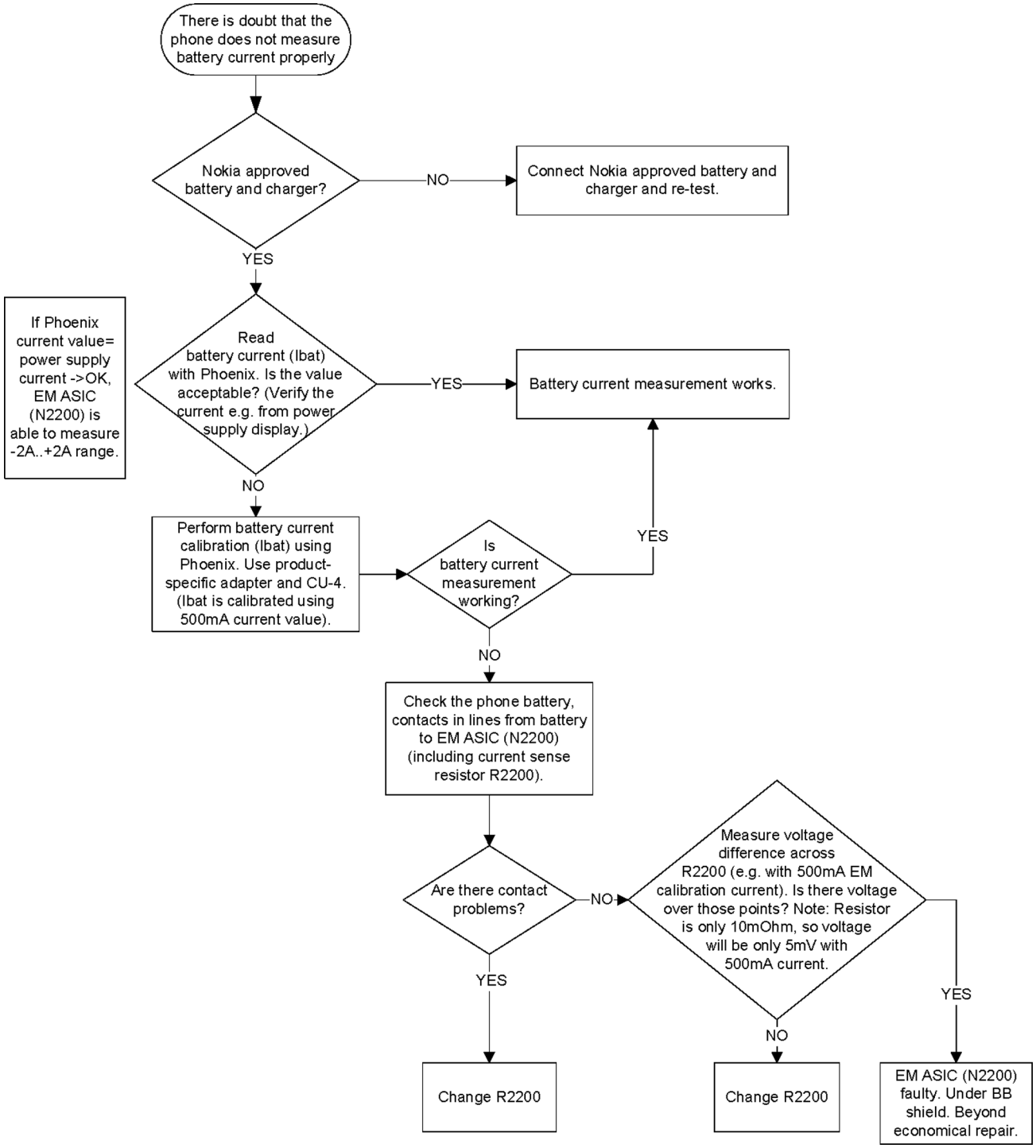
Battery current measuring fault troubleshooting

Troubleshooting flow



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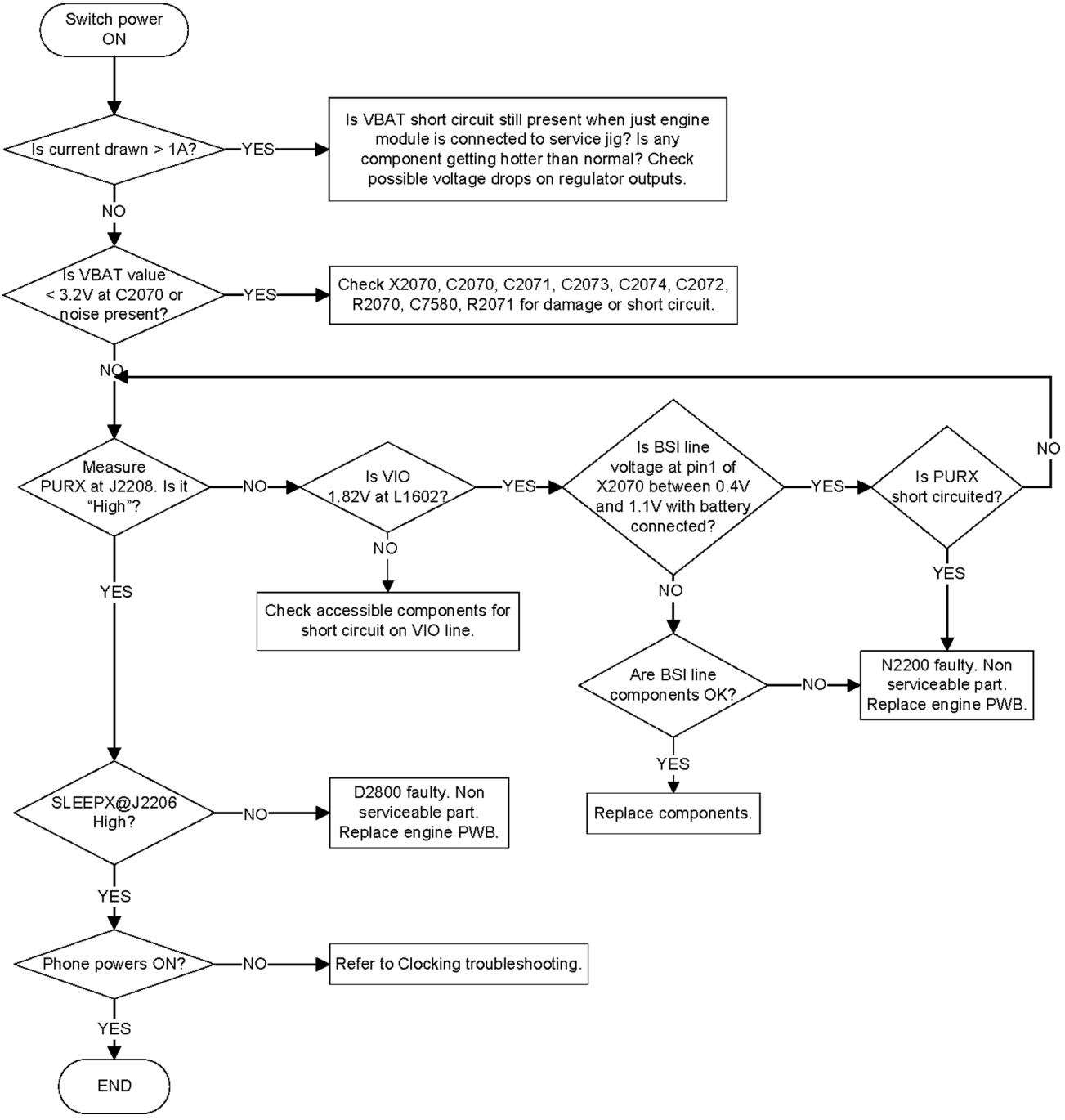
General power checking troubleshooting

Troubleshooting flow



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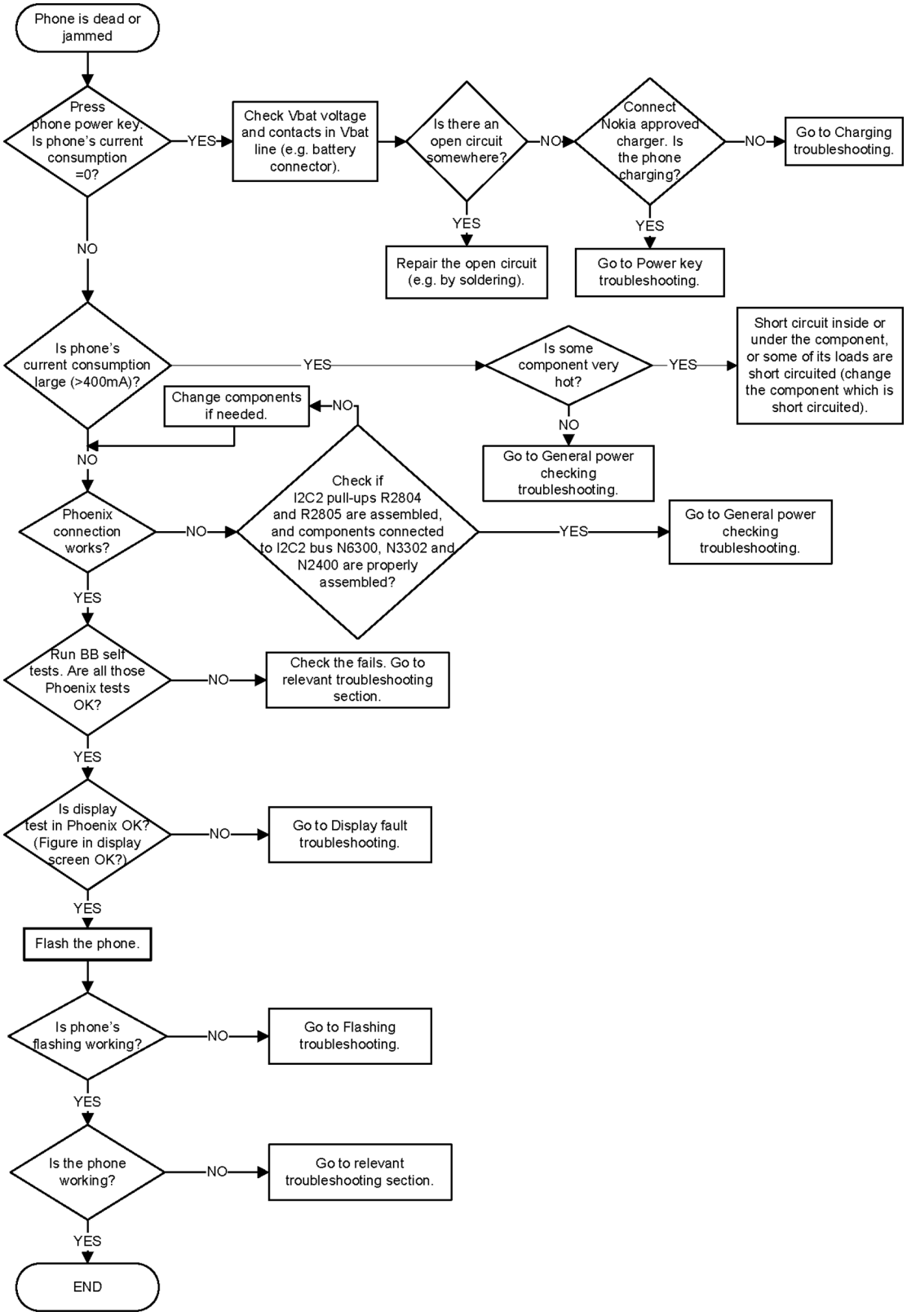
Dead or jammed device troubleshooting

Troubleshooting flow



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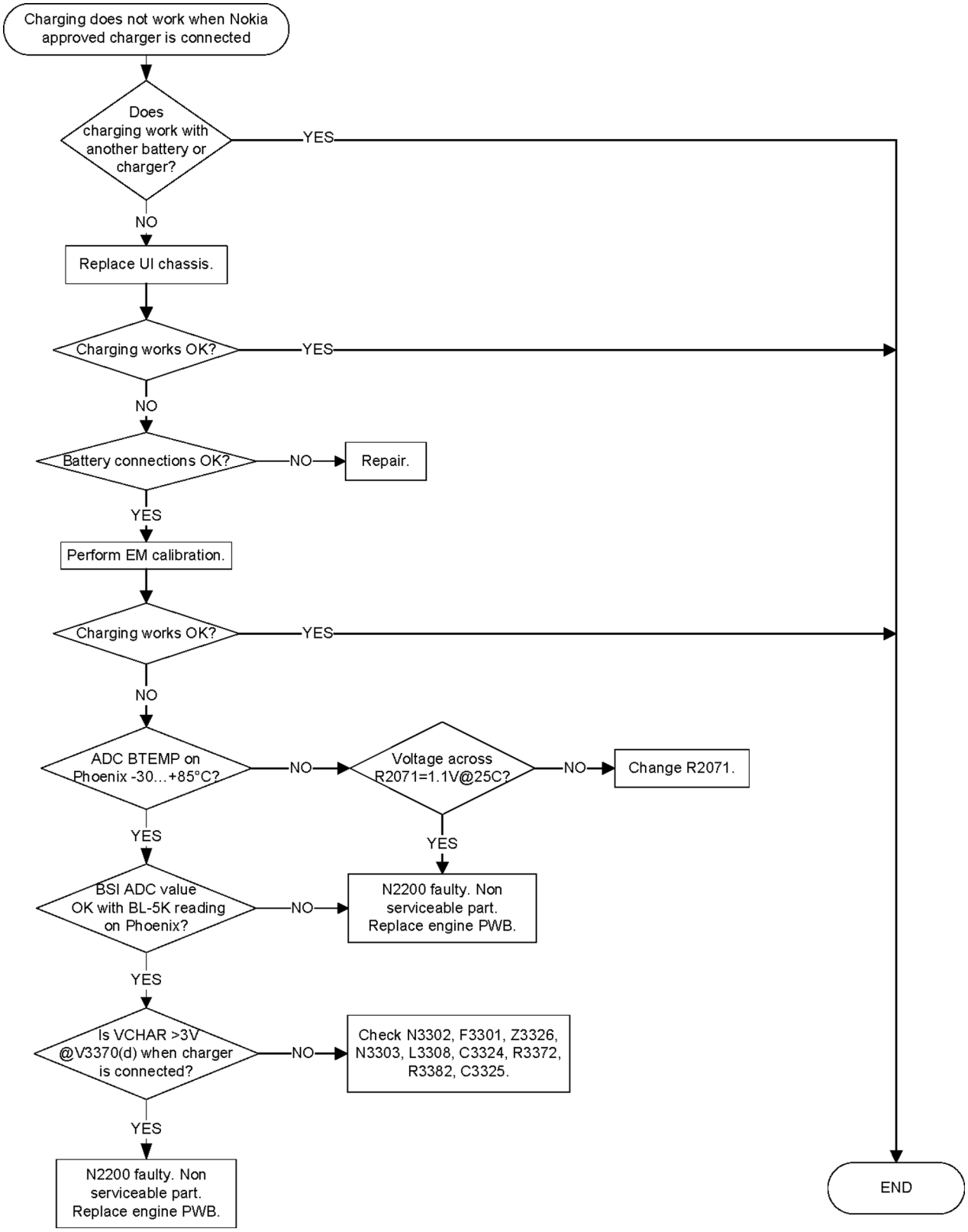
Dynamo charging troubleshooting

Troubleshooting flow



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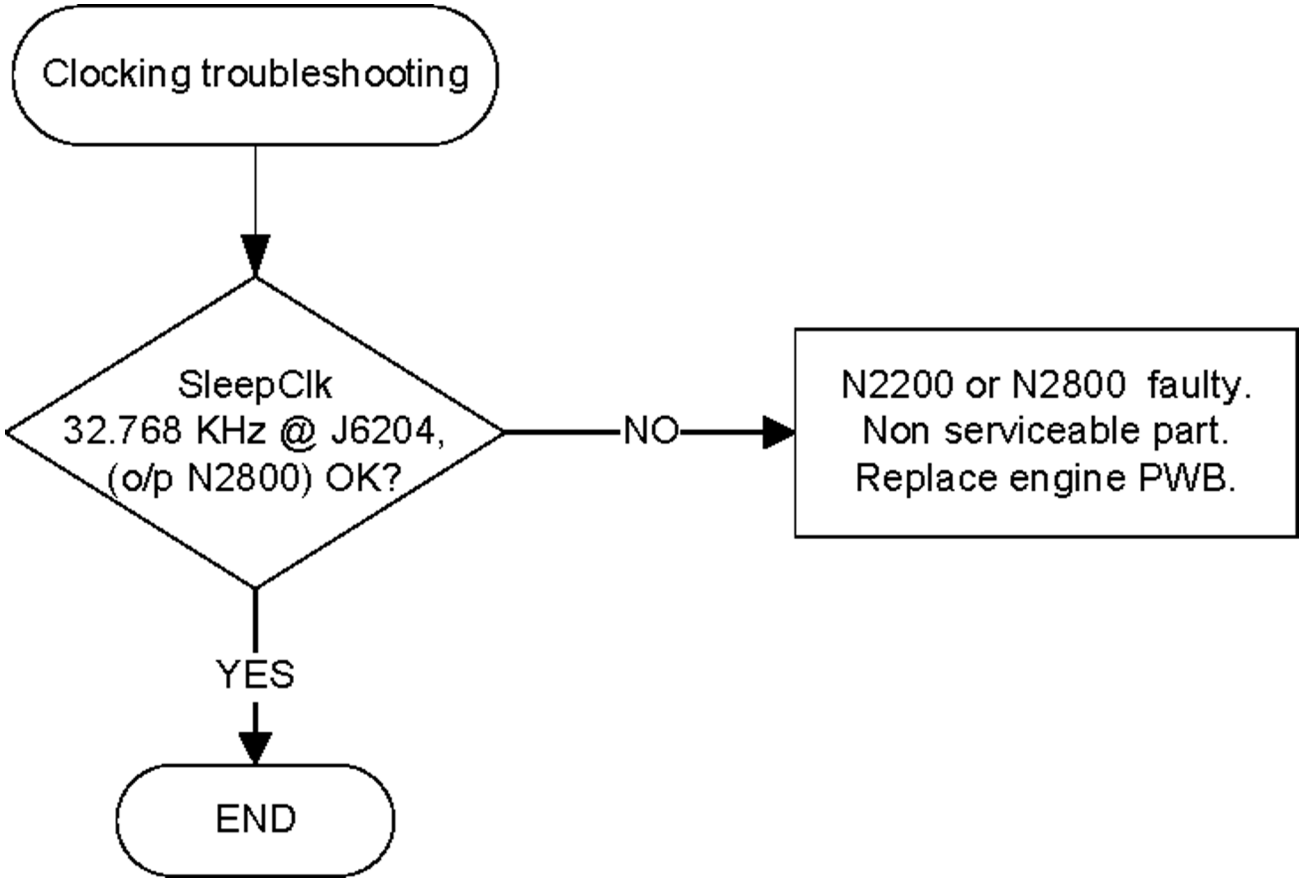
Clocking troubleshooting

Troubleshooting flow



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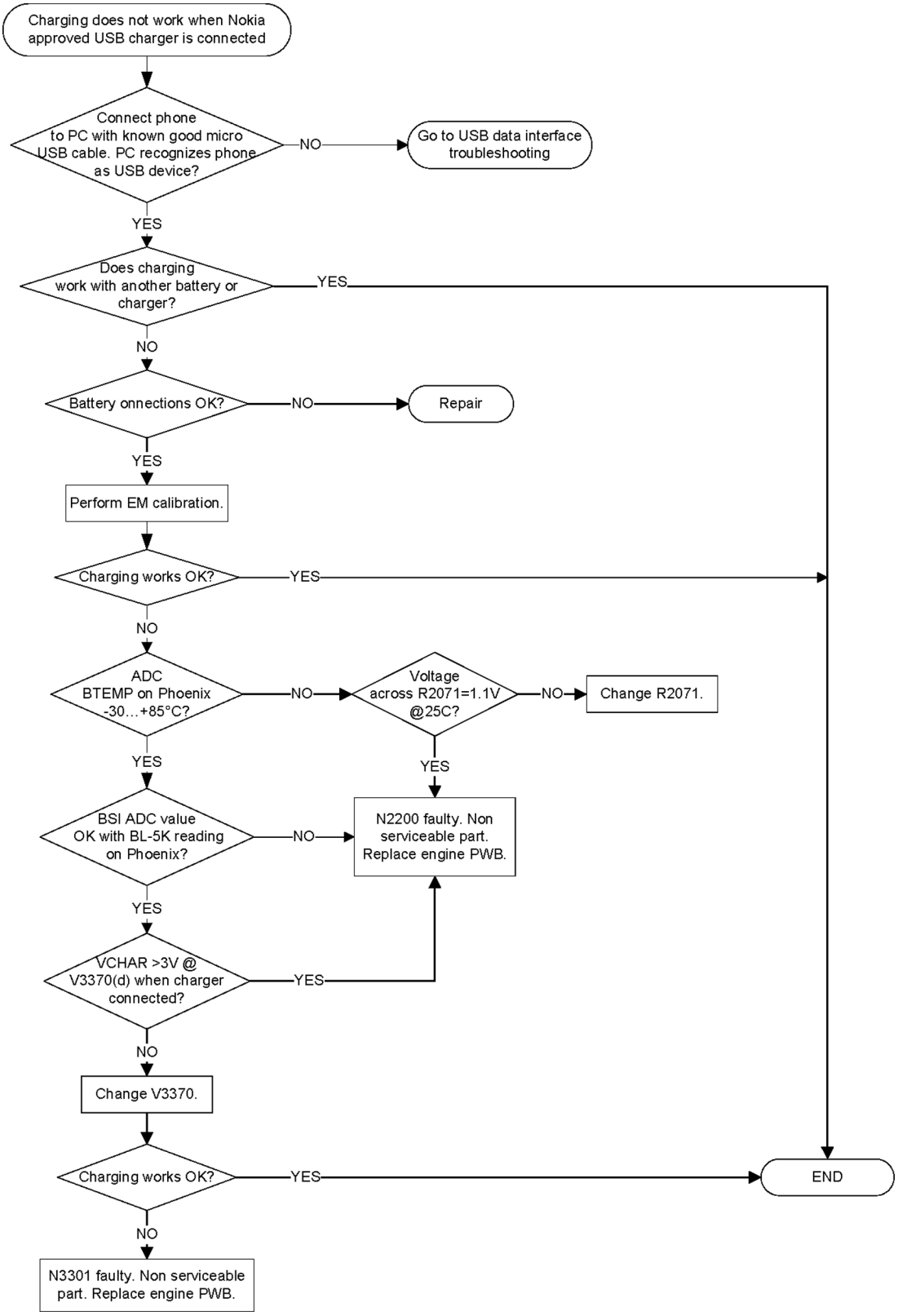
USB charging troubleshooting

Troubleshooting flow



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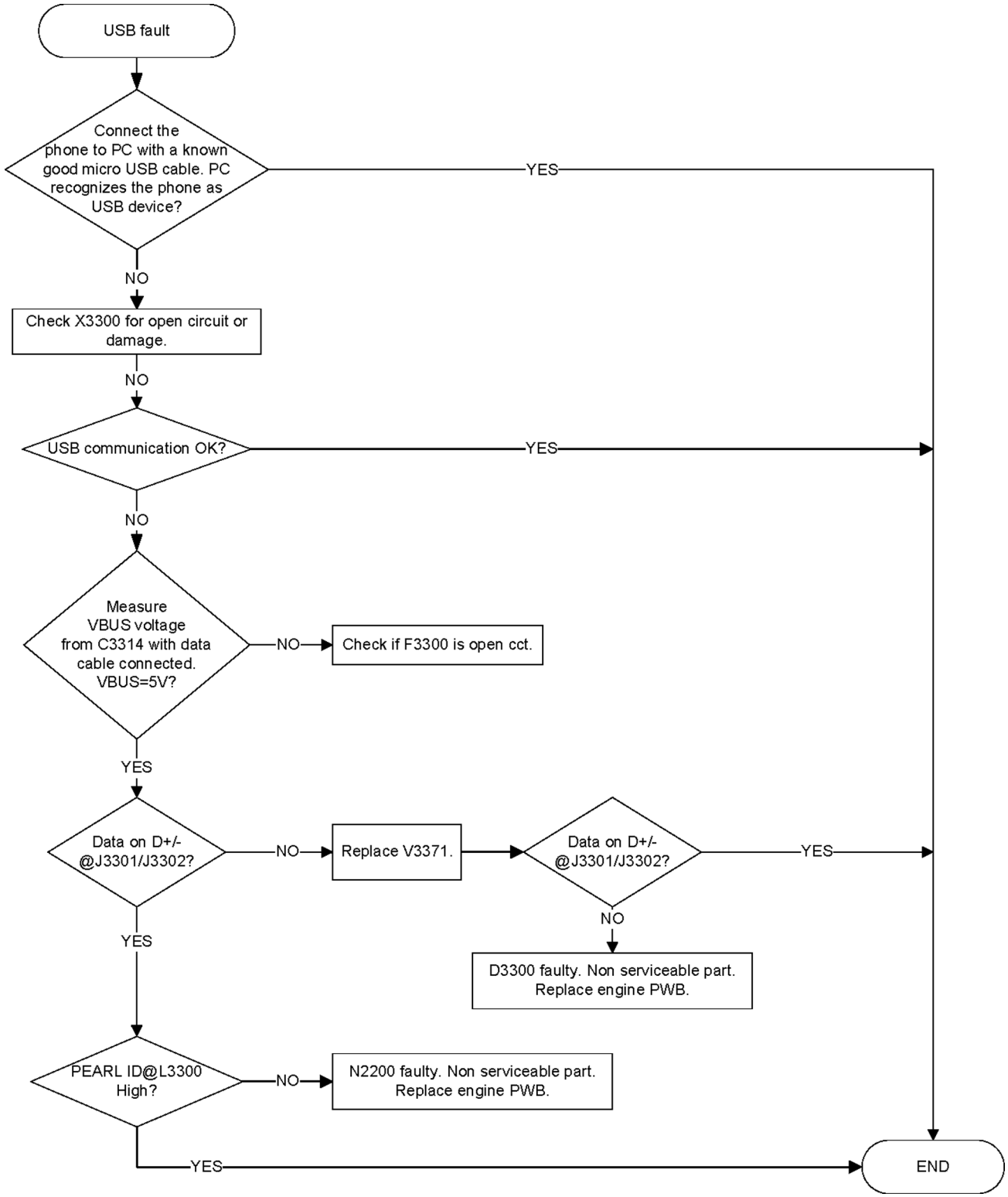
Interface troubleshooting

USB data interface troubleshooting

Troubleshooting flow



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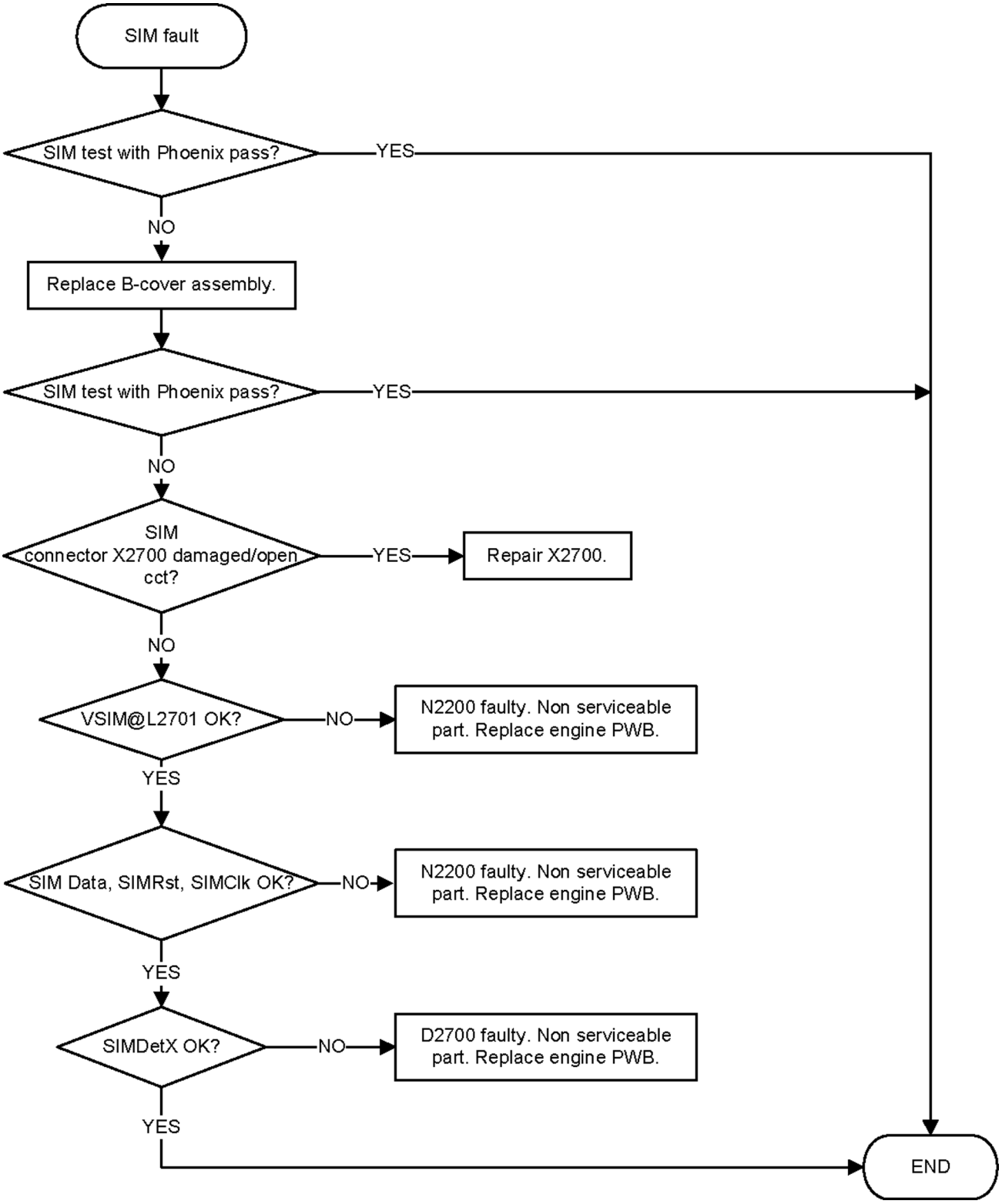
SIM card troubleshooting

Troubleshooting flow



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SIM power-on sequence on X2700. Sequence is first done at 1.8V and then changed to 3.0V.

Figure 9 SIM power-on sequence on X2700. Sequence is first done at 1.8V and then changed to 3.0V.

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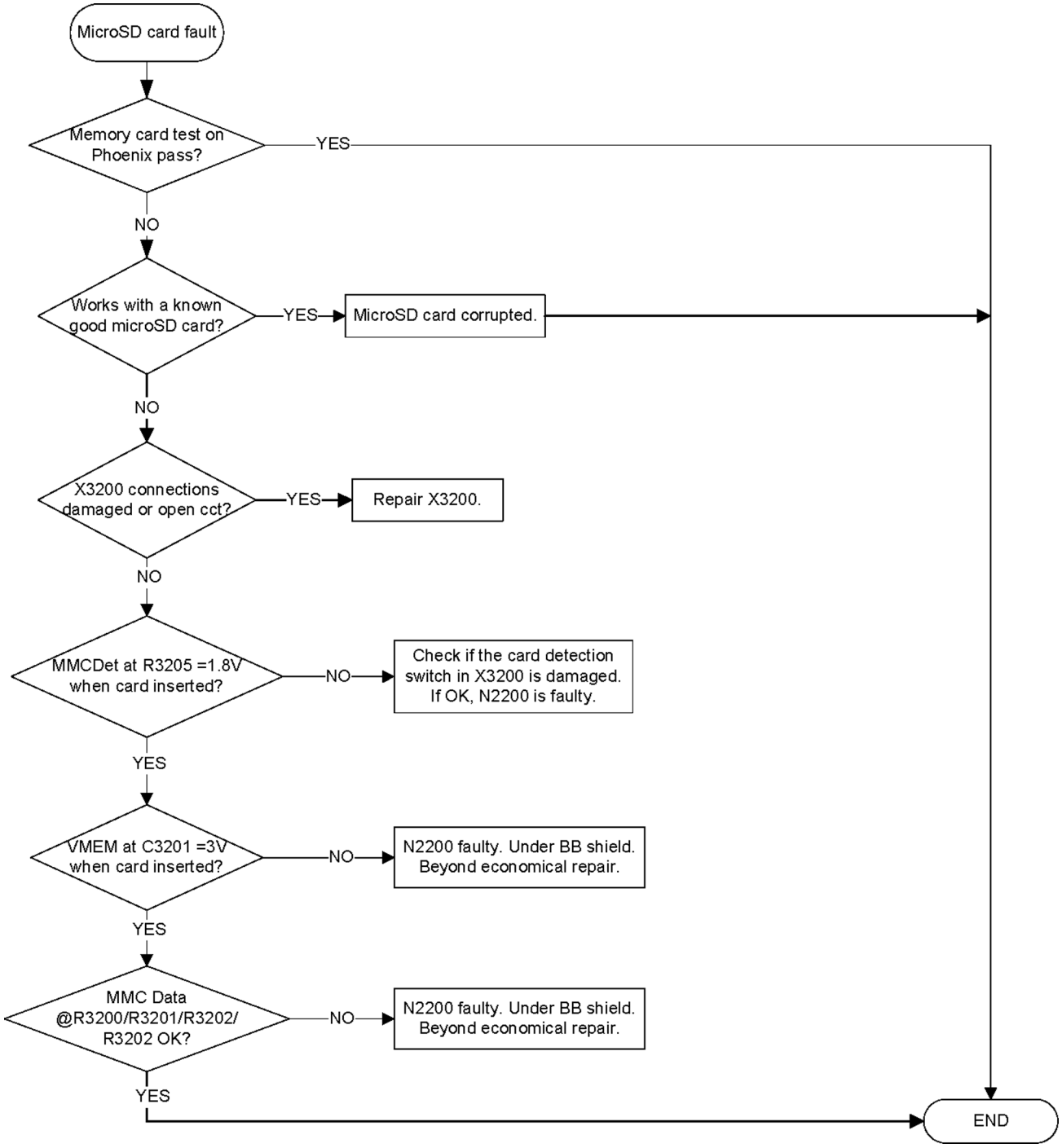
MicroSD card troubleshooting

Troubleshooting flow



IVE troubleshooting

Introduction to IVE troubleshooting

The IVE engine is a next generation imaging and video engine based on BCM2727B. The BCM2727B acts as imaging, video, display, and HDTV and SDTV hardware accelerator.

The following references on the PWB help in the effective debugging and troubleshooting of IVE.

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Sr. No	Reference	Description
1	B1400	19.2MHz Crystal
2	D1400	IVE/BCM2727B IC

The following test points on the PWB help in effective debugging and troubleshooting.

Sr. No	Signal name	Measuring point	Description
1	VIVE_2V5_FILT	L1406	2.5V supply to BCM2727B
2	VIVE_2V8_FILT	L1404	2.8V supply to BCM2727B
3	VIVE_1V8_FILT	L1402	1.8V supply to BCM2727B
4	VBAT	L1407	VBAT supply to BCM2727B
5	RUN	J1451	Enable signal to IVE. This needs to be High for IVE to be Up.
6	XIN	C1448	19.2MHz clock to IVE

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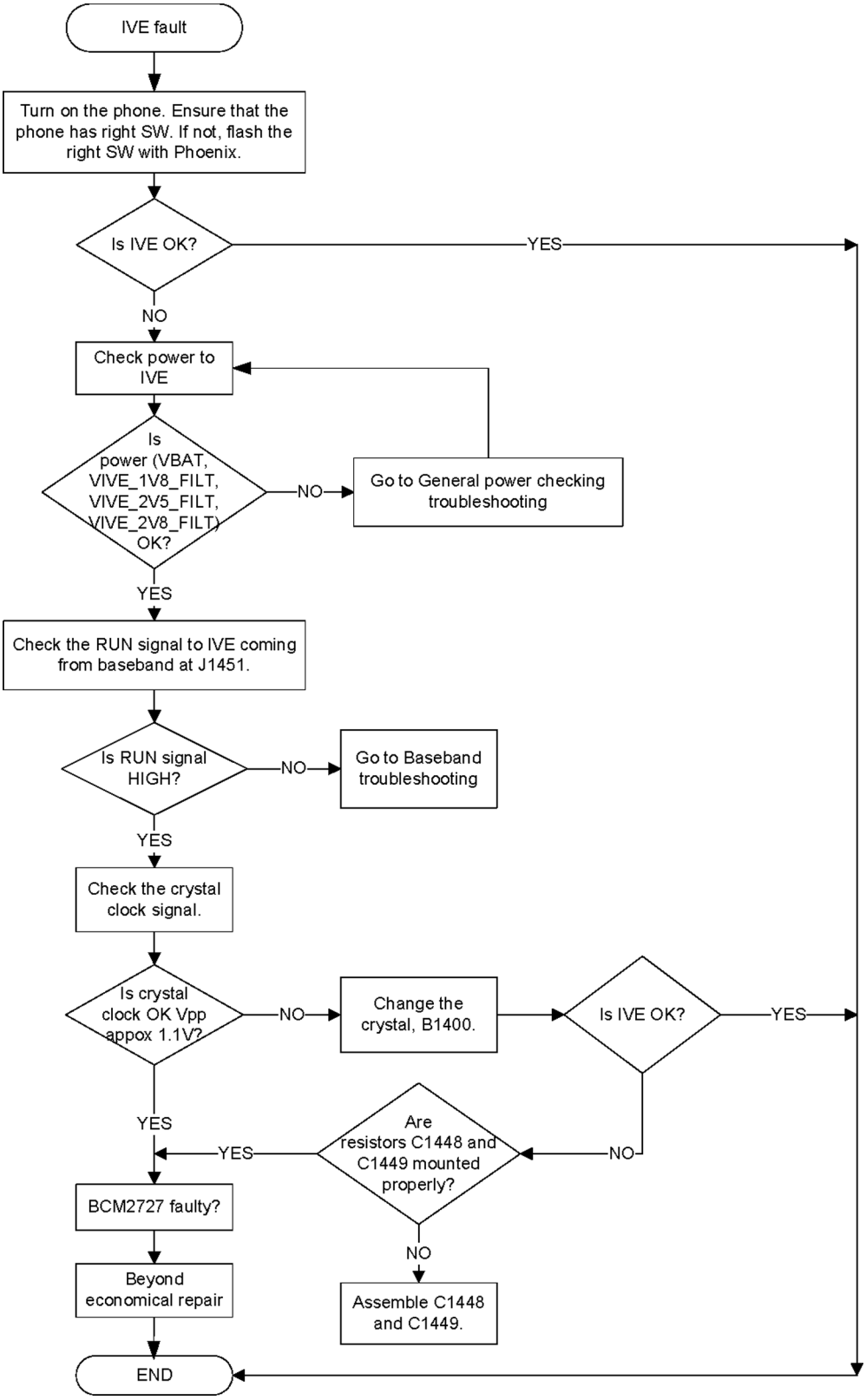
IVE troubleshooting

Troubleshooting flow



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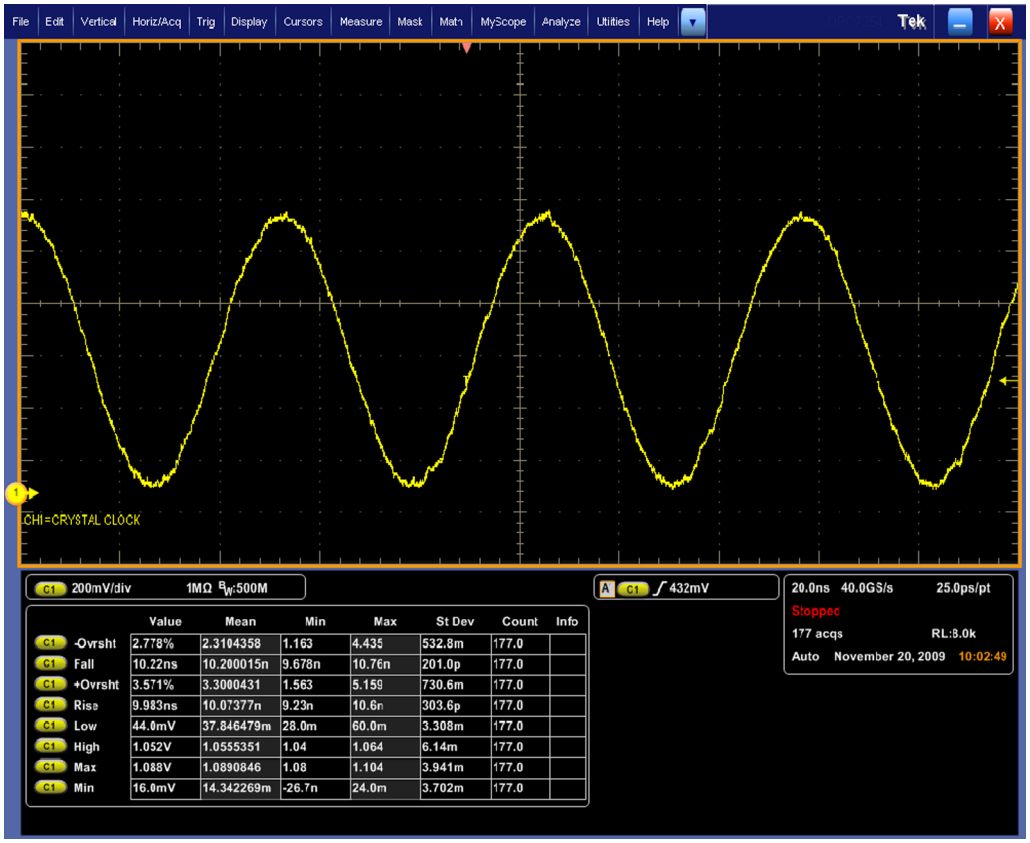

Figure 10 Expected Crystal clock input to BCM2727B on Oscilloscope

TV out troubleshooting

Introduction to SDTV troubleshooting

SDTV

The phone has SDTV capability. The phone can be connected to an analog TV through a TV Out cable.
The following references on the PWB help in the effective debugging and troubleshooting of SDTV Out.

Sr. No	Reference	Description
1	R1419	DAC termination resistor. Resistor value 15 OHMS.
2	D1400	BCM2727B IC
3	N2001	Analog switch
4	L2001	Ferrite bead on the CVBS signal
5	X2000	AV connector

The following test points on the PWB help in effective debugging and troubleshooting.

Sr No	Signal name	Measuring point	Description
1	CVBS	X2000.1/J2000	SDTV signal

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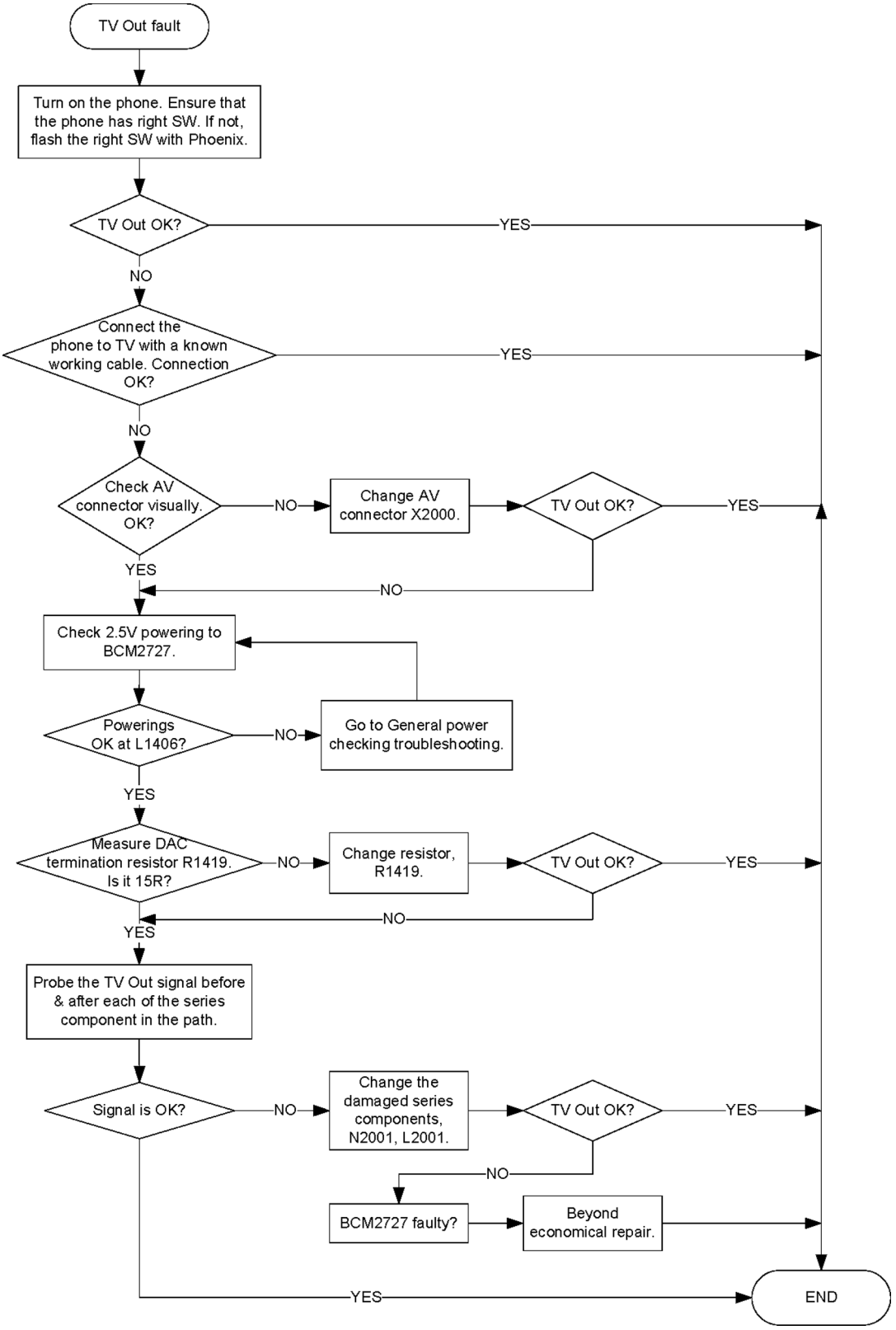
SDTV out troubleshooting

Troubleshooting flow



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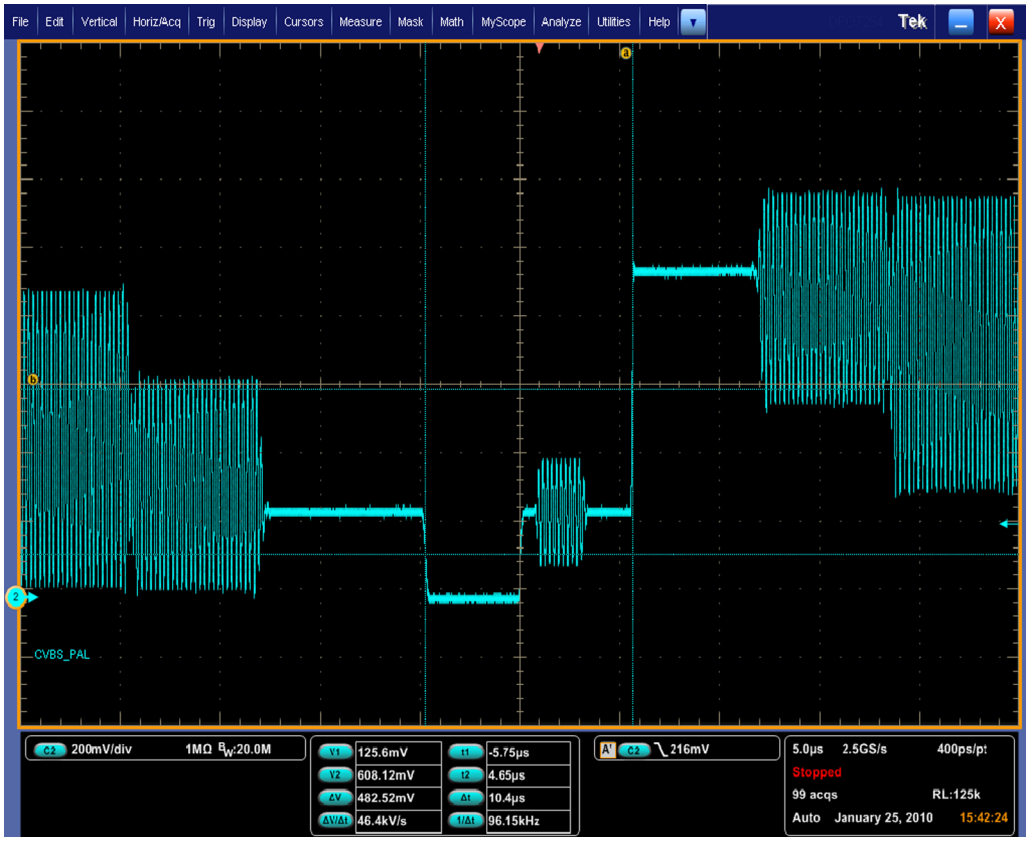

Figure 11 Expected SDTV CVBS PAL signal on Oscilloscope

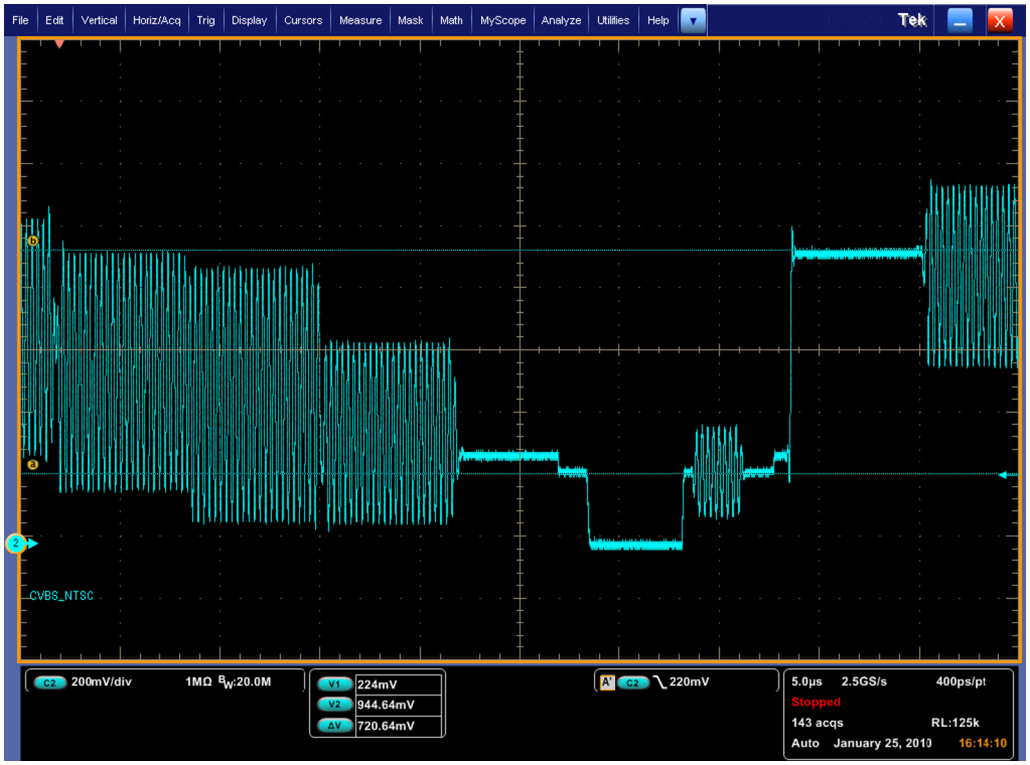

Figure 12 Expected SDTV CVBS NTSC signal on Oscilloscope

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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 6 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 7 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.

