

Performance Description / Leistungsbeschreibung (LB)

Product/Version/Country:

UMTS Phone **ONYX**

Document Title:

ONYX PERFORMANCE DESCRIPTION -V1_0.DOC

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1 List of References

1.1 Project specific references

The appendices and enclosures (if present as files) are saved separately on the KLF network under ***K:\ENTWPROJ\X95_Onyx\documents_declarations\M1***

No.	Document	Date	Link
1.	Product description ONYX (EMEA) (this document)		<i>K:\ENTWPROJ\X95_Onyx\documents_and_declarations\M1\ONYX_Performance_description_V1.0.doc</i>
2.	ONYX M1 Product Contract		<i>K:\ENTWPROJ\X95_Onyx\documents_and_declarations\M1</i>
3.	M1 declaration «project team»		<i>K:\ENTWPROJ\X95_Onyx\documents_and_declarations\M1</i>
4.	Software Product Description		
5.	Software MMI Specifications EasyDM => Public Folder		<i>...Public Folders/Projects/Q6250/05_Generic/35_UISpecification/MMISpecification/Onyx</i>
6.	Major Risk Assessment		<i>K:\ENTWPROJ\X95_Onyx\PD-Team\Qualitätsmanagement_HWRMEA_Risk_Management\M1_Review\ Onyx-Risk-Ass_M0-S0-M1-2006-03-13_SW.xls</i>
7.	Accessories for the BenQ mobiles ONYX (EMEA)		<i>K:\ENTWPROJ\X95_Onyx\PD-Team\Accessory_Devices\Accessory Portfolio ONYX 2006-03-15.ppt</i>
8.	Project schedule		<i>K:\ENTWPROJ\X95_Onyx\PD-Team\Primavera\PLT_MasterPlan_2006_CW 10.pdf</i>

The ONYX M1 milestone will be declared according to “QMS Procedure No.: T008-MP Milestone Results in Product Development” (Issue 7.01 Published: 13. Jun. 2005).

1.2 General References

- All references which are especially important for specific disciplines should be listed in the particular chapters.
In any case the requirements listed in chapter “12 Approval” has to be fulfilled by all disciplines.

2 General Data

2.1 Design, the Mystery 3G Stone.

The ONYX is a Slider phone.

Only one colour concept will be supported for ONYX at launch.

For design issues please contact Markus Feldhoff

2.2 Key Features ONYX

Design: Slider Form Factor

FSR Foil at upper cover include 5 way navi joystick

Key Features:

UMTS Technology & 3-band GSM
FSR technology
QVGA Display:240x320
True Colour 16.7 MIO Colours to show pictures, normally black if no illumination is switched on.
3.2 Mpix auto focus , 8xDZ, additional a VGA for video conferencing
Double action camera side key
Bluetooth, FM Radio, T-flash Card (mircoSD)
Design shell bundle
Wired Headset volume control bundle
Illumination concept Mystery

Bands

900/1800/1900MHz GSM/GPRS
2100 UMTS
GPRS Class10

Battery:

Li-Ion Polymer Battery
Nominal Capacity: 950 mAh (typical)
GSM Capacity: 900 mAh (typical)

Stand-by and talk times which based on Kestrel:

Talk/standby	QCT 6250A
WCDMA Standby	250hrs
WCDMA Talk	3h 30 min
GSM Standby	310 hrs
GSM Talk powerlevel 5	3h 15 min
GSM Talk powerlevel 19	6 hrs

Precondition to reach measurements:

GSM Standby

Description: Measurement taken with the mobile camped on a PGSM network with cell power -50 dBm. The current measured is the average over 100 Paging Periods. Display off.
=> 3mA Multiframes 5 => 950mAh => ~310h

**UMTS Standby
work**

Description: Measurement taken with the mobile camped on a WCDMA network with cell power -75 dBm, Paging Service = AMR Voice, DL Channel = 10700, UL Channel = 9750, Soft Handover = off, Compressed Mode = off. The current measured is the average over 300 seconds. Display off.
=> 3,8mA DRX6 => 950mAh => ~250h

GSM Talk

Description: Measurement taken with the mobile camped on a PGSM network with cell power -50 dBm and Mobile DTX off. The current measured is the average over 1000 26 multiframes (120 seconds).
=> 275mA PowerLevel 5 => 900mAh => ~3,2h
=> 145mA PowerLevel 19 => 900mAh => ~6h

UMTS Talk work

Description: Measurement taken with the mobile camped on a WCDMA network with cell power -75 dBm, Paging Service = AMR Voice, DL Channel = 10700, UL Channel = 9750, Soft Handover = off, Compressed Mode = off. The current measured is the average over 300 seconds.
=> 275mA Power Level -5dBm => 900mAh => ~3,2h

SIM Card:

Small (= "Plug In") 1.8 V or 3 V-SIM card (Phase II).

Antenna

Integrated Quad band antenna

Receiver Sensitivity:

Compliant with 3GPP specification TS34.121, Rel. 99

Transmitter Power:

Compliant with 3GPP specification TS34.121, Rel. 99
The transmitter output power is compliant to following power classes:
UMTS: nominal 0,25W -> power class 4
GSM 900: nominal 2W -> power class 4
GSM1800/GSM1900: nominal 1W -> power class 1

Speech Coder:

Half Rate, Full Rate, Enhanced Full Rate and Adaptive Multi Rate speech coders are available as standard.

Temperature Range:

-10°C to + 55°C (Normal operation)
-30°C to + 85°C (Storage capability)

Display:

Type	full graphic
Resolution	240 x 320 Pixel
Technology	eTFT / True Color
Colours	16.7 Mio, TFT 256k
Frame Rate	15 frames/sec
Pixel size / mm	0,126mm (0.024mm per subpixel)
Active area / mm	30,24 mm x 40,32 mm
Illumination	White (4LEDs integrated)

3x4 Block Keypad:

- Keypad glued
- 12-key-block (0-9, #, *)
- tactile finder on key "5"
- 8 white LED's for keypad

Upper Slider Part:

- Five-way Navikey

- FSR Foil with 6 keys, LSK, RSK, On-hock, Off-hock, Clear and Task-switcher
- Chrome plated navi key ring with center push button.
- 8 white LED's for illumination

Sidekeys:

- Double action camera key, on press for focus next press to take picture.

Acoustics:

- Combined hands free / ringer speaker at rear side of phone, next to camera
- Dedicated ear piece speaker, allowing small dimensions as not needed as hands free speaker
- SMT microphone
- Polyphonic ringer tones (parallel to GPRS data transfer: 16 voices; all other Use Cases: 40 voices)
- Hands free mode
- different selectable volume levels for hands free, handset and ringer mode (for the amount see SW product description)

2.3 Comparison with current Product generation

Feature	Hydra	Kestrel	Onyx
Supported Systems	Trippel Band (EMEA, APAC) GSM 900/GSM1800/ GSM1900	Quad Band GSM900/GSM1800/GS M1900/UMTS2100	Quad Band GSM900/GSM1800/GSM1 900/UMTS2100
Stand-by Time	SL75: 290h	UMTS 300h GSM: 310h	UMTS 250h GSM 310h
Talk Time	SL75: 280min	UMTS 180min GSM: 220min	UMTS 3h 30min GSM 3h 15min
Battery Technology Battery Capacity	Li-Ion Battery Pack Nominal Cap.: 700 mAh	Li-Ion Battery Pack Nominal Cap.: 930mAh	Li-Ion Battery Pack Nominal Cap.: 950mAh
Weight	?	?	<100g
Volume	Approx. 78 cm ³	Approx. 80cm ³	Approx. 77,8cm ³
Length	92 mm	94 mm	89 mm
Width	48 mm	51,0mm	47 mm
Thickness	23 mm	16.5mm	23 mm
SIM	Plug-In 1.8V/3V	Plug-In 1.8V/3V	Plug-In 1.8V/3V
Antenna	Integrated	Integrated	Integrated
Antenna Perform- ance in comparison	SL75 27,5dBm@900MHz 25,0dBm@1800MHz 23,0dBm@1900MHz	EF81 28.0 dBm@900MHz 25.0 dBm@1800MHz 25.0 dBm@1900MHz 17.0 dBm@UMTS2100	SL91 26,5-27dbm@900MHz 24,5-25dbm@1800MHz 23,5-24dbm@1900MHz 15-15,5dbm@UMTS2100
Half Rate	Yes	Yes	Yes
Enhanced Full Rate	Yes	Yes	Yes
AMR	Yes	Yes	Yes
Fax/Data	Yes	Yes	Yes
GPRS	Yes (Class 8)	Yes (Class 10)	Yes (Class 10)
Keypad Illumination	Yes (white)	Yes (white)	Yes (white)
Display / Display Illumination	TFT 256k colour	TFT 256k colour	TrueColor 16.7 Mio
Ringer volume level	- Typ. ≥ 95dB(A) @ 5cm	- Typ. ≥ 95dB(A) @ 5cm	- Typ. ≥ 95dB(A) @ 5cm

3 Mechanics

3.1 Unit Description ONYX

The ONYX is a Slider phone with 2 integrated cameras for video telephony and photo applications. The video telephony camera and the camera key are placed above the base keypad underneath the slider. The auto focus mega pixel camera will be actuated by a double action side switch. The upper and the lower part are connected by a semi automatic slider which has a spring support to open and close the slider by a soft push on the slider part. The phone has two different acoustic moduls one for receiver mode on the topside and one for sound ringer and hands free mode with separate hole on the bottom side. Additional there is a hinge reader for exchangeable T Flash- Mirco SD cards behind the battery.

The 6 soft-, send/end- and function-keys on the upper part of the Slider phone will be done as FSR technology (Force Sensor Resistor), 3 on the left hand side and 3 on the right hand side of the 5-way-navi key in the middle. Special designed front cover will be without any split lines done with IMF-Technology which gives an more or less complete dark appearance. If you switch the phone on you can see the former also

dark display and the artworks of the function-keys are illuminated as well as the navi key. There will be only one black variant.

3.2 Interfaces ONYX to accessories

The phone has the following compatible interfaces to accessories:

- electrically by the Lumberg I/O connector (NANO Lumberg)
- Bluetooth interface is implemented
- Flip reader for Micro SD-Cards(exchangeable) is available
- Design shell

Key-Data

Volume	78 cm ³
Length	89 mm
Width	47 mm
Thickness	23 mm

3.3 Housing and keypad colours

Part	Material	Colour	Surface Finish
Front Cover (2 shot molding)	PC	black	IMF, high glossy
Support panel (2 shot molding)	BT45 000000 Natur +Lexan	Chrome / transpar- ent	Galvanized
Slider rear cover	Stainless steel	Black	PVD plated black matt
Lowercase (1 shot molding)	PC/ABS	black	Matt Lacquered
Battery Cover (1 shot molding)	PC/ABS	black	Matt Lacquered
Side button (2 shot molding)	PC/ABS+TPE	Black	Lacquered, high glossy
Number and video telephony key (1 shot molding)	Hard Caps on Silicon	Black	Lacquered, high glossy
Navi Key (2 shot molding)	PC+PC/ABS	Chromium glossy	Galvanized

Onyx Project Profile		L36880-N3450-A999		ASB00100207696							
Mechanics / el. mechanics / Design:				SAP no.	PM R&D	Mat Stat SAP no.	1st supplier	Share	PM R&D	Mat Stat. Suppl.	2nd supplier
Keypad				KEYPAD NUMERIC ONYX LATIN	A5B000900207722	40	DKJUL CO. LTD		40		SIUTECH TECHNOLOG
ASSY BASE ONYX				COVER BASE ONYX	A5B000900207692	40	LUMBERG CONNECT GMBH & CO. KG				
				ANTENNA UMTS GSM ONYX	A5B000900207693	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				ANTENNA BT ONYX	A5B00075800611	40	LUMBERG CONNECT GMBH & CO. KG				
				VIBRA MOTOR X95 3.2MM	A5B00075817595	40	LUMBERG CONNECT GMBH & CO. KG				
				ACO SPEAKER 8 OHM STEREO ONYX	A5B00075844080	40	SHICOH ENGINEERING CO., LTD.				
				BUTTON SIDEKEY CAMERA ONYX	A5B000900208896	40	BUJEON COMPONENTS CO. LTD.				
				CONNECTOR 1 POGO-PIN GSM/UMTS-ANT. ONYX	A5B00075838759	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
						40	TYCO ELECTRONIC AMP				
ASSY COVER BATTERY ONYX				ASSY COVER BATTERY ONYX	A5B000900207696	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				COVER BATTERY ONYX	A5B000900207696	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				CUSHION SPEAKER ONYX	A5B000900207699	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				MESH SPEAKER ONYX	A5B000900207729	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
					A5B000900209806	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
ASSY SLIDER ONYX				ASSY COVER SLIDER FRONT ONYX	A5B000900207680	40	LUMBERG CONNECT GMBH & CO. KG				
				COVER SLIDER FRONT ONYX	A5B00900212694	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				FOIL PROTECTIVE COVER SLIDER FRONT ONYX	A5B00900207691	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				SCREW INSERT M1.6*2.2 ONYX	A5B00900206203	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				SCREW INSERT M1.6*1.4 ONYX	A5B00900209852	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				MESH RECEIVER FRONT ONYX	A5B00900209853	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				CUSHION DISPLAY ONYX	A5B00900207695	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				LCD MODULE 240*320 256K TFT CARINA 3	A5B00075844320	40	EPSON EUROPE ELECTRONICS GMBH				
				ACOREC/VEDYN KESTREL	A5B00075612539	40	HOSIDEN EUROPE GMBH				
				SWITCH FSR FOL ONYX	A5B00900207725	40	ELECTRADE GMBH				
				FRAME FSR SWITCH SUPPORT ONYX	A5B00900207723	40	BALDA SOLUTIONS DEUTSCHLAND GMBH				
				FCP/ONYX/SLIDER	A5B00075801620	40	ICHIA TECHNOLOGIES INC.	40	M-FLEX		
				FOIL MDF SLIDER ONYX	A5B00900208189	40	TOPBOUND TECHNOLOGY INC.				
				KEYPAD NAVI KEY ONYX	A5B00900208189	40	SIUTECH TECHNOLOGY (EUROPE) LT				DKJUL CO. LTD
				COVER SLIDER REAR ONYX	A5B00900207721	40	LUMBERG CONNECT GMBH & CO. KG				
				ASSY SEMI-AUTO SLIDER ONYX	A5B00900207728	40	LUMBERG CONNECT GMBH & CO. KG				
				FOIL MDF BASE ONYX	A5B00900207724	40	TOPBOUND TECHNOLOGY INC.				
				FCP/ONYX/MMI	A5B00075801621	40	ICHIA TECHNOLOGIES INC.	40	M-FLEX		
				SENSOR MAGNET 5.0*2.0*1.0 ONYX	A5B00900209829	40	BUJEON COMPONENTS CO. LTD.				
				SENSOR MAGNET 0.5*0.5 ONYX	A5B00900209830	40	BUJEON COMPONENTS CO. LTD.				
Dig. Hardware / Baseband:				SAP no.	1st supplier	Share					2nd supplier
Mobile Station Modem				IC TELEC MSM6250A CSP409	A5B00075647643	10	QUALCOMM CDMA TECHNOLOGIES			97	QUALCOMM CDMA TEC
Flash				IC FLASHM61GB/8/SDRAM2*256MB*32 BGA225	A5B00075794535	99	Intel			97	AMD
Battery pack				BATTERY PACK/X95/LHON620MAH/EUROPE	A5B00075830912	40	VARTA MICROBATTERY GMBH				
LCD-module				LCD MODULE 240*320 256K TFT CARINA 3	A5B00075844320	40	EPSON EUROPE ELECTRONICS GMBH	40			
Camera-module				IC CAMERA MODULE 3 MAF KOALA	A5B0007589519	40	SAMSUNG ELECTRO-MECHANICS GMBH				
Camera-module				IC CAMERA MODULE X95 VGA 5*5 SEMCO	A5B00075932689	40	SAMSUNG ELECTRO-MECHANICS GMBH				
Speaker				ACO SPEAKER 8 OHM STEREO ONYX	A5B00075844080	40	BUJEON COMPONENTS CO. LTD.				
Receiver				ACOREC/VEDYN KESTREL	A5B00075612539	20	HOSIDEN EUROPE GMBH				
Microphone				ACO MICRO ECM 4MM OMNIDIRECTIONAL	A5B00075098861	10	Bujeon			10	Hosiden
FM Radio				IC FM RADIO TEA5764UK WL34 (BGA49)	A5B00075684254	40	PHILIPS SEMICONDUCTORS				
RF:				SAP no.	1st supplier	Share					2nd supplier
Chipset				IC TELEC TRANSCEIVER RTR6250-REV.D QFN56	A5B00075688060	10	QUALCOMM CDMA TECHNOLOGIES				
Chipset				IC TELEC RECEIVER RFR6250-REV.E QFN48	A5B00076688061	10	QUALCOMM CDMA TECHNOLOGIES				
Power Amplifier GSM				IC MODULE PA FP08143B SMD	A5B00075200770	10	HITACHI HIGH-TECHNOLOGIES EUROPE GM				
Power Amplifier UMTS				IC TELEC ACPM-7881 SMD	A5B00075025982	10	AVAGO TECHNOLOGIES INTERNATIONAL				AVAGO TECHNOLOGIE
Bluetooth Chip				IC TRANSCEIVER/BLUETOOTH/BCM2004 SMD	A5B00075296818	51	BROADCOM SINGAPORE PTE LTD.				
FEMT (Front-End-Modul)				IC FEM GSM/UMTS SMD	A5B00075392790	51	MURATA ELECTRONIK GMBH	10			TDK ELECTRONIC EUR
Connectivity:				SAP no.	1st supplier	Share					2nd supplier
SIM-reader				CONNECTOR SIM CARD READER K1 SMD	A5B00075109079	10	LUMBERG CONNECT GMBH & CO. KG				
Camera connector				CONNECTOR CAMERA THROUGH BOARD 20PIN SMD	A5B00075789521	40	SMK EUROPE N.V.				
Battery connector				CONNECTOR/BATTERY 3-POL/X85	A5B00075536067	20	FCI				
RF connector				CONNECTOR COAX SOCKET SWITCHED SMD	A5B00075530183	20	Tyco			10	Hirose
Pogo Pin antenna				CONNECTOR 1 POGO-PIN ANTENNA ONYX	A5B00075822087	40	YOKOWO CO LTD				
Pogo Pin GSM/UMTS				CONNECTOR 1 POGO-PIN GSM/UMTS-ANT. ONYX	A5B00075838759	40	TYCO ELECTRONIC AMP				
F2F connector				CONNECTOR F2F FEMALE 20 POL.0.4 MM SMD	A5B00075505765	20	TYCO ELECTRONIC AMP				
Cardreader Transflash				CONNECTOR CARDREADER TRANSFLASH HINGE	A5B00075496653	20	ALPS ELECTRIC EUROPA GMBH				
I/O connector				NANO-IO/JACK/PITCH=0.8MM/H=2.0MM/SMD/12P	A5B00075411792	20	Lumberg				
B2F connector				CONNECTOR B2F 40PIN MALE SMD	A5B00075789734	40	Hirose				
B2F connector				CONNECTOR B2F 20PIN MALE SMD	A5B00075789736	40	Hirose				
Miscellaneous				SAP no.	1st supplier	Share					2nd supplier
Main PCB				PCB/ONYX/MAINBOARD/A1	A5B00900207565	40	AT&S				
FPC Slider				FCP/ONYX/SLIDER	A5B00075801620	40	ICHIA TECHNOLOGIES INC.			40	M-FLEX
FPC MMI				FCP/ONYX/MMI	A5B00075801621	40	ICHIA TECHNOLOGIES INC.			40	M-FLEX
Power supply				POWER SUPPLY X95/EU/NANO-CONNECTOR	A5B00075532639	10	Astac			40	Frivo
Packaging				PACKINGS/ONYX/INT	A5B00075900609	??????????????					
UG				UG-M1/ONYX/DE-EN	A5B00075800608	??????????????					
UG				UG3/ONYX/ITALIAN	A5B00075800606	??????????????					
UG				UG4/ONYX/FRENCH	A5B00075800607	??????????????					

Assembly concept

K:\ENTWPROJ\X95_Onyx\PD-Team\Mechanical_Design_MD\CAD

4 Electronic

Following chapters give an overview about the hardware of the Onyx

5 RF Hardware

Following chapters give an overview about the RF hardware of the Onyx.

5.1 RF Section

The RF section consists of three data capable transceivers and two further broadcast receivers. The first transceiver is an IMS UMTS 2100MHz 3G solution which realises the conversion of the RF WCDMA signals from the antenna to the baseband and vice versa. The second transceiver is a GSM part which realizes the conversion of the GMSK-RF-signals from the antenna to the baseband and vice versa.

The UMTS part works in compressed mode to allow co-existence with GSM systems. The UMTS Transmitter and Receiver are active at the same time (FDD system) and a duplexer is used to pass signals to the receiver or transmitter RFICs. In the receiving direction the signal is passed through an LNA, filtered and a direct down conversion mixer is used to generate I and Q signals for the baseband. In the transmit direction the IQ signals from the baseband are modulated on to the carrier signals which are filtered and then amplified by the UMTS PA. The PA output impedance is protected by an isolator at the output which passes the signal on to the duplexer. A SP7T FEM is used to switch the RF signal from the antenna between the UMTS transceiver and the various GSM modes.

The GSM part supports triple band operation in the frequency ranges EGSM900, DCS1800, PCS19000 respectively supporting GPRS functionality up to multiclass 10. In the receiving direction the RF signals are filtered and then directly downconverted and split into the I- and Q-component and led to the D/A-converter of the logic part. In the transmission direction the GMSK signal is generated in an Up Conversion Modulation Phase Locked Loop by modulation of the I- and Q-signals which are generated in the logic part. The high power Tx VCO is external to the RFIC. Behind that the signals are amplified in the power amplifier. The GSM Transmitter and Receiver are never active at the same time (TDMA system).

The Bluetooth solution is realized in a single IC with an external SAW filter.

RF Chipset Overview

- RTR6250 Qualcomm
 - GSM Tx/Rx UMTS Tx RFLO1, (PLL for GPS LO, not used)
- RFR6250 Qualcomm
 - UMTS Rx GPS Rx UMTS VCO, (VCO for GPS, not used)
- VC-TXCO – 19.2MHz
- GSM Tx VCO
- GSM PA Module
- UMTS PA Module
- UMTS Duplexer and Isolator
- FEM
- Various SAW Filters
- BCM2004 Bluetooth IC

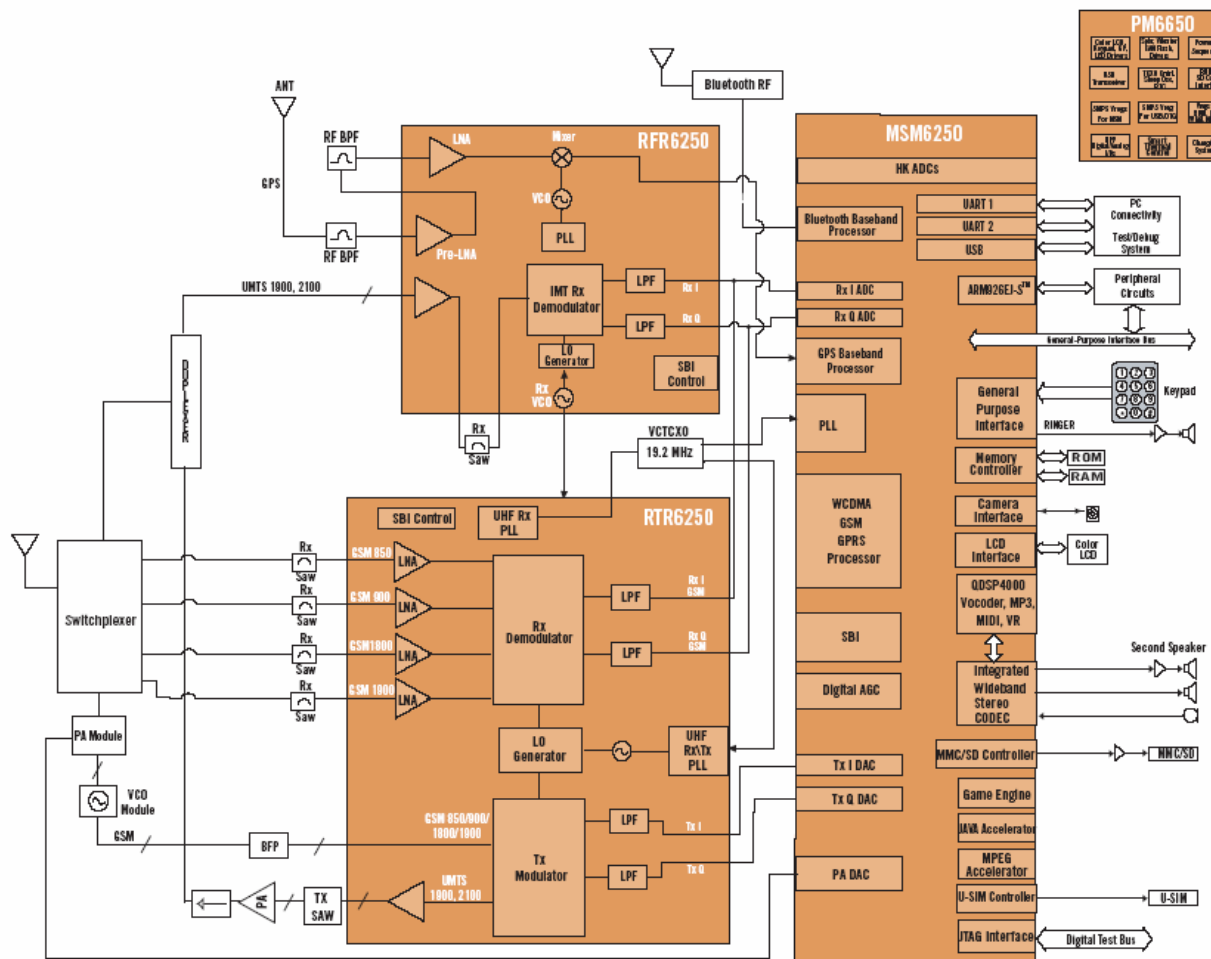


Figure 5-1 Qualcomm MSM6250 Platform III radioOne solution.

5.1.1 Compliance

5.1.1.1 Receiver Sensitivity:

The Receiver Sensitivity must comply with the corresponding GSM recommendations in all operating conditions (temperature, battery level.....)

GSM 900:	-102dBm (Specification, static & with fading)
GSM1800/GSM1900:	-102dBm (Specification, static & with fading)
UMTS2100	-106,7dBm (Specification, static & with fading)

5.1.1.2 Transmitter Power:

The RF part is compliant to GSM 11.10-1 release 1999 version 8.30. The transmitter output power is compliant to following power classes:

GSM 900:	nominal 2W -> power class 4
GSM1800/GSM1900:	nominal 1W -> power class 1
UMTS2100	nominal 250mW -> power class 3

5.1.1.3 Transmit output Power (all channels)

GSM 900	> 31,0dBm at normal conditions
GSM1800	> 28,0dBm at normal conditions
GSM1900	> 28,0dBm at normal conditions
UMTS2100	> 21,0dBm at normal conditions

5.1.1.4 AF signal-to-noise ratio

-S/(N+D) > 20dB measured at the receiver capsule at a nominal sound pressure of 94dbspl (1Pa) at 1kHz

5.1.2 Qualcomm radioOne ZIF RF Solution

5.1.2.1 Functional block diagram

The functional block diagram shows the Onyx A1 RF solution.

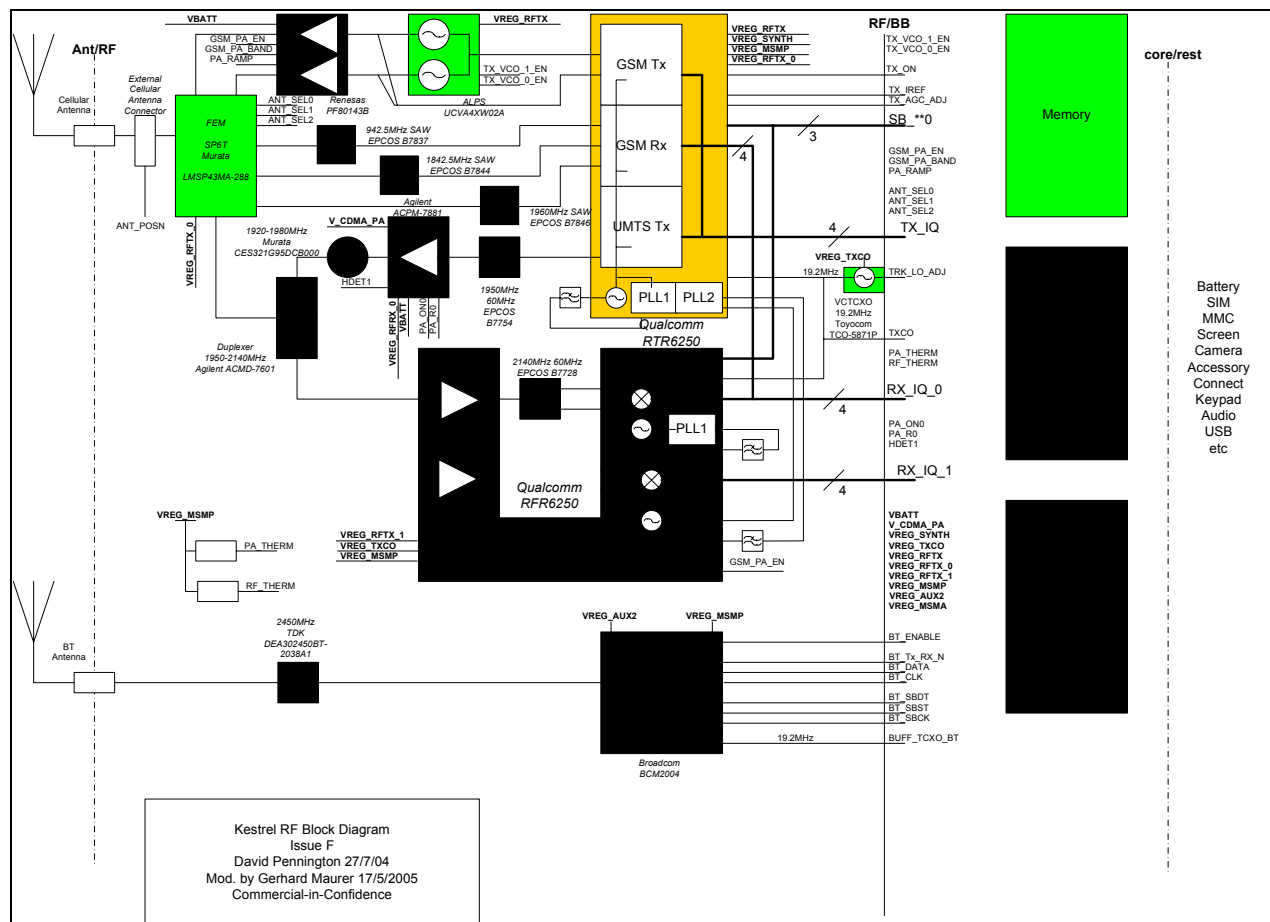


Figure 5-2 RF Block Diagram.

5.1.2.2 Murata SP6T Frontend-Module (FEM)

The FEM includes a switch for switching the Antenna between UMTS and the various GSM Tx and Rx modes. The FEM also includes two low pass filters to reduce the harmonics in the GSM Tx paths. The FEM is a SP6T supplied by Murata.

5.1.2.3 Discrete 19.2MHz TCXO reference oscillator

The 19.2 MHz signal is generated by a integrated TXCO. The frequency is controlled by the MSM6250 Baseband.

5.1.2.4 Qualcomm RTR6250 GSM Tx/Rx and UMTS Tx

The RTR6250 is a GSM Transceiver and UMTS Tx RFIC, the IC forms a key part of the Qualcomm solution. The block diagram is shown below.

