Nokia Customer Care

Service Manual

RM-340; RM-341 (Nokia 2600c-2; Nokia 2600c-2b)

Mobile Terminal

Part No: 9205777 (Issue 1)

COMPANY CONFIDENTIAL

Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	12/2007	Y Liu	

Copyright

IMPORTANT

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

Warnings and cautions

Warnings

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

Cautions

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

For your safety

QUALIFIED SERVICE

Only qualified personnel may install or repair phone equipment.

ACCESSORIES AND BATTERIES

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

CONNECTING TO OTHER DEVICES

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

Care and maintenance

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

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

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

ESD protection

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

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

To replace the covers ESD protection must be applied.

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

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

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

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

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

Battery information

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

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

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

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

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

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

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

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

Do not dispose of batteries in a fire!

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

Company Policy

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

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

Please state:

- Title of the Document + Issue Number/Date of publication
- Latest Amendment Number (if applicable)
- Page(s) and/or Figure(s) in error

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Nokia 2600c-2; Nokia 2600c-2b Service Manual Structure

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1 — General Information

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RM-340/RM-341 product selection

The RM-340 is the EU version of the telephone with a dual band transceiver unit designed for the GSM900 and GSM1800 networks.

The RM-341 is the US version of the telephone with a dual band transceiver unit designed for the GSM850 and GSM1900 networks.

Figure 1 RM-340/341 product picture

Features

Hardware features

- EGSM dualband 900/1800 for EMEA, APAC, China, LTA·
- GSM dualband 850/1900 for LTA
- Display: 128x160 TFT color display
- Codecs: HR, FR, EFR and AMR
- IHF Slim Malt 16mm Speaker
- Internal antenna
- Easy flash II system connector
- BT combined with FM radio
- VGA camera
- Built-in Vibra
- GPRS: Class 6

Software features

- OS: ISA
- UI Style: S40
- MIDP 2.0 Java, with latest APIs
- Browser: XHTML over TCP/IP (WAP 2.0 compliant)
- Video capture and playback (7.5fps, H.263; MPEG4)
- MMS 1.2
- English-Chinese dictionary for China/APAC
- E-mail Client 4
- Nokia Xpress audio messaging

UI features

- Douglas V UI style with 3 soft keysl
- Nokia Series 40 user interface
- MP3 ringing tones & 40 polyphonic ringing tones
- Themes, colour games and wall papers
- Java games (downloadable)
- To-do list and Notes
- Countdown timer
- Phonebook image
- Menu with animated icons
- 2 font sizes are supported in the editor
- Calendar in day/week/month view
- Chinese lunar Calendar II (not for all regions)
- “Pulsating light” indicating missed call, unread messages, etc.

Mobile enhancements

Table 1 Power

Type	Name
BL-5BT	Battery 870 mAh Li-Ion
AC-3	Compact charger
AC-4	Travel charger
AC-5	Compact travel charger
CA-44	Charger adapter
DC-4	Mobile charger

Table 2 Car

Type	Name
CK-15W	Display car kit

Type	Name
CK-20W	Multimedia car kit
CK-25W	Multimedia car kit

Table 3 Audio

Type	Name
HS-38W	Nokia bluetooth headset BH-202
HS-40	Headset
HS-47	Stereo headset
HS-50W	Nokia bluetooth headset BH-300
HS-51W	Nokia bluetooth headset BH-301
HS-52W	Nokia bluetooth headset BH-201
HS-58W	Nokia bluetooth headset BH-200
HS-68W	Nokia bluetooth headset BH-203
HS-73W	Nokia bluetooth headset BH-302
HS-78W	Nokia bluetooth headset BH-100
HS-79W	Nokia bluetooth headset BH-303
HS-80W	Nokia bluetooth headset BH-208
HS-84W/88W	Nokia bluetooth headset BH-204
HS-85W	Nokia bluetooth headset BH-206
HS-86W	Nokia bluetooth headset BH-207
MD-4	Mini speakers

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2 — Service Devices and Service Concepts

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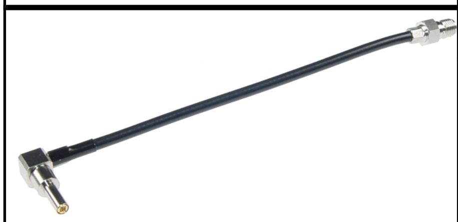
Service devices

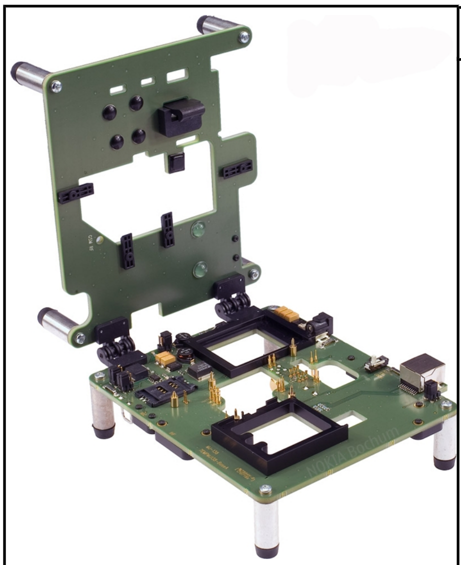
The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-340; RM-341. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

<table>
<tr><td rowspan="2"></td><td>CA-106DS</td><td>Easy flash II cable</td><td></td></tr>
<tr><td colspan="3">The cable is used for connecting phone DC port to the flash prommer FPS-10.</td></tr>
<tr><td rowspan="2"></td><td>CA-111DS</td><td>Easy flash II cable</td><td></td></tr>
<tr><td colspan="3">The cable is used for connecting phone DC port to either POS flashing device FLS-4S or to the PROMMER box FPS-11.</td></tr>
<tr><td rowspan="2"></td><td>CA-112DS</td><td>Easy flash II cable</td><td></td></tr>
<tr><td colspan="3">The CA-112DS easy flash II cable is used for connecting phone DC port to the PROMMER facilities (FLS-5, FPS-21).</td></tr>
</table>

	CA-41PS	Power cable	Power cable for connection of e.g. the JBV-1 docking station to the FPS-10 prommer box.
	CA-52PS	DC Cable	The cable is used to connect JBV-1 docking station to the phone charger jack for ADC/VCHAR/ICHAR calibration.
	CA-58RS	RF Cable	This RF cable is used together with MJ-138 to connect to RF measurement equipment.
	DA-69	Docking station adapter	The docking station adapter is used for this phone in combination with JBV-1. The adapter supports flashing and energy management calibration, Features include: • compatible with JBV-1 • easy phone attachment and detachment • reliable phone locking • switch for detecting phone • replaceable SIM interface

<table>
<tr><td rowspan="2"></td><td>DAU-9S</td><td>MBUS cable</td><td></td></tr>
<tr><td colspan="3">The MBUS cable DAU-9S has a modular connector and is used, for example, between the PC's serial port and module jigs, flash adapters or docking station adapters.
Note: Docking station adapters valid for DCT4 products.</td></tr>
<tr><td rowspan="2"></td><td>FLS-4S</td><td>Flash device</td><td></td></tr>
<tr><td colspan="3">FLS-4S is a dongle and flash device incorporated into one package, developed specifically for POS use.</td></tr>
<tr><td rowspan="2"></td><td>FLS-5</td><td>Flash device</td><td></td></tr>
<tr><td colspan="3">FLS-5 is a dongle and flash device incorporated into one package, developed specifically for POS use.
Note: FLS-5 can be used as an alternative to PKD-1.</td></tr>
</table>

	FPS-10	Flash prommer	
	FPS-10 interfaces with: • PC • Control unit • Flash adapter • Smart card FPS-10 flash prommer features: • Flash functionality for BB5 and DCT-4 terminals • Smart Card reader for SX-2 or SX-4 • USB traffic forwarding • USB to FBUS/Flashbus conversion • LAN to FBUS/Flashbus and USB conversion • Vusb output switchable by PC command FPS-10 sales package includes: • FPS-10 prommer • Power Supply with 5 country specific cords • USB cable **Note:** FPS-21 is substitute FPS-10 if FPS-10 has not been set up.		
	JBV-1	Docking station	
	The JBV-1 docking station is a general tool that has been designed for calibration and software update use. The JBV-1 is used together with a docking station adapter as one unit In calibration mode the JBV-1 is powered by an external power supply: 11-16V DC. When flashing the power for the phone must be taken from the flash prommer. **Note:** JBV-1 main electrical functions are: • adjustable VBATT calibration voltage, current measurement limit voltage: VCHAR, current measurement: ICHAR • adjustable ADC calibration voltage via BTEM and the BSI signal • BTEMP and BSI calibration resistor • signal from FBUS to the phone via the parallel jig • control via FBUS or USB • Flash OK/FAIL indication		



MJ-138	Module jig	

MJ-138 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 and UI module
- Provides galvanic connection to all needed test pads in module
- Duplicated SIM connector
- Audio components: IHF, MIC
- Connector for control unit

Note: CA-58RS(RF cable) is used together with MJ-138. CA-58RS is not a part of the MJ-138 sales package and has to be ordered separately.

The following table shows the attenuation values for MJ-138:

Band	Tuning Channel	Attenuation RX	Tolerance RX	Attenuation TX	Tolerance TX
GSM 900	975	-6.0884	1	-6.9200	2
	38	-6.4203	1	-7.4584	2
	124	-6.6911	1	-8.4678	2
GSM 1800	512	-8.8416	1	-7.5614	2
	700	-8.0418	1	-7.0011	2
	885	-7.7039	1	-6.4946	2

PCS-1	Power cable	

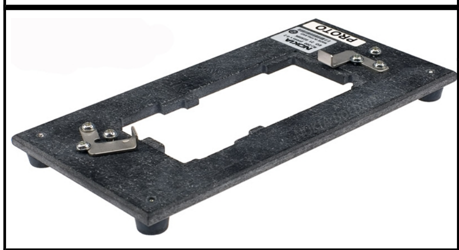
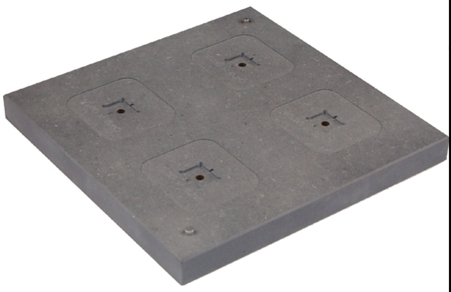
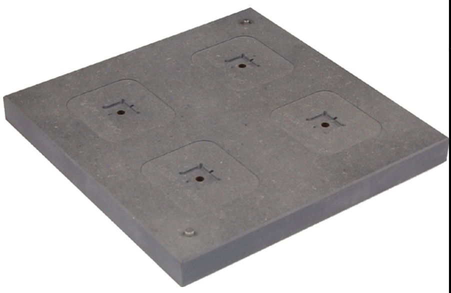
The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.

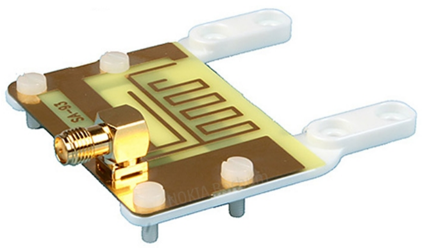
PK-1	Software protection key	

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.

	PKD-1	SW security device	
	SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC. Without the device, it is not possible to use the service software. Printer or any such device can be connected to the PC through the device if needed.		
	RJ-200	Soldering jig	
	The jig is used for soldering and as a rework jig for the system module. It is made of lead-free rework compatible material.		
	RJ-51	Rework jig	
	To be used with ST-30!		
	RJ-72	Rework jig	
	To be used with rework stencil ST-32.		



SA-93	RF coupler	

The coupler is used for Go/No-Go test after changing components in the RF part of the phone.

It is mounted on the docking station adapter.

The following table shows attenuations from the antenna pads of the mobile terminal to the SMA connectors of SA-93:

Band	Tuning channel	Attenuation RX (dB)	Attenuation TX(dB)
GSM850	128	8	8
	190	8	8
	251	8	8
GSM900	38	8	8
	124	8	8
	975	8	8
GSM1800	512	10	10
	700	10	10
	885	10	10
GSM1900	512	10	10
	661	10	10
	810	10	10

SRT-6	Opening tool	

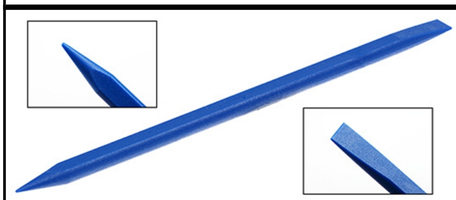
SRT-6 is used to open phone covers and B-to-B connectors.

Caution: Handle the tool with care because the tip is only 0.7 mm in diameter.

When not in use, store in a safe location.

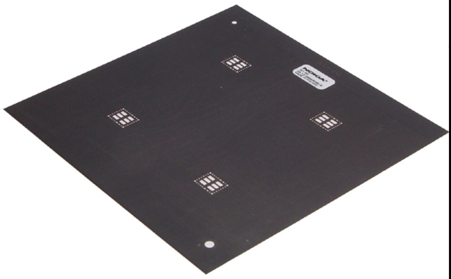
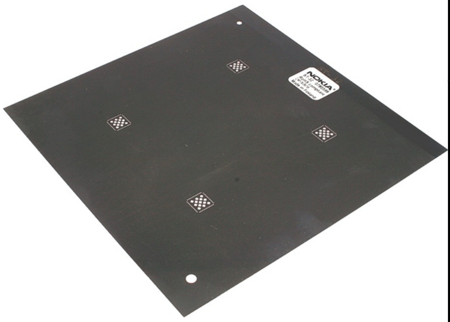
SS-88	Camera removal tool	

The camera removal tool SS-88 is used to remove/attach the front camera module from/to the socket.



SS-93	Opening tool	

SS-93 is used for opening JAE connectors.

<table>
<tr><td rowspan="2"></td><td>ST-30</td><td>Rework stencil</td><td></td></tr>
<tr><td colspan="3">It is used together with RJ-51 to rework N6301.</td></tr>
<tr><td rowspan="2"></td><td>ST-32</td><td>Rework stencil for B2100</td><td></td></tr>
<tr><td colspan="3">Rework stencil to be used together with RJ-72 for rework of B2100.</td></tr>
<tr><td rowspan="2"></td><td>SX-4</td><td>Smart card</td><td></td></tr>
<tr><td colspan="3">SX-4 is a BB5 security device used to protect critical features in tuning and testing.
SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed.</td></tr>
<tr><td rowspan="2"></td><td>XCS-4</td><td>Modular cable</td><td></td></tr>
<tr><td colspan="3">XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.</td></tr>
</table>

	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 • WLAN: 0.6+-0.1dB		

Service concepts

POS flash concept with FLS-4S

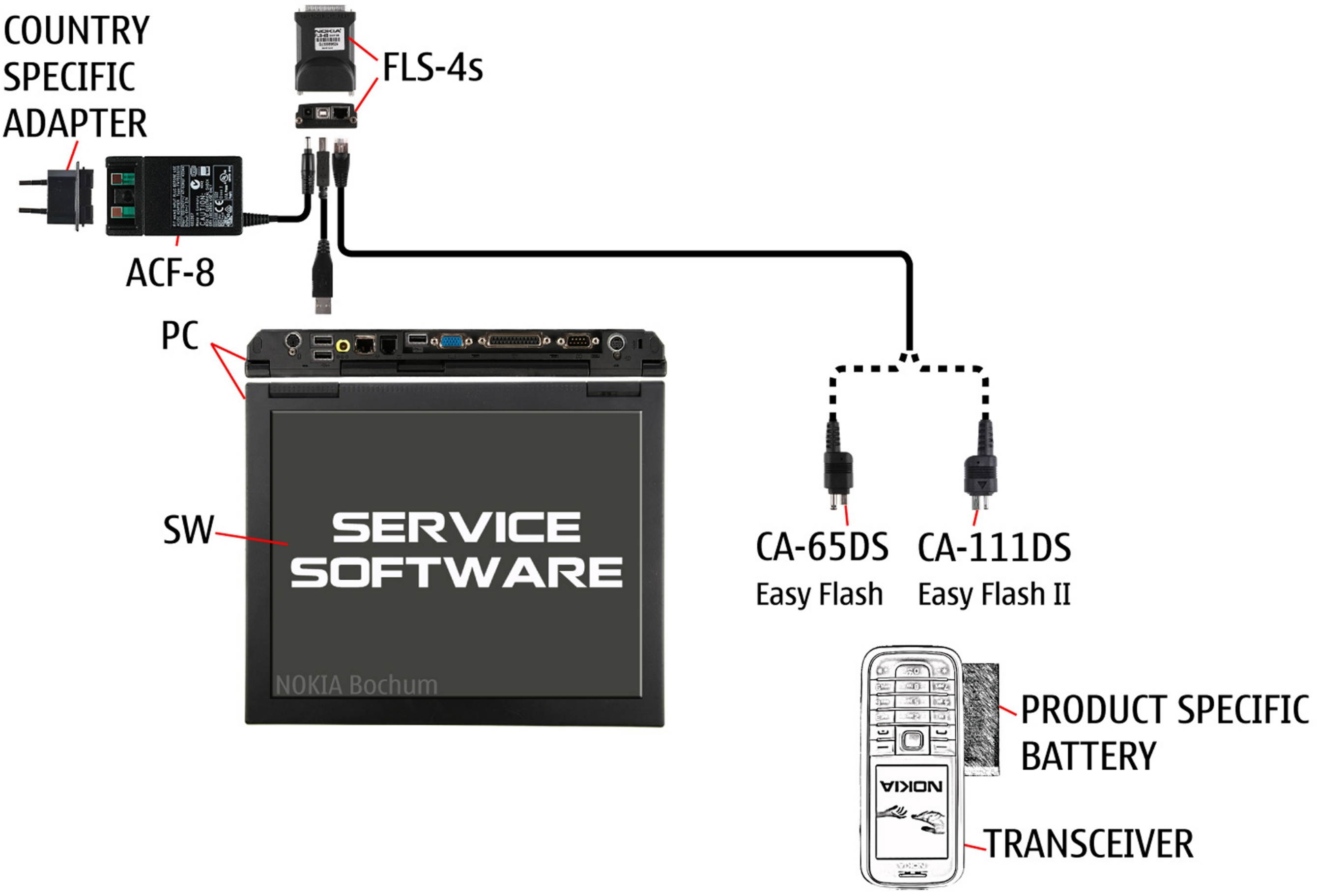


Figure 2 POS flash concept with FLS-4S

POS flash concept with FLS-5

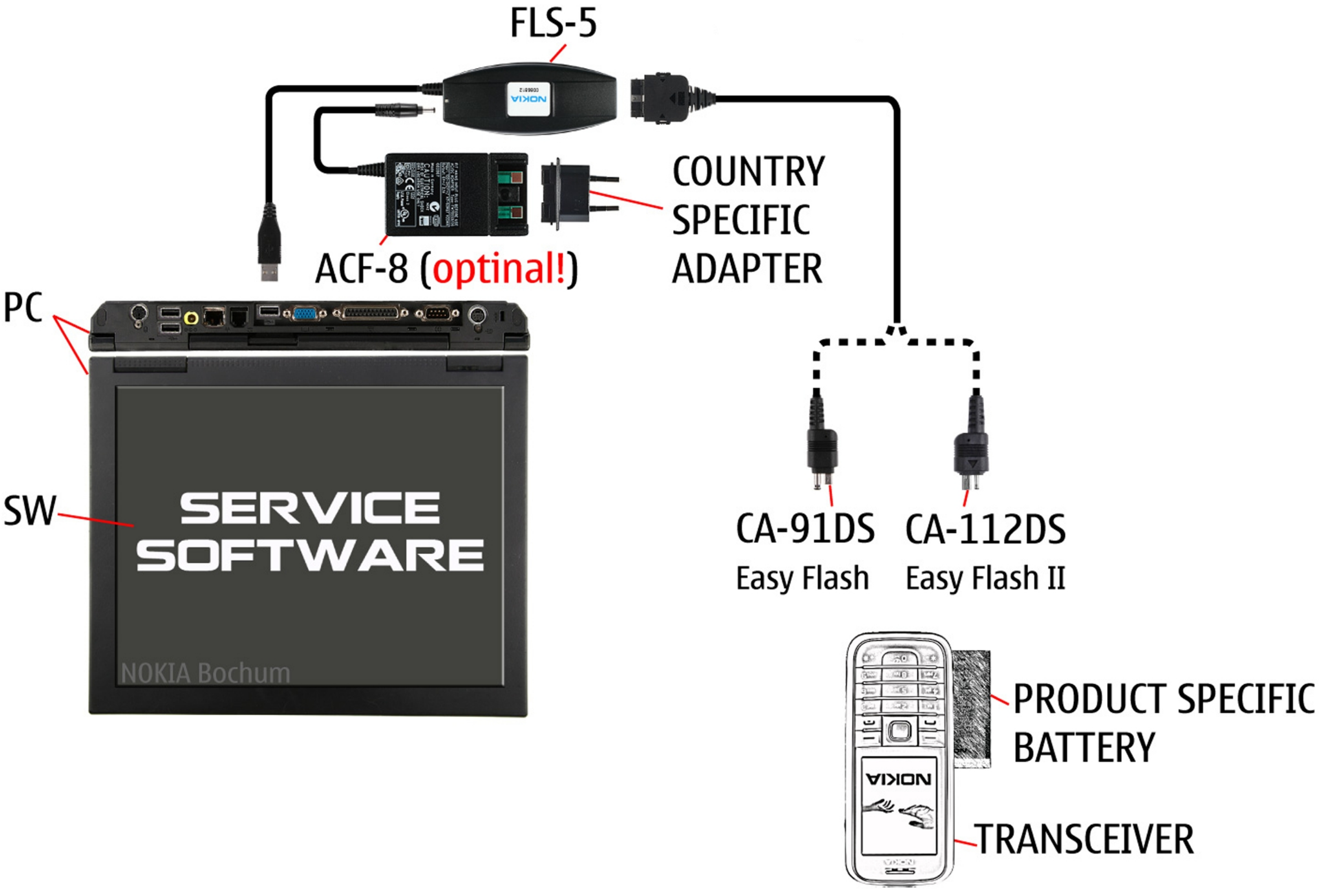


Figure 3 POS flash concept with FLS-5

Flash concept with FPS-10

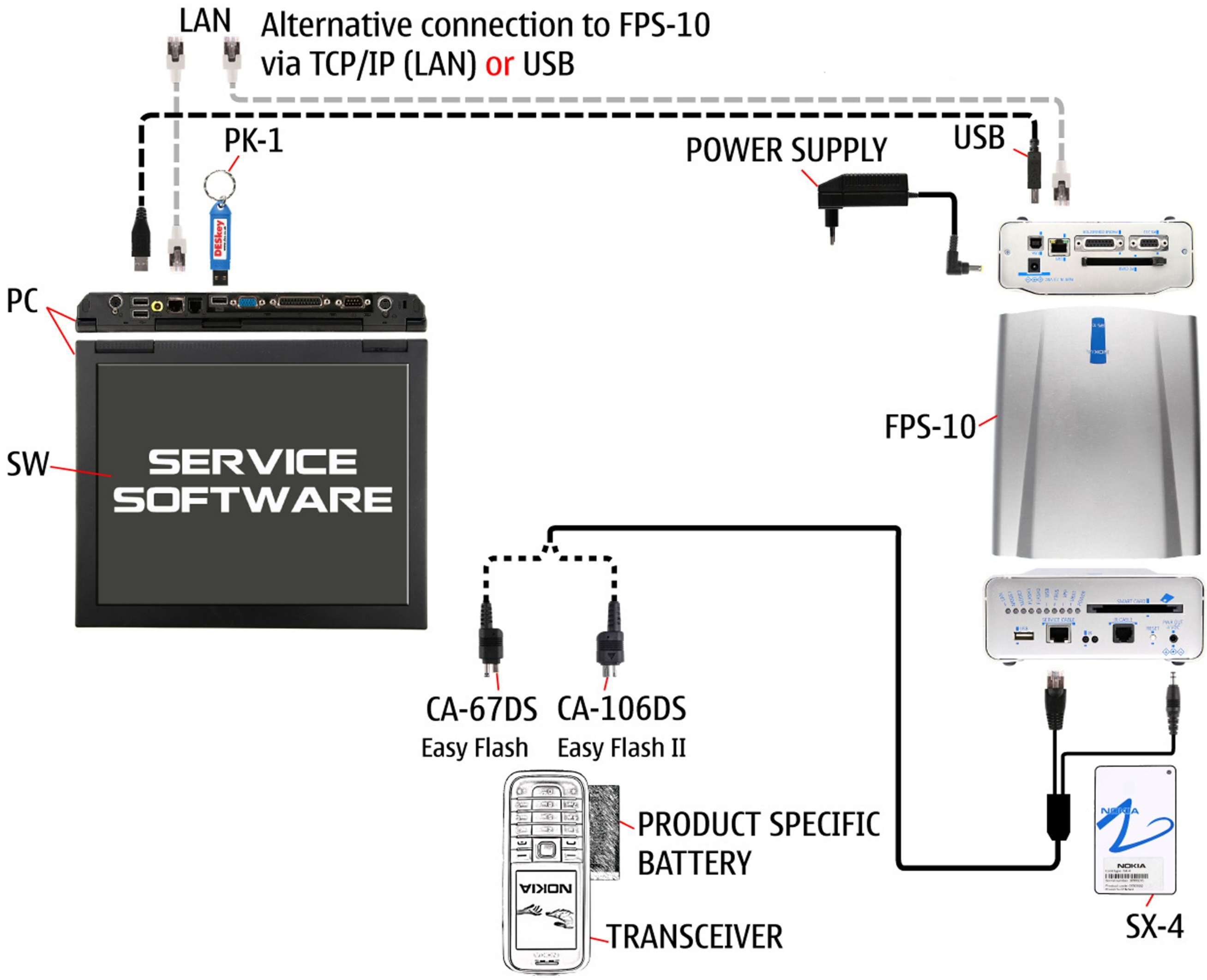


Figure 4 Flash concept with FPS-10

RF-test/BB-tune concept with JBV-1

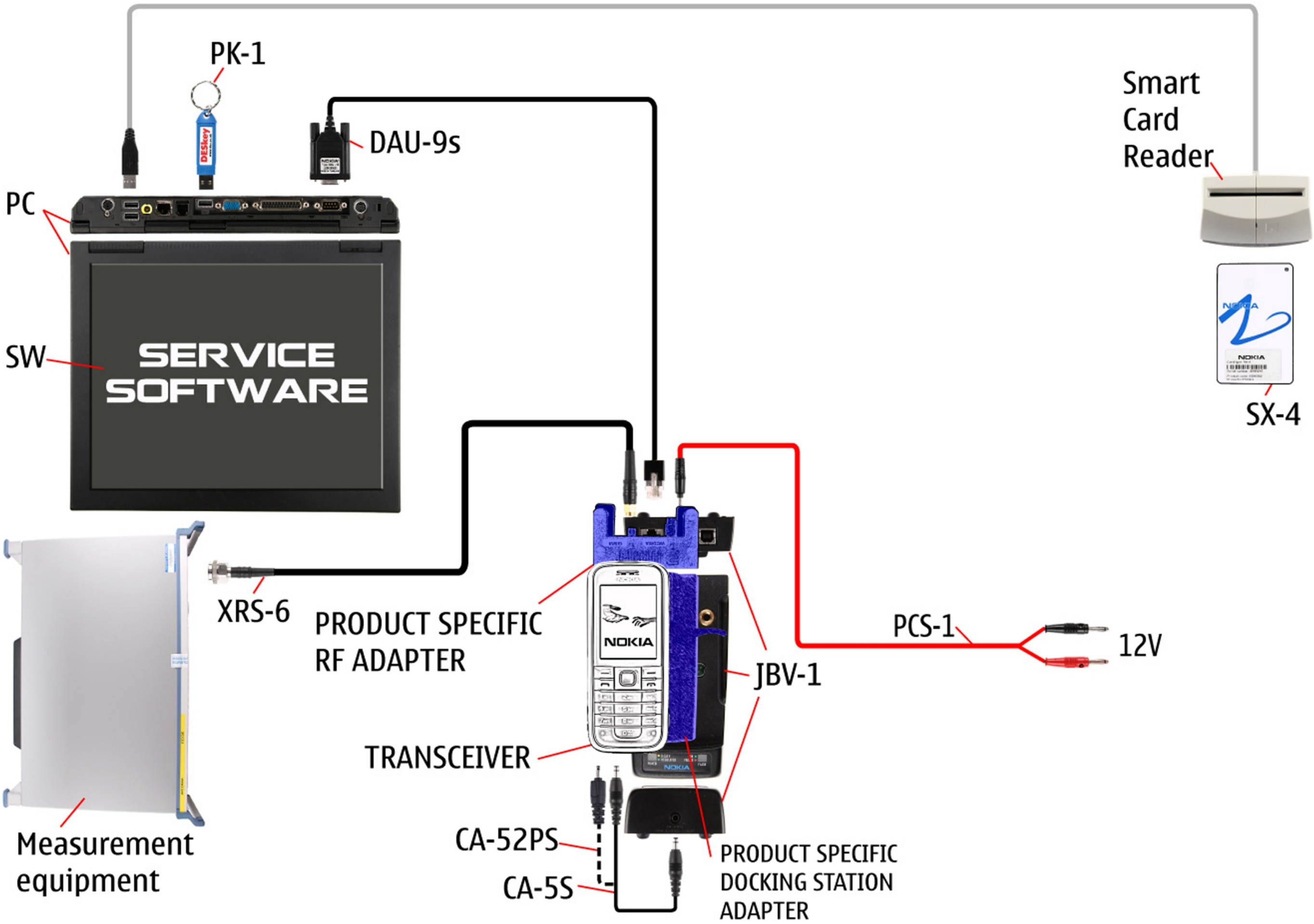


Figure 5 RF-test/BB-tune concept with JBV-1

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EM calibration concept with JBV-1

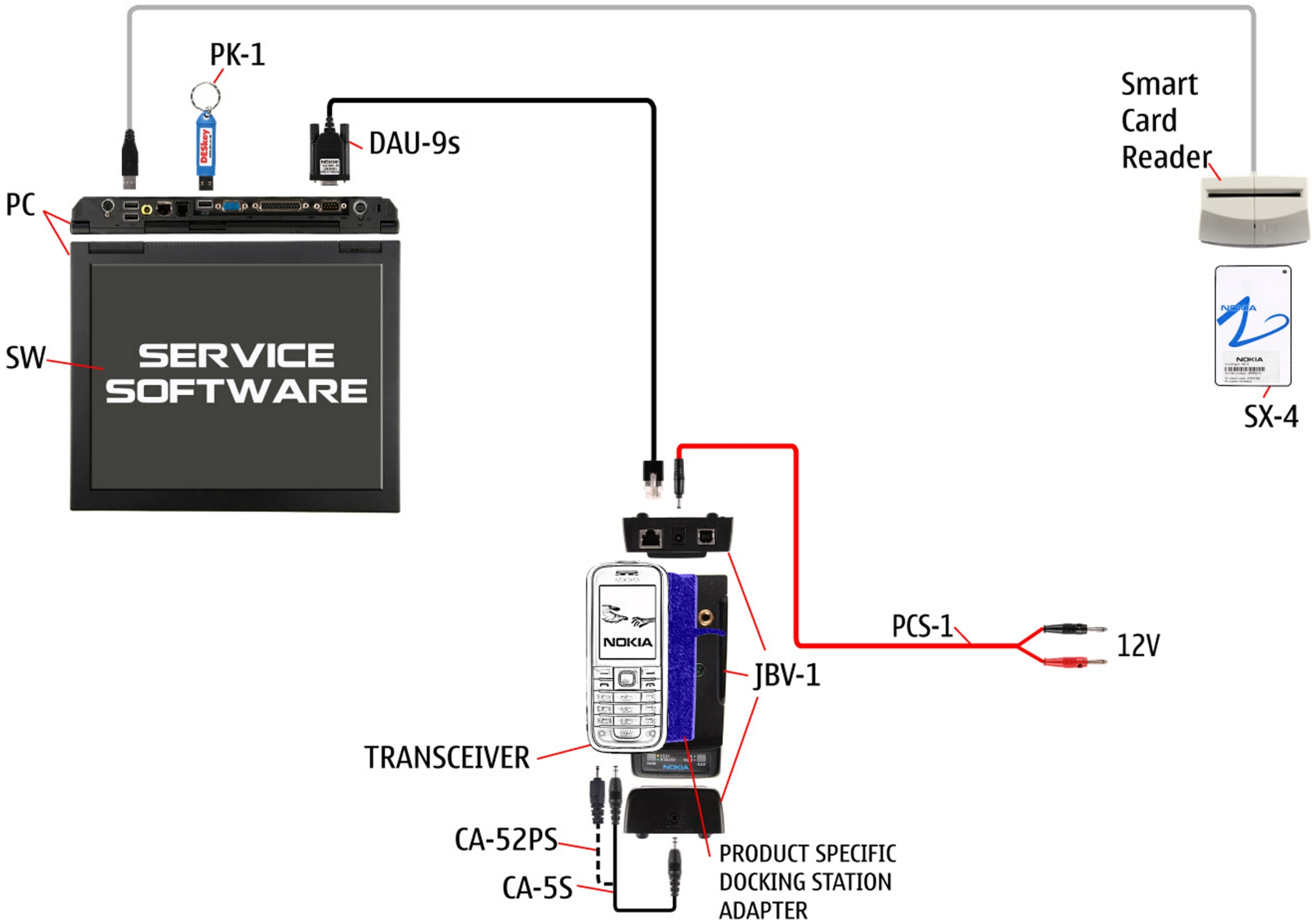

Figure 6 EM calibration concept with JBV-1

RF-test/BB-tune & flash concept with JBV-1, FPS-10

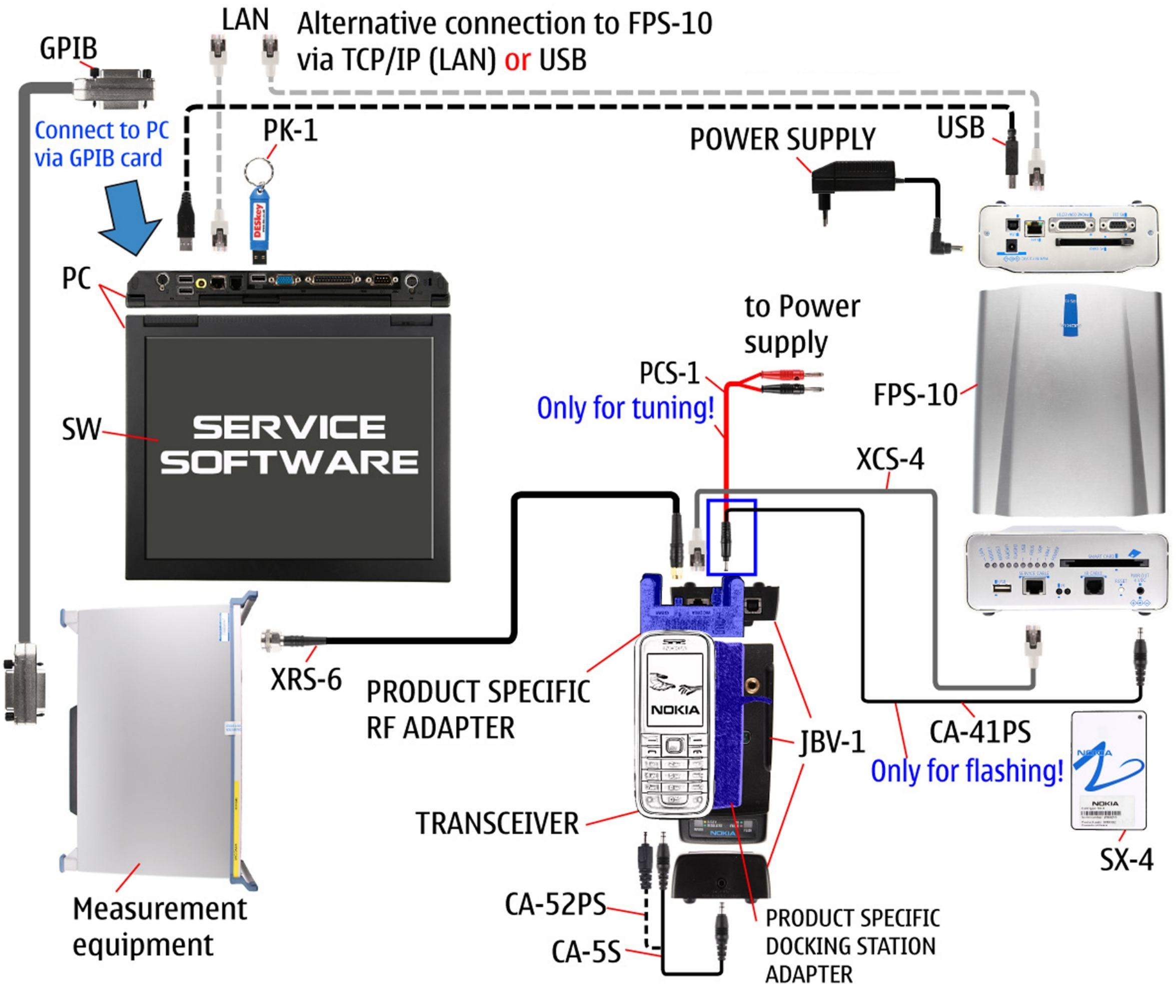

Figure 7 RF-test/BB-tune & flash concept with JBV-1, FPS-10

RF/BB tune& flash concept with MJ-137, FPS-10

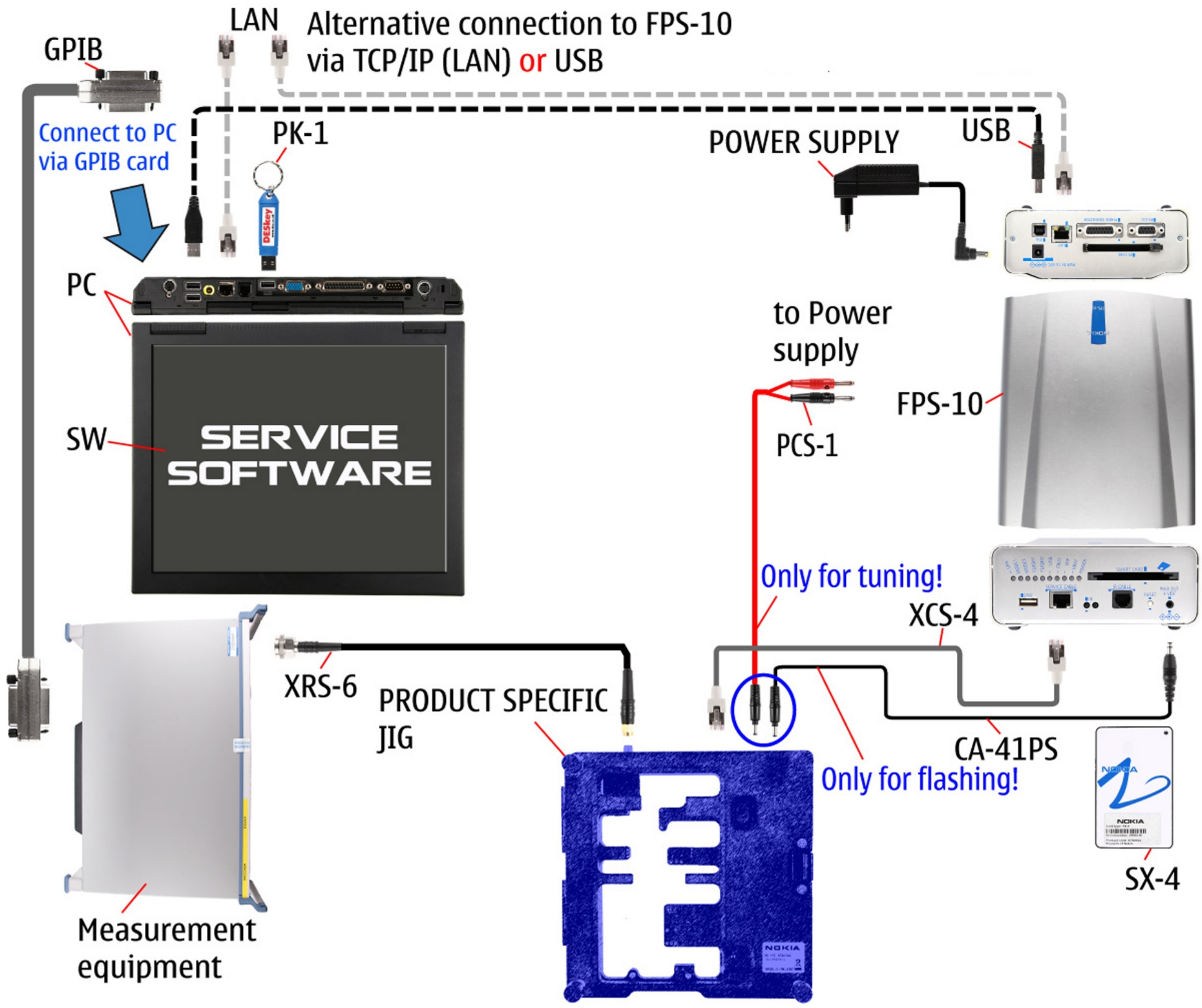

Figure 8 RF/BB tune& flash concept with MJ-137, FPS-10

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3 — Baseband Troubleshooting Instructions

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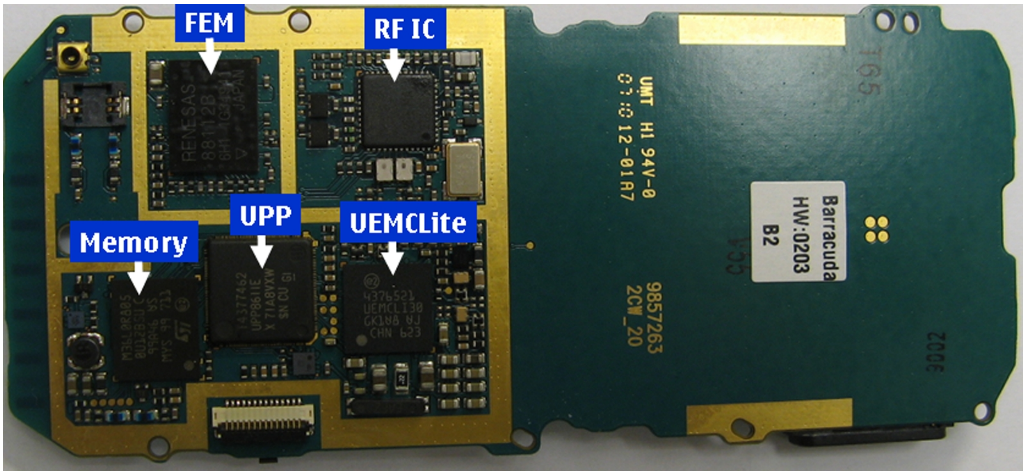
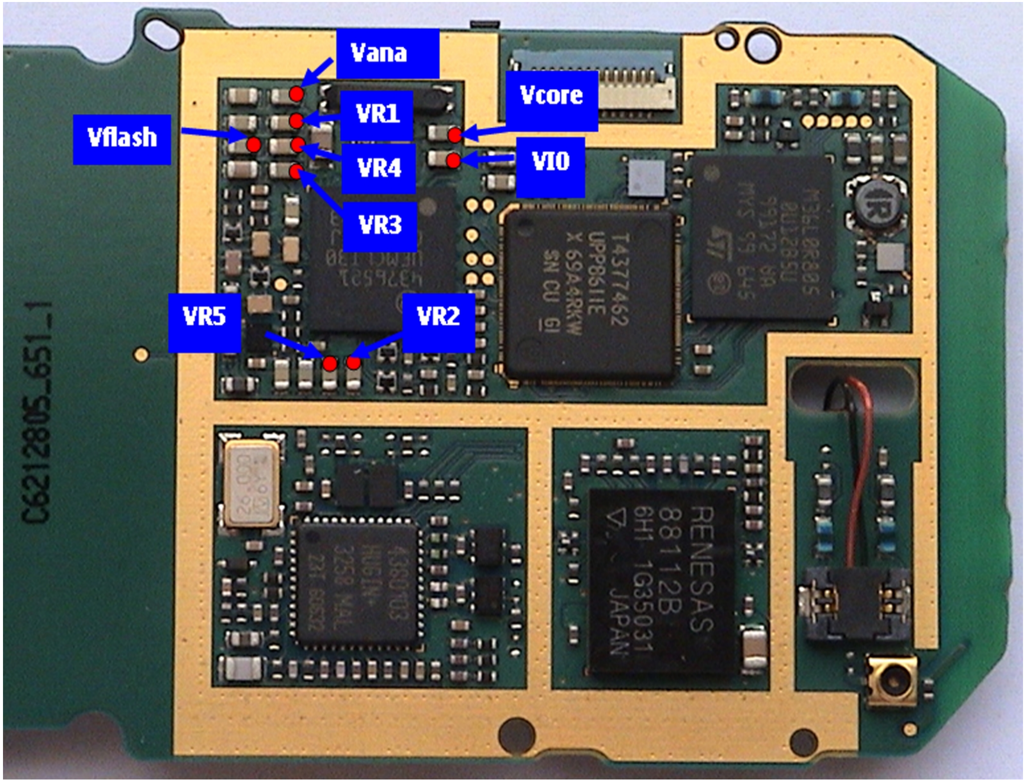
General baseband troubleshooting

Key components



Power supply test points



Phone cannot be powered on (I)

Context

This means that the phone does not use any current at all when the supply is connected and/or power key is pressed. It is assumed that the voltage supplied is 3.6VDC. The UEMCLite will prevent any functionality at battery/supply levels below 2.9VDC.

