Programmes After Market Services
Technical Documentation

# *SERVICE MANUAL*

[NMP Part No.0275454]

## NSB-7 Cellular Phones

NOKIA

Issue 1 06/00

# Programmes After Market Services
# Technical Documentation

## Amendment Record Sheet

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# Programmes After Market Services
# Technical Documentation

## NSB-7 Overall Manual Contents

## Contents:

# Programmes After Market Services Technical Documentation

## IMPORTANT

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

## 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 Ltd. should be notified in writing.

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## Warnings and Cautions

Please refer to the phone's user guide for instructions relating to operation, care and maintenance including important safety information. Note also the following:

### Warnings:

1. 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.
2. THE HANDPORTABLE TELEPHONE MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES EG PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
3. 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.

### Cautions:

1. Servicing and alignment must be undertaken by qualified personnel only.
2. Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
3. Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
4. Use only approved components as specified in the parts list.
5. Ensure all components, modules screws and insulators are correctly re-fitted after servicing and alignment. Ensure all cables and wires are repositioned correctly.

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# General Information

 

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# Product Selection

## Hand portables

The NSB-7 is a single band hand portable mobile telephone for the GSM1900 networks

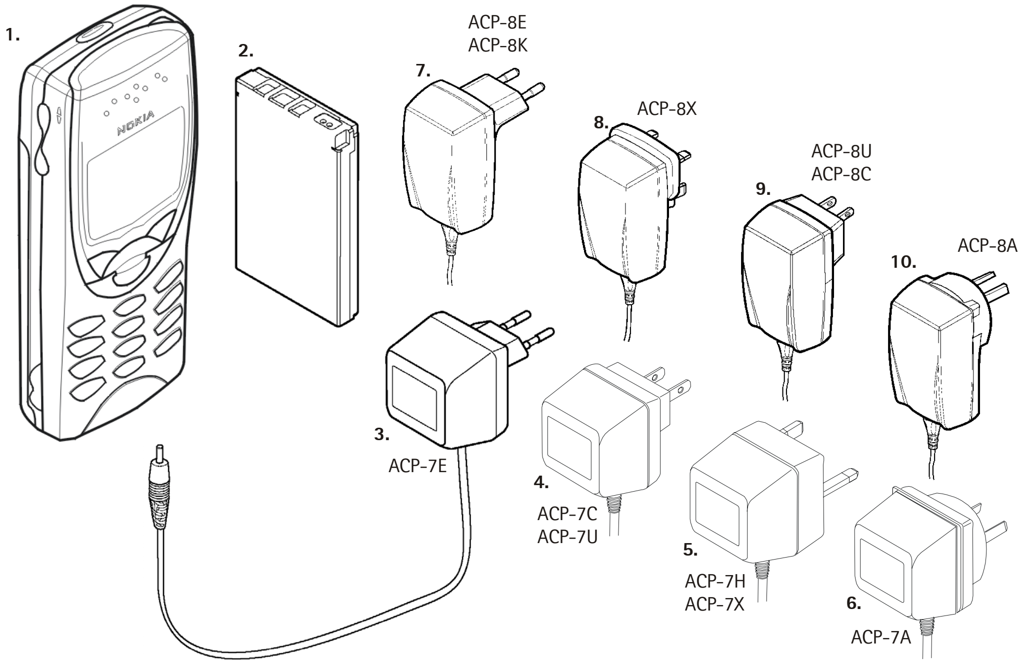


**Figure 1: Hand portables**

| Item | Name: | Type Code: | Material Code: |
|---|---|---|---|
| 1. | Transceiver | See Product | Variants |
| 2. | Standard Battery (Li-ion 650 mAh) | BLB-2 | 0670246 |
| | Standard Battery (Li-ion 650 mAh) for Americas | BLB-2 | 0670322 |
| 3. | AC Travel Charger (Euro plug) 207-253 Vac | ACP-7E | 0675144 |
| 4. | AC Travel Charger (US plug) 108-132 Vac | ACP-7U | 0675143 |
| | AC Travel Charger (US plug) 198-242 Vac | ACP-7C | 0675158 |
| 5. | AC Travel Charger (UK plug) 207-253 Vac | ACP-7X | 0675145 |
| | AC Travel Charger (UK plug) 180-220 Vac | ACP-7H | 0675146 |
| 6. | AC Travel Charger (Australia plug) 216-264 Vac | ACP-7A | 0675148 |
| 7. | Performance Travel Charger Euro plug 90-264 Vac | ACP-8E | 0675195 |
| | Performance Travel Charger Korea plug 90-264 Vac | ACP-8K | 0675199 |
| 8. | Performance Travel Charger UK plug 90-264 Vac | ACP-8X | 0675197 |
| 9. | Performance Travel Charger US plug 90-264 Vac | ACP-8U | 0675196 |
| | Performance Travel Charger China plug 90-264 Vac | ACP-8C | 0675211 |
| 10. | Performance Travel Charger Australia plug 90-264 Vac | ACP-8A | 0675214 |

  

## Desktop Option

The desktop option allows the user to charge the phone from the mains.

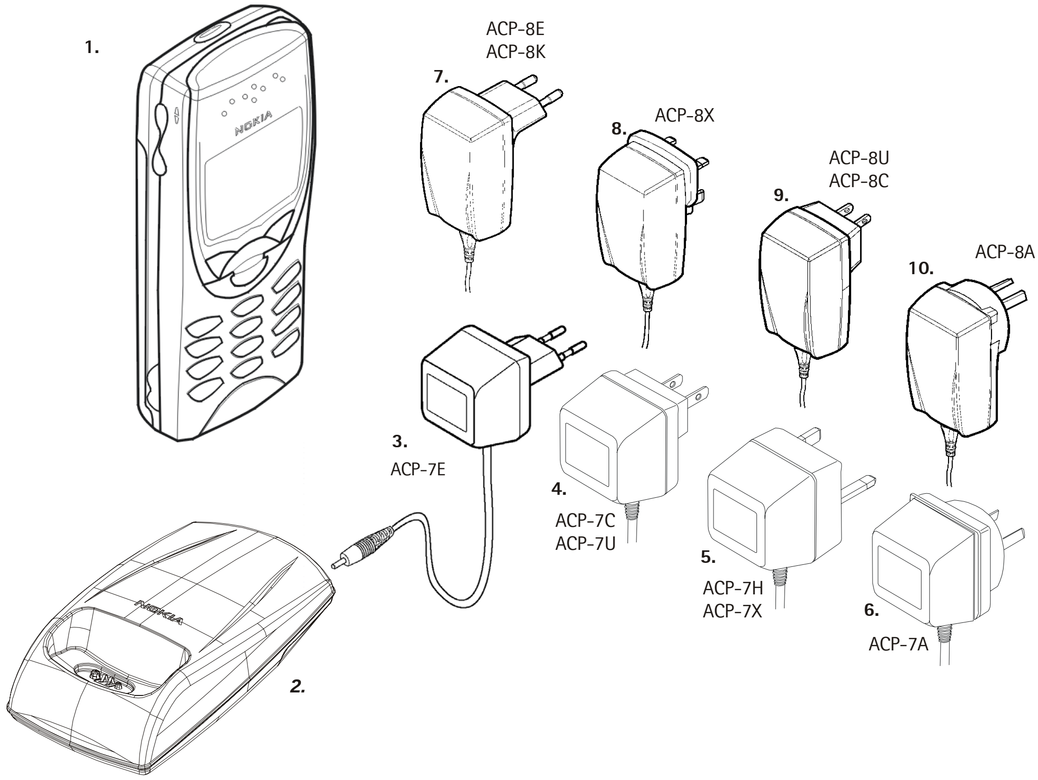


**Figure 2: Desktop option**

| Item | Name: | Type Code: | Material Code: |
|---|---|---|---|
| 1. | Transceiver | See Product | Variants |
| 2 | Desk stand | DCV-1B | 0675220 |
| 3. | AC Travel Charger (Euro plug) 207-253 Vac | ACP-7E | 0675144 |
| 4. | AC Travel Charger (US plug) 108-132 Vac | ACP-7U | 0675143 |
| | AC Travel Charger (US plug) 198-242 Vac | ACP-7C | 0675158 |
| 5. | AC Travel Charger (UK plug) 207-253 Vac | ACP-7X | 0675145 |
| | AC Travel Charger (UK plug) 180-220 Vac | ACP-7H | 0675146 |
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| 7. | Performance Travel Charger Euro plug 90-264 Vac | ACP-8E | 0675195 |
| | Performance Travel Charger Korea plug 90-264 Vac | ACP-8K | 0675199 |
| 8. | Performance Travel Charger UK plug 90-264 Vac | ACP-8X | 0675197 |
| 9. | Performance Travel Charger US plug 90-264 Vac | ACP-8U | 0675196 |
| | Performance Travel Charger China plug 90-264 Vac | ACP-8C | 0675211 |
| 10. | Performance Travel Charger Australia plug 90-264 Vac | ACP-8A | 0675214 |

## Express Car Kit (CARK-124) Option for Americas

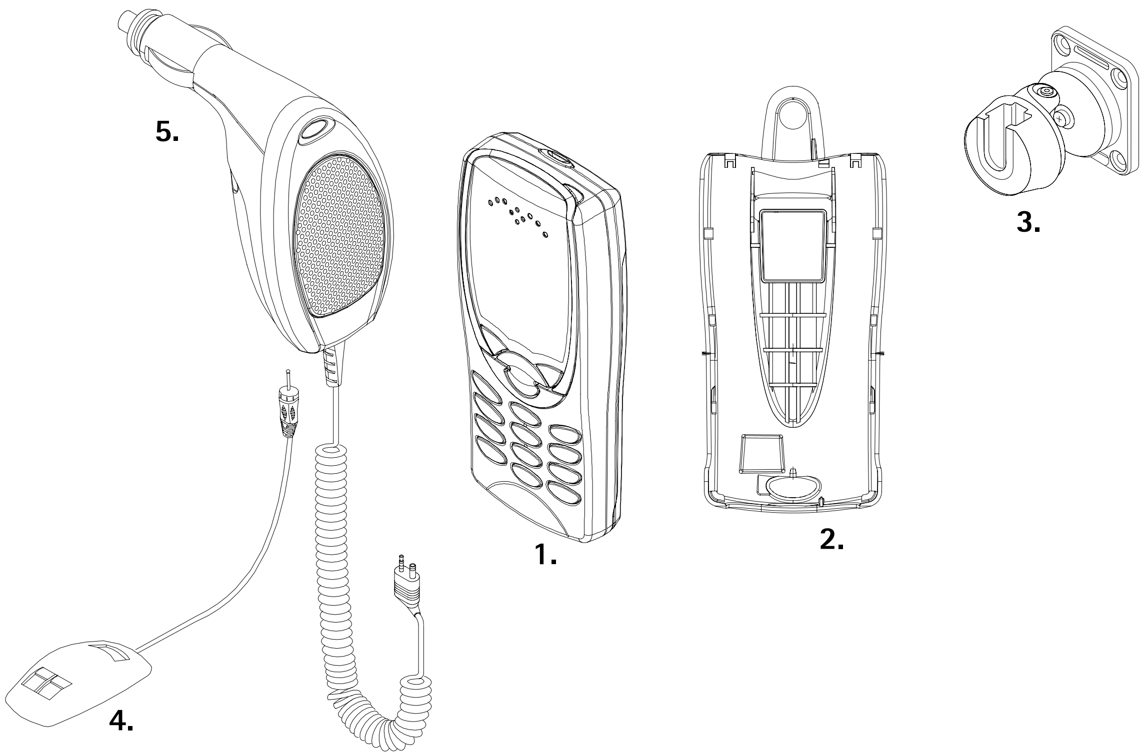


**Figure 3: Express Car Kit (CARK-124)**

| | Item Name: | Type Code: | Material Code: |
|---|---|---|---|
| | Express Car Kit for Americas (Retail Pack) | CARK-124 | 0080372 |
| 1. | Transceiver (Not included, see Product Variants) | | |
| 2. | Pocket Clip | SKB-2 | 0720218 |
| 3. | Swivel Mount | HHS-12 | 0620054 |
| 4. | Hands Free Microphone | HFM-8 | 0690016 |
| 5. | Hands Free Cigarette Lighter Charger | PPH-1 | 0675182 |

# Product and Module List

| Unit/Type: | Product Code: |
|---|---|
| Transceiver NSB-7 | See Product Variants |
| Standard Battery BLB-2 (Li-ion 650 mAh) | 0670246 |
| Standard Battery BLB-2 (Li-ion 650 mAh) for Americas | 0670322 |
| AC Travel Charger ACP-7E (EURO) 207-253 Vac | 0675144 |
| AC Travel Charger ACP-7U (US) 108-132 Vac | 0675143 |
| AC Travel Charger ACP-7C (US) 198-242 Vac | 0675158 |
| AC Travel Charger ACP-7X (UK) 207-253 Vac | 0675145 |
| AC Travel Charger ACP-7H (UK) 180-220 Vac | 0675146 |
| AC Travel Charger ACP-7A (AUS) 216-264 Vac | 0675148 |
| Performance Travel Charger ACP-8E (EURO) 90-264 Vac | 0675195 |
| Performance Travel Charger ACP-8K (KOREA) 90-264 Vac | 0675199 |
| Performance Travel Charger ACP-8X (UK) 90-264 Vac | 0675197 |
| Performance Travel Charger ACP-8U (US) 90-264 Vac | 0675196 |
| Performance Travel Charger ACP-8C (CHINA) 90-264 Vac | 0675211 |
| Performance Travel Charger ACP-8A (AUS) 90-264 Vac | 0675214 |
| Headset HDC-5 | 0694059 |
| Loopset LPS-3 | 0630244 |
| Pocket Clip SKB-2 | 0720218 |
| Desk Stand DCV-1B | 0675220 |
| Swivel Mount HHS-12 | 0620054 |
| HF Microphone HFM-8 | 0690016 |
| Plug & Play HF Cigarette Lighter Charger PPH-1 | 0675182 |
| Cigarette Lighter Charger LCH-8 | 0675231 |
| Cigarette Lighter Charger LCH-9 | 0675120 |
| Carrying Case CBK-3V | 0272237 |
| Carrying Case CBK-3H | 0272236 |

# Technical Specifications

## General Specifications of Transceiver NSB-7

| Parameter | Unit |
|---|---|
| Cellular System | GSM1900 |
| RX frequency band | 1930 ...1990 MHz |
| TX frequency band | 1850 ...1910 MHz |
| Output power | +0 ...+29 dBm / 1.0 mW ...1 W |
| Duplex spacing | 80 MHz |
| Number of RF channels | 299 |
| Channel spacing | 200 kHz |
| Number of TX power levels | 16 |
| Sensitivity, static channel | -102 dBm |
| Frequency error, static channel | < 0.1 ppm |
| RMS phase error | < 5.0 o |
| Peak phase error | < 20.0 o |

# System Module

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Schematic Diagrams: RB9 (at the back of the binder)

List of Figures

# Transceiver NSB-7

## Introduction

The NSB-7 is a single band transceiver unit designed for the GSM1900 networks. It is GSM1900 power class 1 (1W) transceiver.

The transceiver consists of System/RF module (RB9), Display module (UX7) and assembly parts.

The transceiver has a full graphic display and the user interface is based on a jack style UI with two soft keys.

A back mounted antenna is used, there is no connection to an external antenna.

The transceiver has a low leakage tolerant earpiece and an omnidirectional microphone, providing excellent audio quality. The transceiver supports full rate, an enhanced full rate and a half rate speech decoding.

An integrated IR link provides a connection between two NSB-7 transceivers or a transceiver and a PC (internal data), or a transceiver and a printer.

The small SIM (Subscriber Identity Module) card is located under the back cover of the phone.

### Operational Modes

There are five different operational modes:

- power off mode
- idle mode
- active mode
- charge mode
- local mode

In the power off mode only the circuits needed for power up are supplied.

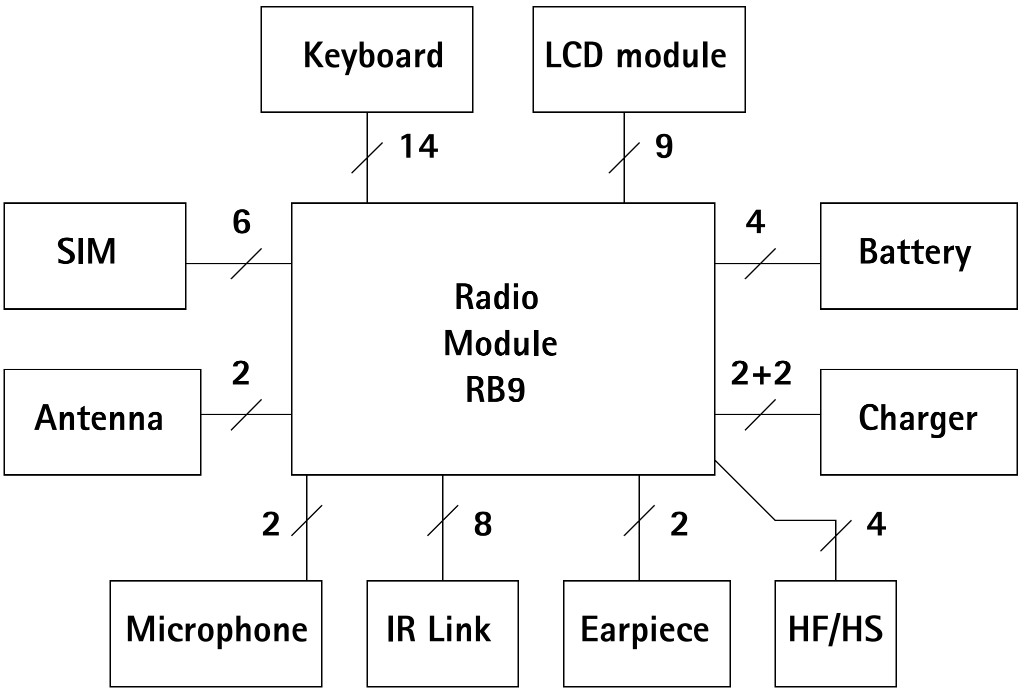
In the idle mode circuits are powered down and only the sleep clock is running.

In the active mode all the circuits are supplied with power although some parts might be in idle state part of the time.

The charge mode is effective in parallel with all previous modes. The charge mode itself consists of two different states, i.e. the fast charge and the maintenance mode.

The local mode is used for alignment and testing.

## Interconnection Diagram



# System Module

## Baseband Module

The ASICs are in the uBGA package. Flash and SRAM chips are inside the same package. EEPROM is software emulated with Flash. These changes have decreased the number of I/O between the ICs. Smaller I/O count has made using smaller packages possible

The baseband architecture supports a power saving function called "sleep mode". This sleep mode shuts off the VCTCXO, which is used as system clock source for both RF and baseband. During the sleep mode the system runs from a 32 kHz crystal. The phone is waken up by a timer running from this 32 kHz clock supply. The sleeping time is determined by some network parameters. The sleep mode is entered when both the MCU and the DSP are in stand-by mode and the normal VCTCXO clock has been switched off.

The battery charging is controlled by a PWM signal from the CCONT. The PWM duty cycle is determined by a charging software and is fed to the CHAPS charging switch.

Two types of chargers can be connected to the phone. Standard chargers (two wires) provide a coarse supply power, which is switched by the CHAPS for suitable charging voltage and current. Advanced chargers (three wires) are equipped with a control input. Three wire chargers are treated like two wire ones.

### Block Diagram

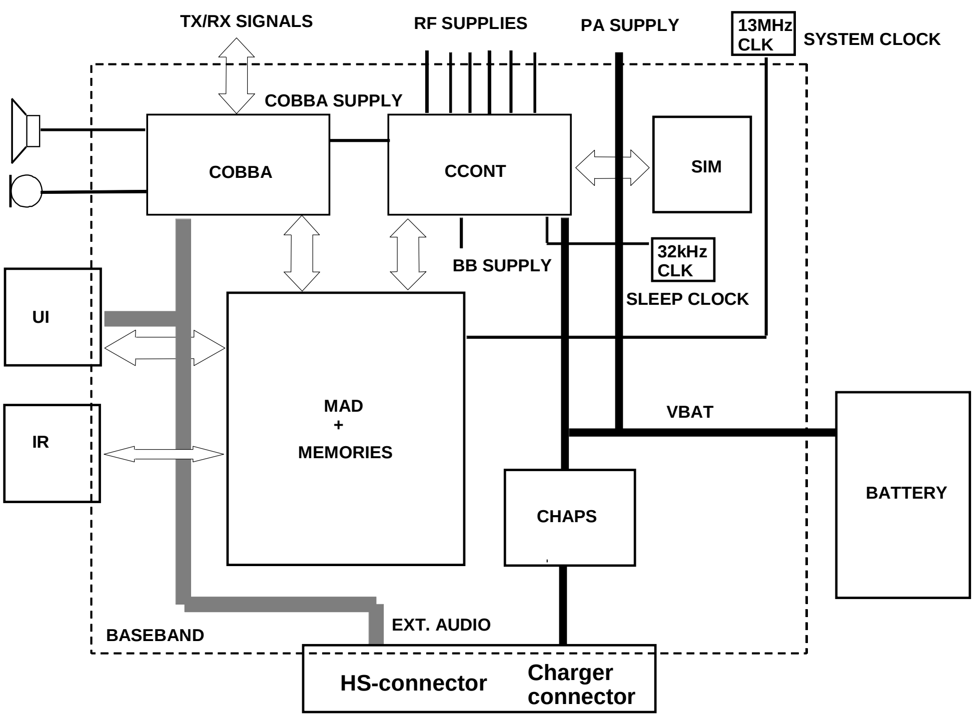



**Figure 1: Block Diagram**

## Technical Summary

The baseband module consists of four ASICs; CHAPS, CCONT, COBBA-GJP and MAD2WD1, which take care of the baseband functions of the engine.

The baseband is running from a 2.8V power rail, which is supplied by a power controlling ASIC CCONT. MAD2WD1 supply voltages are VBB and VCORE (V2V), VBB feed I/O pins so that MAD2WD1 is externally fully compatible with old versions. VCORE feed MAD2WD1 internal functions supply voltage; CPU, DSP and system logic. In the CCONT there are 6 individually controlled regulator outputs for RF-section and two outputs for the baseband. In addition there is one +5V power supply output (V5V). The CCONT contains also a SIM interface, which supports both 3V and 5V SIM-cards. A real time clock function is integrated into the CCONT, which utilizes the same 32kHz clock supply as the sleep clock. A backup power supply is provided for the RTC, which keeps the real time clock running when the main battery is removed. The backup power supply is a rechargable battery. The backup time with the battery is ten minutes minimum.

The analog interface between the baseband and the RF section is handled by a COBBA ASIC. COBBA 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 to and from the user interface. The COBBA supplies the analog TXC and AFC signals to RF section according to the MAD DSP digital control. Data transmission between the COBBA and the MAD is implemented using serial bus for high speed signalling and for PCM coded audio signals. Digital speech processing is handled by the MAD ASIC. COBBA is a dual voltage circuit, the digital parts are running from the baseband supply VBB and the analog parts are running from the analog supply VCOBBA.

The baseband supports both internal and external microphone inputs and speaker outputs. Input and output signal source selection and gain control is done by the COBBA according to control messages from the MAD. Keypad tones, DTMF and other audio tones are generated and encoded by the MAD and transmitted to the COBBA for decoding. A buzzer and an external vibra alert control signals are generated by the MAD with separate PWM outputs.

EMC shielding is implemented using a metallized plastic frame. On the other side the engine is shielded with PCB grounding. Heat generated by the circuitry will be conducted out via the PCB ground planes.

# Technical Specifications

## Absolute Maximum Ratings

| Parameter | Rating |
|---|---|
| Battery voltage | -0.3... 5.3 V |
| Charger input voltage | -5.0... 16V |

## DC Characteristics

| Line Symbol | Minimum | Typical / Nominal | Maximum | Unit / Notes |
|---|---|---|---|---|
| Supply battery voltage | 3.0 | 3.9 | 4.8 | V |
| Battery powerup voltage (HW) | 2.9 | 3.0 | 3.1 | V |
| Battery cut off voltage (HW) | 2.7 | 2.8 | 2.9 | V (3.1 V SW cutoff) |
| Regulated baseband supply voltage | 2.7 | 2.8 | 2.85 | V |
| Regulated baseband supply current | 3 | 50 | 125 | mA |
| COBBA analog supply voltage | 2.7 | 2.8 | 2.85 | V |
| COBBA analog supply current | 5 | 20 | 100 | mA |
| Regulated 5V supply voltage | 4.8 | 5.0 | 5.2 | V |
| Regulated 5V supply current | 0 | 1 | 30 | mA |
| Regulated 5V SIM supply voltage | 4.8 | 5.0 | 5.2 | V |
| Regulated 5V SIM supply current | 3 | 10 | 30 | mA |
| Regulated 3V SIM supply voltage | 2.8 | 3.0 | 3.2 | V |
| Regulated 3V SIM supply current | 1 | 6 | 30 | mA |
| Voltage reference | 1.4775 | 1.5 | 1.5225 | V |

## External and Internal Signals and Connections

This section describes the external electrical connection and interface levels on the baseband. The electrical interface specifications are collected into tables that covers a connector or a defined interface.

## DC (charger) connector

DC (charger) connector is physically integrated in the same component with the accessory interface connector. DC connector has both jack and contact pads for desk stand.

| Name | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|
| VIN | 0 | | 12 | V | |
| | 0 | | 850 | mA | |
| L_GND | 0 | | 0.3 | V | |

### Service Connector

| Name | Parameter | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|
| MBUS | Serial clock from the Prommer | 0<br>2.0 | logic low<br>logic low | 0.8<br>2.85 | V | Prommer detection and Serial Clock for synchronous communi-cation |
| FBUS_RX | Serial data from the Prommer | 0<br>2.0 | logic low<br>logic high | 0.8<br>2.85 | V | Receive Data from Prommer to Baseband |
| FBUS_TX | Data acknowledge to the Prommer | 0<br>2.0 | logic low<br>logic high | 0.5<br>2.85 | V | Transmit Data from Baseband to Prommer |
| GND | GND | 0 | | 0 | V | Ground |

The service connector is used as a flash programming interface for updating (i.e. re-programming) the flash program memory and an electrical access for services to the engine.

When the flash prommer is connected to the phone supply power is provided through the battery contacts and the phone is powered up with a pulse given to the BTEMP line.

### Battery connector

The BSI contact on the battery connector is used to detect when the battery is to be removed to be able to shut down the operations of the SIM card before the power is lost if the battery is removed with power on. The BSI contact disconnects earlier than the supply power contacts to give enough time for the SIM and LCD shut down.

| Name | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|
| VBATT | 3.0 | 3.9 | 4.2 | V | Battery voltage |
| BSI | 0 | | 2.85 | V | Battery size indication<br>Phone has 100kohm pull-up resistor.<br>SIM Card removal detection<br>(Threshold is 2.4V@VBB=2.8V) |
| | | 68 | | kohm | Battery indication resistor (BLB-2) |
| | | | | kohm | Battery indication resistor (service battery) |

| Name | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|
| BTEMP | 0 | | 1.4 | V | Battery temperature indication<br>Phone has a 100k (+/-5%) pull-up resistor, Battery package has a NTC pull-down resistor: 47k +/-5%@+25C, B=4050 +/-3% |
| | 2.1<br>5 | <br>10 | 3<br>30 | V<br>ms | Phone power up by battery (input)<br>Power up pulse width |
| | | | | | |
| | 0 | | 1 | kohm | Local mode initialization (in production) |
| BGND | 0 | | 0 | V | Battery ground |

### SIM card connector

The SIM card connector is located on the engine beside the battery pack.

| Pin | Name | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|---|
| 4 | GND | GND | 0 | | 0 | V | Ground |
| 3, 5 | VSIM | 5V SIM Card<br>3V SIM Card | 4.8<br>2.8 | 5.0<br>3.0 | 5.2<br>3.2 | V | Supply voltage |
| 6 | DATA | 5V Vin/Vout<br><br>3V Vin/Vout | 4.0<br>0<br>2.8<br>0 | "1"<br>"0"<br>"1"<br>"0" | VSIM<br>0.5<br>VSIM<br>0.5 | V | SIM data<br>Trise/Tfall max 1us |
| 2 | SIMRST | 5V SIM Card<br>3V SIM Card | 4.0<br>2.8 | "1"<br>"1" | VSIM<br>VSIM | V | SIM reset |
| 1 | SIMCLK | Frequency<br>Trise/Tfall | | 3.25 | <br>25 | MHz<br>ns | SIM clock |

### RTC backup battery

The RTC block in CCONT needs a power backup to keep the clock running when the phone battery is disconnected. The backup power is supplied from a rechargable Li-ion battery that can keep the clock running ten minutes minimum. The backup battery is charged from the main battery through CHAPS.

| Signal | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| VBACK | Backup battery charging from CHAPS | 3.02 | 3.15 | 3.28 | V | |
| | Backup battery charging from CHAPS | 100 | 200 | 500 | uA | Vout@VBAT-0.2V |
| VBACK | Backup battery supply to CCONT | 2 | | 3.28 | V | |

| Signal | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| | Backup battery supply to CCONT | | 80 | | uA | |

## Functional Description

### Power Distribution

In normal operation the baseband is powered from the phone's battery. The battery consists of one Lithium-Ion cell. An external charger can be used for recharging the battery and supplying power to the phone.

The baseband contains parts that control power distribution to whole phone excluding those parts that use continuous battery supply. The battery feeds power directly to the CCONT and UI (buzzer and display and keyboard lights).

The power management circuit CHAPS provides protection against over voltages, charger failures and pirate chargers etc. that would otherwise cause damage to the phone.

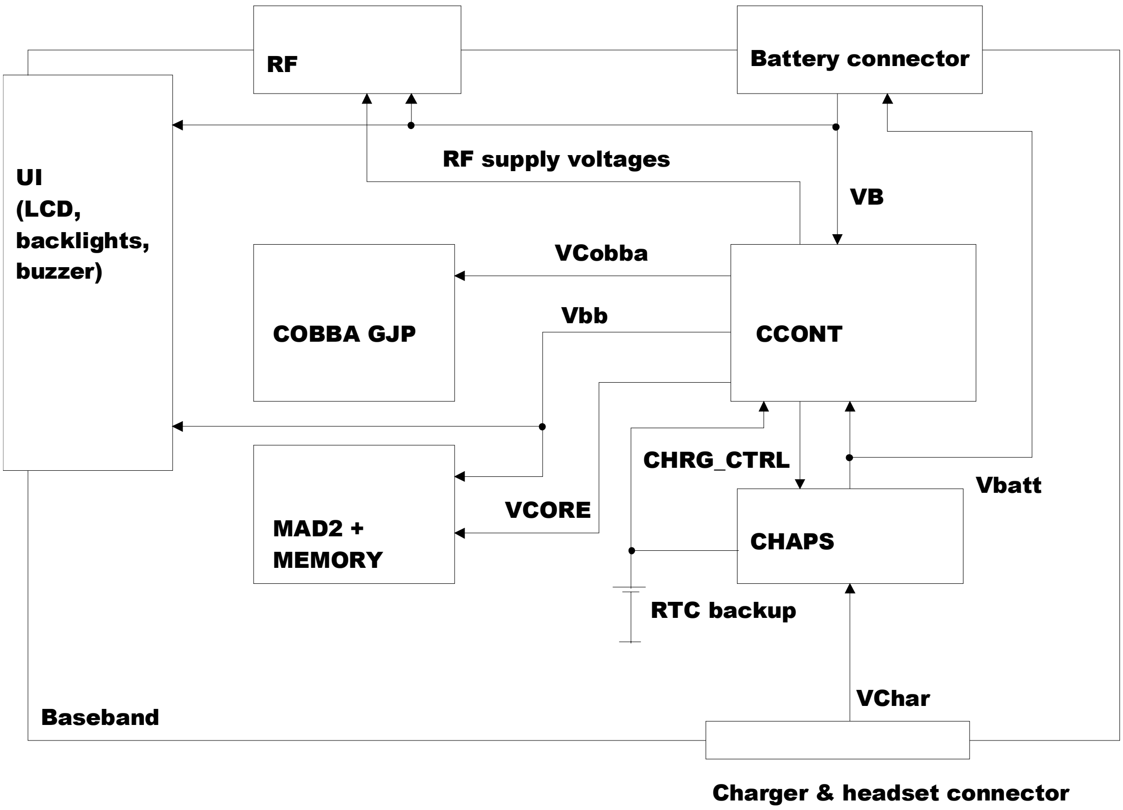



Figure 2: Block Diagram of Power Distribution

### Battery Interface

## Battery charging

The electrical specifications give the idle voltages produced by the acceptable chargers at the DC connector input. The absolute maximum input voltage is 30V due to the transient suppressor that is protecting the charger input. At phone end there is no difference between a plug-in charger or a desktop charger. The DC-jack pins and bottom connector charging pads are connected together inside the phone.

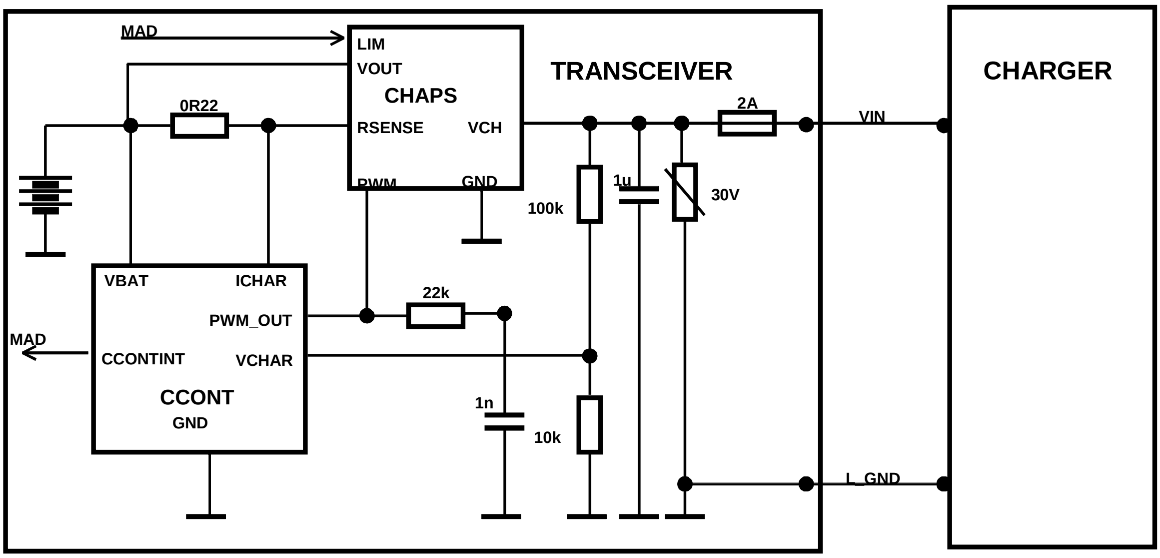



**Figure 3: Charging Block Diagram**

## Startup Charging

When a charger is connected, the CHAPS is supplying a startup current minimum of 130mA to the phone. The startup current provides initial charging to a phone with an empty battery. Startup circuit charges the battery until the battery voltage level is reaches 3.0V (+/- 0.1V) and the CCONT releases the PURX reset signal and program execution starts. Charging mode is changed from startup charging to PWM charging that is controlled by the MCU software. If the battery voltage reaches 3.55V (3.75V maximum) before the program has taken control over the charging, the startup current is switched off. For accessory detection, startup current is possible cut via CCUT line. The startup current is switched on again when the battery voltage is sunken 100mV (nominal).

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| VOUT Start-up mode cutoff limit | Vstart | 3.45 | 3.55 | 3.75 | V |
| VOUT Start-up mode hysteresis<br>NOTE: Cout=4.7 uF | Vstarthys | 80 | 100 | 200 | mV |
| Start-up regulator output current<br>VOUT=0V....Vstart | Istart | 130 | 165 | 200 | mA |

### Battery Overvoltage Protection

Output overvoltage protection is used to protect phone from damage. This function is also used to define the protection cutoff voltage for the Lithium-Ion battery. The power switch is immediately turned OFF if the voltage in VOUT rises above the selected limit VLIM.

| Parameter | Symbol | LIM input | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output voltage cutoff limit (during transmission or Li-battery) | VLIM | LOW | 4.4 | 4.6 | 4.8 | V |

The voltage limit (VLIM1 or VLIM2) is selected by logic LOW or logic HIGH on the CHAPS (N101) VLIM input pin.

When the switch in output overvoltage situation has once turned OFF, it stays OFF until the battery voltage falls below VLIM and PWM = LOW is detected. The switch can be turned on again by setting PWM = HIGH.

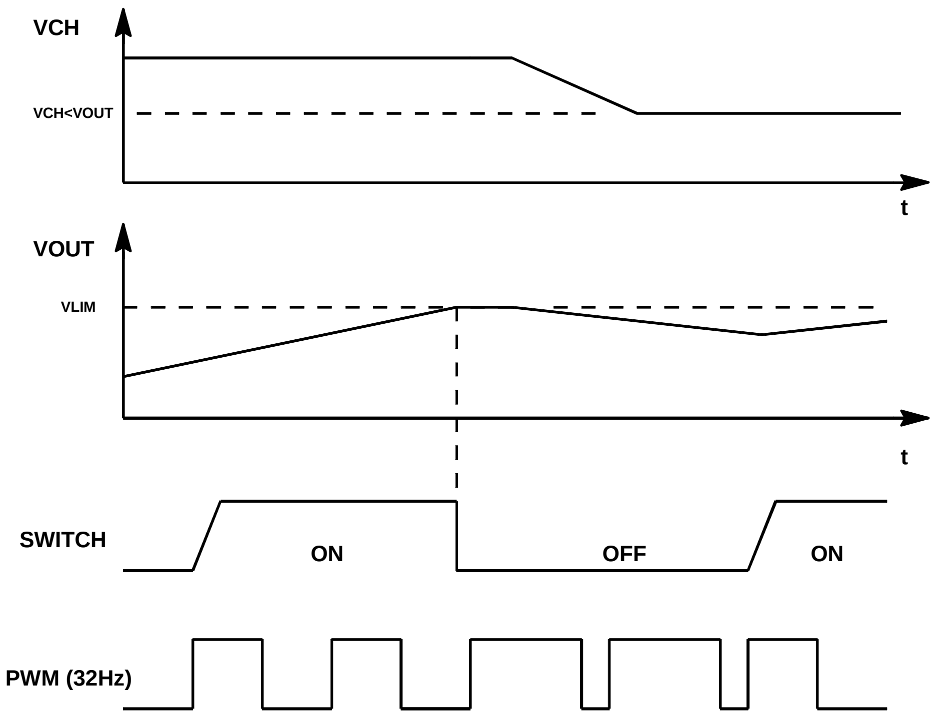
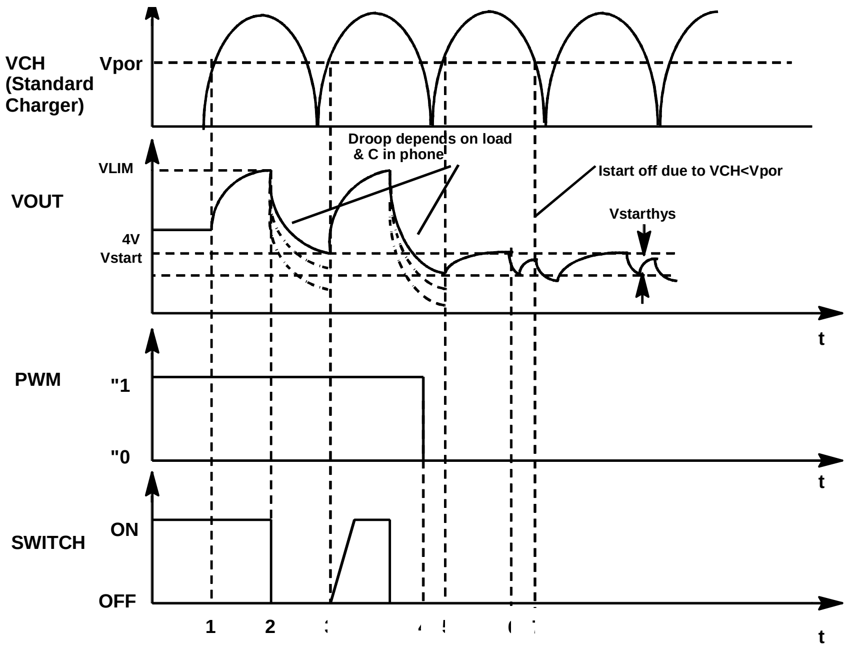



**Figure 4: Output Overvoltage Protection (in principle; not in time scale)**

### Battery Removal During Charging

Output overvoltage protection is also needed in case the main battery is removed when charger connected or charger is connected before the battery is connected to the phone.

With a charger connected, if VOUT exceeds VLIM, CHAPS turns switch OFF until the charger input has sunken below Vpor (nominal 3.0V, maximum 3.4V). MCU software will stop the charging (turn off PWM) when it detects that battery has been removed. The CHAPS remains in protection state as long as PWM stays HIGH after the output overvoltage situation has occured.




1 Battery removed, (standard) charger connected, VOUT rises (follows charger voltage)
2. VOUT exceeds limit VLIM(X), switch is turned immediately OFF
3 VOUT falls (because no battery) , also VCH<Vpor (standard chargers full-rectified output). When VCH > Vpor and VOUT < VLIM(X) -> switch turned on again (also PWM is still HIGH) and VOUT again exceeds VLIM(X).
4. Software sets PWM = LOW -> CHAPS does not enter PWM mode
5. PWM low -> Startup mode, startup current flows until Vstart limit reached
6. VOUT exceeds limit Vstart, Istart is turned off
7. VCH falls below Vpor

**Figure 5: Output Overvoltage Protection When Battery Removed (in principle; not in time scale)**

### PWM

When a charger is used, the power switch is turned ON and OFF by the PWM input. PWM rate is 1Hz. When PWM is HIGH, the switch is ON and the output current Iout = charger current - CHAPS supply current. When PWM is LOW, the switch is OFF and the output current Iout = 0. To prevent the switching transients inducing noise in audio circuitry of the phone soft switching is used.

### Battery Identification

Different battery types are identified by a pulldown resistor inside the battery pack. The BSI line inside transceiver has a 100k pull-up to VBB. The MCU can identify the battery by reading the BSI line DC-voltage level with a CCONT (N100) A/D-converter.

| Name | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|
| BSI | 0 | | 2.8 | V | Battery size indication 100k pull-up resistor to VBB in phone<br>SIM Card removal detection (Threshold is 2.4V@VBB=2.8V) |
| | | 68 | | kohm | Indication of a BLB-2 battery (600mAh Li-Ion) |
| | | 22 | | kohm | Indication resistor for a service battery |
| | -5 | | 5 | % | Indication resistor and pull-up resistor tolerance |

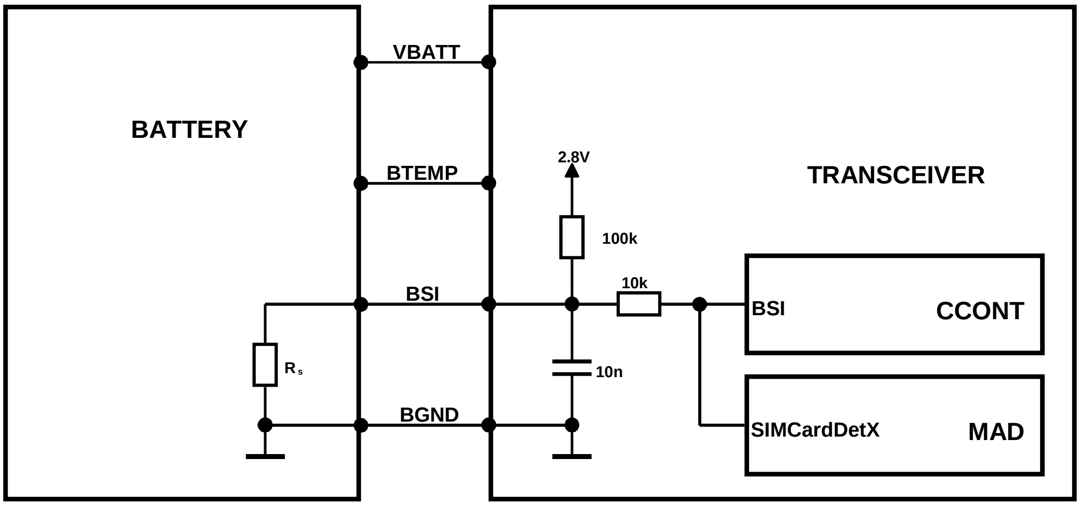



**Figure 6: BSI connections for all battery types**

The battery identification line is used also for battery removal detection. The BSI line is connected to a SIMCardDetX line of MAD2. SIMCardDetX is a threshold detector with a nominal input switching level 0.85xVcc for a rising edge and 0.55xVcc for a falling edge. The battery removal detection is used as a trigger to power down the SIM card before the power is lost. The BSI contact in the battery contact disconnects before the other contacts so that there is a delay between battery removal detection and supply power off.

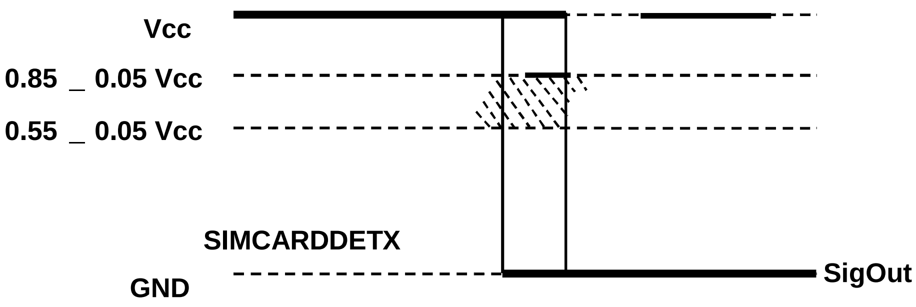



**Figure 7: SIMCardDetX Detection Levels**

## Battery Temperature

The battery temperature is measured with a NTC inside the battery pack. The BTEMP line inside transceiver has a 100k pull-up to VREF. The MCU can calculate the battery temperature by reading the BTEMP line DC-voltage level with a CCONT (N100) A/D-converter.

| Pin | Name | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| 3 | BTEMP | 0 | | 1.4 | V | Battery temperature indication 100k pull-up resistor to VREF in phone<br>Battery package has NTC pull-down resistor: 47k +/-5%@+25C, B=4050 +/-3% |
| | | 2.1<br>5 | <br>10 | 3<br>20 | V<br>ms | Phone power up by battery (input)<br>Power up pulse width |
| | | | 47 | | Kohm | Service battery value |
| | | -5 | | 5 | % | 100k pull-up resistor tolerance |

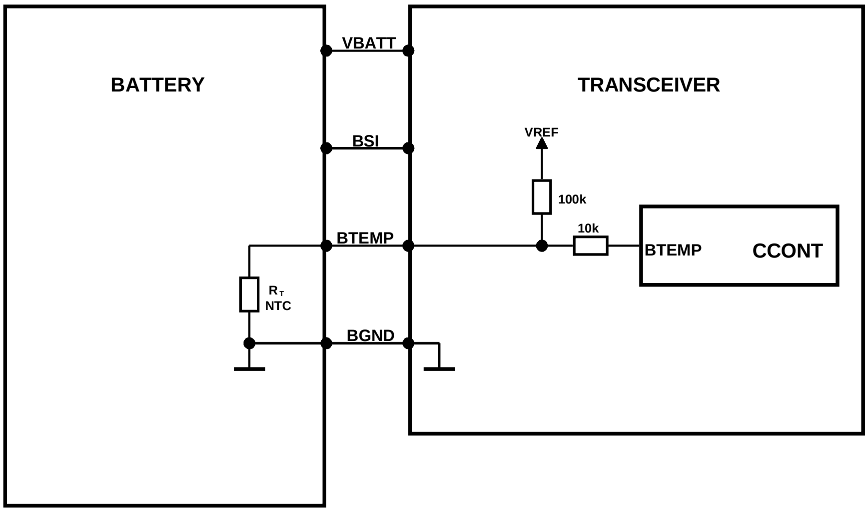



**Figure 8: Standard Battery BTEMP connection**

Based on 47 kohm ± 5 % NTC with B = 4090 ±1.5 %. Without any alignment, with that and 1 % pull-up resistor, ± 2.5 _C accuracy is achieved between - 20 and +60 _C (± 3.5 _C @ -40 ... +85 _C).

## Supply Voltage Regulators

The heart of the power distribution is the CCONT. It includes all the voltage regulators and feeds the power to the whole system. The baseband digital parts are powered from the VBB regulator which provides 2.8V baseband supply. The baseband regulator is active always when the phone is powered on. The VBB baseband regulator feeds MAD and memories, VCORE for MAD core, COBBA digital parts and the LCD driver in the UI section. There is a separate regulator for a SIM card. The regulator is selectable between 3V and 5V and controlled by the SIMPwr line from MAD to CCONT. The COBBA analog parts are powered from a dedicated 2.8V supply VCOBBA. The CCONT supplies also 5V for RF and for flash VPP. The CCONT contains a real time clock function, which is powered from a RTC backup when the main battery is disconnected. The RTC backup is rechargable polyacene battery. The battery is charged from the main battery voltage by the CHAPS when the main battery voltage is over 3.2V.

| Operating Mode | Vref | RF REG | VCOBBA | VBB | VSIM | SIMIF | Vcore |
|---|---|---|---|---|---|---|---|
| Power off | Off | Off | Off | Off | Off | Pull-down | Off |
| Power on | On | On/Off | On | On | On | On/Off | On |
| Reset | On | Off<br>VR1 On | On | On | Off | Pull-down | On |
| Sleep | On | Off | Off | On | On | On/Off | On |

**NOTE: COBBA regulator is off in SLEEP mode. Its output pin may be fed from $V_{BB}$ in SLEEP mode by setting bit RFReg(5) to'1' (default).**

CCONT includes also five additional 2.8V regulators providing power to the RF section. These regulators can be controlled either by the direct control signals from MAD or by the RF regulator control register in CCONT which MAD can update. Below are the listed the MAD control lines and the regulators they are controlling.

- TxPwr controls **VTX regulator (VR5)**
- RxPwr controls **VRX regulator (VR2)**
- SynthPwr controls all the rf regulators except VR1
- VCXOPwr controls VXO regulator (VR1)

CCONT generates also a 1.5 V reference voltage VREF to COBBA. The VREF voltage is also used as a reference to some of the CCONT A/D converters.

In addition to the above mentioned signals MAD includes also TXP control signal which goes to HAGAR power control block. The transmitter power control TXC is led from COBBA to HAGAR.

| Characteristics | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Output current VR1-VR6 | Vout@2.8V | | | 100 | mA |
| Output current VR7<br>Depends on external BJT | Vout@2.8V | | | 150 | mA |
| Output current VR7BASE<br>Base current limit | Vout@2.8V | | | -10 | mA |
| Output current VBB On<br>Current limit 250mA<br>Output current VBB Sleep<br>Current limit 5mA | Vout@2.8V<br><br>Vout@2.8V | | | 125<br><br>1 | mA<br><br>mA |
| Output voltage VR1-VR7 | over full temperature, input voltage and load range | 2.7 | 2.8 | 2.85 | V |
| Output voltage VBB | over full temperature, input voltage and load range | 2.7 | 2.8 | 2.85 | V |
| Output voltage V2V<br>(VCORE) | Programmable:<br>Vout=1.3V+225mV*n<br>N = 0,1,2,3,4,5,6 | 1.30 | | 2.65 | V |
| Output voltage V2V<br>(VCORE) tolerance | | -5 | | +5 | % |
| Line regulation (not VBB) | F v 10kHz, 2)<br>VBAT>3.15V | 49 | | | DB |

| Characteristics | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Line regulation (not VBB) | F v 100kHz, 2)<br>VBAT>3.15v | 40 | | | DB |
| Line regulation VBB, V2V (VCORE) | F v 100kHz 2) | 30 | | | DB |
| Load regulation | T = 25_C | | 0.6 | 1 | mV/mA |
| Supply current (each regulator) VR1...VR7 | ON mode | | $I_{out}$/<br>60+330 | $I_{out}$/<br>10+540 | mA |
| Supply current VBB | ON mode | | $I_{out}$/60+<br>250 | $I_{out}$/10+<br>400 | mA |
| Supply current VBB | SLEEP mode | | $I_{out}$/60+<br>100 | $I_{out}$/10+<br>150 | mA |
| Output voltage V2V (VCORE) | MAD2WD1 C10<br>MAD2WD1 C07<br>MAD2WD1 C05 | | 2.65<br>1.75<br>1.75 | | V |

NOTE 1: Characteristics above are NOT valid if Vbat < 3.0V.
NOTE 2: Line regulation is 20dB for f<100kHz when battery voltage is lower than 3.1V.

### Switched Mode Supply VSIM

There is a switched mode supply for SIM-interface. SIM voltage is selected via serial IO. The 5V SMR can be switched on independently of the SIM voltage selection, but can't be switched off when VSIM voltage value is set to 5V.

| Characteristics | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Output voltage VSIM | Over temperature<br>Over current | 2.8<br>4.8 | 3.0<br>5.0 | 3.2<br>5.2 | V |
| Output voltage V5V | Over temp & current | 4.8 | 5.0 | 5.2 | V |
| Output voltage V5V_2 | Over temperature | 5.0 | | 6.0 | V |
| Output current VSIM | Continuous DC | | | 30 | mA |
| Output current V5V | Continuous DC | | | 30 | mA |
| Current consumption VSIM | on<br>sleep | | 200<br>100 | 330<br>150 | uA<br>uA |

NOTE: VSIM and V5V can give together a total of 30mA.

In the next figure the principle of the SMR / VSIM-functions is shown.

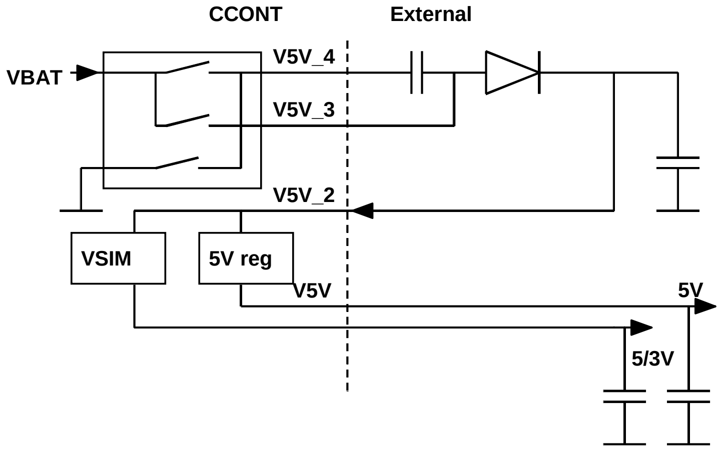



**Figure 9: Principle of the SMR Power Functions**

## Power Up and Power Down

The baseband is powered up by:

1 Pressing the power key, that generates a PWRONX interrupt signal from the power key to the CCONT, which starts the power up procedure.

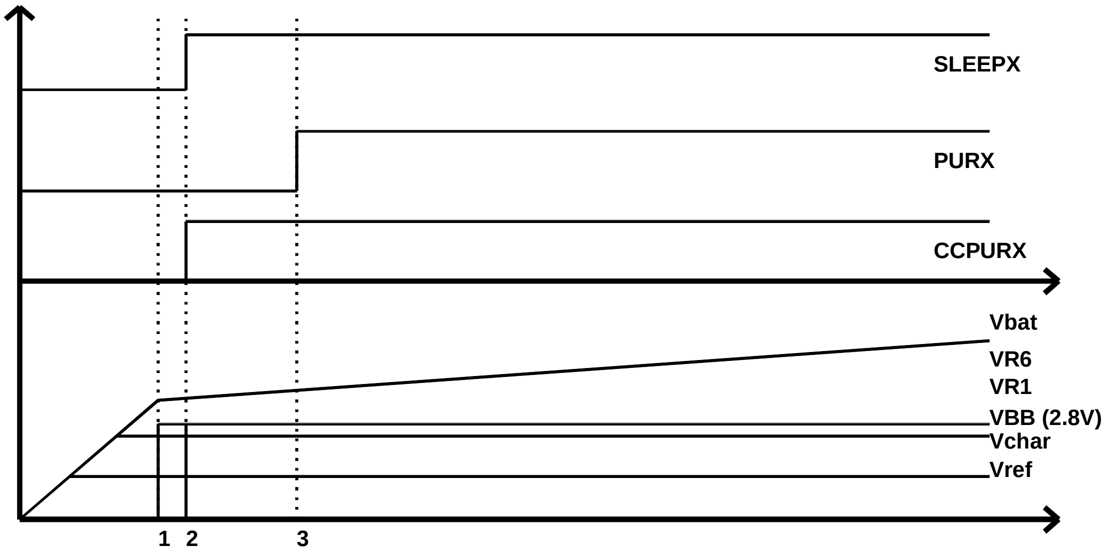
2 Connecting a charger to the phone. The CCONT recognizes the charger from the VCHAR voltage and starts the power up procedure.

3 A RTC interrupt. If the real time clock is set to alarm and the phone is switched off, the RTC generates an interrupt signal, when the alarm is gone off. The RTC interrupt signal is connected to the PWRONX line to give a power on signal to the CCONT just like the power key.

4 A battery interrupt. Intelligent battery packs have a possibility to power up the phone. When the battery gives a short (10ms) voltage pulse through the BTEMP pin, the CCONT wakes up and starts the power on procedure.

## Power up with charger

When the charger is connected CCONT will switch on the CCONT digital voltage as soon as the battery voltage exceeds 3.0V. The reset for CCONT's digital parts is released when the operating voltage is stabilized (50 us from switching on the voltages). Operating voltage for VCXO is also switched on. The counter in CCONT digital section will keep MAD in reset for 62 ms (PURX) to make sure that the clock provided by VCXO is stable. After this delay MAD reset is released, and VCXO -control (SLEEPX) is given to MAD. The next diagram explains the power on procedure with charger (the picture assumes empty battery, but the situation would be the same with full battery):




**1: Battery voltage over 3.0==>Digital voltages to CCONT (VBB)**
**2: CCONT digital reset released. VCXO turned on**
**3: 62ms delay before PURX released**

**Figure 10: Power Up With Charger**

When the phone is powered up with an empty battery pack using the standard charger, the charger may not supply enough current for standard powerup procedure and the powerup must be delayed.

### Power Up with the Power Switch (PWRONX)

When the power on switch is pressed the PWRONX signal will go low. CCONT will switch on the CCONT digital section and VCXO as was the case with the charger driven power up. If PWRONX is low when the 64 ms delay expires, PURX is released and SLEEPX control goes to MAD. If PWRONX is not low when 64 ms expires, PURX will not be released, and

CCONT will go to power off (digital section will send power off signal to analog parts)

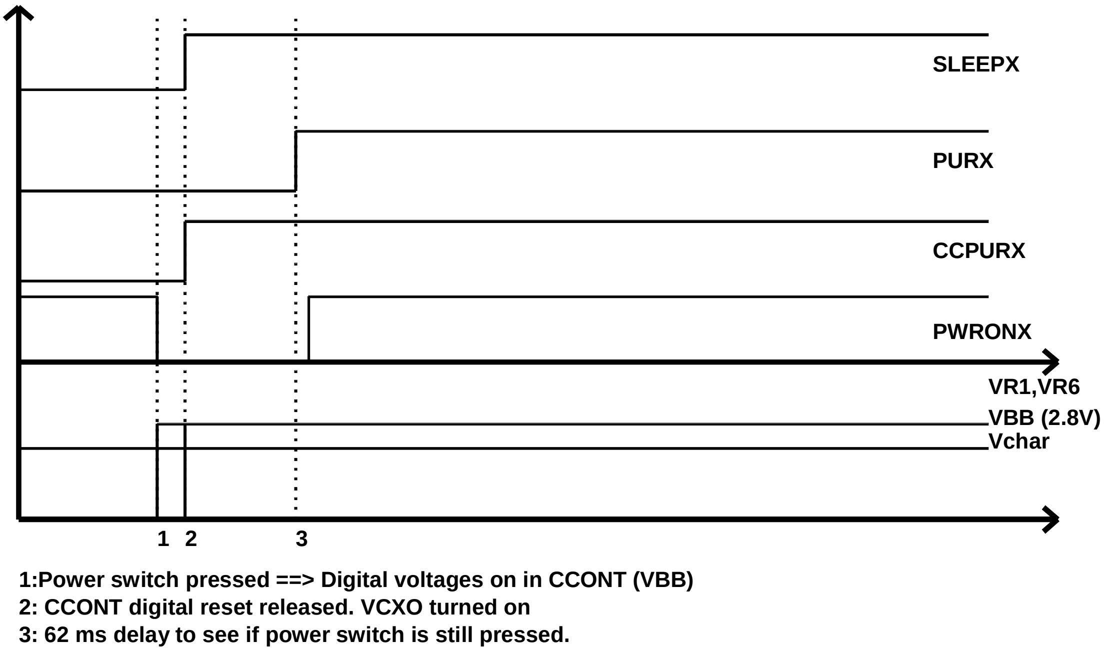



**Figure 11: Power Up With Switch**

## Power Up by RTC

RTC (internal in CCONT) can power the phone up by changing RTCPwr to logical 1.

## Power Up by IBI

IBI can power CCONT up by giving a short pulse (10ms) through the BTEMP line. After powerup BTEMP will act as any other input channel for ADC.

When the PURX reset is released, the MAD releases the system reset ExtSysResetX and the internal MCUResetX signals and starts the boot program execution from MAD bootrom if MAD GenSDIO pin is pulled low or from external memory if GenSDIO pin is pulled high. In normal operation the program execution continues from the flash program memory. If the MBUS line is pulled low during the power up the bootrom starts a flash programming sequence and waits for the prommer response through FBUS_RX line.

## Power Down

The baseband is powered down by:

1 Pressing the power key, that is monitored by the MAD, which starts the power down procedure.

2 If the battery voltage is dropped below the operation limit, either by not charging it or by removing the battery.

3 Letting the CCONT watchdog expire, which switches off all CCONT regulators and

the phone is powered down.

4 Setting the real time clock to power off the phone by a timer. The RTC generates an interrupt signal, when the alarm is gone off. The RTC interrupt signal is connected to the PWRONX line to give a power off signal to the CCONT just like the power key.

The power down is controlled by the MAD. When the power key has been pressed long enough or the battery voltage is dropped below the limit the MCU initiates a power down procedure and disconnects the SIM power. Then the MCU outputs a system reset signal and resets the DSP. If there is no charger connected the MCU writes a short delay to CCONT watchdog and resets itself. After the set delay the CCONT watchdog expires, which activates the PURX and all regulators are switched off and the phone is powered down by the CCONT.

If a charger is connected when the power key is pressed the phone enters into the acting dead mode.

## Modes of Operation

### 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 Mode

In the active mode the phone is in normal operation, scanning for channels, listening to a base station, transmitting and processing information. All the CCONT regulators are operating. 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.

### Sleep Mode

In the sleep mode all the regulators except the baseband VBB and the SIM card VSIM regulators are off. Sleep mode is activated by the MAD after MCU and DSP clocks have been switched off. The voltage regulators for the RF section are switched off and the VCXO power control, VCXOPwr is set low. In this state only the 32 kHz sleep clock oscillator in CCONT is running. The flash memory power down input is connected to the ExtSysResetX signal, and the flash is deep powered down during the sleep mode.

The sleep mode is exited either by the expiration of a sleep clock counter in the MAD or by some external interrupt, generated by a charger connection, key press, headset connection etc. The MAD starts the wake up sequence and sets the VCXOPwr and ExtSysResetX control high. After VCXO settling time other regulators and clocks are enabled for active mode.

If the battery pack is disconnect during the sleep mode, the CCONT pulls the SIM interface lines low as there is no time to wake up the MCU.

#### 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 CCONT controlled by the charging software running in the MAD.

The power management circuitry controls the charging current delivered from the charger to the battery. Charging is controlled with a PWM input signal, generated by the CCONT. The PWM pulse width is controlled by the MAD and sent to the CCONT through a serial data bus. The battery voltage rise is limited by turning the CHAPS switch off when the battery voltage has reached 4.2 V. Charging current is monitored by measuring the voltage drop across a 220 mohm resistor.

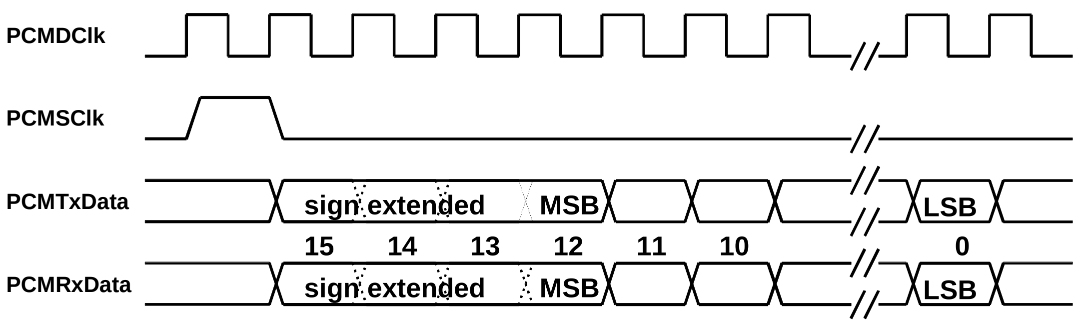
#### Watchdog

The Watchdog block inside CCONT contains a watchdog counter and some additional logic which are used for controlling the power on and power off procedures of CCONT. Watchdog output is disabled when WDDisX pin is tied low. The WD–counter runs during that time, though. Watchdog counter is reset internally to 32 s at power up. Normally it is reset by MAD writing a control word to the WDReg.

## Audio Control

### PCM serial interface

The interface consists of following signals: a PCM codec master clock (PCMDClk), a frame synchronization signal to DSP (PCMSClk), a codec transmit data line (PCMTX) and a codec receive data line (PCMRX). The COBBA-GJP generates the PCMDClk clock, which is supplied to DSP SIO. The COBBA-GJP also generates the PCMSClk signal to DSP by dividing the PCMDClk. The PCMDClk frequency is 512 kHz. PCMSClk frequency is 8.0 kHz.



## Digital Control

The baseband functions are controlled by the MAD ASIC, which consists of a MCU, a system ASIC and a DSP. MAD with the GSM/PCN specific ASIC is named to MAD2.

## MAD2 WD1

MAD2 WD1 contains following building blocks:

- ARM RISC processor with both 16-bit instruction set (THUMB mode) and 32-bit instruction set (ARM mode)
- TI Lead DSP core with peripherals:
- API (Arm Port Interface memory) for MCU-DSP communication, DSP code download, MCU interrupt handling vectors (in DSP RAM) and DSP booting.
- Serial port (connection to PCM)
- Timer
- DSP memory
- BUSC (BusController for controlling accesses from ARM to API, System Logic and MCU external memories, both 8- and 16-bit memories)
- System Logic
- CTSI (Clock, Timing, Sleep and Interrupt control)
- MCUIF (Interface to ARM via BUSC). Contains MCU BootROM
- DSPIF (Interface to DSP)
- MFI (Interface to COBBA AD/DA Converters)
- CODER (Block encoding/decoding and A51&A52 ciphering)
- AccIF (Accessory Interface)
- SCU (Synthesizer Control Unit for controlling 2 separate synthesizer)
- UIF (Keyboard interface, serial control interface for COBBA PCM Codec, LCD Driver and CCONT)
- SIMI (SimCard interface with enhanced features)
- PUP (Parallel IO, USART and PWM control unit for vibra and buzzer)
- Flexpool

The MAD2 operates from a 13 MHz system clock, which is generated from the 13Mhz VCXO frequency. The MAD2 supplies a 6,5 MHz or a 13 MHz internal clock for the MCU and system logic blocks and a 13 MHz clock for the DSP, where it is multiplied to 45.5 MHz DSP clock. The system clock can be stopped for a system sleep mode by disabling the VCXO supply power from the CCONT regulator output. The CCONT provides a 32 kHz sleep clock for internal use and to the MAD2, which is used for the sleep mode timing. The sleep clock is active when there is a battery voltage available i.e. always when the battery is connected.

MAD2WD1 supply voltages are VBB and VCORE (V2V), VBB feed I/O pins so that MAD2WD1 is externally fully compatible with old versions. VCORE feed MAD2WD1 internal functions supply voltage; CPU, DSP and system logic.

