

Nokia Customer Care

Service Manual

RM-179; RM-223 (Nokia N81)

Mobile Terminal

Part No: (Issue 1)

COMPANY CONFIDENTIAL



Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	09/2007	MHa	

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IMPORTANT

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

Warnings and cautions

Warnings

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

Cautions

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

ESD protection

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

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

To replace the covers ESD protection must be applied.

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

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

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

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

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

Care and maintenance

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

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

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

Company Policy

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

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

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Battery information

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

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

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

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

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

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

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

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

Do not dispose of batteries in a fire!

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

Nokia N81 Service Manual Structure

- 1 General Information
- 2 Service Tools and Service Concepts
- 3 Baseband Troubleshooting
- 4 RF troubleshooting
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- 6 System Module and User Interface
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Nokia Customer Care

1 — General Information

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■ Product selection

RM-179/223 is a WCDMA/GSM dual mode handportable phone. It supports EGSM900/1800/1900 and WCDMA2100. RM-179 has 8GB internal memory and RM-223 a micro SD card.

RM-179/223 is a 3GPP Release 4 terminal supporting CSD/HCS, GPRS/EGPRS and WCDMA data bearers. For WCDMA the maximum bit rate is up to 384 kbps for downlink and 384 kbps for uplink with simultaneous CS speech or CS video (max. 64 kbps).

For 2G and 2.5G networks the RM-179/223 is a Class B EGPRS MSC 32, which means a in maximum download speed of up to 296kbit/s with EGPRS, and up to 107kbit/s with GPRS. According to GSM standard 05.05 it responds to class 4 (max. 2W) in GSM 850 and EGSM 900, class 1 (1W) is DCS 1800, and class 1 in PCS 1900.

RM-179/223 supports Bluetooth 2.0 + EDR standard and two-way video calls with two integrated cameras, on the front and one on the back. The main camera is an integrated 2 Megapixel camera with a digital zoom and the secondary CIF camera is for video calls.

RM-179/223 is an MMS (Multimedia Messaging Service) enabled multimedia device. The MMS implementation follows the OMA MMS standard release 1.2. It has a large 2.4" QVGA (320x240 pixels) TFT display with 16 million colors.

The HTML browser is a highly advanced internet browser also capable of viewing operator domain XHTML Mobile Profile (MP) content.

RM-179/223 uses Symbian 9.x (S60) operating system and supports also MIDP Java 2.0, providing a good platform for compelling 3rd party applications.



Figure 1 RM-179 phone

Figure 2 RM-223 phone

■ Product features and sales package

Hardware features

- GPRS multi slot at least class 10 (4+1, 2+2), class B

- EGPRS multi slot at least class 10 (4+1, 2+2), class B
- DTM Support (MSC11)
- Speech codecs: FR, EFR, AMR
- Internal handsfree/music stereo speaker
- Internal vibrating alert
- 2mm charger

Display and keys

- Active matrix 2.4" QVGA main colour display (320 x 240 pixels), up to 16 million colors
- Media keys: play/pause, forward, rewind, stop
- Keys: two gaming keys, two softkeys, send & end, 5-way navigator, S60 keys (application, clear), ITU-T keypad, volume keys (up & down), camera key, power key, lock switch, Navi™ wheel

Connectivity

- WLAN IEEE802.11 b/g with UPnP support
- Bluetooth Specification 2.0 (profiles supported: DUN, OPP, FTP, HFP, GOEP, GAP, SPP, HSP, BIP, A2DP)
- Micro USB 2.0 Full Speed (mass storage class)
- Nokia AV Connector 3.5mm

Software features

- Operating system: Symbian ver. 9.2
- User interface: S60 3rd Edition, Feature Pack (S60 3.1)
- NCP 5.0
- Java™ MIDP 2.0, CLDC 1.1
- Flash Lite 2.0
- C++ and Java SDKs

Additional technical specifications

- Protocols: MTP, UPnP, TCP/IP

Memory

- Internal flash memory (8 GB) (RM-179)
- MicroSD card (support up to 32GB, hotswap) (RM-223)

Sales package

- Transceiver RM-179/223
- 3.5mm Stereo Headset with Remote Control (HS-45 + AD-54)
- MicroSD card (1GB) (MU-22) (only RM-223)
- Micro USB Data Cable (CA-101)
- Battery (BP-6MT)
- Travel Charger (AC-5)
- CD ROM
- User Guide
- Quick Guide

- Sales carton

■ Mobile enhancements

Data

Enhancement	Type
Charging connectivity cable	CA-100
Micro-USB connect cable	CA-101
MicroSD card	MU-27 (256 MB)
	MU-28 (512 MB)
	MU-22 (1 GB)
	MU-37 (2 GB)
	MU-41 (4 GB)

Power

Enhancement	Type
Battery 1050 mAh	BP-6MT
Travel charger	AC-4
	AC-5
Mobile charger	DC-4
Baby feeder, large battery to charge phone battery 3 -5 times	DC-1
First aid charger	DC-8
Retractable mobile charger	DC-9
Charger adapter	CA-44

Audio

Enhancement	Type
Stereo headset	HS-43
	HS-48
Music headset	HS-16
	AD-43
Headset	HS-41
3.5 mm headphone	HS-44
	HS-45
	HS-61
	HS-62

Enhancement	Type
Bluetooth headset	BH-200
	BH-300
	BH-600
	BH-301
	BH-302
	BH-801
	BH-202
	BH-700
	BH-800
	BH-900
	HS-26W
	BH-201
	BH-207
	BH-701
	BH-902
	BH-100
	BH-303
BH-208	
BH-602	
Bluetooth stereo headset	HS-12W
	BH-601
	BH-500
	BH-501
TTY adapter	HDA-12

Messaging

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

Music

Enhancement	Type
Music headphones	HS-61
Advanced music headphones	HS-62
Mini speaker	MD-4

Enhancement	Type
Music speaker	MD-3
Bluetooth speaker	MD-5W

Positioning

Enhancement	Type
Wireless GPS module	LD-3W

Car

Enhancement	Type
Wireless plug-in car handsfree	HF-6W
	HF-33W
	HF-34W
	HF-35W
Advanced car kit	CK-7W
	CK-15W
	CK-20W
	CK-25W
Car kit	Nokia 616
Universal holder	CR-82

■ Technical specifications

Transceiver general specifications

Unit	Dimensions (L x W x T) (mm)	Weight (g)	Volume (cm ³)
Transceiver with BP-6MT 1050 mAh li-ion battery	102 x 50 x 17.9	~140	88

Main RF characteristics for GSM850/EGSM900/GSM1800/GSM1900 and WCDMA phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900, or WCDMA2100
Rx frequency band	GSM850: 869 - 894MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA2100: 2110 - 2170 MHz

Parameter	Unit
Tx frequency band	GSM850: 824 - 849MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
	WCDMA2100: 1920 - 1980 MHz
Output power	GSM850: +5 ...+33dBm/3.2mW ... 2W
	GSM900: +5 ... +33dBm/3.2mW ... 2W
	GSM1800: +0 ... +30dBm/1.0mW ... 1W
	GSM1900: +0 ... +30dBm/1.0mW ... 1W
	WCDMA -50 ... 24 dBm
Number of RF channels	GSM850: 125
	GSM900: 175
	GSM1800: 375
	GSM1900: 299
Channel spacing	200 kHz
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16

Battery endurance

Battery	Talk time	Stand-by	Video call time	Music playback time
BP-6MT 1050 mAh	4.3h (GSM@29dBm) 3h (WCDMA@10dBm)	17days (GSM) 20days (WCDMA)	2.1h	10h

Note: Operation times may vary depending on radio access technology used, operator network configuration and usage.

Charging times

AC-5
1h20min

2 — Service Tools and Service Concepts

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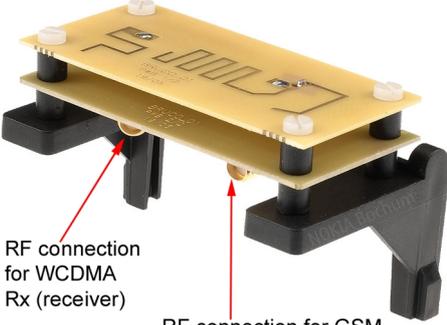
■ **Service tools**

Product specific tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-179; RM-223, refer to various concepts.

<p>FS-37</p> 	<p>FS-37</p>	<p>Flash adapter</p>	
<p>FS-37 is a product specific adapter for SW update and testing purposes. It is compatible to SS-62 and SS-46. It provides galvanic connection to terminal test pads and battery connector.</p>			

<p>MJ-114</p> 	MJ-114	Module jig																																													
<p>The module jig offers engine module component level repair, analysis and alignment capabilities in combination with CU-4.</p> <p>Features:</p> <ul style="list-style-type: none"> • connection interfaces for GSM, WCDMA, Bluetooth and WLAN antenna • galvanic connection to engine module test pads • multiplexing between USB and FBUS media, controlled by VUSB with CU-4 • lid interconnection with test points for measurements • connection to lid assembly incl. displays and earpiece • connector for e.g. CU-4 control unit • connection for BT / SIM / SD-card module <p>Note: There is one RF connection for GSM and WCDMA 2100 Tx (transmitter path) and one RF connection for WCDMA 2100 Rx (receiver path).</p> <ul style="list-style-type: none"> • Table 1 MJ-114 attenuation table <table border="1" data-bbox="598 922 1339 1512"> <thead> <tr> <th>Band (mid. ch.)</th> <th>Channel</th> <th>Frequency /MHz</th> <th>Attenuation Loss / dB</th> </tr> </thead> <tbody> <tr> <td>850 TX</td> <td>189</td> <td>836,6</td> <td>0,32</td> </tr> <tr> <td>850 RX</td> <td>189</td> <td>881,6</td> <td>0,3</td> </tr> <tr> <td>900 TX</td> <td>37</td> <td>897,4</td> <td>0,27</td> </tr> <tr> <td>900 RX</td> <td>37</td> <td>942,4</td> <td>0,32</td> </tr> <tr> <td>1800 TX</td> <td>700</td> <td>1747,8</td> <td>0,33</td> </tr> <tr> <td>1800 RX</td> <td>700</td> <td>1842,8</td> <td>0,4</td> </tr> <tr> <td>1900 TX</td> <td>661</td> <td>1880</td> <td>0,35</td> </tr> <tr> <td>1900 RX</td> <td>661</td> <td>1910</td> <td>0,4</td> </tr> <tr> <td>WCDMA TX</td> <td>9750</td> <td>1950</td> <td>0,4</td> </tr> <tr> <td>WCDMA RX</td> <td>10700</td> <td>2140</td> <td>0,4</td> </tr> </tbody> </table>				Band (mid. ch.)	Channel	Frequency /MHz	Attenuation Loss / dB	850 TX	189	836,6	0,32	850 RX	189	881,6	0,3	900 TX	37	897,4	0,27	900 RX	37	942,4	0,32	1800 TX	700	1747,8	0,33	1800 RX	700	1842,8	0,4	1900 TX	661	1880	0,35	1900 RX	661	1910	0,4	WCDMA TX	9750	1950	0,4	WCDMA RX	10700	2140	0,4
Band (mid. ch.)	Channel	Frequency /MHz	Attenuation Loss / dB																																												
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WCDMA TX	9750	1950	0,4																																												
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<p>RJ-130</p> 	RJ-130	Soldering jig																																													
<p>RJ-130 is a jig to support component level exchange with soldering machines for the engine module.</p>																																															

 <p>RF connection for WCDMA Rx (receiver)</p> <p>RF connection for GSM and WCDMA Tx (WCDMA 2100 transmitter path)</p> <p>Note: The unused port has to be terminated with 50 Ohm SMA termination, otherwise the attenuation table will not be valid.</p>	SA-113	RF coupler	
	<p>SA-113 is an RF coupler for WCDMA and GSM RF testing. It is used together with the product-specific flash adapter.</p> <p>For the attenuation values, see SA-113 attenuation values (page 2-7).</p>		

SA-113 attenuation values

The following table shows attenuations from the antenna pads of the mobile terminal to the SMA connectors of SA-113:

Band		Channel UP/DOWN	TX f [MHz]	RX f [MHz]	Slider OPEN		Slider CLOSE	
					TX Loss [dB]	RX Loss [dB]	TX Loss [dB]	RX Loss [dB]
GSM 850	Low	128	824.2	869.2	7.34	13.16	6.84	13.33
	Mid	189	836.4	881.4	6.47	12.07	5.90	12.04
	High	251	858.8	893.8	5.94	10.65	5.26	10.05
GSM 900	Low	975	880.2	925.2	11.76	6.45	10.52	5.44
	Mid	37	897.4	942.8	10.56	6.12	8.63	4.79
	High	124	915.8	960.8	4.31	6.48	4.13	4.93
GSM 1800	Low	512	1710.2	1805.2	11.82	19.03	10.61	18.03
	Mid	698	1747.4	1842.4	11.68	16.89	10.79	15.33
	High	885	1784.8	1879.8	12.24	14.88	11.19	13.16
GSM 1900	Low	512	1850.2	1930.2	12.15	12.06	11.05	11.32
	Mid	661	1880.0	1960.0	11.85	12.79	10.95	11.76
	High	810	1909.8	1989.8	11.93	13.20	11.35	11.89
WCDMA I	Low	9613 / 10563	1922.4	2112.4	17.60	16.82	17.47	15.21
	Mid	9750 / 10700	1950.0	2140.0	17.80	15.61	17.24	14.54
	High	9887 / 10837	1977.6	2167.6	17.82	15.77	17.19	15.20

General tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-179; RM-223, refer to various concepts.



CU-4

Control unit

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

The unit has the following features:

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

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

Instructions

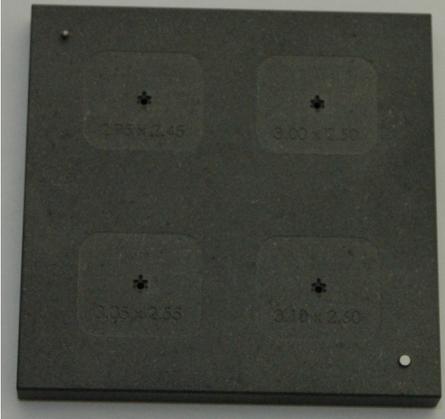
- 1 Connect a service tool (jig, flash adapter) to CU-4.
- 2 Connect CU-4 to your PC with a USB cable.
- 3 Connect supply voltage (12 V)
- 4 Connect an FBUS cable (if necessary).
- 5 Start Phoenix service software.

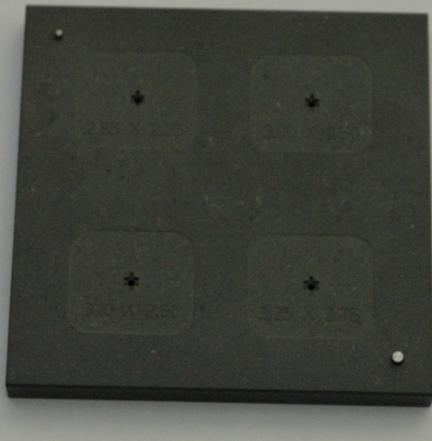
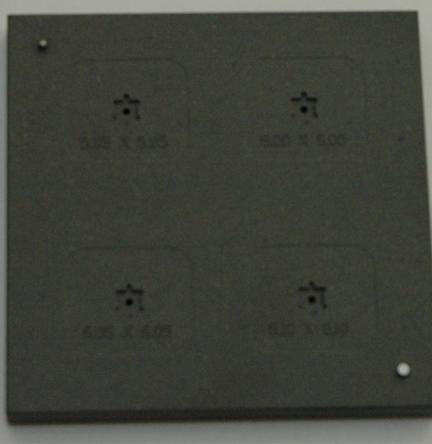


Note: Phoenix enables CU-4 regulators via USB when it is started.

Reconnecting the power supply requires a Phoenix restart.

	FLS-5	Flash device	
<p>FLS-5 is a dongle and flash device incorporated into one package, developed specifically for POS use.</p> <p>Note: FLS-5 can be used as an alternative to PKD-1.</p>			
	FPS-10	Flash prommer	
<p>FPS-10 interfaces with:</p> <ul style="list-style-type: none"> • PC • Control unit • Flash adapter • Smart card <p>FPS-10 flash prommer features:</p> <ul style="list-style-type: none"> • Flash functionality for BB5 and DCT-4 terminals • Smart Card reader for SX-2 or SX-4 • USB traffic forwarding • USB to FBUS/Flashbus conversion • LAN to FBUS/Flashbus and USB conversion • Vusb output switchable by PC command <p>FPS-10 sales package includes:</p> <ul style="list-style-type: none"> • FPS-10 prommer • Power Supply with 5 country specific cords • USB cable <p>Note: FPS-21 is substitute FPS-10 if FPS-10 has not been set up.</p>			
	JXS-1	RF shield box	
<p>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.</p> <p>The shield box is not an active device, it contains only passive filtering components for RF attenuation.</p>			

	<p>PK-1</p>	<p>Software protection key</p>	
	<p>PKD-1</p>	<p>SW security device</p>	
	<p>RJ-104</p>	<p>Rework jig</p>	
	<p>RJ-157</p>	<p>Rework jig</p>	
			<p>RJ-157 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-55 stencil.</p>

	RJ-160	Rework jig	
<p>RJ-160 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-55 stencil.</p>			
	RJ-169	Rework jig	
<p>RJ-169 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-59 stencil.</p>			
	RJ-93	Rework jig	
<p>RJ-93 is used as a rework jig for the Front End Module (FEM). This rework jig takes the FEM or power amplifier (PA) module (N7520) for spreading the soldering paste to the component. Must be used together with the ST-40 stencil.</p>			
	SB-6	Bluetooth test and interface box (sales package)	
<p>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 .</p> <p>Sales package includes:</p> <ul style="list-style-type: none"> • SB-6 test box • Installation and warranty information 			

 <p>The image shows a black rectangular tool with a blue handle at the top. A white label on the tool reads 'NOKIA SPS-1 0710301 01-10-0191 MADE IN FINLAND'.</p>	SPS-1	Soldering Paste Spreader	
<p>The SPS-1 allows spreading of solder to the LGA components pads over the rework stencils.</p>			
 <p>The image shows a blue, triangular-shaped plastic tool with a circular indentation on its top surface.</p>	SRT-6	Opening tool	
<p>SRT-6 is used to open phone covers.</p>			
 <p>The image shows a black plastic interface adapter with a gold-plated connector on one side and various ports on the other.</p>	SS-46	Interface adapter	
<p>SS-46 acts as an interface adapter between the flash adapter and FPS-10.</p>			
 <p>The image shows a black plastic base for a flash adapter, featuring a green strip and several clips.</p>	SS-62	Generic flash adapter base for BB5	
<ul style="list-style-type: none"> • generic base for flash adapters and couplers • SS-62 equipped with a clip interlock system • provides standardised interface towards Control Unit • provides RF connection using galvanic connector or coupler • multiplexing between USB and FBUS media, controlled by VUSB 			

	ST-37	BTHFM rework stencil	
<p>ST-37 stencil is used with the RJ-104 rework jig to service the BTHFM (D6000) module.</p>			
	ST-40	Rework stencil	
<p>ST-40 is a rework stencil that is used with the RJ-93 rework jig to service the Front End Module (N7520).</p>			
	ST-55	Rework stencil	
<p>ST-55 is a rework stencil used with rework jig RJ-157 and RJ-160.</p>			
	ST-59	Rework stencil	
<p>ST-59 is a rework stencil used with rework jig RJ-169.</p>			
	SX-4	Smart card	
<p>SX-4 is a BB5 security device used to protect critical features in tuning and testing. SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed.</p>			

Cables

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-179; RM-223, refer to various concepts.

 <p>CA-101 100cm</p>	CA-101	Micro USB cable	
<p>The CA-101 is a USB-to-microUSB data cable that allows connections between the PC and the phone.</p>			
	CA-35S	Power cable	
<p>CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter.</p>			
	CA-58RS	RF tuning cable	
<p>RF tuning cable for use with a flash adapter. CA-58RS RF cable extends adapter features to allow RF function tests and RF tuning in GSM bands.</p> <p>Features include:</p> <ul style="list-style-type: none"> • easy to use together with flash adapter or even stand alone • most accurate RF connection to phone module under test • most accurate RF connection to phone module under test • low attenuation and small “ripple” over the width of each GSM band <p>Note: The RF cable must be used for RF tuning.</p>			

	<p>DAU-9S</p>	<p>MBUS cable</p>	
<p>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.</p> <p>Note: Docking station adapters valid for DCT4 products.</p>			
	<p>PCS-1</p>	<p>Power cable</p>	
<p>The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.</p>			
	<p>XCS-4</p>	<p>Modular cable</p>	
<p>XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.</p>			
	<p>XRF-1</p>	<p>RF cable</p>	
<p>The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.</p> <p>SMA to N-Connector ca. 610mm.</p> <p>Attenuation for:</p> <ul style="list-style-type: none"> • GSM850/900: 0.3+-0.1 dB • GSM1800/1900: 0.5+-0.1 dB • WLAN: 0.6+-0.1dB 			

■ Service concepts

POS (Point of Sale) flash concept

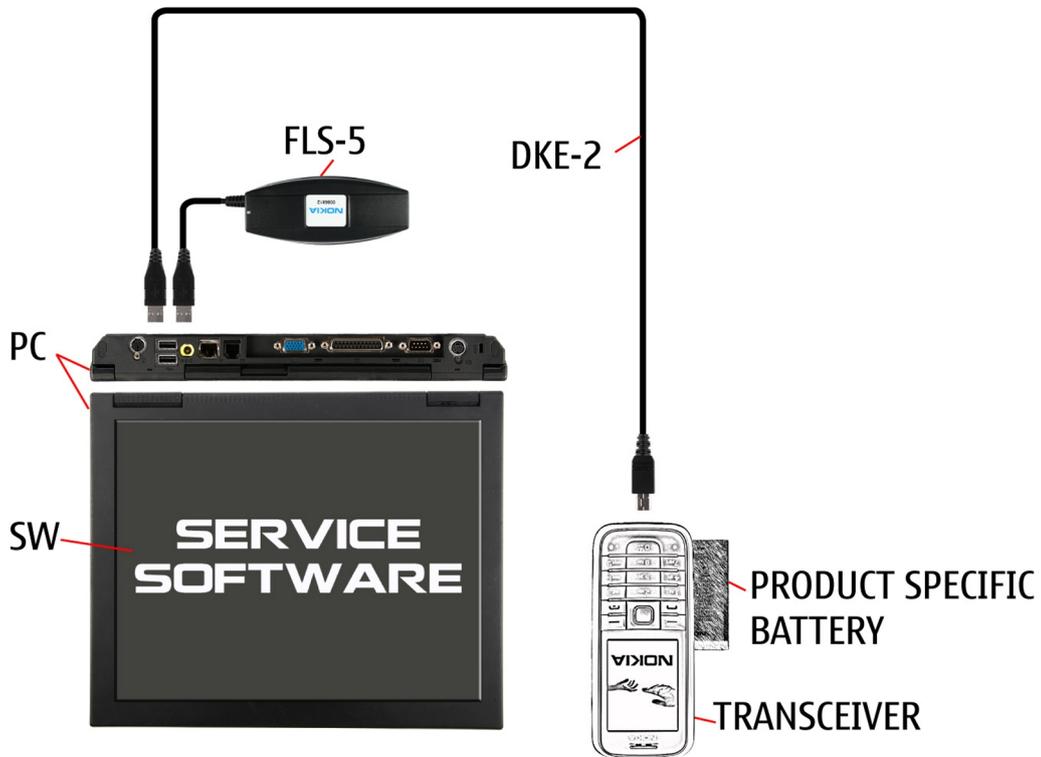


Figure 3 POS flash concept

Type	Description
Product specific tools	
BP-6MT	Battery
Other tools	
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
DKE-2	USB connectivity cable

Flash concept with FPS-10

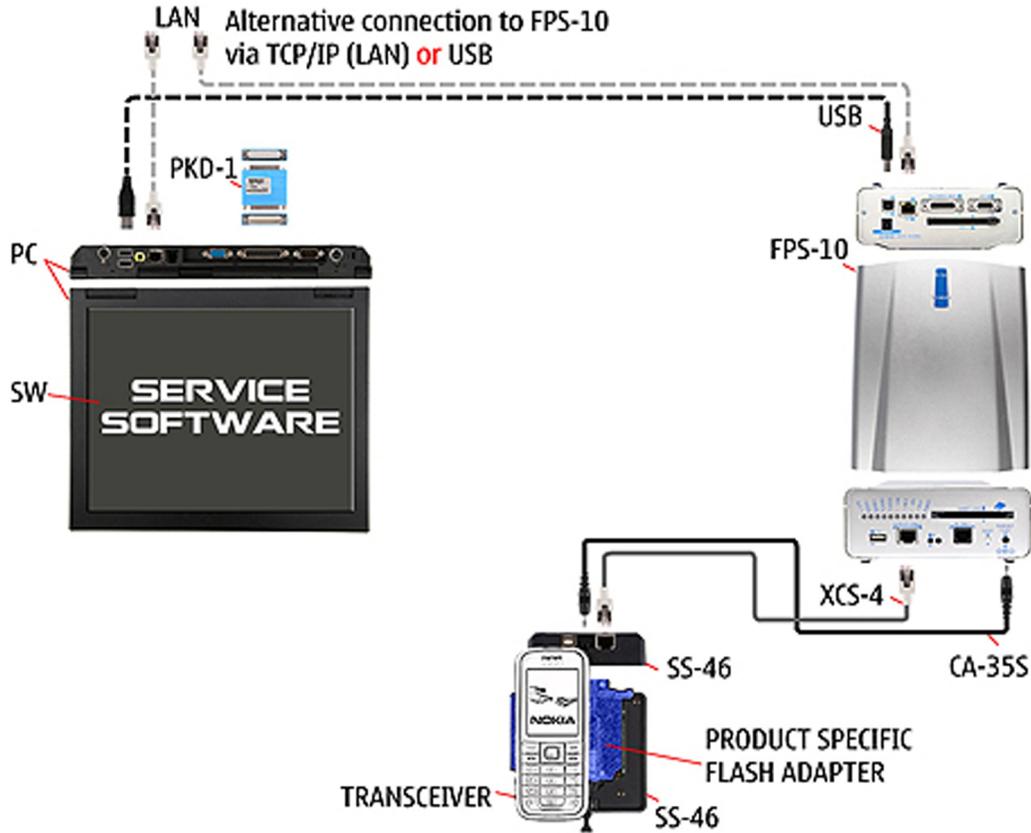


Figure 4 Basic flash concept with FPS-10

Type	Description
Product specific devices	
FS-37	Flash adapter
Other devices	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable
	USB cable

Flash concept with FLS-5 and SS-46

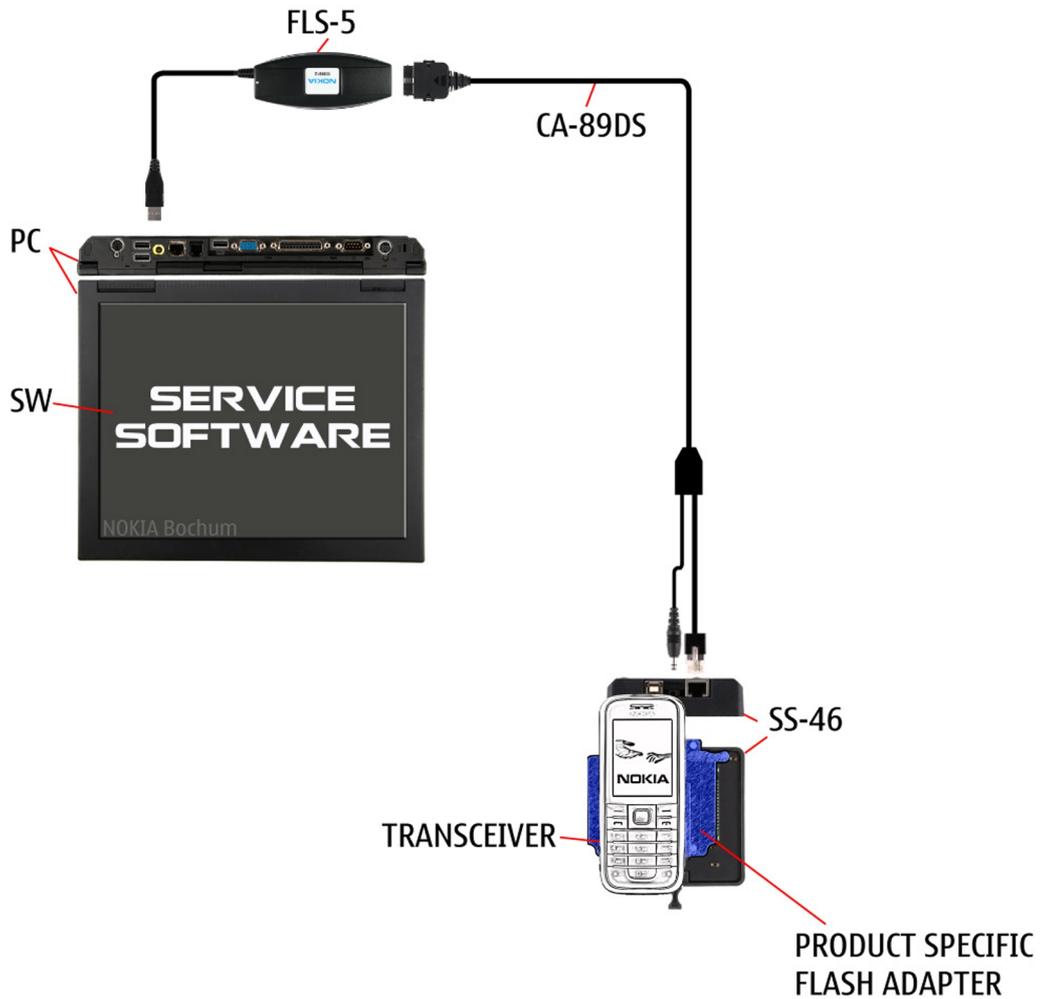


Figure 5 Flash concept with FLS-5 and SS-46

Type	Description
Product specific tools	
FS-37	Flash adapter
Other tools	
FLS-5	POS flash dongle
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
CA-89DS	Cable

CU-4 flash concept with FPS-10

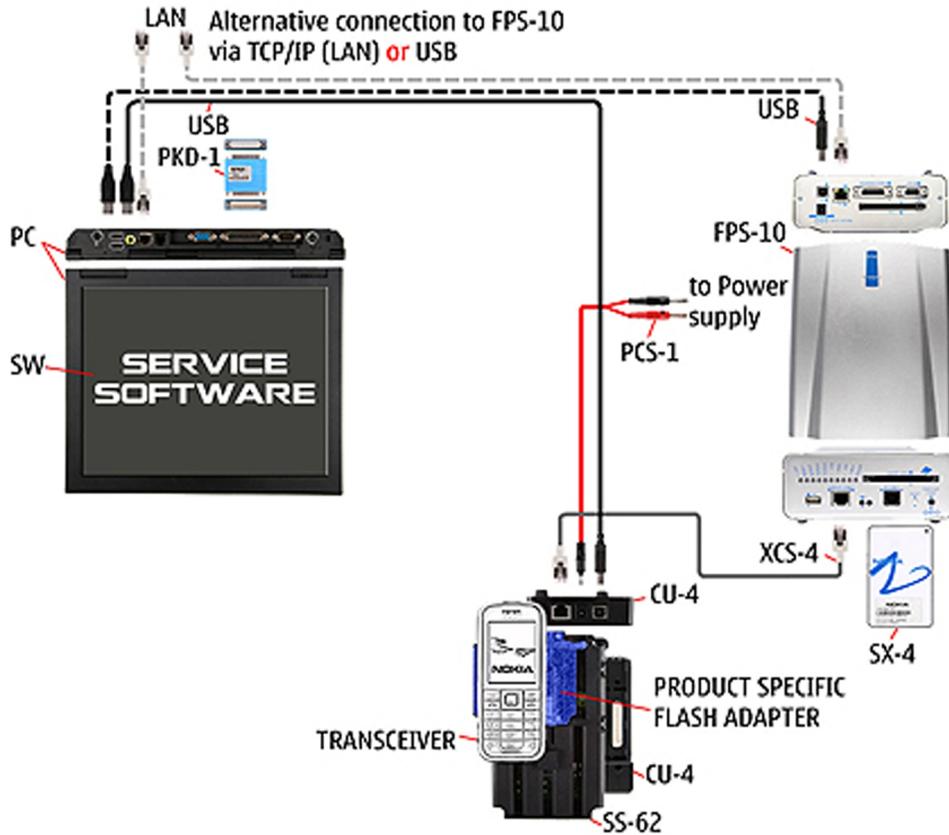


Figure 6 CU-4 flash concept with FPS-10

Type	Description
Product specific devices	
FS-37	Flash adapter
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	
PCS-1	Power cable
XCS-4	Modular cable
	Standard USB cable
	USB cable

Flash concept with FLS-5 and SS-62

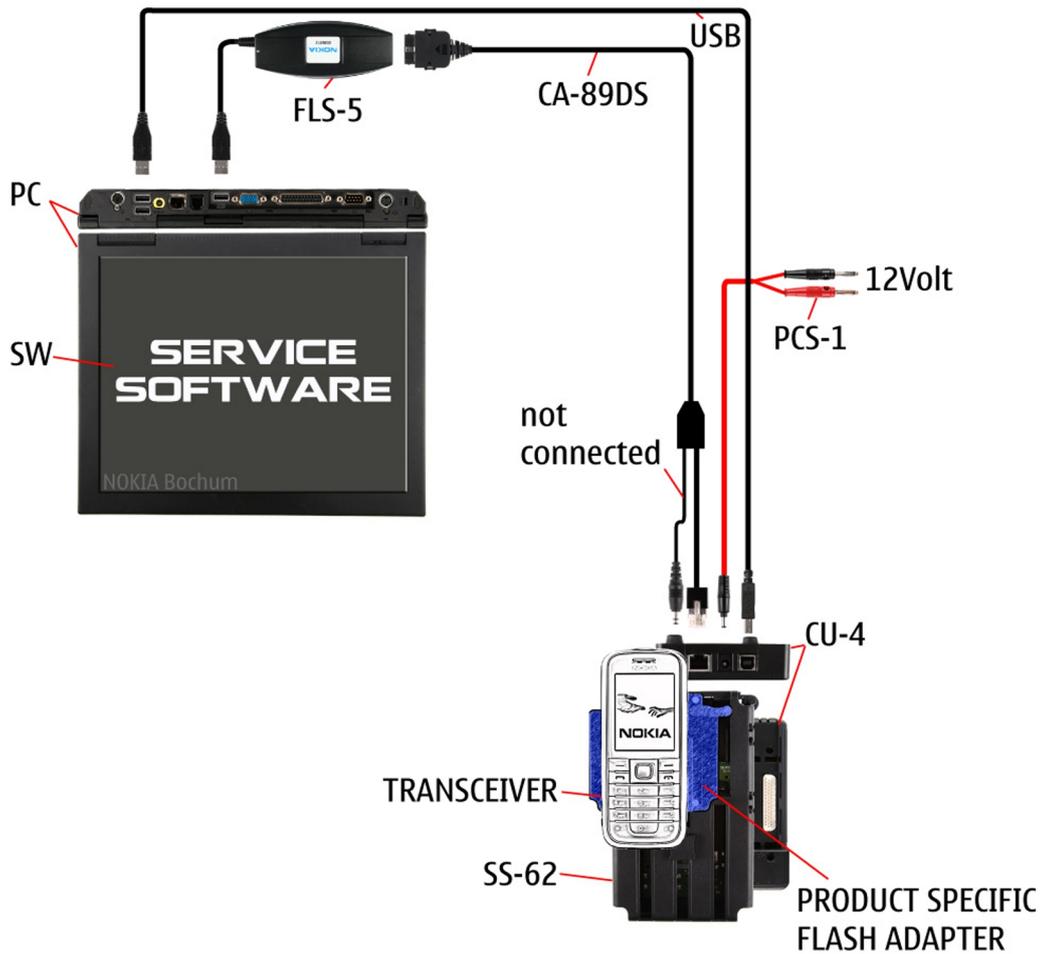


Figure 7 Basic flash concept with FLS-5 and SS-62

Type	Description
Product specific tools	
FS-37	Flash adapter
Other tools	
CU-4	Control unit
FLS-5	POS flash dongle
SS-62	Flash adapter base
	PC with Phoenix service software
Cables	
CA-89DS	Cable
PCS-1	Power cable
	Standard USB cable
	USB cable

Flash concept with FLS-5 and module jig

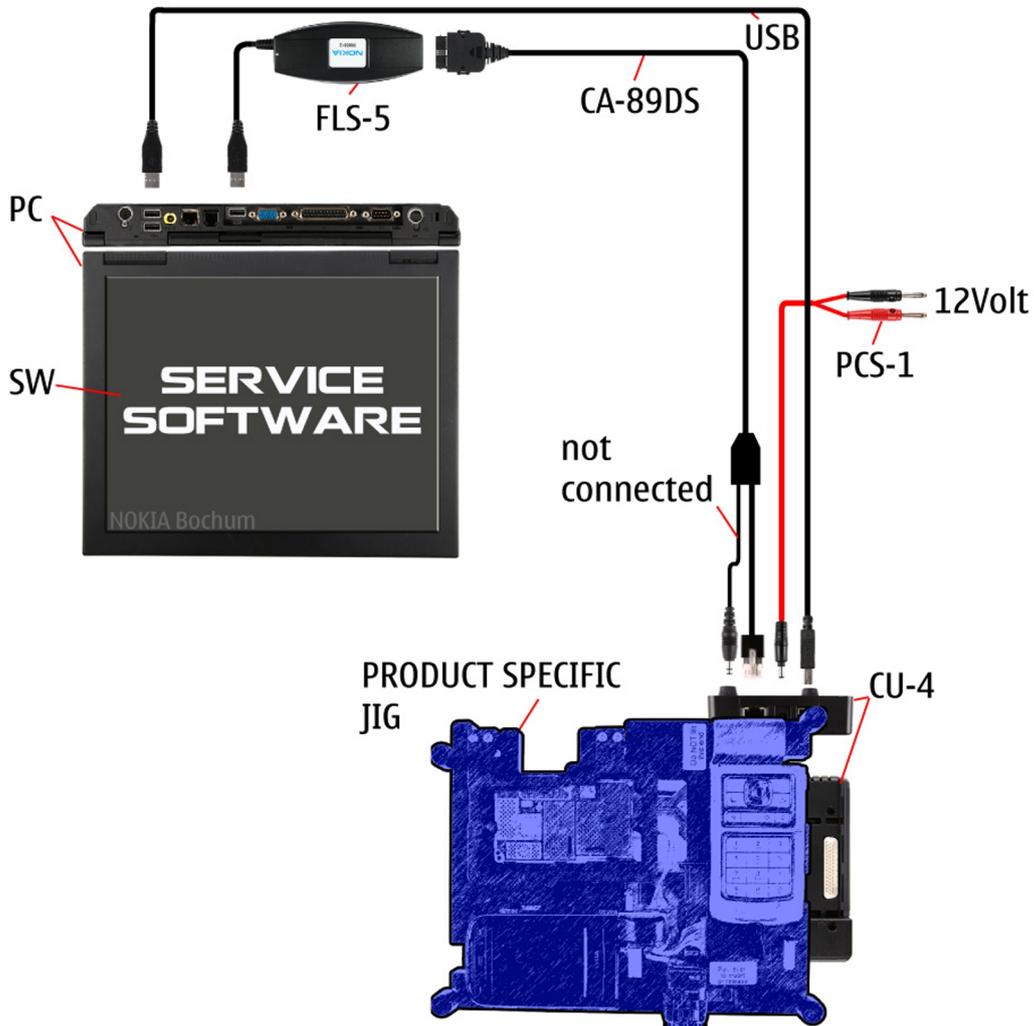


Figure 8 Flash concept with FLS-5 and module jig

Type	Description
Product specific tools	
MJ-114	Module jig
Other tools	
CU-4	Control unit
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
CA-89DS	Cable
PCS-1	DC power cable
	USB cable

Module jig service concept

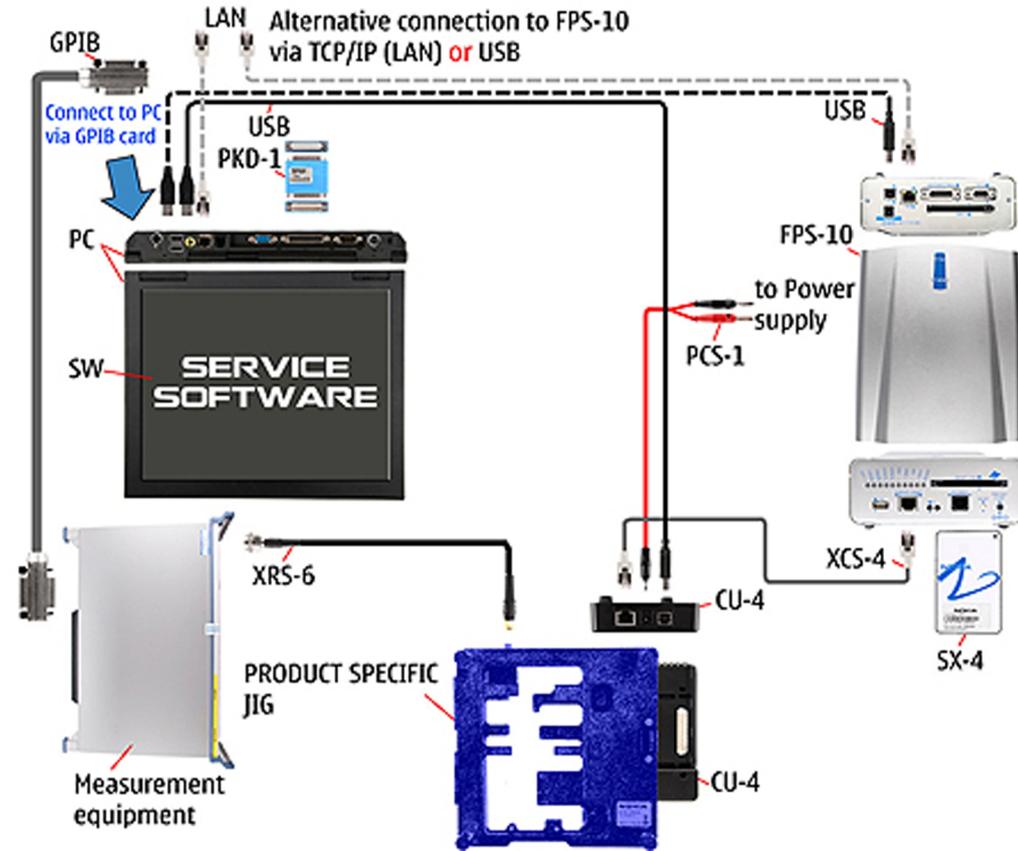


Figure 9 Module jig service concept

Type	Description
Phone specific devices	
MJ-114	Module jig
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SX-4	Smart card
	PC with VPOS and Phoenix service software
	Measurement equipment
Cables	
PCS-1	DC power cable
XCS-4	Modular cable
XRF-1	RF cable
	USB cable

Type	Description
	GPIB control cable

Service concept for RF testing and RF/BB tuning

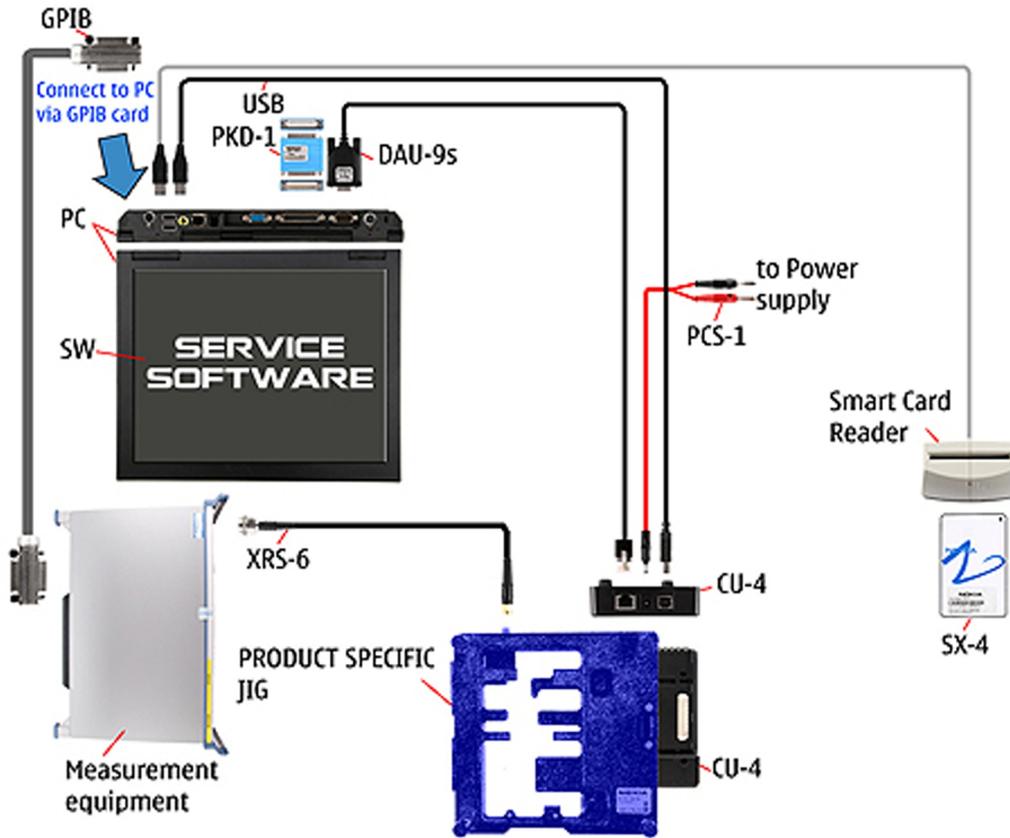


Figure 10 Service concept for RF testing and RF/BB tuning

Type	Description
Product specific devices	
MJ-114	Module jig
Other devices	
CU-4	Control unit
PKD-1/PK-1	SW security device
SX-4	Smart card
	Measurement equipment
	Smart card reader
	PC with Phoenix service software
Cables	
DAU-9S	MBUS cable
PCS-1	DC power cable

Type	Description
XRS-6	RF cable
	GPIB control cable
	USB cable

RF testing / BB tuning concept

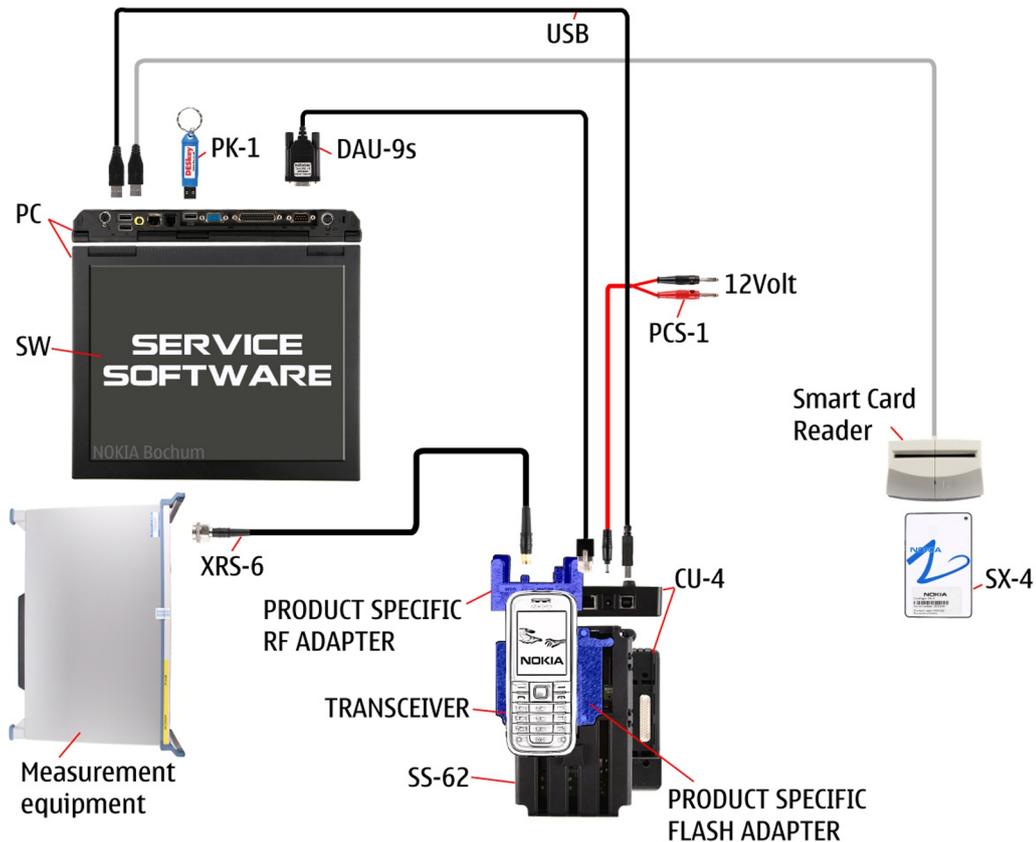


Figure 11 RF testing / BB tuning concept

Type	Description
Product specific tools	
FS-37	Flash adapter
SA-113	RF coupler
Other tools	
CU-4	Control unit
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card
	Measurement equipment
	Smart card reader
	PC with Phoenix service software

Type	Description
Cables	
DAU-9s	MBUS cable
PCS-1	DC power cable
XRS-6	RF cable
	USB cable

RF/BB tuning and flashing with FPS-10

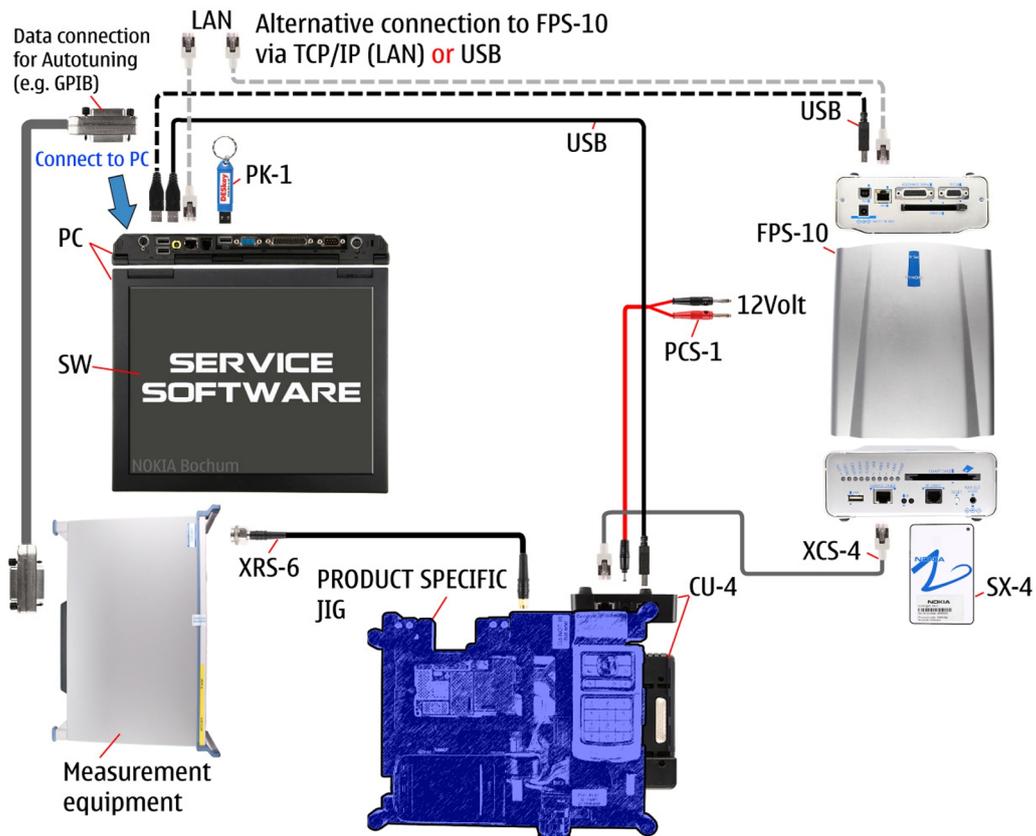


Figure 12 RF/BB tuning and flashing with FPS-10

Type	Description
Product specific tools	
MJ-114	Module jig
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SX-4	Smart card
	Measurement equipment
	PC with Phoenix service software

Type	Description
Cables	
PCS-1	DC power cable
XCS-4	Modular cable
XRS-6	RF cable
	USB cable

RF/BB tuning and flashing with FLS-5

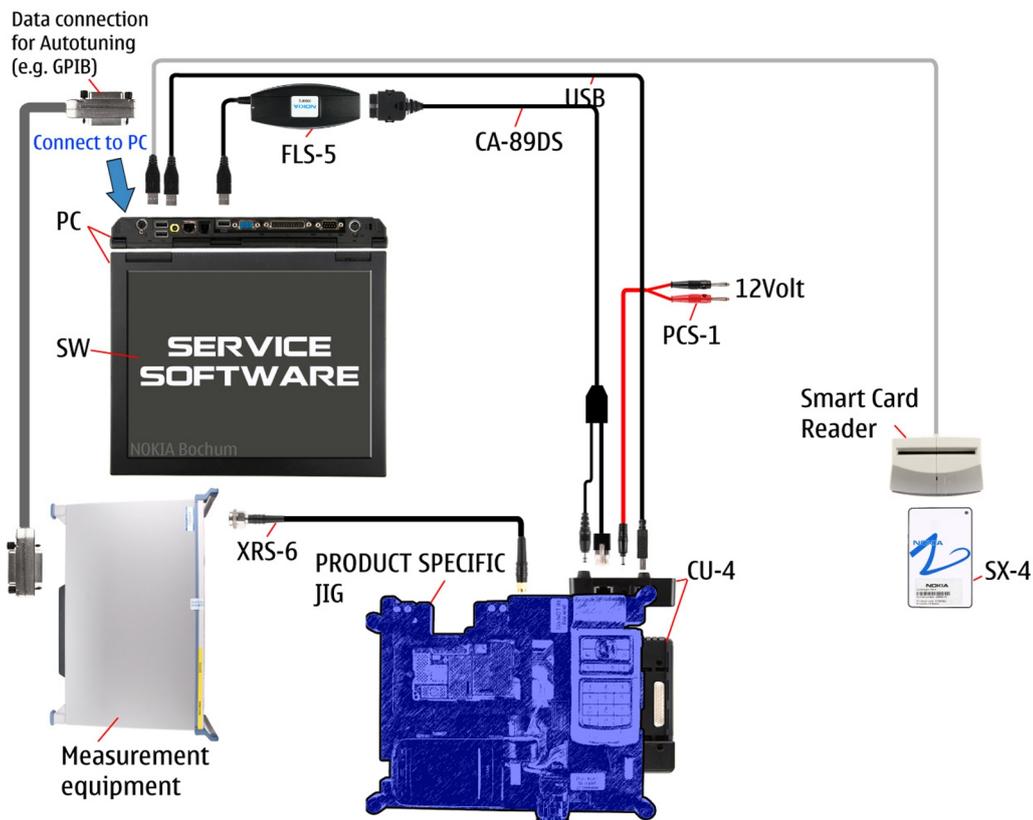


Figure 13 RF/BB tuning and flashing with FLS-5

Type	Description
Product specific tools	
MJ-114	Module jig
Other tools	
CU-4	Control unit
FLS-5	POS flash dongle
PKD-1/PK-1	SW security device
SX-4	Smart card
	Measurement equipment
	PC with Phoenix service software

Type	Description
	Smart card reader
Cables	
CA-89DS	Cable
PCS-1	DC power cable
XRS-6	RF cable
	USB cable

Bluetooth test concept with SB-6

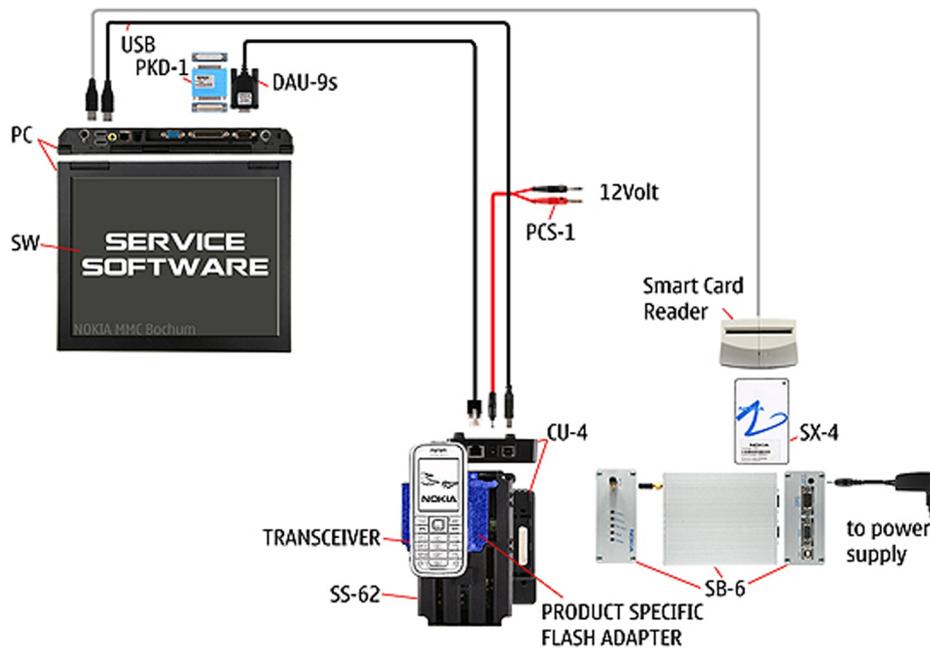


Figure 14 Bluetooth test concept with SB-6

Type	Description
Product specific tools	
FS-37	Flash adapter
Other tools	
CU-4	Control unit
PKD-1	SW Security device
SS-62	Generic base adapter
SB-6	BT test box
ACP-8	Charger for SB-6
Cables	
PCS-1	Power cable
DAU-9S	Cable

Type	Description
PCS-1	DC power cable
	Standard USB cable

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Nokia Customer Care

3 — Baseband Troubleshooting

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Figure 27 Single-ended output waveform of the HP_in_Ext_out loop. 3-44

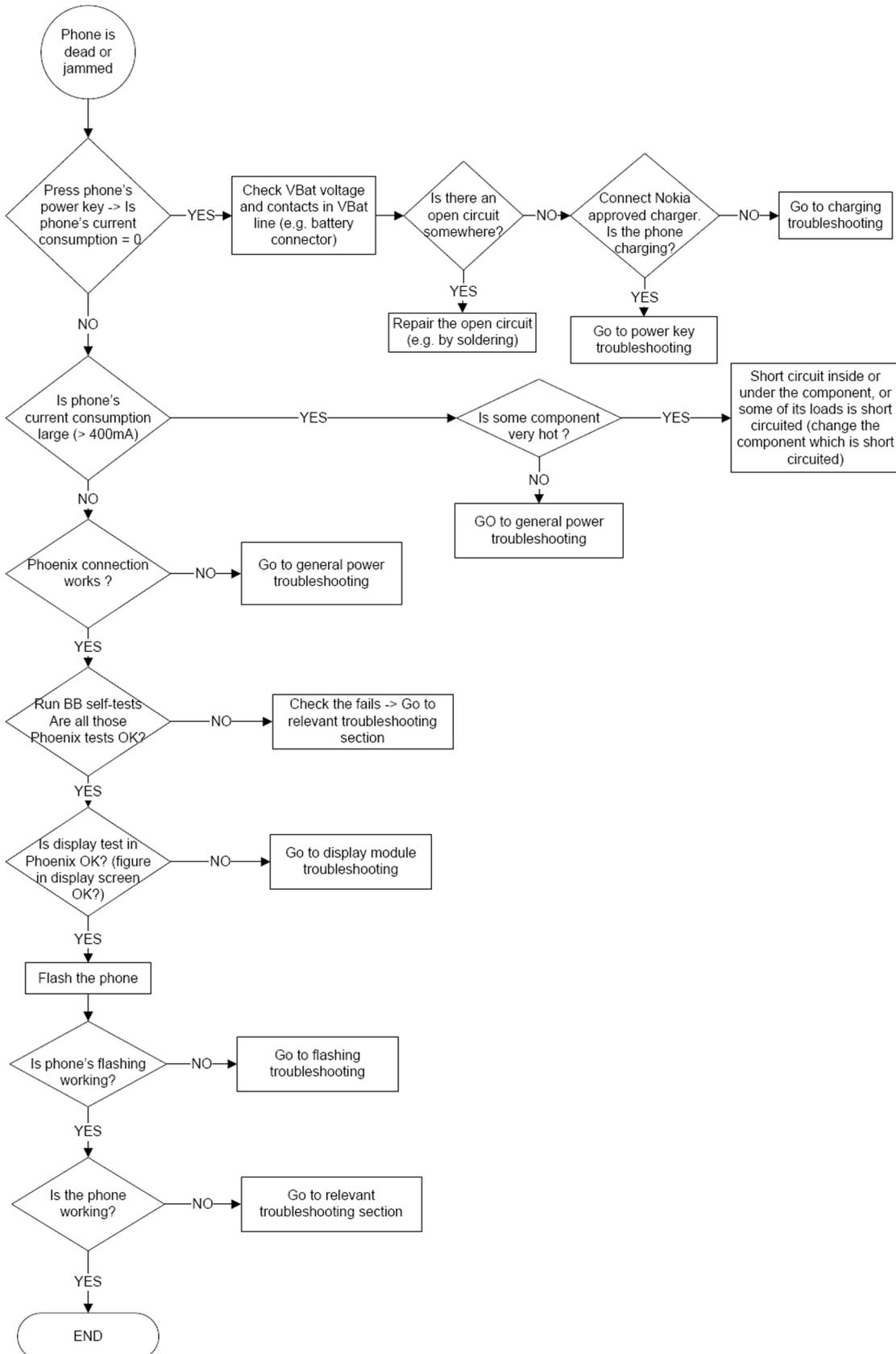
■ Troubleshooting overview

For practical reasons, troubleshooting is divided into two sections;

- Baseband troubleshooting, including camera, FM radio and Bluetooth.
- RF troubleshooting

■ Dead or jammed device troubleshooting

Troubleshooting flow



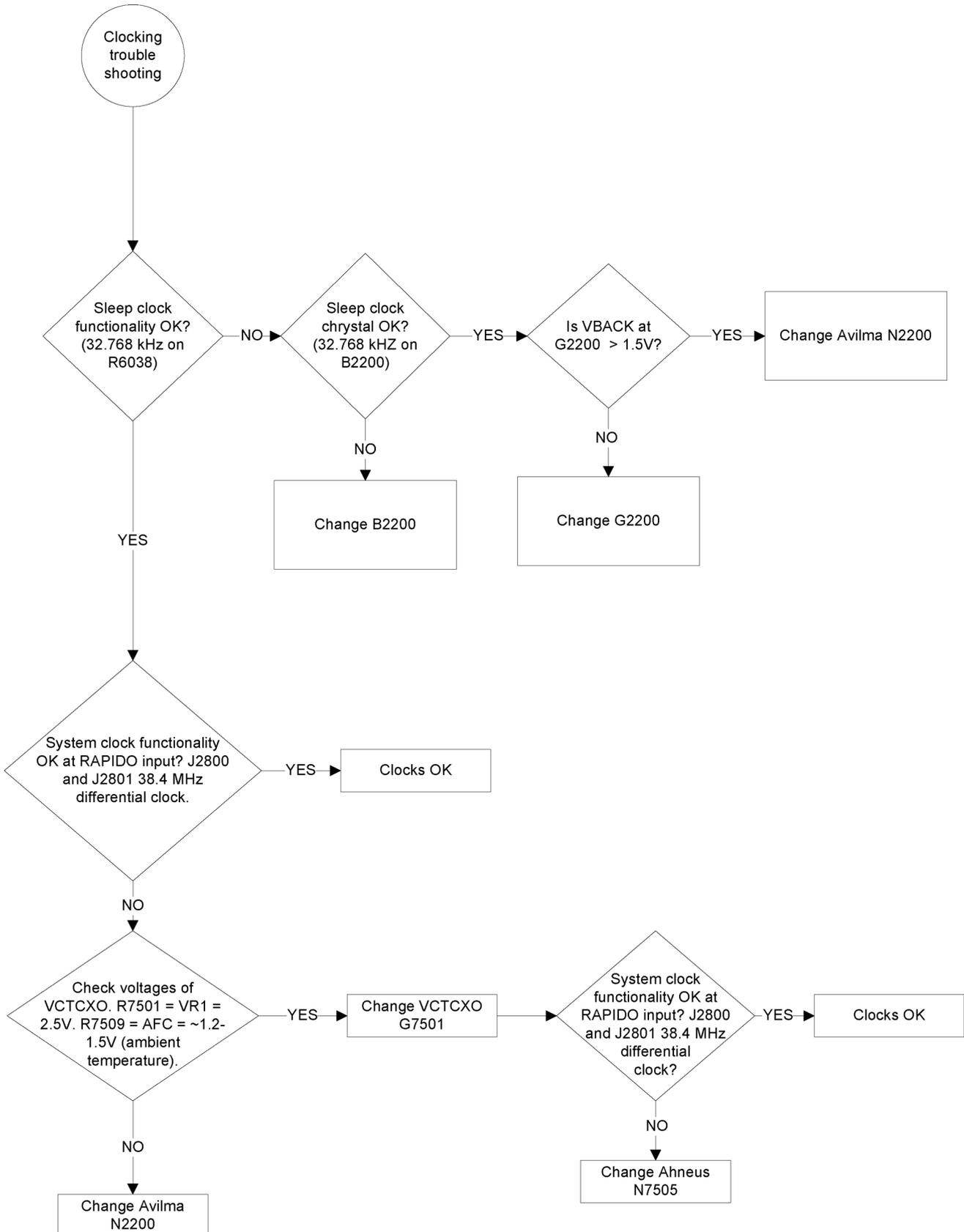
■ **General power checking**

Check the following voltages:

Signal name	Regulator	Sleep	Idle	Nominal voltage	Main user	Notes	Supply
VIO	External SMPS N2201	ON	ON	1.82	Displays, I/Os		
VBACK	AVILMA	ON	ON	2.6	Back-up battery		
VSIM1							
VSIM2	AVILMA	ON	ON				VBAT3
VDRAM	External SMPS N2201	ON	ON	1.82	SDRAM		
VAUX	AVILMA	OFF	OFF	2.78	FM radio, ALS, MR sensor, displays		VBAT5
VANA	AVILMA	ON	ON	2.5	AVILMA		VBAT4
VR1	AVILMA	OFF	ON	2.5	Crystal oscillators		VBAT4
VRFC	AVILMA	ON	OFF	1.8	RAPIDO converters		
VRCP1	AVILMA			4.75	To RF parts	RF active	VBATCP
VRCP2	AVILMA			4.75			VBATCP
VREF	AVILMA	ON	ON	1.35	RF reference		
VCORE	External SMPS N2390	ON	ON	1.35/1.05 on sleep	RAPIDO digital core		
VOUT	BETTY	OFF	OFF	2.5	Audio switch		
VCAMANA	External LDO N2501			2.8	Camera		
VCAMDIG	External SMPS N2500			1.8	Camera, STV984		
LEDOUT	External SMPS N2301			< 18	Display backlight	According to Regulator spec	
VSD	SD levelshifter			2.9	MicroSD card		
VIO_VILMA	AVILMA	ON	ON	1.82	Audio, BT		

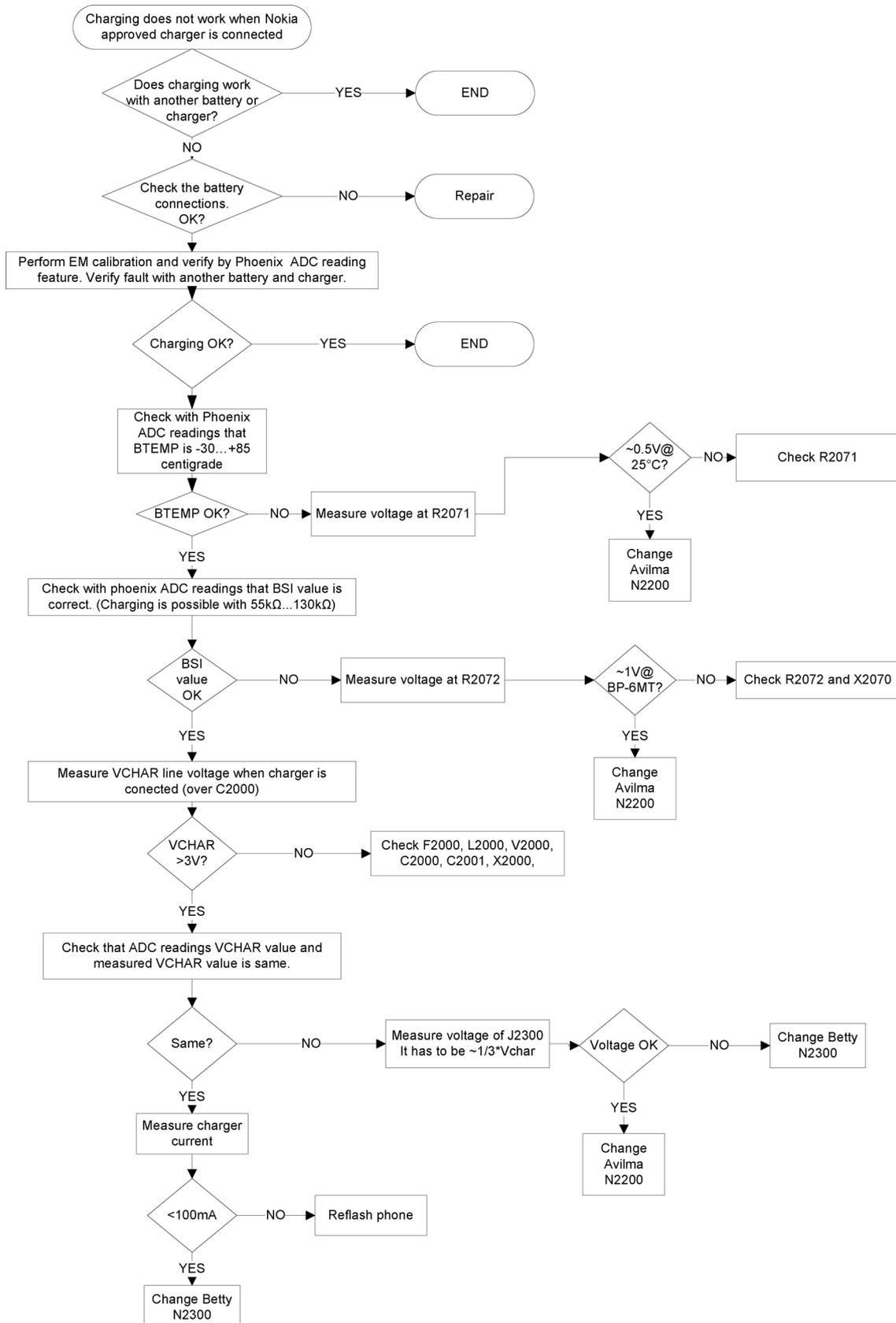
■ **Clocking troubleshooting**

Troubleshooting flow



■ Charging troubleshooting

Troubleshooting flow



Backup battery troubleshooting

Verify that the backup battery is empty ($U < 1V$). Switch the phone on. Measure voltage of the battery when the main battery is connected to the phone and the phone is switched on.

