

Performance Description / Leistungsbeschreibung (LB)

Product/Version/Country:

 UMTS Phone **Wolf5**

Document Title: WOLF5_PERFORMANCE_DESCRIPTION_M1_FINAL.PDF

| Name | Department | Signature, Date |
|--------------------------|------------|-----------------|
| Thomas Engelhardt(PLT) | ICM MP | _____ |
| Johann Krammer (PLT-SW) | ICM MP | _____ |
| Christian Senninger (PM) | ICM MP | _____ |
| Sebastian Kuritke (BA) | ICM MP | _____ |
| Joern Watzke (SPM) | ICM MP | _____ |

| Name | Department | Location |
|-----------------|-----------------|----------|
| Mr. Asmussen | ICM MP PD HW | KLf |
| Mrs. Braun | ICM MP PBM PG85 | Mch G |
| Mr. Dr. Bursik | ICM MP PD PGU | Mch G |
| Mr. Cron | ICM MP SM PM | Mch G |
| Mr. Danneil | ICM MP GS APE | Mch G |
| Mr. Freeguard | ICM MP PBM | Mch G |
| Mr. Gast | ICM MP PBM GPM | Mch G |
| Mr. Dr. Homann | ICM MP PD SW | Mch G |
| Mr. Hornung | ICM MP PBM PPM | Mch G |
| Mr. Dr. Klebsch | ICM MP PD | Mch G |
| Mrs. Lohmann | ICM MP S PS | Mch G |
| Mr. Dr. Meedt | ICM MP SCM NPI | Mch G |
| Mr. Meyer | ICM MP CCQ | Mch G |
| Mr. Dr. Klebsch | ICM MP PD | Mch G |
| Mrs. Remerie | ICM MP PBM PG75 | Mch G |
| Mr. Riesmeyer | ICM MP AD RD | Mch G |
| Mr. Dr. Speth | ICM MP PM BA | Mch G |
| Mr. Thonhauser | ICM MP PD MD | Mch G |
| Mr. Topel | ICM MP PD SWP | Mch G |
| PD/REA-Team | | |
| | | |

Updates:

| Version | Date | Name | Amendment |
|---------|----------|--------|------------------------|
| 0.1 | 01.10.04 | Watzke | Enter Responsibilities |
| Final | 27.10.04 | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

This version of the document is saved on the Munich Network under:
<\\Mchglv01\data\projekte\PROJ_SPECIAL\W5\documents_declarations\M1\
M1 documentation\WOLF5_PERFORMANCE_DESCRIPTION_M1_FINAL.PDF>

Content

| | | |
|----------|--|-----------|
| 1 | LIST OF REFERENCES | 6 |
| 1.1 | PROJECT SPECIFIC REFERENCES | 6 |
| 1.2 | GENERAL REFERENCES | 7 |
| 2 | GENERAL DATA | 7 |
| 2.1 | DESIGN | 7 |
| 2.2 | KEY FEATURES WOLF 5 | 8 |
| 2.3 | COMPARISON WITH CURRENT PRODUCT GENERATION | 10 |
| 3 | MECHANICS | 10 |
| 3.1 | UNIT DESCRIPTION WOLF-5 | 10 |
| 3.2 | INTERFACES WOLF-5 TO ACCESSORIES | 11 |
| 3.3 | HOUSING AND KEYPAD COLOURS | 11 |
| 3.4 | PCB TOP-SIDE | 15 |
| 3.5 | PCB BOTTOM-SIDE | 16 |
| 4 | ELECTRONIC | 17 |
| 4.1 | RF SECTION | 17 |
| 4.1.1 | <i>Compliance</i> | 18 |
| 4.1.2 | <i>Qualcomm radioOne ZIF RF Solution</i> | 19 |
| 4.2 | BLUETOOTH | 24 |
| 4.3 | FM/RDS RADIO | 26 |
| 4.4 | DIGITAL HARDWARE | 27 |
| 4.4.1 | <i>Overview of Hardware Structure</i> | 27 |
| 4.4.2 | <i>Digital Baseband</i> | 28 |
| 4.4.3 | <i>Display Module</i> | 32 |
| 4.4.4 | <i>SIM</i> | 36 |
| 4.4.5 | <i>IRDA and Fuel Gauge</i> | 36 |
| 4.4.6 | <i>RS-MULTIMEDIACARD</i> | 37 |
| 4.4.7 | <i>Cameras</i> | 37 |
| 4.4.8 | <i>Clip On Flash Trigger</i> | 37 |
| 4.4.9 | <i>Vibration Motor</i> | 38 |
| 4.4.10 | <i>Keypad Mapping</i> | 39 |
| 4.4.11 | <i>Electro Acoustic</i> | 40 |
| 4.4.12 | <i>Power Supply, Battery, Charging</i> | 40 |
| 4.4.13 | <i>Audio Concept</i> | 49 |
| 4.4.14 | <i>Interfaces</i> | 51 |
| 4.4.15 | <i>Printed Circuit Board (Main Board)</i> | 59 |
| 4.4.16 | <i>Wolf-5 MMI board: - TBC</i> | 63 |
| 4.5 | EMC-CONCEPT | 64 |
| 4.5.1 | <i>EMC</i> | 64 |
| 4.5.2 | <i>Keypad</i> | 64 |
| 4.5.3 | <i>Display</i> | 64 |
| 4.5.4 | <i>Antenna performance</i> | 64 |
| 4.5.5 | <i>SAR</i> | 64 |
| 5 | SOFTWARE | 65 |
| 5.1 | ARCHITECTURE OVERVIEW | 66 |
| 5.2 | CUSTOMISATION | 68 |
| 5.2.1 | <i>Customization Concept</i> | 68 |
| 5.2.2 | <i>Process environment</i> | 69 |
| 6 | ACCESSORIES | 69 |
| 7 | MANUFACTURING CONCEPT | 70 |
| 7.1 | OVERVIEW AND GENERAL REQUIREMENTS | 70 |

| | | |
|-----------|--|-----------|
| 7.2 | MODULES | 70 |
| 7.3 | COMPONENTS SPECTRUM..... | 70 |
| 7.3.1 | SMD Component Number and Number of Types (as of 19 th of December 2003) | 70 |
| 7.3.2 | SMD Spectrum (as of 4 th of October 2004) | 71 |
| 7.3.3 | Manual Soldering..... | 71 |
| 7.3.4 | Delivered Form of the Components..... | 71 |
| 7.4 | PRODUCTION MEANS AND STAGES..... | 71 |
| 7.5 | BASIC ASSEMBLY CONCEPT | 72 |
| 7.6 | NO-ID-PHONE SUPPORT | 73 |
| 7.7 | NEW PRODUCTION TECHNOLOGY | 73 |
| 7.8 | QUALITY TARGETS..... | 73 |
| 7.9 | EXPECTED PRODUCTION QUANTITIES/PRODUCTION CAPACITY | 73 |
| 7.10 | RAMP UP PLAN KLF | 74 |
| 8 | TEST RIG PLANNING | 75 |
| 8.1 | GENERAL REQUIREMENTS | 75 |
| 8.2 | QUALITY TARGETS..... | 75 |
| 9 | CUSTOMER CARE..... | 76 |
| 9.1 | CUSTOMER CARE STRATEGY..... | 76 |
| 9.2 | SERVICE OBJECTIVES..... | 76 |
| 9.3 | REPAIR LEVEL DEFINITION | 76 |
| 9.4 | WORLD-WIDE DISTRIBUTION OF SERVICE LEVEL..... | 76 |
| 9.5 | ROLL OUT PLAN FOR THE SERVICE CONCEPT | 77 |
| 9.6 | SERVICE PARTS..... | 77 |
| 9.7 | TECHNICAL SERVICE REQUIREMENTS..... | 78 |
| 9.7.1 | Test equipment | 78 |
| 9.7.2 | Technical Service Requirements..... | 78 |
| 10 | QUALITY | 79 |
| 10.1 | GENERAL QUALITY REQUIREMENTS | 79 |
| 10.2 | ENVIRONMENTAL PROTECTION | 82 |
| 10.3 | QUALITY PLAN | 83 |
| 10.4 | DEPARTMENT PSQA-PLANS..... | 83 |
| 10.5 | PRODUCT SAFETY AND TECHNICAL RISK ASSESSMENT | 83 |
| 10.6 | SOFTWARE QUALITY | 84 |
| 10.7 | FIELD TRIALS..... | 84 |
| | Technical Field Trial..... | 85 |
| | Time Frame | 85 |
| | Performance aspects covered by Field Trial (Overview)..... | 86 |
| 10.8 | REQUIREMENTS FOR PRODUCT AUDIT..... | 86 |
| 10.9 | REQUIREMENTS FOR OUTGOING INSPECTION | 87 |
| 10.10 | FIELD RETURN RATE..... | 87 |
| 10.11 | QUALITY OF SUPPLIERS AND COMPONENTS..... | 87 |
| 10.12 | QUALITY IN PRODUCTION | 87 |
| 10.13 | DEVIATIONS FROM AGREED QUALITY LEVEL | 88 |
| 11 | TYPE APPROVAL WOLF5..... | 89 |
| 11.1 | REGULATORY REQUIREMENTS - OVERVIEW | 89 |
| 11.1.1 | European Community..... | 89 |
| 11.1.2 | Outside Europe..... | 89 |
| 11.2 | VOLUNTARY REQUIREMENTS - OVERVIEW..... | 89 |
| 11.2.1 | GCF | 89 |
| 11.2.2 | PTCRB..... | 89 |
| 11.2.3 | Additional voluntary requirements | 89 |
| 11.3 | REQUIREMENTS MATRIX..... | 90 |
| 11.3.1 | Regulatory requirements | 90 |
| 11.3.2 | "Voluntary" requirements | 90 |

| | |
|--|------------|
| * BLUETOOTH CERTIFICATION MANDATORY IF BLUETOOTH IS ACTIVATED. | 92 |
| 11.4 REGULATORY REQUIREMENTS - DETAILED | 92 |
| 11.4.1 <i>Health aspect</i> | 92 |
| 11.4.2 <i>Safety aspect</i> | 92 |
| 11.4.3 <i>EMC aspect</i> | 93 |
| 11.4.4 <i>Radio spectrum usage aspect</i> | 94 |
| 11.5 SPECIAL REQUIREMENTS | 96 |
| 11.5.1 <i>European Community</i> | 96 |
| 11.5.2 <i>USA</i> | 97 |
| 11.5.3 <i>IMEI Security</i> | 97 |
| 11.5.4 <i>Inter-operability</i> | 97 |
| 11.6 VOLUNTARY REQUIREMENTS - DETAILED | 98 |
| 11.6.1 <i>Global Certification Forum - Inter-operability</i> | 98 |
| 11.6.2 <i>Bluetooth functionality</i> | 99 |
| 11.6.3 <i>WAP functionality</i> | 99 |
| 11.6.4 <i>IrDA functionality</i> | 99 |
| 11.6.5 <i>USB functionality</i> | 99 |
| 11.6.6 <i>Network Selection from SIM Card Preferred List</i> | 99 |
| 11.7 MARKING AND LABELLING | 99 |
| 11.8 CHINA / APAC | 101 |
| 11.8.1 <i>General APAC & China requirements</i> | 101 |
| 11.8.2 <i>Bluetooth Products</i> | 101 |
| 11.8.3 <i>Additional APAC & China Requirements</i> | 101 |
| 11.9 VARIANT OVERVIEW | 102 |
| 11.10 ADDITIONAL SYSTEMTEST REQUIREMENTS | 102 |
| 11.10.1 <i>Interfaces</i> | 102 |
| 11.11 SPECIAL ISSUES TO WOLF5 | 102 |
| 11.11.1 <i>AGPS</i> | 102 |
| 12 MILESTONES | 103 |
| 13 MISCELLANEOUS..... | 103 |
| 13.1 TECHNICAL RISKS | 103 |
| 13.2 PACKAGING/USER MANUAL | 103 |
| 13.3 ECONOMIC PRODUCT PLAN | 103 |
| 13.4 PATENTS | 104 |

1 List of References

1.1 Project specific references

The appendices and enclosures (if present as files) are saved separately on the Munich network under **P:\PROJ_SPECIAL\W5\documents_declarations\M1\M1 documentation**

| No. | Document | Date | File Name |
|-----|---|----------|--|
| 1. | Product description Wolf 5 (EMEA, APAC) (this document) | | <i>Wolf5 Performance description – V1.0.doc</i> |
| 2. | Wolf 5 M1 Product Contract | | <i>M1_Wolf5_081004.ppt</i> |
| 3. | M1 declaration «project team» | | <i>folder M1/declarations</i> |
| 4. | Software Product Description | | <i>Featurelist_V0.60_working.xls</i> |
| 5. | Software MMI Specifications | | <i>P:\PROJ_SPECIAL\W5\PE-Teams\UI\Input_Specs_Quest\Sirius_UI_Specs_090104</i> |
| 6. | Major Risk Assessment | | <i>Wolf 5 List of risks M1.xls</i> |
| 7. | Major Software Risk Assessment | | <i>Software RiskManagementPlanV0.92.xls</i> |
| 8. | Accessories for the Mobile Phones Wolf5 (EMEA, APAC) | 21.10.04 | <i>Wolf5 AD Portfolio 18.10.04.ppt</i> |
| 9. | Project schedule | 29.10.03 | <i>wolf5_schedule_041005.pdf</i> |
| 10. | Project schedule Wolf5 Accessory | 28.10.03 | <i>Wolf5_Holder_based_on_Gleichteilekonzept_111004</i> |

The Wolf5 M1 milestone will be declared according to “QMS Procedure No.: T008-MP Milestone Results in Product Development” (Issue 5 Published: 10. Nov. 2003).

1.2 General References

- All references which are especially important for specific disciplines should be listed in the particular chapters.
In any case the requirements listed in chapter “11 Approval” has to be fulfilled by all disciplines.

2 General Data

2.1 Design

The Wolf 5 is a block type phone.

There is one colour concept (white) considered in Wolf 5

For design issues please contact Jörn Watzke ICM MP PBM 3G

For detailed description, please see chapter 2.2

For detailed target group description, please see the Wolf 5 product contract

2.2 Key Features Wolf 5

| | |
|----------------------|---|
| Design: | Mono Block type Phone Keys bridgeless in x-direction, joystick |
| Key Features: | UMTS Technology & 3-band GSM QVGA Display:320x240 256k TFT Color, normally black Two cameras: 2MPix for still picture / video recording, CIF for video conferencing AGPS, Bluetooth, FM Radio, RS-MultiMedia Card Applications & Accessories: AGPS client |
| Bands | 900/1800/1900MHz GSM/GPRS 2100 UMTS GPRS Class10 |
| Battery: | Lilon Battery Pack Nominal Capacity: 1000mAh@0.2CA GSM Capacity: 980 mAh |

Stand-by and talk times :

| Talk/standby | FFA6250 w/RTR6250 Build AMSS 4.0 |
|------------------------|--|
| WCDMA Standby 2.56 DRX | 420 hr |
| WCDMA Standby 1.28 DRX | 310 hr |
| WCDMA Standby 0.64 DRX | 200 hr |
| WCDMA Talk at +0 dBm | 3.10 hr |
| GSM Standby MFRM = 7 | 400 hr |
| GSM Standby MFRM = 5 | 340 hr |
| GSM Standby MFRM = 3 | 265 hr |
| GSM Talk at +29 dBm | 3.65 hr |

Note: Values assume an 800mAh battery. Values do not consider display currents.

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

| | |
|----------------|------------------------------|
| Antenna | Integrated Quad band antenna |
|----------------|------------------------------|

| | |
|------------------------------|---|
| Receiver Sensitivity: | Compliant with 3GPP specification TS34.121, Rel. 99 |
|------------------------------|---|

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

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

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

Display:

| Type | full graphic |
|------------------|--|
| Resolution | 240 x 320 Pixel |
| Technology | TFT (Epson) |
| No of Colours | 256k |
| Frame Rate | 15 frames/sec |
| Pixel size / mm | 0.141 mm x 0.141 mm (1 pixel consists of 3 sub-pixels in red, green and blue) |
| Active area / mm | 33,84 mm x 45.12 mm |
| Illumination | White (4LEDs in series integrated) |

3x4 Block Keypad:

- Front side decorated
- Partly bridgeless keypad (i.e. horizontally bridgeless)
- 12-key-block (0-9, #, *)
- tactile finder on key "5"
- colour adapted to u-shaped aluminium brushed sheet metal piece
- Four blue LED's for keypad

Function block with Operator key:

- Five-way Navikey
- Chrome plated navi key ring with center push button, operator logo can be printed on the button which is clipped on the navi key.
- Four keys, functions: Back, Web access, Left & right softkey
- All keys except navi have front side decoration
- Four blue LED's for Navikey

Edge Keys:

- ON/OFF key combined with the END key; the symbol ⓘ (I inside O) is used as a symbol for ON/OFF.
- Video telephony key
- Task key
- Two LED's for edge keys, one red, one green
- front side decorated

Sidekeys:

- No illumination
- Three sidekeys, functions: PoC, Volume, Camera
- Sidekeys galvanized

Acoustics:

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

2.3 Comparison with current Product generation

| Feature | S65/66 Penelope | Wolf 5 | improvement |
|--|--|---|-------------|
| Supported Systems | Trippel/Dualband (EMEA, APAC) GSM 900/GSM1800/ GSM1900 | Quad Band GSM900/GSM1800/G SM1900/UMTS2100 | |
| Stand-by Time | SL55: 200h SL56: 175h | GSM: 400h @ MFRM7, 800mAh | |
| Talk Time | SL55: 210min SL56: 180min | GSM: 220min* @ 29dBm, 800mAh | |
| Battery Technology Battery Capacity | Li-Ion Battery Pack Nominal Cap.: 500 mAh | Li-Ion Battery Pack Nominal Cap.: 1000mAh | |
| Weight | Approx. 75g | Tbd. | |
| Volume | Approx. 63 cm ³ | Approx. 108cm ³ | |
| Length | 81,6mm | 111,5mm | |
| Width | 44,5mm | 51,0mm (@Keypad) | |
| Thickness | 21,9mm | 20,0mm | |
| SIM | Plug-In 1.8V/3V | Plug-In 1.8V/3V | |
| Antenna | Integrated | Integrated | |
| Antenna Perform- ance in comparison to S35 | SL55 28,3dBm@900MHz 26,1dBm@1800MHz 25,2dBm@1900MHz SL56 27,0dBm@850MHz - 26,7dBm@1900MHz | According to general quality requirements, Rev. 4.1 | |
| Antenna Perform- ance in comparison to C56 | | | |
| Half Rate | Yes | Yes | |
| Enhanced Full Rate | Yes | Yes | |
| AMR | Yes | Yes | |
| Fax/Data | Yes | Yes | |
| GPRS | Yes (Class 8) | Yes (Class 10) | |
| Keypad Illumination | Yes (white) | Yes (white) | |
| Display / Display Illumination | STN 4k colour | TFT 256k colour | |
| Ringer volume level | - Typ. ≥ 95dB(A) @ 5cm | - Typ. ≥ 95dB(A) @ 5cm | |

3 Mechanics**3.1 Unit Description Wolf-5**

The Wolf 5 is a brick phone with 2 integrated cameras for video telephony and photo applications. The phone has two different acoustic moduls one for receiver mode on the topside and one for sound ringer and hands free mode with separate hole on the bottom side. Additional speciality is a slot for exchangeable RS MultiMediaCard at the side of the phone.

The keypad is new for a Siemens brick phone and has beside the usual navigation and number key block beneath the display and the 2 sidekeys on both side surfaces further 4 edgekeys (2 on each side) beside the LCD module for extended UMTS related functionality. Special design element on the rear side is a prominent area with a grid of holes for the loudspeaker.

There will be one colour variant, white/silver. Colours attribution can be found in chapter 3.3.

3.2 Interfaces Wolf-5 to accessories

The phone has the following compatible interfaces to accessories:

- electrically by the Lumberg I/O connector (Lumberg slim)
- antenna connection by courtesy of RF connector
- IR and Bluetooth interface is implemented
- Slot wit reader for additional reduced size MultiMediaCard (exchangable) is available
- car holder interface is implemented

Key-Data

| | |
|-----------|------------------------------|
| Volume | Approx. 108 ccm |
| Length | 111,5 mm |
| Width | 53,7 mm (LCD), 51mm (keypad) |
| Thickness | 20 mm |

3.3 Housing and keypad colours

| Part | Material | Colour | Surface Finish |
|---|----------------------|-----------------|--|
| Upper Case (1 shot molding) | PC/ABS | white | Lacquered, high glossy |
| Metal frame (assembled on UC) | aluminium | aluminium | Brushed, anodized |
| Display lens | PMMA | transparent | front side decoration glossy and scratch protection |
| Side panels (1 shot molding), (assembled to UC) | PC/ABS | silver | Lacquered, |
| Lower Case (1 shot molding) | PC/ABS | Silver | Lacquered, |
| Speaker cover (1 shot molding) | PC/ABS | Silver | Lacquered, |
| Antenna rear cover (1 shot molding) | PC/ABS | white | Lacquered, high glossy |
| Battery Case (1 shot molding) | PC/ABS | White or Black | Lacquered, mat |
| Number and Function Keys | Hard Caps on Silicon | Silver | Lacquered |
| Navi Key frame, side keys | PC/ABS | Chromium glossy | Metalized |

Partlist Transceiver Unit WOLF5:

| Explosio level | Component number | Siemens Part number | Log. mat. no | Object description | Comp. Qty |
|-------------------|------------------|---------------------|----------------|--------------------|--------------|
| 0 | A5B00900160733 | S30880-S8900-A90 | A5B00075422567 | TU/WOLF5_DIS_A90 | 0 |

| | | | | | |
|-----|---|--------------------|----------------|--|---|
| ..1 | A5B00900160518 | C39158-A148-A1 | A5B00075385679 | UC ASS WOLF5 | 1 |
| ..2 | A5B00900160523 | C39158-A148-B1 | A5B00075406420 | UC DEC WOLF5 | 1 |
| ..2 | A5B00900160529 | C39158-A148-C340 | A5B00075406440 | PROTECTIVE FOIL DPL WOLF5 | 1 |
| ..2 | A5B00900160525 | C39158-A148-B300 | A5B00075406422 | DPL DECORATED WOLF5 | 1 |
| ..2 | A5B00900160542 | C39158-A148-C300 | A5B00075406438 | METAL FRAME WOLF5 | 1 |
| ..2 | A5B00900160553 | C39158-A148-B910 | A5B00075406432 | SIDE PANEL LEFT DEC WOLF5 | 1 |
| ..2 | A5B00900160702 | C39158-A148-B911 | A5B00075406433 | SIDE PANEL RIGHT DEC WOLF5 | 1 |
| ..2 | A5B00900165034 | C39158-A148-B721 | A5B00075406423 | SIDEKEY BUTTON CAM/POC WOLF5 | 1 |
| ..2 | A5B00900165031 | C39158-A148-B720 | A5B00075406424 | SIDEKEY BUTTON VOLUME WOLF5 | 1 |
| ..2 | A5B00900165036 | C39158-A148-B722 | A5B00075406426 | EDGEKEY BUTTON SEND/VT WOLF5 | 1 |
| ..2 | A5B00900165039 | C39158-A148-B723 | A5B00075406427 | EDGEKEY BUTTON END/TASK WOLF5 | 1 |
| ..2 | A5B00900165052 | C39158-A148-B730 | A5B00075406425 | MULTIMEDIACARD EJECTOR BUTTON WOLF5 | 1 |
| ..2 | A5B00900165009 | C39158-A148-C91 | A5B00075406435 | IRDA LENS WOLF5 | 1 |
| ..2 | A5B00900165054 | C39158-A148-C225 | A5B00075406436 | CAMERA SEALING WOLF5 | 1 |
| ..2 | A5B00900165053 | C39158-A148-C226 | A5B00075406437 | ACOUSTIC SEALING WOLF5 | 1 |
| ..1 | A5B00900165055 | C39158-A148-A699 | A5B00075406419 | MMI ASS WOLF5 | 1 |
| ..2 | A5B00900165059 | C39158-A148-C65 | A5B00075406430 | KEYPAD CARRIER WOLF5 | 1 |
| ..2 | A5B00075384969 | C39158-A148-C82-1 | A5B00075384969 | ANT A-GPS ANTENNA WOLF5 | 1 |
| ..2 | A5B00075406180 | C39212-Z3-C85 | A5B00075406180 | RECEIVER 8MM W5/PHILIPS SOUND SOLUTIONS | 1 |
| ..2 | A5B00075411966 | S30880-Q8900-D2-1 | A5B00075411966 | FPC WOLF5 MMI-KEYPAD-MODULE A1+ ASSEM V1 | 1 |
| ..2 | A5B00900165071 | C39158-A148-C60 | A5B00075406428 | METAL DOME FOIL SIDEKEYS WOLF5 | 2 |
| ..2 | A5B00900165060 | C39158-A148-C61 | A5B00075406429 | METAL DOME FOIL NUMERIC WOLF5 | 1 |
| ..2 | A5B00900165072 | C39158-A148-C301 | A5B00075406439 | GROUND PLANE A-GPS WOLF5 | 1 |
| ..2 | ADHESIVE TAPE NUMERIC C39158-A148-C240 | | | | 1 |
| ..2 | ADHESIVE TAPE SIDEKEYS C39158-A148-C241 | | | | 2 |
| ..2 | ADHESIVE TAPE EDGEKEYS C39158-A148-C242 | | | | 2 |
| ..1 | A5B00900160519 | C39158-A148-A200 | A5B00075385680 | LC ASS WOLF5 | 1 |
| ..2 | A5B00900160565 | C39158-A148-B200 | A5B00075406421 | LC DEC WOLF5 | 1 |
| ..2 | A5B00900160567 | C39158-A148-B900 | A5B00075406431 | CAMERA LOOP WOLF5 | 1 |
| ..2 | A5B00900160570 | C39158-A148-B930 | A5B00075406434 | SPEAKER COVER WOLF5 | 1 |
| ..2 | A5B00075133942 | V39197-F5133-F942 | A5B00075133942 | WATER CONTACT INDICATOR | 1 |
| ..2 | A5B00075384968 | C39158-A148-C81-1 | A5B00075384968 | ANT BLUETOOTH ANTENNA WOLF5 | 1 |
| ..2 | A5B00075098861 | C39254-Z6-C104 | A5B00075098861 | ACO/MICROPHONE KUR0023-018 4MM | 1 |
| ..2 | A5B00075040075 | C39453-Z5-C251 | A5B00075040075 | VI-BRAMOTOR/11MM*4MM/CW/R3MM*L4MM | 1 |
| ..2 | A5B00075384765 | C39158-A148-C80-1 | A5B00075384765 | ANT GSM/UMTS ANTENNA WOLF5 | 1 |
| ..2 | A5B00075406184 | C39212-Z3-C95 | A5B00075406184 | SPEAKER X75 FOR WOLF5 | 1 |
| ..1 | A5B00075411991 | C39453-Z5-C300 | A5B00075411991 | CAMERA-MODUL X75 2.0 MEGA-PIXEL COLOR | 1 |
| ..1 | A5B00025241357 | Z30880-Z9999-Z27-1 | A5B00025241357 | Approval label 27x16mm | 1 |

