C35(i), M35(i), S35i
Level 2.5e

Repair Documentation

V 1.0

Table of Contents:

1. List of available level 2,5e parts P35

ID-No	Type	Name(function)/Location	Rep-Code	Order No.
D100	IC	GAIM /Logic	4GAI	L36820-L6071-D670
D103	IC	Egold/ Logic	4EGO	L36810-G6096-D670
D200	IC	ASIC/ Pow.Supply	4PSA	L36145-J4682-Y16
D402	IC	LMX-PLL/RF	4PLL	L36820-L6038-D670
Z4450	IC	Bright/RF	4BRI	L36820-L6048-D670
N400/401	IC	Volt. Reg./RF	4REG	L36810-C6049-D670
N501	IC	Op.Amp./RF	4OPA	L36810-C6053-D670
N502	IC	PA/RF	4PAM	L36851-Z2002-A40
V211	Trans.	Charg./Logic	4CHT	L36830-C1046-D670
V305	Trans.	Ringer-Light/logic	4RIT	L36830-C1081-D670
V305	Trans.	Vibra/logic	4VIT	L36702-C1340-S67
V460	Trans.	LNA/logic	4LNA	L36840-C2039-D670
V501/502	Trans.	TX/RF	4SWT	L36840-C4013-D670
V508	Trans.	TX/RF	4SWT	L36840-C4014-D670
V306/800	Diode	Vibra-Ringer/Logic	4RID	L36840-D53-D670
Z100	Quartz	Egold/Logic	4OSC	L36145-F102-Y8 (B1 lay.)
			4OSC	L36145-F102-Y9 (B2 lay.)
Z601	Quartz	13MHz/RF	4VCX	L36145-F220-Y4
Z404	VCO	1LO/RF	4VC1	L36145-G100-Y68
Z480	VCO	TX/RF	4VCT	L36145-G100-Y37
Z440	Filter	IF/RF	4IFF	L36145-K280-Y132
Z450	Filter	RX-PCN/RF	4FI1	L36145-K280-Y133
Z451	Filter	RX-PCN/RF	4Fi2	L36145-K280-Y135
Z460	Filter	RX-GSM/RF	4FI3	L36145-K280-Y118
Z461	Filter	RX-GSM/RF	4FI4	L36145-K280-Y121

2. Required Equipment for Level 2,5e P35

- GSM-Tester (CMU200 or 4400S incl. Options)
- PC-incl. Monitor, Keyboard and Mouse
- Bootadapter 2000 (L36880-N9241-A200)
- Troubleshooting Frame P35 (F30032-A74-A1)
- Power Supply
- Spectrum Analyser (Advantest 3221)
- RF-Probe incl. Power Supply (e.g. from Agilent)
- Oscilloscope incl. Probe
- RF-Connector (N<>SMA(f))
- Power Supply Cables
- Dongle (F30032-P28-A1)
- BGA Soldering equipment

Reference: **Equipment recommendation Level 2,5e**

3. Required Software for Level 2,5e P35

- Windows NT Version4
- Winsui P35
- Winswup
- Windows software for GSM-Tester
- Software for 13MHz adjustment

4. Radio Part

Notes

The radio part converts the I/Q base band signals supplied by the logic (EGAIM) into RF-signals with characteristics as per the GSM recommendation (transmission) which are radiated by the antenna.
Or the radio part converts the received GMSK signal supplied by the antenna into IQ base band signals which can then be further processed by the logic (EGAIM). The radio part is designed for Dual Band operation and can therefore serve the frequency bands EGSM900 and GSM1800. The radio part can never transmit and receive in both bands simultaneously. However, the monitor time slot can be selected independently of the frequency band.
Transmitter and receiver are of course never operated simultaneously.

The radio part consists of the following blocks:

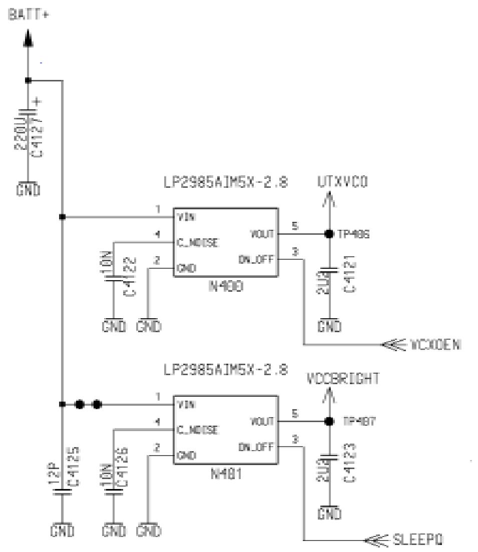
- Power supply
- Synthesizer
- Receiver
- Transmitter
- Transmitter (Power amplifier)
- Antenna Switch

4.1 Power Supply RF-Part

Two voltage regulators (N400/401) with a nominal output voltage of 2.8V in the SOT23-5 housing are used. The voltage regulator N400 is activated via VCXOEN provided by the ASIC.
The voltage regulator N401 is activated via SLEEPQ provided by the Egold.
To reduce interference signals a 220µF electrolytic capacitor is connected to the input of the regulators.

The name of the voltages are: a) **UTXVCO** activated by VCXOEN
and b) **VCCBRIGHT** activated by SLEEPQ

For both voltages BATT+ is required.