Wait a few minutes and monitor that the backup battery voltage rises. Switch off the phone, disconnect the main battery and monitor that the voltage of the backup battery decreases. Normal behaviour of the voltage is described in the figures below.

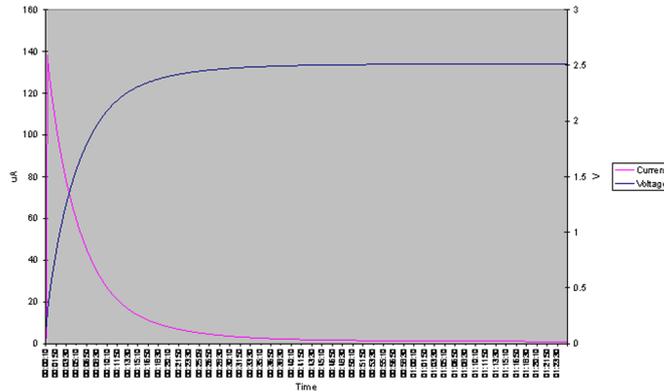


Figure 15 Charging backup battery

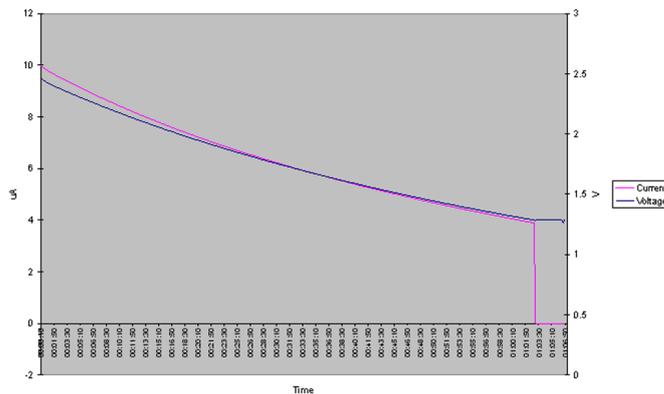
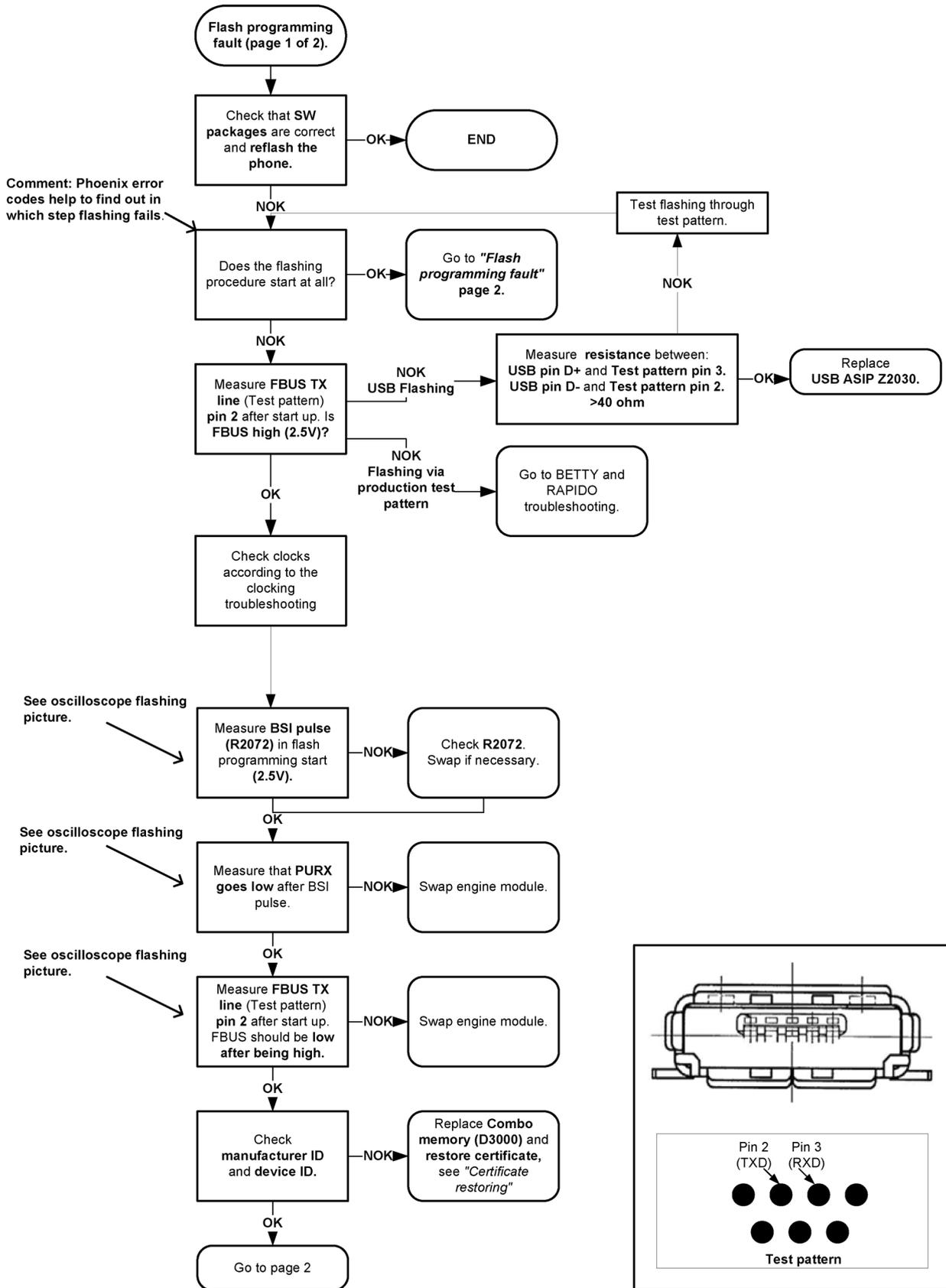


Figure 16 Discharging backup battery

If the voltage rises and falls quickly, check whether either G2200 or C2233 is broken or short-circuited. Backup battery can be also dead. If the voltage stays $\sim 0V$, check resistance VBACK against GND. If there is no short circuit, AVILMA is faulty. Replace AVILMA.

Flash programming fault troubleshooting

Part 1



Part 2

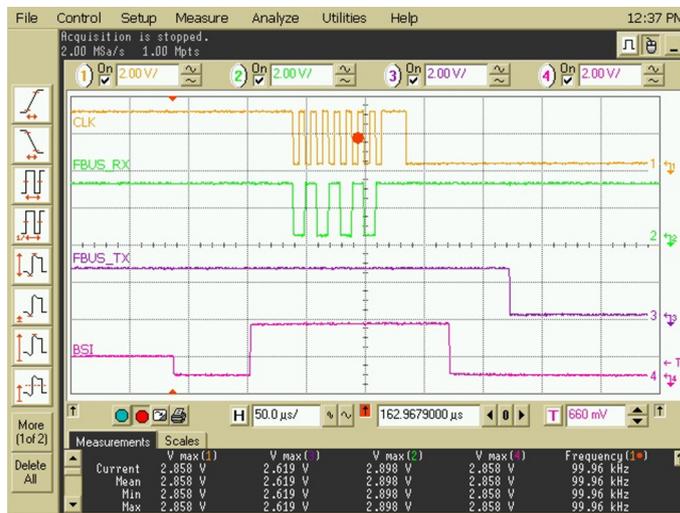
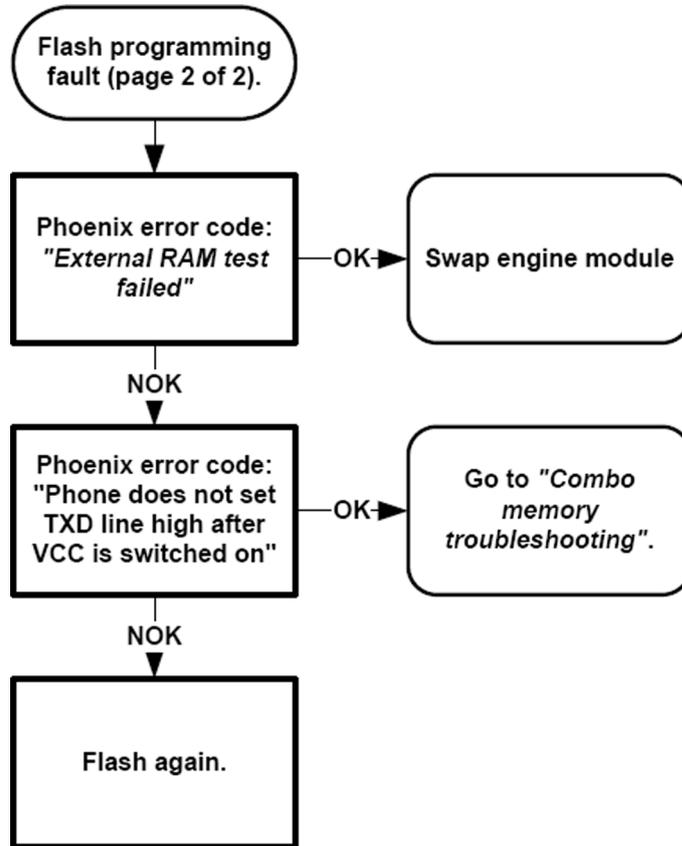
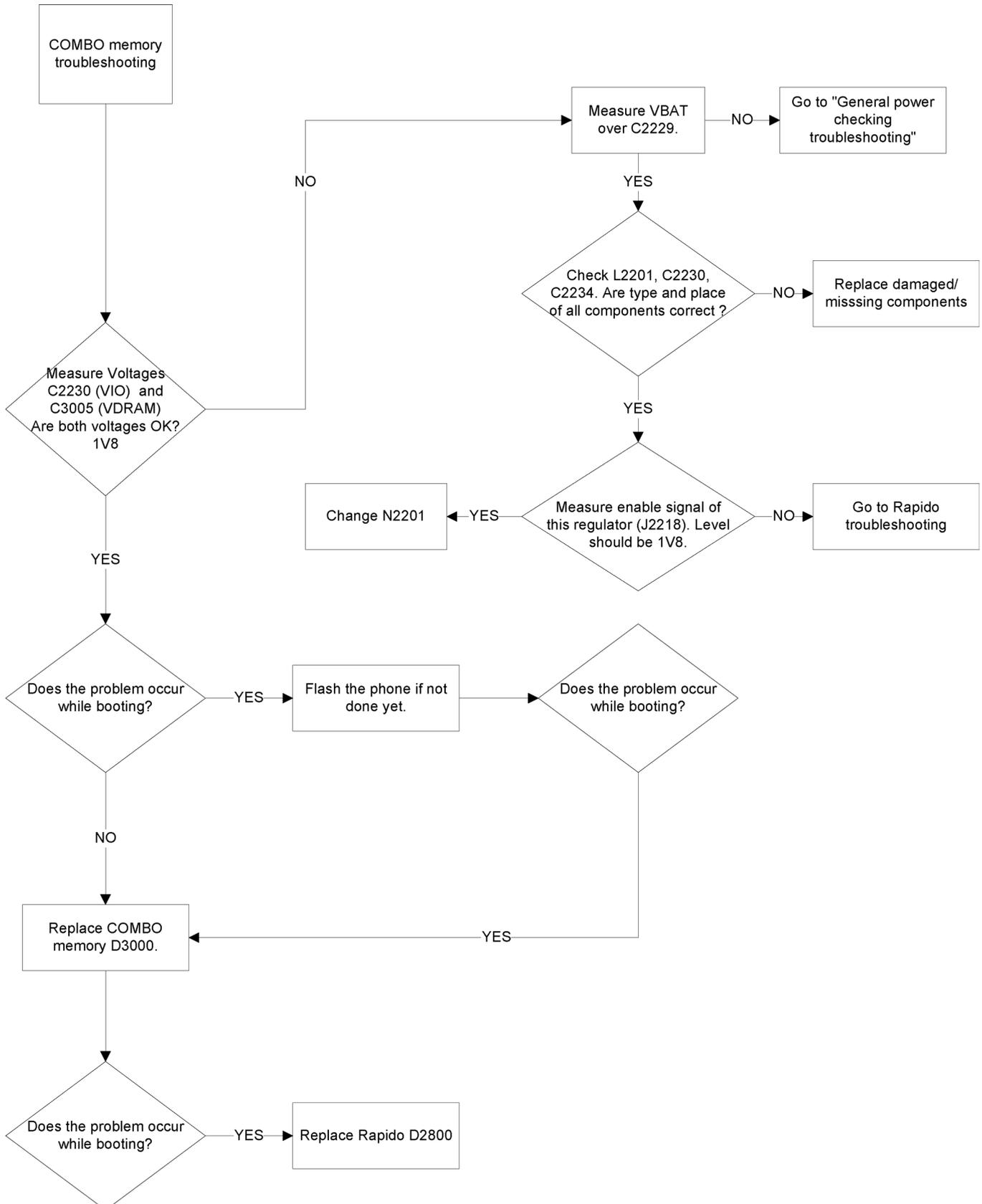


Figure 17 Take single trig measurement for the rise of the BSI signal.

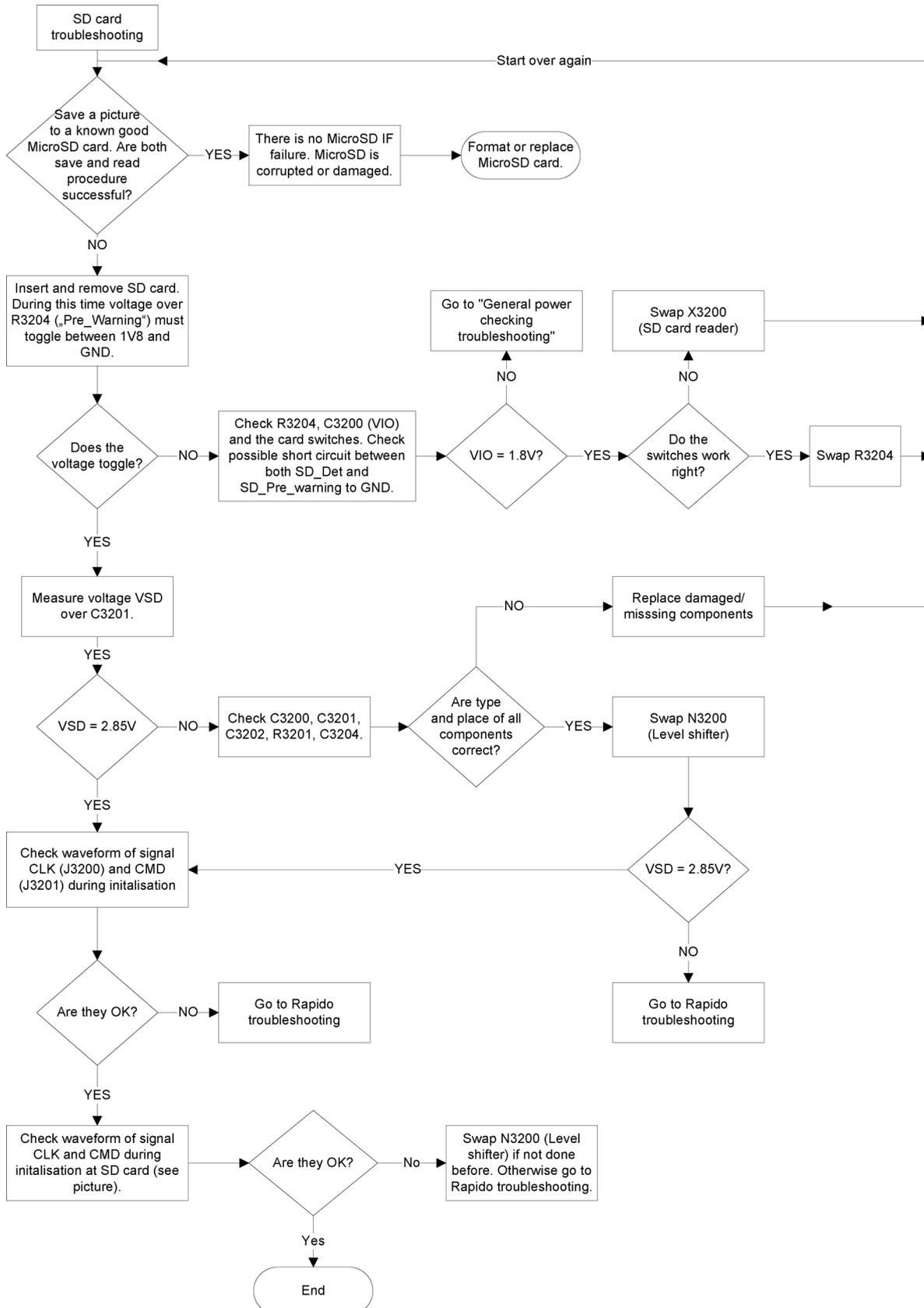
■ **Combo memory troubleshooting**

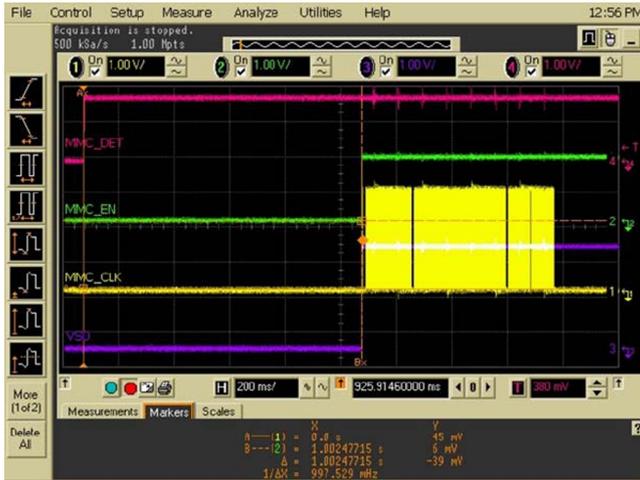
Troubleshooting flow



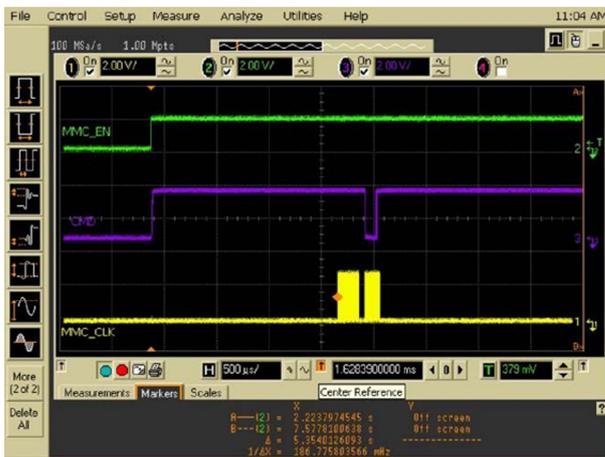
■ **MicroSD card troubleshooting**

Troubleshooting flow





MicroSD interface signals timing when door is closed.



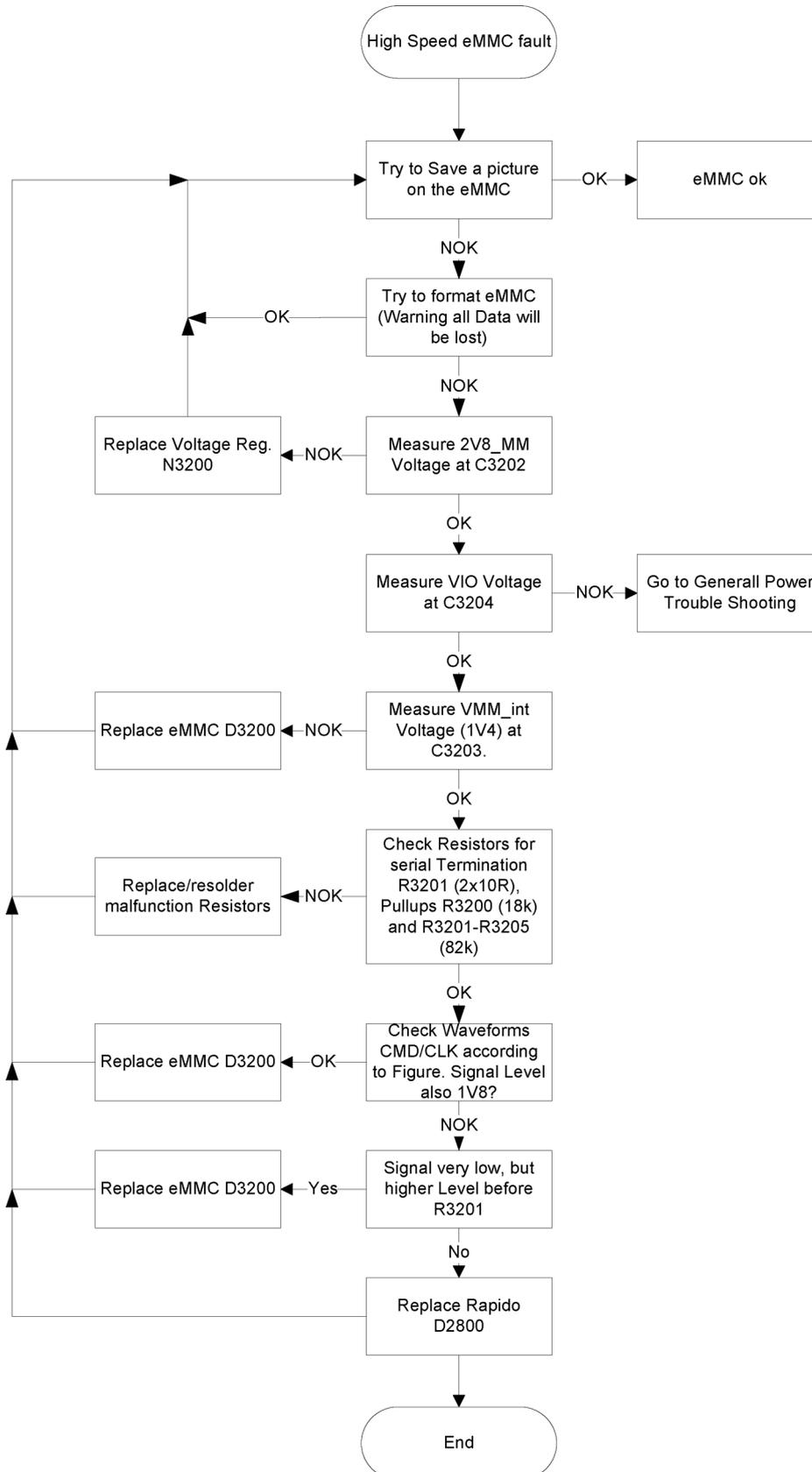
CLK and CMD signals during card initialisation when card is not inserted. Measured from the microSD connector.



CLK and CMD signals during card initialisation when card is not inserted. Measured from the microSD connector

■ **EMMC troubleshooting**

Troubleshooting flow



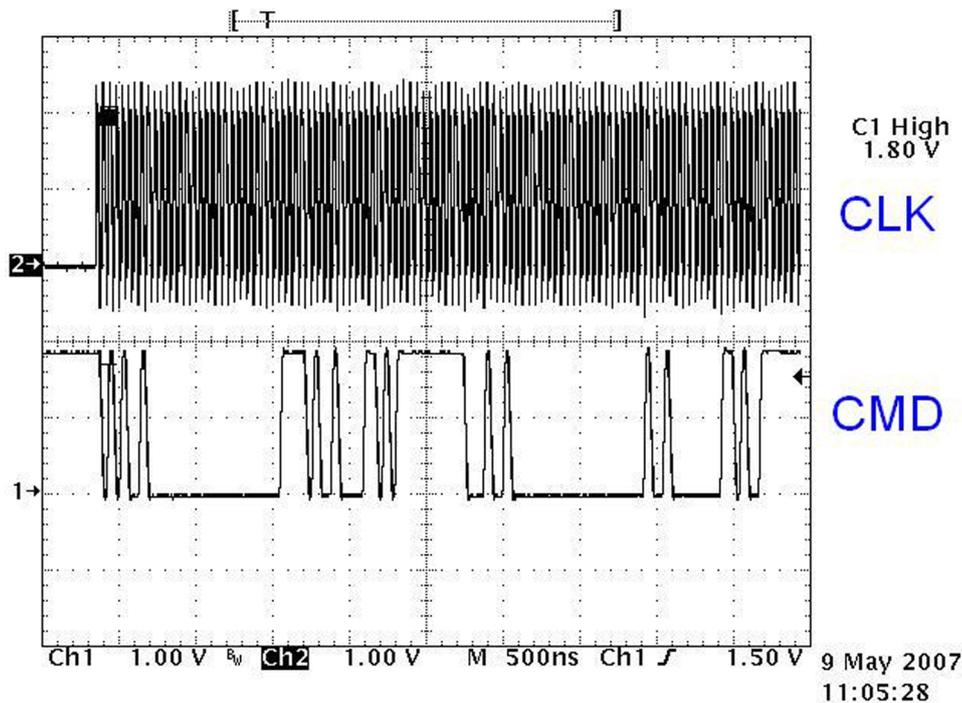
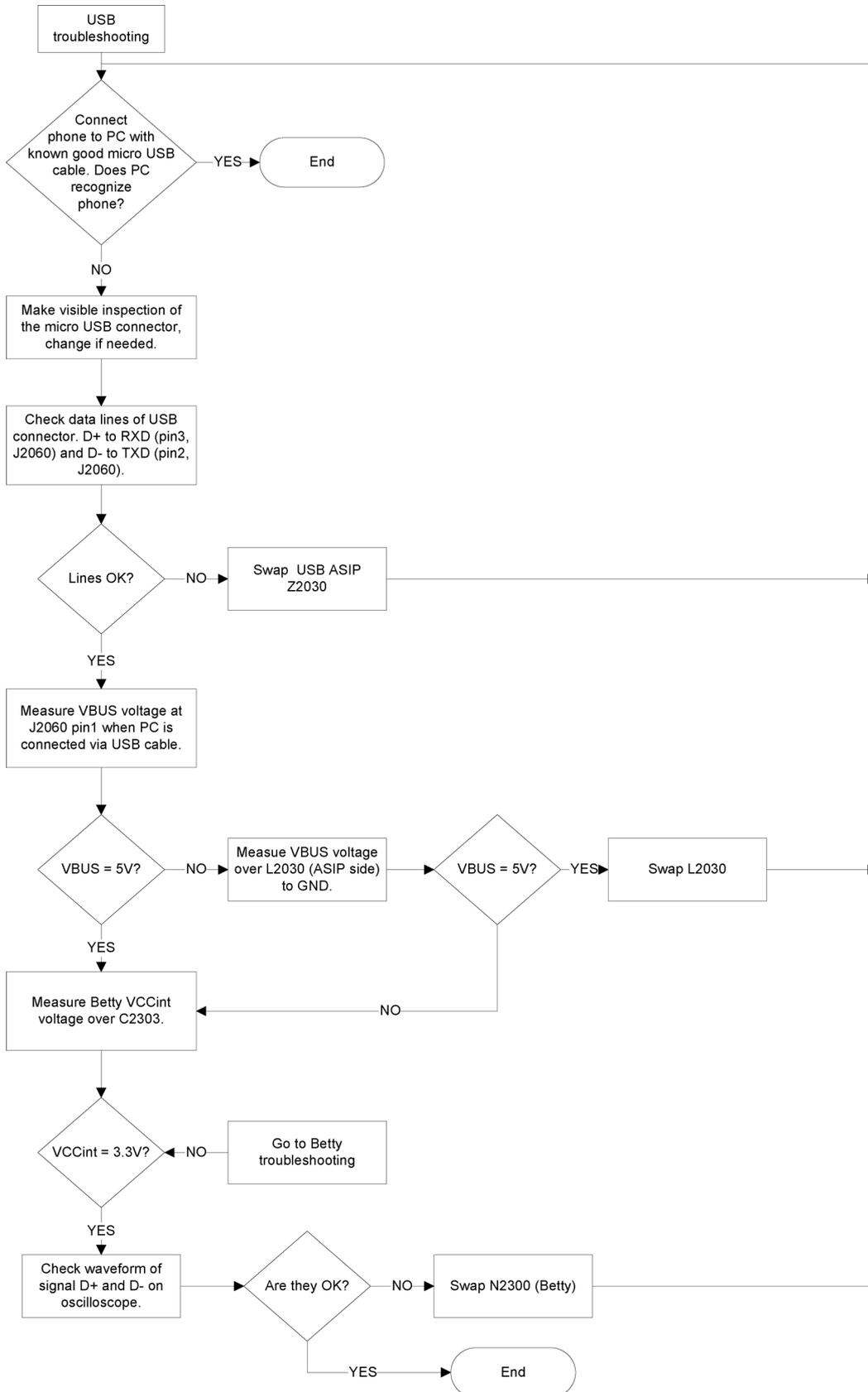


Figure 18 EMMC initialise

■ **USB interface troubleshooting**

Troubleshooting flow



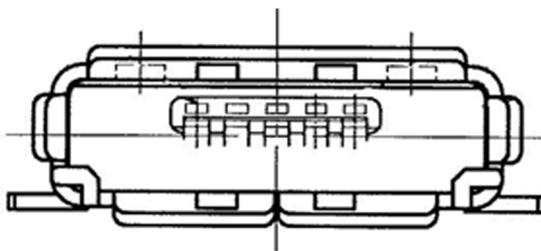
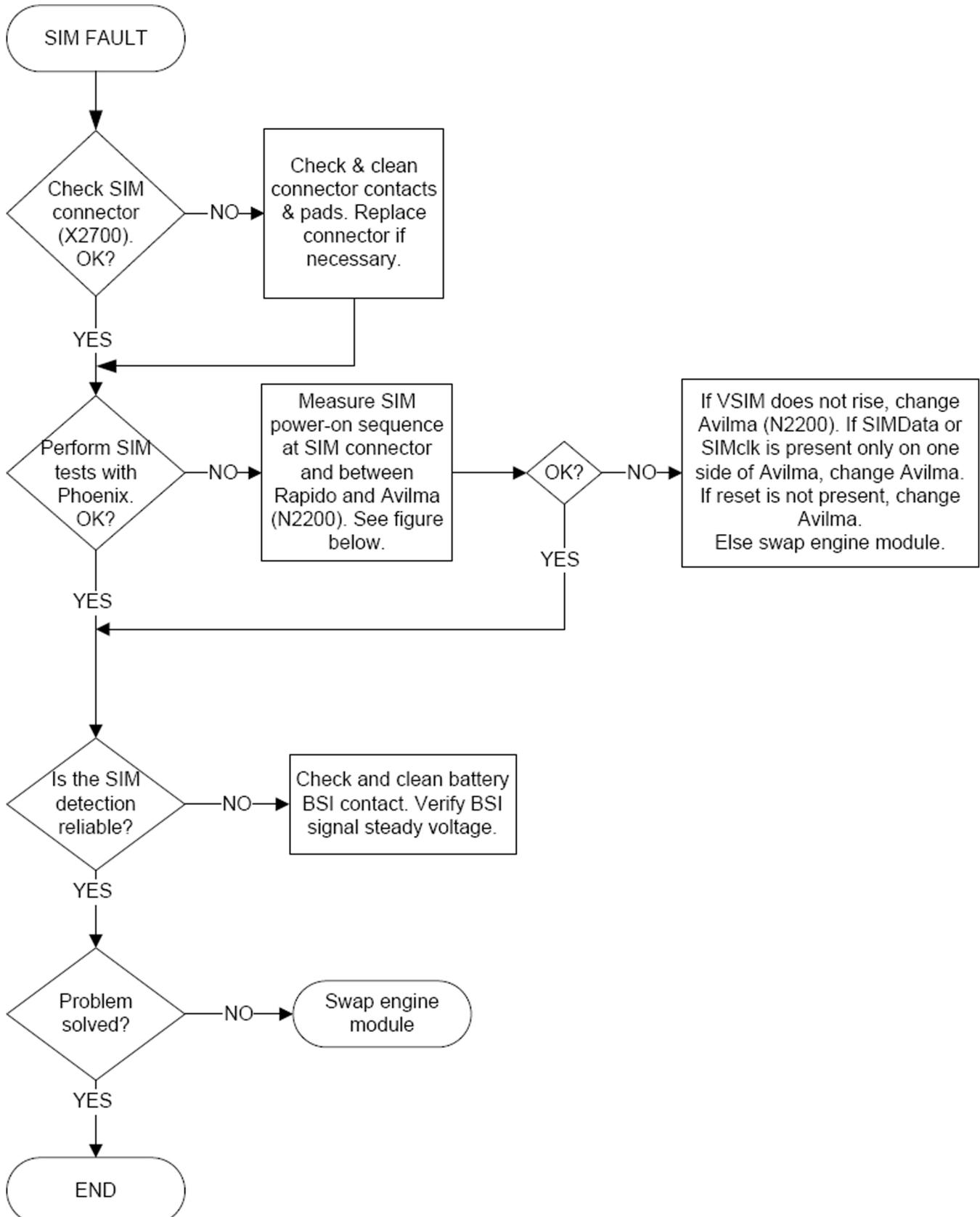


Figure 19 USB connector

■ SIM card troubleshooting

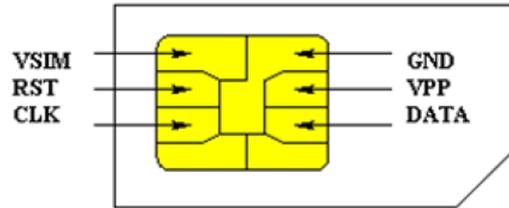
Troubleshooting flow



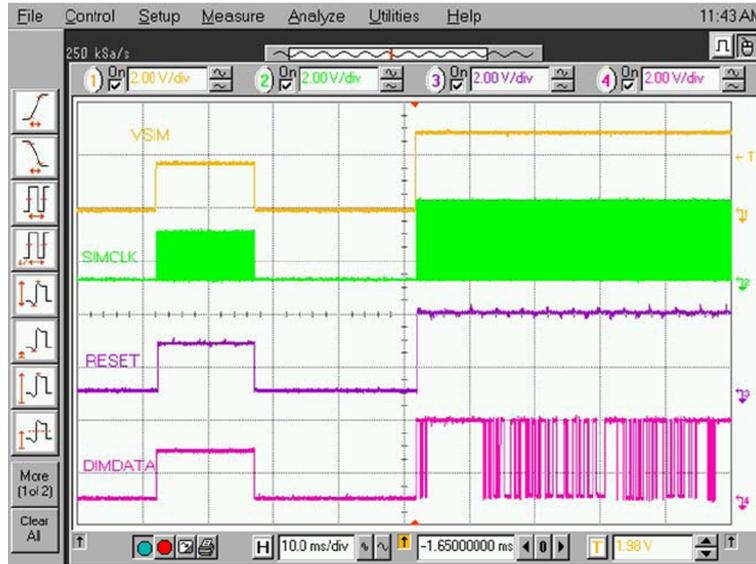
SIM power-on sequence

Testpoints between Rapido and AVILMA
J2213 = SIMCLK
J2214 = SIMDATA
J2215 = SIMIOC

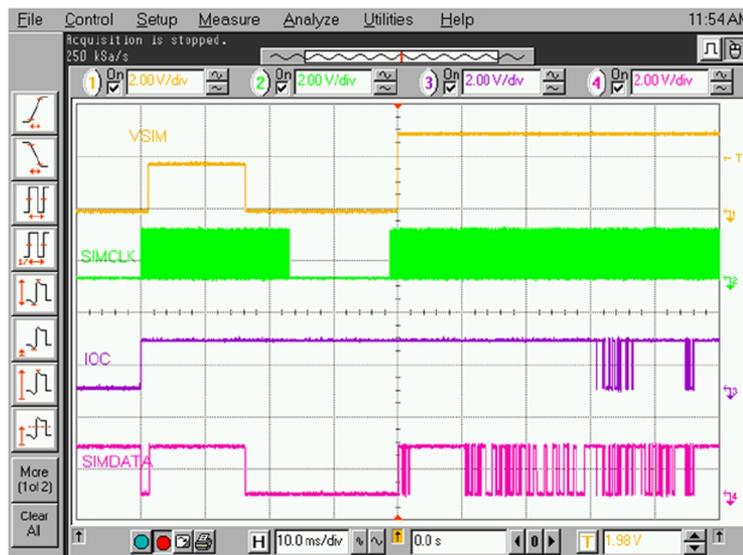
Fsimclk = 3.84MHz



SIM contacts



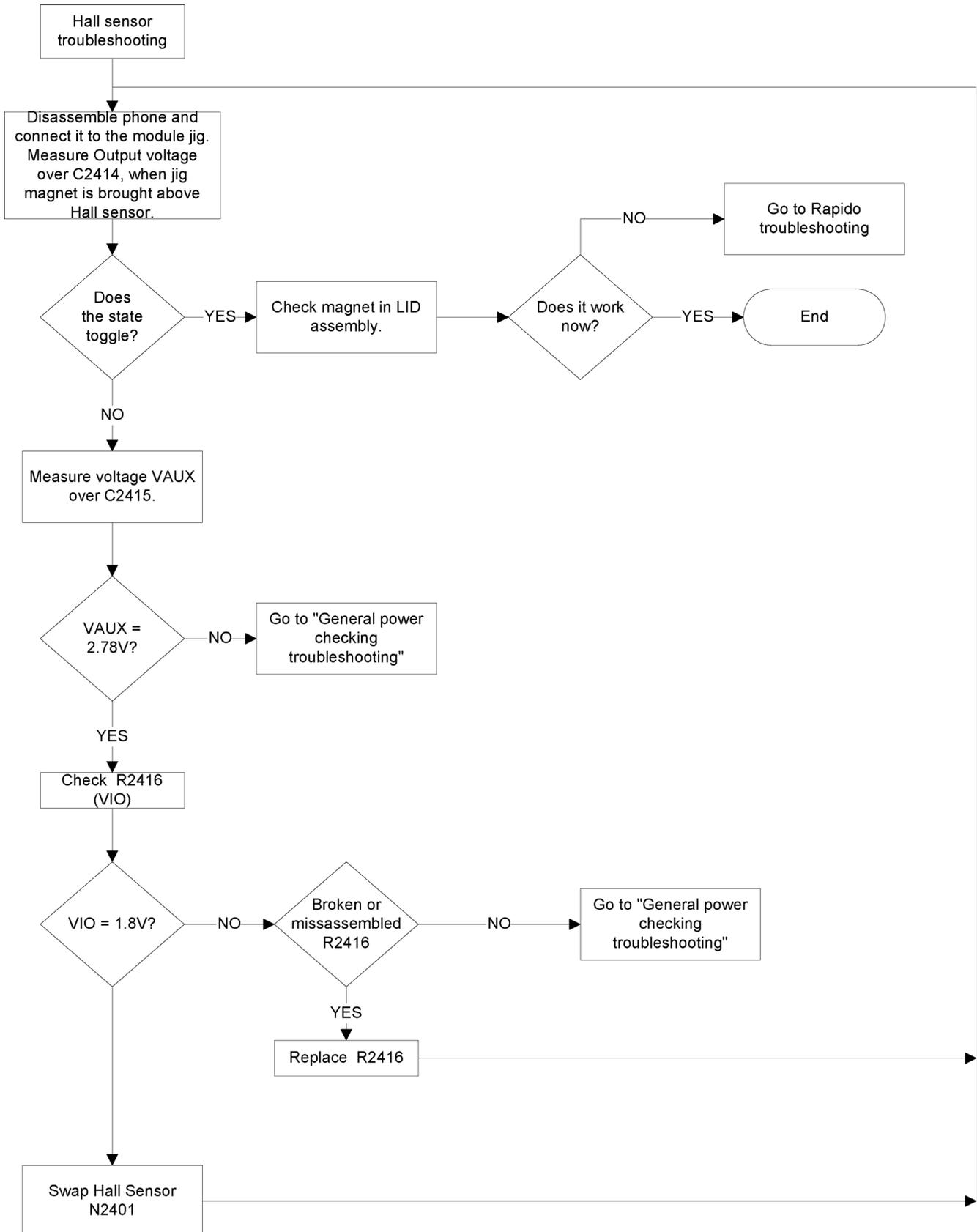
SIM power-on sequence on X2700.



SIM power-on sequence between Rapido and Avilma.

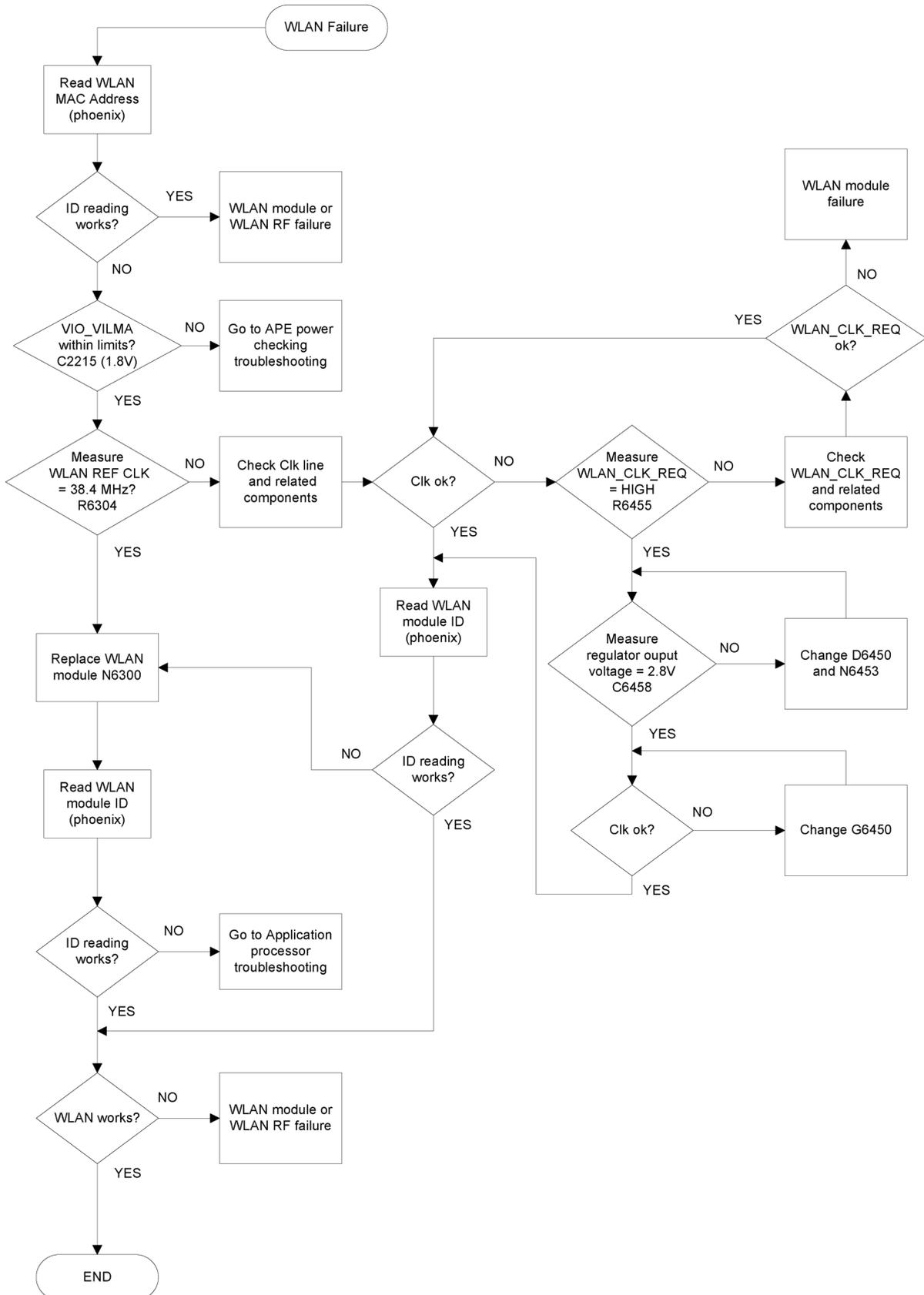
■ **Hall sensor troubleshooting**

Troubleshooting flow



■ **WLAN interface troubleshooting**

Troubleshooting flow



	Bitrate / [Mb/s]	Modulation	Power / [dBm]
802.11 b	1	DBPSK	12
	2	DQPSK	12
	5.5	CCK	12
	11	CCK	12
802.11 g	6	BPSK	10
	9	BPSK	10
	12	QPSK	10
	18	QPSK	10
	24	16QAM	9
	36	16QAM	9
	48	64QAM	9
	54	64QAM	9

Figure 20 WLAN alignment targets

■ Keyboard troubleshooting

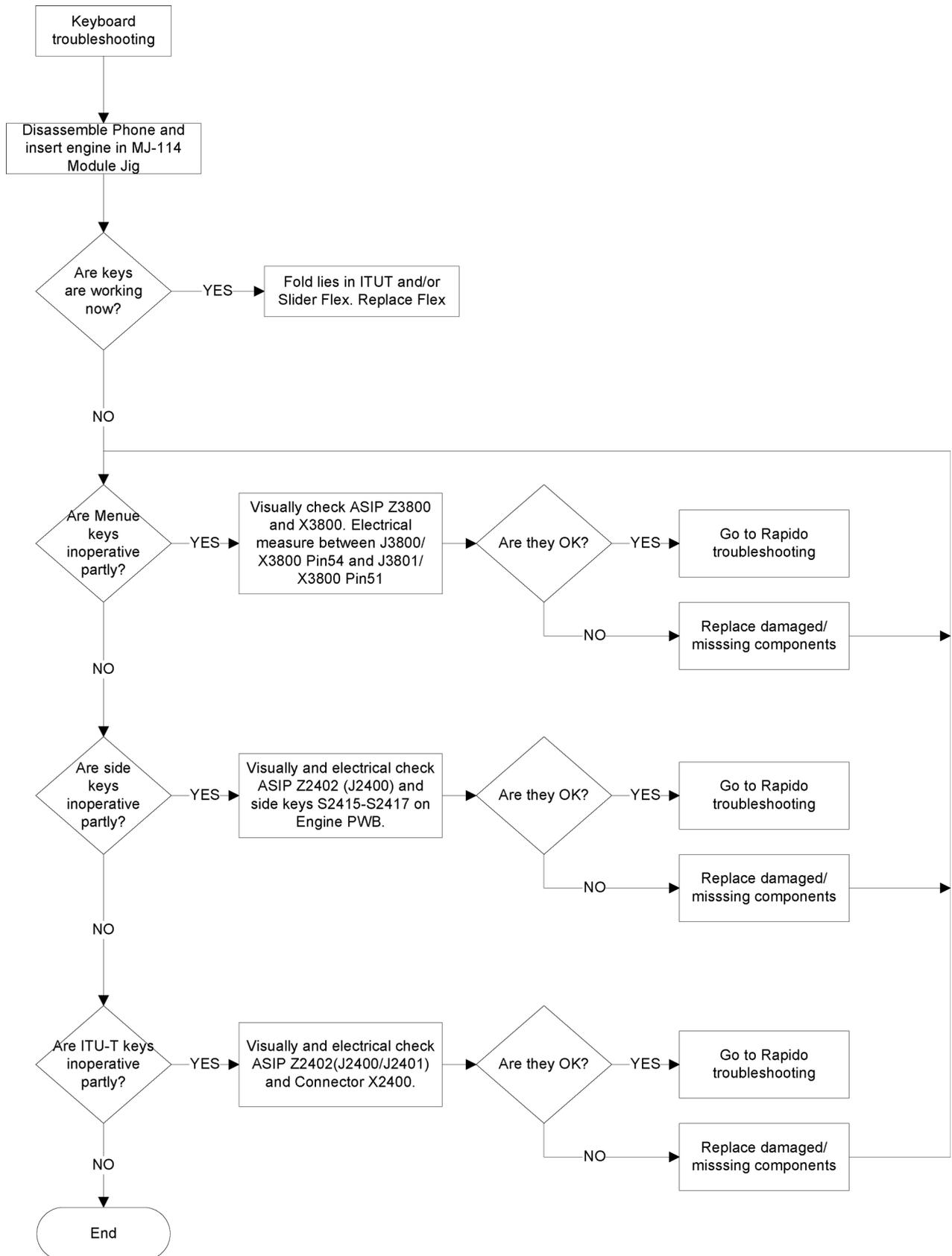
Context

There are two possible failure modes in the keyboard module:

- One or more keys can be stuck, so that the key does not react when a keydome is pressed. This kind of failure is caused by mechanical reasons (dirt, rust).
- Malfunction of several keys at the same time; this happens when one or more rows or columns are failing (shortcut or open connection). For a more detailed description of the keyboard and keymatrix, see section Keyboard.

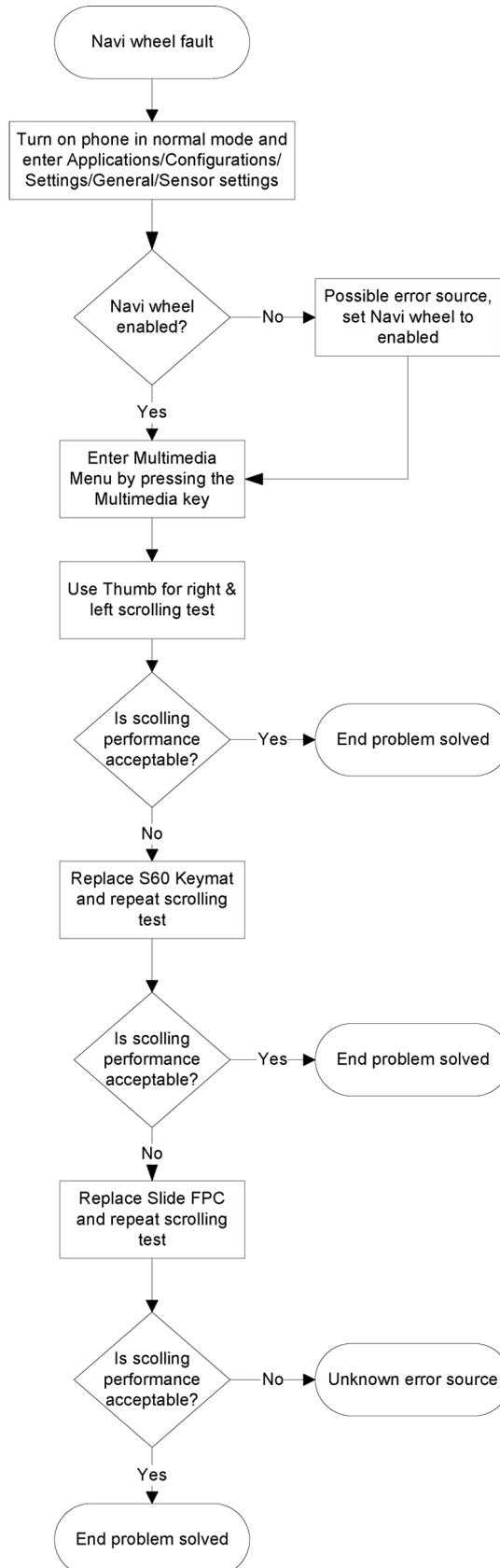
If the failure mode is not clear, start with the Keyboard Test in Phoenix.

Troubleshooting flow



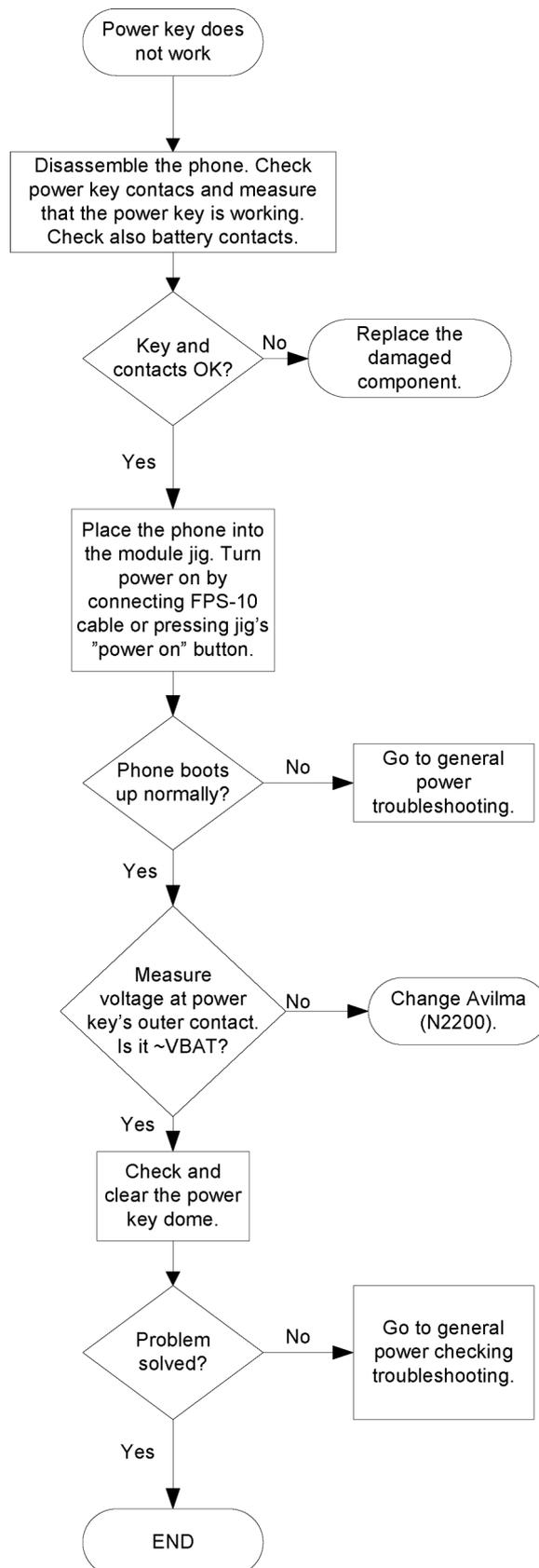
■ **NaviWheel troubleshooting**

Troubleshooting flow



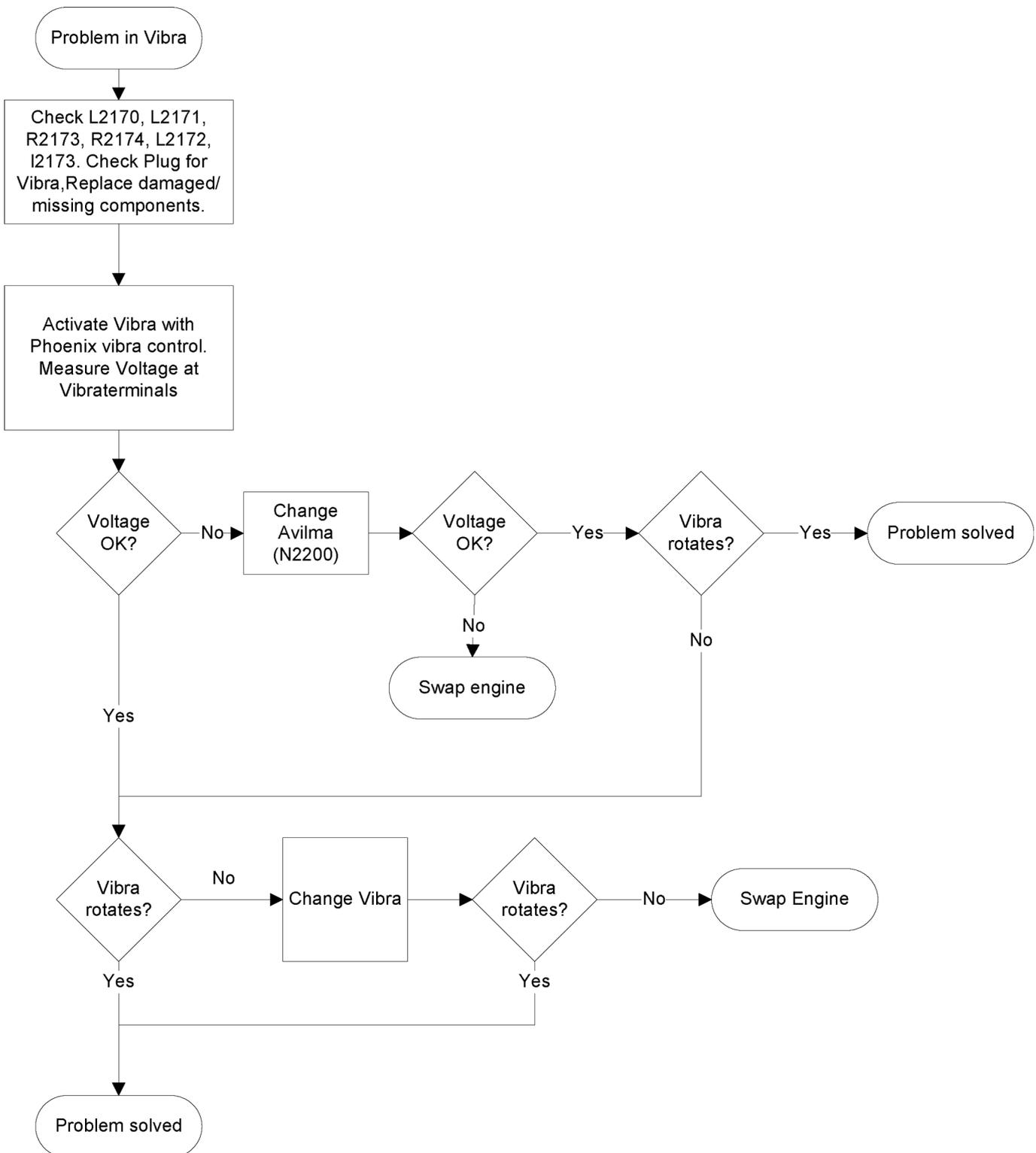
■ Power key troubleshooting

Troubleshooting flow



■ **Vibra troubleshooting**

Troubleshooting flow



■ Display module troubleshooting

General instructions for display troubleshooting

Context

- The display is in a normal mode when the phone is in active use.
- The display is off when the phone is in the screen saver mode. Then power LED is active.
- The operating modes of the display can be controlled with the help of *Phoenix*.

Table 2 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 cause can also be in the display connector, 70pol engine connector, the SliderFlex or in the backlight power source in the main engine of the phone. 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 3 Pixel defects

Item		White dot defect				Black dot defect	Total
		R	G	B	White Dot Total		
1	Defect counts	1	1	1	1	1	1
2	Combined defect counts	Not allowed. Two single dot defects that are within 5 mm of each other should be interpreted as combined dot defect.					