Troubleshooting flow

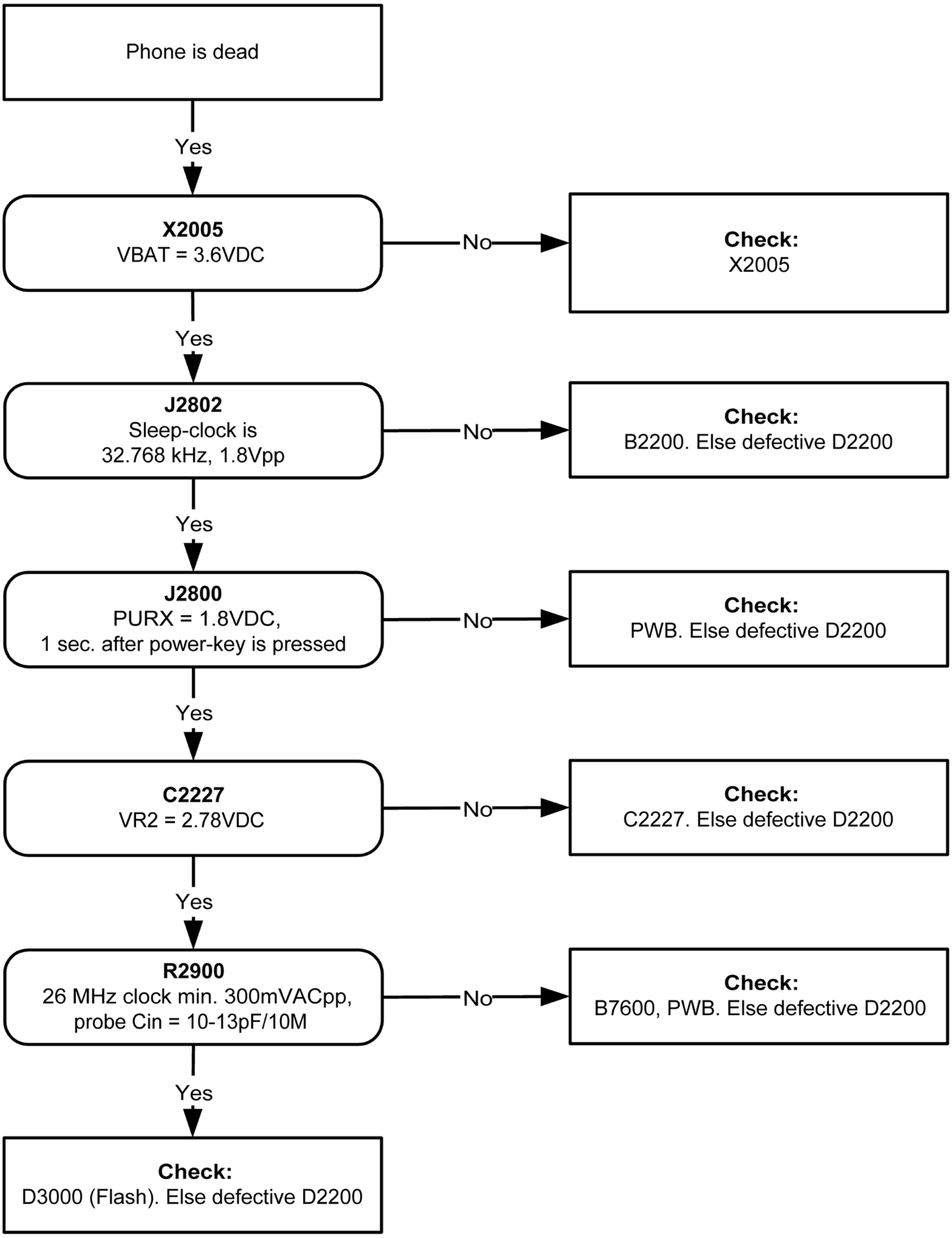


Figure 9 Troubleshooting when phone cannot be powered on

Phone cannot be powered on (II)

Context

If this kind of failure is presenting itself immediately after FLALI, it is most likely caused by ASIC's missing contact with PWB.

If the MCU doesn't service the watchdog register within the UEMCLite, the operations watchdog will run out after approximately 32 seconds. Unfortunately, the service routine can not be measured.

Troubleshooting flow

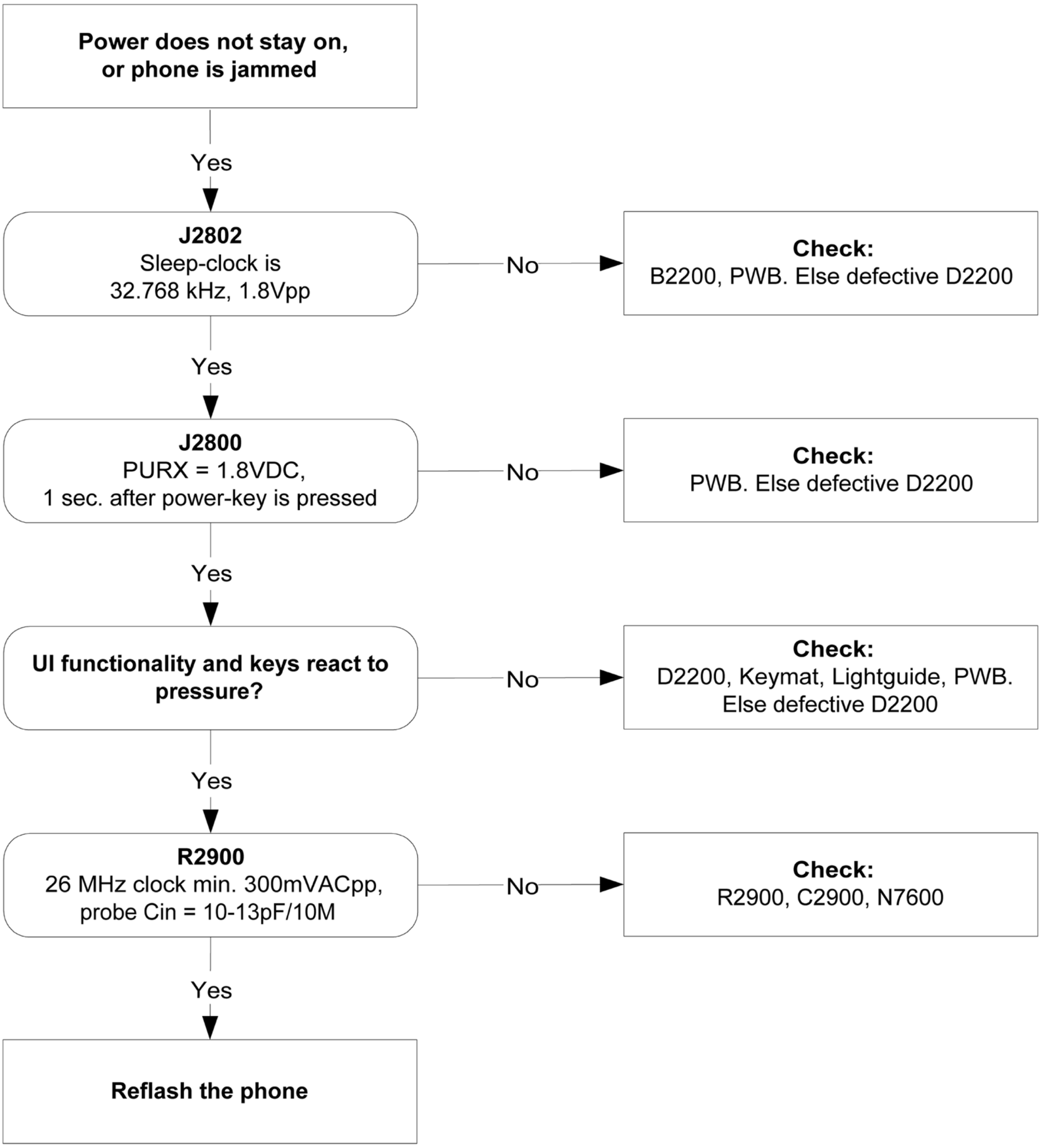


Figure 10 Troubleshooting when phone does not stay on or phone is jammed

Phone cannot be flashed

Context

The flash programming can be done via the pads on the PWB (J2060). If failed, then follow up the trouble shooting flow chart.

In case of flash failure in the FLALI station, swap the phone and send it back to the care program for further analysis. Possible failures could be short-circuit of balls under µBGAs (UEMCLite, UPP4M, FLASH), or missing or misaligned components.

In flash programming error cases, the flash prommer can give some information about a fault. The fault information messages could be:

Phone doesn't set FBUS_TX line low

Because of the use of uBGA components, it is not possible to verify if there is a short circuit in the control and address lines of MCU (UPP8M) and the memory (flash).

Troubleshooting flow

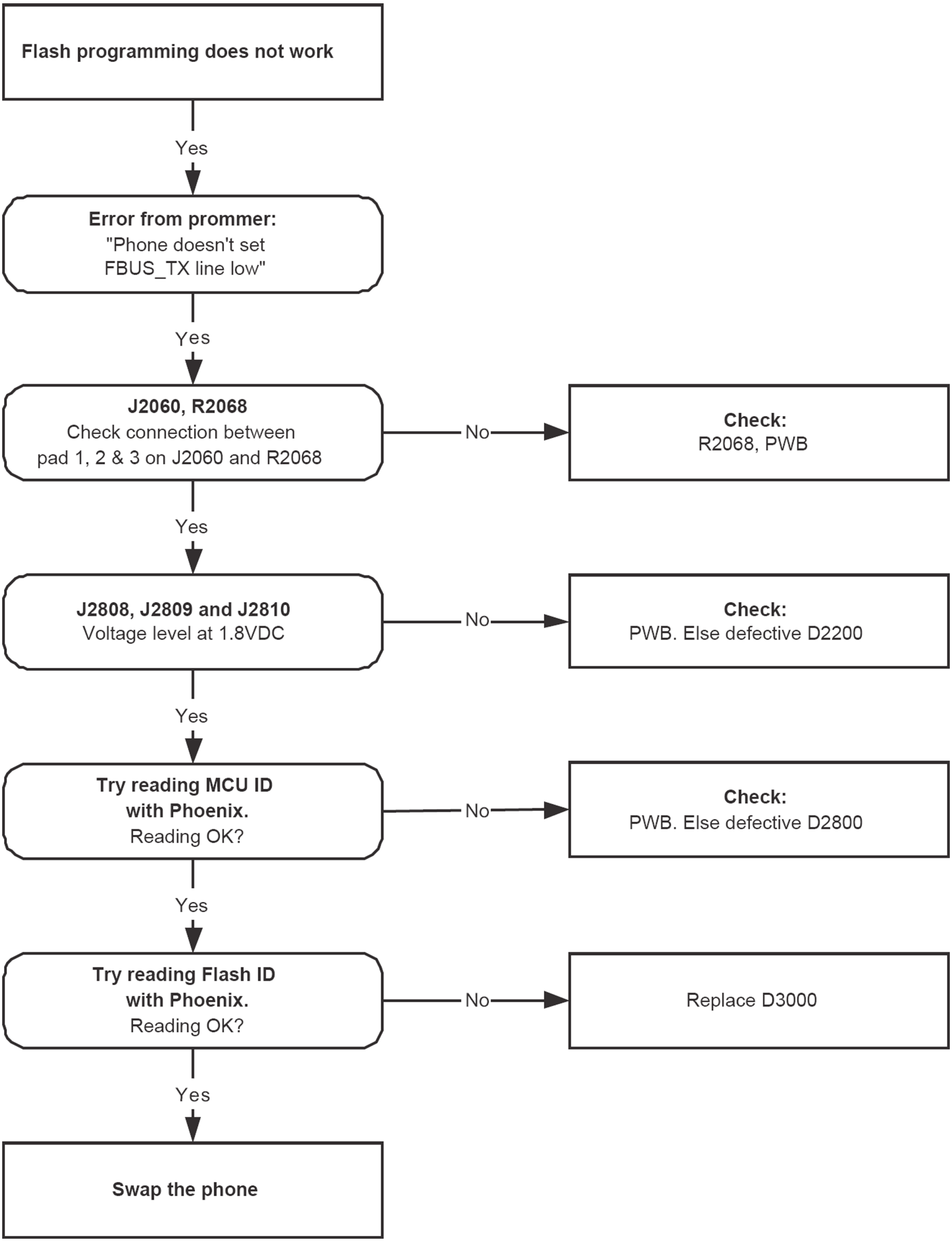


Figure 11 Flash programming fault

Easy flash programming does not work

Context

The flash programming can be done via the easy flash connector. If failed, then follow up the trouble shooting below.

It is not possible to verify if there is a short circuit in control and address lines of MCU (UPP8M) and memory (flash) because BGA package is used in RM-340/341.

Troubleshooting flow

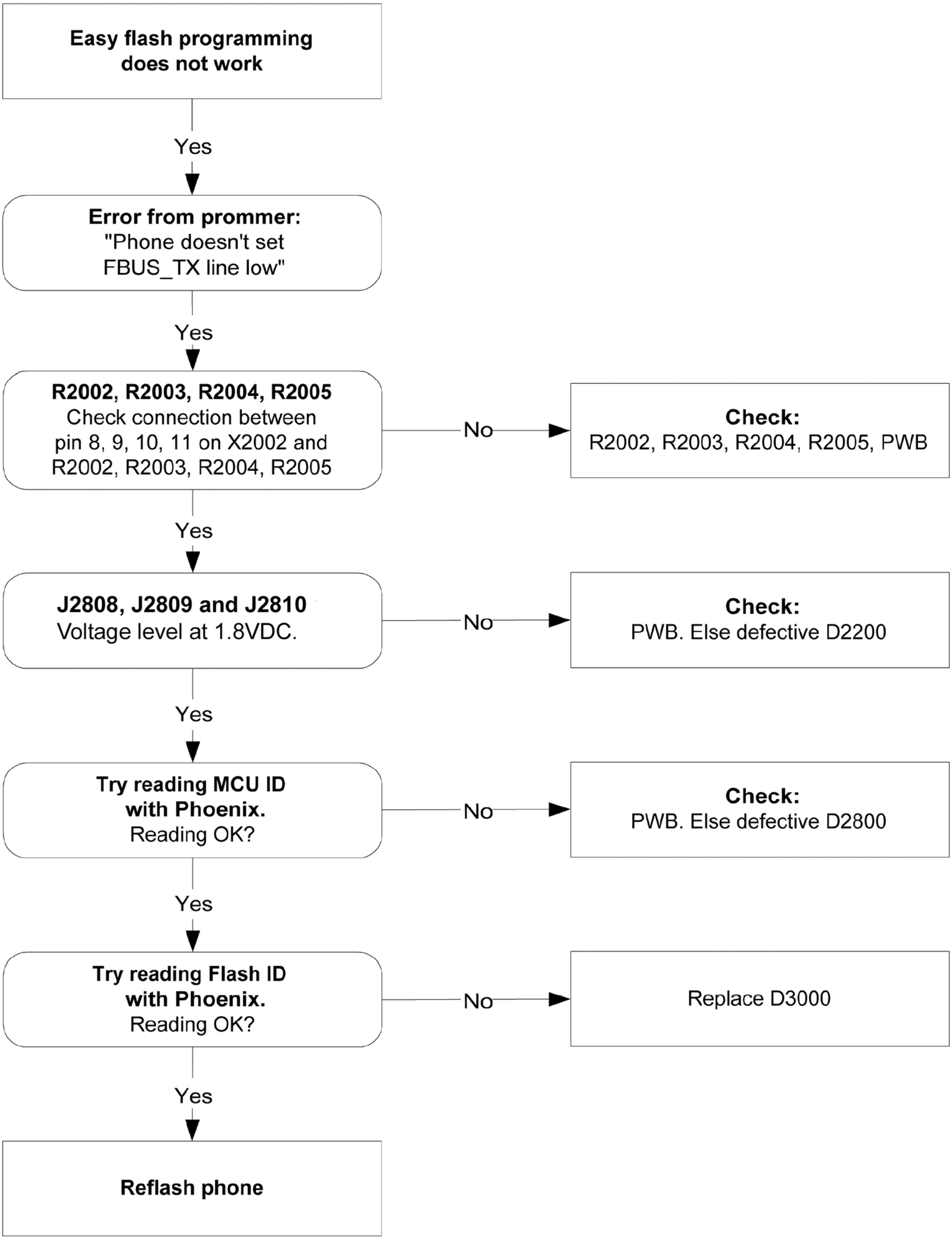


Figure 12 Easy flash programming fault

Display shows "Contact Service"

Troubleshooting flow

This error can only happen at power up where several self-tests are run. If any of these test cases fails the display will show the message: "Contact Service".

They are individual test cases, so the below lineup of error hunting's has no chronological order. Use common sense and experience to decide which test case to start error hunting at.

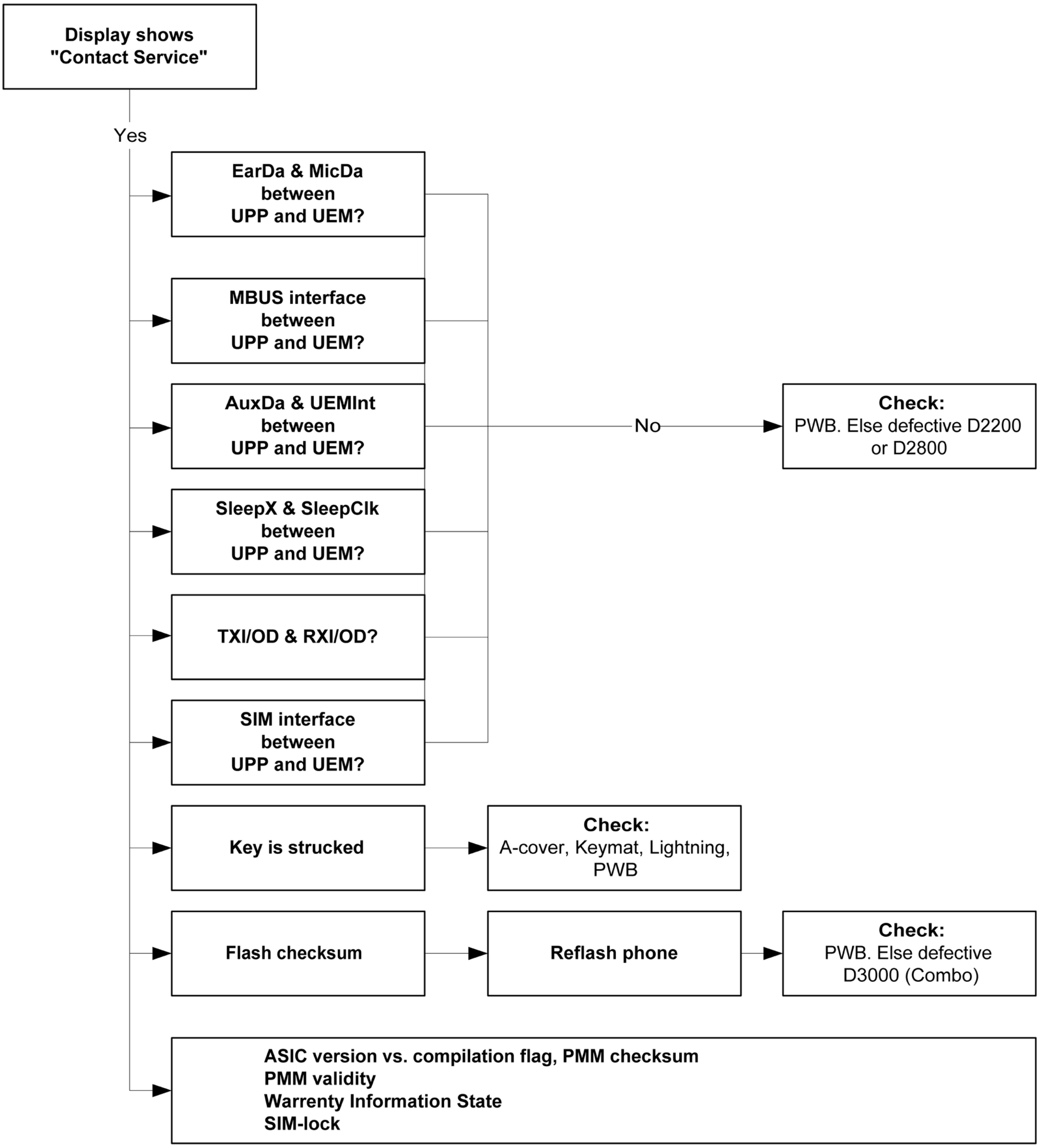


Figure 13 Troubleshooting when the "Contact Service" message is seen

The phone does not register to the networks, or the phone cannot make a call

Context

If the phone doesn't register to the network, the fault can be in either BB or RF. Only few signals can be tested since several signals are 'buried' in one or more of the inner layers of the PWB.

First, check that SIM LOCK is not causing the error by using a Test-SIM card and connect the phone to a tester.

Troubleshooting flow

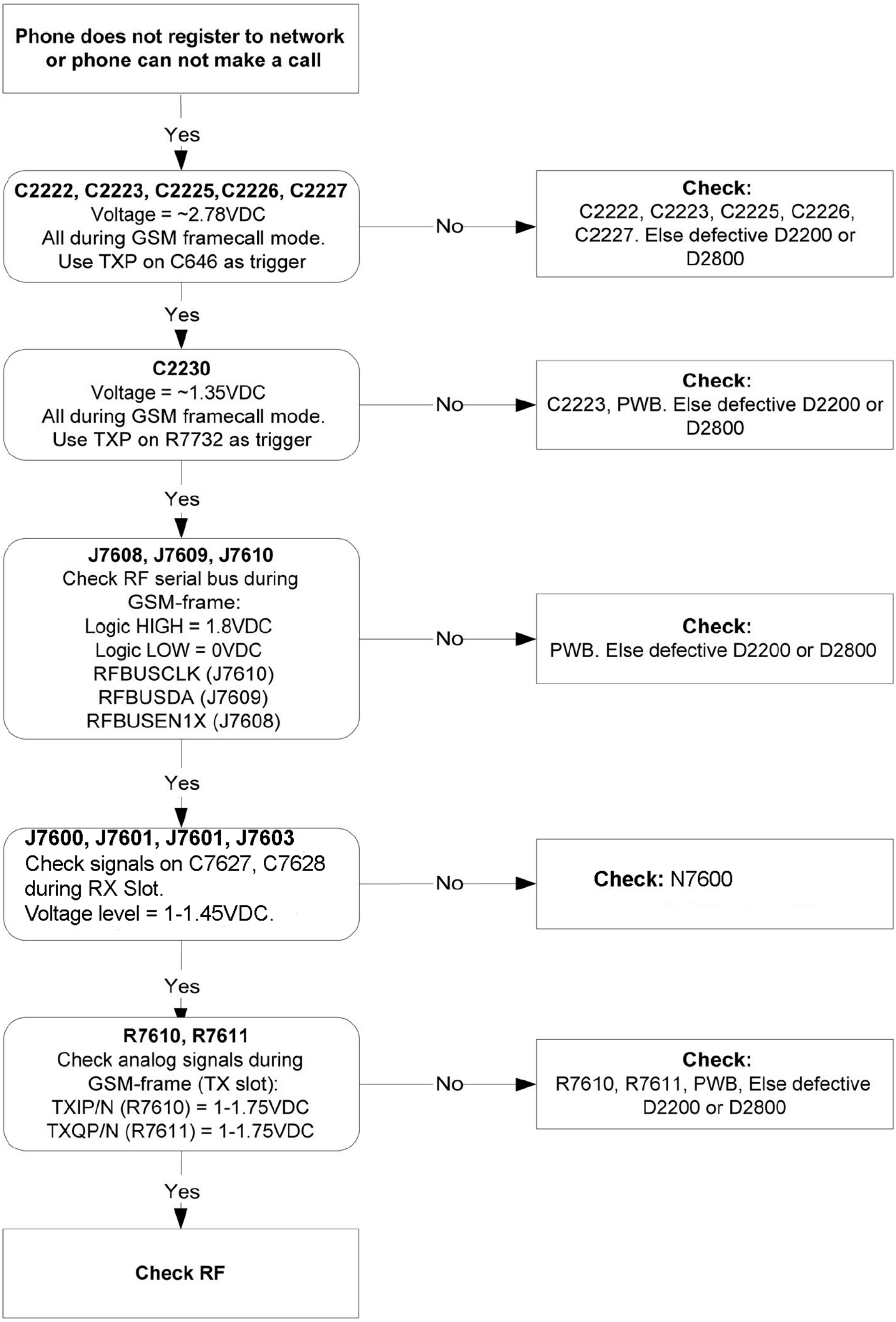


Figure 14 No registering or call

SIM related faults

Insert SIM card fault

Troubleshooting flow

The hardware of the SIM interface from UEMCLite (D2200) to the SIM connector (X2700) can be tested without a SIM card. When the power is switched on the phone first check for a 1.8V SIM card and then a 3V SIM card. The phone will try this four times, where after it will display "Insert SIM card".

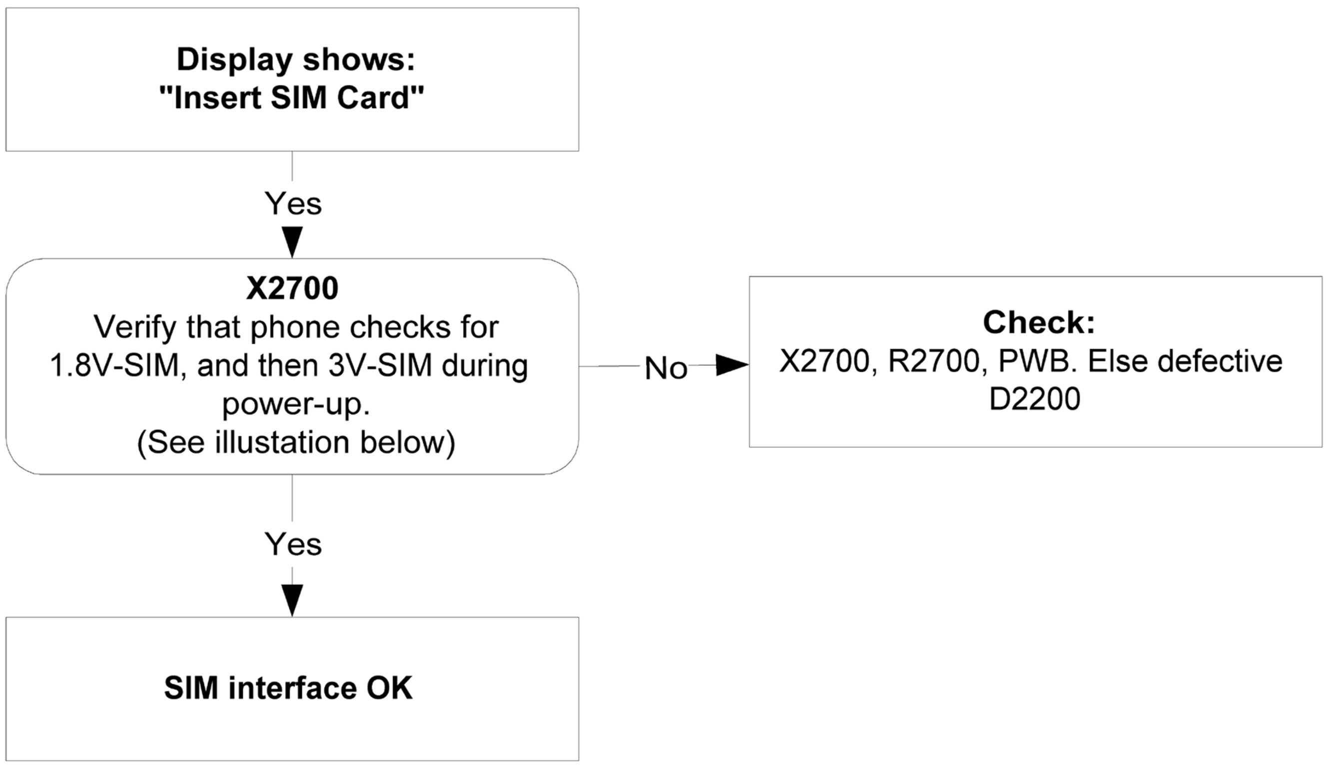


Figure 15 Insert SIM card fault

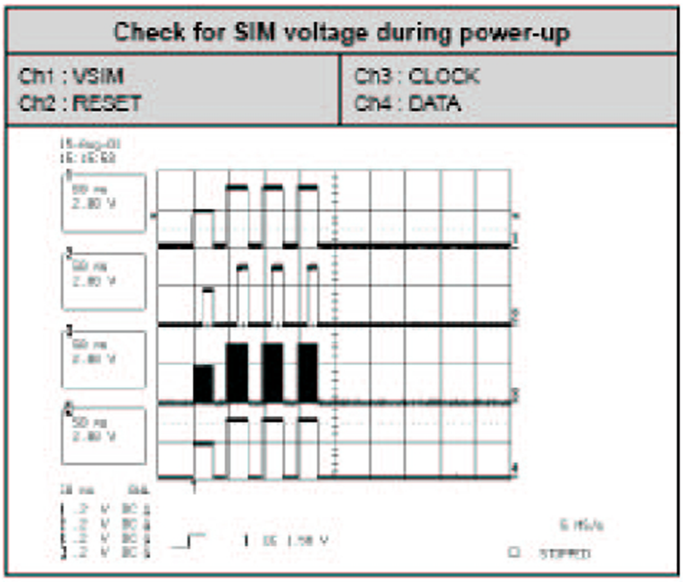


Figure 16 Signal diagram

SIM card rejected

The error ”SIM card rejected” means that the ATR message received from SIM card is corrupted, e.g. data signal levels are wrong. The first data is always ATR and it is sent from card to phone.

For reference a picture with normal SIM power-up is shown below.

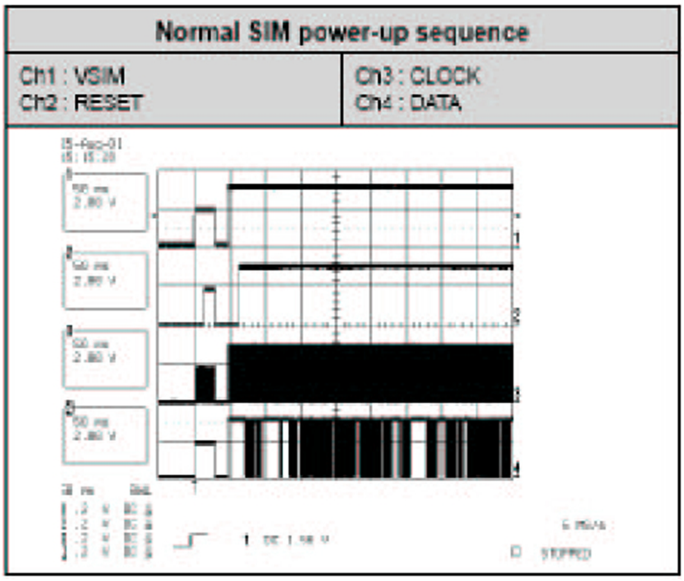


Figure 17 Signal diagram

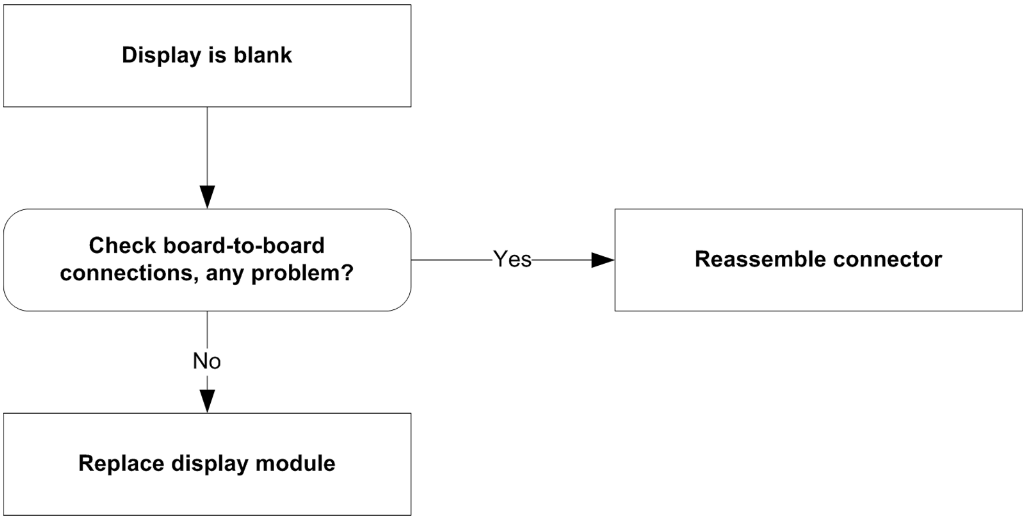
User interface

Blank display

Context

The display does not show any information at all. If there is only main or sub display blank, the problem mostly exists in individual display. Replace related display first. For main and sub display blank, refer to troubleshooting flow below.

Troubleshooting flow

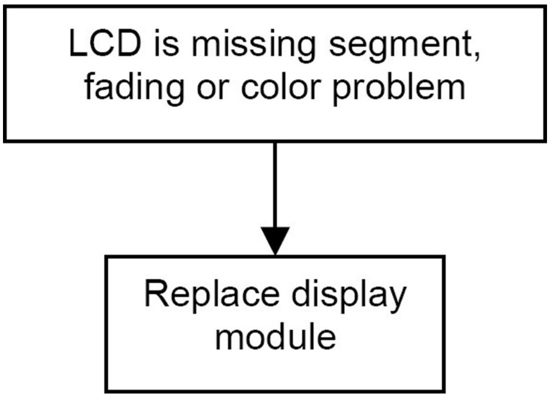


Corrupted display

Context

The display contains missing or fading segments, or color presentation is incorrect.

Troubleshooting flow

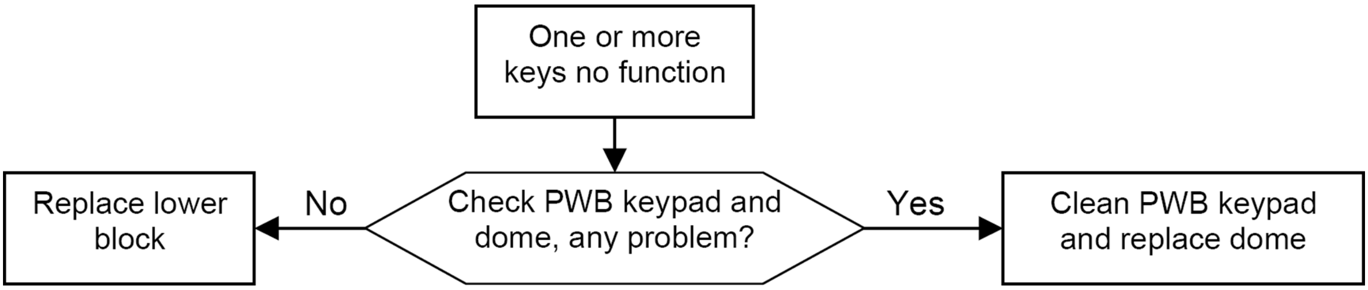


Dead keys

Context

One or more keys has no function.

Troubleshooting flow

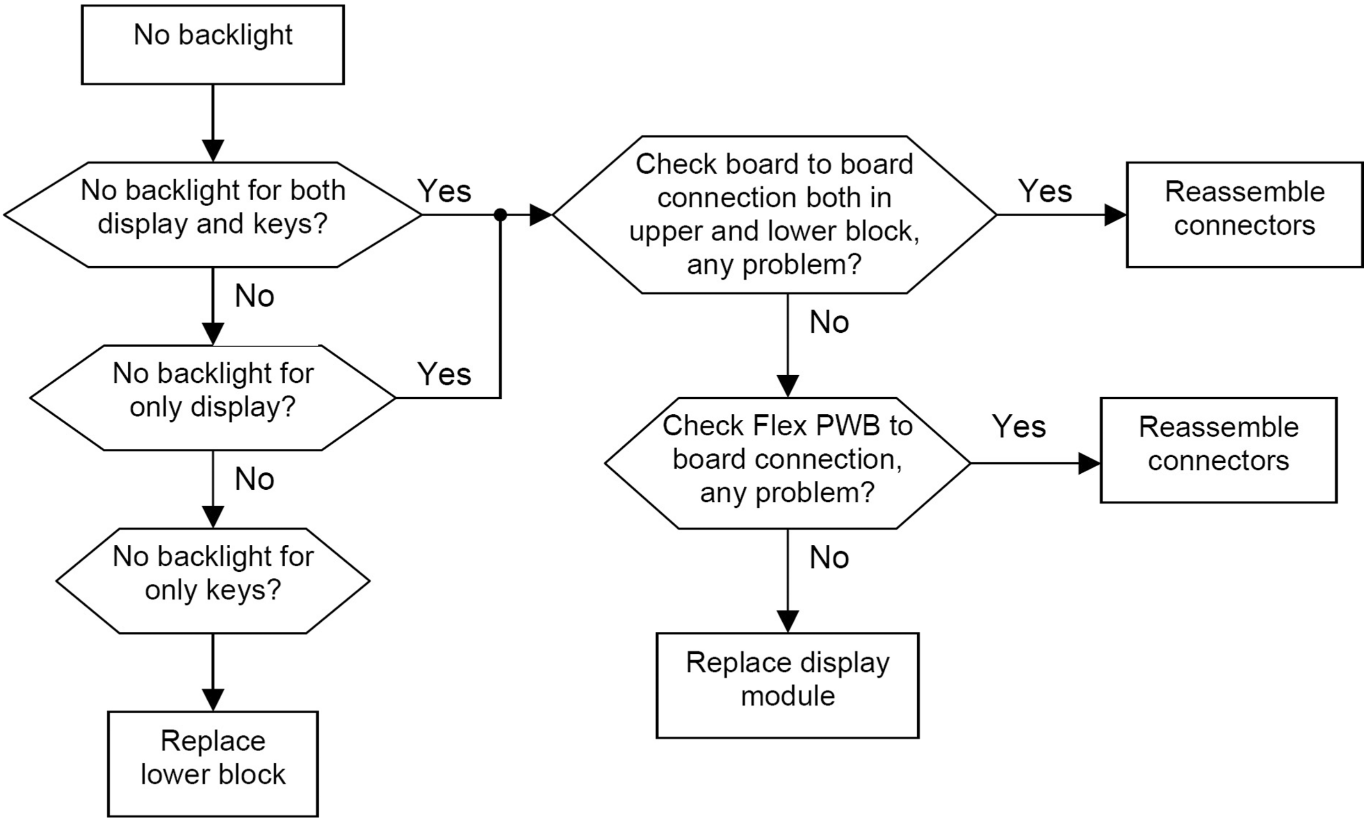


No backlight for display or/and keys

Context

There are 3 kinds of statuses: No backlight for both display and keys; No backlight for only display; No backlight for only keys.

Troubleshooting flow



Audio troubleshooting

Audio troubleshooting using phoenix

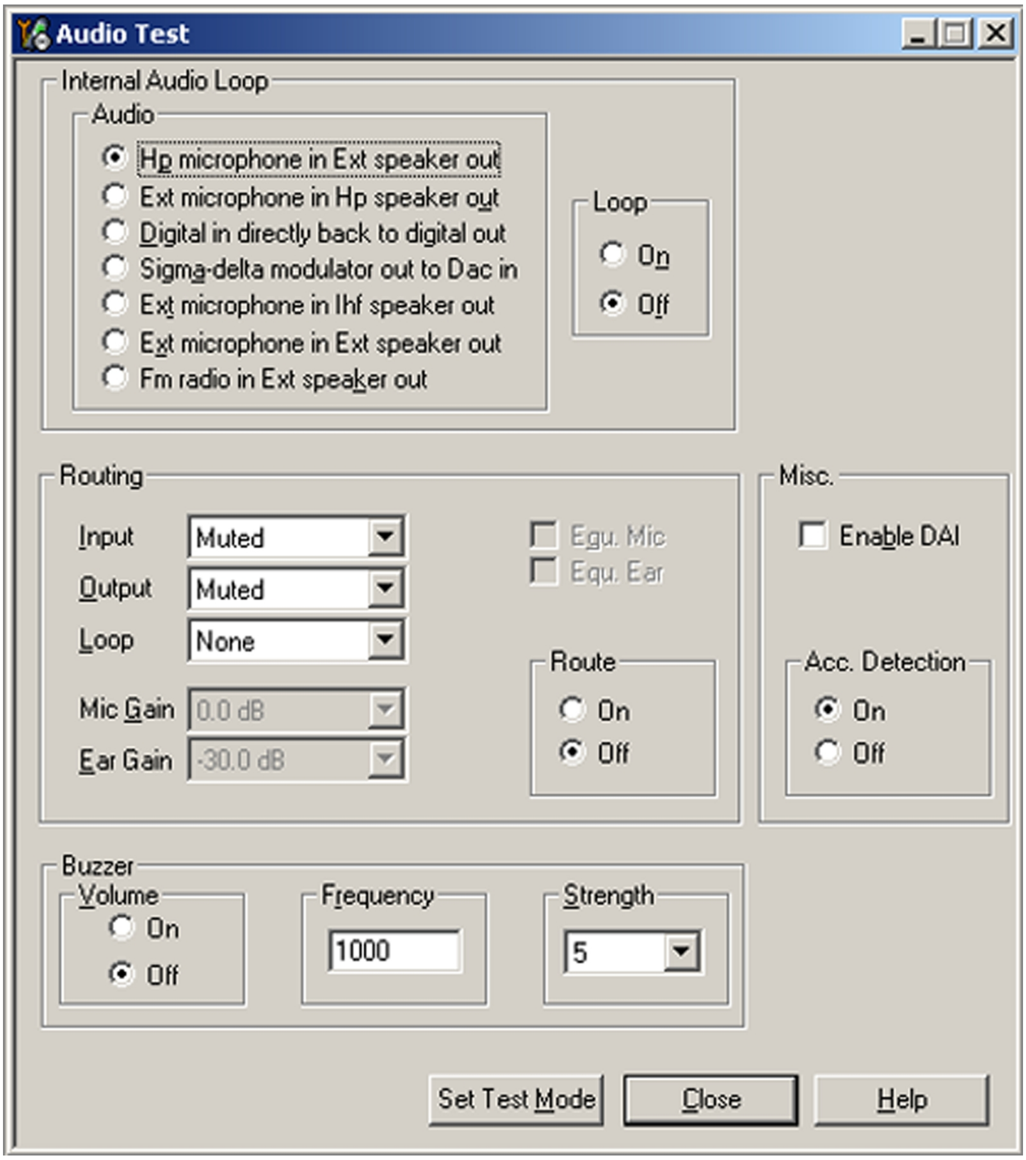


Figure 18 Phoenix audio test window

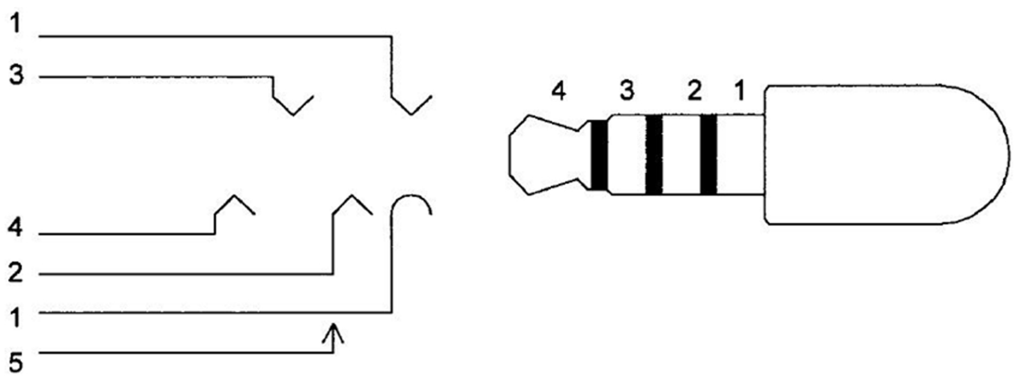


Figure 19 4-pole jack plug for audio accessory

Table 4 Connector for External Audio Accessories

Pin	Signal name	Direction	Description
5	PLUGDET	Input	Terminal internal connection, plug detection
4	HS EAR L	Output	Audio output
3	HS EAR R	Output	Audio output
2	HS MIC	Input	Multiplexed microphone audio and control data
1	HS GND	-	Ground contact

Check microphone using "Hp microphone in Ext speaker out" loop

Steps

1. Connect phone with Phoenix.
2. Open “audio test” window from “Testing -> Audio test”, as shown in *Figure Phoenix audio test window* above.
3. Select “Hp microphone in Ext speaker out”
4. Select "Acc. Detection" as "Off".
5. Select “Loop” as “On”
6. Input sound at microphone port, for example 94dB SPL 1kHz.

7. Check if signal is detected at HS EAR L/R, shown in *Figure 4-pole jack plug for audio accessory* above.

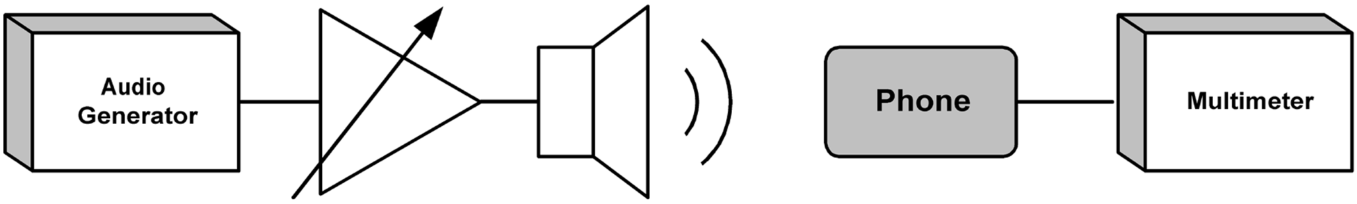


Figure 20 Test arrangement for microphone

Check earpiece using "Ext microphone in Hp speaker out" loop

Steps

1. Connect phone with Phoenix.
2. Open the *Audio Test* window from **Testing**→ **Audio test** , as shown in Figure *Phoenix audio test window* above.
3. Select **Ext microphone in Hp speaker out**.
4. Select **Acc.Detection** as **Off**.
5. Select **Loop** as **On**.
6. Input signal to HS MIC, as shown in Figure *4-pole jack plug for audio accessory* above, for example 100mVpp, 1kHz.
7. Check if sound is heard in the earpiece.

Figure 21 Test arrangement for of earpiece

Check IHF & ringing tone function using "Buzzer"

Steps

1. Connect phone with Phoenix.
2. Open “audio test” window from “Testing -> Audio test”, as shown in *Figure Phoenix audio test window* above.
3. In “Buzzer” area, select suitable signal to be played, for example 1 kHz, Strength 5”
4. Select “Volume” as “On”

5. Check if sound is heard in IHF.

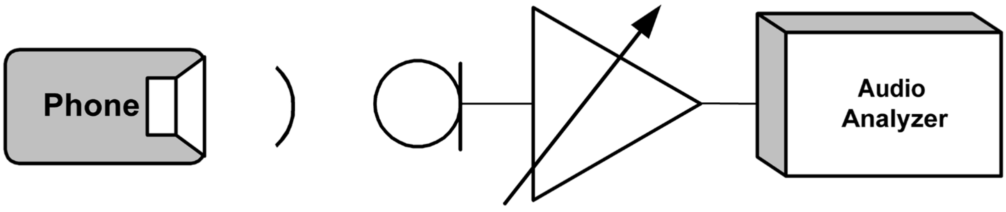


Figure 22 Checking IHF and ring tone by using "Buzzer"

Check vibra function using "Vibra control"

Steps

1. Connect phone with Phoenix.
2. Open “Vibra control” window from “Testing -> Vibra control”, as shown in the figure below.
3. Select suitable intensity value, for example 53 %.
4. Select “Vibra state” as “Enabled”
5. Click “Write”.
6. Check if Vibra works.