4.2 Frequency generation

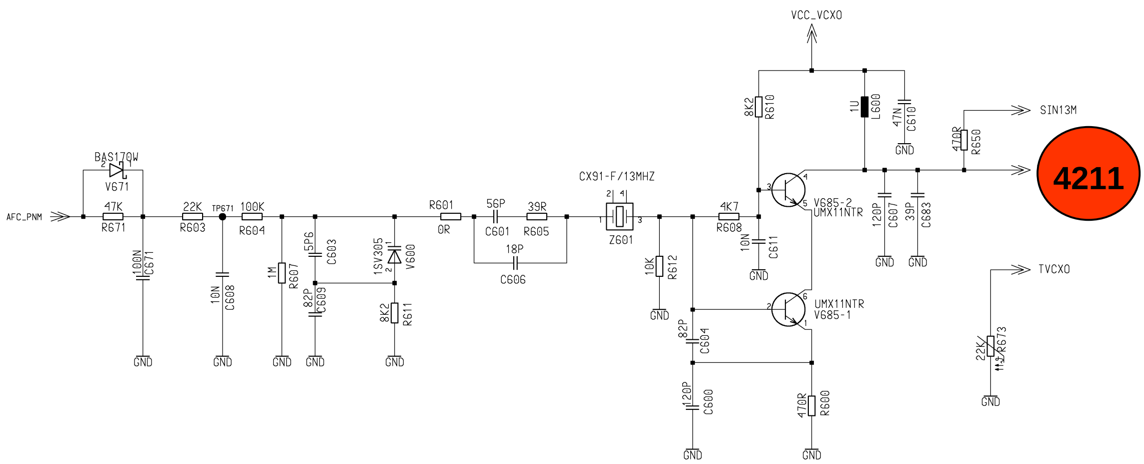
4.2.1 Synthesizer : The discrete VCXO (13MHz)

The generation of the 13MHz signal is done in the P35 via a discrete VCXO.
A Colpitts oscillator with a post-switched buffer stage is used as oscillator switch.
The subsequent oscillating circuit (C607,C683, L600) and the resistor R650 create a de-coupling of the synthesiser from interference signals coming from the logic.
The oscillator frequency is controlled by the (AFC_PNM) signal which is generated from the EGOLD and the capacity diode V600.
To reduce the charging time of the low pass (R671, C671) the resistor R671 is bridged by the diode V671
For the temperature control a temperature-dependent resistance R673 is placed near the VCXO.

The required voltage VCC_VCXO is provided by the N400 (UTXVCO) through R411

The picture 4211 shows you the signal at the collector of the transistor V685.