Steps

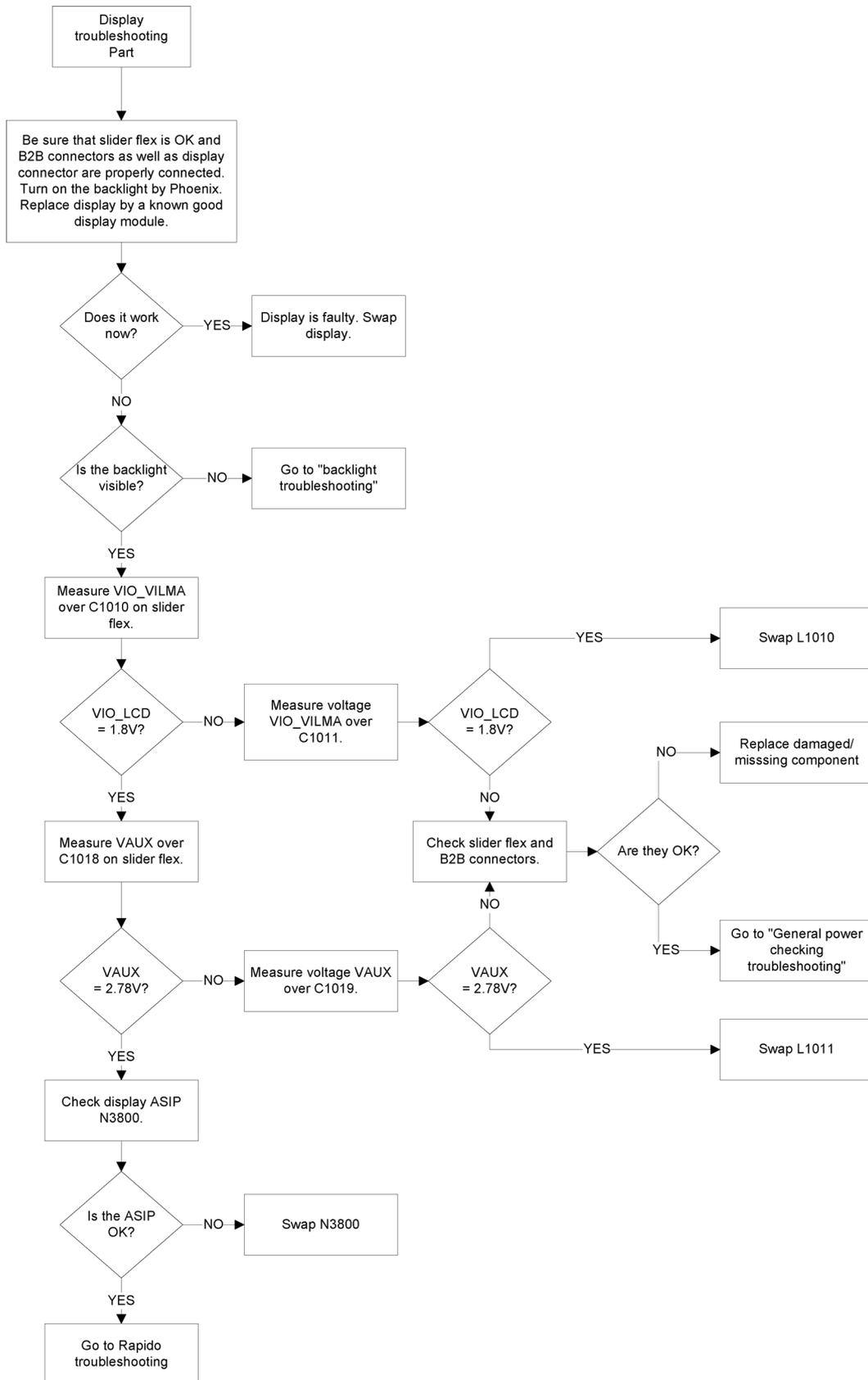
1. Verify with a working SlideModule that the fault is not the SliderFlex.
2. Verify with a working display that the fault is not on the display module itself.
The display module cannot be repaired.
3. Check that the cellular engine is working normally.
 - i To check the functionality, connect the phone to a docking station.
 - ii Start *Phoenix* service software.
 - iii Read the phone information to check that also the application engine is functioning normally (you should be able to read the APE ID).
4. Proceed to the display troubleshooting flowcharts.
Use the **Display Test** tool in *Phoenix* to find the detailed fault mode.

Display troubleshooting

Context

Before going to display troubleshooting flow, make sure that the engine is working and starting up correctly. If the problem is in the engine, go to baseband troubleshooting.

Troubleshooting flow



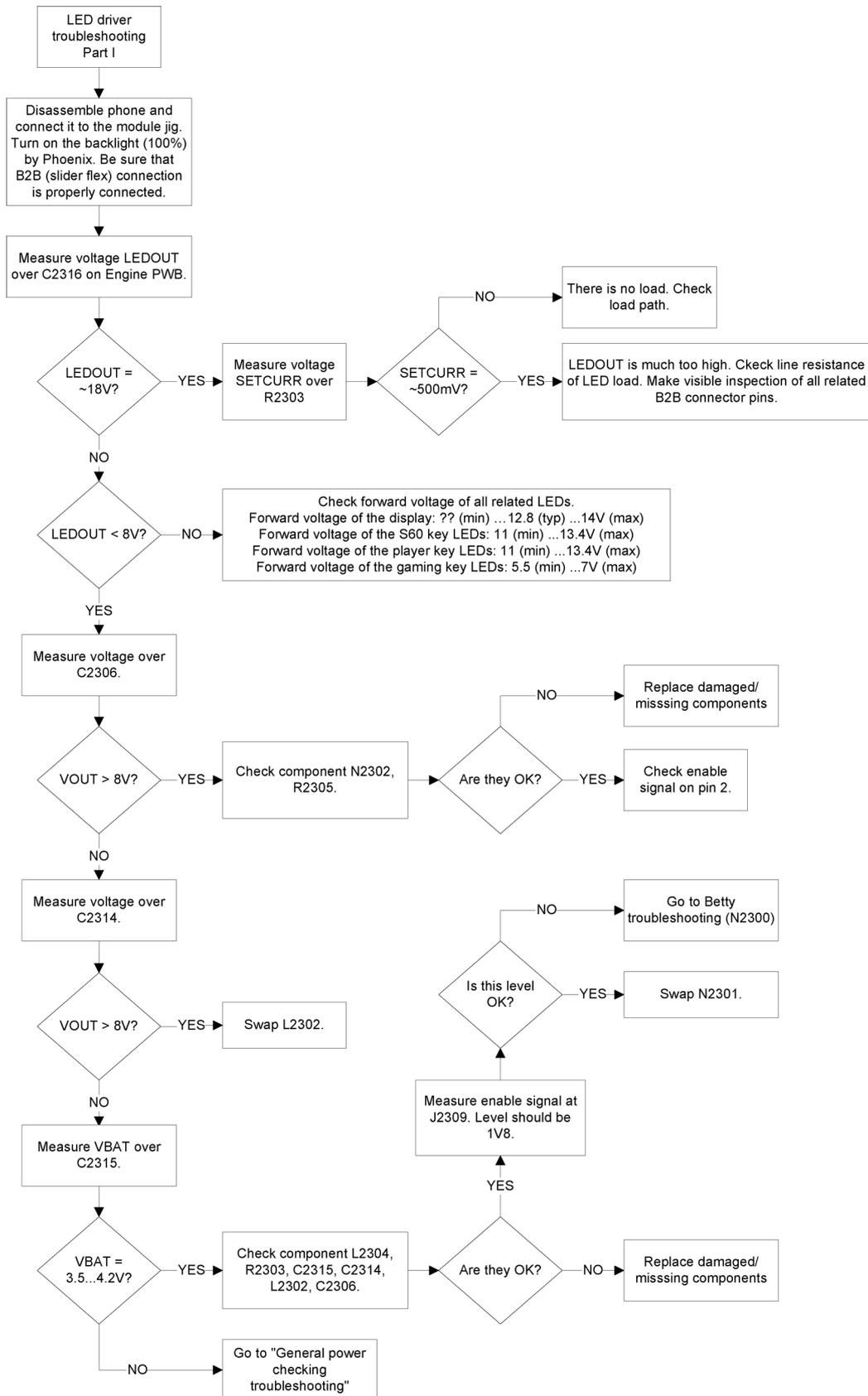
LED driver troubleshooting

Context

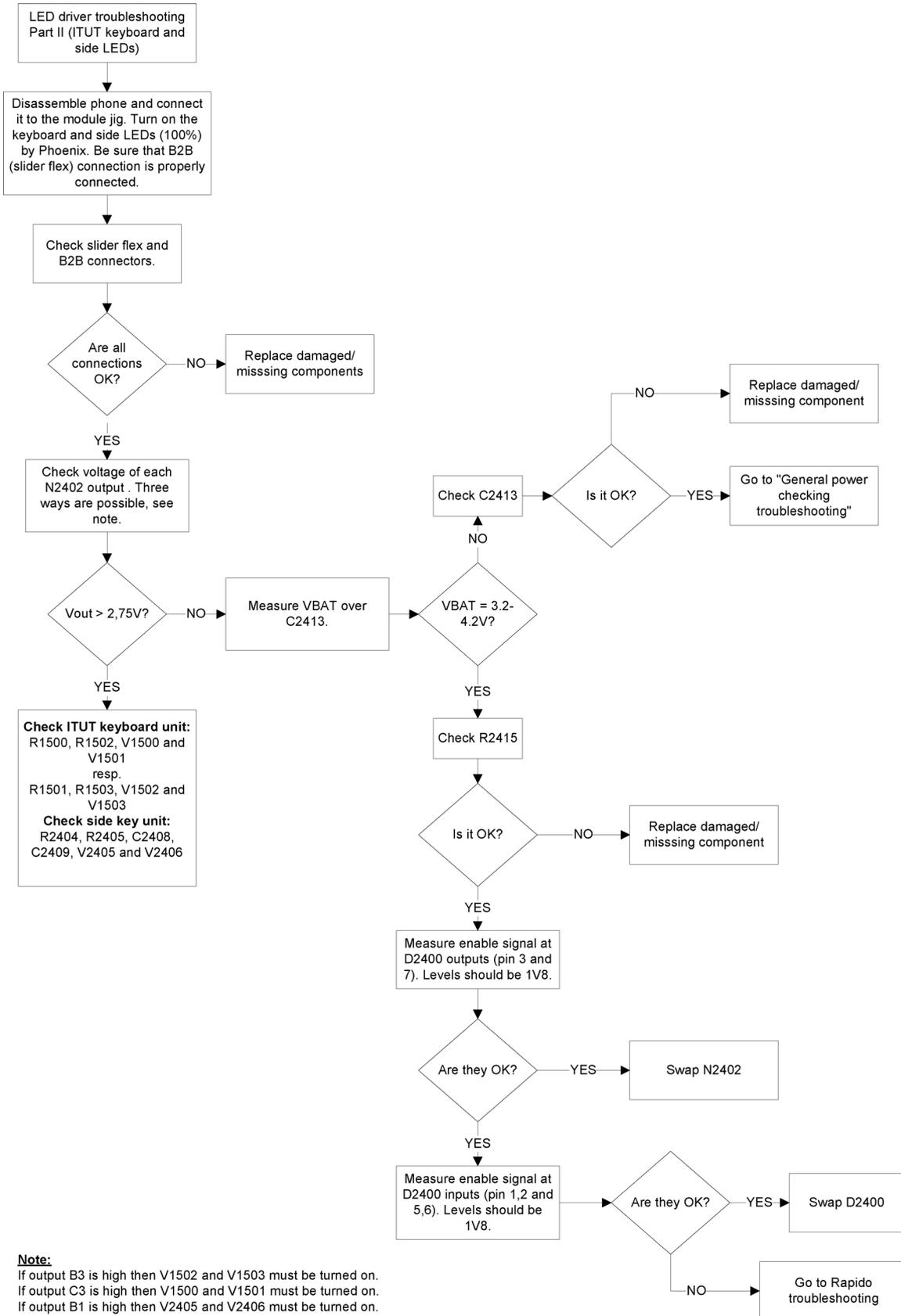
The phone has three illumination drivers. One of them provides the LED current for the display, the menu keys and the gaming keys. One other provides the LED current for ITU-keyboard and side keys.

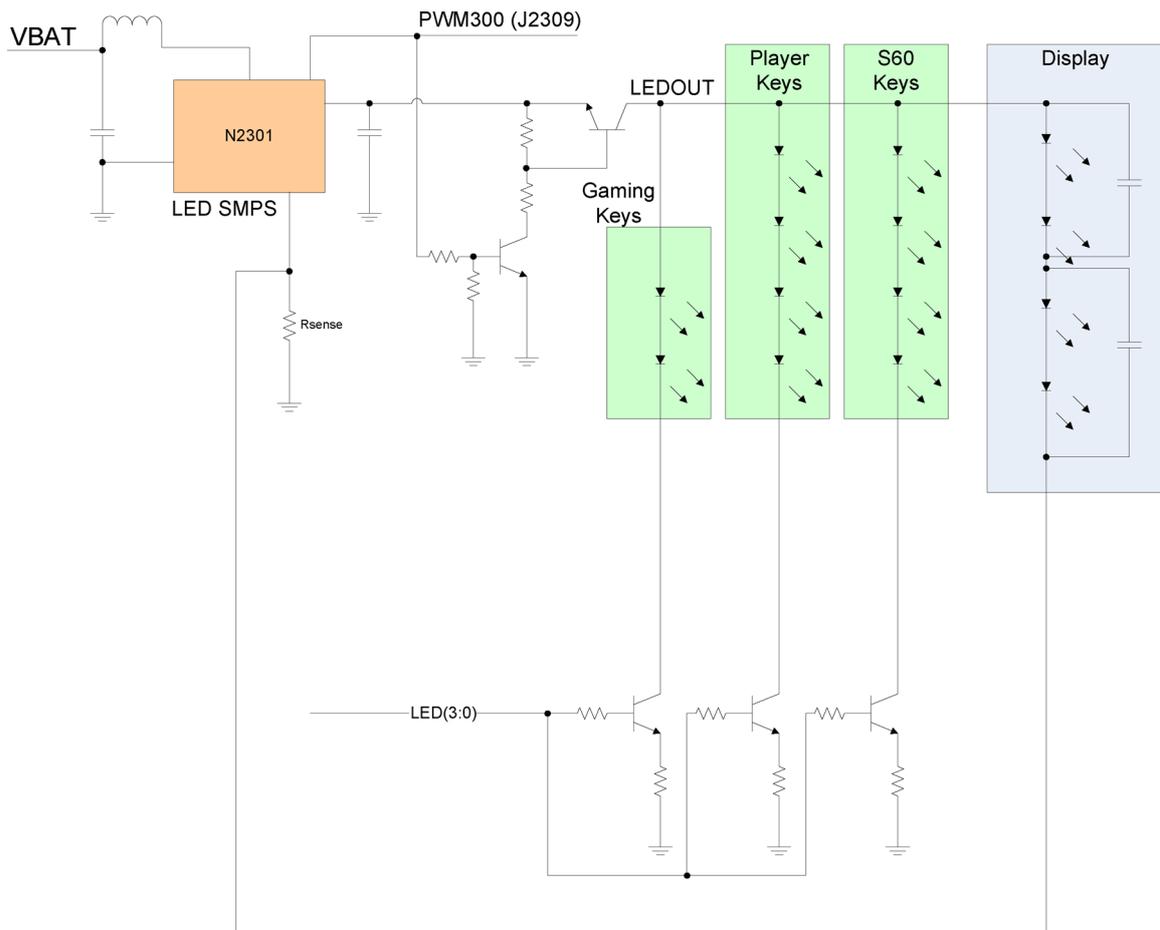
The third one provides the FlashLED current. For instructions for troubleshooting this driver, see [Flash LED troubleshooting \(page 5–13\)](#).

LED driver troubleshooting part 1



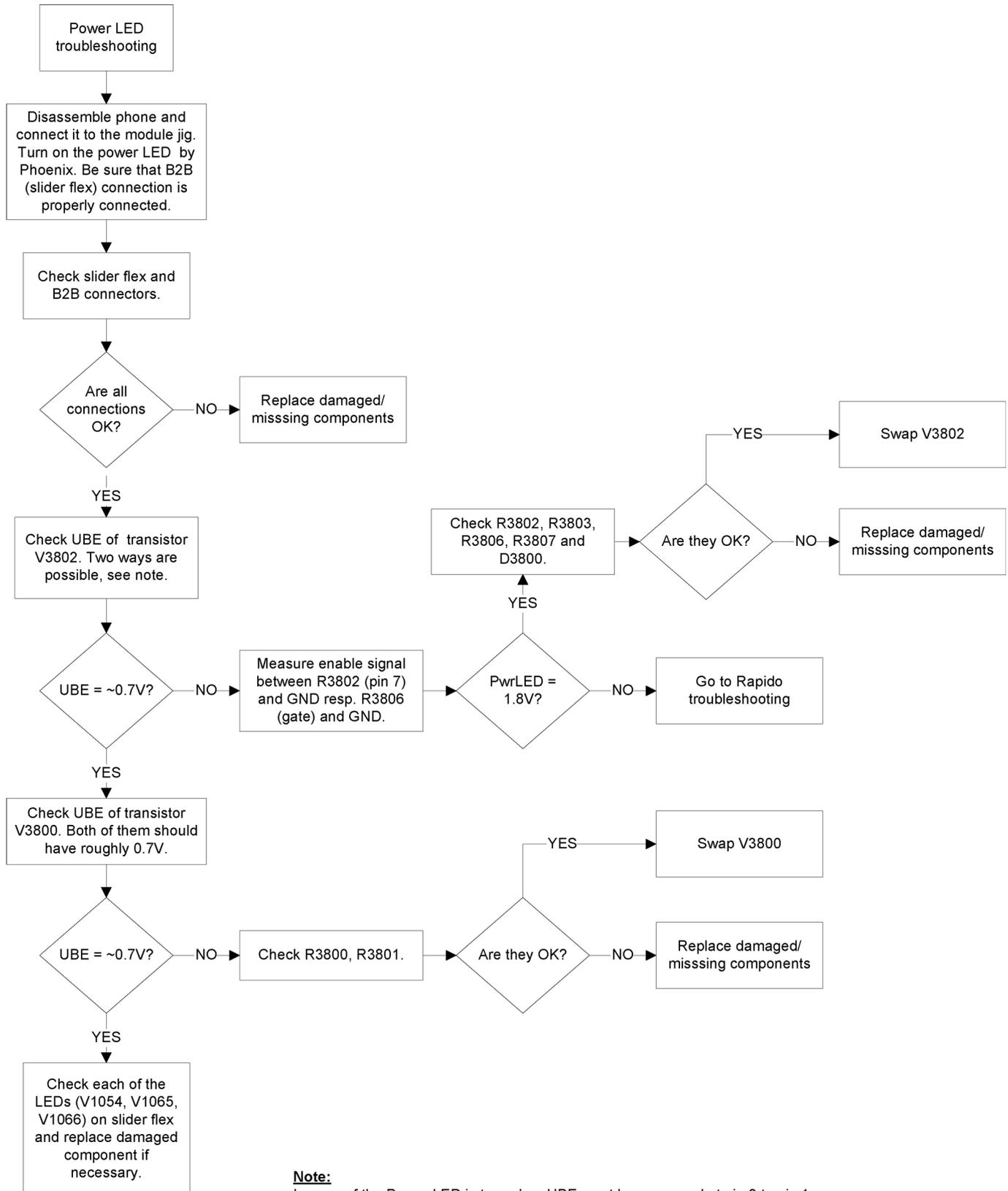
LED driver troubleshooting part 2





Power LED troubleshooting

Troubleshooting flow



Note:

In case of the Power LED is turned on UBE must be measured at pin 2 to pin 1.
In case of the Keyboard LEDs are turned on UBE must be measured at pin 6 to pin 4.

■ **Bluetooth and FM radio**

Introduction to Bluetooth/FM Radio troubleshooting

Bluetooth problems that can occur:

Problem	Description
A malfunction in the BT ASIC, BB ASICs or Phone's BT SMD components.	This could have many causes i.e. SW or HW related.
No BT link can be established.	<ul style="list-style-type: none"> • Bad contact of c-clips (X6302, X6300) to the corresponding antenna pads. • Damaged component or bad contact of R6420 (0 Ohm), BT/WLAN frontend (N6301) or ISM band filter (Z6300).

Bluetooth/FM Radio component layout

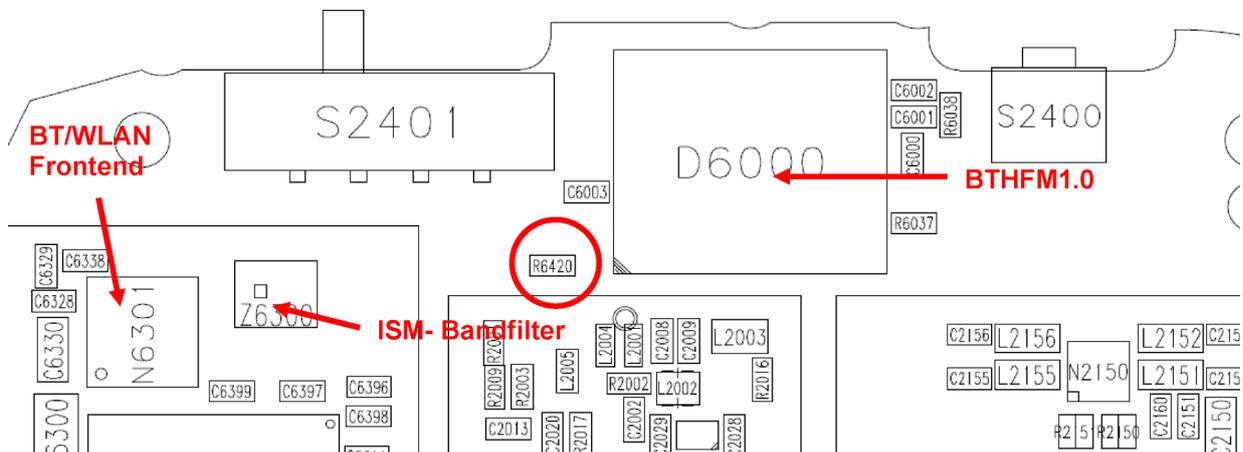


Figure 21 Bluetooth and FM radio component layout

Bluetooth settings for Phoenix

Steps

1. Start *Phoenix* service software.
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing**→**Bluetooth LOCALS** .
5. Locate JBT-9's serial number (12 digits) found in the type label on the back of JBT-9.
In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.
6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.
This needs to be done only once provided that JBT-9 is not changed.
7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

Results

Bit Error Rate test result is displayed in the *Bit Error Rate (BER) Tests* pane in the *Bluetooth LOCALS* window.

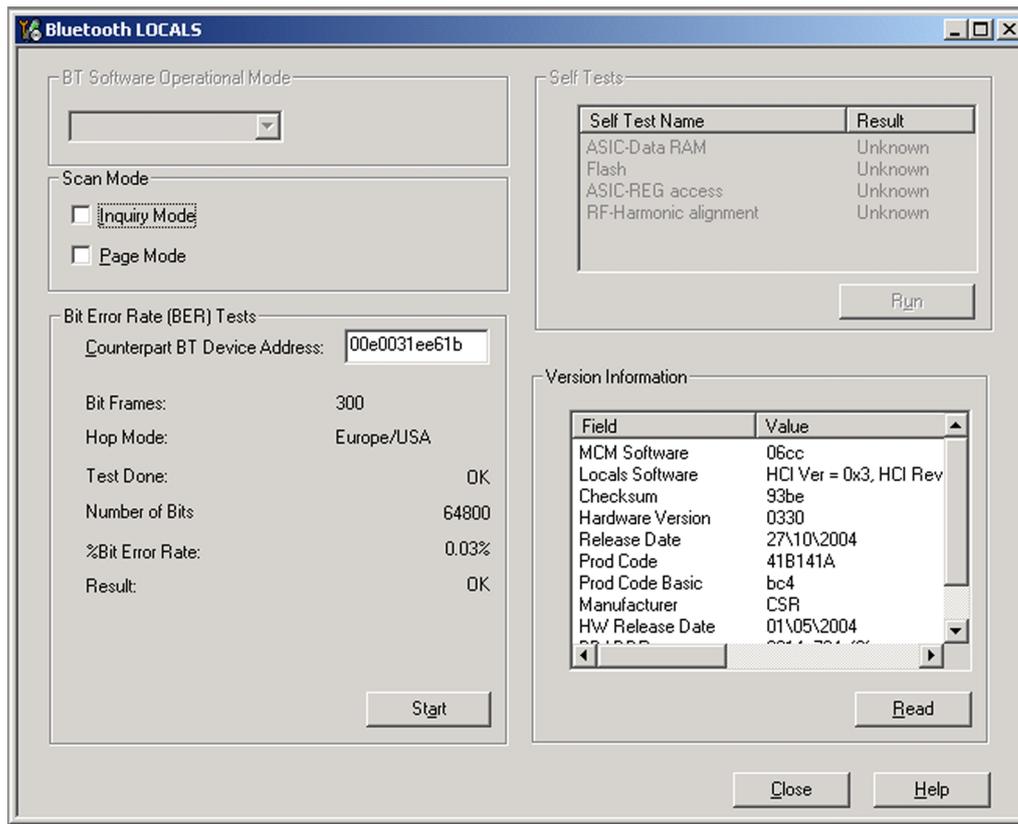


Figure 22 BER test result

Bluetooth self tests in Phoenix

Steps

1. Start *Phoenix* service software.
2. Choose **File** → **Scan Product**.
3. Place the phone to a flash adapter.
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 related tests:
 - **ST_LPRF_IF_TEST**
 - **ST_LPRF_AUDIO_LINES_TEST**
 - **ST_BT_WAKEUP_TEST**

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

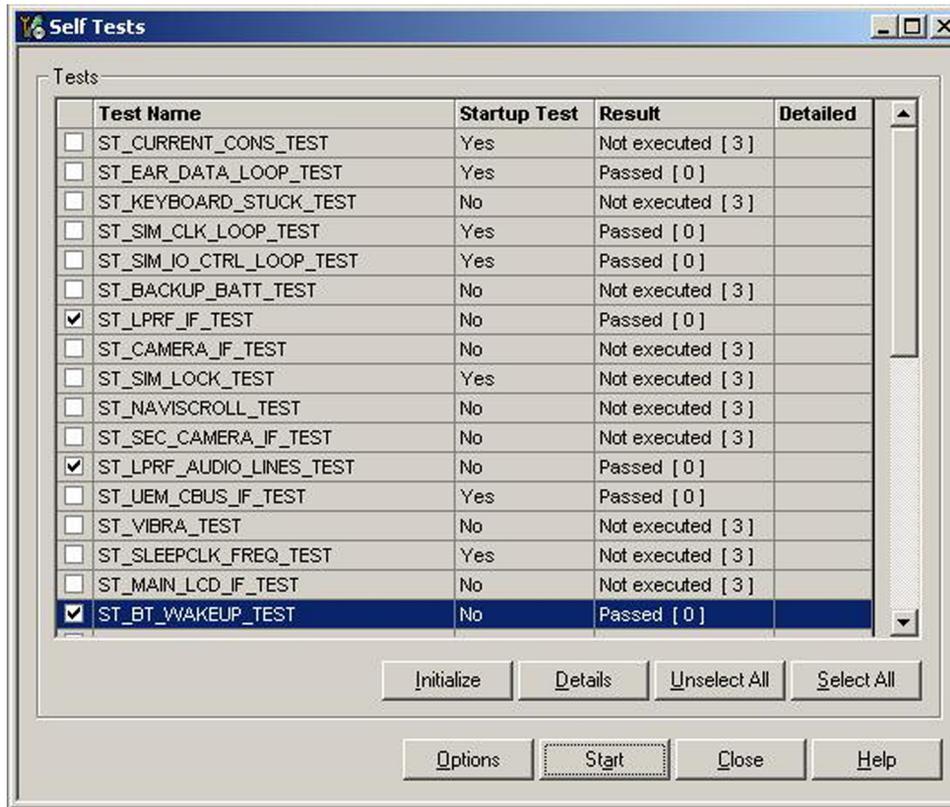
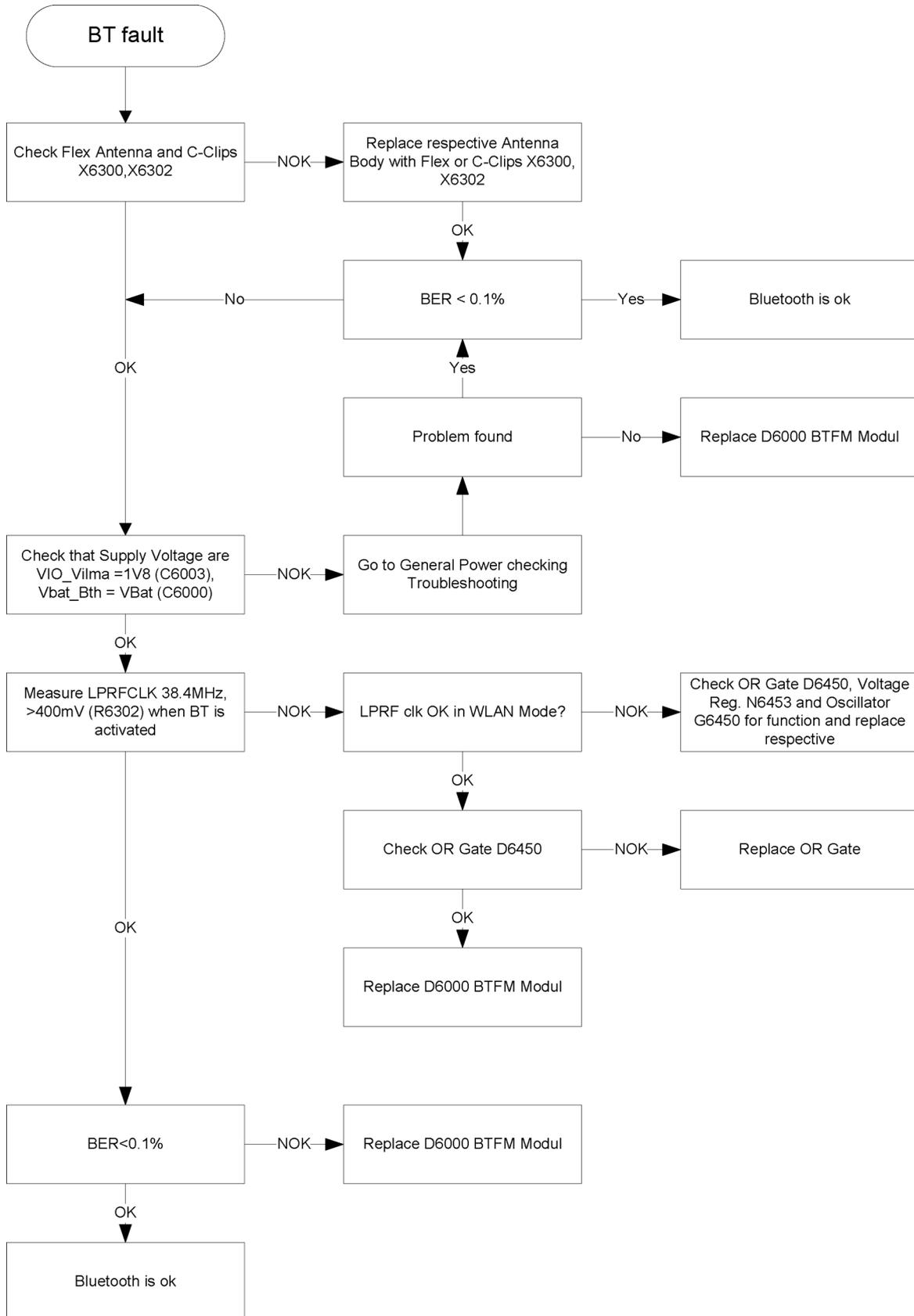


Figure 23 Bluetooth self tests in *Phoenix*

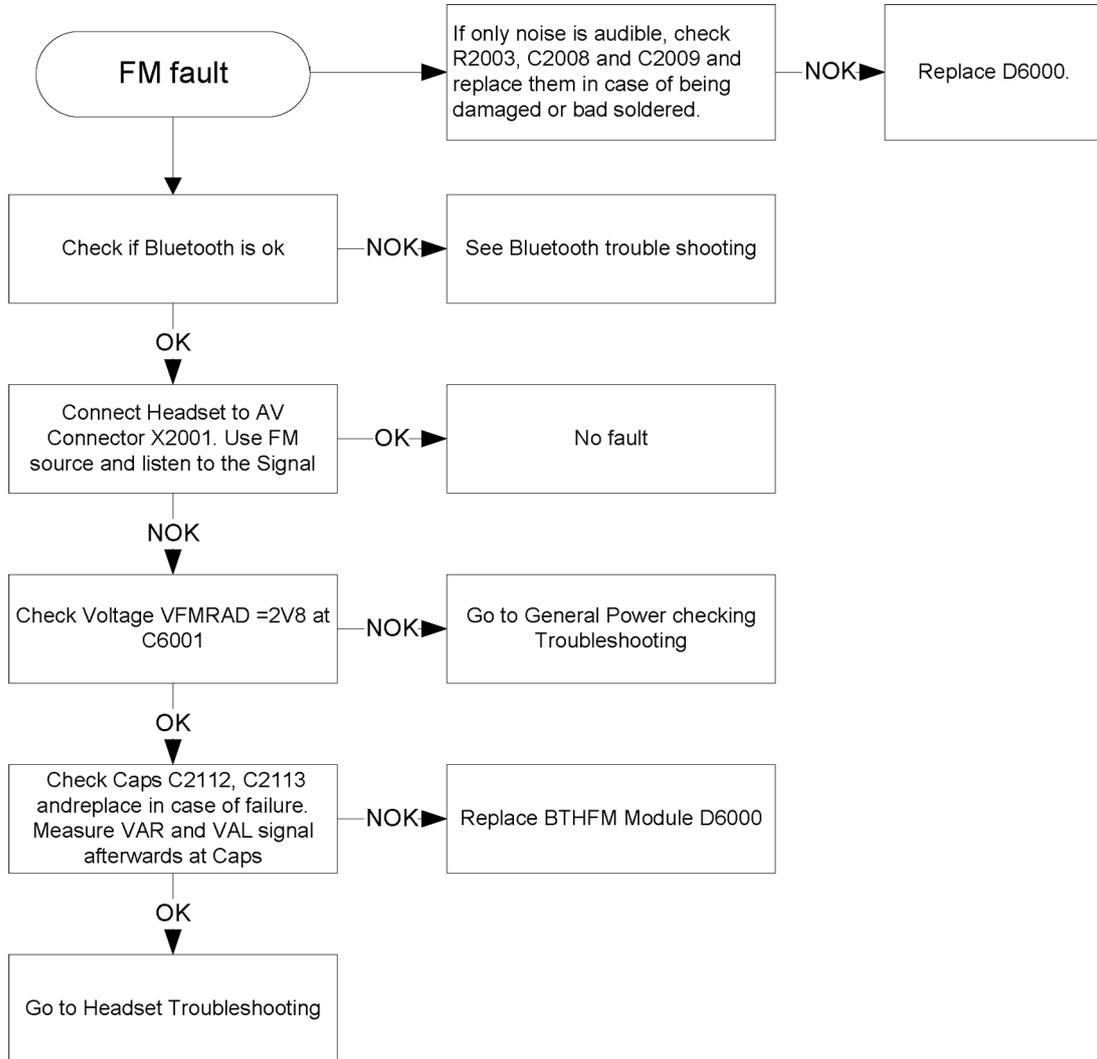
Bluetooth troubleshooting

Troubleshooting flow



FM radio troubleshooting

Troubleshooting flow



■ Audio troubleshooting

Audio troubleshooting test instructions

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

When measuring single ended, each output is measured against ground.

Note: Do not connect ground of single ended probe to 2nd signal of differential lines.

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, input signal frequency must be set to 2kHz.

The signal for input is single ended.

Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- Current probe (Internal handsfree PWM output measurement)
- Phoenix service software
- Power supply 3.7V

Test procedure

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

- External mic to external earpiece
- External mic to internal earpiece
- External mic to internal handsfree speaker (IHF, mono signal to both speakers)
- Internal mic to external earpiece

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 can not be changed using phoenix. Correct pins and signals for each test see following table.

Phoenix audio loop tests and test results

The results presented in the table apply, when no accessory is connected. Earpiece, internal mic and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured levels.

The gain values presented in table apply for differential output vs single ended input.

Loop test	Input terminal	Output terminal	Path gain [dB] fixed	Input Voltage [mVpp]	Differential output voltage [mVpp]	Output DC level [V]	Output current
Ext Mic -> Ext Earp	HS-MIC & GND	HSEARL&GND	-8.6	1000	367	1,2	
		HSEARR&GND					
Ext Mic -> Int Earp	HS-MIC & GND	EarP & GND	-10	1000	310	1,2	
		EarN & GND					
Ext Mic -> Int Hands Free	XMICP & GND	B2150 B2151 all terminals	8,5	920	2520	0	~25mA each
	XMICN & GND						
Int Mic -> Int Hands Free	Acoustical input, 1khz sine wave	IHF Speakerpad		94 dB SPL			-

Measurement data

Earpiece signal

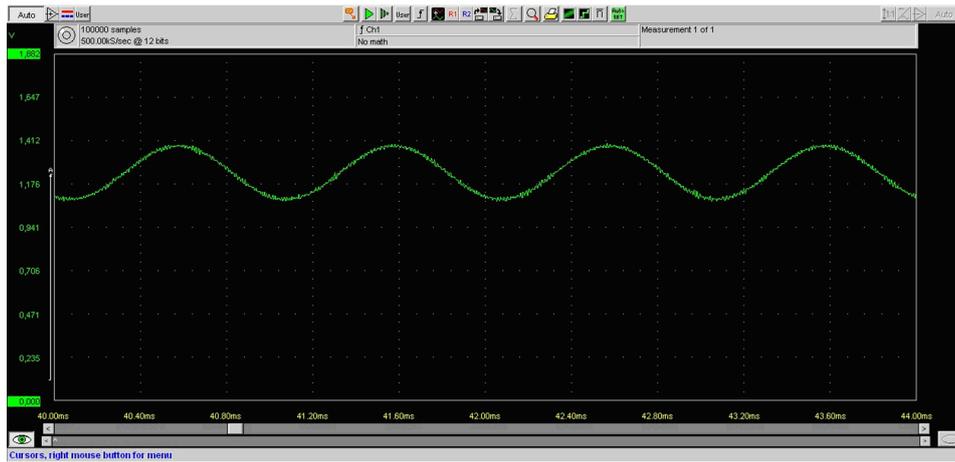


Figure 24 Single-ended output waveform of the Ext_in_HP_out measurement when earpiece is connected.

Integrated handsfree signal



Figure 25 Differential output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected.

External output from AV

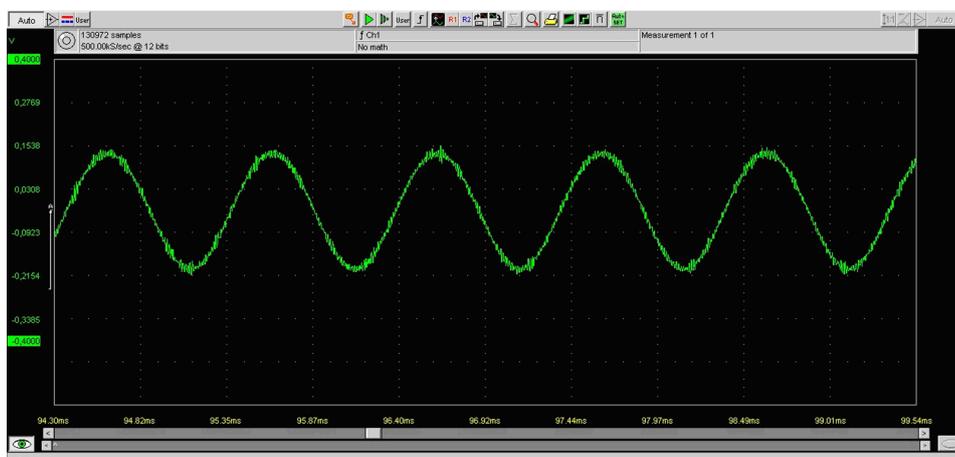


Figure 26 Single-ended output waveform of the Ext_in_Ext_out loop.

External output from AV (acoustic input)

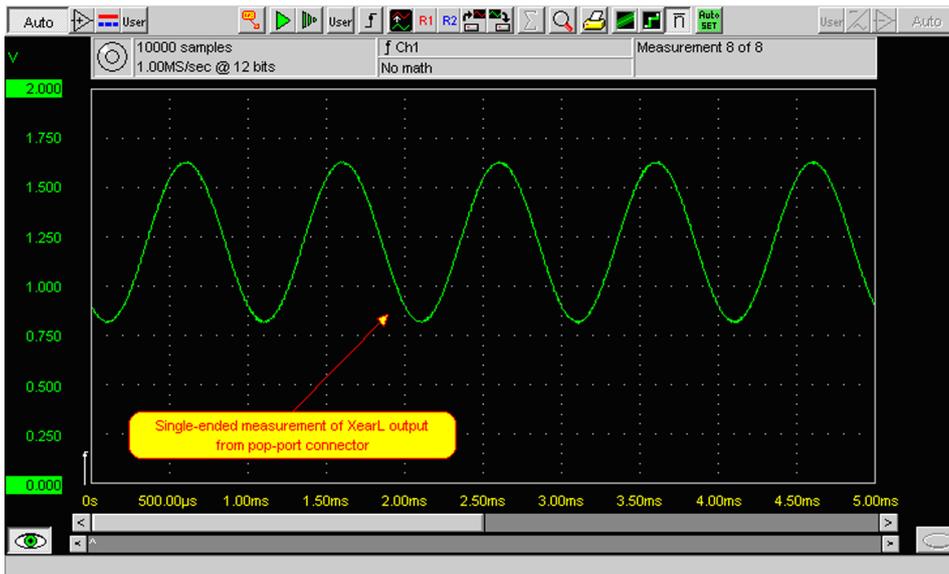
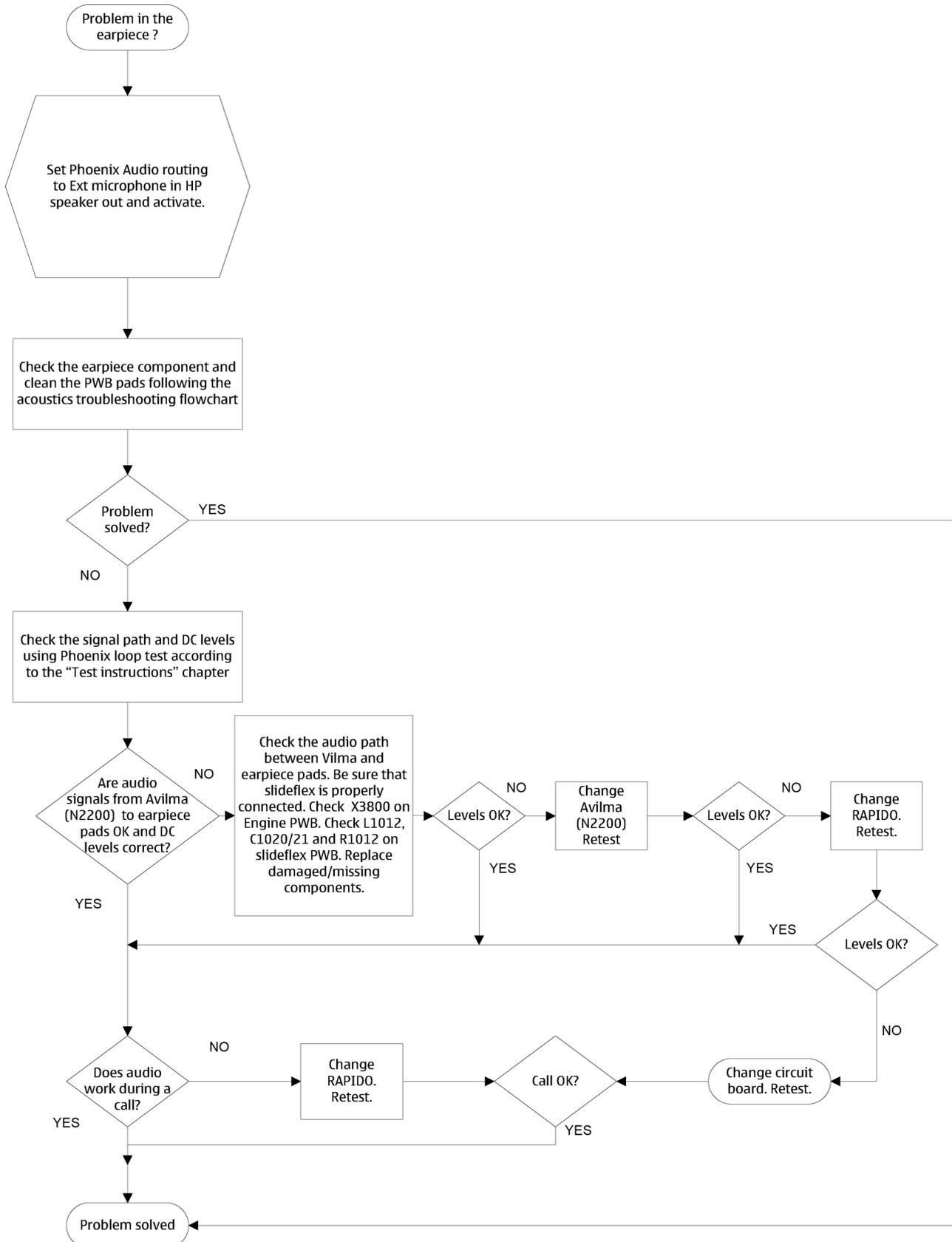


Figure 27 Single-ended output waveform of the HP_in_Ext_out loop.

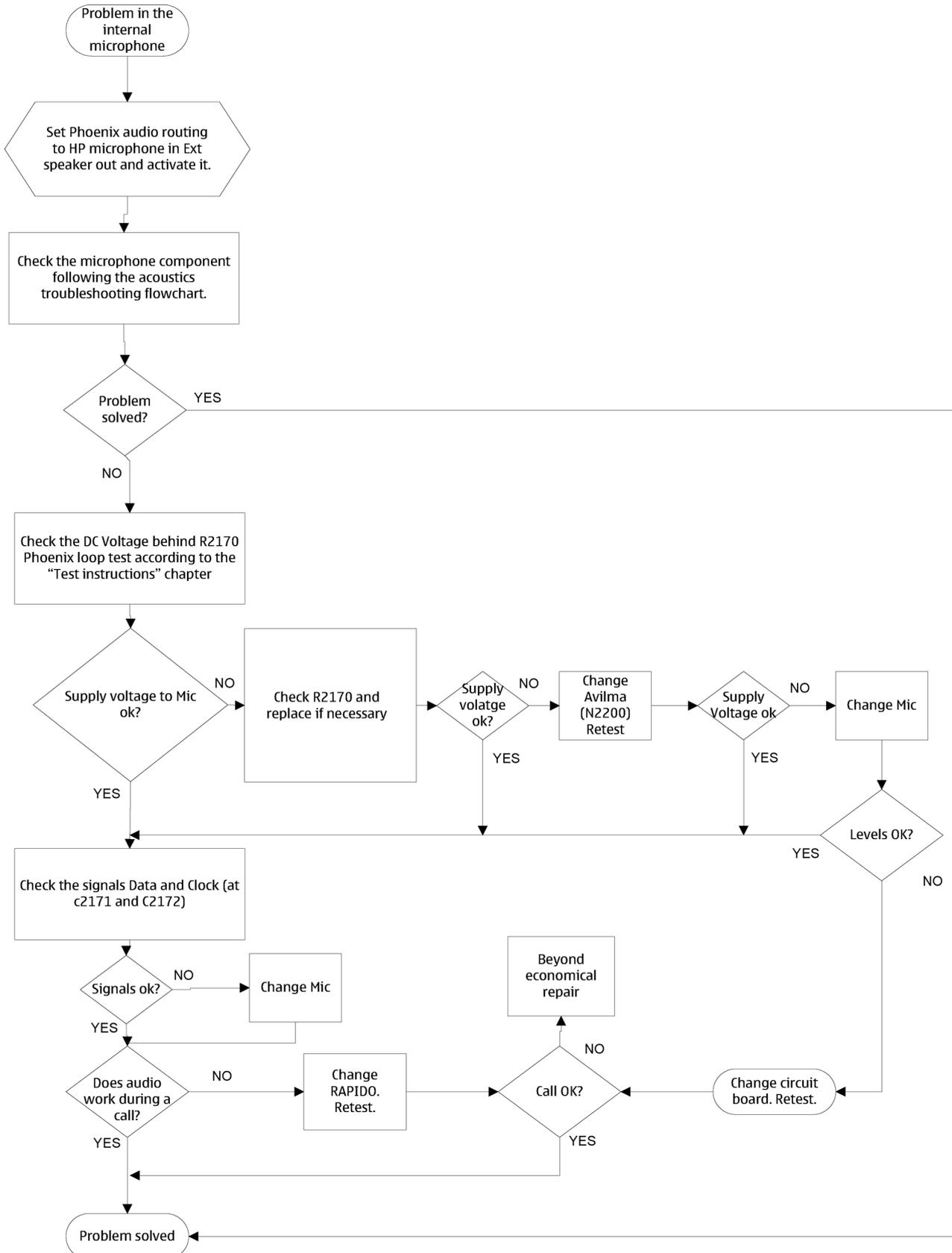
Internal earpiece troubleshooting

Troubleshooting flow



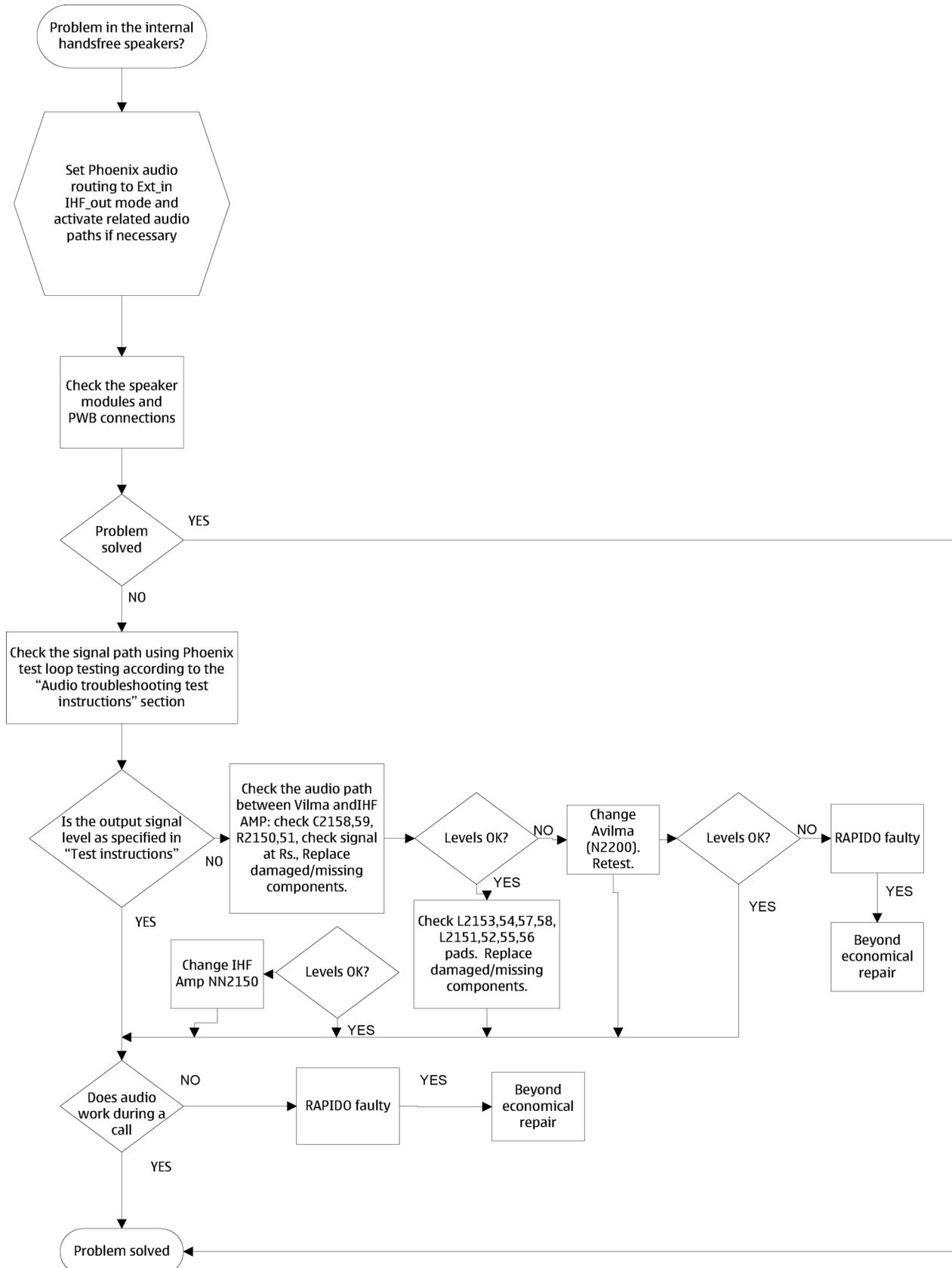
Internal microphone troubleshooting

Troubleshooting flow



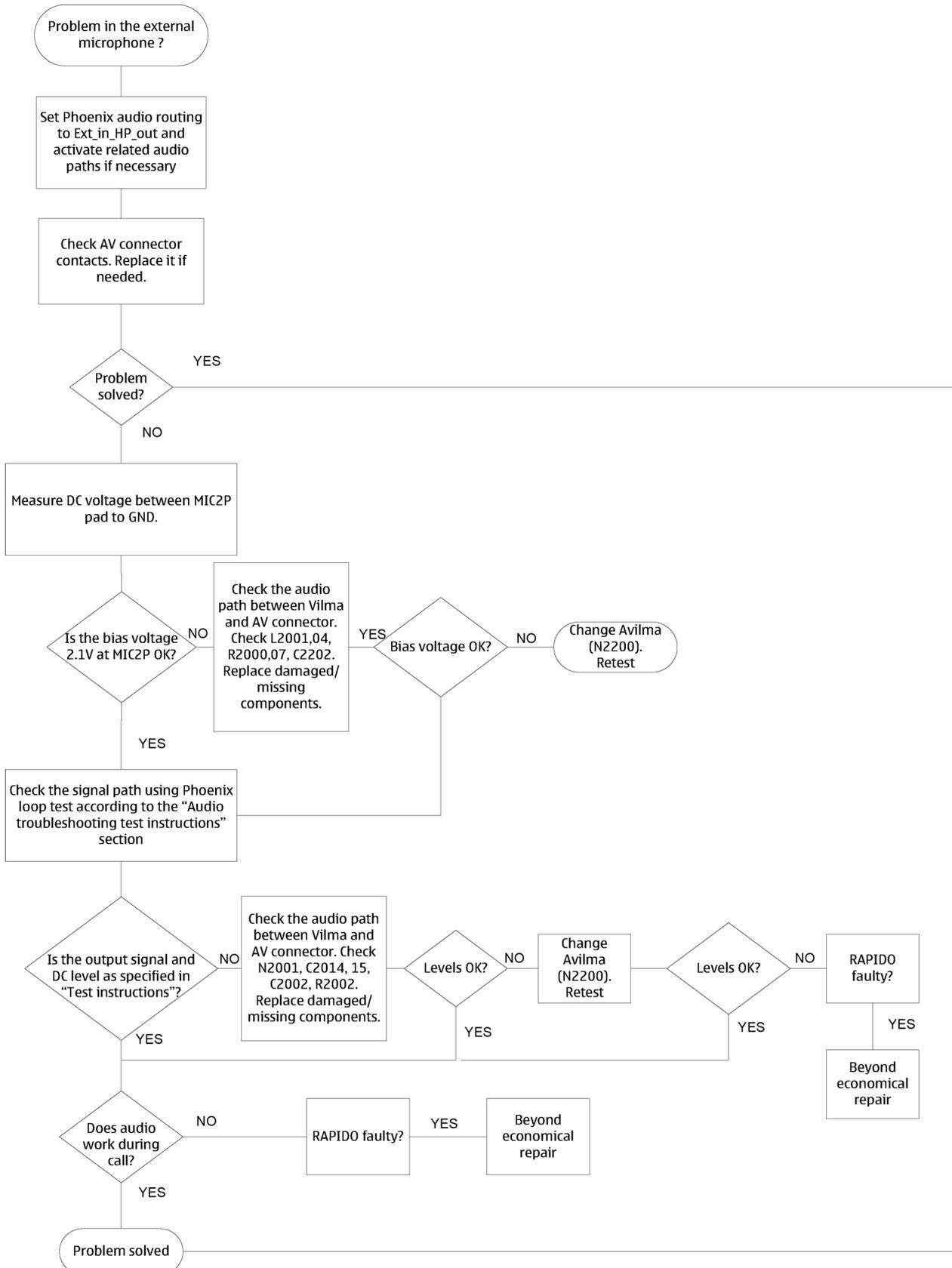
IHF speakers troubleshooting

Troubleshooting flow



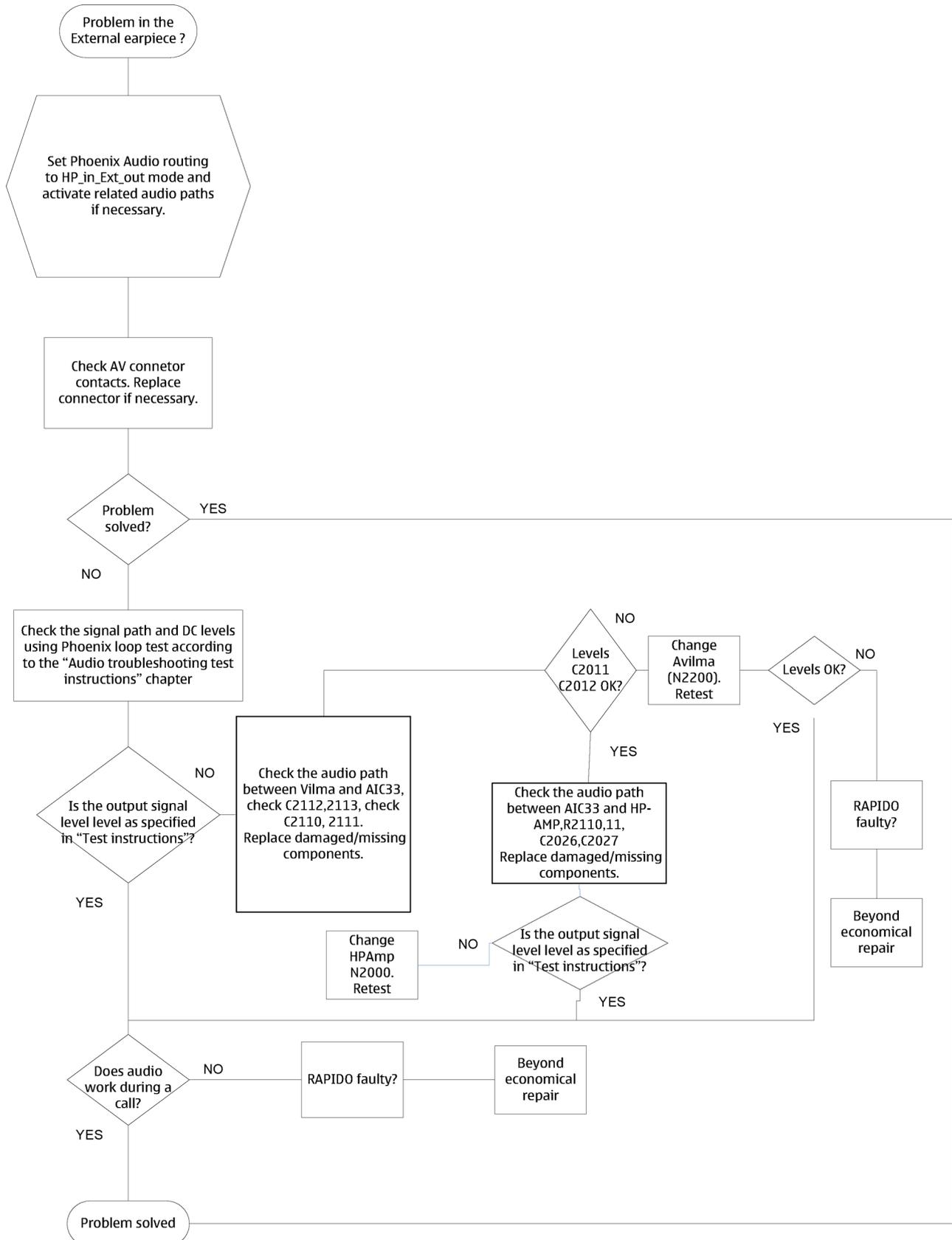
External microphone troubleshooting

Troubleshooting flow



External earpiece troubleshooting

Troubleshooting flow



Acoustics troubleshooting

Introduction to acoustics troubleshooting

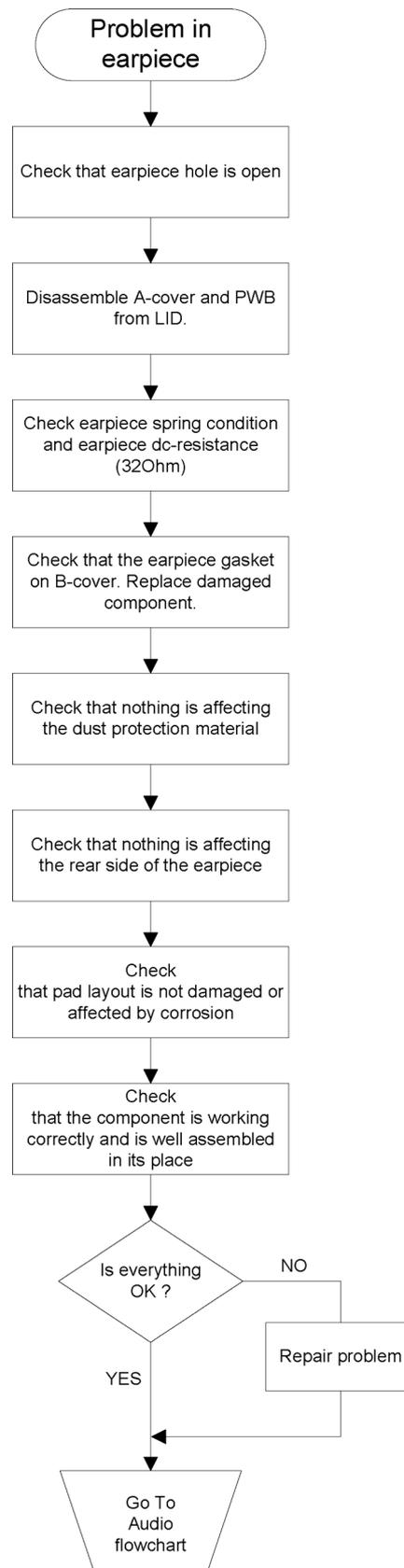
Acoustics design ensures that the sound is detected correctly with a microphone and properly radiated to the outside of the device by speaker(s). The acoustics of the phone includes three basic systems: earpiece, Integrated Hands Free (IHF) and microphone.

The sound reproduced from the earpiece radiates through a single hole on the front cover (A-cover). The sound reproduced from the IHF speakers radiates from left and right sound holes located on both sides of the device. Microphone is located at the bottom, next to the system connector.

For a correct functionality of the phone, all sound holes must be always open. When the phone is used, care must be taken not to close any of those holes with a hand or fingers. The phone should be dry and clean, and no objects must be located in such a way that they close any of the holes.

