Nokia Customer Care

Service Manual

RM-614 (C3-00)

Mobile Terminal

Part No: 9219735 (Issue 1)

COMPANY CONFIDENTIAL

NOKIA
Care

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Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Original issue	04/2010	Jeff Zhao	

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IMPORTANT

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

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Warnings and cautions

Warnings

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

Cautions

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

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For your safety

QUALIFIED SERVICE

Only qualified personnel may install or repair phone equipment.

ACCESSORIES AND BATTERIES

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

CONNECTING TO OTHER DEVICES

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

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Care and maintenance

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

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

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

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ESD protection

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

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

To replace the covers ESD protection must be applied.

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

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

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

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

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

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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.

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C3-00 Service Manual Structure

1 General information
2 Service Devices and Service Concepts
3 BB Troubleshooting and Manual Tuning Guide
4 RF troubleshooting
5 System Module
6 BOB (WLAN/FM/BT)
Glossary

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1 — General information

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Product selection

RM-614 (C3–00) is a GSM Quad-band phone, supporting EGSM 850/900/1800/1900 bands.

Figure 1 RM-614 (C3–00) 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
- 2MPix camera
- BT 2.0
- Stereo FM radio & RDS
- MP3 player
- Micro SD memory card slot
- FOTA
- GPRS

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- Codecs supported: FR, EFR, HR, AMR
- SIM support: 3volt, 1.8volt
- WLAN (b/g)
- Keymat: hard tops
- loudness: 102 db
- Dedicated Messaging Hard Key
- Dedicated Contacts 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
- DRM 2.0
- WAP 2.0
- MMS 1.3
- SyncML 1.2
- Nokia Xpress Audio messaging
- Active Home Screen with integrated widgets
- WAPI for China

Accessories

In-box:

- Phone: C3–00
- Battery: BL-5J, 1320 mAh
- 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-5J 1320 mAh Li Lion battery pack	115.5 x 58.1 x 13.6	114	63.2

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Battery Endurance

Battery	Talk Time		Stand-by Time	
BL-5J with 1320 mAh Li Lion standard battery	Best Talk Time	GSMA Talk Time	Best Stand-by Time	GSMA Stand-by Time
	Up to 30 hours	7 hours	Up to 1000 hours	800 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.

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2 — Service Devices and Service Concepts

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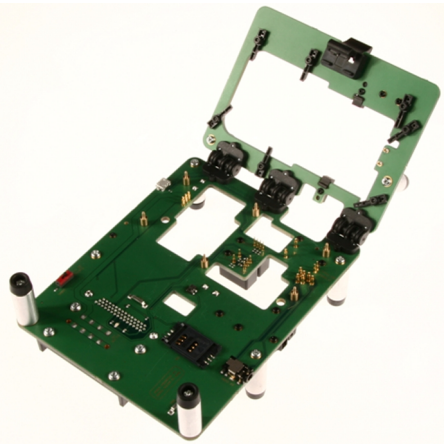
Service devices

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-614. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

<table>
<tr><td rowspan="2">  </td><td>MJ-262</td><td>Module jig</td><td></td></tr>
<tr><td colspan="3">MJ-262 is meant for component level troubleshooting.
The jig includes an RF interface for GSM and Bluetooth. In addition, it has the following features:
• Provides mechanical interface with the engine module
• Provides galvanic connection to all needed test pads in module
• MMC interface
• Duplicated SIM connector
• Connector for control unit
• Access for AV- and USB connectors
• CA-128RS cable is used together with this jig for RF testing.</td></tr>
</table>

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-614. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

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CU-4

CU-4	Control unit	

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

The unit has the following features:

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

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

Instructions

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

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

Reconnecting the power supply requires a Phoenix restart.

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FLS-5	Flash device	

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

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

FPS-21

FPS-21	Flash prommer	

FPS-21 sales package:

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

FPS-21 interfaces:

Front

- Service cable connector

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

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

Rear

- DC power input

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

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

  For connecting a PC.
- Phone connector

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

  For connecting the FPS-21 to LAN.

Inside

- Four SD card memory slots

  For internal storage memory.

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

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	PK-1	Software protection key	
	PK-1 is a hardware protection key with a USB interface. It has the same functionality as the PKD-1 series dongle. PK-1 is meant for use with a PC that does not have a series interface. To use this USB dongle for security service functions please register the dongle in the same way as the PKD-1 series dongle.		
	RJ-230	Common jig	
	RJ-230 is a jig used for soldering and as a rework jig for the engine module.		
	SB-6	Bluetooth tester	
	The SB-6 test box is a generic device to perform Bluetooth bit error rate testing and doing cordless FBUS connection via Bluetooth.		
	SB-7	WLAN test box	
	WLAN test requires defined position for the device.		

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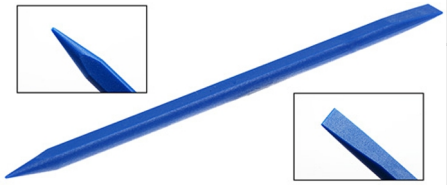
	SRT-6	Opening tool	
	SRT-6 is used to open phone covers. **Note:** The SRT-6 is included in the Nokia Standard Toolkit.		
	SS-93	Blue stick tool	
	SS-93 is used for general disassembly and assembly tasks.		
	SX-4	Smart card	
	SX-4 is a BB5 security device used to protect critical features in tuning and 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-614. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

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

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

XRS-6	RF cable	
The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment. SMA to N-Connector approximately 610 mm. Attenuation for: • GSM850/900: 0.3+-0.1 dB • GSM1800/1900: 0.5+-0.1 dB		

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Service concepts

Level 1 POS flash concept

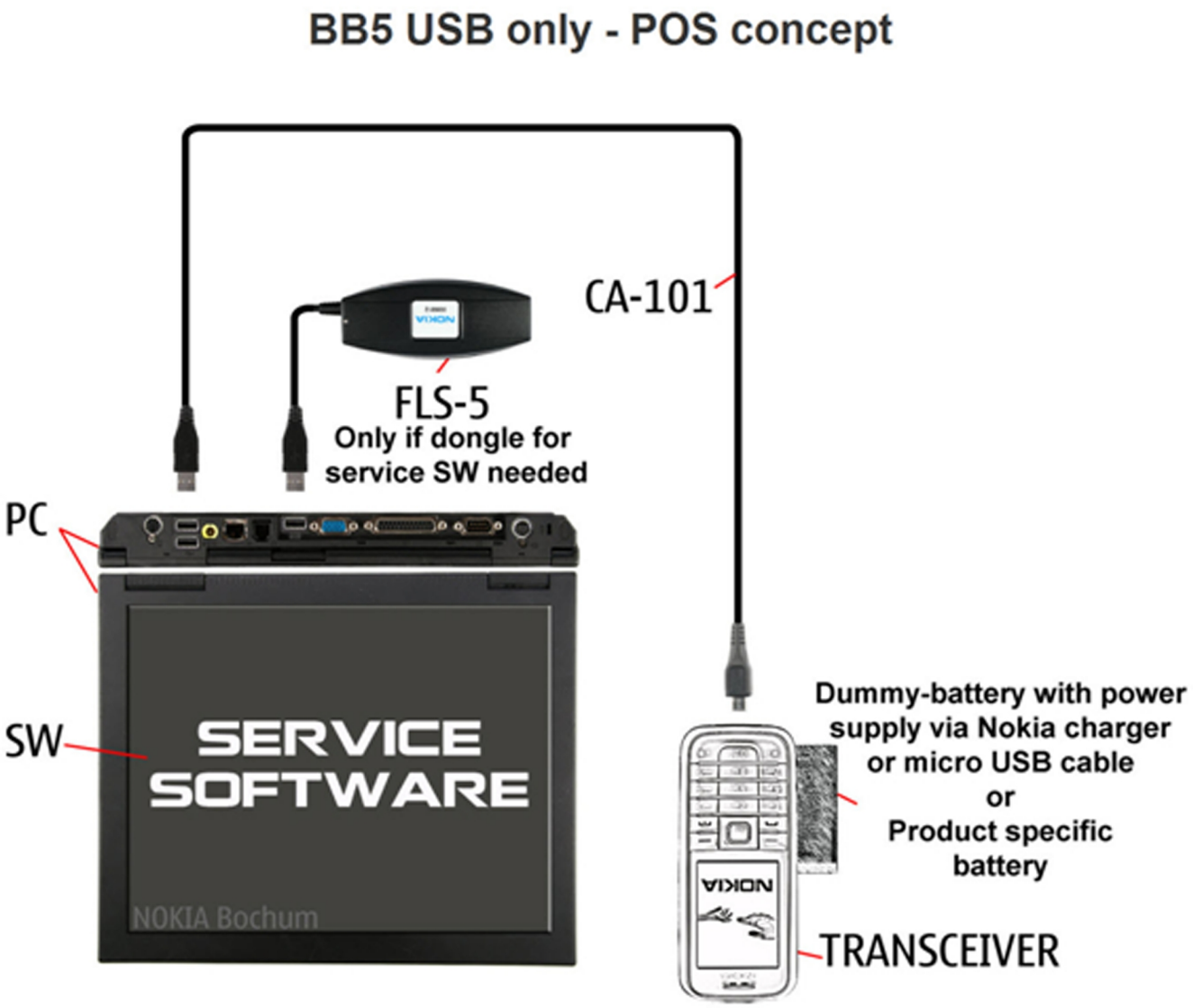

Figure 2 Level 1 POS flash concept

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

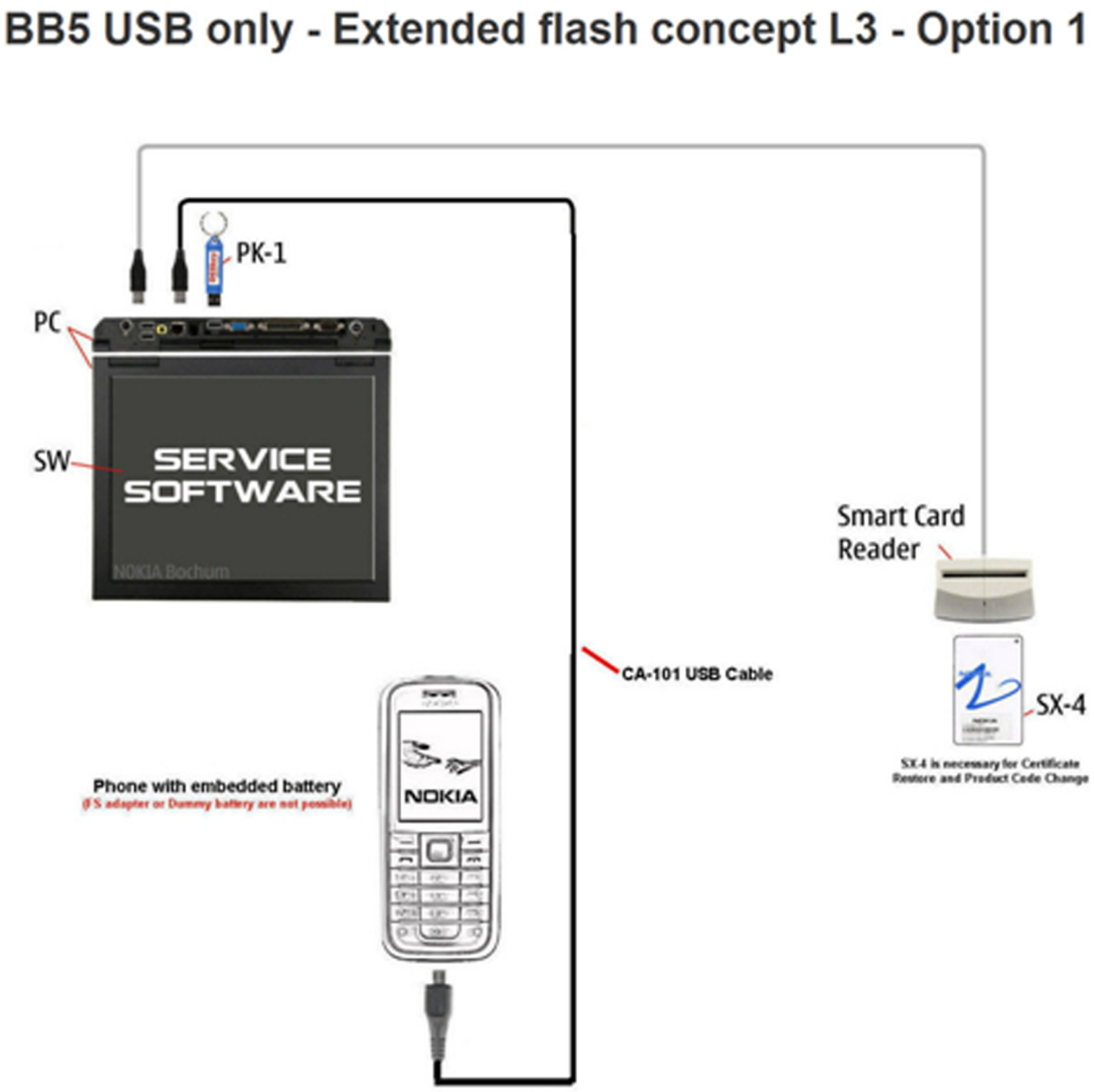

Figure 3 Level 3 concept for flashing, certificate restore and product code change (option 1)

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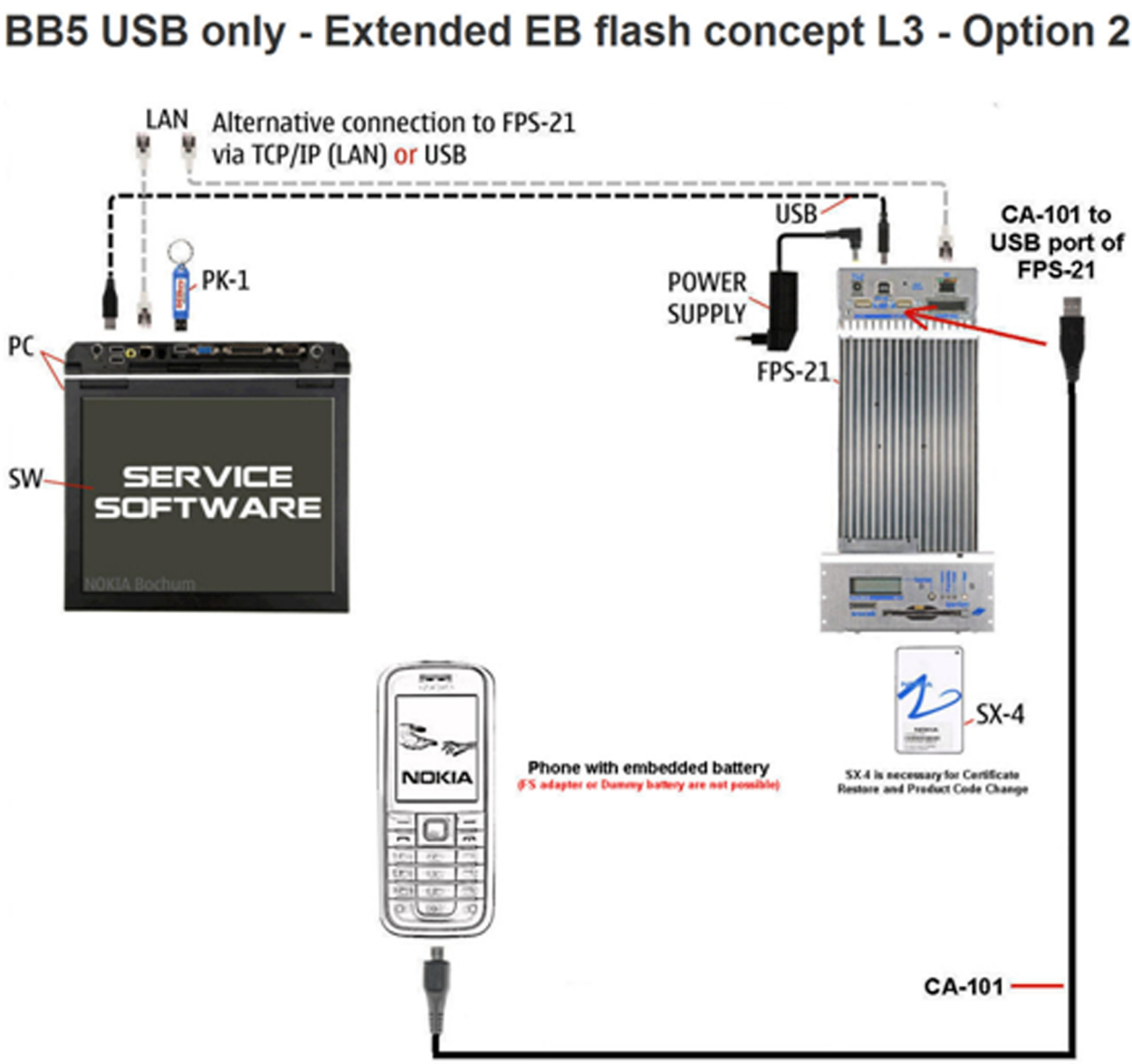

Figure 4 Level 3 concept for flashing, certificate restore and product code change (option 2)

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

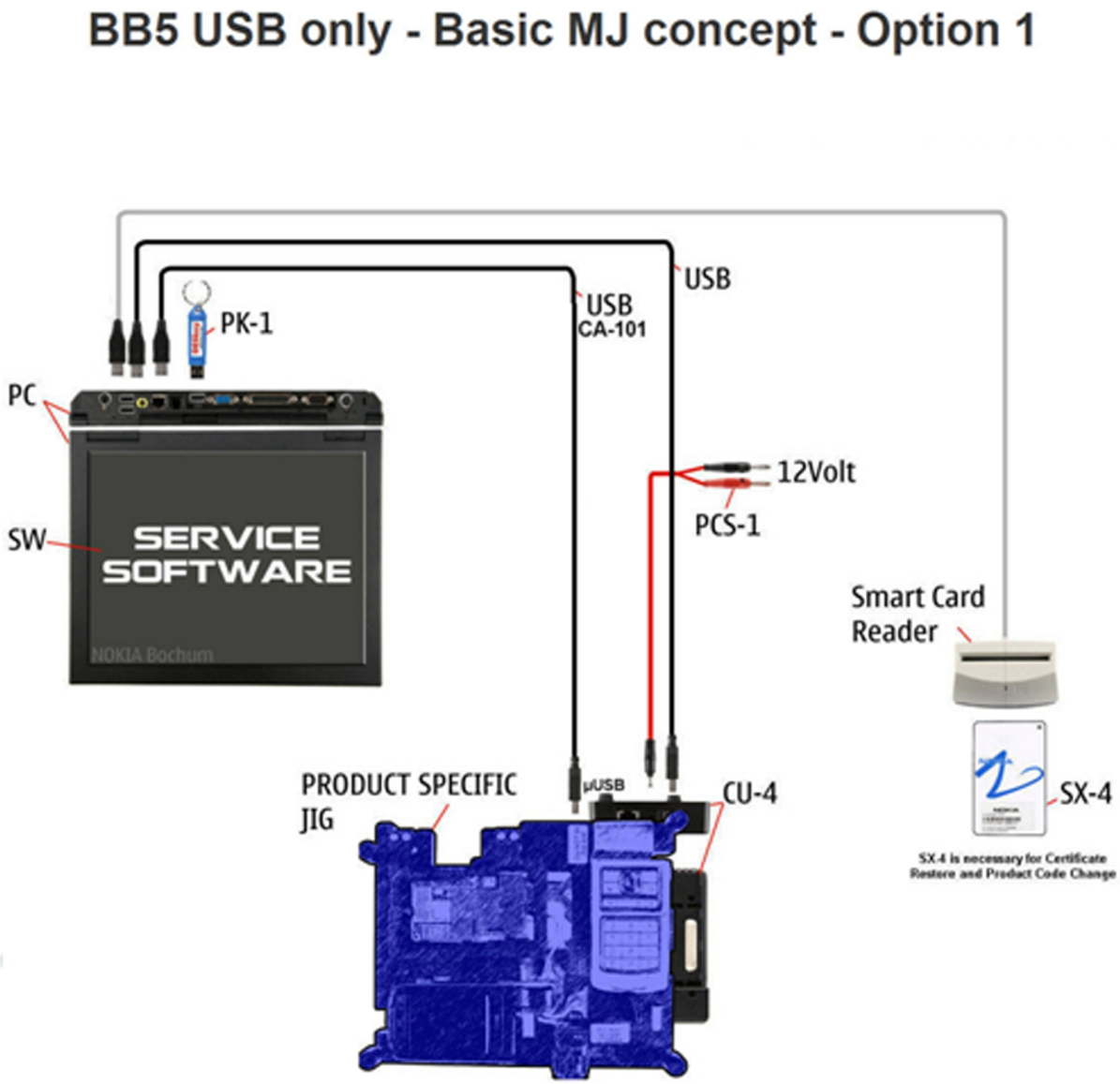

Figure 5 Level 3 concept for flashing, certificate restore, product code change and EM calibration in MJ (option 1)

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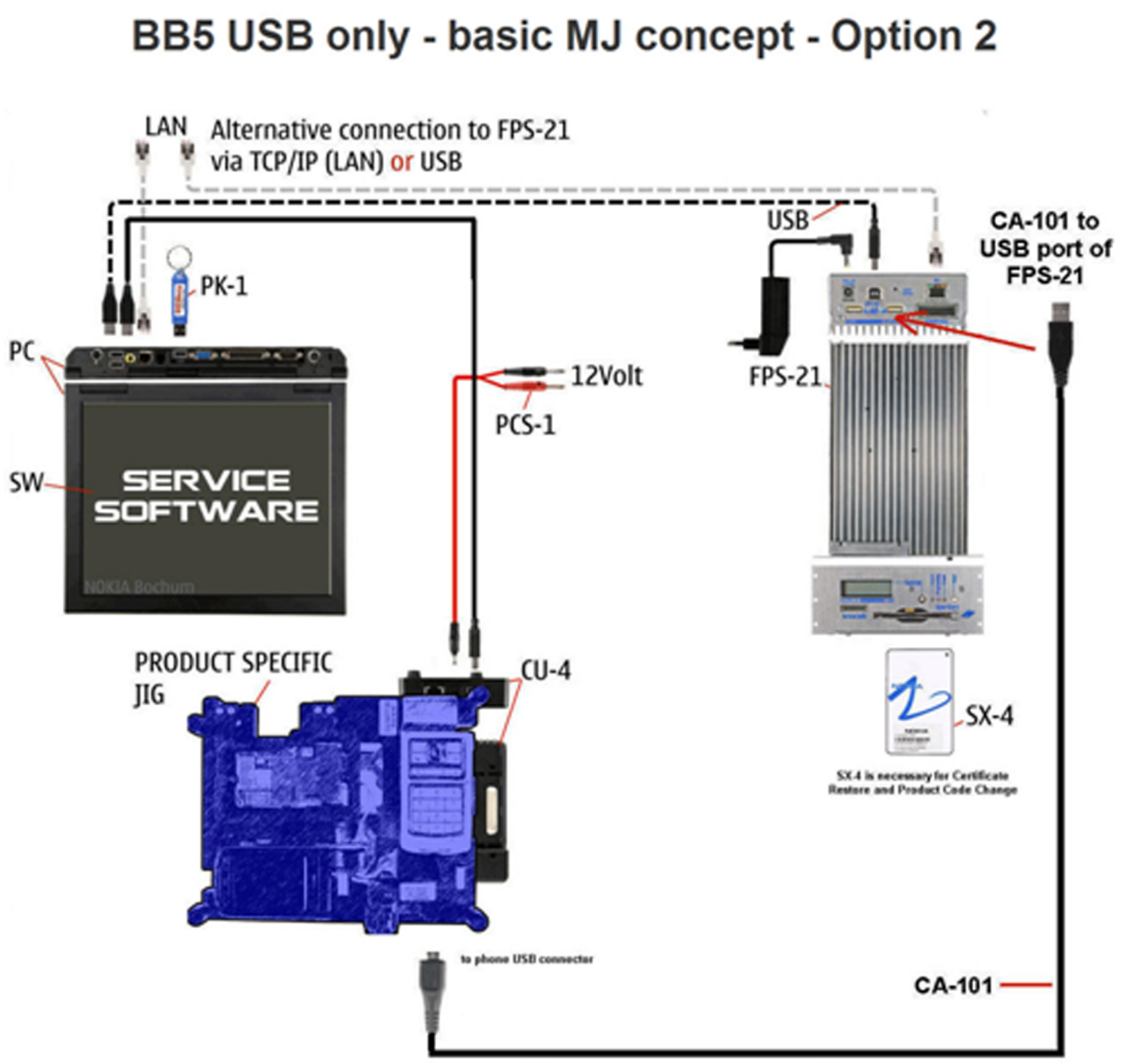

Figure 6 Level 3 concept for flashing, certificate restore, product code change and EM calibration in MJ (option 2)

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Level 3 concept for BB and RF tuning

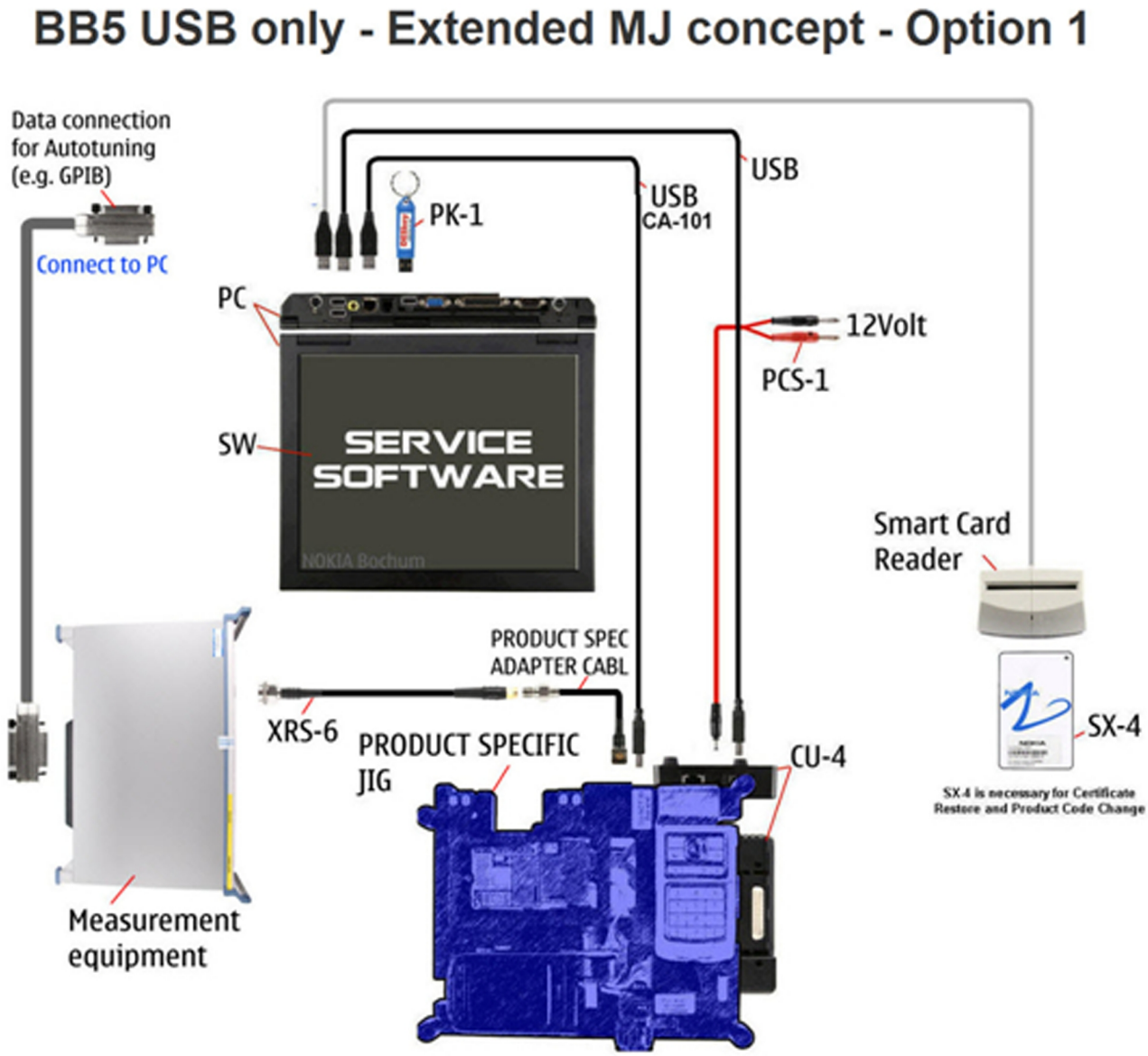

Figure 7 Level 3 concept for BB and RF tuning (option 1)

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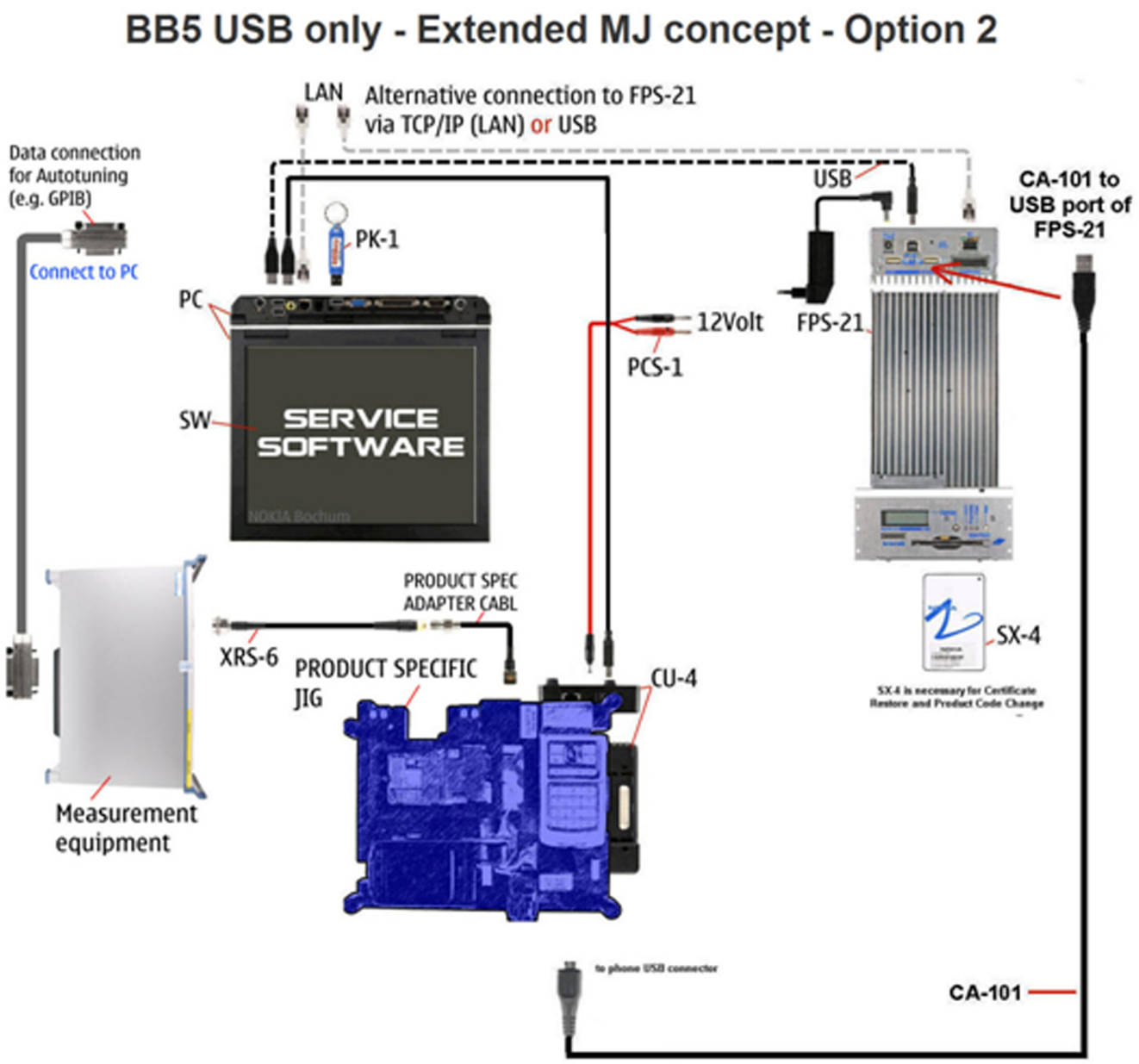

Figure 8 Level 3 concept for BB and RF tuning (option 2)

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Level 3 BT (Bluetooth) test Concept

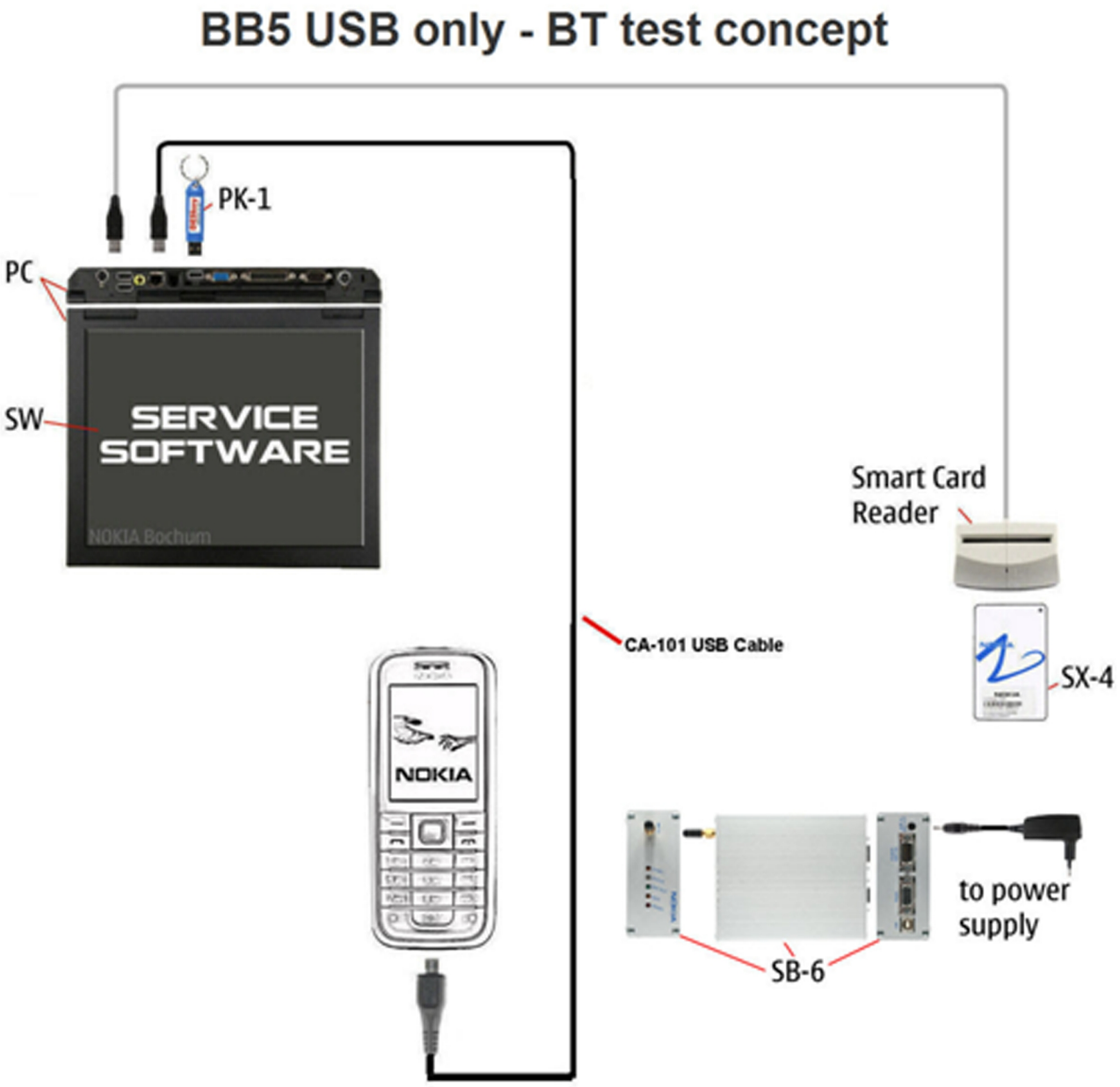

Figure 9 Level 3 BT (Bluetooth) test Concept

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Level 3 WLAN test concept

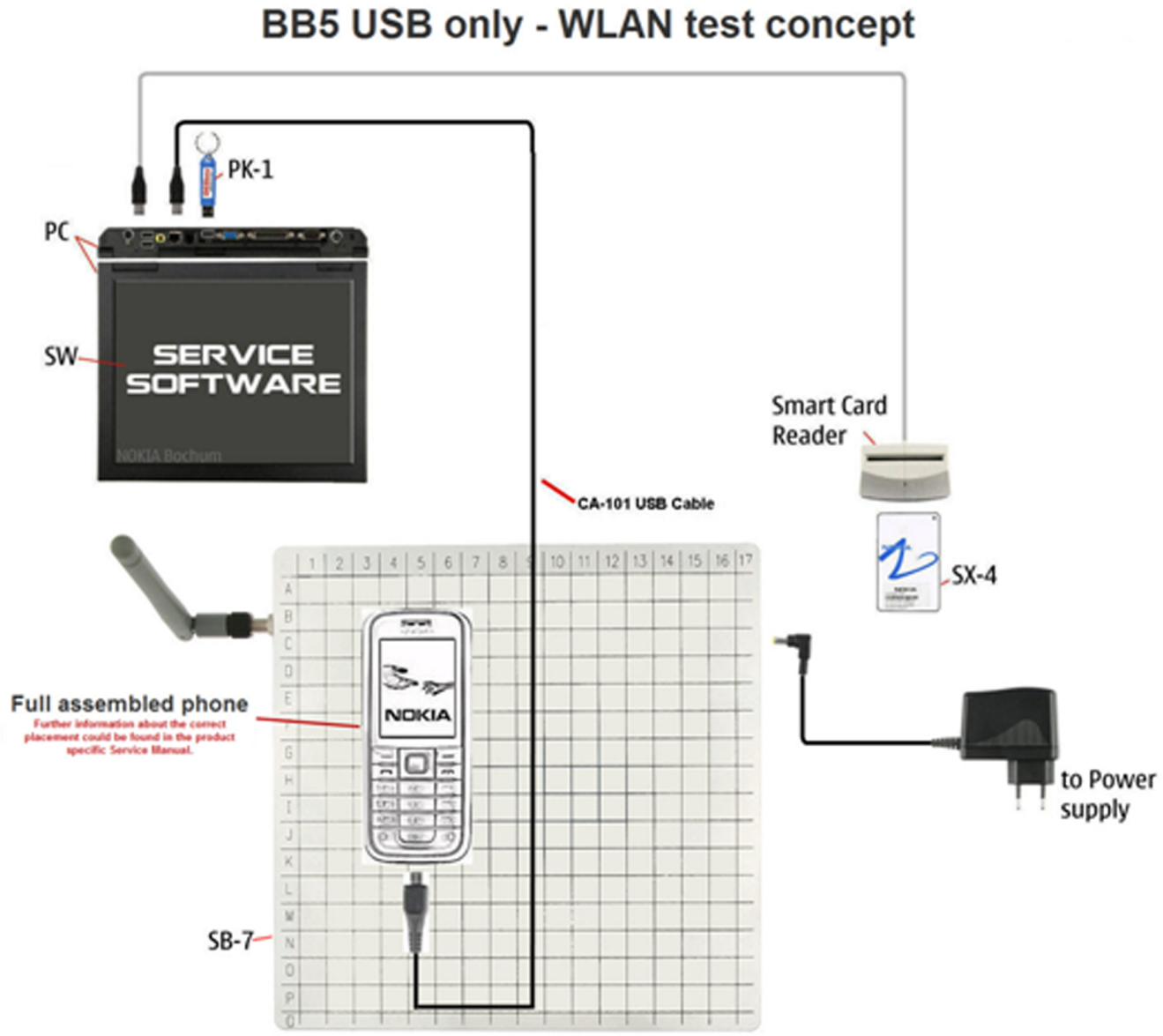

Figure 10 Level 3 WLAN test concept

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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.

