

Performance Description (LB)

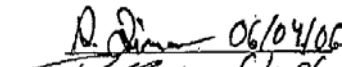
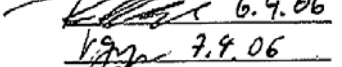

Chameleon

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Project specific references

No.	File	Revision	Issued
[1]	SACD SABD X75	1.0	21.12.2004
[2]	Accessory Encryption	-	20.01.2004
[3]	AD Portfolio CHAMELEON 2005-04-29		30.03.2006
[4]	Ordering AD Development Samples - Process Description	0.2	27.01.2006
[5]	Audio Processing Mobile Phones - Accessories	1.0	13.02.2006
[6]	Hardware Interface Specification NANO IO	1.5	16.03.2006
[7]	Global 85 AD Samples Orderlist		27.03.2006
[8]	RF-BB-interface spec B6PLA 241105.doc	1.0	16.07.2004
[9]	PF09039B PA spec proposal V04.pdf		
[10]	Technical Service Requirements		
[11]	General Quality Requirements	1.1.1	21.06.2006
[12]	Chameleon Steckbrief	3.5.2005	1.0
[13]	X95 Feature List.xls	X75_SW_FeatureList V41.10	29.03.2006
[14]	Chameleon PD team protocol	V 08	05.4.2005
[15]	Chameleon Risk Assessment M1		
[16]	Chameleon_M1_document_V1.1_komp.ppt		

General References

- General Quality Requirements (Rev. 1.1.1, 2006-02-21)
- CENELC, SC211/B, WGMTE (2nd draft, Rome, Feb. 1996, 3rd draft, Zurich, April 1996)
- ETS 300 019-1-0 / ETS 300 019-2-7 (Environmental Requirements)
- ETR 051 (Human Factors - Basic Requirements) and ETR 166 (Evaluation Methods)
- IEC 68 ff. (Environmental Requirements)
- DIN 40050 (Climatic Conditions and Protection Classes)
- DIN 40839 (Line-Connected Disturbance Variables Impacting On-Board Networks of Road Vehicles)
- Low-Voltage Guidelines 73/23 EWG (revised in 93/68 EWG)
- VDA Recommendations
- EN 1811 Reference Testing Procedure for Nickel releasing Products in Prolonged Direct Contact with Human Skin
- Laser Guidelines IEC 60825
- DIN EN 22248 Packaging; complete, filled transport packages; vertical impact test by dropping
- SN 47030-1 Molded plastics; thermoplastic molding materials; Siemens-item-numbers
- SN 27650 Testing of Paint Coatings and Similar Coatings; Test for Abrasive Strength
- EN ISO 2233 Packaging. Complete, filled transport packages. Conditioning for testing
- SN 36350-1 Environment Compatible Products; Part 1: Guide for product development
- USB – Specification Revision 2.0
- DIN VDE 0470 (IP classes - 53/54; German version of EN 60 529)
- R&TTE 99/5/EC Guidelines for Telecommunications Terminals

Supplementary Documents for PCS 1900

- IEEE C95.1-1991 Standard for Safety Values for Electromagnetic Fields
- EIA / TIA 571 Environmental Aspects for Telecommunications Equipment
- EIA / TIA 136, 136A, 136-270B (TDMA)
- Safety Requirements as per CSA 22.2 No.950-95 (UL 1950)

1 General

1.1 Design

Design

Chameleon has one design variant. For the variant ID concept and the end customer the frontcover of the slider can be exchanged with two screws..The different operator logos can be printed into the IMF foil of the frontcover. Product name is also part of the backside printing of the front cover. A logo printed (e.g. operator logo) on the battery cover is not feasible for the soft touch lacquered cover and on the real application battery cover.

Materials and Finishing

Materials/technologies used include PC-ABS for Slider Front Cover, Antenna carrier, base front cover, battery cover. PMMA flat sheet display lens (scratch protection on the top and a small printed frame on the backside). Magnesium for the Slider Lower Case. Hardcaps with silicone for the numeric keypad in the Base (painted, laser etched). Function keys in the Slider are split into two different technologies: Integrated into the Front Cover for soft key and send end key, centre key partly galvanized, PC-ABS for the 5-way Navigation key, lacquered PC-ABS cap for the centre push button. Side keys are galvanised PC-ABS

Colours

Color variants are not finally decided. Base front cover will always be silver NCVM decorated; slider keypad will always be the same color, base keypad will always be silver lacquered, camera ring will always have the same artwork and design.

1.2 Key Features

- Changeable front cover, battery cover also in real material variants
- Bright QVGA display, 2' / 262,144 colours / (indoor & outdoor readability)
- Built in FM-Radio
- State-of-the-art feature set (video function, 1,3 Mpix camera, LED flash, audio capability, MicroSD card slot optional, Bluetooth,)
- Battery Li-Ion 730 mAh
- Talk Time depending on Network Situation 6,3h - 3,4h - 2,8h
- Standby Time in Idle depending on Network Situation 360h - 310h - 210h
- Network Type Tri-Band (900/1800/1900)
- Connectivity Bluetooth, USB

For details please see the "Steckbrief" [12]

1.3 Comparison with Previous Products

Story Predecessor: Swift/Hydra
Technical Predecessor: Swift/Obsidian

2 Mechanics

2.1 Unit Description X95 Chameleon

Chameleon is a Slider mobile phone with a 2 inch QVGA Display and a semiautomatic slider system. The cases are 1K molded plastic parts with different surface treatments, soft touch lacquer, IMD, IMF, non conductive vacuum metallization and some galvanized keys.

The front cover of the phone can be exchanged. Two screws need to be unscrewed with a bundled torx driver. The SD card can be inserted with disassembled front cover only.

The SIM card must be inserted into the SIM reader after removing the battery cover and the battery.

A necklace hook on the backside of the slider allows the customer to use a necklace.

The keys of the slider keypad are integrated into the front cover. The icons of the key area are not illuminated. The key area is surrounded by translucent silicone bezels. They are illuminated with white backlight.

A status light indicator illuminates the center of the slider navigation key area with red light.

2.2 Assembly Concept for the Customer

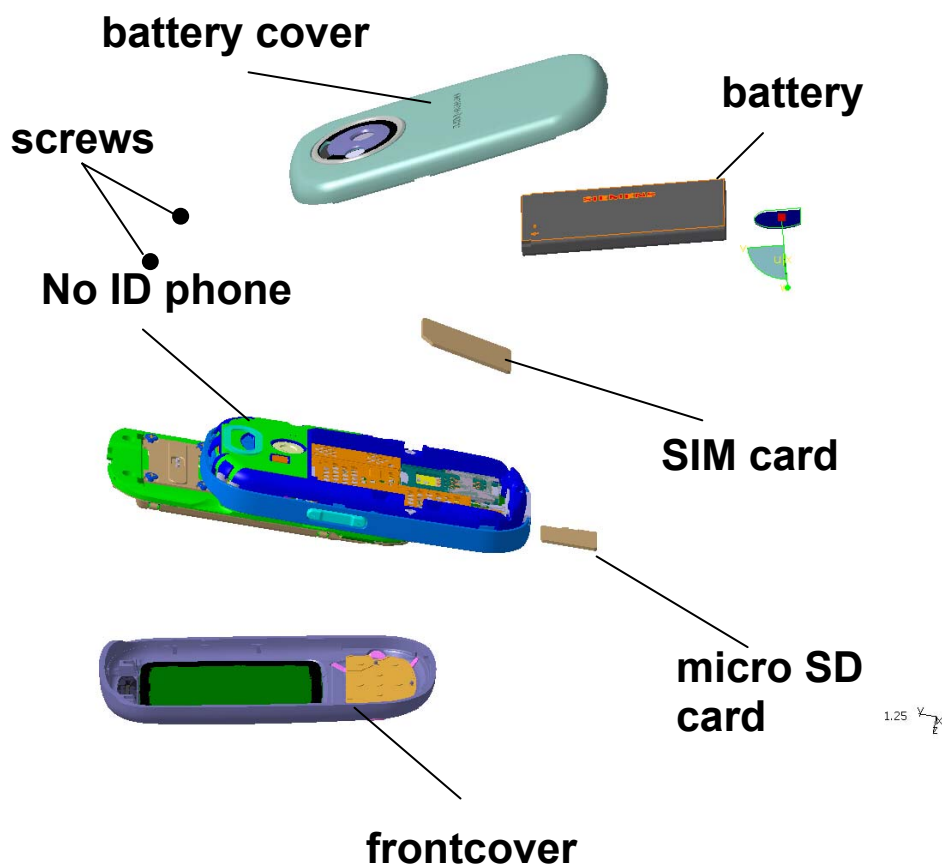


Figure 1 Assembly Concept for the Customer

2.3 Interfaces X95 Chameleon to accessories

Chameleon has no 50 Ohm RF connector. The I/O-connector (Nano IO) is located on the bottom of the phone.

2.4 Key-Data

Volume: 66ccm
 Length: 88mm
 Width: 45mm
 Thickness: 20.2mm

2.5 Housing Colors

Part	Material	Ramp-up Colour	Surface Finish
Slider front cover	PC/ABS	Tbd.	IMF decoration in different coors and deigns
Display lens	PMMA	anthracite	outside scratch protection + tampon printed frame inside
Slider keypad	PC +ABS galvanic	Silver and black inlay	Galvanized navi ring with black insert and black center push button
Base front cover	PC/ABS	silver	Non conductive vacuum metalization, high glossy
Side keys	ABS + TPE	Chrome	Chrome plated high glossy
Battery-Cover	PC/ABS	div.	- Soft touch feeling as standard - Leather and cloths as fabric materials - IMD as separate variant
12 Keypad	PC / ABS hardcaps glued on silicone	silver	Painted and laser edged

2.6 Assembly

2.6.1 Assembly Slider complete

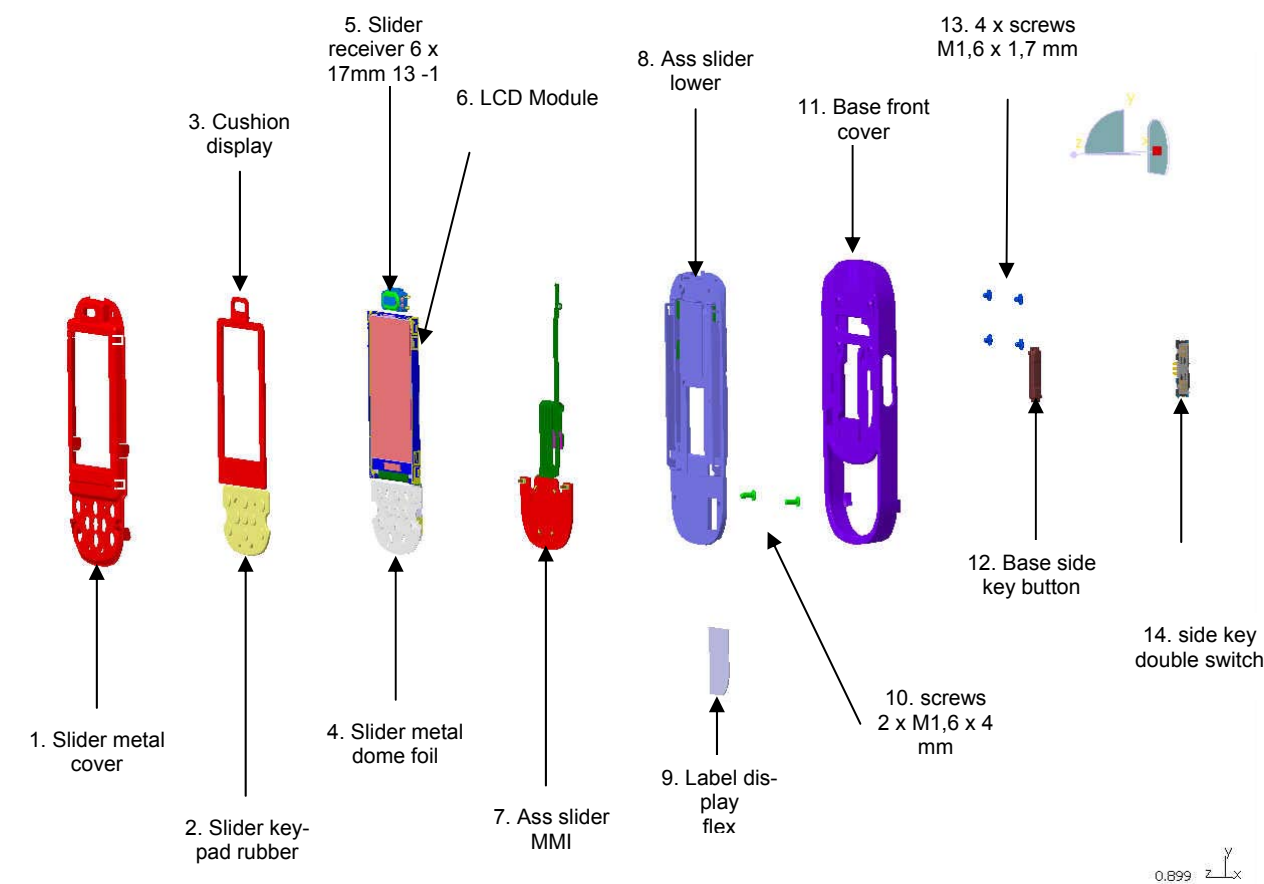


Figure 2 Assembly Slider complete

No	Part	Material	Dimensions [mm]	Wall thickness [mm]	technology	tooling / assembly
1	Slider metal cover	1.43 10	84,5 x 43,8 x 3,6 mm	0,3 mm	Deep drawn and stamped part	
2	Slider keypad rubber	Silicone rubber	18,6 x 41,2 x 1 mm	1 mm	Supplier Silitech	Stuck into slider metal cover
3	Cushion display	Tbd.	58,9 x 38,6 x 0,75 mm	0,75 mm		Glued into slider metal cover
4	Slider metal dome foil	PC foil, with adhesive and metal domes	~ 84 x 43 x 1,8 mm	0,3 mm	Supplier tbd.	Glued to Ass. Slider MMI
5	Slider Receiver	div.	6 x 17x 2,9 mm		6x17mm 13-1 supplier Hosiden	Stuck to Ass. Slider lower case
6	LCD module Carina	div.	52,1 x 36,7 x 2,6 mm		Display LCD Carina Supplier Epson, Philips	Stuck into slider lower case

7	Assembly slider MMI	div.			Rigid flex, assembled with LED's, capacitors and B2B connector	Stuck into slider lower case
8	Slider lower case	PPA 50% GF	84 x 44,7 x 7,3 mm	0,8 ... 2,2 mm	Supplier KH Vatec Assembled with guide, bushes and springs, decorated from backside	Screwed together with base front cover and slider metal cover
9	Label display flex	Tbd.	20,9 x 16 x 0,3 mm	0,3 mm	With adhesive	Glued to slider lower case
10	screws 2 x M1,6 x 4 mm				Cross slot screws	
11	Base front cover	PC / ABS	88,7 x 47,6 x 6 mm	0,4 ... 2 mm	PVD non conductive coated	1k tooling with 4 outside slider
12	Base side key button	TPE – PC/ABS	3,1 x 17 x 3,9 mm		2k galvanized part	Stuck into base front cover
13	Screws 4 x M1,6 x 1,7 mm				Cross slot screws	
14	Switch Dual no SMD ITT				Supplier ITT	Stuck together with button into base front cover

2.6.2 Assembly Slider Front Cover

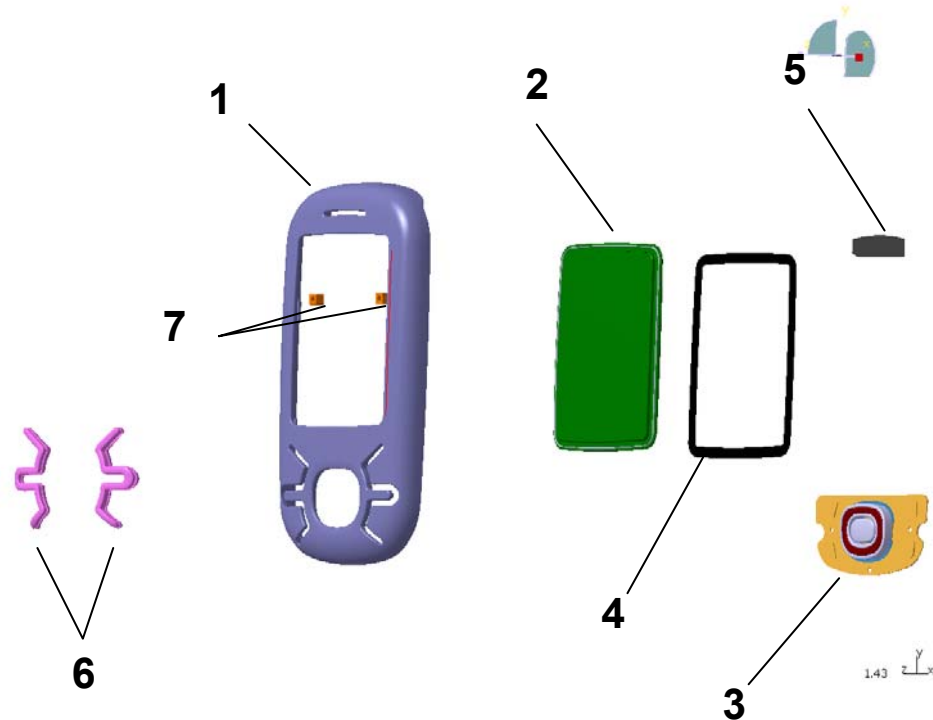


Figure 3 Assembly Slider Front Cover

No	Part	Material	Dimensions [mm]	Wall thickness [mm]	technology	tooling / assembly
1.	Slider Front Cover	PC/ABS	48 x 88 x 9 mm	0,7 ... 2 mm	1k plastic part IMF	1k tooling with two inside slider
2.	Display Lens	PMMA 8N		0,7 ... 2 mm	1k part, decoration DD for front side and backside printing	Ultrasonic welded to slider front cover
3.	Assembly slider Keypad	div.			Supplier Silitech	Stuck into slider front cover
4.	Front cover display cushion	Tbd.				Glued to slider front cover
5.	Slider speaker mesh	Tbd.				Glued to slider front cover
6.	Keypad Bezel	Silicone, translucent.			1k moulding	Sticked into slider front cover
7.	Screw inserts	Tbd.			M1,6	Sticked and heat steaked

2.6.3 Antenna carrier

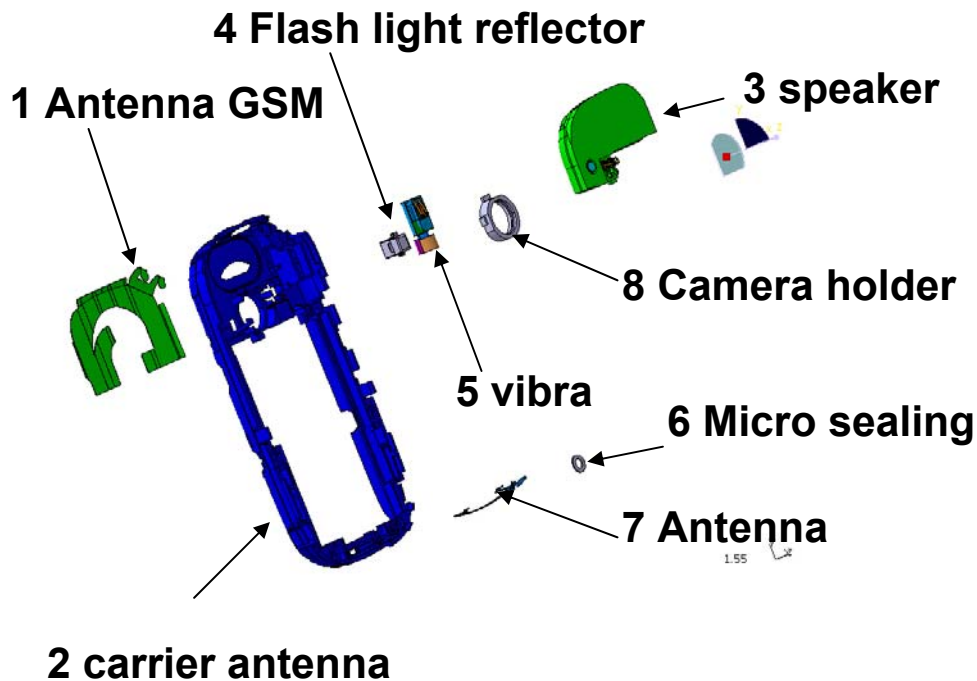


Figure 4 Antenna carrier

No	Part	Material	Dimensions [mm]	Wall thickness [mm]	technology	tooling / assembly
1.	Antenna GSM	Copper foil	~ 43 x 40 mm	0,19 mm		Glued to carrier antenna GSM
2.	Carrier antenna	PC / ABS	56,7 x 44,3 x 7 mm	0,8 ... 2 mm	1k moulding, not decorated	
3.	speaker	div.			Supplier Hosiden	Snap into carrier antenna GSM
4.	Flash light reflector	Clear PC	4,3 x 4,3 x 4,8 mm			Stuck into carrier antenna GSM
5.	Vibra Motor	div.			Supplier Shico, Copal	
6.	Micro sealing	Cushion				Glued into carrier
7.	Antenna BT	Nickel Silver	25 x 7 mm	0,14 mm	Bended part	Stuck into Carrier