| | | | | | |
|---|--------------------------------------|--------------------|----------------|--|---|
| | | | | | |
| 1 | A5B00900160522 | C39158-A148-B600 | A5B00075385678 | KEYPAD WOLF5 LATIN | 1 |
| | | | | | |
| 1 | A5B00075038800 | C39158-A109-B900 | A5B00075038800 | SCREW 1,6 X 6,8 K1 | 6 |
| | | | | | |
| 1 | A5B00075282480 | V24851-Z1508-A145 | A5B00075282480 | IC CAMERA MODUL (ONLY AGILENT) CIF HERA | 1 |
| | | | | | |
| 1 | A5B00900164109 | C39158-A148-C157 | A5B00075406448 | SHIELDING COVER CAMERA WOLF5 | 1 |
| | | | | | |
| 1 | A5B00075391025 | V24851-Z1508-A120 | A5B00075391025 | LCD MODULE TFT QVGA SCOR- PIO/WOLF5 | 1 |
| | | | | | |
| 1 | A5B00900160521 | C39158-A148-B550 | A5B00075385677 | REAR COVER DEC WOLF5 | 1 |
| | | | | | |
| 1 | A5B00900160696 | S30880-Q8900-A100 | A5B00075422566 | BOARD-SW0/WOLF5/LAYOUT-A1 | 1 |
| 2 | A5B00900166654 | S30880-Q8900-A3 | A5B00075422565 | BOARD/WOLF5/MAIN A1+ ASSEMBLY V1 | 1 |
| 3 | A5B00900164851 | W30880-Q8900-A2 | A5B00075412764 | PCB/K3/WOLF5/MAINBOARD A1.2 | 1 |
| | Main Components Assembled | | | | |
| 3 | A5B00075389865 | C39158-A148-A906-1 | A5B00075389865 | SHIELDING BT WOLF5 | 1 |
| 3 | A5B00075389864 | C39158-A148-A905-1 | A5B00075389864 | SHIELDING FM-RADIO WOLF5 | 1 |
| 3 | A5B00075389819 | C39158-A148-A900-1 | A5B00075389819 | SHIELDING BB WOLF5 | 1 |
| 3 | A5B00075389820 | C39158-A148-A901-1 | A5B00075389820 | SHIELDING FEM WOLF5 | 1 |
| 3 | A5B00075389821 | C39158-A148-A902-1 | A5B00075389821 | SHIELDING GSM-UMTS WOLF5 | 1 |
| 3 | A5B00075389862 | C39158-A148-A903-1 | A5B00075389862 | SHIELDING RX WOLF5 | 1 |
| 3 | A5B00075389863 | C39158-A148-A904-1 | A5B00075389863 | SHIELDING PM WOLF5 | 1 |
| 3 | A5B00075415237 | C39158-A148-C92-1 | A5B00075415237 | DISPLAY FRAME WOLF5 | 1 |
| 3 | A5B00075366353 | V39151-F5472-M4 | A5B00075366353 | IND3*3FS4U7MA0,74 | 1 |
| 3 | A5B00026020014 | V20840-D61-D670 | A5B00026020014 | DISDIODE1SV305/V20840-D61-D670 | 2 |
| 3 | A5B00075285266 | V20840-C3008-D670 | A5B00075285266 | DISTRANS PNP 0,5A 30V SOT89 | 1 |
| 3 | A5B00075001429 | V20840-D5076-D670 | A5B00075001429 | DISDIODE SCHOTTKY BARRIER SOD323 | 1 |
| 3 | A5B00021883068 | V20820-C6047-D670 | A5B00021883068 | DISTRANSBCR48PN | 2 |
| 3 | A5B00075375363 | V20840-D3137-D670 | A5B00075375363 | DISDIODE BZX585-C2V7/MM5Z2V7T1 SOD523 | 2 |
| 3 | A5B00075008492 | V39197-F5008-F492 | A5B00075008492 | IC LOW PROFILE IRDA 115.2 KBIT/S SMD | 1 |
| 3 | A5B00075159231 | V20840-C4059-D670 | A5B00075159231 | DIS TRANS ARRAY 2*PNP 10K/47K SOT666 | 2 |
| 3 | A5B00075011391 | V20840-C4057-D670 | A5B00075011391 | DIS TRANS ARRAY EMD12 EMT6 | 1 |
| 3 | A5B00075175839 | V20840-C4060-D670 | A5B00075175839 | DIS TRANS ARRAY EMD9 EMT6 | 1 |
| 3 | A5B00075356873 | V20840-D4056-D670 | A5B00075356873 | DISDIODE ESD-PROTECTION DUAL SOT23 | 1 |
| 3 | A5B00026020861 | V20840-D4043-D670 | A5B00026020861 | DIODENARRAY ES/V20840-D4043-D670 | 1 |
| 3 | A5B00075292750 | V20830-C1137-D670 | A5B00075292750 | DISTRANS DUAL N-CH 20V SOT363 | 1 |
| 3 | A5B00075328613 | V20840-D5120-D670 | A5B00075328613 | DISDIODE SCHOTTKY 40V SOD323 | 1 |
| 3 | A5B00075285095 | V20840-D5086-D670 | A5B00075285095 | DISDIODE RB551V-30/PMEG3005AEA SOD323 | 4 |
| 3 | A5B00075285094 | V20830-C3007-D670 | A5B00075285094 | DISTRANS P-CH SI2333DS/FDN306P SOT23 | 2 |
| 3 | A5B00075332581 | V20810-B6177-D670 | A5B00075332581 | IC LOGIC16- BITBUFFER74ALVCH16244ZQLR SMT | 2 |
| 3 | A5B00075215162 | V20810-F6348-D670 | A5B00075215162 | IC SDRAM 256MB 105MHZ CSP54 LEAD- FREE | 2 |
| 3 | A5B00075296615 | V20810-F6355-D670 | A5B00075296615 | IC FLASH NAND 64MB*8 1,8V TBGA63 LEADFRE | 1 |
| 3 | A5B00075292968 | V20820-L6164-D670 | A5B00075292968 | IC TELECOM MSM6250 CSP409 | 1 |

Assembly drawing: Upper Case Assy. Compl.

Drawing will be supplied on request

Assembly drawing: Transceiver Unit

Drawing will be supplied on request

[illegible]

4 Electronic

Following chapters give an overview about the hardware of the Wolf-5

4.1 RF Section

The RF section consists of three data capable transceivers and two further broadcast receivers. The first transceiver is an IMS UMTS 2100MHz 3G solution which realises the conversion of the RF WCDMA signals from the antenna to the baseband and visa versa. The second transceiver is a GSM part which realizes the conversion of the GMSK-RF-signals from the antenna to the baseband and visa versa. The third transceiver is a Bluetooth type Personal Wireless LAN system. The first broadcast receiver is an RDS compliant FM radio solution. The second is a GPS location receiver which is integrated into the UMTS receiver IC. The GPS software will allow assistance from a suitably enabled network (A-GPS); standalone operation with out network assistance is also supported.

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

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

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

The GPS receiver is integrated into the UMTS receiver RFIC. Two stages of filtering are provided before and after the LNA. The GPS down conversion is again a direct conversion system.

The FM radio solution is also realized in a single IC. This is the only part which does not form part of the default Qualcomm radioONE chipset solution.

RF Chipset Overview

- RTR6250 Qualcomm
 - GSM Tx/Rx UMTS Tx RFLO1, PLL for GPS LO
- RFR6250 Qualcomm
 - UMTS Rx GPS Rx UMTS VCO, VCO for GPS
- TXCO – 19.2MHz
- GSM Tx VCO
- GSM PA Module
- UMTS PA Module
- UMTS Duplexer and Isolator
- FEM .
- Various SAW Filters.
- BCM2004 Bluetooth IC
- FM Radio

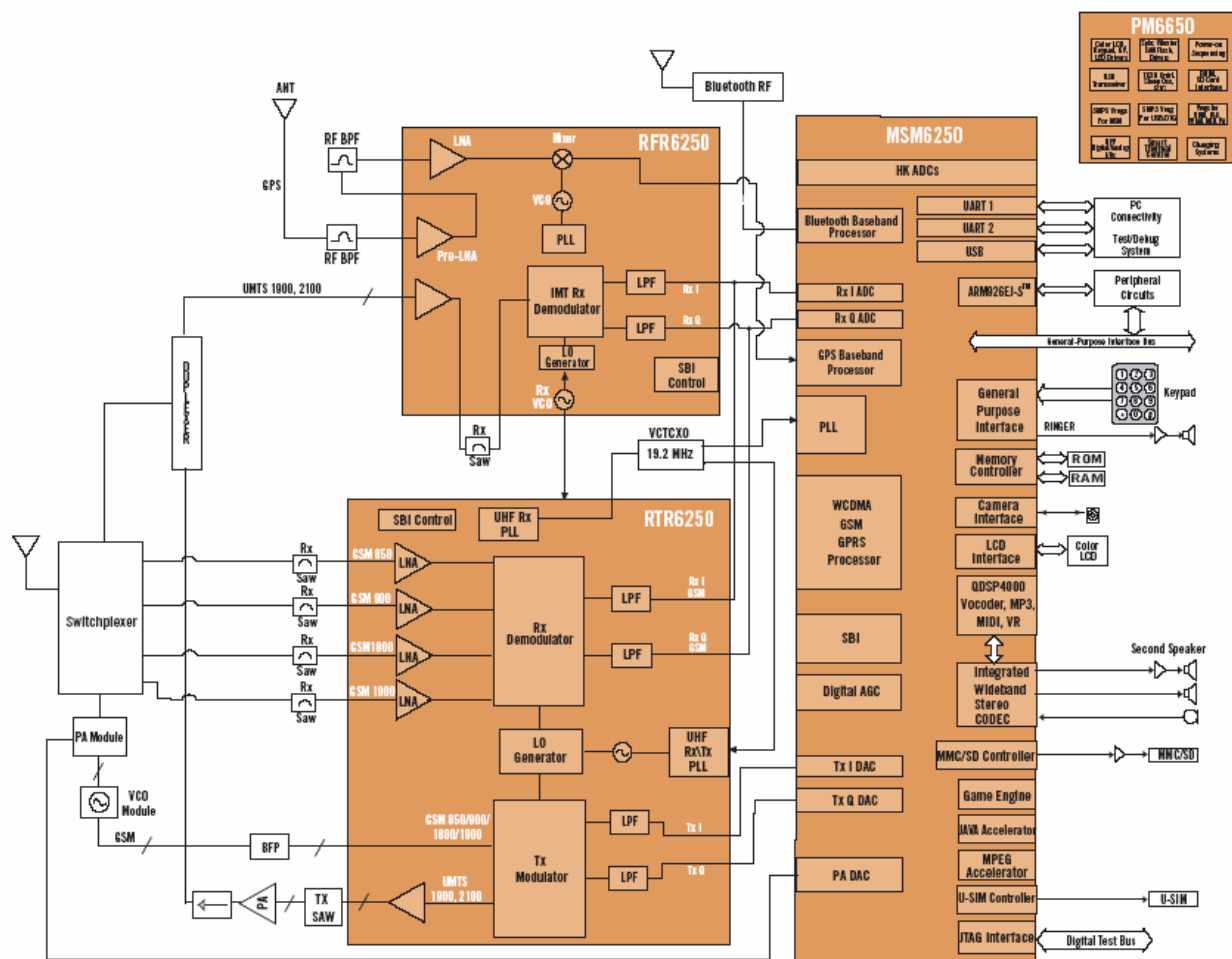


Figure 4-1 Qualcomm MSM6250 Platform III radioOne solution.

4.1.1 Compliance

4.1.1.1 Receiver Sensitivity:

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

GSM 900: -102dBm (Specification, static & with fading)

GSM1800/GSM1900: -102dBm (Specification, static & with fading)

UMTS2100

GPS

4.1.1.2 Transmitter Power:

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

GSM 900: nominal 2W -> power class 4

GSM1800/GSM1900: nominal 1W -> power class 1

UMTS2100

| | |
|---------|--------------------------------|
| GSM 900 | > 31,0dBm at normal conditions |
| GSM1800 | > 28,0dBm at normal conditions |
| GSM1900 | > 28.0dBm at normal conditions |

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

4.1.2.1 Functional block diagram

Wolf 5 RF Block Diagram
Issue F
David Pennington
27/7/04
Commercial-in-Confidence

Figure 4-2 RF Block Diagram.

4.1.2.2 Panasonic Frontend-Module (FEM) – A1

The FEM includes a switch for switching the Antenna between UMTS and the various GSM Tx and Rx modes. The FEM also includes two low pass filters to reduce the harmonics in the GSM Tx paths. The FEM in A1 is a SP7T supplied by Panasonic, based on the reference design.

4.1.2.3 MuRata SP6T FEM – A1+

The A1+ design will use a cheaper part from MuRata. This will be a S6PT switch for switching the Antenna between UMTS and the various GSM Tx and Rx modes. This will preclude a Quad Band solution.

4.1.2.4 Discrete 19.2MHz TCXO reference oscillator

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

4.1.2.5 Qualcomm RTR6250 GSM Tx/Rx and UMTS Tx

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

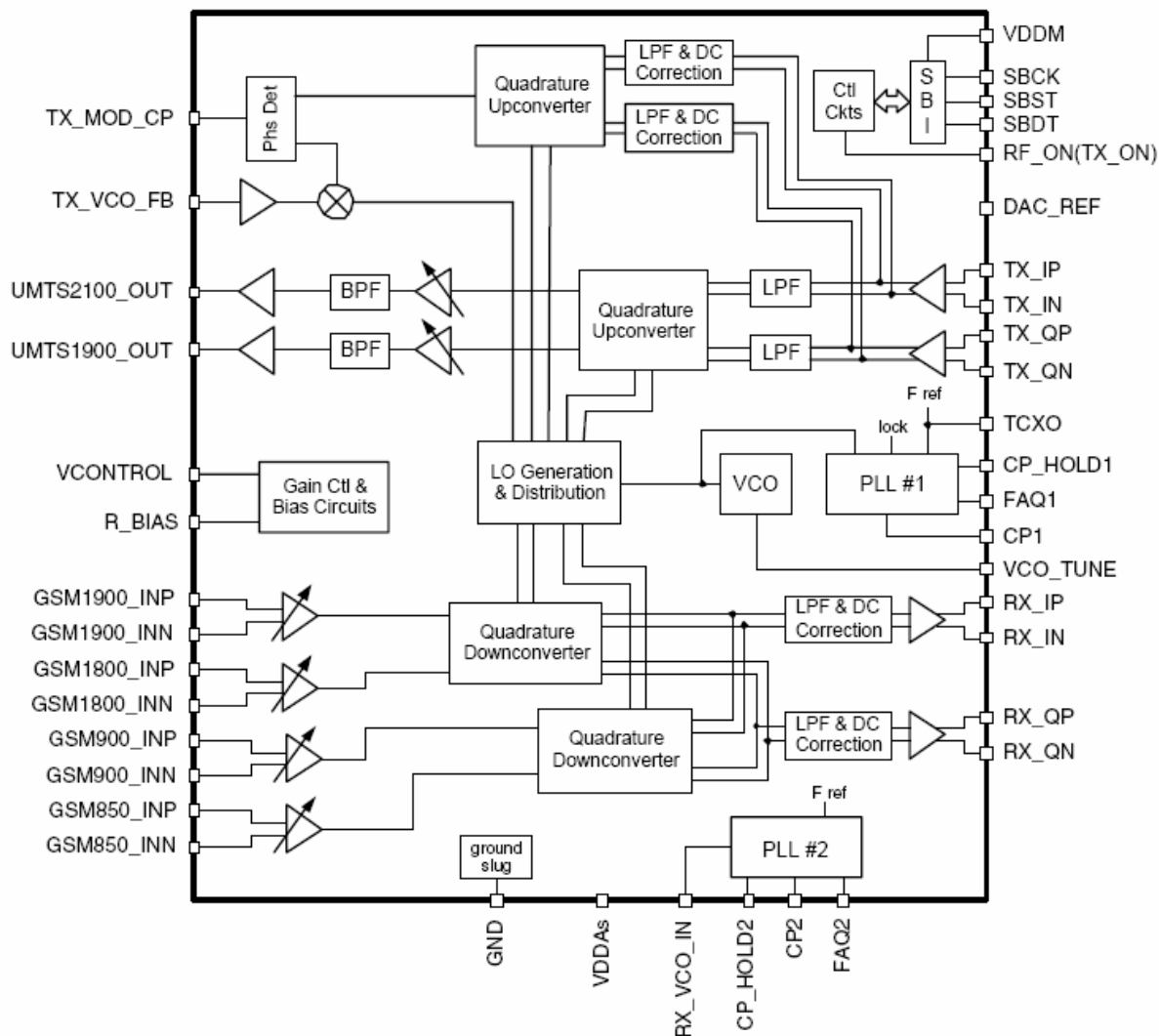


Figure 4-3 RTR6250 Block Diagram.

4.1.2.5.1 Frequency generation

The RTR6250 contains two PLL, the first is used by the RTR for all the GSM transceiver functions and for the UMTS Tx LO generation. The second PLL is used to control the GPS VCO in the sister RFR6250 RFIC.

4.1.2.5.2 UMTS Tx

The IQ signals from the baseband are directly up-converted to the RF band by a Quadrature Upconverter and passed to the external filter. The UMTS 1900 Tx path is not used in Wolf 5.

4.1.2.5.3 GSM Rx

The GSM Receiver is a Zero IF architecture with direct conversion by the IC. Although the IC provides 4 input paths, the GSM850 Receiver is not used in Wolf 5.

4.1.2.5.4 GSM Tx

The GSM Transmitter uses a Offset Phase Lock Loop Architecture. The High Power VCO is external to the RTR6250. A feedback signal from the VCO is down-converted and the phase compared to that of an

upconverted version of the IQ signals from the baseband. The resultant control signal is filtered and passed to the High power VCO.

4.1.2.6 Qualcomm RFR6250 UMTS and GPS Rx

The RFR6250 RFIC adds the UMTS and GPS receiver functionality to the RTR6250 IC. A block diagram is shown below.

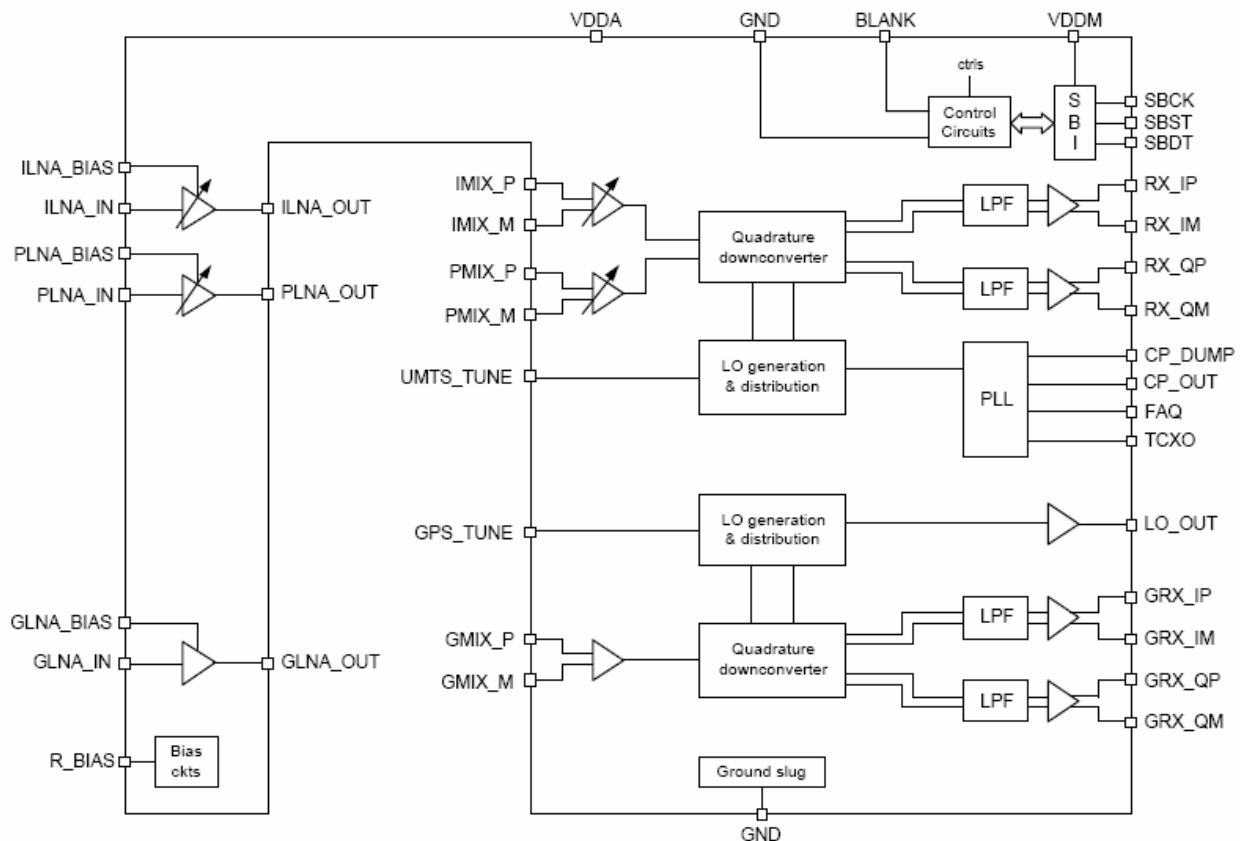


Figure 4-4 RTR6250 Block Diagram.

4.1.2.6.1 Frequency Generation

The RFR6250 has two VCOs. The first is for the UMTS Direct Conversion receiver. The second is for the GPS receiver and the PLL for this VCO is on the RTR6250 RFIC.

4.1.2.6.2 UMTS Rx

The RFR6250 provide an LNA and then an output to allow further input filtering. The balanced signal is reintroduced to the RFR6250 and down converted by the Zero IF Quadrature Downconverter. The UMTS 1900 Rx path (PLNA, PMIX) is not used in Wolf 5.

4.1.2.6.3 GPS Rx

The GPS path is similar to the UMTS path, but uses a higher power LNA to compensate for the DCS self blocking. The RFR6250 does allow the GPS Rx path to be switched off during GSM Transmit pulses.

4.1.2.7 External GSM Blocks**4.1.2.7.1 GSM Dual Band Tx VCO**

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

4.1.2.7.2 GSM Dual Band PA Module – A1

The power amplifier used in the A1 board is a PA-module from RFMD, that was to be used by Ulm.

4.1.2.7.3 GSM Dual Band PA Module – A1+

The power amplifier in the A1+ board is a PA module from Renesas, which is now being used by Ulm. It contains two separate amplifier chains for EGSM900 and DCS1800 / PCS1900 operation, both matched to 50 Ω at all signal ports. It is possible to control the output-power of both bands via one PA_RAMP-port. The appropriate amplifier chain is activated by a logic signal, which is provided by the MSM6250 (GSM_PA_BAND).

4.1.2.7.4 GSM Rx SAW Filters

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

4.1.2.8 External UMTS Blocks**4.1.2.8.1 UMTS Tx SAW Filter**

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

4.1.2.8.2 UMTS PA Module – A1

The power amplifier used at A1 is a PA-module from RFMD. This amplifier has now been withdrawn by RFMD.

4.1.2.8.3 UMTS PA Module – A1+

The power amplifier to be used in A1+ is a PA-module from Agilent. The Baseband supports two modes of operation, to allow high efficiency low power operation. Further the baseband Power management IC (PMIC) provides a step down converter to supply a lower V_CDMA_PA for even better low power efficiency operation. The Agilent module supports a different method of control, but its quiescent current is low enough that these extra modes may be unnecessary.

4.1.2.8.4 Isolator

To ensure that the output power and ACLR requirements are met, the power amplifier requires the output impedance be controlled and a Isolator is used after the amplifier, before the duplexer.

4.1.2.8.5 Duplexer

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

4.1.2.8.6 UMTS Rx SAW Filter

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

4.1.2.9 External GPS Filters

Two GPS filters are provided, the first has to be both low loss and high isolation at the GSM transmit frequencies to protect the LNA in the RFR6250. The second filter provides extra isolation and balanced signals to the down conversion mixer.