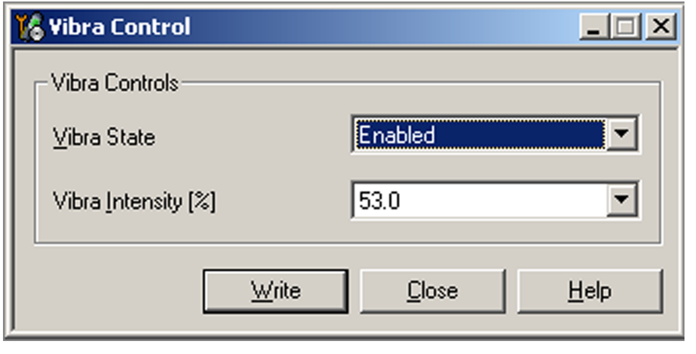


Figure 23 Checking vibra function by using vibra control

Earpiece fault

Troubleshooting flow

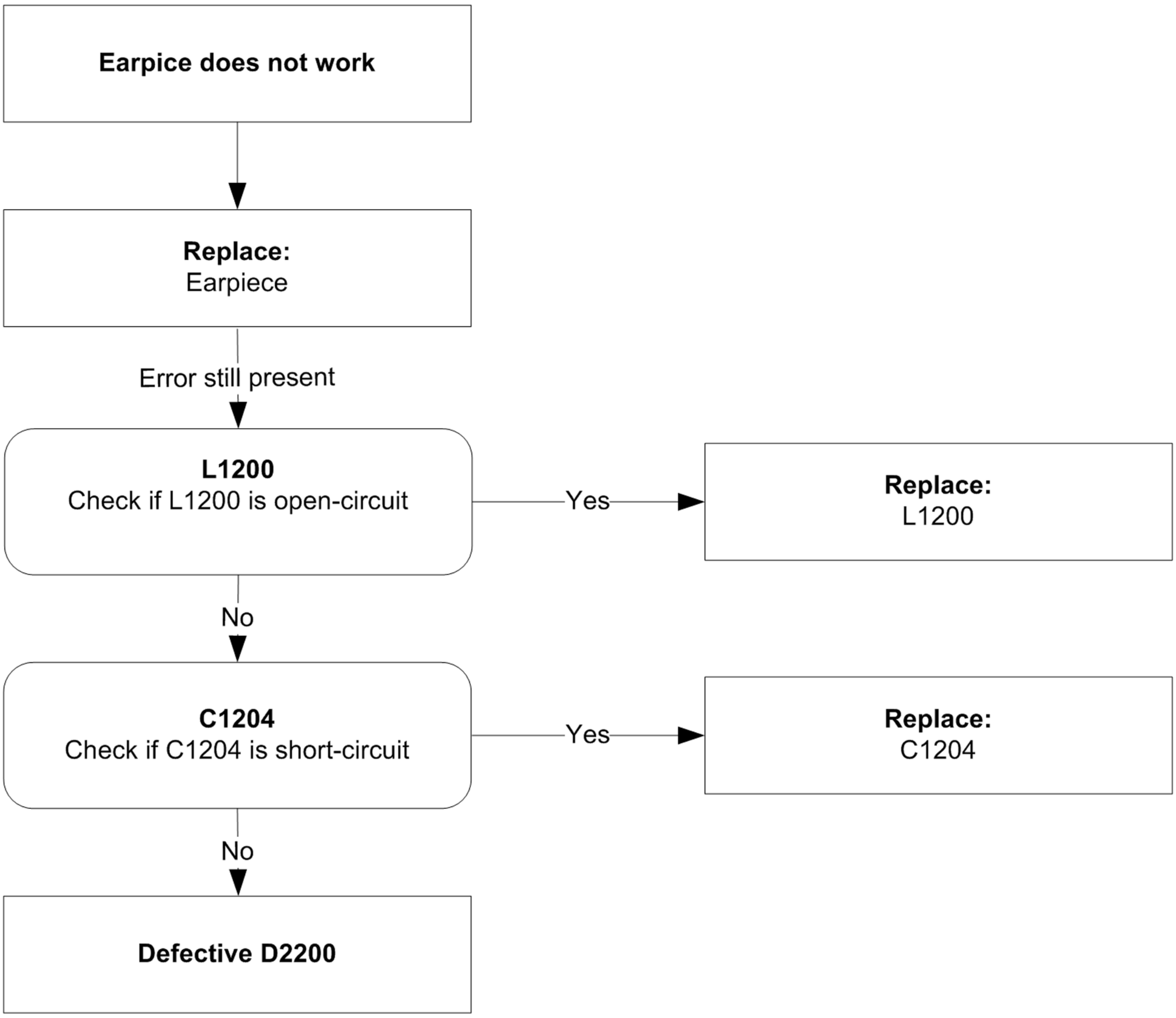


Figure 24 Earpiece fault flow chart

IHF/ringing tone fault

Troubleshooting flow

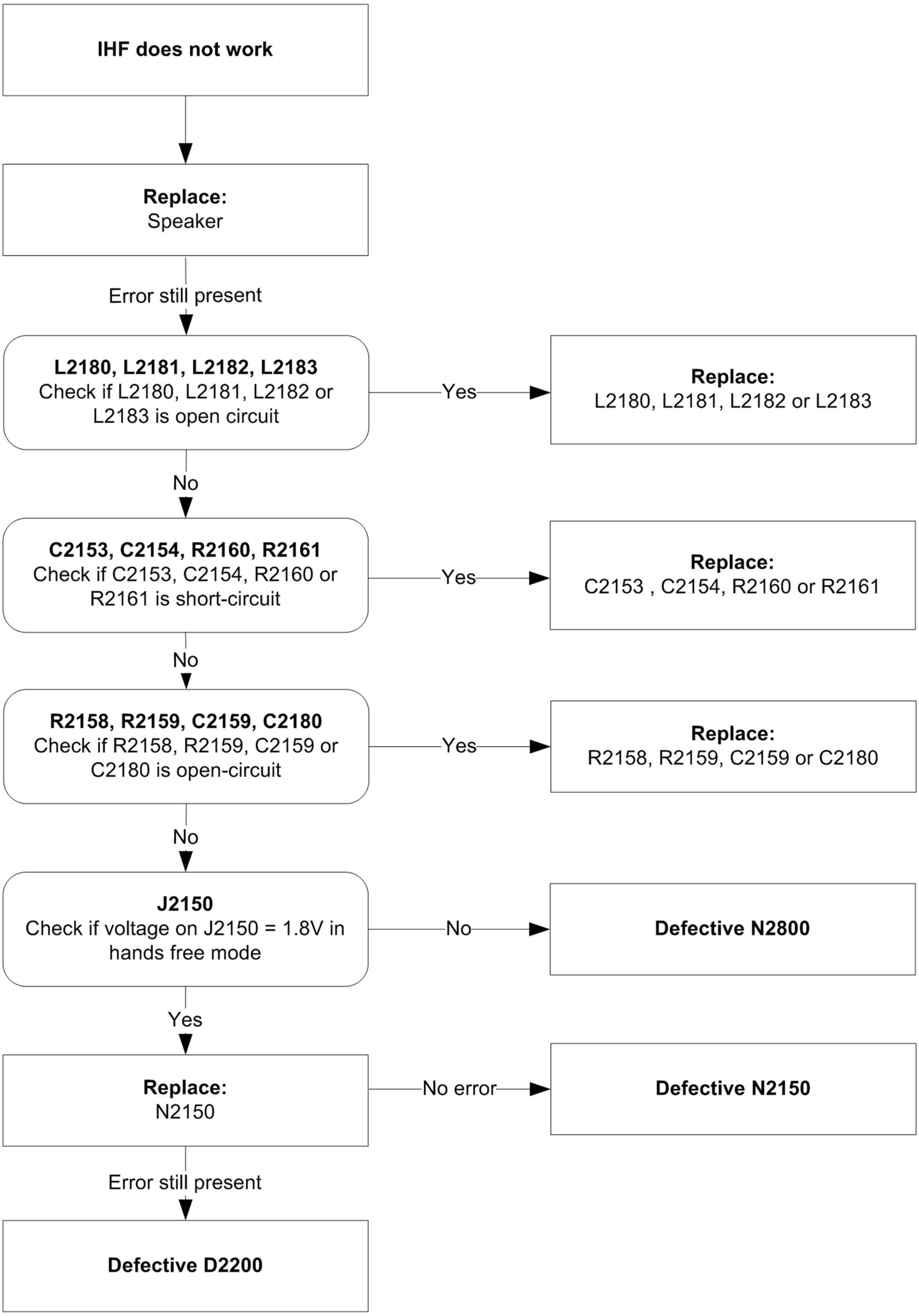


Figure 25 IHF/ringing tone fault flow chart

Microphone fault

Troubleshooting flow

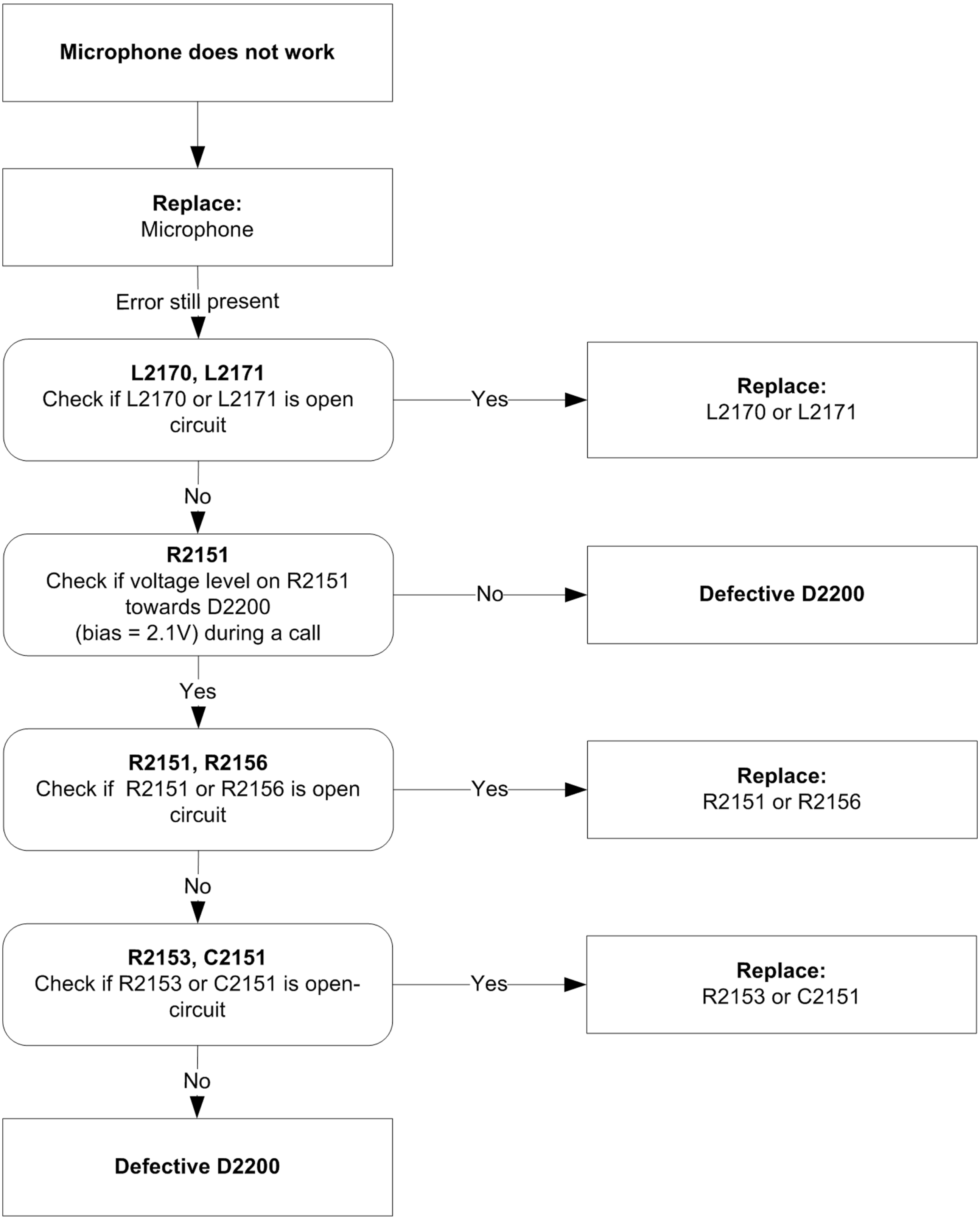


Figure 26 Microphone fault flow chart

Headset earpiece fault

Troubleshooting flow

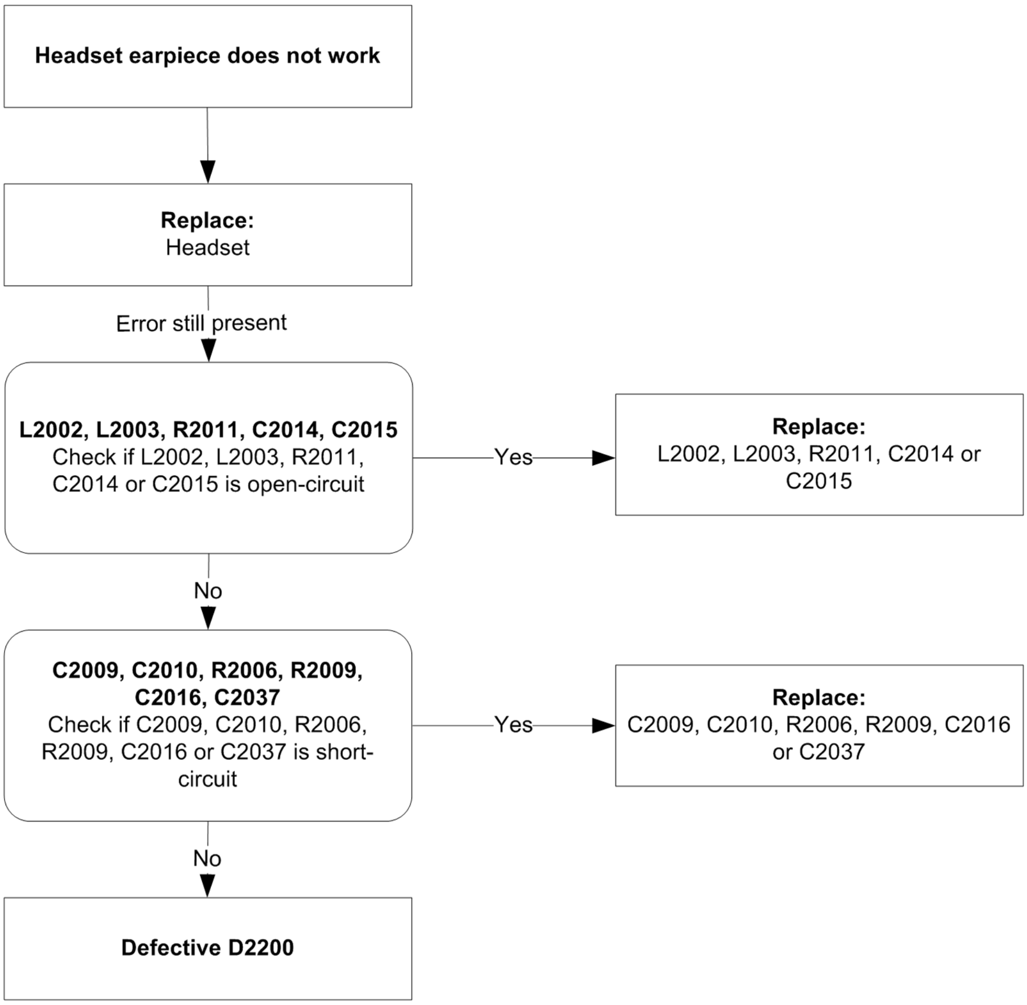


Figure 27 Headset earpiece fault flow chart

Headset microphone fault

Troubleshooting flow

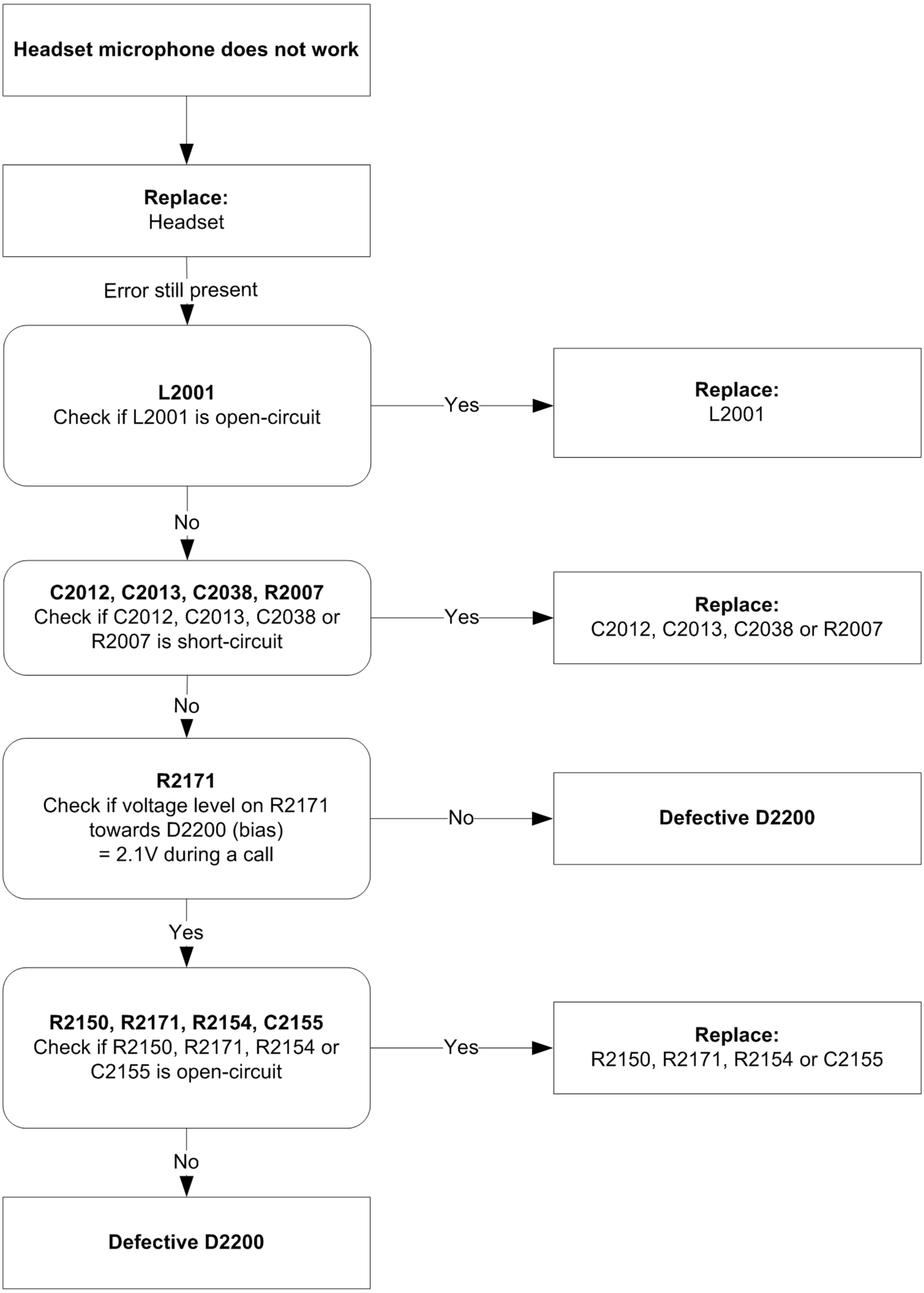


Figure 28 Headset microphone fault flow chart

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4 — RF Troubleshooting Instructions

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Table of Contents

List of Figures

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General RF troubleshooting

General RF troubleshooting

Most RF semiconductors are static discharge sensitive

Two types of measurements are used in the following. It will be specified if the measurement type is "RF" or "LF".

- RF measurements are done with a Spectrum Analyzer and a high-frequency 500 ohm passive probe, for example HP54006A. (Note that when measuring with the 500ohm probe the signal will be around 20dB attenuated. The values in the following will have these 20dB subtracted and represent the real value seen on the spectrum analyzer). Note that the testing have some losses which must be taken into consideration when calibrating the test system.
- LF (Low frequency) and DC measurements should be done with a 10:1 probe and an oscilloscope. The probe used in the following is 10Mohm/8pF passive probe. If using another probe then bear in mind that the voltages displayed may be slightly different. Always make sure the measurement set-up is calibrated when measuring RF parameters on the antenna pad. Remember to include the loss in the module repair jig when realigning the phone.

So ESD protection must be applied during repair (ground straps and ESD soldering irons). Mjoelner and Bifrost are moisture sensitive so parts must be pre-baked prior to soldering. Apart from key-components described in this document there are a lot of discrete components (resistors, inductors and capacitors) for which troubleshooting is done by checking if soldering of the component is done properly and checking if the component is missing from PWB. Capacitors can be checked for short-circuiting and resistors for value by means of an ohmmeter, but be aware in-circuit measurements should be evaluated carefully. In the following both the name EGSM and GSM850 will be used for the lower band and both PCN and GSM1900 will be used for the upper band.

RF key components

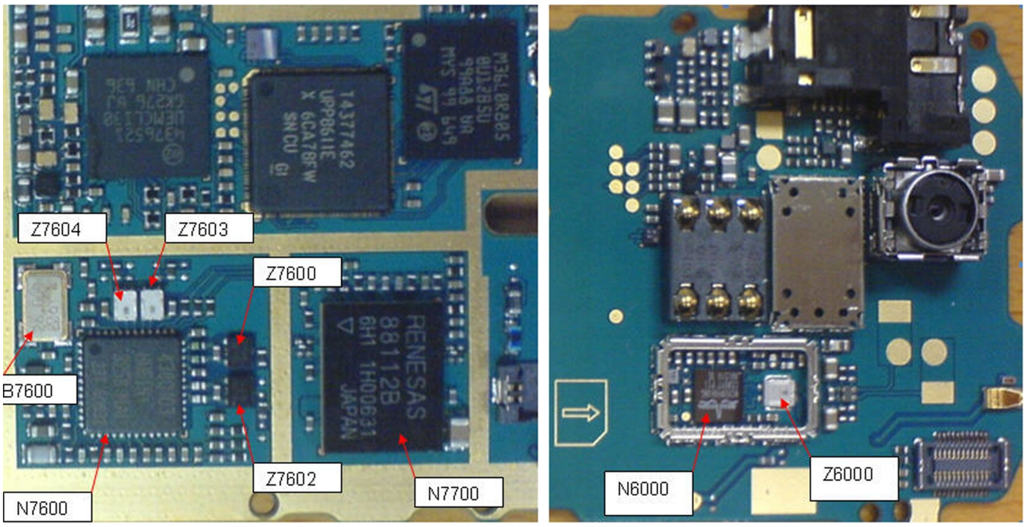


Figure 29 RF key components on PWB

N7600	PMB3258 RF IC
N7700	FEM (PA and antenna switch)
Z7602	EGSM 850/900 RX SAW filter
Z7600	DCS 1800/PCS1900 RX SAW filter

Z7603	EGSM 850/900 TX filter
Z7604	DCS 1800/PCS1900 TX filter
B7600	26 MHz crystal
N6000	BT & FM IC
Z6000	BT SAW filter

Refer to the picture below for measuring points at the UEM (D2200).

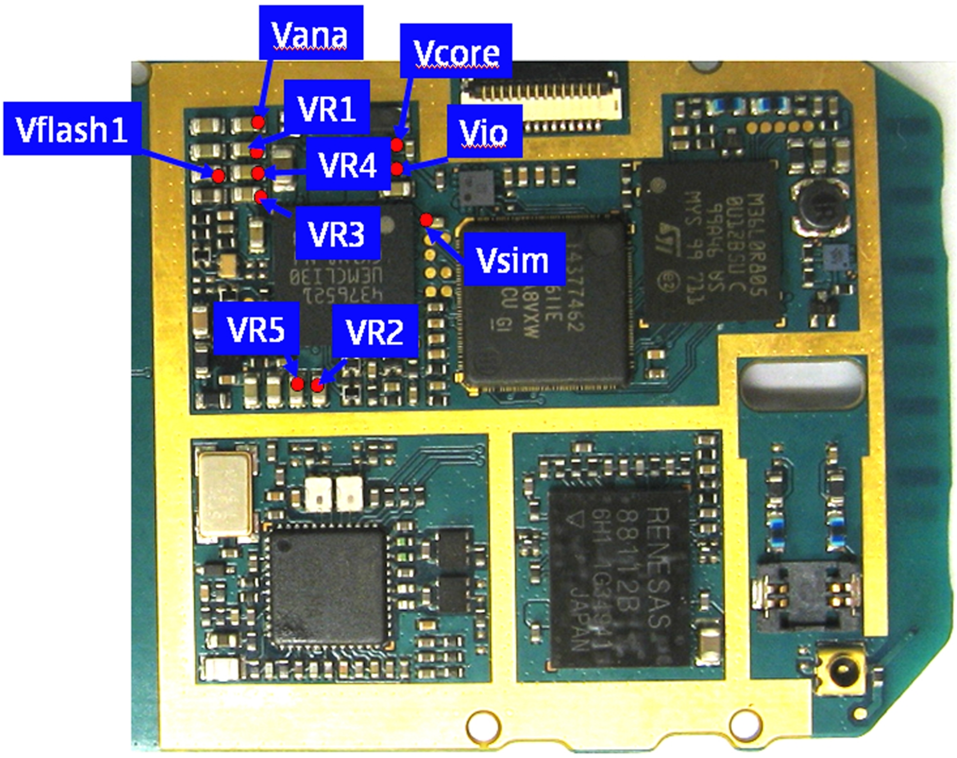


Figure 30 Supply points at UEM (D2200)

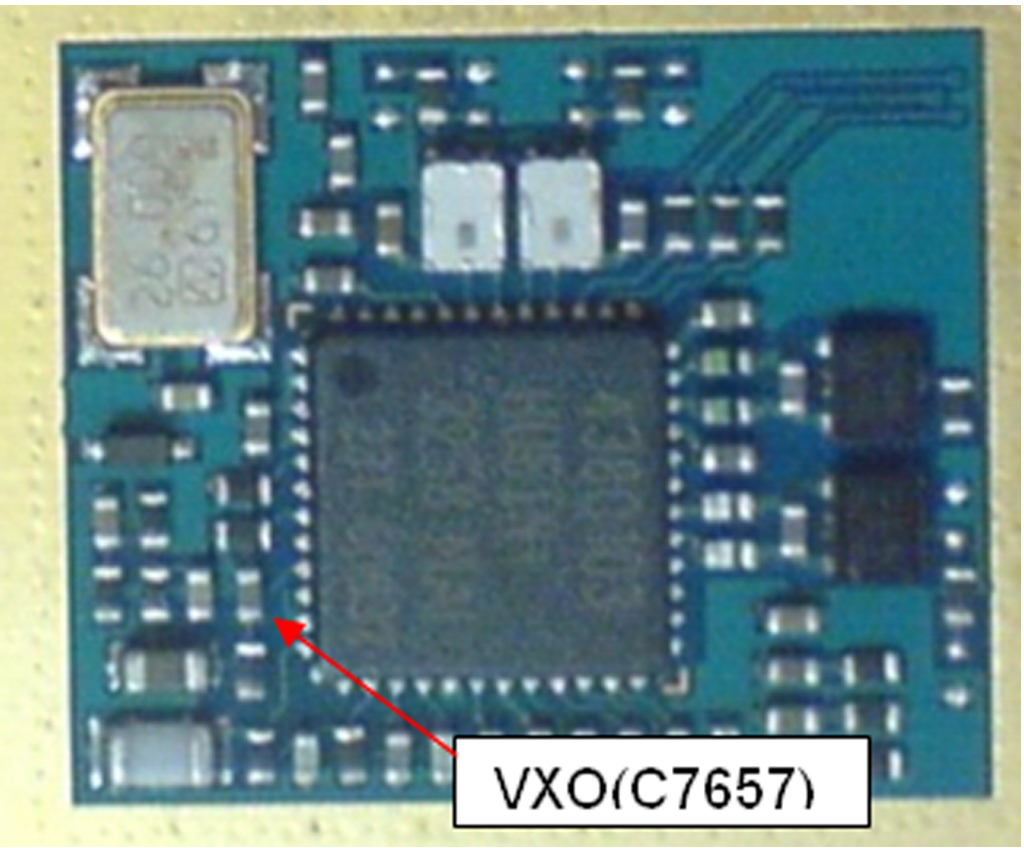


Figure 31 Supply point at RF IC (N7600)

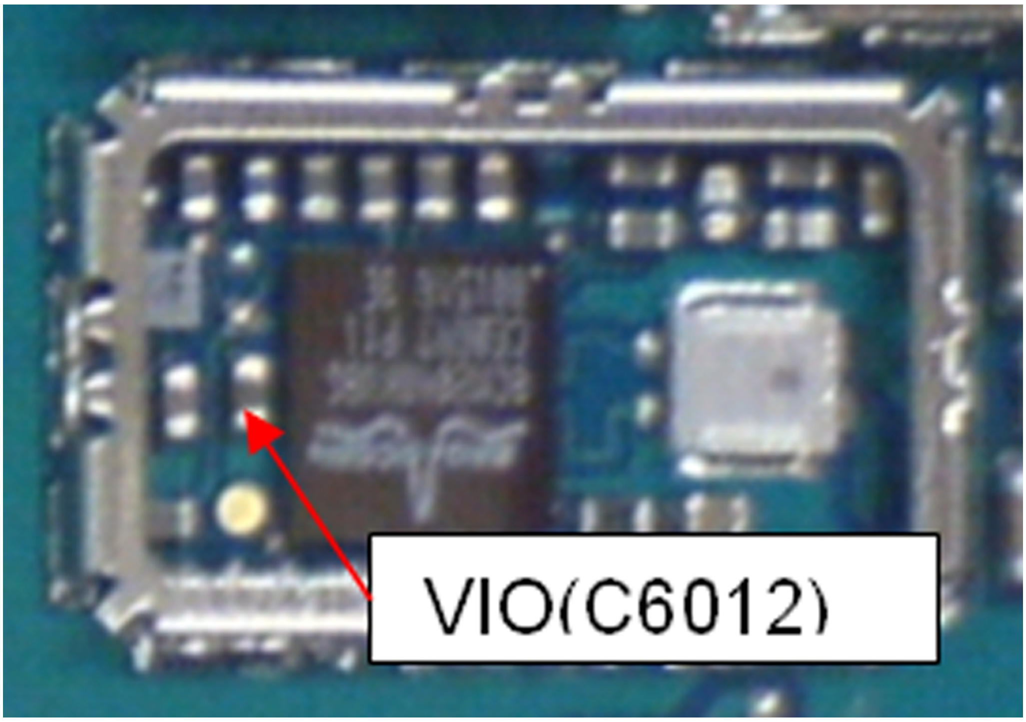


Figure 32 Supply point at BT & FM IC (N6000)

Auto tuning

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/NT) with GPIB card
- Power supply
- Product specific module jig
- Cables: 3 (alt.1) RF cable, 1 GPIB cable and DAU-9S
- Signal analyser (TX), signal generator (RX) and RF-splitter *or* one device including all.

Phoenix preparations

Copy the two phone specific ini-files, for example *rm_13_tunings.ini* and *autotune_RM-13.ini,* to a phone specific folder, for example *|Phoenix|products|RM-13|*.

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 The first time you are using automatic tuning on this phone model, on this computer, you will have to *Set loss* for cables and jigs.

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

4 If you need more assistance, please refer to the Phoenix *Help*.

RM-340 receiver

General instructions for GSM900 RX troubleshooting

Steps

1. Connect the phone to a PC with the module repair jig.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Active Unit: RX
   - ii Band: GSM 900
   - iii Operation Mode: Continuous mode
   - iv RX/TX Channel 37
   - v AGC: 8: FEG_ON + DTOS_ON+BB_6=Vgain_36

Results

The setup should now look like this:

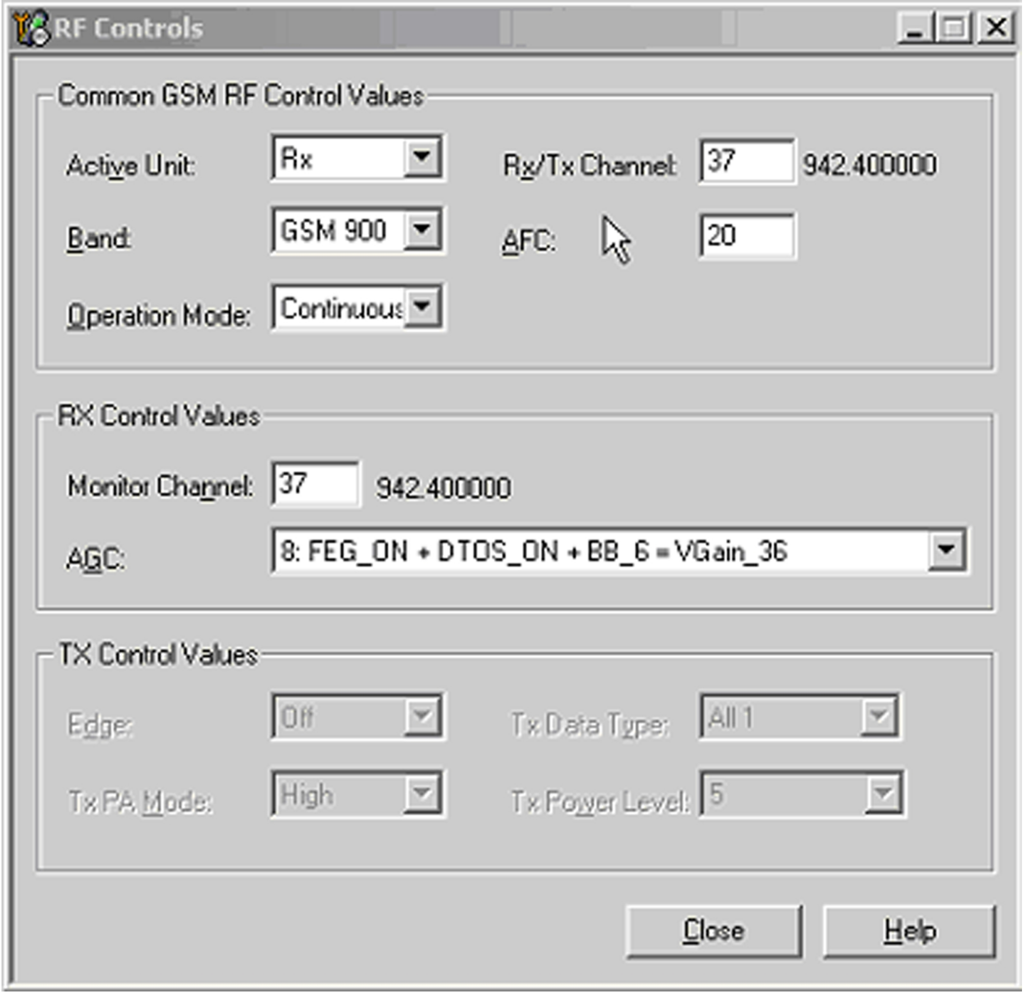


Figure 33 GSM900 RF controls window

Troubleshooting diagram for GSM900 receiver

Troubleshooting flow

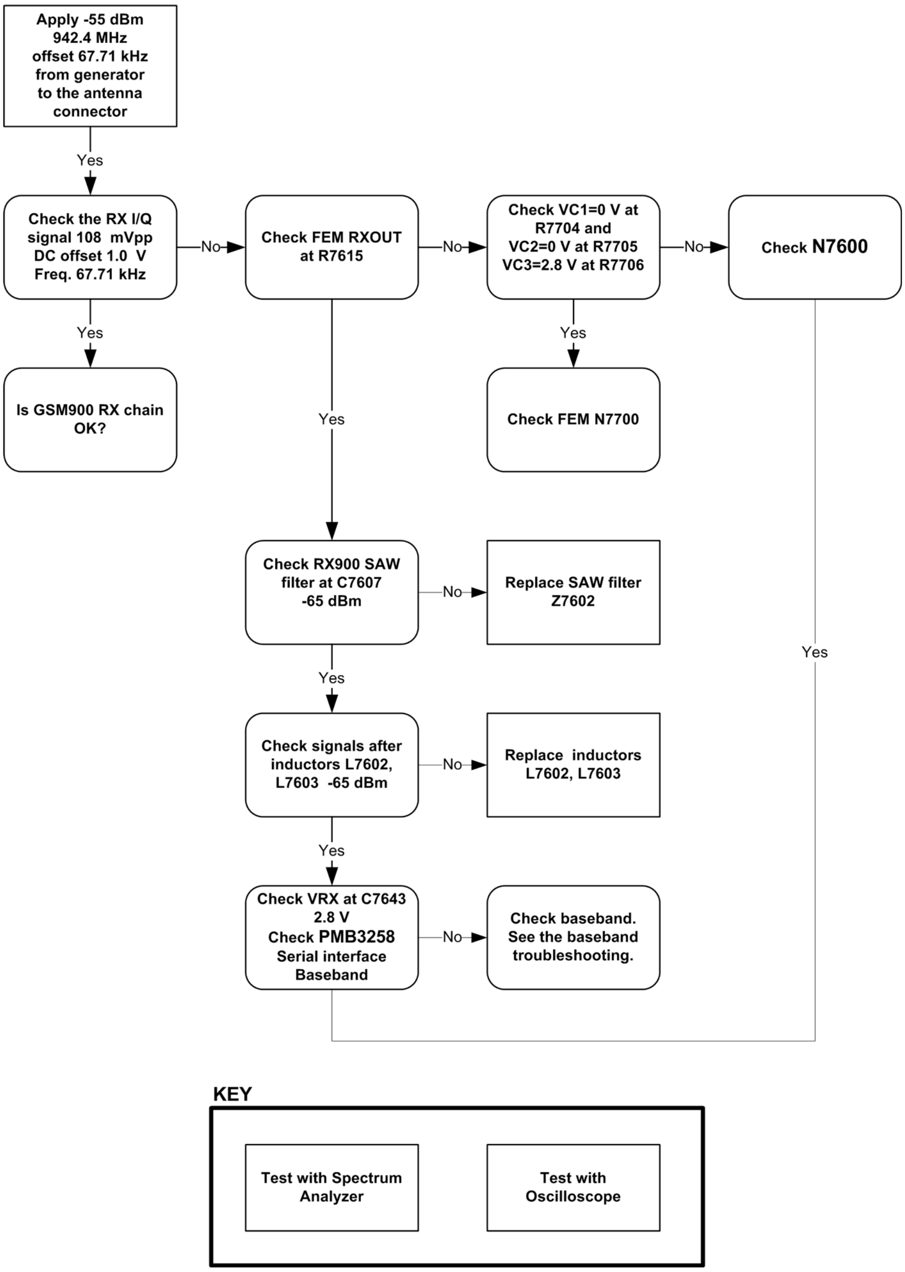


Figure 34 GSM900 receiver troubleshooting

Results

By measuring with an oscilloscope at RXIP or RXQP on a working GSM900 receiver this picture should be seen. Signal amplitude peak-peak 108mV. DC offset 1.0V.

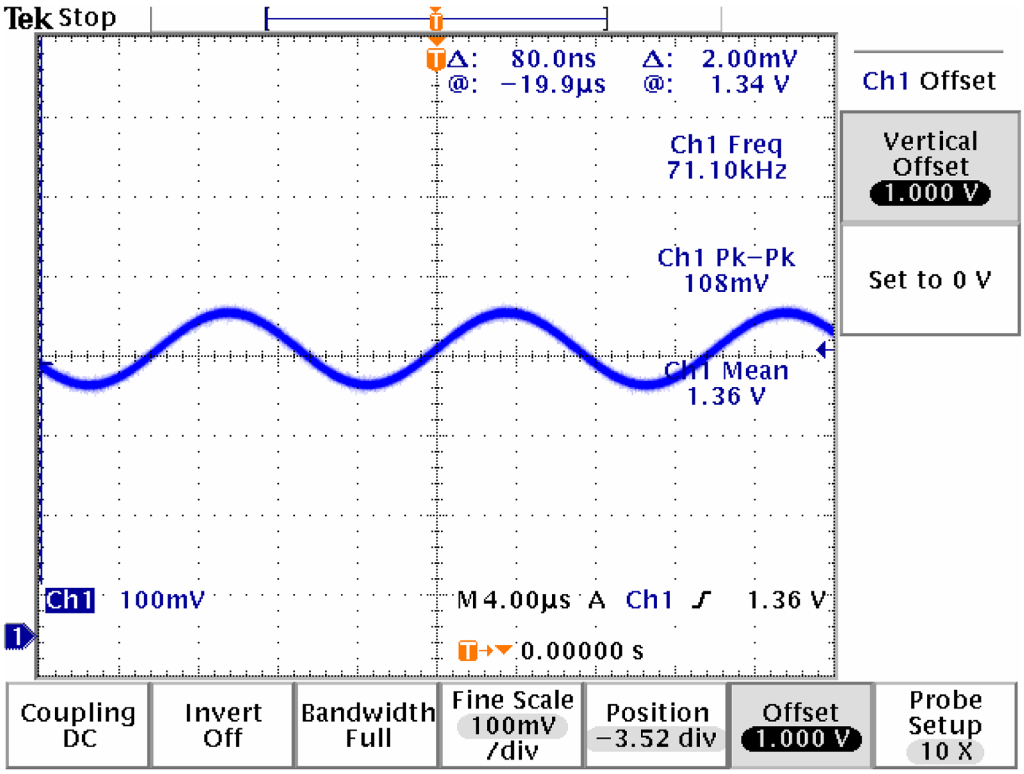


Figure 35 900 RX I/Q signal waveform

General instructions for GSM 1800 RX troubleshooting

Steps

1. Connect the phone to a PC with the module repair jig.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Active Unit: RX
   - ii Band: GSM 1800
   - iii Operation Mode: Continuous mode
   - iv RX/TX Channel 700
   - v AGC: 8: FEG_ON + DTOS_ON+BB_6=Vgain_36

Results

The setup should now look like this:

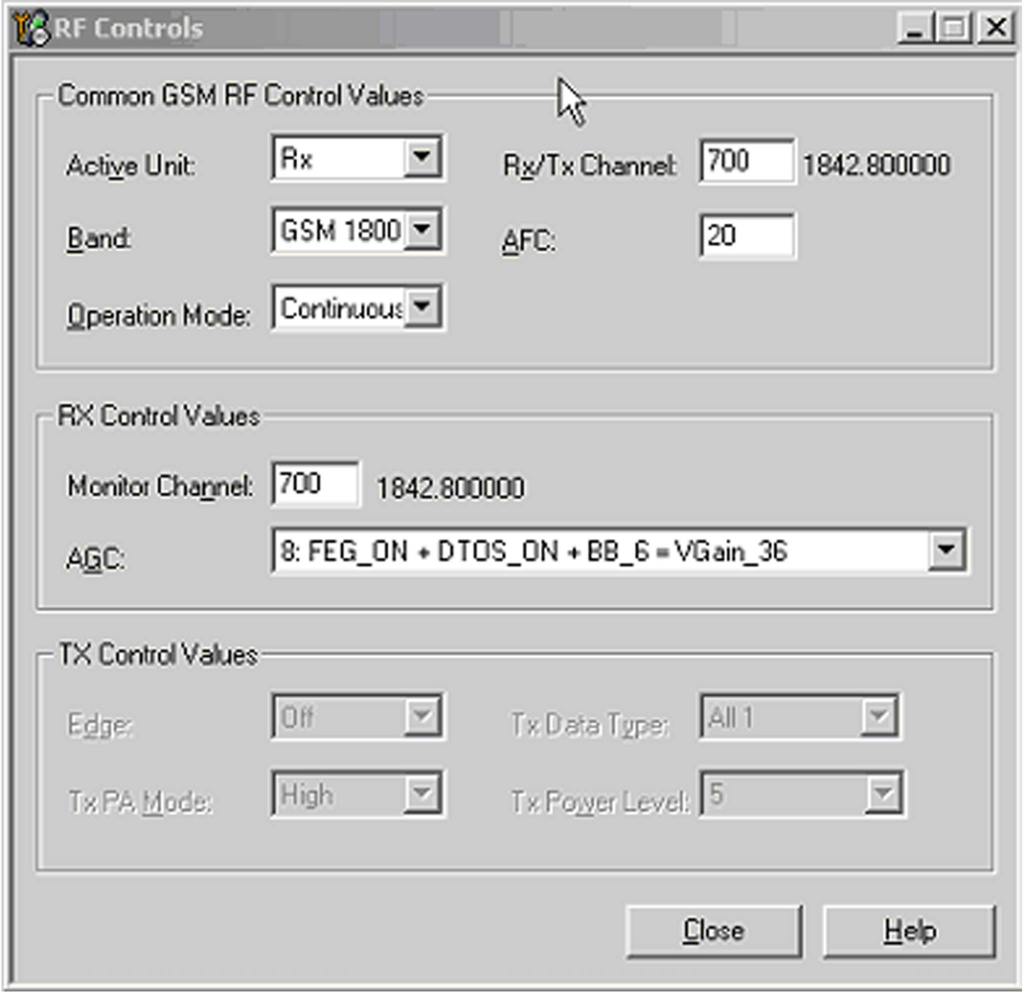


Figure 36 GSM1800 RF controls window

Troubleshooting diagram for GSM1800 receiver

Troubleshooting flow

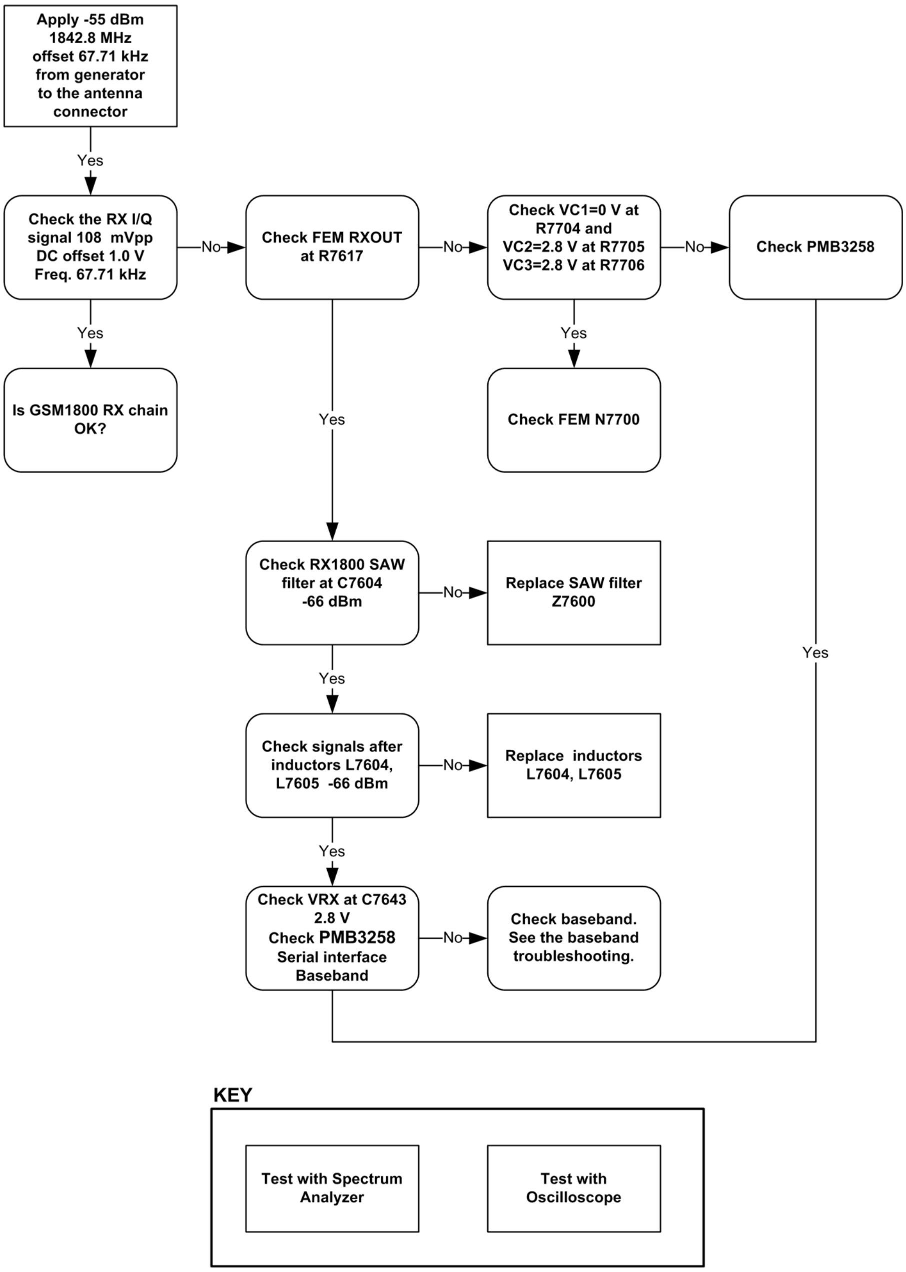


Figure 37 GSM1800 receiver troubleshooting

Results

By measuring with an oscilloscope at RXIP or RXQP on a working GSM1800 receiver this picture should be seen. Signal amplitude peak-peak 114mV. DC offset 1.0V.

