

**Nokia Customer Care**

# ***Service Manual***

**RM-709 (Nokia X2-01)**  
**Mobile Terminal**  
*Part No: 9222978 (Issue 1)*

***COMPANY CONFIDENTIAL***



**Amendment Record Sheet**

Amendment No	Date	Inserted By	Comments
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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.

## **For your safety**

### **QUALIFIED SERVICE**

Only qualified personnel may install or repair phone equipment.

### **ACCESSORIES AND BATTERIES**

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

### **CONNECTING TO OTHER DEVICES**

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

## 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.

## 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.

## 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 Ni-Cd/NiMH 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.

## 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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## **Nokia X2-01 Service Manual Structure**

- 1 General information
- 2 Service Devices and Service Concepts
- 3 BB Troubleshooting and Manual Tuning Guide
- 4 RF troubleshooting
- 5 Camera Module Troubleshooting
- 6 System Module
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# Nokia Customer Care

## 1 — General information

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## ■ Product selection

RM-709 (X2-01) is a GSM Quad-band phone, supporting EGSM 850/900/1800/1900 bands.



Figure 1 RM-709 (X2-01) product picture

## ■ Phone features

### Hardware features

- Protocols supported: 850/900/1800/1900 (Quad-bands)
- Broadcom HW 130 (2G)
- Combo 128MB / 64MB memory
- Micro USB
- 2mm classic Dynamo DC
- 3.5 mm AV connector
- 2.36" QVGA landscape display
- VGA camera
- BT 2.0
- Stereo FM radio & RDS
- MP3 player
- Micro SD memory card slot
- FOTA
- GPRS

- Dedicated Messaging Hard Key
- Dedicated Music Hard Key

## SW features (ISA S40 SPR9.2)

- BT 2.1 + EDR
- FM radio supporting RDS
- GPRS multi-slot class 32(TX+RX 3+5 max slot6) and EGPRS MSC32(TX+RX 3+5 max slot6)
- Java MIDP 2.1
- Adobe Flash 3.0
- WAP 2.0
- MMS 1.3
- Ovi Store 2.0.1
- Nokia Xpress Audio messaging
- Active Home Screen with integrated widgets

## ■ Accessories

### In-box:

- Phone: X2-01
- Battery: BL-5C, 1020mAh
- Charger: AC-3 (shorter) for Global (AC-8C & CA-100c for China only)
- Headset: WH-102

For out-box accessories, please refer to enhancement list document.

## ■ Technical specifications

### General specifications

Unit	Dimension (mm)	Weight (g)	Volume (cc)
Transceiver with BL-5C 1020mAh Li Lion battery pack	119.4 x 59.8 x 14.3	107.5	86.64

### Battery Endurance

Battery	Talk Time		Stand-by Time	
BL-5C with 1020mAh Li ion standard battery	Best Talk Time	GSMA Talk Time	Best Stand-by Time	GSMA Stand-by Time
	Up to 23 hours	5 hours	Up to 646.39 hours	622 hours

**Note:** Variation in operation time will occur depending on SIM card, network settings and usage. Talk time is increased by up to 30% if half rate is active and reduced by 5% if enhanced full rate is active.

## **2 — Service Devices and Service Concepts**

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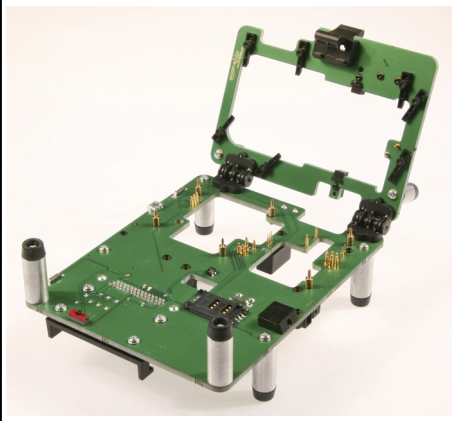
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## ■ Service devices



### Product specific devices



The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-709. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.




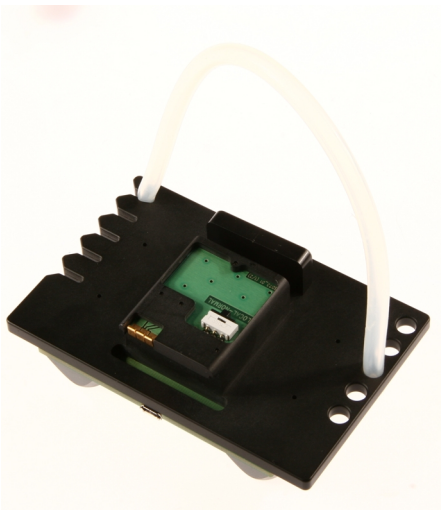
	MJ-299	Module jig	
	<p>MJ-299 is meant for component level troubleshooting.</p> <p>The jig includes an RF interface for GSM and Bluetooth. In addition, it has the following features:</p> <ul style="list-style-type: none"><li>• Provides mechanical interface with the engine module</li><li>• Provides galvanic connection to all needed test pads in module</li><li>• MMC interface</li><li>• Duplicated SIM connector</li><li>• Connector for control unit</li><li>• Access for AV- and USB connectors</li><li>• CA-128RS cable is used together with this jig for RF testing.</li></ul>		


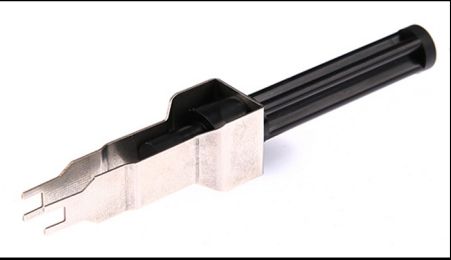
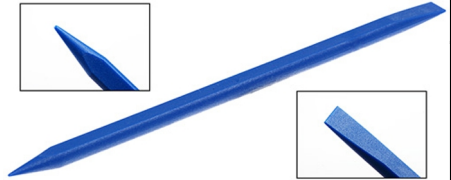

### General devices

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-709. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

<p><b>CU-4</b></p> 	CU-4	Control unit	
	<p>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.</p> <p>The unit has the following features:</p> <ul style="list-style-type: none"> <li>• software controlled via USB</li> <li>• EM calibration function</li> <li>• Forwards FBUS/Flashbus traffic to/from terminal</li> <li>• Forwards USB traffic to/from terminal</li> <li>• software controlled BSI values</li> <li>• regulated VBATT voltage</li> <li>• 2 x USB2.0 connector (Hub)</li> <li>• FBUS and USB connections supported</li> </ul> <p>When using CU-4, note the special order of connecting cables and other service equipment:</p> <p><b>Instructions</b></p> <ol style="list-style-type: none"> <li>1 Connect a service tool (jig, flash adapter) to CU-4.</li> <li>2 Connect CU-4 to your PC with a USB cable.</li> <li>3 Connect supply voltage (12 V)</li> <li>4 Connect an FBUS cable (if necessary).</li> <li>5 Start Phoenix service software.</li> </ol> <div data-bbox="735 1149 1267 1756">  </div> <p><b>Note:</b> Phoenix enables CU-4 regulators via USB when it is started.</p> <p>Reconnecting the power supply requires a Phoenix restart.</p>		


	FLS-5	Flash device	
<b>FPS-21</b> 	FPS-21	Flash prommer	
	<p><b>FPS-21 sales package:</b></p> <ul style="list-style-type: none"> <li>• FPS-21 prommer</li> <li>• AC-35 power supply</li> <li>• CA-31D USB cable</li> </ul> <p><b>FPS-21 interfaces:</b></p> <p><i>Front</i></p> <ul style="list-style-type: none"> <li>• Service cable connector Provides Flashbus, USB and VBAT connections to a mobile device.</li> <li>• SmartCard socket A SmartCard is needed to allow DCT-4 generation mobile device programming.</li> </ul> <p><i>Rear</i></p> <ul style="list-style-type: none"> <li>• DC power input For connecting the external power supply (AC-35).</li> <li>• Two USB A type ports (USB1/USB3) Can be used, for example, for connecting external storage memory devices or mobile devices</li> <li>• One USB B type device connector (USB2) For connecting a PC.</li> <li>• Phone connector Service cable connection for connecting Flashbus/FLA.</li> <li>• Ethernet RJ45 type socket (LAN) For connecting the FPS-21 to LAN.</li> </ul> <p><i>Inside</i></p> <ul style="list-style-type: none"> <li>• Four SD card memory slots For internal storage memory.</li> </ul> <p><b>Note:</b> In order to access the SD memory card slots inside FPS-21, the prommer needs to be opened by removing the front panel, rear panel and heatsink from the prommer body.</p>		



	PK-1	Software protection key	
	<p>PK-1 is a hardware protection key with a USB interface. It has the same functionality as the PKD-1 series dongle.</p> <p>PK-1 is meant for use with a PC that does not have a series interface. To use this USB dongle for security service functions please register the dongle in the same way as the PKD-1 series dongle.</p>		
	RJ-230	Common jig	
	<p>RJ-230 is a jig used for soldering and as a rework jig for the engine module.</p>		
	SB-6	Bluetooth tester	
	<p>The SB-6 test box is a generic device to perform Bluetooth bit error rate testing and doing cordless FBUS connection via Bluetooth.</p>		
	SD-73	Dummy battery	
	<p>SD-73 is designed to support mass SW flashing which enables local mode while connecting the phone.</p>		

	SRT-6	Opening tool	
	SRT-6 is used to open phone covers. <b>Note:</b> The SRT-6 is included in the Nokia Standard Toolkit.		
	SS-88	Camera removal tool	
	The camera removal tool SS-88 is used to remove/attach the camera module from/to the camera socket of the phone PWB.		
	SS-93	Blue stick tool	
	SS-93 is used for general disassembly and assembly tasks.		
	SX-4	Smart card	
	SX-4 is a BB5 security device used to protect critical features in tuning and testing. SX-4 is also needed together with FPS-21 when DCT-4 phones are flashed.		

## Cables

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-709. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

 <b>CA-101</b> 100cm	CA-101	Micro USB cable	
	The CA-101 is a USB-to-microUSB data cable that allows connections between the PC and the phone.		

	PCS-1	Power cable	
	XRS-6	RF cable	
<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>The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment. SMA to N-Connector approximately 610 mm. Attenuation for:</p> <ul style="list-style-type: none"> <li>• GSM850/900: 0.3+-0.1 dB</li> <li>• GSM1800/1900: 0.5+-0.1 dB</li> </ul>			

## ■ Service concepts

### Level 1 POS flash concept

#### BB5 USB only - POS concept

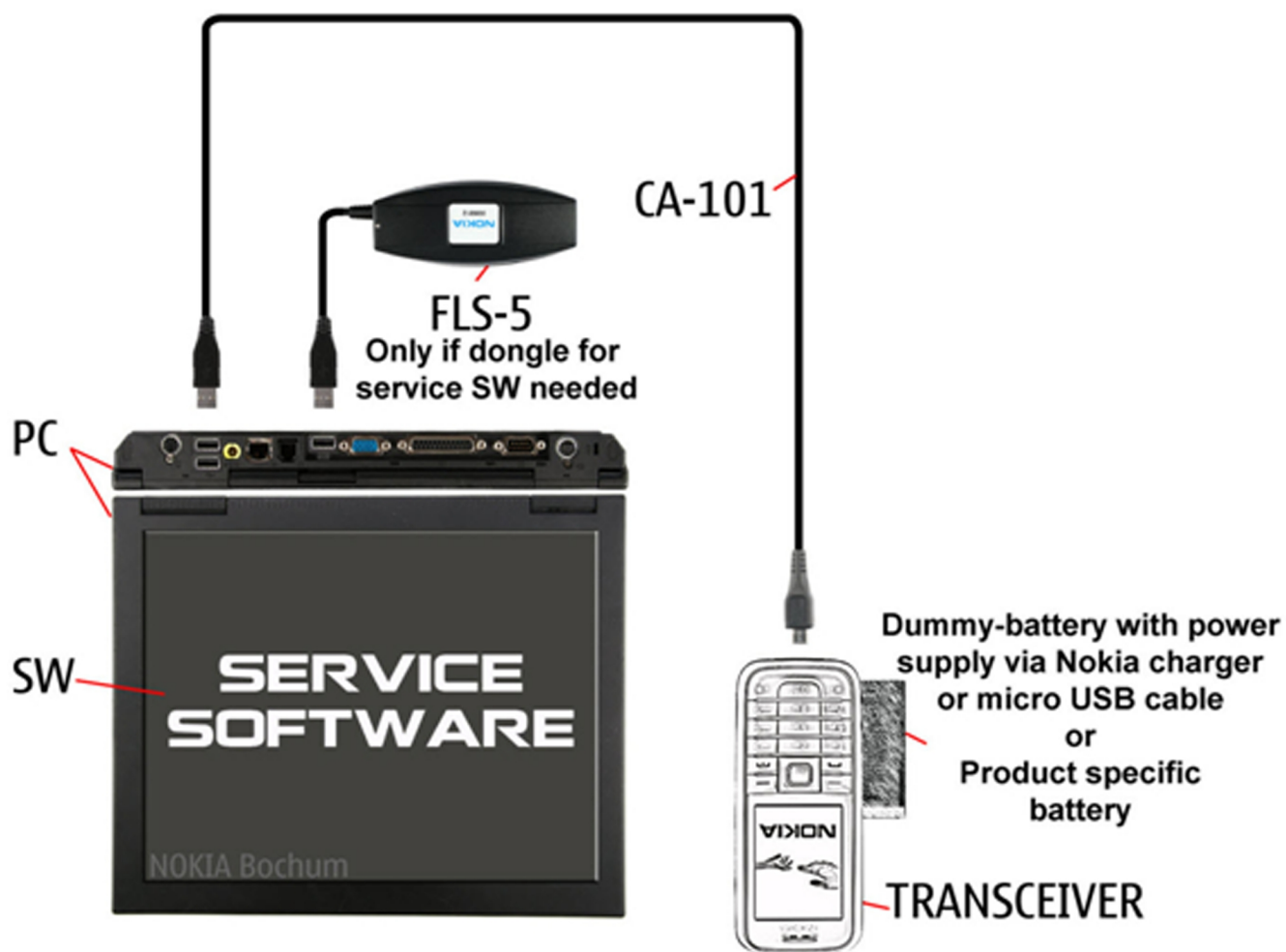


Figure 2 Level 1 POS flash concept

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

BB5 USB only - Extended flash concept L3 - Option 1

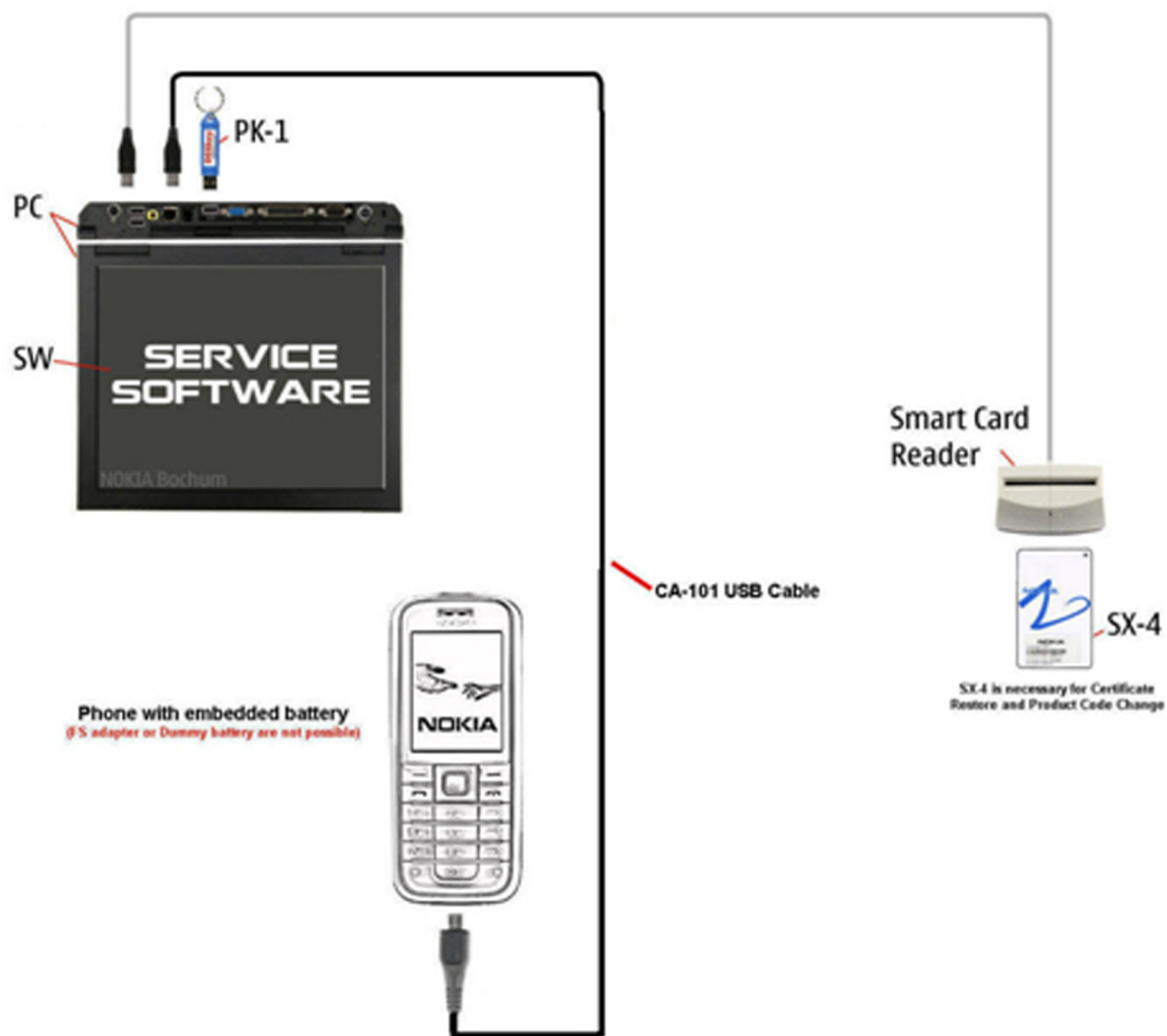


Figure 3 Level 3 concept for flashing, certificate restore and product code change (option 1)

## BB5 USB only - Extended EB flash concept L3 - Option 2

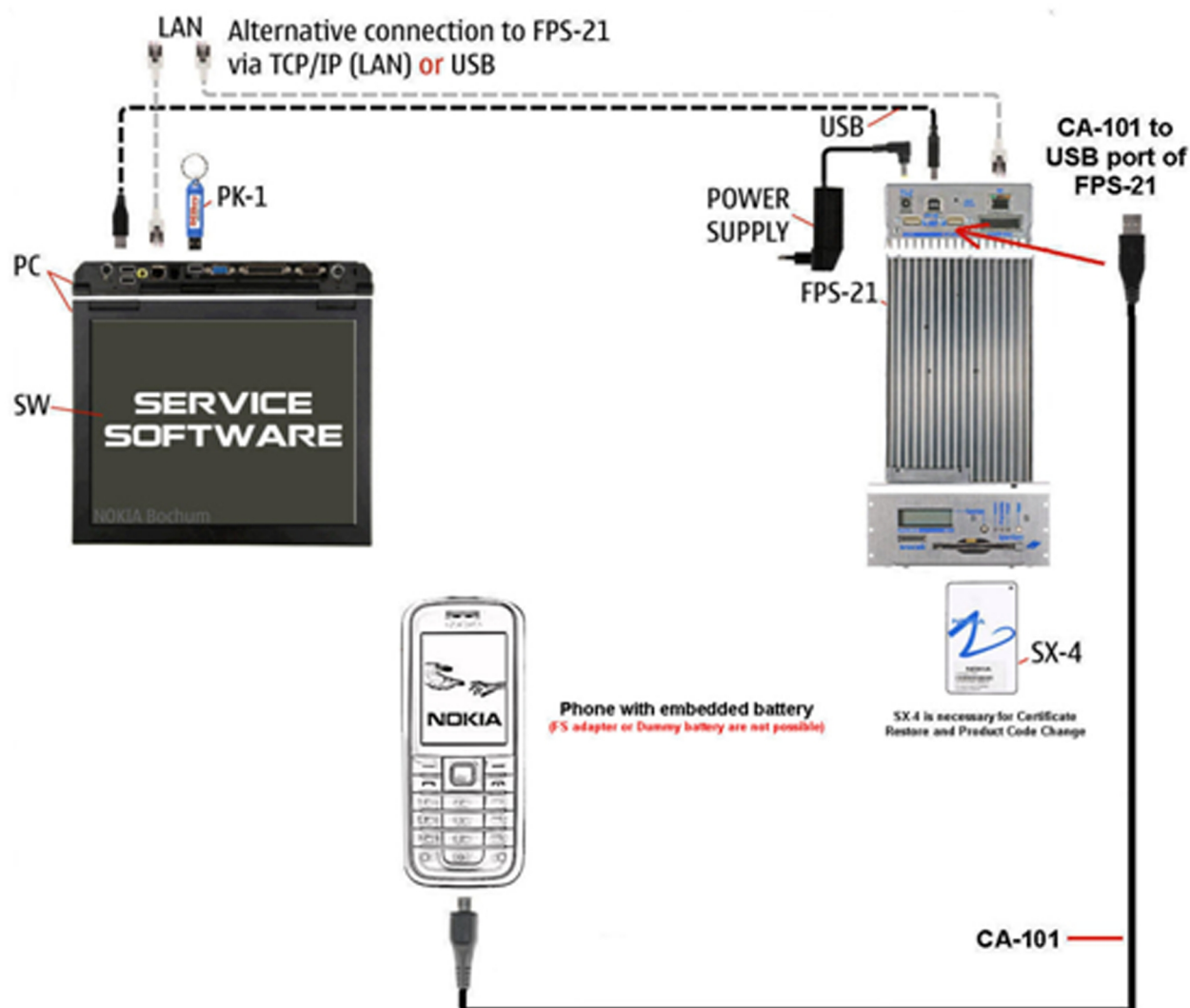
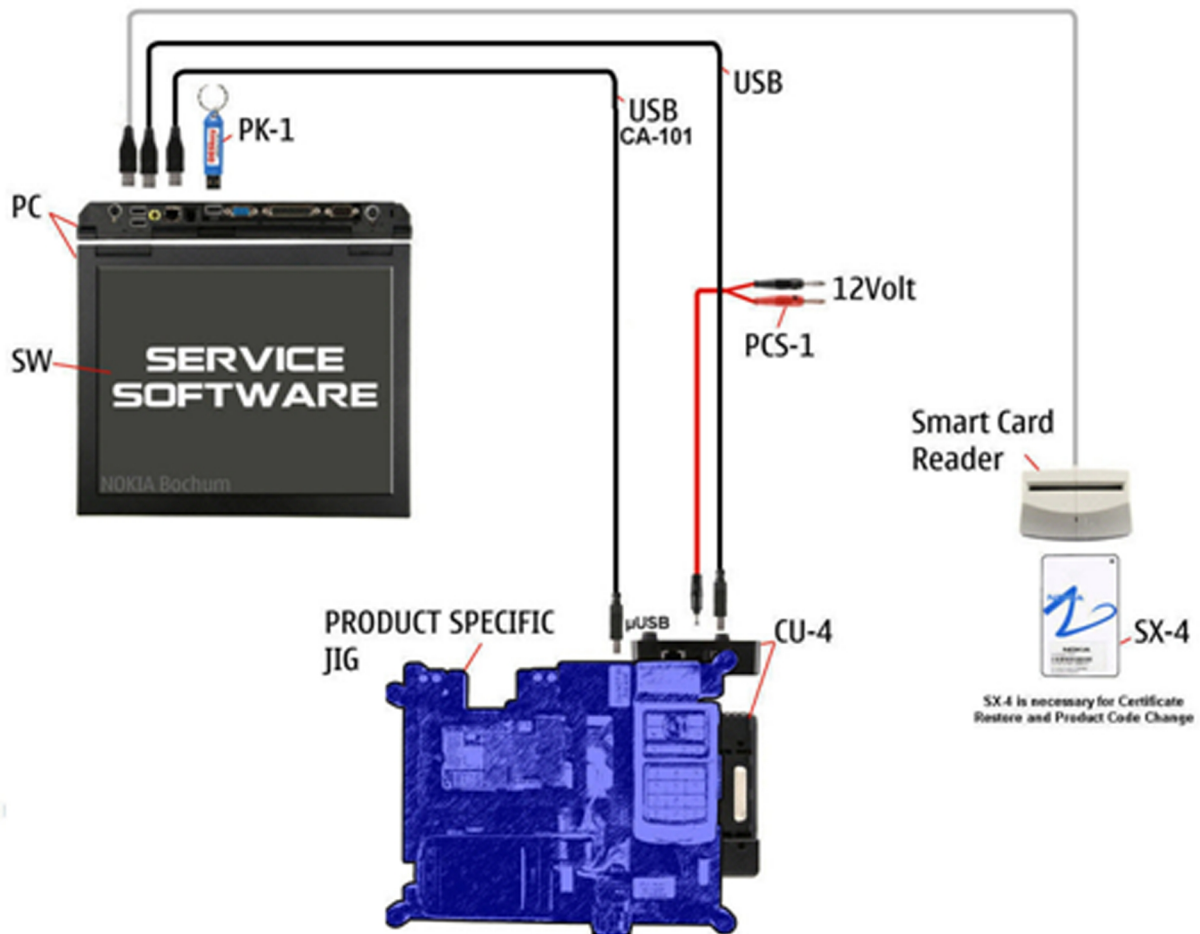


Figure 4 Level 3 concept for flashing, certificate restore and product code change (option 2)

**Level 3 concept for flashing, certificate restore, product code change and EM calibration in MJ**

**BB5 USB only - Basic MJ concept - Option 1**



**Figure 5 Level 3 concept for flashing, certificate restore, product code change and EM calibration in MJ (option 1)**

## BB5 USB only - basic MJ concept - Option 2

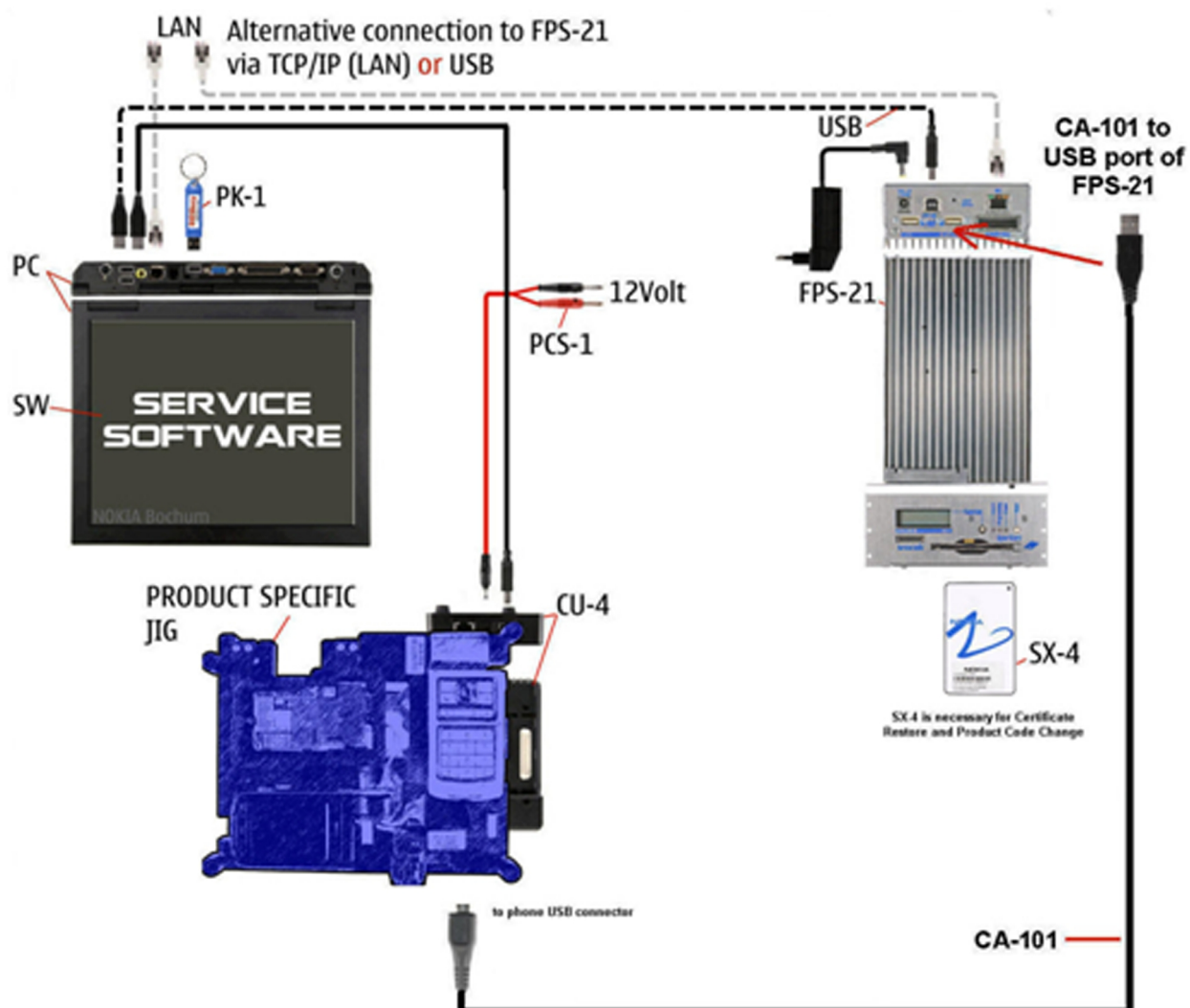


Figure 6 Level 3 concept for flashing, certificate restore, product code change and EM calibration in MJ (option 2)

Level 3 concept for BB and RF tuning

## BB5 USB only - Extended MJ concept - Option 1

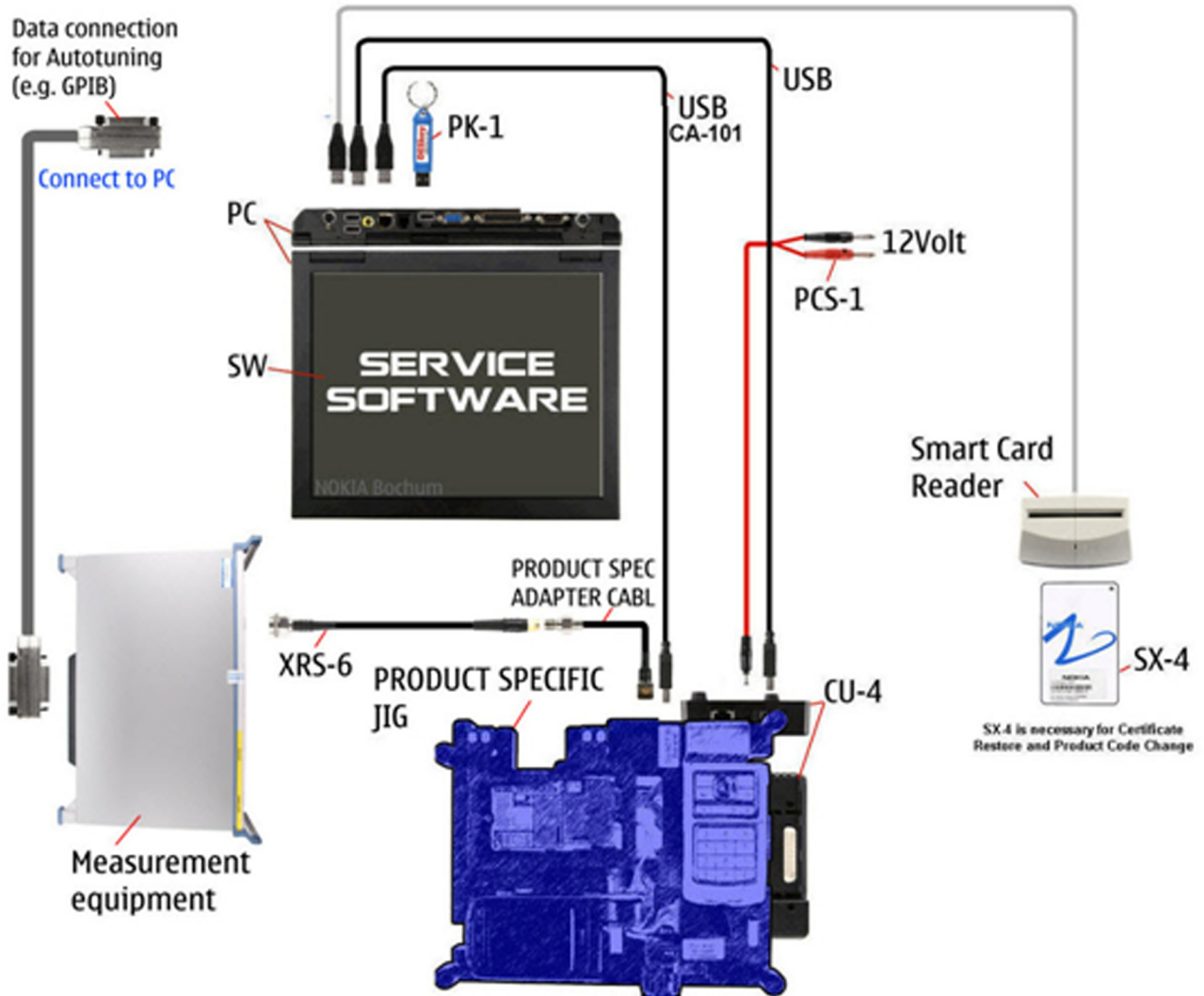


Figure 7 Level 3 concept for BB and RF tuning (option 1)

## BB5 USB only - Extended MJ concept - Option 2

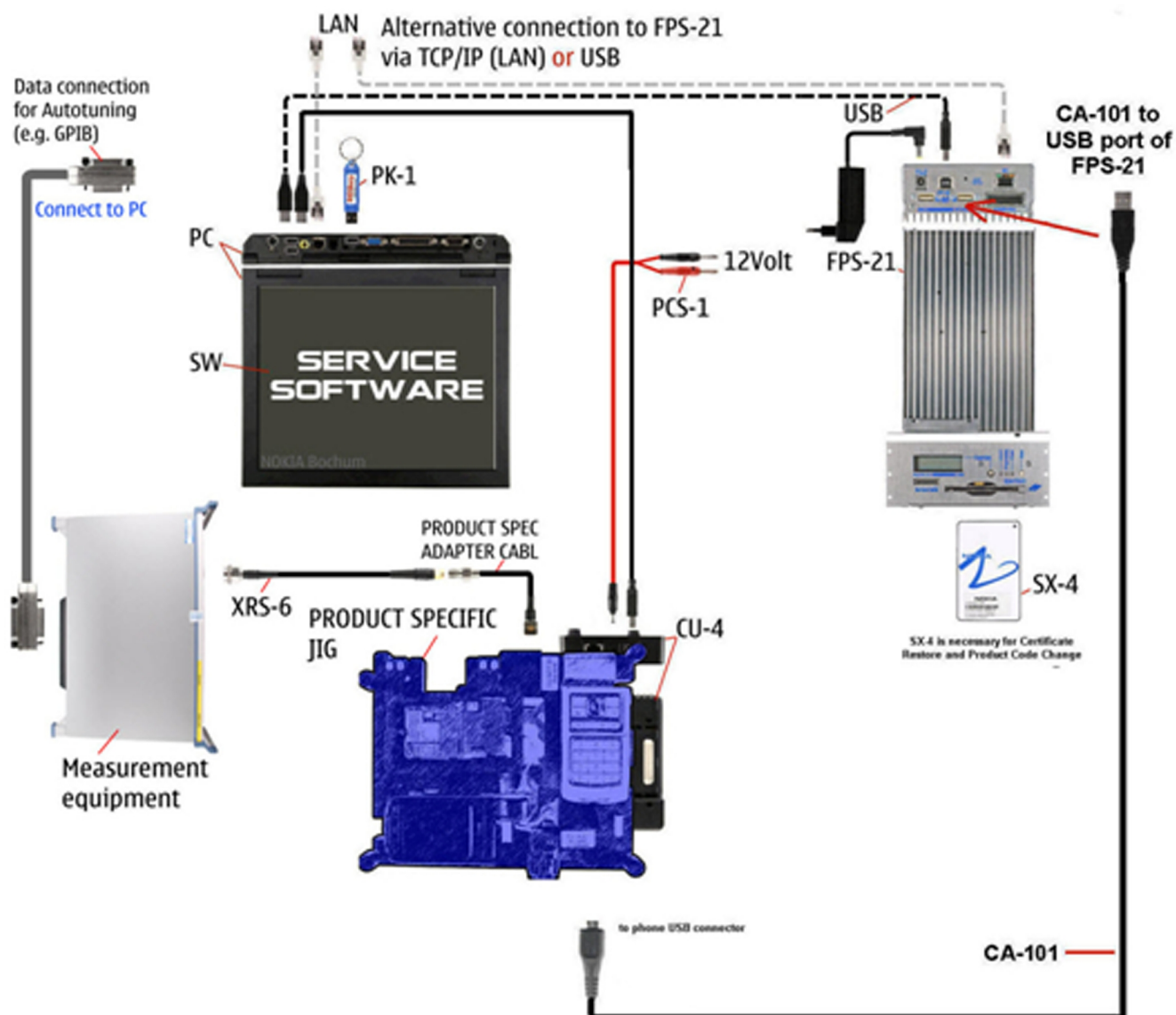


Figure 8 Level 3 concept for BB and RF tuning (option 2)

## Level 3 BT (Bluetooth) test Concept

### BB5 USB only - BT test concept

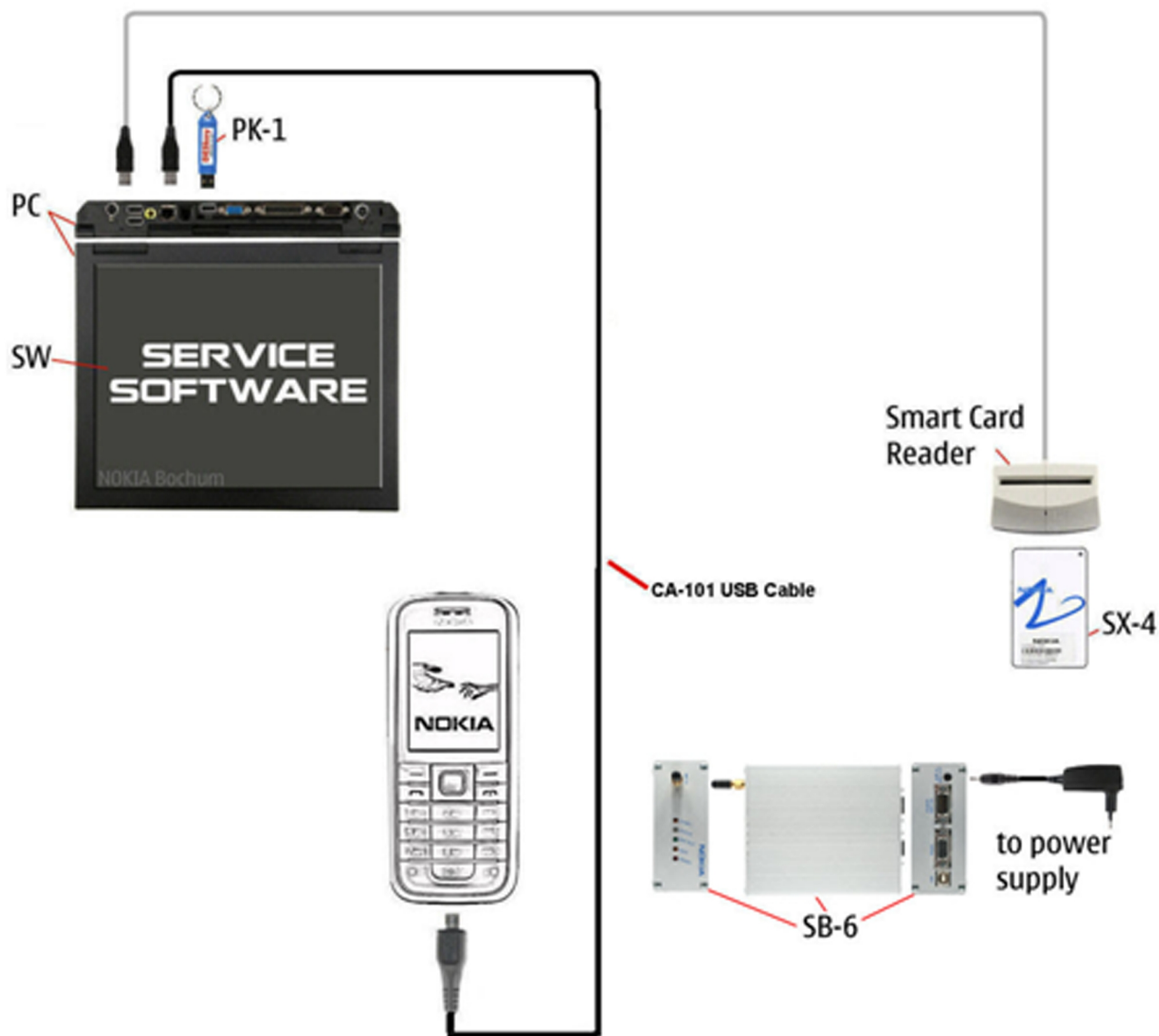


Figure 9 Level 3 BT (Bluetooth) test Concept

## **3 — BB Troubleshooting and Manual Tuning Guide**

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## ■ Introduction to BB Troubleshooting

Nearly all of the functions of the phone are contained within or controlled by the D2800 Juno BB ASIC so most of the debugging will be centered there. The D2800 Juno BB ASIC is static sensitive so precautions must be taken to avoid damaging this or other devices from excessive ESD.

## ■ Baseband self tests in Phoenix

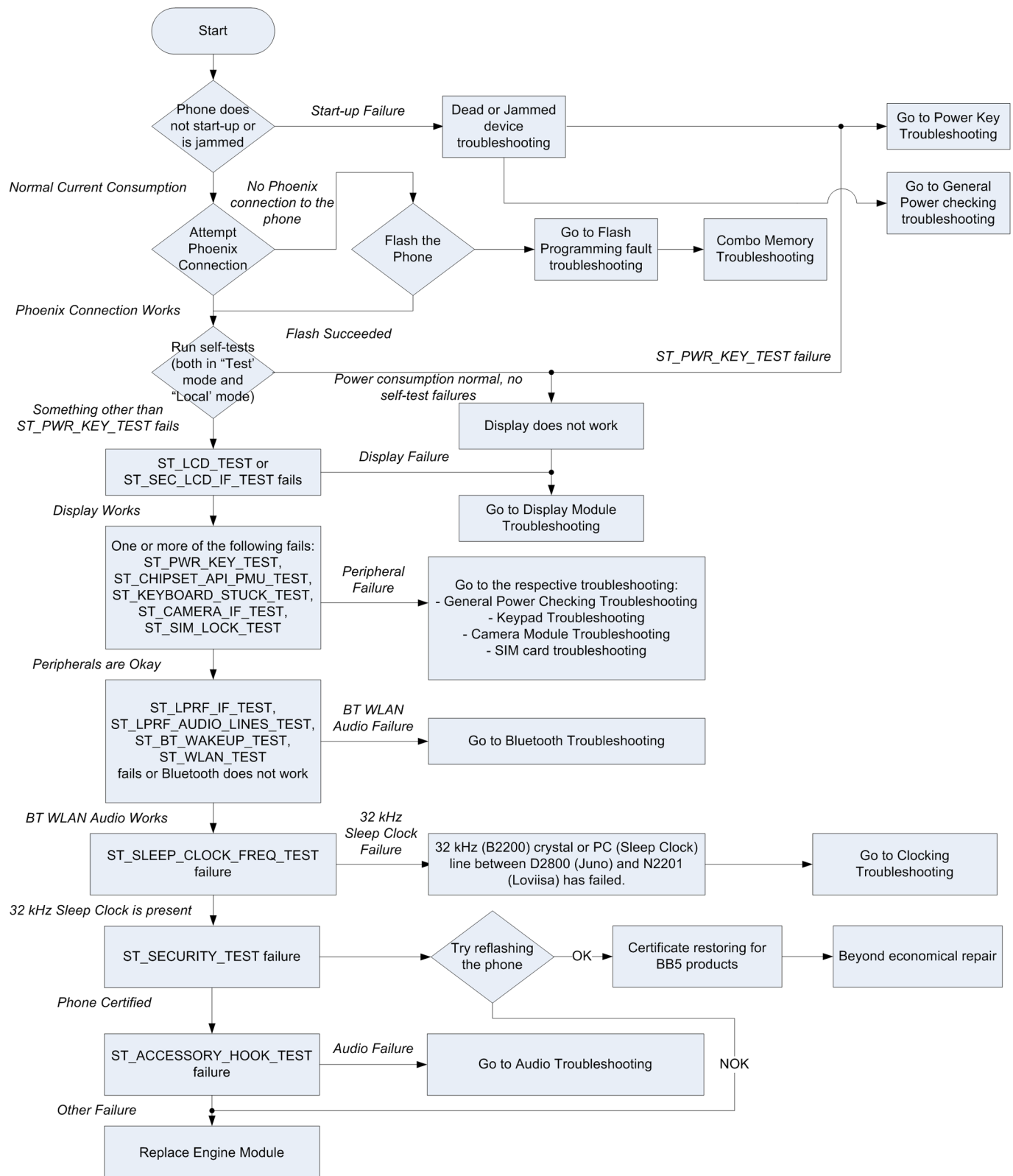
### Context

Always start the trouble-shooting procedure by running the Phoenix self tests. If a test fails, please follow the diagram in the *Baseband Main Troubleshooting* section.

If the phone is dead and you cannot perform the self-test, please go to *Dead or Jammed Device Troubleshooting*.