4.2 Bluetooth

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

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

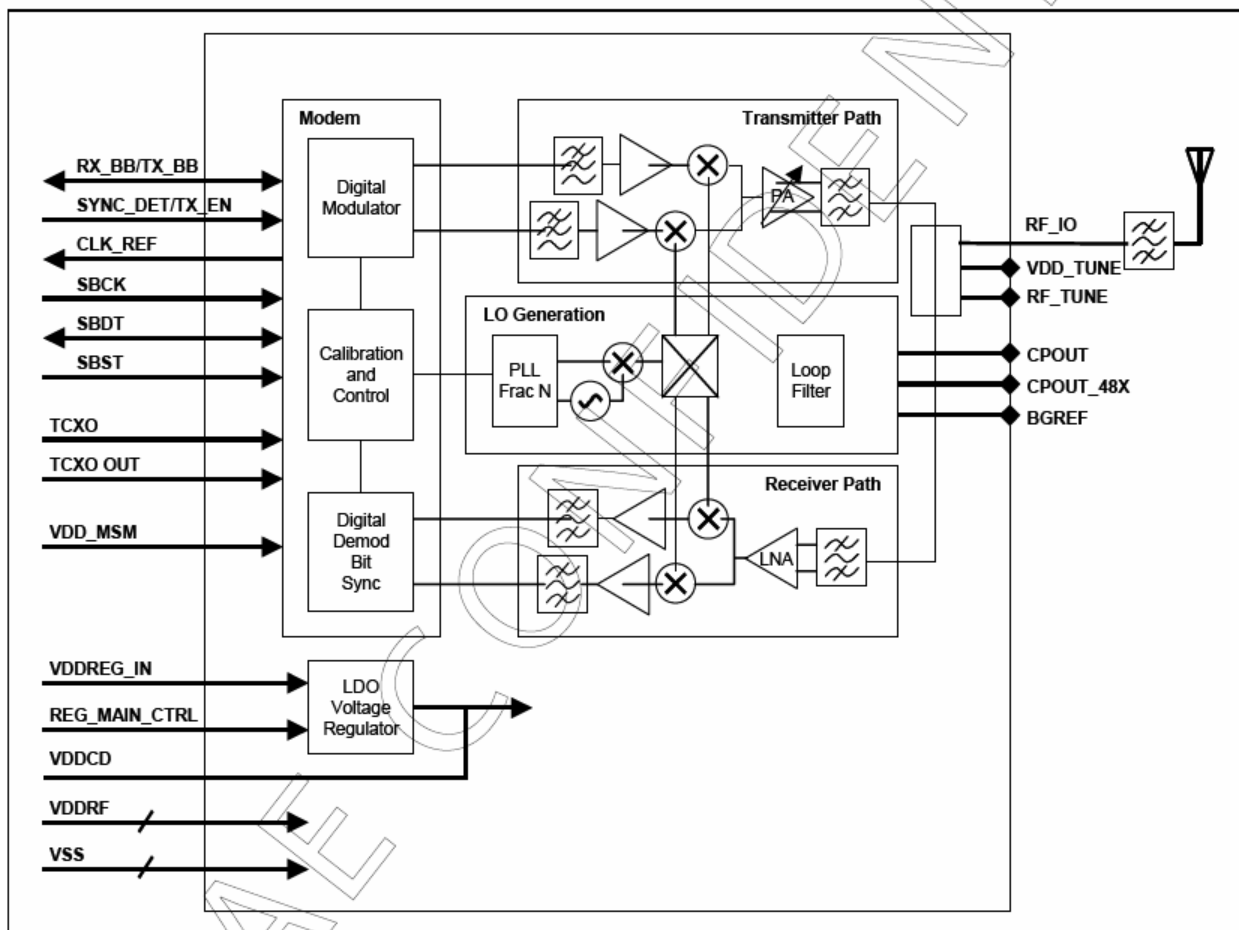


Figure 4-5 Bluetooth Block Diagram.

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

ance of the receive chain is reflected in the IP3, cochannel interference, and out-of-band blocking specifications. An on-chip demodulator bit slicer provides a post-slicer digital output, time aligned to a 12 MHz reference clock for interfacing to the QUALCOMM Bluetooth-enabled MSM.

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

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

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

The BCM2004 also provides its own power supply regulation.

For reducing co-existence issues including Tx noise in the GSM Rx Bands and self blocking, a SAW filter is provided. The antenna and test point with its matching network completes the Bluetooth solution in the Wolf-5 project.

4.3 FM/RDS Radio

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

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

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

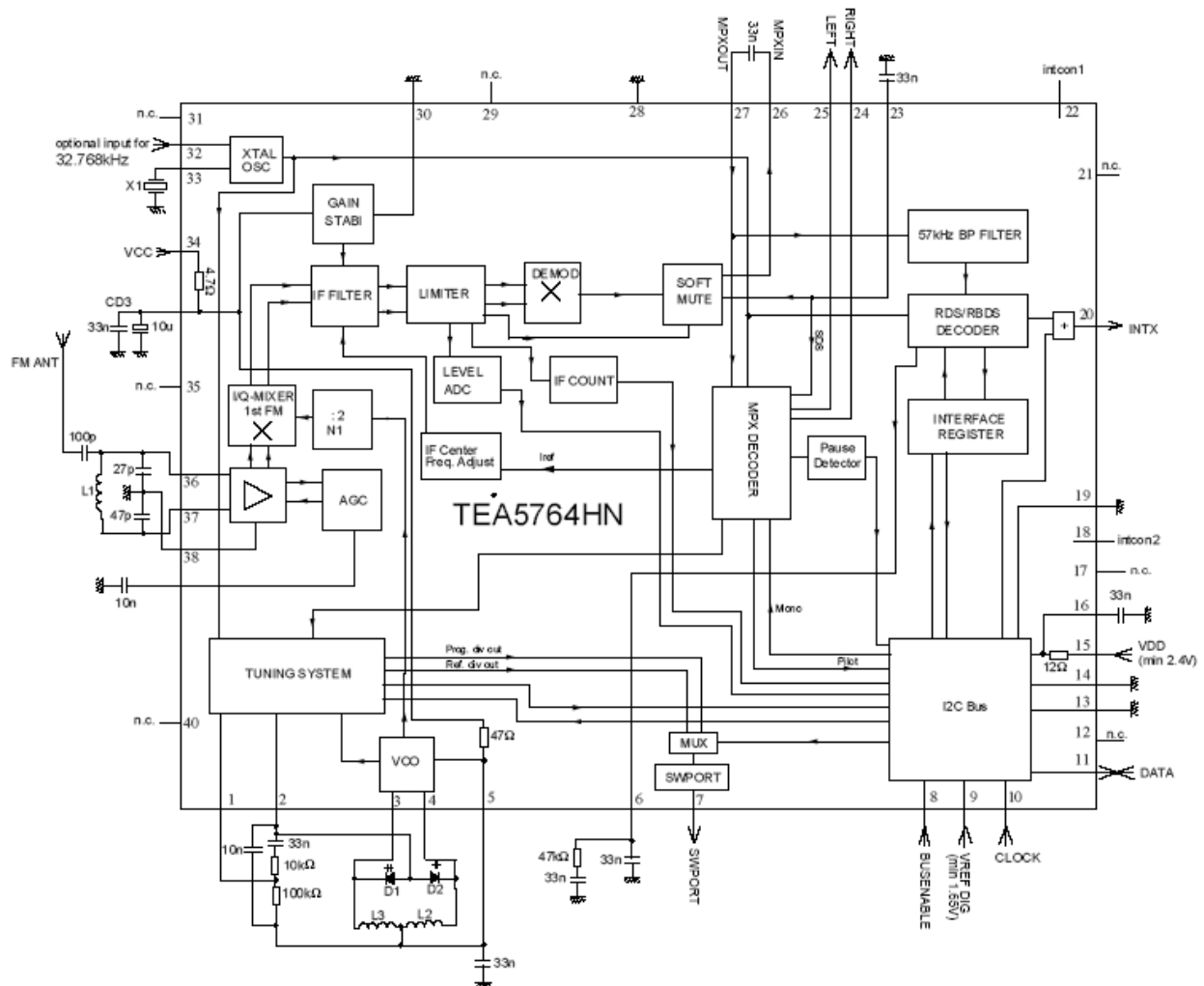


Figure 4-6 FM Block Diagram.

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

The antenna is provided by the accessory cable, which with its matching and splitting network completes the FM solution in the Wolf 5 project.

4.4 Digital Hardware

4.4.1 Overview of Hardware Structure

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

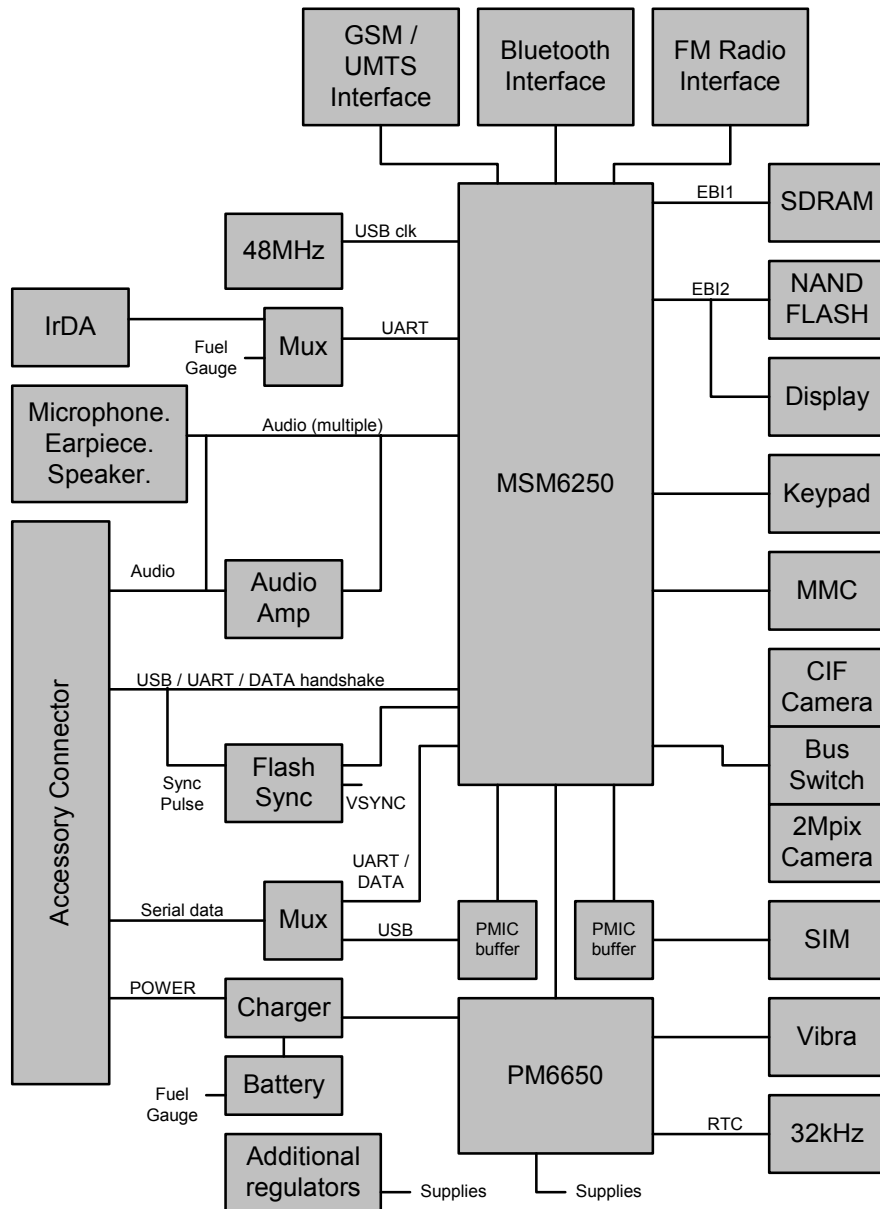


Figure 4-7 Wolf 5 Baseband System Overview

| Component | 1 st Supplier | 2 nd /3 rd source | Notes |
|------------------------------|------------------------------|---|--|
| Baseband | | | |
| MSM6250 Mobile Station Modem | Qualcomm | No 2 nd source | 409-ball CSP package (0.5mm Ball Pitch) |
| Memory | | | |
| FLASH | Samsung NAND 512Mb | Hynix, ST Microelectronics, Toshiba | NAND flash technology 8-bit multiplexed IO interface 1.8V supply |
| LPSPDRAM | 2 x Samsung 256Mb | 2 x Micron 256Mb | LPSPDRAM with automatic TCSR (both Samsung and Micron parts) |
| Power Management Unit | | | |
| PM6650 Power Management IC | Qualcomm | No 2 nd source | 84 BCCS package (7 mm × 7 mm body with a height of 0.80 mm) |
| Display | | | |
| TFT/TFD display | Epson | No 2 nd source | |
| IRDA | | | |
| IRDA Module | Citizen | Agilent | |
| Battery | | | |
| Lilon - Cell | NEC | Varta | |
| Cameras | | | |
| CIF camera | Hera CIF camera from Agilent | No 2 nd source | |
| Mega Pixel camera | Semtec | No 2 nd source | |

4.4.2 Digital Baseband

4.4.2.1 Mobile Station Modem MSM6250

The QUALCOMM CDMA Technologies (QCT) MSM6250 Mobile Station Modem chipset and system software is designed to address the Frequency Division Duplex Direct Sequence Wideband CDMA mode of the IMT-2000 standard and the Global System for Mobile communications (GSM/ GPRS) standards. The MSM6250 device integrates the ARM926EJ-S processor, offering the ARM Jazelle Java hardware accelerator, two low-power, high-performance QDSP4000 Digital Signal Processor cores and a wideband stereo codec for support of enhanced digital audio applications. The QDSP4000 core eliminates the need for the multimedia companion processors normally required for video and audio-based applications, playing MP3 music files, MIDI synthesizer, video and still-image record and playback, and 2D/3D graphics functions. The MSM6250 mobile station modem solution includes multimedia features such as Qtunes MP3 player software and Compact Media Extension MIDI-based multimedia software.

Wolf 5 system software is executed by an ARM926EJ-S embedded microprocessor and controls most of the functionality of the phone. The user interface of the phone includes the keypad, LCD display, and ringer. These are under the direct control of the MSM6250 mobile station modem.

The integrated wideband stereo CODEC converts an analog audio signal, either differential or single-ended, from the microphone into digital signals for the MSM6250 mobile station modem's vocoder. The integrated CODEC also converts digital audio data from the vocoder into an analog audio signal, either differential or single-ended, for the earpiece. The internal vocoder supports all 8 AMR modes, along with implementing two echo cancellers, one for the earseal and an acoustic echo canceller for carkit applica-

tions. The vocoder also supports DTMF generation and detection, Advanced Noise Suppression, audio AGC control, and automatic volume control.

By integrating the gpsOne baseband functionality, the MSM6250 chipset provides an assisted GPS solution with unmatched acquisition speed, accuracy and sensitivity for services on GSM/GPRS/UMTS networks worldwide.

The MSM6250 mobile station modem is available in a 409-pin, 0.5mm pitch, Chip Scale Package.

MSM6250 general features

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

W-CDMA FDD features supported by the MSM6250 Mobile Station Modem

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

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

- SMS
- PS data rate 384kbps DL / 64 kbps UL, simultaneous or 128/128 simultaneous
- CS data rate 64kbps DL / 64 kbps UL
- AMR (all rates)

GSM/GPRS features supported by the MSM6250 Mobile Station Modem

The following GSM modes and data rates are supported by MSM6250. Support modes conform to release '99 specification of sub-feature.

- SMS
- Voice features
 - FR
 - EFR
 - AMR
 - HR
 - A5/1 and A5/2 ciphering
- Circuit switched data features
 - 9.6 k
 - 14.4 k
 - Fax
 - Transparent and non-transparent modes for CS data
 - No sub rates are supported
- Packet switched data (GPRS)
 - Class B (Multislot Class 10)
 - CS schemes CS1, CS2, CS3, and CS4
 - GEA1 and GEA2 ciphering
 - Maximum of 4 Rx timeslots per frame
- DTM (dual transfer mode) "simple class A" where GSM and GPRS are simultaneous on the same ARFCN.

MSM6250 Mobile Station Modem audio processing features

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

MSM6250 Mobile Station Modem microprocessor subsystem

- Industry standard ARM926EJ-S™ embedded microprocessor subsystem
- Java hardware acceleration
- Enhanced memory support
- Dual memory buses (EBI1 & EBI2)
- 1.8 V or 2.6 V memory interface support for EBI2
- 1.8 V memory interface support for EBI1
- Page and burst mode NOR FLASH or SRAM
- Burst mode is supported on all four EBI1 chip selects
- NAND FLASH memory interface
- Boot from NAND
- Low-power SDRAM (LP-SDRAM) interface
- Multimedia Card (reduced size) support
- Internal watchdog and sleep timers

- The ARM926EJ-S microprocessor can operate at up to 150MHz with variable rate, software-controlled clocks to provide greater standby time.
- ANSI/IEEE 1149.1A-93 compliant JTAG interface for testability
- Embedded trace macrocell for native mode debugging of the ARM processor

MSM6250 Mobile Station Modem supported interface features

- Enhanced USB interface (full-speed USB-OTG)
- Enhanced universal asynchronous receiver transmitter (UART) serial ports
- General-purpose I/O pins
- External keypad interface
- Parallel LCD interface
- Serial bus interface (SBI) that controls the other QUALCOMM ASICs in the subscriber unit.
- Pulse density modulated (PDM) outputs for user-defined analog control
- General-purpose programmable M/N counter output
- Programmable ringer output
- Integrated USIM controller for direct interface to USIM card reader
- HKADC for monitoring of analog parameters (6-channel)
- Stereo DAC interface
- Integrated mass storage device controller for direct interface to high memory storage cards (e.g., MULTIMEDIACARD)
- Bluetooth™ interface (BlueQ™)
- Megapixel camera interface, supporting up to 2 megapixel images

Real Time Clock

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

4.4.2.2 LPSDRAM

Memory used for volatile data storage.

LPSDRAM= Low Power Synchronous high data rate Dynamic Random Access Memory

| | |
|----------------------|------------------------|
| Memory Size: | 512Mb (16Mb x 32 bits) |
| Data Bus: | 32 Bit |
| Frequency: | 105 MHz max. |
| Power supply: | 1.8 V |
| Banks: | 4 |

Four banks operation / Burst read, single-bit write operation / Auto refresh / auto TCSR (Temperature Compensated Self Refresh), PASR (Partial Array Self Refresh), DS (Driver Strength)

4.4.2.3 FLASH

NAND Flash Memory of 1Gb for Code storage and Data storage. Code cannot be executed directly from NAND Flash and therefore needs to be transferred and executed from RAM.

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

There is a serial number on the flash which cannot be changed (unique ID for Copyright Protection).

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

| | |
|---------------------|---|
| Memory Size: | 512 Mb (64MB) optionally 1Gb (128MB) |
| I/O Bus: | 8 Bits (command/Address/Data multiplexed) |

Power Supply: 1.8 V
Flash Performance:

Page Read Operation

- Page size: (512 + 16) Bytes
- Random access: 15 us max.
- Serial Page Access: 60ns (min.)

Fast Write Cycle

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

Memory Organisation:

512 M bit with spare 16 M bit capacity, optionally 1G bit with spare 32M bit capacity
The memory array consists of 4096 (8192) separately erasable 16K-byte Blocks
A Block consists of 32 Pages
A Page consists of 512 bytes + 16 spare bytes

4.4.3 Display Module

4.4.3.1 Overview

The Wolf 5 display is a 2.2" QVGA (240x320) TFT display with 262 k (18 bit) color depth. The supplier for the TFT display is Epson - there is no second source. The controller is integrated with the display module. The display interface is connected to the 16-bit wide external bus interface (EBI2) of the MSM6250, which is also shared with the NAND Flash. The display I/O supply voltage (VIO) is 1.8 V while the main display power supply (VDD) is 2.85 V.

The display backlight is generated by 4 LEDs connected in series inside the display module. The required supply voltage of 20V is generated by a step-up converter.

4.4.3.2 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

- an Active Matrix Liquid Crystal Display Panel, transfective, 2.2", 240x320 dots, 262k colours, negative mode with wide viewing angle technology (ASV)
- a single chip display controller mounted on the display glass (COG) which is connected to a FPC inside the module
- a light guide with 4 white LEDs (Nichia NESW008B)
- Illumination foil stack (with inverted prism sheet) is implemented in the module to achieve the specified brightness and homogeneity
- A FPC with all passive components.
- A plastic frame
- Full contrast adjusted
- An electrical interface that consists of a 30 pin B2B connector from Molex. The female (larger part of the connector) is on the module
- Parallel 8/16-bit parallel CPU interface, can be switched by one pin which is part of the interface
- Target for mechanical design and delivery concept is to support automatic and half automatic display assembly at Siemens production line

4.4.3.3 Expected optical performance

| Items | Reflective Mode | | Transmissive Mode | | Unit |
|---|-----------------|-----|-------------------|-----|-------------------|
| Main Display | Min | Typ | Min | Typ | |
| Contrast Ratio | 15 | 20 | 200 | 300 | - |
| Luminance | - | - | 170 | 240 | cd/m ² |
| Colour Gamut Ratio (related to NSTC) | 7 | 10 | 45 | 55 | % |
| Reflectance (diff. light hemisphere) | 2,7 | 3,4 | - | - | % |

4.4.3.4 Mechanical description

| | | |
|-------------------------------|--|--|
| Main Display | | |
| Resolution : | 240x320 | Pixel Pitch : 0,141x0,141 mm2 |
| Dimensions : | panel dimensions: 38.0 mm x 54.6 mm active area : 33,84 mm x 45.12 mm Black Area: 37,4mm x 48,7 mm module dimension: 41 mm x 58mm x 3,5mm | |
| Pixel Size : | 0.141 mm x 0.141 mm | 1 pixel consists of 3 sub-pixels in red, green and blue |
| Technology : | a-Si TFT | with colour filters |
| Operating Temperature: | -20°C....+55°C | |
| Backlight : | Light guide + 4 white side-shooter LEDs / mounted on the flex foil inside the module | Nichia NESW008B, color rankb5, brightness rank U/T |

4.4.3.5 Available display modules

| Supplier | Supplier Part Nr. | Controller / Sub controller | Siemens SAP |
|----------|-------------------|--------------------------------|----------------|
| Epson | tbd | Epson-NEC μPD 161971 | A5B00075391025 |

In case of a later qualification of a second source 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 | 100 kOhm resistor between |
| Epson | LCD_CS <-> LCD_A0 |
| Tbd | LCD_CS <-> VDD I/O |
| Tbd | LCD_A0 <-> LCD_D0 |

4.4.3.6 Interface Display - Module to Wolf 5 PCB

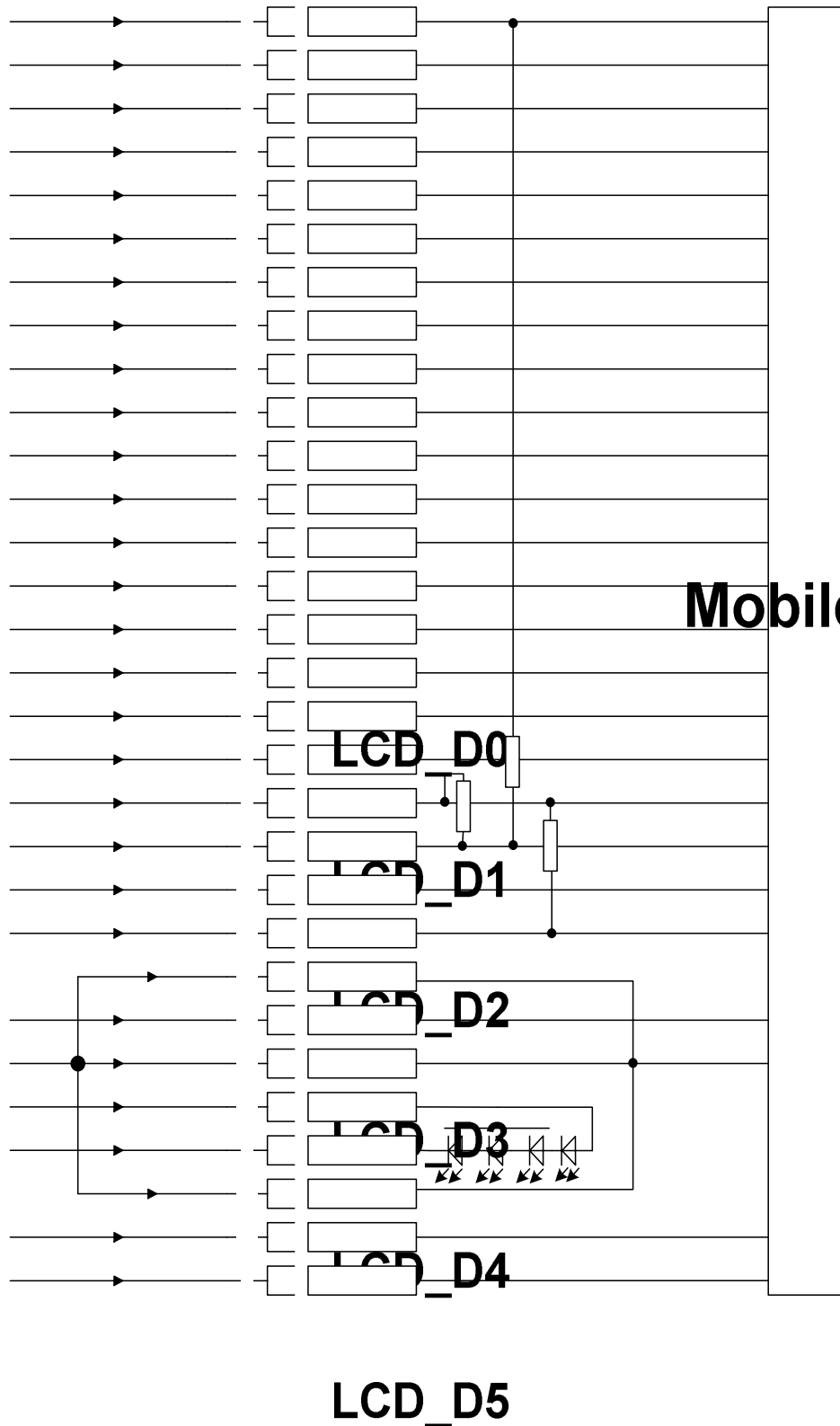
The display is connected to the main PCB via a 30-pin connector mounted on a short flex.