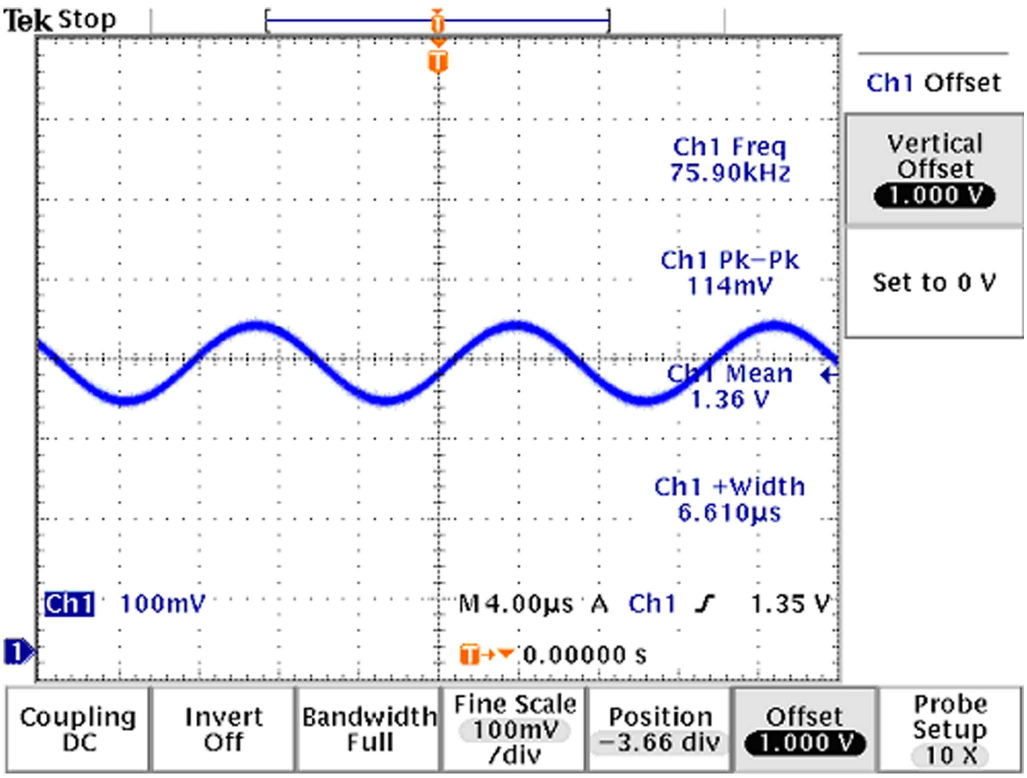


Figure 38 1800 RX I/Q signal waveform

Measurement points in the receiver

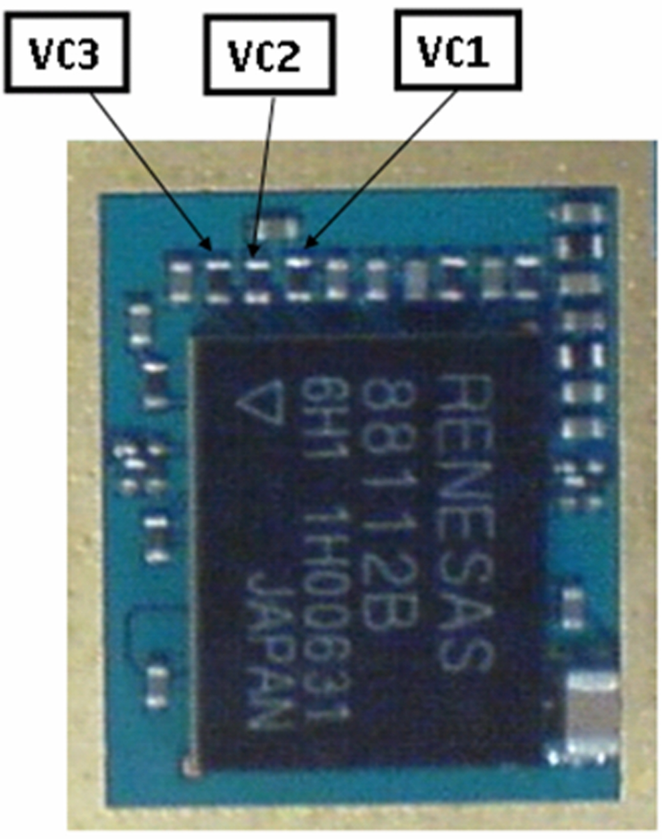


Figure 39 RX measurements point of the control voltages to FEM N7700

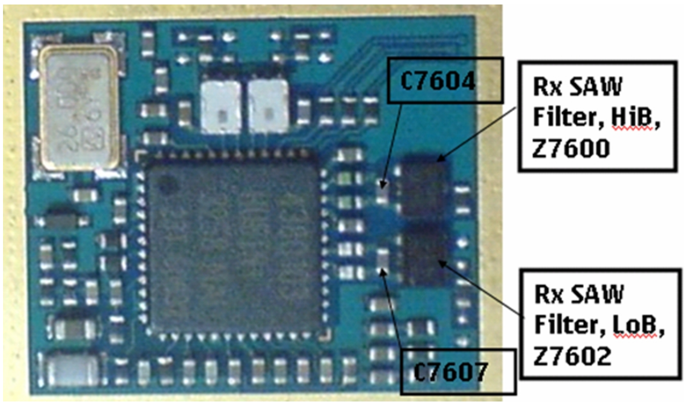


Figure 40 Measurement points at the RX SAW Filters – Z7600/Z7602

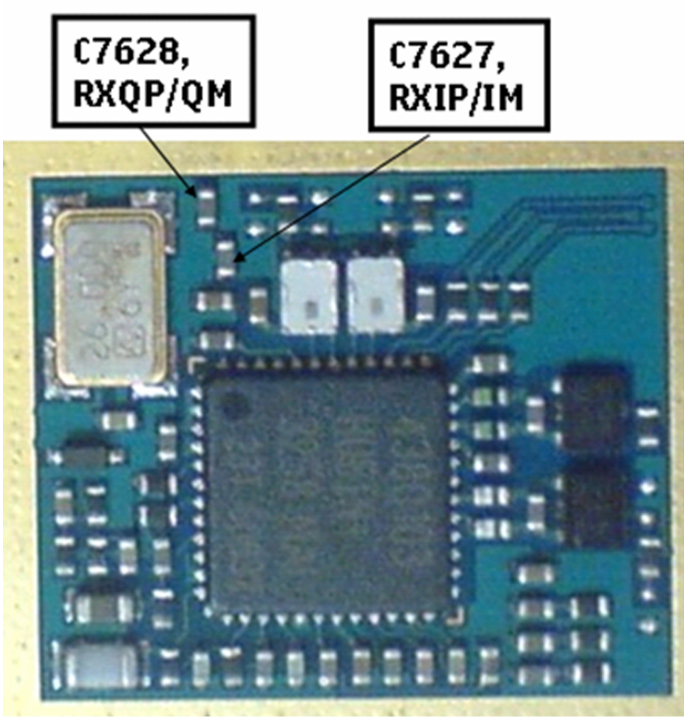


Figure 41 RX I/Q signals

RM-340 transmitter

General instructions for GSM 900 TX troubleshooting

Steps

1. Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to an attenuator at least 10dB before connected to the measurement equipment, otherwise the PA may be damaged.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Band: GSM 900

ii Active Unit: TX

iii TX Power Level: 5

iv TX Data Type: Random

Results

The setup should now look like this:

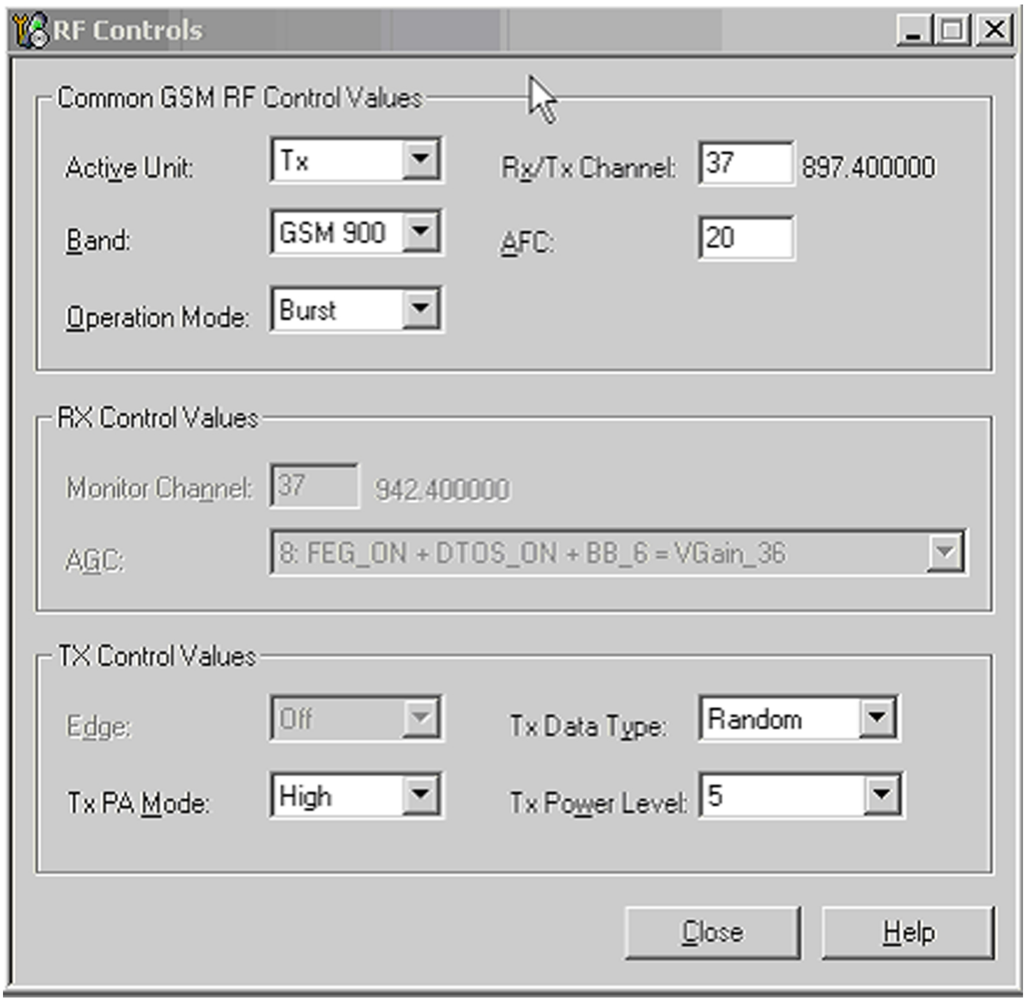


Figure 42 GSM 900 RF controls window

Troubleshooting diagram for GSM900 transmitter

Troubleshooting flow

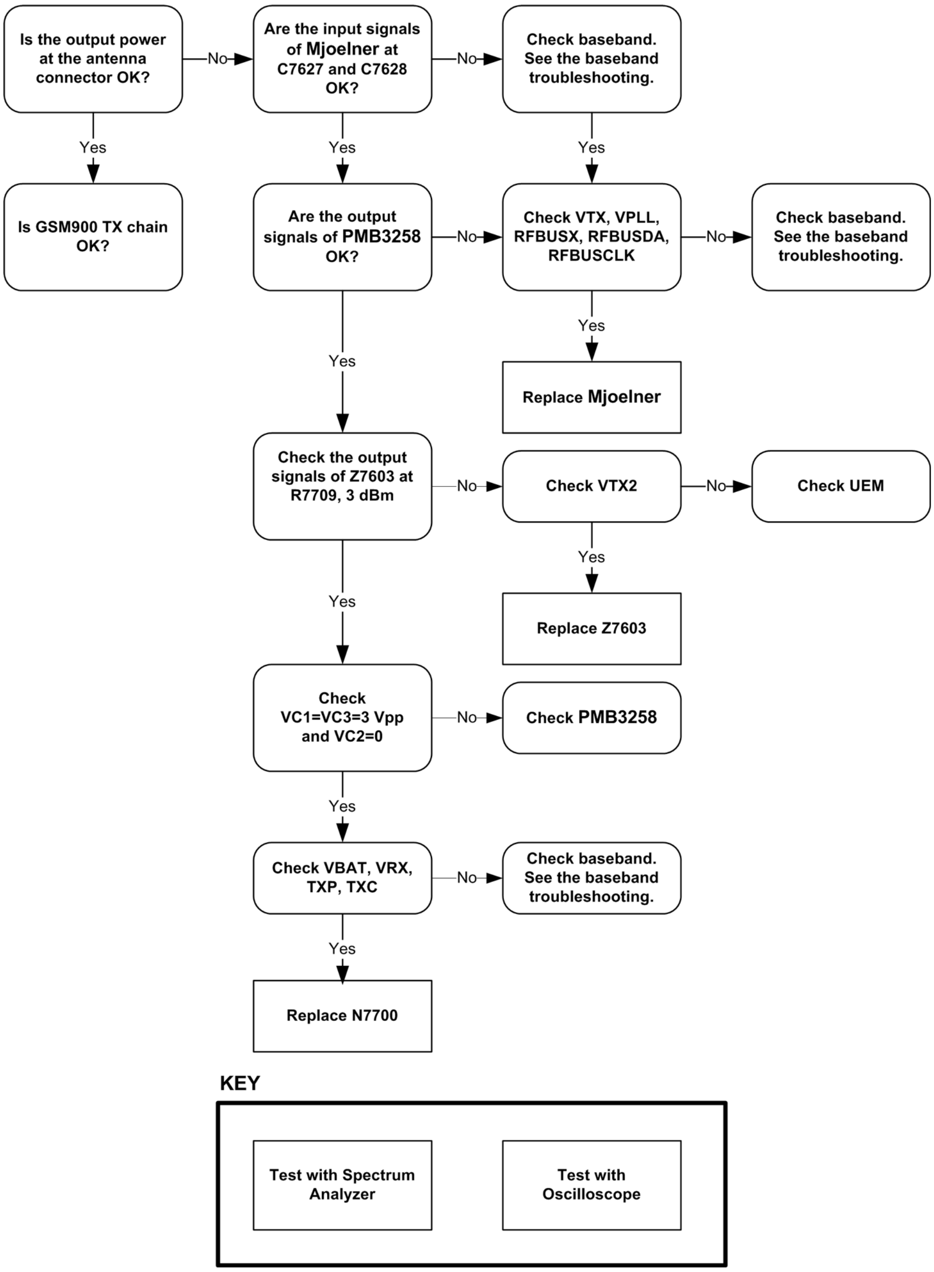


Figure 43 GSM900 tarnsmitter troubleshooting

GSM900 TX output power

Measure the output power of the phone; it should be about 32.5dBm. Remember the cable loss is about 0.3dB.

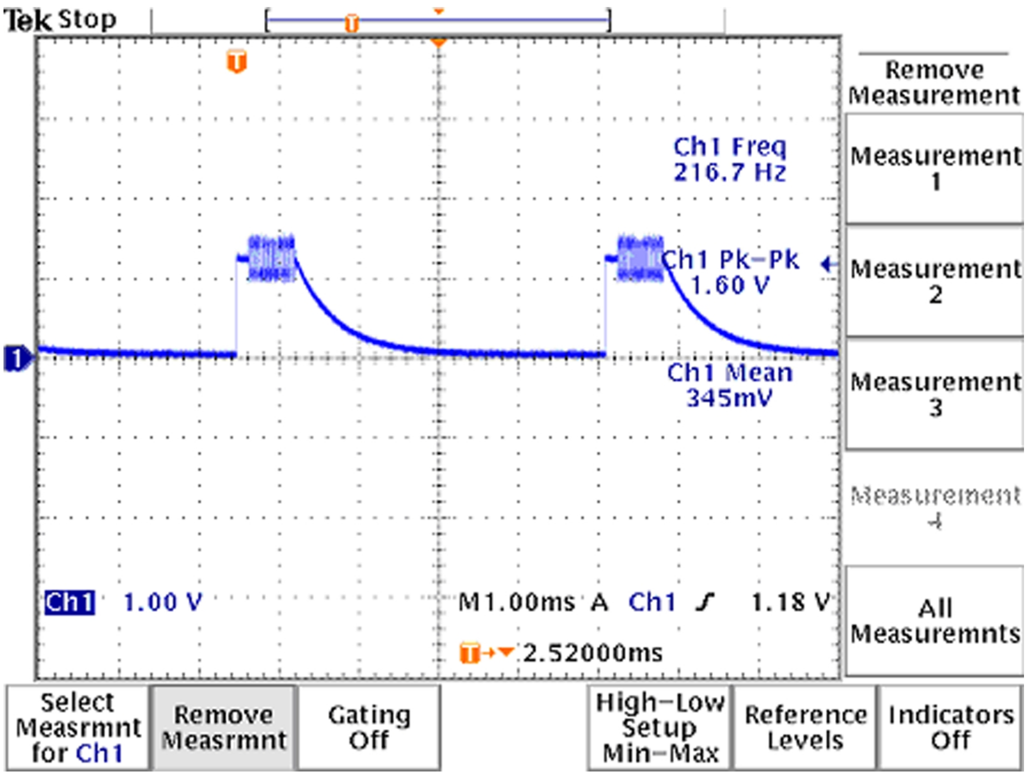


Figure 44 TX I/O signal

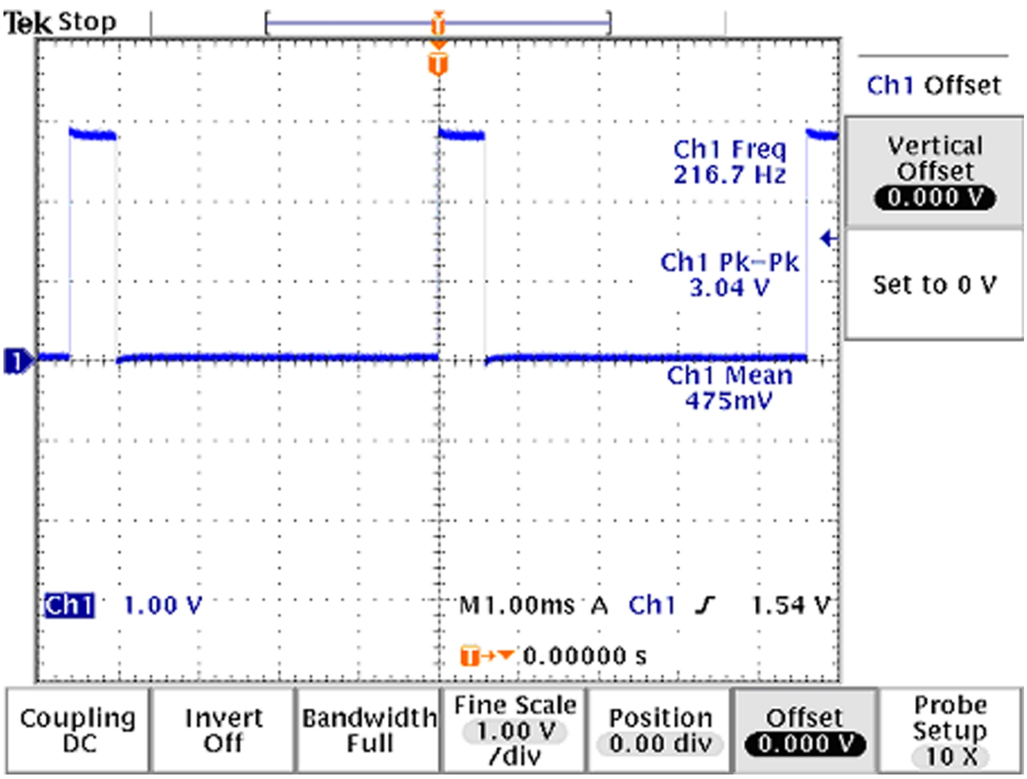


Figure 45 VC1, VC3 signals

COMPANY CONFIDENTIAL

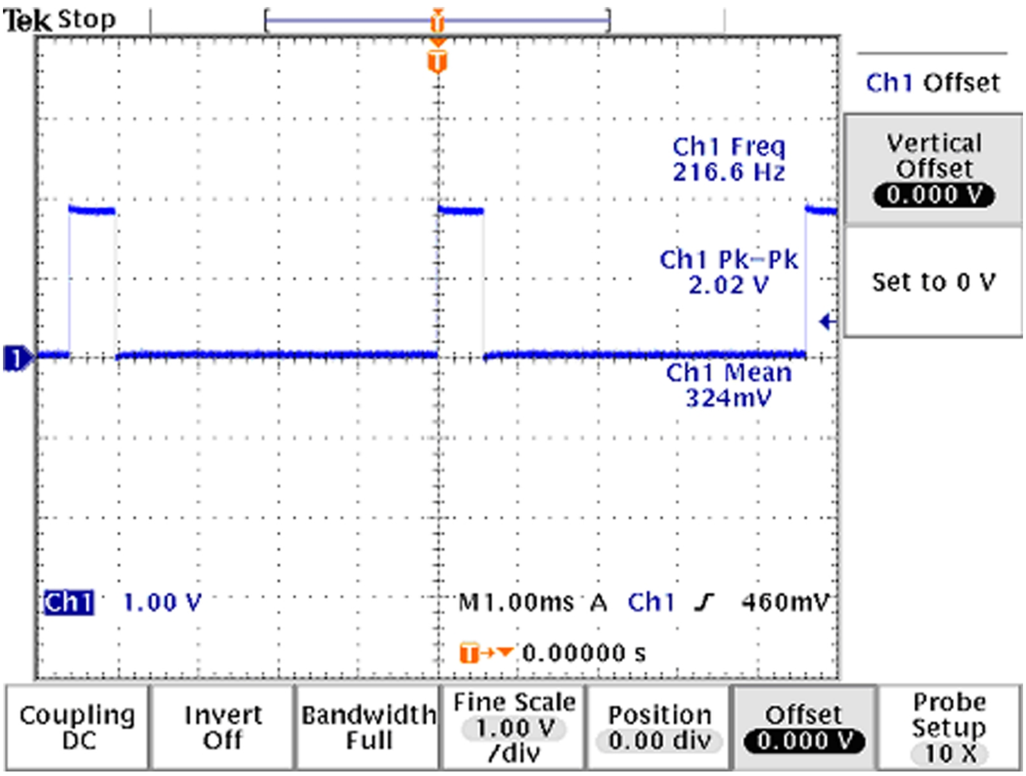


Figure 46 TXP signal

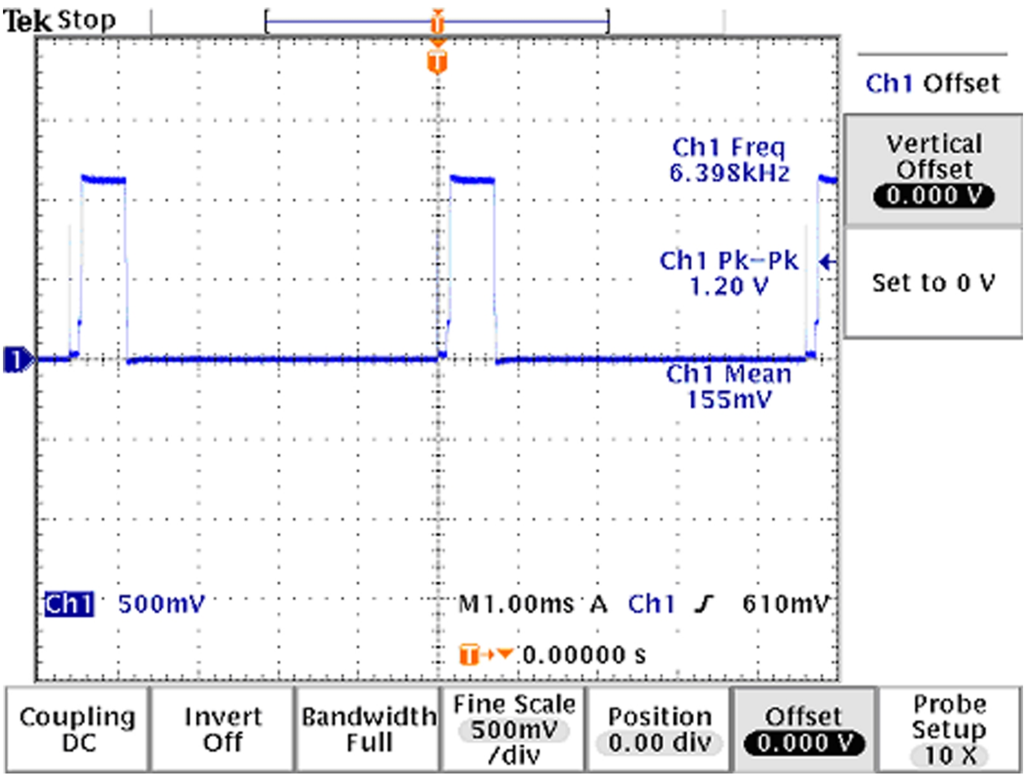


Figure 47 TXC signals at PCL5

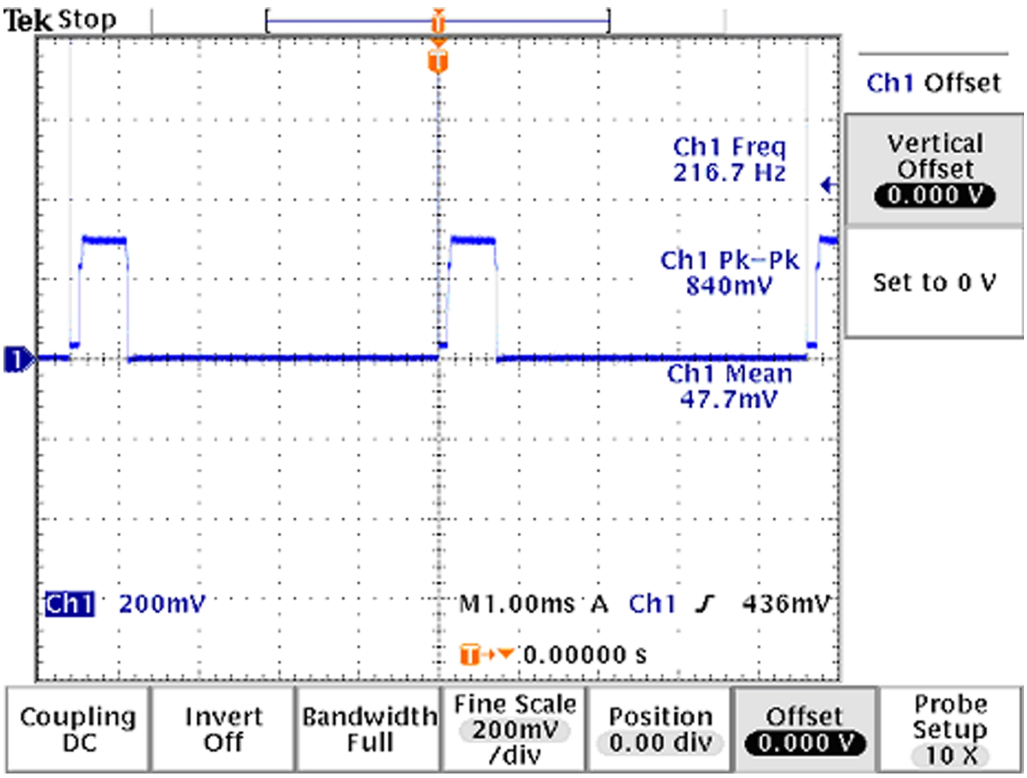


Figure 48 TXC signals at PCL19

General instructions for GSM1800 TX troubleshooting

Steps

1. Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to an attenuator at least 10dB before connected to the measurement equipment, otherwise the PA may be damaged.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Band: GSM 1800
   - ii Active Unit: TX
   - iii TX Power Level: 0
   - iv TX Data Type: Random

Results

The setup should now look like this:

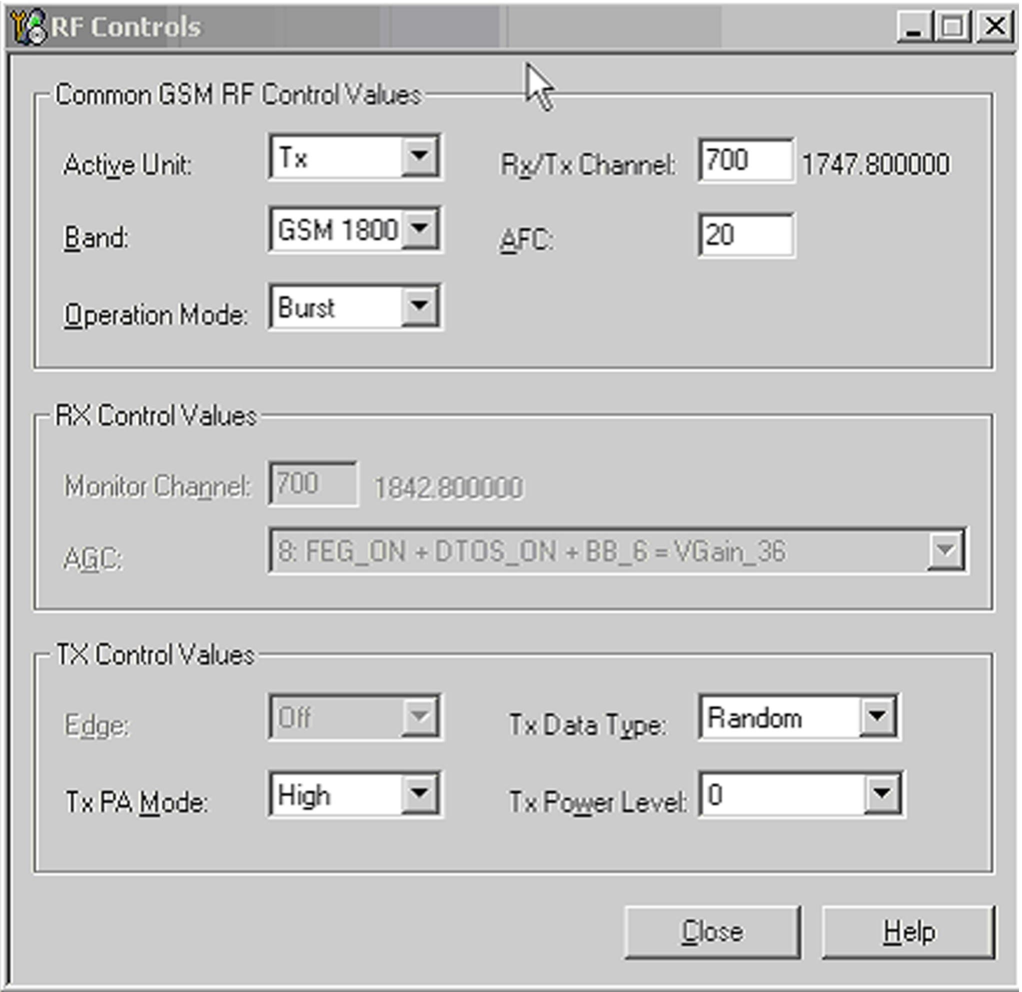


Figure 49 GSM 1800 RF controls window

Troubleshooting diagram for GSM1800 transmitter

Troubleshooting flow

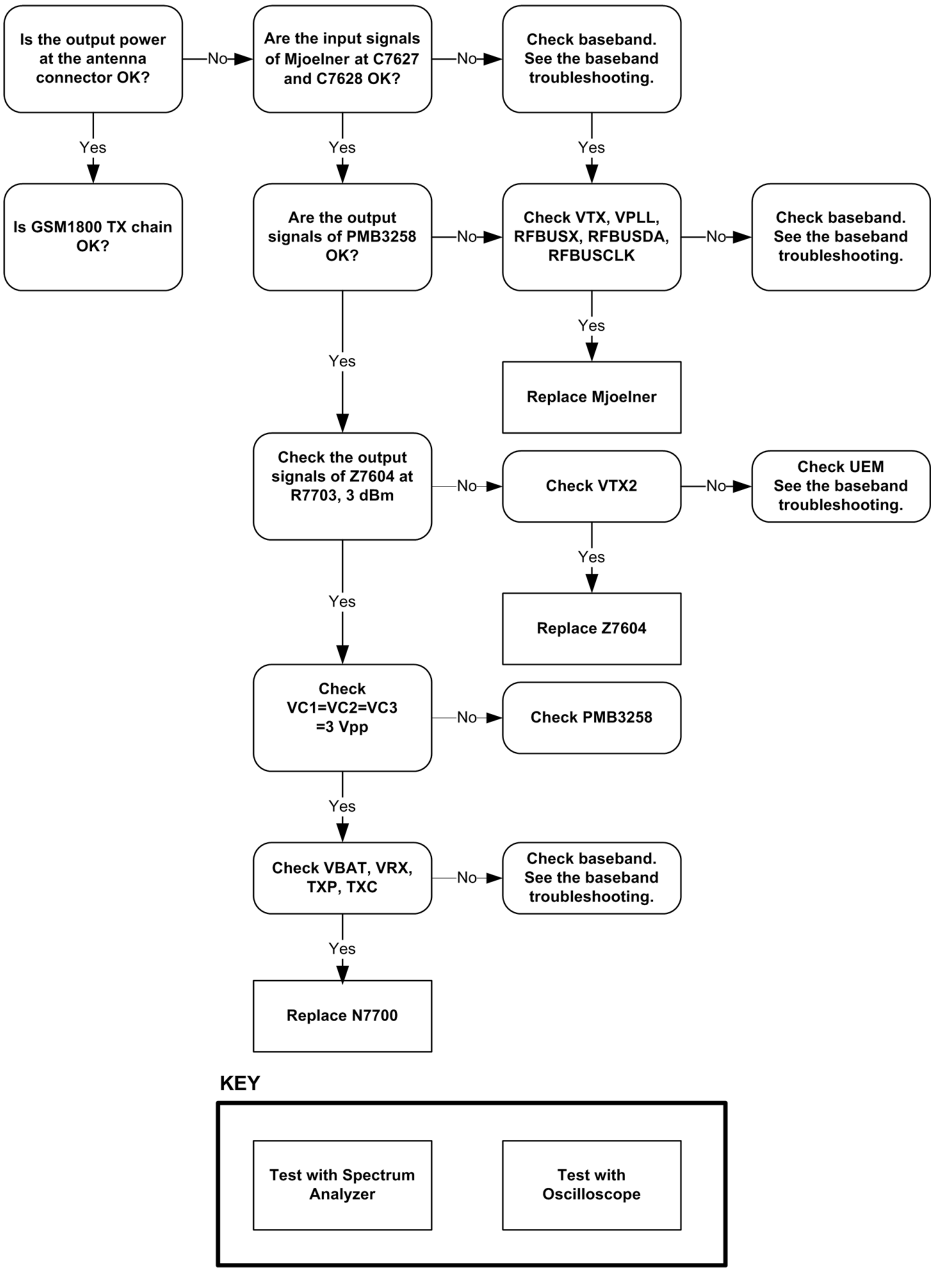


Figure 50 GSM1800 transmitter troubleshooting

GSM1800 TX output power

Measure the output power of the phone; it should be about 30.5dBm. Remember the cable loss is about 0.5dB.

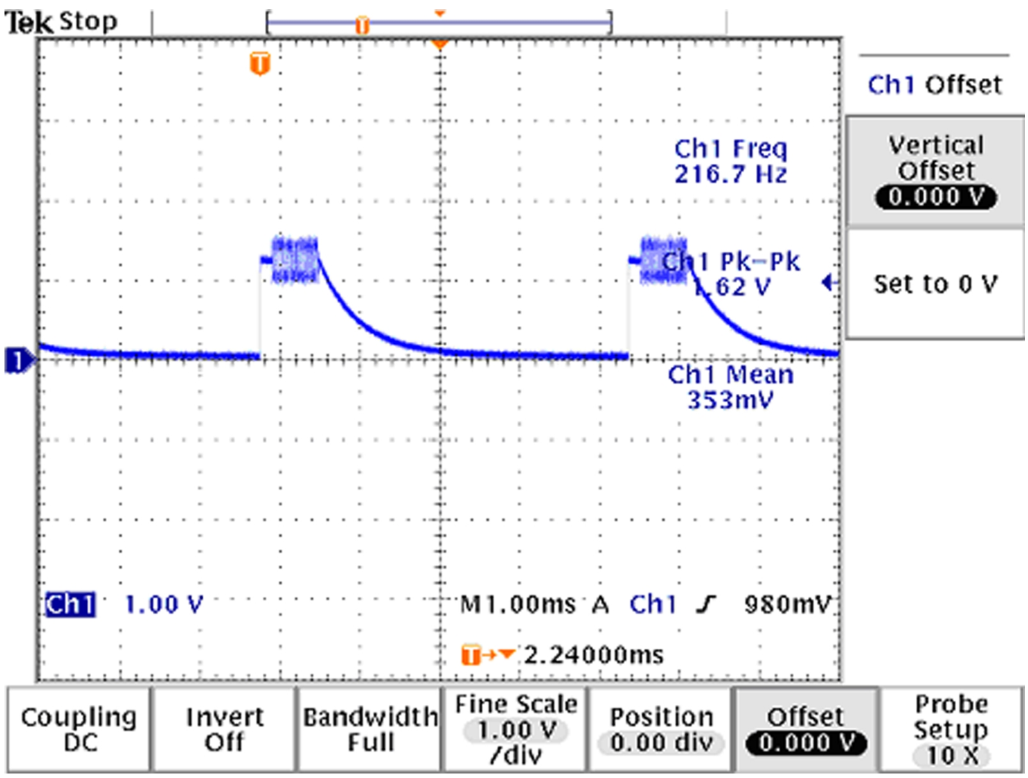


Figure 51 TX I/O signal

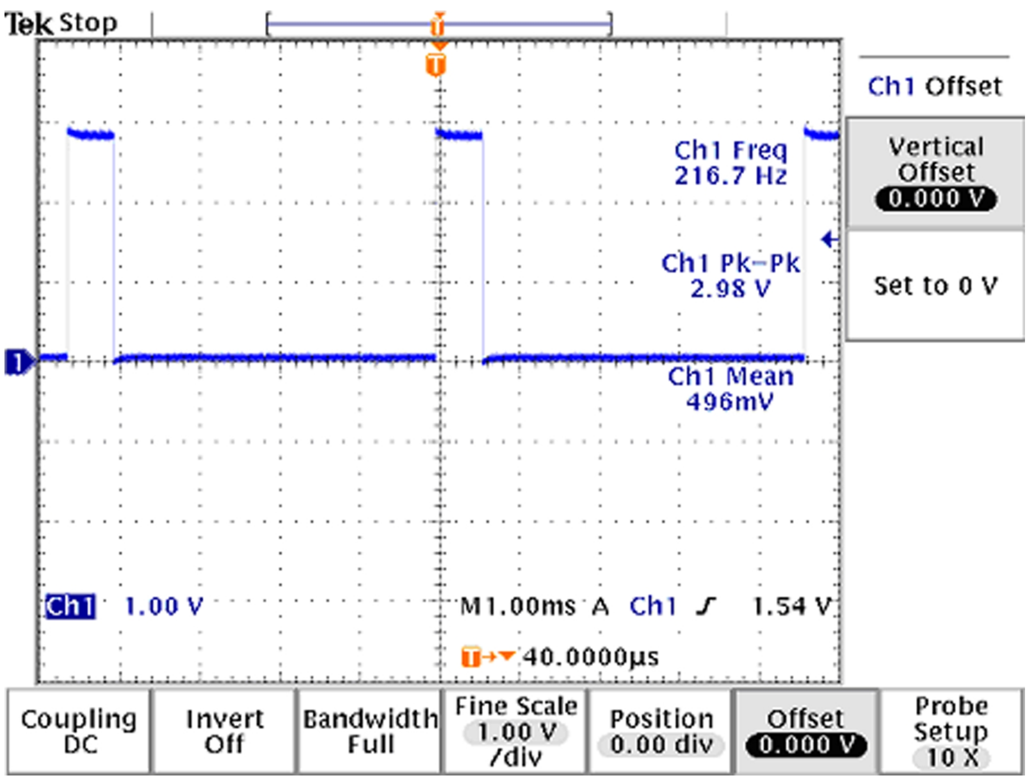


Figure 52 VC1, VC2, VC3 signals

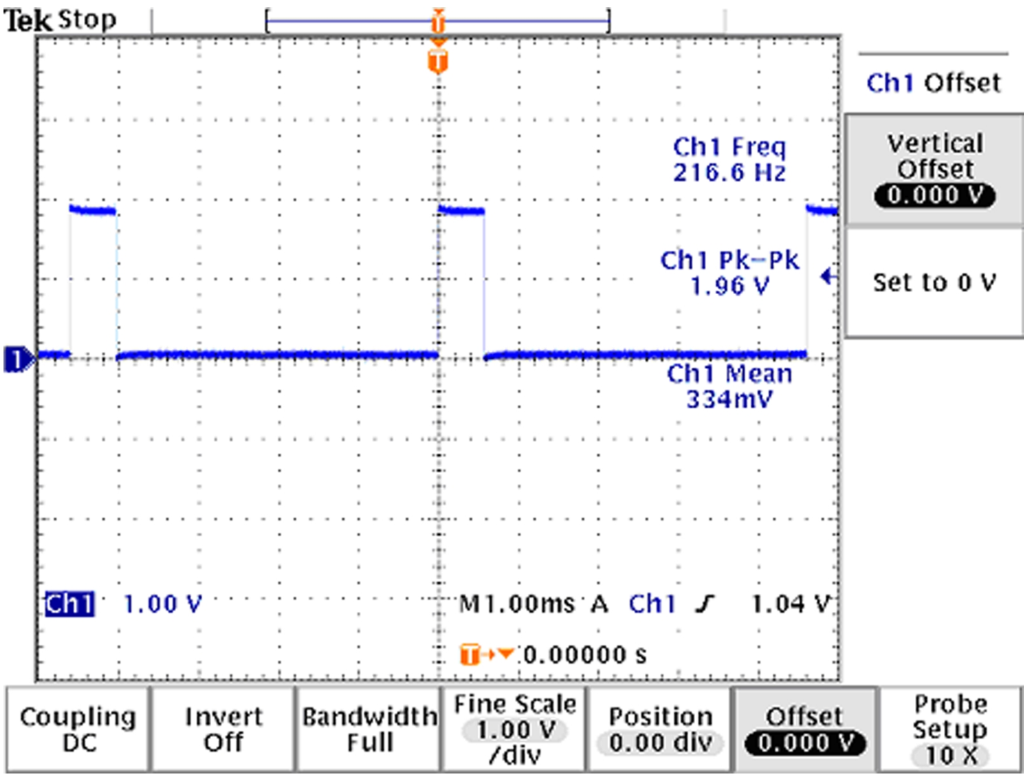


Figure 53 TXP signal

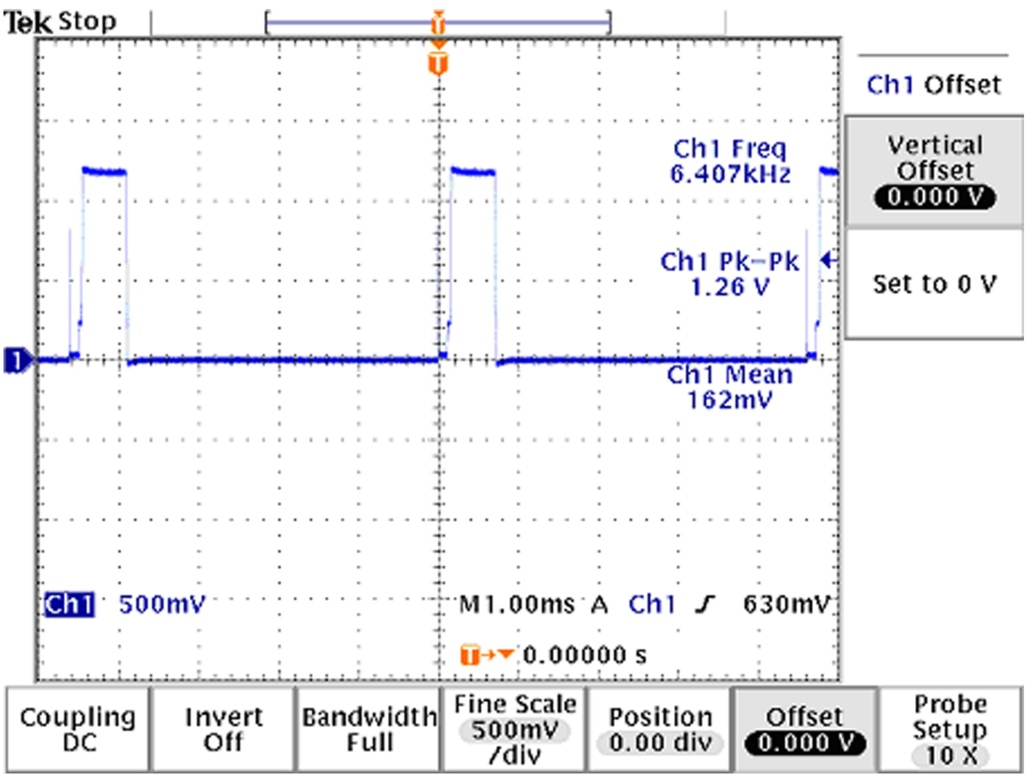


Figure 54 TXC signals at PCL0

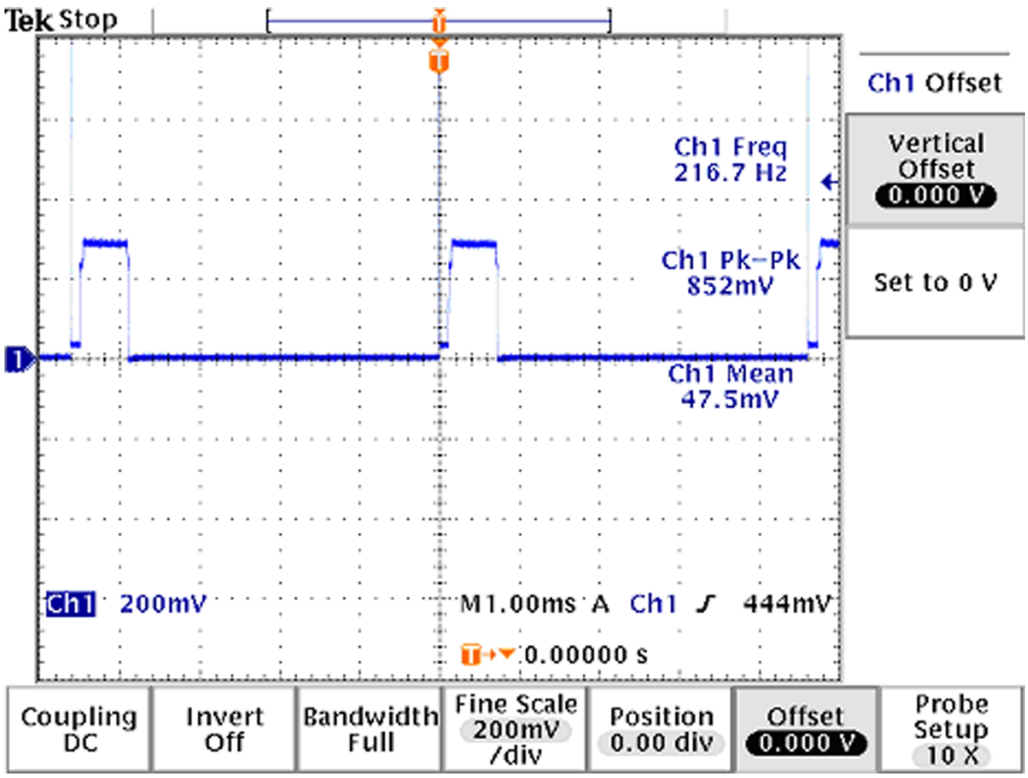


Figure 55 TXC signals at PCL15

RM-341 receiver

General instructions for GSM 850 RX troubleshooting

Steps

1. Connect the phone to a PC with the module repair jig.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Active Unit: RX
   - ii Band: GSM 850
   - iii Operation Mode: Continuous mode
   - iv RX/TX Channel 190
   - v AGC: 8: FEG_ON + DTOS_ON+BB_6=Vgain_36