**Note:** The phone must be powered-down and in the PWR\_OFF state when replacing components.

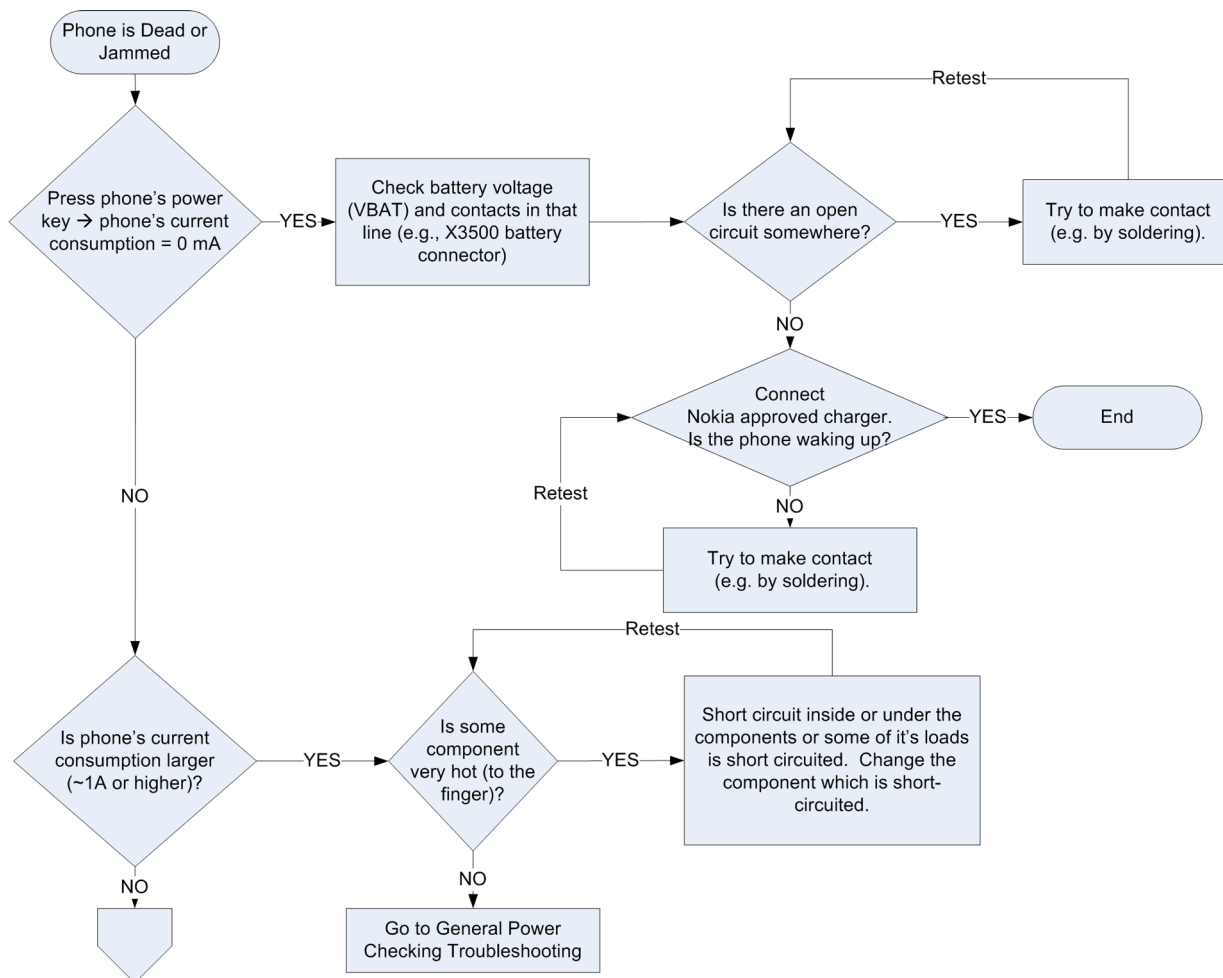
## Troubleshooting flow



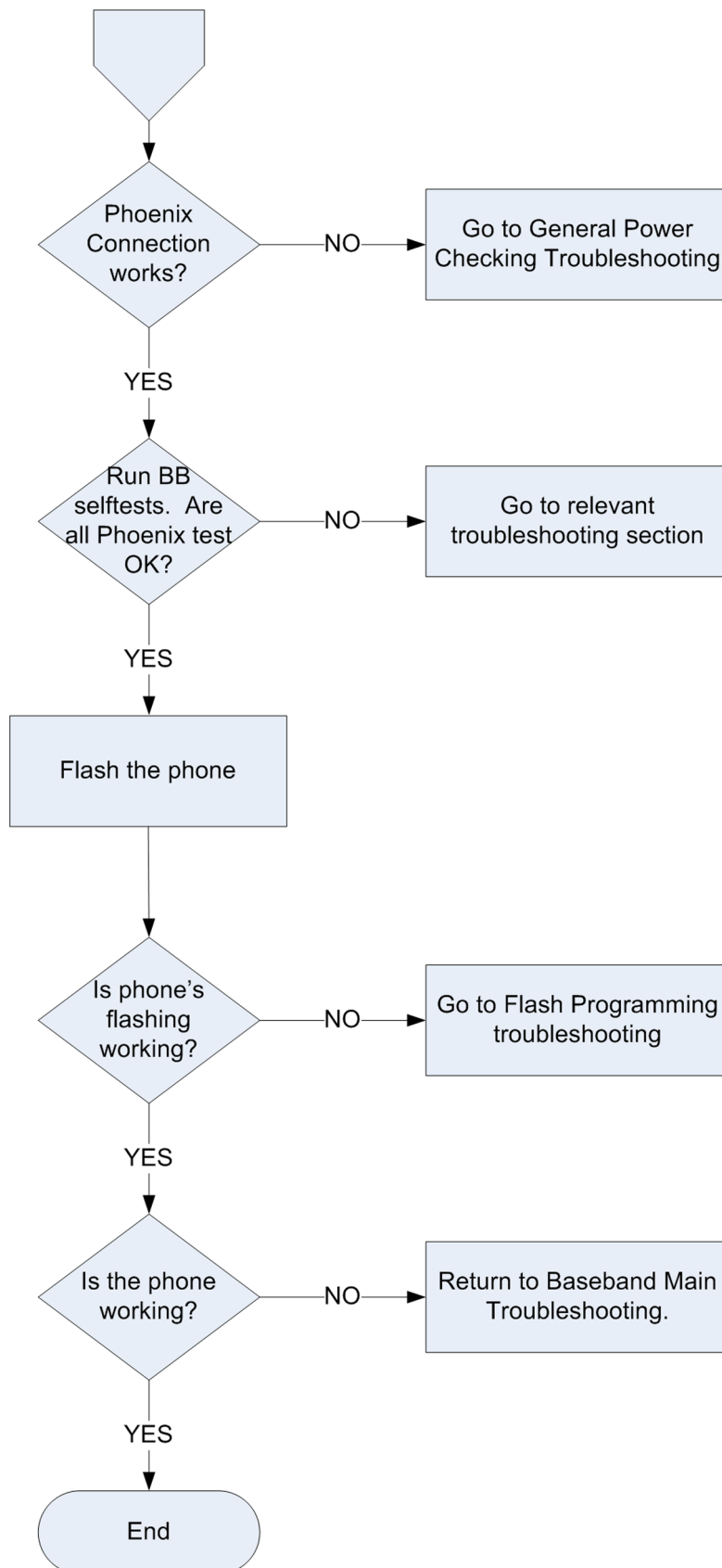
## ■ Power and charging troubleshooting

### Dead or jammed device troubleshooting

#### Troubleshooting flow



## Troubleshooting flow



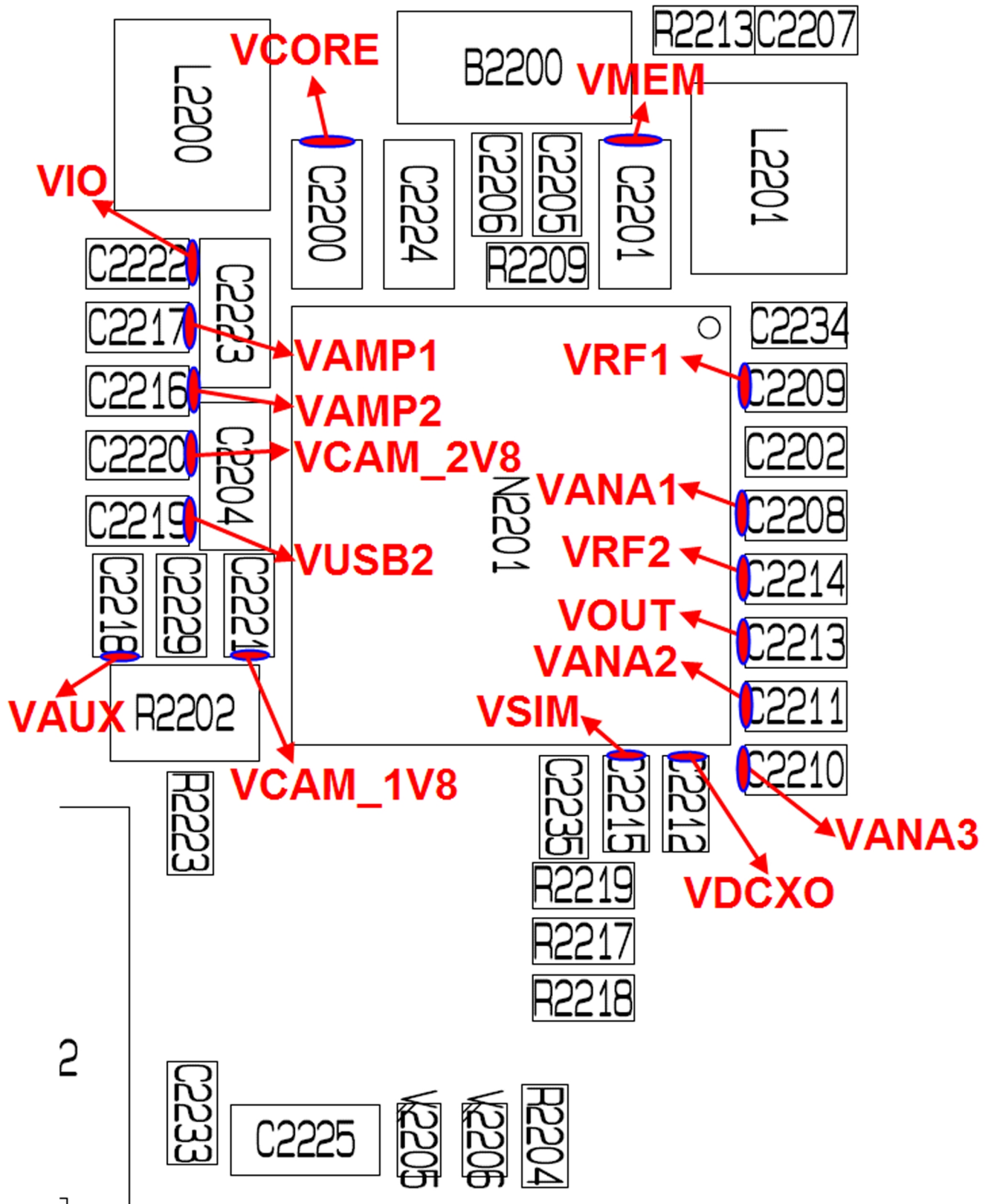
## General power checking

Check the following supply voltages from the N2201 Loviisa PMU to the D2800 Juno BB ASIC:

Signal name	Regulator	Sleep	Active	Main user	Probe point	Nominal voltage (V)
VUSB2	VMSLD02	ON	ON	NVM digital supply, analog supply for USB I/O	C2219	3.3
VIO	VIOLDO	ON	ON	CMOS I/O digital supply, digital supply for BBL I/O	C2222	1.8
VCORE	VCSRL	ON	ON	core digital supply, digital supply for RF, analog supply for USB PLL	C2200	1.2/1.01
VRF2	VRFLD01	OFF	ON	analog supply for RF	C2214	2.7
VRF1	VLVLD02	OFF	ON	analog supply for RF	C2209	1.3
VDCX0	VLCLDO	OFF	ON	analog supply for RF	C2212	1.3
VSIM	VSIMLDO	TBD	ON	digital supply for SIM I/O	C2215	3.0
VAMP2	VHCLD02	OFF	ON	digital supply for SDIO I/O	C2216	1.8
VMEM	VIOSRL	ON	ON	digital supply for nvSRAM I/O, digital supply for EMI I/O	C2201	1.8
VANA1	VLVLD01	ON	ON	analog supply for MainPLL, analog supply for AppsPLL, analog supply for USB, analog supply for USB, CSI-2/CCP2 I/O, DSI I/O, analog supply for dual DAC	C2208	1.2

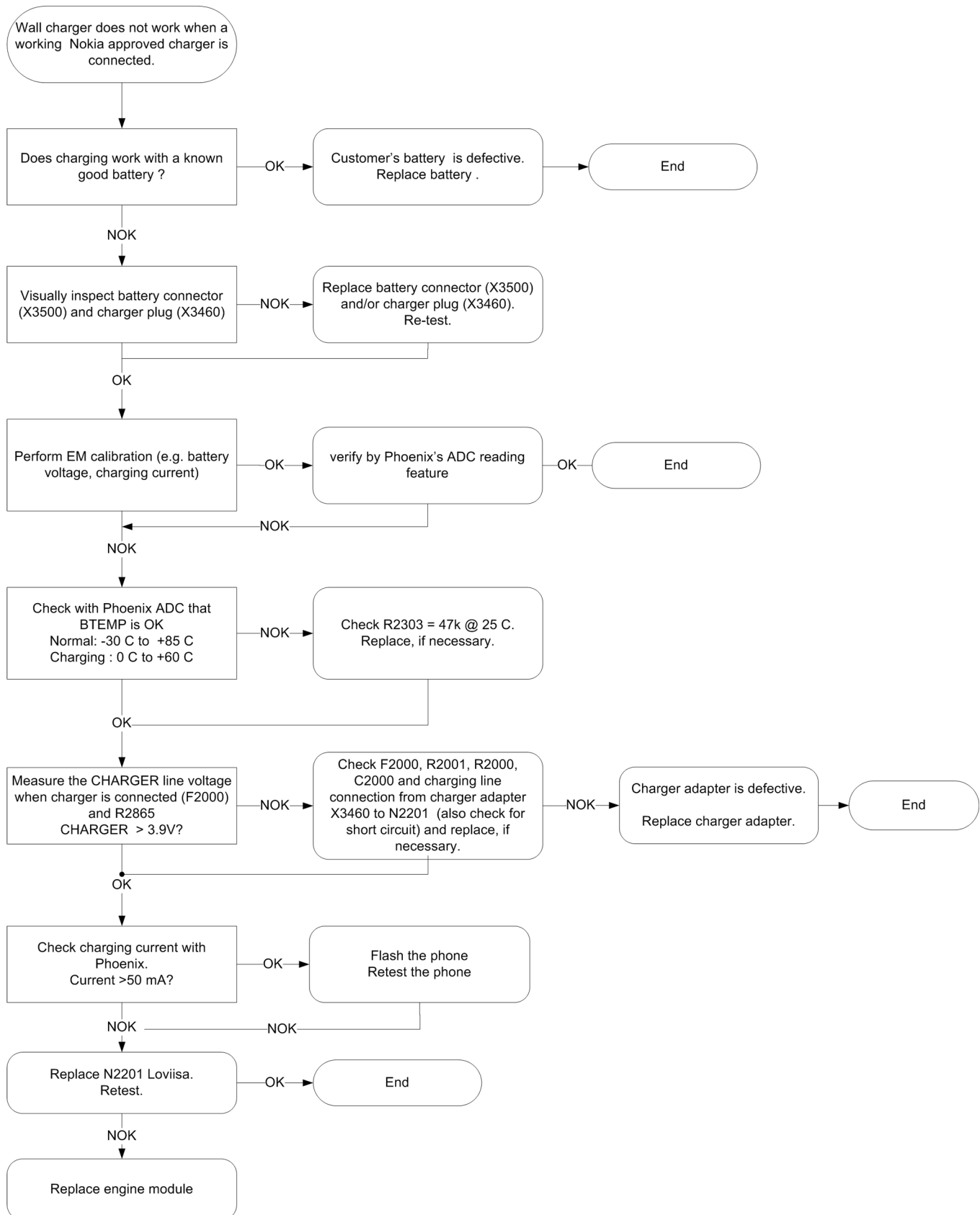
Signal name	Regulator	Sleep	Active	Main user	Probe point	Nominal voltage (V)
VOUT	VRFLD02	ON	ON	analog supply for USB and ACI	C2213	2.5
VANA2	VALD02	ON	ON	analog supply for ADC (4-to-1) and IHF	C2211	2.5
VANA3	VALD01	ON	ON	analog supply for microphone and Aux ADC/DAC,	C2210	3.0
VAMP1	VHCLD01	OFF	ON	analog supply for DDAC left outputs, analog supply for DDAC right and left outputs, Vibra	C2207, C2217	3.0

VCORE will be trimmed to approximately 1.0V in the Sleep mode.



## Charging troubleshooting

### Wall Charger Troubleshooting





## Clocking troubleshooting

### Context

The D2800 Juno BB ASIC requires two clocks for proper operation. Both are provided by on-board crystals.

- The 32 kHz crystal is connected to the N2201 PMU and is transmitted to the D2800 Juno BB ASIC.
- The 26 MHz crystal is connected directly to the D2800 Juno BB ASIC. The D2800 Juno BB ASIC can output four copies of the 26 MHz input clock from its CK1, CK2, RF\_XON, and RF\_XOP pins, however, only the RF\_XON output is used.

**Note:** All test-points are located under the RF shielding.

#### 1) 32 kHz crystal (B2200)

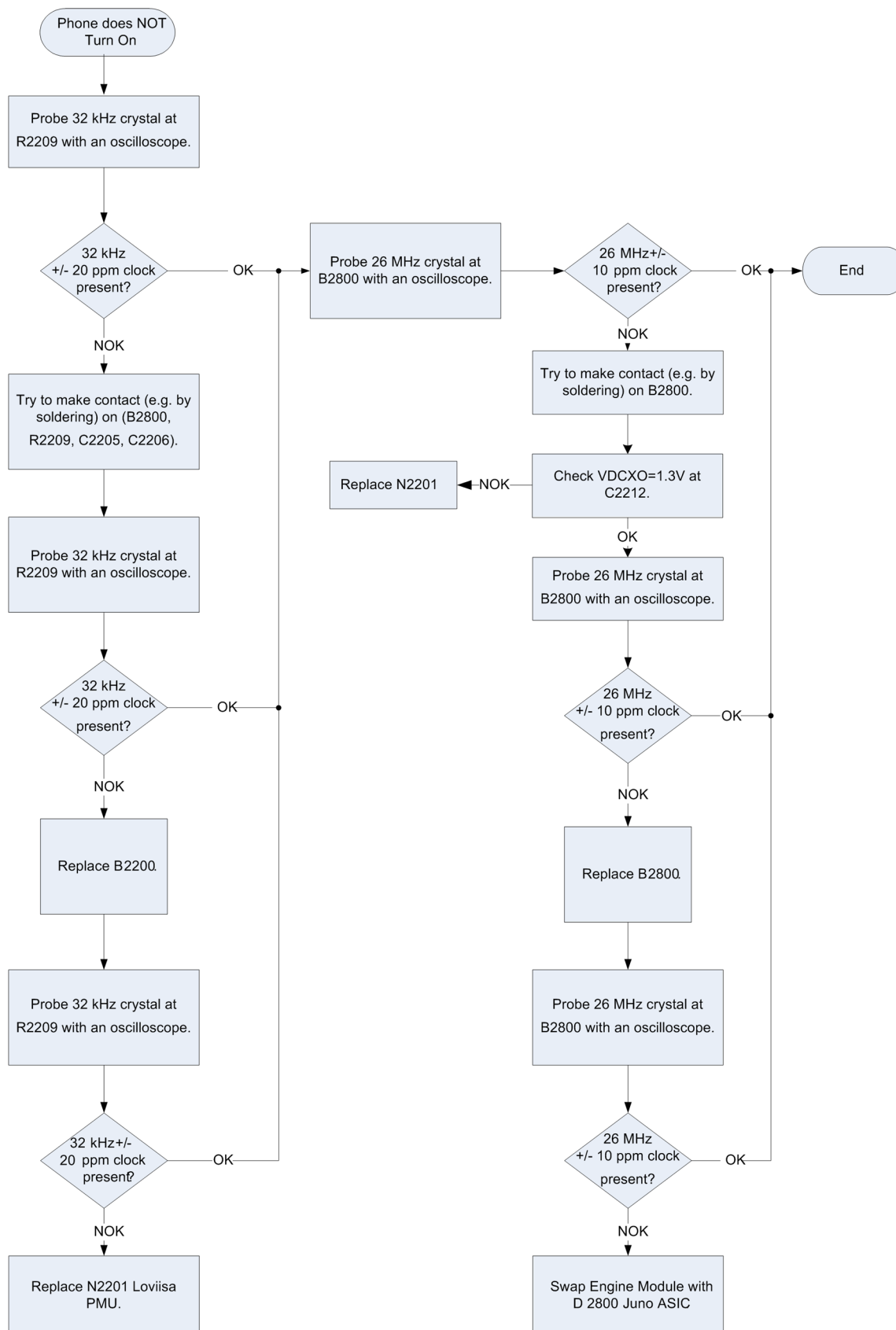
The 32 kHz clock to the N2201 Loviisa can be tested by setting the oscilloscope probe on R2209.

#### 2) 26 MHz crystal (B2800)

- The 26 MHz clock to the D2800 Juno can be tested by setting the oscilloscope probe on B2800.
- RF\_XON output clock can be tested by probing C6094 near the BT/FM/WLAN module.