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **A1** | MCUGemIO 0 | O | | 2 | 0 | | MCU General purpose output port |
| **C2** | LEADGND | | | | | | Lead Ground |
| **D2** | Col4 | I/O | UIF | 2 | Input | Programmable pullup PR0201 | I/O line for keyboard column 4 |
| **D3** | Col3 | I/O | UIF | 2 | Input | Programmable pullup PR0201 | I/O line for keyboard column 3 |
| **H11** | MCUGenIO1 | I/O | | 2 | Input, pullup | Pullup PR0201 | General purpose I/O port |
| **E4** | **GND** | | | | | | Ground |
| **D4** | Col2 | I/O | UIF | 2 | Input | Programmable pullup PR0201 | I/O line for keyboard column 2 |
| **C4** | Col1 | I/O | UIF | 2 | Input | programmable pullup PR0201 | I/O line for keyboard column 1 |
| **C3** | Col0 | I/O | UIF | 2 | Input | programmable pullup PR0201 | I/O line for keyboard column 0 |
| **D1** | LCDCSX | I/O | UIF | 2 | Input | external pullup/down | serial LCD driver chip select, parallel LCD driver enable |
| **E1** | LEADVCC | | | | | | Lead Power |
| **F12** | LoByteSelX | | | | | | NC |

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **E3** | Row5LCDCD | I/O | UIF | 2 | Input, pullup | pullup PR0201 | Keyboard row5 data I/O, serial LCD driver command/data indicator, parallel LCD driver read/write select |
| **N4** | **VCC_CORE** | | | | | Core VCC in 3325c10 | Power |
| **E2** | Row4 | I/O | UIF | 2 | Input, pullup | pullup PR0201 | I/O line for keyboard row 4, parallel LCD driver register selection control |
| **F4** | Row3 | I/O | UIF | 2 | Input, pullup | pullup PR0201 | I/O line for keyboard row 3, parallel LCD driver data |
| **F3** | Row2 | I/O | UIF | 2 | Input, pullup | pullup PR0201 | I/O line for keyboard row 2, parallel LCD driver data |
| **F2** | Row1 | I/O | UIF | 2 | Input, pullup | pullup PR0201 | I/O line for keyboard row 1, parallel LCD driver data |
| **F1** | Row0 | I/O | UIF | 2 | Input, pullup | pullup PR0201 | I/O line for keyboard row 0, parallel LCD driver data |
| **L11** | JTDO | O | | 2 | Tri-state | | JTAG data out |
| **L5** | **GND** | | | | | | Ground |
| **N12** | JTRst | I | | | Input, pulldown | pulldown PD0201 | JTAG reset |
| **M12** | JTClk | I | | | Input | pulldown PD0201 | JTAG Clock |
| **N13** | JTDI | I | | | Input, pullup | pullup PR0201 | JTAG data in |
| **M13** | JTMS | I | | | Input, pullup | pullup PR0201 | JTAG mode select |
| **G13** | **VCC_IO** | | | | | IO VCC in 3325c10 | Power |
| **L12** | CoEmu0 | I/O | | 2 | Input, pullup | pullup PR0201 | DSP/MCU emulation port 0 |
| **L13** | CoEmu1 | I/O | | 2 | Input, pullup | pullup PR0201 | DSP/MCU emulation port 1 |
| **H4** | LEADGND | | | | | | Lead Ground |

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **L1** | ARMGND | | | | | | ARM Ground |
| **N3** | MCUAd0 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **K4** | ARMVCC | | | | | | ARM Power |
| **N2** | MCUAd1 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **N1** | MCUAd2 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **M4** | MCUAd3 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **M3** | MCUAd4 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **M2** | MCUAd5 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **M1** | MCUAd6 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **H1** | **VCC_IO** | | | | | IO VCC in 3325c10 | Power |
| **L4** | MCUAd7 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **L3** | MCUAd8 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **L2** | MCUAd9 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **K5** | MCUAd10 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **J4** | **GND** | | | | | | Ground |
| **K3** | MCUAd11 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **K2** | MCUAd12 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **K1** | MCUAd13 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **J3** | MCUAd14 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **J2** | MCUAd15 | O | MCU MEMORY | 2 | 0 | | MCU address bus |

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **J1** | MCUAd16 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **M10** | **VCC_CORE** | | | | | Core VCC in 3325c10 | Power |
| **H3** | MCUAd17 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **H2** | MCUAd18 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **G4** | MCUAd19 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **G3** | MCUAd20 | O | MCU MEMORY | 2 | 0 | | MCU address bus |
| **G2** | VCONT | O | | | | | |
| **K6** | ExtMCUDa0 | I/O | MCU MEMORY | 2 | Input | | MCU data bus |
| **K9** | **GND** | | | | | | Ground |
| **L6** | ExtMCUDa1 | I/O | MCU MEMORY | 2 | Output | | MCU data bus |
| **M6** | ExtMCUDa2 | I/O | MCU MEMORY | 2 | Output | | MCU data bus |
| **N6** | ExtMCUDa3 | I/O | MCU MEMORY | 2 | Output | | MCU data bus |
| **L7** | ExtMCUDa4 | I/O | MCU MEMORY | 2 | Output | | MCU data bus |
| **M7** | ExtMCUDa5 | I/O | MCU MEMORY | 2 | Output | | MCU data bus |
| **N7** | ExtMCUDa6 | I/O | MCU MEMORY | 2 | Output | | MCU data bus |
| **N8** | ExtMCUDa7 | I/O | MCU MEMORY | 2 | Output | | MCU data bus |
| **M8** | MCUGenIODa0 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |
| **L8** | MCUGenIODa1 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |
| **K8** | MCUGenIODa2 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |
| **N9** | MCUGenIODa3 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **E10** | **GND** | | | | | | Ground |
| **M9** | MCUGenIODa 4 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |
| **L9** | MCUGenIODa 5 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |
| **N10** | MCUGenIODa 6 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |
| **L10** | MCUGenIODa 7 | I/O | | 2 | Input | MCU Data in 16-bit mode | General purpose I/O port |
| **M5** | MCURdX | O | MCU MEMORY | 2 | 1 | | MCU Read strobe |
| **G11** | **VCC_CORE** | | | | | Core VCC in 3325c10 | Power |
| **N5** | MCUWrX | O | MCU MEMORY | 2 | 1 | | MCU write strobe |
| **N11** | ROM1SelX | O | MCU ROM | 2 | 1 | | ROM chip select |
| **M11** | RAMSelX | O | MCU RAM | 2 | 1 | | RAM chip select |
| **J11** | IRON | O | IR Mod | 2 | 1 | | IR control |
| **A1** | MCUGenIO1 | I/O | | 2 | Input, pullup | pullup PR0201 | General purpose I/O port |
| **D8** | DSPXF | O | | 2 | 1 | | External flag |
| **K10** | SCVCC | | | | | | Special cell Power |
| **K11** | RFClk | I | VCXO | | Input | | System clock from VCTCXO |
| **K12** | RFClkGnd | | | | Input | | System clock reference ground input |
| **K13** | SIMCardDetX | I | | | Input | | SIM card detection |
| **J10** | SCGND | | | | | | Special cell Ground |
| **D9** | BuzzPWM | O | BUZZER | 2 | 0 | | Buzzer PWM control |
| **D11** | LEADVCC | | | | | | LEAD Power |
| **G12** | VibraPWM | O | VIBRA | 2 | 0 | | Vibra PWM control |
| **C9** | **GND** | | | | | | Ground |
| **E12** | MCUGenIO3 | I/O | | 2 | Input, pullup | pullup PR1001 | General purpose I/O port |

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **E13** | MCUGenIO2 | I/O | | 2 | Input, pullup | pullup PR1001 | General purpose I/O port |
| **J13** | KBLights | O | UIF | 2 | 1 | | |
| **C5** | AccTxData | I/O | | 4 | Tri- State | external pullup | Accessory TX data, Flash_TX |
| **B6** | **VCC_IO** | | | | | IO VCC in 3325c10 | Power |
| **F11** | HookDet | I | | | Input | | Non-MBUS accessory connection detector |
| **F10** | HeadDet | I | | | Input | | Headset detection interrupt |
| **D6** | AccRxData | I | | | Input | | Accessory RX data, Flash_RX |
| **D5** | **GND** | | | | | | Ground |
| **G10** | MCUGenIO4 | I/O | | 2 | Input, pulldown | pulldown PD1001 | General purpose I/O port |
| **B5** | MBUS | I/O | | 2 | Input, external pullup | external pullup | MBUS, Flash clock |
| **E11** | VCXOPwr | O | CCONT | 2 | 1 | | VCXO regulator control |
| **D13** | SynthPwr | O | CCONT | 2 | 0 | | Synthesizer regulator control |
| **B7** | **VCC_CORE** | | | | | Core VCC in 3325c10 | Power |
| **C10** | GenCCONTCSX | O | CCONT | 2 | 1 | | Chip select to CCONT |
| **F13** | LEADGND | | | | | | LEAD Ground |
| **B10** | GenSDIO | I/O | CCONT, UIF | 2 | Input, external pullup/ down | external pullup/down depending on how to boot | Serial data in/out |
| **A10** | GenSClk | O | CCONT, UIF | 2 | 0 | | Serial clock |
| **C11** | SIMCardData | I/O | CCONT | 2 | 0 | | SIM data |
| **J12** | **GND** | | | | | | Ground |
| **B13** | PURX | I | CCONT | | Input | | Power Up Reset |

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **B12** | CCONTInt | I | CCONT | | Input | | CCONT interrupt |
| **A13** | Clk32k | I | CCONT | | Input | | Sleep clock oscillator input |
| **D10** | **VCC_IO** | | | | | IO VCC in 3325c10 | Power |
| **A12** | SIMCardClk | O | CCONT | 2 | 0 | | SIM clock |
| **B11** | SIMCardRstX | O | CCONT | 2 | 0 | | SIM reset |
| **A11** | SIMCardIOC | O | CCONT | 2 | 0 | | SIM data in/out control |
| **D12** | SIMCardPwr | O | CCONT | 2 | 0 | | SIM power control |
| **H10** | LEADVCC | | | | | | LEAD Power |
| **C13** | RxPwr | O | | 2 | 0 | | (RX regulator control) |
| **C12** | TxPwr | O | | 2 | 0 | | (TX regulator control) |
| **H12** | TestMode | I | | | Input, pulldown | pulldown PD0201 | Test mode select |
| **H13** | ExtSysResetX | O | | 2 | 0 | | System Reset |
| **B9** | PCMTxData | O | COBBA | 2 | 0 | | Transmit data, DX |
| **K7** | **VCC_IO** | | | | | IO VCC in 3325c10 | Power |
| **A9** | PCMRxData | I | COBBA | | Input | | Receive data, RX |
| **B8** | PCMDClk | I | COBBA | | Input | | Transmit clock, CLKX |
| **A8** | PCMSClk | I | COBBA | | Input | | Transmit frame sync, FSX |
| **C6** | COBBAClk | O | COBBA | 4 | 1 | | COBBA clock, 13 MHz |
| **A6** | COBBACSX | | COBBA | | | | COBBA |
| **A7** | COBBASD | | COBBA | | | | COBBA |
| **C7** | IData | | COBBA | | | | COBBA |
| **D7** | QData | | COBBA | | | | COBBA |
| **G1** | **VCC_CORE** | | | | | Core VCC in 3325c10 | Power |
| **C1** | DSPGenOut3 | O | RF | 2 | 0 | | DSP general purpose output |
| **B4** | DSPGenOut2 | O | RF | 2 | 0 | | DSP general purpose output |

| Pin No: | Pin Name | Pin Type | Connected to/ from | Drive req. mA | Reset State | Note | Explanation |
|---|---|---|---|---|---|---|---|
| **A4** | DSPGenOut1 | O | RF | 2 | 0 | | DSP general purpose output |
| **A5** | DSPGenOut0 | O | CRFU | 2 | 0 | | DSP general purpose output |
| **A3** | FrACtrl | O | RF | 2 | 0 | | RF front amplifier control |
| **B3** | SynthEna | O | HAGAR | 2 | 0 | | Synthesizer data enable |
| **B1** | SynthClk | O | HAGAR | 2 | 0 | | Synthesizer clock |
| **B2** | SynthData | O | HAGAR | 2 | 0 | | Synthesizer data |
| **A2** | TxPA | O | HAGAR | 2 | 0 | | Power amplifier control |

## Memories

### MAD memory configuration

The MAD2WD1 used in NSB-7 contains 16 kWords RAM, and 80 kWords ROM memory.

### Memory

The MCU program code resides in an external flash program memory, which size is 16Mbits (1024k x 16bit). The MCU work (data) memory size is 2048 kbits (256k x 16bit). Flash and SRAM memory chips are packed in same combo memory package.

The BusController (BUSC) section in the MAD decodes the chip select signals for the external memory devices and the system logic. BUSC controls internal and external bus drivers and multiplexers connected to the MCU data bus. The MCU address space is divided into access areas with separate chip select signals. BUSC supports a programmable number of wait states for each memory range.

### Program and Data Memory

The MCU program code resides in the program memory. The program memory is 16Mbits (1024k x 16bit) Flash memory.

The flash memory has a power down pin that should be kept low, during the power up phase of the flash to ensure that the device is powered up in the correct state, read only. The power down pin is utilized in the system sleep mode by connecting the ExtSysResetX to the flash power down pin to minimize the flash power consumption during the sleep.

Nonvolatile data memory is implemented with program (Flash) memory. Special EEPROM emulation (EEEMmu) software is utilized.

### Work Memory

The work memory is a static RAM of size 2096k (256k x 16). The memory contents are lost when the baseband voltage is switched off. All retained data must be stored into the data memory when the phone is powered down.

### MCU Memory Requirements

| Device | Organisation | Access Time ns | Wait States Used | Remarks |
|---|---|---|---|---|
| FLASH | 1024kx16 | 120 | 1 | uBGA 48 |
| SRAM | 256kx16 | 120 | 1 | uBGA 48 |

### MCU Memory Map

MAD2 supports maximum of 4GB internal and 4MB external address space. External memories use address lines MCUAd0 to MCUAd21 and 8-bit/16-bit databus. The BUSC bus controller supports 8- and 16-bit access for byte, double byte, word and double word data. Access wait states (0, 1 or 2) and used databus width can be selected separately for each memory block.

### Flash Programming

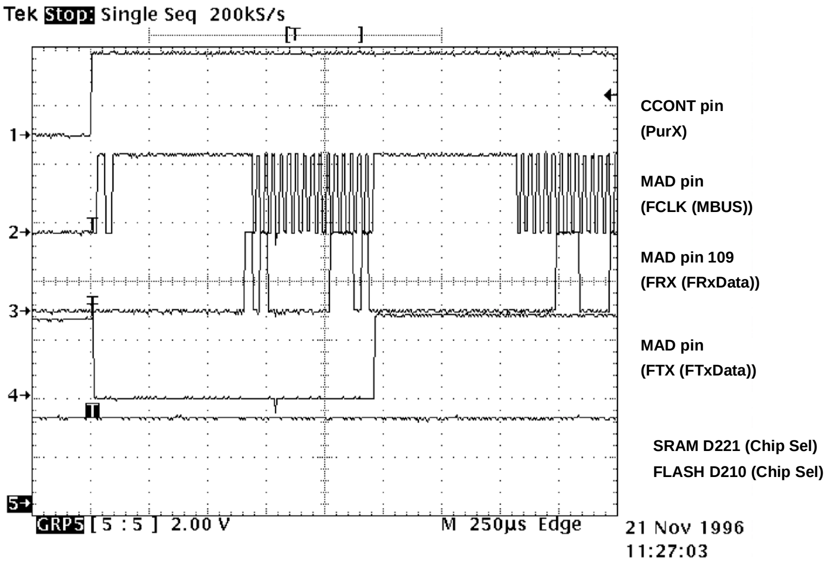
The phone has to be connected to the flash loading adapter so that supply voltage for the phone and data transmission lines can be supplied from/to the adapter. When adapter switches supply voltage to the phone, the program execution starts from the BOOT ROM and the MCU investigates in the early start-up sequence if the flash prommer is connected. This is done by checking the status of the MBUS-line. Normally this line is high but when the flash prommer is connected the line is forced low by the prommer.

The flash prommer serial data receive line is in receive mode waiting for an acknowledgement from the phone. The data transmit line from the baseband to the prommer is initially high. When the baseband has recognized the flash prommer, the TX-line is pulled low. This acknowledgement is used to start to toggle MBUS (FCLK) line three times in order that MAD2 gets initialized. This must be happened within 15 ms after TX line is pulled low. After that the data transfer of the first two bytes from the flash prommer to the baseband on the RX-line must be done within 1 ms.

When MAD2 has received the secondary boot byte count information, it forces TX line high. Now, the secondary boot code must be sent to the phone within 10 ms per 16 bit word. If these time-out values are exceeded, the MCU (MAD2) starts normal code execution from flash. After this, the timing between the phone and the flash prommer is handled with dummy bites.

A 5V programming voltage is supplied inside the transceiver from the battery voltage with a switch mode regulator (5V/30mA) of the CCONT. The 5V is connected to VPP pin of the flash.

| Characteristics | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Time from boot indication to MAD2 initialization sequence | | | 15 | ms |
| Time from MAD2 initialization sequence to byte length information | | | 1 | ms |
| Time from byte length information to end of secondary boot code loading. | | | 10 per16 bit word | ms |



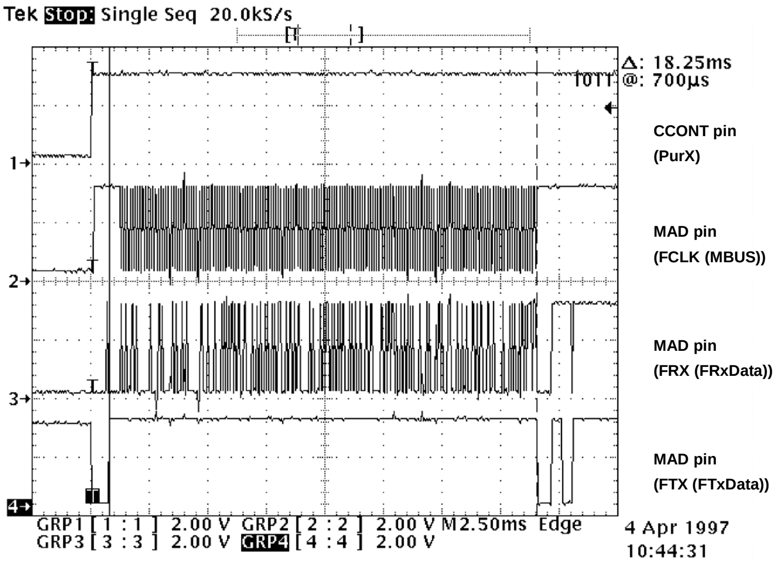




**Figure 12: Flash Programming Sequence**

## COBBA GJP

COBBA GJP ASIC provides an interface between the baseband and the RF-circuitry. COBBA performs analogue to digital conversion of the receive signal. For transmit path COBBA performs digital to analogue conversion of the transmit amplifier power control ramp and the in-phase and quadrature signals. A slow speed digital to analogue converter will provide automatic frequency control (AFC).

COBBA is at any time connected to MAD asic with two interfaces, one for transferring TX and RX data between MAD and COBBA and one for transferring codec RX/TX samples.

### Real time clock

Requirements for a real time clock implementation are a basic clock (hours and minutes), a calender and a timer with alarm and power on/off -function and miscellaneous calls. The RTC will contain only the time base and the alarm timer but all other functions (e.g. calendar) will be implemented with the MCU software. The RTC needs a power backup to keep the clock running when the phone battery is disconnected. The backup power is supplied from a rechargable Li-ion battery that can keep the clock running some ten minutes. If the backup has expired, the RTC clock restarts after the main battery is connected. The CCONT keeps MCU in reset until the 32kHz source is settled (1s max).

The CCONT is an ideal place for an integrated real time clock as the asic already contains the power up/down functions and a sleep control with the 32kHz sleep clock, which is running always when the phone battery is connected. This sleep clock is used for a time source to a RTC block.

### RTC backup battery charging

CHAPS has a current limited voltage regulator for charging a backup battery. The regulator derives its power from VOUT so that charging can take place without the need to connect a charger. The backup battery is only used to provide power to a real time clock when VOUT is not present so it is important that power to the charging circuitry is derived from VOUT and that the charging circuitry does not present a load to the backup battery when VOUT is not present.

It should not be possible for charging current to flow from the backup battery into VOUT if VOUT happens to be lower than VBACK. Charging current will gradually diminish as the backup battery voltage reaches that of the regulation voltage.

### Security

The phone flash program and IMEI code are software protected using an external security device that is connected between the phone and a PC. The security device uses the phone given IMEI number, the software version number and a 24bit hardware random serial number that is read from the COBBA and calculates a flash authority identification number that is stored into the phone (emulated) EEPROM.

### Baseband EMC Strategy

The baseband EMC strategy is divided into electrical and mechanical items. As electrical guide lines, clocks and high speed signals should be routed in inner layers and away from the PCB edges. Clock signals distributed to other circuits should have series resistors incorporated to reduce rise times and reflections. Slew rate controlled buffers should be used on custom components wherever possible to reduce the EMC produced by the circuit. Separate power supplies for digital, analog and rf-blocks should be used as much as possible. Baseband and RF supply power rails should be isolated from each other by means of inductors in the power supply rail to prevent high frequency components produced on the baseband power supply rail to spread out over the RF power supply plane. This might be required to avoid interference from digital circuits to affect the performance of RF section.

All external connectors and connection must be filtered using RC or LC networks to prevent the high frequency components from entering connection cables that then will act as antennas. The amount of this type of EMC component is in straight relation to the amount of external connections. The type of network and amount of components to be used is determined by the AC and DC impedance characteristic of that particular signal. Low impedance signals requires LC network while medium impedance level signals, input signals at moderate band width can use RC networks.

The EMC protection should also prevent external or internal signals to cause interference to baseband and in particular to audio signals. Internal interference is generated by the transmitter burst frequency and the switchmode charging. The transmitter burst frequency interference is likely to cause noise to both microphone and earphone signals. The transmitter RF interference is likely to cause more problems in the microphone circuitry than in the earphone circuitry since the earpiece is a low impedance dynamic type.

As mechanical guide lines, the baseband and RF sections should be isolated from each other using EMC shielding, which suppresses radiated interferences. The transmitter burst frequency can also generate mechanical vibrations that can be picked up by the microphone if it is not properly isolated from the chassis using rubber or some other soft material. Connection wires to internal microphone and earphone should be as short as possible to reduce the interference caused by internal signals.

ESD protection has to be implemented on each external connection that is accessible during normal operation of the phone.

### Baseband Testing

The MCU software enters a local mode at startup if a dummy battery is attached and the battery temperature value is high enough. This means that the fixed resistor on the BTEMP line must correspond to a temperature higher than +85 C. In the local mode the baseband can be controlled through MBUS or FBUS connections by a PC-locals software. Baseband internal connections are tested with self tests if possible. By connecting MAD2 pin ROW5 to ground, MAD2 pins are toggled as a daisy chain, which can be used for detecting short circuits in MAD2 pins. Test pads will be placed on engine pcb for service and production trouble shooting purposes in some supply voltage and signal lines.

### Alignments

Within alignment those parameters are adjusted, that cannot be set accurate enough by design, because of component tolerances.

Due to use of 5% resistor values, the channels of the CCONT A/D converters need to be aligned in the production phase.

Within battery voltage VBATT tuning the MCU software reads the A/D reading from

CCONT at 3.6V and stores this reading to EEPROM memory as a reference point. Another reference point is created by assuming that when the input voltage is zero, A/D reading is also zero. Now the slope is known and A/D readings can be calibrated. Calibration is included in VBATT A/D reading task.

Battery charging voltage VCHAR and current ICHAR are calibrated using one test setting. Test jig in production line must have a connection to battery terminals. ICHAR is adjusted to 500mA and VCHAR to 8.4V with appropriate load connected to the battery terminals.

BTEMP is calibrated with 47kohm resistor.

BSI is calibrated with 22kohm resistor.

### Baseband Startup for Testing

When an unprogrammed module is powered up the first time the MCU starts from the boot rom inside the MAD2. The MBUS line is to be kept low to inform the MCU that the flash prommer is connected and the MCU should stop after the boot and wait for a download code.

When the flash programming is performed successfully the MCU switches to flash prom software. If the baseband is powered up for the first time the MCU will remain in local mode as the factory set has not been executed. To allow re-programming of working modules the MCU is at startup forced into local mode by connecting the BSI and BTEMP signals to ground using specified resistors.

# RF Module

This RF module takes care of all RF functions of GSM1900 single band engine. RF circuitry is on one side of a 8 layer transceiver PCB. PCB area for the RF circuitry is about 15 cm2. RF design is based on the first dualband direct conversion RF-IC "Hagar". So there is no intermediate frequency. That means the number of components is lower than before and there shall be much less interference problems than previously.

### Shielding

EMC emissions are taken care by using metallized plastic shield which screens the whole transceiver. Internal screening is realized by isolated partitions, these are the PA and the VCO blocks. The baseband circuitry is located on the same side of pcb.

Minimum height on RF board is 1.8 mm and a little space has been reserved for higher components (2.5 mm). In addition there is a possibility to put some higher (max. 2.0 mm) components in low area (recesses can be made in plastic shield). Heat generated by the circuitry will be conducted out via the PCB ground planes and metal shields.

## Environmental Specifications

### Normal and Extreme voltages

Lithium-Ion battery (1cell)

| | |
|---|---|
| Nominal Voltage | 4.1 V |
| Lower Extreme Voltage | 3.45 V (0.85 x 4.1 V = 3.49 V, "the MS shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shut-down voltage") |
| Higher Extreme Voltage | Nominal |
| Absolute Maximum Voltage | 5.1 V |
| Software Cut-off Voltage | 3.1 V |

### Temperature Conditions

RF Specifications are met within

-10...+55 deg C ambient temperature.

Storage temperature range is

-40...+70 deg C.

### Humidity

Relative humidity range is 5... 95%.
This module is not protected against water. Condensation or splashed water

might cause malfunction momentary. Long term wetness will cause permanent damage (corrosion etc.).

### Vibration

All requirements must be met in following vibration conditions:

| Freq. | ASD (Acceleration Spectral Density) random vibration |
|---|---|
| 10...100 Hz | 3 $m^2/s^3$ (0.0132 $g^2$/Hz) |
| 100...500 Hz | -3 dB/Octave |

### ESD Strength

Module should withstand an electrostatic discharge from 150 pF capacitor via 300 ohm resistor. Conducted discharge into antenna and battery connector is 8 kV (>10 discharges) and air contact 15 kV (>10 discharges).

## Main Technical Specifications

### Maximum Ratings

| Parameter | Rating |
|---|---|
| Normal battery voltage, idle mode | 3.6 V |
| Regulated supply voltage | 2.8 +/- 3% V |
| Voltage reference | 1.5 +/- 1.5% V |
| Operating temperature range | -10...+55 deg. C |
| Absolute maximum voltage | 5.1 V |
| Software cut-off voltage | 3.1 V |

## RF Frequency Plan

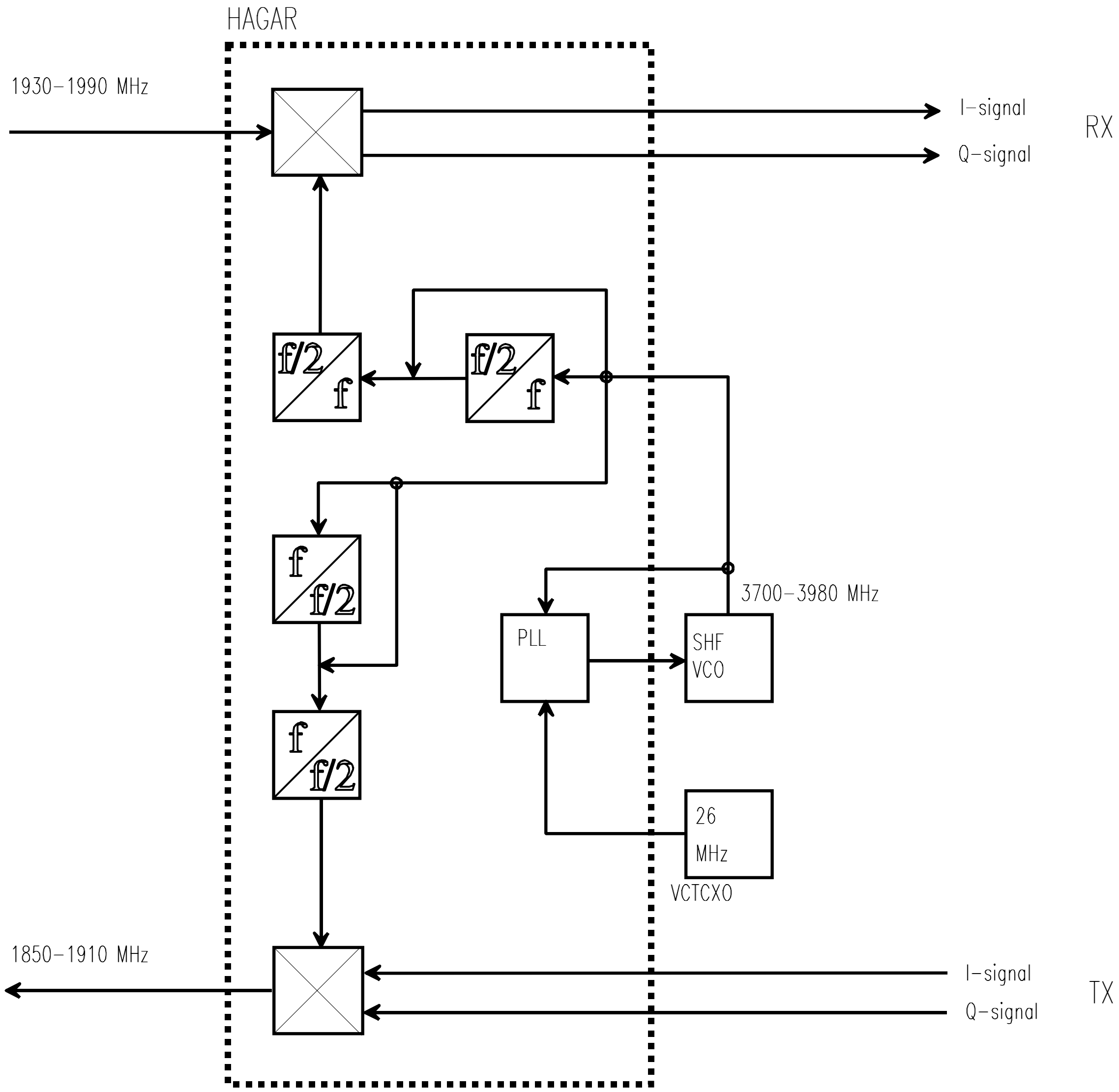



Figure 13: RF Frequency Plan

## DC Characteristics

### Regulators

Transceiver has a multi function power management IC at baseband section, which contains among other functions also 7 pcs of 2.8 V regulators. All regulators can be controlled individually with 2.8 V logic directly or through control register. In GSM direct controls are used to get fast switching because the regulators are used to enable RF functions.

VREF_2 from CCONT IC and RXREF from COBBA IC are used as the reference voltages for HAGAR RF-IC, VREF_2 (1.5V) for bias reference and RXREF (1.2V) for RX ADC's reference.

## Control Signals

| VXCO PWR | SYNTH PWR | RX PWR | TX PWR | TXP | Typ.current cons. | Notes |
|---|---|---|---|---|---|---|
| L | L | L | L | L | <10 uA | Leakage current (PA) |
| H | H | L | L | L | 28 mA | Synthesizer |
| H | H | H | L | L | 81 mA | RX active |
| H | H | L | H | L | 138 mA | TX active except PA |
| H | H | L | H | H | 1700 mA | TX active, full power |

All regulators are connected to HAGAR and directed with SYNTPWR. Different modes are switched on via serial bus.

All control signals are coming from MAD2 (2.8 V logic signals).

List of the needed supply voltages:

| Volt. source | Name of the supply | Load |
|---|---|---|
| V5V | VCP | PLL charge pump, VCO |
| VR5 | VTX | TX modulator |
| VR1 | VXO | VCTCXO |
| VR2 | VRX | HAGAR IC (LNA2+mixer+DTOS) |
| VR4 | VSYN_2 | HAGAR IC (div+LO-buff+prescaler) |
| VR3 | VSYN_1 | LNA + HAGAR (Vdd_bb) |
| VR6 | | COBBA analog parts |
| VREF_2 | | ref. voltage for HAGAR |
| RXREF (COBBA) | | ref. voltage for HAGAR |
| TXVGSM (Hagar) | | Ant. sw. GSM |
| TXVDCS (Hagar) | | Ant. sw. DCS |
| TXVDET (Hagar) | | Power detector |
| Vbatt | VBATT | RF regulators in CCONT, PA |

## Power Distribution Diagram

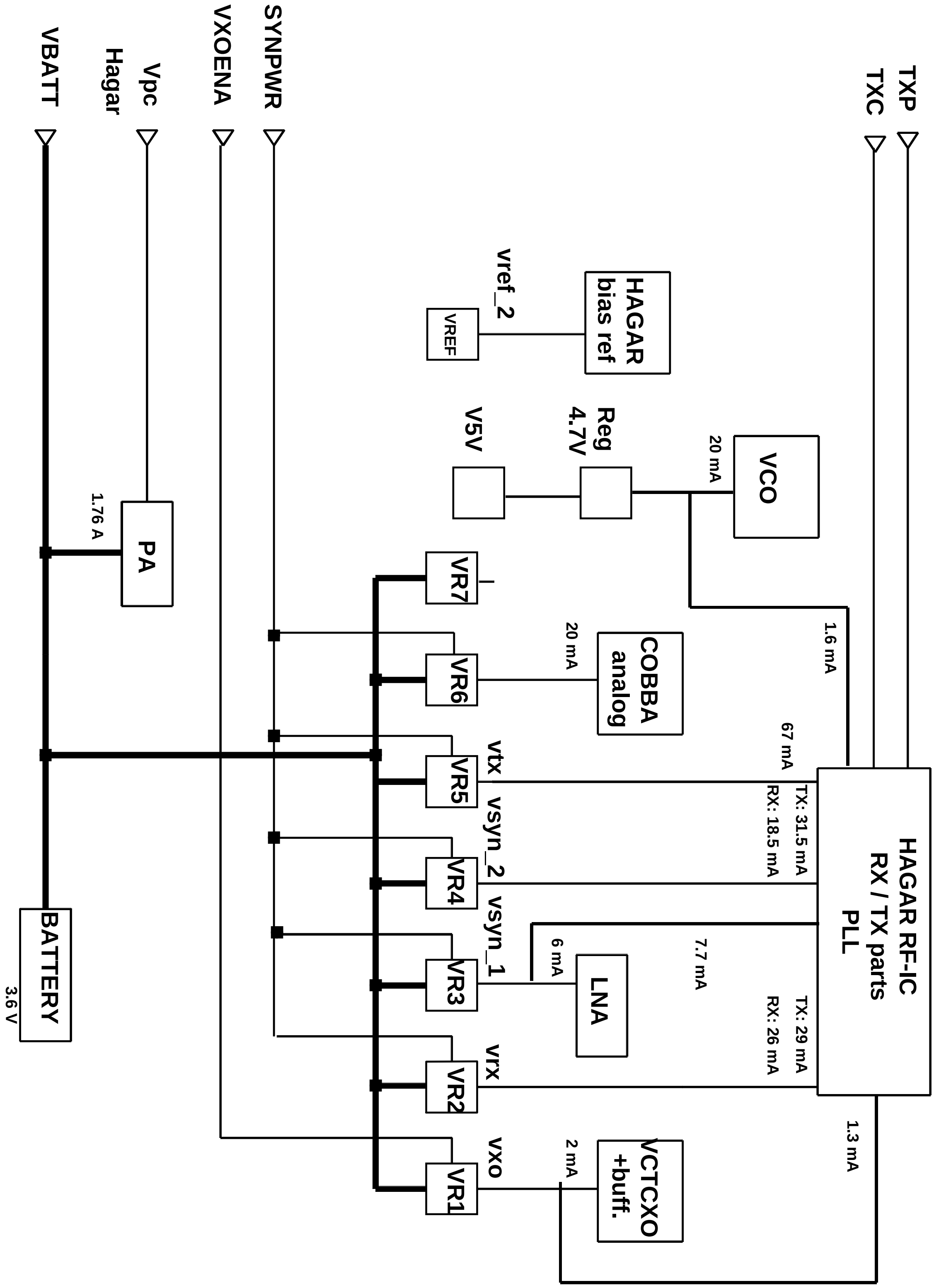



**Figure 14: Power Distribution Diagram**

# RF Characteristics

## GSM1900 (PCS1900)

| Item | Values |
|---|---|
| Receive Frequency Range | 1930.2 ... 1989.8 MHz |
| Transmit Frequency Range | 1850.2 ... 1909.8 MHz |
| Duplex Spacing | 80 MHz |
| Channel Spacing | 200 kHz |
| Number of Channels | 299 |
| Power Class | 1 |
| Number of Power Levels | 16 |

## Transmitter Characteristics

| Item | Values |
|---|---|
| Type | Direct conversion, single band, non-linear, FDMA/TDMA |
| LO Frequency Range | 3700.4... 3819.6 MHz |
| Output Power | 1 W peak |
| Gain Control Range | min. 30 dB |
| Maximum Phase Error (RMS/peak) | 5 deg / 20 deg |

## Output Power Requirements

| Parameter | Min. | Typ. | Max. | Unit / Notes |
|---|---|---|---|---|
| Max. Output Power | | 29.0 | | dBm |
| Max. Output Power Tolerance (Power Level 0) | | | +/- 2.0<br>+/- 2.5 | dB, normal condition<br>dB, extreme condition |
| Output Power Tolerance / Power Levels 1...8 | | | +/- 3.0<br>+/- 4.0 | dB, normal condition<br>dB, extreme condition |
| Output Power Tolerance / Power Levels 9...13 | | | +/- 4.0<br>+/- 5.0 | dB, normal condition<br>dB, extreme condition |
| Output Power Tolerance / Power Levels 14 and 15 | | | +/- 5.0<br>+/- 6.0 | dB, normal cond.<br>dB, extreme cond. |

**Output RF Spectrum due to modulation**

| Power level | 100 kHz | 200 kHz | 250 kHz | 400 kHz | 600 to 1800 kHz | 1800 to 6000 kHz | > 6000 kHz | Unit |
|---|---|---|---|---|---|---|---|---|
| | Measurement Bandwidth 30 kHz | | | | | Measurement Bandwidth 100 kHz | | |
| PL 0 | +0.5 | -30 | -33 | -60 | -60 | -65 | -73 | dBc |
| PL 1 | +0.5 | -30 | -33 | -60 | -60 | -63 | -71 | dBc |
| PL 2 | +0.5 | -30 | -33 | -60 | -60 | -61 | -69 | dBc |
| PL 3 and lower | +0.5 | -30 | -33 | -60 | -60 | -59 | -67 | dBc |

**Spectrum due to switching transients**

| Power Level | 400 kHz | 600 kHz | 1200 kHz | 1800 kHz | Unit |
|---|---|---|---|---|---|
| all | -23 | -26 | -32 | -36 | dBm |
| | Measurement Bandwidth 30 kHz | | | | |

**Spurious Emissions (when allocated a channel)**

| Frequency Range | Min. | Typ. | Max. | Unit / Notes |
|---|---|---|---|---|
| 9 kHz... 1 GHz | | | -36 | dBm |
| 1... 12.75 GHz | | | -30 | dBm * |
| * 1930 ... 1990 MHz | | | -71 | dBm |

A maximum of five exceptions with a level up to –36 dBm are permitted in the band 1930...1990 MHz for each ARFCN used in the measurements.

### Spurious Emissions (idle mode)

| Frequency Range | Min. | Typ. | Max. | Unit / Notes |
|---|---|---|---|---|
| 9 kHz... 1 GHz | | | -57 | dBm |
| 1... 12.75 GHz | | | -47 | dBm * |
| * 1850 ... 1910 MHz | | | -53 | dBm |

### Frequency Error and Phase Accuracy

| Propagation condition | Min. | Typ. | Max. | Unit/Notes |
|---|---|---|---|---|
| Static ch. | | | +/- 0.1 | ppm |
| TU1.5 | | | +/- 320 | Hz |
| TU50 | | | +/- 260 | Hz |
| HT100 | | | +/- 350 | Hz |
| RA130 | | | +/- 400 | Hz |
| RMS Phase Error | | | 5.0 | deg |
| Peak Deviation | | | 20.0 | deg |

## Receiver Characteristics

| Item | Values |
|---|---|
| Type | Direct conversion, single band, linear, FDMA/TDMA |
| LO Frequencies | 3860.4... 3979.6 MHz |
| Typical 3 dB Bandwidth | +/- 91 kHz |
| Sensitivity | min. - 102 dBm, S/N >8 dB |
| Typical Total Receiver Voltage Gain (from antenna to RX ADC) | 86 dB |
| Receiver Output Level (RF Level -95 dBm) | 230 mVpp, single ended I/Q-signals to RX ADCs |
| Typical AGC Dynamic Range | 83 dB |
| Accurate AGC Control Range | 50 dB |
| Typical AGC Step in LNA | 33 dB |
| Usable Input Dynamic Range | -102... -10 dBm |
| RSSI Dynamic Range | -110... -48 dBm |
| Compensated Gain Variation in Receive Band | +/- 1.0 dB |

### Blocking Requirements

| Frequency Band | Minimum | Typical / Nominal | Maximum | Unit / Notes |
|---|---|---|---|---|
| 600 kHz <= [f – fo] < 800 kHz | -43 | | | dBm / in-band |
| 800 kHz <= [f – fo] < 1.6 MHz | -43 | | | dBm / in-band |
| 1.6 MHz <= [f – fo] < 3 MHz | -33 | | | dBm / in-band |
| 3 MHz <= [f – fo] | -26 | | | dBm / in-band |
| 100 kHz – < 1830 MHz | 0 | | | dBm / out-of-band |
| 1830 MHz – < 1910 MHz | -12 | | | dBm / out-of-band |
| > 2010 MHz – 2070 MHz | -12 | | | dBm / out-of-band |
| > 2070 MHz – 12.75 GHz | 0 | | | dBm / out-of-band |

In-band (1910...2010 MHz); maximum of twelve occurrences are permitted.

Out-of-band; maximum of 24 occurrences are permitted.

### AM Suppression Requirements

| Frequency Band | Minimum | Typical / Nominal | Maximum | Unit / Notes |
|---|---|---|---|---|
| [f – fo] >= 6 MHz * | -29 | | | dBm |

* Interferer is TDMA signal, pseudo random GMSK modulated at integer multiple of 200 kHz distance from wanted signal.

Interferer is at least 2 channels separated from any identified spurious response.

Interferer is active one time slot and delayed in time between 61 and 86 bit periods relative to the wanted signal bursts. It's also synchronized.

### Sensitivity, Inter modulation, Spurious Rejection and Emissions

| Parameter | Minimum | Typical / Nominal | Maximum | Unit / Notes |
|---|---|---|---|---|
| Reference Sensitivity Level | | | -102 | dBm |
| Inter modulation Rejection | 50 | | | dB, fo=2*f1-f2, [f2-f1]=800 kHz |
| Spurious Response Rejection | 56 * | | | dB |
| Spurious Emissions | | | -57 | dBm, 9 kHz - 1 GHz |
| | | | -47 | dBm, 1 GHz - 12.75 GHz |

* 12 occurrences allowed in band 1910-2010 MHz/test ch. Rest of the occurrences have to meet blocking requirements. Max. 24 spurious responses are allowed in combined band 100 kHz-1830 MHz and 2010 MHz-12.75 GHz, other responses have to be in the limits of blocking specification.

### Reference Interference level

| Parameter | Minimum | Typical / Nominal | Maximum | Unit / Notes |
|---|---|---|---|---|
| Cochannel Interference Ratio | 9 | | | dB |
| Adjacent (200 kHz) Interference Ratio | -9 | | | dB |
| Adjacent (400 kHz) Interference Ratio | -41 | | | dB |
| Adjacent (600 kHz) Interference Ratio | -49 | | | dB |

Interferer is modulated with random GMSK. Interferer and wanted signals are faded.

## RF Block Diagram

Architecture contains RF-IC ("Hagar"), PA module, VCO module, VCTCXO module and discrete LNA stage.

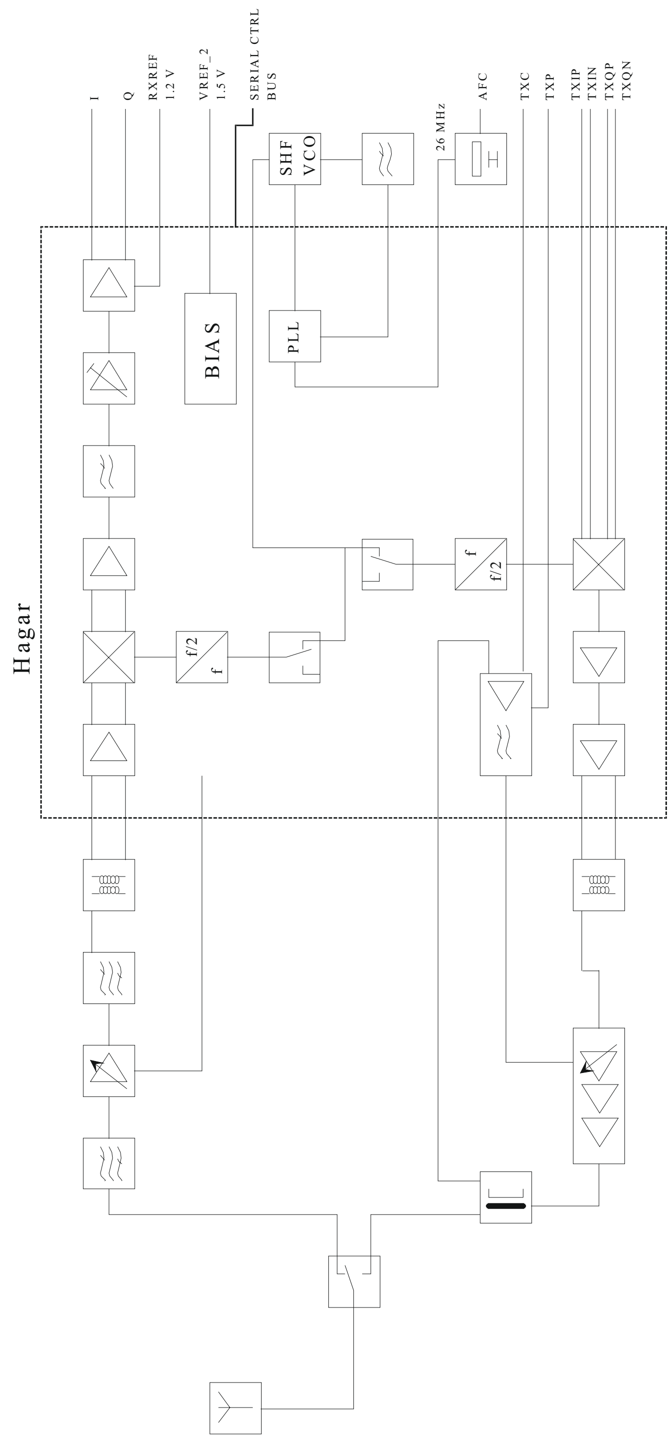



**Figure 15: RF Block Diagram**

## Frequency synthesizer

VCO frequency is locked by PLL into a stable frequency source, which is a VCTCXO module (Voltage Controlled Temperature Compensated Crystal Oscillator). VCTCXO is running at 26 MHz. Temperature effect is controlled by AFC (Automatic Frequency Control) voltage. VCTCXO is locked to a frequency of base station. AFC is generated by baseband with a 11 bit conventional DAC in COBBA asic.

PLL is located in HAGAR RF-IC and is controlled via serial bus by COBBA (in baseband). There is a 64/65 (P/P+1) pre-scaler, an N- and A-divider, a reference divider, a phase detector and a charge pump for an external loop filter. SHF (Super High Frequency) local signal, generated by a VCO module (Voltage Controlled Oscillator), is fed to the pre-scaler. The pre-scaler is a dual modulus divider. Output of the pre-scaler is fed to the N- and A-divider which generates an input to the phase detector. The phase detector compares this signal to a reference signal (400kHz) which is divided by the reference divider from VCTCXO output. Output of the phase detector is connected to the charge pump which charges or discharges an integrator capacitor in the loop filter depending on a phase of measured frequency compared to the reference frequency.

The loop filter filters out pulses and generates a DC control voltage to the VCO. The loop filter defines a step response of PLL (Phase Locked Loop), i.e. Settling Time, and effects to a stability of the loop - that's why the integrator capacitor has got a resistor for phase compensation. Other filter components are for sideband rejection. Dividers are controlled via serial bus. SDATA is for data, SCLK is a serial clock for the bus and SENA1 is a latch enable which stores new data into the dividers.

LO signal is generated by a SHF VCO module. The VCO has double frequency in GSM1900 compared to actual RF channel frequency. The LO signal is divided by two in HAGAR.

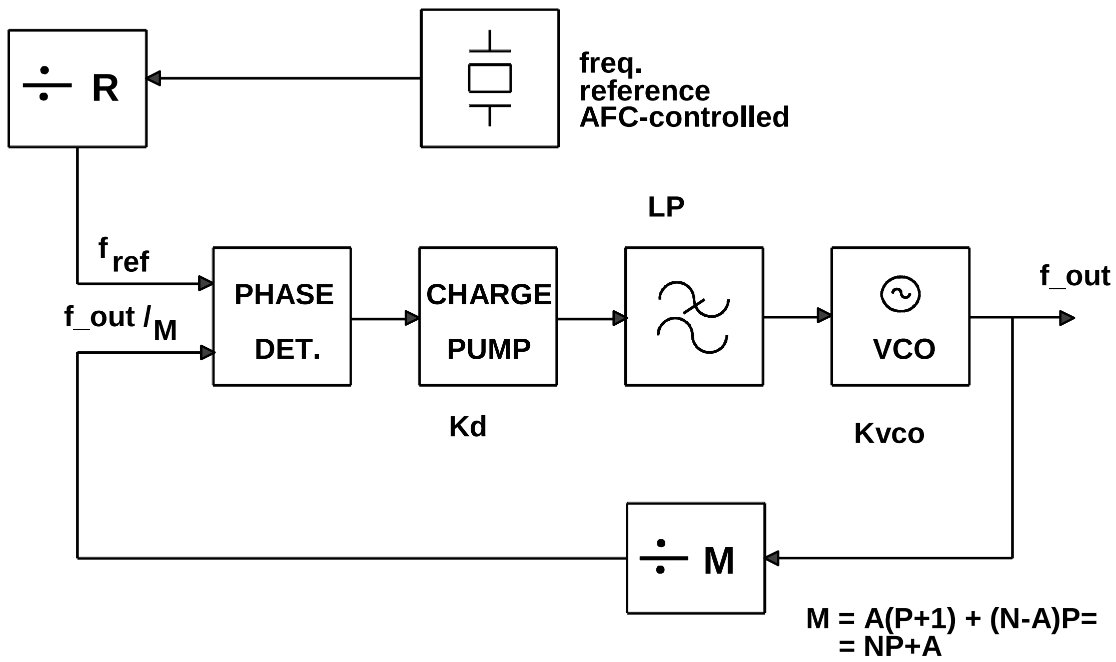


Figure 16: Phase Locked Loop

## Receiver

Receiver is a direct conversion linear receiver. Received RF signal from antenna is fed via Antenna Switch to the 1st RX SAW filter and a discrete LNA (Low Noise Amplifier). Gain selection control of the LNA comes from HAGAR IC. Gain step is activated when RF level in antenna is about -40 dBm.

After the LNA amplified signal (with low noise level) is fed to a bandpass filter (the 2nd RX SAW filter). The RX filters define how good are the blocking characteristics against spurious signals outside the receive band and the protection against spurious responses.

These bandpass filtered signals are then balanced with baluns. Differential RX signal is amplified and mixed directly down to a BB frequency in HAGAR. Local Oscillator signal is generated by an external VCO. The VCO signal is divided by 2. PLL and dividers are in HAGAR IC.

From the mixer output to an ADC input RX signal is divided to I- and Q-signals. Accurate phasing is generated by LO dividers. After the mixer DTOS amplifiers convert the differential signals to single ended. DTOS has two gain stages. The first one has constant gain of 12dB and 85kHz cut off frequency. The gain of second stage is controlled by control signal g10. If g10 is high (1) the gain is 6dB and if g10 is low (0) the gain is -4dB.

The active channel filters in HAGAR IC provides selectivity for channels (-3dB @ +/-100 kHz typ.). Integrated baseband filter is an active RC filter with two off-chip capacitors. Long RC time constant needed in the channel selection filter of direct conversion receiver is produced by large off-chip capacitors because the impedance levels could not be increased due to noise specifications. The baseband filter consists of two stages, DTOS and BIQUAD. DTOS is a differential to single-ended converter having 8dB or 18dB gain. BIQUAD is a modified Sallen-Key Biquad.

Integrated resistors and capacitors are tunable. These are controlled by a digital control word. The correct control words which compensate process variation of the integrated resistors and capacitors and tolerance of the off-chip capacitors are found by a calibration circuit.

The next stage in receiver chain is an AGC amplifier - also integrated in HAGAR. The AGC has a digital gain control via serial bus from COBBA IC. The AGC stage provides gain control range of 40 dB (10 dB steps) for the receiver and also necessary DC compensation. The 10 dB AGC step is implemented by DTOS stages.

The DC compensation is made during DCN1 and DCN2 operations (controlled via serial bus). DCN1 is carried out by charging large external capacitors in the AGC stages to a voltage which cause a zero dc-offset. DCN2 sets the signal offset to a constant value (RXREF 1.2 V). The RXREF signal (from COBBA GJP) is used as a zero level to RX ADCs.

Single ended filtered I/Q-signal is finally fed to the ADCs of COBBA. The input level for ADC is 1.4 Vpp max.

## Transmitter

Transmitter chain consists of a final frequency IQ-modulator, a single band power amplifier and a power control loop.

I- and Q-signals are generated by baseband in COBBA asic. After post filtering (RC network) the signals are modulated by IQ-modulator in HAGAR IC. The LO signal for modulator is generated by a VCO and is divided by 2. After modulator the TX signal is amplified and buffered. HAGAR TX output level is +3 dBm minimum.

Next the TX signal is converted to single ended by discrete baluns. The final amplification is realized by the power amplifier (PA). It has a 50 ohm input and output. Right output power is controlled by a power control loop. The PA is able to generate over 1 W output power (0 dBm input level). The gain control range is over 35 dB to get desired power levels and power ramping up/down.

Harmonics generated by the nonlinear PA are filtered out by the diplexer inside the antenna switch module.

Power control circuitry consists of a discrete power detector and an error amplifier (in HAGAR). There is a directional coupler between the PA output and the antenna switch. The directional coupler takes a sample from the TX power with a certain ratio. The sampled signal is rectified by a schottky-diode to produce a DC signal (after filtering). The detected voltage is compared by the error amplifier in HAGAR to TXC voltage which is generated by a DA converter in COBBA. The TXC has got a raised cosine form ($\cos^4$ function) which reduces switching transients when pulsing the TX power up and down. Because dynamic range of the detector is not wide enough to control the TX power (actually the RF output voltage) over the whole range there is a control named TXP to work under the detected levels. Burst is enabled and set to rise with TXP until the output level is high enough, i.e. when the feedback loop works. The loop controls the TX output to rise to a wanted output level. The burst has got a template of TXC ramp. Because the feedback loops can be unstable the loop is compensated by a dominating pole. The pole decreases gain at high frequencies to insure phase margins high enough.

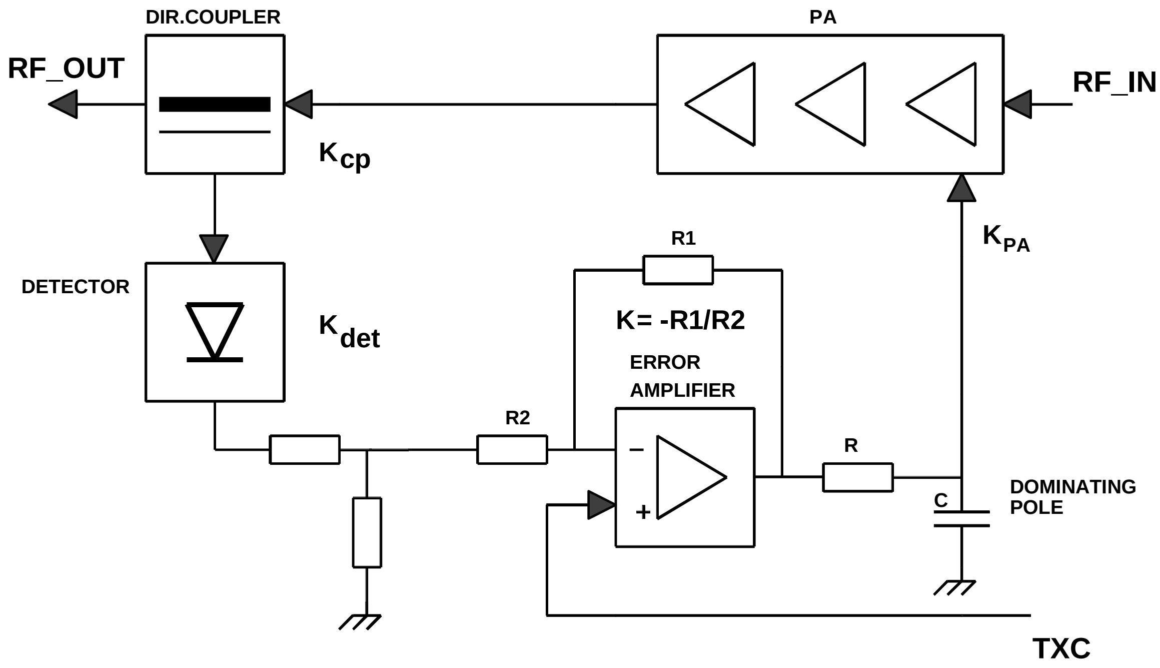



**Figure 17: Power Control Loop Diagram**

## AGC strategy

AGC amplifier is used to maintain output level of the receiver in certain range. AGC has to be set before each received burst. This is called pre-monitoring. Receiver is switched on roughly 280 µs before the burst begins. DSP measures received signal level and adjusts AGC amplifier via serial bus from COBBA GJP.

There is a 50 dB accurate gain control (10 dB steps) and one larger step (~30 dB) in LNA. LNA AGC gain step size depends on a channel with some amount.

RSSI must be measured accurately on range of -48...-110 dBm. Above -48 dBm level MS reports to base station the same reading.

Production calibration is done by two RF levels. The LNA gain step is not calibrated.

## AFC function

AFC is used to lock the transceivers clock to the frequency of base station. AFC voltage is generated by COBBA asic with a 11 bit DA converter. In the AFC control line a RC filter is used to reduce noise coming from the converter. Settling time requirement for the RC network comes from signalling, i.e. how often PSW (Pure Sine Wave) slots occur. The PSW is repeated in every 10th frame. It means there is a PSW every 46 ms. The AFC tracks base station frequency continuously. This way the transceiver gets a stable frequency. Temperature does not affect to VCTCXO frequency very fast.

Settling time requirement comes also from the start-up time allowed. When the transceiver is in sleep mode and "wakes up" to a receive mode there is only ca. 5 ms for the AFC voltage to settle. When the first burst comes in the system clock has to be settled with +/- 0.1 ppm frequency accuracy. The VCTCXO module requires also 5 ms to settle to the final frequency. Amplitude rises to full swing in 1... 2 ms. Because the frequency settling time is higher this oscillator must be powered up early enough.

## DC Compensation

DC compensation is done during DCN1 and DCN2 operations (controlled via serial bus). DCN1 is carried out by charging large external capacitors in AGC stages to a voltage which causes a zero dc offset. DCN2 sets the signal offset to a constant value (RXREF 1.2 V).

## Parts List of RB9 (EDMS Issue 5.3)

Code: 0201512

| ITEM | CODE | DESCRIPTION | VALUE | TYPE |
|---|---|---|---|---|
| R100 | 1430826 | Chip resistor | 680 k | 5 % 0.063 W 0402 |
| R101 | 1430804 | Chip resistor | 100 k | 5 % 0.063 W 0402 |
| R102 | 1430796 | Chip resistor | 47 k | 5 % 0.063 W 0402 |
| R103 | 1430770 | Chip resistor | 4.7 k | 5 % 0.063 W 0402 |
| R104 | 1430796 | Chip resistor | 47 k | 5 % 0.063 W 0402 |
| R105 | 1430754 | Chip resistor | 1.0 k | 5 % 0.063 W 0402 |
| R109 | 1620017 | Res network 0w06 2x100r j | 0404 | 0404 |
| R110 | 1430826 | Chip resistor | 680 k | 5 % 0.063 W 0402 |
| R111 | 1430820 | Chip resistor | 470 k | 5 % 0.063 W 0402 |
| R118 | 1430778 | Chip resistor | 10 k | 5 % 0.063 W 0402 |
| R120 | 1620025 | Res network 0w06 2x100k j | 0404 | 0404 |
| R122 | 1620019 | Res network 0w06 2x10k j | 0404 | 0404 |
| R124 | 1620017 | Res network 0w06 2x100r j | 0404 | 0404 |
| R128 | 1430718 | Chip resistor | 47 | 5 % 0.063 W 0402 |
| R131 | 1419003 | Chip resistor | 0.22 | 5 % 1210 |
| R154 | 1430325 | Chip resistor | 2.2 M | 5 % 0.063 W 0603 |
| R201 | 1430812 | Chip resistor | 220 k | 5 % 0.063 W 0402 |
| R202 | 1430804 | Chip resistor | 100 k | 5 % 0.063 W 0402 |
| R203 | 1430770 | Chip resistor | 4.7 k | 5 % 0.063 W 0402 |
| R205 | 1430762 | Chip resistor | 2.2 k | 5 % 0.063 W 0402 |
| R206 | 1430762 | Chip resistor | 2.2 k | 5 % 0.063 W 0402 |
| R207 | 1430726 | Chip resistor | 100 | 5 % 0.063 W 0402 |
| R208 | 1430726 | Chip resistor | 100 | 5 % 0.063 W 0402 |
| R209 | 1825021 | Chip varistor vwm14v vc46v | 0402 | 0402 |
| R210 | 1825021 | Chip varistor vwm14v vc46v | 0402 | 0402 |
| R211 | 1430754 | Chip resistor | 1.0 k | 5 % 0.063 W 0402 |
| R215 | 1620023 | Res network 0w06 2x47k j | 0404 | 0404 |
| R252 | 1430754 | Chip resistor | 1.0 k | 5 % 0.063 W 0402 |
| R254 | 1430760 | Chip resistor | 1.8 k | 5 % 0.063 W 0402 |
| R256 | 1430718 | Chip resistor | 47 | 5 % 0.063 W 0402 |
| R257 | 1430718 | Chip resistor | 47 | 5 % 0.063 W 0402 |
| R258 | 1430746 | Chip resistor | 560 | 5 % 0.063 W 0402 |
| R260 | 1430744 | Chip resistor | 470 | 5 % 0.063 W 0402 |
| R261 | 1430726 | Chip resistor | 100 | 5 % 0.063 W 0402 |
| R262 | 1825021 | Chip varistor vwm14v vc46v | 0402 | 0402 |
| R263 | 1825021 | Chip varistor vwm14v vc46v | 0402 | 0402 |
| R266 | 1430796 | Chip resistor | 47 k | 5 % 0.063 W 0402 |
| R267 | 1430762 | Chip resistor | 2.2 k | 5 % 0.063 W 0402 |
| R268 | 1430744 | Chip resistor | 470 | 5 % 0.063 W 0402 |
| R269 | 1620025 | Res network 0w06 2x100k j | 0404 | 0404 |
| R270 | 1430792 | Chip resistor | 33 k | 5 % 0.063 W 0402 |
| R272 | 1430804 | Chip resistor | 100 k | 5 % 0.063 W 0402 |
| R273 | 1430792 | Chip resistor | 33 k | 5 % 0.063 W 0402 |
| R274 | 1430812 | Chip resistor | 220 k | 5 % 0.063 W 0402 |
| R275 | 1620105 | Res network 0w06 2x2k2 j | 0404 | 0404 |
| R277 | 1620025 | Res network 0w06 2x100k j | 0404 | 0404 |
| R310 | 1430778 | Chip resistor | 10 k | 5 % 0.063 W 0402 |

| | | | | |
|---|---|---|---|---|
| R311 | 1430778 | Chip resistor | 10 k | 5 % 0.063 W 0402 |
| R350 | 1430155 | Chip resistor | 15 | 5 % 0.1 W 0603 |
| R351 | 1430155 | Chip resistor | 15 | 5 % 0.1 W 0603 |
| R352 | 1430155 | Chip resistor | 15 | 5 % 0.1 W 0603 |
| R353 | 1430155 | Chip resistor | 15 | 5 % 0.1 W 0603 |
| R354 | 1825021 | Chip varistor vwm14v vc46v | 0402 | 0402 |
| R371 | 1430137 | Chip resistor | 1.0 k | 1 % 0.063 W 0402 |
| R372 | 1430137 | Chip resistor | 1.0 k | 1 % 0.063 W 0402 |
| R373 | 1430137 | Chip resistor | 1.0 k | 1 % 0.063 W 0402 |
| R374 | 1430137 | Chip resistor | 1.0 k | 1 % 0.063 W 0402 |
| R403 | 1430702 | Chip resistor | 12 | 5 % 0.063 W 0402 |
| R404 | 1430702 | Chip resistor | 12 | 5 % 0.063 W 0402 |
| R510 | 1620003 | Res network 0w03 4x100r j | 0804 | 0804 |
| R530 | 1620019 | Res network 0w06 2x10k j | 0404 | 0404 |
| R532 | 1430832 | Chip resistor | 2.7 k | 5 % 0.063 W 0402 |
| R533 | 1430778 | Chip resistor | 10 k | 5 % 0.063 W 0402 |
| R541 | 1620033 | Res network 0w06 2x5k6 j | 0404 | 0404 |
| R546 | 1620033 | Res network 0w06 2x5k6 j | 0404 | 0404 |
| R563 | 1430187 | Chip resistor | 47 k | 1 % 0.063 W 0402 |
| R564 | 1430746 | Chip resistor | 560 | 5 % 0.063 W 0402 |
| R565 | 1430770 | Chip resistor | 4.7 k | 5 % 0.063 W 0402 |
| R614 | 1430728 | Chip resistor | 120 | 5 % 0.063 W 0402 |
| R640 | 1430738 | Chip resistor | 270 | 5 % 0.063 W 0402 |
| R643 | 1430832 | Chip resistor | 2.7 k | 5 % 0.063 W 0402 |
| R645 | 1430832 | Chip resistor | 2.7 k | 5 % 0.063 W 0402 |
| R672 | 1430728 | Chip resistor | 120 | 5 % 0.063 W 0402 |
| R732 | 1430746 | Chip resistor | 560 | 5 % 0.063 W 0402 |
| R737 | 1430744 | Chip resistor | 470 | 5 % 0.063 W 0402 |
| R738 | 1430706 | Chip resistor | 15 | 5 % 0.063 W 0402 |
| R740 | 1430730 | Chip resistor | 150 | 5 % 0.063 W 0402 |
| R741 | 1430730 | Chip resistor | 150 | 5 % 0.063 W 0402 |
| R743 | 1430690 | Chip jumper | | 0402 |
| R744 | 1430710 | Chip resistor | 22 | 5 % 0.063 W 0402 |
| R754 | 1430720 | Chip resistor | 56 | 5 % 0.063 W 0402 |
| R763 | 1430774 | Chip resistor | 6.8 k | 5 % 0.063 W 0402 |
| R764 | 1430776 | Chip resistor | 8.2 k | 5 % 0.063 W 0402 |
| R790 | 1430788 | Chip resistor | 22 k | 5 % 0.063 W 0402 |
| R791 | 1430770 | Chip resistor | 4.7 k | 5 % 0.063 W 0402 |
| R792 | 1430780 | Chip resistor | 12 k | 5 % 0.063 W 0402 |
| R800 | 1430778 | Chip resistor | 10 k | 5 % 0.063 W 0402 |
| R801 | 1430774 | Chip resistor | 6.8 k | 5 % 0.063 W 0402 |
| R802 | 1430764 | Chip resistor | 3.3 k | 5 % 0.063 W 0402 |
| R805 | 1620505 | Res network 0w04 | 2DB ATT | 0404 |
| R806 | 1430738 | Chip resistor | 270 | 5 % 0.063 W 0402 |
| R807 | 1430738 | Chip resistor | 270 | 5 % 0.063 W 0402 |
| R829 | 1430752 | Chip resistor | 820 | 5 % 0.063 W 0402 |
| R830 | 1430762 | Chip resistor | 2.2 k | 5 % 0.063 W 0402 |
| R831 | 1430718 | Chip resistor | 47 | 5 % 0.063 W 0402 |
| R832 | 1430788 | Chip resistor | 22 k | 5 % 0.063 W 0402 |
| R833 | 1430762 | Chip resistor | 2.2 k | 5 % 0.063 W 0402 |
| R834 | 1430812 | Chip resistor | 220 k | 5 % 0.063 W 0402 |
| C101 | 2320548 | Ceramic cap. | 33 p | 5 % 50 V 0402 |

| | | | | |
|---|---|---|---|---|
| C102 | 2320538 | Ceramic cap. | 12 p | 5 % 50 V 0402 |
| C103 | 2312411 | Ceramic cap. | 1.0 u | 20 % 25 V 1206 |
| C104 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C105 | 2611719 | Tantalum cap. | 10 u | 20 % 10 V 2.0x1.35x1.35 |
| C106 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C107 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C108 | 2312401 | Ceramic cap. | 1.0 u | 10 % 10 V 0805 |
| C113 | 2320508 | Ceramic cap. | 1.0 p | 0.25 % 50 V 0402 |
| C120 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C121 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C127 | 2320805 | Ceramic cap. | 100 n | 10 % 10 V 0402 |
| C128 | 2312401 | Ceramic cap. | 1.0 u | 10 % 10 V 0805 |
| C129 | 2312401 | Ceramic cap. | 1.0 u | 10 % 10 V 0805 |
| C131 | 2611719 | Tantalum cap. | 10 u | 20 % 10 V 2.0x1.35x1.35 |
| C132 | 2611741 | Tantalum cap. | 4.7 u | 20 % 10 V 2.0x1.3x1.2 |
| C133 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C140 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C142 | 2611719 | Tantalum cap. | 10 u | 20 % 10 V 2.0x1.35x1.35 |
| C150 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C151 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C152 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C153 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C154 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C163 | 2320602 | Ceramic cap. | 4.7 p | 0.25 % 50 V 0402 |
| C165 | 2611737 | Tantalum cap. | 68 u | 20 % 16 V 7.3x4.3x2.0 |
| C169 | 2320602 | Ceramic cap. | 4.7 p | 0.25 % 50 V 0402 |
| C200 | 2320544 | Ceramic cap. | 22 p | 5 % 50 V 0402 |
| C201 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C203 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C204 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C205 | 2610203 | Tantalum cap. | 2.2 u | 20 % 10 V 2.0x1.3x1.2 |
| C206 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C207 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C208 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C209 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C211 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C212 | 2320779 | Ceramic cap. | 100 n | 10 % 16 V 0603 |
| C213 | 2320744 | Ceramic cap. | 1.0 n | 10 % 50 V 0402 |
| C221 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C231 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C241 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C247 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C248 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C249 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C251 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C253 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C257 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C258 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C259 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C260 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C262 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C263 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |

| | | | | |
|---|---|---|---|---|
| C268 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C269 | 2320544 | Ceramic cap. | 22 p | 5 % 50 V 0402 |
| C270 | 2610207 | Tantalum cap. | 10 u | 20 % 2.0x1.3x1.2 |
| C276 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C291 | 2320546 | Ceramic cap. | 27 p | 5 % 50 V 0402 |
| C292 | 2320546 | Ceramic cap. | 27 p | 5 % 50 V 0402 |
| C293 | 2320546 | Ceramic cap. | 27 p | 5 % 50 V 0402 |
| C296 | 2610207 | Tantalum cap. | 10 u | 20 % 2.0x1.3x1.2 |
| C297 | 2610207 | Tantalum cap. | 10 u | 20 % 2.0x1.3x1.2 |
| C299 | 2320546 | Ceramic cap. | 27 p | 5 % 50 V 0402 |
| C303 | 2320744 | Ceramic cap. | 1.0 n | 10 % 50 V 0402 |
| C304 | 2320744 | Ceramic cap. | 1.0 n | 10 % 50 V 0402 |
| C306 | 2320598 | Ceramic cap. | 3.9 n | 5 % 50 V 0402 |
| C307 | 2320598 | Ceramic cap. | 3.9 n | 5 % 50 V 0402 |
| C310 | 2312401 | Ceramic cap. | 1.0 u | 10 % 10 V 0805 |
| C330 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C331 | 2320779 | Ceramic cap. | 100 n | 10 % 16 V 0603 |
| C342 | 2320560 | Ceramic cap. | 100 p | 5 % 50 V 0402 |
| C371 | 2320564 | Ceramic cap. | 150 p | 5 % 50 V 0402 |
| C372 | 2320564 | Ceramic cap. | 150 p | 5 % 50 V 0402 |
| C373 | 2320564 | Ceramic cap. | 150 p | 5 % 50 V 0402 |
| C400 | 2320481 | Ceramic cap. | 5R 1 u | 10 % 0603 |
| C401 | 2320805 | Ceramic cap. | 100 n | 10 % 10 V 0402 |
| C405 | 2320544 | Ceramic cap. | 22 p | 5 % 50 V 0402 |
| C406 | 2320805 | Ceramic cap. | 100 n | 10 % 10 V 0402 |
| C510 | 2320135 | Ceramic cap. | 150 n | 10 % 10 V 0603 |
| C511 | 2320135 | Ceramic cap. | 150 n | 10 % 10 V 0603 |
| C512 | 2320135 | Ceramic cap. | 150 n | 10 % 10 V 0603 |
| C513 | 2320135 | Ceramic cap. | 150 n | 10 % 10 V 0603 |
| C520 | 2320485 | Ceramic cap. | 470 p | 5 % 50 V 0603 |
| C521 | 2320485 | Ceramic cap. | 470 p | 5 % 50 V 0603 |
| C522 | 2320485 | Ceramic cap. | 470 p | 5 % 50 V 0603 |
| C523 | 2320485 | Ceramic cap. | 470 p | 5 % 50 V 0603 |
| C530 | 2320631 | Ceramic cap. | 180 p | 5 % 25 V 0402 |
| C531 | 2320631 | Ceramic cap. | 180 p | 5 % 25 V 0402 |
| C532 | 2320781 | Ceramic cap. | 47 n | 20 % 16 V 0603 |
| C533 | 2320781 | Ceramic cap. | 47 n | 20 % 16 V 0603 |
| C534 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C535 | 2320546 | Ceramic cap. | 27 p | 5 % 50 V 0402 |
| C540 | 2320556 | Ceramic cap. | 68 p | 5 % 50 V 0402 |
| C541 | 2320556 | Ceramic cap. | 68 p | 5 % 50 V 0402 |
| C550 | 2320598 | Ceramic cap. | 3.9 n | 5 % 50 V 0402 |
| C557 | 2320554 | Ceramic cap. | 56 p | 5 % 50 V 0402 |
| C560 | 2320548 | Ceramic cap. | 33 p | 5 % 50 V 0402 |
| C561 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C562 | 2320546 | Ceramic cap. | 27 p | 5 % 50 V 0402 |
| C564 | 2320783 | Ceramic cap. | 33 n | 10 % 10 V 0402 |
| C612 | 2320564 | Ceramic cap. | 150 p | 5 % 50 V 0402 |
| C621 | 2320805 | Ceramic cap. | 100 n | 10 % 10 V 0402 |
| C630 | 2320534 | Ceramic cap. | 8.2 p | 0.25 % 50 V 0402 |
| C631 | 2320534 | Ceramic cap. | 8.2 p | 0.25 % 50 V 0402 |
| C640 | 2320520 | Ceramic cap. | 2.2 p | 0.25 % 50 V 0402 |

| | | | | |
|---|---|---|---|---|
| C642 | 2320744 | Ceramic cap. | 1.0 n | 10 % 50 V 0402 |
| C643 | 2320540 | Ceramic cap. | 15 p | 5 % 50 V 0402 |
| C644 | 2320516 | Ceramic cap. | 1.5 p | 0.25 % 50 V 0402 |
| C645 | 2320540 | Ceramic cap. | 15 p | 5 % 50 V 0402 |
| C711 | 2320540 | Ceramic cap. | 15 p | 5 % 50 V 0402 |
| C712 | 2320744 | Ceramic cap. | 1.0 n | 10 % 50 V 0402 |
| C714 | 2320779 | Ceramic cap. | 100 n | 10 % 16 V 0603 |
| C717 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C718 | 2320602 | Ceramic cap. | 4.7 p | 0.25 % 50 V 0402 |
| C721 | 2320536 | Ceramic cap. | 10 p | 5 % 50 V 0402 |
| C723 | 2320548 | Ceramic cap. | 33 p | 5 % 50 V 0402 |
| C731 | 2320596 | Ceramic cap. | 3.3 n | 5 % 50 V 0402 |
| C733 | 2320536 | Ceramic cap. | 10 p | 5 % 50 V 0402 |
| C734 | 2320536 | Ceramic cap. | 10 p | 5 % 50 V 0402 |
| C737 | 2320508 | Ceramic cap. | 1.0 p | 0.25 % 50 V 0402 |
| C743 | 2320540 | Ceramic cap. | 15 p | 5 % 50 V 0402 |
| C747 | 2320602 | Ceramic cap. | 4.7 p | 0.25 % 50 V 0402 |
| C752 | 2320560 | Ceramic cap. | 100 p | 5 % 50 V 0402 |
| C759 | 2320602 | Ceramic cap. | 4.7 p | 0.25 % 50 V 0402 |
| C761 | 2320536 | Ceramic cap. | 10 p | 5 % 50 V 0402 |
| C765 | 2320540 | Ceramic cap. | 15 p | 5 % 50 V 0402 |
| C772 | 2611741 | Tantalum cap. | 4.7 u | 20 % 10 V 2.0x1.3x1.2 |
| C782 | 2320520 | Ceramic cap. | 2.2 p | 0.25 % 50 V 0402 |
| C783 | 2312401 | Ceramic cap. | 1.0 u | 10 % 10 V 0805 |
| C785 | 2320805 | Ceramic cap. | 100 n | 10 % 10 V 0402 |
| C790 | 2320518 | Ceramic cap. | 1.8 p | 0.25 % 50 V 0402 |
| C792 | 2320560 | Ceramic cap. | 100 p | 5 % 50 V 0402 |
| C793 | 2320540 | Ceramic cap. | 15 p | 5 % 50 V 0402 |
| C794 | 2312215 | Ceramic cap. | 2.2 n | 5 % 50 V 0805 |
| C799 | 2320534 | Ceramic cap. | 8.2 p | 0.25 % 50 V 0402 |
| C801 | 2320564 | Ceramic cap. | 150 p | 5 % 50 V 0402 |
| C802 | 2312221 | Ceramic cap. | 4.7 n | 5 % 25 V 0805 |
| C803 | 2320564 | Ceramic cap. | 150 p | 5 % 50 V 0402 |
| C804 | 2320520 | Ceramic cap. | 2.2 p | 0.25 % 50 V 0402 |
| C805 | 2610203 | Tantalum cap. | 2.2 u | 20 % 10 V 2.0x1.3x1.2 |
| C806 | 2320508 | Ceramic cap. | 1.0 p | 0.25 % 50 V 0402 |
| C829 | 2320560 | Ceramic cap. | 100 p | 5 % 50 V 0402 |
| C830 | 2320560 | Ceramic cap. | 100 p | 5 % 50 V 0402 |
| C831 | 2310793 | Ceramic cap. | 2.2 u | 10 % 10 V 0805 |
| C832 | 2320778 | Ceramic cap. | 10 n | 10 % 16 V 0402 |
| C833 | 2320744 | Ceramic cap. | 1.0 n | 10 % 50 V 0402 |
| C834 | 2320744 | Ceramic cap. | 1.0 n | 10 % 50 V 0402 |
| C835 | 2320540 | Ceramic cap. | 15 p | 5 % 50 V 0402 |
| C836 | 2320544 | Ceramic cap. | 22 p | 5 % 50 V 0402 |
| C860 | 2320548 | Ceramic cap. | 33 p | 5 % 50 V 0402 |
| L103 | 3203705 | Ferrite bead 0.015r 42r/100m | 0805 | 0805 |
| L104 | 3203705 | Ferrite bead 0.015r 42r/100m | 0805 | 0805 |
| L200 | 3203709 | Ferrite bead 0.5r 120r/100m | 0402 | 0402 |
| L271 | 3203709 | Ferrite bead 0.5r 120r/100m | 0402 | 0402 |
| L272 | 3203709 | Ferrite bead 0.5r 120r/100m | 0402 | 0402 |
| L303 | 3203709 | Ferrite bead 0.5r 120r/100m | 0402 | 0402 |
| L304 | 3203709 | Ferrite bead 0.5r 120r/100m | 0402 | 0402 |

| | | | | |
|---|---|---|---|---|
| L505 | 3646053 | Chip coil | 4 n | Q=28/800M 0402 |
| L553 | 4551019 | Dir.coup. 1880+-30mhz 1 | | 4DB 2X1.22x1.25 |
| L600 | 3646055 | Chip coil | 8 n | 5 % Q=28/800 MHz 0402 |
| L601 | 3646085 | Chip coil | 6 n | 10 % Q=29/800 MHz 0402 |
| L630 | 3646055 | Chip coil | 8 n | 5 % Q=28/800 MHz 0402 |
| L739 | 3646087 | Chip coil | 1 n | Q=31/800M 0402 |
| L751 | 3203705 | Ferrite bead 0.015r 42r/100m 0805 | | 0805 |
| L752 | 3640043 | Chip coil | 4 n | 10 % Q=50/1GHZ 0805 |
| L758 | 3646027 | Chip coil | 33 n | 5 % Q=7/100 MHz 0402 |
| L800 | 3648808 | Chip coil | | 10 % Q=50 1206 |
| B100 | 4510219 | Crystal | 32.768 k | +-30PPM 9PF |
| B301 | 5140157 | Buzzer 85db 3000hz 3.0v 8.5x8.5x | | 8.5x8.5x3 |
| G800 | 4350237 | Vco 3700-3980mhz 2.7v 20ma pcs | | |
| G830 | 4510261 | VCTCXO | 26 M | +-5PPM 2.7VGSM |
| F101 | 5119019 | SM, fuse f 1.5a 32v | | 0603 |
| Z600 | 4511167 | Saw filter | | 1960+-30 M |
| Z620 | 4511167 | Saw filter | | 1960+-30 M |
| Z670 | 4550203 | Ant.switch 1850-1990mhz 6.7x5x2 | | 6.7x5x2 |
| H400 | 9510608 | Rf-can assembly dmc02694 hda56 | | |
| T630 | 3640431 | Transf balun 1920mhz+/-70mhz 0805 | | 0805 |
| T740 | 3640431 | Transf balun 1920mhz+/-70mhz 0805 | | 0805 |
| T800 | 3640423 | Transf balun 3.7ghz+/-300mhz 0805 | | 0805 |
| V100 | 1825023 | Chip varistor vwm9v vc20v | 0805 | 0805 |
| V101 | 4210052 | Transistor | DTC114EE | npn RB V EM3 |
| V104 | 4113651 | Trans. supr. | QUAD | 6 V SOT23-5 |
| V116 | 4110067 | Schottky diode | MBR0520L | 20 V 0.5 A SOD123 |
| V250 | 4210119 | Transistor | BC849CW | npn 30 V 0.1 A SOT323 |
| V251 | 4210119 | Transistor | BC849CW | npn 30 V 0.1 A SOT323 |
| V252 | 4210052 | Transistor | DTC114EE | npn RB V EM3 |
| V254 | 4110089 | Diode x 2 | BAV70W | 70 V .5 A 4 ns SOT323 |
| V320 | 4860005 | Led Green | | 0603 |
| V321 | 4860005 | Led Green | | 0603 |
| V322 | 4860005 | Led Green | | 0603 |
| V323 | 4860005 | Led Green | | 0603 |
| V324 | 4860005 | Led Green | | 0603 |
| V325 | 4860005 | Led Green | | 0603 |
| V331 | 4864389 | Led | | 0603 |
| V332 | 4864389 | Led | | 0603 |
| V333 | 4864389 | Led | | 0603 |
| V334 | 4864389 | Led | | 0603 |
| V335 | 4864389 | Led | | 0603 |
| V336 | 4864389 | Led | | 0603 |
| V343 | 4110089 | Diode x 2 | BAV70W | 70 V .5 A 4 ns SOT323 |
| V360 | 4110089 | Diode x 2 | BAV70W | 70 V .5 A 4 ns SOT323 |
| V760 | 4110078 | Schdix2 bas70-05w 70v 70ma sot323 | | SOT323 |
| V800 | 4210119 | Transistor | BC849CW | npn 30 V 0.1 A SOT323 |
| V903 | 4210185 | Transistor | | SOT343 |
| V905 | 4210119 | Transistor | BC849CW | npn 30 V 0.1 A SOT323 |
| D200 | 4370677 | Mad2wd1 v18 rom5 f741541g ubga144 | | UBGA144 |
| D210 | 4340747 | Combomemory 16m flash+2m sram csp | | CSP |
| N100 | 4370467 | Ccont2i wfd163kg64t/8 lfbga8x8 | | |
| N101 | 4370621 | Chaps v2.0 u423v20g36t lbga6x6 | | |

| | | | | |
|---|---|---|---|---|
| N220 | 4340413 | IC, regulator | TK11230BMC | 3.0 V SOT23L |
| N250 | 4370643 | Cobba_gjp v4.1 v257bg64t/8 bga64 | | BGA64 |
| N310 | 4370433 | Uiswitch sttm23av20t tssop20 | | TSSOP20 |
| N400 | 4860081 | Irda qsdl-m134#021 115.2kbps 2v7 | | 2V7 |
| N401 | 4340335 | IC, regulator | TK11228AM | SSO6 |
| N505 | 4370667 | Hagar 3 sttza8hg80t lfbga80 | | LFBGA80 |
| N600 | 4340719 | IC, regulator | TK11247BMC | 4.7 V SOT23L |
| N702 | 4350241 | IC, pow.amp. | | |
| S330 | 5209001 | SM, sw tact spst 12v 50ma side k | | KEY |
| M300 | 9854352 | PCB UX7V 4.5X4.5X1.6 D 140/PA | | |
| | 9854432 | PCB RB9 94.7X40.0X1.0 M8 4/PA | | |

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# UI Module

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# UIF Module

## Introduction

UI module is implemented on the same PCB board with BB-module and RF-module. UI HW parts are LCD, backlighting, audio parts, IR, keyboard, power key and vibra.