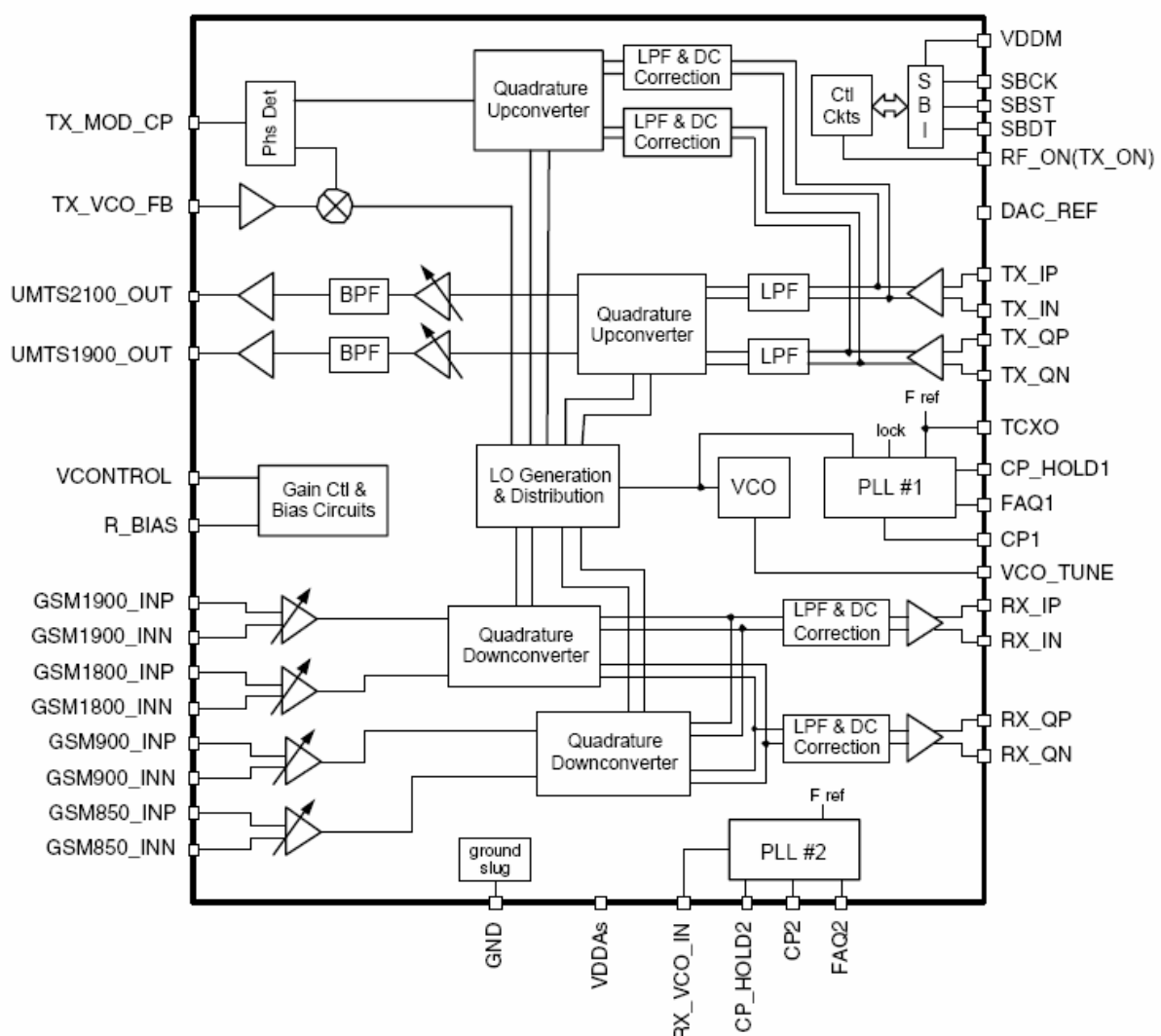


Figure 5-3 RTR6250 Block Diagram.

5.1.2.4.1 Frequency generation

The RTR6250 contains two PLL, the first is used by the RTR for all the GSM transceiver functions and for the UMTS Tx LO generation. The second PLL is for control of the GPS VCO in the sister RFR6250 RFIC but not used in Onyx.

5.1.2.4.2 UMTS Tx

The IQ signals from the baseband are directly up-converted to the RF band by a Quadrature Upconverter and passed to the external filter. The UMTS 1900 Tx path is not used in Onyx.

5.1.2.4.3 GSM Rx

The GSM Receiver is a Zero IF architecture with direct conversion by the IC. Although the IC provides 4 input paths, the GSM850 Receiver is not used in Onyx.

5.1.2.4.4 GSM Tx

The GSM Transmitter uses an Offset Phase Lock Loop Architecture. The High Power VCO is external to the RTR6250. A feedback signal from the VCO is down-converted and the phase compared to that of an upconverted version of the IQ signals from the baseband. The resulting control signal is filtered and passed to the High power VCO.

5.1.2.5 Qualcomm RFR6250 UMTS and GPS Rx

The RFR6250 RFIC adds the UMTS and GPS receiver functionality to the RTR6250 IC but the GPS Rx path is not used in Onyx. A block diagram is shown below.

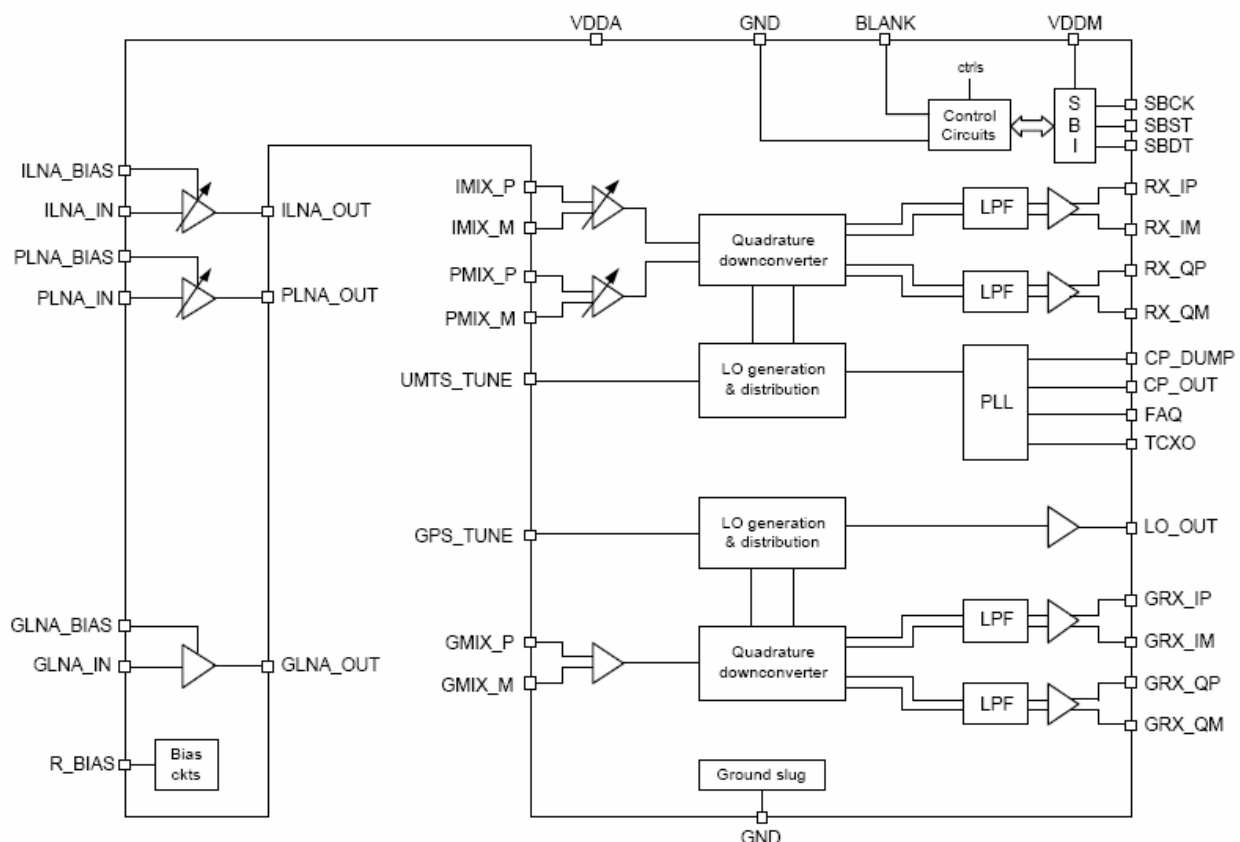


Figure 5-4 RTR6250 Block Diagram.

5.1.2.5.1 Frequency Generation

The RFR6250 has two VCOs. The first is for the UMTS Direct Conversion receiver. The second is for the GPS receiver which is not used in Onyx. The PLL for this GPS Rx VCO is on the RTR6250 RFIC.

5.1.2.5.2 UMTS Rx

The RFR6250 provides an LNA and then an output to allow further input filtering. The balanced signal is reintroduced to the RFR6250 and down converted by the Zero IF Quadrature Downconverter. The UMTS 1900 Rx path (PLNA, PMIX) is not used in Onyx.

5.1.2.5.3 GPS Rx (not used in Onyx)

The GPS path which is not used in Onyx is similar to the UMTS path, but uses a higher power LNA to compensate for the DCS self blocking. The RFR6250 does allow the GPS Rx path to be switched off during GSM Transmit pulses.

5.1.2.6 External GSM Blocks

5.1.2.6.1 GSM Dual Band Tx VCO

The GSM Tx VCO is external to the RTR6250 and uses filtered signals from the RTR6250 to provide the GMSK signal to the Power Amplifier

5.1.2.6.2 GSM Dual Band PA Module

The power amplifier is a PA module from Renesas used in GSM 65 and 75 gen. It contains two separate amplifier chains for EGSM900 and DCS1800 / PCS1900 operation both matched to 50 Ω at all signal ports. It is possible to control the output power of both bands via one PA_RAMP-port. The appropriate amplifier chain is activated by a logic signal which is provided by the MSM6250 (GSM_PA_BAND).

5.1.2.6.3 GSM Rx SAW Filters

Three SAW filters are used, one for each band, in the GSM Receiver. These are provided with matching circuits and also provide the balanced input to the RTR6250.

5.1.2.7 External UMTS Blocks

5.1.2.7.1 UMTS Tx SAW Filter

A single SAW filter is used in the UMTS Tx path before the PA module

5.1.2.7.2 UMTS PA Module

The power amplifier is a PA module from Agilent. The baseband supports two modes of operation to allow high efficiency low power operation. Further the baseband Power Management IC (PMIC) provides a step down converter to supply a lower V_CDMA_PA for even better low power efficiency operation. The Agilent module supports a different method of control, but its quiescent current is low enough such that these extra modes might be unnecessary.

5.1.2.7.3 Isolator

To ensure that the output power and ACLR requirements are met the power amplifier requires the output impedance to be controlled and an isolator is used behind the amplifier and before the duplexer.

5.1.2.7.4 Duplexer

To enable the full duplex FDD operation the UMTS transmit and receive are both operational. The duplexer is used to route the signal from the antenna (via the FEM) to the receiver and from the transmitter to the antenna (again via the FEM). The duplexer also provides some filtering.

5.1.2.7.5 UMTS Rx SAW Filter

This SAW filter provides both the balanced signals to the second stage of the RFR6250 but also extra filtering in the UMTS path behind the LNA.

5.2 Bluetooth

The Broadcom Chip, Blutonium MSM-Compliant BlueQ, BCM2004, realizes Bluetooth. The IC includes both the Baseband and the RF section.

In the digital part there are the digital demodulator, the GFSK modulator, the fractional N PLL for $\Sigma\Delta$ modulation, and other necessary circuits. These are connected with the MSM6250 processor. The analogue part of the $\Sigma\Delta$ synthesizer is in the RF section. There are also the receiver and the transmitter, the front-end, and the VCO. The loop filter circuit is external.

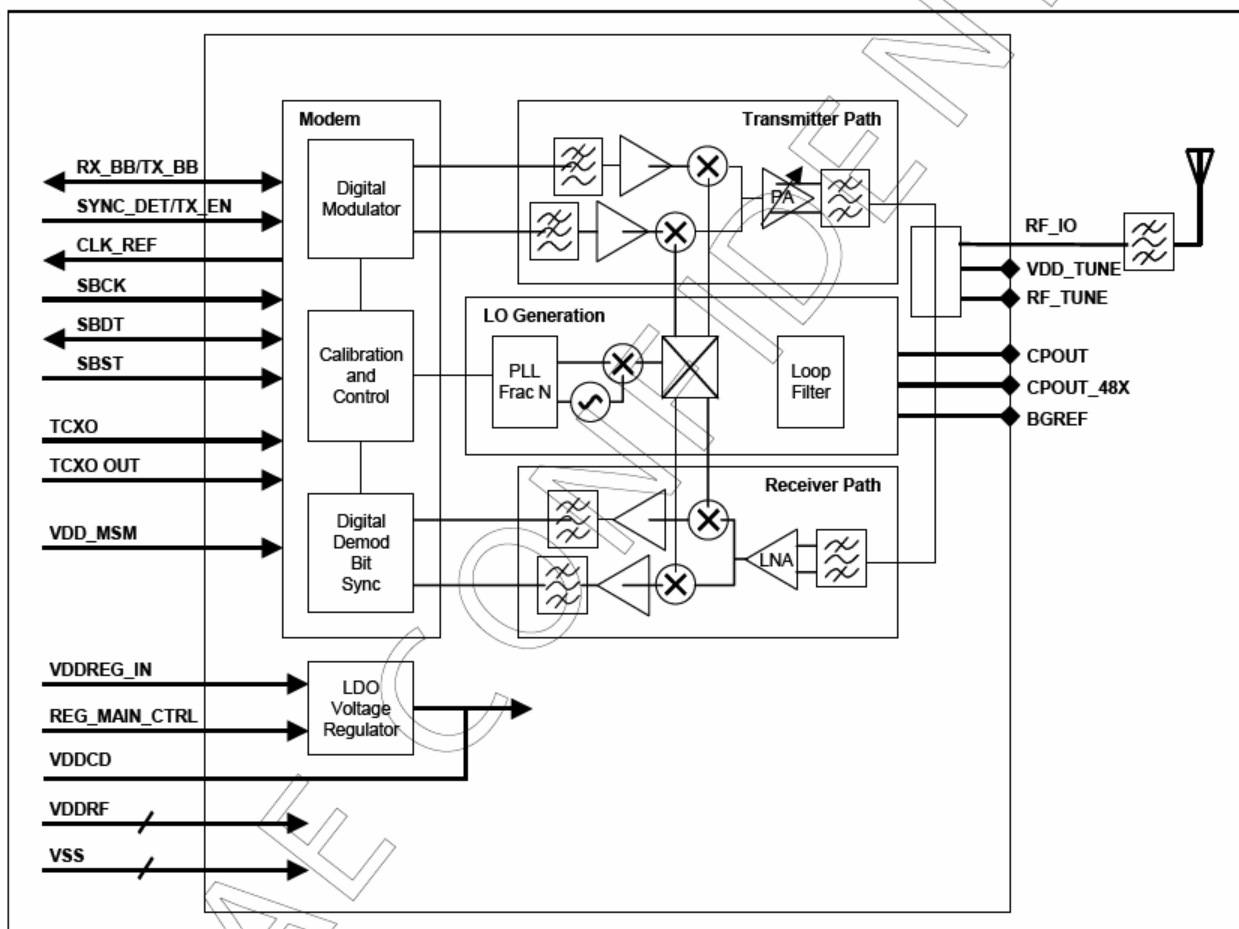


Figure 5-5 Bluetooth Block Diagram.

The receiver has a high degree of linearity, an extended dynamic range, and high order on-chip channel filtering to ensure reliable operation in the noisy 2.4 GHz ISM band. With an external bandpass filter the

receiver ensures optimal Bluetooth operation in the presence of high-level CDMA signals. The performance of the receive chain is reflected in the IP3, cochannel interference, and out-of-band blocking specifications. An on-chip demodulator bit slicer provides a post-slicer digital output, time aligned to a 12 MHz reference clock for interfacing to the QUALCOMM Bluetooth-enabled MSM.

The BCM2004 features a fully integrated transmitter. Baseband data is GFSK modulated and up converted to the 2.4 GHz ISM band via an internal mixer. The output Power Amplifier (PA) provides a nominal power output of 0dBm (assuming bandpass filter loss of 2dB) with the capability to increase the output power to +4 dBm or decrease the output power using register based controls accessible via the BlueQ serial interface. In addition, a power control provides 28 dB of gain control in 4 dB step sizes. Spurious transmitter signals are kept to a minimum in the CDMA frequency bands so that the BCM2004 may coexist with CDMA phone circuitry.

Local Oscillator (LO) generation provides fast frequency hopping (1600 hops/second) across the 79 maximum available channels. The LO generation sub-block employs a proprietary architecture for high immunity to LO pulling during PA operation. Partial on-chip loop filtering increases device stability and reduces the number of external components resulting in a smaller bill of material and a smaller board area.

The BCM2004 features on-chip calibration eliminating process variation across components. This enables the BCM2004 to be used in high-volume applications with no tuning required during production.

The BCM2004 also provides its own power supply regulation.

For reducing co-existence issues including Tx noise in the GSM Rx Bands and self blocking a SAW filter is provided. The antenna and test point with its matching network completes the Bluetooth solution in the Ke-strel project.

5.3 FM/RDS Radio

The Philips Chip TEA5764NH, Single Cellular, realizes FM Radio and RDS Data.

The Chip includes the Base band part and the RF section.

The TEA5764 is a single chip electronically tuned FM stereo radio with RDS/RBDS demodulator and RDS/RBDS decoder for low voltage application with fully integrated IF selectivity and demodulation. The radio is completely adjustment free and does only require a minimum of small and low cost external components. The radio can tune the European-, US- and Japan FM bands. The Radio does not meet all of the requirements from EN55020 a trade off was done to make possible the stated features.

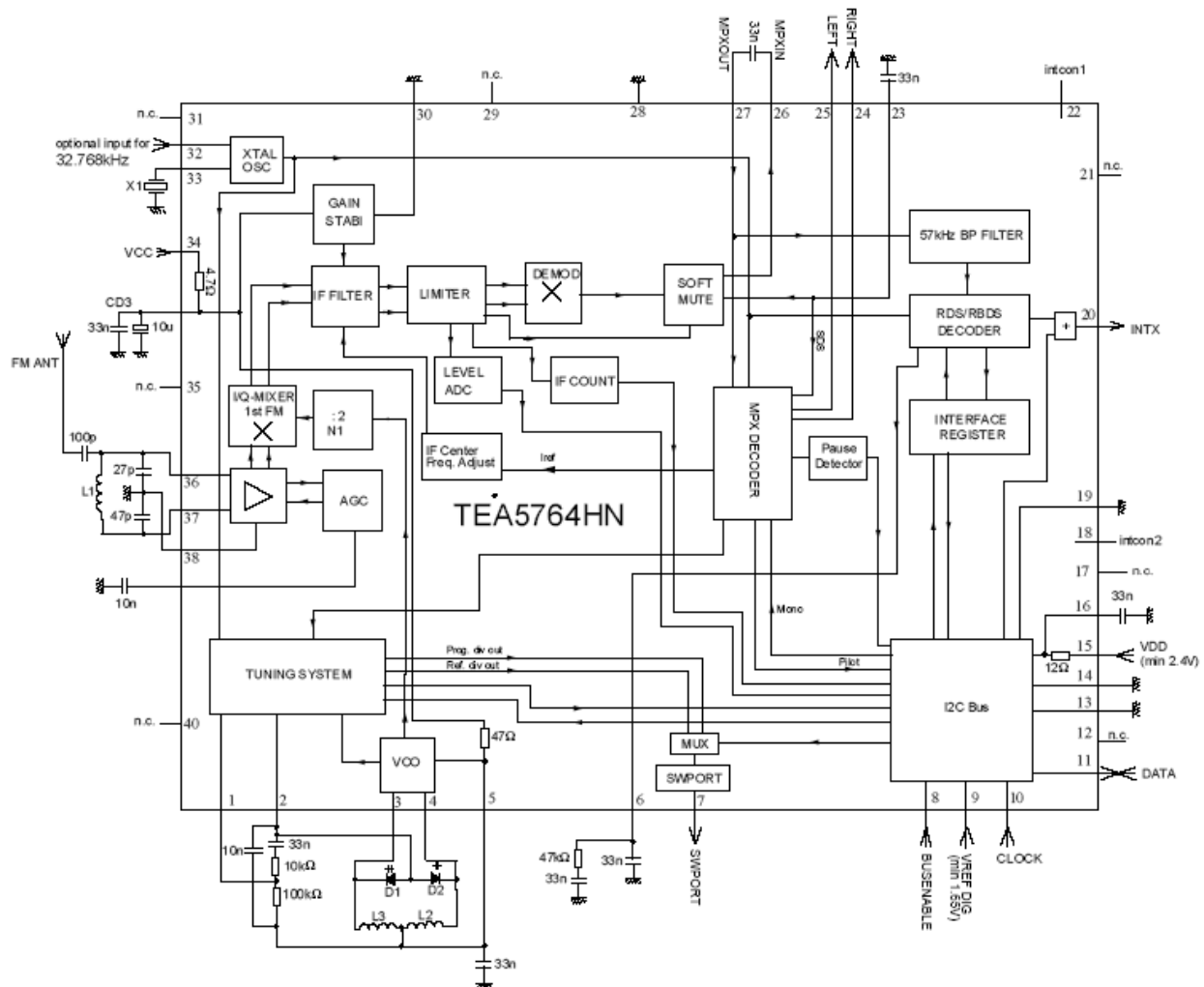


Figure 5-6 FM Block Diagram.

The FM Radio will be controlled by the MSM6250 processor using the I2C Bus.

The antenna is provided by the accessory cable, which with its matching and splitting network completes the FM solution in the ONYX project.

5.4 Digital Hardware

5.4.1 Overview of Hardware Structure

The following figure gives an overview of the Baseband system. A detailed description follows in the chapters below.

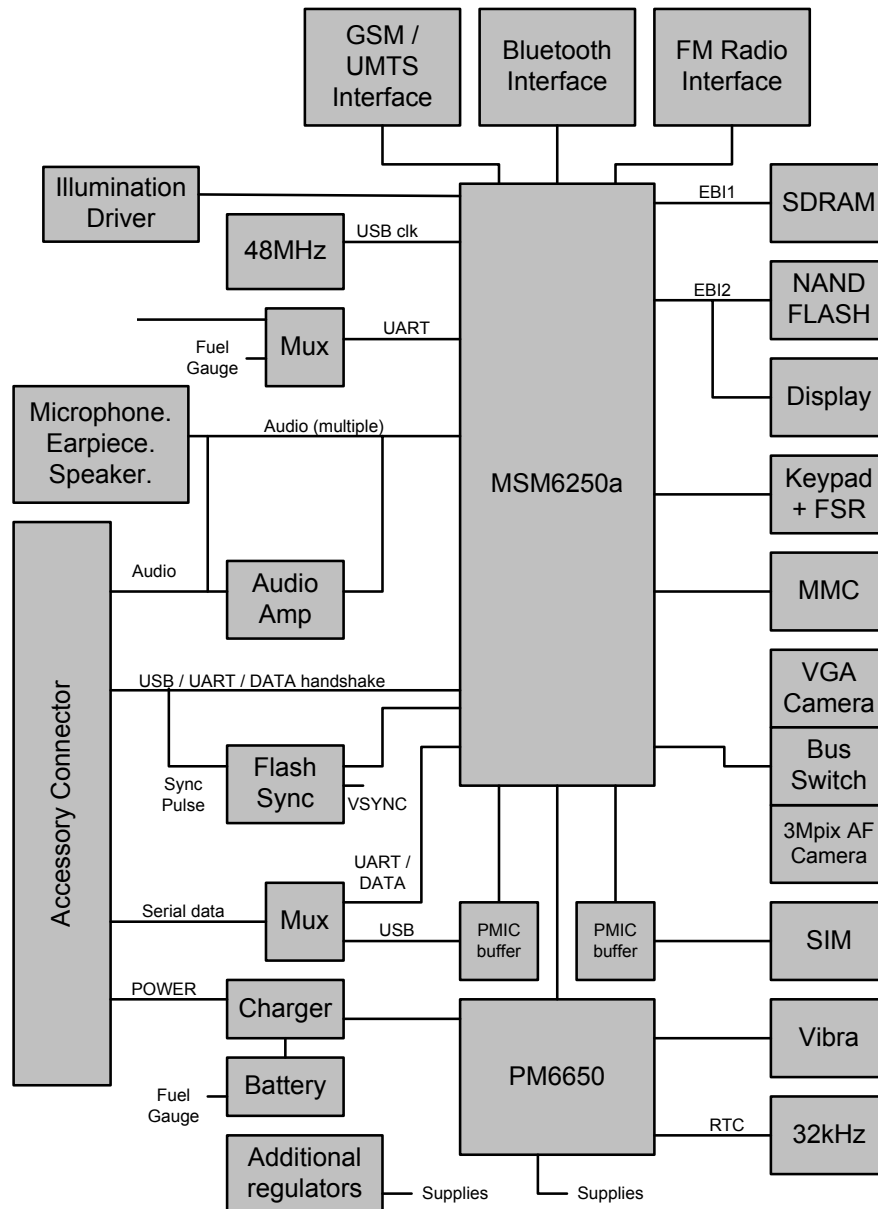


Figure 5-7 ONYX Baseband System Overview

6250 HW Key Components		ONYX		
		First Source	Second Source	Third Source
		Supplier Name	Supplier Name	Supplier Name
BB Key Components				
Baseband Chip		QUALCOMM (MSM6250A)		
Power Management Chip		QUALCOMM (PM6650-2J)		
Memory	SDRAM	TOSHIBA ELECTRONICS		
	FLASH	(1Gbit*8 NAND FLASH + 512Mbit*32 SDRAM)		
Display 1		Epson (Carina 3) (Interface speed needs to be checked)	Only Fallbacksolution: Phillips (Carina 2) (by now no 16M colour)	
Display 2		-		
Display Driver		LP3985 (2,9V) National	STM	AMS
Display Backlight Driver		LM2733 (20,6V) Fairchild		
Camera 1	Module	3,2MPix: SAMSUNG ELECTRO-MECHANICS		
	Sensor	3,2MPix: BIOMORPHIC VLSI		
Camera 2	Module	VGA 5x5: SAMSUNG ELECTRO-MECHANICS		
	Sensor	VGA 5x5: BIOMORPHIC VLSI		
Camera Driver		LP3985 (2,7V) National	STM	
Camera Switch		(not necessary from B1)		
Autofocus Driver		LP3985 (2,9V) National	STM	AMS
Autofocus ISP		- (integrated in Camera)		
Flash LED		-		
EMI Filter (IO Connector)		PHILIPS GMBH	ST MICROELECTRONICS N.V.	
USB / RS-232 Switch		MAXIM GMBH		
32 kHz Crystal		EPSON EUROPE ELECTRONICS	MICRO CRYSTAL	
48 MHz Crystal		FRISCHER ELECTRONIC SA	AVX GMBH	
Fuel Gauge		TEXAS INSTRUMENTS INC.		
Hall Sensor		IFX TLE4913		
Memory Card Reader		ALPS ELECTRIC EUROPA		
Headset Amplifier		ST MICROELECTRONICS N.V.		
Speaker 1 (Loudspeaker)		Bujeon 10 x 26 mm^2		
Speaker 2 (Receiver)		HOSIDEN EUROPE (same as Swan)		
Microphone		HOSIDEN EUROPE (same as X75)	Bujeon	
Vibra Motor		SHICOH ENGINEERING	Only Fallbacksolution: Bujeon	
Battery		Package: VARTA MICROBATTERY, Cell: Sony		
Flex	for Slider	Mflex		
Flex	for MMI	Mflex		
FSR-Foil		Interlink / Elektrade		

5.4.2 Digital Baseband

5.4.2.1 Baseband Processor

More detail on the MSM6250A can be found in the Product Specification (**Fehler! Verweisquelle konnte nicht gefunden werden.**).

A detailed description of the electrical functionality of each pin of the MSM6250A is given in the MSM6250A Pin List Description document (**Fehler! Verweisquelle konnte nicht gefunden werden.**).

5.4.2.1.1 MSM6250A Product Description

The QUALCOMM CDMA Technologies (QCT) MSM6250A Mobile Station Modem chipset and system software is designed to address the Frequency Division Duplex Direct Sequence Wideband CDMA mode of the IMT-2000 standard and the Global System for Mobile communications (GSM/ GPRS) standards. The MSM6250A device integrates the ARM926EJ-S processor, offering the ARM Jazelle Java hardware accelerator, two low-power, high-performance QDSP4000 Digital Signal Processor cores and a wideband stereo codec for support of enhanced digital audio applications. The QDSP4000 core eliminates the need for the multimedia companion processors normally required for video and audio-based applications, playing MP3 & AAC music files, MIDI synthesizer, video and still-image record and playback, and 2D/3D graphics functions. The MSM6250A mobile station modem solution includes multimedia features such as Qtunes MP3 player software and Compact Media Extension MIDI-based multimedia software.

ONYX system software is executed by an ARM926EJ-S embedded microprocessor and controls most of the functionality of the phone. The user interface of the phone includes the keypad, LCD display, and ringer. These are under the direct control of the MSM6250A mobile station modem.

The integrated wideband stereo CODEC converts an analogue audio signal, either differential or single-ended, from the microphone into digital signals for the MSM6250A mobile station modem's vocoder. The integrated CODEC also converts digital audio data from the vocoder into an analogue audio signal, either differential or single-ended, for the earpiece. The internal vocoder supports all 8 AMR modes, along with implementing two echo cancellers, one for the earseal and an acoustic echo canceller for carkit applications. The vocoder also supports DTMF generation and detection, Advanced Noise Suppression, audio AGC control, and automatic volume control.

The MSM6250A package is a 409-pin, 0.5mm pitch, Chip Scale Package.

5.4.2.1.1.1 MSM6250A general features

- Supports UMTS FDD release 99 September 2002 standard air interface
- Supports GSM/GPRS in addition to W-CDMA
- Supports low-power, low-frequency crystal to enable TCXO shutoff
- radioOne™ Zero IF interface Zero IF support - DC offset cancellation and digital variable gain amplifier
- Software-controlled power management features
- Hardware support for inter-frequency and inter-radio access technology searching in CM (WCDMA-GSM)
- Higher-speed serial bus interface, operating at up to 10 MHz and capable of handling four hardware requests
- Multimedia card hardware support
- Serial bus controller: standard 100 kbps and Fast 400 kbps
- MPEG4 video encoder
- 2-D and 3-D graphics accelerator for gaming applications
- Hardware acceleration supporting video capture and video telephony
- USB slave functionality

- Integrated wideband stereo CODEC for digital audio application

5.4.2.1.1.2 W-CDMA FDD features supported by the MSM6250A Mobile Station Modem

The MSM6250 supports release 99 September 2002 of W-CDMA FDD standard, including following features:

- All modes and data rates for W-CDMA frequency division duplex (FDD), with the following restrictions:
- The downlink supports the following specifications:
 - Up to four physical channels, including the broadcast channel (BCH), if present
 - Up to three dedicated physical channels (DPCH)
 - The downlink supports the following user equipment (UE):
 - Four coded composite transport channels (CCTrCH), 9 transport channels (TrCH) (eight plus one for BCH), 32 transport blocks (TrCSPBk) ending at any 10 ms frame boundary
 - 128 transport formats in a transport format set (TFS) over all channels
 - A maximum aggregate data rate of 384 kbps (excluding the BCH), with additional restrictions limiting data to be decoded at any radio frame boundary to 6400 bits (excluding the BCH)
 - Spreading factor (SF) restriction, such that the sum of 1/SF of all channels (excluding BCH) is $\leq 1/4$
 - Compressed mode (CM) support for inter-frequency and inter-RAT
 - SF (spreading factor) range support from 4 to 256
 - The following transmit diversity modes are supported:
 - Space time transmit diversity (STTD)
 - Time-switched transmit diversity (TSTD)
 - Closed-loop feedback transmit diversity (CLTD)
- The uplink supports the following specifications:
 - The uplink provides the following UE support:
 - One physical channel, eight TrCH, and 16 TrBks starting at any frame boundary
 - A maximum data rate of 512 kbps
 - Full SF range support from 4 to 256
 - SMS
 - PS data rate 384kbps DL / 64 kbps UL, simultaneous or 128/128 simultaneous
 - CS data rate 64kbps DL / 64 kbps UL
 - AMR (all rates)

5.4.2.1.1.3 GSM/GPRS features supported by the MSM6250A Mobile Station Modem

The following GSM modes and data rates are supported by MSM6250a. Support modes conform to release '99 specification of sub-feature.

- SMS
- Voice features
 - FR
 - EFR
 - AMR
 - HR
 - A5/1 and A5/2 ciphering
- Circuit switched data features
 - 9.6 k
 - 14.4 k
 - Fax
 - Transparent and non-transparent modes for CS data
 - No sub rates are supported
- Packet switched data (GPRS)
 - Class B (Multislot Class 10)
 - CS schemes CS1, CS2, CS3, and CS4

- GEA1 and GEA2 ciphering
- Maximum of 4 Rx timeslots per frame
- DTM (dual transfer mode) "simple class A" where GSM and GPRS are simultaneous on the same ARFCN.

5.4.2.1.1.4 MSM6250A Mobile Station Modem audio processing features

- Integrated stereo CODEC with microphone and earphone amplifiers
- Integrated wideband stereo CODEC
- Three microphone inputs (analogue)
- Three speaker outputs (analogue)
- EarSeal echo cancellation (ESEC)
- Acoustic echo canceller of hands-free applications
- AMR vocoder
- Dual-tone multiple-frequency (DTMF) generation and detection
- Qtunes™ MP3 player software
- Compact Media Extension (CMX™) MIDI-based multimedia software

5.4.2.1.1.5 MSM6250A Mobile Station Modem microprocessor subsystem

- Industry standard ARM926EJ-S™ embedded microprocessor subsystem
- Java hardware acceleration
- Enhanced memory support
- Dual memory buses (EBI1 & EBI2)
- 1.8 V or 2.6 V memory interface support for EBI2 (Wolf 4 uses 1.85V)
- 1.85 V memory interface support for EBI1
- Page and burst mode NOR FLASH or SRAM
- Burst mode is supported on all four EBI1 chip selects
- NAND FLASH memory interface
- Boot from NAND
- Low-power SDRAM (LP-SDRAM) interface
- Flash Memory Card (MicroSD) support
- Internal watchdog and sleep timers
- The ARM926EJ-S microprocessor can operate at up to 150MHz with variable rate, software-controlled clocks to provide greater standby time.
- ANSI/IEEE 1149.1A-93 compliant JTAG interface for testability
- Embedded trace macrocell for native mode debugging of the ARM processor

5.4.2.1.1.6 MSM6250A Mobile Station Modem supported interface features

- Enhanced USB interface (full-speed USB-OTG)
- Enhanced universal asynchronous receiver transmitter (UART) serial ports
- General-purpose I/O pins
- External keypad interface
- Parallel LCD interface
- Serial bus interface (SBI) that controls the other QUALCOMM ASICs in the subscriber unit.
- Pulse density modulated (PDM) outputs for user-defined analog control
- General-purpose programmable M/N counter output
- Programmable ringer output
- Integrated USIM controller for direct interface to USIM card reader
- HKADC for monitoring of analog parameters (6-channel)
- Stereo DAC interface
- Integrated mass storage device controller for direct interface to high memory storage cards (e.g., MMC/SD)
- Bluetooth™ interface (BlueQ™)

- Megapixel camera interface, supporting up to 2 megapixel images

5.4.2.1.2 MSM6250A Power Supplies

The Supplies used by the MSM6250A are generated by the PM6650-2 (Section **Fehler! Verweisquelle konnte nicht gefunden werden.**). They are as follows:

Supply Name	Value	Power Domain
VREG_MSMC	1.25 V (±3%)	Digital Core only.
VREG_MSME	1.850 V (±3%)	SDRAM interface (EBI1 bus), NAND FLASH and LCD interface (EBI2 bus), Supply voltage for IO Pad group 2
VREG_MSMA	2.600 V (±3%)	Analog circuits
VREG_MSMP	2.600 V (±3%)	Supply voltage for IO Pad group 3

Table 1 MSM6250A Power Supplies

The supplies become active while the phone is in the Reset state during “Phone On” operation (PON_RST_N from the PM6650-2 is low). They remain active until the phone is turned off.