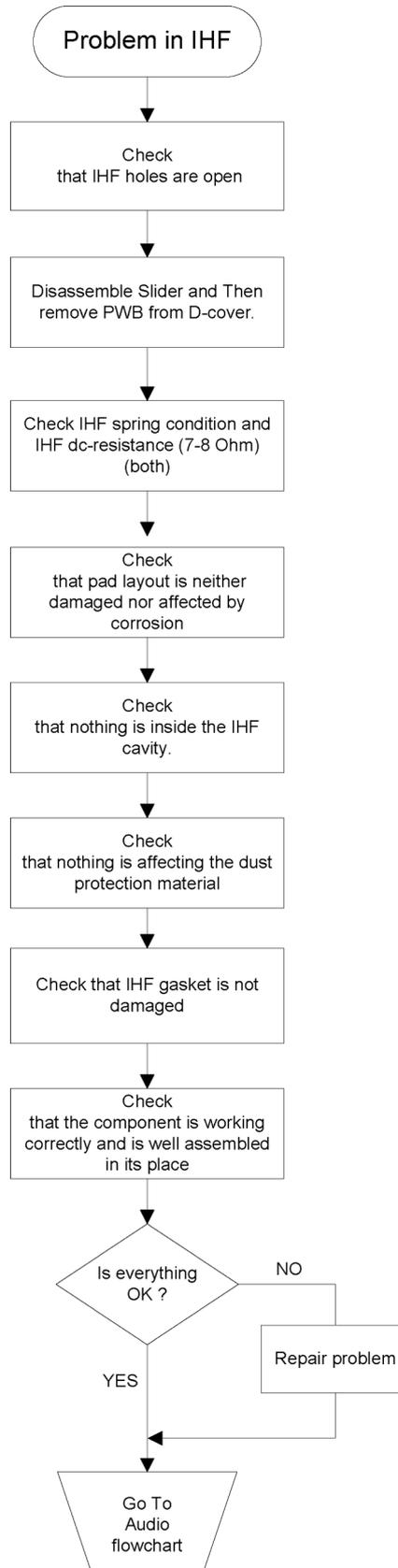
Earpiece troubleshooting

Troubleshooting flow



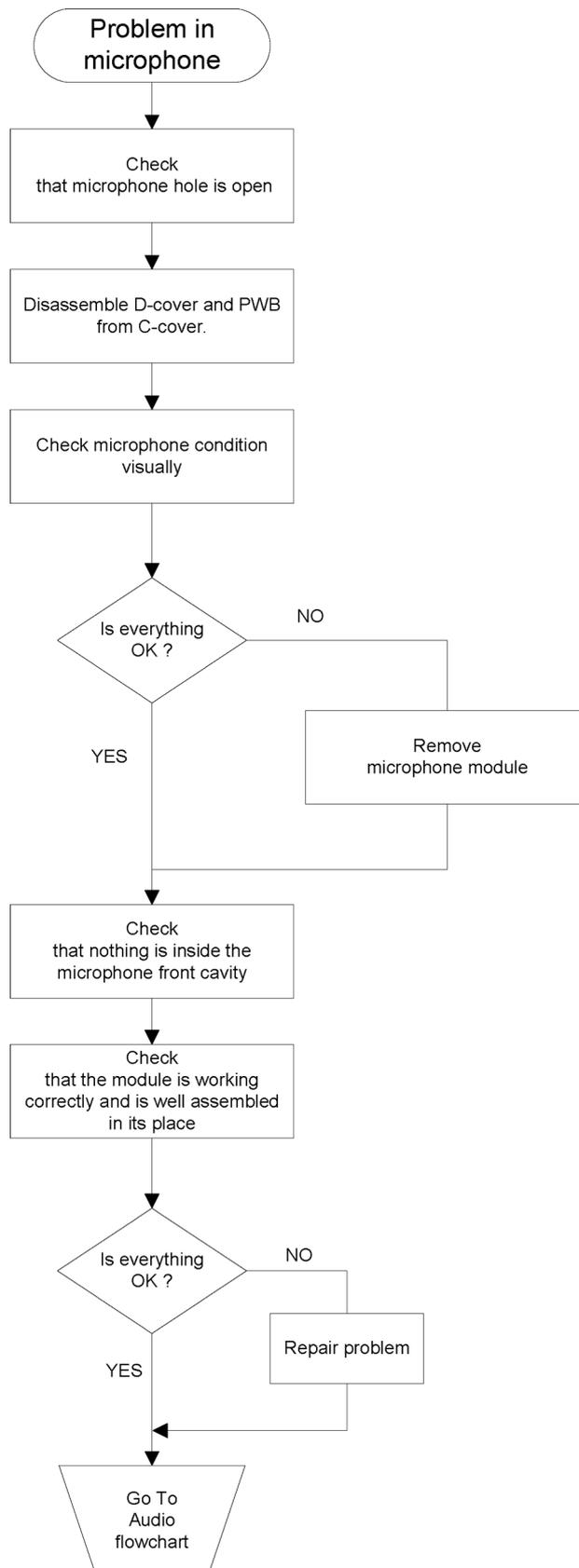
IHF troubleshooting

Troubleshooting flow



Microphone troubleshooting

Troubleshooting flow



■ Baseband manual tuning guide

Certificate restoring for BB5 products

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.

The procedure for certificate restoring is the following:

- Flash the phone with the latest available software using FPS-10 or FPS-20.
 - Note:** USB flashing does not work for a dead BB5 phone.
- Create a request file.
- Send the file to Nokia by e-mail. Use the following addresses depending on your location:
 - APAC: sydney.service@nokia.com
 - CHINA: repair.ams@nokia.com
 - E&A: salo.repair@nokia.com
 - AMERICAS: fls1.usa@nokia.com
- When you receive a reply from Nokia, carry out certificate restoring.
- Tune the phone completely.
 - Note:** SX-4 smart card is needed.
- If the phone resets after certificate restoring, reflash the phone again.

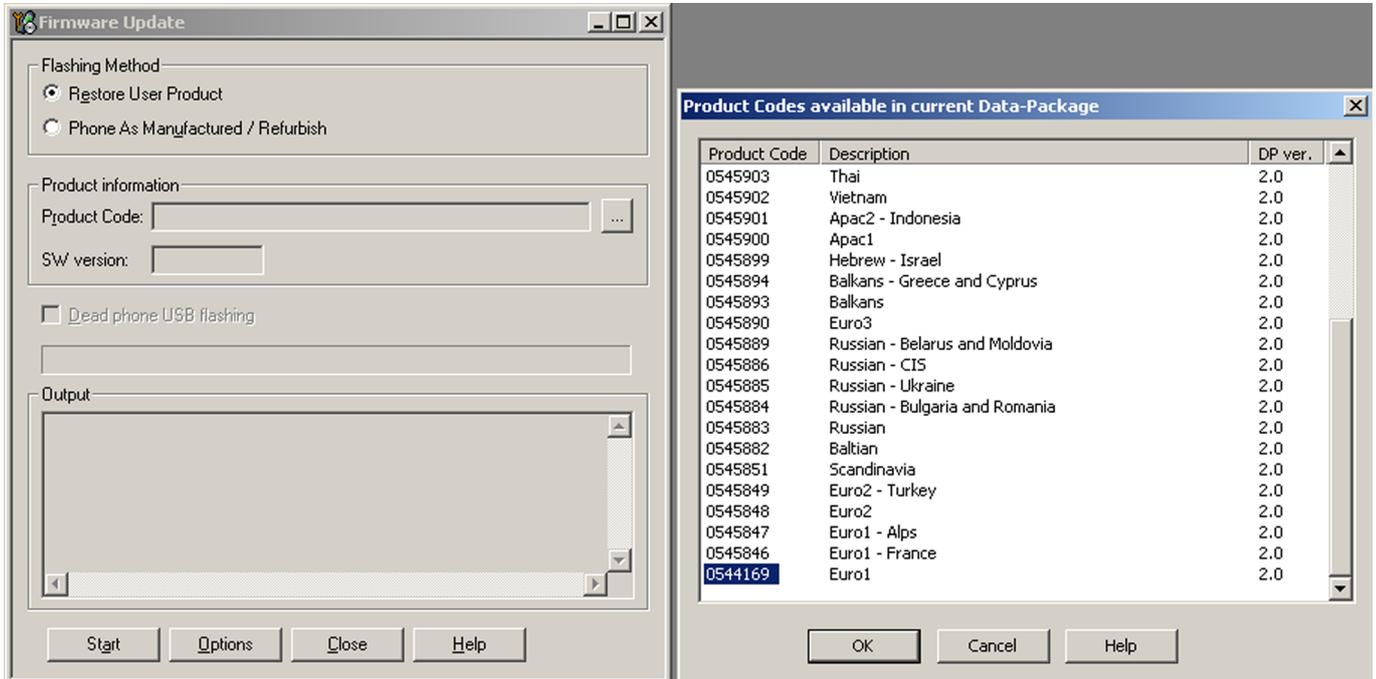
Required equipment and setup:

- Phoenix service software V2006.44.6.163 or newer
- The latest phone model specific Phoenix data package
- PK-1 dongle
- SX-4 smart card (Enables BB5 testing and tuning features)
 - Note:** FPS-10 has an integrated smart card reader.
- Activated e.g FPS-10 flash prommer
- Flash update package V07.04.013 or newer for FPS-10 flash prommer
- CU-4 control unit
- USB cable from PC USB Port to CU-4 control unit
- Phone model specific adapter for CU-4 control unit
- PCS-1 cable to power CU-4 from external power supply
- XCS-4 modular cable between flash prommer and CU-4
 - Note:** CU-4 must be supplied with +12 V from an external power supply in all steps of certificate restoring.

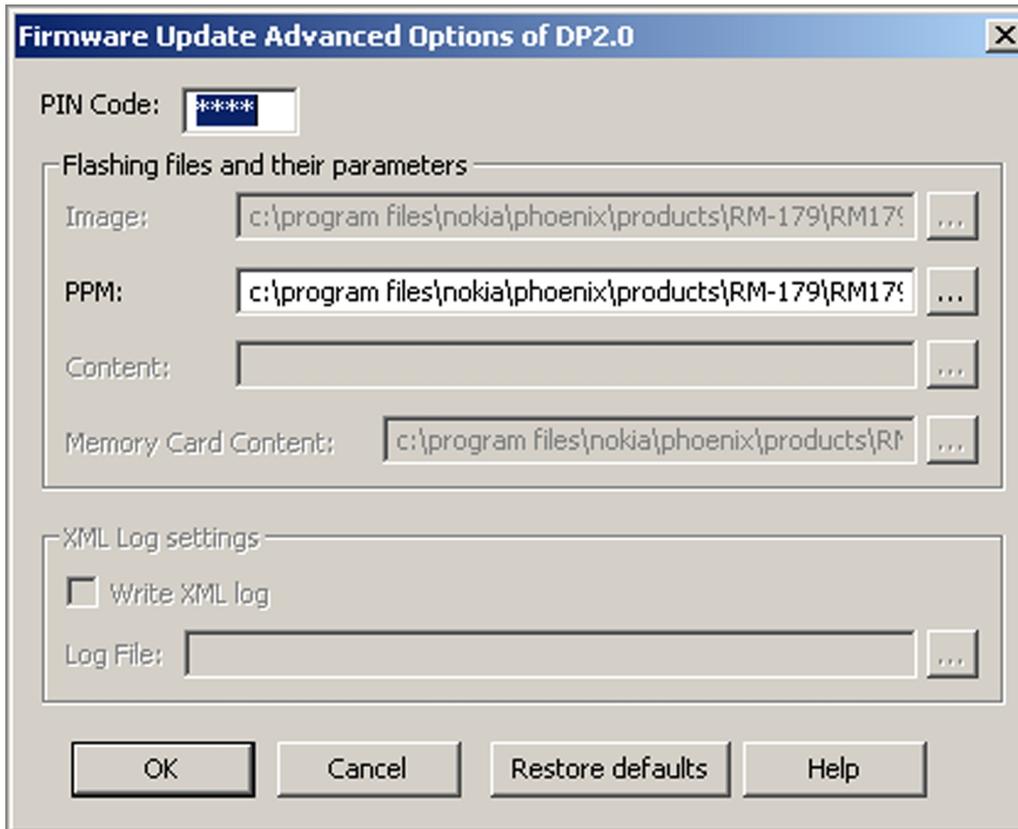
Steps

1. Program the phone software.
 - i Start *Phoenix* and login. Make sure the connection has been managed correctly for FPS-10.
 - ii Update the phone MCU software to the latest available version.
 - If the new flash is empty and the phone cannot communicate with *Phoenix*, reflash the phone.

- iii Choose the product manually from **File**→**Open Product** , and click **OK**.
Wait for the phone type designator (e.g. "RM-1") to be displayed in the status bar.
- iv Go to **Flashing**→**Firmware Update** and wait until *Phoenix* reads the product data as shown in the following picture.

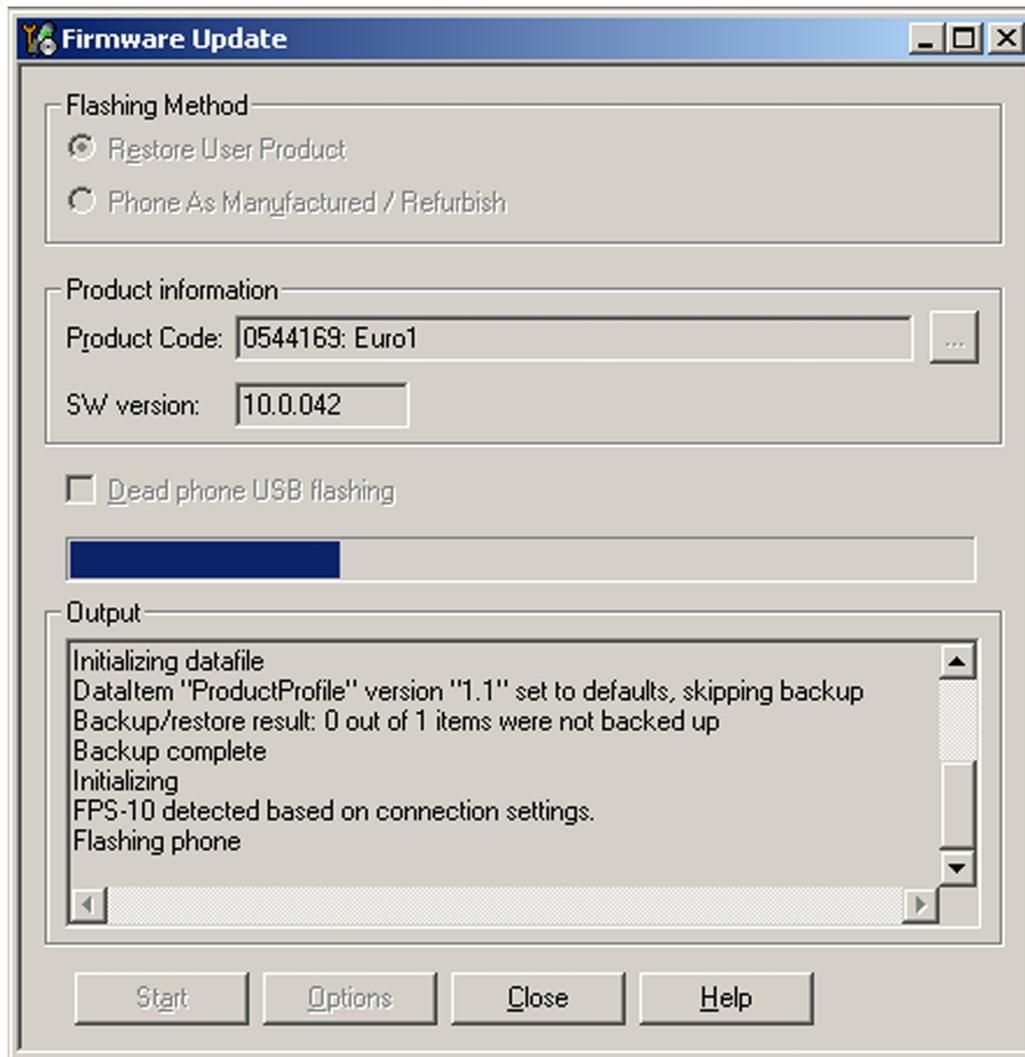


Different flash files can be selected by **Flashing**→**Firmware Update**→**Options** as show in the screenshot below.



- v To continue, click **Start**.

Progress bars and messages on the screen show actions during phone programming, please wait.

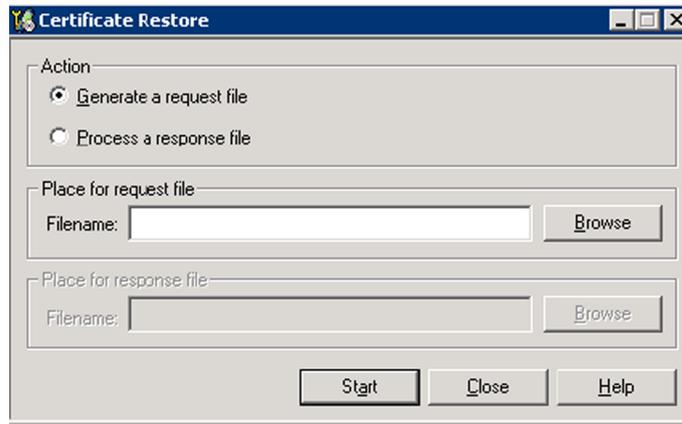


Programming is completed when *Flashing Completed* message is displayed.

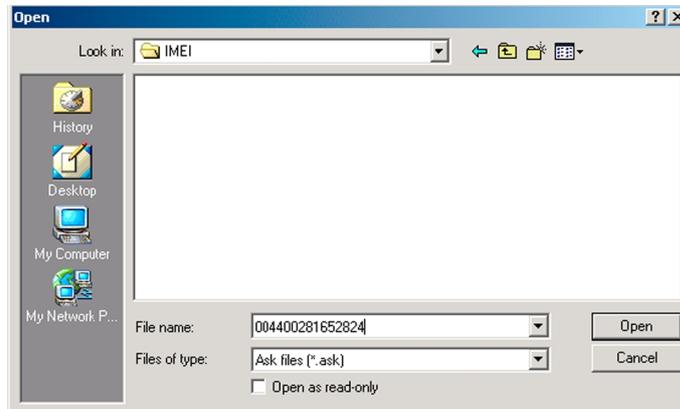
The product type designator and MCU SW version are displayed in the status bar.

- vi Close the *Firmware Update* window and then choose **File**→**Close Product** .
2. Create a *Request* file.
- For this procedure, you must supply +12 V to CU-4 from an external power supply.
- i To connect the phone with *Phoenix*, choose **File**→**Scan Product** .
 - ii Choose **Tools**→**Certificate Restore** .

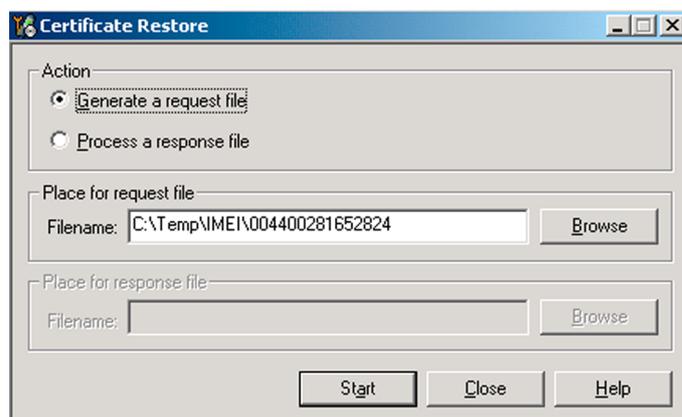
iii To choose a location for the request file, click **Browse**.



iv Name the file so that you can easily identify it, and click **Open**.



The name of the file and its location are shown.



v To create the *Request* file, click **Start**.

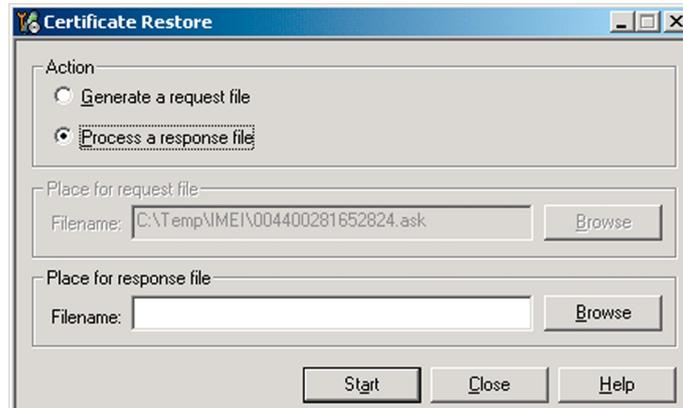
vi When the file for certificate restore has been created, send it to Nokia as an e-mail attachment.

3. Restore certificate.

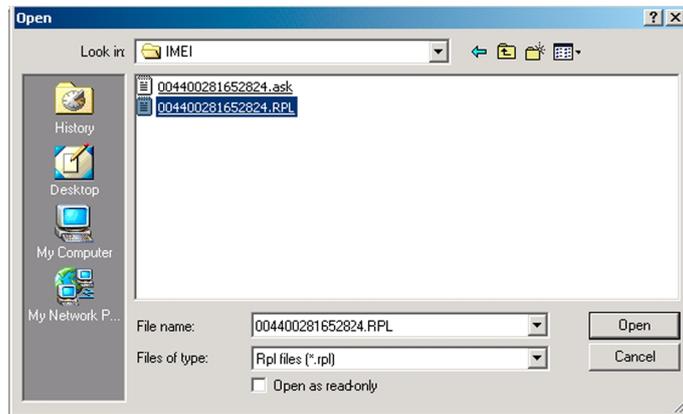
For this procedure, you must supply +12 V to CU-4 from an external power supply.

- i Save the reply file sent by Nokia to your computer.
- ii Start *Phoenix* service software.
- iii Choose **File**→**Scan Product**.

- iv From the **Tools** menu, choose **Certificate Restore** and select **Process a response file** in the *Action* pane.

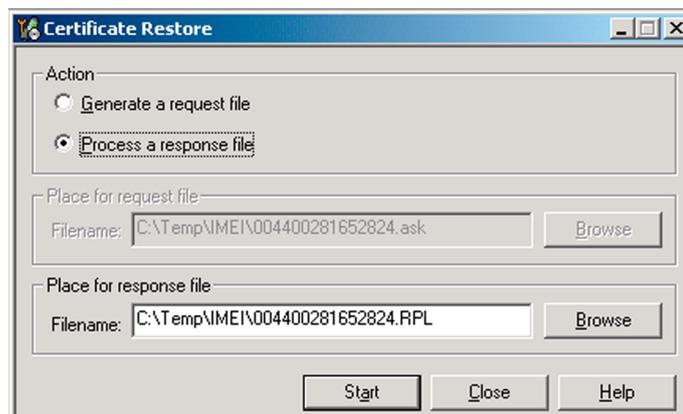


- v To choose the location where response file is saved, click **Browse**.
- vi Click **Open**.



The name of the file and the path where it is located are shown.

- vii To write the file to phone, click **Start**.



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.

Energy management calibration

Prerequisites

Energy Management (EM) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (that is, **battery voltage, BSI, battery current**) to get an accurate AD conversion result.

Hardware setup:

- An external power supply is needed.
- Supply 12V DC from an external power supply to CU-4 to power up the phone.
- The phone must be connected to a CU-4 control unit with a product-specific flash adapter.

Steps

1. Place the phone to the docking station adapter (CU-4 is connected to the adapter).
2. Start *Phoenix* service software.
3. Choose **File**→ **Scan Product**.
4. Choose **Tuning**→**Energy Management**.
5. To show the current values in the phone memory, click **Read**, and check that communication between the phone and CU-4 works.
6. Check that the **CU-4 used** check box is checked.
7. Select the item(s) to be calibrated.

Note: ADC calibration has to be performed before other item(s). However, if all calibrations are selected at the same time, there is no need to perform the ADC calibration first.

8. Click **Calibrate**.

The calibration of the selected item(s) is carried out automatically.

The candidates for the new calibration values are shown in the *Calculated values* column. If the new calibration values seem to be acceptable (please refer to the following "Calibration value limits" table), click **Write** to store the new calibration values to the phone permanent memory.

Table 4 Calibration value limits

Parameter	Min.	Max.
ADC Offset	-20	20
ADC Gain	12000	14000
BSI Gain	1100	1300
VBAT Offset	2400	2650
VBAT Gain	19000	23000
VCHAR Gain	N/A	N/A
IBAT (ICal) Gain	7750	12250

9. Click **Read**, and confirm that the new calibration values are stored in the phone memory correctly. If the values are not stored to the phone memory, click **Write** and/or repeat the procedure again.
10. To end the procedure, close the *Energy Management Calibration* window.

4 — 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).

Pre-baking

These parts are moisture sensitive and must be pre-baked prior to soldering:

- RFIC N7505
- Front End Module (FEM) N7520
- WCDMA PA N7540

Discrete components

In addition to the key-components, there are a number of discrete components (resistors, inductors and capacitors) for which troubleshooting is done mainly by *visual inspection*.

Capacitors: check for short circuits.

Resistors: check value with an ohm meter.

Note: In-circuit measurements should be evaluated carefully

Measuring equipment

All measurements should be done using:

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

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

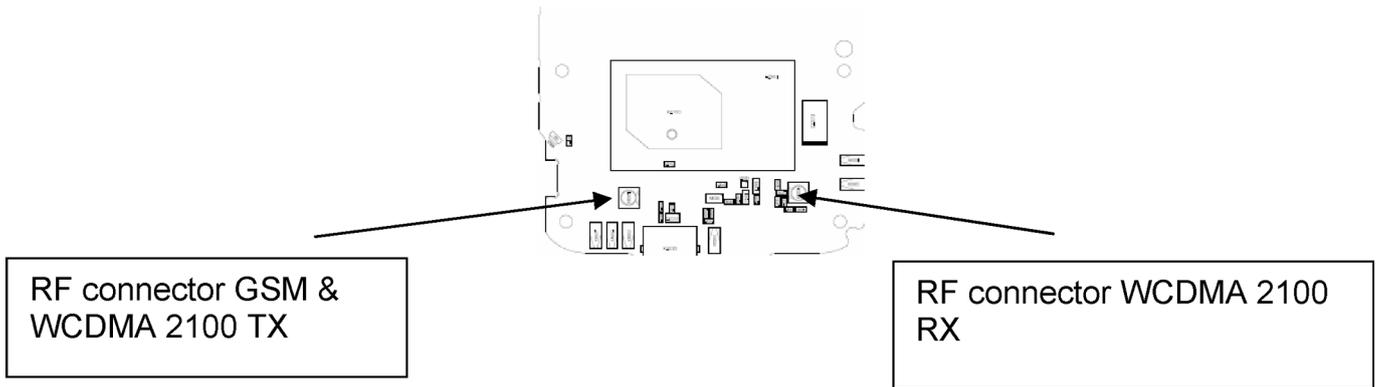
Note: All measurements with an RF coupler should be performed in an RF-shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, testing at frequencies of nearby base stations should be avoided.

Level of repair

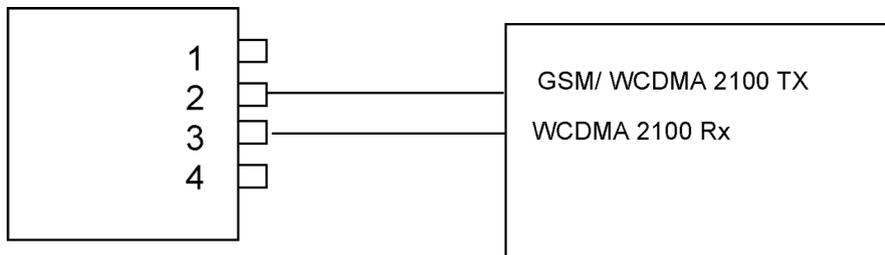
The scope of this guideline is to enable repairs at key-component level. Some key-components are not accessible, i.e. not replaceable. Please refer to the list of [Non-replaceable RF components \(page 4–8\)](#).

General information on RF troubleshooting

The RF frontend solution has two signal paths to the antenna feed points. One signal path is for GSM and WCDMA 2100 Tx (WCDMA transmitter path) and the second one is for WCDMA 2100 RX (WCDMA receiver path). This fact has to be considered when connecting measurement equipment to the product.



This frontend solution needs some attention for the selection and connection of RF test equipment. Connection of multiport test equipment (for example R&S CMU 200) is shown in the figure below.



Port 2 is configured as out and in port; port 3 is configured as out port.

Connection of single port test equipment (Ansitsu) is shown in the figure below.

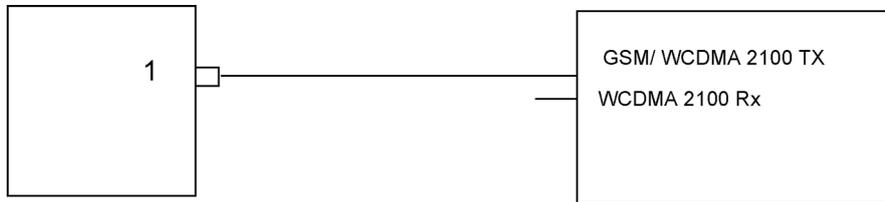


Figure 28 GSM test

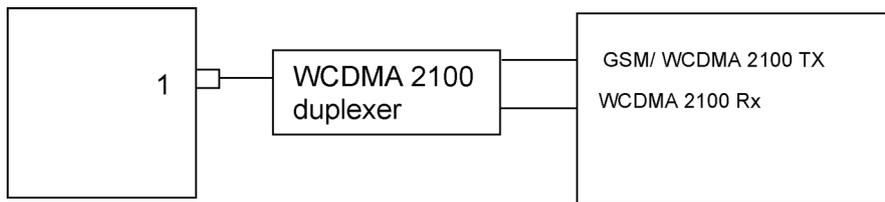


Figure 29 WCDMA 2100 test

Port 2 is configured as out and in port; port 3 is configured as out port.

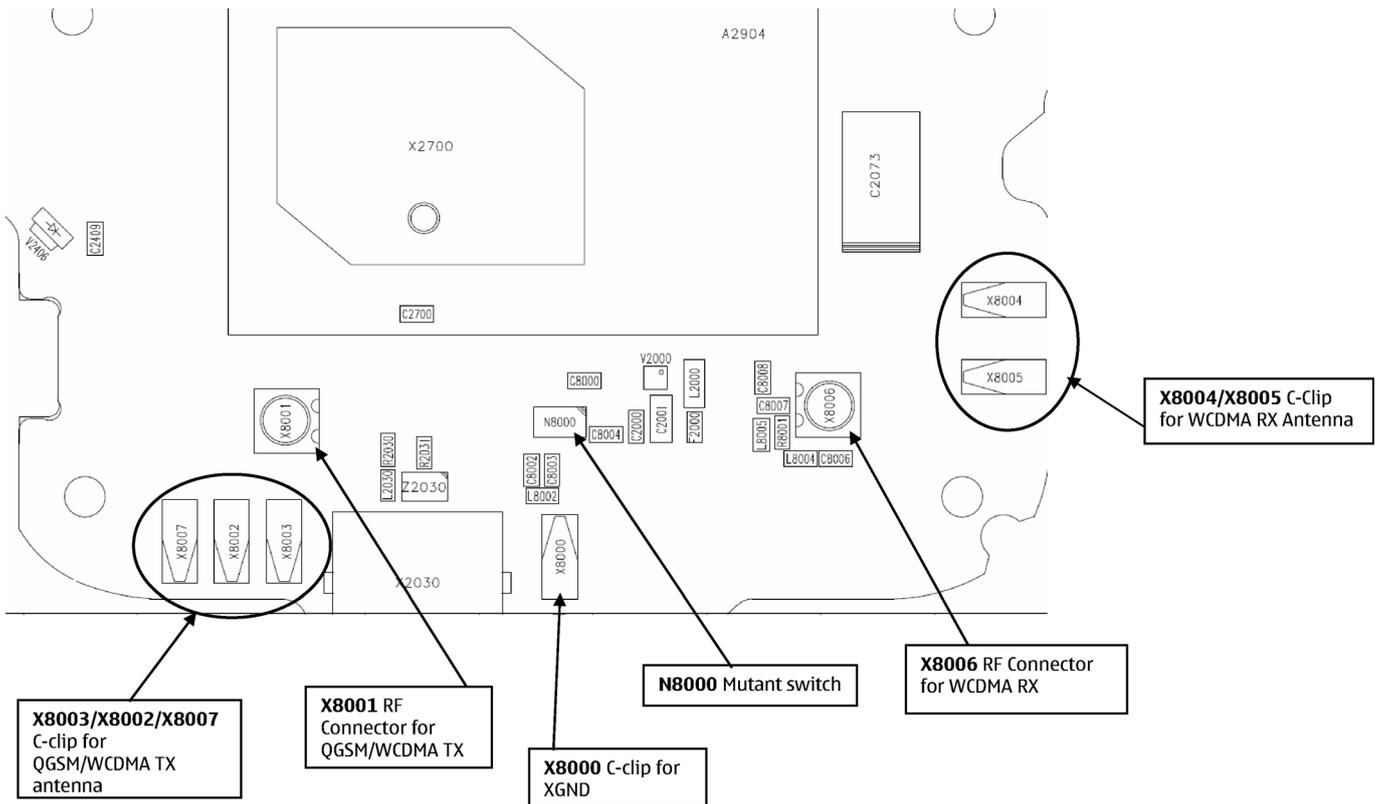
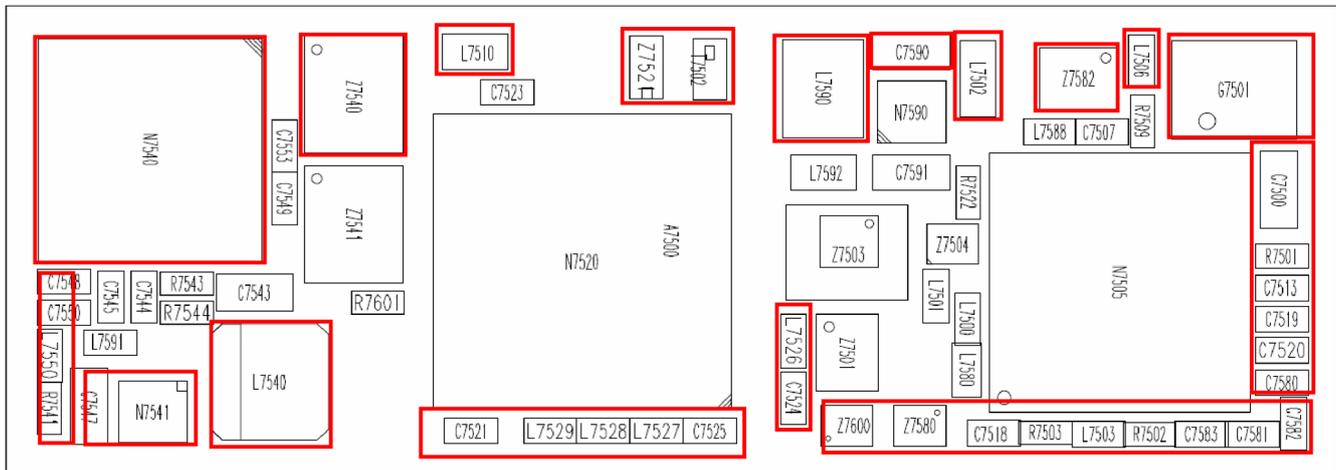


Figure 31 RF key components - bottom

Non-replaceable RF components

The following RF components cannot be replaced because of their location on the PWB:



Non-replaceable RF components			
N7540	L7528	L7506	C7583
C7548	L7527	G7501	R7502
C7550	C7525	C7500	L7503
L7550	L7510	R7501	R7503
R7541	Z7521	C7513	C7518

Non-replaceable RF components			
C7547	T7502	C7519	Z7580
N7541	L7590	C7520	Z7600
L7540	C7590	C7580	C7524
C7521	Z7582	C7582	L7526
L7529	L7502	C7581	

General voltage checking

Steps

1. Set up the main board in the module jig. The phone should be in local mode.
2. Check the following:

#	Signal name	Test point	Voltage (all bands)
1	VCTOX0 supply	R7501	2.5 V
2	Ahneus supply from Dc/Dc conv.	C7590	3.2 V
3	FEM supply	L7510	3.9 V
4	WCDMA PA supply from Dc/Dc conv.	C7543	0 V (minimum 1.3 V when transmitting)
5	Vbat at WCDMA PA	C7547	3.9 V
6	Supply input to DC/DC conv (N7590)	L7592	3.9 V

* With these settings, the result should be 1.3 V.

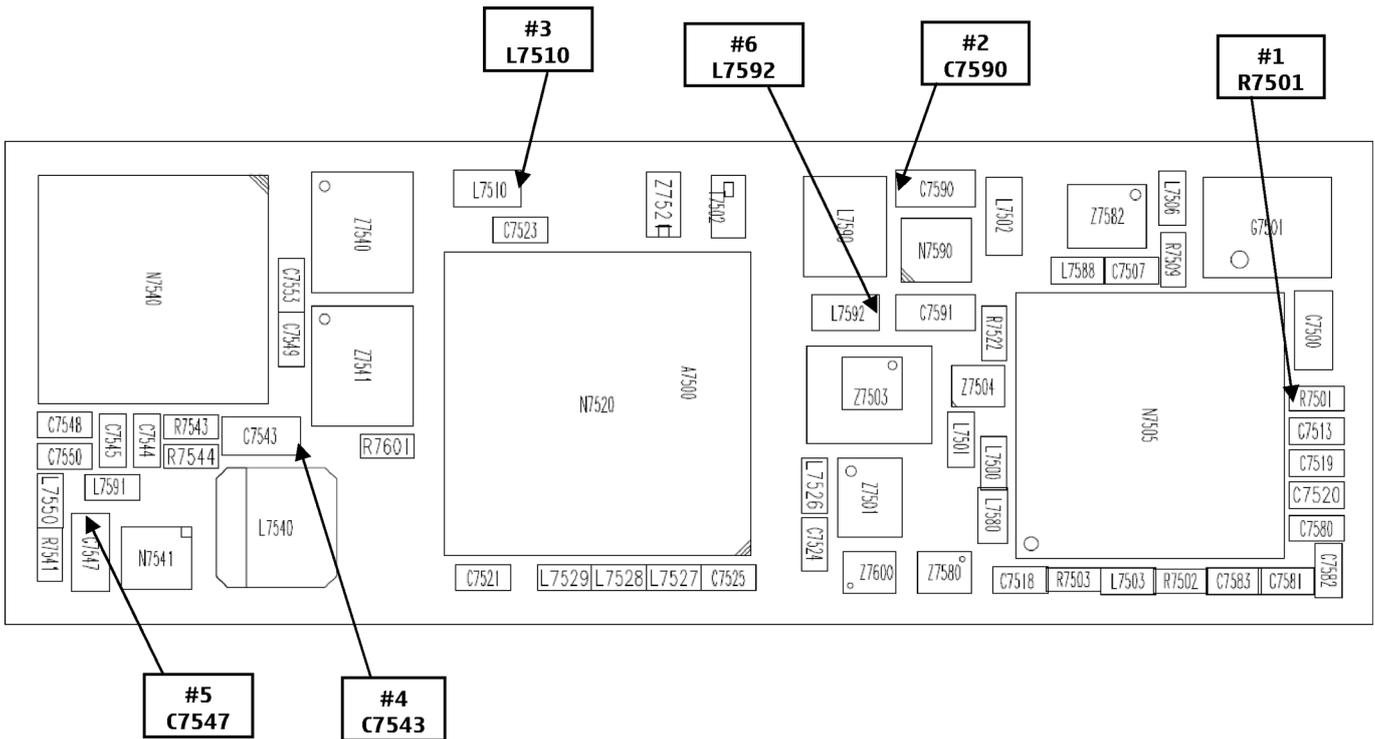


Figure 32 General voltage checking test points

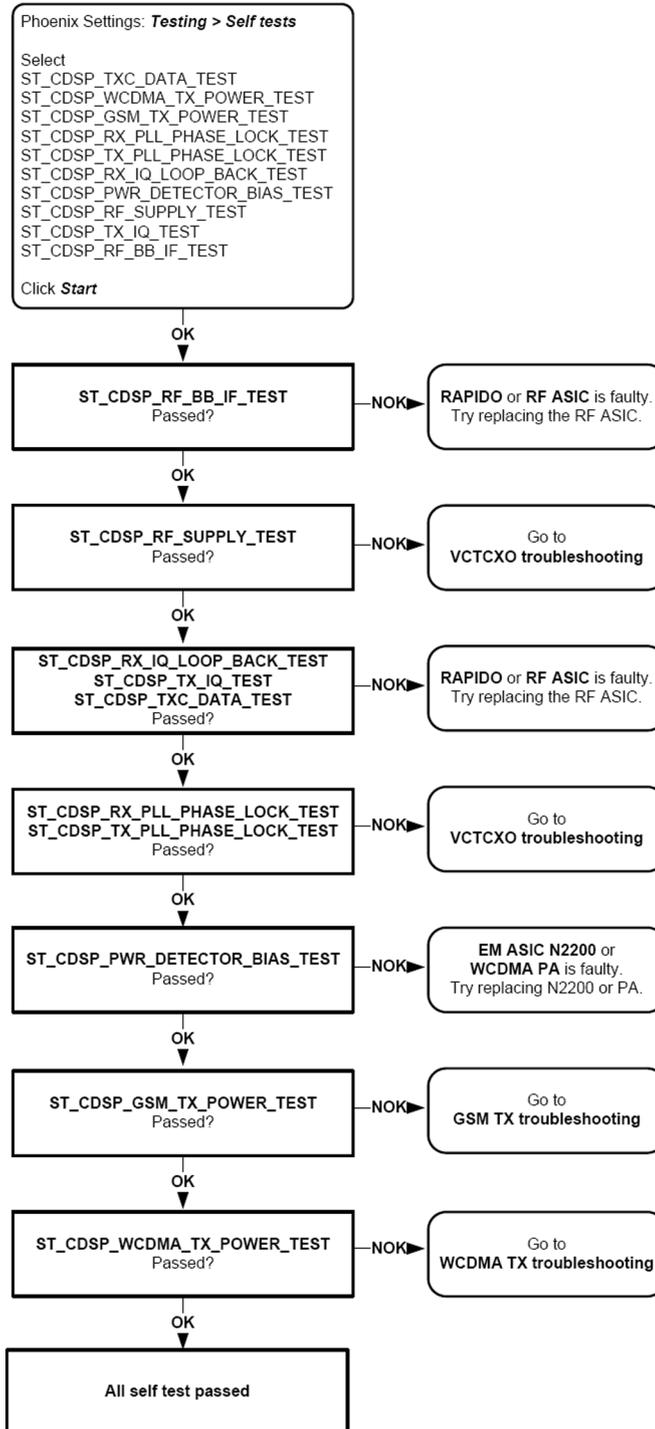
Phoenix self tests

Context

Always start the troubleshooting procedure by running the Phoenix self tests. If a test fails, please follow the diagram below.

If the phone is dead and you cannot perform the self tests, go to *Dead or jammed device troubleshooting*, in the baseband troubleshooting section.

Troubleshooting flow



Receiver troubleshooting

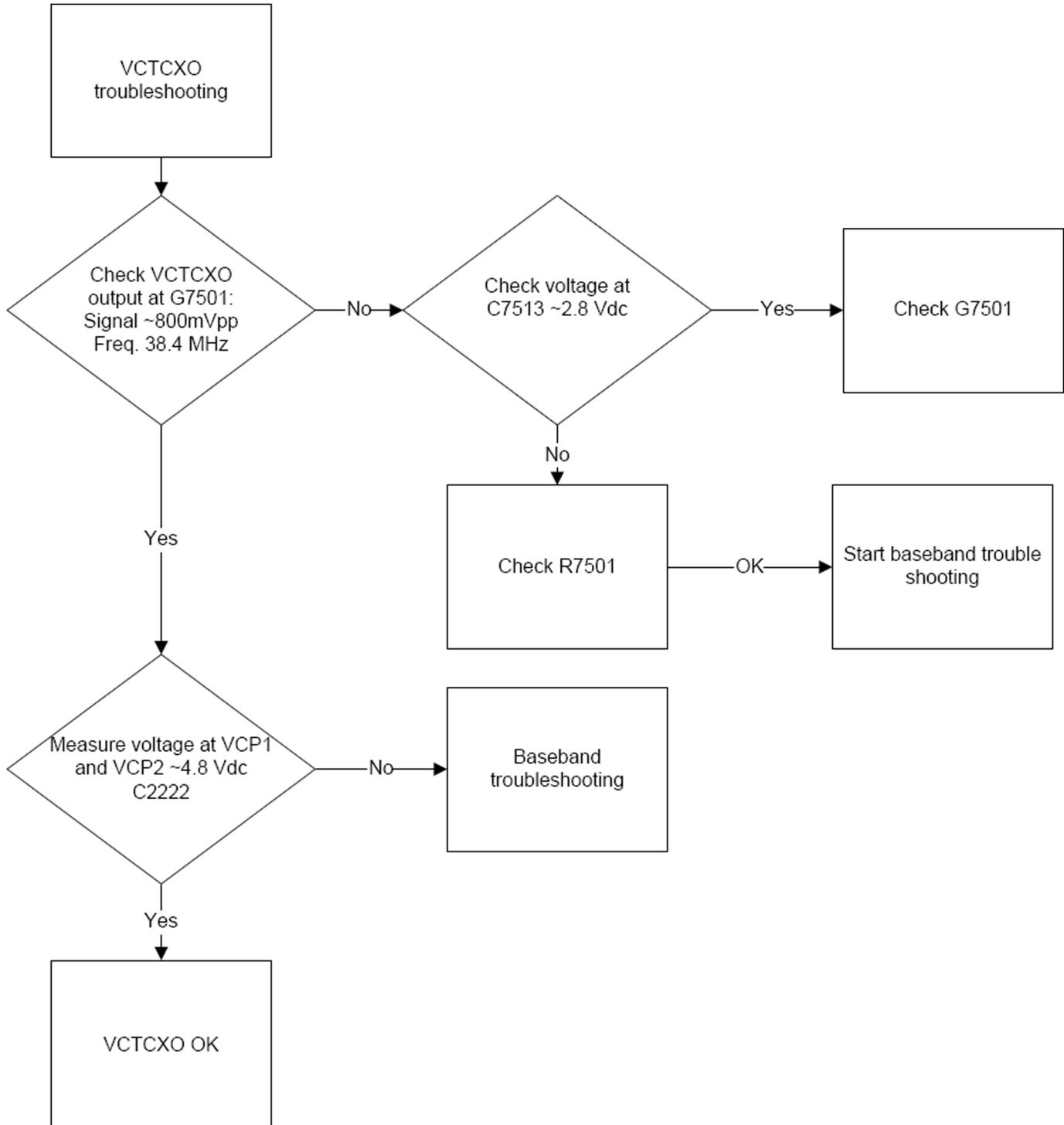
Introduction to receiver (RX) troubleshooting

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 \(page 4-17\)](#). For a similar test in WCDMA mode, see [WCDMA RSSI measurement \(page 4-20\)](#).

VCTCXO troubleshooting

Troubleshooting flow



RX GSM850 troubleshooting

Troubleshooting flow



RX GSM900 troubleshooting

Troubleshooting flow



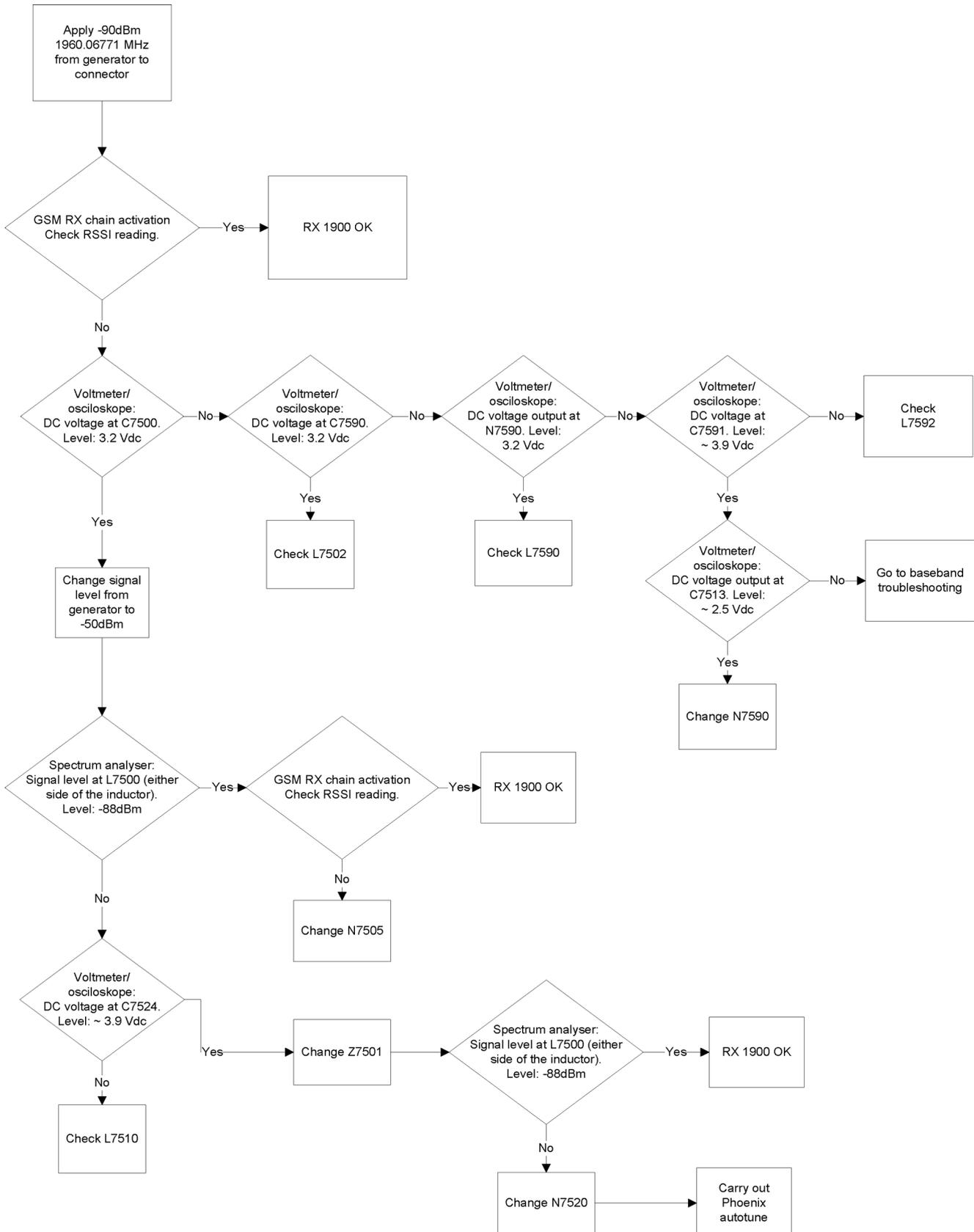
RX GSM1800 troubleshooting

Troubleshooting flow



RX GSM1900 troubleshooting

Troubleshooting flow



GSM RX chain activation for manual measurements/GSM RSSI measurement

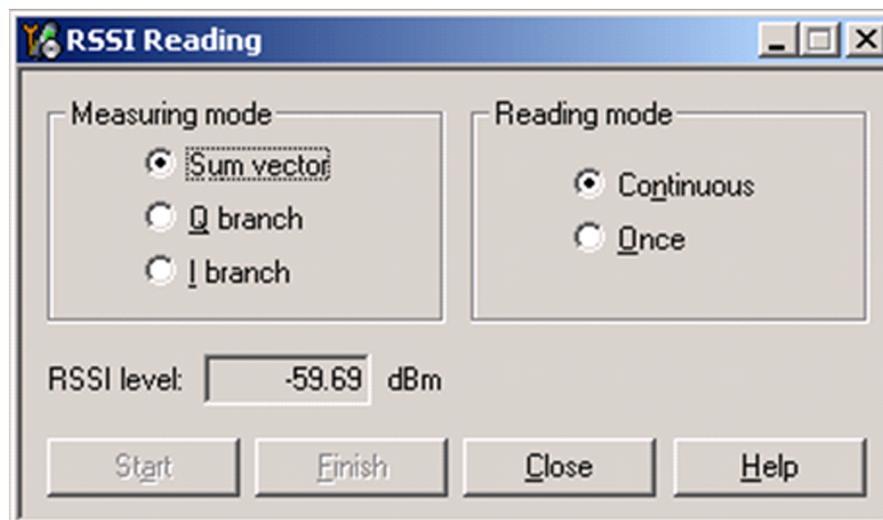
Prerequisites

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 (67.71kHz offset) at -60dBm	942.46771MHz (67.71kHz offset) at -60dBm	1842.86771MHz (67.71kHz offset) at -60dBm	1960.06771MHz (67.71kHz offset) at -60dBm

Steps

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



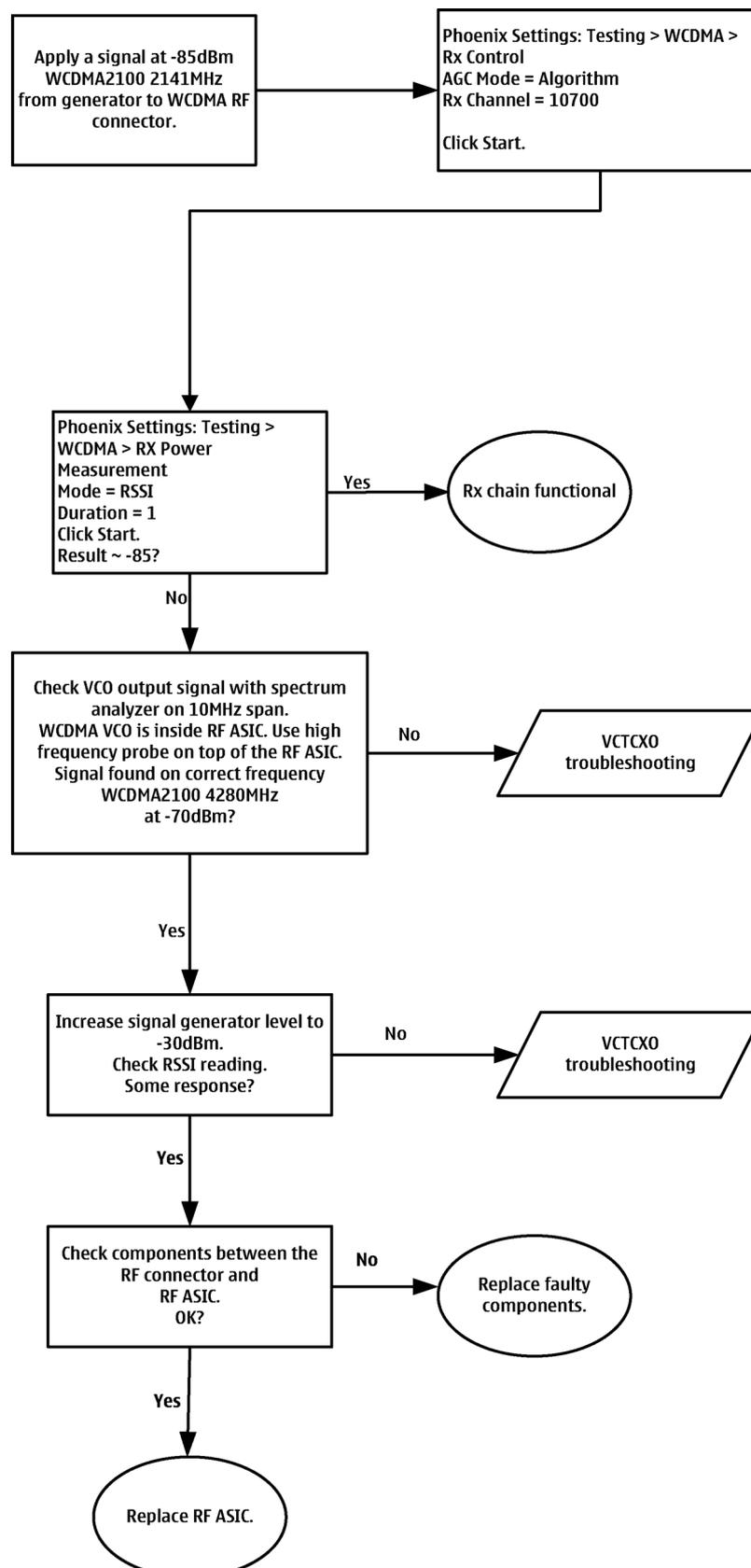
Results

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 receiver troubleshooting

Troubleshooting flow



WCDMA RX chain activation for manual measurement

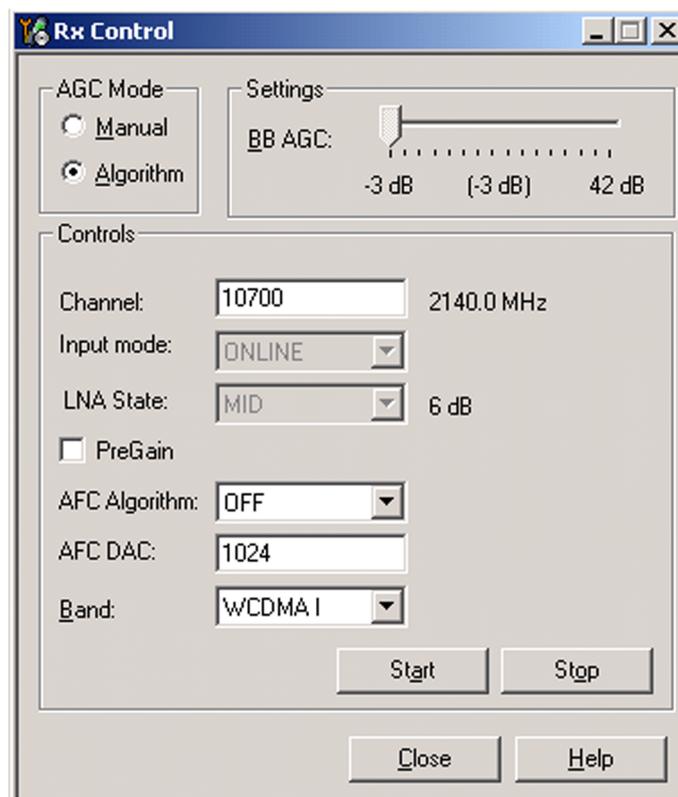
Prerequisites

Make the following settings in Phoenix service software:

Setting	WCDMA2100
Phoenix Channel	10700
Signal generator to antenna connector	2141.0 MHz

Steps

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



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.

4. Set the following RF generator settings:

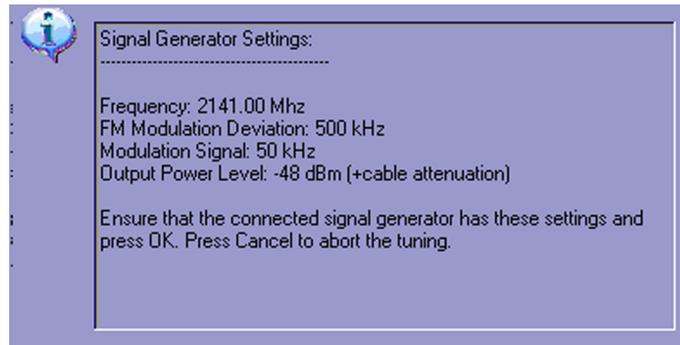


Figure 33 WCDMA RX generator settings

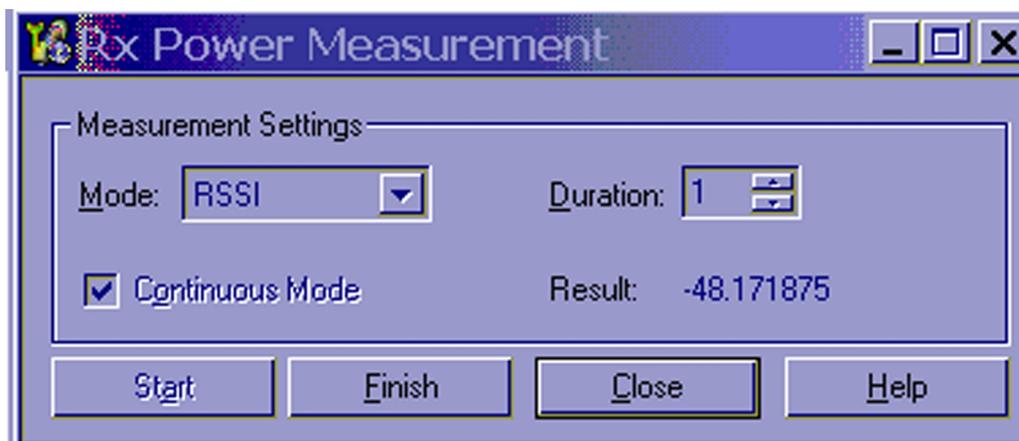
WCDMA RSSI measurement

Prerequisites

WCDMA RX must be activated before RSSI can be measured. For instructions, please refer to [WCDMA RX chain activation \(page 4-19\)](#).

Steps

1. From the Phoenix testing menu, select **WCDMA**→**RX Power measurement**
2. In the RX Power measurement window, select:
 - Mode: RSSI
 - Continuous mode



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

■ 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**).

Use the following settings:

RF Controls

Common GSM RF Control Values

Active Unit: Tx Rx/Tx Channel: 37 897.400000

Band: GSM 900 AFC: -28

Operation Mode: Burst

RX Control Values

Monitor Channel: 37 942.400000

AGC: 22

TX Control Values

Edge: Off Tx Data Type: Random

Tx PA Mode: High Tx Power Level: 5

Stop Close Help

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

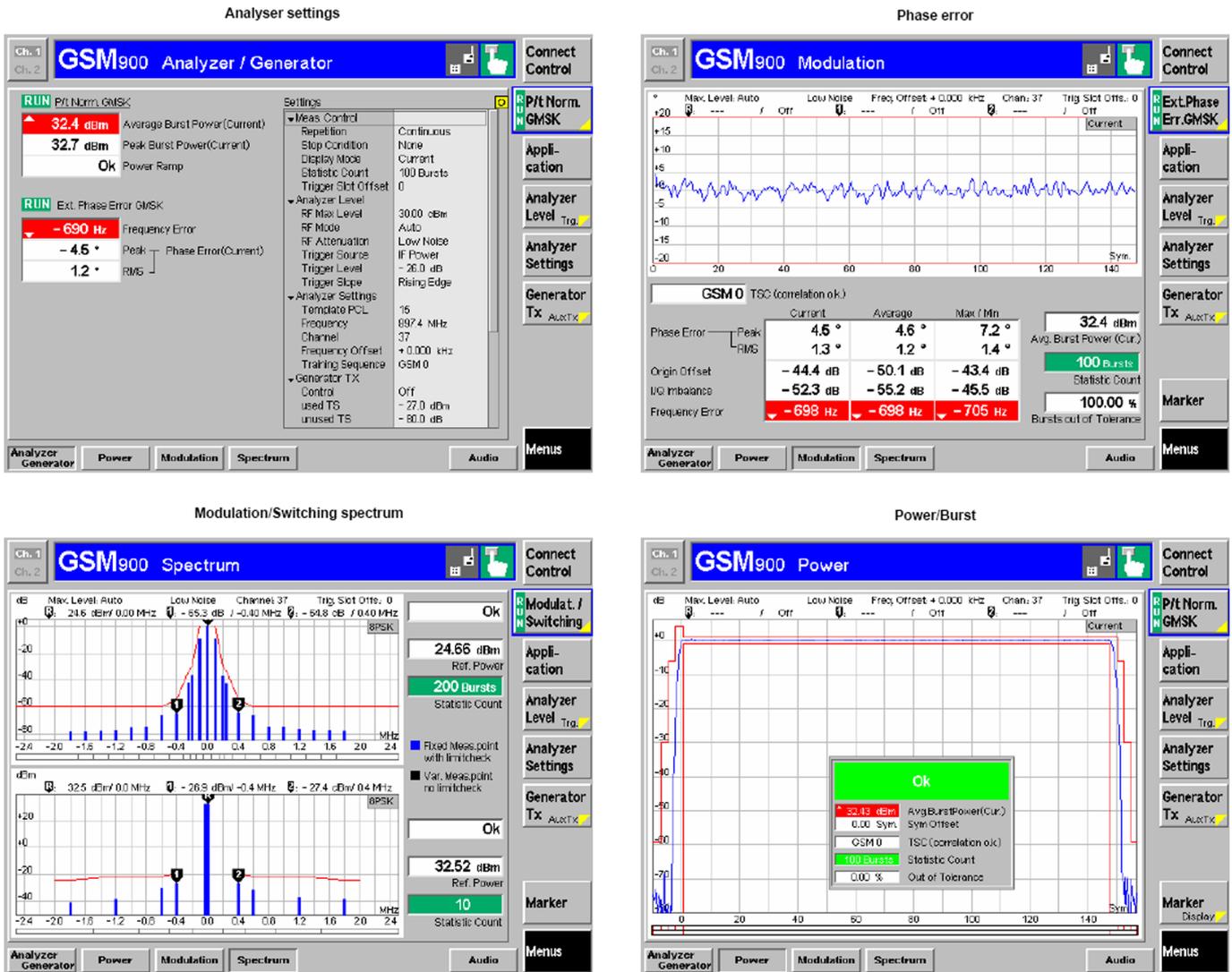


Figure 34 Typical readings

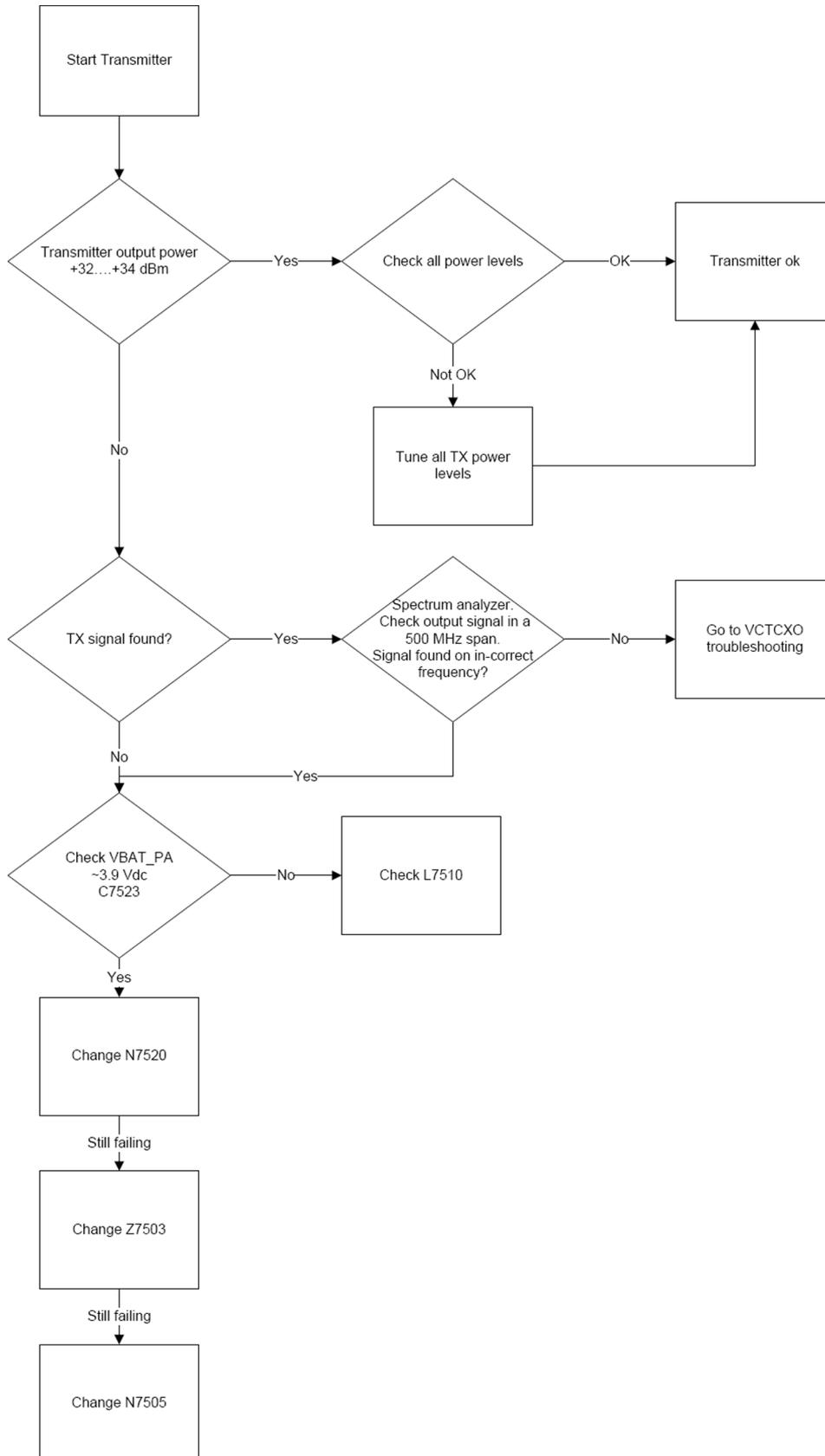
4. Change the power level (RF controls) and make sure the power reading follows accordingly.