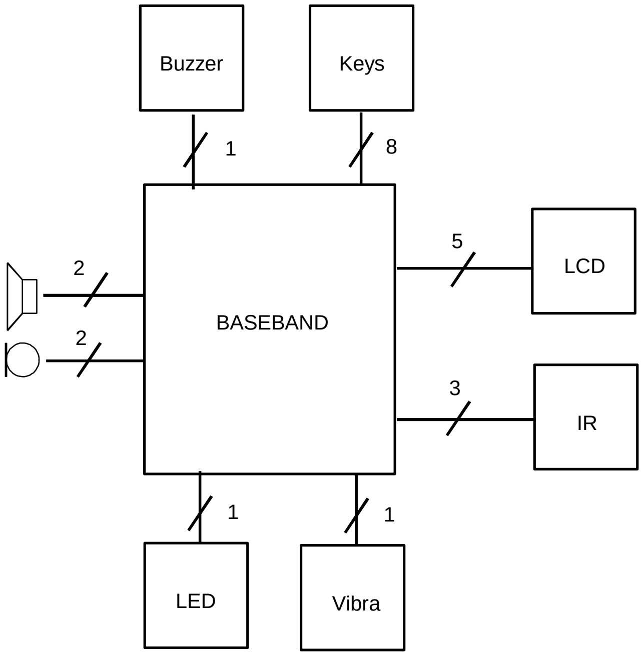



**Figure 1: User Interface**

### BB Interface

| Signal | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| IRONX | IR-module on/off | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | IR on state<br>Iout@2mA |
| FBUS_RX | IR receive pulse<br>IR receive no pulse | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | |
| FBUS_TX<br><br>VIBRA | IR transmit pulse<br>IR transmit no pulse<br>From VB | 0.7 x VBB<br>0<br>0.9 | <br><br>1.0<br>115 | VBB<br>0.3 x VBB<br>1.1<br>140 | V<br>V<br>V<br>mA | Iout@2mA |
| ROW (0:4) | ROWS | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | Keyboard matrix row |
| COL (0:4) | COL0 | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | Keyboard matrix column |
| VB | Battery Voltage | 3.0 | | 4.8 | V | Battery voltage (for lights) |

| Signal | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| PWRONX | | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | Power on key |
| ROW5/<br>LCDCD | LCD command/data | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | keyboard matrix row 5<br>LCD driver code/data selection |
| SCL | Serial clock for LCD | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | LCD driver serial clock |
| SDA | Serial data for LCD | | | 0.3 x VBB<br>VBB | V | LCD driver serial data |
| LCDEN | LCD enable | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | LCD driver chip select |
| LCDRSTX | Reset | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | LCD driver reset |
| GND | | 0 | | 0 | V | Ground |
| BUZZER | | 0<br>0.7 x VBB<br>440<br>0 | | 0.3 x VBB<br>VBB<br>4700<br>50 | V<br>V<br>Hz<br>% | PWM low level<br>PWM high level<br>Buzzer PWM fre-quency<br>PWM duty cycle |
| VBB | | 2.7 | 2.8 | 2.9 | V | Logic supply voltage |
| LIGHT | | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | Illumination control |
| EARN | | | 17.6 | 788 | mV | Connected to COBBA EARN output. |
| EARP | | | 17.6 | 788 | mV | Connected to COBBA EARP output. |
| CCUT | Charging control | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | | Stops charging |

### LCD Module Interface

| Pin | Line Symbol | Parameter | Min | Typical | Max | Unit | Notes |
|---|---|---|---|---|---|---|---|
| 1 | VBB | Supply voltage | 2.7 | 2.8 | 2.9<br>300 | V<br>uA | |
| 2 | SCLK | Serial clock input | 0<br>0 | | 4.0<br>VBB | MHz | VBB=2.7V |
| 3 | SDA | Serial data input | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | |
| 4 | LCDCDX | Control/display data flag input | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | Control<br>Data |
| 5 | LCDCSX | Chip select input | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | Active |
| 6 | OSC | External clock for LCD | 30.4 | 32.0 | 33.6 | kHz | Connected to VBB on PCB |
| 7 | GND | Ground | | 0 | | V | |
| 8 | VOUT | DC/DC voltage converter output | | | 9 | V | |
| 9 | LCDRSTX | Reset | 0<br>0.7 x VBB | | 0.3 x VBB<br>VBB | V | Active |

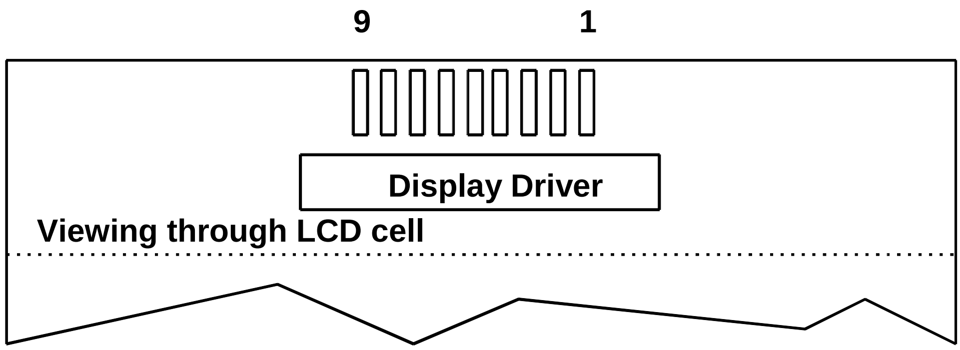



**Figure 2: View through LCD Cell**

**Bottom Connector Signals**

| Name | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|
| XMICP, XMICN | | 2.2 | | kΩ | Input AC impedance |
| | | | 1 | Vpp | Maximum signal level |
| | 1.47 | | 1.55 | V | Mute (output DC level) |
| | 2.5 | | 2.9 | V | Unmute (output DC level) |
| | 100 | | 600 | µA | Bias current |
| | | 60 | 350 | mV | Maximum signal level |
| XEARP, XEARN | | 47 | | W | Output AC impedance (ref.GND) |
| | | 10 | | µF | Series output capacitance |
| | 16 | | 300 | W | Load AC impedance to GND (Headset) |
| | | 6.8 | | kΩ | Load AC impendance to GND (Accessory) |
| | | | 1.0 | Vpp | Maximum output level (no load) |
| | | 22 | 626 | mV | Output signal level |
| | | 10 | | kΩ | Load DC resistance to GND (Accessory) |
| | 16 | | 1500 | W | Load DC resistance to GND (Headset) |
| | | 2.8 | | V | DC voltage (100k pull-up to VBB) |
| HEADDET | | 21 | | µA | When accessory is not connected |

An external headset device is connected to the system connector XMIC and XEAR lines, from which the signals are routed to COBBA MIC3 microphone inputs and HF earphone outputs.

# Functional Description

## Audio Control

The audio control and processing is taken care of by the COBBA-GJP, which contains the audio and RF codecs, and the MAD2, which contains the MCU, ASIC and DSP blocks handling and processing the audio signals.

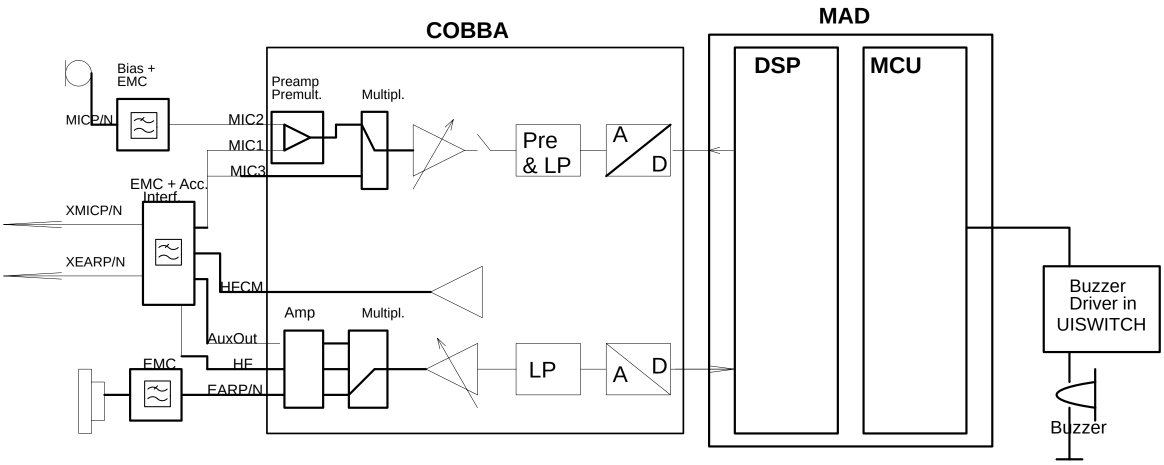



**Figure 3: Audio Control**

The baseband supports three microphone inputs and two earphone outputs. The inputs can be taken from an internal microphone, a headset microphone or PPH-1 microphones. The microphone signals from different sources are connected to separate inputs at the COBBA-GJP ASIC. Inputs for the microphone signals are differential type.

The MIC1 inputs are used for a headset microphone that can be connected directly to the HS/HF connector. The internal microphone is connected to MIC2 inputs. In COBBA there are also three audio signal outputs of which dual ended EAR lines are used for internal ear piece and HF line accessory audio output. The third audio output AUXOUT is used for bias supply to the headset microphone. PData(2) is used for PPH-1 mute control.

The output for the internal earphone is a dual ended type output capable of driving a dynamic type speaker. The output for the external accessory and the headset is dual ended (differential). Input and output signal source selection and gain control is performed inside the COBBA-GJP ASIC according to control messages from the MAD2. Keypad tones, DTMF, and other audio tones are generated and encoded by the MAD2 and transmitted to the COBBA-GJP for decoding.

**External audio connections**

The external audio connections are presented on the next page. A headset and PPH-1 can be connected directly to the system connector. The headset microphone bias is supplied from COBBA AUXOUT output and fed to microphone through XMICP line.

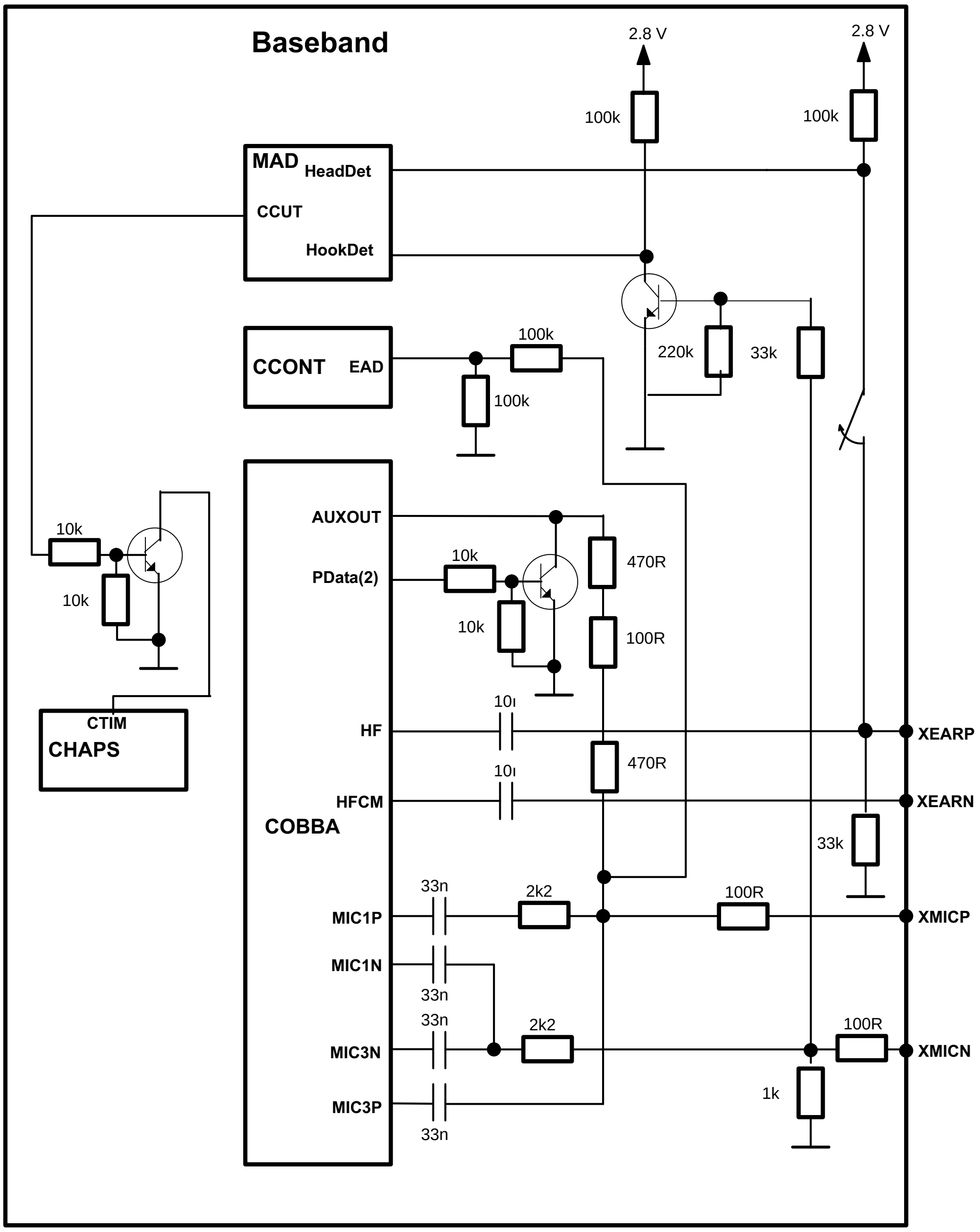



**Figure 4: External Audio Connections**

### Analog audio accessory detection

In XERP signal there is a 100 kΩ pull-up and 33k pull-down in the transceiver for HeadDet. The HeadDet is pulled up when an accessory is connected, and pulled down when disconnected. To get HeadDet working properly the system connector must be assembled otherwise the transceiver will assume that some accessory is connected. In XMICN signal there is a 1.2 kΩ pull-down in the transceiver and serial 1.2 kΩ from AUXOUT to XMICP. The XMICN is connected to the transistor which is then connected to the HookDet line (in MAD).

External accessory notices powered-up phone by detecting voltage in HeadDet line.

| Accessory connected | HookDet*) | HeadDet**) | Notes |
|---|---|---|---|
| No accessory connected | High | Low | |
| Headset with a button switch pressed | Low | High | XEAR and XMIC loaded (dc) |
| Headset with a button switch released | High | High | XEAR and XMIC loaded (dc) |
| Hands free (PPH-1) | Low | High | XMIC loaded (dc) |

*') HookDet is used only for detect button in headset.*

*'') HeadDet is used only for detect that some accessory is connected into system connector.*

**NOTE:** Charging must stop when the detection sequences are done! CCUT signal at high stops charging.

### Headset detection

The external headset device is connected to the headset connector, from which the signals are routed to COBBA headset microphone inputs and earphone outputs. In the XMICN line there is a 1.0 kΩ pulldown in the transceiver. The microphone is a low resistance pull-up compared to the transceiver pulldown.

When there is no call going, the AUXOUT is in high impedance state and the XMICN and XMICP are pulled down. When a headset is connected, the XMICP is pulled up. The switch inside the system connector is connected to the HeadDet line (in MAD), an interrupt is given due to both connection and disconnection.

**NOTE:** If the headset is connected switch closed, the transceiver can not detect if the headset or PPH-1 in power off mode is connected. When switch is released to open the transceiver can not any more detect the headset without polling by SW.

### Headset switch detection

In the XMICN line there is a 1.0 kΩ pulldown in the transceiver. The microphone is a low resistance pull-up compared to the transceiver pulldown. When a remote control switch is open, there is a capacitor in parallel with the microphone, so the XMICN is pulled up and HookDet pulled closed, the XMICN is pulled down via the microphone and HookDet is pulled up. So both pressing and releasing of the button gives an interrupt when AUX-OUT is set to 2.1 V.

### PPH–1 detection

The external Plug and Play PPH-1 device is connected to the system connector, from which the signals are routed to COBBA headset microphone inputs and earphone outputs. In the XMICN line there is a 1.0 kΩ pull-down in the transceiver. The PPH-1 has a low resistance pull-up compared to the transceiver pull-down. When there is no call going, the AUXOUT is in high impedance state and the XMICN and XMICP is pulled down. When a powered PPH-1 is connected, the XMICP is pulled up. The switch inside the system connector is connected to the HeadDet line (in MAD), an interrupt is given due to both connection and disconnection.

The PPH-1 device has two operating mode devices with external microphone and without external microphone. When internal microphone is used the detection signal (EAD) is higher than when external microphone is used.

**NOTE I**: If the PPH-1 is connected in power off mode, the transceiver can not detect if the device is a headset or a PPH-1 connected. When PPH-1 is powered on it is possible to detect when case of PPH-1.

**NOTE II**: If the external microphone is connected from or disconnected to PPH-1 it is not possible for the transceiver to detect when that happens.

### Internal audio connections

The speech coding functions are performed by the DSP in the MAD2 and the coded speech blocks are transferred to the COBBA for digital to analog conversion, down link direction. In the up link direction the PCM coded speech blocks are read from the COBBA by the DSP.

## Display Circuit

The display circuit includes LCD module UX7 and two capacitors. The LCD module is COG (Chip on Glass) technology. The connection method for chip on the glass is ACF, Adhesive Conductive Film. The LCD module is connected to the UI board with STAX elastomer. Capacitors are placed on the PCB.

The display driver includes HW-reset, voltage tripler or quadrupler which depends on temperature, temperature compensating circuit and low power control. Driver includes 84x48 RAM memory which is used when some elements are created on the display. Elements can be created with software. Driver doesn't include CG-ROM. One bit in RAM is the same as one pixel on the display.

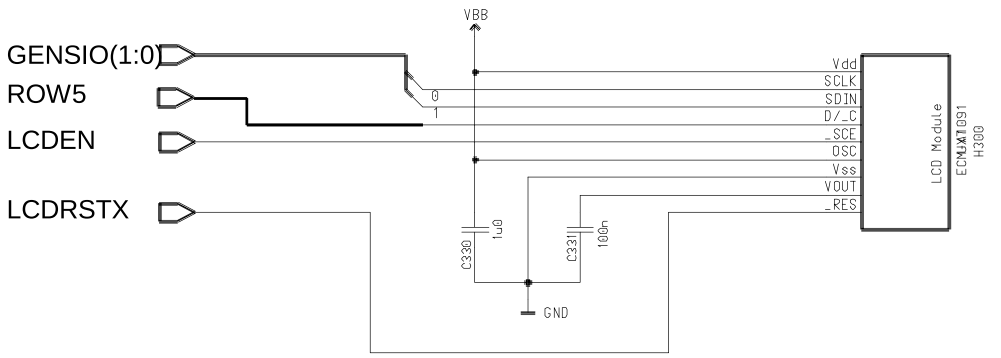



**Figure 5: Display Circuit**

**Keyboard**

Matrix size is 5 rows and 5 columns. Scanning is used for keyboard reading. Rows and columns are connected to the MAD interface

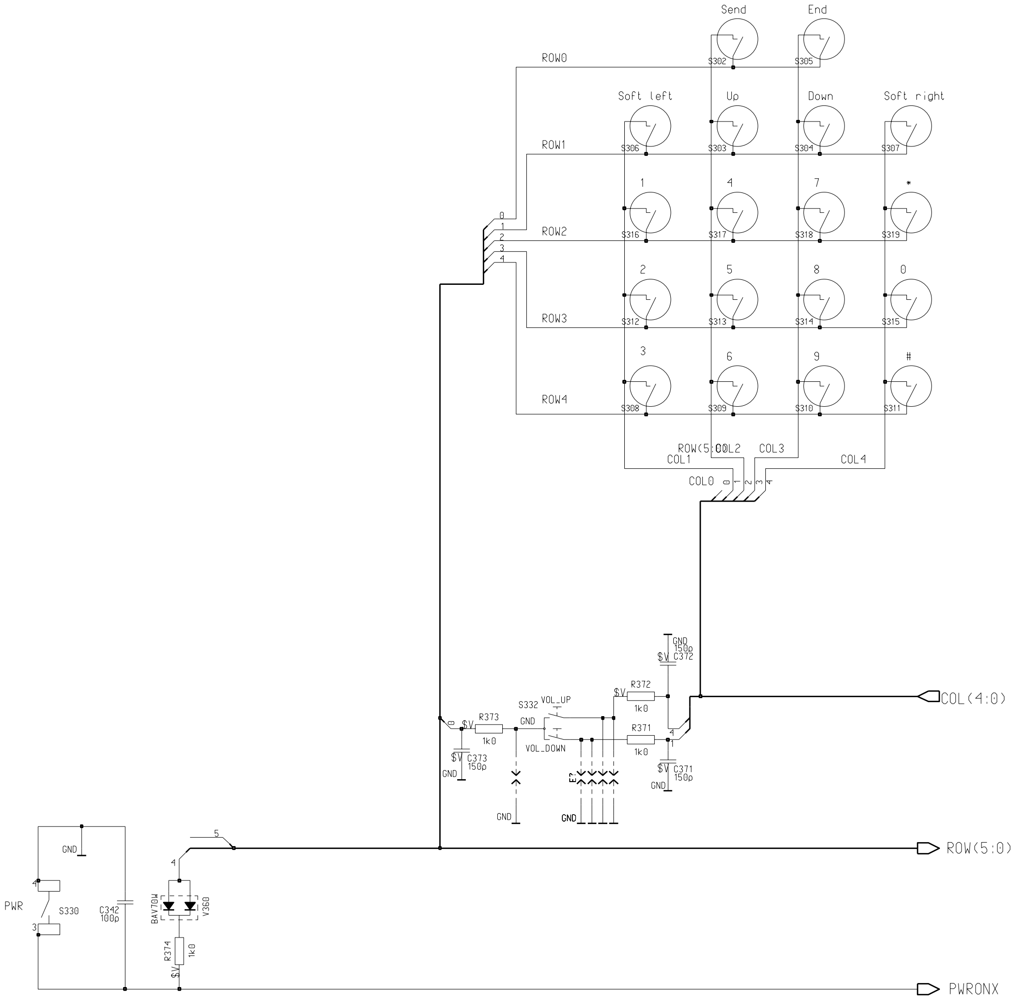



**Figure 6: Keyboard**

| ROW/COL | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| 0 | SLIDE SWT | Side Key | Send | End/Mode | Side key |
| 1 | NC | Soft left | Up | Down | Soft right |
| 2 | NC | 1 | 4 | 7 | * |
| 3 | NC | 2 | 5 | 8 | 0 |
| 4 | PWR switch | 3 | 6 | 9 | # |

NC = Not Connected

**Power Key**

Micro switch is used as a power key on the UI module. Circuitry includes the micro switch and two diodes which are needed for MAD interface. Power key is connected to CCONT. Power switch is active in LOW state. Power key is connected to ROW4.

**Backlighting**

Switching circuits for backlighting are placed on the UI module. Display and keyboard lighting are connected together. When LIGHT-signal is HIGH the lights are on and when LIGHT-signal is LOW state lights are off.

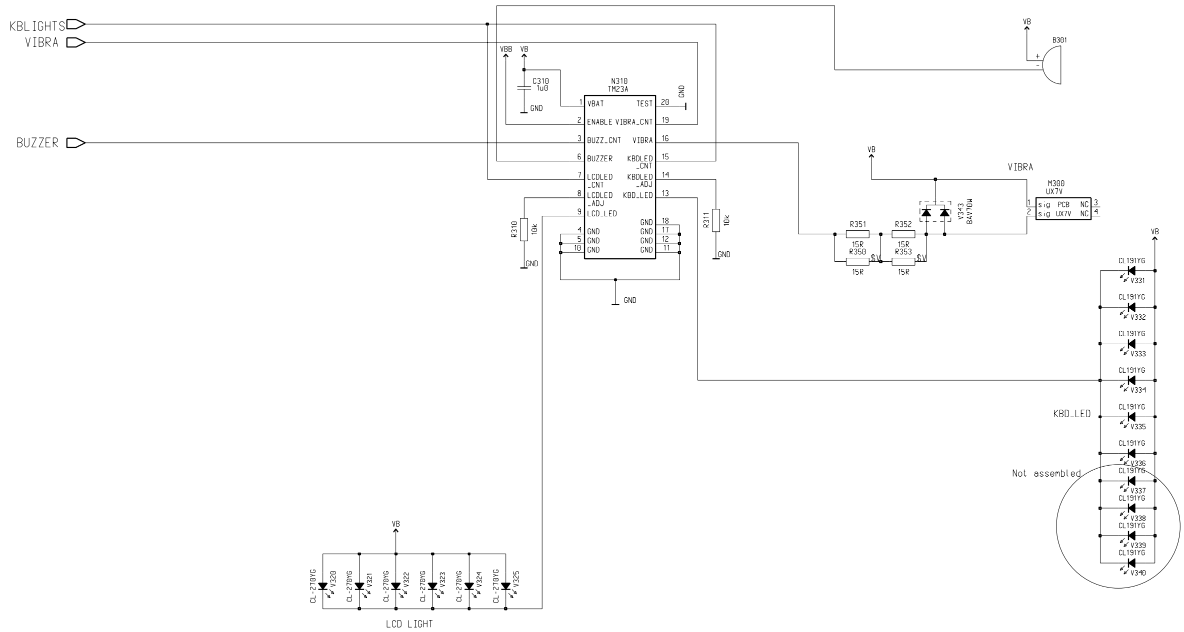



**Figure 7: Backlighting**

Backlighting is made by LED's, three LED's on the right and three on the left side of the display. LED's are compatible with CL270-YG and those are side illuminating. Light is on when LIGHT-signal is in the HIGH state.

The keyboard backlighting is made by 6 LED's.. The LED's are compatible with CL190-YG. Backlighting is on when LIGHT-signal is on HIGH state.

## Buzzer

Alerting tones and/or melodies as a signal of an incoming call are generated with a buzzer that is controlled with a PWM signal by the MAD via UISWITCH. Also key press and user function response beeps are generated with the buzzer. The buzzer is a SMD device and is placed on the mother board. Target for SPL is 100dB (A) at 5cm.

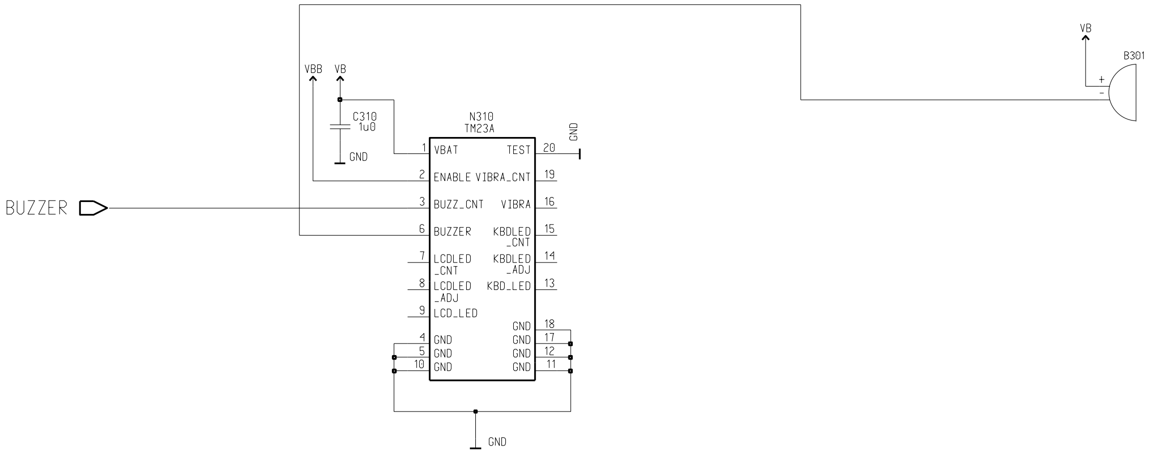



**Figure 8: Buzzer**

**Speaker**

Speaker circuit includes pads for speaker and 2 capacitors, 2 ferrites for EMC protection.

The speaker is sealed to the A-cover with gasket and UI PCB with supporting light guide. With that the frequency response is more constant. The speaker does not need holes for PCB. This gives reliable sound quality for the phone and it can be estimated in several environments. Arrangement is a leak tolerant speaker.

The low impedance, dynamic type earphone is connected to a differential output in the COBBA audio codec. The electrical specifications for the earphone output are shown below. The voltage level at each output is given as reference to ground. Earphone levels are given to 32 ohm load.

| | Nominal | Maximum | Notes |
|---|---|---|---|
| COBBA output, differential, 6dB gain | 17.6mV | 788mV | ENGINE - UI Interface; Estimate, must be checked with final ear-piece construction |
| Earpiece sound pressure (sensitivity +28dBPa/V 1kHz) | -7dBPa | +26dBPa | Measured as shielded (in brackets with leak ring) |

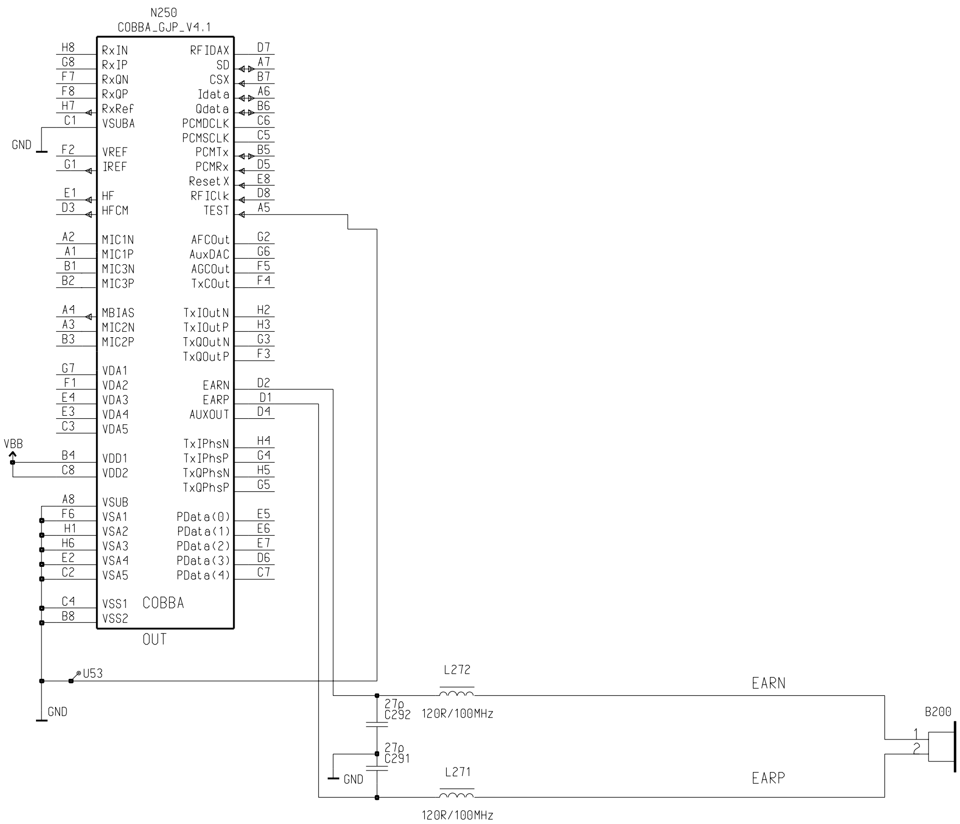



**Figure 9: Speaker**

## Microphone

The internal microphone is placed on the B-cover. Microphone is OMNI directional. The microphone requires a bias current to operate. The bias current is generated from VCOBBA supply with a transistor. EMC protection parts are implemented on the motherboard.

| Pin | Name | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| X300/2 | MICP | | 0.55 | 4.1 | mV | Connected to COBBA MIC2N input. The maximum value corresponds to 1kHz, 0 dBmO network level with input amplifier gain set to 32 dB. Typical value is maximum value - 16 dB |
| X300/1 | MICN | | 0.55 | 4.1 | mV | Connected to COBBA MIC2P input. The maximum value corresponds to 1kHz, 0 dBmO network level with input amplifier gain set to 32 dB. Typical value is maximum value - 16 dB |

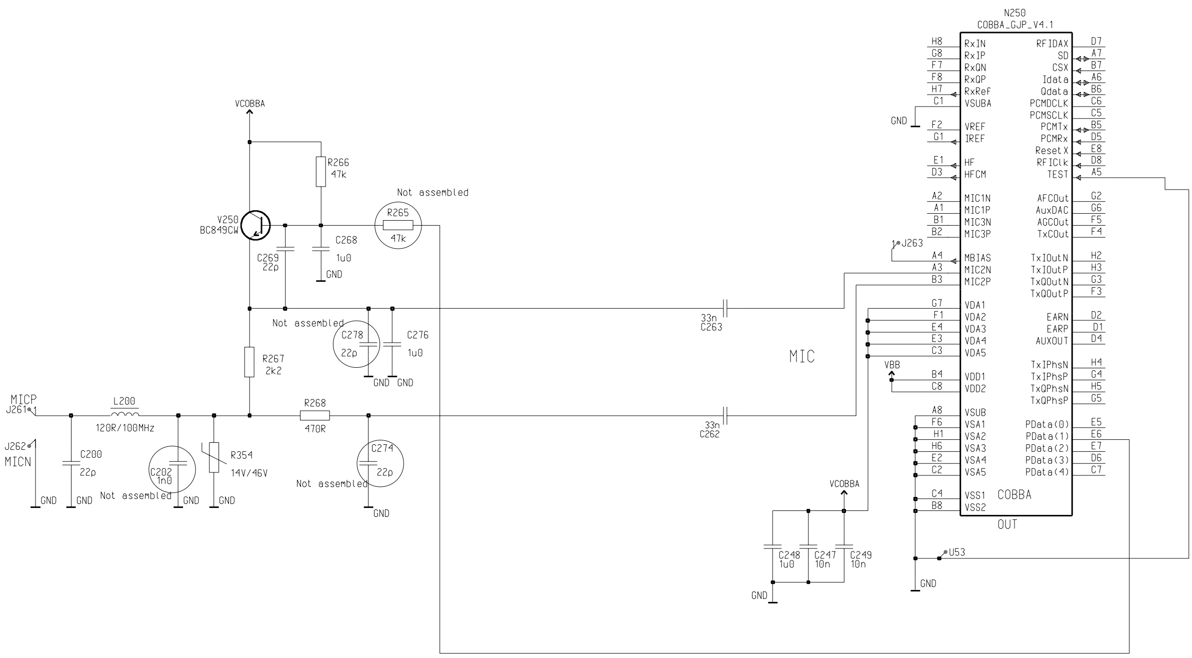



Figure 10: Microphone

### Vibra Alerting Device

A vibra alerting device is used for giving silent signal to the user of an in coming call. Vibra is located in the phone. The vibra is controlled with a PWM signal by the MAD via UISWITCH.

| Signal | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| M300/1 | | 1.0 | 1.1 | 2.0 | V | Measured against M300/2 |
| $I_{vibra}$ | Rated load current<br>Rated load speed | <br>7000 | 115<br>8000 | 140<br>12000 | mA<br>rpm | |

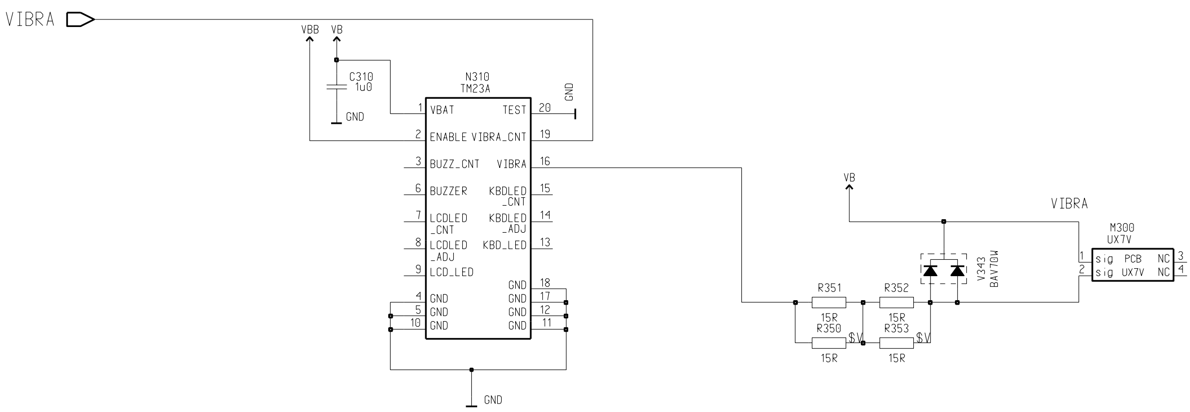



**Figure 11: Vibra Alerting Device**

**IR Module**

An infrared transceiver module is designed to substitute an electrical cable between the phone and a PC. The infrared transceiver module is a stand alone component capable to perform infrared transmitting and receiving functions by transforming signals transmitted in infrared light from and to electrical data pulses running in two wire asynchronous databus. IR is located at the left bottom corner of the product.

| Signal | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| IRONX | IR-module on/off | 0.7 x VBB<br><br>0 | | VBB<br><br>0.3 x VBB | V | Iout@2mA, IR is at off state<br>IR, is at on state |
| FBUS_RX | IR receive no pulse<br>IR receive pulse | 0.7 x VBB<br>0 | | VBB<br>0.3 x VBB | V | |
| FBUS_TX | IR transmit pulse<br>IR transmit no pulse | 0.7 x VBB<br>0 | | VBB<br>0.3 x VBB | V | Iout@2mA |

The module is activated with an IRONX signal by the MAD, which supplies power to the module. The IR datalines are connected to the MAD accessory interface AccIf via FBUS. The AccIf in MAD performs pulse encoding and shaping for transmitted data and detection and decoding for received data pulses.

The data is transferred over the IR link using serial data at speeds 9.6, 19.2, 38.4, 57.6 or 115.2 kbits/s, which leads to maximum throughput of 92.160 kbits/s. The IR module used does not comply with the IrDA 1.0 specification (InfraRed Data Association), which is based on the HP SIR (Hewlett-Packard`s Serial InfraRed) concept. Maximum transmission distance is set to 60cm.

In IR transmission a light pulse corresponds to 0-bit and a "dark pulse" corresponds to 1-bit.

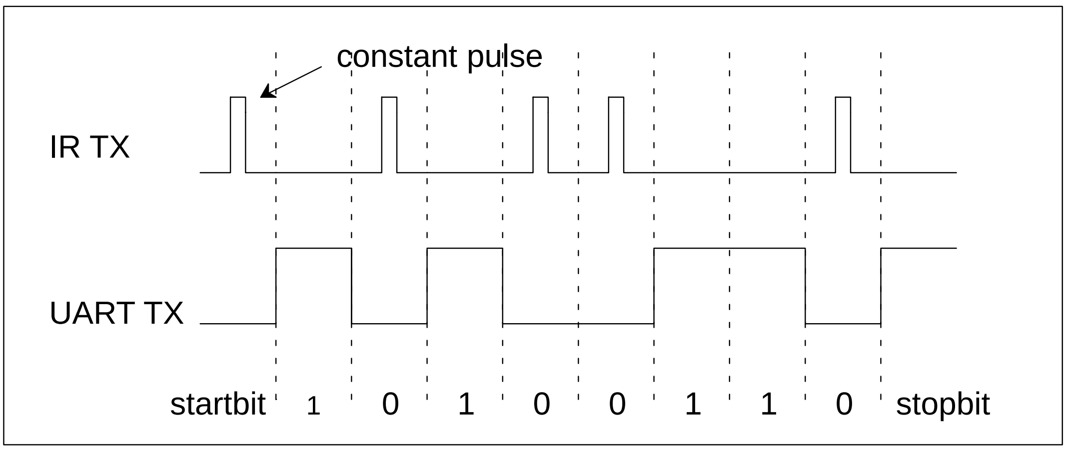



**Figure 12: IR Transmission**

The FBUS cannot be used for external accessory communication, when the infrared mode is selected. Infrared communication reserves the FBUS completely.

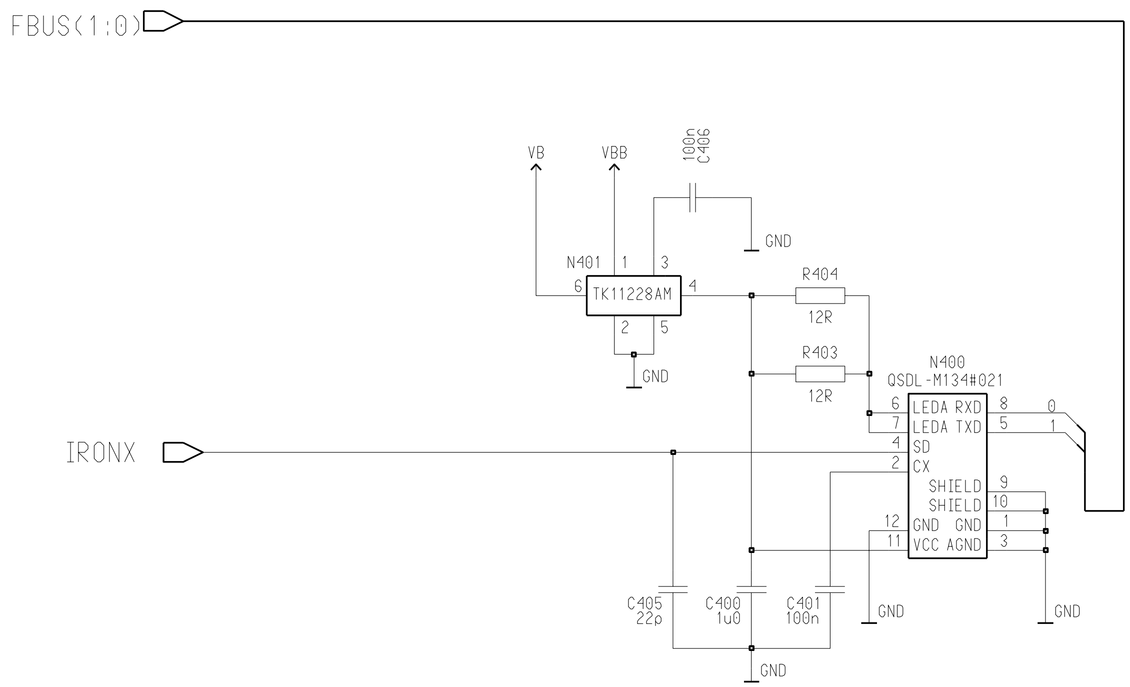
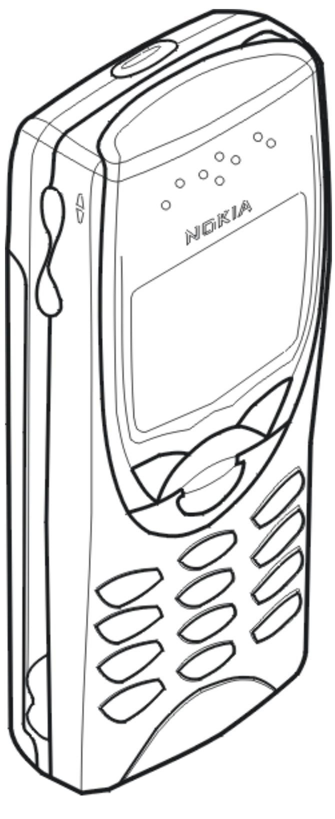



**Figure 13: IR Module**

# Product Variants



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# Transceiver NSB-7

The NSB-7 is a single band transceiver unit designed for the GSM1900 networks. It is a GSM1900 power class 1 (1W) transceiver.

The plug-in SIM (Subscriber Identity Module) card is located inside the phone. SIM card is accessed after removal of B-cover and battery.

**NOTE: The Service Manual is intended for use by qualified service personnel only.**

## Modules

| | |
|---|---|
| Basic Transceiver NSB-7 | 0503440 |
| • System Module RB9 | 0201512 |
| • Mechanics MNSB7NX | 0262160 |
| • Software SW NSB-7 | 0241268 |

## Exploded View of Transceiver NSB-7

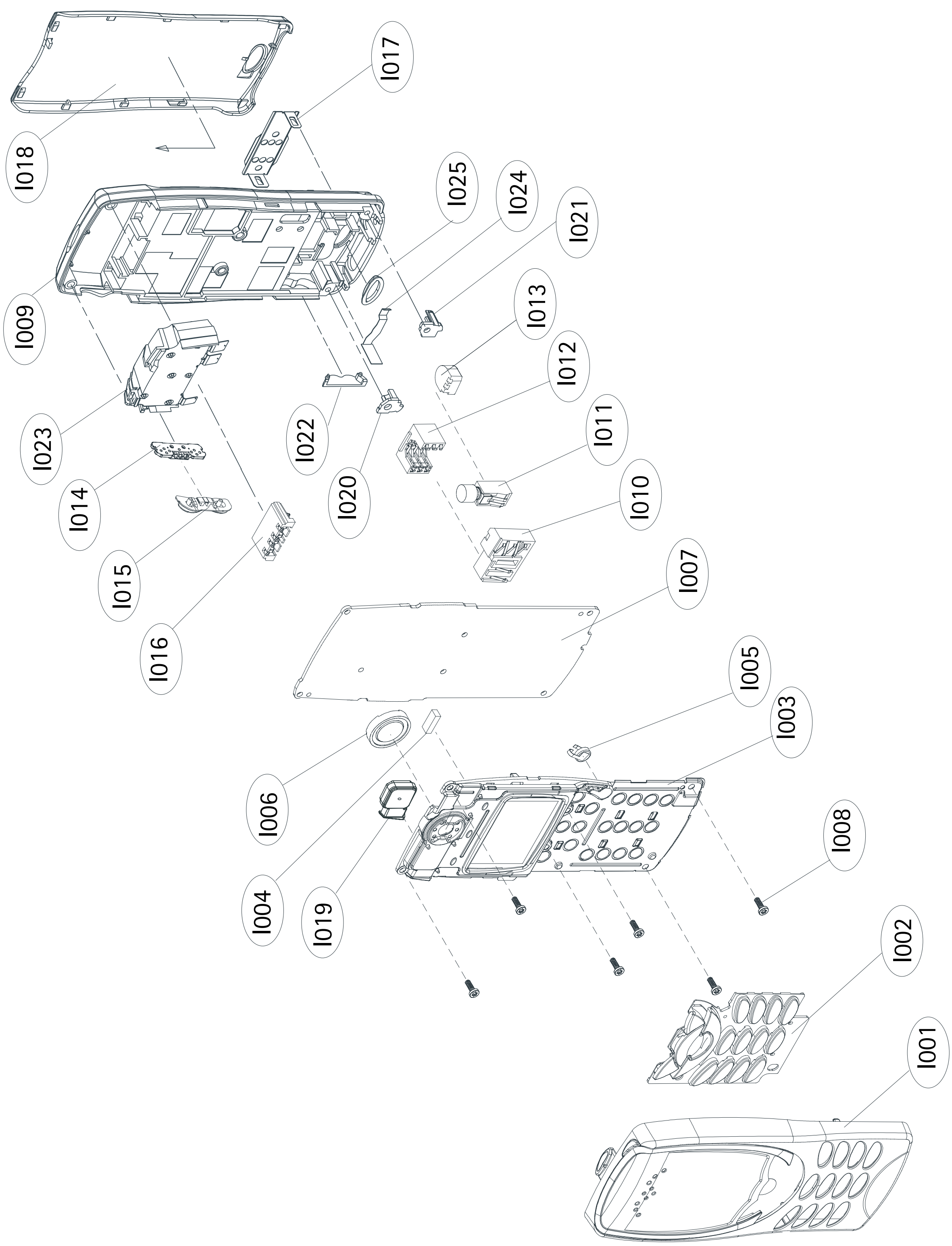


**Figure 1: Exploded view of Transceiver NSB-7**

## Assembly Parts of NSB-7

| CIRCUIT REF./ ITEM | Q'TY | CODE | DESCRIPTION | VALUE, TYPE |
|---|---|---|---|---|
| I001 | | 9456862 | A-cover assy | DMC03126 |
| I002 | | 9790398 | Keymat assy NSM-3 | DMC02324 |
| Or | | 9790448 | Keymat assy US NSB-7 | |
| I003 | | 9490095 | LCD module assy | DMC02362 |
| I004 | | 9780250 | Connector elastomer silicon stax | |
| I005 | | 4700127 | RTC battery | |
| I006 | | 5140067 | Speaker + spring 103+3 dB | |
| I007 | | 0201512 | RB9 radio module | |
| I008 | 6 | 6150029 | Screw M1.6x4.5 flat head 0.8mm **(Use 17 Ncm torque**) | |
| I009 | | 9490133 | B-cover assy | DMC02341 |
| I010 | | 5409095 | DC & HS connector | |
| I011 | | 6800041 | Vibra motor assy | |
| I012 | | 5409117 | SIM connector | |
| I013 | | 5140175 | Microphone+holder+springs | |
| I014 | | 5219019 | Volume switch up/down | |
| I015 | | 9790397 | Volume key | DMD05078 |
| I016 | | 5409093 | Battery connector 4 pole | |
| I017 | | 9560085 | SIM spring | DMD05211 |
| I018 | | 9456594 | Battery cover | DMD05082 |
| I019 | | 9480526 | Buzzer gasket | |
| I020 | | 9460327 | A-cover fixing left | DMD05127 |
| I021 | | 9460328 | A-cover fixing right | DMD05128 |
| I022 | | 9451600 | IR window | |
| I023 | | 0660210 | Antenna pifa 1850-1990 MHz GSM | |
| I024 | | 9510545 | Battery latch spring | DMD05129 |
| I025 | | 9451601 | Battery latch | DMD05083 |

# Service Software Instructions

 

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# Service Software

## General

To run the Service Software, a parallel port software protection device (PKD-1) has to be connected. TDF-4 box must connected to PC for flashing purposes. The test functions send test messages from PC to mobile stations (MS) and receive results and show them in the PC display. The messages can be sent via M2BUS or FBUS.

Note: if this software is to be run on lap top's, the power saving feature MUST be switched off.

### Hardware requirements for Windows 3.11

The recommended minimum hardware standard to run Service Software is any computer which is 386 33 MHz or greater with at least 4 MB of memory and VGA type display (640 x 480). This assumes that only the WinTesla with phone module is active, i.e. other Windows packages are not running in the background.

### Hardware requirements for Windows 95

The recommended minimum hardware standard to run Service Software is any computer which has Pentium processor, memory 8 MB and meets HW requirements recommended by Microsoft.

## Software Environment of the Support Modules

The Service Software user interface is intended for the following environments: Microsoft Windows 3.11, 95 and NT. For those who are familiar with Windows environment this application will be easy to use. Detailed information about Windows and application usage can be found from the relevant Microsoft Windows Users Guide.

As an ordinary Windows application, the main idea in the user interface is that selections are made with menus, push buttons and short-cut keys. Selections can be done by using keyboard and/or mouse. There is always a status bar displayed at the bottom of the main window which contains information about current actions.

## Servicing Equipment

NSB-7 specific:

| | |
|---|---|
| Service SW diskette 3.5" for NSB-7 | 0774080 |
| Flash SW packages on CD | 0775227 |
| Service Box JBU-6 | 0770153 |
| RF Adapter RA5 for JBU-6 | 0201591 |
| Module Jig MJS-9 | 0750154 |
| RF Cable XRF-1 (SMA/N-connector) | 0730085 |
| RF Cable XRS-3 (N/N-connector) | 0730184 |
| Flash Loading Adapter FLA-10 | 0081346 |
| Soldering Jig MJS-21 | 0770225 |
| LCD CD9 | 0770244 |
| Battery Connector Extractor tool SRT-3 | 0770226 |
| **Common to other models but needed also for NSB-7:** | |
| Flash Loading Adapter FLA-7 | 0770119 |
| Flash Loading Adapter FLA-5 | 0770085 |
| Prommer FPS-4S | 0085095 |
| Flash Security Box TDF-4 | 0770106 |
| Audio Box JBA-6 | 0770184 |
| DC-DC Cable SCB-3 | 0730114 |
| Service Cable XMS-3 (XCM-5 can also be used) | 0730174 |
| DC Power Cable PCS-1 for JBU-6 | 0730012 |
| Service MBUS Cable DAU-9S | 0730108 |
| D9 - D9 Cable AXS-4 (Included in FPS-4 sales pack) | 0730090 |

| | |
|---|---|
| D15-D15 Cable AX5 | 0081275 |
| DC Cable PCC-1 | 0730053 |
| Software Protection Key PKD-1 | 0750018 |
| IR module for TDF-4 | 0750079 |

*) Note: A number of PC's of an older generation use the Intel, National Semiconductor, or United Microelectronics IC 8250 as the serial port UART. This is a comparatively inefficient circuit for current purposes and does not necessarily support the M2BUS adapter at 9600 baud. The newer UART's NS16450 and NS16550AF of National Semiconductor offer solutions for these problems.

## Installation

### Mechanical Connections

Caution: Make sure that you have switched off the PC and the printer before making connections.

Caution: Do not connect the PKD-1 key to the serial port. You may damage your PKD-1!

The software controls the phone via a separate adapter connected to the serial port of the PC, and to the telephone's M2BUS (DAU-9S).

Attach the dongle PKD-1 to the parallel port 1 (25-pin female D-connector) of the PC. When connecting PKD-1 to the parallel port, be sure that you insert the computer side of the PKD-1 to the PC (male side). If you use a printer on parallel port 1, install the PKD-1 between the PC and your printer cable.

The PKD-1 should not affect devices working with it. If some errors occur (errors in printing are possible) please try printing without the PKD-1. If printing is OK without the PKD-1 please contact your dealer. We will offer you a new PKD-1 in exchange for your old one.

**Installing the Service Software on PC Hard Disk**

The program is delivered on a diskette and is copy protected with a dongle PKD-1. It must be present in parallel port when using Service software.

The program must be installed on the hard disk before use.

Keep the original diskette safe to enable upgrading of the program!

**First time installation of WinTesla:**

Do the following to make a complete WinTesla installation with support for NSB-7:

Insert the WinTesla software diskette into the floppy drive on your computer (i.e. Drive A:)

**For Windows 3.1 and 3.11:**

Start Windows, type *win <Enter>*

Open the File manager, open Main window and start File manager.

Select the floppy drive and:

Start installation, double-click the *wt_inst.exe* file.

Follow the instructions on the screen. Write down the directory where WinTesla is installed on your hard disk.

When installation has finished remove the WinTesla software disk from your floppy drive.

Insert the Dongle driver diskette into your floppy drive.

Select the floppy drive and:

Start installation, double-click the *dk2wn16.exe* file.

Follow the instructions on the screen.

When installation has finished remove the dongle driver software disk from your floppy drive.

Continue with the support modules installation.

**For Windows 95 and NT:**

Open Microsoft Explorer, Select *Start -Programs - Explorer*

Select the floppy drive and:

Start installation, double-click the *wt_inst.exe* file.

Follow the instructions on the screen. Write down the directory where WinTesla is installed on your hard disk.

When installation has finished remove the WinTesla software disk from your floppy drive.

Insert the Dongle driver diskette into your floppy drive.

Select the floppy drive and:

Start installation, double-click the *dk2wn32.exe* file.

Follow the instructions on the screen.

When installation has finished remove the dongle driver software disk from your floppy drive.

Continue with the support modules installation.

**Installation of NSB-7 support modules (WinTesla already installed):**

To install the new Service Software Program, follow the steps below:

Insert the new Service software diskette into the floppy drive on of your computer (i.e. Drive A:)

**For Windows 3.1 and 3.11:**

Start Windows, type *win <Enter>* and open the File manager.

Open Main window and start File Manager, select the floppy drive.

Start installation, double-click the *nsek13i.exe* file.

Follow the instructions on the screen.

**For Windows 95 and NT:**

Open Microsoft Explorer, select *Start -Programs- Explorer*

Select the floppy drive.

Start installation, double-click the *nsek13i.exe* file.

Follow the instructions on the screen.

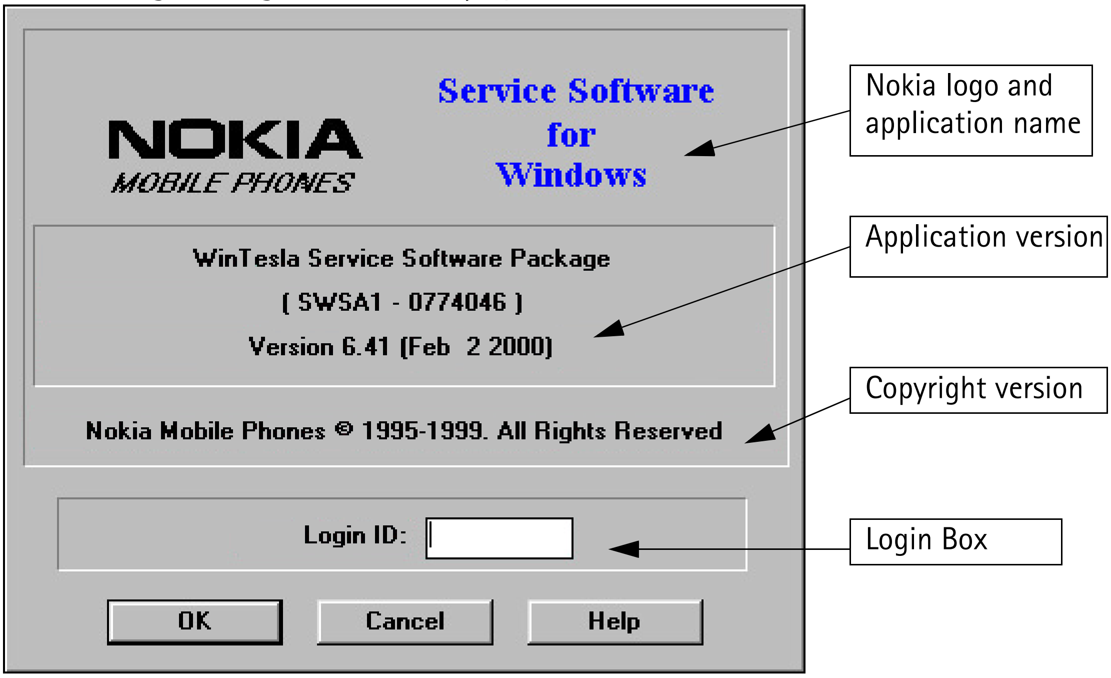
# Common Properties of the User Interface

This chapter describes how the User Interface CLF (Common Look and Feel) must appear to the user.

The User Interface MUST be capable of being driven without the use of a mouse, as the service engineer rarely has space on the bench to use a mouse.

## Login Dialog

When the Service Software application is invoked, by checking on the Service Software icon, the Login dialog box will be displayed on the screen.




**Nokia logo and application name** bitmap (-)

Displays Nokia logo and name of the application.

**Application version** static text (-)

Contains the name and version of the application.

**Copyright notice** static text (-)

Copyright is informed as: **"Nokia Mobile Phones (c) 1996. All Rights Reserved".**

**Login Box** edit box (-)

The user Login ID edit box, where the user enters his/her faultlog user name. (See Faultlog User Guide)

**OK** button (default key)

The user name is stored in memory and the dialog box is closed. When the dialog box is closed, the application starts.

**Cancel** button (ESC)

The Dialog box is closed and application is started, but the Faultlog feature is disabled.

**Help** button (F1)

Activates the Windows Help application and displays context sensitive Help.

## Main Window


**Title bar**

The *title bar* is located at the top of the window.

A title bar contains the following elements:

- Application Control-menu button
- Maximise button
- Minimise button
- Name of the application
- Restore button

The properties of these elements and their usage is described in Ref 3- Microsoft Windows Version 3.1 Users Guide chapter one (Windows Basics) and chapter two (Application Basics).

**Menu bar**

The menu bar is below the title bar and contains all available menu selections. The menu bar is a dynamic element and is dependent on the dongle type fitted, and whether a phone is connected.

Underlined characters in menu names and options indicates that the menu selection can be done by pressing Alt+ *underlined character*. Options can also be selected by activating menu bar with Alt- key (or F10 key) and using arrow-keys to highlight the desired menu. In that case, selection is done by pressing *Enter*.

Menus can also be selected by using the mouse as described in Ref 3-Microsoft Windows Version 3.1 Users Guide

**Status bar**

The status bar is displayed at the bottom of the Service Software main window. The status bar contains information about the menu selections and events.

The left area of the status bar describes the actions of menu items as the user uses the arrow keys to navigate through menus.

The status bar texts are explained in detailed in each of command's description.

The right areas of the status bar indicate which of the following keys are latched down:

| Indicator | Description |
|---|---|
| USER | Entered Login ID. |
| CAP | The Caps Lock key is latched down. |
| NUM | The Num Lock key is latched down. |
| SCRL | The Scroll Lock key is latched down. |

**Tool bar**

The *tool* bar is NOT defined and will not be implemented until specified by this document.

## Menu Bar

The Service Software package will have two menu bar configurations. The first, is an abbreviated version that contains the minimum number of menus that allows package configurations when a phone is NOT connected. The second is described below:

The menu bar MUST only contain the follow menus for the Service Software package when a phone is connected:

- Product*
- Configure*
- Tuning
- Testing
- Software
- Dealer
- View
- Help*

* - always displayed, even if no phone is connected.

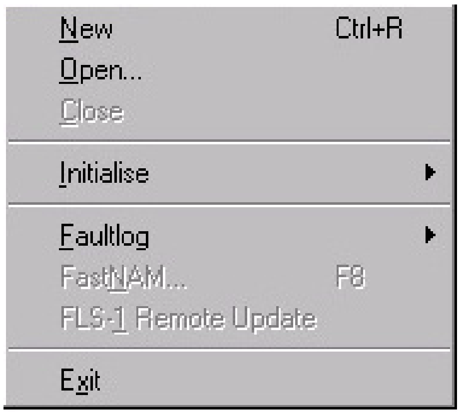
A menu is broken down into sections that are indicated with menu separators. Each sections identifies a logical difference from itself and other sections, i.e. between transmitter and receiver. Any items that are required to be added to a menu lists will be added on the bottom of the appropriate menu section list. If a new item is to be added which is common to two or more phone types, then that menu item will become a common menu item.

The menu lists will use the Microsoft [...] symbol after an item name to indicate that selecting that item will NOT initiate an operation immediately, i.e. a dialog box will be displayed for the user to select options or type in data and press the OK button before the operation is performed.

**Product**

The Product menu contains at least the following menu items:

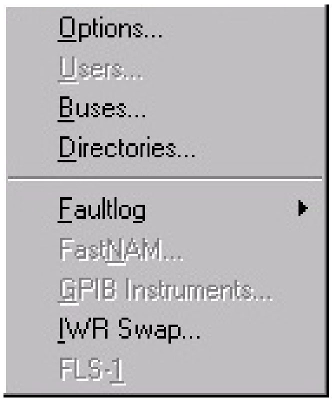
- New Ctrl+R
- Open...
- Close
- Initialize
  - Normal Mode F5
  - Local Mode Shift+F5
- Faultlog
  - Activate Faultlog... F9
  - Edit Faultlog...
- Exit Alt+F4




**Configure**

The Configure menu contains at least the following items:

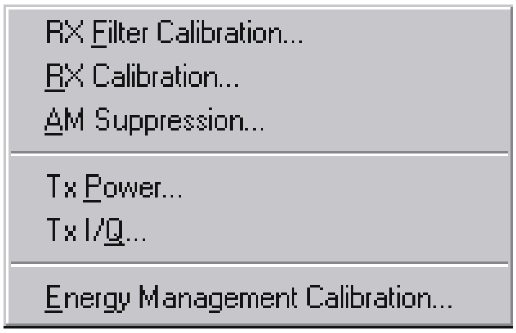
- Options...
- Buses...
- Directories...
- Faultlog...
- IWR Swap



**Tuning**

The Tuning menu contains at least the following menu sections:

- RX Filter Calibration...
- RX Calibration...
- AM Suppression...
- Tx Power...
- Tx I/Q...
- Energy Management Calibration...




**Testing**

The Testing menu contains at least the following sections:

- RF Controls...
- RSSI Reading ...
- Self Tests
- ADC Readings
- Audio
- User Interface
- Call Simulation
- Noise Sensitivity...
- IR Test
- Vibra Test...

## Software

The Software menu contains at least the following menu sections:

- Product Profile...
- Start Up Self-tests...
- Set Factory Values
- Phone Identity...
- Warranty State...
- Production Data Edit...


## Dealer

The Dealer menu contains at least the following menu sections:

- User Settings...
- Short Code Memory...
- SCM & User settings ...
- Restore User Defaults...
- Set UI/DEV Default Values ...
- Operators Settings...
- IWR Swap...
- Flash Phone...


## View

The View menu contains at least the following sections:

- Quick/RF Info...
- Phone Information...

**Phone Identity Window**

The Phone Identity window should contain, as a minimum, the following data:

- Software Version(s)
- Hardware Version(s)
- Serial Number(s)
- Product Code

This window will only be used as a display window and therefore will not allow editing of the displayed data. This window will not contain any controls other than a scroll bar.

**Help**

The Help menu contains at least the following menu items:

- Contents
- Search for Help On...
- How to use Help
- About WinTesla

## Mouse Cursors

The standards Windows pointer will be used as the mouse cursor.

During time consuming tasks e.g. communication to phone, an hour glass will be shown informing the user that a task is in progress. The application uses the hour glass cursor to inform user that the application has taken the control and any actions from user will be ignored.

When a function is initiated, the hour glass will be displayed and when the function has finished the mouse pointer will return to normal.

## Reserved Keys

The following Hot keys and Short Cut keys are reserved either as Microsoft standard keys or as part of the Common Look and Feel specified by this document.