Results

The setup should now look like this:

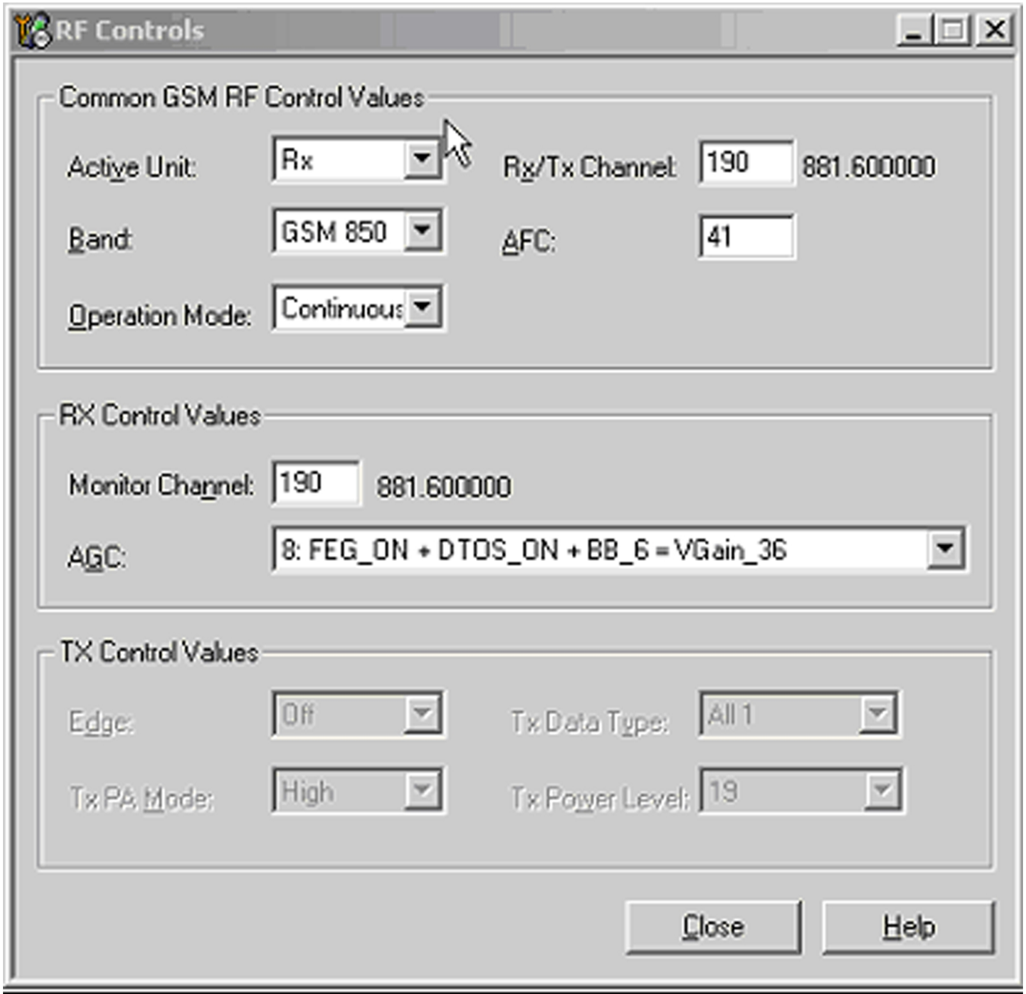


Figure 56 GSM850 RF controls window

Troubleshooting diagram for GSM850 receiver

Troubleshooting flow

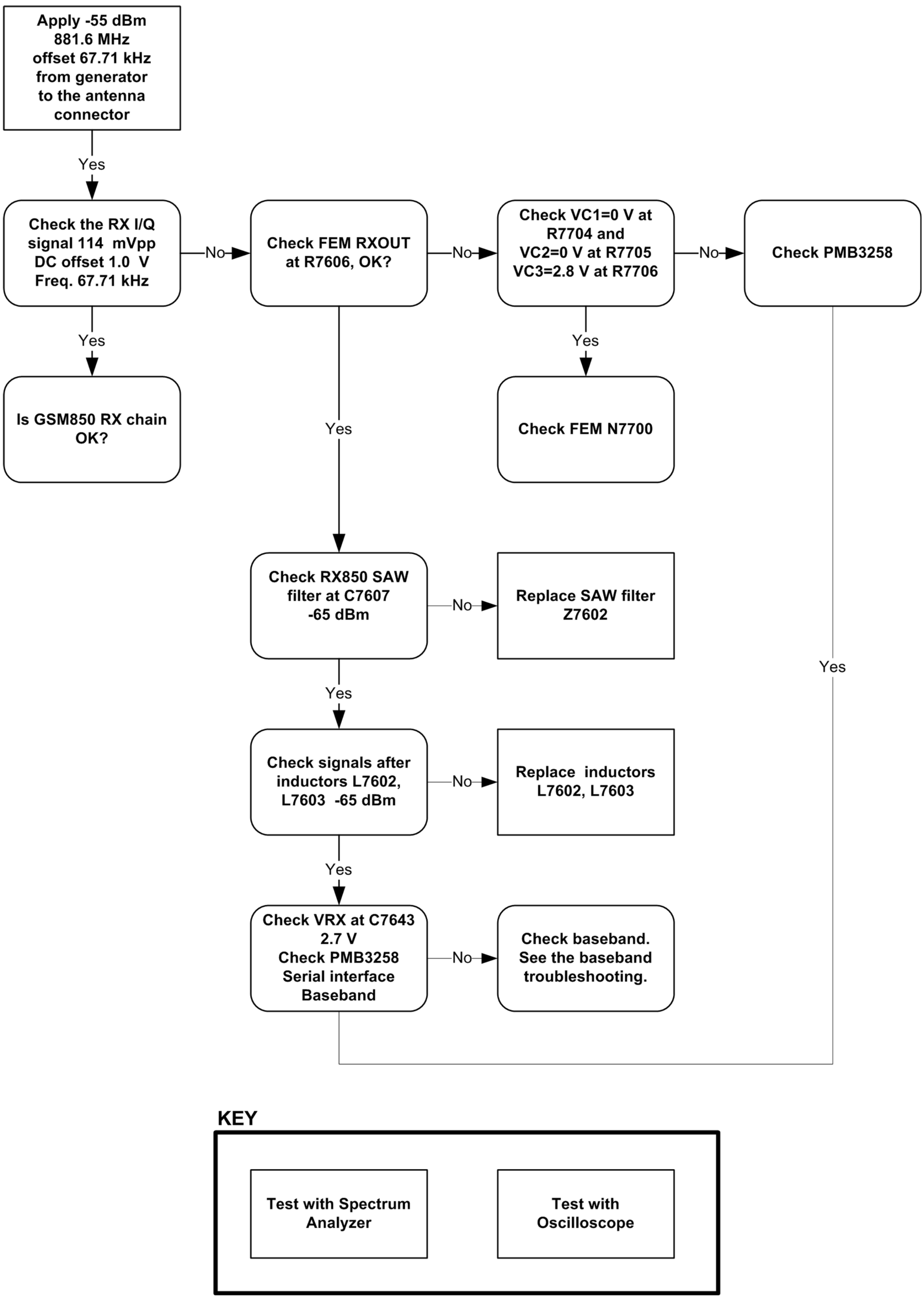


Figure 57 GSM850 receiver troubleshooting

Results

By measuring with an oscilloscope at RXIP or RXQP on a working GSM850 receiver this picture should be seen. Signal amplitude 114mVp-p. DC offset 1.0V.

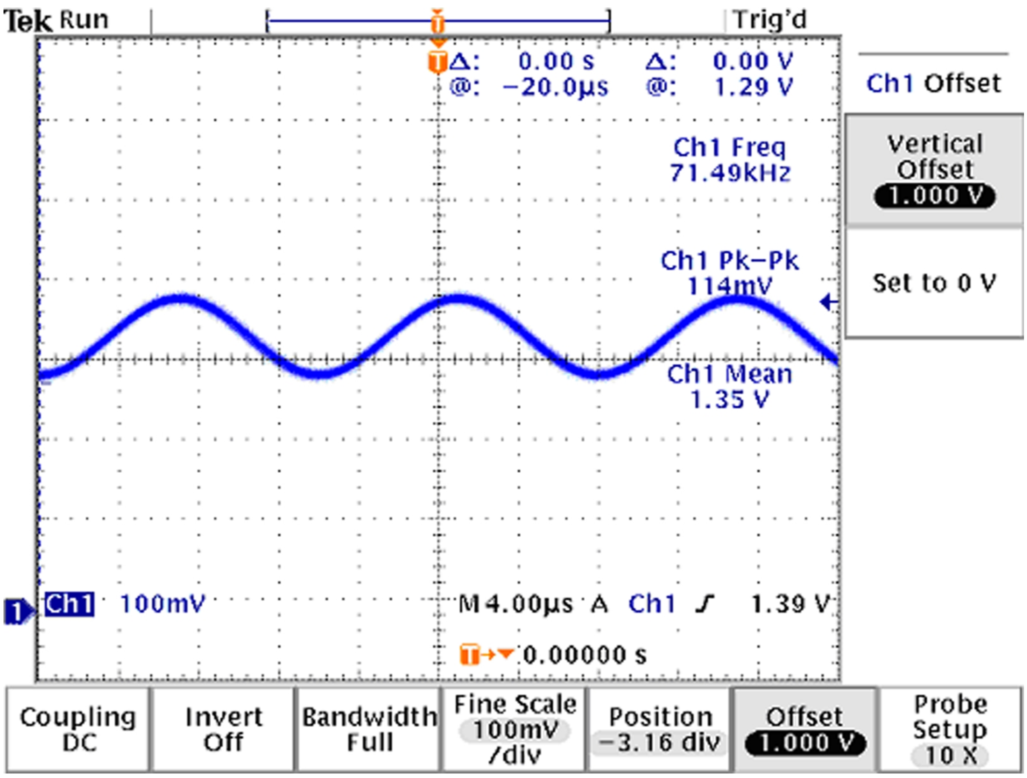


Figure 58 850 RX I/Q signal waveform

General instructions for GSM1900 RX troubleshooting

Steps

1. Connect the phone to a PC with the module repair jig.
2. Start Phoenix and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Active Unit: RX
   - ii Band: GSM 1900
   - iii Operation Mode: Continuous mode
   - iv RX/TX Channel 661
   - v AGC: 8: FEG_ON + DTOS_ON+BB_6=Vgain_36

Results

The setup should now look like this:

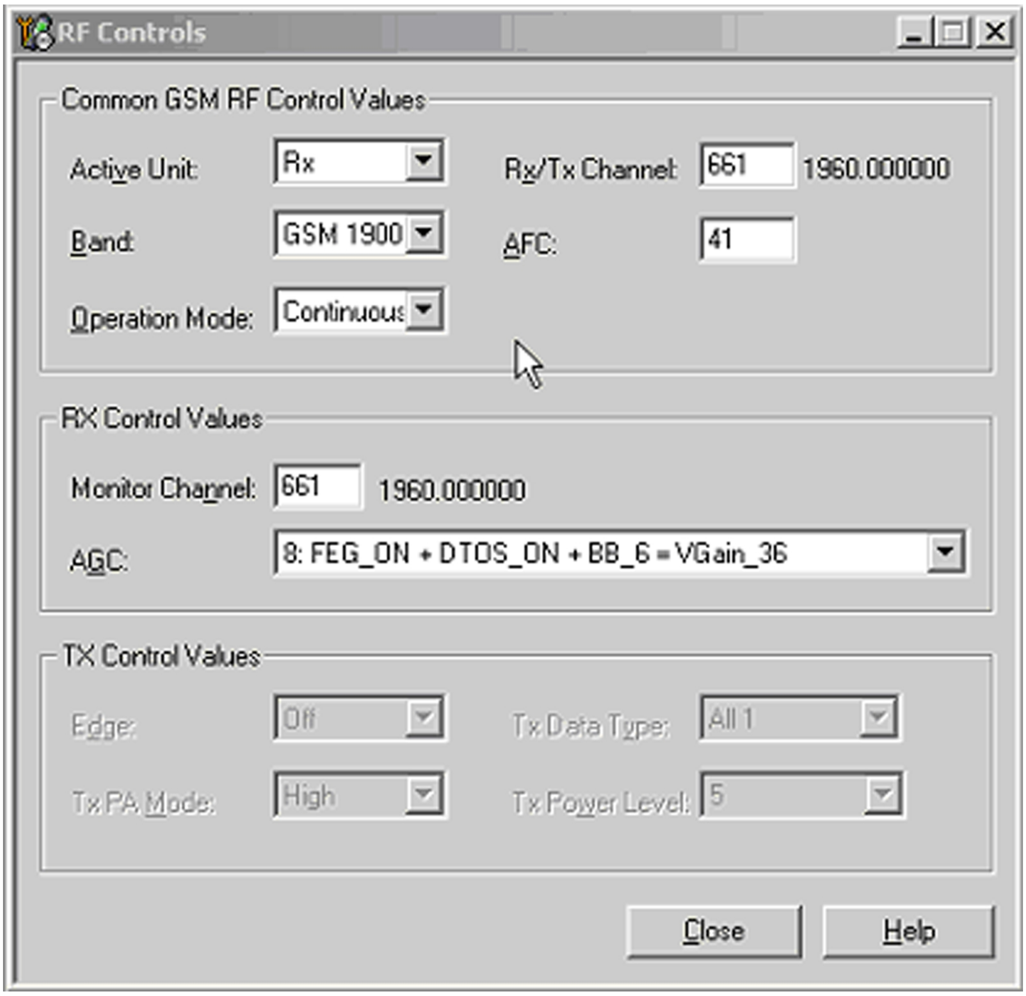


Figure 59 GSM 1900 RF controls window

Troubleshooting diagram for GSM1900 receiver

Troubleshooting flow

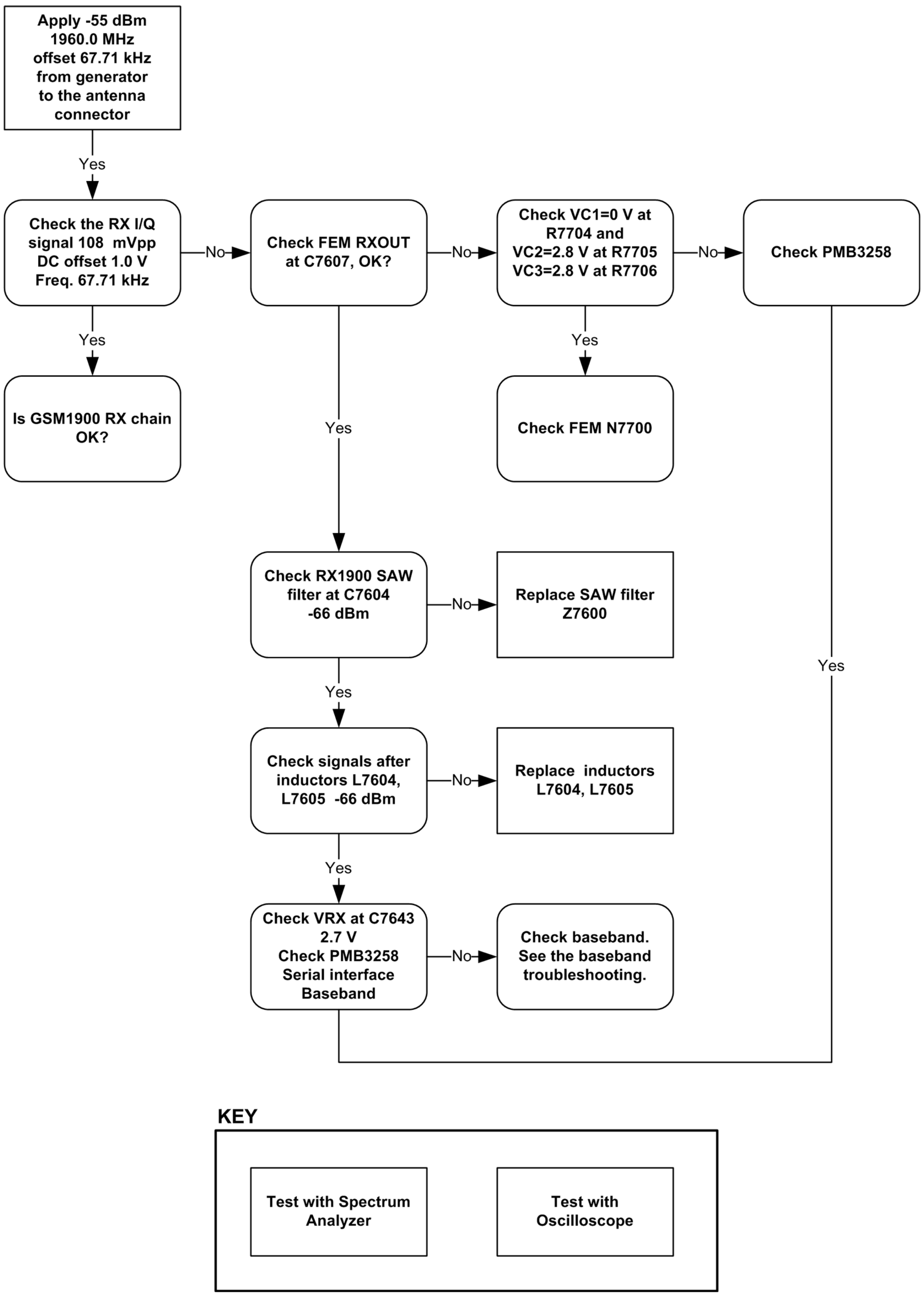


Figure 60 GSM1900 receiver troubleshooting

Results

By measuring with an oscilloscope at RXIP or RXQP on a working GSM1900 receiver this picture should be seen. Signal amplitude 108 mVp-p. DC offset 1.0V.

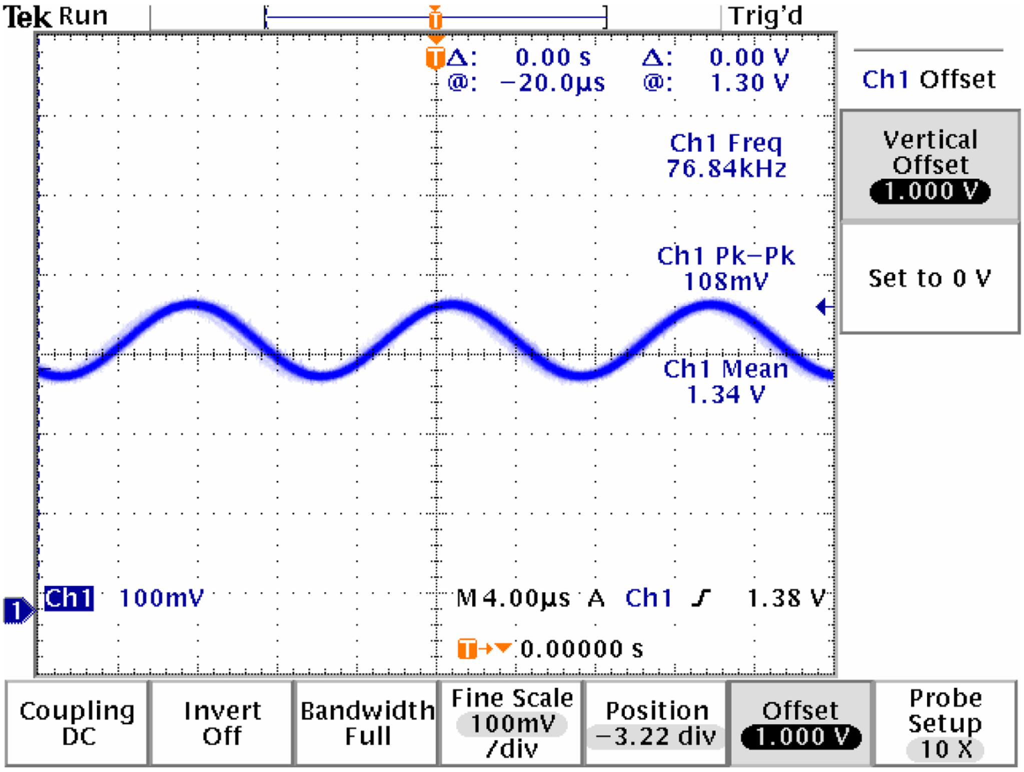


Figure 61 1900 RX I/Q signal waveform

Measurement points in the receiver

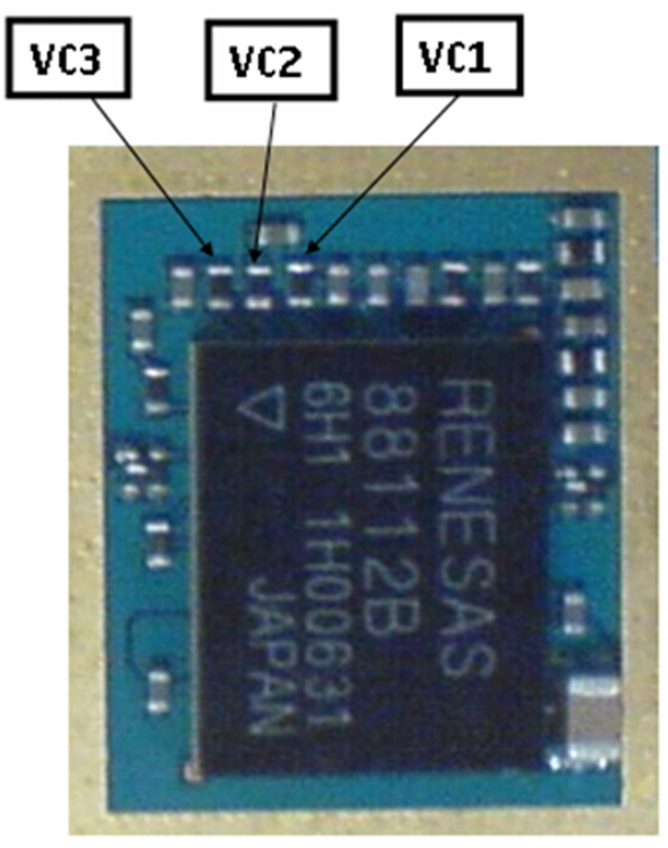


Figure 62 RX measurements point of the control voltages to FEM N7700

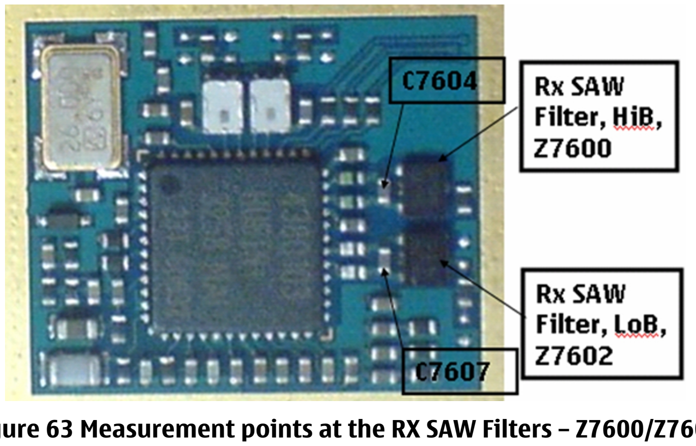


Figure 63 Measurement points at the RX SAW Filters – Z7600/Z7602

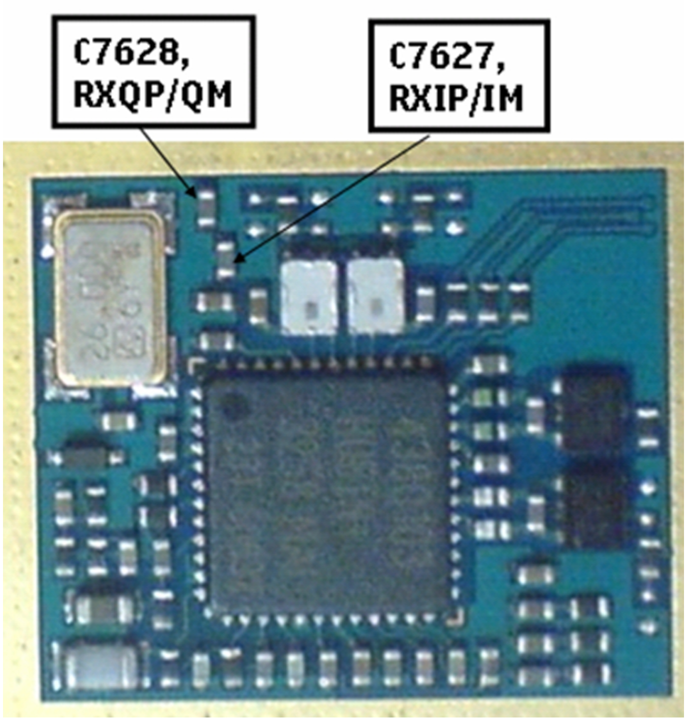


Figure 64 RX I/Q signals

RM-341 transmitter

General instructions for GSM 850 TX troubleshooting

Steps

1. Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to an attenuator at least 10dB before connected to the measurement equipment, otherwise the PA may be damaged.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Band: GSM 850
   - ii Active Unit: TX
   - iii TX Power Level: 5
   - iv TX Data Type: Random

Results

The setup should now look like this:

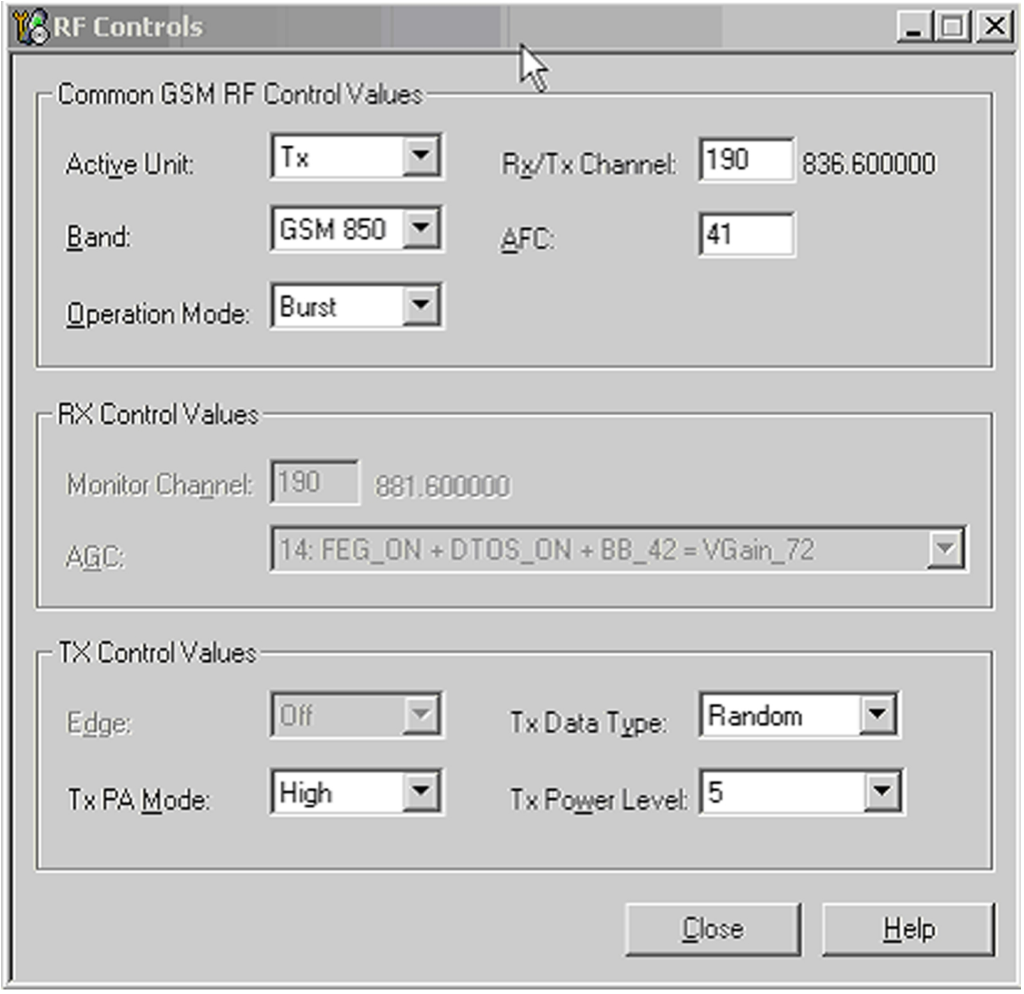


Figure 65 GSM 850 RF controls window

Troubleshooting diagram for GSM850 transmitter

Troubleshooting flow

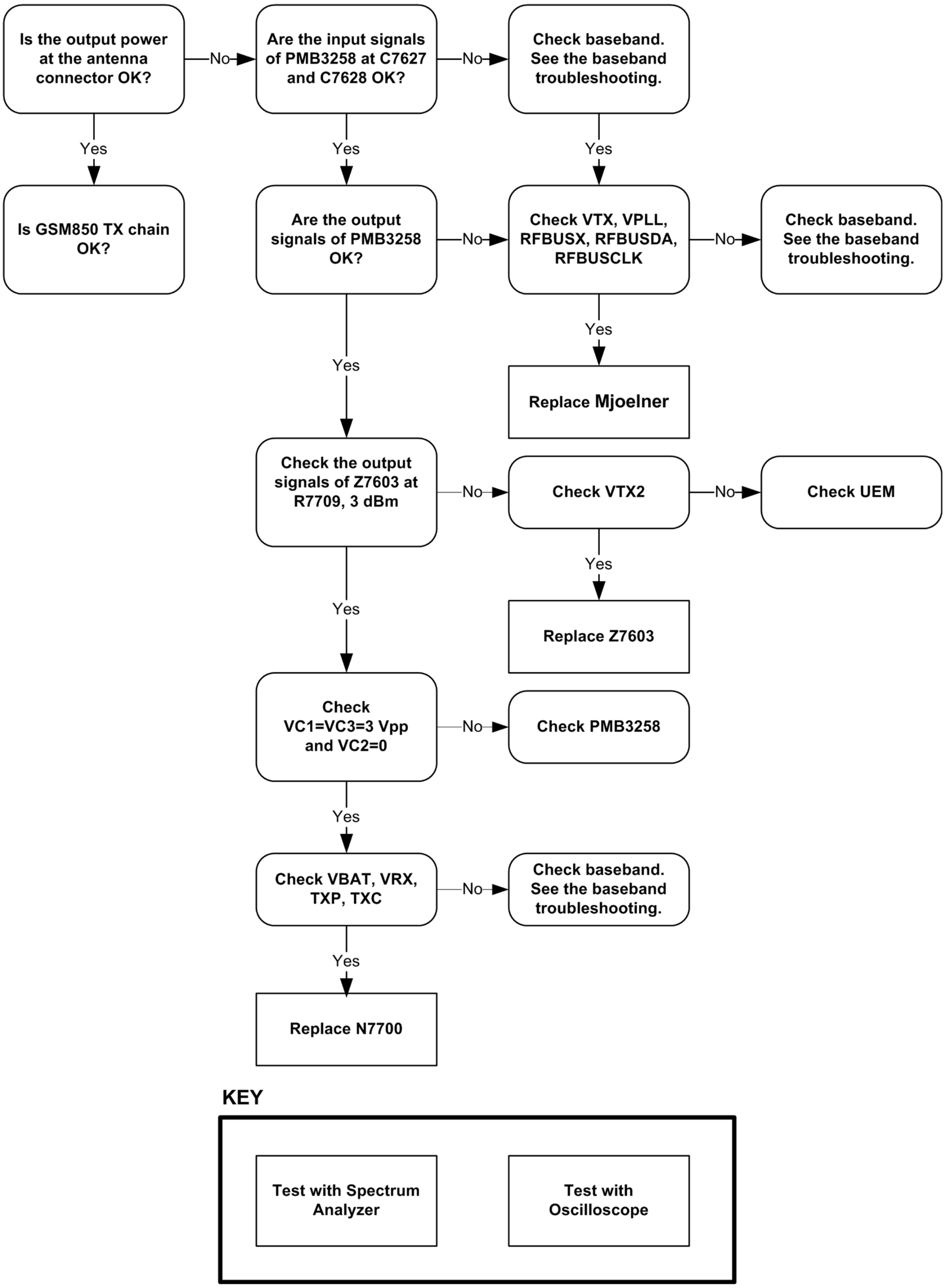


Figure 66 GSM850 transmitter troubleshooting

GSM850 TX output power

Measure the output power of the phone; it should be about 32.5 dBm. Remember the cable loss is about 0.3 dB.

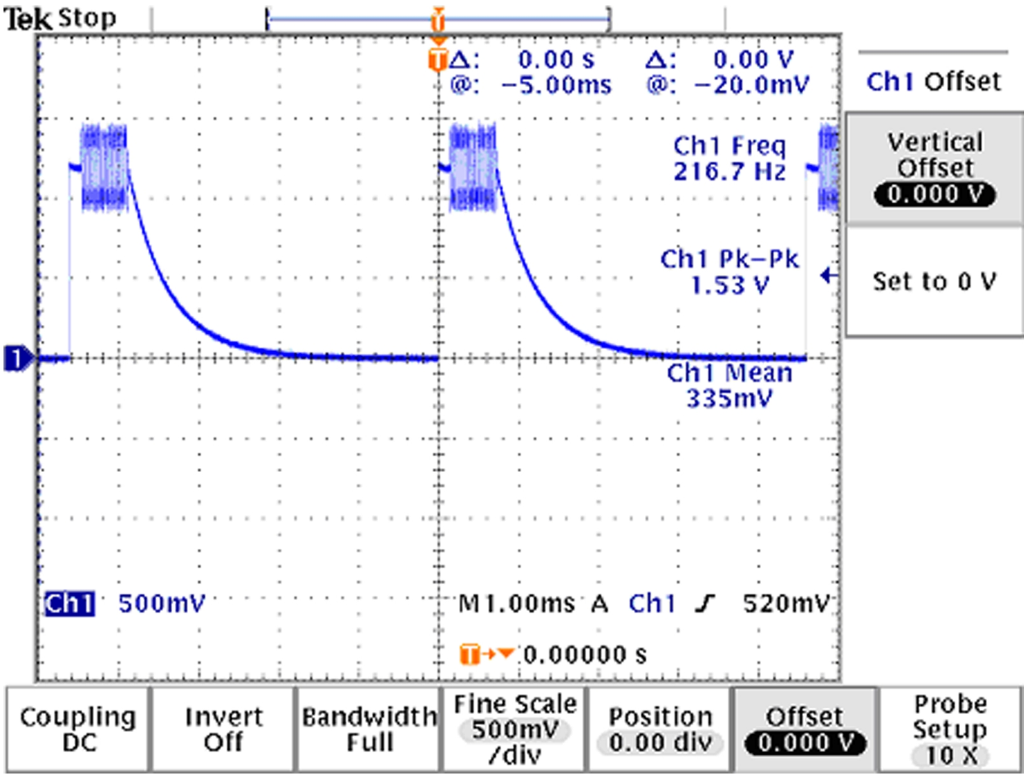


Figure 67 TX I/O signal

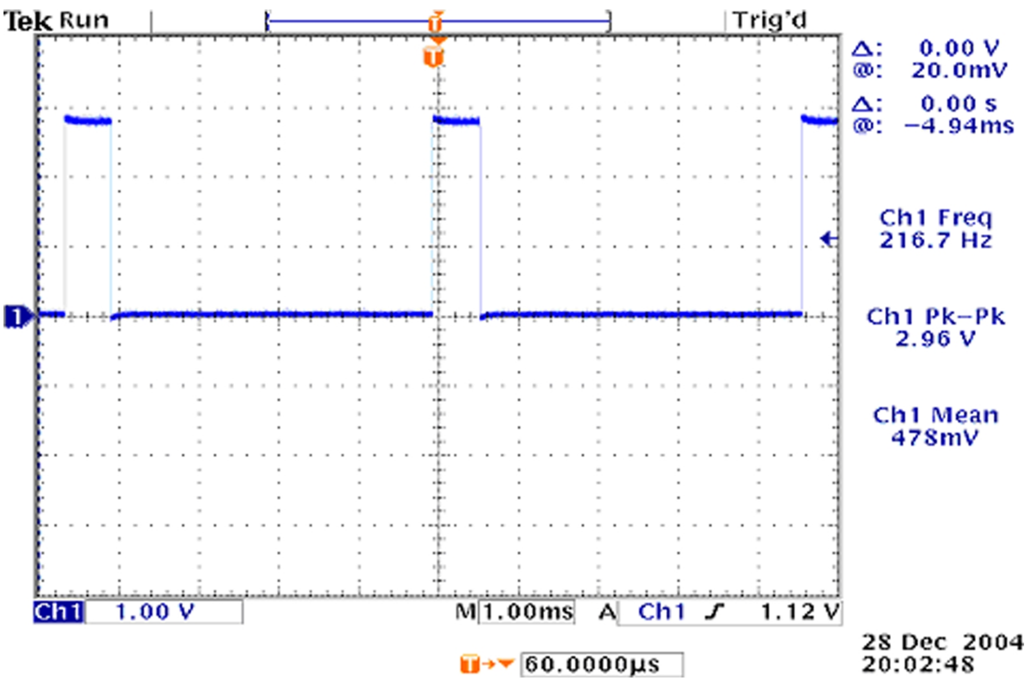


Figure 68 VC1, VC3 signal

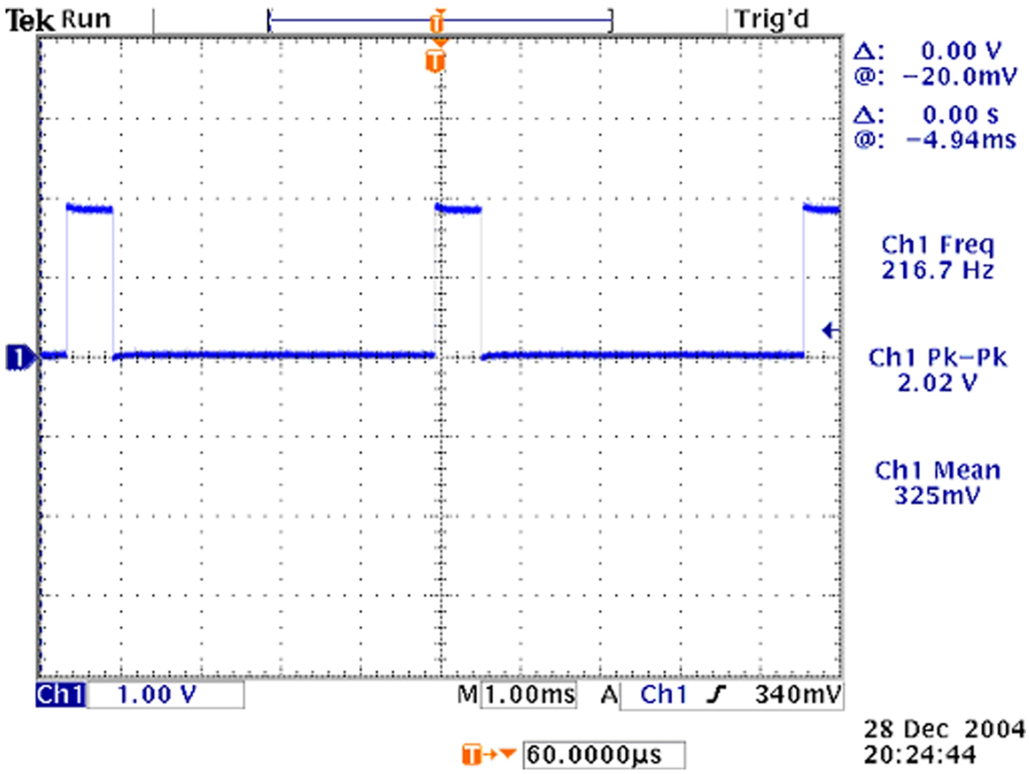


Figure 69 TXP signal

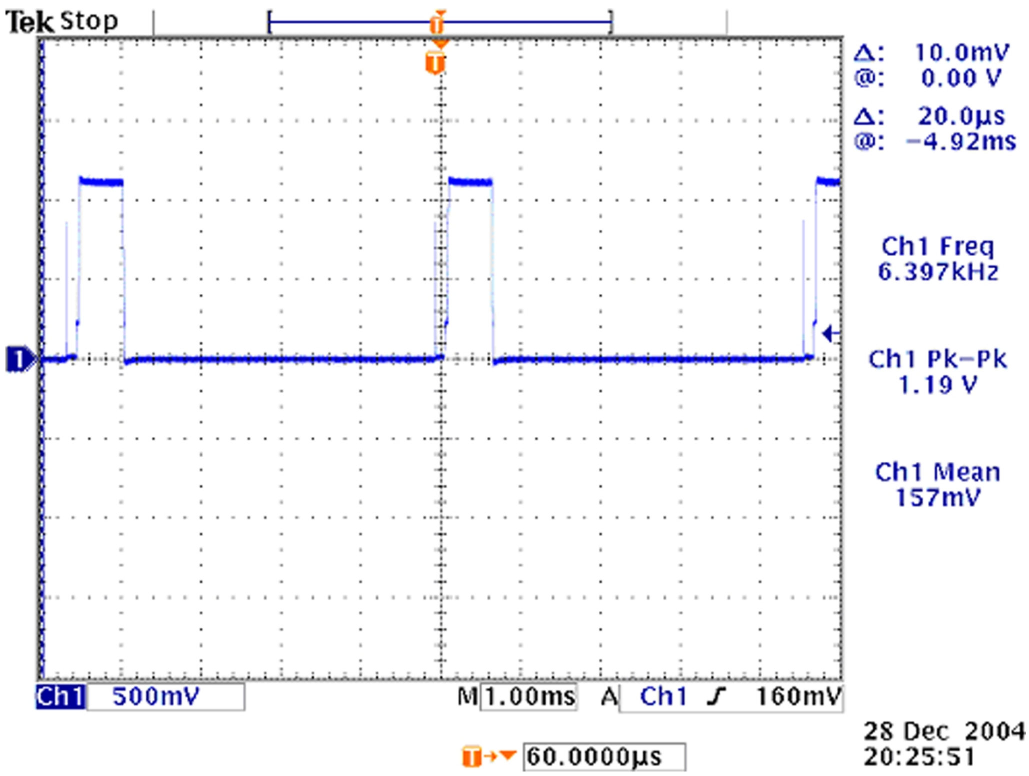


Figure 70 TXC signals at PCL5

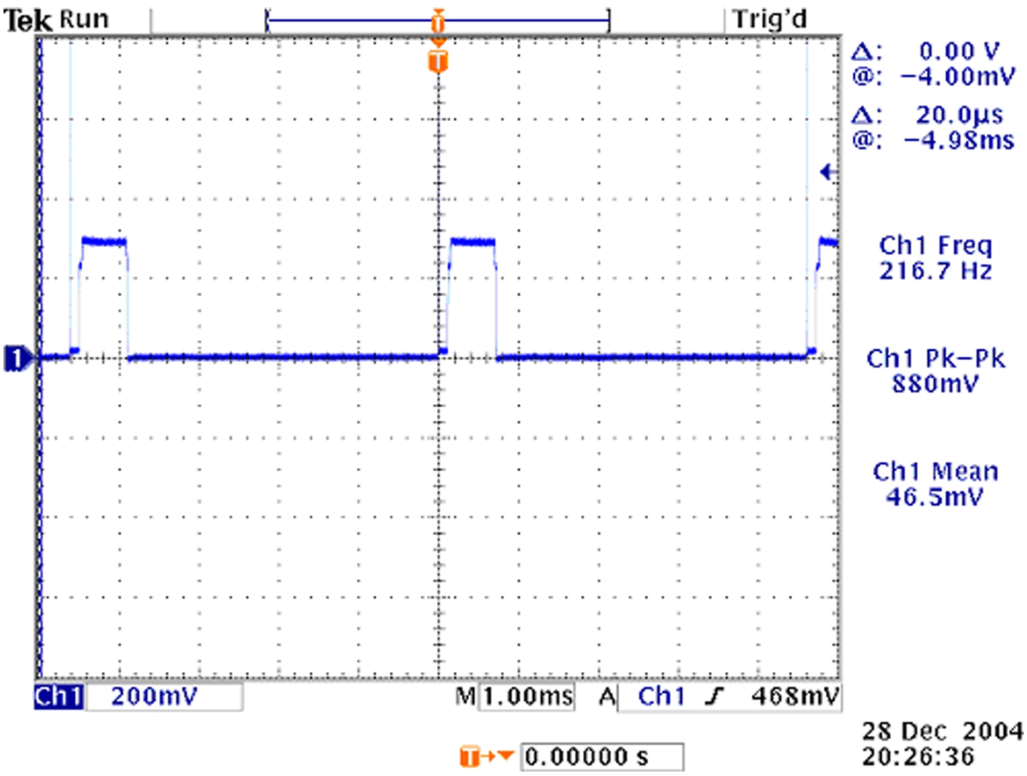


Figure 71 TXC signals at PCL19

General instructions for GSM1900 TX troubleshooting

Steps

1. Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to an attenuator at least 10dB before connected to the measurement equipment, otherwise the PA may be damaged.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Band: GSM 1900
   - ii Active Unit: TX
   - iii TX Power Level: 0
   - iv TX Data Type: Random