5.4.2.1.3 MSM6250A Clocks and Clock Distribution

Clock distribution is shown in Figure 5-8 below:

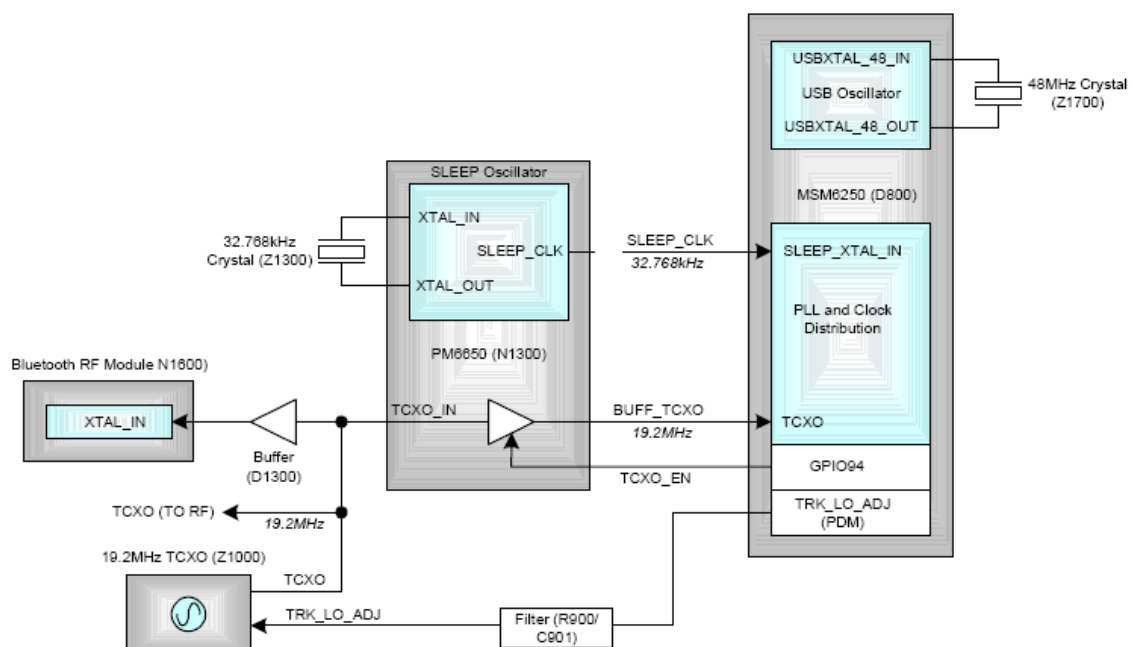


Figure 5-8 Clock Distribution

The master clock for Baseband and RF systems runs at 19.2MHz. The clock is generated by Voltage-Controlled-Temperature-Compensated-Crystal-Oscillator Z1000. The clock is buffered to VREG_MSMP (2.6V) levels within the PM6650-2, and then sent to the MSM6250A. The PM6650 buffer is enabled by logic control TCXO_EN from the MSM6250A. The MSM6250A integrates a phase-locked loop (PLL) and digital dividers to derive internal clocks from the TCXO clock input.

The TCXO is also buffered by D1300 to feed the Bluetooth RF Module, N1600. This buffer is only enabled if the Bluetooth supply (VREG_AUX2) is active.

A 32.768kHz clock (SLEEP_CLK) is generated by the PM6650-2, and fed to the MSM6250A. This clock is used for low-power operation during phone Idle periods, when the TCXO is disabled. It also drives a Real-Time-Clock (RTC) circuit in the PM6650-2. The power supply for the Sleep Oscillator and associated Real-Time-Clock is derived from the battery voltage and backup capacitor C1312. This means the clock is active during the phone is powered off, and for more than 40 seconds after the battery is removed.

A 48MHz clock is provided by Z1700. This is used internally by the MSM6250 to control USB functions.

5.4.2.1.4 MSM6250A Bootup and Mode Control

The MSM6250A supports booting from the NAND FLASH memory. The high pullup (R1700) on the boot-mode input pin is used to indicate to the MSM hardware that FLASH bootup is required. After power-on reset, the MSM hardware automatically loads the boot code from NAND flash to an on-chip boot SRAM, and then releases the ARM to execute from this boot SRAM. By executing the boot code, the ARM processor transfers the entire phone software to the SDRAM, and then branches to the SDRAM to execute the phone software and completes the boot-up process.

The MSM6250A runs in "Native" mode. This mode is selected by the Mode 0, Mode 1, and Mode 2 pins (Schematic sheet 17). The pins are left floating (internal pulldown resistors) to select Native mode. Note that the Mode pins are connected to additional MSM6250A pins. This is a requirement of the device - the signals are not required for any external functions.

MSM6250A Clocks and Mode Control signals are summarised below:

MSM6250A Function	Signal	Function
TCXO	BUFF_TCXO	TCXO clock input from PM6650-2
USB_XTAL48_IN	(48MHz crystal)	48 MHz crystal oscillator input
USB_XTAL48_OUT	(48MHz crystal)	48 MHz crystal oscillator
SLEEP_XTAL_IN	SLEEP_CLK	Low-power sleep crystal oscillator from PM6650-2
SLEEP_XTAL_OUT		(not used)
RESIN_N	PON_RST_N	Hardware reset input from PM6650-2
RESOUT_N		(not used)
RESOUT_N_EBI1	RESOUT1_N	Reset output generated by RESIN_N and by wdog_reset. Reset to LCD, NAND FLASH
WDOG_EN		(not used)
MODE[2]		(not used)
MODE[1]		(not used)
MODE[0]		(not used)
BOOT_MODE		pull-up to VREG_MSMP (boot from NAND)

Table 2 MSM6250A Clocks and Mode Control

5.4.2.1.5 MSM6250A JTAG

JTAG access is hidden on the production version of ONYX to prevent unauthorised access. The design authority should be contacted if detailed information is required.

The JTAG interface on the MSM6250A is accessible by a Test Access Port (TAP). This port includes the following signals:

MSM6250A Function	Signal	Function
RESIN_N	JTAG_RESOUT_N	Hardware reset signal from PM6650-2
TRST_N	JTAG_TRST_N	JTAG reset. (not used on Production phone)
TCK	JTAG_TCK	JTAG clock input. (not used on Production phone)
TMS	JTAG_TMS	JTAG mode select input. (not used on Production phone)
TDI	JTAG_TDI	JTAG data input. (not used on Production phone)
TDO	JTAG_TDO	JTAG data output. (not used on Production phone)
RTCK	JTAG_RTCK	JTAG ARM9 clock input. (not used on Production phone)

Table 3 JTAG Interface

The MSM6250A Device Specification (**Fehler! Verweisquelle konnte nicht gefunden werden.**) should be consulted for more details.

5.4.2.1.6 Real Time Clock

The real time clock (degree of accuracy TBD 150ppm) is powered via a separate voltage regulator inside the PMIC. Via a capacitor, data is kept in the internal RAM during a battery change for at least 30 40 TBD seconds. An alarm function is also integrated with which it is possible to switch the phone on and off.

5.4.3 External Memory

5.4.3.1 SDRAM

Onyx uses a 512Mbit SDRAM memory for volatile data storage. This memory is a part of the MCP (D1001) The device is powered from VREG_MSME (1.85V), and is interfaced to the MSM6250A using the dedicated EB11 bus. Device specifications are as follows:

- **Memory Size:** 512Mb
- **Data Bus:** 32 Bit
- **Frequency:** 105 MHz max.
- **Power supply:** 1.85 V (VREG_MSME)
- **Banks:** 4

There is no second source

5.4.3.2 NAND FLASH

Onyx contains 1Gbit of NAND Flash memory for Code storage and Data storage. This memory is a part of the MCP (D1001) The FLASH is powered from VREG_MSME (1.85V) and interfaces to the MSM6250A with the EBI2 bus. This bus is shared with the Display.

Code cannot be executed directly from NAND Flash and therefore needs to be transferred and executed from RAM.

The NAND flash is a 128Mx8bit device providing a cost effective solution for solid-state mass storage. The 8-bit I/O pins serve for address, data input/output and command input.

The device also includes one block sized OTP (One Time Programmable) which can be used to permanently store calibration values and the phone's IMEI number.

Memory Size: 1 Gbit
I/O Bus: 8 Bits (command/Address/Data multiplexed)
Power Supply: 1.85 V (VREG_MSME)
Flash Performance:

Page Read Operation

- Page size: 528 Bytes
- Cell array to register access: 25 us max.
- Serial Read cycle: 50ns (min.)

Fast Write Cycle

- Page Program time: 200 us typical
- Block Erase time: 2 ms typical

Memory Organisation:

1 Gbit
The memory array consists of 8192 separately erasable (16K +512)byte Blocks
A Block consists of 32 Pages
A Page consists of 528 bytes

The following NAND FLASH device will be used:
Toshiba 1Gbit- TH58DYG02A2XGP5HB0 (Vendor ID 98h, Device ID 78h).

The protected area on the FLASH operates as follows:

Toshiba proposed a solution where the 'unprotect mechanism' (of the standard block protection) of the NAND flash is disabled via a fuse. With this disabled 'unprotect mechanism' a protected block of the NAND flash can not be modified (or unprotected) at any time.

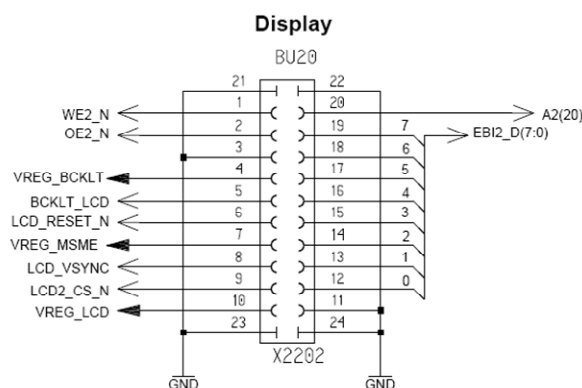
This applies to the complete data area of the flash! So if SW sets the protection for any block in the NAND flash it can not be reset. The fuse (for disabling the 'unprotect mechanism') has to be burnt during the outgoing test at Toshiba (customized flash)! Apart from the block protection, the NAND flash operation is the same as for standard devices.

There is no second source

5.4.4 Display Module

5.4.4.1 Overview

The CARINA-3 display has a resolution of 240x320 pixel with a colour depth of 16.7 million colours. It contains an active matrix display (TFT) and a plastic housing. It generates the colours by red, green and blue colour filters. For ONYX one source is used (Epson with Rohm controller). The controller is directly mounted on the panel of the display (COG). In order to guarantee a very efficient illumination white LEDs are mounted on a flex foil inside the module. In addition, all passive components which are necessary to drive the LCD are also assembled on this FPC (flexible printed circuit). The software can detect the displays automatically due to the hardware coding. Thus, the only interconnections to BenQ's PCB are the data lines and the power supply lines of the controller and the white LEDs. The interface is realized by a board to board connector with 20 pins which is assembled on BenQ's MMI flex foil that is connected to



BenQ's PCB.flex foil

4420-23200The ONYX display is a 2.0" QVGA (240x320) TFT display with 16.7 million (24 bit) color depth. The supplier for the TFT display is Epson - there is no second source. The controller is integrated with the display module. The display interface is connected to the 16-bit wide external bus interface (EBI2) of the MSM6250, which is also shared with the NAND Flash. The display I/O supply voltage (VIO) is 1.8 V while the main display power supply (VDD) is 2.85 V.

The display backlight is generated by 4 LEDs connected in series inside the display module. The brightness is controlled by the LED driver inside the PMIC MSM6650. The required supply voltage of 20-23 V is generated by a step-up converter TBD.

The display is blanked at power-up and after a hardware reset.

5.4.4.2 Interface Display - Module to ONYX PCB

The display is connected to the main PCB via a 30-pin connector mounted on a short flex, as shown in Figure 5-9.

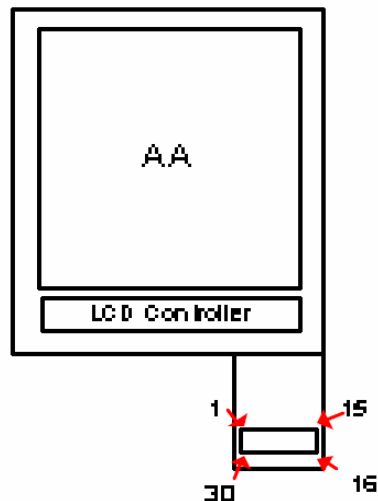


Figure 5-9 Orientation of LCD Connector with respect to Display (viewed from above)

5.4.4.3 Realisation Principles

The display is capable of 64 gray levels for each of the three (RGB) colours, achieved using PWM. It is capable of operating in the following modes:

- 8 bits/pixel (332 data mode)
- 16 bits/pixel (565 data mode)
- 12 bits/pixel (444 data mode)
- 18 bits/pixel (666 data mode)

Functions available include vertical scrolling, page and column automatic increment

The display is also capable of pausing the display update process on part of the screen to reduce power consumption.

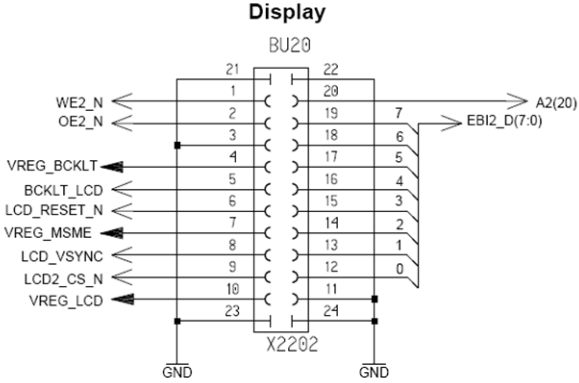
5.4.4.4 Contrast and Color Adjustment

Colour adjustment is achieved using the RGBSET command, which defines the look up table used to map the input data to the corresponding 18-bit pixel colour.

Contrast adjustment is achieved by writing an 8-bit value to the display using the WRCNTR command. The default value is 03Fhex.

5.4.4.5 Characteristic Dimensions and Features

ofMMI flex	Requirements
------------	--------------

<div style="text-align: center;"> Display  </div> <div style="display: flex; justify-content: space-between; padding: 5px;"> foil Dimen- </div>	
Pixel Pitch (μm^2)	0.042xRGB x 0.126
Active Area Width (mm)	30.04
Active Area Length (mm)	40.32
Black Area: Width (mm)	30.04
Black Area: Length (mm)	48.72
Module Width excluding flex (mm)	41
Module Length excluding flex (mm)	58
Module Thickness (mm)	3.5

5.4.4.6 Illumination

a) Keyboard

The lower keypad backlight is supplied by 8 white LEDs. They are grouped in 4 channels. Each of the channels contain two LEDs in parallel and can be switched to the PWM separate. This allows to switch on the keypad rows sequentiell to get a light effect.

The upper keypad backlight is supplied by 8 white LEDs. Four of them switched in a row used to light up the six FSR-Keys. They build the next channel which can be switched to the PWM. The Navi-Key is illuminated by four additional LEDs which are connected in a row. For this LED Group there is used an extra PWM to get the possibility to make the Navi-Key-light "Breathing" indepentand of the other light groups

b) Display

The LCD backlight is supplied by 4 white LEDs. These are connected in series to a high voltage supply (> 17V) to ensure uniform illumination. Current is limited to 15mA, and brightness is controlled using PWM from an MSM6250 GPIO pin.

c) Navigation key

The Navi-key is also supplied by 4 white LED's, again connected in series to > 17V. Current is set to 10mA max. and controlled by a MSM6250 GPIO (PDM function on GPIO92)

5.4.5 SIM

SIM cards with supply voltages of 3V will be supported. The hardware can also support 1.8V cards. However, the ONYX software will only support 3V. 1.8V support may be made available if required (e.g. an operator's request). An Integrated EMI Filter and ESD Protection device is connected to the SIM lines to protect the phone.

5.4.6 Fuel Gauge

Fuel Gauge communicate with the MSM6250A using the UART.

The Battery Pack contains a Fuel Gauge Monitor from Texas Instrument (BQ27000). The Fuel Gauge signal is a 1-wire HDQ interface.

The Fuel Gauge interface is open-drain at the battery pack. It has a pull up to VREG_MSMP. Since the single-wire interface is operated in an open-drain environment, an open-drain driver circuit (V2101) has been added to the FUEL_GAUGE_TXD interface of the Fuel Gauge

Data is passed from the TXD line to the Fuel Gauge as follows:

The FUEL_GAUGE line is pulled to VREG_MSMP

When FUEL_GAUGE_TXD is set to low, the collector of V2101 (b) is pulled high, which causes V2101 (a) to pull FUEL_GAUGE low. This data is read by the Fuel Gauge. The FUEL_GAUGE_RXD line goes low at the same time, but this is ignored by the MSM6250A.

Data is passed from the Fuel Gauge to the RXD line as follows:

The battery Fuel Gauge has an internal pull down transistor. This pulls FUEL_GAUGE low, which in turn sets FUEL_GAUGE_RXD to low to the MSM6250A.

5.4.7 T-Flash mircoSD

MicroSDcards (μSDcards) with supply voltages of 3V only will be supported and only in 1-bit mode. The interface lines are protected with Spark Gaps and EMI-Filters. Card insertion/removal detection is supported on pin DAT3 of the μSDcard. When a card is inserted this pin is pulled to up to Vcc.

5.4.8 Cameras

ONYX has 2 integrated cameras which are supplied by Samsung Electro-Mechanics. A VGA camera (640 x 480) is included to support video conferencing with display of the local user image at a maximum frame rate of 15fps. The second camera is a 3.14 Mega Pixels sensor with Autofocus primarily for capturing high-resolution still images but does also support video capture.

Both cameras are interfaced via the MSM6250 camera interface. It is a standard CCIR656 based interface consisting of 8 data lines, vertical and horizontal synchronization lines, a master clock into the sensors and a pixel clock output from the sensors. Both camera interfaces can be tristated and are directly connected to the single MSM6250 camera interface. Only one camera can be selected at any time. The cameras are configured and controlled via the I2C bus. Power is supplied to the cameras via 2 single output external 2.7V voltage regulators. One of them supplies the VGA camera and the other one the sensor of the 3.2 mega pixels camera. An additional voltage regulator with 2.9V is used for the Autofocus motor.

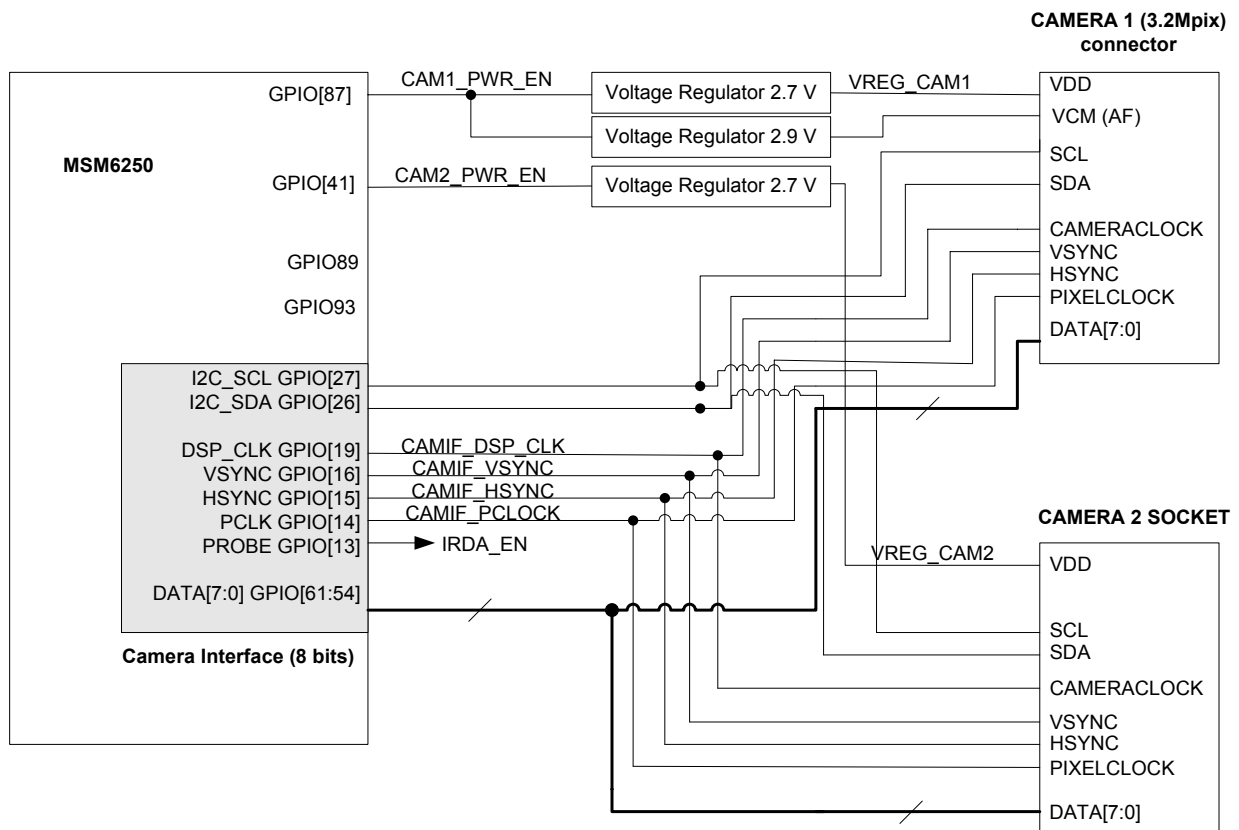
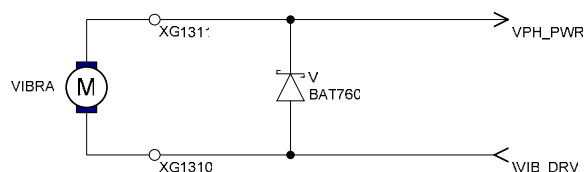


Figure 5-10 Camera Interfaces

5.4.9 Vibration Motor

The vibration motor is controlled directly by the PM6650 power management circuit. The motor is connected to VPH_PWR and the voltage regulator output VIB_DRV. The voltage on VPH_PWR is directly coupled to the voltage of the battery. To ensure a constant voltage of 3.0V at the vibration motor pin VIB_DRV can be programmed from 1.2V to 3.1V accordingly. A flyback diode is connected across the motor terminals to prevent inductive kickback during turn-off and suppress voltage transients that could damage the IC.



5.4.10 Keypad Mapping

The keypad mapping and interfacing with the MSM6250 is illustrated in Figure 5-11. The END/Power key is part of the FSR-foil and, unlike as in other phones, cannot be used to switch on the phones. The phone is actually switched on by opening the slider so that one of the two Hall-sensors gives a signal to the PMIC (pin KPDPWR_N) through a pulse shaping circuit. The switching-off procedure instead is realised as usual by pressing the END key.

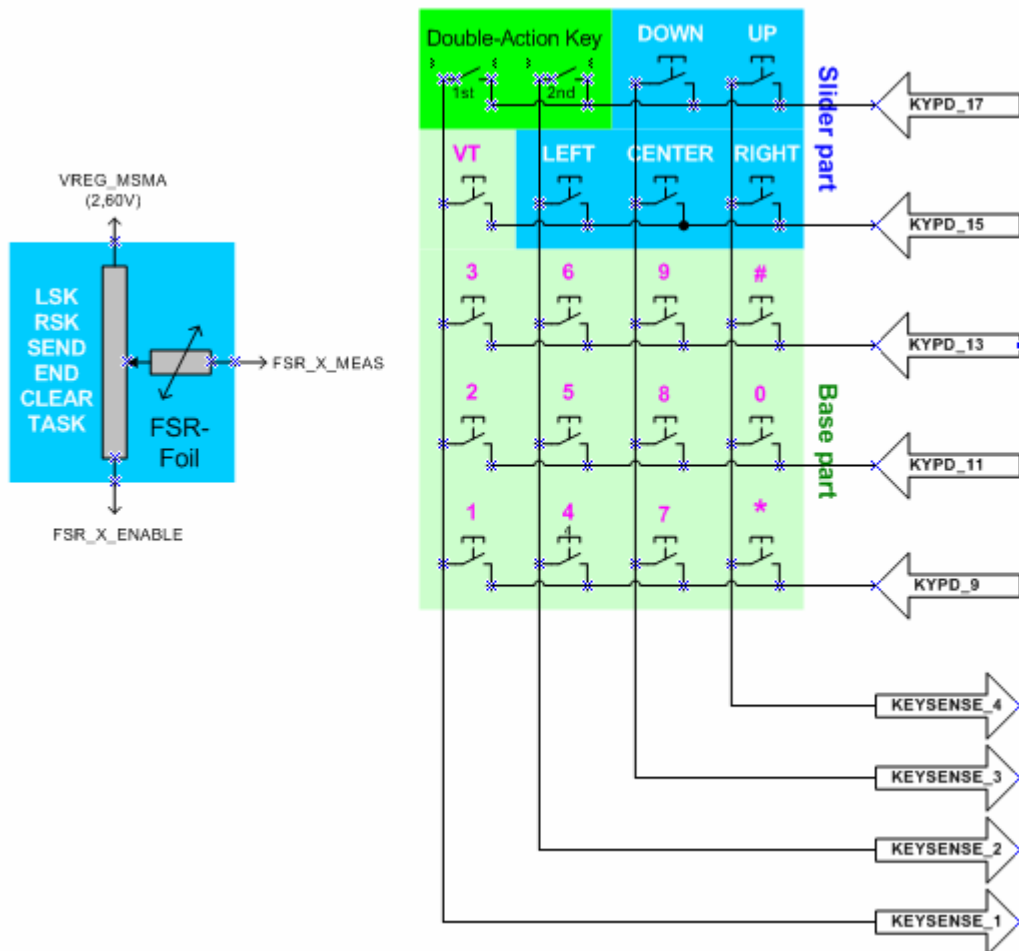
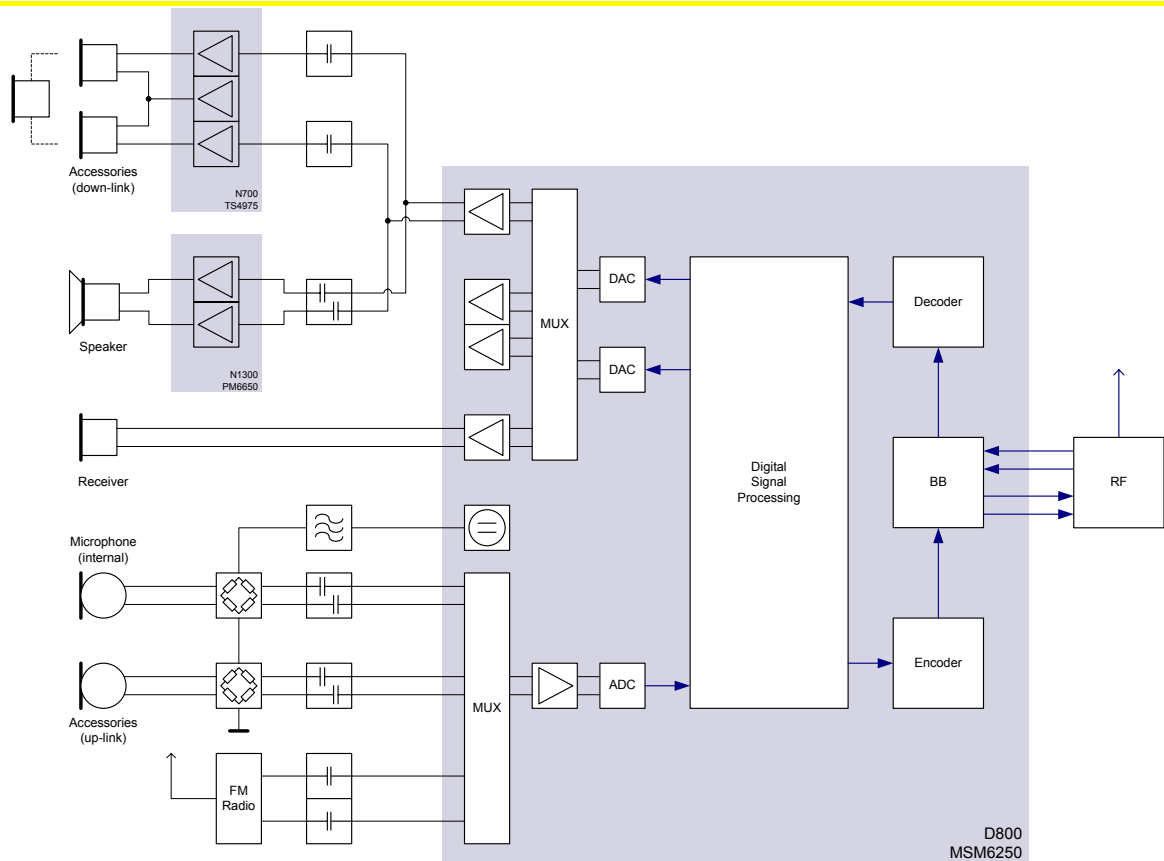


Figure 5-11: Keypad Arrangement and Functions

5.4.11 Audio and Acoustics

To support different kind of audio related features several components are intended:

- An omni-directional microphone to pick up all kind of sounds including voice
- A dedicated receiver for listening on a voice call
- A speaker to play back all kind of sounds and to support speaker phone functionality
- A vibration motor for supporting silent alerts and special (gaming) effects
- An accessories interface for connecting headsets, car kits, etc.
- Furthermore a FM radio circuit has to be supported to be played back via an internal signal processing path.



The chipset of the MSM6250 family from Qualcomm encloses many parts supporting different and more or less distributed functionalities.

The MSM6250 supports an analogue audio front-end, an analogue-to-digital converter, a digital-to-analogue converter and a DSP-unit for signal processing including voice CODEC. The analogue front-end itself offers three outputs, two microphone- and one line-input and a DC output for supplying microphones. Furthermore the PM6650 power management device contains a power amplifier to drive the internal speaker and a voltage regulator to control the vibration motor.

Finally a dedicated stereo amplifier TS4975 is intended to drive all kind of accessories for play-back (down-link).

5.4.11.1 Microphone circuit

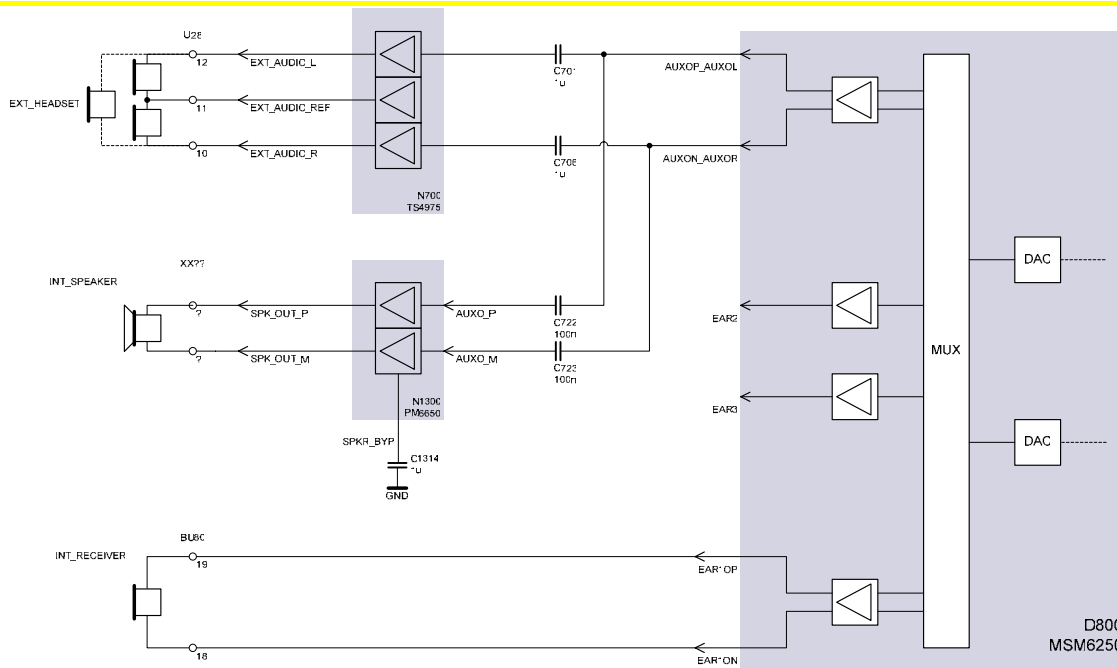
The microphone circuit based on the MSM6259 analogue front-end supports both the internal microphone and the (optional) accessories microphone. Additional a stereo line input is used to pick-up the FM radio audio signal. All of those signals are routed to an internal multiplexer to select one of them for further processing.