The displays needs for the panel a supply voltage of VDD = 2.90 V and VDD_I/O = 1,7...3,1V . Four white side-shooter LEDs for illumination are mounted on the module FPC.

For data transmission there is used a (8 or) 16-bit parallel interface with a maximum transfer-rate of 6.5 Mbit/s.

To avoid tearing effects during data transmission a synchronisation signal is available on pin "LCD-VSYNC" as shown in the following wiring diagram.

Wiring Diagram for Orion (QVGA) display module



Mobile Phone PC

Pin description Orion Display:

| No | Pin Name | Short Description | No | Pin Name | Short Description |
|----|-----------|--|----|------------------|---|
| 1 | VLED- | Cathode LED | 30 | VLED+ | LED Current @ 17 mA (Anode of the LED's) |
| 2 | MODE | LOW: 8 bit parallel interface HIGH: 16 bit parallel interface | 29 | GND | Power supply GND |
| 3 | LCD_CS | Chip Select | 28 | VIO (1,7..3,0 V) | VIO (1,7..3,0 V) |
| 4 | LCD_A0 | Data/Command | 27 | GND | Power supply GND |
| 5 | RD | Read signal | 26 | VLCD (2,7..2,9V) | VLCD (2,7..3,1V) |
| 6 | WR | Write signal | 25 | LCD_VSYNC | Synch Pin to avoid tearing effect |
| 7 | DAT0 | Parallel data bus | 24 | DAT8 | Data Lines |
| 8 | DAT1 | Parallel data bus | 23 | DAT9 | Parallel data bus |
| 9 | DAT2 | Parallel data bus | 22 | DAT10 | Parallel data bus |
| 10 | DAT3 | Parallel data bus | 21 | DAT11 | Parallel data bus |
| 11 | DAT4 | Parallel data bus | 20 | DAT12 | Parallel data bus |
| 12 | DAT5 | Parallel data bus | 19 | DAT13 | Parallel data bus |
| 13 | DAT6 | Parallel data bus | 18 | DAT14 | Parallel data bus |
| 14 | DAT7 | Parallel data bus | 17 | DAT15 | Parallel data bus |
| 15 | LCD_RESET | Reset | 16 | GND | Power supply GND |

nc: not connected

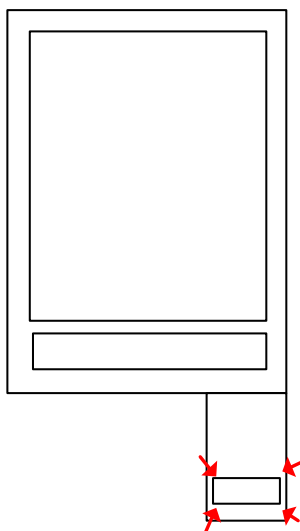


Figure 4-8 Orientation of LCD Connector with respect to Display (viewed from above, female connector shows to PCB)

4.4.3.7 Realisation 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).

4.4.3.8 Contrast and Color Adjustment

For the display module no contrast adjustment is necessary. The contrast is fixed in the module. It is not necessary to change the contrast by the mobile phone software.

The colour adjustment of the display panel is fixed by the supplier.

4.4.3.9 Illumination**a) Display**

The 4 serial LEDs for the display are supplied by a constant voltage source combined with a constant current sink, to ensure the same brightness and colour of the white backlight. Brightness is controlled by a PWM signal realized as GPIO pin (MSM6250).

The current for the LEDs is limited to max. 18 mA by a current sink on the mobile phone PCB.

b) Keyboard

The keypad backlight is supplied by 8 blue LEDs, 1 red LED and 1 green LED. These are arranged as two chains of 5 LEDs, both connected to a high voltage supply (> 16V). Current is limited to 3mA through each chain of LEDs, and brightness is controlled using PWM from an MSM6250 GPIO pin.

4.4.4 SIM

SIM cards with supply voltages of 3V will be supported. The hardware can also support 1.8V cards. However, the Wolf 5 software will only support 3V. 1.8V support may be made available if required (e.g. an operator's request). An Integrated EMI Filter and ESD Protection device from ST Microelectronics is connected to the SIM lines to protect the phone.

4.4.5 IRDA and Fuel Gauge

A Low-Power infrared data interface, compatible to "IrDA - Infrared Data Association; Serial Infrared Physical Layer Specification, Version 1.3", supporting transmission rates up to 115.2kbps (Serial IrDA) will be provided. As a Low-Power-Device, the infrared data interface has a transmission range of at least:

- 20cm to other Low-Power-Devices and
- 30cm to Standard-Devices

The viewing angle is $\pm 15^\circ$ (resulting in 30° viewing cone). The Infrared-Interface implies a Class 1 IR-LED, according to IEC 60825-1:1993+A1:1997+A2:2000.

The Battery Pack contains a Fuel Gauge Monitor from Texas Instrument (BQ26500). The Fuel Gauge signal is a 1-wire HDQ interface. It is interfaced to the MSM6250 via the same UART port as the IrDA. The multiplexing of the IrDA with the Fuel Gauge is illustrated below.

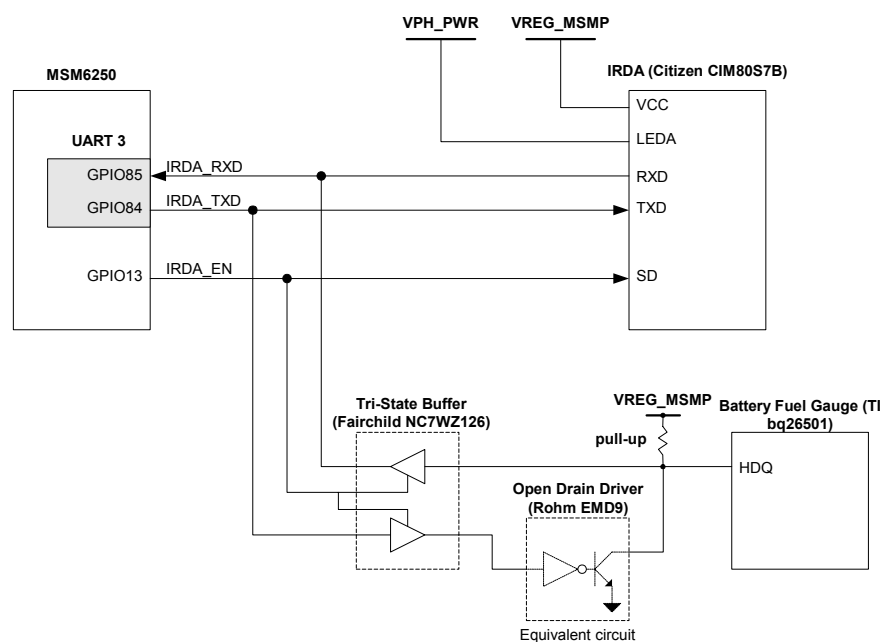


Figure 4-9 IrDA and Fuel Gauge multiplexing

4.4.6 RS-MULTIMEDIACARD

Reduced-Sized MULTIMEDIACARD with supply voltages of 3V only will be supported. The MULTIMEDIACARD interface lines are protected with Spark Gaps and ESD suppressors from ST Microelectronics (ESDA6V1-SW6). Capacitors are also connected to these lines to filter out EMI.

MULTIMEDIACARD insertion/removal detection is supported with a pull-up on one of the VSS pins of the MULTIMEDIACARD connector. When a card is inserted this pin is pulled to ground by the MultiMediaCard. The VSS pin level is monitored in software by GPIO35 of the MSM6250.

4.4.7 Cameras

Wolf 5 has 2 integrated cameras. A CIF camera (352 x 288) from Renesas or Agilent is included to support video conferencing with display of the local user image at a maximum frame rate of 15fps. The second camera is a 2 Mega Pixels sensor primarily for capturing high-resolution still images but does also support video capture. The later camera is supplied by TBD.

Both cameras are interfaced via the MSM6250 camera interface. It is a standard CCIR656 based interface consisting of 8 data lines, vertical and horizontal synchronization lines, a master clock into the sensors, a pixel clock output from the sensors and a synchronization signal for controlling the Flash of the 2 Mega Pixel camera. Both camera interfaces are multiplexed into the single MSM6250 camera interface via two SN74LVCH16244 bus switches as illustrated in below. Only one camera can be selected at any time. The cameras are configured and controlled via the I2C bus (also multiplexed). Power is supplied to the camera via a dual output external 2.85V voltage regulator.

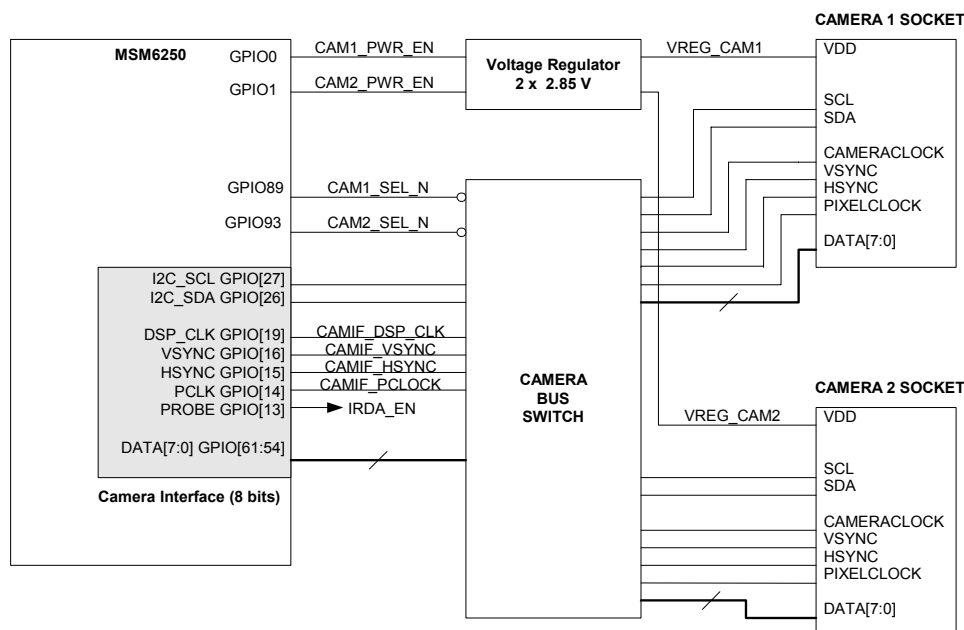


Figure 4-10 Camera Interfaces multiplexing

4.4.8 Clip On Flash Trigger

An optional flash for use with the Mega Pixel camera can be clipped onto the phone's Accessory Connector. The flash accessory specification is detailed in the Clip On Flash Product Specification V0.6. The Flash accessory needs to be triggered by the phone. The trigger signal for the Flash accessory is generated on the DCD/CLK pin of the Accessory Connector. The specification emphasises the need for the flash to illuminate all camera pixels when they are all sensitive.

For the Omnivision MegaPixel Camera-chip the Camera driven Vsync will go high at the start of an image capture cycle, remain high for a precharge period of at least 40µseconds and for at least a further 162 µs while all pixels are sensitive prior to Vsync returning low. When the Camera shutter is activated, The MSM6250 needs to enable one full V-sync pulse during the active camera period. So it must monitor the vertical synchronization signal CAMIF_VSYNC and enable FLASH_EN after a rising edge of CAMIF_VSYNC, as shown below. Note that the DCD pin of UART1 (MSM_UART1_DCD_N) needs to be tri-stated during this period since this pin is also connected to the DCD/CLK pin of the Accessory Connector (Flash Trigger Pin).

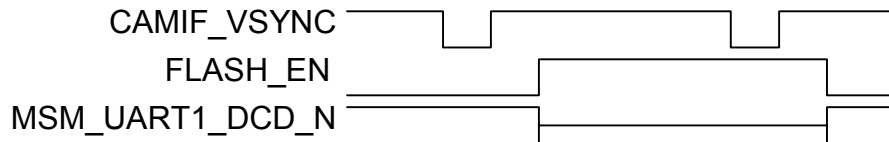


Figure 4-11 Camera Flash Trigger Signal

The arrangement provided below allows the Flash trigger (CLK/DCD) to be driven by the CAMIF_VSYNC line from the camera(s) whilst being controlled by the MSM6250. The COF will only receive the DCD/CLK trigger providing that both the CAMIF_VSYNC and FLASH_EN trigger lines are high. This ensures that the start of the trigger can be delayed by the MSM6250 and only remains there for the duration of CAMIF_VSYNC. The MSM6250 can thus enable the sync pulse by taking FLASH_EN (GPIO64) high, and setting MSM_UART1_DCD_N to tri-state.

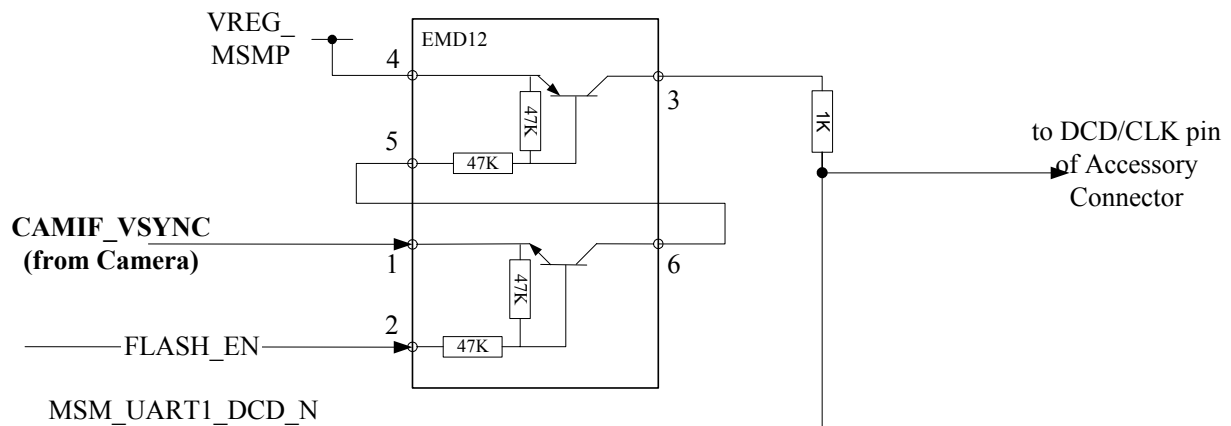


Figure 4-12 Flash Trigger Circuit

4.4.9 Vibration Motor

The vibration motor is mounted in the lower case. The electrical connection to the PCB is realised with pressure contacts.

The vibration motor is controlled with the PM6650 vibra motor driver as illustrated in Figure 4-13. The vibration driver is an SBI-programmable voltage output that is referenced to VDD; when off its output voltage is VDD. An external diode protects the PM6650 driver from the motor's inductive kickback. The motor is connected between VDD and pin 25 (VIB_DRV_N); the voltage across the motor is: $V_m = VDD - V_{out}$ where V_{out} is the PM6650 voltage at pin 25. The driver (pin 25) is programmable to support motors from 1.2 to 3.1V (in 100 mV increments). VDD corresponds to the handset supply voltage (VPH_PWR).

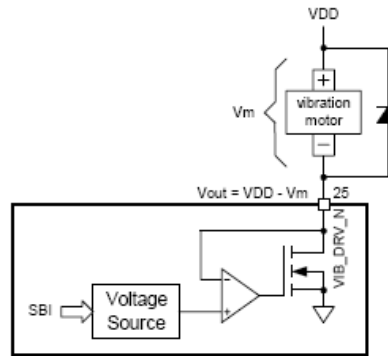


Figure 4-13 Vibration Motor Driver (PM6650)

4.4.10 Keypad Mapping

The keypad mapping and interfacing with the MSM6250 is illustrated in Figure 4-14. The END/Power key is connected directly to the PHONE_ON input to the PMIC (KPDPWR_N pin). This key is read independently of the matrix to allow it to also be used to power-on the phone.

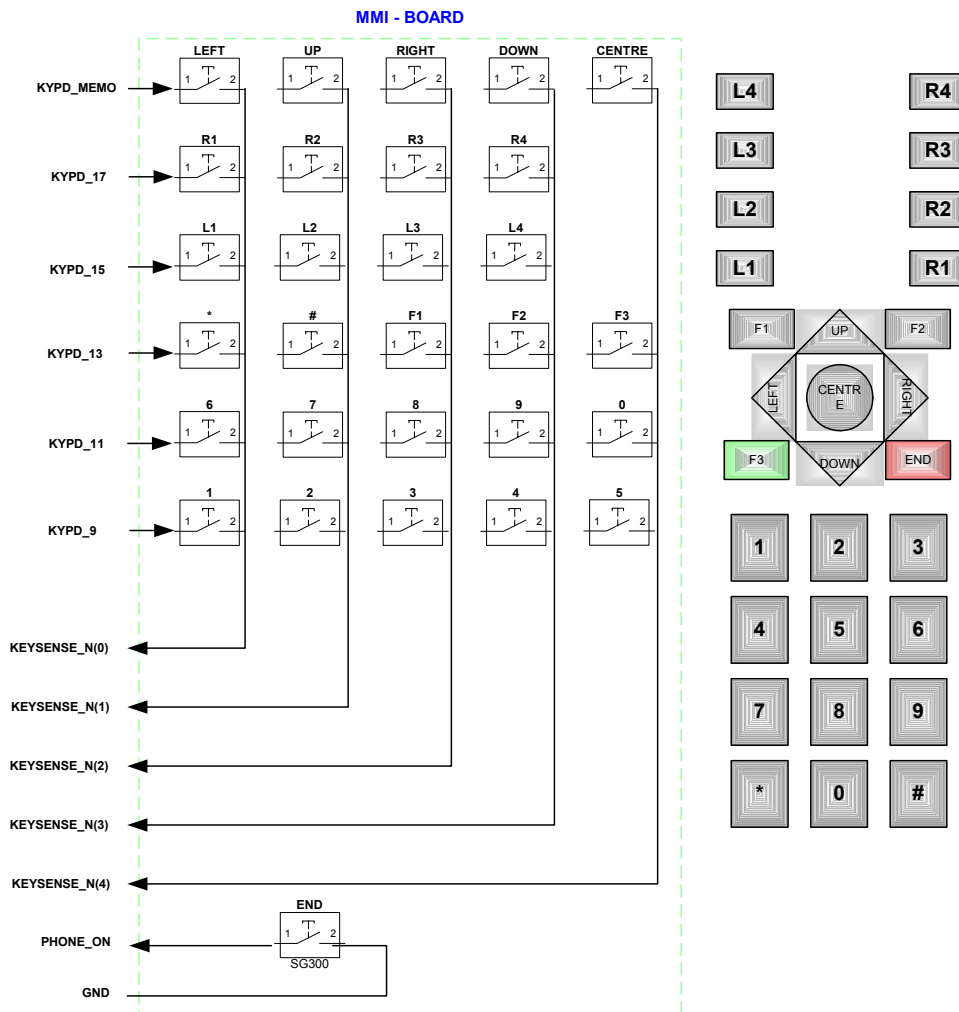


Figure 4-14: Keypad Arrangement and Functions

4.4.11 Electro Acoustic

The electro acoustic concept is based on an omni-directional microphone and a two-speaker solution, i.e. a small receiver for normal phone conversation and a larger speaker for handheld hands-free and alerting/ringing. The two-speaker concept is largely dictated by the chipset design, but also features a welcome decrease in the risk of acoustic shock.

- The ø4mm microphone is the same as used for C65 and is mechanically integrated into the back part.
- The speaker is based on the X75 speaker core with a sealed backvolume of 1.5ccm (similar to Minos). It is partly located in the antenna volume and has outlet to the back side of the phone.
- The ø8mm receiver is mounted in a plastic part which both serves as front volume for the receiver and also supports the A-GPS antenna. Outlet is on the front of the phone close to the center line.

4.4.12 Power Supply, Battery, Charging**4.4.12.1 Overview**

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

The following restrictions must be observed:

- The phone cannot be operated without battery inserted.
- The phone will be damaged if the battery is inserted with wrong polarity (the mechanics of the phone prevent the battery from being put in the wrong way round. The electric system assumes that the battery has been inserted correctly. This must be ensured via suitable QA measures).
- It is very inadvisable to remove the battery whilst the phone is connected to the charger unit as damage may result to the phone electronics.

4.4.12.2 PM6650

A block diagram of the PM6650 power management IC is given in Figure 4-4-15. The PM6650 contains the following functions:

- Complete power management, housekeeping, and user interface functions for wireless devices—CDMA and non-CDMA handsets, modems, PC cards, PDAs, etc.
- Input power management
 - Valid external supply attachment and removal detection
 - Supports unregulated (closed-loop) external charger supplies and USB supplies as input power sources
 - Supports lithium-ion main batteries
 - Trickle, constant current, constant voltage, and pulsed charging of the main battery
 - Supports coin cell backup battery (including charging). Note that a capacitor is used in this implementation in place of a coin cell to provide momentary power loss survival.
 - Battery voltage detectors with programmable thresholds
 - VDD collapse protection
 - Charger current regulation and real-time monitoring for over-current protection
 - Charger transistor protection by power limit control
 - Control drivers for two external pass transistors and one external battery MOSFET—MOSFET is optional
 - Voltage, current, and power control loops
 - Automated recovery from sudden momentary power loss
- Output voltage regulation
 - One boost (step-up) switched-mode power supply (SMPS) for driving white LEDs
 - Three buck (step-down) switched-mode power supplies that efficiently generate MSMC, MSME, and PA (or second MSMC) supply voltages

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

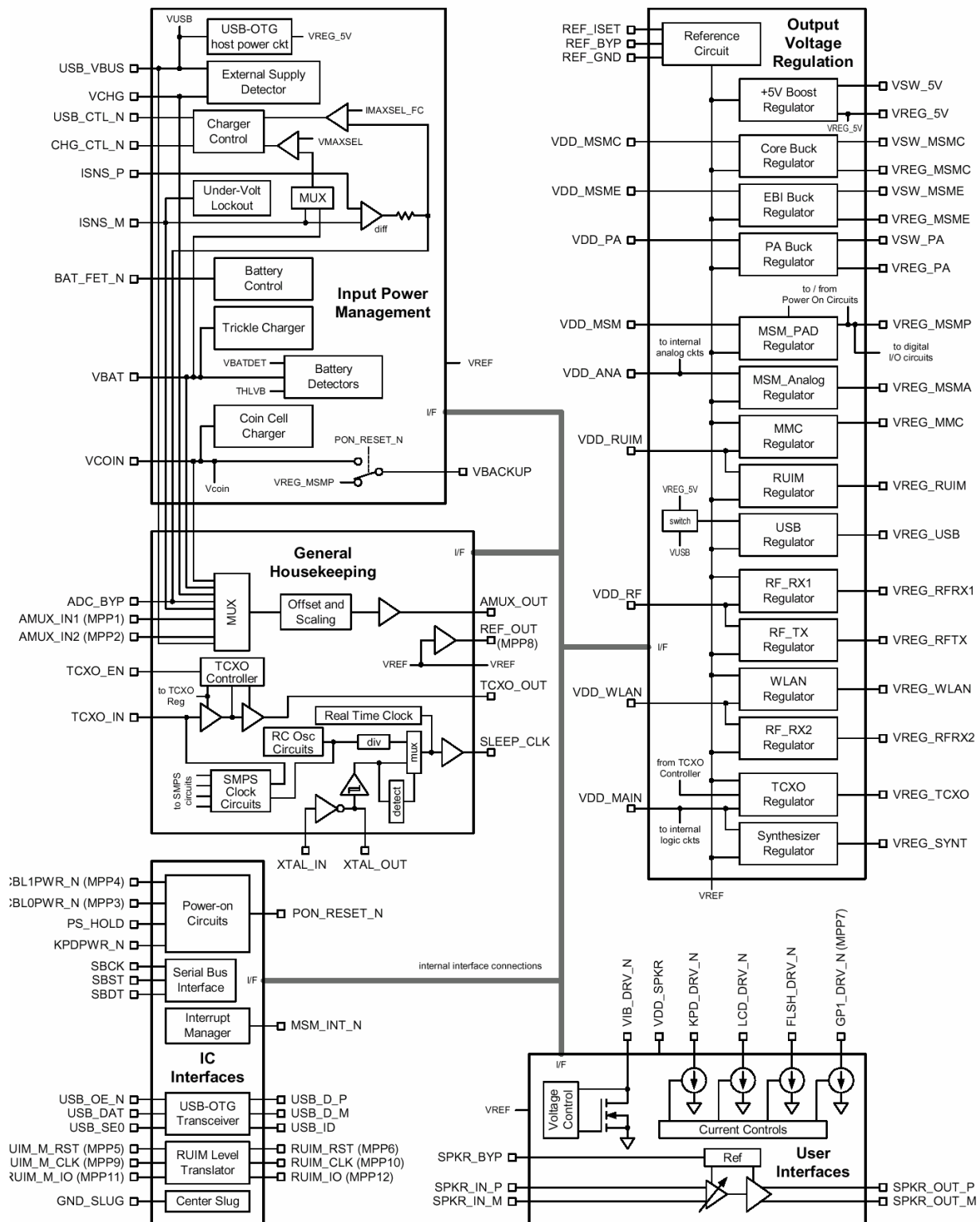


Figure 4-4-15. PM6650 IC Functional Block Diagram.