### Short Cut Function Keys

| Key | Description | Defined by |
|---|---|---|
| F1 | Context Sensitive Help | Microsoft |
| F5 | Normal Mode | NMP |
| Shift+F5 | Local Mode | NMP |
| F9 | Activate Faultlog | NMP |
| F10 | Go to Menu Bar | Microsoft |
| Ctrl+F4 | Close Active Window | Microsoft |

### Alt Hot Keys

| Key | Description | Defined by |
|---|---|---|
| Alt+F4 | Exit Active Application | Microsoft |
| Alt+H | Help | Microsoft |

### Ctrl Hot Keys

| Key | Description | Defined by |
|---|---|---|
| Ctrl+N | File - New | Microsoft |
| Ctrl+O | File - Open | Microsoft |

| | | |
|---|---|---|
| Ctrl+P | File - Print | Microsoft |
| Ctrl+R | Product - New | NMP |

**Shift Hot Keys**

| Key | Description | Defined by |
|---|---|---|
| Shift+F5 | Local Mode | NMP |

**Key Strokes**

| Key | Description | Defined by |
|---|---|---|
| Alt+P | Product Menu | NMP |
| Alt+P,N | New | NMP |
| Alt+P,O | Open | NMP |
| Alt+P,C | Close | NMP |
| Alt+P,I | Initialize Pop-up | NMP |
| Alt+P,I,N | Normal Mode | NMP |
| Alt+P,I,L | Local Mode | NMP |
| Alt+P,F | Faultlog Pop-up | NMP |
| Alt+P,F,A | Activate Faultlog | NMP |
| Alt+P,F,E | Edit Faultlog | NMP |
| Alt+P,X | Exit Application | NMP |
| Alt+C | Configure | NMP |
| Alt+C,O | Option | NMP |
| Alt+C,D | Directories | NMP |
| Alt+C,F | Faultlog | NMP |
| Alt+C,G | GPIB instruments (disabled) | NMP |
| Alt+T | Tuning Menu | NMP |

| | | |
|---|---|---|
| Alt+T,R | RX Calibration | NMP |
| Alt+T,X | Tx Power | NMP |
| Alt+T,Q | Tx I/Q | NMP |
| Alt+T,E | Energy Management calibration | NMP |
| Alt+E | Testing Menu | NMP |
| Alt+E,F | RF Controls | NMP |
| Alt+E,R | RSSI Reading | NMP |
| Alt+E,S | Self Tests | NMP |
| Alt+E,A | ADC Readings | NMP |
| Alt+E,U | Audio | NMP |
| Alt+E,U,I | Audio Internal | NMP |
| Alt+E,U,E | Audio External | NMP |
| Alt+E,U | User Interface | NMP |
| Alt+E,C | Call Simulation | NMP |
| Alt+E,N | Noise Sensitivity | NMP |
| Alt+E,I | IR Test | NMP |
| Alt+S | Software Menu | NMP |
| Alt+S,P | Product Profile | NMP |
| Alt+S,S | Start-up Self Tests | NMP |
| Alt+S,V | Set Default Values | NMP |
| Alt+S,I | Phone Identity | NMP |
| Alt+S,P | Production Data Edit | NMP |
| Alt+S,F | Flash Phone | NMP |
| Alt+D | Dealer Menu | NMP |

| | | |
|---|---|---|
| Alt+D,U | User Settings | NMP |
| Alt+D,S | Short Code Memory | NMP |
| Alt+D,M | SCM & User Settings | NMP |
| Alt+D,V | Set UI/DEV Default Values | NMP |
| Alt+V | View Menu | NMP |
| Alt+V,Q | Quick/RF Info | NMP |
| Alt+V,P | Phone Identity | NMP |
| Alt+H | Help Menu | Microsoft |
| Alt+H,I | Index | Microsoft |
| Alt+H,G | General Help | Microsoft |
| Alt+H,U | Using Help | Microsoft |
| Alt+H,A | About WinTesla | NMP |
| Alt+H,S | About AS Locals | NMP |

## Help Functions

The Help User Interface will be the standard Windows help tool called WinHelp.

The context sensitive help is activated with **F1**-key. Help contains also Using Help which describes how to use help facility. Refer to the Windows manual for detailed description on the Windows Help.

## Dialog boxes

The Service Software application uses many different dialog boxes. Dialog boxes are used to display data and prompt the user for input.

Dialog boxes are opened from menus or with short-cut keys. Dialog boxes have different properties but some features are common.

All service dialog boxes must be modal, that is, the user will not be able to start another operation without first closing the present dialog box.

All dialog boxes will contain the following entities:

- Help button
- Title bar
- At least one button other than Help
- Application Control-menu Button

## Common Dialog boxes

This sections describes the common dialog boxes used in the Service Software package, and the context in which they will be used.

### Note Message Box

When the user has made an illegal selection, a note message box dialog will be opened and message text is displayed. The message box is also opened when the program has some information for the user. The size of the dialog box may vary. An information dialog box is recognized by the **!**-icon.

The dialog box will also contain an OK button and a Help button.

**OK** button (default key):

Acknowledge displayed information and continue. The dialog box is closed after selection.

**Help** button (Alt+H):

Opens context sensitive help as F1-key does.

**Query Message Box**

Confirmations and questions are asked in a query message box. A query dialog box is recognized by the **?**-icon.

The dialog box will also contain a Yes button, a No button, and a Help button.

**Yes** button (Alt+Y or Y) (default key):

Accepts confirmation or question.

**No** button (Alt+N or N):

Denies confirmation or question.

**Help** button (Alt+H):

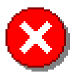
Opens context sensitive help as F1-key does.

The buttons may also be OK and Cancel. The operation of these buttons are the same as in the Note dialog box.

**Error Message Box**

Error message dialog boxes use the Stop-icon. When a “Stop”-dialog box is shown, the current operation is terminated.

The dialog box has a description about the failed operation and reason. Pressing F1 (Help) application opens the appropriate help topic that gives information about recommended actions.



The dialog box will also contain an OK button and a Help button.

**OK** button (default key):

Acknowledges displayed information and terminate current operation.
The dialog box is closed after selection.

**Help** button (Alt+H):

Open context sensitive help as F1-key does.

## Custom Dialog boxes

All custom dialog boxes will contain the pre-defined buttons as defined below in the section - Buttons. However, it is recognized that features may require additional button types, but the addition of these non-standard buttons should be carefully considered to minimise any inconsistencies between implementations.

The buttons will be positioned down the right-hand side of the dialog boxes. The default action will be **OK**, except where that default action could result in an irretrievable failure.

All tuning dialogs that contain tuning results, will display the old tuned data read from the phone before the tuning was performed, as well as the newly tuned data.

List boxes will be used to display lists of data, such as tuning data, test results etc.

The use of Radio buttons should be limited and carefully considered. The use of radio buttons defines the number of possible choices available to the user, which may be acceptable for one project, but not for another.

## Buttons

All buttons must be the Microsoft style of buttons.

In general, the default button will be the action button, the Close button or the Yes button, but this will depend on the context of the dialog box that the button is associated with.

**(action)** button:

Accepts and validates entered settings and values and closes the dialog. If the values have not been changed, then no action will be taken. The status bar will reflect the status. The user should only be queried, if the settings or values accepted will over-write data that CAN NOT be reproduced.

A greyed **OK** button indicates that settings selected by the user are not acceptable.

**Close** button:

Closes the current dialog box. Does not send or store anything and closes the dialog. The Close button is only used for dialogs that do not set or change any data.

**Cancel** button (Esc):

Cancel operation. Does not send or store anything and closes the dialog box.

A greyed **Cancel** button indicates that it is not possible to quit from this dialog box.

**Yes** button (ALT+Y or Y):

Replies Yes to a question asked of the user.

**No** button (ALT+N or N):

Replies No to a question asked of the user.

**Help** button (ALT+H):

Opens context sensitive help as F1-key does.

## Reporting Status

The status bar will be used to report the present status to the user. When a feature is initiated, the status bar will be updated with a brief description of the function. The status bar will also be updated at key points in a time consuming function.

If an error is to be reported to the user, it will be displayed in the status bar as well as displayed in a common error dialog box. This will mean the user is not delayed from progressing on to the next operation unless an error occurs, in which case, the user will have to acknowledge the error by pressing the OK button.

# NSB-7 FEATURES

## Menu bar

After Sales SW's menus follow the menu structure specified in WinTesla User Interface Specification. This specification will describe functionality that differs from WinTesla specification.

## Product

### New command

| Activation | Status Bar Text |
|---|---|
| Alt, P, N | Re-scan a new phone |
| Ctrl+R | |

If phone is changed (with same phone type only serial number is changed) phone will be initialised to local/normal mode (selected in TESLA.INI). If phone is changed to different phone type the current DLLs are unloaded and new ones are loaded for that phone.

If the Quick/RF Info view is open, window will be automatically updated.

If Phone Information view is open, window will be automatically updated.

**NOTE:** When different type of phone is changed user should select Product/New, so that application recognises phone type change and loads correct menu.

### Open... command

| Activation | Status Bar Text |
|---|---|
| Alt, P, O | Force load phone specific functionality |

Phone is set to local/normal mode. If no phone is found, connection parameters (from Configure/Busses) are displayed to user and application asks from user does (s)he want to use that connection to flash a phone. If user selects **Yes**, current connection is used and flash only menu is loaded. If user selects **No**, application tries next connection, if there is one.

**Initialise command**

| Activation | Status Bar Text |
|---|---|
| Alt, P, I | |

Opens a sub menu which contains the following options:

**Normal Mode**

| Activation | Status Bar Text |
|---|---|
| Alt, P, I, N | Initialises phone to normal mode |
| F5 | |

When normal mode has been activated or program has been started, self-test results will be asked from MCU. If fault was found in the tests, an error message is shown. If normal mode has been set successfully (no self test error has been found), and paging listening has been started, the used AFC value is requested from MS.

Initialisation routine checks phone's cellular type and if unsupported phone is detected, application unloads the DLLs.

The After Sales SW sets automatically the MS state to normal mode when needed.

If phone identification view is open, window will be automatically updated. Also if RF Information Window is open it will be updated to quick info view.

**NOTE:** When phone is changed to an other but phone type does not change, user may select Product/Initialise/Normal Mode instead of Product/New.

**Local Mode**

| Activation | Status Bar Text |
|---|---|
| Alt, P, I, L | Initialises phone to local mode |
| Shift+F5 | |

Selection will change the MS state to *local*. When user selects item from Testing or Tuning menus, the After Sales SW software will change automatically the MS state to local.

The After Sales SW sets automatically the MS state to normal mode when needed.

Also if quick info view is open it will be updated to RF Information view.

**Faultlog command**

| Activation | Status Bar Text |
|---|---|
| Alt, P, F | Opens a sub menu. Only enabled when user has logged in. |

**Activate Faultlog**

| Activation | Status Bar Text |
|---|---|
| Alt, P, F, A<br>F9 | Activates the faultlog. Only enabled when user has logged in. |

**Edit Faultlog**

| Activation | Status Bar Text |
|---|---|
| Alt, P, F, E | Allows user to edit faultlog entries. Only enabled when a user has logged in. |

**Exit command**

| Activation | Status Bar Text |
|---|---|
| Alt, P, X | Exits the WinTesla application. |

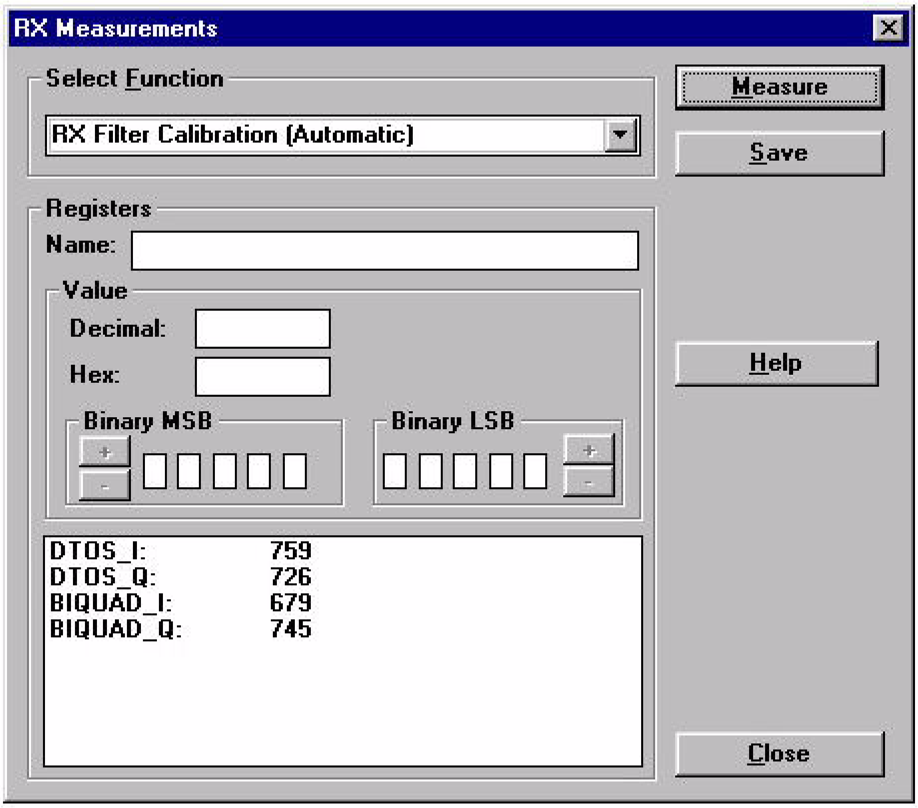
## Tuning

The tuning menu offers functions for ME adjustments.

### RX Filter Calibration... command

| Activation | Status Bar Text |
|---|---|
| Alt, T, M | Open RX Measurements dialog box |

Starts RX Filter Calibration tuning for the phone.




Dialog mode: **Modal**

RX Measurements dialog has the following items:

Select Function list box:

Shows list of automatic selections.

Value group:

This group has several items. At the bottom there is a list of registers and values they currently have. Double clicking a record from the list will bring it's name to the name edit box. The value is shown in the three different format decimal, hexadecimal and binary. All these controls display the same value and changing one causes changes to others too.

Measure button:

This button activates the measurement.

Save button:

This saves values to the phone.

Close button:

This button closes the dialog without saving anything.

Help button:

This button opens help.

**RX Calibration... command**

| Activation | Status Bar Text |
|---|---|
| Alt, T, R | Open RX Calibration dialog box |

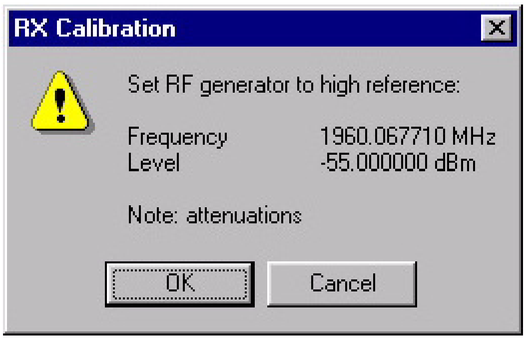
Starts RX calibration.

The next automatic selections are made when this tuning function is activated:

- Phone is set to local mode
- Update RF information window

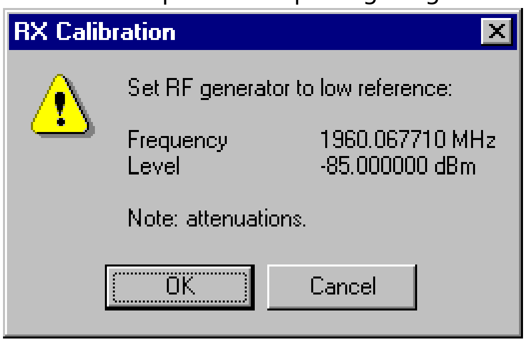
The measurement is started automatically when RX calibration is entered. The measurement is done in five steps:

1. User is requested to put signal generator to high input level (read from.INI file).



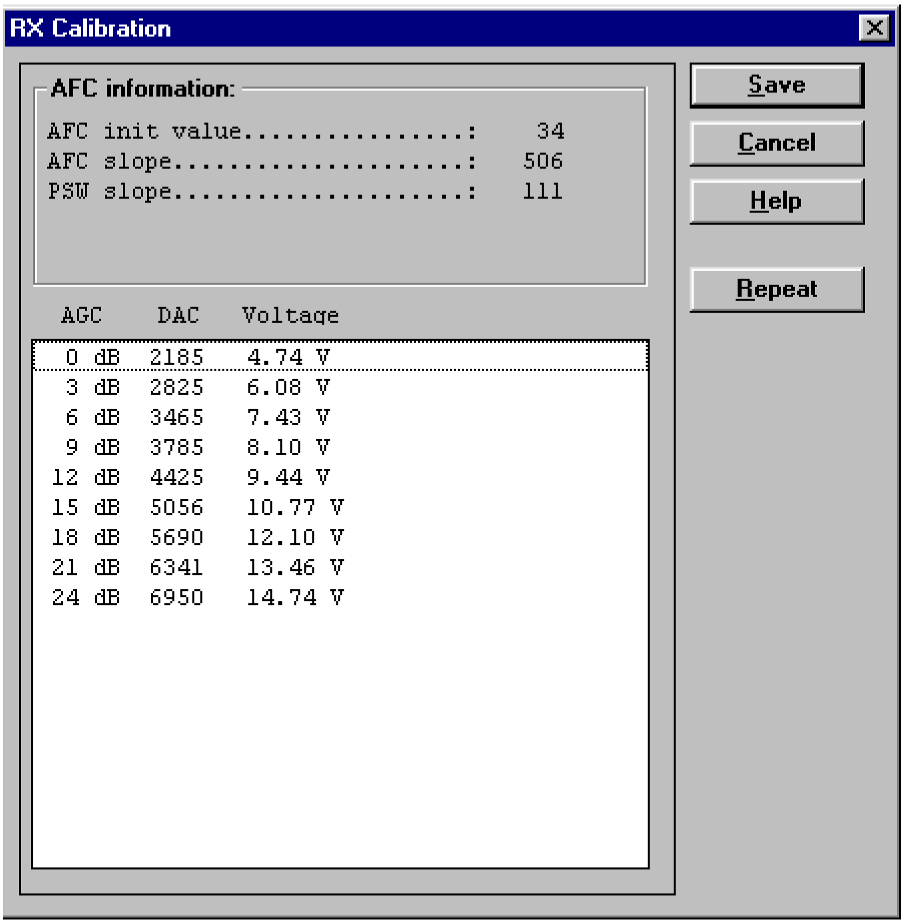

2. Measurement with high input level is executed

3. User is requested to put signal generator to low input level (read from.INI file).




4. Measurement with low input level is executed

5. The **RX Calibration** dialog will be updated when previous steps are done.




Dialog mode: **modal**

RX Calibration dialog has the following items:

AFC information box:

Shows AFC init value, AFC slope and PSW slope values.

AGC List box (ALT+A):

AGC, DAC, Voltage.

Repeat button (ALT+R):

Measurement can be started again by pressing this button.

Save button (ALT+S):

Dialog is closed and tuning is saved to phone.

Cancel button (ESC):

Dialog is closed and tuning is not saved to phone.

When calibration is ended, the DAC value checking is made and if it is not successful, error message is shown.

When exit is made, the next selections are set to the values which were selected before this adjustment.

Operation Mode

Update RF Information window

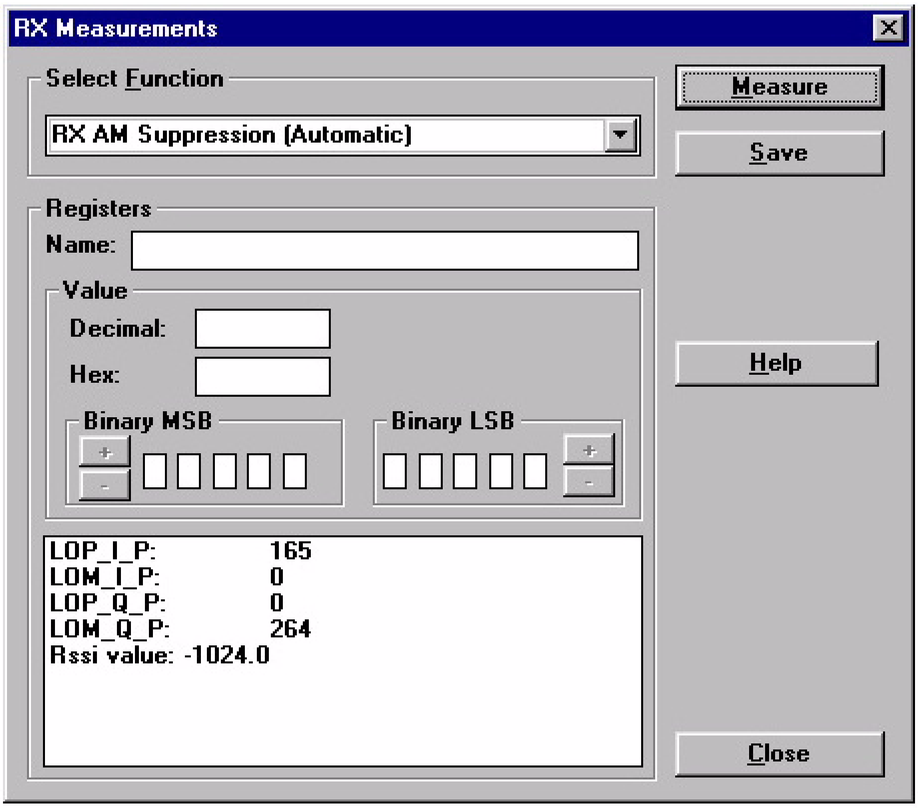
The exit and the use of AGC-control values is done same way as exit from power level tuning and power coefficient use:

**RX AM Suppression... command**

| Activation | Status Bar Text |
|---|---|
| Alt, T, M, A | Open RX Measurements dialog box |

Starts RX AM Suppression tuning for the phone.




Dialog mode: **Modal**

RX Measurements dialog has the following items:

Select Function list box:

Shows list of automatic selections.

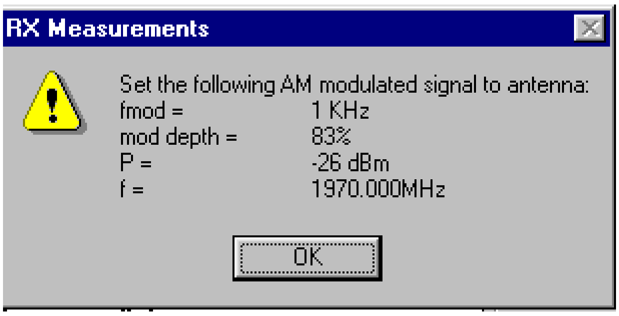
Value group:

This group has several items. At the bottom there is a list of registers and values they currently have. Double clicking a record from the list will bring it's name to the name edit box. The value is shown in the three different format decimal, hexadecimal and binary. All these controls display the same value and changing one causes changes to others too. Last line shows RSSI value.

Measure button:

This button causes the measurement to be done. When selected following dialog is shown. Set RF Generator with the following signal:

| | |
|---|---|
| f | =1970 MHz |
| P | =-26 dBm |
| f mod | =1 kHz |
| modulation depth | =83% |




Save button:

This saves the values to the phone.

Close button:

This button closes the dialog without saving anything.

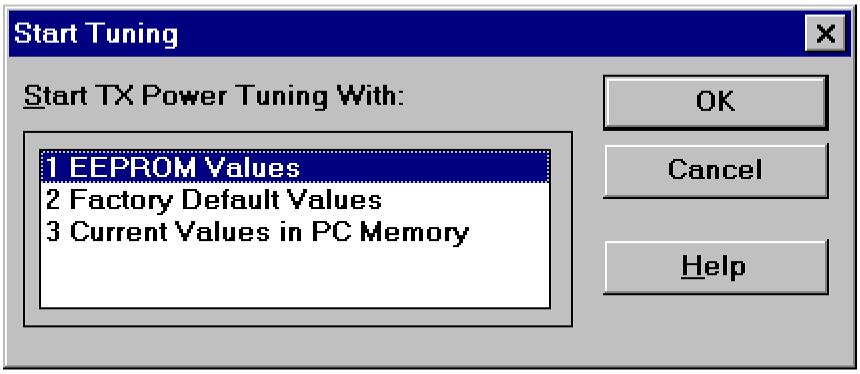
Help button:

This button opens help.

**Tx Power... command**

| Activation | Status Bar Text |
|---|---|
| Alt, T, X | Open TX Power Tuning dialog box |

Starts TX power tuning.




Tuning is started automatically with EEPROM values. If values read from EEPROM are not valid then user is able to start the tuning with factory values. There is a notification shown if this happens.

Start Tuning dialog has following items:

Start Tuning With list box (ALT+S):

1 EEPROM Values

Tuning values are load from ME's EEPROM.

2 Factory Default Values

Tuning values are load from ME's flash.

3 Current Values in PC memory

Tuning values are load from program's internal memory.

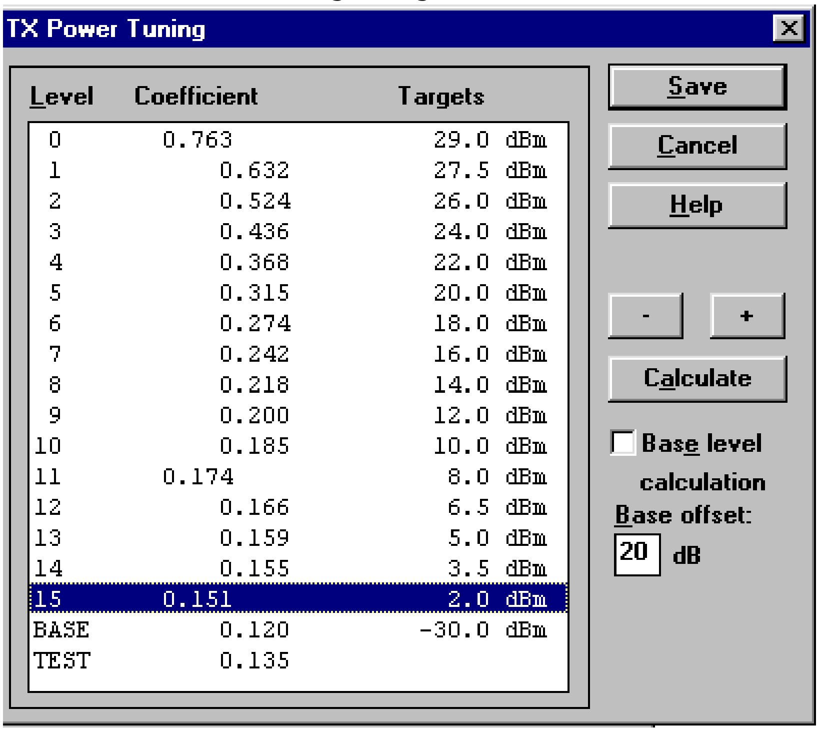
The next automatic selections are made when this tuning function is activated:

- the BASE power level is selected
- Operation mode = TX pulsed

The **TX Power Tuning** dialog will be activated automatically after value selection.

GSM1900 TX Power Tuning dialog:




Dialog mode: **modal**

To get a clear image, set spectrum analyser as follows:

| | |
|---|---|
| frequency | 1880 MHz (depends on the used ch) |
| span | 0 Hz |
| resolution bw | 3 MHz |
| video bw | 3 MHz |
| sweep time | 10 ms |

Tune highest level to 28 dBm

Select power level 11

tune power level to 6 dBm
select lowest power level
tune lowest power level to 0 dBm
press calculate button to calculate other power levels
save power level calibration results by pressing Save button.

TX Power Tuning dialog has following items:

Level, Coefficient and Targets list box (ALT+L):

The power is presented in GSM 1900 values. The base power is selected automatically when the dialog is opened. The test value is not saved to the EEPROM. The test value can be changed during tuning as other power coefficients and the program remembers its value when tuning function is activated later again.

If there is more power levels in the phone that can fit into window the window is scrollable. When phone is initialised the program asks the number of power levels used in the phone.

Only three power coefficients (highest, third smallest and lowest) are needed to tune (left justified Coefficients) and the rest of them are calculated.

The tuning position is highlighted and can be tuned with +/- keys or left/right cursor keys.

Calculate button (ALT+C):

The calculation is activated with this button. The power coefficients which are calculated from the tuned coefficients are displayed on the different columns than the others. All values can be tuned if needed. When **Base level calculation** is checked, base level is calculated.

Base level calculation check box:

If this box is checked the base level is calculated.

Base offset edit box:

This edit box shows the base offset value that user can change. The base level calculation check box must be checked before this value is used. After this value is changed user must do the calculation. **NOTE:** Do not use Enter-button to accept this value.

+/- buttons (+/- and left/right cursor keys):

+ and - buttons will cause power changing by 0.25dB steps. When these keys are used the coefficient value is updated on the tuning window.

Save button (ENTER):

Dialog is closed and tuned values are saved to phone. Base offset is saved to TESLA.INI.

Cancel button (ESC):

Dialog is closed and tuning is not saved to phone.

When selections are used, the power value checking is made and if it is not successful, error message is shown. The test checks that all power coefficients are in descending order (same order than power levels).

If the power tuning function is ended and EEPROM values are not received or EEPROM fault is noticed, an error message is shown.

When all power coefficients have such values that they don't cause any error messages, they can be saved. The last used tuning power is in use after exit.

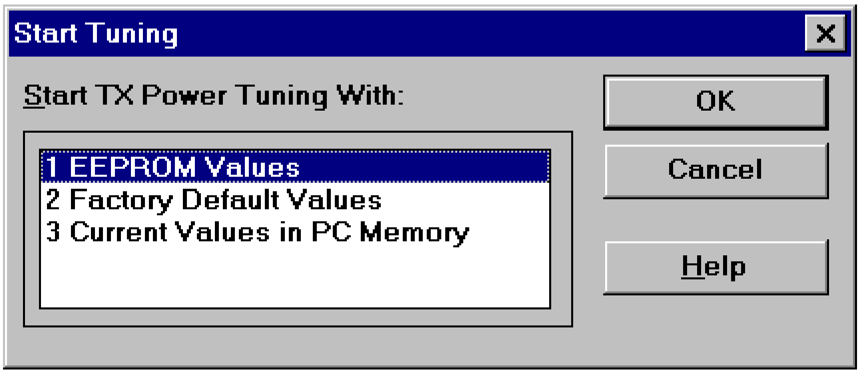
The next automatic selection is made when this tuning function is ended:

Operation Mode = RX pulsed

When dialog is closed original band is selected.

**Tx I/Q... command**

| Activation | Status Bar Text |
|---|---|
| Alt, T,Q | Open TX I/Q Tuning dialog box |




To get a clear image, set spectrum analyser as follows:

| | |
|---|---|
| frequency | 1880 MHz (depends on the used ch) |
| span | 200 Hz |
| resolution bw | 10 MHz |
| video bw | 1 MHz |
| sweep time | 1 ms |

This function is used for tuning TX I and Q branch DC offset, amplitude difference and phase difference.

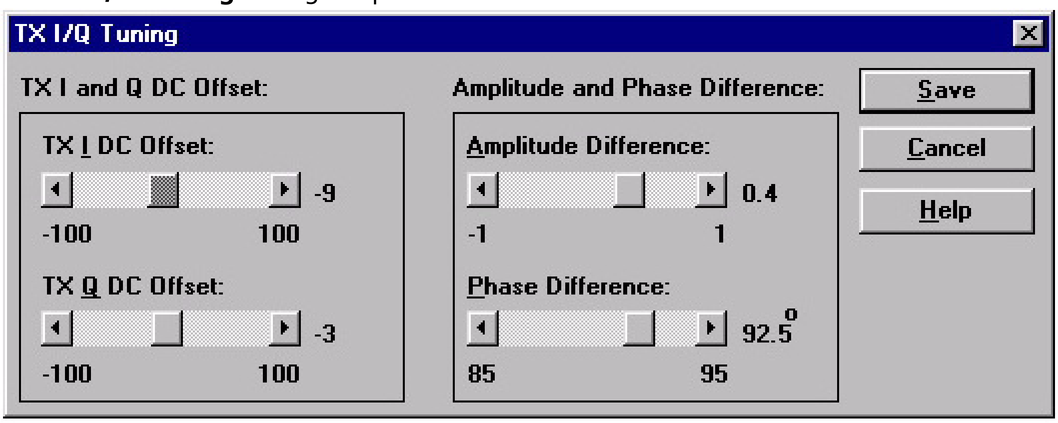
Tuning is started automatically with EEPROM values.

The next automatic selections are made when this function is activated:

Operation Mode = TX pulsed

Update RF Information window

The **TX I/Q Tuning** dialog is opened.



Dialog mode: **modal**

TX I/Q Tuning has following items:

Tune TX I DC Offset scroll bar (ALT+I):

The DC Offset is shown as percents (%) from the + maximum value. 0% means that there is no DC. The value range is -100%...100%. The value is rounded to the nearest integer value.

Tune TX Q DC Offset scroll bar (ALT+Q):

The operation of this function is the same as one above, except with this selection the Q branch DC Offset is tuned. The value range is -100%...100%. The value is rounded to the nearest integer value.

Tune Amplitude Difference scroll bar (ALT+A):

When this selection is made user can increase or decrease the amplitude difference within 0.1 dB steps. The value range is -1...1.

Tune Phase Difference scroll bar (ALT+P):

When this selection is made user can increase or decrease the phase difference within 0.55 steps. The current phase difference is shown on the tuning window with numbers and bar figure. The value range is 85...95.

Save/OK button (ENTER):

Dialog is closed and tuning is saved to phone. When tuning phone in GSM 1900 band values are only saved to PC memory.

Cancel button (ESC):

Dialog is closed and tuning is not saved to phone.

After each value change the new value is sent to the phone.

The next automatic selection is made when TX I / Q tuning function is ended:

- Operation Mode = RX pulsed
- Update RF Information window

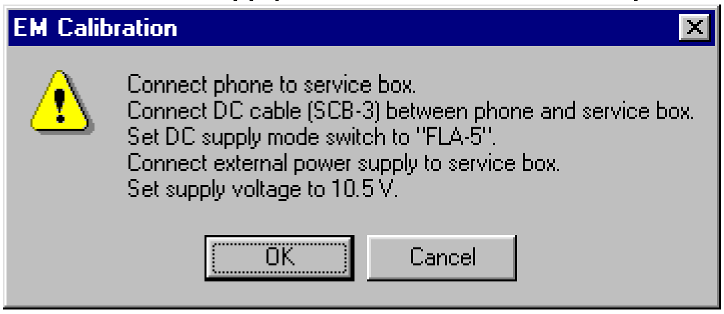
## Energy Management Calibration... command

| Activation | Status Bar Text |
|---|---|
| Alt, T,E | Calibrate Battery Voltage |

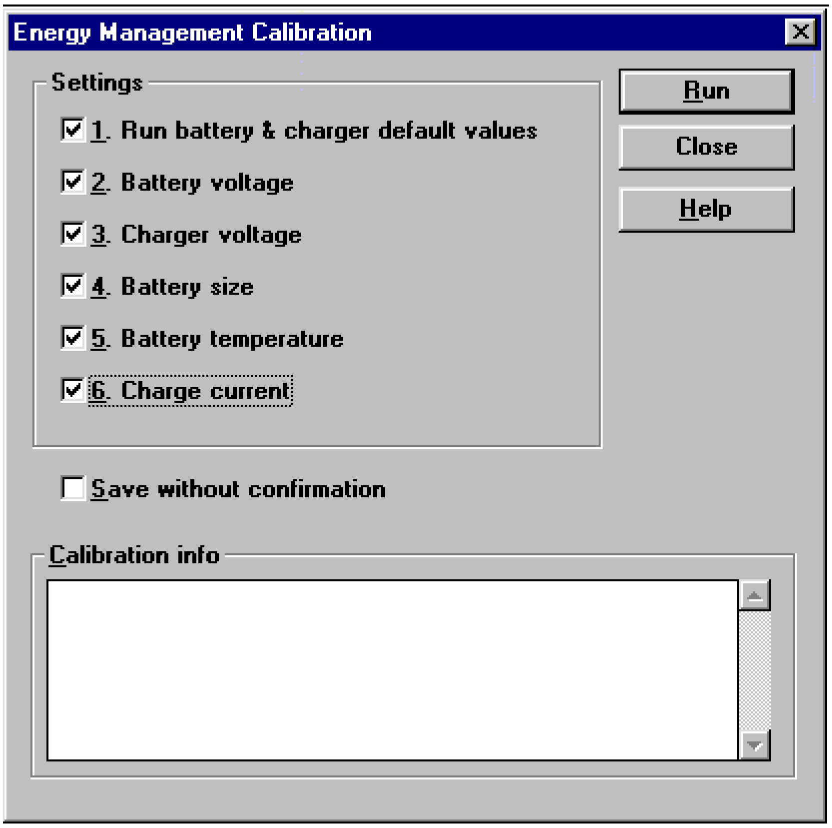
This function is for battery a/d and charge current tunings.

Before battery a/d tuning is started a voltage setting request is shown to user (Set supply voltage to 10,5 V). Service Battery is in this case JBU-6.

**NOTE: Set DC Supply Mode in JBU-6 in FLA-5 position!!**




When power is connected and user selects Yes to continue, the application displays the **Energy Management Calibration** dialog box:




Dialog mode: **modal**

Energy Management Calibration dialog has following items:

Settings group box:

Contains EM calibration setting check boxes:

1. Run battery & charger default values check box (ALT+1):

Runs battery & charger default values to phone when selected

2. Battery voltage check box (ALT+2):

Calibrates battery voltage A/D value.

3. Charger voltage check box (ALT+3):

Calibrates charge voltage A/D value.

4. Battery size check box (ALT+4):

Calibrates battery size A/D value.

5. Battery temperature check box (ALT+5):

Calibrates battery temperature A/D value.

6. Charge current check box (ALT+6):

Calibrates charging current.

Save without confirmation check box (ALT+S):

When selected, all selected calibrations are saved to phone without confirmation, otherwise user must confirm every A/D value saved to phone. Calibration info is automatically scrolled during confirmation.

Calibration info list box (ALT+S)

Shows information about current calibrations.

Run button (ENTER):

All selected settings are executed.

Close button (ESC):

Dialog is closed.

Help button (ALT+H):

Context sensitive help.

After battery a/d tunings a voltage setting request is shown to user (Set supply voltage to 8.0 V).

## Testing

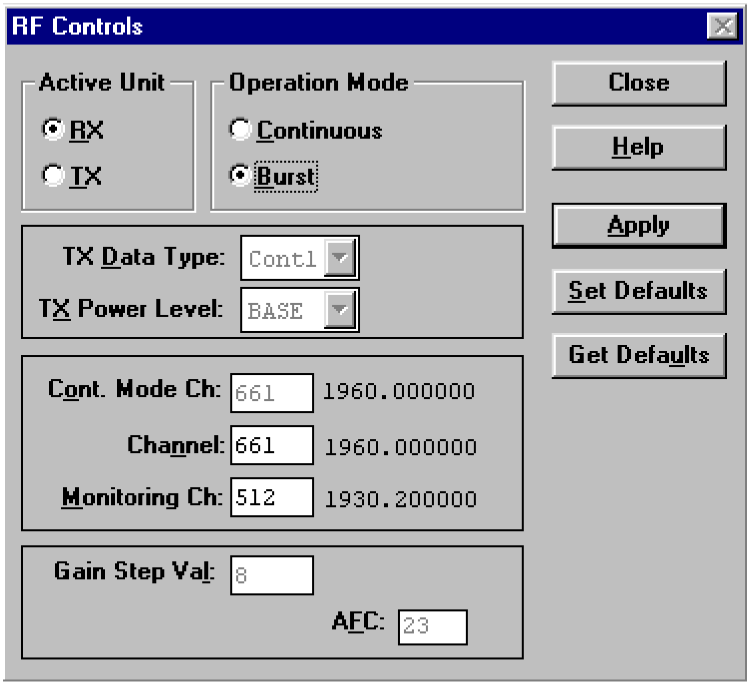
The Testing sub menu offers functions for ME testing.

### RF Controls... command

| Activation | Status Bar Text |
|---|---|
| Alt, E,R | Open RF Controls dialog box |

This function is used for RF testing.

Command opens **RF Controls** dialog, which contains data for testing and adjustments.




Dialog mode: **modal**

RF Controls dialog has following items:

Active Unit group:

RX radio button (ALT+R):

When *RX* is selected, the next functions are made:

Data transmission is deactivated

TX power is deactivated

If operation mode is continuous,

- AGC is controlled
- RX continuous mode channel is activated

RF Information window is updated

The RX value is always given as default.

**Note!** Function is activated immediately, Apply is not needed.

TX radio button (ALT+T):

When *TX* is selected, the next functions are made:

Data transmission is activated

If operation mode is continuous,

- Operation mode is set to burst

RF Information window is updated

Continuous mode radio button is disabled.

**Note!** Function is activated immediately, Apply is not needed.

Operation Mode group:

Continuous radio button (ALT+C):

When *continuous* selection is used,

synthesizer is set to constant frequency

synthesizer channel number is as given with Continuous Mode Channel selection

transmitter power is not connected

if Active Unit is RX, AGC is controlled

**Note!** Function is activated immediately, Apply is not needed.

Burst radio button (ALT+B):

When burst selection is used,

synthesizer is controlled by using receiving/transmission/measuring synthesizer control sequence synthesizer channel numbers are as given with Channel/Monitoring Channel selections

if Active Unit is TX, data (selected with TX Data Type) is sent and the TX power is connected

**Note!** Function is activated immediately, Apply is not needed.

TX Data Type drop list (ALT+D):

This list changes the transmission data type. List consists following options: 0, 1, Random. After Random data selection 0 is used. If Operating Mode is *continuous*, TX Data Type Random causes different data sending than in burst mode.

TX Power Level edit box (ALT+T):

With this value is possible to change the transmission power. The user can give the needed power value or select the test value, which is tuned with TX power tuning function. The test value is found at the end of the list.

TX Power have value OFF and is disabled (greyed) when active unit is RX. When the TX power is tuned with test value (smallest value) the TX Power has value TEST.

Channel edit box (ALT+H):

User can enter here channel number that is used for both transmission and receiving. The frequency of the selected channel is shown after selection.

Monitoring Channel edit box (ALT+M):

This field selects neighbour monitoring channel. The frequency of the selected channel is shown after selection.

Continuous Mode Channel edit box (ALT+C):

To this edit box user can type continuous mode channel which may have all channel numbers.

The used frequency depends on the Active Unit. If Active Unit is RX, then RX frequency is used, else TX frequency. The frequency of the selected channel is shown after selection.

Gain Step Value edit box (ALT+L):

This selection allows user to set up the receiver gain step in continuous mode. There are nine (0...8) steps (0...2 with LNA and 3...8 without LNA). In the burst mode selection is automatic.

AFC edit box (ALT+F):

This selection allows user manually tune the 26 MHz clock. Limits are -1023...-1024

Apply button (ALT+A):

Accepts entered values and validates them. After validation application sends corresponding messages to ME. Closes dialog and updates Info Window.

**Note!** Active Unit and Operation mode are not send with because they are activated immediately.

Set Defaults button (ALT+S):

Sets current values as default Rf Controls values.

Get Defaults button (ALT+U):

Gets default Rf Controls values as current values.

The next automatic selection is made when Quick testing function is ended:

Active Unit = RX

Update RF Information window

The next table shows the dialog's properties on different situations:

ACTIVE UNIT = TX:

TX Data Type: Updated

AGC values: Greyed

Monitoring Channel: Greyed

OPERATION MODE = BURST:

TX Power Level: Updated

Continuous Mode Channel: Greyed

Channel: Updated

OPERATION MODE = CONT.:

TX Power Level: OFF, Greyed

Continuous Mode Channel: Updated

Channel: Greyed

ACTIVE UNIT = RX:

TX Data Type: Greyed

TX Power Level: OFF, Greyed

OPERATION MODE = BURST:

AGC values: Greyed

Continuous Mode Channel: Greyed

Channel: Updated

Monitoring Channel: Updated

OPERATION MODE = CONT:

AGC values: Updated

Continuous Mode Channel: Updated

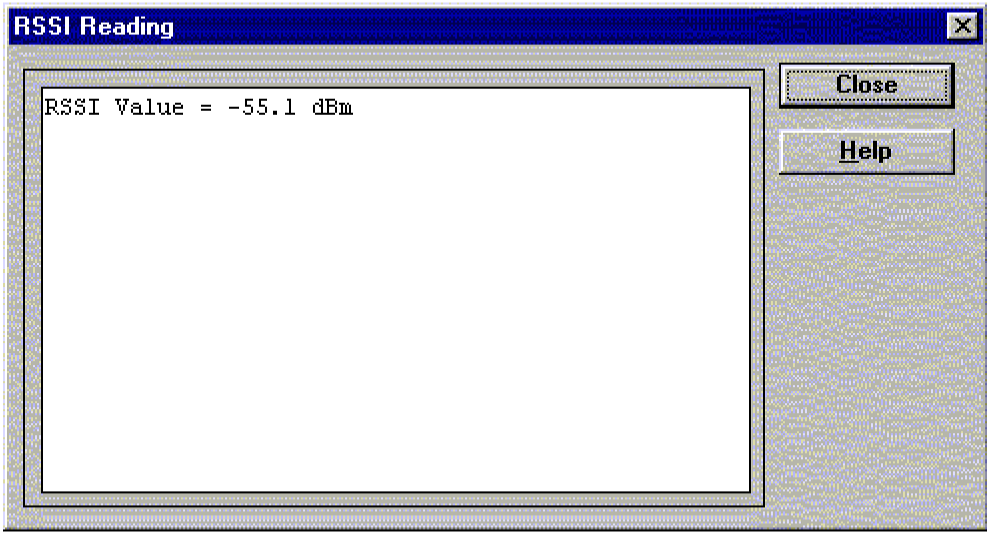
Channel: Greyed

Monitoring Channel: Greyed

**RSSI Reading... command**

| Activation | Status Bar Text |
|---|---|
| Alt, E,R | Read continuously RSSI value |

Command opens RSSI Reading dialog:




Dialog mode: **modal**

RSSI value is read continuously until user presses ESC-key or Close button to cancel reading.

RSSI Reading dialog has following items:

**Close** (ENTER) button:

Closes the RSSI Reading dialog. Does not send anything to phone.

**Help** button:

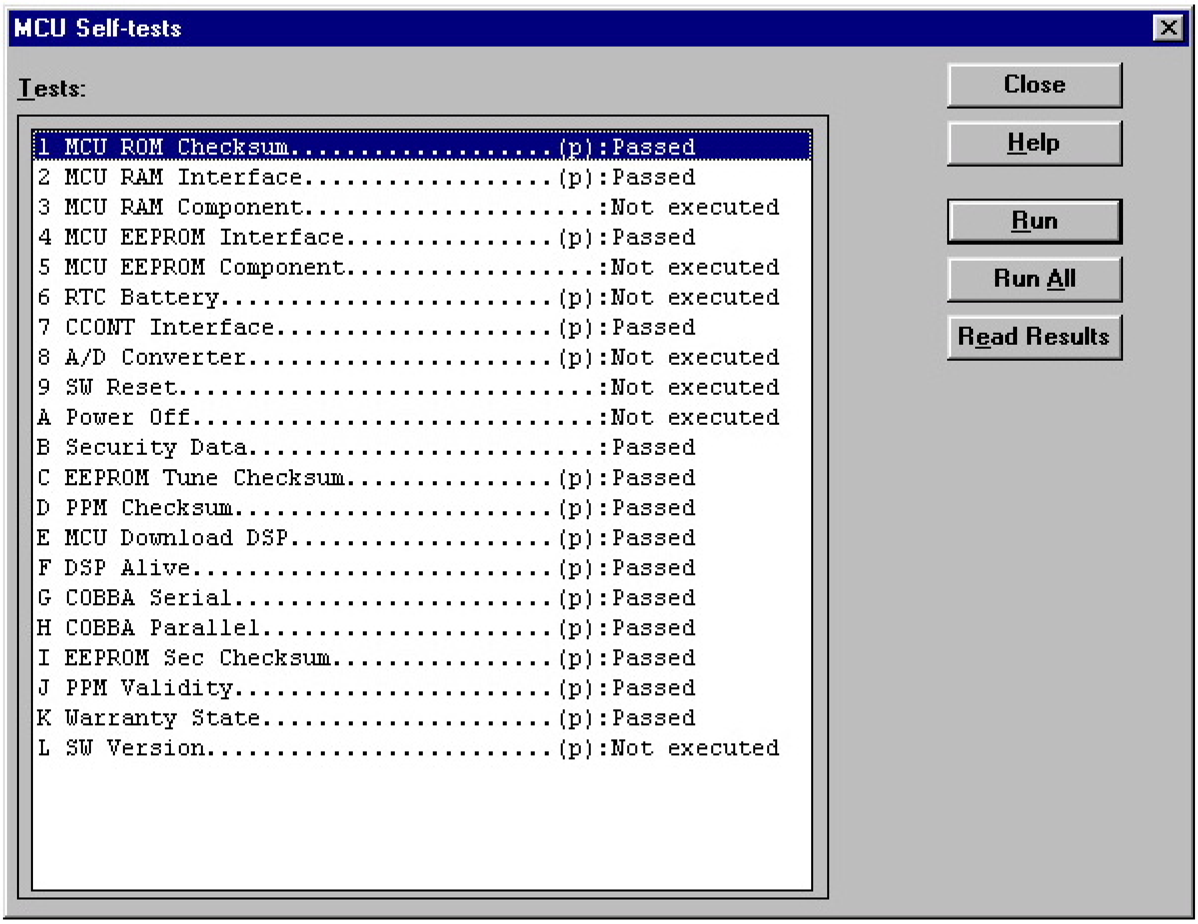
Context sensitive help.

**Self Tests... command**

| Activation | Status Bar Text |
|---|---|
| Alt, E,S | Open MCU Self-tests dialog box |

Command is used for reading self test results and running self tests.

When the selection is made, the test result is read from ME. The test result will be shown to the user within **MCU Self-test** dialog.




Dialog mode: **modal**

MCU Self-test dialog has following items:

Tests list box (ALT+T):

The field "(p)" in the screen example means that the test is also run in power up. The field "/s)" means that this test is selectable one.

Test states are updated according to results received from the phone. Possible test states will be one of the next:

- Passed

- Failed
- No response
- Not executed
- Not valid
- RUNNING....

Note that power-off test have no values, because if test has been passed, power has been turned off. If power-off test fails a special error message window is shown. If no response is received to power off test message in a few seconds, the user is informed by special info window, where user is asked to turn the power on and then press the return key.

Note also that power-off test (if passed) turns power off and power should be reconnected by using the phones key pad after the successful test. After the power has been connected to phone, the normal start-up routines are made and the self-test results are shown in the MCU self-tests menu (i.e. all other than power-up self-tests are in Not executed state after the power-up routines).

Run button (ALT+R):

User can select desired test from list and hit **Run** button. When user selects test to be run the text *RUNNING...* is shown in test state field and test is run. When results are received the test state field is updated according to the result.

If no response was received in the defined time, an *error message box* will be shown and the test state is changed to *No response*. Phone is set to local mode if it is not already.

Run All button (ALT+A):

User can run all listed tests. The text *RUNNING...* is shown in test state field and test is run. When results are received the test state field is updated according to the result. When state field is updated application moves to next test and repeats previous cycle. Phone is set to local mode if it is not already there.

**Supported Self Tests**

1 MCU ROM Checksum................

2 MCU RAM Interface...............

3 MCU RAM Component...............

4 MCU EEPROM Interface............

5 MCU EEPROM Component............

6 RTC Battery.....................

7 CCONT Interface.................

8 A/D Converter...................

9 SW Reset........................

A Power Off.......................

B Security Data...................

C EEPROM Tune Checksum............

D PPM Checksum....................

E MCU Download DSP................

F DSP Alive.......................

G COBBA Serial.......................

H COBBA Parallel.....................

I EEPROM Sec Checksum................

J PPM Validity....................

K Warranty State....................

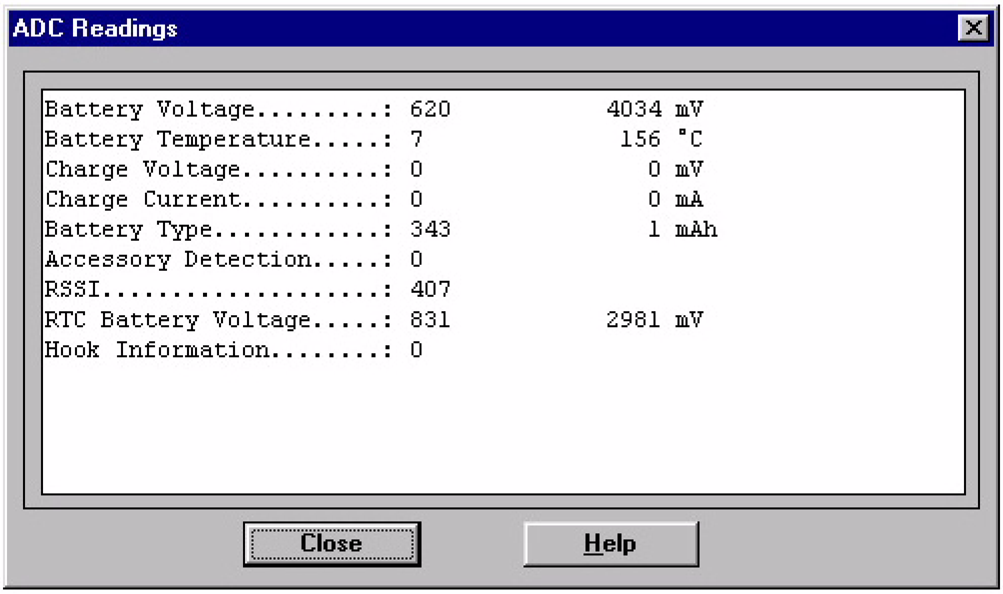
L SW Version....................

## ADC Readings... command

| Activation | Status Bar Text |
|---|---|
| Alt, E,A | Open ADC Readings dialog box. |

Command is used to read and show A/D values from phone.

Command opens **ADC Readings** dialog.




Dialog mode: **modal**

ADC Readings dialog has static text field where measurements are updated to window every one second.

ADC Readings dialog has following items:

Close (ENTER) button:

Closes the ADC Readings dialog. Does not send anything to phone.

Help button:

Context sensitive help.

**A/D Readings:**

Following a/d readings are measured:

Battery Voltage.........:

Battery Temperature.....:

Charge Voltage..........:

Charge Current..........:

Battery Type............:

Accessory Detection......:

Hook....................:

RSSI....................:

VCXO Temperature........:

**Audio... command**

| Activation | Status Bar Text |
|---|---|
| Alt, E,U | |

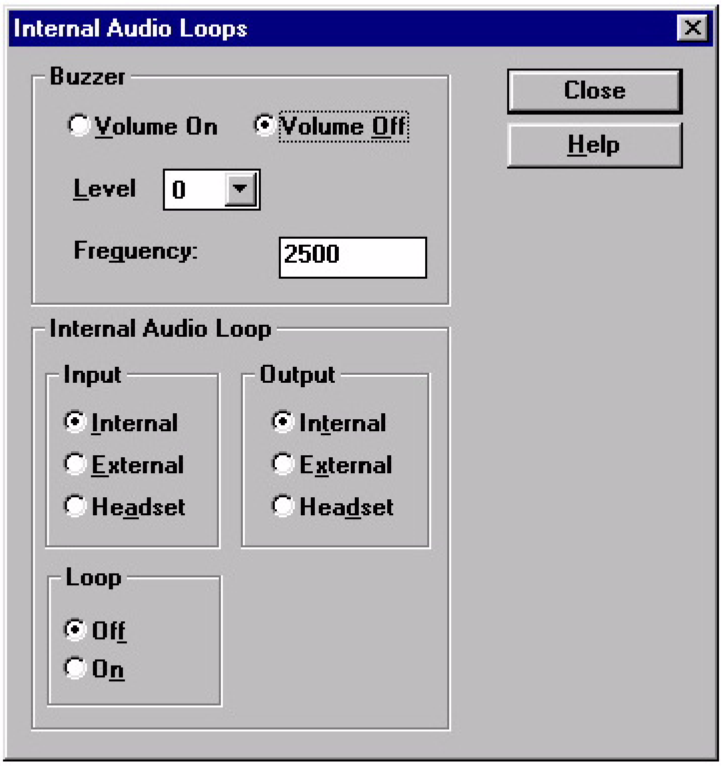
Opens a sub menu which contains following options:

**Internal Audio Loops**

| Activation | Status Bar Text |
|---|---|
| Alt, E,U,I | Open Internal Audio loops dialog box. |

Command is used for making internal audio loop tests in **Internal Audio Loops** dialog.

**NOTE:** For EXTERNAL AUDIO Audio Box is needed!




Dialog mode: **modal**

Internal Audio Loops dialog has following items:

Buzzer Volume group:

Next three different values can be selected for Buzzer volume:

Volume On radio button (ALT+V):

Turns buzzer on.

Volume Off radio button (ALT+O):

Turns buzzer off.

Level drop down list (ALT+L):

Sets level of a buzzer. Allowed range 0...254

Frequency radio button (ALT+Q):

Turns buzzer off.

Internal Audio Loop group:

Input group:

Next two different values can be selected for input:

Internal radio button (ALT+I):

Turns internal input.

External radio button (ALT+I):

Turns external input.

Headset radio button (ALT+A):

Turns headset input. Note: If Output is not Headset, loop is turned off.

Output group:

Next two different values can be selected for output:

Internal radio button (ALT+T):

Turns internal output.

External radio button (ALT+X):

Turns external output.

Headset radio button (ALT+D):

Turns headset output. Note: If Input is not Headset, loop is turned off.

Loop group:

Next two different values can be selected for loop:

Off radio button (ALT+F):

Turns audio loop off.

On radio button (ALT+N):

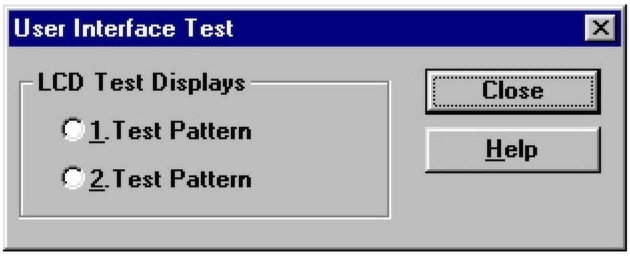
Turns audio loop on.

When dialog is closed with the Buzzer Volume is switched always off. Also internal audio loop is turned off.

**User Interface... command**

| Activation | Status Bar Text |
| --- | --- |
| Alt, E,U | Open User Interface Tests dialog box |

Command is used for making display tests in **Display Tests** dialog.




Dialog mode: **modal**

Display Tests dialog has following items:

1. Test Pattern radio button (ALT+1):

In test display 1 all indicators are displayed and the display is filled horizontally.

2. Test Pattern radio button (ALT+2):

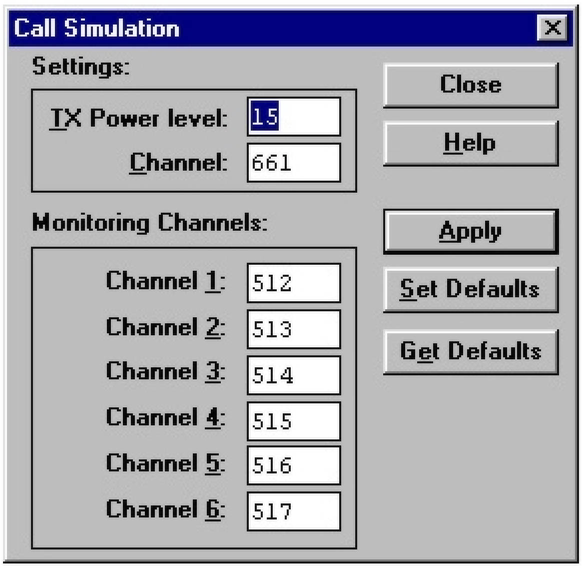
In test display 2 all of the indicators are displayed and the display is filled with vertically.

When dialog is closed the phone LCD display is cleared.

**Call Simulation... command**

| Activation | Status Bar Text |
| --- | --- |
| Alt, E,C | Open Call Simulation dialog box |

Command is used for making call simulation. Function opens **Call Simulation** dialog.




Dialog mode: **modal**

Call Simulation dialog has following items:

TX Power Level edit box (ALT+T):

All power levels can be selected. This updates same parameter as **TX Power Level** in the **RF Controls** dialog. Note that TEST value cannot be selected. If TEST value was in use when Call simulation menu selected, power level is changed to smallest value.

Channel edit box (ALT+C):

This tells the normal operating RF channel number. Normal GSM 1900 channel numbers can be selected. Same channel is used both for transmission and receiving. This updates same parameter as **Channel** in the **RF-Controls** dialog.

Channel 1,2,3,4,5,6 edit box (ALT+1,2,...):

Channels for monitoring are specified with these six selections. All GSM 1900 channel numbers can be used. If more than one selection has same number, the monitoring channel list (neighbour list) will have less than 6 selected channels. The minimum number of monitoring channels is one (all channels have same value). The monitoring channel can also have same value as normal operating channel.

The first monitoring channel updates same parameter as **Monitoring Channel** in the **RF-Controls** dialog.

Apply button (ALT+A):

Validates and sends entered data to ME.

Set Defaults button (ALT+S):

Sets current values as default Call Simulation values.

Get Defaults button (ALT+G):

Gets default Call Simulation values as current values.

**Noise Sensitivity... command**

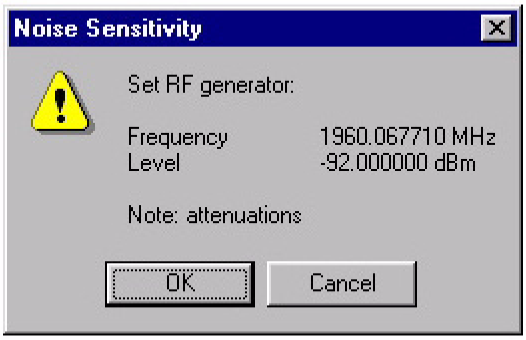
| Activation | Status Bar Text |
|---|---|
| Alt, E,N | Opens Noise sensitivity dialog box |

Command is used for noise sensitivity measurement.

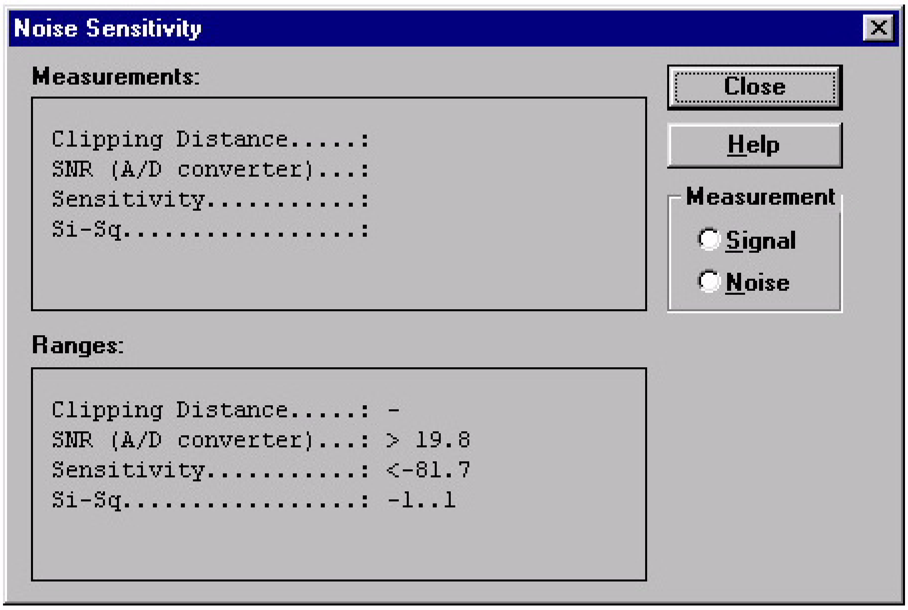
The next automatic selections are made when this tuning function is activated:

- Operation mode = RX cont
- AGC = 81 dB

Before function opens **Noise Sensitivity** dialog application prompts:




Then application opens **Noise Sensitivity** dialog:




Dialog mode: **modal**

Noise Sensitivity dialog has following items:

Measurements group:

Clipping distance is the difference to the signal clipping value. SNR is measured in AD converter.

The last value on the display is signal power difference between I and Q branch. The numbers are shown in 0.1dB accuracy. The error messages, "OUT OF RANGE", are shown only if the SNR and/or amplitude difference values are not acceptable.

Signal/Noise radio button (ALT+S/ALT+N):

When buttons are pressed, the RX I and Q burst data is asked, text "SIGNAL MEASURING..." or "NOISE MEASURING..." will come to the measurement group window. The power level value should be -92 dBm during signal measurement.

When signal data is received, distance to clipping signal level is shown as dBs on the display. When either signal or noise measurement results are received "MEASURING" text is removed and measurements are updated to screen. When both measurements (signal and noise) are done at least once, the signal to noise relation and difference are also shown on the display.

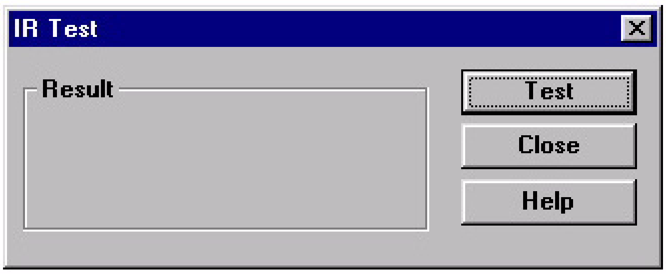
When exit is made, the next selections are set to the values which were selected before this adjustment.

- Operation mode
- AGC value

**IR Test... command**

| Activation | Status Bar Text |
|---|---|
| Alt, E,I | IR module test |

Command is used for making IR module test. Function opens **IR Test** dialog:




Dialog mode: **modal**

IR Test dialog has following items:

Result box:

Result can be OK/FAILED

Test (ENTER) button:

Starts IR Test.

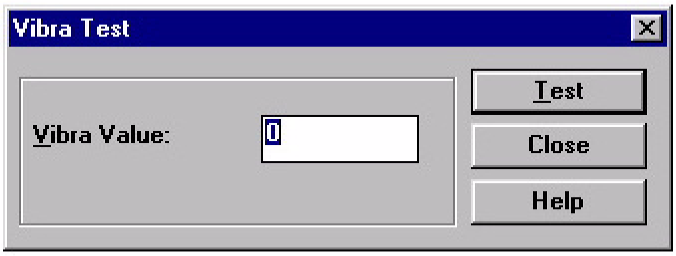
Close button:

Closes the IR Test dialog.

**Vibra Test... command**

| Activation | Status Bar Text |
|---|---|
| Alt, E, V | Vibrator module test |

This command is used for testing phone's or battery's vibrator. Function opens **Vibra Test** dialog:




Dialog mode: **modal**

Vibra Test dialog has following items:

Vibra Value box:

Edit box where you can enter value from 0 to 255.

Test (ENTER) button:

Starts Vibra Test.

Close button:

Closes the Vibra Test dialog. When dialog box is closed also the vibra test is stopped.

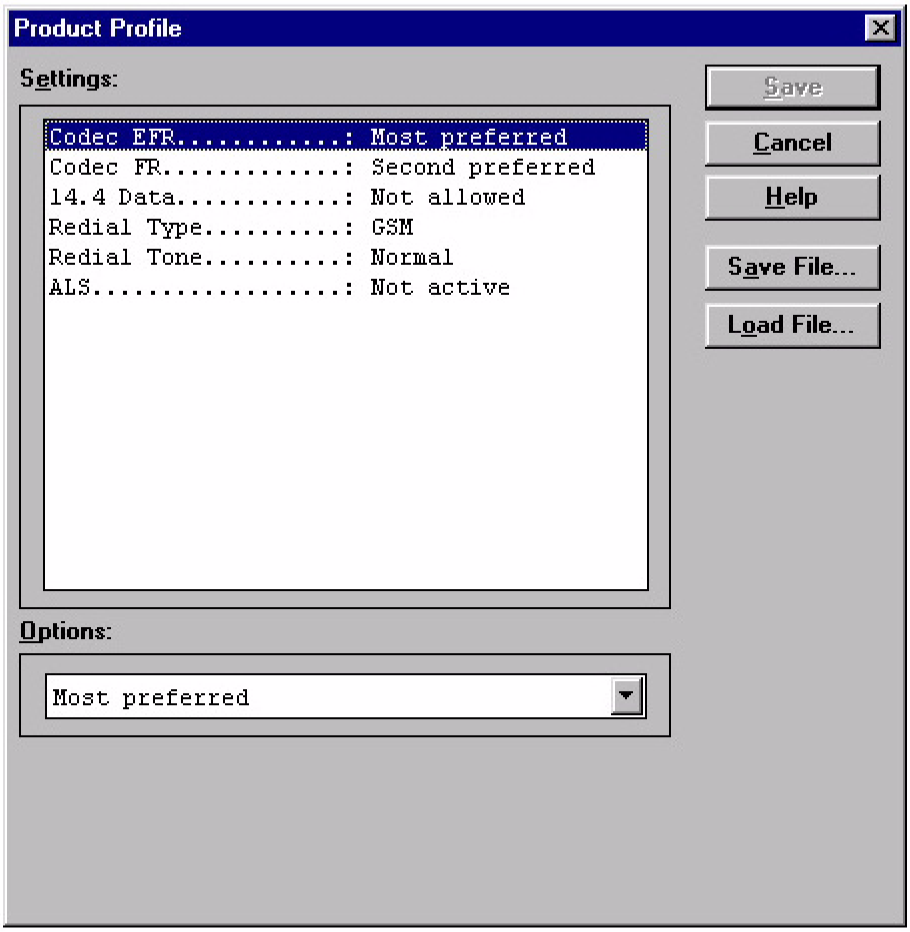
## Software

### Product Profile... command

| Activation | Status Bar Text |
|---|---|
| Alt, S,P | Open Product Profile settings dialog box. |

Function is used for making product profile settings.

When command is activated the product profile information is read from EEPROM and **Product Profile** dialog is opened.




Dialog mode: **modal**

Product Profile dialog has following items:

Settings list box (ALT+E):

A list where user can select desired setting.

User can toggle setting with following **Options** drop list or by double clicking desired setting in list box.

Options drop list (ALT+O):

List allows user to set options to each settings which are listed in **Settings** list box.

Save (OK) button (ENTER)

Selections are accepted and saved to EEPROM.

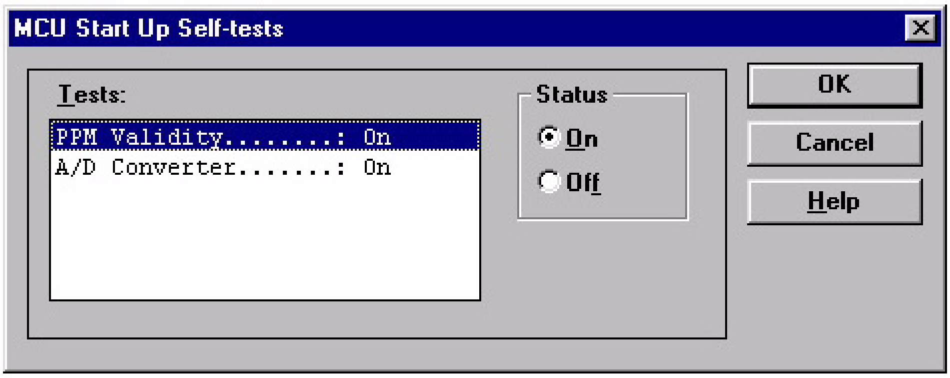
Cancel button (ESC)

Selections are ignored and control is returned back to main menu.

**Start Up Self-tests... command**

| Activation | Status Bar Text |
|---|---|
| Alt, S,S | Open MCU start Up self-tests dialog box. |

Function is used for changing the state of the EEPROM selectable tests in **MCU Start Up Self-tests** dialog.




Dialog mode: **modal**

MCU Start Up Self-tests dialog has following items:

Tests list box (ALT+T):

When dialog is opened, the previous values will be read from the MCU EEPROM and shown on the list box.

Status group:

When radio button **On** is selected, the test will be run every time when automatic start up self-tests are activated (e.g. in power up).

Save button (ENTER)

Selections are accepted and saved to EEPROM. A power up routine is made to phone.

Cancel button (ESC)

Selections are ignored and control is returned back to main menu.

Selectable Start-Up self tests:

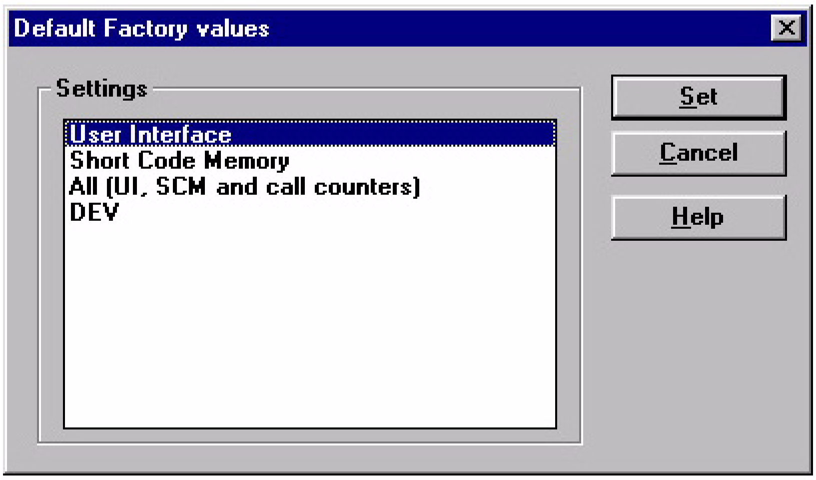
PPM Validity

A/D Converter

**Set Factory Values... command**

| Activation | Status Bar Text |
|---|---|
| Alt, S,V | Set factory values |

With this selection user can set factory defaults to phone. This selection opens **Default Factory values** dialog.




Dialog mode: **modal**

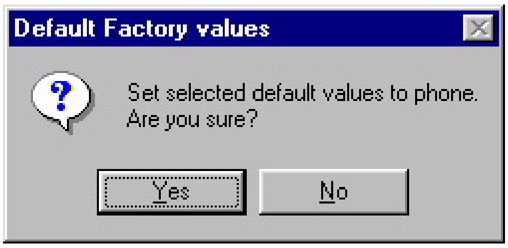
Default Factory Values dialog has following items:

Settings list box:

Contains the selectable factory values.

Set button:

Sets the selected factory value to phone. Before setting software asks confirmation:




Cancel button:

Closes the Default Factory Values dialog.

Available Settings:

User Interface, Short Code Memory, All (UI, SCM and call counters)

**Phone Identity... command**

| Activation | Status Bar Text |
|---|---|
| Alt, S,I | Open Phone Identity dialog box for editing |

Function is used to edit phone identity. **NOTE:** product code cannot be changed with this dialog, if product code is invalid, e.g. after EEPROM change, change product code first with **Production Data Edit**. With this dialog IMEI or SIM locks may be changed in following manner:

current phone information is read from phone

user edits User Name (and IMEI and Product Code, if they were not read correctly from phone. But if you have to change product code it must be done in the Production Data edit dialog. To edit other fields than User Name and IMEI, Input entries from FAX must be checked)

dialog information is saved to file, which is sent to secure place where actual programming information may be constructed

programming information is received from secure place in an other file, which is loaded to dialog

program checks input values and if they are correct programming information is written to phone (Input values are compared with values read from phone)

Function opens **Phone Identity** dialog.