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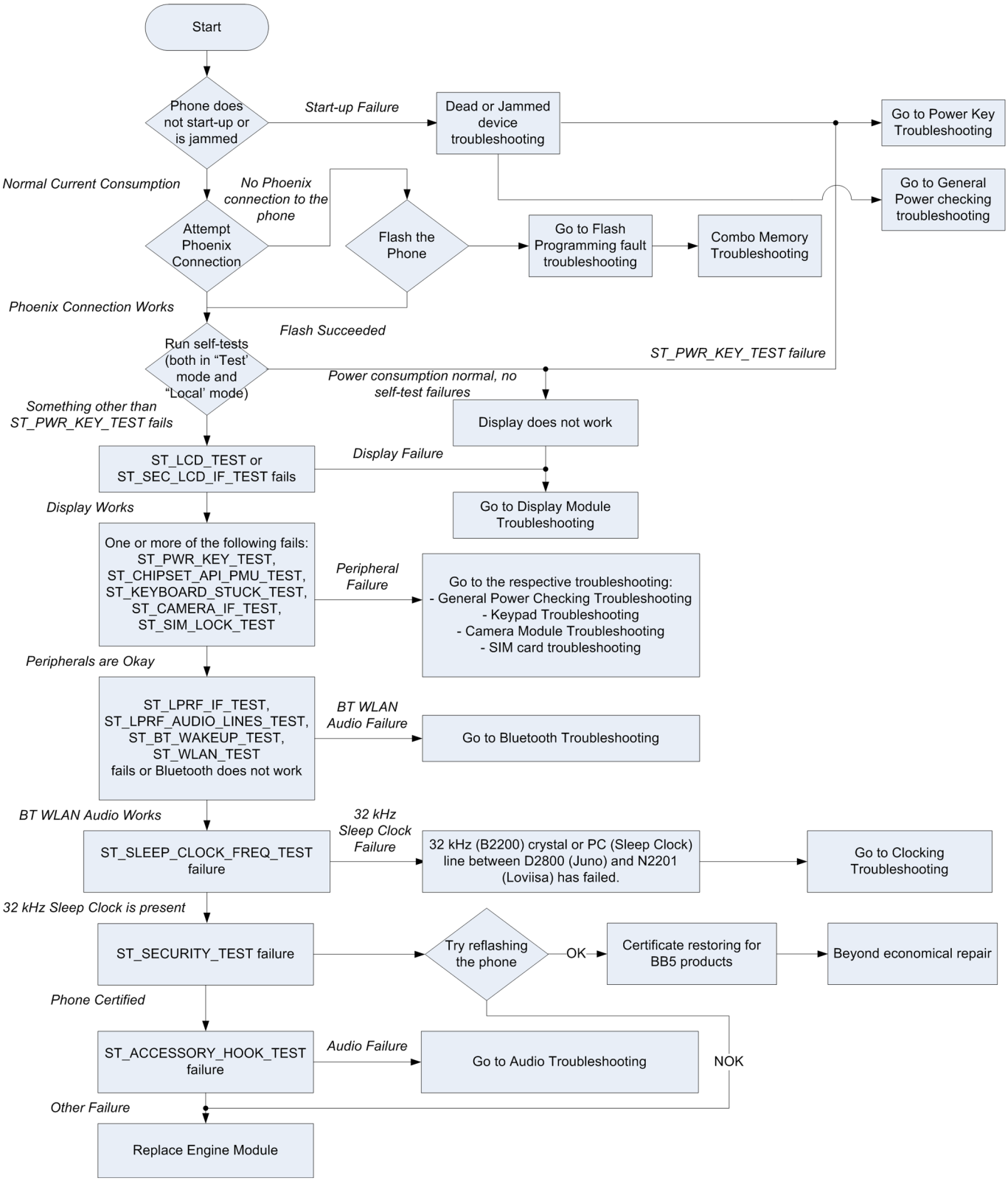
Troubleshooting flow



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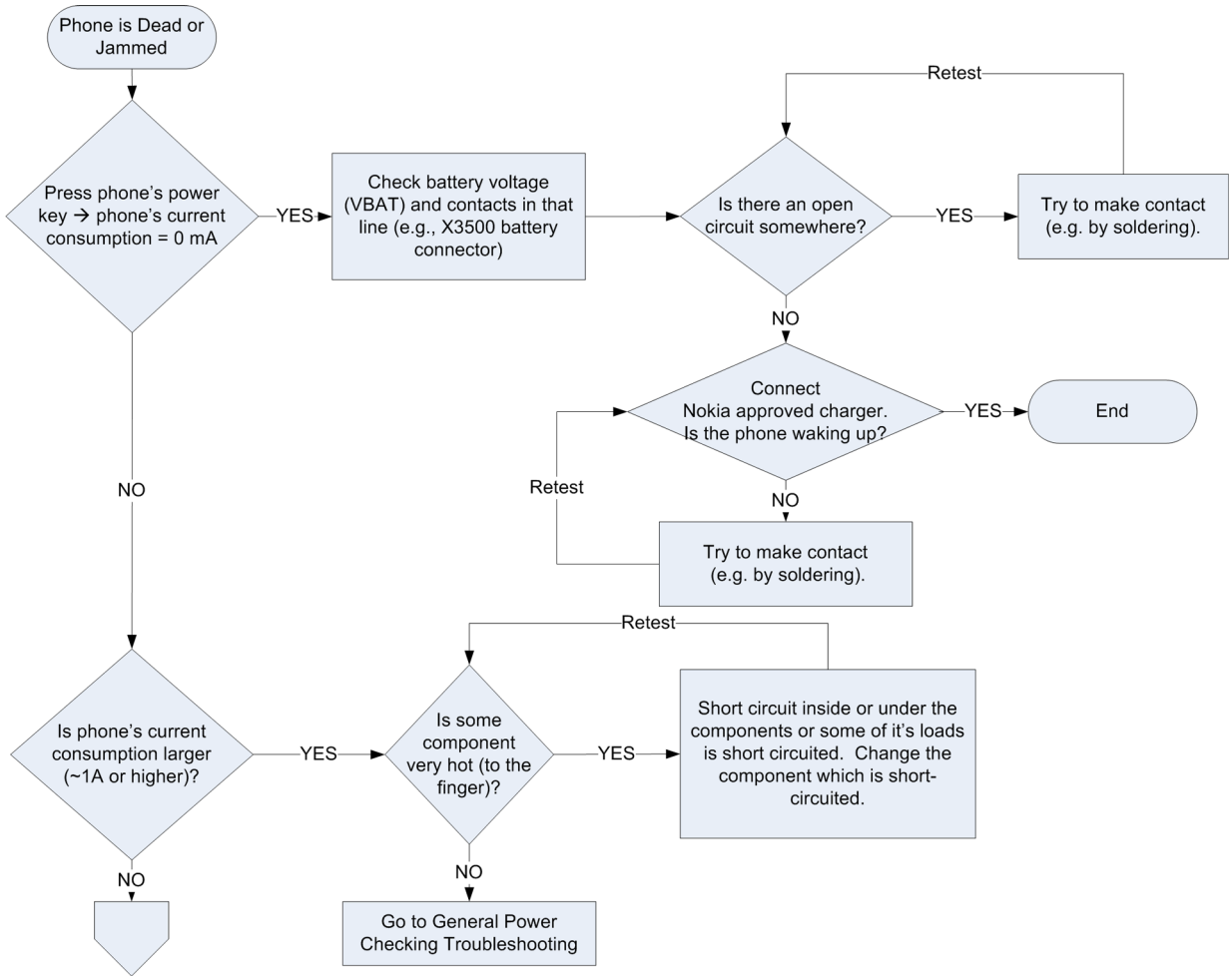
Power and charging troubleshooting

Dead or jammed device troubleshooting

Troubleshooting flow



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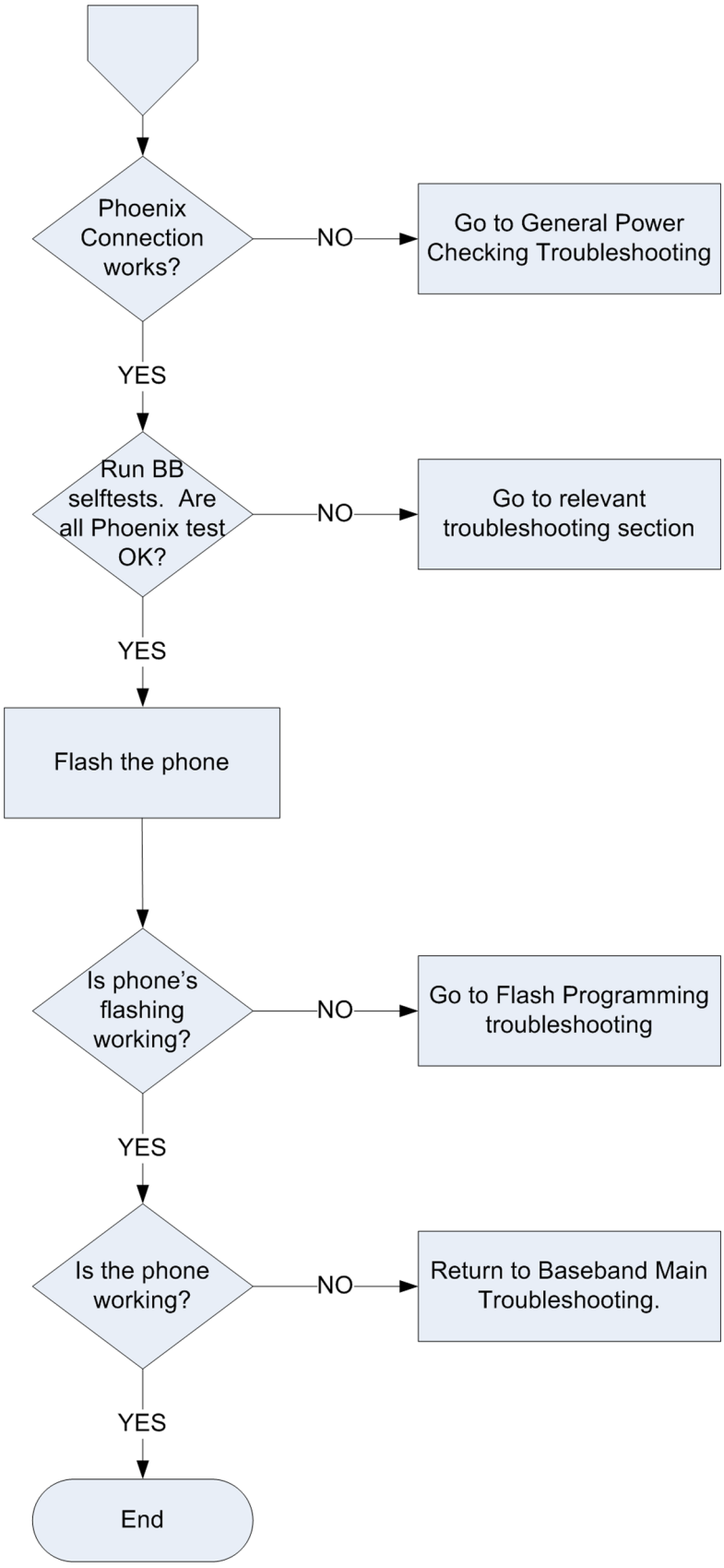
Troubleshooting flow



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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	VMSLDO2	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	VRFLDO1	OFF	ON	analog supply for RF	C2214	2.7
VRF1	VLVLDO2	OFF	ON	analog supply for RF	C2209	1.3
VDCXO	VLCLDO	OFF	ON	analog supply for RF	C2212	1.3
VSIM	VSIMLDO	TBD	ON	digital supply for SIM I/O	C2215	3.0
VAMP2	VHCLDO2	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	VLVLDO1	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

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Signal name	Regulator	Sleep	Active	Main user	Probe point	Nominal voltage (V)
VOUT	VRFLDO2	ON	ON	analog supply for USB and ACI	C2213	2.5
VANA2	VALDO2	ON	ON	analog supply for ADC (4-to-1) and IHF	C2211	2.5
VANA3	VALDO1	ON	ON	analog supply for microphone and Aux ADC/ DAC,	C2210	3.0
VAMP1	VHCLDO1	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.

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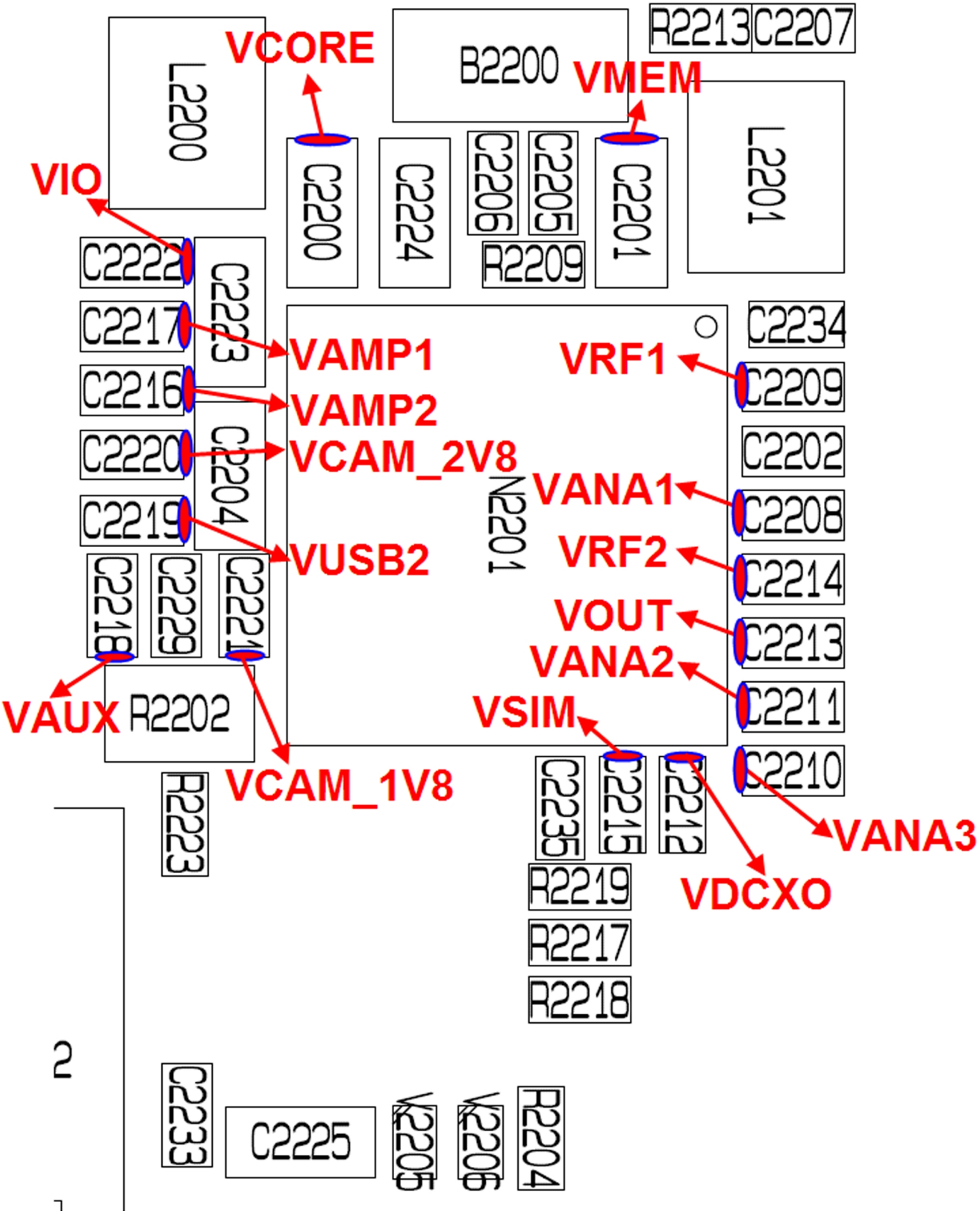

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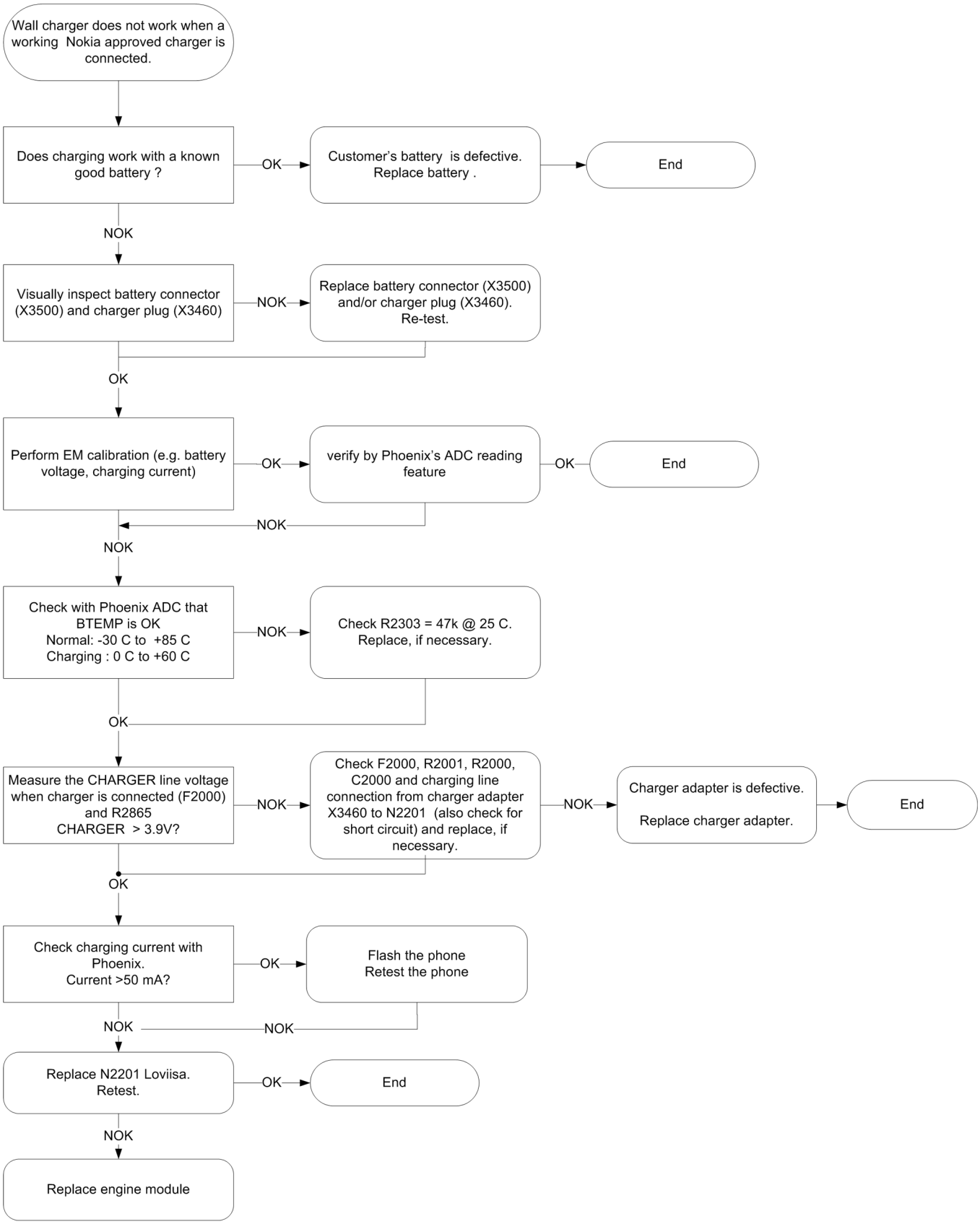
Charging troubleshooting

Wall Charger Troubleshooting



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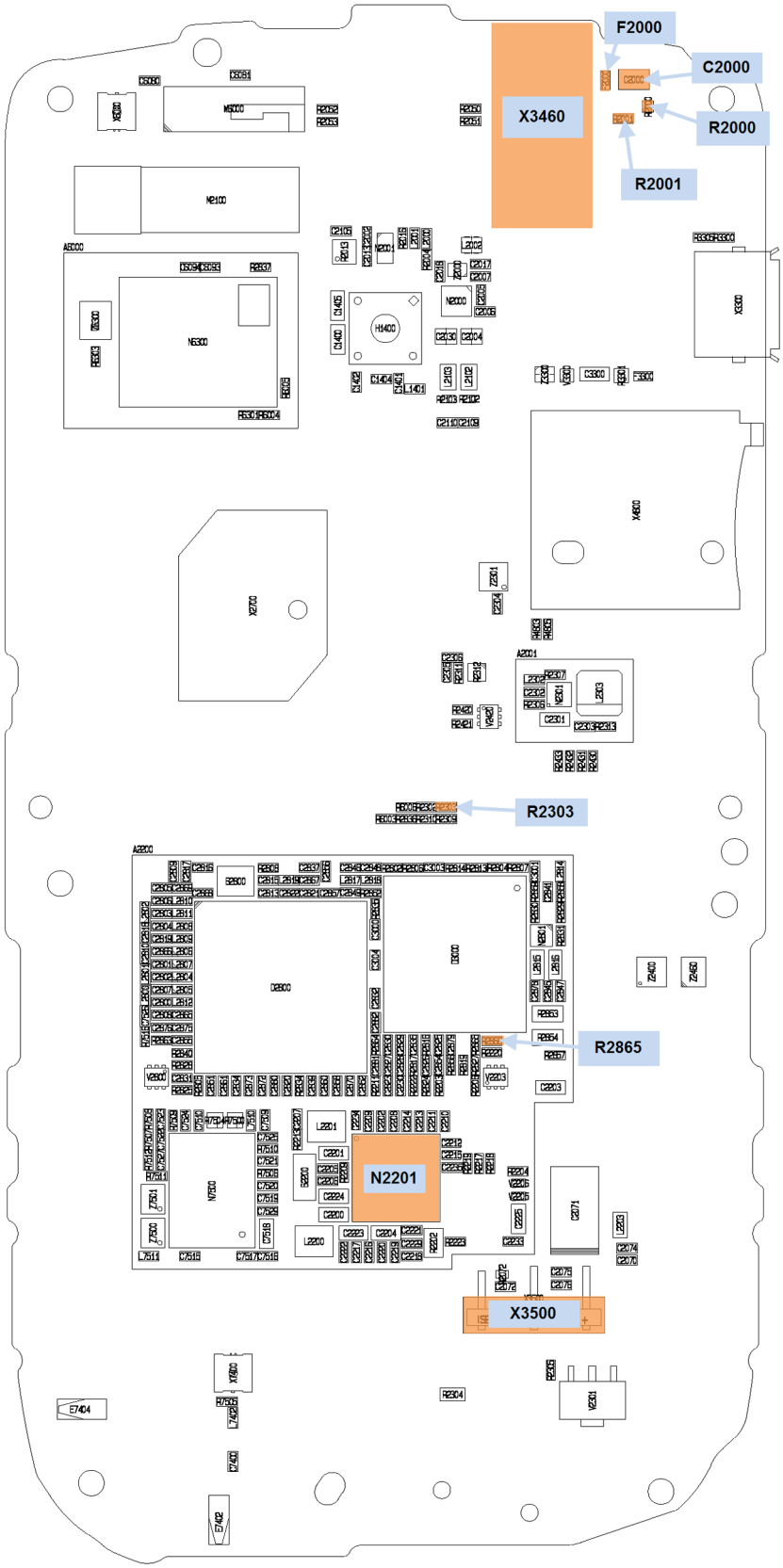
Component Placement



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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 it's 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.

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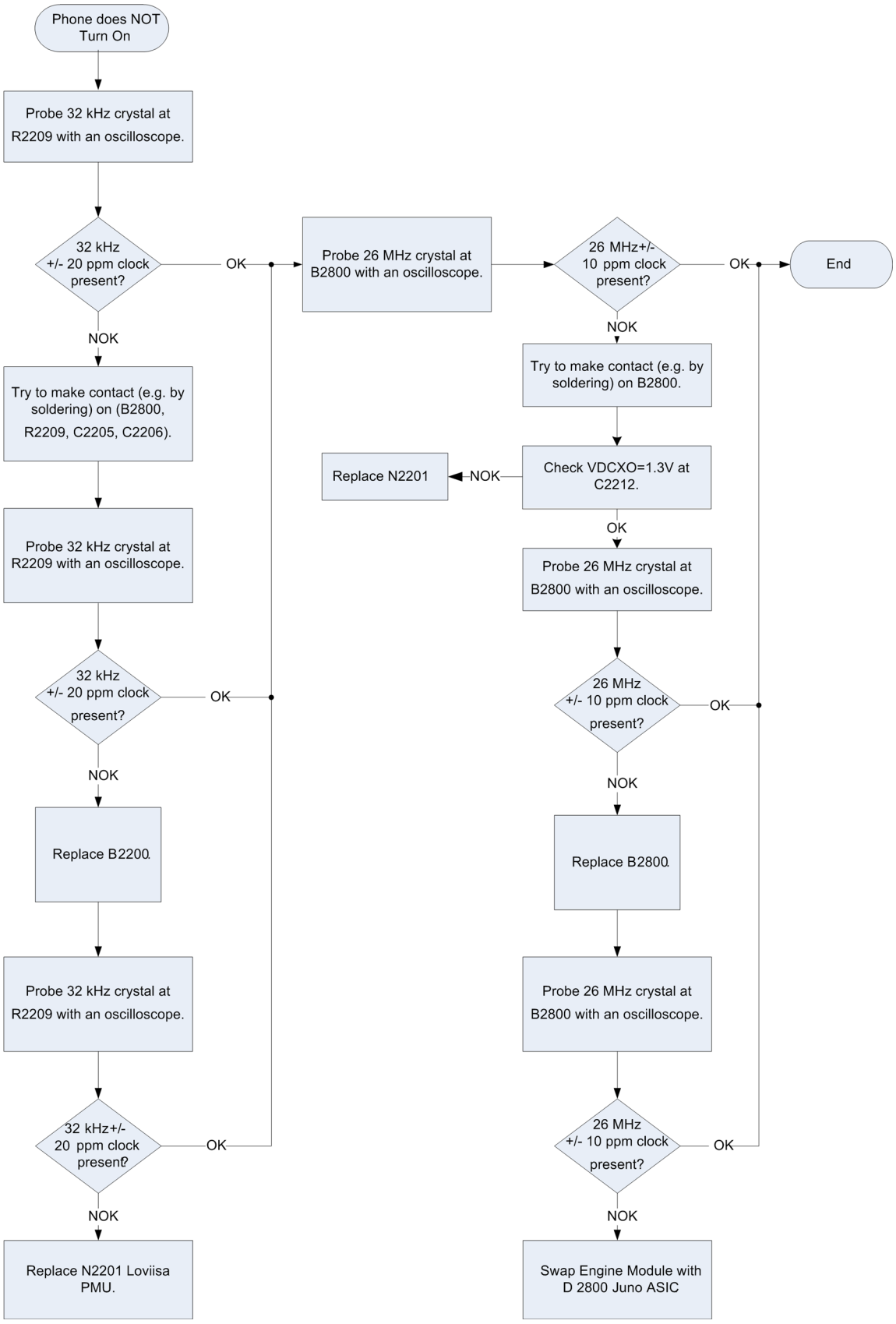
Troubleshooting flow



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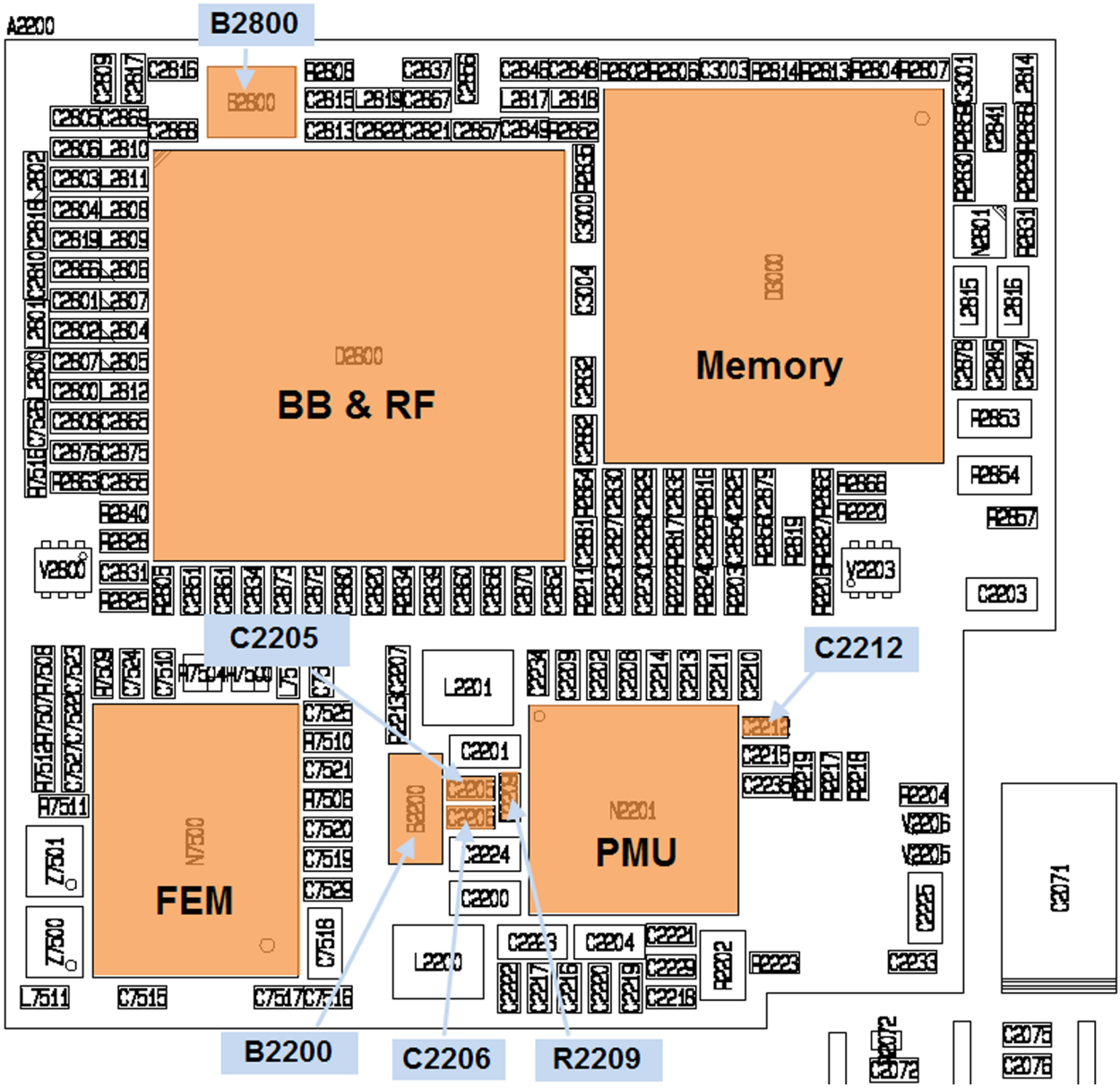

Figure 11 Clocking troubleshooting component location

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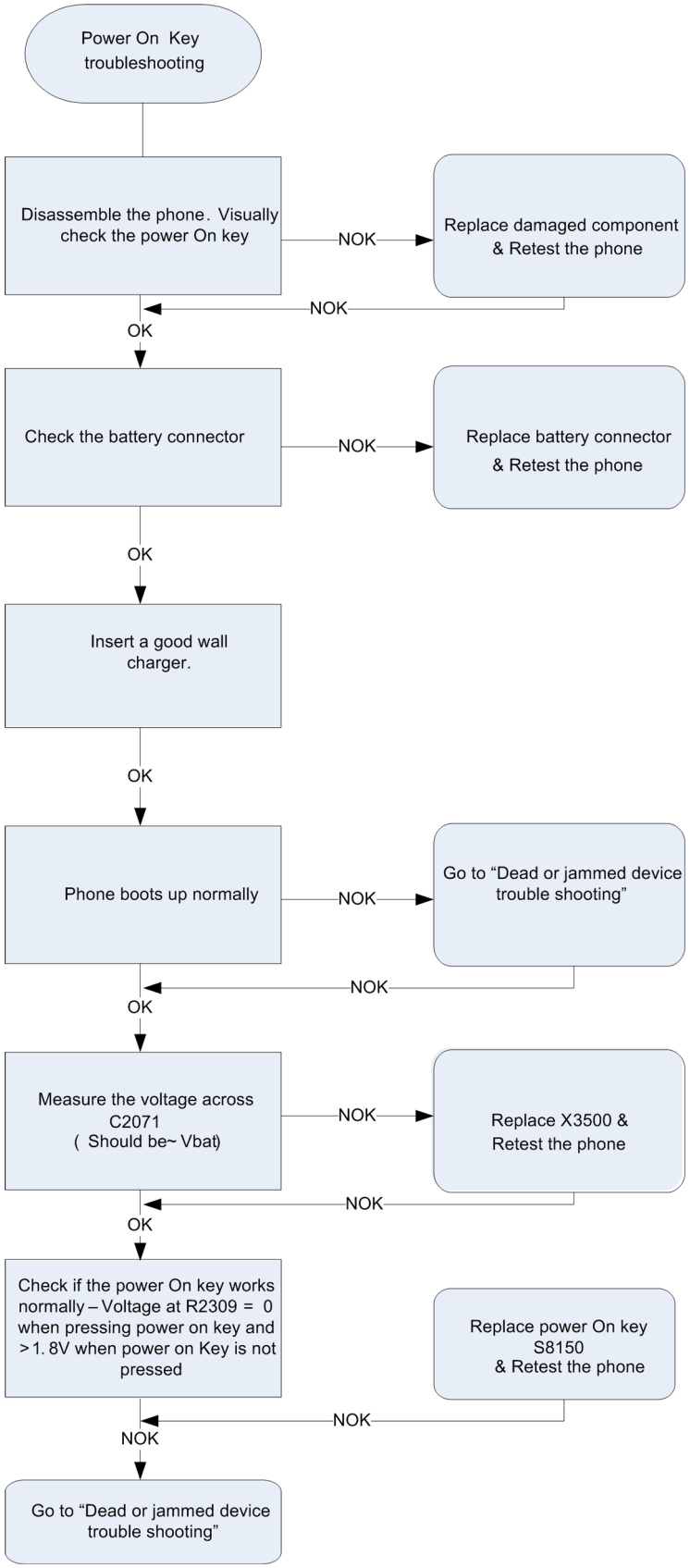
Power On key troubleshooting

Troubleshooting flow



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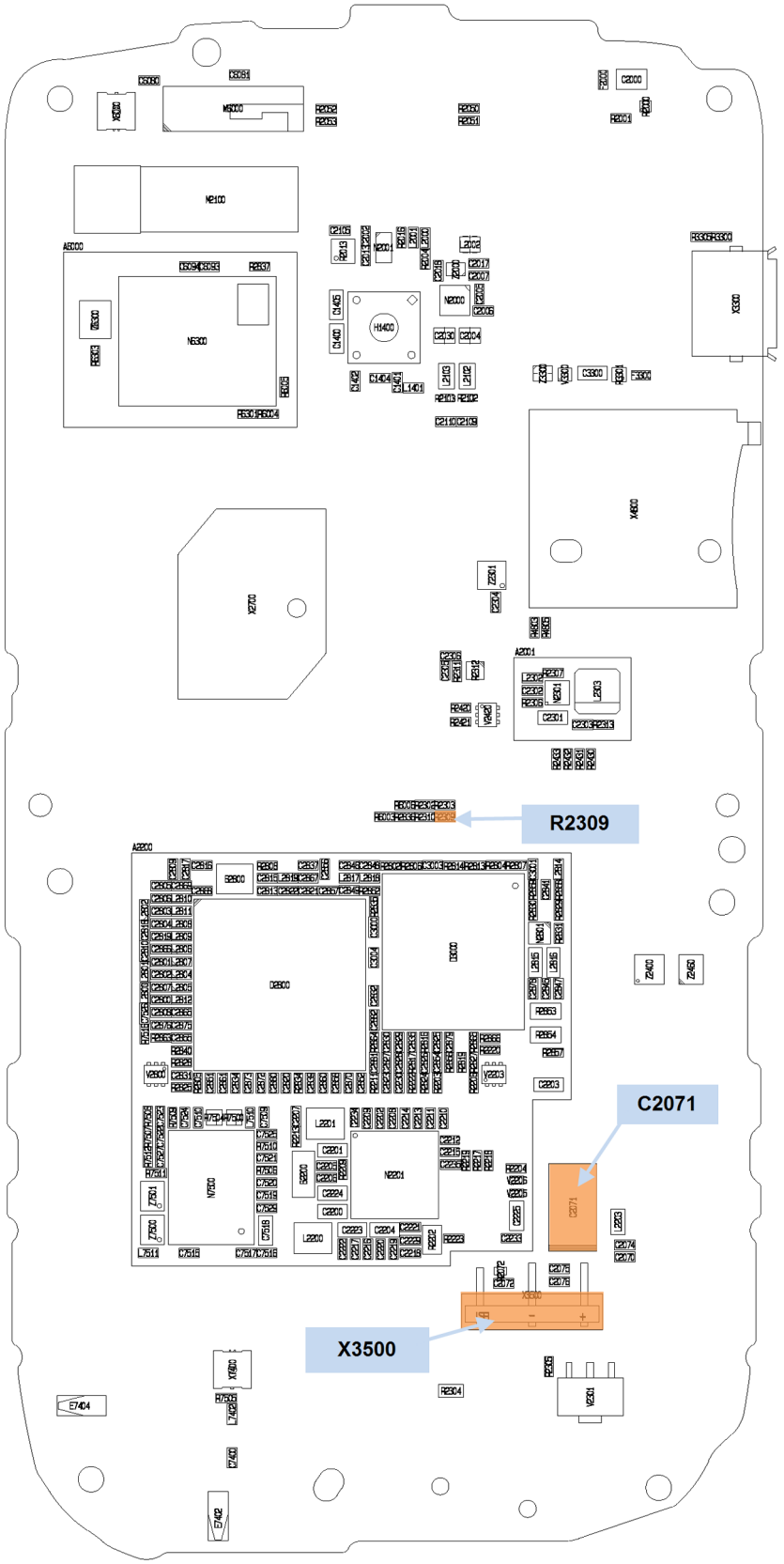

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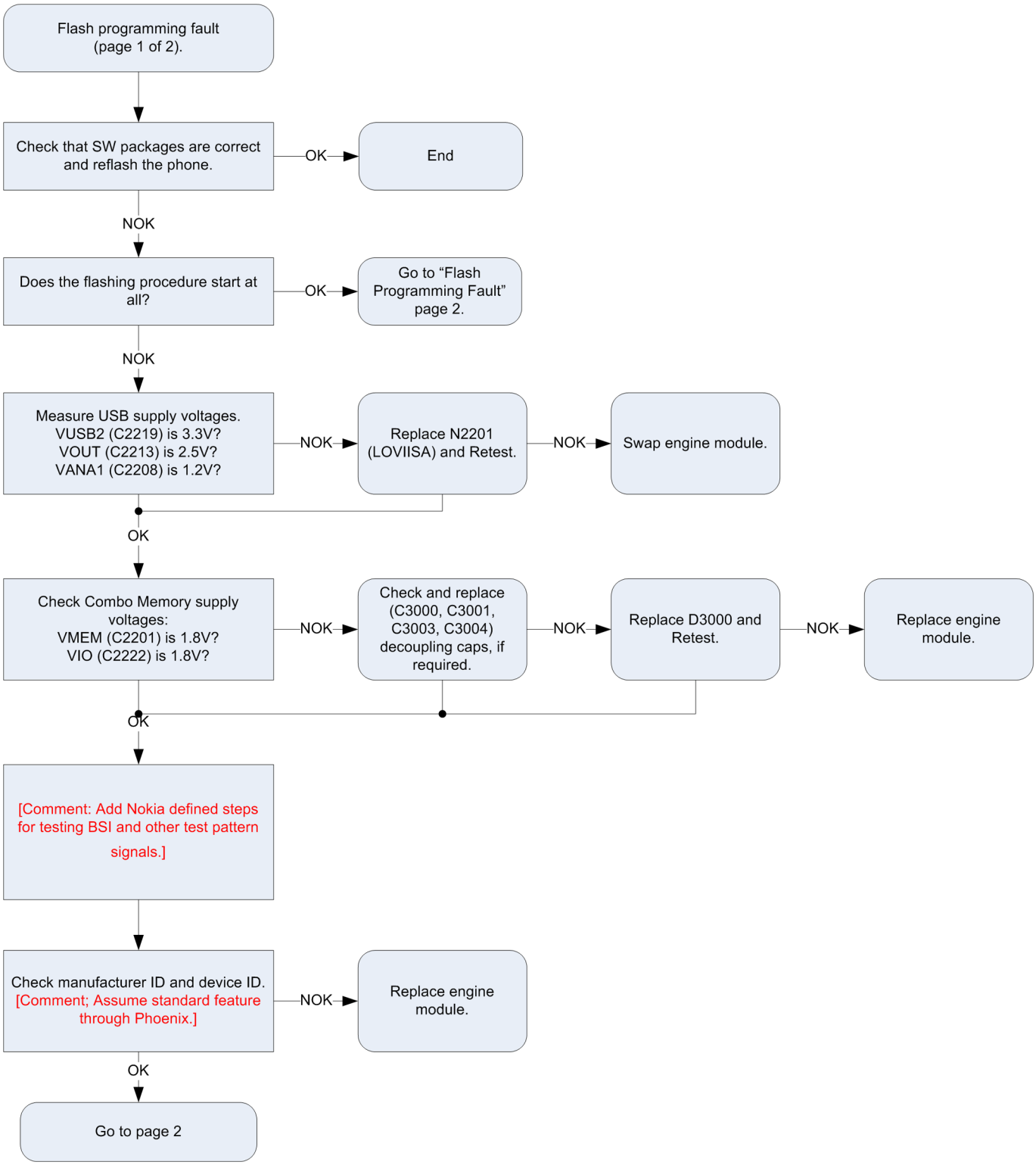
Interface troubleshooting

Flash Programming Troubleshooting

Troubleshooting flow



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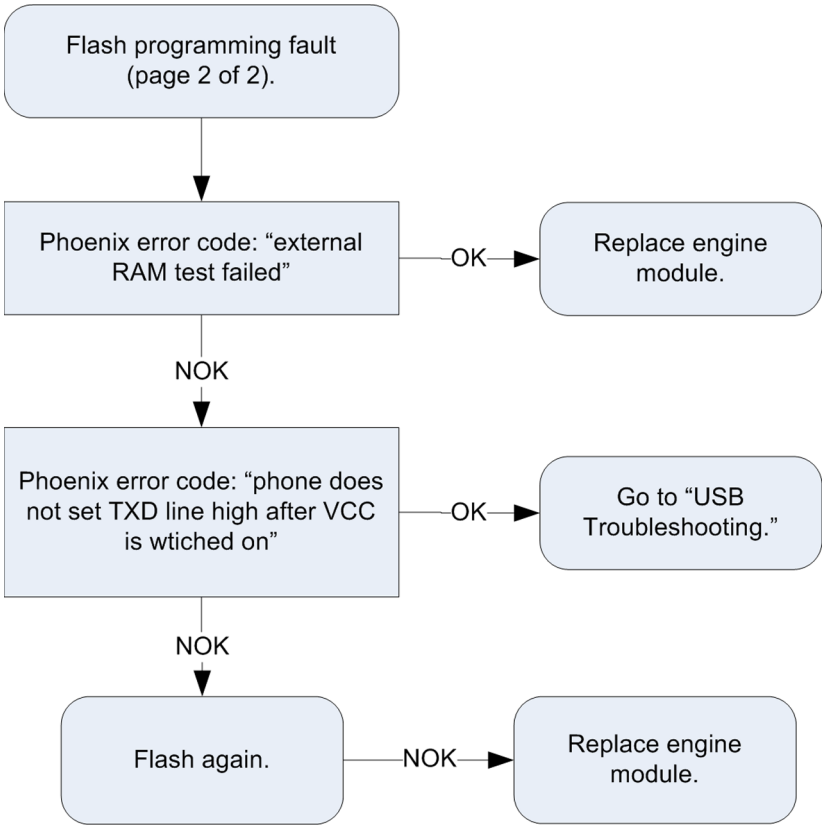

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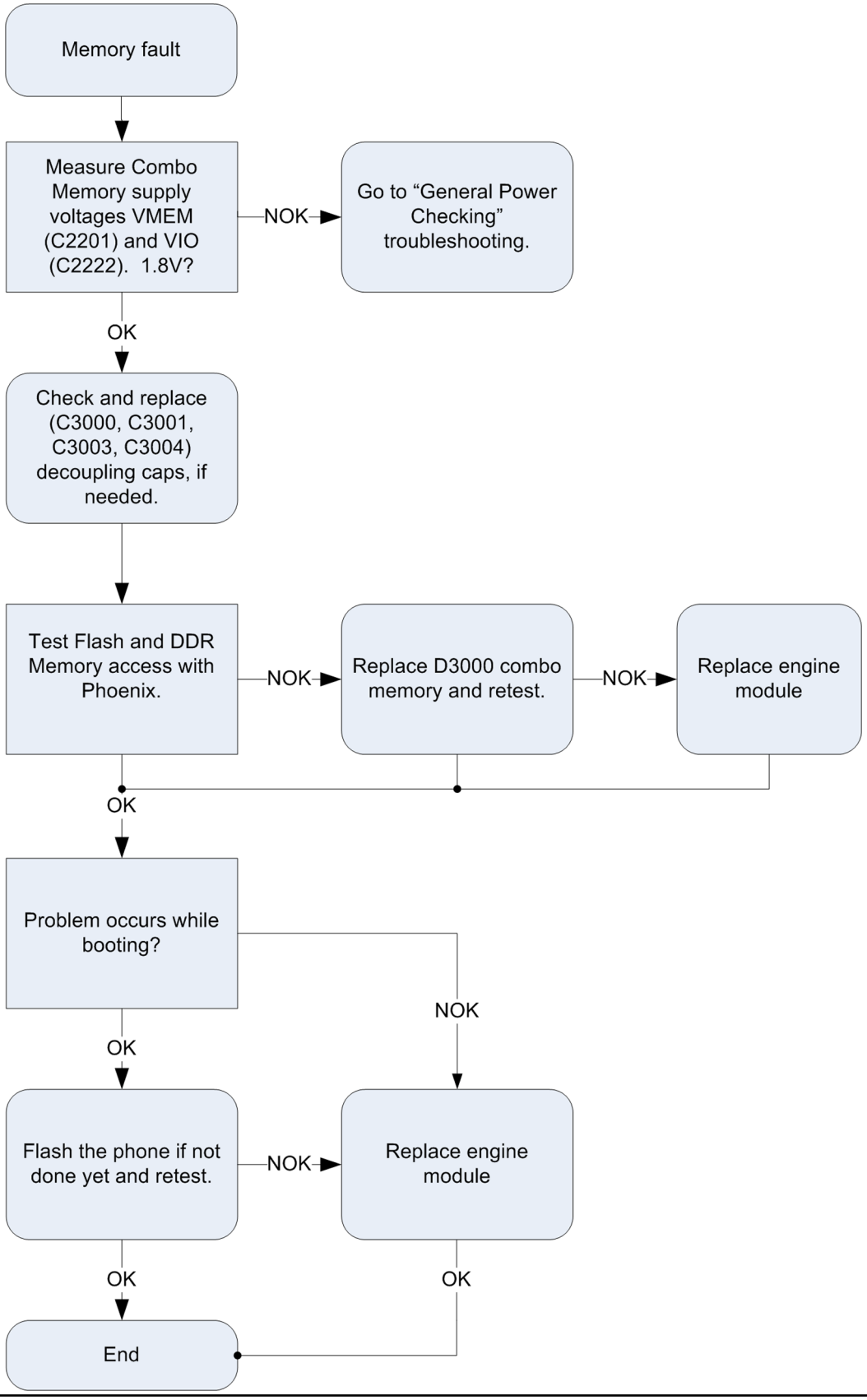
Memory Troubleshooting