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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 8 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.

Introduction to display troubleshooting

The display module used is based on AM OLED technology and supports display format of 360 columns x 640 rows. The dimension of the display module is 47.8 mm x 86.3 mm x 2.12 mm. The module will interface to the phone via FPC with a 20 pins board to board connector.

The following references on the PWB help in the effective debugging and troubleshooting of the display.

Sr No	Reference	Description
1	X1600	Display connector
2	R1604	Series resistor on display Reset line. Reset signal needs to be High for the display to be Up.
3	D1400	BCM2727B IC

The following test points on the PWB help in effective debugging and troubleshooting.

Sr. No	Signal name	Measuring point	Description
1	VIO	L1602	1.8V supply to display
2	VBAT	L1601	VBAT supply to display
3	DISP_RESET_N	R1604	Reset signal to display module. The reset signal needs to be High for the display to be Up.

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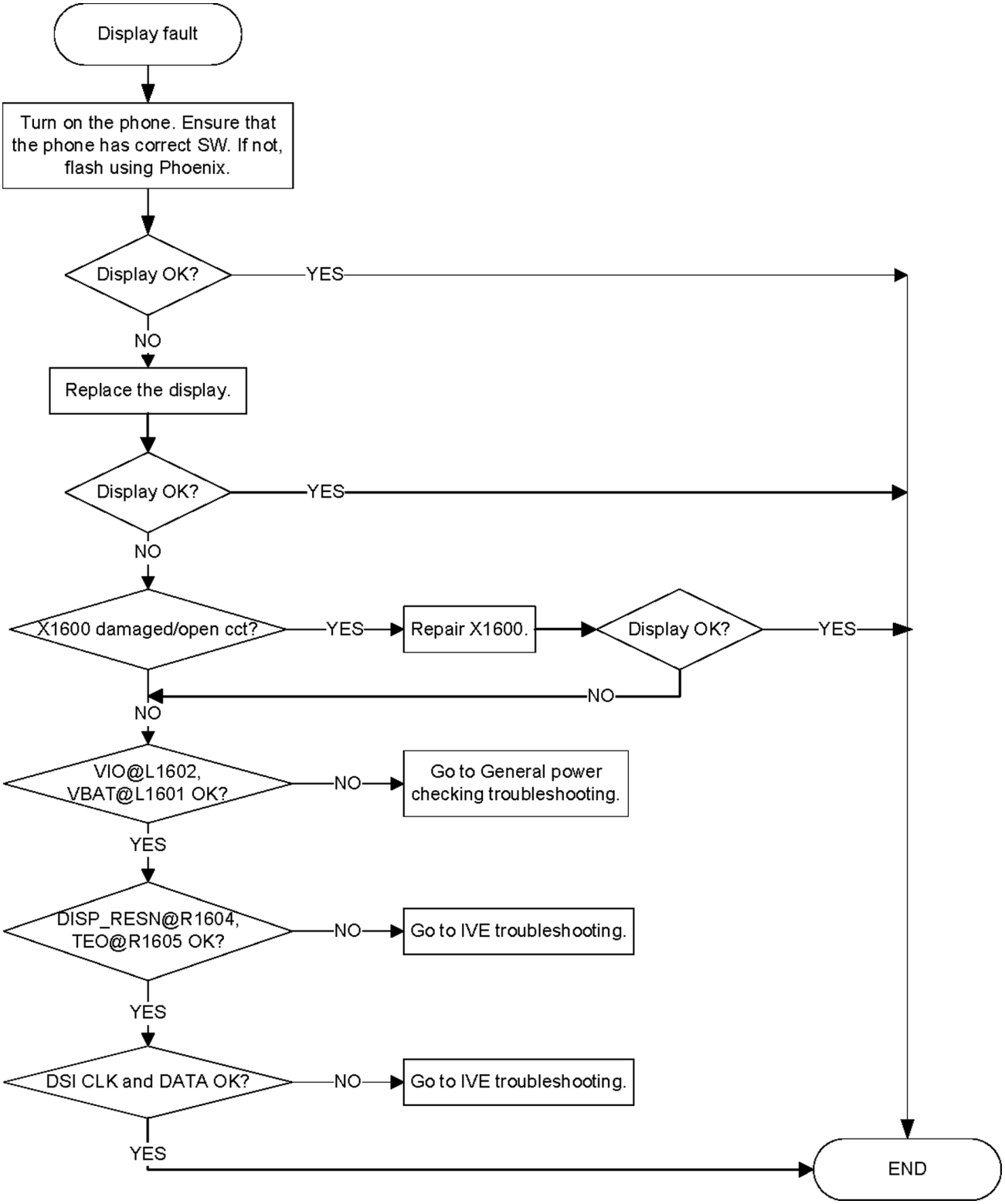
Display fault troubleshooting

Troubleshooting flow



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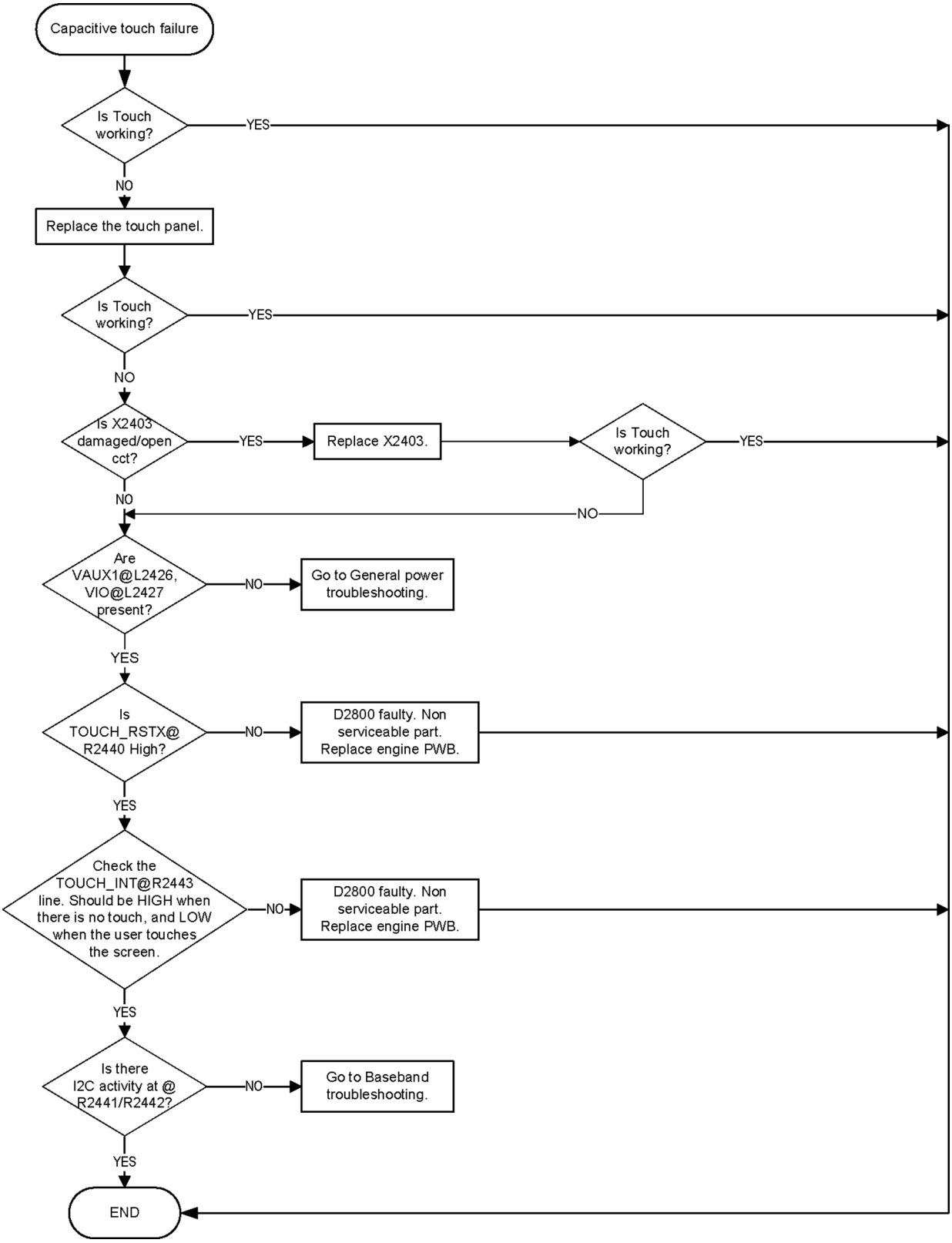
Touch panel troubleshooting

Troubleshooting flow



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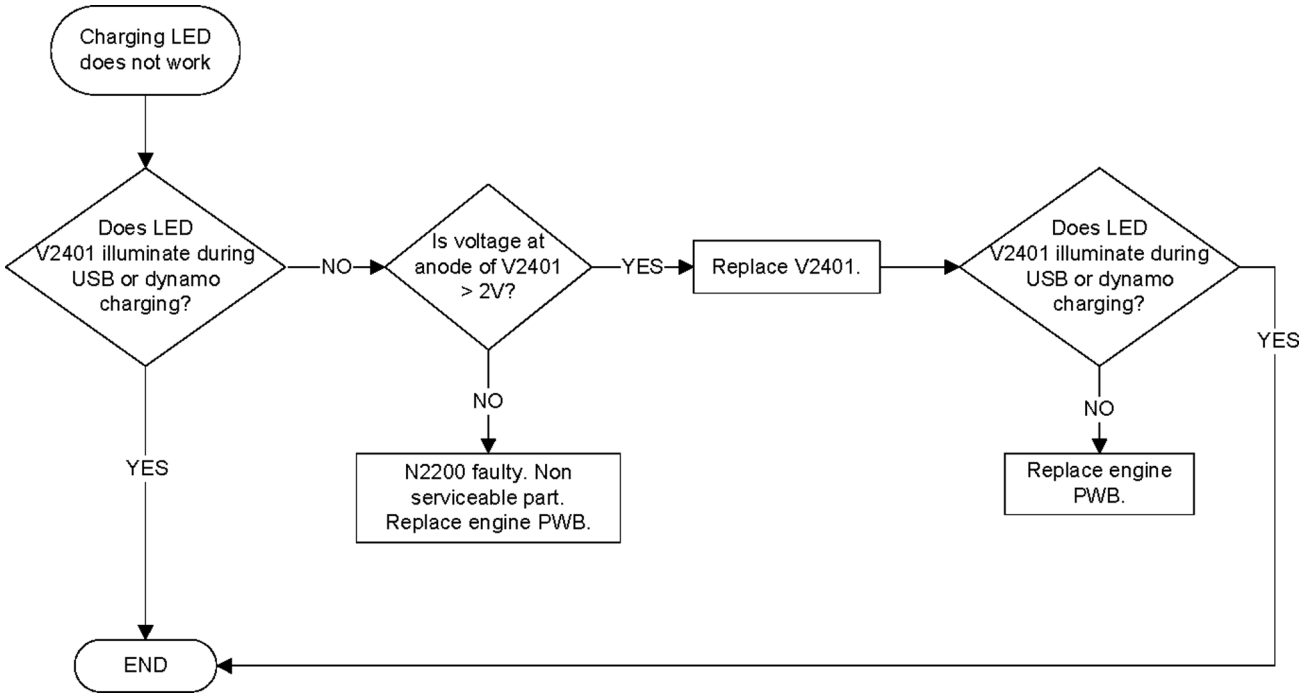
Illumination troubleshooting

Charging illumination troubleshooting

Troubleshooting flow



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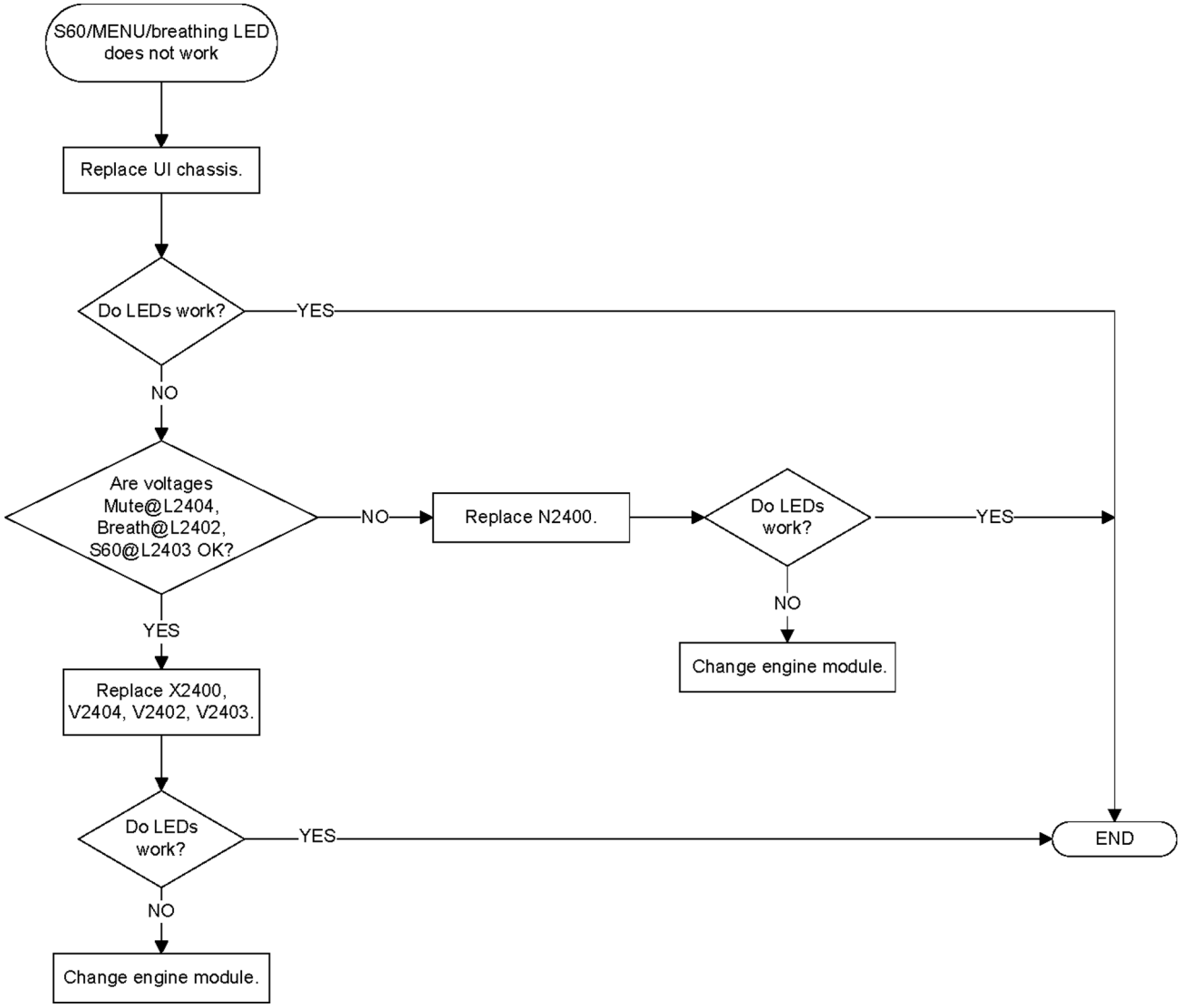
Menu key backlight troubleshooting

Troubleshooting flow



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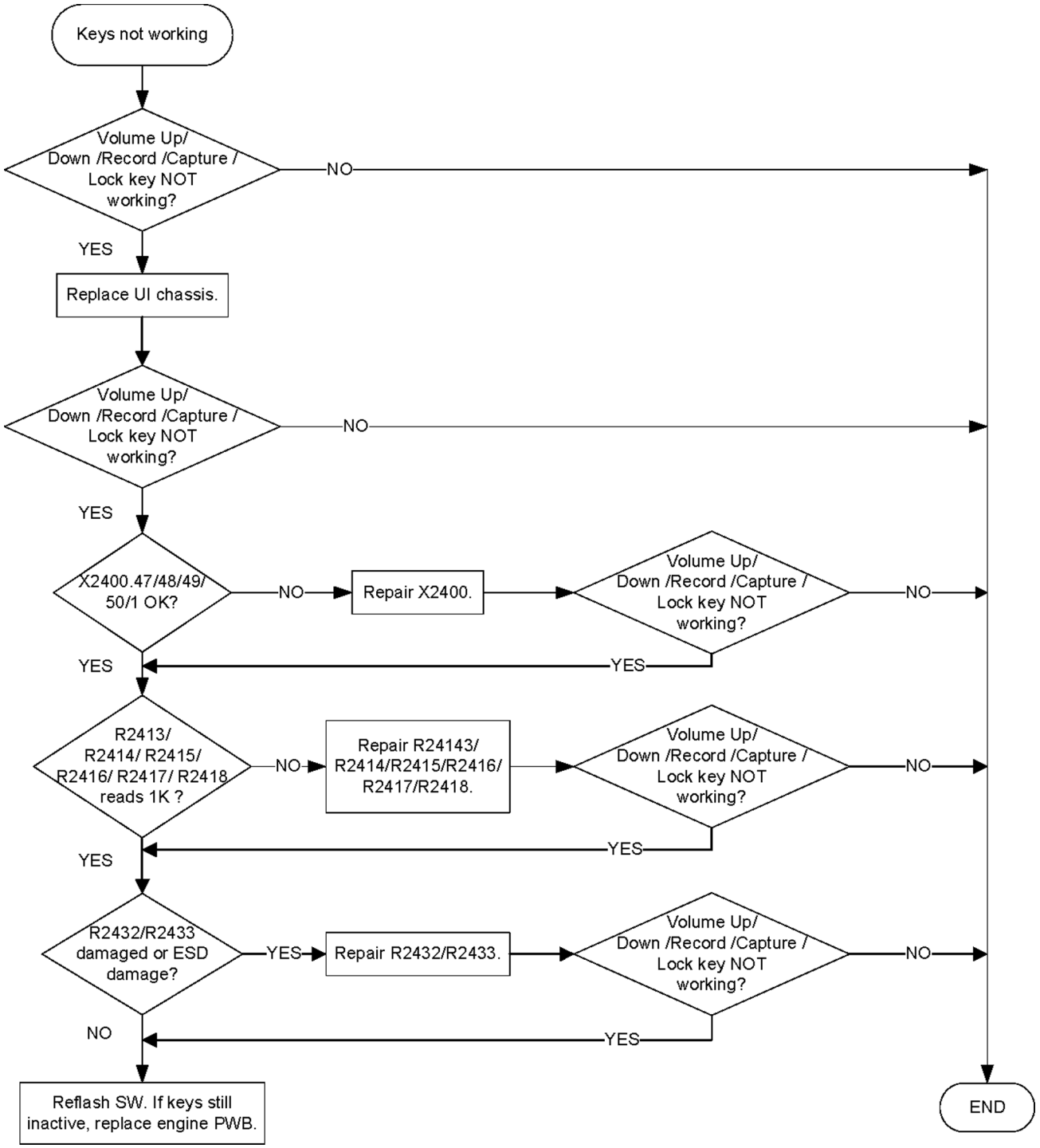
Keyboard troubleshooting

Keys troubleshooting

Troubleshooting flow



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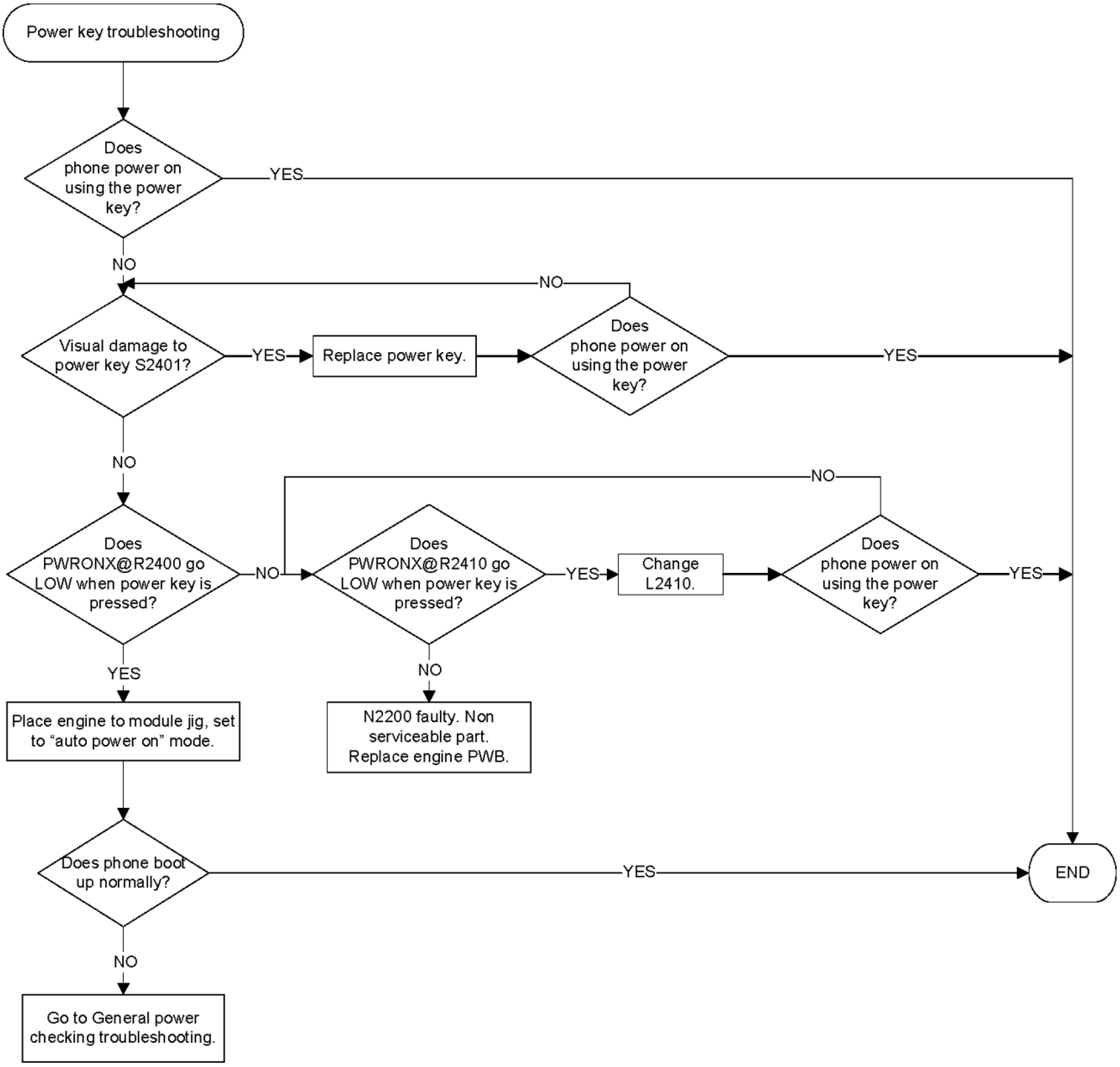
Power key troubleshooting

Troubleshooting flow



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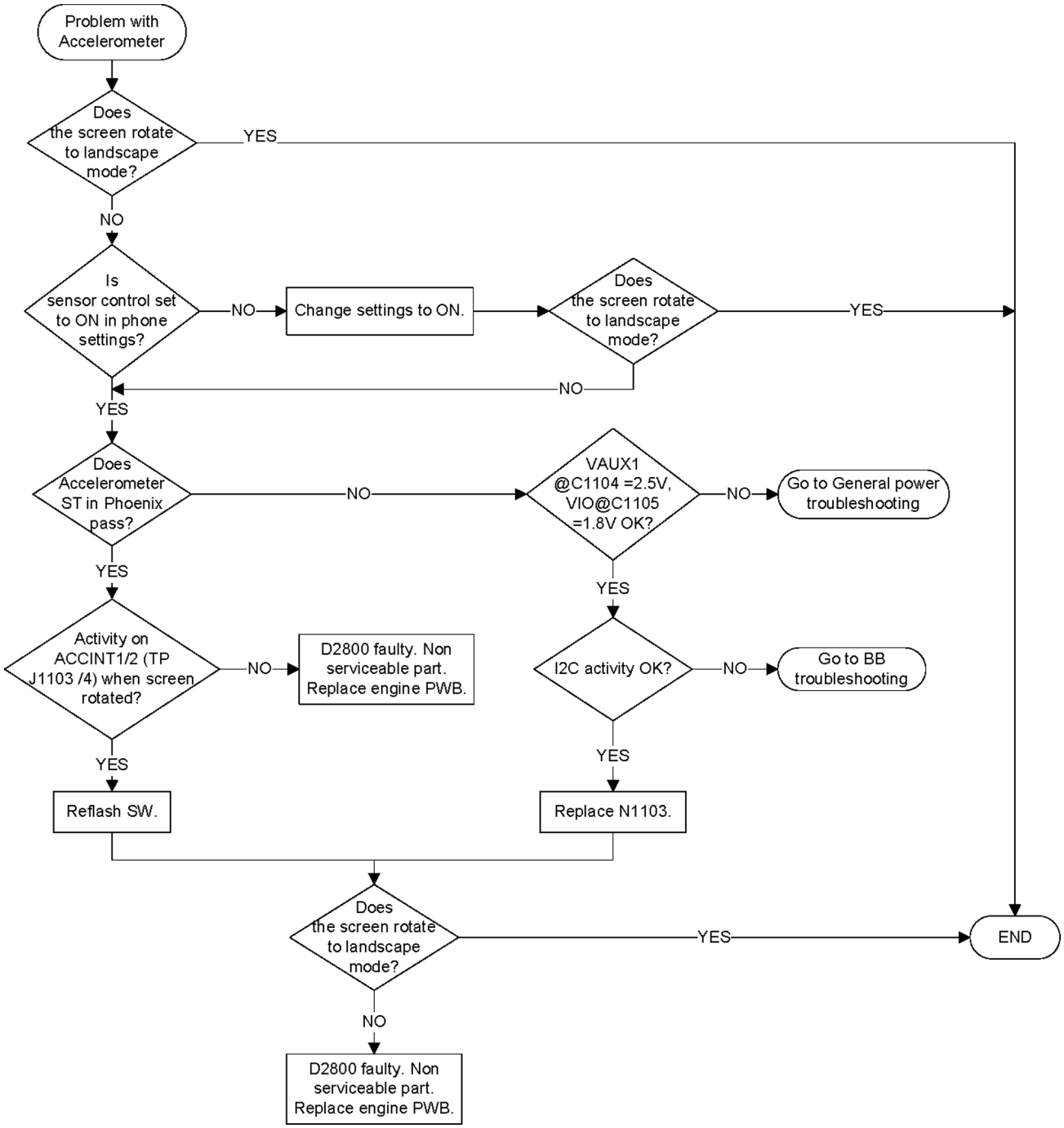
Sensors troubleshooting

Accelerometer troubleshooting

Troubleshooting flow



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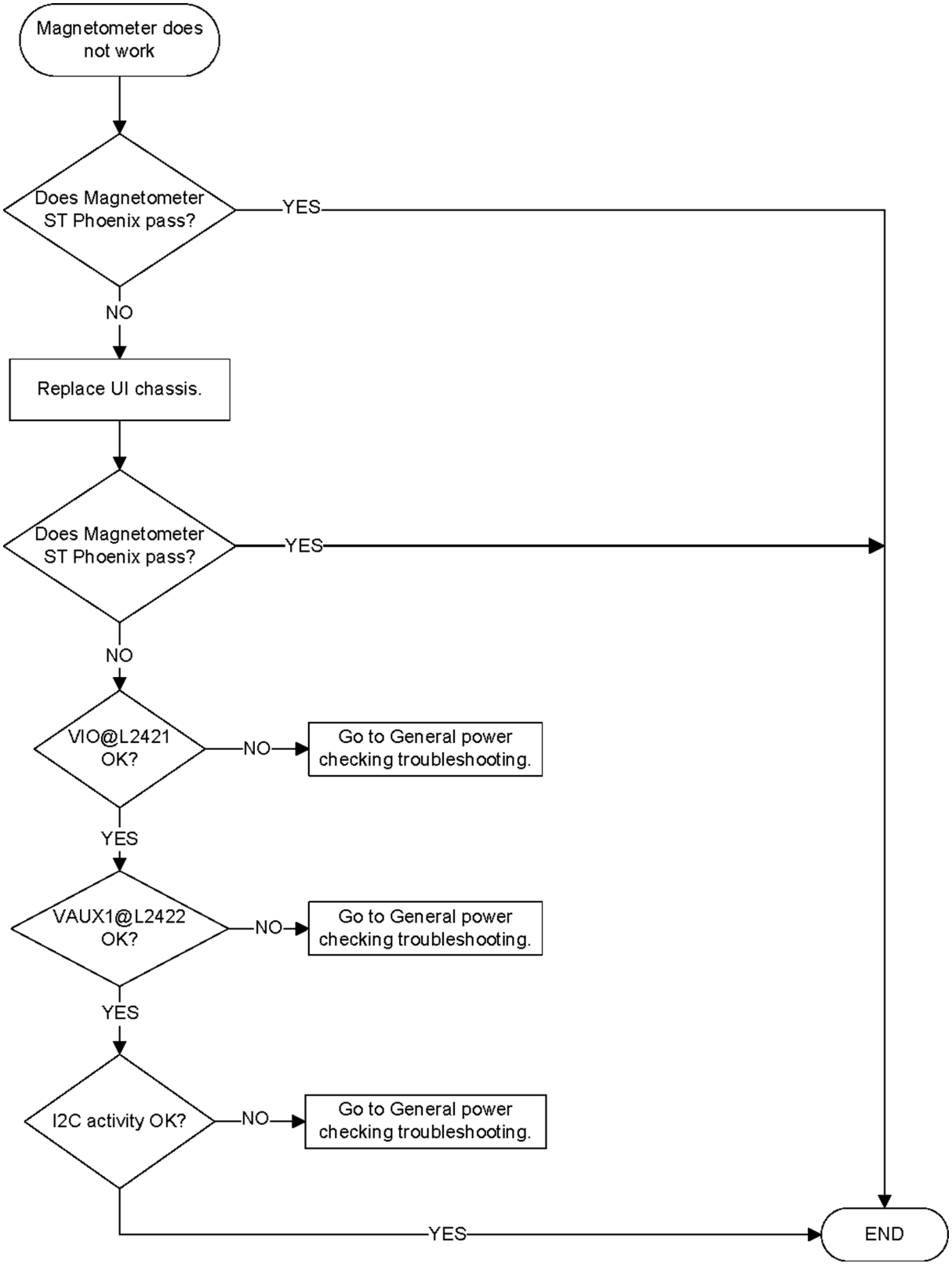
Magnetometer troubleshooting

Troubleshooting flow



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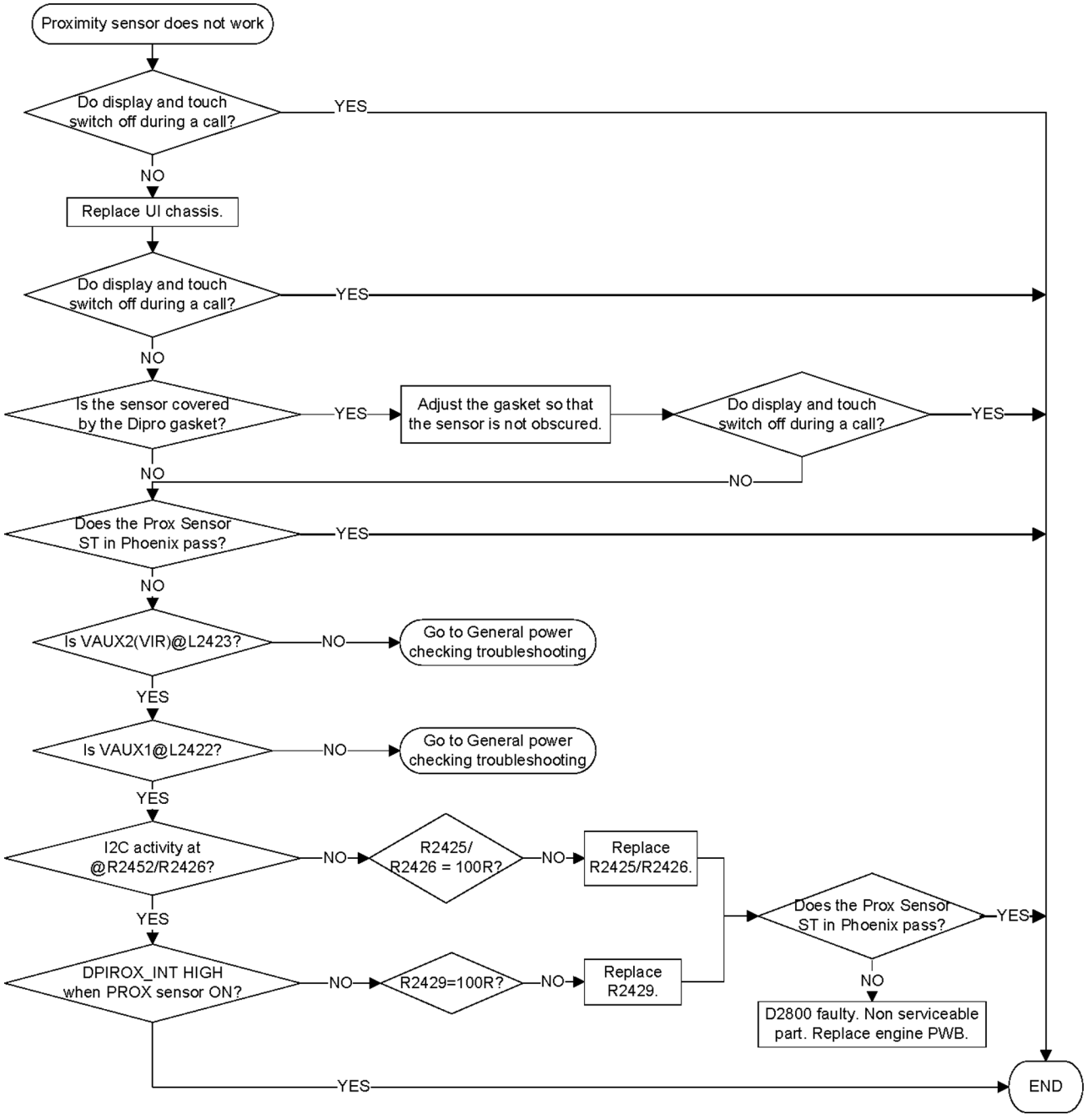
Proximity sensor troubleshooting

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.

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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				
External headset mic to IHF mono	HS_MIC & GND	L4855 & L4856	10	200		630
		L4857 & L4858				

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Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Output DC level [V]	Output voltage [mVp-p]
Internal digital microphone to headset	Acoustical Input, 1kHz sine wave	HS_L & GND HS_R & GND	NA	94 dBSPL		70

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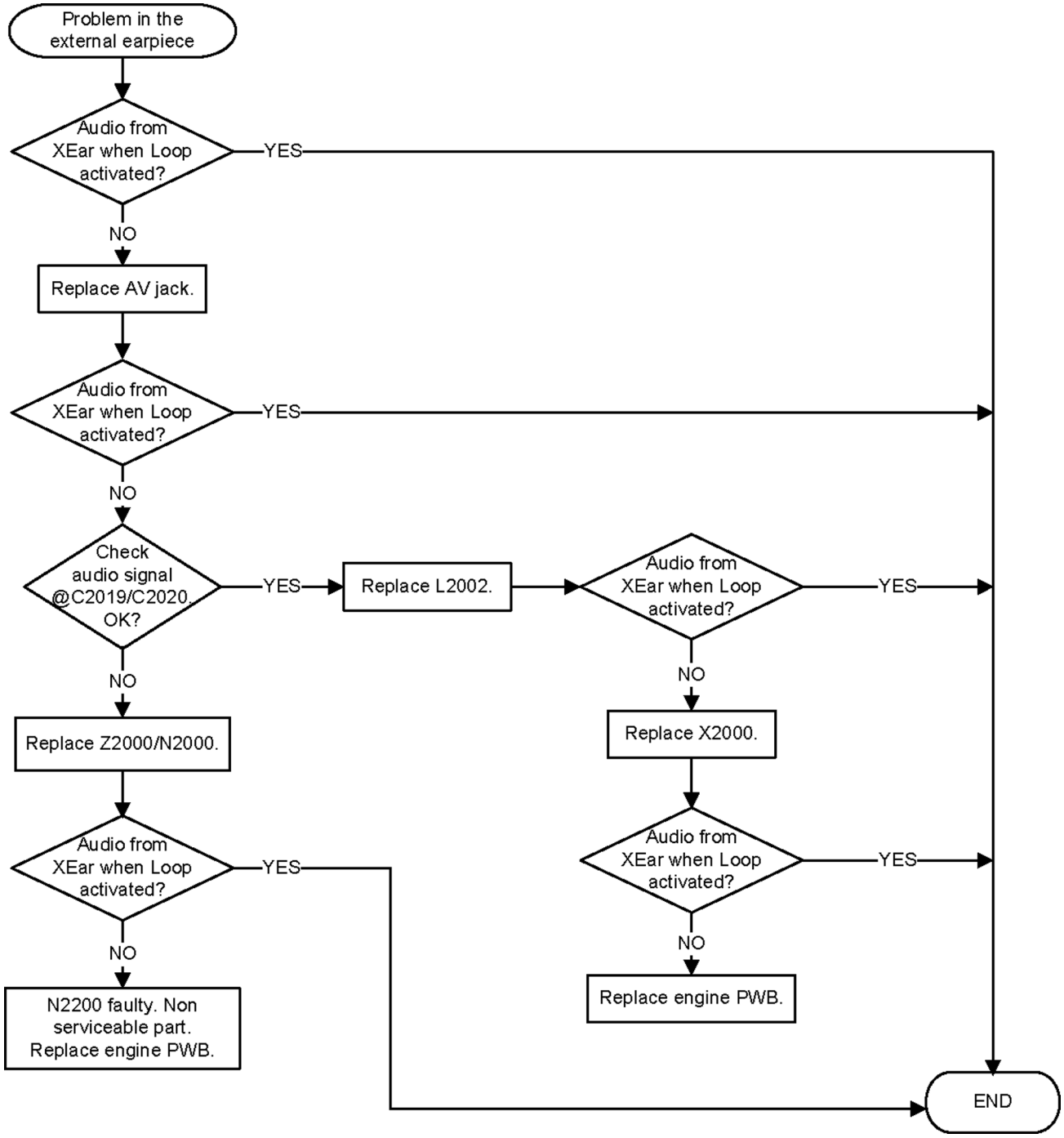
External earpiece troubleshooting

Troubleshooting flow



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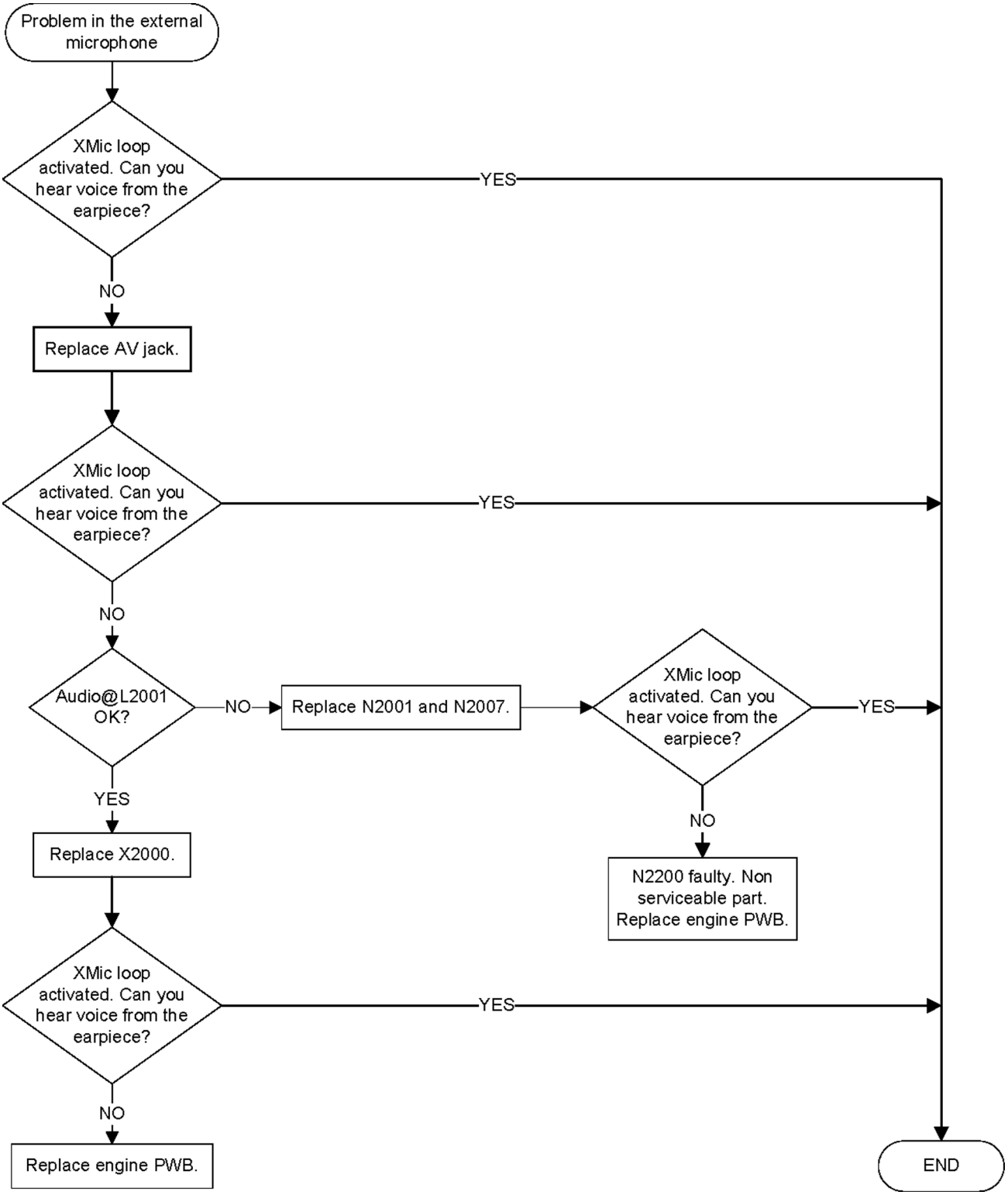
External microphone troubleshooting

Troubleshooting flow



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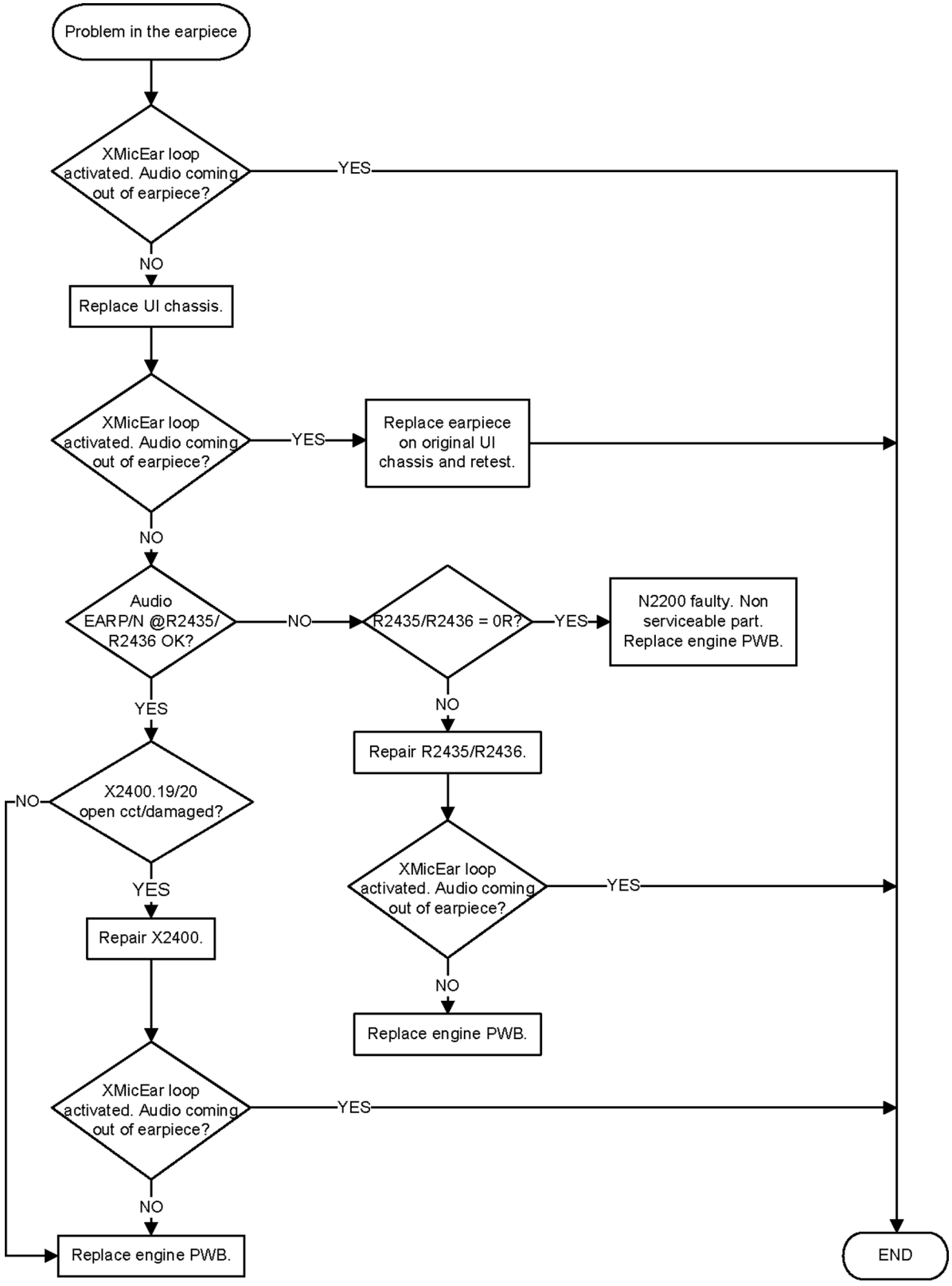
Internal earpiece troubleshooting

Troubleshooting flow



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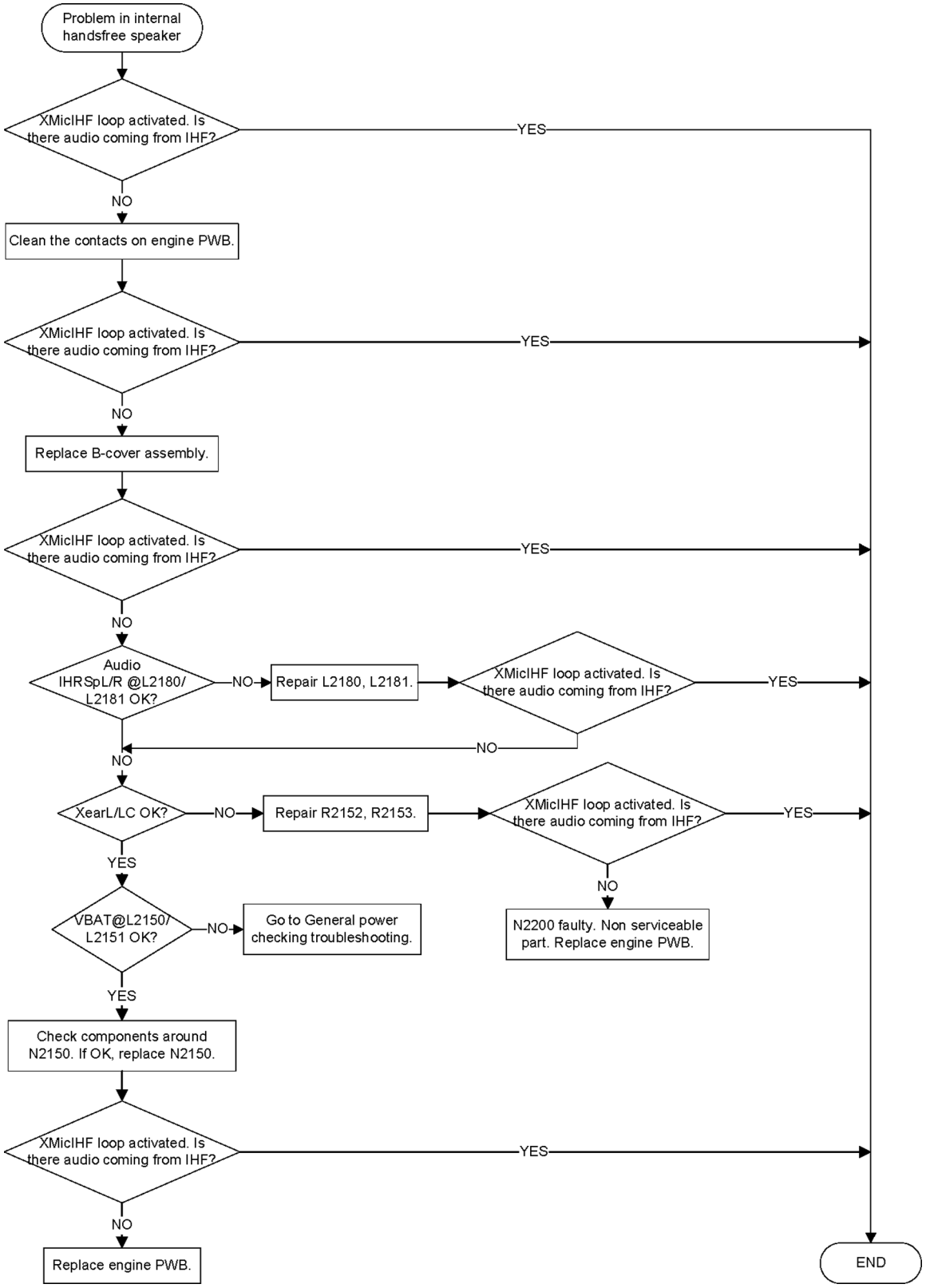
Internal handsfree (IHF) troubleshooting