Internally the MSM6250 boosts the signal using an amplifier featuring an adjustable gain of -2.0dB, +6.0dB, +8dB or +16.0dB. Furthermore an operational amplifier is available as an additional gain stage. This gain stage can be configured in a wide range by external components. Currently a high-pass functionality for DC decoupling with a gain of 20.0dB is intended. After this final analogue amplifier the signal is transferred to the digital domain by two analogue-to-digital converters.

Electret condenser microphones (ECM), as used in current designs, need a DC supply for operating. This supply (MICBIAS) is supported by the analogue front-end using a dedicated voltage regulator. The output voltage is filtered by a simple RC low-pass filter to improve the noise rejection and distributed via two pairs of resistors. Each of this pairs is part of a bridge circuit further including a microphone (internal or part of an accessory) and a resistor substituting the impedance of the microphone. The principle idea behind this circuit is to reduce noise in the microphone path (up-link) caused by noise on MICBIAS: if the substitution-resistor matches the microphone's impedance then the differential input of the MSM6250 doesn't pick-up this noise. On the other hand signals generated by the microphone (MIC*P) are 'seen' against a constant voltage (MIC*N) and therefore handled as intended signal. This is not a true-balanced approach.



This signal can be configured as two channel (stereo) single ended or one channel (mono) balanced depending on the application.



5.4.11.3 FM Radio

A FM-Radio chip (TEA5764UK from Philips) has been intended which requires additional audio functionality. It's stereo output is fed into the auxiliary input of the MSM6250 audio CODEC. FM radio can be played in stereo mode. However, recording can only be done in mono due to the limitation that the auxiliary audio input can only be re-directed to single A-to-D converter within the MSM6250 audio CODEC.

The FM Radio can only be used while a headset is connected to the accessory connector because the GND_MIC wire is needed as FM antenna.

5.4.12 Power Supply, Battery, Charging

5.4.12.1 Overview

All the important functions for the power supply of the phone are carried out by the PM6650 power management IC from Qualcomm. The POWER-pin of the I/O-Connector is for charging the battery with an external power supply.

5.4.12.2 PM6650-2

A block diagram of the PM6650-2 power management IC is given in Figure 4-5-12. The PM6650-2 contains the following functions:

- Complete power management, housekeeping, and user interface functions for wireless devices—CDMA and non-CDMA handsets, modems, PC cards, PDAs, etc.
- Input power management
 - Valid external supply attachment and removal detection
 - Supports unregulated (closed-loop) external charger supplies and USB supplies as input power sources
 - Supports lithium-ion main batteries
 - Trickle, constant current, constant voltage, and pulsed charging of the main battery
 - Supports coin cell backup battery (including charging). Note that a capacitor is used in this implementation in place of a coin cell to provide momentary power loss survival.
 - Battery voltage detectors with programmable thresholds
 - VDD collapse protection

- Charger current regulation and real-time monitoring for over-current protection
 - Charger transistor protection by power limit control
 - Control drivers for two external pass transistors (one used in this design) and one external battery MOSFET
 - Voltage, current, and power control loops
 - Automated recovery from sudden momentary power loss
- Output voltage regulation
 - One boost (step-up) switched-mode power supply (SMPS)
 - Three buck (step-down) switched-mode power supplies that efficiently generate MSMC, MSME, and PA (or second MSMC) supply voltages
 - Supports dynamic voltage scaling (DVS) for MSMC and PA
 - Eleven low dropout regulator circuits with programmable output voltages, implemented using three different current ratings: 300 mA (two), 150 mA (six), and 50 mA (three). These can be used to power MSMA, MSMP, RFRX1, RFRX2, RFTX, SYNT, TCXO, WLAN, MMC/SD, USB, and RUIM circuits.
 - All regulators can be individually enabled/disabled for power saving
 - Low power mode available on MSMA and MSMP regulators
 - All regulated outputs are derived from a common bandgap reference—close tracking
- Integrated handset-level housekeeping functions reduces external parts count, size, cost
 - Analog multiplexer selects from 8 internal and up to 18 external inputs
 - Multiplexer output's offset and gain are adjusted, increasing the effective ADC resolution
 - Adjusted multiplexer output is buffered and routed to an MSM device ADC
 - Dual oscillators – 32.768 kHz off-chip crystal and on-chip RC assures MSM device sleep clock
 - Crystal oscillator detector and automated switch-over upon lost oscillation
 - Real time clock for tracking time and generating associated alarms
 - On-chip adjustments minimize crystal oscillator frequency errors
 - Circuits control TCXO warm-up and synchronize, deglitch, and buffer the TCXO signal
 - TCXO buffer control for optimal QPH/catnap timing
 - Three-stage over-temperature protection (smart thermal control)
- Integrated handset-level user interfaces
 - Four programmable current sinks recommended as keypad backlight, LCD backlight, camera flash, and general-purpose drivers
 - Driver circuit compatible with 1.3 to 3.0 V vibration motors
 - Speaker driver with programmable gain, turn-on time, and muting; differential operation (drives external 8 Ω speakers with volume controlled 500 mW)
- IC-level interfaces
 - MSM device-compatible 3-line SBI for efficient initialization, status, and control
 - Supports the MSM device's interrupt processing with an internal interrupt manager
 - Many functions monitored and reported through real-time and interrupt status signals
 - Dedicated circuits for controlled power-on sequencing, including the MSM device's reset signal
 - Several events continuously monitored for triggering power-on/power-off sequences
 - Supports and orchestrates soft resets
 - USB-OTG transceiver for full-speed (12 Mbit/sec) and low speed (1.5 Mbit/sec) interfacing of the MSM device to computers as a USB peripheral, or connecting the MSM device to other peripherals
 - RUIM level translators enable MSM device interfacing with external modules
- Twelve multi-purpose pins that can be configured as digital or analog I/Os, bi-directional I/Os, or current sinks. Default functions support the RUIM level translators, power-on circuits, analog multiplexer inputs, an LED driver, and a reference voltage buffer.
- Highly integrated functionality in a small package – 84-pin BCCS with a large center slug for electrical ground, mechanical stability, and thermal relief

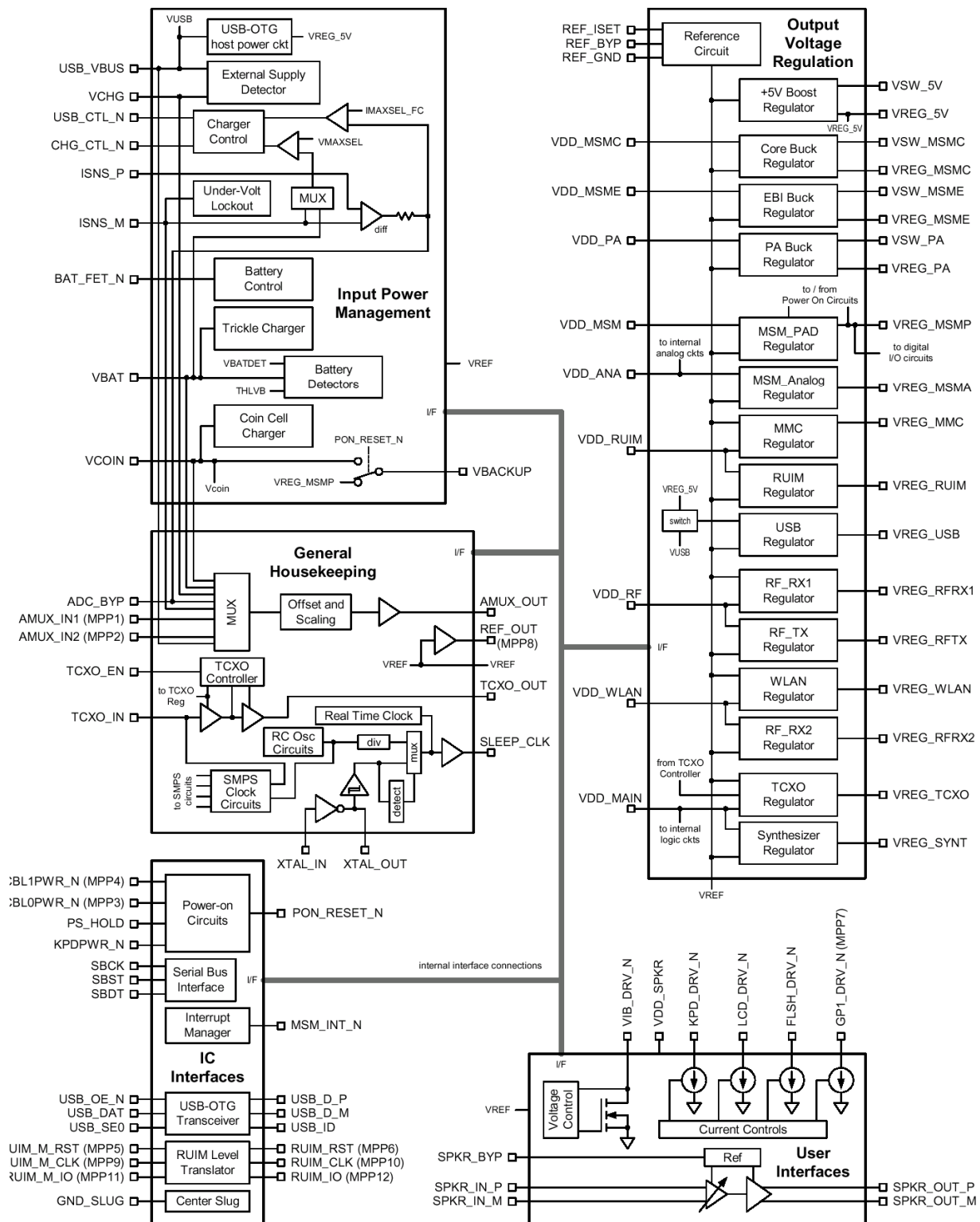


Figure 4-5-13. PM6650 IC Functional Block Diagram.

Voltage Regulators and Voltage Converters

5.4.12.3 Voltage Regulators and Voltage Converters

The table below lists the voltage supplies of the PM6650-2. Note that the Rated Current is the current at which the regulator meets all its performance specifications. Higher currents are allowed but higher input voltages may be required and some performance characteristics may become degraded.

PM6650 Supply Source	Supply Net Name	Voltage range	Voltage set to	Baseband Supplies	RF Supplies
VREG_RFRX_1	VREG_RFRX_0	1.50 - 3.05V (150mA)	2.85V		N200 (Antenna switch), D500 (RTR6250), RF3188 WCDMA PA.
VREG_RFRX_2	VREG_RFRX_1	1.50 - 3.05V (150mA)	2.85V		N600 (RFR6250)
VREG_RFTX	VREG_RFTX	1.50 - 3.05V (150mA)	2.85V		Z402 (power detector), D500 (RTR6250), Z300 (GSM VCO)
VREG_PA (Step-down Switcher)	(not used)	0.75 - 3.05V (500mA)	Variable		Not used
VREG_SYNT	VREG_SYNT	1.50 - 3.05V (50mA)	2.85V		D500 (RTR6250),
VREG_TCXO	VREG_TCXO	1.50 - 3.05V (50mA)	2.85V	D1300 (Bluetooth clock buffer),	Z1000 (TCXO), N600 (RFR6250),
VREG_MSMP	VREG_MSMP	1.50 - 3.05V (300mA)	2.6V	N1600 (Bluetooth IC), D2400 (Camera Bus Switch), D2401 (I2C switch), S2300/S2301 (Hall Sensors), D800 (MSM6250 VDD_P3, VDD_P4), Z1200 (EMIF05MUX)	N600 (RFR6250), D500 (RTR6250)
VREG_MSME (Step-down Switcher)	VREG_MSME	0.75 - 3.05V (500mA)	1.85V	X3100 (LCD), D1000 (NAND FLASH), D1001 (SDRAM), D800 (MSM6250 VDD_P2, VDD_P1)	

VREG_MSMC (Step-down Switcher)	VREG_MSMC	0.75 - 3.05V (500mA)	1.25V	D800 (MSM6250 VDD_C)	
VREG_MSMA	VREG_MSMA	1.50 - 3.05V (300mA)	2.6V	D800 (MSM6250 VDD_A), D800 (MSM6250 VDD_PLL), D800 (MSM6250 VDD_DAC), N700 (Audio Amp), Hardware ID,	RF/PA temperature sense,
VREG_MMC	VREG_AUX1	1.50 - 3.05V (150mA)	2.85V	X1400 (MicroSD Card)	
VREG_WLAN	VREG_AUX2	1.50 - 3.05V (150mA)	2.85V	N1600 (Bluetooth IC)	
VREG_RUIM	VREG_UIM	1.50 - 3.05V (150mA)	3.0v	Z1500 (SIM Card)	
VREG_5V (Step-up Switcher)	(Used internally to PM6650-2 for USB)	3.0 - 6.1V (400mA)	5V		Used for generation of VREG_USB
VREG_USB	(not used)	3.30V (50mA)	3.3V		On board USB functions

Table 4 PM6650-2 Power Supplies

5.4.12.4 Additional Power Supplies

The following additional external regulators are required for Kestrel

Regulator	Supply Net Name	Voltage set to	Supplies	Enabled by
N1900	VRFG_CAM2	2.7V	VGA Camera	CAM2_PWR_EN
N1901	VREG_CAM1_COIL	2.9V	Voice coil 3.0M Camera	CAM1_PWR_EN
N1904	VREG_CAM1	2.7V	3.0M Camera	CAM1_PWR_EN
N1903	VREG_LCD	2.9V	display	LCD_EN
N1902	VREG_BCKLT LCD and Keypad Backlight	20V6	LCD and Keypad Backlight	BACKLIGHT_EN

Table 5 PM6650-2 Additional Regulators

5.4.12.5 PM6650-2 Signal Interfaces

The PM6650-2 contains many additional functions as well as power supply regulators. The main signal interfaces to these functions are summarised here. More details on the main functions are presented later.

PM6650-2 Function	Signal	Function
Clock interfaces. The TCXO clock is buffered to VREG_MSMP and fed to the MSM6250A. The buffer and VREG_TCXO regulator are enabled by the MSM6250A. The 32.768kHz Sleep clock is generated on the PM6650-2 and fed to the MSM6250A.		
TCXO_EN	TCXO_EN	Control input from MSM6250A to enable TCXO tasks
TCXO_IN	TCXO	19.2MHz signal input
TCXO_OUT	BUFF_TCXO	Buffered 19.2MHz signal fed to MSM6250A
SLEEP_CLK	SLEEP_CLK	32.768 kHz sleep clock signal. Fed to MSM sleep clock Input.
SIM Card interfaces. The SIM signals to/from the MSM6250A are level-shifted to VREG_UIM levels.		
RUIM_M_RST	USIM_RESET	SIM signal level shifter interface to MSM6250A
RUIM_RST	UIM_P_RESET	SIM signal level shifter interface to SIM Card
RUIM_M_CLK	USIM_CLK	SIM signal level shifter interface to MSM6250A
RUIM_CLK	UIM_P_CLK	SIM signal level shifter interface to SIM Card
RUIM_M_IO	USIM_DATA	SIM signal level shifter interface to MSM6250A
RUIM_IO	UIM_P_DATA	SIM signal level shifter interface to SIM Card
USB Interface. The MSM6250A USB signals interface to a USB transceiver on the PM6650-2		
USB_OE	USB_OE_TP_N	USB interface to MSM6250A
USB_DAT	USB_DAT_VP	USB interface to MSM6250A
USB_SE0	USB_SE0_VM	USB interface to MSM6250A
USB_D_P	USN_CONN_D_P	USB interface to connector via USB switch Z1201
USB_D_M	USB_CONN_D_M	USB interface to connector via USB switch Z1201
/USB_CTL	(no connection)	(not used)
USB_ID	(no connection)	(not used)
USB_VBUS	(47K to ground)	(not used)
Charger Functions. The PM6650-2 senses the charger and battery voltages, and charge current, to control the charging process.		
VCHG	POWER	Charger voltage Sense line for charging functions
ISNS_M	ICHARGEOUT	Charging current sense input
ISNS_P	ICHARGE	Charging current sense input
CHG_CTL	CHG_CNT_N	Charger Transistor control
Vbat	VBATT	Battery voltage Sense line for charging functions
BAT_FET_N	BAT_FET	Battery MOSFET control
Audio Buffer. The Audio output from the MSM6250A is amplified to drive the ringer speaker.		
SPKR_IN_M	AUXO_M	Speaker Drive Amp input
SPKR_IN_P	AUXO_P	Speaker Drive Amp input
SPKR_OUT_M	SPKR_OUT_M	Speaker Drive Amp output
SPKR_OUT_P	SPKR_OUT_P	Speaker Drive Amp output

PM6650-2 Function	Signal	Function
MSM6250A Communication. Uses a synchronous serial interface.		
SBDT	PM_SBDT	Serial Control Bus Data
SBCK	PM_SBCK	Serial Control Bus Clock
SBST	PM_SBST	Serial Control Bus Strobe
MSM_INT	PM_INT_N	Interrupt signal to MSM. Used to initiate comms.
Logic control. There are not enough general IO pins on the MSM6250A, so some logic control is handled by the PM6650-2		
/GP1_DRV		Not used
/CBL0PWR	PA_R0	Not used
AMUX_IN1		Not used
AMUX_IN2	LCD_RST_N	LCD Reset.
Current control. The vibramotor is driven by a current sink function on the PM6650-2		
/VIB_DRV	VIB_DRV	Current sink for Vibrator Motor
Power Management. Power on/off and backup functions		
VCOIN	(100uF capacitor, C1312)	Back-up capacitor. 100uF for 40 sec backup
/PON_RST	PON_RST_N	Reset output to MSM6250A
/KPDPWR	PHONE_ON	Direct connection to Power / End Key
PS_HOLD	PS_HOLD / JTAG_PS_HOLD	Power latch from MSM / JTAG
Analogue Multiplexer. Analogue voltages sensed on the PM6650-2 are fed to an ADC on the MSM6250A for measurement.		
AMUX_OUT	AMUX_OUT	Multiplexer output to MSM6250A ADC

Table 6 PM6650-2 Signal Interfaces

5.4.12.6 Power On/Off Sequencing

5.4.12.6.1 Power-On Sequence

The PM6650-2 includes circuitry to manage the power-on and off operations. Dedicated circuits continuously monitor events that might trigger a power-on sequence. If any of the events occur these circuits power-on the PM6650-2 IC and take the MSM device out of reset.

The inputs to the power-on circuit are:

- PHONE_ON. This is the input from the END/Power key on the Keypad. A low voltage on this line initiates the power-up sequence.
- Voltage detected on POWER line. This indicates that an external supply has been connected.
- Real Time Clock alarm triggered. While the PM6650-2 IC is off the Real Time Clock (RTC) and its oscillator source are still active. This allows continued monitoring of RTC alarms programmed via software. If an alarm occurs while the PM6650-2 IC is off an alarm interrupt is generated and the power-on sequence is initiated.

- Sudden Momentary Power Loss (SMPL) condition was detected and an SMPL recovery is initiated. If the power-on circuits detect that the SMPL function is enabled when the PS_HOLD signal is cleared, the power-on sequence is initiated.

The normal power-on sequence begins when the keypad power button is pressed; this pulls the PM6650-2 PHONE_ON input to the PM6650-2 low. At this point the PM6650-2 holds the Reset output to the MSM6250A (PON_RST_N) low, and turns on the following power supplies in the following sequence:

- VREG_MSMC
- VREG_MSME
- VREG_MSMP
- VREG_MSMA
- VREG_TCXO

As each regulator is enabled, detector circuits confirm that it powers up properly before triggering a wait interval. After the wait interval expires, the next regulator is enabled. This process continues until all the default-on regulators have powered up successfully. Once all the default-on regulators are on another wait interval is observed before the PON_RESET_N signal is driven high.

For a successful power-on sequence, the MSM6250A must then initialise and drive the PS_HOLD signal high within a given time. If it does so, the power remains latched on. This sequence is shown in the diagram below:

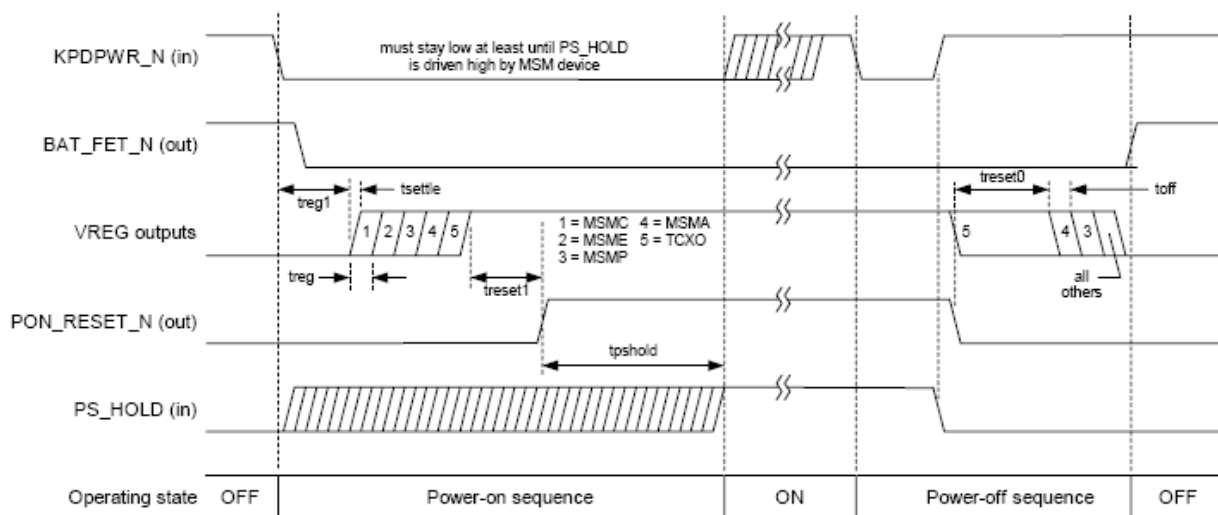


Figure 5-14 Power Supply On / Off Sequencing

5.4.12.6.2 Power-Off Sequence

The PM6650-2 is in an ON state while the PS_HOLD signal from the MSM6250A is high. Under this condition, the PM6650-2 continually monitors events that could trigger a power-off sequence:

- The MSM drives the PS_HOLD signal low in response to the handset user pressing the keypad power button.
- The PM6650-2 die temperature exceeds the over-temperature threshold.

The most common power-off sequence begins with the keypad power button being pressed while the MSM6250A is powered on and operational. The PM6650-2 PHONE_ON signal is connected to the handset keypad power button and is pulled up internally. The MSM6250A monitors the state of the key through

interrupts from the PM6650-2. When an interrupt is triggered it initiates the following power-down sequence:

- The user presses and holds the END key for at least the minimum interval. The powerdown sequence is aborted if not pressed long enough.
- Any information that needs to be saved is written to Flash ROM.
- The PM6650-2 is prevented from powering up again.
- The power-off sequence waits until the user releases the END key, otherwise the PM6650-2 IC will power-up again.
- The MSM6250A drives the PS_HOLD signal low to cause the PM6650-2 IC to power-down the handset.
- The PM6650-2 IC drives PON_RESET_N low to reset the MSM and other external devices, and disables the TCXO regulator. The PM6650-2 VBACKUP pin is internally connected to its VCOIN pin to provide backup power to SRAM.
- After an interval several conditions are checked to determine the next action:
 - If the over-temperature threshold was exceeded then the PON_RESET_N signal is immediately driven low and all PM6650-2 circuits are turned off. The over-temperature feature protects the PM6650-2 IC and cannot be disabled.
 - If VPH_PWR is below the set threshold then the PON_RESET_N signal is immediately driven low and all PM6650-2 circuits are turned off. This feature protects the battery and cannot be disabled.
 - If the over-temperature threshold was not exceeded, VPH_PWR is above the threshold, and the Watchdog Restart bit is set then the Watchdog Interrupt status bit is set, the MSM device is restarted, its watchdog timer is reset, and the PM6650-2 IC is restarted without fully powering down.
 - If the over-temperature threshold was not exceeded, VPH_PWR is above the threshold, and the Sudden Momentary Power Loss (SMPL) function is enabled then the SMPL recovery is executed.
- If none of the above combinations occur, the normal power-down sequence is continued.
- The remaining regulators are powered down in the following sequence:
 - VREG_MSMA
 - VREG_MSMP
 - all others
- An interval is allowed for both the MSMA and MSMP regulator outputs to discharge before all the other regulators are turned off. Another interval passes then the bandgap reference and all other unneeded circuits are disabled.
- The PM6650-2 IC turns off the battery MOSFET by driving BAT_FET_N high and makes sure the external supply is disconnected by driving CHG_CTL_N high. With all sources disconnected the PM6650-2 has no applied power and the phone is powered down.
- PM6650-2 IC is now OFF.

5.4.12.7 Battery / Charging

5.4.12.7.1 Battery

The Onyx Battery is a Lilon - Battery that is nominally rated at 3.7 V open circuit terminal voltage. The maximum open circuit voltage of for this battery is 4.2 V.

The nominal capacity of the battery is 950 mAh (discharge with constant current of 200mA), under GSM-discharge conditions (discharge with pulsed current) the discharge capacity of the battery is higher than 900 mAh.

The inner resistance is 135mOhm.

In Onyx the same standby- and talk times are expected as the measurments from Kestrel show:

Standby GSM: 325h

Standby UMTS:211h

Talk GSM: 3:10 ... 5:48h (Different network settings)

Talk UMTS: 1:35 ... 3:25h (Different network settings)

The battery pack has an in-built electrical protection circuit and an additional safety element (thermo fuse) that prevents the Li-Ion Polymer cell from explosions also under extreme misuse conditions.

The battery contains a BQ27000 Fuel Gauge Circuit from Texas Instruments. The interface to the Fuel Gauge is a 1-wire HDQ interface. See Section FUEL GAUGE for details of the interface.

Fuel gauge parameters:

The BQ27000 is programmed with some parameters controlling charging, switch-off behaviour and battery status indication. Most important are the parameters EDV1 (End of Discharge Voltage 1) and EDVF (End of Discharge Voltage Final). These values will be adapted to the system on the basis of battery cell discharge curve and the minimum working voltage of the ONYX phone.

5.4.12.7.2 Phone shutdown due to low battery

Shutdown of the handset takes place in two stages. Both stages of shutdown are controlled by software depending on parameters read from the battery fuel gauge. These stages are:

- Stage 1: This occurs either when the fuel gauge reports the EDV1 voltage (if the fuel gauge is reporting that it is uncalibrated), or when the fuel gauge reports that the first capacity limit has been passed by setting the EDV1 flag to 1.
- Stage 2: This occurs when the battery fuel gauge reports that the cell voltage has fallen below the EDVF voltage. (Note that the fuel gauge EDVF flag is not used in current software)

Fuel gauge readings cannot be synchronised with GSM RF bursts so to avoid fluctuations in readings, the fuel gauge effectively applies a RC filter with a cut off frequency of 159Hz (time constant 6.3ms) to the readings to generate a filtered value which is reported via the digital interface.

The fuel gauge reports cell voltage, not battery terminal voltage. Hence under high load conditions an error will exist if the cell voltage is assumed to be the handset battery terminal voltage or particularly the GSM PA voltage. The difference is greatest under high current supply conditions and worst case is full power GSM in which the RF PA current approaches 2A for full power transmit. Under these conditions the total voltage drop from cell to PA is in the order of 250mV.

With a calibrated cell at 25C the primary shutdown point is intended to occur when sufficient capacity remains to allow a 3 minute call at high power which is deemed to be a supply current of 350mA. The requirement is for 1 minute, hence 3 minutes is intended to allow some margin for cell aging and other effects.

5.4.12.7.3 Battery calibration

For a full description of fuel gauge calibration it is strongly recommended to consult the BQ27000 data sheet (**Fehler! Verweisquelle konnte nicht gefunden werden.**).

In brief, the fuel gauge will indicate that it is uncalibrated (CI flag = 1) unless charging has continued until the average charge current has fallen below the taper current (see table in section **Fehler! Verweisquelle konnte nicht gefunden werden.**). Discharge is also part of the learning cycle and discharge must take place at an average current below the “initial max load” to count as a valid discharge cycle.

5.4.12.8 Charging

5.4.12.8.1 General considerations

*Note: On initial inspection charging would appear to be a simple process. However, the safety requirements of Lilon cells necessitates that the phone charging system must monitor and control the process carefully. Control is achieved by means of the on board PM6650 ADC and from measurements made by a fuel gauge IC integrated into the battery. The charging system therefore combines: phone software; PM6650 firmware; and a fuel gauge system. The combined system is complex and a full understanding can only be gained by reference to **Fehler! Verweisquelle konnte nicht gefunden werden.** and the Qualcomm source code header files where parameters are defined.*

The following restrictions must be observed:

- The phone cannot be operated without battery inserted.
- The phone will be damaged if the battery is inserted with wrong polarity (the mechanics of the phone prevents backward insertion of the battery. The electric system assumes that the battery has been inserted correctly. This must be ensured by means of suitable QA measures).
- It is inadvisable to remove the battery whilst the phone is connected to the charger unit however this action is not expected to damage the phone.
- Charging is permitted within a temperature range of 0°C to +45°C.
- During charging the battery terminal average voltage must not exceed $4,2 \text{ V} \pm 50 \text{ mV}$.

The battery is charged in the phone. The hardware and software is designed for Lilon with 4.2V technology.

Charging is started as soon as the phone is connected to an external charger. If the phone is not switched on, then charging shall take place in the background (the customer can see this from the “Charge” symbol on the display).

5.4.12.8.2 Charging hardware

All important power supply functions are covered by the PM6650 power management IC from Qualcomm. The POWER-pin of the I/O-Connector is the input for charging the battery with an external power supply.

Charging is enabled through a PNP bipolar pass transistor (V1100) in the phone. This transistor operates as a switch in charging situations other than USB charging and closes the circuit from the external charger to the battery. The processor takes over control of this switch depending on the charge level of the battery, whereby a disable function in the PM6650 hardware can override/interrupt the charging in the case of over voltage of the battery.

Charging time depends on the charger and the operating mode of the phone. With the phone in standby and a wide range standard charger the charge current will be typically 650 mA. Total charging time shall then be 2 hrs or less.

The charging and battery switch components are illustrated in **Fehler! Verweisquelle konnte nicht gefunden werden.**, these components are controlled by the PM6650. The components comprise: a pass transistor (V1100) which can be operated in linear mode or driven into full saturation by the PM6650 to operate as a switch; a 0.1Ω charge current sense resistor (R1102); a battery switch FET (V1102) which features a very low on resistance.

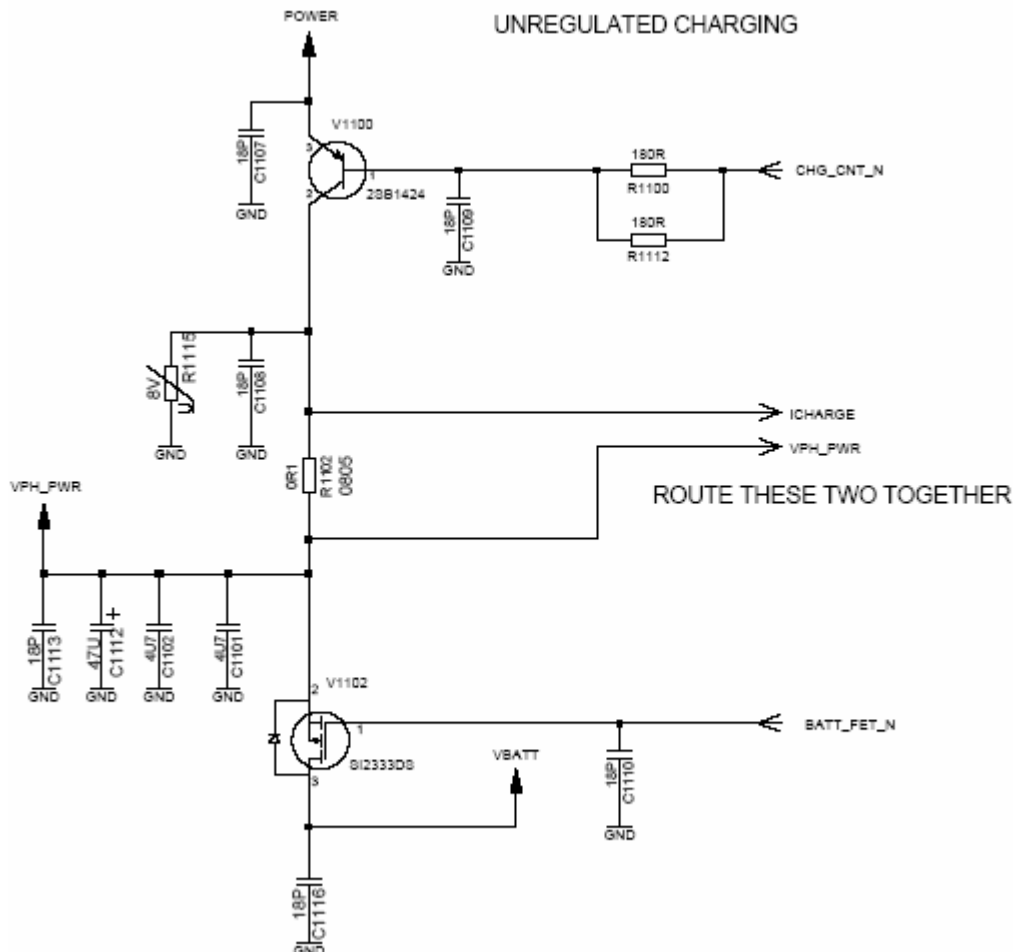


Figure 5-15 Charging circuit elements controlled by the PM6650

The following signals are involved in the Battery charging process:

Signal	Function
POWER	This is the Supply connection to the Accessory Connector.
CHG_CNT_N	Drive signal from PM6650. The control for the pass transistor, V1100. Low voltage turns on the transistor.
ICHARGE	Positive current sensor input to PM6650. Used to generate feedback signal for CHG_CNT_N control.