2.6.4 Battery cover

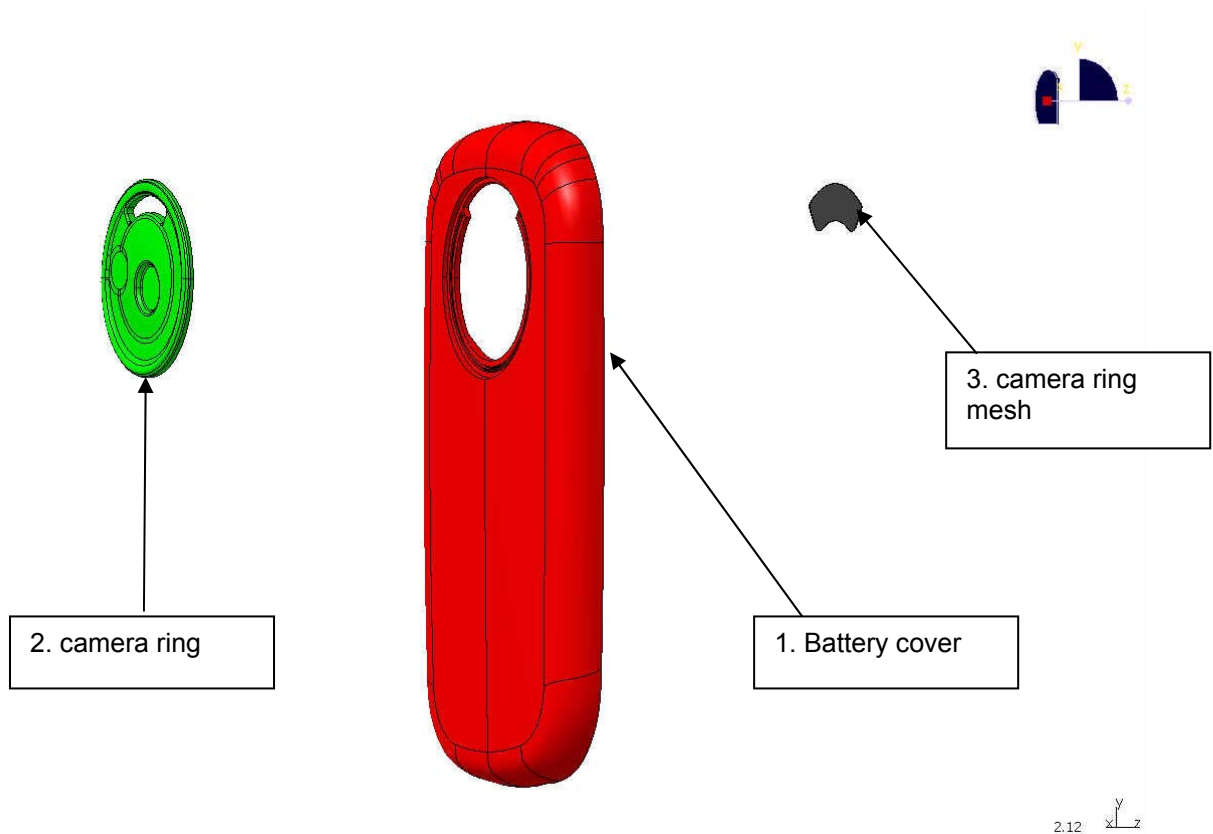


Figure 5 Battery cover

No	Part	Material	Dimensions [mm]	Wall thickness [mm]	technology	tooling / assembly
1.	Battery cover	PC/ABS	86,8 x 45,7 x 6 mm	0,8 ... 1,2 mm	- 1k moulding soft touch lacquered part - 1k IMD tooling - 1k real application moulding	1k tooling with 4 inside slider
2.	Camera ring	PMMA	Diameter 26 mm		IMF or IMD	1k tooling w/o slider / glued to battery cover
3.	Camera ring mesh	Tbd.				glued to battery cover
4.	glasses	Hardened glass	Tbd.		Not in picture Open discussion about cover glass for camera and also flash light	glued to camera ring

2.7 Preassembly of PCB

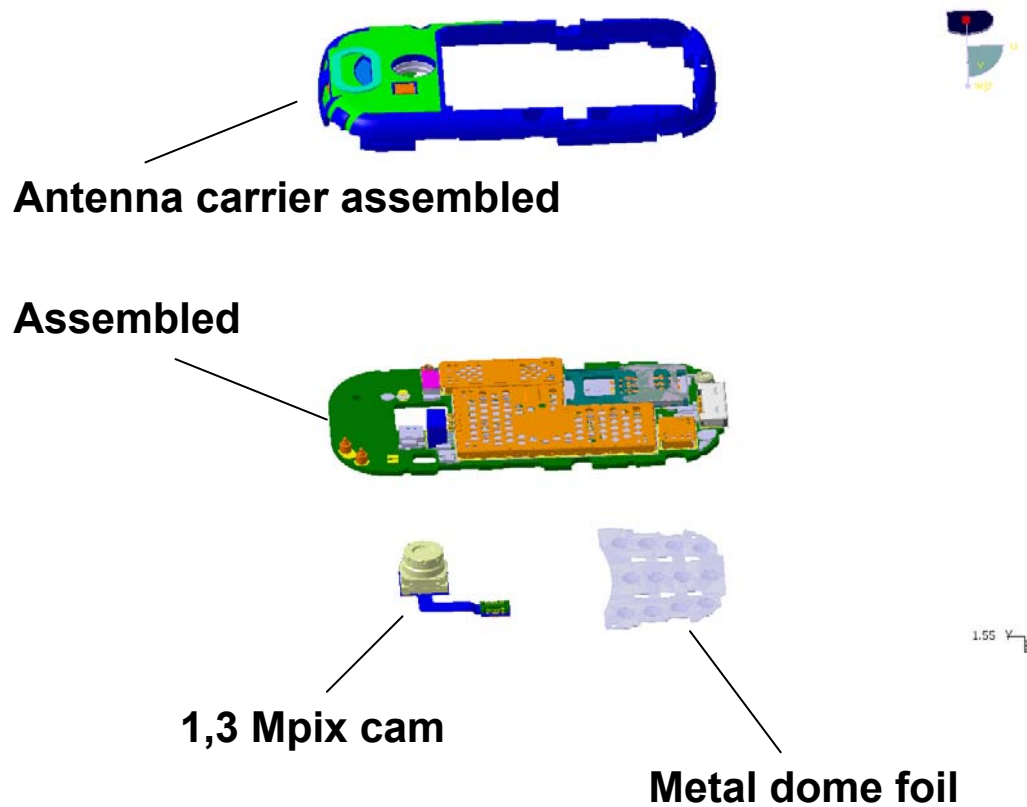


Figure 6 Preassembly of PCB

2.8 Main PCB

2.8.1 Top-Side

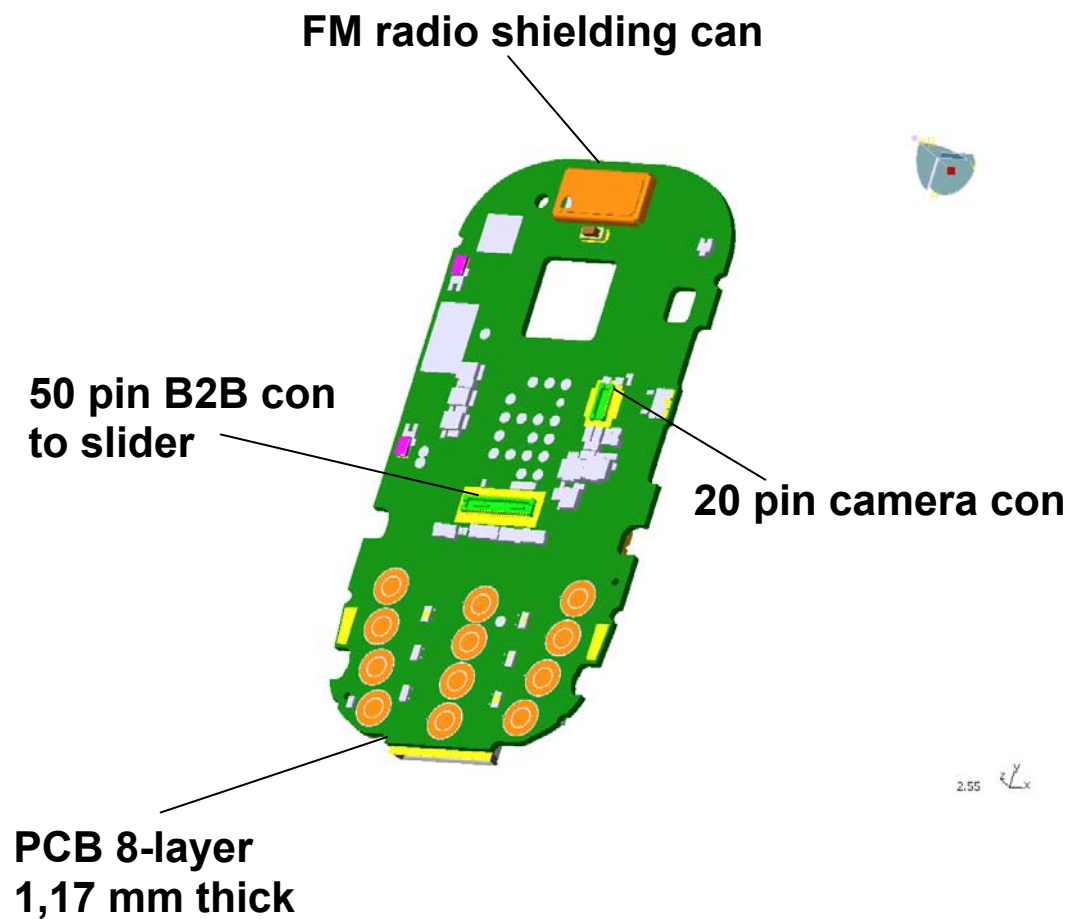


Figure 7 Main PCB Top Side

2.8.2 Bottom-Side

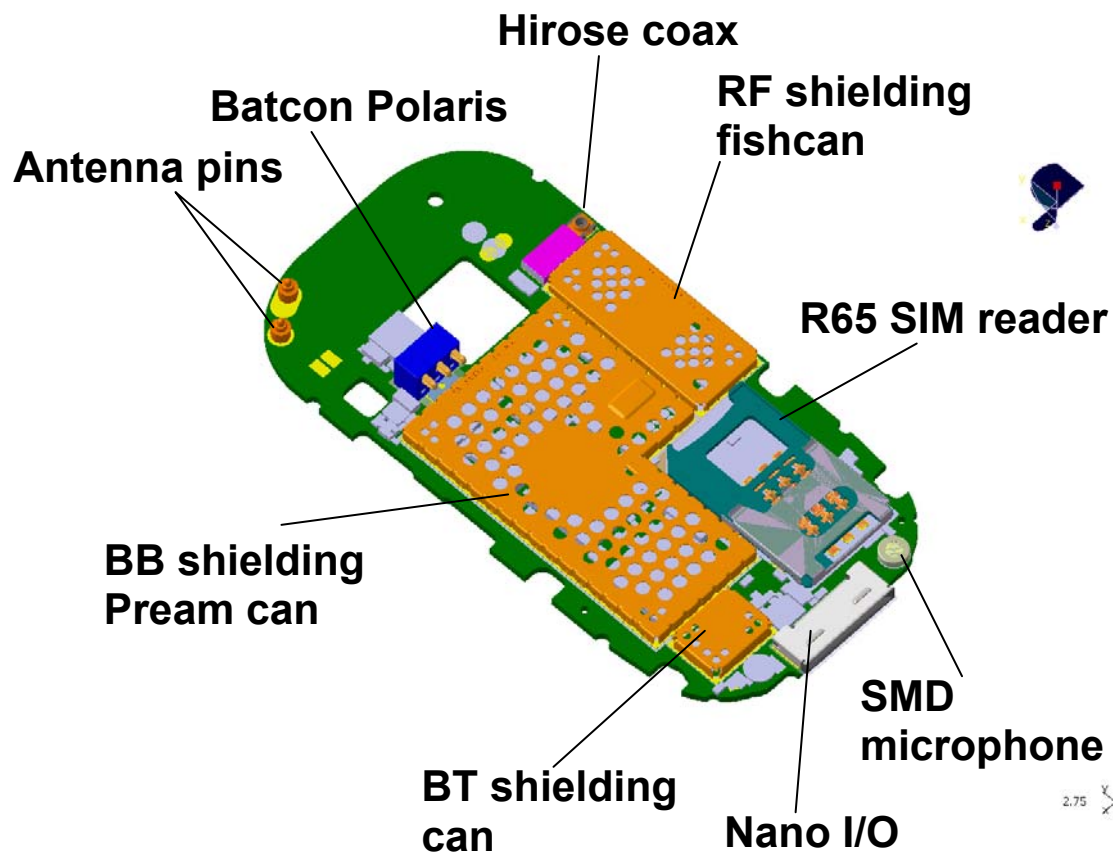


Figure 8 Main PCB Bottom Side

2.9 MMI FPC

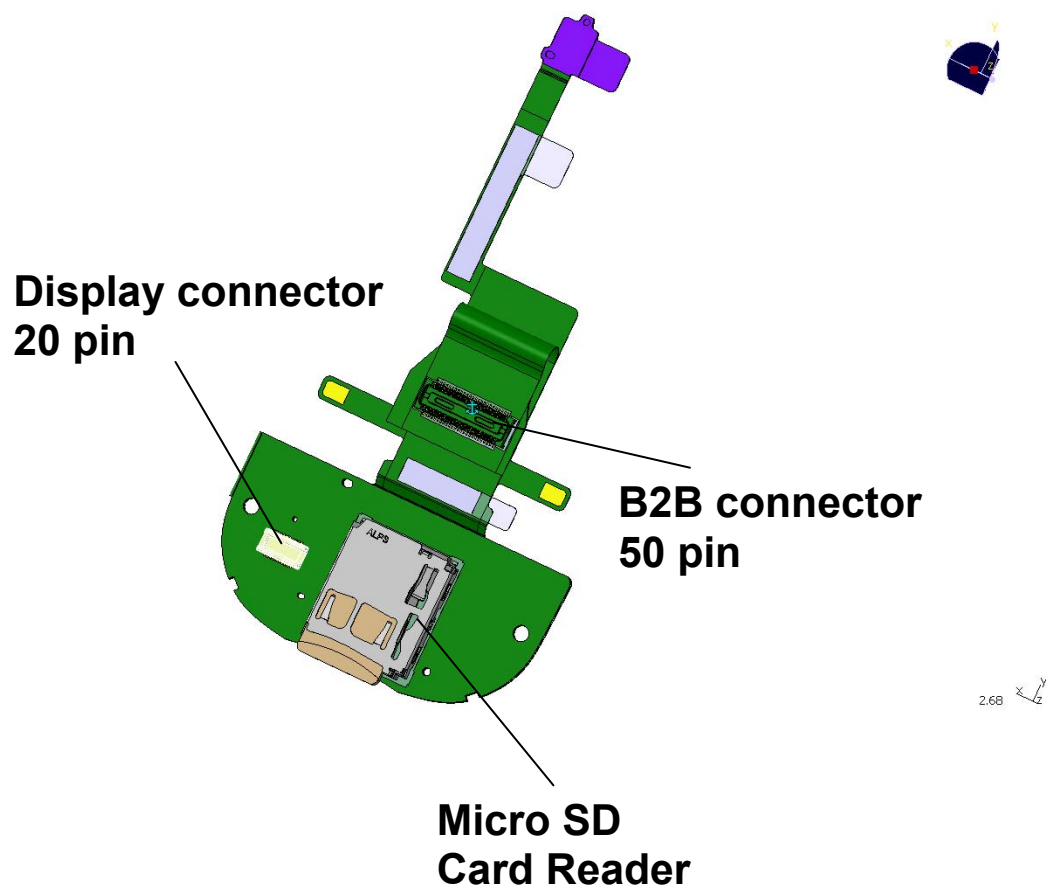


Figure 9 MMI FPC Bottom

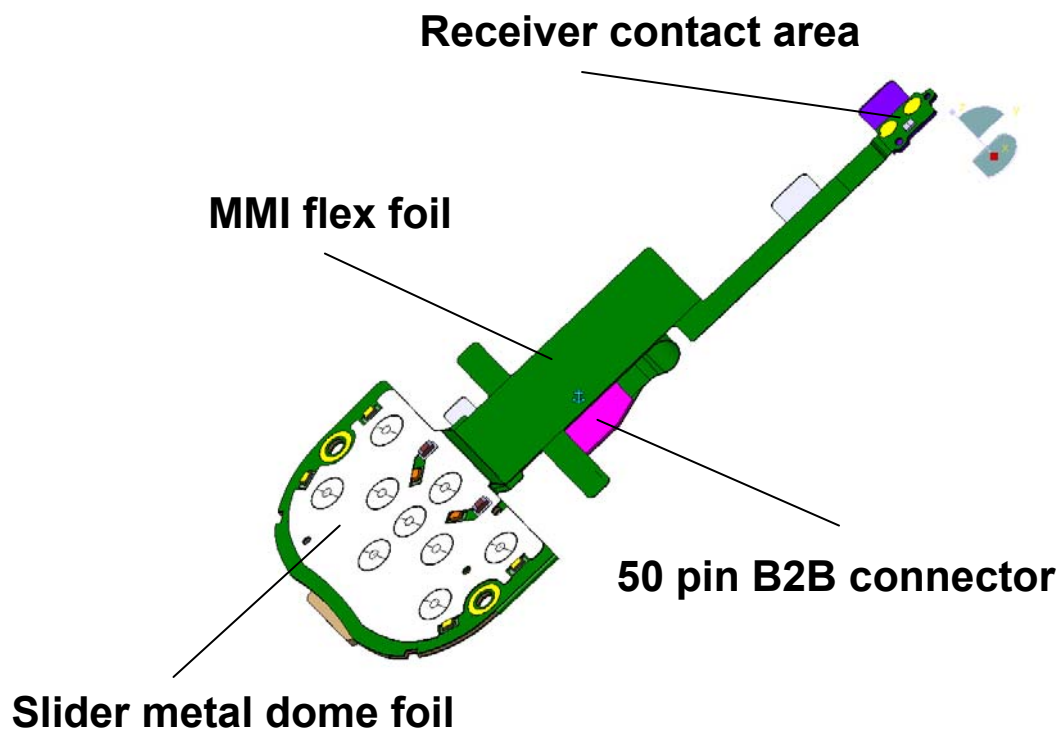


Figure 10 MMI FPC Top

2.10 Device Assembly

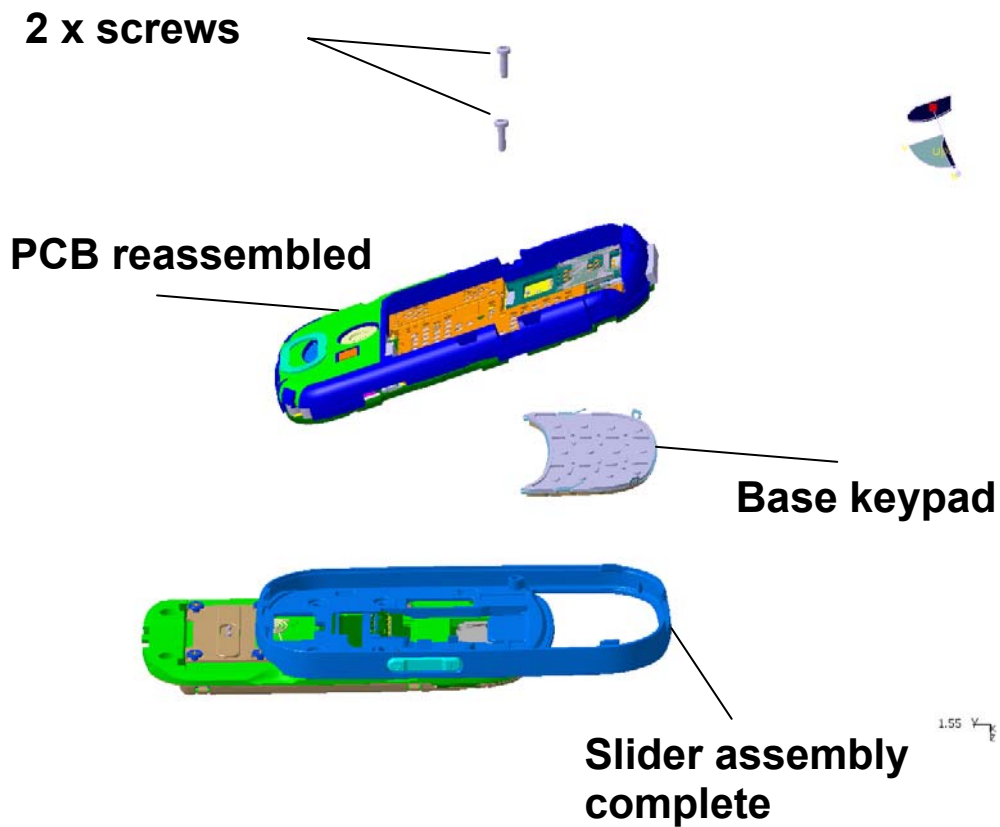


Figure 11 Device Assembly

3 Electronic

3.1 Radio part

3.1.1 Introduction

The radio part realizes the conversion of the GMSK/8PSK RF-signals from the antenna to the base-band and vice versa. In the receiving direction, the signals are split in the I- and Q-component and led to the A/D-converter of the logic part. In the transmission direction, the GMSK/8PSK signals are generated digitally by the baseband section. After D/A conversion the analogue signals are fed into an IQ modulator and upconverted to radio frequencies by the polar loop system. After that the signals are amplified in the power amplifier.