Troubleshooting flow



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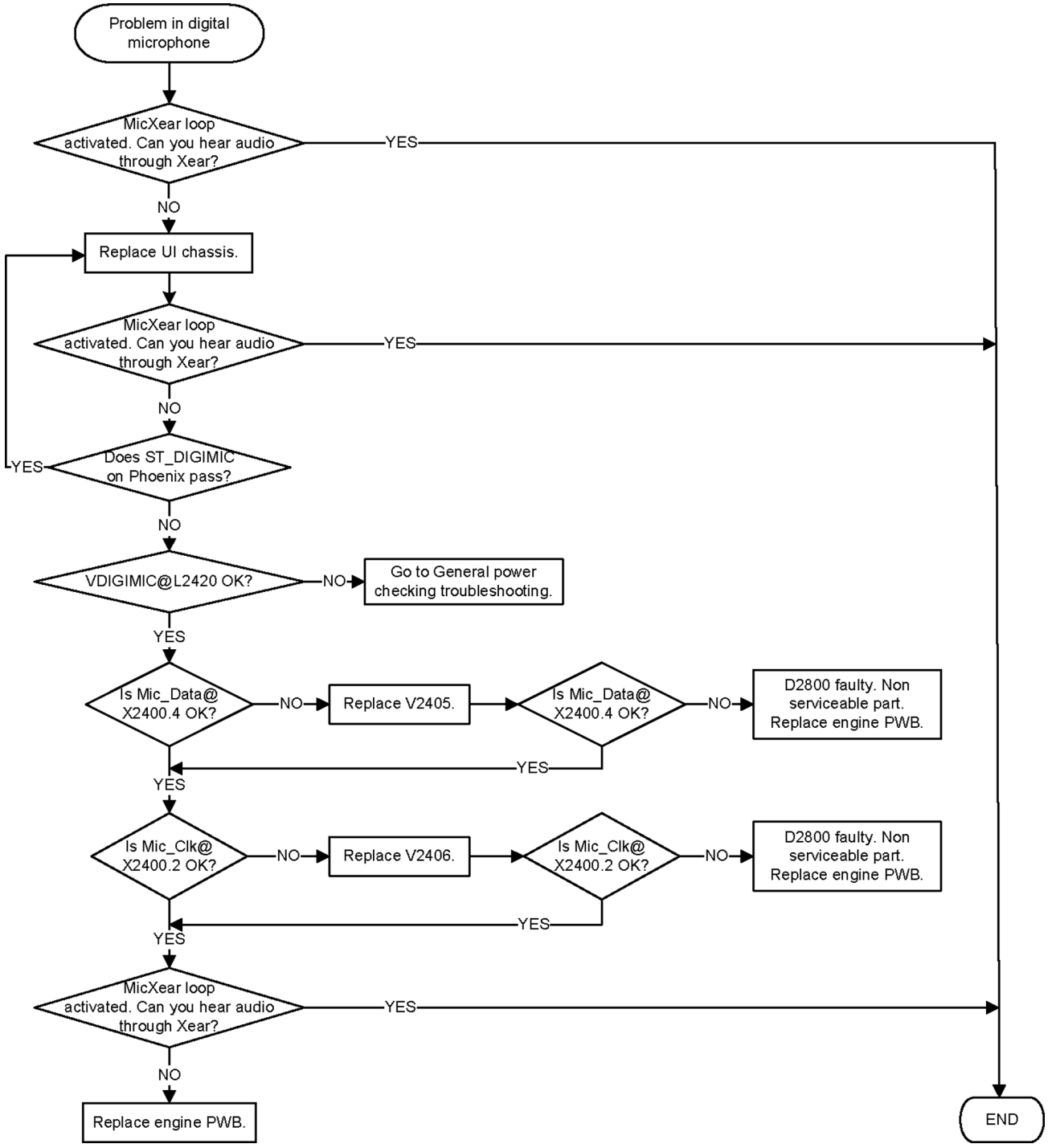
Internal microphone troubleshooting

Troubleshooting flow



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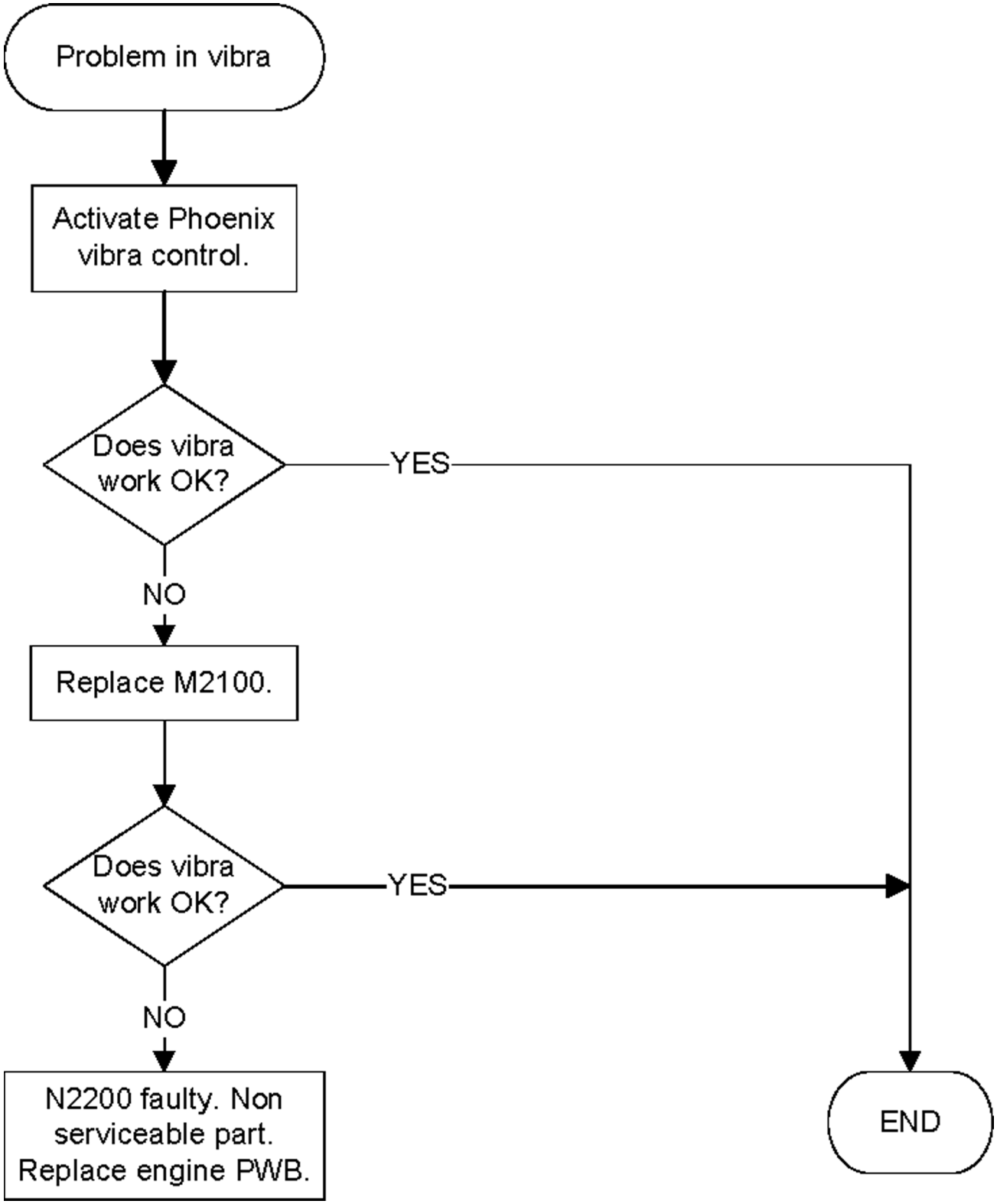
Vibra troubleshooting

Troubleshooting flow



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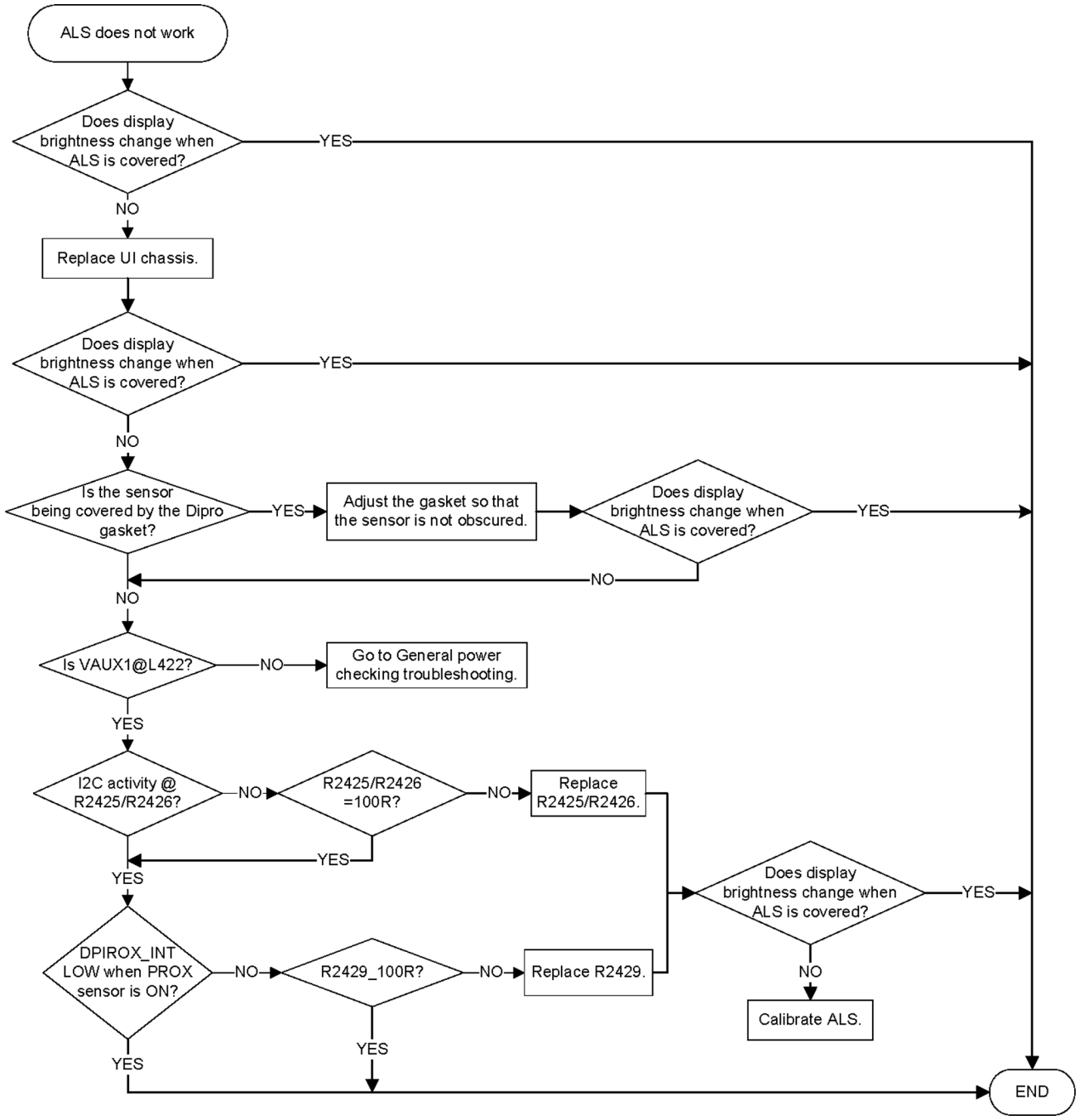
ALS technical description and troubleshooting

ALS troubleshooting

Troubleshooting flow



Re-tuning ALS

There is no need to re-tune ALS, since ALS default value will be written the first time the phone boots up.

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Bluetooth and FM radio troubleshooting

Introduction to Bluetooth/FM radio troubleshooting

Bluetooth/WLAN antenna

The Bluetooth/WLAN signal is generated from BOB to the shared WLAN/BT antenna on the phone's B-cover. Check the antenna pin contacts with Bluetooth/WLAN antenna.

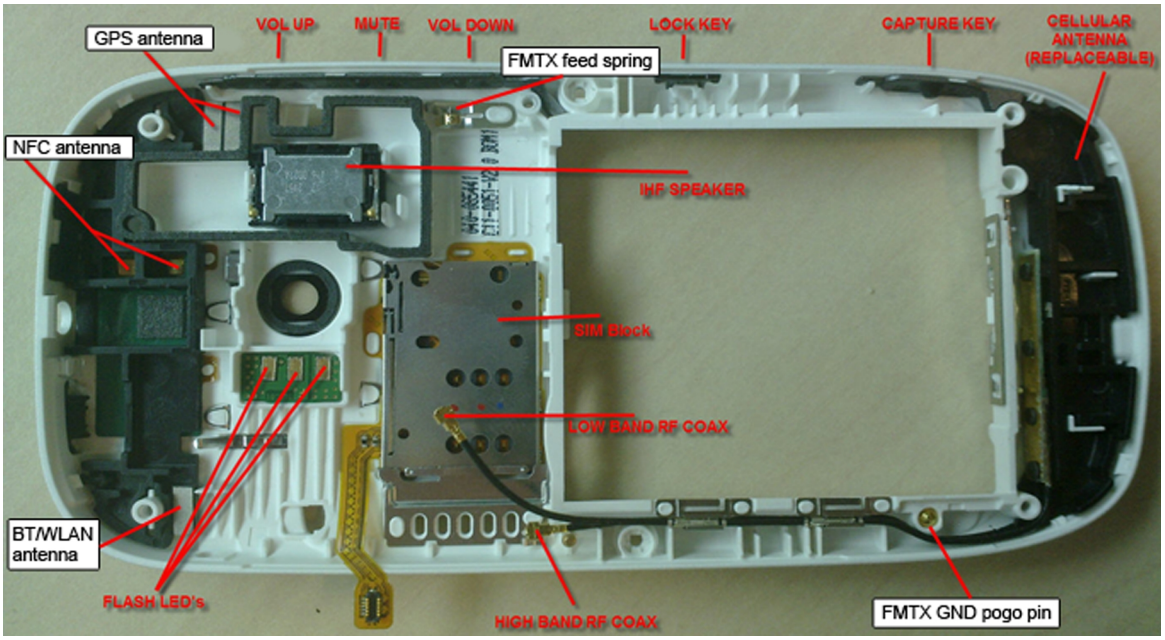

Figure 13 Bluetooth/WLAN antenna

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

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Symptom	Problem	Repair solution
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 FM antenna (headset jack)	Repair components
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 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)

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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

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**

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7. To run the tests, click **Start**.

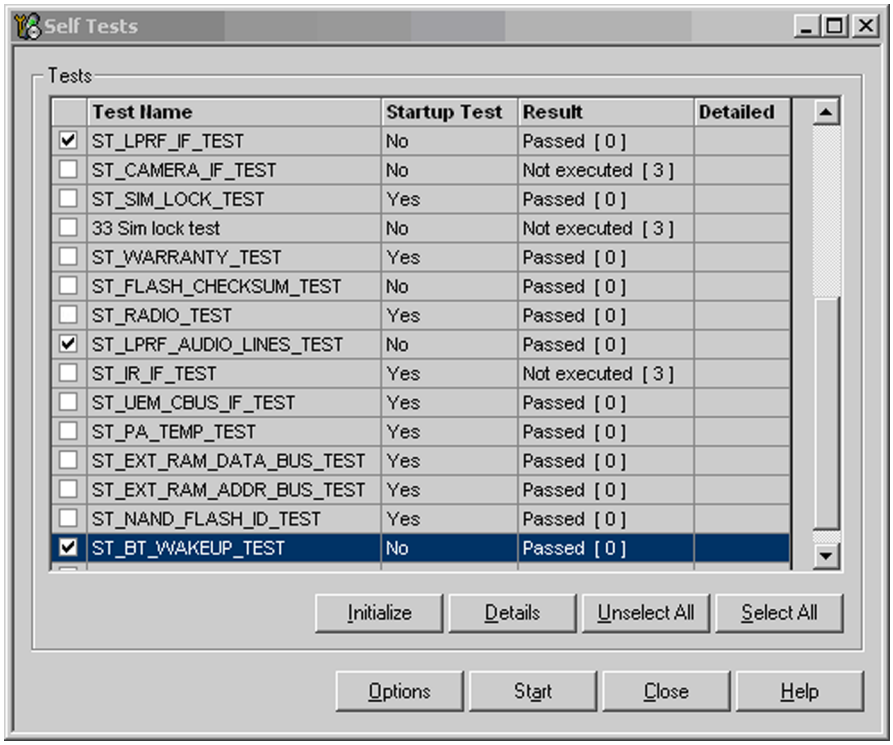

Figure 14 Bluetooth and FM radio self tests in *Phoenix*

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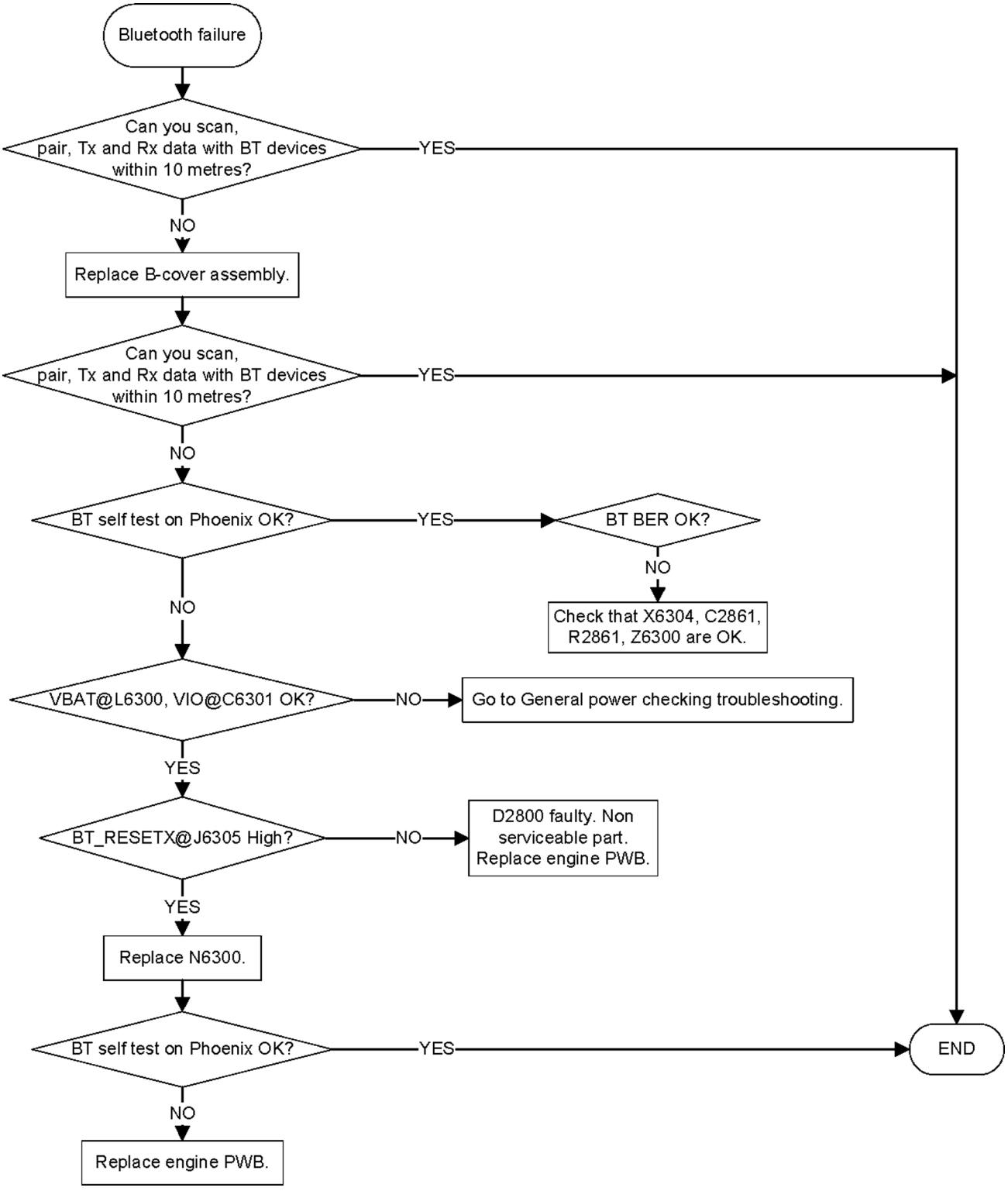
Bluetooth troubleshooting

Troubleshooting flow



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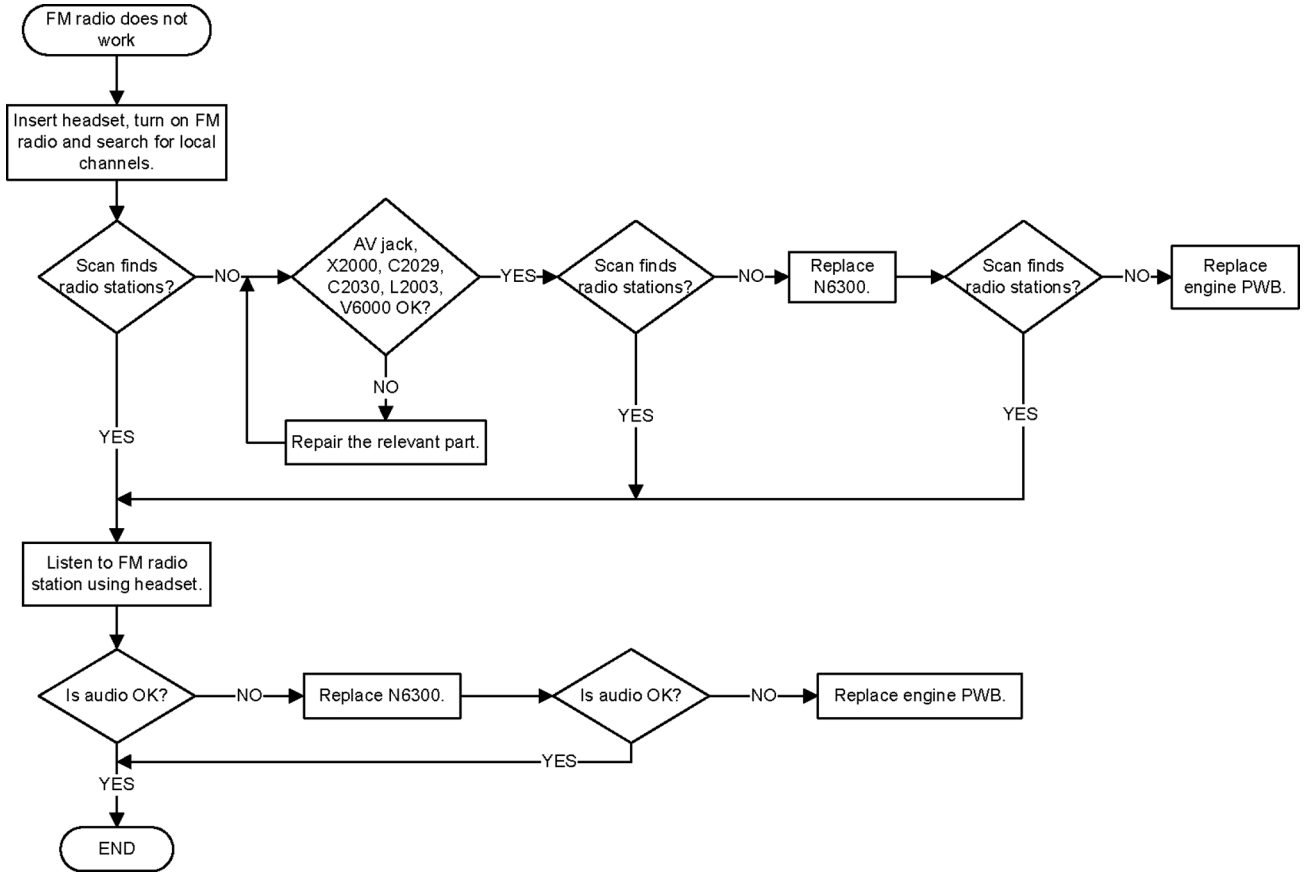
FM radio troubleshooting

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 alternatively 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.

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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.

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*.

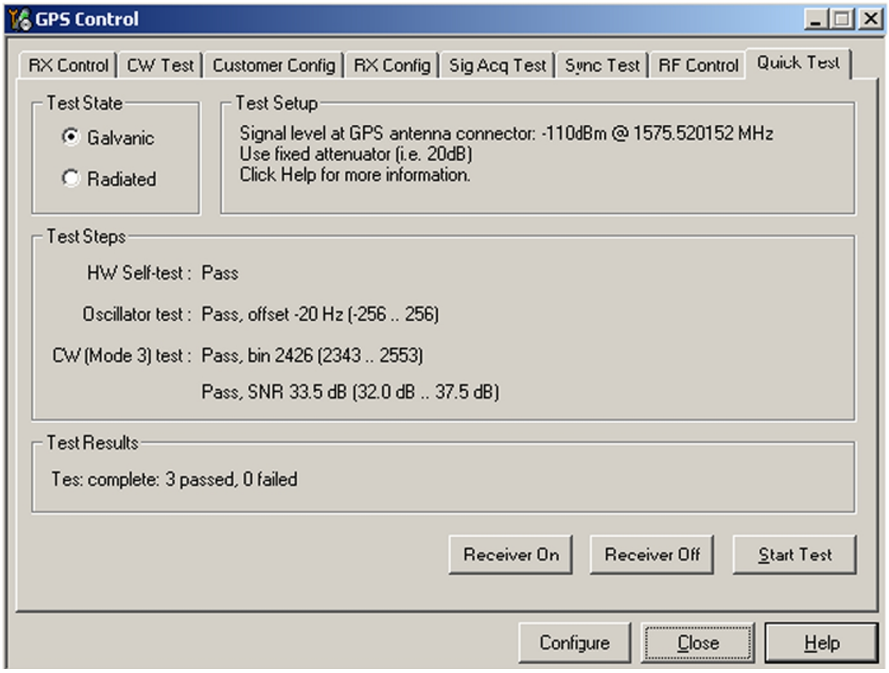

Figure 15 GPS Quick Test window

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.

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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.

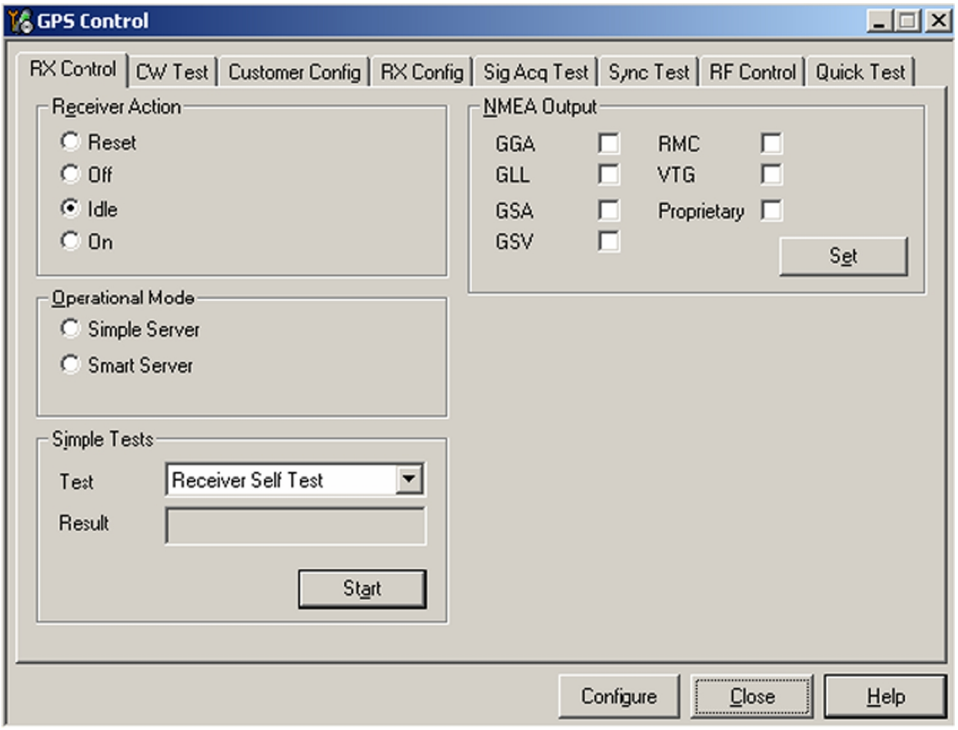

Figure 16 GPS Control dialogue box

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.

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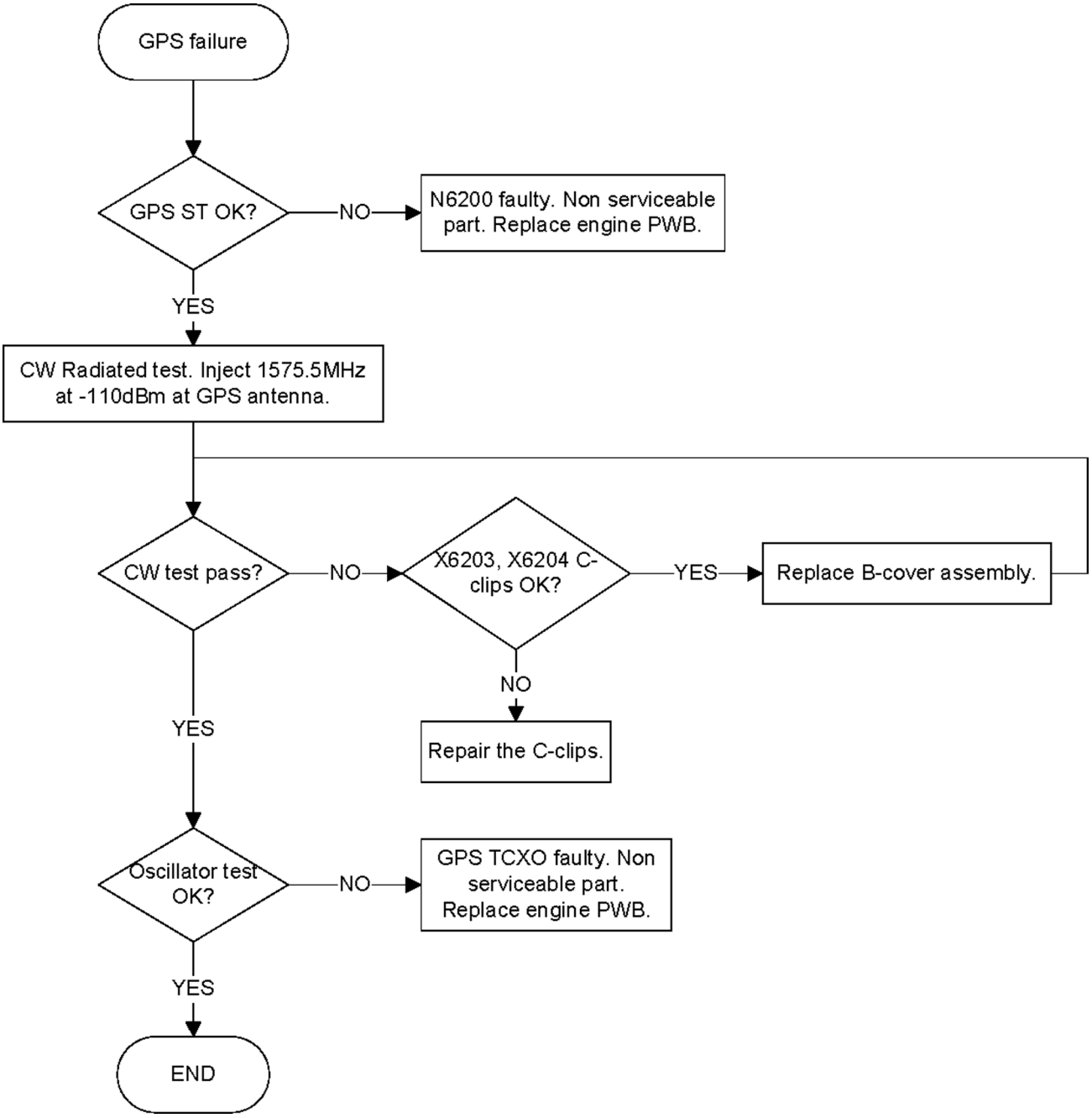
GPS troubleshooting

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.

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WLAN settings for Phoenix

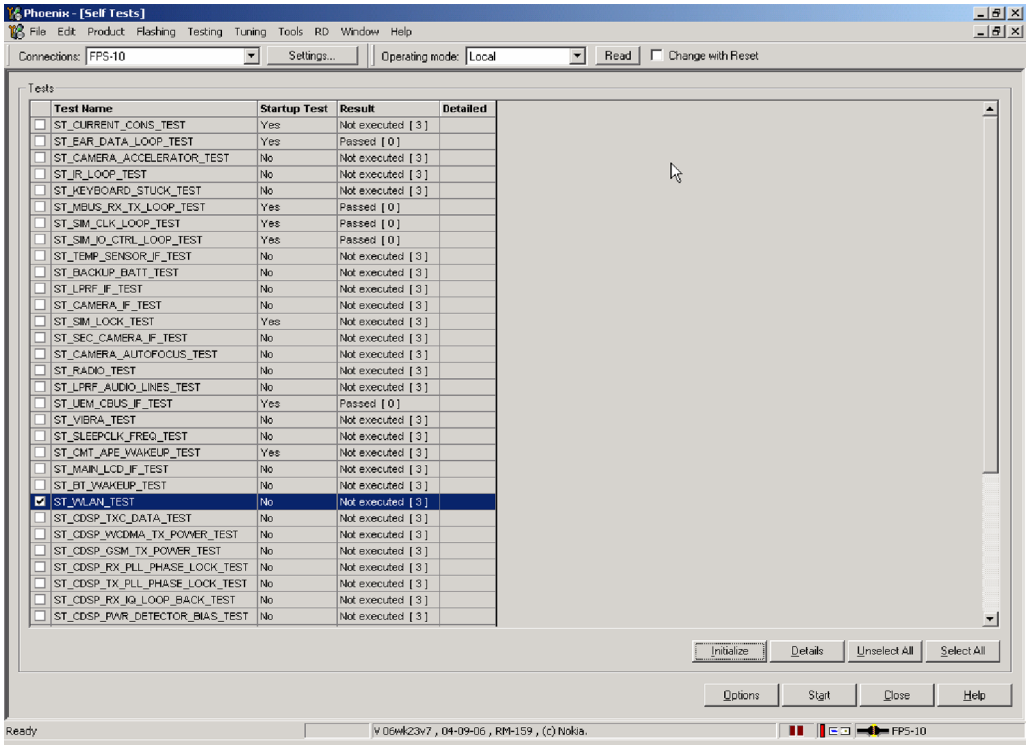
Use the following to test WLAN using Phoenix:

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.

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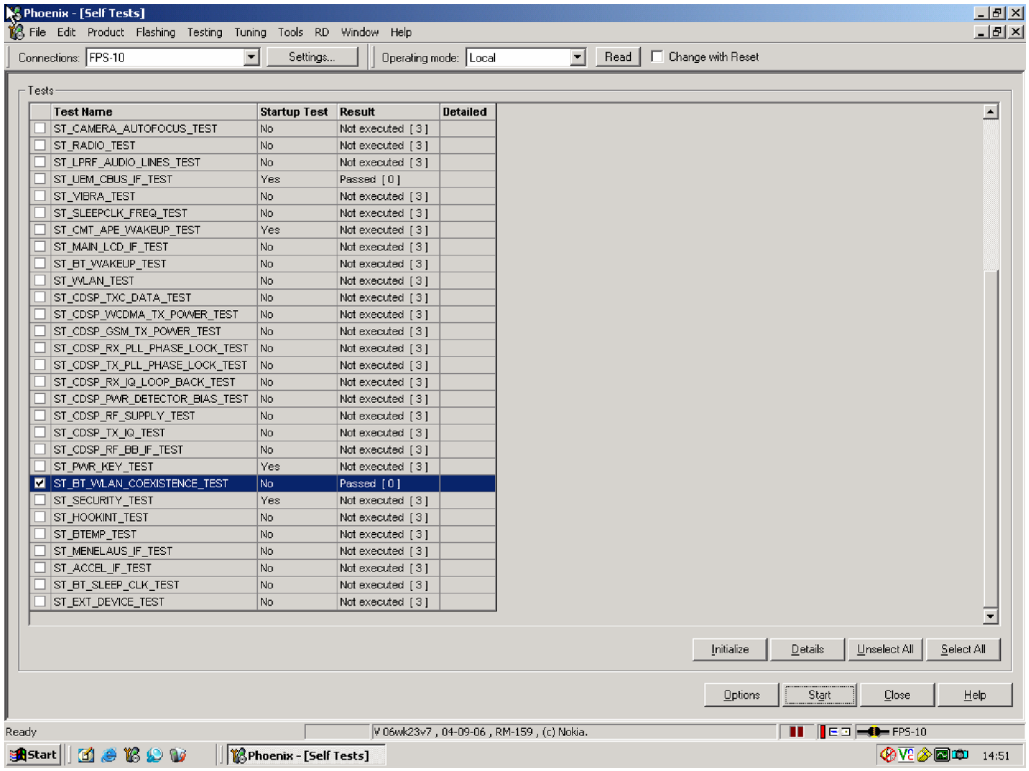

In summary, these two Self tests provide a simple means of ensuring the Host engine is able to communicate with the WLAN module and check the interface to BTH. More detailed WLAN performance test is covered in WLAN functional test section.

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.

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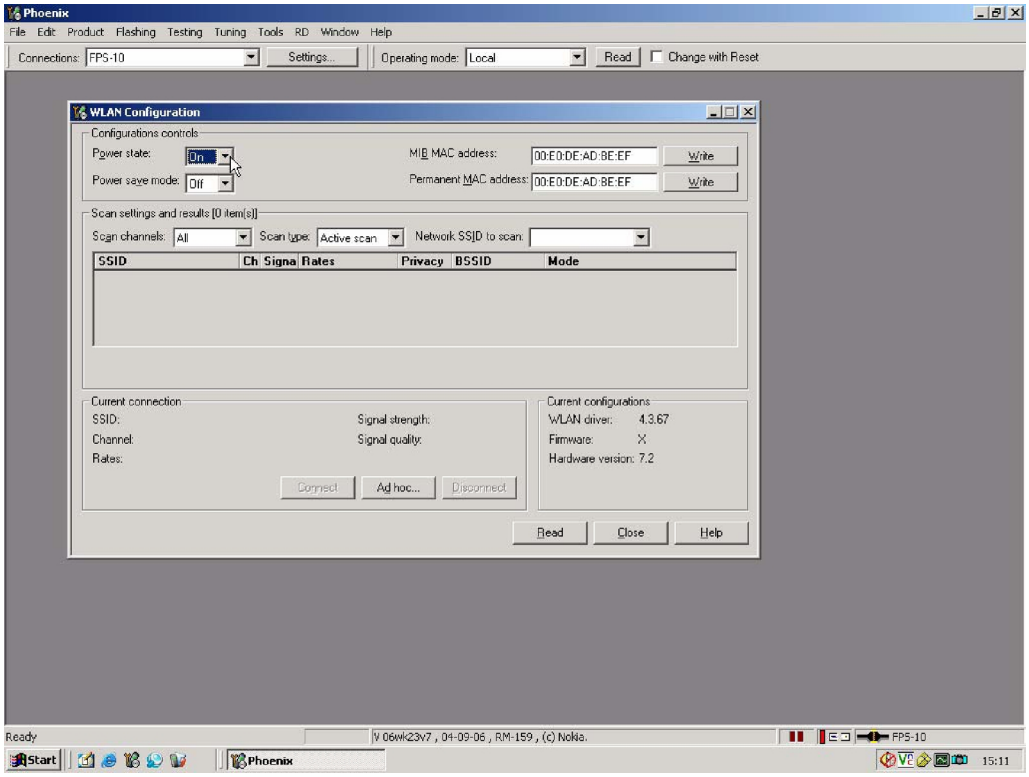

TX tests

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.

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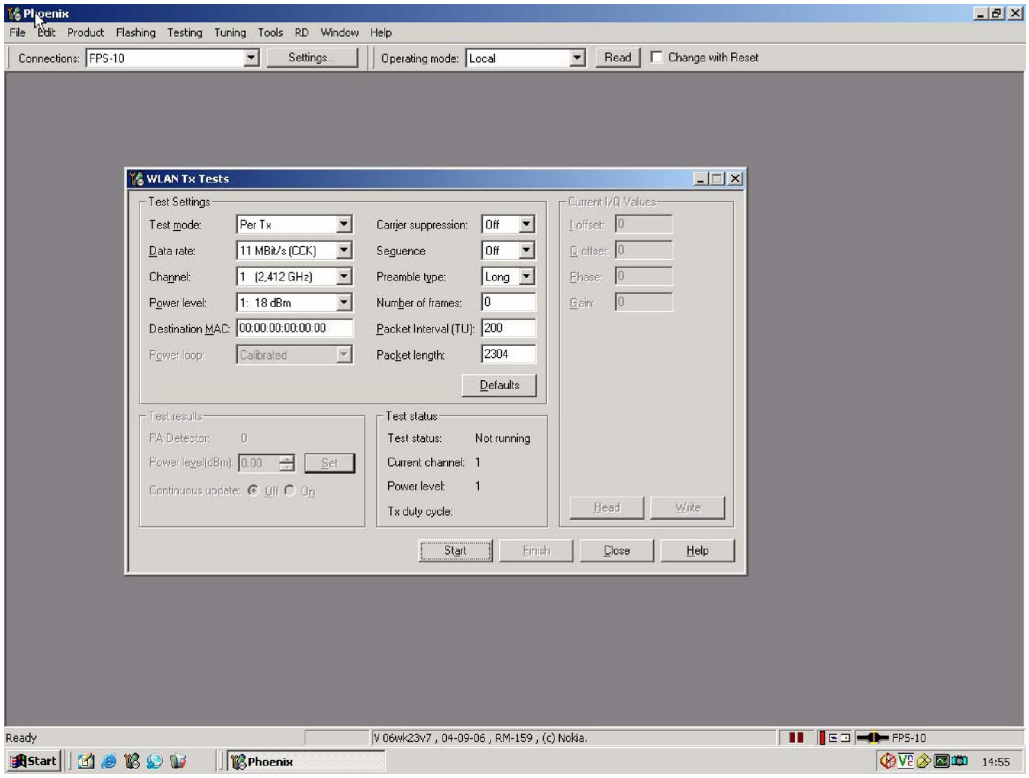

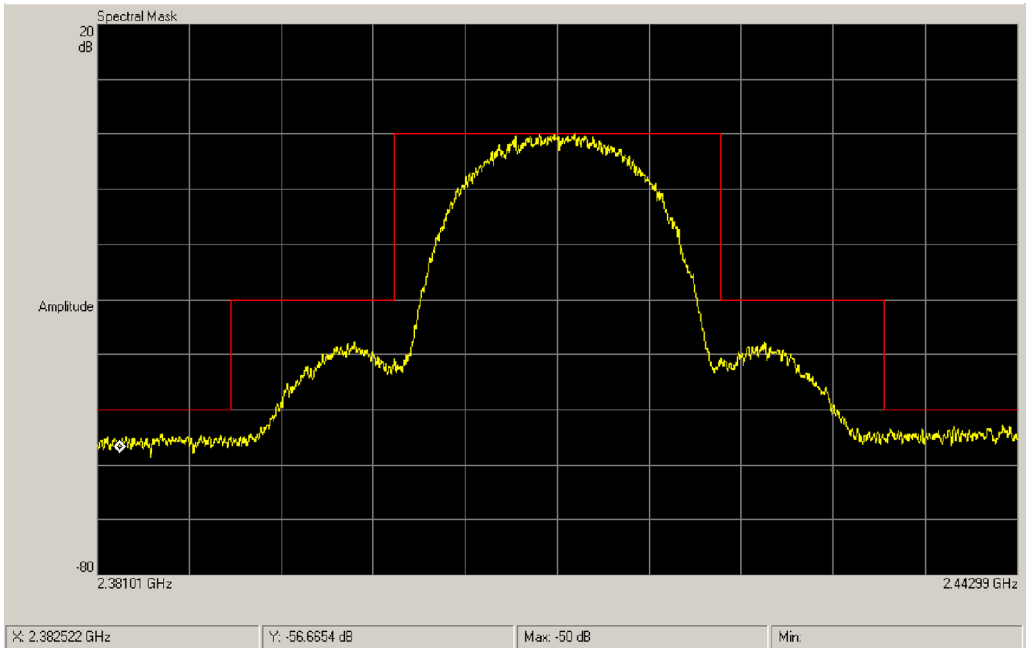

RX Tests

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.

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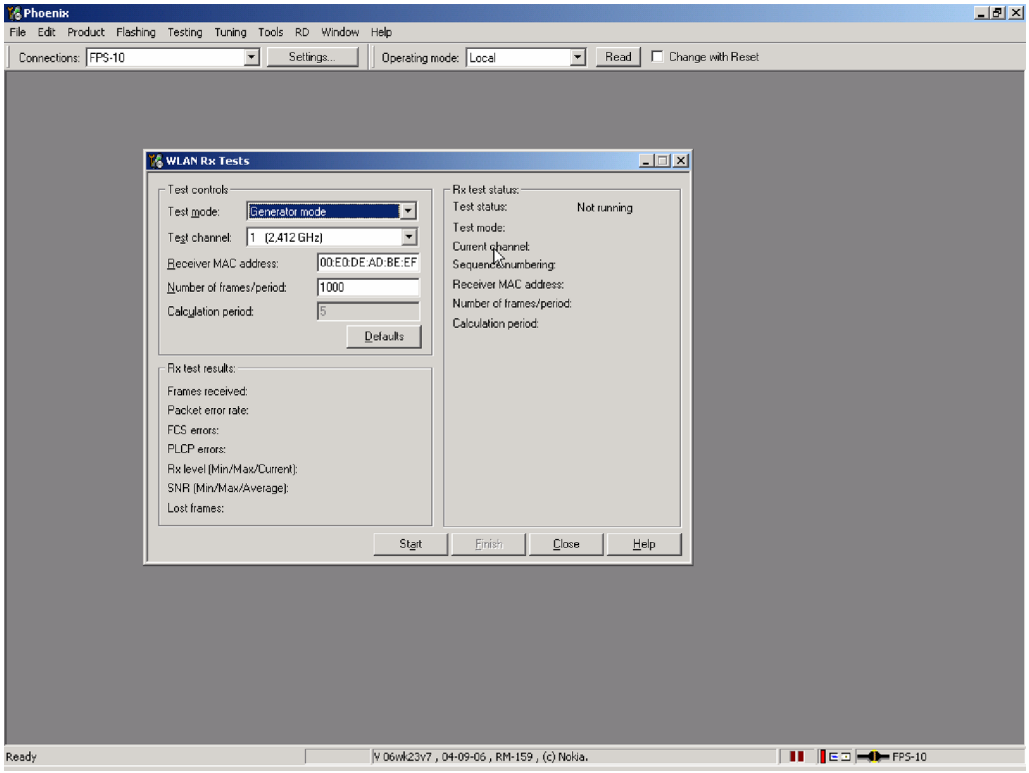
From the testing toolbar select WLAN Rx Test option shown below. This test can be used to verify Rx configuration and functionality.

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 GBIP.