Signal	Function
ICHARGEOUT	Negative current sensor input to PM6650. Used to generate feedback signal for CHG_CNT_N control. Note this is the same signal as VPH_PWR - the main supply for the phone circuitry.
BATT_FET_N	Drive signal from PM6650. The control for the Battery Switch MOSFET, V1102. Low voltage turns on the MOSFET.
VBATT	Battery voltage monitored by PM6650. This line is also used to trickle charge the battery when it has very low voltage.

Table 7 Battery Charging Signals

The external charger voltage is presented on line "POWER". When using the Siemens standard charger it is imperative that the pass transistor is operated as a fully saturated switch and that sufficient current is drawn from the charger to guarantee voltage fold back which minimises the voltage across the pass transistor and therefore maintains the dissipation of the pass transistor within acceptably low bounds.

When operating from a USB charge source, the input voltage is limited to 5.25V maximum (no fold back) and charge current capability of the USB device is relatively low so the pass transistor can be operated in linear mode.

5.4.12.8.3 Charger Recognition

Charging starts when the charger is plugged into the phone. On plugging the charger the voltage is measured to determine if it is a standard charger type (input voltage > 6.1V and <10V) or a USB charger (input voltage <6.1V). If the charger fits neither category charging is immediately suspended.

On plug in the charger is identified. In case of a USB cable a phase of enumeration takes place where the USB master is queried for the current it can supply. In case of a wall charger charging starts at once. If the battery voltage is >4.1V the charging DONE state applies and no charging takes place. If the battery voltage is <4.1V the FAST charging mode is invoked.

5.4.12.8.4 Algorithm for Standard (Wall) Charger, Car Charger, Car Kit

The charging algorithm for all charger types except USB cable takes place in three phases:

- The first phase (Trickle Charging, constant low current) is passed through only when the battery voltage is less than 3.0 V. The trickle charge current is set by SW to 80mA.
- The second phase (Main Charging, Fast Charging) is a constant current charging phase. The current is limited by the current capability of the charger unit. The accessory interface specification allows a maximum charge current of 950mA at 3V. The standard wall charger delivers typically 650mA to the battery.
The current limit of the PM6650 is set to 1.2A to ensure charger voltage fold back, thus reducing the pass transistor power dissipation. Fast charging terminates when the battery terminal voltage reaches 4.2V, measured by Fuel Gauge. At the end of fast charging the battery will be charged to approximately 80% of its capacity.
- The third and final phase of charging (Top Off Charging) is a constant voltage phase. By means of current pulsing with decreasing duty cycle the average charge current is decreased such that the

terminal voltage is kept constant at 4.2V. During pulse charging the current pulses are again set by the maximum current capability of the charger unit. The terminal voltage of the battery is not permitted to exceed 4.375V during the on period of the pulse. When the average charge current (measured by the fuel gauge) falls below the taper current value (stored in a fuel gauge register, ca.77mA) charging is suspended and charging is considered to be completed.

Output VI-curve

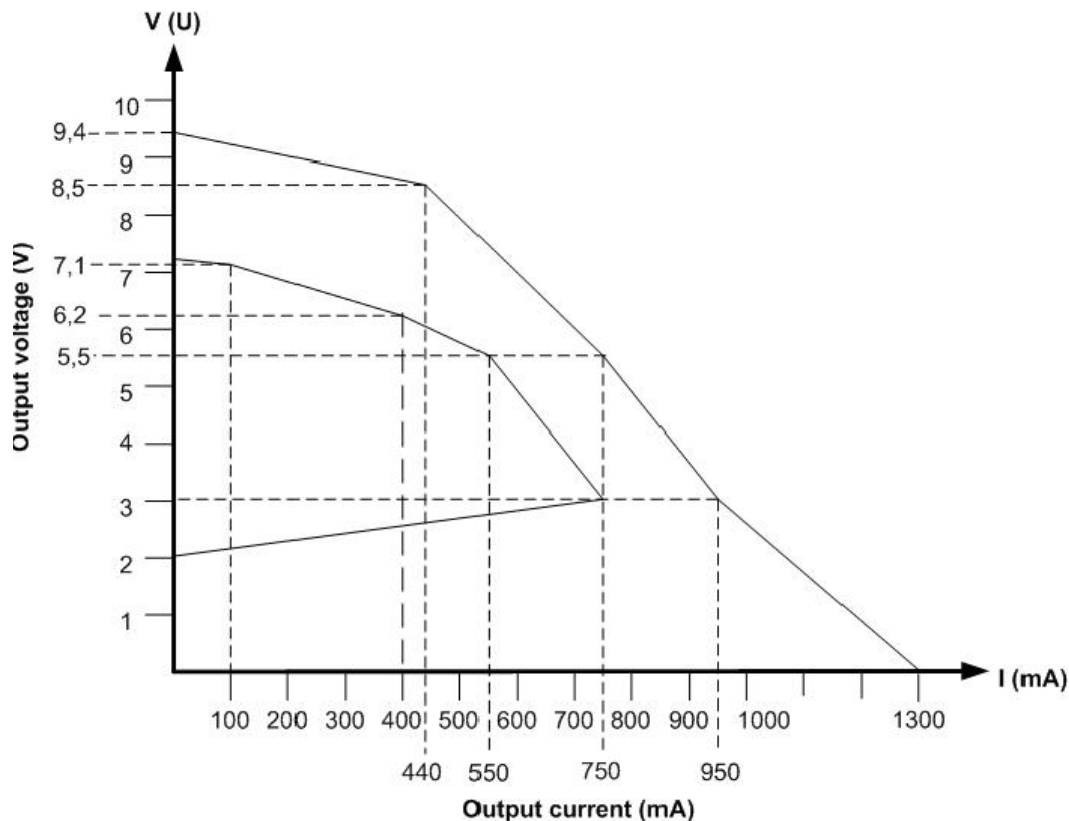


Figure 5-16 Example of a Siemens charger operating envelope.

5.4.12.8.5 Algorithm for USB Charging

The PM6650 supports USB charging. USB charging supply voltage (measured at the mobile connector pin) is specified to 4.4V to 5.25 V. USB charge mode is invoked if the voltage on the POWER line is measured by the PM6650 to be less than 6.1V. The USB charge current must be limited by the USB device (mobile phone) to 100 mA or 500 mA depending on the power type of the USB port (High Power Port / Low Power Port). The mobile phone must initially assume a low power port. During USB enumeration the mobile phone receives information about the power class of the host. Charging is only possible from a high power USB port because the 100mA from a low power port are not sufficient for both supplying the phone and charging the battery.

Control of charge current is achieved by operating the pass transistor in linear mode. The PM6650 monitors the dissipation of the pass transistor via current and voltage measurements and can be programmed to limit the charge current in accordance with the maximum dissipation allowable for the pass transistor which is 1.0W.

On plug in of the USB master, following enumeration, if the battery voltage is determined to be >4.1V the charge mode is set to USB DONE and no charge current flows into the battery. If the battery voltage is <4.1V the charge mode is set to USB FAST and the maximum current allowed by the USB charge controller flows into the handset.

When the battery voltage reaches a level of 4.2V USB FAST charging is terminated and USB TOPOFF mode is entered. USB TOPOFF is a constant voltage charging phase where the voltage is maintained at 4.2V by the PM6650 and the current is regulated down. Charging is terminated either by the fuel gauge IMIN flag indicating charge completion or when the USB TOPOFF timer expires.

After end of charge, when the battery voltage falls below 4.1V, the USB TOPOFF charging mode is repeated. If the voltage falls below 4.0V USB FAST charge mode is reentered.

Trickle charge (of a deeply discharged battery) from a USB cable is not possible, because the USB spec allows an unconfigured device only to draw up to 100mA for up to 100ms. The mobile cannot be run from its discharged battery and 100ms are not enough for enumeration, but enumeration is needed for getting power from the host.

Thus if a battery is fully discharged it cannot be recharged using USB as the power source and the user must briefly connect the phone to a standard charger to bring the battery up for USB operation. Normally trickle charging from a standard charger takes only a few minutes.

5.4.12.8.6 Measurement of Battery voltage, Battery Type and Ambient Temperature

Measurement of the battery terminal voltage is carried out by the MSM6250. The PM6650 routes the voltage to be measured to the MS6250 ADC on the AMUX_OUT line. This is the output of the Analogue Multiplexer in the PM6650.

The fuel gauge is an in-built feature of the battery. It has registers which are read and written to using a single line HDQ digital interface. Many parameters can be read from the fuel gauge including cell voltage, temperature and charge status. The fuel gauge integrated circuit is a TI Bq27000. For further information it is recommended to consult the data sheet.

During the charging process information from the PM6650/MSM6250 ADC and the battery fuel gauge are used to make decisions about the charging process.

5.4.12.8.7 Timing of the Battery Voltage Measurement

In previous generations of Siemens phones, unless the battery was being charged, the measurement was done inside the TX time slot. During charging it was done after the TX time slot. However, a TX synchronous measurement timing like that is no more possible when using a fuel gauge based cell voltage measurement inside the battery pack.

The fuel gauge even has to apply digital filtering to its measurement results in order to avoid fluctuation of the readings caused by the unsynchronous TX bursts.

5.4.12.8.8 Recognition of the Battery Type

The battery on-board protection and fuel gauge circuitry has a register addressable and read over the HDQ bus which can be used to hold battery type information.

5.4.13 Accessory Interface

5.4.13.1 Overview

A standard, "N", Siemens Accessory Connector allows approved devices to interface to the phone. These devices include Battery Chargers, Data Transfer cables (USB or UART), Camera Flash, and Audio products (Headset, Car Kit etc). Signals at the Accessory connector are listed below:

Pin	Signal	Function	Connection
1	RTS_USB_D_P	RS232 RTS input. USB D+ signal. Accessory recognition.	UART/USB multiplexer switch (Z1200) and USB switch Z1201. Then to MSM6250 UART1 (RFR_N) or PM6650 USB driver (D_P)
2	CTS_USB_D_M	RS232 CTS output. USB D- signal. Accessory recognition.	UART/USB multiplexer switch (Z1200) and USB switch Z1201. Then to MSM6250 UART1 (CTS_N) or PM6650 USB driver (D_M)
3	TX	RS232 data output. Accessory recognition.	UART EMI Filter (Z1200). Then to MSM6250 UART1.
4	RX	RS232 data input. Accessory recognition.	UART EMI Filter (Z1200). Then to MSM6250 UART1.
5	GND	Ground	
6	DCD	RS232 DCD output. CLK signal output. Accessory recognition. Trigger for clip-on Flash	UART EMI Filter (Z1200). Then to MSM6250 UART1
7	POWER	External charging input. Supply out to accessories	Battery Charger (V1100). Regulator for supply output (N1100).
8	GND_MIC	Reference ground for microphone signal.	MSM6250 MIC2N
9	EXT_MIC	Input for external microphone.	MSM6250 MIC2P
10	EXT_AUDIO_R	Right Audio channel output.	Audio amplifier (N700).
11	EXT_AUDIO_REF	Ground reference for Audio signals.	Audio amplifier (N700).
12	EXT_AUDIO_L	Left Audio channel output.	Audio amplifier (N700).

Table 8 Accessory Connector Interfaces

5.4.13.2 UART and USB multiplexing

On the Accessory Connector, the differential signals (D+ and D-) of the USB interface are multiplexed with the UART signals RTS and CTS. A simplified block diagram showing the multiplexing arrangement is given in Figure 14-17.

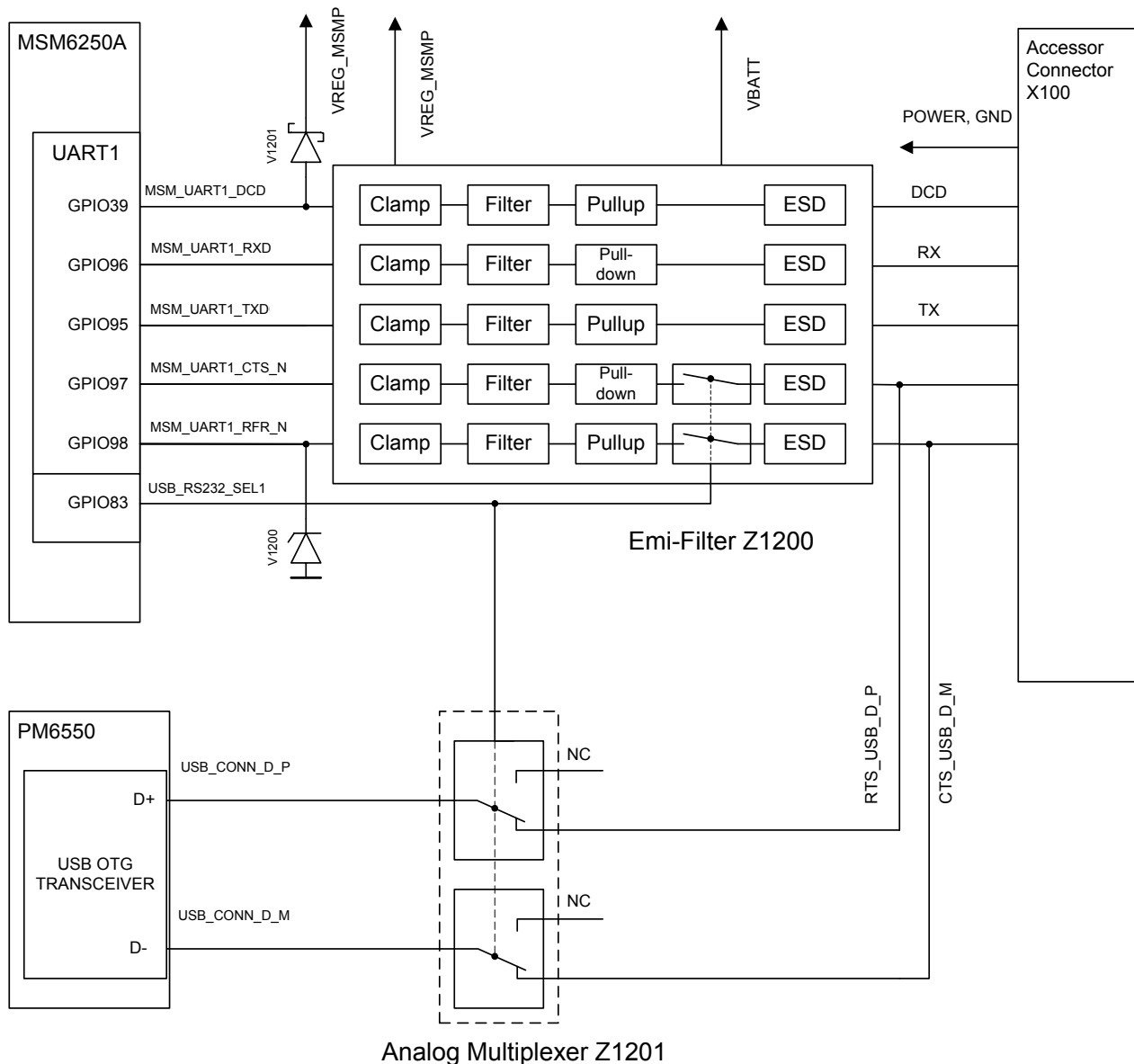


Figure 14-17 UART / USB Multiplexing Block Diagram

All UART lines from the accessory connector pass through the filter Z1200 (5-Channel Filter Array with Switches and ESD protection) to protect the MSM6250.

The signals MSM_UART1_RFR_N and MSM_UART1_CTS_N need additional overvoltage protection V1200 and V1201 because the signals from the accessory connector may have VUSB-level (USB requirement).

The signals RTS_USB_D_P and CTS_USB_D_M from the Accessory Connector X100 are connected via low-impedance multiplexer Z1201 to the PM6650 USB port, or via switches in Emi-Filter Z1200 to UART1 of the MSM6250A. Selection is controlled by the USB_RS232_SEL1 line. When the phone is switched off, the switches connect to the UART. This is required for Accessory detection..

5.4.13.3 Connector Default Configuration

When no accessory is present, the accessory connector must be configured to a specific default state. This default state only applies when the phone is switched on or when the phone stays in charge mode. The default values are shown in Table 9.

Pin	Signal	Default Level	Default Direction
1	D+/RTS	H (pull up)	in
2	D-/CTS	L (pull down)	in
3	TX	H (pull up)	out
4	RX	L (pull down)	in
5	GND	GND	/
6	Flash/DCD	H (pull up)	in
7	POWER	L (pull down)	Off
8	MIC_GND	GND	/
9	MIC	Z	Off
10	AUDIO_R	Z	Off
11	AUDIO_REF	Z	Off
12	AUDIO_L	Z	Off

Table 9 Accessory Connector Initial Configuration

Z means the driver is in high impedance state.

Refer to Sections 5.4.13.4 and 5.4.13.5 for additional information on the connector default configuration (i.e. when no accessory connected).

5.4.13.4 Accessory Detection

When initially connected to Kestrel, the accessory type must be determined. This is achieved by monitoring the following signals:

- MSM_UART1_RXD
- MSM_UART1_CTS_N
- MSM_UART1_RFR_N
- MSM_UART1_DCD_N

The MSM6250 must set these signals to be inputs with no internal pull-up/downs if no accessory is connected. The Rx line has an external (inside Z2100) pull-down, the CTS, RFR, and DCD lines have an external pull-up. The MSM6250 must also set the USB/UART switch to connect the Tx/Rx pins on the connector to the UART (See Section 5.4.13.5).

When an accessory is connected, the MSM6250 detects a change in state on one or more of the lines. The lines may be pulled high, low, or connected to the Tx line in order to identify the accessory. Full details of this process are given in "Hardware Specification NANO IO Connector V1.4" (Section 5). Once the accessory is recognized, the Accessory Connector signals are configured appropriately.

5.4.13.5 UART

The UART at the Onyx Accessory Connector requires the Status signals CTS, RTS, and DCD to be configured as a “DCE” device. This has DCD and CTS as outputs, and RTS as an input. However, Tx and Rx are configured as a “DTE” device, with Tx output and Rx input.

UART1 on the MSM6250 is configured as a full “DTE” device, with Tx and Rx as above, but with DCD and CTS as inputs, and RTS(RFR) as an output. CTS and RTS(RFR) are connected directly to the UART hardware block, so their functionality cannot be changed. DCD is connected to a GPIO pin.

To make the two compatible, connections are required as follows:

- MSM_UART1_TXD. Data output from MSM6250. Connects to TX pin.
- MSM_UART1_RXD. Data input to MSM6250. Connects to RX pin.
- MSM_UART1_CTS_N. Control input to MSM6250. Connects to CTS_USB_D_M pin.
- MSM_UART1_RFR_N. Control output from MSM6250. Connects to RTS_USB_D_P pin.
- MSM_UART1_DCD_N. Control output from MSM6250. Connects to DCD pin.

Swapping the RTS and CTS signals as above allows these signals to be directly connected to accessories without modifying the function of UART1. The signal “switch” is made at the EMI filter Z1200.

DCD becomes an output (DCE) function rather than an input. This requires a modification to the software driver.

The RTS_USB_D_P and CTS_USB_D_M pins on the Accessory connector are switched between USB and UART functions as required. UART operation is selected by holding USB_RS232_SEL1 (GPIO83) low. The UART needs to be selected in order to detect the function of a newly connected Accessory.

5.4.13.6 USB

Onyx does not contain a full USB connector. USB data is supported using two pins on the Accessory connector. These pins are switched between USB and UART functions as required. USB operation is selected by holding USB_RS232_SEL1 (GPIO83) high.

Onyx supports USB data transfer at 12Mbits/sec.

A separate USB power input is not provided. If a USB accessory supports charging, the supply is present at the same POWER pin as used by Battery Chargers. Therefore there is only one charging pass transistor (V1100). No USB power output is provided.

The MSM6250 contains a dedicated USB controller core. This interfaces to a USB Transceiver core on the PM6650. The PM6650 provides the USB interface D+ and D- lines. The PM6650 USB Transceiver is powered from an internal 3.3V supply. This supply is generated from the 5V boost switching supply on the PM6650. Interfaces between the Controller and Transceiver are shown below:

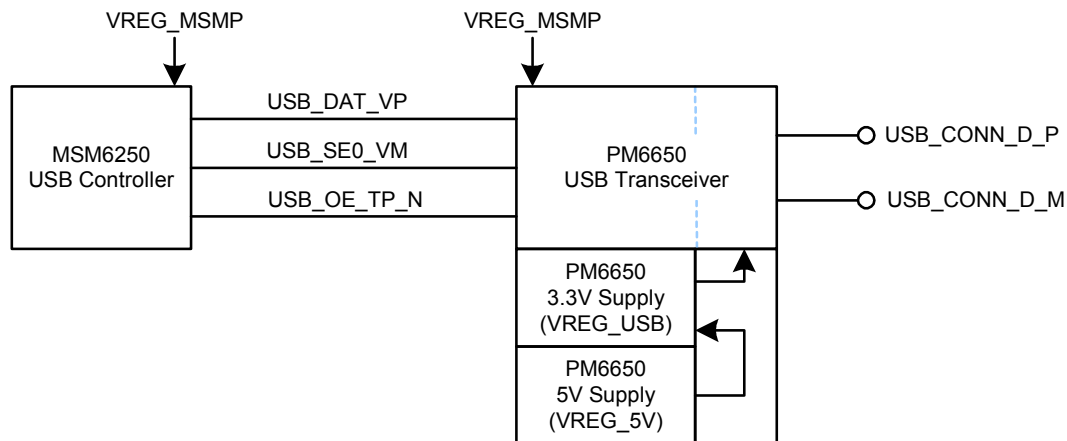


Figure 5-18 USB Controller and Transceiver interfaces

Signal functions are as follows:

Signal	Function
USB_DAT_VP	Plus (+) line of the digital-differential, bi-directional USB signal to/from the MSM6250. Signal levels are translated between MSM and USB domains within the PM6650 IC.
USB_SE0_VM	Minus (-) line of the digital-differential, bi-directional USB signal to/from the MSM6250. Signal levels are translated between MSM and USB domains within the PM6650 IC.
USB_OE_TP_N	USB output enable signal (active LOW). Driven by MSM6250
USB_CONN_D_P	Plus (+) line of the differential, bi-directional USB signal to/from the Accessory Connector.
USB_CONN_D_M	Minus (-) line of the differential, bi-directional USB signal to/from the Accessory Connector.

Table 10 USB Interface Signals

5.4.13.7 Audio interference and suspension of pulse charging

The low frequency pulsing of the charge current which takes place in TOPOFF charge mode causes audible interference when audio circuits are active. Hence in all such modes TOPOFF is suspended and constant current (FAST) charging becomes the only available charging mode. In this mode if the battery voltage falls below 4.0V FAST charging will be started and will terminate when the voltage reaches 4.2V. In both cases the voltage is read from the fuel gauge.

Consequently assuming that the charger can supply sufficient current to run phone activity and supply charge current, the battery voltage will be maintained to be always 4.0V or greater. If the phone is removed from the charger just before FAST charging is about to restart the battery will not be fully charged. However a high percentage of charge will remain at a battery voltage of 4.0V and satisfactory performance should be achieved for the user.

5.4.14 Hall Effect Switches

Two Hall effect switches are used to detect the state of the MMI slider. One detects the slider open position the other detects the slider closed position.

The switch Infineon TLE4913 low power Hall-effect devices identical are new. Very low power consumption is achieved with a timing scheme controlled by an oscillator and a sequencer. This circuitry activates the sensor for 50 μ s (typical operating time) sets the output state after sequential questioning of the switch-points and latches it with the beginning of the following standby phase (max. 200 ms). In the standby phase the average current is reduced to typical 4 μ A. Because of the long standby time compared to the operating time the overall averaged current is only slightly higher than the standby current.

The "Open Hall-Switch" is also used to turn on the mobile phone. Therefore a Monoflop is needed which generates a switch on pulse.

The device uses an open drain output that is switched on in response to an external magnetic field. A logic low level therefore indicates the switch is active. This possible switch states are summarised in the table below.

HALL_SW_OPEN_N	Slider Position
0	Open
1	Closed

5.4.15 Interfaces

5.4.15.1 Interface USIM Module

The USIM electrical interface is provided by the RUIM (Removable User Identity Module) Level Translator Module of the PM6650 (PMIC) Power Management chip. The USIM signal levels are referenced to the dedicated SIM voltage regulator RUIM from the PMIC.

Notes to the chipcard pins:

- All directions (IN/OUT) given are seen from the point of view of the direction of the phone
- The currents which flow into the radio part are negative
- For the Electrical Interface Levels please refer to the ESTI TS 102 221 V3.14.0 v3.14.0
- Use of 1.8V and 3.0V SIM cards possible

Pin Name	IN/OUT	Level	Remarks
CLK	O	HIGH: $V_{DDX} - 0.45V \leq U \leq V_{DDX}$ LOW: $0 \leq U \leq 0.45 V$ $I = 3mA \text{ min}$	Clock signal from RUIM module of PMIC
RST	O	HIGH: $V_{DDX} - 0.45V \leq U \leq V_{DDX}$ LOW: $0 \leq U \leq 0.45 V$ $I = 3mA \text{ min}$	Reset signal from RUIM
IO	I	HIGH: $0.65 V_{DDX} \leq U \leq V_{DDX} + 0.3V$ LOW: $-0.3V \leq U \leq 0.35 V_{DDX}$ Leakage current $I_L = \pm 200nA$	Data pin with a 4.7k Ω pull up at the VREG_RUIM supply voltage

Pin Name	IN/OUT	Level	Remarks
	O	HIGH: $V_{DDX} - 0.45V \leq U \leq V_{DDX}$ LOW: $0 \leq U \leq 0.45V$ $I = 3mA \text{ min}$	
VCC	O	Set from 1.5V to 3.05V in 50mV incr. ($I = 150mA$)	Linear Voltage Regulator VREG_RUIM from PMIC. A 220 nF capacitor is situated close to the USIM card connector

V_{DDX} is the power supply voltage associated with the input or output pin, i.e. for the USIM interface, it corresponds to VREG_RUIM.

5.4.15.2 Interface Vibra Module

Pin	Name	IN/OUT	Level	Remarks
1	VPH_PWR		Approx. equal to Battery level (3.0V to 4.2V)	
2	VIB_DRV_N		Programmable in 100 mV increments $I_{max} = 225mA$	Driver Motor Pin from the PMIC. This Driver pin is a low-side driver.

5.4.15.3 Interface Earpiece TBC

Note:

- The pins are positioned on the earpiece
- Interface IN/OUT seen from the radio part

Pin	Name	IN/OUT	Level	Remarks
1	EAR1OP	O		MSM6250 Earphone 1 amplifier output (+)
2	EAR1ON	O		MSM6250 Earphone 1 amplifier output (-)

5.4.15.4 Rear-mounted Speaker Module TBC

Pin	Name	IN/OUT	Level	Remarks
XG705	SPKR_OUT_M	O		PMIC Differential Speaker Driver circuit (+)
XG706	SPKR_OUT_P	O		PMIC Differential Speaker Driver circuit (-)

5.4.15.5 Interface Microphone Module TBC

Pin	Name	IN/OUT	Level	Remarks
1	MIC1P	I		MSM6250 Mic 1 input (+)
2	MIC1N	I		MSM6250 Mic 1 input (-)
-	MICBIAS	O	provides 1 mA of current at 1.8 volts DC	MSM6250 Microphone bias supply output connected to MIC1P via a 2.2kΩ resistor

5.4.15.6 Interface Battery Module

Pin	Name	Level	Remarks
-----	------	-------	---------

Pin	Name	Level	Remarks
1	VBATT	-	Positive battery pole
2	FUEL_GAUGE		Fuel gauge
3	GND	3 V... 4.5V	Negative battery pole
4	GND		Ground

5.4.15.7 Interface MicroSDcard Module

Notes to the SDcard interface:

- The SDcard interface is configured to operate in MMC mode (not in SPI mode).
- For the Electrical Interface Levels please refer to 'The Multimedia Card System Specification' Version 3.31.

Pin	Name	IN/OUT	Level	Remarks
C1	DAT2	I/O	Not used.	Pulled up to VREG_AUX1 with a 100kΩ resistor.
C2	CD_DAT3	I/O	Pull up within the card to VREG_AUX1	Pulled up to VREG_AUX1 with a 100kΩ resistor.
C3	CMD	I/O	MSM6250 Pad Group 3	pull-up to VREG_AUX1 integrated in EMI-Filter.
C4	VDD	SUP	Programmable voltage 1.500 to 3.050 V. Defaults to 2.85V. 150 mA current rating.	VREG_AUX1 (VREG_MMC) PMIC linear voltage regulator for MMC.
C5	CLK	MSM6250 Pad Group 3	MSM6250 Pad Group 3	
C6	VSS	SUP	Ground	
C7	DAT	I/O	MSM6250 Pad Group 3	pull-up to VREG_AUX1 integrated in EMI-Filter.
C8	DAT2	I/O	Not used.	Pulled up to VREG_AUX1 with a 100kΩ resistor.

MSM6250 Pad Group 3 is powered from PMIC MSMP voltage, i.e. $V_{DDX} = 2.6V$. Pad Group 3 has the following DC voltage characteristics:

Output HIGH: $V_{DDX} - 0.45V \leq U \leq V_{DDX}$

Output LOW: $0 \leq U \leq 0.45V$

Input HIGH: $0.65 V_{DDX} \leq U \leq V_{DDX} + 0.3V$

Input LOW: $-0.3V \leq U \leq 0.35 V_{DDX}$

5.4.15.8 Interface LCD Module TBC

Pin	Name	IN/OUT	Level	Remarks

5.4.15.9 Interface Radio Control

Please see project drive (..\K:\ENTW\PROJ\X95_Onyx\PD-Team\Baseband_BB\Layout_Support\ KES-TREL portpin Liste 25_01_2006.xls) for the complete RF-BB Interface description.