Voltage Regulators and Voltage Converters

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

| Name | Default Condi- tions | Voltage Range | Rated Current | Usage |
|--|-------------------------|------------------|---------------|--|
| Switched Mode Power Supply - Boost (step-up) | | | | |
| +5V (VSW_5V) | OFF, 5.000 V | 3.000 to 6.100 V | 400 mA | LCD Backlight |
| Switched Mode Power Supply - Buck (step-down) | | | | |
| MSMC | ON, 1.375 V | 0.750 to 3.050 V | 500 mA | MSM6250 Digital Core at 1.375V |
| MSME | ON, 1.800 V | 0.750 to 3.050 V | 500 mA | SDRAM (EBI1 bus); NAND Flash (EBI2 bus); LCD (EBI2 bus); MSM6250 supply voltage for Pad2 |
| PA | OFF, 1.800 V | 0.750 to 3.050 V | 500 mA | WCDMA Power amp; dynamically adjusted to minimize power dissipation |
| Linear Regulators | | | | |
| MSMA | ON, 2.600 V | 1.500 to 3.050 V | 300 mA | MSM6250 analog circuits; FM radio; Audio Amp. (LM4911) |
| MSMP | ON, 2.600 V | 1.500 to 3.050 V | 300 mA | MSM periphery circuits; IrDA; Bluetooth; Camera Bus Switch; PA/RF Temp. sensor; FM radio |
| MULTIME- DIACARD | OFF, 2.850 V | 1.500 to 3.050 V | 150 mA | MultiMediaCard |
| RFRX1 | OFF, 2.850 V | 1.500 to 3.050 V | 150 mA | Antenna Switch; RTR6250 |
| RFRX2 | OFF, 2.850 V | 1.500 to 3.050 V | 150 mA | RFR6250 |
| RFTX | OFF, 2.850 V | 1.500 to 3.050 V | 150 mA | GSM TX/VCO; RTR6250 |
| RUIM | OFF, 2.850 V | 1.500 to 3.050 V | 150 mA | USIM Card |
| WLAN | OFF, 2.850 V | 1.500 to 3.050 V | 150 mA | Bluetooth |
| SYNT (VREG_SYN TH) | OFF, 2.850 V | 1.500 to 3.050 V | 50 mA | RTR6250 |
| TCXO | ON, 2.850 V | 1.500 to 3.050 V | 50 mA | TCXO; Supply voltage for 2-input NAND gate NC7SZ00L6X |
| USB | OFF, 3.300 V | 3.300 V | 50 mA | Internal USB transceiver; should not be used for external loads |

The Wolf 5 design includes the following additional Voltage sources (TBD):

- An external Accessory supply (2.7V nominal at 300 mA max)
- A voltage regulator with dual output to supply both cameras with 2.85V.
- A boost converter switching regulator for the LCD backlight (nominally 23V) to be used in future Wolf 5 board iterations

4.4.12.3 Battery

Wolf 5 Battery is a High Capacity Lilon - Battery Pack nominally rated at 4.2 V open circuit terminal voltage and about 1000 mAh minimal capacity. The battery pack will have in-built electrical protection circuitry and will have an in-built fuel gauge addressable via a HDQ single line interface.

The battery pack is still under development and therefore the detailed parameters are subject to change.

Key required features

Siemens Confidential ©

ICM MP PD

Product Description Wolf5_PERFORMANCE_DESCRIPTION_M1_FINAL.Doc

Page 43 of 104

Printing Date: 28.10.04

- Lilon Battery Pack
- Nominal Capacity: 1000 mAh @ 0,2 CA / 20°C
- Over charge detection voltage: 4.300 V +/- 25 mV
- Over charge release voltage: 4.100 V +/- 30 mV
- Over discharge detection voltage: 2.400 V +/- 35 mV(Charger Connection)
2.900 V +/- 70 mV(Charger non-connection)
- Over Current Detection: 2.000 – 5.000 A
-
- Over charge detection delay time: 1.0 s +/- 0.2s
- Over discharge detection delay time: 96 ms +/- 19.2 ms
- Over current detection delay time: 12.0 ms +/- 2.4 ms
- Consumption current: - operating mode: max. 100.0 µA (Typ. 70.0 µA)
- - Power Saving mode: max 5.0 µA

Charging

If starting with a deeply discharge battery, charging must take place in three distinct phases. It is important during charging that the maximum battery terminal voltage does not exceed 4,2 V ± 50 mV.

Trickle charging with a current below 100mA is only necessary when the battery voltage is less than 3.0 V.

The second phase is termed fast or constant current charging. The current for standard fast charging can be 950 mA max which is set by the maximum capability of the charger unit. Fast charging terminates when the battery terminal voltage reaches 4.2V. At the end of fast charging the battery will be charged to approximately 80% of its fully charge capacity.

The final phase of charging is pulsed. A constant on period of 100 ms is used and the terminal voltage of the battery is not permitted to exceed 4.3V during the on period of the pulse. The off time of the pulse is controlled such that the open circuit terminal voltage of the battery converges on 4.2V. Charging is considered to be complete when the average current falls below C/20 (C is the nominal 1 hour discharge current i.e. 1A in this case)

Stand-by time (detailed measurements need to be done)

- 375 hrs WCDMA standby
- 325 hrs GSM standby

Talk time

- 3.0 hrs WCDMA talk time
- 3.75 hrs GSM talk time

Notes:

1. All numbers based on 800 mA- hr battery (usable capacity)
2. WCDMA talk time assumes 0 dBm output power
3. WCDMA DRX cycle = 2.56 seconds.
4. WCDMA standby calculated for PICH receiving only.
5. GSM numbers calculated per ECTEL document TW. 09 (DRX 5)

4.4.12.4 Charging Concept

4.4.12.4.1 General

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

Charging is started as soon as the phone is connected to an external charger. If the phone is not switched on, then charging shall take place in the background (the customer can see this via the "Charge" symbol in the display). During normal use whilst connected to a charger, the phone will be charged (restrictions: see below).

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

To control the charging process it is necessary to measure the prevailing battery temperature and the battery terminal voltage. Charging is permitted inside a temperature range of 0°C to +45°C.

Charging time is dependent upon the charger and the operating mode of the phone during the charge process. With the phone in standby and assuming that the charger obeys the Normal Charger VI Envelope, then the charge current will be a maximum of 950 mA. Total charging time shall then be 1.5 hrs or less.

The charging and battery switch components are illustrated in Figure 4-4-16, these components are controlled by the PMIC. The components comprise: a pass transistor (V703) which can be operated in linear mode or driven into full saturation by the PMIC to operate as a switch; a low value charge current sensing resistor; a battery switch FET which features a very low on resistance.

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

When operating from a USB charge source, the output charge current capability of the USB device is relatively low and the pass transistor will be operated in linear mode to appropriately limit the charging current.

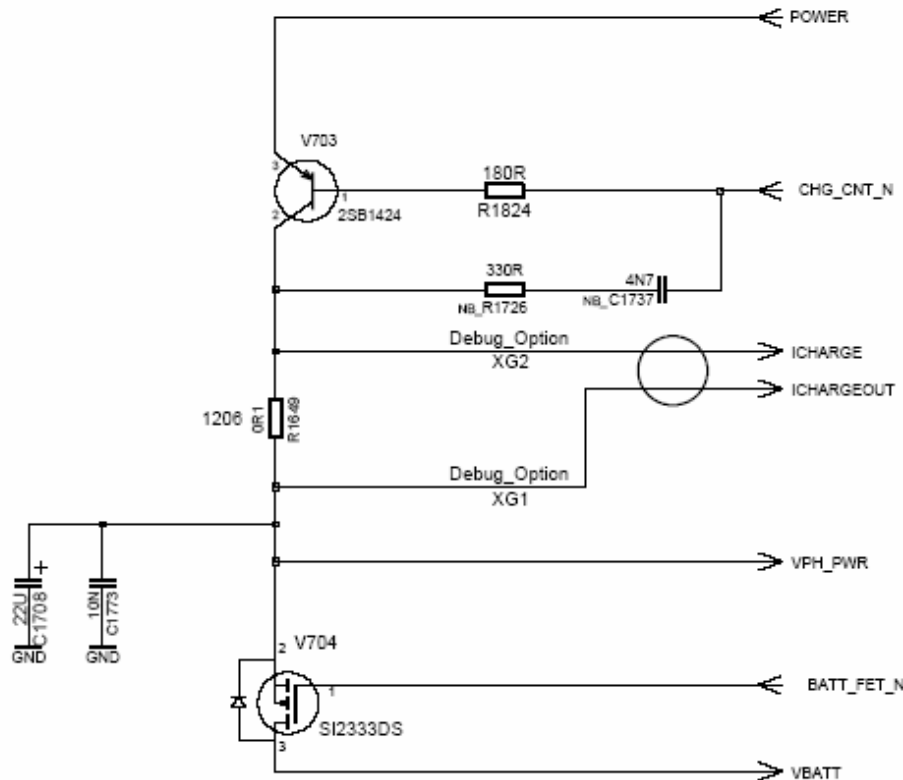


Figure 4-4-16. Charging circuit elements controlled by the PMIC

4.4.12.4.2 Measurement of Battery voltage, Battery Type and Ambient Temperature

Measurement of the battery terminal voltage will be carried out by the PMIC which has an internal temperature compensated voltage reference and an ADC based measurement system.

A battery fuel gauge, is an in-built features of the battery. The fuel gauge has registers which are addressed and read using a single line HDQ digital interface. Many parameters can be read from the fuel gauge including cell voltage, temperature and charge status.

4.4.12.4.3 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. (Wolf5 timing is TBD)

Battery fuel gauge measurement timing cannot be controlled externally to the battery, hence battery status must be determined purely from battery temperature, history, and charge/discharge measurements.

4.4.12.4.4 Recognition of the Battery Type

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

4.4.12.4.5 Charging Characteristic of Lithium-Ion Cells

Lithion batteries which are not initially deeply discharged, are charged with a constant current of approximately 1C (where C is the nominal ampere-hour rating of the battery)) until a maximum terminal voltage of $4.2V \pm 20mV$ is achieved. At this point the battery has been charged to about 80% of its full capacity and the terminal voltage falls back from 4.2V. The charging mode is then switched to pulsed during which the battery is supplied with 100 ms pulses of current. The on time is fixed at 100ms but the off time is variable and dependent upon the off time battery terminal voltage. The off time battery voltage is monitored and allowed to converge towards 4.2V. The off times gradually increase, decreasing the average current. Pulse charging ceases when the average current falls to C/20.

Lithion cell charging is only permitted between the temperature limits of 0°C and 50°C.

Total charge cycle time is expected to be a maximum of 1.5 hours when a charger capable of supplying 700mA is used.

4.4.12.4.6 Trickle Charging

When a Lithion battery is deeply discharged, the terminal voltage drops below 3.0V and a period of trickle charging is necessary to bring the terminal voltage up to 3.0V whereupon fast charging can commence.

The PMIC controls the trickle charge process via an internal programmable current source. The nominal trickle charge rate for Wolf 5 is 80 mA.

4.4.12.4.7 Normal Charging (Fast charge)

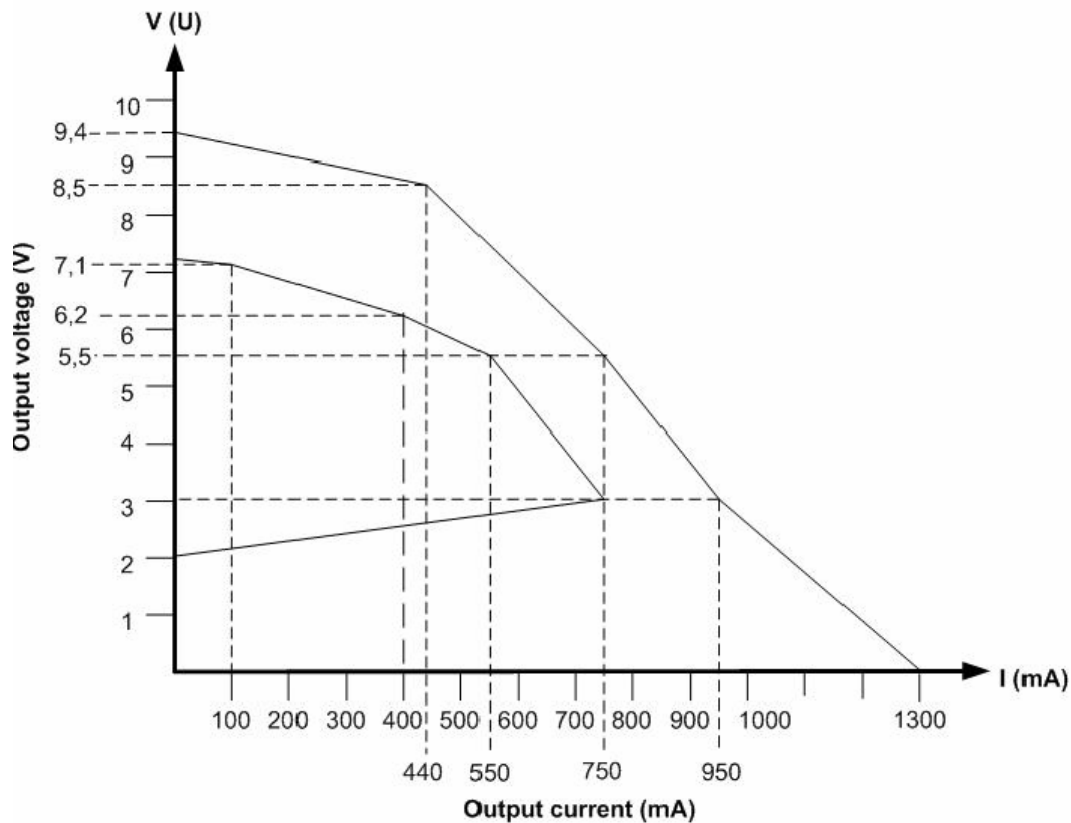
For battery voltages above 3.0 V and normal ambient temperature between 0°C and 50°C the battery can be charged with a charge current up to 1C. This charging mode is software controlled and starts if an accessory (charger) is detected with a supply voltage above 6.4 Volt by the PMIC. The level of charge current is only limited by the charger. The Wolf 5 normal charger is the Siemens Travel Charger which obeys the output envelope shown below.

Fast charging ceases when the PMIC registers that the battery terminal voltage has reached $4.2V \pm 20mV$ and the charging mode changes to pulsed current. Note that when the charging current is removed the battery terminal voltage drops back from 4.2V and at this point the battery will hold approximately 80% of its fully charge capacity.

Note that the charge input transistor to the phone must always be operated in full saturation and sufficient current must be drawn from the charger to ensure voltage fold back occurs thus minimising the dissipation of the input transistor. The consequence of this requirement is that the charge alone defines the charge

current supplied to the battery. The charge current should therefore be a maximum of 950mA but could be less if a lower power charger is employed.

Output VI-curve

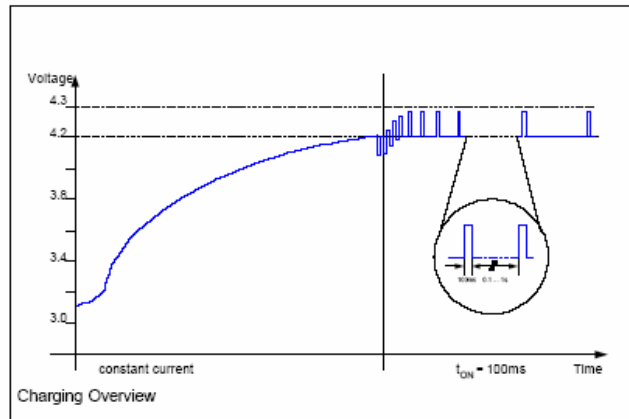


4.4.12.4.8 Pulsed charging

The pulsed charging mode is used to bring up the battery voltage (VBAT) to 4.2 V. If the input transistor is switched off at a level of 4.2V, the battery voltage drops down. This dropdown voltage depends on the temperature, the age of the battery etc. During pulsed charging the input transistor is pulsed with a fixed switch on time of 100 ms and the battery voltage is measured in the off periods and will converge on V_{MAXSE} which is nominally 4.2V. Depending on VBAT the pause varies between 0.1 s to 1 s (see figure below).

Pulsed charging is considered to be complete

Note for Wolf 5 project: The pulse charging is finished, if V_{MAXSEL} is detected T_{OFF} ms T_{DONE} times.



4.4.12.4.9 Special Constant Current Charging

If it proves that pulsed charging causes audio interference, which is quite probable, then this special mode of charge cycling will be used to permit the phone to receive charge whilst operating with an audio call. The special mode is required because the charge pass transistor must be driven into full saturation and sufficient current must be taken from the charger to achieve voltage fold back to minimise the dissipation of the pass transistor. If the battery is fully charged and an audio call is taken whilst the phone is being charged, then insufficient current will be taken from the charger to ensure voltage fold back. Therefore the call must begin with charging temporarily suspended and consequently power being drawn from the battery.

. If VBAT falls under a level lower than the dropdown voltage after constant current mode (for example 3.8 V) the input transistor is switched on until VBAT reach 4.2 V . Then the transistor is switched off and the software suspends charging again until VBAT falls under this level. The voltage threshold is calculated by software and depends on the temperature, the age of the battery and so on. After the call connection is finished, constant current charging or pulsed charging is resumed, depending on VBAT.

In this mode, it is feasible that the user may remove the phone from the charger at the end of the call or before the battery has been fully re-charged. Perhaps for example at the end of a car journey during which the phone was used. Under these circumstances it must be accepted that the battery may not be fully charged. Voltage thresholds must be arranged so that the minimum charge to which the battery is discharged is about 80% of full capacity.

Note for Wolf 5 project: This mode is fully software controlled.

4.4.12.4.10 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 100 mA or 500 mA depending on the capability of the USB source. The handset must initially assume the lower capability and then interrogate the device to establish if a higher charge current is possible.

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

4.4.13 Audio Concept

Refer to the figure below for complete details of the Audio set-up.

4.4.13.1 Microphone, Speaker and Hands-free Speaker

Wolf 5 contains an internal Earpiece Receiver, a Hands-free/Ringer Speaker and a Microphone. The Microphone and the Earpiece Receiver are connected to the MSM6250 dedicated audio CODEC inputs. The Hands-free Speaker is connected to the output speaker driver of the PMIC with the audio signal for the Hands-free Speaker provided by the auxiliary output of the MSM6250 audio CODEC.

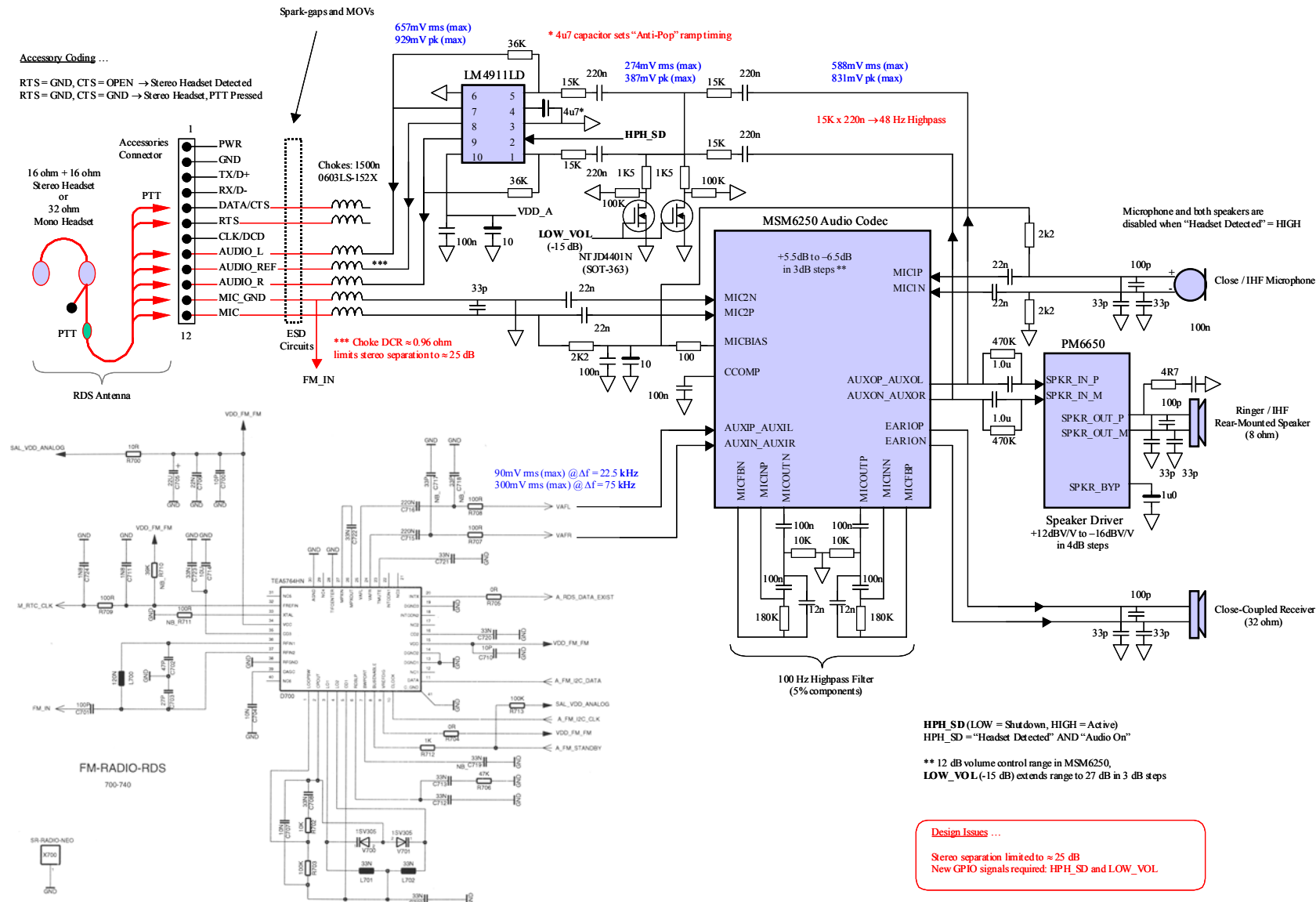
4.4.13.2 Headset

It is possible to connect a mono or Stereo Headset with microphone via the Accessory Connector. The audio output of the Accessory Connector is provided by the auxiliary output of the MSM6250 audio CODEC which is also used as an audio source for the Hands-free Speaker. The audio output to the Accessory Connector is amplified by an external audio driver (LM4911LD). The microphone input from the Headset is connected to the second microphone input of the MSM6250 audio CODEC.

4.4.13.3 FM Radio

The stereo output from the Philips FM Radio chip is fed into the auxiliary input of the MSM6250 audio CODEC. FM radio can be played in stereo mode. However, FM recording can only be done in mono due to the limitation that the auxiliary audio input can only be re-directed to single A-to-D converter within the MSM6250 audio CODEC.

FM Radio can only be played back with a Headset connected to the Accessory Connector because the FM antenna is implemented with one of the headset leads (MIC_GND).