**Note:** This step will require the RF\_XON output clock for BT/FM/WLAN module to be enabled through Phoenix SW.

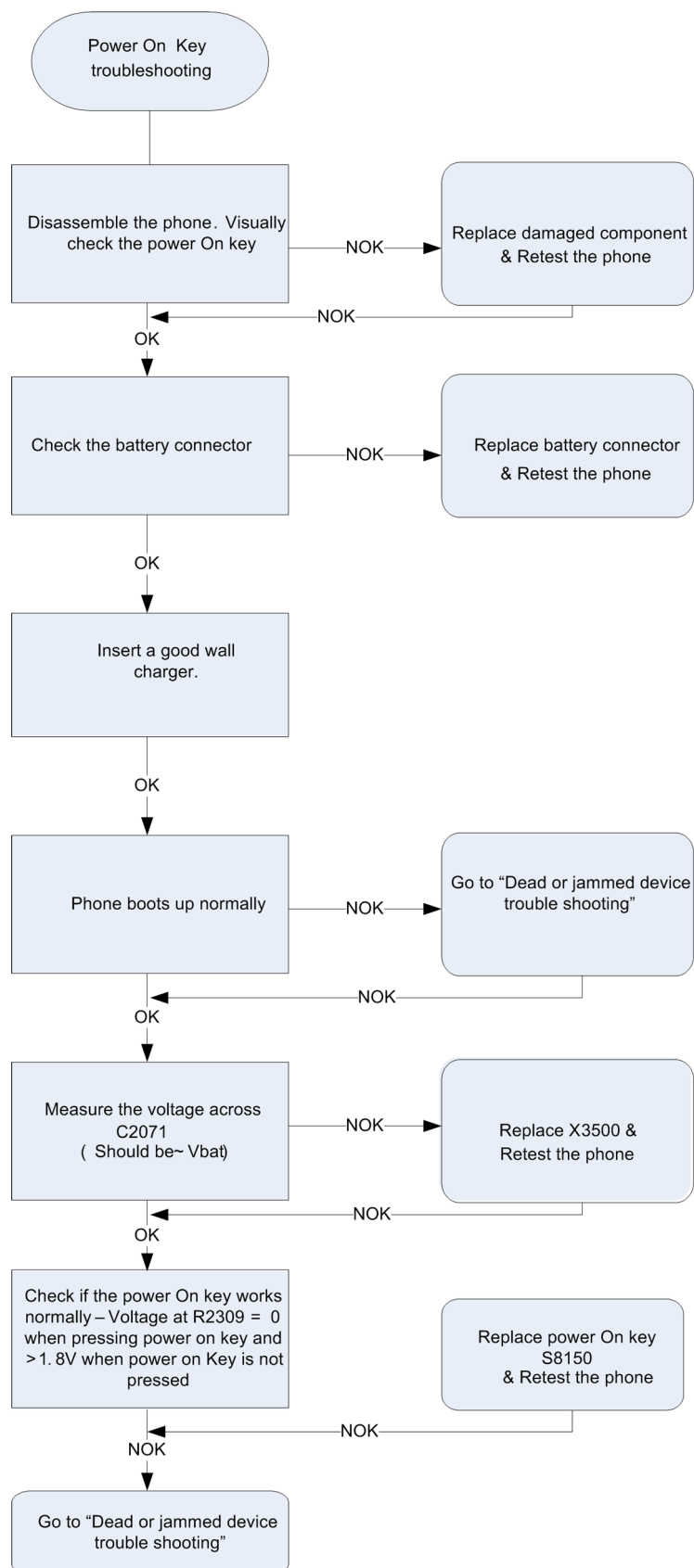
## Troubleshooting flow

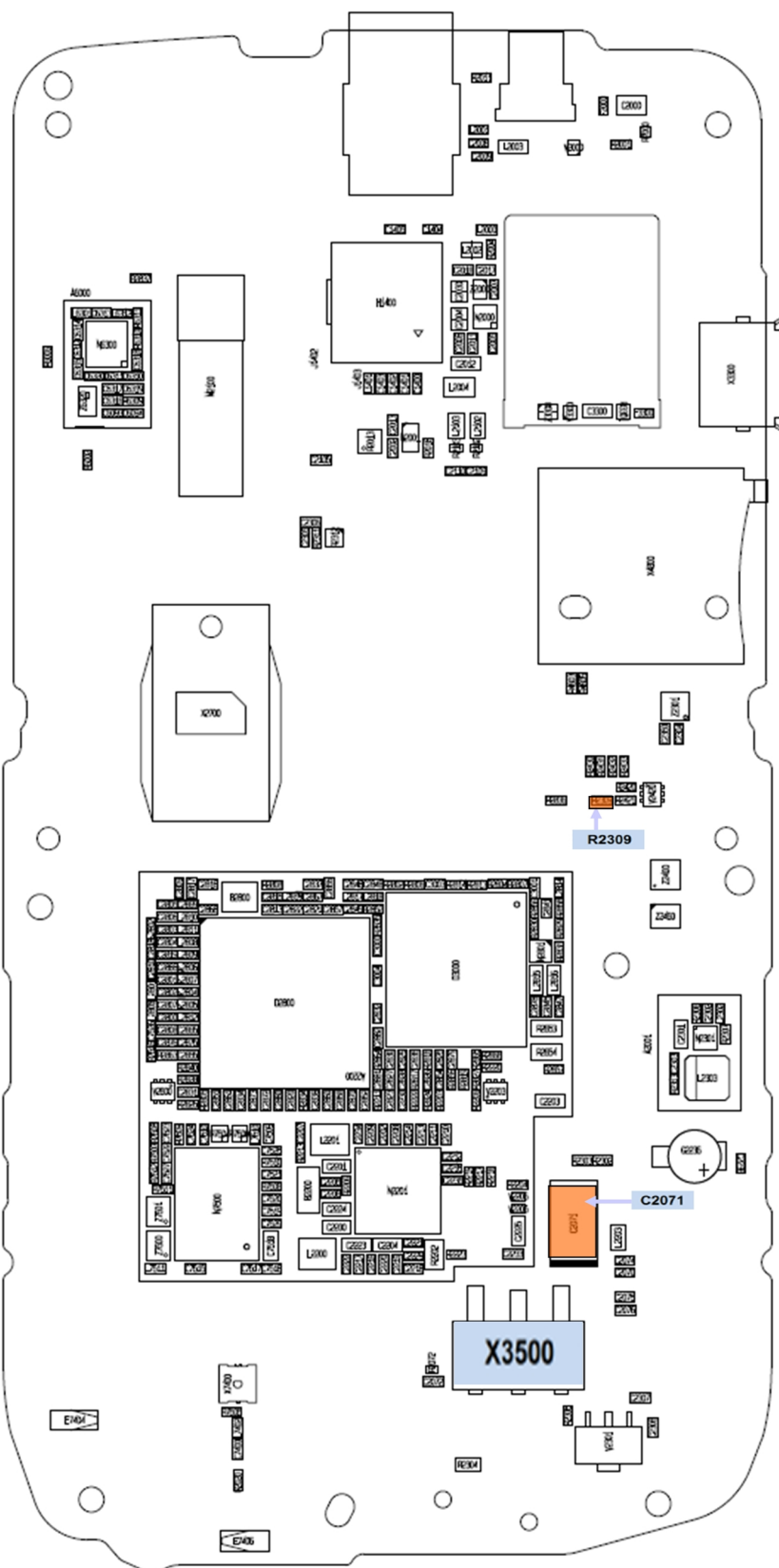




## Power On key troubleshooting

### Troubleshooting flow

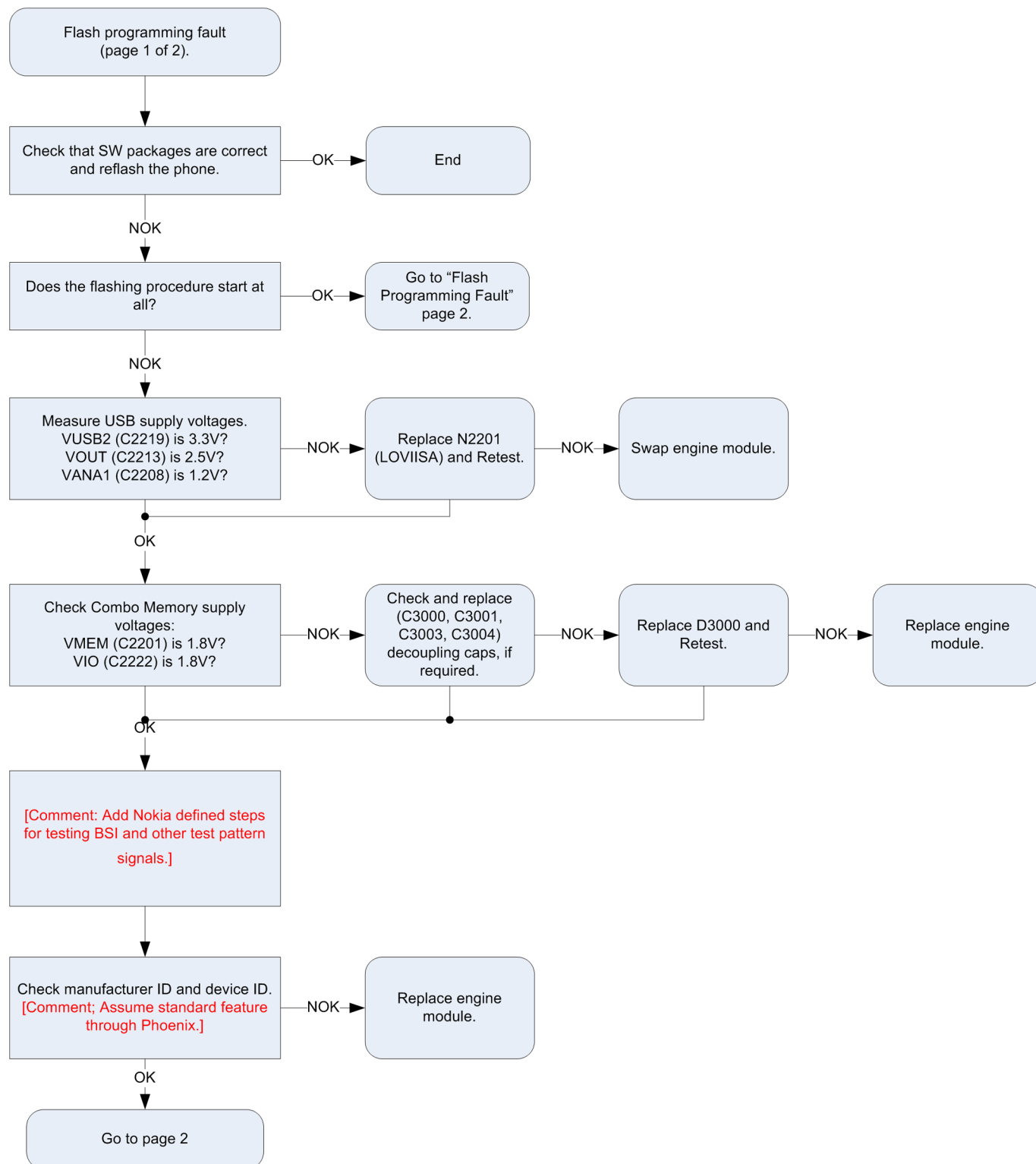


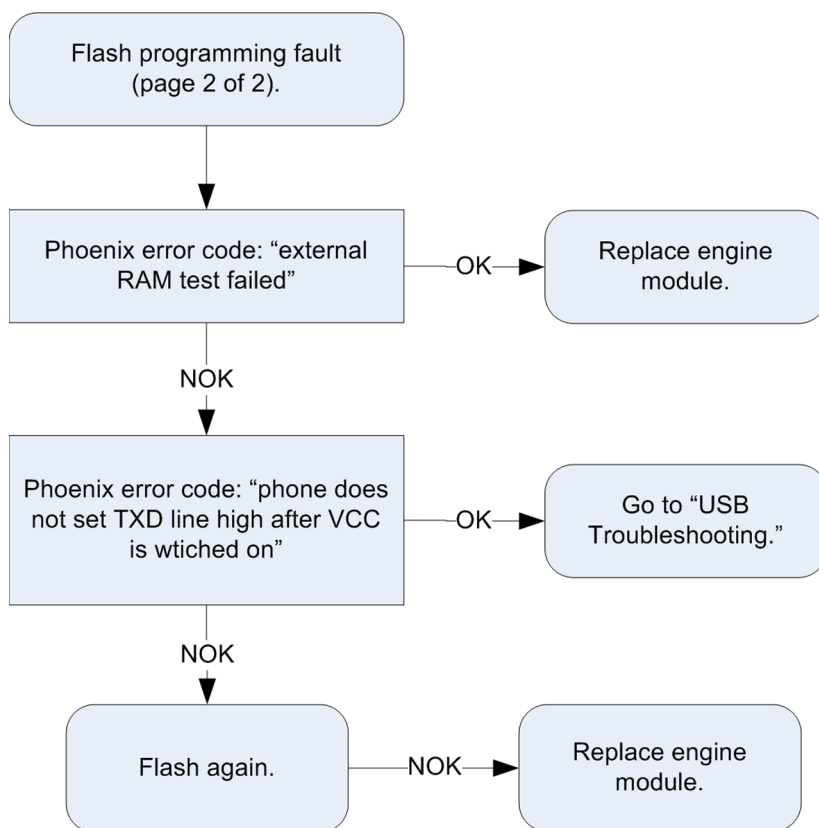


## ■ Interface troubleshooting

### Flash Programming Troubleshooting

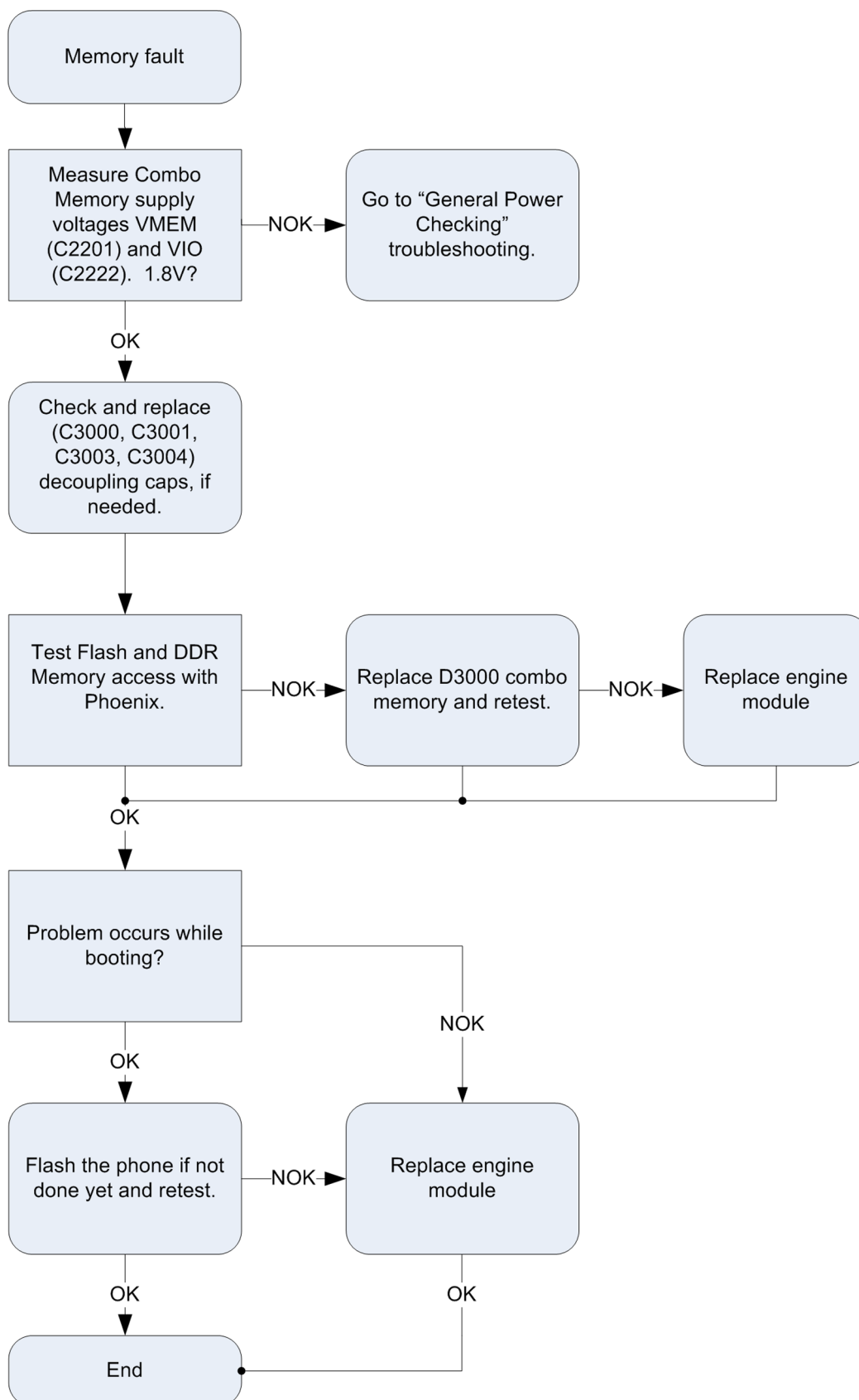
#### Troubleshooting flow

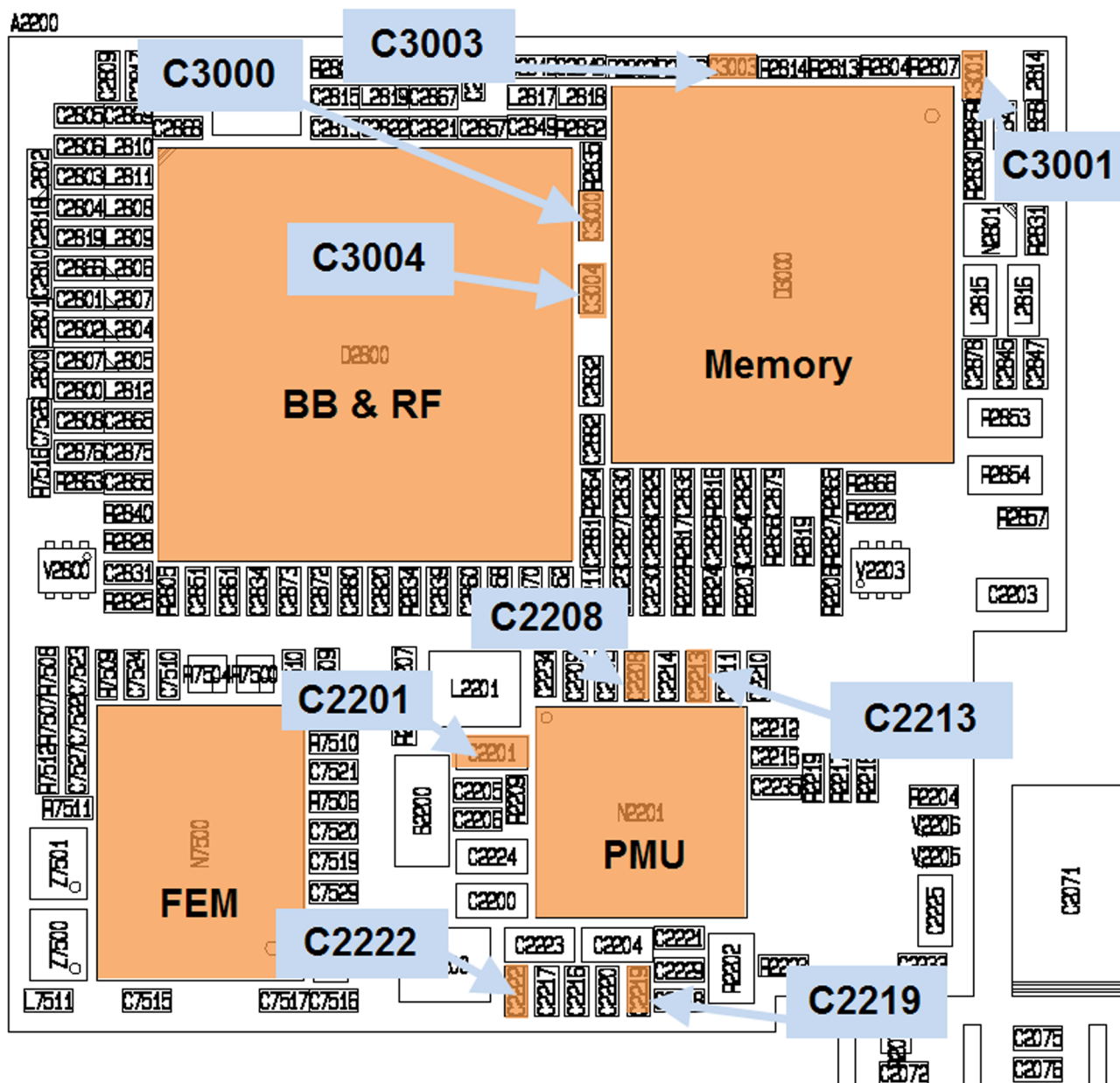




## Memory Troubleshooting

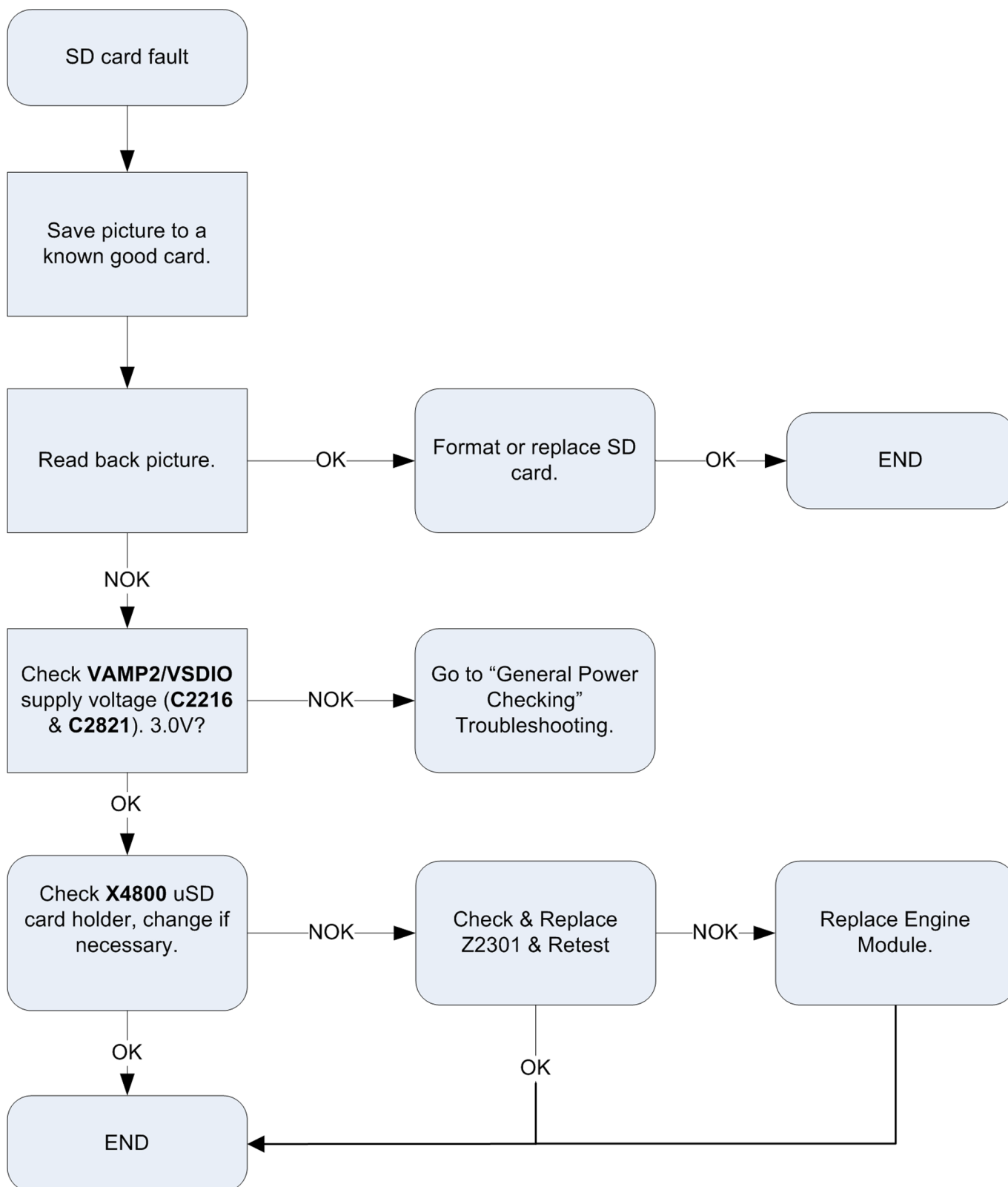
### Troubleshooting flow





## Memory Card Troubleshooting

### Troubleshooting flow



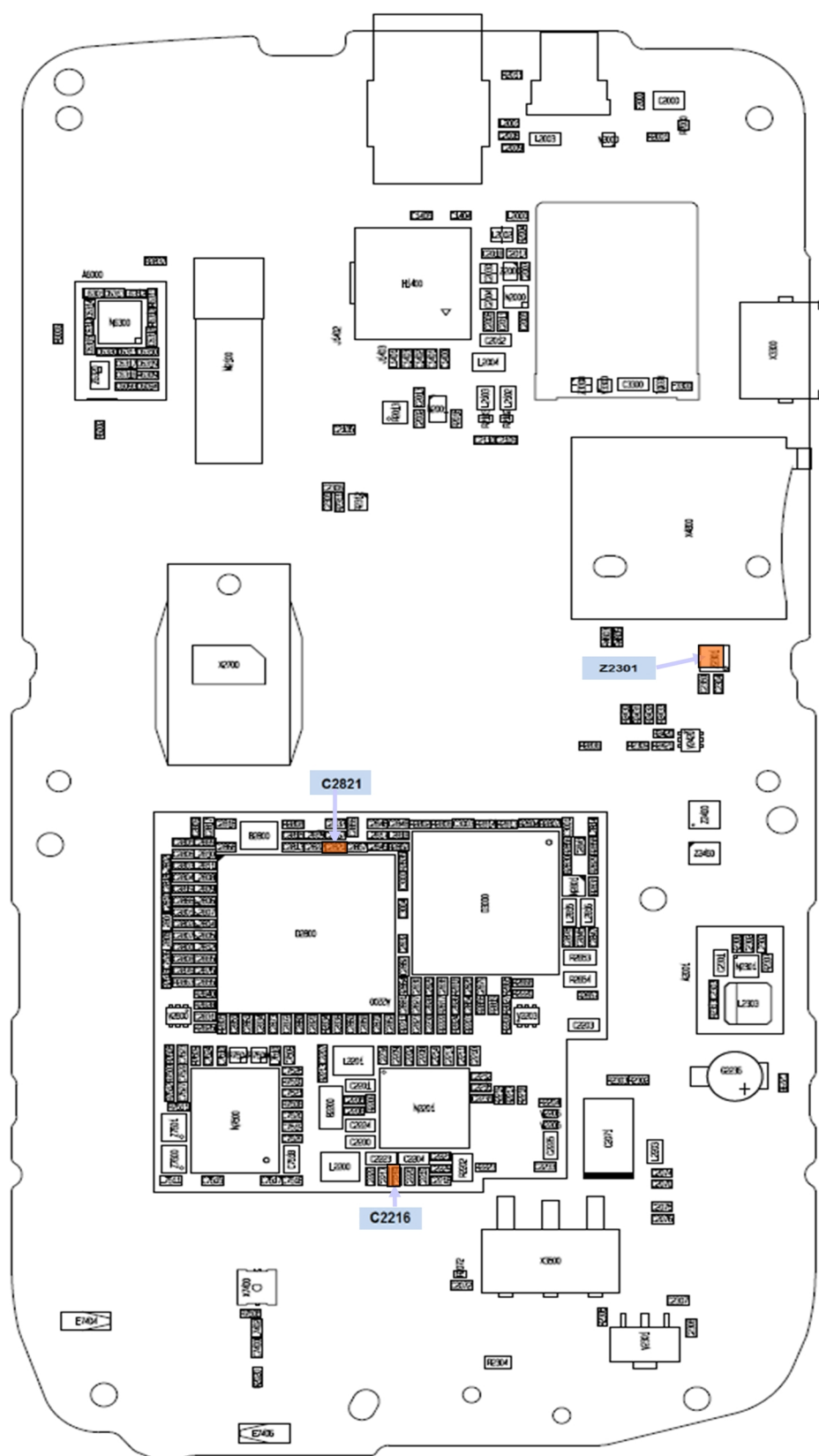


Figure 12 Probe placement diagram

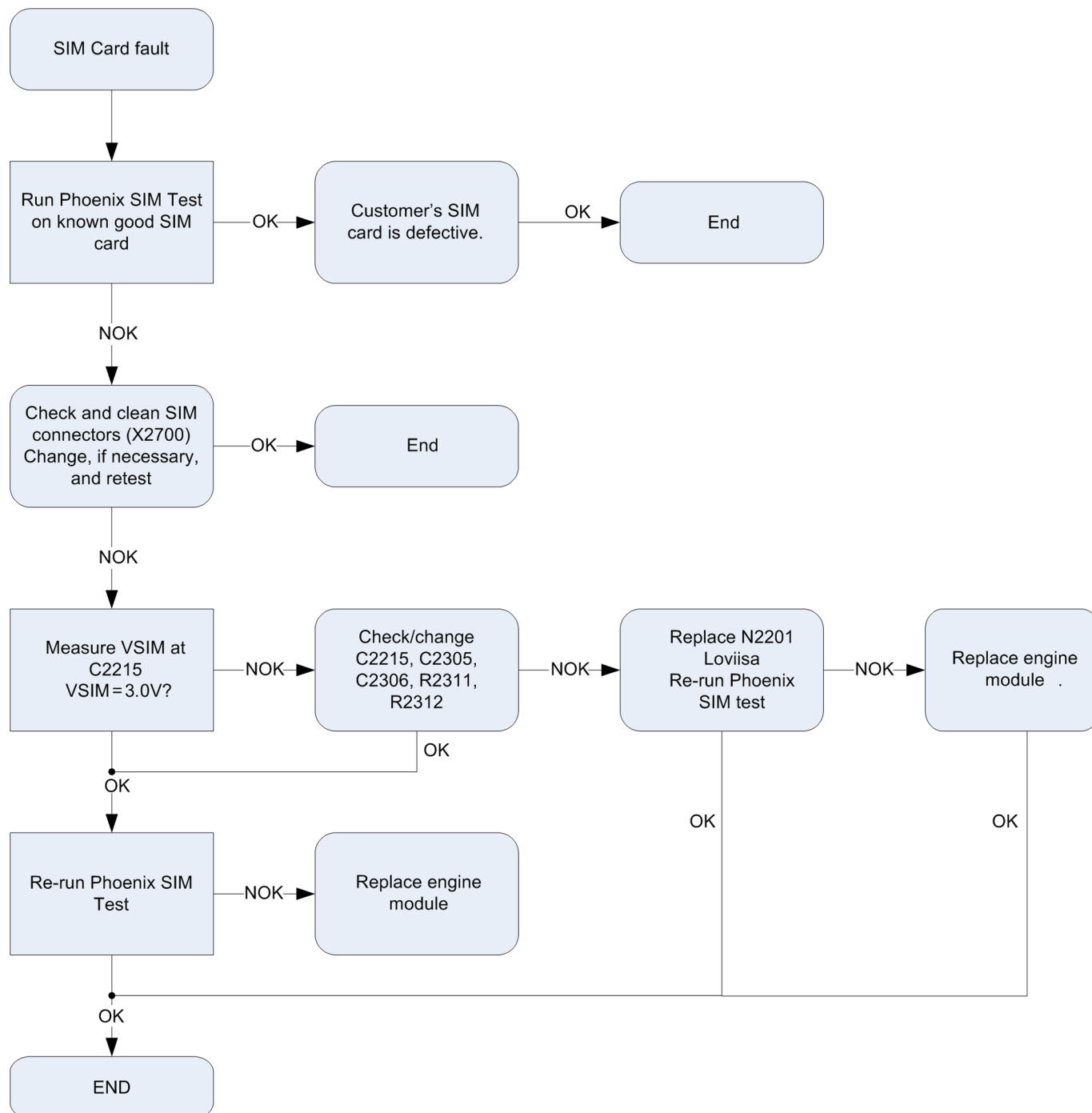
## SIM Card Troubleshooting

### Context

#### Note:

Battery must be inserted in order to power-up the phone, which will block access to the SIM and surrounding components for probing.

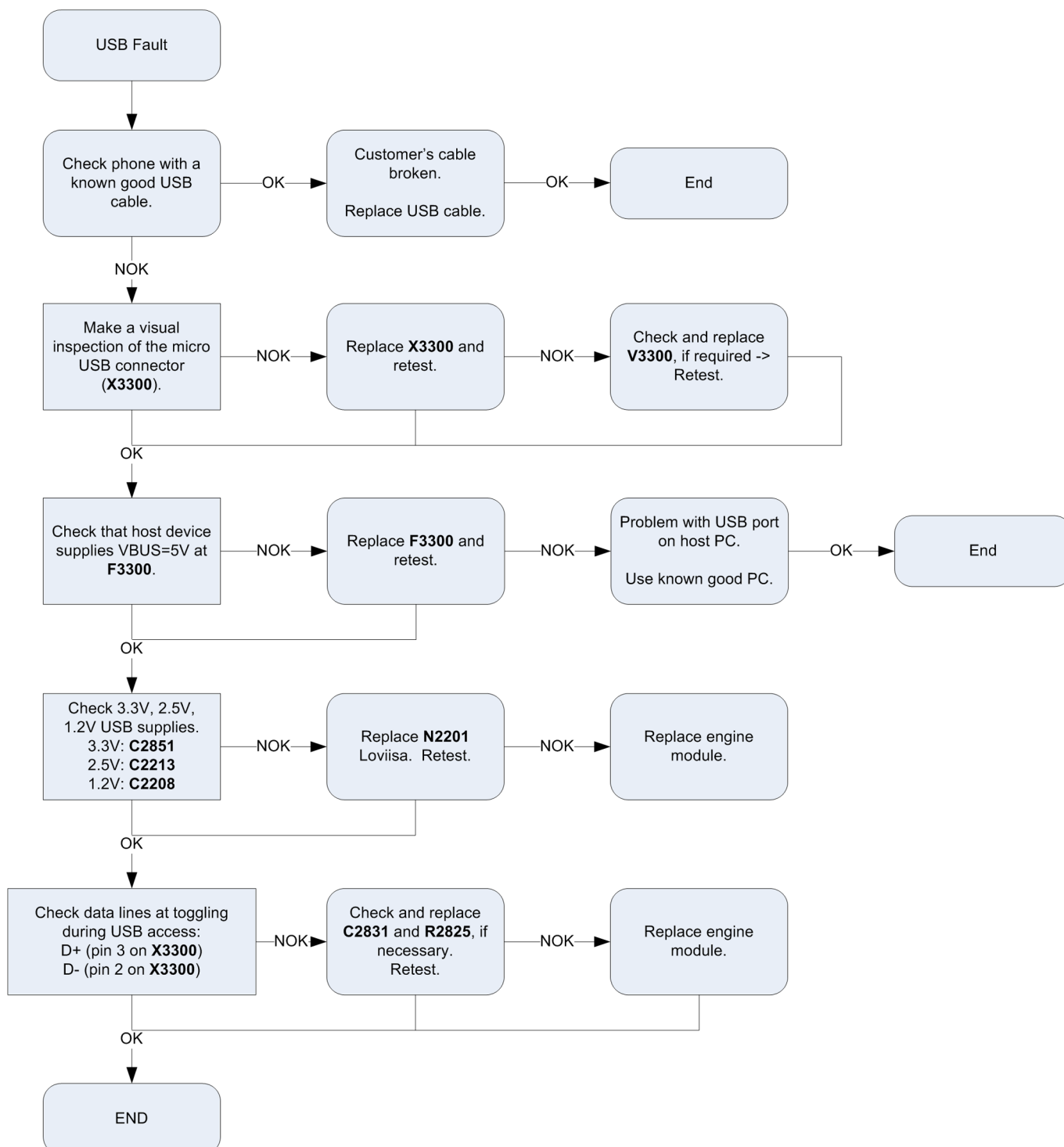
### Troubleshooting flow





## USB Interface Troubleshooting

### Troubleshooting flow

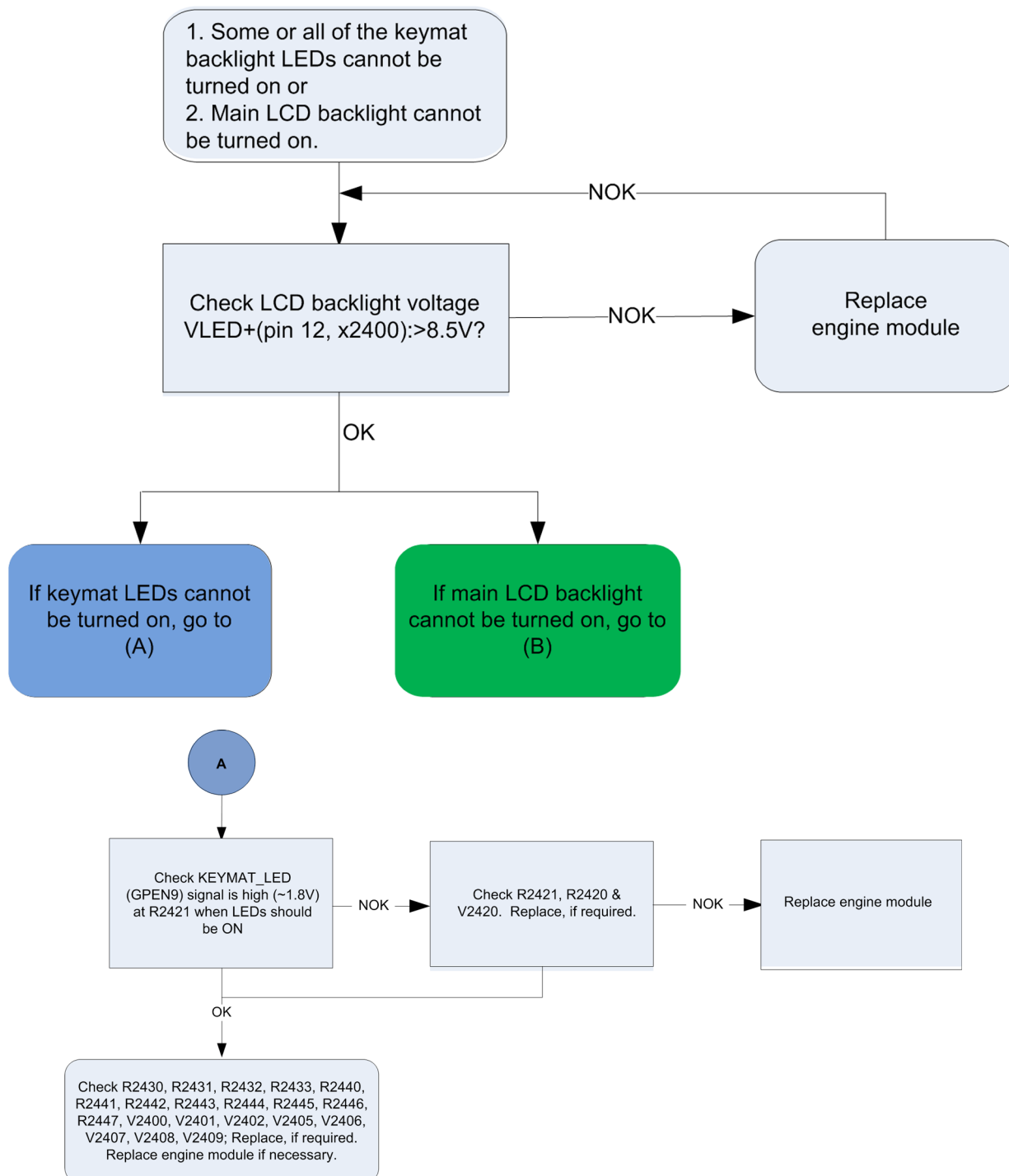


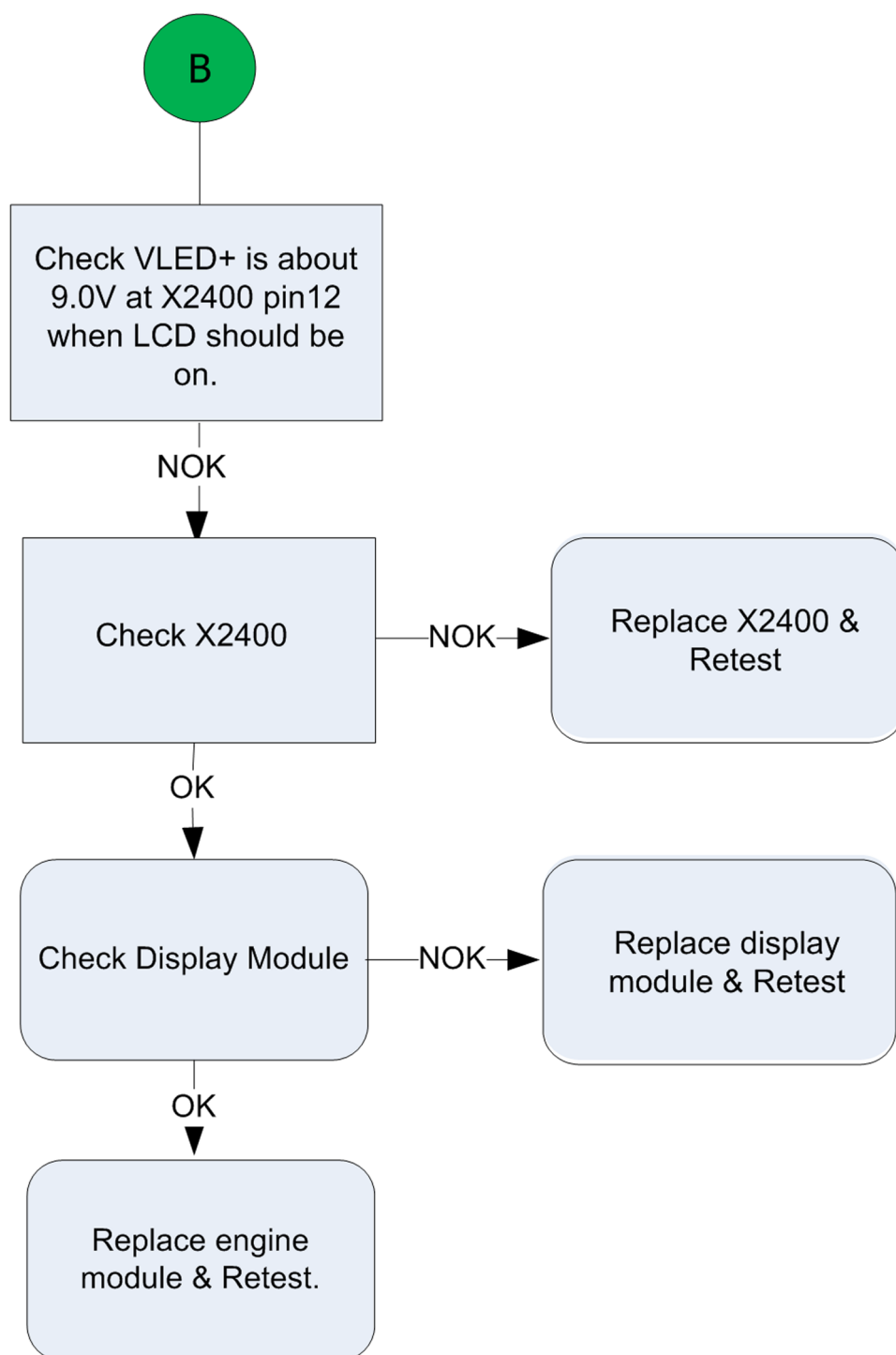


## ■ User interface troubleshooting

### Backlight and Illumination Troubleshooting

#### Troubleshooting flow





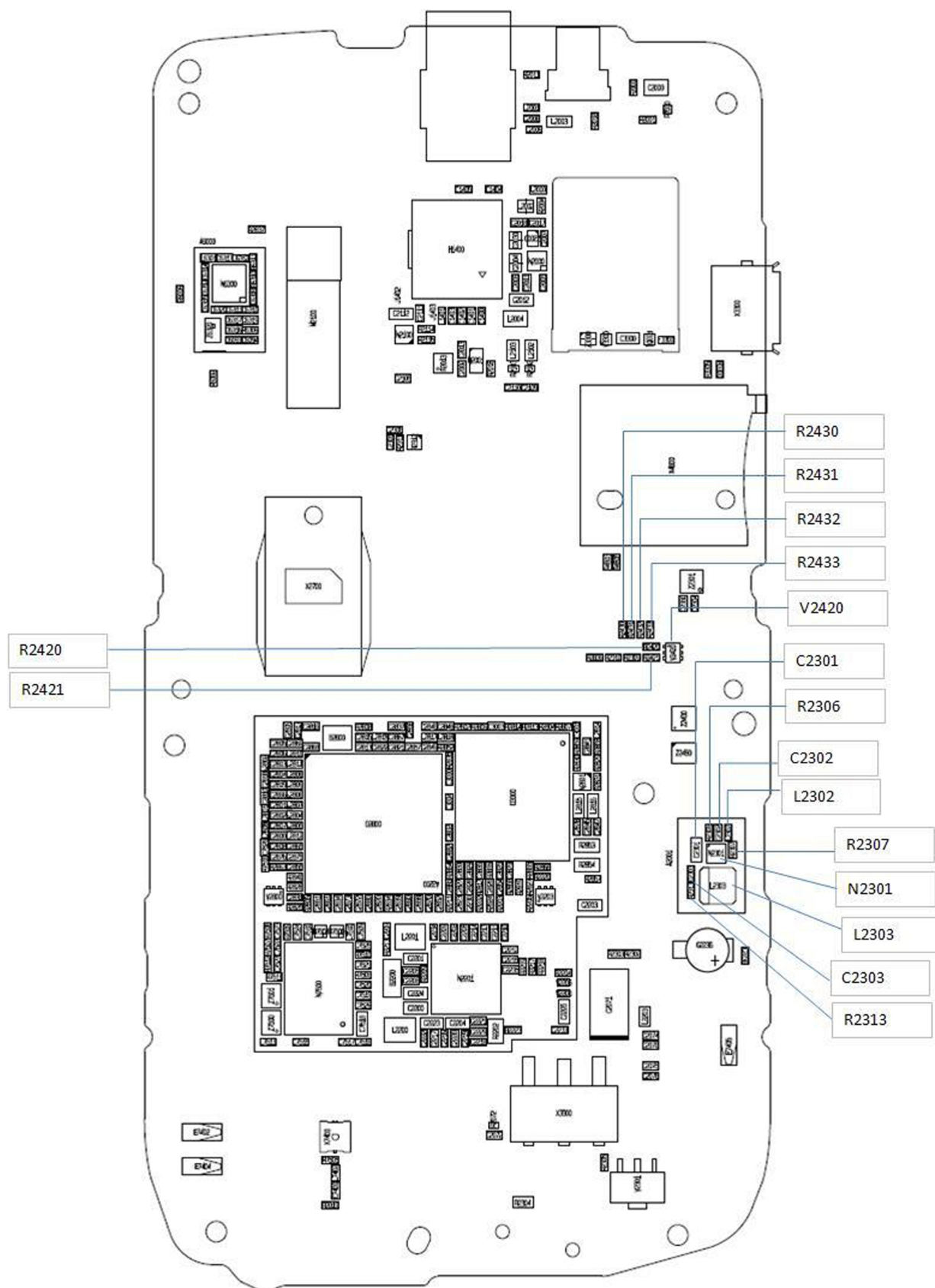
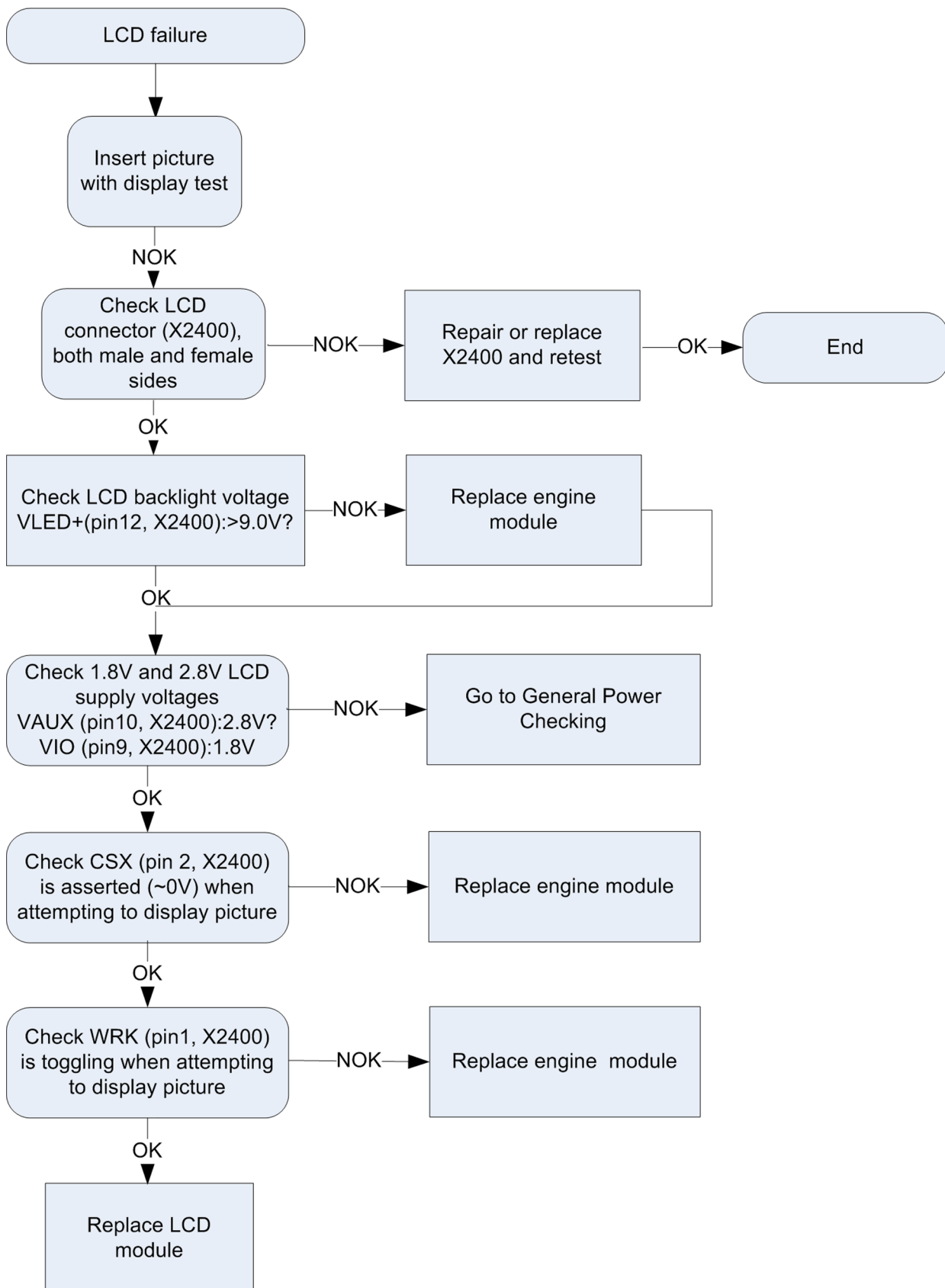


Figure 15 Probe placement diagram

## Display Interface Troubleshooting

### Troubleshooting flow



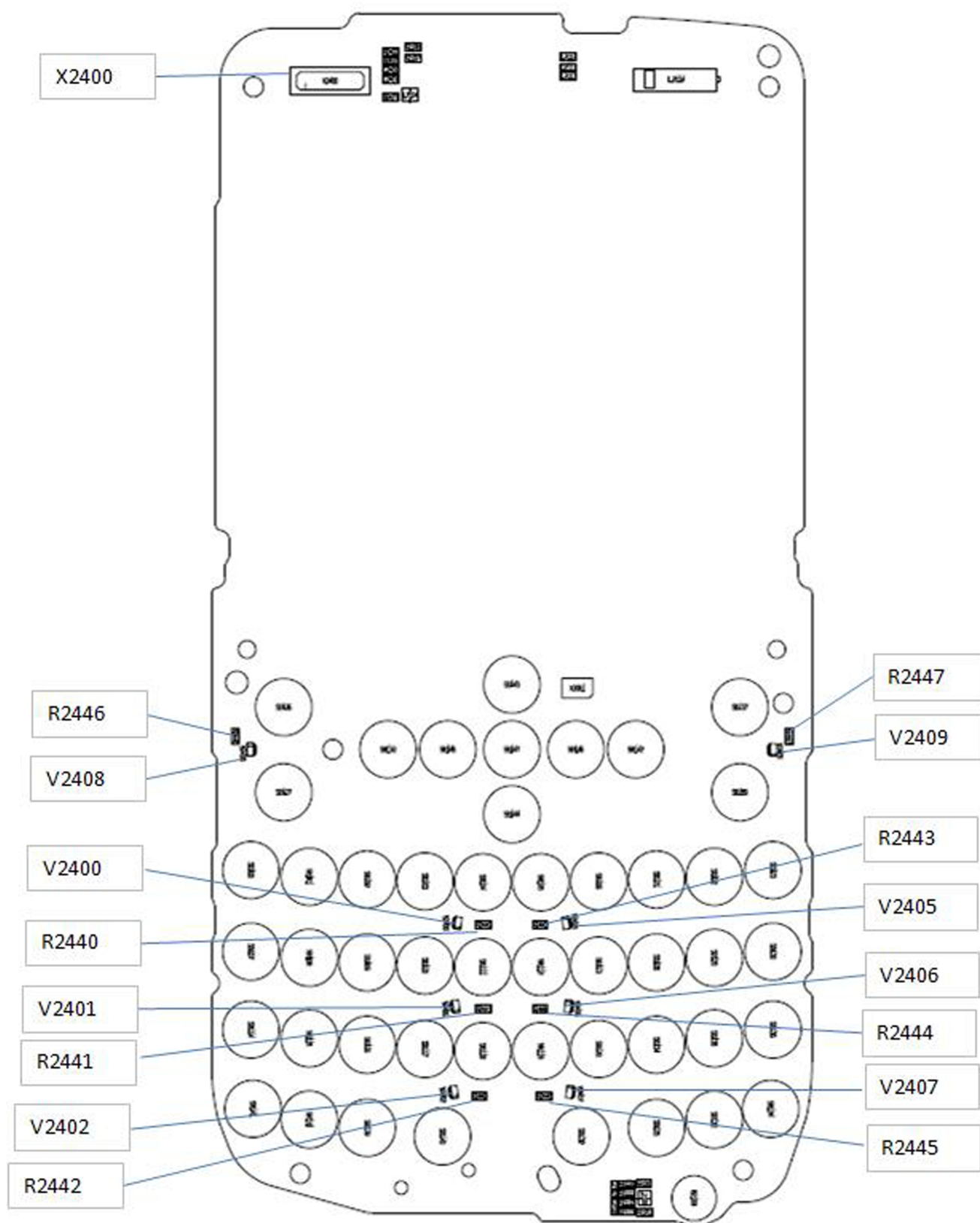


Figure 16 Probe placement diagram

## Keypad Troubleshooting

### Troubleshooting flow

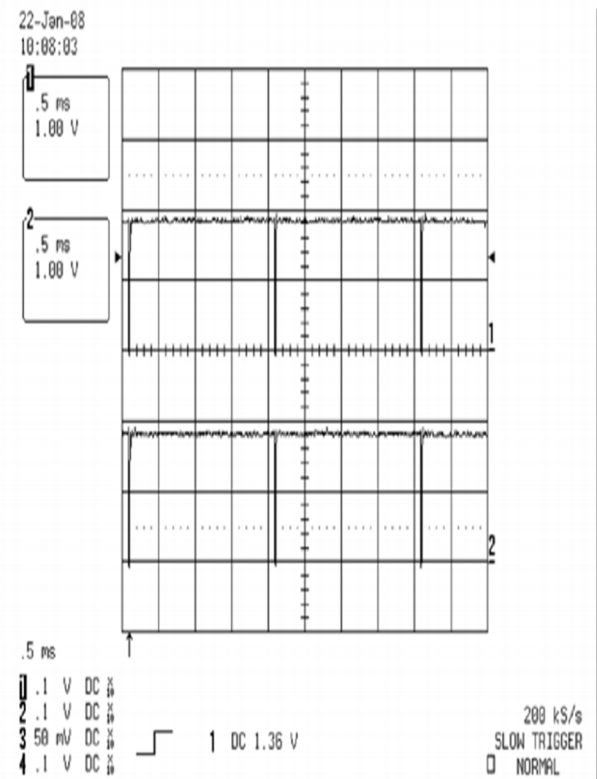
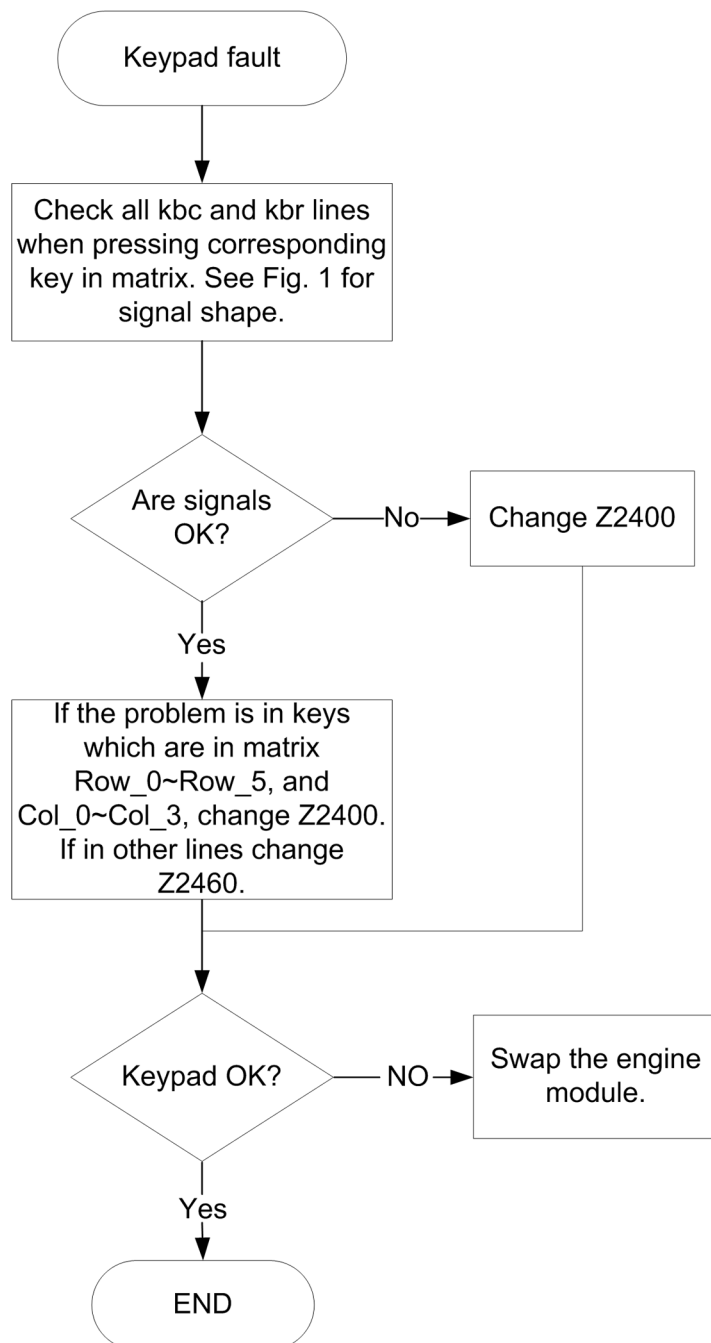


Fig.1: kbc and kbr signals when pressing key

	COLUMN 0	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
ROW 0	Q	W	E	R <sup>1</sup>	T <sup>2</sup>	Y <sup>3</sup>	U <sup>*</sup>
ROW 1	A	S	D	F <sup>4</sup>	G <sup>5</sup>	H <sup>6</sup>	J <sup>#</sup>
ROW 2	Z	X	C	V <sup>7</sup>	B <sup>8</sup>	N <sup>9</sup>	M <sup>0</sup>
ROW 3	I	O	P	Ctrl	@	SW L	Send
ROW 4	K	L	Backspace	Shift			Social
ROW 5	,	.	Enter	SW R		?	
ROW 6	Sym	Space	Fn		Messaging		
ROW 7	UP	Down	Left	Right	Select		

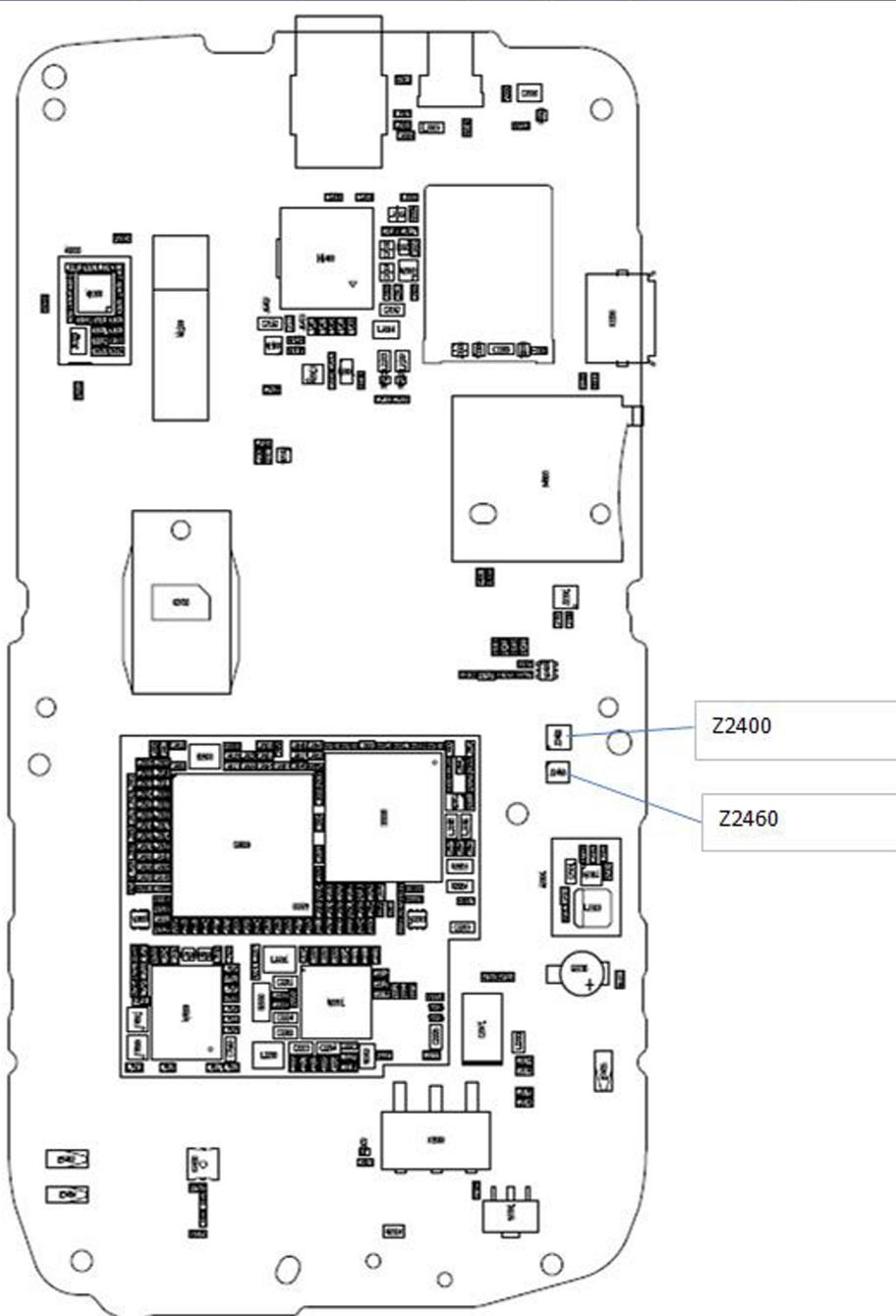


Figure 17 Probe placement diagram

## ■ Audio troubleshooting

### Audio troubleshooting test instructions

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

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

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 1kHz.

The input signal for each loop test can be either single-ended or differential.

### Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- 'Active speaker' or 'speaker and power amplifier'
- Sound level meter
- Current probe (Internal handsfree DPMA output measurement)
- Phoenix service software
- Battery voltage 3.7V

### Test procedure

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

- External microphone to Internal earpiece
- External microphone to Internal handsfree speaker
- Internal microphone 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 they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

### Phoenix audio loop tests and test results

The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7V. Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

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

Loop test	Input terminal	Output terminal	Mic Tx PGA gain [dB]	Rx PGA gain	Input voltage [mVp-p]	Differential output voltage [mVp-p]	Output DC level [V]	Output current [mA]
External Mic to External Earpiece	MIC2 P (R2016) and GND	HS_EAR_L [J2003] and GND	0	-3	1000	710	1.2	NA
		HS_EAR_R [J2004] and GND						
	MIC2 N (R2016) and GND	HS_EAR_L [J2003] and GND						
		HS_EAR_R [J2004] and GND						
External Mic to Internal Earpiece	MIC2 P (R2016) and GND	EARP [R2106] not assembled and GND	0	-3	1000	710	1.2	NA
		EARN [R2107] not assembled and GND						
	MIC2 N (R2016) and GND	EARP [R2106] not assembled and GND						
		EARN [R2107] not assembled and GND						
External Mic to Internal handset	MIC2 P (R2016) and GND	HFSP [R2102]	0	-3	1000	710	0	25mA (calc.)
		HFSPN [R2103]						
	MIC2 N (R2016) and GND	HFSP [R2102]						
		HFSPN [R2103]						

Loop test	Input terminal	Output terminal	Mic Tx PGA gain [dB]	Rx PGA gain	Input voltage [mVp-p]	Differential output voltage [mVp-p]	Output DC level [V]	Output current [mA]
Internal Mic to External Earpiece	MIC1 P (R2100)	HS_EAR_L [J2003] and GND	0	-3	1000	710	1.2	NA
		HS_EAR_R [J2004] and GND						
	MIC1 N (R2101)	HS_EAR_L [J2003] and GND						
		HS_EAR_R [J2004] and GND						

## Placement Diagram

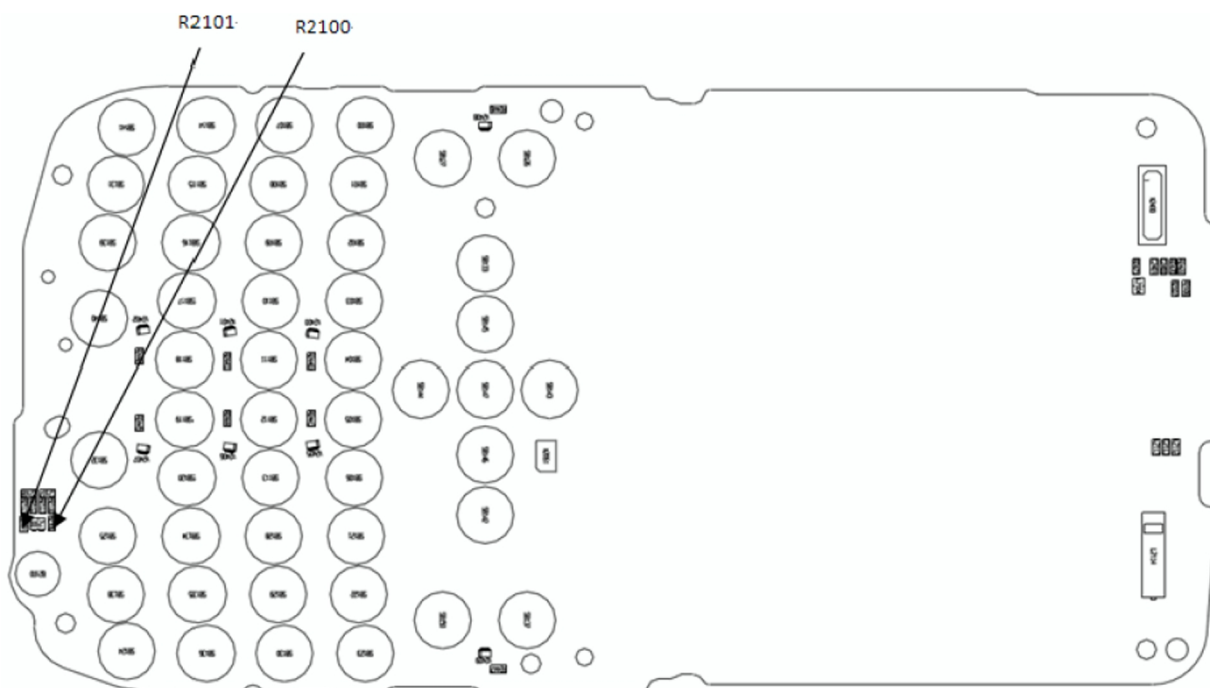


Figure 18 Front side

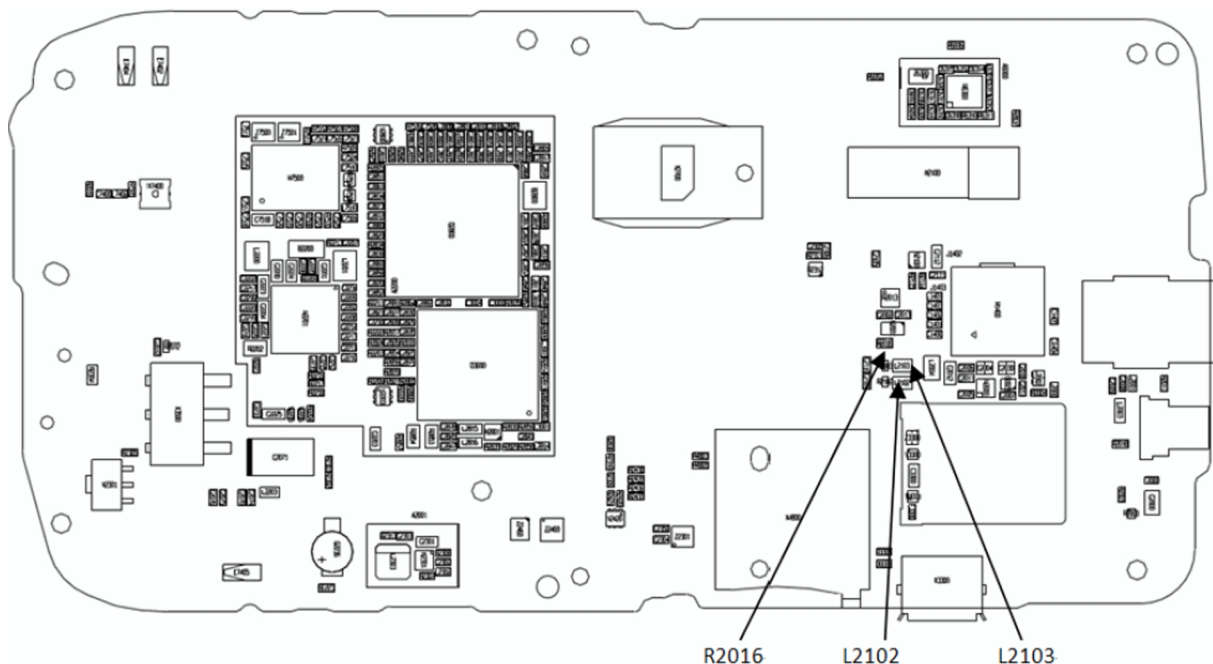
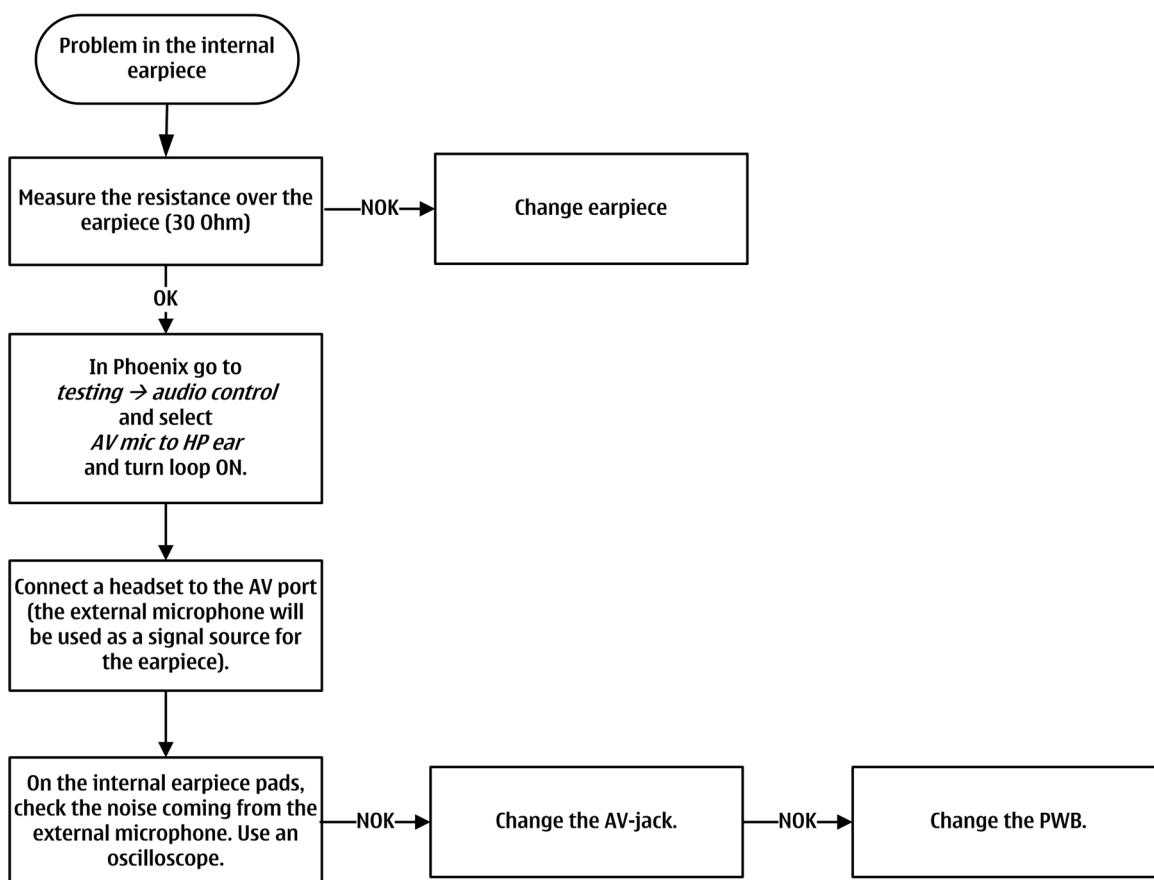


Figure 19 Back side

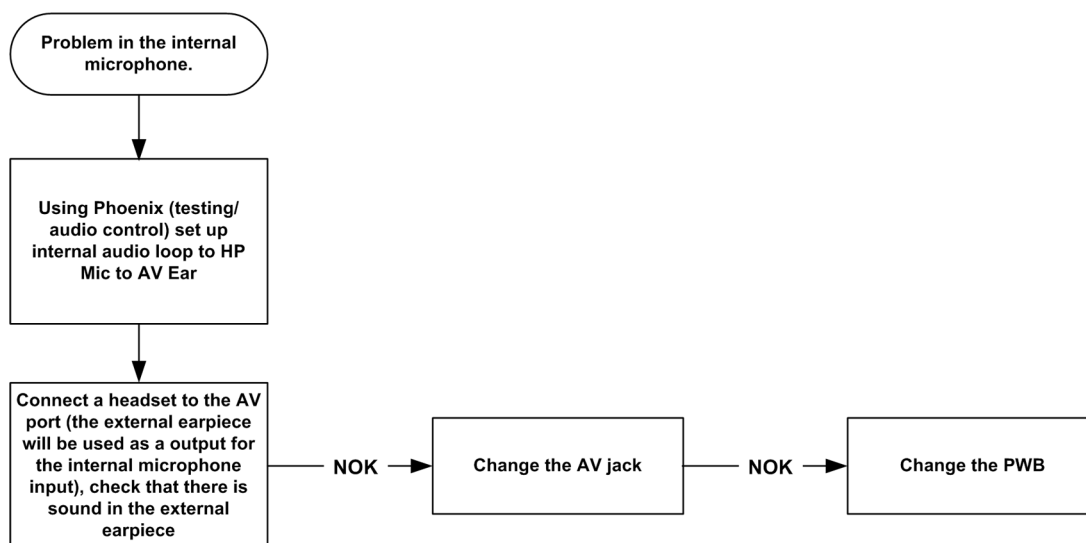
## Internal earpiece troubleshooting

### Troubleshooting flow



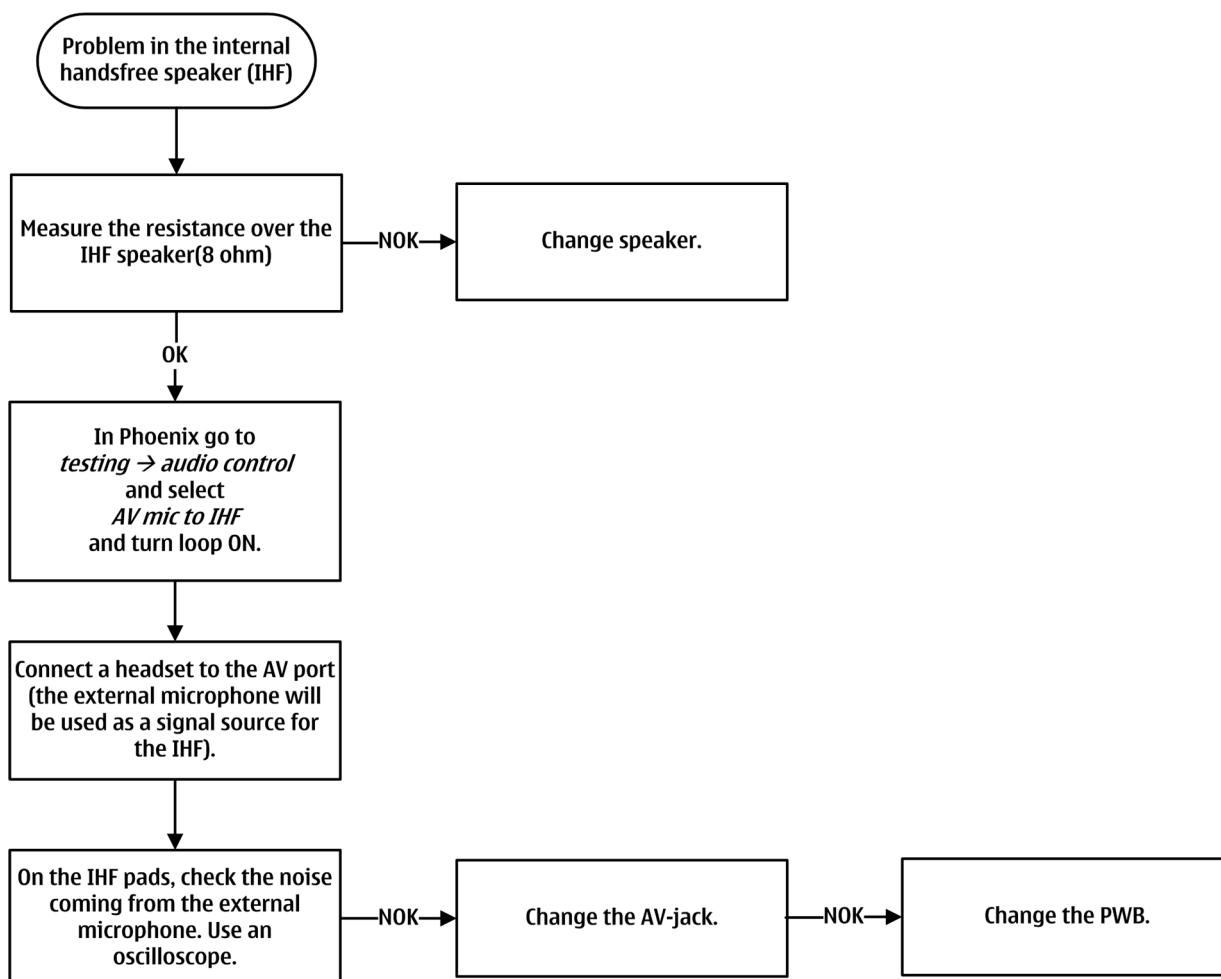
## Internal microphone troubleshooting

### Troubleshooting flow



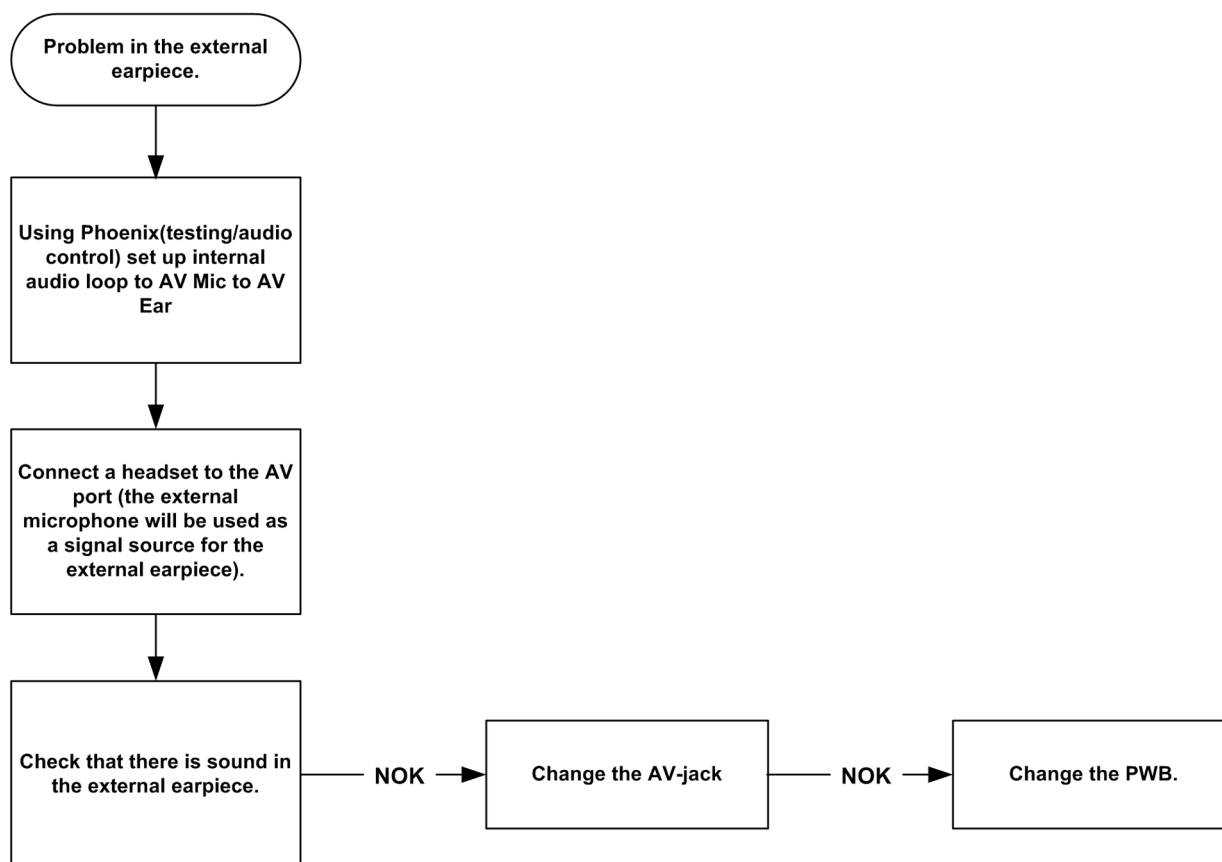
## Internal handsfree (IHF) troubleshooting

### Troubleshooting flow



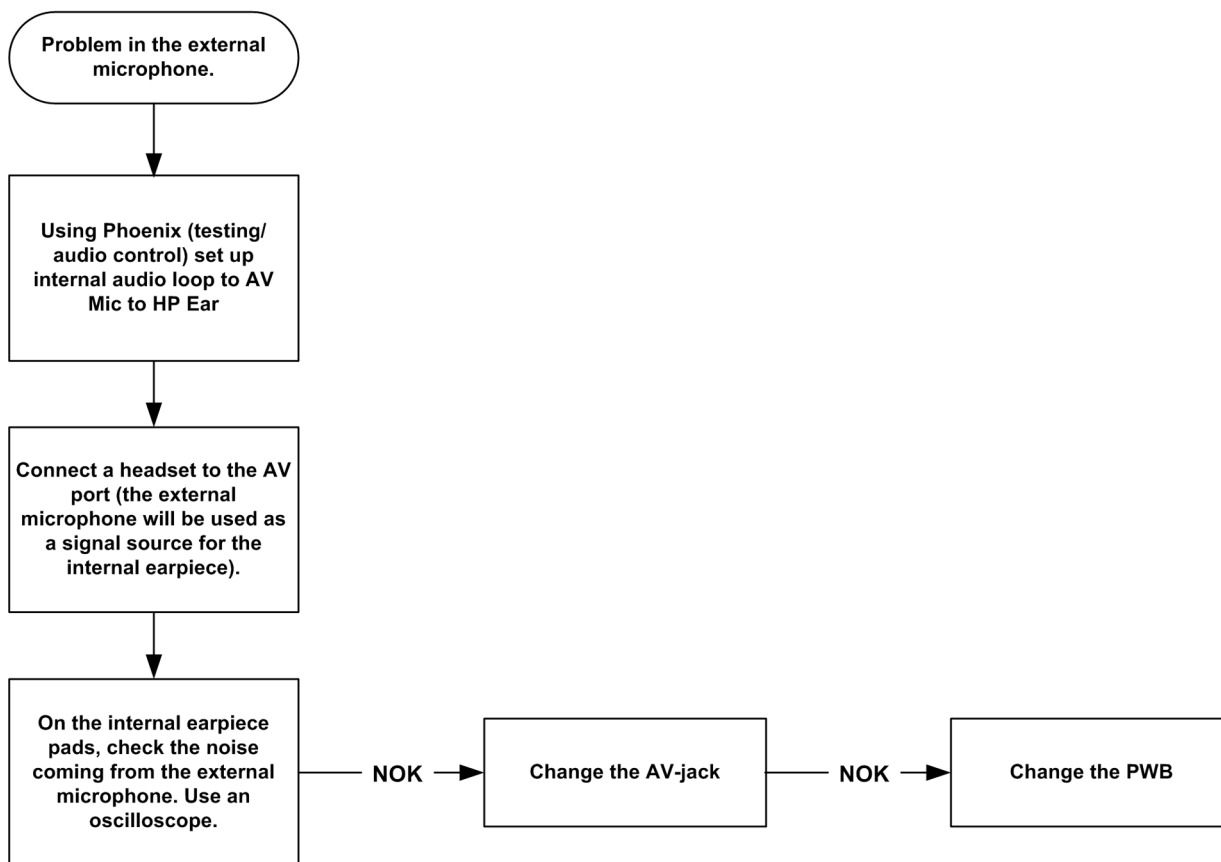
## External earpiece troubleshooting

### Troubleshooting flow



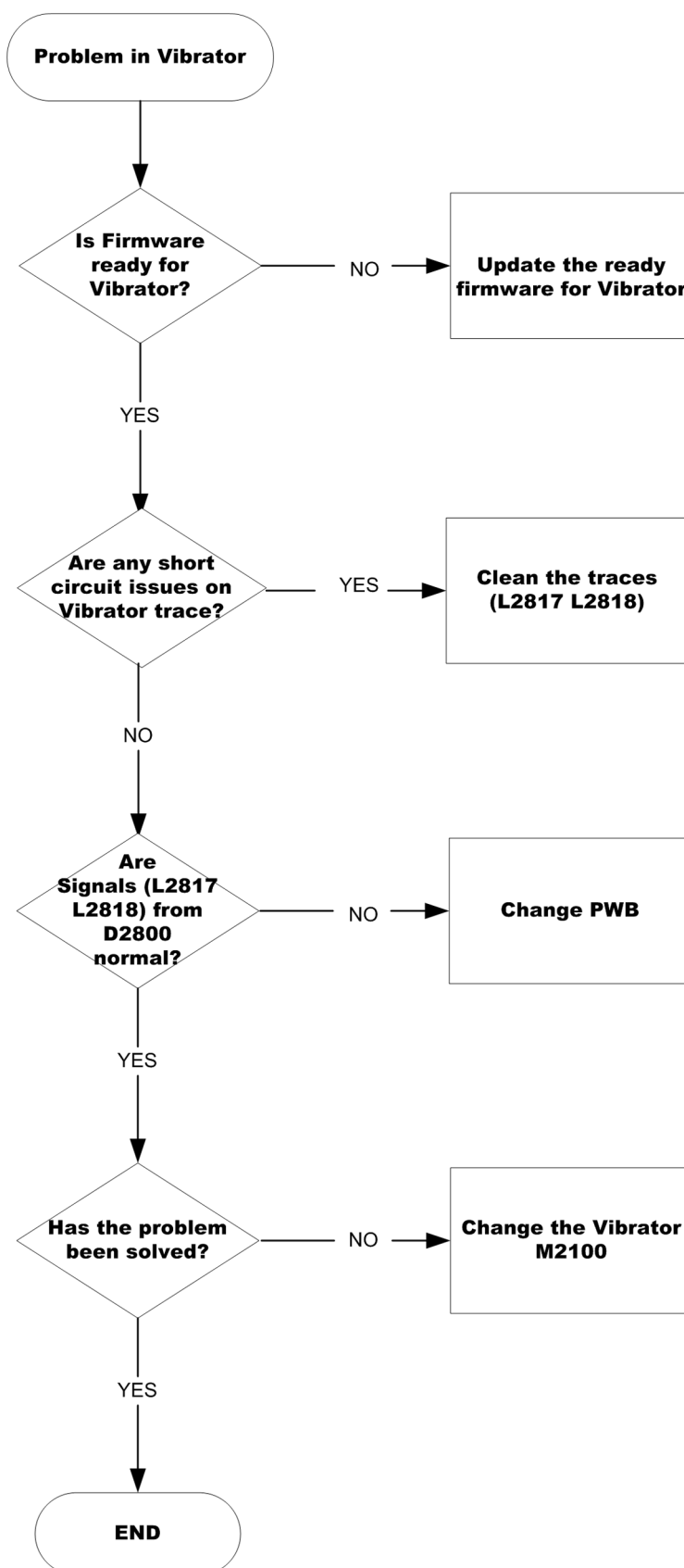
## External microphone troubleshooting

### Troubleshooting flow



## Vibrator troubleshooting

### Troubleshooting flow



## ■ Baseband manual tuning guide

### Certificate restoring

#### Context

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

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

*The procedure for certificate restoring is the following:*

- Flash the phone with the latest available software using FPS-10 and FPS-21.  
**Note:** If the COMBO memory of a phone is replaced, the ENO SW must be flashed first before performing the "normal" firmware flashing.
- Execute the certificate restore process in Phoenix.
- 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 supporting RM-709.
- The latest phone model specific *Phoenix* data package.
- PK-1 dongle
- SX-4 smart card (Enables testing and tuning features)
- Activated FPS-10 OR FPS-21 flash prommer OR External smart card reader
- Latest flash update package for FPS-10 or FPS-21 flash prommers
- CU-4 control unit
- USB cable from PC USB Port to 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.  
**Note:** If the COMBO memory of a phone is replaced, the ENO SW must be flashed first before performing the "normal" firmware flashing.
2. Execute the certificate restore process in *Phoenix*.

#### 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. Connect CU-4 with MJ-299, and place phone to the Module jig MJ-299.
2. Start *Phoenix* service software.
3. Choose **File** → **Scan Product**.
4. Choose **Tuning** → **Energy Management Calibration**.
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 **Tune**.
9. The calibration of the selected item(s) is carried out manually.  
**Note:** Currently *Phoenix* cannot support automatic tuning. The external settings are needed according to pop-up requirement.
10. Click **Calculate**.
11. 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 1 Calibration value limits

Parameter	Min.	Max.
ADC Offset	-	-3
ADC Gain	-	13183
BSI Gain	-	1174
VBAT Offset	-	2515
VBAT Gain	-	21450
IBAT (ICal) Gain	-	10001

12. 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.
13. 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:

- Juno D2800
- Front End Module N7500

#### 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.

Inductors: check for open circuits.

**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:** 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.

**Note:** After the RF shielding can is removed (for measurement or repair), it must be replaced with a new one and cannot be reused.

## RF key components

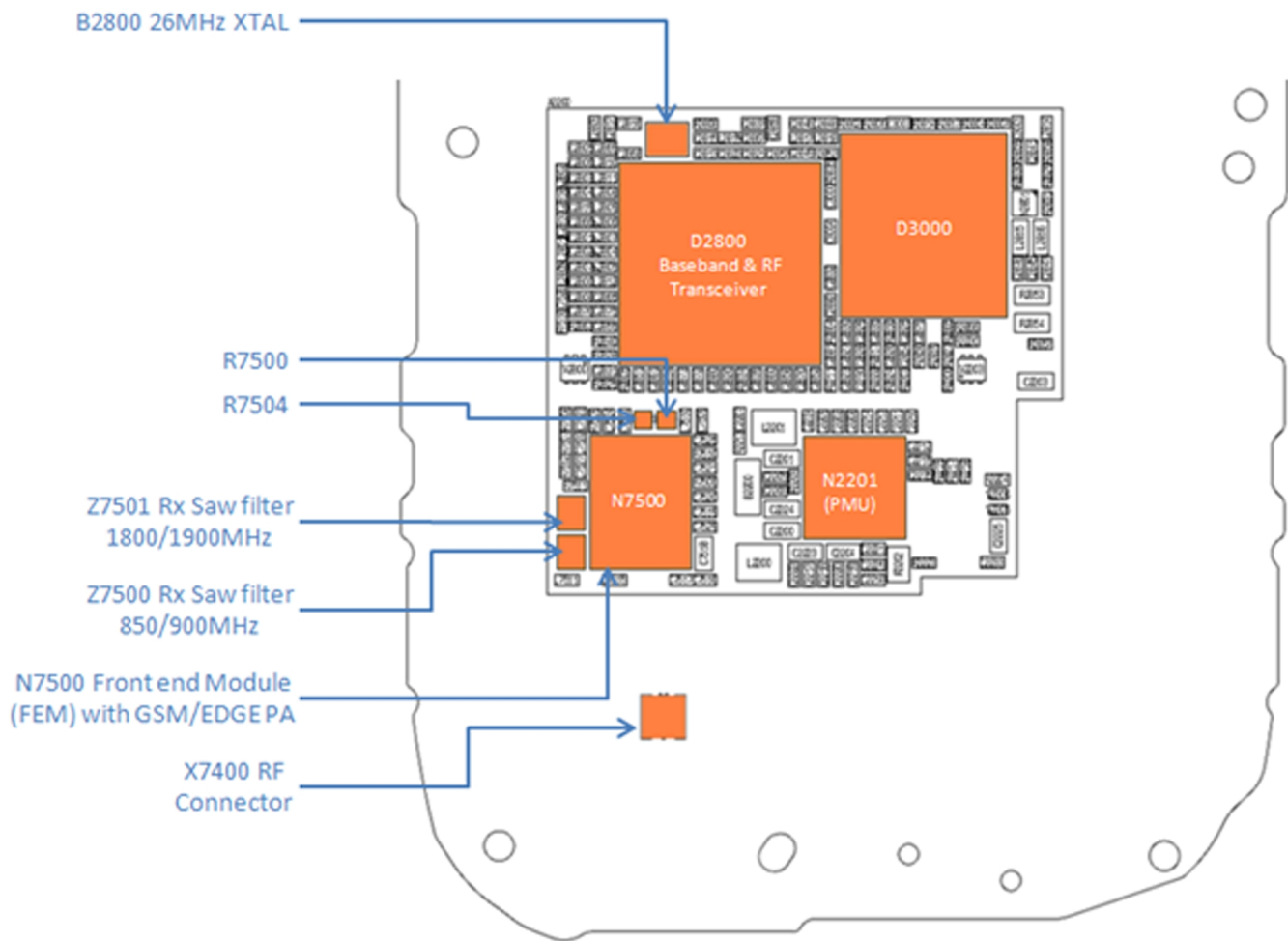


Figure 20 RF key components

### ■ Auto tuning for RF

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: XRS-6 (RF cable), USB cable and GBIP cable
- Signal analyser (TX), signal generator (RX) and RF-splitter *or* one device including all.

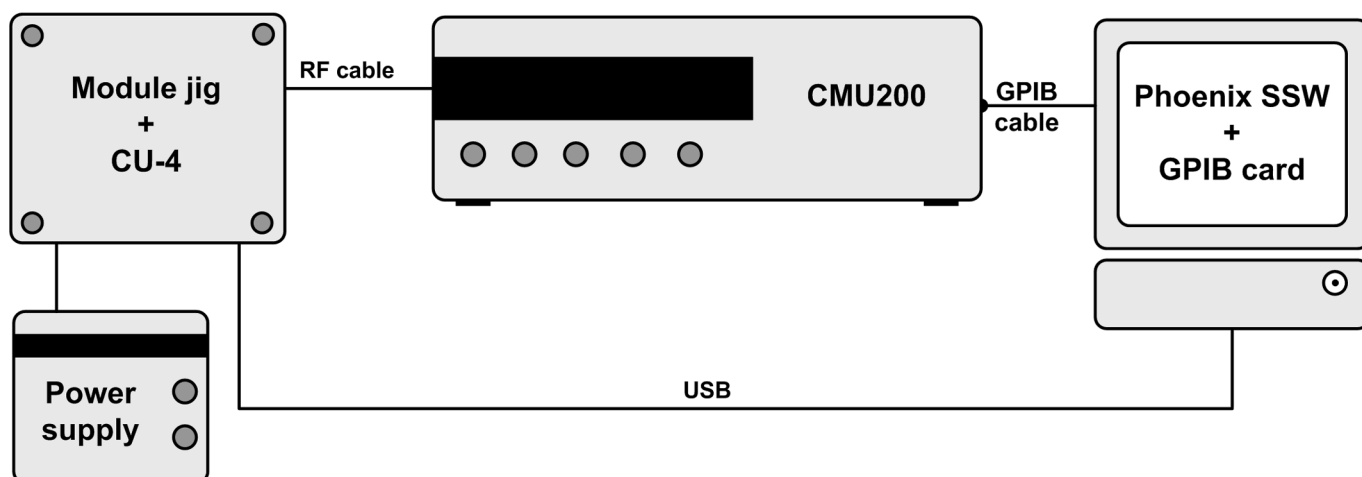


Figure 21 Auto tuning concept with CMU200

**Note:** Crossover Cable connection between computer and CMU200 is recommended (refer to Service devices chapter and Module Jig concepts).

## Phoenix and config file preparations

Install the phone specific data package.

## 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 Start autotuning, clicking the *Tune* button.

## ■ General RF voltage checking

### General voltage checking

#### Steps

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

Table 2 21351/Juno Supplies

#	Signal Name	Test Point	Voltage (All Bands)
1	VDCX0 (INT_VDCX0)	C2813	1.3V (analog supply for DCX0)
2	VRF1 (VRF1_RX, VRF1_PLL, VRF1_TXPLL)	C2817 or C2819 or C2868	1.3V (analog supply for RX, Main PLL, TXPLL)
3	VCORE (VCORE_DSP)	C2822 (L2819)	1.2V (Digital Supply for DSP)
4	VRF2	C2810 or C2866	2.7V (analog supply for RX & PA Driver & LDO)

Table 3 FEM Supplies/Control Signals

#	Signal Name	Test Point	Voltage (All Bands)
1	VBAT (FEM Supply)	C7529	3.7V
2	TX_EN	C7525	1.8V
3	TR_SW_EN	C7521	1.8V
4	MODE	C7522	1.8V
5	BS1	C7523	1.8V
6	BS2	C7524	1.8V

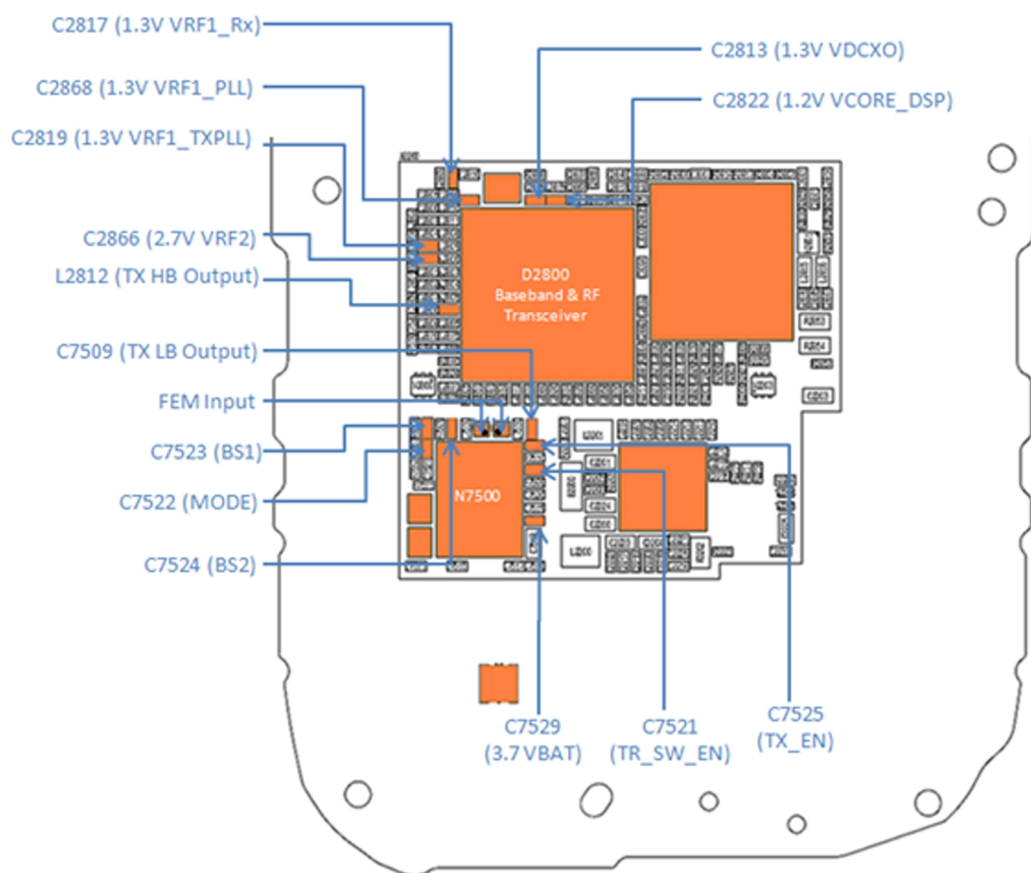


Figure 22 General voltage checking test points (main board, top side)

## FEM Control Signal

When troubleshooting the FEM, it's important to check its' control signal. If the control signal didn't operate correctly, FEM might not turn on or it might turn on in different mode. Table xxx shows the control logic for TX\_EN, BS1, BS1, MODE, and TX\_SW\_EN. Figure xxx shows the timing diagram that one expects when probing these signals.

Table 4 FEM Control Logics

Operational State	TX_EN	BS1	BS2	MODE	TX_SW_EN	Notes
Sleep/standby	0	0	0	0	0	

Operational State	TX_EN	BS1	BS2	MODE	TX_SW_EN	Notes
Low band EDGE	1	0	0	0	0	High Isolation before ramp up
Low band EDGE	1	0	0	0	1	Normal EDGE mode, switch enabled. VRAMP signal sets PA bias condition. Fixed gain PA
Low band GMSK	1	0	0	1	0	High isolation mode before ramp up, saturation correction disabled
Low band GMSK	1	0	0	1	1	Normal GMSK mode, switch enabled, saturation correction disabled. VRAMP signal controls output power.
Low band GMSK	1	0	1	1	0	High isolation mode before ramp up, saturation correction enabled.

Operational State	TX_EN	BS1	BS2	MODE	TX_SW_EN	Notes
Low band GMSK	1	0	1	1	1	Normal GMSK mode, switch enabled, saturation correction enabled. VRAMP signal controls output power.
High band EDGE	1	1	0	0	0	High Isolation before ramp up
High band EDGE	1	1	0	0	1	Normal EDGE mode, switch enabled. VRAMP signal sets PA bias condition. Fixed gain PA
High band GMSK	1	1	0	1	0	High isolation mode before ramp up, saturation correction disabled
High band GMSK	1	1	0	1	1	Normal GMSK mode, switch enabled, saturation correction disabled. VRAMP signal controls output power.

Operational State	TX_EN	BS1	BS2	MODE	TX_SW_EN	Notes
High band GMSK	1	1	1	1	0	High isolation mode before ramp up, saturation correction enabled
High band GMSK	1	1	1	1	1	Normal GMSK mode, switch enabled, saturation correction enabled. VRAMP signal controls output power.
RX1 Path Enabled	0	0	0	1	0	May be used for high or low band receive
RX2 Path Enabled	0	0	1	1	0	May be used for high or low band receive
RX3 Path Enabled	0	1	1	1	0	May be used for high or low band receive
RX4 Path Enabled	0	1	0	1	0	May be used for high or low band receive

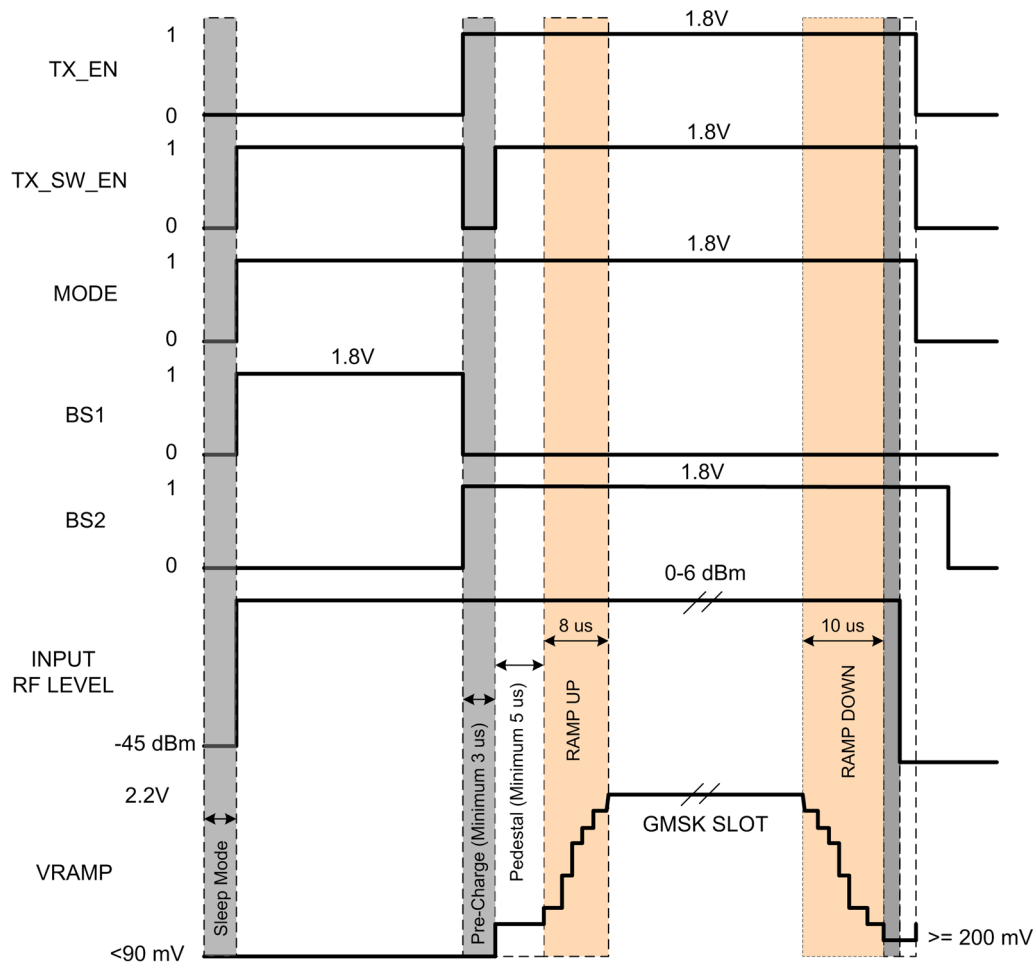


Figure 23 GMSK Control Signal in time domain

## ■ 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 the GSM RSSI reading. This test measures the signal strength of the receive signal.

## RF Test Points in RX Troubleshooting

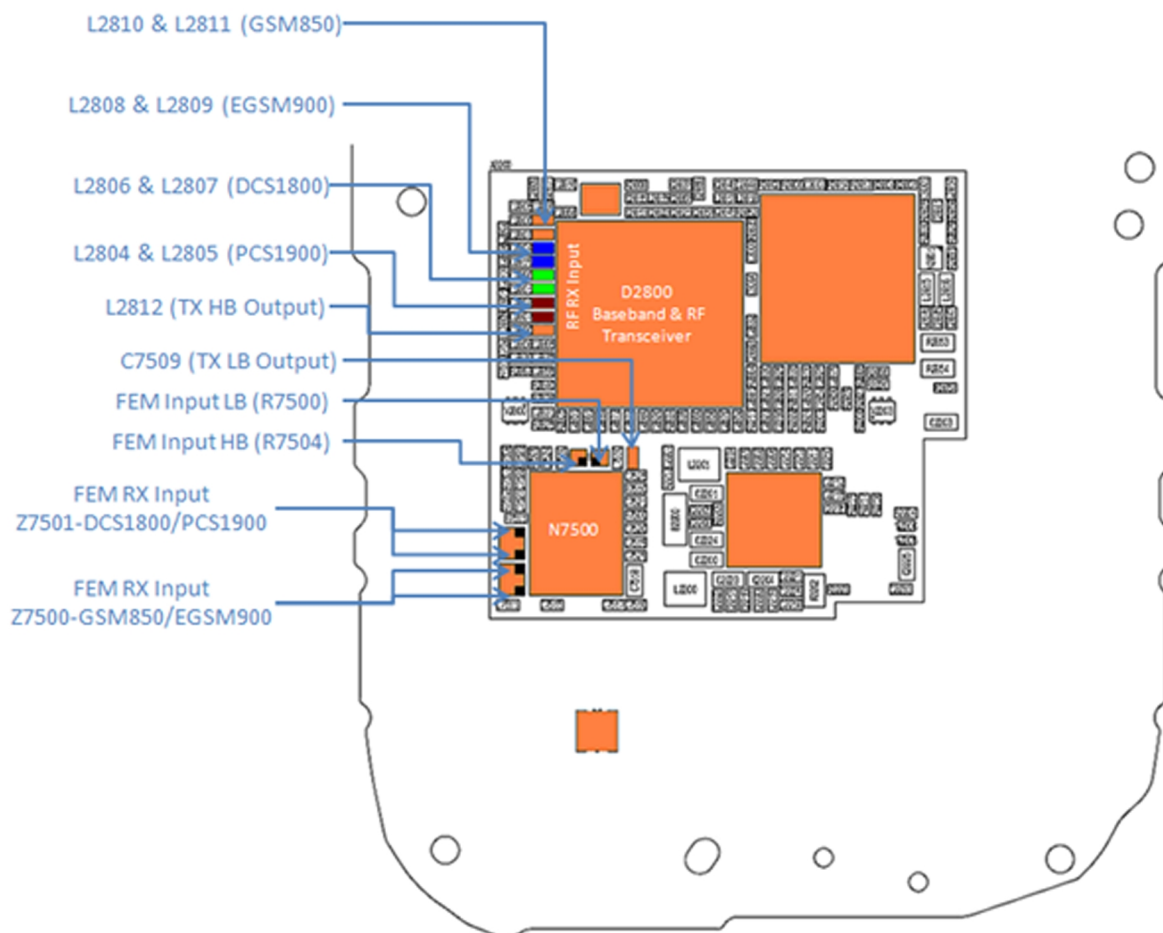


Figure 24 RF transmitter & receiver test points

## GSM RX chain activation for manual measurements/GSM RSSI measurement

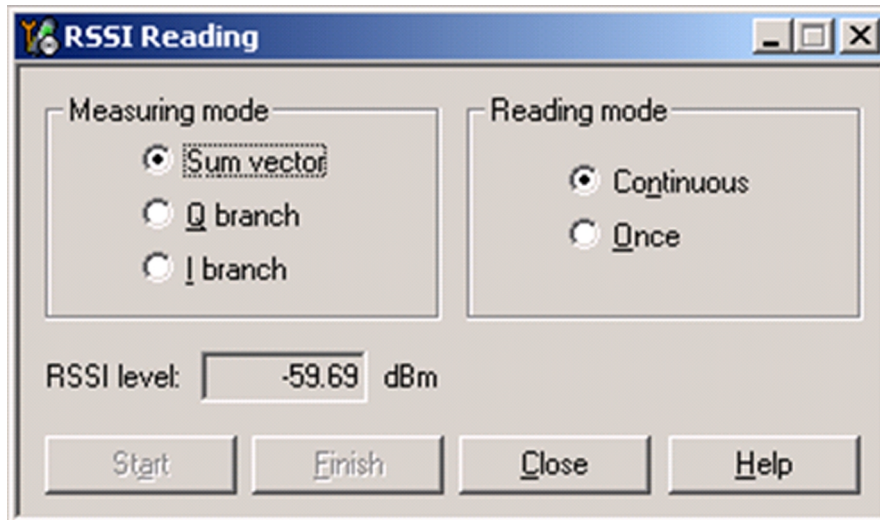
### Prerequisites

Make the following settings in Phoenix service software:

Setting	GSM850	GSM900	GSM1800	GSM1900
Phoenix Channel	190	37	700	661
Signal generator to antenna connector	881.66771 MHz (67.71 kHz offset) at -60 dBm	942.46771 MHz (67.71kHz offset) at -60dBm	1842.86771 MHz (67.71kHz offset) at -60dBm	1960.046771 MHz (67.71 kHz) at -60 dBm

### Steps

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



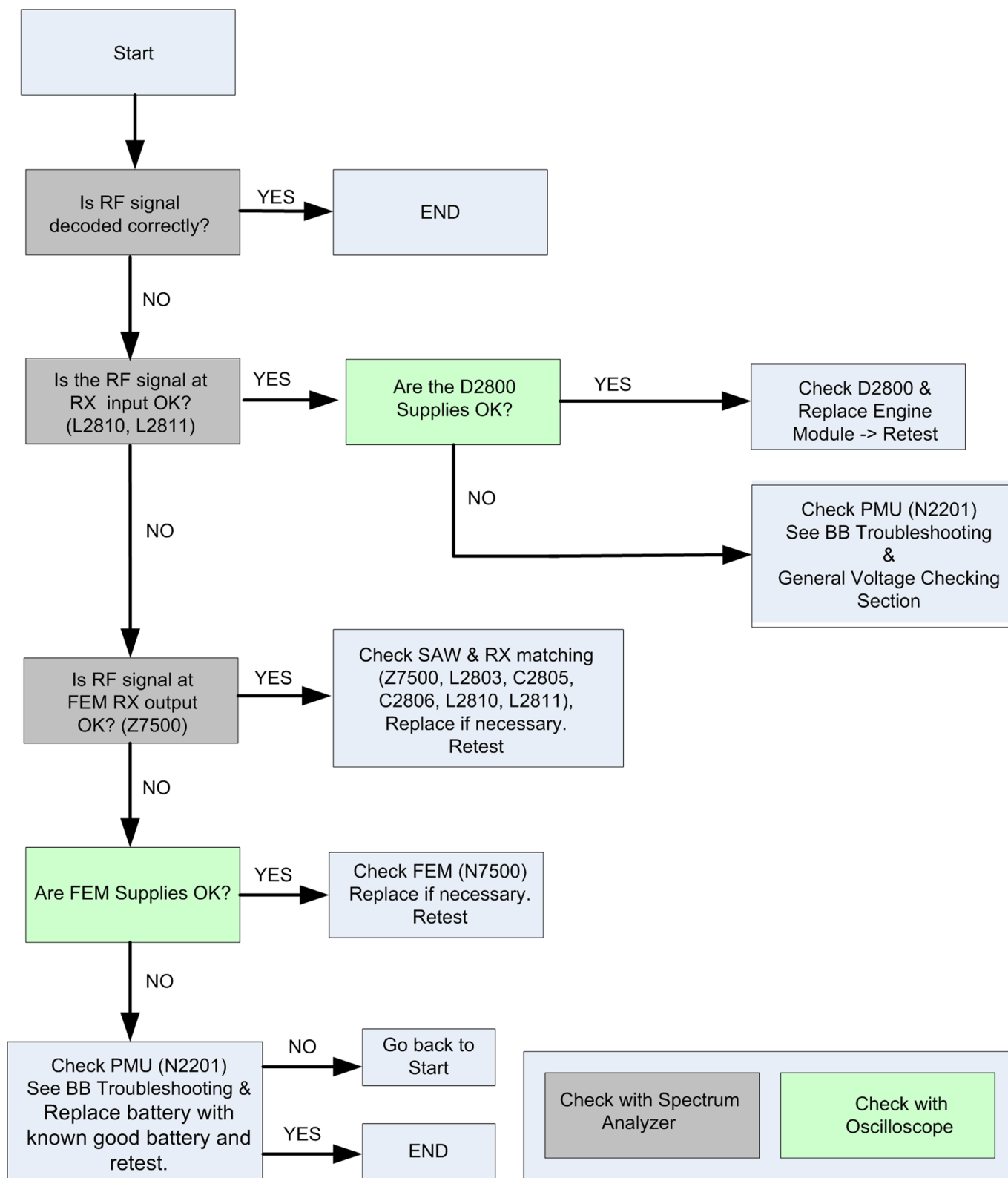
## Results

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.