Next actions

You can troubleshoot the GSM transmitter for each GSM band separately, one band at a time. If you want to troubleshoot GSM850, GSM1800 or GSM1900, change the band with the RF controls and set the communication analyser accordingly.

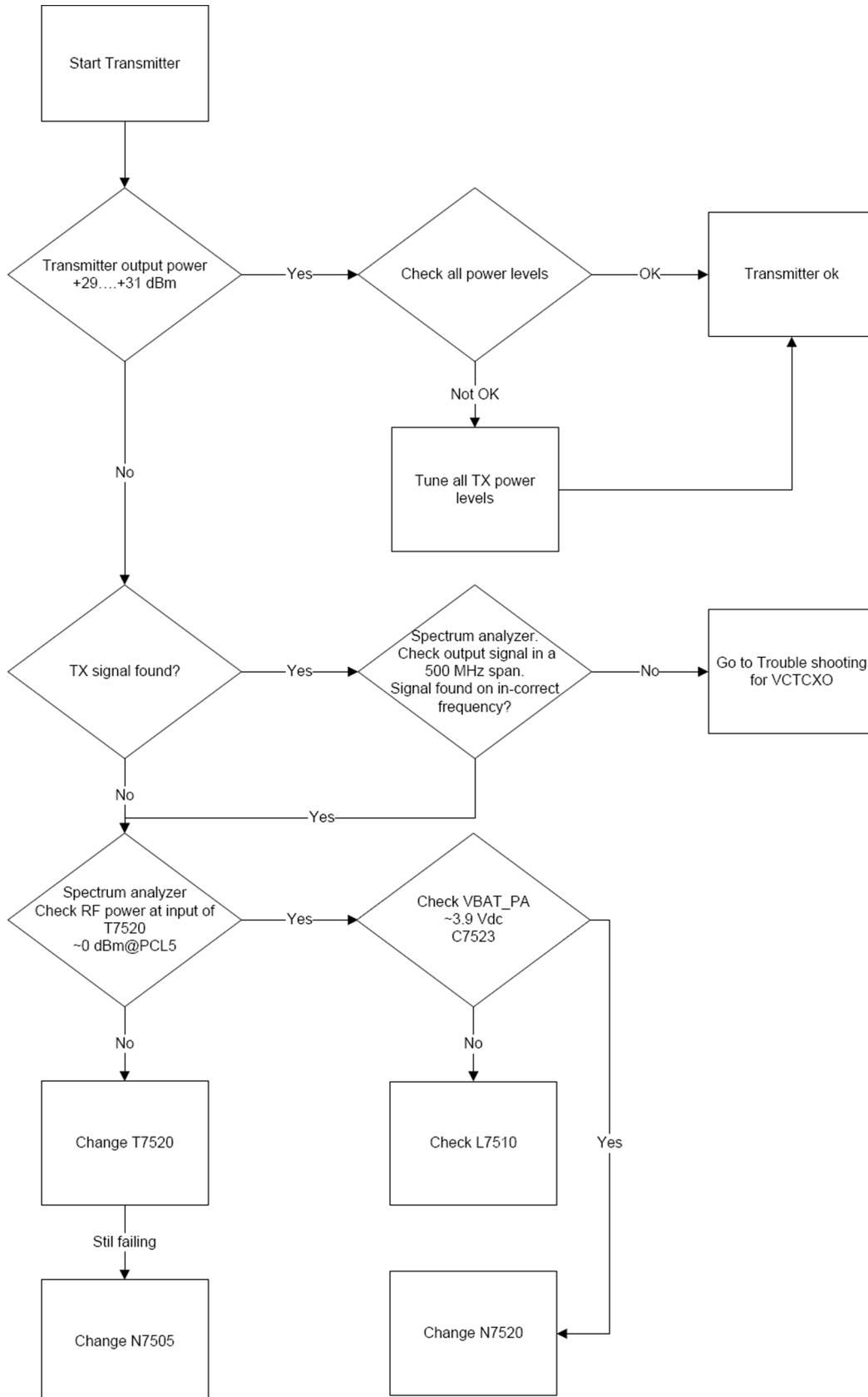
TX 850/900 troubleshooting

Troubleshooting flow



TX 1800/1900 troubleshooting

Troubleshooting flow



Checking antenna functionality

The device has a main GSM and WCDMA 2100 antenna. The main antenna is the visible gold structure on the black plastic carrier. The main antenna has six connections to the PWB via C-clips. The main antenna consist of two radiator structures for quadband GSM/ WCDMA 2100 TX and a WCDMA 2100 RX.

The BT/Wlan antenna is the visible flexid PWB covered with black paint. The antenna is connected to the PWB with two C-clips.



Main (GSM/ WCDMA 2100) antenna

BT/ WLAN antenna

Main antenna functionality

The main antenna is an active antenna. It is functioning normally when the feeds and the GND have proper connection to the PWB.

The radiator is made from a durable gold colored conductive layer. This layer has to be visually intact.

The main antenna functionality must be checked by measuring the transmitted power with an RF coupler at GSM 1800 channel 610 and GSM 900 channel 37. The test in GSM 1800 and GSM 900 take care that the active path (XGND) of the antenna is working.

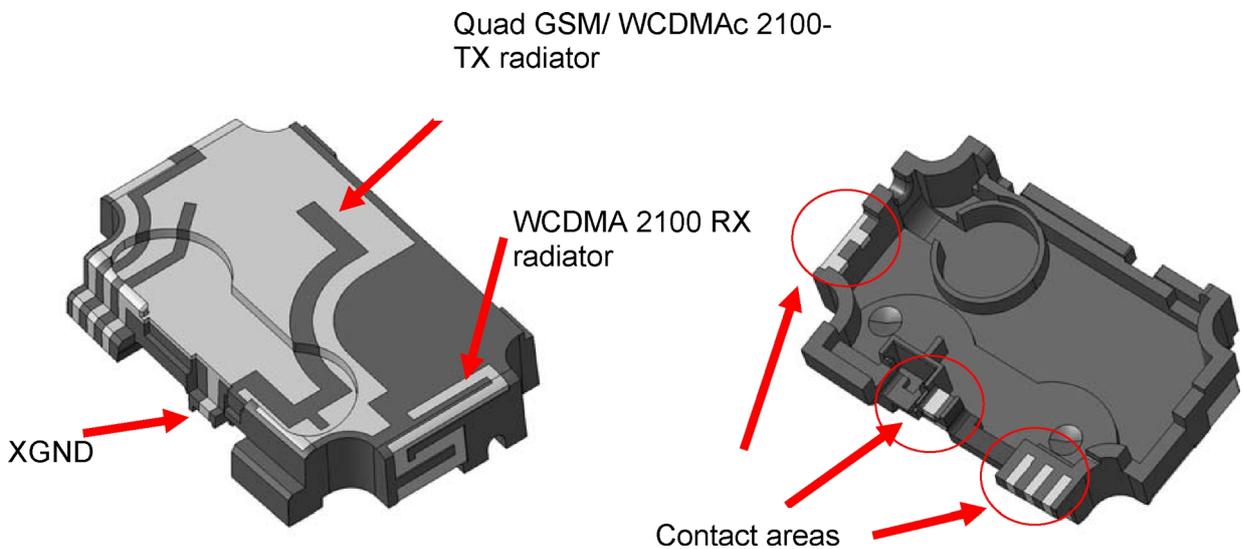
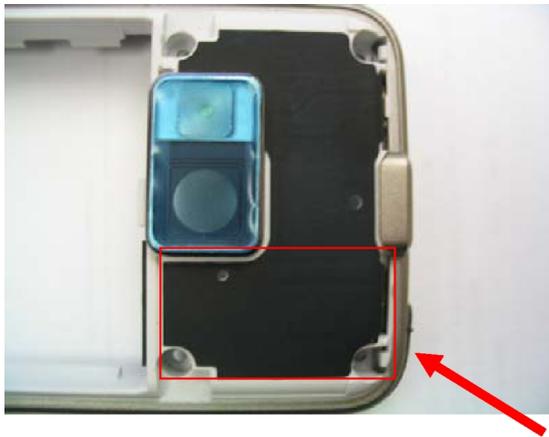


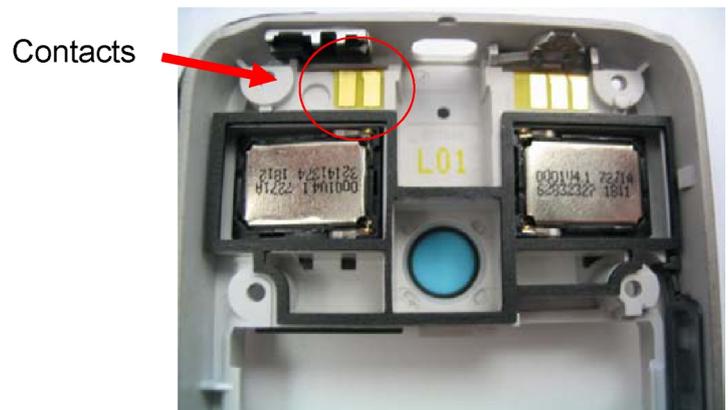
Figure 35 Main antenna

BT/WLAN antenna functionality

The BT/WLAN antenna is functioning normally when the feeds and the GND have proper connection to the PWB. The radiator is made from a flexid PWB which has to be visually intact.



Area of the BT/ WLAN
antenna radiator



WCDMA transmitter troubleshooting

Steps

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

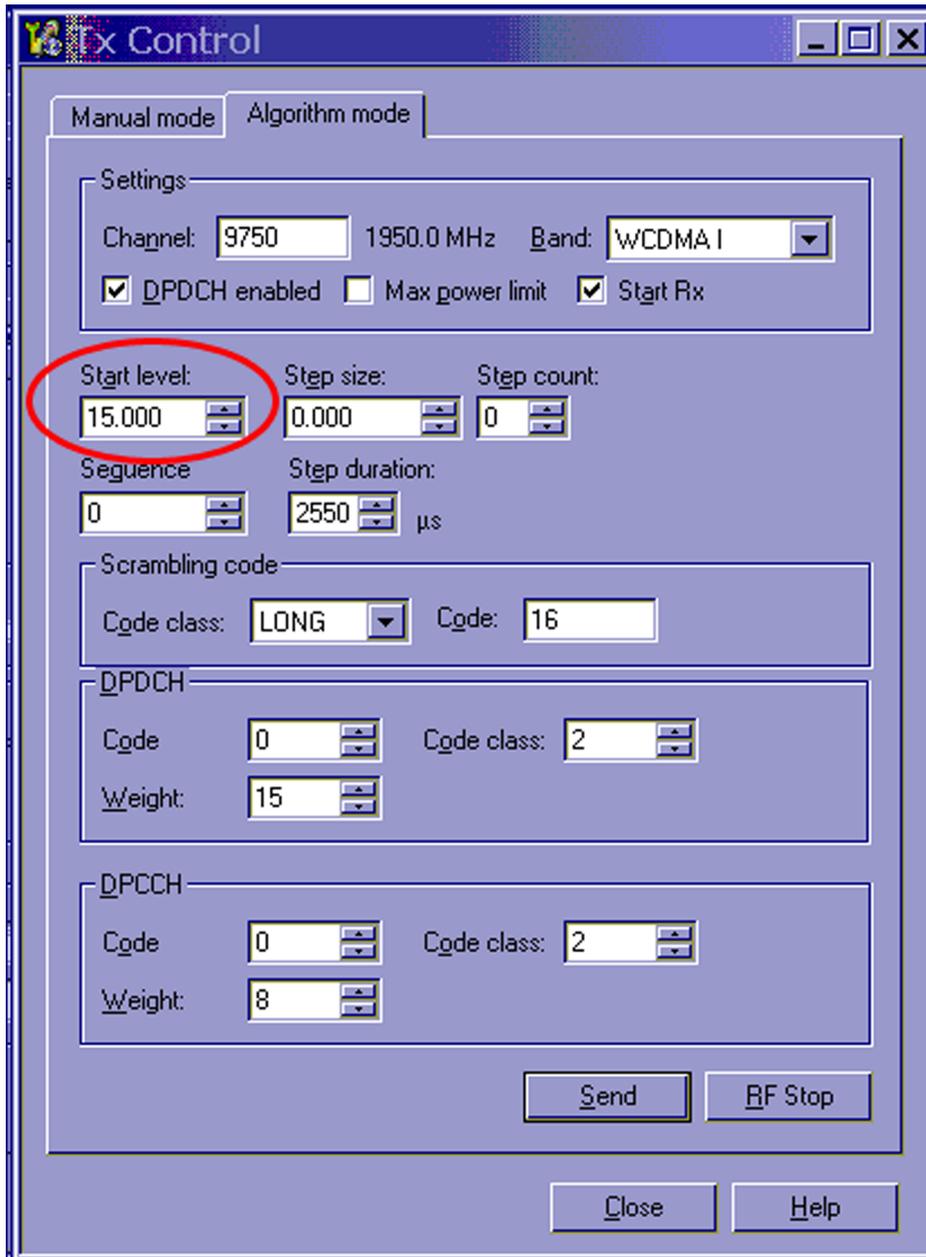


Figure 36 Phoenix WCDMA TX control window

Note: Use the **Start level** option to set the TX power level.

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. Use the CMU200 to check the WCDMA power.

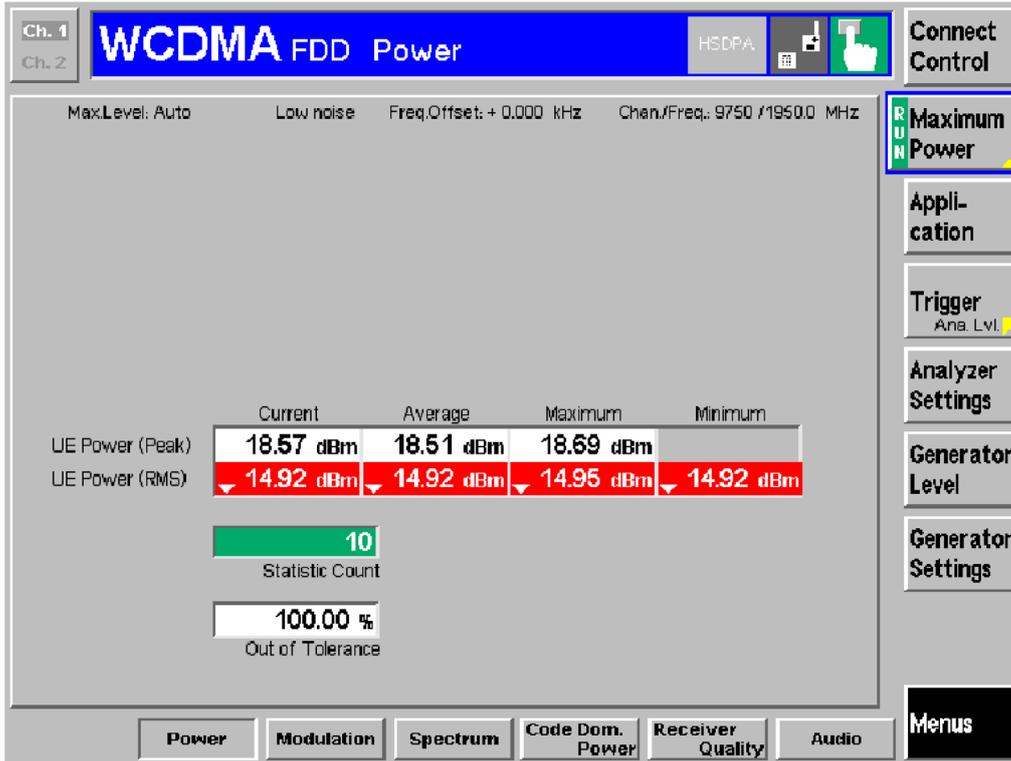
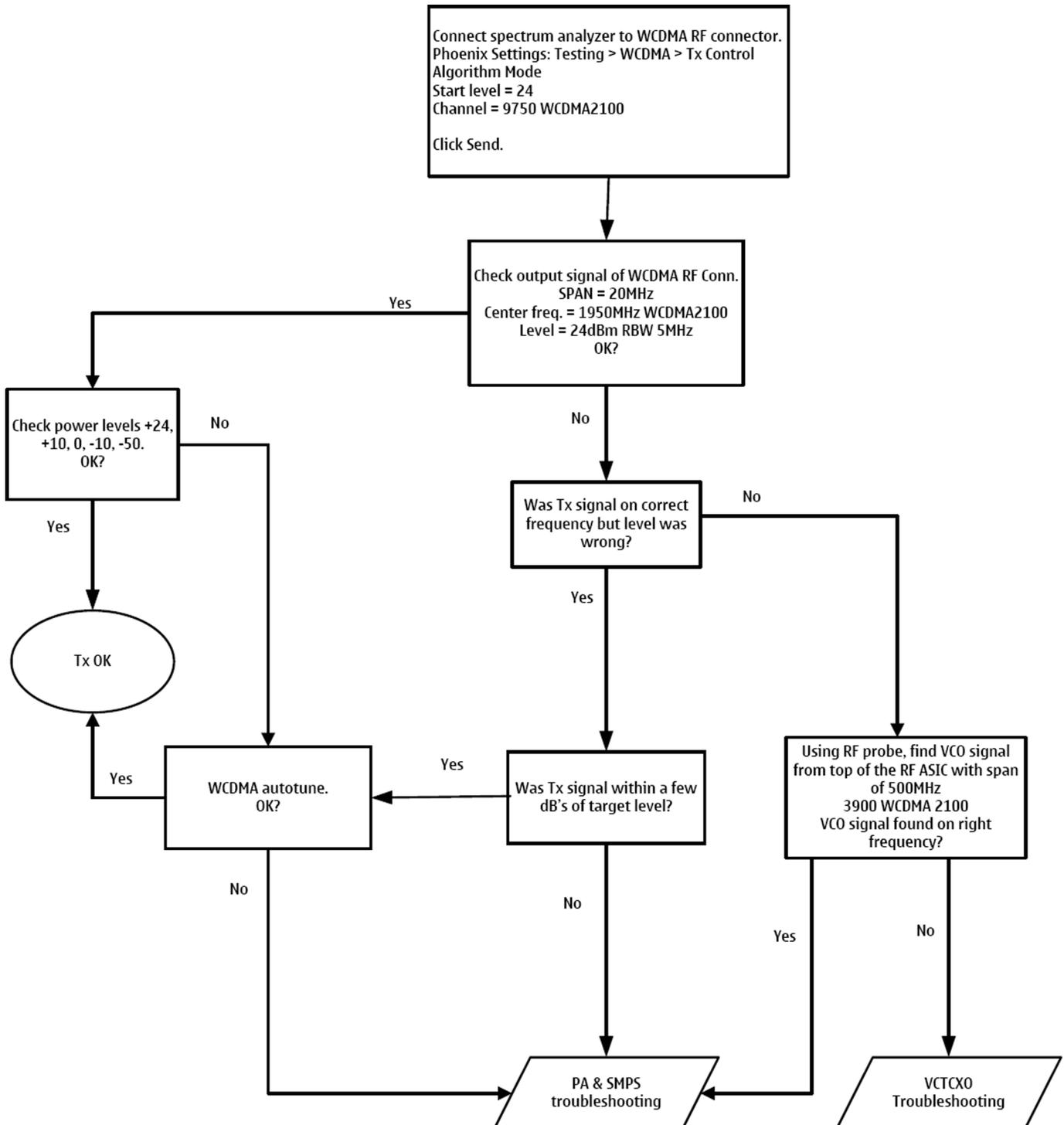


Figure 37 WCDMA power window

WCDMA transmitter troubleshooting flowchart

Troubleshooting flow



RF tunings

Introduction to RF tunings

Important: Only perform RF tunings if:

- one or more of the RF components have been replaced
- flash memory chip is replaced or corrupted.

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

Important: After RF component replacements, **always** use autotuning. Manual tunings are only required in rare cases.

Cable and adapter losses

RF cables and adapters have some losses. They have to be taken into account when the phone is tuned. As all RF losses are frequency dependent, the user has to act very carefully and understand the measurement setup.

For RF attenuations of the module jig, please refer to the Service tools section.

Autotuning for BB5

This phone can be tuned automatically.

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

Hardware set up

Hardware requirements for auto tuning:

- PC (Windows 2000/XP) with GPIB card
- Power supply
- Product specific module jig
- Cables: XRF-1 (RF cable), USB cable, GBIP cable and DAU-9S
- Signal analyser (TX), signal generator (RX) and RF-splitter *or* one device including all.

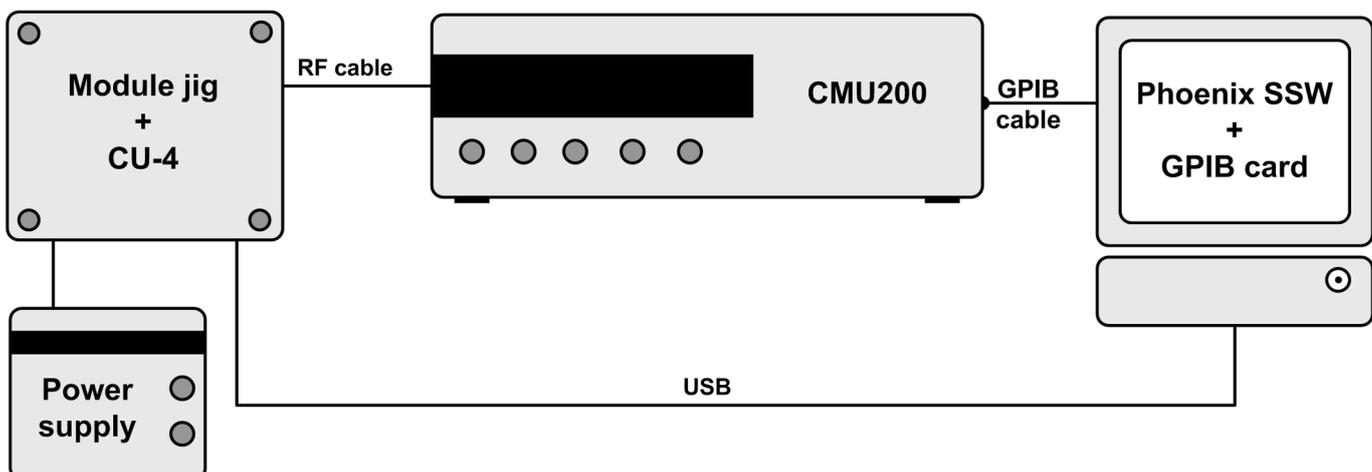


Figure 38 Auto tuning concept with CMU200

Phoenix preparations

Install the phone-specific data package. This defines the phone-specific settings.

Auto tuning procedure

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

- 2 To go to autotune, select *Tuning (Alt-U) > Auto-Tune (Alt-A)* from the menu.
- 3 Remember to set the correct attenuation values before autotuning.
- 4 To start autotuning, click the *Tune* button.

■ System mode independent manual tunings

RF channel filter calibration

Context

RF channel filter calibration tunes the internal low pass filters of the RF ASIC, that limit the bandwidth of BB IQ signals.

Table 5 Rf channel filter calibration tuning limits

	Min	Typ	Max
Tx filter	0	10	31
RX mixer	0	13	31
Rx filter	0	16	31

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning** → **Rf Channel Filter Calibration**.
3. Click **Tune**.
4. To save the values to the PMM (Phone Permanent Memory) area, click **Write**.
5. To close the *Rf Channel Filter Calibration* window, click **Close**.

Results

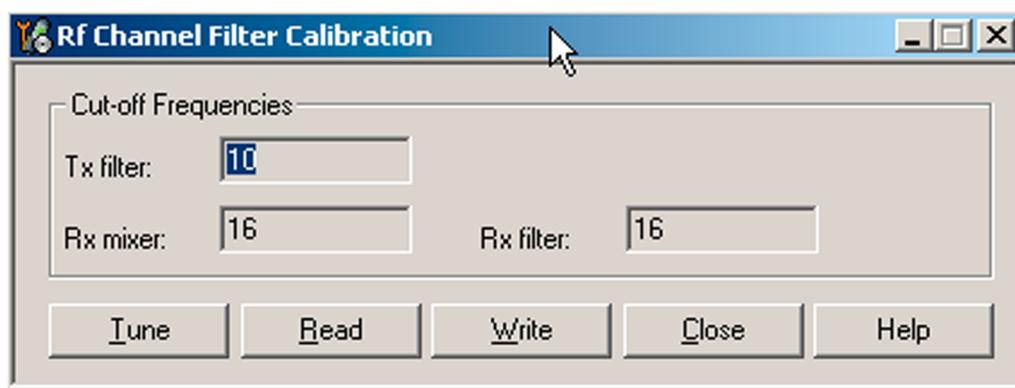


Figure 39 Rf channel filter calibration typical values

PA (power amplifier) detection

Context

The PA detection procedure detects which PA manufacturer is used for phone PAs.

If a PA is changed or if the permanent memory (PMM) data is corrupted, PA detection has to be performed before Tx tunings.

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning**→**PA Detection** .
3. Click **Tune**.
4. Check that the detected PA manufacturers are corresponding to the actual chips on the board.
5. To end the procedure, click **Close**.

■ GSM receiver tunings

Rx calibration (GSM)

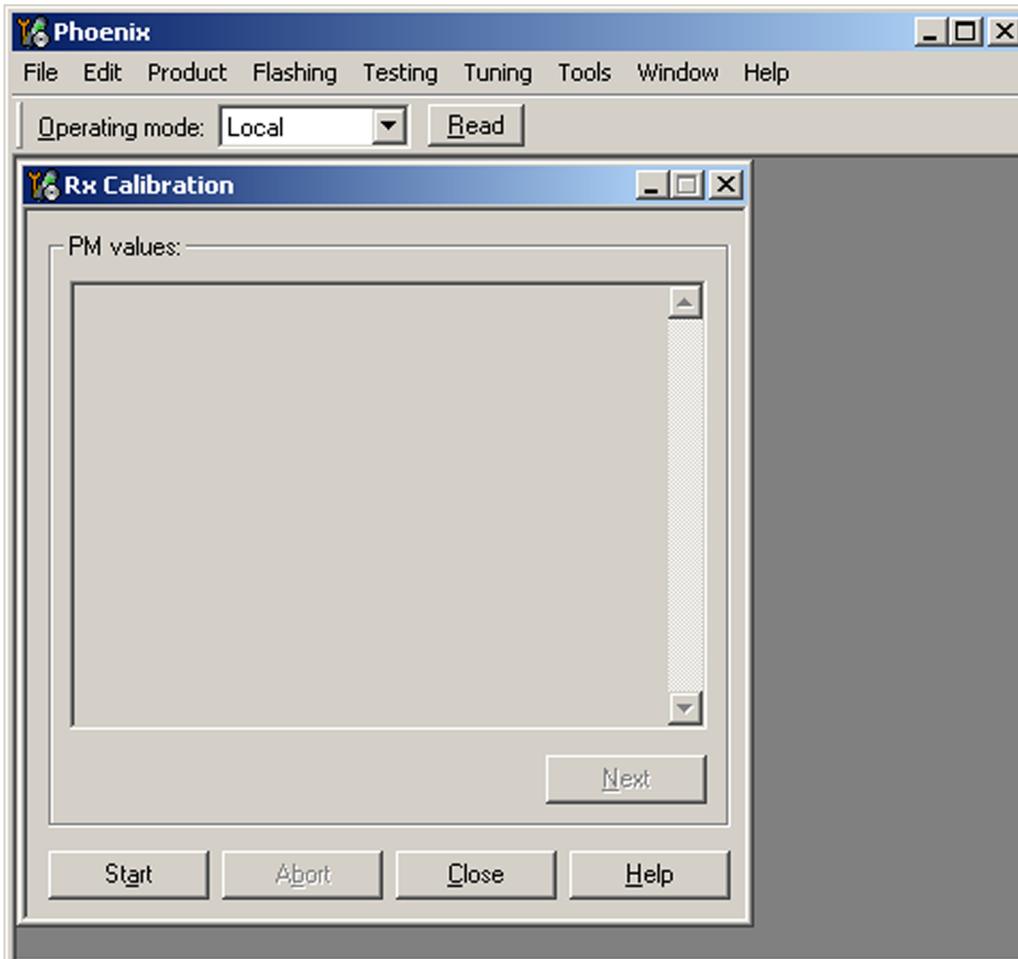
Context

Rx Calibration is used to find out the real gain values of the GSM Rx AGC system and tuning response of the AFC system (AFC D/A init value and AFC slope)

Steps

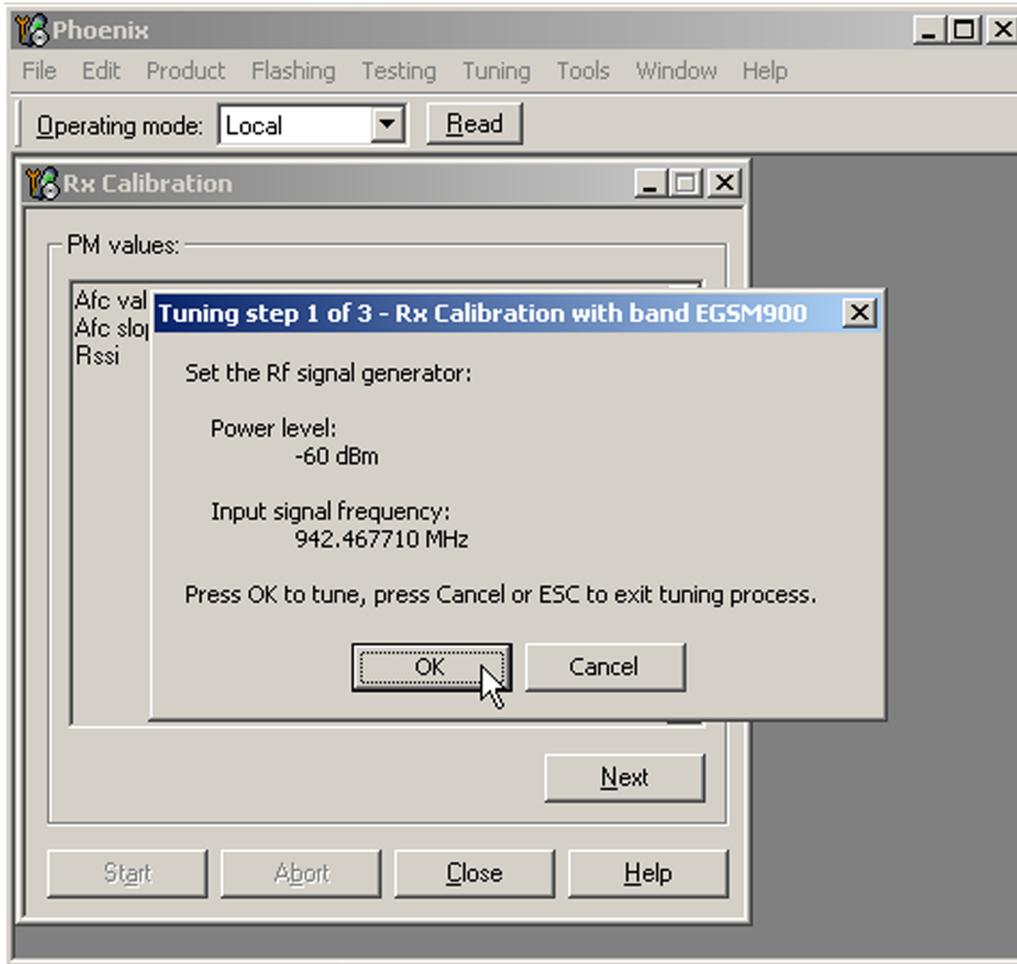
1. Connect the GSM connector of the module jig to a signal generator.
2. Start *Phoenix* service software.
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning**→**GSM**→**Rx Calibration** .

5. Click **Start**.



6. Connect the signal generator to the phone, and set frequency and amplitude as instructed in the **Rx Calibration with band EGSM900** (step 1-3) pop-up window.

Important: The calibration uses a non-modulated CW signal. Increase the signal generator level by cable attenuation and module jig probe attenuation.

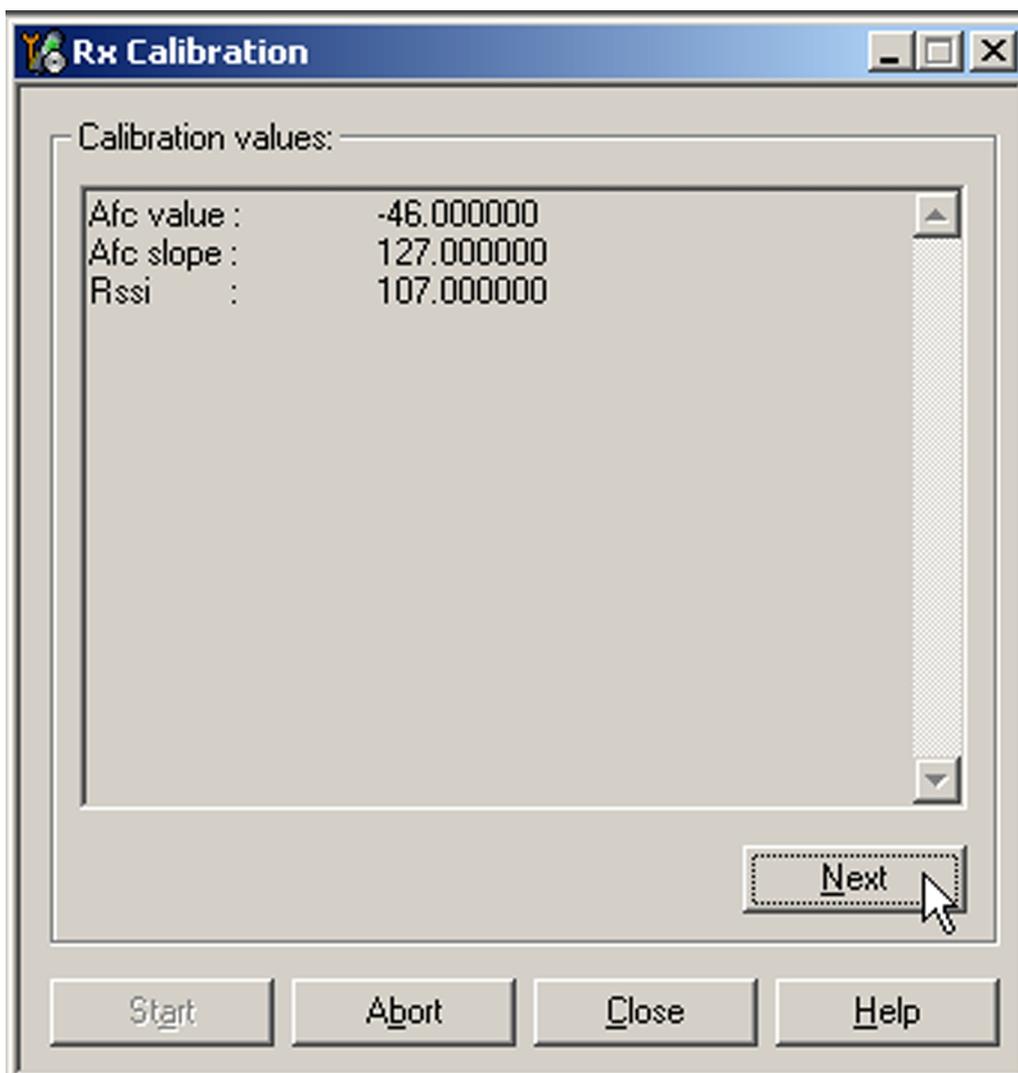


7. To perform the tuning, click **OK**.
8. Check that the tuning values are within the limits specified in the following table:

Table 6 RF tuning limits in Rx calibration

	Min	Typ	Max	Unit
GSM850				
AFC Value (init)	-200	-80..40	200	dB
AFC slope	0	108..121	200	dB
RSSI (AGC-0)	106	107..110	114	dB
GSM900				
AFC Value (init)	-200	-105..62	200	dB
AFC slope	0	122	200	dB
RSSI (AGC-0)	106	107...110	114	dB
GSM1800				
RSSI (AGC-0)	105	105...109	114	dB
GSM1900				
RSSI (AGC-0)	105	105...109	114	dB

9. Click **Next** to continue with GSM1800 Rx tuning.



Next actions

Repeat steps 6 to 9 for GSM1800 and GSM1900

Rx band filter response compensation (GSM)

Prerequisites

Rx calibration must be performed before the Rx band filter response compensation.

Context

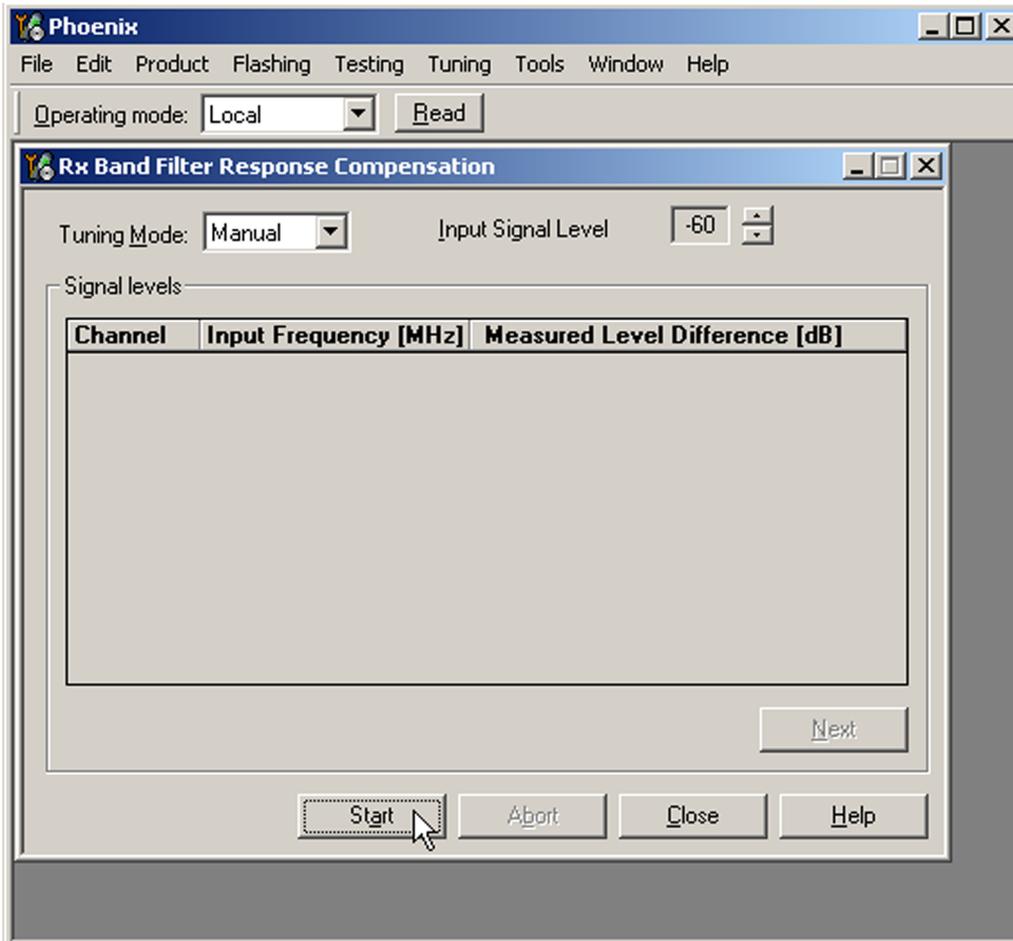
On each GSM Rx band, there is a band filter in front of the RF ASIC front end. The amplitude ripple caused by these filters causes ripple to the RSSI measurement, and therefore calibration is needed.

The calibration has to be repeated for each GSM band.

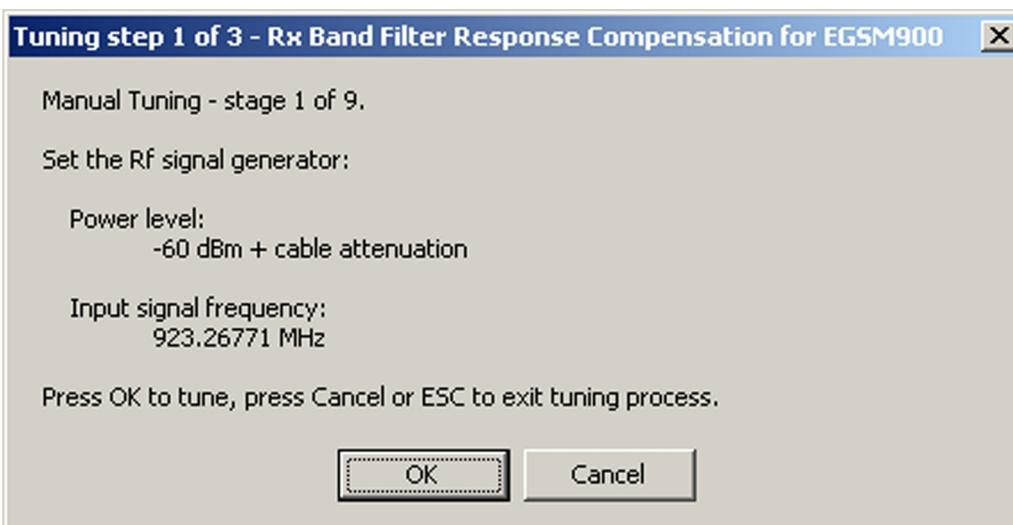
Steps

1. Connect the GSM connector of the module jig to a signal generator.
2. Start *Phoenix* service software.
3. From the **Operating mode** drop-down menu, set mode to **Local**.

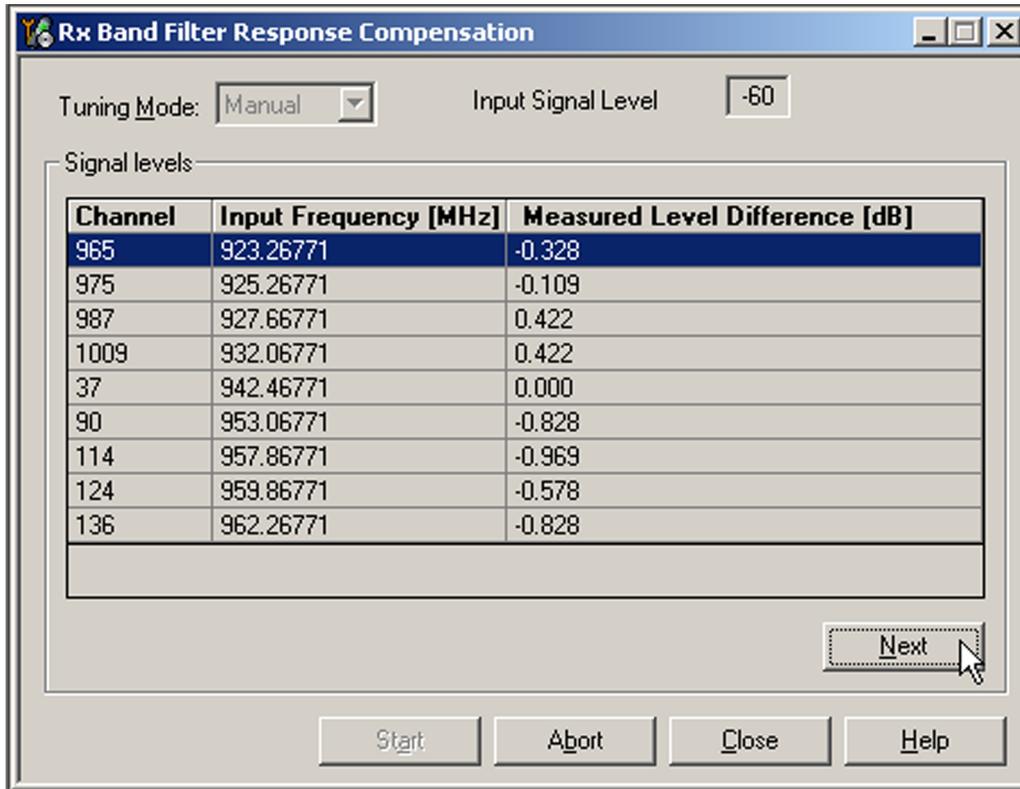
4. Select **GSM900** band.
5. Choose **Tuning**→**GSM**→**Rx Band Filter Response Compensation** .
6. Select **Tuning mode: manual**
7. Click **Start**.



8. Connect the signal generator to the phone, and set frequency and amplitude as instructed in the *Rx Band Filter Response Compensation for EGSM900* pop-up window, step 1-3.



9. To perform tuning, click **OK**.
10. Go through all 9 frequencies. The following table will be shown:



11. Check that the tuning values are within the limits specified in the following table:

	Min	Typ	Max	Unit
GSM850				
Ch. 118/867.26771 MHz	-6	-1	2	dB
Ch. 128/869.26771 MHz	-3	0	2	dB
Ch. 140/871.66771 MHz	-3	0	2	dB
Ch. 172/878.06771 MHz	-2	0	2	dB
Ch. 190/881.66771 MHz	-2	0	2	dB
Ch. 217 / 887.06771 MHz	-2	0	2	dB
Ch. 241/891.86771 MHz	-3	0	2	dB
Ch. 251/893.86771 MHz	-3	0	2	dB
Ch. 261/895.86771 MHz	-6	-1	-2	dB
GSM900				
Ch. 965 / 923.26771 MHz	-6	-1	2	dB
Ch. 975 / 925.26771 MHz	-3	0	2	dB
Ch. 987 / 927.66771 MHz	-3	0	2	dB
Ch. 1009 / 932.06771 MHz	-2	0	2	dB

	Min	Typ	Max	Unit
Ch. 37 / 942.46771 MHz	-2	0	2	dB
Ch. 90 / 953.06771 MHz	-2	0	2	dB
Ch. 114 / 957.86771 MHz	-3	0	2	dB
Ch. 124 / 959.86771 MHz	-3	0	2	dB
Ch. 136 / 962.26771 MHz	-6	-1	2	dB
GSM1800				
Ch. 497 / 1802.26771 MHz	-6	-1	3	dB
Ch. 512 / 1805.26771 MHz	-3	0	3	dB
Ch. 535 / 1809.86771 MHz	-3	0	3	dB
Ch. 606 / 1824.06771 MHz	-3	0	3	dB
Ch. 700 / 1842.86771 MHz	-3	0	3	dB
Ch. 791 / 1861.06771 MHz	-3	0	3	dB
Ch. 870 / 1876.86771 MHz	-3	0	3	dB
Ch. 885 / 1879.86771 MHz	-3	0	3	dB
Ch. 908 / 1884.46771 MHz	-6	-1	3	dB
GSM1900				
Ch. 496 / 1927.06771 MHz	-6	-1	2	dB
Ch. 512 / 1930.26771 MHz	-3	0	2	dB
Ch. 537 / 1935.26771 MHz	-3	0	2	dB
Ch. 586 / 1945.06771 MHz	-3	0	2	dB
Ch. 661 / 1960.06771 MHz	-3	0	2	dB
Ch. 736 / 1975.06771 MHz	-3	0	2	dB
Ch. 794 / 1986.66771 MHz	-3	0	2	dB
Ch. 810 / 1989.86771 MHz	-3	0	2	dB
Ch. 835 / 1994.86771 MHz	-6	-1	2	dB

12. If the values are within the limits, click **Next** to continue to the next band.

Next actions

Repeat the steps 8 to 12 for GSM1800 and GSM1900.

■ GSM transmitter tunings

Tx IQ tuning (GSM)

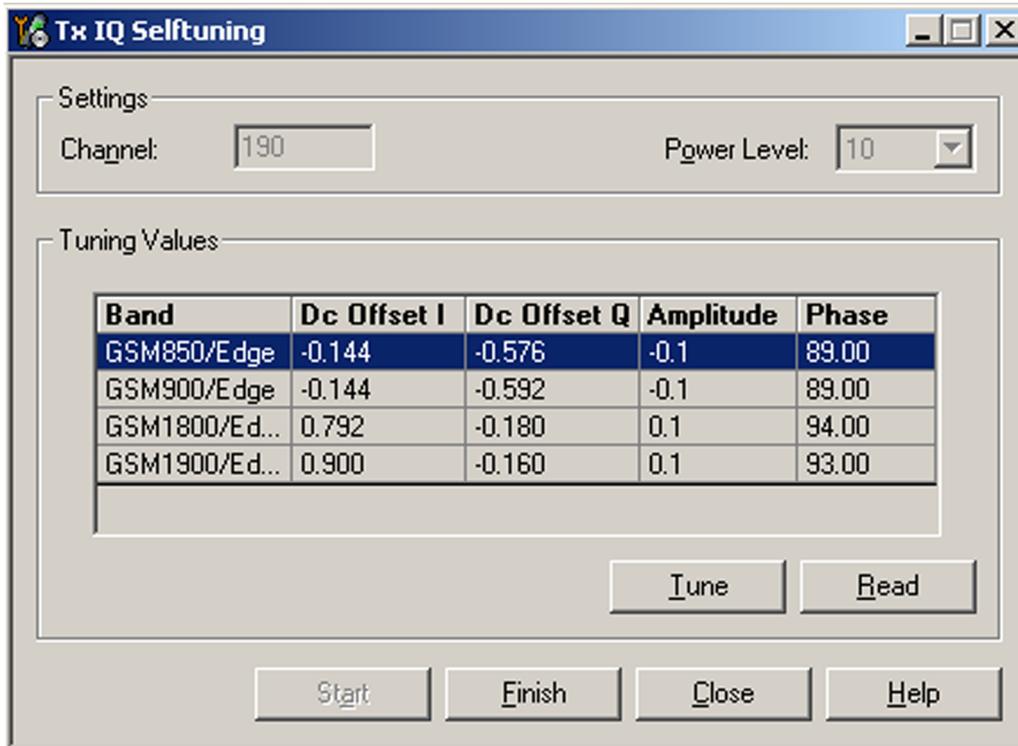
Context

The Tx path branches to I and Q signals at RF I/Q modulator. Modulator and analog hardware located after it cause unequal amplitude and phase disturbance to I and Q signal paths. Tx IQ tuning balances the I and Q branches.

Tx IQ tuning must be performed for all GSM bands.

Steps

1. Start *Phoenix* service software.
2. From the **Operating mode** drop-down menu, set mode to **Local**.
3. Choose **Tuning**→**GSM**→**Tx IQ Tuning** .
4. Select **Mode: Automatic**.



5. Select **Band: GSM900** and click **Start**.
6. Click **Next** to start GSM1800 band TX IQ tuning.
7. Click **Next** to start GSM1900 band TX IQ tuning.
8. Click **Finish** and then **Close**.

Next actions

Tuning sliders should be close to the center of the scale after the tuning and within the limits specified in the following table. If they are not within the limits, check Tx IQ quality manually.

	Min	Typ	Max	Unit
GSM850				
I DC offset / Q DC offset	-6	-4	6	%
Ampl	-1	0	1	dB
Phase	85	90	95	°
GSM900				

	Min	Typ	Max	Unit
I DC offset / Q DC offset	-6	-4	6	%
Ampl	-1	0	1	dB
Phase	85	90	95	°
GSM1800/GSM1900				
I/Q DC	-6	0.5	6	%
Ampl	-1	0	1	dB
Phase	95	100	110	°

Tx power level tuning (GSM)

Context

Because of variations at the IC (Integrated Circuit) process and discrete component values, the actual transmitter RF gain of each phone is different. Tx power level tuning is used to find out mapping factors called 'power coefficients'. These adjust the GSM transmitter output power to fulfill the specifications.

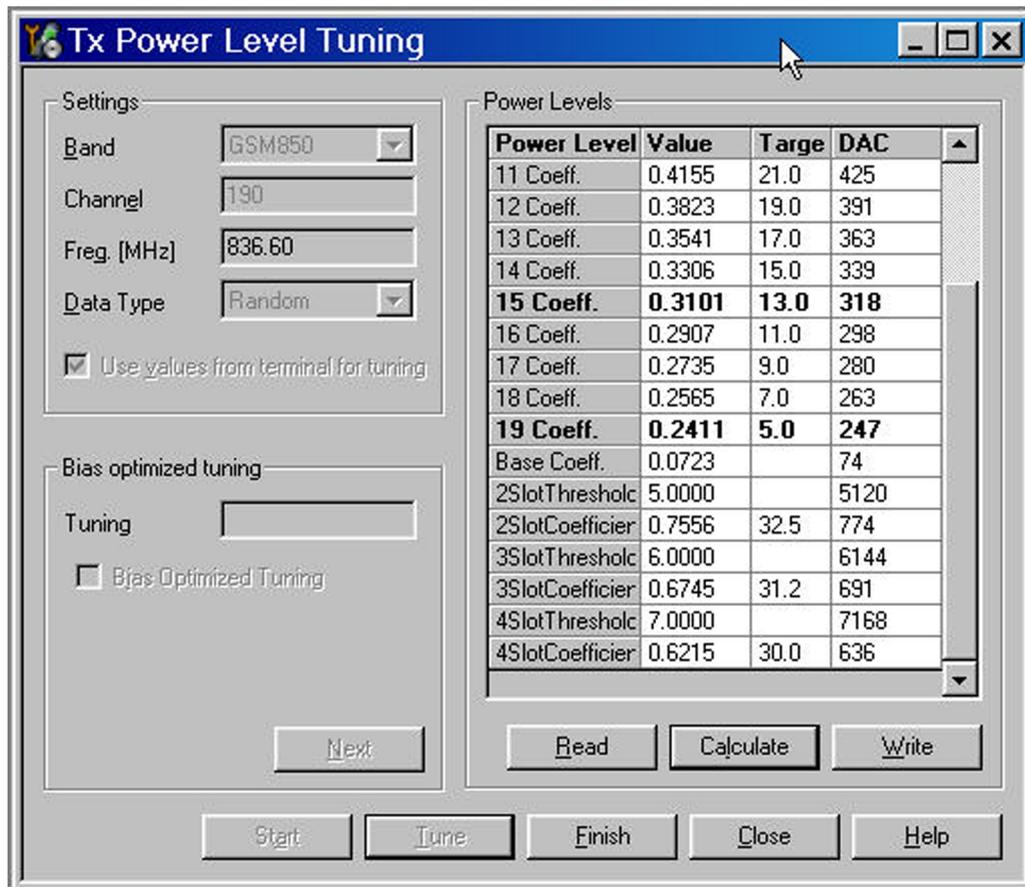
For EDGE transmission, the bias settings of the GSM PA are adjusted in order to improve linearity. This affects the PA gain and hence the power levels have to be aligned separately for EDGE transmission.

Tx power level tuning has to be performed on all GSM bands.

Steps

1. Connect the phone to a spectrum analyzer.
2. Start *Phoenix* service software.
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning**→**GSM**→**Tx Power Level Tuning**.

5. Click **Start.I**



6. Set the spectrum analyzer for power level tuning:

Frequency	Channel frequency: <ul style="list-style-type: none"> • 836.6 MHz GSM850 • 897.4MHz GSM900 • 1747.8MHz GSM1800 • 1880MHz GSM1900
Span	0 Hz
Sweep time	2ms
Trigger	Video triggering (-10dBm)
Resolution BW	3MHz
Video BW	3MHz
Reference level offset	sum cable attenuation with module jig attenuation
Reference level	33dBm

A power meter with a peak power detector can be also used. Remember to take the attenuations into account.

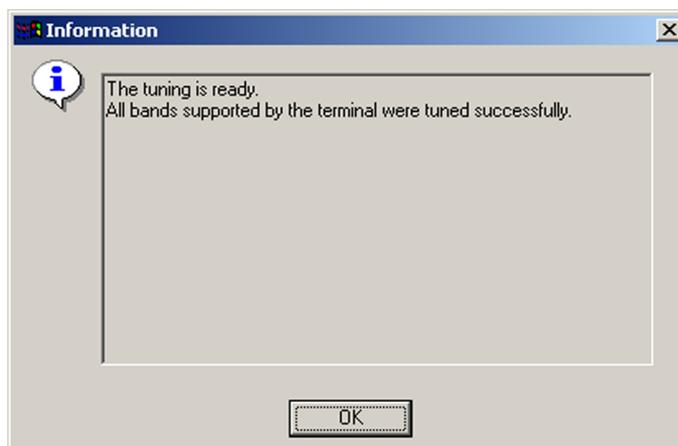
7. Set the tuning targets according to the values in the table below

GMSK	1 slot	2 slot	3 slot
850	32.5 dBm	32.5 dBm	30.5 dBm
900	32.5 dBm	32.5 dBm	30.5 dBm
1800	29.5 dBm	29.5 dBm	29.5 dBm
1900	29.5 dBm	29.5 dBm	29.5 dBm
EDGE	1 slot	2 slot	3 slot
850	26,5dBm	26,5dBm	26,5dBm
900	26,5dBm	26,5dBm	26,5dBm
1800	25dBm	25dBm	25dBm
1900	25dBm	25dBm	25dBm

8. Adjust power for all bold power levels to correspond the **Target dBm** column by pressing + or – keys.
9. If all bold power levels are adjusted, click **Next** to continue with **GSM850 EDGE**.
10. Adjust power for all bold power levels to correspond the **Target dBm** column by pressing + or – keys.

Next actions

Continue tuning the bold power levels of the GSM900, GSM1800 and GSM1900 bands. You will see this message, if finished successfully:



■ WCDMA receiver tunings

RX calibration (WCDMA)

Context

Rx calibration tuning routine calculates the real gain values of the WCDMA Rx AGC system. There is also a SAW filter between front end LNA and mixer in the receive chain, which causes ripple in the RSSI measurement, this is calibrated out. The SAW filter is intergrated into RF ASIC N7500.

Rx calibration can be done in two different ways, manual tune and sweep mode tune. If the signal generator in use supports frequency sweep table, the calibration is done in one step.

Steps

1. For manual tuning, set mode to **Local** in the **Operating Mode** dropdown menu.
2. In the **Tuning** menu, choose **WCDMA**→**Rx Calibration** .
3. Click **Start**.
4. Select Band "WCDMA 2100".
5. Click **Tune**.
6. Setup the signal generator to correspond with the values on the, *Rx Calibration* pop-up window and click **OK**.

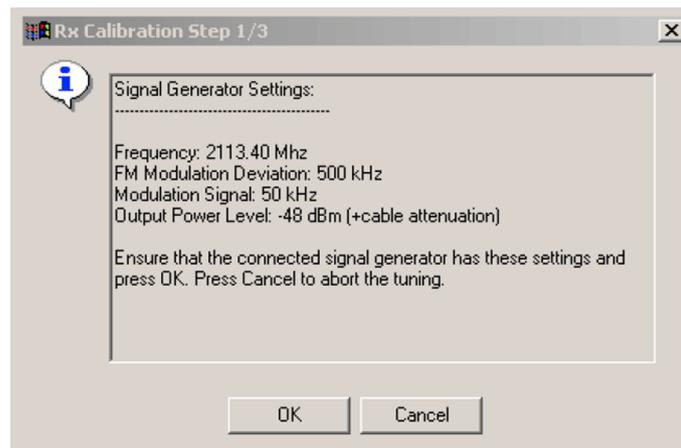
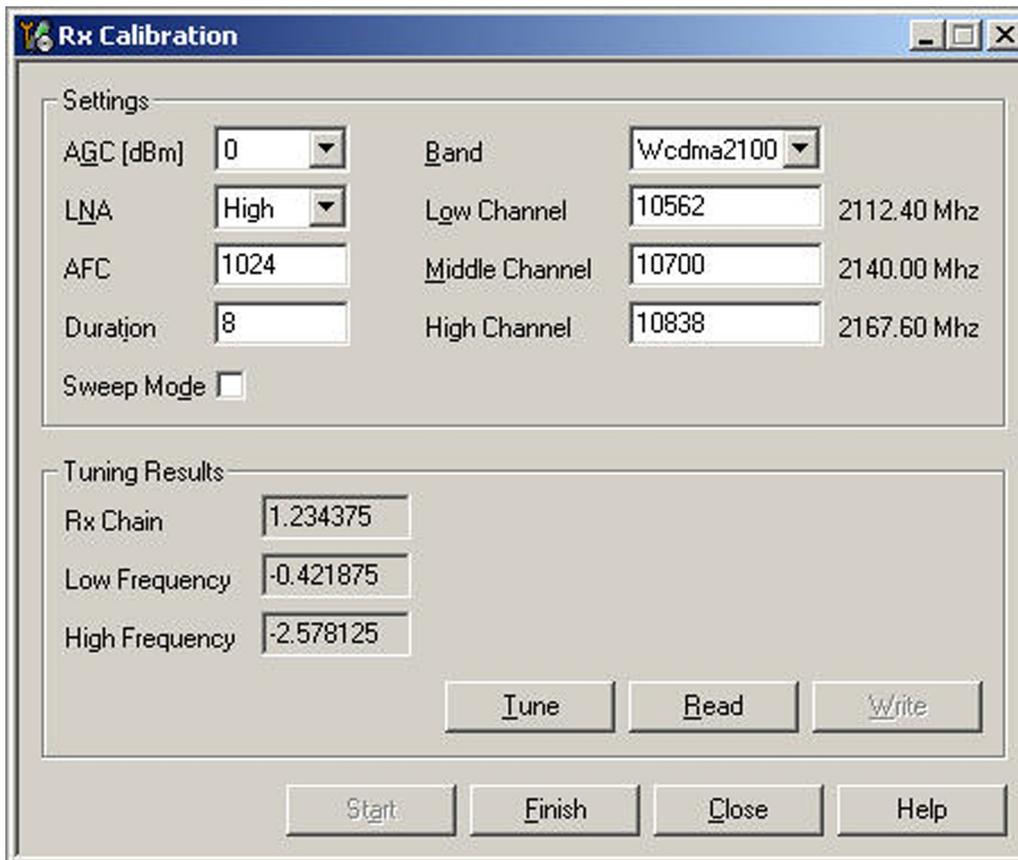


Figure 40 Pop-up window for WCDMA2100

7. Repeat step 6. for Middle and High channels.



8. Ensure Tuning Results are within limits specified in the table below:
If values are OK, click **Write** to save the values.

	Band	Min	Typ	Max	Unit
Rx chain	2100	-6	1.5 to 3.5	6	dB
Low Frequency		-5	-0.7 to 4.0	5	
High Frequency		-5	-0.7 to 4.0	5	

Alternative steps

- For sweep mode tuning, set **Mode** to **Local** in the **Operating Mode** dropdown menu.
- In the **Tuning** menu, choose **WCDMA**→ **Rx Calibration** .
- Click **Start**.
- Select **Band**, "WCDAM2100".
- Check the **Sweep Mode** box.
- Click **Tune**.

- Setup the signal generator to correspond with the values on the *Rx Calibration* pop-up window and click **OK**.