7. The setup should now look like this:

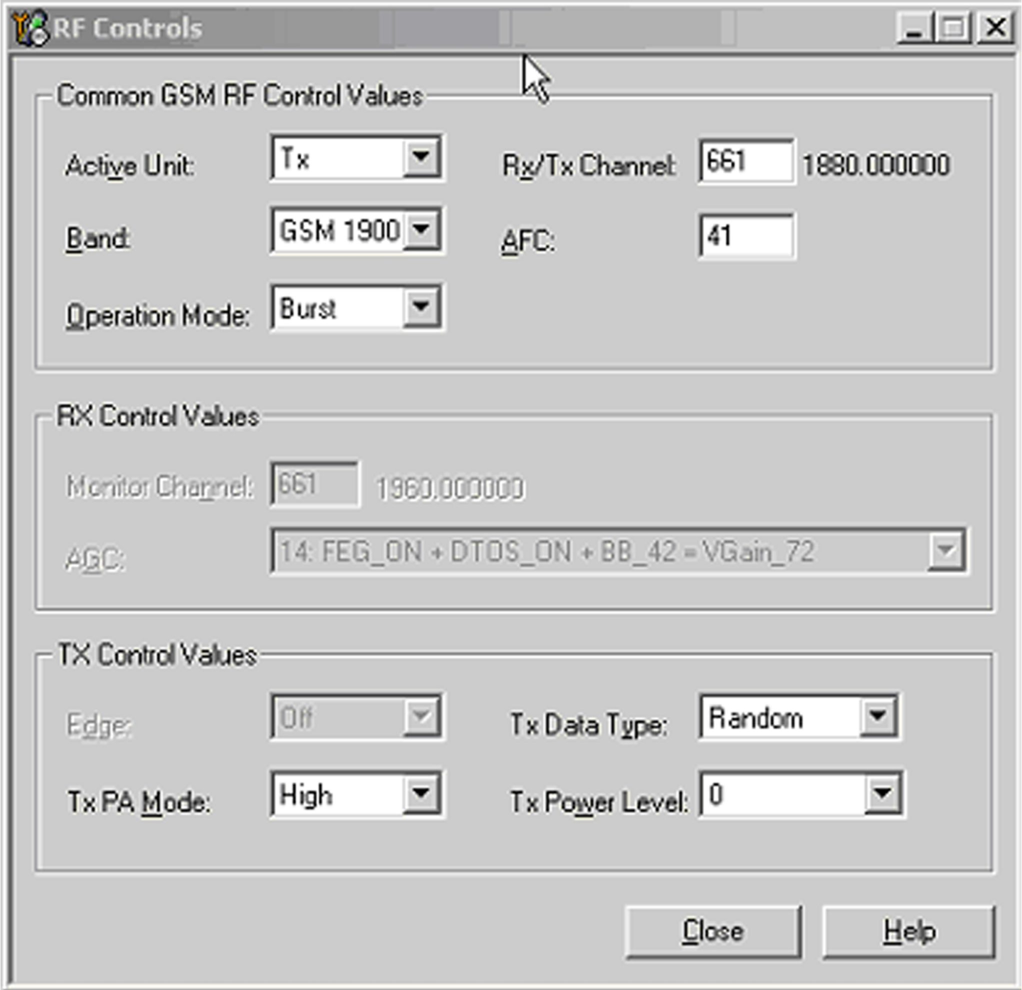


Figure 72 GSM 1900 RF controls window

Troubleshooting diagram for GSM1900 transmitter

Troubleshooting flow

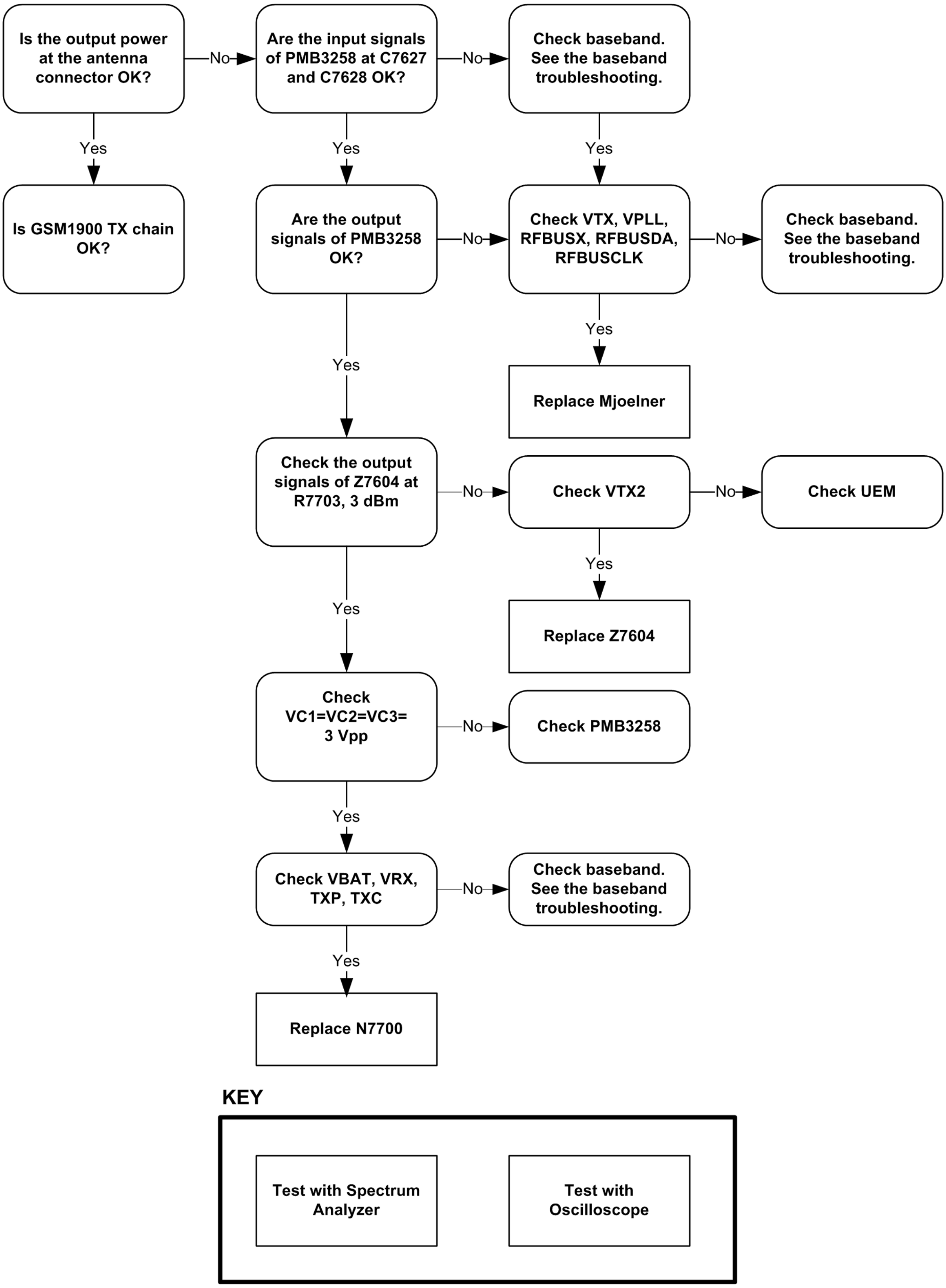


Figure 73 GSM1900 transmitter troubleshooting

GSM1900 TX output power

Measure the output power of the phone; it should be about 29.1dBm. Remember the cable loss is about 0.5dB.

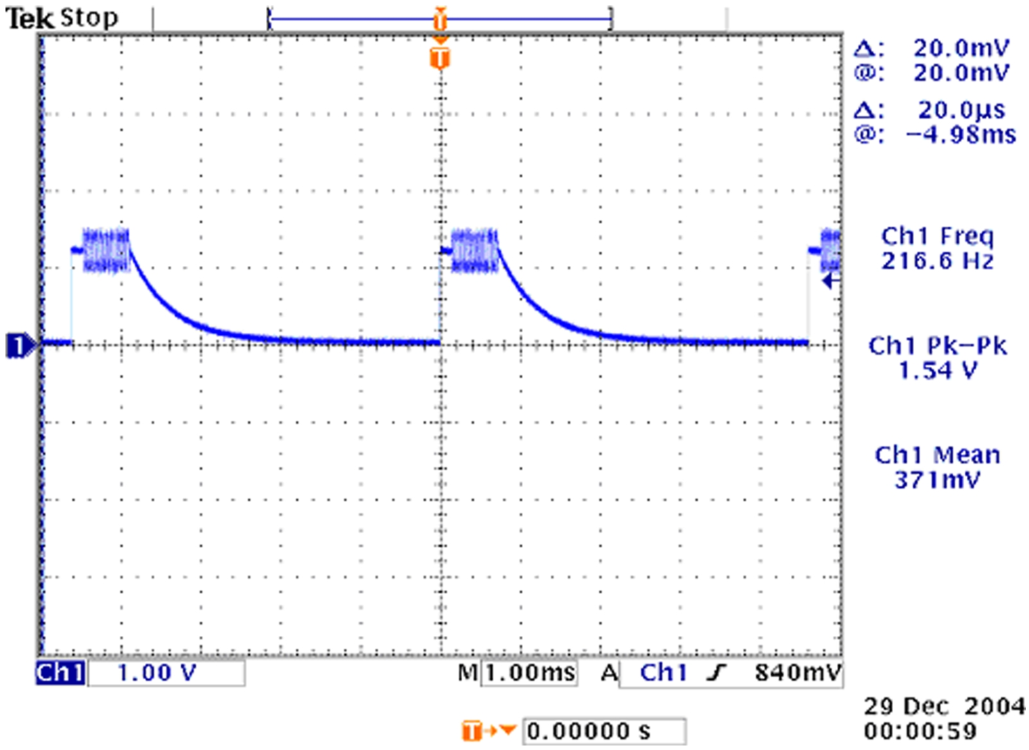


Figure 74 TX I/O signal

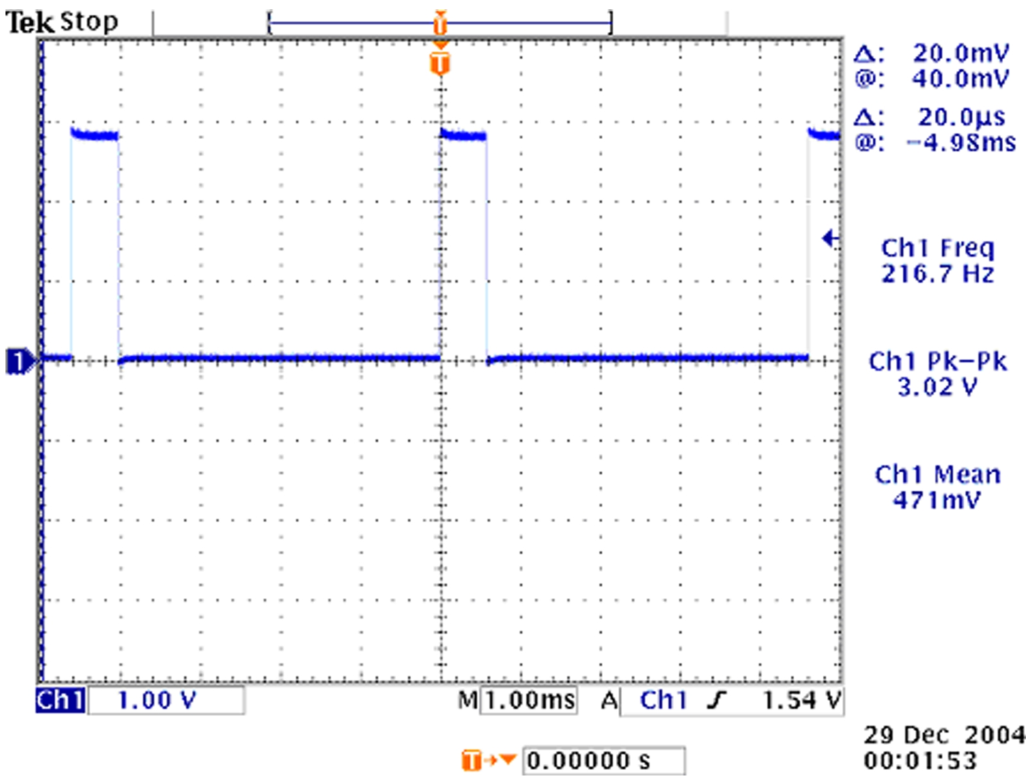


Figure 75 VC1, VC2, VC3 signals

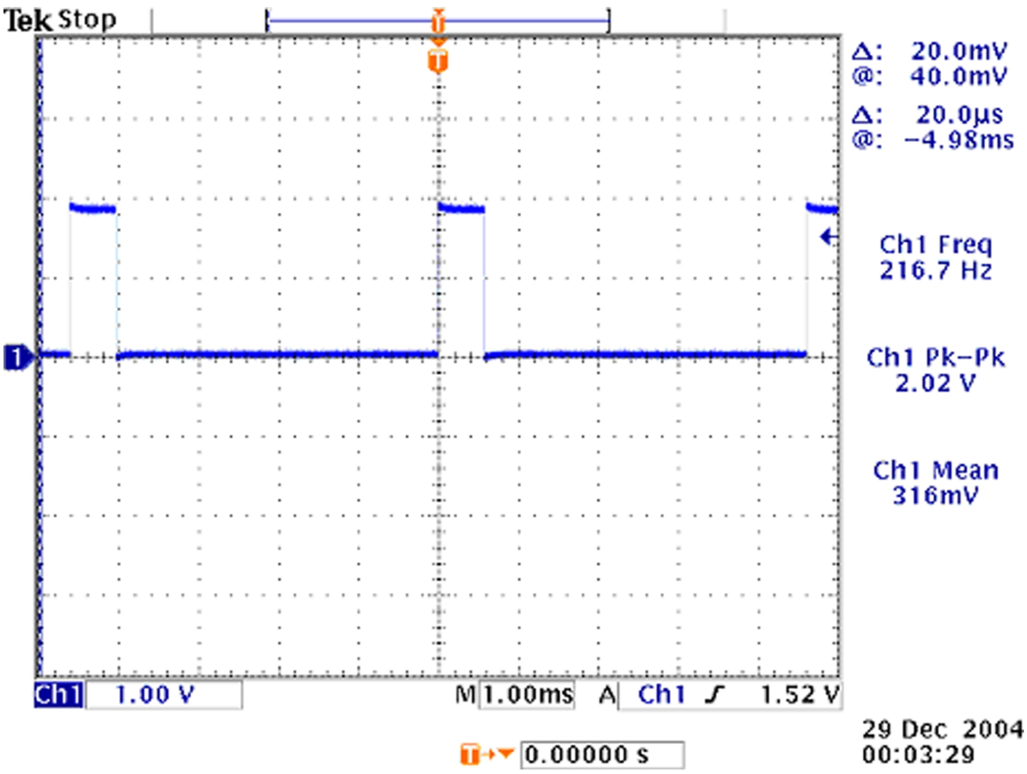


Figure 76 TXP signal

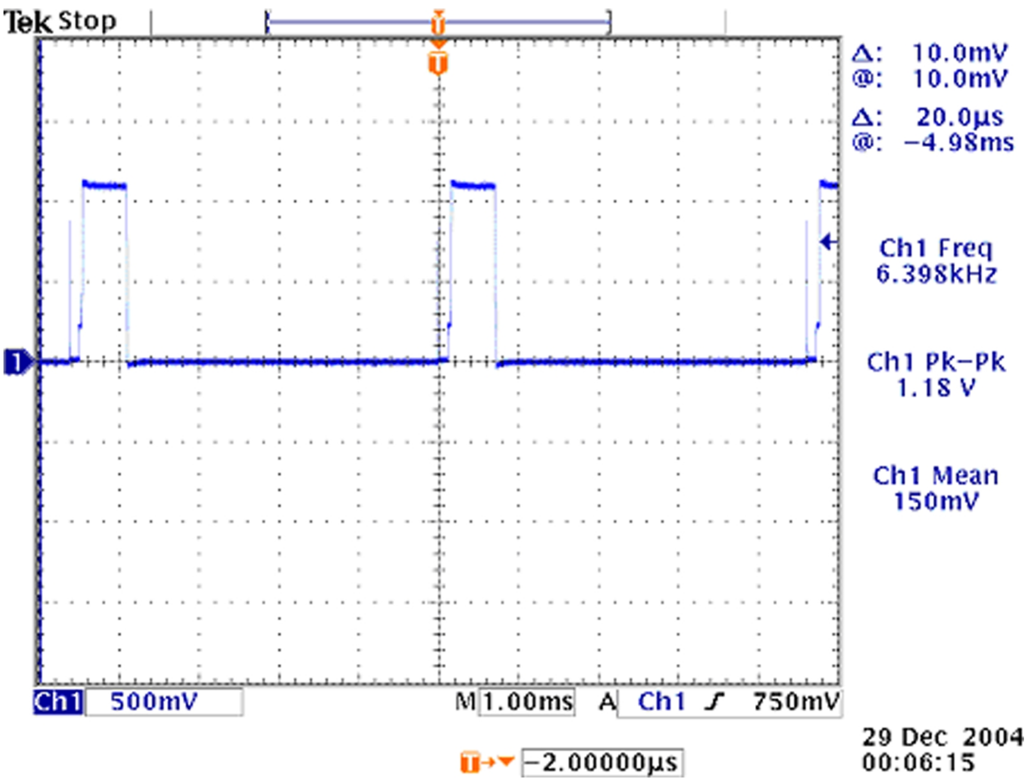


Figure 77 TXC signals at PCL0

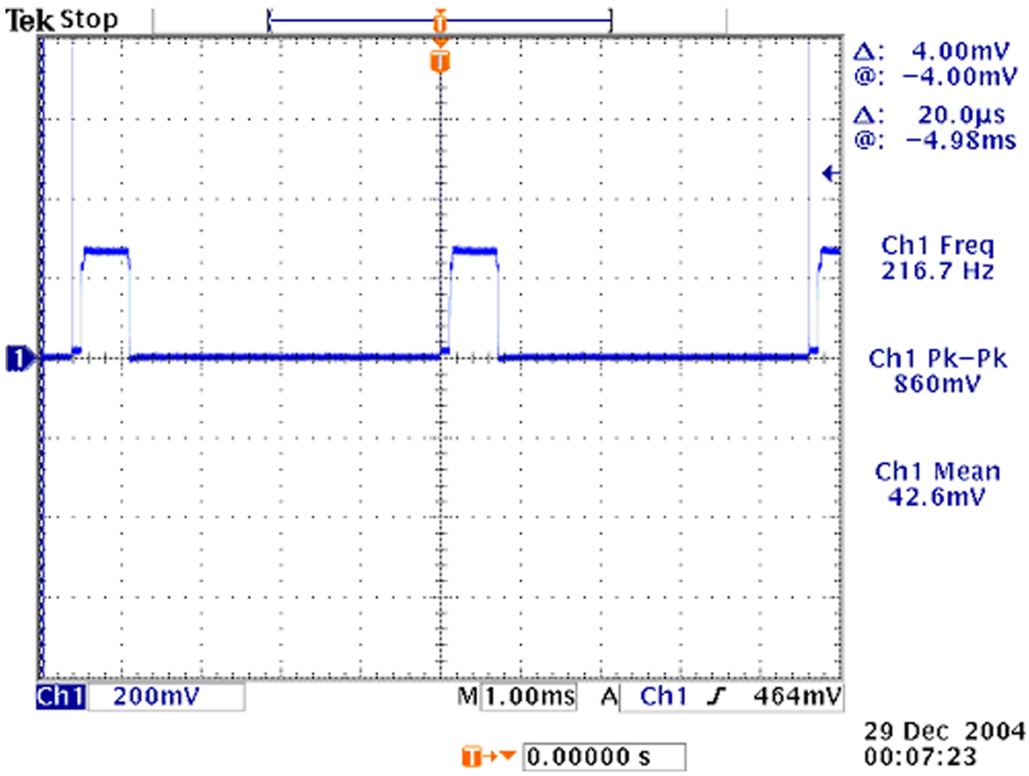


Figure 78 TXC signals at PCL15

Synthesizer troubleshooting

Introduction

26 MHz Reference Oscillator (VCXO)

There is only one PLL synthesizer generating Local Oscillator frequencies for both RX and TX in both bands (PCN and EGSM). The VCO frequency is divided by 2 for PCN operation or by 4 for EGSM operation inside the Mjoelner IC.

The 26MHz oscillator is located near the Mjoelner IC. (N7600). The coarse frequency for this oscillator is set by an external crystal (B7600). The reference oscillator is used as a reference frequency for the PLL synthesizer and as the system clock for the Baseband. The 26MHz signal is divided by 2 to achieve 13MHz inside the UPP IC (D2800).

The 26MHz signal from the VCXO can be measured by probing R2900. The level at this point is approx. 770mVpp. Frequency of this oscillator is adjusted by changing the AFC-register inside the UEM IC. Example Signal Measured at VCXO output (R2900).

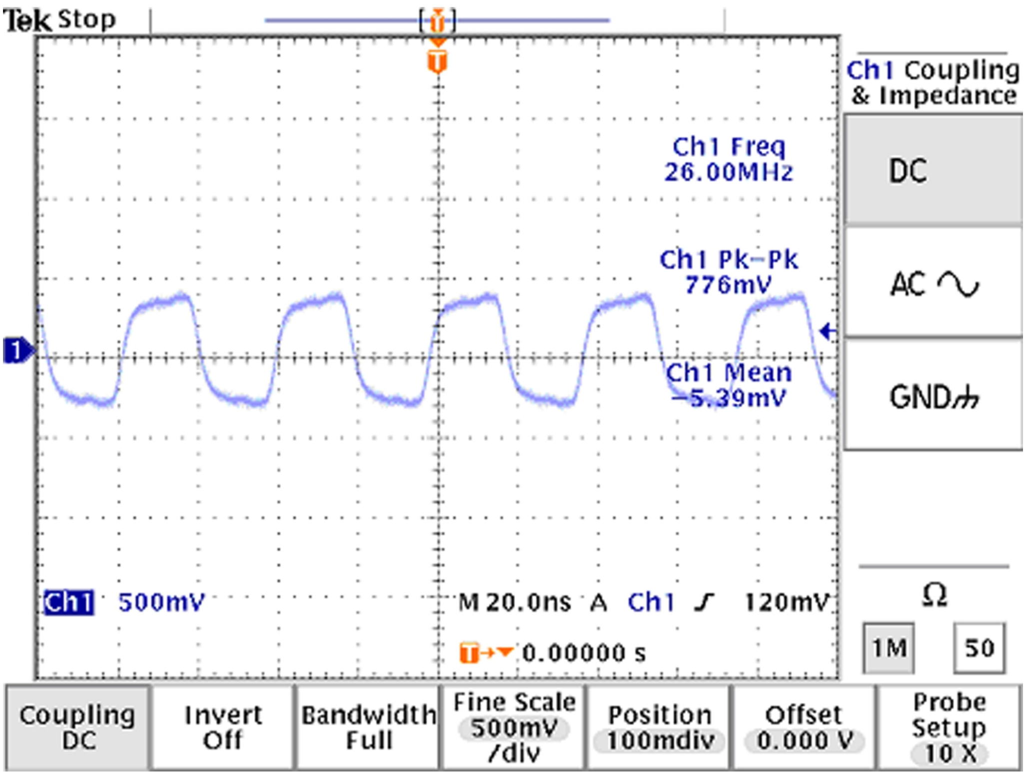


Figure 79 VCXO 26 MHz waveform

Troubleshooting diagram for PLL synthesizer

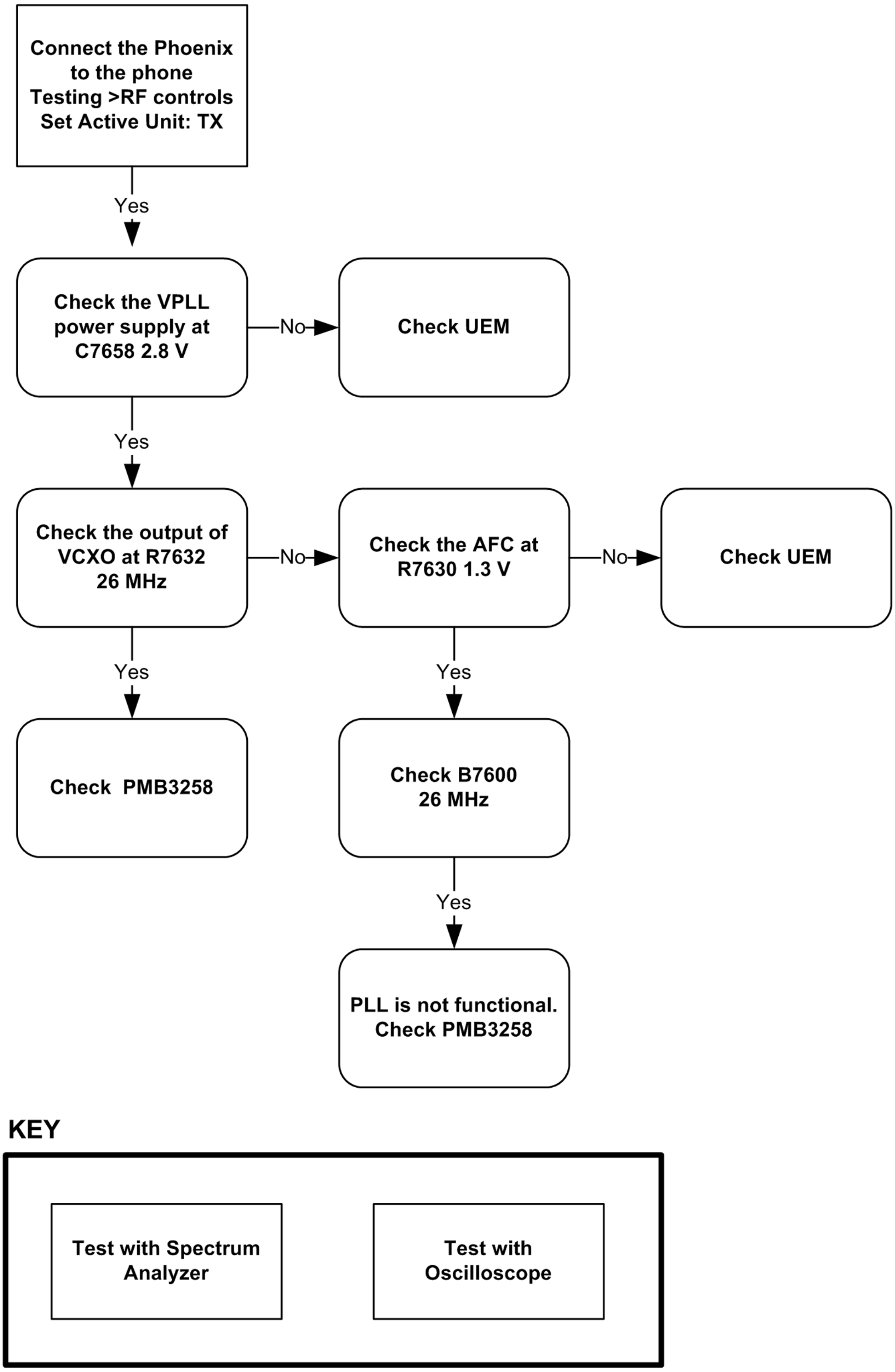


Figure 80 PLL Troubleshooting diagram

Measurement points at the VCXO

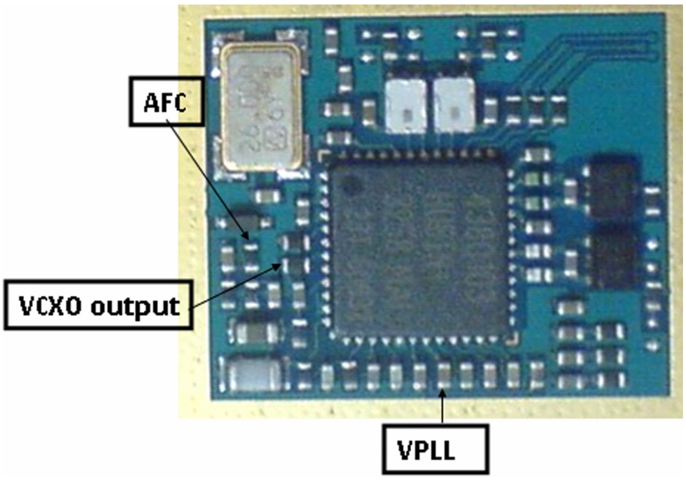


Figure 81 Measurement point for VCXO

FM radio and bluetooth troubleshooting

Measurement settings

Steps

1. Connect the phone to a PC with the module repair jig.
2. Start Phoenix and establish a connection to the phone with the data cable e.g. FBUS.
3. Phoenix settings shall be as follows:

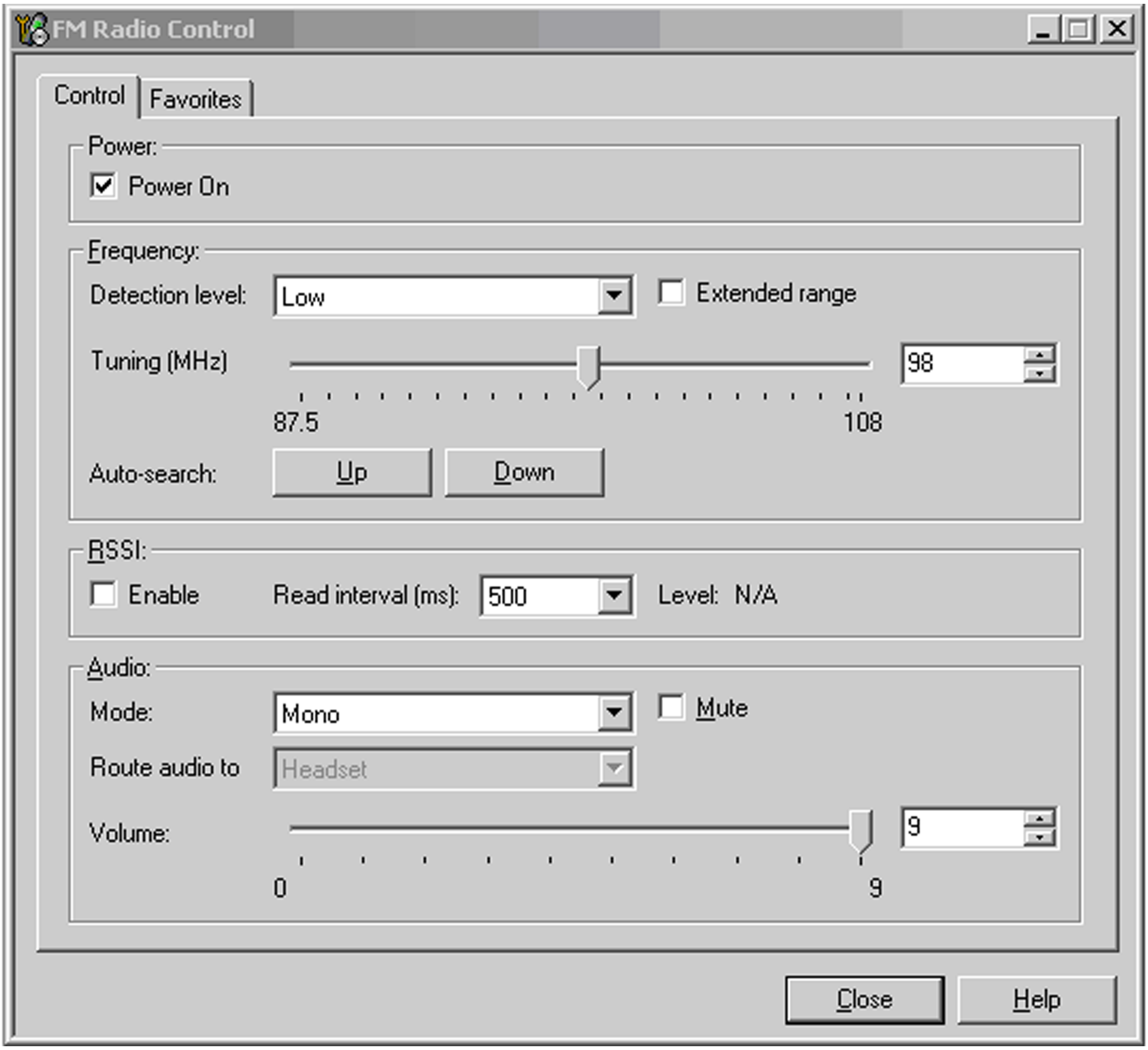


Figure 82 Phoenix settings

4. Establish input of a standard FM signal to the FM module.
5. Signal generator settings shall be as follows:
   i Frequency: 98 MHz
   ii Level: - 60 dBm
   iii FM deviation: 75 kHz
   iv LFGEN frequency: 1 kHZ

Troubleshooting diagram for FM radio

Troubleshooting flow

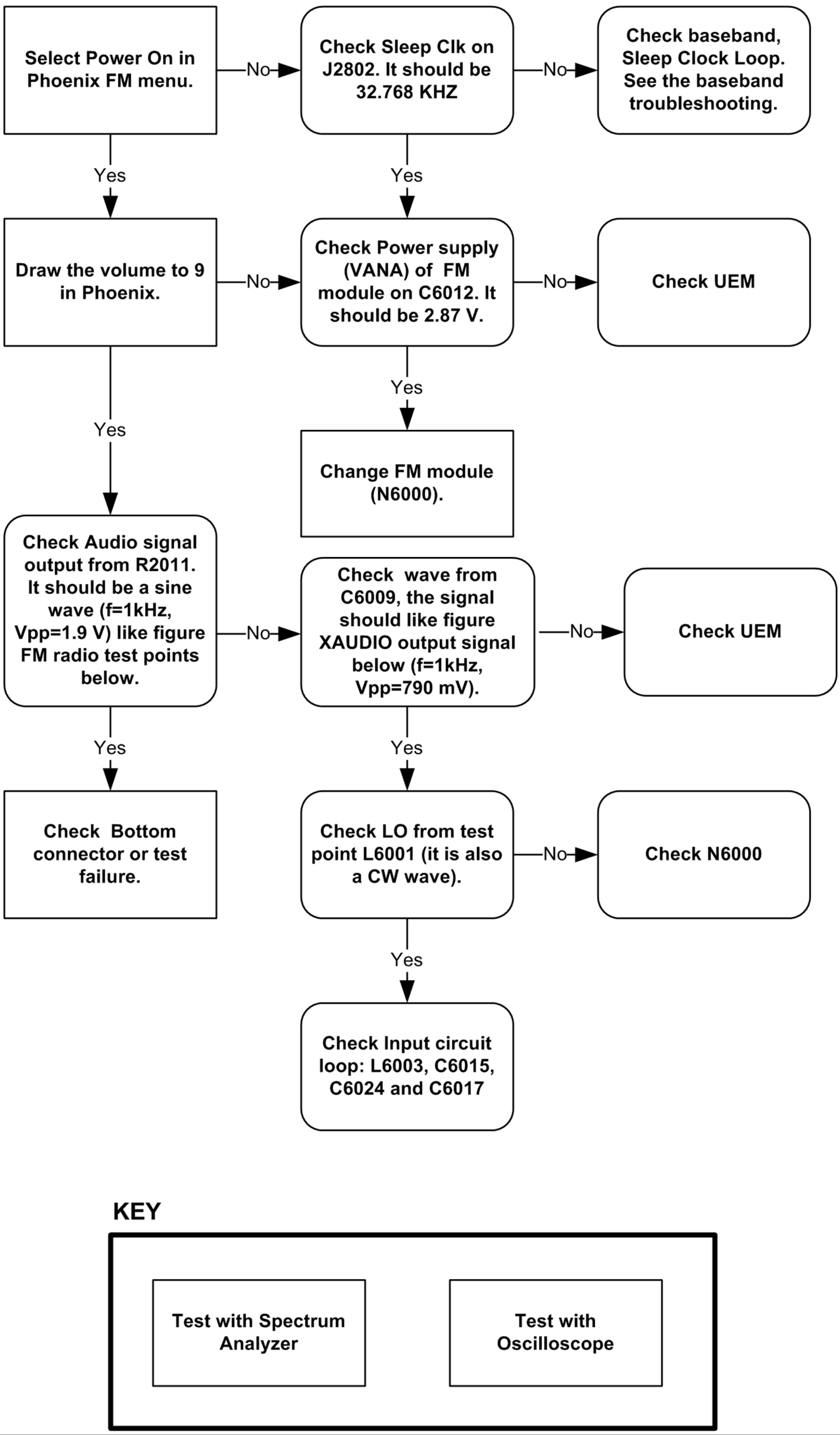


Figure 83 FM radio troubleshooting diagram

Bluetooth and FM radio test points

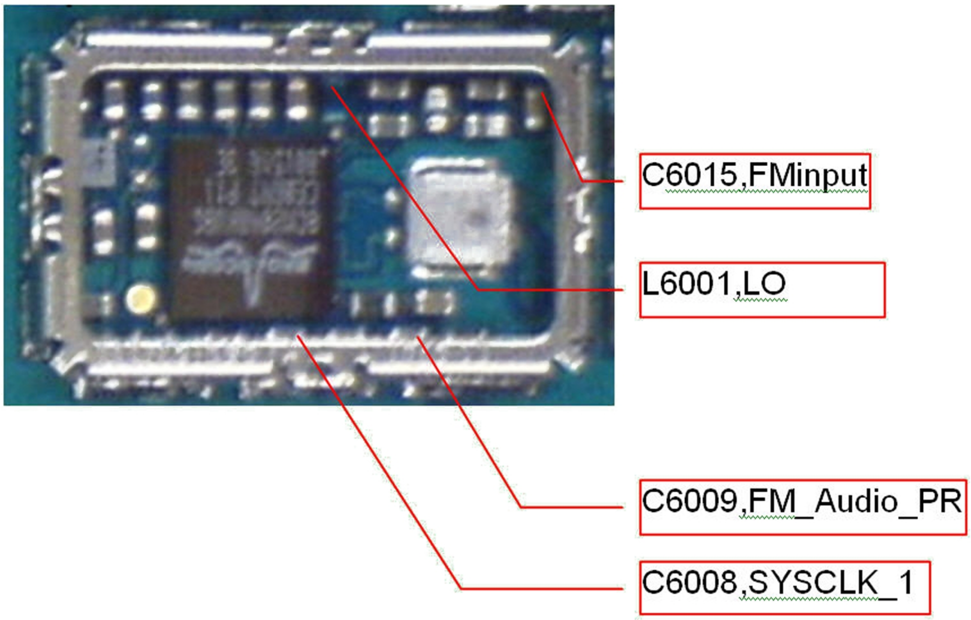


Figure 84 Bluetooth and FM radio test points

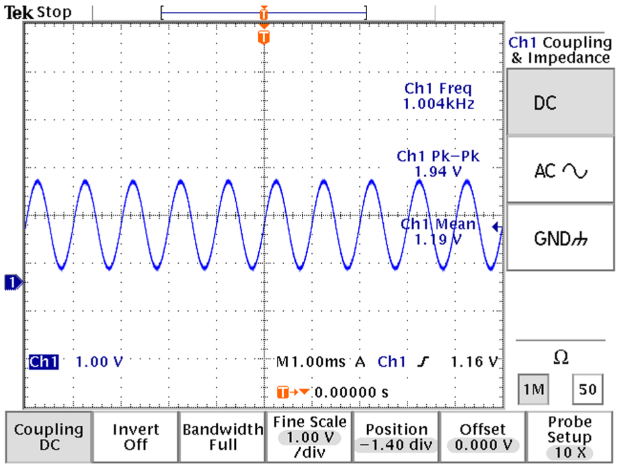


Figure 85 XAUDIO output signal

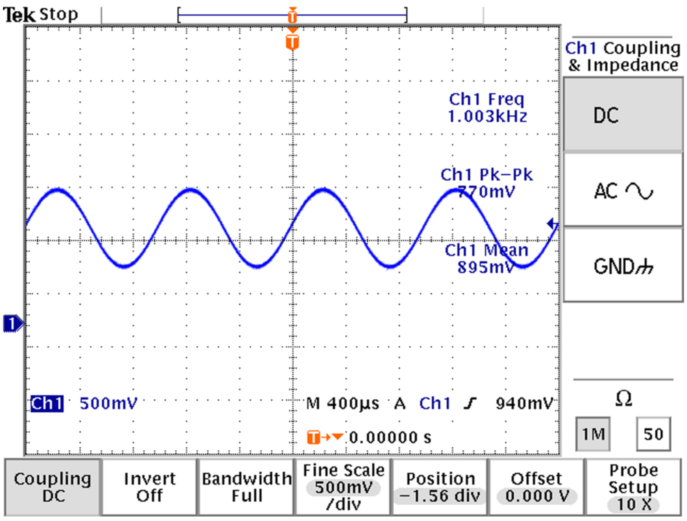


Figure 86 FM module output signal

Introduction to Bluetooth troubleshooting

There are two main Bluetooth (BT) problems that can occur:

Problem	Description
Detachment of the BT antenna.	This would most likely happen if the device has been dropped repeatedly to the ground. It could cause the BT antenna to become loose or partially detached from the PWB.
A malfunction in the BT ASIC, BB ASICs or the phone's BT SMD components.	This is unpredictable and could have many causes i.e. SW or HW related.

The main issue is to find out if the problem is related to the BT antenna or related to the BT system or the phone's BB and then replace/fix the faulty component. For location of the antenna, please refer to the exploded view in the Parts and layouts section.

Bluetooth settings for Phoenix

Steps

1. Start *Phoenix* service software.
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing→Bluetooth LOCALS** .
5. Locate JBT-9's serial number (12 digits) found in the type label on the back of JBT-9.

   In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.
6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.