Auto tuning procedure

1 Open the **Tuning → WLAN_TX_TUNING** menu and click **Start Power Calibration.**

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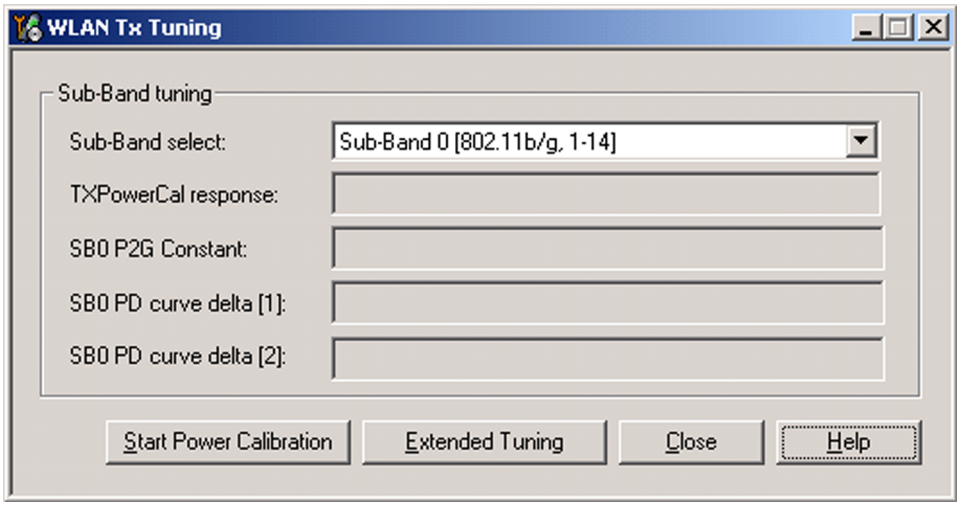
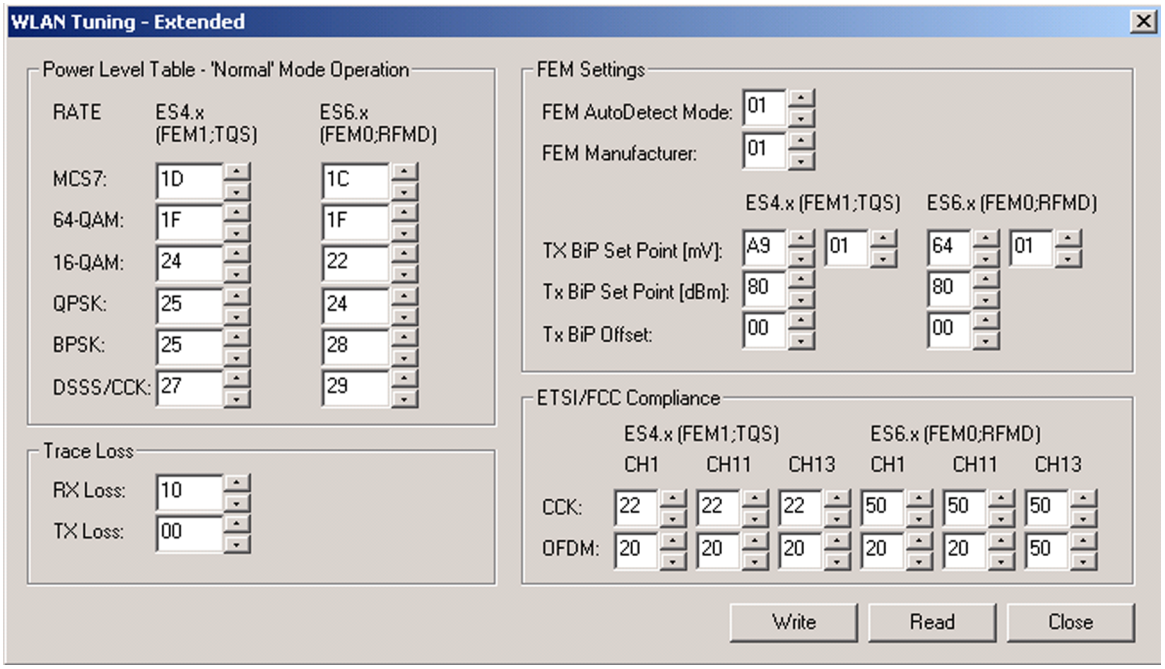


2 To save the tune data, open the **Extended Tuning** menu and click **Write.**



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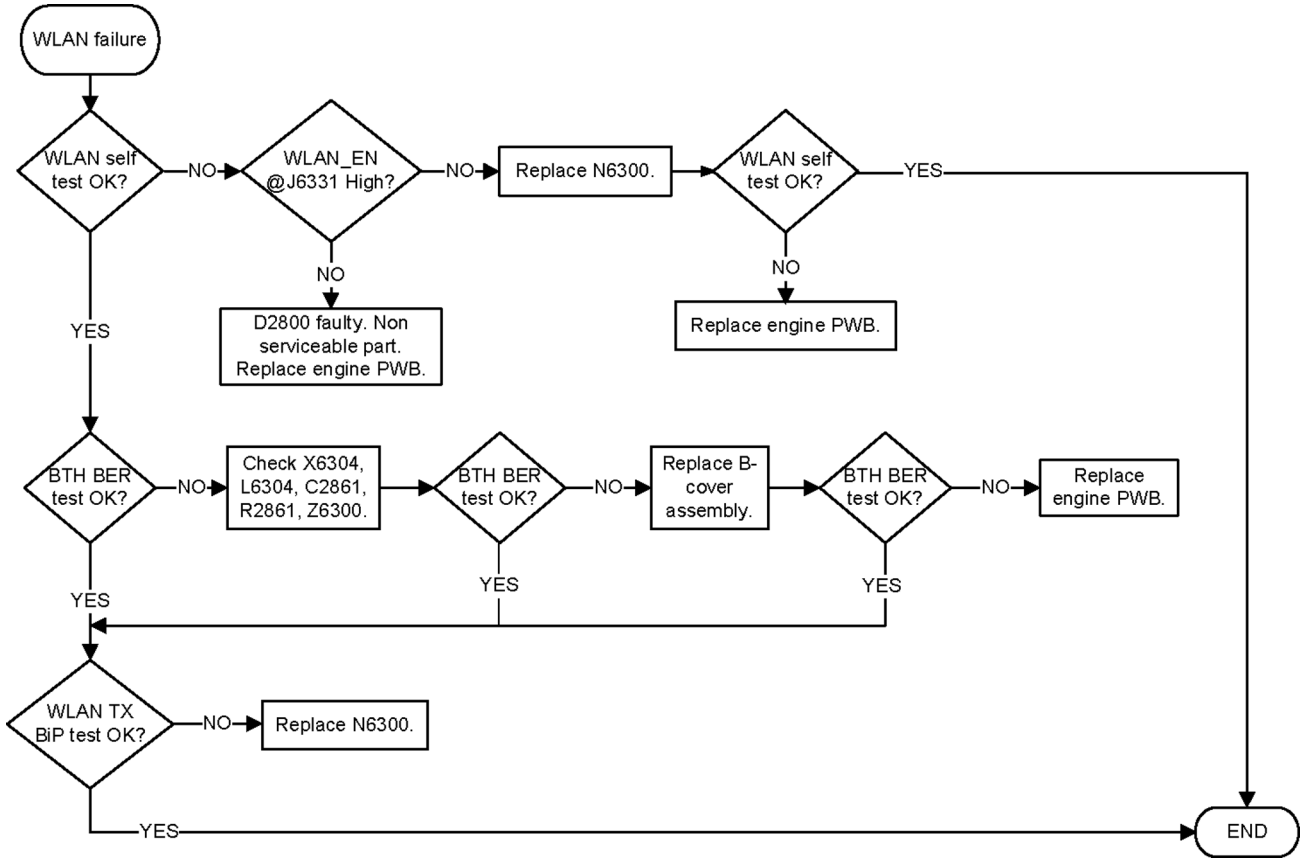
WLAN troubleshooting

Troubleshooting flow



FMTx troubleshooting

General

The handset uses the metallic battery cover as FMTX antenna. The connection to the antenna is exposed by disassembling the phone and removing the PWB.

The antenna requires two connection points, a signal contact spring which contacts the battery cover and the contact pad on the main PWB (X6000), and a grounding pogo pin (connecting the FMTX antenna to a small FMTX PCB inserted into the UI chassis). Both the spring and pogo pin are assembled on the B-cover. It is important to check these connection points for damage or dirt since the performance of the FMTx implementation will be severely impaired if these connections are not in good condition.

General visual inspection guidelines

- Check the condition of the antenna spring, pogo pin and contact pads.
- Check that the N6300 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.

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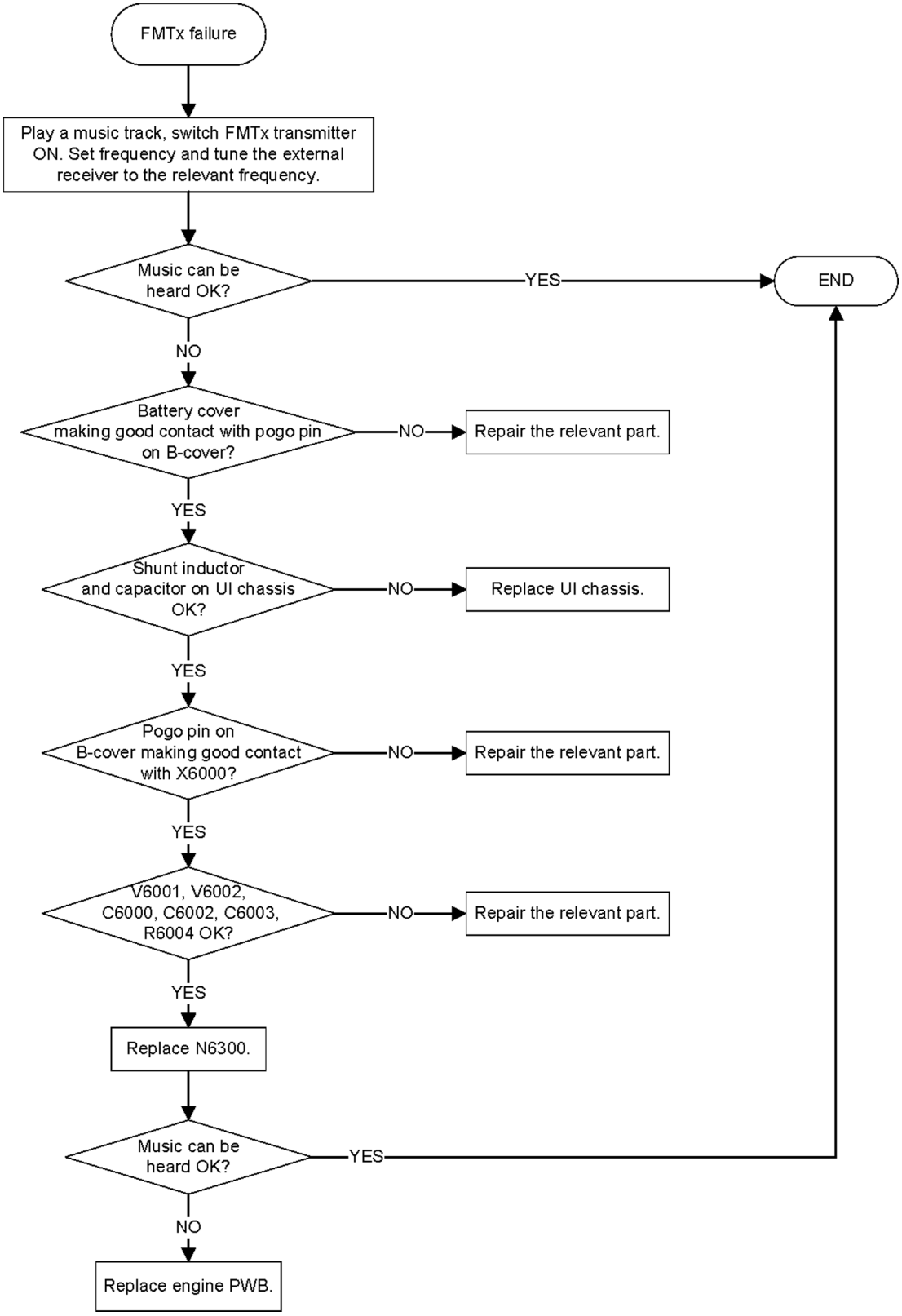
FMTx troubleshooting

Troubleshooting flow



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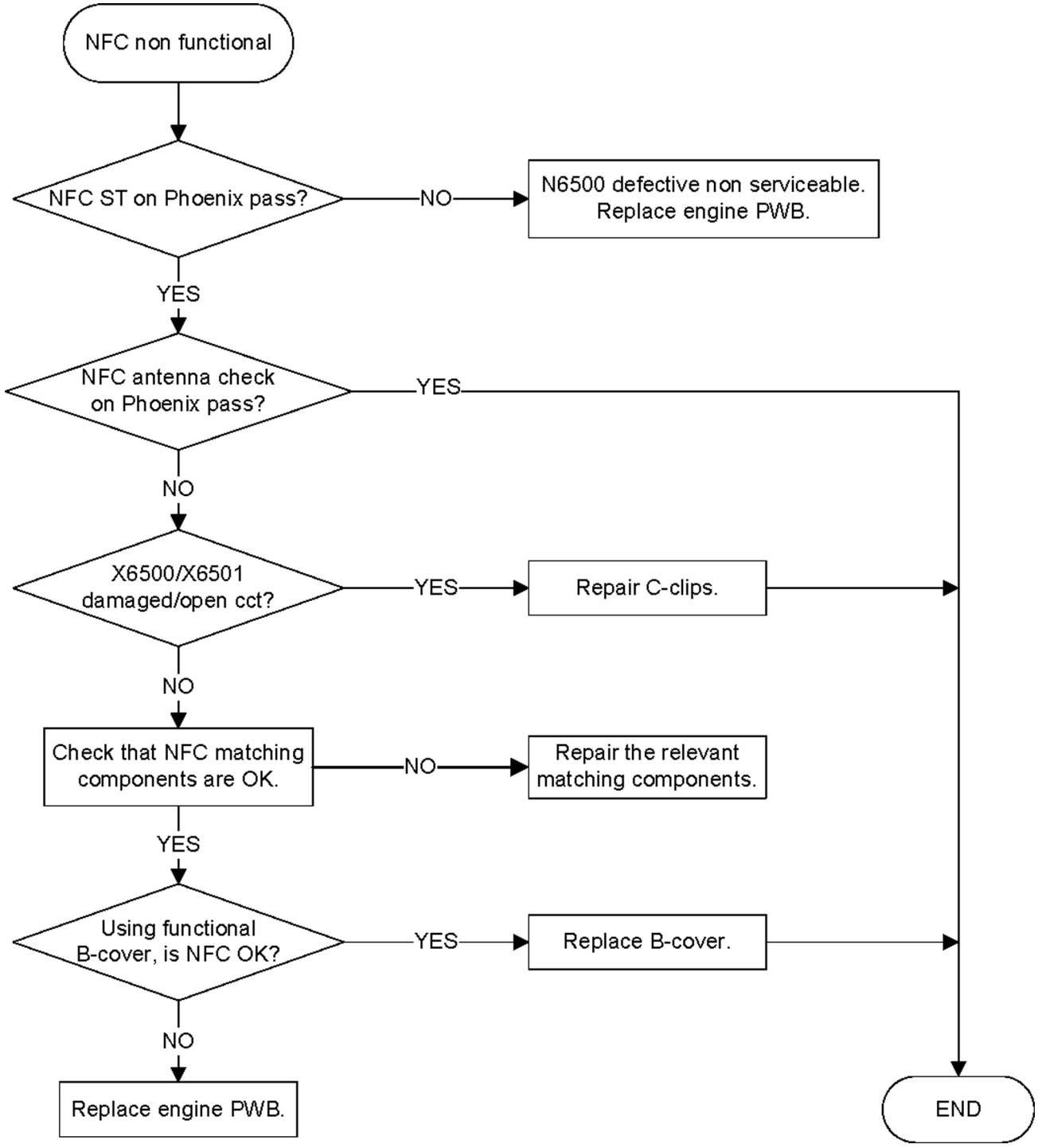
NFC troubleshooting

Troubleshooting flow



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Baseband manual tuning guide

Certificate restoring

Context

This procedure is performed when the device certificate is corrupted for some reason.

All tunings (RF & Baseband, UI) must be done after performing the certificate restoring procedure.

Required equipment and setup:

- Latest *Phoenix* service software.
- "Tucson add on" package if one has been released between complete Phoenix releases
- FPS-10 or 21 Flash prommer updated with latest flash update package.
- Latest product specific data package, supporting for the variants you want to change the phones to. Certificate restoring without flashing does not require data packages to be installed
- SX-4 or SX-4T Smart Card, which has been registered for Tucson use in Nokia Online Security Device Master, and for which local Nokia Care has granted Tucson user rights
- BB 5.0 models:SS-46 with phone specific flash adapter connected to flash prommer
- DCT-4 models:JBV-1 with phone specific flash adapter connected to flash prommer
- Active online connection to internet, please refer to Technical Bulletins for IP addresses

Connection to Tucson online server:

- All requests are handled online. That means a permanent Internet connection is required. Previously used e-mail based system is no longer in use.
- Phoenix, when contacting Tucson server, is using IP address, **147.243.3.169 port 443**

Terms in Tucson:

- When certificate restoring for BB 5 products or IMEI rebuild for DCT-4 products is performed, existing data from Nokia System is programmed in the phone. The phone will be in the same condition as it was when it left the factory for the first time.
- If "Product Code Change" has been SUCCESSFULLY performed with Tucson after the phone left the factory, it will be restored back to the variant it was made into during Product Code change event.
- It is recommended to perform "Restore" function without selecting "Flash Product" – option to avoid possible SW downgrade which causes the phone to die.

The procedure for certificate restoring is the following:

Steps

1. Connect phone and scan product, read phone information to check communication with phone.
2. Open *Tools -> Menu*.

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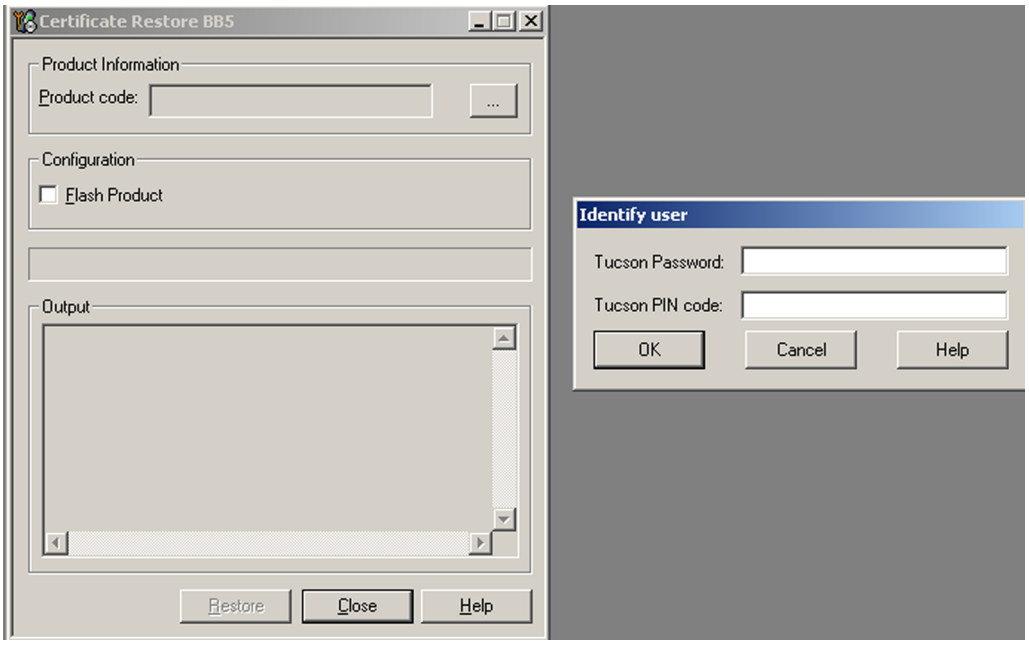
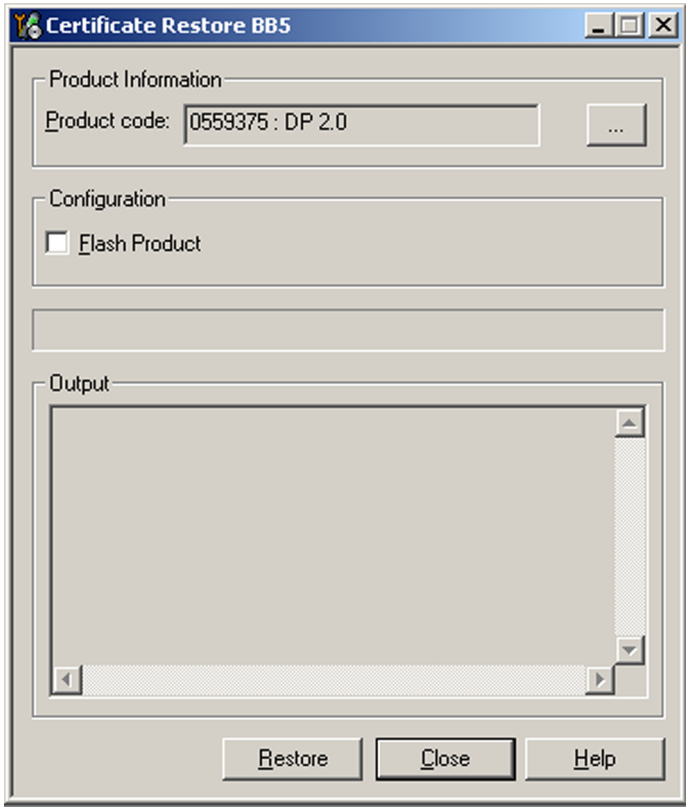
3. Provide Tucson password and PIN code which have been delivered to you by email. Please note that characters are case sensitive.



4. Select OK, Phoenix will read product information from phone.
5. Product code shown on the UI does not matter, because during restoring it will be replaced by the product code which is the latest one stored in Nokia system.
6. It is recommended to perform "Restore"-function without selecting "Flash Product"-option to avoid possible SW downgrade which causes the phone to die.



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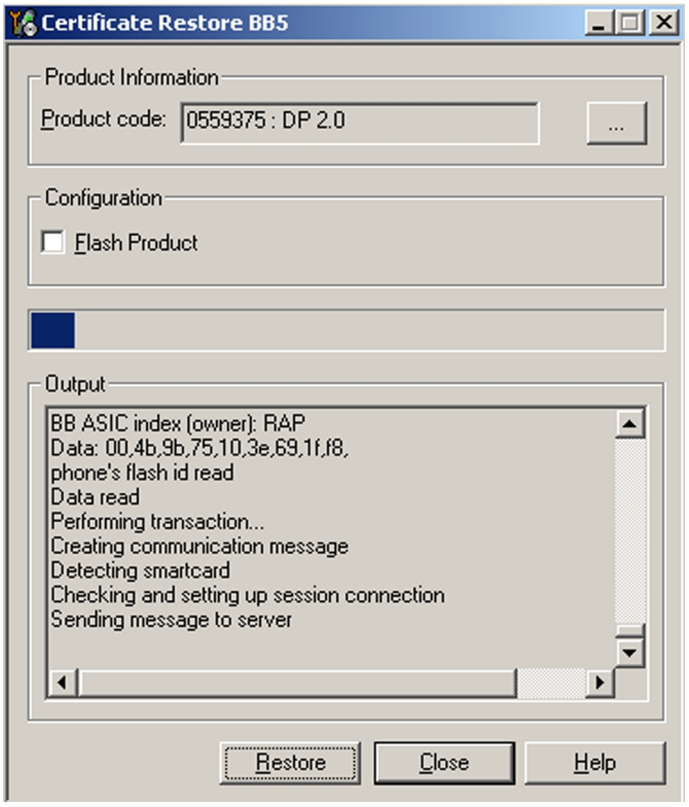
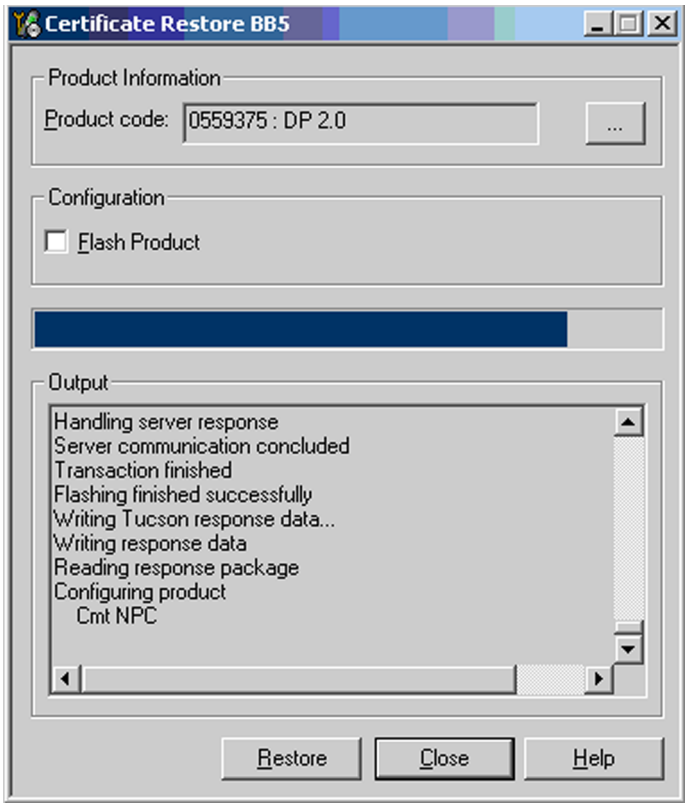
7. Information from phone and Smart Card are read and connection to Tucson server is established.



8. Information from Nokia system is retreived and programmed in the phone.



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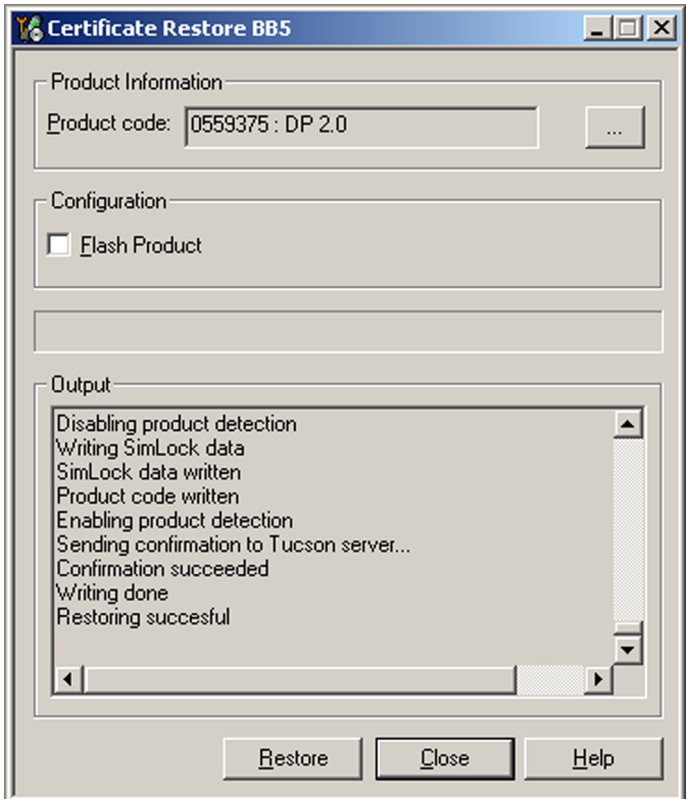
9. After programming, confirmation about successful event is sent to Nokia system.



Next actions

After a successful rewrite, you must retune the phone completely by using *Phoenix* tuning functions.

Important: Perform all tunings: RF, BB, and UI.

Product code change

Context

- When Product Code change with Tucson is successfully performed, phone variant will be changed. Data for the new variant is extracted from Nokia System, and programmed in the phone.
- After successful change, phone specific information in Nokia systems will match the new variant, and it can be used for e.g. certificate restoring. If you perform several product code changes, Nokia system will always be up to date with the latest successful event.
- Failed / incomplete actions will not change the phone specific information in Nokia systems.
- This function can be performed with or without flashing the phone with correct software, selection can be made by checking / unchecking the tick box on Phoenix UI.

The procedure for product code change is the following:

Steps

1. Connect phone and scan product, read phone information to check communication with phone
2. Open *Tools -> Product Code Change*.

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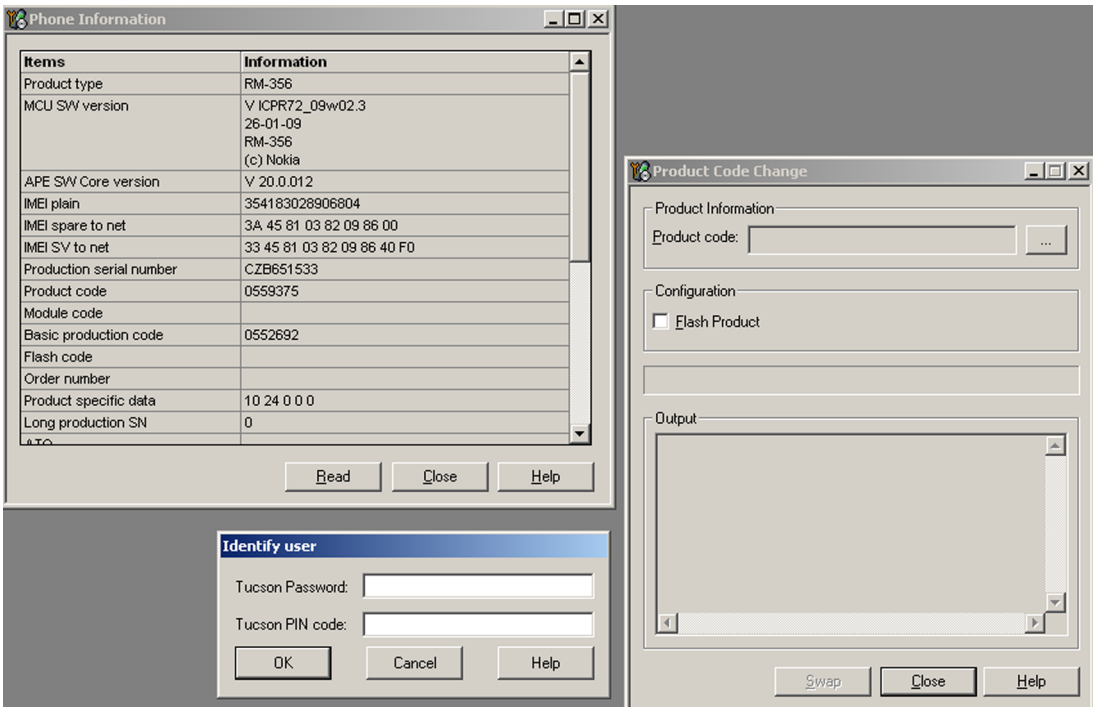
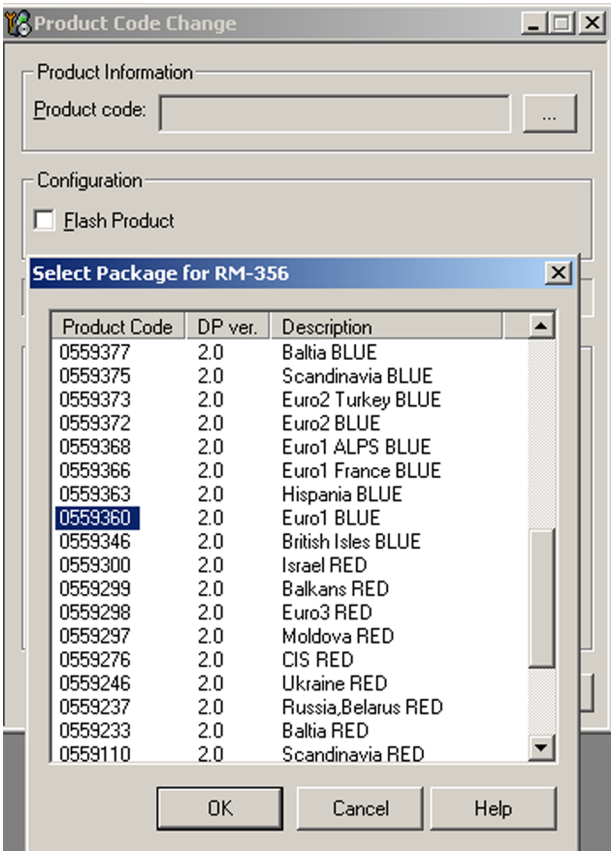
3. Provide Tucson password and PIN code which have been delivered to you by email. Please note that characters are case sensitive.



4. Select product code of new variant from list. If the product code you want is not shown, please install correct data package including the variant.
5. Select “OK” and “SWAP”.



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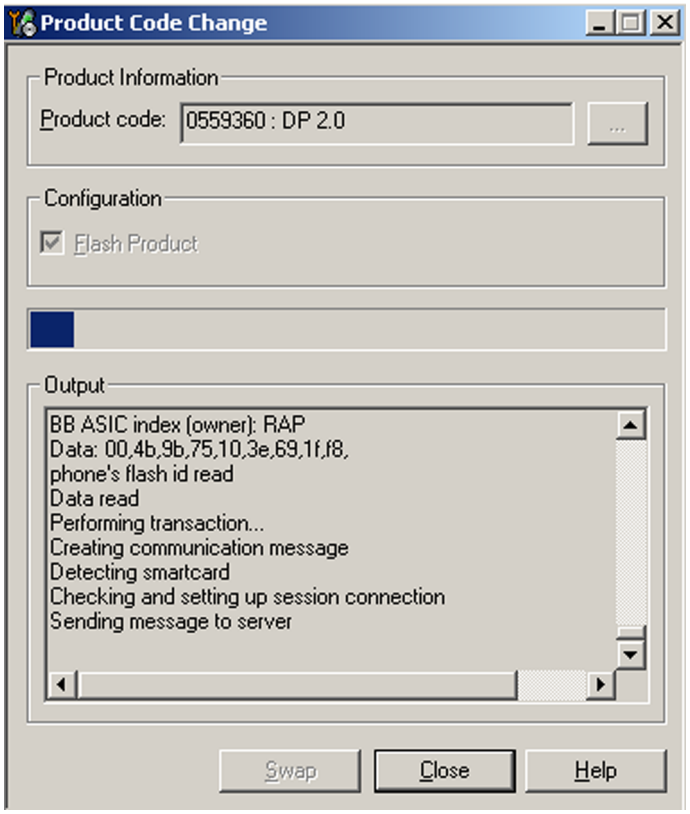
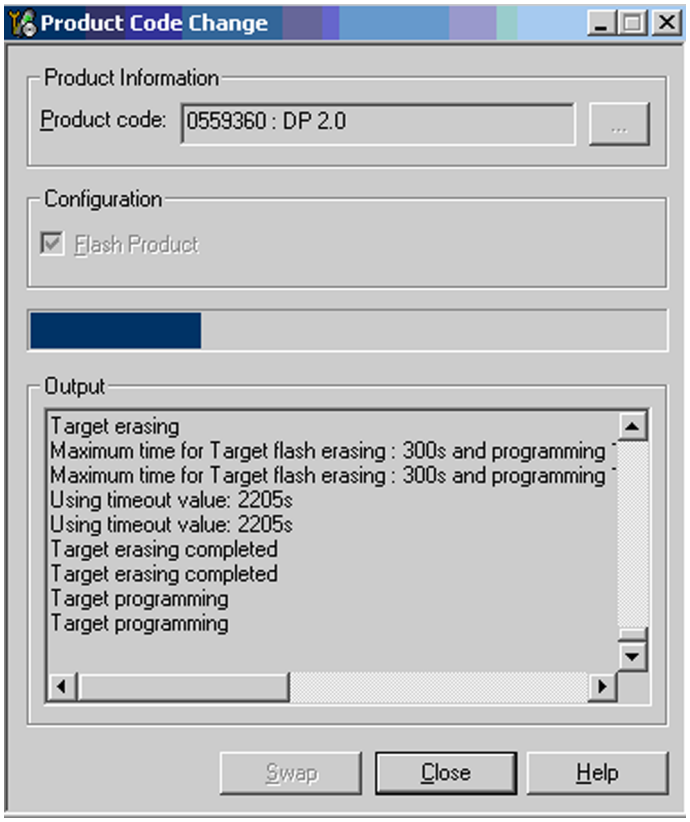
6. Information from phone is read and connection to Tucson server is established.



7. If "Flash Product" – option was selected, phone SW is programmed.



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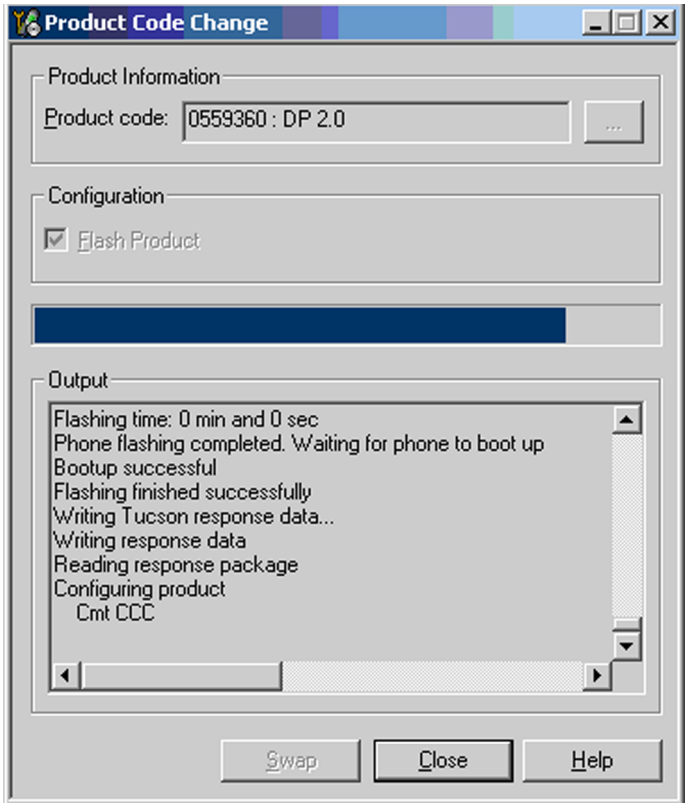
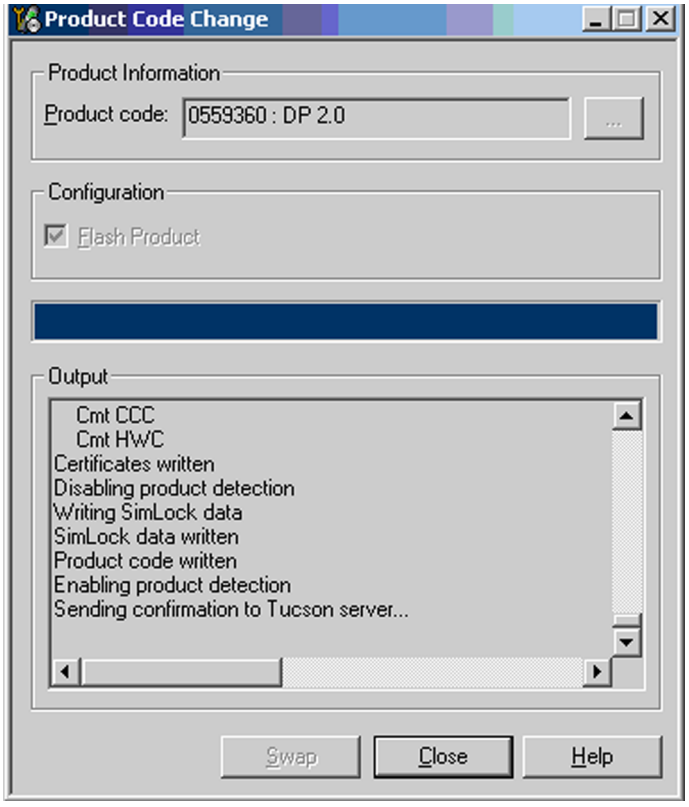
8. New data retrieved from Nokia system is programmed in the phone.



9. Confirmation about successful event is sent to Nokia system.



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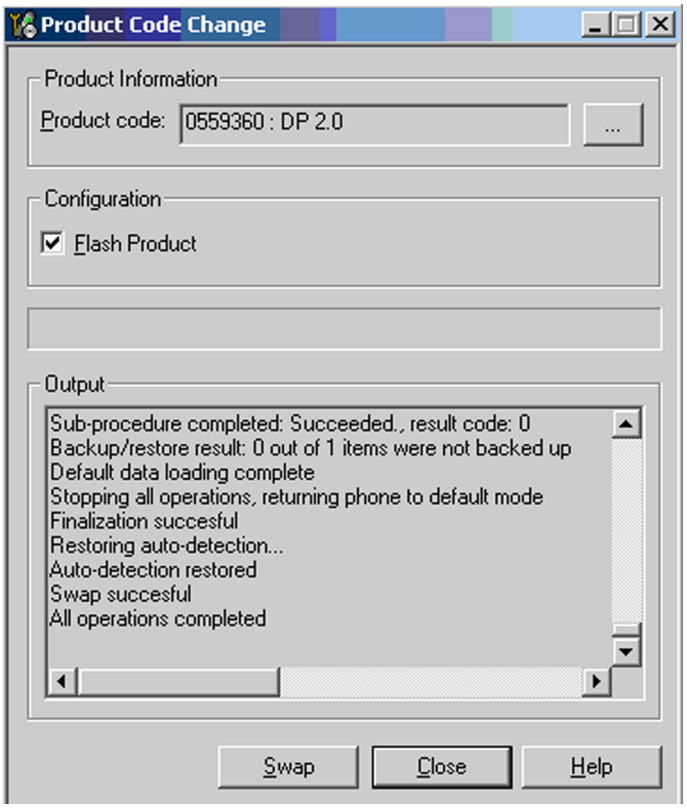
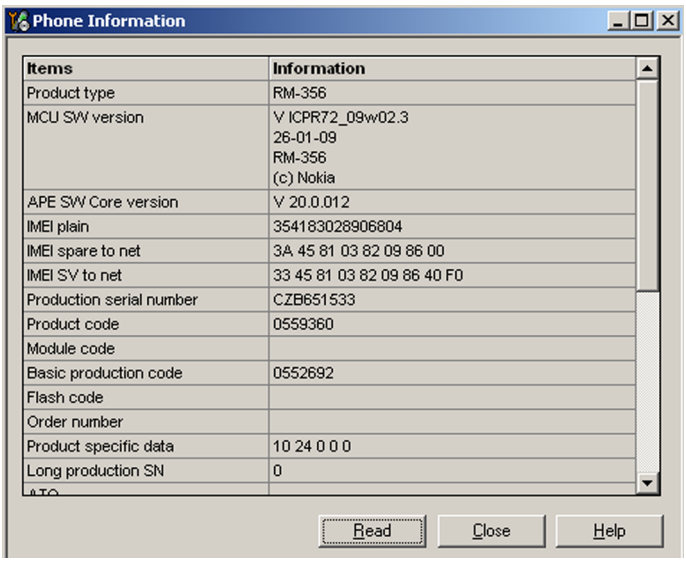
10. Phone has now been changed to another variant. If there is need to restore the data, this information will be sent back to phone. Warranty information in NOL will show the current information in about 24 hours.





Energy management calibration

Energy management calibration is not required in this phone because the relevant components are under solder can and not serviceable according to the Care policy.

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4 — Cellular RF Troubleshooting

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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 analyzer, for example Rohde & Schwarz CMU200. (Alternatively a spectrum analyzer 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 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 transmitters may disturb nearby 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.

RF key components

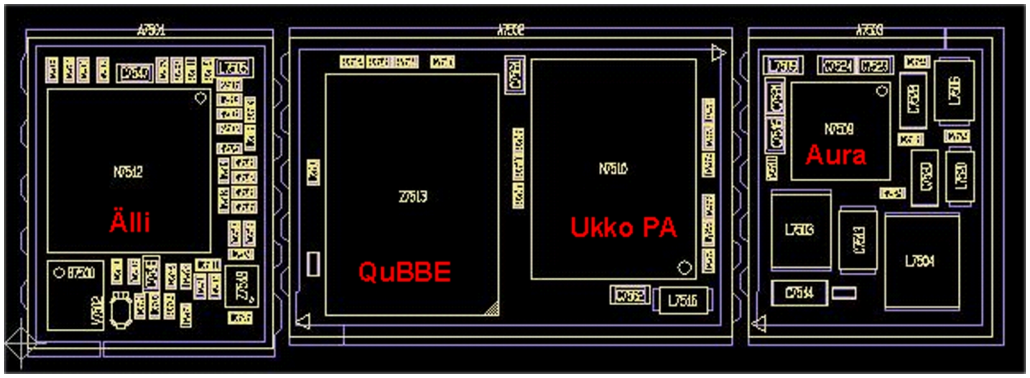

Figure 17 RF key components

Shielding

Linko RF has separate shielding cans for:

- Älli + surroundings (Shield C)
- QuBBE + Ukko PA (Shield B)
- Aura + surroundings (Shield A)

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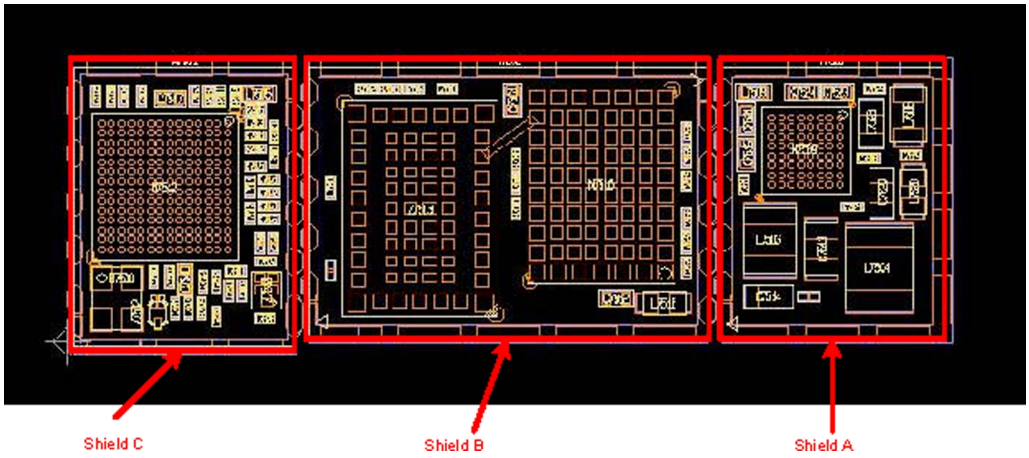

Figure 18 Linko shields

RF tuning and testing

RF auto tuning and testing with Nokia Care Suite

Introduction to cellular RF tunings

RM-675 cellular RF engine has been tuned correctly in production. There is no reason to do re-calibration unless one or more of the RF components are changed or memory (D3000) is corrupted.

RM-675 can be tuned automatically. Auto tuning is designed to align the phone's RF part easily and faster. It performs calibrations, tunings and measurements of RX and TX. The results are displayed and logged in a result file, if initiated.

Note: Always perform RF tuning with the help of the module jig MJ-277, never with RF couplers. Using an RF coupler in the tuning phase will cause a complete mistuning of the RF part.

Important: After RF component changes, **always** perform cellular RF auto tuning.

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 the RF losses are frequency dependent, the user has to act very carefully and understand the measurement setup. For RF attenuations of the CA-181RS RF cable, please refer to section 'Service Tools and Service Concepts'.

Hardware set up

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

Nokia Care Suite preparations

Install Testing And Tuning Tool add-on application to Nokia Care Suite. Automatic RF testing and tuning is not possible without this application. There is no more support in Phoenix to auto tune RM-675 product.

Install the phone specific data package, for example *Nokia_firmware_RM-675_EUROPE_10.014_v41.0.exe*. This defines phone specific settings.

RF auto tuning procedure

Note: If RF splitter is in use, skip steps 10, 11 and 12.

1 Make sure the phone (in the module jig) is connected to the PC.

2 Connect the RF cable between the phone (low band antenna connector) and the communication tester. If an RF splitter is in use, connect both low and high band antenna cables.

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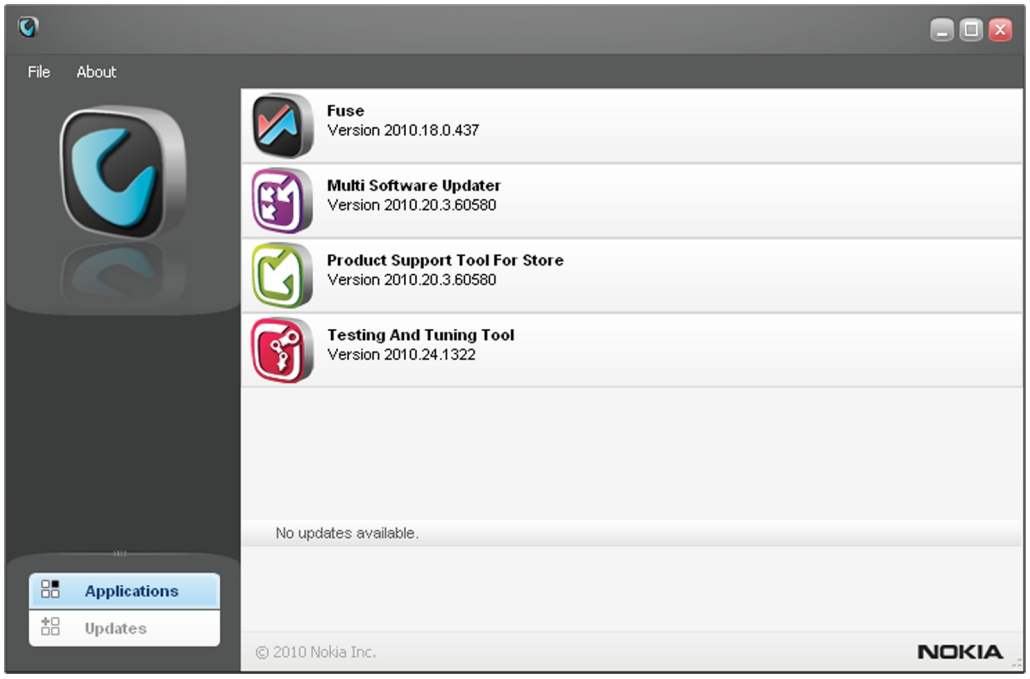
3 Start *Nokia Care Suite* application. The following window opens:

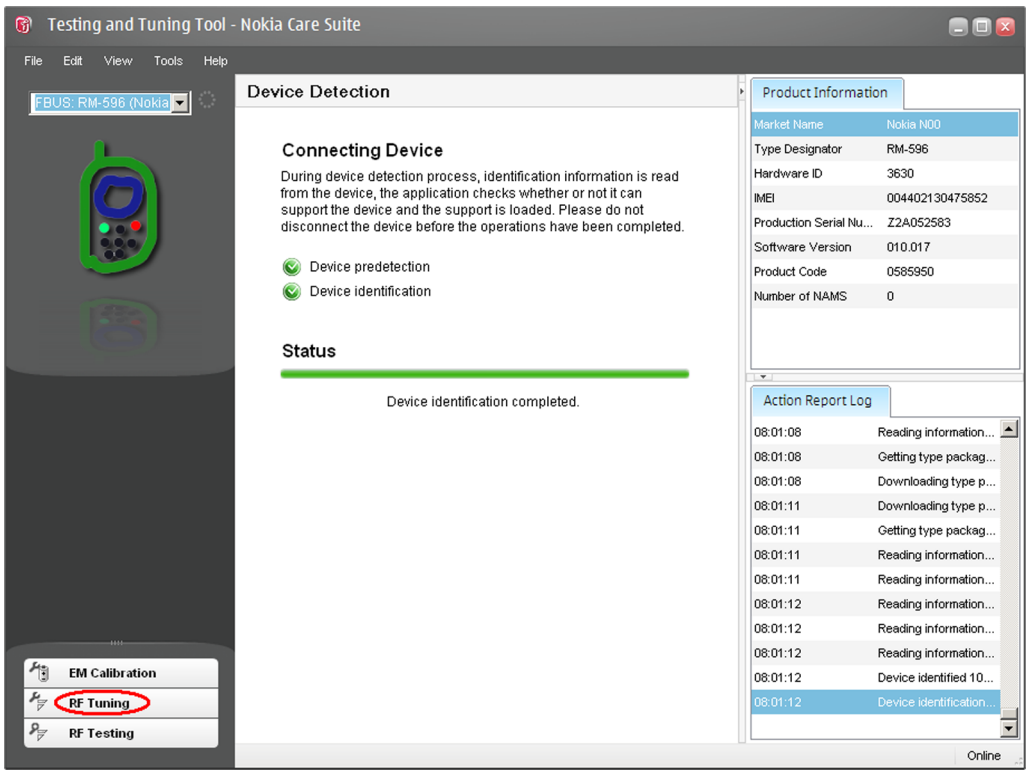


Note: The window appearance may differ depending on the *Nokia Care Suite* version.