Baseband				RF
Signal name	Connection	Pin	comment	Connection
GSM / GPS / WCDMA RADIO INTERFACE				
SBST_0	MSM6250 Serial bus driver	H26	Serial communication bus. Strobe.	RTR6250
				RFR6250
SBDT_0	MSM6250 Serial bus driver	J23	Serial communication bus. Data.	RTR6250
				RFR6250
SBCK_0	MSM6250 Serial bus driver	K21	Serial communication bus. Clock.	RTR6250
				RFR6250
RX0_I_M,	MSM6250 IQ ADC	V21	GSM Receive IQ path.	RTR6250
			WCDMA Receive IQ path.	RFR6250
RX0_I_P,	MSM6250 IQ ADC	W21	GSM Receive IQ path.	RTR6250
			WCDMA Receive IQ path.	RFR6250
RX0_Q_M,	MSM6250 IQ ADC	Y25	GSM Receive IQ path.	RTR6250
			WCDMA Receive IQ path.	RFR6250
RX0_Q_P	MSM6250 IQ ADC	Y26	GSM Receive IQ path.	RTR6250
			WCDMA Receive IQ path.	RFR6250
RX1_I_M,	MSM6250 IQ ADC	V25	GPS Receive IQ path.	RFR6250
RX1_I_P,	MSM6250 IQ ADC	W26	GPS Receive IQ path.	RFR6250
RX1_Q_M,	MSM6250 IQ ADC	U21	GPS Receive IQ path.	RFR6250
RX1_Q_P	MSM6250 IQ ADC	U23	GPS Receive IQ path.	RFR6250
TX_I_M,	MSM6250 IQ DAC	A14	GSM / WCDMA Transmit IQ path.	RTR6250
TX_I_P,	MSM6250 IQ DAC	B14	GSM / WCDMA Transmit IQ path.	RTR6250
TX_Q_M,	MSM6250 IQ DAC	A13	GSM / WCDMA Transmit IQ path.	RTR6250
TX_Q_P	MSM6250 IQ DAC	B13	GSM / WCDMA Transmit IQ path.	RTR6250
TX_IREF	MSM6250 IQ DAC ref	F13	TX IQ DAC reference generated by RTR6250 fed to MSM6250	RTR6250
TX_ON	MSM6250 RF Interface	H12	Enable UMTS Transmitter. Used for GSM power sequencing.	RTR6250
TX_AGC_ADJ	MSM6250 RF Interface	L14	TX gain control voltage (PDM) from MSM6250. Has RC Filter.	RTR6250
PA_R0	MSM6250 RF Interface	H17	PA High/ Low power mode select from MSM6250. (also connects to PMIC...)	RF3188 WCDMA PA
PA_ON0	MSM6250 RF Interface	B19	PA enable control from MSM6250.	RF3188 WCDMA PA
HDET1	MSM6250 ADC	Y21	WCDMA Power detect voltage. ADC Input Range is GND to VREG_MSMA. Resolution 8-bits. DNL +/- 0.75 LSB. INL +/-1.5LSB. Input 5KOhms/ 12pF typ.	RF3188 WCDMA PA
TX_VCO_1_EN_N	MSM6250 RF Interface	H10	GSM VCO enable.	UCVA4XW02A GSM TX VCO
TX_VCO_0_EN_N	MSM6250 RF Interface	D11	GSM VCO enable.	UCVA4XW02A GSM TX VCO
GSM_PA_EN	MSM6250 RF Interface	A8	GSM PA enable.	RF3147 GSM PA
			GPS Blanking	RFR6250
GSM_PA_BAND	MSM6250 RF Interface	D9	GSM PA Band select.	RF3147 GSM PA
PA_RAMP	MSM6250 DAC	P26	GSM power control from MSM6250 DAC.	RF3147 GSM PA via RC 15K-68p
ANT_SEL0	MSM6250 RF Interface	R19	Antenna signal path selection.	Panasonic GN06005L01QU
ANT_SEL1	MSM6250 RF Interface	T23	Antenna signal path selection.	Panasonic GN06005L01QU
ANT_SEL2	MSM6250 RF Interface	B4	Antenna signal path selection.	Panasonic GN06005L01QU
ANT_POSN	MSM6250 GPIO 17 O/P	N26	Indicates when external antenna connected. This input requires an internal pullup.	Antenna connector
PA_THERM	MSM6250 ADC. HKA IN3	AC25	Indicates temperature close to PA. ADC characteristics configurable.	Temperature sensor
RF_THERM	MSM6250 ADC. HKA IN1	AB25	Indicates temperature of general RF section. ADC characteristics configurable.	Temperature sensor
TRK_LO_ADJ	MSM6250 RF Interface	H14	VCTCXO frequency adjust voltage (PDM) from MSM6250. Has RC filter.	VCTCXO
TCXO	PM6650	58	19.2MHz reference from TXCO to BB	VCTCXO

FM RADIO INTERFACE				
SLEEP_CLK	PMIC 32.768kHz buffered clock	45	Duty Cycle 30 - 70%	TEA5764HN
A_RDS_DATA_EXIST	MSM6250 GPIO 18 I/P	L19	Interrupt to MSM6250.	
I2C_SDA	MSM6250 I2C Interface	J21	maximum line capacitance of 400pF, and loading by 10 devices.	
I2C_SCL	MSM6250 I2C Interface	J19	I2C clock master. 2k2 pullup resistor allows maximum line capacitance of 400pF, and loading by 10 devices.	
A_FM_STANDBY	MSM6250 GPIO 29 O/P	N23	Digital section Enable.	
AUXIP	MSM6250 Auxiliary input Left	AE15	Left Audio Channel. Vpp spec for amplifier enabled.	
AUXIN	MSM6250 Auxiliary input Right	AF19	Right Audio Channel. Vpp spec for amplifier enabled.	
BLUETOOTH INTERFACE				
BT_CLK	MSM6250 Bluetooth interface	G23	Reference clock to MSM6250	
BT_ENABLE	MSM6250 GPIO 12 O/P	D5	Device internal regulator enable	
BT_DATA	MSM6250 Bluetooth interface	D26	Bidirectional data interface.	
BT_TX_RX_N	MSM6250 Bluetooth interface	G21	Multi-purpose control.	
BT_SBDT	MSM6250 Bluetooth interface	E25	Serial communication bus. Data.	
BT_SBST	MSM6250 Bluetooth interface	F23	Serial communication bus. Strobe.	
BT_SBCK	MSM6250 Bluetooth interface	E26	Serial communication bus. Clock.	
BUFF_TCXO_BT	Buffered 19.2MHz clock	4	3.0V supply.	

5.4.15.10 Interface Accessories (I/O-Module) TBC

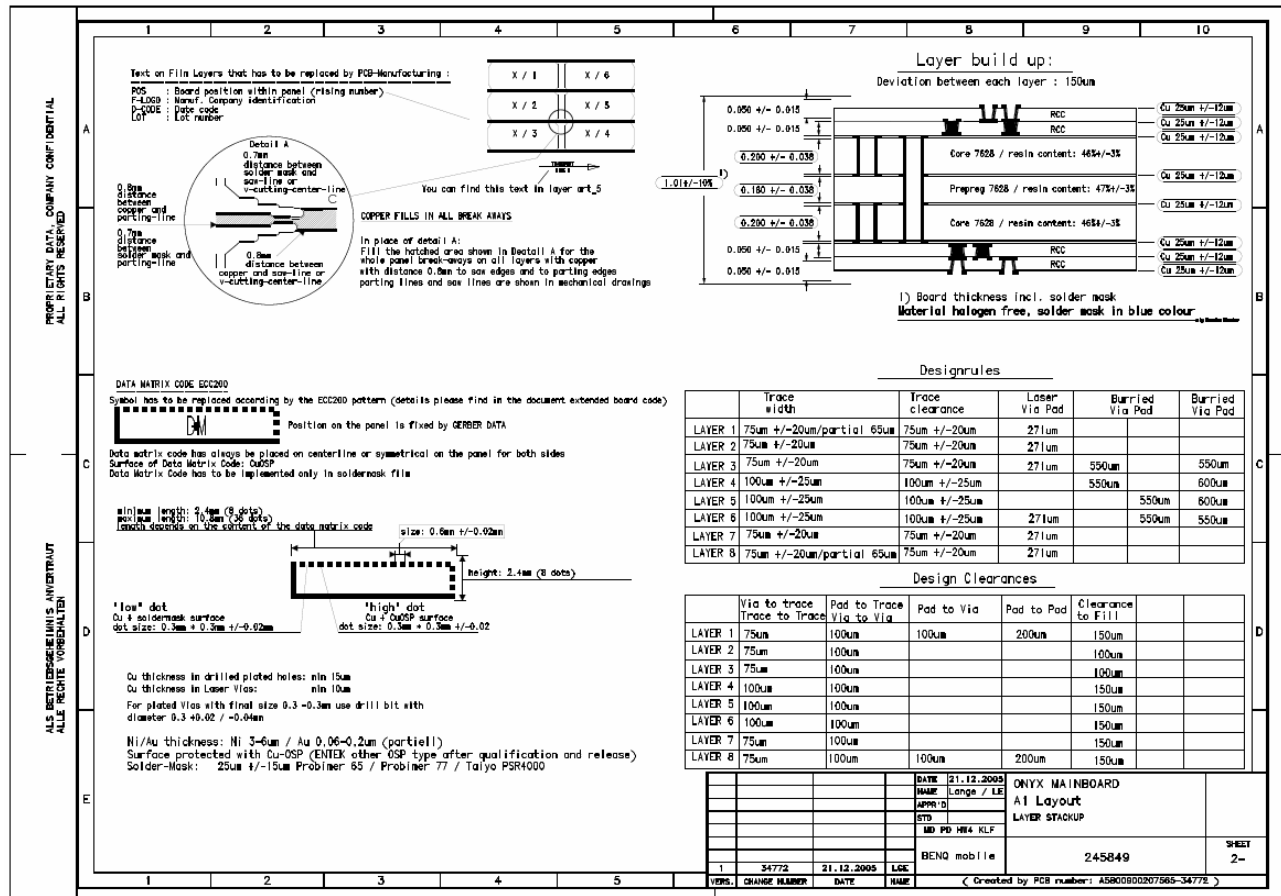
Please see 4.4.13.4 Table 21.

5.4.16

5.4.17 Printed Circuit Board (Main Board)

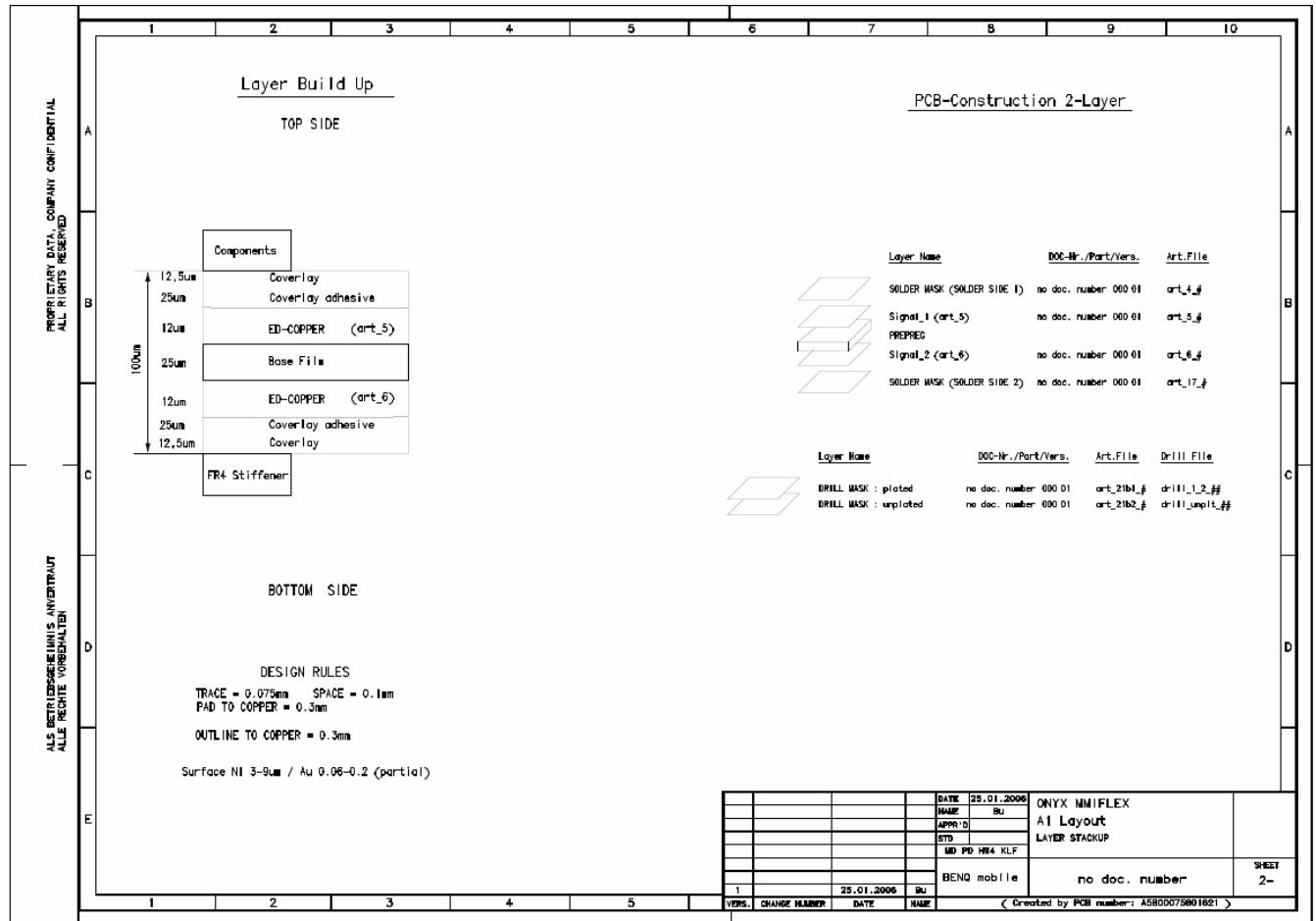
The Onyx has the following layer build of the Printed Circuit Board (PCB), namely the main board. The PCB will be produced with Halogen free material and will have 8 (2+2+2+2)layers.

Onyx- main board layer build up:

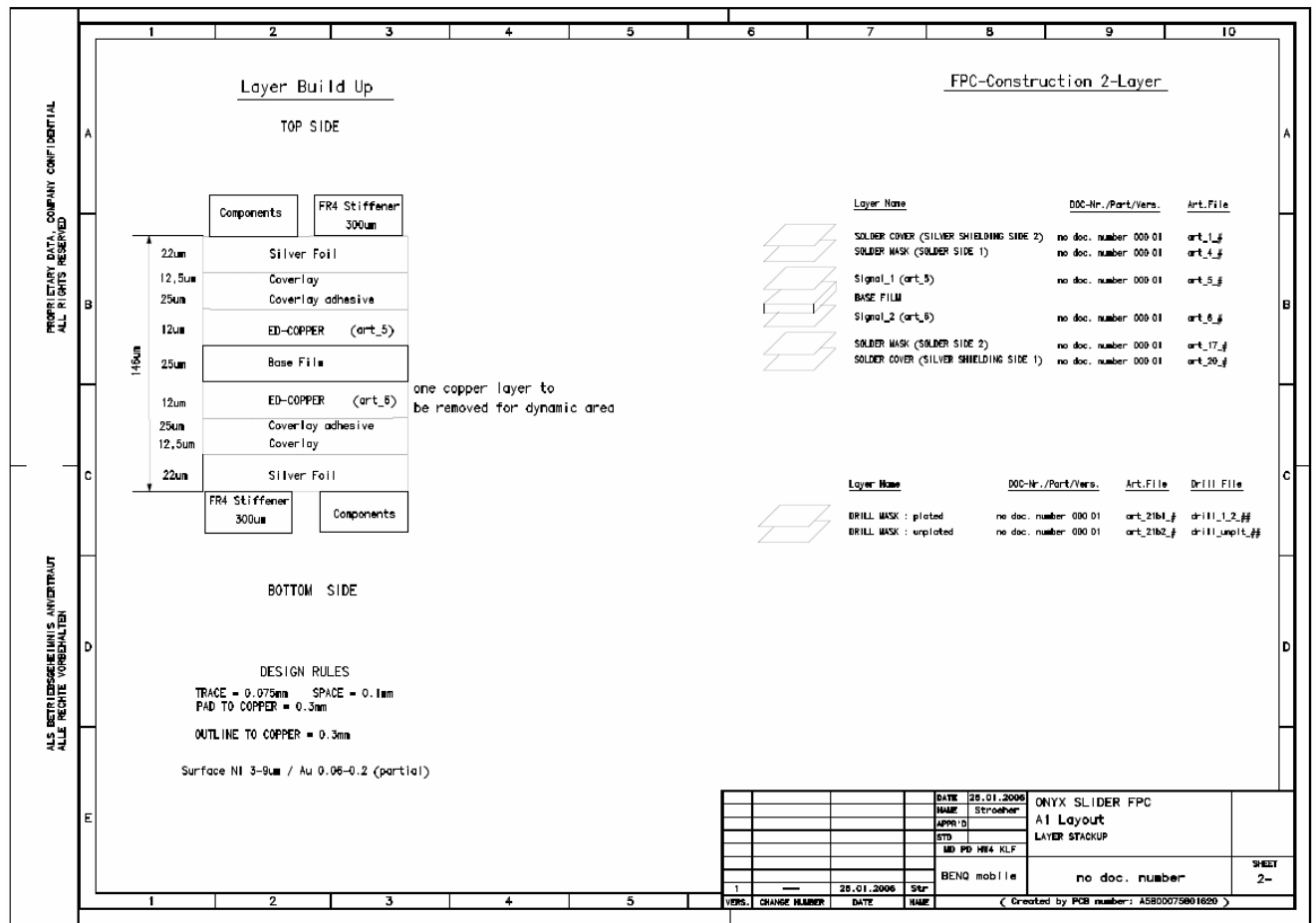


5.4.18 ONYX FPCs:

The MMI board will be a 2 layer FPC



The Slider Flex will be a 2 layer FPC and single layer FPC in dynamic area with shielding on both sides:



5.5 EMC-Concept

5.5.1 EMC

Electromagnetic Compatibility will be verified according General Quality Requirements, Release Number: 1.7.1. Chapter VII EMC & EMF

5.5.2 Keypad

The keypad, including FSR foil, joystick and double action key, must be completely closed in so that no ESD disruptive discharges can occur. Otherwise additional protection measures will be arranged.

5.5.3 3 Mega Pixel Camera

The 3 mega pixel camera should be complied shielded. This is not possible due to limited space reason inside antenna volume. Degradation of receiver sensitivity during active 3 mega pixel camera expected.

5.5.4 Display

Due to unknown results of the actual display and rotation of display by 180° (LCD controller in the north) self interferer are expected during active display.

5.5.5 Antenna performance

ONYX uses an integrated PIFA-antenna. Values for antenna performance as described in the M0 declaration can be reached. Detailed values will be listed in chapter 2.3. The expected antenna performance is in some ranges below the wanted FBT requirement, due to design reason. The expected antenna performance was already confirmed by PM during M0. New Measurements towards M1 shows increased Antenna Performances.

5.5.6 Desktop stand

In case when mobile lies in desktop stand, additional loss of antenna performance expected, because the antenna is covered by plastic. Conductive material near the GSM/UMTS/Bluetooth antenna area is not allowed and non conductive material like plastic should be avoided.

5.5.7 Project Plan

With TPM Target Plan development time is significant reduced compared to earlier projects. This could have bad influence to EMC Quality and this lead to high risk on time to market.

5.5.8 SAR

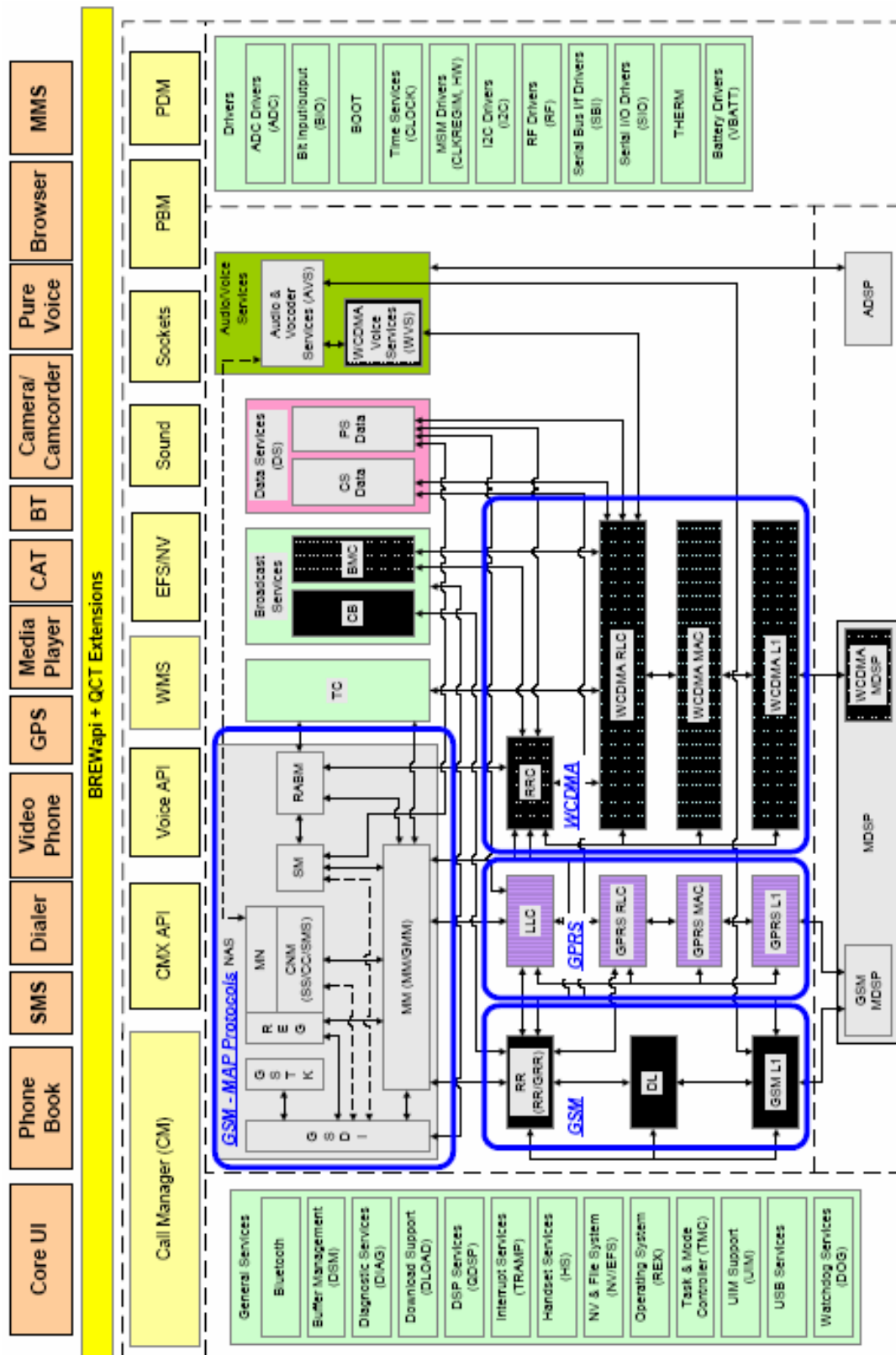
No exceeding of legal SAR values expected. Detailed values **tbd**. At present status no guaranty for meeting all BenQ mobile internal SAR requirements (according to GQR) can be given. Two ground contacts to design ring in the north and in the south should be considered by MD.

6 Software

The software will be implemented in compliance with the Feature list V40

The user interface will be described in the specifications located in http://mchp72ra.mch.sbs.de:8002/sap/bc/bsp/sap/z_easydms/default.htm?sap-client=400&easydms-dokar=F01&easydms-doknr=262880&easydms-doktl=000&easydms-dokvr=01&easydms-docfile=&easydms-action=.

6.1 Architecture Overview



L1 (PHY) Physical Layer Control and Drivers supports:

- Encoding/modulation
- Decoding/deinterleaving
- Search/acquisition
- Demodulation
- System timekeeping
- L3/L2 interfaces
- Action time support
- RF/gain control
- mDSP sync/async interface

Physical Layer maps transport channels to physical channels and supports both UL/DL CCTrCH configuration and control

L2 MAC (Medium Access Control) supports:

- UL and DL mapping of logical channels to transport channels
- Attachment/removal of MAC header
- TFCS selection
- RACH control
- Traffic volume measurement

L2 RLC (Radio Link Control)

- Consists of three modes of operation:
 - Transparent mode
 - Unacknowledged mode
 - Acknowledged mode
- Provides for segmentation/reassembly, acknowledgement, and SDU-to-PDU mapping for both control plane signalling and user plane data

L3 RRC (Radio Resource Control Protocol) supports:

- Connection establishment for NAS layers
- NAS data transfer
- Configuration/reconfiguration of L2/L1 layers
- Radio bearer setup/release/reconfiguration
- Measurement control and reporting
- Cell selection/reselection
- Diversity control for soft and hard handoff
- Security procedures for authentication and ciphering
- Establishes and maintains radio link with UTRAN

NAS MM (Mobility Management) supports:

- PLMN selection
- IMSI/TMSI attachment/detachment of registration
- Location area updating
- Connection Management sublayer services
- Authentication

NAS GMM (GPRS Mobility Management) supports:

- System selection
- P-TMSI attachment/detachment
- Registration and authentication for the GPRS network

NAS CC (Call Control) supports:

- Mobile-originated/mobile-terminated call setup and termination
- Emergency call setup
- Call maintenance
- Supplementary Services call support
- DTMF support
- Call reestablishment

NAS SM (Session Management)

- Provides functions to activate, modify, and delete contexts for Packet Data Protocols (PDP)

NAS SMS (Short Message Services) over circuit-switched connections supports:

- SMS Control protocol

NAS GSMS (GPRS Short Message Services) supports:

- Short Message Services over packet-switched connections

NAS SS (Supplementary Services) supports:

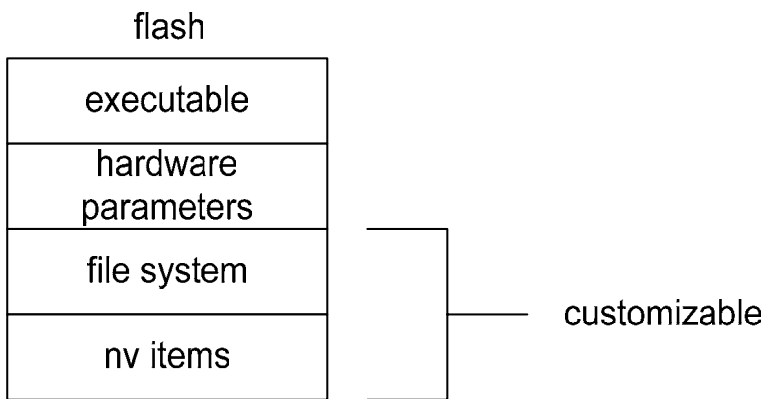
- Multiparty calling
- Call waiting
- Call forwarding
- Call barring
- Call hold
- Calling line identification
- Connected line identification
- Advice of charge
- Closed user group
- Call transfer
- Other GSM Phase 2+ features

6.2 Customisation

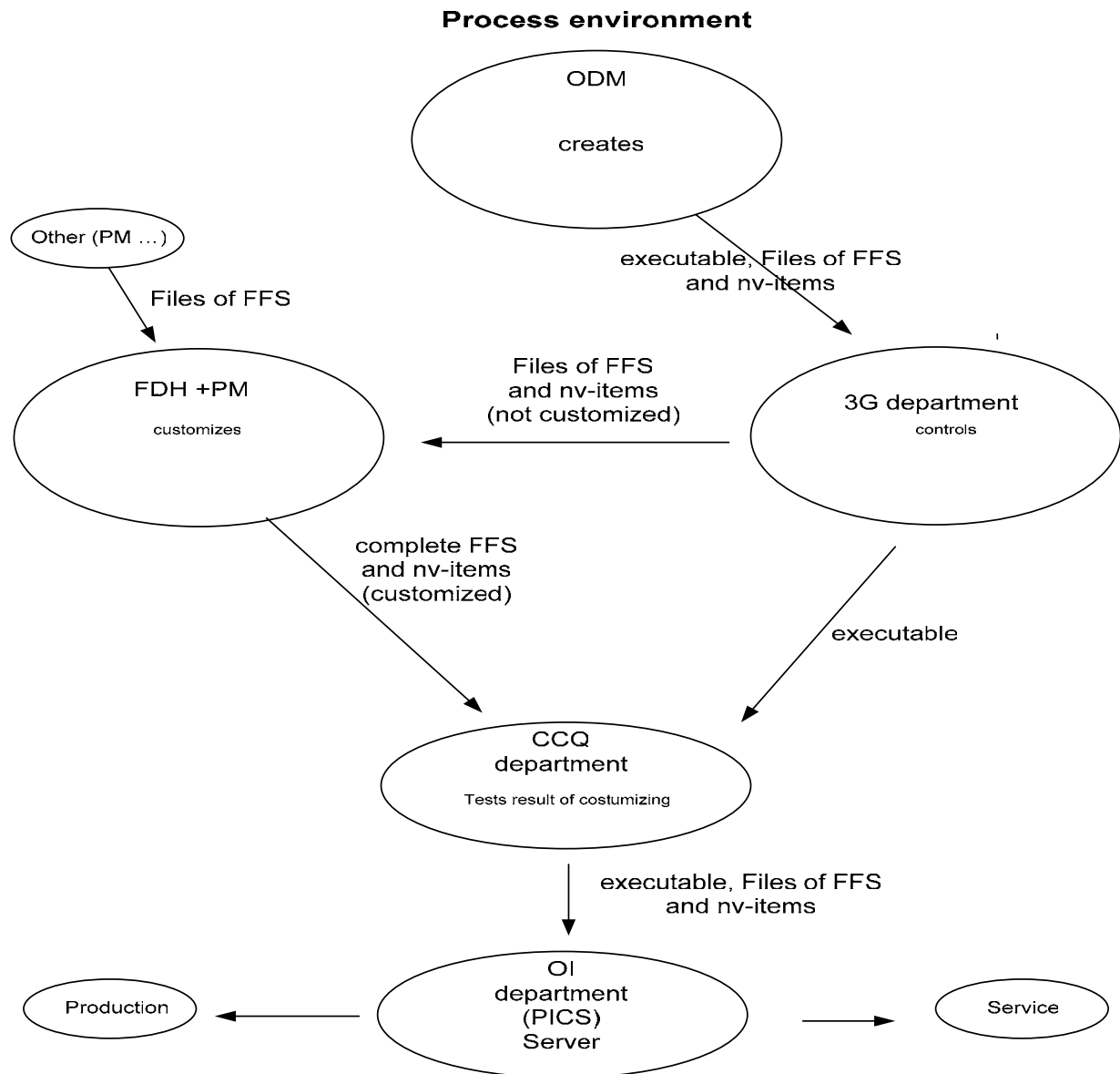
The Software will be launched as one single variant. This software has to be tested by the system test group and CCQ (field test). This software includes the customer specific initialisation of the Flex Menu Tree, Skins, Themes and certificates. A customer may request a more complex customisation variant, which cannot be handled, based on the standard customisation. Those variants can of course be supported but the time schedule and the availability of resources has to be agreed with R&D and all parties involved for each variant individually.

6.2.1 Customization Concept

Customization means the adaptation for vendor requirements of a software version that is downloaded to a flash. This adaptation does not affect the executable code or hardware dependent parameters.



6.2.2 Process environment



In several steps the ODM delivers according to the agreed project progress the executable (Core-SW), a basic Flash-File-System and the information about all nv-items (non volatile items, known as EE-light and EE-full) to the 3G-Department. This information will be input to the 3G-department-configuration-management as well as be forwarded to the departments responsible for collecting the vendor-specific customization data and generating the appropriate data files for download (known as map-files). This part of the process will be nearly identical to what is known from the native products including the use of the tools mobicon and factory-data-handler. The output is forwarded to the CCQ department which is responsible for checking the customized data for correctness. The output is placed on the PIC Server and released by CCQ thus ready for download for productions and service reasons.

7 Accessories

7.1 Portfolio

Compatible Accessory Devices for ONYX are listed below.

Product	Description	Comment
FCL-xxx	Carrying Case	Belt case, made of leather
EBA-xxx	Battery	Same as for the mobile itself
ETC 100/110	Travel Charger	
ECC-100	CarCharger Plus	Allows parallel use of Car-Charger and Headset
EDS-100	Desk Top Stand	
EDS-xxx	Onyx Desk Top Stand	Special bundling product for Onyx, provides lightning effects
HHS-120	Headset Purestyle	
HHS-110	Headset (PTT)	(with PTT button)
HHS-100	Headset Basic	(w/o PTT button)
HHS-150	Headset Stereo	
HHS-xxx	Headset Stereo Volume Control	Special Bundling product for Onyx, has attenuator in headset
* HHB-750	Bluetooth Headset Stereo	with display, remote control, call, music
* HHB-xxx	Bluetooth Headset Stereo II	call, music
* HHB-180	Bluetooth Stereo Headset	call, music
* HHB-xxx	Bluetooth Stereo Headset Sport	call, music
HHB-700	Headset Bluetooth	Mono Bluetooth Headset
HHB 505	Headset Bluetooth	Mono Bluetooth Headset
HHB 600	Headset Bluetooth	Mono Bluetooth Headset
HHB100	Headset Bluetooth BASIC	Mono Bluetooth Headset
HHB130	Headset Bluetooth CLIP	Mono Bluetooth Headset
HHB160	Headset Bluetooth PREMIUM	Mono Bluetooth Headset
HKP-100	CarKit Portable	Wired CarKit
HMH-100	Passive Holder Universal	Mobile holder for car use
** CK Linefit (tbd)	CarKit Linefit (tbd)	Install type CarKit from third parties using BenQ's authentication chip
HKW-700	CarKit Portable Bluetooth	Handsfree CarKit
HKW-100	CarKit Bluetooth Easy	New Handsfree CarKit
HKW-710	CarKit Bluetooth	Developed fro 75 generation
* HKW-720	CarKit Bluetooth SIM Access	Developed fro 75 generation
HKW-600	CarKit Bluetooth	Bluetooth Mode only, no support of wired mode requested Developed for 65 generation
HKW-xxx	CarKit Bluetooth Voice	New product
* HKW-xxx	CarKit Bluetooth SIM Voice	New product
DCA-140	Data Cable USB-USB	

DCS-100	Sync.-Station	Consists of DeskTopStand EDS-100 and Data Cable USB- USB DCA-140
* IMS-100	Mobile Music Set Bluetooth	Call, music, volume control from mobile to Music Set
IHM-100	Music Cable	Lumberg-to-Cynch Cable

* the support of these devices is not agreed for M1, but is handled by a separate CR, which is not agreed at M1

** this device is not requested at M1, but maybe requested by a separate CR

7.2 General Accessory Requirements

The general requirements to be fulfilled by the mobile phone are mentioned in the references
Hardware Specification Nano I/O Connector [Hardware_Interface_Specification_NANO_IO.pdf],
Siemens Accessory AT Interface [SACD_SABD_NANO_IO.pdf],
Accessory Encryption [Accessory_Encryption.pdf],
Audio-Processing Mobile Phones / Accessories [Audio_Processing_Mobile_Phones_-_Accessories.pdf]
and
Requirements for 85 Phone Design [Mechanical_Interface_Requirements_PG85.pdf].

These documents are store in the archive file
Accessory Product Information [Accessory Product Information.zip].

7.3 Specific Accessory Requirements

For each supported accessory device some specific requirements are listed in the archive folder file
Accessory Product Information [Accessory Product Information.zip]
This contains more detailed requirements regarding phone software,

Product Onyx DeskTop Stand:
This product will be handled in a separate project with its own timeline and specifications.

Product Headset Stereo Volume Control:
This product will be handled in a separate project with its own timeline and specifications.

For Onyx-specific Products see chapter 1.1 Project specific references.

7.4 Desktop Shell and Headset volume Control Projects requirements

As a Desktop Shell (DTS) and Headset volume control will be a bundled Accessory we need to specify some major point to ensure the delivery of Quality and Quantity in time to meet our target DS time-line including DTS and wired headset volume controlled.