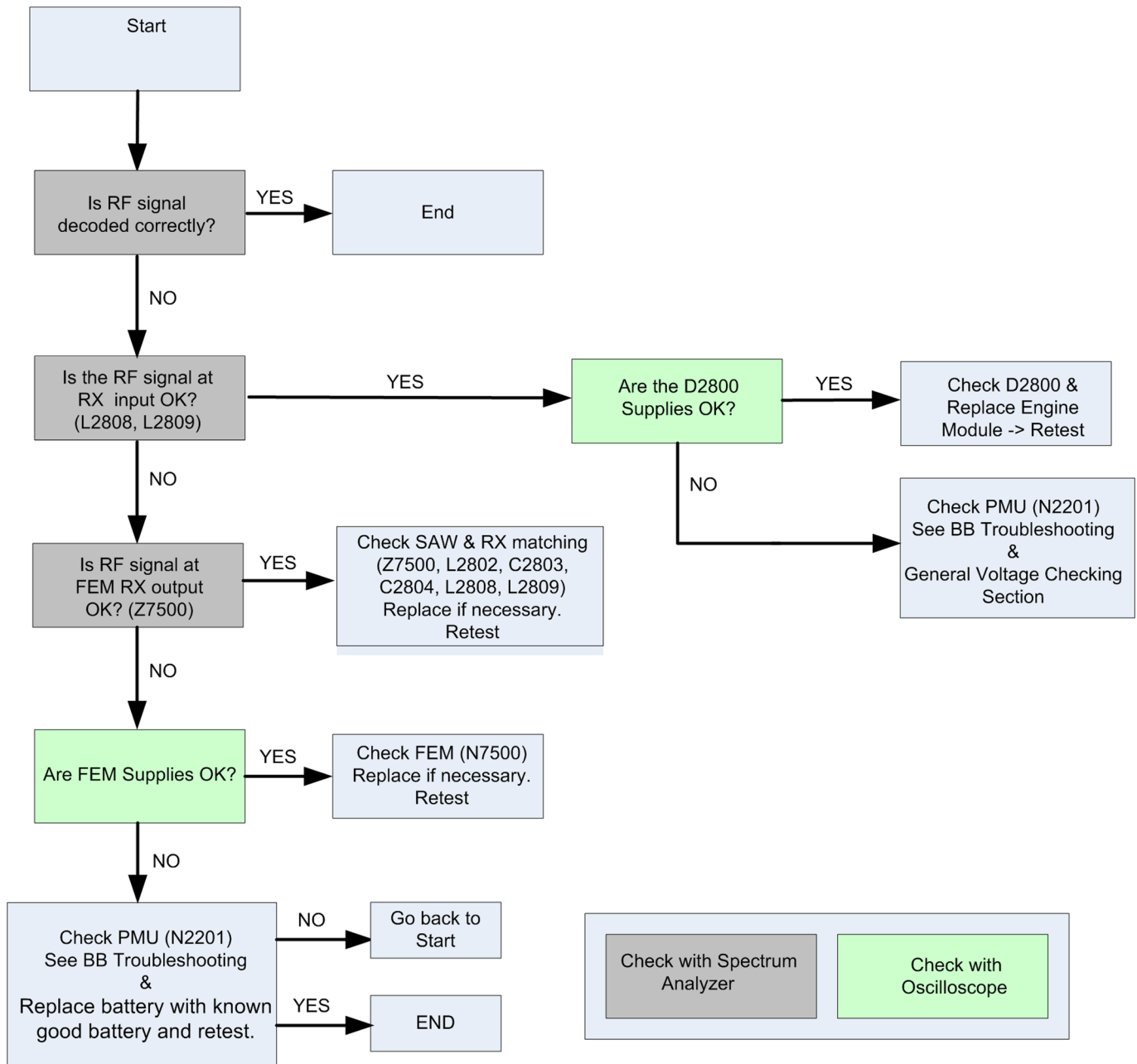
## RX troubleshooting for GSM850

### Troubleshooting flow



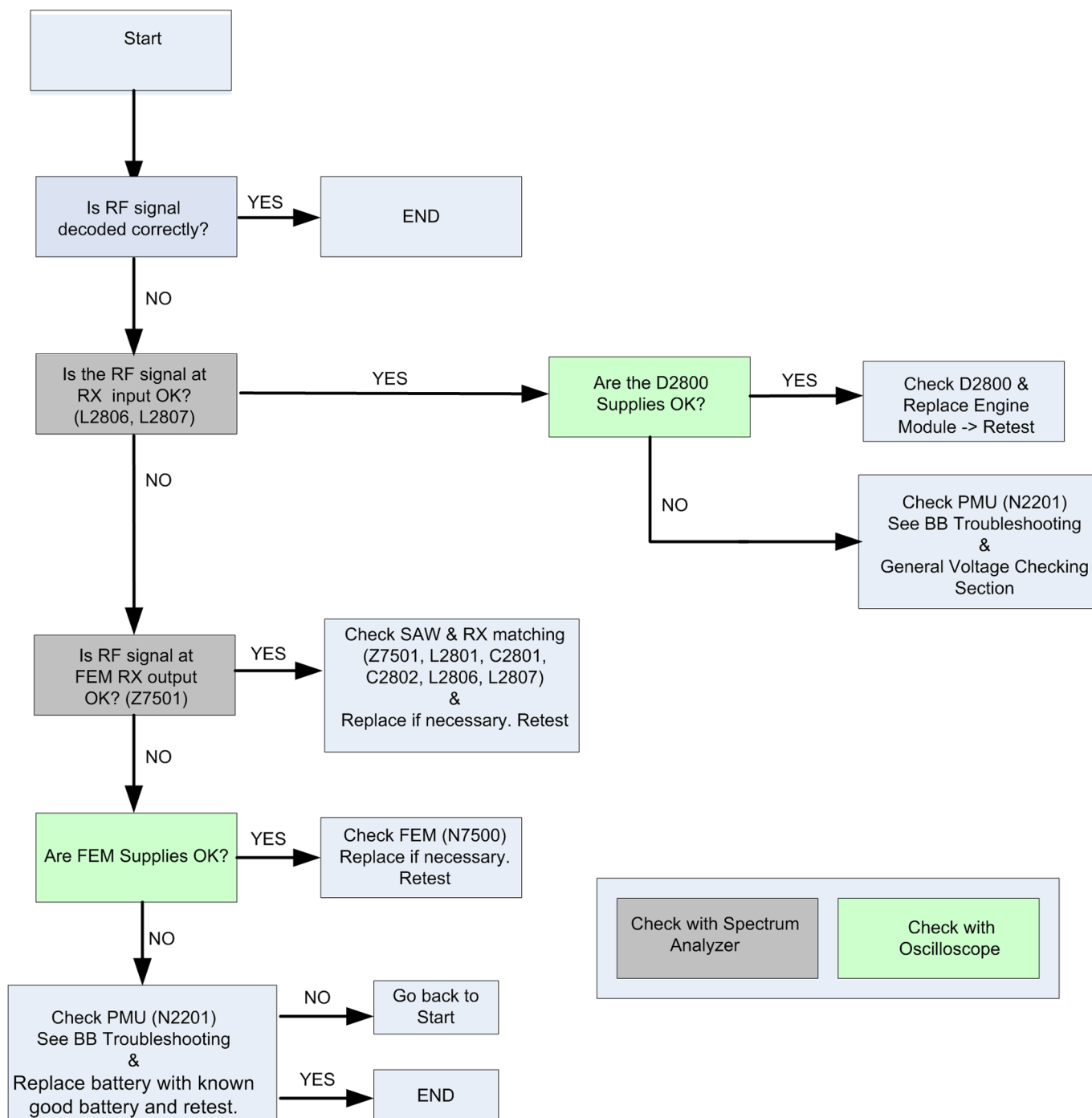
## RX troubleshooting for GSM900

### Troubleshooting flow



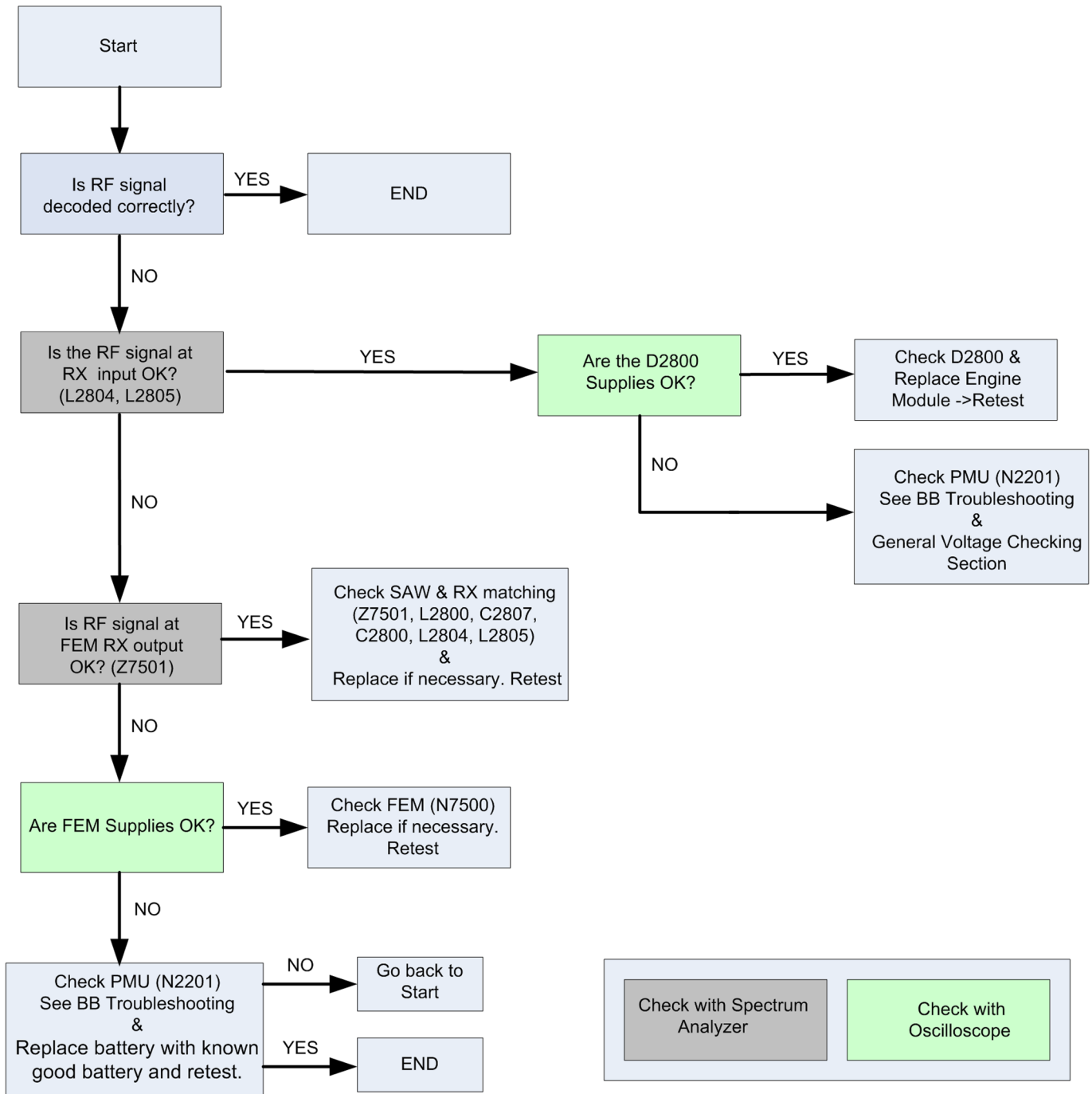
## RX troubleshooting for GSM1800

### Troubleshooting flow



## RX troubleshooting for GSM1900

### Troubleshooting flow



## Transmitter troubleshooting

### Introduction to 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".
- Remember that re-tuning is not a fix! Phones are tuned correctly in production

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

## RF Test Points in TX Troubleshooting

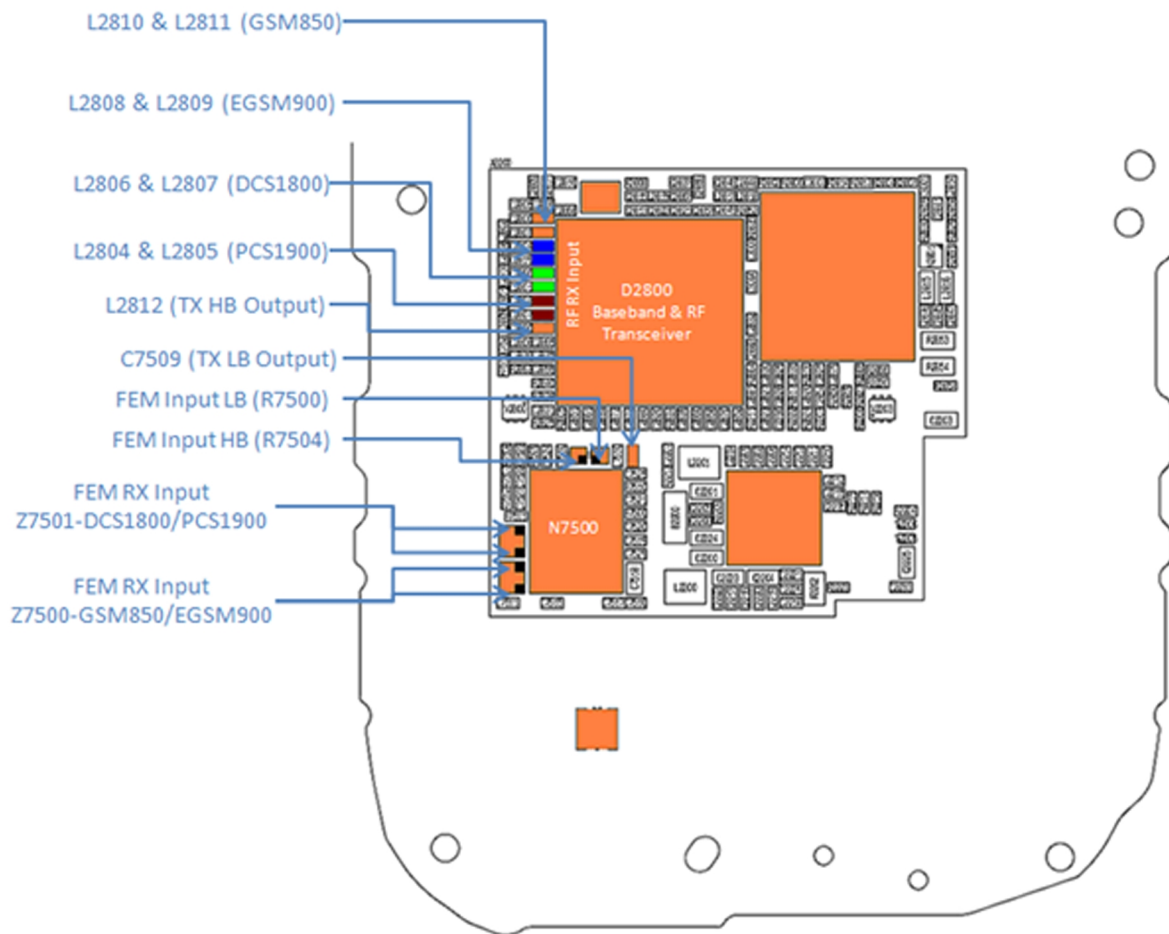


Figure 25 RF transmitter & receiver test points

## RF Transmitter Self-test

### Context

The purpose of RF PA self-test for the phone is to verify the interconnections between RFPA and BCM21351 ASIC.

The self-test will run a series of TX bursts and measure associated Vdet based on different permutations of the TX control signals. When test is complete it will return either a PASS or FAIL and error report. The signals including in the coverage can be found in Table 1.

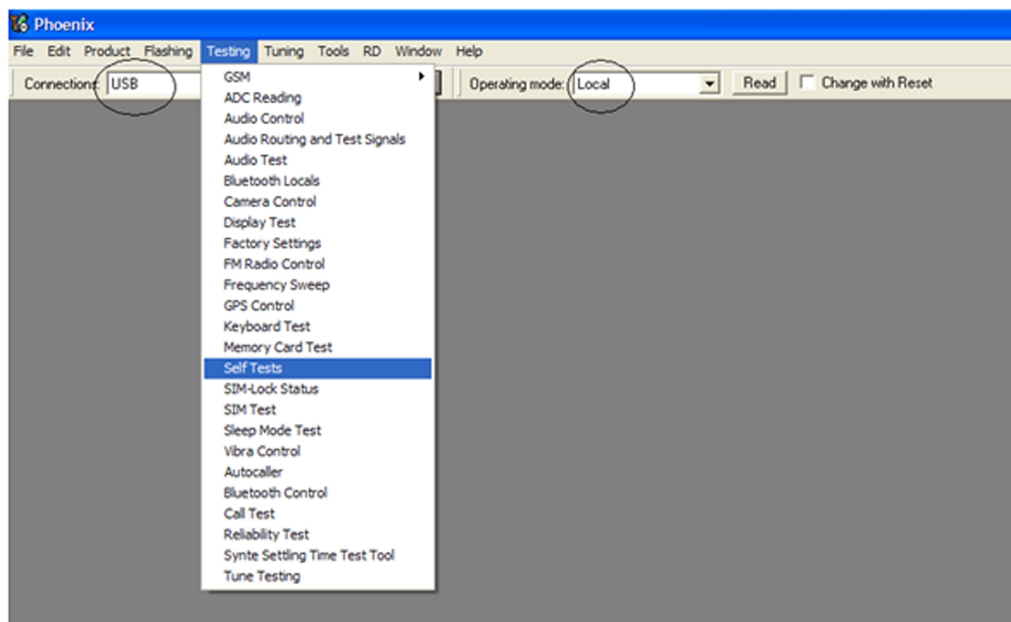
**Table 5 Signals Coverage in RFPA Self-test Option**

RFPA Signal Name	Pin Description	Self-Test Coverage
TX_EN	Power Amp Enable	YES
VRAMP	Analog PA Bias/Output Power Control	YES
TR_SW_EN	Transmit/Receive Switch	YES
BS1, BS2	Band Select (Cell, EGSM vs. DCS, PCS)	YES
MODE	Edge vs. GMSK	YES
VDET	Log Detect output Voltage	YES
TX1	RF Input (CEL & EGSM Bands)	YES
TX2	RF Input (DCS & PCS Bands)	YES

**Note:** In order to make a phone call, power cycle the phone is needed after executing *ST\_CHIPSET\_API\_RFPA\_TEST*

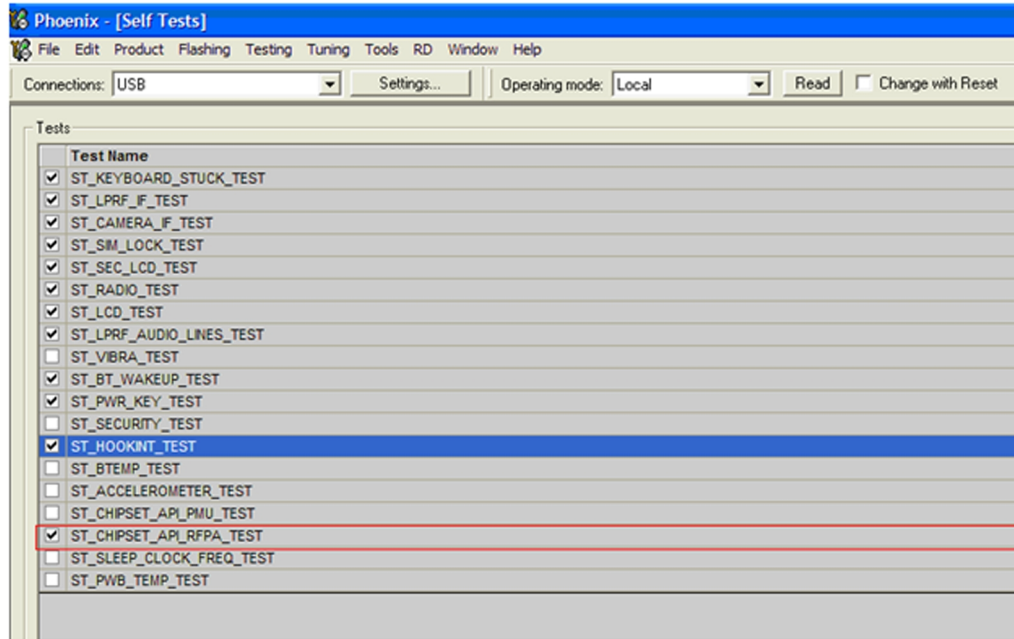
## Steps

1. From Phoenix software menu, select **Testing** → **Self Tests** .



**Note:** Make sure that Connection set to USB and Operating mode set to Local

2. The Self Tests window will pop up as shown below. To run RF Self Test only, check *ST\_CHIPSET\_API\_RFPA\_TEST* and uncheck all other Test Name.



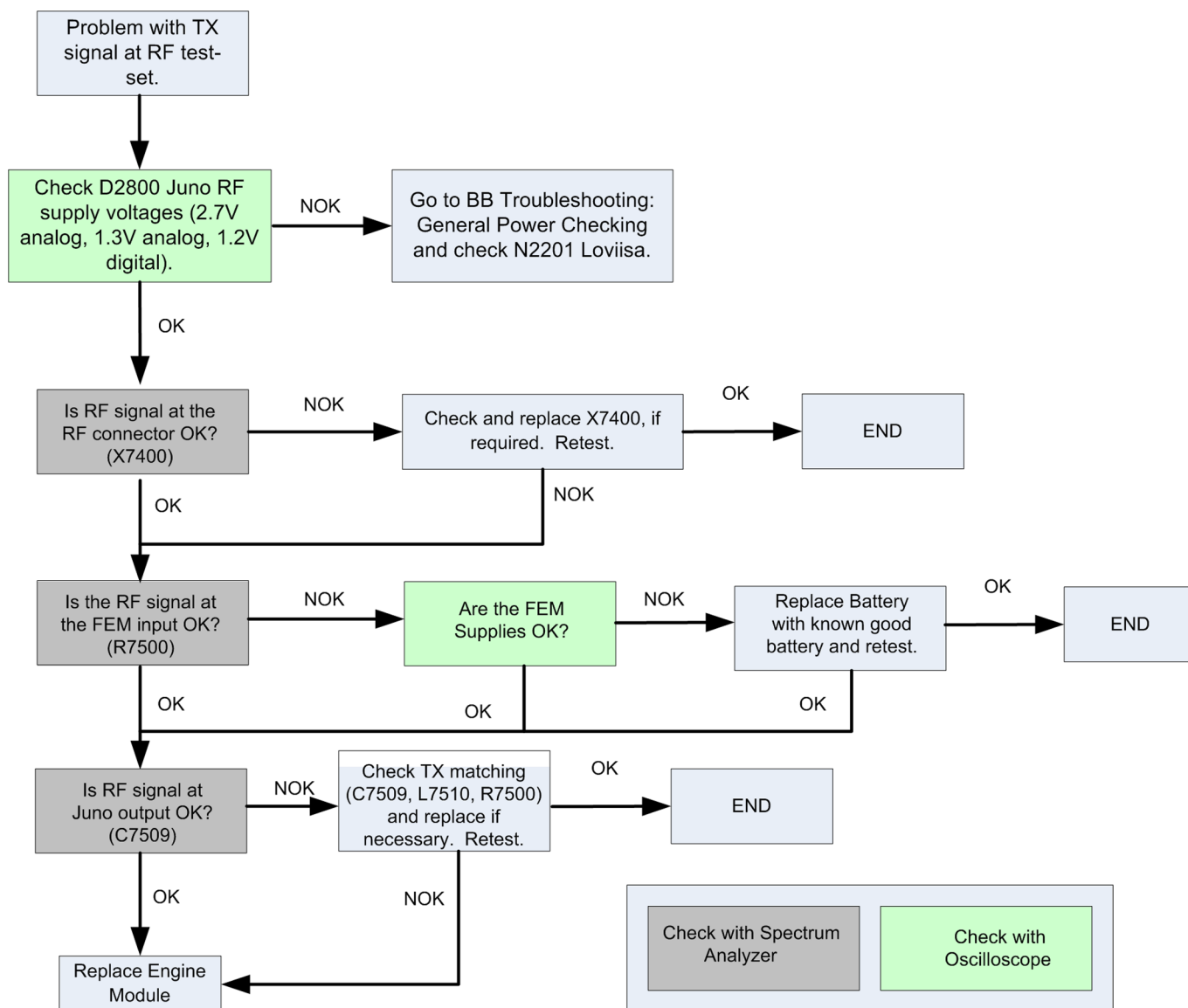
3. Click on **START** button to execute *ST\_CHIPSET\_API\_RFPA\_TEST*.  
If the Results column shows "**Pass**", it means all paths from BB/RF IC chips to Front-end module are continuity without any unconnected path.  
If the Results column shows "**Fail**", follow the Troubleshooting flowchart.



<b>Startup Test</b>	<b>Result</b>	<b>Detailed</b>
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	Passed [0]	
No	RUNNING...	
No	Passed [0]	
No	Passed [0]	

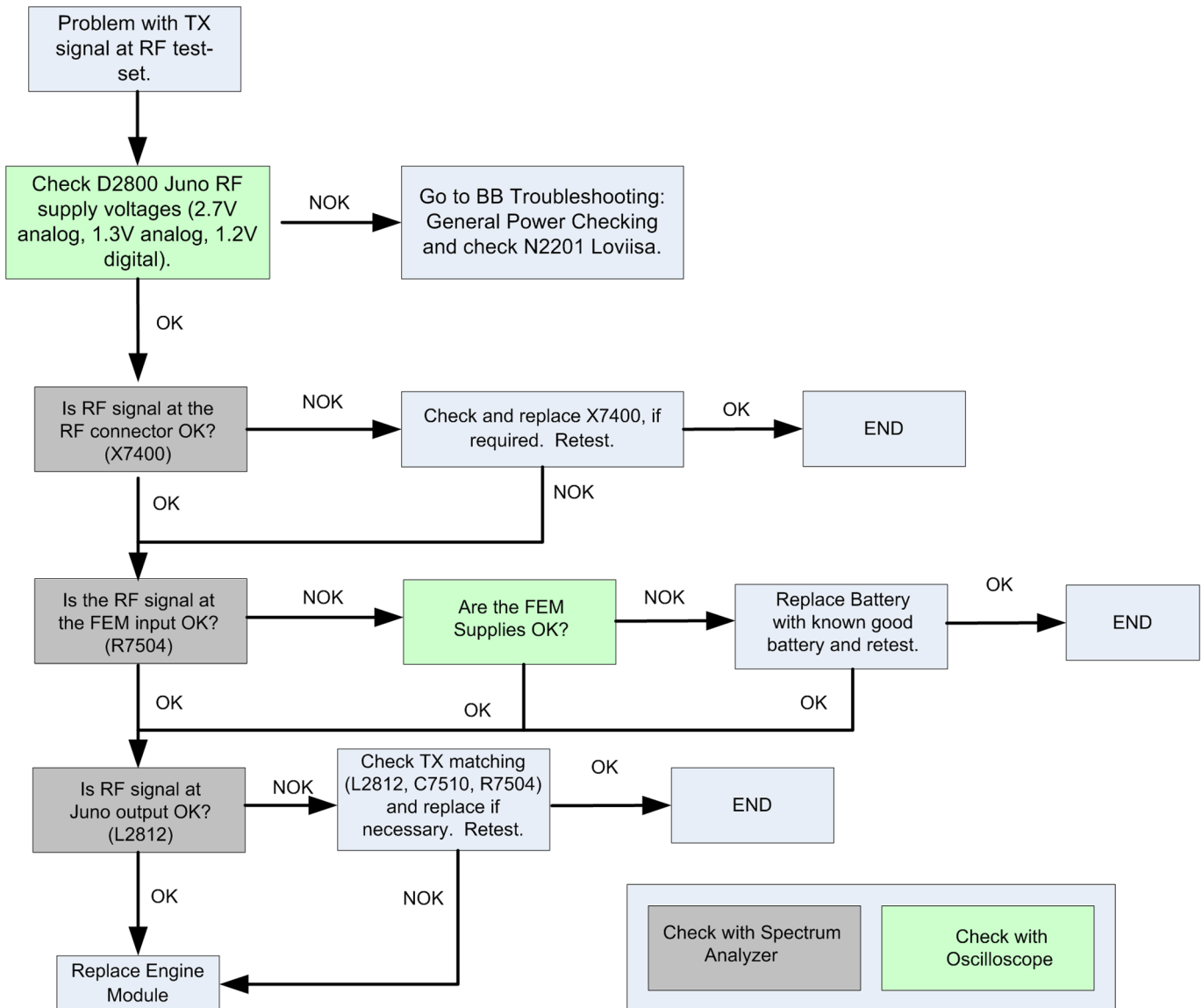
## TX troubleshooting for GSM850/900

### Troubleshooting flow



## TX troubleshooting for DCS1800/PCS1800

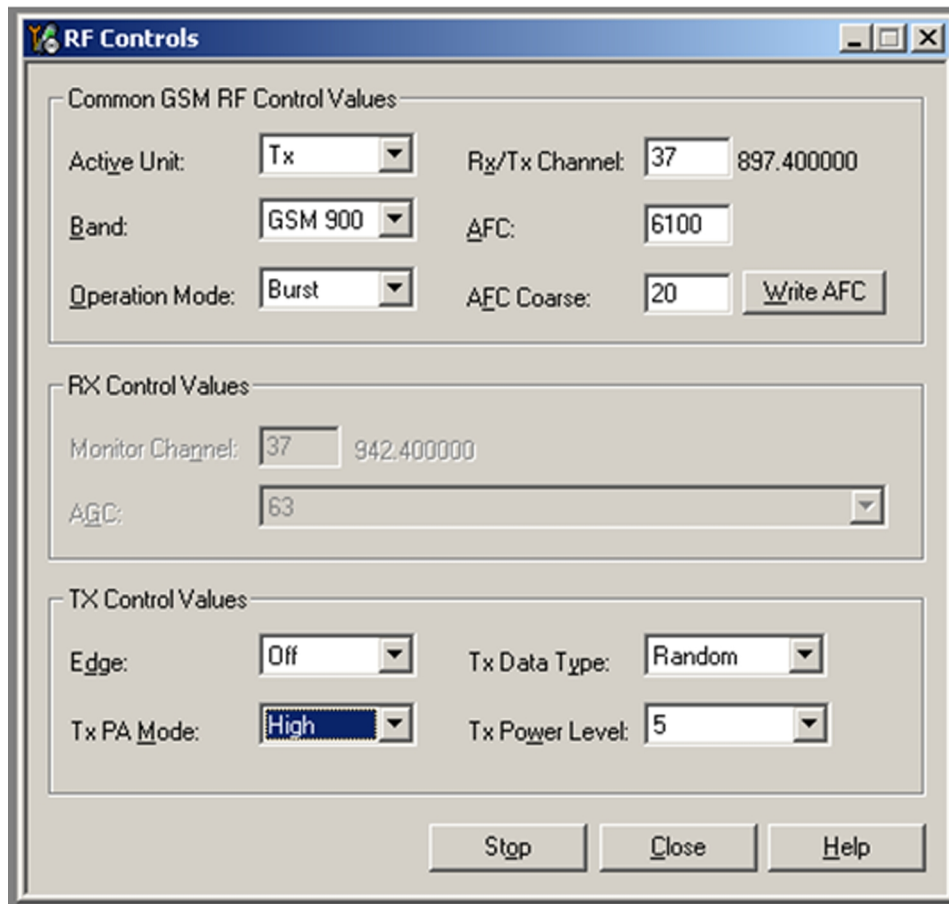
### Troubleshooting flow



## GSM transmitter troubleshooting

### Steps

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



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

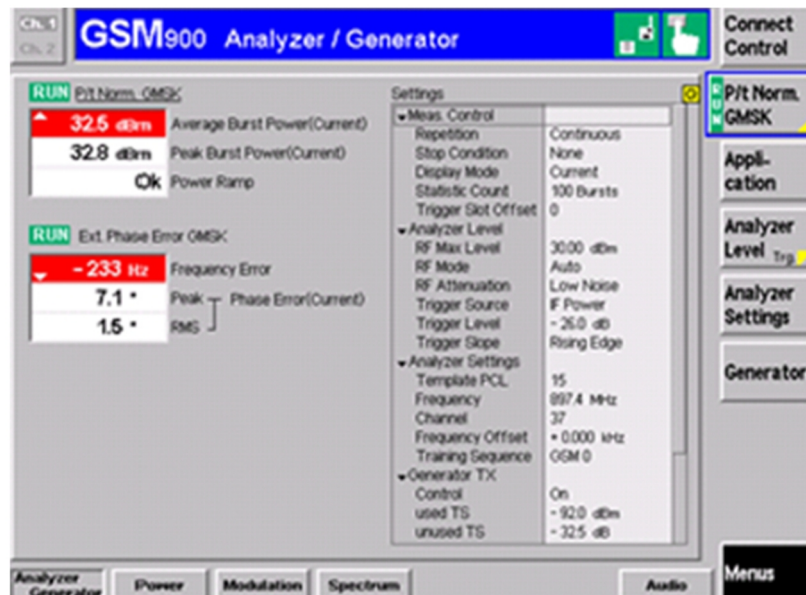


Figure 26 Analyzer setting

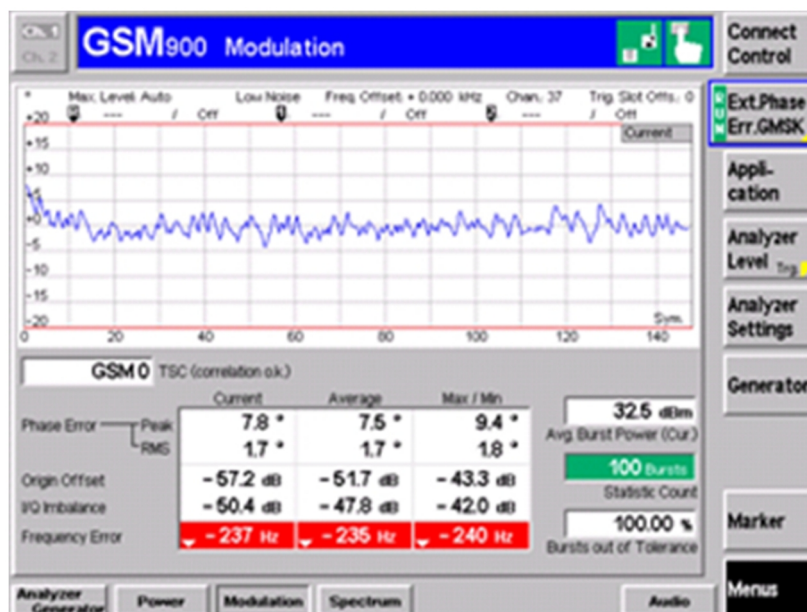


Figure 27 Phase error

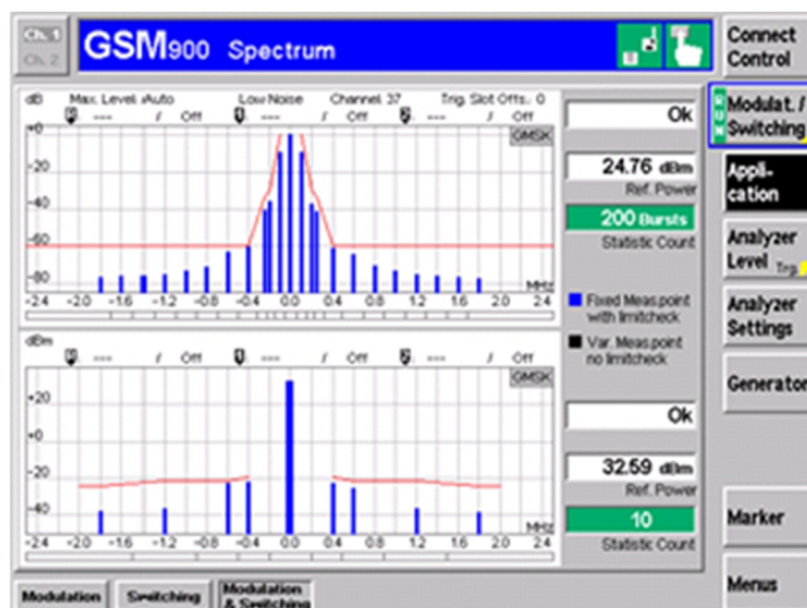


Figure 28 Modulation/Switching spectrum

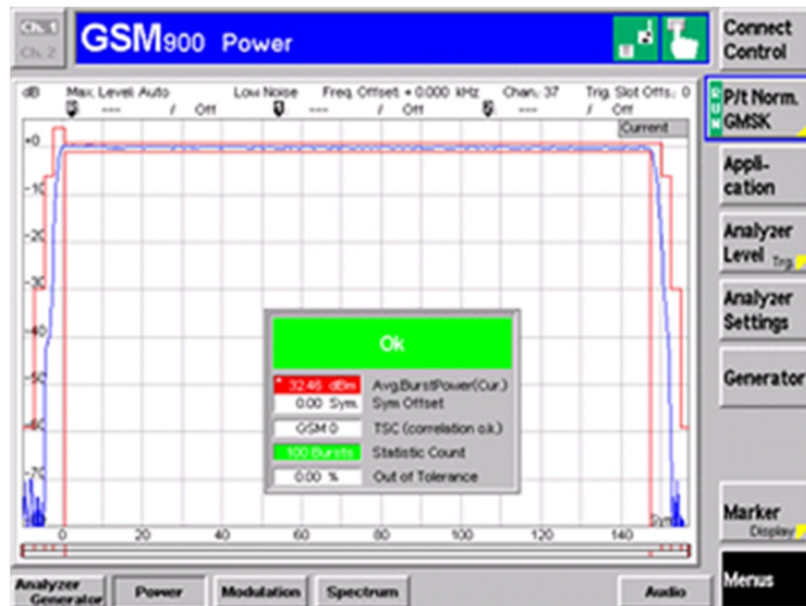


Figure 29 Power/Burst



Figure 30 Edge

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

## Next actions

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

## Bluetooth and FM radio troubleshooting

### Introduction

The Bluetooth and FM radio receiver and transmitter are combined in the same ASIC, so these features are all checked when troubleshooting (if supported). If the phone does not support the FM transmitter feature there will be no FM TX discrete components or antenna.

## Component Placement

The placement of Bluetooth and FM components and test probe points is shown below.

The Bluetooth antenna is product specific (PWB track, SMD antenna, clip on antenna, or antenna integrated into phone covers) and is typically located near the side of the PWB.

The FM receiver RF signal is routed through a product specific FM antenna matching circuit to the phone headset connector. Typically, the FM receiver antenna matching circuit is located near to the phone headset connector. The FM receiver audio signal is routed to the headset connector through the BB ASIC shared by the phone audio functions.

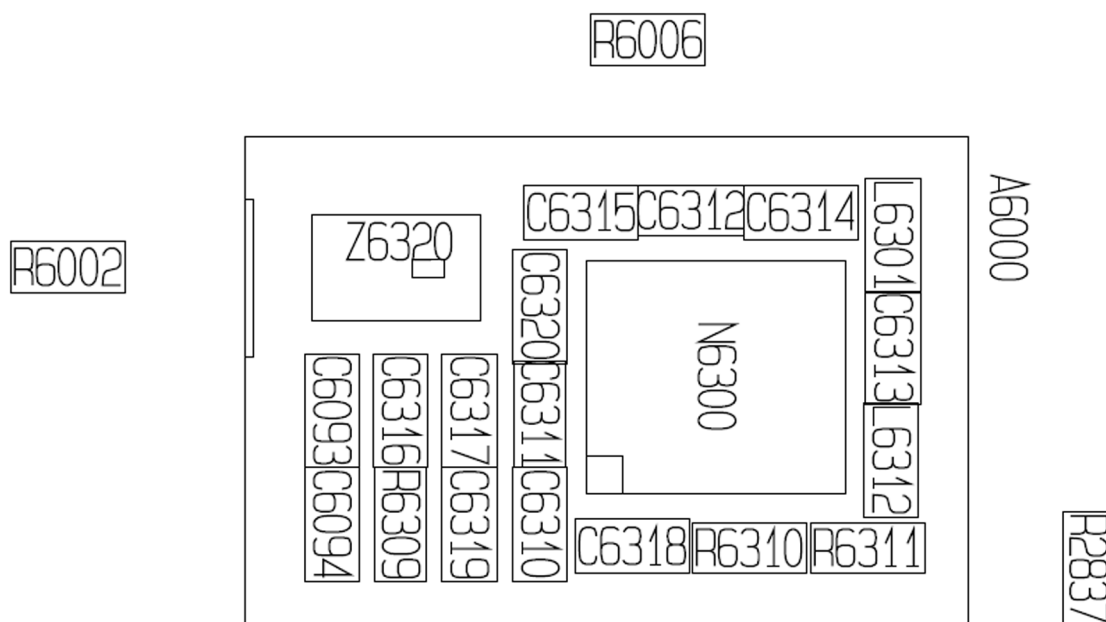


Figure 31 Test points in Bluetooth-FM ASIC circuit – BTHFMTXRD53.0b (TI BL6450)

## Symptom, Problem and Repair Solution

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

Symptom	Problem	Repair Solution
Unable to switch on Bluetooth on phone user interface	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs or SMD components.	Replacement of Bluetooth/FM ASIC/module
Able to send data file to another Bluetooth device, but unable to hear audio through functional Bluetooth headset	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs (PCM interface).	Replacement of Bluetooth/FM ASIC/module
Able to turn switch on Bluetooth on phone user interface, but unable to detect other Bluetooth devices	Open circuit solder joints or detached component in Bluetooth antenna circuit.	Repair of Bluetooth antenna circuit

Symptom	Problem	Repair Solution
Problems connecting to specific manufacturer/model Bluetooth accessory (specific Bluetooth profile supported by phone and accessory in product specification)	Possible interoperability issue with accessory fixed in recent Nokia phone software release (check Nokia Service Bulletin for latest information)	Update phone software to latest version if advised in Nokia Service Bulletin.  Note: The phone Bluetooth Address and software version are displayed by pressing *#2820# when Bluetooth is on.
Able to turn on FM radio and Bluetooth on phone user interface, but unable to detect local FM radio stations with FM headset inserted	Open circuit solder joints or detached component in FM receiver antenna circuit.	Repair of FM receiver antenna circuit
Able to perform scans to detect local FM radio stations with functional FM headset inserted, but unable to hear FM audio through headset.	Open circuit solder joints or detached component in FM receiver audio path between Bluetooth/FM ASIC and headset.	Repair of FM audio circuit

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

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

## Test Coverage

The tests listed in the table below should be performed to verify whether the Bluetooth and FM receiver and transmitter are functional.

As Bluetooth and FM receiver and transmitter share the same ASIC, all of these functions should be re-tested after repair to the Bluetooth-FM circuit (if supported by the phone).

Test	Test Coverage	Repair solution
Bluetooth Self Test: ST_LPRF_IF_TEST	Bluetooth-FM ASIC UART interface (controls Bluetooth and FM receiver and transmitter)	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Self Test: ST_BT_WAKEUP_TEST	Bluetooth ASIC interrupt control interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Self Test: ST_LPRF_AUDIO_LINES_TEST	Bluetooth ASIC PCM interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Functional Test: BER test with BT-Box or functional test with other Bluetooth device	Bluetooth antenna circuit	Repair of Bluetooth antenna circuit (including RF filter or WLAN switch if fitted)

Test	Test Coverage	Repair solution
FM Radio Functional Test: Perform scan for local radio stations and check station list displayed on phone	FM receiver antenna circuit	Repair of FM antenna circuit (between BTHFM ASIC and headset connector)
FM Radio Functional Test: Listen to local radio station	FM receiver audio circuit	Repair of FM receiver audio circuit (between BTHFM ASIC and headset connector)

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

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

If radio reception is poor inside the service centre buildings, the FM receiver can be tested using another FM transmitter device connected to a music player.

If the BTHFM ASIC, FM TX antenna or components between the ASIC and antenna have been replaced the FM transmitter alignment must be performed to ensure that the output complies with ETSI / FCC legal limits.

## Test Procedure

### Bluetooth Self Tests

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

Steps:

- 1 Place the phone in the flash adapter or connect data cable to phone.
- 2 Start Phoenix service software.
- 3 Choose File → Scan Product.
- 4 From the Mode drop-down menu, set to Local.
- 5 Choose Testing → Self Tests.
- 6 In the Self Tests window check the following Bluetooth tests:
  - ST\_LPRF\_IF\_TEST
  - ST\_LPRF\_AUDIO\_LINES\_TEST
  - ST\_BT\_WAKEUP\_TEST
- 7 To run the test, click Start.

### FM Receiver Self Tests

The self test ST\_FM\_RADIO\_TEST used on previous phone designs is not available. As Bluetooth and FM radio share the same control interfaces, FM radio control interfaces are tested using the Bluetooth Self Tests.

### Bluetooth BER Test

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

Steps:

- 1 Place the phone in the flash adapter or connect data cable to phone.
- 2 Start Phoenix service software.
- 3 Choose File → Scan Product.