Note: *Fuse, Multi Software Updater, Product Support Tool For Store* and *Testing And Tuning Tool* are Care Suite add-on applications. The list is different if there are different add-on applications installed.

4 To open the application, double-click **Testing And Tuning Tool** icon.

5 If the application is able to find a connected phone, the following view will open:



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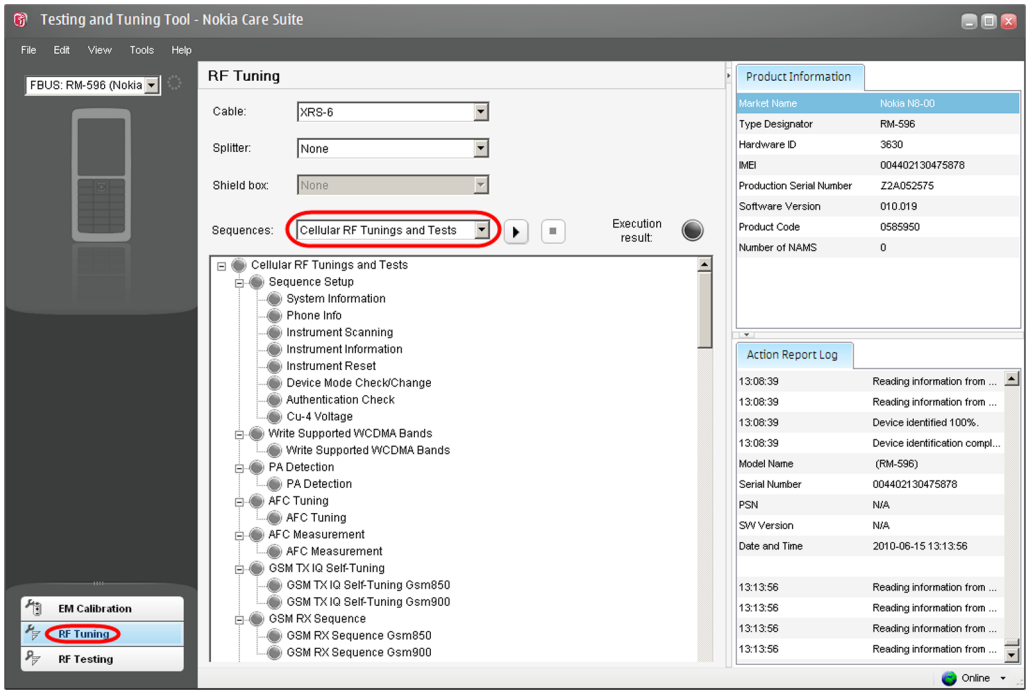
Note: The window appearance may differ depending on the *Nokia Care Suite* and *Testing And Tuning Tool* versions

6 Click on the **RF Tuning** button. The following view opens:

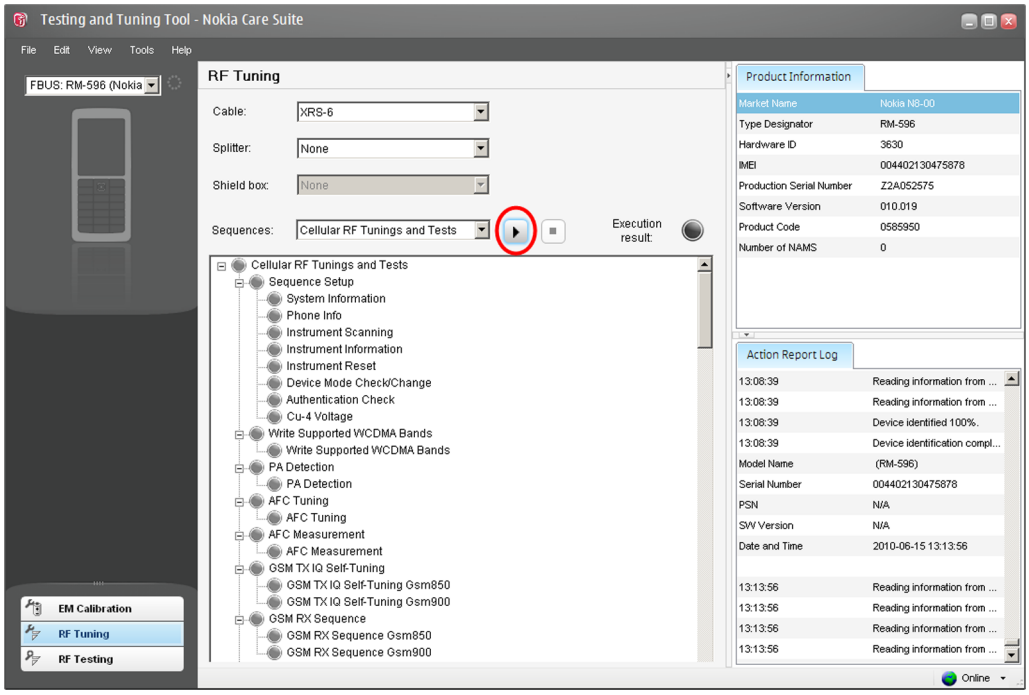


Note: The window appearance may differ depending on the *Nokia Care Suite* and *Testing And Tuning Tool* versions

7 Select **Cellular RF Tunings and Tests** from the drop-down menu.

8 Select the RF cable used (and possible RF splitter / RF shield box) from the drop-down menu. CA-181RS attenuation values are always taken automatically into account when RM-675 product is connected to *Nokia Care Suite* tool.

9 Click the **Run** button.



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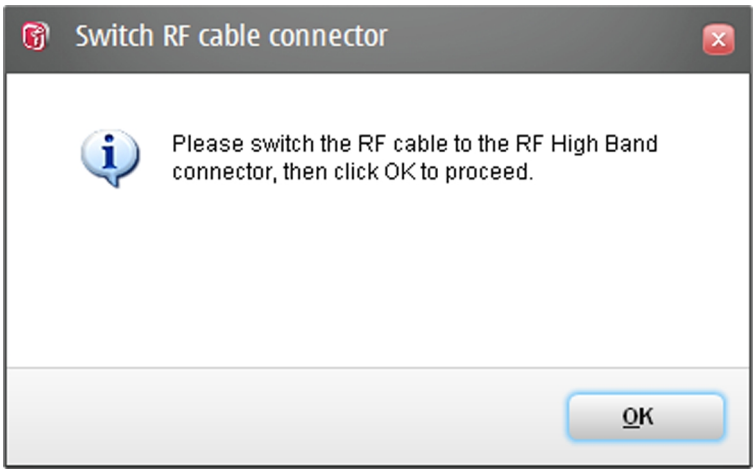
Note: The window appearance may differ depending on the *Nokia Care Suite* and *Testing And Tuning Tool* versions

10 If no critical errors happen during the low band RF tuning procedure, the following window will pop up:

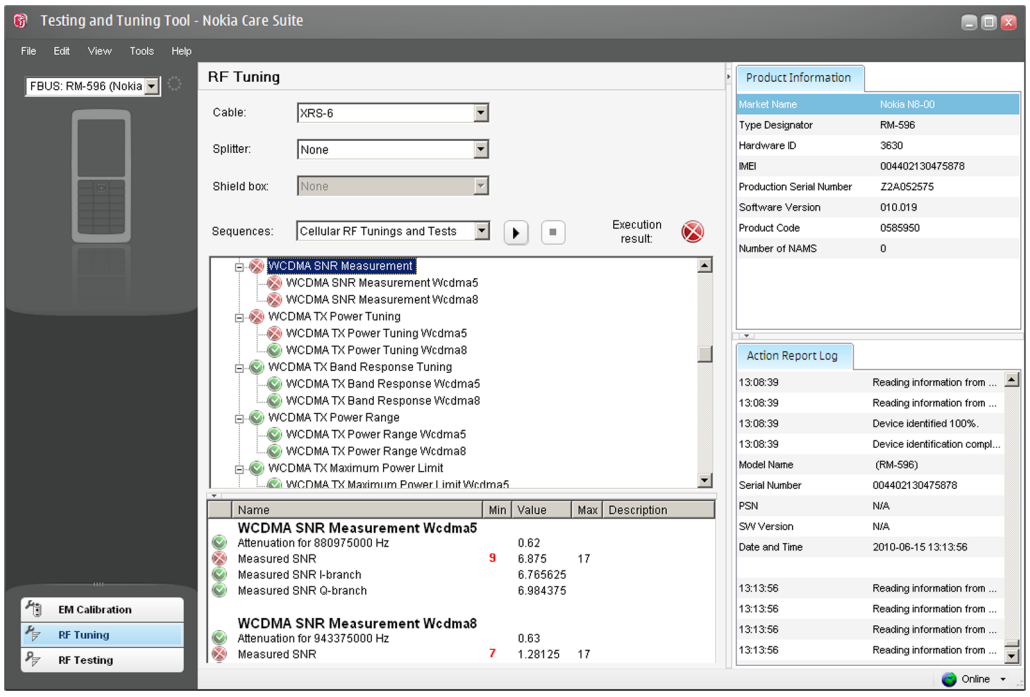


11 Change the CA-181RS cable to the high band RF connector on the phone PWB.

12 Click **OK** and RF tunings will automatically be performed for high cellular bands.

13 RF tunings will be ready when all the tunings and measurements are green in the tool window and no errors occur.

14 If errors do happen, failed tuning/testing steps are marked with a red color and more detailed results are shown on the screen. An example fail case is shown below:



Note: The window appearance may differ depending on the *Nokia Care Suite* and *Testing And Tuning Tool* versions

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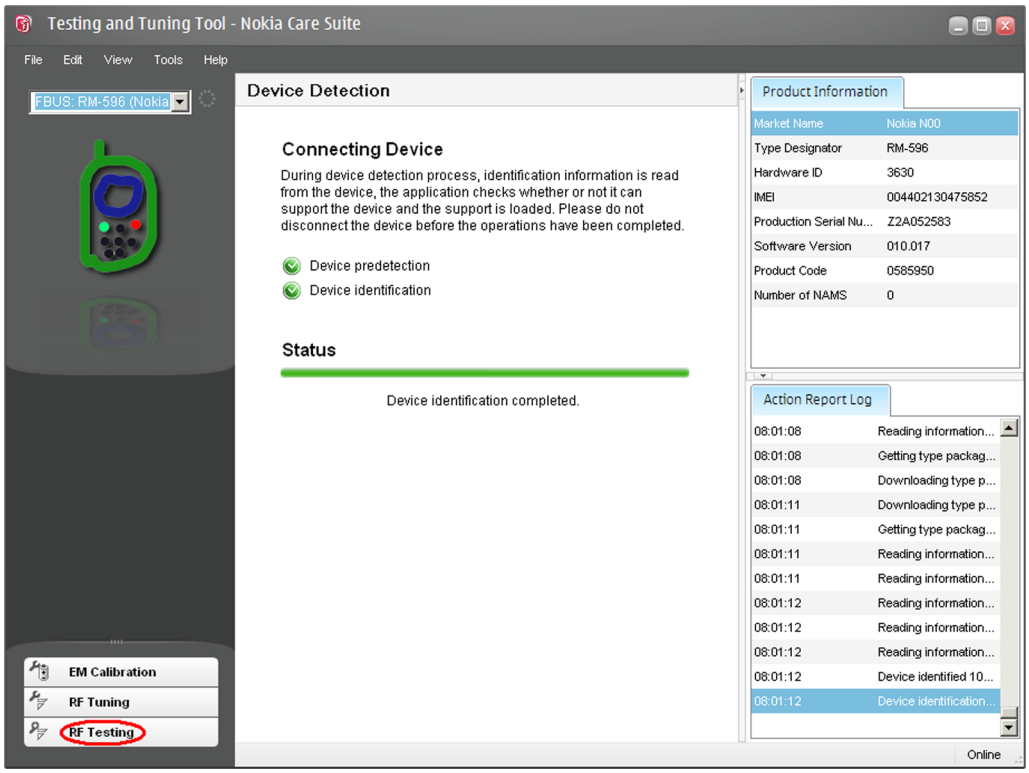
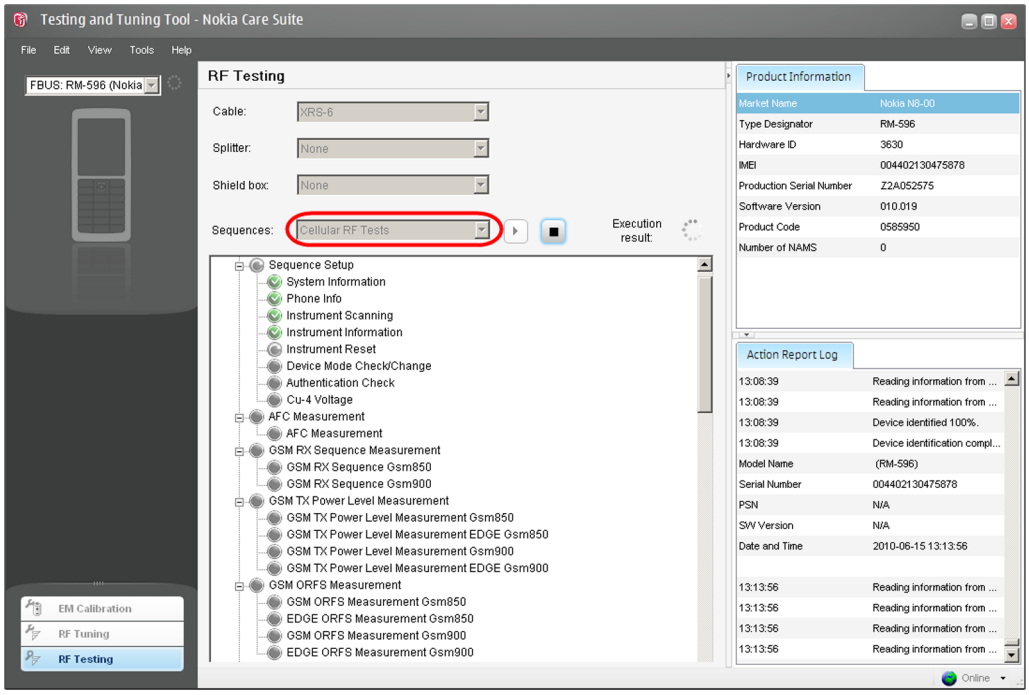
Automatic RF testing with Nokia Care Suite

Testing And Tuning Tool add-on application can be used also for non-signalling RF tests. The automatic RF testing procedure is the same as explained in the chapter *RF auto tuning procedure*, but **RF Testing** should be selected in the *Testing And Tuning Tool* main window instead of **RF Tuning** .





Note: The window appearance may differ depending on the *Nokia Care Suite* and *Testing And Tuning Tool* versions.

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RF Testing selection does all the same measurements as **RF Tuning** , but does not perform any tunings. *RF Testing* is a safe way to check the basic cellular RF performance of the phone. The following test cases will be performed (the complete set of measurements may differ depending on the data package content):

- GSM SNR
- GSM RSSI
- GSM / EDGE TX Power Level
- GSM Modulation & Switching spectrum
- GSM EDGE EVM
- GSM Burst Template
- GSM Phase Error
- WCDMA RSSI
- WCDMA SNR
- WCDMA TX Power Range
- WCDMA TX Max Output Power
- WCDMA ACP
- WCDMA EVM

Self test troubleshooting

Troubleshooting with RF Self tests

Context

Linko (N7512) RF ASIC contains test structures that can be used to detect certain RF related errors. In order to use these self tests the most efficient way, it is very important that the tests are performed in a certain order, or at least that the error data is analyzed in this order. The tests are designed so that by going through them in this order it is easy to find the problem component without any redundant checks. The flowchart presented in this document is based on that idea.

The testing order recommended and used in this troubleshooting guide is the following:

1 ST_CDSP_RF_BB_IF test (86)
   - Tests the functionality of the BB/Linko serial interface & Reset lines.
   - If this test fails, it means that there is a problem in programming of the N7512 and all of the following tests cannot give correct data.

2 ST_CDSP_STROBE_TEST (124)
   - Tests the functionality of the RFStrobe signal.

3 ST_CDSP_DIGI_RXTX_IF_TEST (125)
   - Test checks that the digital RX and TX lines between BB and N7512 are properly connected.

4 ST_CDSP_TX_WCDMA_POWER_TEST (75)
   - Checks the output power of the WCDMA transmitter.

5 ST_CDSP_RF_SUPPLY_TEST (83)
   - Tests the functionality of N7512 bias block, regulators, reference voltage line and, supply connections.
   - If these fail, all other N7512 tests can/will fail.

6 ST_CDSP_PA_ID_PIN_TEST (127)
   - The purpose of this test is to identify the PAs of the different vendors.

To get the best out of these instructions you need to have the valid schematics at hand.

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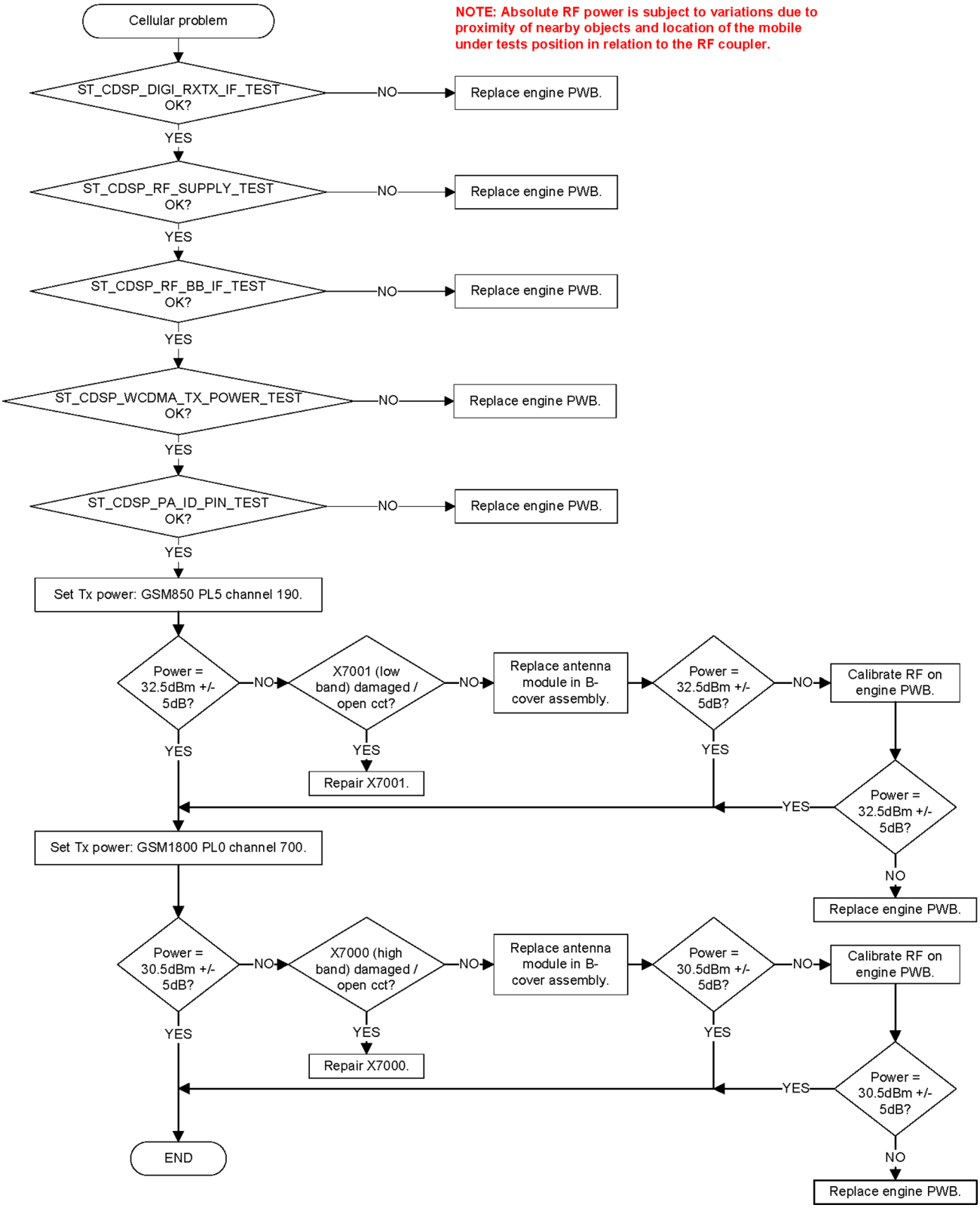
Because all the RF components are under solder shields which are not allowed for repair in service, the introduction of separate Self tests has been removed. Any identified RF component failure will require the use of light SWAP.

Troubleshooting flow



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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**)

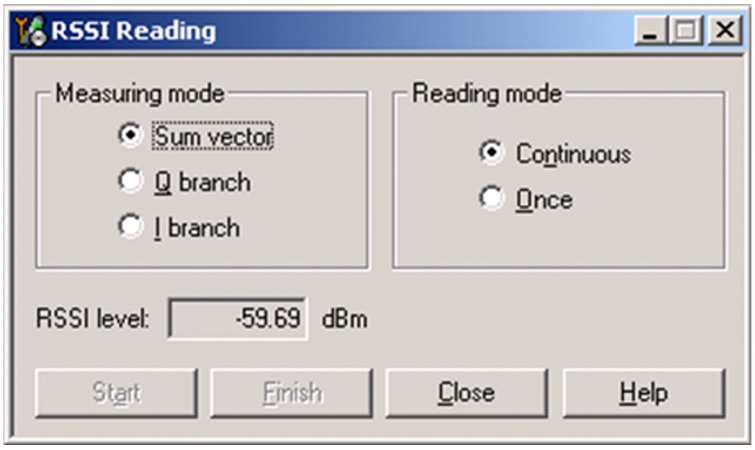

Figure 19 Phoenix GSM RSSI reading window

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.

WCDMA RX chain activation for manual measurement

Steps

1. Via Phoenix Testing menu, choose **WCDMA/RX Control**.

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2. In the RX control window, make the following settings:

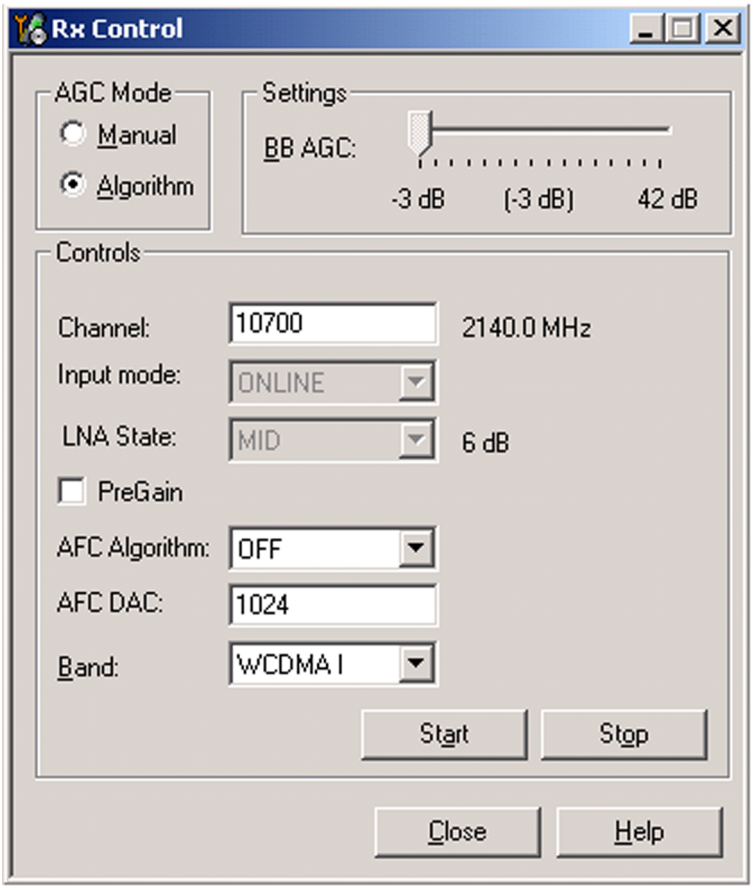

Figure 20 Phoenix WCDMA RX Control window

Note: Channel for band WCDMA I 10700, II 9800, IV 1637, V 4408, 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 (2141 MHz for channel 10700 WCDMA band I, CW signal).

Steps

1. Set the RF generator settings.

   Note: Frequency for band WCDMA I 2141.0 MHz, II 1961.0 MHz, IV 2133.4 MHz, V 882.6 MHz, VIII 943.4 MHz.

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

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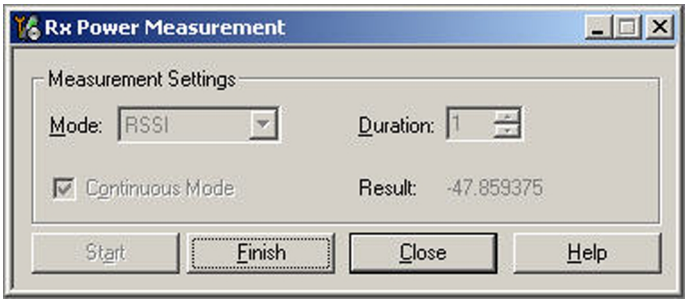

Figure 21 Phoenix WCDMA RX power measurement window

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

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

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:

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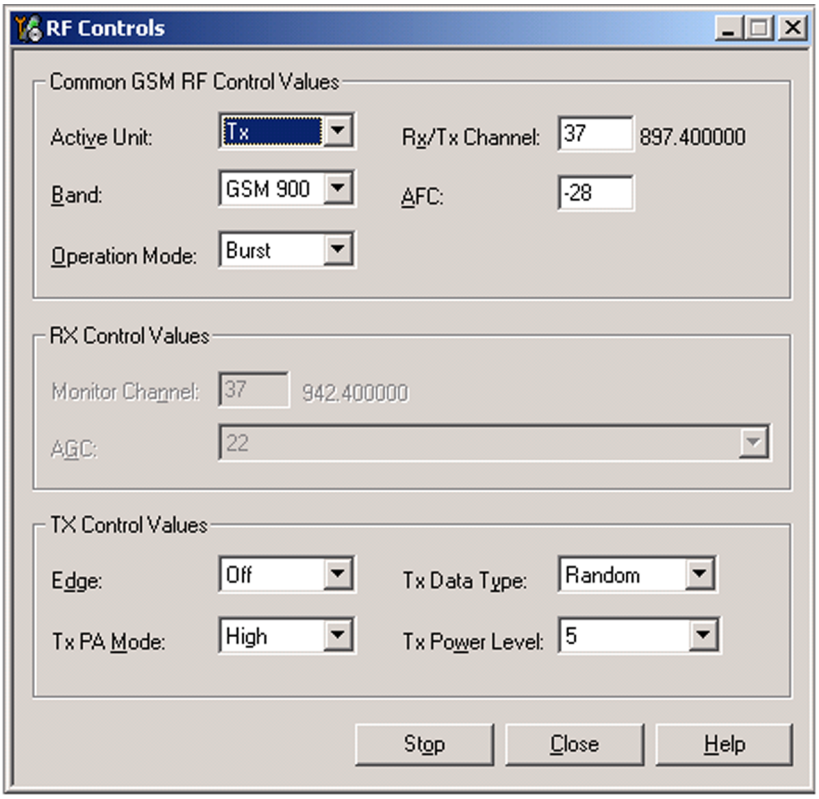

Figure 22 Phoenix GSM RF controls window

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

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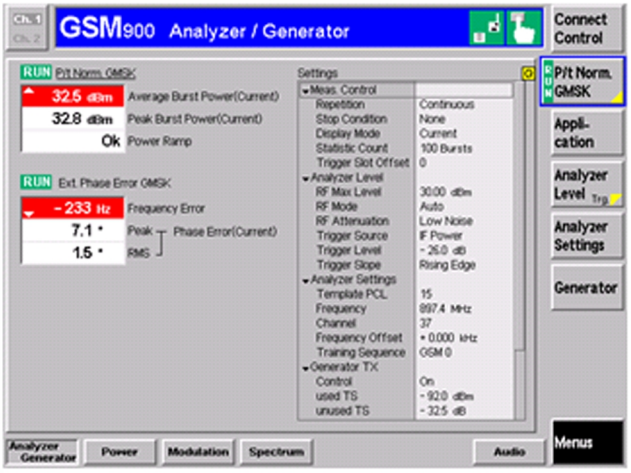
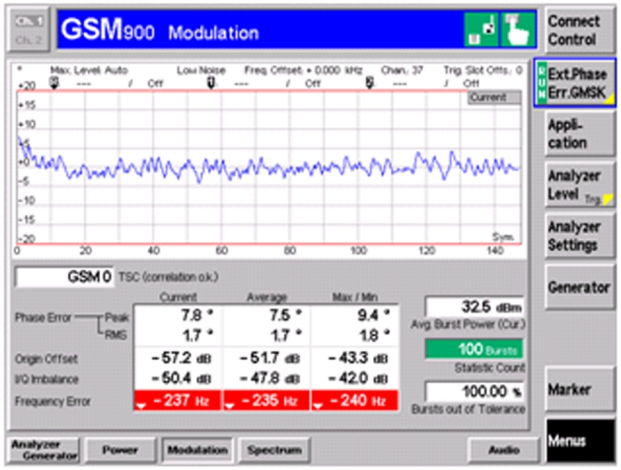
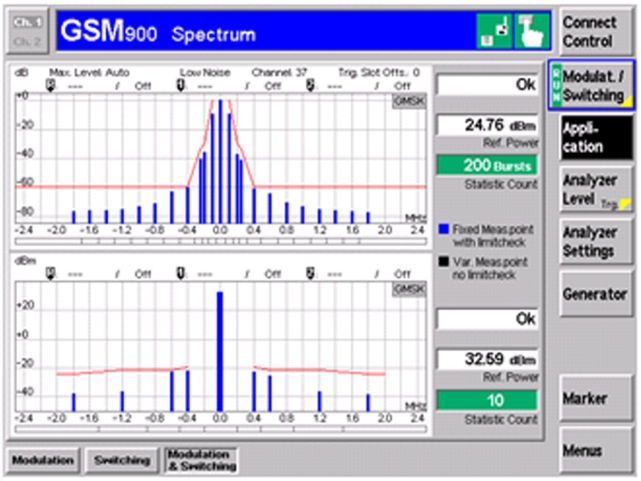
Analyser settings



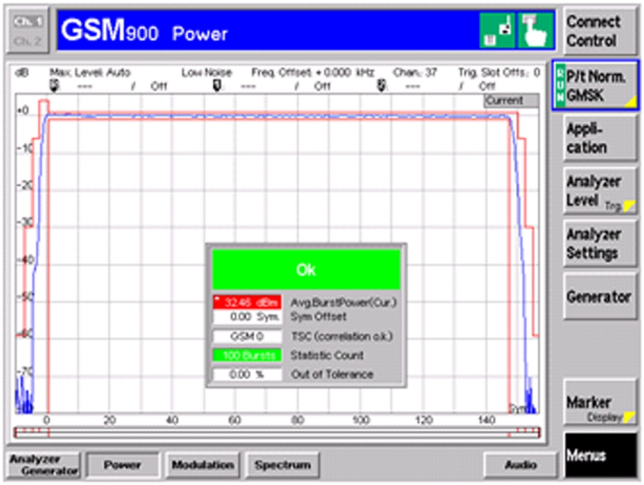
Phase error



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.

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Next actions

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

GSM TX output power check and troubleshooting

The tuning targets in GSM mode are:

- Low Band
  - GMSK: 32.5 dBm
  - EDGE: 27 dBm
- High Band
  - GMSK: 30.5 dBm
  - EDGE: 26 dBm

Band	Mid channel
GSM850	190
GSM900	37
GSM1800	700
GSM1900	661

Max power level			
	VPA	Average current	Peak current
Nominal	High band: 4...5V		
	Low band: 4...5V	200...300 mA	2 A
Mid level		100...200 mA	
Low level		< 100 mA	

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:

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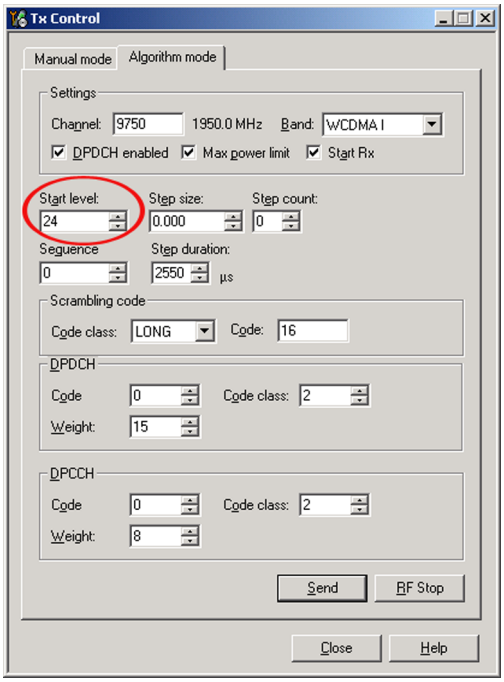

Note: For WCDMA TX channels: band I 9750, II 9400, IV 1412, V 4183, VIII 2787.

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).

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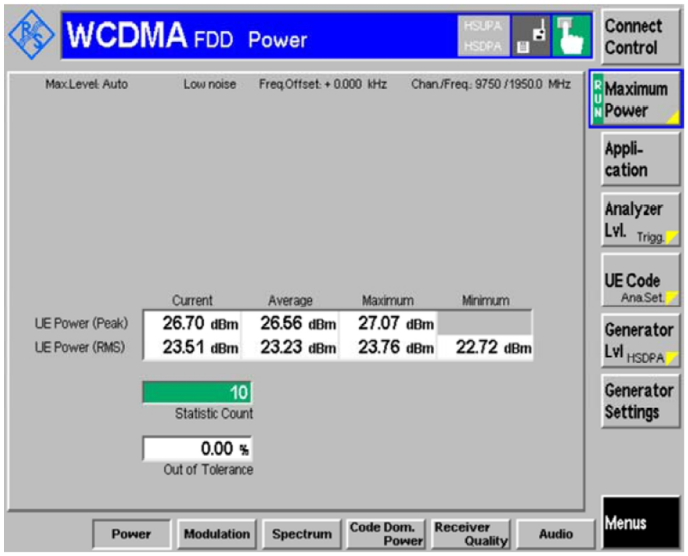
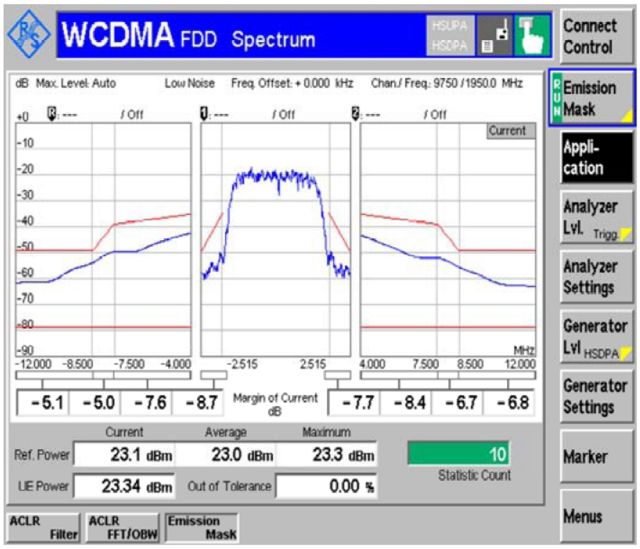
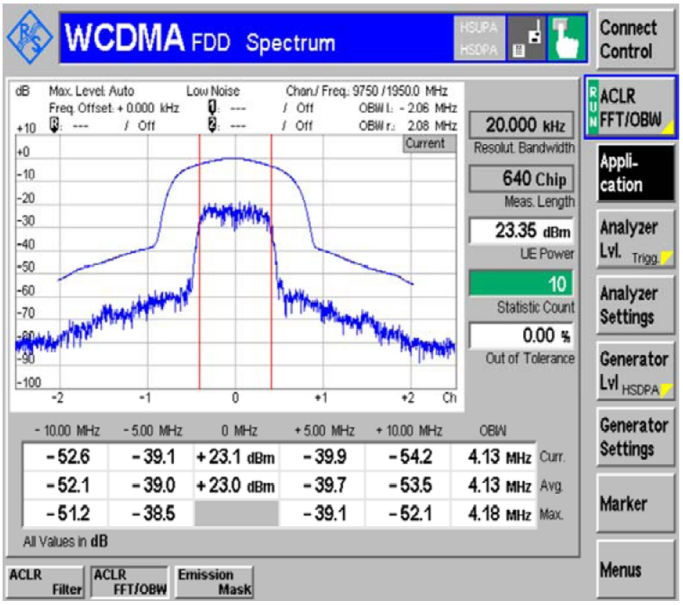
Power



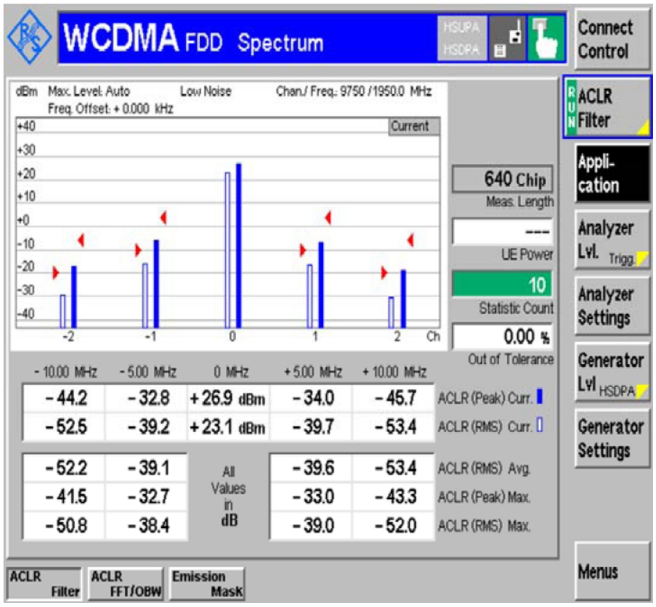
Spectrum - Emission Mask



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 overview

The phone has five antennas in total. Four of them are on the B-cover: a cellular antenna, a GPS antenna, a WLAN/BT antenna and an NFC antenna; and metal C-cover functions as an FMTX antenna.

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The cellular antenna covers the GSM and WCDMA bands and has separate antenna feeds for low and high band. Connection is implemented by C-clips (3pcs). The main antenna consists of an LDS (plating on plastic) antenna module, an antenna PWB and two coax cables. It is located at the bottom of the B-cover.

The GPS and BT/WLAN antennas are placed on one plastic carrier at the top of the phone. The GPS antenna is located on the right-hand side (volume key side) and the BT/WLAN antenna on the left-hand side (charger side). Both antennas are connected to the main PWB by C-clips.

The NFC antenna consists of a flexi and a ferrite-sheet and is attached to the top of the B-cover with adhesive. Connection to the main PWB is implemented by two C-clips.

The FMTX antenna is a metallic battery cover. Feeding from the PWB is implemented by a spring connection, and the GND connection to the PWB by a pogo pin.

Main antenna functionality

The main antenna is functioning normally when the feed and GND pads take proper contact to the contact springs on the PWB, and the antenna plated tracks are visually intact.

The main antenna functionality must also be checked by measuring the transmitted power with RF coupler at GSM900 channel 124 for low band and at GSM1900 channel 661 for high band.

Antenna troubleshooting

Antenna contacts, visual check

The main antenna has three C-clips on the antenna PCB for connections, visually check that they take proper contact to the antenna pattern.

The main antenna has two coax cables for connection to the main PWB, check the cable connectors for any damage and that the receptacles on the PWB are clear.

Check that the BT/WLAN, GPS and NFC antenna pads take proper contact to the C-clips on the PWB and the C-clips are clearly open.

Check that the FMTX feed spring and pogo pin are clearly open, and take proper contacts to the PWB and battery cover. Check that the contact pads on the PWB are clear.

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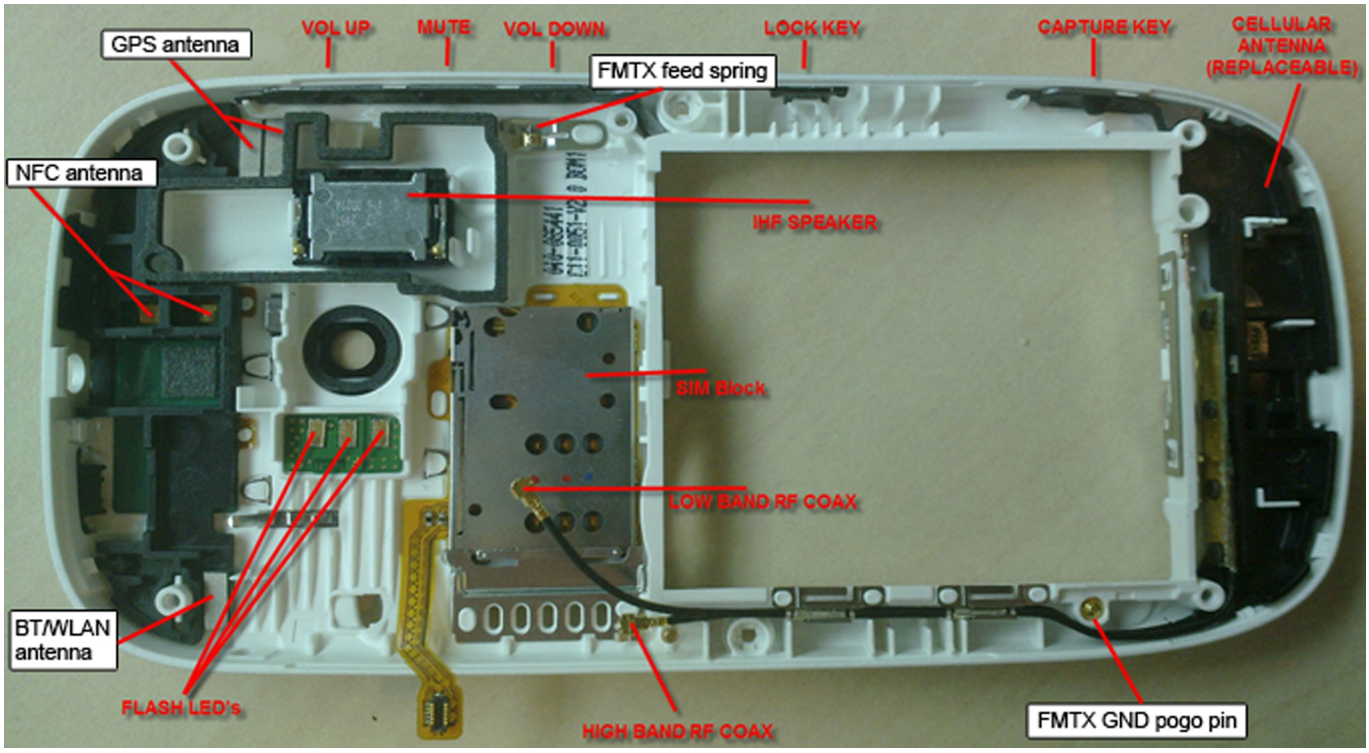

Figure 23 Antennas

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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

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.
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.

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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.

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.

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.

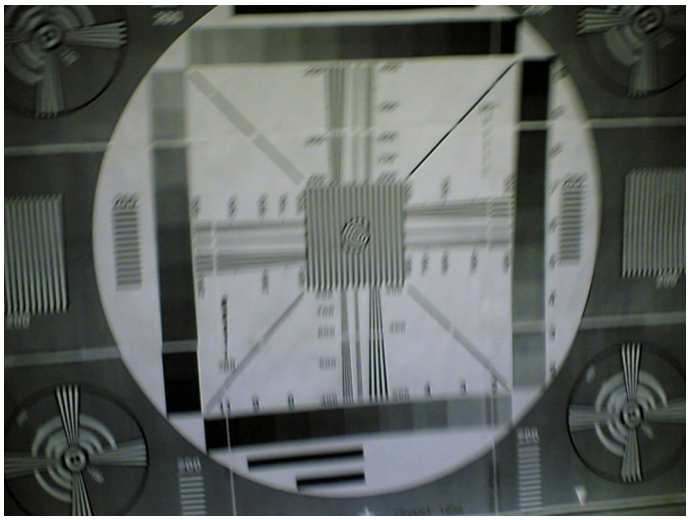

Figure 24 Blurring caused by shaking hands

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.

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Figure 25 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 26 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.

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Figure 27 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 28 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.

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Figure 29 A lens reflection effect caused by sunshine

Examples of good quality images

Figure 30 Good image taken indoors

Figure 31 Good image taken outdoors

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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.

EDoF impact on image quality

This phone uses EDoF (Extended Depth of Field) technology for its main camera. The technology differs from AF and fixed focus cameras.

With EDoF technology, both near and far objects will be sharp and in focus. A key limitation is that objects closer than 50 cm to the camera will not be in focus and there is no macro mode.

Field returns are possible if users do not understand why objects closer than 50 cm are not in focus. This can easily be verified by capturing an image 50 cm from the camera and checking if it is in focus.

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.

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Figure 32 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 four possible sources for the problem:

1 The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.

2 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.

3 There is dirt between the protection window and the camera lens.

4 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 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.

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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.

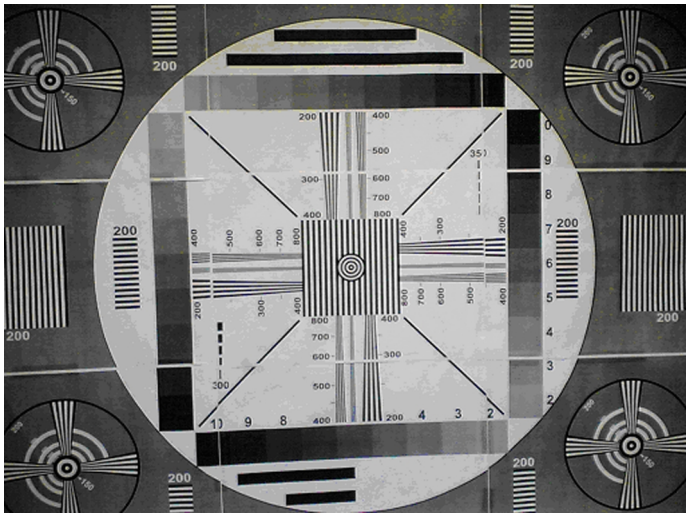

Figure 33 Image taken with clear protection window

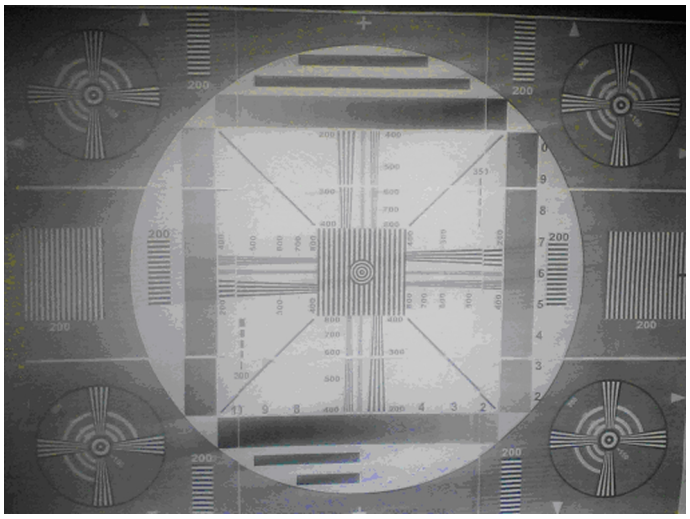

Figure 34 Image taken with greasy protection window

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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 35 Image of point light sources taken with a clean protective window

Figure 36 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.