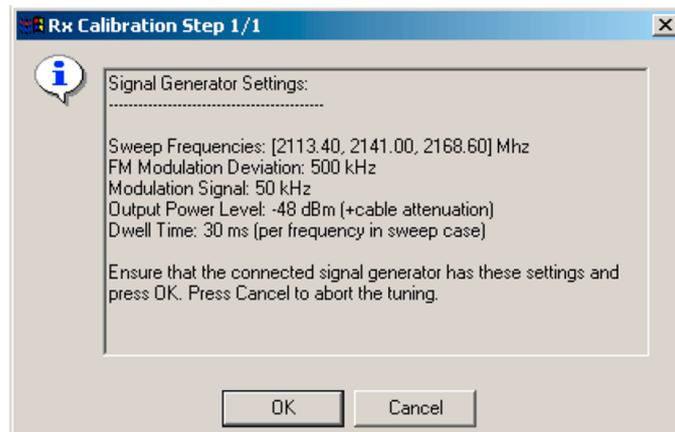


Figure 41 Pop-up window for WCDMA2100

- Ensure Tuning Results are within limits specified in the table above: If values are OK, click **Write** to save the values to the phone.
- Close the tuning window.

■ WCDMA transmitter tunings

Tx AGC & power detector (WCDMA)

Context

Tx AGC & power detector tuning has two purposes:

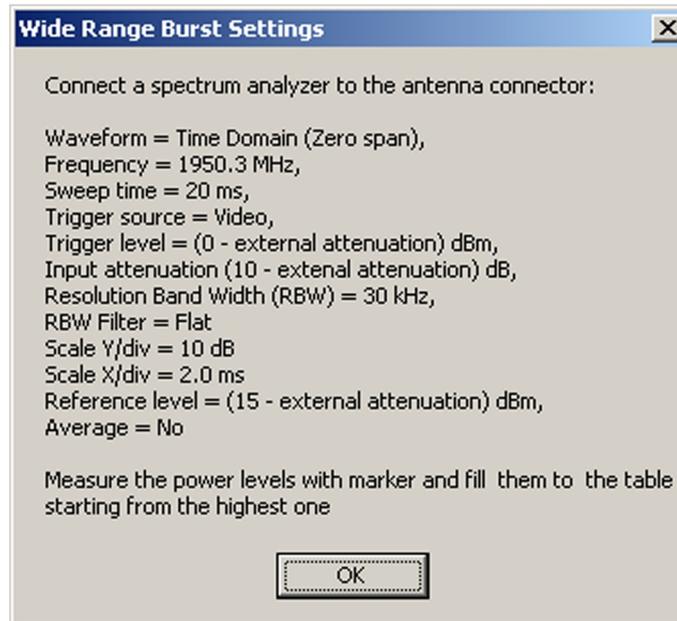
- to enable the phone to select the correct Tx C value accurately in order to produce the required RF level
- to enable the phone to measure its own transmitter power accurately

There are two ways to perform the tuning. For an alternative method, see [Alternative steps \(page 4–51\)](#).

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning**→**WCDMA**→**Tx AGC & Power Detector**.
3. Click **Start**.
4. In the *Wide Range* pane, click **Tune** (the leftmost **Tune** button).

- Set up the spectrum analyzer in the following way:

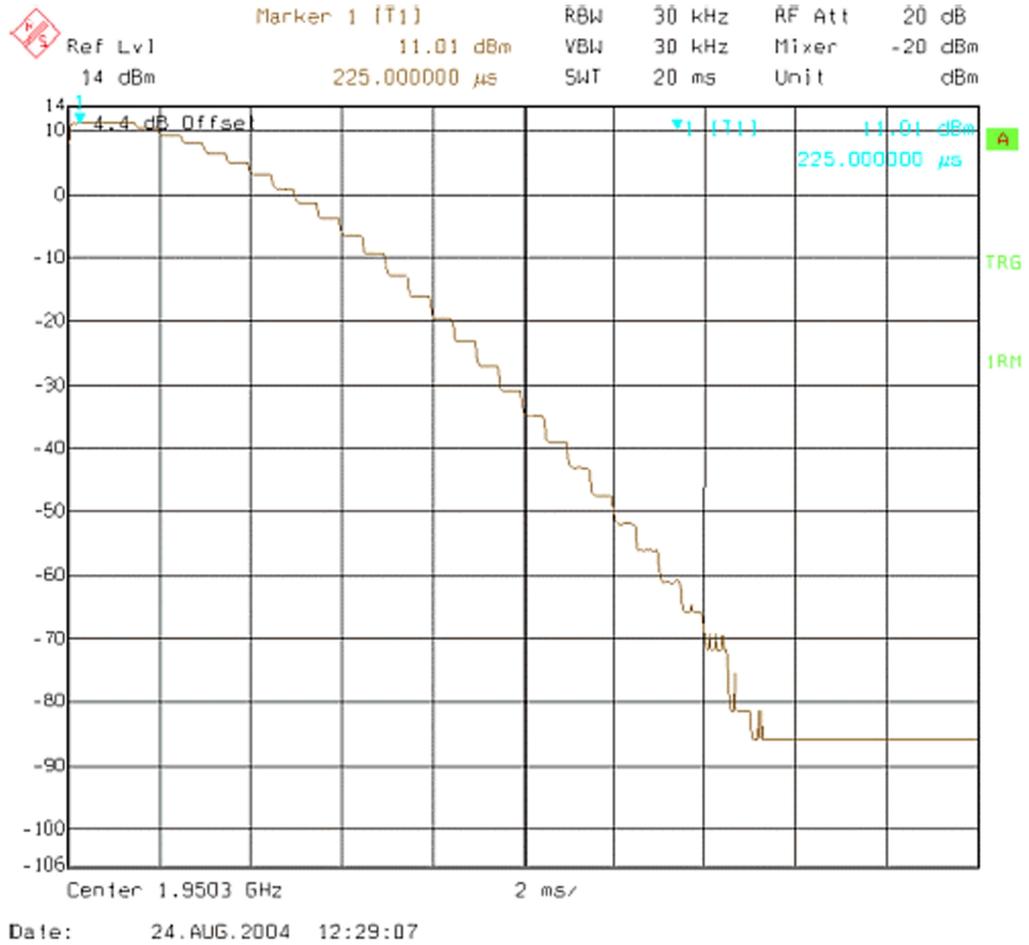


- After setting the spectrum analyzer, click **OK**.
- Measure the power levels with a marker.

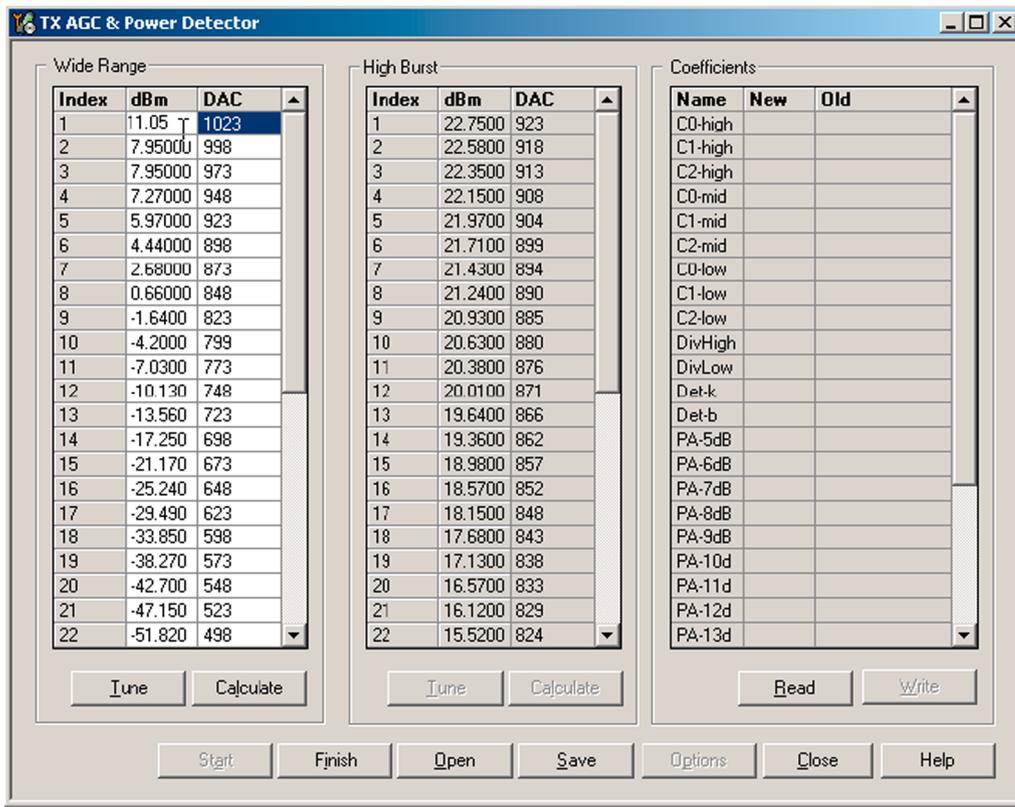
Take the first measurement from 250 us after the trigger, the second after 750 us, the third after 1220 us and so on for every 500 us until the table is filled.

Note: It must be possible to measure power levels down to -68 dBm. The measured power levels must be monotonously decreasing.

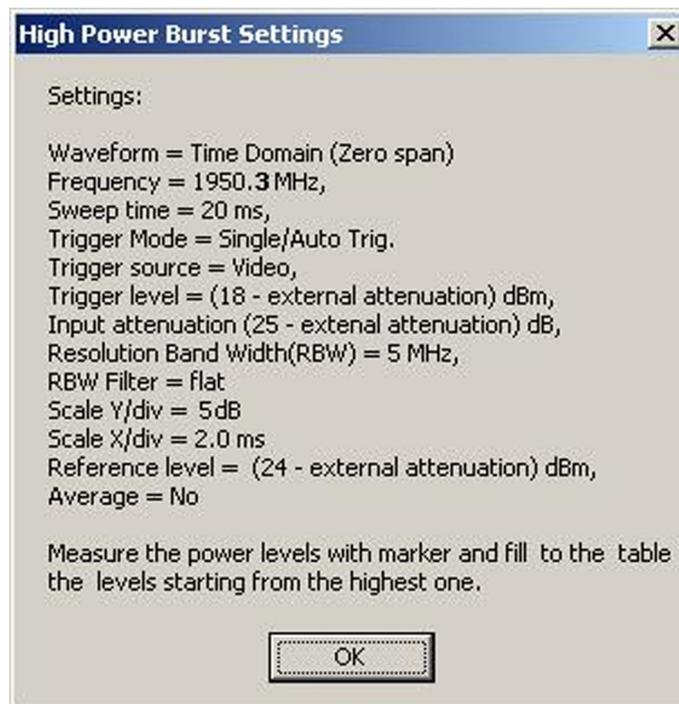
Make sure that the marker is not measuring the level of noise spikes on lower levels.



8. Fill in the power level values (in dBm) to the *Wide Range* table.



9. In the *Wide Range* pane, click **Calculate**.
10. In the *High Burst* pane, click **Tune**.
11. Adjust the spectrum analyzer according to the following settings:



12. Measure the power levels with a marker.

Take the first measurement from 250 us after the trigger, the second after 750 us, the third after 1220 us and so on for every 500 us until the table is filled.

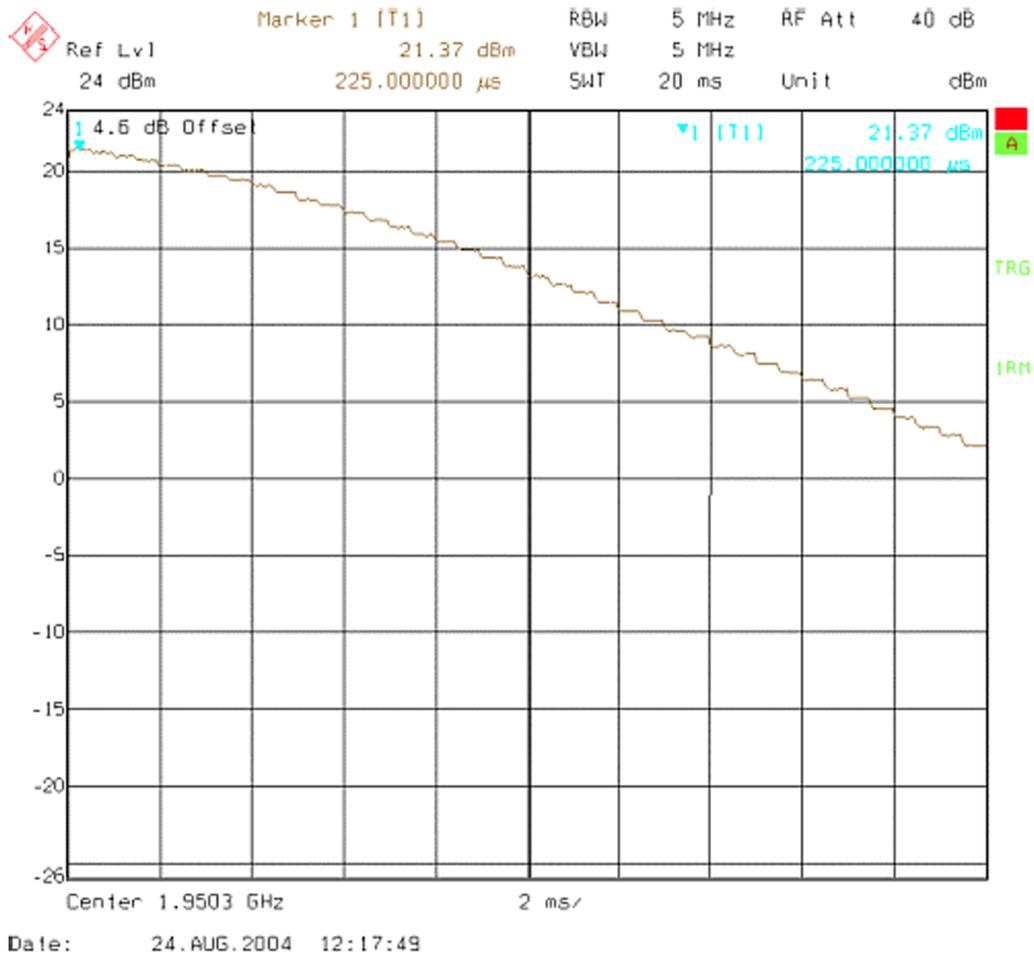


Figure 42 High burst measurement

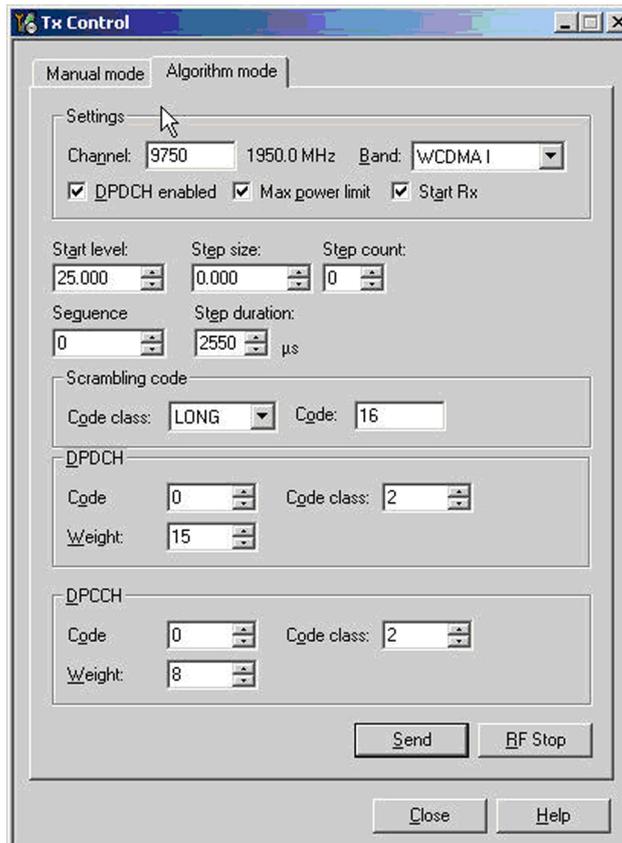
13. In the *High Burst* pane, click **Calculate**.

14. Check that the calculated values are within the limits specified in the following table:

	Min	Max
C0-high	-0.5	5
C1-high	-50	50
C2-high	400	900
C0-mid	-0.7	0.7
C1-mid	0	50
C2-mid	400	900
C0-low	-4	4
C1-low	-400	440
C2-low	-10000	15000

	Min	Max
Det-k	100	220
Det-b	0	150

15. To save the coefficients to the phone, click **Write**.
16. To close the *Tx AGC & Power Detector* window, click **Close**.
17. Choose **Testing**→**WCDMA**→**Tx Control**.
18. Select the *Algorithm* mode tab.



19. Write the target power level 25 dBm to the *Start level* line and check the **Max power limit** check box (detector calibration check).
20. Setup the spectrum analyzer with the following settings:

Center frequency:	1950.3 MHz
Span:	0 Hz
Reference level offset:	Cable attenuations + adapter attenuation
Reference level:	25 dBm or -20 dBm depending on the level measured
Input attenuation:	Automatic
Resolution bandwidth:	5 MHz
Video bandwidth:	5 MHz
Sweep time:	20 ms

Detector:	RMS detector
Average:	No
Trigger:	Free run

21. Click **Send**.
22. Measure the WCDMA output power.
It should be around 23.5 dBm.
23. Click **RF Stop** and uncheck the **Max power limit** check box.
24. Repeat steps **19** to **23** for levels +21, +7, 0, -20 and -40 dBm.
The measured output power may not differ more than +2 dB from the requested value at level +21 dBm and no more than +-4 dB on lower levels.
Remember to stop the RF before sending new data.

Alternative steps

- Measure the wide range levels normally and write down the levels that are possible to measure.
- Click **Finish**.
- Click **Options**.
- Change the first wide range DAC value to *573* and change the number of tuning steps to *21*.
- Change the spectrum analyzer reference level to *-20* dBm and adjust the input attenuator to the lowest value possible.
- In the *Wide Range* pane, click **Tune** and fill in the rest of values starting from the 19th level.

Tx band response calibration (WCDMA)

Context

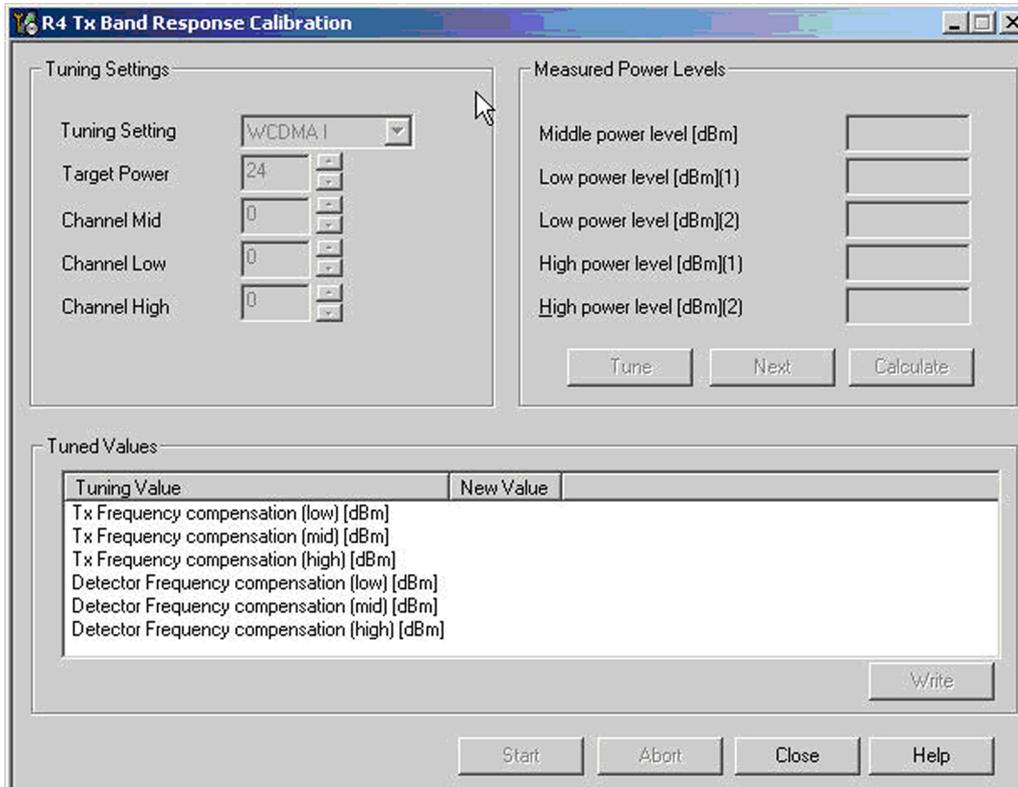
The purpose of this tuning operation is to calibrate the WCDMA Tx performance. It defines the power detector and Tx frequency compensation values. However, before starting this tuning procedure, it is necessary to carry out Tx AGC & Power Detector Calibration tuning. This is because its results will be needed for this tuning operation.

- In the *Tuning Settings* pane, it is possible to edit the numbers of channels used in this tuning operation.
- If the **Calibrate Detector Response** check box is checked, only Tx response is calibrated. Zero is written to the power detector compensation values block in the permanent memory (PM) of the terminal.
- **Detector Calibration level** shows the power level used for calibrating the power detector in this tuning procedure.
- **Tx Calibration level** shows the power level used for calibrating tx frequency in this tuning procedure.
- In the *Measured Power Levels* pane, you can insert the dBm values read from the power meter.
- In the *Tuned Values* pane, the values that are stored in the permanent memory (PM) of the terminal in Current columns are shown.
- New values are added to *New* column when the **Calculate** button is clicked.
- The **Abort** button aborts the tuning operation without saving the tuned values.
- The **Read** button reads the tuned values in the PM of the terminal, and displays them in the *Tuned Values* pane in in the *Current* column.

Steps

1. Start *Phoenix* service software.

2. Choose **File**→**Scan Product** .
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning**→**WCDMA**→**R4 Tx Band Response Calibration** .
5. Click **Start**.



The current values are shown in the *Tuned Values* pane.

6. Click **Tune**.
7. Connect the power meter to the terminal, and set it to **Channel Mid** frequency.
8. Read the values of slot 1 and slot 2 from the power meter and enter them to **Middle power level** fields in the **Measured Power Levels** pane.

Slot 1 is used for detector calibration and slot 2 for Tx calibration.

9. Click **Next**.
10. Switch the power meter to **Channel Low** frequency.
11. Read the values from the power meter, and enter them to **Low power level** fields.
12. Switch the power meter to **Channel High** frequency.
13. Read the values from the power meter, and enter them to **High power level** fields.
14. Click **Next**.
15. Click **Calculate**.

The tuned values are shown in the *Tuned Values* pane in the *New* column.

16. Check that the tuned values are within the limits presented in the following table. If they are OK, click **Yes**.

	Min	Max
Tx Freq Comp (the first and last value)	-4	+4

- To save the tuned values to the terminal, click **Write**.
- Close the *Tx Band Response Calibration* window.

Tx LO leakage (WCDMA)

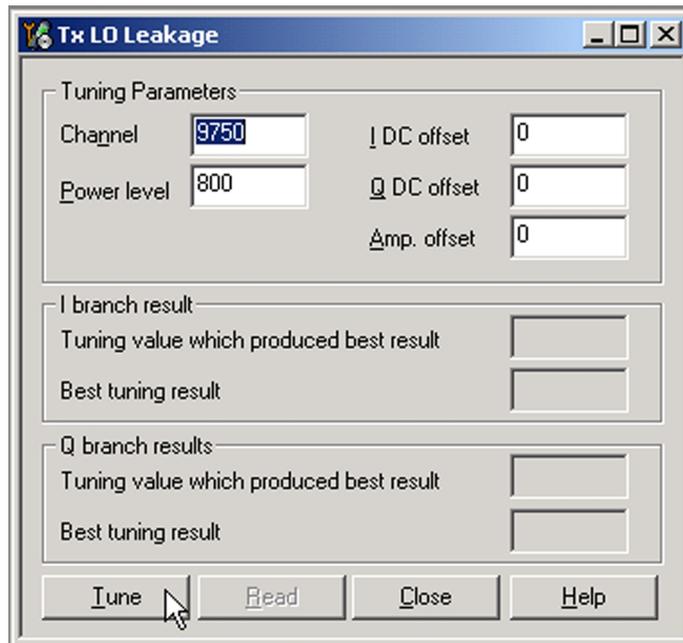
Context

The purpose of Tx LO leakage tuning is to minimize the carrier leakage of the IQ-modulator which is caused by the DC offset voltages in the Tx IQ-signal lines and in the actual IQ modulator.

The tuning improves WCDMA Tx AGC dynamics at low power levels. A self-calibration routine selects the best combination for internal control words in order to produce minimum LO leakage.

Steps

- From the **Operating mode** drop-down menu, set mode to **Local**.
- Choose **Tuning**→**WCDMA**→**Tx LO Leakage**.
- Click **Tune**.



- To end the tuning, click **Close**.

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5 — Camera Module Troubleshooting

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■ Camera construction

This section describes the mechanical construction of both camera modules for getting a better understanding of the actual mechanical structure of each module.

■ Main camera construction

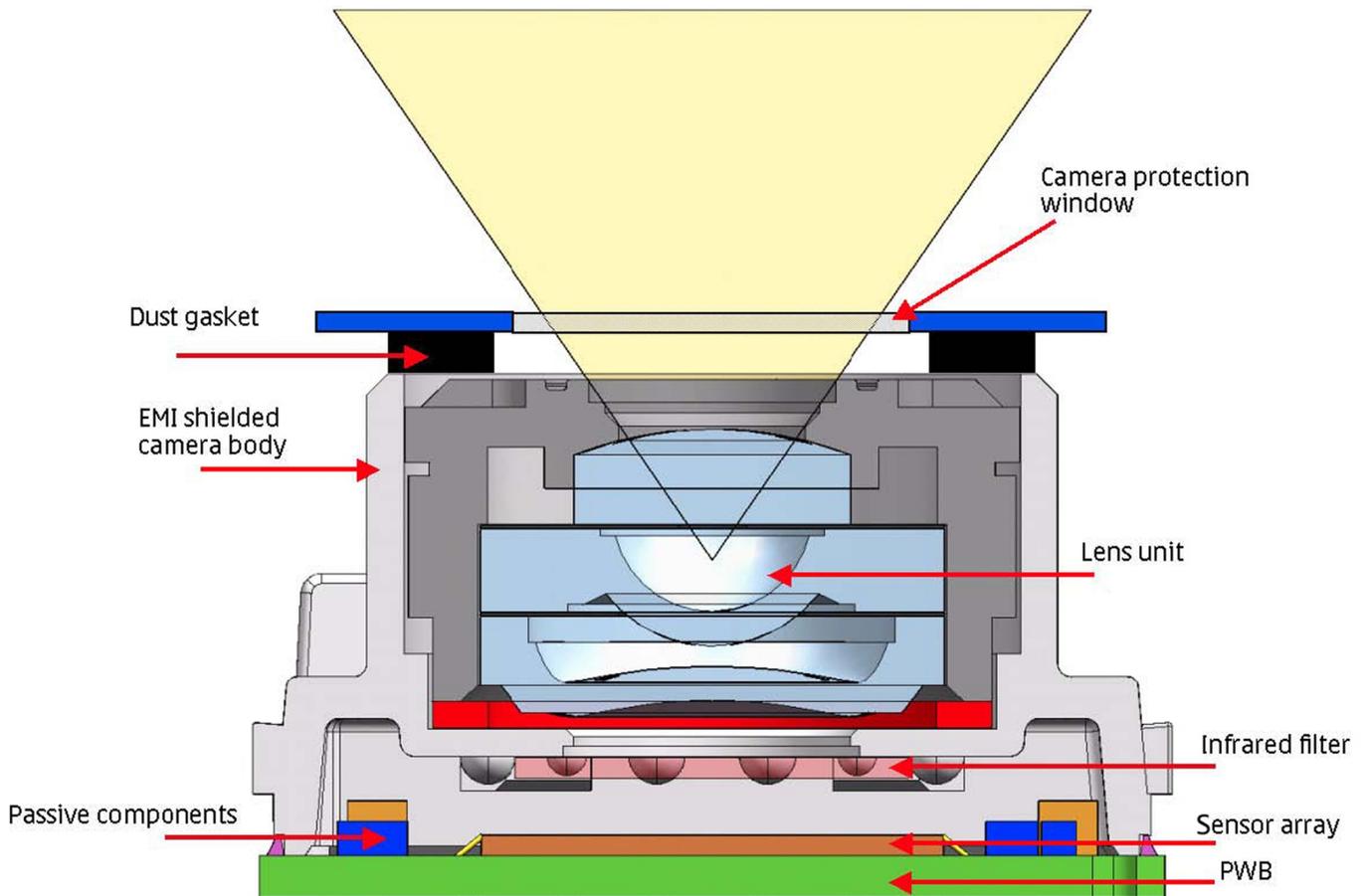


Figure 43 Camera module cross section and assembly principle



Figure 44 Main camera module bottom view including serial numbering

The camera module as a component is not a repairable part, meaning that the components inside the module may not be changed. Cleaning dust from the front face is allowed only. Use clean compressed air.

The camera module uses socket type connecting. For versioning, laser marked serial numbering is used on the PWB.

The main parts of the module are:

- Lens unit including lens aperture.
- Infrared filter; used to prevent infrared light from contaminating the image colors. The IR filter is glued to the EMI shielded camera body.
- Camera body; made of conductive metallized plastic and attached to the PWB with glue.
- Sensor array including DSP functions is glued and wire-bonded to the PWB.
- PWB, FR-4 type
- Socket type connection
- Laser-marked serial numbering on PWB (for versioning)
- Passive components
- Camera protection window; part of the phone cover mechanics
- Dust gasket between the lens unit and camera protection window

■ Secondary camera construction

The camera module as a component is not a repairable part because it is soldered on LID PWB. To exchange front camera module the whole LID PWB has to be exchanged. Cleaning dust from the front face is allowed only. Use clean compressed air.

The front camera module is constructed from 3 major components: lens unit, sensor and shield plate. The lens unit includes the lens holder, lens, aperture and IR-cut glass. Sensor is glued on lens holder. Both are covered with the shield plate. It also includes the module marking (1pin position).

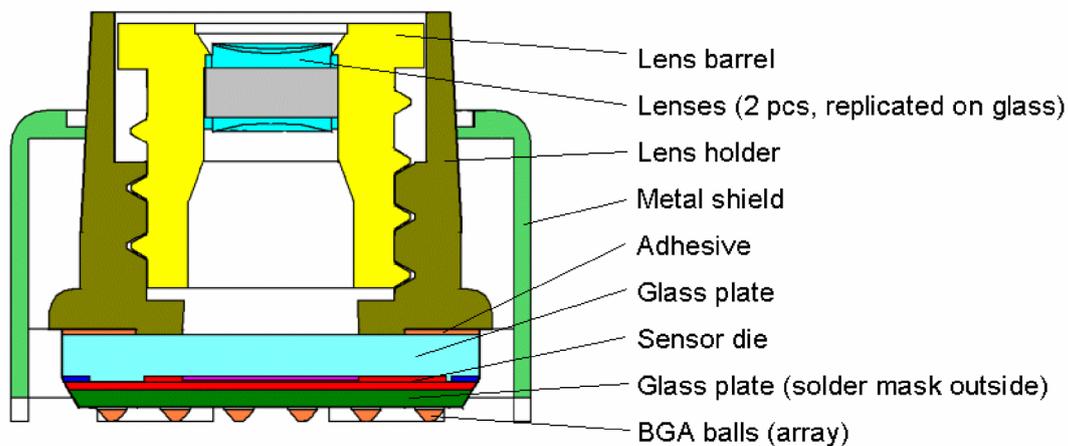
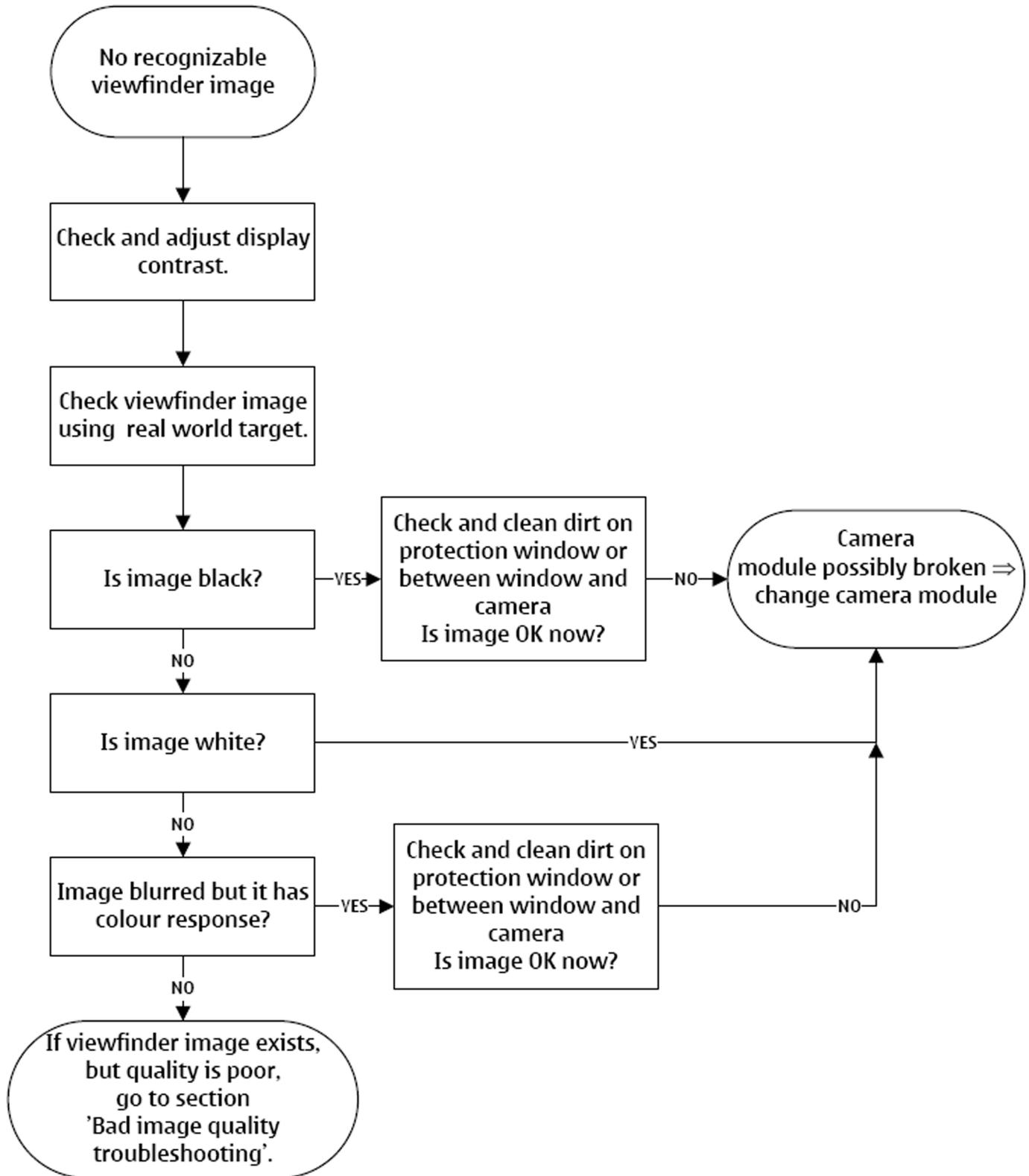


Figure 45 Front camera module cross section and assembly principle

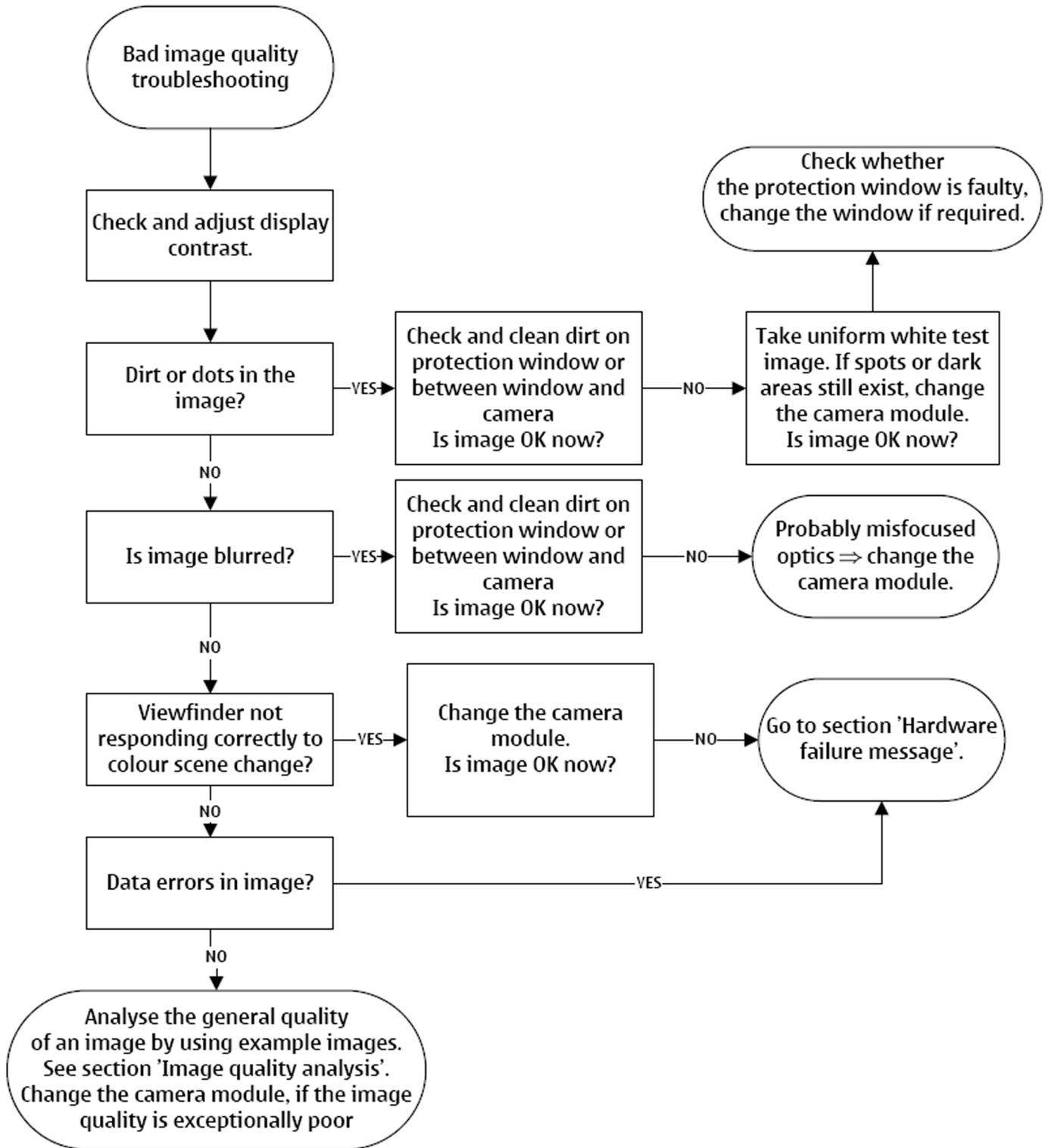
■ **Camera viewfinder troubleshooting**

Troubleshooting flow



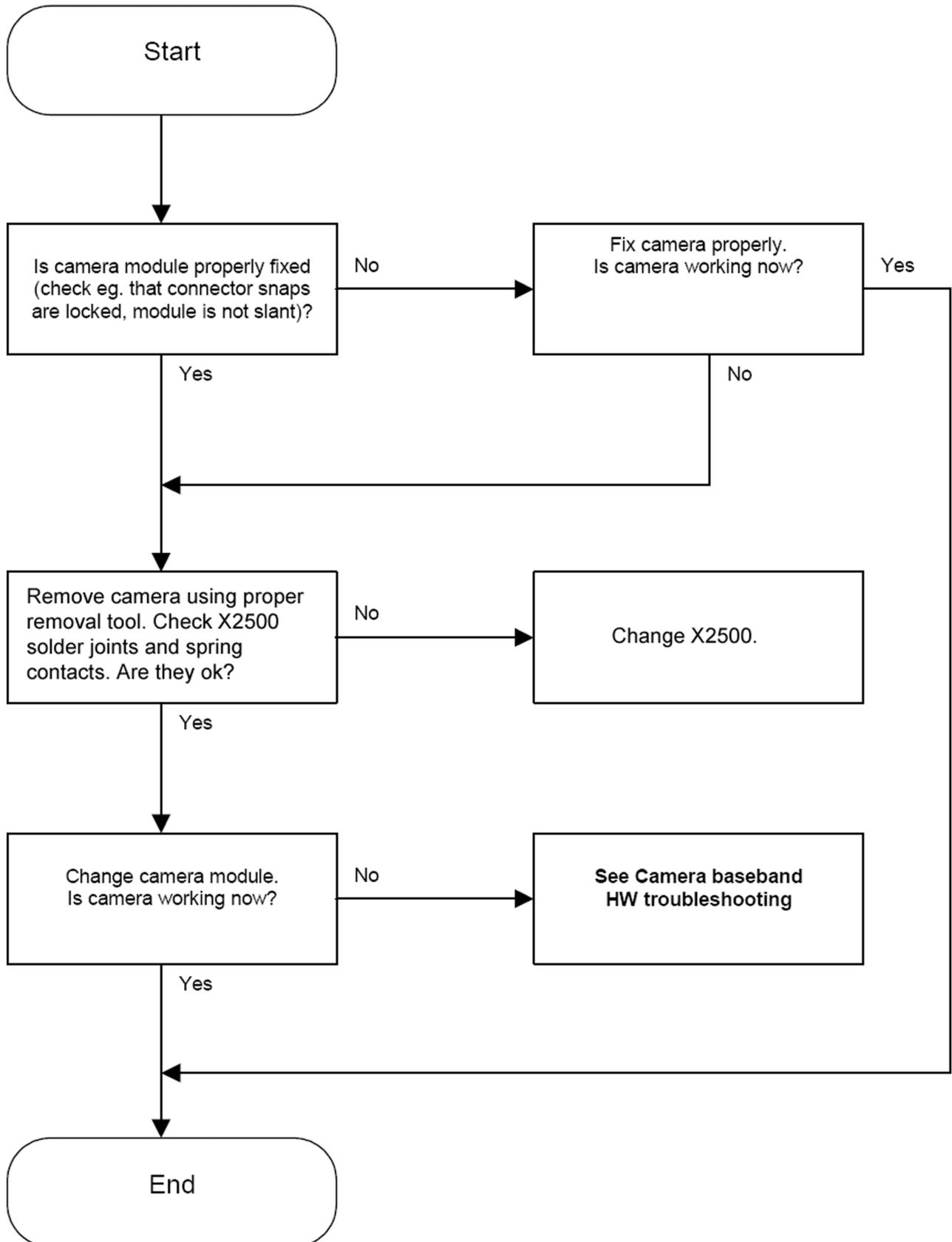
■ **Bad camera image quality troubleshooting**

Troubleshooting flow



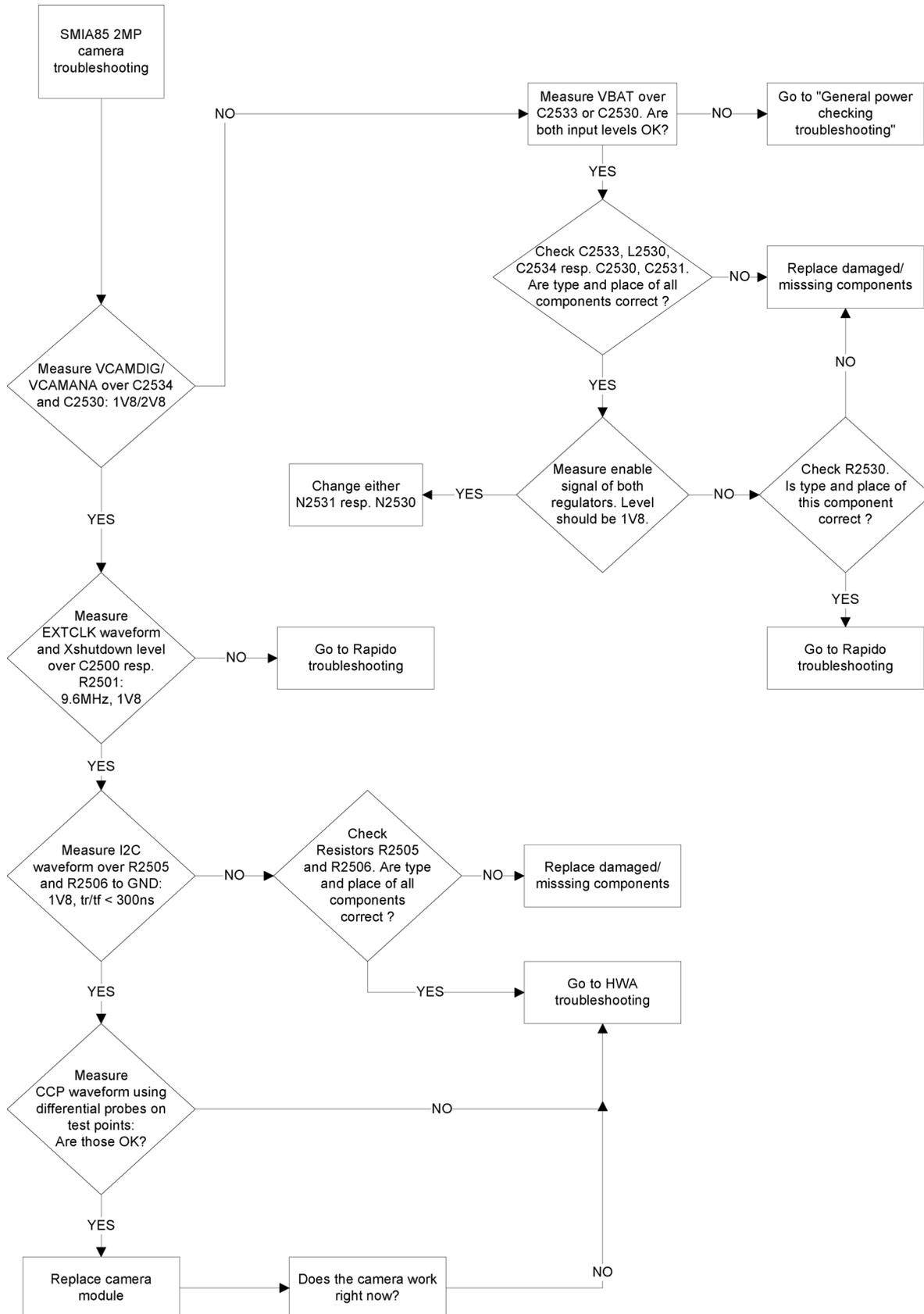
■ **Main camera troubleshooting**

Troubleshooting flow



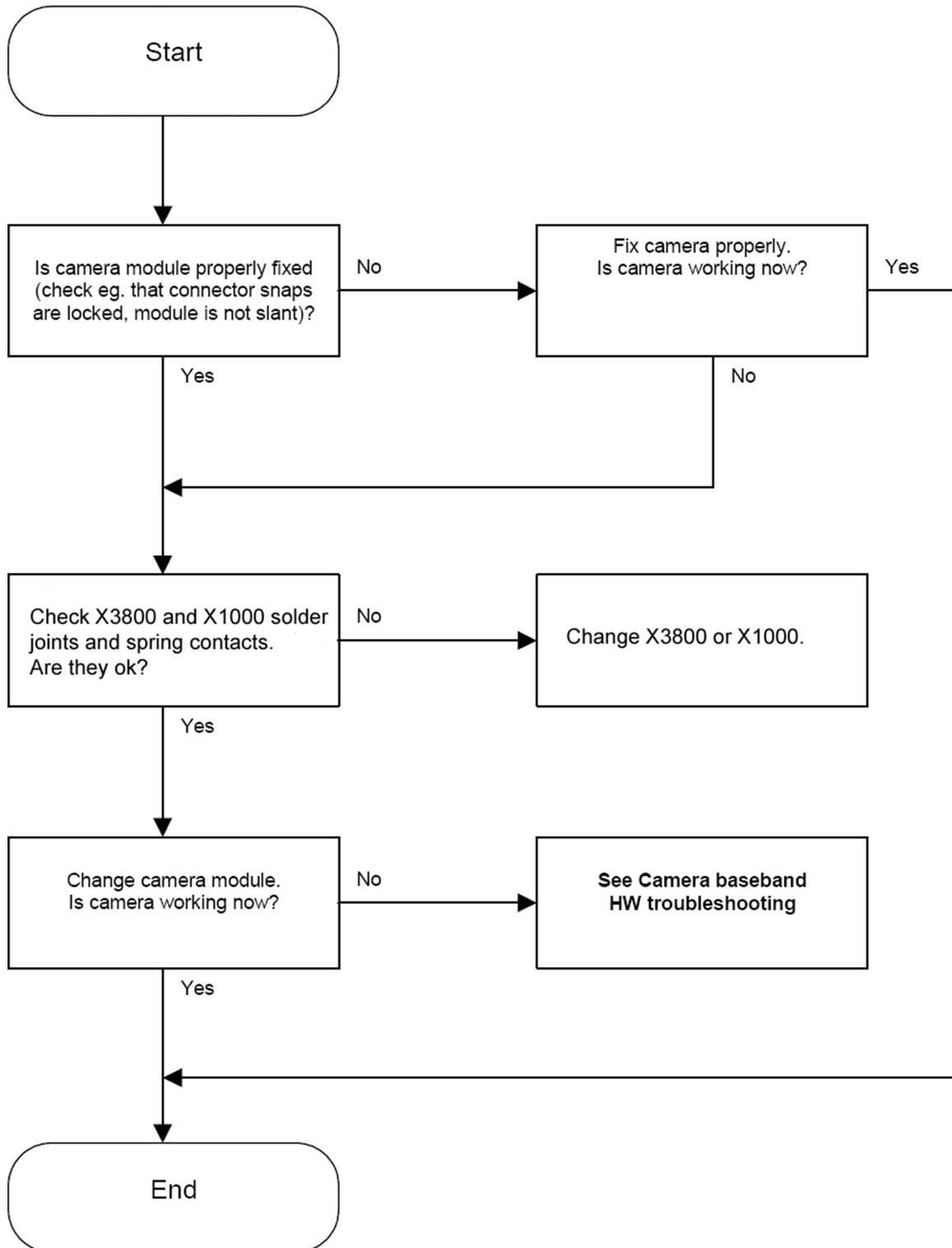
■ Main camera baseband HW troubleshooting

Troubleshooting flow



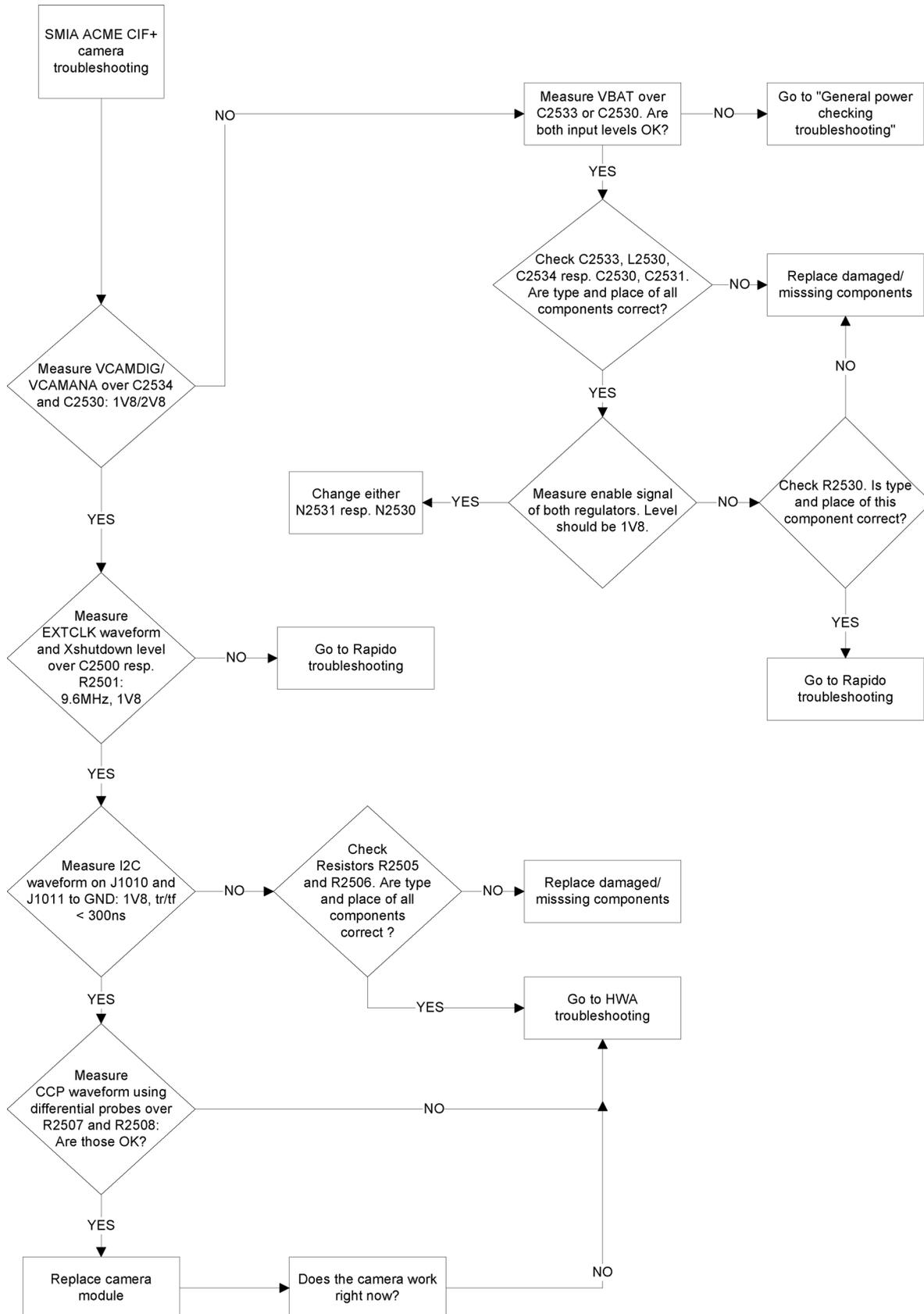
■ **Secondary camera troubleshooting**

Troubleshooting flow



■ Secondary camera baseband HW troubleshooting

Troubleshooting flow



■ Flash LED troubleshooting

Introduction to flash LED troubleshooting

A fault or complaint associated to LED flash operation can be roughly categorized into two subgroups:

- 1 Flash is not functional at all (no light output at all).
- 2 Images can be taken and they are recognizable but for some reason the quality of images is degraded.

Examples of quality degradations:

- Brightness is not sufficient.
- Brightness is too much = overexposed.
- Only portions of the image brightness (e.g., left, right, top or bottom) are proper and the rest are not.

The quality of an image is very difficult to measure quantitatively, and even comparative measurements are difficult (comparing two images), if the difference between reference images is small. If a user is not satisfied with his/her device's image quality, it is fairly difficult to accurately test the device and get an exact result, which would tell if the device is working properly.

Often subjective evaluation has to be used for finding out if there is something wrong in the flash. Some training or experience of a correctly operating reference device may be needed in order to detect possible faults. It is easy for a user to take low quality images in bad conditions. Therefore, the camera and flash operation has to be always checked in constant conditions (lighting, temperature) or by using a second, known-to-be good reference device.

Flash LED and image taking conditions

This section describes some of common factors, which may cause poor image quality if not taken into account by end users when taking pictures, and may therefore result in complaints. The items described are normal to the camera and LED flash operation and do not raise a need for servicing the components.



Figure 46 Example of a good quality image taken with the flash LED

Distance to the target (too close)

There is no feedback in the flash system, which means that the light output is constant in every situation. This causes the images to overexposure, when shot from close distance. The flash LED is designed to work optimally between distances of 70 cm – 1.2 m.

This is normal behaviour; do not change the flash module.



Figure 47 overexposed image

Distance to the target (too far away):

The power of the white LED flash is still very modest compared to xenon flash technology. Even with full power, the maximum distance for an acceptable image quality is roughly 1.2 m. If the distance is greater than 1.2 m, the images will appear dark and the noise level increases.

This is normal behaviour; do not change the flash module.



Figure 48 Dark and noisy image

Shaken (= blurred) images

The traditional xenon flash has the advantage of stopping the movement. This is a result of an extremely short and intense light pulse, which makes it possible for a camera to use very short exposure time. Due to the weak output of the LED flash, the exposure time has to be actually increased in the viewfinder mode in total blackness, instead of shortening it. This allows the sensor to integrate longer and collect more light but this also easily creates blurred images if care is not taken.

In addition to the limitation due to small LED flash light, handshake owing to camcorder type product concept and shutter button operation exists. These are not errors but a limitation of the product. No need to change the LED flash module.



Figure 49 Shaken image

Camera white balance failure and overexposure due to presence of ambient light

Because the spectral output of the flash is known, the white balance and the exposure control of the camera work in optimal way with the flash in total blackness. This is why some of the pictures may fail (i.e. images get a bit yellow or reddish, or greenish or bluish, depending on the ambient light characteristics, as well as overexposed or underexposed).

If the flash works correctly in dark conditions, there is no need to change the flash module.

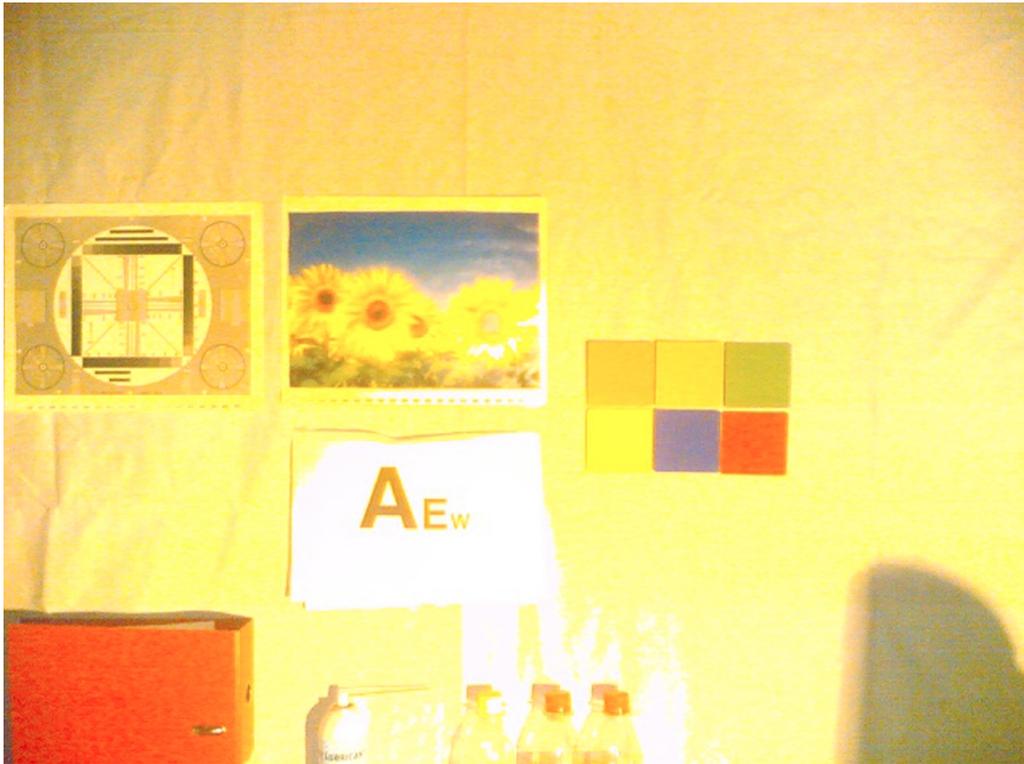


Figure 50 Camera white balance failure and overexposure

Colour difference between different modules

There is some variation in the spectrum of the flash, which derives from the manufacturing process of the white LEDs. Because of this variation, there may be some variation in the colour of the images as well.

This is normal behaviour; do not change the flash module.



Figure 51 Color difference between flash colour limit samples

Flash LED construction

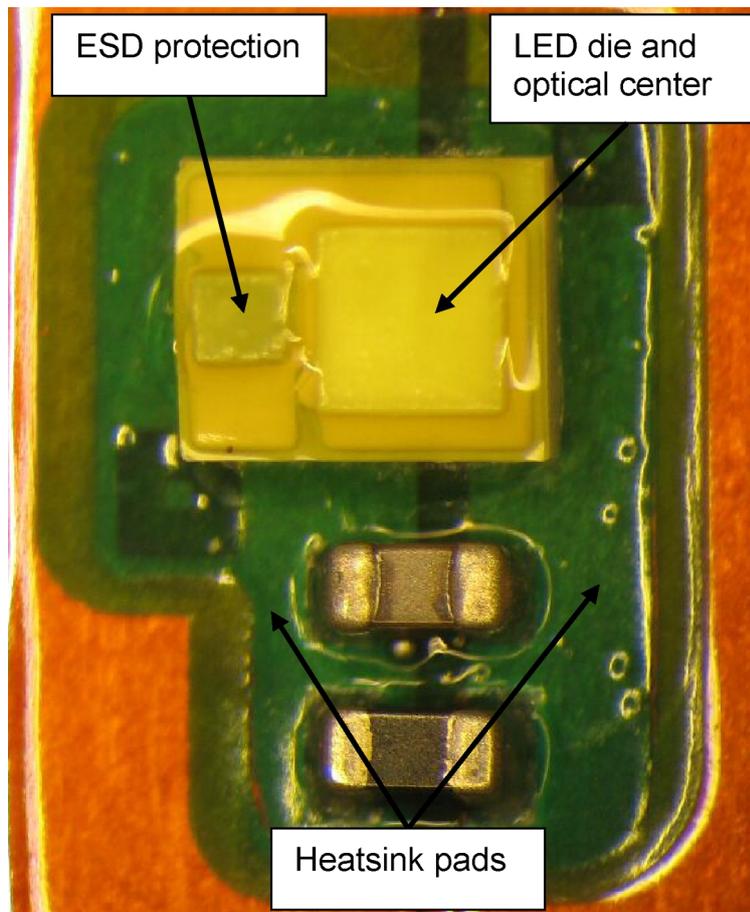


Figure 52 Mechanical construction of the flash LED module

Analysing image quality

Possible faults in image quality

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

- LED module is not flashing at all
- Image colours are not good
- Flash power is weak

Testing flash module functionality

Context

With the help of this test you can check the flash module's overall functionality.

Always set the flash to FORCED FLASH mode when performing the test. The FORCED FLASH mode enforces the LED module to flash, even if there is some ambient light present.

Steps

1. Take an image with the flash and monitor at same time whether the LED module flashes.

Results

If the LED flashes normally, the overall functionality of the module is OK.

Testing image colours with flash

Context

With the help of this test you can check if the image colours are normal when using the flash.

Steps

1. Take an image of a target, which contains something white in total blackness from less than 1 m range.

Results

If the white target appears to be white, the flash is working correctly. However, remember that there is some variation in the flash colour from module to module.

Testing flash power

Context

With the help of this test you can check if the flash is working with adequate power level.

Steps

1. Take an image with the flash in total blackness (ambient light <1 lux) of a target 80 cm - 1 m away.

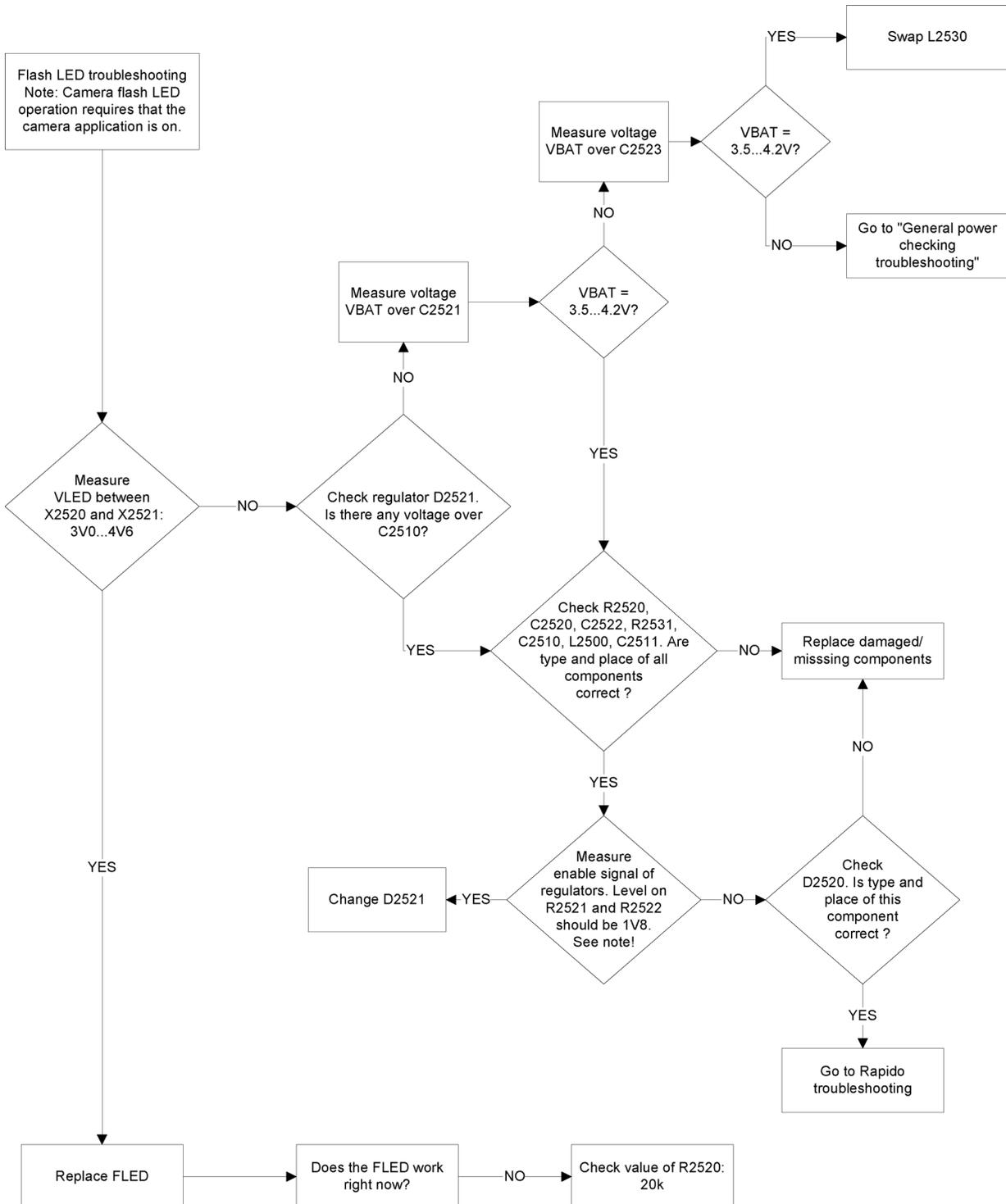
Results

If the flash is working normally with adequate power level, the image is correctly exposed between distances 80 cm to 1 m.