Notes



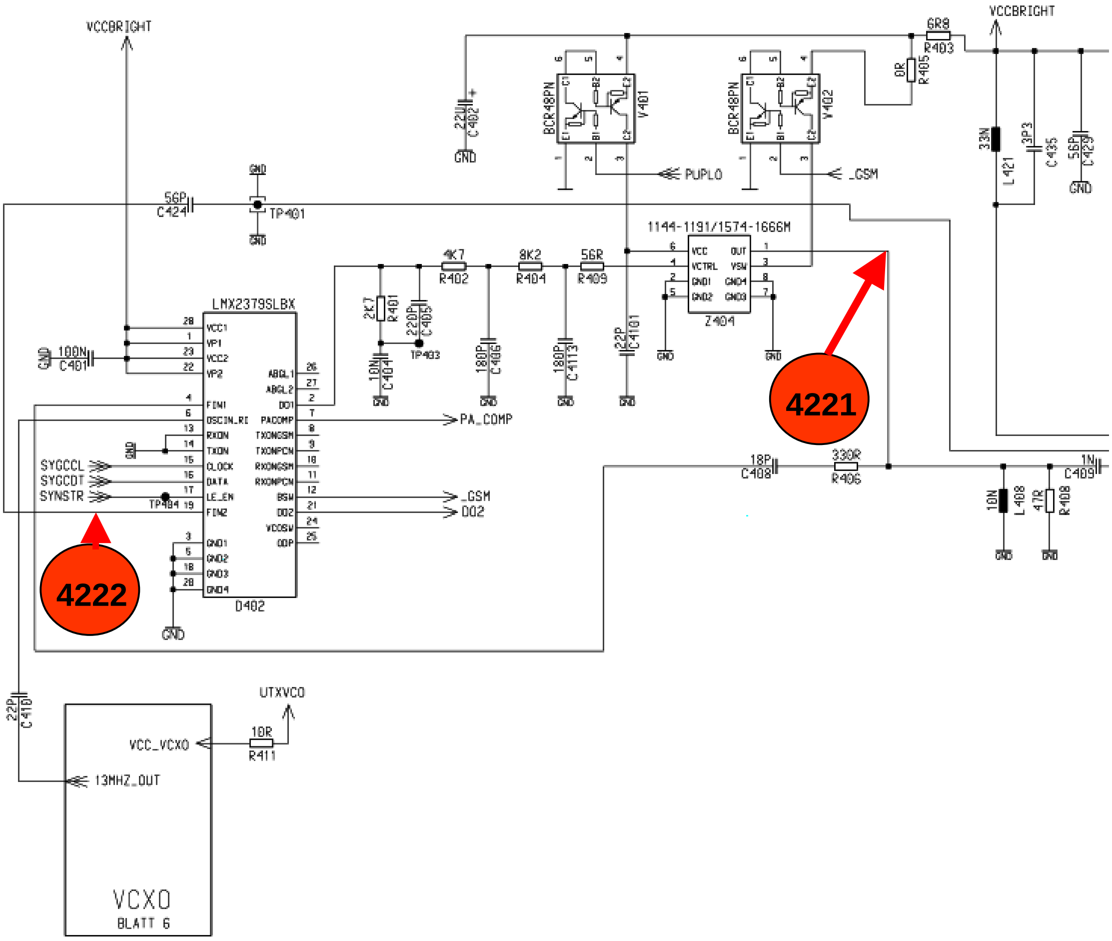
4.2.2 Synthesizer : LO1

The first local oscillator (LO1) consists of the PLL-IC (**D402**), a loop filter and a VCO (**Z404**) module. This LO1 circuit generates frequencies from 1144MHz to 1191MHz for GSM 900 operation and from 1574MHz to 1666MHz for GSM 1800 operation. It is switched to select the channels in stages of 200kHz.
The loop filter has a limit frequency of approx. 10kHz and a periodic suppression.
The VCO module is switched on via the signal PUPLO (V401).
The switching between GSM900 and GSM1800 is done via the signal _GSM (V402), generated by (D402) through the programming signals SYGCCL, SYGCDT,SYNSTR
The VCO output signal enables the BRIGHT IC to mix the IF-Frequency (225 MHz)
The VCO output is also guided to the PLL-IC (D402) to ensure the frequency stability (DO1<>VCTRL). To do so the 13MHz frequency is used as the reference signal for the PLL circuit.
The programming of the PLL-IC is realised by the EGOLD with the signals:
SYGCCL; SYGCDT and SYNSTR.

The required voltage VCCBRIGHT is provided by N401.
The _GSM **(not GSM900)** signal is on "H" level

The picture **4221** shows the VCO output signal
The picture **4222** shows the programming signals for the PLL

Notes



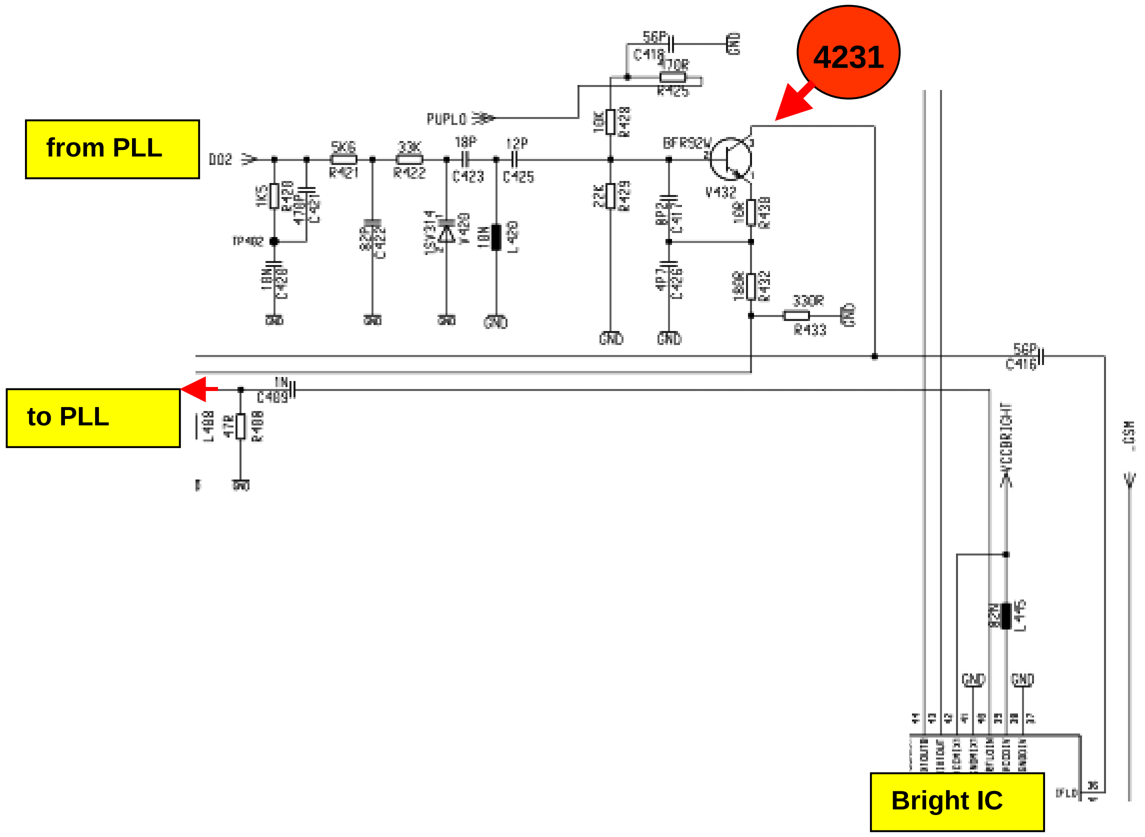
4.2.3 Synthesizer : LO2

Notes

The second local oscillator (LO2) consists of the PLL-IC (D402), a loop filter, the BRIGHT IC and a discrete VCO. The LO2 circuit generates the frequencies 520MHz or 540MHz as required. The mobile phone normally uses the frequency 540MHz. The LO2 switches to 520MHz in the GSM1800 TX mode only. The Signal (_GSM) is used for switching. The loop filter has a limit frequency of approx. 10kHz and a periodic suppression.
The oscillator is constructed discretely, whereby the active part and its operating point setting are integrated in the BRIGHT (see BRIGHT Block diagram) .
The PUPLO signal is switching on the discrete LO2 circuit.
The BRIGHT IC is supplied via L445 with VCCBRIGHT