Transmitter and Receiver are never active at the same time. Therefore full duplex operation is not possible. However the monitoring band (monitoring timeslot) in the TDMA-frame can be chosen independently of the receiving respectively the transmitting band (RX- and TX timeslot of the band).

The RF part is dimensioned for quad band operation in the frequency ranges GSM850/EGSM900/DCS1800/ PCS1900 supporting EGPRS functionality up to multiclass 12.

As depicted in the table, there is only one solution implemented.

RENESAS (single solution)	
Renesas Bright 6PLA chip set (R2A60163BG) <ul style="list-style-type: none"> • PLL for integrated local oscillator LO including loop filter • Fully integrated TxVCO and TX-PLL including loop filter • Direct conversion receiver including LNA, DC-mixer, channel filtering and PGC-amplifier • Active part of 26 MHz reference oscillator and varicap • Integrated Polar Loop, phase and amplitude control of transmitted output power 	
Renesas transmit PA PF09039B	
Hitachi Frontend-Module <ul style="list-style-type: none"> • HWXQ521 including RX-/TX-switch and EGSM900 / DCS1800 / PCS 1900 receiver SAW-filters or • HWXQ522 including RX-/TX-switch and GSM850 / DCS1800 / PCS 1900 receiver SAW-filters or • HWXR591 including RX-/TX-switch and GSM850 / EGSM900 / DCS1800 / PCS 1900 receiver SAW-filters 	
Crystal and passive circuitry of the 26MHz VCXO reference oscillator	

3.1.2 Compliance

Receiver Sensitivity:

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

EGSM 900: GMSK: -102dBm (Specification, with fading; static@25°C GMSK:-108.0dBm)

GSM1800: GMSK: -102dBm (Specification, with fading; static@25°C GMSK:-107.0dBm)

GSM1900: GMSK: -102dBm (Specification, with fading; static@25°C GMSK:-106.5dBm)

Concerning 8PSK, the required sensitivity highly depends on the used Coding Scheme. The Receiver will fulfill the corresponding GSM recommendations specified in 3GPP TS51.010-1 V4.9.0 (2002-07) section 14.18.1 table 14.18.3b.

Transmitter Power:

The RF part is compliant to GSM 3GPP TS51.010-1 V4.9.0 (2002-07). The transmitter output power (reference point is 50 Ohm test connector) is compliant to following power classes:

EGSM900: GMSK: power class 4; 8PSK: power class E2

GSM1800/GSM1900: GMSK: power class 1; 8PSK: power class E2

The following values are valid for normal conditions:

EGSM 900 GMSK: >31,1dBm (31,6dBm nominal) 8PSK: >25,6dBm (26,1 dBm nominal)

GSM1800 GMSK: >29,0dBm (29,5dBm nominal) 8PSK: >23,5dBm (24,0 dBm nominal)

GSM1900 GMSK: >29,0dBm (29,5dBm nominal) 8PSK: >23,5dBm (24,0 dBm nominal)

3.1.3 Description Quadband radio (Renesas Solution)

3.1.3.1 Renesas Bright 6PLA chipset (R2A60163BG)

3.1.3.1.1 Local oscillator (~3.6GHz)

The local oscillator (LO) consists of a PLL and VCO inside Bright 6PLA and an integrated loop filter. The VCO includes an calibration mechanism which is triggered automatically before each synthesizer programming.

3.1.3.1.2 RF-PLL

The RF-PLL is a fractional-N-PLL. The RF frequency is calculated within B6PLA from the channel frequency information which is programmed into B6PLA. In TX mode there is the possibility to correct the RF frequency by a few 100Hz to correct for TX frequency errors. The reference frequency of the PLL is 26MHz. The PLL is controlled by the internal state machine.

3.1.3.1.3 RFVCO (LO)

The full oscillation range is divided into 256 sub bands and covers 3476 to 4026MHz. The choice of the appropriate band and the complete operation is controlled internally by the Bright state machine.

3.1.3.1.4 TX IF generation

The IF signal, which is used in TX mode only, is derived from the RFVCO signal by a divider. Four different divider ratios (40, 44, 48, and 52) can be selected by programming. As with the channel frequency also the RFVCO frequency changes the TX IF is no longer a fixed frequency but changes also depending on the divider ratio in the range from 68.4MHz to 100.6MHz.

3.1.3.1.5 Receiver

The Bright 6PLA incorporates four RF LNAs for GSM850, EGSM900, DCS1800 and PCS1900 operation followed by direct conversion mixers which are IQ demodulators. The LNA/mixer can be switched in normal-, low-, lower-gain and high isolation mode. For the "normal gain" state the mixers are optimised in terms of conversion gain and noise figure, in the "low gain" state the mixers are optimised for large-signal behaviour for operation at a high input power levels. The "lower gain mode" reduces the RF-level by activating a differential impedance in front of the LNA to improve the large signal performance.

Triple band operation (GSM850, DCS1800 and PCS1900) is also possible because both low band LNA's can both operate in the GSM850 and EGSM900 bands. The frequency bands are determined by the front-end module which is used and by the synthesizer programming.

Furthermore the IC includes a programmable gain baseband amplifier PGA (90dB control range, 2dB steps) with automatic DC offset calibration. The channel filtering is realized inside the chip with a four stage baseband filter for both IQ chains. Two capacitors which are part of the first passive RC-filters are now integrated and calibrated during the initialization sequence of B6PLA. The second, third and fourth filters are active filters and are fully integrated. The distributed channel filter is necessary to suppress adjacent channel and inband-blocking interferer to avoid any compression in each amplifier stage.

The downconverted IQ signals are fed into the A/D converters inside the SGOLD2. By a special algorithm the level of the IQ signals is kept constant on a defined level by varying the PGA gain and selecting the appropriate LNA gains.

3.1.3.1.6 Transmitter

Polar Loop

The generation of the modulated RF signal in Bright 6PLA is based on the principle of the polar loop architecture. The IQ signals generated by the SGOLD2 baseband are modulated to the transmit IF of 68.4MHz to 100.6MHz by an IQ modulator. The required IF is generated by dividing the RFVCO signal.

As in a conventional upconversion loop the IF signal is upconverted to the transmit frequency. Therefore a downconverter and a phase detector are used in order to compare the IF signal to the downconverted transmit signal. This loop is called PM loop and is used for GMSK operation.

In 8PSK mode the transmit IF signal is split into PM and AM components. A second loop is then used to control the AM components. Therefore an AM detector is implemented which compares the transmit IF signal and the downconverted transmit signal. The AM loop is also used for power ramping. Inside the AM loop there are two analogue gain controlled amplifiers. These are used for setting the output power level and to keep the loop bandwidth constant. External attenuators are required in the feedback paths from PA to B6PLA to adjust the feedback level to PA's from different suppliers.

The separated AM and PM components of an 8PSK signal are finally fit together inside the PA. The PA is driven by the TXVCO signals containing the PM components. The AM component is added by an amplitude control input pin, which controls the supply voltage of the RF transistors and therefore the PA output power level.

All loop filters for PM and AM loops are fully integrated within B6PLA. To achieve a good output modulation spectrum it is necessary that the bandwidths of the PM loop and the AM loop are quite well adjusted to their target bandwidth. For the PM loop there is an automatic calibration mechanism within B6PLA running prior to each TX slot. The AM loop bandwidth is calibrated only one time in the factory.

TxVCO

The TxVCO is integrated inside Bright 6PLA. It consists of 256 VCO bands operating in the frequency range 1648MHz to 1910MHz. The signal for the low bands GSM850 and EGSM900 is generated by a 1/2 divider. Two independent output buffers, one for each band, deliver the output signal to the PA module input. The choice of the appropriate VCO band is done automatically and controlled by the internal state machine.

3.1.3.2 Renesas transmitter power amplifier PF09036B

3.1.3.2.1 PA Module

The power amplifier is a PA module from Renesas, matched to 50 Ω at all signal ports. It contains a two stage amplifier for the GSM850/EGSM900 and a three stage amplifier for DCS1800/PCS1900 operation. It is possible to control the output power level of both bands via one VRAMP port. The appropriate amplifier chain is activated by a logic signal, which is provided by B6PLA (TXBAND). The module is switched on by a control signal generated by the B6PLA internal state machine. The RF transistor bias voltage is generated inside the PA module. The PA module consists also of two additional directional coupler to provide the needed RF feedback signal for the AM control in 8PSK mode.

3.1.3.2.2 Power control

In GMSK operation the output power is directly controlled by a control voltage coming from SGOLD2. This voltage is fed through B6PLA and connected to the PA module (VRAMP). The 3GPP specification can be fulfilled without power sensing or any type of feedback.

In 8PSK operation the AM loop controls the output power level. Therefore the same SGOLD2 signal is used but connected to the variable gain amplifiers inside B6PLA. The AM control voltage finally controls the PA module (VRAMP). All switching between GMSK and 8PSK modes is controlled by the B6PLA internal state machine.

3.1.3.2.3 Hitachi Frontend-Module (FEM)

The FEM includes the RX/TX- and bandswitch function based on a combined PIN diode and diplexer-circuit. In the transmit paths a harmonic filtering for GSM850/EGSM900 and DCS1800/PCS1900 is realized to avoid additional discrete filters. The isolation in TX OFF mode is used to achieve the isolation which is necessary before the active part of the burst. Two control lines from B6PLA which are connected to the state machine control the band-selection of the TX switches. The receiver chains include SAW filters for GSM850, EGSM900, DCS1800 and PCS1900 to protect the receivers from strong blocking signals according to the 3GPP specification.

3.1.3.2.4 Variants

X85 uses either the triple bands EGSM900/DCS1800/PCS1900 and GSM850/DCS1800/PCS1900 or The quad band GSM850/EGSM900/DCS1800/PCS1900 as three variants.

3.1.3.3 Discrete 26MHz VCXO reference oscillator

The 26 MHz signal is created by an integrated VCXO. A Colpitts oscillator is used with a post-connected buffer stage. The active part and the varicaps are realized within the Bright. The integrated varicap is split up into different smaller varicaps to adjust the center frequency of the VCXO with different crystal vendors and mass production variation. For temperature measurements of the VCXO an external temperature sensor is used. The frequency of the reference oscillator can be fine tuned by the baseband via a filtered PNM modulated AFC signal. Three active buffer stages are included in Bright 6PLA to provide clock signals for the baseband IC, Bluetooth and the PMU.

3.1.3.4 Functional block diagram

The functional block diagram shows the Renesas RF solution with Bright 6PLA.

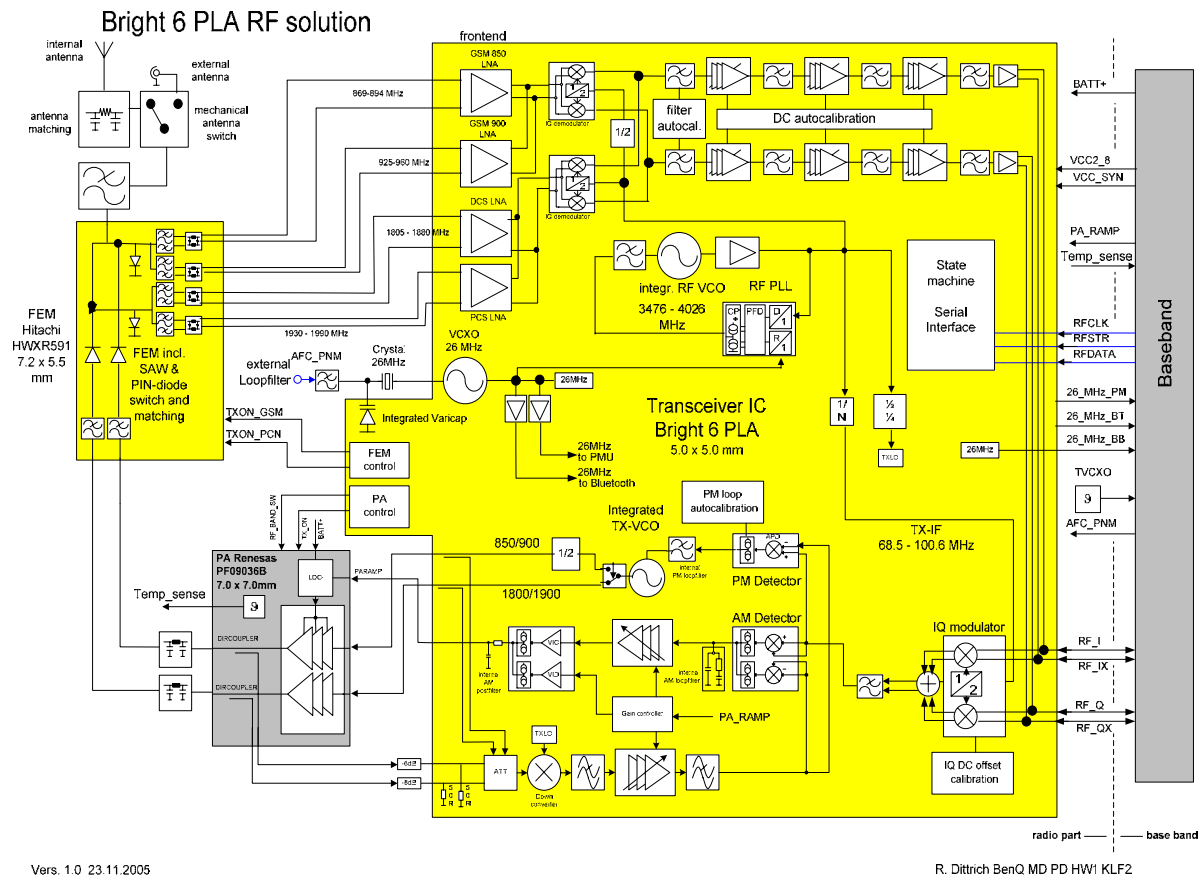


Figure 12 Renesas RF functional block diagram

3.1.4 Bluetooth

The Bluetooth Interface is compatible to the Bluetooth specification version 1.2 power class 2 (-6 dBm up to +4dBm) with a RX sensitivity better than -70 dBm and support multipoint connections. It supports a transmission rate up to 723 kBit/s data asymmetrically over the air interface. The transmission range is approx. 10 m. Between SGOLD2 and BRF6150 a data rate up to 921.6 kbit/s is used.

The following hardware versions are used for the X75 products:

BRF6150					
SAP-Number: A5B00075152653					
Version	Label <small>NOTE2</small>	FW in ROM <small>NOTE1</small>	HW revision <small>NOTE3</small>	Status	Remark
V2.11	P6150B1	0x0d1a (2.0.26)	0x01	available	First version used as stacked flash devices for FW test
V2.12	P6150C1	0x0dB0 (3.0.48)	0x02	available	used for A1 run
V2.22	P6150D1	0x0dB0 (3.0.48)	0x03	sample in Sep. 2004	only HW Changes: - remove Pull up @ CLK_REQ - changes at XTAL - CODEC Hi-Z for PCMOUT same internal FW used for B1 run
V2.23	P6150E1	tbd	0x04	sample in Dec. 2004	no HW changes new ROM firmware used for B1+, B2 run

NOTE1: Return Parameter of the HCI Command "Read_Local_Version_Information"

NOTE2: Stacked Flash Samples 2.11 has following Label: P6150B5

NOTE3: Return Parameter "Chip Revision" of the Command "HCI_VS_Get_System_Status_Island2"

The following table shows the interface between SGOLD2, PMU and the BRF6150:

Pin name BRF6150	@ BRF6150	Signal name Schematic S65 / S66	Meaning	Connected to
VDD_IN_BB VDD_IN_RFIO VDD_IN_ANA VDD_IN_OSC	IN	VDD_BT VDD_BT_RF2	Main power supply	STV-ASIC "VRF3"
VDD_IO_x VDD_IO_SF_x	IN	2.65V 2.65V (2.9V)	IO Power supply 2.9V needed for stacked flash	PMU VDD IO SGOLD REG3 2.65V (REG1 2.9V)
HCI_RTS	OUT	BT_CTS	USART IF	SGOLD2 "USART1_CTS"
HCI_RX	IN	BT_TX	USART IF	SGOLD2 "IRDA_TX" or SGOLD2 "USIF_TXD_MSTR"
HCI_TX	OUT	BT_RX	USART IF	SGOLD2 "USART1_RX" or SGOLD2 "USIF_RXD_MSTR"
HCI_CTS	IN	BT_RTS	USART IF	SGOLD2 "USART1_RTS"
AUD_CLK	IN	BT_PCM_CLK	PCM IF	SGOLD2 "I2S1_CLK"
AUD_FSYNC	IN	BT_PCM_SYNC	PCM IF	SGOLD2 "I2S1_WA0"
AUD_IN	IN	BT_PCM_IN	PCM IF	SGOLD2 "I2S1_TX"
AUD_OUT	OUT	BT_PCM_OUT	PCM IF	SGOLD2 "I2S1_RX"
HCI_TX	OUT	BT_WAKEUP_GM	Wakeup-line, needed if H5 is not used	SGOLD2 "KP_IN6"
NSHUT_DOWN	IN	BT_RESET	Reset	PMU "Outport"
CLK32	IN	CLK32	32,768 kHz +-250ppm Rectangular wave	S-GOLD2 "CLK32"
XTALP_FAST_C K_IN	IN	BT_SIN26M	26MHz clock signal sine wave	RF-GSM "VOUTEF2"
IO0_EXT_CLK_R EQ_OUT	OUT	BT_VCXOEN	26MHz clock request	PMU "SLEEP2N"

3.1.5 FM radio

The FM radio is based on Philips TEA5761UK (A5B00075407207) which is a stereo FM radio receiver without RDS decoder. The Philips TEA5764UK (A5B00075684254) which includes a RDS decoder is also supported by the PCB layout. A special variant of the parts list and mobile software is required before the RDS functionality can be utilized.

The tuning range is the EU/US 87.5 - 108.0 MHz band, but the FM radio IC also supports the Japanese 76.0 - 91.0 MHz band. The pre-emphasis is controlled by software and set to either 50 us (EU) or 75 us (US) based on information from the GSM network.

The FM radio is based on a fully integrated low IF architecture with an integrated integer synthesizer.

Programming of the FM radio is performed over the I2C bus. A 32.768 kHz clock signal is provided by the base band for the FM radio.

No RF and LF adjustments are required in production.

Three different search threshold levels can be selected by the user. An automatic stereo/mono blend feature and a forced mono setting are supported by the FM radio IC.

FM radio functionality is available during all combinations of GSM and Bluetooth scenarios. However it is not available for the user in all scenarios due to the actual implementation of SW and audio.

Operating temperature range is -10 to 60 °C.

3.2 Digital Hardware and Electro Acoustic

3.2.1 Overview

The HW Design is close aligned with the X75 Platform HW Design, see. All device specific parts, dedicated to the Chameleon, are specified below.