Remember that the brightness level in the corners is always less than in the center of the image because of camera and flash optics.

Camera flash LED troubleshooting

Troubleshooting flow



Logical table of regulator D2521

Flash mode: EN1 = 1, EN2 = 0

Notification mode: EN1 = 1, EN2 = 1

Note

■ Indicator LED troubleshooting

RM-179 implements a flash light for taking pictures in dark conditions and which is also used as notification light in video recording mode. In notification mode flash LED is driven with torch current and PWM of 1/32 (up to 4,7mA). In this mode the logical input of EN1 is 1 and for EN2 it is 0. For notification light troubleshooting, [Camera flash LED troubleshooting \(page 5–20\)](#) flow chart can be used.

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6 — System Module and User Interface

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■ Introduction

Phone description

RAPIDO is the main digital baseband ASIC in the phone. It contains functionality for both WCDMA and GSM EDGE.

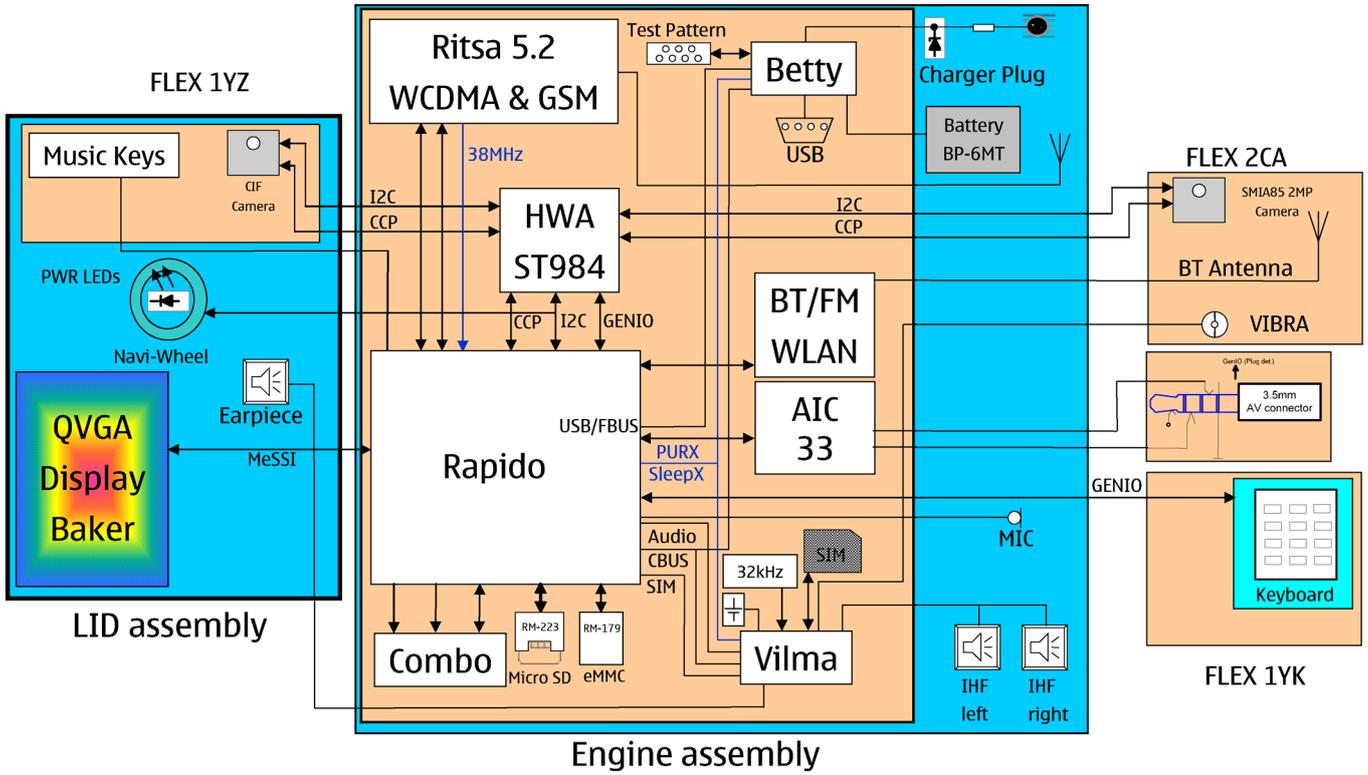
AVILMA is mainly the audio ASIC in the phone and BETTY is basically the energy management controller for the phone.

Bluetooth and FM radio are physically integrated in one single ASIC.

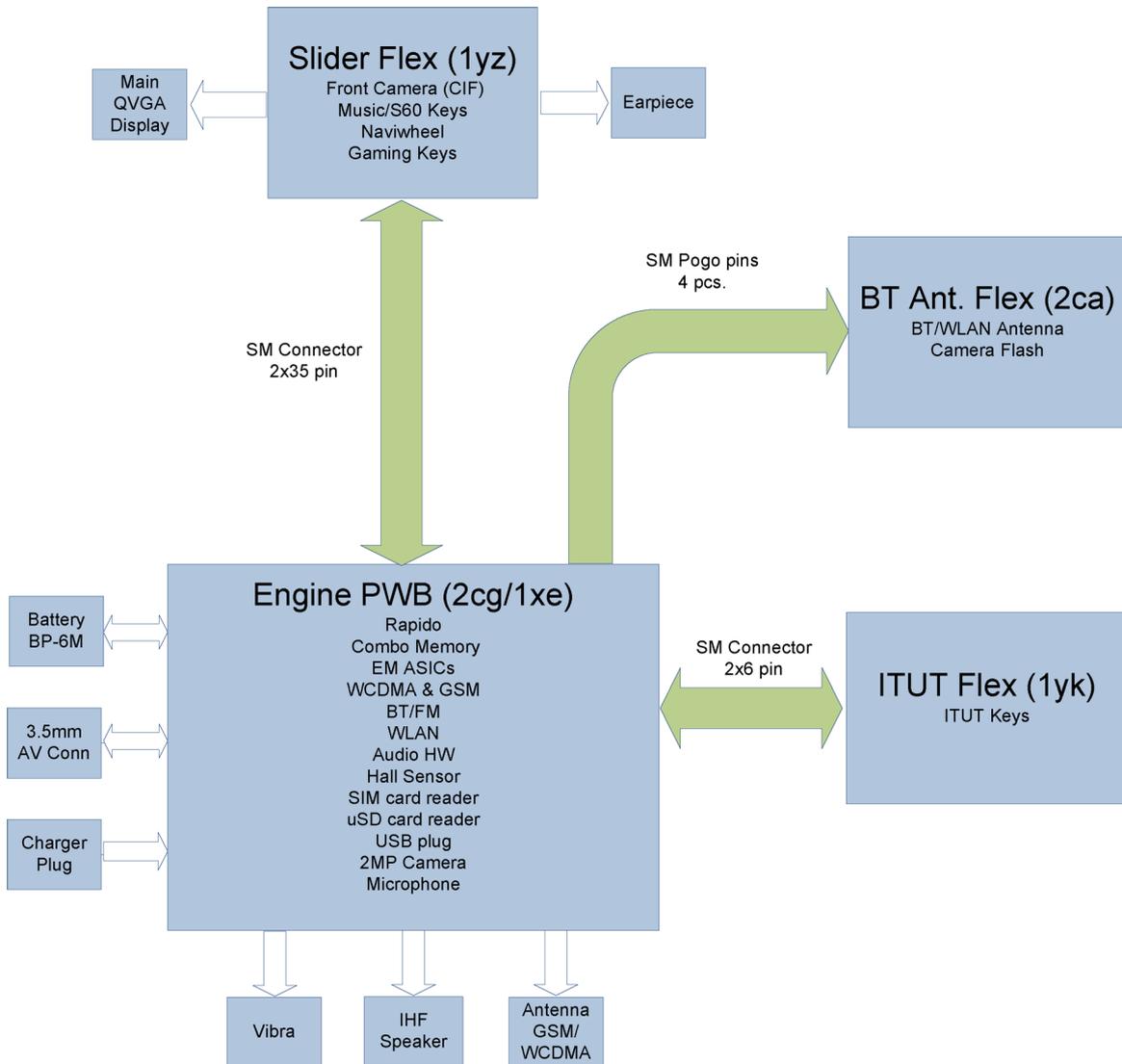
Key components

Function	Description	Item ref
Baseband ASIC	AVILMA BETTY	N2200 N2300
RF ASIC	Ahneus	N7505
Processor	RAPIDO	D2800
Camera accelerator	HWA STV984N	D2500
PA GSM	Front end module (FEM), quad band	N7520
PA WCDMA		N7540
Oscillators	VCTCXO Balun GSM Balum WCDMA	G7501 T7502 T7580
Memory	768Mb DDR SDRAM + 1Gb NAND FLASH Combo	D3000
Back-up battery	RTC back-up battery 311	G2200
FM radio	BTHFM1.0 module	D6000
Bluetooth	BTHFM1.0 module	D6000
Open/closed slider detection	Hall sensor	N2403
Battery	BP-6MT	
Battery connector	Tabby blade interface	X2070
RF connector		X7501

System module block diagram



Board and module connections



Energy management

Battery and charging

BP-6MT battery

The phone is powered by a BP-6MT battery block. It provides a capacity of 1050mAh minimum and contains a BSI resistor for the battery identification. Its battery interface is based on blade type connector where the transceiver side has blades and the counter parts are on battery side.

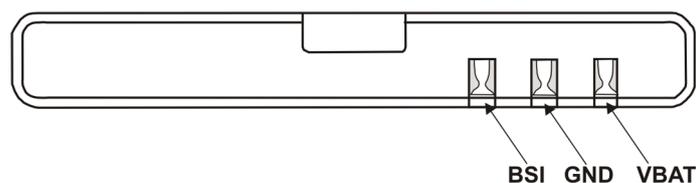


Figure 53 Battery pin order

The battery temperature is estimated by measuring separate battery temperature NTC via the BTEMP line. This is located on the main PWB, at the place where the phone temperature is closest to the battery temperature.

Battery connector

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

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

The BSI line is used to recognize the battery capacity by a battery internal pull down resistor.

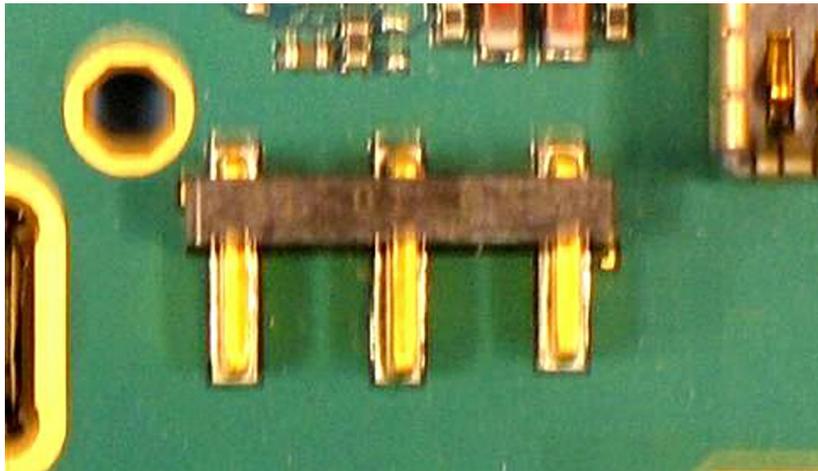


Figure 54 Battery connector

Charging

This phone is charged through the smaller Nokia standard interface (2.0 mm plug). The wider standard charger (3.5 mm) can be used together with the CA-44 charger adapter.



Figure 55 Small (right) and wide (left) charger plug

Charging is controlled by energy management, and external components are needed to protect the baseband module against EMC, reverse polarity and transient frequency deviation.

Backup battery

When the main battery is not attached EM ASIC (N2200) goes in backup mode using back-up battery that supplies voltage to RTC in EM ASIC (N2200).

Normal and extreme voltages

Energy management is mainly carried out in the two Application Specific Integrated Circuits (ASICs) BETTY and AVILMA. These two circuits contains a number of regulators. In addition there are some external regulators too.

In the table below, normal and extreme voltages are shown when a BP-6MT battery is used.

Table 7 Nominal voltages

Voltage	Voltage [V]	Condition
General Conditions		
Nominal voltage	3.700	
Lower extreme voltage	3.145	
Higher extreme voltage	4.230	
(fast charging)		
HW Shutdown Voltages		
Vmstr+	2.1 ± 0.1	Off to on
Vmstr-	1.9 ± 0.1	On to off
SW Shutdown Voltages		
Sw shutdown	3.25	In call
Sw shutdown	3.25	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).

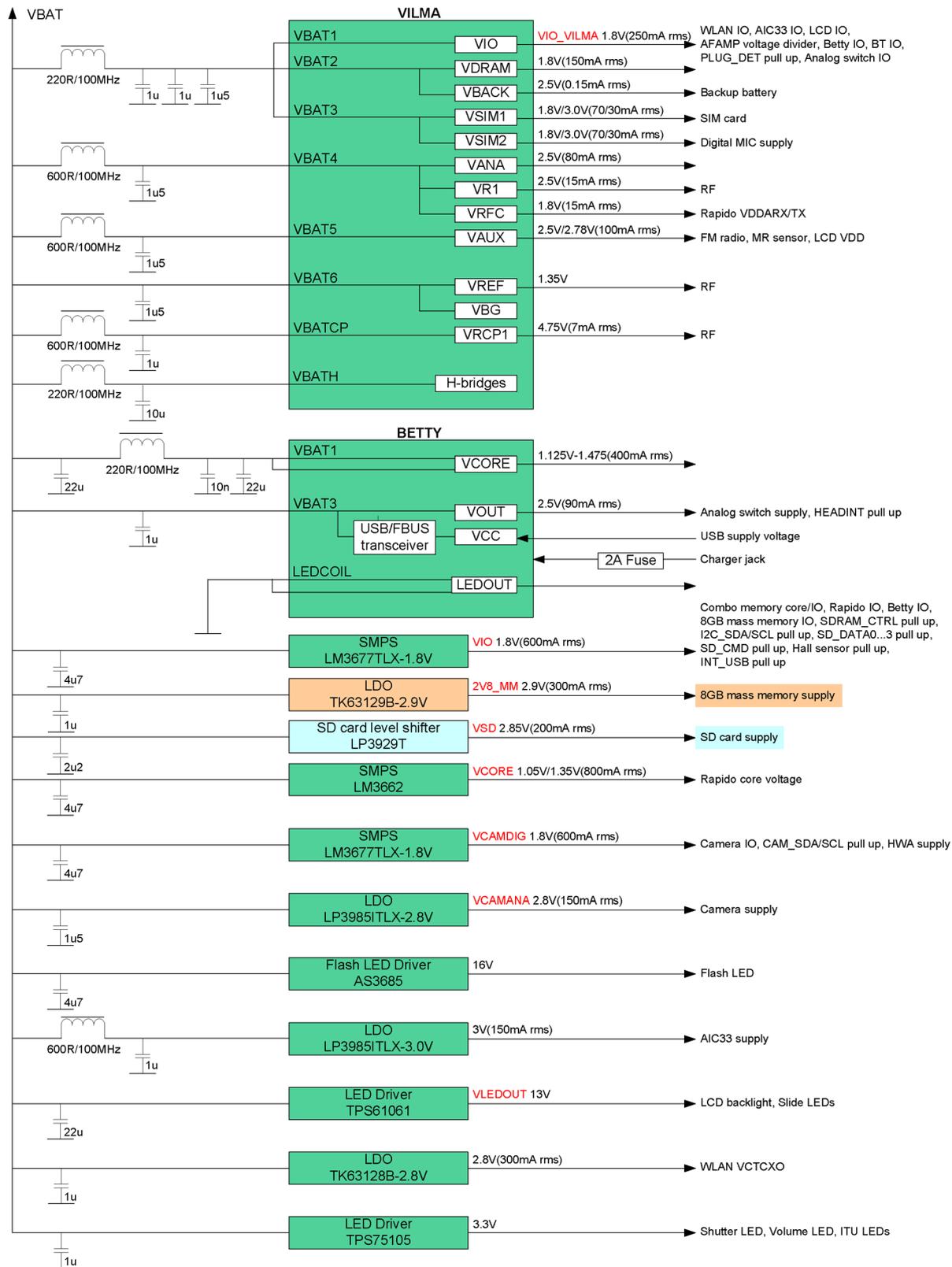
Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). The power key is connected to EM ASIC N2200 (AVILMA) via PWRONX signal.

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 AVILMA 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 voltage is adequate and the 32 kHz oscillator is running (RTC is on).
PWR_OFF	In this mode (warm), the main battery is present and its voltage is over N2300 BETTY 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.

Mode	Description
RESET	RESET mode is a synonym for start-up sequence. RESET mode uses 32 kHz clock to count the REST 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.

Power distribution



Engine-PWB 2CG
Engine-PWB 1XE/2GP

Clocking scheme

The BT module uses two clock signals (Ref_clk = 38.4 MHz and Sleepclock = 32.768 KHz) which are provided by the WLAN-module (TCXO).

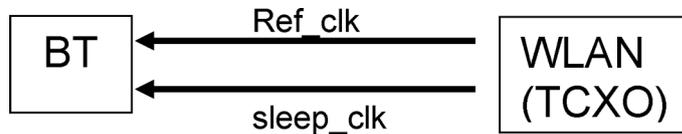


Figure 56 Clocking scheme

■ Bluetooth

Bluetooth provides a fully digital link for communication between a master unit (the phone) and one or more slave units (e.g. a wireless headset). Data and control interface for a low power RF module is provided by the module.

The Bluetooth is physically integrated with the FM radio into one single module. From a functional point of view they, however, have nothing in common.

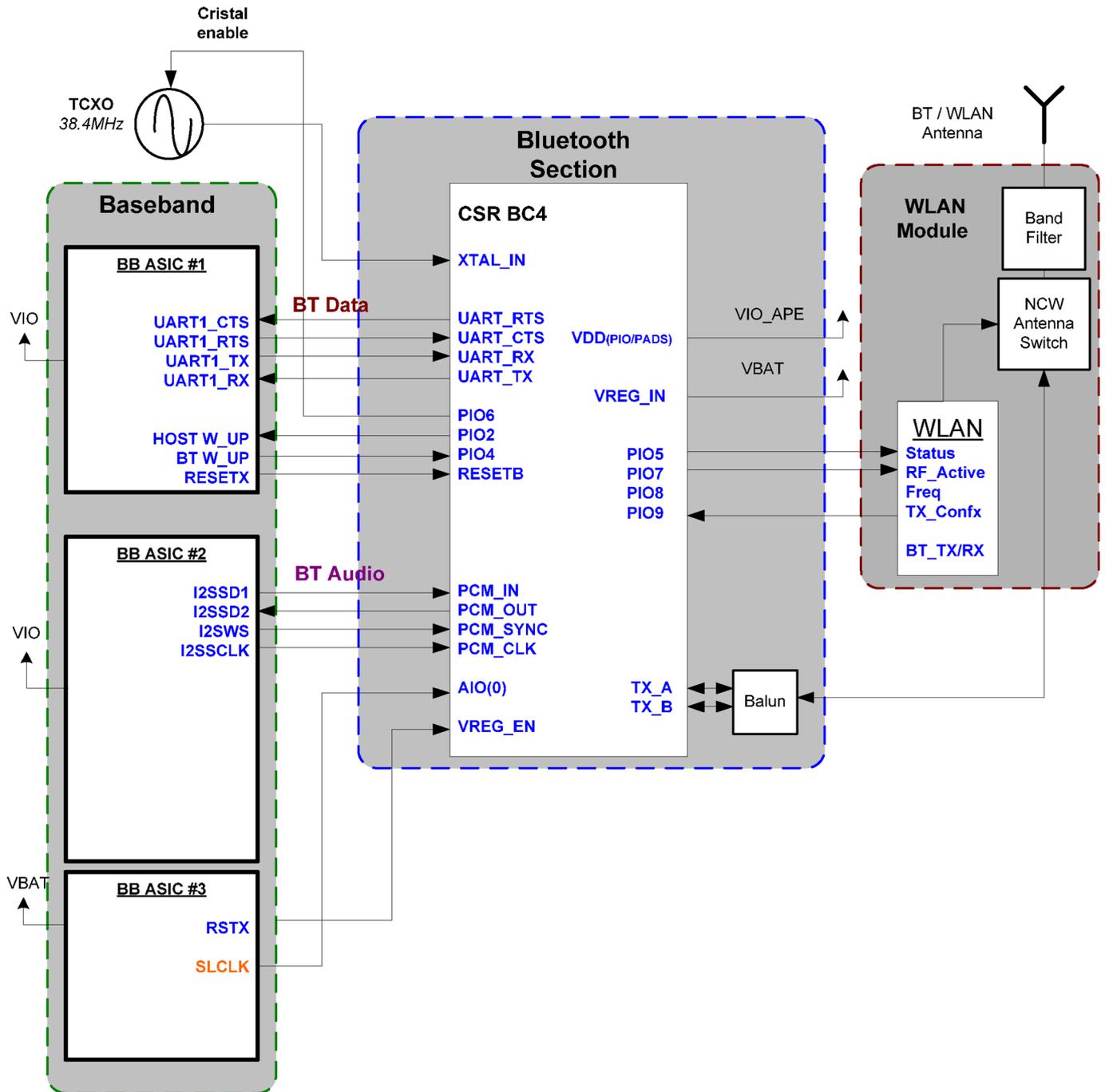
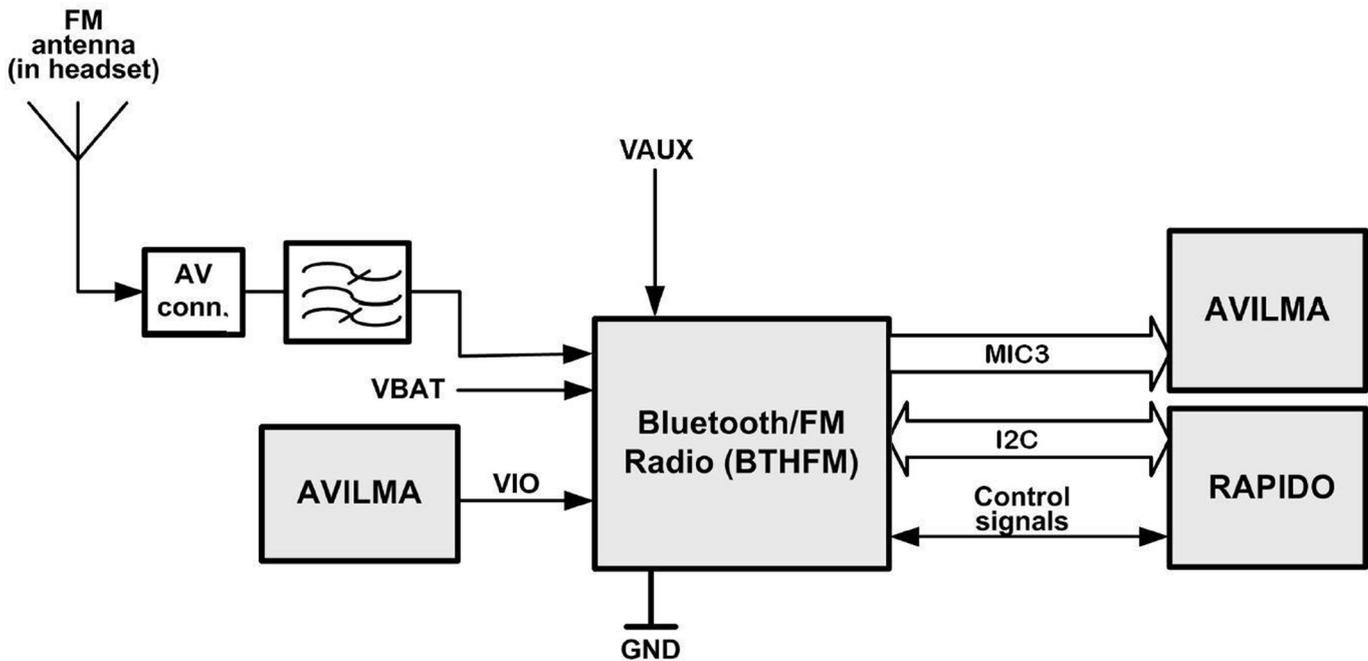


Figure 57 Bluetooth hardware block diagram

■ FM radio

The FM radio is physically integrated with the Bluetooth into one single module. From a functional point of view they, however, have nothing in common.



The FM radio is an integrated circuit, controlled by MCU software through a serial bus interface. The wires of the headset are used as elements of the antenna, and no other antenna is needed for FM radio reception.

The FM radio is provided with VAUX (2V8).

The radio has an automatic band search function, which can search for a strong station.

■ WLAN

WLAN engine is divided into STLC4550 WLAN transceiver module and radio front-end module (FEM) RF5924.

STMicroelectronics Phaser STLC4550 is a three-die multichip module, partitioned to radio, baseband and energy management die. STLC4550 is packaged to 8.5 mm x 8.0 mm x 1.4 mm 240-ball 0.5 mm pitch LFBGA.

STLC4550 implements 802.11b/g WLAN radio for embedded, low-power and small form factor mobile applications. STLC4550 conforms to the IEEE 802.11b/g protocols operating in 2.4 GHz band supporting OFDM data rates of 54, 48, 36, 24, 18, 12, 9, and 6 Mbps as well as CCK data rates of 11 and 5.5 Mbps and legacy data rates of 2 and 1 Mbps. IEEE802.11e/i protocol extensions are included to implement quality of service (QoS) and security functions.

STLC4550 has a fully integrated radio chip including a direct-conversion transceiver, RF synthesizer and VCO, and high-speed data converters. Digital interface is used for transferring the sampled data between radio and baseband chip. The baseband chip implements OFDM/CCK digital baseband processor and ARM9- based MAC with internal SRAM memories. The baseband includes required logic and interfaces to enable time-shared simultaneous use of BT and WLAN.

The energy management unit integrates required power management functions to operate the system from VBAT (3.0 – 5.5 V). The EM unit generates 1.2 V digital core voltage, two 1.8 V supplies for RF and 2.8 V LDO for PA bias supply. The EM unit also integrates power-on reset circuitry and level-shifters for RF front-end GaAs switches.

Host interface is provided by a flexible serial interface (SPI) supporting clock frequency upto 48 MHz. The maximum usable SPI clock rate depends on the host side clocking options and timing requirements. Typically rates of 14 – 24 MHz are achieved. WLAN/BT coexistence interface enables automatic time shared usage of WLAN and Bluetooth.

The system uses 38.4 MHz reference clock. In this device, a dedicated oscillator circuit for WLAN and bluetooth reference clock is used. Low power sleep mode operation is enabled using 32768Hz low speed clock and energy management stand-by state.

WLAN RFMD RF5924 front end module is used. Power amplifier, RF-switches and baluns are integrated to FEM. The PA includes power detector for closed-loop power control purposes. WLAN/BT bandpass filter is external ceramic filter.

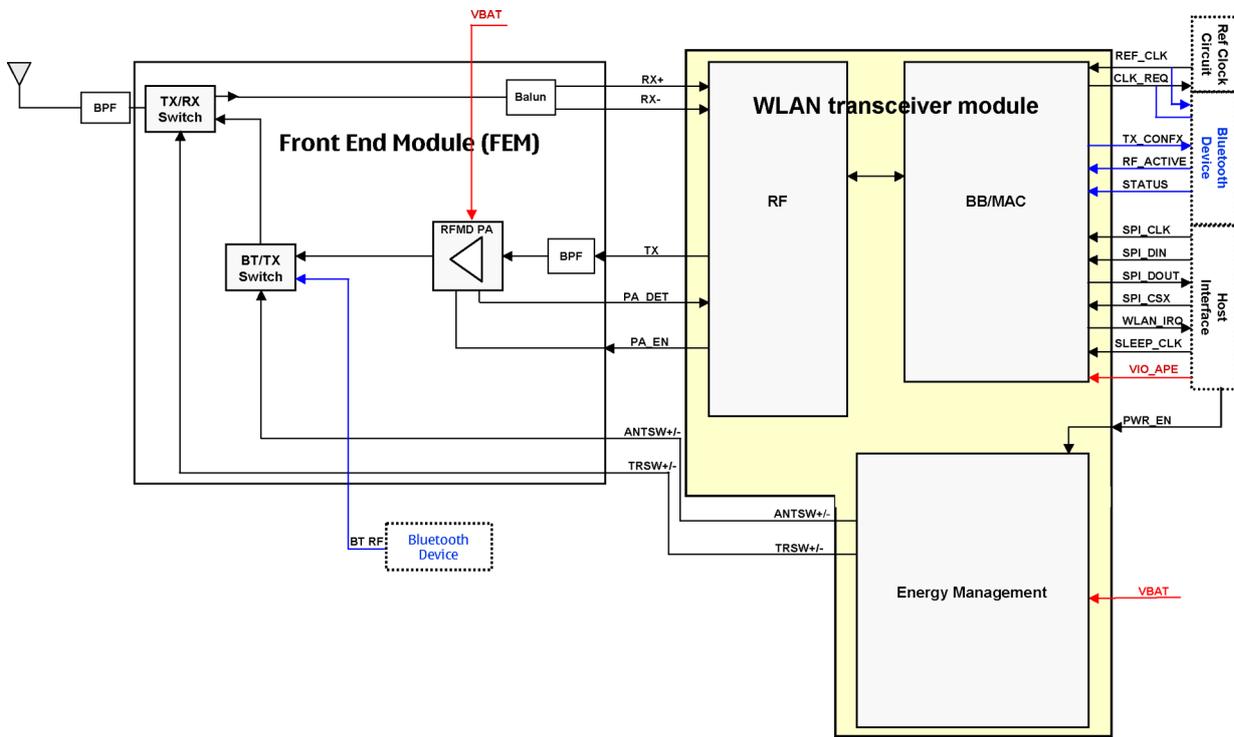


Table 8 General WLAN specifications

Supported channels	USA 1-11 (2412-2462MHz)
	ETSI 1-13 (2412-2472MHz)
Barker/CCK (1, 2, 5.5, 11Mbps datarate)	12 dBm
OFDM-BPSK (6, 9 Mb/s)	10 dBm
OFDM-QPSK (12, 18 Mb/s)	10 dBm
OFDM-16QAM (24, 36 Mb/s)	9 dBm
OFDM-64QAM (48, 54 Mb/s)	9 dBm
Power control range	0-17dBm
Receiver sensitivity (typical)	-83dBm
11M/bits. 1024bytes / 8% PER	-70dBm
54 Mb/s, 1000 bytes, 10% PER	

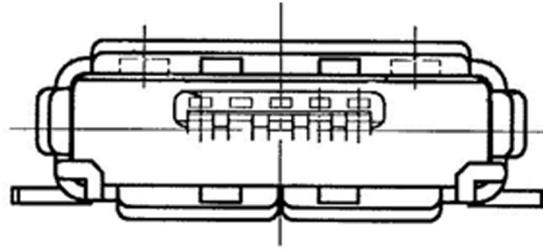
■ USB

USB (Universal Serial Bus) provides a wired connectivity between a PC and peripheral devices. It is a differential serial bus.

USB 2.0 is supported with full speed (12 Mbps).

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

This phone is provided with a specific connector for microUSB.



■ **CBUS interface**

CBUS is a "main" system control bus in BB5. RAPIDO controls the functionality of EM ASIC (N2200) and EM ASIC (N2300) ASICs with CBUS.

CBUS is a four-wire half-duplex master-slave interface. In BB5 CBUS clock frequency is 2.4 MHz.

■ **FBUS**

USB and FBUS have multiplexed interface between EM ASIC (2300) and RAPIDO.

■ **ECI interface**

The ECI (Enhancement Control Interface) is a point-to-point, bi-directional, single line serial bus.

The purpose of the ECI is to identify and authenticate the accessory, and to act as a data bus (intended for control purposes) between the phone and the accessory .

■ **Charger interface**

Charging control and charge switch are situated in EM ASIC (N2300).

If the temperature rises too high and the thermal protection is activated, EM ASIC (N2300) goes to protection mode.

■ **SIM interface**

The device has one SIM (Subscriber Identification Module) interface. It is only accessible if battery is removed. The SIM interface consists of an internal interface between RAPIDO and EM ASIC (N2200), and of an external interface between N2200 and SIM contacts.

The SIM IF is shown in the following figure:

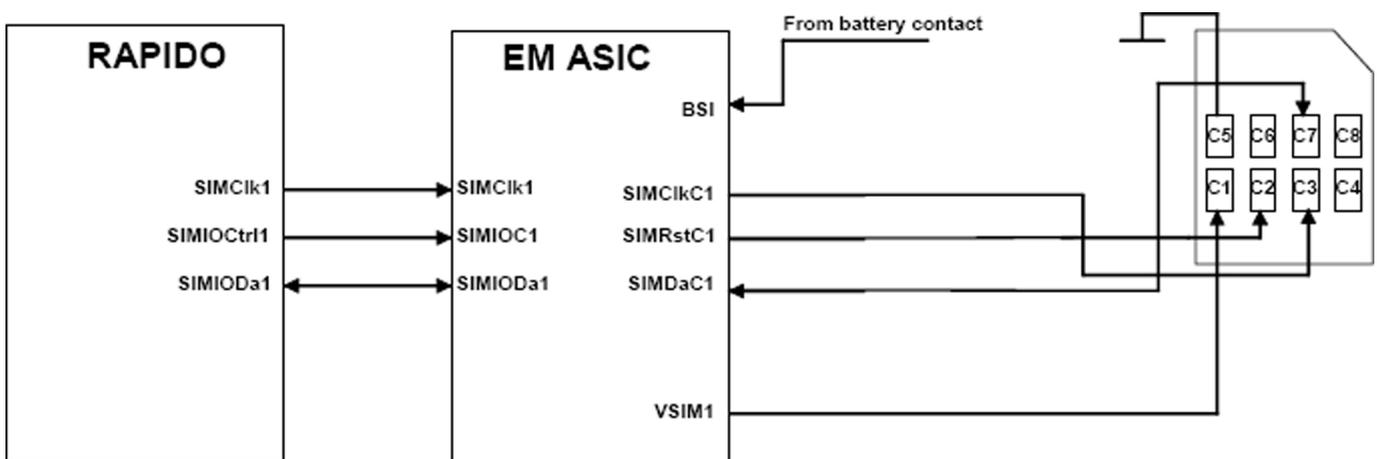


Figure 58 SIM interface

The EM ASIC handles the detection of the SIM card. The detection method is based in the BSI line. Because of the location of the SIM card, removing the battery causes a quick power down of the SIM IF.

The EM ASIC SIM1 interface supports both 1.8 V and 3.0 V 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 a 3 V interface voltage is used. The data communication between the card and the phone is asynchronous half duplex, and the clock supplied to the card is 1-5 MHz, which is 3.2 MHz by default (in GSM system). The data baud rate is the SIM card clock frequency divided by 372 (by default), 64, 32 or 16.

■ **µSD card interface**

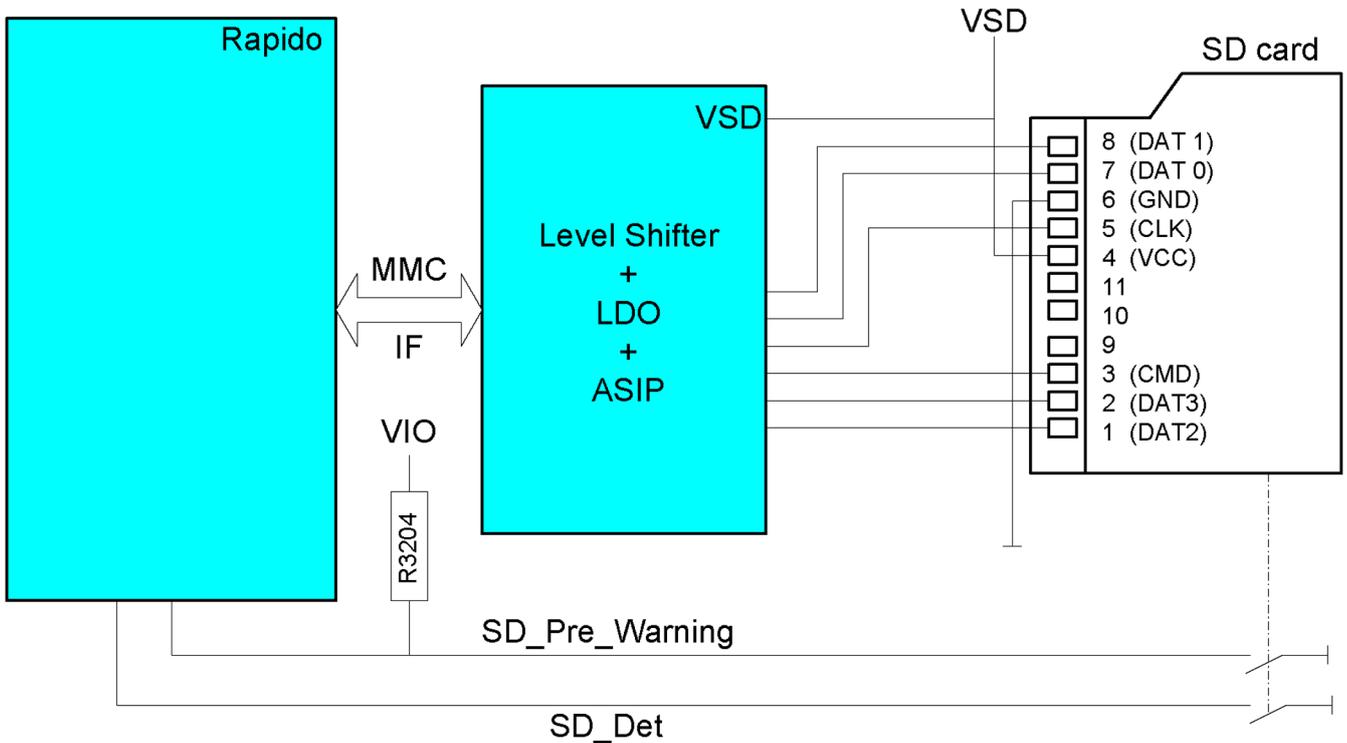


Figure 59 SD interface

The µSD card is connected to the engine by an external level shifter with an ESD protection filter. Supplied voltages:

- VSD: 2.85 V (from level shifter)
- VIO: 1.8 V (from AVILMA)

The µSD card door state is detected by a detect switch. 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.

■ **Camera concept**

Cameras

The device has two integrated digital cameras. The main camera is meant for high quality still imaging and video capture. The secondary (front) camera is meant for video conferencing but it can also be used for still image capture.

Main camera characteristics

Sensor type	CMOS
-------------	------

Sensor photo detectors	2.0 Million (1600 x 1200 pixels)
F number/Aperture	f/2.8
Focal length	4.4 mm
Focus range	40 cm to infinity
Still Image resolutions	1600x1200, 1152x864 and 640x480
Still images file format	EXIF (JPEG), *.jpg
Video resolutions	320x240, 176x144 and 128x96
Video clip length	30 sec short mode or 1 hour free mode
Video file format	3GPP, (*.3gp)
Exposure control	Automatic
White balance	Automatic, sunny, cloudy, incandescent, flurescent
Colour tones	Normal, sepia, vivid, black&white, negative
Capture Modes	Still capture mode, video mode and sequence mode
Selftimer	10, 20, 30 s
Flash settings	Auto, off and forced

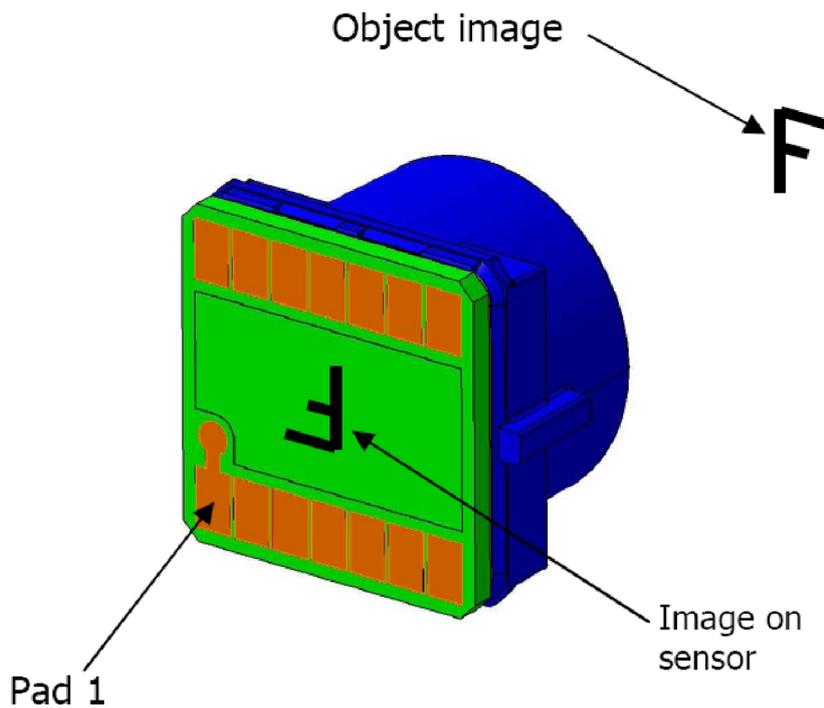


Figure 60 Main camera image orientation

Secondary camera characteristics

Sensor type	CMOS
Sensor photo detectors (effective)	384x320
F number/Aperture	2.8

Focus range	25cm -> 1m
Still image resolutions	320x240
Still images format	EXIF (.jpg)
Video resolutions	352x288, 176x144 or 128x96
Video clip length	30sec short mode or 1 hour free mode
Video file format	3GPP, (*.3gp)
White Balance	Automatic
Colours	16.7 Million, 24bit

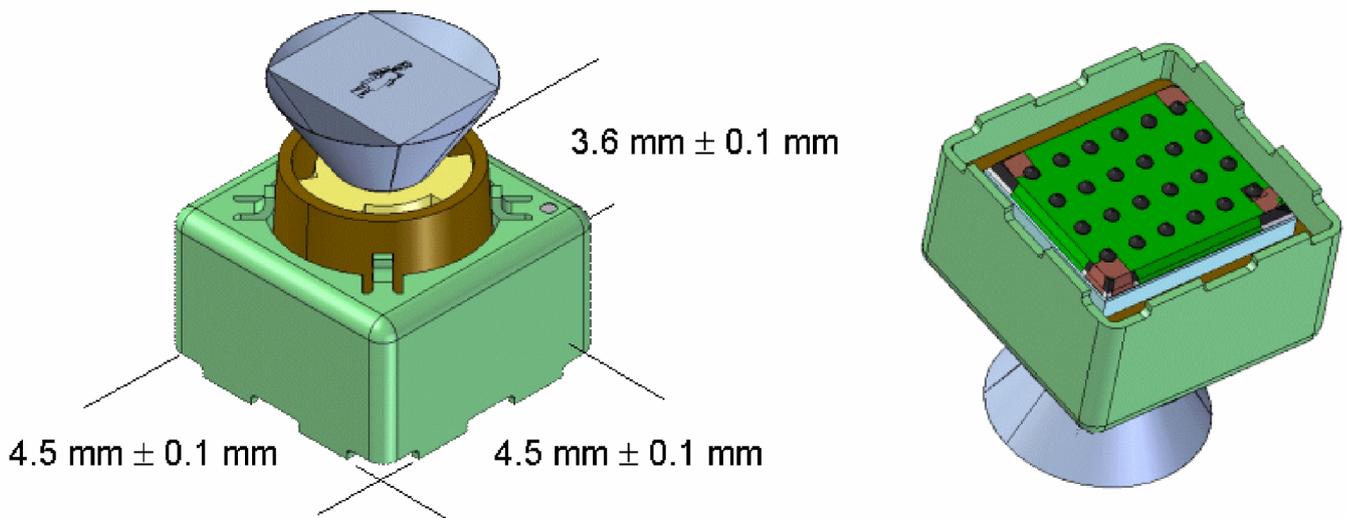


Figure 61 Secondary camera mechanical outline

Camera flash

The device back camera has a camera flash module located directly beside the camera, providing better lighting conditions in darker environments. The indicator LED close to the flash module is used as an indicator light for certain use cases.

The camera flash is a single die, ultra compact light sources. Therefore the LED does not include lens. It is part of the phone cover to ensure a proper light pattern at the target.

The dimensions of the camera flash module are $1.65 \pm 0.1 \text{ mm} \times 2.05 \pm 0.1 \text{ mm} \times 0.7 \text{ mm}$.

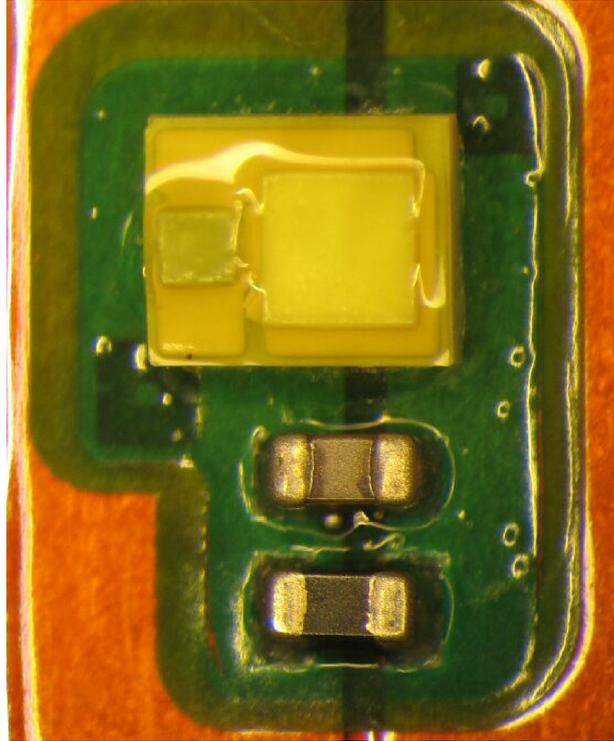
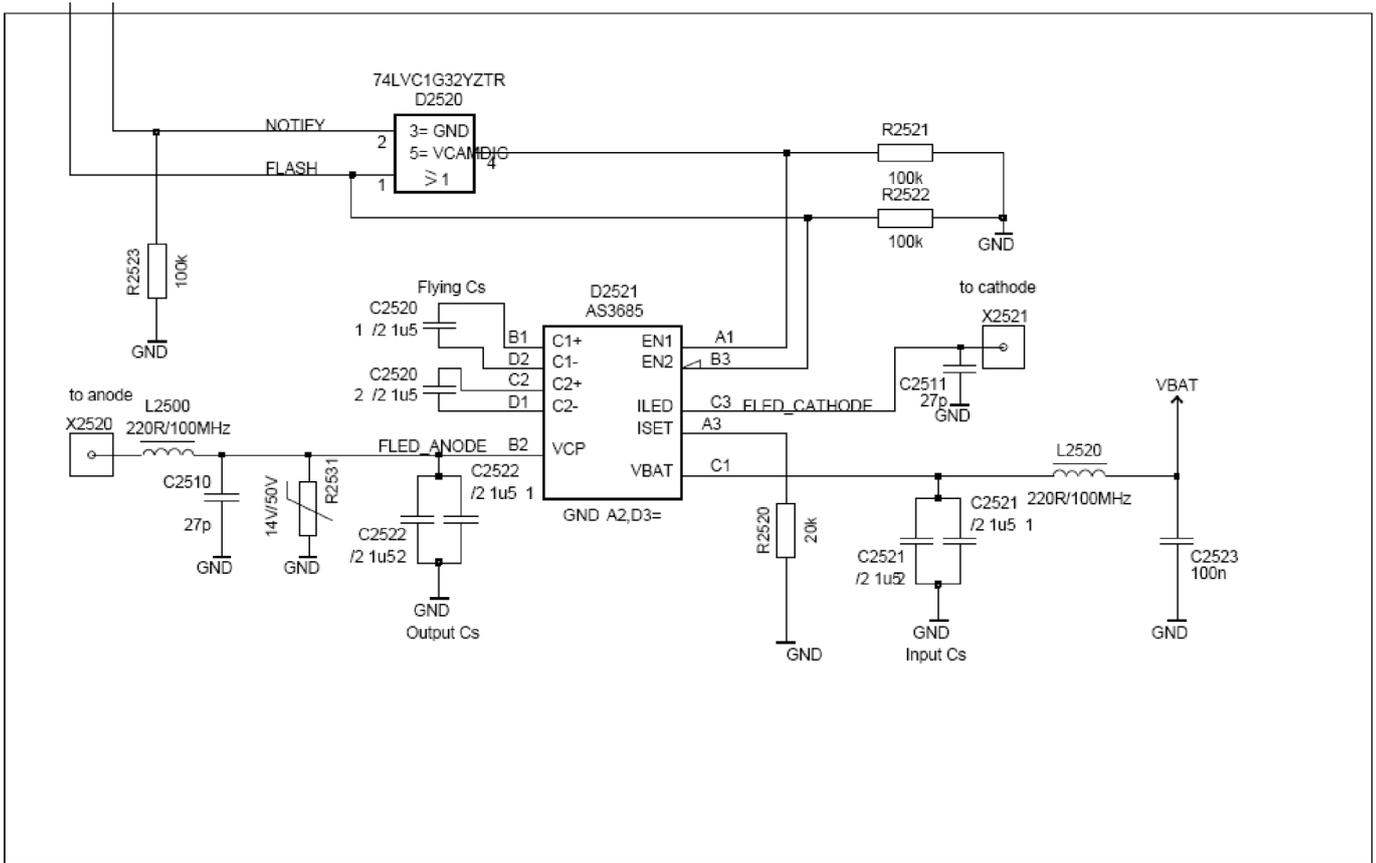
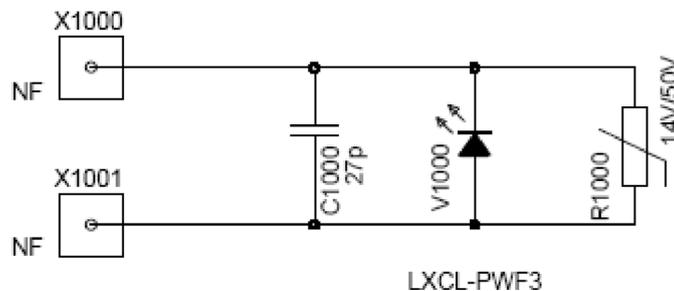


Figure 62 Flash LED



Flash LED



Hardware accelerator

The STV0984N is an ultra low power mobile imaging digital signal processor which supports SMIA CMOS color image sensors up to 2 Megapixel resolution. It performs all the required data processing to deliver good quality in view finder, still and movie color images.

The STV0984N performs high quality color processing on images, achieving JPEG compression if requested by Rapido. Further, it includes programmable GPIOs to control external flash LED. STV0984 provides internal buffering capability along with a versatile clock manager to accommodate different data rates between input sensors and Rapido interface.

Data is transferred from sensor to STV0984N through Low Electromagnetic Interference (EMI) interface; using the CCP 2.0 data transfer protocol over LVDS (2 separate CCP 2.0 receivers).

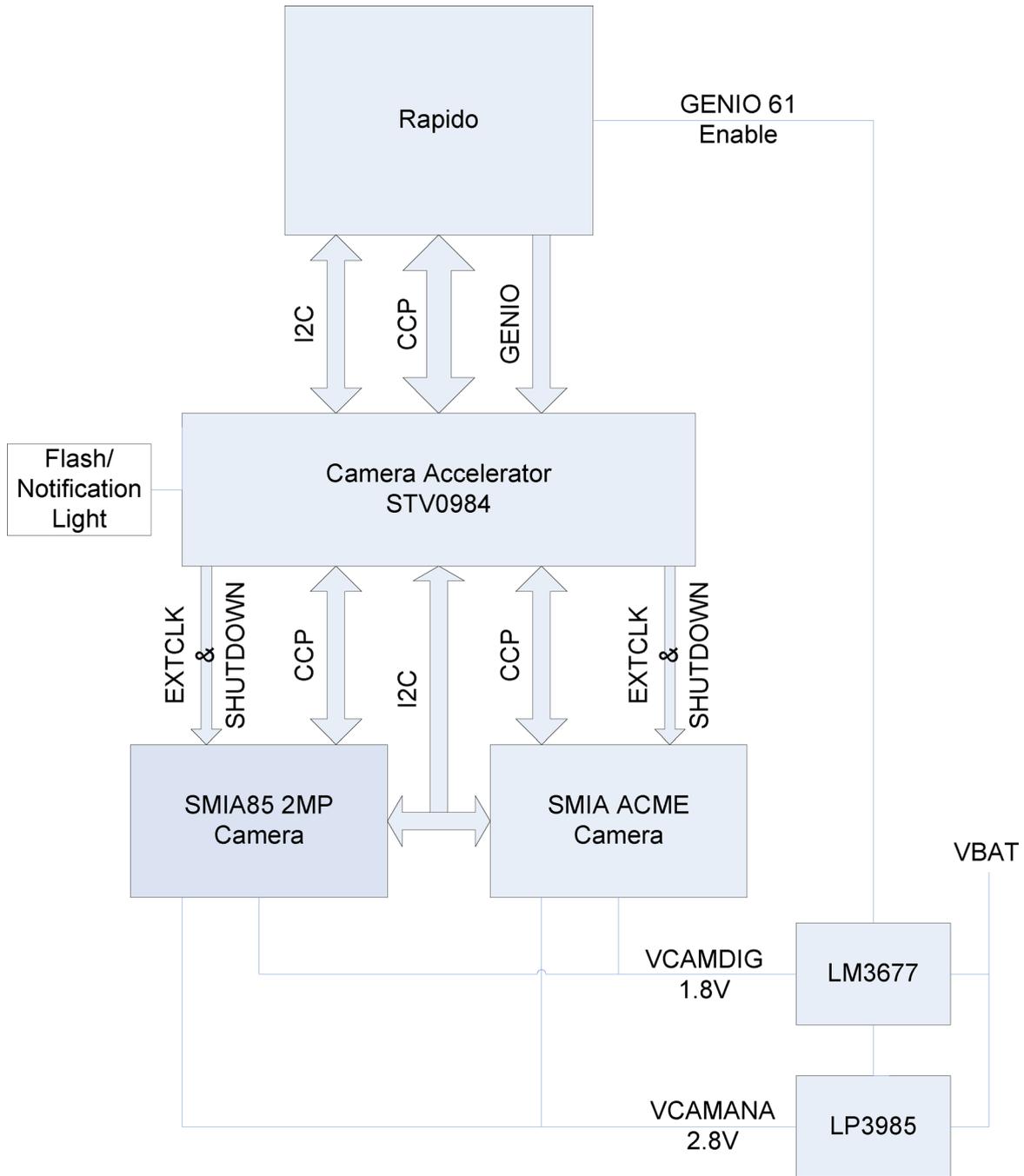


Figure 63 Camera overview

User interface

Display module

This phone has one display:

- Active TFT QVGA display supports up to 16,777,216 colors (320 x 240 pixels, 2.2 inches)

The display is connected to Rapido MeSSI interface. Signal filtering is done via LCD-ASIP components placed on engine PWB. The MeSSI interface is operated with 8.77 MHz.

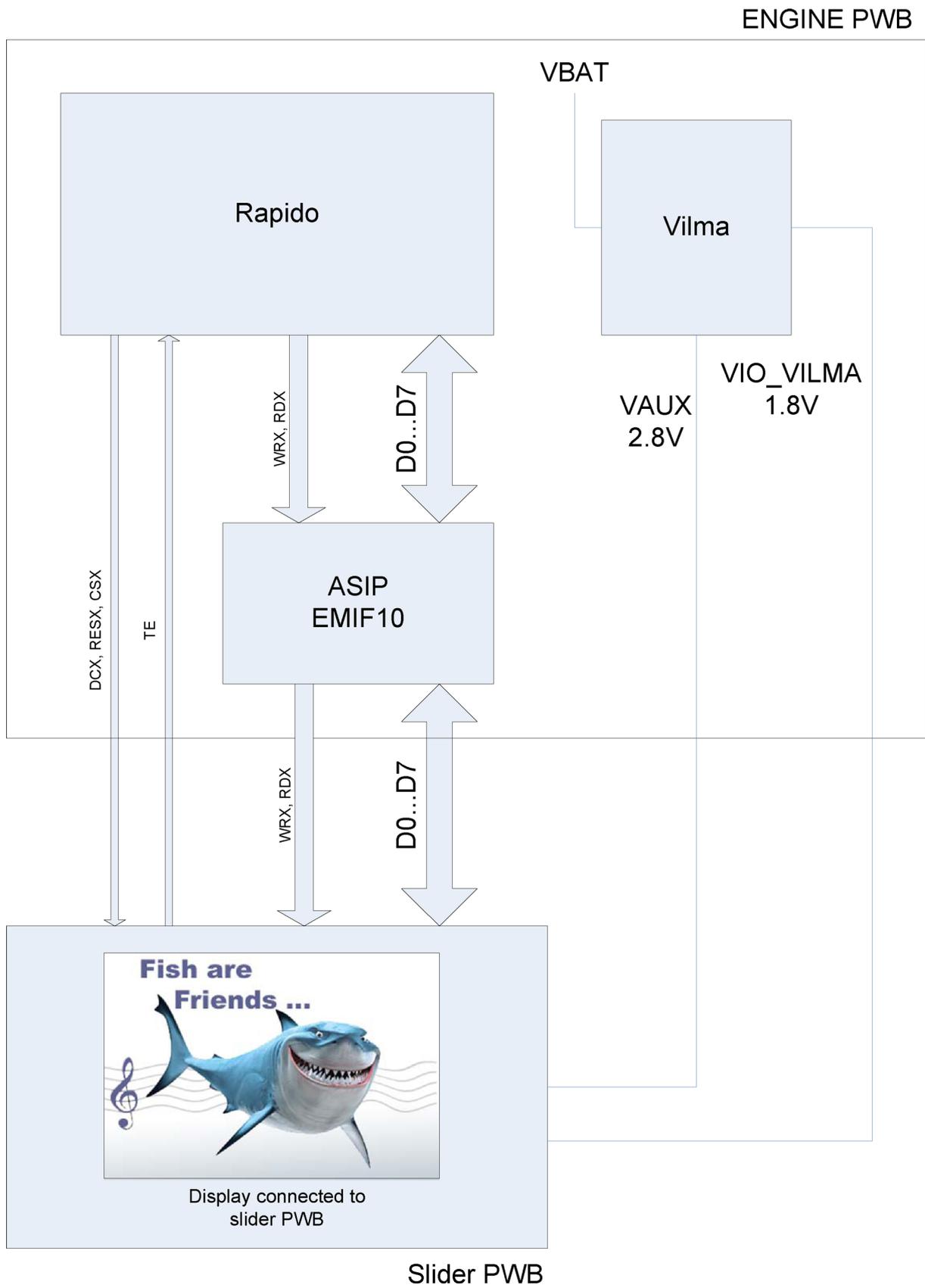


Figure 64 Display overview

Display characteristics

Table 9 Display characteristics

Item	Specification
Active area resolution	240x320 (166ppi)
Interface	MeSSI-8/16 with 8 bit data IF
Number of colors	24bit (normal mode)
	3bit (partial mode)
Size	41,8mm x 59,4mm x 2mm
Illumination	2x2 white LEDs
	230 mcd
Viewing angle	3,6,9,12 o'clock
Technology	AM-LCD

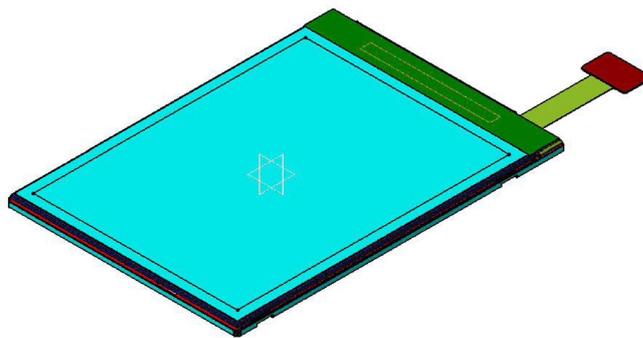


Figure 65 Display mechanical outline

Keyboard and other keys

The keyboard interface of the Rapido supports a 8x8 keyboard matrix. In this phone two 4x4 sub matrixes are used. One for the ITUT keys (Row4-7/Collumn4-7) on the ITUT flex. The other is used for the S60/music keys (Row0-3/Collumn0-3) on the slide FPC. Both matrixes are protected by ASIPs on the engine PWB.

	COL0	COL1	COL2	COL3	COL4	COL5	COL6	COL7
ROW0	Up	Left	R-Soft	Play		ITUT keys 		
ROW1	Down	Right	end	Clear				
ROW2	L-Soft	App	Select	Stop				
ROW3	send	Op/Mult.	Backward	Forward				
ROW4		 S60 keys			Vol Up	1	6	8
ROW5					Shutter	5	7	#
ROW6						9	0	3
ROW7						Vol Down	*	2

Figure 68 RM-179 key matrix

Backlight and illumination

Display and menu key illumination

Display

The display has 2x2 LEDs in series included for backlight illumination. They are connected to have 4 LEDs in series and driven with a constant current source SMPS (N2301). Driving current is 15mA and its PWM dimmed (EN). In addition a "load-disconnect" circuit (N2302) is implemented. This avoids ringing of the output capacity C2314. Basic filtering on VLEDOUT is done with L2302, C2305 and C2316.

Menu keys

Three LED chains for S60 Keys, Music Keys and Gaming Keys are derived from VLEDOUT and driven by a constant current source at 5 mA. Each chain has separate ENABLE signal and dimmed with VLEDOUT. Gaming Key LEDs have additional ESD protection.

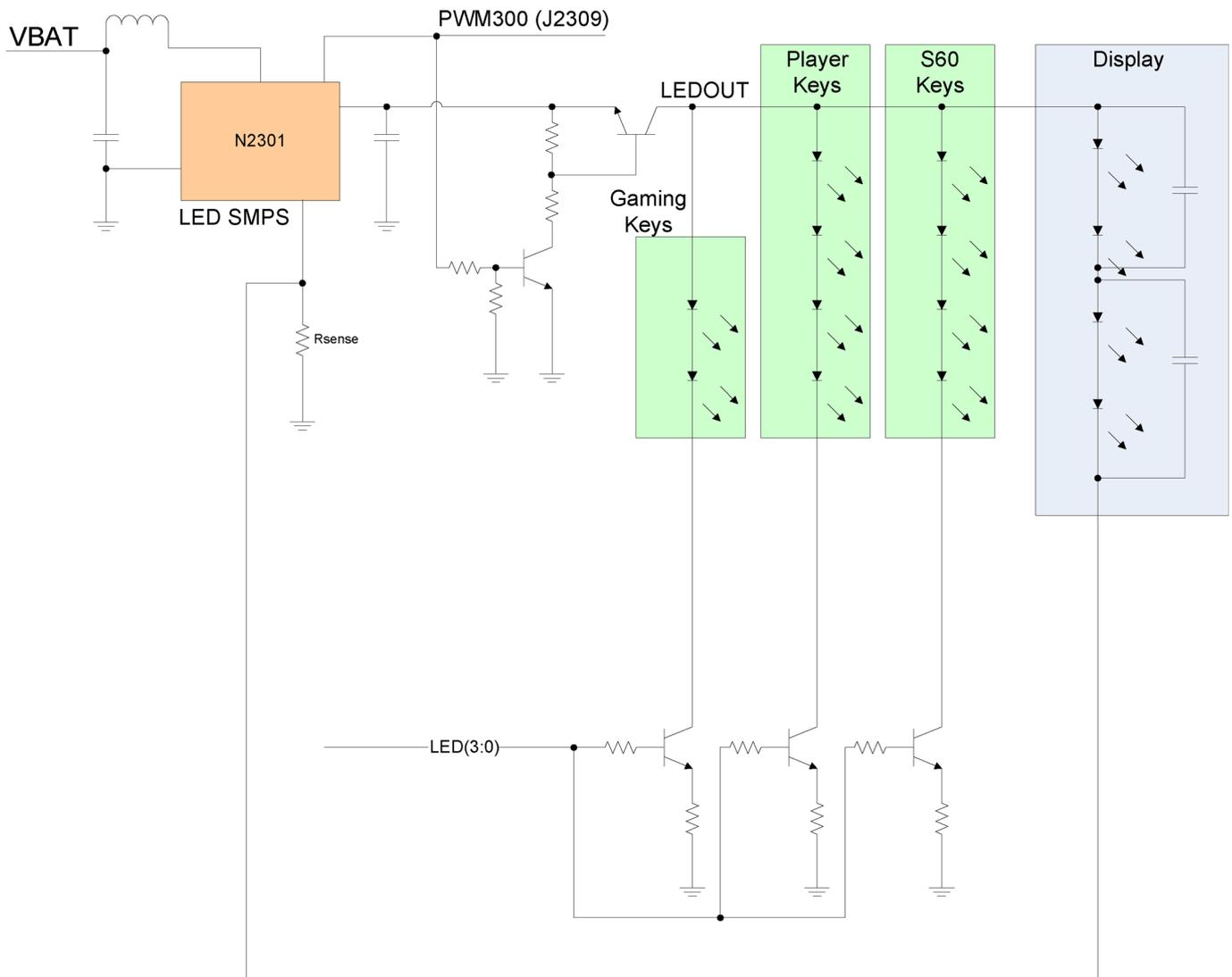


Figure 69 Illumination overview

ITUT keyboard and side key illumination

ITUT keyboard is illuminated with 2x2 LEDs in parallel and side keys are illuminated with 1x2 LEDs in parallel. Each two LEDs are driven by a High-Side driver output (N2302) with 10mA which results in 5mA per LED. ITUT-LEDs are connected to channel A and side-LEDs are connected to channel B. Each channel can be separately switched on and off (ENA, ENB). Both channels are ORed (D2400) with PWM signal to achieve dimming when display is dimmed.