Troubleshooting flow



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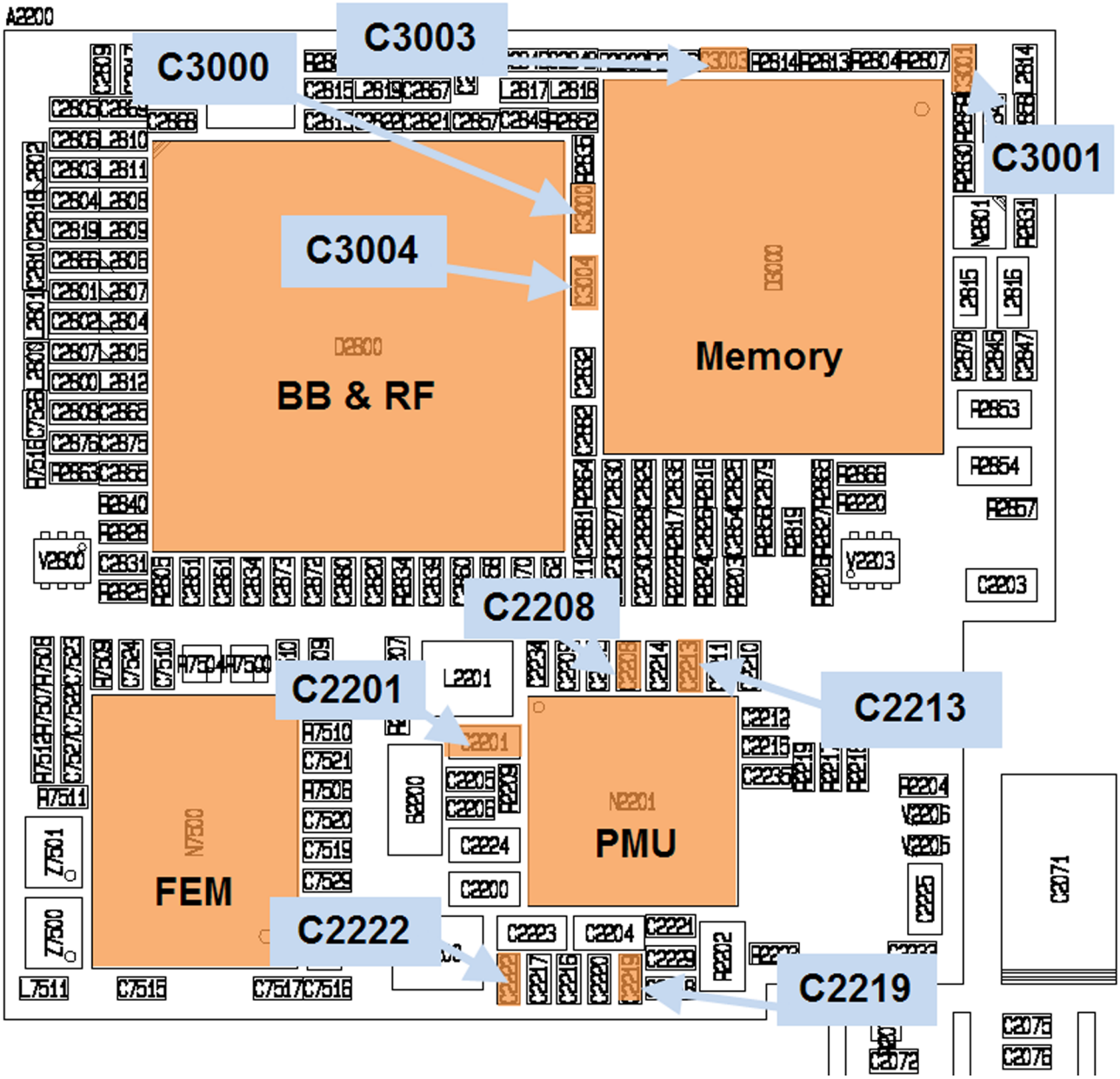

Figure 12 Probe placement diagram

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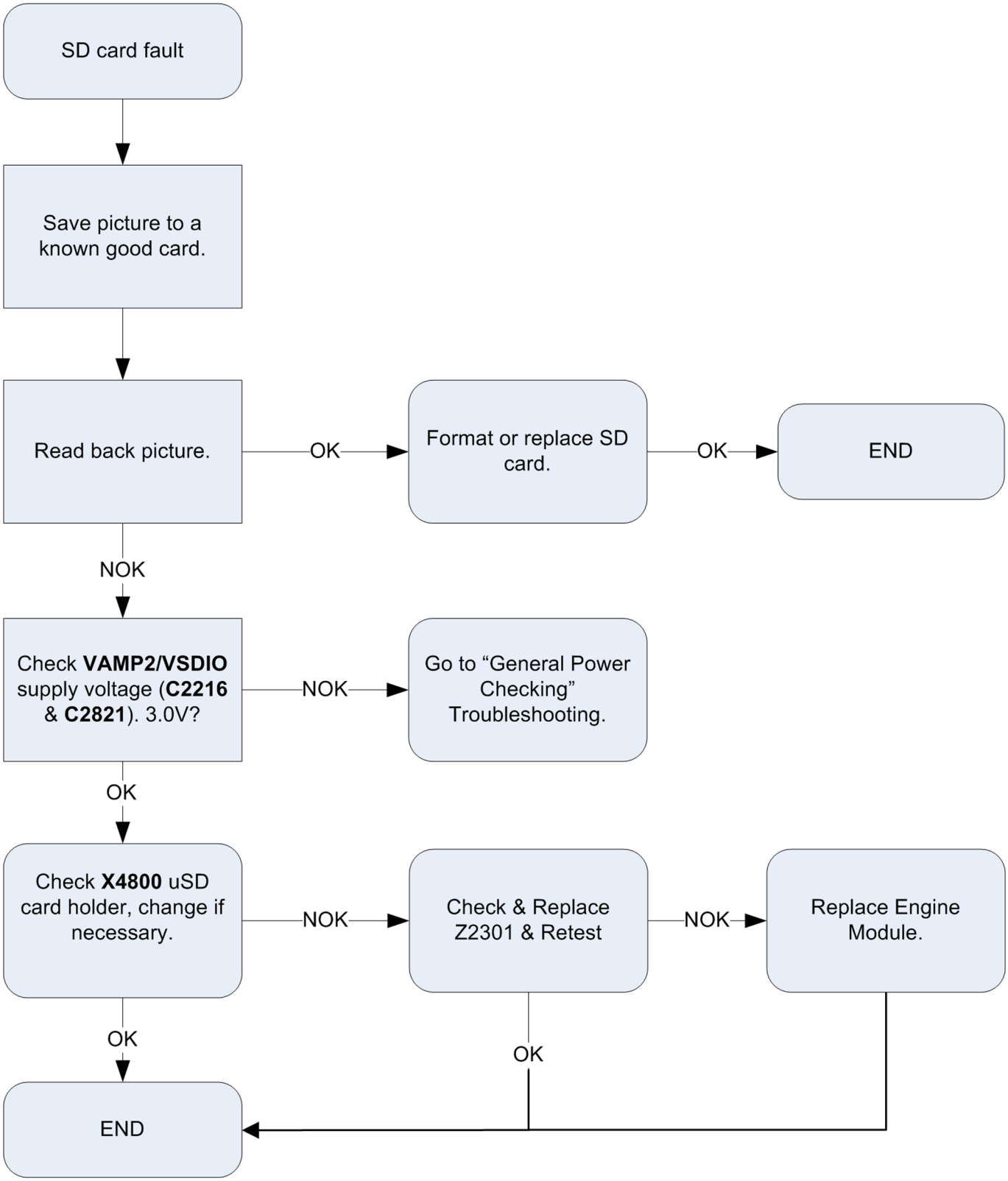
Memory Card Troubleshooting

Troubleshooting flow



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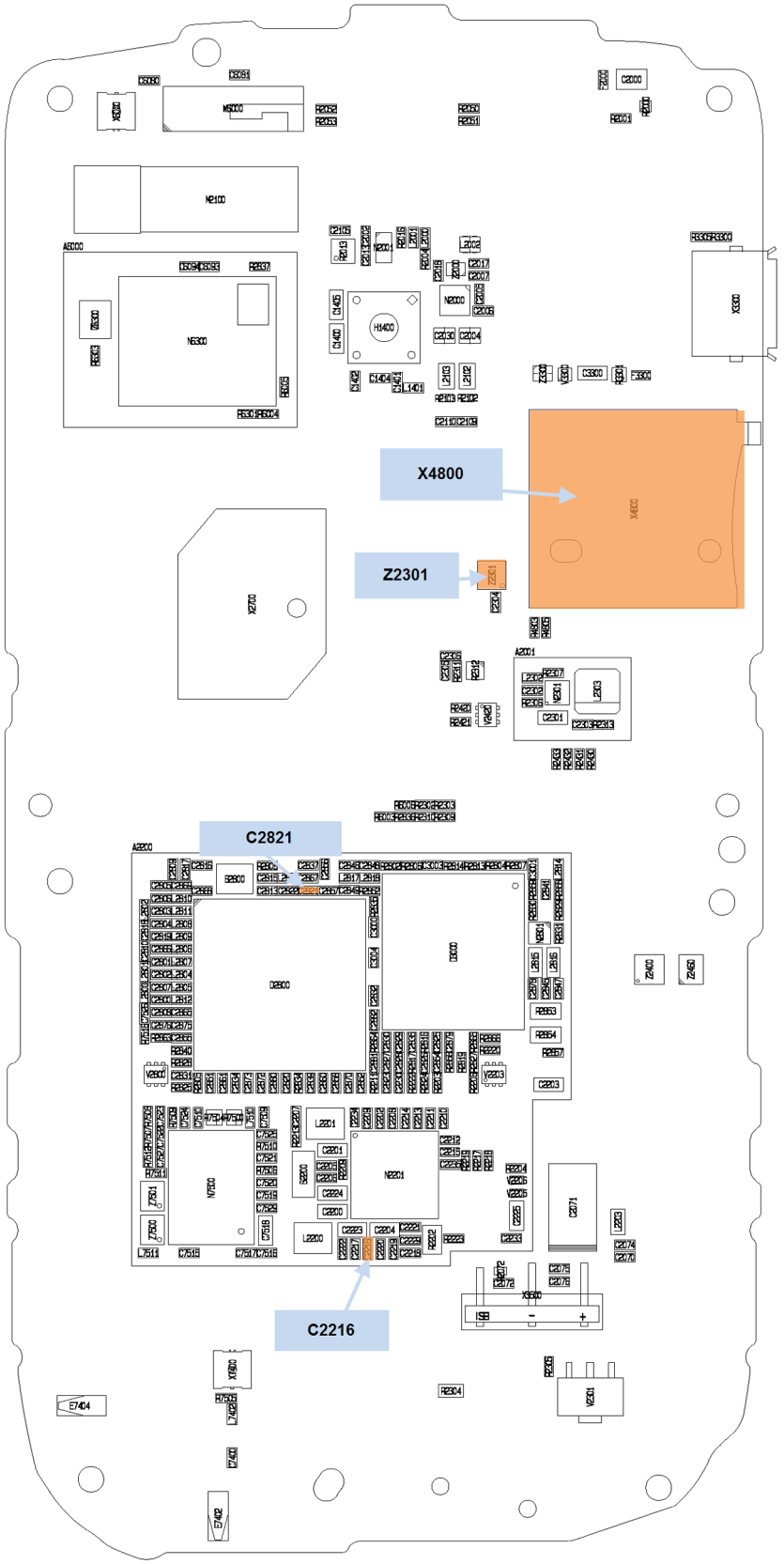

Figure 13 Probe placement diagram

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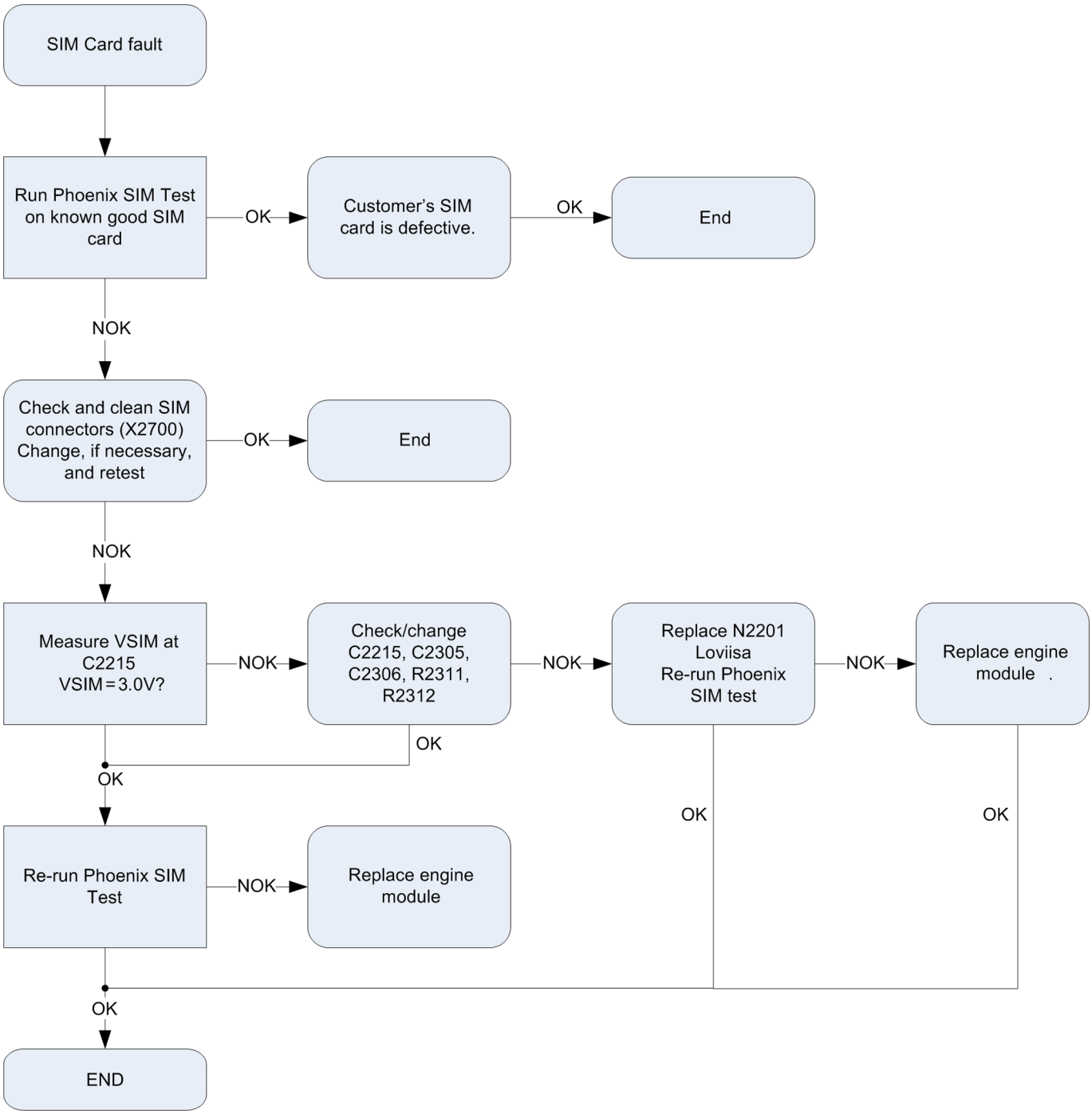
SIM Card Troubleshooting

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



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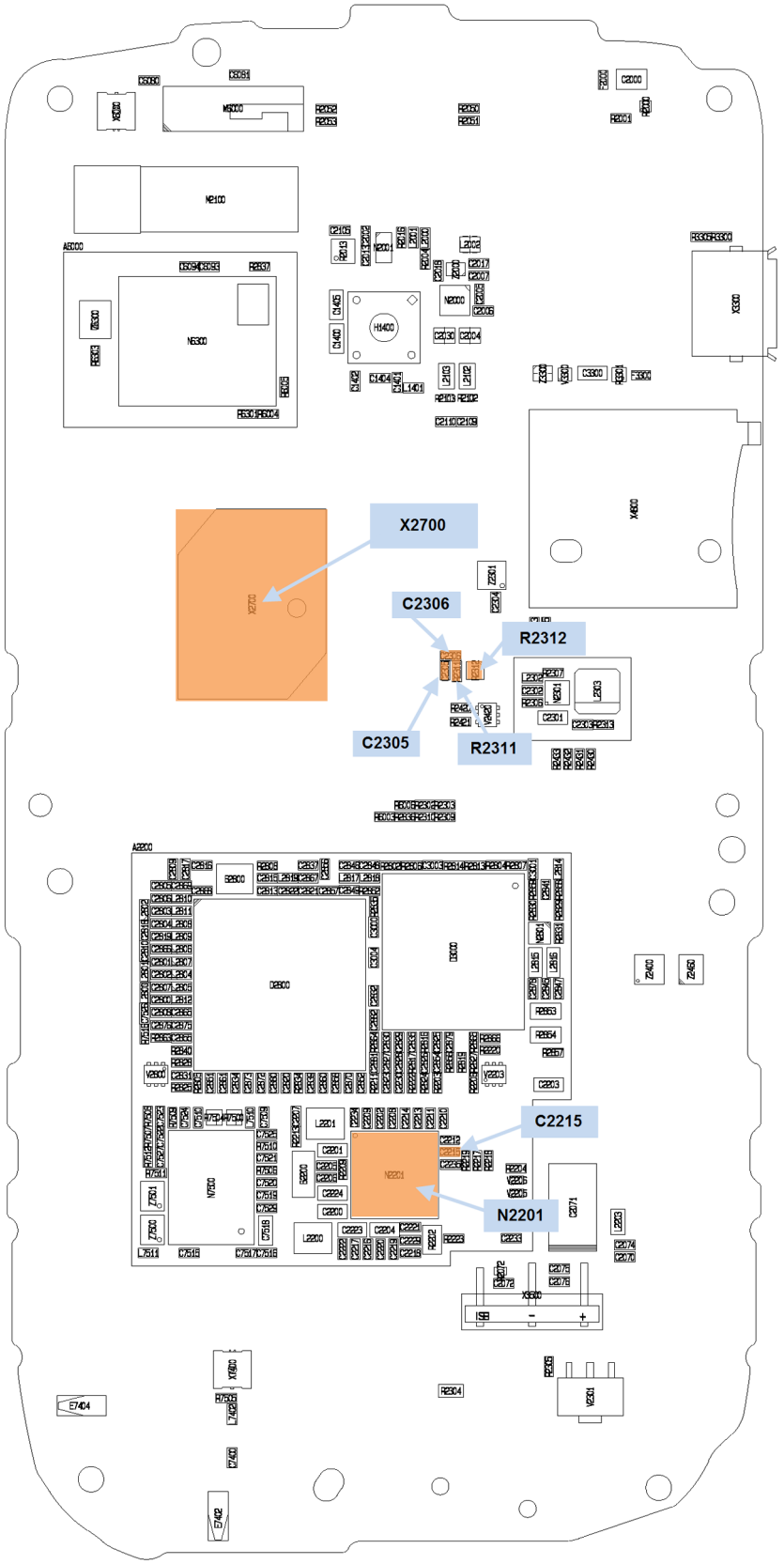

Figure 14 Probe placement diagram

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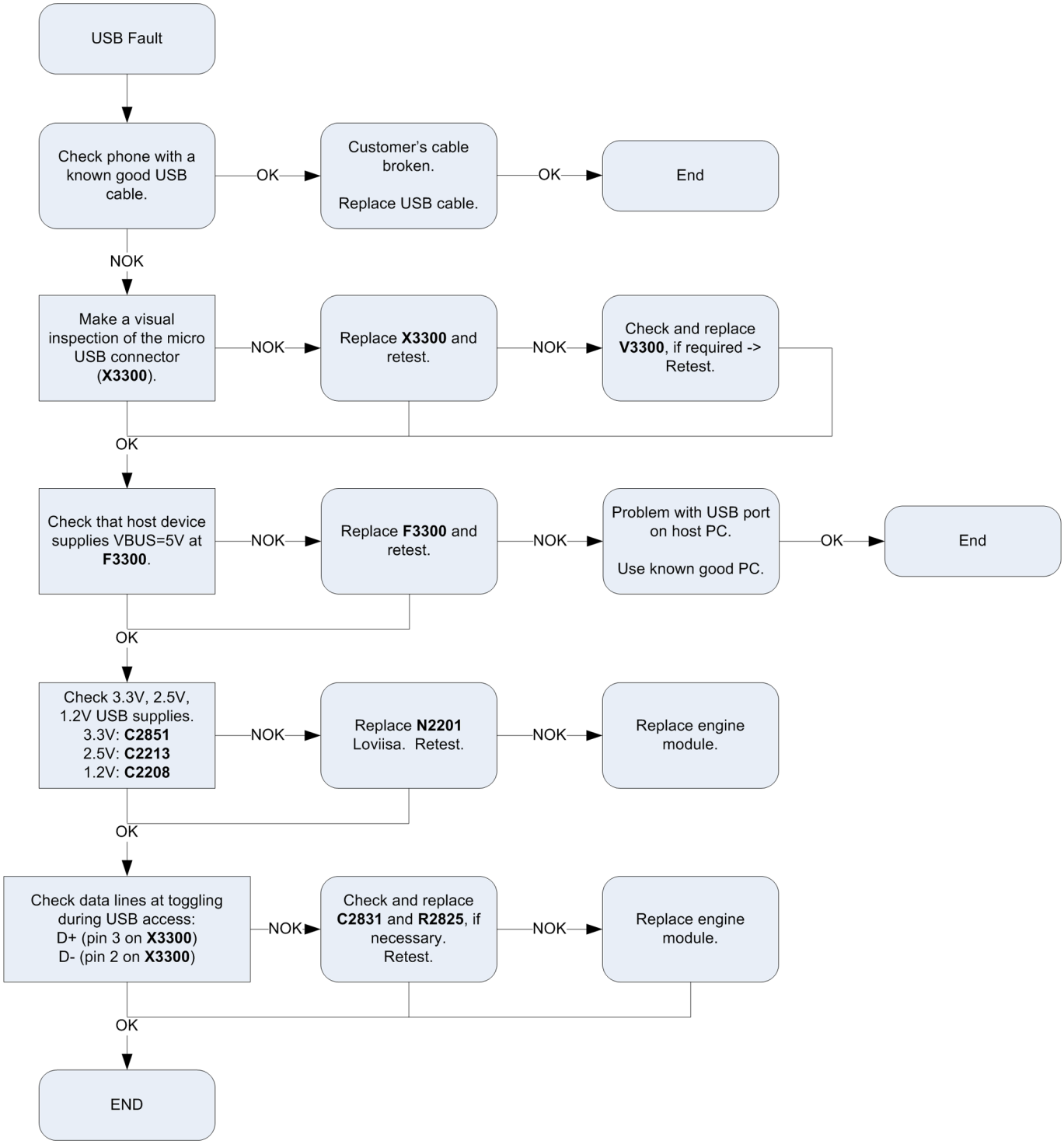
USB Interface Troubleshooting

Troubleshooting flow



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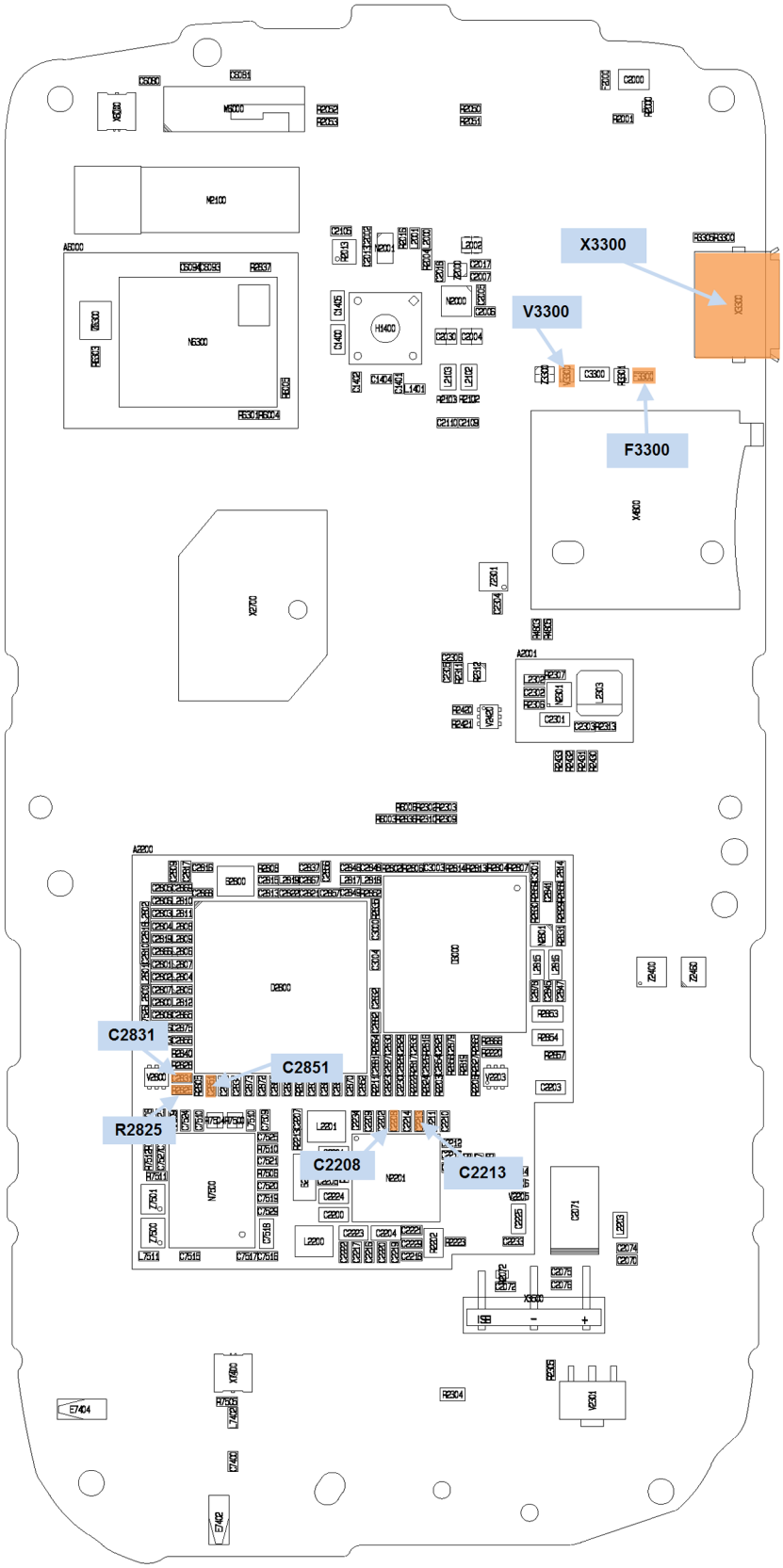

Figure 15 Probe placement diagram

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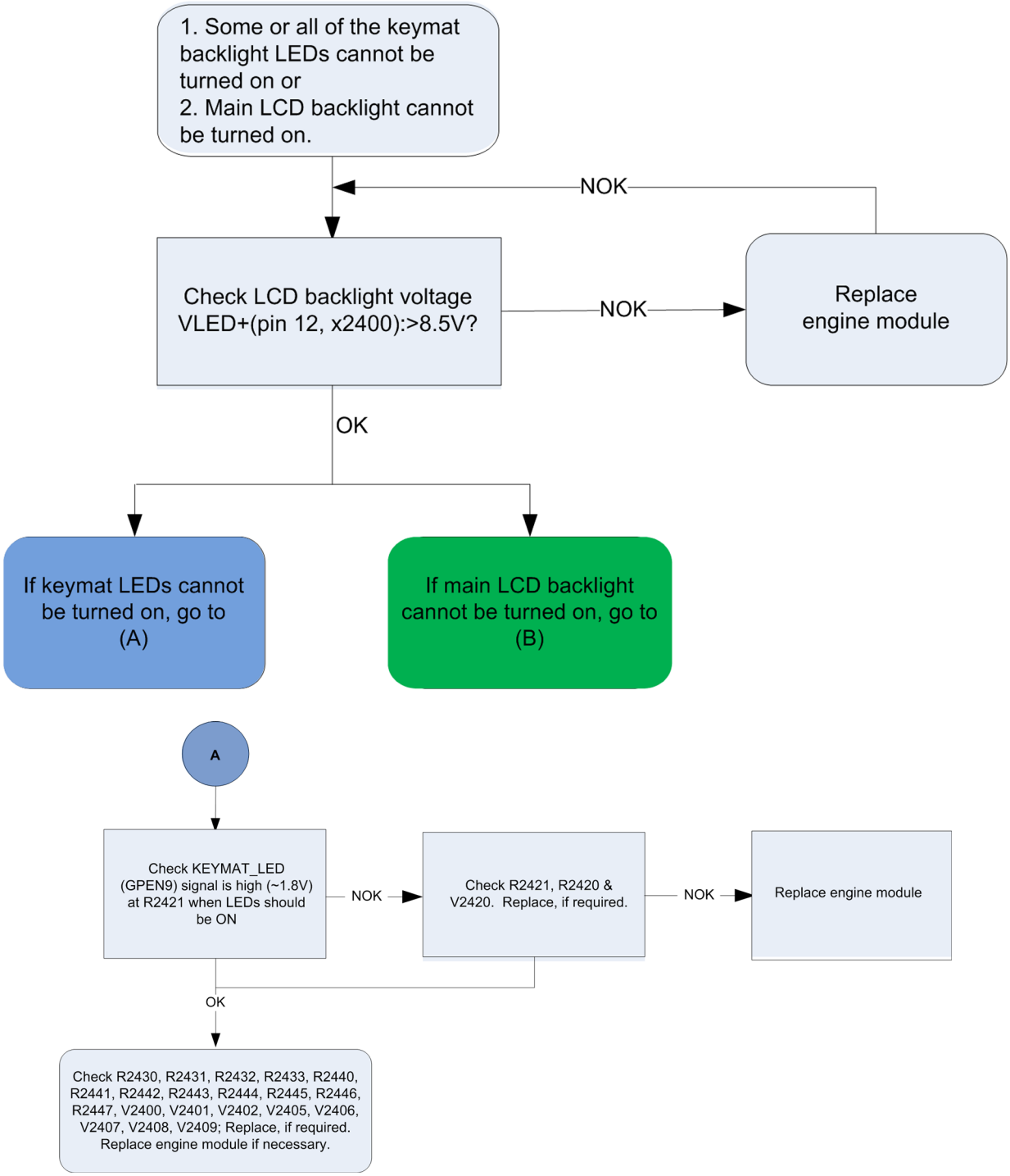
User interface troubleshooting

Backlight and Illumination Troubleshooting

Troubleshooting flow



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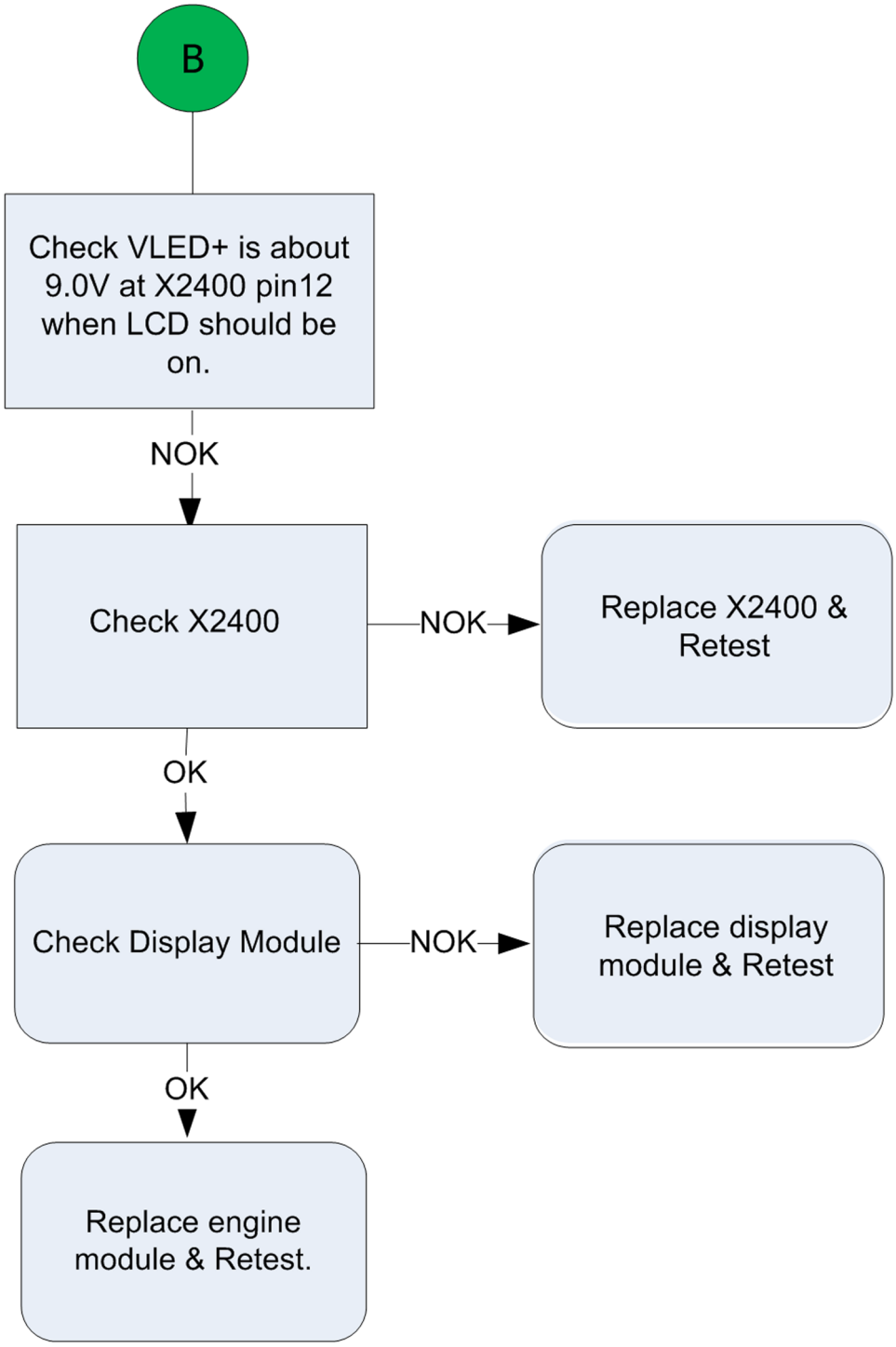

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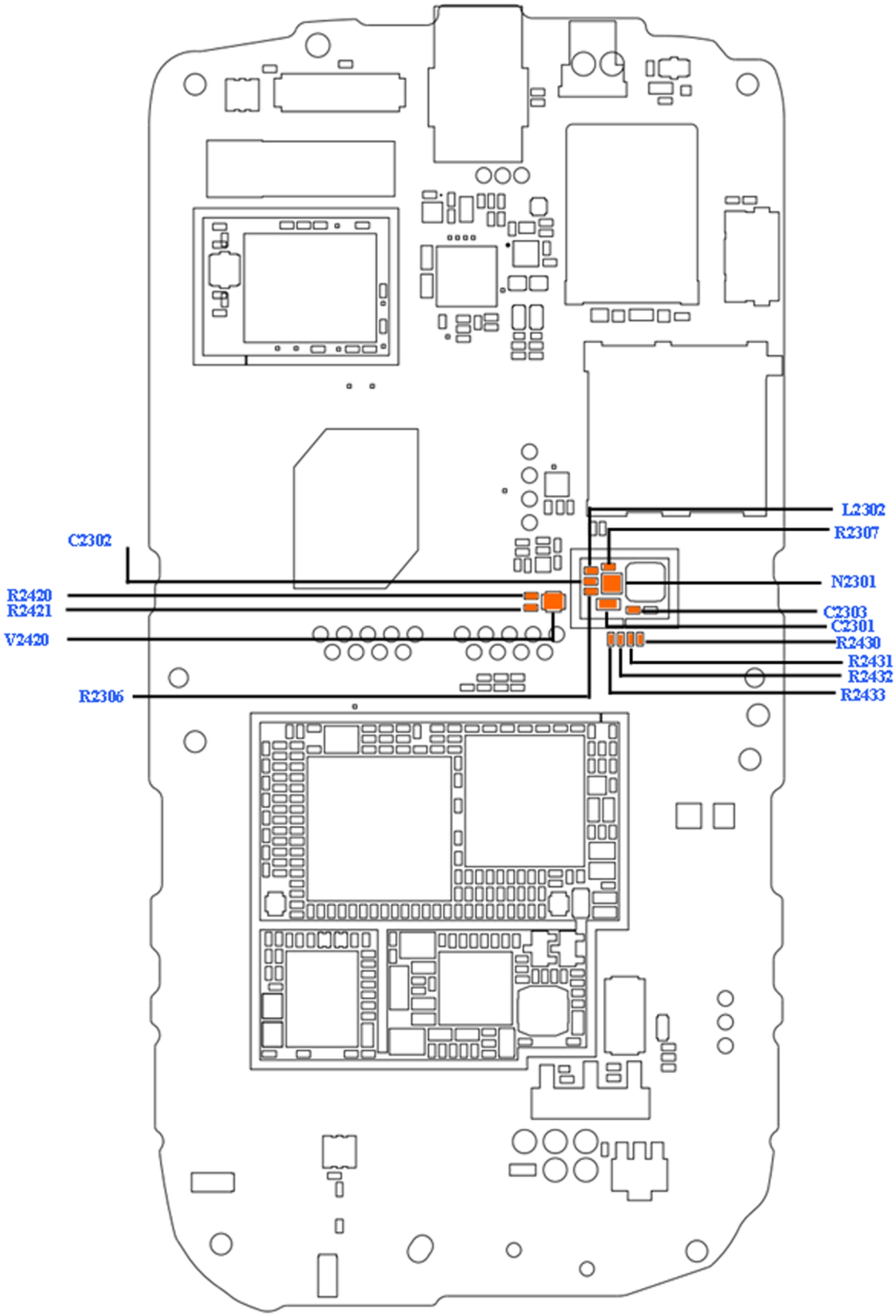

Figure 16 Probe placement diagram

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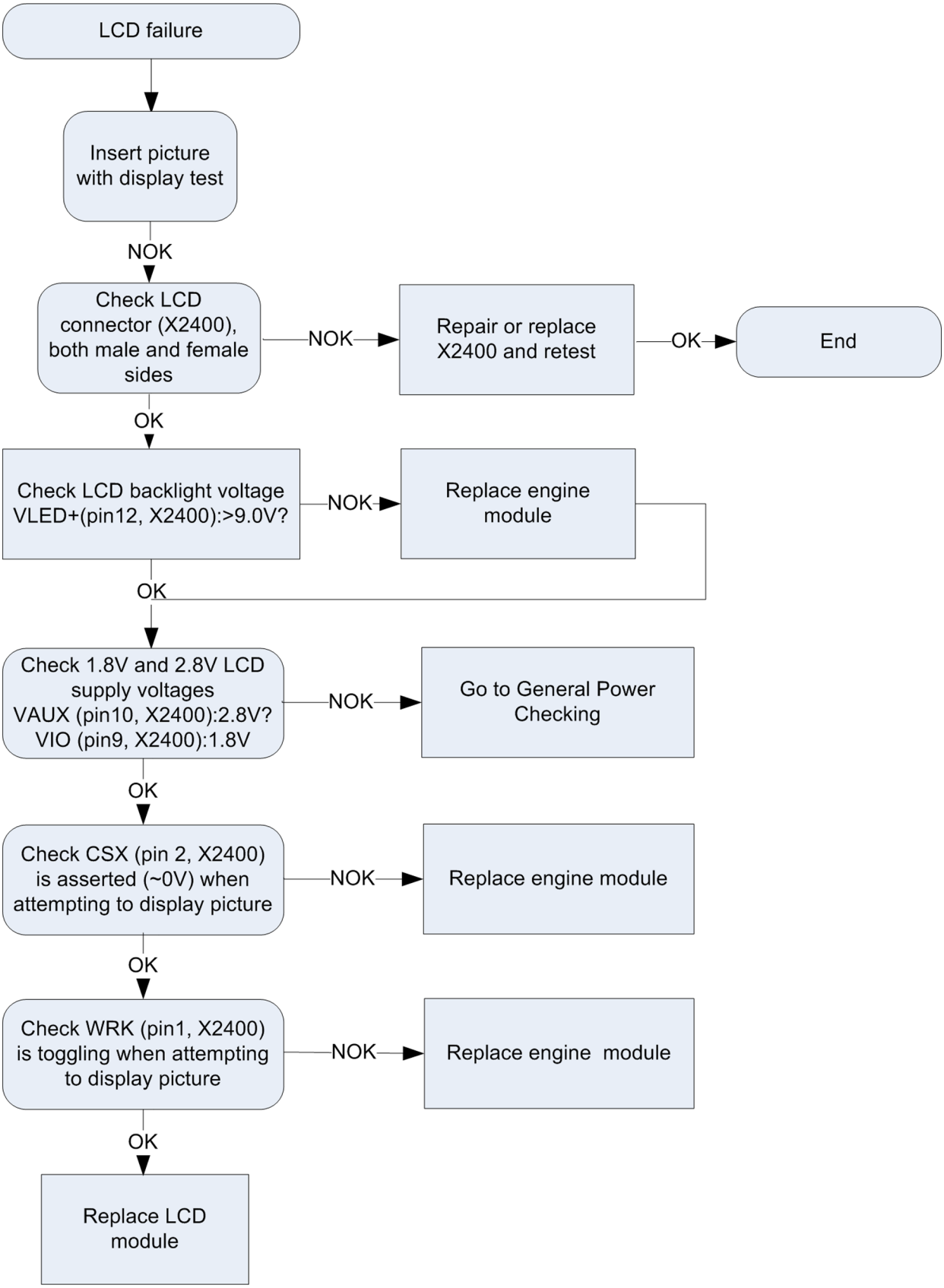
Display Interface Troubleshooting