Dialog mode: **modal**

Phone Identity dialog has following items:

User Name edit box (ALT+U):

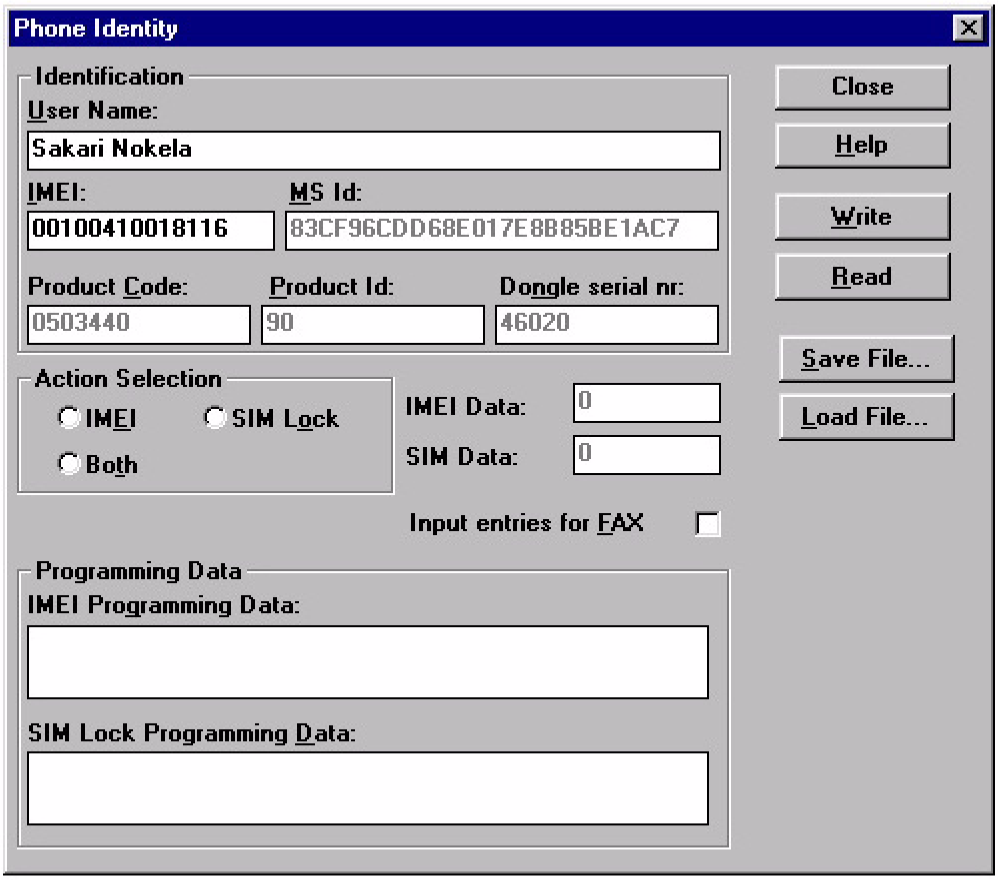
Field where user can enter user identification.

IMEI edit box (ALT+I):

Field where user can enter IMEI value. Field can contain up to 40 digits.This field is automatically filled, if ME is connected to the PC when dialog is loaded.

Product Code edit box (ALT+P):

Field where user can enter Product Code value. This field is automatically filled, if ME is connected to the PC when dialog is loaded. NOTE: Product code cannot be changed with this dialog, if product code is invalid, e.g. after EEPROM change, change product code first with Production Data Edit command.




MS Id edit box (ALT+M):

Field where user can enter MS Id corresponding programming data. This field is automatically filled, if ME is connected to the PC when dialog is loaded.

Product Id edit box (ALT+R):

Field where user can enter Product Id. This field is automatically filled, if ME is connected to the PC when dialog is loaded.

Dongle Serial nr. edit box (ALT+N):

Field where user can enter Product Id. This field is automatically filled, if ME is connected to the PC when dialog is loaded.

IMEI Data edit box:

Field where user can enter IMEI Data entry. This field is automatically filled, when file is loaded or data is saved.

SIM Data edit box:

Field where user can enter SIM Data entry. This field is automatically filled, when file is loaded or data is saved.

IMEI radio button:

File and ME operations contains only IMEI data.

SIM Lock radio button:

File and ME operations contains only SIM Lock data.

BOTH radio button:

File and ME operations contains both SIM Lock and IMEI data.

IMEI Programming Data edit box (ALT+I):

IMEI programming data is read from file or entered by user to this field.

SIM Lock Programming Data edit box (ALT+D):

SIM Lock programming data is read from file or entered by user to this field.

Input entries for FAX check box (ALT+F):

When checked all fields become editable to allow user to enter values by hand e.g. from FAX.

Close button (ESC):

Cancels all edits and does not save values to phone.

Help button

Opens a help text.

Write button (ALT+W):

Writes programming data to phone. Actions are selected with Action Selection radio button.

Read button (ALT+R):

Reads identification data from phone and shows it in dialog controls. Needed data is selected by Action Selection radio button.

Save File... button (ALT+S):

Writes a file containing data needed by security place application to create needed programming data. File is selected with File Save As dialog.

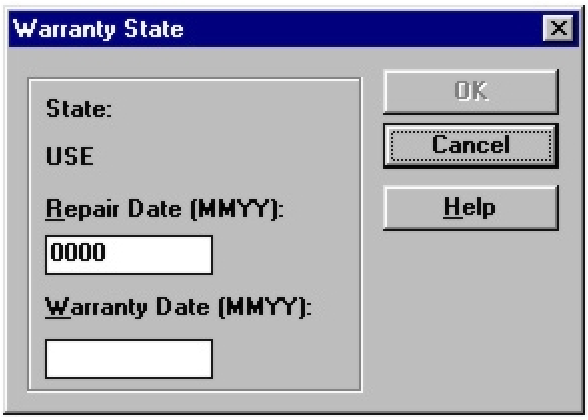
Load File... button (ALT+L):

Reads a file containing data needed to program selected data. File is selected with File Open dialog.

**Warranty State... command**

| Activation | Status Bar Text |
|---|---|
| Alt, S,W | Open Warranty State dialog box |

This command is used to set the warranty state of a phone. When selected application opens **Warranty State** dialog box.




Dialog mode: **modal**

Warranty State dialog has the following items:

State static text:

USE For normal phones.

DEFECTIVE

For phones which are being swapped. A warranty and other information is transferred to the working phone.

EXCHANGE

For phones which are already repaired from **DEFECTIVE** one.

Repair Date edit box:

When Warranty State is **USE** user can edit repair date. Otherwise field is read only. Format is MMYY, where MM stands for month digits and YY stands for year digits.

Warranty Date edit box:

When state is **DEFECTIVE** user can edit warranty date. When warranty date is saved warranty state will be **EXCHANGE**. Format is MMYY, where MM stands for month digits and YY stands for year digits.

OK button (ENTER):

Closes the dialog box and saves the edited date to the phone. This button is enabled only when phone is Repair Date or Warranty Date is changed.

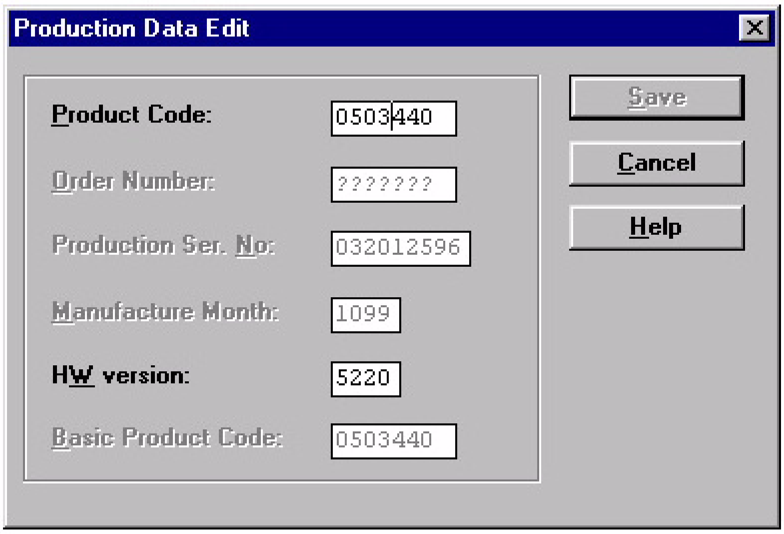
Cancel button (ESC):

Closes the dialog box and does not save the warranty state to the phone.

**Production Data Edit... command**

| Activation | Status Bar Text |
|---|---|
| Alt, S,P | Open Production Data Edit dialog box |

This command is used for programming HW version and other production data to phone. Only fields that are editable are validated and written to phone. Function opens the following **Production Data Edit** dialog box.




Dialog mode: **modal**

Production Data dialog has the following items:

Production Code edit box:

User can edit production code.

Order Number edit box (read only):

Displays order number. Order number “???????” is accepted, but not written to phone.

Production Ser. No edit box (read only):

Displays production serial number.

Manufacture Month edit box (read only):

Displays manufacturing month.

HW Version edit box:

User can edit HW version.

OK button (ENTER):

Closes the dialog box and writes HW version to ME.

Cancel button (ESC):

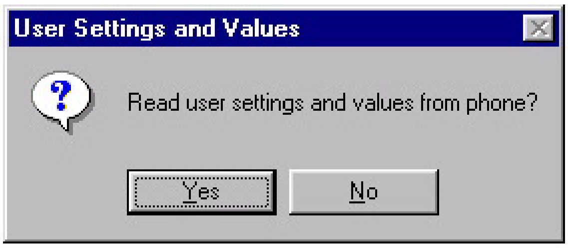
Closes the dialog box and does not write HW version to ME.

## Dealer

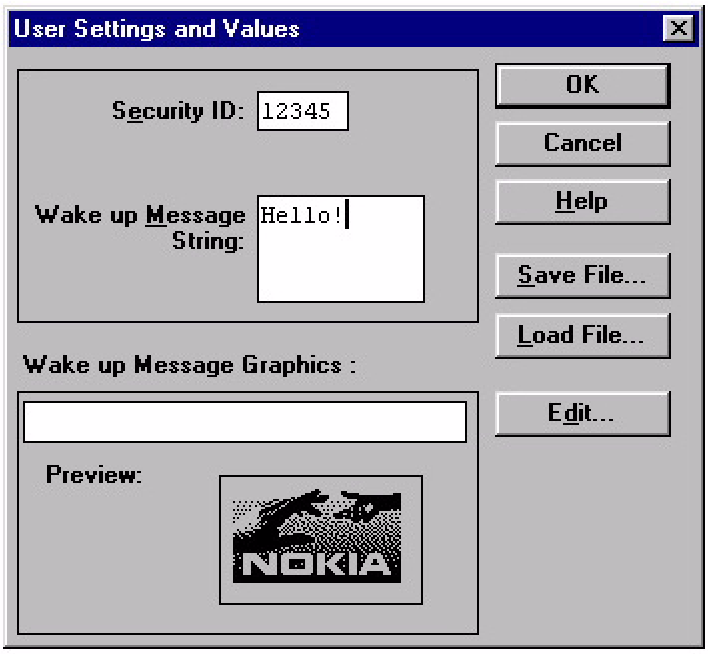
The dealer sub menu offers functions for ME settings for dealers.

### User Settings... command

| Activation | Status Bar Text |
|---|---|
| Alt, D,U | Open User Setting dialog box |




This command is used to edit some user settings. When this command is selected user is asked to read settings from the phone. After answering that dialog following **User Settings and Values** dialog is displayed.




**NOTE**: This is a screen example.

Dialog mode: **modal**

User Settings dialog box has following items:

Security ID edit box:

User can change security code in ME.

Preview picture:

Shows graphical Wake up message. This picture is not available, if phone does not support WUG.

Wake up Message Graphics edit box (read only):

Shows name of file picture file loaded. This picture is not available, if phone does not support WUG.

Save File... button (ALT+S):

User can save user settings to file.

Load File button (ALT+L):

User can load user settings from file.

Edit... button (ALT+D):

Start Windows Paintbrush to edit loaded or saved graphical Wake up message. This picture is not available, if phone does not support WUG.

OK button (ENTER):

Writes user settings to phone.

Cancel button (ESC):

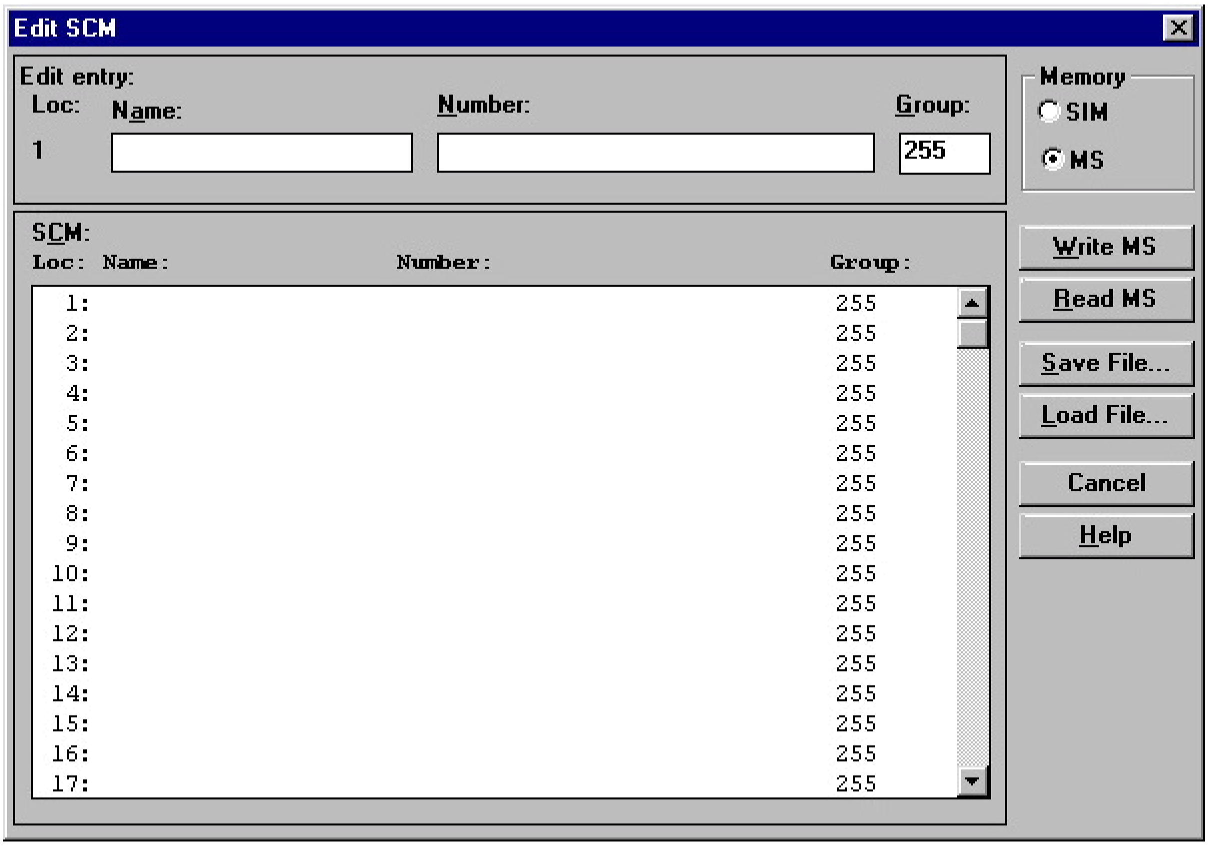
Closes the dialog box

**Short Code Memory... command**

| Activation | Status Bar Text |
|---|---|
| Alt, S,C | Open Edit SCM dialog box. |

This command is used for reading, storing and modifying the SIM/ME SCM values. Before dialog is opened number of memory places is read from phone. If phone does not have SCM in ME Memory selection is disabled and SIM is used as default. If SIM is selected user may be asked to insert PIN and/or wait for SIM to wake up.

Function opens the following **Edit SCM** dialog:




Dialog mode: **modal**

Edit SCM dialog has the following items:

Loc static text:

Displays current location.

Name edit box (ALT+A):

Edit the Name.

Number edit box (ALT+N):

Edit the Number.

Group edit box:

Edit the Group number.

SCM list box (ALT+C):

List for available names and numbers.

Write MS / Write SIM button (ALT+W):

Write SCM values to phone or SIM and checks the validity of names and numbers.

Read MS / Read SIM button (ALT+R):

Read SCM values from phone or SIM.

Save File... button (ALT+S):

Opens a default Windows **File Save As** dialog and asks filename where to save SCM values.

Load File... button (ALT+L):

Opens a default Windows **File Open** dialog and asks filename where from load SCM values. Checks the validity of names and numbers.

Memory group box:

When memory is selected **SCM** list box size is adjusted to correspond memory size. Adjusting is done either adding empty entries to the end or removing entries from the list box.

SIM radio button:

Selects dialog to edit SIM memory. NOTE: PIN code must be set before editing SIM. During SIM selection user may be asked to insert PIN code and/or wait for SIM to wake up.

MS radio button:

Selects dialog to edit phone memory. This is default when dialog is opened.

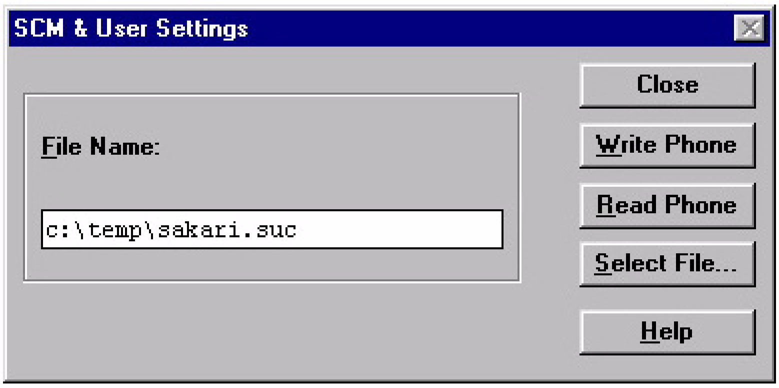
When all values are sent and responses received, waiting window is removed and **Edit SCM** is back in control. The waiting state can be broken with **Cancel** (ESC) button. If writing to the ME is broken, only part of the SCM entries in the ME may be changed.

### SCM & User Settings... command

| Activation | Status Bar Text |
|---|---|
| Alt, D,M | Open SCM & User settings dialog box. |

This command is used to get SCM and user settings from phone to file and vice versa. Following information is loaded/saved with this dialog: all user settings, graphical/text wake up message, SCM, alarms, calendar items and CLI logos and groups. Only values of supported features are saved or loaded. Also SCM in SIM is not saved or loaded.

When data is written or read phone waiting dialog is showed to user.




Dialog mode: **modal**

SCM & User Settings dialog box has following items:

File Name edit field (ALT+F):

User can edit file name or select file with Open File dialog. When dialog is opened, it contains name of the previously saved or loaded file.

Write Phone button (ALT+W):

Loads settings from file and writes them to phone.

Read Phone button (ALT+R):

Reads settings from phone and writes them to file.

Select File button (ALT+S):

Opens Open File dialog, with which user can select the file, that contains the data to be loaded to ME or file to which data is saved from ME. If user selects OK button, the name of selected file is copied to File Name edit field.

Close button (ESC):

Closes the dialog box.

**Restore User Defaults... command**

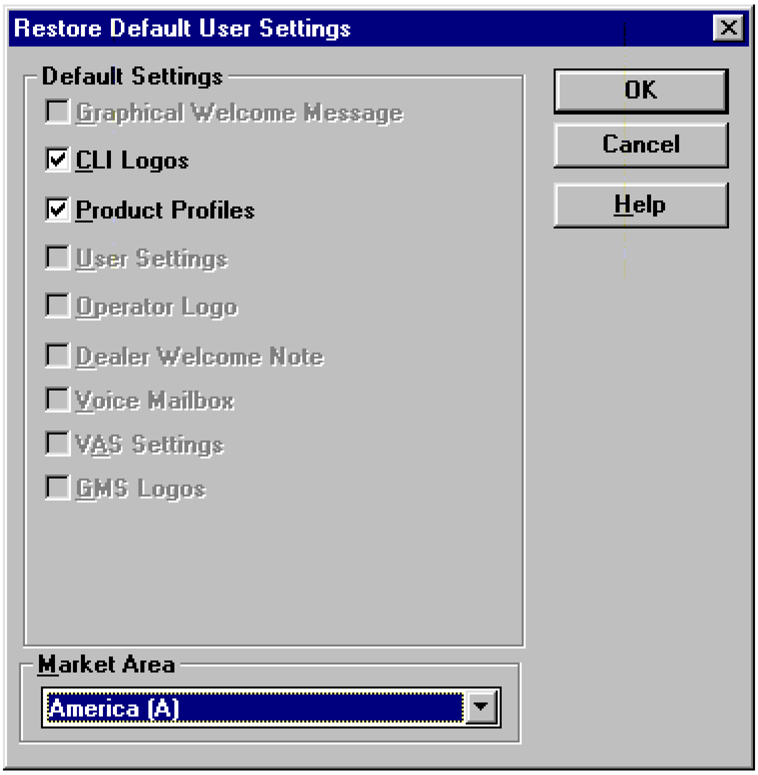
| Activation | Status Bar Text |
|---|---|

Alt, D,R Open Restore Default User Settings.

This command is used to restore Default User Settings, if they have degenerated. Dialog may be opened from menu, or is opened automatically, when loading or saving user settings fails or is skipped during flashing (see Flash Phone... command). The dialog is also opened after full factory set.

Default settings are loaded from files in product specific subdirectory of WinTesla directory e.g. for NSM-X this directory could be *c:\wintesla\nsm-X*. Into these directories user should unpack all flash packages. Market areas and corresponding files are described in INI-file in product specific subdirectory e.g. for NSM-X this file would be *c:\wintesla\nsm-X\nsm-X.ini.* INI-file is common to all flash packages, but market areas are added to Market Area list, when new flash packages are unpacked to product specific subdirectory.

Selecting Restore User Defaults opens following Restore Default User Settings dialog.




**NOTE:** This is a screen example. Actually enabled settings may differ.

Dialog mode: **modal**

Restore Default User Settings dialog box has following items:

Default Settings static text:

User can check one or more check boxes to restore corresponding defaults from file to ME. Check boxes are disabled/enabled according to settings available in selected

Market Area.

Graphical Welcome Message check box (ALT+G):

When checked user selects to restore default graphical welcome message.

CLI Logos check box (ALT+C):

When checked user selects to restore default CLI logos.

Product Profiles check box (ALT+P):

When checked user selects to restore default product profiles.

User Settings check box (ALT+U):

When checked user selects to restore default user settings.

Operator Logo check box (ALT+O):

When checked user selects to restore default operator logo.

Dealer Welcome Note check box (ALT+D):

When checked user selects to restore default dealer welcome note.

Voice Mail box check box (ALT+V):

When checked user selects to restore default voice mailbox number.

Market Area drop list (ALT+M):

User selects market area of the phone.

Write Phone button (ALT+W):

Loads settings from files and writes them to phone.

Close button (ESC):

Closes the dialog box.

**Set UI/DEV Default Values... command**

| Activation | Status Bar Text |
|---|---|

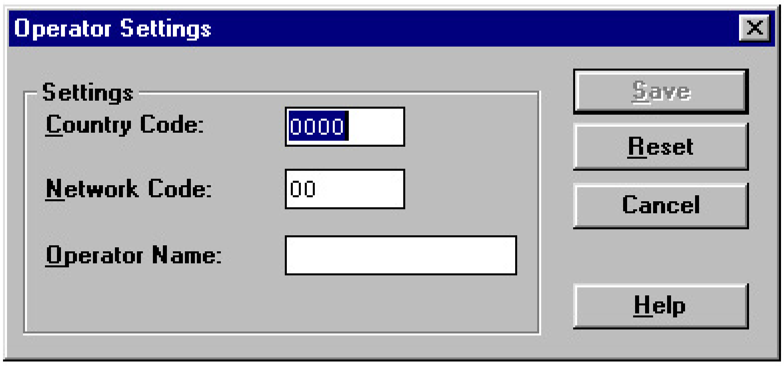
| | |
|---|---|
| Alt, D,V | Reset phone to UI and SCM factory settings |

After selection application asks confirmation: “Are you sure you want to set UI/DEV to factory settings?”. If Yes is answered, default settings are re-setted to phone.

**Operators Settings... command**

| Activation | Status Bar Text |
|---|---|
| Alt, D,O | Open Operator Settings dialog. |

This command is used to set operator settings This selection opens following Operator Settings dialog.




Dialog mode: **modal**

Operator Settings dialog box has following items:

Settings group:

Country Code edit box (ALT+C):

User can edit country code (3 or 4 digits).

Network Code edit box (ALT+N):

User can edit network code (2 digits).

Operator Name edit box (ALT+O):

User can edit operator name (10 characters).

Save button (ENTER, ALT+S):

Saves settings to phone and closes dialog.

Reset button (ALT+R):

Clears operator settings form phone and closes dialog.

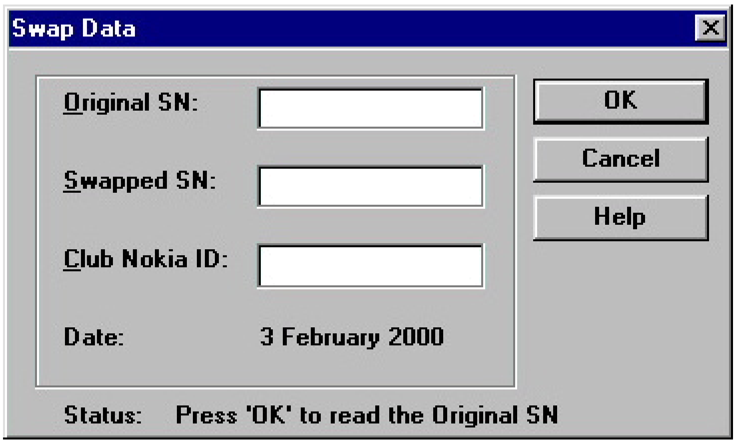
Cancel button (ESC):

Closes the dialog box and do not save settings to phone.

### IWR Swap... command

| Activation | Status Bar Text |
|---|---|
| Alt, D,I | Open IWR Swap dialog. |

This command is used to swap serial numbers of two phones. This selection opens following **IWR Swap** dialog.




Dialog mode: **modal**

IWR Swap dialog box has following items:

Original SN: edit box (ALT+O):

Edit box where the original serial number is shown

Swapped SN: edit box (ALT+S):

Edit box where the swapped serial number is shown

Club Nokia ID: edit box (ALT+C):

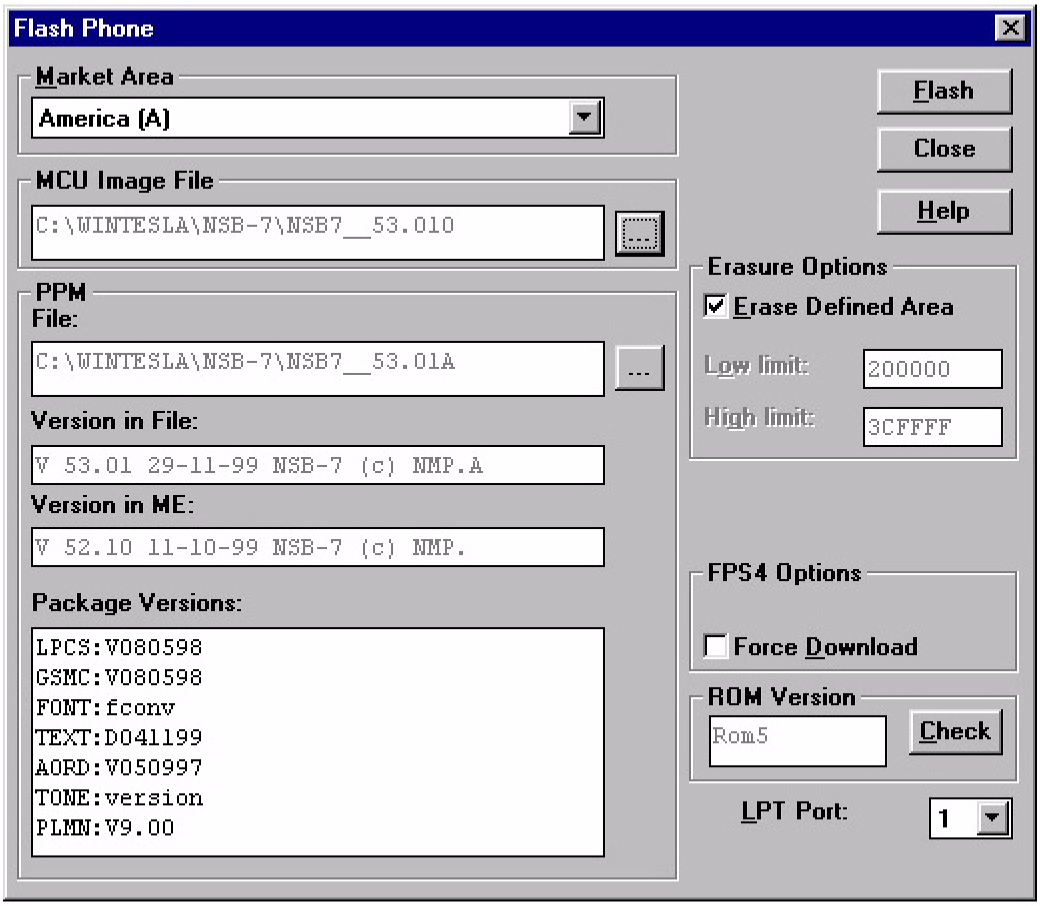
Edit box where the Club Nokia ID is shown

## Flash Phone... command

| Activation | Status Bar Text |
|---|---|
| Alt, D,F | Open Flash Phone dialog box. |

This command is used for flashing new software into the phone. When flashing dead phone, user may be asked to select phone type. If more than one phone is flashed without closing dialog, then user **must press Check** button after phone has been changed.

Selection opens the following **Flash Phone** dialog box. When flashing is started, waiting windows is showed telling the user estimated flashing time. Flashing files are delivered in product and market area specific flash packages. These packages should be unpacked to product specific subdirectory of WinTesla directory e.g. *C:\WINTESLA\NSM-X* for NSM-X flash. This directory will then contain product specific INI-file e.g. NSM-X.INI in which different market areas and files are described.




**NOTE:** This is a screen sample, actual information may differ.

Dialog mode: **modal**

Flash Phone dialog box has following items:

Market Area group:

Drop down list box (ALT+M):

User can select correct market area for phone. With this selection correct image and PPM files are loaded to edit fields. Usually this is the correct way to select files to be flashed.

MCU Image File group:

Edit field (read only):

Displays path of image file to be flashed.

...button:

Opens Open File dialog, with which user can select an image file to be flashed to ME. If user selects OK button, the name of selected file is copied to Flash Image edit field. Usually you should use Market Area list box to select Image file.

PPM group:

Edit field (read only):

Displays path of PPM package file to be flashed.

...button:

Opens Open File dialog, with which user can select a PPM package file to be flashed to ME. If user selects OK button, the name of selected file is copied to PPM Image edit field. Usually you should use Market Area list box to select PPM file.

Version in File edit field (read only):

MCU SW version string of the PPM package.

Package Versions edit field (read only):

Lists the file versions of PPM package.

Flash button (ALT+F):

Starts flashing selected files to phone. Before flashing asks, does user want to save all user settings to file (and load them after flashing). If reading user settings to ME or writing them to ME failed, Restore Default User Settings dialog is opened and user can restore default settings to phone.

**NOTE:** If settings are saved but flashing fails or for some other reason setting are not loaded back to phone, the saved settings can be loaded phone later. When settings are saved they are also copied to files which names are generated from phone PSN.

If settings are not loaded back to phone after flashing those files are left and found by application when phone is flashed next time. After successful loading to phone files are removed.

Close button (ESC):

Closes the dialog box and does not start flashing.

Erasure Options group:

Erase Defined Area check box:

If it is checked, prommer erases from phone EEPROM area defined with **Low limit** and **High limit** fields. If it is not checked only new blocks are erased from phone EEPROM. If values in fields are not valid, then check box is disabled. Check box state is read from flash pack ini-file, from entry **EraseDefinedArea**.

Low limit edit box (read only):

Hexadecimal value defining low erase limit, value should be plain hexadecimal without any prefix. Field value is read from flash pack ini-file, from entry **LowEraseLimit**.

High limit edit box (read only):

Hexadecimal value defining high erase limit, value should be plain hexadecimal without any prefix. Field value is read from flash pack ini-file, from entry **HighEraseLimit**.

Force Download check box (ALT+D):

Forces downloading of selected PPM file to a prommer even, if it already exists there. Can be used to replace a corrupted file in a prommer with a proper one.

ROM Version Group:

ROM Version edit box:

Shows rom version of flashed phone.

Check button (Alt+A):

Checks connected phone, reads MCU SW and ROM version from the phone and loads market areas. If application cannot detect **ROM version**, user is shown ROM Version selection dialog. If application cannot detect phone type, user is shown **Phone Type Selection** dialog.

LPT Port list box (ALT+L):

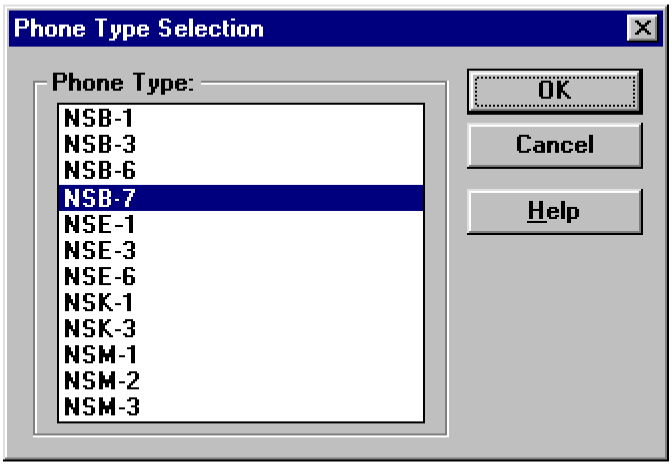
  

User can select parallel port to be used when flashed.

During flashing status dialog is showed. After phone is flashed current time in PC is set to phone and user is asked to check that the time is correct. If flashing succeeded “Flashing completed!” message is shown to user, if flashing failed “Flashing failed” message is shown instead.

After flashing phone several self-test are checked or run. If some of those fail, then Flash Id, factory sets or user settings are not written to phone. For example if SW Version fails, then MCU SW version does not match phone HW and user should flash MCU SW and PPM for correct ROM version.

Phone Type Selection dialog




**NOTE:** This is a screen sample, actual information may differ.

Dialog mode: **modal.**

Phone Type Selection dialog has following items:

Phone Type group:

List box:

User can select phone type.

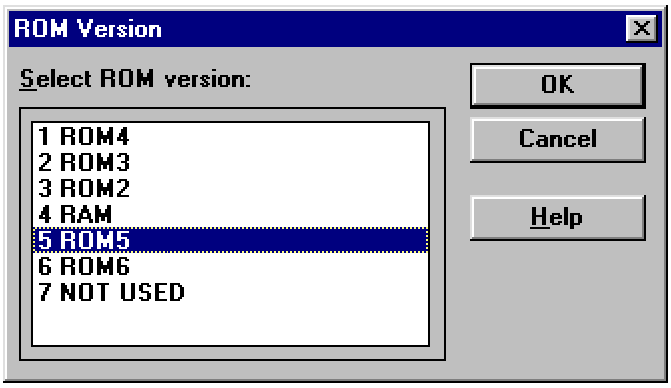
OK button (ENTER):

User accepts selected phone type.

Cancel button (ESC):

Phone type selection is cancelled and operation is aborted.

ROM Version dialog




**NOTE:** This is a screen sample, actual information may differ.

Dialog mode: **modal**

ROM Version dialog has following items:

Select ROM version group:

List box:

User can select ROM version of phone.

OK button (ENTER):

User accepts selected ROM version.

Cancel button (ESC):

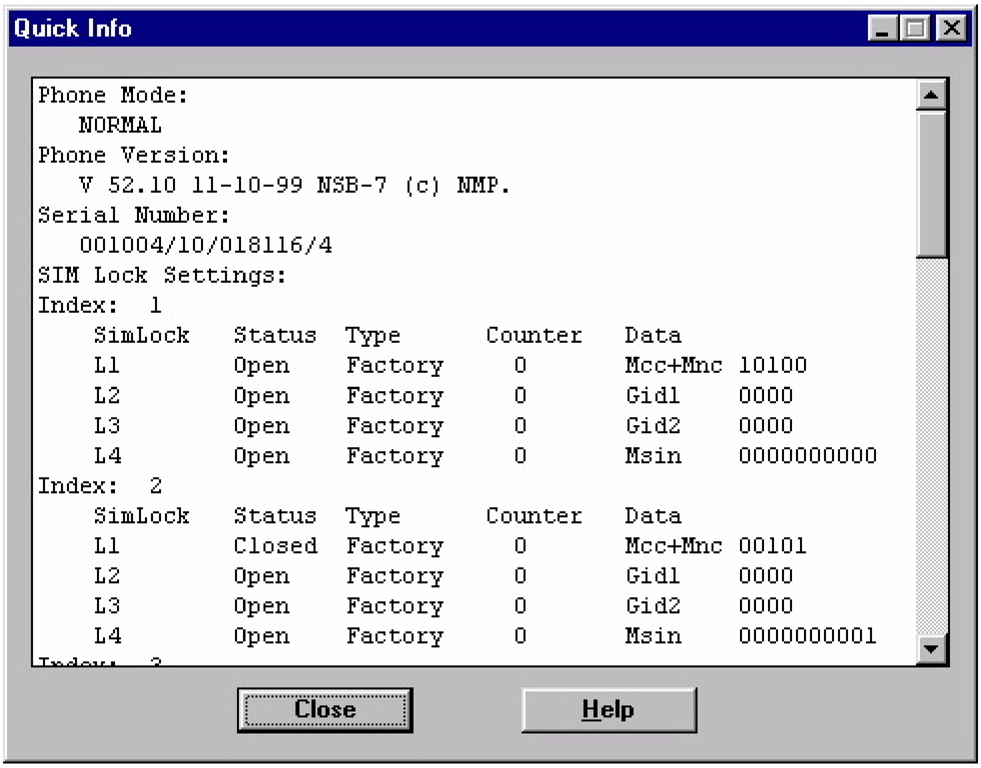
ROM version selection is cancelled and operation is aborted.

## View

### Quick/RF Info... command

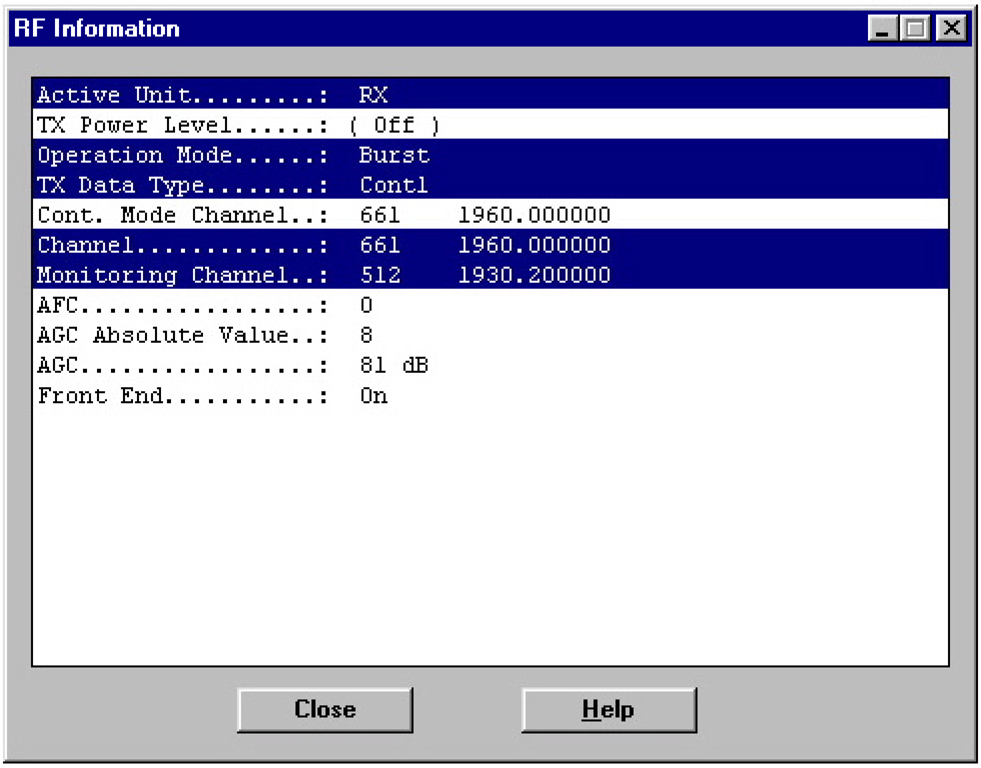
| Activation | Status Bar Text |
|---|---|
| Alt, V,Q | View Quick/RF information. |

If phone is in normal mode following **Quick Info** is shown:




Dialog mode: **modeless**

If phone is in local mode following **RF Information** is shown. Information is shown in a modeless dialog which may be left open during other operations. It is also updated when ever needed.



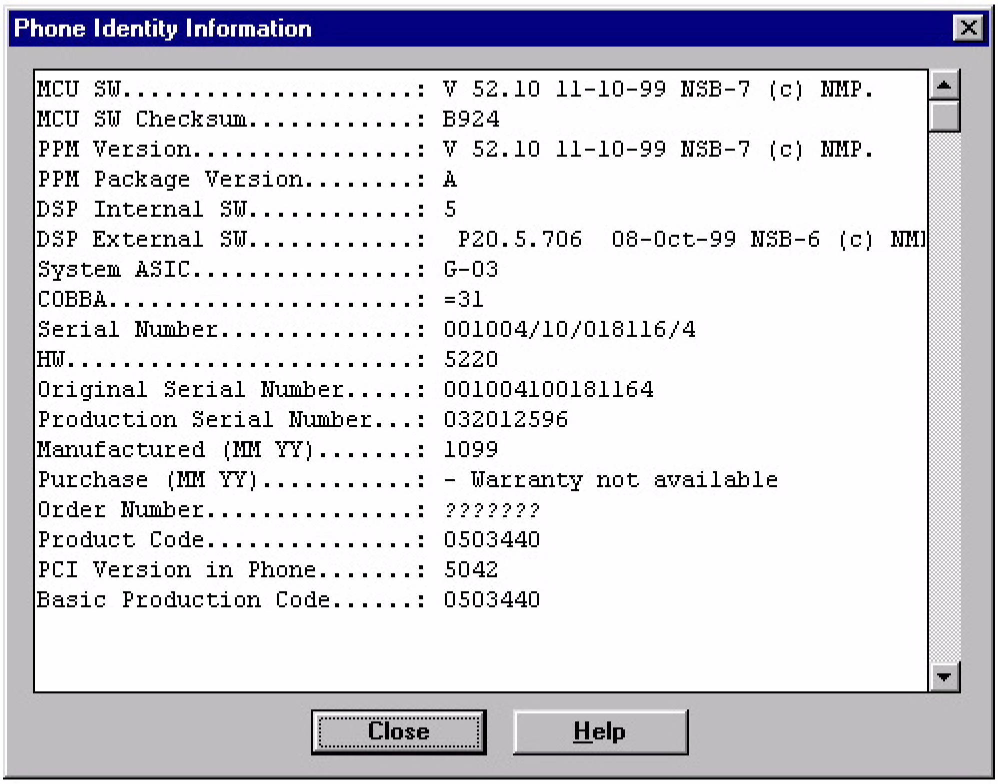

Dialog mode: **modeless**

Selections show what data is currently updated by PC.

## Phone Information... command

| Activation | Status Bar Text |
|---|---|
| Alt, V,P | View Phone Identity. |

Command opens **Phone Identity Information** dialog, which shows identification information. Information is shown in a modeless dialog which may be left open during other operations. It is also updated when ever needed.




Dialog mode: **modeless**

### Initialization file

The After Sales Software has an initialisation file which has extension .INI. Initialisation file is TESLA.INI which includes all next selections (on mentioned menus or dialogs) and parameters:

Common Settings:

[STARTUP]
Mode=0 // 0 = normal mode, 1 = local mode, 2 = do nothing
RF Controls dialog
Active Unit (Active Unit=)
TX Power Level (TX Power Level=)
Operation Mode (Operation Mode=)
TX Data Type (TX Data Type=)

Continuous Mode Channel (Cont Mode Channel=)
Channel (Channel=)
Monitoring Channel 1 (Monitoring Channel=)
AGC dB value (AGC=)

AGC Absolute Value (AGCAbsolute=)
Front End (FrontEnd=)

Call Simulation dialog

Monitoring Channel 2 (Monitoring Channel 2 =)

Monitoring Channel 3 (Monitoring Channel 3 =)

Monitoring Channel 4 (Monitoring Channel 4 =)

Monitoring Channel 5 (Monitoring Channel 5 =)

Monitoring Channel 6 (Monitoring Channel 6 =)

All selections and parameters which are not same as in the RF Controls menu.

TX Power Tuning dialog ([TX Power Tuning])

TX power coefficients

TX I/Q Tuning dialog ([TX I/Q Tuning])

TX I/Q

# Tuning Instructions

## General

All tuning operations are carried out using the service software. The service software turns the phone into the locals mode, in which the phone can be outwardly controlled via the MBUS interface.

Tuning is based on the software communicating with the D/A and A/D converters of the phone. In some instances the phone processor will also calculate the required correction parameter.

The tuning values of the phone reside on the EEPROM. The contents of the EEPROM can be read by the service software and saved as a file. This is advisable when there is need to retain that information, e.g. in view of replacement of the circuit. The program also enables writing the default parameters on the EEPROM, in which case all tuning steps should be carried out.

**During tuning, proceed as follows:**

- Take care not to damage sensitive measuring instruments with excessive RF power.
- Carry out all tuning steps in the shortest possible time to avoid excessive heating of RF units.
- Perform all tuning steps in the order presented.
- Never try to mask a fault by tuning it out!

## Required Equipment

PC with service software; see separate section for instructions on installation and use.

Service accessories; see equipment setup pictures.

Multimeter or DVM.

GSM radio telephone test station or separate measuring equipment as follows:

- RF generator
- pulse power meter
- spectrum analyzer
- attenuator and branching unit

## Equipment Setup

*Caution:* *Make sure that you have switched off the PC and the printer before making connections !*

*Caution:* *Do not connect the PKD-1 key to the serial port. You may damage your PKD-1 !*

Attach the protection key PKD-1 to parallel port one (25-pin female D-connector) of the PC. When connecting the PKD-1 to the parallel port be sure that you insert the PC end of the PKD-1 to the PC (male side). If you use a printer on parallel port one, place the PKD-1 between the PC and your printer cable.

Next connect the M2BUS service cable, DAU-9S, to the serial port (RS-232) of the computer. Attach one end of the service cable to the PC serial port and the other end to the service box, JBU-6. For servicing the phone with the covers in place the service box should always be used.

When the phone covers are removed the jigs should be used.

## Equipment Setup for Calibration and Tuning with RA5

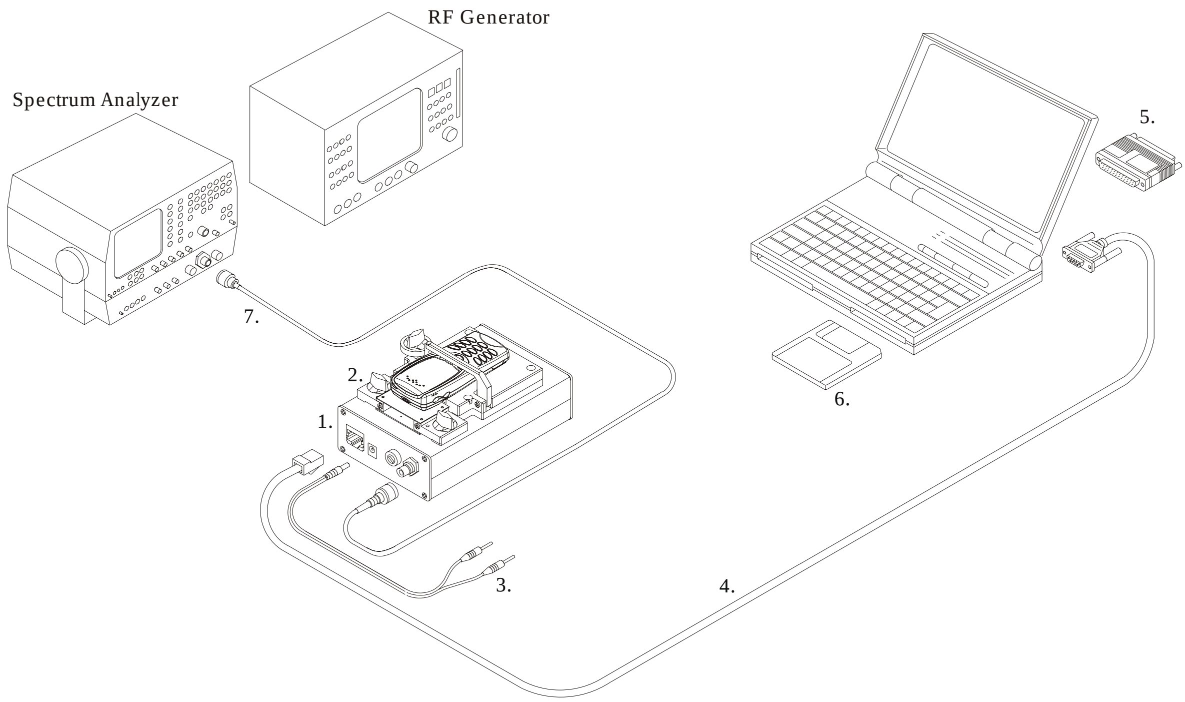



**Figure 1: Equipment Setup for Calibration and Tuning**

| Item: | Service Accessory: | Product Code: |
|---|---|---|
| 1 | Service Box JBU-6 | 0770153 |
| 2 | RF Module RA5 for JBU-6 | 0201591 |
| 3 | DC Power Cable PCS-1 | 0730012 |
| 4 | Service MBUS Cable DAU-9S | 0730108 |
| 5 | Software Protection Key PKD-1 | 0750018 |
| 6 | Service SW diskette 3.5" for NSB-7<br>Flash SW packages on CD | 0774080<br>0775227 |
| 7 | RF Cable XRS-3 | 0730184 |

## Equipment Setup for Testing Audio & Charging

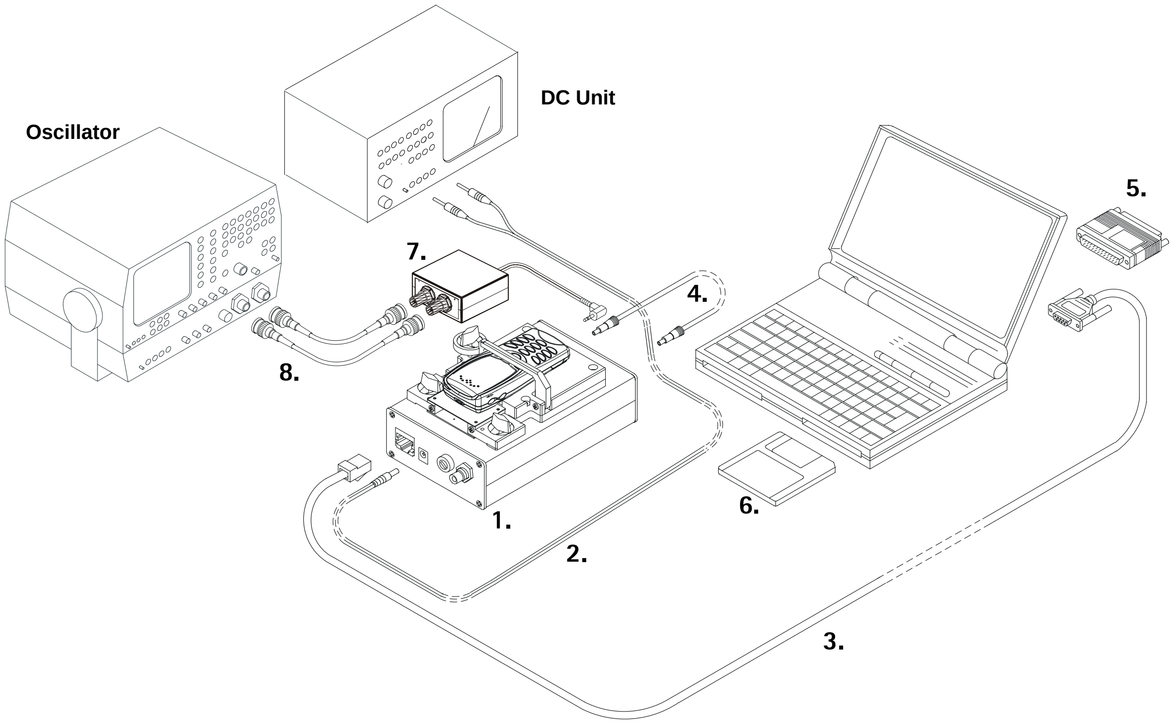



**Figure 2: Equipment Setup for Testing Audio & Charging**

| Item: | Service Accessory: | Product Code: |
|---|---|---|
| 1 | Service Box JBU-6 | 0770153 |
| 2 | DC Power Cable PCS-1 | 0730012 |
| 3 | Service MBUS Cable DAU-9S | 0730108 |
| 4 | DC-DC Cable SCB-3 | 0730114 |
| 5 | Software Protection Key PKD-1 | 0750018 |
| 6 | Service SW diskette 3.5" for NSB-7<br>Flash SW packages on CD | 0774080<br>0775227 |
| 7 | Audio Box JBA-6 | 0770184 |
| 8 | Audio Cable ADS-3 | 0730197 |

## Flash Concept with JBU-6

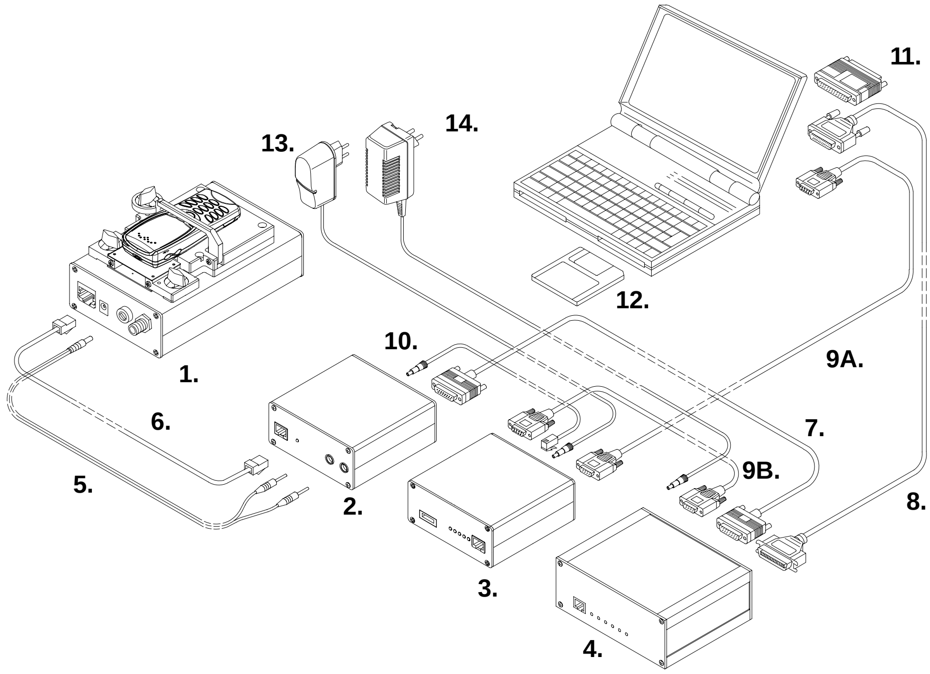



**Figure 3: Flash Concept with JBU-6**

| Item: | Service Accessory: | Product Code: |
|---|---|---|
| 1 | Service Box JBU-6 | 0770153 |
| 2 | *Flash Loading Adapter FLA-5 | 0080178 |
| 3 | Flash Security Box TDF-4<br>IR Module JLP-1 for TDF-4 | 0770106<br>0750079 |
| 4 | Flash Prommer FPS-4S | 0085095 |
| 5 | DC Power Cable PCS-1 for JBU-6 | 0730012 |
| 6 | Service Cable XMS-3 | 0730174 |
| 7 | D15-D15 Cable AXS-5 | 0730091 |
| 8 | Printer Cable (Included in FPS-4 Sales Pack) | 0730029 |
| 9A | D9-D9 Cable AXS-4 (Included in FPS-4 Sales Pack) | 0730090 |
| 9B | D9-D9 Cable AXS-4U | 0730163 |
| 10 | DC Cable PCC-1 | 0730053 |
| 11 | Software Protection Key PKD-1 | 0750018 |
| 12 | Service SW diskette 3.5” for NSB-7 | 0774080 |
| 13 | Travel Charger ACH-6U (USA/Japan) | 0675085 |
| 14 | AC Charger ACL-3E (Included in FPS 4 Sales Pack) | 0680015 |
| 15 | DC-DC Cable SCB-3 | 0730114 |

***FLA-7 can be used (see Flashing with FLA-10 for FLA-7 setup).**

## Testing Without Covers - Using Test-frame MJS-9

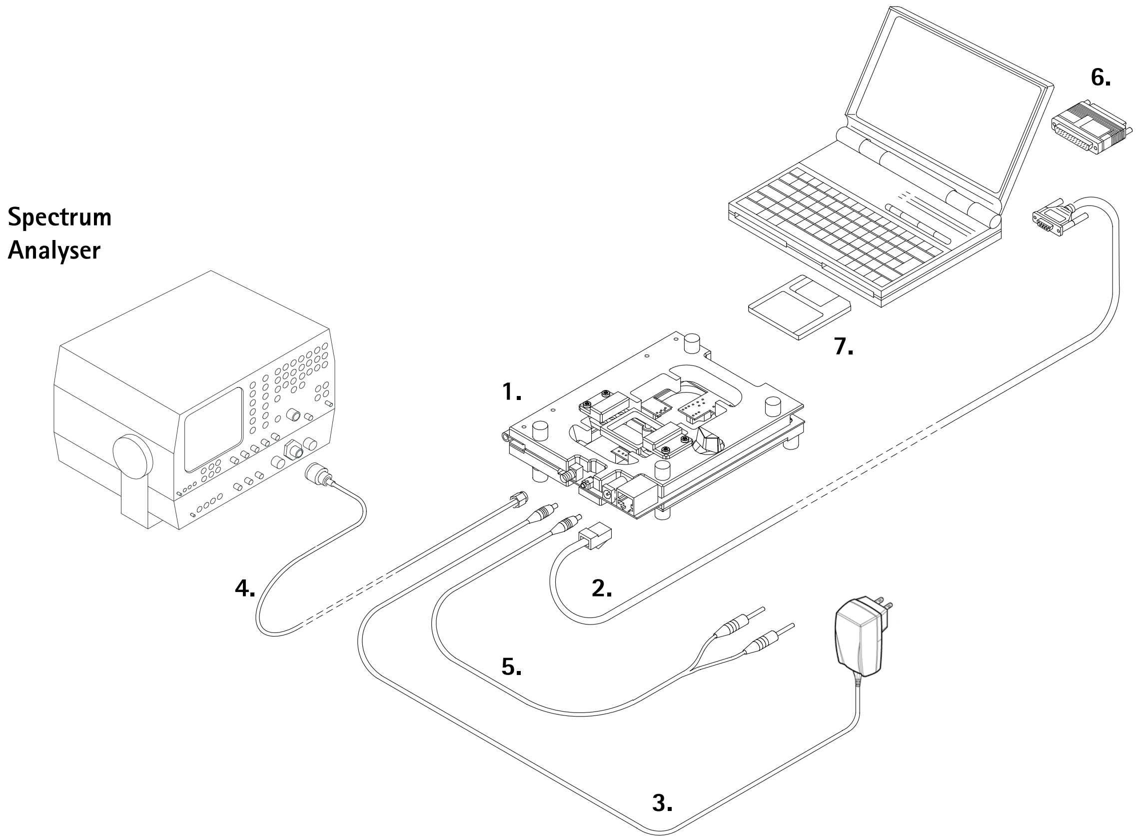



**Figure 4: Testing Without Covers- Using Test-Frame MJS-9**

| Item: | Service Accessory: | Product Code: |
|---|---|---|
| 1 | Module Jig MJS-9* | 0770154 |
| 2 | Service MBUS Cable DAU-9S | 0730108 |
| 3 | ACP-8 Travel Charger (see code: General Information Chapter) | |
| 4 | RF Antenna Cable XRF-1 | 0730085 |
| 5 | DC Power Cable PCS-1 | 0730012 |
| 6 | Software Protection Key PKD-1 | 0750018 |
| 7 | Service SW diskette 3.5" for NSB-7<br>Flash SW packages on CD | 0774080<br>0775227 |
| 8 | LCD CD9 | 0770244 |

*) The nominal operating voltage for MJS-9 is 8.0 V.
The supply voltage for MJS-9 must never exceed 15.0 V

## Flashing With FLA-10

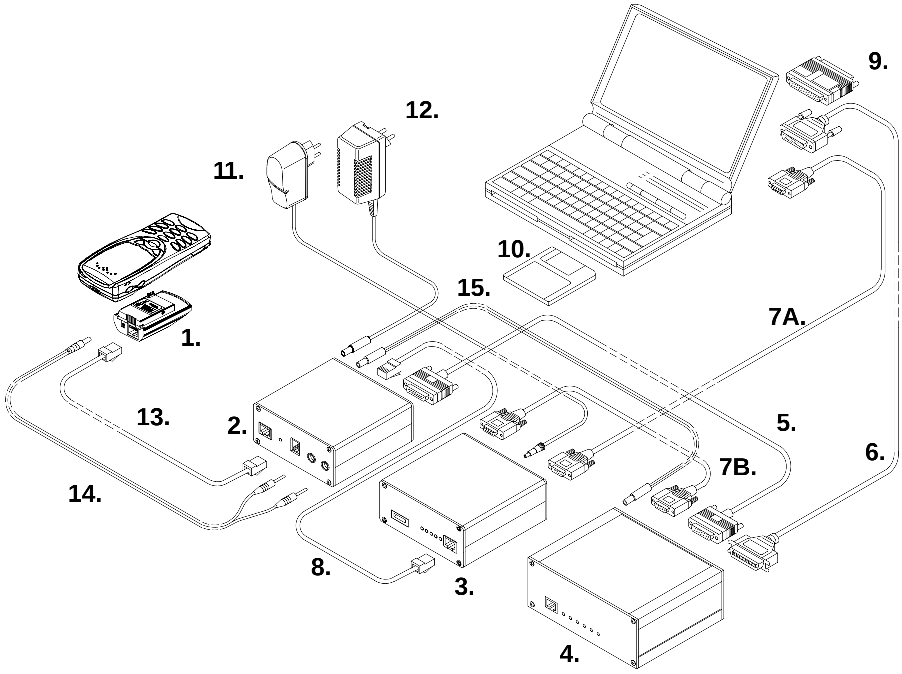



Figure 5: Flashing With FLA-10

| Item: | Service Accessory: | Product Code: |
|---|---|---|
| 1 | Service Flash Adapter FLA-10 | 0081346 |
| 2 | *Flash Loading Adapter FLA-7 | 0080326 |
| 3 | Flash Security Box TDF-4<br>IR Module JLP-1 for TDF-4 | 0770106<br>0750079 |
| 4 | Flash prommer FPS-4S | 0085095 |
| 5 | D15-D15 Cable AXS-5 | 0730091 |
| 6 | Printer Cable (Included in FPS-4 Sales Pack) | 0730029 |
| 7A | D9-D9 Cable AXS-4 (Included in FPS-4 Sales Pack) | 0730090 |
| 7B | D9-D9 Cable AXS-4U | 0730163 |
| 8 | Service Cable XCM-5 | 0730142 |
| 9 | Software Protection Key PKD-1 | 0750018 |
| 10 | Service SW diskette 3.5" for NSB-7 | 0774080 |
| 11 | Travel Charger ACH-6U (USA/Japan) | 0675085 |
| 12 | AC Charger ACL-3E (Included in FPS 4 Sales Pack) | 0680015 |
| 13 | Service Cable XMS-3 | 0730174 |
| 14 | DC Power Cable PCS-1 | 0730012 |
| 15 | Power Cable SCF-7 | 0730141 |

*** FLA-5 can also be used (see Flash Concept with JBU-6 for FLA-5 setup).**

## POS Flash Concept with FLA-10

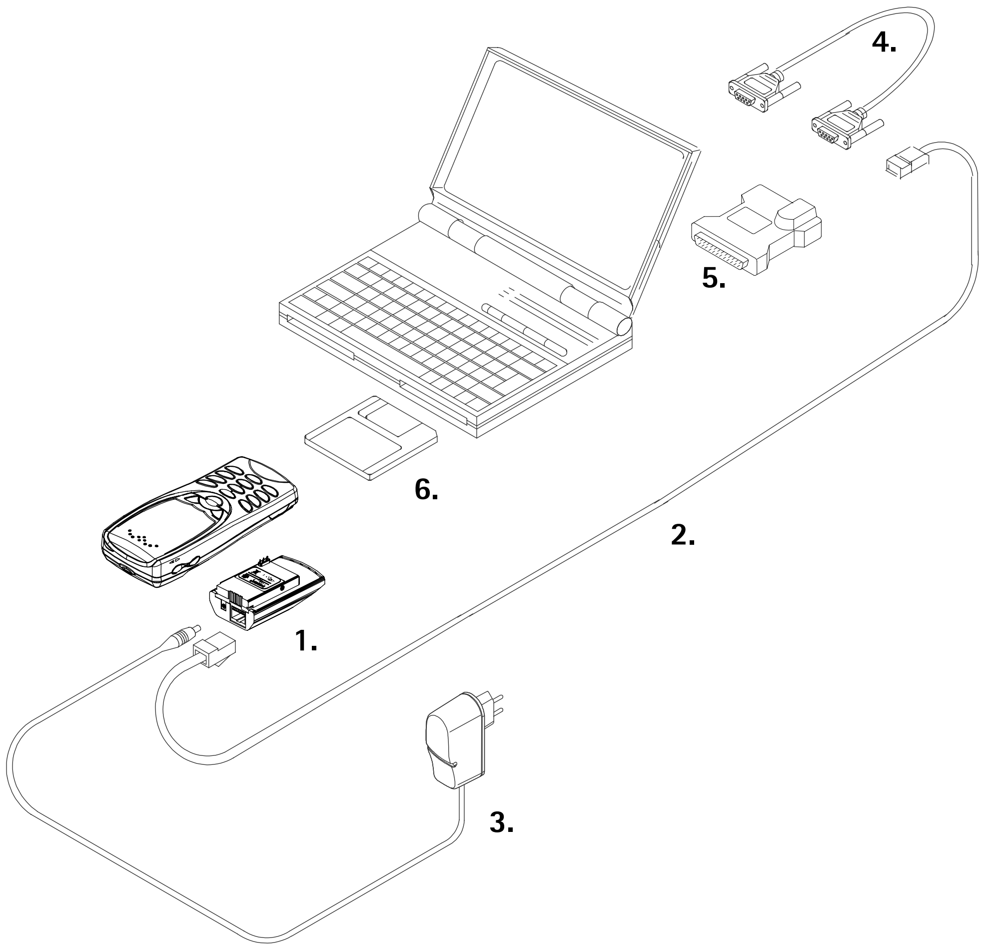



**Figure 6: POS Flash Concept with FLA-10**

| Item: | Service Accessory: | Product Code: |
|---|---|---|
| 1 | Flash Loading Adapter FLA-10 | 0081346 |
| 2 | Service Cable XMS-3 | 0730174 |
| 3 | Travel Charger ACP-8 (see code: General Information Chapter) | |
| 4 | D9-D9 Cable AXS-4U | 0730163 |
| 5 | POS Flash Adapter FLS-2D (USA) | 0081309 |
| 6 | Service SW diskette 3.5" for NSB-7<br>Flash SW packages on CD | 0774080<br>0775227 |

## Warranty Transfer

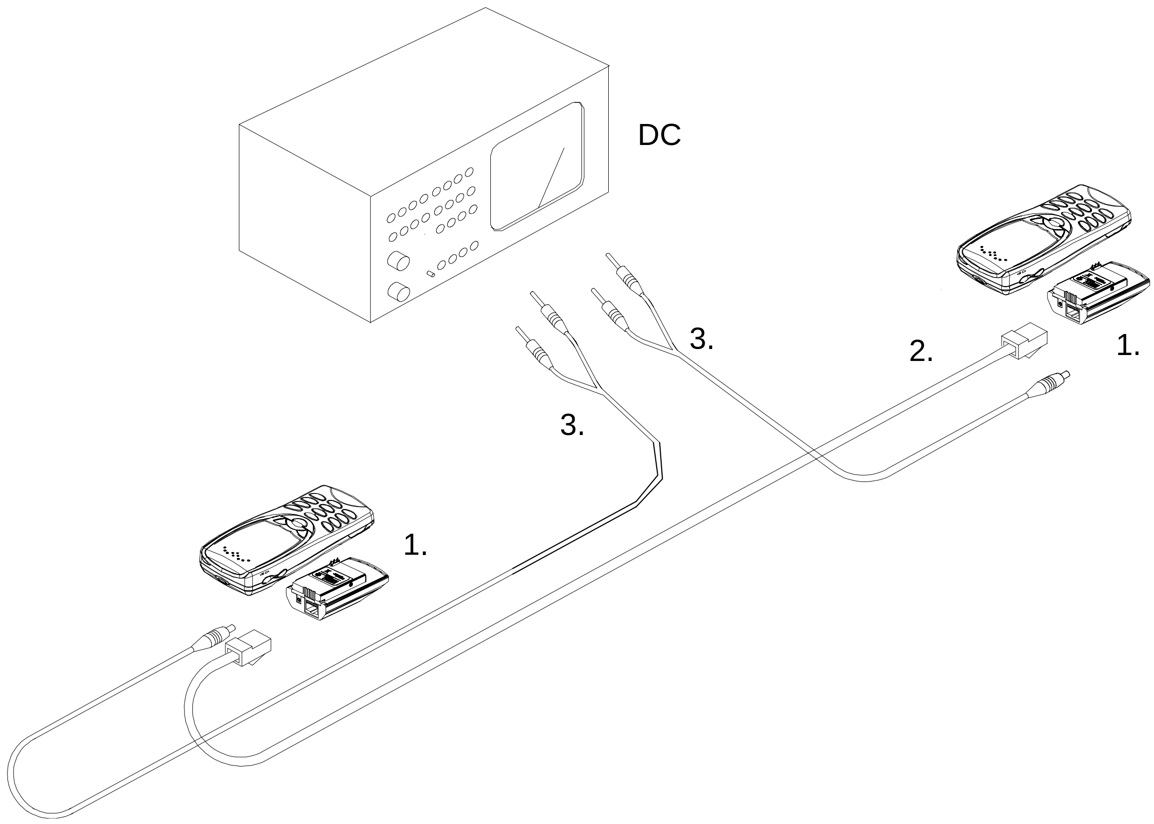



**Figure 7: Warranty Transfer**

| Item: | Service Accessory: | Product Code: |
|---|---|---|
| 1 | Flash Loading Adapter FLA-10 | 0081346 |
| 2 | Service Cable XMS-3 | 0730174 |
| 3 | DC Power Cable PCS-1 | 0730012 |

## Tuning Steps

### 1. Coupler Module RA5 Attenuation Measurements

Every coupler has its own individual attenuation values in different channels and therefore it is important to use accurate attenuation values to ensure the reliable results of tuning and testing.

Coupler module RA5 has to be calibrated in next cases:

- When coupler is taking into use the first time
- When RF cable or attenuator is changed

Calibration should be done once a week and has been recommended to calibrate coupler always when module is removed from JBU-6 service box and placed back.

Pay attention to the following instructions in calibration:

- Keep JBU-6 box in the same place on the table during measurements
- Close the cover of JBU-6 box carefully
- Do not touch to JBU-6 box during measurements
- Take care that cables aren't lying above cover

Calibration procedure step by step:

1 Insert coupler module RA5 to its place properly.

2 Connect cables for JBU-6 box and measuring devices carefully. Check that DC SUPPLY MODE has been switched to FLA-5 in JBU-6.

3 Insert golden phone in the JBU-6 box.

4 Adjust DC power supply voltage to 9V. Switch power on.

5 Close the cover of the JBU-6 box and start WinTesla.

- Choose "Product" -> "open" -> "NSB-7" -> "OK"

In the case of RX calibration:

- Choose from Menu bar "Testing" and then "RF controls"
- Ensure that settings are as follows:

Activate Unit: RX

Operation Mode: Burst

Channel: 661

- Press "Apply" and close window
- Set RF generator to correct frequency 1960.067710 MHz and level -55.0 dBm + cable attenuation (if cable attenuation is 0.5 dB, then level is –54.5 dBm)
- Choose from Menu bar "Testing" and then "RSSI Reading". Write down the RSSI value. Close window.
- Coupler attenuation value = RX value of Golden phone - RSSI value

In the case of TX calibration:

- Choose from Menu bar "Testing" and then "RF controls"
- Ensure that settings are as follows:

Activate Unit: TX

Operation Mode: Burst

TX Power level: 0

Channel: 661

- Press "Apply"
- Set Spectrum analyzer's settings as follows

Center frequency 1880 MHz

Res BW 10 MHz Max.

Video BW 10 MHz Max.

Span 0 Hz

Sweep time 2 ms

REF level 35 dBm

RF att. 40 dB

REF level offset (e.g. attenuator 10 dB + cable 0.5 dB) 10.5 dB

Set marker to point to a peak value

- Write down the TX power value of spectrum analyzer.
- Coupler attenuation value = TX value of Golden phone - TX power value of spectrum analyzer

**2. RX and TX Tuning with RA5**

Calibration of the coupler has to be made before tuning. In tuning has to be used attenuation values got from calibration.

Tuning procedure step by step:

1 Insert coupler module RA5 to its place properly.

2 Connect cables for JBU-6 box and measuring devices carefully. Check that DC SUPPLY MODE has been switched to FLA-5 in JBU-6.