Block diagram for Chameleon

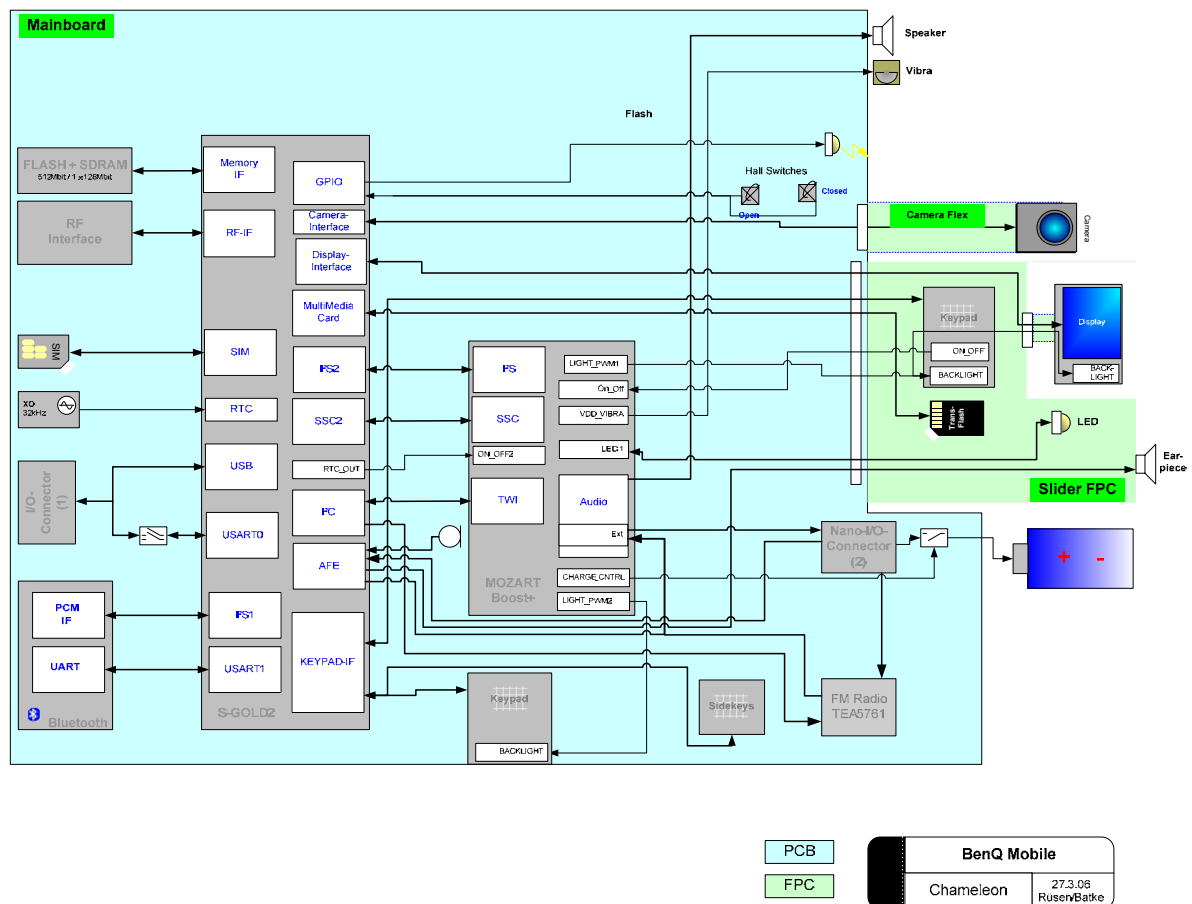


Figure 13 Base Band Block Diagramm

3.2.2 Digital Baseband

3.2.2.1 Baseband Processor S-GOLD2 (PMB8876)

The S-GOLD2 is the successor of the SGOLDlite and will be used as the baseband solution for low to mid range phones as well as wireless modules.

It uses the ARM 926EJ-S core at 208MHz, a MOVE Companion Processor is attached. Furthermore the Teaklite DSP will run with up to 138,67 MHz.

Supported Standards

- EGPRS class 12 MCS 1..9
- GSM speech FR, HR, EFR and AMR-NB
- GSM data 2.4kbit/s, 4.8kbit/s, 9.6kbits, and 14.4kbit/s
- HSCSD class 10
- GPRS class 12 CS 1..4

Processing cores

- ARM926EJ-S 32 bit processor core with operating frequency up to 208 MHz for controller functions. The ARM926EJ-S includes an MMU, and the Jazelle Java extension for Java acceleration.

- TEAKLite® DSP core with operating frequency 138.67 MHz.

ARM-Memory

- 8 kByte Boot ROM on the AHB
- 96 kByte SRAM on the AHB, flexibly usable as program or data RAM
- 16kByte Cache for Program (internal)
- 8 kByte tightly coupled memory for Program (internal)
- 8 kByte Cache for Data (internal)
- 8 kByte tightly coupled memory for Data (internal)

TEAKLite®-Memory (word: 16bit)

- 104 kwords Program ROM
- 8 kwords Program RAM
- 60 kwords Data ROM
- 37 kwords Data RAM
- Incremental Redundancy (IR) Memory of 35904 words of 16 bit

Shared Memory Blocks (word: 16bit)

- 3k words Shared RAM (dual ported) between controller system and TEAKLite®.

Controller Bus System

The processing cores and their peripherals are connected by powerful buses:

- Multi-layer AHB for connecting the ARM, the master interfaces of the Camera Interface, of the Flash Controller DMA port and of the free programmable DMA, the main internal and external memory and the peripheral buses.

- FPI-Bus for connecting the controller peripherals which require DMA support, called hereafter FPI1 respectively.

- FPI-Bus for connecting GSM peripherals, called hereafter FPI3 bus

- A controller FPI bus for connecting the low performance controller peripherals such as key-pad etc., called hereafter FPI2 bus.

- FPI1, FPI2 and FPI3 are connected asynchronously to the AHB buses. 1 DMA controller with 8 channels releases the controller from data transfers.

- AHB Lite-Bus for connecting multimedia and high performance peripherals, called AHB_PER hereafter. This peripheral bus is connected to the multilayer AHB 'backbone' by an asynchronous, burst capable AHB2AHB bridge which is shared between accessing masters.

The DMA controller is enabled to access AHB_PER by the use of its second Master Interface.

TEAKLite® Bus System

TEAKLite® data bus for connecting the TEAKLite® data memory and the TEAKLite® peripherals. Also the data bus is connected into the controller system via shared RAMs to the FPI3 bus.

TEAKLite® program buses for connecting the TEAKLite® program memory to the TEAKLite®.

Clock System

The clock system allows widely independent selection of frequencies for the essential parts of the S-GOLD2™. Thus power consumption and performance can be optimized for each application.

Functional Hardware blocks

CPU and DSP Timers

Programmable PLL with additional phase shifters for system clock generation

GSM Timer Module that off-loads the CPU from radio channel timing

GMSK Modulator according to GSM-standard 05.04 (5/2000)

GMSK Modulator: gauss-filter with $B \cdot T = 0.3$

Hardware accelerators for equalizer and channel decoding

A5/1, A5/2, A5/3 Cipher Unit (A5/3 added in S-GOLDlite™ V1.1)

GEA1, GEA2, GEA3 Cipher Unit to support GPRS data transmission (GEA3 added in S-GOLDlite™ V1.1)

Advanced static and dynamic power management features including TDMA-Frame synchronous low-power mode and enhanced CPU modes (idle and sleep modes)

Incremental Redundancy Memory for EDGE class 12 support

GMSK / 8-PSK Modulator according to GSM-standard 05.04 (5/2000)

GMSK Modulator: gauss-filter with $B \cdot T = 0.3$

EDGE Modulator: 8PSK-modulation with linearised GMSK-pulse-filter

MOVE coprocessor performing motion estimation for video encoding algorithms (H.263, MPEG-4)

Interfaces and Features

Keypad Interface for scanning keypads up to **8 rows** and **8 columns** (sum of rows and columns up to 16)

Pulse Number Modulation output for Automatic Frequency Correction (AFC)

Serial RF Control Interface; support of direct conversion RF

2 USARTs with autobaud detection and hardware flow control

IrDA Controller integrated in USART0 and USART1 (with IrDA support up to 115.2 kbps) V1.0
: IrDA integrated in USART0 only (not relevant for Chameleon as no Irda!).

1 Serial Synchronous SPI compatible interfaces in the controller domain

1 Serial Synchronous SPI compatible interface in the TEAKLite® domain

I2C-bus interface (e.g. connection to S/M-Power)

2 bidirectional and one unidirectional I2S interface accessible from the TEAKLite®

USB V1.1 mini host interface for full speed devices with up to 2 interfaces and 4 endpoints configurable supporting also USB on-the-go functionality

IEEE 1149.1 compliant JTAG port for Boundary Scan and debug

ISO 7816 compatible SIM card interface

Enhanced digital (phase linearity, adj/ co-channel interference) baseband filters, including analog prefilters and high resolution analog-to-digital converters.

Digital and analog audio filters including wideband audio capable digital-to-analog and analog-to-digital converters.

Audio front-end will be accessible from MCU (via shared memory) and the TEAKLite® (i.e. voice recognition and echo cancellation can run on TEAKLite®)

Hifi Stereo voiceband with CD-Quality

Separate analog-to-digital converter for various general purpose measurements like battery voltage, battery, VCXO and environmental temperature, battery technology, transmission power, offset, onchip temperature, etc.

Ringer support for highly oversampled PDM/PWM input signals for more versatility in ringer tone generation

Differential VMIC generation

RF power ramping functions

DAI Interface according to GSM 11.10 is implemented via dedicated I2S mode

26 MHz master clock input

External memory interface:

1.8V interface data bus: 16 bit non-multiplexed and multiplexed, 32 bit multiplexed for each of the 4 address regions 128 MByte with 32-bit access or 64 MByte with a 16-bit access are addressable

supports asynchronous devices (i.e. SRAM, display) including write buffer for cache line write

supports synchronous devices (SDRAMs and Flash Memory) up to **104 MHz**

Port logic for external port signals

Comprehensive static and dynamic Power Management

Various frequency options during operation mode

32 kHz clock in standby mode

Sleep control in standby mode

RAMs and ROMs in power save mode during standby mode

Additional leakage current reduction in standby mode possible by switching off the power for the TEAKLite® subsystem.

Debug Features:

OCDS level 2+ (run control, non-intrusive program flow trace and limited data flow trace) for ARM and OCDS level 1+ (run control, limited program flow trace) for the TEAKLite® multi-core debug support

4 monitor pins for important internal signals and most pad signals

2 General Purpose Timers with 3 32-bit timers

Serial number

Real time clock with alarm functions

2 capture/compare units with 16 channels

A fast parallel Display Interface

Extensive debug support for the controller and the DSP system

ITU-R BT.656 compatible Camera Interface

Programmable clock output for a camera

Multimedia/Secure Digital Card Interface (MMCI/SD; SDIO capable; microSD support)

Flash Controller DMA Port (FCDP) supporting NAND flash (error correction capability)

Multimedia extension interface (MMIC-IF) supporting external hardware accelerator

ICs such as complex display/camera modules or graphic accelerators. (not used for Chameleon)

Fast IrDA Interface supporting IrDA's SIR, MIR and FIR standards (not used for Chameleon)

Universal Serial Interface (USIF) enabling asynchronous or synchronous serial data transmission.

Signal Processing Firmware Support

FR, HR, EFR, and AMR NBspeech and channel codecs

Data transmission channel codecs for 2.4, 4.8, 9.6 and 14.4 kbit/s

HSCDS class 10 support

GPRS class 12 support with coding schemes CS1..4

Support for Handsfree, side- and signaling tone generation

MMS-support

EGPRS class 12 with modulation and coding schemes MCS1..9 (Release 5 compliant)

Polyphonic ringer for up to 64 voices at sampling rates up to 48kHz

SAIC

64 voices midi (pseudo) stereo

Enhanced audio visualization
Speaker Independent name + digit dialing

3.2.3 External memory

The external memory is a two die stacked device with one Flash for code and data and one LP-SDRAM as main memory. The densities are 512Mbit flash and 128Mbit SD-Ram. All memories are sharing the EBU_AHB- BUS to SGold2¹.

3.2.3.1 Flash

It is a non-volatile-, re-programmable- memory (SW-updateable), with a high performance interface. The mobile-SW can be executed directly. The Flash has an unchangeable serial number.

Intel Sibley:

Memory Size:	512 Mbit (64 MByte)
Data Bus:	16 Bit
IO / Core Voltage Supply:	typ. 1.8V
Boot Block:	Top
Access Time:	
Asynchronous (Initial) Mode:	93 ns
Synchronous Burst Mode:	108 MHz / 7ns clock to data output
	Support 8-, 16-, or continuous-burst-read
Architecture:	8 partitions
Dual Operations:	Read while Write (RWW) or Read while Erase (RWE)
Program Feature:	Single Word and Buffer Programming
	Factory Programming (VPP = 9 V) (not used)

3.2.3.2 Low Power SDRAM

The SDRAM (Synchronic Dynamic Random Access Memory) is for volatile data.

Memory Size:	128 Mbit (16 MByte)
Data Bus:	16Bit
IO / Core Voltage Supply:	typ. 1.8 V
Synchronous Burst Mode:	104MHz (CL=3) Burst
Features:	Four banks operation / Burst read single bit write operation / Auto refresh

3.2.4 Camera

The camera module consists of a 1.3MPix-CMOS sensor, image processor circuitry, lens and holder, lens hood, cover glass and housing to attach the camera on the PCB. It is the same camera used for the X.75 platform. Connectivity from camera module to PCB is realized by a Chameleon-specific flexible cable.

Resolution:	1.3 MPix (1280x1024 pixels)
Focus range [mm]:	300 - ∞
Centre Resolution CTF(30%):	200 lpph

¹ The X75 Products that are related to the R65 Platform still have a SGOLD2 and the Memory configurations are 256Mbit Code Flash stacked with 128Mbit LP-SDRAM

Data Format YUV:

MPix, VGA, QVGA, QQVGA, CIF, QCIF

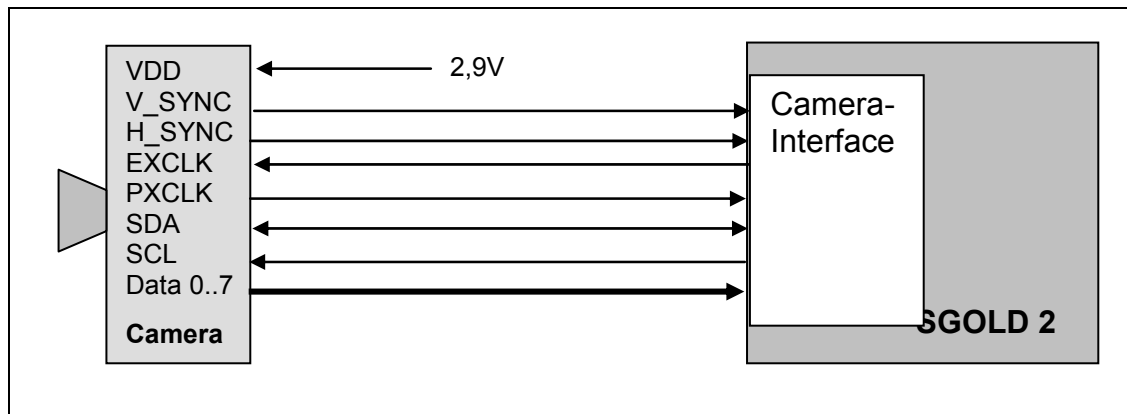


Figure 14 Electrical Camera Interface

3.2.5 Pin list (board to flex connector)

Pin Number	Pin Name	Description	I/O ¹
01	SCL	I2C Clock	O
02	SDA	I2C Data	I/O
03	GND	Ground	N/A
04	V_SYNC	Vertical Synchronization	I
05	H_SYNC	Horizontal Synchronization	I
06	GND	Ground	N/A
07	Pixel Clock	Pixel Data Clock	I
08	GND	Ground	N/A
09	EXCLK	Camera Clock	O
10	GND	Ground	N/A
11	VDD	Supply Voltage 2,9V	N/A
12	Data 0	Data bit 0	I
13	Data 1	Data bit 1	I
14	Data 2	Data bit 2	I
15	Data 3	Data bit 3	I
16	Data 4	Data bit 4	I
17	Data 5	Data bit 5	I
18	Data 6	Data bit 6	I
19	Data 7	Data bit 7	I
20	GND	Ground	N/A

¹ Seen from the processor

3.2.6 Internal LED Flash

The LED Flash Module is controlled by the SGold2 and can be operated in two modes. One is the video/torch mode (low current) and the other the flash mode (high current). The duration of the flash can also be set by the SGold2. It has to be guaranteed that the flash LED is switched off after the defined flash duration especially after a software breakdown. (HW Timer)

Feature:

Video/Torchlight (10 Lux at 50 cm)
Flash Light (70 Lux at 50 cm)
Red Eye Reduction/ Pre-flash

Dimensions: 4 mm x 4 mm x 1,5 mm
Luminous Intensity: 8,5 cd (min) @ 20mA, forward voltage
Radiation Angle : +/- 25°
Lifecycle : 30000 flashes

The flash LED consists of four dies, which have to be connected in series. Each die will be driven with about 65mA in flash mode (Pulse) and 7-10mA in the torch mode (DC). The Flash LED would be turned on at least for 2 V-SYNC cycles to guarantee a complete image exposure. The flash LED will be used in the low light mode of the camera (6.25 fps), therefore the minimum switch on time in the flash mode is 320ms. To avoid any damage of the LED the turn on time should not exceed 400ms for high peak currents (~ 90mA).

Due to the fact that the current consumption in Talk-Mode, especially in a TX-Burst, is very high, the battery voltage will drop several 100mV. If the Flash is also active during a TX-Burst the voltage will drop dramatically in this case. So the Flash will be disabled during TX-Burst by SW.

Regarding the low battery capacity and the high current consumption during Flash the battery voltage will also drop. To avoid a hard Switch-Off of the phone the Flash-functionality will only be enabled until a certain voltage limit.

White LED's are very sensitive to electronic discharge, therefore counter measurements are necessary. Also the factory has to take care of this, because the LED vendors only guarantee 500V.

Block diagram:

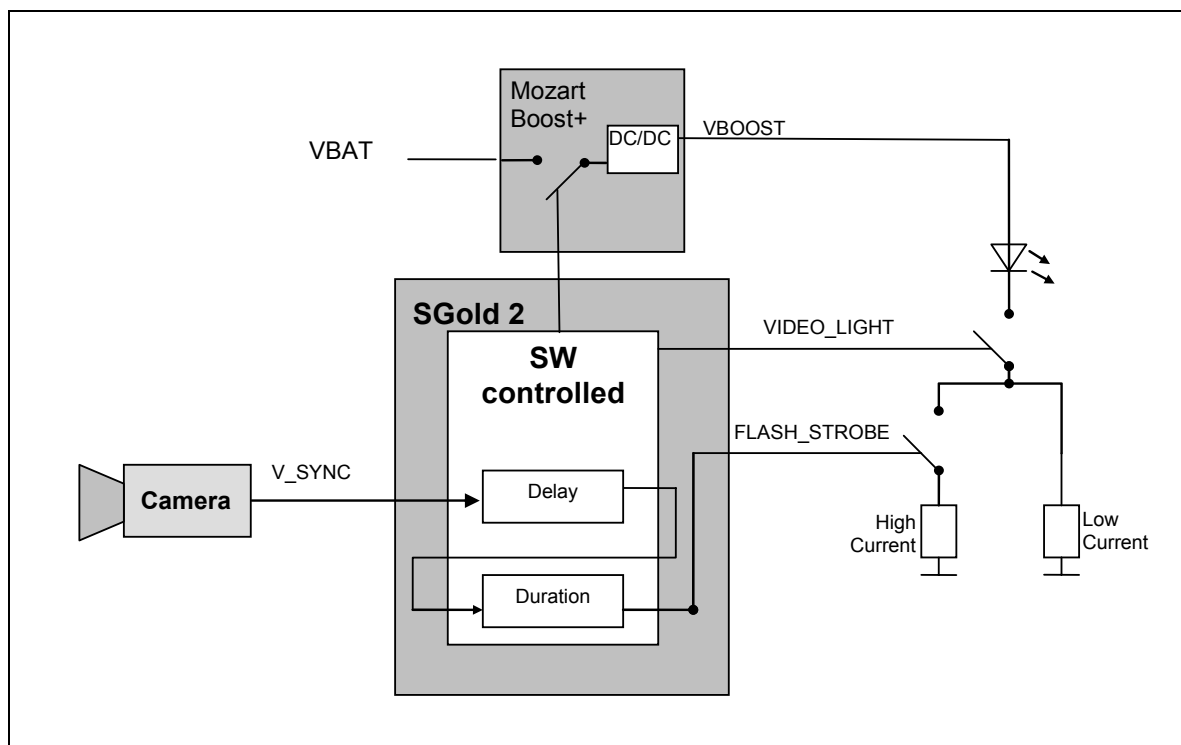


Figure 15 Flash Light Block Diagram

3.2.7 Display Module

3.1.1.1 General description

In the mobile phone a display module with an intelligent graphic Liquid Crystal Display (LCD) is used. The display module consists of the following parts and features

Active Matrix Liquid Crystal Display Panel, transfective, 2.0", 240x320 dots, 262k colors, normally black with wide viewing angle technology (typ4)

The display will have:

- a display controller mounted on the display glass (COG) which is connected to a FPC inside the module,
- a Light guide with 4 white LEDs in serial connection,
- a PCB/FPC with all passive components. and
- a metal frame.