Troubleshooting flow



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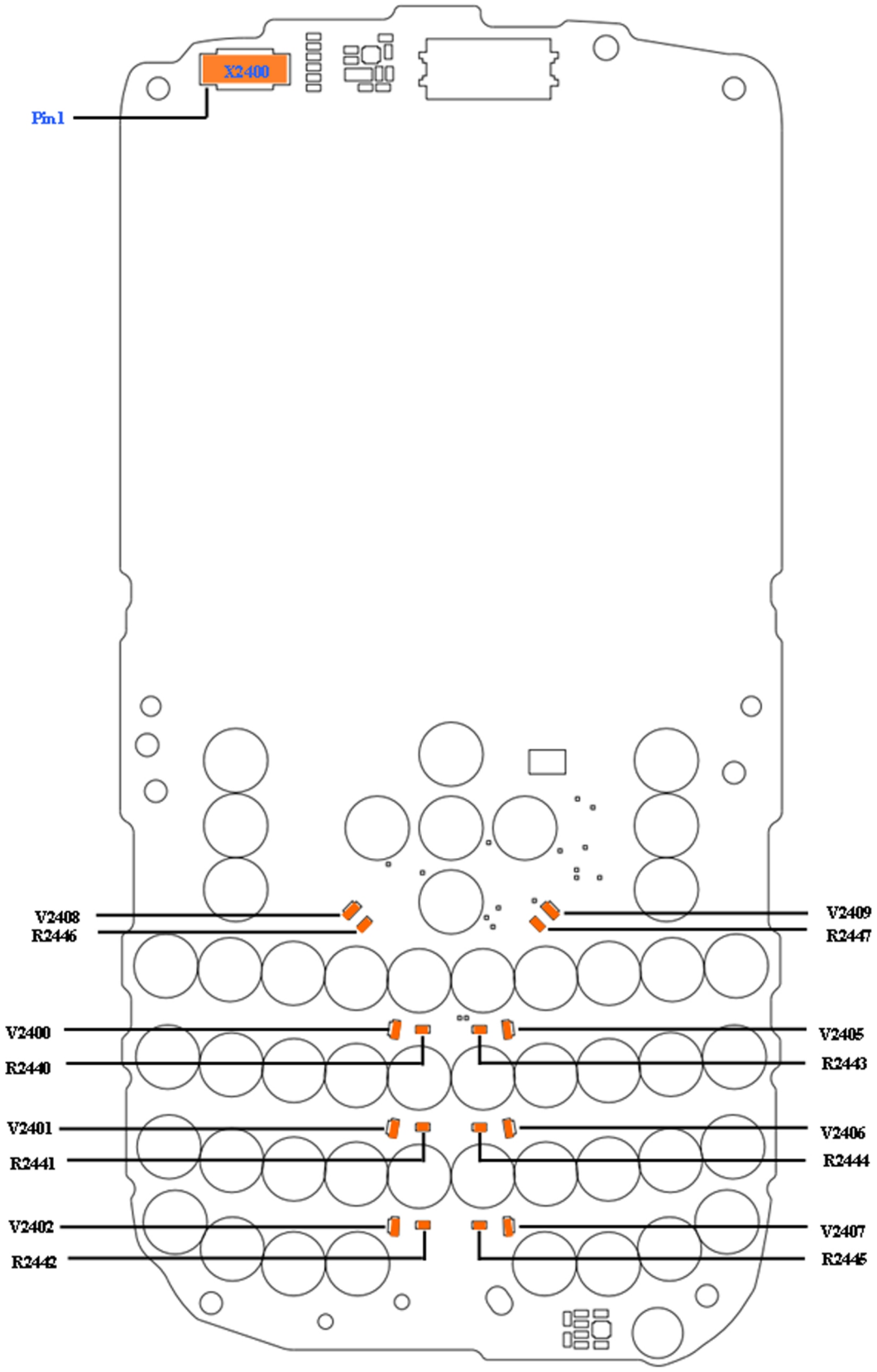

Figure 17 Probe placement diagram

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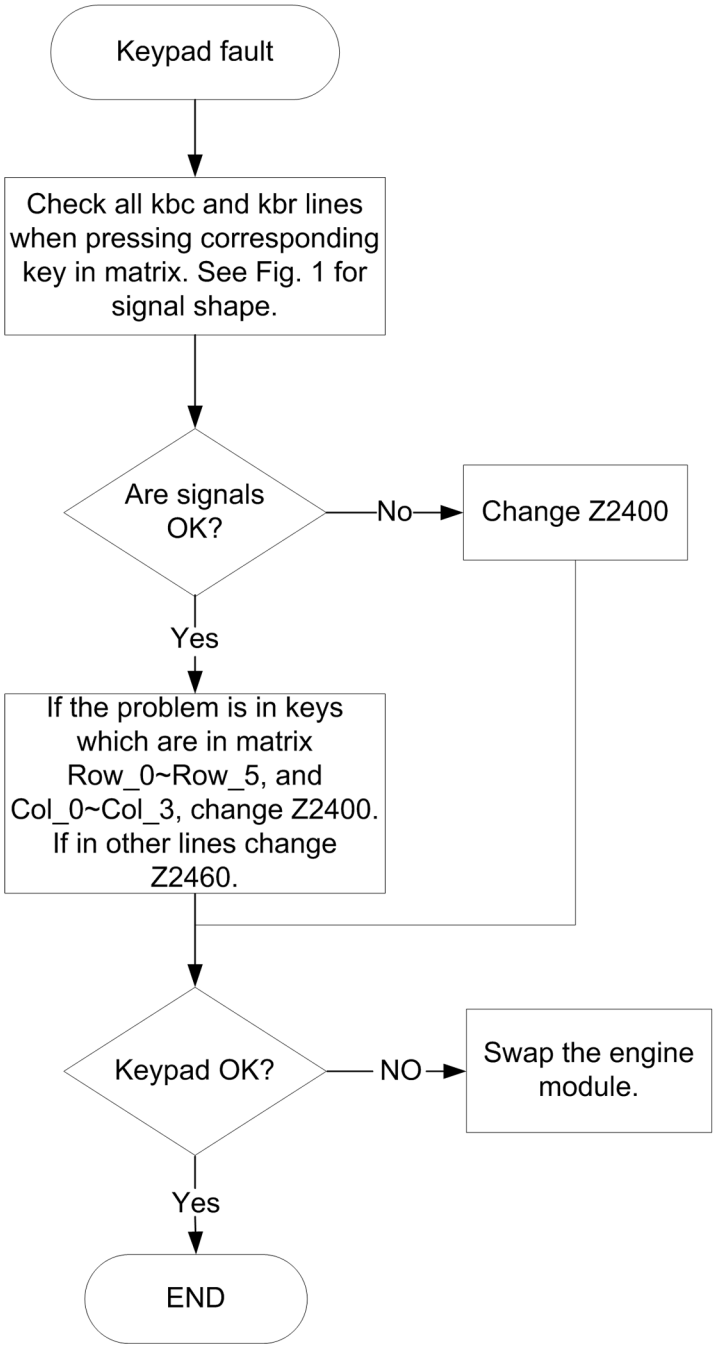
Keypad Troubleshooting

Troubleshooting flow



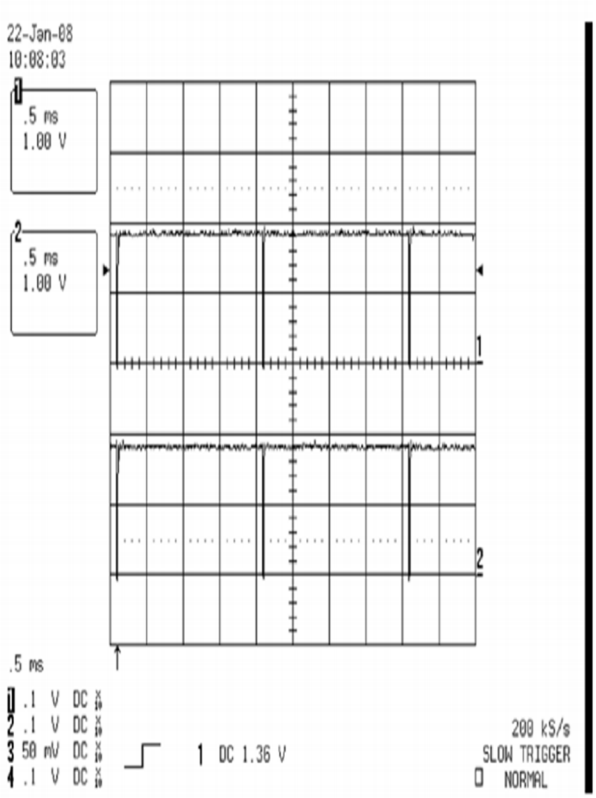


Fig.1: kbc and kbr signals when pressing key

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	COLUMN_0	COLUMN_1	COLUMN_2	COLUMN_3	COLUMN_4	COLUMN_5	COLUMN_6
ROW_0	Q	W	E	R[1]	T[2]	Y[3]	U*
ROW_1	A	S	D	F[4]	G[5]	H[6]	J#
ROW_2	Z	X	C	V[7]	B[8]	N[9]	M[0]
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		

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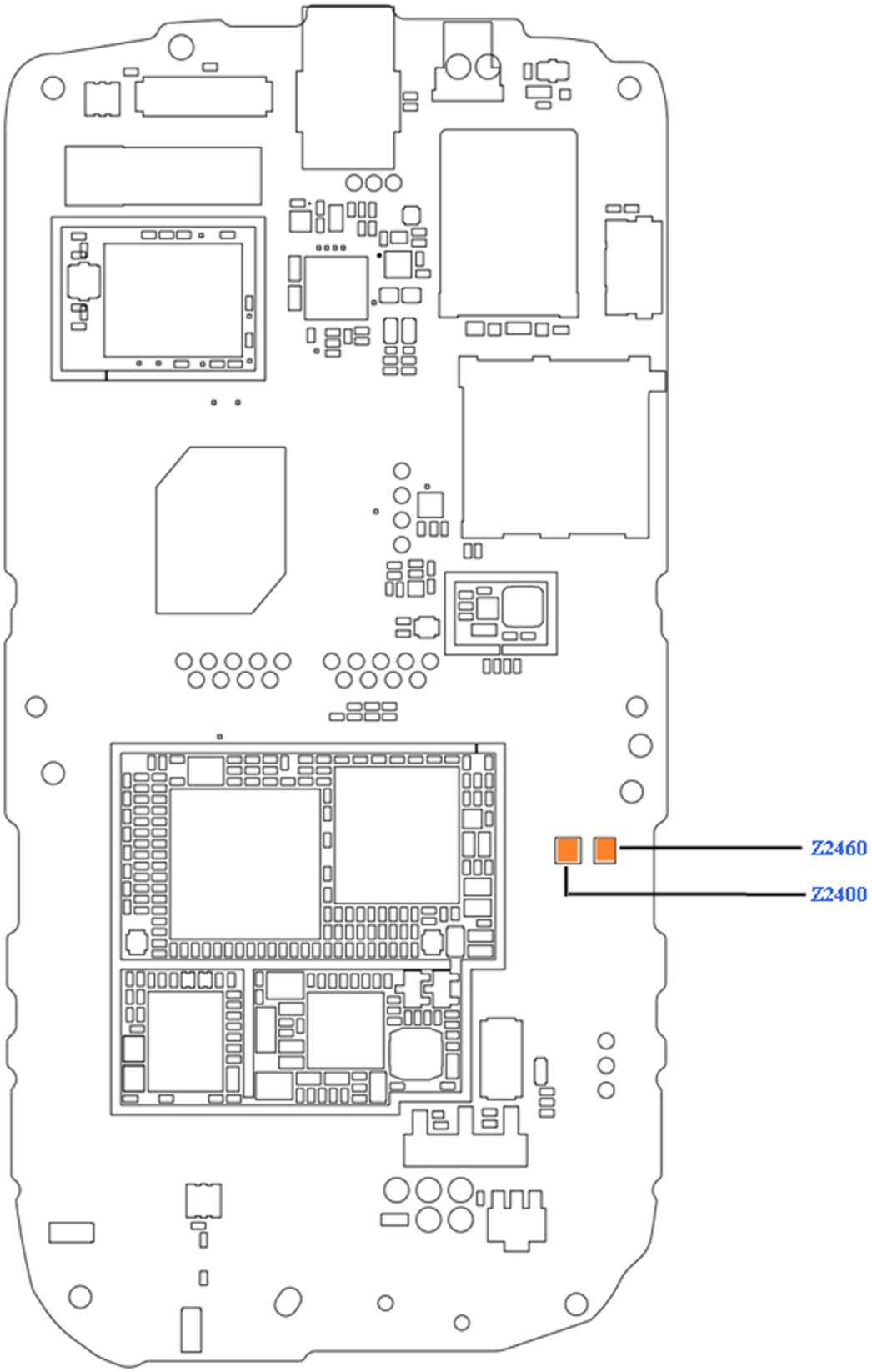

Figure 18 Probe placement diagram

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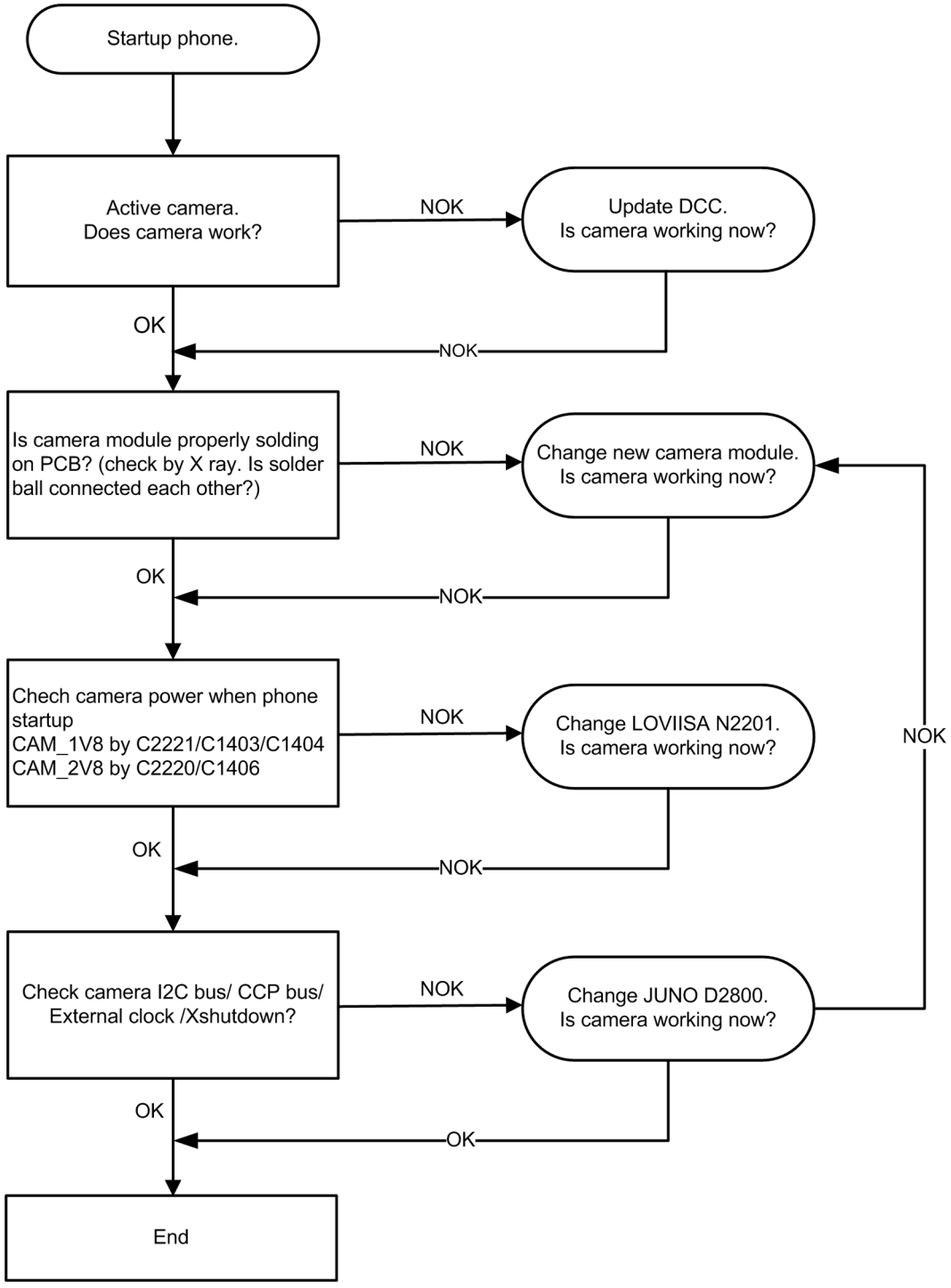
Camera troubleshooting

Camera HW Troubleshooting

Troubleshooting flow



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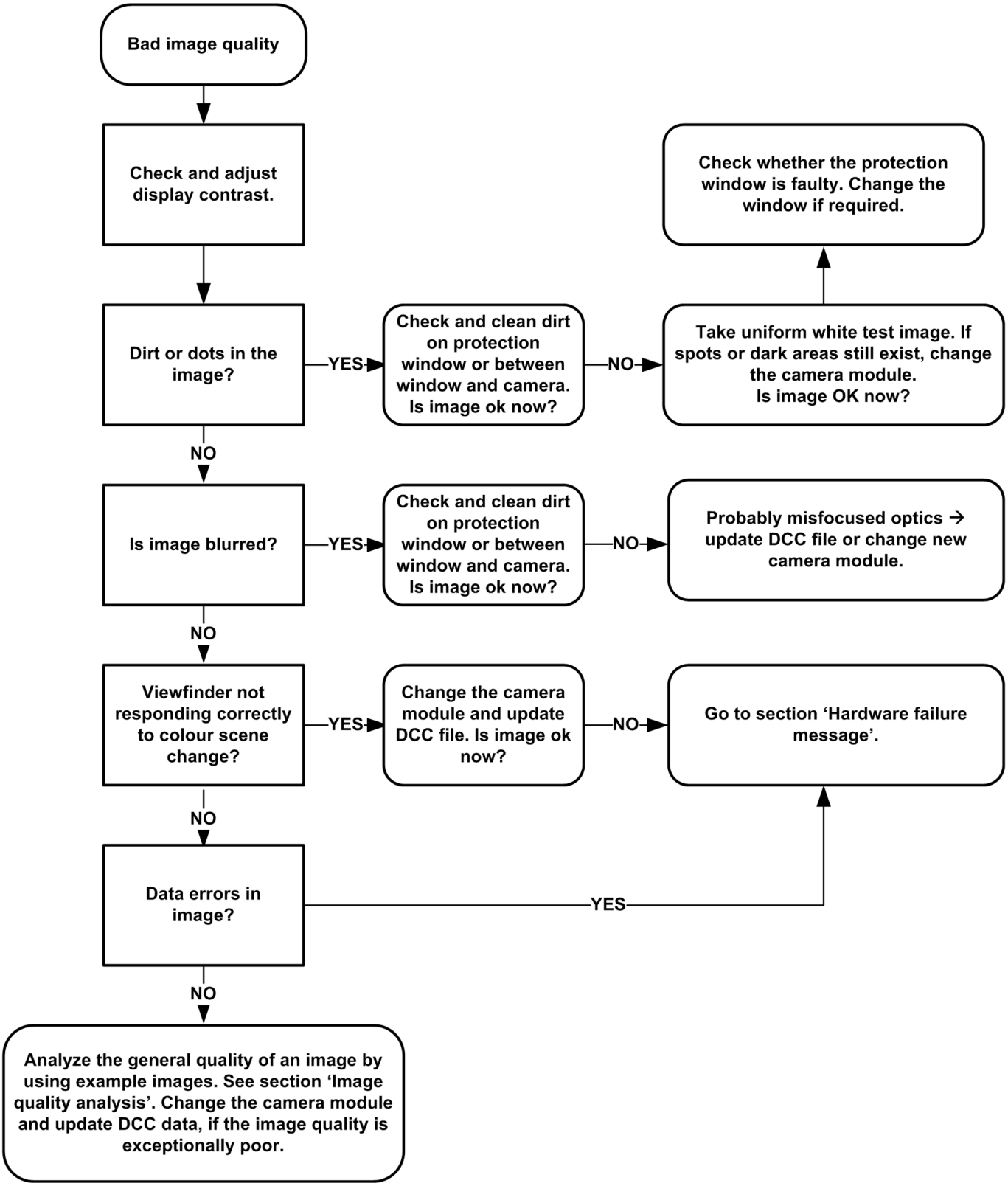
Bad Camera Image Quality Troubleshooting

Troubleshooting flow



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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.

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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	MIC2P (R2106) and GND	HS_EAR_L [J2003] and GND	0	-3	1000	710	1.2	NA
		HS_EAR_R [J2004] and GND						
	MIC2N (R2106) and GND	HS_EAR_L [J2003] and GND						
		HS_EAR_R [J2004] and GND						
External Mic to Internal Earpiece	MIC2P (R2106) and GND	EARP [R2106] not assembled and GND	0	-3	1000	710	1.2	NA
		EARN [R2107] not assembled and GND						
	MIC2N (R2106) and GND	EARP [R2106] not assembled and GND						
		EARN [R2107] not assembled and GND						

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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 Internal handsfree	MIC2P (R2106) and GND	HFSPP [R2102]	0	-3	1000	710	0	25mA (calc.)
		HFSPN [R2103]						
	MIC2N (R2106) and GND	HFSPP [R2102]						
		HFSPN [R2103]						
Internal Mic to External Earpiece	MIC1P (R2100)	HS_EAR_L [J2003] and GND	0	-3	1000	710	1.2	NA
		HS_EAR_R [J2004] and GND						
	MIC1N (R2101)	HS_EAR_L [J2003] and GND						
		HS_EAR_R [J2004] and GND						

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Placement Diagram

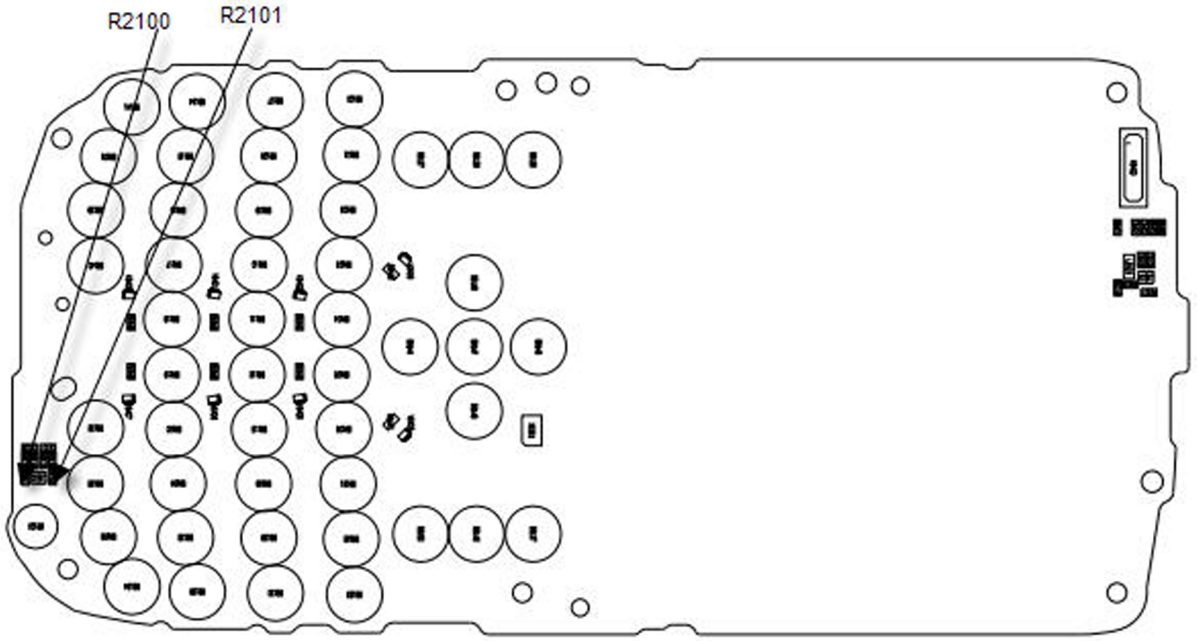

Figure 19 Front side

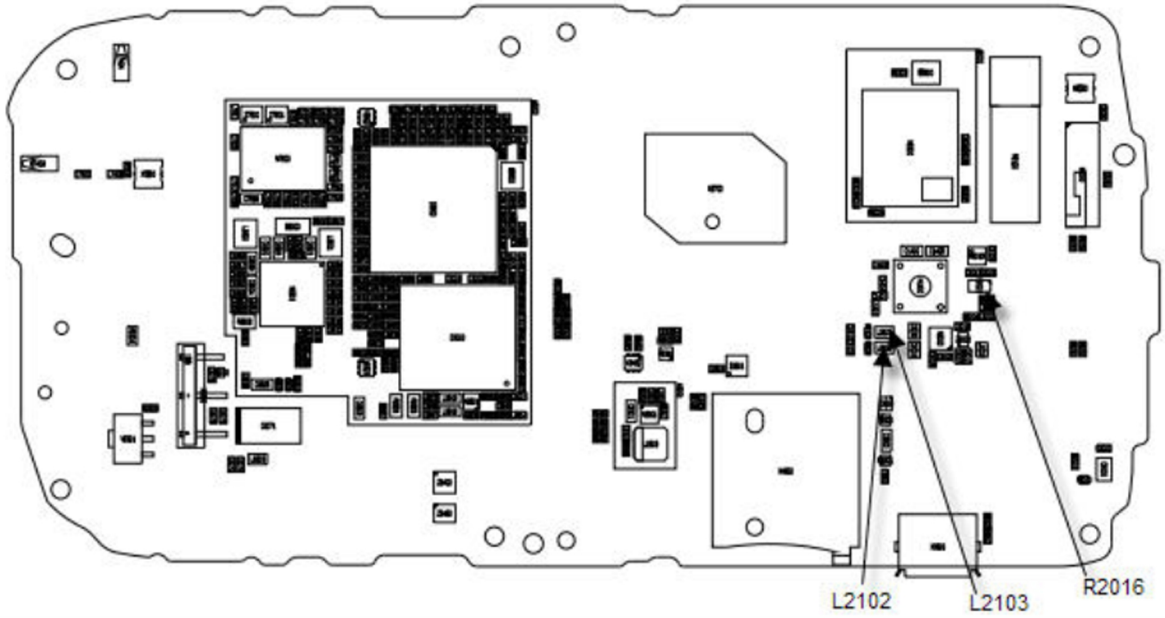

Figure 20 Back side

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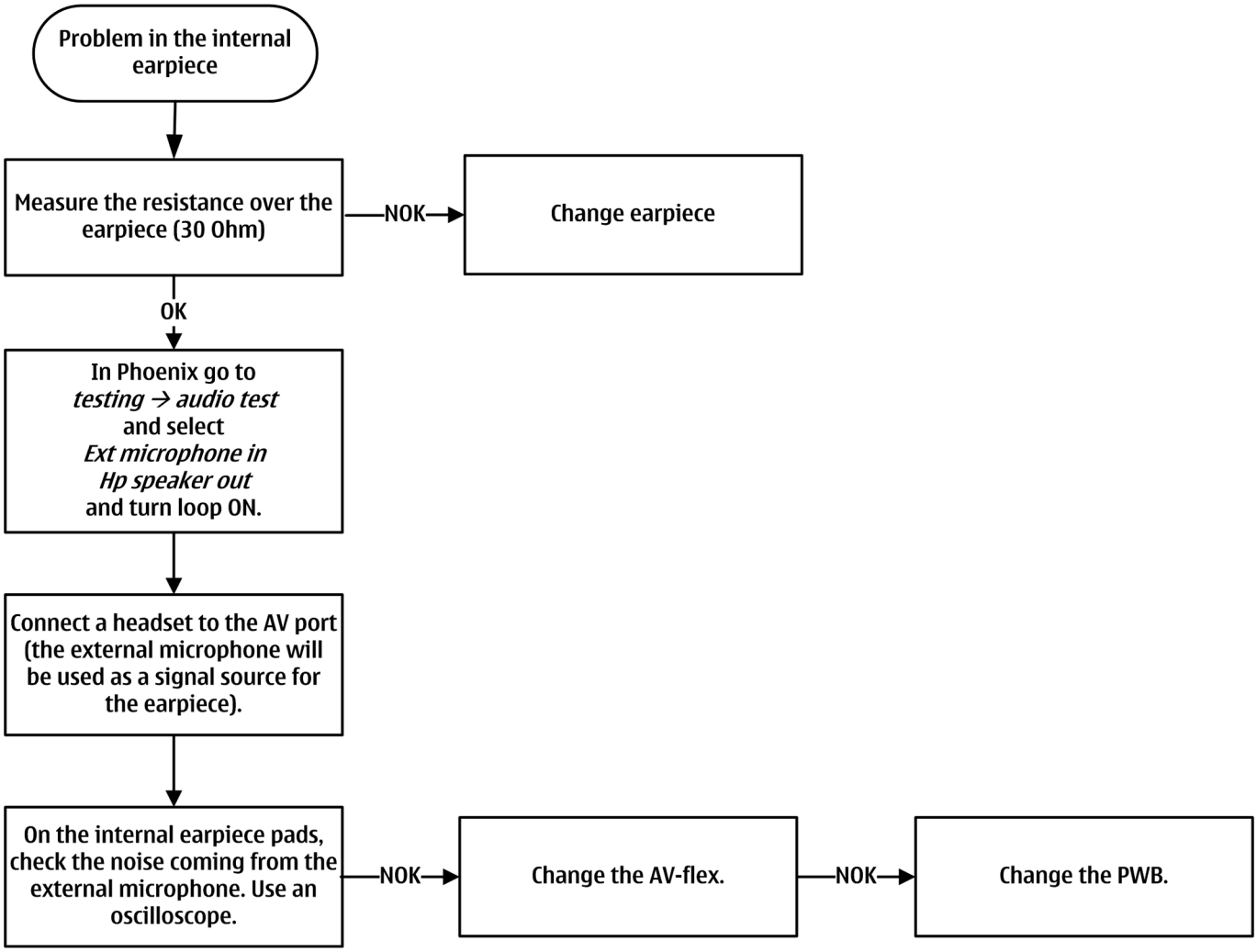
Internal earpiece troubleshooting

Troubleshooting flow



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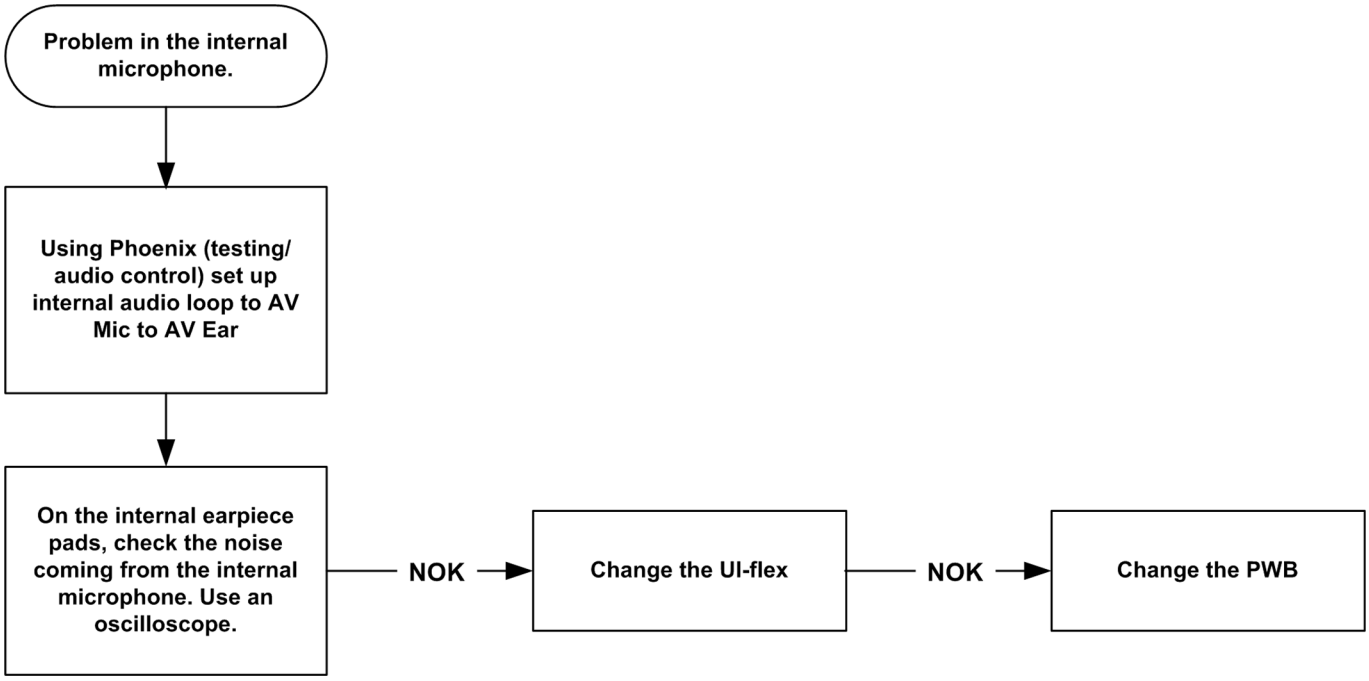
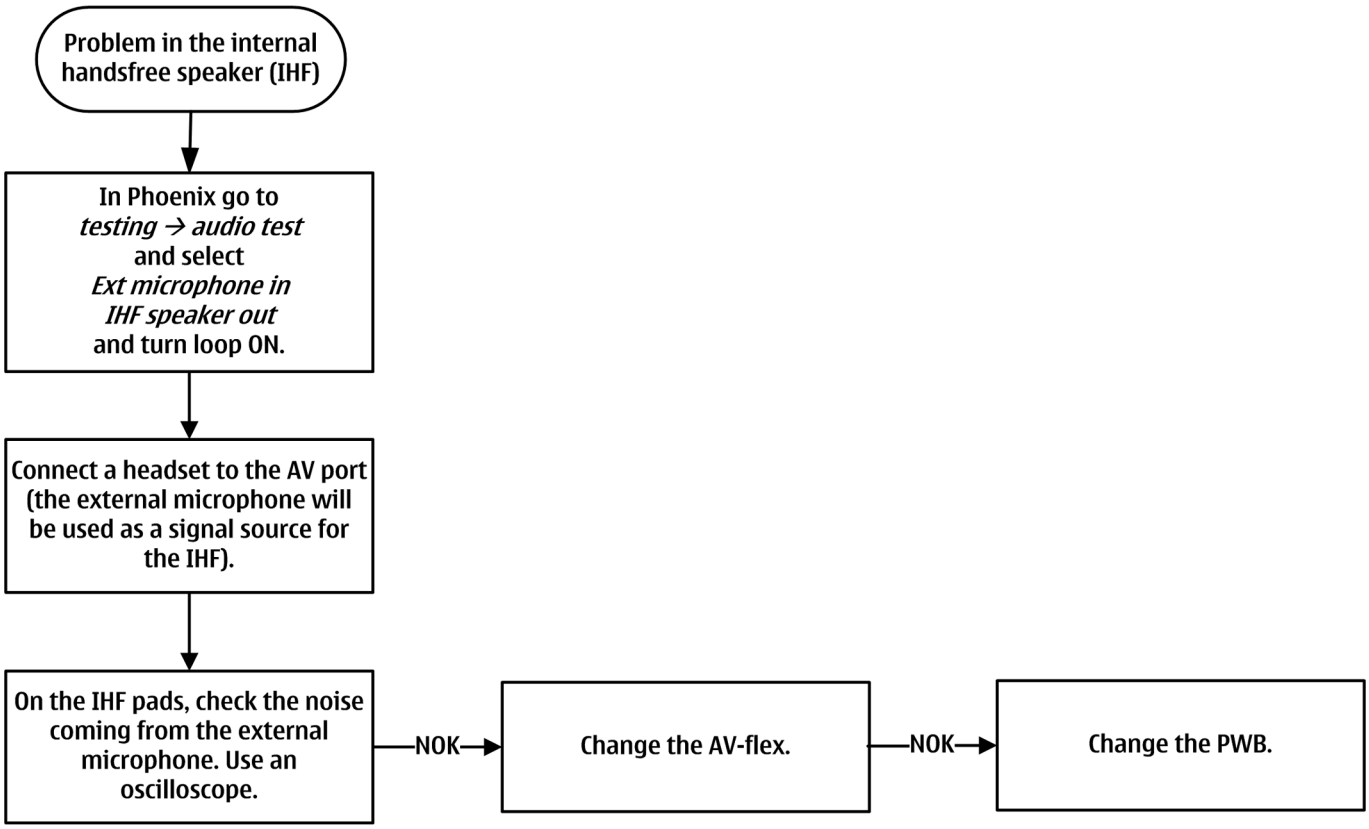
Internal microphone troubleshooting

Troubleshooting flow



Internal handsfree (IHF) troubleshooting

Troubleshooting flow



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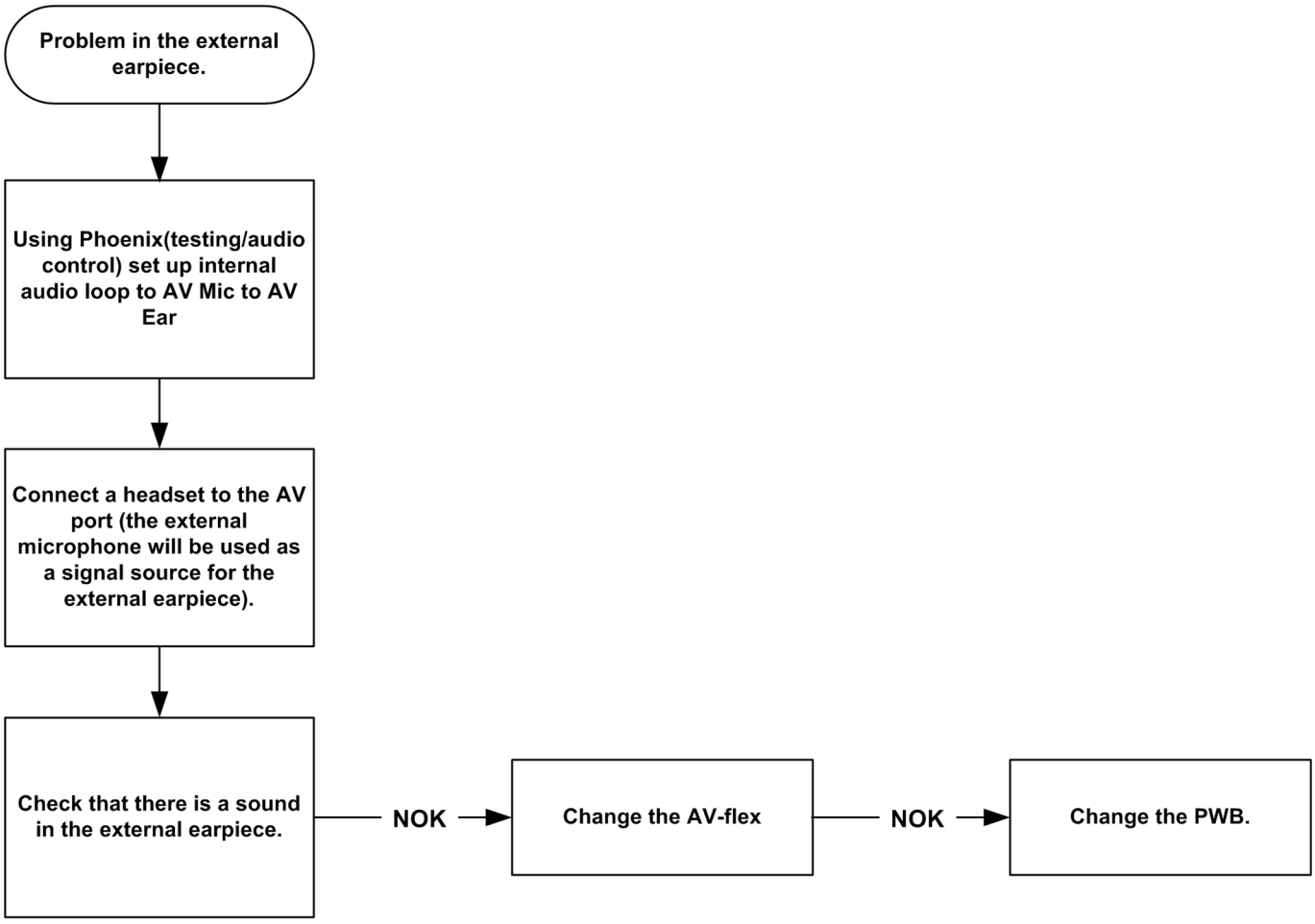
External earpiece troubleshooting

Troubleshooting flow



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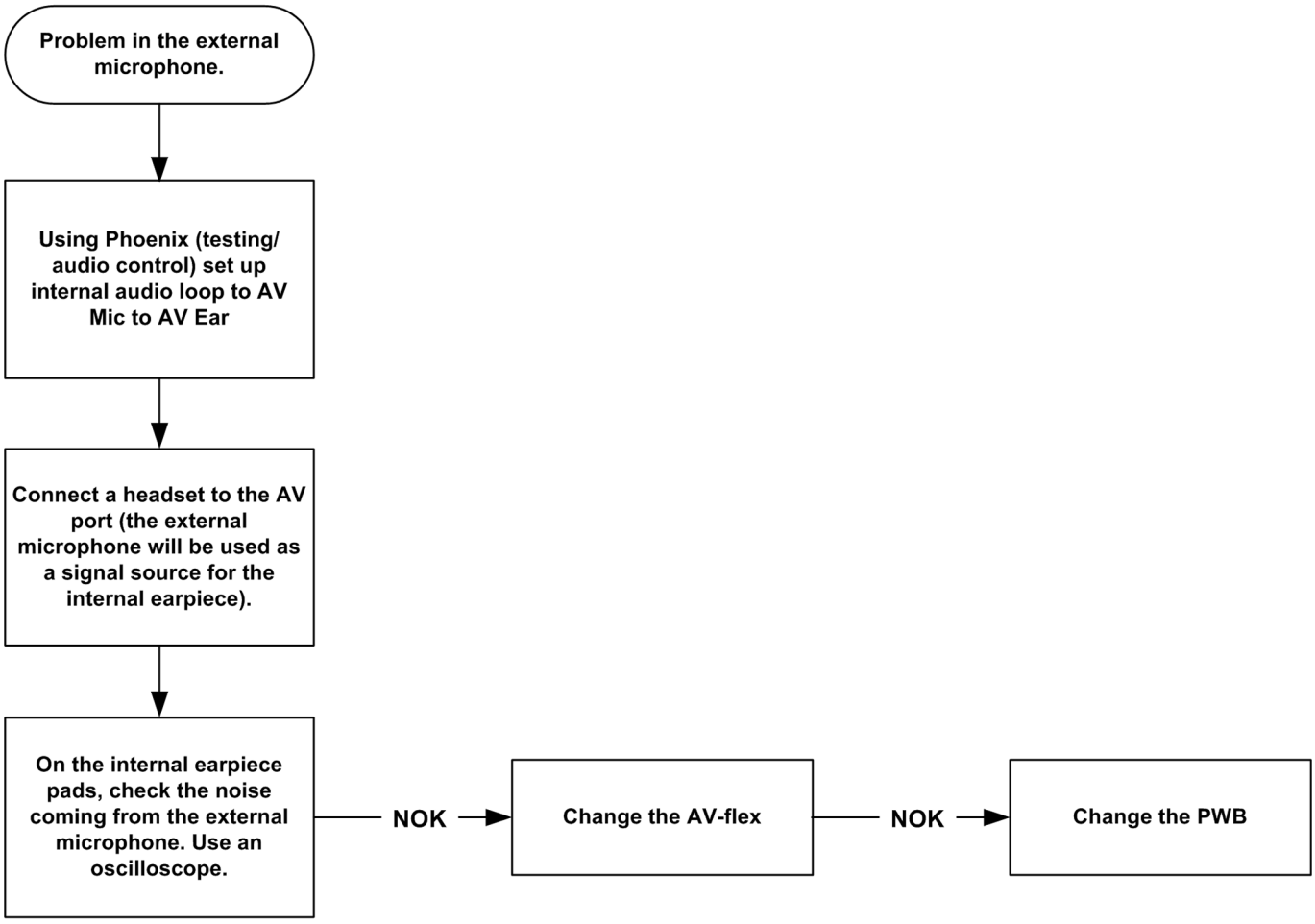
External microphone troubleshooting

Troubleshooting flow



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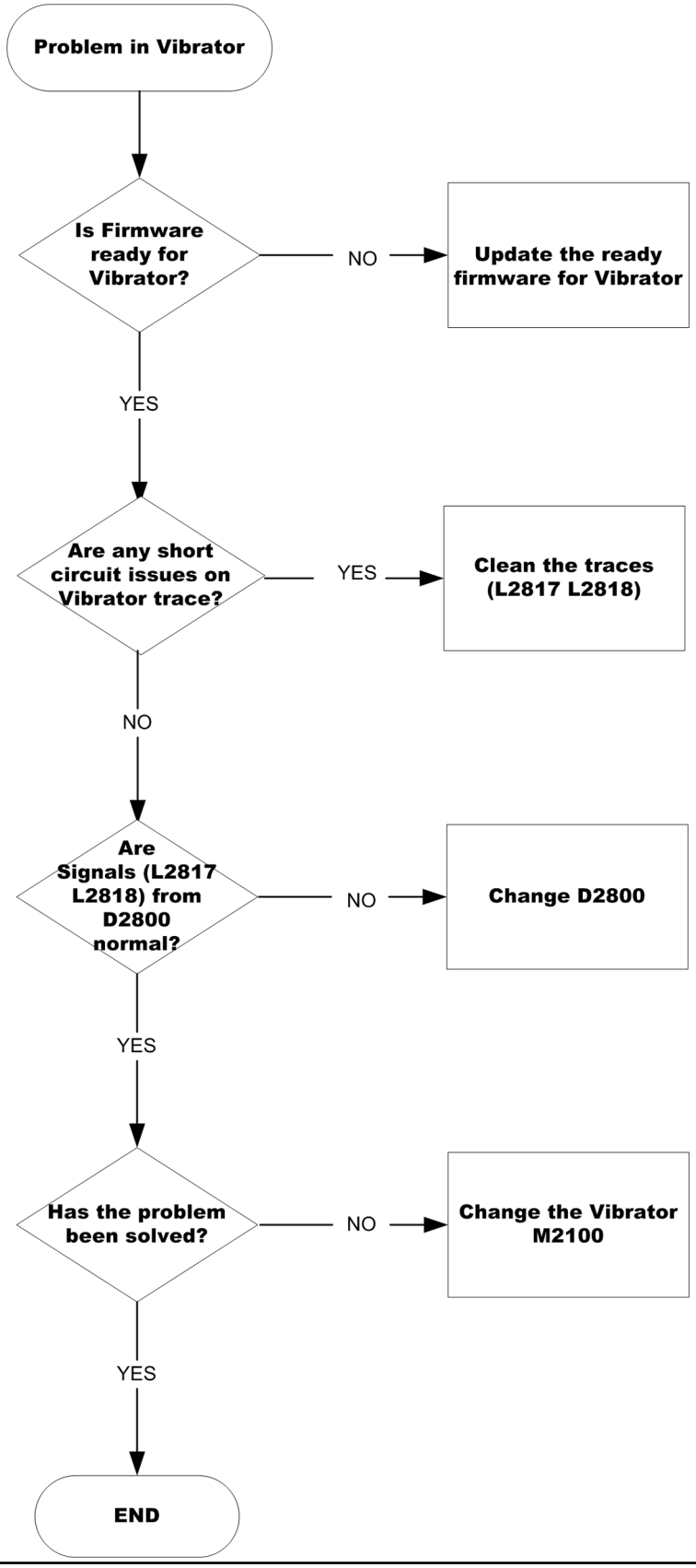
Vibrator troubleshooting

Troubleshooting flow



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Baseband manual tuning guide

Certificate restoring

Context

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

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

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-614.
- 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.