4.4.14 Interfaces**4.4.14.1 Interface USIM Module**

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

Notes to the chipcard pins:

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

| Pin Name | IN/OUT | Level | Remarks |
|----------|--------|---|--|
| CLK | O | HIGH: $V_{DDX} - 0.45V \leq U \leq V_{DDX}$ LOW: $0 \leq U \leq 0.45 V$ $I = 3mA \text{ min}$ | Clock signal from RUIM module of PMIC |
| RST | O | HIGH: $V_{DDX} - 0.45V \leq U \leq V_{DDX}$ LOW: $0 \leq U \leq 0.45 V$ $I = 3mA \text{ min}$ | Reset signal from RUIM |
| IO | I | HIGH: $0.65 V_{DDX} \leq U \leq V_{DDX} + 0.3V$ LOW: $-0.3V \leq U \leq 0.35 V_{DDX}$ Leakage current $I_L = \pm 200nA$ | Data pin with a 4.7k Ω pull up at the VREG_RUIM supply voltage |
| | O | HIGH: $V_{DDX} - 0.45V \leq U \leq V_{DDX}$ LOW: $0 \leq U \leq 0.45 V$ $I = 3mA \text{ min}$ | |
| VCC | O | Set from 1.5V to 3.05V in 50mV incr. ($I = 150mA$) | Linear Voltage Regulator VREG_RUIM from PMIC. A 220 nF capacitor is situated close to the USIM card connector |

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

4.4.14.2 Interface Vibra Module

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

4.4.14.3 Interface Earpiece

Note:

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

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

4.4.14.4 Rear-mounted Speaker Module

| Pin | Name | IN/OUT | Level | Remarks |
|-------|------------|--------|-------|--|
| TP145 | SPKR_OUT_M | O | | PMIC Differential Speaker Driver circuit (+) |
| TP146 | SPKR_OUT_P | O | | PMIC Differential Speaker Driver circuit (-) |

4.4.14.5 Interface Microphone Module

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

4.4.14.6 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 ≤10 mΩ / Contact

4.4.14.7 Interface RS-MULTIMEDIACARD Module

Notes to the MULTIMEDIACARD interface:

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

| Pin | Name | IN/OUT | Level | Remarks |
|-----|---------|--------|--|---|
| C1 | CD_DAT3 | | Reserved (not used). Pull up to VREG_AUX1 | Pulled up to VREG_AUX1 with a 100kΩ resistor. |
| C2 | CMD | I/O | MSM6250 Pad Group 3 | 10kΩ pull-up. High voltage input tolerant (3.0V) |
| C3 | VSS | | - | Connected to ground. |
| C4 | VDD | O | Programmable voltage 1.500 to 3.050 V. Defaults to 2.85V. 150 mA current rating. | VREG_AUX1 (VREG_MULTIMEDIACARD) PMIC linear voltage regulator for MULTIMEDIACARD. |
| C5 | CLK | O | | 51kΩ pull-up. |

| Pin | Name | IN/OUT | Level | Remarks |
|-----|------|--------|---------------------|--|
| C6 | VSS | | - | Pulled up to VREG_MSME AUX1 with a 100kΩ resistor. Used to detect card hot swap. |
| C7 | DAT | I/O | MSM6250 Pad Group 3 | 51kΩ pull-up. High voltage input tolerant (3.0V) |

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

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

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

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

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

4.4.14.8 Interface LCD Module (QVGA display)

| No | Pin Name | I/O* | Level | Short Description |
|----|------------------|------|---|---|
| 1 | VLED- | P | Controlled by PWM + current sink | Cathode LED |
| 2 | MODE | I | See below | LOW: 8 bit parallel interface HIGH: 16 bit parallel interface |
| 3 | LCD_CS | I | See below | Chip Select |
| 4 | LCD_A0 | I | See below | Data/Command |
| 5 | RD | I | See below | Read signal |
| 6 | WR | I | See below | Write signal |
| 7 | DAT0 | I/O | See below | Parallel data bus |
| 8 | DAT1 | I/O | See below | Parallel data bus |
| 9 | DAT2 | I/O | See below | Parallel data bus |
| 10 | DAT3 | I/O | See below | Parallel data bus |
| 11 | DAT4 | I/O | See below | Parallel data bus |
| 12 | DAT5 | I/O | See below | Parallel data bus |
| 13 | DAT6 | I/O | See below | Parallel data bus |
| 14 | DAT7 | I/O | See below | Parallel data bus |
| 15 | LCD_RESET | I | See below | Reset |
| 16 | GND | P | | Power supply GND |
| 17 | DAT15 | I/O | See below | Parallel data bus |
| 18 | DAT14 | I/O | See below | Parallel data bus |
| 19 | DAT13 | I/O | See below | Parallel data bus |
| 20 | DAT12 | I/O | See below | Parallel data bus |
| 21 | DAT11 | I/O | See below | Parallel data bus |
| 22 | DAT10 | I/O | See below | Parallel data bus |
| 23 | DAT9 | I/O | See below | Parallel data bus |
| 24 | DAT8 | I/O | See below | Parallel data bus |
| 25 | LCD_VSYNC | O | See below $V_{min} 2.7V$ $V_{typ} 2.9V$ $V_{max} 3.1V$ | Data Lines Synch Pin to avoid tearing effect VLCD (2.7..3.1V) |
| 26 | VLCD (2.7..2.9V) | P | | |
| 27 | GND | P | | Power supply GND |
| 28 | VIO (1.7..3.0 V) | P | $V_{min} 1.7V$ $V_{typ} 1.8V$ $V_{max} 3.0V$ | VIO (1.7..3.0 V) |
| 29 | GND | P | | Power supply GND |
| 30 | VLED+ | P | ~20V | LED Current @ 15 mA (Anode of the LED's) |

*View from LCD controller/ display module (P=Power supply, I=Input, O=Output)

Voltage characteristics for all data signals (I or I/O):

VIn_low_max = $0,3 \cdot V_{IO}$

VIn_high_min = $0,7 \cdot V_{IO}$

Vout_low_max = $0,5V$

Vout_high_min = $V_{IO} - 0,5V$

4.4.14.9 Interface Radio Control

Please see project drive (..\W5\PE-Teams\HW\S0_Documents\X72_UJ_2241_006 W5 RF BB Interface Specification Issue 1.xls) for the complete RF-BB Interface description.

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

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

4.4.14.10 Interface Accessories (I/O-Module)

For more information about the interface specification between the mobile and the accessories refer to: Hardware Specification X75, Accessory Interface V0.1, Clip on Flash Product Specification V0.6 and the USB – Specification Revision 2.0

| Pin | Name | IN/OUT | Level | Maximum load impedance | Notes |
|-----|---------------|--------------|--|------------------------|---|
| 1 | POWER | I/O | $U_{in} = 4,4V$ to $5,25V$ USB-Charge $U_{in} = 5,8V$ to $10V$ trickle and normal charge $U_{out,min,peak} = 3,1V @ 0A$ $U_{out,min,AVG} = 3,4V @ 0A$ $R_{i_{mobile,max}} = 600m\Omega$ $I_{max,in} = 1A$ $I_{max,out} = -2,2A$ for 1ms $I_{max,out} = -300mA$ for continuous mode Mobile switched off $I_{out} = -100\mu A$ $I_{in} = 500\mu A @ V_{in} < 5,4V$ | <1000 μF | POWER is needed for charging batteries and for supplying the accessories. If accessories are supplied by mobile, talk-time and standby-time from telephone are reduced. Therefore it has to be respected on an as low as possible power consumption in the accessories. |
| 2 | GND | | Ground Digital | | |
| 3 | TX/ D+ | O I/O | TX: $V_{OL,max} = 0,2V @ I_{OL} = 0\mu A$ $V_{OL,max} = 0,327V @ I_{OL,max} = 100\mu A$ $V_{OH,min} = 2,36V @ I_{OH} = 0\mu A$ $V_{OH,max} = 2,71V @ I_{OH} = 0\mu A$ D+: $V_{IL,max,USB} = 0,8V$ $V_{IH,min,USB} = 2,7V$ $V_{IH,max,USB} = 3,6V$ | <75pF | Serial interface 120k $\Omega \pm 20\%$ Pull up against 2V65 $\pm 80mV$ USB-interface full-speed 12Mbit/s Serial interface is switched off 25,5Ohm length resistor, 1,5kOhm $\pm 1\%$ PU to 3,1V switchable |

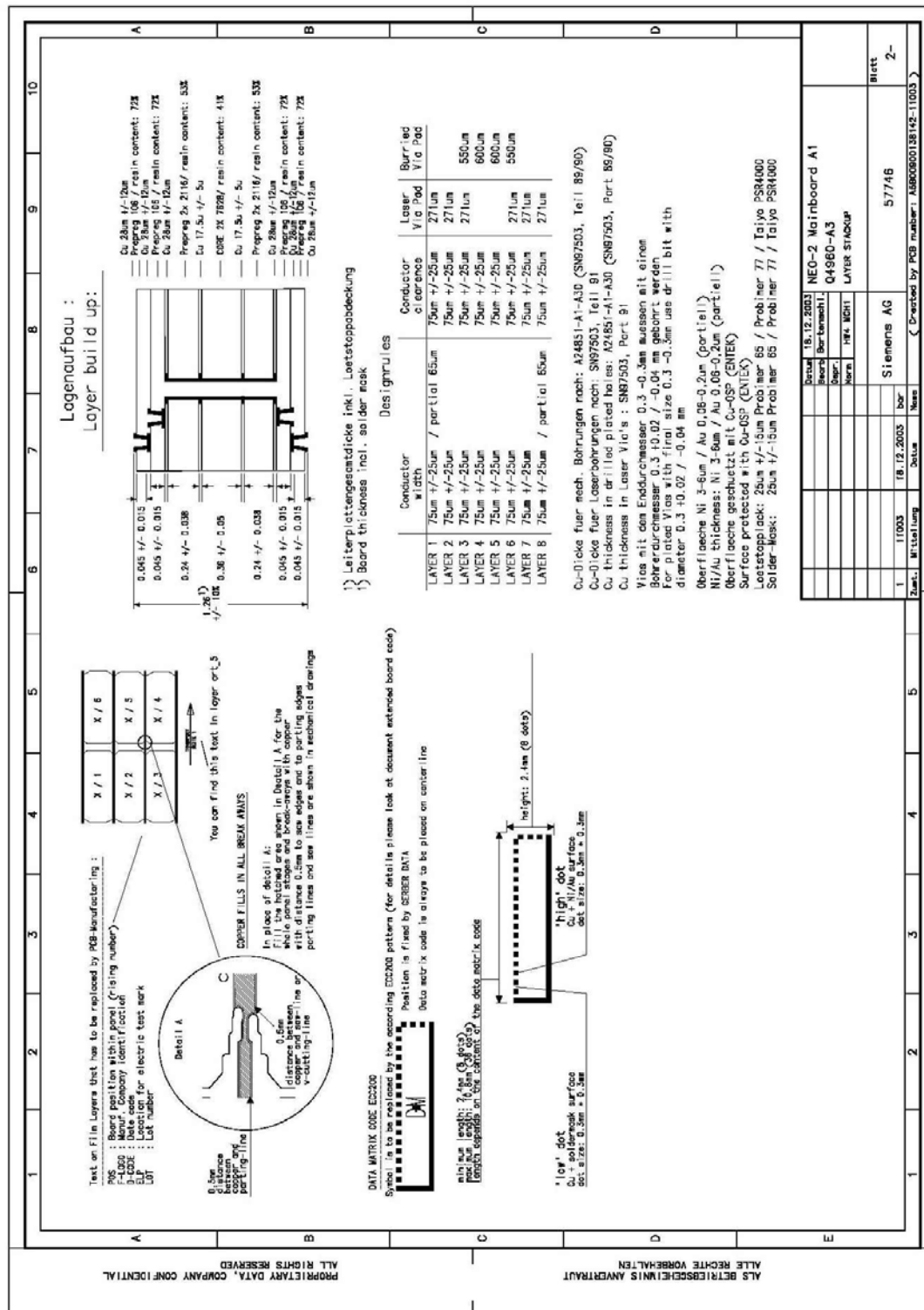
| | | | | | |
|----|-----------------|-------------|---|--|---|
| | | | $V_{OL,max,USB} = 0,3V$ $V_{OH,min,USB} = 2,8V$ $V_{OH,max,USB} = 3,162V$ | | |
| 4 | RX D- | I | RX : $V_{IL,min} = -0,3V$ $V_{IL,max} = 512mV$ $V_{IH,min} = 1,912V$ $V_{IH,max} = 3,3V$ D-: See D+ | <75pF | Serial interface $220k\Omega \pm 20\%$ Pull down interrupt able USB-interface full-speed 12Mbit/s Serial interface is switched off $25,5\Omega$ length resistor, |
| 5 | DATA/CTS | I/O | $V_{OL,max} = 0,2V @ I_{OL} = 0\mu A$ $V_{OL,max} = 0,325V @ I_{OL,max} = 100\mu A$ $V_{OH,min} = 2,37V @ I_{OH} = 0\mu A$ $V_{OH,min} = 2,24V @ I_{OH,max} = -100\mu A$ $V_{OH,max} = 2,96V @ I_{OH} = 0\mu A$ $V_{IL,min} = -0,3V$ $V_{IL,max} = 493mV$ $V_{IH,min} = 1,9V$ $V_{IH,max} = 3,3V$ | | Data-line for accessory-bus Use as CTS in data operation. $150k\Omega \pm 20\%$ Pull up against $2V65 \pm 80mV$ interrupt able |
| 6 | RTS | I/O | like Pin 5 | | Use as RTS in data-operation. $150k\Omega \pm 20\%$ Pull up against $2V65 \pm 80mV$ interrupt able |
| 7 | CLK/DCD | I/O | like Pin 5 + Release of ClipOnFlash | | Clock-line for accessory-bus. Use as DTC in data-operation. $150k\Omega \pm 20\%$ Pull up against $2V65 \pm 80mV$ interrupt able + Release of ClipOnFlash, the $150k\Omega$ PU is bridged over PNP transistor |
| 8 | STEREO1_OUT | Analog O | $U_{max,mono} = 5,2V_{pp}$ (Between STEREO1_OUT and STEREO2_OUT) $U_{max,stereo} = 2,6V_{pp}$ 68mW | $>12,8\Omega$ $<660pF$ $<400\mu H$ | driving ext. left speaker to PHANTOM_BUF_OUT with mono-headset STEREO1_OUT and STEREO2_OUT differential mode |
| 9 | PHANTOM_BUF_OUT | Analog O | $U_{max} = 1,44V$ | | mid-voltage in stereo mode reference to STEREO1_OUT and STEREO2_OUT in mono mode not used |
| 10 | STEREO2_OUT | Analog O | $U_{max,mono} = 5,2V_{pp}$ (Between STEREO1_OUT and STEREO2_OUT) $U_{max,stereo} = 2,6V_{pp}$ 68mW | $>12,8\Omega$ $<660pF$ $<400\mu H$ | driving ext. right to PHANTOM_BUF_OUT with mono-headset STEREO1_OUT and STEREO2_OUT differ- |

| | | | | | |
|----|--------------|-------------|------------------------|--|---------------------|
| | | | | | ential mode |
| 11 | GND_MIC | Analog I | Ground analog | | for ext. microphone |
| 12 | MICEA_ AC | Analog I | $U_{\max} = 1,1V_{pp}$ | | External microphone |

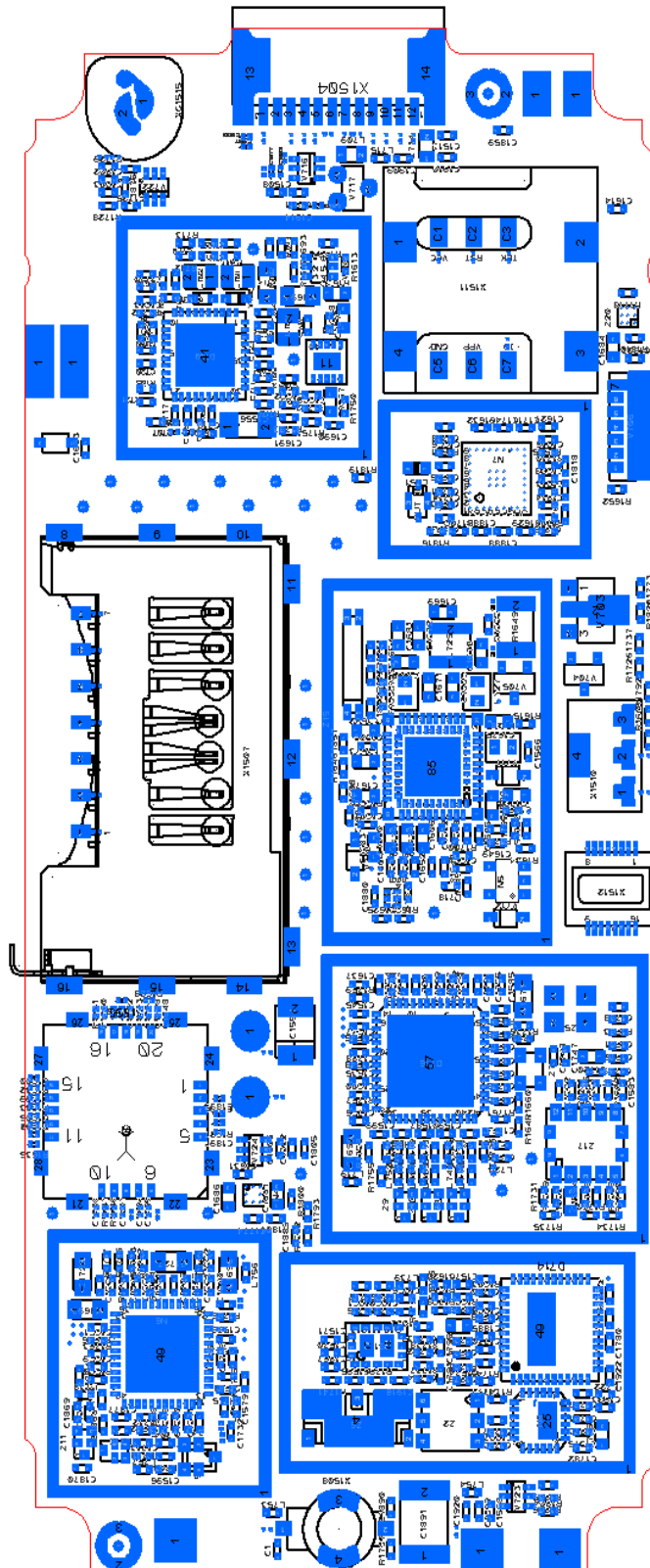
4.4.15 Printed Circuit Board (Main Board)

The Wolf-5 has following layer build, assembly and parts-list of the Printed Circuit Boards (PCB), namely the main board and the MMI board. The PCB will be produced with CuOSP surface and will have 8 (2+4+2)layers.

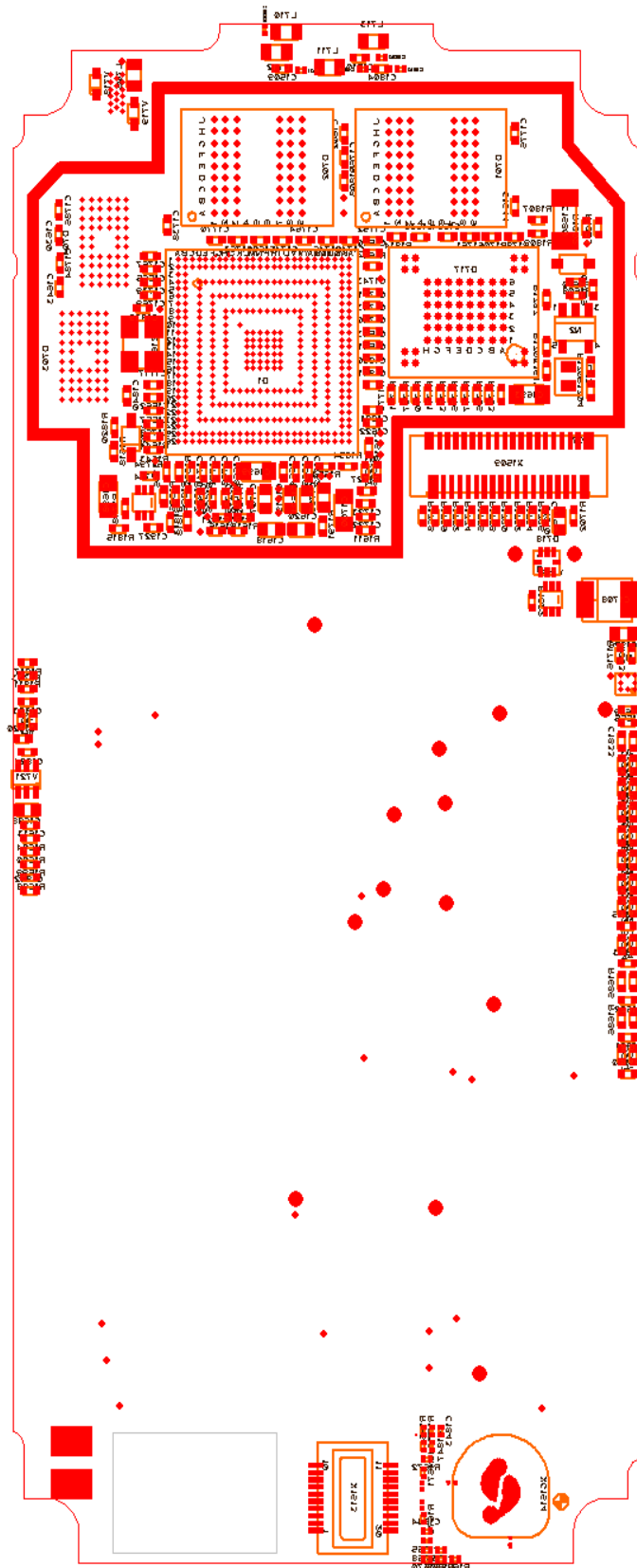
Wolf-5- main board layer build up:



4.4.15.1 Wolf-5 main board assembly plan (top side, RF,PMIC,SIM, MULTIMEDIACARD):



4.4.15.2 Wolf-5 main board assembly plan (bottom side - BB, LCD, and Memory):

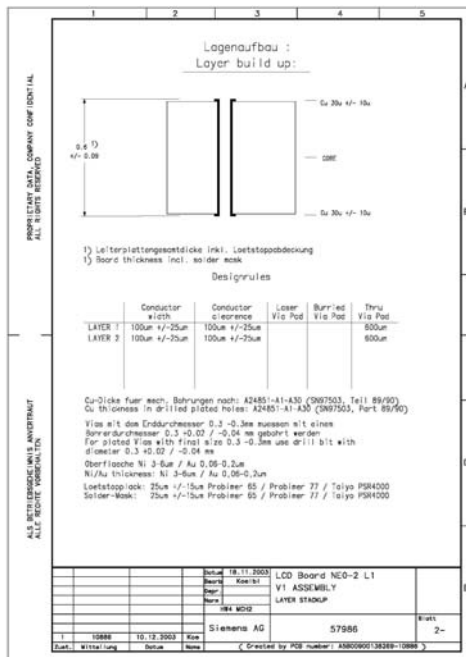


4.4.15.3 WOLF-5 main board part list (key components):

| Item Number | Subitem | Siemens Part number | Component number | Object description | # material value (Shortname) |
|-------------|---------|---------------------|------------------|--|------------------------------|
| 2360 | Z1 | V30145-K280-Y293 | A5B00075106012 | FILTER SAW AGPS 1575,42MHZ B7840 SMD | SAW-FILTER B7840 |
| 2590 | Z10 | V30145-K280-Y332 | A5B00075371914 | FILT/SAW/RX/DCS1800MHZ/B7844 | B7844 |
| 2560 | Z11 | V30145-K280-Y304 | A5B00075221667 | FILSAW 1575,42 MHZ B7829 SMD | SAW FILTER |
| 2430 | Z12 | V30145-K280-Y328 | A5B00075366862 | FIL BP 2,4GHZ SMD | Bluetooth Filter |
| 2300 | Z15 | V30145-F102-Y10 | A5B00027010674 | QUARZ/SMD | 32.768KHZ |
| 2570 | Z16 | V30145-F260-Y3 | A5B00075296617 | OSCCRYST 5-48,0MHZ SMD 3,2X2,5MM | CRYSTAL48MHZ |
| 2580 | Z17 | V30145-G100-Y108 | A5B00075293871 | OSCVCO 824-915MHZ SMD | 815MHZ |
| 2200 | Z19 | V20840-U6064-D670 | A5B00075277428 | FILEMI EMIF05-MUX01F2 CSP17 LEADFREE | EMIF05-MUX01F2 |
| 2370 | Z2 | V30145-K260-Y75 | A5B00075058210 | ISOLATOR 1920-1980MHZ SMD | ISOLATOR |
| 2540 | Z20 | V20820-U6056-D670 | A5B00075175039 | FILEMI SIM PROTECTION CSP8 LEADED | EMIF FILTER |
| 2290 | Z4 | V39197-F5020-F34 | A5B00075020034 | EPCOS/SAW/LOW-LOSS-FILTER/2140,0MHZ/LG02 | 2140.0MHZ |
| 2330 | Z5 | V30145-G200-Y27 | A5B00075371912 | OSCOSCI TCXO TCO-5871 19.2MHZ SMD | TCXO 19.2MHZ |
| 2640 | Z6 | V30145-K280-Y311 | A5B00075292743 | FILTER/DUPLEX/UMTS2100 | FILTER/DUPLEX/UMTS2100 |
| 2550 | Z7 | V30145-K280-Y314 | A5B00075294847 | FILT/SAW/UMTS2100/1950MHZ/B7754 | SAW FILTER |
| 2620 | Z8 | V30145-K280-Y333 | A5B00075371915 | FILT/SAW/RX/GSM900MHZ/B7837 | B7837 |
| 2610 | Z9 | V30145-K280-Y331 | A5B00075371913 | FILT/SAW/RX/PCS1900MHZ/B7846 | B7846 |
| 2220 | D1 | V20820-L6164-D670 | A5B00075292968 | IC TELEC MSM6250 CSP409 | MSM6250 |
| 2230 | D700 | V20820-L6150-D670 | A5B00075069964 | IC TELEC TEA5764HN HVQFN40 | TEA5764HN |
| 2210 | D701 | V20810-F6348-D670 | A5B00075215162 | IC SDRAM 256MB 105MHZ CSP54 LEADFREE | SDRAM 256MB |
| 2210 | D702 | V20810-F6348-D670 | A5B00075215162 | IC SDRAM 256MB 105MHZ CSP54 LEADFREE | SDRAM 256MB |
| 2450 | D703 | V20810-B6177-D670 | A5B00075332581 | IC LOGIC16-BITBUFFER74ALVCH16244ZQLR SMT | IC LOGIC16-BITBUFFER |
| 2450 | D704 | V20810-B6177-D670 | A5B00075332581 | IC LOGIC16-BITBUFFER74ALVCH16244ZQLR SMT | IC LOGIC16-BITBUFFER |
| 2470 | D707 | V20810-C6183-D670 | A5B00075332613 | IC LOGIC TINY 2INPUT NANDGATE NC7SZ00L6X | NC7SZ00L6X |
| 2420 | D714 | V24851-Z2002-A67 | A5B00075043905 | IC MODUL PA RF3147 SMD | RF3147 |
| 2440 | D716 | V20820-L6165-D670 | A5B00075293882 | IC TELEC TRANSCEIVER/RTR6250 QFN56 | RTR6250 |
| 2460 | D717 | V20810-F6355-D670 | A5B00075296615 | IC FLASH NAND 512MBX8K K9F1208Q0C-HIB0 T | 512MBIT |
| 2280 | D718 | V20810-B6134-D670 | A5B00075095714 | IC LOGIC NC7WZ126L8X MAC08A | NC7WZ126L8X MAC08A |
| 2600 | S1 | V20820-V6017-D670 | A5B00075294358 | IC SP7T ANTENNA SWITCH MODULE SMT | SWITCH MODULE |
| 2250 | N1 | V20820-C6254-D670 | A5B00075292745 | IC-AMPLIFIER/HEADPHONE/LM4911 | LM4911LD |
| 2240 | N2 | V20820-C6271-D670 | A5B00075060150 | ANALOG DC/DC BOOST C. SOT23-5 LEAD FREE | IC DC-DC CONVERTER TPS61040 |
| 2260 | N3 | V20810-C6065-D670 | A5B00025734256 | ICRGLUSMD 2,8V/V20810-C6065-D670 | LP1986 |
| 2260 | N4 | V20810-C6065-D670 | A5B00025734256 | ICRGLUSMD 2,8V/V20810-C6065-D670 | LP1986 |
| 2520 | N5 | V20810-C6181-D670 | A5B00075328481 | IC VOLTAGE REG.TPS73601DRBR SMD ADJUSTA | IC VOLTAGE REG.TPS73601DRB |
| 2510 | N6 | V20820-L6166-D670 | A5B00075332822 | IC TELEC RECEIVER/GPS UMTS/RFR6250 | RFR6250 |
| 2500 | N7 | V20810-L6155-D670 | A5B00075295818 | IC TRANSCEIVER/BLUETOOTH/BCM2004 SMD | IC BLUETOOTH/BCM2004 |
| 2490 | N8 | V20820-L6169-D670 | A5B00075353616 | IC-UMTS POWER AMPLIFIER RF3188 | RF3188 |
| 2480 | N9 | V30145-J4681-Y57 | A5B00075293211 | IC/POWER-MANAGEMENT/PM6650 | PM6650 |
| 2150 | V706 | V39197-F5008-F492 | A5B00075008492 | IC LOW PROFILE IRDA 115.2 KBIT/S SMD | CIM-80 S7B-T |

4.4.16 Wolf-5 MMI board: - TBC

The MMI board will be a standard 2 layer PCB



4.5 EMC-Concept

4.5.1 EMC

Electromagnetic Compatibility will be verified according General Quality Requirements, Rev. 4.19, part 5.5, 2004-05-19 .