The required voltage VCCBRIGHT is provided by N401

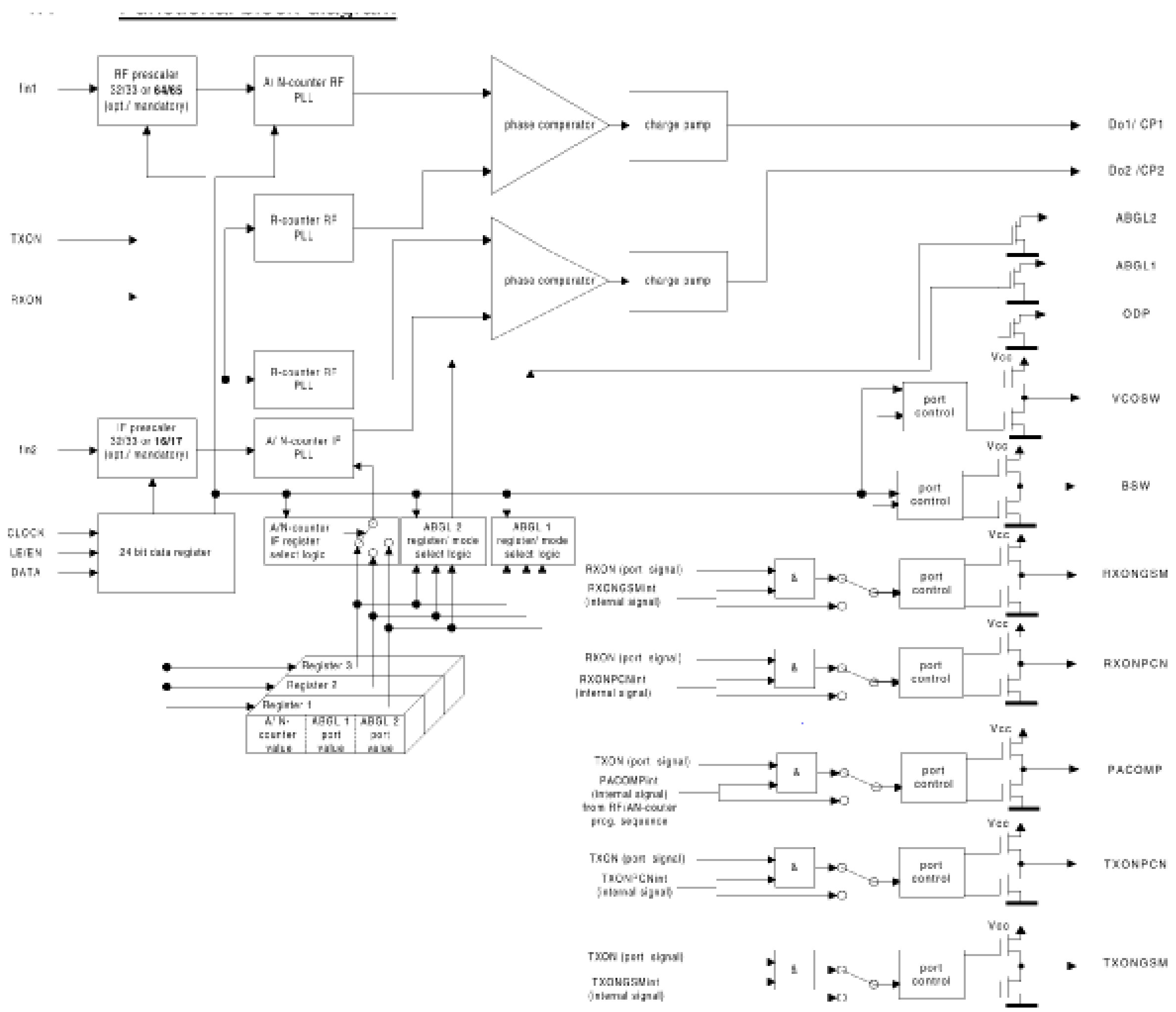
The picture 4231 shows the LO2 output signal



4.2.4 Synthesizer : PLL

PLL-IC LMX2379SLBX (D402)

Blockdiagramm



The required voltage VCCBRIGHT is provided by N401

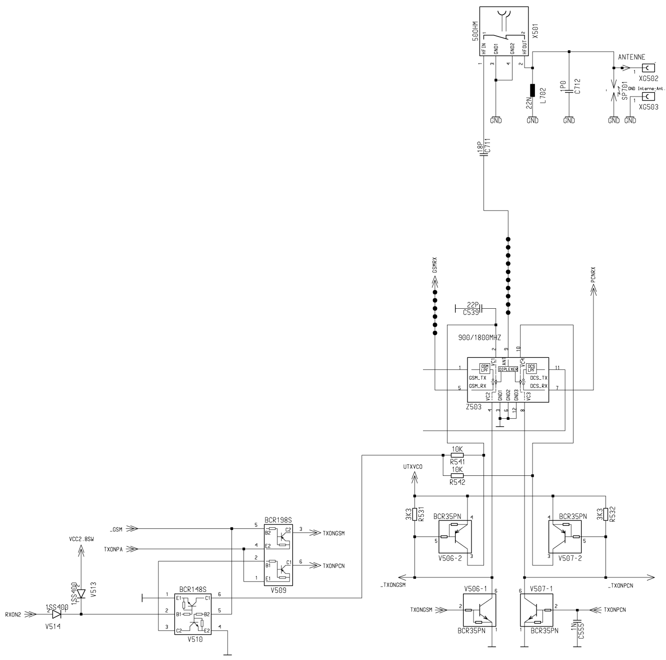
4.3 Antenna switch (mechanical/electrical)

Internal/External <> GSM900/1800 <> Receiver/Transmitter

Notes

The P35 mobile consists of two antenna switches.

a: The mechanical antenna switch (connector X501) for the differentiation between the internal and external antenna.



b: The electrical antenna switch (Diplexer Z503) for the differentiation between the receiving and transmitting signals, just like the differentiation between GSM900 and GSM1800
To do so the signals "_GSM; TXONPA; RXON2" are required to switch the input signals VC1–VC4.