It will be full contrast adjusted

The display is connected to the slider FPB via a 20-pin B2B connector containing a parallel 8-bit interface.

3.1.1.2 Expected optical performance

Items	Reflective Mode		Transmissive Mode		Unit
	Min	Typ	Min	Typ	
Main-Display					
Contrast Ratio	10	15		250	-
Luminance	-	-	200	240	cd/m ²
Color Gamut Ratio Related to NSTC	7	9	55	65	%

3.1.1.3 Mechanical performance

Main Display		
Resolution :	240x320	
Dimensions :	module dimensions: 36.5 mm x 52.2 mm active area : 30.24 mm x 40.32 mm	
Pixel Size :	0.21 mm x 0.21 mm	1 pixel consists of 3 sub-pixels in red, green and blue
Technology :	TFT	with color filters
Operating Temperature:	-20°C....+55°C	
Backlight :	Light guide + 4 white side-shooter LEDs / mounted on the flex foil inside the module	A3 color rank from Nichia

3.1.1.4 Available Display modules

Supplier	Supplier Part Nr.	Controller / Sub controller	BENQ SAP
Philips Epson	TBD. L5F30357P00	Toshiba JBT6K Rohm BU66E01CH-3BW	A5B00075577893
Philips Epson (from B1 run on)	TBD. L5F30542T00	Toshiba JBT6K NEC	A5B00075874169

The display supplier can be detected automatically by the mobile phone software because of different hardware coding on the flex foil. For the hardware coding the following resistor setting is available:

Display Supplier	Supplier	Revision		
	R1	R2	R3	Description
Philips	0	0	1	(B1)
		0	1	(B1+)
		0	1	(B2)
		Tbd	tbd	(Pilot/MP)
Epson	1	1	1	A (B1)
		1	0	B (B1 recent)
		0	1	C (B1+)
		0	0	D (B2)

1: there is a 100k mounted
0: there is no resistor mounted
DIF_CS <-> DIF_RS = R1
DIF_CS <-> DIF_D0 = R2
DIF_CS <-> DIF_D1 = R3

3.1.1.5 Interface of the display module.

All displays need a supply voltage of VDD_2.9 = 2.90 V.
For VDD_IO, voltages from 1.8V up to 2.9V can be used without any modification of the hardware.
Four white side-shooter LEDs for illumination are mounted on the module FPC. The current for the LEDs is limited to 18mA by a current sink on the mobile phone PCB. All 4 LEDs are driven serial.
For data transmission there is used an 8-bit parallel interface with a maximum transfer-rate of 10 MHz.
To avoid tearing effects during data transmission a synchronisation signal is available on pin "LCD-sync".

The connector (on the phone side) has the following layout.

Pin Number	Pin Name	Description
1	DIF_RESET1	Reset; low active
2	DIF_D1	Parallel 8bit data IF D1
3	DIF_D0	Parallel 8bit data IF D0 (LSB)
4	GND	Ground
5	DIF_CD	Data=high/Command=low
6	2V85	Supply Voltage LCD 2,9V typ
7	VINT	Supply Voltage I/O 2.6V typ.
8	DIF_CS1	Chip Select, low active
9	LIGHT_DISP	Supply Voltage LED-
10	VBOOST_LIGHT	Supply Voltage LED+
11	DIF_VSYNC	Picture Sync against Tearing Effect
12	GND	Ground
13	DIF_WR	Write (Clock), active at rising edge

Pin Number	Pin Name	Description
14	DIF_RD	Read, active at falling edge
15	DIF_D2	Parallel 8bit data IF D2
16	DIF_D3	Parallel 8bit data IF D3
17	DIF_D4	Parallel 8bit data IF D4
18	DIF_D5	Parallel 8bit data IF D5
19	DIF_D6	Parallel 8bit data IF D6
20	DIF_D7	Parallel 8bit data IF D7 (MSB)

3.1.1.6 Realization Principles / Boundary Conditions

The typical operation temperatures are: -20°C to +55°C. The reduced functional temperature range is -25°C to +65°C (the contrast will not be according to the specifications, but will still be readable).

3.1.1.7 Contrast and Color Adjustment

For all display modules no contrast adjustment is necessary. The contrast is fixed in the module. It is not possible to change the contrast by the mobile phone software. Also the color adjustment of the display panel is fixed by the supplier.

3.1.1.8 Illumination

The 4 backlight LEDs of the display are connected in series and supplied by a constant current source, to ensure the same brightness and color. The brightness of the display backlight is driven by a PWM signal. The same PWM signal is driving the brightness of the Slider-Keypad (see chapter Keyboard and Display Illumination).

3.1.2 SLI-LED

Due to the fact that the display will be switched off in Standby-Mode for power saving reasons, a signaling LED is used for indicating that the device is switched on and working or any other action has occurred (incoming call, network lost, download ongoing, etc.). It is placed in the slider part and its color is green. The LED current is controlled by the Mozart Boost+. The blinking frequency is controlled by the Mozart Boost+ and will be set by SW.

3.1.3 Hall switches

To detect the open/close slider positions, the Chameleon has two hall sensor modules mounted on the main PCB, which are stimulated by a magnet mounted in the slider part.

3.1.4 MMI

3.1.4.1 Keyboard

3.1.4.1.1 Base Keyboard

The Base-Keypad matrix consists of the keys "0" to "9", "*", "#". The keys are realized by metal domes over contacts located on main board

3.1.4.1.2 Slider Keyboard

The Slider-Keypad matrix consists of two soft keys, a 5-way-navy-key, a "SEND"-key, and an "END"-key. They are placed on Slider-FPC, which is folded and stabilized with a metal stiffener in the keypad area. The "END"-Key has a double-function. If the mobile phone is switched off the "END"-key is sup-

ported by a resistor with RTC-Voltage. When the key is pressed the voltage is pulled down to zero and the power supply ASIC switches on the mobile phone. If the mobile phone is switched ON, the "END"-key acts as a normal key same as the other ones. However if the "END" key is pressed for a longer time, the software recognizes this and switches the power supply ASIC off via I²C command.

3.1.4.1.3 Side Keys

In addition, two side keys (two rocker keys) are connected to the matrix. They are located on the main PCB. The functions are volume up and down.

3.1.4.2 Keypad Illumination

The illumination of the Base-Keypad will be done as follow:

6x white LEDs (top shooter) driven by max. 5mA / LED

The illumination of the Slider-Keypad will be done via 4 high brightness LEDs in serial; color: white, type: **side**-shooter, driven by max. 5mA / LED).

Note: The illumination of the Slider-Keypad is coupled with the illumination of the display.

3.1.5 SIM

The SIM-interface of S-GOLD2 is powered with 2.9V on supply-line VDD_SIM (SGOLD domain VDD2.1). Although VDD_SIM is always 2.9V the interface supports both 3V SIM-cards as specified in GSM 11.12 and 1.8V SIM-cards as specified in GSM 11.18, because it is mandatory for 1.8V SIM-cards to support 3V \pm 10%.

The SIM interface consists of the three signals SIM_CLK, SIM_RST and SIM_IO for communication and the Power-line VDD_SIM for supplying 2.9V to the SIM-card. VDD_SIM is supplied from the PM-ASIC and is switchable via an I²C-command. The Data-line SIM_IO should have open-drain drivers on both sides of the interface, thus a the external pull up resistor R1614 to VDD_SIM is necessary.

C1605 is buffering the supply-voltage for the SIM-card and should be placed close to the SIM-Reader. A special feature inside the PM-ASIC guarantees, that C1605 is actively discharged within 1ms after turning the supply voltage VDD_SIM off, as requested by GSM 11.11.

To ensure electromagnetic compatibility for SIM interface an ESD/EMI-filter Z1601 is used. This filter should also be placed close to the SIM-Reader.

3.1.6 Bluetooth

The Bluetooth Interface is based on the BRF6150 (D5100) from Texas Instruments. The BRF6150 is a single chip, this means the digital base-band and the radio part are implemented on the same silicon. The necessary firmware up to the HCI interface is stored in a diffusion ROM. As package a 4.6 mm by 4.6 mm S-PGBA-N63 package is used.

The Bluetooth-Device-Address and the initialisation settings and values are stored in the GSM-Flash (EESIMU). During the start up of the BRF6150 the Mobile software writes this information to the device. Each Mobile Phone needs a unique Bluetooth-Device-Address. The BRF6150 support the possibility to use a patch RAM for bug fixes. The needed patch must also be stored in the EESIMU. It is important that the patch is stored in an additional Block.

The interface between the BRF6150 and GSM-Host-System consists of the following parts:

- Power supply (Power supply RF and base-band, I/O power supply)

- Clock supply (26MHz, 32,768 kHz)
- PCM interface (four lines, for voice sample)
- UART interface (four lines, for data and control)
- Miscellaneous (RESET)

3.1.7 Memory Card

The memory card is controlled by the MMC/SD interface of the SGOLD2. The actual card type is called MicroSD. Currently commercially available is the Transflash™ Card, a proprietary SD-card from SANDISK with a very small outline. But MicroSD Cards will soon also be produced by other manufacturers. The SD-card interface is based on the MMC-card interface with three signals MMC_CMD, MMC_DAT, MMC_CLK. The Data bus of the SD card might be switched to 4-Bit mode if higher data rates are required. This feature is not supported in the current HW design due to restrictions by the flex PCB.

Physical pin layout of MMC/SD/microSD cards:

	9	1	2	3	4	5	6	7	8
MMC		CS	CMD	VSS1	VDD	CLK	VSS2	DAT	
SD	DAT2	CD/DAT 3	CMD	VSS1	VDD	CLK	VSS2	DAT0	DAT1
microSD	DAT2	CD/DAT 3	CMD		VDD	CLK	VSS	DAT0	DAT1
	1	2	3		4	5	6	7	8

SPI mode

The MMC-interface of SD/MMC cards can be switched into SPI mode with the first initialization command. In order to prevent the card from switching into SPI mode, the level on Pin2 (CD/DAT3) of the card must be high during the initialization. We use a pull up resistor on this pin.

Card detection

The MicroSD card has differently from the normal sized SD/MMC card, only one GND pin. That is why we cannot use the same detection as with MMC cards. The actually used Micro-SD-card reader contains an electrical isolated switch, which creates a state change on a SGOLD2 GPIO. With the external switch, it is possible to detect if a card is present or not, even if the card has been removed or inserted during a power down mode, where the card power is off.

Card reset

SD/MMC cards do not have a reset input. A hardware reset must be done by cycling down the power supply of the card.

3.1.8 FM-Radio

Chameleon has an FM-Radio mounted on the main PCB. The FM-Radio is a normal FM-Radio without RDS from Philips (TEA 5761 UK). The FM-radio is controlled by I²C and the audio is connected via Mozart Boost+/Twigo Boost+.

3.1.9 Vibration Motor

All details are specified in [Fehler! Verweisquelle konnte nicht gefunden werden.].

The vibration motor is mounted in the flip case. The electrical connection to the PCB is realized with spring contacts.

The SL65 Vibration motor will be reused. The vibration motor uses a silicon grommet motor housing to improve drop shock performance.

The vibration motor is connected with vibration motor drive of Power Management Unit.

3.1.10 Electro Acoustic

In downlink Chameleon uses two transducers to reproduce the sound signal:

For the earpiece function a 6x14mm receiver (same part as in CF110-Flamingo; impedance 32Ohm nominal) is used; this transducer operates only in the handset mode, i.e. it reproduces the voice call far end signal when the phone is placed at the users ear.

Mechanically the receiver is located at the "northern" end of the slider part. The receiver has a "closed" backside (i.e. it doesn't vent into the phone housing); instead the venting is realized by a small duct leading to the "northern" end of the phone.

A metal baffle on top of the receiver module provides ESD protection.

The speaker module, a box with a closed back volume of approx. 0.8ccm, is used to perform hands-free mode, multimedia/sound ringer and signal tone playback.

The module, based on the X75 speaker core (8 Ohms impedance) is located in the base part on the back side of the mobile phone and is especially built to fit in the Chameleon mechanical design.

The Speaker outlet is realized by a small part of a ring around the camera optics on the backside of the phone.

The microphone is a reflow-solderable, omnidirectional 4mm ECM.

It is soldered onto the backside of the main PCB, partly underneath the battery. Since there are severe height restrictions at this position, a very thin (t=1.3mm) microphone variant had been chosen.

The mic inlet is sealed by a PU foam ring (gasket), which is glued into the base part lower using a self-adhesive tape.

Due to the usage of an omni directional Microphone type, only one sound inlet is necessary.

To reduce the current consumption in standard handset mode, the receiver and the microphone circuit are connected in the analog domain with the AFE of the S-Gold. This measure improves the talk time in comparison to the digital I²S / Mozart AFE solution used in the first X75 platform design.

The Speaker is directly driven by the Mozart ASIC Speaker amplifier.

3.1.11 Power Supply, Battery, Charging

3.1.11.1 Overview

Most of the important functions for the power supply of the phone are carried out by the power supply ASIC Mozart Boost+/Twigo4 Boost+. There are some additional power supply regulators for supply of the camera and Micro SD-card. The POWER-pin of the I/O-Connector is for charging the battery with an external current limited power supply. The standard charger is an unregulated open loop switched-mode charger.

The following restrictions must be observed:

- The phone cannot be operated without the battery being inserted.
- The phone will be damaged if the battery is inserted with wrong polarity (the mechanics of the phone prevent the battery from being put in a wrong way. The electric

system assumes that the battery has been inserted correctly. This must be ensured via suitable QA measures).

- The phone will be damaged if a charger with wrong polarity is connected. The correct polarity has to be ensured by suitable QA measures.

3.1.11.2 PMU Mozartboost+ / Twigo4boost+

The power supply ASIC is composed of following functions:

- Powerdown-Mode
- Sleep Mode
- Trickle Charge Mode
- Power on Reset
- Digital state machine to control switch on and supervise the μ C with a watchdog
- 17 Voltage regulators
- internal Controllers for Buck/Boost-converters using external components
- Low power voltage regulator
- Additional output ports
- Voltage supervision
- Temperature supervision with external and internal sensor
- Battery charge control
- TWI Interface (I²C interface)
- Bandgap reference
- High performance audio quality
- Audio multiplexer for selection of audio input
- Audio amplifier stereo/mono
- 16 bit Sigma/Delta DAC with Clock recovery and I²S Interface
- SW configurable HW Pattern generator for Service Light and Battery trickle charge indication after deep discharge condition.

3.1.11.3 Voltage Regulators and DC/DC converters

Power Management Unit (PMU, "Mozart Boost+") Power Supplies

	Voltage	Voltage option change per	Current [mA]	start up default	ON/OFF by	Power supply name Chameleon	Domain
REG 1	2,9V (+/-2%)	I2C default per metal	0...140	on	I2C	2.9V	SGOLD, Display
	2,65V (+/-2%)						
REG 2a	1,5V (+/-2%) 1,3V...1,5V in 100mV steps	I2C default per metal	0...300	on		1.5V_UC	not used
REG 2b	1,5V (+/-2%) 1,3V...1,5V in 100mV steps	I2C default per metal	0...100	on	I2C	1.5V_DSP	not used/ turned off by SW
REG 3	2,65V (+/-2%)	I2C default per metal	0...140	on		2.65V	SGOLD, Bluetooth, Hall Switch, Audio/Video Interface
	2,5V (+/-2%)						
MEM REG1	1,8V (+/-2%)	I2C default	0...250	on	I2C	1.8V_MEM1	SGOLD, Flash/SDRAM, Au

	2,5V (+/-2%)						
MEM REG2	1,8V (+/-2%)	metal	0...150	on	I2C	1.8V_MEM2	not used /turned off by SW
	2,5V (+/-2%)						
AUDIO REGa	2,9V (+/-2%)	n.a.	0...190	off	I2C	VAUDREGA	internal use
AUDIO REGb	2,65 (+/- 2%)	n.a.	0...30	off	I2C	n/a (Mozart internal use)	internal use
RF REG1	2,74V (+/-2%)	I2C default per metal	0...150	Sleep1_N or Sleep2_N	I2C	VDD_RF1	RF Tranceiver
	2,54V (+/-2%)						
	2,85V (+/-2%)						
RF REG2	1,53V (+/-2%) (CA Version)	I2C default per metal	0...180mA	depends on RF2_EN input	I2C	VDD_RF2	RF Tranceiver
	2,7V (+/-2%)						
	2,85V (+/-2%)						
RF REG3	1,8V (+/-2%)	I2C default per metal	0...180	depends on RF3_EN input	I2C	VDD_BT	Bluetooth
	2,7V (+/-2%)						
	2,85V (+/-2%)						
AFC REG	2,65V (+/-2%)	I2C default per metal	0...2	always active	n.a.	VDD_AFC	SGOLD
LP_REG	2,0V	I2C default per metal	0...2	always active	n.a.	VDD_RTC	SGOLD
SIM REGa	2,9V (+/-2%)	I2C default per metal	0...70	off	I2C	VDD_SIM	SIM
	1,8V (+/-2%)						
SIM REGb	2,9V (+/-2%)	I2C default per metal	0...10	on	I2C	n/a (not used)	not used
	1,8V (+/-2%)						
USB REG	3,1V (+/-2%)	n.a.	0...40	on	I2C	VDD_USB	SGOLD
VIBRA	2,8V (+/-2%)	n.a.	0...140	off	I2C	VDD_VIBRA	Vibra
DCDC STEP DOWN (BUCK-Converter)	1,5V	I2C	700	on	I2C	VBUCK	SGOLD
	2,1V						
BOOST-Converter:	19V	ext. Resistor divider	60mA for 400ms 30mA continuous	off	I2C	VBOOST	Flash-LED, Keypad backlight, Display backlight

Non PMU power supplies

	Voltage	Voltage option change per	Current [mA]	start up default	ON/OFF by	Power supply name Chameleon	Domain
LDO: LP3985ITLX-2.9	2,9V	n/a	150	off	VEN pin	DVDD_CAMERA	Camera
LDO: LP3985ITLX-2.9	2,9V	n/a	150	off	VEN pin	MMC_VCC	MicroSD card

3.1.11.4 Battery

A Li-Ion Battery with a nominal capacity¹ of 760 mAh (at relevant time frame), defined for the Obsidian project, will be used.

Under GSM – discharge conditions² the battery will provide a discharge capacity of 730 mAh.

An internal safety circuit prevents from over-charging, over-discharging and over-current.

Actually two sources of this battery are available

3.1.11.5 Charging Concept

3.1.11.5.1 General

The battery is charged in the phone. The hardware and software is designed for Li-Ion 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 takes place in the background (the customer can see this via the “Charge” symbol in the display). During normal use the phone is being charged (restrictions: see below).

Charging is enabled via a PMOS-Switch in the phone. This PMOS-Switch closes the circuit for the external charger to the battery. The processor takes over the control of this switch depending on the charge level of the battery, whereby a disable function in the PMU hardware can override/interrupt the charging in the case of over voltage of the battery

For controlling the charging process it is necessary to measure the ambient (phone) temperature and the battery voltage. The temperature sensor will be an NTC resistor with a nominal resistance of 22k Ω at 25°C. The determination of the temperature is achieved via a voltage measurement on a voltage divider in which one component is the NTC. Charging is ongoing as long the temperature is within the range +0°C to 50°C. The maximal charge time will be approx. 3 hours with a standard charger. With travel charge the charge time is approx. 2 hours

3.1.11.5.2 Measurement of Battery voltage, Battery Type and Ambient Temperature

The voltage equivalent of the temperature and battery code on the voltage separator will be calculated as the difference against a reference voltage of the S-GOLD2. Inside the S-GOLD2 are some analog to digital converters. They are used to measure the battery voltage, battery code resistor and the ambient temperature.

3.1.11.5.3 Timing of the Battery Voltage Measurement

Unless the battery is being charged, the measurement shall be made in the TX time slot. During charging it will be done after the TX time slot.

There will be measurements inside and outside the burst rated.

3.1.11.5.4 Recognition of the Battery Type

The two different batteries will be encoded by different resistors within the battery pack itself.

Source 1 (Samsung) - Internal recognition resistor 13kOhms.

Source 1 (LG) - Internal recognition resistor 14kOhms.

3.1.11.5.5 Charging Characteristic of Lithium-Ion Cells

Li-Ion batteries are charged with a U/I characteristic, i.e. the charging current is regulated in relation to the battery voltage until a minimal charging current has been achieved. The maximum charging current is given by the connected charger. The battery voltage must not exceed 4.2V \pm 50mV average. During the charging pulse current the voltage may reach 4.3V. The temperature range in which charging of the phone may be performed is in the ranges from 0...50°C. Outside this range no charging takes place, the battery only supplies current.