4.5.2 Keypad

The keypad, including side keys and joystick, must be completely closed in so that no ESD disruptive discharges can occur. Otherwise grounded lightning conductors will be arranged.

4.5.3 Display

Due to unknown results of the actual display development higher self interferer are expected.

4.5.4 Antenna performance

Wolf 5 uses an integrated PIFA-antenna. Detailed values are not available at the current stage but will be listed in chapter 2.3.

4.5.5 SAR

SIEMENS target (1g): below 0.8 W/kg @ head (1TX) and body worn with carry solution in 2,5cm-distance

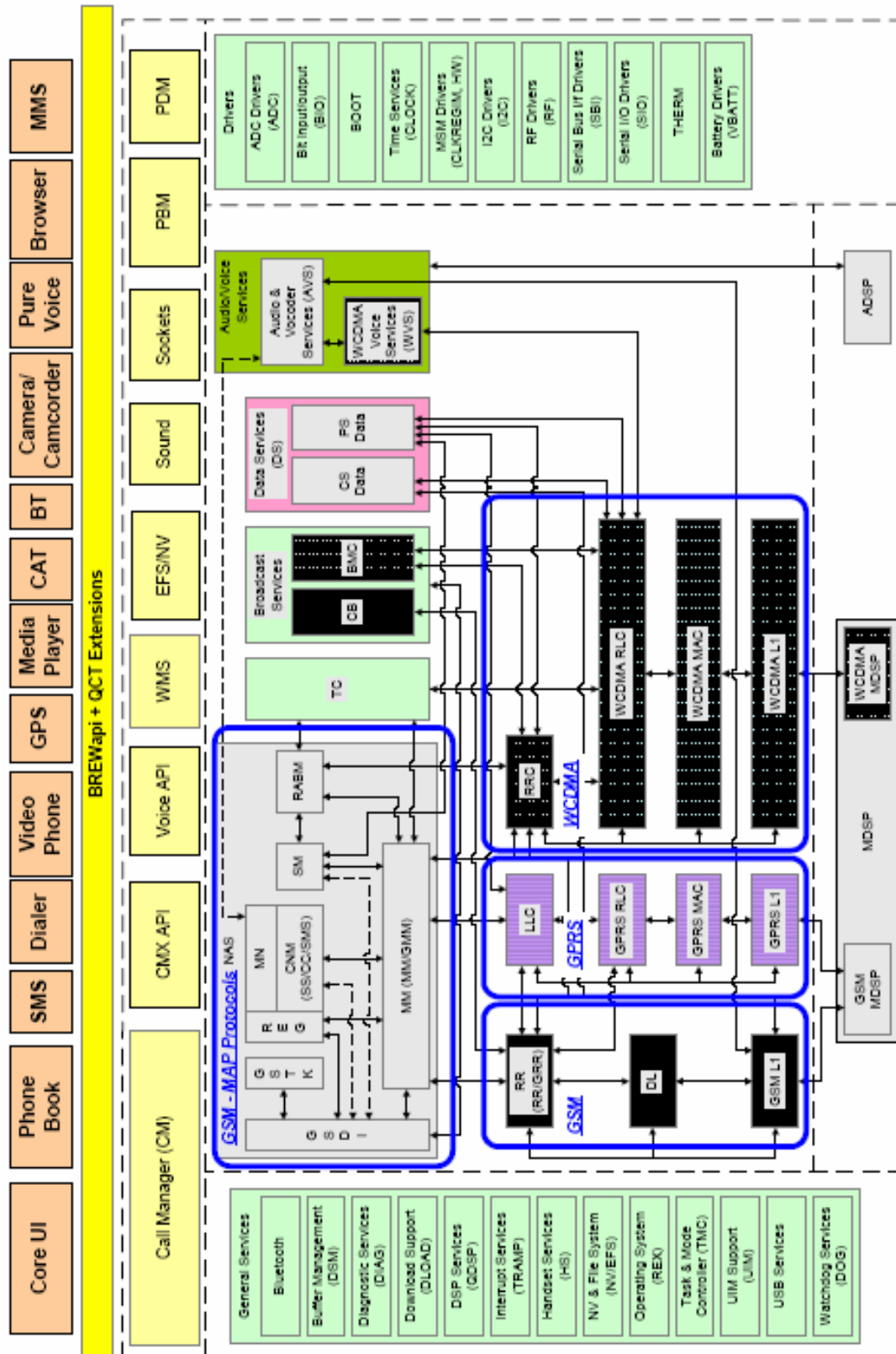
5 Software

The software will be implemented in compliance with the Feature list V0.60.

The user interface will be described in the specifications located in \\Mchgclv01\data\projekte\PROJ_SPECIAL\W5\PE-Teams\UI\Input_Specs_Quest\04_released. The available specifications are listed in \\Mchgclv01\data\projekte\PROJ_SPECIAL\W5\PE-Teams\UI\Input_Specs_Quest\UI_Spec_Tracking_9_29_04_update.xls

Please see chapter 1.1 Project specific references for the dedicated links.

5.1 Architecture Overview



L1 (PHY) Physical Layer Control and Drivers supports:

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

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

L2 MAC (Medium Access Control) supports:

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

L2 RLC (Radio Link Control)

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

L3 RRC (Radio Resource Control Protocol) supports:

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

NAS MM (Mobility Management) supports:

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

NAS GMM (GPRS Mobility Management) supports:

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

NAS CC (Call Control) supports:

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

NAS SM (Session Management)

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

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

- SMS Control protocol

NAS GSMS (GPRS Short Message Services) supports:

- Short Message Services over packet-switched connections

NAS SS (Supplementary Services) supports:

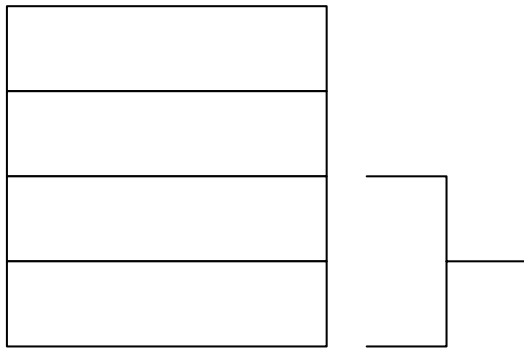
- Multiparty calling
- Call waiting
- Call forwarding
- Call barring
- Call hold
- Calling line identification
- Connected line identification
- Advice of charge
- Closed user group
- Call transfer
- Other GSM Phase 2+ features

5.2 Customisation

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

5.2.1 Customization Concept

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



flash

5.2.2 Process environment

Error! Objects cannot be created from editing field codes.

executable

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

hardware
parameters

file system

6 Accessories

For the Wolf5 accessory devices a separate Performance Description (see chapter 1.1 Project specific references) will be available. The following figure gives a preliminary about the planned accessories. Beyond this portfolio additional accessory devices must be supported as they are described in the annex 13.

nv items

| Original Accessories – Portfolio EMEA/APAC 10/05 | | | | | Accessory Devices | Wolf 5 |
|--|--------------------------------------|------------------------------------|--|--------------------------------|---------------------------|--------|
| Fashion & Carry | Energy | Handsfree Portable | Car Solutions | Multi-tainment | Office | |
| Case | Li-Ion Battery xxx mAh EBA-xxx | Headset Bluetooth HHB-600 / 610 | Car Kit Bluetooth Portable HKW-700 | Gamepad tbc | Data Cable USB DCA-540 | |
| | Travel Charger ETC-600/610 | Charger Adapter ECA-500 | Car Kit Bluetooth 75 | Biker Set II tbc | | |
| | Car Charger Plus ECC-600 | Bluetooth Stereo Headset 1) | Car Kit Bluetooth SIM Access | Bluetooth Media Link Tbc 1) | | |
| | Car Charger | Classic Bluetooth Headset II | Car Kit Comfort Voice HKC-xxx | Mobile Sound Set tbc | | |
| | | Headset Purestyle HHS-610 | Mobile Holder HMH-xxx | Flash IFL-600 | | |
| | | Headset HHS-510 | Mobile Holder Antenna HMH-xxx | | | |
| | | Headset Basic HHS-500 | Car Kit Easy Universal HKP-700 | | 1) Mono only | |
| | | Headset Stereo HHS-550 | Car Kit Easy Universal upgrade HKD-700 | Car Kit Portable HKP-500 | | |

Supports Phone Story

Products compatible with 65 series*

Products compatible with 75 series

Phone specific

For bulk only

* Backwards compatible

© Siemens O. Mitterfeller / COM MD AD PM 14th Oct 04

SIEMENS
mobile

7 Manufacturing Concept

7.1 Overview and general requirements

The manufacture of the Wolf5 main PCB will be done on the standard SMD production lines for mobile phones with plumbiferous components and **lead free solder past** (new interim production technology). Further it is absolutely essential to comply with the following design rules and to include these into the product definition.

Topic: Design Specification for Printed Circuit Boards
Author: ICM MP SCM GO 23 KLF Mr. Diepers

7.2 Modules

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

7.3 Components Spectrum

7.3.1 SMD Component Number and Number of Types (as of 19th of December 2003)

Main PCB:

| | Anzahl Bauelementeteile / number of components | | Anzahl Bauelementetypen / number of com. types | |
|-----------|---|--------------------|---|--------------------|
| | Side 1 (Top) | Side 2 (Bottom) | Side 1 (Top) | Side 2 (Bottom) |
| | 458 | 217 | 157 | 64 |
| Summe/sum | 675 | | 188 | |

7.3.2 SMD Spectrum (as of 4th of October 2004)

The smallest passive design form is Chip 02/01, the smallest grid used is 0.5mm.

15 Components with CSP Housing

- PM6650, Pitch 0.5mm
- Memories: Flash 512Mbit (Samsung, Hynix, Toshiba)
- BT Chip
- BB Chipset
- SDRAM
- FM Radio
- Transceiver
- GSM Receiver

Components for special SMD Processing (F-Machines)

- I/O Connector
- SIM-Reader
- MultiMediaCard reader
- Battery Connector
- RF plug
- Shielding (6 pieces in fish-can-technology, 1 piece in prem-can-technology) for SMD Processing

7.3.3 Manual Soldering

No manual soldering planned.

7.3.4 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 SCM GO 23.

7.4 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
Sipplace 80S/HS50/80F
Opto-Control AOI
Sipplace 80F
Soltec re-flow soldering unit

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

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

B. Panel-Separation

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

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

C. Testing PCB

Inline testing of main PCB automatically

Pematech Test-Line

D. Mobile-Assembly

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

Product specific fixtures
Product specific fixture
Weber automatic screw station

E. Testing and Customization of Mobile

Testing of Mobile in customer end test
Software- Customization of Mobile
Hardware-Customization of Mobile
(snap in center part of navi-key, snap in rear cover)

Pematech automatic customer end test
Engmatec customer init

manually customer init

E. Packaging

Packaging of Mobile and all accessory

semiautomatic

7.5 Basic Assembly Concept

See chapter 3.3, Assembling Drawings Wolf5

7.6 No-ID-Phone Support

The mechanical concept of Wolf5 allows a production of Non-ID-Phones, which is agreed within the project-team.

Siemens logo above the display lense, no operator-specific key-pad, for customization are 3 potential areas defined:

- Battery Cover
- Rear Cover (Antenna area) -> snap in fit
- Navi-center-key -> snap in fit (like Neo)

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

7.7 New production technology

- Leadfree soldering Process
- 0.5pitch CSP components high count pins, PM 6650 with new packaging
- 512MBit Flash ? boot process

7.8 Quality Targets

The following quality targets are aimed at:

| Production Step | |
|-------------------|--------|
| 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.

7.9 Expected Production Quantities/Production Capacity

For the Wolf5 we are targeting approx. 850 thousand units (worldwide) over a life cycle of 14 months. The peak is planned to be 86 k/month and is expected in November 2005. The start of the pilot series is planned for CW28/05 and it is aimed to produce 25k mobiles till 22th of September 2005.

7.10 Ramp up Plan KLF

More Detailed information, please contact Thomas Schär SCM-PL
Current ramp up plan version (07.10.2004): V2

Wolf 5 Ramp Up Plan V2.0

last change

07.10.04

Thomas Schär

Pilot Run

Ramp Up

Series

| month in 2005 | | | | | | | | | | | | | | | | | | | | |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | Jun | Jul | Jul | Jul | Jul | Aug | Aug | Aug | Aug | Aug | Sep | Sep | Sep | Sep | Okt | Okt | Okt | Okt | Okt | Nov |
| calendar-week in 2005 | CW 26 | CW 27 | CW 28 | CW 29 | CW 30 | CW 31 | CW 32 | CW 33 | CW 34 | CW 35 | CW 36 | CW 37 | CW 38 | CW 39 | CW 40 | CW 41 | CW 42 | CW 43 | CW 44 | CW 45 |
| status part list | 27.Jun | 04.Jul | 11.Jul | 18.Jul | 25.Jul | 01.Aug | 08.Aug | 15.Aug | 22.Aug | 29.Aug | 05.Sep | 12.Sep | 19.Sep | 26.Sep | 03.Okt | 10.Okt | 17.Okt | 24.Okt | 31.Okt | 07.Nov |
| milestones | | S3 | pilot | pilot | | PS | | | | | | | | | | S4 | | | | |
| disposition plan for new / critical parts | 0,5 | 2,3 | 0,7 | 1,0 | 2,0 | 2,8 | 3,6 | 4,9 | 6,1 | 7,3 | 8,8 | 8,0 | 8,0 | 11,7 | 12,7 | 13,6 | 14,5 | 16,0 | 16,0 | 16,5 |
| production plan global | | 0,0 | 0,3 | 1,5 | 0,0 | 0,7 | 1,5 | 2,3 | 3,0 | 4,1 | 5,1 | 6,1 | 8,0 | 11,7 | 12,7 | 13,6 | 14,5 | 16,0 | 16,0 | 16,5 |
| phones ready for delivery on stock total | | | | 0,3 | 1,5 | 0,0 | 0,7 | 1,5 | 2,3 | 3,0 | 4,1 | 5,1 | 6,1 | 8,0 | 11,7 | 12,7 | 13,6 | 14,5 | 16,0 | 16,5 |
| phones ready for delivery on stock total /month | | | | | 1,8 | | | | | 7,5 | | | | 23,3 | | | | 52,5 | | 89,5 |
| production plan KLF total | | | 0,3 | 1,5 | | 0,7 | 1,5 | 2,3 | 3,0 | 4,1 | 5,1 | 6,1 | 8,0 | 11,7 | 12,7 | 13,6 | 14,5 | 16,0 | 16,0 | 16,5 |

8 Test Rig Planning

8.1 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 NPI 31 and GO 2. Concerning this a test technology workshop has been carried out (03.-04.08.2005, Bernd Potthoff; ICM MP SCM NPI31).

The most essential requirements are as follows:

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

For more details please refer to "Testing technical standards for mobile phones" (Prüftechnische Anforderungen; pv1pta37.doc; Version 3.7; 05.10.2004)

8.2 Quality Targets

The following quality targets are aimed at:

| Testlevel | Yield (first pass) |
|-------------------------|--------------------|
| Functional Test | 90,0% |
| Adjustment-/Systemtest | 96,0% |
| Customertest | 93,0% |
| Customer Initialization | 99,0% |

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

The target test time is less than 160 seconds for a board and less than 70 seconds for a device.

9 Customer Care

9.1 Customer Care strategy

Attached diagram documents contains the CCQ MP Strategy:

Error! Objects cannot be created from editing field codes.

The acceptable care standard per region for Wolf 5 as well as the additional service packages has to be defined together with sales and PM.

9.2 Service Objectives

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

9.3 Repair level definition

In general, 6 repair levels for mobile phones are defined:

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

9.4 World-wide distribution of service level

- Europe/Near East/RSA
 - level 1/2/2.5/2.5e repairs at the LSO and/or service partners
 - swap and/or repair of devices for end users
 - level 3 repair at Siemens workshops
- Far East/Australia
 - level 1/2/2.5/2.5e repairs at the LSO and/or service partners

- swap and/or repair of devices for end users
- level 3 repairs at the ASC in Singapore
- Republic of China
 - level 1/2/2.5/2.5e repairs at service partners
 - repair of devices for end users
 - level 3 repairs at the Service Centre Shanghai

9.5 Roll out plan for the service concept

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

9.6 Service parts

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

Swap:

- mobile phone without battery for variants which will be distributed in Germany and China
- control board without SIM lock
- control boards for each SIM lock type as prepared SIM lock

Spare parts*:

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

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

9.7 Technical Service Requirements**9.7.1 Test equipment**

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

9.7.2 Technical Service Requirements

The 'Global Repair Requirements' are written down in the M0 Document and available in the appropriate project folder to the 2 documents:

\\Mchgciv01\data\projekte\PROJ_SPECIAL\W5\PE-Teams\CC\M0 Input\

Global+Repair+Requirements+A0+Wolf5.doc

Global+Repair+Requirements+A1+Wolf5.doc

- In principal all Technical Service Requirements of the M0 Document will be fulfilled. Still under discussion is the Water Indicator.

10 Quality

10.1 General Quality Requirements

The general quality requirements for phone and accessories are contained in the document "General Quality Requirements for Cellular Deliverables (Cellular Phones / Pocket PCs and Accessories)" that was agreed between Development, Product Marketing, Purchasing and Quality Management.

The version currently in force and valid for this project is V 4.18. 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 General Quality Requirements V 4.18.

Temperature Ranges for Mobile Phones

| | | |
|--|--------------------------------|---|
| Warehousing | -40°C to +85°C | Mobile phone without packaging |
| Non-deformation (plastics) | -40°C to +85°C | -30°C for LCD display/ camera |
| Solar radiation (outdoor) | 1120 W/m ² at +55°C | |
| Battery operation | -10°C to +55°C | Fully operable according to relevant specifications |
| Operation with external power source | -20°C to +65°C | Additional check for making/ receiving calls (emergency call) |
| Nondestructive range in switched on mode | -30°C to +70°C | |

Ease of Operation

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

Insertion and removal of the SIM card must be easy to handle. The reader / SIM card 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 SIM card has been inserted properly. The system must tolerate a possible incorrect operation. The card (holder and reader) may not be damaged if incorrectly inserted. If incorrectly inserted, the card must be easy to remove.

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

Sealing

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

Lifetime and Utilisation

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

Number of cycles for operation elements

| Operating element: | Number of repetitions: |
|-----------------------------|------------------------|
| 1. Normal key | 150,000 |
| 2. Navi key | 400,000 |
| 3. Soft key | 200,000 |
| 4. I/O connector | 10,000 |
| 5. SIM contacts | 2,000 |
| 6. Flexible cables | 80,000 |
| 7. Battery lock | 2,000 |
| 8. Battery contact | 2,000 |
| 9. Vibrator (tremblings) | 250,000 |
| 10. MULTIMEDIACARD contacts | 5,000 |
| 11. Hinge Funktion | 80,000 |
| 12. Hinge IP64 | 20,000 |

Other requirements

- The contrast of the LCD display must not reduce by more than 50% within 5 years.
- The phone housing must be distortion-proof for its service life and resistance against fracture from a fall from 1.52m on 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 from a height of 1.52m in any situation without incurring damage.
The battery must withstand a fall from 1.00 m on to concrete or steel.
- The life of the battery under GSM 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 resitant 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: | 10N |
| b) Dyed granulated material: | 10N |
| c) Dyed granulated material, polished: | 5N |
| d) Painted surface: | 7 N |

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

Mechanical, Climatic and Ageing Requirements

Mechanical, Climatic and Ageing Requirements for mobile phones and accessories (test specifications and assessment criteria) are contained in detail in the General Quality Requirements V 4.18.

Electromagnetic Compatibility, SAR and Others

Standards and additional Siemens requirements regarding EMC, ESD, SAR and other issues are contained in detail in the General Quality Requirements V 4.18.

These requirements include the Siemens requirements for robustness against ESD discharges (+/- 8 kV direct contact discharge and +/- 15 kV air discharge without ground connection, with permissible functional disturbances but no damage).

10.2 Environmental Protection

Siemens AG 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
- No pollutants must be used
- Recycling/disposal documentation must be drawn up

Requirements of Recycling Process

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

Dismantling or taking to pieces of telephones in:

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

Recycling Concept

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

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

Construction

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

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

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

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

For detailed descriptions and information please refer to SN 36350.

General

- As few separate parts as possible
- Avoid material compounding (e.g. sticking together of different materials and laminates)
- Joining and de-jointing wherever possible in one direction

- Guarantee accessibility of disassembly tooling
- Use unified screw heads in respect of type and size

Connections

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

Materials Selection

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

10.3 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

10.4 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 5 from November 10th 2003: Radio, EMC, Digital and mixed signal HW, SW, Mechanics and Layout/Production Data.

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

10.5 Product Safety and Technical Risk Assessment

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

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

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

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

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

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

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

Suitable means (e.g. ramping like in L55) to guarantee protection from acoustic shock have to be implemented.

Special Precautions:

- Precautions (mechanical, software engineering) must be taken to prevent danger to or injury of the user through inadvertent switching on of the device.
- Software engineering precautions are to be taken to prevent danger to or injury of the user through an acoustic shock as the ringer function or Handsfree is implemented over the receiver. A separate review must be carried out to ensure that this requirement is met.

Product Safety and the Software

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

10.6 Software Quality**Software QA Plan**

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

Software Process Code

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

10.7 Field Trials**Aim and Focus of the Field Trail**

- Confirmation of compliance in home and foreign networks. Tests according to GCF AP (GSM Certification Forum - Application Procedure)
- Confirmation of hardware and software quality (ready to be introduced into the market)

- Detection of weak points in the HW construction of the mobile phone and accessories, SW errors/bugs by functional tests as well the check of user manual

Realisation

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

Test Level

Technical Field Trial

Tests in GSM 900/1800/1900 and 3G networks shall be coordinated and performed by QM PV. QM PV will create the corresponded test list.

Time Frame

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

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

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

Hardware

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

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

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

Software

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

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

- During the Field Trial phase, the SW of the mobile phone shall be upgradeable also outside the factory (e.g. SIEMENS LG's). The necessary SW tools + HW (upgrade cable) shall be made available to QM PV at S25. QM PV shall have at least limited EEPROM read/write access (SW exit codes etc.)

- Any SW feature implementation, which leads to the need of a SW update which can not be done in the field (e.g. re-writing the IMEI because of implementation of security features) shall be implemented prior to the start of the Field Trial.

Engineering equipment

The following equipment shall be made available to ICM MP CCQ QM PV:

| Description | Number | Date |
|---|--------|------|
| Mobile phones (B1) including charger (The voltage range of the charger shall include AC220-240V; 50/60Hz or if applicable AC100-120V; 50/60Hz. A plug adapter for standard European socket outlets – if necessary – shall be available). (Note: Those samples are needed to test the Tracer SW, SW upgrade etc. prior to the Field Trial) | - | S25 |
| Tracer Software | - | S25 |
| Tracing Hardware (cable) | 25 | S25 |
| Tracing Hardware (adapted devices; 2 nd Bfc Bus connector) | 16 | S25 |
| Mobile – Boot Configuration (e.g. Upgrade cable if different from tracing cable, service box etc.) | 25 | S25 |
| SW upgrade tools (e.g. SWUP, Initialisation tool) | - | S25 |
| External Antenna (possibility to connect the mobile to a CMD) | - | S25 |
| Access to SW and HW – error tracking database | - | S25 |
| Others: Overview to the planned SW “standard – variant” (Documentation) | - | S3 |

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

Performance aspects covered by Field Trial (Overview)

The following general functions and aspects of the mobile phone shall be tested during the GCF and End User Field Trial. For the End User 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
- **3G part under construction approx. January 2005**

10.8 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.

10.9 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.