The matrix below shows the different conditions at the Diplexer and the accompanying signals.

	VC1 (pin2)	VC2 (pin4)	VC3 (pin8)	VC4 (pin10)
GSM TX	**high**	**low**	**low**	**low**
GSM RX	**low**	**high**	**low**	**low**
PCN TX	**low**	**low**	**low**	**high**
PCN RX	**low**	**low**	**high**	**low**

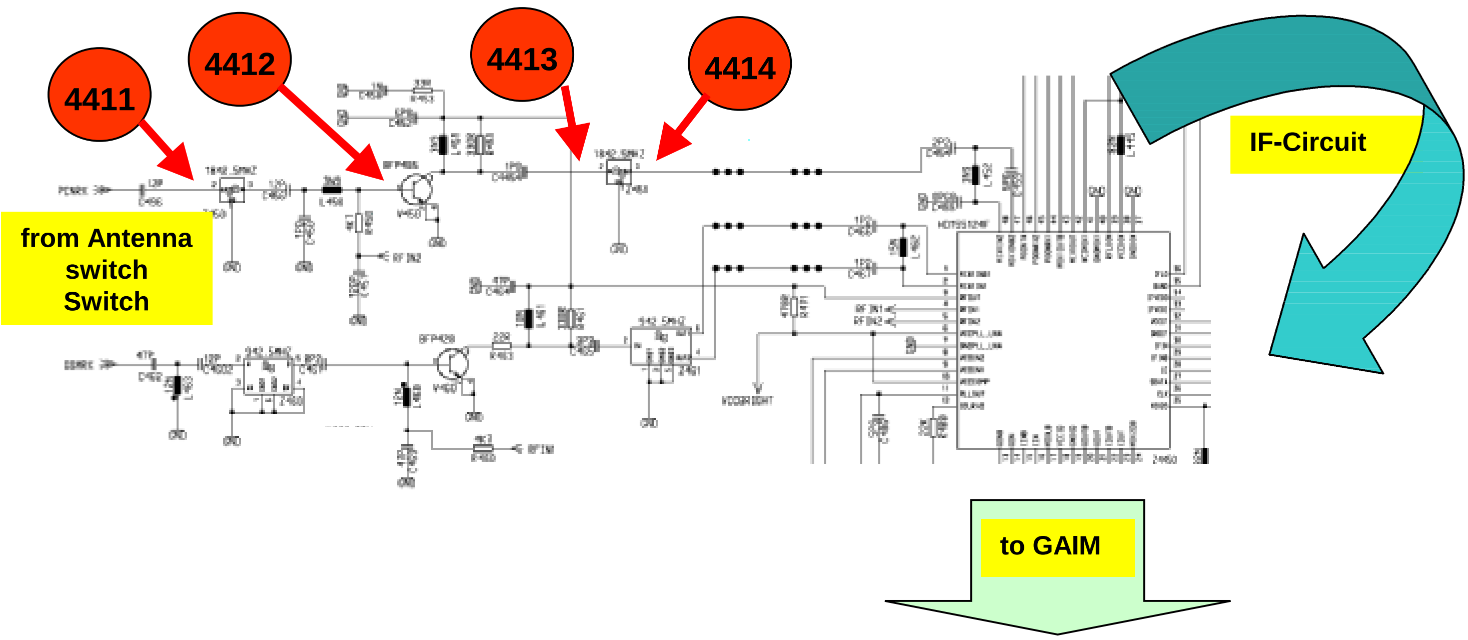
4.4 Receivers

4.4.1 Receiver: GSM1800-LNA and Filter

After the antenna switch, up to the first mixer the GSM1800 receiver circuit Consists of a ceramic front end filter (**Z450**),a LNA (**L**ow **N**oise **A**mplifier **V450**) and a ceramic inter-stage filter (**Z451**).
The front-end filter (double-pole ceramic filter) has an insertion loss of max. 1.5dB with an intermediate frequency selection of minimum 32dB.
The GSM1800 LNA V450 is a discrete module with an amplification of approx. 17dB.
The collector current of the transistor is stabilised via an integrated regulating switch inside the BRIGHT Z4450.The collector current is defined through the resistance of the resistor R471. The LNA is switched on via the signal (RFIN2) from BRIGHT IC.
After the amplification an other inter-stage filter ((Z451) a 3-pole ceramic filter) is used to reduce the amplification interference.
This filter has an insertion loss of maximum 3.7dB with an intermediate frequency selection of minimum 38dB.
The non-symmetrical output of the filter (Z451) is connected to the 1st PCN mixer via a balancing and adaptation circuit .(C454, L452, C459, C455) This circuit converts the asymmetrical input signal into a symmetrical signal.