- 4 Choose Testing → Bluetooth LOCALS
- 5 Locate the BT-box serial number (12 digits) found in the type label on the back of the SB-6 Bluetooth test box.
- 6 In the Bluetooth LOCALS window, write the 12-digit serial number on the Counterpart BT Device Address line.
- 7 Place the BT-box near (within 10 cm) of the phone and click Run BER Test.

The screenshot shows the 'Bluetooth Locals' application window. It contains several sections for configuring and running Bluetooth tests.

**BT Software Operational Mode:** Set to 'Normal'.

**Rx/Tx Functions:** Includes checkboxes for 'Rx On' and 'Tx On', and dropdowns for 'Channel (MHz)' (0 [2402]), 'Slot Length' (DH1), 'Power Level' (-24), and 'Tx Bit Pattern' (Alternate).

**Bit Error Rate (BER) Tests:**

- Counterpart BT Device Address: 00e0031ee5ef
- Hop Mode: Whole Frequency Range
- Bit Frames (1-300): 300
- Rx Channel (0-78): 0
- Tx Channel (0-78): 0

**BER Test Results:**

- Bit Error Rate: 0.05%
- Packet Error: 0.00%
- No. Of Bits: 64800
- Test Status: Success

**Self Tests:** A table showing the results of various self-tests.

Self Test Name	Result
ASIC Data RAM	Pass
Flash	Pass
ASIC REG access	Pass
RF-Harmonic alignment	Pass

**Scan Mode:** Includes checkboxes for 'Inquiry Mode' and 'Page Mode'.

**BT Reset:** Set to 'Cold'.

**BT Activation:** Set to 'On'.

**Neighbouring BT Devices:** A list of discovered devices with their names and addresses.

Device Name	Device Address
Unknown1	001e4cfe3a19
Unknown2	0022a500be12
	001cf05c647f
	0022a5e94092
	15c8db71900
Unknown3	001cf05c645d
	001f00bcee96
	001c26d621f9
	001c26db7800
	001237088206
	0016cdd6d893
	0014a4dae5e5
Unknown4	0021fe78d52b
	0009a9500538
	000a3a7de347
Unknown5	0022689c62832
	001d1d0793cc

Search Timeout: 15. Number of Devices Found: 70.

**Version Information:** A table showing software and hardware versions.

Field	Value
MM Software	1.31
MM Software	MCL_08w27
Checksum	11
Device Address	1DA500580200
Hardware Version	0001

Buttons at the bottom: Run BER Test, Run Self Tests, Start Search, Stop Search, Update Info, Close, Help.

## Bluetooth troubleshooting

### Troubleshooting flow

The specific troubleshooting fault repair chart only needs to be followed if there is a fault with a particular function.

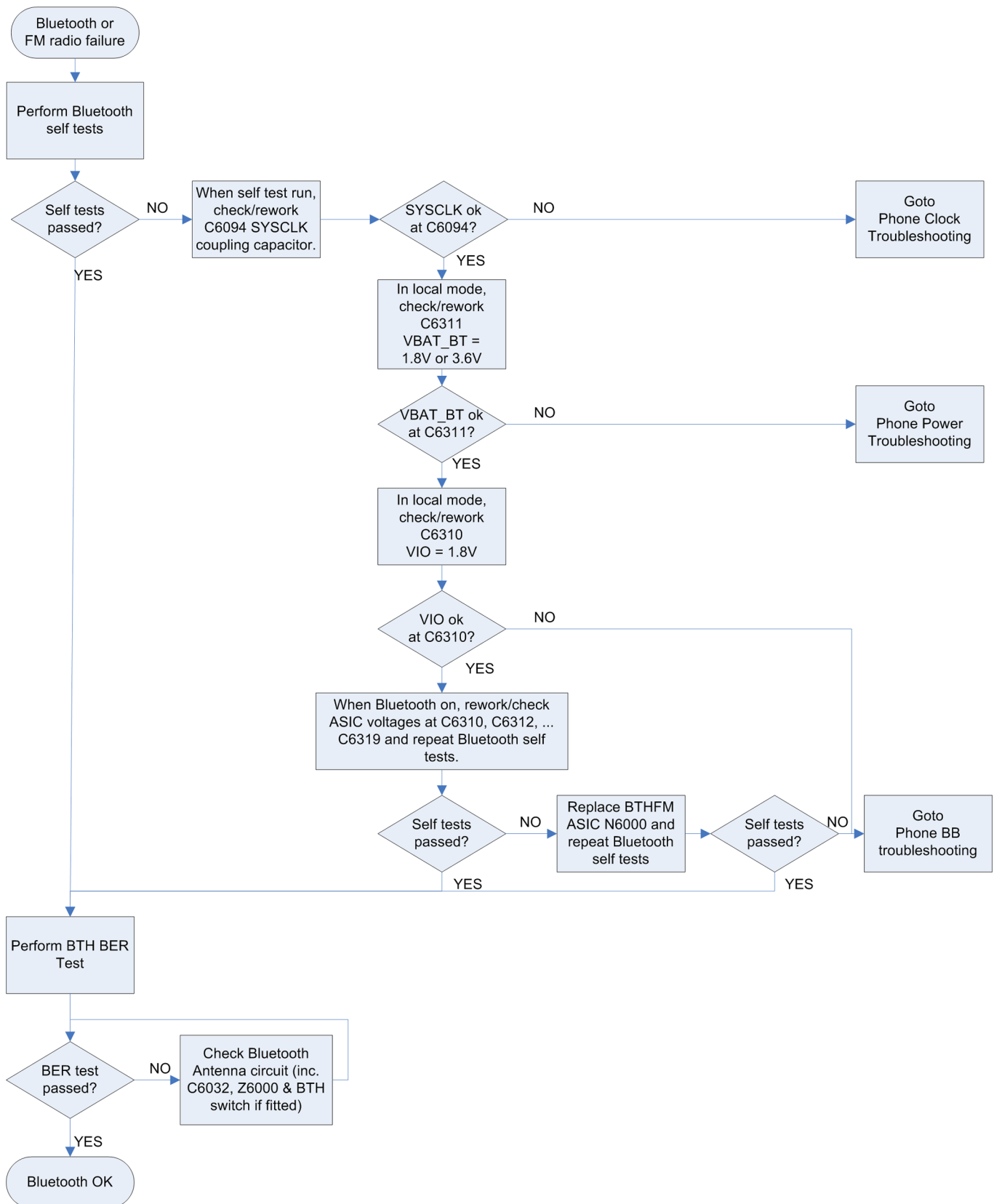
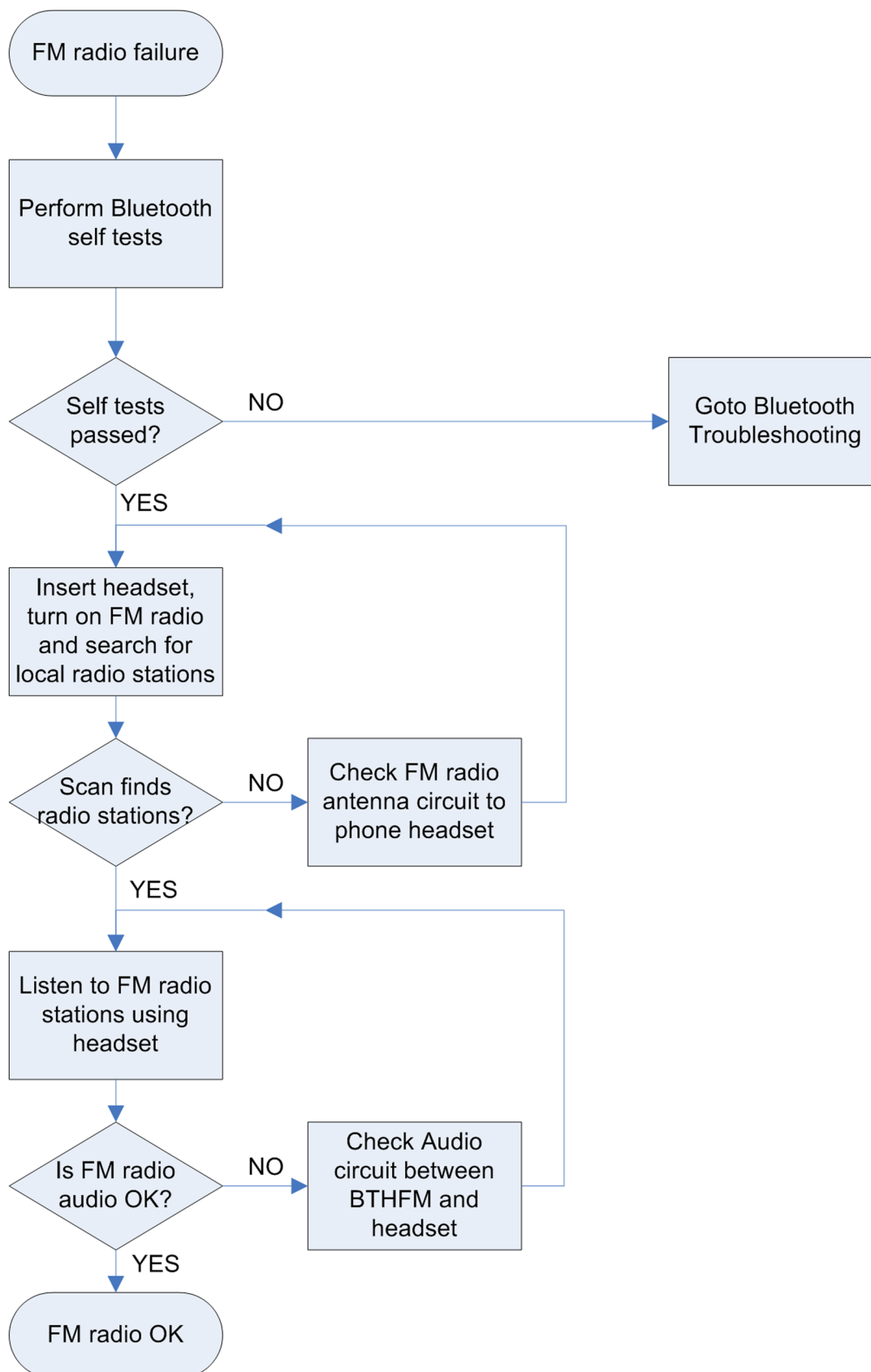


Figure 32 Troubleshooting diagram: Bluetooth

## FM receiver troubleshooting

### Troubleshooting flow



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## **5 — Camera Module Troubleshooting**

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## ■ Introduction to camera module troubleshooting

### Background, tools and terminology

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

- 1 Camera is not functional at all; no image can be taken.
- 2 Images can be taken but there is nothing recognizable in them.
- 3 Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded.

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

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training or experience of a correctly operating reference device may be needed in order to detect what actually is wrong.

It is easy for the user to take bad images in bad conditions. Therefore the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference.

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

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

### Terms

Dynamic range	Camera's ability to capture details in dark and bright areas of the scene simultaneously.
Exposure time	Camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically i.e. there is no mechanical moving parts like in film cameras.
Flicker	Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image.
Noise	Variation of response between pixels with same level of input illumination.
Resolution	Usually the amount of pixels in the camera sensor; for example, RM-392/393 has a 640 x 480 pixel sensor resolution. In some occasions the term resolution is used for describing the sharpness of the images.

Sensitivity	Camera module's sensitivity to light. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film.
Sharpness	Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics or high levels of digital zoom, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance.

### ■ The effect of image taking conditions on image quality

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

#### Distance to target

The lens in the module is specified to operate satisfactorily from 30 cm to infinite distance of scene objects. In practice, the operation is such that close objects may be noticed to get more blurred when distance to them is shorter than 30 cm. The lack of sharpness is first visible in full resolution images. If observing just the viewfinder, even very close objects may seem to appear sharp. This is normal; do not change the camera module.



Figure 33 Blurred image. Target too close.

#### The amount of light available

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

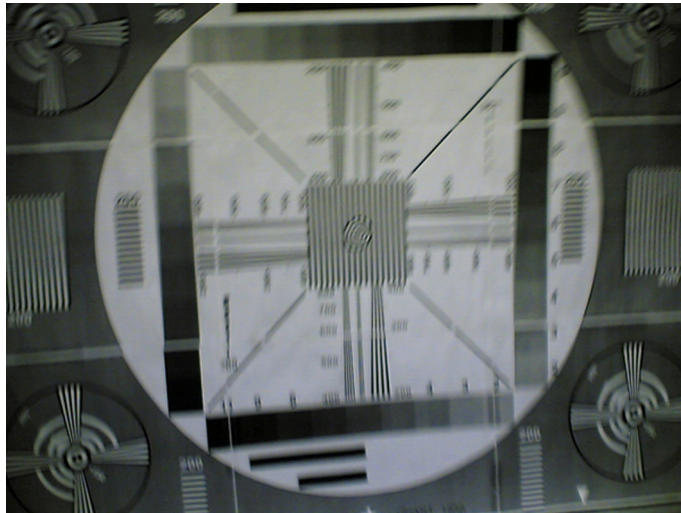


Figure 34 Blurring caused by shaking hands

### Movement in bright light

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



Figure 35 Near objects get skewed when taking images from a moving vehicle

## Temperature

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



Figure 36 Noisy image taken in +70 degrees Celsius

## Phone display

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

## Basic rules of photography (especially shooting against light)

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

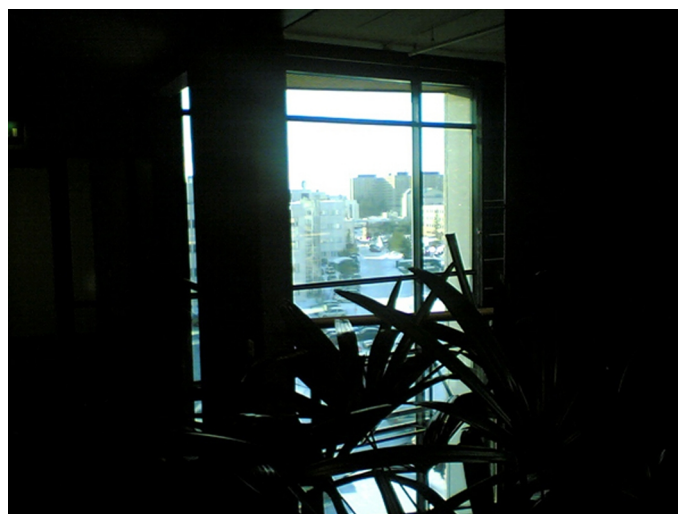


Figure 37 Image taken against light

## Flicker

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

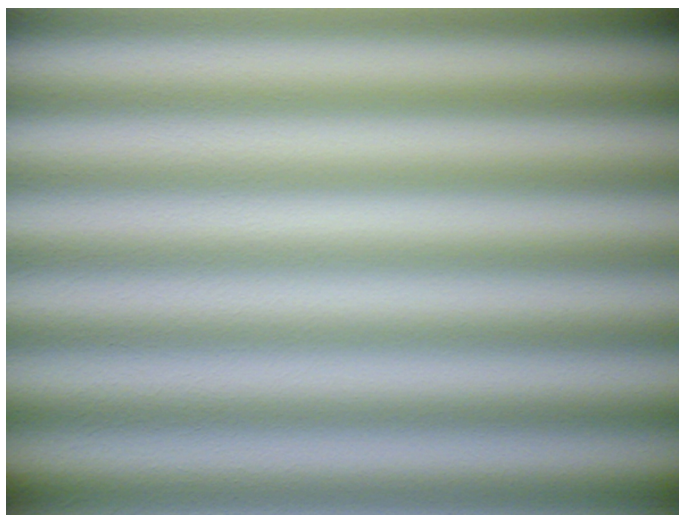


Figure 38 Flicker in an image; object illuminated by strong fluorescent light

## Bright light outside of image view

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



Figure 39 A lens reflection effect caused by sunshine

## Examples of good quality images



**Figure 40 Good image taken indoors**



**Figure 41 Good image taken outdoors**

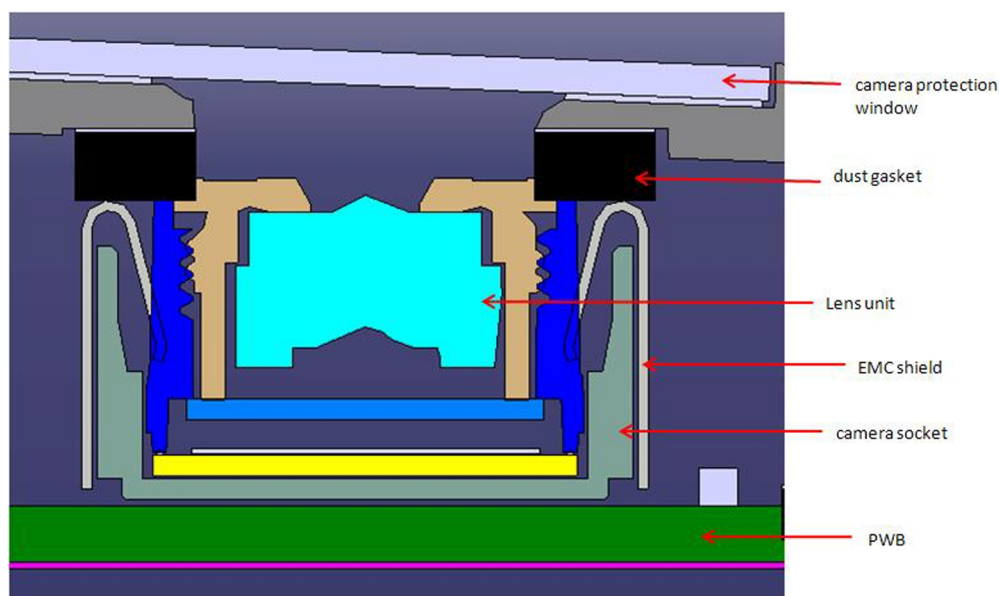
## ■ Camera construction

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

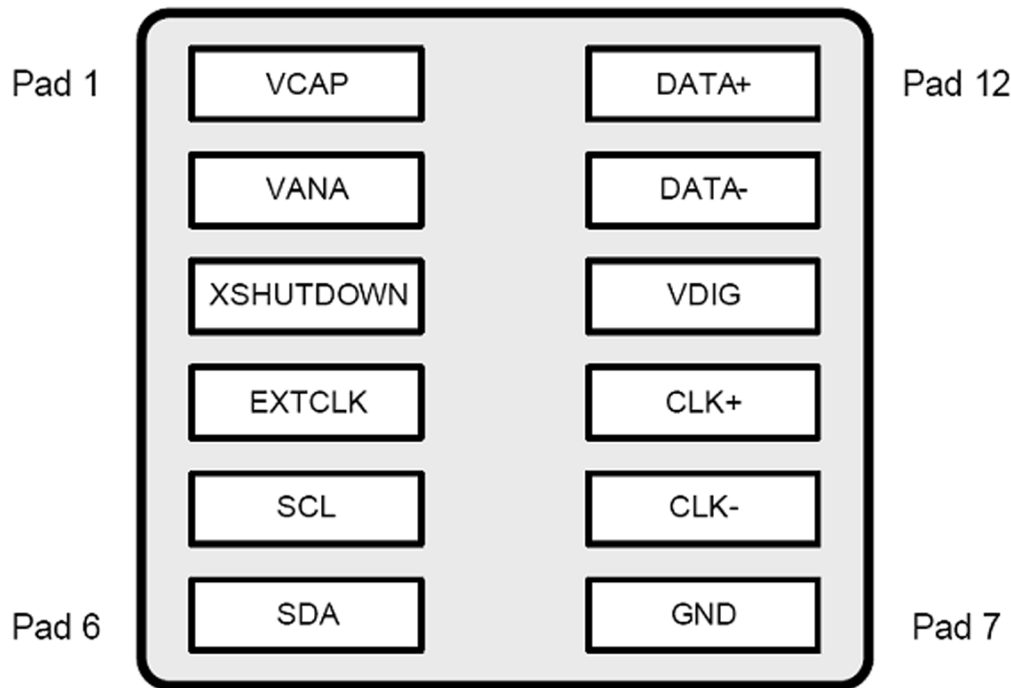
**Table 6 Camera specifications**

Sensor type	CMOS Sensor
Photo detectors	0.3 million
F number/Aperture	f/2.8
Focal length	1.78 mm
Focus range	20 cm to infinity
Still Image resolutions	640x480, 320x240
Still images file format	EXIF (JPEG), *.jpg

Video resolutions	128x96, at 10 frames per second
Video clip length	10 seconds or free, maximal clip length in free mode is limited by the data storing capabilities of the device
Video file format	3GPP, *.3gp
Exposure	Automatic
White Balance	Automatic
Colours	16.7 million / 24-bit
Capture Modes	Night mode, Sequence mode, self timer



**Figure 42 Camera module cross section and assembly principle**



**Figure 43 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 colours. 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
- Passive components
- Camera protection window; part of the phone cover mechanics
- Dust gasket between the lens unit and camera protection window

### ■ Dynamic camera configuration

DCC (Dynamic Camera Configuration) is a system to allow final camera tuning values to be programmed on Service Centre. DCC data generated for a camera hardware is set by Camera Entity IQ department and placed into global DCC settings database. Service centres could replace a defective module with a spare one to get camera function recovered by updating DCC data.

### DCC data update instruction

Service software is used to update DCC data when camera configuration (a camera or a hardware accelerator) of the terminal has been changed. Service software DCC update feature reads camera configuration identification from the terminal, selects a new configuration data file from DP (data package) and writes data into the memory of the terminal during the process. If the update fails, new camera configuration installed into the terminal is not supported by DP. Always update DCC when a camera or a HWA has been changed.

In Service software press “Read”, and the Camera Configuration window shows available DCC data file name and its version to upload. If the previous camera configuration was the same as installed, then Current Configuration Version displays DCC data version currently in the terminal memory, otherwise it shows xxx.xxx. Press “Upload” and then the DCC data settings are updated.

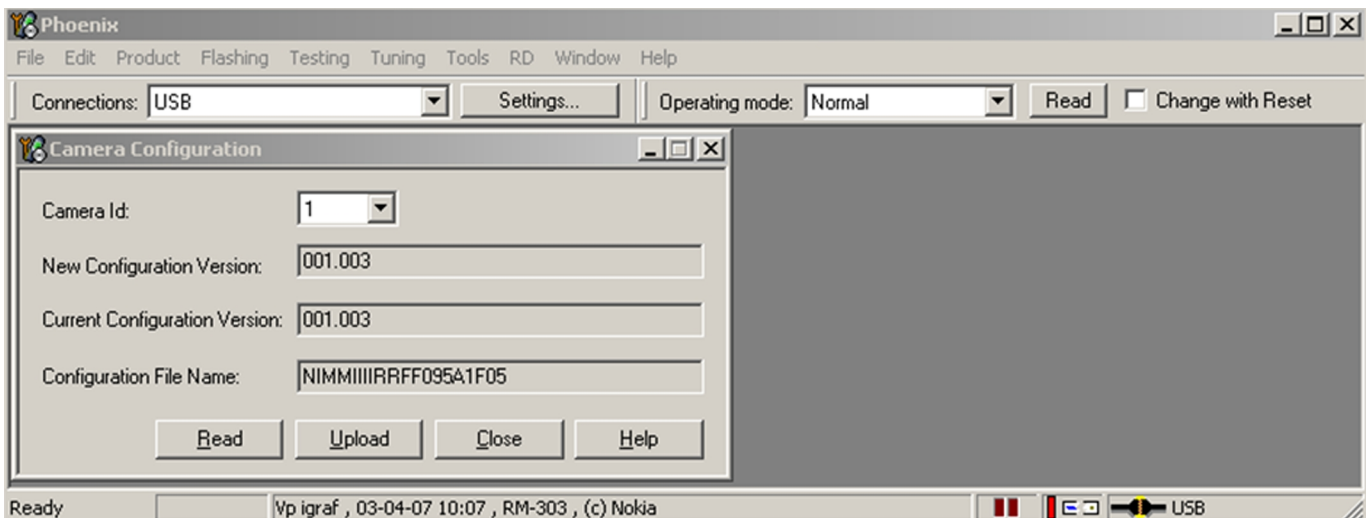


Figure 44 DCC data update

## ■ Image quality analysis

### Testing for dust in camera module

#### Symptoms and diagnosis

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

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

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

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



**Figure 45 Effects of dust on optical path**

If large dust particles get trapped on top of the lens surface in the cavity between camera window and lens, they will cause image blurring and poor contrast. The dust gasket between the window and lens should prevent any particles from getting into the cavity after the manufacturing phase. Dust in this position should be blown away by using compressed air.

Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial. Always check the image sharpness after removing dust.

## Testing camera image sharpness

### Symptoms and diagnosis

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

- 1 The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.
- 2 The photographed object is too close – the camera lens operates with distances from 20 cm to infinity. This is no cause to replace camera module.
- 3 User has tried to take pictures in too dark conditions, and images are blurred due to handshake or movement. This is no cause to replace camera module.
- 4 There is dirt between the protection window and camera lens.

- 5 The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.
- 6 The camera lens is misfocused because of a manufacturing error.
- 7 Very high level of digital zoom is used

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

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

- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

## Steps

1. Take several images of small objects in the distance of 1-2 metres.
2. Analyse the images on a PC screen at 100% scaling with the reference images.

Pay attention to the computer display settings: at least 65000 colors (16-bit) have to be used. True colour (24-bit, 16 million colours) or 32-bit (full colour) setting is recommended.

## Next actions

If there appears to be a clearly noticeable difference between the reference image and the test images, the module might have a misfocused lens -> change the module.

Re-check the resolution after changing the camera module.

If the changed module produces the same result, the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module.

## Dirty camera lens protection window

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

It should be noted that the effects of any dirt in images can vary much. It may be difficult to judge whether the window has been dirty or if something else is wrong. Therefore, the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

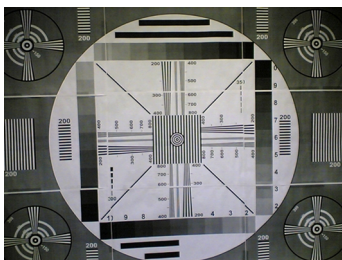


Figure 46 Image taken with clean protection window

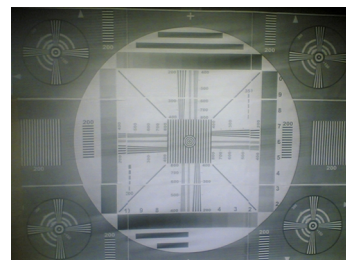


Figure 47 Image taken with greasy protection window

## Image bit errors

Bit errors are image defects caused by data transmission errors between the camera module and the phone baseband and/or errors inside the module.

Usually bit errors can be easily detected in images, and they are best visible in full resolution images. A good practice is to use a uniform white test target when analysing these errors. The errors are clearly visible, colourful sharp dots or lines in camera images. See the following figure.



**Figure 48 Bit errors caused by JPEG compression**

One type of bit error is a lack of bit depth. In this case, the image is almost totally black under normal conditions, and only senses something in very highly illuminated environments. Typically this is a contact problem between the camera module and the phone main PWB. Very black images and viewfinder may also be caused by failure of the 2.8V supply to the camera. You should check the camera assembly and connector contacts.

If the fault is in the camera module, bit errors are typically visible only when using some specific image resolution. For example, in case of a viewfinder fault, the error might exist but is not visible in a full size image.

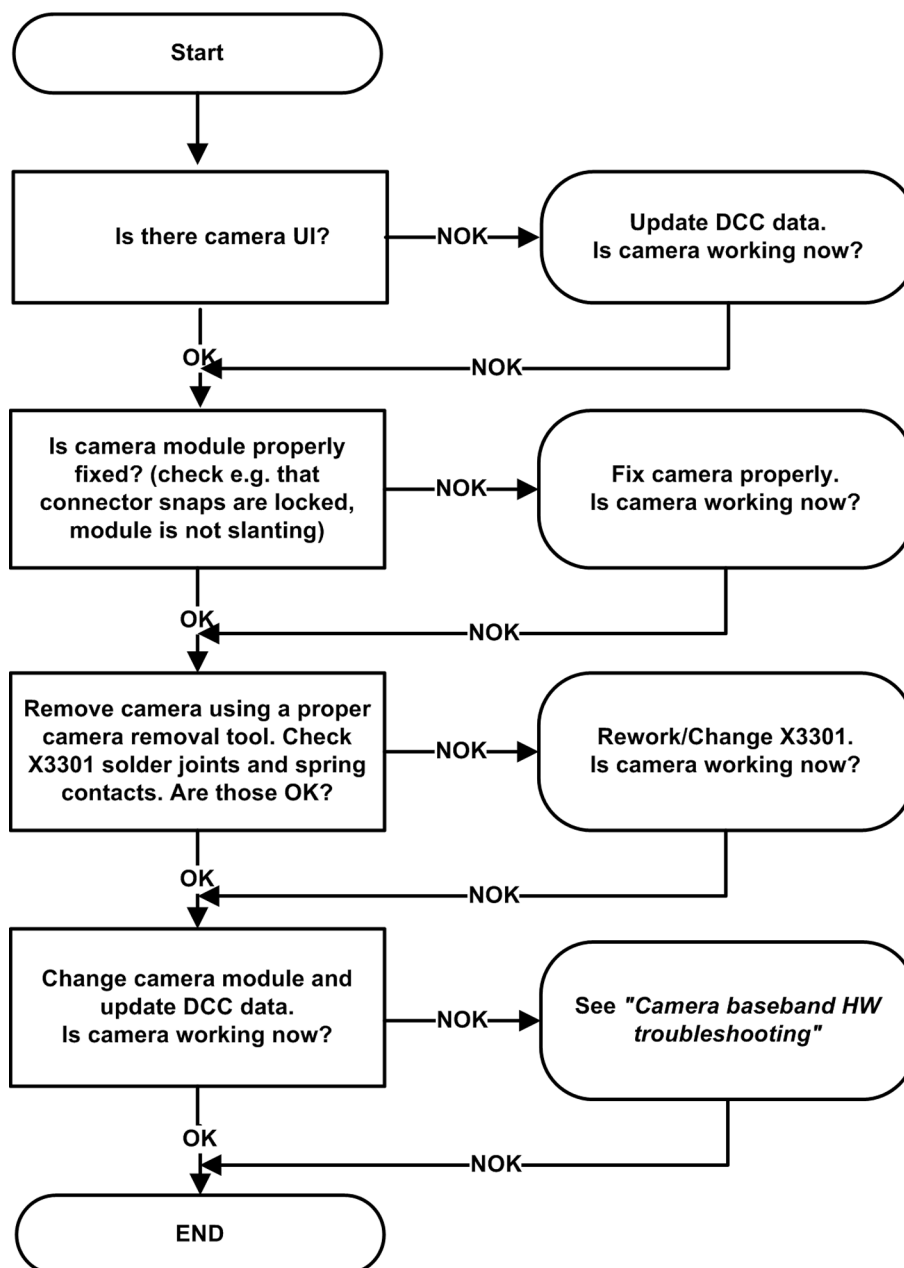
## ■ Camera troubleshooting flowcharts

### Camera hardware failure message troubleshooting

#### Context

If you get a hardware failure message when using the camera, follow the next troubleshooting flowchart.

## Troubleshooting flow

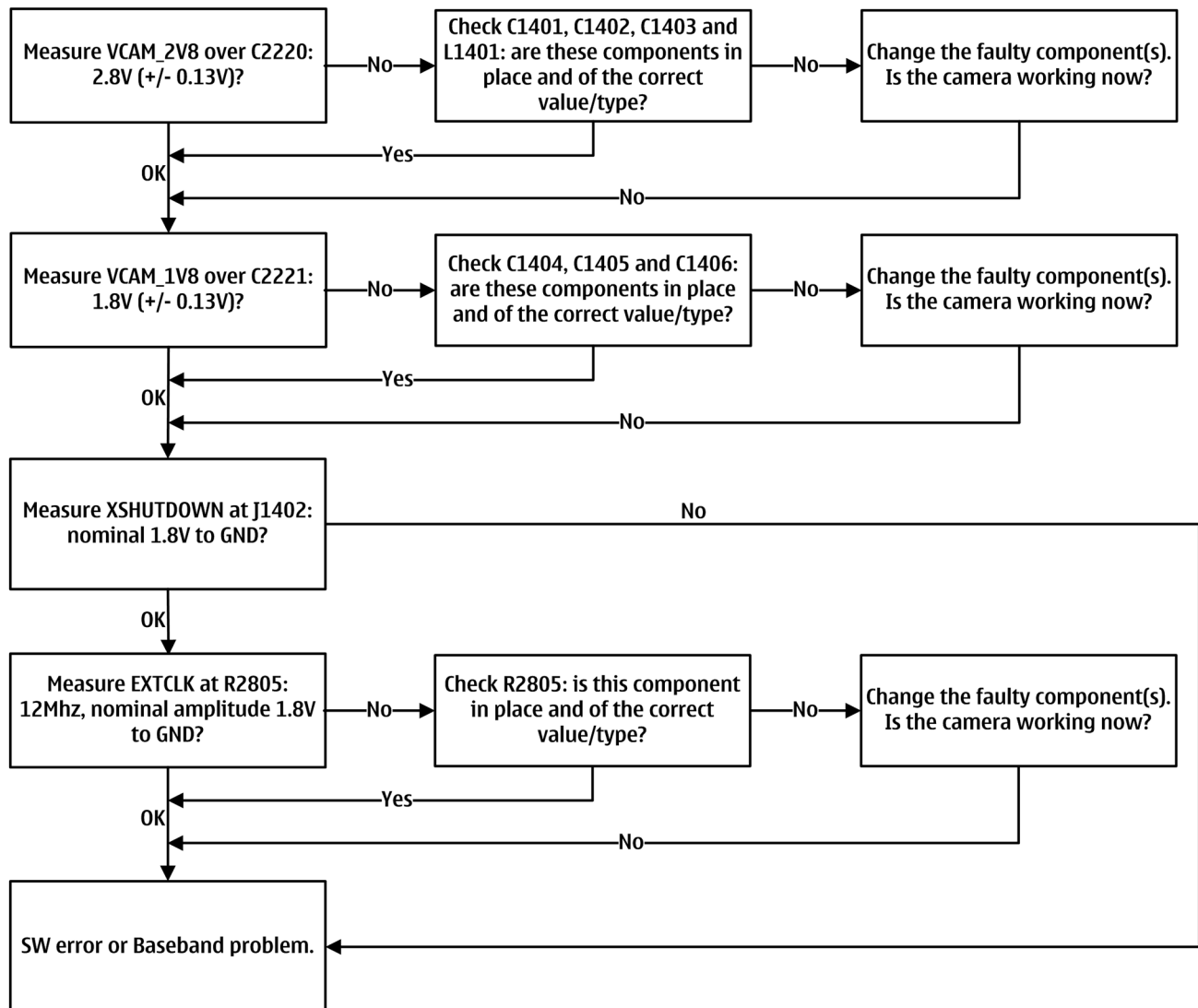


**Note:** Make sure that the phone has the latest software before continuing.

## Camera baseband HW troubleshooting

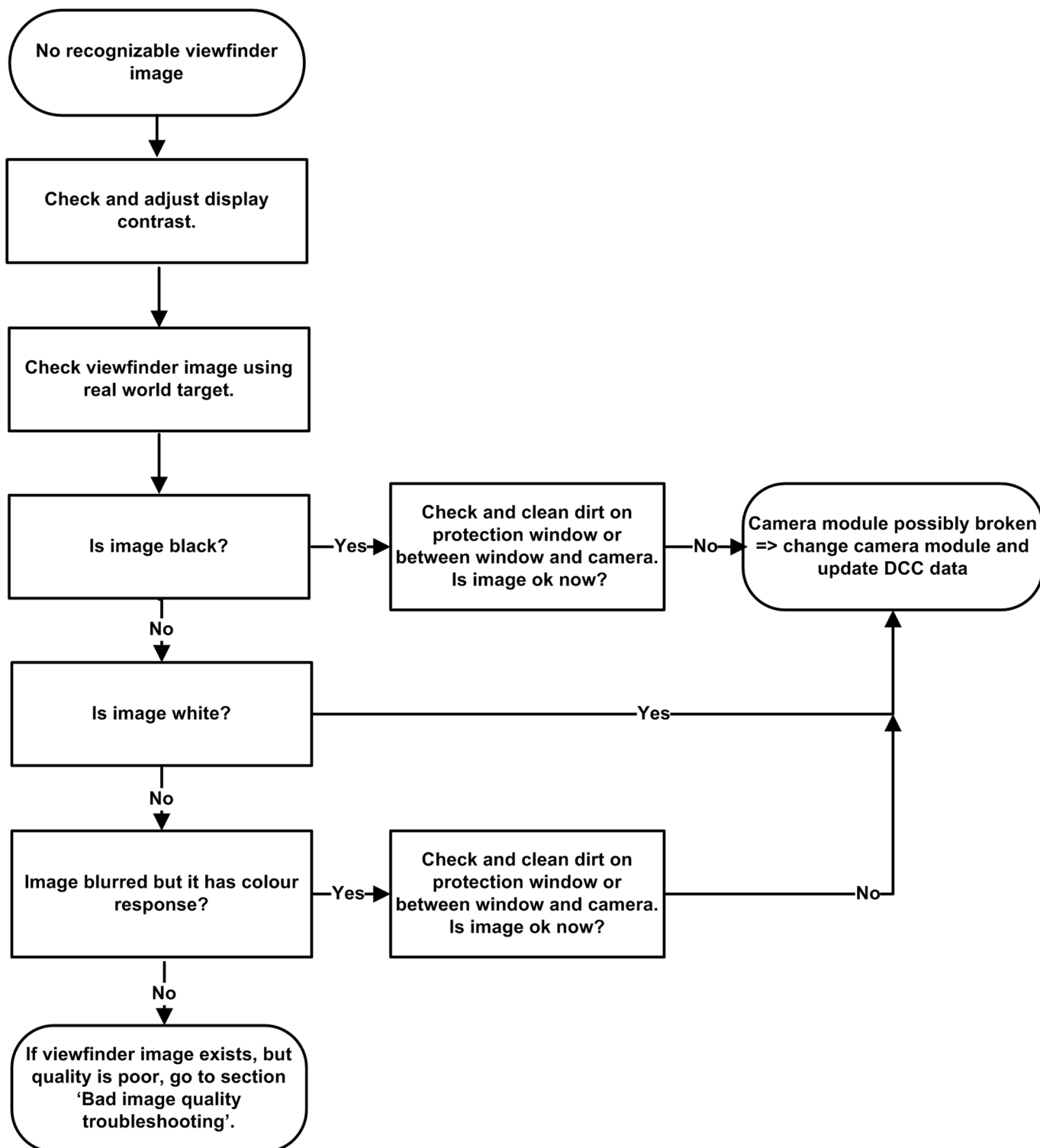
### Troubleshooting flow

Note: the camera application must be activated for any camera signals including voltages to be present.



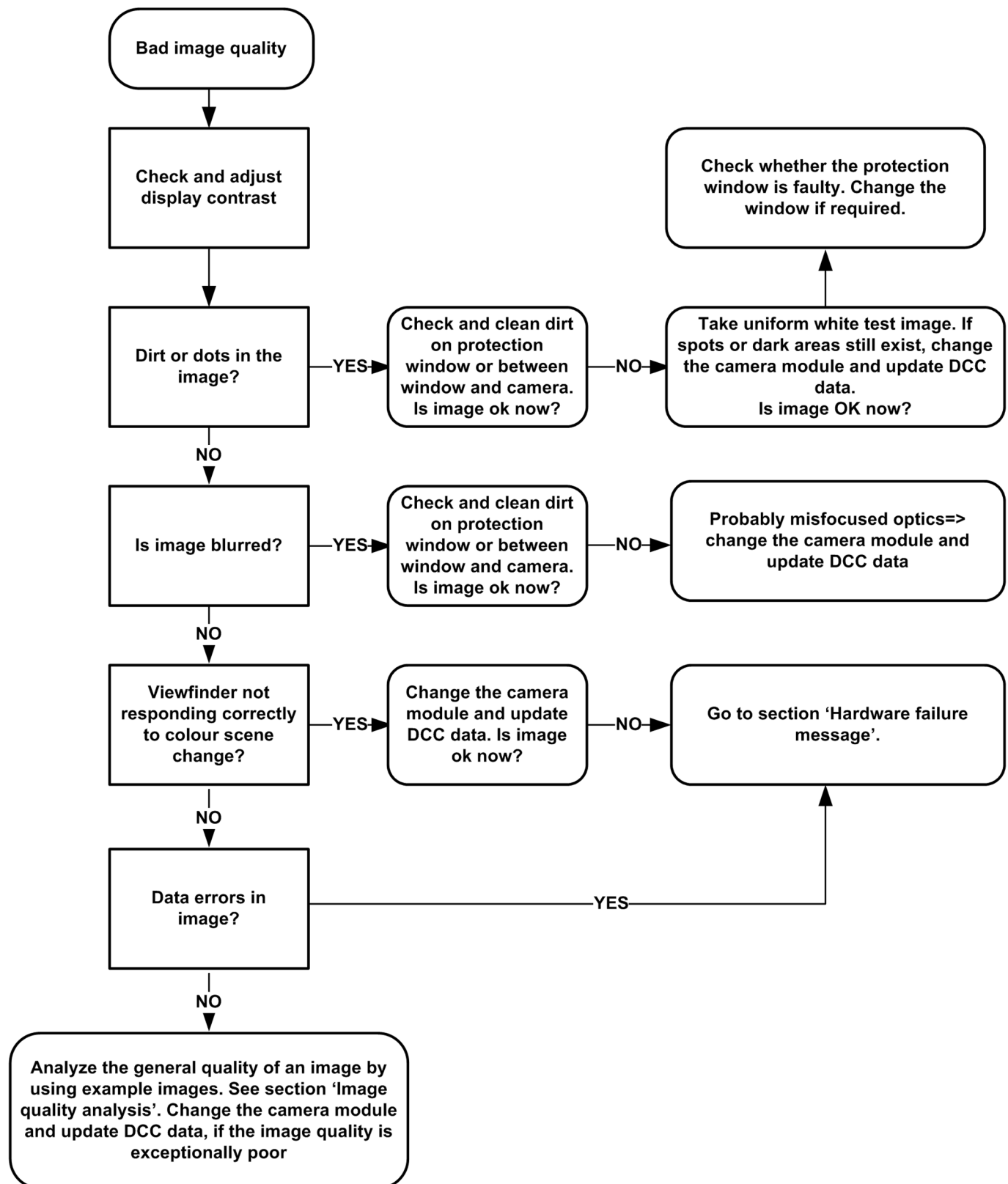
## Camera viewfinder troubleshooting

### Troubleshooting flow



## Bad camera image quality troubleshooting

### Troubleshooting flow



## 6 — System Module

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## ■ Introduction

### Phone description

RM-709 is a mono-block phone supporting EGSM850/900/1800/1900.

### Display and Keypad Features

- Single LCD
- Primary: 2.36" 320x240 pixel, 262K color display
- 48 keys

### Hardware Features

- 0.3M pixel camera
- Micro USB 2.0 port for data transfer and charging
- 3.5mm AV connector
- Bluetooth
- Radio, FM Stereo
- Internal vibrator and antenna
- [tbd]-MB of user memory
- Hot swap micro SD card slot
- Stereo FM radio and Music Player (MP3, MP4, eAAC, WMA)
- Video (H.263, H264, MPEG4-SP) playback and recording
- Midi polyphonic ringer
- RTC and alarm features

### RF Features

- GSM/EGSM – 850/900/1800/1900
- GPRS Class 32

### Baseband Function Description

The D2800 "Juno" is a single-chip EDGE/GPRS/GSM multimedia baseband processor with quad-bands support for worldwide GSM coverage and roaming ability. The D2800 "Juno" has a fully integrated RF transceiver along with all analog and digital baseband functions onto a single, monolithic piece of silicon.

The integrated RF in the D2800 "Juno" can supports GSM/EDGE/GPRS Class 33; however, the phone product implement Class 32. Juno has a proprietary high-performance modem technology to increase network capacity. It also has SAIC support for voice, data, echo cancelling, and noise suppression to improve cellular handset reception and voice quality.

The D2800 "Juno" has an integrated ARM9 processor operating at 208 MHz for fast applications computing. The ARM9 processor can access the 1-Gbit of non-volatile Flash memory and 512-Mbit of DDR SDRAM over independent memory interfaces. The 16-bit Flash memory interface operates at 78 MHz and the 16-bit SDRAM interface operates at 156 MHz.

The D2800 "Juno" has extensive integrated multimedia functionality for camera, LCD, and audio.

- Serial SMIA camera interface with integrated Image Signal Processor (ISP).
- Dual MIPI LCD panels (DBI-B/Messi and DBI-C/Lossi) with up to 16M colors.
- Graphics engine

- The integrated video CODEC supports 30-fps full-rate encode and decode H.264, H.263, WMV9, and MPEG4 at high-quality QVGA resolution.

The D2800 "Juno" baseband has extensive mixed-signal integration and advanced audio capabilities. An external audio processor device is not required. The D2800 "Juno" has fully integrated audio support for driving dual 100-mW hi-fi stereo speakers for a headset and an earpiece, line drivers for driving an external class D amplifiers for a Internal Hands-free (IHF) speakerphone or ringer, and a class D Vibra driver for a synchronized vibrator. The D2800 "Juno" has support for internal and external analog microphones.

The D2800 "Juno" has on-chip digital audio mixing, an integrated 64-tone polyphonic ringer, and a 5-band equalizer. It has Integrated MP3, AAC, AAC+, eAAC, WMA, and W-AMR CODECs and supports downloadable CODECs with on-chip SRAM.

The D2800 "Juno" has extensive peripheral interfaces and extreme flexibility to support GPS, Bluetooth®/FM, Wi-Fi®, Mobile TV or an external multimedia processor.

- Universal subscriber identity module (USIM) controller.
- 480-Mbps USB 2.0 OTG v1.3 with on-chip mixed-signal transceivers for fast data transfer.
- uSD for expandable external storage.
- I2S & PCM interfaces for transferring audio samples.
- Broadcom Serial Control (BSC, I2C-compatible) for peripheral control.
- SPI for interfacing to peripherals or multimedia processor(s).
- ACI accessory plug-in interface.
- 8-bit and 10-bit ADC inputs with 0-1.2V input range.

## Chipset

The platform chipset consists of the JUNO Baseband/RF ASIC, LOVIISA PMU ASIC, and BT/FM module.