¹ Battery will be discharged with 150mA, down to a voltage of 2,75 V

² Battery will be discharged with 2A(0.6ms)+0.25A(0.4ms) down to 3.2V

3.1.11.5.6 Trickle Charging

The PMU is able to charge the battery at voltages below 3.2V without any support from the charge SW. The current will be measured indirectly via the voltage drop over a shunt resistor and linearly regulated inside the PMU by means of the external FET. The current level during trickle charge for voltages <2.8V is in a range of 20-50mA and in a range of 50-100mA for voltages up to 3.2V. To limit the power dissipation of the dual charge FET the trickle charging is stopped in case the output voltage of the charger exceeds 10 Volt. The maximum trickle time is limited to 1 hour. As soon as the battery voltage reaches 3.2 V the PMU will switch on the phone automatically and normal charging will be initiated by software.

3.1.11.5.7 Normal Charging (Rapid charge)

For battery voltages above 3.2 Volt and normal ambient temperature between 0 and 50°C the battery can be charged with a charge current up to 1C. This charging mode is SW controlled and starts if an accessory (charger) is detected with a supply voltage above 6.4 Volt by the PMU ASIC. The level of charge current is only limited by the charger.

3.1.11.5.8 USB Charging

The PMU can support USB charging when USB charging is integrated in the charging software. If charge voltage is in the range 4.4V to 5.25 V USB charging is ongoing. During USB charging only limited charging is possible. Charge current is limited to 75, 150, 300 or 400mA.

3.1.12 Interfaces

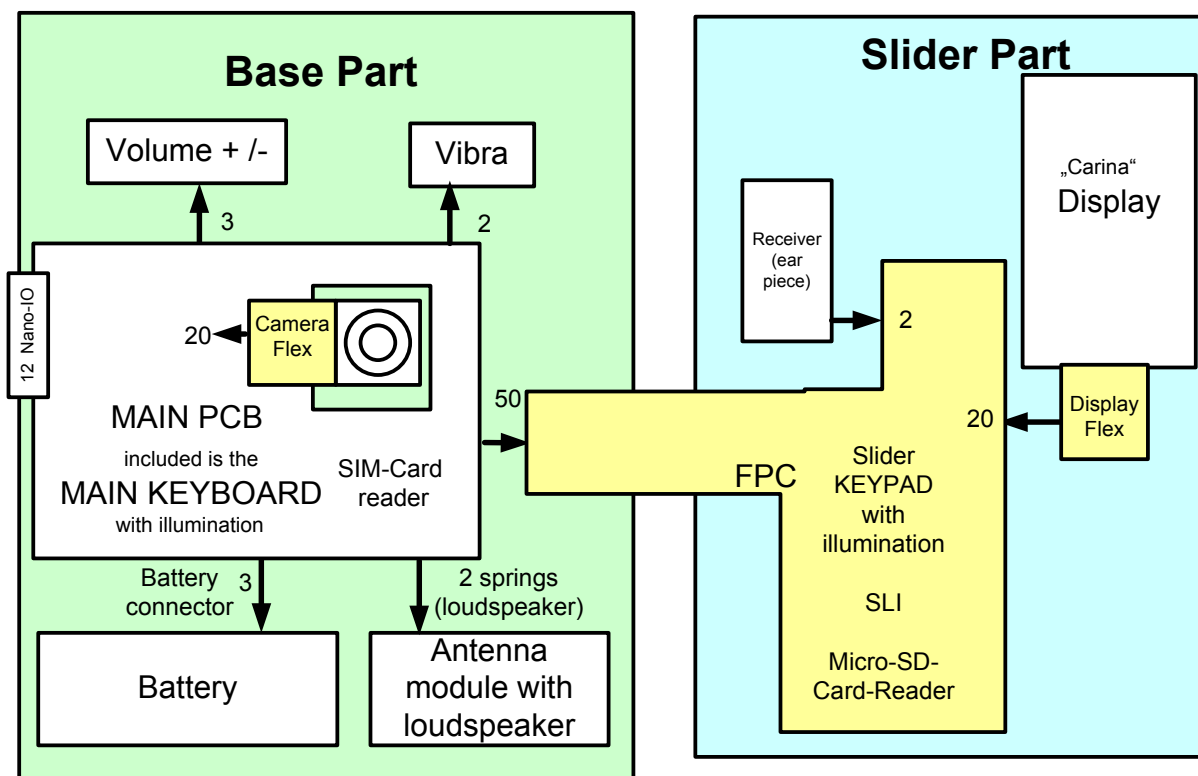


Figure 16 Overview interfaces

3.1.12.1 Main-Board <-> Camera

The camera connector is placed on the main board

Camera Interface

Function	Signal	Pin No.	Signal	Function
I2C Clock	SCL	1	20	GND
I2C Data	SDA	2	19	CAM_DAT7
Ground	GND	3	18	CAM_DAT6
Vertical Synchronizati- on	V_SYNC	4	17	CAM_DAT5
Horizontal Synch.	H_SYNC	5	16	CAM_DAT4
Ground	GND	6	15	CAM_DAT3
Pixel Data Clock	CAM_PCLK	7	14	CAM_DAT2
Ground	GND	8	13	CAM_DAT1
	CAM_CLKOU			
Camera Clock	T	9	12	CAM_DAT0
Ground	GND	10	11	DVDD_CAMERA
				Supply 2,9V

3.1.12.2 Main-Board <-> Slider-FPC

Main connector Main PCB - Flex-PCB

	Pin No.	
GND	1	50
GND	2	49
VBOOST	3	48
GND	4	47
LIGHT_DISP	5	46
GND	6	45
DISP_CS1_EMI	7	44
DISP_CD_EMI	8	43
DISP_D0_EMI	9	42
DISP_D1_EMI	10	41
DISP_RESET1_EMI	11	40
GND	12	39
2.9V	13	38
2.65V	14	37
GND	15	36
DISP_WR_EMI	16	35
GND	17	34
DISP_VD_EMI	18	33
DISP_RD_EMI	19	32
DISP_D2_EMI	20	31
DISP_D7_EMI	21	30
DISP_D6_EMI	22	29
DISP_D5_EMI	23	28
DISP_D4_EMI	24	27
DISP_D3_EMI	25	26

3.1.12.3 Side key interface

The side key contacts the main PCB

Contact pad	Signal	Function	Switch
XG2703	KP_IN2_EMI	UP (Vol+)	Key to GND
XG2701	GND	Reference	
XG2704	KP_IN2_EMI	DOWN (Vol-)	Key to GND

3.1.12.4 Camera – Display Interface Module

In X95 generation the ATI chip is removed; camera as well as display are driven directly by the S_GOLD2™ chip. Commands to the camera are sent via the I2C interface, the picture-data output of the camera goes over a parallel 8-bit interface.

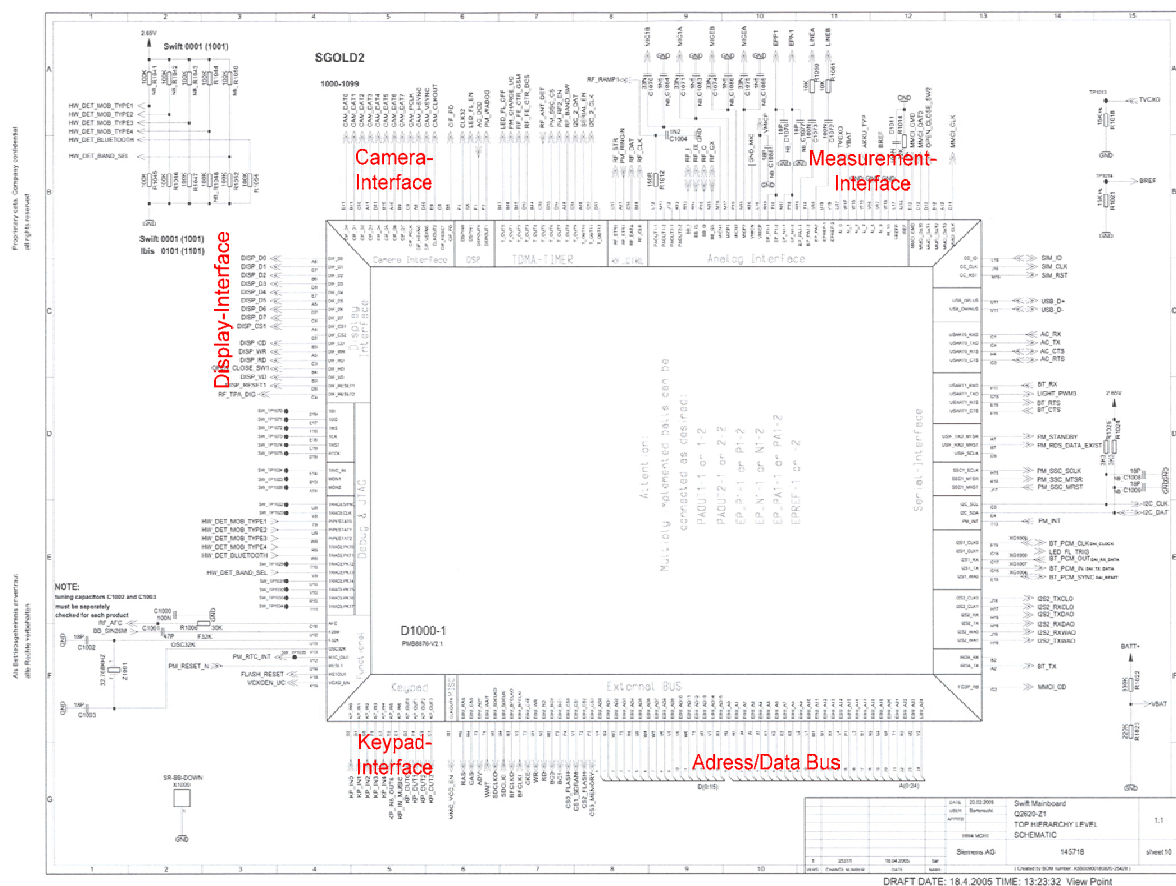


Figure 17 Electrical Camera-Display Interface on SGold2

3.1.12.5 Interface SIM Module

All level and timing related requirements are described in ISO/IEC 7816-3, chapter 4.3 "Voltage and current values". (Caution: S-GOLD2 spec refers to this spec for "Identification cards", but the same figures can be found in the GSM-spec 11.11, chapter 5 "Electronic signals and transmission protocols", which is the relevant spec for mobile phone type approval.)

The SIM card reader is soldered on the main PCB.

PIN	Pin Name	Signal	Function
1	CCCLK (SG2)	SIM_CLK	Clock supply from SG2 to SIM-card
2	CCRST (SG2)	SIM_RST	Reset line from SG2 to SIM-card
3	CCIO (SG2)	SIM_IO	Bidirectional data-line between SG2 and SIM-card
4	VSIMREGA (PM_ASIC)	VDDSIM	SIM-card supply voltage 2.9V

3.1.12.6 Micro SD Card Reader

The Micro-SD-Card reader is soldered on the slider-FPC

Signal	Function	Direction at MMC	Driver type
MMC_DAT	Data	Bi-directional	Push-pull
MMC_CMD		Bi-directional	Push-pull/open-drain
MMC_CLK	Clock	Input	n/a
MMC_VCC	Power supply	Input	
MMC_CD	Card detection	Output (no electrical connection to card)	Mechanical switch in reader
GND	GND		

3.1.12.7 Interface Vibra Module

The vibra-module contacts the main PCB

Pin	Name	IN/OUT	Level	Remarks
1	VDD_VIBRA	O	$U \approx V_{batt} - U(FET)$ $I_{max} \approx .90 \text{ mA}$	Vbatt will be switched by PWM-signal with internal FET to VDD_Vibra in Mozart-Asic
2	GND		GND	

3.1.12.8 Interface Earpiece

Note:

The earpiece is connected on the Slider FPC
The pins are positioned on the earpiece
Interface IN/OUT seen from the radio part

Pin	Name	IN/OUT	Level	Remarks
1	EPP1	O	3.7 Vpp (relative to EPN1) @ 16Ω load and $U_{Batt}=4.0 \text{ V}$	1st connection to the internal earpiece. Earpiece can be switched off in the case of accessory operation. EPP1 builds together with EPN1 the differential output to drive the "earpiece"
2	EPN1	O	3.7 Vpp (relative to EPP1) @ 16Ω load and $U_{Batt}=4.0 \text{ V}$	2nd connection to the internal earpiece.

3.1.12.9 Interface Speaker Module

Pin	Name	IN/OUT	Level	Remarks
-----	------	--------	-------	---------

1	Mono1_out	O	5.5 Vpp (relative to Mono1_out) @ 6.4Ω load and $U_{\text{Batt}}=4.0 \text{ V}$	1st connection to the internal Speaker. Ear-piece can be switched off in the case of accessory operation. Mono1_out builds together with Mono2_out1 the differential output to drive the "Speaker" for hands-free and multimedia operation
2	Mono2_out	O	5.5 Vpp (relative to Mono2_out) @ 6.4Ω load and $U_{\text{Batt}}=4.0 \text{ V}$	2nd connection to the internal Speaker.

3.1.12.10 Interface Battery Module

Pin	Name	Level	Remarks
1	GND	-	Ground
2	AKKU_TYP	0V...2.65V	Recognition of battery/supplier
3	BATT+	3 V... 4.5V	Positive battery pole

Transition resistances $\leq 10 \text{ m}\Omega$ / Contact

3.1.12.11 Interface Radio Control

Details are specified in [Fehler! Verweisquelle konnte nicht gefunden werden.].

3.1.12.12 Interface Accessories (I/O-Module)

For more information about the interface specification between the mobile and the accessories refer to: Hardware Interface Specification [6].

3.1.13 Charger Unit (Mains adaptor)

The power supply consists of a switch mode power supply (self-oscillating transistor flyback converter principle). The charging current of the single range charger has a nominal value of 400mA at 5V and is unregulated, i.e. is mainly dependent on the output voltage. The dependency of temperature and mains voltage variations is only minor. The wide range charger (travel charger) has a nominal value of 620mA at 5V.

Country Variations (for single range charger):

In order to cover all the countries planned, the following variations are necessary:

- Europe 230 V_{AC} nom. /50Hz
- UK 240 V_{AC} nom. /50Hz
- Australia 240 V_{AC} nom. /50Hz
- US/Taiwan 120 V_{AC} nom. /60Hz
- China 220 V_{AC} nom. /50Hz
- Argentina 220 V_{AC} nom. /50Hz

Country Variations (for wide range charger):

In order to cover all the countries planned, the following variations are necessary:

- Europe 90 → 264 V_{AC} 50/60Hz
- UK 90 → 264 V_{AC} 50/60Hz
- Australia 90 → 264 V_{AC} 50/60Hz
- US/Taiwan 90 → 264 V_{AC} 50/60Hz

- China 90 → 264 V_{AC} 50/60Hz
- Brazil 90 → 264 V_{AC} 50/60Hz

The wide range chargers covers all variants. The colour of the housing is black.

The connection lead will have two wires (strands).

The minimum cross-section of the leads shall be for power and GND: AWG26 or AWG30

The length of the leads shall be nominally 1.5m.

The plug-in connection is the 12-pole NF Lumberg nano plug. For the power supply unit, only 2 poles will be occupied.

The Chameleon 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+4+2) layer.

Chameleon-main board layer build up:



PCB-Construction B-Layer									
Layer Name	DWG-Id./Part/Vers.	Art-File	Drill-File	Layer Name	DWG-Id./Part/Vers.	Art-File			
DRILL MASK : plated	227592 000 01	art_21b1.d	drill_1_2.d	GOLD MASK (SOLDER SIDE 1)	227592 000 01	art_2.d			
DRILL MASK : plated	227592 000 01	art_21b2.d	drill_2_3.d	SOLDER MASK (SOLDER SIDE 1)	227592 000 01	art_4.d			
DRILL MASK : plated	227592 000 01	art_21b3.d	drill_3_6.d	Signal_1 (art_5)	227592 000 01	art_5.d			
DRILL MASK : plated	227592 000 01	art_21b4.d	drill_4_7.d	PREFRES	227592 000 01	art_6.d			
DRILL MASK : plated	227592 000 01	art_21b5.d	drill_5_8.d	Signal_2 (art_6)	227592 000 01	art_7.d			
DRILL MASK : unplated	227592 000 01	art_21b6.d	drill_unpl1.d	PREFRES	227592 000 01	art_8.d			
				Signal_3 (art_7)	227592 000 01	art_9.d			
				PREFRES	227592 000 01	art_10.d			
				Signal_4 (art_8)	227592 000 01	art_11.d			
				PREFRES	227592 000 01	art_12.d			
				Signal_5 (art_9)	227592 000 01	art_13.d			
				PREFRES	227592 000 01	art_14.d			
				Signal_6 (art_10)	227592 000 01	art_15.d			
				PREFRES	227592 000 01	art_16.d			
				Signal_7 (art_11)	227592 000 01	art_17.d			
				PREFRES	227592 000 01	art_18.d			
				Signal_8 (art_12)	227592 000 01	art_19.d			
				SOLDER MASK (SOLDER SIDE 2)	227592 000 01	art_20.d			
				GOLD MASK (SOLDER SIDE 2)	227592 000 01	art_21.d			

Explanation of PCB - Data	
Drill Data :	Artwork data :
Data Format : Excellon XXX.YY	Data Format : Gerber XXX.YYY
Scale : 1:1	Scale : 1:1
Units : absolute in [mm]	Units : absolute in [mm]
Routing : present	Routing : present
Trailing zeros : present	Trailing zeros : present
Drill file names : d-x.y (plated holes)	Record length : 06
d-unpl1 (unplated holes)	Artwork file names : art_x
x = drill layer	x = number 1.....21
y = drill and layer	
Documentation :	
Layer table : layer-table.dwg <:TOP> # - Sheet Number of Document	
Drill info : drill-info.dwg <:TOP>	
Mech.Dwg : construction.dwg (PANEL Pans=0.25, Pans4=0.35, Pans5=0.5)	
Text on File Layers that has to be replaced by PCB-Manufacturing :	
PWB : Board position within panel (-r=ring number)	
P-000 : Manuf. Company Identification	
B-000 : Data code	
ELP : Location for electric test work	
LUT : Lot number	
BN : Data Matrix Ecd200	

# : "A.SEP" File Data Single Board	Printed Circuit Board : 43008000200302-52586
# : "B.SEP" File Data Panel	Drill Information : 227592 000 01
# : "C.TXT" Drill-Data Single Board	
# : "D.TXT" Drill-Data Panel	

All Gerber/Excellon data is generated as top view (based on this layer table) !
Manufacturing use, to test: description : A24951-11-120-1-25

DATE	18.10.2005	X95 Swan Complete Variants
NAME	James Wu	All Layout
DATE		LAYER STAMP
DATE		MP PD MW 4 BLP
DATE		BENQ mobile
DATE		227592
DATE		SHEET 1+

Created by PCB number: 43008000200302-52586

Figure 19 Main PCB layer table

3.2.9 Chameleon FPC:

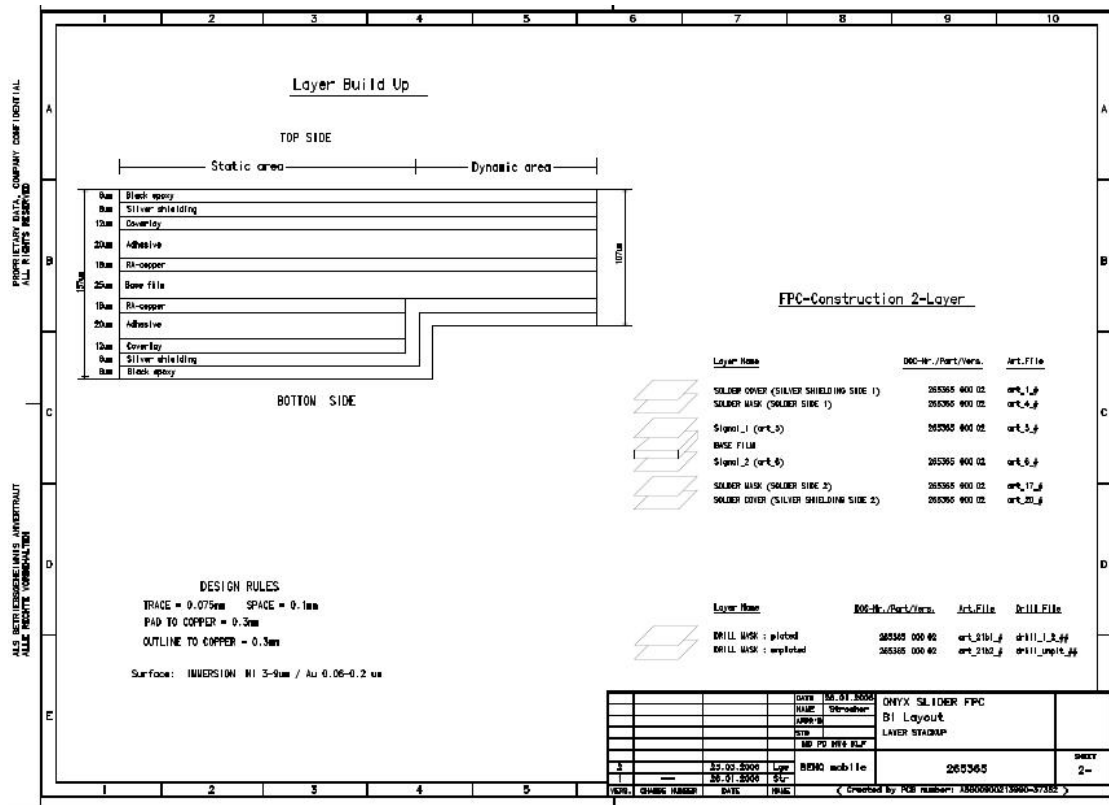


Figure 20 FPC stack up



3.3 EMC/ESD-

3.3.1 Concept

3.3.1.1 EMC

To reduce EMC components on the PCB and to increase manufacturing capacity all EMC components which may not be needed are left empty at the beginning.
By intensive test EA always checks to reduce number of EMC components to what is even necessary.