The required voltage VCCBright is provided by the N401

Notes

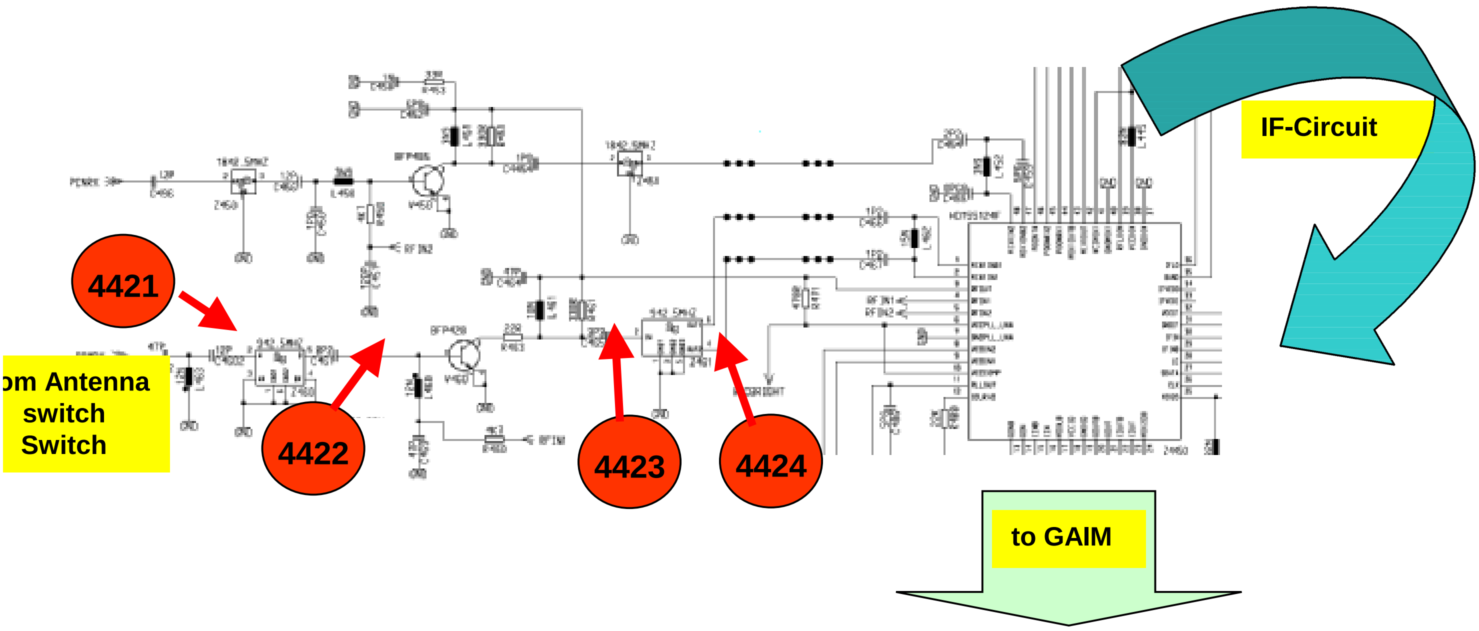


4.4.2 Receiver: GSM900-LNA and Filter

After the antenna switch the GSM900 receiver signal runs through the SAW front end filter (Z460). The front end filter has an insertion loss of approx. 2.5dB and a ripple of approx. 1dB.
The amplification of the subsequent LNA V460 has been reduced to approx. 18dB The operating point stabilisation of the LNA transistor is accomplished via the BRIGHT and the resistor R471. The LNA is switched on via the signal (RFIN1) from BRIGHT IC. The output is adapted by corresponding components to the subsequent SAW inter-stage filter (Z461). This filter has an insertion loss of approx. 3.5dB and a ripple of approx. 1.5dB. The symmetrical filter output of the inter-stage filter is adapted to the input of the first mixer (Z4450).
The symmetrical output of the filter (Z461) is connected to the 1st GSM mixer via an adaptation circuit .(C466, C467 L462)