The JUNO with a companion Loviisa PMU combines application processor, RF transceiver, and power management with audio, 0.3 Mpixel camera, LCD, and extensive peripheral and accessory interfaces (keypad, USB, SIM, UART, SPI, µSD).

## Key components

All power supplies required by the D2800 "Juno" are provided by the N2201 "Loviisa" PMU.

The D2800 "Juno" requires two external clocks for proper operation. A 32 kHz clock supplied by the N2201 "Loviisa" PMU and a 26 MHz clock which is frequency multiplied internally and used throughout the device. The integrated RF in the D2800 "Juno" only requires external SAW filters (Z7500, Z7501) and a GSM/EDGE FEM for transmission (N7500).

The N2201 "Loviisa" only requires a 32 kHz clock for proper operation.

Description	Reference
Multimedia Baseband and RF ASIC - "Juno"	D2800
Combo memory - 1 Gb oneNAND Flash / 512 Mb DDR RAM	D3000
Power Management Unit - "Loviisa"	N2201
GSM/EDGE Front-end module (Amplifier + switch)	N7500
Dual GSM RX SAW filter for GSM850 and GSM900	Z7500
Dual GSM RX SAW filter for GSM1800 and GSM1900	Z7501
BT/FM Radio module	N6300

Description	Reference
Audio amplifier (Stereo headset)	N2000
Audio amplifier (Internal hands free, mono)	N2801
26 RF MHz Crystal (8 pF)	B2800
32 kHz System reference crystal, RTC	B2200
Vibrator	M2100
LED Driver	N2301
Camera Module	H1400
Battery	
Battery Connector	X3500
Charger Plug	X3460
SIM Card Holder	X2700
3.5mm AV Connector	X2001
uSD Card Holder	X4800
Micro USB Connector	X3300

## Key component placement

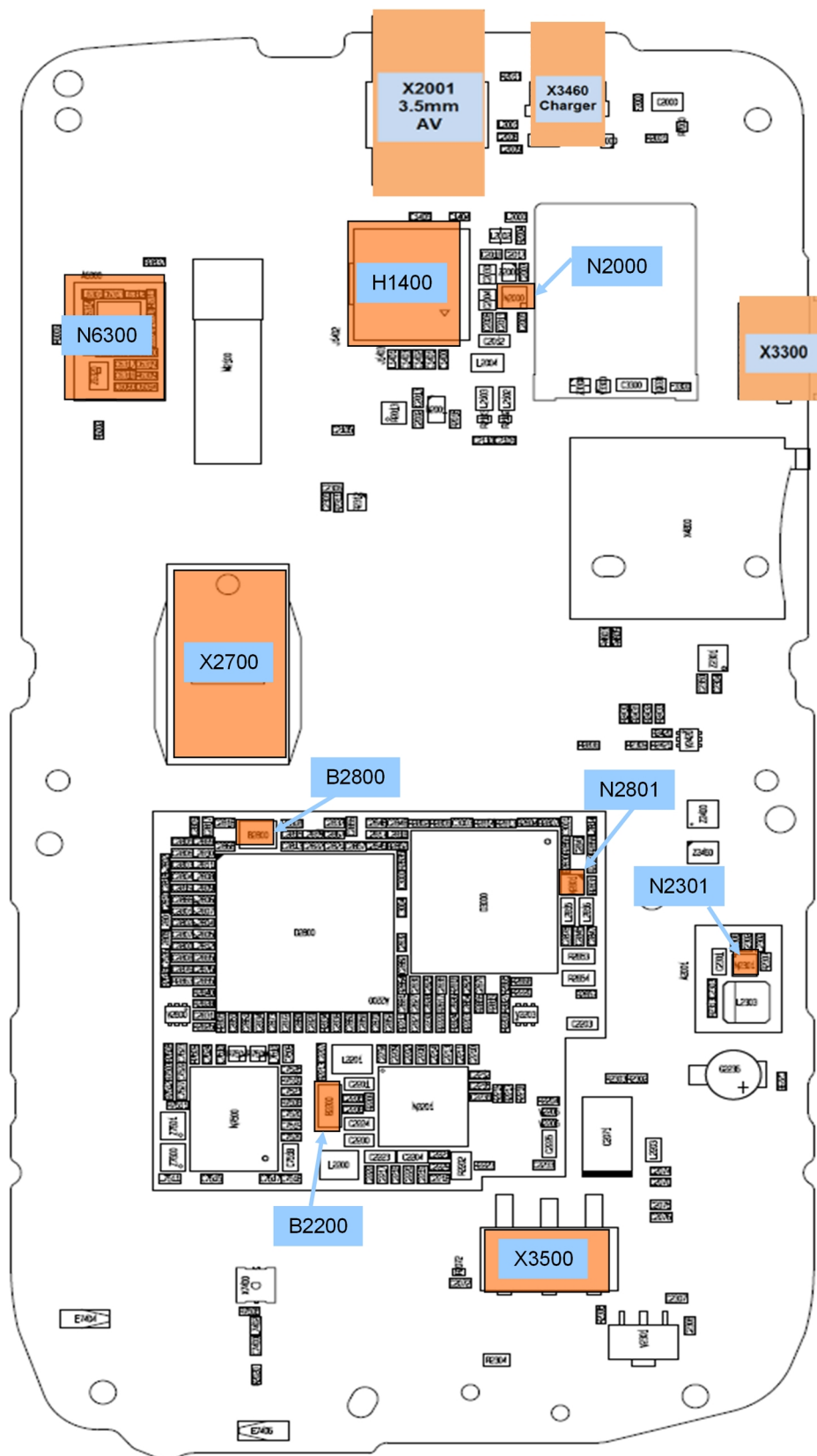
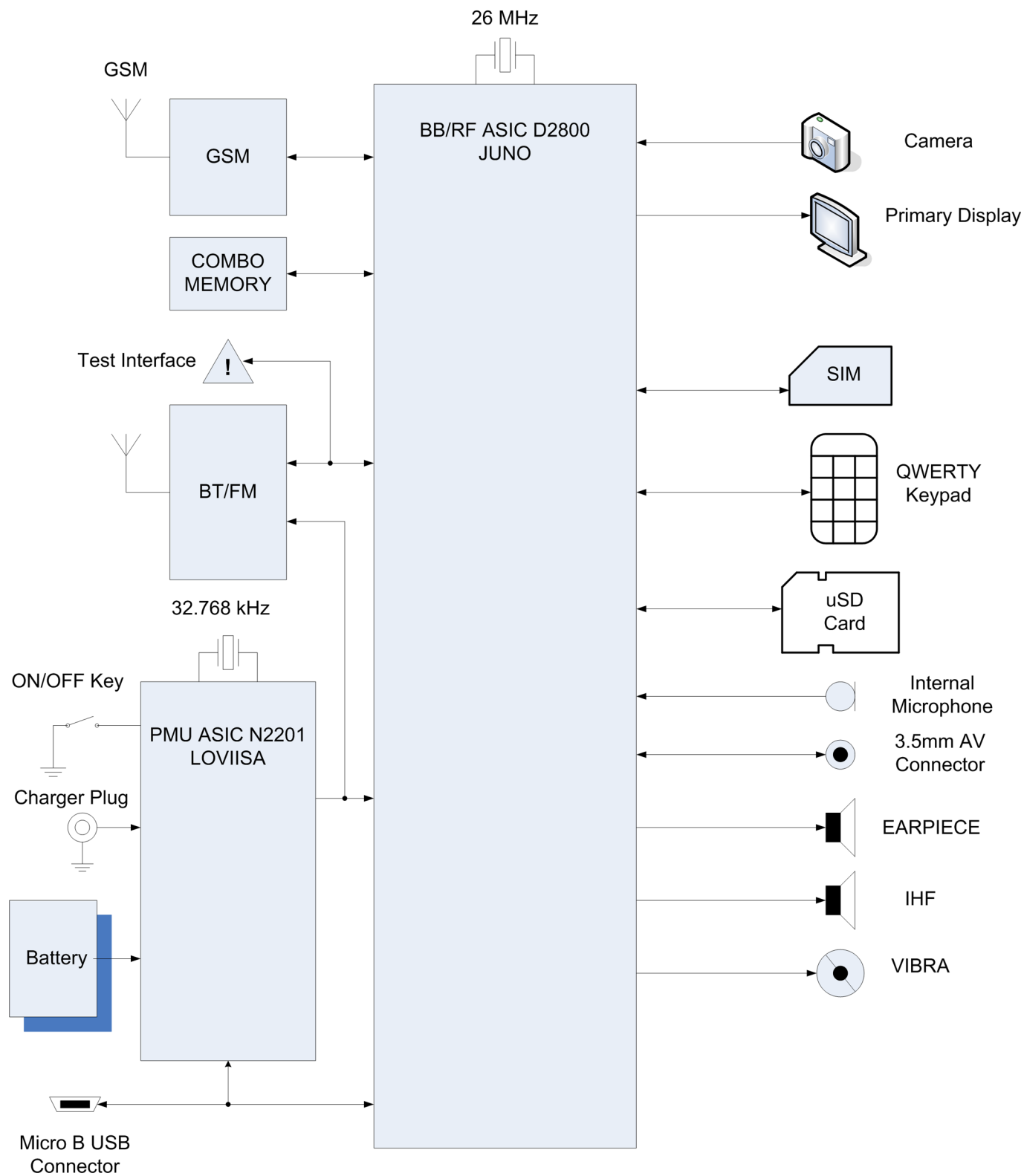


Figure 49 Key component placement

## System module block diagram



## ■ Energy management

### Electrical Interface Between Baseband and Battery

#### Introduction

The PMU (N2201) contains a fully-featured and host-interactive interface between the battery and JUNO BB ASIC (D2800).

The PMU provides 11 LDOs and 2 switchers to run JUNO BB ASIC D2800 and other on-board devices.

When a charger is inserted, the PMU will check the battery signal (BAT\_PRSENT) to detect whether the battery is present before powering up. A battery must be present and its voltage must be higher than 3.3V in order to power up the PMU.

The JUNO BB ASIC D2800 can monitor the battery voltage through its ADCIN1 input.

The PMU will use the BAT\_PRSENT signal to detect when the battery is removed and will initiate a shut-down. The PMU will alert the JUNO BB ASIC that the battery has been removed by sending an interrupt through its \_BATRM output. The JUNO BB ASIC can also monitor the BSI signal from the battery with its ADCIN3 input to detect battery type. The thermal resistor R2303 is used to monitor temperature. The N2201 will be shut down if the temperature is too high or too low.

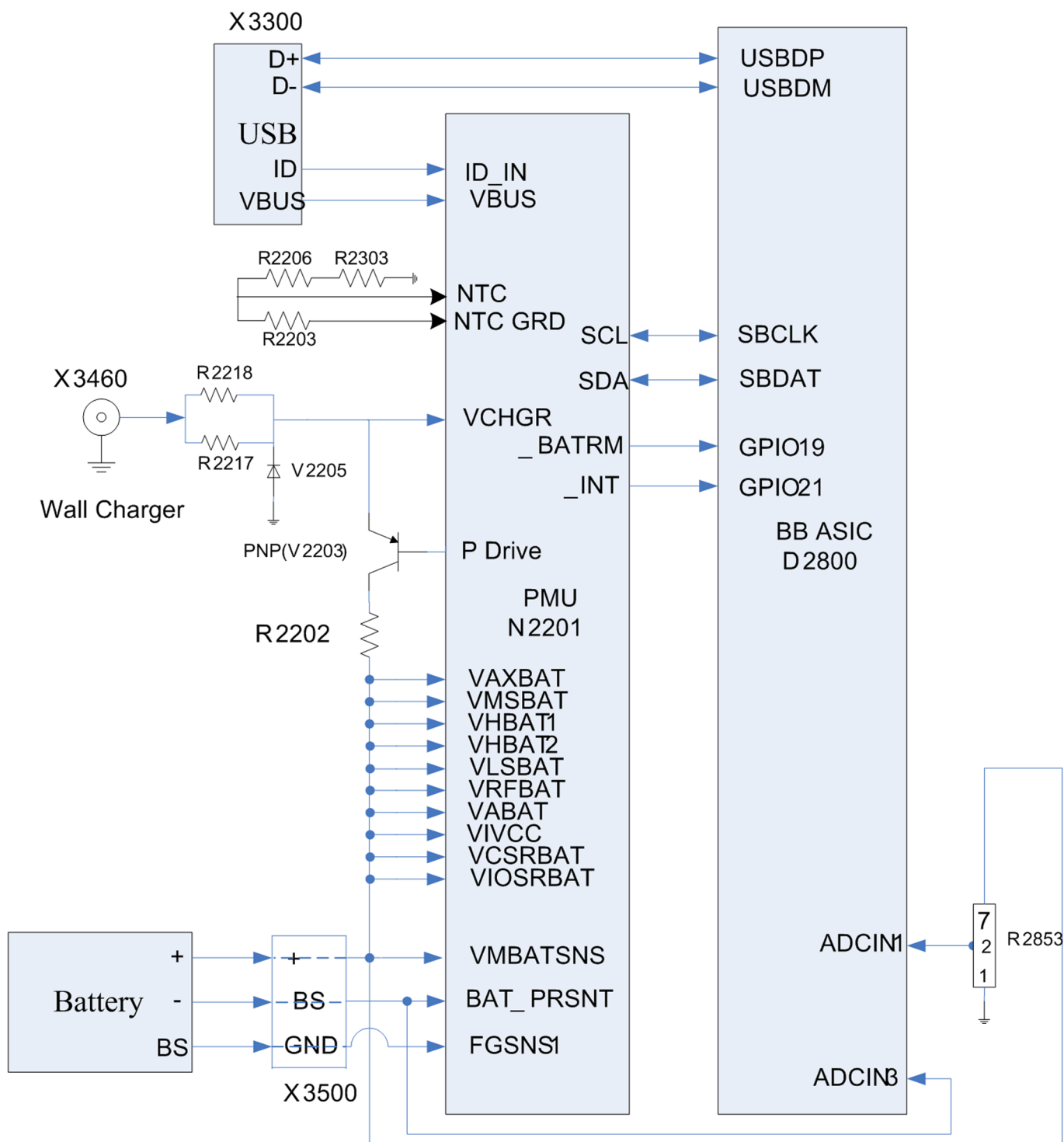


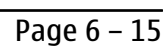
Figure 50 Electrical interface between battery and PMU and baseband

Table 7 Battery, LOVIISA PMU, JUNO BB ASIC Power Distribution

Input	PMU Pin	Regulator Type	Signal Name	Min	TYP (V)	Max	21351 Power Pin	21351 Function
Battery	IOLD0	LDO	VIO	-3%	1.8	3%	VDDO_1P8	I/O Digital: Keypad
							VDDO_SDIO	SD Interface
							BBL_VDD0	BBL
Battery	HCLD01	LDO	VAMP1	-3%	3.2	3%	VBRSPVDD	Vibrator
							DDACSPVDDR3P0	Right Speaker
							DDACSPVDDL3P0	Left Speaker
Battery	HCLD02	LDO	VAMP2	-3%	3.2	3%	VDDO_SDIO	Digital SDIO Wlan
Battery	LVLD01	LDO	VANA1	-3%	1.2	3%	USBVDD12PLL	USB PLL
							DSI_AVDD1P2	Camera
							DDACDVD1P2	Daul DAC
							CCP2_AVDD1P2	Camera
							USBAVDD12	USB
							MPLL_AVDD1P2	Modem PLL
							APLL_AVDD1P2	Applicat ion PLL
Battery	ALD02	LDO	VANA2	-3%	2.5	3%	ADCAVDD2P5	IN ADC (1-4)
							IHFAVDD2P5	High Fedelity Driver

Input	PMU Pin	Regulator Type	Signal Name	Min	TYP (V)	Max	21351 Power Pin	21351 Function
Battery	ALD01	LDO	VANA3	-3%	3	3%	AUXARXA VDD3P0	Aux ADC/ DAC, uPhone
							DDACAVD D30	Dual DAC Audio
Battery	CSR	SR	VCORE	-3%	1.2	3%	VDDC	Vcore Digital Supply
							USBVDD1 2PLL	USB PLL
							RF_DSP_V DDC	RF DSP
Battery	LCLD0	LDO	VDCX0	-3%	1.3	3%	RF_VDD_X 0	26 MHz Crystal Oscillator
Battery	IOSR	SR	VMEM	-3%	1.8	3%	VDDO_EM I	Flash & DDR Memories
							VDDP_EM I	External Memory interface
							VDDO_FA	Non volatile SRAM
Battery	RFLD02	LDO	VOUT	-3%	2.5	3%	USBAVDD 25	USB Analog
							ACI_AVDD 2P5	Accessory Control Interface

Input	PMU Pin	Regulator Type	Signal Name	Min	TYP (V)	Max	21351 Power Pin	21351 Function
Battery	LVLD02	LDO	VRF1	-3%	1.3	3%	RF_VDD_RXRF	Receiver RF
							RF_VDD_PLL	RF Main PLL
							RF_VDD_RXIF	Receiver IF
							RF_VDD_TXPLL	Transmitter PLL
							RF_VDD_TXLO	Transmitter Local Oscillator
Battery	RFLD01	LDO	VRF2	-3%	2.7	3%	RF_VDD_PA	Power Amplifier interface
							RF_VDD_RX2P7	Analog Receiver
Battery	MSLD02	LDO	VUSB2	-3%	3.3	3%	USBAVDD33	3.3 VUSB Analog
							NVM_VDDP	NV_RAM



## Electrical Interface Between Baseband and Charger

### Introduction

The main battery charger of the LOVIISA PMU (N2201) features an autonomous, yet, fully customizable pulse-mode charger and switch-mode charger for a single-cell Li-ion polymer battery. The LOVIISA PMU supports trickle and rapid charge via wall or USB chargers.

The LOVIISA PMU will generate an interrupt signal to the JUNO BB ASIC (D2810) to alert it of a change in the charger status. The JUNO BB ASIC will then read the PMU interrupt register through the Broadcom Serial Control (BSC, I2C-compatible) interface to determine the charger status.

R2202 is the current sense resistor for both wall & USB chargers.

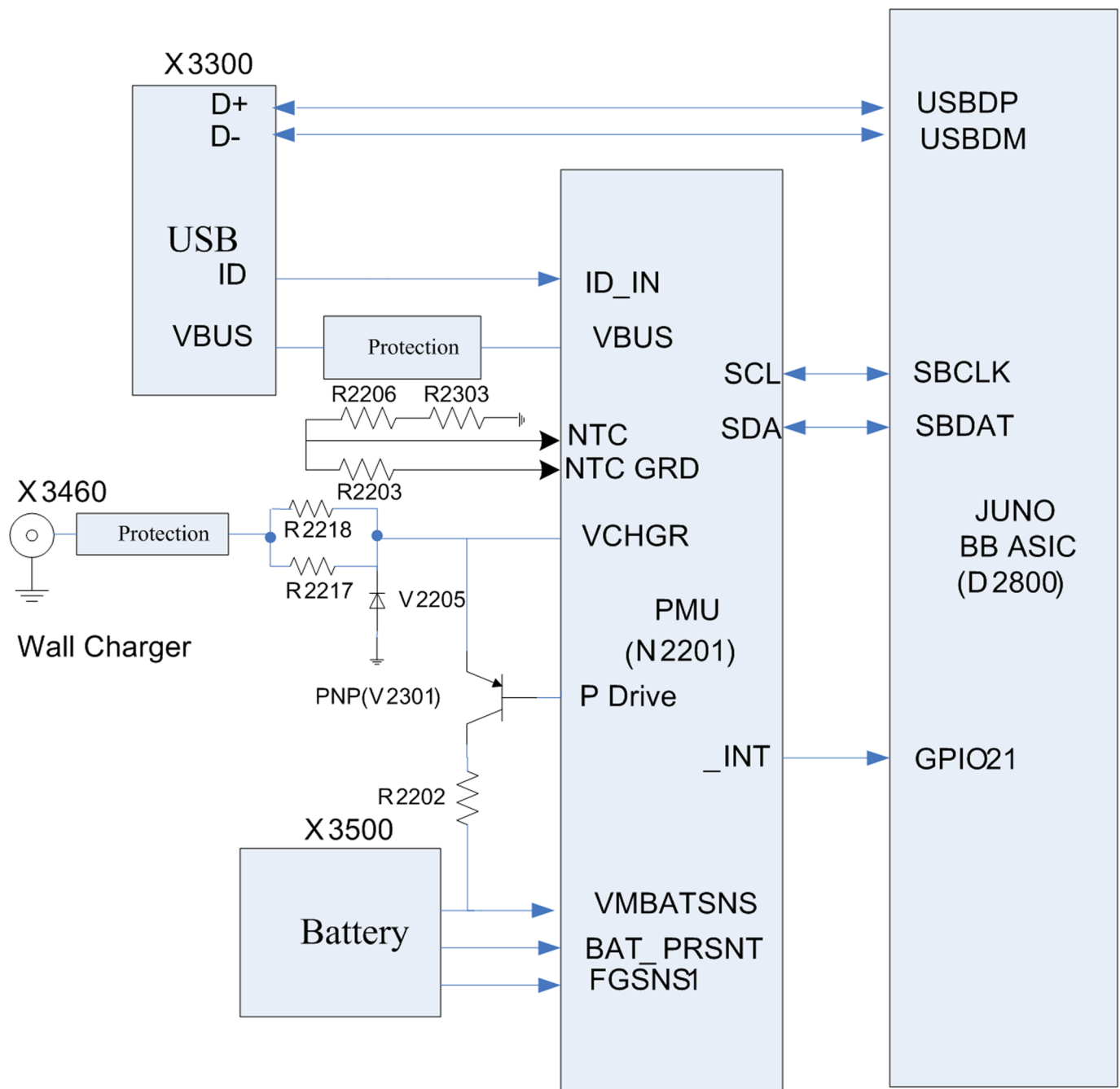


Figure 51 Electrical interface between charger and PMU and baseband

## Wall Charger

The Wall charger input provides a voltage supply that is higher than 3.9V to the VCHGR input on the LOVIISA PMU (N2201).

The Wall charger will start in trickle mode with 90 mA charging current when the battery voltage is less than 2.9V. When the battery voltage is equal to or high than 2.9V, it will allow up to 1.0 A of charging current.

The LOVIISA PMU uses the PDrive signal to control the charging current through the external PNP transistor. The JUNO BB ASIC changes the charging current through the BSC interface to meet the thermo specification by using AUXADCIN3 signal(linear charger).The thermal resistor R2303 is used to monitor the temperature of the phone. Charger will stop charging when the temperature is too hot or to cold.

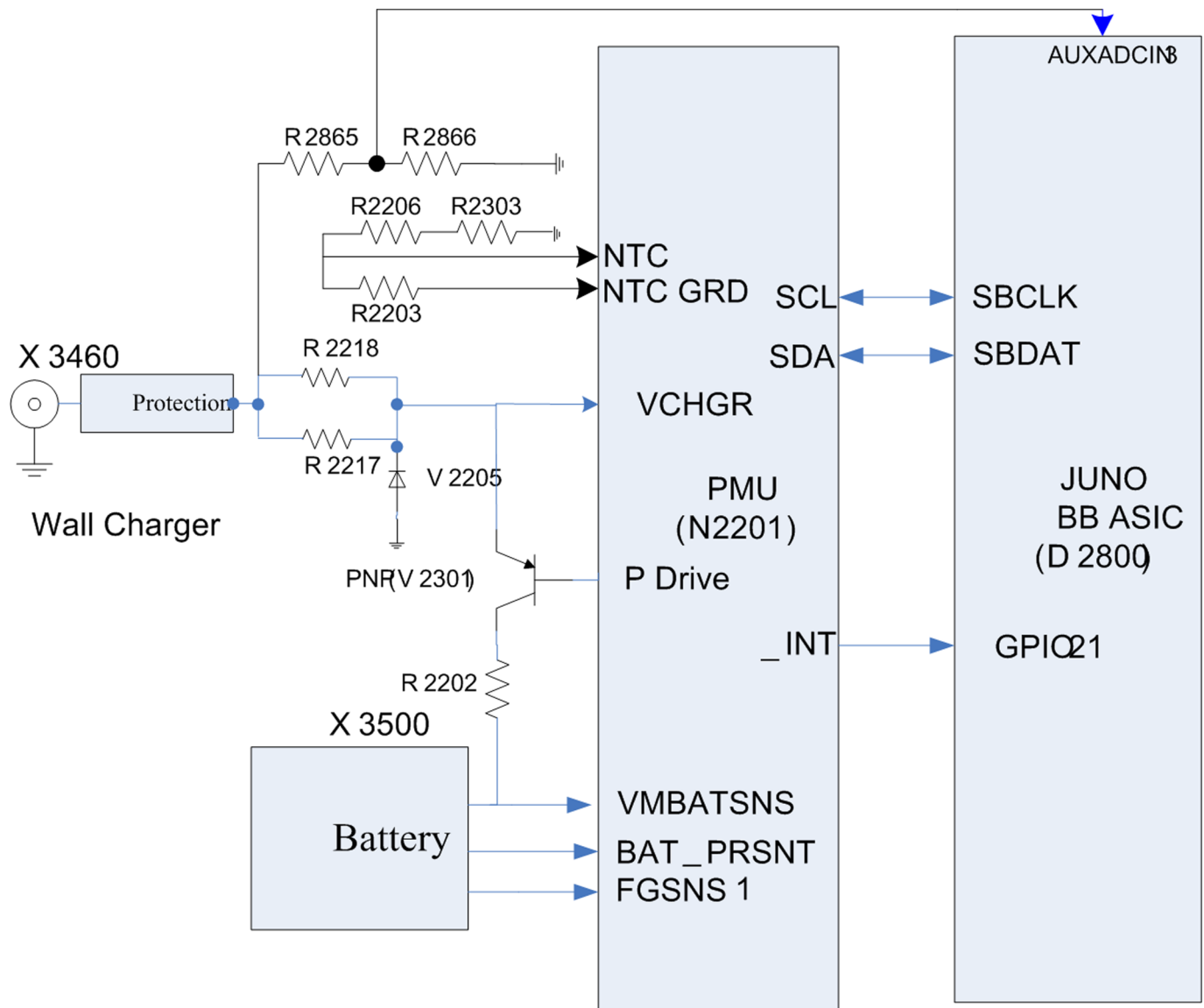


Figure 52 Wall charger

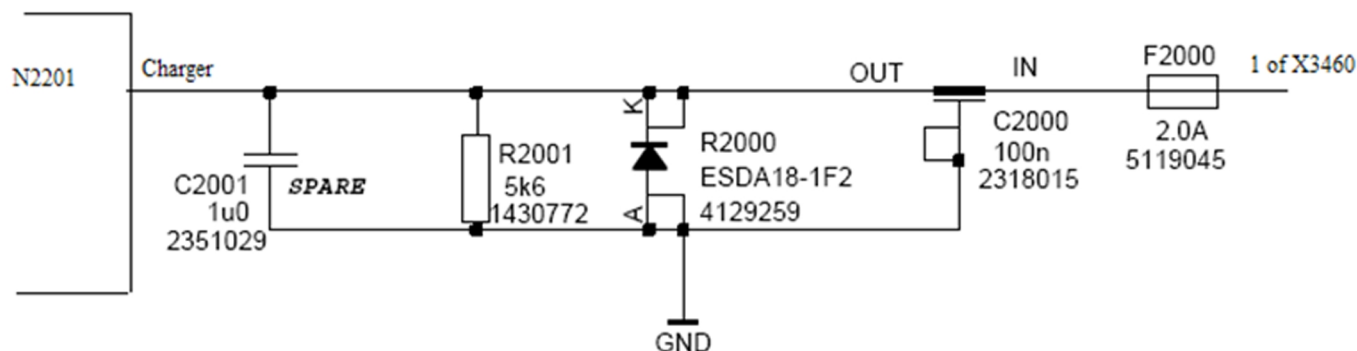


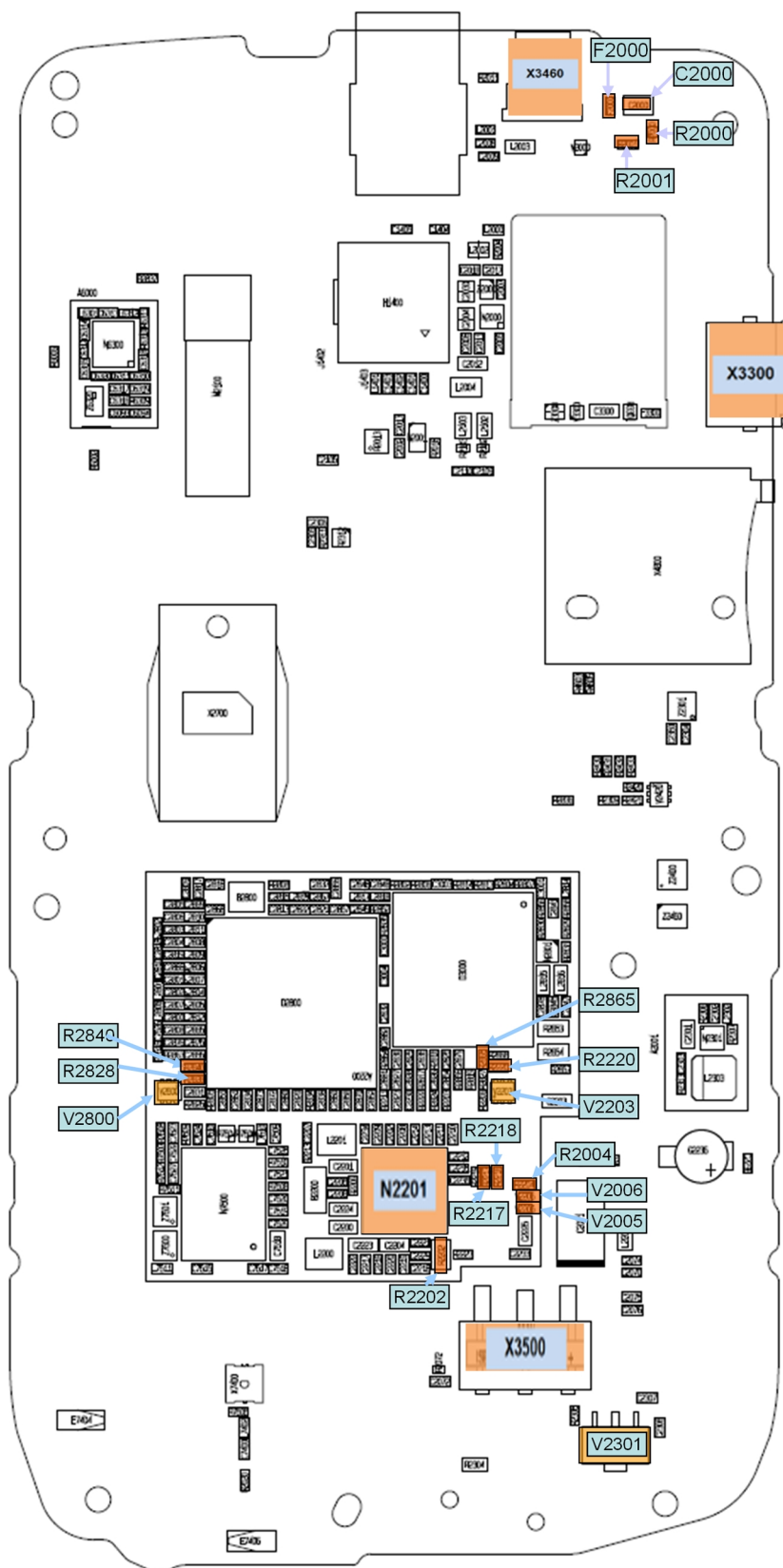
Figure 53 Wall charger protection

Table 8 Charger electrical specification

Symbol	Parameter	CONDITION	Min	Type	Max	Unit
VMBAT	Main Battery Voltage Charging Range		0		4.3	V
fSW	USB Switch Mode Charger Frequency		-	2	-	MHz
RSENSE	External Current Sense Resistor		99	100	101	mΩ

Table 9 Wall charger

Symbol	Parameter	CONDITION	Min	Type	Max	Unit
VCHGR	Wall Adapter Input Voltage Range	External PNP device required	4.65	-	9.3	V
		No charging	9.3	-	20	
	Wall Adapter Presence Detection		4.37	4.5	4.64	V
	Trickle Charging Current	Battery voltage is lower than 3.3V	75	85	100	mA
	Constant Charging Current	Battery present	430	450	475	mA



## Normal and extreme voltages

Energy management is mainly carried out in an Application Specific Integrated Circuit (ASIC) N2201 Loviisa. This circuit contains a number of regulators.

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

**Table 10 Nominal voltages**

Voltage	Voltage [V]	Condition
General Conditions		
Nominal voltage	4.0	
Lower extreme voltage	3.4	
Higher extreme voltage (fast charging)	4.2	
HW Shutdown Voltages		
Hw shutdown	2.9	GSM burst mode
Hw shutdown	3.0	idle mode
SW Shutdown Voltages		
Sw shutdown	3.2	In idle
Sw shutdown	3.106	In call
Min Operating Voltage		
V <sub>coff+</sub>	3.2	Off to on
V <sub>coff-</sub>	2.62	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.

## Modes of operation

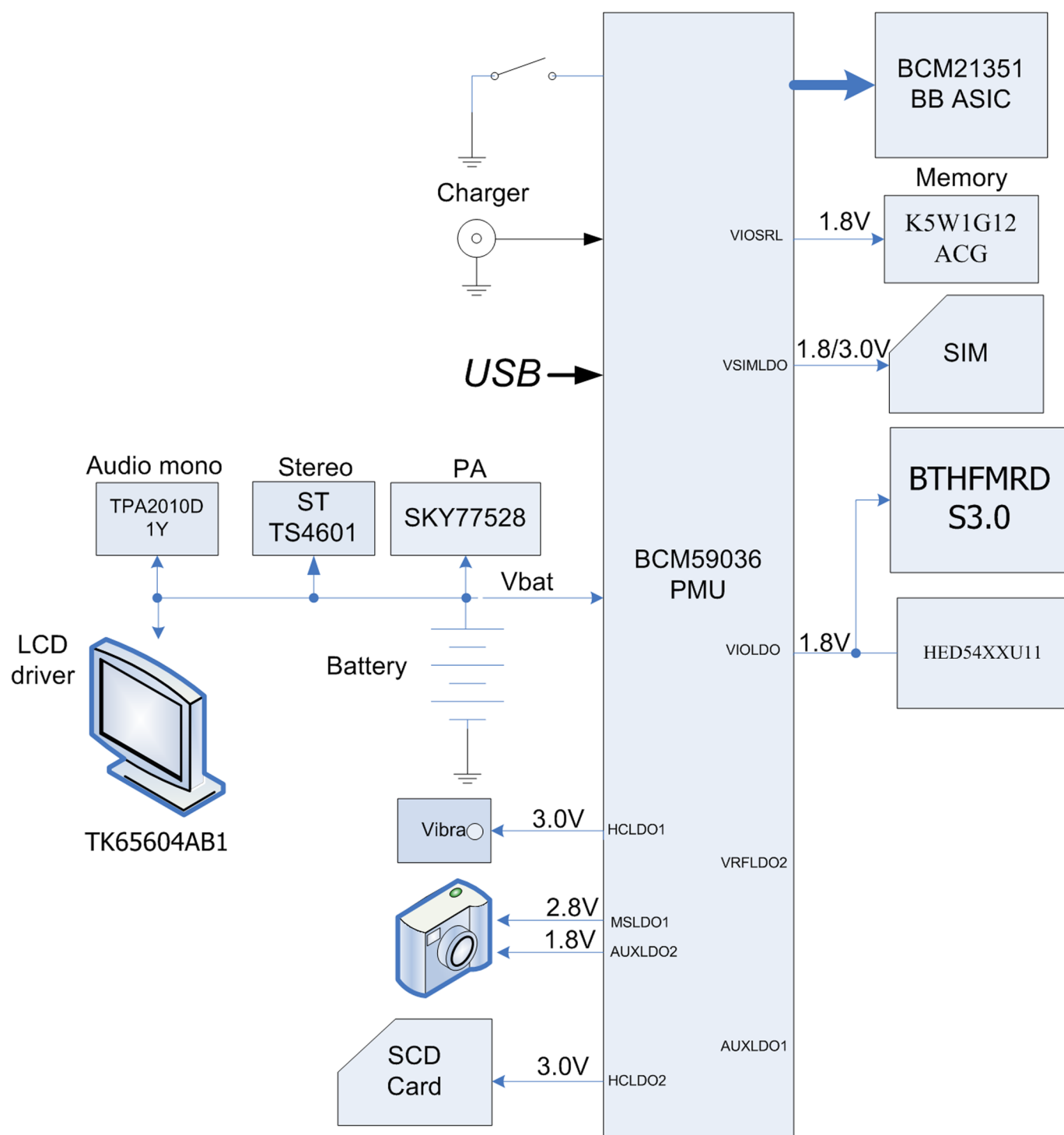
Mode	Description
NO_SUPPLY	The battery is not present or it's voltage is too low for the phone to turn on.
PWR_OFF	The battery voltage is present and it's voltage is over the 3.3V master reset threshold. All the regulators are off. The PMU RTC is on and the 32 kHz oscillator is on but the PMU is not sending the 32 kHz clock to the D2800 (BCM21351) and the BT/FM module.
CHARGING (PWR_OFF)	The phone is turning on (if it is in PWR_OFF mode) when battery voltage is higher than 3.3V. The PMU will charge the battery up to 4.2V when the wall charger is plugged in. [Comment: The phone may turn on into the NORMAL (PWR_ON) mode momentarily and then go into a power saving mode (SLEEP). This will be determined by Nokia firmware.]
RESET	Reset mode is a synonym for the startup sequence.

Mode	Description
NORMAL (PWR_ON)	The PMU is in the normal operating mode and is sending out the 32 kHz clock to the D2800 (BCM21351) and BT/FM module. The BB ASIC in normal operating mode with the UI enabled.
CHARGING (PWR_ON)	The phone is in the NORMAL (PWR_ON) mode. The PMU will charge the battery up to 4.2V when the wall charger is plugged in. The phone will stay in the CHARGING (PWR_ON) mode.
LOCAL	Test mode to run diagnostics for trouble-shooting. The phone UI is off.
SLEEP	Sleep mode is entered only from the NORMAL (PWR_ON) mode with the aid of SW when the system's activity is low to extend the battery life.
FLASHING	Flashing mode is for SW downloading.

**Note:** The actual modes and operation in these modes will be determined by Nokia firmware.

## Power Distribution

The following figure shows a top-level view of the power distribution on the Voyager platform.



**Table 11 Top Level Power Distribution Table**

Supply	Voltage	Chip #	Ref	Function
Battery	Vbat	BCM 59036	N2201	Power Management
Battery	Vbat	TK65604AB1	N2301	LED Backlight Driver
Battery	Vbat	TPA2010D1YZFR	N2801	IHF Audio Amplifier

Supply	Voltage	Chip #	Ref	Function
Battery	Vbat	TS4601EIJ	N2000	Headset Audio Amplifier
Battery	Vbat	Skyworks 77528	N7500	FEM
BCM59036 HC1	3.0V	LIS302DL	N6501	Accelerometer
BCM 59036 AUX1	2.8V	LCD Voltage Connector	X2400	LCD
BCM 59036 VIO	1.8V	LCD Voltage Connector	X2400	LCD
BCM 59036 VIO	1.8V	HED54XXU11	N6500	Hall Sensor
BCM59036 HC1	3.0V	KHN4NX1RA	M3440	Vibrator
BCM 59036 VIO	1.8V	BTFMMTXRDS3_0B	N/A	Blue Tooth & FM Radio
BCM59036 VIOSR	1.8V	K5W1G12ACG-BL60	D3000	Memory
BCM59036 MSLD01	2.8V	Camera Connector	ACF	Camera
BCM59036 AUXLD02	1.8V	Camera Connector	ACF	Camera
BCM59036 HC2	3.0V	SD card Connector	X3560	SD Card
BCM59036 VSIM	1.8/3.0V	SIM Card Connector	X3540	SIM

Table 12 59036PMU&21351 BB Power Distribution Table

Signal Name	Regulator Type	PMU Pin	Status on reset	Rating (V)	Rated (mA)	21351 Function
VX	LDO	AUXLD01	OFF	1.8	150	LCD Analog
VAMP1	LDO	HCLD01	OFF	3.2	350	Analog : Vibra, DDAC L&R
VAMP2	LDO	HCLD02	OFF	3.2	350	Digital SDIO
VANA1	LDO	LVLD01	ON	1.2	150	Analog:USB, Dual DAC, DSI, M&APLL
VANA2	LDO	ALD02	ON	2.5	150	Analog:ADC (1-4) & IHF
VANA3	LDO	ALD01	ON	3	150	Analog: u_phone, aux ADC/DAC, Dual DAC
VCORE	SR	CSR	ON	1.2	500	Vcore Digital, USB PLL, RF_DSP

Signal Name	Regulator Type	PMU Pin	Status on reset	Rating (V)	Rated (mA)	21351 Function
VDCX0	LDO	LCLD0	ON	1.3	20	RF_DCX0
VIO	LDO	IOLD0	ON	1.8	200	BBL, IO
VMEM	SR	IOSR	ON	1.8	500	Flash & DDR Memories, External Memory interface, NVRAM
VOUT	LDO	RFLD02	ON	2.5	150	Analog: USB , ACI
VRF1	LDO	LVLD02	OFF	1.3	150	RF: RX, PLL, IF, TX_PLL, TX_L0
VRF2	LDO	RFLD01	OFF	2.7	150	RF: PA , RX
VUSB2	LDO	MSLD02	ON	3.3	150	USB: Analog, NVM

## ■ SIM, $\mu$ SD

### Electrical Interface Between Baseband and SIM

#### Introduction

The SIM interface on the D2800 JUNO (BCM21351) BB ASIC works in conjunction with the N2201 LOVIISA PMU to support emergency shut-down. When the PMU detects that the battery has been removed, it will notify the D2800 JUNO BB ASIC which will then start an orderly shutdown of the SIMCLK, SIMRST, and SIMDAT pins. The PMU will then disable the VSIMLDO supply.

The signals on the SIM interface can support 1.8V or 3.0V CMOS signaling levels. The VSIMLDO supply from the N2201 LOVIISA PMU determines the signaling levels.

SIM Interface				
Pin Name	Pin	I/O	Type	Description
SIMCLK	B12	O	CMOS	SIM clock
SIMRST	E12	O	CMOS	SIM reset signal
SIMDAT	D12	I/O	CMOS	SIM data signal
GPI019	V6	I	CMOS	SIM emergency shut-down
SIMVDDO	A12			1.8V / 3.0V Digital Supply for SIM Transceivers

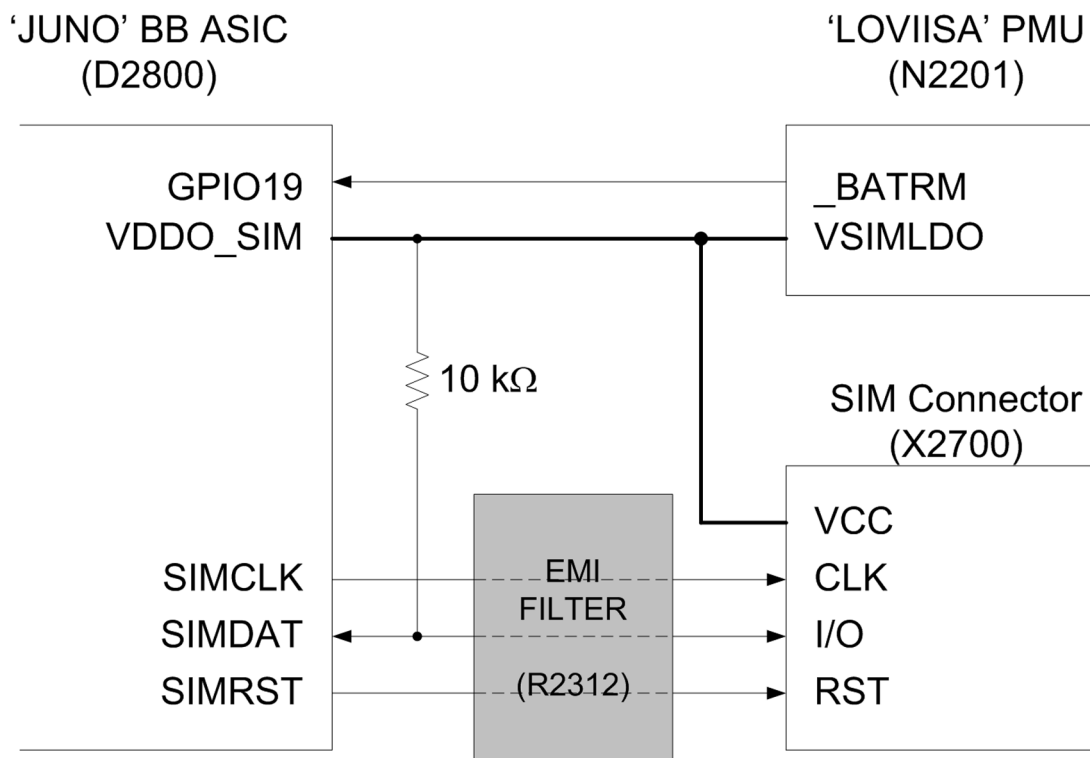


Figure 54 Electrical interface between baseband and SIM

## Electrical Interface Between Baseband and Memory Card

### Introduction

The D2800 JUNO (BCM21351) BB ASIC has an integrated SDIO interface which can be used to support an external memory card. The SDIO interface I/O buffers are protected by the Z2301 EMI filter. In addition to the integrated SDIO interface, GPIO16 is used as a card detection signal from the uSD card slot.

The signals on the SDIO interface can support 1.8V or 3.0V CMOS signaling levels. The VHCLD02 supply from the N2201 LOVIISA PMU determines the signaling levels.