Galvanized/ Metal Housings

Galvanized or metal parts always have high impact on antenna efficiency, SAR and EMC. Performance depends on the grounding concept of the phone. An optimization or change of grounding concept must result in meeting Antenna/SAR/EMC requirements.

3.3.1.2 ESD

3.3.1.2.1 Mechanical Design

The construction of the phone must be designed in the best possible way to protect all circuits against ESD discharge. Main parts for ESD protection are the designed metallic parts as they look like in the S0 status. All these parts must be grounded.
If this concept for ESD protection is not feasible due to conflicts with mechanical details, negative impacts on SAR or antenna performance, the ESD concept must be changed.

3.3.1.2.2 Keypad

To protect the circuits against ESD discharge the keypads are protected by a metal cover. It is secured that at the end of the metal cover a discharge is grounded.

3.3.1.2.3 SIM

ESD protection circuit for SIM contacts will be as in Minos project. Assuming that the SGOLD2 is used again, less problems are expected.

3.3.1.3 Desensitizing

3.3.1.3.1 Camera

The camera including the camera-flex must be shielded, but due to space reasons this is declined.
The camera-flex will be shielded by one side.
There is a high risk for self interferer when using a non- or partly shielded camera and camera-flex.
If the camera is active while a call is established higher self interferer may increase to a level that is not compliant with BenQ General Quality requirements.
In Camera preview mode RX performance will be reduced caused by the camera clocks.

3.3.1.3.2 Display:

Due to the connection on the flex, higher self interferer are expected.
Furthermore, RF power radiated by the antenna or RF-components may have an impact on the display contrast.

3.3.1.3.3 FM-Radio

Due to placement in the north part of the phone the FM-Radio performance will be degraded.

3.3.1.3.4 Card Reader

Mounting card reader on the flexy causes radiation of high clock rate. EMC measures are very critical because baseband operating card reader close to limits.

3.3.2 Requirements

3.3.2.1 Electromagnetic Compatibility

The EMC-requirements according R&TTE and FCC will be met.
Mobile design concept may cause exceptions from General Quality Requirements (Rev. 1.1.1, 2006-02-21, chapter 7 EMC/EMF) .

3.3.2.2 Antenna performance

The Chameleon antenna is integrated in the mobile. It is mounted on the top side of the base part of the phone (flex foil antenna) and will be connected with 2 Pogo pins to the main PCB. The antenna is a triple band antenna (GSM900, PCN1800, PCS1900). It has to work for opened and closed positions. It is the target to meet FBT requirements (v30_040928) in all use cases. Due to less antenna volume (4.7 ccm) the antenna performance in GSM900 Tx and PCS1900 Tx will be approximately 1dB below FBT requirements.

Actual FBT requirements are: (minimum per channel)

	TX	RX
EGSM	28dBm	-101dBm
PCN	25dBm	-101dBm
PCS	25dBm	-101dBm

3.3.2.3 SAR

BenQ mobile internal requirements:

- Head SAR: 0,6W/kg @ 10g avg.
- Body SAR: <2W/kg @ 10g avg @ 0mm @ 1TX

First head measurements indicated that head target should be achievable. Body worn measurements are to be done.

4 Software

The software for Chameleon is an Obsidian sw with minor changes (see sw delivery plan). The SW will be available from the MCH_C75_Platform (R-IDB SO) database. Customization will follow the guidelines made for Obsidian/Swift.

SW specific documentation for Chameleon can be found here:

\\10.97.109.73\vol1\DATEN\GRUPPEN\KLF_ALL\ENTW\PROJ\X95_Chameleon\PD-TEAM\07_SW

4.1 Software Feature List

Refer to version 041.10 of the X75 SG2 Swift Feature List.

\\10.97.109.73\vol1\DATEN\GRUPPEN\KLF_ALL\ENTW\PROJ\X95_Chameleon\PD-TEAM\07_SW\03_RequirementsManagement\05_Featurelist\03_X75_SG2_Swift_Feature_List_V2_0_041_09_hhs.xls

The final feature list has been released.

4.2 Requirements to SW

Refer to X75 platform requirements Version 2.6 in the following document

\\10.96.232.211\data\projekte\PROJ\X75_Platform\X75_General_Platform\PE-Teams\Requiremts_to_SW\Requirements_to_SW_V2.6_001.xls.

4.3 SW delivery plan:

The major sw deliveries will be shown in the table below.

Since Chameleon is a follower to Obsidian (who is a follower to Swift) there will hardly be any changes to the Obsidian sw.

SW delivery for	SW complexity	Delivery date.
B1 boards	<ul style="list-style-type: none">Correct hw & sw idBFC command support for FM-radio.	7 th of April 2006
B1+ boards		7 th of June 2006
B2 boards		26 th of July 2006
S25 SW freeze	All sw features implemented.	16 th of June 2006
Type Approval	Stable TA SW	18 th of August 2006
Delivery Start		4 th of September 2006

Dates taken from Primavera (2006.03.24)

The following changes will be introduced in the Chameleon sw compared to Obsidian:

- JSR184 update from 1.0 to 1.1.
- Implementation of old CR1860 (Introduction of MySkin Java application)

Beside the above mentioned issues the following will be updated as well for Chameleon:

- MPM
- PCTools
- AT-command set
- Mobicon

5 Accessories

5.1 General

Product and Feature Specifications for Accessory Devices are filed under the folder

<https://ims.icn.siemens.de/livelink/livelink?func=ll&objId=330191734&objAction=Browse&sort=ordering>

5.2 Portfolio

Compatible Accessory Devices for Chameleon are listed below. Please also refer to **[Fehler! Verweisquelle konnte nicht gefunden werden.]**.

Product	Description	Comment
FCL-700 Case	Carrying Case	Leather case or from other fabric
Battery	Battery	Same as for the mobile itself
ETC-100/110 Trav. Chrg.	Travel Charger	
ECC-100 CC Plus	CarCharger Plus	Allows parallel use of CarCharger and Headset
EDS-100 DTS	Desk Top Stand	
HHS-120 HS Purestyle	Headset Purestyle	
HHS-110 HS	Headset	(with PTT button)
HHS-100 HS Basic	Headset Basic	(w/o PTT button)
HHS-150 HS Stereo	Headset Stereo	
HHB-700 HS BT	Headset Bluetooth	Developed for 75 generation
HHB-500/505/600 HS BT	Headset Bluetooth	Developed for earlier generations than 75
HHB-100/130/160 HS BT	Headset Bluetooth	New Bluetooth Headsets with same requirements as HHB-700
HKP-100 CKP	CarKit Portable	
HMH-100	Mobile Holder	Holding device for handsets in car environment
HKW-110 CKE BT Voice	CarKit Bluetooth Easy Voice	Developed for 95 generation
HKW-120 CK BT Voice	CarKit Bluetooth Voice	Developed for 95 generation
HKW-260 CK BT Voice	CarKit BluetoothSIM Access Voice	Developed for 95 generation
CK Linefit	CarKit Linefit	Install type Carkit from third parties using BenQ-Siemens's authentication chip
HKW-700 CKP BT	CarKit Portable Bluetooth	Developed for 75 generation
HKW-710 CK BT	CarKit Bluetooth	Developed for 75 generation
HKW-720 CK BT SIM	CarKit Bluetooth SIM Access	Developed for 75 generation
HKW-600 CK BT 65	CarKit Bluetooth	Developed for 65 generation
DCA-140 DC USB-USB	Data Cable USB-USB	
DSC-100 SS	Sync.-Station	Consists of DeskTopStand and Data Cable USB-USB
DCA-100 DC serial	Data Cable serial-serial	
IHM-100 Music Cable	Music Cable	Lumberg to Cynch connection to connect Home HiFi

5.3 Feature List

All Features are specified in the global X75 Feature List, refer **[Fehler! Verweisquelle konnte nicht gefunden werden.]**.

5.4 Hardware Interface Specification

Please refer to [5] and **[Fehler! Verweisquelle konnte nicht gefunden werden.]**.

5.5 Software Interface

Please refer to [1] and [2].

5.6 Samples

The Accessory Sample Planning is carried out by the Global Lines, without direct dedication to the Project. For details regarding planning process, refer to **[Fehler! Verweisquelle konnte nicht gefunden werden.]**.

For the planning list refer to [7].

6 Manufacturing Concept

6.1 Overview and general requirements

The manufacture of the Chameleon Main PCB will be done on the standard SMD production lines for mobile phones 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 (PLM DIS No. 27867)
 Author: [BMG PHE SCM TLM PT 11](#)

Topic: Guideline shielding technology (PLM DIS No. 72735)
 Author: [BMG PHE SCM TLM PT 11](#)

Topic: Design Guideline "Robust PCB/MP for lead free process"
 Author: [BMG PHE SCM TLM PT 11](#)

6.2 Modules

The differences of SMT-components from top to bottom side will be compensated by the usage of "3 times top/ bottom" PCB panel.

6.3 Components Spectrum

6.3.1 SMD Component Number and Number of Types

Main PCB: M1 status

	Anzahl Bauelemente / number of components		Anzahl Bauelementetypen / number of com. types	
	Side 1 (Top)	Side 2 (Bottom)	Side 1 (Top)	Side 2 (Bottom)
sum	337		111	

6.3.2 SMD Spectrum (M1 status)

The smallest passive design form is Chip 0201, the smallest grid used is 0.4mm.

Components with CSP Housing

- Memories: Flash 512 Mbit (Intel/ Sibley)
- BT Chip
- BB Chipset
- Transceiver
- GSM Receiver
- FM radio

Components for special SMD Processing (F-Machines)

- Nano I/O Connector
- SIM-Reader
- 1 x B2B Connector (50 pins), Pitch 0.4mm
- RF plug (Hirose)
- Shielding (BT one piece shielding / RF and Logic Fish-Can/ FM radio Can shielding) for SMD Processing

6.3.3 Manual Soldering

No manual soldering planned.

6.3.4 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 [BMG PHE SCM TLM PT 11](#).

All mechanical components have to be delivered acc. to DIS 61119. Any deviations from this packaging can be decided only by [BMG PHE SCM TLM PT 13](#).

6.4 Production Means and Stages

Overview of all production steps

- A. SMT-Placement
- B. Panel-Separation
- C. Testing PCB
- D. Mobile-Assembly
- E. Testing and Customization of Mobile
- F. 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

Opto-Control AOI

Siplace 80F

Soltec re-flow soldering unit

Soldering pasting side 2

SMD placement side 2

Optical Revision side 2

SMD placement shielding and special components

Reflow soldering side 2

DEK Screen printing machine

Siplace 80S/HS50/80F

Opto-Control AOI

Siplace 80F

Soltec reflow soldering unit

B. Panel-Separation

Automatic panel separation (Inline)

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

Pre-Assembly of mechanical parts manually and autom.

Baumann Assembly Line for autom. Assembly;

Final assembly of mobile manually and automatically

Baumann Assembly Line for autom. Assembly; product specific fixtures

Automatic screw of mobile

Weber automatic screw station

E. Testing and Customization of Mobile

Testing of Mobile in customer test

Pematech automatic customer test

Software- Customization of Mobile

Pematech Multibooter

Hardware-Customization of Mobile

manually / optional automatically

(mounting of slider frontcase)

E. Packaging

Packaging of Mobile and all accessories

semiautomatic / automatic

I/O Plug

manually

6.5 Basic Assembly Concept

See chapter "Assembling Drawings"

Fulfill automatic assembly requirement

6.6 No-ID-Phone Support

Main keypad (Base Upper-Part) and Sub keypad (Slider Upper-Part) contains no operator specific printings.

6.7 New production technology

- Lead-free soldering Process
- Trans-Flash Reader on slider part (not tested within production)
- 2 receivers in Phone (acoustic-shock)

6.8 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.

6.9 Expected Production Quantities/Production Capacity

Production volume: 1,915 Mio. Phones over lifecycle

Peak volume (month): 215 k in July 2007



95_Chameleon Ramp
Up plan

Ramp up (status M1):

7 Test Set-Up

7.1 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 with [BMG PHE SCM TLM PT2](#) and [BMG PHE SCM TLM LCM 3](#).

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, too (see design regulation).
- Fulfill PCB requirements with regards to the carrier-fixings and reference-holes (see design regulation).
- Make available a Windows NT software library for controlling the mobile phone functions.

For more details please refer to the document "Testing technical standards for mobile phones" [SAP document: 78925 (in the newest version)]

7.2 Quality Targets

The following quality targets (first pass yields) are aimed at:

Test level	Yield
Functional Test	96,00%
Adjustment-/System test	98,75%
Customer-/Camera test	99,0 % 96,00%
Customer Init	99,00%

The Cpk-Value 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 1%.
The target test cycle time is equal or less than 17 second.

8 Customer Care

8.1 Strategy

Attached diagram documents the modular care concept which fulfils the specific customer needs for our products:

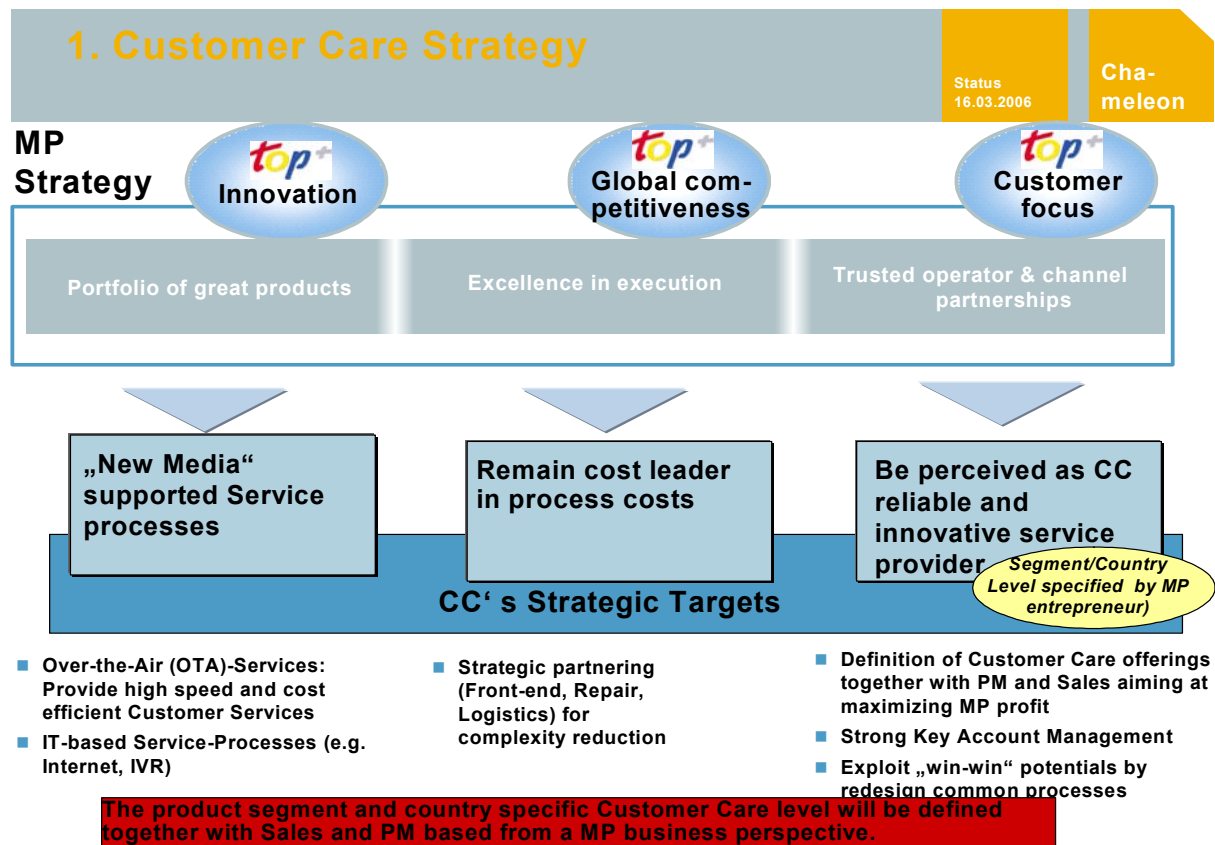


Figure 22 Customer Care Strategy

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

8.2 Repair Level

In general, 4 repair levels for mobile phones are defined:

- **Level 1**
Not necessary to open the mobile phone for repair; service like software updates, reset and swap of mobile phones; advice of end users
- **Level 2**
Exchange of mechanical parts like housing, keypads etc.
Carry out of function test.
- **Level 3**
Trouble shooting and repair of defined soldered components ("top 10 failures") and appropriate tests without adjustment procedures. Can include parts of levels above.
- **Level 4**
Trouble shooting and repair of all soldered components including complete adjustment and test. Can include parts of levels above.

8.3 World-wide distribution of service level

- Europe/Near East/RSA/America
 - level 2/3 repairs at the LSO and/or service partners
 - swap and/or repair of devices for end users
 - level 4 repair at BenQ workshops
- Far East/Australia
 - level 2/3 repairs at the LSO and/or service partners
 - swap and/or repair of devices for end users
 - level 4 repairs at the ASC in Singapore
- Republic of China
 - level 2/3 repairs at service partners
 - repair of devices for end users
 - level 4 repairs at the Service Centre Shanghai

8.4 Roll out plan for the service concept

- Acceptable care standard and additional service packages are defined together with PM and sales at market launch at the latest.
- 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 after 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.

8.5 Service parts

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

Swap:

- mobile phone without battery for variants which will be distributed in Germany
- control board
- control boards if special required SW locked

Spare parts*¹: Upper case housings
Lower case housings
Speaker
Receiver
Keypad
PCB LCD support
PCB MMI incl. metal dome
MMI support frame
Hinge upper assembly incl. Hinge upper, hinge ring
IrDA lens
Main board
Carrier north
Antenna
Microphone
Vibra motor
Battery cover
Accessory components

8.6 Technical Service Requirements

8.6.1 Test equipment

The test concept will be deduced by the concept the production applies (level 2.5/3). All necessary information regarding change of used hard and software for testing must be provided to the service project responsible immediately by the production implementation responsible.

8.6.2 Technical Service Requirements

This is only a short overview. The complete Requirements are described under [**Fehler! Verweisquelle konnte nicht gefunden werden.**].

All technical Service Requirements of the M0 Document will be fulfilled except of the following deviations: None

8.6.3 Main Requirements for the Hardware

Mechanically (separately) exchangeable shall be all housing parts, the display, the microphone, the loudspeaker, the keypad, the main PCB, the vibra, the shielding frames etc. in order to allow access to the electronic parts.

¹ final decision on spare parts will be made after B1+ prototyping

8.6.4 Main Requirements for the Software

It shall be possible to program specific initializations (customization) locally at the LSO side. These initializations are variant- or customer specific- data like welcome text, ringer melodies, WAP/GPRS profiles, SIM lock, IMEI, SW etc.

In order to support trouble shooting via the Xfocus, the device shall support all API / AT commands as defined in Annex 1. A call centre monitor according to the BenQ specifications has to be implemented in the mobile SW.

This shall allow qualified remote diagnostics of the customer's phone through call centers as defined in Annex 2 of **[Fehler! Verweisquelle konnte nicht gefunden werden.]**.

8.6.5 Main Technological

It shall be possible to completely disassemble and assemble the mobile with standard tools. Reuse of case shells shall be possible. Software updates shall be possible via the BenQ Global Repair Tool (GRT) with a minimum speed of 406 kBaud.