The required voltage VCCBright is provided by the N401

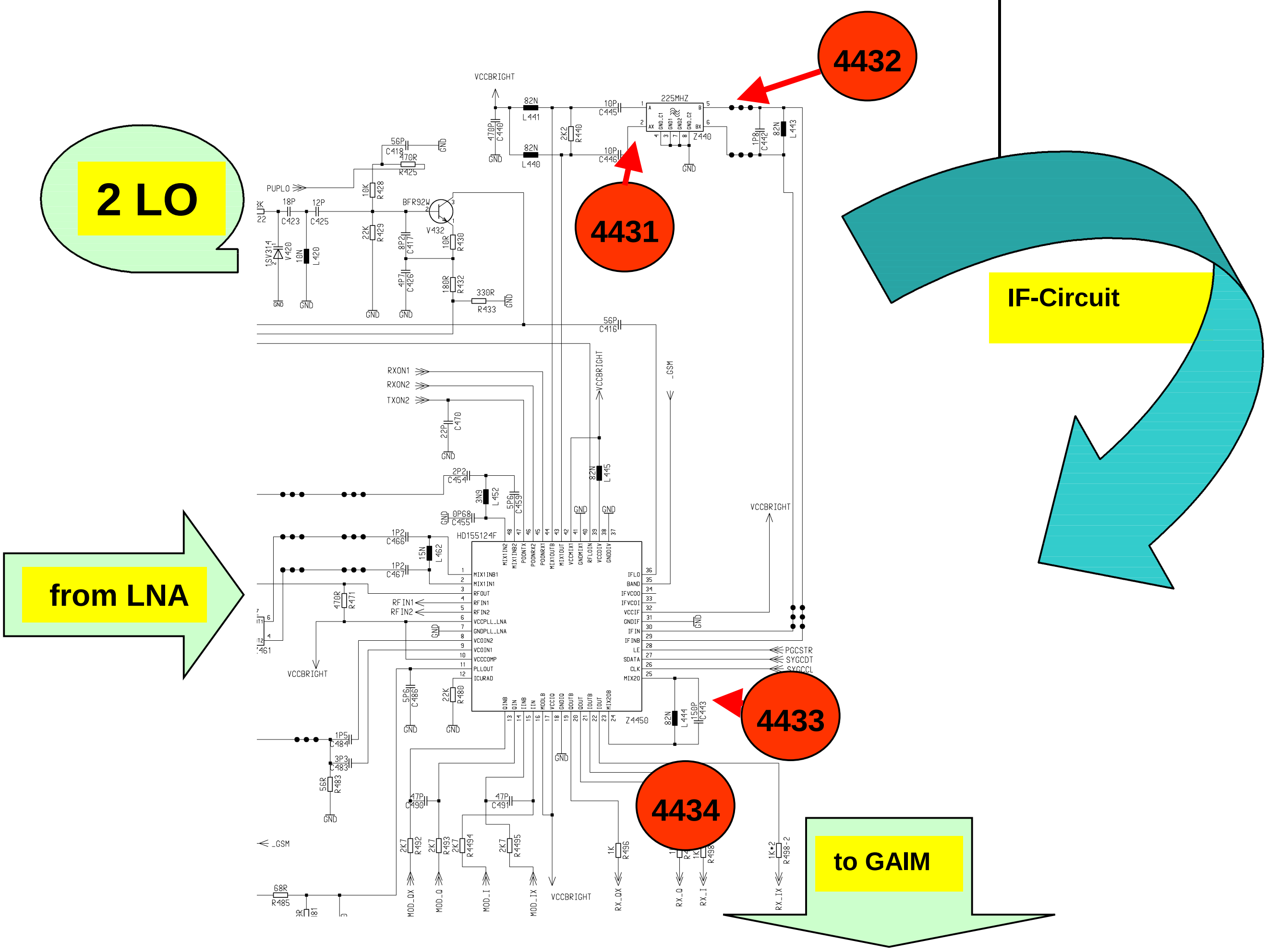
Notes



4.4.3 Receiver : Mixer, IF Amplifier and Demodulator

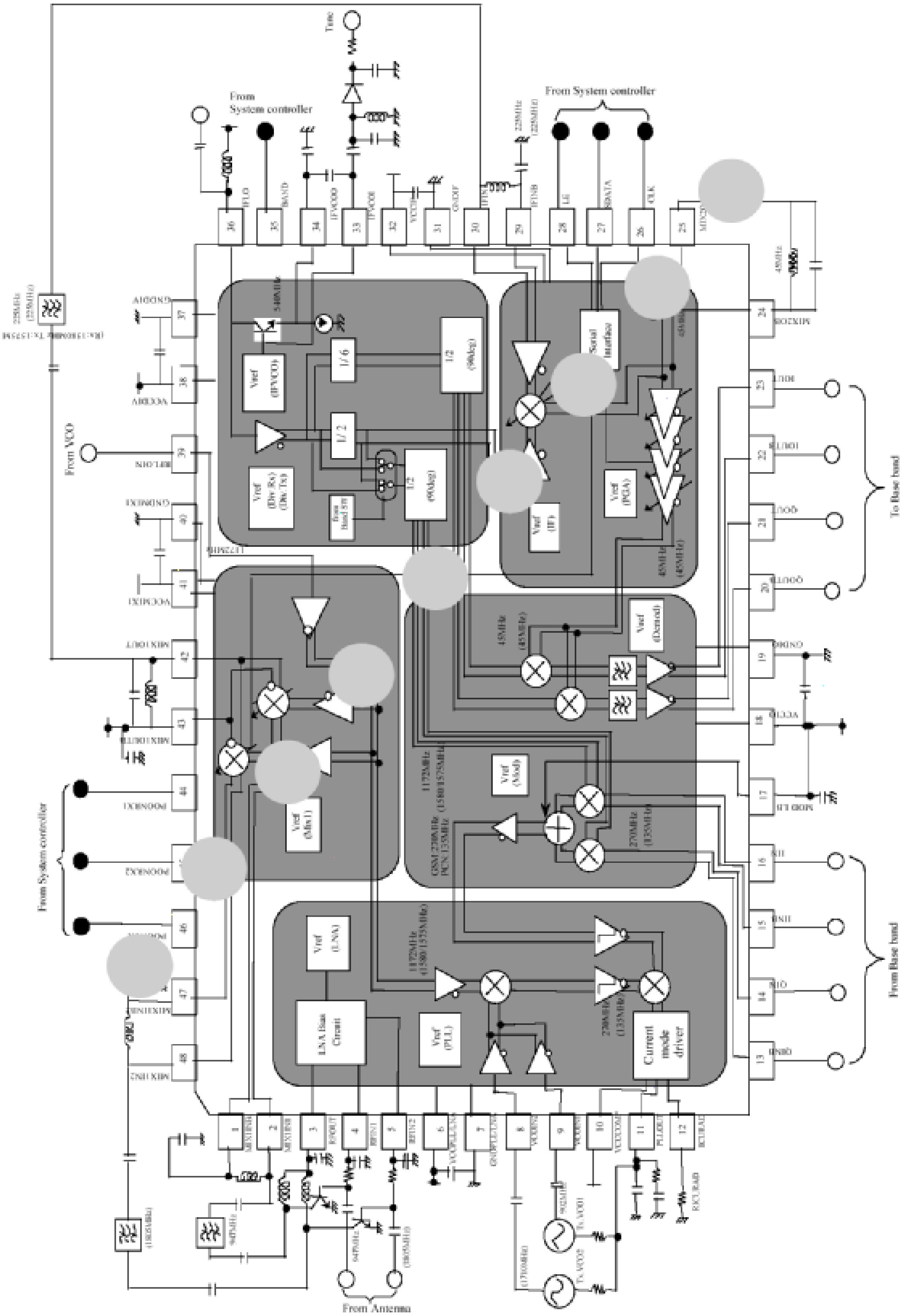
The BRIGHT IC (Z4450) has two separate input mixers one for EGSM900 and one for GSM1800. Both mixer blocks are designed as Gilbert cells and they are switchable in the conversion gain (dynamic: 12dB for GSM and 10dB for PCN).
The mixing result for both mixers is an intermediate frequency from 225MHz.
For GSM900 the LO1 frequency is RX frequency **plus** intermediate frequency.
For GSM1800 the LO1 frequency is RX frequency **minus** intermediate frequency.
After passing an external IF Filter (Z440) the signal is mixed down with the LO2 to 45MHz. After further filtration the 45MHz IF signal arrives at the programmable IF amplifier in the (Z4450). This amplifier has a dynamic of 96dB and can be set via a 6-bit programming word (PGCSTR;SYGCDT;SYGCCL) in 2dB steps.
Finally the signal is mixed down in the demodulator to DC in order to generate the differential I and Q signals.(RX_I,RX_IX-RX_Q,RX_QX) This signals are guided to the EGAIM to the A/D converters in the base band path.