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

Figure 37 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 38 Light from the flash has reflected on particles in front of the camera

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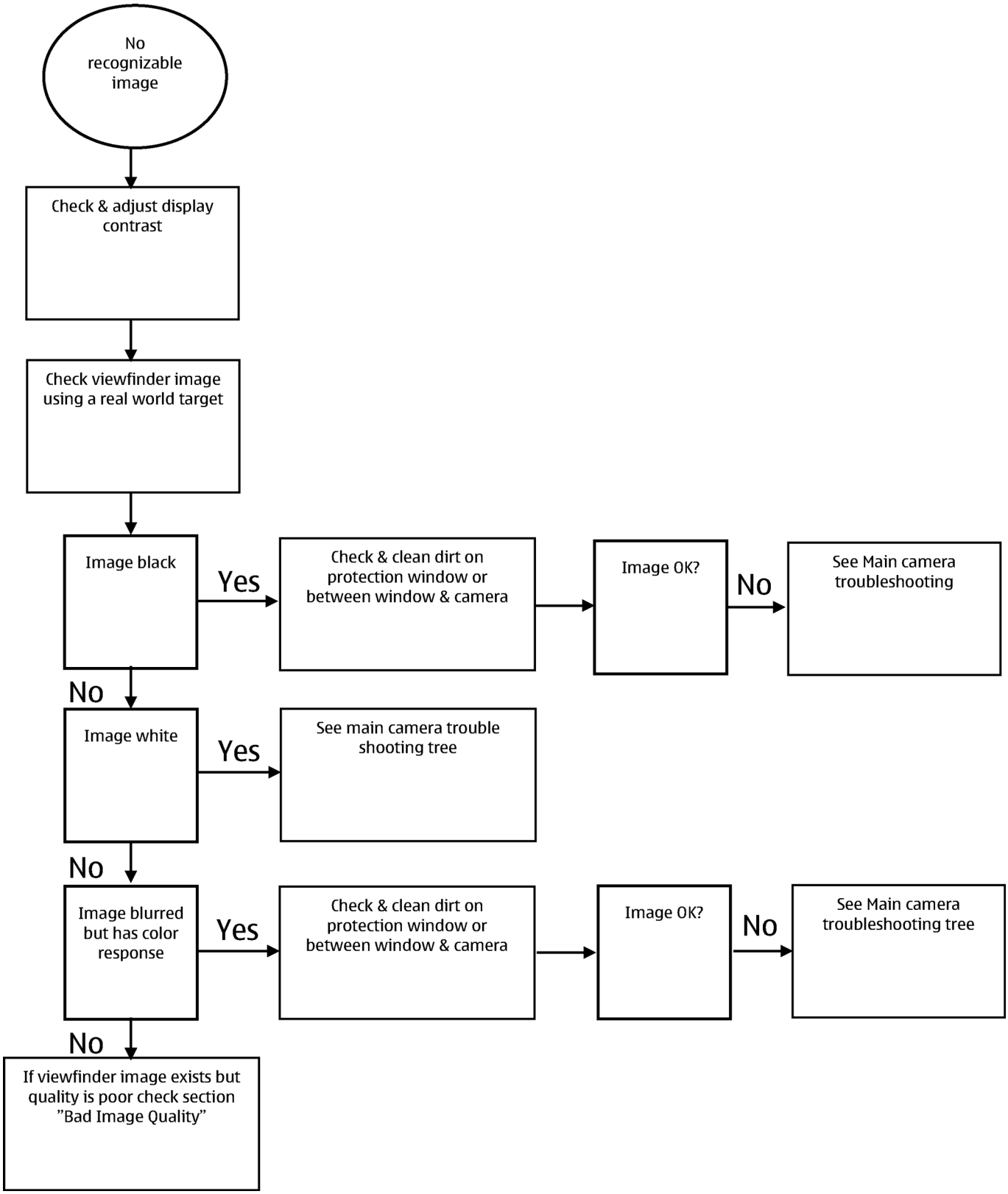
Main (back) camera troubleshooting flowcharts

No recognizable viewfinder image

Troubleshooting flow



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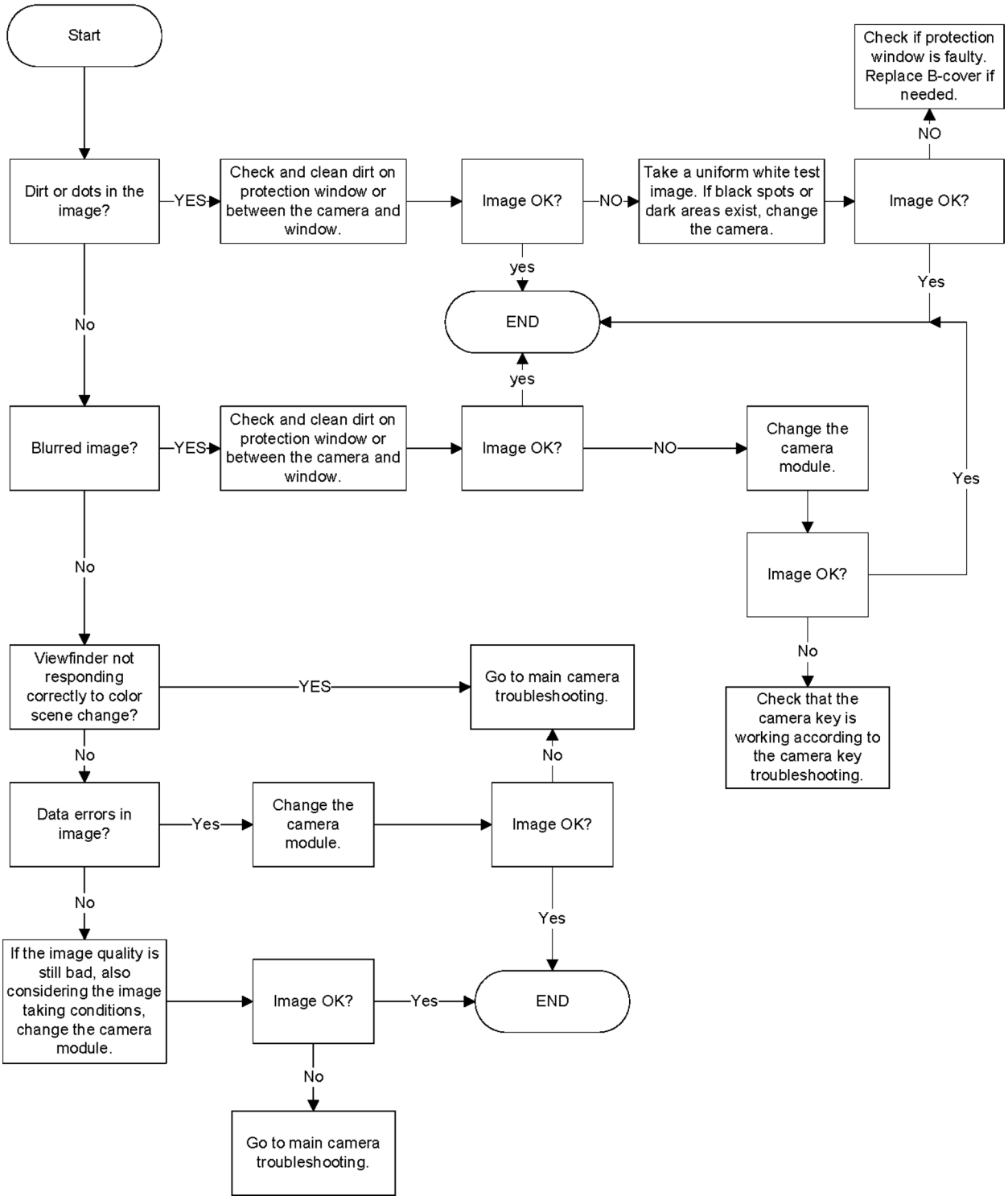
Bad image quality troubleshooting

Troubleshooting flow

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



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Main camera troubleshooting

Context

The following references on the PWB help in the effective debugging and troubleshooting of the main/ primary camera.

Sr. No	Reference	Description
1	X1476	Primary camera socket
2	R1477, R1478	Pull-up resistors on primary camera I2C lines. Resistor value 4.7 KOHMS.
3	D1400	BCM2727B IC
4	N1515	VCAM_1V8 regulator
5	N1517	VCAM_2V8 regulator

The following test points on the PWB help in the effective debugging and troubleshooting.

Sr. No	Signal name	Measuring point	Description
1	VCAM_1V8	L1477/C1479	1.8V supply to primary camera
2	VCAM_2V8	L1604/C1483	2.8V supply to primary camera
3	VDIG_ENABLE	J1515	Enable signal for VCAM_1V8 regulator. This signal needs to be High for the regulator to be On.
4	VANA_ENABLE	J1516	Enable signal for VCAM_2V8 regulator. This signal needs to be High for the regulator to be On.
5	PRI_CAM_CLK	R1430	External clock signal to primary camera
6	PRI_CAM_I2C(1:0)	R1477, R1478	I2C signals for primary camera

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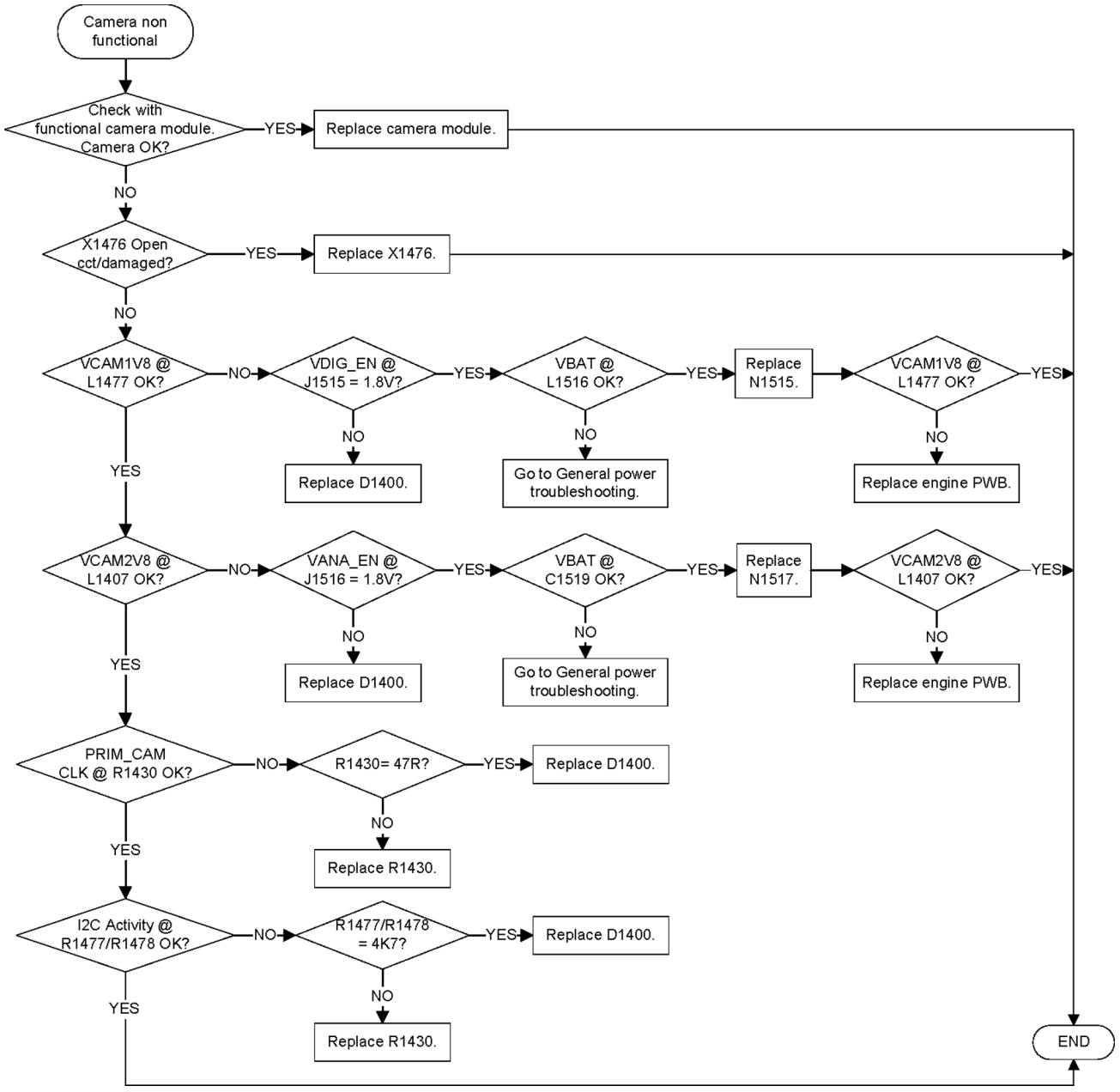
Troubleshooting flow



Secondary camera troubleshooting

Context

The following references on the PWB help in the effective debugging and troubleshooting of the secondary camera.

Sr. No	Reference	Description
1	H1000	Secondary camera on UI flex
2	R1487, R1488	Pull-up resistors on the secondary camera I2C lines. Resistor value 4.7 KOHMS.

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Sr. No	Reference	Description
3	D1400	BCM2727B IC
4	N1515	VCAM_1V8 regulator
5	N1517	VCAM_2V8 regulator

The following test points on the PWB help in the effective debugging and troubleshooting.

Sr. No	Signal name	Measuring point	Description
1	VCAM_1V8	L2425	1.8V supply to secondary camera
2	VCAM_2V8	L2424	2.8V supply to secondary camera
3	VDIG_ENABLE	J1515	Enable signal for VCAM_1V8 regulator. This signal needs to be High for the regulator to be On.
4	VANA_ENABLE	J1516	Enable signal for VCAM_2V8 regulator. This signal needs to be High for the regulator to be On.
5	SEC_CAM_CLK	R1429	External clock signal to secondary camera
6	SEC_CAM_SHUTDOWN	X2400, Pin 28	Shutdown signal to secondary camera. This needs to be High for the camera to be Up.
7	SEC_CAM_I2C(1:0)	R1487, R1488	I2C signals for secondary camera

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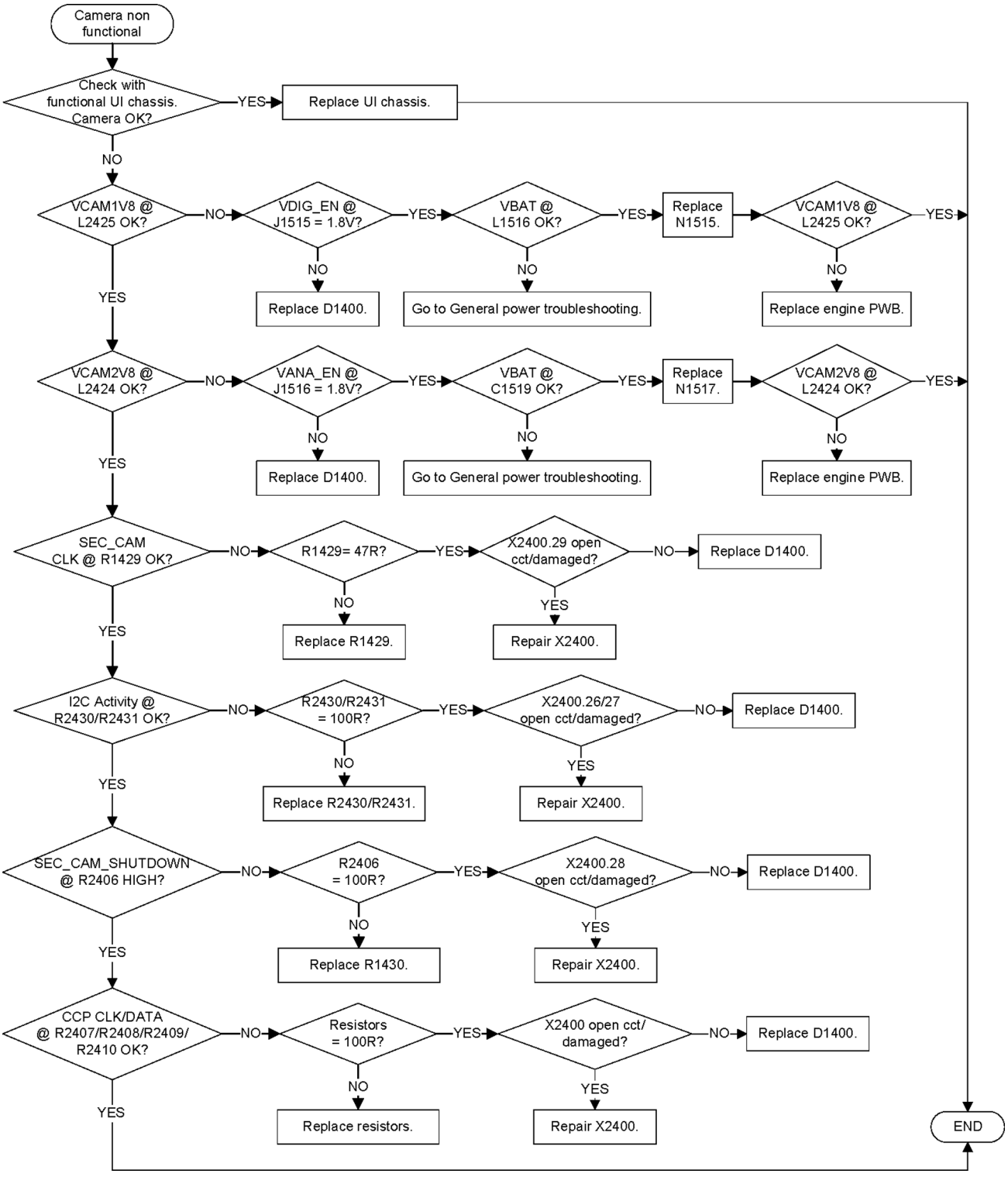
Troubleshooting flow



Flash troubleshooting

Context

The following references on the PWB help in the effective debugging and troubleshooting of the flash.

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Sr. No	Reference	Description
1	N1497	Flash driver
2	X1496/X1497/X1498	Gemini 3 LED flash connectors
3	D1400	BCM2727B IC

The following test points on the PWB help in the effective debugging and troubleshooting of the flash.

Sr. No	Signal name	Measuring point	Description
1	VBAT	L1517/L1518	VBAT supply to flash driver
2	FLASH_TRIGGER	J1497	Flash trigger signal
3	FLASH_ENABLE	J1499	Flash enable signal
4	TORCH_ENABLE	J1498	Torch mode enable signal

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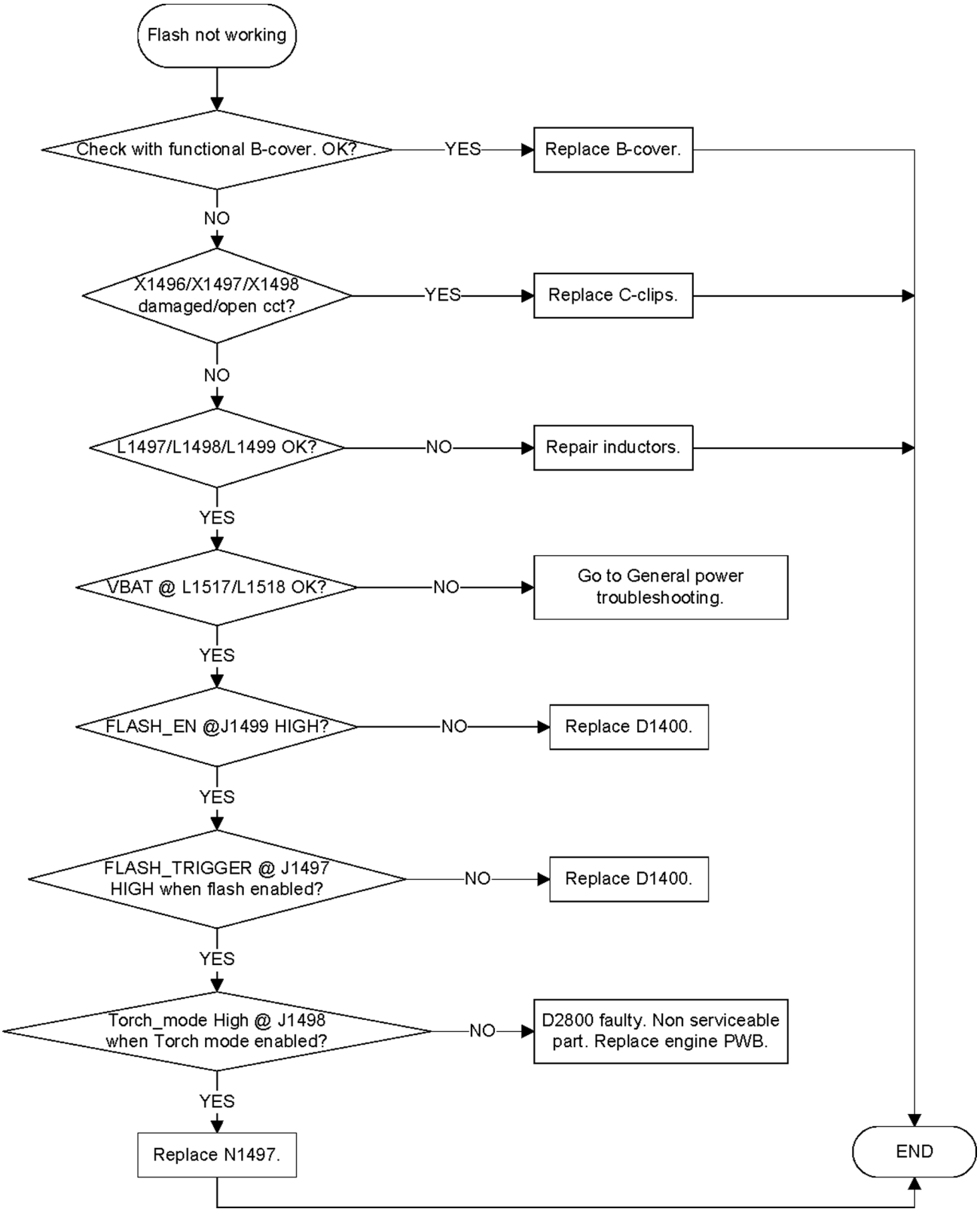
Troubleshooting flow



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6 — System Module

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Introduction

Phone description

RAPUYAMA is the main digital baseband ASIC in the phone. It contains functionality for both WCDMA and GSM EDGE. The hardware accelerator is used for imaging and video.

GAZOO/PEARL (N2200) is the main audio and energy management controller for the phone.

Key components

Function	Description	Item ref
Main PWB	3GB	
UI flexi module (chassis)	3GR	
SIM flexi module	3GS	
Flash module	3GU	
Touch module	3GV	
Baseband ASIC	EM ASIC GAZOO/PEARL	N2200
RF ASIC	LINKO	N7512
Processor	RAPUYAMA	D2800
GSM/WCDMA PA	GSM850/900/1800/1900 WCDMA850/900/1700/1900/2100	N7510
Oscillators	VCTCXO TCXO 16.368 MHZ Crystal 32.768KHZ Crystal 38.4 MHZ Crystal 19.2 MHZ	G6200 B2200 B7500 B1400
CMT memory	Combo POP4 2Gb DDR + 8Gb M3 NAND (stacked with RAPU)	D3000
Back-up capacitor	RTC back-up capacitor	G2200
WLAN/ Bluetooth/ FM radio/ FM transmitter	BOB 1.0M-b module	N6300
GPS	GPSCost4.1	N6200
Battery	BL-5K	
Battery connector	Tabby blade interface	X2070
UI flex connector	Board-to board connector for UI flex module	
Display connector	Board-to-board connector	
RF connectors		
USB transceiver	ISP1707 HS USB transceiver	D3300
MicroSD connector		X3200
eMMC	8GB internal mass memory	D3200
SIM flex connector		X2700

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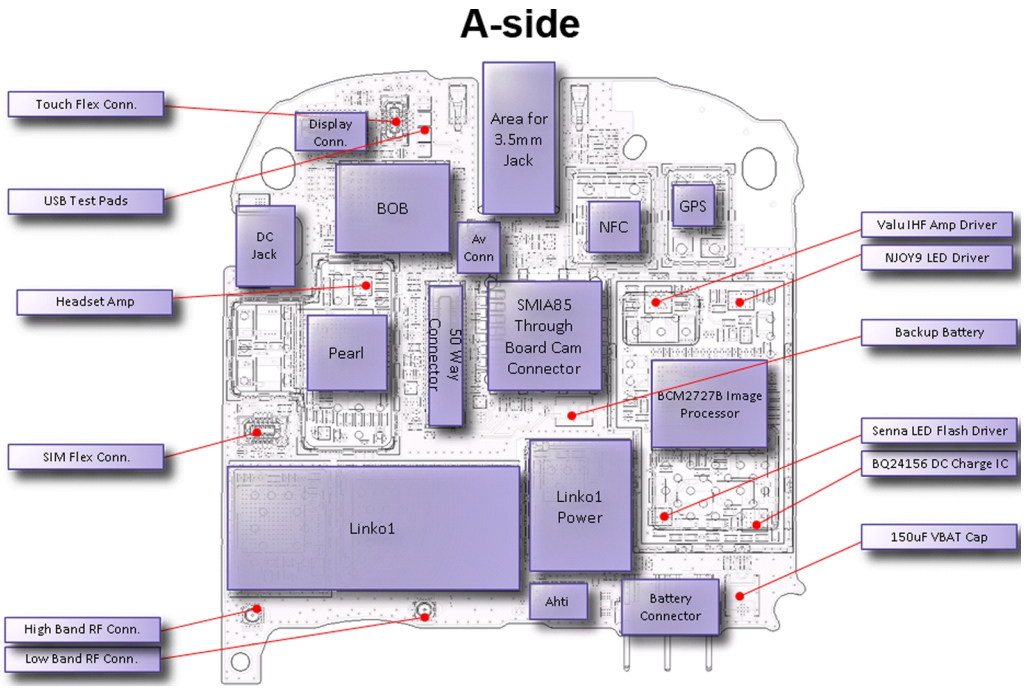
Function	Description	Item ref
Touch module connector		X2403
IVE	Imaging processor	D1400
AV connector		
Charging connector	BQ24156	N3350
Earpiece	Petra	
Microphone	Knopfler	
IHF	Mean	B2150
Vibra		M2105
Accelerometer	3-axis accelerometer Ahti	N1103
Magnetometer	3-axis magnetic sensor	N1105
Combined Proximity Sensor and Ambient Light Sensor	DiPro	

Key component placement



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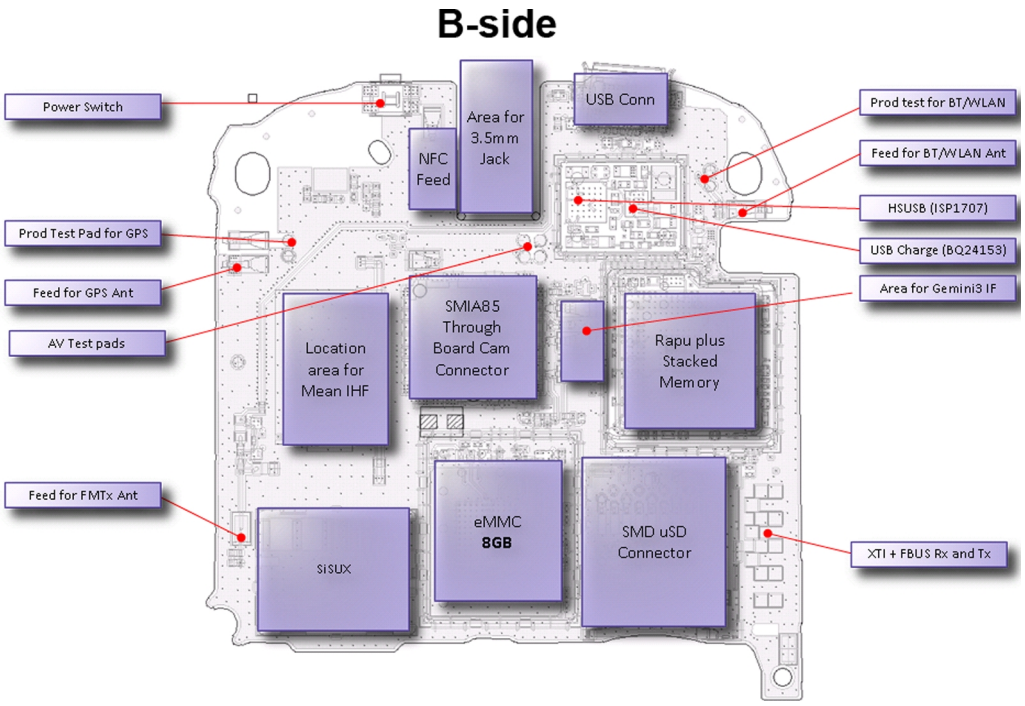

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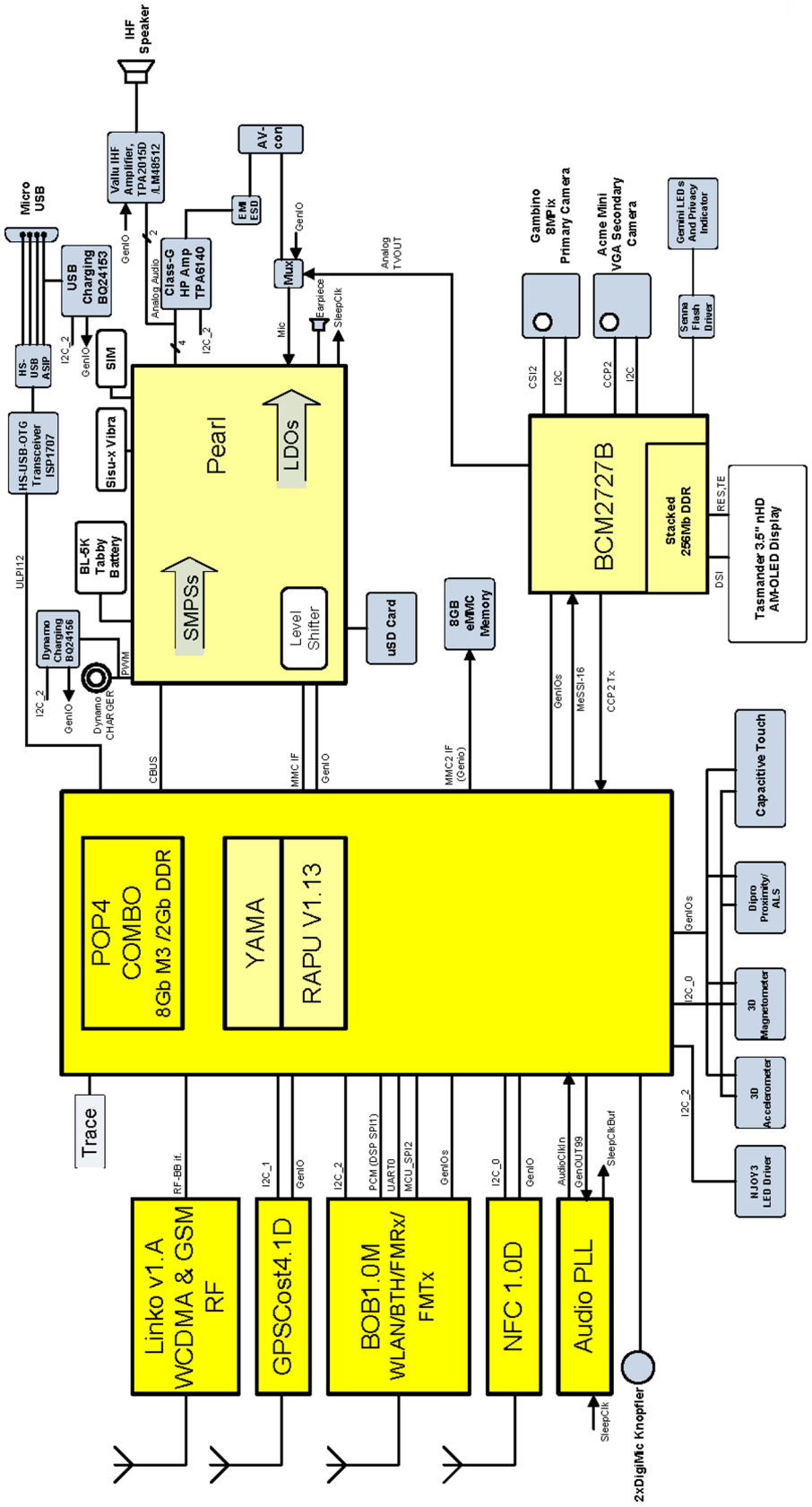
System module block diagram



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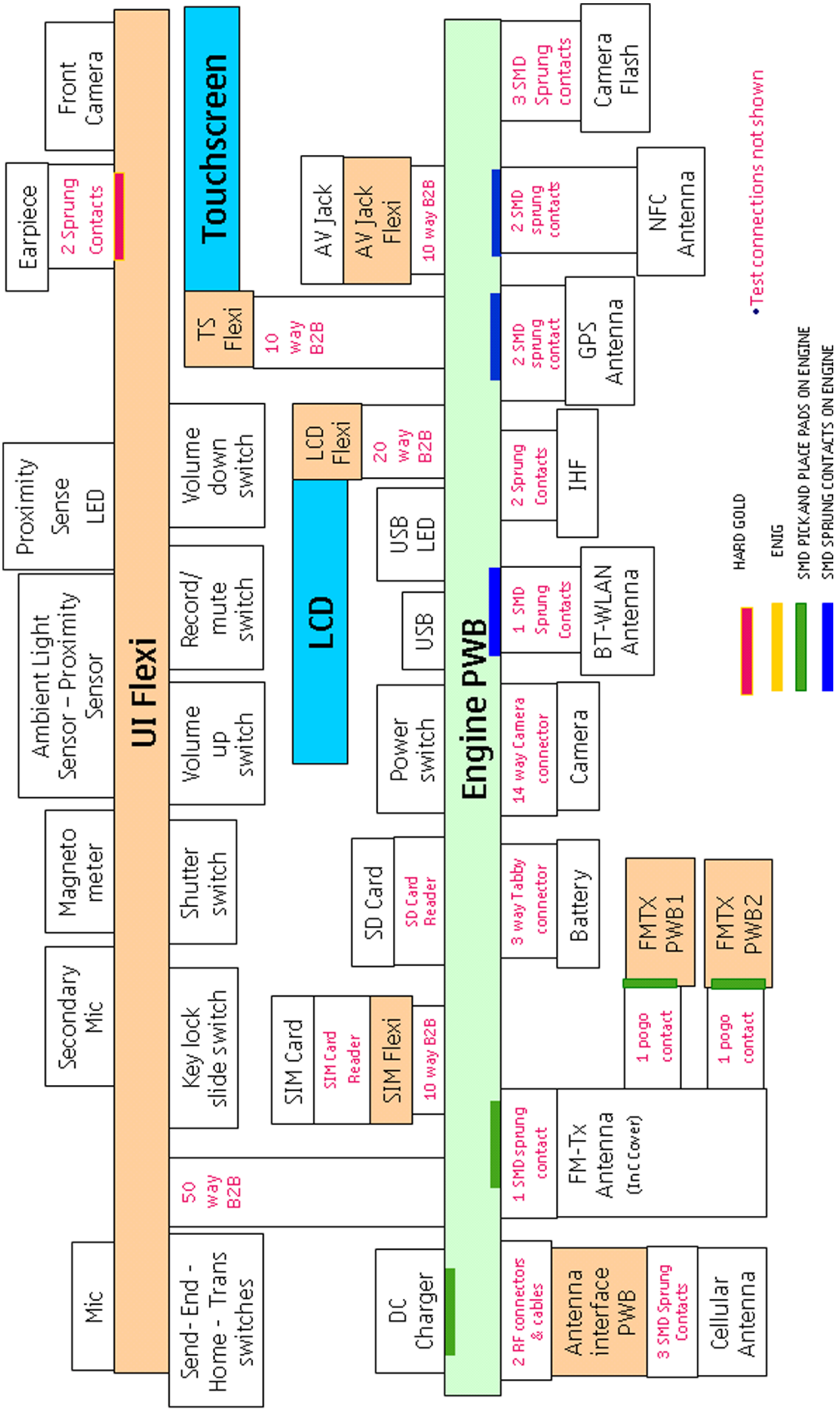
Board and module connections



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Energy management

Battery and charging

BL-5K battery

The phone is powered by a 3-pole BL-5K battery 1200 mAh battery. The three poles are named VBAT, BSI and GND where the BSI line is used to recognize the battery capacity. This is done by means of an internal battery pull down resistor.

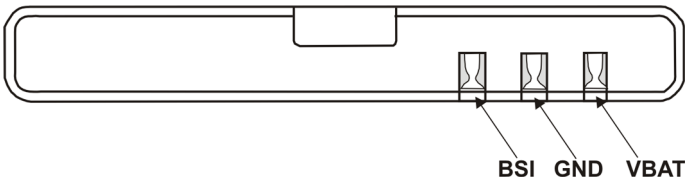

Figure 39 Battery pin order

The battery temperature is estimated by measuring separate temperature NTC resistor via the BTEMP line of EM ASIC N2200. This is located on the main PWB, near the battery connector.

Battery connector

The battery connector is a blade connector. It has three blades;

- BSI (Battery size indicator)
- GND (Ground)
- VBAT (Battery voltage)

Figure 40 Blade battery connector

Charging

The phone is charged through the 2 mm Nokia standard interface charger plug. Charging is controlled by dynamo charging IC BQ24156 (N3350). Dynamo charger detection is handled by EM ASIC (N2200) and external components are needed to protect the baseband module against EMC, reverse polarity and transient frequency deviation. For charger detection, a pulse of duration 15ms is sent to EM ASIC via V3370 MOSFET.

Normal and extreme voltages

Energy management is mainly carried out in the EM ASIC (N2200) that contains a number of regulators. In addition, there are also some external regulators.

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

Table 9 Nominal voltages

Voltage	Voltage [V]	Condition
General Conditions		
Nominal voltage	3.700	

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Voltage	Voltage [V]	Condition
Lower extreme voltage	3.145	
Higher extreme voltage (fast charging)	4.230	
HW Shutdown Voltages		
Vmstr+	2.1 ± 0.1	Off to on
Vmstr-	1.9 ± 0.1	On to off
SW Shutdown Voltages		
Sw shutdown	3.15	In call
Sw shutdown	3.3	In idle
Min Operating Voltage		
Vcoff+	2.9 ± 0.1	Off to on
Vcoff-	2.6 ± 0.1	On to off

Power key and system power up

When the battery is placed in the phone, the power key circuits are energized. When the power key is pressed, the system boots up (if an adequate battery voltage is present).

Power down can be initiated by pressing the power key again and the system is powered down with the aid of SW. The power key is connected to EM ASIC (N2200) via the PWRONX signal.

The PWRONX line cannot be detected when SW hangs. For that reason, the user has to remove the battery.

Modes of operation

Mode	Description
NO_SUPPLY	(Dead) mode means that the main battery is not present or its voltage is too low (below N2200 master reset threshold) and that the back-up battery voltage is too low.
BACK_UP	The main battery is not present or its voltage is too low but back-up battery is adequate and the 32 kHz oscillator is running.
PWR_OFF	In this mode (warm), the main battery is present and its voltage is over N2200 master reset threshold. All regulators are disabled, PURX is on low state, the RTC is on and the oscillator is on. PWR_OFF (cold) mode is almost the same as PWR_OFF (warm), but the RTC and the oscillator are off.
RESET	RESET mode is a synonym for start-up sequence. RESET mode uses 32 kHz clock to count the RESET mode delay (typically 16ms).
SLEEP	SLEEP mode is entered only from PWR_ON mode with the aid of SW when the system's activity is low.
FLASHING	FLASHING mode is for SW downloading.

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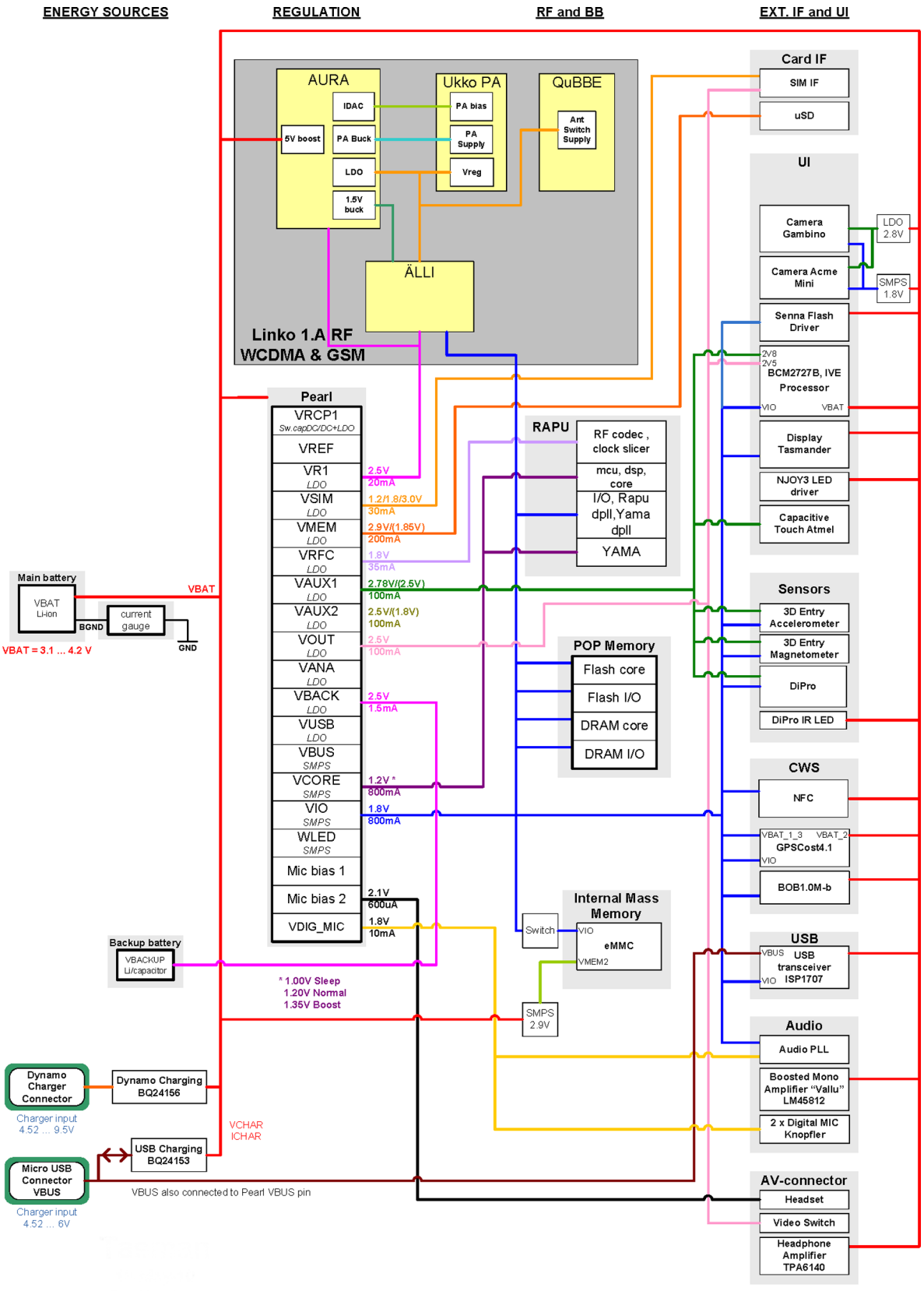
Power distribution



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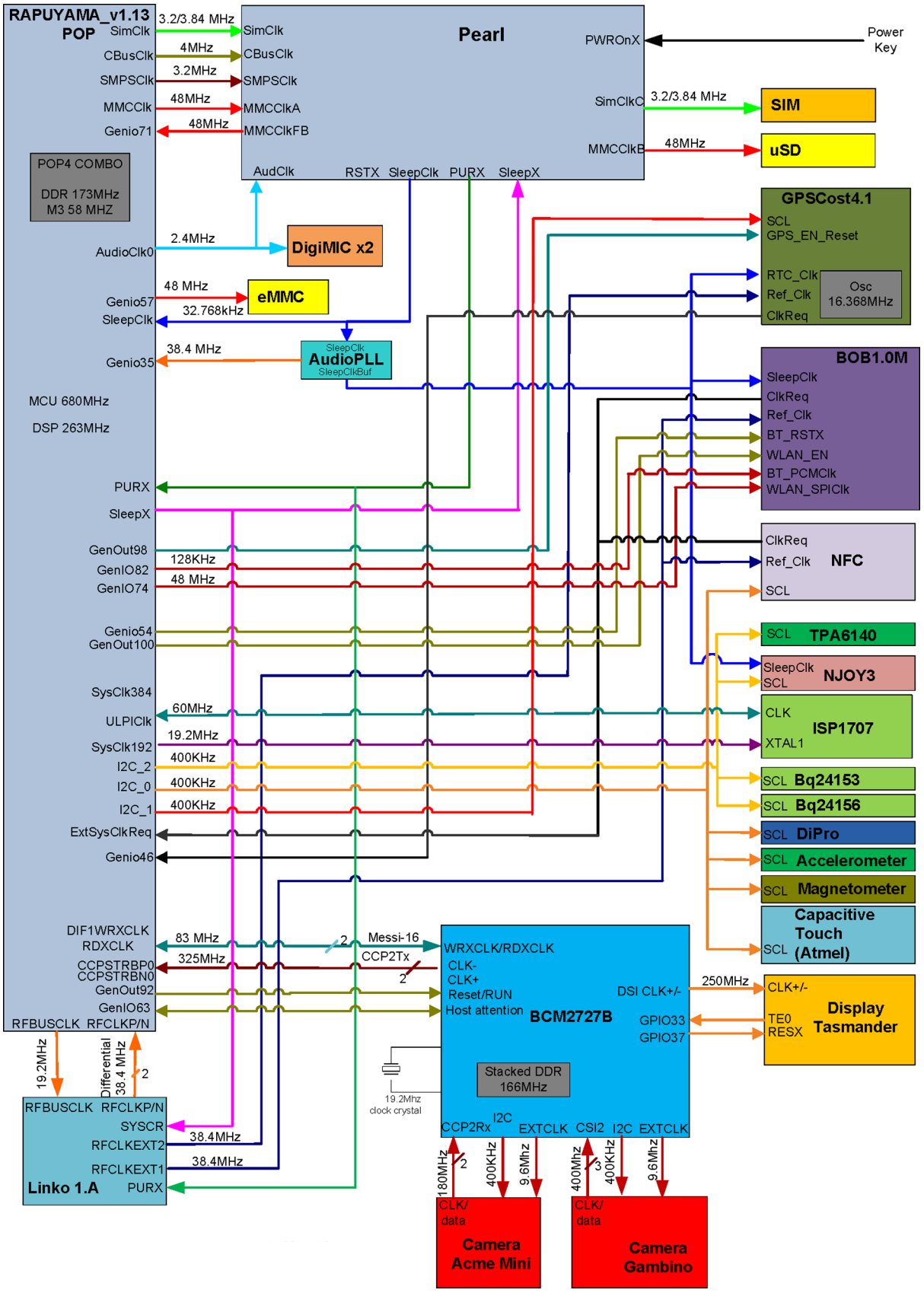
Clocking scheme



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SIM interface

The phone has a SIM (Subscriber Identification Module) interface including a SIM connector.

The SIM interface consists of an internal interface between RAPU and EM ASIC (N2200), and an external interface between EM ASIC and SIM contacts.

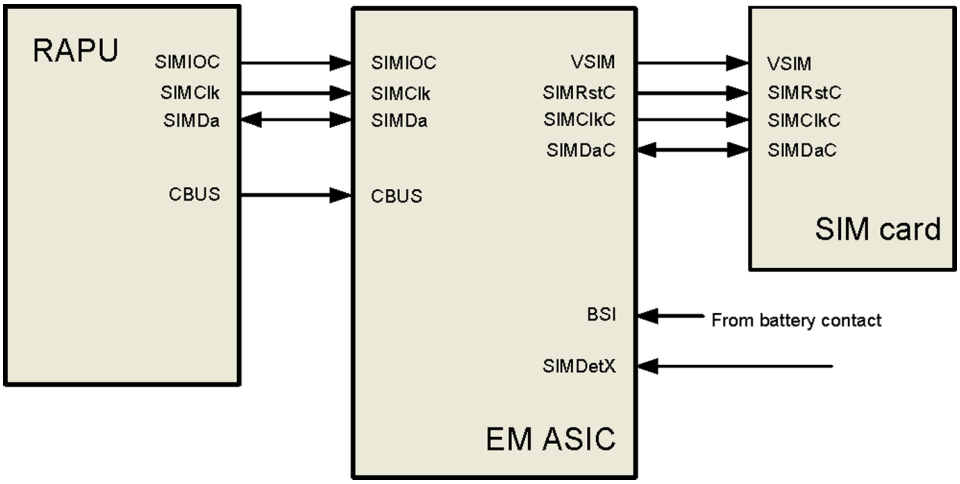

Figure 41 SIM interface

As the phone does not have a traditional battery cover due to semi-fixed battery concept, the SIM card can be removed and inserted without removing the battery. For safe SIM card functionality, a new Puzzle push-push SIM reader with card detection and removal pre-warning switches is used.

Pre-warning and card detect signals are connected together in the Puzzle layout symbol, so there is only one switch connection in the schematics symbol. The combined switch signal is connected through an inverter to Gazoo/Pearl SimDetX input. The following figure shows the principle of SIM circuitry with the Puzzle.