Project Lead of the DTS will be Frank Templin. He is responsible for driving the development of this accessory related to ensure the delivery of development samples in time. Quantity planning will be setup separately. All issues related to SCM QM are completely in responsibility from AD, Hr. Riesmeyer. A time schedule of delivery of supplier samples will be generated and aligned with the prototype planning of ONYX to ensure the fully support of prototype runs and delivery of DTS according to the ramp-up planning. Jens Knapmeyer who is part of PD-Team will communicate the status of DTS inside the PD-Team and take issue back to Frank Templin.

Status Onyx M1:

Supplier selection not yet finalist, last BOM value communicate to TPM and APE. Actually the AD M1 of DTS itself are not reached yet, but will not block ONYX M1 so far. Timeline of DTS will be synchronizes to ensure DS. A1 parts of DTS PCB have to deliver at least by mid of May for SW to ensure S25 Quality in time.

B1 DTS Samples 29.06.2006

B1+ DTS Samples 07.08.2006

B2 DTS Samples 14.09.2006

AD Sample planning sheet at IMS will include DTS and Headset volume control and have to be final at least at CW 12.

8 Manufacturing Concept

8.1 Overview and general requirements

The manufacture of the ONYX main PCB will be done on the standard SMD production lines for BenQ mobiles with lead free components and lead free solder paste.

Further it is absolutely essential to comply with the following design rules and to include these into the product definition.

Topic: Design Specification for Printed Circuit Boards

Author: PHE SCM TLM PT 11 KLF Mr. Mittelstädt

8.2 Modules

The differences of smt-components from top to bottom side will be compensated by the use of combined 3 times top/bottom PCB panel (6 times mirror panel).

8.3 Components Spectrum

8.3.1 SMD Component Number and Number of Types (as of 13th of February 2006)

Main PCB:

	Anzahl Bauelementeteile / number of components		Anzahl Bauelementetypen / number of com. types	
	Side 1 (Top)	Side 2 (Bottom)	Side 1 (Top)	Side 2 (Bottom)
	407	296	103	116
Summe/sum	703		186	

8.3.2 SMD Spectrum (as of 13th of February 2006)

The smallest passive design form is Chip 02/01, the smallest grid used is 0.4 mm.

15 Components with CSP Housing

- msm6250A Pitch 0.5mm
- Memories: Flash 1 GBit Nand (Toshiba)
- BT Chip
- FM Radio
- GSM Receiver
- RF Transceiver RFR6250
- RF Frontend
- Power Supply 6650

Components for special SMD Processing (F-Machines)

- BTBConnector pitch 0.4
- BTF connector pitch 0.4
- I/O Connector
- SIM-Reader
- Transflash Card reader
- Battery Connector
- RF plug
- Shielding (4 pieces in fish-can-technology, 2 pieces in prem-can-technology) for SMD Processing
- VGA Camera socket
- Megapixel inhouse transport edges
- PogoPin

8.3.3 Manual Soldering

No manual soldering planned.

8.3.4 Delivered Form of the Components

All SMD Components have to be delivered in 13" tape and reel. Any deviations from this packaging can be decided on or cleared only by PHE SCM TLM PT 11.

8.4 Production Means and Stages

Overview of all production steps

- SMT-Placement
- Panel-Separation
- Testing PCB
- Mobile-Assembly
- Testing and Customization of Mobile
- Packaging

A. SMT-Placement

Automatic Loading of panels

Soldering pasting side 1

SMD placement side 1

Optical Revision side 1

SMD placement shielding and special components

Re-flow soldering side 1

DEK Screen printing machine
Siplace 80S/HS50/80F/X-Series
Opto-Control AOI
Siplace 80F
Soltec re-flow soldering unit

Soldering pasting side 2

SMD placement side 2

DEK Screen printing machine
Siplace 80S/HS50/80F/X-Series

Optical Revision side 2
SMD placement shielding and special components
Re-flow soldering side 2

Opto-Control AOI
Siplace 80F
Soltec re-flow soldering unit

B. Panel-Separation

Automatic panel separation
Sort out of defect PCB by FABEL-Database automatically
Put PCB into test carrier automatically
Automatic loading of test carrier

Pematech Saw Separation Station
Pematech Saw Separation Station
Pematech Saw Separation Station
Pematech Saw Separation Station

C. Testing PCB

Inline testing of main PCB automatically

Pematech Test-Line

D. Mobile-Assembly

Preassembly of mechanical parts manually
Final assembly of mobile manually
Automatic screw of mobile

Product specific fixtures
Product specific fixture
Weber automatic screw station

Or

Preassembly of mechanical parts automatic
Final assembly of mobile automatic
Automatic screw of mobile

Automatic A²T Line
Automatic A²T Line
Weber automatic screw station

E. Testing and Customization of Mobile

Testing of Mobile in customer end test
Software- Customization of Mobile
Hardware-Customization of Mobile (snap in rear cover)

Pematech automatic customer end test
Engmatec customer init
manually customer init

F. Packaging

Packaging of Mobile and all accessory

semiautomatic

8.5 Basic Assembly Concept

See chapter 3.3, Assembling Drawings ONYX

8.6 Design to Customer Support

The mechanical concept of ONYX allows a production of Non-ID-Phones, which is agreed within the project-team.

BenQ mobile logo above the display lense, no operator-specific key-pad, for customization is one potential area defined:

- Battery Cover

All Customization will be done in Config. Center with separate handling of above mentioned parts and booting of customize specific SW.

8.7 New production technology

As of 13th February no new production technologies are planned.

8.8 Quality Targets

The following quality targets are aimed at:

Production Step	Aim
-----------------	-----

Placement Quality	40 dpm
Soldering	10 dpm
BE faults	50 dpm

The targets will not be achieved during the run-in phase. They can be achieved in a stable production line only.

8.9 Expected Production Quantities/Production Capacity

For the ONYX we are targeting approx. 950 thousand units (worldwide) over a life cycle of 15 months. The peak is planned to be 90 k/month and is expected in December 2006. The start of the pilot series is planned for CW36/05 and it is aimed to produce 39k mobiles till 20th of October 2006.

8.10 Ramp up Plan KLF

More Detailed information, please contact Rolf Gillitzer
Current ramp up plan version (11.01.2006): V2

Product Onyx

Revision: V2.0

Date: 11.01.2006

Production Peak Capacity: 90k / M (Dec. '06.)

Life Cycle Volume: 0,95 Mio

Material Peak Capacity: 117k /M => 30k /W
(including 30% upside potential)

last change:

12.01.06

12.01.06	Pilot Run				Ramp Up																Series	
month in 2006	Aug	Aug	Sep	Sep	Sep	Sep	Okt	Okt	Okt	Okt	Nov	Nov	Nov	Nov	Nov	Dez	Dez	Dez	Dez	Jan	Jan	
calender-week in 2006	CW 34	CW 35	CW 36	CW 37	CW 38	CW 39	CW 40	CW 41	CW 42	CW 43	CW 44	CW 45	CW 46	CW 47	CW 48	CW 49	CW 50	CW 51	CW 52	CW 01	CW 02	
	21. Aug	28. Aug	04. Sep	11. Sep	18. Sep	25. Sep	02. Okt	09. Okt	16. Okt	23. Okt	30. Okt	06. Nov	13. Nov	20. Nov	27. Nov	04. Dez	11. Dez	18. Dez	25. Dez	01. Jan	08. Jan	
milestones	S3		pilot	pilot	PS		Customer Approval		DS			S4										
dispo plan for critical parts	2,0	2,3	5,3	9,6	11,5	11,9	15,1	12,4	14,1	9,8	9,5	9,6	19,8	21,3	21,5	22,5	23,0	23,0	23,0	14,0	13,0	
production plan global	0,0	0,0	1,0	1,5	4,1	9,3	10,8	11,4	14,1	8,5	9,0	9,6	18,8	21,3	21,5	22,0	22,5	23,0	23,0	13,0	13,0	
rebooting of devices in KLF						0,0	0,0	0,0	25,0	10,7	0,0	0,0	0,0	0,0								
phones ready for delivery on stock total	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	39,1	19,2	9,0	9,6	18,8	21,3	21,5	22,0	22,5	23,0	23,0	13,0	
phones ready for delivery on stock total /month										39,1					77,9				89,0			
prod. plan KLF no-ID			1	1,5	4,1	9,3	10,8	11,4														
prod. plan KLF variant									14,1	8,5	9,0	9,6	18,8	21,3	21,5	22,0	22,5	23,0	23,0	13,0	13,0	
rebooting of devices in KLF									25	10,7												
production plan KLF total			1	1,5	4,1	9,3	10,8	11,4	14,1	8,5	9,0	9,6	18,8	21,3	21,5	22,0	22,5	23,0	23,0	13,0	13,0	
phones ready for delivery on stock KLF										39,1	19,2	9,0	9,6	18,8	21,3	21,5	22,0	22,5	23,0	23,0	13,0	
dispo variant L36880-Nxxxx-A888	2	2,3	4,3	8,1	7,3	2,5	4,3	0,9	0,0	1,3	0,5	0,0	1,0	0	0	0,5	0,45	0	0	1		

conditions:

2 Lines planned to fulfill Ramp Up volume

9 Test Rig Planning

9.1 General Requirements

It is absolutely essential to comply with the following requirements and to include these into the product definition. Any deviations from them must be clarified PHE SCM TLM PT2. Concerning this a test technology workshop has been carried out (26.01.2006, Claus Gräbsch; PHE SCM TLM PT21).

The most essential requirements are as follows:

- The central module can be switched on and operated via the mixer plug.
- No mechanical match-ups.
- Make sure that the necessary RF measuring points are given 50 Ohm impedance or make available any necessary impedance transformation outside switching.
- Match ups with higher requirements as regards accuracy (transmitter output etc.) are only possible in the testing stage Adjustment / System test.
- The free spaces and the test point diameters for test points must be kept to (see design regulation).
- Fulfil PCB requirements as regards the fixing borings and carrier only (see design regulation).
- Make available a Windows NT software library for controlling the phone functions.

For more details please refer to "Testing technical standards for BenQ mobiles" (Prüftechnische Anforderungen; pv1pta41.doc; Version 4.1; 10.11.2005)

9.2 Quality Targets

The following quality targets are aimed at:

Testlevel	Yield (first pass)
Functional Test	90,0%
Adjustment-/Systemtest	96,0%
Cameratest	98,0%
Customertest	94,0%
Customer Initialization	99,0%

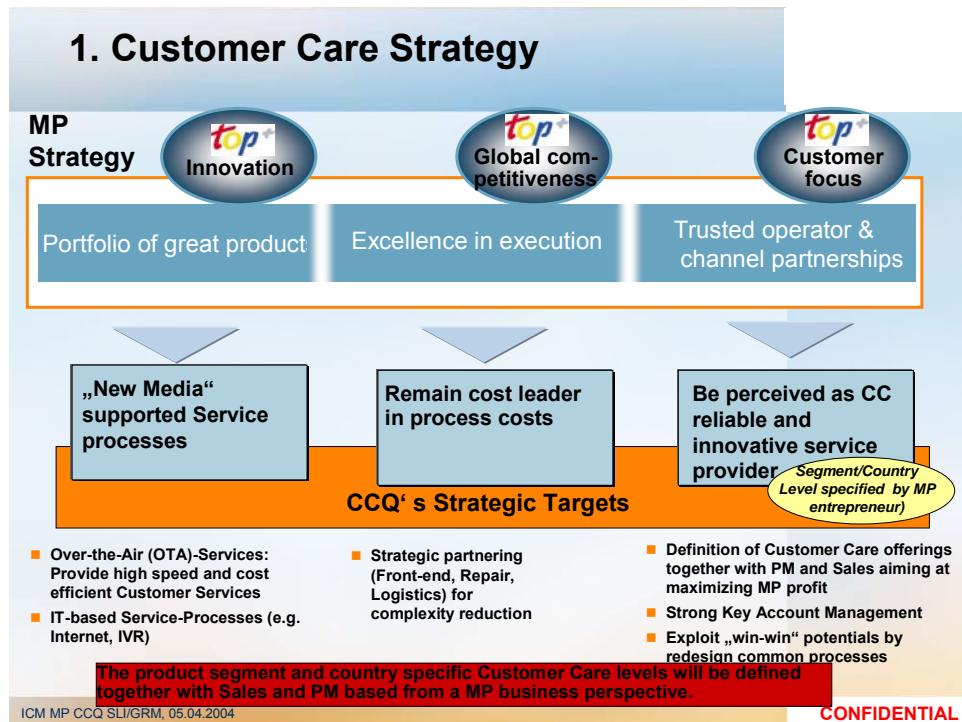
The Cpk of each test case in the test levels has to be equal or larger than 1,5 (for all Gaussian distributed processes. Further each fault in test levels must be lower than 0,5%.

The target test time is less than 120 seconds for a board and less than 37 seconds for a device.

10 Customer Care

10.1 Customer Care strategy

Attached diagram documents contains the CCQ MP Strategy:



The acceptable care standard per region for ONYX as well as the additional service packages has to be defined together with sales and PM.

10.2 Service Objectives

- BenQ mobile bears responsibility for the products with a BenQ mobile Logo and co-branded products
- Local Service Organisations (LSO's) will ensure the international service for a country or a region
- Implementation of hotline for customers (end users)
- Supply of small parts to end user via hotline
- Standard repair fee will be charged for out of warranty repairs
- Car mounting and accessory service will be rendered by business partner (retailers)
- SW update over the air (SWUOTA) as a mandatory feature starting with product launch.
- Strategic wireless Services like phone settings over the air (OTA Standard – SyncMLDM) will be continuously enhanced in order to reduce hotline calls
- SW update and download of phone settings should be possible for end customer directly via internet
- Self help tool via Internet for the end customer based on the CCQ knowledge database

10.3 Repair level definition

In general, 6 repair levels for BenQ mobiles are defined:

- Level 0
Phone is not disassembled: SW Updates, un-blocking variant configuration, logistics, in-warranty check, error reproduction
- Level 1
Change of non soldered components like housing, keypads etc., exceptions: adjustment for display
- Level 2
Exchange of complete boards
- Level 2.5
Trouble shooting and repair of defined soldered components without adjustment
- Level 2.5e (extended).
Trouble shooting and repair of defined soldered components including adjustment
- Level 3
Trouble shooting and repair of all soldered components including complete adjustment and test. Use of automated test equipment.

10.4 World-wide distribution of service level

- Europe/Near East/RSA
 - level 1/2/2.5/2.5e repairs at the LSO and/or service partners
 - swap and/or repair of devices for end users
 - level 3 repair at BenQ mobile workshops
- Far East/Australia
 - level 1/2/2.5/2.5e repairs at the LSO and/or service partners
 - swap and/or repair of devices for end users
 - level 3 repairs at the ASC in Singapore
- Republic of China
 - level 1/2/2.5/2.5e repairs at service partners
 - repair of devices for end users
 - level 3 repairs at the Service Centre Shanghai

10.5 Roll out plan for the service concept

- Definition of the service parts when the mechanical design is available (or samples) but 4 month before market launch at the latest.
- Service parts will be planned on a basis of the expected return rate and quantities (1 month after the availability of the planned quantities of the sales department)
- The procurement of these planned service parts will be initiated.
- The prices for service parts and repair fees will be available via e-commerce two weeks prior to market launch.
- Quantity of swap units/delivery units for the affected LSO's are agreed and delivery is initiated at market launch at the latest.
- Investment for repair line will be planned (2 month after M1). This planning is put into action at market launch at the latest.
- Carry out of the training for the service partners (LSO's) is planned and will be put into action with market launch.
- Service documentation and training documents will be available via Internet on market launch at the latest.
- Crosscheck of the user guide by the hotline staff.
- Training of the hotline 4 weeks before market launch at the latest.
- Definition and procurement/making of test equipment and test software. This will be available on market launch at the latest.

10.6 Service parts

As soon as the mechanical design is available the service parts will be defined. In principle the following parts will be defined:

Spare parts*:

- Upper case shell
- Lower case housing
- accessory components
- display unit/module
- vibra motor
- microphone
- camera module
- speaker / acoustic sealing
- battery cover
- shielding cover
- keypad

11 Quality

11.1 General Quality Requirements

The general quality requirements for phone and accessories are contained in the documents:

“General Quality Requirements for Cellular Deliverables (Cellular Phones / Pocket PCs and Accessories)” that was agreed between Development, Product Marketing, Purchasing and Quality Management. E.g.:

- Chapter 1_General_2006_01_20 .doc
- Chapter3_1 Accessory-2006_01_18.DOC
- Chapter3_2 Accessory 2006_01_18.DOC

“General Quality Requirements for Cellular Deliverables (Cellular Phones / Pocket PCs and Accessories)” that was agreed between Development, Product Marketing, Purchasing and Quality Management.

The version currently in force and valid for this project is **rev. 1.1.1**. In case of new revisions of the document after M1, Product Marketing, Development, Business Administration and Quality Management have to agree if any updated requirements shall be applied in this project.

The remainder of this subsection outlines some basic requirements. For details and additional requirements refer to the “**Quality Requirements for cellular devices**” **rev. 1.1.1 18.01.06**.

Temperature ranges for mobile phones:

Warehousing	-40°C to +85°C	Mobile phone without packaging and battery (acc. battery spec)
Non-deformation (plastics)	-40°C to +85°C	At temperatures between -30 and -40 °C the LCD display/ camera may have a reduced function due to freezing. After defrosting the full functionality has to be regained.
Solar radiation (outdoor)	1120 W/m² at +55°C	
Battery operation	-10°C to +55°C	fully operable according to 3GPP TS 51.010-2 (newest version) specification
Operation with external power source	-20°C to +60°C	Additional check for making/ receiving calls (emergency call)
Nondestructive range in switched on mode	-30°C to +70°C	

11.2 General operation and function requirements

Standards regarding the ease of operation / user-friendliness for different components include, amongst others:

Housing

The casings must keep their shape when pressed in the user's hand. Manual pressure on the casings may not lead to physical damage or impact the function of the test device.

The front and back casings must fit tight; no noticeable play between the casings is allowed. No creaking and grating is accepted. There may be no noticeable projections or protrusions (seam or ridge / overflow). The join must be uniform.

The surface must have a good feel and be dirt resistant. In particular, fingerprints (oil and sweat marks) must not show on the housing surface.

The materials used (housing parts and adhesives) may not be hazardous to the user's health. Also, the housing may not have a noticeable smell.

Bridges are not allowed to strut on PCB (damaging of copper-tracks).

Keypad

Keys must have a noticeable mechanical pressure point supported by a mechanical resistance or acoustic "click".

The number "5" key must have a nub or other tangible means of orientation (ETSI-Standard; ES201381). Incorrect pressing of keys (off-center, forceful pressing) may not lead to a mechanical sticking of the keys. The illumination of the keypad has to conform to the product specification (potential faults are single-edged illuminated keypads or a consistent decrease of the illumination from one side to the other, if a uniform illumination is required).

The printing and/or key markings must be clearly legible.

The individual operating elements must be designed in such a way that they are easy to operate (applies, in particular, to the keypad). The power ON / OFF key must be secured against inadvertent switching on. If metal domes are in use, the keypad has to be connected (glued) to the PCB in a dustproof way.

Display and Window

The contrast and read-out angle should be optimized so that the display is as free from distortion and reflection as possible. The display must be designed in such a way that the user cannot see the insides of the unit. The lighting must be uniform.

The window must be designed in such a way (form and placement) that it is largely protected against inadvertent scratching (for example, the housing may be designed so that it protects the window). At the same time, the window must be designed in such a way that the underlying display is not destroyed if placed under pressure.

The display window shall be designed in such a way that an accumulation of dirt or grime between the glass and the window due to static charging is avoided.

The clearness of the display window may not change (become opaque) due to exposure to climatic factors (neither before, during nor after testing). There may be no permanent changes in the colors shown on the display after the various climatic tests have been performed.

The visibility of the display must be correct when using polarization glasses.

SIM Card Reader / Transflash Card Reader

Insertion and removal of the SIM/Transflash card must be easy to handle. The reader must allow smooth movement, with only marginal play. The reader may not tilt or jam. To prevent incorrect operation, there must be a clear control to show that the card has been inserted properly. The system must tolerate a possible incorrect operation. The card (holder and reader) may not be damaged if incorrectly inserted. If incorrectly inserted, the card must be easy to remove.

Removal during operation of the phone may not lead to damage of the SIM and Transflash card.

Plug System

The plug must be easy to plug in, without noticeable play. The plug must go in straight and may not jam. The patch plug must lock cleanly into place.

An incorrect insertion of the plug (upside down, i.e. 180° flip-over) must be prohibited.

Mechanical stress to the soldering points must be avoided.

I/O connector

All pins of the I/O-connector must withstand a short circuit to 0 V or to any other pin without a remaining impact. This is also valid for the external connectors of the battery pack and the contacts of the whole accessory as well. The inversely polarized feed of external voltages to accessories and / or unit may not lead to a hazard of the customer.

Battery Pack

The battery pack must allow smooth movement, with only marginal play. The pack may not tilt or jam when inserted or removed. The lock may not jam, must be easy to operate and may not show any wear and tear for the life of the unit. All moveable parts must be covered to prevent injury to the user. The battery pack must be designed in such a way that it cannot be inserted incorrectly.

If the housing should be specially designed, the color of all related parts must be uniform to ensure a suitable match.

Camera

An illumination control has to be selected for the image performance (typical mode by default). Blooming, smearing and other effects may not occur in the presence of difficult light situations (illumination control). Any color changes, any image quality reduction and any impairment caused by the LCD or other components are not allowed.

Sealing

The sealing parts shall have no influence to the performance of the functions (key, camera, I/O). The colour and form of sealing parts shall remain over the lifetime.

Lifetime and Utilisation

For the complete life of the phone the following functions of the phone must be guaranteed and must remain preserved without any optically visible wear (excerpt from Standard Test Plan):

Number of cycles for operation elements:

	Operating element:	Number of repetitions:
ME 1.1B	1. Keypad	
	Navigation key:	400,000
	Soft key:	200,000
	Normal key:	150,000
	Side key:	100,000
ME 1.2B	2. I/O connector	10,000
ME 1.3O	3. DC connector	10,000
ME 1.4B	4. SIM contacts	2,000
ME 1.5O	5. Slider	80,000
ME 1.6O	6. Latch in battery	2,000 for normal phones ≤ 30,000 for special application (Flash card inside the battery case or easy access for playing such as e. g. Hermes B1)
ME 1.7B	7. Battery contact	2,000
ME 1.8B	8. Vibrator (trembling)	150,000
ME 1.9B	9. Flash card contacts	10,000
ME 1.10O	10. coax switch for	
ME 1.11O	a) car kit	10,000
	b) production	100
ME 1.15O	15. Removable flash	10,000

Other requirements

- The contrast of the LCD display must not reduce by more than 50% within 5 years.
- The phone housing must be distortion-proof for its service life and resistance against fracture from a certain height (check details within general quality requirements) to a concrete surface.
- No changes of vibrator performance (loudness and vibration) over the lifetime.
- The phone must (with or without a battery) withstand a fall on to a concrete floor in any situation without incurring damage. (check details within general quality requirements)
The battery must withstand a fall from 1.00 m on to concrete or steel.
- The life of the battery under **GSM** automatic/or/ **UMTS** conditions is around 500 charge cycles and within this time the battery performance must not fall below 80% of its nominal capacity.

Sealing parts in the enclosure shall be resistant against surface abrasion.

Scratch proof ness

Tested with hardness tester - Erichsen, model 318 (engraving stylus type Bosch Ø 0.75 mm, speed 10 mm/sec., length 10 mm)

a) Display window with scratch resistance:	10N
b) Dyed granulated material: - löschen	10N
c) Dyed granulated material, polished:-löschen	5N
d) Painted surface:-löschen	7 N

Very faint marks that only change the surface shine are not to be considered as scratches.

IP Classes

IP classes (dust and water resistance) for the product are defined as follows:

Dust / Foreign body - Water resistance	
Cell phone:	IP 50 (in special cases IP classes have to be defined e. g. IP 54)
SIM card reader:	IP 40
External Antenna:	IP 62
Camera	IP 64
Accessories	see section "accessory"

Mechanical, Climatic and Ageing Requirements

Mechanical, Climatic and Ageing Requirements for BenQ mobiles and accessories (test specifications and assessment criteria) are contained in detail in the „Quality Requirements for cellular devices“ (rev. 1.1.1 18.01.06).

Electromagnetic Compatibility, SAR and Others

Standards and additional BenQ mobile requirements regarding EMC, ESD, SAR and other issues are contained in detail in the „Quality Requirements for cellular devices“ (Chapter_7_EMC_2006_01_18).

These requirements include the BenQ mobile requirements for robustness against ESD discharges Mobiles standalone (no ground connection):

direct contact discharge: up to +/- 6 kV (no impact on performance criteria)

air discharge: up to +/- 10 kV (no impact on performance criteria)

Measurement tolerance has to be considered.

11.3 Environmental Protection

Major and detail regulation about this matter is defined in the Chapter VIII: **Environmental Protection Requirements** of the General Quality Requirements.

BenQ mobile AG places great emphasis on the importance of environmental protection. The law is also making greater demands on the recyclables of products. One of the most significant publications in this respect is the “Electronic Waste Regulation”, which prescribes as obligatory the recycling of used electrical appliances. In order to do full justice to these requirements and to our own ecological aims, the following considerations are paramount when dealing with new products:

- The product must be able to be dismantled easily
- No use of welds and adhesives
- A reduction in the variety of materials used
- Avoidance of compound materials
- Marking of plastic parts
- No pollutants must be used
- Recycling/disposal documentation must be drawn up

Requirements of Recycling Process

As we cannot make any safe predictions on the nature of future recycling technology, the following recommendations are based on the trends recognisable today for future recycling technology. In this respect recycling technology requires that old machines can be dismantled, taken to pieces and sorted out into those materials for which reprocessing capacities exist or which have to be taken to depots or incinerators.

Dismantling or taking to pieces of telephones in:

- Electronic/electrical components (assembled FBG, display,)
- Plastics (by type) (housing, ...)
- Cable and leads (coax cable, ...)
- Metal (screws, ...)
- Paper/cardboard (IMEI plate, ...)
- Waste/other (Keypad mat, earpiece, ...)

Recycling Concept

Depending on the structure of the components the requirements on materials must satisfy motor car requirements:

- No use of Cadmium
- No CFCs
- As far as possible components made of polymer materials must be marked (depending on size)
- Emission of organic compounds
- Free from Asbestos
- Marking of the battery pack (Recycling Instructions: don't throw into fire, etc.)

Construction

For a construction sequence, which does justice to recycling factors those operational steps, are important which determine the choice of material and the method of jointing them.

An easy-to-assemble automated construction normally also fulfils the criteria for easy disassembly.

From the point of view of recycling, the rules and basic premises of the standard design and the standard constructional design must be kept and extended.

The following recommendations are a general aid for making sure that when the product is designed and developed, the parts of the newly developed products can be recycled.

For detailed descriptions and information please refer to SN 36350.

General

- As few separate parts as possible
- Avoid material compounding (e.g. sticking together of different materials and laminates)
- Joining and de-jointing wherever possible in one direction
- Guarantee accessibility of disassembly tooling
- Use unified screw heads in respect of type and size

Connections

- Connections should be used which can still be separated easily even after the planned product utilisation life.
- The number of different types of connection should be minimised.
- Standardised connection processes should be selected.
- Self-retaining connection processes (clipping and snapping) should be used.
- In the case of snap connections, one unlocking possibility should always be foreseen. If this is not possible, then the connection should be easy to take apart by knocking.

Materials Selection

- Reduce the number of different materials used
- Only use plastic from the selected or preferred list
- Do not use any materials which are difficult to recycle
- Plastic parts should be marked in line with DIN 54840 or MP-specific regulations (Standard Construction Concept, Sheet 32.1),
- Avoid using material compounding (e.g. injected plugs, sticking of different materials, laminates). If it is not possible to avoid these compound structures, then separating aids should be foreseen, e.g. easy opening points, and these should be included in the User Manual.

11.4 Quality Plan

A project specific quality plan is created and maintained by the QM department. This document contains:

- Checklist of basic failures from former products
- FMEAs (responsible: R&D)
- Environmental Tests (status of device, variants, amount; RD responsible before B2, QM responsible from B2)
- Field trial (status of device, amount)
- Product audit
- Milestone review
- Checklist risk analysis
- Checklist safety instructions in the user manual

11.5 Department PSQA-Plans

Project specific quality assurance plans (PSQA-plans) are defined by the relevant departments and responsible persons are named. These departments are, according to MEP Issue 7.01 Published: 13.07.2005

A PSQA-Plan is mandatory for Radio, EMC, Digital and mixed HW, SW (includes SP-part), Mechanics, Layout Production Data and Production Technology.

The PSQA-plans should contain, amongst others:

- Planning of failure mode and effect analysis (FMEAs)
- Planning of design reviews
- Test plans for components / sub-systems / assemblies
- For the mechanical PSQA-plan: Test plans for environmental testing (shock, drop, climatic factors, aging, etc.) in the mechanical test plan
- For the Electrical and EMC PSQA-plans: Test plans for electrical and EMC tests to ensure compliance with the requirements set out in the specifications for the device and the interfaces

11.6 Product Safety and Technical Risk Assessment

A technical risk assessment for this project will be created until M1 by the Quality department. The technical risk assessment contains, amongst others, acoustic shock, short circuits, charger, battery.

For reasons of product liability, the user must be protected from electric shock caused by voltages applied to the outside of the device or the accessories.

The product and supplied accessories (in the following called only "product") must comply with all relevant international and/or national standards in accordance of the country of distribution.

For Europe the product must comply with all relevant EU directives in order to fulfil the requirements for CE marking.

- 1) The Radio and Telecommunications Terminal Equipment Directive
- 2) Low Voltage Directive (LVD)
- 3) EMC Directive
- 4) SAR
- 5) VDA guidelines (Accessories)

For each of the directive the applicable international harmonised standard(s) have to be applied. National deviations or standards (in case international standards are not existing) in accordance to the country of distribution have to be considered.

Where harmonised standards do not exist, latest technical publications have to be considered.

All requirements for product safety issues is defined by the **chapter IX: Product Safety** of the General Quality Requirement documentation.

Special precautions

- Precautions (mechanical, software engineering) must be taken to prevent danger to or injury of the user through inadvertent switching on of the device.
- Software engineering precautions are to be taken to prevent danger to or injury of the user through an acoustic shock. A separate review must be carried out to ensure that this requirement is met.
- In order to protect the user, ramping has to be activated for all tones and melodies (increase of the sound pressure level from a value below 120 dB SPL to the maximum value in 1.5 seconds or longer). If ramping is not possible (short tones, like signal tones), the sound pressure level shall not exceed 120 dB SPL.
- Alternatively, the user protection may be realized by use of a second speaker at the backside of the phone. In this case, all tones exceeding 120 dB SPL have to be emitted by the second speaker.

All requirements for product safety issues is defined by the **chapter IX: Product Safety** of the General Quality Requirement documentation.

11.7 Product safety and software

- Precautions (mechanical, software engineering) must be taken to prevent danger to or injury of the user through inadvertent switching on of the device.
- Software engineering precautions are to be taken to prevent danger to or injury of the user through an acoustic shock. A separate review must be carried out by R&D-Department to ensure that this requirement is met.

All requirements for product safety issues is defined by the **chapter IX: Product Safety** of the General Quality Requirement documentation.

11.8 Software Quality

Software QA Plan

A Software Quality Assurance Plan will be set in place until M1 that sets out both the general and project-specific requirements and stipulates the quality assurance measures that are to be taken during the development process. Reviews by Quality Management are done on the basis of the currently valid milestone checklists and the stipulations set out in the Software Quality Assurance Plan.

Software Process Code

Software is to be developed in accordance with the Software Process Code (QMS – VA T010 SW-Pro) set out in the Software Project Management Guidelines (currently in the pipeline) and the Software Quality Assurance Process (QMS – VA Q025-MP SW-QA in projects).

11.9 Field Trials

General

This procedure shall be used for BenQ internal products.

Aim and Focus of the Field Trail

- Confirmation of compliance in home and foreign networks. Tests according to GCF AP (GSM Certification Forum - Application Procedure)
- Confirmation of hardware and software quality (ready to be introduced into the market)
- Detection of weak points in the HW construction of the BenQ mobile and accessories, SW errors/bugs by functional tests as well the check of user manual

Realisation

- Dependent on the product specification, GCF Field Trial tests in different GSM and 3G (under clarification with GC Forum) networks will be performed
- End User test with pre-production samples (BENQ MOBILE B2-samples)
- Extended End User with samples from pilot series
- The accessories for the product shall be included in the Field Trial

Technical Field Trial

Tests in GSM 900/1800/1900 and UMTS networks shall be coordinated and performed by QM PV. QM PV will create the corresponded test list.

Time Frame

The basic functionality with the accessory shall be tested and confirmed with B1 samples.

The official Field Trial shall start with the provision of B2 pre-production samples at S3 and shall end with S4 (at least four weeks testing time). The extended Field Trial shall start with the production of the first samples from the pilot series (at least four weeks testing time).