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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-262, and place phone to the Module jig MJ-262.
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.

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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.

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RF key components

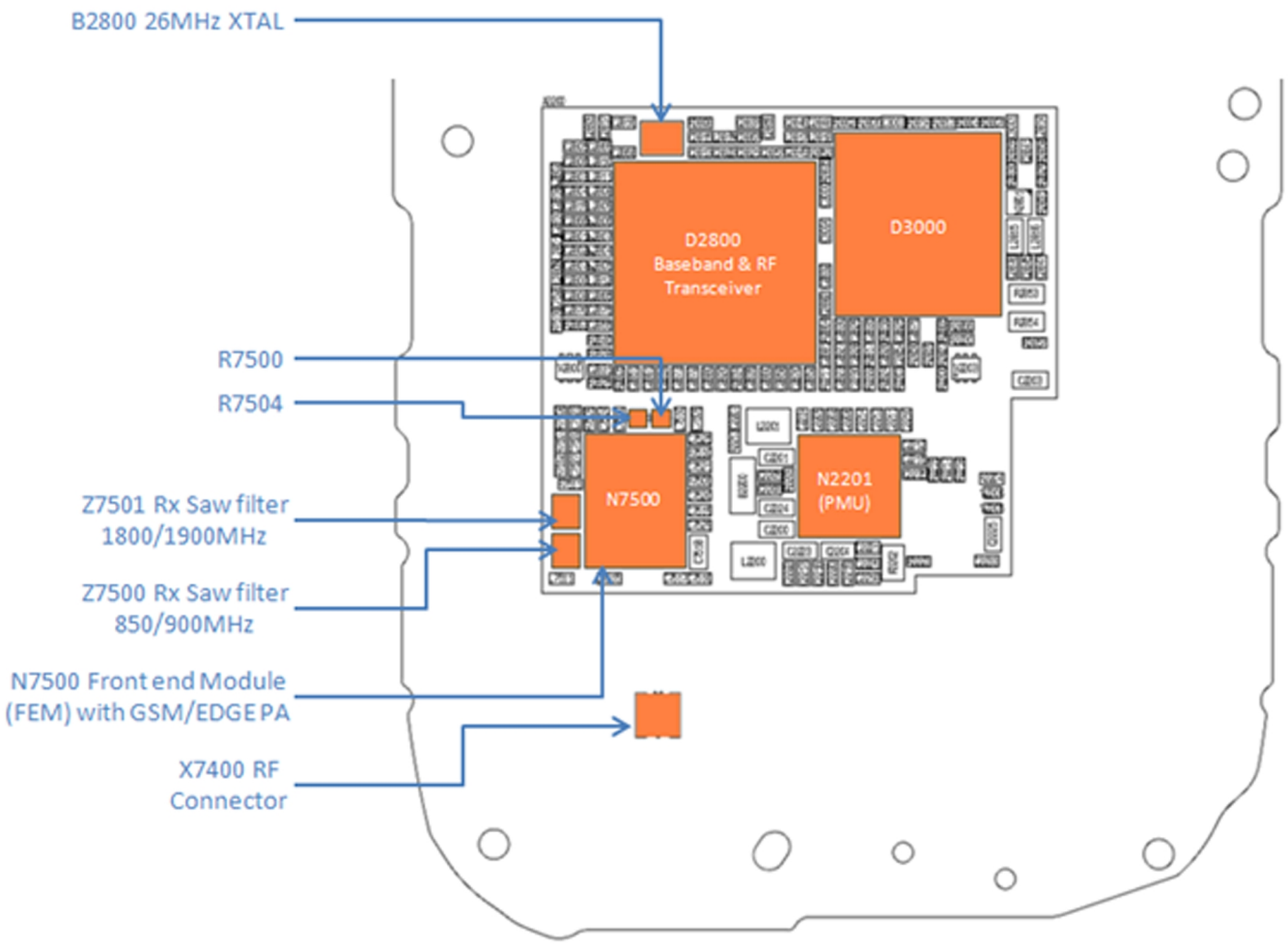

Figure 21 RF key components

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.

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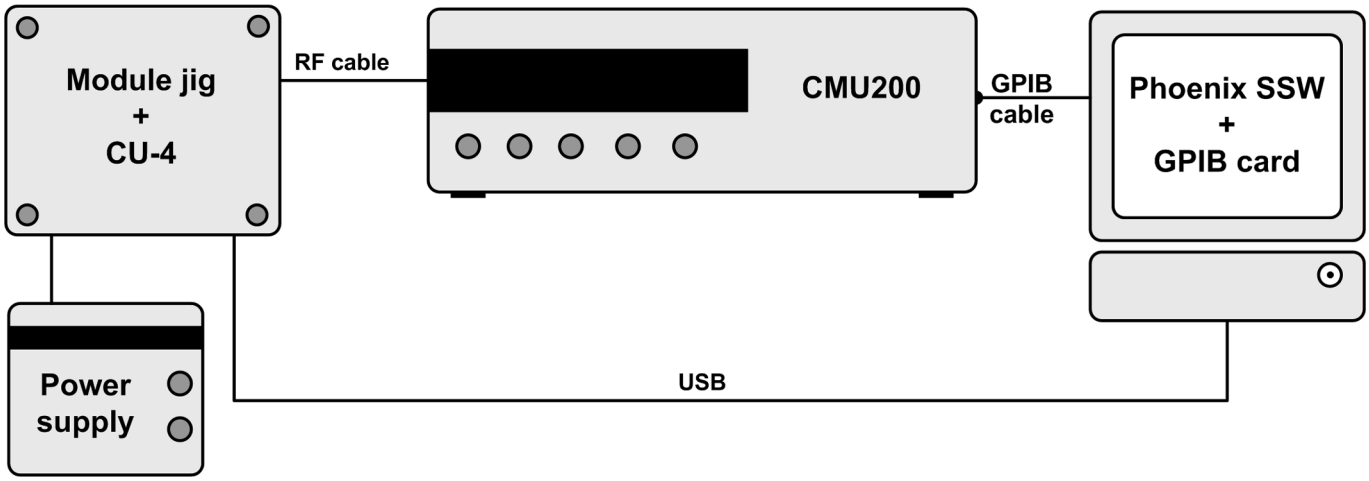

Figure 22 Auto tuning concept with CMU200

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	VDCXO (INT_VDCXO)	C2813	1.3V (analog supply for DCXO)
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)

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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

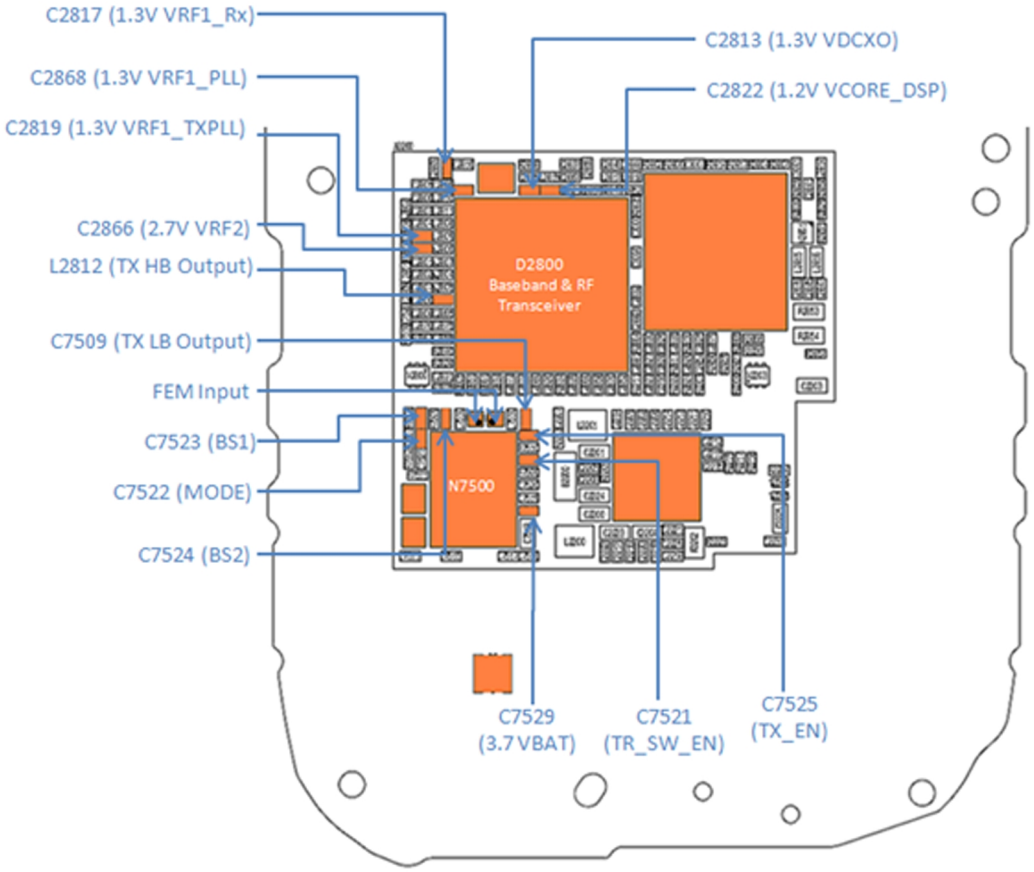

Figure 23 General voltage checking test points (main board, top side)

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	

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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.

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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.

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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

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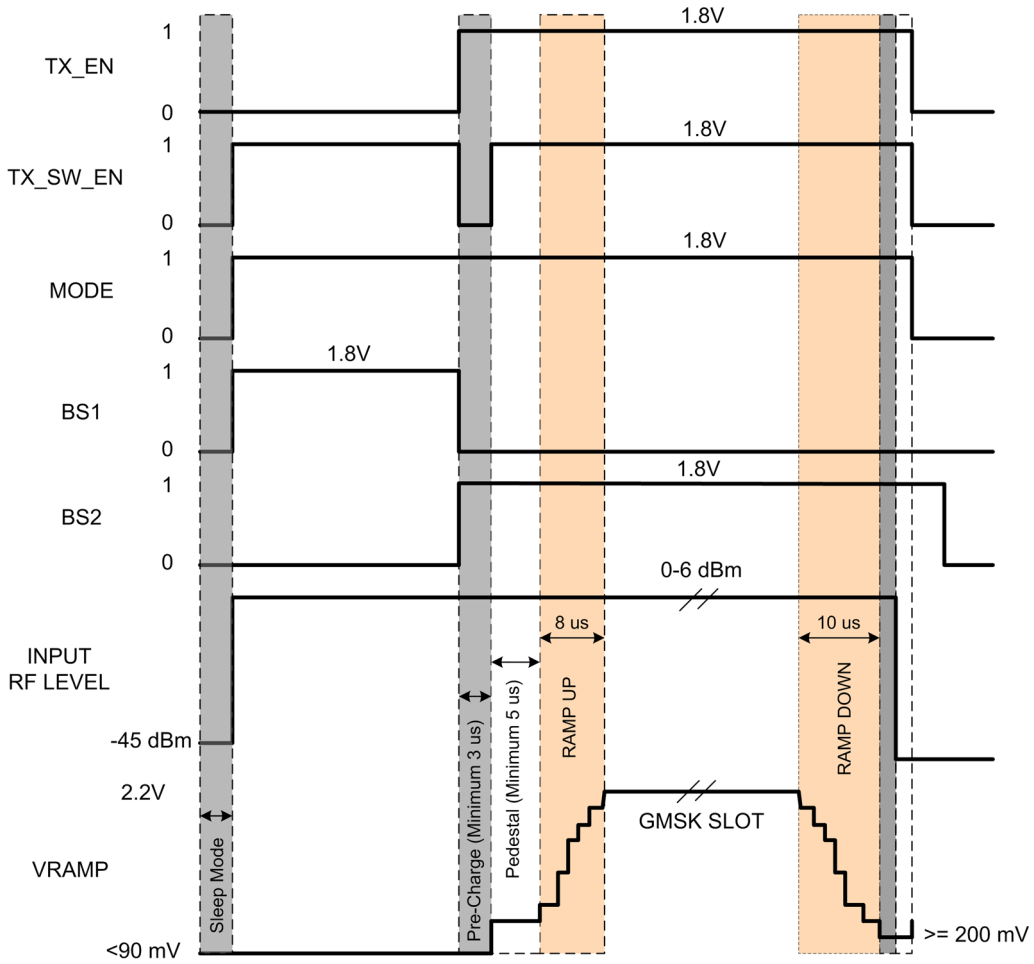

Figure 24 GMSK Control Signal in time domain

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.

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RF Test Points in RX Troubleshooting

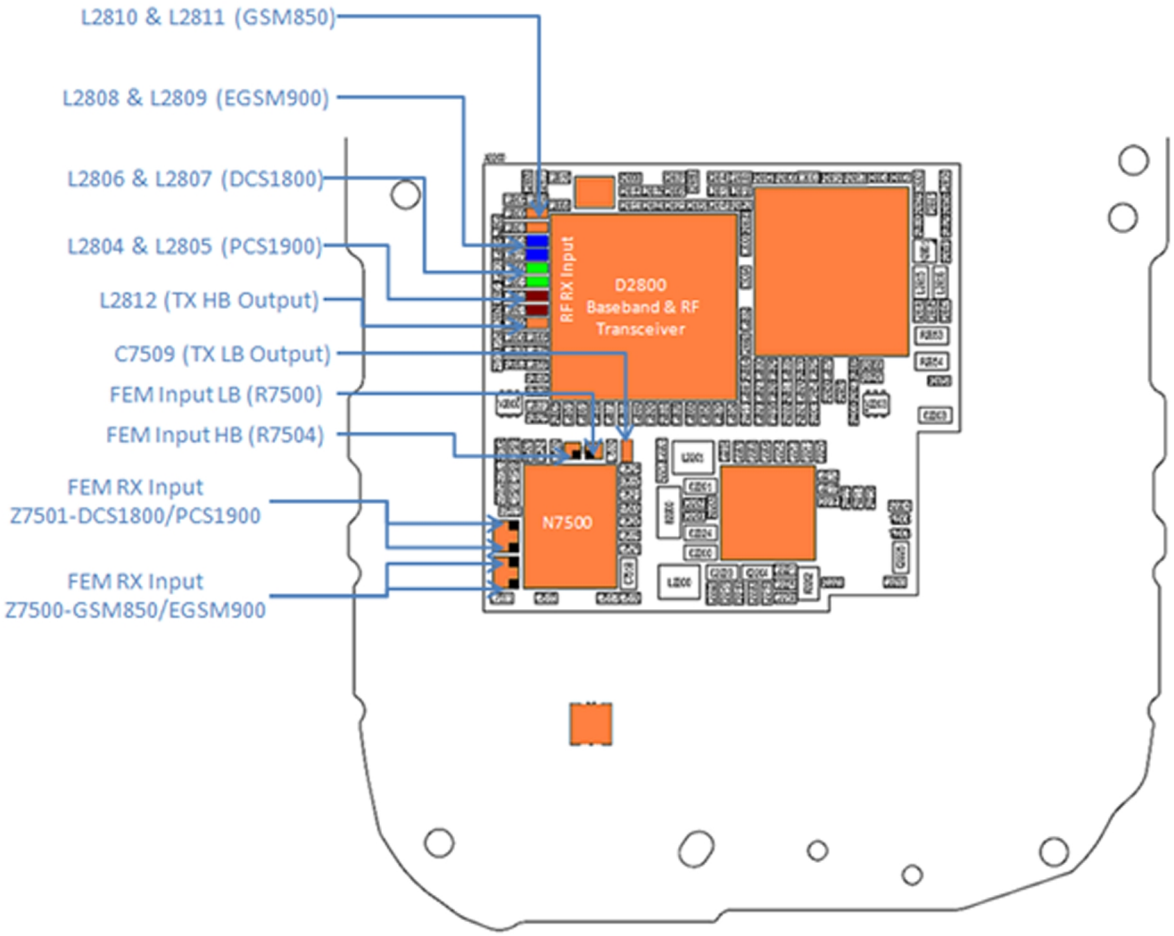

Figure 25 RF transmitter & receiver test points

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**)

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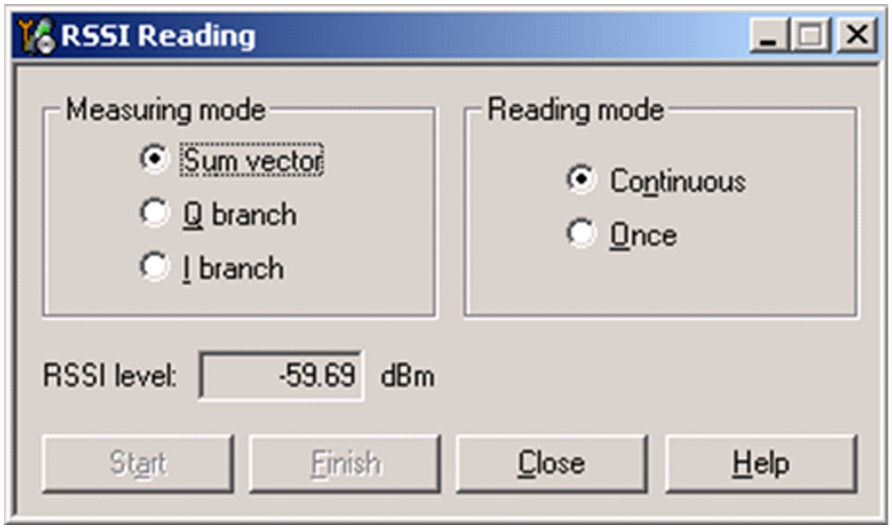

Results

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.

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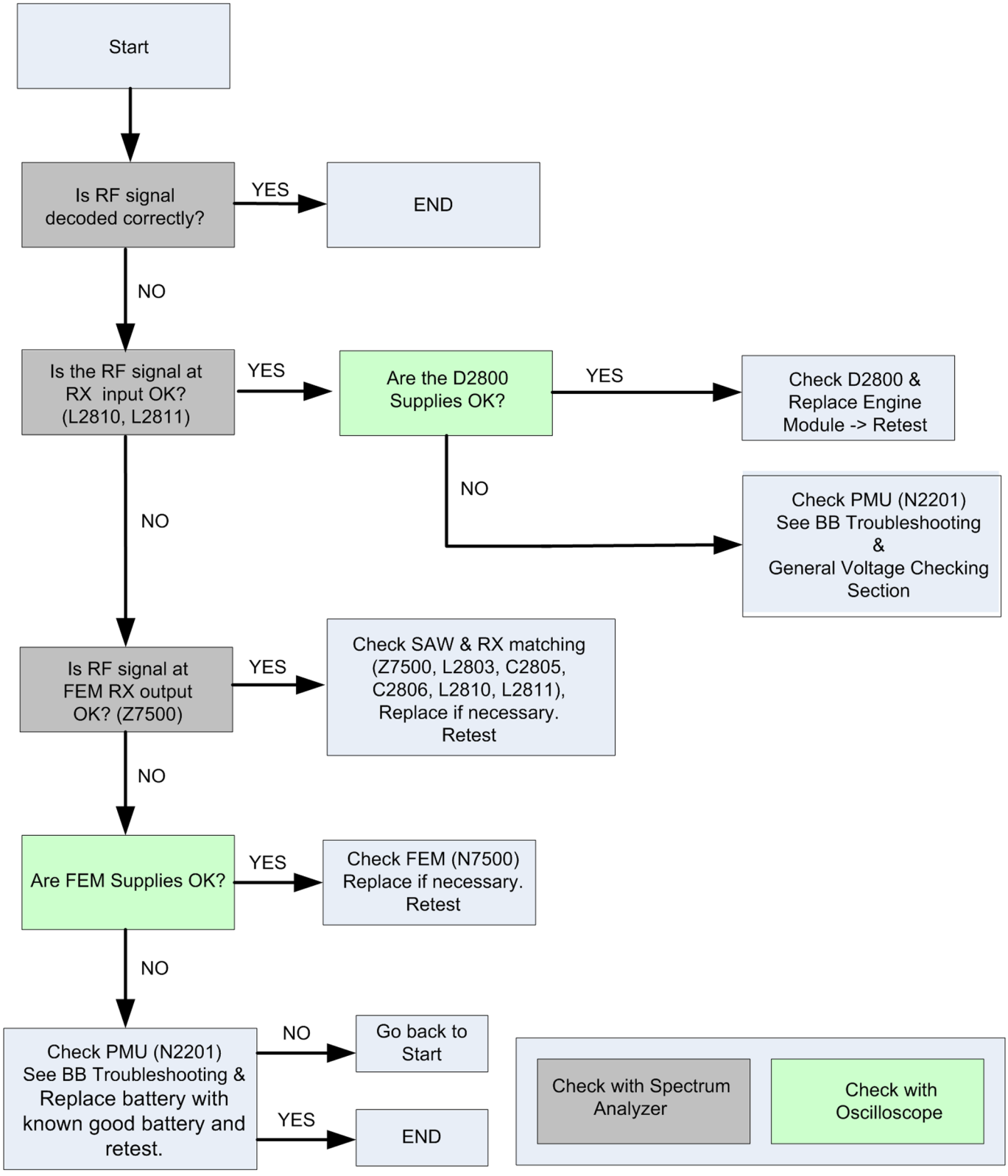
RX troubleshooting for GSM850

Troubleshooting flow



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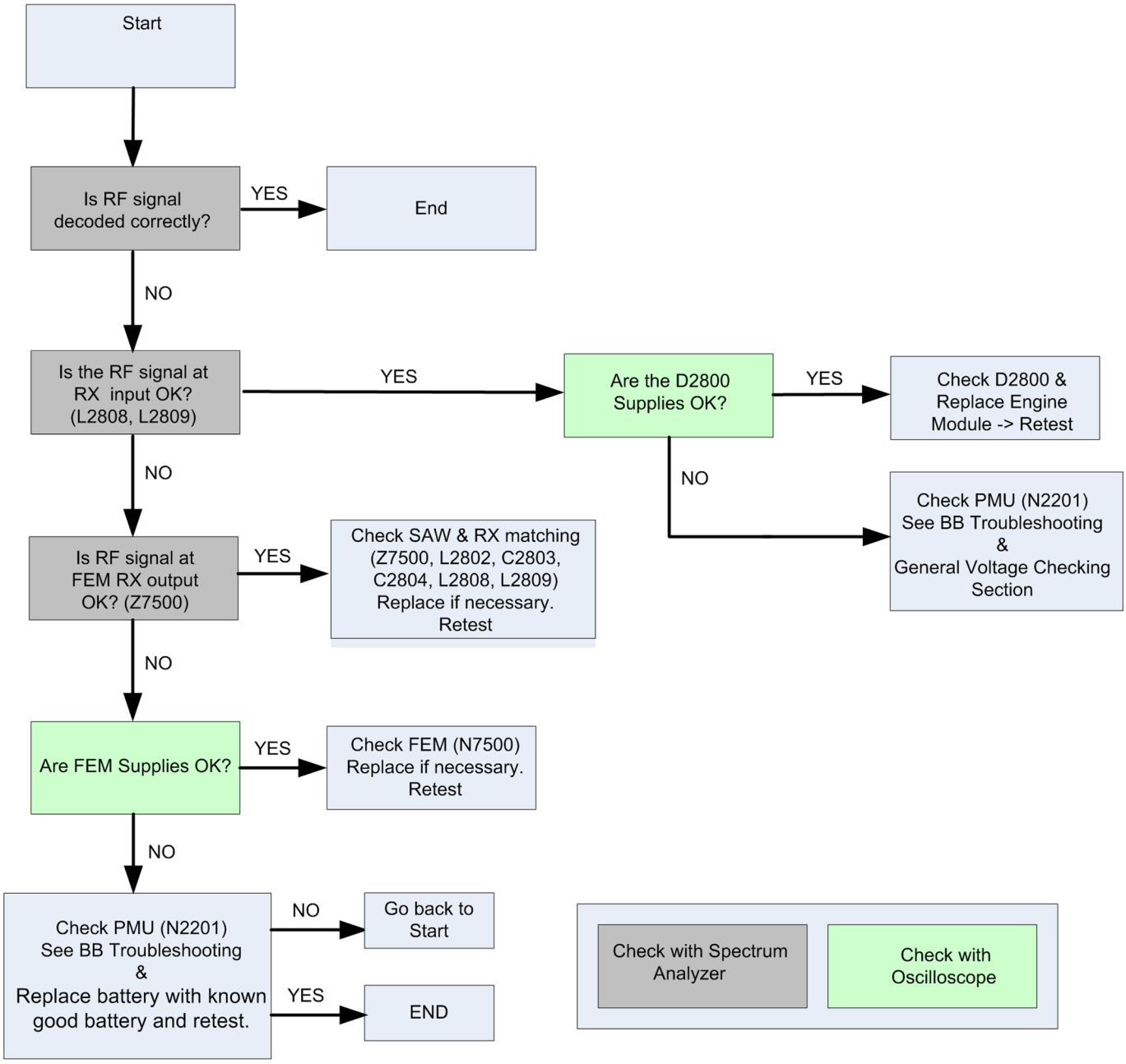
RX troubleshooting for GSM900

Troubleshooting flow



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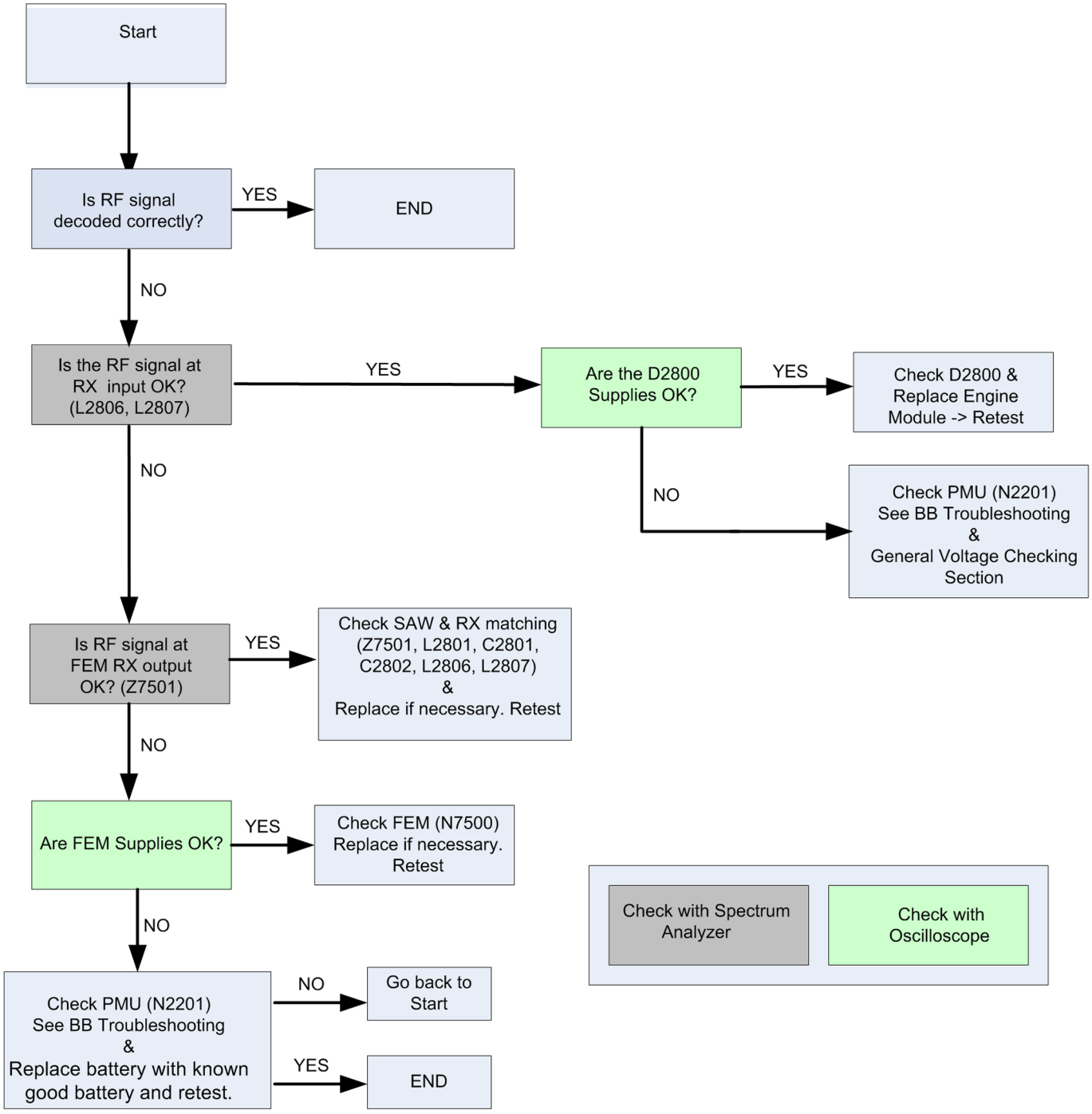
RX troubleshooting for GSM1800

Troubleshooting flow



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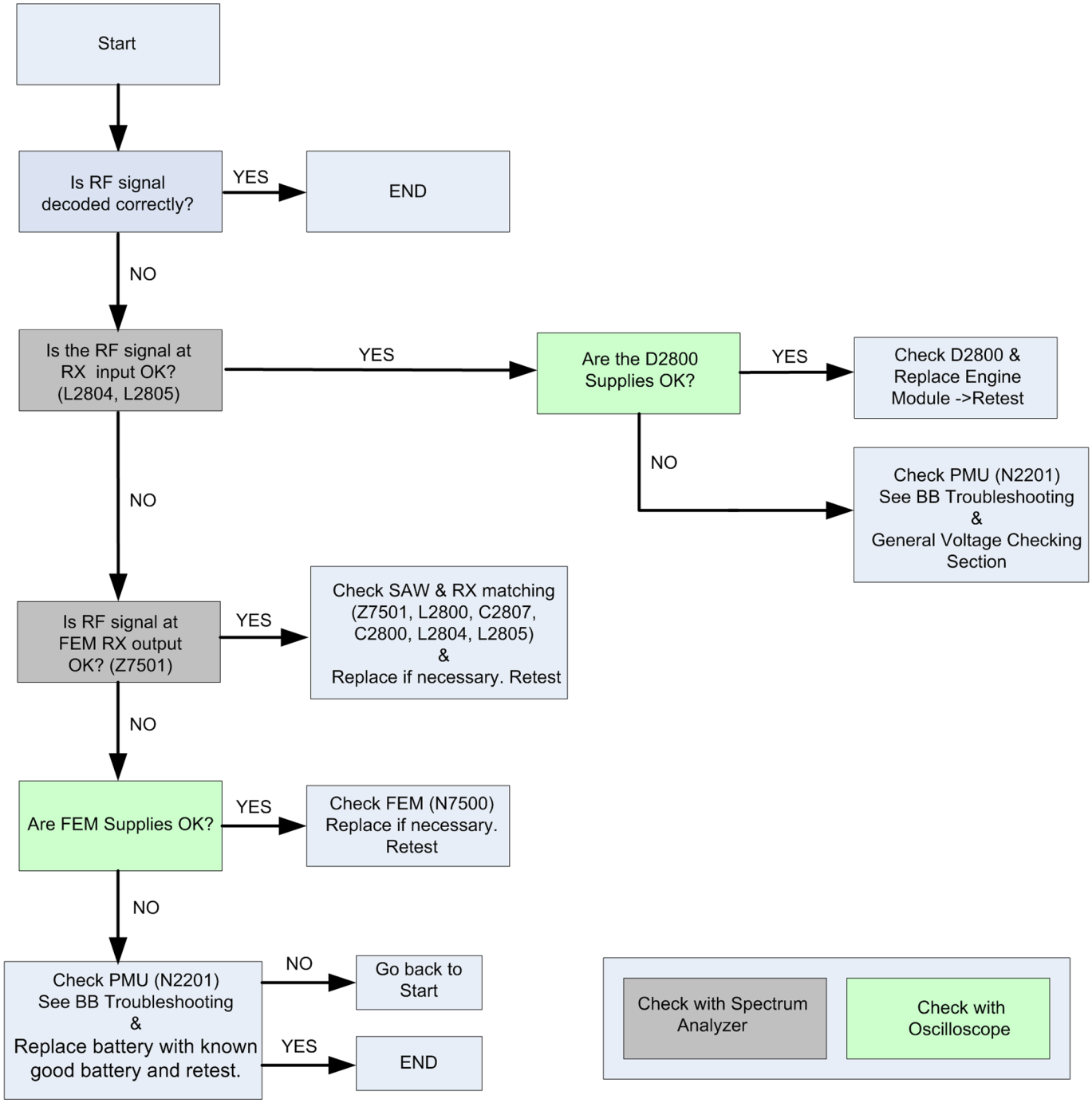
RX troubleshooting for GSM1900

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!

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- 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 Ω 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

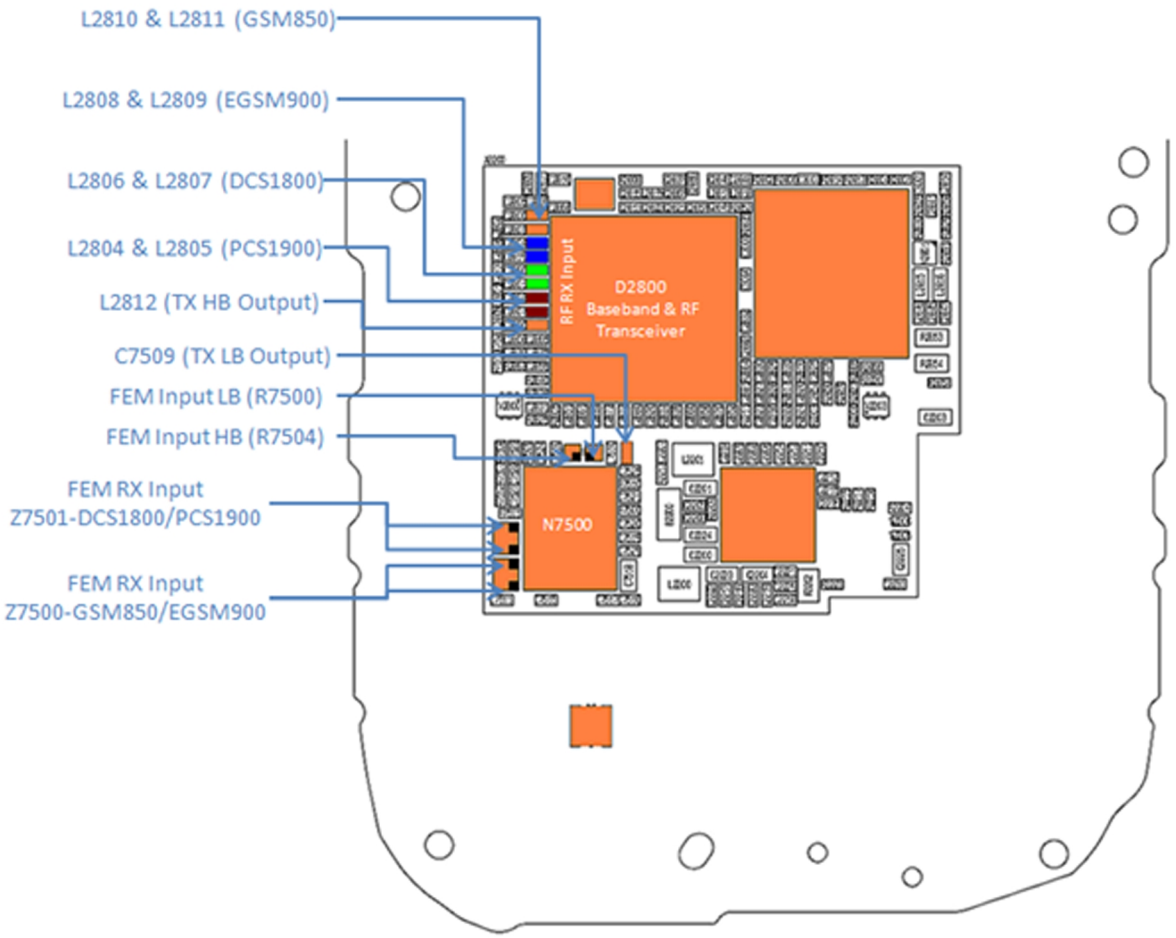

Figure 26 RF transmitter & receiver test points

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.

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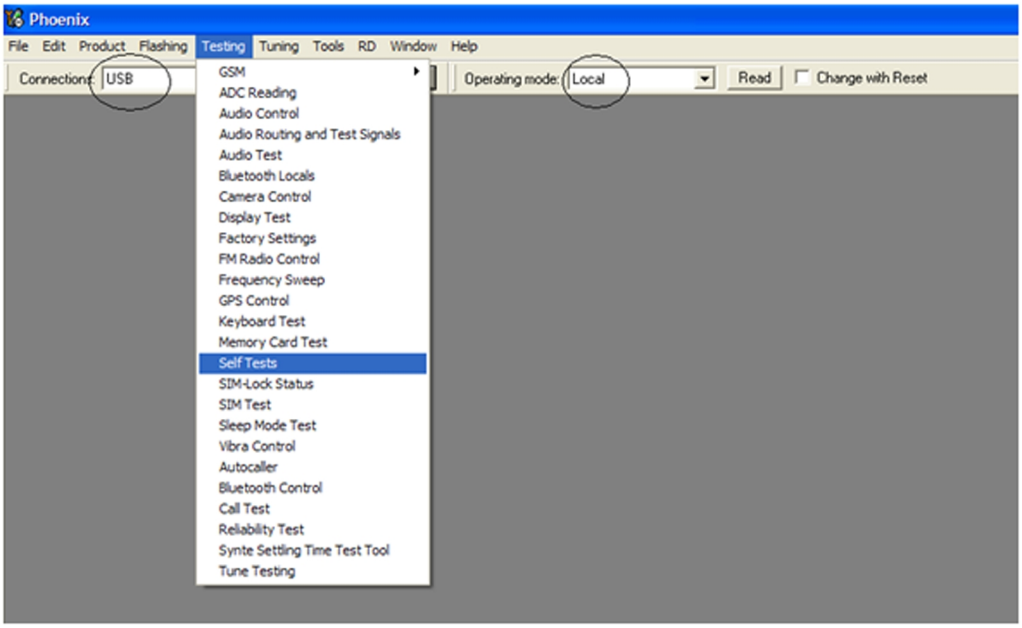
Table 5 Signals Coverage in RFPA Self-test Option

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.