   This needs to be done only once provided that JBT-9 is not changed.
7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

Results

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

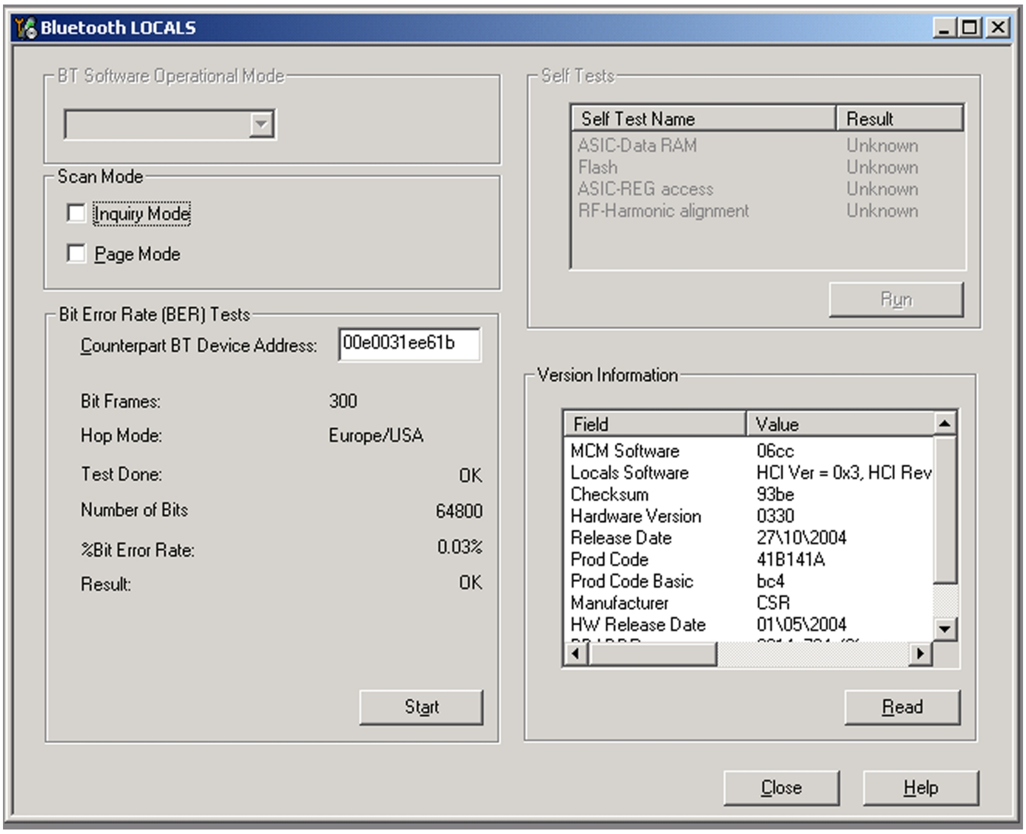


Figure 87 BER test result

Bluetooth self tests in Phoenix

Steps

1. Start *Phoenix* service software.
2. Choose**File→Scan Product.**
3. Place the phone to a flash adapter.
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**

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

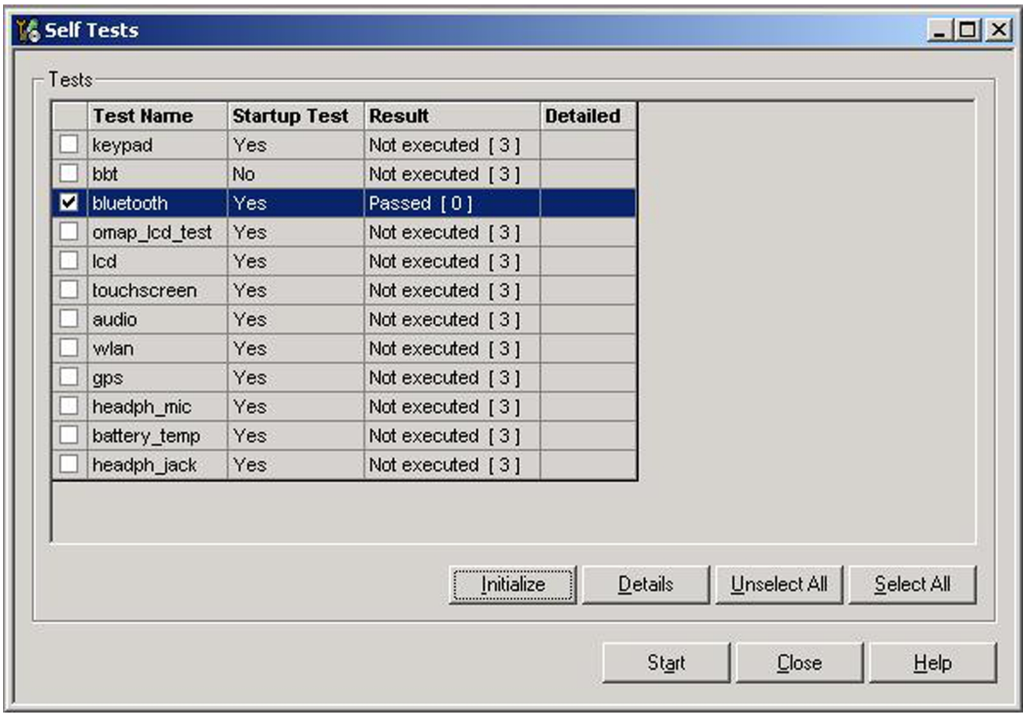


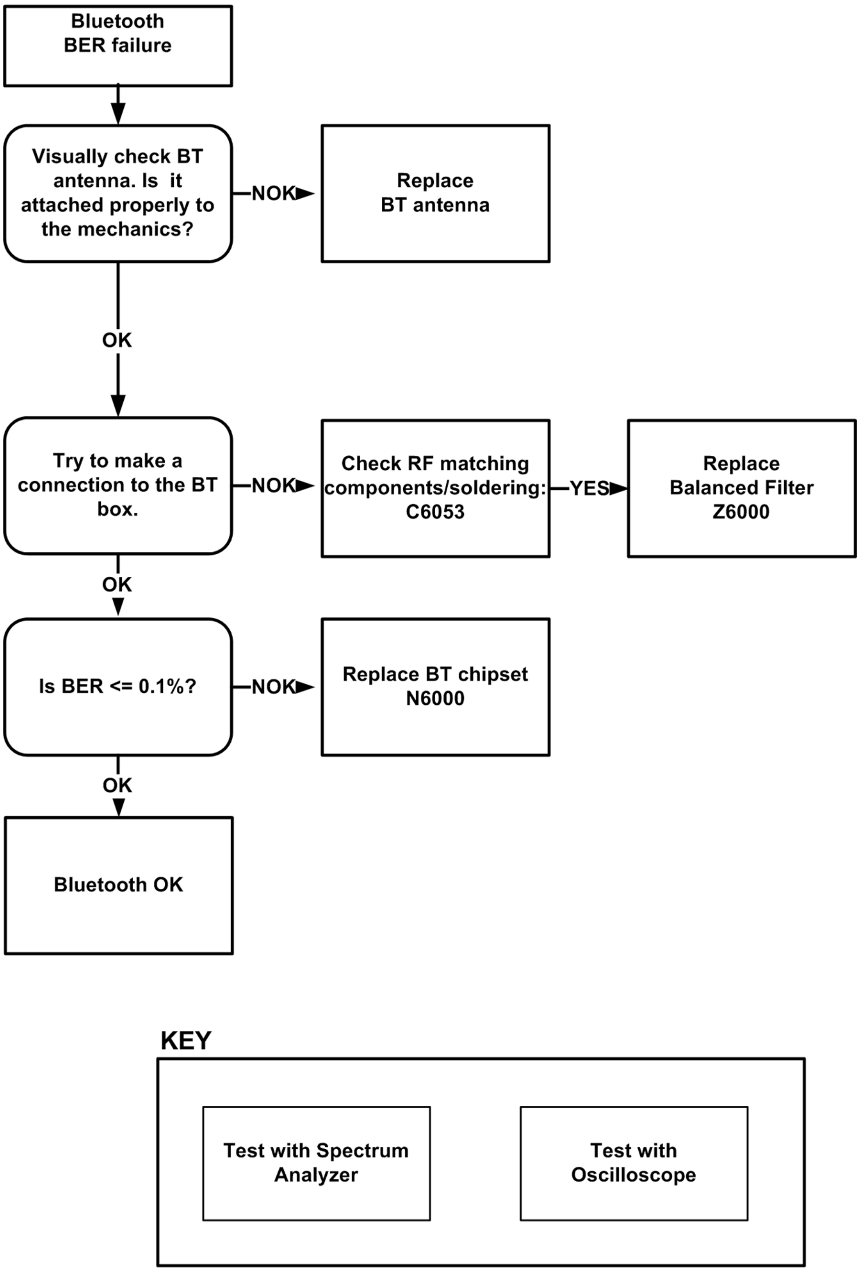
Figure 88 Bluetooth self tests in *Phoenix*

Bluetooth BER failure troubleshooting

Context

Basic encoding rules, BER, is a self-identifying and self-delimiting encoding scheme, which means that each data value can be identified, extracted and decoded individually.

Bluetooth circuit troubleshooting diagram



Antenna troubleshooting

Antenna troubleshooting diagram

Troubleshooting flow

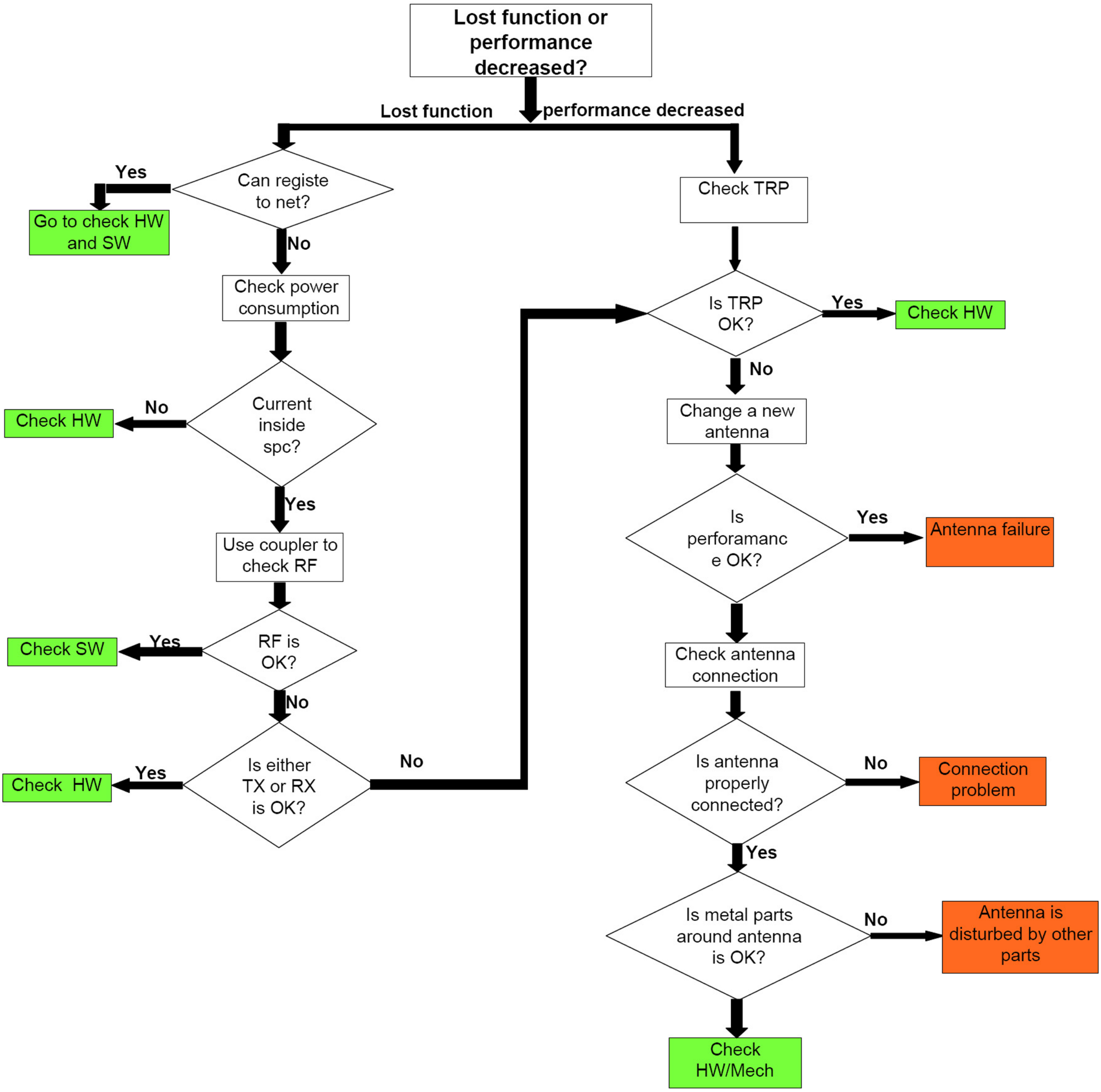


Figure 89 Antenna troubleshooting

5 — Camera Module Troubleshooting

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Introduction to camera module troubleshooting

Background, tools and terminology

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

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

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

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

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

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

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

Terms

Dynamic range	Camera's ability to capture details in dark and bright areas of the scene simultaneously.
Exposure time	Camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically i.e. there is no mechanical moving parts like in film cameras.
Flicker	Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image.
Noise	Variation of response between pixels with same level of input illumination.
Resolution	Usually the amount of pixels in the camera sensor; for example, RM-340/341 has a 640 x 480 pixel sensor resolution. In some occasions the term resolution is used for describing the sharpness of the images.

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

The effect of image taking conditions on image quality

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

Distance to target

The lens in the module is specified to operate satisfactorily from 20 cm to infinite distance of scene objects. In practice, the operation is such that close objects may be noticed to get more blurred when distance to them is shorter than 20 cm. The lack of sharpness is first visible in full resolution images. If observing just the viewfinder, even very close objects may seem to appear sharp. This is normal; do not change the camera module.

Figure 90 Blurred image. Target too close.

The amount of light available

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

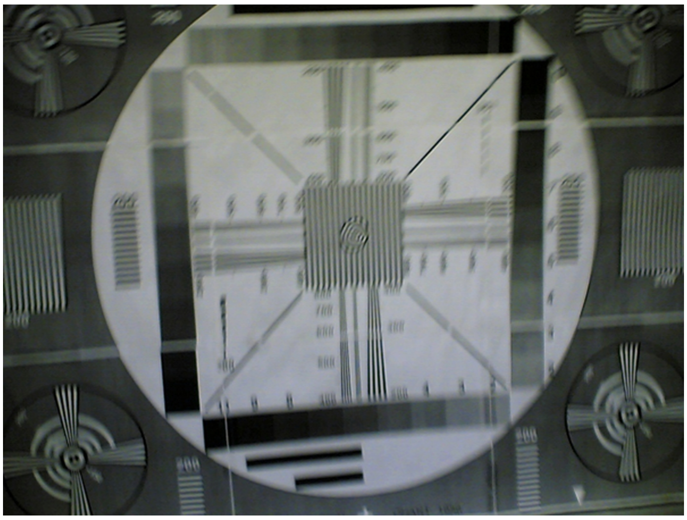


Figure 91 Blurring caused by shaking hands

Movement in bright light

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

Figure 92 Near objects get skewed when taking images from a moving vehicle

Temperature

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

Figure 93 Noisy image taken in +70 degrees Celsius

Phone display

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

Basic rules of photography (especially shooting against light)

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

Figure 94 Image taken against light

Flicker

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

Figure 95 Flicker in an image; object illuminated by strong fluorescent light

Bright light outside of image view

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

Figure 96 A lens reflection effect caused by sunshine

Examples of good quality images

Figure 97 Good image taken indoors

Figure 98 Good image taken outdoors

Camera construction

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

Table 5 Camera specifications

Sensor type	CMOS Sensor
Photo detectors	0.3 million
F number/Aperture	f/2.8
Focal length	1.78 mm
Focus range	20 cm to infinity
Still Image resolutions	640x480, 320x240, 160x120
Still images file format	EXIF (JPEG), *.jpg

Video resolutions	128x96, at 13 frames per second
Video clip length	9 seconds or free, maximal clip length in free mode is 2 minutes (limited by the data storing capabilities of the device)
Video file format	3GPP, *.3gp
Exposure	Automatic
White Balance	Automatic
Colours	16.7 million / 24-bit
Capture Modes	Night mode, Sequence mode, self timer

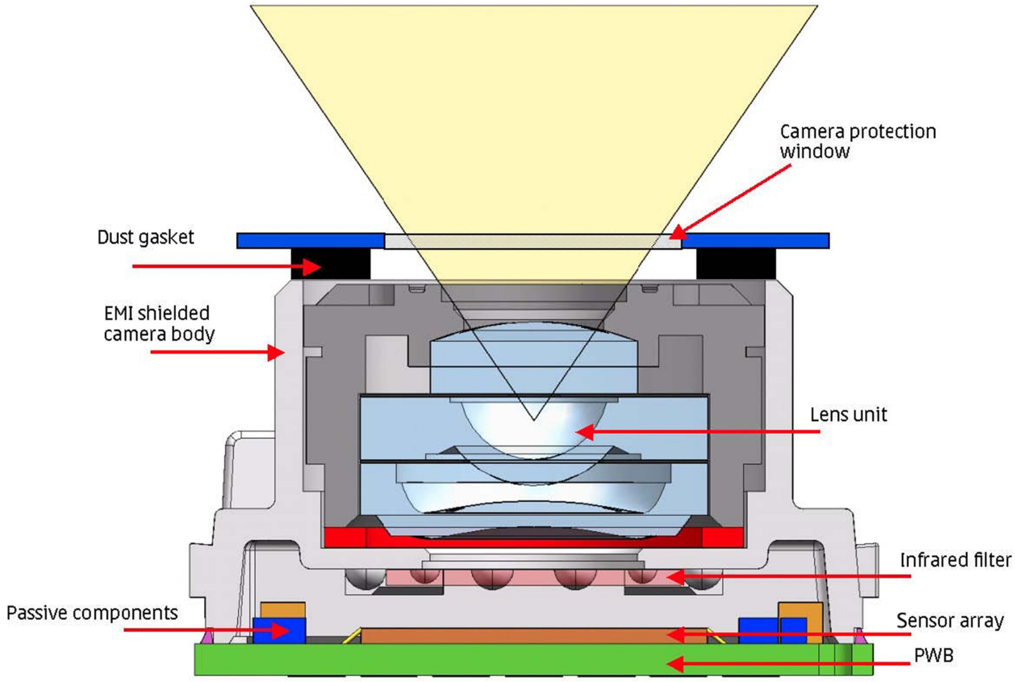


Figure 99 Camera module cross section and assembly principle

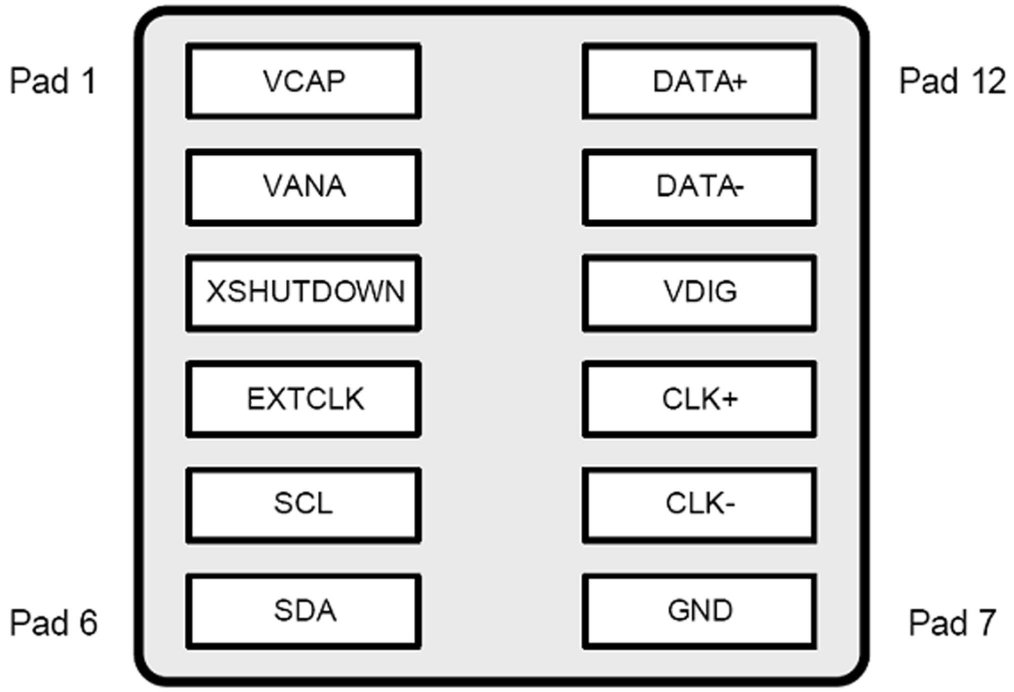


Figure 100 Camera module bottom view including serial numbering

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

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

The main parts of the module are:

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

Dynamic camera configuration

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

DCC data update instruction

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

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

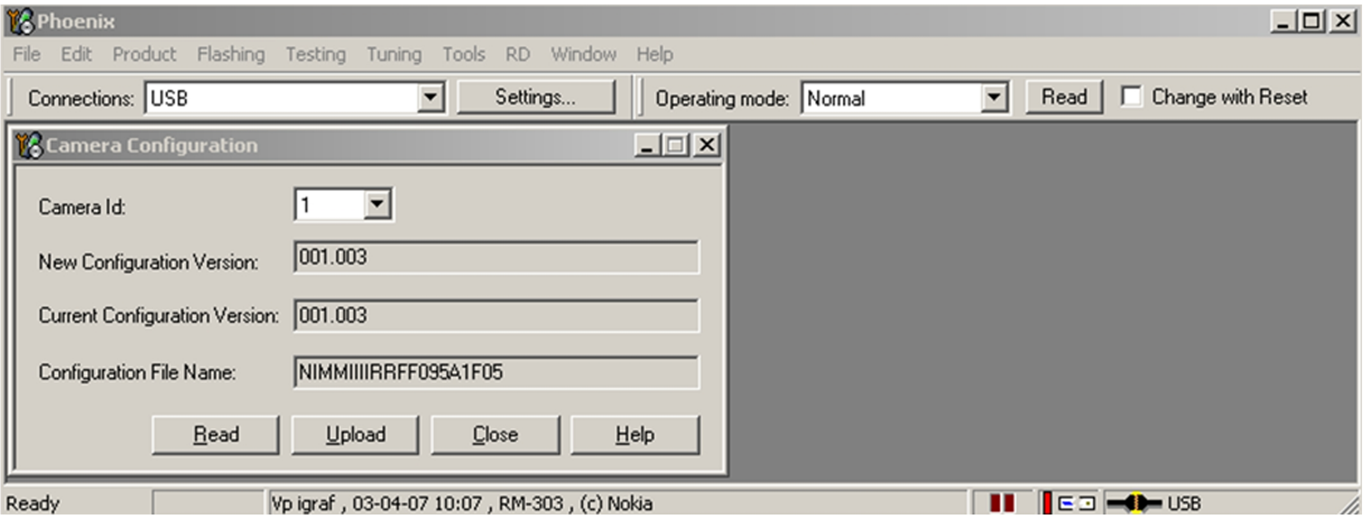


Figure 101 DCC data update

Image quality analysis

Testing for dust in camera module

Symptoms and diagnosis

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

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

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

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

Figure 102 Effects of dust on optical path

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

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

Testing camera image sharpness

Symptoms and diagnosis

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

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

2 The photographed object is too close – the camera lens operates with distances from 20 cm to infinity. This is no cause to replace camera module.

3 User has tried to take pictures in too dark conditions, and images are blurred due to handshake or movement. This is no cause to replace camera module.

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

5 The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

6 The camera lens is misfocused because of a manufacturing error.

7 Very high level of digital zoom is used

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

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

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

Steps

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

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

Next actions

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

Re-check the resolution after changing the camera module.

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

Dirty camera lens protection window

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

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

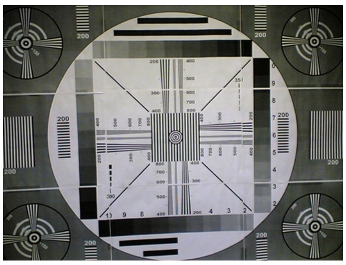


Figure 103 Image taken with clean protection window

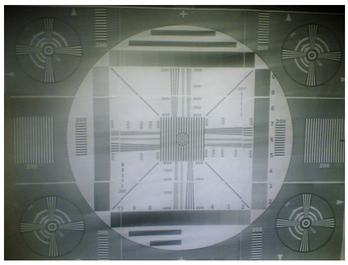


Figure 104 Image taken with greasy protection window

Image bit errors

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

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

Figure 105 Bit errors caused by JPEG compression

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

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

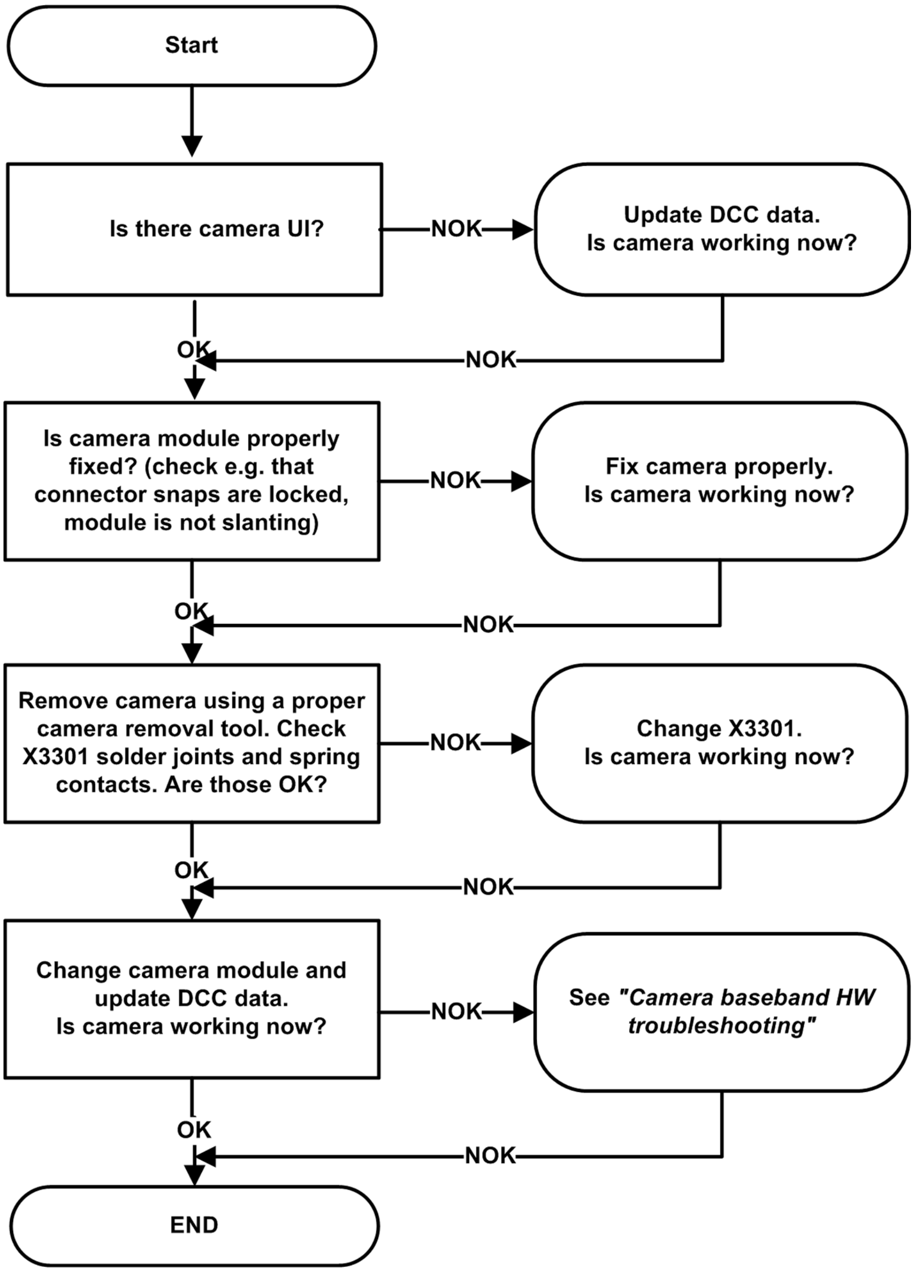
Camera troubleshooting flowcharts

Camera hardware failure message troubleshooting

Context

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

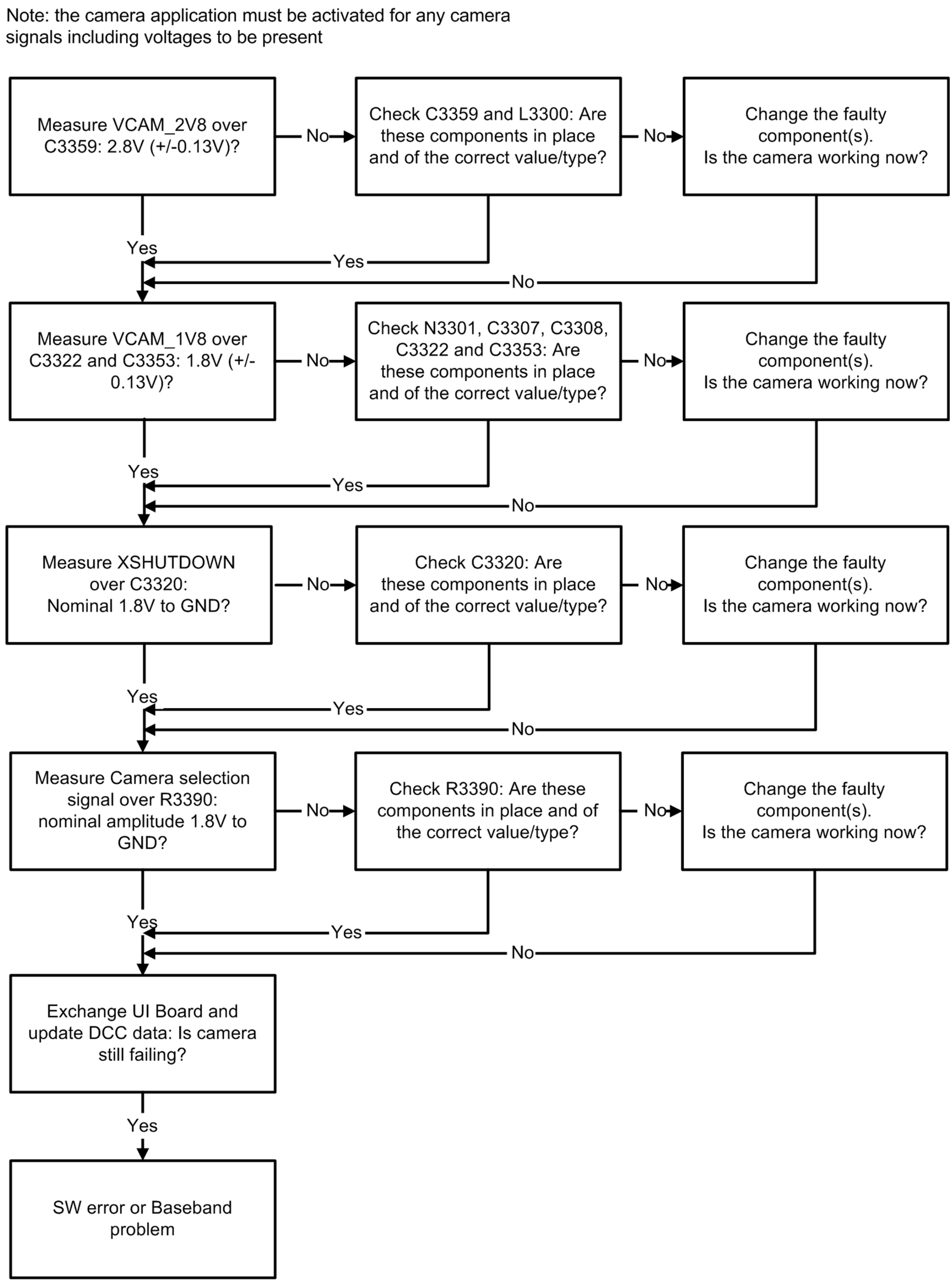
Troubleshooting flow



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

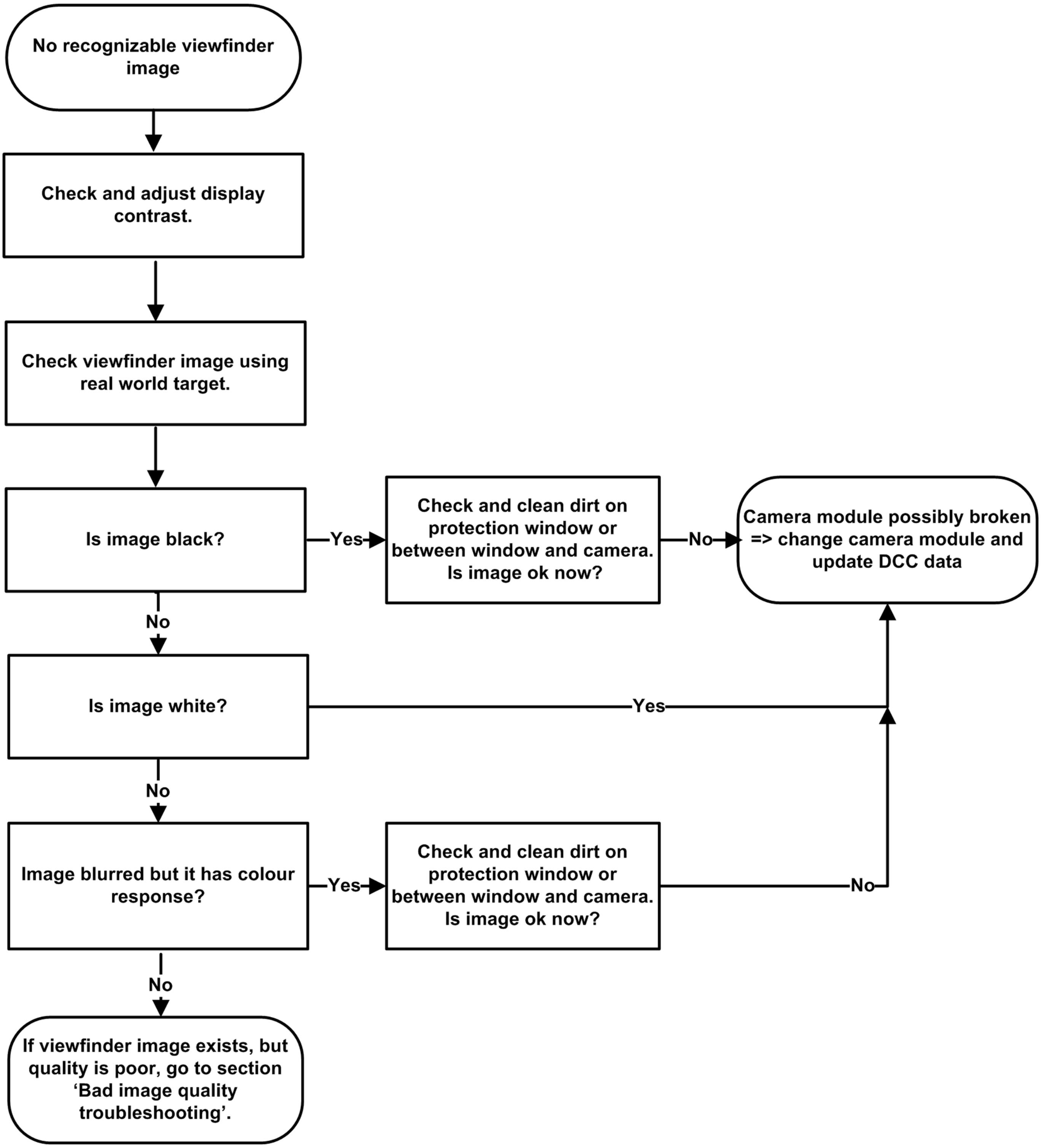
Camera baseband HW troubleshooting

Troubleshooting flow



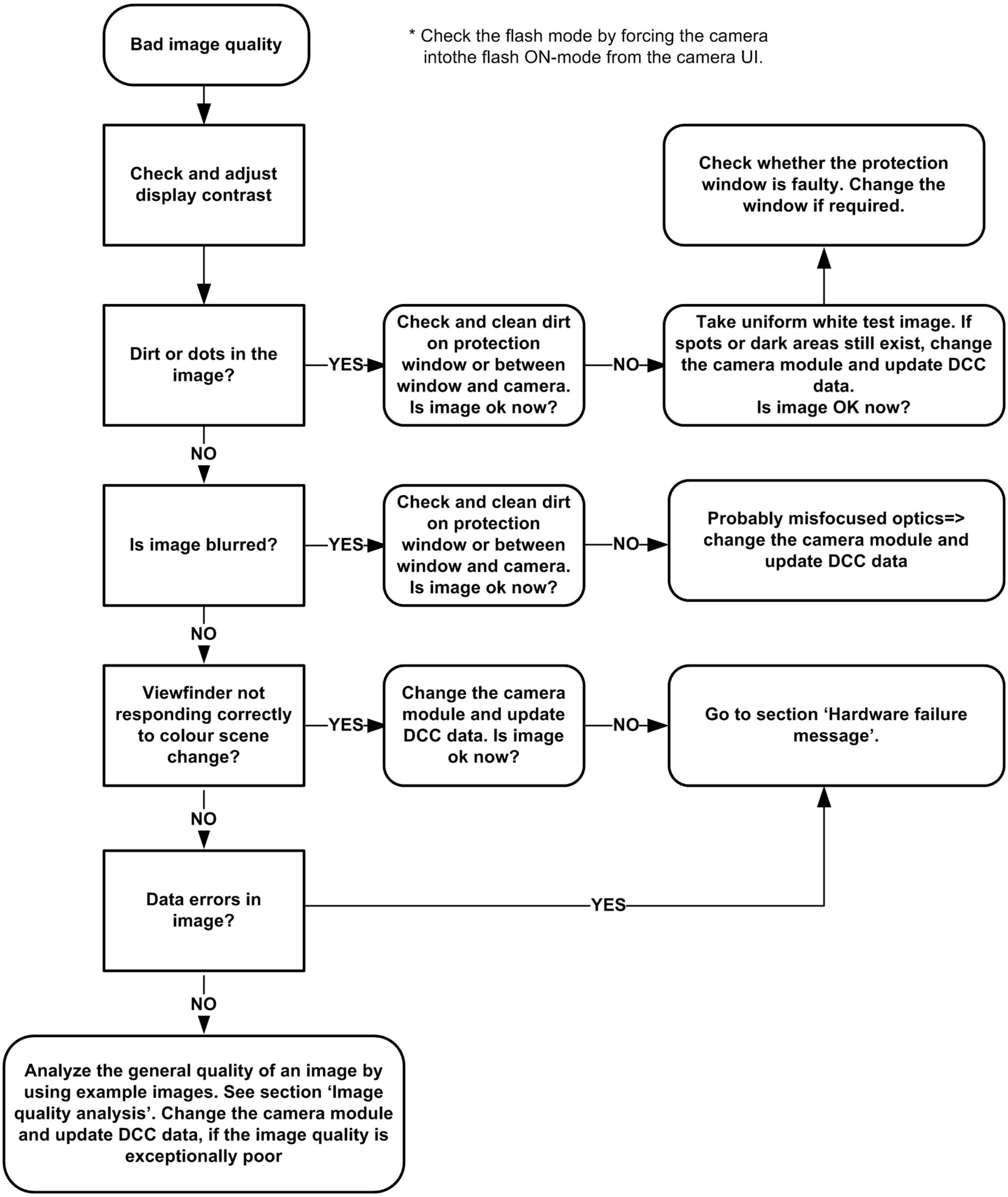
Camera viewfinder troubleshooting

Troubleshooting flow



Bad camera image quality troubleshooting

Troubleshooting flow



6 — System Module

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System module block diagram

The main board consists of a radio frequency part and a baseband part. The User Interface parts are situated at the UI side, which is on the opposite side of the engine board. The 2CP is the engine module of the mobile device, and the 2CQ is the UI module of module of the mobile device.

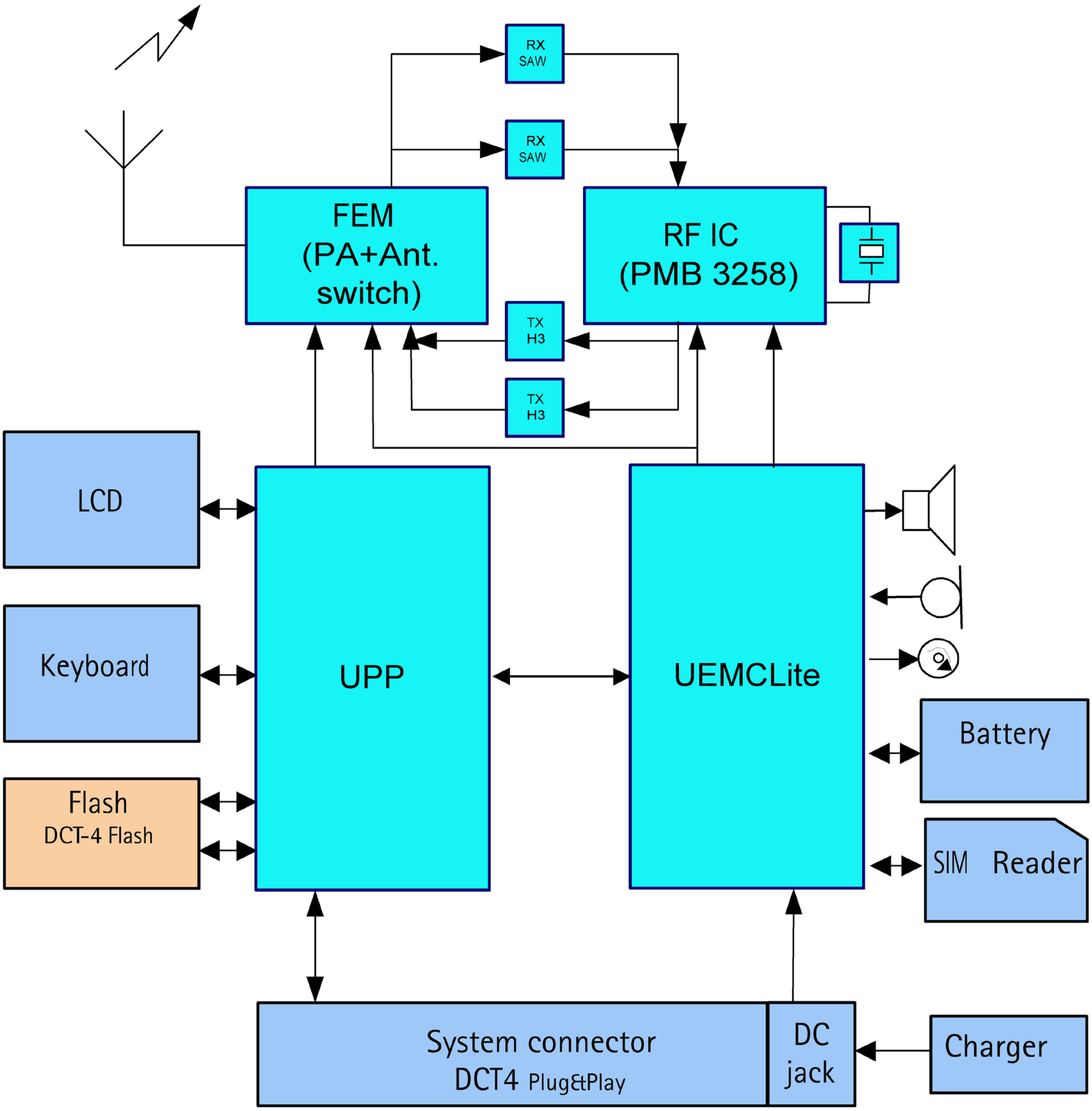

Figure 106 Module block diagram

Baseband description

Functional description

The BB core is based on UPP8M CPU. UPP8M takes care of all the signal processing and operation controlling tasks of the mobile device. For power management, there is one main ASIC for controlling charging and supplying power UEMCLite plus a discrete power supply. The main reset for the system is generated by the UEMCLite. The memory comprises of 128 Mbit flash and 16 Mbit PsRAM. memory devices that are stacked on top of each other in a single Combo package.

The interface to the RF and audio sections is also handled by the UEMCLite. This ASIC provides A/D and D/A conversion of the in-phase and quadrature receive and transmit signal paths and also A/D and D/A conversions of received and transmitted audio signals. Data transmission between UEMCLite and RF and the UPP8M is implemented using different serial connections (CBUS, DBUS and RFBUS). Digital speech processing is handled by UPP8M ASIC.

A real time clock function is integrated into UEMCLite, which utilizes the same 32 kHz-clock source as the sleep clock. The SLCK/RTC runs all time when the phone battery is connected. It is running also when the phone is switched off. In UEMCLite there is no back up battery/capacitor connection.

There are three audio transducers in the product; 16 mm speaker, an earpiece and a microphone. The earpiece is used to generate audios for earpiece; the speaker is used to generate audios for IHF and ringing tones. A separate audio amplifier drives the speaker. There is only one microphone for both HS and IHF modes.

The display is an TFT type color display with 65536 colors and 128 x 160 pixels with backlighting. The keypad module features a function keymat with a 4-way navigation key with a center selection key.

UPP

UPP (Universal Phone Processor) is the digital ASIC of the DCT4 generation base band. UPP8M includes 4.5 MBit internal RAM, 16/32-bit RISC MCU core. UPP8Mv6.11 includes ARM7TDMI rev4 16/32-bit RISC MCU core, TI Lead3 16-bit DSP phase2+ core with DMA controller, ROM for MCU boot code and all digital control logic.

Memory

This mobile uses two kinds of memories, Flash and Synchronous RAM (SRAM). These memories have are sharing the same bus interface to UPP8M. SDRAM is used as the working memory. The SRAM size is 16 Mbits.

SRAM I/O is 1.8 V and core 1.8 V supplied by UEMCLite regulator VIO. All memory contents are lost if the supply voltage is switched off.

Multiplexed flash memory interface is used to store the MCU program code and user data.

Configuration of flash memory is a 128 Mbit NOR flash memory. Flash I/O and core voltage are 1.8 V.

UEMCLite

The UEMCLite is a low cost energy management ASIC contains for BB use two 2.78V LDO regulators, 1.8V linear regulator, programmable 1.0 - 1.5 V linear regulator and 1.8/3.0 V LDO regulator. For RF use UEMCLite has five 2.78 V LDOs. In addition, the UEMCLite contains audio codec, A/D converters, RF converters, many drivers, etc.

External regulators

White LED Driver solution is implemented with DC/DC converter. The driver circuit is controlled by UEM output pin DLIGHT, which add external pull up using a digital transistor and one resistor. The schematics also combined the UEMIO (5) to control DC/DC enable as another optional using two jumper.

Energy management

Filter components

The master of EM control is UEMCLite and with SW it has the main control of the system voltages and operating modes. The power distribution diagram is presented in the illustration below.