Table 13 D2800 Baseband ASIC (BCM21351) Memory Card Interface Pins

SDIO #1				
Pin Name	Pin	I/O	Type	Description
SD1CK	F14	O	CMOS	SDIO Clock
SD1CMD	B13	I/O	CMOS	SDIO Command
SD1DAT0	E14	I/O	CMOS	SDIO Data bus
SD1DAT1	D13			
SD1DAT2	A14			
SD1DAT3	E13			
GPIO16	T4	I	CMOS	Card Detect/ Hotswap

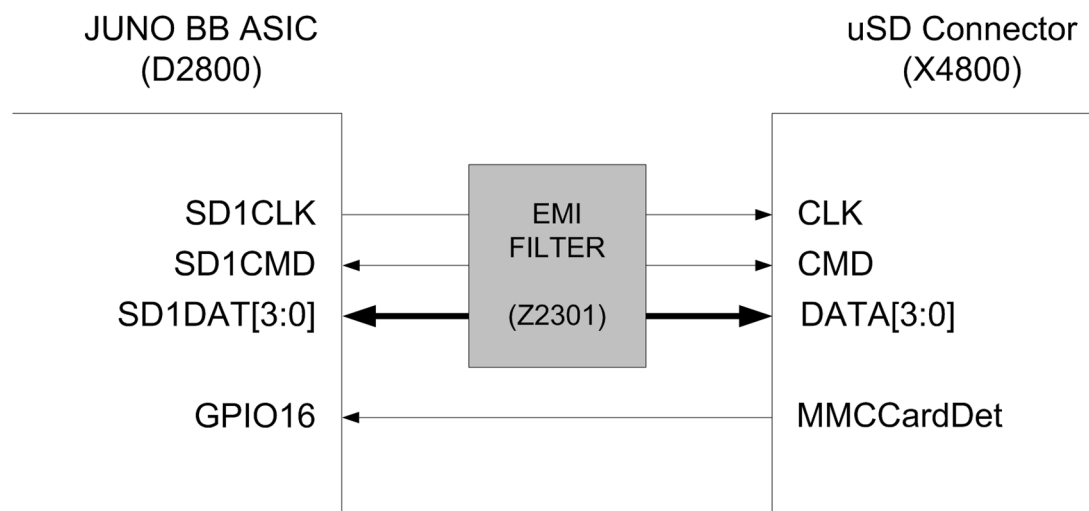


Figure 55 Electrical interface between baseband and memory card

## ■ User interface

### Electrical Interface Between Baseband and Displays

#### Introduction

The D2800 (BCM21351) BB ASIC drives the LCD panel. The LCD panel uses 8-bit Messi (DBI-B) signaling. Additionally, GPIO25 is used as a tearing effect signal from the LCD panel and GPIO24 is used as a single reset signal.

The LCD signals are connected to LCD panel through the X2400 Connector.

All signals on the LCD interface use 1.8V CMOS signaling levels.

#### D2800 Baseband ASIC (BCM21351) Display Interface Pins

Pin Name	Pin	I/O	Type	Description
LCDCS0	B8	0	CMOS	LCD Panel chip select
LCDCD	D11	0	CMOS	LCD command/data select
LCDWE	E8	0	CMOS	LCD write enable
LCDRE	E9	0	CMOS	LCD read enable
LCDD0	E11	I/O	CMOS	LCD 8-bit data bus
LCDD1	F11			
LCDD2	A10			
LCDD3	B10			
LCDD4	D10			
LCDD5	B9			
LCDD6	E10			
LCDD7	D9			
GPIO24	A11	0	CMOS	LCD Reset
GPIO25	B11	I	CMOS	LCD Panel Tearing Effect

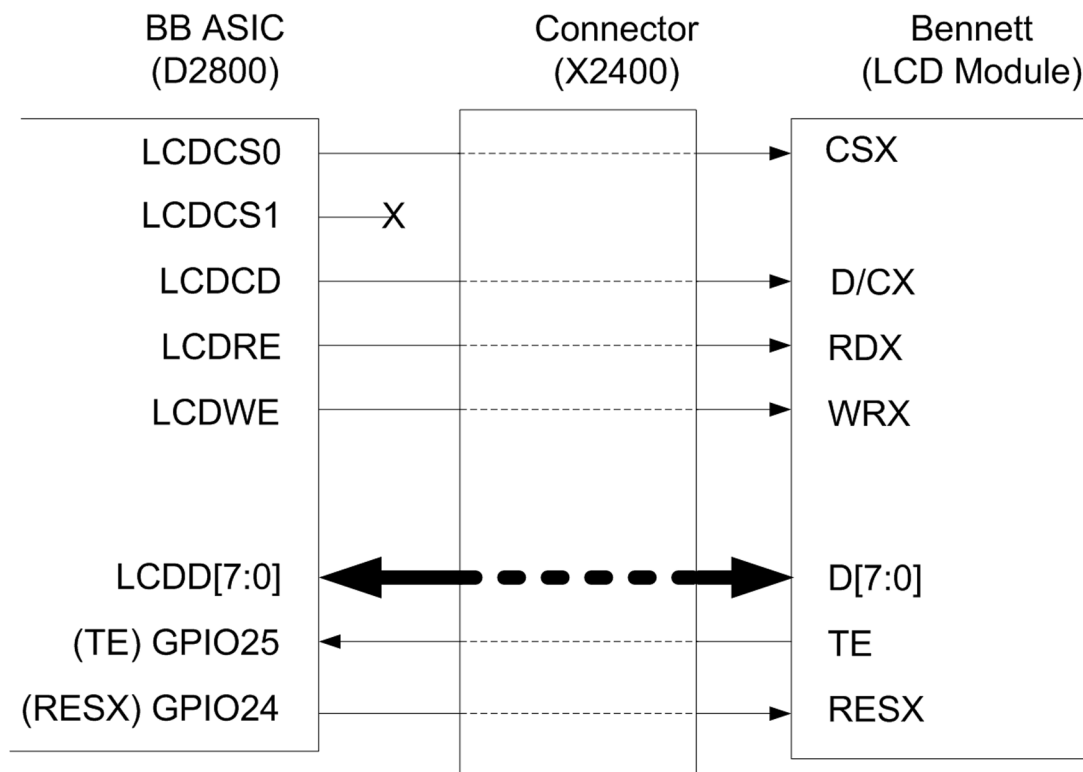


Figure 56 D2800 Baseband ASIC (BCM21351) Display Interface Pins

## Electrical Interface Between Baseband and Keypad

### Introduction

The D2800 JUNO (BCM21351) BB ASIC uses its GPIOs for the keypad interface. The keypad interface orients the keys in rows and columns where GPIO[0:7] are used for rows 0 through 7 and GPIO[8-14] are used for columns 0 through 6.

The GPIO I/O buffers on the D2800 JUNO are protected by the Z2400 & Z2460 EMI filter.

All GPIOs use 1.8V CMOS signaling levels.

### D2800 Baseband ASIC (BCM21351) Keypad Interface Pins

Keypad				
Pin Name	Pin	I/O	Type	Description
GPIO0	M5	0	CMOS	Row 0
GPIO1	R7	0	CMOS	Row 1
GPIO2	M4	0	CMOS	Row 2
GPIO3	R6	0	CMOS	Row 3
GPIO4	R5	0	CMOS	Row 4
GPIO5	T6	0	CMOS	Row 5
GPIO6	N4	0	CMOS	Row 6
GPIO7	T5	0	CMOS	Row 7

Keypad				
Pin Name	Pin	I/O	Type	Description
GPI08	P4	I	CMOS	Column 0
GPI09	U8	I	CMOS	Column 1
GPI010	P2	I	CMOS	Column 2
GPI011	U7	I	CMOS	Column 3
GPI012	U6	I	CMOS	Column 4
GPI013	R2	I	CMOS	Column 5
GPI014	R4	I	CMOS	Column 6

			COL_0	COL_1	COL_2	COL_3	COL_4	COL_5	COL_6
			COLUMN: key matrix						
			0	1	2	3	4	5	6
ROW 0	ROW: key matrix	0	Q	W	E	R <sup>1</sup>	T <sup>2</sup>	Y <sup>3</sup>	U <sup>4</sup>
ROW 1		1	A	S	D	F <sup>4</sup>	G <sup>5</sup>	H <sup>6</sup>	J <sup>#</sup>
ROW 2		2	Z	X	C	V <sup>7</sup>	B <sup>8</sup>	N <sup>9</sup>	M <sup>0</sup>
ROW 3		3	I	O	P	Ctrl	@	SW L	Send
ROW 4		4	K	L	Backspace	Shift			Social
ROW 5		5	,	.	Enter	SW R		?	
ROW 6		6	Sym	Space	Fn		Messaging		
ROW 7		7	UP	Down	Left	Right	Select		

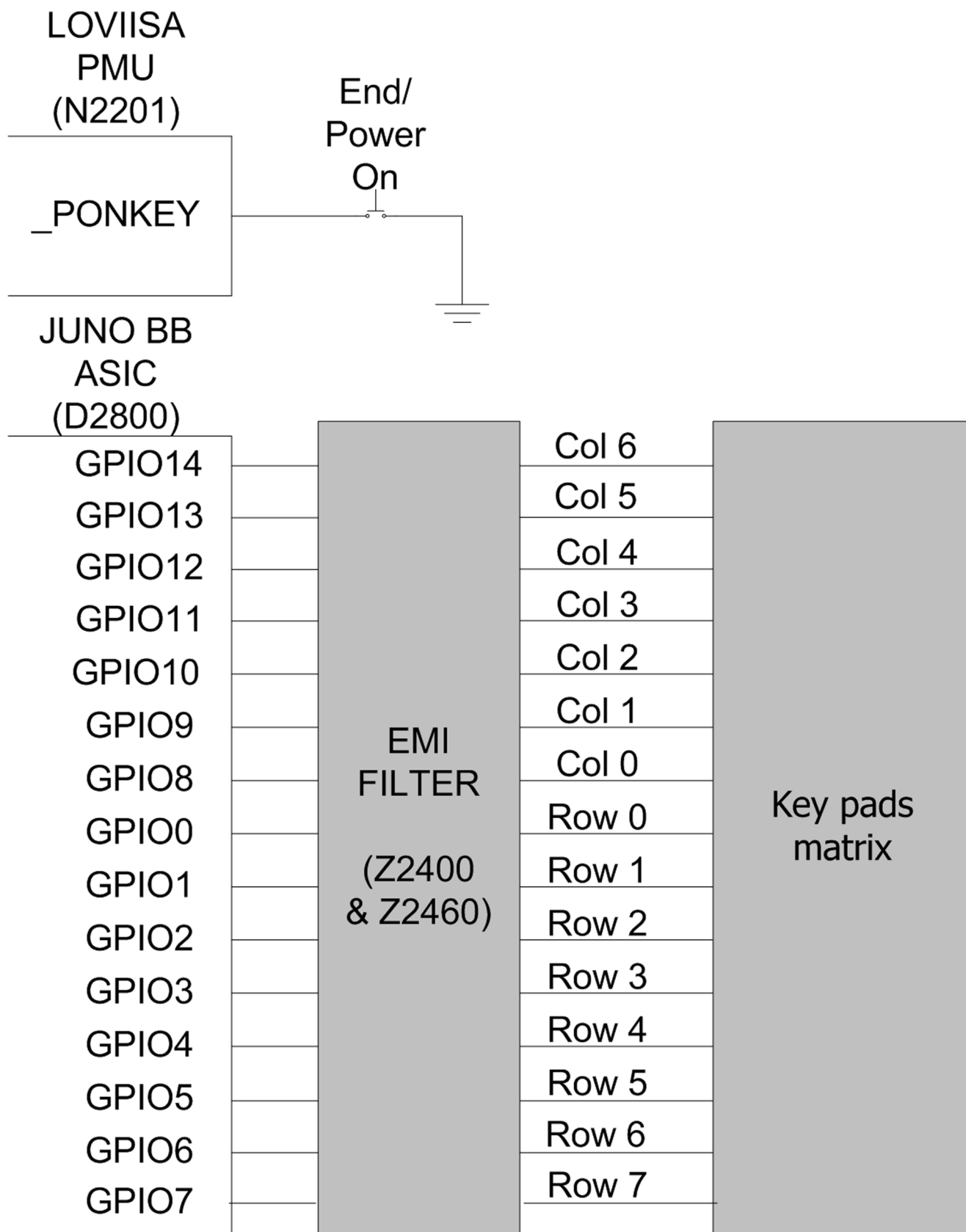


Figure 57 D2800 Baseband ASIC (BCM21351) Keypad Interface Pins

## Electrical Interface Between Baseband and Backlight and Illumination

### Introduction

The D2800 JUNO (BCM21351) BB ASIC uses its' GPIO and GPEN pins to control the backlight and illumination. GPIO17 is used to enable the N2301 LED driver and GPEN9 is used to enable the keypad light.

The GPIO and GPEN signals use 1.8V CMOS signaling levels.

### D2800 Baseband ASIC (BCM21351) Backlight Illumination Pins

Backlight and Illumination				
Pin Name	Pin	I/O	Type	Description
GPIO17	V7	0	CMOS	Enable LED driver
GPEN9	B7	0	CMOS	Enable Keypad Light

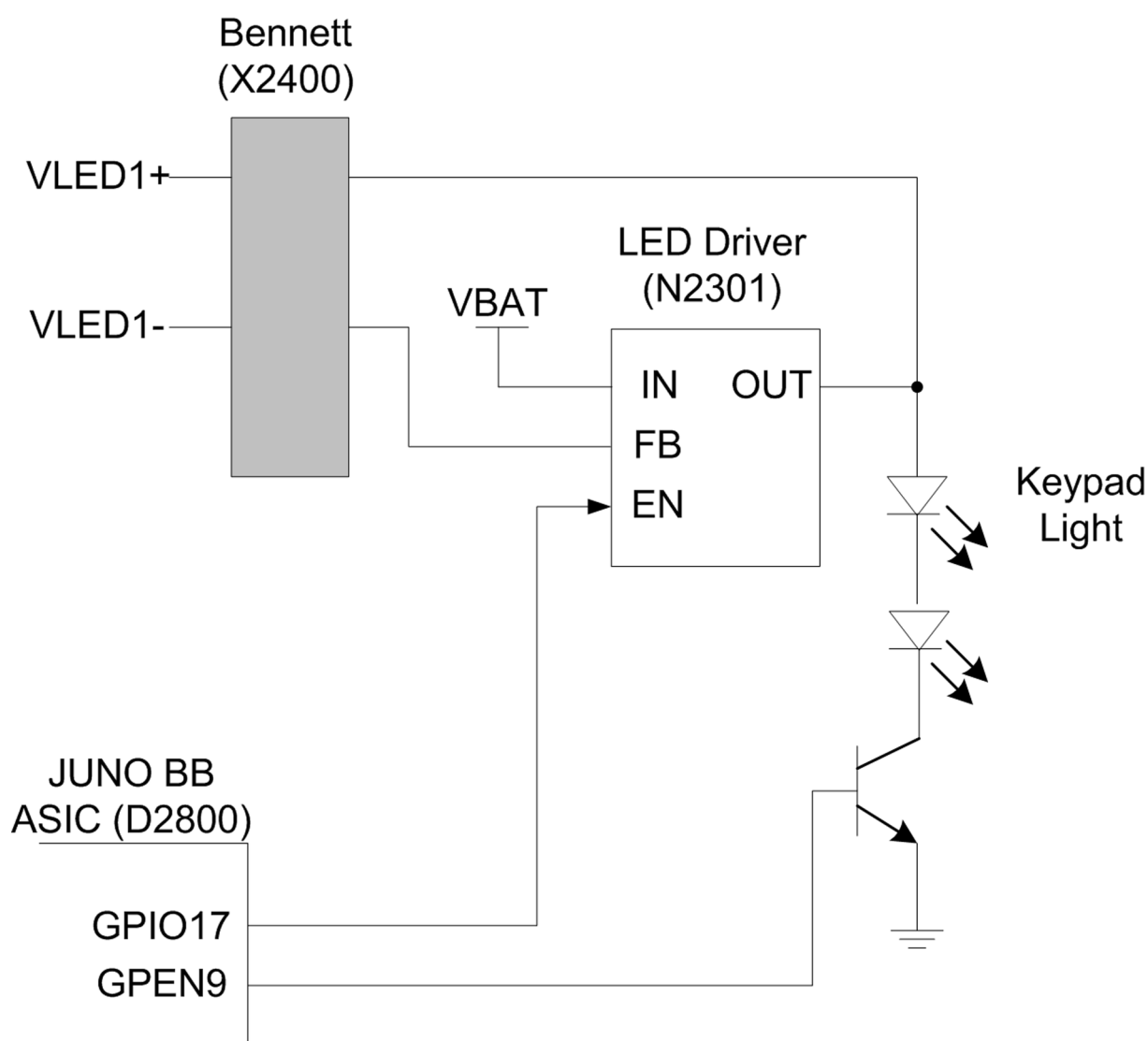


Figure 58 Keypad backlight & LED driver diagram

## Electrical Interface Between Baseband and Camera

### Introduction

The D2800 JUNO (BCM21351) BB ASIC has an integrated Compact Camera Port 2 (CCP-2) serial camera interface. The BB ASIC provides a CMOS reference clock and shut-down signal. The camera is controlled by the Broadcom Serial Control (BSC) #2 interface.

The CAMCK and GPIO23 signals use 1.8V CMOS signaling levels. The BSC (I2C-compatible) interface open-drain I/O are also referenced to 1.8V. The differential clock and data signals from the camera use 1.2V CCP-2 (LVDS) signaling levels.

### D2800 Baseband ASIC (BCM21351) Camera Interface Pins

CCP-2 Serial Camera Interface				
Pin Name	Pin	I/O	Type	Description
CAMCK	W5	0	CMOS	Clock to camera
CCP2_M_C P_CLK	AC6	I	CCP-2	CCP-2 Differential Clock
CCP2_M_C M_CLK	AC5			
CCP2_M_D P0	AB6	I	CCP-2	CCP-2 Differential Data
CCP2_M_D M0	AB5			
GPIO23	V10	0	CMOS	Shutdown
BSCCLK	W4	0	Open- Drain	BSC #2 (I2C-compatible) clock
BSCDAT	Y4	I/O	Open- Drain	BSC #2 (I2C-compatible) data

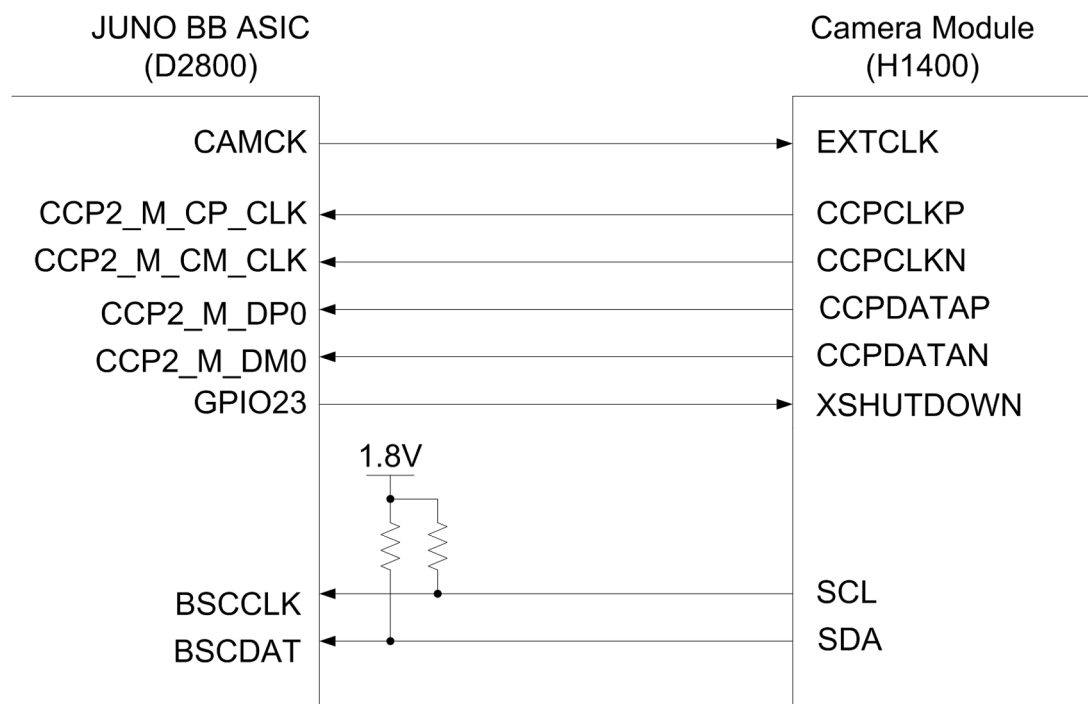


Figure 59 D2800 baseband ASIC (BCM21351) camera interface pins

## Electrical Interface Between Baseband and Vibra

### Introduction

The D2800 JUNO (BCM21351) BB ASIC has an integrated Vibra driver. Vibra outputs will swing approximately 3V peak-to-peak.

### D2800 Baseband ASIC (BCM21351) Vibra Interface Pins

Vibra				
Pin Name	Pin	I/O	Type	Description
VBRAMPL P400P	AC12	0	Analog	Vibra positive output
VBRAMPL P400M	AC13	0	Analog	Vibra negative output

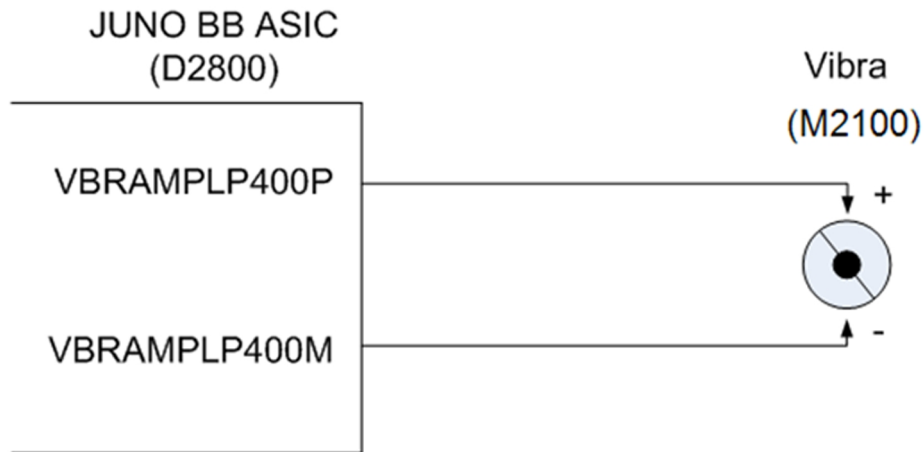


Figure 60 D2800 baseband ASIC (BCM21351) vibra interface pins

## Audio Concept

### Audio Concept

The core audio hardware is integrated in the D2800 ASIC (JUNO). The D2800 provides the interfaces to all of the audio transducers and additionally includes the output to the Vibra motor. The headset stereo output is driven by an audio amplifier (N2000) and the IHF speaker is driven by D-class audio amplifiers (N2801).

There are 4 audio transducers:

- Microphone (Internal)
- 3.5mm jack for an Auxiliary Microphone (External) or Headset
- 1 Earpiece
- 1 IHF (Internal Hands Free) speaker

The platform supports the following audio applications:

- Voice Telephony
- Voice Recording
- FM Radio Reception
- FM Radio Recording
- Video Recording
- Stored Content Playback (audio such as MP3, WAV, AAC etc. as well as combined with video)
- Above services combined with a Bluetooth headset

Several audio paths exist for most audio applications. For example, voice signals can be sampled using either an internal or an external microphone. Audio samples can be played back through the earpiece, IHF speaker or through the headset. Finally, hearing aids are supported by the addition of a Tele-coil, capable of transferring the audio into a hearing aid through induction.

The follow diagram shows six audio paths:

**Internal Microphone:** microphone path 1 through ARXMICP1 and ARXMICN1. The differential pair goes through a few passive components and then to the audio connector AUDIOCONN directly.

**External Microphone:** microphone path 2 through ARXMICP2 and ARXMICN2. The differential signal goes through the EMI filter, some passive components and then to the audio connector AVCONN.

**Headset:** DDACAMP channel A. This signal is a 100mW left and right differential pair. This signal goes through an external amplifier N2000, some passive components and then to the audio connector AVCONN.

**Earpiece:** DDACAMP channel B. The differential pair goes to the audio connector AUDIOCONN directly.

IHF: IHFAMP left channel. The differential pair goes through the 100nH inductors and then to the audio connector AUDIOCONN.

Vibra: VBRAMP left channel. The differential pair go to the audio connector AUDIOCONN directly.

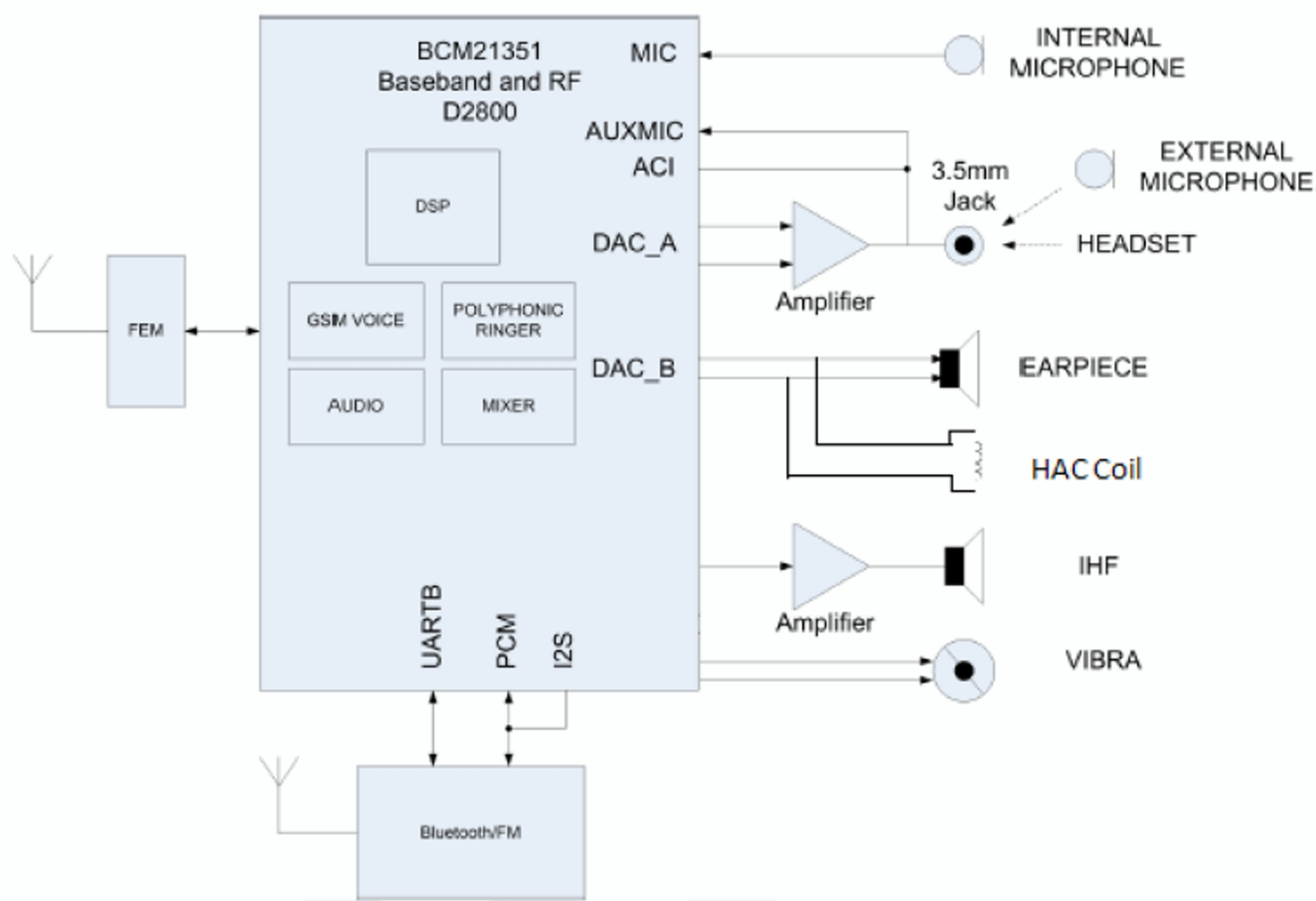


Figure 61 Audio block diagram

## Electrical Interface Between Baseband and Audio Components

### Introduction

The D2800 JUNO (BCM21351) BB ASIC has interfaces for an internal and external microphone, earpiece drivers, stereo headset drivers, and mono internal hands-free drivers. It also has an Accessory Component Interface (ACI) interface to identify peripherals plugged into the 3.5mm AV jack. Two GPIO pins are used for detecting when a plug is inserted into the X2001 AV connector and another is used for enabling the HAC amplifier.

The AVI signals are referenced to 2.5V. All three GPIO pins use 1.8V CMOS signaling levels.

### D2800 Baseband ASIC (BCM21351) Audio Interface Pins

Audio				
Pin Name	Pin	I/O	Type	Description
ARXMICP1	T22	I	Analog	Internal MIC Input +
ARXMICN1	R22	I	Analog	Internal MIC Input -
ARXMICBI AS	U22	Out put	Analog	Internal MIC Bias

Audio				
Pin Name	Pin	I/O	Type	Description
ACI_DATA	Y23	I/O	Analog	ACI Data Input/Output
ACI_AUDIO IN	W22	I	Analog	ACI MIC bias point
GPI030	V17	I/O	CMOS	Plug Detect
GPI014	R4	I/O	CMOS	Connect Detect
ARXMICP2	R23	I	Analog	External MIC Input +
ARXMICN2	T23	I	Analog	External MIC Input -
ARXAUXMI CBIAS	U23	Out put	Analog	External MIC Bias
GPI022	V2	I/O	CMOS	HAC Amplifier Enable
DDACAMP LP100A	V12	0	Analog	External Headset Left Driver +
DDACAMP LN100A	U12	0	Analog	External Headset Left Driver -
DDACAMP RP100A	U13	0	Analog	External Headset Right Driver +
DDACAMP RN100A	V13	0	Analog	External Headset Right Driver -
DDACAMP LP100B	Y12	0	Analog	Earpiece Driver +
DDACAMP LN100B	W12	0	Analog	Earpiece Driver -
IHFAMPRP LINOUT	AB21	0	Analog	Internal Hands-free driver +
IHFAMPRN LINOUT	AA21	0	Analog	Internal Hands-free driver -

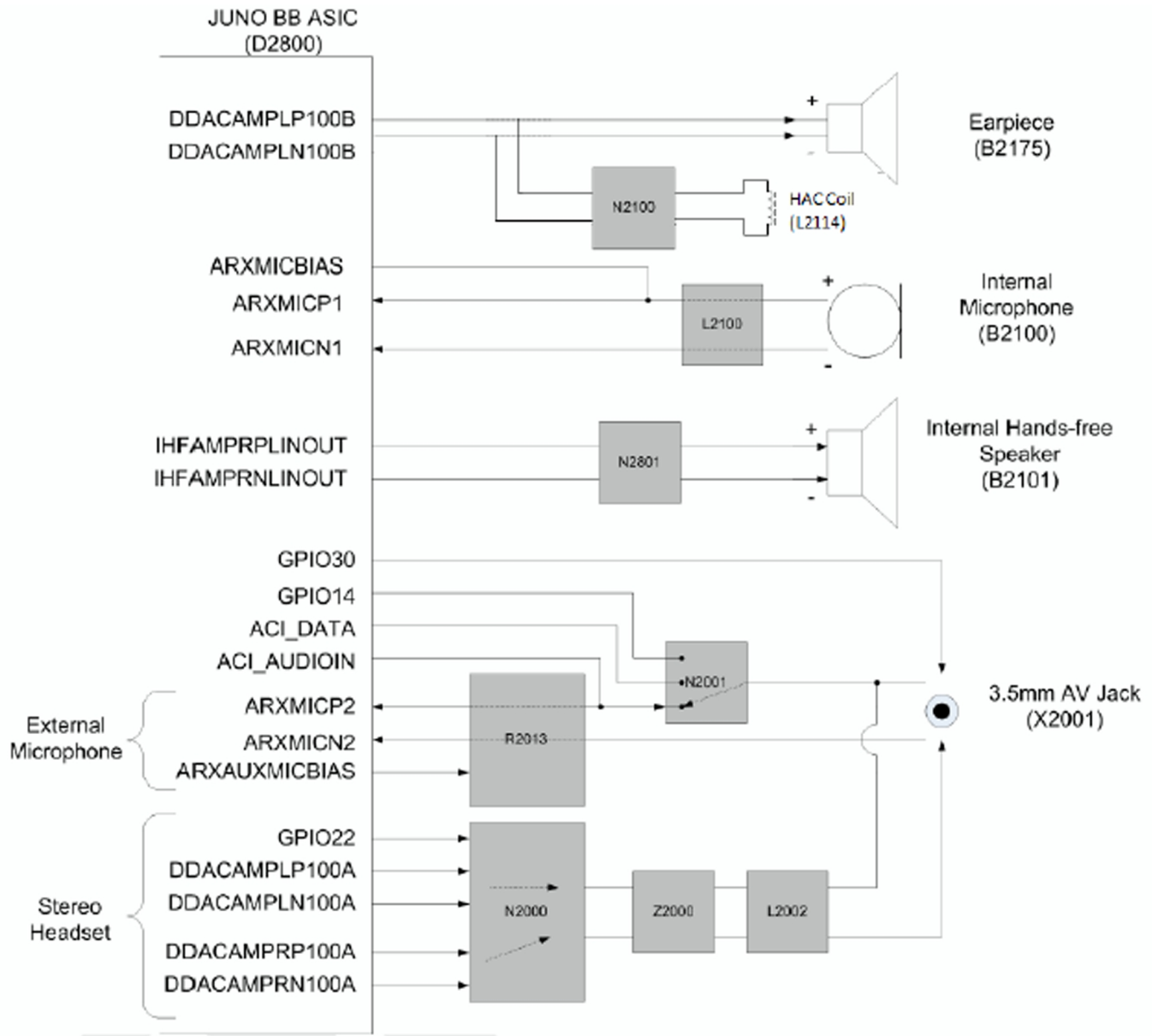


Figure 62 Electrical interface between baseband and audio components

## ■ RF description

### RF General Description

The platform is based on the capabilities of the D2800 Juno Baseband ASIC (BCM21351) – a 65-nm quad-band EDGE/GPRS/GSM multimedia baseband processor with an embedded RF transceiver.

The D2800 Juno (BCM21351) embedded RF transceiver subsystem is a quad-band, Class 33 EDGE capable, implemented in the phone as Class 32. It has a low-IF receiver and a polar transmitter that requires no transmit filters and uses a standard linear PA. The D2800 Juno has a 26 MHz integral DCX0 connected internally to the RF and PLLs with four buffered 26 MHz clock outputs. The platform only uses one of the 26 MHz clock outputs, RF\_XON.

## Basic RF Features

Supported Modulation	GMSK and 8PSK
Frequency Bands supported	GSM850: ARFCN 128-251 - TX: 824.00-849.00 MHz - RX: 869.00-894.00 MHz EGSM900: ARFCN 975-1023, 1-124 - TX: 880.00-915.00 MHz - RX: 925.00-950.00 MHz GSM1800 (DCS): ARFCN 512-885 - TX: 1710.00 – 1785.00 MHz - RX: 1805.00 -- 1880.00 MHz GSM1900 (PCS): ARFCN 512-810 - TX: 1850.00 – 1910 MHz - RX: 1930.00 – 1990 MHz
Band configurations	Quad-band
GMSK Power Class	Class 4 (GSM850 and GSM900) Class 1 (GSM1800 and GSM1900)
8PSK Power Class	Class E2 (All bands)
Multislot Class	MSC 32
Static sensitivity level	-108 dBm typical (All bands)

## RF Key Components

Description	Reference
Multimedia Baseband and RF ASIC - "Juno"	D2800
GSM/EDGE Front-end module (Amplifier + switch)	N7500
Dual GSM RX SAW filter for GSM850 and GSM900	Z7500
Dual GSM RX SAW filter for GSM1800 and GSM1900	Z7501
26 RF MHz Crystal (8 pF)	B2800

### GSM Receiver

The D2800 Juno BB/RF ASIC contains four low noise amplifiers (LNA), one for each band. The receiver uses a low-IF architecture, meaning the incoming RF signal to the mixer is quadrature-down-converted to the IF frequency.

The following figure shows the interface between the receiver section of D2800 Juno's integrated RF with the FEM.

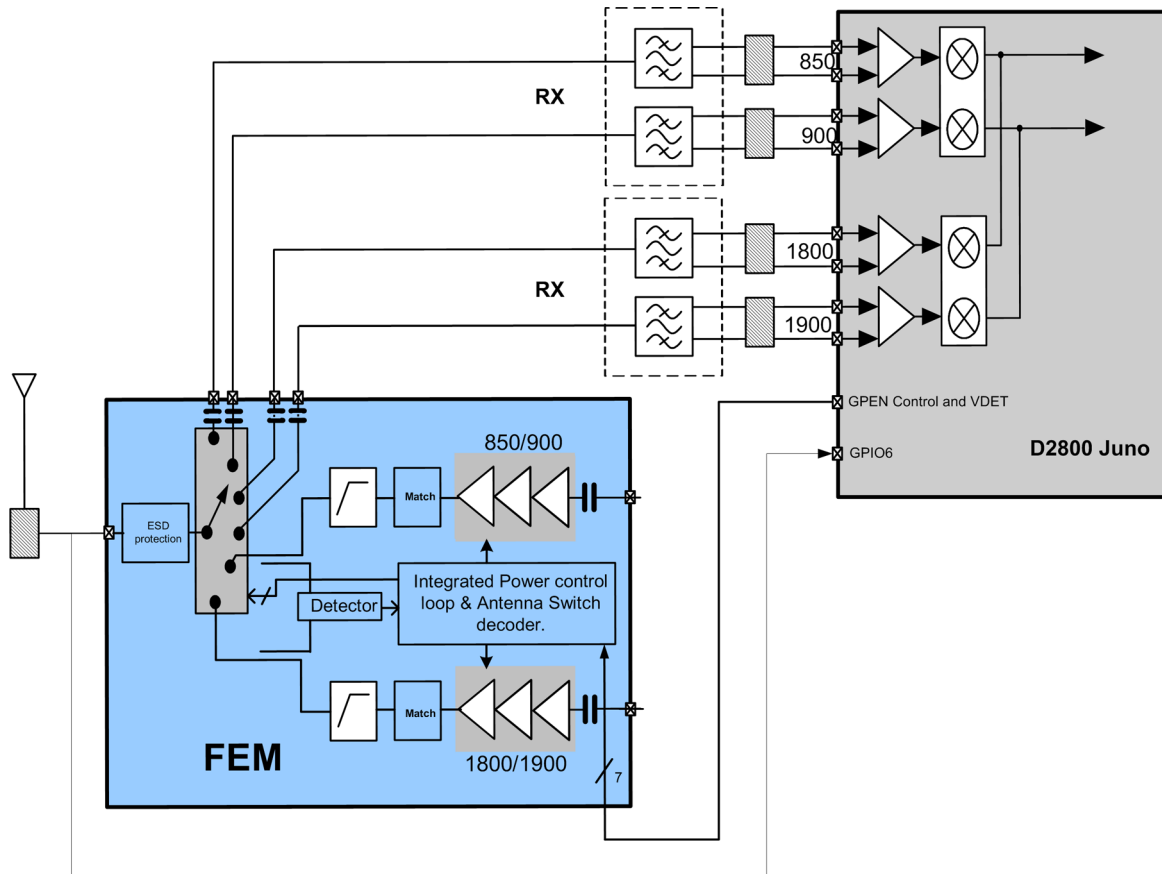


Figure 63 RF receiver module

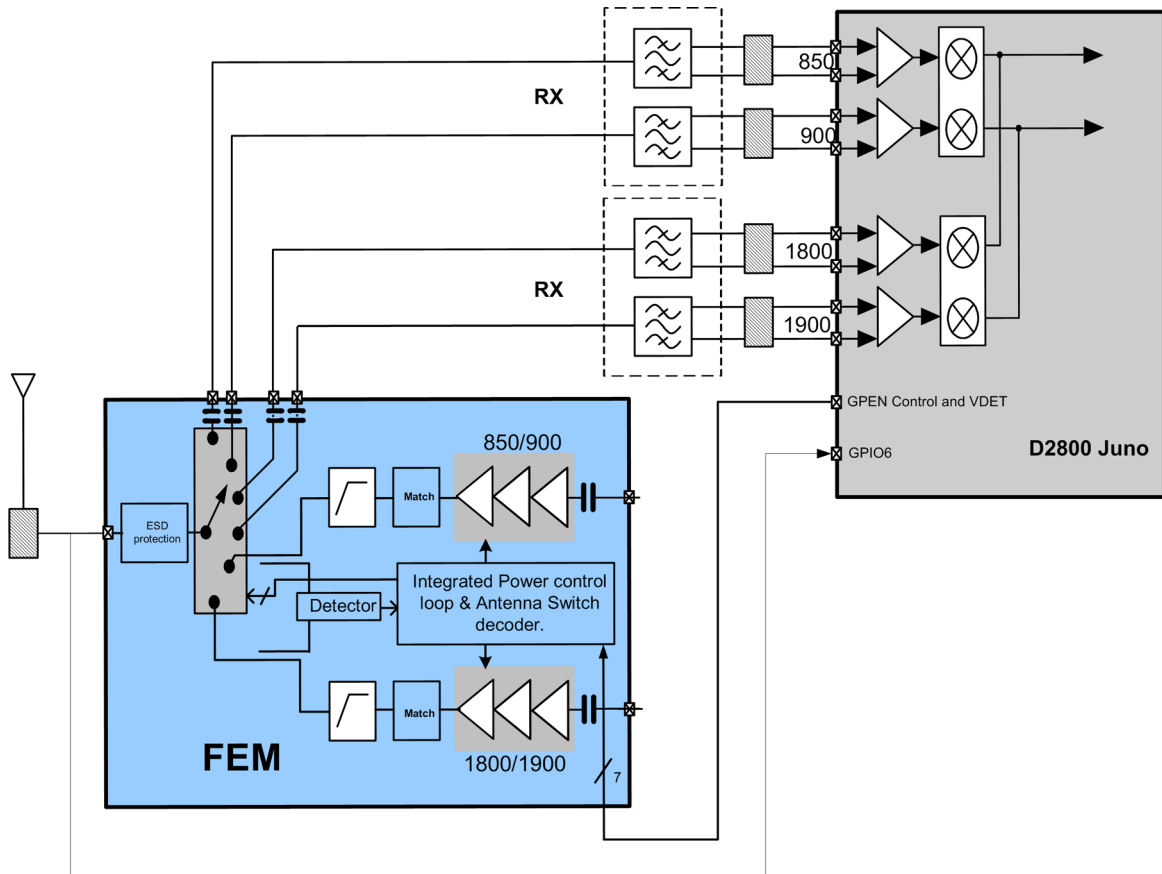
## Introduction to Receiver Functionality

The analogue signal is received by the phone's antenna and is converted to a digital signal by the integrated RF and processed by the D2800 Juno BB ASIC (i.e., to the earpiece).

Most of the receiver functions are integrated inside D2800 Juno BB ASIC. Signal with different frequencies take different paths, therefore are handled by different components. The only required external components are a single antenna switch a SAW filter, including matching, for each of the four frequency bands. The antenna switch circuitry is a part of the Front End Module (FEM) and the four SAW filters (Z7500 & Z7501) are contained in 2 dual packages where one is used for low bands (GSM850/GSM900) and the other for high bands (GSM1800/GSM1900).

## GSM Transmitter

The transmit chain consists of the transmitter section of the D2800 Juno's integrated RF and a dual-mode quad-band FEM.



**Figure 64 RF transmitter module**

Simple external component matching at the radio output pins produces adequate drive power and a stable input match for the FEM input.

The FEM is a combined PA and switch supporting both quad band (GSM850/900/1800/1900) and dual mode operation (GMSK/EDGE).

In GMSK mode, the FEM is operated in saturated mode using fixed input (0..6 dBm) and variable gain. VRAMP signal is generated in the BB section and feed to the FEM module for power ramping control.

In EDGE mode the FEM is operated in linear mode with variable input and fixed gain. In this mode the VRAMP act as bias for the FEM. Depending on Power levels the bias will have different values. This feature is needed in order to improve the efficiency of the PA section and thereby lowering the current especially at the lower levels.

The antenna output of the FEM is connected to the RF test switch or Antenna feeding point depending on conducted or radiated state.

## Introduction to Transmitter Functionality

The digital baseband signal (i.e., 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 (i.e., GSM900).

The transmit chain consist of the transmitter section of the D2800 Juno's integrated RF and a quad-band-dual-mode FEM Module. The transmitter functions are implemented in the D2800 Juno BB ASIC. The transmitter provides the following capability:(GSM1800/GSM1900).

- GMSK mode: Power Class 4 for GSM850 and GSM900 bands (up to 33 dBm), Power Class 1 for DCS1800 and PCS 1900 bands (up to 30 dBm)
- EDGE/8PSK mode: Power Class E2 (27 dBm LB, 26 dBm HB).

## ■ Technical specifications

### Main RF characteristics for GSM band phone

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800, GSM1900
RX Frequency band	GSM850: 869 - 894 MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
TX Frequency band	GSM850: 824 - 849 MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
Number of RF channels	GSM850: 124 (ARFCN 128-251)
	EGSM: 174 (ARFCN 975-1023, 1-124)
	GSM1800: 374 (ARFCN 512-885)
	GSM1900: 299 (ARFCN 512-810)
Channel spacing	200 kHz
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16

### Environmental conditions

Environmental condition	Ambient temperature	Notes
Normal operation	-15 °C ... +55 °C	Specifications fulfilled
Reduced performance	55 °C ... +70 °C and -30°C ... - 15°C	Operational only for short periods
Intermittent or no operation	-40 °C ... -15 °C and +70 °C ... +85°C	Operation not guaranteed but an attempt to operate will not damage the phone
No operation or storage	<-40 °C and >+85 °C	No storage. An attempt to operate may cause permanent damage
Charging allowed	-10 °C ... +60 °C	
Long term storage conditions	0 °C ... +85 °C	

Environmental condition	Ambient temperature	Notes
Humidity and water resistance		Relative humidity range is 5 to 95%. Condensed or dripping water may cause intermittent malfunctions. Protection against dripping water has to be implemented in (enclosure) mechanics. Continuous dampness will cause permanent damage to the module.

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# Nokia Customer Care

## Glossary

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

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

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

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

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

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