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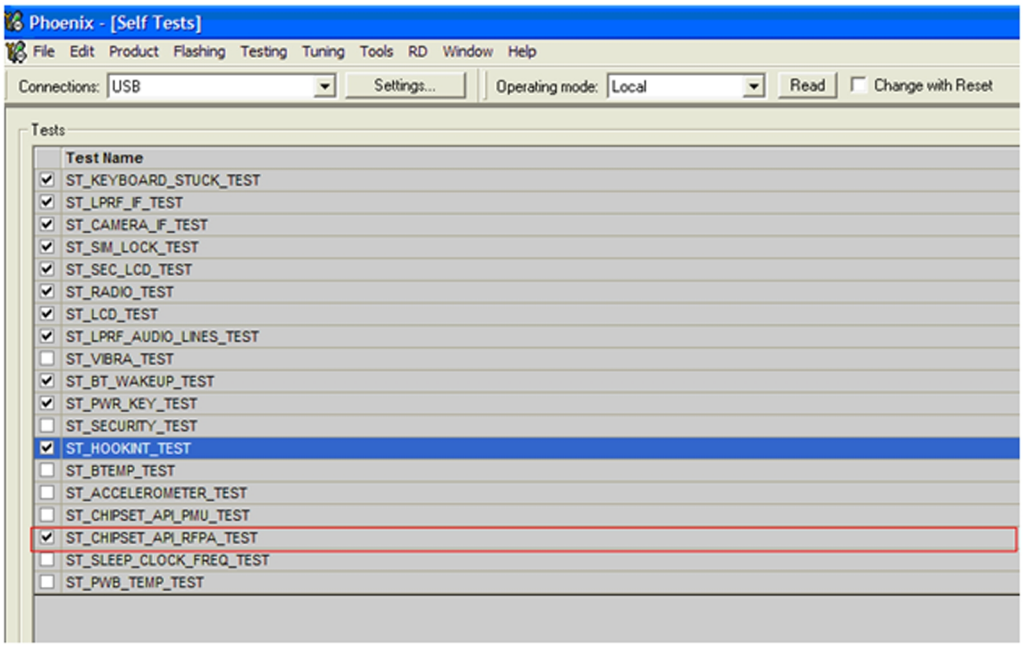

3. Click on **START** button to execute *ST_CHIPSET_API_RFPA_TEST.*

   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.

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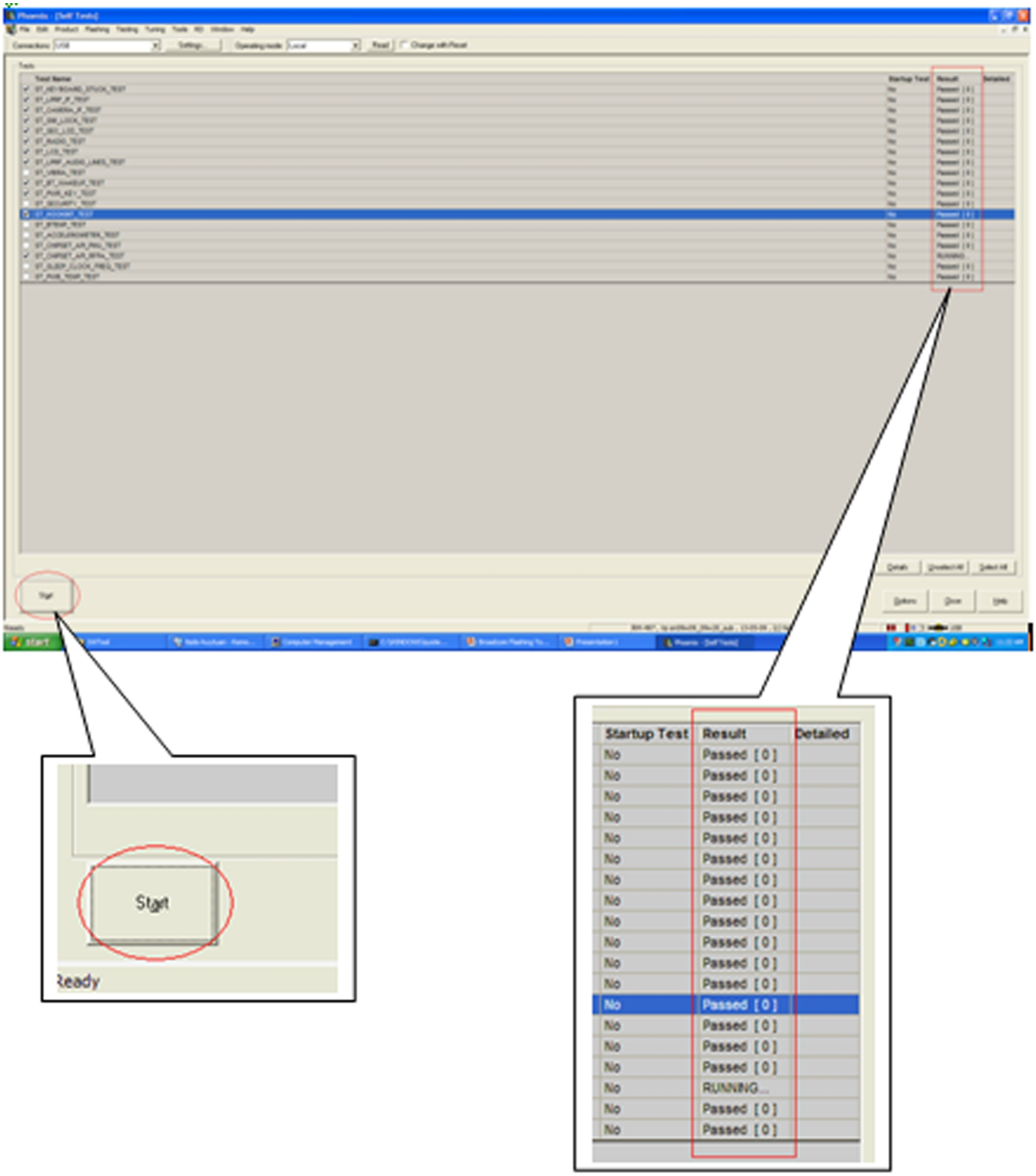

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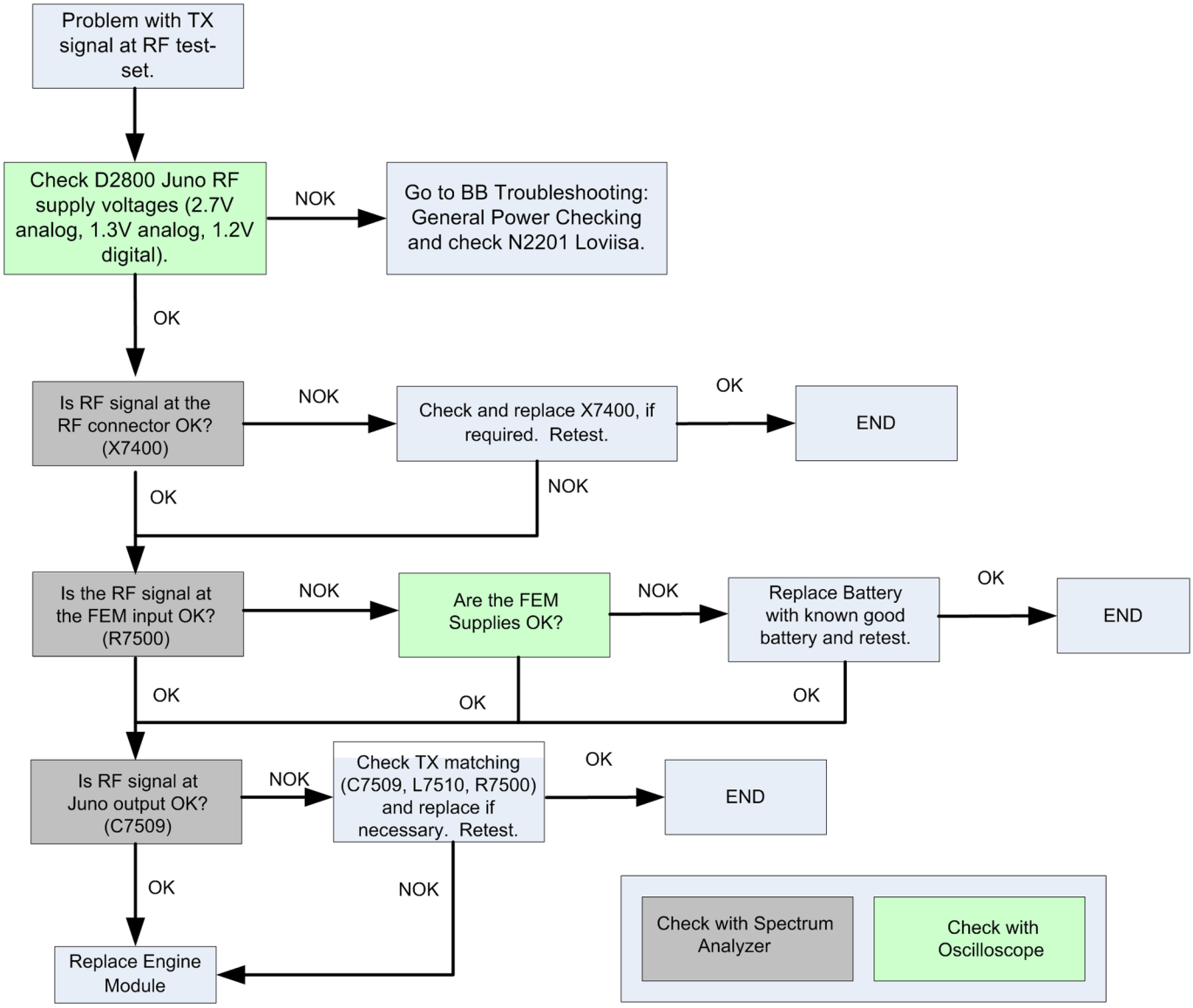
TX troubleshooting for GSM850/900

Troubleshooting flow



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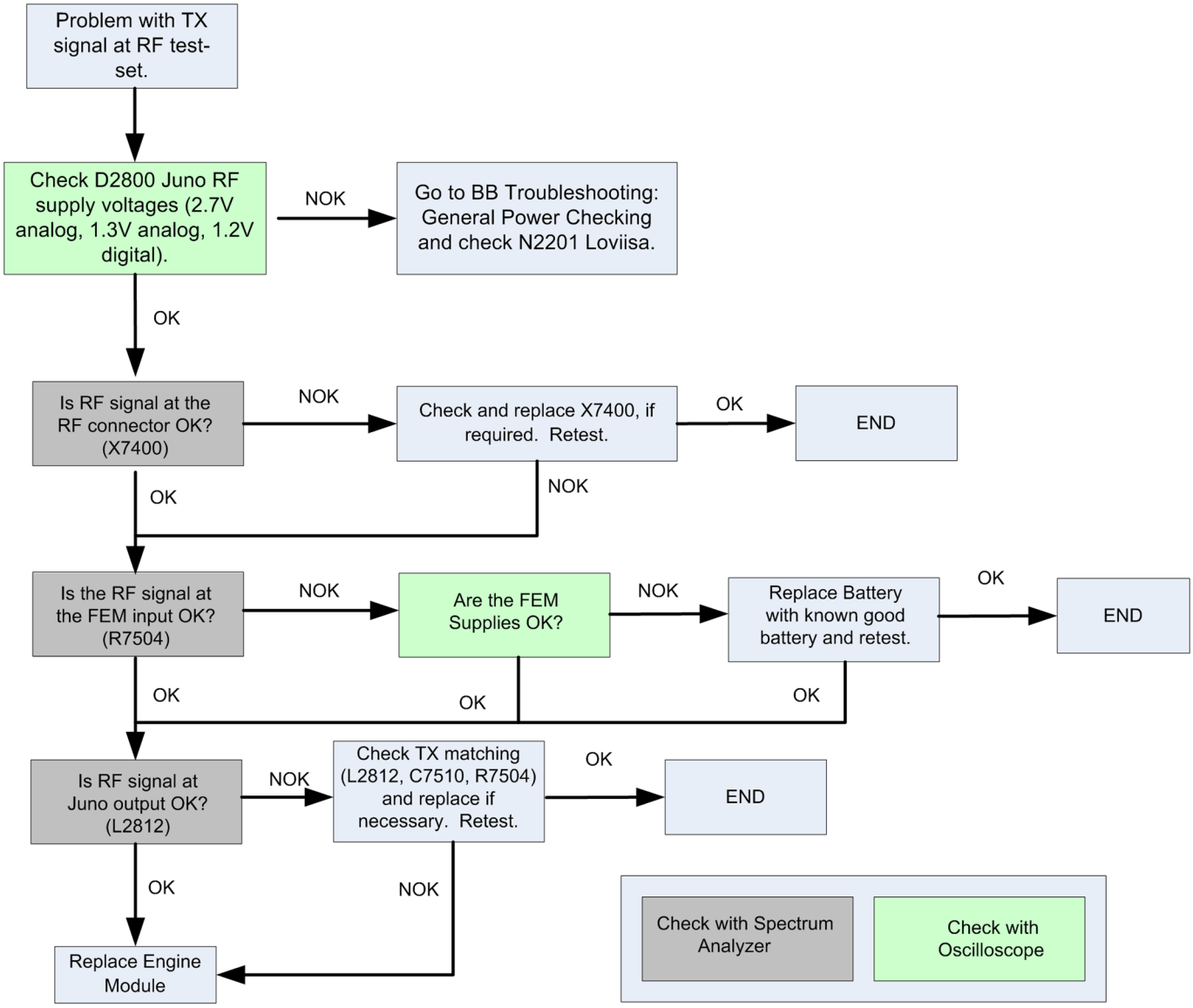
TX troubleshooting for DCS1800/PCS1800

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:

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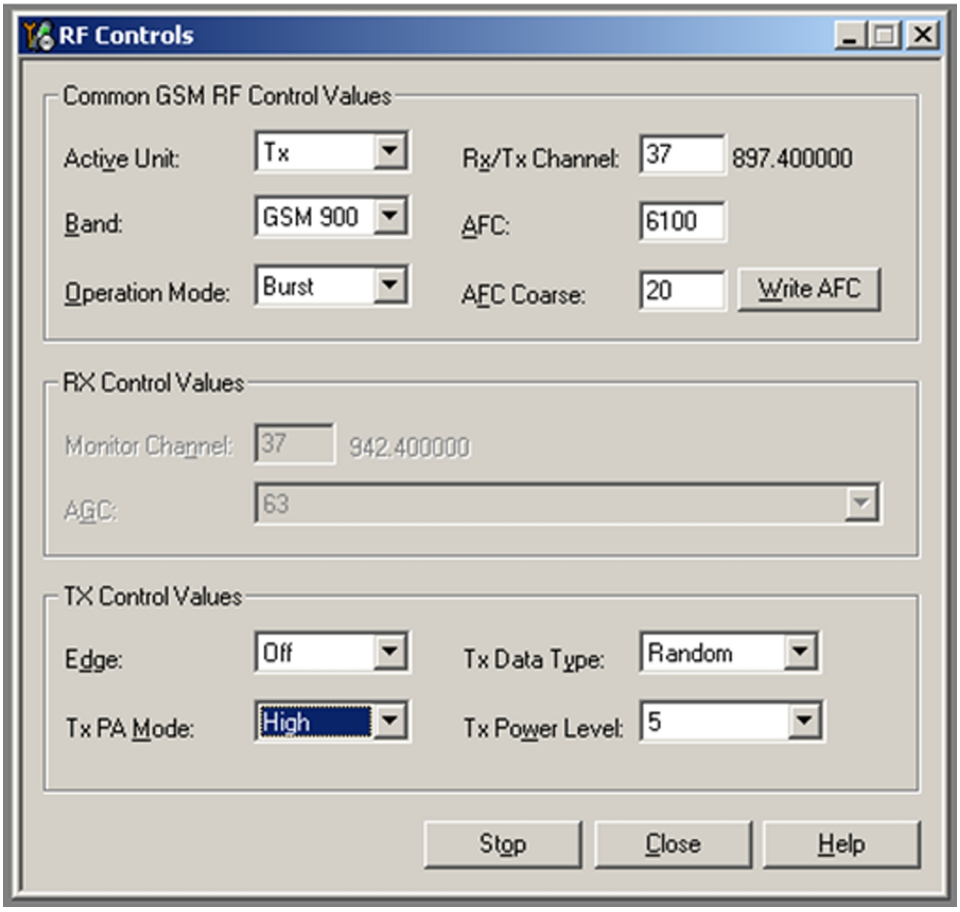

3. Check the basic TX parameters (i.e. power, phase error, modulation and switching spectrum), using a communication analyser (for example CMU200).

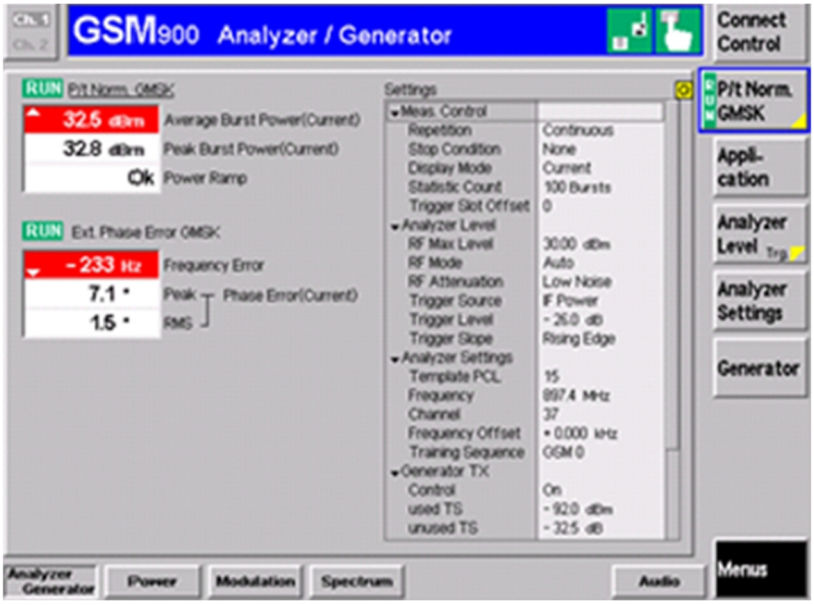

Figure 27 Analyzer setting

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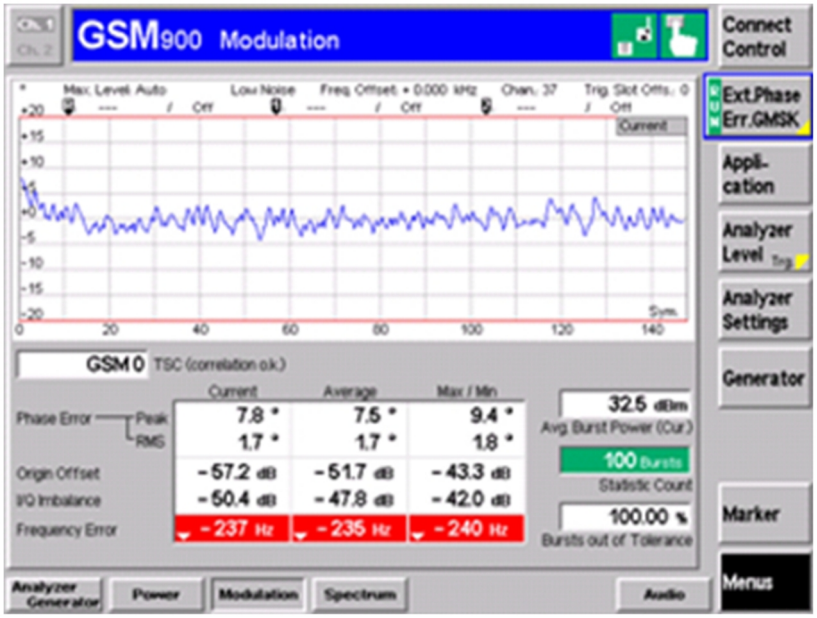

Figure 28 Phase error

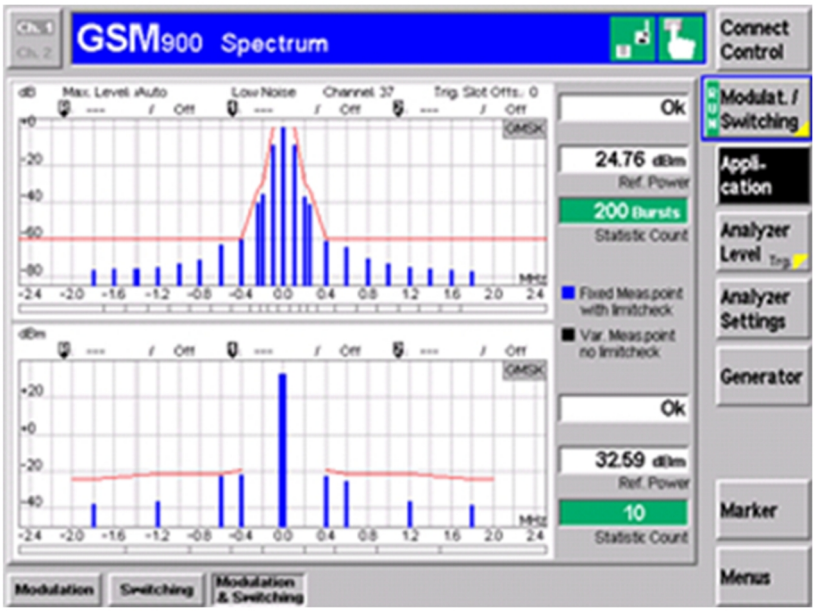

Figure 29 Modulation/Switching spectrum

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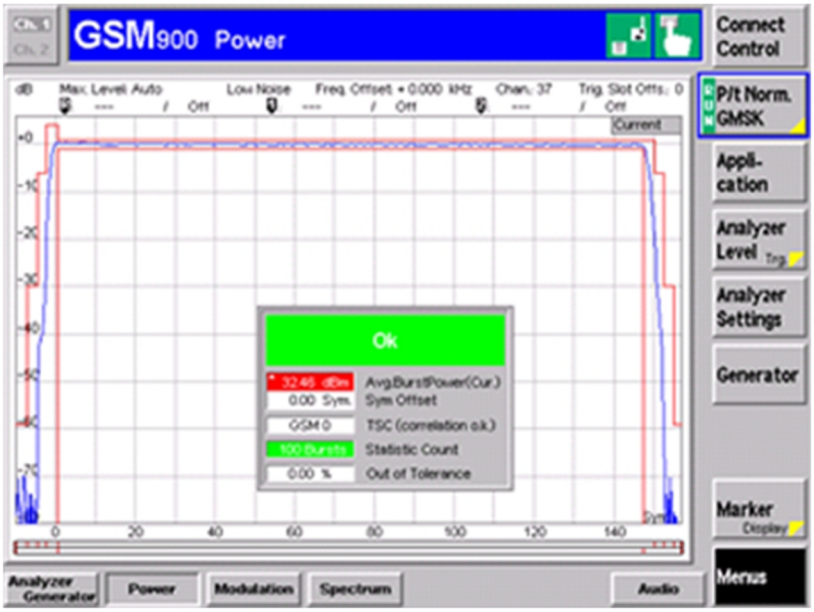

Figure 30 Power/Burst

Figure 31 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.

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5 — System Module

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Introduction

Phone description

RM-614 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

- 2M 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

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- 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, 2.0 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

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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

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Key component placement

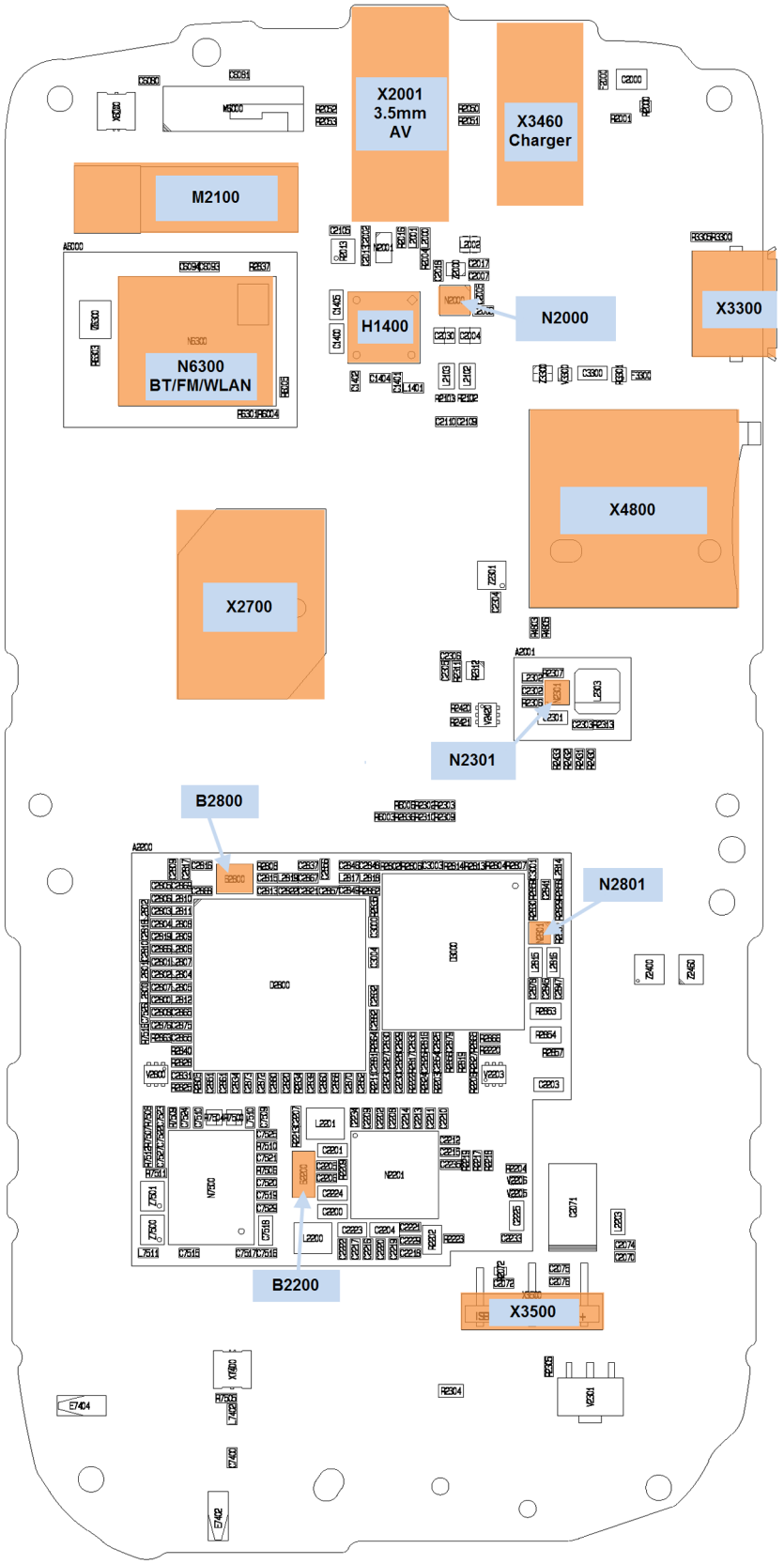

Figure 32 Key component placement

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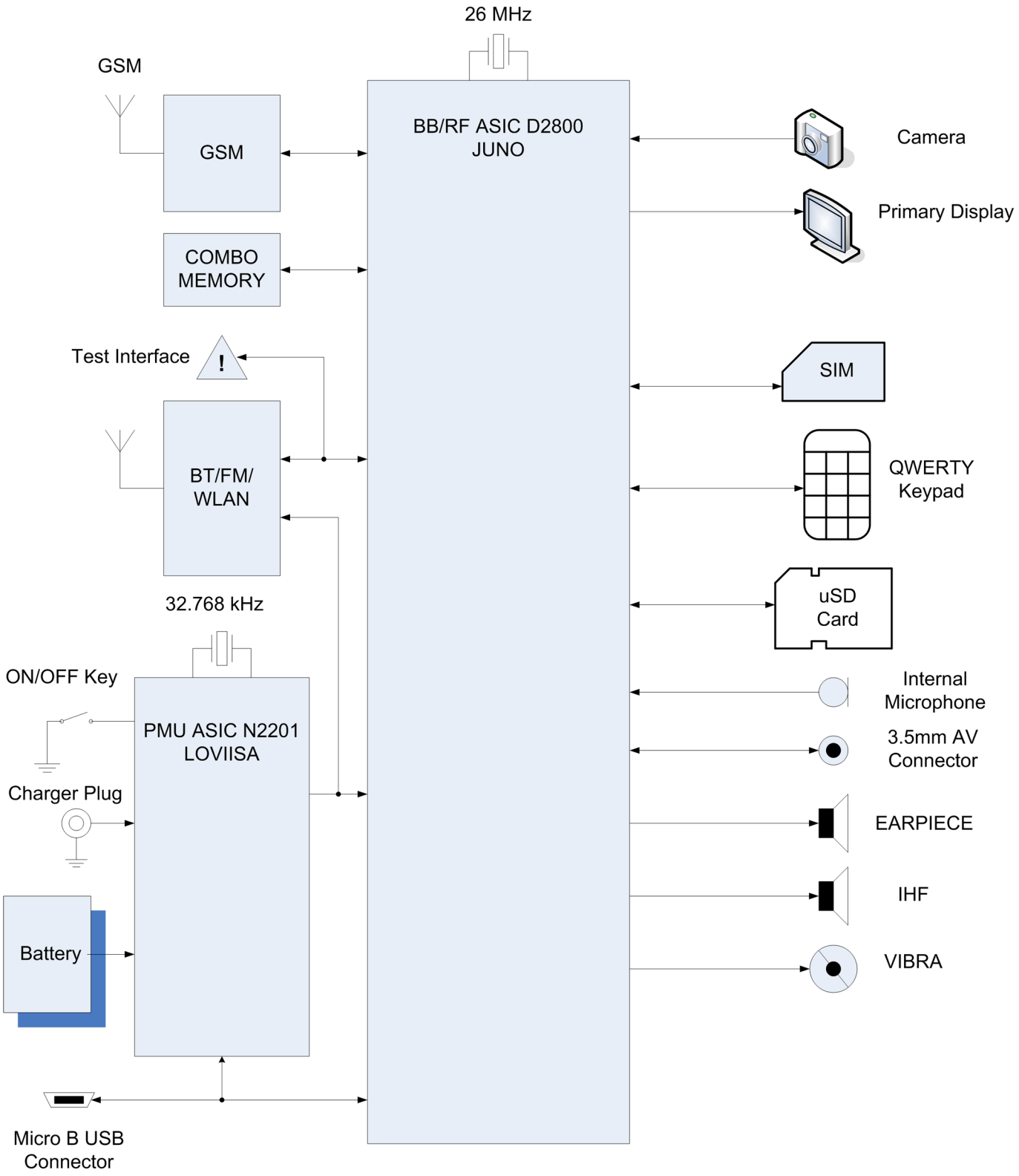
System module block diagram



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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_PRSNT) to detect whether the battery is present before powering up. A battery must be present and it's 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 it's ADCIN1 input.

The PMU will use the BAT_PRSNT 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 it's _BATRM output. The JUNO BB ASIC can also monitor the BSI signal from the battery with it's 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.

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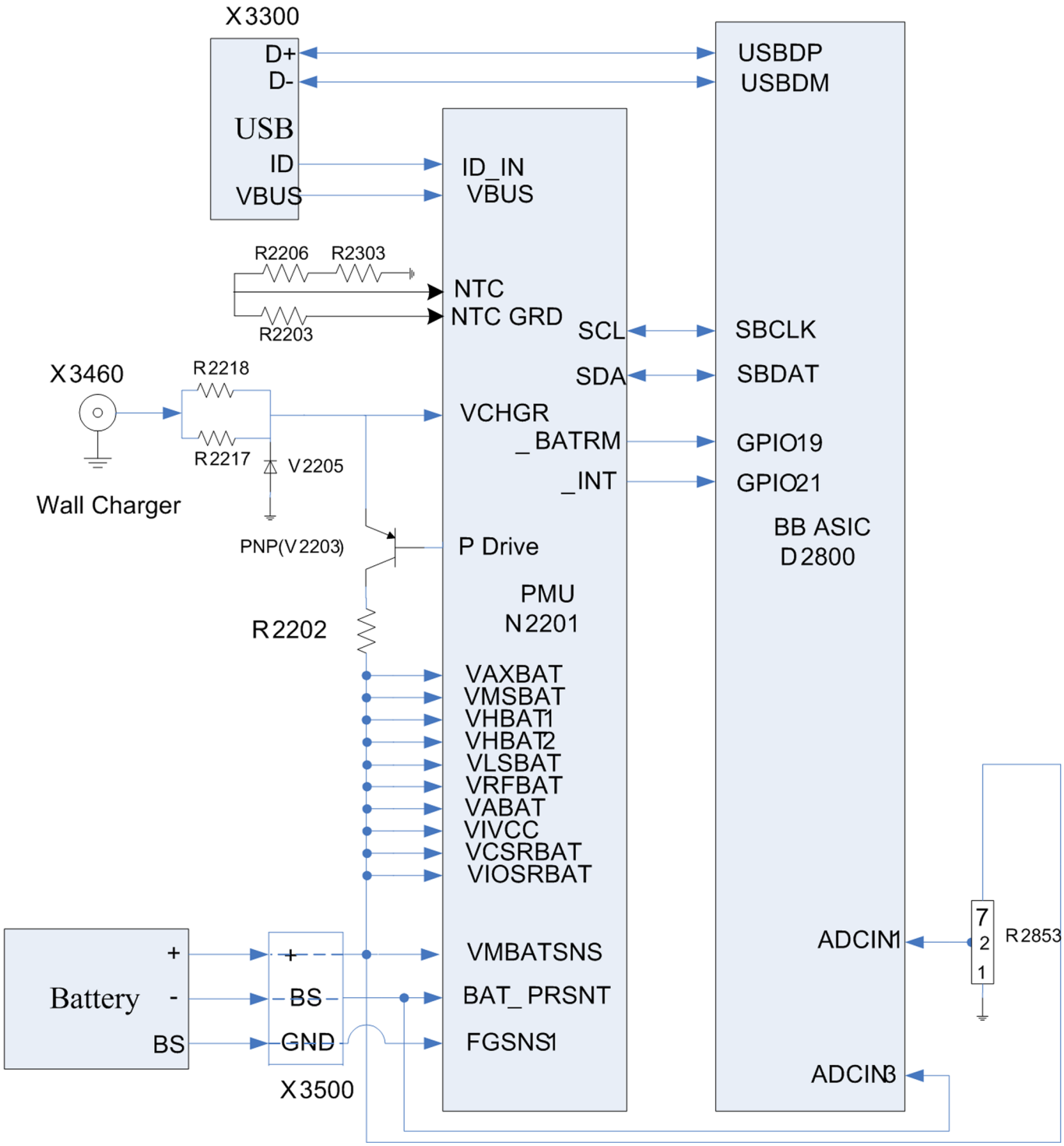

Figure 33 Electrical interface between battery and PMU and baseband

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Table 6 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	IOLDO	LDO	VIO	-3%	1.8	3%	VDDO_1P8	I/O Digital: Keypad
							VDDO_SDIO	SD Interface
							BBL_VDDO	BBL
Battery	HCLDO1	LDO	VAMP1	-3%	3.2	3%	VBRSPVDD	Vibrator
							DDACSPVDDR3P0	Right Speaker
							DDACSPVDDL3P0	Left Speaker
Battery	HCLDO2	LDO	VAMP2	-3%	3.2	3%	VDDO_SDIO	Digital SDIO Wlan
Battery	LVLDO1	LDO	VANA1	-3%	1.2	3%	USBVDD12PLL	USB PLL
							DSI_AVDD1P2	Camera
							DDACDVDD1P2	Daul DADC
							CCP2_AVDD1P2	Camera
							USBAVDD12	USB
							MPLL_AVDD1P2	Modem PLL
							APLL_AVDD1P2	Application PLL
Battery	ALDO2	LDO	VANA2	-3%	2.5	3%	ADCAVDD2P5	IN ADC (1-4)
							IHFAVDD2P5	High Fedelity Driver

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Input	PMU Pin	Regulator Type	Signal Name	Min	TYP (V)	Max	21351 Power Pin	21351 Function
Battery	ALDO1	LDO	VANA3	-3%	3	3%	AUXARXAVDD3P0	Aux ADC/ DAC, uPhone
							DDACAVDD30	Dual DAC Audio
Battery	CSR	SR	VCORE	-3%	1.2	3%	VDDC	Vcore Digital Supply
							USBVDD12PLL	USB PLL
							RF_DSP_VDDC	RF DSP
Battery	LCLDO	LDO	VDCXO	-3%	1.3	3%	RF_VDD_XO	26 MHz Crystal Oscillator
Battery	IOSR	SR	VMEM	-3%	1.8	3%	VDDO_EMI	Flash & DDR Memories
							VDDP_EMI	External Memory interface
							VDDO_FA	Non volatile SRAM
Battery	RFLDO2	LDO	VOUT	-3%	2.5	3%	USBAVDD25	USB Analog
							ACI_AVDD2P5	Accessory Control Interface

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Input	PMU Pin	Regulator Type	Signal Name	Min	TYP (V)	Max	21351 Power Pin	21351 Function
Battery	LVLDO2	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	RFLDO1	LDO	VRF2	-3%	2.7	3%	RF_VDD_PA	Power Amplifier interface
							RF_VDD_RX2P7	Analog Receiver
Battery	MSLDO2	LDO	VUSB2	-3%	3.3	3%	USBAVDD33	3.3 VUSB Analog
							NVM_VDDP	NV_RAM

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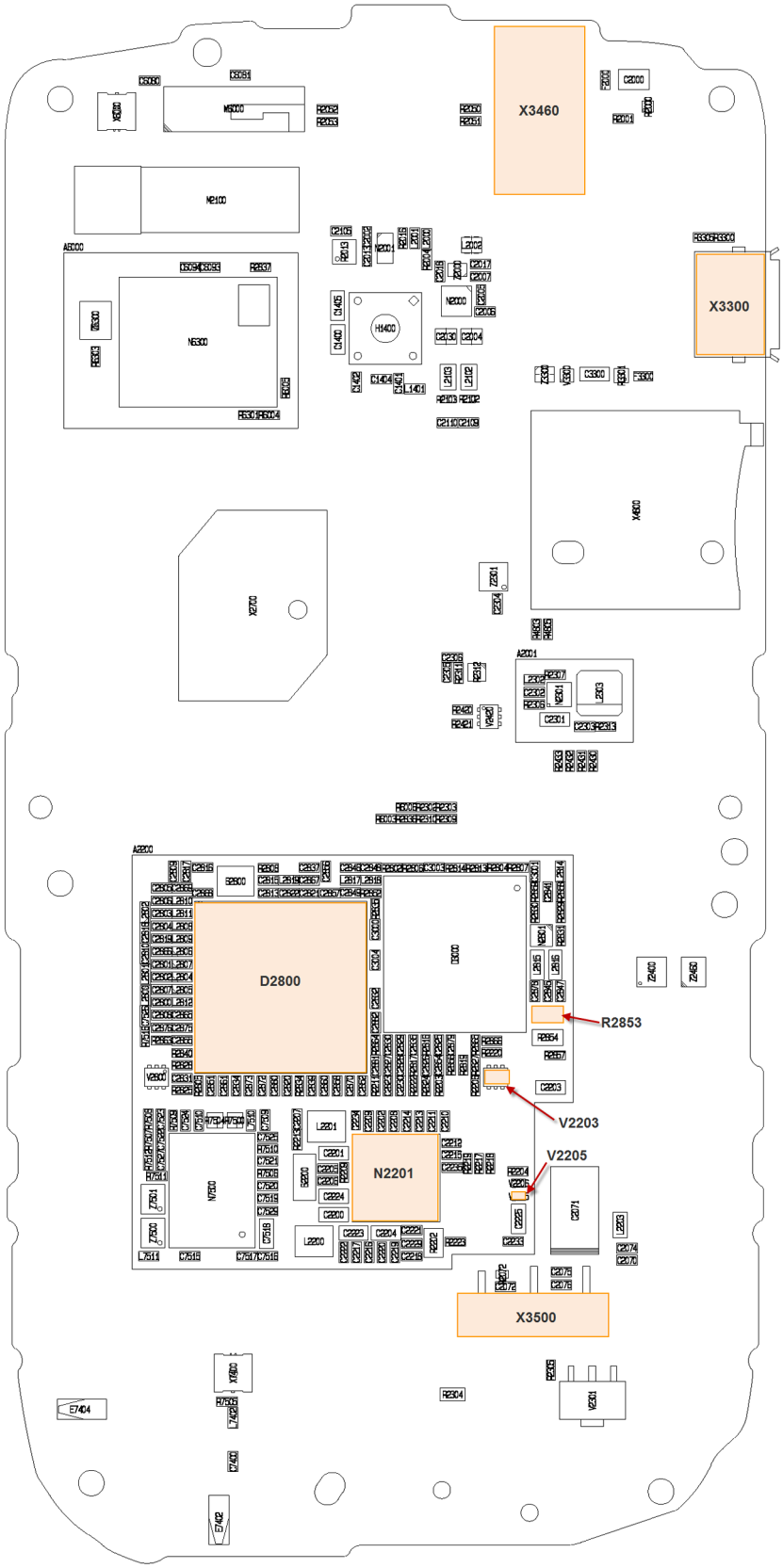

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Electrical Interface Between Baseband and Charger

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.

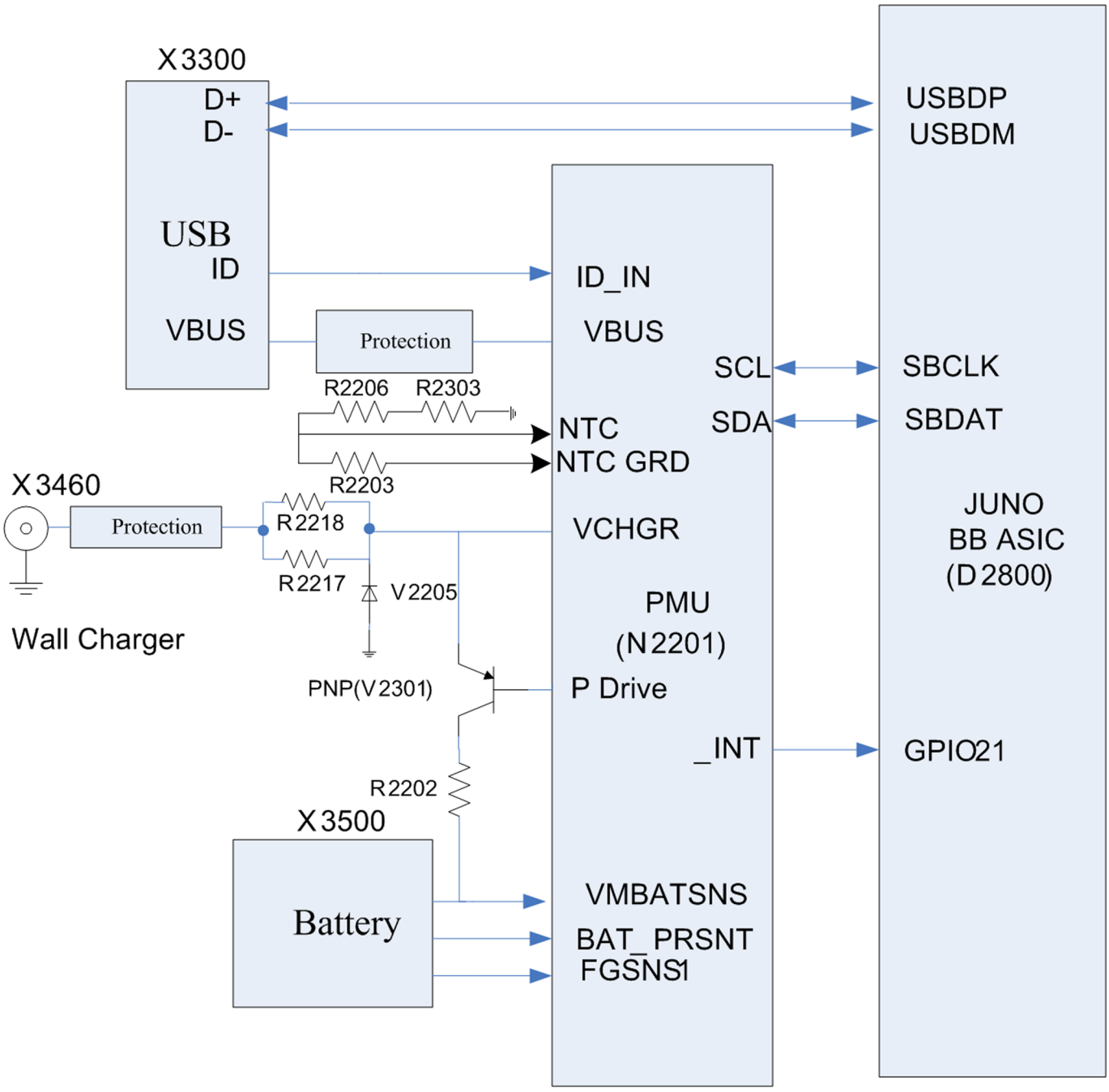

Figure 34 Electrical interface between charger and PMU and baseband

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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.