8.7 Training

Samples of the terminals must be available in time and defined quantity in order to perform the training sequence for all technical matters at least 6 weeks before market launch.

Required documents (provided by Global Repair Management):

- Level 3 manual
- SW update manual and customization
- Video for disassembling and assembling
- Video for SW update and customization

9 Quality

9.1 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.:

Check with the update Version in IMS:

<https://www.benqmobile.siemens.com/livelihood/livelihood.exe?func=ll&objId=336029667&objAction=browse&sort=name&viewType=1>

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**.

9.1.1 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/m ² 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	

9.1.2 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 or 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 / Micro SD Card Reader

Insertion and removal of the SIM/Micro SD 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 Micro SD 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 colour changes, any image quality reduction and any impairment caused by the LCD or other components are not allowed.

Slider

Slider push and sliding force must be defined before M1. Start and End position must be defined by SW and perceptible mechanical fixing point. Sliding must be smooth without hook on and tilting.

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.

9.1.3 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	
	a) car kit b) production	10,000 100
ME 1.11O		
ME 1.12O	12. camera flexible/removable	10,000
ME 1.13OB	13. housing change	500
ME 1.14O	14. Joy stick	400,000
ME 1.15O	15. Removable flash	10,000

Other requirements

- The brightness uniformity of the LCD display must not reduce by more than 50% within 3 years. For OLED Display (blue colour) life time over 25.000h must be ensured
- The phone housing must be distortion-proof for its service life and resistance against fracture from a certain hight (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 resisitant against surface abrasion.

Scratch proofness

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) Painted surface:	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:

Exact IP class definition must be done in product feature listing !

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"

9.1.4 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).

9.1.5 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):

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.

9.2 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 places great emphasis on the importance of environmental protection. The law is also making greater demands on the recyclability 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 (e.g. garbage can in battery area)
- No pollutants must be used
- Recycling/disposal documentation must be drawn up

9.2.1 Requirements of Recycling Process

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, ...) |

9.2.2 Recycling Concept

(the parts of the product have to be **compliant to RoHS (2002/95/EC)** and also **compliant to EU legal** requirements)

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.)

9.2.3 Compliance with EU-Directive 2002/95/EC

"Restriction on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment - RoHS"

9.2.3.1 Introduction

The Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment requires, that our products do not contain the following substances

- Lead
- Cadmium
- Mercury

- Chromium (VI)
- PBB, PBDE (polybrominated bi-phenyls; polybrominated di-phenyl ethers)

as of July 1st 2006. The contracted product shall be in compliance with the EU Directive from now on.

All components included in the part delivered have been made using homogenous materials (materials that cannot be mechanically disjointed into different materials) which meet the following tolerances:

- max. 0.1% by weight of lead
- max. 0.1% by weight of mercury
- max. 0.01% by weight of cadmium¹
- max. 0.1% by weight of chromium(VI)-compounds (hexavalent chromium determined as % by weight for Cr)²
- max. 0.1% by weight of polybrominated biphenyls (PBB)
- max. 0.1% by weight of polybrominated diphenylethers (PBDE)³

9.2.4 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.

For detailed descriptions and information please refer to **SN 36350/ 1-3**.

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
- Plastic parts should be marked in line with DIN 54840 or MP-specific regulations (Standard Construction Concept, Sheet 32.1)

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.

9.3 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

9.4 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

9.5 Product Safety and Technical Risk Assessment

A technical risk analysis for this project will be created until M1 by the Quality department, updated before DS and signed by PLT, PM and QM.

- „Risk analysis“ is the examination on available information to identify risks and dangers.
- Danger, endangering and risk are related to each other. Risk is the probability that a danger occurs by a potential source of danger, where possible danger may lead to physical injuries and/or a damage to health or materials.

According to the following dangers the minimum requirements are defined in EN60950, nevertheless country-specific requirements may exceed these.

- Hazards from mechanics and construction
- Electrical hazard
- Hazardous by human body currents
- High energy
- Fire
- Heat
- Radiation
- Chemical hazards
- Hazards by laser or other optical radiation
- Acoustic emission

9.6 Switching failures in communication systems.

For Europe the product must comply with all relevant EU directives and declared in the CE Document

- The Radio and Telecommunications Terminal Equipment Directive
- Low Voltage Directive (LVD)
- EN 60950
- EMC Directive
- SAR
- 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.

9.7 General Safety requirements as part of the product specification

Acoustic shock

The purpose of this requirement is to avoid damage to customers' hearing. As different measurement methods result in varying values of sound pressure level, the method which is applied by BenQ is described in separate documents:

- a) Requirement Specification Acoustic Shock Protection (latest version)
- b) Matrix Product to ASP Requirements

Unintended power on (air plane mode)

The purpose of this requirement is to avoid critical situations during flights (If the phone is switched on by pressure on the "power on" button, while the PIN code is deactivated, the mobile is searching the network up to highest power stage (2 W)).

The RF emissions can have an influence on the control system of the plane. Special safety precaution in the user guide is required.

Tantalum Elcos

The purpose of this requirement is to protect customers' health. Tantalum elcos can be exploded by over current peak. This requirement is only valid for elcos which capacity is higher than 10 μF . Elcos which capacity exceeds this value must be placed under shielding.

Battery safety

The characteristic of Lion and LiPolymer batteries is that they can be exploded by rough handling and / or during unexpectedly variation of voltage (peak). This requirement is suitable and necessary to protect customers' health. Special safety precaution in the user guide is required: For technical details see battery specification.

Safety current circuit (phone)

This protection is necessary if the customer doesn't use original accessories like a battery (e.g. use of pirate battery). Special safety precaution in the user guide is required.

Flash

To protect customers' health in special situations (like car driving) the legal requirements for laser class have to be fulfilled. Special safety precaution in the user guide is required.

Surface temperature

The surface temperature is defined in EN 60950 table 4B.

Requirement for user guide: No info about operating temperature in chapter "Technical data".

Recommendation for user guide: In chapter "Time and temperature ". The phone may heat up considerably during data transfer or when using UMTS. This is normal and not dangerous.

9.8 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, targets and methods and stipulates the quality assurance measures that are to be taken during the development process within SW and Systemtest.

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).

9.9 Field Trial (Pre-Validation, GCF and EUAT)

9.9.1 General

This procedure shall be used for BenQ internal products and exclude OEM/ODM products.

9.9.2 Aim and Focus of the Field Trial

- 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

9.9.3 Realisation

- Dependent on the product specification, GCF Field Trial tests in different GSM and UMTS networks will be performed,
- EUAT1/2 with B2 prototype samples,
- After DS, EUAT2/2 with samples from pilot series,
- The accessories for the product shall be included in the EUAT.

9.9.4 Technical EUAT/GCF Field Trial

Tests in GSM 850/900/1800/1900 and UMTS networks shall be coordinated and performed by QM PV. QM PV will create the corresponded test list.

9.9.5 Time Frame

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

The official EUAT shall start with the provision of B2 prototype samples S3-SW and shall end with S4 (at least 5 weeks test before and after DS).

The beginning of the EUAT shall start under the following conditions:

Hardware

- B2 EUAT samples are available. Those samples shall have the final layout ready for approval. For the EUAT it will be taken into account that HW - variants (e.g. alternate display manufacturers) exist. Such different variants shall be available for the EUAT.
- For the EUAT2/2, 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 EUAT
- The EUAT 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 EUAT 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
- EUAT 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 EUAT phase will lead to re-tests)
- At milestone S3 (prior to the EUAT), 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 EUAT, shall be closed.

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

- During the EUAT 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 EUAT.

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 EUAT)	-	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).

9.9.6 Performance aspects covered by EUAT (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

9.9.7 Documentation

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

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

The successfully finished EUAT is the basic for the milestone S4.

9.9.8 Quantity Planning for Pre-Validation, GCF-Test and EUAT

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
APAC	Reference PV plan
China Variant	Reference PV plan
Customer Acceptance	Reference PV plan
US	Reference PV plan
SWAP	Reference PV plan

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

Mobile devices have to be available latest 2 cw before start of field test (EUAT / GCF)

Quantity has to be divided into available HW-Variants

The box content should include the final shipping parts (e.g. charger, headset, MMC, Transflash...)

9.9.9 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 (eg BRD-Handel) should be available before shipping

9.9.10 Customization

Customization will be tested within EUAT. QM PQA PV only perform tests in countries and networks which are included in global PV team.

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

9.9.11 Accessory

Accessory field test will be performed within EUAT.

Accessories have to be available 2 weeks before start of EUAT.

9.9.12 Realization

The Pre-validation can start with B1 phones. The aim is to support the SW development with special analysing of defined function tests. It will end with the beginning of the EUAT.

- **EUAT**
- The end user acceptance test will start with a maturity (SW) of S3 and B2 HW. It will take at least 5 weeks before DS.
- **GSM-GCF FT**
- The GCF fieldtest will start with a maturity (SW) of S3 and B2 HW. It will take approximately 5 weeks of testing (incl. GCF report).
- **UMTS-GCF FT**
- The GCF fieldtest will start with a maturity (SW) of S3 and B2 HW. It will take approximately 8 weeks of testing (incl. GCF report).

9.9.13 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 < 12dB
- Reproducibility TX +/- 0,3dB
- 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.

9.9.14 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.

9.10 Field Return Rate

Return Rate A	Class <= 4,5 %	(based on 24 month warranty) low end
Return Rate C/M	Class <= 9,0%	(based on 24 month warranty) mid range
Return Rate S/SL	Class <= 12,0 %	(based on 24 month warranty) high class

9.11 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".

9.12 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 switchings, simple assembly concepts, a reduction/standardisation of the parts (phone, accompanying 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	[%]	**	**	98,7	98,8
first pass yield device test	[%]	**	**	93,4	95,0
first pass yield customer init	[%]	**	**	99,1	99,0
Delivery process					
Outgoing inspection/mobile	[dpm]	500	100	400	500,00
Outgoing inspection/delivery content	[dpm]	2900	1000	800	500,00

** key figures not existing

FY 04 / 05 OGI values for all product groups

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.

9.13 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 Management, QM Lead and Q Gate review team.

10 System Test

10.1 Introduction

This document describes certification requirements for GSM/GPRS/EDGE terminals in terms of regulatory requirements within EC and voluntary requirements within EC and US.

Therefore, this document covers aspects of R&TTE and GCF/OMA certifications.

The document provides additional information of relevance to FCC certification, but does not intend to cover all aspects of FCC certification.

The FCC information contained in this document is for ST Modem internal purposes only. The full information related to FCC is in the responsibility of EMC/Antenna.

This document does intentionally not handle requirements for APAC, in particular China.

In the following, GSM/GPRS/EDGE terminals are referred to as GSM terminals.

10.2 Abbreviations and Definitions

Abbreviation	Definition
Bluetooth SIG	Bluetooth Special Interests Group
EA	EMC/Antenna; i.e. a sub-department within RF department
EC	The European Community
EMC	Electro-Magnetic Compatibility
FCC	Federal Communications Commission
GCF	Global Certification Forum
GSMA	GSM Association. The Association of GSM Network Operators worldwide.
GSMNA	GSM North America. The North American Regional Interest Group of the GSM Association.
HAC	Hearing Aid Compatibility
IEC	International Electro-technical Committee
IC	Industry Canada
PTCRB	PCS Type Certification Review Board
R&TTE	Directive 1999/5/EC – Radio Equipment and Telecommunications Terminal Equipment Directive
SAR	Specific Absorption Rate
(U)SIM	(UMTS) Subscriber Identity Module
SAT	SIM Application Toolkit
SDO	Standards Development Organisation
UMTS	Universal Mobile Telecommunications System
3GPP	Third Generation Partnership Project. A project of SDOs in charge of elaboration of specifications for a 3. Generation mobile radio system (UMTS).

10.3 Regulatory requirements - Overview

10.3.1 European Community

GSM terminals are under the scope of Directive 1999/5/EEC, 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

10.3.2 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.

10.4 Voluntary requirements - Overview

10.4.1 GCF

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

10.4.2 PTCRB

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

PTCRB will not be done for Chameleon.

10.4.3 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.

10.5 Requirements Matrix

10.5.1 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: V1.5.1 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

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

10.5.2 “Voluntary” requirements

Aspect	Certification planned for typical Product	Specified by	Technical requirements
Terminal <-> network interoperability and Application Enablers	Yes	GSM and UMTS: Global Certification Forum (GCF)	GCF-CC Database Field Trials IOP testing
Bluetooth functionality ¹	Yes Bluetooth certification shall be printed on the box	Bluetooth Special Interest Group	Bluetooth Qualification Program Reference Document
WAP functionality	No	The Open Group	WAP Certification and Testing Process
USB functionality	No No certification required. Only test of USB compliance will be done.	USB Implementers Forum	USB Compliance Program
CTIA	No	CTIA	CTIA GSM-1900 Terminal Unit Certification Program Management Document
Sync ML (OMA DS&DM)	No (voluntary)	OMA / Data Sync (DS), Device Management (DM)	
Java (Engine)	Yes (mandatory) Sun requires it	Sun	
MMS (OMA)	No (voluntary)	OMA / MMS	
IMPS (Instant Messaging and Presence Services) (OMA)	No (voluntary) If IMPS will be become GCF mandatory then certification has to be done. TBC	OMA	
DRM (Digital Right Management)	No (voluntary) DRM 1.x not longer supported by OMA	OMA	

¹ Bluetooth certification mandatory if Bluetooth is activated

10.6 Regulatory requirements - detailed

10.6.1 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.

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.

10.6.2 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/EC 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	2000	Safety of information technology equipment	1.7.2006
EN 60 950-1	2001	Safety of information technology equipment	---

National standards for other regions e.g. AS 3260 for Australia and UL60950 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 Underwriters Laboratories (UL) File Listings (Yellow Cards) and Certificates of Conformity with all deliveries. PCBs as well as batteries need to be UL recognised.

IEC/EN 60825-1/2

- This standard must be fulfilled for the flash LED
- The handbook should contain at least following hints concerning the Flash LED (proposal from other mobile phone producer). Flash Precautions Class 1 LED Product This product complies with, IEC/EN60 825-1 "Safety of Laser Products". Class 1 products are safe under reasonably foreseeable conditions of operation. Do not fire the flash at drivers of road vehicles, as this may cause the driver to lose control of the vehicle and result in a traffic accident.

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

10.6.3 EMC aspect

10.6.3.1 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	V1.2.1	common requirements for a large range of product types	30.11.05
EN 301 489-1	V1.3.1	common requirements for a large range of product types	30.11.05
EN 301 489-1	V1.4.1	common requirements for a large range of product types	11.08.2008
EN 301 489-1	V1.5.1	common requirements for a large range of product types	---
EN 301 489-7	V1.1.1	specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range	30.11.2005
EN 301 489-7	V1.2.1	specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range	---

Relevant harmonized standard for article 3.1b)	Version	Purpose	Date of cessation of presumption of conformity
EN 301 489-17	V1.1.1	specific requirements for short-range devices; i.e. Bluetooth functionality	30.11.2005
EN 301 489-17	V1.2.1	specific requirements for short-range devices; i.e. Bluetooth functionality	---
EN 55020 A1: 2003 A2: 2005	2002	FM Radio receiver – Immunity aspects	---
EN 55013 A1: 2003	2001	FM Radio receiver – Emission aspects	---

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 manufactures 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.

10.6.4 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/hta/R&TTE/rtte.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

10.6.4.1 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.	---

10.6.4.2 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 300 328-2	V1.2.1	Short range device ISM 2.4 GHz	30.04.2006
EN 300 328	V1.4.1	Short range device ISM 2.4 GHz	30.04.2006
EN 300 328	V1.5.1	Short range device ISM 2.4 GHz	31.08.2006
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.	---

For US, the FCC handles radio spectrum aspects. See EMC section above.

10.6.5 Special requirements

10.6.5.1 European Community

Directive 1999/5/EC 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.

10.6.6 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.

10.7 Voluntary requirements

10.7.1 Global Certification Forum - Inter-operability

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.

10.7.2 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
\\139.23.136.24\dataaw\projekte\ENTWDOKUI\I&T_ALG\NA_Certification\PTCRB

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.

10.7.3 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.

10.7.4 WAP functionality

WAP is standardized by Wireless Application Protocol Forum. Testing and Certification of WAP devices is 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 program on behalf of WAP Forum as Certification Authority.

10.7.5 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

10.8 Marking, Labeling and User Guide

10.8.1 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: ¹ CE + Notified Body Identifier
	Terminals using non-harmonised frequency bands: CE + Notified Body Identifier + Alert symbol (!)
	BenQ 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	BenQ Siemens stock number

10.8.1.1 CE marking layout and requirements

¹ Bluetooth transmitters below 10mW transmitted power are handled as harmonised frequency bands.

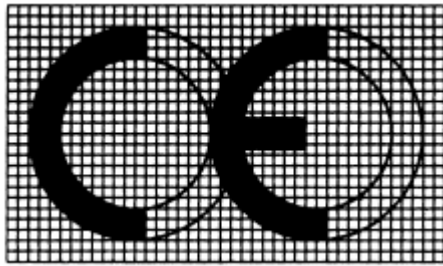


Figure 23 CE marking

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.

10.8.1.2 Notified Body Identifiers

Typically used Notified Bodies and corresponding Identifiers

Notified Body	Identifier
BABT	0168
Cetecom ICT	0682

10.8.2 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.

10.8.3 Variant Overview

Requirement	CHAMELEON(900/1800/1900)	CHAMELEON China
R&TTE	X	X
FCC	X	X
GCF	X	X
CCC (MII China)		X
TTY		

Requirement	CHAMELEON(900/1800/1900)	CHAMELEON China
HAC		
IMEI Security Declaration	X	X

10.8.4 Additional System Test requirements

10.8.4.1 Interfaces

10.8.4.1.1 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 (SL55 solution). The related GSM specification is 3GPP TS 51.010-1 Annex A.

10.8.4.1.2 BFC/RCCP Interface

For remote control during type approval testing (FTA "Auto mode"), the mobile supports BFB, BFC(or equivalent) and AT-C/RCCP commands via serial interface for basic call procedures and GPRS testing.

If the BFB library replaced by BFC, in principal the same functionality (remote control) for the mobile has to be provided.

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

10.8.5 New type approval and certification requirements

Within the certification schemes GCF new approval/certification requirements came up, which will be applicable for CHAMELEON. Some of those are driven by the so called Application enabler group; others are driven by PTCRB/CTIA (OTAP).

Those requirements are:

Requirements	Scheme	Type of testing	Responsibility	Status
MMS	PTCRB / GCF	IOT testing	ST	mandatory
		Conformance testing		mandatory
EMS	PTCRB / GCF	IOT	ST	See Note
		Conformance testing		See Note
IMPS	GCF	IOT	ST	See Note
		Conformance testing		

Note:

Additional requirements might be defined by a so called application enabler group. Those additional requirements might become mandatory for CHAMELEON, as these product will go through type approval and certification in 2

11 Time Line

11.1 General

The complete Project has been planned with Primavera Project Manager. Following information have been withdrawn from that.

11.2 Milestones

	Milestone	Date EMEA	Date APAC
M0	Preliminary Project Plan / Start of Packaging Formation	20.03.2006	
S0	Requirement Release / Design Decision	20.03.2006	
M1	Implementation Release / Product Contract	31.03.2006	
S15	A1 Module Operable in Basic Function, 100 % Mechanical Data Released	17.05.2006	
S2	Tested Functional Sample (B1)	10.07.2006	
S25	Tested Prototype Device (B1+)	07.08.2006	
S3 HW	Pre-series Release HW based on B2 tested devices / NO SW-S3	06.09.2006	
AS	Approval Start	05.06.2006	
PS	Production Start	11.10.2006	
S3	Pre-series Release	16.10.2006	
DS	Delivery Start	10.11.2006	4 weeks after DS EMEA
S4	Series Production Baseline	22.12.2006	
M3	Release for Unrestricted Series Delivery	22.12.2006	

11.3 Prototype Availability

	Prototype Run	Date
A1	No Run planed	
B1	Soft Tool Devices	08.05.2006 (main run)
B1+	1 st Hard Tool Devices	03.08.2006 (main run)
B2	2 nd Hard Tool Devices for Approval only	22.08.2006 (main run)
pilot	3 rd Hard Tool Devices	09.10.2006

11.4 Reference Samples

	Prototype Run	Qty.	Date
B2	2 nd Hard Tool Devices for Approval only	Tbd	05.09. 2006

12 Miscellaneous

12.1 Technical Risks

Please refer to the current PD team protocol [14] and the M1 risk Assessment [15]

12.2 Packaging/User Manual

Please refer to the M1 Document [16]

12.3 Economic Product Plan

Please refer to the M1 Document [16]

12.4 Patents

Please refer to the M1 Document [16]