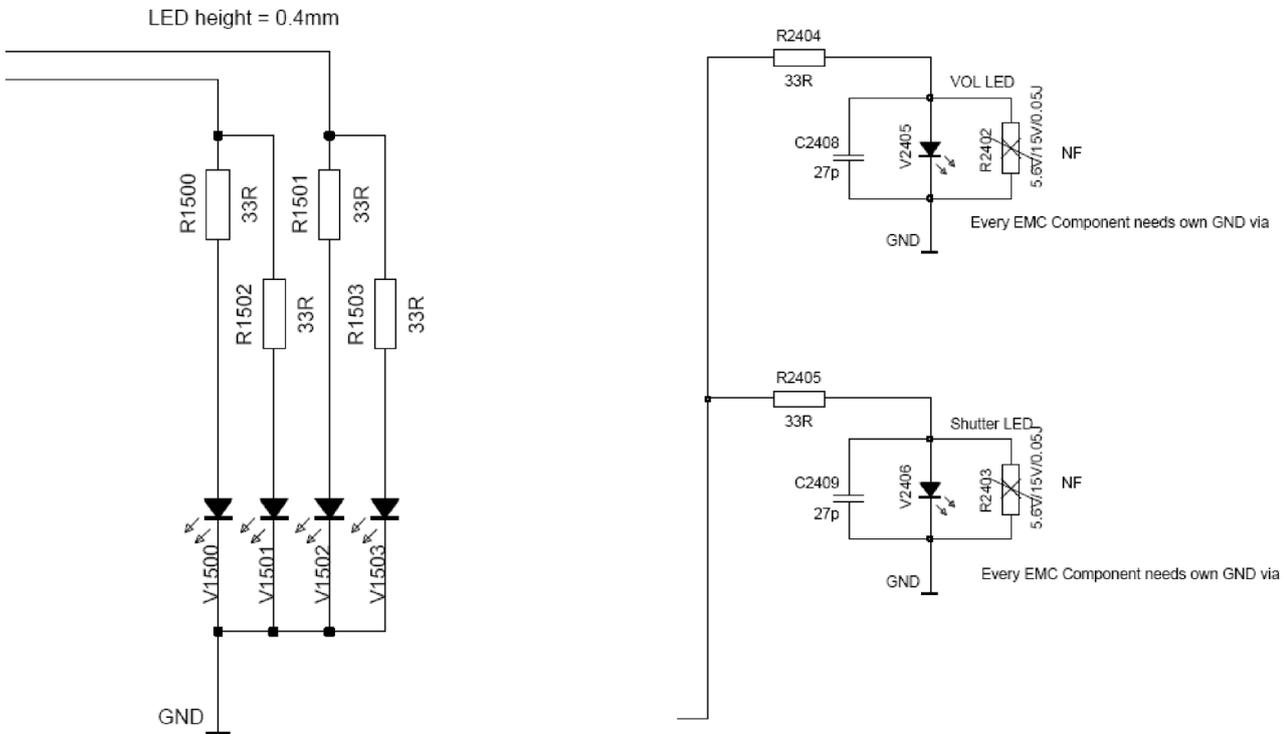
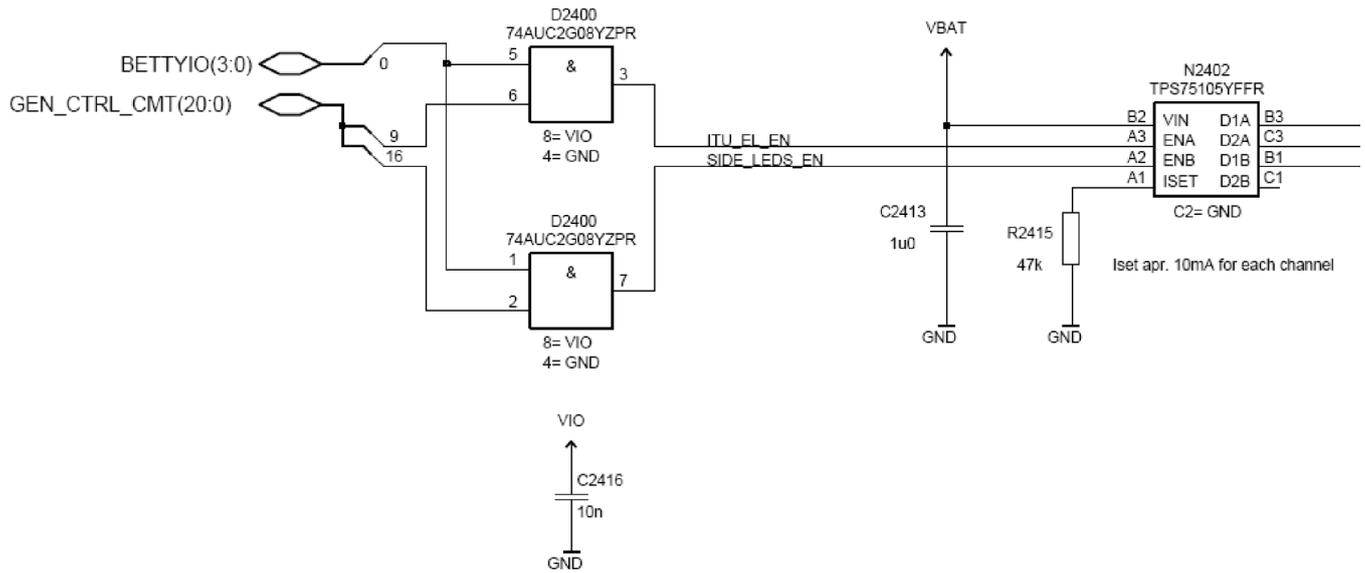


Figure 70 ITUT keyboard and side key backlight

NaviWheel illumination (power LED)

The NaviWheel illumination has three LEDs in parallel and driven in two modes: S60 and Power-Save mode. In S60 mode driving current is 15mA with gives 5mA per LED. It is activated whenever S60 LEDs of menu keyboard are activated. In this mode dimming is not supported.

In order to save current and increase the standby time, the phone provides an extra power saving mode where the display will be switched off after a certain time of user inactivity. A low frequently blinking NAVIWheel will indicate, that the phone is still alive (no empty battery). In Power-Save mode driving current is 6mA which will lead to 2mA per LED.

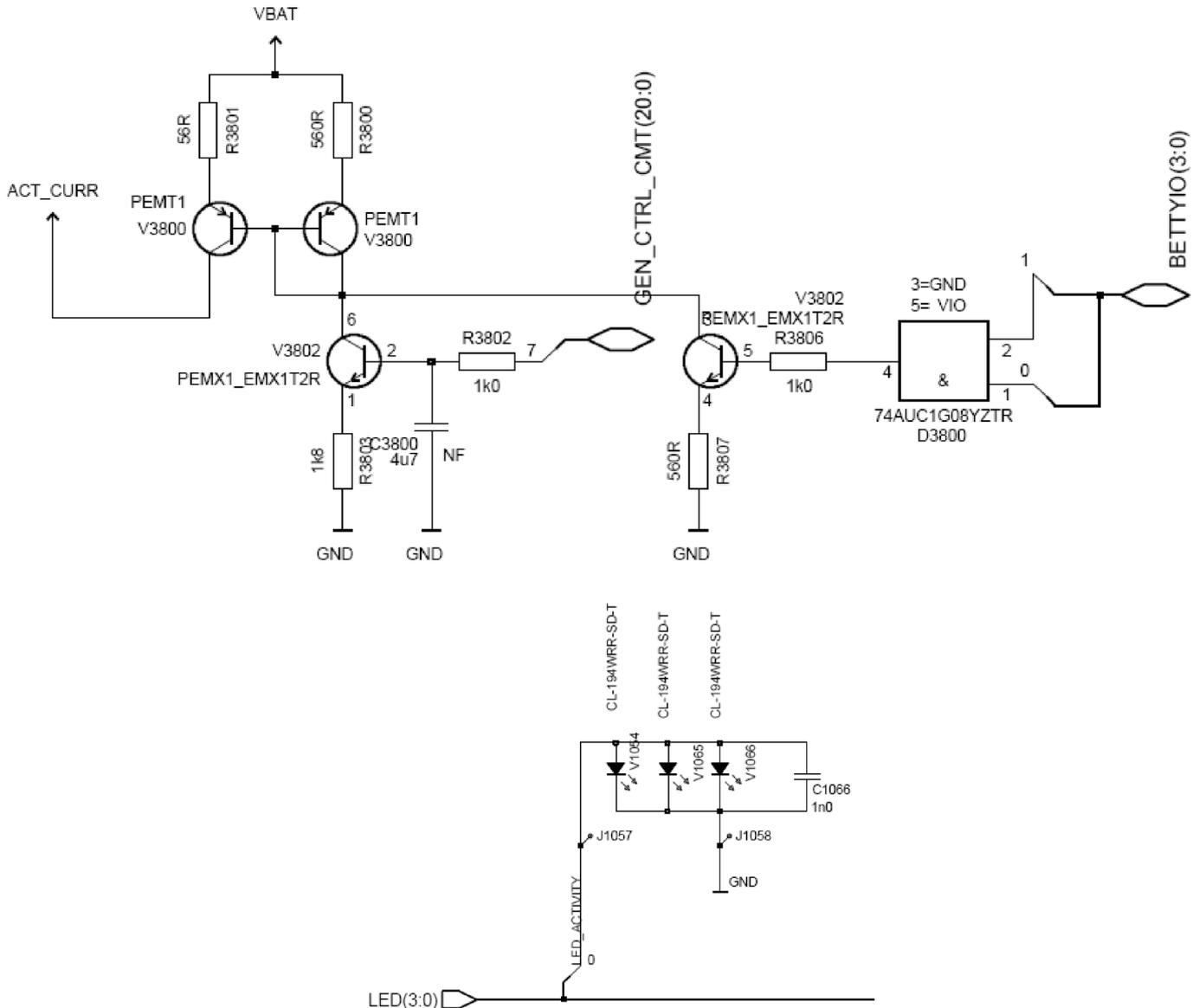


Figure 71 High side driver schematic

Hall sensor

The hall sensor is for the open/closed slider detection. The sensor that is mounted on the engine PWB works together with a magnet on the slide FPC module.

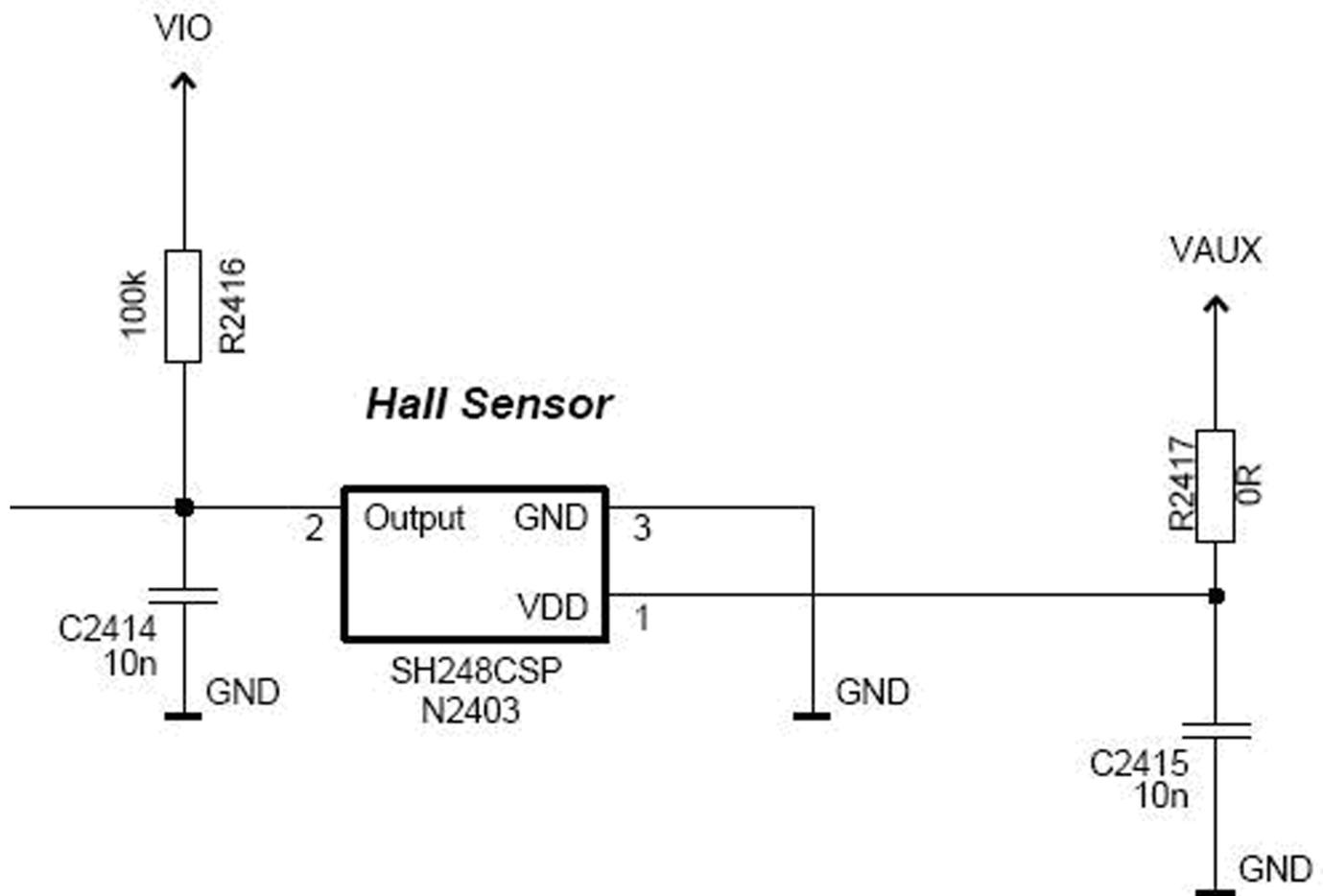


Figure 72 Hall sensor connection

■ ASICs

RAPIDO ASIC

Rapido ASIC is a 3G Radio Application Processor.

EM ASIC N2300

The EM ASIC (N2300) includes the following functional blocks:

- Core supply generation
- Charge control circuitry
- Level shifter and regulator for USB/FBUS
- Current gauge for battery current measuring
- LED driver for backlights
- Digital interface (CBUS)

EM ASIC N2200

The EM ASIC (N2200) includes the following functional blocks:

- Start up logic and reset control
- Charger detection
- Battery voltage monitoring

- 32.768kHz clock with external crystal
- Real time clock with external backup battery
- SIM card interface
- Stereo audio codecs and amplifiers
- A/D converter
- Regulators
- Vibra interface
- Digital interface (CBUS)

EMC ASIP (Appcation Specified Integrated Passive) have been integrated inside the ASIC. It includes biasing passives for microphone , EMC filter for SIM, microphones etc.

■ Combo memory

The application memory of the device consists of NAND/DDR combo memory. The stacked DDR/NAND application memory has 768 Mbit of DDR memory and 1 Gbit of flash memory.

■ Audio concept

Audio HW architecture

The functional core of the audio hardware is built around the two ASICs Rapido engine and mixed signal ASIC AVILMA.

AVILMA provides an interface for the transducers and accessory connector. Integrated handsfree stereo speakers are driven by a Class-D audio amplifier TPA2012D2 (second source LM4674A). An audio DAC AIC33 and audio amplifier TPA6130A2 (or second source TS4601) are used to supply HiFi audio signals to external headphone/headset.

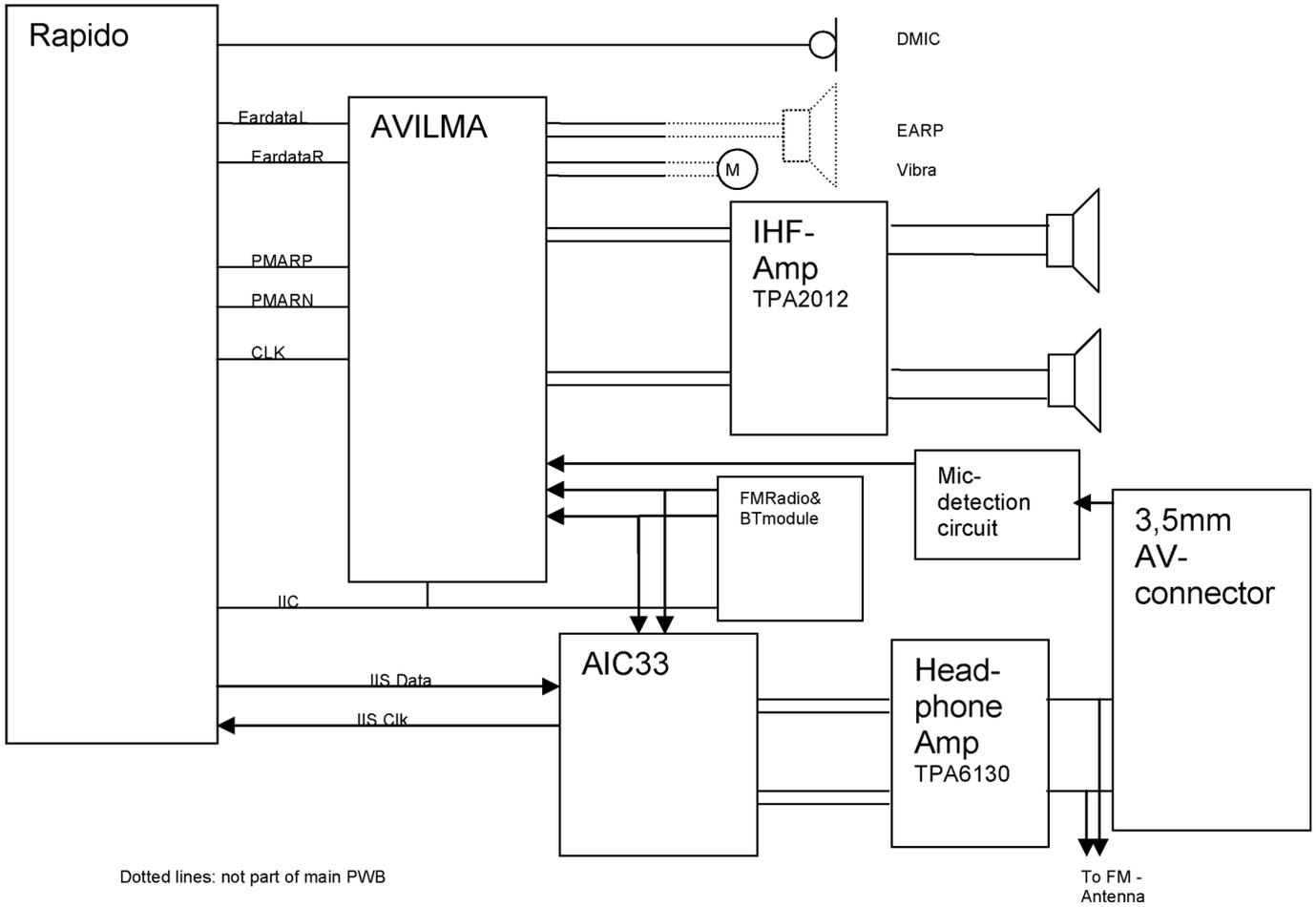
The audio transducers are:

- Dynamic earpiece (located on slider)
- Two dynamic speakers
- Digital microphone

In addition to the audio transducers, AVILMA also provides an output for the dynamic vibra component.

All galvanic audio accessories are connected to AV accessory connector.

A Bluetooth audio and FM-radio module, connected to Rapido, AVILMA and AIC33 supports Bluetooth audio and radio functionality.



Internal microphone

Internal microphone is used for Handportable (HP) and Internal Handsfree (IHF) call modes. A digital MEMS-microphone is connected directly to Rapido via Data (MicData on Genio42) and CLK (AudioCLK). Mic is powered by VSIM2.

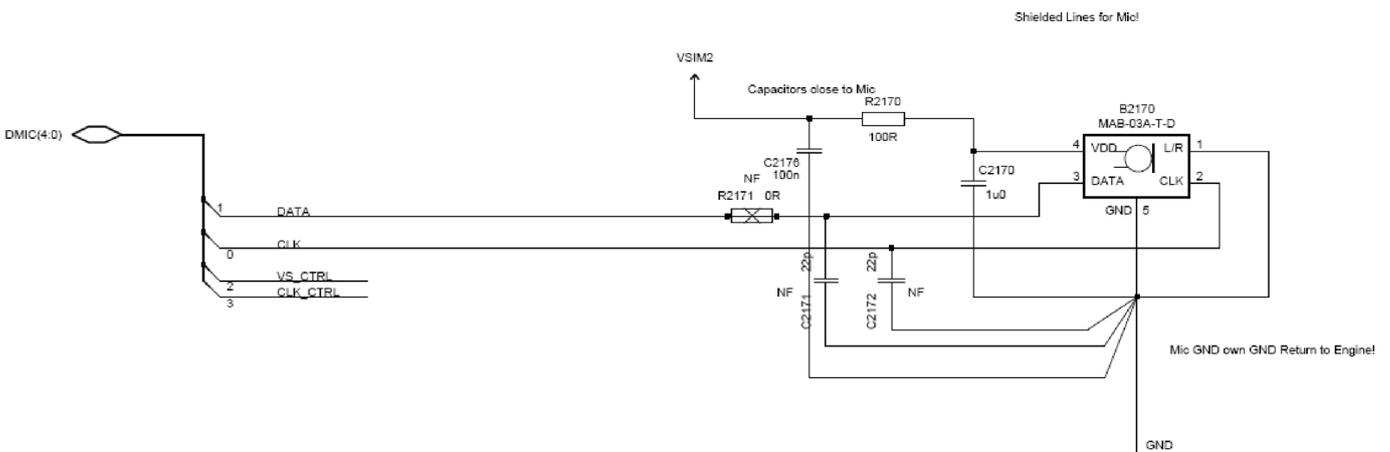


Figure 73 Internal microphone circuitry

External microphone

Headsets provide external analog microphone via AV connector.

Accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

External mic uses AVILMA (N2200) Mic2P and Mic2N inputs. External mic circuitry is biased by AVILMA's MicB2 bias voltage output. This bias voltage is filtered by R2207 and C2202 and the fed through R2200.

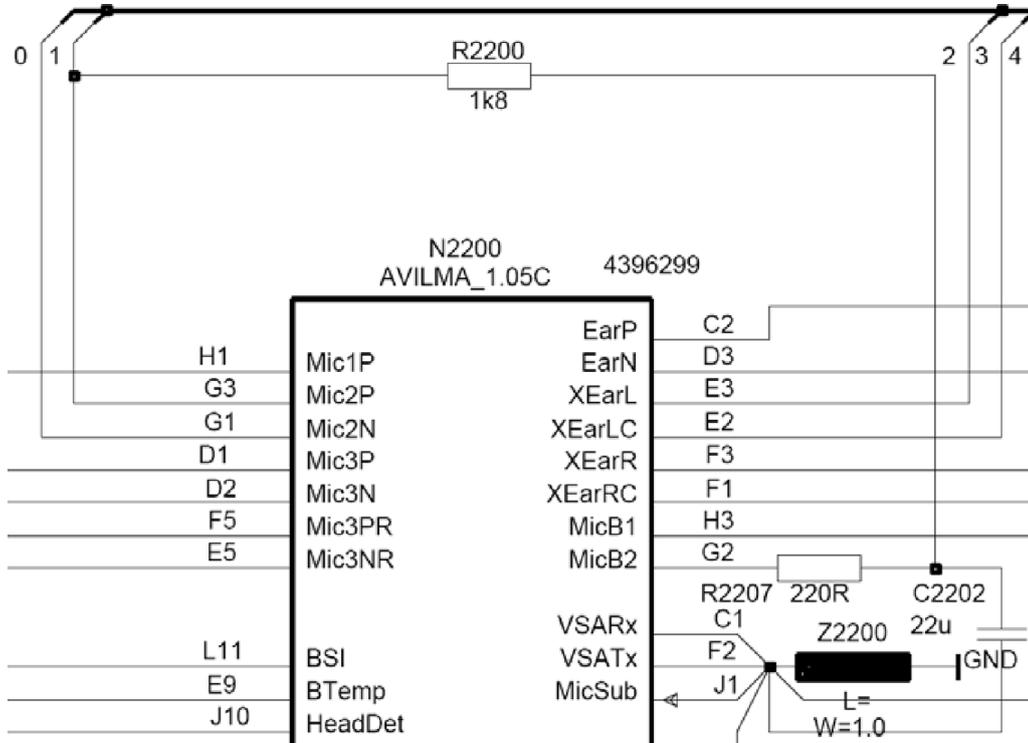


Figure 74 MicBias circuitry

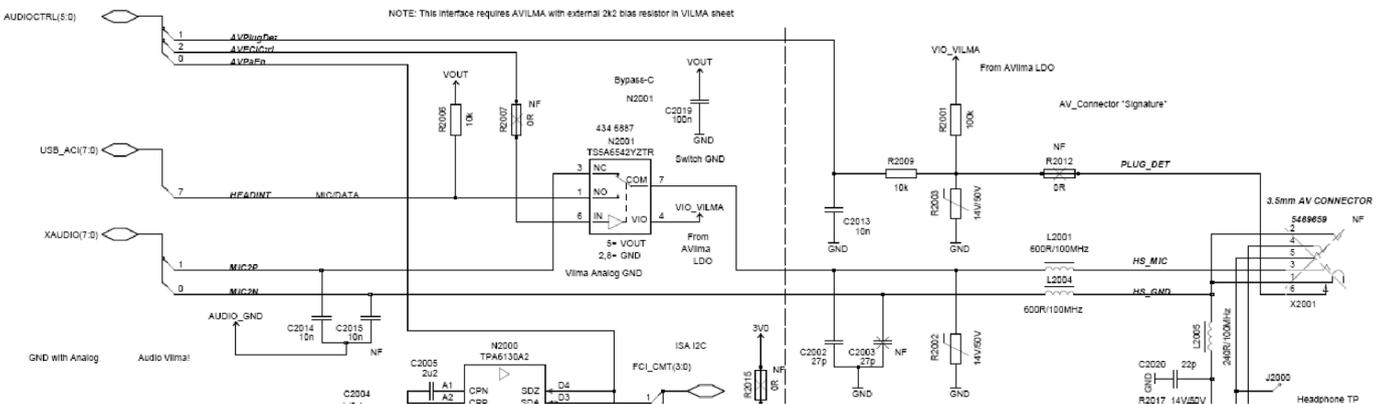


Figure 75 External mic circuitry

Internal earpiece

Internal earpiece is used for Handportable (HP) call mode. A dynamic earpiece is connected to AVILMA via slide FPC 1YZ in slider.

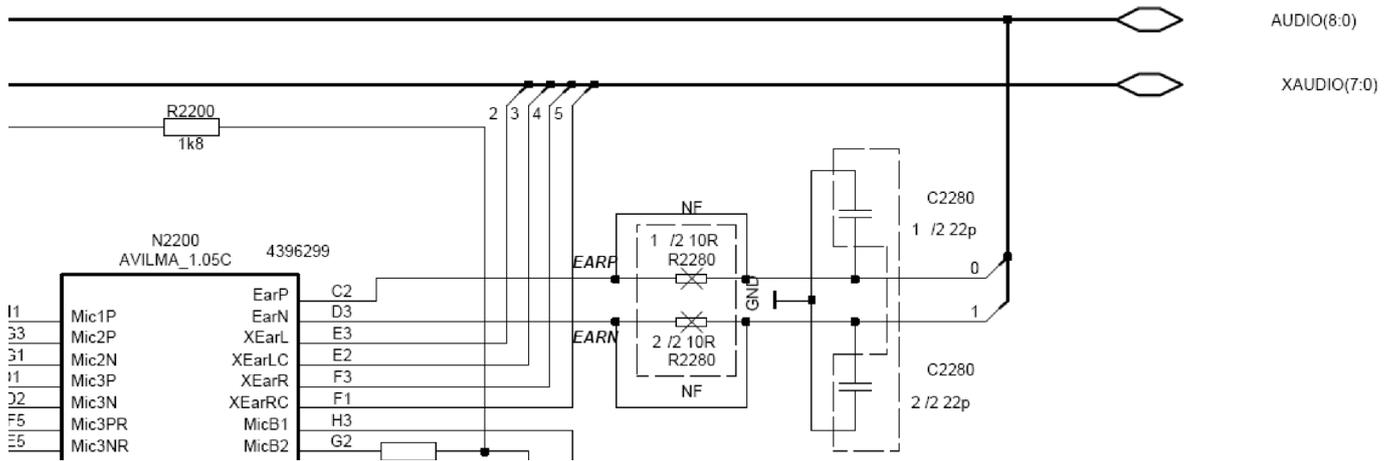


Figure 76 AVILMA output

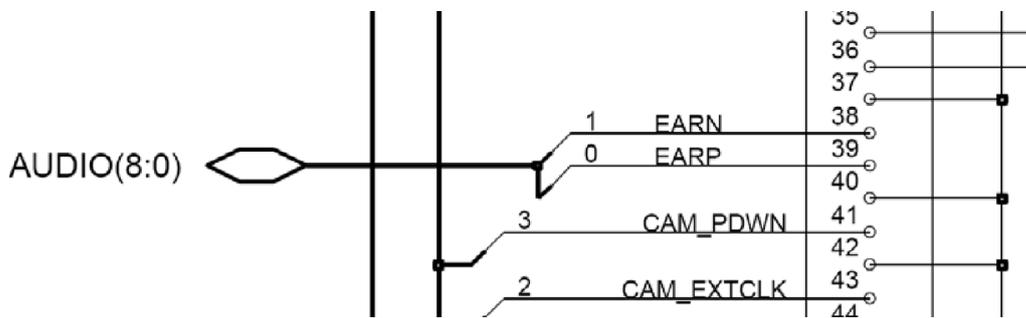


Figure 77 Connector X3800 to Flexboard

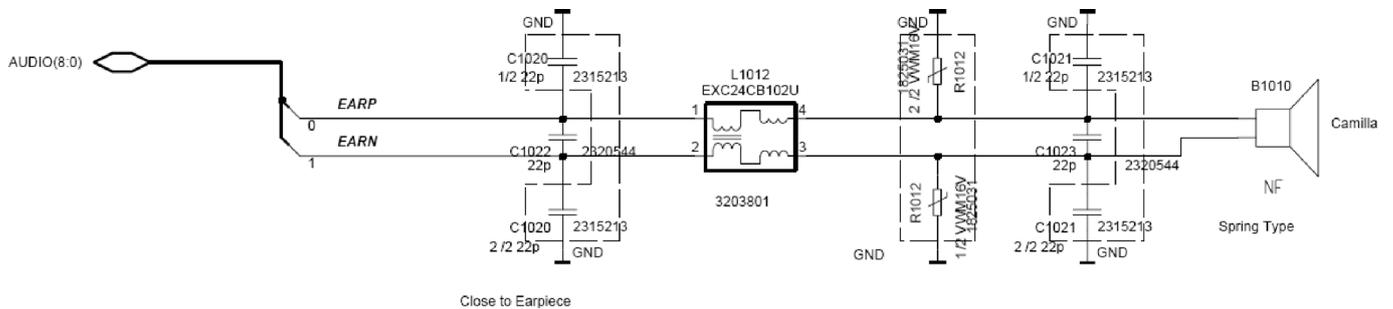


Figure 78 Connection to earpiece on slide FPC board

Internal speakers

Internal speakers are used for Internal Handsfree (IHF) call mode, Video call, ringing tones, FM radio and music listening.

Two dynamic speakers are connected to AVILMA's outputs Xear left and right in differential mode with a highpassfilter (C2158/R2150 and C2159/R2151) and a stereo calss D amplifier TPA2012D2 with a fixed gain of 12dB. Amplifier is shut down if not in use.

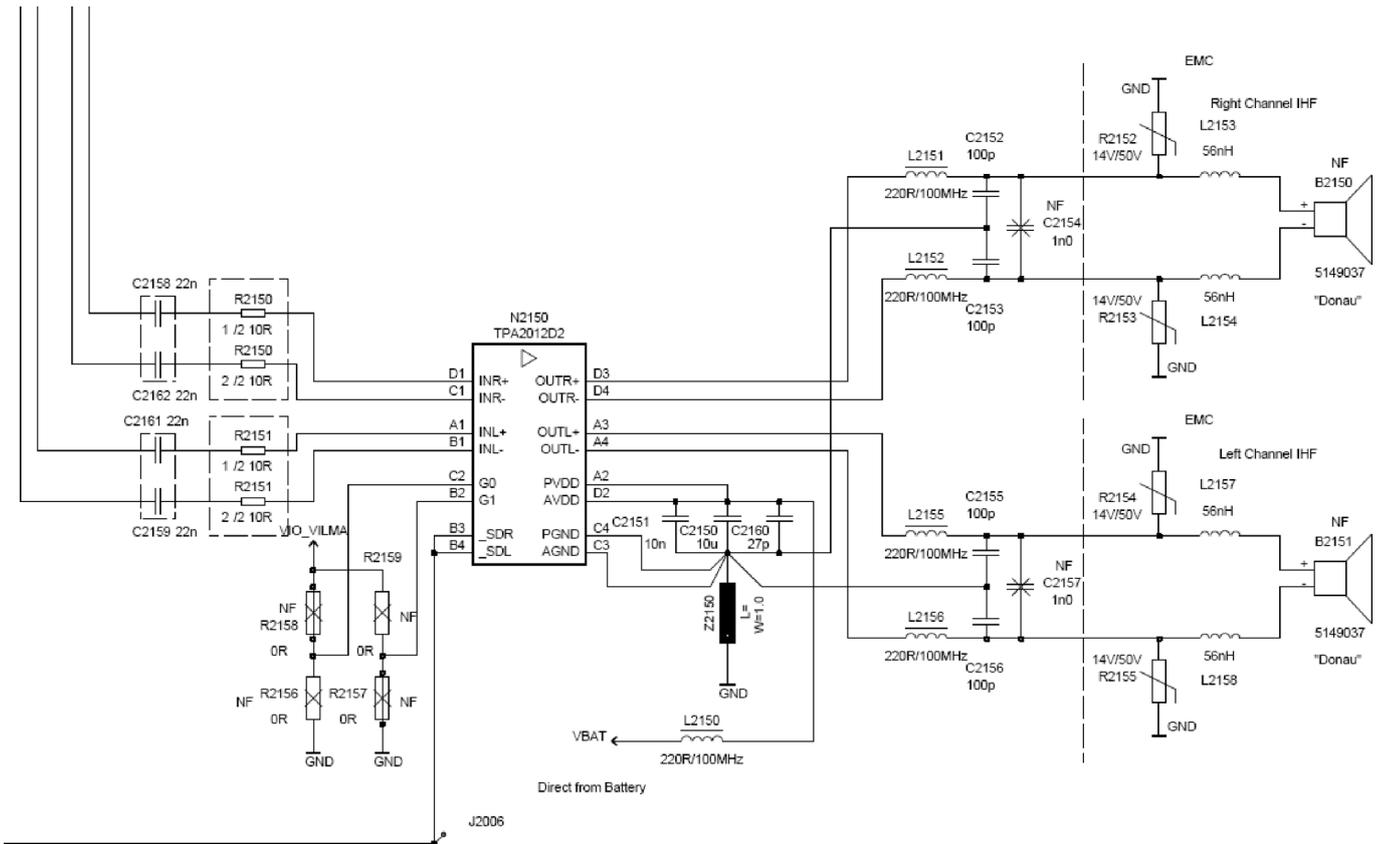


Figure 79 Internal speaker circuitry

External earpiece

All galvanic accessories are connected to av connector (except for USB-devices).

The accessory audio mode is automatically enabled/disabled during connection /disconnection of dedicated phone accessories.

The Rapido ASIC provides the I2S digital interface for AIC33. Rapido controls and supplies a signal for AIC33 digitally. AIC33 output is directed to AV connector through audio amplifier TPA6130.

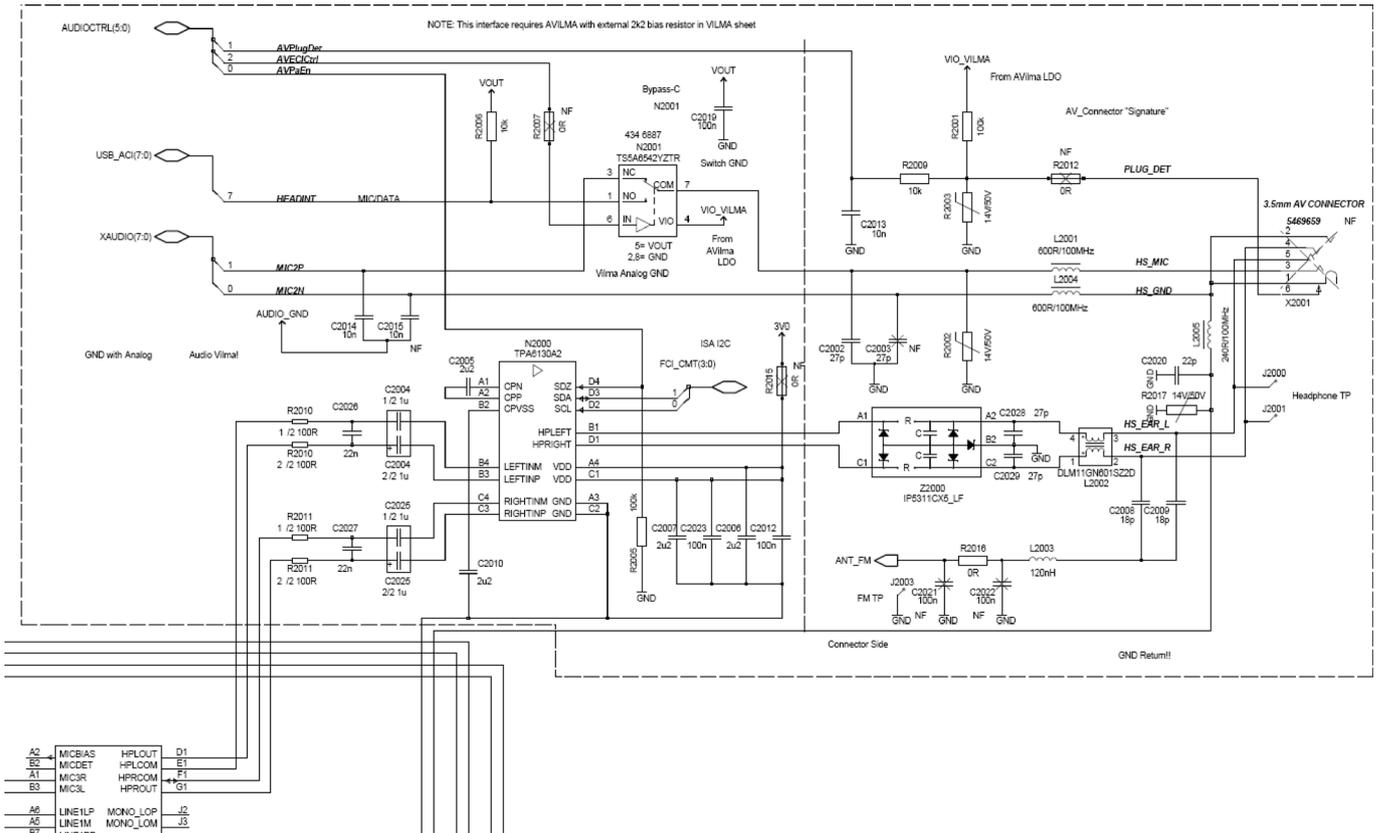


Figure 80 AV connector circuitry

Vibra circuitry

Vibra is used for Vibra alarm function.

The vibra motor is connected to AVILMA asic VibraP and VibraN pulse width modulated outputs through Filter. Vibra is built into cover and connected via cable to plug on PWB.

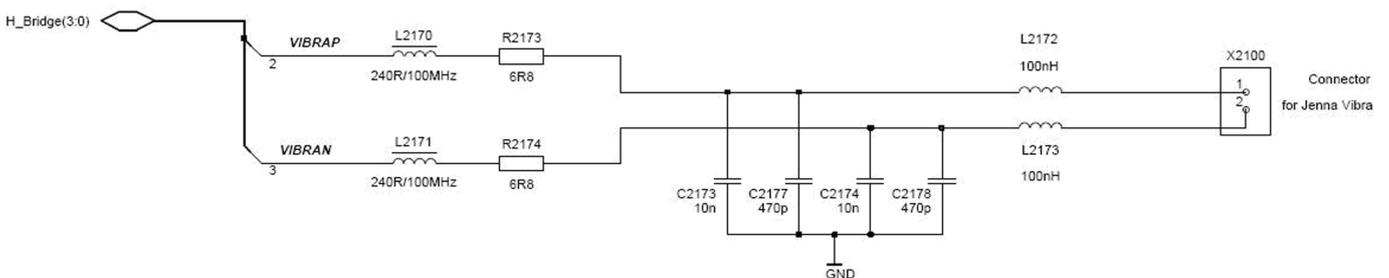


Figure 81 Vibra circuitry

AV connector

The AV Connector consists of single ended mono or stereo audio output and mono audio input. The following table shows the AV interface electrical characteristics.

Table 10 AV interface electrical characteristics

Signal name	Function/Parameter	Min	Typ	Max	Unit	Note
HSMIC	HS mic audio input	-	-	1,3	Vpp	Max neg level 0,7V

Signal name	Function/Parameter	Min	Typ	Max	Unit	Note
HSEARL*)	HS Ear L audio output	-	-	2	Vpp	SPR requirement
HSEARR*)	HS Ear R audio output	-	-	2	Vpp	SPR requirement
Micbias	HS MICbias Voltage	2,05	2,1	2,25	V	
ECI	Vin high	1,7	-	2,6	V	
ECI	Vin low	0	-	0,7	V	

*) Non EU variants have +6dB higher max level (double max value)

■ Baseband technical specifications

External interfaces

Name of connection	Connector reference
USB	X2030 (on engine PWB)
Charger plug	X2000
AV connector (Headset)	X2001 (on engine PWB)
SIM reader	X2700 (on engine PWB)
Micro SD reader	X3200 (on engine PWB)
Battery connector	X2070 (on engine PWB)

SIM IF connections

Pin	Signal	I/O	Engine connection		Notes
C1	VSIM	Out	EM ASIC N2200	VSIM1	Supply voltage to SIM card, 1.8V or 3.0V.
C2	SIMRST	Out	EM ASIC N2200	SIMRstC1	Reset signal to SIM card
C3	SIMCLK	Out	EM ASIC N2200	SIMClkC1	Clock signal to SIM card
C5	GND	-	GND		Ground
C7	SIMDATA	In/Out	EM ASIC N2200	SIMDaC1	Data input /output

Charger connector and charging interface connections & electrical characteristics

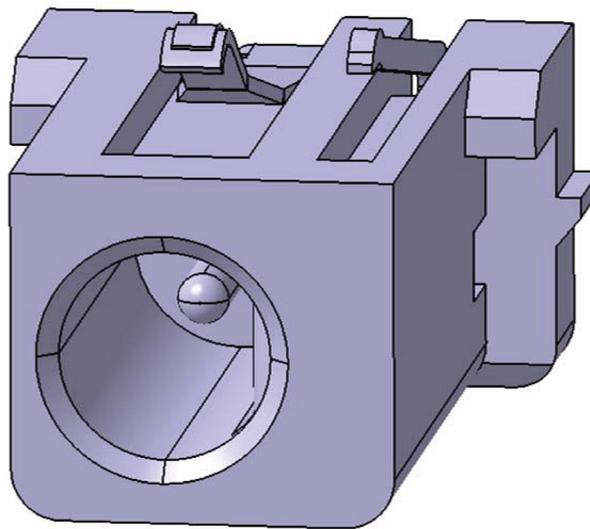


Figure 82 Charger connector

Table 11 Charging interface connections

Pin	Signal	I/O	Engine connection		Notes
1	Vchar	In	N2300	VCharIn1 VCharIn2 VCharInK	Charging voltage / charger detection, Center pin
2	Charge GND		Ground		Charger ground

Table 12 Charging IF electrical characteristics

Description	Parameter	Min	Max	Unit	Notes
Vchar	V Charge	0	16	V	Limit is given by suppressor diode
Vchar	I Charge		1.1	A	Value valid for PWM mode charge current
Charge GND			1.1	A	Value valid for PWM mode charge current

Internal interfaces

Name of Connection	Connector reference	Module
IHF speaker connector (right/left)	B2150/B2151	Engine assembly
Microphone connector	B2170	Engine assembly
BTB connector (Slide FPC)	X3800	Engine assembly
BTB connector on Slide FPC	X1000	Slide FPC
BTB connector (ITUT FPC)	X2400	Engine assembly
BTB connector on ITUT FPC	X1500	ITUT FPC

Name of Connection	Connector reference	Module
BTB connector (BT FPC)	X2520/X2521/X6300/ X6302	Engine assembly
BTB connector on BT FPC	X1000/X1001/X1002	BT FPC
Main camera connector	X2500	Engine assembly
Vibra connector	X2100	Engine assembly
Display connector	X1010	Slide FPC
Earpiece connector	B1010	Slide FPC

Back-up battery interface electrical characteristics

Table 13 Back-up battery connections

Pin name	I/O	Connection	Notes
VBACK	<->	N2200 - VBACK	Back-up battery G2200 is connected to N2200 directly

Table 14 Back-up battery electrical characteristics

Description	Parameter	Min	Typ	Max	Unit
Back-Up Battery Voltage	Vback			2.6	V

■ **RF description**

Block diagram

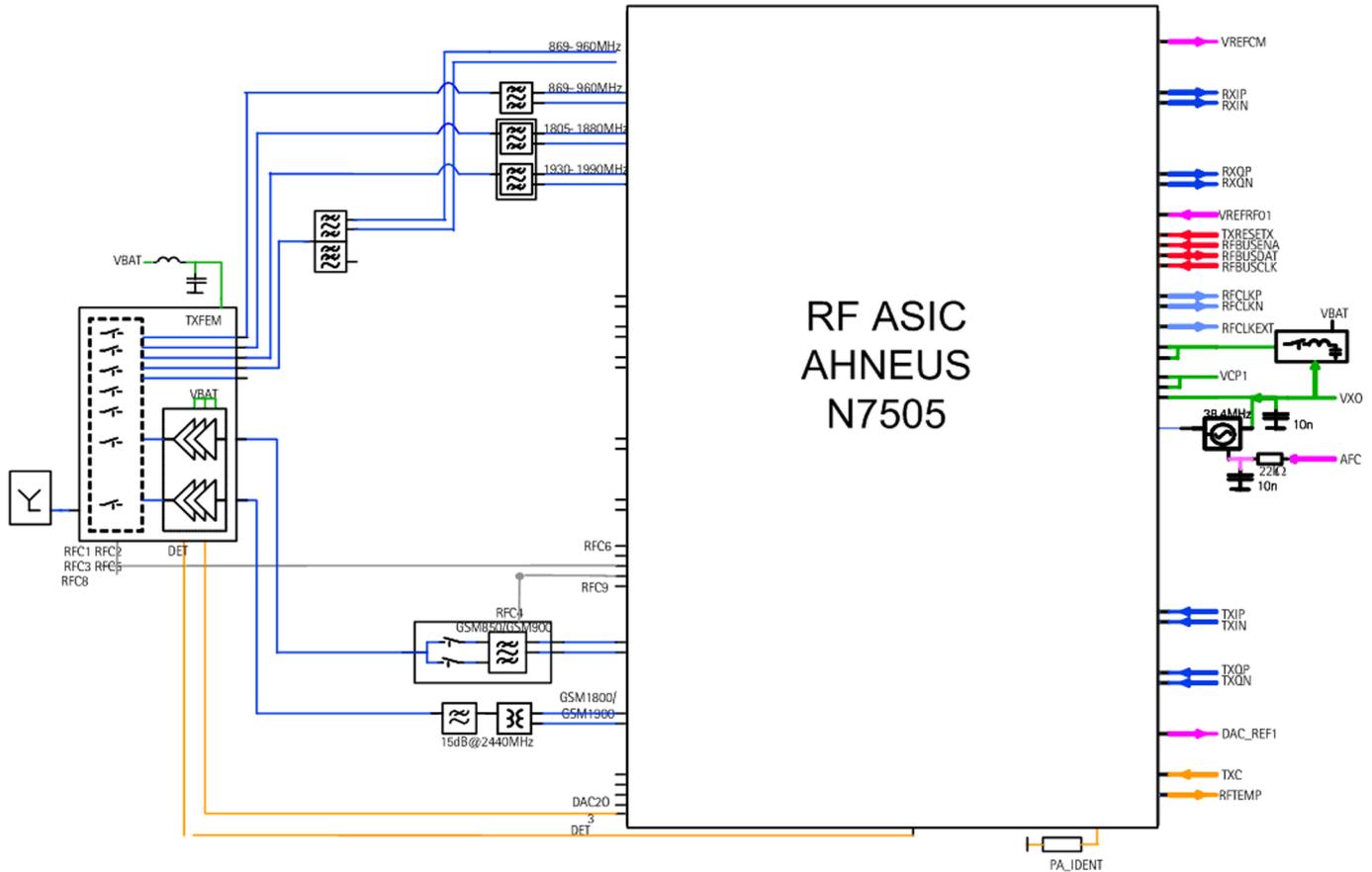


Figure 83 RF block diagram using RF ASIC N7505

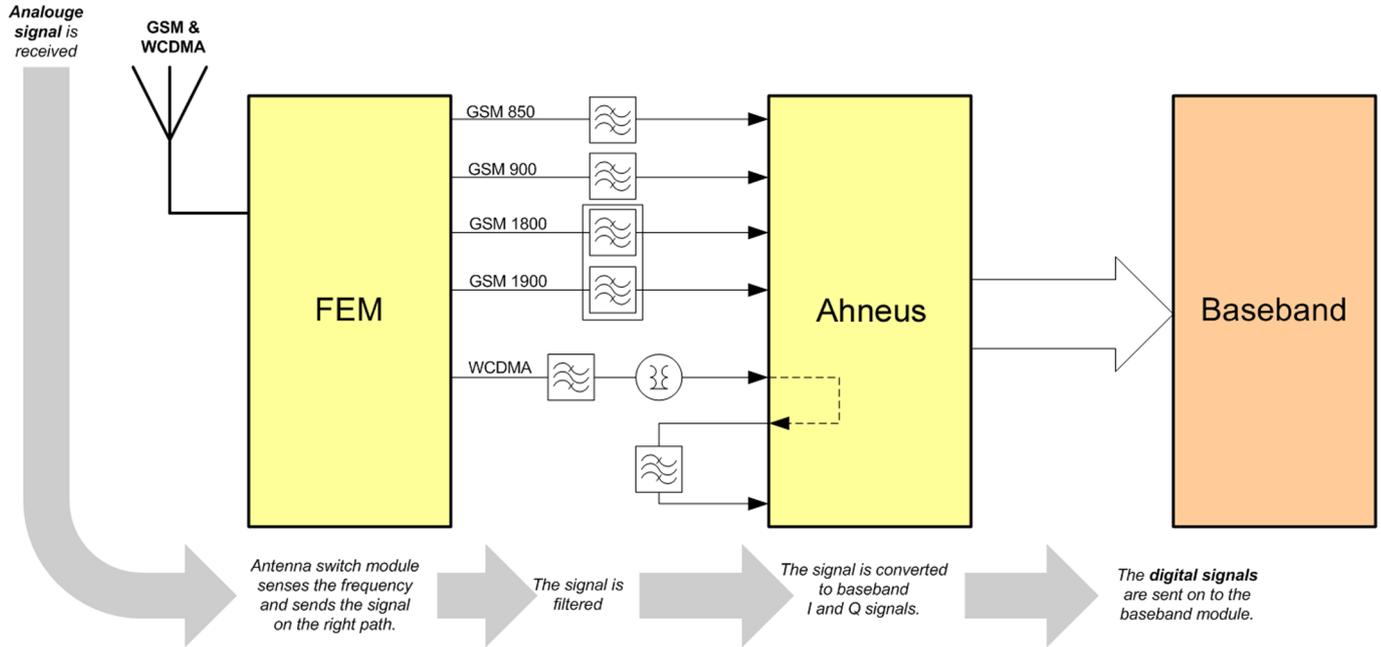
The RF block diagram uses RF ASIC N7505 that performs the RF back-end functions of receive and transmit function of the cellular transceiver.

Receiver (RX)

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

The receiver functions are implemented in the RF ASIC.

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

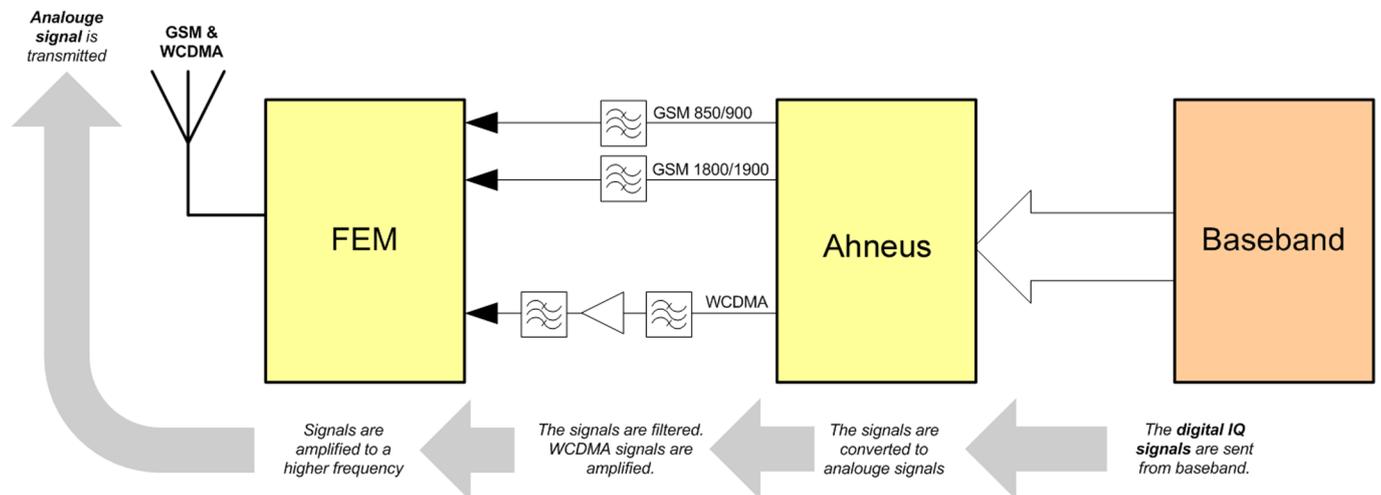


Transmitter (TX)

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

The transmitter functions are implemented in the RF ASIC.

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



■ Frequency mappings

GSM850 frequencies

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

EGSM900 frequencies

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

GSM1800 frequencies

Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	793	1766.4	1861.4	3532.8	3722.8
513	1710.4	1805.4	3420.8	3610.8	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	794	1766.6	1861.6	3533.2	3723.2
514	1710.6	1805.6	3421.2	3611.2	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	795	1766.8	1861.8	3533.6	3723.6
515	1710.8	1805.8	3421.6	3611.6	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	796	1767.0	1862.0	3534.0	3724.0
516	1711.0	1806.0	3422.0	3612.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	797	1767.2	1862.2	3534.4	3724.4
517	1711.2	1806.2	3422.4	3612.4	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	798	1767.4	1862.4	3534.8	3724.8
518	1711.4	1806.4	3422.8	3612.8	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	799	1767.6	1862.6	3535.2	3725.2
519	1711.6	1806.6	3423.2	3613.2	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	800	1767.8	1862.8	3535.6	3725.6
520	1711.8	1806.8	3423.6	3613.6	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	801	1768.0	1863.0	3536.0	3726.0
521	1712.0	1807.0	3424.0	3614.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	802	1768.2	1863.2	3536.4	3726.4
522	1712.2	1807.2	3424.4	3614.4	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	803	1768.4	1863.4	3536.8	3726.8
523	1712.4	1807.4	3424.8	3614.8	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	804	1768.6	1863.6	3537.2	3727.2
524	1712.6	1807.6	3425.2	3615.2	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	805	1768.8	1863.8	3537.6	3727.6
525	1712.8	1807.8	3425.6	3615.6	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	806	1769.0	1864.0	3538.0	3728.0
526	1713.0	1808.0	3426.0	3616.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	807	1769.2	1864.2	3538.4	3728.4
527	1713.2	1808.2	3426.4	3616.4	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	808	1769.4	1864.4	3538.8	3728.8
528	1713.4	1808.4	3426.8	3616.8	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	809	1769.6	1864.6	3539.2	3729.2
529	1713.6	1808.6	3427.2	3617.2	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	810	1769.8	1864.8	3539.6	3729.6
530	1713.8	1808.8	3427.6	3617.6	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	811	1770.0	1865.0	3540.0	3730.0
531	1714.0	1809.0	3428.0	3618.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	812	1770.2	1865.2	3540.4	3730.4
532	1714.2	1809.2	3428.4	3618.4	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	813	1770.4	1865.4	3540.8	3730.8
533	1714.4	1809.4	3428.8	3618.8	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	814	1770.6	1865.6	3541.2	3731.2
534	1714.6	1809.6	3429.2	3619.2	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	815	1770.8	1865.8	3541.6	3731.6
535	1714.8	1809.8	3429.6	3619.6	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	816	1771.0	1866.0	3542.0	3732.0
536	1715.0	1810.0	3430.0	3620.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	817	1771.2	1866.2	3542.4	3732.4
537	1715.2	1810.2	3430.4	3620.4	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	818	1771.4	1866.4	3542.8	3732.8
538	1715.4	1810.4	3430.8	3620.8	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	819	1771.6	1866.6	3543.2	3733.2
539	1715.6	1810.6	3431.2	3621.2	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	820	1771.8	1866.8	3543.6	3733.6
540	1715.8	1810.8	3431.6	3621.6	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	821	1772.0	1867.0	3544.0	3734.0
541	1716.0	1811.0	3432.0	3622.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	822	1772.2	1867.2	3544.4	3734.4
542	1716.2	1811.2	3432.4	3622.4	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	823	1772.4	1867.4	3544.8	3734.8
543	1716.4	1811.4	3432.8	3622.8	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	824	1772.6	1867.6	3545.2	3735.2
544	1716.6	1811.6	3433.2	3623.2	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	825	1772.8	1867.8	3545.6	3735.6
545	1716.8	1811.8	3433.6	3623.6	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	826	1773.0	1868.0	3546.0	3736.0
546	1717.0	1812.0	3434.0	3624.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	827	1773.2	1868.2	3546.4	3736.4
547	1717.2	1812.2	3434.4	3624.4	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	828	1773.4	1868.4	3546.8	3736.8
548	1717.4	1812.4	3434.8	3624.8	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	829	1773.6	1868.6	3547.2	3737.2
549	1717.6	1812.6	3435.2	3625.2	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	830	1773.8	1868.8	3547.6	3737.6
550	1717.8	1812.8	3435.6	3625.6	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	831	1774.0	1869.0	3548.0	3738.0
551	1718.0	1813.0	3436.0	3626.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	832	1774.2	1869.2	3548.4	3738.4
552	1718.2	1813.2	3436.4	3626.4	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	833	1774.4	1869.4	3548.8	3738.8
553	1718.4	1813.4	3436.8	3626.8	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	834	1774.6	1869.6	3549.2	3739.2
554	1718.6	1813.6	3437.2	3627.2	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	835	1774.8	1869.8	3549.6	3739.6
555	1718.8	1813.8	3437.6	3627.6	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	836	1775.0	1870.0	3550.0	3740.0
556	1719.0	1814.0	3438.0	3628.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	837	1775.2	1870.2	3550.4	3740.4
557	1719.2	1814.2	3438.4	3628.4	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	838	1775.4	1870.4	3550.8	3740.8
558	1719.4	1814.4	3438.8	3628.8	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	839	1775.6	1870.6	3551.2	3741.2
559	1719.6	1814.6	3439.2	3629.2	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	840	1775.8	1870.8	3551.6	3741.6
560	1719.8	1814.8	3439.6	3629.6	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	841	1776.0	1871.0	3552.0	3742.0
561	1720.0	1815.0	3440.0	3630.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	842	1776.2	1871.2	3552.4	3742.4
562	1720.2	1815.2	3440.4	3630.4	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	843	1776.4	1871.4	3552.8	3742.8
563	1720.4	1815.4	3440.8	3630.8	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	844	1776.6	1871.6	3553.2	3743.2
564	1720.6	1815.6	3441.2	3631.2	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	845	1776.8	1871.8	3553.6	3743.6
565	1720.8	1815.8	3441.6	3631.6	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	846	1777.0	1872.0	3554.0	3744.0
566	1721.0	1816.0	3442.0	3632.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	847	1777.2	1872.2	3554.4	3744.4
567	1721.2	1816.2	3442.4	3632.4	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	848	1777.4	1872.4	3554.8	3744.8
568	1721.4	1816.4	3442.8	3632.8	662	1740.2	1835.2	3480.4	3670.4	756	1759.0								

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										

WCDMA 2100 Rx frequencies

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

WCDMA 2100 Tx frequencies

Ch	Tx	VCO Tx												
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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Nokia Customer Care

Glossary

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A/D-converter	Analog-to-digital converter
ACI	Accessory Control Interface
ADC	Analog-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
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
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
CSR	cambridge silicon radio
CSTN	Color Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analogue converter
DAC	Digital-to-analogue converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo
DCT-4	Digital Core Technology
DMA	Direct memory access
DP	Data Package

DPLL	Digital Phase Locked Loop
DSP	Digital Signal Processor
DtoS	Differential to Single ended
EDGE	Enhanced data rates for global/GSM evaluation
EGSM	Extended GSM
EM	Energy management
EMC	Electromagnetic compability
EMI	Electromagnetic interference
ESD	Electrostatic discharge
FCI	Functional cover interface
FPS	Flash Programming Tool
FR	Full rate
FSTN	Film compensated super twisted nematic
GMSK	Gaussian Minimum Shift Keying
GND	Ground, conductive mass
GPIO	General-purpose interface bus
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global System for Mobile communication
HF	Hands free
HFCM	Handsfree Common
HS	Handset
HSCSD	High speed circuit switched data (data transmission connection faster than GSM)
HW	Hardware
I/O	Input/Output
IBAT	Battery current
IC	Integrated circuit
ICHAR	Charger current
IF	Interface
IHF	Integrated hands free
IMEI	International Mobile Equipment Identity
IR	Infrared
IrDA	Infrared Data Association
ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out

LED	Light-emitting diode
LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
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
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x and BB5
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board
PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RF	Radio Frequency
RF PopPort TM	Reduced function PopPortTM interface
RFBUS	Serial control Bus For RF
RSK	Right Soft Key
RS-MMC	Reduced size Multi Media Card
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
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
UPP	Universal Phone Processor
UPP_WD2	Communicator version of DCT4 system ASIC
USB	Universal Serial Bus
VBAT	Battery voltage
VCHAR	Charger voltage
VCO	Voltage controlled oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VCXO	Voltage Controlled Crystal Oscillator
Vp-p	Peak-to-peak voltage
VSIM	SIM voltage
WAP	Wireless application protocol
WD	Watchdog
XHTML	Extensible hypertext markup language
Zocus	Current sensor, (used to monitor the current flow to and from the battery)