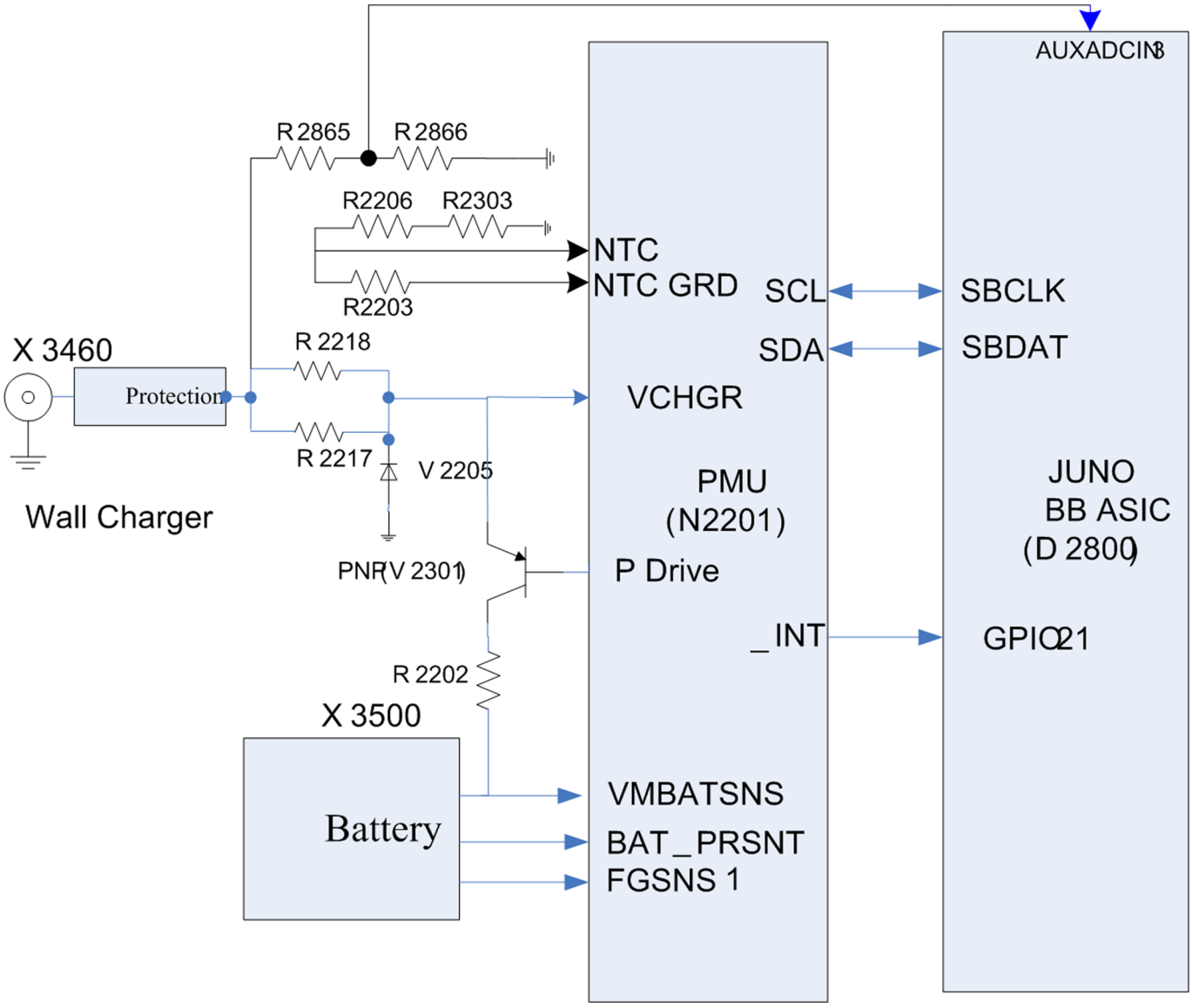

Figure 35 Wall charger

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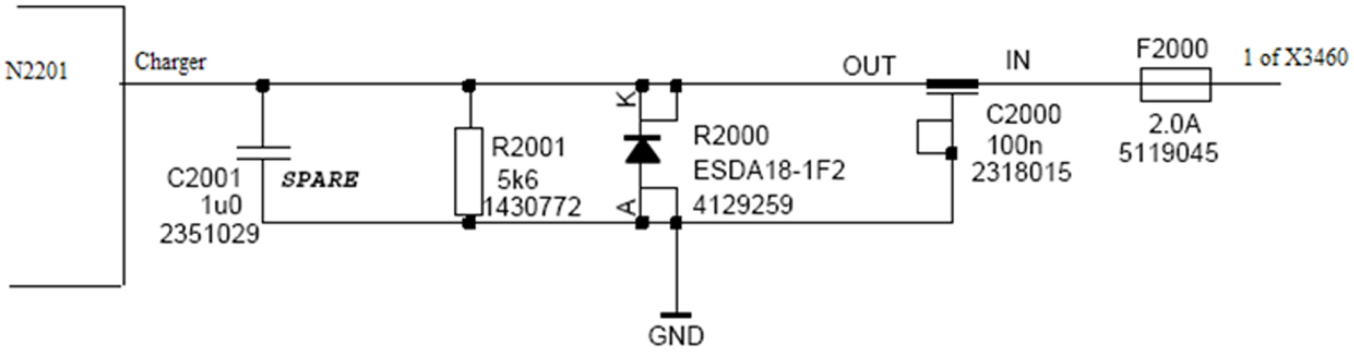

Figure 36 Wall charger protection

Table 7 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 8 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

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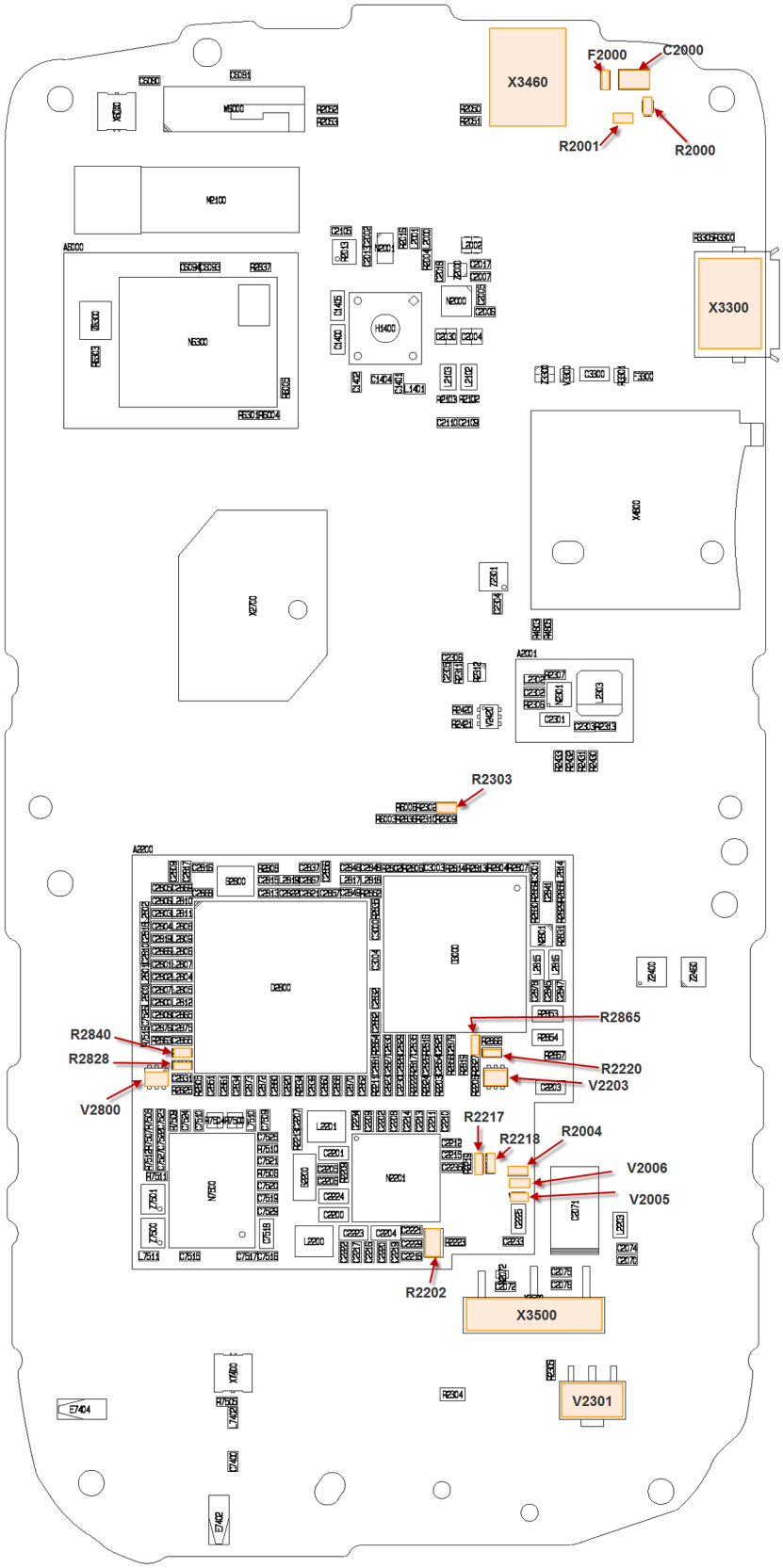

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Normal and extreme voltages

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 9 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		
Vcoff+	3.2	Off to on
Vcoff-	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.

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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.

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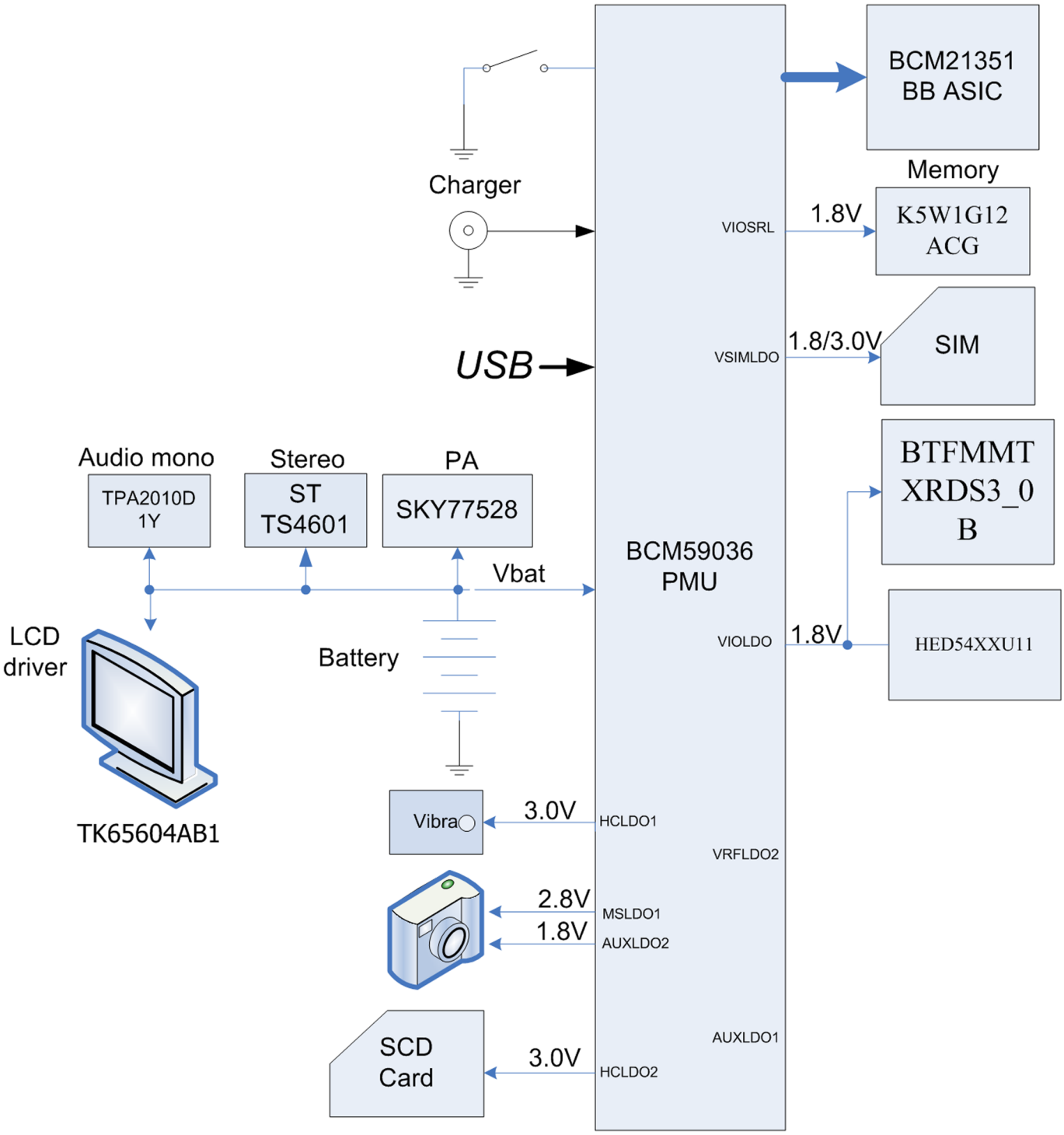

Table 10 Top Level Power Distribution Table

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

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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 MSLDO1	2.8V	Camera Connector	ACF	Camera
BCM59036 AUXLDO2	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 11 59036PMU&21351 BB Power Distribution Table

Signal Name	Regulator Type	PMU Pin	Status on reset	Rating (V)	Rated (mA)	21351 Function
VX	LDO	AUXLDO1	OFF	1.8	150	LCD Analog
VAMP1	LDO	HCLDO1	OFF	3.2	350	Analog : Vibra, DDAC L&R
VAMP2	LDO	HCLDO2	OFF	3.2	350	Digital SDIO
VANA1	LDO	LVLDO1	ON	1.2	150	Analog:USB, Dual DAC, DSI, M&APLL
VANA2	LDO	ALDO2	ON	2.5	150	Analog:ADC (1-4) & IHF
VANA3	LDO	ALDO1	ON	3	150	Analog: u_phone,aux ADC/DAC, Dual DAC
VCORE	SR	CSR	ON	1.2	500	Vcore Digital, USB PLL, RF_DSP

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Signal Name	Regulator Type	PMU Pin	Status on reset	Rating (V)	Rated (mA)	21351 Function
VDCXO	LDO	LCLDO	ON	1.3	20	RF_DCXO
VIO	LDO	IOLDO	ON	1.8	200	BBL, IO
VMEM	SR	IOSR	ON	1.8	500	Flash & DDR Memories, External Memory interface, NVRAM
VOUT	LDO	RFLDO2	ON	2.5	150	Analog: USB , ACI
VRF1	LDO	LVLDO2	OFF	1.3	150	RF: RX, PLL, IF, TX_PLL,TX_LO
VRF2	LDO	RFLDO1	OFF	2.7	150	RF: PA , RX
VUSB2	LDO	MSLDO2	ON	3.3	150	USB: Analog, NVM

SIM, µSD

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
GPIO19	V6	I	CMOS	SIM emergency shut-down
SIMVDDO	A12			1.8V / 3.0V Digital Supply for SIM Transceivers

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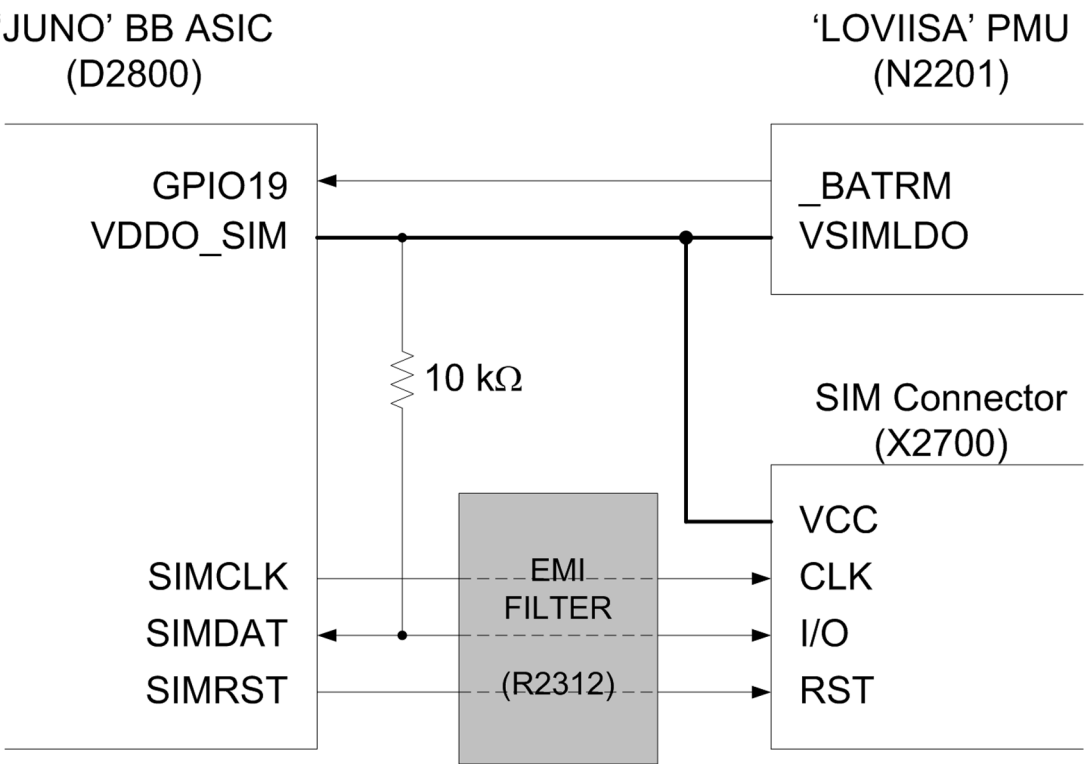

Figure 37 Electrical interface between baseband and SIM

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 VHCLDO2 supply from the N2201 LOVIISA PMU determines the signaling levels.

Table 12 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

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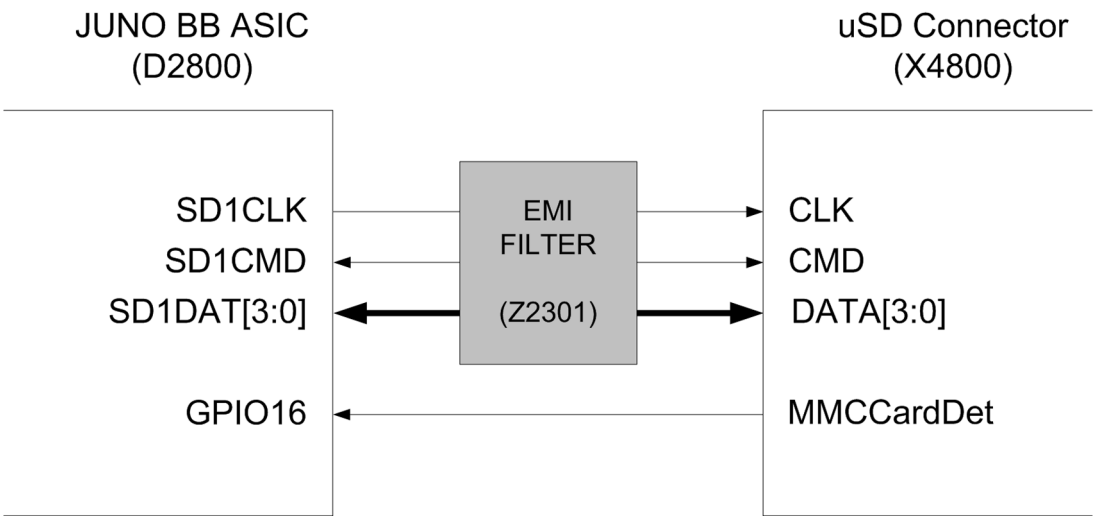

Figure 38 Electrical interface between baseband and memory card

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	O	CMOS	LCD Panel chip select
LCDCD	D11	O	CMOS	LCD command/data select
LCDWE	E8	O	CMOS	LCD write enable
LCDRE	E9	O	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	O	CMOS	LCD Reset
GPIO25	B11	I	CMOS	LCD Panel Tearing Effect

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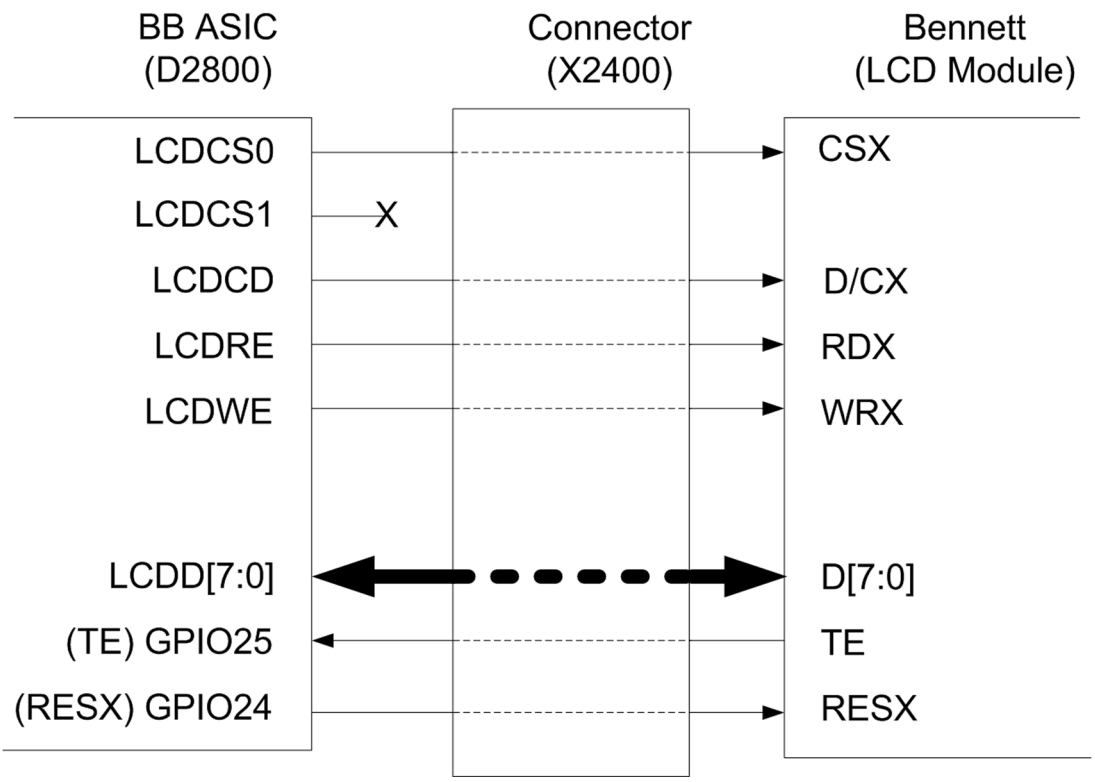

Figure 39 D2800 Baseband ASIC (BCM21351) Display Interface Pins

Electrical Interface Between Baseband and Keypad

Introduction

The D2800 JUNO (BCM21351) BB ASIC uses it's 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	O	CMOS	Row 0
GPIO1	R7	O	CMOS	Row 1
GPIO2	M4	O	CMOS	Row 2
GPIO3	R6	O	CMOS	Row 3
GPIO4	R5	O	CMOS	Row 4
GPIO5	T6	O	CMOS	Row 5
GPIO6	N4	O	CMOS	Row 6
GPIO7	T5	O	CMOS	Row 7

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Keypad				
Pin Name	Pin	I/O	Type	Description
GPIO8	P4	I	CMOS	Column 0
GPIO9	U8	I	CMOS	Column 1
GPIO10	P2	I	CMOS	Column 2
GPIO11	U7	I	CMOS	Column 3
GPIO12	U6	I	CMOS	Column 4
GPIO13	R2	I	CMOS	Column 5
GPIO14	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[1]	T[2]	Y[3]	U[*]
ROW_1		1	A	S	D	F[4]	G[5]	H[6]	J[#]
ROW_2		2	Z	X	C	V[7]	B[8]	N[9]	M[0]
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		

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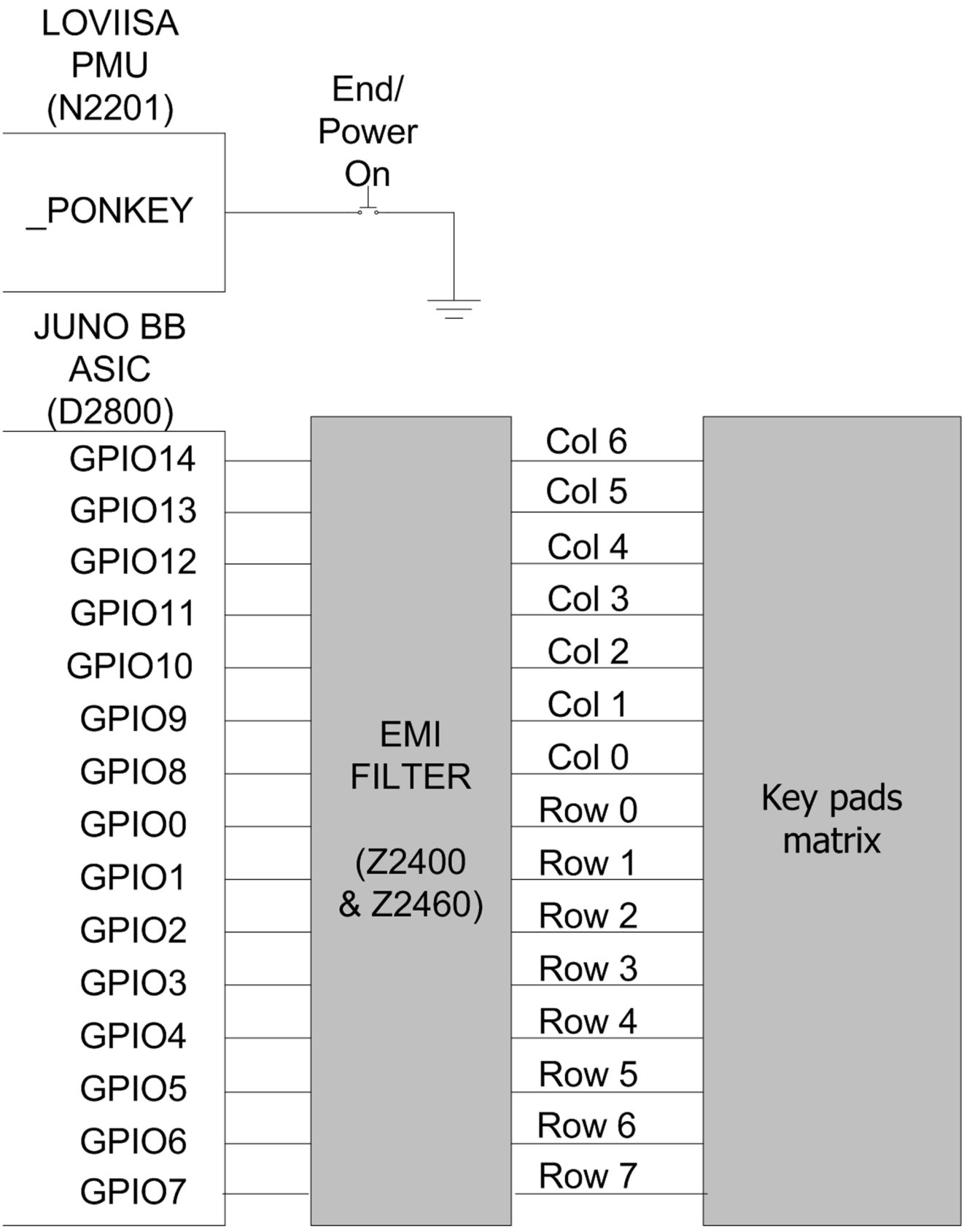

Figure 40 D2800 Baseband ASIC (BCM21351) Keypad Interface Pins

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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	O	CMOS	Enable LED driver
GPEN9	B7	O	CMOS	Enable Keypad Light

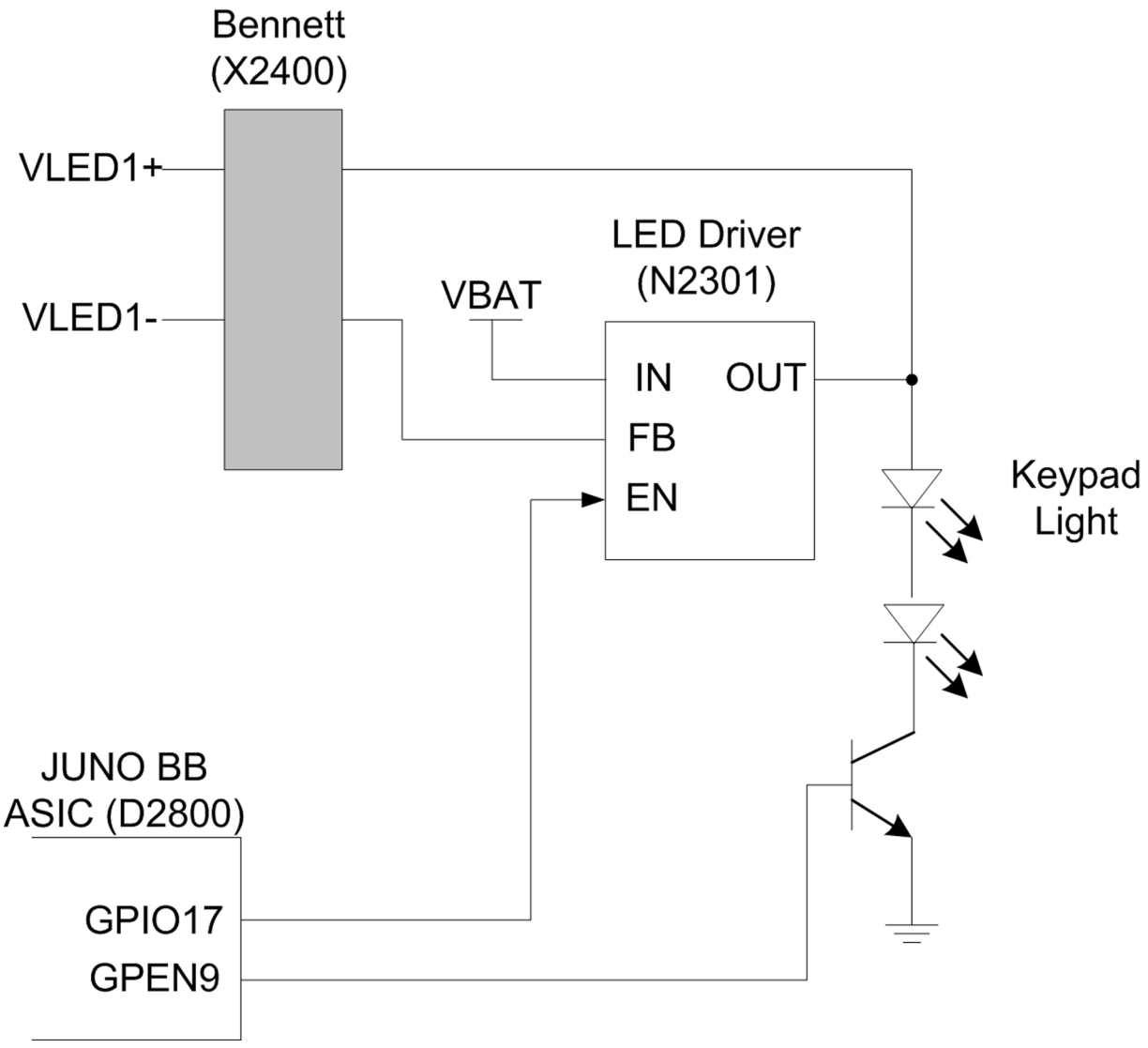

Figure 41 Keypad backlight & LED driver diagram

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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	O	CMOS	Clock to camera
CCP2_M_CP_CLK	AC6	I	CCP-2	CCP-2 Differential Clock
CCP2_M_CM_CLK	AC5			
CCP2_M_DP0	AB6	I	CCP-2	CCP-2 Differential Data
CCP2_M_DM0	AB5			
GPIO23	V10	O	CMOS	Shutdown
BSCCLK	W4	O	Open-Drain	BSC #2 (I2C-compatible) clock
BSCDAT	Y4	I/O	Open-Drain	BSC #2 (I2C-compatible) data

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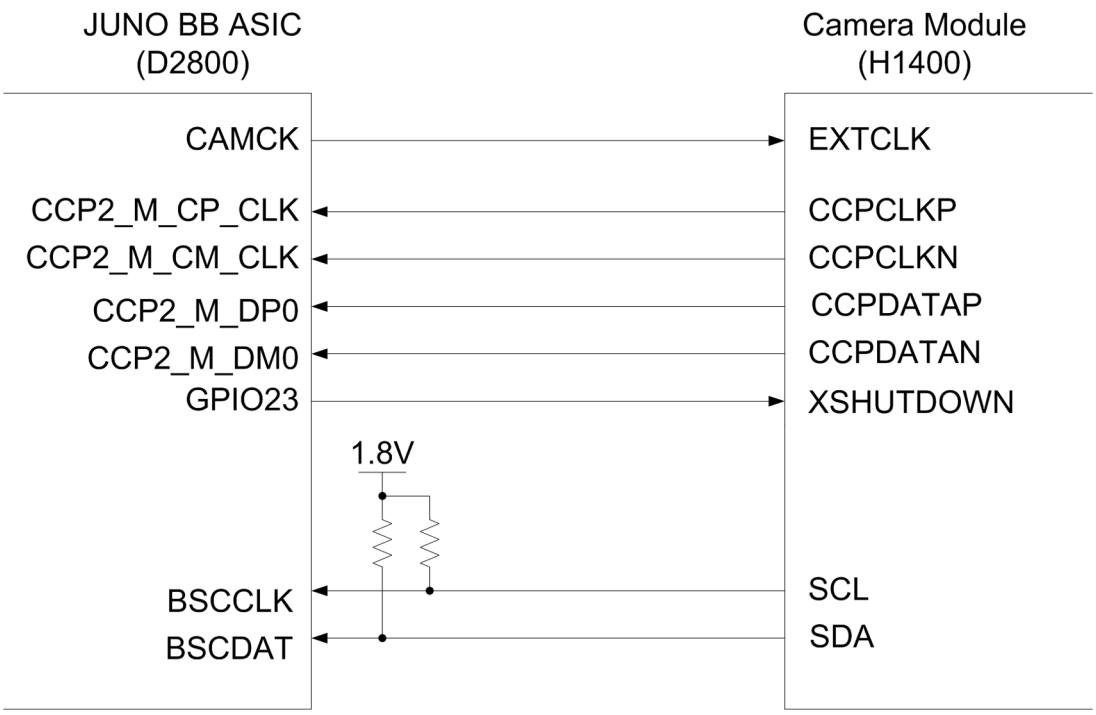

Figure 42 D2800 baseband ASIC (BCM21351) camera interface pins

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**
VBRAMPLP400P	AC12	O	Analog	Vibra positive output
VBRAMPLP400M	AC13	O	Analog	Vibra negative output

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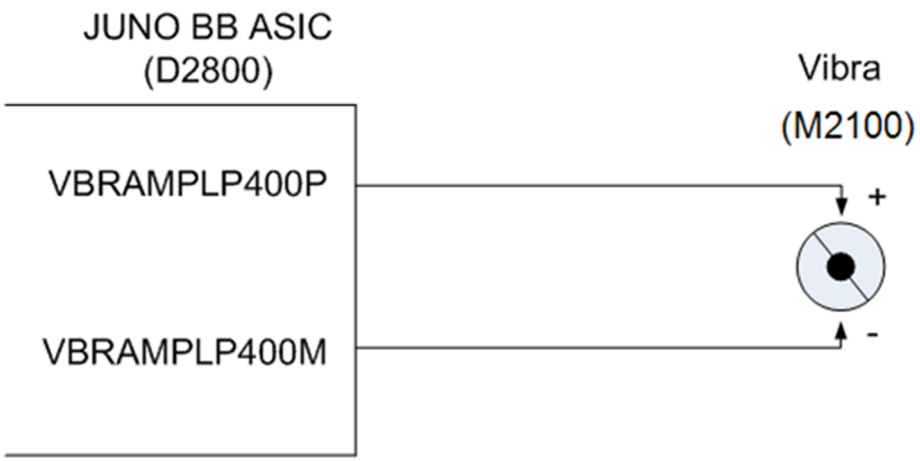

Figure 43 D2800 baseband ASIC (BCM21351) vibra interface pins

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.

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

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

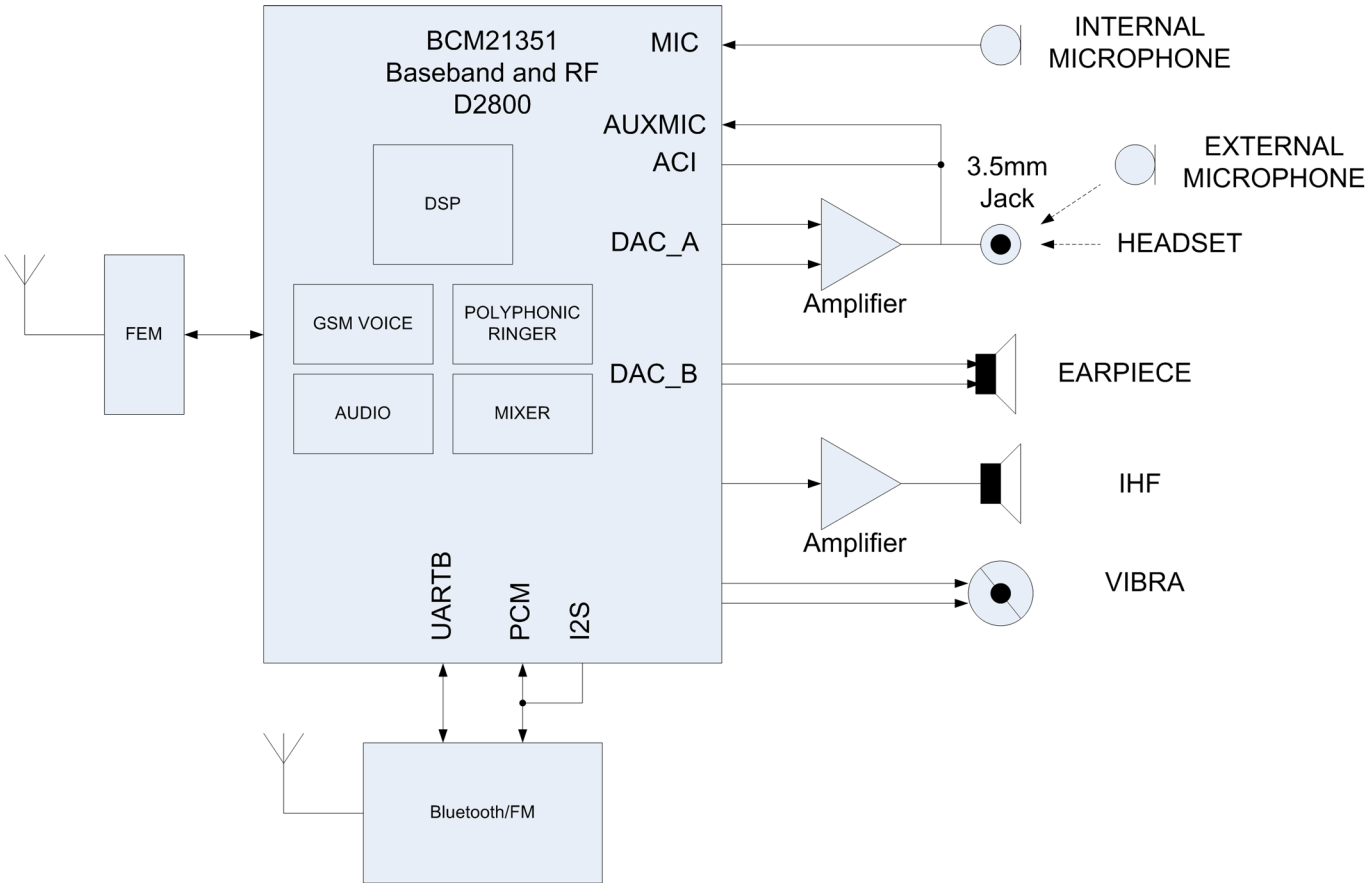

Figure 44 Audio block diagram

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 stereo headset 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 -
ARXMICBIAS	U22	Output	Analog	Internal MIC Bias

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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
GPIO30	V17	I/O	CMOS	Plug Detect
GPIO14	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
GPIO22	V2	I/O	CMOS	Headset Amplifier Enable
DDACAMP LP100A	V12	O	Analog	External Headset Left Driver +
DDACAMP LN100A	U12	O	Analog	External Headset Left Driver -
DDACAMP RP100A	U13	O	Analog	External Headset Right Driver +
DDACAMP RN100A	V13	O	Analog	External Headset Right Driver -
DDACAMP LP100B	Y12	O	Analog	Earpiece Driver +
DDACAMP LN100B	W12	O	Analog	Earpiece Driver -
IHFAMPRP LINOUT	AB21	O	Analog	Internal Hands-free driver +
IHFAMPRN LINOUT	AA21	O	Analog	Internal Hands-free driver -

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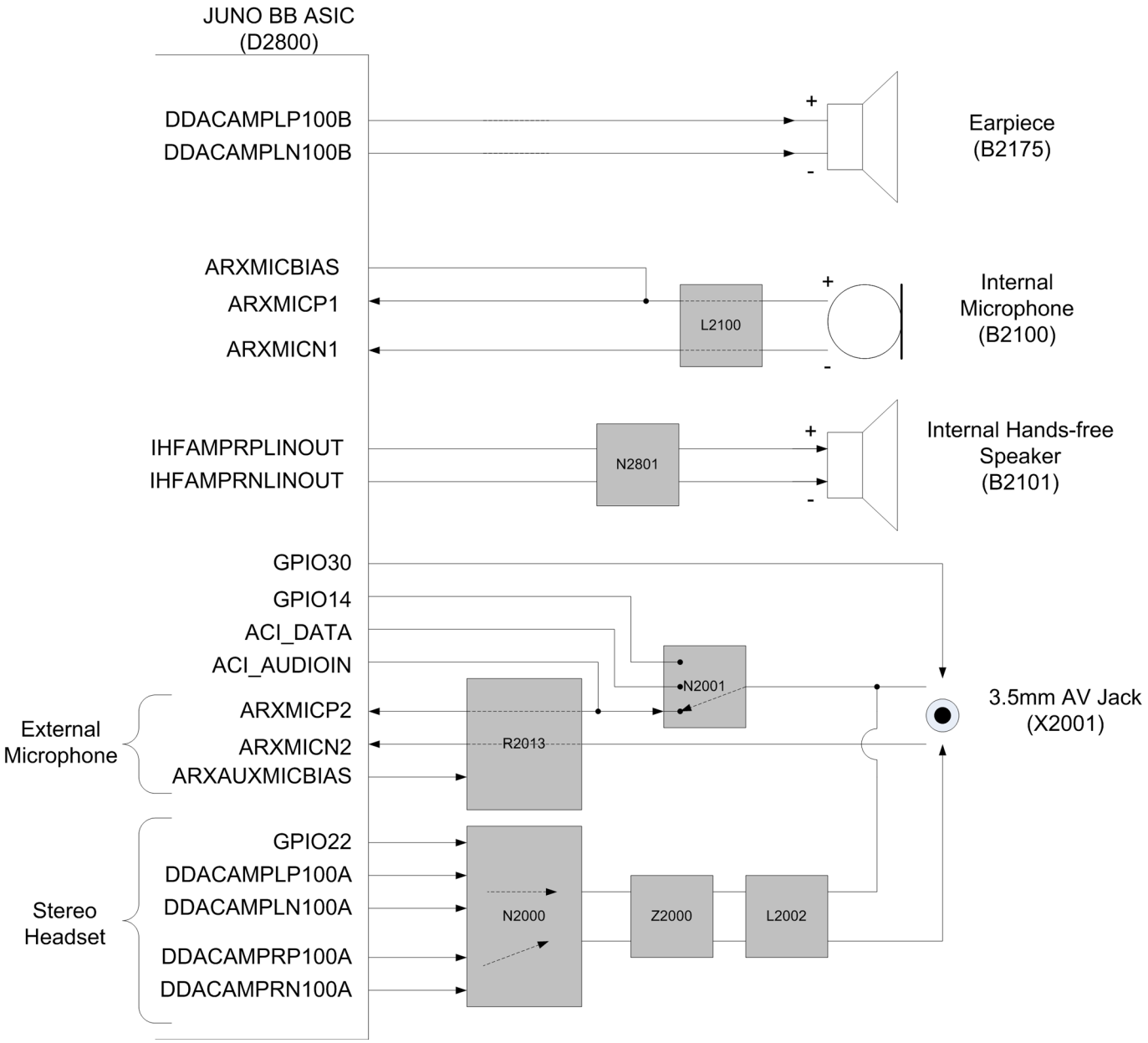

Figure 45 Electrical interface between baseband and audio components

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 DCXO 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.