3 Insert phone in the JBU-6 box.

4 Adjust DC power supply to 9V. Switch power on.

5 Close the cover of the JBU-6 box and start WinTesla.

In the case of RX tuning:

- Choose from Menu bar "Tuning" and then "RX calibration"
- Set RF generator to frequency 1960.067710 MHz and high level -55.0 dBm + cable attenuation + coupler attenuation (if cable attenuation is 0.5 dB and coupler attenuation e.g. 4.5 dB then level is –50 dBm). Press OK.
- Set RF generator to frequency 1960.067710 MHz and low level -85.0 dBm + cable attenuation + coupler attenuation (if cable attenuation is 0.5 dB and coupler attenuation e.g. 4.5 dB then level is –80 dBm). Press OK.
- In next window press "save".

In the case of TX tuning:

- Choose from Menu bar "Tuning" and then "TX power"
- When "start tuning" window opens select "1 EEPROM values". Press OK.
- Set Spectrum analyzer's settings as follows:

Center frequency 1960 MHz

Res BW 10 MHz Max.

Video BW 10 MHz Max.

Span 0 Hz

Sweep time 2 ms

REF level 35 dBm

REF level offset (e.g. attenuator 10 dB + cable 0.5 dB + coupler attenuation e.g. 4 dB) 14.5 dB

Set marker to point a peak value

- Tune the phone at three power levels (0, 11, and 15) to the target values.
- Press "calculate" and then "save".

### 3. RX Filter Calibration

BB-filter tuning is fully internal operation. External signal generators etc. are not needed, only command for phone to execute filter calibration procedure.

**Troubleshooting**

If the calibration does not succeed the software normally reports “Unable to read data from phone” or “Failed to set high reference” or “Failed to set low reference”.

In this case check first the basic functionality of the receiver chain: RF generator frequency set as in the calibration and level for example to the high reference value.

Then go to the RSSI reading menu (under RF controls). If the reading is very low there is something broken in the receiver and must be found by measuring voltages and signal levels at different places (information of these can be found in Disassembly & Troubleshooting Chapter of this manual).

If the RSSI reading seems to be within 5 - 10 dB the same as the RF input level check that the VCTCXO frequency is close enough the wanted frequency. This is most easiest done by measuring VCO frequency in GSM1900 middle channel 661 (VCO frequency is be 3920 MHz). If the deviation is bigger than about +/-50 kHz it is probable that the VCTCXO is not operating correctly.

If both of these (RSSI reading and the frequency) seem to be correct and calibration still fails the most probable reason is that there must be some missing gain step in Hagar or then the problem must be in COBBA.

### 4. AM suppression tuning

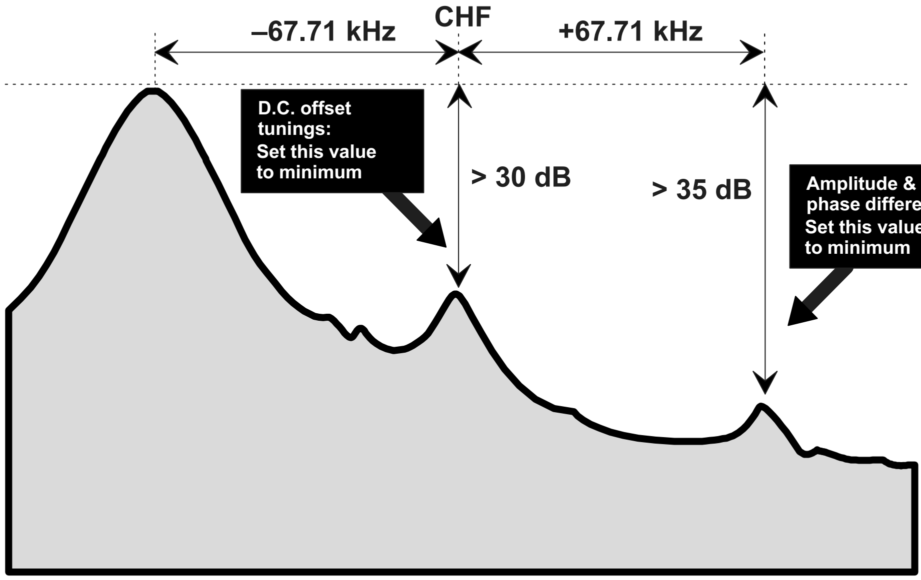
AM suppression calibration is for tuning four Hagar parameters to get as small RSSI value as possible.

For AM-suppression calibration external signal generator with AM-modulation is needed.

Signal generator setup: AM-modulation, fmod = 1 kHz, mod. depth = 83% f = ch(default)+10 MHz, P = -26 dBm (GSM 1900)

Test limits for AM-calibr. results: -86 dBm (GSM 1900)

**NOTE!** Base level **must** be adjusted manually because the calculation most often fails.




### 5. I/Q Modulator Alignments

See chapter “Service Software Instructions” and section “TX I/Q... command” for further information.

**Procedure:**

Connect the spectrum analyser to the service box JBU-6. The recommended spectrum analyser settings are: span 200 kHz, resolution BW 10 kHz, video BW 1 kHz, sweep 1 s, input attenuation 30 dB.

- From *RF controls* menu make sure that TX data type is 1.
- Go to *TX I/Q tuning menu*. The alignment channel for GSM 1900 is 661 (1880 MHz).
- Select the “TX I DC offset” option and adjust the level of the centre frequency

(CHF) to minimum.

- Select the “TX Q DC offset” option and adjust the level of the CHF again to minimum.
- After finding both minima change “TX I DC offset” by step or two from the current value to both directions to see, whether better minimum can be found for CHF.
- Select the “Amplitude Difference” option and adjust the level of the CHF +67.71 kHz again to minimum.
- After al the minima have been found press “Save” button to store the value to phone EEPROM.

**Targets:**

The level of the centre frequency CHF should be at least **30 dB** down to the wanted sideband CHF -67.71 kHz.

The level of the unwanted sideband CHF +67.71 kHz should be at least **35 dB** down to the wanted sideband CHF -67.71 kHz.

### 6. Energy Management Calibration

See section “Tuning - Energy Management Calibration... command” for further information.

## Appendix 1, Vocabulary

| Abbreviation | Description |
|---|---|
| ASIC | Custom circuit which for instance controls communication between MCU and DSP |
| JBU-6 | Service box |
| CLF | Common Look and Feel |
| CLI | Calling Line Identification |
| COBBA | Common Base Band Analog |
| DATA | DATA interface module |
| DAU-9S/P | MBUS/FBUS cable |
| DLL | Dynamic Link Library |
| DSP | Digital Signal Processor which controls radio interface and speech coding/decoding |
| EEPROM | Memory for adjustment parameters (Electrically Erasable and Programmable Read Only Memory) |
| FBUS | Fast serial bus |
| IMEI | International Mobile Equipment Identification code |
| IR | Infra Red transmitter |
| M2BUS | Serial communication bus which can be connected to accessory devices and test PC |
| MCU | Master Control Unit processor |
| MDI | MCU DSP Interface; message interface via ASIC registers |
| ME | Mobile Equipment |
| MODAL (dialog box) | A modal dialog box requires the user to complete interaction within a dialog box, and close it before continuing with any further interaction outside the window. |
| MODELESS (dialog box) | A modeless dialog box allows the user to interact with other windows and applications. |

| | |
|---|---|
| MS | Mobile Station |
| PC | IBM PS/AT or compatible personal computer |
| PCI | Phone Controlling Interface SW for PC |
| PKD-1/1NS/1CS | Hardware protection key (DESKEY DK2) for protecting service software from illegal copying. The software will not work without this key ! |
| RF | Radio Frequency parts |
| RTC | Real Time Clock |
| SW | Software |
| TDF-4 | Flash security box |
| UI | User Interface |

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# Service Tools

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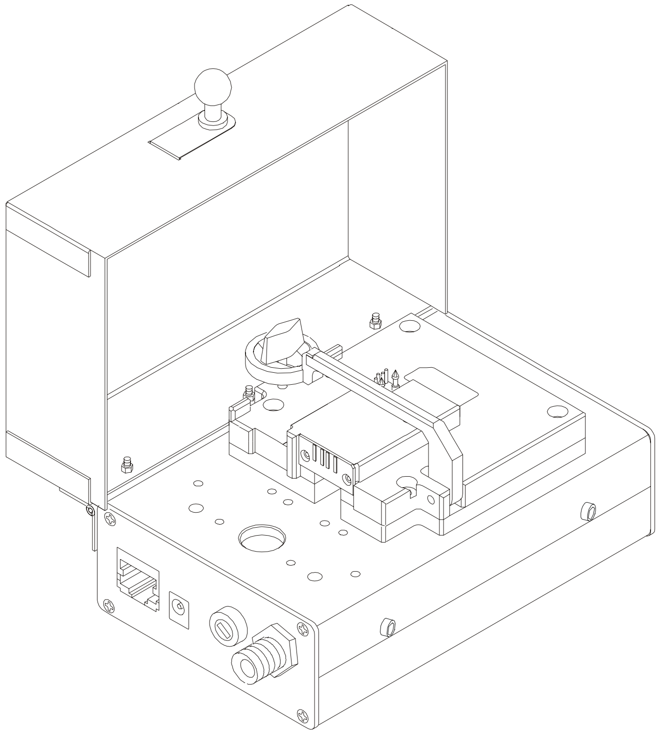
## Service Box JBU-6

The Service Box JBU-6 is used:
- to make connection between transceiver and FLA-5/FLA-7 for flashing
- to help functional tests
- to enable connection to test/measurement devices
- to generate accurate 4.1 and 8.4 voltage for Vbatt and Vin/Vchar lines
- to generate accurate 500mA current for charging calibration Vin line
- to generate 10 ms IBI-pulse to BTMP-line

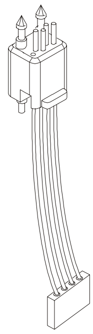
NOTE: JBU-6 cover should be closed during measurements.

### Product Code

Service Box JBU-6: 0770153



**SCD-6:**
Sales Package code: 0080329
Product Code: 9780263



Pinset Cable SCD-6:
Spare part for JBU-6:

**Figure 1: View of Service Box JBU-6**

### RF Module RA5 for Service Box JBU-6

RF Module RA5: 0201591

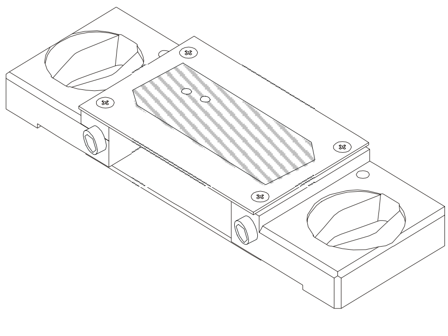


**Figure 2: View of RF Module RA5**

## Test Jig MJS-9

The Test Jig MJS-9 is used for repair of system/RF module*. The zoom in picture contains two changeable over voltage protection components:

| | |
|---|---|
| SM Fuse F2.0 A 32V 1206 F 001 T | 5119002 (larger of the two) |
| VWM 5.6V VC15.5 R 008 T | 1825019 |

See next page for additional info.

### Product Code

| | |
|---|---|
| Module Jig MJS-9: | 0770154 |

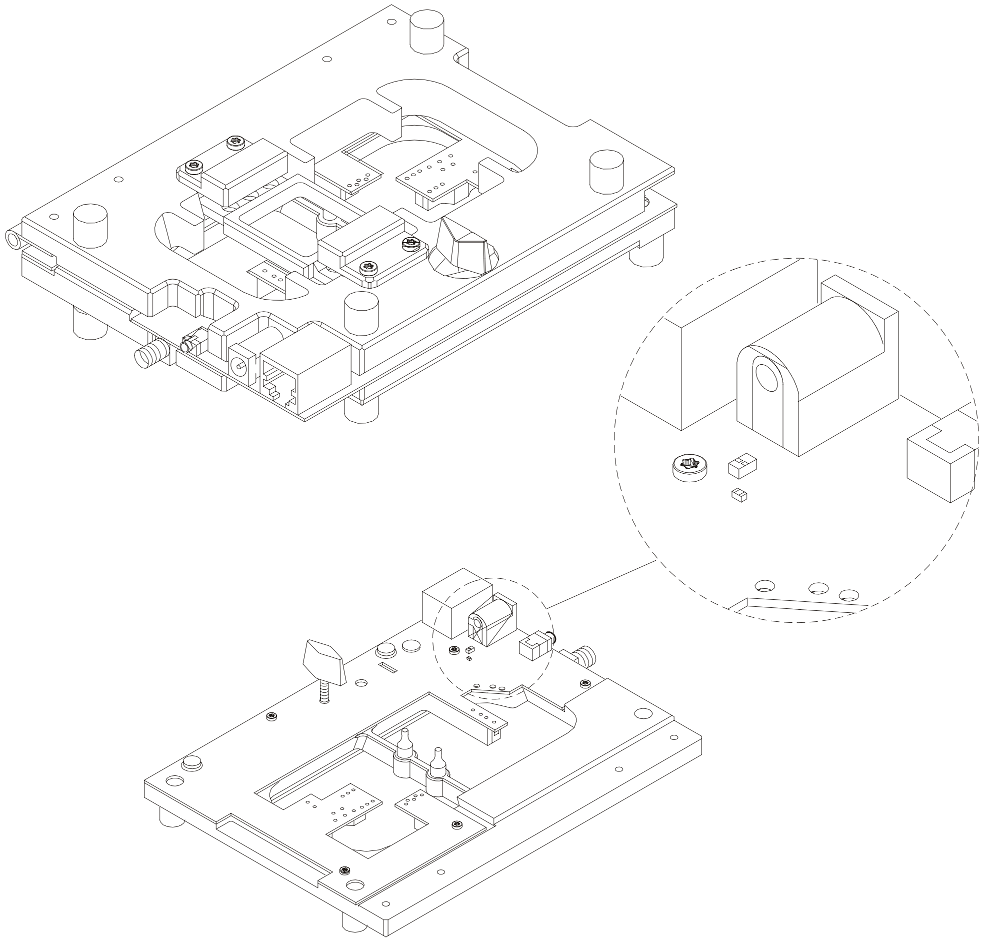
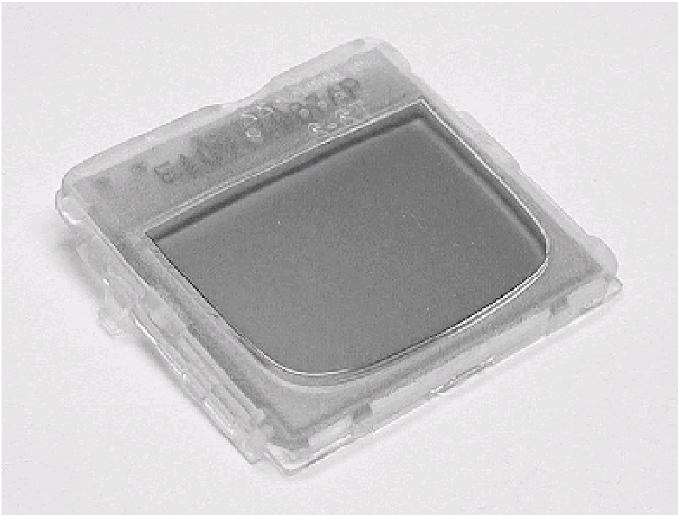


**Figure 3: View of Module Jig MJS-9**

| | |
|---|---|
| * Note: | The nominal supply voltage for MJS-9 is +8.0 V.<br>The supply voltage must not exceed + 15.0 V.<br>(MJS-9 has over voltage protection). |

Use modified LCD CD9 module when servicing
With MJS-9. Product Code: 0770244



Remove LCD/Keymat module from PCB before installing the radio module into the Service Jig MJS-9. Use LCD CD9 Module instead of the original NSB-7 module.

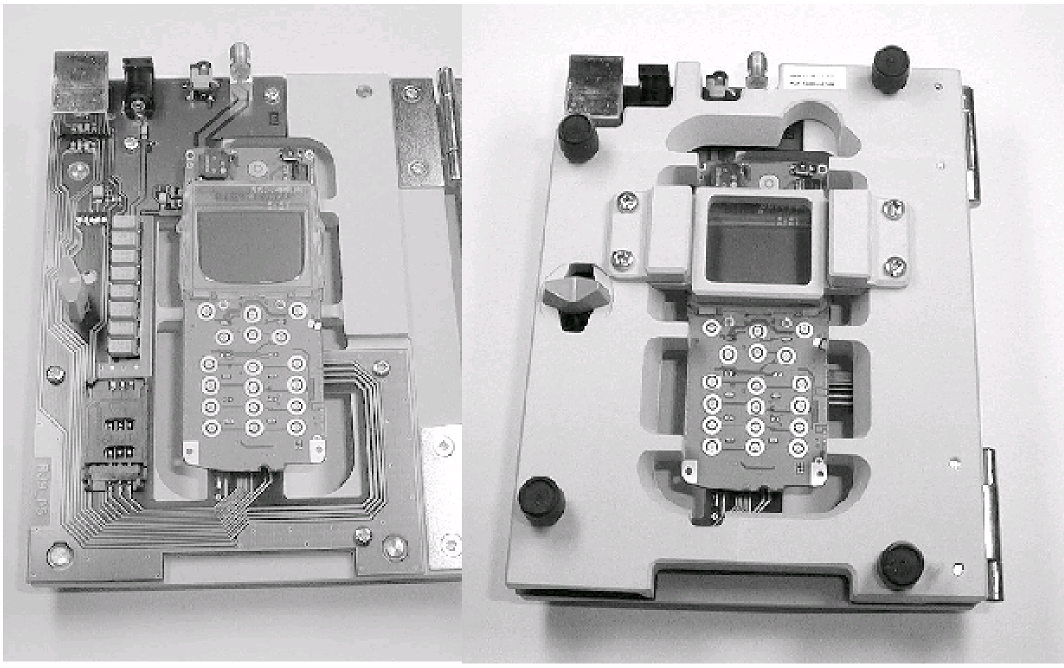


**Figure 4: View of PCB module in MJS-9 Jig**

## Service Audio Box JBA-6

The Service Audio Box JBA-6 is used between the phone or and audio measuring equipment.

### Product Code

Service Audio Box JBA-6 0770184

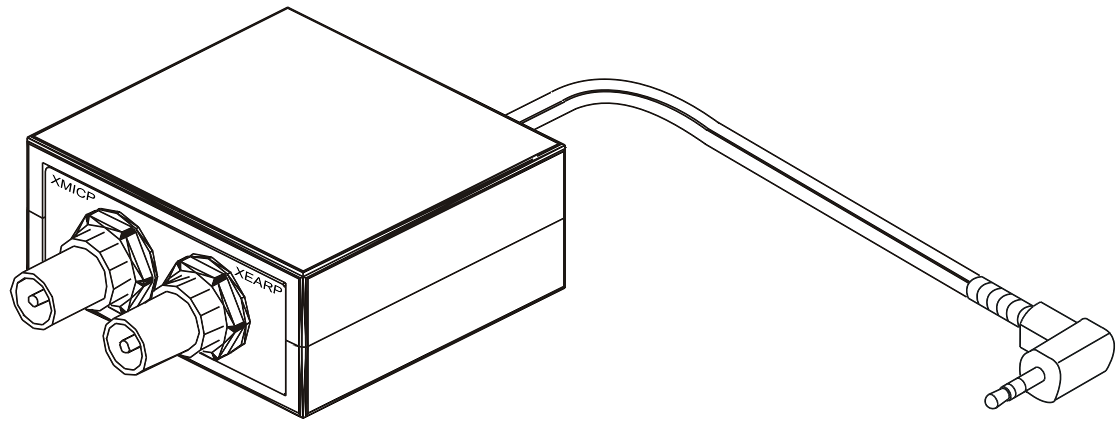



**Figure 5: View of Service Audio Box JBA-6**

## IR Data Interface Module JLP-1

IR Data Interface Module JLP-1 fits in the Security Box TDF-4 and can be used to perform IR tests with Wintesla.

### Product Code

| | |
|---|---|
| IR Data Interface Module JLP-1 | 0750079 |


**Figure 6: View of IR Data Interface Module JLP-1**

## Soldering Jig MJS-21

The Soldering Jig MJS-21 is used for soldering (in automatic soldering machines) and as a rework jig for the system module, if special fixings (like extra feet) are used.

**Product Code**

| | |
|---|---|
| Module Jig MJS-21: | 0770225 |
| Rubber Feet (4pcs included with MJS-21) | 6501005 |

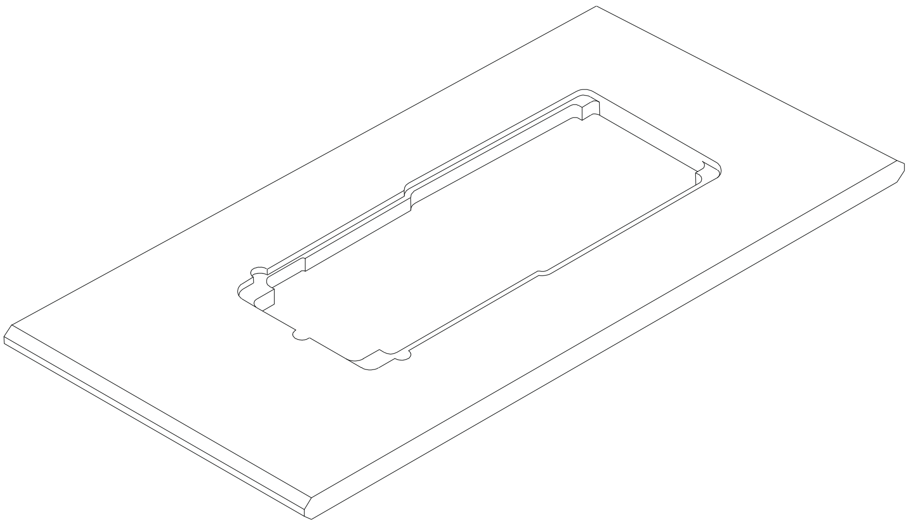


**Figure 7: View of Soldering Jig MJS-21**

## Flash Loading Adapter FLA-10

The Flash Loading Adapter FLA-10 is used in place of the phone's normal battery during service or flashing, to supply a controlled operating voltage.

### Sales Package Code

| | |
|---|---|
| Flash Loading Adapter FLA-10: | 0081346 |

Sales package contains:

| | |
|---|---|
| Flash Loading Adapter FLA-10 (bulk) | 0770229 |
| DC Cable FLC-2 | 0730185 |

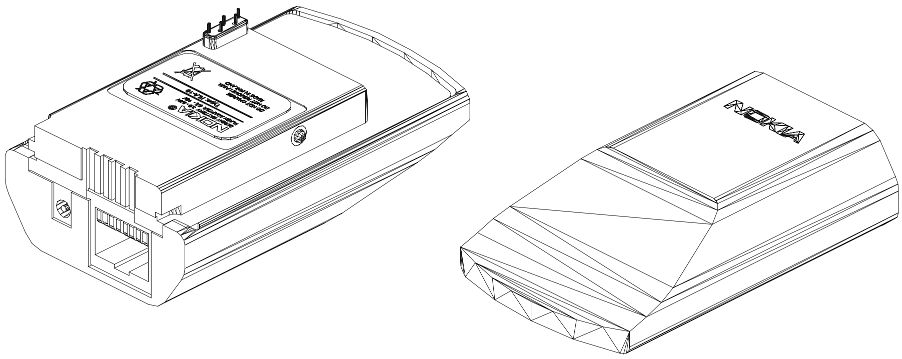


Figure 8: View of Flash Loading Adapter FLA-10

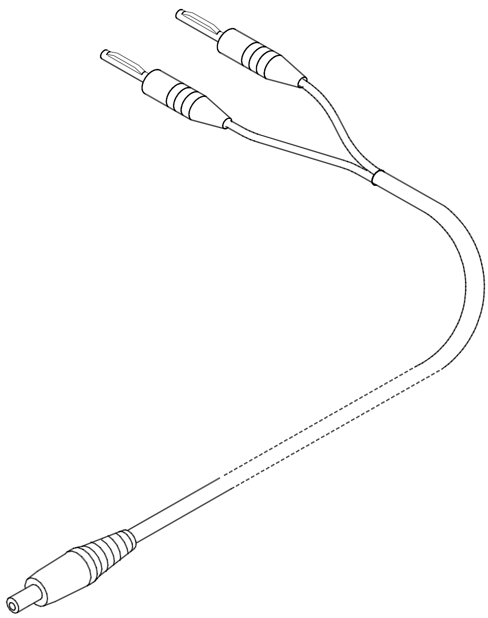


Figure 9: View of FLC-2 Cable

## Battery Connector Extractor Tool SRT-3

The Battery Connector Extractor Tool is used to remove the battery connector from the main frame.

### Product Code

| | |
|---|---|
| Battery Connector Extractor Tool SRT-3 | 0770226 |

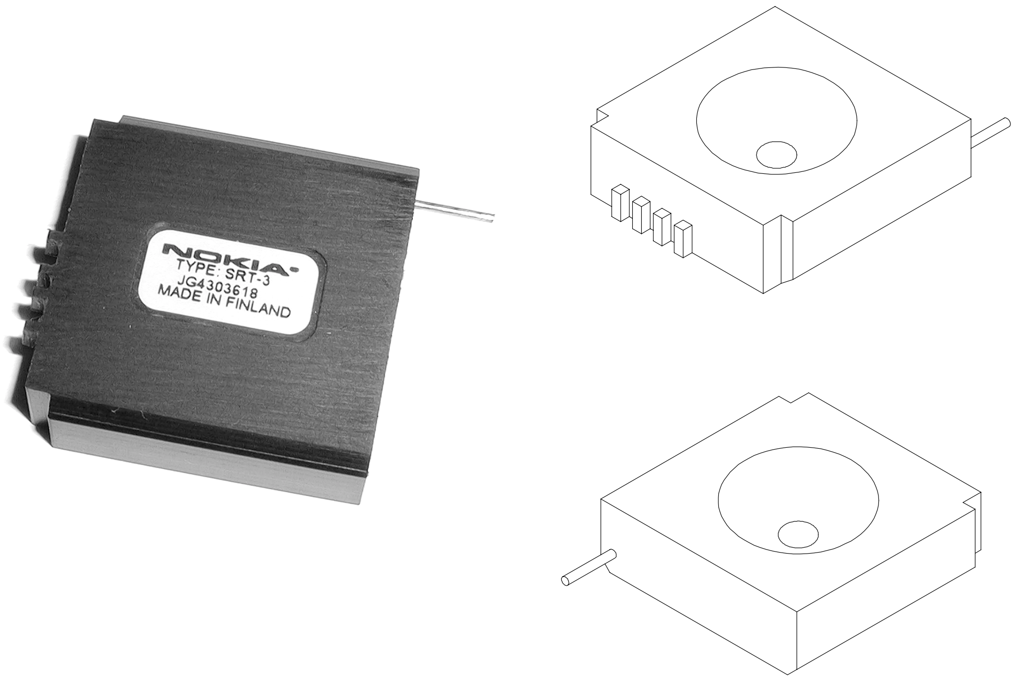



**Figure 10: View of Battery Connector Extractor Tool SRT-3**

## Flash Loading Adapter FLA-5 (Sales Pack)

The Flash Loading Adapter FLA-5 is used with the Flash Adapter FLA-10 and Service Cable XMS-3. Power is supplied to the FLA-5 from the Flash Security Box TDF-4 via the DC cable PCC-1B, (The PCC-1B cable can be replaced with a Travel Charger ACH-6), and is connected to the Flash Prommer FPS-4S with the cable AXS-5.

The sales pack includes:

| | |
|---|---|
| - Flash Loading Adapter FLA-5 | 0770085 |
| - Service Cable SCH-5 | 0730098 |
| - D15 - D15 Cable AXS5 | 0730091 |
| - Installation software for FPS-4 | 8400041 |

### Sales Package Code

| | |
|---|---|
| Flash Loading Adapter FLA-5 | 0080178 |

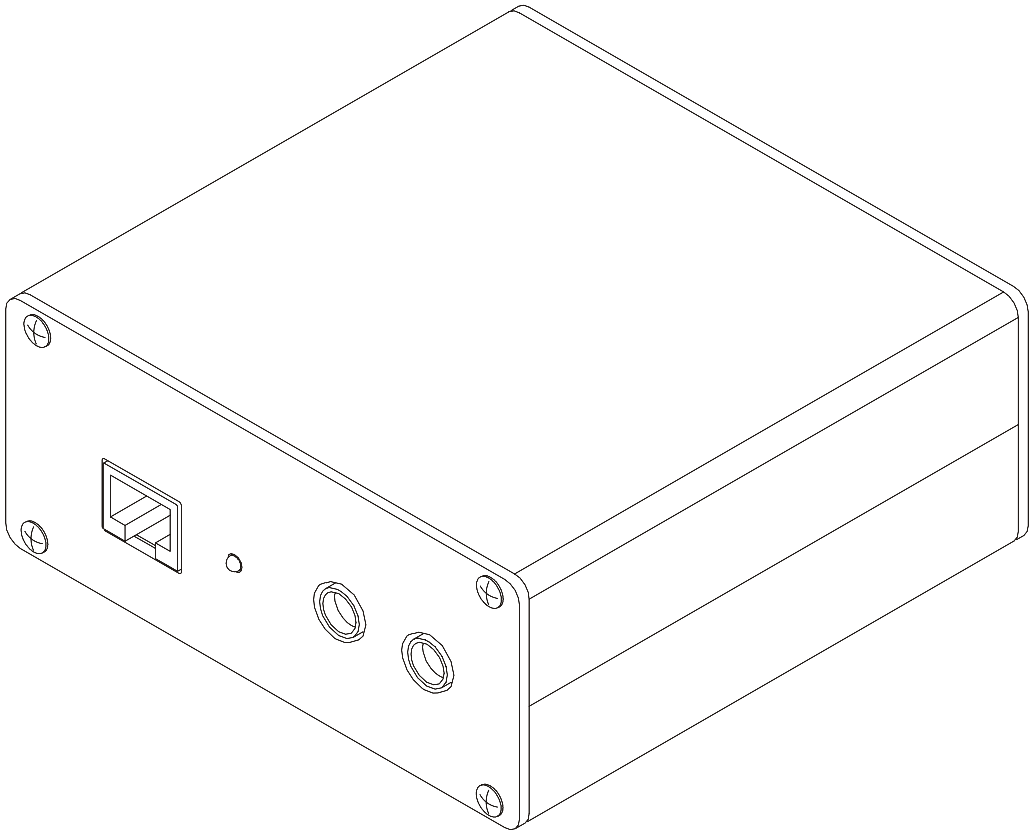


**Figure 11: View of Flash Loading Adapter FLA-5**

## Flash Loading Adapter FLA-7 (Sales Pack) Optional

NOTE: If you already have FLA-5, FLA-7 is not needed. The Flash Loading Adapter FLA-7 is used with FLA-10 and Service Cable XMS-3. Power is supplied to FLA-7 from ACL-3 Charger and is transfered through Power Cable SCF-7 to Flash Prommer FPS-4S.

The sales pack includes:

| | |
|---|---|
| - Flash Loading Adapter FLA-7 | 0770119 |
| - *Service Cable XCM-5 | 0730142 |
| - Power Cable SCF-7 | 0730141 |
| - Service Cable assy AXS-5 | 0730091 |

*Note: Service Cable XMS-3 (0730174) is used with NSB-7

### Sales Package Code

Flash Loading Adapter FLA-7: 0080326

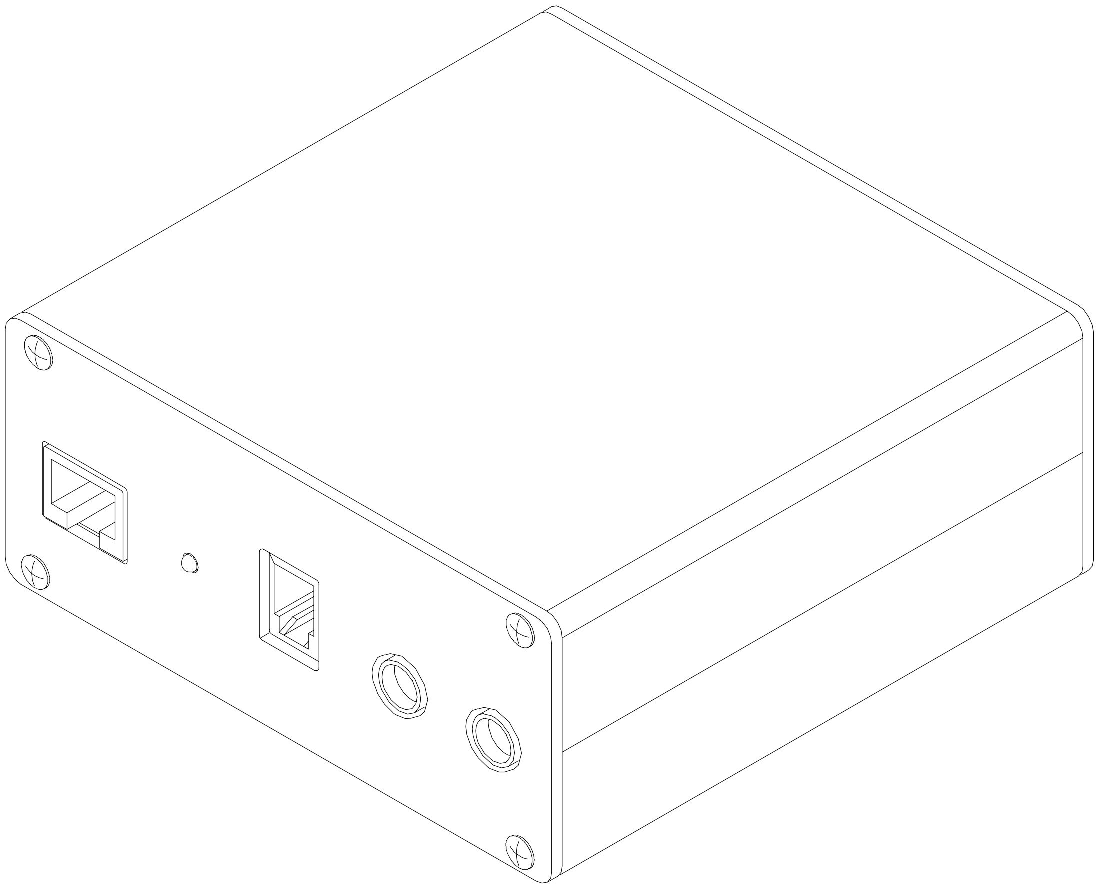


**Figure 12: View of Flash Loading Adapter FLA-7**

## Flash Prommer FPS-4S (Sales Pack)

The Flash Prommer FPS-4S is used to update the main software of the phone. Updating is done by first loading the new MCU software from the PC to the flash prommer, and then loading the new SW from the prommer to the phone. When updating more than one phone in succession, the MCU software only needs to be loaded to the prommer once.

The sales pack includes:

| | |
|---|---|
| - Flash Prommer FPS-4 | 0750090 |
| - Charger ACL-3E | 0680015 |
| - Printer cable IBM DB25F/57-30360 | 0730029 |
| - D9 - D9 Cable AXS-4 | 0730090 |
| - Flash Prommer software 3" disk | 0774043 |

### Sales Package Code

| | |
|---|---|
| Flash Prommer FPS-4S: | 0085095 |
| Flash Prommer FPS-4S: | 0081275 (US with ACL-3E removed) |

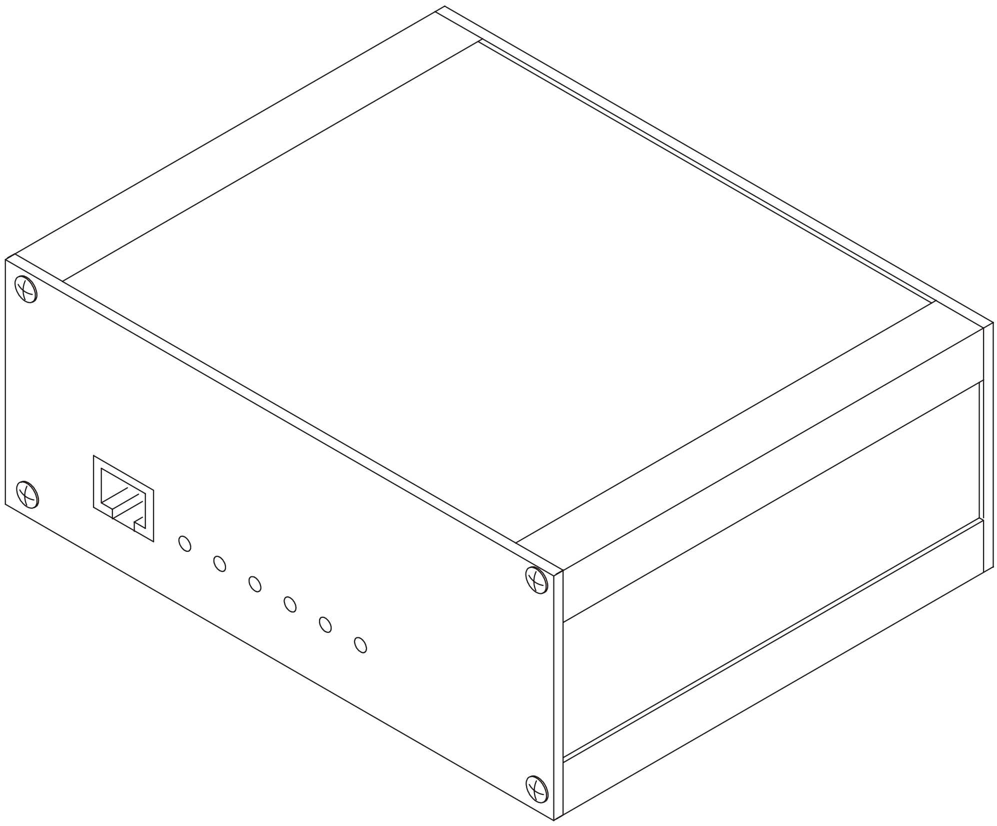


**Figure 13: Veiw of Flash Prommer FPS-4S**

## Security Box TDF-4

The Security Box TDF-4 is required for updating MCU software, and infra red testing.

Note 1: TDF-4 is delivered in de-activated mode. Fill in the enclosed Activation Request Form, and fax to NMP Salo to get the activation code

Note 2: The infra red module JLP-1 (P/N 0750079) is not included in the TDF-4 sales package.

### Product Code

| | |
|---|---|
| Security Box TDF-4: | 0770106 |

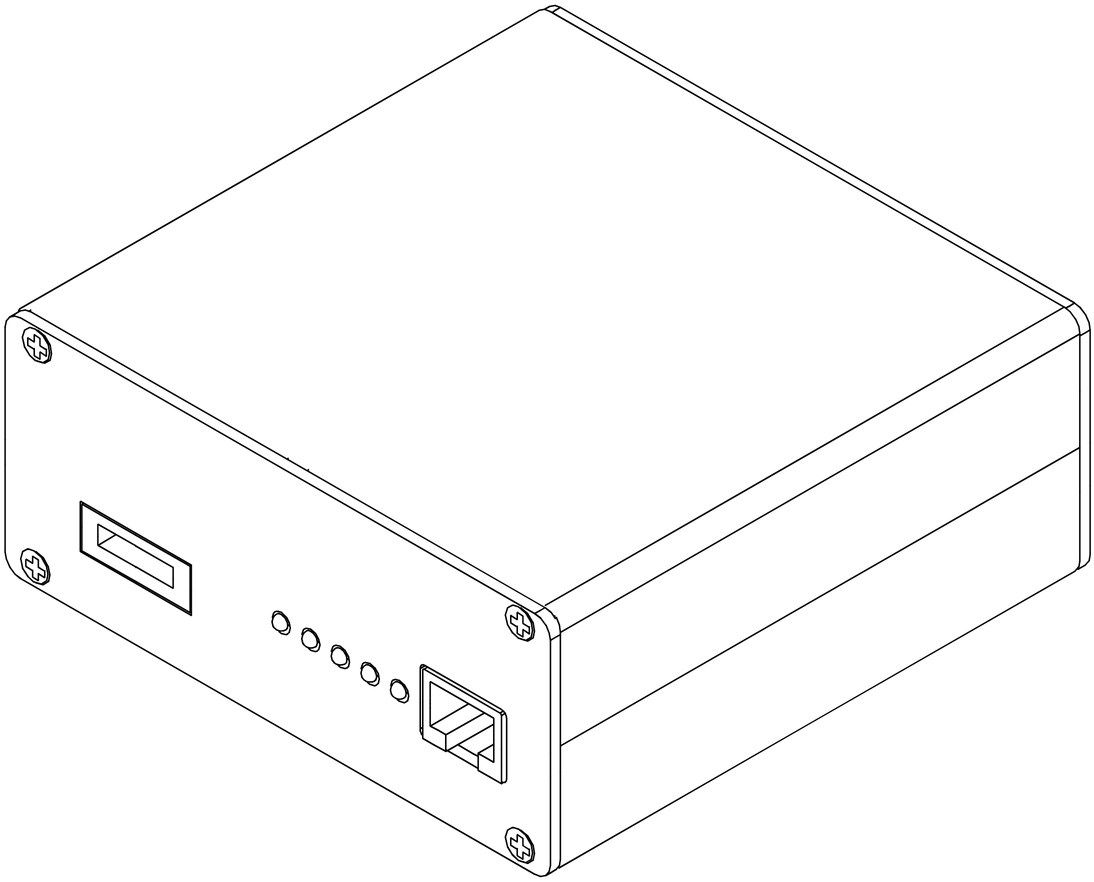


**Figure 14: View of Security Box TDF-4**

## D9-D9 Cable AXS-4U

The D9-D9 cable AXS-4U is used to connect two 9 pin D connectors. e.g. between PC serial port and FLS-2D.

**Product Code**

| | |
|---|---|
| D9-D9 Cable AXS-4U | 0730163 |

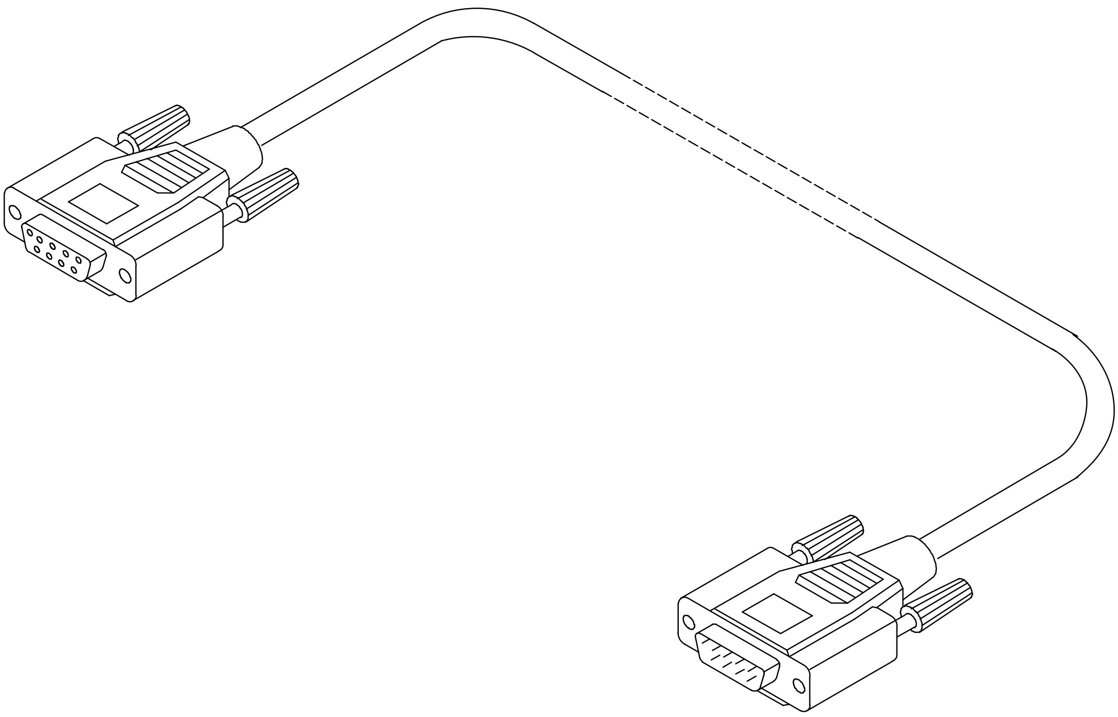


**Figure 15: View of D9-D9 Cable AXS-4U**

## D9-D9 Cable AXS-4

The D9-D9 cable AXS-4 is used to connect two 9 pin D connectors. e.g. between PC and TDF-4 security box.

### Product Code

| | |
|---|---|
| D9-D9 Cable AXS-4 | 0730090 |

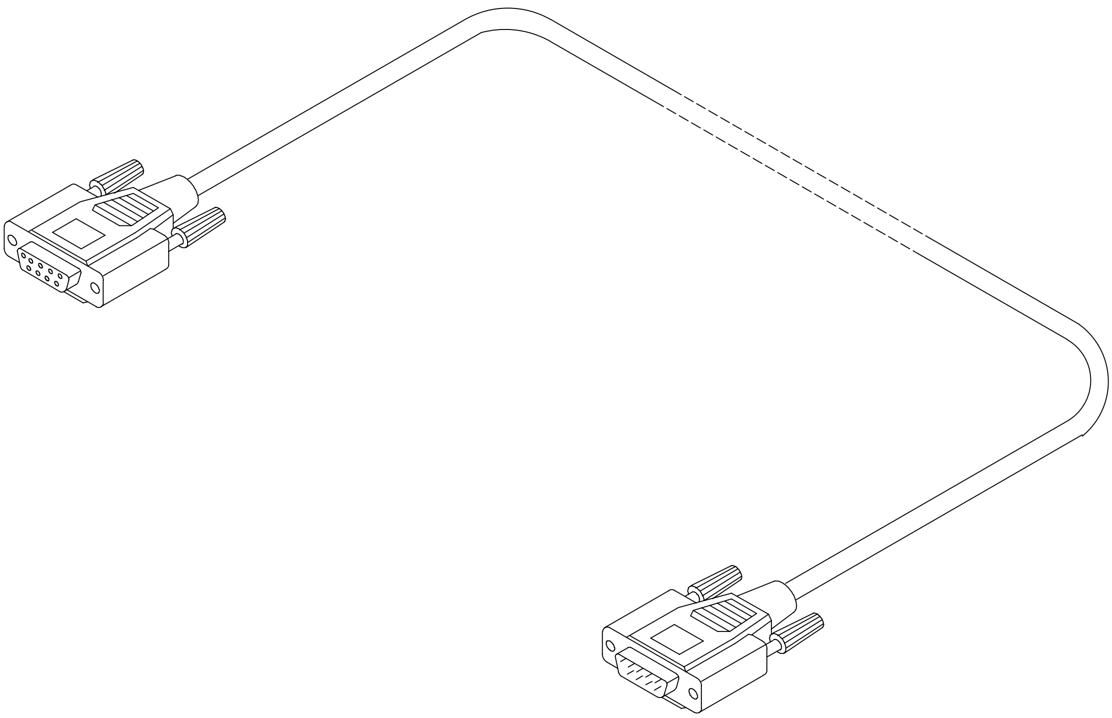


**Figure 16: View of D9-D9 Cable AXS-4**

## D15-D15 Cable AXS-5

The D15-D15 Cable AXS-5 is used to connect two 15 pin D connectors. e.g. between FLA-5/7 and FPS-4S.

### Product Code

D15-D15 Cable AXS-5: 0730091

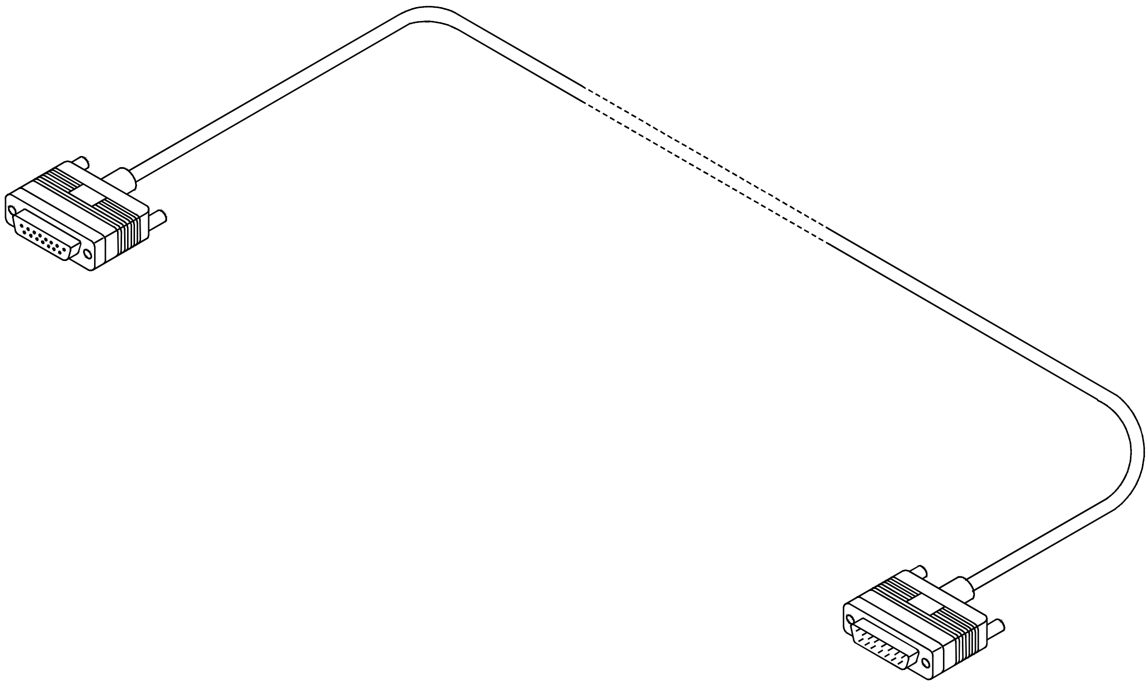


**Figure 17: View of D15-D15 Cable AXS-5**

## Audio Cable ADS-3

The audio cable connects to the Audio box JBA-6.

**Product Code**

| | |
|---|---|
| Audio Cable ADS-3 | 0730197 |

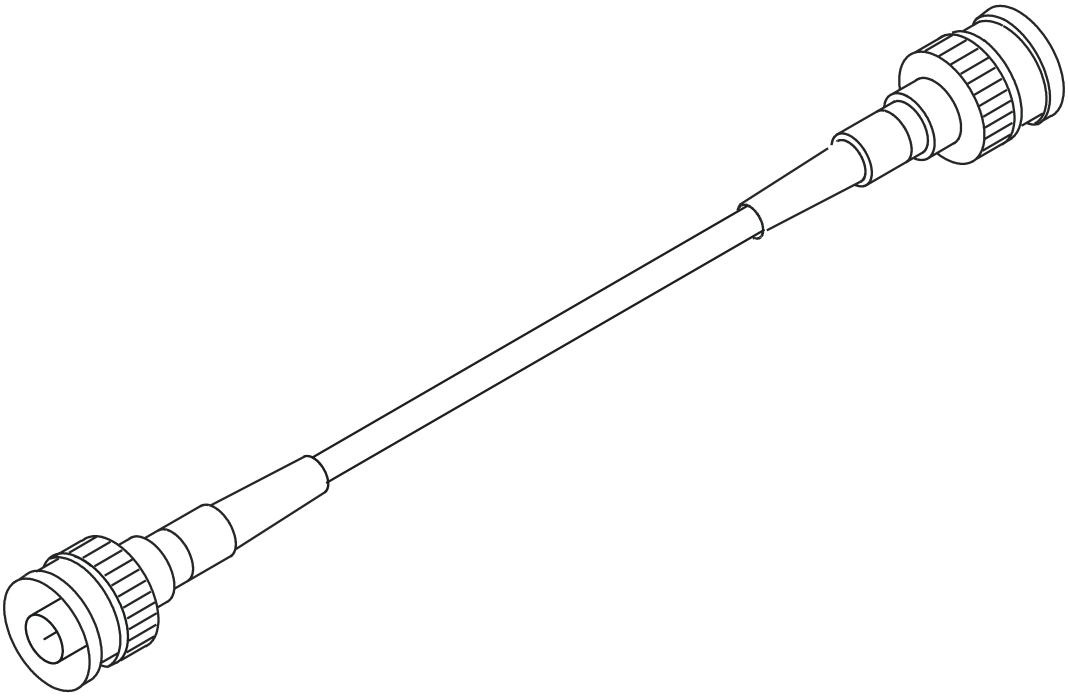


**Figure 18: Veiw of Audio Cable ADS-3**

## DC Charging Cable PCC-1

The DC Cable PCC-1 is used e.g. to connect FLA-5/7 and TDF-4.

### Product Code

DC Cable PCC-1 (with modular RJ connector): 0730053

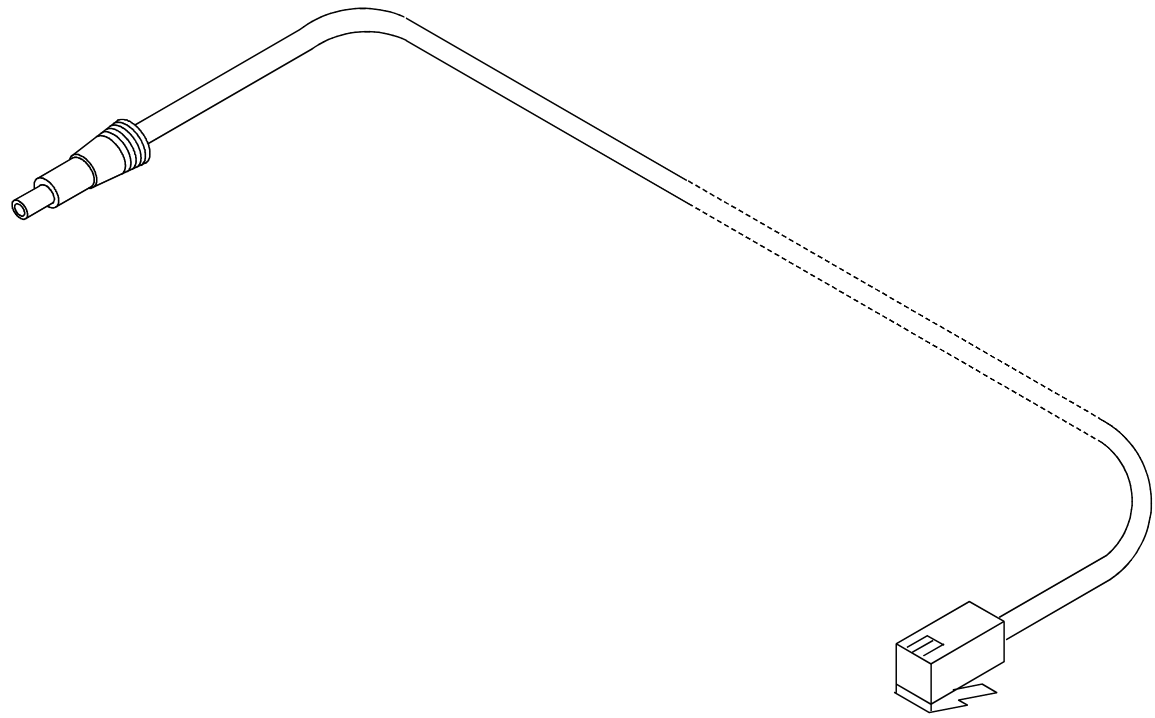


**Figure 19: View of DC Charging Cable PCC-1**

## DC Cable SCB-3

The DC Cable SCB-3 is used to connect the Service Battery to the charger connection Vin of the phone when doing the charger calibration service procedure.

### Product Code

DC Cable SCB-3: 0730114

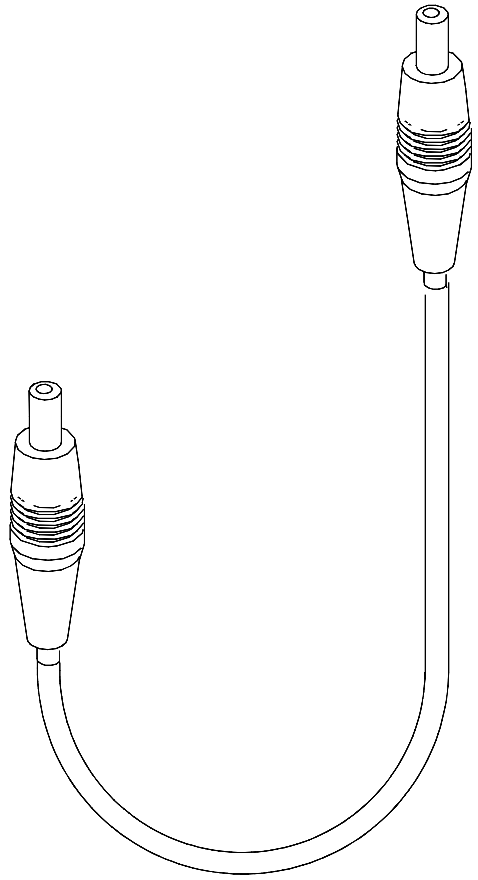


**Figure 20: View of DC Cable SCB-3**

## MBUS Cable DAU-9S

The MBUS Cable DAU-9S has a modular connector, and is used with the service Audio Box JBA-4, or a modular T-adapter.

### Product Code

MBUS Cable DAU-9S: 0730108

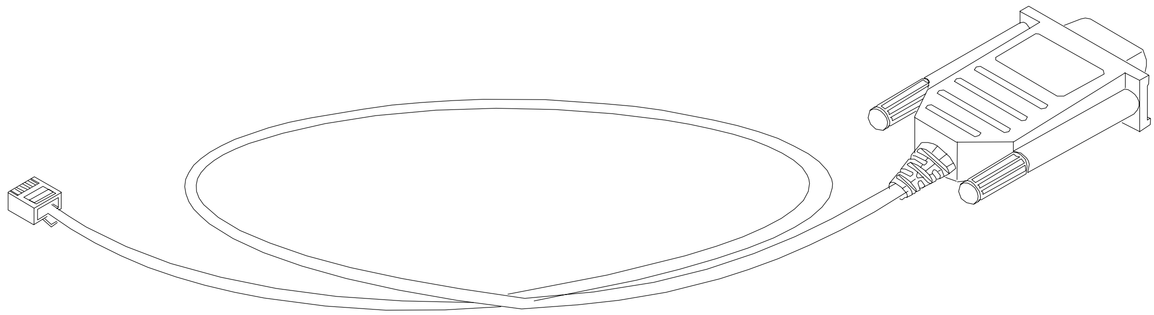


**Figure 21: View of MBUS Cable DAU-9S**

## Power Cable PCS-1

The Power Cable PCS-1 is used to connect the module jigs JBT-1 and JBS-19 to an external power supply. Can be used with FPS-4 also.

### Product Code

Power Cable PCS-1: 0730012

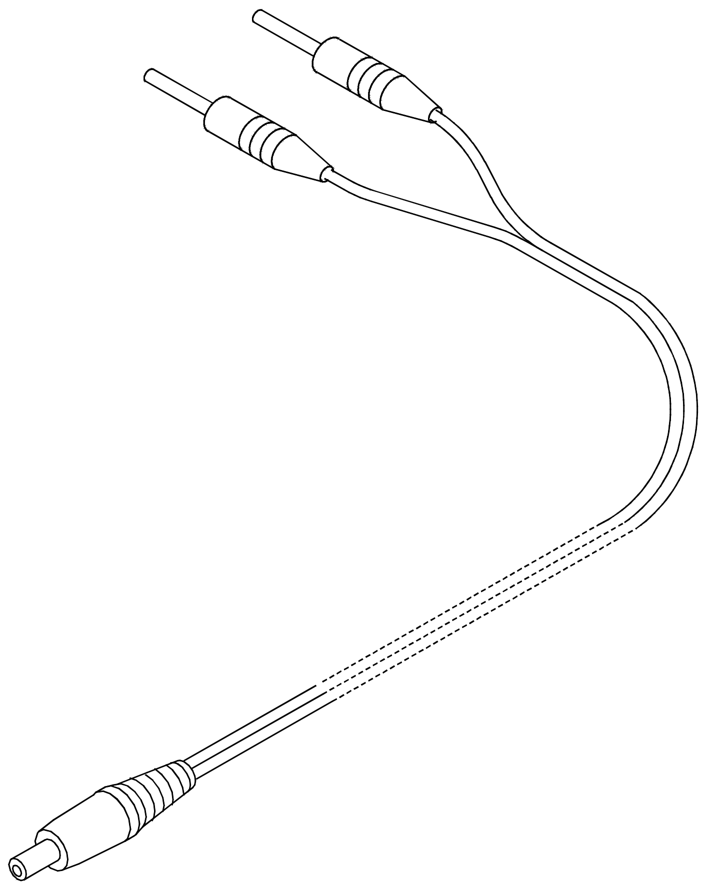


**Figure 22: View of Power Cable PCS-1**

## DC Power Cable SCF-7

The DC Power Cable SCF-7 is used for connecting power from ACL-3 charger via FLA-7 to FPS-4.

### Product Code

| | |
|---|---|
| DC Power Cable SCF-7 | 0730141 |

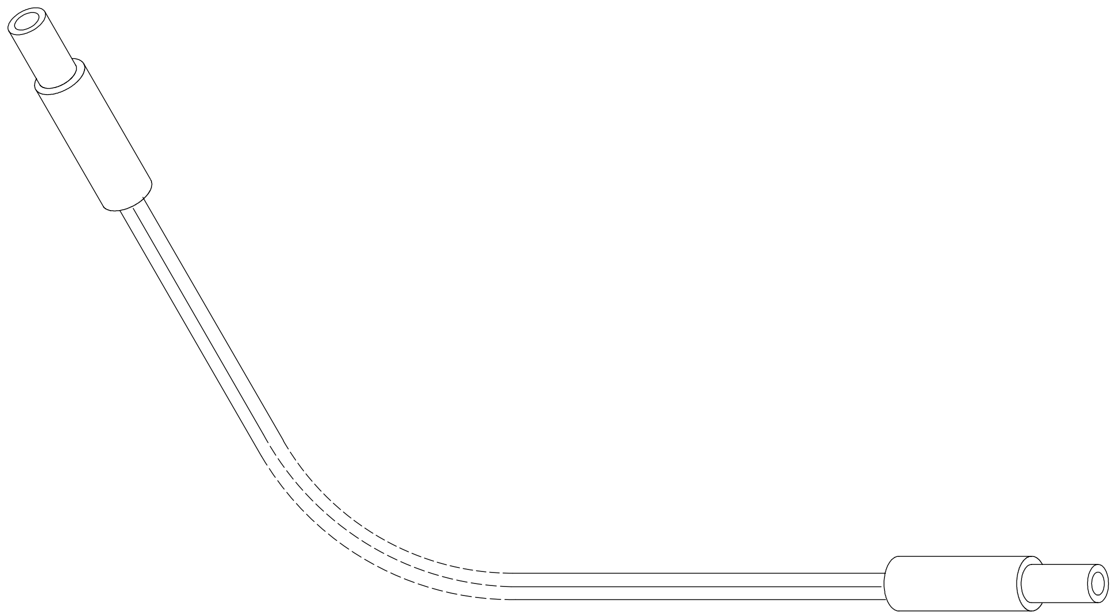


**Figure 23: View of DC Power Cable SCF-7**

## RF Cable XRF-1

RF cable XRF-1 is used to connect Test frame MJS-9 to RF measurement equipment.

### Product Code

RF Cable XRF-1: 0730085

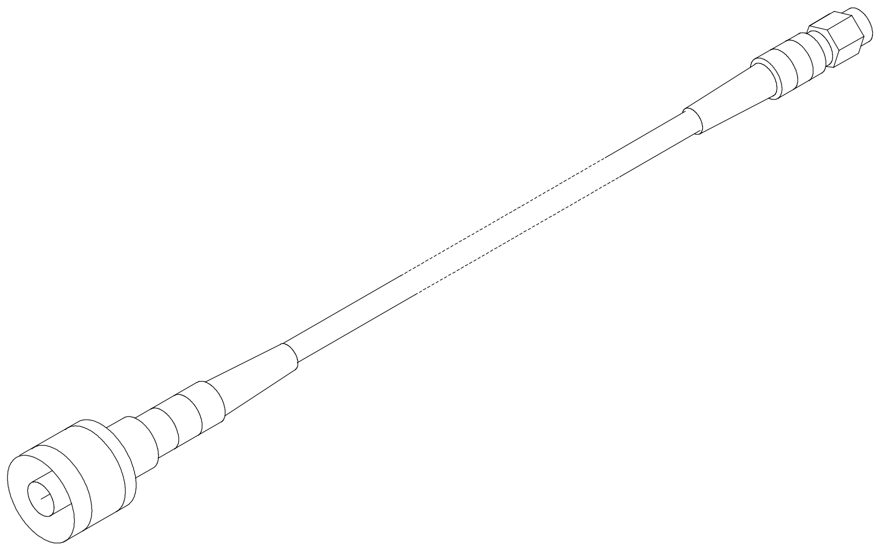


**Figure 24: View of RF Cable XRF-1**

## RF Cable XRS-3

RF cable XRS-3 is used to connect Service Box JBU-6 to RF measurement equipment.

### Product Code

| | |
|---|---|
| RF Cable XRS-3: | 0730184 |

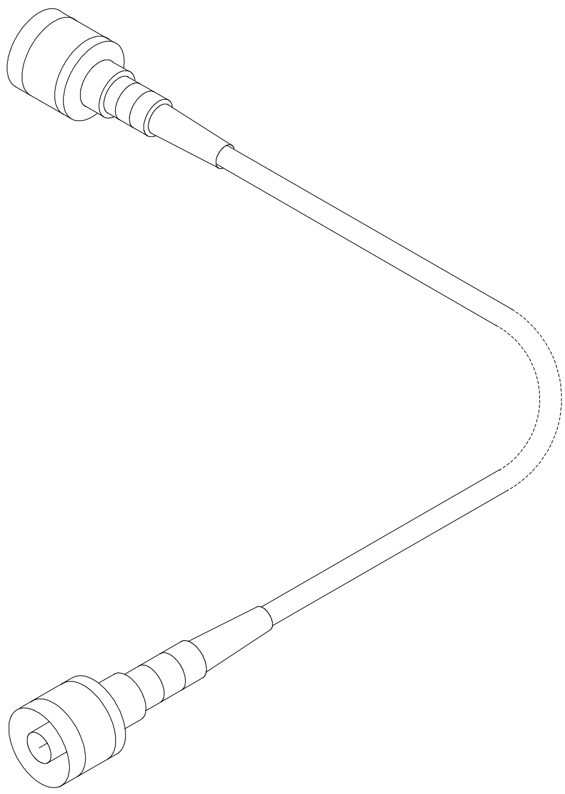


**Figure 25: View of RF Cable XRS-3**

## Service Cable XMS-3

XMS-3 is a modular cable for flashing.

**Product Code**

Service Cable XMS-3: 0730174

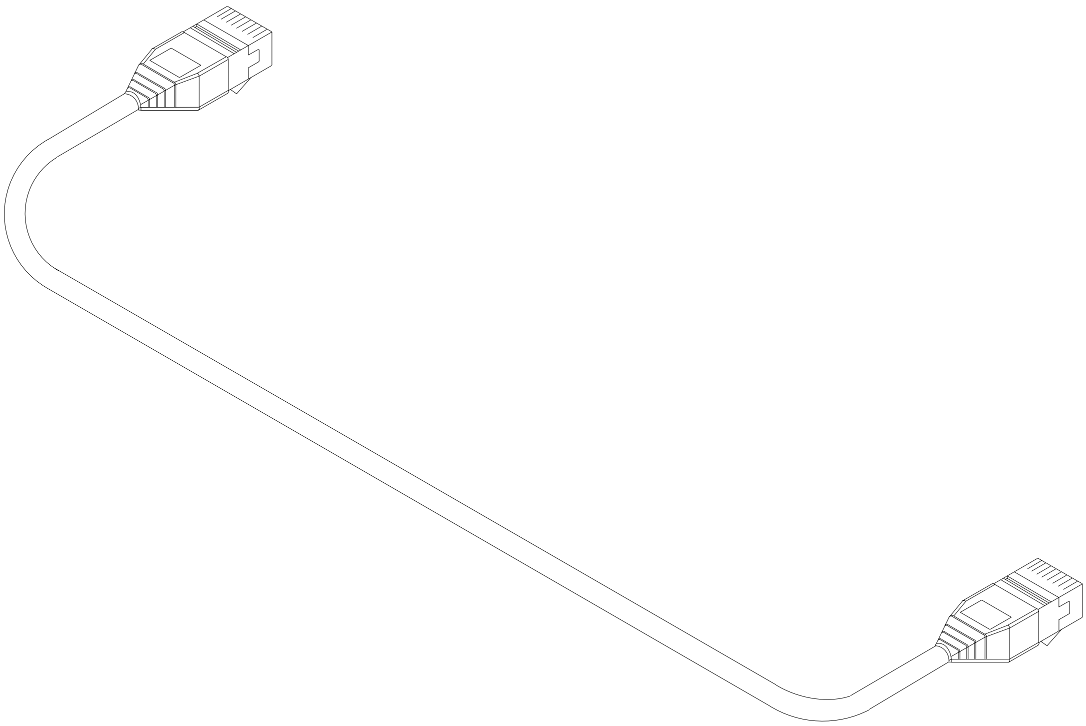


**Figure 26: View of Service Cable XMS-3**

## SW Security Device PKD-1

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 dongle present it is not possible to use the service software. Printer or any such device can be connected to the PC through the dongle if needed.

Caution: Make sure the you have switched off the PC and the printer before making connections!

Caution: Do not connected the PKD-1 to the serial port. You may damage your PKD-1!

### Product Code

SW Security Device PKD-1: 0750018

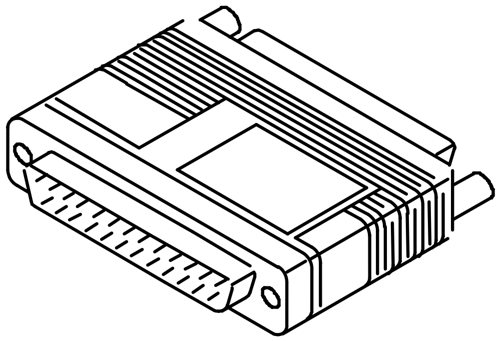


**Figure 27: View of SW Security Device PKD-1**

## Dongle/Flash Device FLS–2D (Sales Pack)

FLS–2D is a dongle and flash device incorporated into one package, developed specifically for POS use.

### Product Code

| | |
|---|---|
| Sales Pack – Europe/Africa | 0081311 |
| Sales Pack –APAC | 0081310 |
| Sales Pack –US | 0081309 |


**Figure 28: View of Dongle/Flash Device FLS–2D**

| Part No. | Description |
|---|---|
| 0750142 | FLS–2D Flash Device. |
| 0730163 | AXS–4U Cable. |
| 0770177 | Disk– Installation package,16bit Dongle Drivers. |
| 0770176 | Disk – Installation package, 32bit Dongle Drivers. |
| 0774120 | Disk – Installation package for the FLE–5 Drivers. |
| 0774123 | Disk – Remote Update Application Installation Package. |
| 0275405 | Installation and User Guide |
| 0275404 | Registration Request Form |

**Note**: *in addition to this Sales Pack, a Service Cable will be required to connect the FLS–2D to the Product/Phone to be flashed, e.g. XMS–3, and a software package to run the flashing process.*

# Disassembly & Troubleshooting

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List of Figures

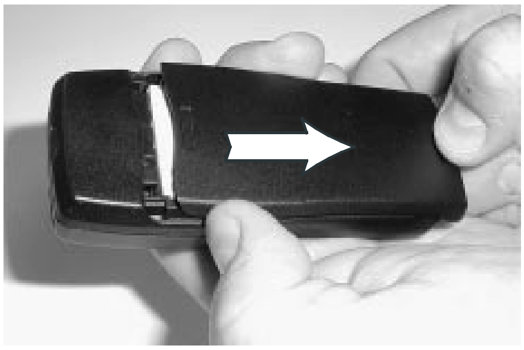
# Disassembly of NSB-7

1.

Remove battery.

Step 1. Press the button at the bottom of the phone.

Step 2. Slide the cover downwards and the cover will be released.



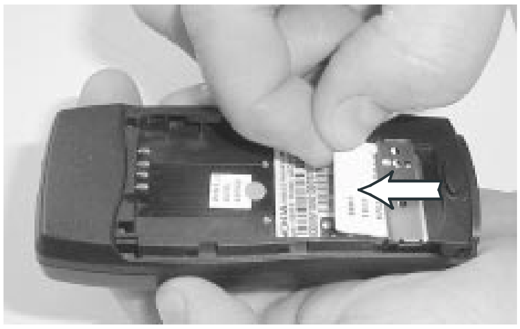
2.

Step 3. lift the battery first from the bottom end.

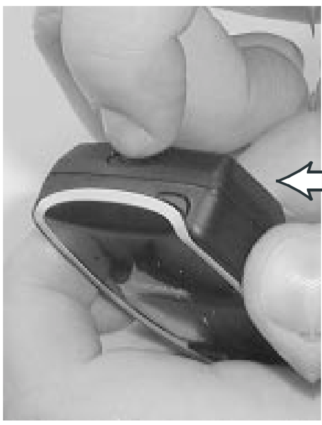
Step 4. Remove the battery.

3.

Remove the SIM card from its location.



4.

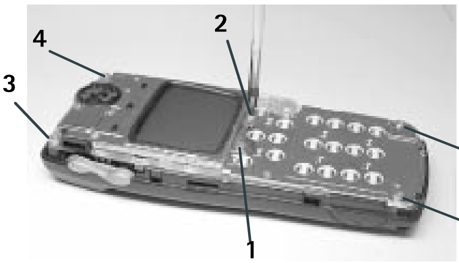


Remove A-cover.

Step 1. Press the button on the top of the phone.

Step 2. Pull A-cover apart.

**NOTE**: Snap fixings at the lower end of A-cover.

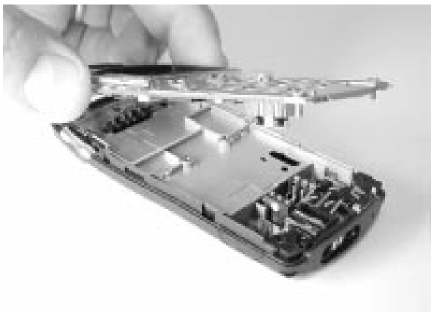



5.

To remove the PCB from the housing, remove the 6 screws.