10.10 Field Return Rate

Return rate <= 10,5 % (FY 04/05) / <= 10,0% (FY 05/06)

10.11 Quality of Suppliers and Components

See separate Quality Assurance Agreements (QAAs) for each supplier and component.

10.12 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.

| | |
|--|--------|
| FPY test station 904 (board test) | 90,0% |
| FPY test station 907 (adjustment/ system test) | 96,0% |
| FPY test station 916 / 923 (camera / customer test) | 93,0%* |
| FPY test station (customer init) | 99,0% |
| outgoing inspection (for both product groups) | 99,90% |
| Performance test station 904 (board test) | 88,0% |
| Performance test station 907 (adjustment/ system test) | 95,5% |
| Performance test station 923 (customer test) | 92,5% |

*The value for this test station will be calculated by multiply value (916) by value (923)

Quality Benchmark Figures (Data source ICM MP SCM NPI31)

NPI requirements

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

mena $\pm 3\sigma$

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.

10.13 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 Marketing, Business Administration,

11 Type Approval Wolf5

11.1 Regulatory requirements - Overview

11.1.1 European Community

As all GSM and UMTS terminals, the Wolf5 is 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

11.1.2 Outside Europe

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

China / APAC approval requirements are under PM responsibility and listed in a separate chapter below.

11.2 Voluntary requirements - Overview

11.2.1 GCF

Within GCF, manufacturers are required to fill in a list of Core Specs (e.g. 3GPP TS 45.005 for RF) applied to the design. Moreover, the exact version of Core Specs shall be listed for a range of Core Specs. The GCF Steering Group defines minimum requirements to Versions of Standards. By default, the terminal design shall therefore be made based on Core Specs.

However, as documented in the risk assessment and in the ST M1 milestone declaration the compliance to Core Specs is not fulfilled for several features.

The GCF requirements are defined in the current version of GCF-CC.

11.2.2 PTCRB

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

11.2.3 Additional voluntary requirements

Besides regulatory requirements, the product shall comply with a range of supplementary, "voluntary" certification schemes.

Voluntary certification schemes are developed by various entities defining requirements for specific functionalities e.g. Bluetooth, IrDA and WAP as described in the requirements matrix.

An additional requirement for TIM, Italy, regarding Network selection from SIM Card Preferred List for GSM terminals is included.

11.3 Requirements Matrix

11.3.1 Regulatory requirements

| Aspect | Region | | | |
|----------------------|------------------|---|---------------|--|
| | Europe | | US (& Canada) | |
| | Mandated by | Technical requirement | Mandated by | Technical requirement |
| Health and safety | R&TTE Art 3.1.a | Health aspect: Specific Absorption Rate (SAR) according to EN 50 360 and EN 50 361. | FCC | FCC SAR Regulation OET 65 |
| | | Safety aspect: Electrical safety according to EN 60 950. | - | - |
| EMC | R&TTE Art. 3.1.b | EN 301 489-1 EN 301 489-7 EN 301 489-17 EN 301 489-24 EN 55013:2001 EN 55020:2002 EN 55022:1998 | FCC | FCC Part 2 FCC Part 15 FCC part 22 FCC Part 24 HAC: ANSI C63.19 is not required as it is not included in the Wolf5 feature list. |
| Radio Spectrum | R&TTE Art 3.2 | EN 301 511 EN 301 908-1 EN 301 908-2 Bluetooth: EN 300 328-2 EN 300 440-2* | | |
| 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" is not required as TTY is not included in Wolf5 feature list. <i>USA FCC Wireless E911 Rules</i> |

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

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

11.3.2 "Voluntary" requirements

| Aspect | Certification planned for Wolf5 | Specified by | Technical requirements |
|---|---|--|---|
| Mobile <-> Network Inter-operability | Yes | GSM and UMTS: Global Certification Forum (GCF) | GCF-CC Field Trials |
| Mobile <-> Network Inter-operability | Yes | GSMNA | PTCRB NATWG.03 |
| Mobile <-> Network Inter-operability and the Application Enabler MMS. | If needed | During 2005 the Application Enablers browsing, streaming, video telephony and Java, etc. , might be included in GCF and/or PTCRB certification | GCF-CC PTCRB NATWG.03 |
| Bluetooth functionality * | Yes Bluetooth certification shall be printed on the box | Bluetooth Special Interest Group (BT-SIG) | Bluetooth Qualification Program Reference Document V0.9 |
| WAP functionality | No | OMA / The Open Group | WAP Certification and Testing Process |
| OpenWave Browser | Yes | OpenWave | Browser Compliance Verification |
| IrDA functionality | No IrDa shall be tested but no type approval is necessary | Infrared Data Association | IrDA Interoperability Tests |
| USB functionality | Yes The certification is mandatory if the USB logo shall be used. | USB Implementers Forum (USB-IF) | USB Compliance Program |
| Network Selection from SIM Card Preferred List | Yes This test shall be performed. | TIM | TIM Proprietary specification |
| CTIA | No | CTIA | CTIA GSM-1900 Terminal Unit Certification Program Management Document |
| Sync ML (OMA DS&DM) | N (voluntary) | OMA / Data Sync (DS), Device Management (DM) | |
| Java (Engine) | Y (mandatory) Sun requires it | Sun | |
| MMS (OMA) | N (voluntary) | OMA / MMS | |
| IMPS (Instant Messaging and Presence Services) (OMA) | N (voluntary) mandatory if we want to use the Wireless Village Logo | OMA / Wireless Village | |
| IrDA | N (voluntary) IrDA shall be tested but no type approval is necessary | Infrared Data Association | |

*** Bluetooth certification mandatory if Bluetooth is activated.**

11.4 Regulatory requirements - detailed

11.4.1 Health aspect

Health is a new aspect introduced by Article 3.1.a of Directive 1999/5/EEC in EC. Specific Absorption Rate is subject to regulatory approval within EC. Harmonised Standards for SAR; i.e. EN 50 360 and EN 50 361 are available and can be used for Annex III of 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 expose to EM fields | --- |

As of today the question remains when the new phantom will be available. Currently testing has still to be done according to EN50 360 but with the old phantom of ES59005. The new phantom is expected within the timeframe of terminals currently under development.

Actual limits currently given by Council Recommendation 1999/519/EEC will be applicable using the Harmonised Standards.

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 both FCC and CTIA in US.

The FCC and CTIA have continuously further developed SAR limits to include requirements for e.g. Body-worn configurations. Requirements as of today are known, however these may not be valid within the timeframe of terminals currently under development.

SAR values for US are made public available at FCC Website. In addition, both FCC and CTIA require detailed wordings to be included in user manuals.

11.4.2 Safety aspect

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

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

EN 60 950 concerns:

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

| Relevant harmonized standard for article 3.1a) | Version | Purpose | Date of cessation of presumption of conformity |
|--|---------|--|--|
| EN 60 950 | 1992 | Safety of information technology equipment | 1.1.2005 |
| EN 60 950 | 2000 | Safety of information technology equipment | 1.7.2006 |
| EN 60 950 | 2001 | Safety of information technology equipment | |

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

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

11.4.3 EMC aspect

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

Under previous European legislation, the EMC standard for GSM terminals ETS 300 342-1 was not harmonised. A range of product specific EMC standards for telecommunications terminal equipment are now restructured into the following relevant harmonized standards for article 3.1 b): (listed in the OJ 10th August 2002)

| Relevant harmonized standard for article 3.1b) | Version | Purpose | Date of cessation of presumption of conformity |
|--|----------------------|---|--|
| EN 301 489-1 | OLD V1.2.1 | common requirements for a large range of product types | 30.6.03 |
| EN 301 489-1 | OLD 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 | |
| EN 301 489-3 | V1.3.1 | specific requirements for short-range devices; i.e. Bluetooth functionality. | 31.10.2003 |
| EN 301 489-3 | OLD V1.2.1 | specific requirements for short-range devices; i.e. Bluetooth functionality. | 31.08.03 |
| EN 301 489-3 | V1.4.1 | specific requirements for short-range devices; i.e. Bluetooth functionality. | 30.11.2005 |
| OLD ETS 300 683 | 1997 | specific requirements for short-range devices; i.e. Bluetooth functionality. | 31.10.03 |
| 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 | |
| EN 301 489-17 | V1.1.1 | specific requirements for short-range devices; i.e. Bluetooth functionality | |
| EN 301 489-24 | V1.1.1 | specific requirements for UMTS FDD terminals | |
| EN 55020 | 2002 | FM Radio receiver – Immunity aspects | |
| EN 55013 | 2001 | Fm Radio receiver – Emission aspects | |
| EN 55022 A1:2000 A2:2003 | 1998 2000 2003 | Information Technology Equipment – radio disturbance characteristics (e.g. for A-GPS) | |

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>

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").

The full FCC report and order is available on the FCC website: FCC-03-168A1.DOC

11.4.4 Radio spectrum usage aspect

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

Under previous European legislation under Directive 91/263/EEC not only radio spectrum usage requirements were defined. At that time, the regulatory requirements for GSM terminals included signalling aspects, acoustics and SIM/ME interface. The corresponding technical requirements were defined in Common Technical Regulations (CTRs) with references to GSM 11.10. Approximately 400+ test cases were included for compliance to the CTRs and/or TBRs for GSM terminals.

Under Directive 1999/5/EEC the only applicable requirements in EC concerns effective radio spectrum usage.

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>

If you type in the following hyperlink including the work item ID (WKI) from the tables above, e.g. 13302 for EN 301 511 v 9.0.2 you get direct detailed information

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

11.4.4.1 Harmonized standards for GSM article 3.2

| Relevant harmonized standard for GSM article 3.2 | Version | Purpose | Date of cessation of presumption of conformity |
|--|------------------------|--|--|
| EN 301 511 | V7.0.1 WKI_ID=9225 | specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range pointing to GSM 11.10 | |
| EN 301 511 | V9.0.2 WKI_ID=13302 | Includes EGPRS and pointing to TS 151 010, is planned to be listed in the OJ 2003-07-30(not in the OJ up to now) | |
| EN 301 419-1 | V4.1.1 | Specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range, refers to GSM 13.01 V4.0.1 (partly old TBR/CTR),! | DO NOT USE ANY MORE |
| EN 301 419-2 | V5.1.1 | specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range HSCSD | DO NOT USE ANY MORE |
| EN 301 419-3 | V5.0.2 | specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range ASCI | DO NOT USE ANY MORE |
| EN 301 419-7 | V5.0.2 | specific requirements for GSM terminals operating in the 900 MHz and 1800 MHz frequency range RGSMS | DO NOT USE ANY MORE |
| | | | |

11.4.4.2 Harmonized standards article 3.2 for IMT2000 UTRA FDD UE

| Relevant harmonized standard for IMT2000 UTRA FDD UE article 3.2 | Version | Purpose | Date of cessation of presumption of conformity |
|--|------------------------|--|--|
| EN 301 908-1 | V1.1.1 WKI_ID=12465 | common requirements for IMT2000 (Release 1), | 31.1.2006 |
| EN 301 908-1 | V2.2.1 WKI_ID=15002 | common requirements for IMT2000 (Release 2), planned to be listed in the OJ 2004-03-31, TFES proposed that the transition period from Release 1 to Release 2 should be two years | |
| EN 301 908-2 | V1.1.1 | IMT2000 UTRA FDD UE (Release 1) | 31.1.2006 |
| EN 301 908-2 | V2.2.1 | IMT2000 UTRA FDD UE (Release 2), planned to be listed in the OJ 2004-03-31, TFES proposed that the transition period from Release | |

| | | | |
|--------------|--------|---|-----------|
| | | 1 to Release 2 should be two years | |
| EN 301 908-3 | V1.1.1 | IMT2000 UTRA FDD UE | 31.1.2006 |
| EN 301 908-3 | V2.2.1 | IMT2000 UTRA FDD UE (UTRA Base stations) | |
| EN 301 908-4 | V1.1.1 | IMT2000 UTRA FDD UE | 31.1.2006 |
| EN 301 908-4 | V2.2.1 | IMT2000 UTRA FDD UE (CDMA multicarrier UE's) | |
| EN 301 908-5 | V1.1.1 | IMT2000 UTRA FDD UE | 31.1.2006 |
| EN 301 908-5 | V2.2.1 | IMT2000 UTRA FDD UE (CDMA multicarrier Base stations) | |
| EN 301 908-6 | V1.1.1 | IMT2000 UTRA FDD UE | 31.1.2006 |
| EN 301 908-6 | V2.2.1 | IMT2000 UTRA FDD UE (IMT2000, CDMA, TDD UE's) | |
| EN 301 908-7 | V1.1.1 | IMT2000 UTRA FDD UE | 31.1.2006 |
| EN 301 908-7 | V2.2.1 | IMT2000 UTRA FDD UE (IMT2000, CDMA, TDD Base stations) | |

11.4.4.3 Harmonized standards article 3.2 for Bluetooth

| Relevant harmonized standard for Bluetooth for article 3.2 | Version | Purpose | Date of cessation of presumption of conformity |
|--|---------|---|--|
| | | | |
| EN 300 328-2 | V1.2.1 | Short range device ISM 2.4 GHz | |
| EN 300 328-2 | V1.4.1 | Short range device ISM 2.4 GHz | 30.06.2006 |
| EN 300 440-2 | V1.1.1 | Short Range 1-40GHz Conformity to EN 300 440-1 and EN 300 440-2 is not mandatory for annex III but helps to prevent extra declarations for France ??? | |

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

11.5 Special requirements

11.5.1 European Community

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

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

By January 2003, no such requirements are defined under Article 3.3 in EC but inclusion of IMEI security is under discussion.

11.5.2 USA

11.5.2.1 TTY (not included in Wolf5 feature list)

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

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

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

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

11.5.2.2 5-key nob

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

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

11.5.3 IMEI Security

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

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

11.5.4 Inter-operability

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

By contrast, this is not the case for US. GSMNA have set up the PCS1900 Type Certification Review Board (PCTRB) and entitled PCTRB to undertake type approval matters including inter-operability aspects for US.

Technical and procedural requirements are given in Permanent Reference Document NATWG.03. 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 addition, also CTIA operates the CTIA GSM-1900 Terminal Unit Certification scheme.

Both CTIA and PCTRB schemes are considered regulatory in US.

11.6 Voluntary requirements - detailed

11.6.1 Global Certification Forum - Inter-operability

Under earlier EU-legislation, GSM terminals were subject to a substantial amount of regulatory testing and certification or type approval before market launch following the provisions of Directive 91/263/EEC.

The amount of tests provided a high degree of confidence that relatively few and small inter-operability problems would occur between handsets and infrastructure of live networks.

Following the implementation of Directive 1999/5/EEC the amount of regulatory testing is reduced to radio spectrum aspects.

Consequently, type approval does not provide the same level of confidence. In particular, inter-operability aspects are not covered by regulatory testing under Directive 1999/5/EEC.

On this background, the GSM Certification Forum (GCF) was established as a voluntary certification scheme for GSM terminals in December 1999 after some years discussions between network operators and handset manufacturers mainly concerning the organisation of GCF, the technical requirements, the relations to authorities and corresponding regulatory requirements etc.

Since January 2002 GCF covers not only GSM terminals, but also UMTS terminals. Consequently GCF was renamed as Global Certification Forum. The scope of GCF is basically to provide a common set of Certification Criterias to re-establish the confidence needed from both sides of the mobile industry, that inter-operability problems can be avoided. During mutual recognition of manufacturer's declarations, duplicate testing can be avoided.

A more 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 corresponding technical requirements are defined in document
- GCF-CC: Certification Criterias

The valid versions of the above mentioned documents is available at

<http://gcf.gsm.org>

Note that a user login and a password is required to access the GCF web site.

Document CC incorporates basically the same technical requirements as were contained in the now expired CTRs. However, new tests are continuously added as new features and services are introduced in the GSM system and for UMTS the roll-out is expected to happen at the end of 2002. Compliance can be demonstrated by conducting tests in test laboratories using validated test cases running on commercially available test equipment.

In addition there is a new requirement for Field Trials. Field Trials are performed on live networks and 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.

Another new requirement after June 2002 from GCF is a declaration concerning the IMEI security.

Following shall the manufacturer declare:

He has taken necessary and sufficient steps to ensure that any individual or organisation cannot economically change the IMEI after the ME's final production process.

And that the IMEI resists tampering, i.e. manipulation and change, by any means (e.g. physical, electrical and software).

Within GCF, manufacturers are required to fill in a list of Core Specs (e.g. 3GPP TS 45.005 for RF) applied to the design. Moreover, the exact version of Core Specs shall be listed for a range of Core Specs. The

GCF Steering Group defines minimum requirements to Versions of Standards. By default, the terminal design shall therefore be made based on Core Specs.

11.6.2 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 (Feb. 2000: Version 0.9).

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.

11.6.3 WAP functionality

WAP is standardised 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 programme on behalf of WAP Forum as Certification Authority.

A more detailed description is given by The Open Group.

11.6.4 IrDA functionality

IrDA is an international organization that creates and promotes interoperable, low cost infrared data interconnection standards that support a walk-up, point-to-point user model. The standards support a broad range of appliances, computing and communications devices.

The IrDA specifications are under restructuring into Profiles as for Bluetooth. Currently (Febr 2001), only one Profile is defined, namely Point and Shoot profile.

More detailed information on IrDA is available at www.irda.org

11.6.5 USB functionality

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

11.6.6 Network Selection from SIM Card Preferred List

This requirement solely applies to TIM, Italy.

The purpose of the test is to check, that a Ph2 GSM terminal equipped with a non-empty SIM card Preferred List, selects a network in an International Roaming scenario, according to Core specification GSM 03.22.

The test specification is available at [\\AALAFS2\\APPL\\$\\SPECS\\TIM\\Tim_Netw_select.pdf](\\AALAFS2\\APPL$\\SPECS\\TIM\\Tim_Netw_select.pdf)

11.7 Marking and labelling

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 |
|-------------------|-----------------------|
|-------------------|-----------------------|

| Requirement basis | Corresponding marking |
|---|---|
| Directive 1999/5/EEC for EC | <p>99/05/EC article 12 and annex VII:</p> <p>Marking required on mobile: CE 0168 (if opinion of BABT as notified body is used) For Bluetooth with higher power classes, additionally the Alert symbol (!) (exclamation mark in a circle) (e.g. CE 0168 (!))</p> <p>Requirements from 99/05/EC annex VII: 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. 3. The CE marking must be affixed to the product or to its data plate. Additionally it must be affixed to the packaging, if any, and to the accompanying documents. 4. The CE marking must be affixed visibly, legibly and indelibly. 5. The equipment class identifier must take a form to be decided by the Commission in accordance with the procedure laid down in Article 14. Where appropriate it must include an element intended to provide information to the user that the apparatus makes use of radio frequency bands where their use is not harmonised throughout the Community. It must have the same height as the initials 'CE'. Notified body numbers and the equipment class identifier, (e.g. !) being part of the CE marking need to be put on the packaging and in the manual as follows:.</p> <p>99/05/EC Article 6.3 Member States shall ensure that the manufacturer or the person responsible for placing the apparatus on the market provides information for the user on the intended use of the apparatus, together with the declaration of conformity to the essential requirements. Where it concerns radio equipment, such information shall be sufficient to identify on the packaging and the instructions for use of the apparatus the Member States or the geographical area within a Member State where the equipment is intended to be used and shall alert the user by the marking on the apparatus referred to in Annex VII, paragraph 5, to potential restrictions or requirements for authorisation of use of the radio equipment in certain Member States. Where it concerns telecommunications terminal equipment, such information shall be sufficient to identify interfaces of the public telecommunications networks to which the equipment is intended to be connected. For all apparatus such information shall be prominently displayed.</p> <p>Siemens Type Designation</p> |
| R&TTE Directive 1999/5/EEC for EC: Article 12 (4) | <p>Apparatus shall be identified by the manufacturer by means of type, batch and/or serial numbers and by the name of the manufacturer or the person responsible for placing the apparatus on the market:</p> <p>Product Name</p> <p>Serial Number / IMEI</p> <p>Manufacturer Name</p> |
| EN 60 950 and other safety standards | Max. rated voltage and current consumption |
| CTIA | CTIA logo (CTIA Certification not mandatory) |
| FCC | FCC-ID number Country of Origin |
| IC | Canada ID |

| Requirement basis | Corresponding marking |
|-------------------|---|
| Additional | Siemens stock number IMEI in bar-code format and writing |
| CCC | CCC label is mandantory for China (MII) |

11.8 China / APAC

11.8.1 General APAC & China requirements

The APAC variants must comply with or have declaration on:

- Declaration of Conformity (Siemens self-declaration) for
 - EN301 511 ("Spectrum Usage" for GSM)
 - EMC: EN 301 489- 1 (V1.3.1 valid until 30.11.05 or V1.4.1)
 - EN 301-489-7 (V1.1.1 valid until 30.11.2005 or V1.2.1)
 - Safety: EN 60950
- BABT Certificate for R&TTE Directive 1999/5/EC (Opinion of Notified Body)
- Test reports for above norms (GSM Report from e.g. Cetecom, 7 layers etc.)
- Declaration of Conformity (Self-declaration document by Siemens) which declares the charger and adapter (3-pin UK plug) for the Siemens product complies with the Safety regulation BS1363
- Commercial Product photographs including front shot, back, PCB board and the "commercial" IMEI number. (Photos has to be taken by a digital camera)
- CB Test Report (by International Electrotechnical Commission (IEC)) or Test Report from other approved authority
- ICNIRP report/certificate meeting International SAR standard the GPRS IOT reports against 5 different Networks. (Ericsson, Nortel and Nokia infrastructure)
- Australian safety approval certification of charger (i.e. copy of certificate issued by Australian regulatory to manufacturer) - see attached pdf file.

11.8.2 Bluetooth Products

- ETSI Standard EN300 328 or EN300 836

11.8.3 Additional APAC & China Requirements

Additionally APAC variants must comply with or have declaration on:

- Charger type approval must be done by charger supplier for Singapore - <http://www.safety.org.sg>
- Australia additional requirement where charger pins must be partially isolated - http://www.aeema.asn.au/docs/insulated_pins.pdf

Additionally China variants must comply with or have declaration on:

- NA test sample drawing:
R&D / PM in HQ send an IMEI list of 500 samples for MII Lab to choose from freely first, then R&D/PM send samples with those with IMEI chosen by the MII Lab to China for EMC testing, RF testing and MT net testing. Samples are not allowed to be replaced and modified during NA testing.
- OEM product:
Must be clearly stated any specified relationship between manufacturer, ODM vendor and the owner of the product in a product investigation form

- Test failure:
If the units failed in testing, there is only one chance to modify, and retest should be conducted after 1 month with new samples re-drawn by MII lab. If the test is still failed, then NA application stop and the product can be re-applied for NA half a year later!

11.9 Variant Overview

| Requirement | Wolf5 EMEA (900/1800/1900/FDD 2100) | Wolf5 China (900/1800/1900/FDD 2100) |
|---------------------------|---|--|
| R&TTE | X | X |
| FCC / IC | X | X |
| PTCRB | X | X |
| GCF | X | X |
| CCC (MII China) | | X |
| TTY | Not supported | |
| HAC | Not supported | Not supported |
| IMEI Security Declaration | X | X |
| 5-key nob | X | X |

TTY and Hearing Aid Compatibility (HAC) are not supported by Wolf5.

11.10 Additional Systemtest requirements

11.10.1 Interfaces

11.10.1.1 50 Ohm RF Interface

The phone needs a 50 Ohm RF interface for approval testing. The interface can be realized by a coax test connector, which is accessible and mechanically suitable for approval testing or by an RF cable with same properties (SL55 solution). The related GSM specification is 3GPP TS 51.010-1 Annex A.

For Wolf5, the RF interface is realized by a 50 Ohm AMP-connector (accessory interface).

11.10.1.2 BFC/RCCP Interface

For remote control during type approval testing (FTA "Automode"), 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 is replaced by BFC, in principal the same functionality (remote control) for the mobile has to be provided.

For the Wolf5 these functionality has to be provided in a way which can be implemented in the Test machine setup of Systemtest.

11.11 Special issues to Wolf5

11.11.1 AGPS

PL-T and PM requires from Systemtest to test the functionality of AGPS applications for the User Plane (UP) AGPS implementation in 2G and 3G networks. All other AGPS implementations will be disabled in the Wolf 5.

12 Milestones

| Wolf 5 Milestones | | | | |
|-------------------|----------|----|--------|----------|
| | Plan | CW | Status | Date |
| M0 | 24.03.04 | 13 | done | 02.07.04 |
| S0 Design Freeze | 12.08.04 | 33 | done | 19.08.04 |
| M1 | 23.09.04 | 33 | | 22.10.04 |
| S15 | 24.01.05 | 04 | | |
| S2 | 08.03.05 | | | |
| S25 | 17.05.05 | | | |
| S3-SW | 24.06.05 | | | |
| S3-HW | 12.07.05 | | | |
| Start TA | 12.07.05 | | | |
| DS | 22.09.05 | | | |
| S3 | 27.07.05 | | | |
| S4 | 07.10.05 | | | |
| M3 | 11.11.05 | | | |

As presented in PSR on 27.10.04

13 Miscellaneous

13.1 Technical Risks

For major risk assessment see separate document "Wolf 5 List of risks M1.xls" within the M1 folder at \\Mchgclv01\data\projekte\PROJ_SPECIAL\W5\documents_declarations\M1\M1 documentation.

13.2 Packaging/User Manual

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

The supply package shall contain:

- Packaging for the phone
- Siemens Wolf 5 phone including battery cover and signs/labels
- Battery pack
- charging unit
- RS-MultiMediaCard tray
- User Manual (up to 4 per supply unit)
- Accessory Leporello
- CD

13.3 Economic Product Plan

The EPP (WPP) is available at Sebastian Kuritke [COM MD PBM 3G BA](#).

13.4 Patents

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