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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.

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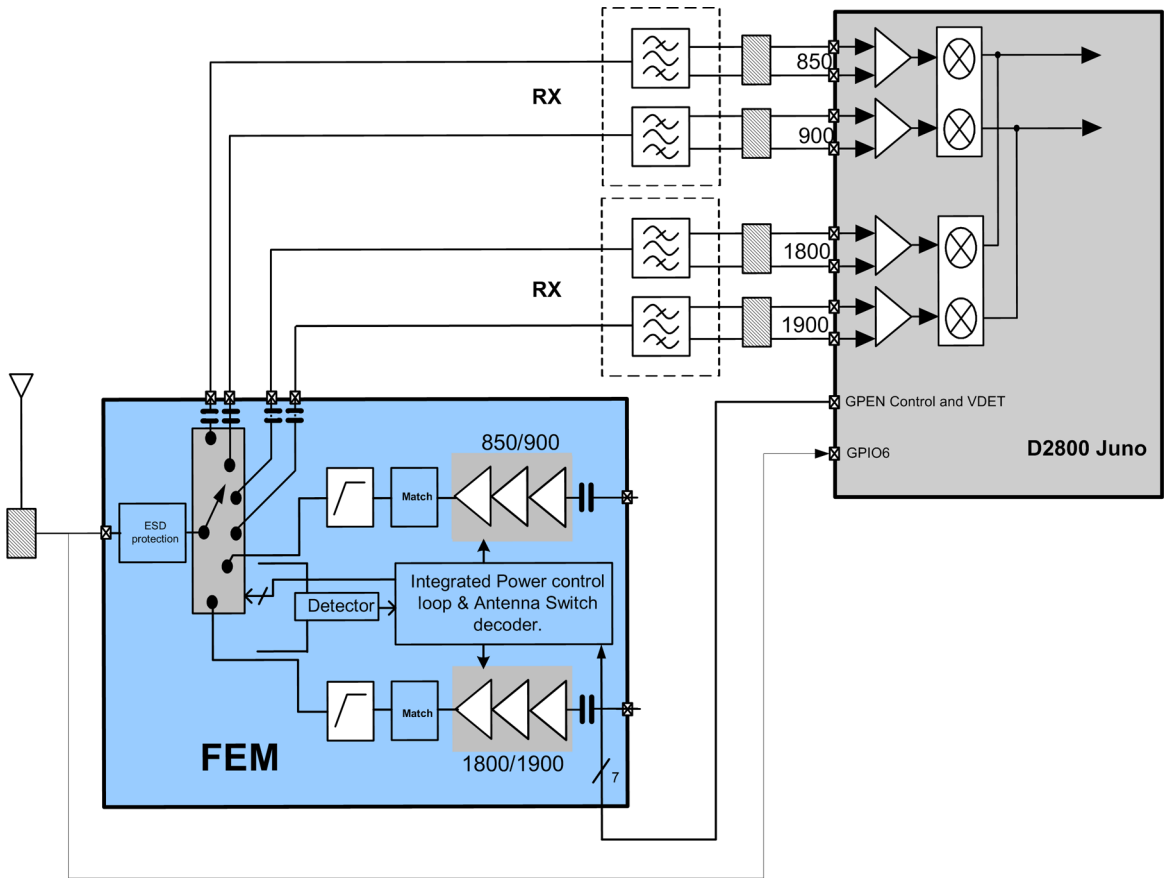

Figure 46 RF receiver module

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.

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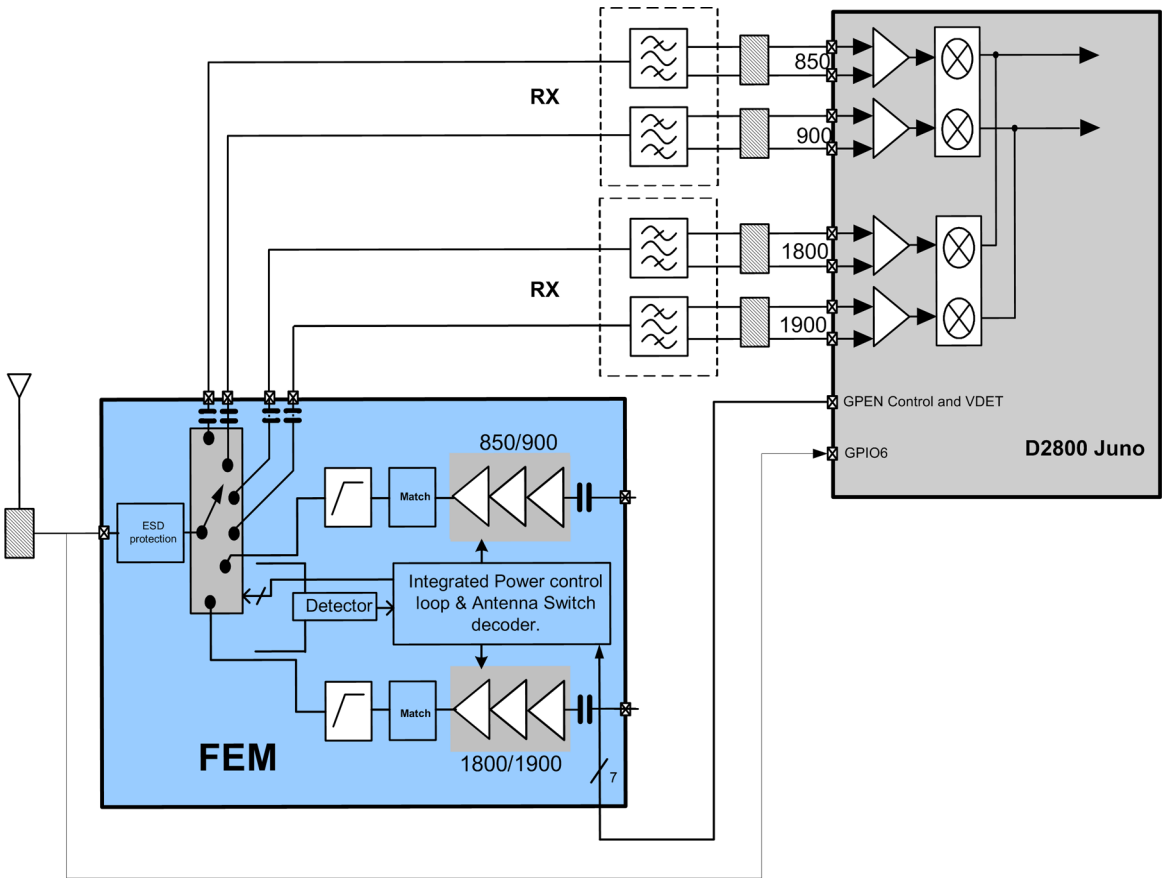

Figure 47 RF transmitter module

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).

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

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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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6 — BOB (WLAN/FM/BT)

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Technical Description

BOB (WLAN/FM/BT) Functional Description

Introduction

The main components of the BOB1.0M-a module is the Broadcom BCM4329 ASIC engine and the Macom MASW-009276 SP3T RF switch.

WLAN Specification

The WLAN function in BOB1.0M-a supports full IEEE 802.11b, g and handheld class n. Integrated CMOS power amplifiers in the BCM4329 support 2.4GHz, optimised for mobile operation.

WLAN Interfaces

- *Host Interface (SPI)*

  The WLAN Engine is configured as an SPI slave. A constant 1.8V VIO is required from the host to provide a means for the module to interrupt the host independently of the availability of the external reference clock.

- *Host Interface Bus Usage*

  The SPI interface and protocol is designed to support a dedicated serial interface, i.e. 100% of the available bus bandwidth is reserved for communication between Host and BCM4329 Engine, i.e. SPI_CSX is not shared.

  The host Engine may re-use the SPI_CLK and SPI_DIN lines when the BOB1.0M-A module is not in use.

  In order to ensure no drive conflicts on the SPI_DOUT and WLAN_IRQ lines, host GPIO connections to these lines is configured as input before WLAN_ENABLE is asserted.

- *IRQ*

  The IRQ signal has two uses. The primary is an interrupt signal sent from the WLAN Engine to the host when it requires host interactions.

  The second option is a ready signal to indicate to the host that the WLAN Engine has woken up following a wake up request sent by the host. The host can wake up the WLAN Engine by writing to a specific interrupt bit in the Status Register over the SPI interface. This register is accessible even when there is no Reference clock present.

- *WLAN_ENABLE*

  The WLAN_ENABLE signal from the host is connected to a single input pin on the BOB1.0M-A modules. The internal reset circuitry will ensure that they will come out of reset correctly.

Bluetooth and FM Radio Functional description

Bluetooth 1.1, 1.2, 2.0+EDR and 2.1+EDR specification compliant (Lisbon release) – up to HCI level.

The Bluetooth and FM sections support Bluetooth 2.1 + EDR (Enhanced Data Rate) and FM + RDS radio reception in both European/American and Japanese bands (the appropriate region-specific FM radio band is pre-configured in the phone software).

The Bluetooth-FM device UART interface allows the device to communicate with the phone baseband engine using Bluetooth HCI (Host Control Interface) commands. When Bluetooth is switched on, the phone user interface the BT_RESETX line is toggled to reset the Bluetooth device, and commands are sent over the UART interface to configure the device. Software may use the I2C interface for FMRX configuration. If UART communication fails (due to a hardware fault) it will not be possible to switch on Bluetooth or the FM radio receiver from the phone user interface.

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To maximise the phone standby time, it is only necessary to provide a SYS_CLK signal when Bluetooth activity occurs, such as sending Bluetooth data to another device, or checking periodically if there are any other Bluetooth devices attempting to communicate with it. At other times when the Bluetooth device is in standby mode or the FM receiver is switched on it is only necessary to provide a SLEEP_CLK signal. The Bluetooth-FM ASIC is powered directly from the phone battery voltage line (VBAT). An internal regulator is enabled when Bluetooth or FM radio is switched on.

The Bluetooth shares its antenna path and filter with WLAN. The internal co-existence scheme controls the RF activity in their shared frequency band.

The audio signal from the FM radio receiver is routed via the phone Audio ASIC to the phone headset or loudspeaker. Alternatively, digital audio is also available in I2S format to the FMRX and FMTX blocks. The external wired headset is also used as an Antenna for the FM radio receiver. The FM radio receiver RF signal is routed from the ASIC via a buried track to an impedance matching circuit placed near the headset connector. When Bluetooth is paired with an external device, such as a headset, digital audio is routed over the PCM interface to the host phone.

Common Clocking Interface

The device has two clock signals: SYS_CLK (19.2MHz, 26.0MHz, or 38.4MHz supported) and SLEEP_CLK (32.768 kHz). The SYS_CLK provides clocking to both WLAN and Bluetooth functions. The SLEEP_CLK is supplied all the time the phone is switched on.

Antenna Switch Control

The WLAN Engine is designed for use with a single antenna shared between itself and the internal BTH radio. The internal power supply control will keep the supply for the switch control on when needed. The antenna is therefore available to the BTH engine when WLAN is powered off.

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Block Diagram

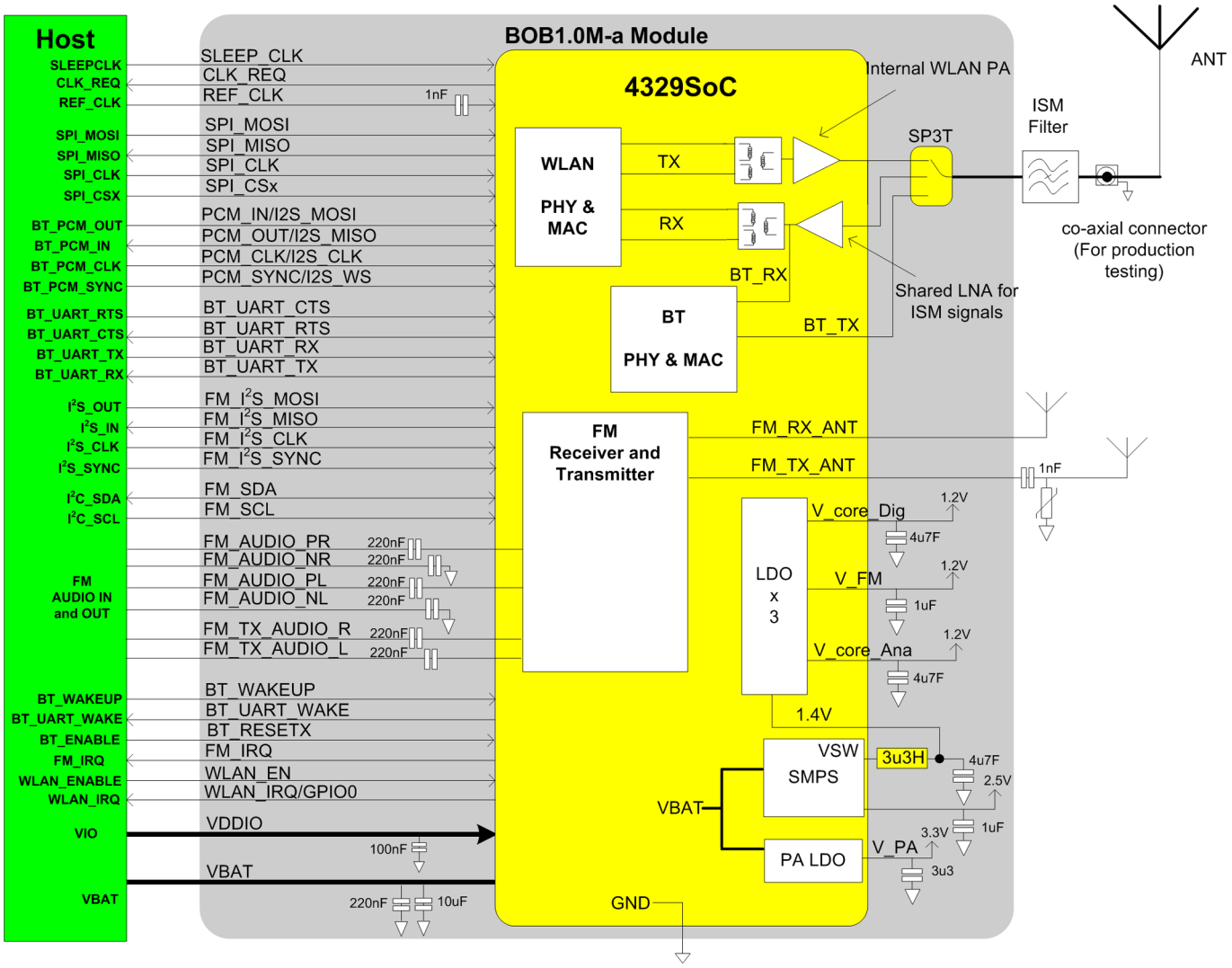

Figure 48 BOB1.0M-A Module Block Diagram & Application Circuit

Interface Signals

Table 13 WLAN, Bluetooth and FM signal list

Signal Name	I/O	Function	Notes
RF			
BT_ANT	B	Bluetooth Antenna Port	
FM_ANT	I	FM Receiver Antenna Port	
Clocking			
SYS_CLK	I	Cellular engine RF clock (19.2, 26.0 or 38.4MHz)	
SLEEP_CLK	I	Cellular engine sleep clock (32.768kHz)	

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Signal Name	I/O	Function	Notes
CLK_REQ	O	Signal from BOB to indicate that SYSCLK is required	
Bluetooth & FM Control			
BT_RESETX	I	Bluetooth ASIC reset	
UART_WAKEUP	O	Signal from Bluetooth ASIC to wakeup host engine	
BT_WAKEUP	I	Signal from host engine to wakeup Bluetooth ASIC	
FM_INTX		FM RX Interrupt to host	
Bluetooth & FM Communication			
UART_RX	I	UART (HCI) interface to/from host engine	
UART_CTS	I		
UART_TX	O		
UART_RTS	O		
I2C_SCL	I	I2C Clock to FM RX & FM TX devices	Alternative to UART
I2C_SDA	B	I2C Bi-directional Data for FM RX & FM TX devices	
I2S_WS	I/O	FM I2S Word Sync: Input if configured for slave mode, output for master mode	
I2S_SCLK	I/O	FM I2S CLK: Input if configured for slave mode, output for master mode	
I2S_SDI	I	FM I2S data in	
I2S_SDO	O	FM I2S data out	
Bluetooth Audio Interface			
PCM_IN	I	PCM interface to/from host engine for Bluetooth audio (headsets accessories etc).	May also be used in a muxed configuration supporting I2S signals.
PCM_OUT	O		
PCM_SYNC	I		
PCM_CLK	I		
FM Radio Audio Interface			
FM_AUDIO_L	O	FM Receiver Analog Audio Output – Left Channel	Alternative I2S digital interface could be used
FM_AUDIO_R	O	FM Receiver Analog Audio Output – Right Channel	
FM_AUDIO_PR	O	Analogue audio out for FM RX	
FM_AUDIO_PL	O	Analogue audio out for FM RX	

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Signal Name	I/O	Function	Notes
FM_AUDIO_NR	O	Analogue audio for FM RX	
FM_AUDIO_NL	O	Analogue audio for FM RX	
WLAN Communication			
SPI_CLK	I	SPI clock from Host to WLAN	When SPI is used, additional SDIO signals are grounded.
SPI_MOSI	I	SPI data from Host to WLAN	
SPI_MISO	O	SPI data from WLAN module to Host	
SPI_CSX	I	SPI Chip select from Host	
SDIO_D1	B	Additional SDIO interface signals not mixed with SPI signals	
SDIO_D2	B	Additional SDIO interface signals not mixed with SPI signals	
WLANENABLE	I	WLAN reset	
WLAN_IRQ	O	WLAN interrupt request	
Power			
VIO	P	Cellular engine I/O supply	
VBAT	P	Phone battery power	Alternative connection to 1.8V supply could be used.

Note: This list should be read in conjunction with the latest BOB1.0M-A Data sheet.

Troubleshooting Guide

BOB (WLAN/FM/BT) Troubleshooting Guide Description

Introduction

The BOB1.0M-a module supports WLAN, BTH and FM RX. From a troubleshooting point of view, WLAN is tested separately, but BTH and FMRX is checked in parallel.

Component Placement

A possible BOB placement is shown below.

The combined WLAN-BTH antenna is product specific PWB track, filter, SMD antenna and is typically located near the side of the PWB. The combined filter for this antenna is shown as component Z6300 below.

The FM receiver RF signal is routed through a product specific FM antenna path 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.

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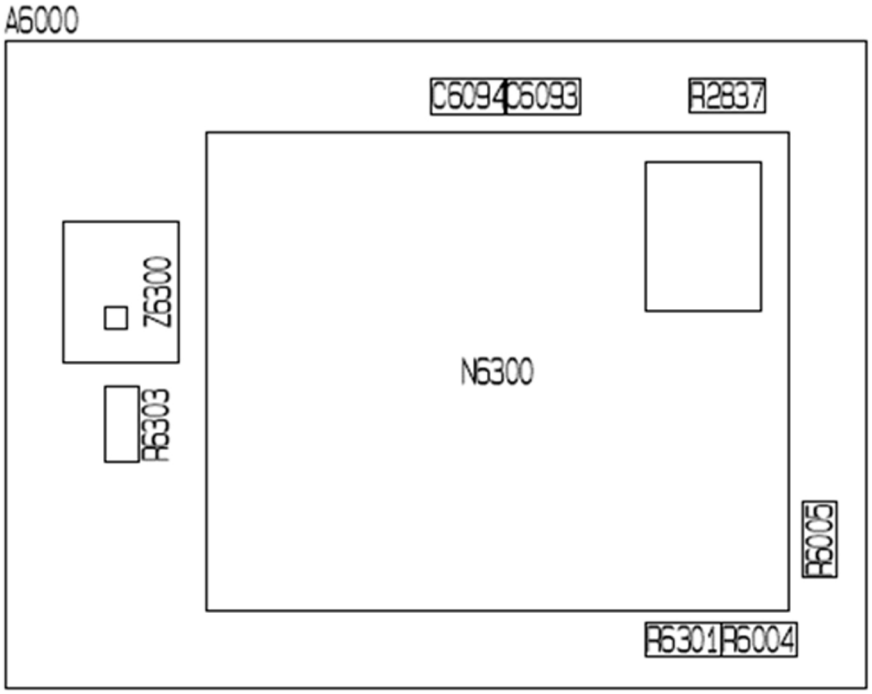

Figure 49 Possible layout around BOB Module circuit

Test points may not necessarily be located near to the ASIC.

Test point details

Required for de-bugging and customer care:

- J6307 CLK_REQ
- J6308 REFCLK_I
- J6309 FM_AUDIO_PR FM RX audio
- J6305 BT_RESET
- J6306 WLAN_ENABLE

Symptom, Problem and Repair Solution

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

Symptom	Problem	Repair Solution
Unable to switch on WLAN on phone user interface	Open circuit solder joints or component failure of BOB module.	Replacement of BOB module or Host.
Able to turn on WLAN via phone user interface, but unable to detect any WLAN APs or other WLAN devices.	Open circuit solder joints or component failure of BOB module or Filter.	Replacement of BOB module or Filter
Able to turn on WLAN via phone user interface, and find AP's and other WLAN devices, but not able to connect.	Problem with TX part of WLAN circuit	Replacement of BOB module

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Symptom	Problem	Repair Solution
Slow download speed when using WLAN as connection method.	System clock possibly degraded.	Change system clock source.
Unable to switch on Bluetooth on phone user interface	Open circuit solder joints or component failure of BOB module or SMD components.	Replacement of BOB 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 BOB module (PCM interface).	Replacement of BOB module
Able to turn switch on Bluetooth on phone user interface, but unable to detect other Bluetooth devices	Open circuit solder joints or detected component in Bluetooth antenna circuit.	Repair of Bluetooth antenna circuit
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
WLAN does not operate as desired with another WLAN device	Other WLAN device is not conforming to ETSI/FCC specifications	Use only certified WLAN products.
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

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Test Coverage

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

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

Test	Test Coverage	Repair Solution
WLAN Self Test: *ST_WLAN_TEST*	WLAN SPI and control interface (Data interface and control of WLAN)	Replacement of BOB
Bluetooth Functional Test: BER test with BT-Box or functional test with other Bluetooth device	Antenna connection from module, including filter.	Replacement of BOB or antenna components
WLAN TX Tuning	Checks WLAN TX path up to module output, and calibrates new module if fitted.	Replacement of BOB or antenna components
Bluetooth Self Test: *ST_LPRF_IF_TEST*	Bluetooth-FM ASIC UART interface (controls Bluetooth and FM receiver and transmitter)	Replacement of BOB module (or repair of phone BB)
Bluetooth Self Test: *ST_BT_WAKEUP_TEST*	Bluetooth ASIC interrupt control interface	Replacement of BOB module (or repair of phone BB)
Bluetooth Self Test: *ST_LPRF_AUDIO_LINES_TEST*	Bluetooth ASIC PCM interface	Replacement of BOB module (or repair of phone BB)
Bluetooth Functional Test: BER test with BT-Box or functional test with other Bluetooth device	Bluetooth antenna circuit	Repair of Bluetooth antenna circuit (including RF filter or WLAN switch if fitted)
FM Radio Functional Test: Perform scan for local radio stations and check station list displayed on phone	FM receiver antenna circuit	Repair of FM antenna circuit (between BTHFMWLAN ASIC and headset connector)
FM Radio Functional Test: Listen to local radio station	FM receiver audio circuit	Repair of FM receiver audio circuit (between BTHFMWLAN 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 function of WLAN, Bluetooth and FM radio receive.

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.

Test Procedure--Phoenix Service Software Set up

WLAN Self Tests

Context

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

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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 WLAN tests:
   - *ST_WLAN_TEST*
7. To run the test, click *Start*.

Bluetooth Self Tests

Context

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. Select **Bus Method** (FBUS or USB) from "**Connections**" box.
5. From the Mode drop-down menu, set to **Local**.
6. Choose **Testing Self Tests**.
7. In the *Self Tests* window check the following Bluetooth tests:
   - *ST_LPRF_IF_TEST*
   - *ST_LPRF_AUDIO_LINES_TEST*
   - *ST_BT_WAKEUP_TEST*
8. 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

Context

SB-6 Bluetooth test box (BT-box) is required to perform a BER test. If a BT-box if not available Bluetooth functionality can be checked by transfering 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**.

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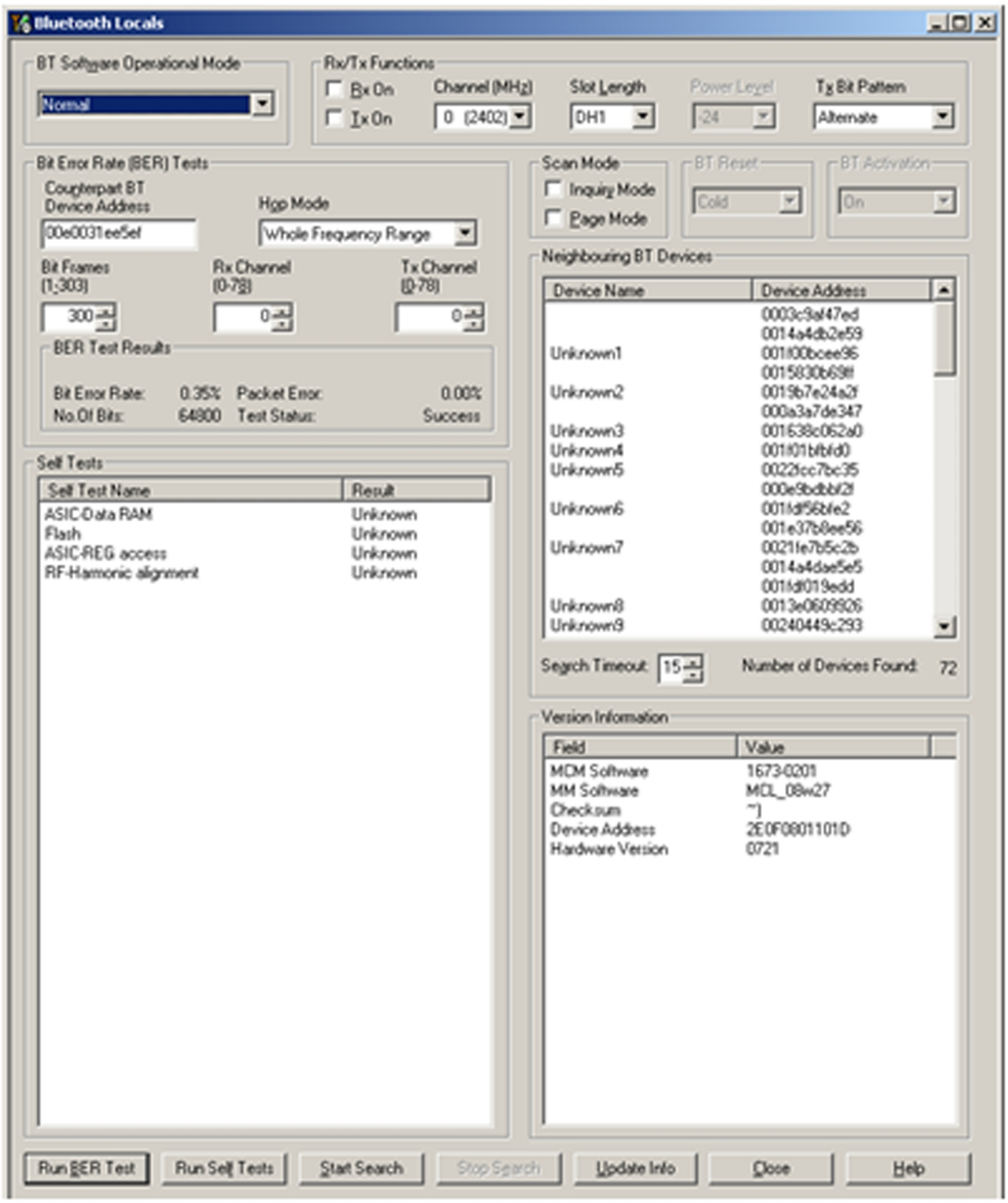
5. Locate the BT-box serial number (12 digits) found in the type label on the back of the SB-6 Bluetooth test box.
6. In the *Bluetooth Locals* window, write the 12-digit serial number on the *Counterpart BT Device Address* line.
7. Place the BT-box near (within 10 cm) of the phone and click *Run BER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



Troubleshooting

General Description

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

The Bluetooth and FM radio receiver functions are combined so these features are all checked when troubleshooting (if supported).

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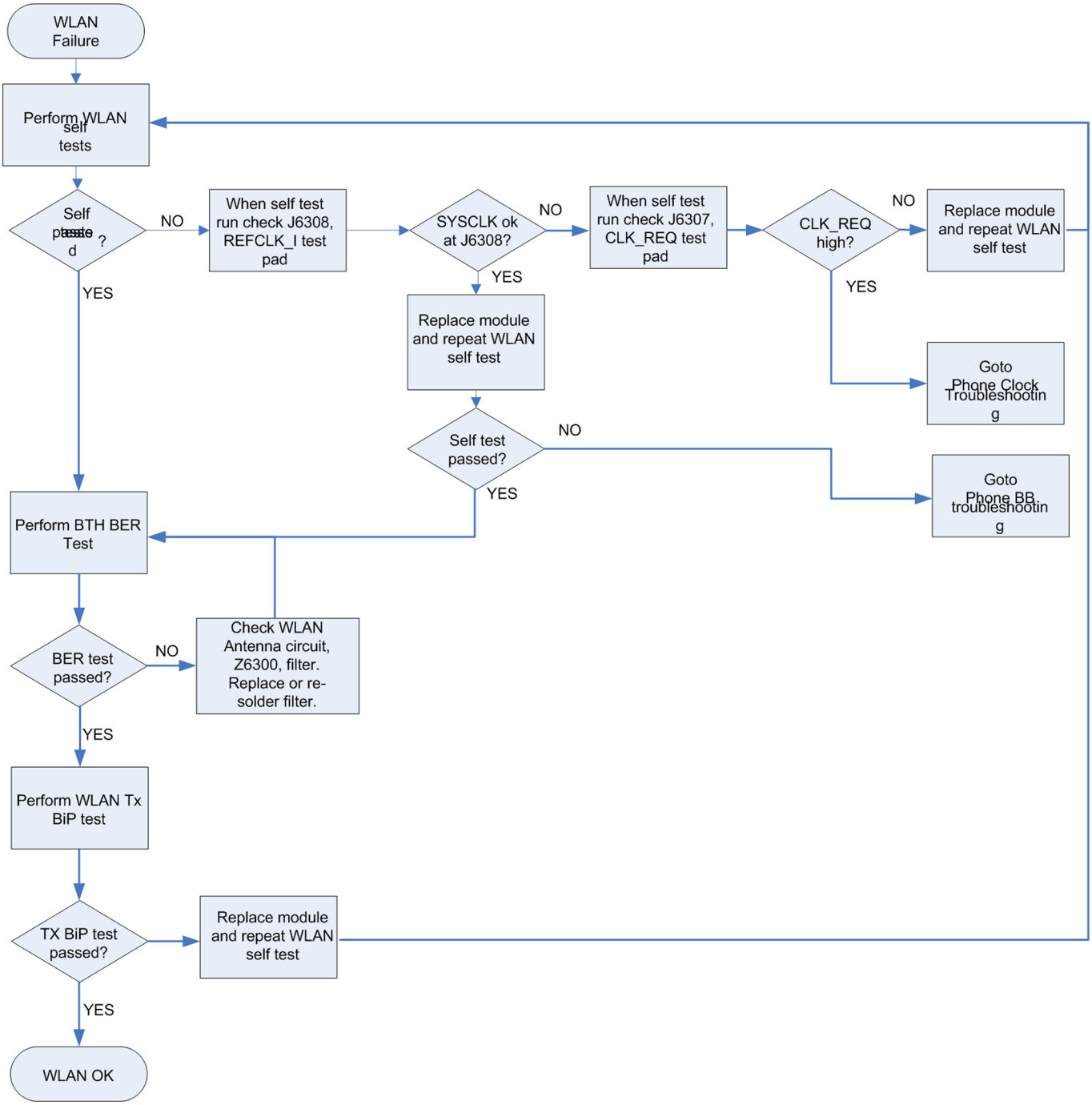
WLAN Troubleshooting

Troubleshooting flow



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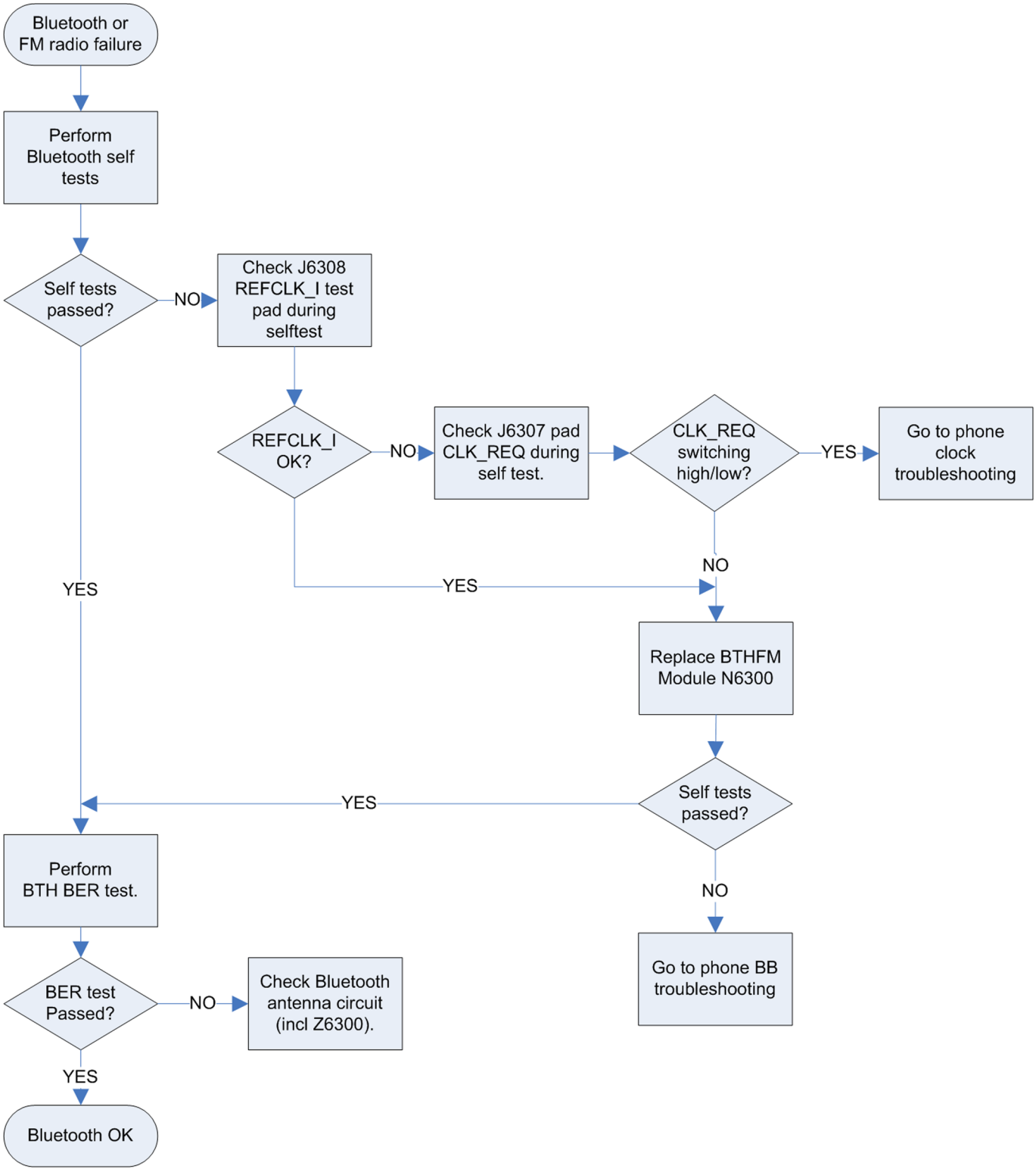
Bluetooth Troubleshooting

Troubleshooting flow



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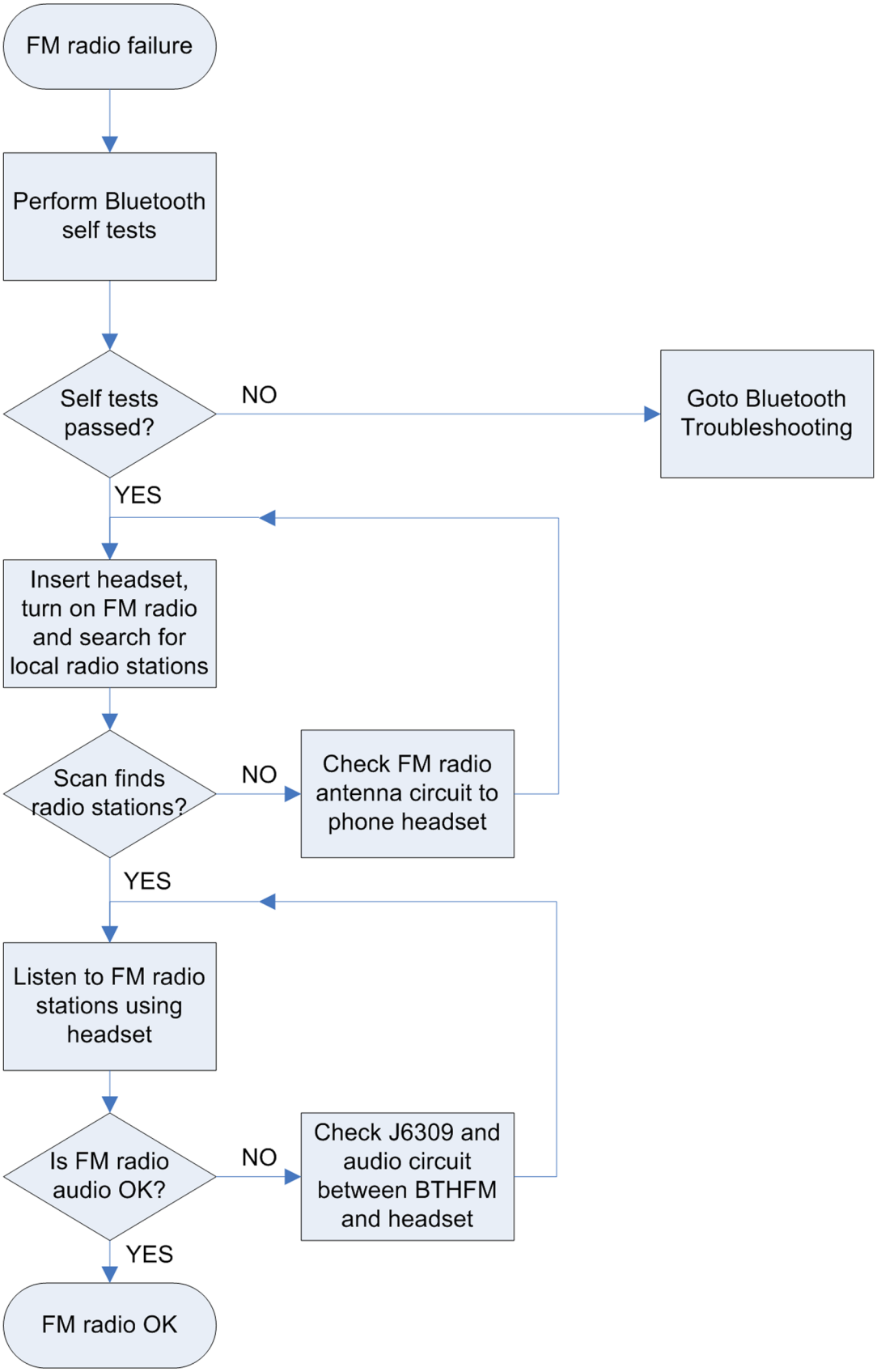
FM Receiver Troubleshooting

Troubleshooting flow



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Glossary

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

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

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

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

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

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