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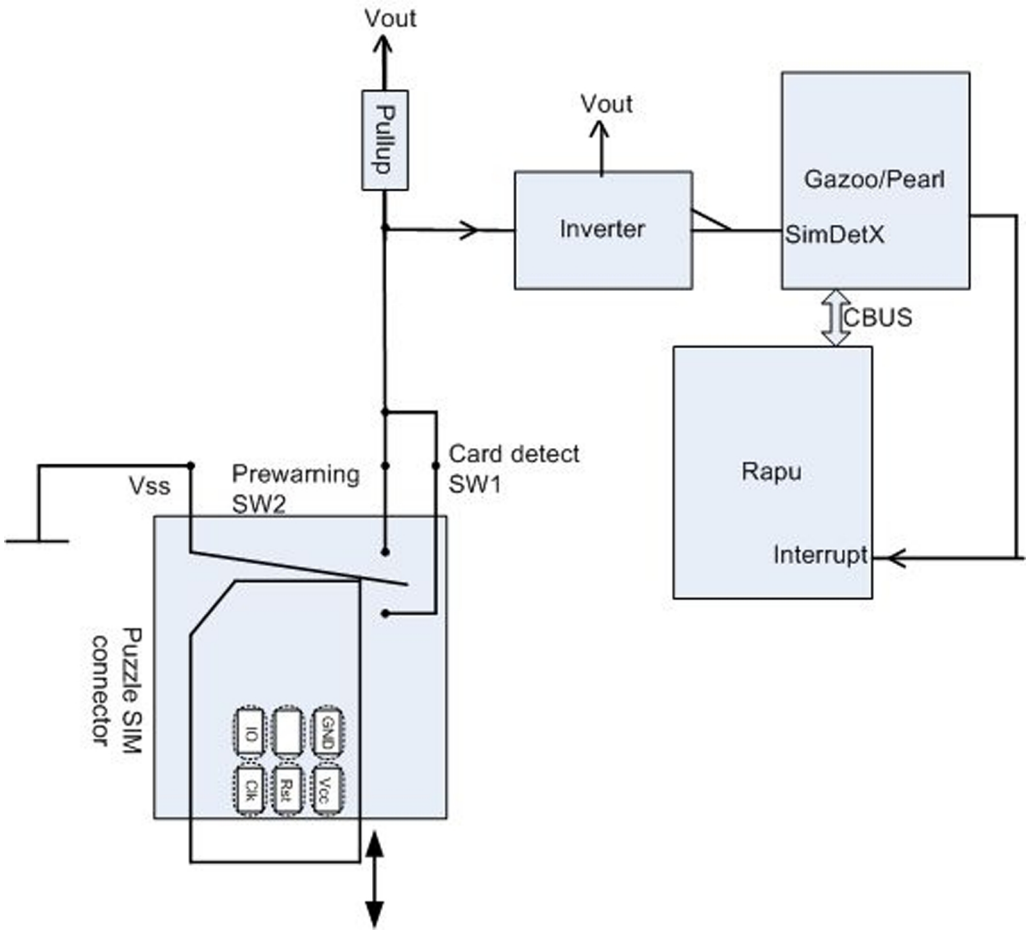

Figure 42 Puzzle SIM connector circuitry

The SIM interface supports both 1.8V and 3.0V SIM cards. The SIM interface voltage is first 1.8 V when the SIM card is inserted, and if the card does not response to the ATR (Answer to Request), 3V interface voltage is used.

Device memory

The memory components of the device are internal COMBO POP4 2Gb DDR + 8Gb M3 (NAND), a card reader for MicroSD, and 8GB eMMC memory which is non-removable and internal to the phone.

The MicroSD is used as a user's data storage memory. The µSD card is connected to RAPU via EM ASIC which has an internal level shifter with an ESD protection filter. The µSD card door state is detected by a detect switch connected to RAPU Genio25. When the door is open, the uSD card is powered off. Hot swap is supported, which means that the card may be plugged in/out at any time, without removing the battery.

The device uses 8GB eMMC (D3200) external memory. The eMMC interface is a 6-wire serial/parallel data bus which includes a clock (CLK), 4 data signals (DAT), and command (CMD) wires. The eMMC interface is completely formed of the GENIOs of RAPU. The eMMC consists of an internal NAND controller and an MMC controller for I/O interface. It is a dual supply device which requires VCC of 2.9V for the NAND core and VCCQ of 1.8V for the MMC I/O interface.

BOB1.0M-b module

The BOB1.0M-b module provides full 802.11b,g & n WLAN, BT 2.1 + EDR, FM RDS and FM TX connectivity.

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BOB is the name given to a generic technology release that combines WLAN, Bluetooth, FM Rx and FM TX radio on a single monolithic IC. The phone uses BOB1.0M-b module that consists of a single chip transceiver WL1271, plus a separate RF front end (FE) device. The BOB1.0M-b release operates in the 2.4GHz (ISM) and the 76-108MHz FM bands.

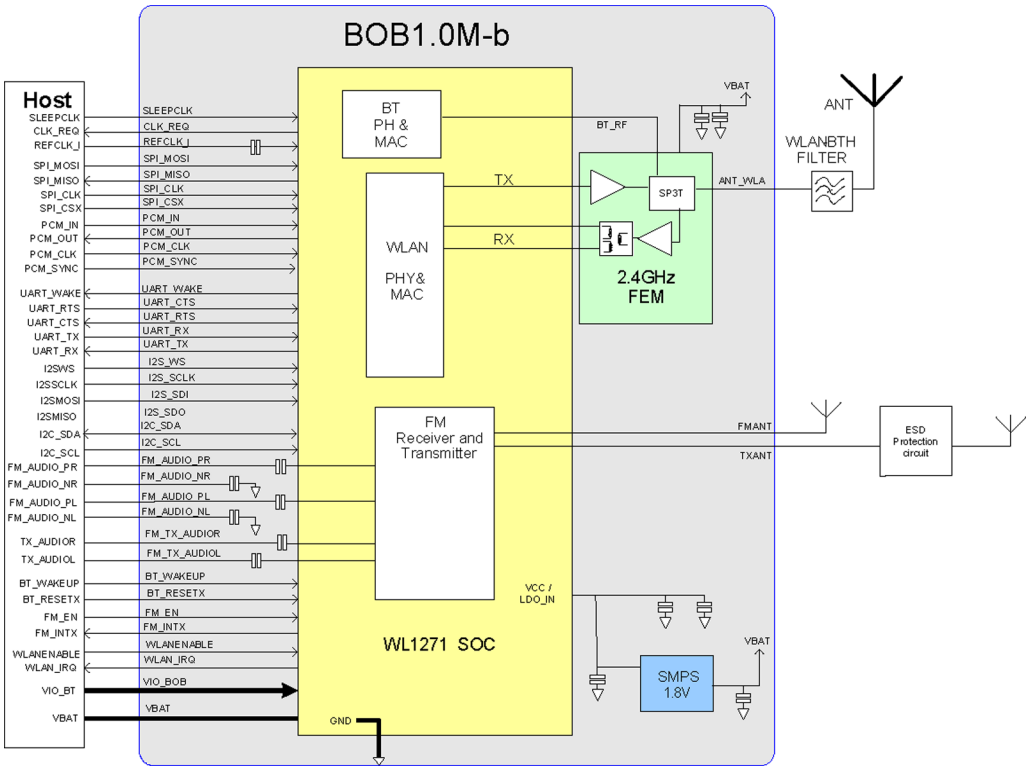

Figure 43 BOB1.0M-b module block diagram and application circuit

From a troubleshooting point of view, WLAN is tested separately, but BTH, FMRX and FMTX are checked in parallel.

REFOUT_EXT1 single ended 38.4 MHz analog clock from Linko RF is provided to BOB1.0M-b. The clock request for the reference clock in the BOB1.0M-b module is shared between WLAN and BTHFM blocks. When either system requires a clock, this signal will be active. The CLK_REQ is connected to ExtSysClkReq pin of RAPU. The SLEEPCLK input of 32.768 KHz clock from EM ASIC is used for power management and for FM in low power mode.

The internal SMPS supplies the whole BOB1.0M-b solution from the phone battery supply, VBAT, apart from VIO, which is needed for interface signal reference levels.

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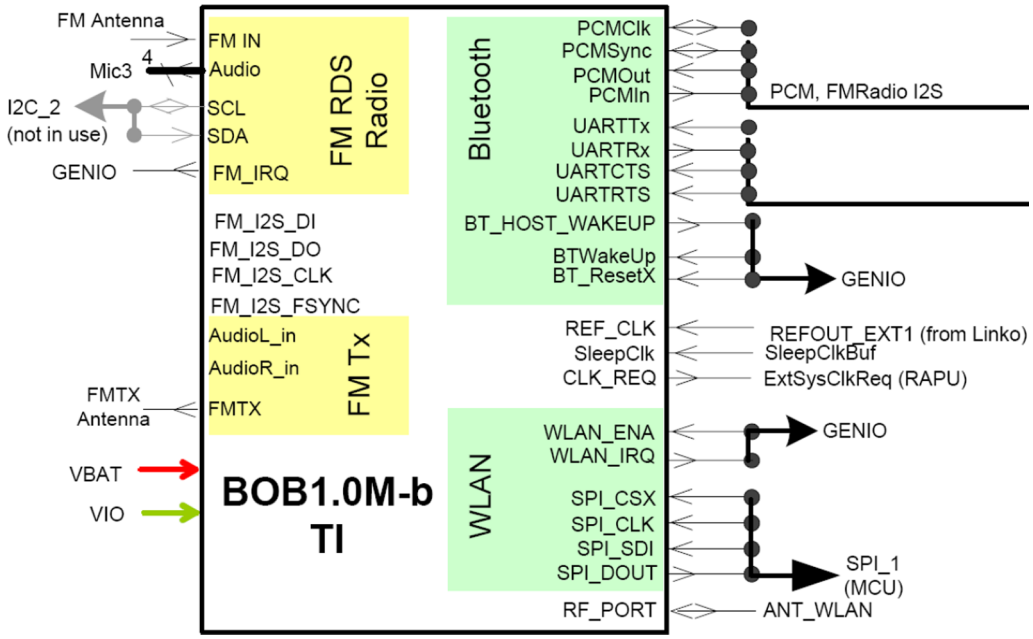

Figure 44 BOB1.0M-b interface

GPS interface

The phone includes an inbuilt single chip GPS receiver GPSCost4.1D, comprising both RF and BB blocks integrated in a single digital die. GPSCost4.1D is connected to RAPU ASIC via I2C_1 and some GENIOs. GPSCost4.1 D operates in Multi-master mode and the REF clock is requested via AGPS_CLK_REQ signal connected to RAPU genio46. REFOUT_EXT2 single ended 38.4 MHz analog clock from Linko RF is provided to GPSCost4.1D.

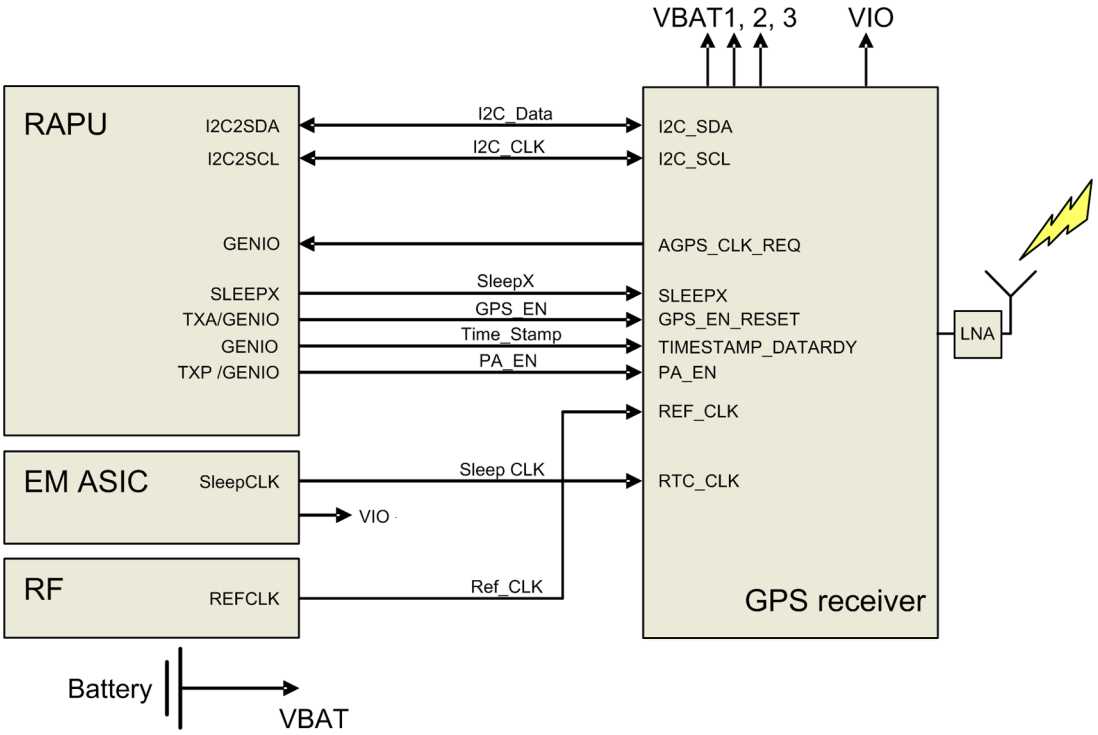

Figure 45 GPS interface

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USB

USB interface

The phone has an interface for USB (Universal Serial Bus). USB is a differential serial bus that provides a wired connectivity between a PC and peripheral devices, as in this case a mobile phone.

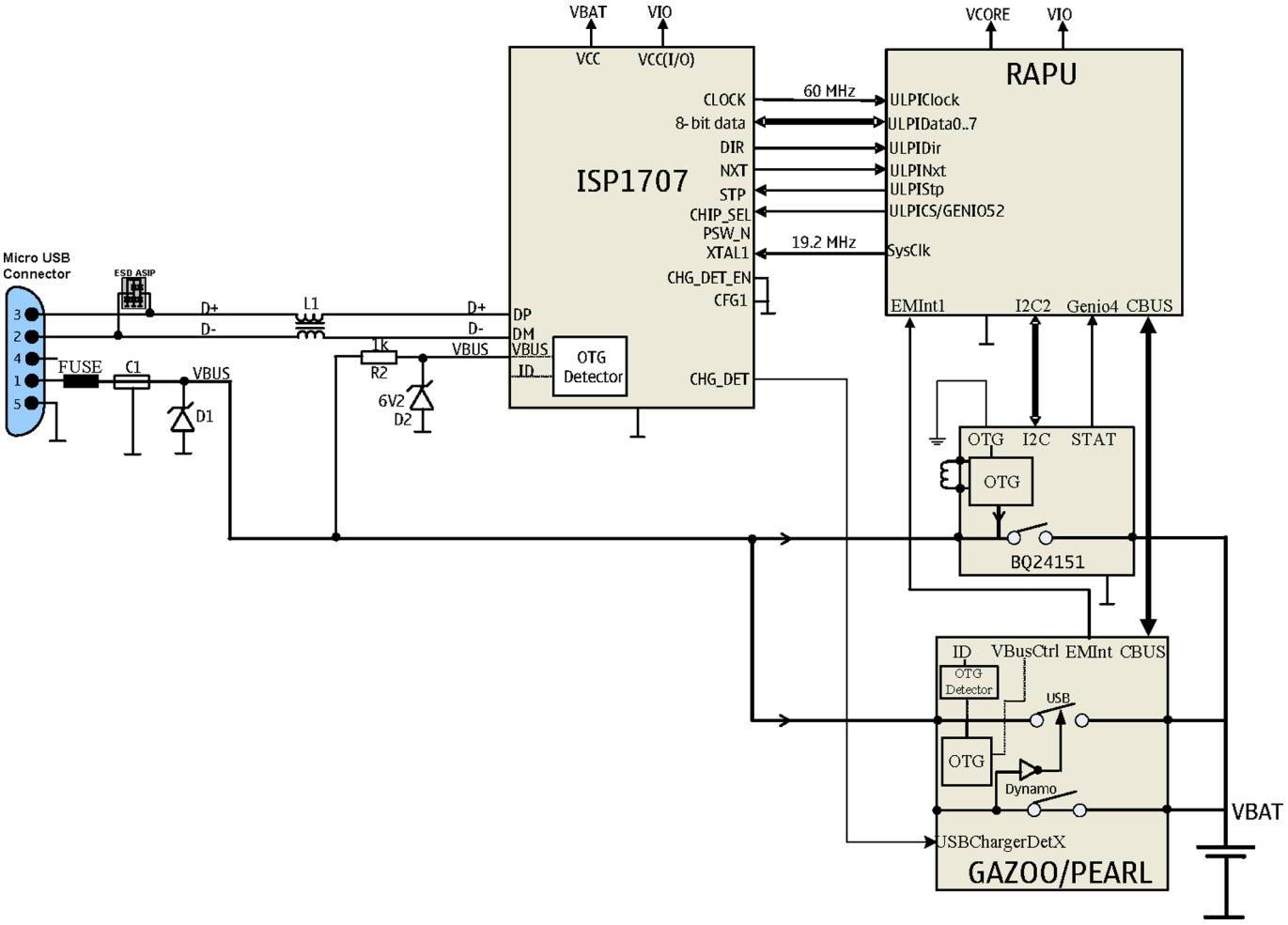

Figure 46 USB interface

The phone supports USB 2.0 with High-Speed (480 Mbps).

Hot swap is supported, which means that USB devices may be plugged in and out at any time.

MicroUSB connector

This phone is provided with a specific connector for microUSB.

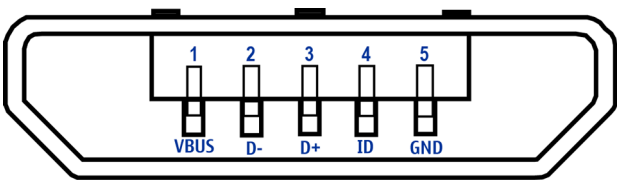

Figure 47 MicroUSB connector

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Charger interface

The charger interface is a 2 mm Dynamo charger plug. Older chargers with a 3.5 mm plug are supported via the charger adapter cable CA-44.

Charging is controlled by EM ASIC. Additional external components are needed for EMC purposes, reverse polarity and transient protection of the input to the baseband module.

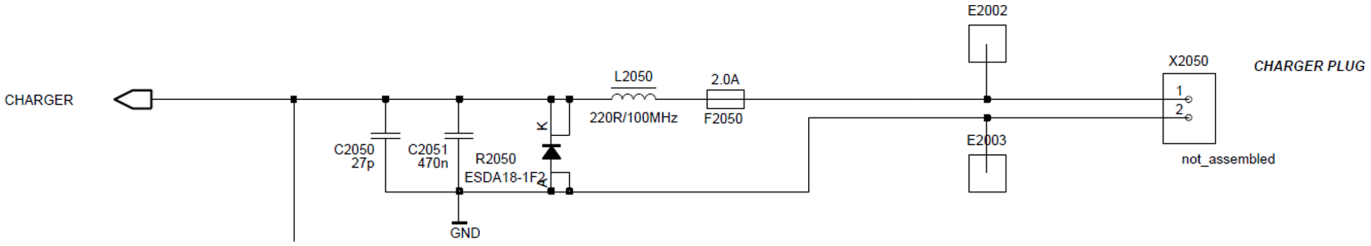

Figure 48 Charger interface

User interface

Touch module

This phone uses Atmel capacitive touch solution.

The Atmel touch module is interfaced to I2C0 bus of RAPU via level shifter (N2500). RAPU's GenIO123 is used for Touch INT.

The Atmel touch module uses VAUX1 for its analogue supply and VIO for its digital supply. Communication with RAPU is via Symbian I2C bus.

Whenever the user touches the touch screen, the controller raises an interrupt to RAPU which initiates I2C transactions to identify the locations the user touches on the display.

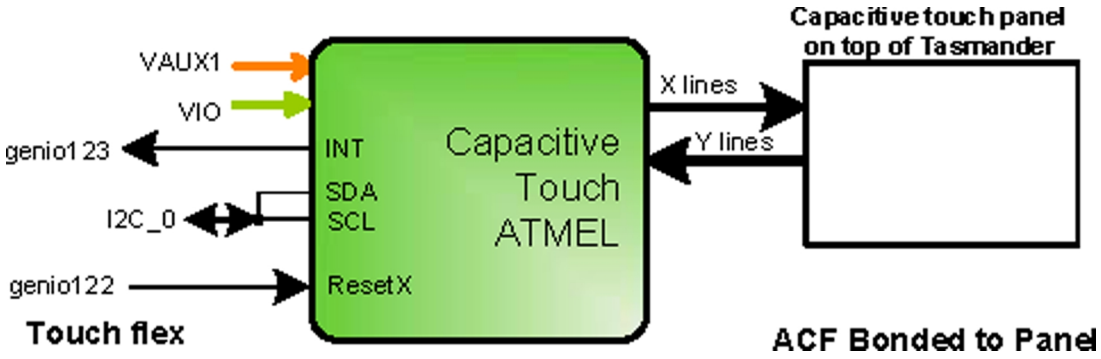

Figure 49 Touch module interface

Proximity sensor and ambient light sensor

This phone uses a combined proximity and ambient light sensor called DiPro.

The proximity part of the device uses an external IR LED supplied by VBAT. The current this LED consumes is controlled by DiPro and set using software. The interrupt output of DiPro changes state when the infra red light from the LED is reflected back by a suitable reflective surface.

The ambient light sensor detects the level of ambient light and adjusts the display and key brightness accordingly whenever the display is active. Covering this sensor results in dimmed display and key lights.

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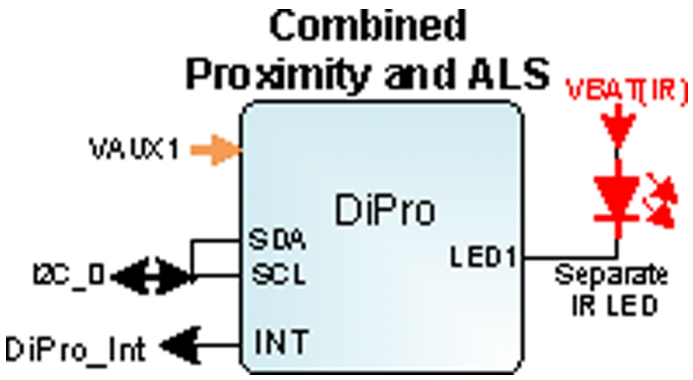

Figure 50 Proximity sensor and ALS

Imaging and video

Multimedia application processor

Multimedia application processor, BCM2727B, is used as a HW accelerator for imaging and video graphics. The key features of BCM2727B are:

- 8MPIx primary camera
- Secondary camera
- Dual LED flash
- nHD OLED DSI display
- NTSC/PAL analog TV-out

MeSSI-16 and CCP2-Tx are the key interfaces between RapuYama and BCM2727B. BCM2727B has in-build 256Mb stacked SDRAM.

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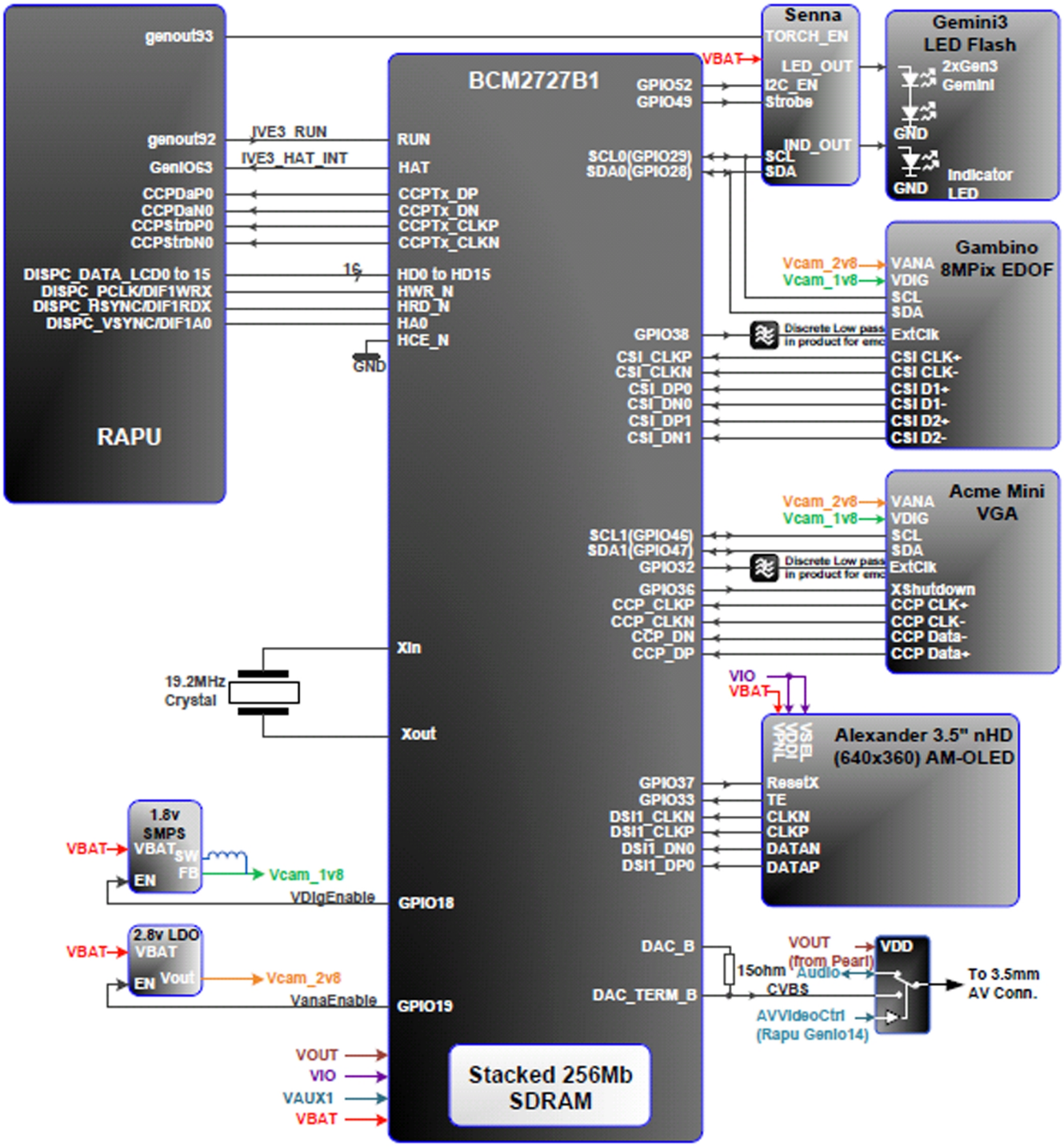

Figure 51 BCM2727B block diagram

Display module

This phone uses a 3.5'' OLED type nHD Tasmander display with 16 million colors. The display module supports the display format of 640 rows x 360 columns . The dimension of the display module is 47.8 mm x 86.3 mm x 2.12 mm. The module interfaces to the phone via FPC with a 20 pins board to board connector.

The primary display is controlled by BCM2727B over DSI interface. The DSI Interface is used for data transfer and control. Other display signals, RESET and TE, are interfaced to BCM2727B.

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TV-out interface

The phone has Analog PAL/NTSC TV-Out capability.

For the Analog TV-out, video data is passed from the host to the BCM2727B over MeSSI-16 interface and BCM2727B sends it to the AV connector. Audio is routed separately by the host to the AV connector.

Cameras

This phone has two cameras, an 8 MPix resolution main camera and a VGA resolution secondary camera. A dual LED flash is used for the main camera.

Primary camera (Gambino)

The primary camera is an 8 Megapixel EDOF (Enhanced Depth of Field) camera module. The module size is 8.5 mm x 8.5 mm x 6.1 mm and it fits into the 20-pin camera socket on the phone. The camera module is SMIA profile 2 compliant and is configured by the BCM2727B using I2C control bus. Image data is transferred to the BCM2727B for furher processing over CSI-2 (PRI_CAM_CSI).

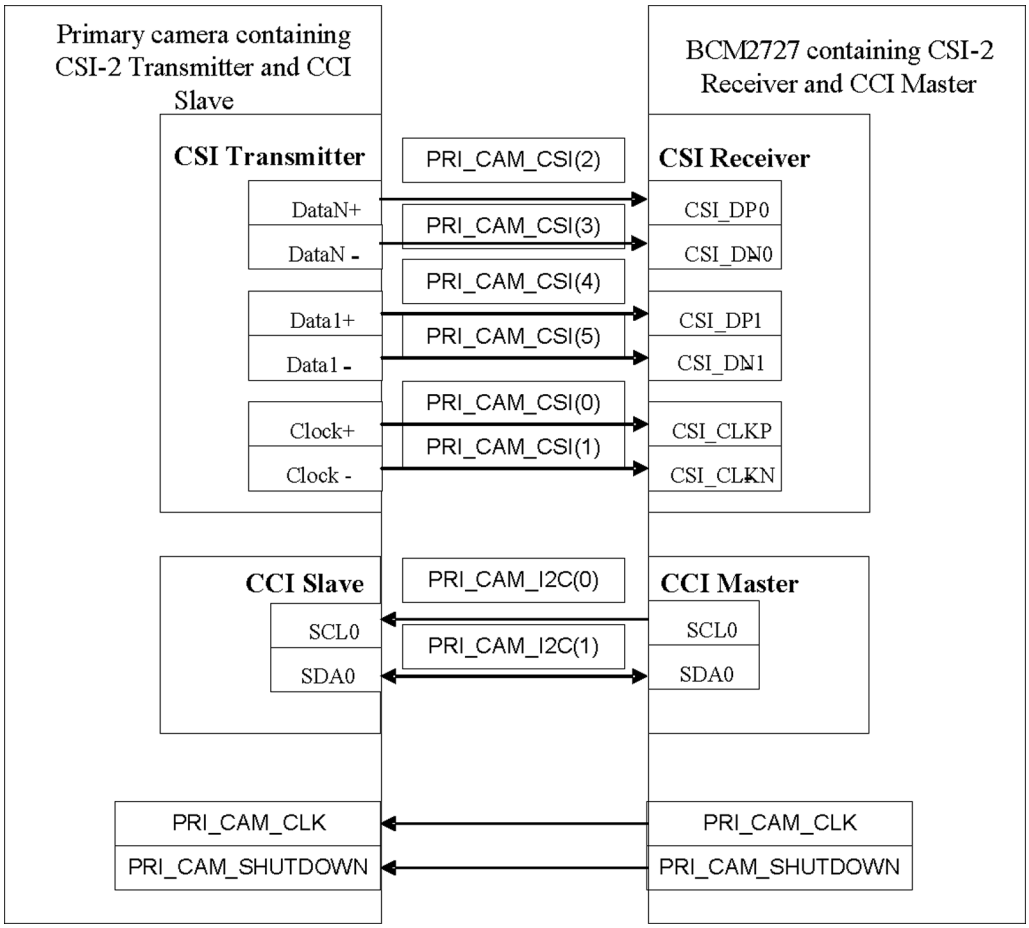

Figure 52 Primary camera interface

Secondary camera (VGA Acme mini)

The secondary camera is a VGA fixed focus camera module. It is SMIA compliant and is configured by the BCM2727B using I2C control bus. Image data is transferred to the BCM2727B for further processing over a CCP based bus (SEC_CAM_CCP).

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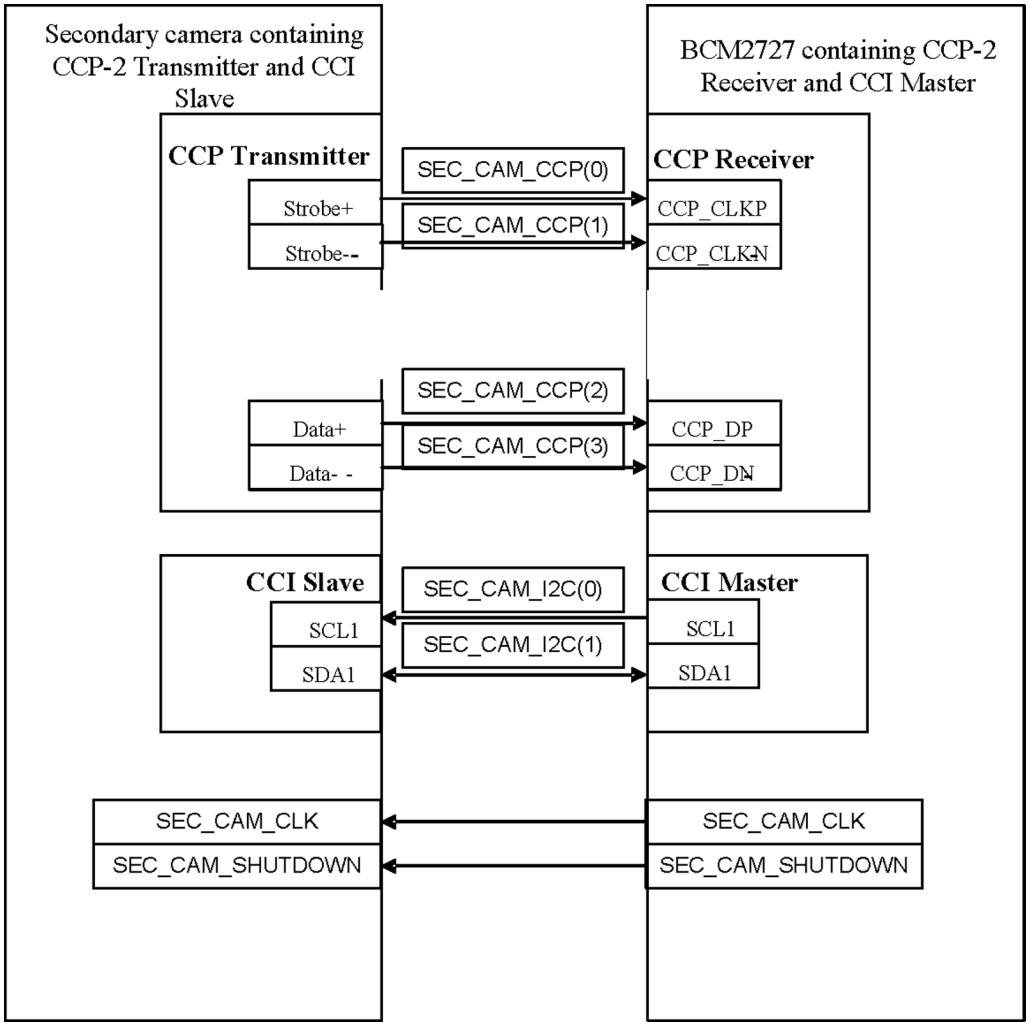

Figure 53 Secondary camera interface

Flash (dual LED)

The dual LED flash consists of two high power white LEDs for use as a camera flash, torch mode and video light. The torch and video light have significantly reduced power compared to the image capture flash. A red indicator light is also present for privacy reasons to indicate when an image is being captured or a video recorded.

Illumination

Key illumination

Home, Send and End key illumination is supported.

The Home key has 2 white LEDs connected in parallel to the R output of LED driver NJOY 3. The red End key LED and the green Send key LED are connected to the G output of NJOY 3. There are also 2 red mute LEDs that can illuminate the Home key to indicate that the user has muted the volume. These LEDs are connected to the B channel of NJOY 3.

Charging illumination

A single white LED is used for charging indication. The LED is connected to EM ASIC “ChInd” pin and blinks only during dead battery USB charging in intervals of 1.5s. When under SW control, this LED provides a fixed light level.

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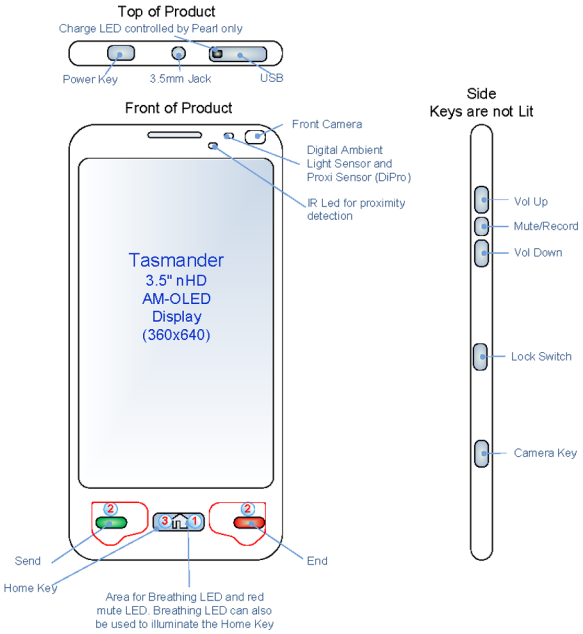

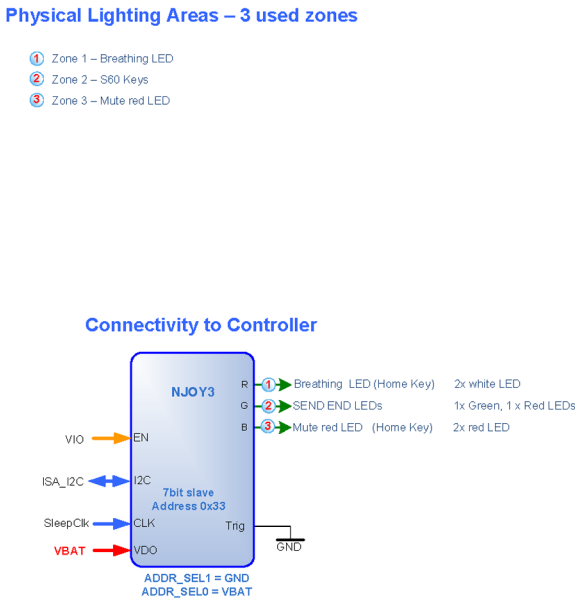

Keyboard interface

All the keys with the exception of the power key are on a key matrix connected directly to RAPU.

Accelerometer

Accelerometer is a geometric type component which can be configured either to generate an inertial wake-up interrupt signal when a programmable acceleration threshold is exceeded along one of the three axes (x, y, and z), or to detect a free-fall event. Each axe has its own sensor and those can measure positive and negative directions.

The 3D accelerometer (N1103) Ahti_A sensor is connected to RAPU via two GENIOs ie Genio12 and Genio44 and I2C_0 bus. Power supply voltage is provided from VIO & VAUX2 output of EM ASIC.

It has the following features:

- 2.16V to 3.6V supply voltage
- 1.8V compatible IOs
- Low power consumption
- ±2g/±8g dynamically selectable scale
- I^2C/SPI digital output interface
- Embedded self test
- 10000g high shock survivability
- Pb free/RoHS compliancy

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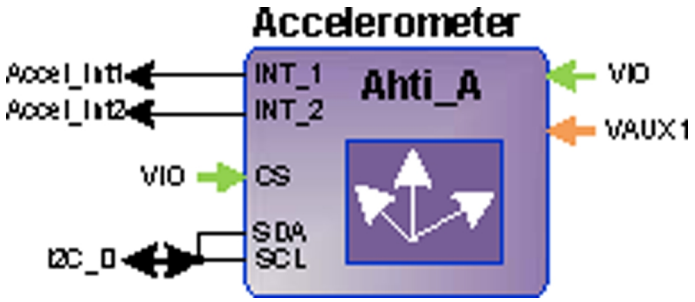

Figure 54 Accelerometer interface

Magnetometer

3D magnetometer sensor (N1105) is connected to RAPU via two GENIOs ie Genio40 and Genio41 and I2C_0 bus. Power supply voltage is provided from VIO & VAUX1 output of EM ASIC. The magnetometer is used as a city compass sensor. It detects the earth magnetic field density and composes bearing information for navigation applications.

The magnetometer has the following features:

- 3-axis magnetometer device suitable for compass application
- Built-in A to D converter for magnetometer data out
- Self test function
- I2C bus interface
- Power modes: OFF mode, stand-by mode and active mode
- DRDY function for measurement data ready
- INT function to inform exceeding magnetic field strength threshold.

The operating temperature is -20°C to +85°C.

The operating supply voltages are:

- Analogue supply +2.4V to +3.6V
- Digital interface supply +1.70V to analogue supply voltage.

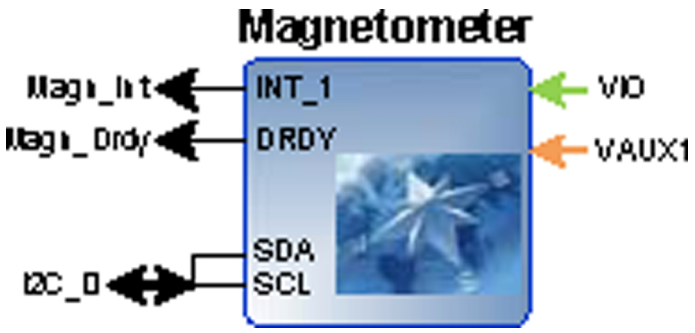

Figure 55 Magnetometer interface

Audio concept

Audio HW architecture

TPA6140 (N2000), BoostMono (N2150) along with mixed-signal ASIC Gazoo/Pearl provides the analogue audio output interfaces and RAPU provides the digital audio output interface support.

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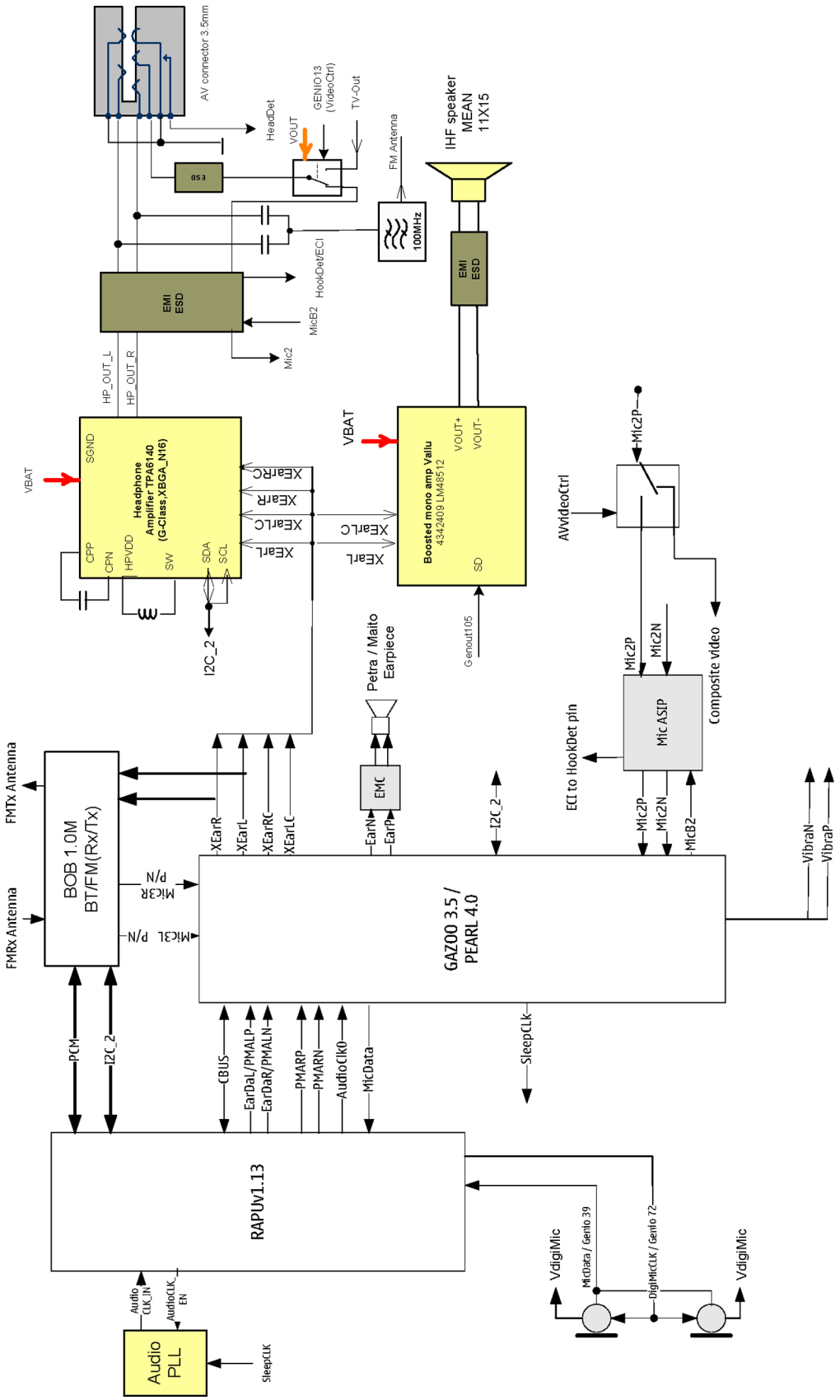

Figure 56 Audio block diagram

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Internal earpiece

The internal earpiece used is Petra (8X12) and is connected to EM ASIC EARP and EARN lines.

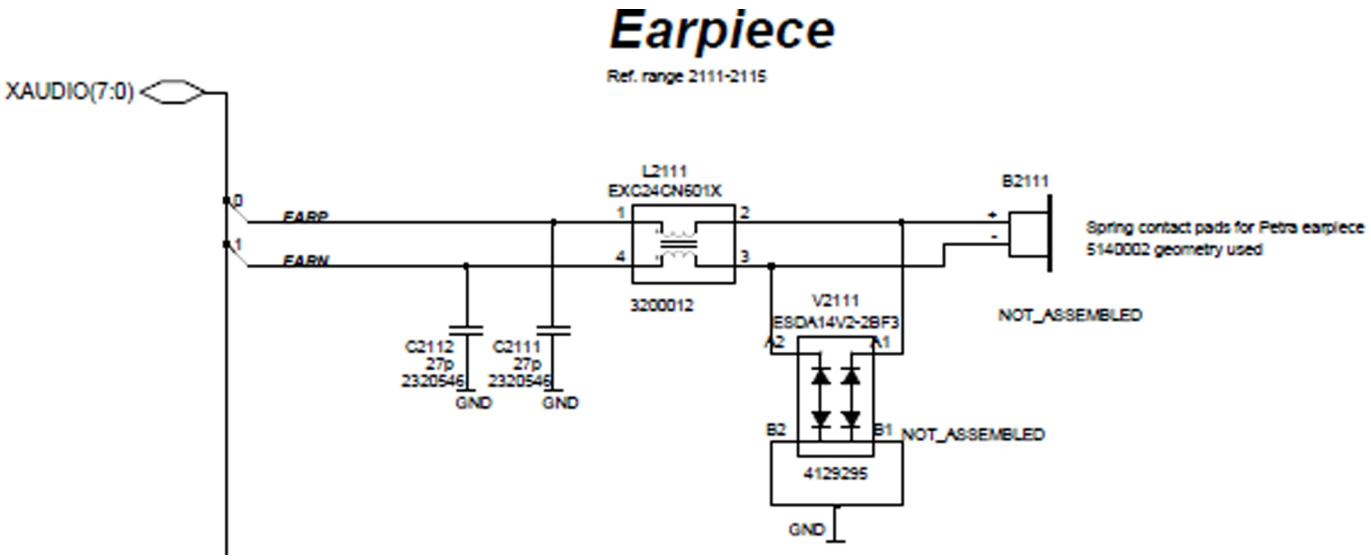

Figure 57 Internal earpiece diagram

Internal handsfree (IHF) speakers

IHF speakers used are Donau and are connected to BoostMono Vallu N2150. Vallu is a mono D-class speaker amplifier with an integrated inductive boost converter. Vallu's differential audio inputs are connected to EM ASIC Gazoo/Pearl XEarL, XEarLC and it can be enabled/disabled by Genout105 from Rapu.

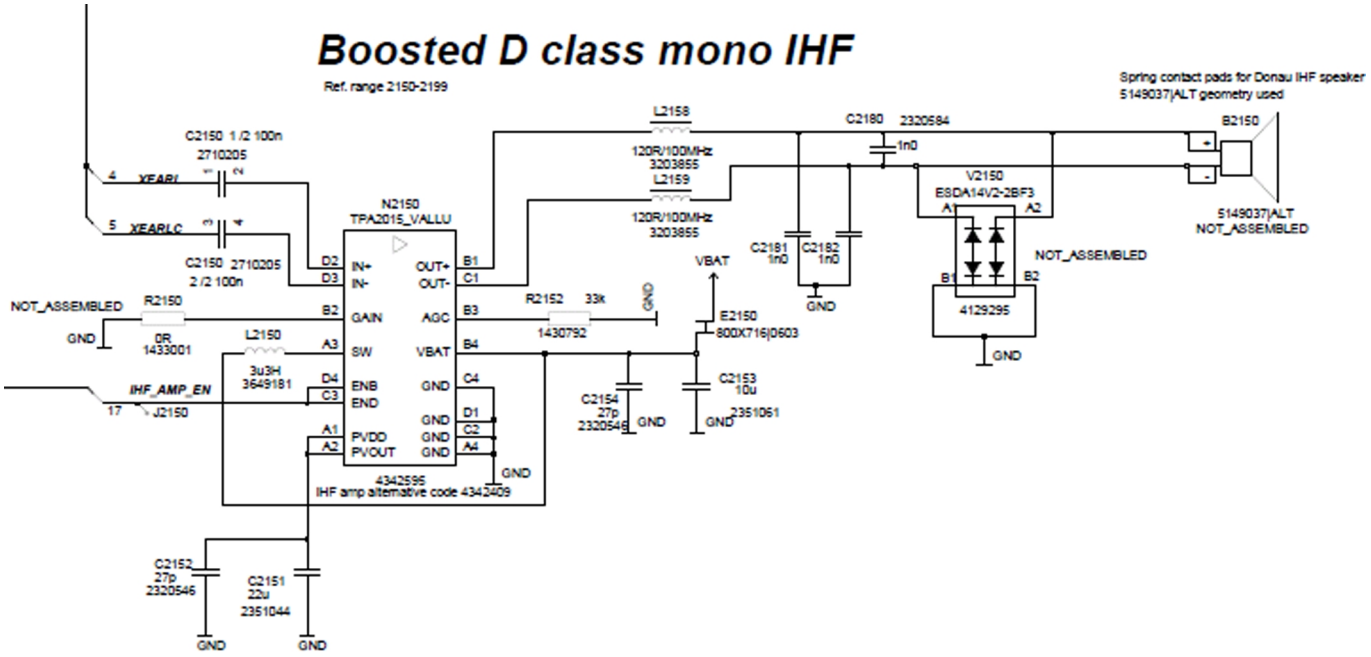

Figure 58 Internal handsfree (IHF) speaker diagram

Internal microphones

Digital microphones used are Knopfler and are connected to Rapu. DigiMic CLK is connected to RAPU Genio72 and DigiMic DATA is connected to Rapu Genio39.