The beginning of the Field Trial shall start under the following conditions:

Hardware

- B2 Field Trial samples are available. Those samples shall have the final layout ready for approval. For the Field Trial it will be taken into account that HW - variants (e.g. alternate display manufacturers) exist. Such different variants shall be available for the Field Trial. The number of samples shall be defined according to Six Sigma tools and dependents on the number of different variants.
- For the extended Field Trial, samples from pilot series shall be made available. The number of samples shall be defined according to Six Sigma tools and dependents on the number of different variants.
- Agreed accessories shall be available for Field Trial
- The Field Trial samples shall have a valid test IMEI
- Access to mobile engineering functions shall be possible
- **Full scope of supply is needed**

To avoid any time delay during the Field Trial phase the following shall be ensured:

- The samples shall have the possibility to record a mobile trace via PC – software (not only in office environment, but also in the field). Necessary HW (e.g. tracing cable, adapted devices with 2nd BFC Bus - connector) and tracing SW shall be made available at S25.
- **The provision of a monitor mode in the mobile shall be ensured**
- **Field Trial samples shall not have a SIMLOCK**

Software:

- The SW shall be stable (frozen).
- All agreed features are implemented and tested. (Note: Implementation of features during the Field Trial phase will lead to re-tests)
- At milestone S3 (prior to the Field Trial), all known errors shall be recorded and evaluated in a review between R&D and Software Quality Assurance. Errors, which hinder the realisation of the Field Trial, shall be closed.

To avoid any time delay during the Field Trial phase the following shall be ensured:

- During the Field Trial phase, the SW of the BenQ mobile shall be upgradeable also outside the factory (e.g. BENQ LG's). The necessary SW tools + HW (upgrade cable) shall be made available to QM PV at S25. QM PV shall have at least limited EEPROM read/write access (SW exit codes etc.)
- Any SW feature implementation, which leads to the need of a SW update which can not be done in the field (e.g. re-writing the IMEI because of implementation of security features) shall be implemented prior to the start of the Field Trial.

Engineering equipment:

The following equipment shall be made available to BenQ MD QM PL PV:

Description	Number	Date
BenQ mobiles (B1) including charger (The voltage range of the charger shall include AC220-240V; 50/60Hz or if applicable AC100-120V; 50/60Hz. A plug adapter for standard European socket outlets – if necessary – shall be available). (Note: Those samples are needed to test the Tracer SW, SW upgrade etc. prior to the Field Trial)	-	S25
Tracer Software	-	S25
Tracing Hardware (cable)	Ref. PV plan	S25
Tracing Hardware (adapted devices; 2 nd Bfc Bus connector)	Ref. PV plan	S25
Mobile – Boot Configuration (e.g. Upgrade cable if different from tracing cable, service box etc.)	Ref. PV plan	S25
SW upgrade tools (e.g. SWUP, Initialisation tool)	-	S25
External Antenna (possibility to connect the mobile to a CMD)	-	S25
Access to SW and HW – error tracking database	-	S25
Others: Overview to the planned SW “standard – variant” (Documentation)	-	S3

It shall be ensured that those engineering equipment can be used during the whole Field Trial phase (no changes after S25).

Performance aspects covered by Field Trial (Overview)

The following general functions and aspects of the mobile phone shall be tested during the GCF and End User Acceptance Test. For the End User Acceptance Test a questionnaire shall be prepared and evaluated.

- Basic handling, including set up, clear and in-call functions
- Cell selection and reselection
- Automatic & manual PLMN selection
- Handover
- Operation of each basic service, supplementary service and features within the scope of GCF and which is supported by mobile. (fax / data services / GPRS). For speech it includes a degree of subjective speech testing sufficient.
- SMS (MO – PP, MT – PP and CB)
- Interworking with different SIM cards (using different types of SIM/card / profile)
- Interworking with agreed accessories
- Review of user manual
- HW Construction of the mobile phone

Documentation

SW / HW - errors from the Field Trial will be recorded in the relevant error tracking data base (e.g. Clear quest for SW; equivalent HW tracking data base).

At the end of the official Field Trial, a summary report shall be prepared.

The successfully finished Field Trial is the basic for the milestone S4.

Quantity Planning Pre-Validation

For the Pre-Validation a quantity of **20 pcs of B1+** samples is needed

Quantity Planning GCF

For the GCF Field Trial a quantity of **25pcs of B2** or newer samples is needed.

Quantity planning customer acceptance test

For the End User Acceptance Test a quantity of **180pcs** of B2or newer samples for field trial mobiles is needed:

Reference for detail planning is the PV plan. This must be finished before M1.

Field trial quantity definition:

GCF	Reference PV plan
EMEA	Reference PV plan
Customer Acceptance	Reference PV plan
SWAP	Reference PV plan

Total: max. **200pcs** (check detail planning in PV plan)

Mobile devices have to be available latest 2 cw before start of field test (End user test / GCF)
quantity has to be divided into available HW-Variants (variants not yet available)
complete selling volume is needed

Remarks

- **all mobiles need the same boot-kernel**
- **all mobiles have to be signed with the Field Test key**
- **all mobiles have to be without any kind of SIM lock**
- open BF Bus
- Information about booting and tooling
- Delta Description for new software versions within GCF FT Certification
- GCF HW and SW delta description from System Test in case of follower declaration
- Evaluation for GCF FT start with SVN from SW PQA
- New software has to be available latest until Friday 09:00h (weekly)
- Access to developer drives
- Actual SW has to be available as *.exe file by start of validation (update via data cable)
- Change of blocks, e.g. new NF parameters, have to be available also as *.exe files
- It is not possible to update mapping files global
- Development environment is not global wide available
- Delta map file (e.g. BRD-Handel) should be available before shipping

Customization

Customization will be tested within End user test. We're able to perform tests in countries and networks we support with field test activities.

Information and tooling (sw tools, test list etc.) should be available latest 2 weeks before pre-validation starts.

Accessory

Accessory field test will be performed in parallel

Accessory has to be available 2 weeks before start of field trial

Realization

The Pre-validation will start at the beginning of April 2004 (agreed with Andreas Betting) with the aim of supporting the SW development. It will end with the beginning of the customer acceptance test. The customer acceptance test will start with a maturity (SW) of S3 and B2 HW. It will take at least 5 weeks. The GCF field test will start with a maturity (SW) of S3 and B2 HW. It will take approximately 3 weeks of testing (incl. GCF report)

11.10 Requirements for Product Audit

If no antenna connector is accessible for the Product Audit, an antenna tube must be made available for measuring purposes at the Product Audit.

- The responsible department for the developing of this antenna tube must be the RD (the Product Audit has only the possibility to support the RD)
- The coupling between mobile antenna and coupling antenna must be $< 12\text{dB}$
- Reproducibility TX $\pm 0,3\text{dB}$
- In case of different RF-chipsets (e.g. Hitachi/ Infineon), it must be possible to use the tube for both variants
- With the antenna tube, it must be possible to test all items of the Product Audit (excluding spurious emissions). These test items are contained in a separate file which is available to RD.

11.11 Requirements for Outgoing Inspection

A Device Check must be implemented in the software based on the implemented feature set and the current requirements for the factory's outgoing inspection and box opening.

11.12 Robust Development

The phone will be developed using the Robust Development Process with RPD modules and targets as described in the RPD scorecard. The RPD process will be regularly monitored.

11.13 Field Return Rate

Return Rate S/S Class over LC $\leq 13,0\%$ (based on 24 month warranty) high class

Calculated return rate for DS : 6,6% HW // 9,0% SW plus 1.5% related to Antenna

Calculated return rate for S4 : 5,9% HW // 5,2% SW

The calculated return rate can be change, if the monthly delivery quantity will be updated.

11.14 Quality of Suppliers and Components

The frequent supplier qualification and evaluation will be done by R&D, Sales, QM and SP. The quality regulation for all preferred supplier is covered by a Quality Assurance Agreements (QAAs). Standard quality targets (e.g. FIT, MTBF) is defined by the Siemens SN 72500 until BenQ has defined new regulation.

The control of component qualification and unlimited release is documented in the SQA plan for each single component. Special test requirements and exceptions from the general regulation is defined in the TTD (technical terms of delivery)

Each single component must be qualified, to reach unlimited release and to declare the S4 milestone. The minimum requirement for the component qualification is the reliability of each component during execution of the general quality requirement testing of a complete mobile/device.

To guarantee at least the 24 month reliability for BenQ products, the target for reliability testing must be defined in such a manner, so that in general no field returns are expected.

The definition of the product related component quality requirements and testing is in control of SD QM and must be aligned with the "General Quality Requirements Chapter 1 to 9".

11.15 Quality in Production

Required Quality in Production

The medium and long-term aims of QA Production are a continuous improvement in the through-flow rates and Q numbers in the production processes.

To achieve these targets the essential factors are qualified processes with Cpk values larger than 1.33, batch tolerant switching, simple assembly concepts, a reduction/standardisation of the parts (phone, ac-

companying packs). In the early developmental stage the pre-requisites should be planned by the departments concerned in order to achieve quality benchmark figures and in the course of the developmental process these should be checked for their effectiveness.

The quality key figures shown in the table are target values that are defined at the beginning of each business year. They are mean values over all products. In the future, detailed target values for different segments might be set.

Reference table :

Required Quality in Production : this is defined by the document :

"Target Agreement Quality Key Figures MP-Production FY 05/06 All Plants" of SCM TLM/QM

Quality key figures A/C/M	unit	FY 02/03	FY 03/04	FY 04/05	target 05/06
Test process					
first pass yield board test	[%]	**	**	95,0	≥ 96,0
first pass yield system test	[%]	**	**	98,6	≥ 98,75
first pass yield camera test	[%]	**	**	*	≥ 99,0
first pass yield customer test *	[%]	**	**	93,9	≥ 96,0
first pass yield customer init	[%]	**	**	98,8	≥ 99,0
Delivery process					
Outgoing inspection/mobile	[dpm]	1200	400	500	≤ 500
Outgoing inspection/delivery center	[dpm]	2600	800	500	≤ 500
* FY 04 / 05 camera and customer test multiplied					
** key figures not existing					
FY 04 / 05 OGI values for all product groups					

As targets agreed

KLf, October 2005

Schmid, BM PHE SCM TLM

Amann, BM PHE SCM QM

Quality Benchmark Figures Data source ICM MP CCQ QM SC

NPI requirements

Requirements Set for Electric Specifications for Mass Production Variability of parameters to be balanced

mena +/- 3σ

Receiver sensitivity (all channels, without fading):

GSM < -104dBm

PCN1800/1900 < -102dBm

Transmit output power (all channels)

GSM >31.5dBm

PCN1800/1900 >29.4dBm

Transmission phase distortion

GSM / PCN 1800/1900 <3.8°

AF signal-to-noise ratio

-S/(N+D)>20dB measured at the receiver capsule at a nominal sound pressure of 94dbspl (1Pa) at 1kHz.

11.16 Deviations from Agreed Quality Level

Any deviations in quality which may occur and the decision as to whether these are to be accepted shall be made by Product Marketing, Business Administration,

12 Type Approval Onyx

12.1 Regulatory requirements - Overview

12.1.1 European Community

GSM and UMTS terminals are under the scope of Directive 1999/5/EC, Radio Equipment & Telecommunications Terminal Equipment (R&TTE). Directive 1999/5/EC is the overall framework for radio equipment and telecommunications terminal equipment for all countries in the European Community (EC) and defines requirements for:

- Health and safety aspects
- EMC aspects
- Spectrum usage aspects

12.1.2 Outside Europe

For North America and other countries outside the EC, the technical requirements are almost identical to those applied in the EC. Additional requirements are listed in the requirements matrix.

China / APAC Variant are up to now not planned and not inside M1 contract, will be handled via CR.

12.2 Voluntary requirements - Overview

12.2.1 GCF

The scope of GCF is terminal network interoperability + additional Application Enablers under running introduction as controlled by GCF SG.

12.2.2 PTCRB (not required for Onyx)

The PTCRB requirements are defined in the current version of the NAPRD. PTCRB is required for customers roaming into the networks of operators part of the PTCRB group (North America)..

12.2.3 Additional voluntary requirements

Besides regulatory requirements and GCF/PTCRB requirements, the terminal shall comply with some further supplementary, "voluntary" certification schemes e.g. Bluetooth Qualification as described in the requirements matrix.

12.3 Requirements Matrix

12.3.1 Regulatory requirements

Aspect	Region			
	Europe		US (& Canada)	
	Mandated by	Technical requirement	Mandated by	Technical requirement
Health and safety	R&TTE Art 3.1.a	Health aspect: Specific Absorption Rate (SAR) EN 50 360/361: 2001	FCC	FCC SAR Regulation OET 65
		Safety aspect: Electrical safety EN 60 950-1: 2001	-	-
EMC	R&TTE Art. 3.1.b	EN 301 489-1: V1.4.1 EN 301 489-7: V1.2.1 EN 55013:2001 EN 55020:2002 EN 55022:1998 IMT2000 UTRA FDD: EN 301 489-24: V1.2.1 Bluetooth: EN 301 489-17: V1.2.1	FCC	FCC Part 2 FCC Part 15 FCC part 22 FCC Part 24
Radio Spectrum	R&TTE Art 3.2	GSM: EN 301 511:V9.0.2 IMT 2000 UTRA FDD UE: EN 301 908-1: V2.2.1 EN 301 908-2: V2.2.1		
		Bluetooth: EN 300 328: V1.6.1 (EN 300 440-2) ¹ : V1.1.1		
Special requirements	R&TTE Art. 3.3	None specified for Europe at the moment. IMEI security is discussed	FCC	TTY: Cellular text Telephone Modem according to 3GPP TS 26.226 TS 26.230 TS 26.231
				5-key nob
				USA FCC Wireless E911 Rules
				HAC: ANSI C63.19

Approval for Canada (Industry Canada, IC) will be done jointly with FCC approval.

¹ Conformity to this requirement is not a must but helps to prevent extra declarations for France.

12.3.2 “Voluntary” requirements

Aspect	Certification planned for Onyx	Specified by	Technical requirements
Mobile <-> Network Inter-operability	Yes	GSM and UMTS: Global Certification Forum (GCF)	GCF-CC Database Field Trials IOP testing
Mobile <-> Network Inter-operability	No	GSMNA	PTCRB NAPRD.03
Mobile <-> Network Inter-operability and the Application Enabler MMS.	Yes	During 2005 the Application Enablers browsing, streaming, video telephony, IMPS and Java, etc., might be included in GCF	GCF-CC
Bluetooth functionality ²	Yes	Bluetooth Special Interest Group (BT-SIG)	Bluetooth Qualification Program Reference Document V1.0 (During 2005 v2.0 could be applicable)
WAP functionality	No	OMA / The Open Group	WAP Certification and Testing Process
OpenWave Browser	Yes	OpenWave	Browser Compliance Verification
USB functionality	Yes	USB Implementers Forum (USB-IF)	USB Compliance Program
Network Selection from SIM Card Preferred List	No	TIM	TIM Proprietary specification
CTIA	No	CTIA	CTIA GSM-1900 Terminal Unit Certification Program Management Document
Sync ML (OMA DS&DM)	N (voluntary)	OMA / Data Sync (DS), Device Management (DM)	
Java (Engine)	Y (mandatory)	Sun	
MMS (OMA)	N (voluntary)	OMA / MMS	
IMPS (Instant Messaging and Presence Services) (OMA)	N (voluntary) mandatory if we want to use the Wireless Village Logo	OMA / Wireless Village	

12.4 Regulatory requirements - detailed

12.4.1 Health aspect

Health is an integral aspect of Article 3.1.a of EU Directive 1999/5/EC.

Specific Absorption Rate is subject to regulatory approval. Harmonised Standards for SAR; i.e. EN 50 360 is available and can be used for demonstrating compliance to R&TTE.

² R&TTE aspects regarding Bluetooth are mandatory

Relevant harmonized standard for article 3.1a)	Version	Purpose	Date of cessation of presumption of conformity
EN 50360	2001	Requirements for mobile phones for human exposure to EM fields	---

In addition to demonstrating technical compliance it is required to disclose actual SAR values to the public by means of a company WEB page.

Health aspects are handled by FCC in US.

The FCC has continuously further developed SAR limits to include requirements for e.g. Body-worn configurations reflected in FCC OET65. Within EU, standardisation of requirements for Body-Worn configuration is still ongoing as of Feb 2005. International standardisation is focused on IEC 62 209. SAR values for US are made public available at FCC Website. In addition, both FCC require detailed wordings to be included in user manuals..

12.4.2 Safety aspect

Safety for stand-alone terminals operating at a few Volts is a new aspect introduced by Article 3.1.a of Directive 1999/5/EEC in EC.

EN 60 950 is the corresponding Harmonised Standard applicable within the EC.

EN 60 950 concerns:

- Protection against electrical shock and hazards
- Protection against thermal rises
- Resistance to heat and fire

Relevant harmonized standard for article 3.1a)	Version	Purpose	Date of cessation of presumption of conformity
EN 60 950-1	2001	Safety of information technology equipment	---

National standards for other regions e.g. AS 3260 for Australia and UL1950 for US are all based on IEC 950, from which also EN 60 950 is derived.

Compliance to safety regulations includes flammability requirements for plastic materials documented by corresponding UL File Listings (Yellow Cards) and Certificates of Conformity with all deliveries. PCBs as well as batteries need to be UL recognised.

12.4.3 EMC aspect

EMC is an integrated requirement of Directive 1999/5/EEC, identified as an essential requirement in Article 3.1.b.

12.4.3.1 Harmonised Standards for EMC aspects

Updated information's on Harmonised Standards for EMC can always be found at the European Commissions website:

<http://europa.eu.int/comm/enterprise/newapproach/standardization/harmstds/reflist/emc.html>

Relevant harmonized standard for article 3.1b)	Version	Purpose	Date of cessation of presumption of conformity
EN 301 489-1	V1.4.1	common requirements for a large range of product types	11.08.2008
EN 301 489-7	V1.2.1	specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range	---
EN 301 489-17	V1.2.1	specific requirements for short-range devices; i.e. Bluetooth functionality	---
EN 301 489-24	V1.2.1	specific requirements for UMTS FDD terminals	---
EN 55020 A1: 2003 A2: 2005	2002	FM Radio receiver – Immunity aspects	---
EN 55013 A1: 2003	2001	FM Radio receiver – Emission aspects	---
EN 55022 A1:1995 A2:1997	1994	Information Technology Equipment – radio disturbance characteristics (e.g. for A-GPS)	01.08.2007
EN 55022 A1:2000 A2:2003	1998 2000 2003	Information Technology Equipment – radio disturbance characteristics (e.g. for A-GPS)	---

For US, the FCC, who is in charge of radio spectrum management, handles the EMC aspect. The corresponding technical requirements are defined in FCC Part 2, Part 15, Part 22 and Part 24. Separate EMC testing and certification is mandatory in US.

The FCC EMC requirements only concern emission. No immunity requirements are applied in US.

HAC – “Hearing Aid Compatibility”: With order from August 2003, the FCC requires major handset manufacturers to bring at least two phones supporting HAC on the US market. The transition period will exceed in August 2005 for EMC requirements (reduced emissions, ANSI C63.19 rating “U3”) and one year later for additional telecoil-coupling (“UT3”). Detailed information is available at the FCC website.

12.4.4 Radio Spectrum usage aspect

Directive 1999/5/EC identifies in Article 3.2 radio spectrum usage as an essential requirement because radio spectrum is a limited resource.

Information of ETSI about harmonized standards:

<http://portal.etsi.org/erm/cta/R&TTE/rte.asp>

Updated information's on Harmonised Standards for R&TTE can always be found at the European Commissions website:

<http://europa.eu.int/comm/enterprise/newapproach/standardization/harmstds/reflist/radiotte.html>

Information about TFES and planned dates for harmonized standards for IMT2000:

<http://portal.etsi.org/msg/TFES.asp>

Other ETSI (EN) Documents can be downloaded via:

<http://pda.etsi.org/pda/queryform.asp>

The status in the ETSI work program (planned publication etc) can be obtained from:

<http://webapp.etsi.org/workProgram/SimpleSearch/QueryForm.asp>

Detailed information can be derived by adding the Work Item ID (WKI) in the link, e.g. 13302 for EN 301 511 V9.0.2.

http://webapp.etsi.org/workProgram/Report_Schedule.asp?WKI_ID=13302

12.4.4.1 Harmonized standards for GSM article 3.2

Relevant harmonized standard for GSM article 3.2	Version	Purpose	Date of cessation of presumption of conformity
EN 301 511	V9.0.2 WKI_ID=13302	Specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range including EGPRS and pointing to TS 151 010.	---

12.4.4.2 Harmonized standards article 3.2 for IMT2000 UTRA FDD UE

Relevant harmonized standard for IMT2000 UTRA FDD UE article 3.2	Version	Purpose	Date of cessation of presumption of conformity
EN 301 908-1	V2.2.1 WKI_ID=15002	common requirements for IMT2000 (Release 2)	---
EN 301 908-2	V2.2.1	IMT2000 UTRA FDD UE (Release 2)	---

12.4.4.3 Harmonized standards article 3.2 for Bluetooth

Relevant harmonized standard for Bluetooth for article 3.2	Version	Purpose	Date of cessation of presumption of conformity
EN 300 328	V1.6.1	Short range device ISM 2.4 GHz	---
EN 300 440-2	V1.1.1	Short Range 1-40GHz Conformity	---

		to EN 300 440-2 is not mandatory but helps to prevent extra declarations for France.	
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For US, the FCC handles radio spectrum aspects. See EMC section above.

12.5 Special requirements

12.5.1 European Community

Directive 1999/5/EEC provides in Article 3.3 several options to include further special requirements concerning:

- Network inter-operability / support for certain network interface connecting points.
- Avoiding harm to the network and degradation of service.
- Safeguards to ensure personal data and privacy of users and subscribers.
- Support of certain features to avoid fraud.
- Support of certain features ensuring access to emergency features.
- Support of certain features to facilitate terminal usage by users with a disability.

By March 2005, no such requirements are defined under Article 3.3 in EC, but inclusion of IMEI security is under heavy discussion.

12.5.2 US

12.5.2.1 TTY (not included in Onyx feature list)

For US, there is a special requirement under Telecommunications Act Section 255 regarding terminal usage by users with a disability. Deaf, hard of hearing, and speech-impaired persons have been using specific Text Telephone (referred to as TTY in North America) equipment in the fixed network for many years to transmit text and speech through ordinary speech traffic channels. Modern digital cellular systems, however, do not provide satisfactory character error rates for text transmitted in the speech channel with the traditional modulation developed for the fixed network. The FCC under the US Government has required an urgent solution for all emergency (911) calls for one specific text telephone protocol called *Baudot Code*.

The standardisation of Cellular Text Telephone Modem takes place within 3GPP. The corresponding technical requirements are defined in

- 3GPP TS 26.226: General description
- 3GPP TS 26.230: Transmitter Bit Exact C-Code
- 3GPP TS 26.231: Minimum Performance Requirements

These special requirements are mandatory as of January 1, 2002. However, a manufacturer fulfils these special requirements if the manufacturer has at least one product supporting TTY on the US market.

12.5.2.2 5-key nob

To ease blind people's use of cellular telephones, a special nob shall be located on the 5-key or just below the 5-key. The nob shall be easily detectable and durable.

12.5.2.3 USA FCC Wireless E911 Rules

For US, the FCC has adopted revisions to USA FCC Wireless E911 Rules according to 3GPP TS 22.071 Annex B. Location of Emergency Calls can be provided by different means. This area is subject to further standardisation.

12.5.2.4 Hearing Aid Compatibility (HAC)

For US, the FCC have adopted revisions to FCC rules providing mandatory support of HAC in cellular phones for the US market as of Aug 2005/Aug 2006.

The corresponding technical requirements are not stable as of February 2005.

12.5.3 IMEI Security

For PTCRB the manufacturer has to confirm IMEI security by “a letter certifying sound engineering practices in securing the IMEI in accordance with 3GPP TS 22.016, section 2. All terminals must comply by June 1st, 2002”.

For GCF IMEI security as specified in the relevant core specification is also required.

12.5.4 Inter-operability

In EC, inter-operability requirements are removed from the regulatory requirements. See above for special requirements under Article 3.3 of Directive 1999/5/EC.

By contrast, this is not the case for US. GSMNA have set up the PCS Type Certification Review Board (PCTRB) and entitled PCTRB to undertake type approval matters including inter-operability aspects for US.

12.6 Voluntary requirements - detailed

12.6.1 Global Certification Forum

The Global Certification Forum (GCF) is dealing with the verification of terminals against the GCF's technical requirements with global recognition and acceptance of results to ensure interoperability between terminals and networks as well as interoperability of application enablers.

In the scope of GCF are GSM terminals operating in the 900/1800 MHz bands and UMTS FDD terminals operating in UMTS FDD band I.

GCF is providing a common set of certification criteria for the following areas:

- RF
- Protocol,
- SIM/SAT/USIM,
- Audio
- Application enabler e.g. Multimedia Messaging Service (MMS).

Certification criteria for further application enablers Video Telephony (VT), Push-to-talk over Cellular (PoC) 1.0, and Instant Messaging (IMPS) 1.0 are likely to be included into GCF during 2005 or early 2006.

The corresponding technical requirements are defined in:

- GCF–CC: Certification Criteria
- CC data base at <http://gcftech.org>

Note: Registration is needed to access the GCF–CC data base.

New certification criteria are continuously added as new features and services are introduced in the GSM and UMTS FDD networks. Compliance can be demonstrated by conducting tests in test laboratories using validated test cases running on commercially available test equipment.

In addition there are requirements for Field Trials. Field Trials have to be performed on live networks and are intended to cover dynamic scenarios, which can not be performed in laboratory environments. Field Trials shall be performed in at least five network configurations per supported band, representing infrastructure implementations from all major suppliers.

Furthermore, a GCF certification declaration shall be accompanied by a list of 3GPP core specifications and its corresponding versions which have been the basis for the implementation of the terminal. Thus, GCF requires that the terminals design and its implementation shall be based on core specifications.

A detailed description of the principles and procedures of GCF is given in

- GCF–PD: Principles Document
- GCF–AP: Application Procedures
- GCF–AD: Abbreviations and Definitions
- GCF–OP: Operating Procedures
- GCF–OB: Operating Budget

The latest versions of the above mentioned documents are available at the GCF web site at <http://gcf.gsm.org>.

Note: Registration is needed to access the GCF–CC data base.

12.6.2 PCS Type Certification Review Board

PTCRB is in principle the US equivalent to GCF.

In the scope of PTCRB are GSM terminals operating in the 850/1900 MHz bands and UMTS FDD terminals operating in UMTS FDD band II.

Technical and procedural requirements are given in the permanent reference document NAPRD.03. The latest version is available from

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PTCRB type certification is based on GSM specifications with modifications per North American Standards and additional requirements from FCC rules, or any other government agency that may have jurisdiction and/or competence in the matter.

In principle PTCRB is a voluntary certification scheme. However, it may be possible that in the US roaming of terminals without PTCRB certification is rejected by individual US network operators.

12.6.3 Bluetooth functionality

Bluetooth is standardised by Bluetooth Special Interest Group (SIG). SIG also specified the Bluetooth Qualification Process. Bluetooth functionality of terminals shall be qualified following the provisions of Bluetooth Qualification Program Reference Document.

The PRD specifies the framework of the qualification process. The details, such as the forms, templates, and checklists used to support this process, are provided in companion documents, which are referred to by the PRD, and/or are accessible using hyperlinks imbedded inside the PRD. Apart from these resources, supplemental information is available at the Bluetooth Web Site, including answers to frequently asked questions (FAQ).

A number of Profiles exists for various Bluetooth functionalities. Specific test suites apply to Profiles.

12.6.4 WAP functionality

WAP is standardised by Wireless Application Protocol Forum. Testing and Certification of WAP devices are undertaken by The Open Group (TOG).

TOG is not a member of WAP Forum, but contracted to develop and maintain application layer test suites and to operate the certification programme on behalf of WAP Forum as Certification Authority.

A more detailed description is given by The Open Group.

12.6.5 USB functionality

The Universal Serial Bus is specified by USB Implementers Forum. Corresponding test requirements are defined in USB Compliance Program. More detailed information on USB is available at www.usb.org

12.6.6 Network Selection from SIM Card Preferred List

This requirement solely applies to TIM, Italy.

The purpose of the test is to check, that a Ph2 GSM terminal equipped with a non-empty SIM card Preferred List, selects a network in an International Roaming scenario, according to Core specification GSM 03.22. The test specification is available at \\AALAFS2\APPL\$\SPECS\TIM\Tim_Netw_select.pdf

12.7 Terminal marking and labelling

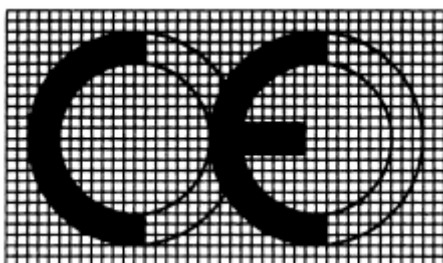
With reference to 1999/5/EC Article 12 and Annex VII a range of mandatory marking and labelling requirements are hereby defined.

Markings shall be visible for inspection without the need for tools.

The size of the IMEI label shall be large enough for all needed signs, numbers, etc. (e.g. IMEI, CE sign, FCC ID).

Requirement basis	Corresponding marking
R&TTE Directive 1999/5/EC	Terminals using harmonised frequency bands only: ³ CE + Notified Body Identifier
	Terminals using non-harmonised frequency bands: CE + Notified Body Identifier + Alert symbol (!)
	Siemens Type Designation
	Serial Number / IMEI in bar-code format and writing
	Manufacturer Name
FCC	FCC-ID number Country of Origin
IC	Canada ID
Additional	Siemens stock number
CCC	CCC label is mandatory for China (MII)

12.7.1 CE marking layout and requirements



³ Bluetooth transmitters below 10mW transmitted power are handled as harmonised frequency bands.

The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the apparatus.

The CE marking must be affixed to the terminal or to its data plate. Additionally it must be affixed to the packaging, if any, and to the accompanying documents.

The CE marking must be affixed visibly, legibly and indelibly.

Notified body Identifier and the equipment class identifier, (e.g. !) if applicable being part of the CE marking need to be put on the packaging and in the manual.

12.7.2 Notified Body Identifiers

Typically used Notified Bodies and corresponding Identifiers

Notified Body	Identifier
BABT	0168
Cetecom ICT	0682

12.8 User Guide

With reference to 1999/5/EC Article 6.3:

The User Guide shall contain information on the intended use of the terminal e.g. supported GSM frequency bands. Where non-harmonised frequency bands are used, any geographical restrictions for its use shall be clearly identified within the User Guide.

The User Guide shall furthermore address a range of FCC and US legal requirements, in particular warnings.

12.9 Variant Overview

Requirement	Onyx EMEA (900/1800/1900/FDD 2100)
R&TTE	X
FCC / IC	X
PTCRB	Not requested
GCF	X
CCC (MII China)	Not inside M1, CR will be raised
TTY	Not supported
HAC	Not supported
IMEI Security Declaration	X
5-key nob	X

TTY and Hearing Aid Compatibility (HAC) are not supported by Onyx.

12.10 Additional Systemtest requirements

12.10.1 Interfaces

12.10.1.1 50 Ohm RF Interface

The phone needs a 50 Ohm RF interface for approval testing. The interface can be realized by a coax test connector, which is accessible and mechanically suitable for approval testing or by an RF cable with same properties (other Siemens mobiles solution). The related GSM specification is 3GPP TS 51.010-1 Annex A.

For Onyx, the RF interface is realized by a 50 Ohm Hirose-connector (accessory interface).

12.10.1.2 BFC/RCCP Interface

For remote control during type approval testing (FTA "Automode", Rf-Performance-Testsystem, remote control), the mobile supports BFB, BFC (or equivalent → this is the QLib for the Qualcomm chipset) and AT-C/RCCP commands via serial interface for basic call procedures and GPRS testing. GPRS should support an "auto attach mode". Basic functions are at least: - switch on and off the mobile, - start the chip card simulation, - simulate key presses on the keypad for originating and accepting a call including dialling a number.

The serial interface has to be of RS232 type but with voltage levels fitting those of the "Bootadapter200x", same as used with Infineon chipset and the BFC or Wolf5.

If the BFB library is replaced by BFC, in principal the same functionality (remote control) for the mobile has to be provided. For the Qualcomm chipset the so called QLib is provided by Qualcomm realizing similar functionalities as the BFC for Infineon chips. The functionality of the QLib shall be supported by the mobile firmware.

For the Onyx these functionality has to be provided in a way which can be implemented in the Test machine setup of System Test.

13 Milestones

ONYX Milestones				
	Plan	CW	Status	Date
M0	23.12.05		done	09.01.06
S0 Design Freeze	19.01.06		done	16.02.06
M1	17.03.06		done	17.03.06
S15	12.04.06			
S2	08.06.06			
S25	21.07.06			
S3-SW	06.10.06			
S3-HW	24.08.06			
Start TA	15.08.06			
DS	20.10.06			
S3	06.10.06			
S4	21.12.06			
M3	21.12.06			

14 Miscellaneous

14.1 Technical Risks

For major risk assessment see separate document “*ONYX List of risks M1.xls*” within the M1 folder

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14.2 Packaging/User Manual

The packaging will be printed in several colours and consists of the packaging itself and an insert. Packaging will be printed with the CE symbol and for customers in Germany with the “green point” in the selected colour. It is intended to do the packaging in the format (233x156x64)mm. The carton will contain a folding base which is self-erecting.

The supply package shall contain:

- Packaging for the phone
- BenQ mobile ONYX phone including battery cover
- Battery pack
- Desktop shell inclusive charging unit
- Stereo wired headset with volume keys
- User Manual (up to 4 per supply unit)
- CD

14.3 Economic Product Plan

The EPP (WPP) is available at ???

14.4 Patents

Patents are not going to be violated and the lettering of the "Innovation Patent" is no longer required.