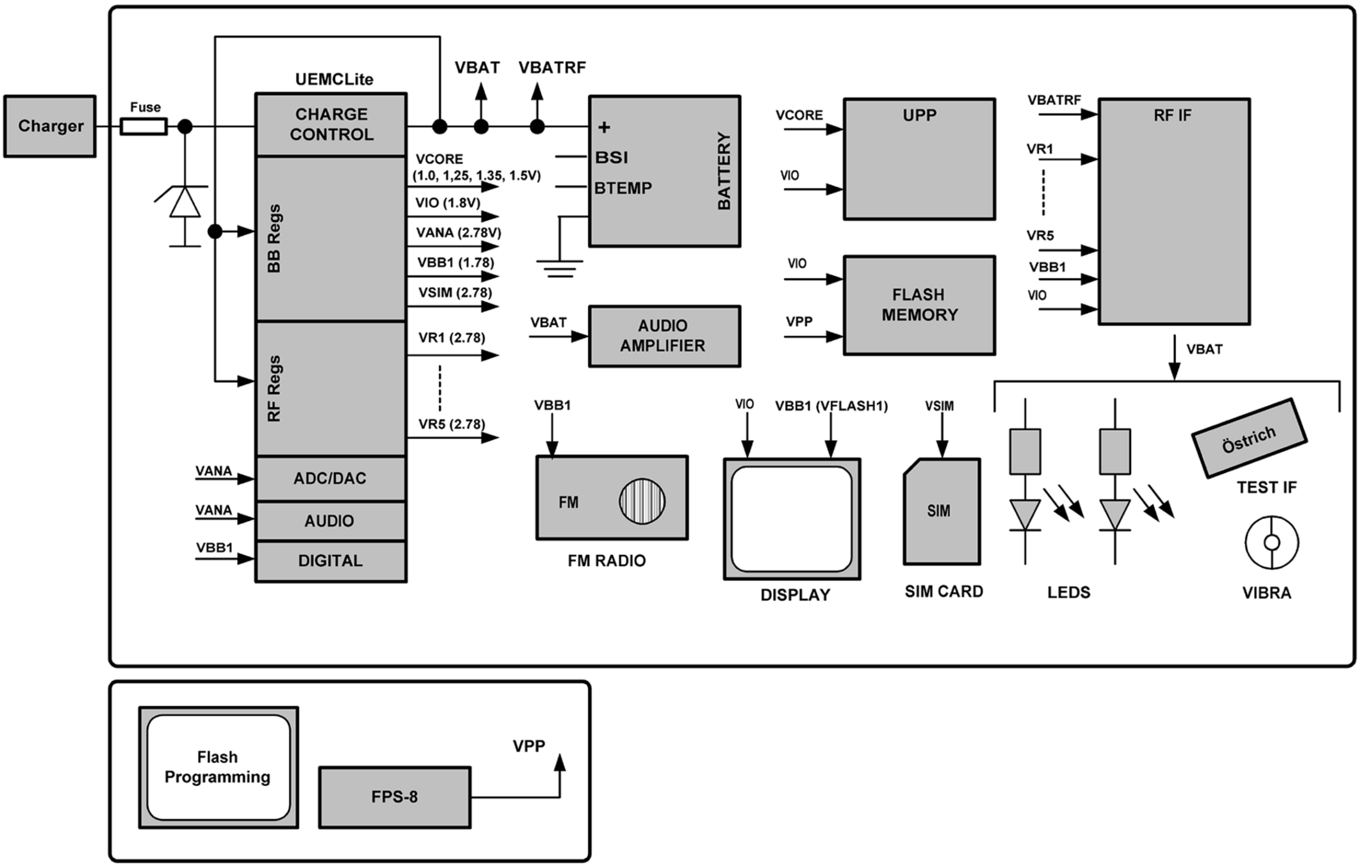

Figure 107 Power connection diagram

All connectors going to the “outside world” have filter components, ESD protection and EMC reduction. The Digital/Data lines on SIM have special dedicated filter ASIP. The below figure show the SIM filtering.

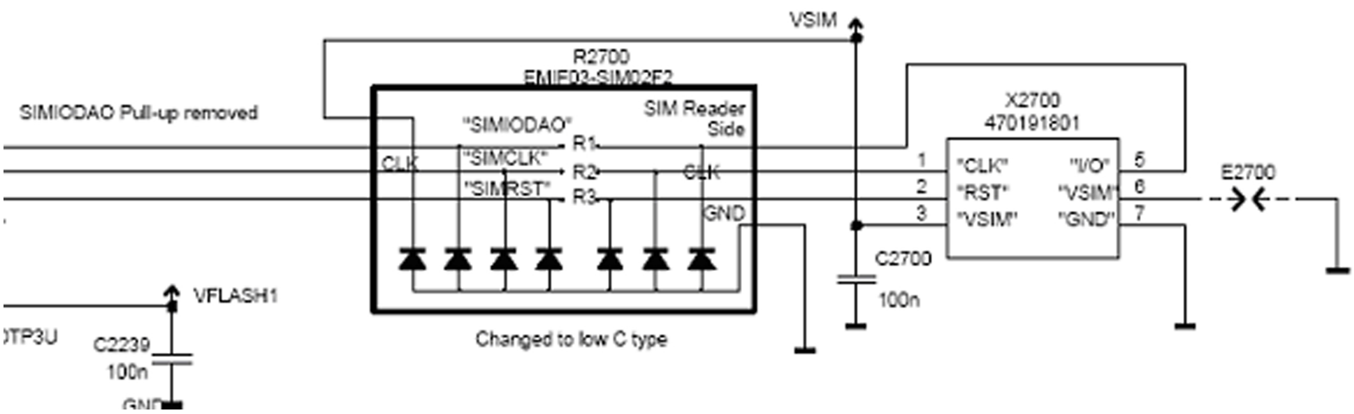

Figure 108 SIM filtering

The Audio circuit: Earpiece, IHF, internal microphone and external speaker are filtered with discrete components (common mode reduction coils, Varistors, caps and resistors), where as the external microphone uses differential mode mic. ASIP

The 16 UEMEClite BB & RF regulators are specified to have a decoupling cap of 1 μF ±20%.

Modes of operation

BB4.0 LiteV2 base band has five different functional modes, which are defined in UEMCLite specification:

- No supply: In NO_SUPPLY mode, the phone has no supply voltage. This mode is due to disconnection of main battery or low battery voltage level in battery. Phone is exiting from NO_SUPPLY mode when sufficient battery voltage level is detected. Battery voltage can rise either by connecting a new battery with VBAT > VMSTR+ or by connecting charger and charging the battery above VMSTR+.
- Acting Dead: If the phone is off when the charger is connected, the phone is powered on but enters a state called "Acting Dead". To the user, the phone acts as if it was switched off. A battery charging alert is given and/or a battery charging indication on the display is shown to acknowledge the user that the battery is being charged.
- Active: In the Active mode the phone is in normal operation, scanning for channels, listening to a base station, transmitting and processing information. There are several sub-states in the active mode depending on if the phone is in burst reception, burst transmission, if DSP is working etc.

  In Active mode the RF regulators are controlled by SW writing into UEMCLite's registers wanted settings: VR regulators can be disabled, enabled or forced into low quiescent current mode. VR2 is always enabled in Active mode for system clock chain supply
- Sleep: In sleep mode VCTCXO is shut down and 32 kHz sleep clock oscillator is used as reference clock for the base band.
- Charging: Charging can be performed in any operating mode. The battery type / size is indicated by a resistor inside the battery pack. The resistor value corresponds to a specific battery capacity. This capacity value is related to the battery technology as different capacity values are achieved by using different battery technology. The battery voltage, temperature, size and current are measured by the UEMCLite and controlled by the charging software running in the UPP. The charging control circuitry (CHACON) inside the UEMCLite controls the charging current delivered from the charger to the battery. The battery voltage rise is limited by turning the UEMCLite switch off when the battery voltage has reached 4.2 V. Charging current is monitored by measuring the voltage drop across a 220 mW resistor. The PWM output doesn't exist any more from UEMCLite to the bottom connector

Voltage limits

Table 6 Voltage limits

Parameter	Description	Value/V
Vmstr+	Master reset threshold (rising)	2.1 ±0.1
Vmstr-	Master reset threshold (falling)	1.9 ±0.1
Vcoff+	Hardware cutoff (rising)	3.1 ±0.1
Vcoff-	Hardware cutoff (falling)	2.8 ±0.1
SW shutdown	SW cutoff limit (> regulator drop-out limit) MIN!	3.2 V

Audio function description

The basic audio structure and communication between HW-audio modules and the audio ASIC's is illustrated in the block diagram below.

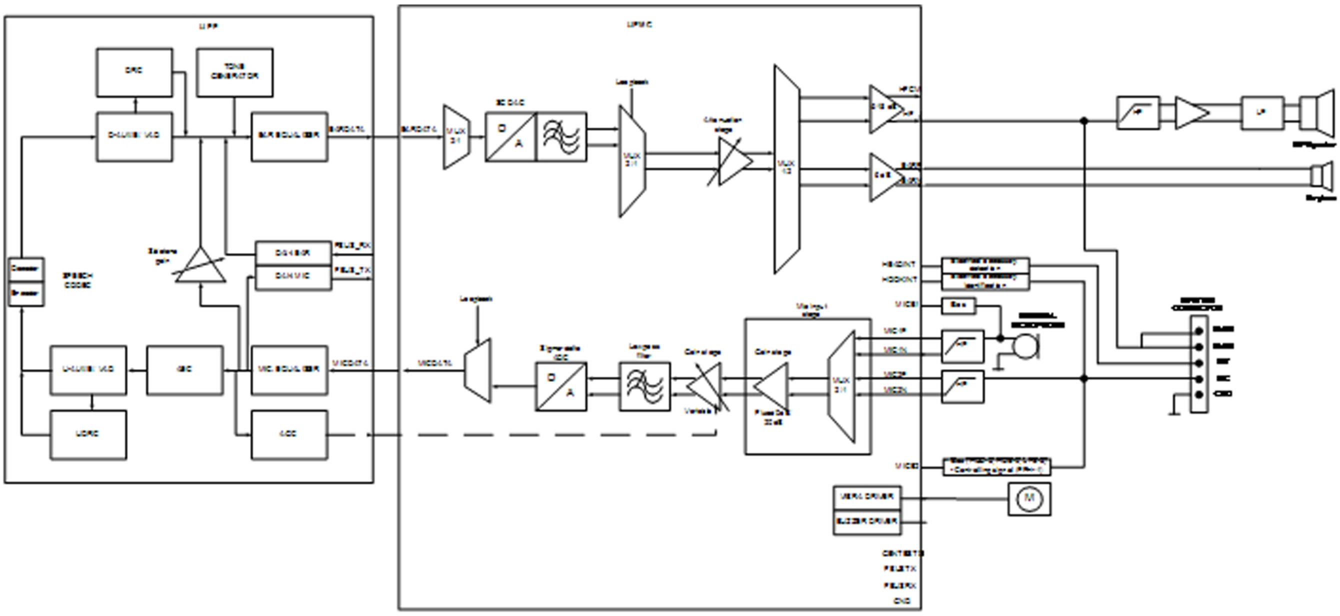

Figure 109 Audio block diagram

UEMcLite supports three microphone inputs and two outputs. The inputs can be used for internal, headset or handsfree microphones. The microphone signals from different sources are connected to separate inputs at the UEMcLite ASIC. The inputs and outputs are all differential.

Three inputs (MIC1, MIC2) and two outputs (EAR, HF) are used in the phone.

MIC1P/MIC1N inputs are used for the internal microphone, using single-ended biasing circuitry. EARP/EARN outputs from UEMcLite are used for hand-portable mode.

Uplink external audio (headset as well as carkit) is connected to MIC2P/MIC2N, while downlink audio is provided via the HF outputs from UEMcLite. A special situation exists since the carkit can be used with two different microphones: either the phone's internal microphone (MIC1-inputs) or an external microphone that connects to the carkit. In these cases UEMcLite is capable of switching between MIC1 and MIC2.

The audio control is taken care of by UEMcLite, which contains the MCU and audio codec. UPP contains DSP blocks, and handling and processing of the audio signals.

Input and output selection, and gain control is performed inside UEMcLite. DTMF-tones and other audio tones are generated and encoded by UPP and transmitted to UEMcLite for decoding.

External audio connector

The system connector, containing a 4-pole Jack plug, gains the access to the external audio interface. The Jack plug, which is integrated in the system connector, contains a mechanical switch, which is used to detect the connection of the accessories. The configuration for the 4-pole Jack-plug is shown in the following figure.

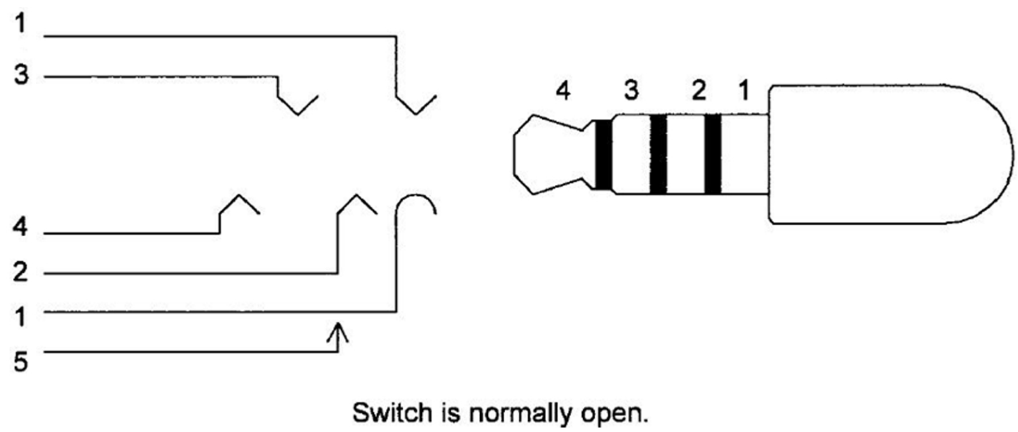

Figure 110 4-pole jack plug for audio accessory

Table 7 Connector for External Audio Accessories

Pin	Signal name	Direction	Description
5	PLUGDET	Input	Terminal internal connection, plug detection
4	HS EAR L	Output	Audio output
3	HS EAR R	Output	Audio output
2	HS MIC	Input	Multiplexed microphone audio and control data
1	HS GND	-	Ground contact

HALL sensor

The HALL sensor is used to recognize the position of the flap.

The HALL sensor incorporates advanced chopper-stabilization techniques to provide accurate and stable magnetic switch points. The circuit design provides an internally controlled clocking mechanism to cycle power to the HALL element and analog signal processing circuits. This serves to place the high current-consuming portions of the circuit into the sleep mode. Periodically the device is awakened by this internal logic and the magnetic flux from the HALL element is evaluated against the predefined thresholds. If the flux density is above or below the BOP/BRP thresholds, the output transistor is driven to change states accordingly. While in the sleep cycle, the output transistor is latched in its previous state.

The output transistor of the SH248CSP is latched on at the presence of a sufficiently strong south or north magnetic field facing the marked side of the package. The output is latched off in the absence of a magnetic field.

The output of hall sensor is sent to GENIO24 of UPP. Baseband knows the status of the hall sensor that represents the phone position (folded or not).

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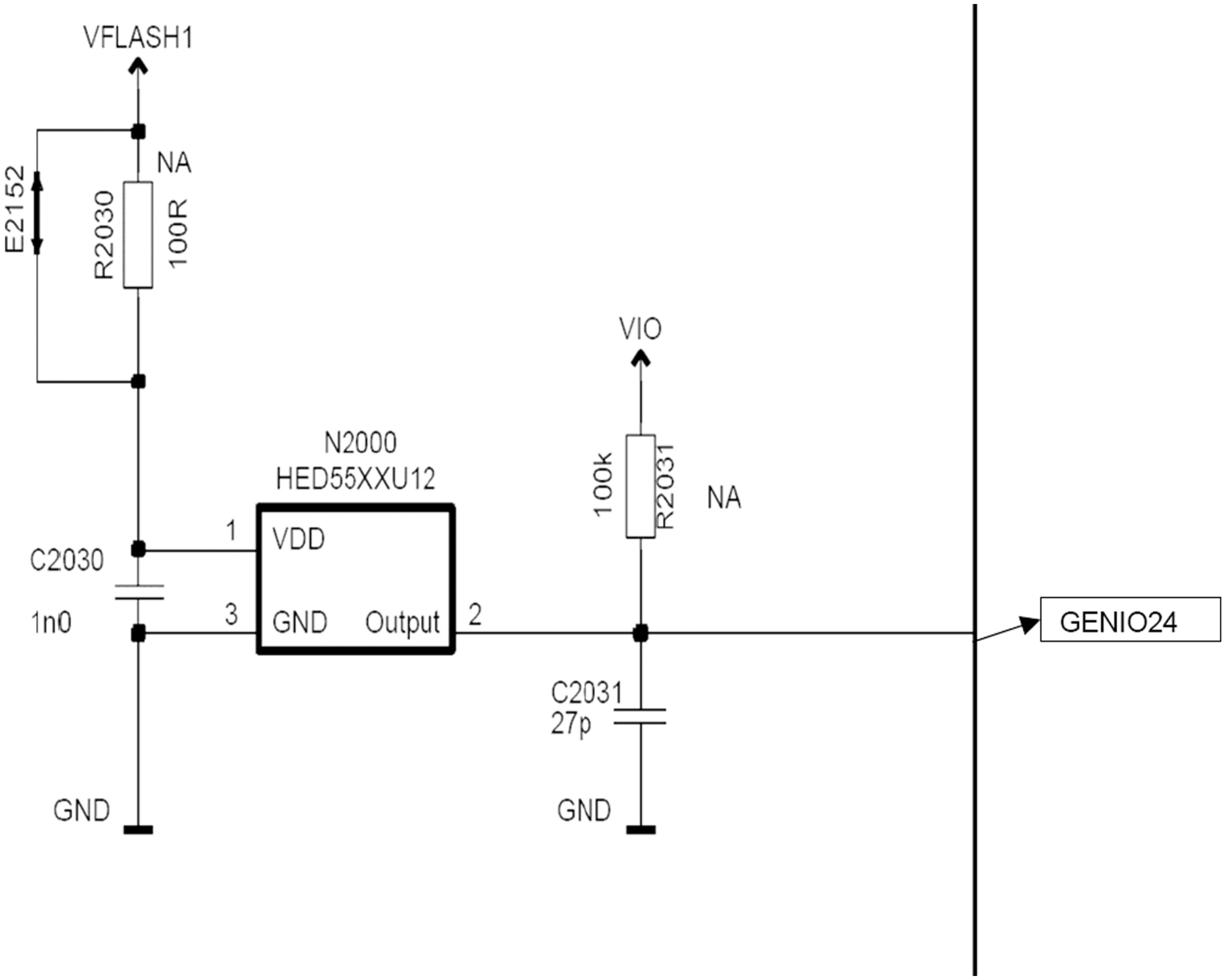

Figure 111 HALL sensor

Interfaces

RF and baseband interfaces

Table 8 AC and DC Characteristics of BB4.0 LiteV2 RF-Base band Digital Signals

Signal name	From	To	Para-meter	Input characteristics				Function
				Min	Typ	Max	Unit	
TXP1	UPP	RF-IC	1	1.38		1.88	V	Depends of the RF design
RFGenOut3	GenIO5		0	0		0.4	V	
			Load Resistance	10			kW	
			Load Capacitance			20	pF	
			Timing Accuracy			¼	symbol	
TXP2	UPP	RF-IC	1	1.38		1.88	V	Depends of the RF design
	(GenIO6)		0	0		0.4	V	
			Load Resistance	10			kW	
			Load Capacitance			20	pF	
			Timing Accuracy			¼	symbol	
RFBusEn1X	UPP	RF-IC	1	1.38		1.88	V	RFIC Chip SelX
			0	0		0.4	V	
			Internal PU Current			50	uA	
			Load resistance	10			kW	
			Load capacitance			20	pF	

Signal name	From	To	Para-meter	Input characteristics				Function
				Min	Typ	Max	Unit	
RFBusDa	UPP / RF-IC	RF-IC/ UPP	1	1.38		1.88	V	Bi-directional RF Control serial bus data,
			0	0		0.4	V	
			Load resistance	10			kW	
			Load capacitanc e			20	pF	
			Data frequency			13	MHz	
RFBusClk	UPP	RF IC	1	1.38		1.88	V	RF Control serial bus bit clock
			0	0		0.4	V	
			Load resistance	10			kW	
			Load capacitanc e			20	pF	
			Data frequency			13	MHz	
GENIO3	UEMCLit e	RF IC	1		2.78		V	RF Control *
			0				V	Depends of the RF design
			Load resistance				kW	
			Output current			4	mA	
GENIO4	UEMCLit e	RF IC	1		2.78		V	Audio clock input in UEMCLiteV3 and LittiV2
			0				V	
			Load resistance				kW	
			Output current			4	mA	
GENIO5	UEMCLit e	RF IC	1		2.78		V	RF Control *
			0				V	Depends of the RF design
			Load resistance				kW	
			Output current			4	mA	

Analogue Signals

Table 9 AC and DC Characteristics of RF-Base band Analogue Signals

Signal name	From	To	Parameter	Min	Typ	Max	Unit	Function
RFCLK	VCTCXO	UPP	Frequency		13/26		MHz	System Clk from RF to BB,
			Signal amplitude	0.2	0.8	1.32	Vpp	13/26 MHz Depending on RF chipset
			Input Impedance	10			kW	UPP minimum recommended amplitude is 0.3Vpp.
			Input Capacitance			10	pF	
			Harmonic Content			-8	dBc	
			Clear signal window (no glitch)	200			mVpp	
			Duty Cycle	40		60	%	
RFCLKGnd	VCTCXO	UPP	DC Level		0		V	System Clock slicer Ref GND, not separated from pwb GND layer
RXIP, RXIN, RXQP, RXQN	RF-IC	UEMCLite	Voltage swing (static)		1.4	1.45	Vpp	Differential positive / negative in-phase and quadrature Rx Signals.
			DC level	1.3	1.35	1.4	V	
			I/Q amplitude mismatch			0.2	dB	
			I/Q phase mismatch	-0.5		0.5	deg	
TXIP, TXIN, TXQP, TXQN	UEMCLite	RF-IC	Differential voltage swing (static)	2.25		2.45	Vpp	Differential positive / negative in-phase and quadrature Tx Signals In High-Z when RX is receiving.
			DC level	1.17	1.20	1.23	V	
			Source Impedance			200	W	

Signal name	From	To	Parameter	Min	Typ	Max	Unit	Function
AFC	UEMCLite	VCTCXO	Voltage Min	0.0		0.1	V	Automatic Frequency Control signal for VCTCXO Programmable
	(AFCOUT)		Max	2.4		2.55		
			Resolution		11		bits	
			Load resistance	1			kW	
			and capacitance			100	nF	
			Source Impedance			200	W	
			Output impedance	10			MW	Path powered down
TxC	UEMCLite	RF-IC	Voltage Min			0.1	V	Transmitter power level and ramping control, Ref UEMCLite RF converter specification
	(AUXOUT)		Max	2.4				
			Source Impedance			200	W	
			Resolution		10		bits	
VCXOTEMP	RF-IC	UEMCLite	Input voltage range	0		2.7	V	
			Input resistance	900		6000	Ohm	
			Resolution		10		bits	
PATEMP	RF-IC	UEMCLite	Voltage at -20oC		1.57		V	Usage depends of the RF design

LCD interface

The display is controlled by phone processor UPP.

The main LCD module is connected to the PWB by a 24-pin board-to-board connector.

The sub LCD module is connected to the PWB by a 10-pin board-to-board connector.

Keyboard

A 5 X 5 matrix keyboad consists of 21 keys, one 10-channel integrated passive filiter arrays with downstream ESD protection of >8KV connect the matrix keyboard to UPP.

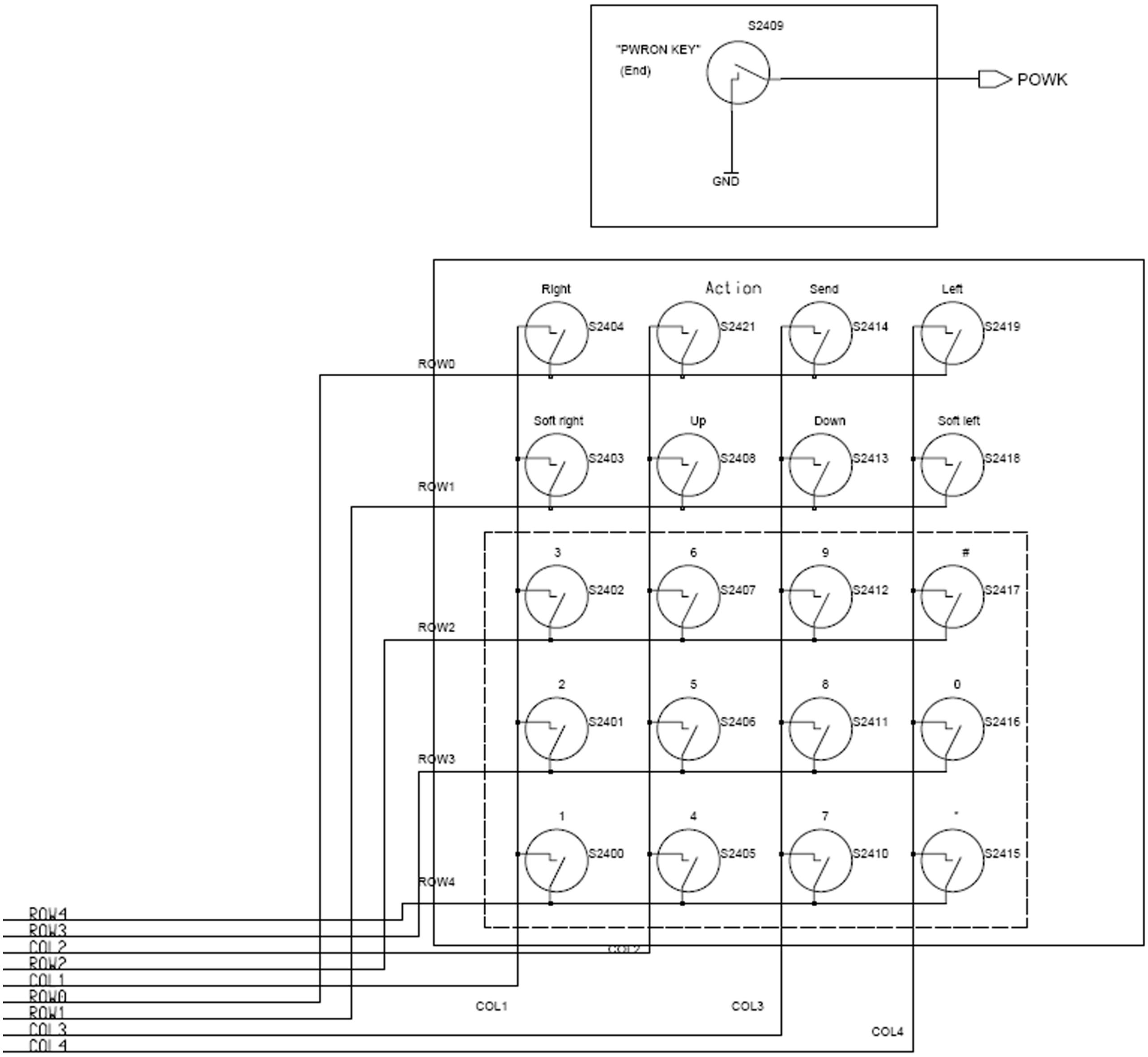

Figure 112 Keyboard schematics

SIM interface

The UEMCLite contains the SIM interface logic level shifting. The SIM interface can be programmed to support 3V and 1.8V SIMs. SIM supply voltage is selected by with register in the UEMCLite. It is only allowed to change the SIM supply voltage when the SIM IF is powered down.

The SIM power up/down sequence is generated in the UEMCLite. This means that the UEMCLite generates the RST signal to the SIM. In addition, the SIMCardDet signal is connected to UEMCLite. The detection is taken from the BSI signal, which detects the removal of the battery. The monitoring of the BSI signal is done by a comparator inside UEMCLite. The comparator offset is such that the comparator outputs do not alter state as long as the battery is connected. The threshold voltage is calculated from the battery size specifications.

The SIM interface is powered up when the SIMCardDet signal indicates ”card in”. This signal is derived from the BSI signal.

Table 10 SIM interface

Pin	Name	Parameter	Min	Typ	Max	Unit	Notes
4	DATA	1.8V Voh	0.9xVSIM		VSIM	V	SIM data (output)
		1.8V Vol	0		0.15xVSIM		
		3V Voh	0.9xVSIM		VSIM		
		3V Vol	0		0.15xVSIM		
		1.8V Vih	0.7xVSIM		VSIM	V	SIM data (input)
		1.8V Vil	0		0.15xVSIM		Trise/Tfall max 1us
		3V Vil	0.7xVSIM		VSIM		
		3V Vil	0		0.15xVSIM		
5	NC						Not connected
6	GND	GND	0		0	V	Ground
VSIM specified in regulator section in this document							

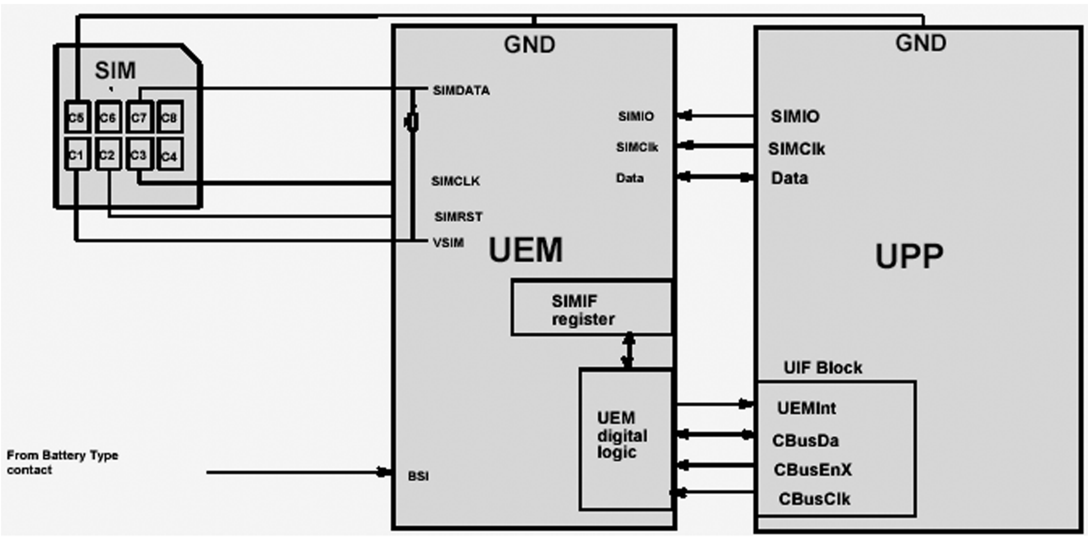

Figure 113 SIM interface block diagram

External signals and connections

Table 11 System connector

Signal	From	To	Min	Nom	Max	Condi-tion	Note
XMICP	HS/HF Mic	UEMC Lite		2/60m V diff		Analog audio in	Headset Mic bias and audio signal 2mV nominal. HF Mic signal 60mV nominal. Differential symmetric input.
						DC bias 2V2kohm	Accessory detection by bias loading
XMICN				2/60m V diff		Ana in / 1k to GND	Hook interrupt by heavy bias loading
XEARP	HS/HF	UEMC Lite		100 mV diff		Ana in	Quasi-differential DC-coupled earpiece/HF amplifier signal to accessory. DC biased to 0.8V
XEARN	EAR/ Amp.						
INT HEADINT	Switch	UEMC Lite		0/2.7V		Dig in	HS interrupt from bottom connector switch when plug inserted.
VCHARIN	Charger	UEMC Lite		11.1Vpeak	16.9 Vpeak	Standard	Vch from Charger Connector, max 20V
					7.9 VRMS		
					1.0 Apeak		
			7.0 VRMS	8.4 VRMS	9.2 VRMS	Fast charger	
					850 mA		
GND					GND		GND from/to Charger connector

Battery connector

Table 12 Battery IF

Signal	From	To	Min	Nom	Max	Note
GND	Global	Batt (-)				Global GND
VBAT		Batt (+)	3.1		5.1	Battery Voltage

Signal	From	To	Min	Nom	Max	Note
BSI		UEMCLite	0		2.78	Analog input, Battery Size Indicator Resistor, 100 kohm pull up to 2.78V (VBB1). FDL Init, refer to flash download.

Battery interface

- Type: BL-5BT
- Technology: Li-Ion, 4.2 V charging, 3.1 V cut-off
- Capacity: 870 mAh.

BL-5BT has a 3 pin interface with overcharge / discharge protection (safety circuit) and battery size indication BSI with an internal resistor. The BSI fixed resistor value indicates type and default capacity of a battery.

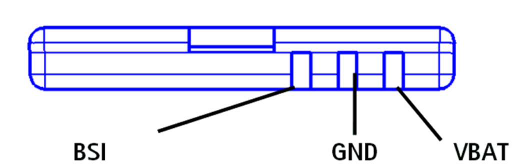

Figure 114 BL-5BT battery pack contacts

Table 13 Pin numbering of battery pack

Signal name	Pin number	Function
GND	2	Negative/common battery terminal
BSI	3	Battery capacity measurement (fixed resistor inside the battery pack)
VBAT	1	Positive battery terminal

PWB outline

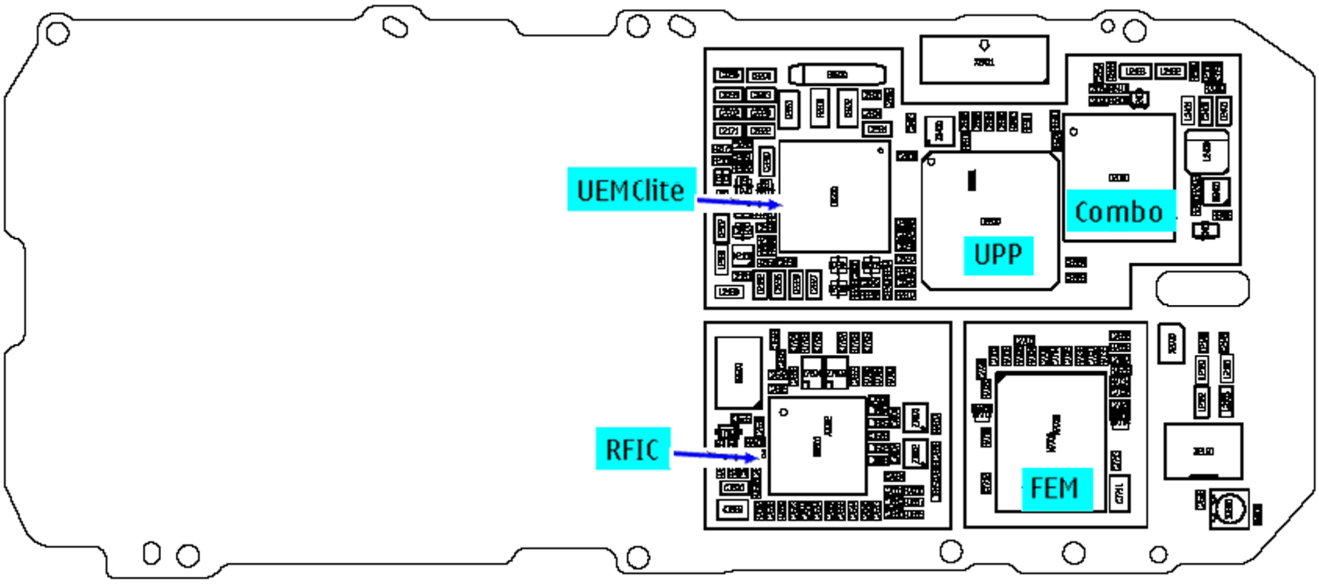

Figure 115 PWB top side component placement

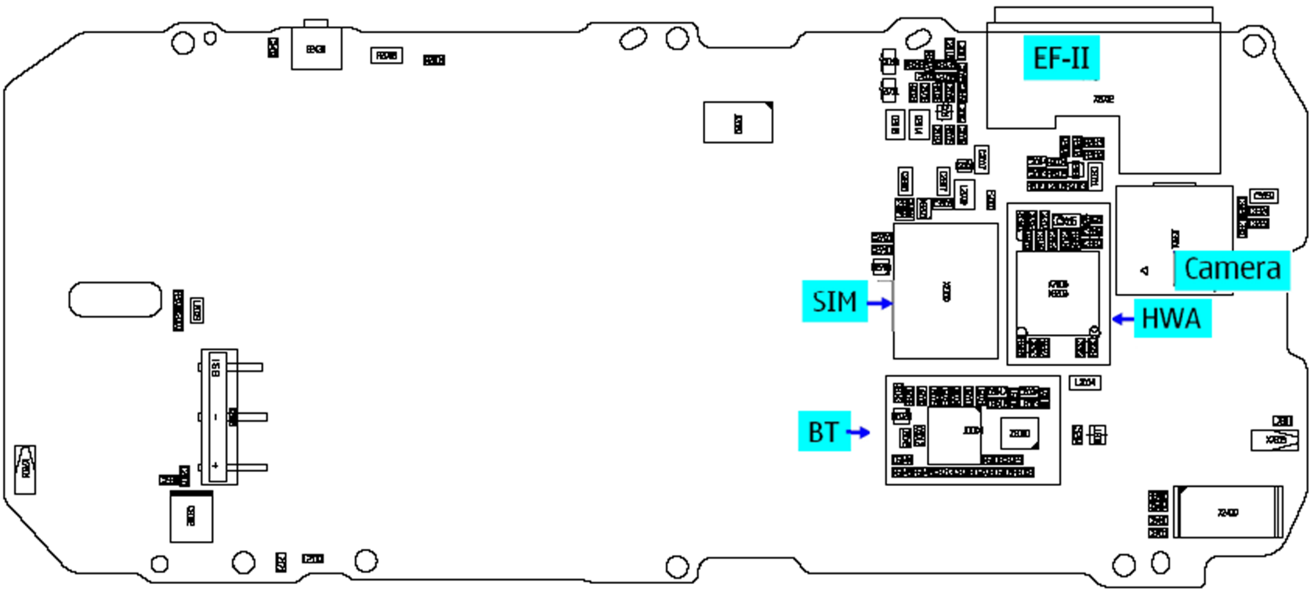

Figure 116 PWB bottom side component placement

RF description

Frequency band, power and multi-slot class

The requirement leads to the specification in the table below:

Table 14 Frequency bands and TX power class

System	Frequency band	TX power class
GSM900	Tx: 880 – 915 MHz	4 (33dBm)

System	Frequency band	TX power class
	Rx: 925 – 960 MHz	
GSM1800	Tx: 1710 – 1785 MHz	1 (30dBm)
	Rx: 1805 – 1880 MHz	

Table 15 Multi-slot class

Multislot Class	
GPRS	MSC 10 (4Dn/2Up), sum=5
E-GPRS	MSC 6 in DL, max. 3Dn

Transmitter - general description

The transmitter has separate, parallel paths covering the different bands. The transmitter operates in GMSK mode only. The power level control circuitry is integrated in the front-end module.

Each path of the transmitter is composed of a baseband lowpass filter for the I/Q signals and a quadrature direct modulator integrated in PMB3258. At the modulator’s output there is a bandpass filter for each band (so-called H3 filter) and a balun transformer to convert the differential output signal from the modulator into a single-ended 50 ohm signal. This signal is fed into the input of the PA. The two power amplifiers and the antenna switch are integrated in a single module with built-in power control loop.

The two control methods used are open-loop Vcc control (RFMD) and feedback control with current sensing. The reference waveform (TXC) for the control loop comes from the baseband. The output of the PA goes into a low pass filter located inside the FEM (Front End Module). Finally the transmit signal goes through the band selection and TX/RX switches to the antenna port.

The FEM is controlled with four digital control signals (TXP, Vc1, Vc2 and Vc3) to meet the TDMA frame timing requirements.

Transmitter - signal processing

The I/Q signals coming from the baseband section are fed into the modulator and converted up to the carrier frequency. The I/Q are post filtered by a 1st order passive RC filter (discrete components on PWB) and a 3rd order active filter (Legendre type) inside PMB3258.

The nominal output level of the modulator is +3.5 dBm in both bands. The modulator's output is an open-collector type and need an external load and a DC supply feed. The load and the DC supply feed are implemented as the part of the H3 filter.

The filtered signal is fed into the input of the FEM, which amplifies it to the desired power level and provides the signal at the antenna port.

There is also a temperature sensor close to the FEM to enable SW temperature compensation for e.g. the power levels. The sensor is connected to one of the slow ADC channels in the baseband.

Receiver - general description

The receiver is a direct conversion linear receiver. It is a dual-band receiver with receiver paths for either GSM850/1900 or GSM900/1800 configuration.

From the antenna, the received RF-signal is fed into the front-end module, which routes the signal to the appropriate RX path. After the FEM, the RX signals are filtered by SAW filters (one for each band), which reject the out-of band blocking signals to low enough level to be handled by the RF ASIC.

There are two paths – one for each band. In each path, the signal is then fed to the low noise amplifier (LNA). One LNA can handle both the GSM850 and GSM900 signals and another is used for GSM1800 and GSM1900. The LNA inputs are matched to the SAW filter outputs by means of discrete LC matching networks. The SAW filters and the matching networks are different for different band combinations, but the PWB layout is the same for both 850/1900 and 900/1800 versions.

The RX front-end circuitry contains the LNA and the quadrature down converting mixers. The front-end gain is programmable so that the gain can be reduced in strong-signal conditions. The mixers at each signal path convert the RF signal directly down to baseband I/Q signals. Local oscillator signals for the mixers are generated by an on-chip VCO.

The output signals (I/Q) of each demodulator are all differential. They are combined to two differential signal paths, one for I-channel and one for Q-channel, common for all bands. The baseband RX signals are then fed into a 3rd order active blocking filter, which has programmable gain. One of the three poles is implemented by an off-chip capacitor connected directly between the mixer outputs. There are a total of two off-chip capacitors, one for I-channel and one for Q-channel, respectively.

After the blocking filter, the signal is fed into a buffer amplifier, which also has programmable gain. Around the amplifier there is the first DC-offset compensation block, which removes most of the cumulated DC offset so far. The DC offset compensation method is based on digital successive approximation technique.

The next block in the RX chain is a switched-capacitor (SC) channel filter, which provides the close-in selectivity for the analog receiver. Because the SC-filter is insensitive to the IC process tolerances, no production calibration of the filter is necessary. The SC-filter operates on 6.5 MHz clock, which is generated by dividing the 26 MHz reference clock by four.

After the SC-filter there is a continuous-time smoothing filter which attenuates the alias signals generated by the sampling process inherent in the SC-filter. The smoothing filter also has programmable gain.

The next block is a programmable gain amplifier (PGA), which has the second DC-offset compensation block around it. The DC-offset compensation method is again based on digital successive approximation technique.

The last block in the analog receiver is an output buffer amplifier, which feeds the differential I/Q signals off-chip to be A/D converted in the digital baseband.

VCXO and PLL

The VCO frequency is locked by a PLL (phase locked loop) into a stable frequency source given by a VCXO. The frequency of the VCXO is in turn locked into the frequency of the base station with the help of an AFC (automatic frequency control) voltage, which is generated in the UEM. The reference frequency is 26 MHz.

The VCXO also provides a 26 MHz system clock for the digital baseband.

The PLL is located in PMB3258 and it is controlled via the RFBUS.

Technical specifications

General specifications

Unit	Dimension LxWxT (mm)	Weight (g)	Volume (cc)
Transceiver with BL-5BT 870mAh Li-Ion battery pack	109.34x46.48x12	73	55

Battery endurance

Nokia measurements of operation times in GSM900/1800

Talk time	
Battery: BL-5BT 870mAh	380 mins

Standby time	
Battery: BL-5BT 870mAh	580 mins

Note: Variation in operation times 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.

Environmental conditions

Environmental condition	Ambient temperature	Notes
Normal operation	-15 ºC ... +55 ºC	Specifications fulfilled
Reduced performance	-30 ...15 ºC and +55ºC ... +70 ºC	Operational only for short periods
Intermittent or no operation	-40 ºC ... -30 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	-15 ºC ... +55 ºC	
Long term storage conditions	0 ºC ... +85 ºC	
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.

Electrical characteristics

Table 16 Normal and extreme voltages

Voltage	Voltage (V)	Condition
General conditions		

Voltage	Voltage (V)	Condition
Nominal voltage	3.90V	a
Lower extreme voltage	3.30V	b
Higher extreme voltage	4.30V	c
HW shutdown voltages		
Vmstr+	2.1V ± 0,1V	Off to on
Vmstr-	1.9V ± 0,1V	On to off
SW shutdown voltages		
SW shutdown	3. 1V	In call
SW shutdown	3. 2V	In idle
Min operating voltage		
Vcoff+	3. 1V ± 0,1V	Off to on
Vcoff-	2. 8V ± 0,1V	On to off
HW reset demands		
Min	1. 0V	d
Max	--	

a. The nominal voltage is defined as being 15% higher than the lower extreme voltage. TA will test with this nominal voltage at an 85% range (0.85x3.9V ª 3.3V).

b. This limit is set to be above SW shutdown limit in TA.

c. During fast charging of an empty battery, this voltage might exceed this value. Voltages between 4.20 and 4.60 might appear for a short while.

d. The minimum battery cell voltage required for the reset circuitry to turn on. This is not confirmed by measures at pt.

Table 17 Current consumption

Condition	Min	Typical	Max	Unit
Call (MoU) (E)GSM 900 GSM 1800 GSM 1900		235 165 226		mA
Idle (MoU)		1.47		mA
Power off	30	33	35	uA

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
BB	Baseband
BC02	Bluetooth module made by CSR
BIQUAD	Bi-quadratic (type of filter function)
BSI	Battery Size Indicator
BT	Bluetooth
CBus	MCU controlled serial bus connected to UPP_WD2, UEME and Zocus
CCP	Compact Camera Port
CDMA	Code division multiple access
CDSP	Cellular DSP (expected to run at low levels)
CLDC	Connected limited device configuration
CMOS	Complimentary metal-oxide semiconductor circuit (low power consumption)
COF	Chip on Foil
COG	Chip on Glass
CPU	Central Processing Unit
CSD	Circuit-switched data
CSR	Cambridge silicon radio
CSTN	Colour Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analogue converter
DAC	Digital-to-analogue converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo
DCT-4	Digital Core Technology

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

ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out
LED	Light-emitting diode
LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
MTP	Multipoint-to-point connection
NTC	Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor
OMA	Object management architecture
OMAP	Operations, maintenance, and administration part
Opamp	Operational Amplifier
PA	Power amplifier
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x and BB5
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board
PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RF	Radio Frequency
RF PopPort™	Reduced function PopPort™ interface
RFBUS	Serial control Bus For RF

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

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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