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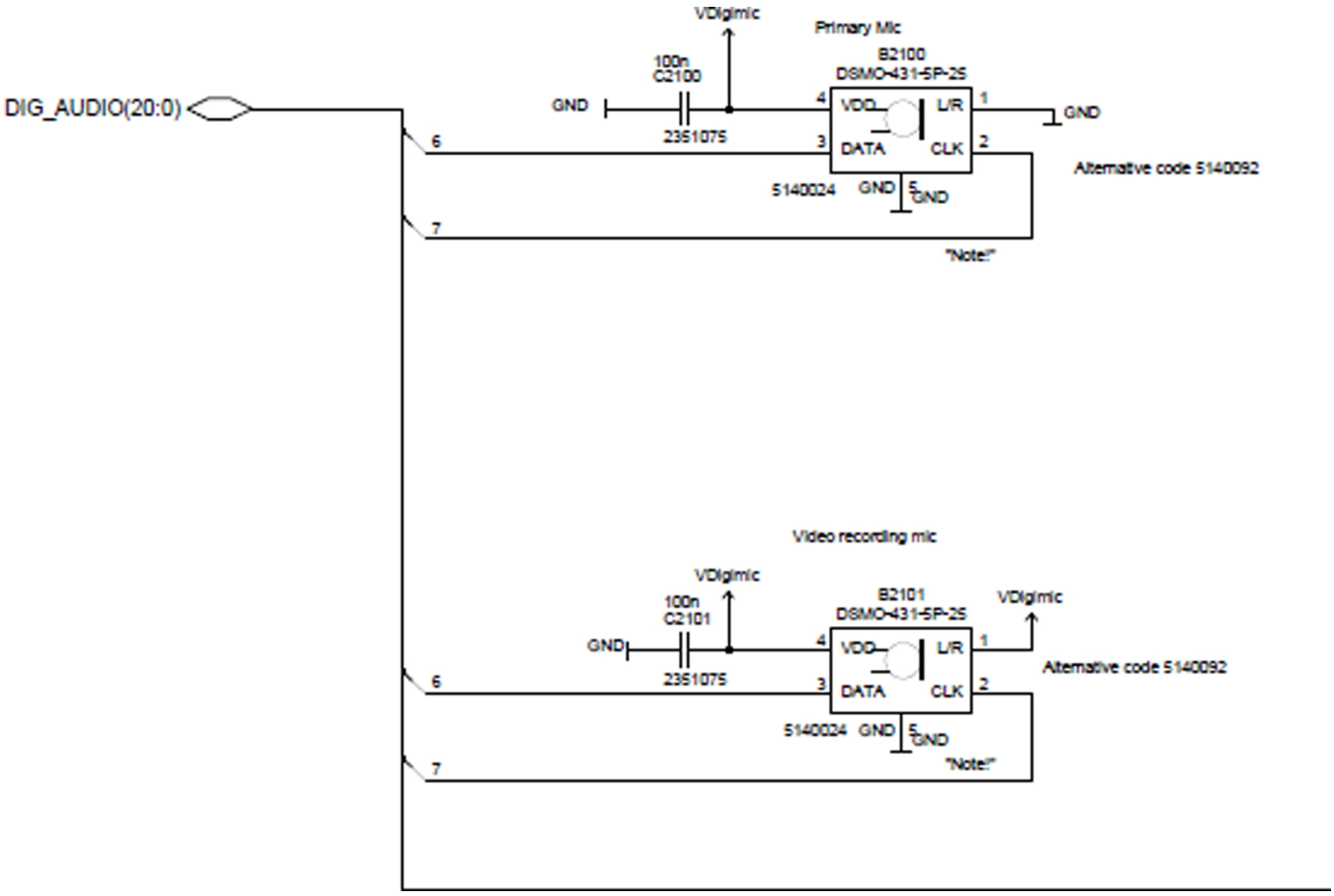

Figure 59 Internal microphones diagram

External earpiece and microphone

The AV headset earpiece is connected to TPA6140 audio amplifier which is used for high quality audio output and to guarantee long playback time for accessory use. TPA6140 is connected to Gazoo/Pearl XEarL, XEarLC, XEarR, XEarRC lines for audio and is controlled via I2C_2 bus by RAPU.

The AV headset microphone line is connected to EM ASIC Gazoo/Pearl Mic2 line via AV switch N2001.

Vibra

Vibra is connected to VibraN and VibraP lines of EM ASIC Gazoo/Pearl.

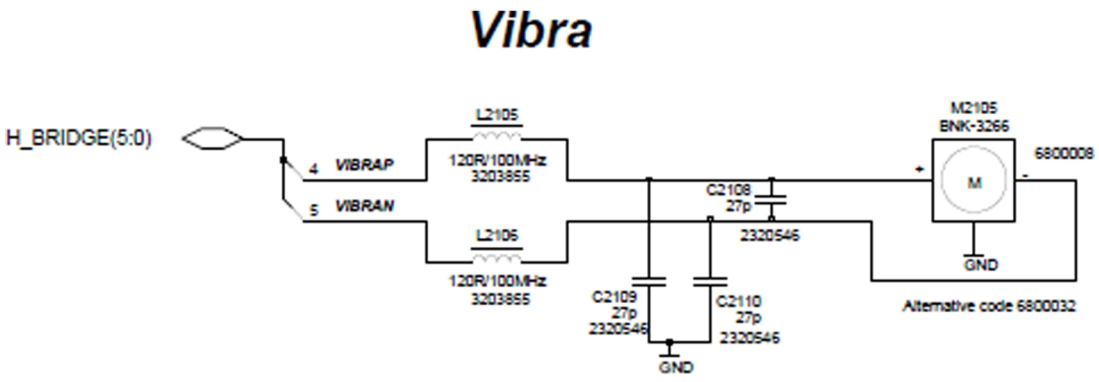

Figure 60 Vibra diagram

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AV connector

The AV connector handles both audio and video signals output. It has audio left and right signals separately (pins 4 and 5) and the microphone signal wired to pin 3.

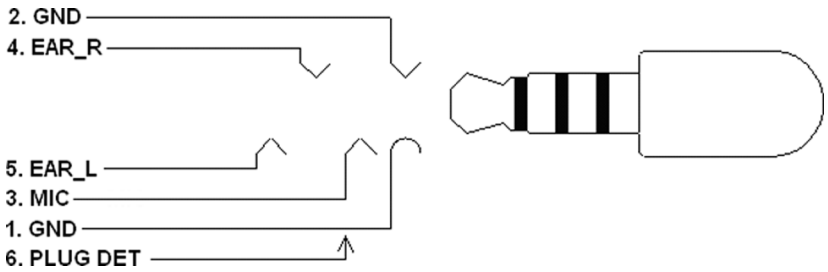

Figure 61 AV connector

The AVVideoControl signal handles microphone usage of the AV connector. The plug detection signal handles the AV connector plug detection with HeadDet signal from EM ASIC.

Cellular RF technical description

RF block

Linko RF consists of the following key components:

- Älli (Transceiver RF Asic)
- Aura (RF power management Asic)
- Ukko PA
- QuBBE (Front end module)

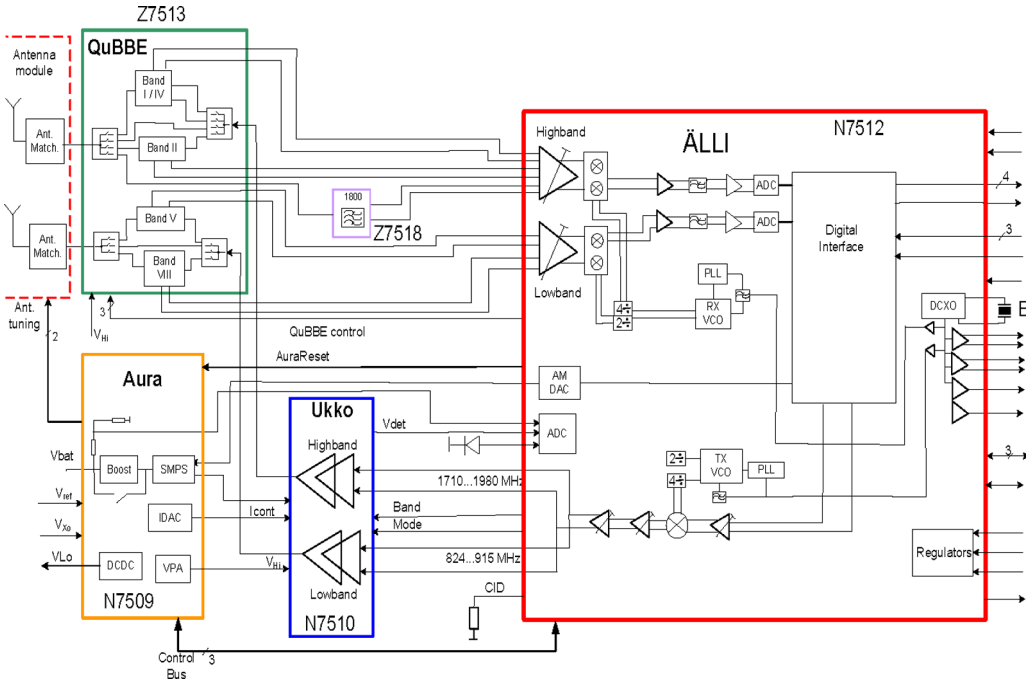

Figure 62 Linko RF block diagram

The RF block uses RF ASIC N7512 that performs the RF back-end functions of receive and transmit function of the cellular transceiver.

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QuBBE

The front end module called QuBBE contains the needed front end filters and the switches. QuBBE contains:

- 3 duplexers (Band II, V, VIII)
- 1 triplexer (Band I, IV)
- 12 switches with the control
- Low and high band GSM TX low bass filters
- 50 ohms low and high and antenna interface

The control signals for the switches come from Älli.

Receiver (RX)

Linko RF has higher integration level compared to previous RF generations and especially more digital design blocks have been integrated to Älli, RF Asic.

Älli contains the receiver chain from LNAs to digital base band interface. Digital RX baseband interface contains four data and one clk signals. The data rate and clock frequency depend on the use case.

The main blocks in Älli are:

- LNAs: Balanced inputs for 850, 900, 1800, 1900, 2100 bands
- Passive mixer
- Analog baseband: Programmable for different modes
- ADC: Programmable Sigma Delta Modulator topology ADC
- RX Digital Front End (RXDFE): Contains for example digital filtering, DC offset compensation, wide/ narrowband power measurement blocks

There is integrated external LNA matching on the bands 900, 1800, 1900 and 2100. On 850 band, there is an integrated matching.

Synthesizer

The synthesizer has separate highly integrated 4GHz VCOs for RX and TX. The integrator capacitors of the loop filter are outside of the IC. The PLLs are fractional type of dividers.

The reference oscillator is an on-chip 38.4 MHz digitally controlled oscillator. The 38.4 MHz crystal is outside of Älli. DCXO delivers the internal clock to Älli, differential clock signal to BB, and two single mode clock signals to NCW modules. Älli delivers a clk signal to diversity RX. The oscillator is controlled via RFBus with AFC signal. Temperature compensation of the oscillator is running by the SW in Älli. The temperature sensor itself is outside of Älli.

Transmitter (TX)

The main features of Linko1 transmitter are:

- Common PA for GSM and WCDMA
  - High and low band signal paths
    - Low band: 824 - 915 MHz
    - High band: 1710 - 1980 MHz
  - Two operation modes in PA
    - Saturation mode in GMSK usage
    - Linear mode in Edge and WCDMA usage
- No TX filter between PA and Älli

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- Common regulators for GSM and WCDMA
  - Boost and SMPS regulators in Aura
    - Feeding the supply voltage to PA
    - Operation frequency varies depending on the used system

Frequency	SMPS	Boost	DCDC
WCDMA	3.0 MHz (typ)	4.5 MHz (typ)	1.3 MHz (typ)
GSM	9.5 MHz	7.5 MHz	2.7 MHz

- Digital interface to baseband
  - WCDMA mode
    - Digital IQ interface
    - 3 data and 1 clk signals
  - GSM mode
    - GSM TX data bits are sourced from baseband via RFBus to Älli

In GMSK mode, the output level of Älli is kept high with all power levels, and the output power is adjusted by altering the collector voltage of PA. In practice, the output level of Älli is also slightly changed (optimized) in the highest power level to keep the PA compression level more constant, which results in better overall efficiency and performance.

In WCDMA and EDGE mode, the output power is tuned by output level of Älli. The supply voltage in WCDMA mode is adjusted in power levels to optimize the current consumption.

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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

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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

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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										

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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					

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WCDMA I (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			

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WCDMA I (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			

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WCDMA II (1900) frequencies

TX CH	RX CH	TX	RX	VCO TX	VCO RX
9262	9662	1852.4	1932.4	3704.8	3864.8
12	412	1852.5	1932.5	3705.0	3865.0
9263	9663	1852.6	1932.6	3705.2	3865.2
9264	9664	1852.8	1932.8	3705.6	3865.6
9265	9665	1853.0	1933.0	3706.0	3866.0
9266	9666	1853.2	1933.2	3706.4	3866.4
9267	9667	1853.4	1933.4	3706.8	3866.8
9268	9668	1853.6	1933.6	3707.2	3867.2
9269	9669	1853.8	1933.8	3707.6	3867.6
9270	9670	1854.0	1934.0	3708.0	3868.0
9271	9671	1854.2	1934.2	3708.4	3868.4
9272	9672	1854.4	1934.4	3708.8	3868.8
9273	9673	1854.6	1934.6	3709.2	3869.2
9274	9674	1854.8	1934.8	3709.6	3869.6
9275	9675	1855.0	1935.0	3710.0	3870.0
9276	9676	1855.2	1935.2	3710.4	3870.4
9277	9677	1855.4	1935.4	3710.8	3870.8
9278	9678	1855.6	1935.6	3711.2	3871.2
9279	9679	1855.8	1935.8	3711.6	3871.6
9280	9680	1856.0	1936.0	3712.0	3872.0
9281	9681	1856.2	1936.2	3712.4	3872.4
9282	9682	1856.4	1936.4	3712.8	3872.8
9283	9683	1856.6	1936.6	3713.2	3873.2
9284	9684	1856.8	1936.8	3713.6	3873.6
9285	9685	1857.0	1937.0	3714.0	3874.0
9286	9686	1857.2	1937.2	3714.4	3874.4
9287	9687	1857.4	1937.4	3714.8	3874.8
37	437	1857.5	1937.5	3715.0	3875.0
9288	9688	1857.6	1937.6	3715.2	3875.2
9289	9689	1857.8	1937.8	3715.6	3875.6
9290	9690	1858.0	1938.0	3716.0	3876.0
9291	9691	1858.2	1938.2	3716.4	3876.4
9292	9692	1858.4	1938.4	3716.8	3876.8
9293	9693	1858.6	1938.6	3717.2	3877.2
9294	9694	1858.8	1938.8	3717.6	3877.6
9295	9695	1859.0	1939.0	3718.0	3878.0
9296	9696	1859.2	1939.2	3718.4	3878.4
9297	9697	1859.4	1939.4	3718.8	3878.8
9298	9698	1859.6	1939.6	3719.2	3879.2
9299	9699	1859.8	1939.8	3719.6	3879.6
9300	9700	1860.0	1940.0	3720.0	3880.0
9301	9701	1860.2	1940.2	3720.4	3880.4
9302	9702	1860.4	1940.4	3720.8	3880.8
9303	9703	1860.6	1940.6	3721.2	3881.2
9304	9704	1860.8	1940.8	3721.6	3881.6
9305	9705	1861.0	1941.0	3722.0	3882.0
9306	9706	1861.2	1941.2	3722.4	3882.4
9307	9707	1861.4	1941.4	3722.8	3882.8
9308	9708	1861.6	1941.6	3723.2	3883.2
9309	9709	1861.8	1941.8	3723.6	3883.6
9310	9710	1862.0	1942.0	3724.0	3884.0
9311	9711	1862.2	1942.2	3724.4	3884.4
9312	9712	1862.4	1942.4	3724.8	3884.8
62	462	1862.5	1942.5	3725.0	3885.0
9313	9713	1862.6	1942.6	3725.2	3885.2
9314	9714	1862.8	1942.8	3725.6	3885.6
9315	9715	1863.0	1943.0	3726.0	3886.0
9316	9716	1863.2	1943.2	3726.4	3886.4
9317	9717	1863.4	1943.4	3726.8	3886.8
9318	9718	1863.6	1943.6	3727.2	3887.2
9319	9719	1863.8	1943.8	3727.6	3887.6
9320	9720	1864.0	1944.0	3728.0	3888.0
9321	9721	1864.2	1944.2	3728.4	3888.4
9322	9722	1864.4	1944.4	3728.8	3888.8
9323	9723	1864.6	1944.6	3729.2	3889.2
9324	9724	1864.8	1944.8	3729.6	3889.6
9325	9725	1865.0	1945.0	3730.0	3890.0
9326	9726	1865.2	1945.2	3730.4	3890.4
9327	9727	1865.4	1945.4	3730.8	3890.8
9328	9728	1865.6	1945.6	3731.2	3891.2
9329	9729	1865.8	1945.8	3731.6	3891.6
9330	9730	1866.0	1946.0	3732.0	3892.0
9331	9731	1866.2	1946.2	3732.4	3892.4
9332	9732	1866.4	1946.4	3732.8	3892.8
9333	9733	1866.6	1946.6	3733.2	3893.2
9334	9734	1866.8	1946.8	3733.6	3893.6
9335	9735	1867.0	1947.0	3734.0	3894.0
9336	9736	1867.2	1947.2	3734.4	3894.4
9337	9737	1867.4	1947.4	3734.8	3894.8
87	487	1867.5	1947.5	3735.0	3895.0
9338	9738	1867.6	1947.6	3735.2	3895.2
9339	9739	1867.8	1947.8	3735.6	3895.6
9340	9740	1868.0	1948.0	3736.0	3896.0
9341	9741	1868.2	1948.2	3736.4	3896.4
9342	9742	1868.4	1948.4	3736.8	3896.8
9343	9743	1868.6	1948.6	3737.2	3897.2
9344	9744	1868.8	1948.8	3737.6	3897.6
9345	9745	1869.0	1949.0	3738.0	3898.0
9346	9746	1869.2	1949.2	3738.4	3898.4
9347	9747	1869.4	1949.4	3738.8	3898.8
9348	9748	1869.6	1949.6	3739.2	3899.2
9349	9749	1869.8	1949.8	3739.6	3899.6
9350	9750	1870.0	1950.0	3740.0	3900.0
9351	9751	1870.2	1950.2	3740.4	3900.4
9352	9752	1870.4	1950.4	3740.8	3900.8
9353	9753	1870.6	1950.6	3741.2	3901.2
9354	9754	1870.8	1950.8	3741.6	3901.6
9355	9755	1871.0	1951.0	3742.0	3902.0
9356	9756	1871.2	1951.2	3742.4	3902.4
9357	9757	1871.4	1951.4	3742.8	3902.8
9358	9758	1871.6	1951.6	3743.2	3903.2
9359	9759	1871.8	1951.8	3743.6	3903.6
9360	9760	1872.0	1952.0	3744.0	3904.0
9361	9761	1872.2	1952.2	3744.4	3904.4
9362	9762	1872.4	1952.4	3744.8	3904.8
112	512	1872.5	1952.5	3745.0	3905.0
9363	9763	1872.6	1952.6	3745.2	3905.2
9364	9764	1872.8	1952.8	3745.6	3905.6
9365	9765	1873.0	1953.0	3746.0	3906.0
9366	9766	1873.2	1953.2	3746.4	3906.4
9367	9767	1873.4	1953.4	3746.8	3906.8
9368	9768	1873.6	1953.6	3747.2	3907.2
9369	9769	1873.8	1953.8	3747.6	3907.6
9370	9770	1874.0	1954.0	3748.0	3908.0
9371	9771	1874.2	1954.2	3748.4	3908.4
9372	9772	1874.4	1954.4	3748.8	3908.8
9373	9773	1874.6	1954.6	3749.2	3909.2
9374	9774	1874.8	1954.8	3749.6	3909.6
9375	9775	1875.0	1955.0	3750.0	3910.0
9376	9776	1875.2	1955.2	3750.4	3910.4
9377	9777	1875.4	1955.4	3750.8	3910.8
9378	9778	1875.6	1955.6	3751.2	3911.2
9379	9779	1875.8	1955.8	3751.6	3911.6
9380	9780	1876.0	1956.0	3752.0	3912.0
9381	9781	1876.2	1956.2	3752.4	3912.4
9382	9782	1876.4	1956.4	3752.8	3912.8
9383	9783	1876.6	1956.6	3753.2	3913.2
9384	9784	1876.8	1956.8	3753.6	3913.6
9385	9785	1877.0	1957.0	3754.0	3914.0
9386	9786	1877.2	1957.2	3754.4	3914.4
9387	9787	1877.4	1957.4	3754.8	3914.8
137	537	1877.5	1957.5	3755.0	3915.0
9388	9788	1877.6	1957.6	3755.2	3915.2
9389	9789	1877.8	1957.8	3755.6	3915.6
9390	9790	1878.0	1958.0	3756.0	3916.0
9391	9791	1878.2	1958.2	3756.4	3916.4
9392	9792	1878.4	1958.4	3756.8	3916.8
9393	9793	1878.6	1958.6	3757.2	3917.2
9394	9794	1878.8	1958.8	3757.6	3917.6
9395	9795	1879.0	1959.0	3758.0	3918.0
9396	9796	1879.2	1959.2	3758.4	3918.4
9397	9797	1879.4	1959.4	3758.8	3918.8
9398	9798	1879.6	1959.6	3759.2	3919.2
9399	9799	1879.8	1959.8	3759.6	3919.6
9400	9800	1880.0	1960.0	3760.0	3920.0
9401	9801	1880.2	1960.2	3760.4	3920.4
9402	9802	1880.4	1960.4	3760.8	3920.8
9403	9803	1880.6	1960.6	3761.2	3921.2
9404	9804	1880.8	1960.8	3761.6	3921.6
9405	9805	1881.0	1961.0	3762.0	3922.0
9406	9806	1881.2	1961.2	3762.4	3922.4
9407	9807	1881.4	1961.4	3762.8	3922.8
9408	9808	1881.6	1961.6	3763.2	3923.2
9409	9809	1881.8	1961.8	3763.6	3923.6
9410	9810	1882.0	1962.0	3764.0	3924.0
9411	9811	1882.2	1962.2	3764.4	3924.4
9412	9812	1882.4	1962.4	3764.8	3924.8
162	562	1882.5	1962.5	3765.0	3925.0
9413	9813	1882.6	1962.6	3765.2	3925.2
9414	9814	1882.8	1962.8	3765.6	3925.6
9415	9815	1883.0	1963.0	3766.0	3926.0
9416	9816	1883.2	1963.2	3766.4	3926.4
9417	9817	1883.4	1963.4	3766.8	3926.8
9418	9818	1883.6	1963.6	3767.2	3927.2
9419	9819	1883.8	1963.8	3767.6	3927.6
9420	9820	1884.0	1964.0	3768.0	3928.0
9421	9821	1884.2	1964.2	3768.4	3928.4
9422	9822	1884.4	1964.4	3768.8	3928.8
9423	9823	1884.6	1964.6	3769.2	3929.2
9424	9824	1884.8	1964.8	3769.6	3929.6
9425	9825	1885.0	1965.0	3770.0	3930.0
9426	9826	1885.2	1965.2	3770.4	3930.4
9427	9827	1885.4	1965.4	3770.8	3930.8
9428	9828	1885.6	1965.6	3771.2	3931.2
9429	9829	1885.8	1965.8	3771.6	3931.6
9430	9830	1886.0	1966.0	3772.0	3932.0
9431	9831	1886.2	1966.2	3772.4	3932.4
9432	9832	1886.4	1966.4	3772.8	3932.8
9433	9833	1886.6	1966.6	3773.2	3933.2
9434	9834	1886.8	1966.8	3773.6	3933.6
9435	9835	1887.0	1967.0	3774.0	3934.0
9436	9836	1887.2	1967.2	3774.4	3934.4
9437	9837	1887.4	1967.4	3774.8	3934.8
187	587	1887.5	1967.5	3775.0	3935.0
9438	9838	1887.6	1967.6	3775.2	3935.2
9439	9839	1887.8	1967.8	3775.6	3935.6
9440	9840	1888.0	1968.0	3776.0	3936.0
9441	9841	1888.2	1968.2	3776.4	3936.4
9442	9842	1888.4	1968.4	3776.8	3936.8
9443	9843	1888.6	1968.6	3777.2	3937.2
9444	9844	1888.8	1968.8	3777.6	3937.6
9445	9845	1889.0	1969.0	3778.0	3938.0
9446	9846	1889.2	1969.2	3778.4	3938.4
9447	9847	1889.4	1969.4	3778.8	3938.8
9448	9848	1889.6	1969.6	3779.2	3939.2
9449	9849	1889.8	1969.8	3779.6	3939.6
9450	9850	1890.0	1970.0	3780.0	3940.0
9451	9851	1890.2	1970.2	3780.4	3940.4
9452	9852	1890.4	1970.4	3780.8	3940.8
9453	9853	1890.6	1970.6	3781.2	3941.2
9454	9854	1890.8	1970.8	3781.6	3941.6
9455	9855	1891.0	1971.0	3782.0	3942.0
9456	9856	1891.2	1971.2	3782.4	3942.4
9457	9857	1891.4	1971.4	3782.8	3942.8
9458	9858	1891.6	1971.6	3783.2	3943.2
9459	9859	1891.8	1971.8	3783.6	3943.6
9460	9860	1892.0	1972.0	3784.0	3944.0
9461	9861	1892.2	1972.2	3784.4	3944.4
9462	9862	1892.4	1972.4	3784.8	3944.8
212	612	1892.5	1972.5	3785.0	3945.0
9463	9863	1892.6	1972.6	3785.2	3945.2
9464	9864	1892.8	1972.8	3785.6	3945.6
9465	9865	1893.0	1973.0	3786.0	3946.0
9466	9866	1893.2	1973.2	3786.4	3946.4
9467	9867	1893.4	1973.4	3786.8	3946.8
9468	9868	1893.6	1973.6	3787.2	3947.2
9469	9869	1893.8	1973.8	3787.6	3947.6
9470	9870	1894.0	1974.0	3788.0	3948.0
9471	9871	1894.2	1974.2	3788.4	3948.4
9472	9872	1894.4	1974.4	3788.8	3948.8
9473	9873	1894.6	1974.6	3789.2	3949.2
9474	9874	1894.8	1974.8	3789.6	3949.6
9475	9875	1895.0	1975.0	3790.0	3950.0
9476	9876	1895.2	1975.2	3790.4	3950.4
9477	9877	1895.4	1975.4	3790.8	3950.8
9478	9878	1895.6	1975.6	3791.2	3951.2
9479	9879	1895.8	1975.8	3791.6	3951.6
9480	9880	1896.0	1976.0	3792.0	3952.0
9481	9881	1896.2	1976.2	3792.4	3952.4
9482	9882	1896.4	1976.4	3792.8	3952.8
9483	9883	1896.6	1976.6	3793.2	3953.2
9484	9884	1896.8	1976.8	3793.6	3953.6
9485	9885	1897.0	1977.0	3794.0	3954.0
9486	9886	1897.2	1977.2	3794.4	3954.4
9487	9887	1897.4	1977.4	3794.8	3954.8
237	637	1897.5	1977.5	3795.0	3955.0
9488	9888	1897.6	1977.6	3795.2	3955.2
9489	9889	1897.8	1977.8	3795.6	3955.6
9490	9890	1898.0	1978.0	3796.0	3956.0
9491	9891	1898.2	1978.2	3796.4	3956.4
9492	9892	1898.4	1978.4	3796.8	3956.8
9493	9893	1898.6	1978.6	3797.2	3957.2
9494	9894	1898.8	1978.8	3797.6	3957.6
9495	9895	1899.0	1979.0	3798.0	3958.0
9496	9896	1899.2	1979.2	3798.4	3958.4
9497	9897	1899.4	1979.4	3798.8	3958.8
9498	9898	1899.6	1979.6	3799.2	3959.2
9499	9899	1899.8	1979.8	3799.6	3959.6
9500	9900	1900.0	1980.0	3800.0	3960.0
9501	9901	1900.2	1980.2	3800.4	3960.4
9502	9902	1900.4	1980.4	3800.8	3960.8
9503	9903	1900.6	1980.6	3801.2	3961.2
9504	9904	1900.8	1980.8	3801.6	3961.6
9505	9905	1901.0	1981.0	3802.0	3962.0
9506	9906	1901.2	1981.2	3802.4	3962.4
9507	9907	1901.4	1981.4	3802.8	3962.8
9508	9908	1901.6	1981.6	3803.2	3963.2
9509	9909	1901.8	1981.8	3803.6	3963.6
9510	9910	1902.0	1982.0	3804.0	3964.0
9511	9911	1902.2	1982.2	3804.4	3964.4
9512	9912	1902.4	1982.4	3804.8	3964.8
262	662	1902.5	1982.5	3805.0	3965.0
9513	9913	1902.6	1982.6	3805.2	3965.2
9514	9914	1902.8	1982.8	3805.6	3965.6
9515	9915	1903.0	1983.0	3806.0	3966.0
9516	9916	1903.2	1983.2	3806.4	3966.4
9517	9917	1903.4	1983.4	3806.8	3966.8
9518	9918	1903.6	1983.6	3807.2	3967.2
9519	9919	1903.8	1983.8	3807.6	3967.6
9520	9920	1904.0	1984.0	3808.0	3968.0
9521	9921	1904.2	1984.2	3808.4	3968.4
9522	9922	1904.4	1984.4	3808.8	3968.8
9523	9923	1904.6	1984.6	3809.2	3969.2
9524	9924	1904.8	1984.8	3809.6	3969.6
9525	9925	1905.0	1985.0	3810.0	3970.0
9526	9926	1905.2	1985.2	3810.4	3970.4
9527	9927	1905.4	1985.4	3810.8	3970.8
9528	9928	1905.6	1985.6	3811.2	3971.2
9529	9929	1905.8	1985.8	3811.6	3971.6
9530	9930	1906.0	1986.0	3812.0	3972.0
9531	9931	1906.2	1986.2	3812.4	3972.4
9532	9932	1906.4	1986.4	3812.8	3972.8
9533	9933	1906.6	1986.6	3813.2	3973.2
9534	9934	1906.8	1986.8	3813.6	3973.6
9535	9935	1907.0	1987.0	3814.0	3974.0
9536	9936	1907.2	1987.2	3814.4	3974.4
9537	9937	1907.4	1987.4	3814.8	3974.8
287	687	1907.5	1987.5	3815.0	3975.0
9538	9938	1907.6	1987.6	3815.2	3975.2

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WCDMA IV (1700/2100) 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

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WCDMA V (850) frequencies

TX CH	RX CH	TX	RX	VCO TX	VCO RX
4132	4357	826.4	871.4	3305.6	3485.6
782	1007	826.5	871.5	3306.0	3486.0
4133	4358	826.6	871.6	3306.4	3486.4
4134	4359	826.8	871.8	3307.2	3487.2
4135	4360	827.0	872.0	3308.0	3488.0
4136	4361	827.2	872.2	3308.8	3488.8
4137	4362	827.4	872.4	3309.6	3489.6
787	1012	827.5	872.5	3310.0	3490.0
4138	4363	827.6	872.6	3310.4	3490.4
4139	4364	827.8	872.8	3311.2	3491.2
4140	4365	828.0	873.0	3312.0	3492.0
4141	4366	828.2	873.2	3312.8	3492.8
4142	4367	828.4	873.4	3313.6	3493.6
4143	4368	828.6	873.6	3314.4	3494.4
4144	4369	828.8	873.8	3315.2	3495.2
4145	4370	829.0	874.0	3316.0	3496.0
4146	4371	829.2	874.2	3316.8	3496.8
4147	4372	829.4	874.4	3317.6	3497.6
4148	4373	829.6	874.6	3318.4	3498.4
4149	4374	829.8	874.8	3319.2	3499.2
4150	4375	830.0	875.0	3320.0	3500.0
4151	4376	830.2	875.2	3320.8	3500.8
4152	4377	830.4	875.4	3321.6	3501.6
4153	4378	830.6	875.6	3322.4	3502.4
4154	4379	830.8	875.8	3323.2	3503.2
4155	4380	831.0	876.0	3324.0	3504.0
4156	4381	831.2	876.2	3324.8	3504.8
4157	4382	831.4	876.4	3325.6	3505.6
807	1032	831.5	876.5	3326.0	3506.0
4158	4383	831.6	876.6	3326.4	3506.4
4159	4384	831.8	876.8	3327.2	3507.2
4160	4385	832.0	877.0	3328.0	3508.0
4161	4386	832.2	877.2	3328.8	3508.8
4162	4387	832.4	877.4	3329.6	3509.6
812	1037	832.5	877.5	3330.0	3510.0
4163	4388	832.6	877.6	3330.4	3510.4
4164	4389	832.8	877.8	3331.2	3511.2
4165	4390	833.0	878.0	3332.0	3512.0
4166	4391	833.2	878.2	3332.8	3512.8
4167	4392	833.4	878.4	3333.6	3513.6
4168	4393	833.6	878.6	3334.4	3514.4
4169	4394	833.8	878.8	3335.2	3515.2
4170	4395	834.0	879.0	3336.0	3516.0
4171	4396	834.2	879.2	3336.8	3516.8
4172	4397	834.4	879.4	3337.6	3517.6
4173	4398	834.6	879.6	3338.4	3518.4
4174	4399	834.8	879.8	3339.2	3519.2
4175	4400	835.0	880.0	3340.0	3520.0
4176	4401	835.2	880.2	3340.8	3520.8
4177	4402	835.4	880.4	3341.6	3521.6
4178	4403	835.6	880.6	3342.4	3522.4
4179	4404	835.8	880.8	3343.2	3523.2
4180	4405	836.0	881.0	3344.0	3524.0
4181	4406	836.2	881.2	3344.8	3524.8

TX CH	RX CH	TX	RX	VCO TX	VCO RX
4182	4407	836.4	881.4	3345.6	3525.6
4183	4408	836.6	881.6	3346.4	3526.4
4184	4409	836.8	881.8	3347.2	3527.2
4185	4410	837.0	882.0	3348.0	3528.0
4186	4411	837.2	882.2	3348.8	3528.8
4187	4412	837.4	882.4	3349.6	3529.6
837	1062	837.5	882.5	3350.0	3530.0
4188	4413	837.6	882.6	3350.4	3530.4
4189	4414	837.8	882.8	3351.2	3531.2
4190	4415	838.0	883.0	3352.0	3532.0
4191	4416	838.2	883.2	3352.8	3532.8
4192	4417	838.4	883.4	3353.6	3533.6
4193	4418	838.6	883.6	3354.4	3534.4
4194	4419	838.8	883.8	3355.2	3535.2
4195	4420	839.0	884.0	3356.0	3536.0
4196	4421	839.2	884.2	3356.8	3536.8
4197	4422	839.4	884.4	3357.6	3537.6
4198	4423	839.6	884.6	3358.4	3538.4
4199	4424	839.8	884.8	3359.2	3539.2
4200	4425	840.0	885.0	3360.0	3540.0
4201	4426	840.2	885.2	3360.8	3540.8
4202	4427	840.4	885.4	3361.6	3541.6
4203	4428	840.6	885.6	3362.4	3542.4
4204	4429	840.8	885.8	3363.2	3543.2
4205	4430	841.0	886.0	3364.0	3544.0
4206	4431	841.2	886.2	3364.8	3544.8
4207	4432	841.4	886.4	3365.6	3545.6
4208	4433	841.6	886.6	3366.4	3546.4
4209	4434	841.8	886.8	3367.2	3547.2
4210	4435	842.0	887.0	3368.0	3548.0
4211	4436	842.2	887.2	3368.8	3548.8
4212	4437	842.4	887.4	3369.6	3549.6
862	1087	842.5	887.5	3370.0	3550.0
4213	4438	842.6	887.6	3370.4	3550.4
4214	4439	842.8	887.8	3371.2	3551.2
4215	4440	843.0	888.0	3372.0	3552.0
4216	4441	843.2	888.2	3372.8	3552.8
4217	4442	843.4	888.4	3373.6	3553.6
4218	4443	843.6	888.6	3374.4	3554.4
4219	4444	843.8	888.8	3375.2	3555.2
4220	4445	844.0	889.0	3376.0	3556.0
4221	4446	844.2	889.2	3376.8	3556.8
4222	4447	844.4	889.4	3377.6	3557.6
4223	4448	844.6	889.6	3378.4	3558.4
4224	4449	844.8	889.8	3379.2	3559.2
4225	4450	845.0	890.0	3380.0	3560.0
4226	4451	845.2	890.2	3380.8	3560.8
4227	4452	845.4	890.4	3381.6	3561.6
4228	4453	845.6	890.6	3382.4	3562.4
4229	4454	845.8	890.8	3383.2	3563.2
4230	4455	846.0	891.0	3384.0	3564.0
4231	4456	846.2	891.2	3384.8	3564.8
4232	4457	846.4	891.4	3385.6	3565.6
4233	4458	846.6	891.6	3386.4	3566.4

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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

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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

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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

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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

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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

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7 — Service information differences between RM-691 and RM-675

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General information

Product data

RM-691 is a WCDMA band variant of the Nokia C7-00.

The key product data differences between the RM-691 and RM-675 are described below.

Connectivity

Table 10 Remote connectivity

Operating bands	RM-691: EGSM 850/900/1800/1900, WCDMA/HSUPA 850/900/1700/2100 (VIII/V/IV/I)

Sales package

- Transceiver RM-691
- Charger (AC-15)
- Battery (BL-5K)
- Music headset (WH-102)
- Connectivity cable (CA-101)
- CD-ROM
- User Guide

Product and module list

Module name	Type code	Notes
System/RF module PWB	3MW	Main PWB with components for RM-691.
UI flexi module	3GR	
Flash module	3GU	

TX powers

Table 11 TX powers - GSM

GMSK	850	900	1800	1900
Absolute Power dBm				
RM-675	32.5	33	30.5	29.5
RM-691	32.5	**32.5**	30.5	31

Table 12 TX powers - WCDMA

WCDMA	V	VIII	IV	I
Absolute Power dBm				
RM-675	23.5	23.5	23.5	23.5
RM-691	23.5	23.5	**23.8**	23.5

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Cellular RF troubleshooting

Key components

The following table shows the key components which are different in RM-691 compared to RM-675. For a detailed PWB layout, see the RM-691 schematics document.

Table 13 Key components changed for RM-691

Ref.	Component name
Z7513	Duplexer module
D3200	EMMC
D3000	Memory
N7510	Power Amplifier
N7512	RF Alli transceiver
Z7518	SAW Filter
Z7523	GSM TX 850/900 SAW Filter
	Cellular antenna module

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:

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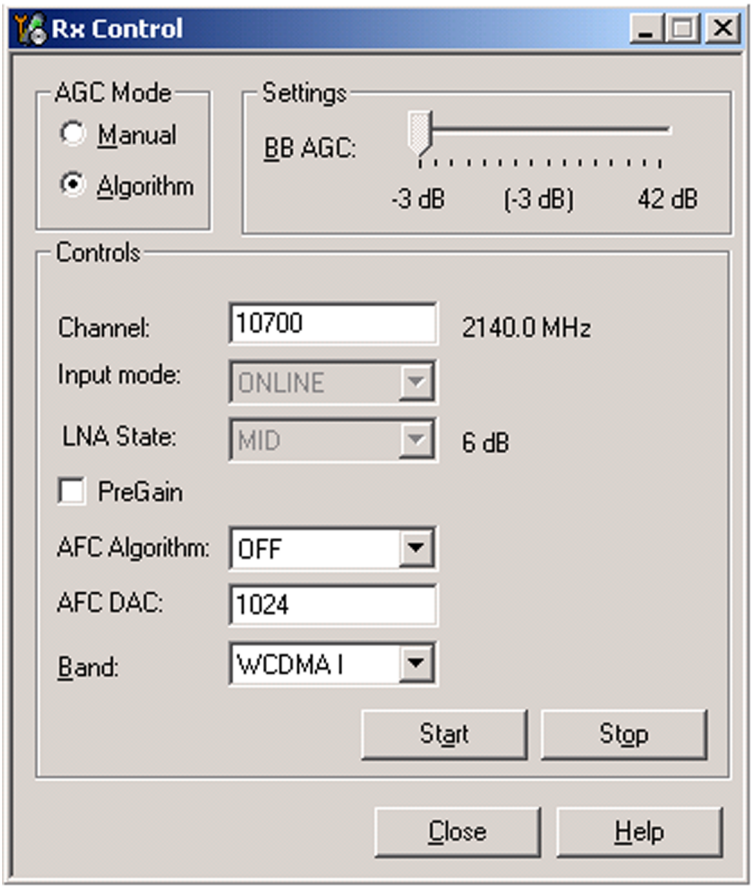

Figure 63 Phoenix WCDMA RX Control window

Note: Channel for band WCDMA I 10700, IV 1637, V 4408, 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 (2141 MHz for channel 10700 WCDMA band I, CW signal).

Steps

1. Set the RF generator settings.

   Note: Frequency for band WCDMA I 2141.0 MHz, IV 2133.4 MHz, V 882.6 MHz, VIII 943.4 MHz.

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

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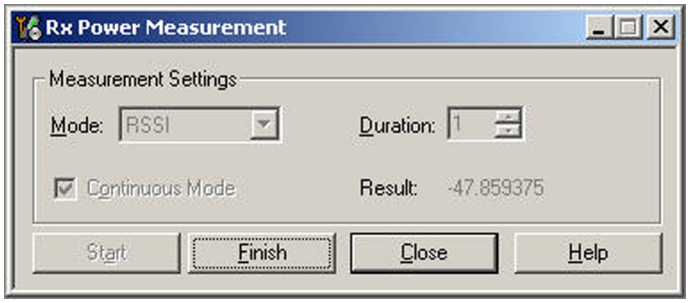


Figure 64 Phoenix WCDMA RX power measurement window

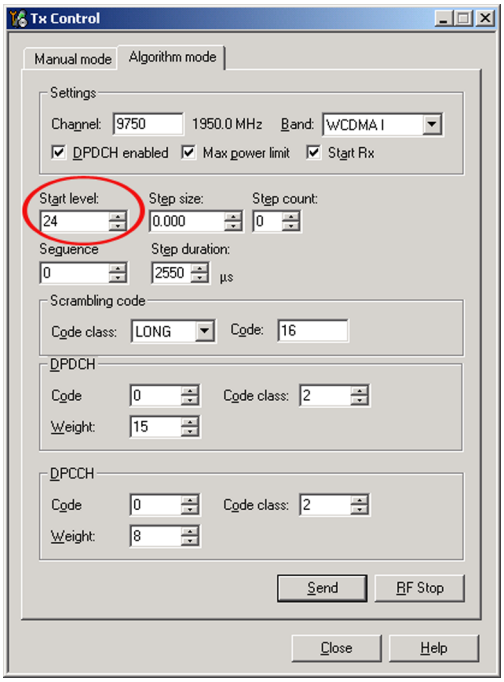
4. Click **Start** to perform the measurement.

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

WCDMA 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, V 4183, 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).

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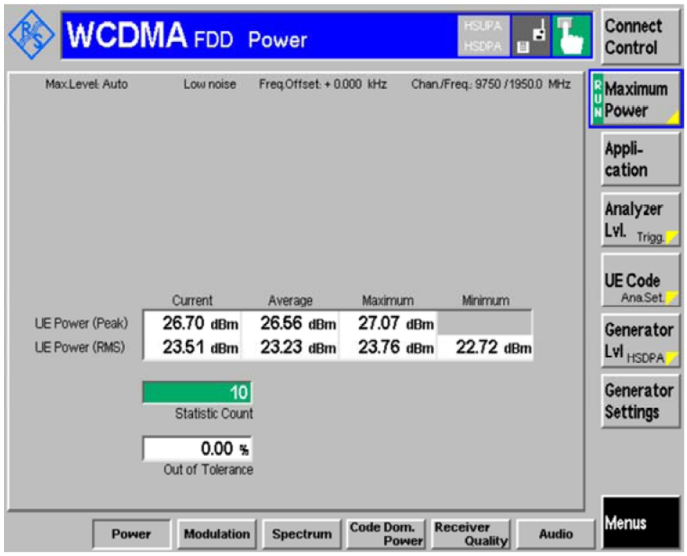
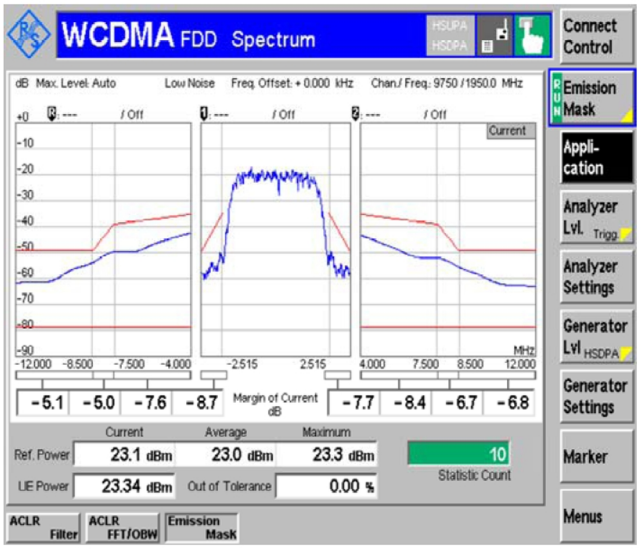
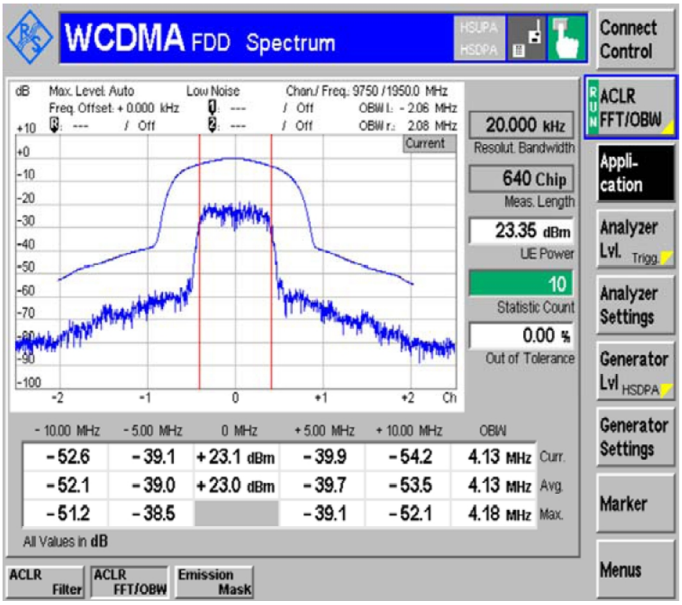
Power



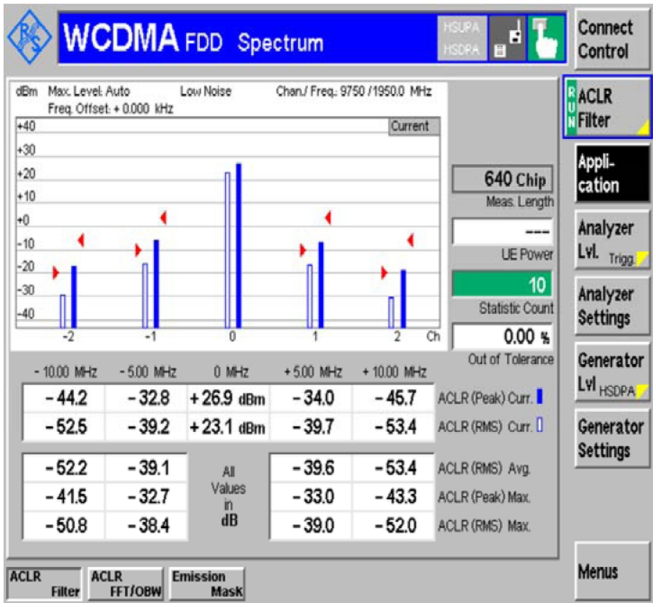
Spectrum - Emission Mask



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 troubleshooting

Note that the B-cover assembly and the main antenna assembly of RM-691 are different from RM-675 as spare parts. The difference in the B-cover assembly and the main antenna module is that RM-691 has white coaxial cables and RM-675 has black coaxial cables.

For more information, see the published BOR technical bulletin.

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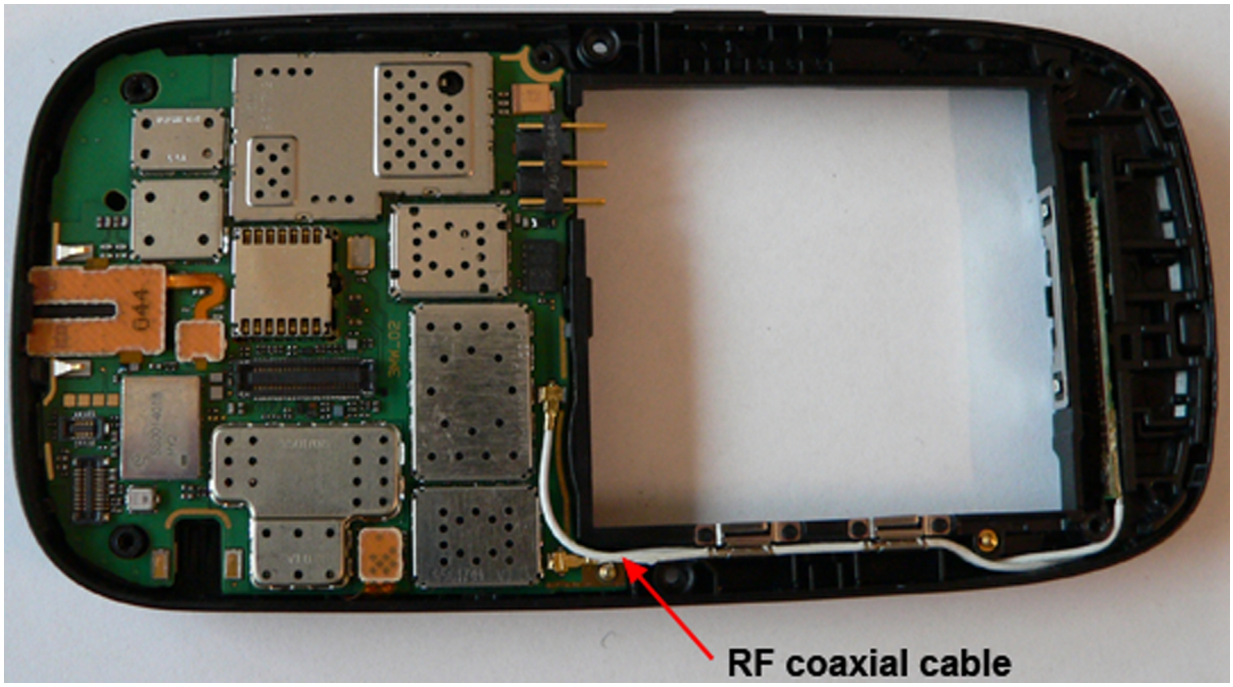

Figure 65 RF coaxial cable

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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

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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

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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

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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

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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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