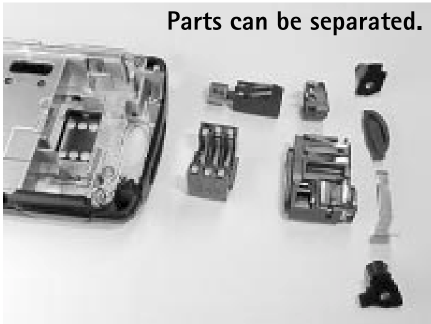
**NOTE:** Picture shows the assembly order
**Disassembly is in the reverse order.**

**NOTE:** When assembling, use 17Ncm of torque for the screws.



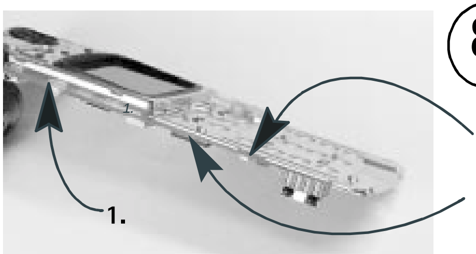
6.

Remove the PCB from B-cover.




7.

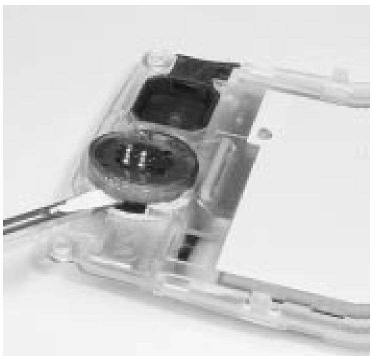
Latch and latch spring can be separated after removal of the left A-cover fixing.




8.

1. When taking the PCB and UI module apart, remember the snap fixings on both sides of the LCD.

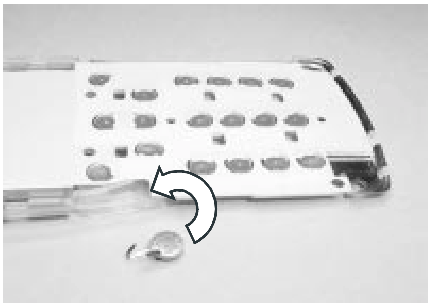
**NOTE:** When assembling, make sure UI and PCB module edges are fitted also correctly.



9.

Remove the speaker from its housing.

**NOTE:** Always install a new speaker, the old speaker must not be used. Handle with care as the speaker cone can be damaged if touched.

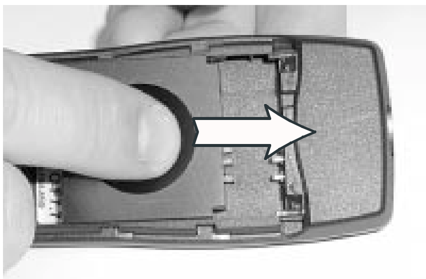


10

Remove the RTC battery from its housing in UI module.

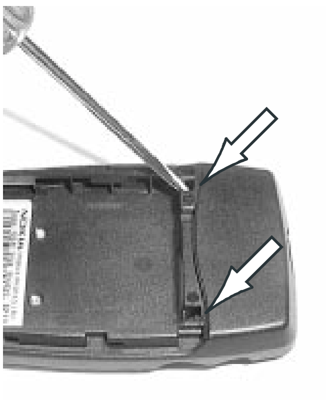
11

Remove the volume switch and key from the B-cover housing.



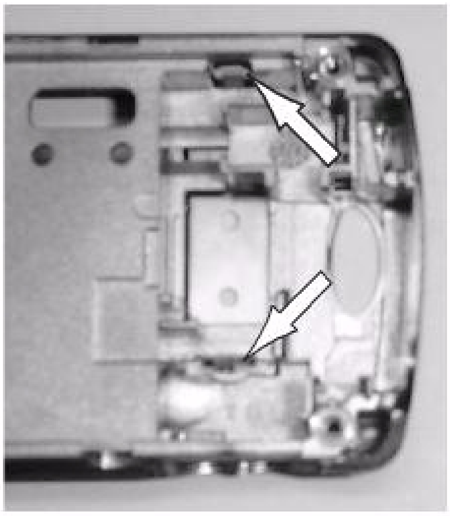
12

Remove the battery connector from its housing using SRT-3 tool.



13

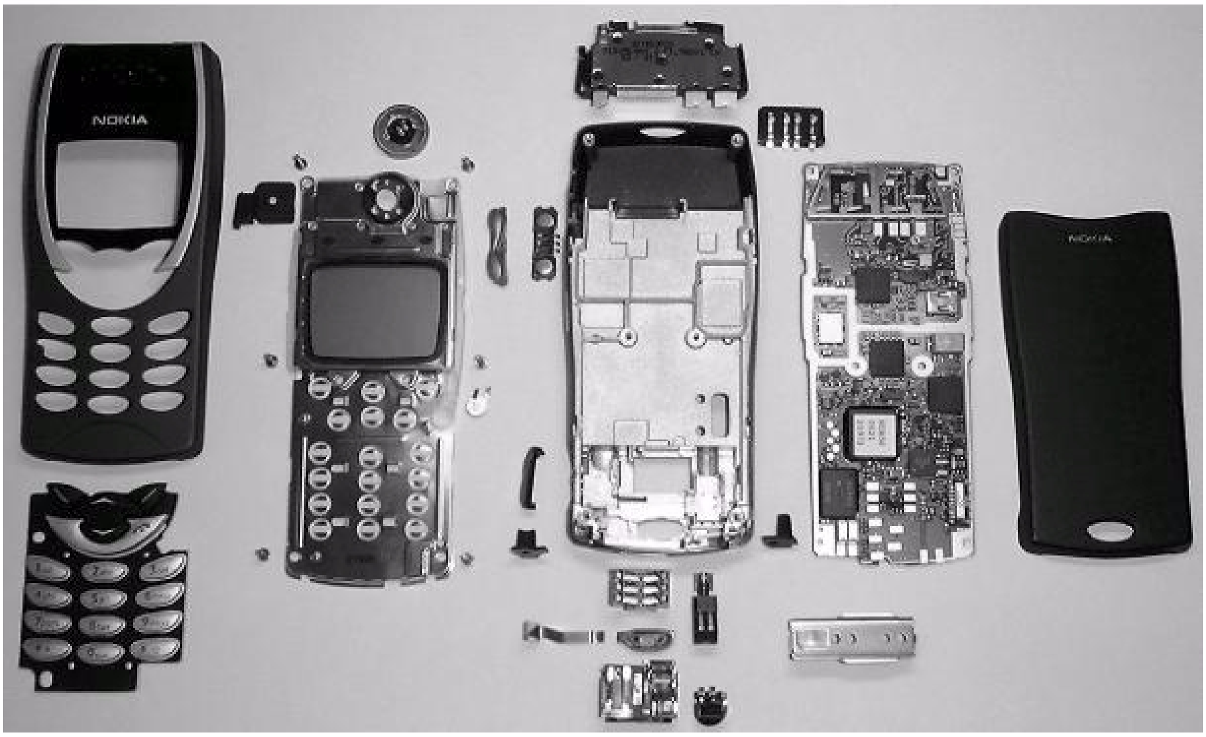
Remove the antenna by releasing the snap fixings at both sides of the phone.



14

Remove the SIM spring by releasing fixings at both ends of the spring.

Main part of the phone disassembled.



# Transceiver Troubleshooting

## Baseband Troubleshooting

### PCB Test Points

| Reference | Signal | Note |
|---|---|---|
| C213 | RFC | MAIN CLOCK (13MHz)<br>HAGAR (N505) -> MAD (D200) |
| J100* | PWM | CHARGE CURRENT CONTROL<br>CCONT (N100) -> CHAPS (N101) |
| J101 | FBUSTX | FBUS TRANSMITTED DATA<br>MAD (D200) -> SERVICE INTERFACE |
| J102 | FBUSRX | FBUS RECEIVED DATA<br>SERVICE INTERFACE -> MAD (D200) |
| J103 | MBUS | ONE WIRE TWO DIRECTION SERIAL BUS (9600 BIT/S)<br>MAD (D200) -> CCONT (N100) |
| J104 | CCONT (N100)CSX | CCONT (N100) CHIP SELECT<br>MAD (D200) -> CCONT (N100) |
| J121# | DATA_A | SIM DATA<br>CCONT (N100) <-> SIM CARD READER (X302) |
| J122# | SIMIO/O_C | SIM IO CONTROL<br>CCONT (N100) <-> SIM CARD READER (X302) |
| J223 | CCONT (N100)INT | CCONT (N100) INTERUPT<br>MAD (D200) -> CCONT (N100) |
| J226 | VCXOPWR | 26MHz SYSTEM CLOCK CONTROL<br>MAD (D200) -> VCXO (G830) |
| J227 | PURX | POWER UP RESET<br>CCONT (N100) -> MAD (D200) |
| J228 | SLEEPCLK | SLEEP CLOCK (32kHz)<br>CCONT (N100) -> MAD (D200) |
| J230 | GND | GROUND |
| J234* | HAGAR<br>(N505)_RESET_X | HAGAR (N505) RESET<br>MAD (D200) -> HAGAR (N505) |
| J235 | ROM1SELX | FLASH CHIP SELECT<br>MAD (D200) -> COMPOMEMORY (D210) |
| J236 | RAMSELX | RAM CHIP SELECT<br>MAD (D200) -> COMPOMEMORY (D210) |
| J237 | SYNTHDATA<br>(SDATA) | HAGAR (N505) SERIAL DATA<br>MAD (D200) -> HAGAR (N505) |
| J239 | DSPXF | NOT CONNECTED |

| Reference | Signal | Note |
|---|---|---|
| U54 | MCURDX | MCU READ<br>MAD (D200) -> COMPOMEMORY (D210) |
| J241 | MCUWRX | MCU WRITE<br>MAD (D200) -> COMPOMEMORY (D210) |
| J242 | MCUAD1 | MCU ADDRESS LINE 1<br>MAD (D200) -> COMPOMEMORY (D210) |
| J245*<br>R205# | SCLK | HAGAR (N505) SERIAL CLOCK<br>MAD (D200) -> HAGAR (N505) |
| J250 | COBBA<br>(N250)CSX | COBBA (N250) CHIP SELECT<br>MAD (D200) -> COBBA (N250) |
| J251 | COBBA<br>(N250)SDA | COBBA (N250) SERIAL BUS DATA<br>MAD (D200) <-> COBBA (N250) |
| J252 | COBBA<br>(N250)CLK | COBBA (N250) SERIAL BUS CLOCK<br>MAD (D200) -> COBBA (N250) |
| J253 | PCMRXDATA | AUDIO RECEIVED DATA<br>COBBA (N250) -> MAD (D200) |
| J254 | PCMDCLK | AUDIO DATA CLOCK (512kHz)<br>MAD (D200) -> COBBA (N250) |
| J255 | PCMSCLK | AUDIO SYNC CLOCK (8kHz)<br>MAD (D200) -> COBBA (N250) |
| J225 | ESYSRESETX | COMPOMEMORY (D210) ENABLE<br>MAD (D200) -> COMPOMEMORY (D210) |
| J256 | PCMTXDATA | AUDIO TRANSMITTED DATA<br>MAD (D200) -> COBBA (N250) |
| J257 | CCUT<br>(MCUGENIO0) | CHARGE CUT<br>MAD (D200) -> CHAPS (N101) |
| J259* | BUTTON_CTRL_2<br>(MCUGENIO2) | HEADSET BUTTON DETECTION CONTROL<br>MAD (D200) -> XMICP |
| J260 | EXTMCUDA0 | MCU DATA LINE 0<br>MAD (D200) <-> COMPOMEMORY (D210) |
| J299*<br>R745# | TXP | TRANSMITTER POWER CONTROL<br>MAD (D200) -> RF |
| L200 | MIC | MIC BIAS VOLTAGE, 2.1v IF NO MIC<br>V250 -> MIC |
| N310 PIN 13 | KBD LIGHT | KEYPAD LED LIGHT CURRENT<br>UI-SWITCH (N310) -> KEYPAD BACKLIGHT LEDS |
| N310 PIN 14 | KBDLED_ADJ | KEYPAD BACKLIGHT BRIGHTNESS ADJUSTMENT<br>R311 -> UI-SWITCH (N310) |
| N310 PIN 16 | VIBRA_CTRL | VIBRA DRIVE<br>UI-SWITCH (N310) -> VIBRA (M300) |

| Reference | Signal | Note |
|---|---|---|
| N310 PIN 19 | VIBRA | VIBRA CONTROL PWM<br>MAD (D200) -> UI-SWITCH (N310) |
| N310 PIN 3 | BUZZER | BUZZER CONTROL PWM<br>MAD (D200) -> UI-SWITCH (N310) |
| N310 PIN 6 | BUZZER_CTRL | BUZZER DRIVE<br>UI-SWITCH (N310) -> BUZZER (B301) |
| N310 PIN 7 | KBLIGHTS | KEYPAD AND DISPLAY BACKLIGHT CONTROL<br>MAD (D200) -> UI-SWITCH (N310) |
| N310 PIN 8 | LCDLED_ADJ | LCD BACKLIGHT BRIGHTNESS ADJUSTMENT<br>R310 -> UI-SWITCH (N310) |
| N310 PIN 9 | LCD LIGHT | LCD LED LIGHT CURRENT<br>UI-SWITCH (N310) -> DISPLAY BACKLIGHT LEDS |
| N400 PIN 4 | IRONX | IRDA (N400) SHUTDOWN<br>MAD (D200) -> IRDA (N400) |
| N401 PIN 4 | IRDA (N400)<br>POWER | 2.8V<br>N401 -> IRDA (N400) |
| R118 | PWRONX | POWER ON BUTTON<br>POWER BUTTON (S330) -> CCONT (N100) |
| R206 | SENA | HAGAR (N505) CHIP SELECT<br>MAD (D200) -> HAGAR (N505) |
| R211 | VPP | FLASH PROGRAMMING VOLTAGE<br>N220 -> COMPOMEMORY (D210) |
| R277 | EAD | ACCESSORY DETECTION<br>XMICP -> CCONT (N100) |

#ONLY IN NSM-2
*ONLY IN NSB-6 and NSB-7

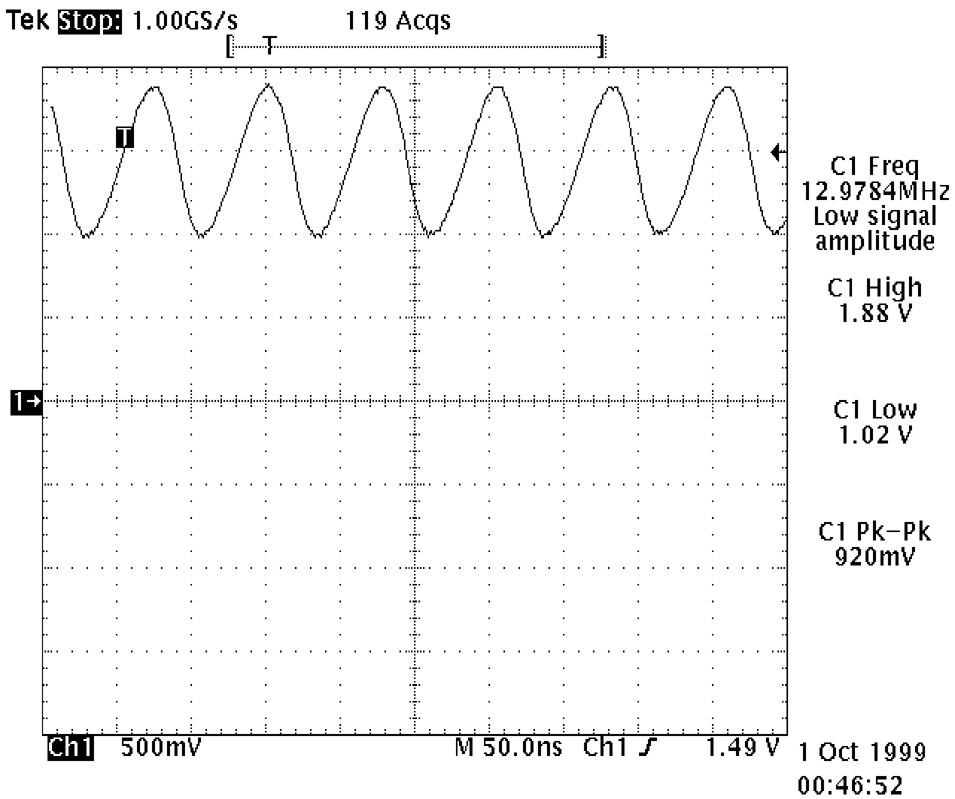



Figure 1: C213, RFC in normal operation

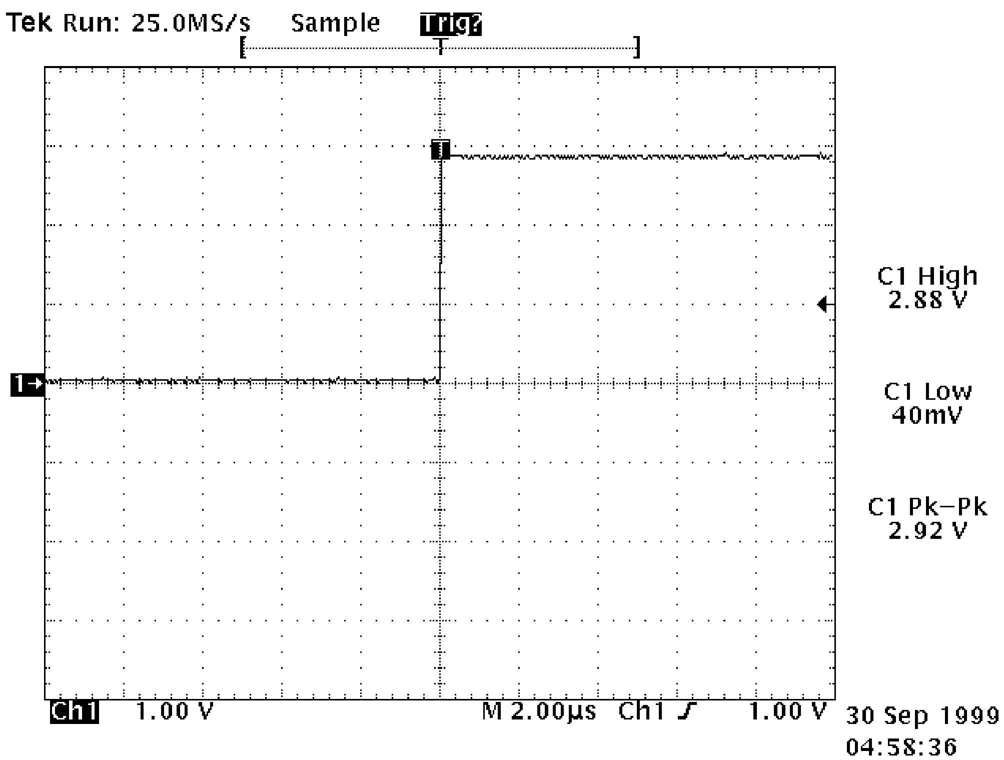



Figure 2: J227, PURX (levels)

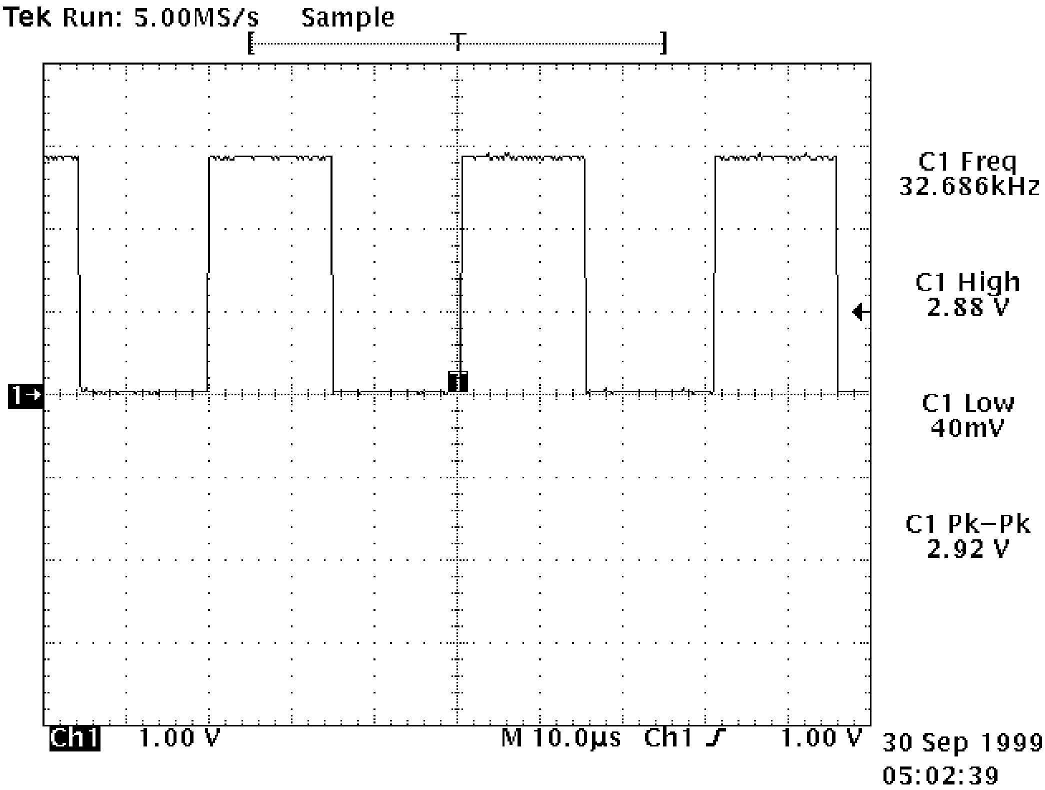



Figure 3: J228, SLEEPCLK

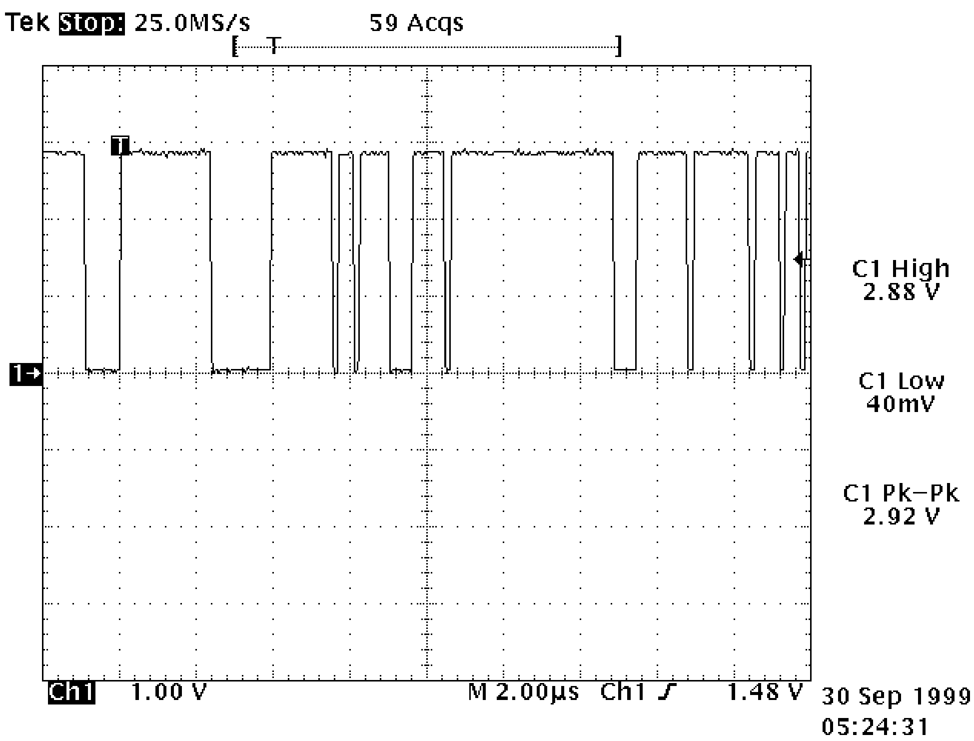



Figure 4: J236, RAMSELX

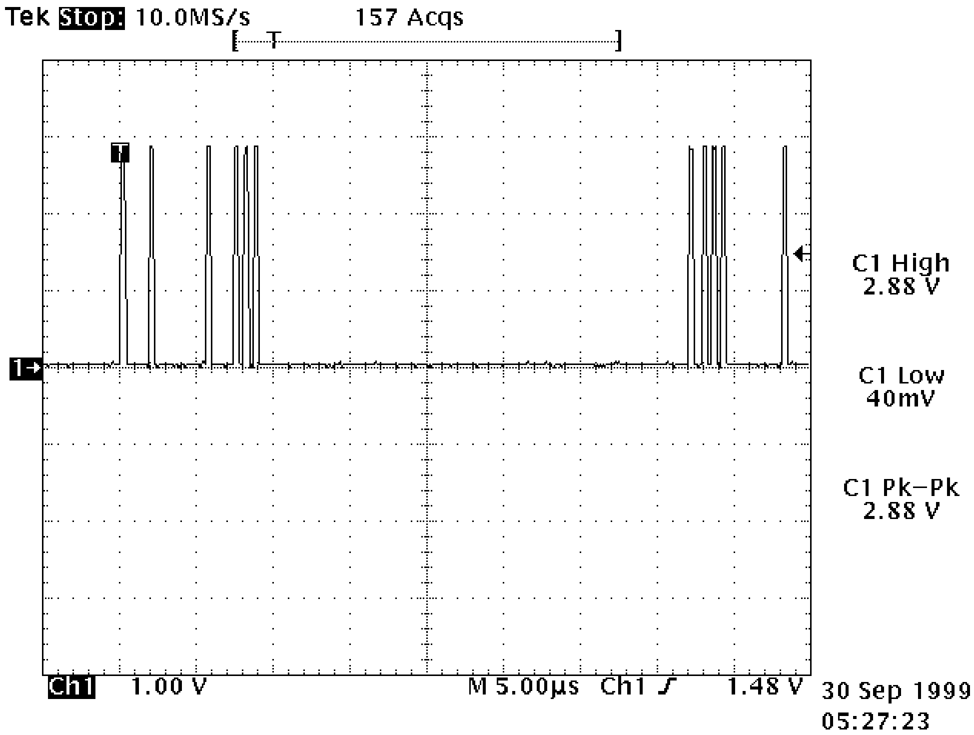



Figure 5: J237, SYNTHDATA

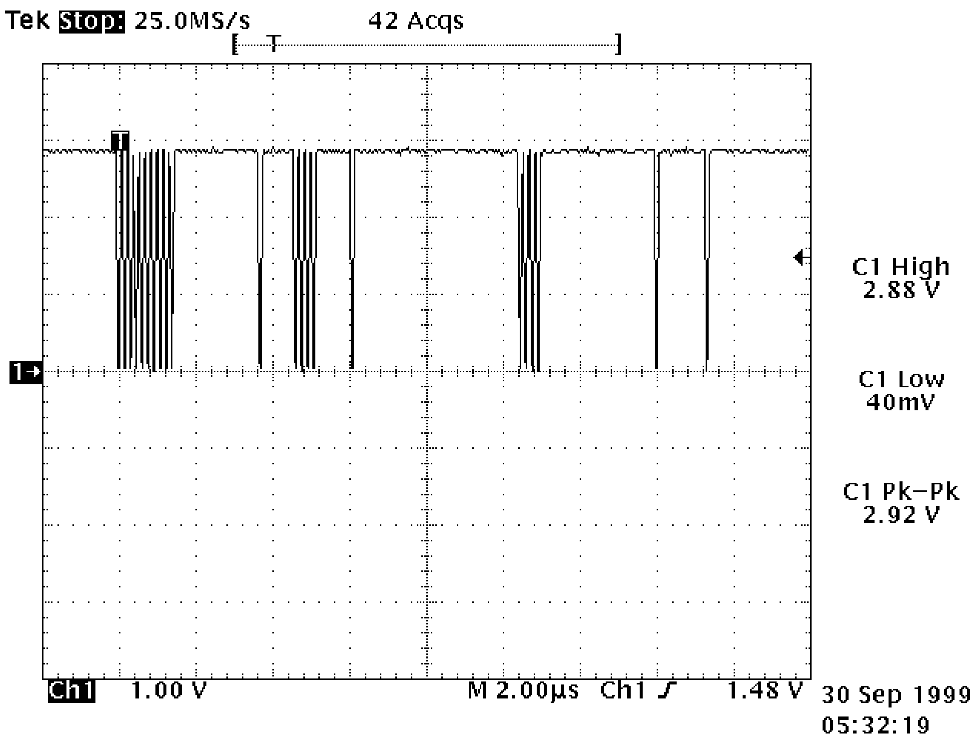



Figure 6: J241, MCUWRX

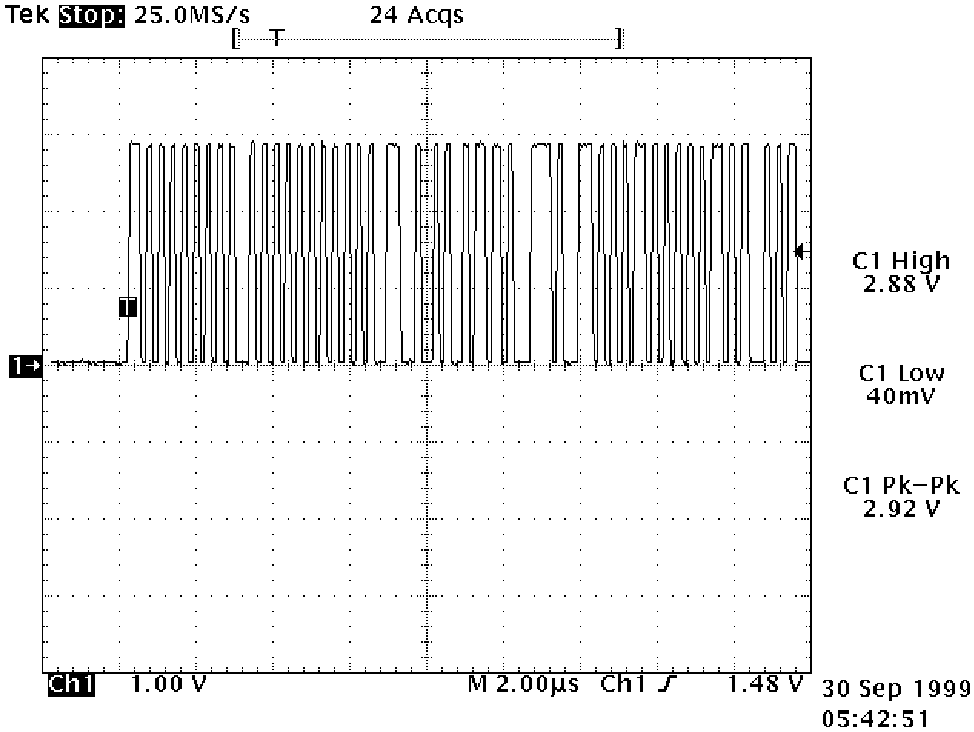



**Figure 7: J242, MCUAD1**

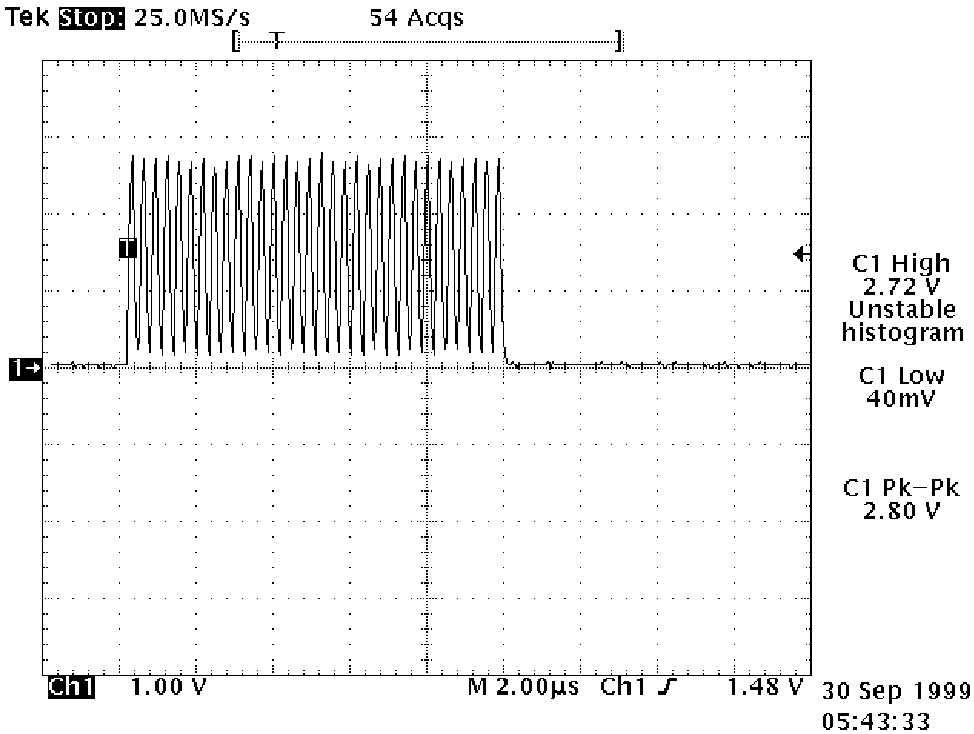



**Figure 8: J245, SCLK**

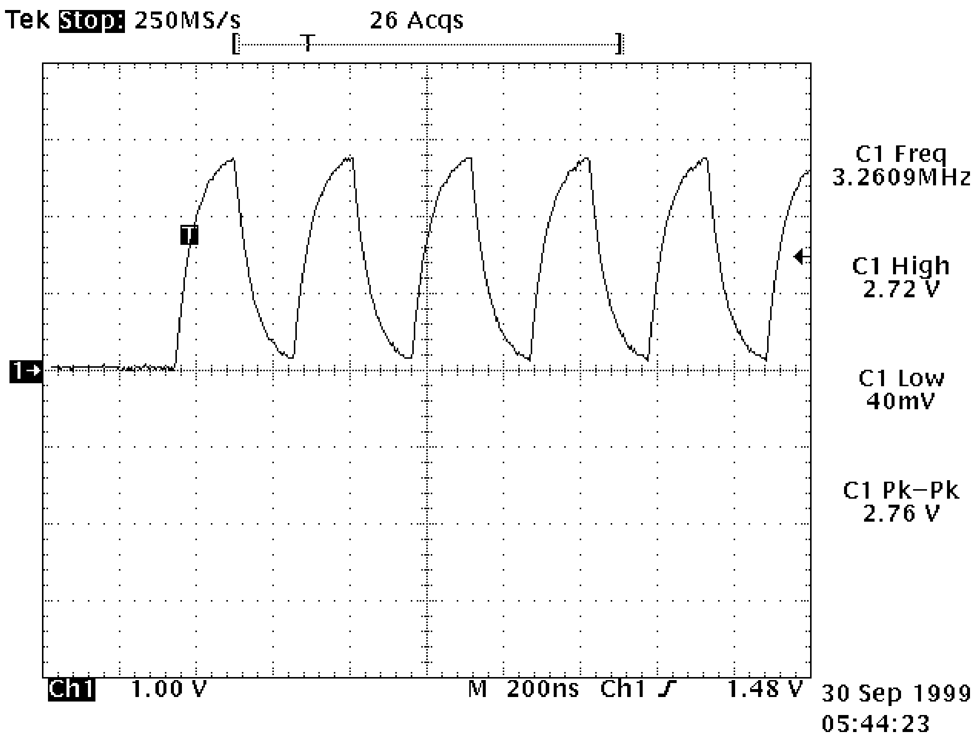



**Figure 9: J245, SCLK (DIFFERENT TIME SCALE IN OSCILLOSCOPE)**

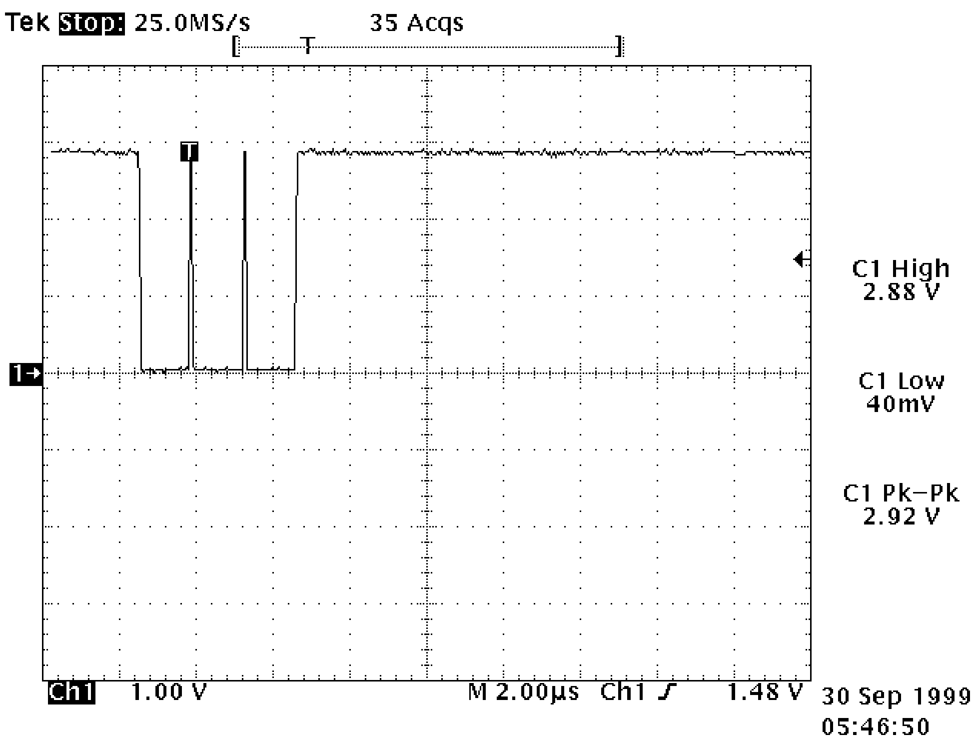



**Figure 10: J250, COBBA (CSX)**

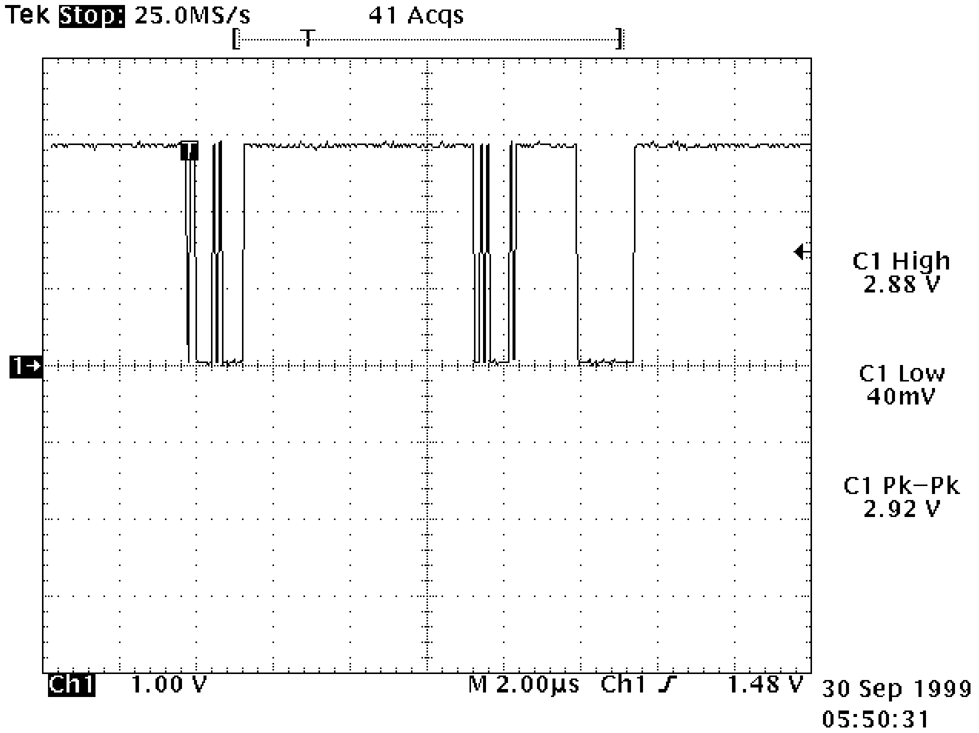



Figure 11: J251, COBBA (SDA)

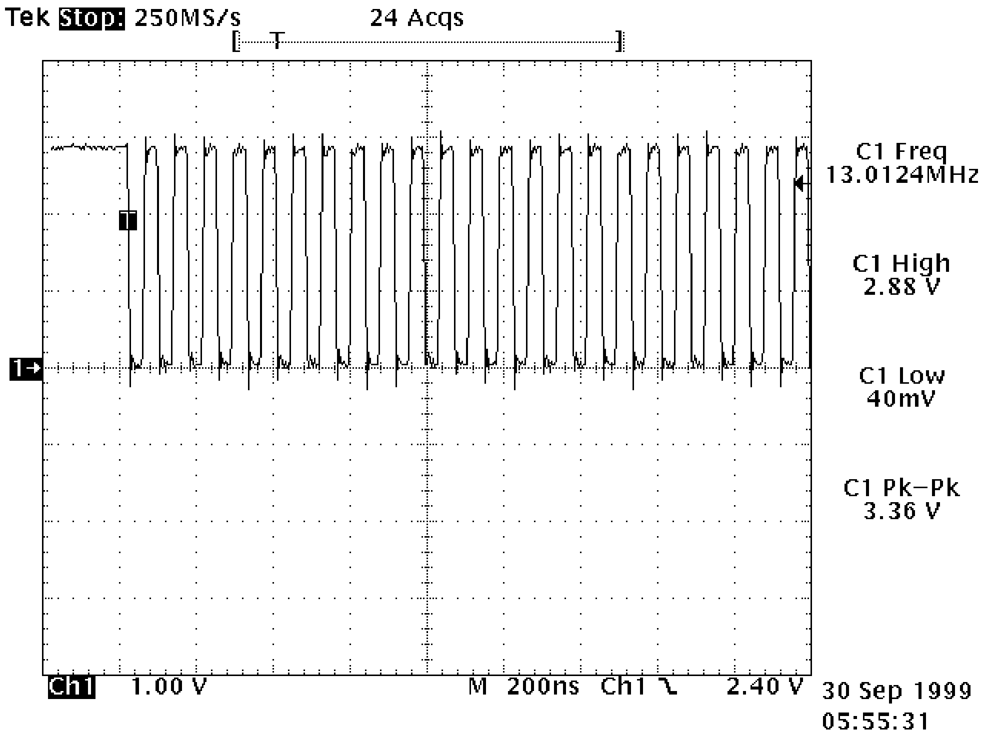



Figure 12: J252, COBBA (CLK)

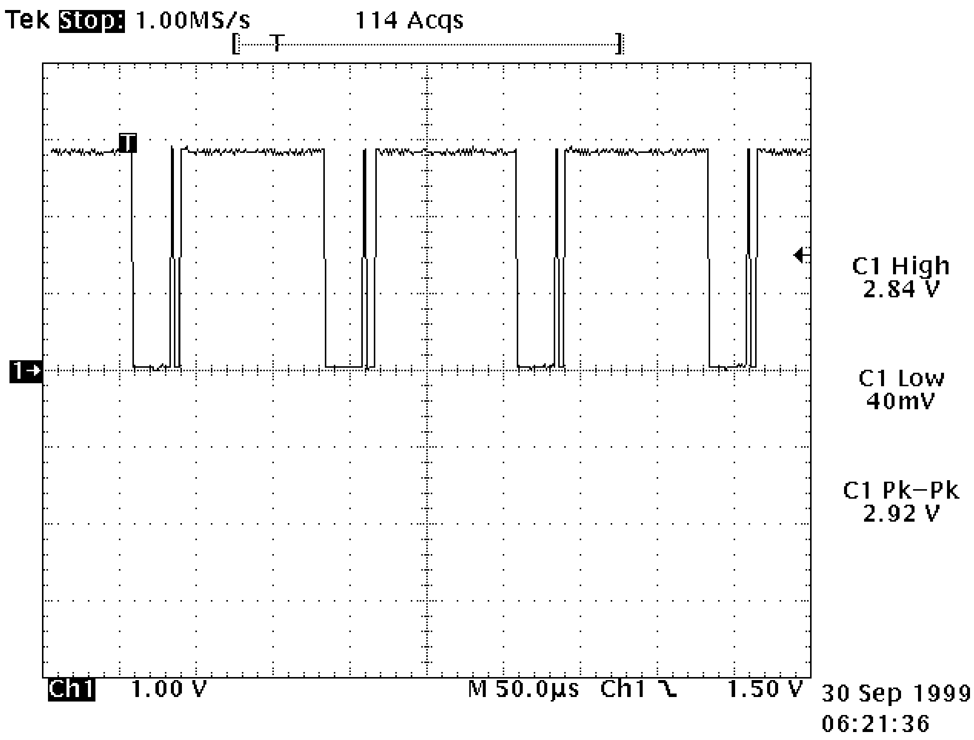



**Figure 13: J253, PCMRXDATA, WinTesla AUdiotest, Loop ON, Input & Output Internal**

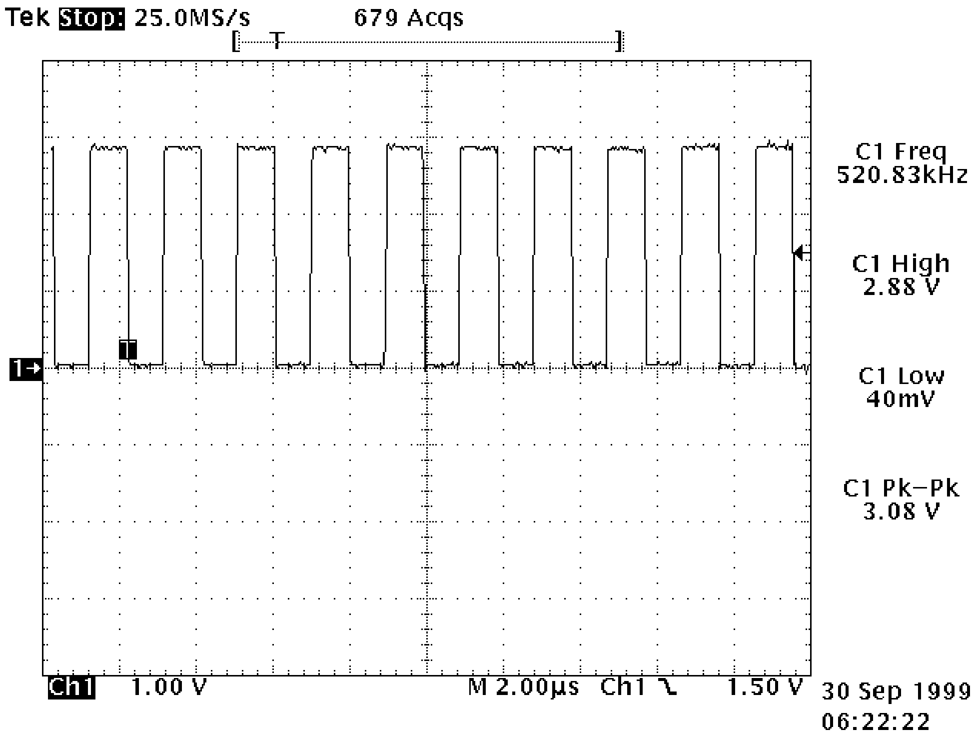



**Figure 14: J254, PCMDCLK**

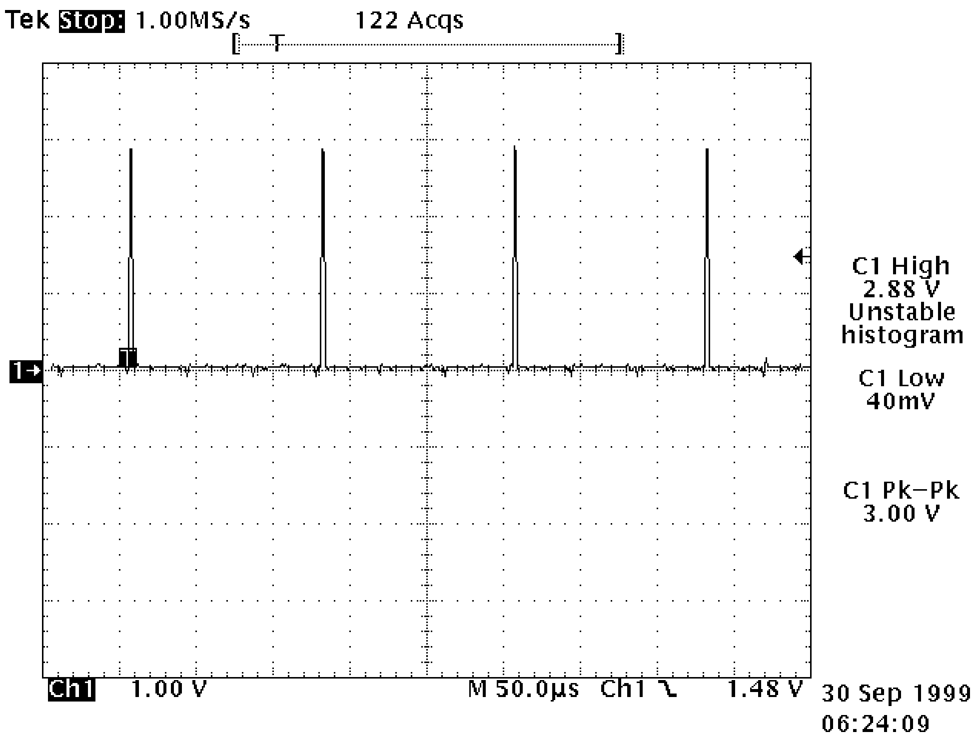



**Figure 15: J255, PCMSCLK**

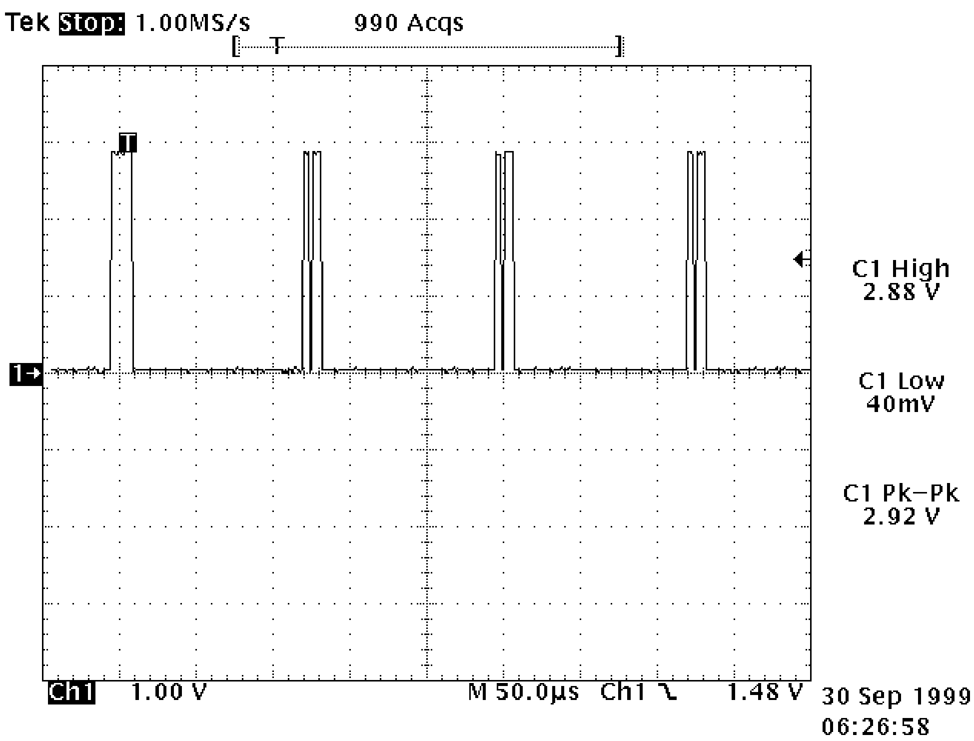



**Figure 16: J256, PCMTXDATA, WinTesla Audiotest, Loop ON, Input & Output Internal**

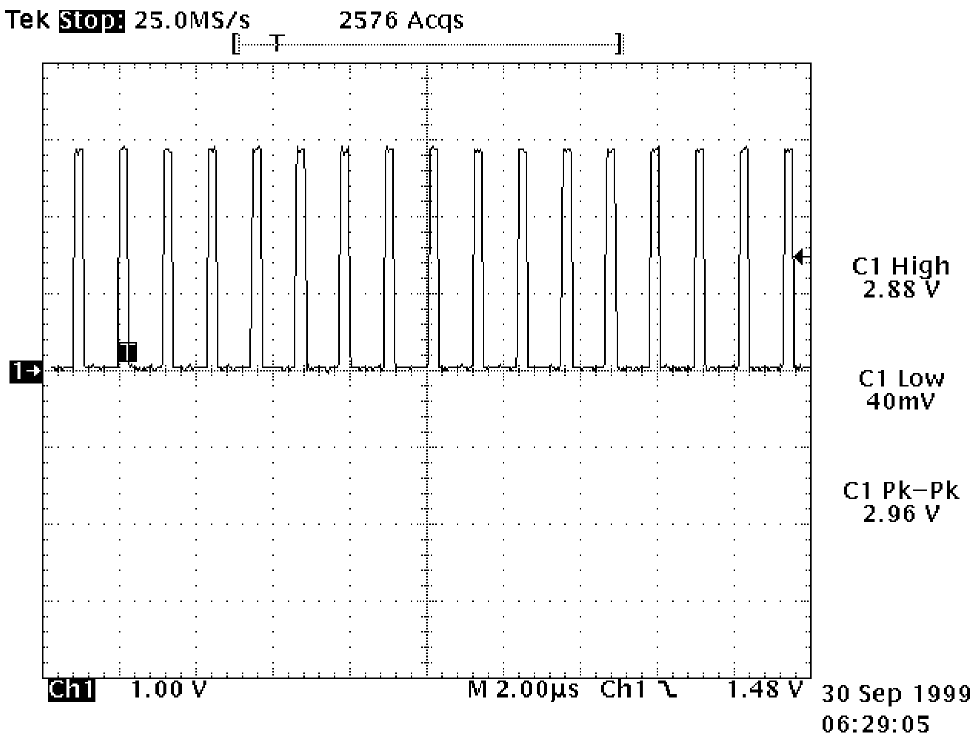



Figure 17: J260, EXTMCUDA0

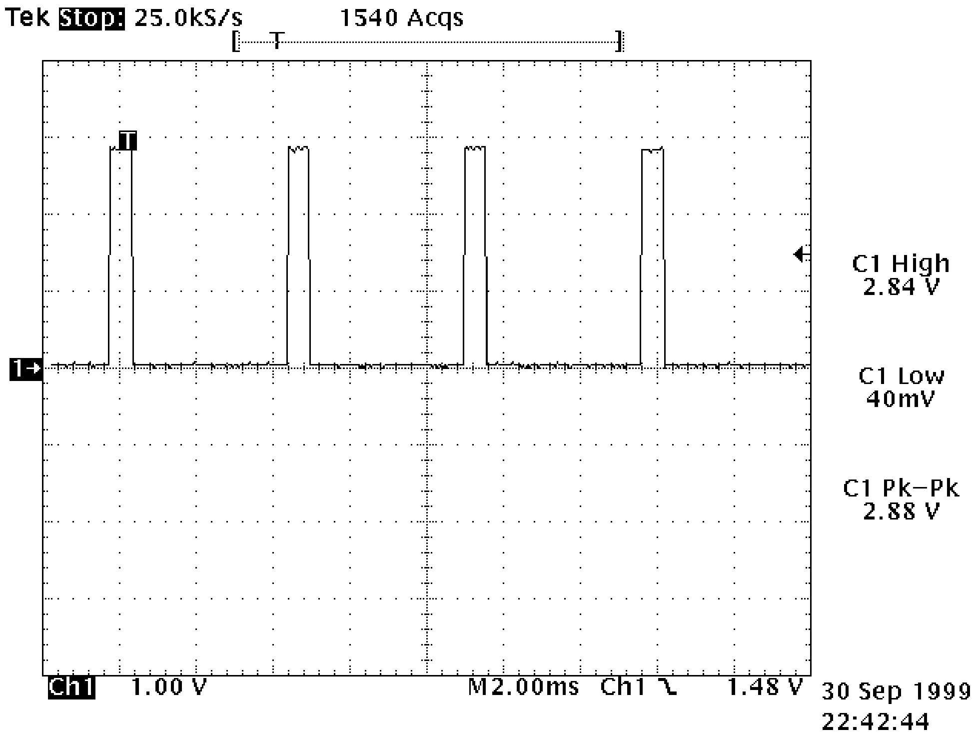



Figure 18: J299, TXP, WinTesla RF Control, TX, Burst, TX level 14, Data Type Cont

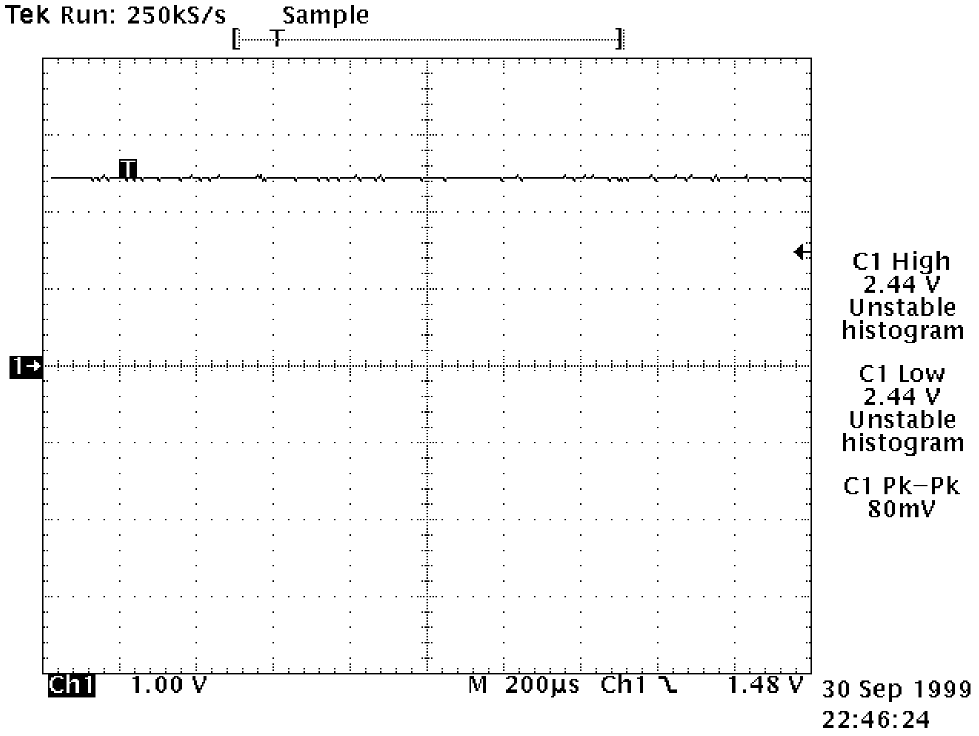



**Figure 19: L200, MIC, no mic connected**

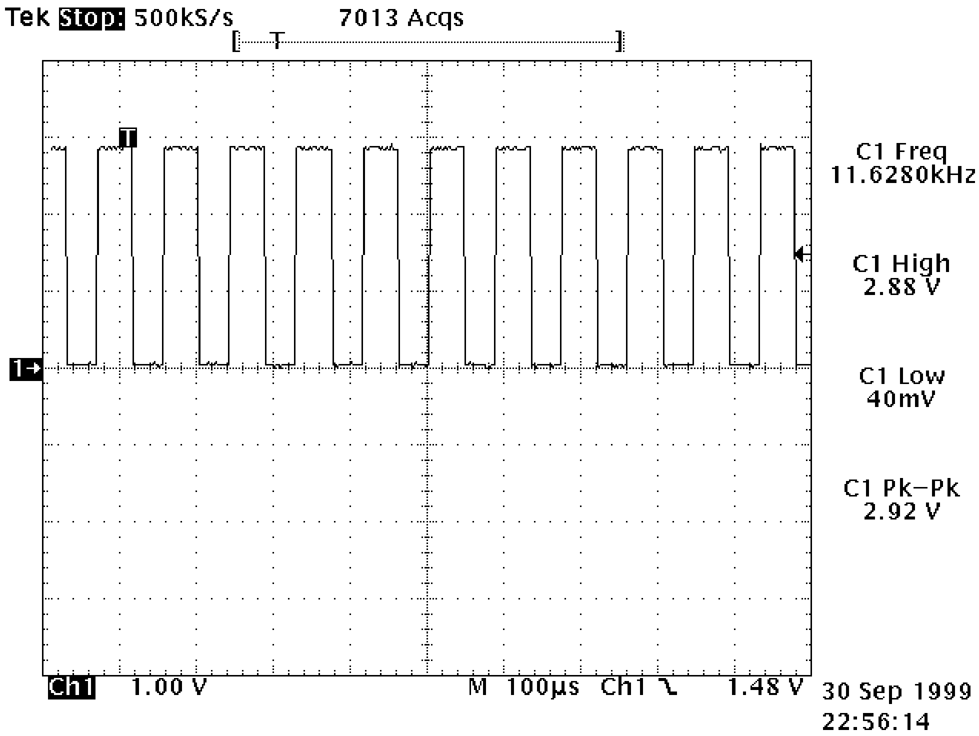



**Figure 20: N310 PIN 19, VIBRA, ACTIVATED FROM KEYPAD**

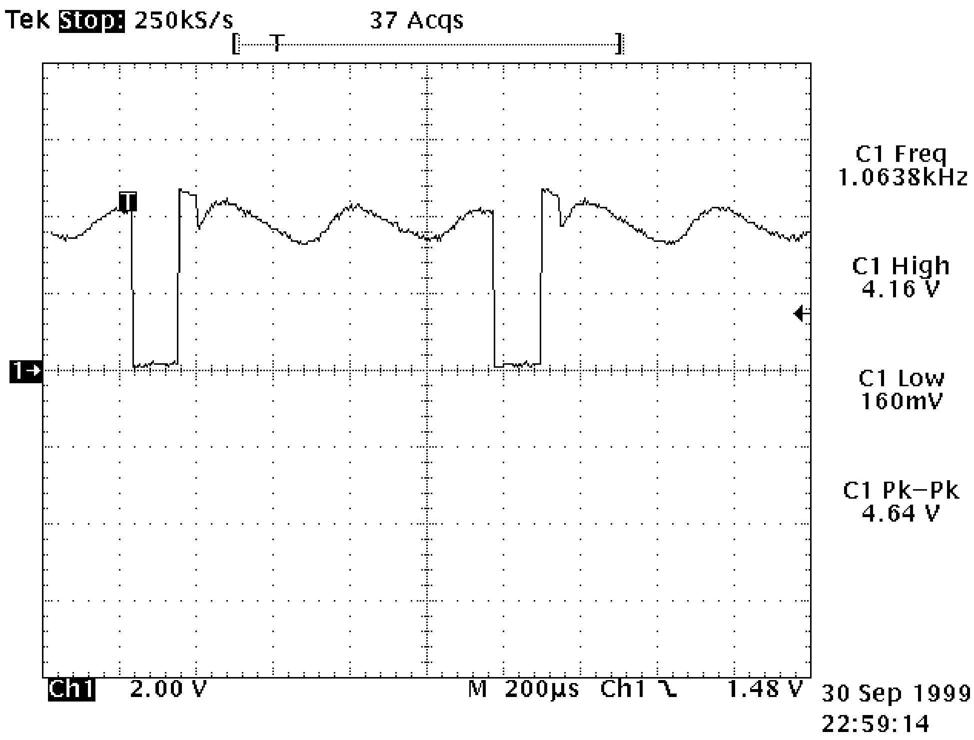



Figure 21: N310 PIN 6, BUZZER_CTRL

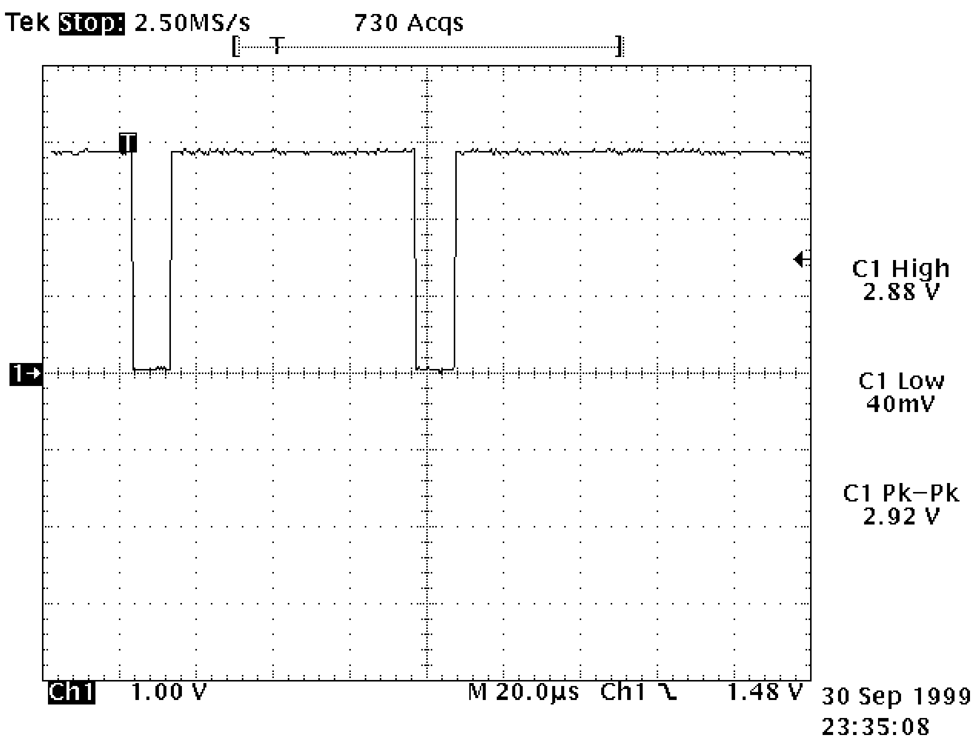



Figure 22: R206, SENA

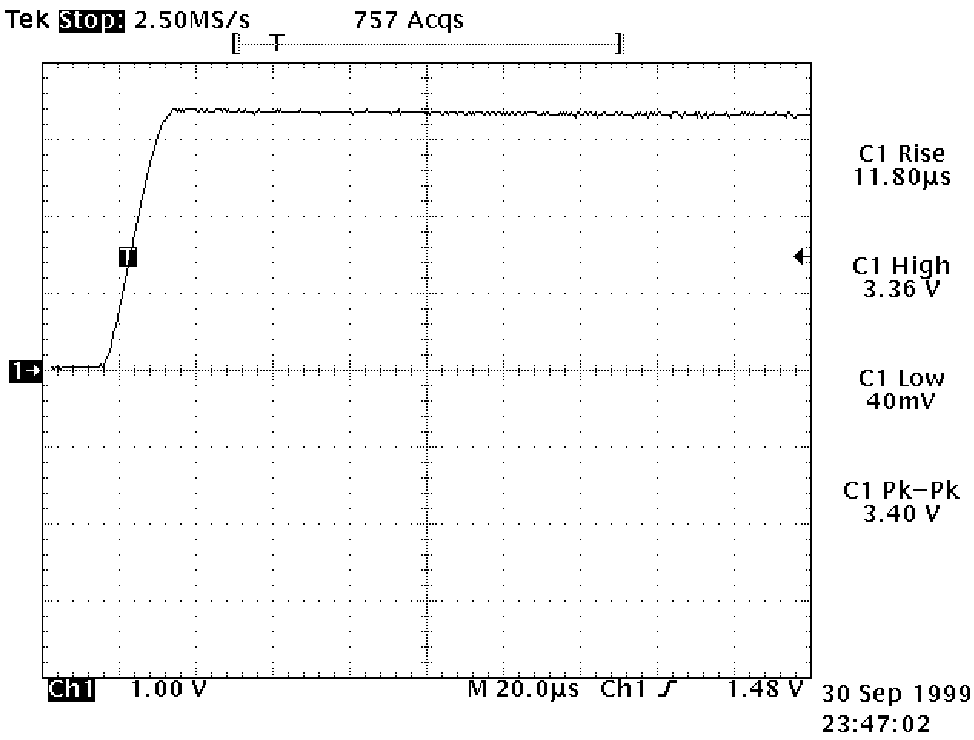



**Figure 23: R211, VPP, WinTesla Self Test, MCU Eeprom interface**

## Testing

The MCU software enters a local mode at start-up if suitable resistors are connected to the BTEMP and BSI lines.

**NOTE!** Baseband doesn't wake up automatically when the battery voltage is connected. Power must be switched on by

pressing the Power key or

inserting a waking pulse BTEMP line or

connecting a charger

In the local mode the baseband can be controlled through MBUS or FBUS connections by a PC-locals software. Baseband internal connections are tested with self tests if possible.

Parameters cannot be set accurate enough by design because of component tolerances. Due to use of 5% resistor values, the channels of the CCONT A/D converters need to be aligned in the production phase. With in battery voltage tuning the MCU software reads the A/D reading from CCONT at 4.1V and stores this reading to emulated EEPROM memory as a reference point. Another reference point is created by assuming that while the input voltage is zero, A/D reading is also zero. Now the slope is known and A/D readings can be calibrated. Calibration is included in VBATT A/D reading task.

**Troubleshooting**

Troubleshooting instructions are divided into following sections:

How to check/fix the system/sleep clock.

How to check/fix the power supplies.

Contact service case.

How to check/fix the SIM faults.

How to check/fix the Audio faults.

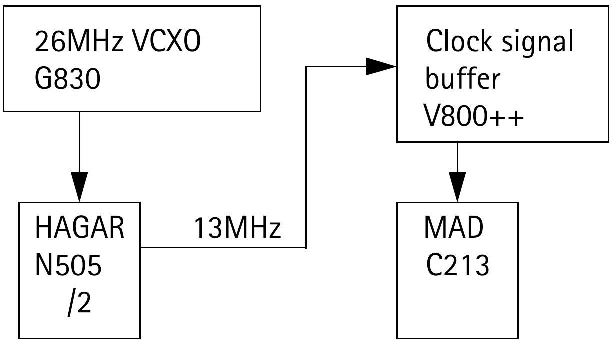
How to check/fix the charger faults.

The first thing to do is to carry out a thorough visual check of the module. Make sure that:

- there are no mechanical damages

- solder joints are OK

Before changing anything ALL SUPPLY VOLTAGES AND SYSTEM CLOCK / SLEEP CLOCK should be checked.



**System Clock**

Check the signal from the C213 Layout picture B signal RFC, should be like in SYSTEM CLOCK picture.

**IF NOT** ↓

Check the signal from the RF side buffer input C829. If there is signal, check the R829, R834, R830, V800, C834 and L800.

**IF THERE ISN'T** ↓

Check the signal from the RF side oscillator VCXO G830 output from C833. There should be 26MHz signal.

**IF IS** → Change the HAGAR N505

**IF THERE ISN'T** ↓

Change the VCXO G830

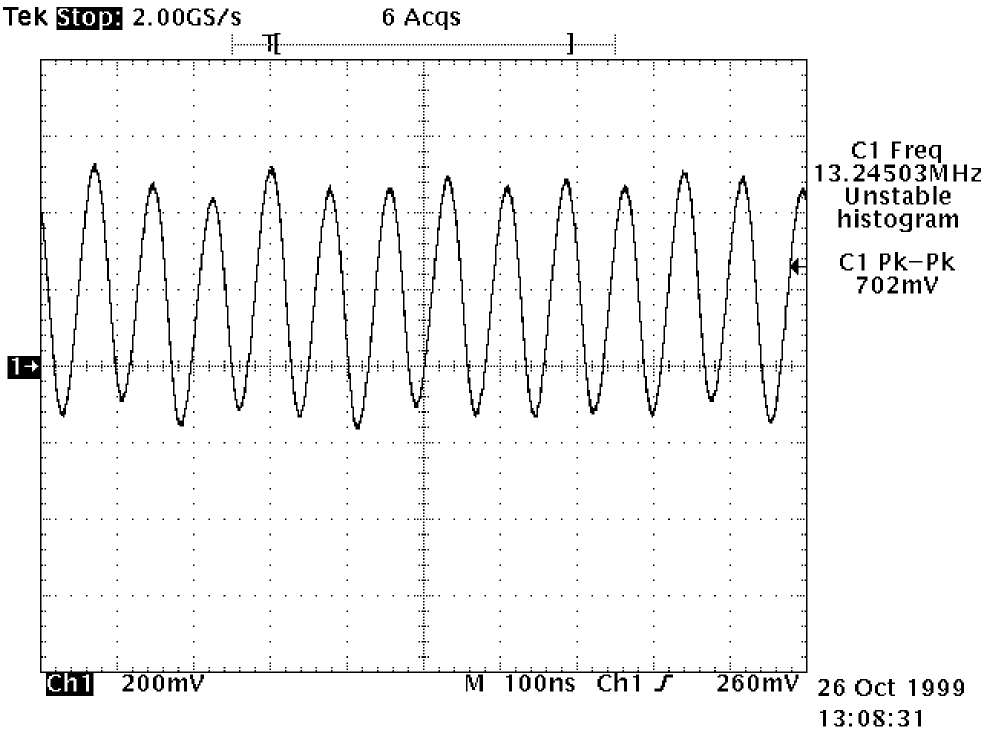



**Figure 24: System clock picture.**

## Sleep Clock

Check the signal from the J228 Layout picture B signal Clk 32kHz, should be like in SLEEP CLOCK picture.

↓ **IF NOT**

Check R100, R154, R102, C102, C101, C113 and B100

↓ **IF OK**

Change the CCONT N100

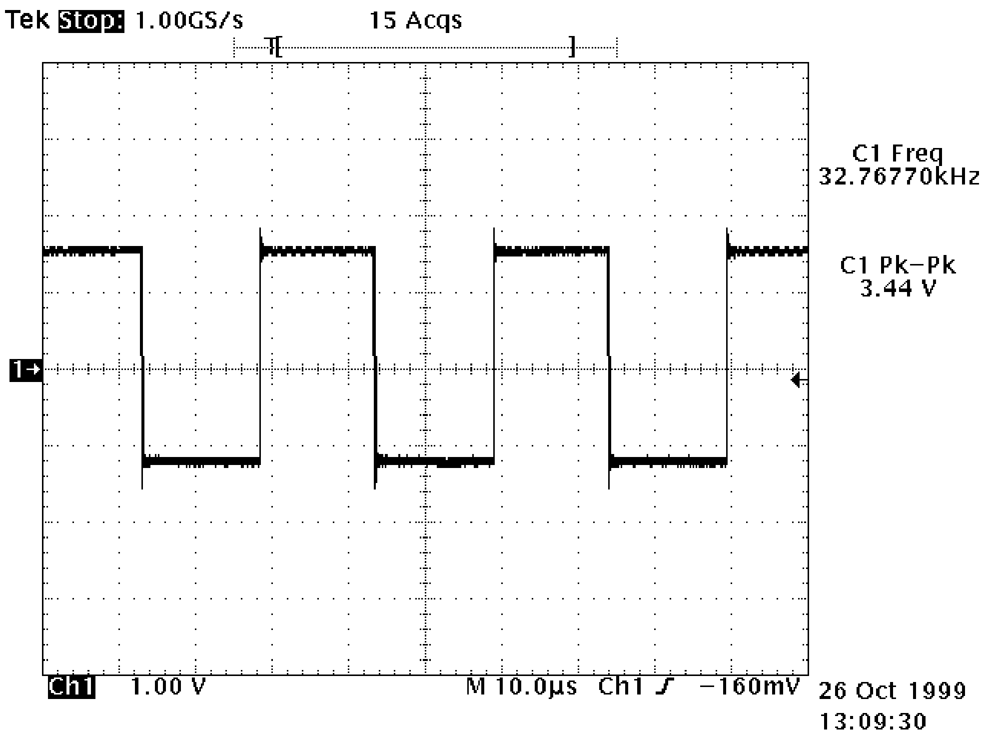



**Figure 25: Sleep clock picture.**

**Power Supplies**

Measure power supplies. Test points are shown in layout picture A.

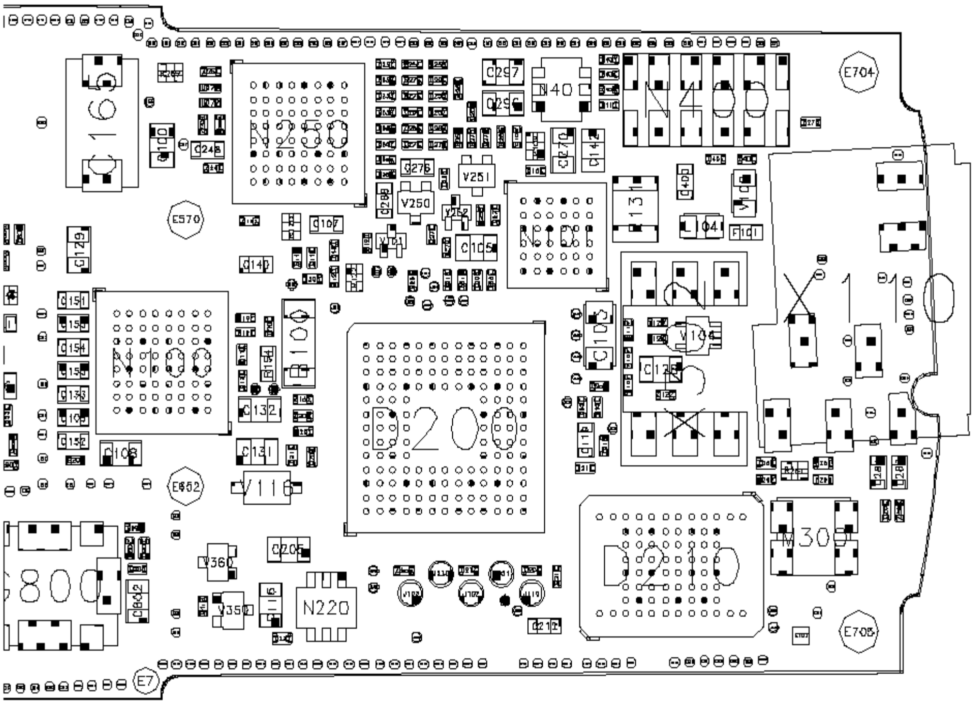
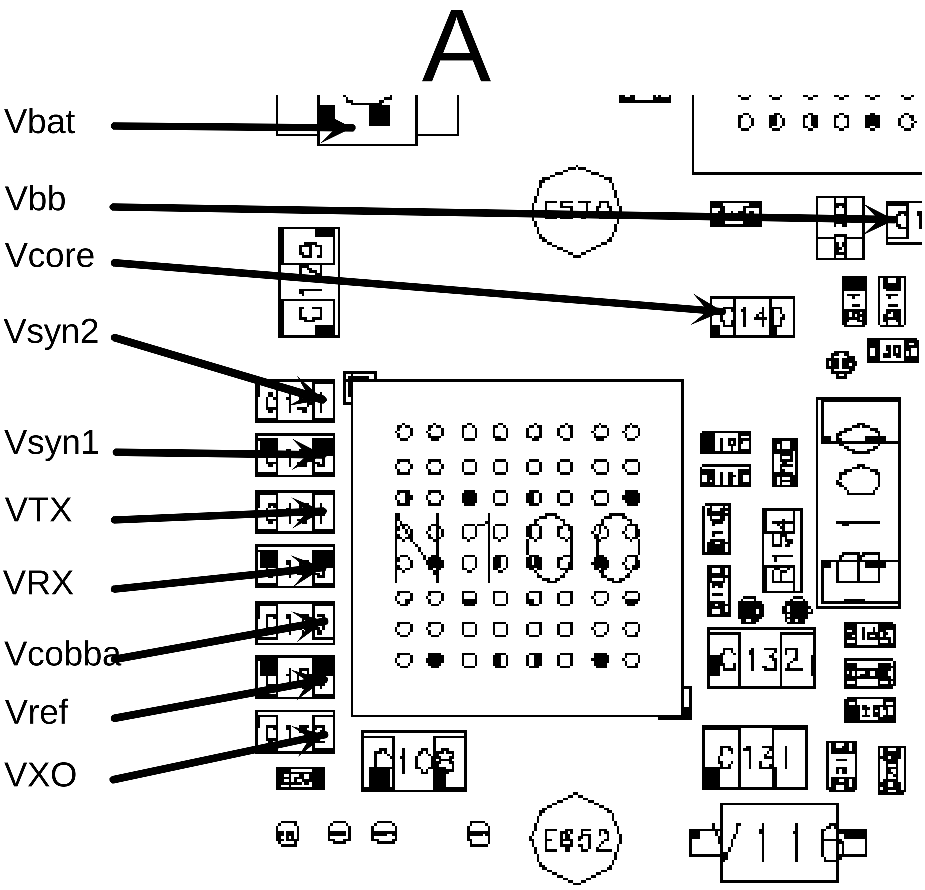


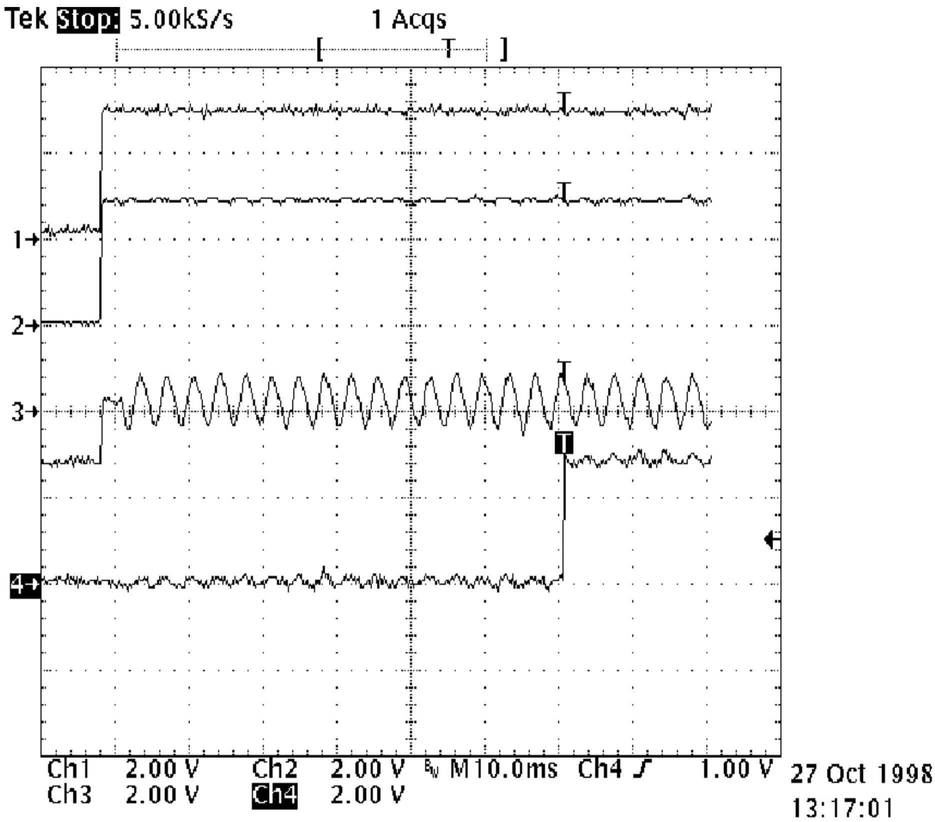

**Figure 26: Layout shown here is NSM-2.**



| | |
|---|---|
| Vbb | = 2.7V - 2.87V |
| Vcore | = 1.3V - 2.65V |
| Vcobba | = 2,67V - 2.85V |
| Vref | = 1.48V - 1.523V |
| Vbat | = 3.11V - 4.2V |
| VXO | = 2,67V - 2.85V |
| VRX | = 2,67V - 2.85V |
| VTX | = 2,67V - 2.85V |
| Vsyn1 | = 2,67V - 2.85V |
| Vsyn2 | = 2,67V - 2.85V |

**Power up sequence test:**

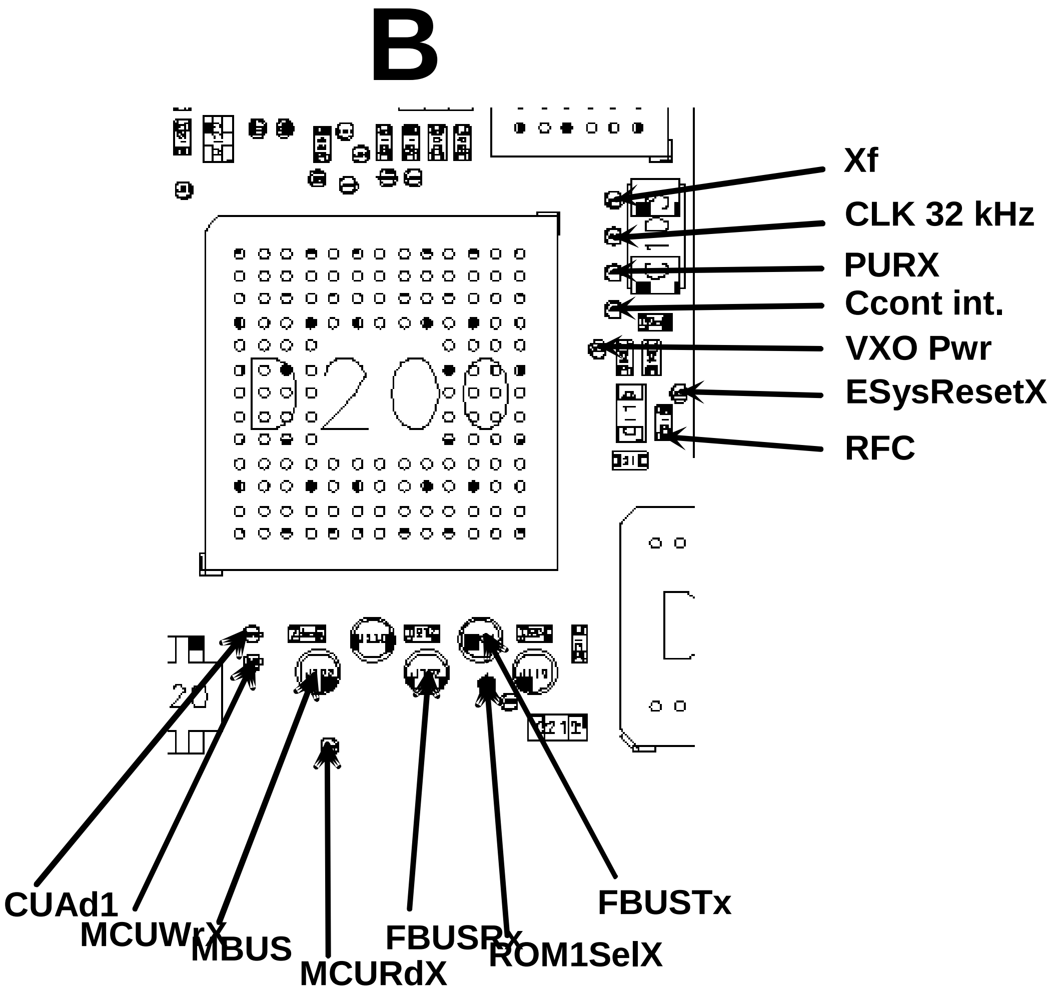
Cconts digital parts keep MAD in reset by keeping PURX down for a delay of 62ms.




Here is shown the start up sequence picture.

Ch1 = Vbb
Ch2 = VXO
Ch3 = SleepClk

Ch4 = PURX (see picture B)




**Phone is totally dead**

The phone doesn't take current at all when the power switch is pressed or when the watchdog disable pin (X001 pin 11) is grounded. Make sure that the battery voltage you use is within the specification, i.e. 3.11.. 4.2 V. If the voltage is lower, hardware of CCONT (N100) prevents power on.

IF battery voltage is inside the specification Change the CCONT.

**Flash programming fails**

The flash programming can be done via panel connector X001 or via dedicated PCB pads. In production, the first programming is done via panel connector. After this, the panel connector is cut away, thus the programming must be done via PCB pads visible through the shield under the battery. The main difference between these is that FLASH-programming voltage is produced differently. The fault finding diagrams for flash programming is shown in the start up sequence picture.

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

- MCU doesn't boot
- Serial clock line failure
- Serial data line failure
- External RAM fault
- Algorithm file or alias ID not found
- MCU flash Vpp error

**Power doesn't stay on or phone is jammed**

If this kind of fault has come after flash programming, there are most probably open joints in ICs. Solder the joints of ICs. Normally the power will be switched off by CCONT (N100) after 30 seconds if the watchdog of the CCONT can not be served by software. This updating can be seen with an oscilloscope at CCONTCSX (J104). In normal case there is a short pulse from "1" to "0" every 8 seconds. The power off function can be prevented by connecting WDDIS (R118 edge side head) to ground.

Because of the under fill, check the supply voltages, clock signals and power up sequence. If power on sequence fails, there are some open connections under MAD or combomemory. If all seems to be correct, it is best way to erase the flash memory and try to put new software to phone.

**Contact service on the phone display**

This fault means that software is able to run and thus the watchdog of CCONT (N100) can be served. Self test functions are run when power is switched on and software is executed from flash. If any of the self tests fails, a "contact service" text is shown on display.

MCU self tests are divided to those executed while power up (start up tests) and ones that can be executed with connected PC. The tests and included items are as follows:

1. MCU ROM checksum
Calculates 16 bit checksum out of Flash code and compares it to one found in Flash.
Items being checked are:
MAD2 <--> Flash data and address lines, CE0,CE1, WE, BYTE, Vcc, GND, Flash internal functionality
2. MCU RAM interface
3. MCU RAM component
4. MCU EEPROM interface
5. MCU EEPROM component
6. RTC battery
7. CCONT interface
8. A/D converter
9. SW reset
A. Power off
B. Security data
C. EEPROM tune checksum

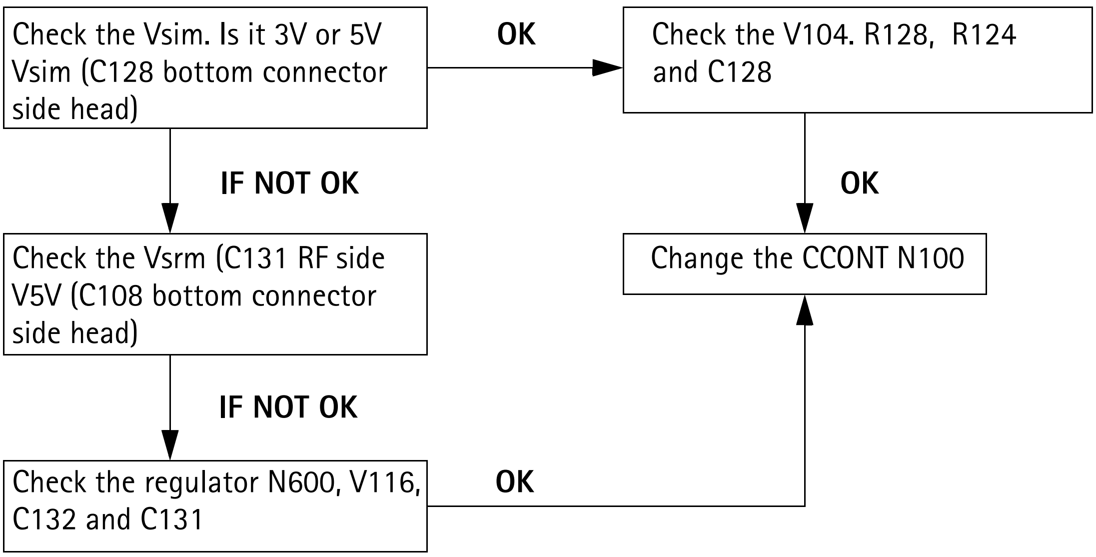
  

D. PPM checksum
E MCU download DSP
F. DSP alive
G. COBBA serial
H COBBA parallel
I. EEPROM checksum
K. PPM validity

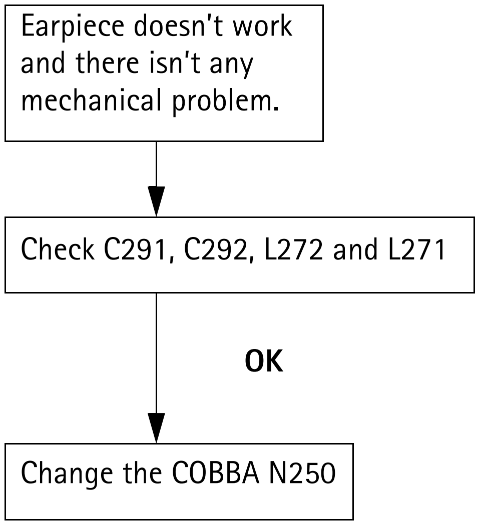
## SIM related faults

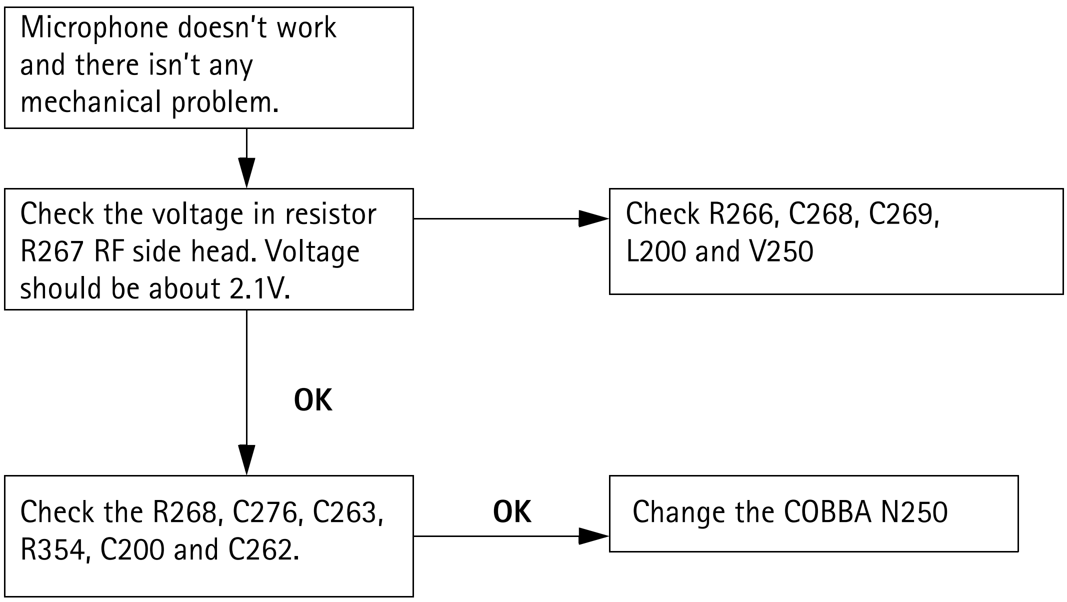
The hardware of the SIM interface from MAD2 (D200) to the SIM connector (X302) can be tested without a SIM card. When the power is switched on and the BSI line is grounded by a resistor, all the used lines (VSIM, RST, CLK, DATA) rise up to 5 V. Thus "Insert SIM card" faults can be found without SIM card.

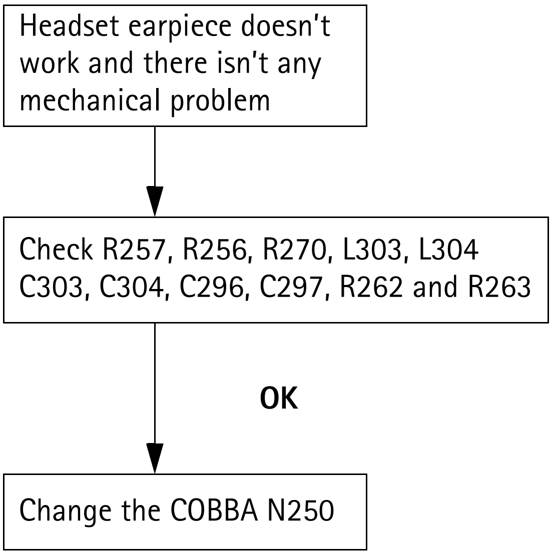
The fault information "Card rejected" indicates that ATR message (the first message is always sent from card to the phone) is sent from card but the message is somehow corrupted, data signal levels are wrong etc. or factory set values (stored to the emulated EEPROM) are not correct.



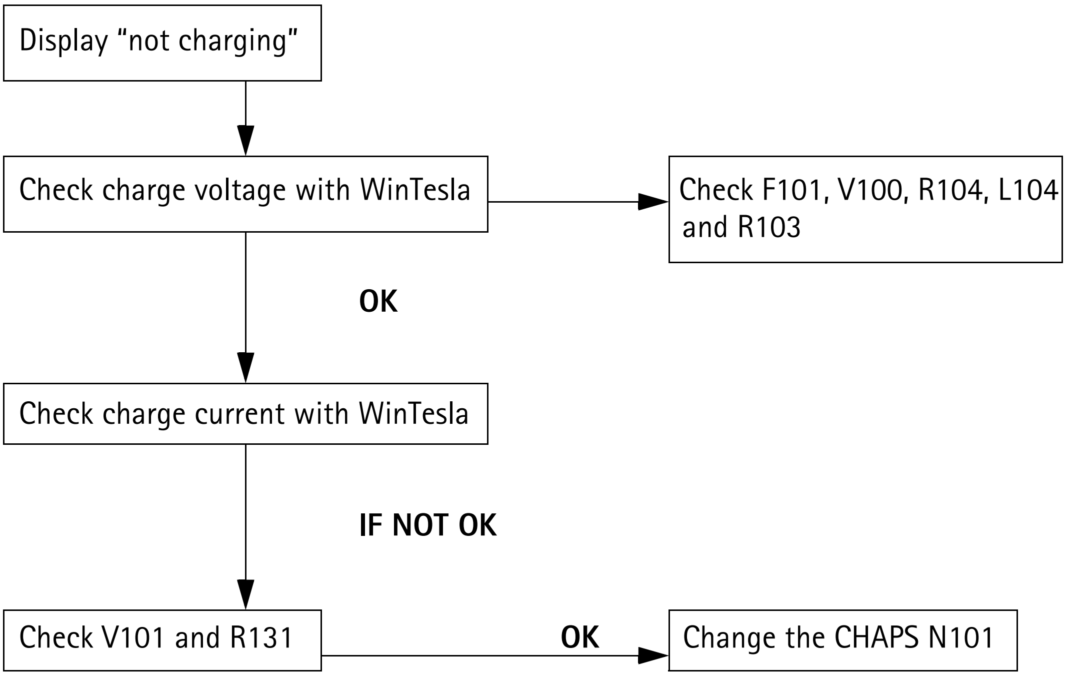
**Audio faults**






**Charging fault**



## RF testpoints

### RX

DC levels (oscilloscope)

| Point: | Signal: | Component: | Comment: | Picture: |
|---|---|---|---|---|
| RX1 | RXIP and RXQP | R530 | I/Q signals (67 kHz) from Hagar to COBBA. | 1 |
| RX2 | RXIP and RXQP | C520 and C521 | Same as RX1 but before AGC state. | 2 |
| RX4 | DCS LNA ctrl | C642 / V905 | ~2.8 V burst controls LNA ON/OFF | 3 |
| RX5 | Rxref | C534 / R533 | DC 1.2 V from COBBA to Hagar | na |
| RX6 | VREF_2 | C564 / R563 | DC 1.5 V from COBBA to Hagar | na |
| RX7 | Vlna | C562 | DC 2.8 V from COBBA to Hagar | 3 |
| RX8 | Vrxrf | C553 / C557 | DC 2.8 V from COBBA to Hagar | na |
| RX9 | Vsynte | C 561 | DC 2.8 V from COBBA to Hagar | na |

RF levels (spectrum analyzer)

| Point: | Signal: | Component: | Comment |
|---|---|---|---|
| RX11 | 1930...1990 MHz | Z600 | Second saw-filter DCS output to baluuns, (-41 dBm) (check level from reference engine) |
| RX13 | 1930...1990 MHz | Z620 | First saw-filter DCS output to LNA, (-58 dBm) (check level from reference engine) |

### TX

DC levels

| Point: | Signal: | Component: | Comment: | Picture: |
|---|---|---|---|---|
| TX1 | TX power level | C714 / R744 | PA selection and control | 4 |
| TX2 | Vdd1 | C772 / L752 | Battery voltage to PA Vbatt 3.3...4.8 V | 5 |
| TX3 | TXP | J519 | TX control signal (antenna switch, differential amplifier | |
| TX16 | TXVDCS | C747 | ~2.5 V burst controls antenna switch | 6 |
| TX6<br>TX7 | TXVdet<br>DET0 | C731 / R732<br>R764 / R763 | Operating voltage to TX detector 2.8 V burst and detected TX level to HAGAR | 7 |
| TX8 | TXQ | R546 | TX Q signals from baseband to Hagar (+-67 kHz, DC level 1.2 V, swing level 1.32 V) | 8 |
| TX9 | TXI | R541 | TX I signals from baseband to Hagar (+-67 kHz, DC level 1.2 V, swing level 1.32 V) | 8 |

| Point: | Signal: | Component: | Comment: | Picture: |
|---|---|---|---|---|
| TX10 | TXC | R792 / C792 | TX power control voltage from baseband to Hagar 0...2.2 V burst | 4 |

RF levels

| Point: | Signal: | Component: | Comment: |
|---|---|---|---|
| TX11 | DET0 | C790 / C794 | Detected TX level to HAGAR |
| TX12 | RX and TX | Z670 / ant. | Final TX frequency and level,<br>(28 dBm, GSM1900 / lev 0)<br>(check level from reference engine) |
| TX20 | PA output DCS | C743 | PA output signal<br>(check level from reference engine) |
| TX21 | Antsw input DCS | Z670 / C721 | Antsw input signal<br>(check level from reference engine) |
| TX15 | PA input DCS | C734 | PA input signal |
| TX22 | PWR detector input | V760 input / C733 | 14 dB below TX output<br>(check level from reference engine) |

## VCO

DC levels

| Point: | Signal: | Component: | Comment: | Picture: |
|---|---|---|---|---|
| VCO1 | VCC | R807 / C804 | 2.64 V DC VCO operating voltage | 9 |
| VCO2 | Vchp | R807 or C783 or C560 | 4.7 V DC from reg. N600 to VCO | 9 |
| VCO3 | VCP | N600 | 5.0 V DC from CCONT to reg. N600 | 9 |
| VCO4 | VC | R802 / G800 | 0.5 V...4.2 V burst DC from Hagar to VCO | 9 |

RF levels

| Point: | Signal: | Component: | Comment: |
|---|---|---|---|
| VCO5 | 3700...3980 MHz | G800 / R805 | VCO signal needs 4 GHz spectrum analyser.*)<br>level ~ 0dBm (check level from reference engine) |

*) RF input signal of PA and VCO operating voltages can be used to check VCO condition if only 3 GHz spectrum analyzer is available.

## VCTCXO

DC levels

| Point : | Signal: | Component: | Comment: |
|---|---|---|---|
| VXO1 | Vtcxo | G830 | VCTCXO operating voltage from CCONT DC 2.8 V |
| VXO2 | AFC | R832 / G830 | AFC from COBBA to VCTCXO DC 0.046...2.254 V |

RF levels

| Point: | Signal: | Component: | Comment: | Picture: |
|---|---|---|---|---|
| VXO3 | 26 MHz | G830 / R833 | Clock signal from VCTCXO to Hagar | 10 |
| VXO4 | 13 MHz | V800 / R834 | RFC from Hagar to MAD | 10 |

**Other checking points**

SCLK R205

SENA R206

SDATA J237

## PICTURES FROM MEASUREMENT POINTS

Pin=-58dBm, Fin= 1960.06771MHz (RSSI Reading ~ -60 dBm)
Channel 1: RX1 RXIP R530
Channel 2: RX1 RXQP R530
Channel 3: RX4 LNA_G V905
...notify the pre-monitoring steps at the beginning of the burst

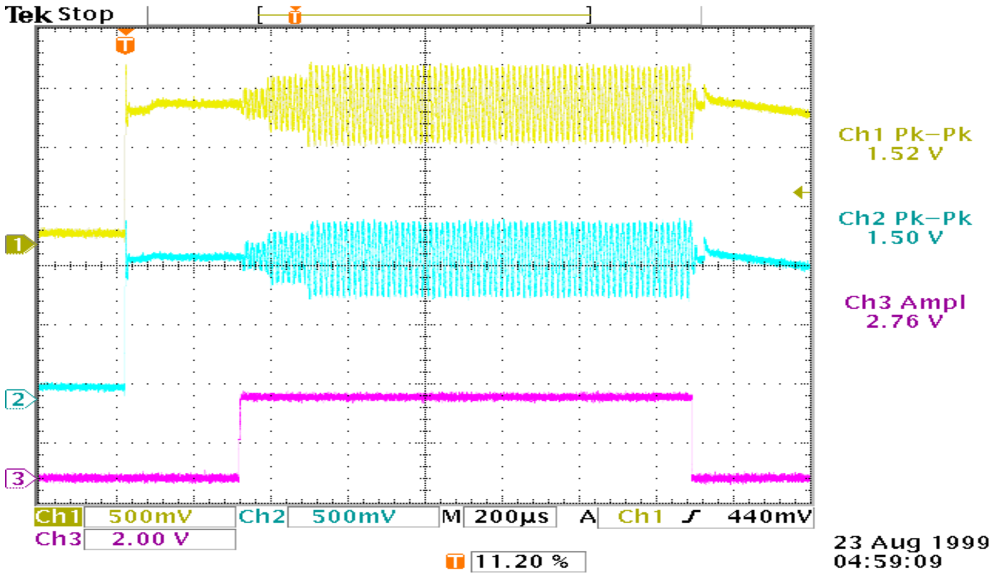



**Figure 27: Picture 1. RX I/Q from Hagar to baseband**

Pin = -50dBm, Fin = 1960.06771MHz
Channel 1: RX2 C521

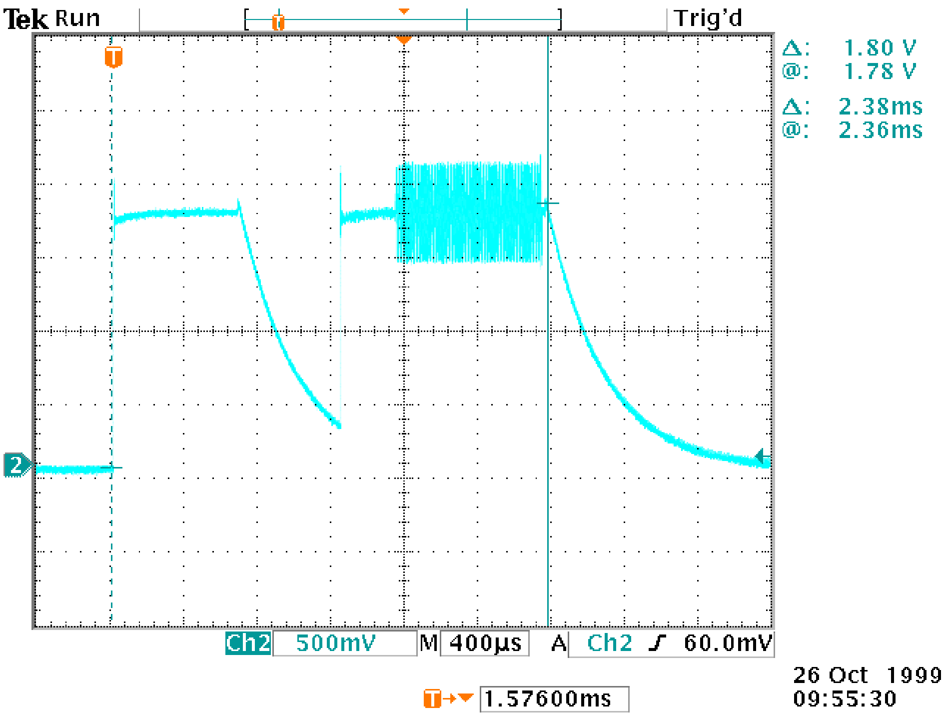



**Figure 28: Picture 2. RX I/Q before AGC**

Channel 2: RX4, base of V905
Channel 3: RX7: Vlna,

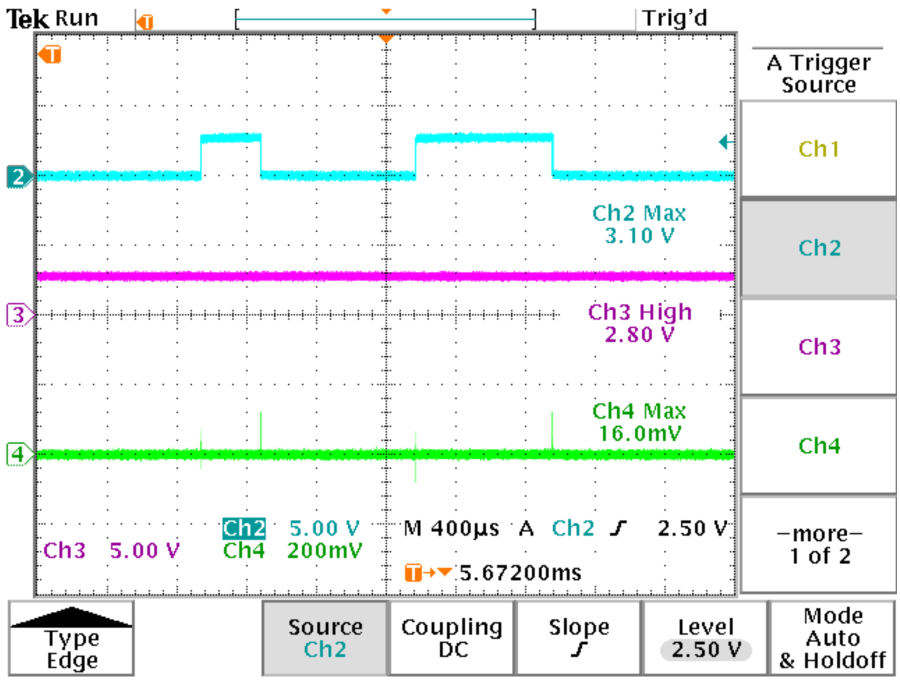



Figure 29: Picture 3. LNA control

Condition: DCS TX, burst mode power level 5
Channel 1: TX3 TXP, J519
Channel 2: TX1 C714, Vpd DCS
Channel 3: TX10, C792, TXC DCS
Channel 4: TX5, C752, VtxB DCS

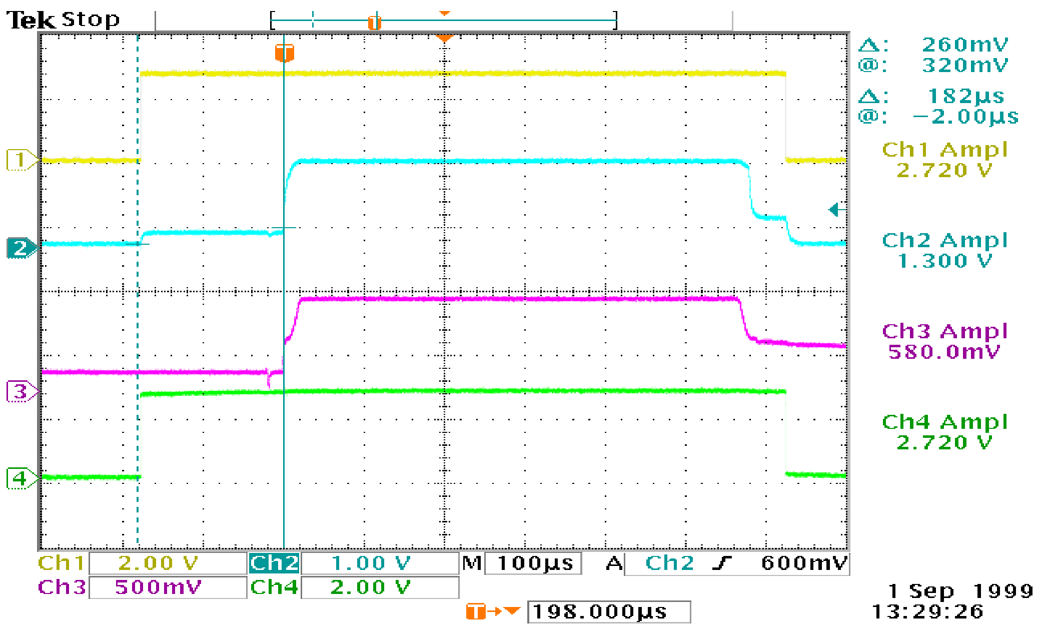



Figure 30: Picture 4. PA selection and control

Condition: DCS TX burst mode power level 0
Channel 2: VCO1, c (VCO) C805
Channel 3: VCO4, Vc (VCO) C803
Channel 1: TX2, VBATT

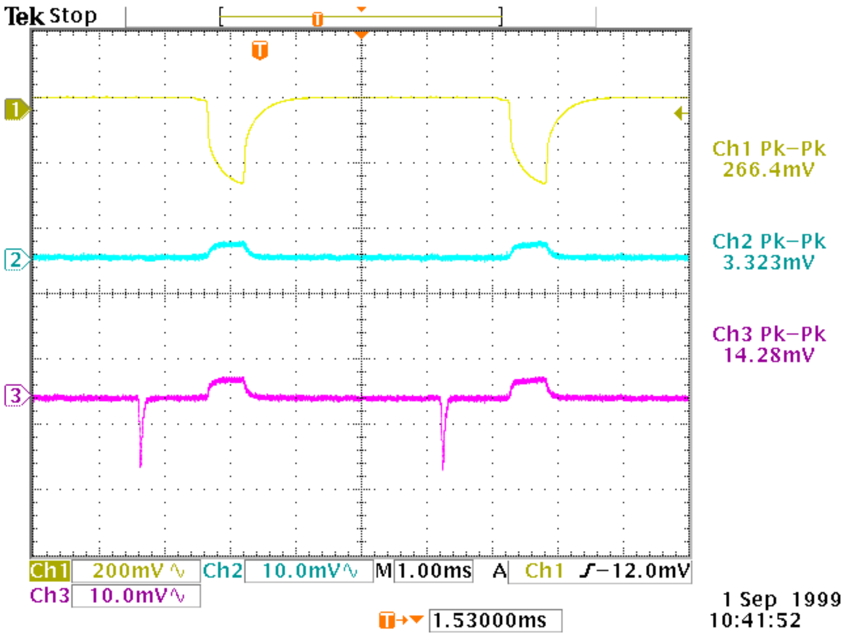



Figure 31: Picture 5. VBATT during TX burst

Channel 1: TX3: TXP, J519
Channel 2: TX16: C747, TXVDCS

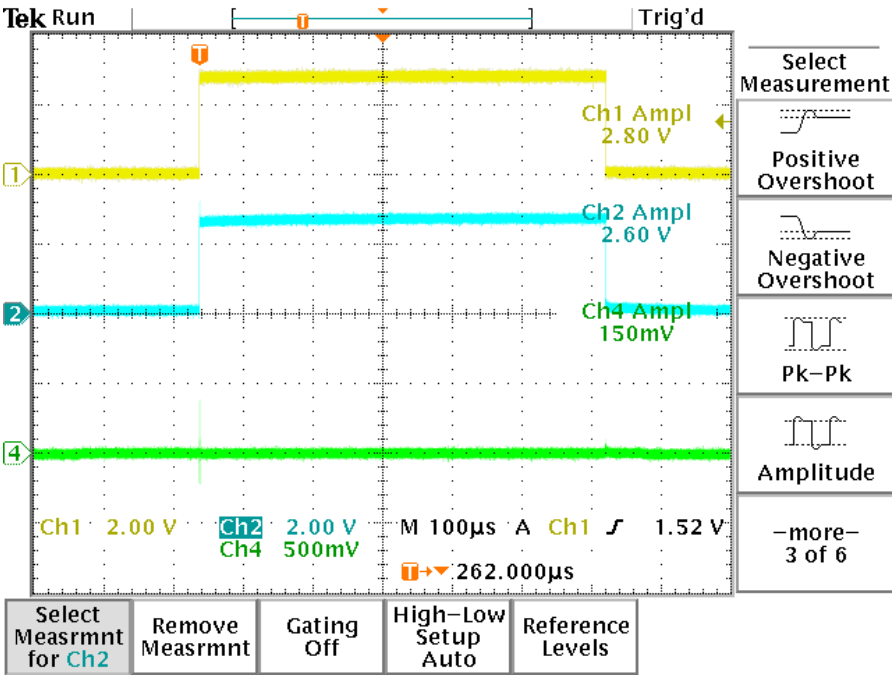



Figure 32: Picture 6. Switch Control

Condition: DCS TX, burst mode poerlevel 5
Channel 4: TX11: C790, DET0,
Channel 3: TX7: C761, DET0
Channel 2: TX6: R754, TXVDET,
Channel 1: TX3: TXP, J519

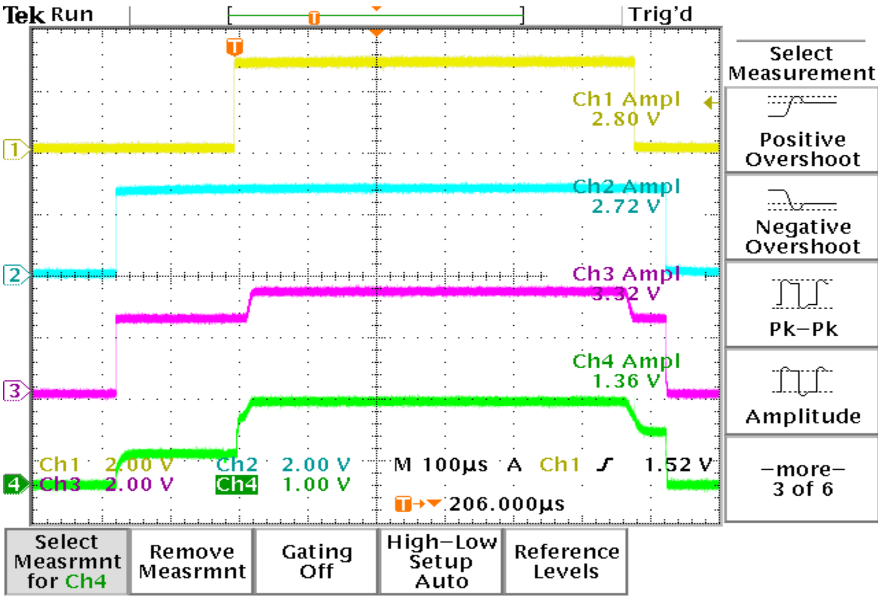



**Figure 33: Picture 7. Power detector control**

Channel 1: TX8 TXQN
Channel 2: TX9 TXIN
(TX burst mode Cont1)

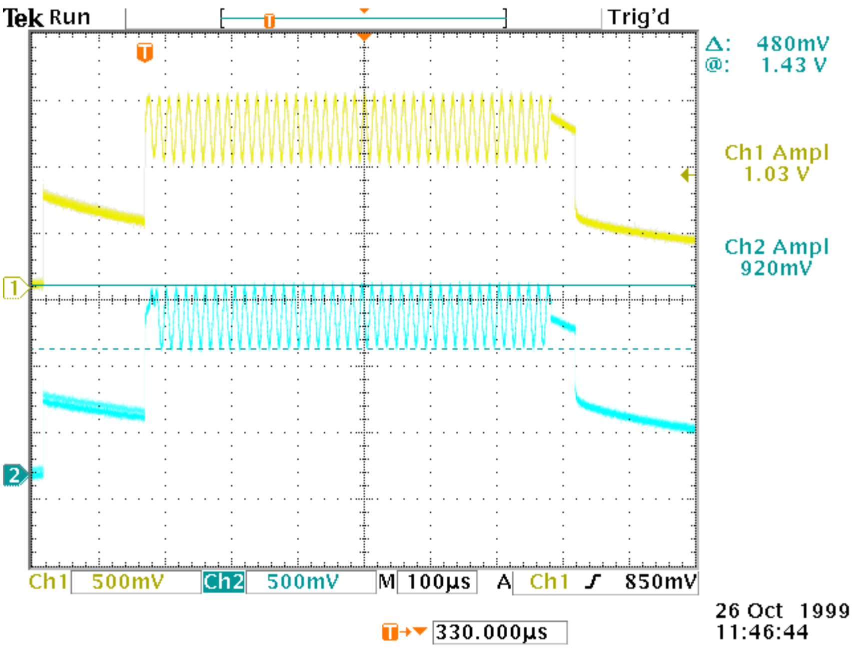



**Figure 34: Picture 8. TX IQ Signals**

Conditions: DCS, RX in burst mode, RX ch810, Monitoring ch512
Channel 1: VCO4 C803, Vc
Channel 2: VCO1 C805, Vcc
Channel 3: VCO3 N600, Vin
Channel 4: VCO2 C782, Vchp

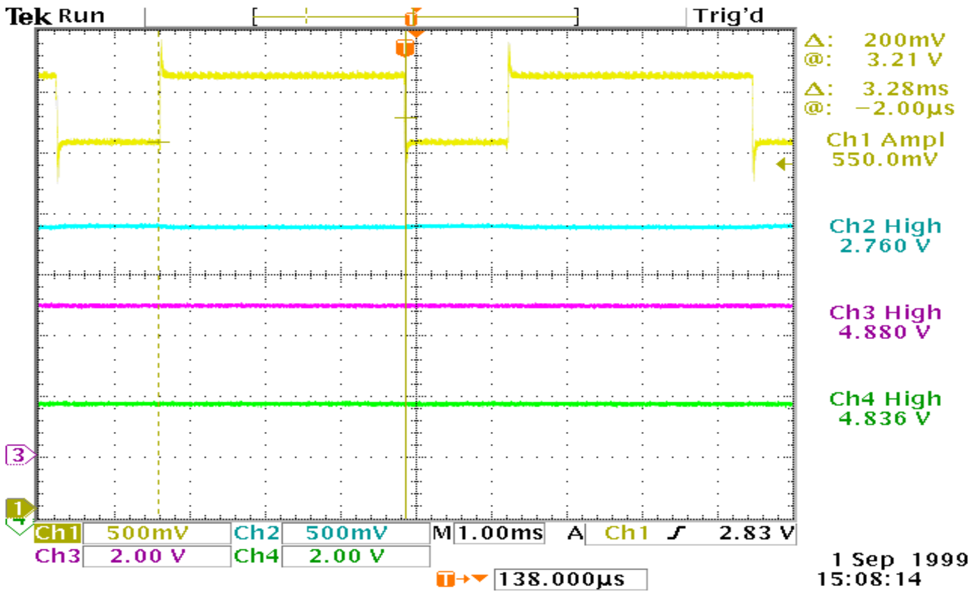



Figure 35: Picture 9. VCO, Operating Voltages

Channel 1: VXO3 L800, RFC
Channel 2: VXO4 R833, VCTCXO_out

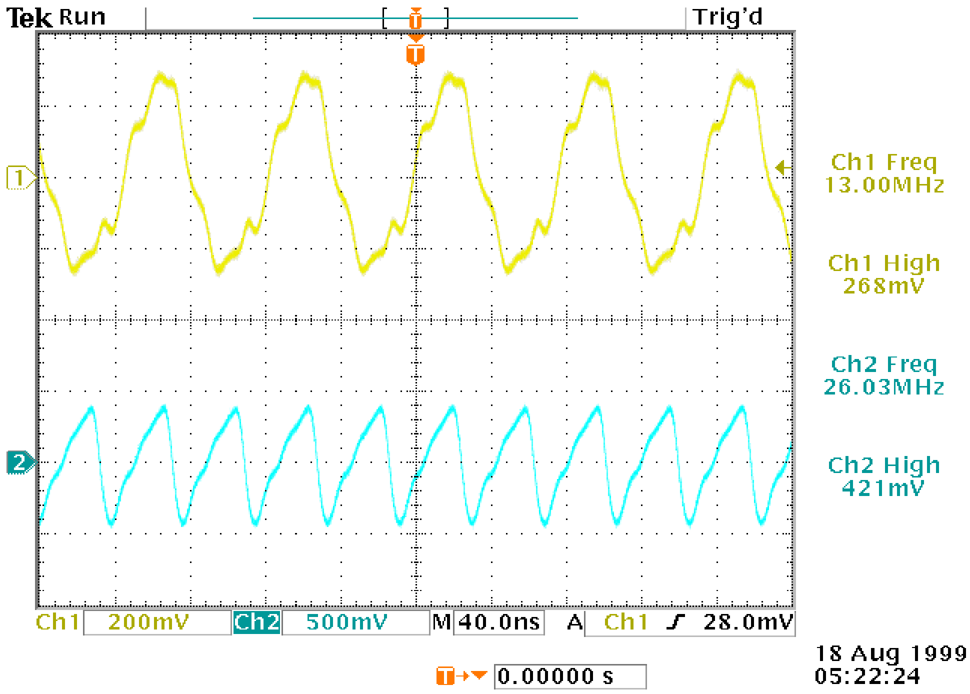



Figure 36: Picture 10. Clock Signals, VCTCXO, RFC

## Receiver Fault Finding

### General

Middle channel 661 is used as a test channel 1960 MHz and signal level in RF generator is set to –50 dBm. Signal levels and forms are referred in RF measurement points. Signal levels can vary depending the measurement method. So it is recommended to make measurements by your way and make own reference level table. The phone which you are using for this reference table must be undamaged.

### Hagar

AGC-block

AGC-block is inside HAGAR. AGC block can be tested measuring the IQ signal with the oscilloscope. IQ signal in RF/BB interface can be measured at points RX1 and RX2.

Point RX1 is after AGC stage and from that point 5 gain steps (3 ... 8) should be found. Basic form of signal can be seen in figure 4 in RF measurement points.

Point RX2 is before AGC stage and only LNA gain step (2... 3) is available in this point. Basic form of the signal is illustrated in RF measurement points.

Controlling AGC with WinTesla

When continuous RX mode is used, AGC gain step can be selected by entering gain step number into the AGC Absolute text box. When burst mode is used in RX AGC is automatically adjusted by the system.

In burst mode signal level in point RX1 should keep its level when RF signal level is adjusted in the limit of AGC dynamic range.

### LNA

LNA operation can be checked out by measuring the signal level from points RX 11 using spectrum analyzer. Signal level measured this point can be found in RF Testpoints. LNA gain step can also be tested from point RX2 by oscilloscope.

### RX-filters

RX-filters can be checked by measuring the signal level from points RX11 and RX13. Signal levels in these points can be found in RF Testpoints.

Mostly problem with these saw filter is the linearity over the frequency band. If that is the case, the measurement should be carried out also with some edge channels.

### Antenna Switch

Antenna switch operation can be tested by measuring the signal level from point RX13 with spectrum analyzer. Signal levels can be verified in RF Testpoints.

Antenna switch RX path is on all the time except during the TX burst.

## Transmitter fault finding

### General

Middle channel 661 is used as a test channel (1880 MHz). Signal levels and forms are referred to in RF testpoints. Signal levels can vary depending the measurement method. So it is recommended to make measurements by your way and make own reference level table. The phone which you are using for this reference table must be undamaged.

Set the wanted operating channel and power level.

### Antenna Switch

When TX mode is in use only burst mode can be used. Antenna switch is controlled with a pulse in control line. This antenna switch control signal can be measured in points TX16. Shape of these control signals can be seen in RF measurement points.

Antenna switch operation can be checked by measuring the signal level from points TX12 and TX21. Specified loss for antenna switch is 1.2 dB but measurement can give some dB more attenuation depending of the method. Check the level from reference engine.

### PA-Module, Directional Coupler and Power Detector

At first the input signal level of the PA should be checked. Input signals can be measured from point TX15. Refer the levels to reference engine and RF Testpoints.

Output of the PA can be checked by measuring the DET0 signal coming out from detector. Measure DET0 from TX11 and refer to the RF measurement points. If this is OK then PA module, Directional coupler and Power Detector are working ok.

If DET0 is not ok check the supply of the detector TXVdet TX6 and check also the input of the detector by measuring the point TX22 with spectrum analyzer. Refer the results to RF Testpoints.

If the TX6 is ok but TX22 not then check PA power control line Vpd if Vpd is ok check the components in RF signal path and check the PA supply voltage.

### HAGAR

RF path

If RF output from HAGAR seems not be ok then IQ input signals from BB to Hagar should be tested. These signals can be measured from points TX8 and TX9 and signals can be referred to RF Testpoints.

Power control

Check the TXC point TX10 DET0 point TX11 and Vpd point TX19 refer the results to RF measurement points. If only Vpd fails then Hagar power control has problems.

## Synthesizer fault finding

### General

To test VCO frequency properly spectrum analyzer has to be able to measure 4GHz frequencies.

### VCTCXO

VCTCXO signal can be measured from point VXO3 and VXO4, VXO4 is 13MHz clock signal for BB parts and VXO3 is 26 MHz signal for Hagar) refer the results to RF measurement points. IF 13 MHz is not present but 26 MHz is Hagar divider has a problem. IF 26 MHz is not present VCTCXO has problem.

### VCO

VCO signal can be measured at point VCO5. VCO operation can be checked also with oscilloscope by measuring the control voltage in RX burst mode. Additional settings should be GSM1900 mode, RX burst mode, channel 810 and monitoring channel 512. Refer to RF measurement points.

If VCO is not operating check Vcc (points VCO1, VCO3 and VCO2) Refer to figure 9 in RF measurement points. If supply voltages are ok VCO has problem.

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# Non Serviceable Accessories

 

Table of Contents

List of Figures

# Standard Battery BLB-2

The BLB-2 is a Li-ion battery with 650 mAh capacity in a white plastic package.

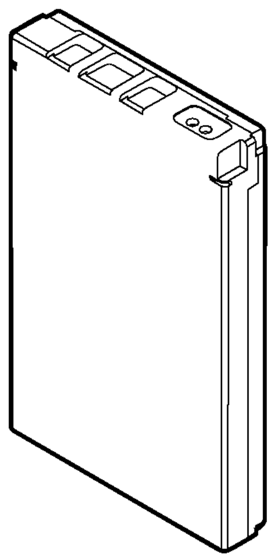

**Figure 1: View of Standard Battery BLB-2**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Battery Pack | BLB-2 | 0670246 |
| Battery Pack for Americas | BLB-2 | 0670322 |

# AC Travel Charger ACP-7

The standard charger is available for different voltage levels and comes with different wall plugs. The standard charger can also be used as a power supply for the desktop stand.

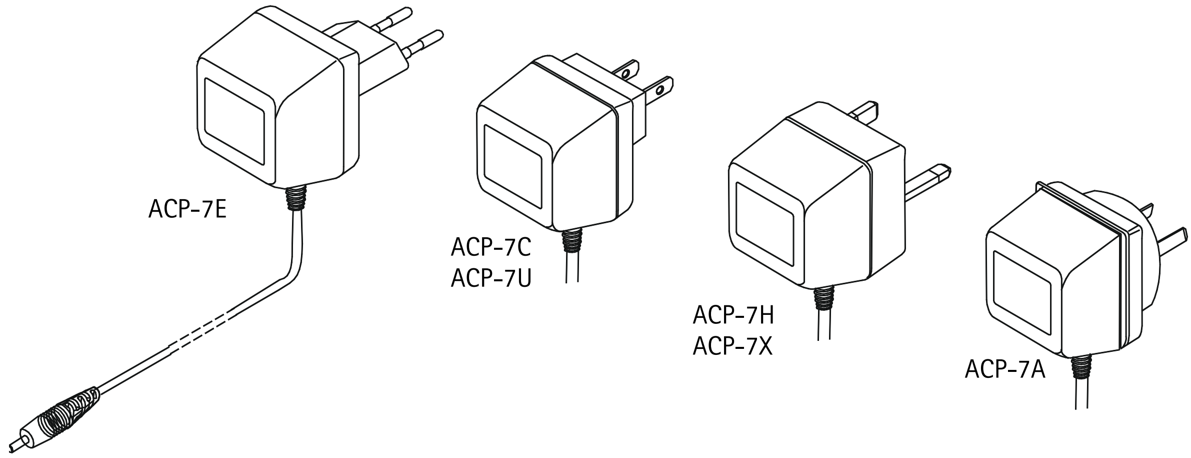


**Figure 2: View of AC Travel Chargers ACP-7**

## Product Codes

| Name: | Type Code: | Material Code: |
|---|---|---|
| AC Travel Charger (Euro plug) 207-253 Vac | ACP-7E | 0675144 |
| AC Travel Charger (US plug) 108-132 Vac | ACP-7U | 0675143 |
| AC Travel Charger (US plug) 198-242 Vac | ACP-7C | 0675158 |
| AC Travel Charger (UK plug) 207-253 Vac | ACP-7X | 0675145 |
| AC Travel Charger (UK plug) 180-220 Vac | ACP-7H | 0675146 |
| AC Travel Charger (Australia plug) 216-264 Vac | ACP-7A | 0675148 |

## Specification

| | |
|---|---|
| Output connectors: | *3.5 mm DC plug, 2-pole* |
| Protection: | PTC protection |
| Output Voltage/Current (typ.) | 7.6 V / 370 mA |

# Performance Travel Charger ACP-8

Operating within the voltage range 90 V...264V AC (50 Hz...60Hz), the Performance Travel Charger is practically current independent in normal office and household use. Like the standard charger, it is compatible with all battery options and is available for different wall sockets.

The Performance Travel Charger can also be used with the desktop stand.

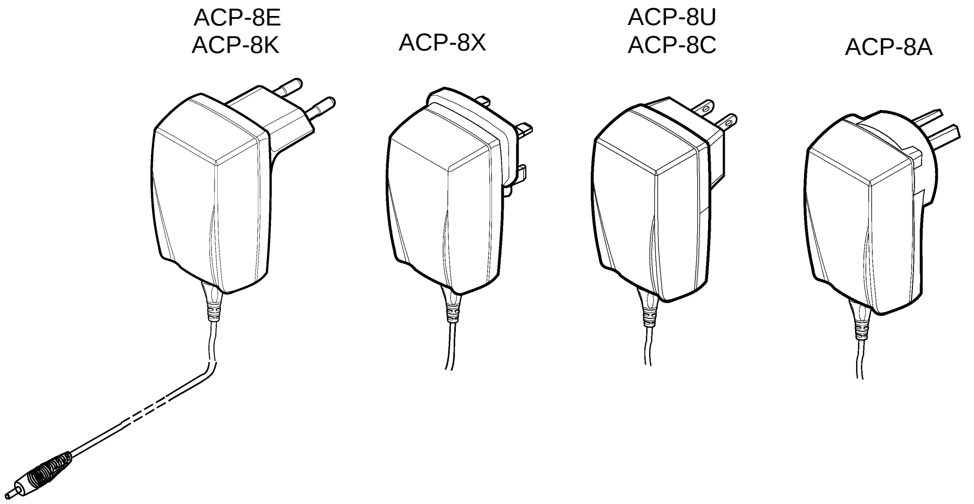


**Figure 3: View of Performance Travel Charger ACP-8**

## Product Codes

| Name: | Type Code: | Material Code: |
|---|---|---|
| Performance Travel Charger Euro plug 90-264 Vac | ACP-8E | 0675195 |
| Performance Travel Charger Korea plug 90-264 Vac | ACP-8K | 0675199 |
| Performance Travel Charger UK plug 90-264 Vac | ACP-8X | 0675197 |
| Performance Travel Charger US plug 90-264 Vac | ACP-8U | 0675196 |
| Performance Travel Charger China plug 90-264 Vac | ACP-8C | 0675211 |
| Performance Travel Charger Australia plug 90-264 Vac | ACP-8A | 0675214 |

## Specification

| | |
|---|---|
| Output connectors: | *3.5 mm DC plug, 2-pole (+,-,control)* |
| Protection: | Output fault voltage 16 V max. |
| Output voltage/current (typ): | 6.0 V (+/-0.3 V)/620 mA |

# Cigarette Lighter Charger LCH-8

A green light indicates that the cigarette lighter charger is ready for charging. Check the charging status on the phone display. The main use is with 12V vehicle system. It is using 3 wire charging structure (controlled constant voltage). It has internal output current limitation of 650mA.

The car battery connectors must perform reliable electrical connection to the cigarette lighter socket.

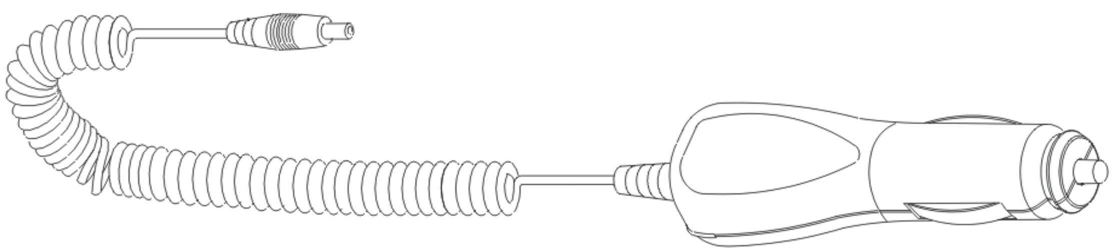

**Figure 4: View of Cigarette Lighter Charger LCH-8**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Cigarette Lighter Charger | LCH-8 | 0675231 |

## Specification

Output connectors: 3.5 mm DC plug. 3 pin.

Protection: input fused, output current limit 650 mA

Voltage

- input: 10.8...32 V
- output: The output voltage is controlled by the phone via 3rd wire.

# Cigarette Lighter Charger LCH-9

A green light indicates that the cigarette lighter charger is ready for charging. Check the charging status on the phone display. The input voltage can be from 11 or 32 V d.c., negative grounding.

The Universal mobile charger can be used with all car accessories provided for your phone except with MCC-1.

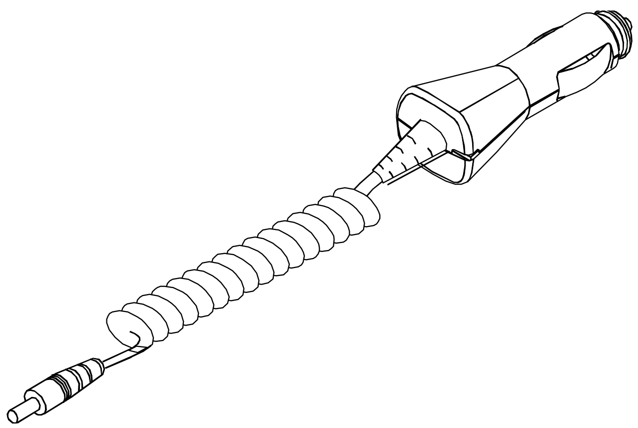

**Figure 5: View of Cigarette Lighter Charger LCH-9**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Cigarette lighter charger | LCH-9 | 0675120 |

## Specification

Connectors

- input: D21/23 mm
- output: 3.5 mm DC plug

Protection: input fused, output current limit 850 mA

Voltage

- input: 11...32 V
- output (nominal): 8.4 V

Nominal output current: 800 mA

# Desktop Stand DCV-1B

The desktop stand provides a mounting place for charging the battery with the transceiver.

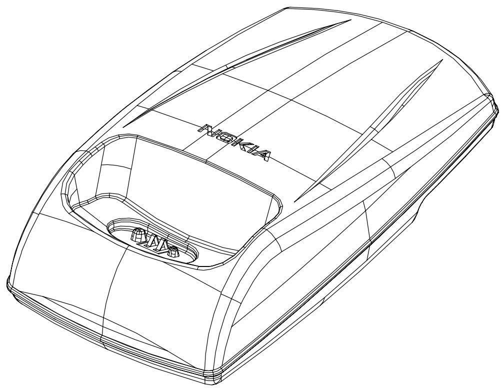


**Figure 6: View of Desktop Stand DCV-1B**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Desktop Stand | DCV-1B | 0675220 |

## Specification

Connections: *3.5 mm DC jack (ACP-7 or ACP-8)*

# Headset HDC-5

The HDC-5 headset provides a hook switch for the phone/microphone.

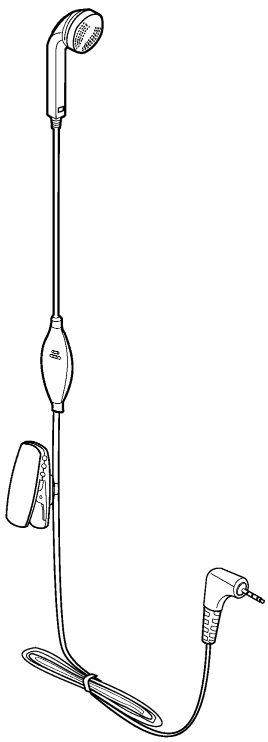

**Figure 7: View of Headset HDC-5**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Headset | HDC-5 | 0694059 |

  

# Plug and Play Hands Free Unit PPH-1

The PPH-1 provides rapid charging for the phone and the possibility for HF operation. The PPH-1 plug and play hands free unit is connected directly to the cigarette lighter in a car. PPH-1 is connected to the phone by a cable with a combinated connector with charger and headset connectors.

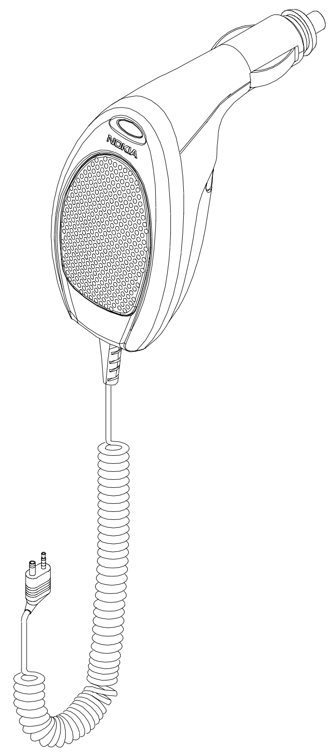

**Figure 8: View of Hands Free Cigarette Charger PPH-1**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Hands Free Unit | PPH-1 | 0675182 |

## Specification

Output connectors: *3.5 mm DC plug, 2-pole (+,-,control)*

Input voltage: 8-16 VDC

Protection: Output fault voltage 16 V max.

Output current: 750 mA max.

# Handsfree Microphone HFM-8

The HFM-8 microphone can be used together with PPH-1 plug and play handsfree unit.

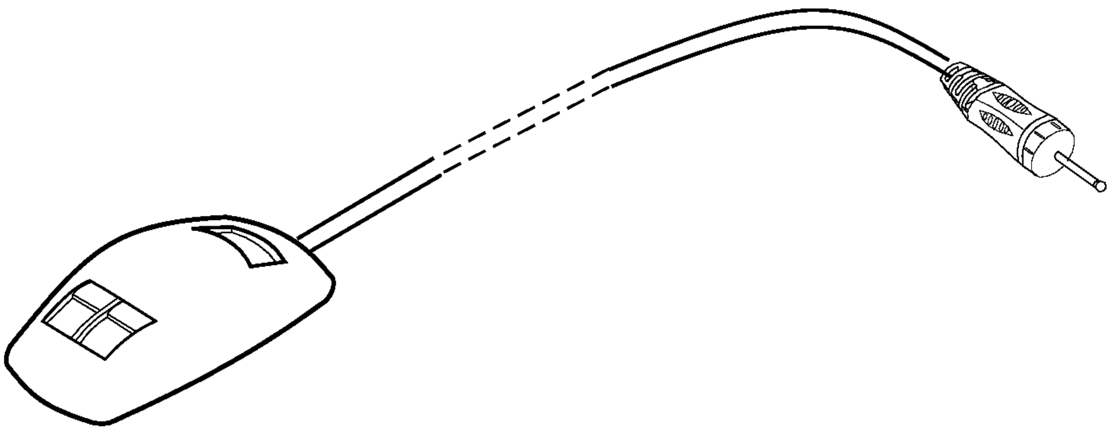

**Figure 9: View of Handsfree Microphone HFM-8**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Handsfree Microphone | HFM-8 | 0690016 |

# Loopset LPS-3

Loopset LPS-3 has been developed for hearing aid users to allow them to use mobile phones. It is based on induction technology. All hearing aids have support for induction loop, i.e. they have a little telecoil inside. This coil can capture the signal supplied to the loop. Standard hearing aids have two operation modes; M-mode for normal microphone use and T-mode for telecoil use.

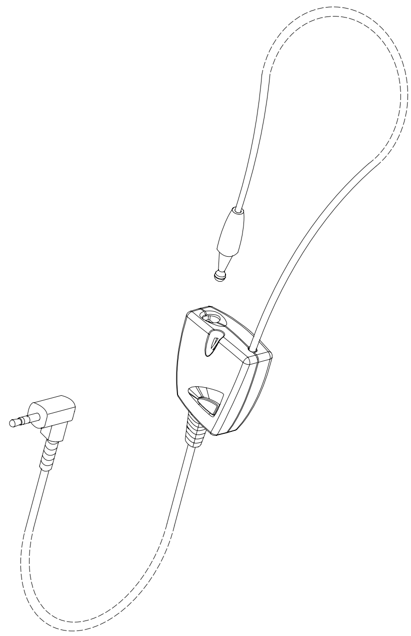

**Figure 10: View of Loopset LPS-3**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Loopset | LPS-3 | 0630244 |

## Recommended Batteries

| Type: | Size/IEC-type: | Rated capacity: | Talk Time (3mA load) | Stand-by (20uA load) |
|---|---|---|---|---|
| Zinc Air Hearing Aid Battery | 675 / PR44 | 540 mAh | 180 hours | 840 hours or 35 days (1) |
| Silver Oxide Hearing Aid Battery | 675 / SR44 | 150 mAh | 50 hours | 7500 hours or 310 days. |
| Alkaline Battery | 675 / LR44 | 110 mAh | 36 hours | 5500 hours or 230 days. |

**NOTE:** (1): The capacity of the zinc air battery will fall 20% in a month. After the activation the zinc battery begins to self-discharge. The battery will be empty within 5 weeks.

# Pocket Clip SKB-2

The Pocket Clip provides an option for carrying the phone. the clip is integrated to a B-cover.

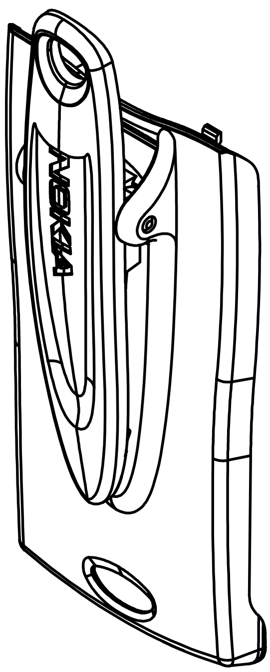


**Figure 11: View of Pocket Clip SKB-2**

## Product Code

| Name: | No: of Pieces | Type Code: | Material Code: |
|---|---|---|---|
| Pocket Clip (Retail Pack) Includes the following: | | SKB-2 | 0720218 |
| Button for SKB-2 | 3 pcs | | |
| Screw | 3 pcs | | |
| Mounting Rubber for SKB-2 | 3 pcs | | |
| Pocket Clip SKB-2 | 1 pcs | | |

**Figure 12: View of Button for SKB-2**

# Swivel Mount HHS-12

The HHS-12 Swivel Mount is a mount that allows the Pocket Clip (SKB-2) to be attached.

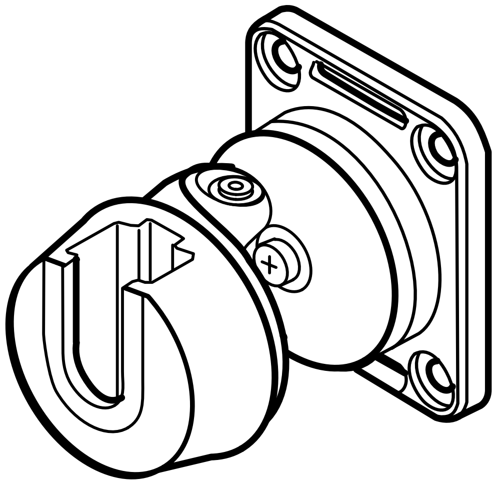

**Figure 13: View of Swivel Mount HHS-12**

## Product Code

| Name: | Type Code: | Material Code: |
|---|---|---|
| Swivel Mount | HHS-12 | 0620054 |

  

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