Notes



4.4.4 Bright IC

Block Diagram



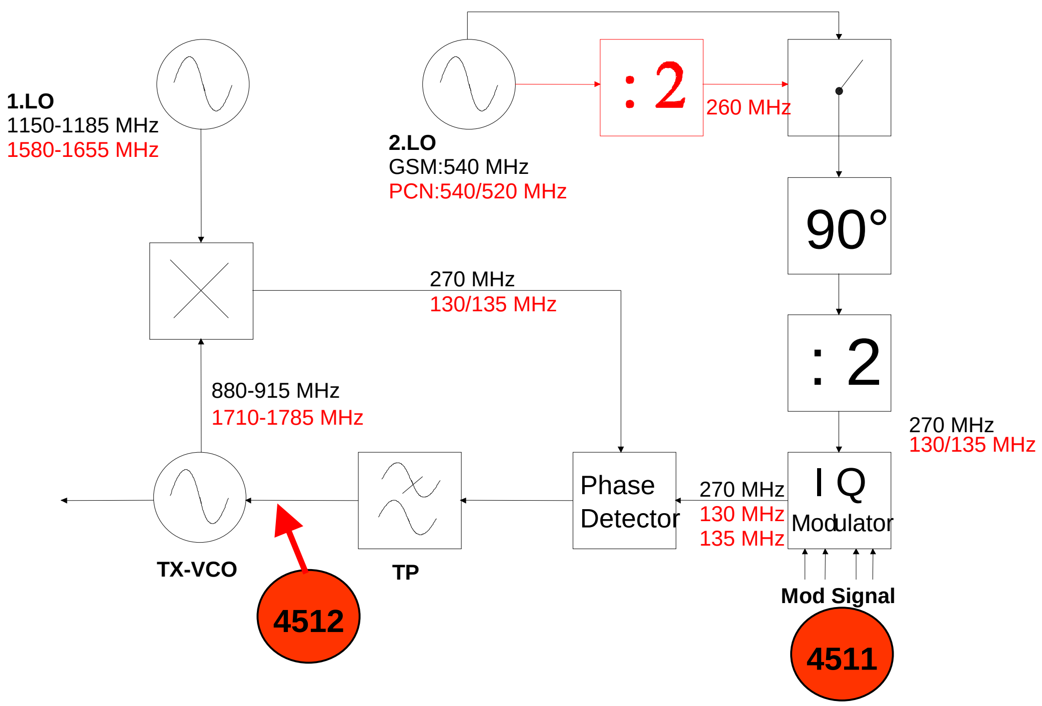
4.5 Transmitter

4.5.1 Transmitter: Modulator and Up-conversion Loop

Notes

The P35 modulation is based on the principle of the up-conversion modulation phase locked loop and is accomplished via the BRIGHT IC(Z4450).
The BRIGHT IC provides the quadratic modulator with the TX IF signals (GSM 270MHz/ PCN 135/130MHz). Whereby these frequencies are mixed from the second local oscillator signals.
This "wrong GMSK RF signal" is compared in a phase detector with the down mixed "final GMSK RF signal".
To get the comparison signal the TXVCO signal is mixed with LO1 signal.
With the help of the 1.LO the GMSK-RF signal appearing at the output of the TXVCO (Z480) is mixed to a ZF (GSM 270MHz/ PCN 135/130MHz) below the TX signal and is led on to the phase detector. The I-Q modulated signal in the ZF position (GSM 270MHz/ PCN 135/130MHz) is also led to the phase detector.
The output signal of the phase detector passes a discrete loop filter formed from capacitors and resistors and controls the TXVCO to work on the right frequency.
This large loop band width guarantees that the regulating process is considerably quicker than the changes in the modulation signal.
The TXVCO is a so-called two-in-one VCO, this means the VCO module contains the GSM-VCO and the PCN-VCO in one housing.
Via a transistor switch (V480) by using the signal _GSM the TXVCO is switched from GSM to PCN.

The required voltage VCCBright is provided by N401
The required voltage UTXVCO is provided by N400

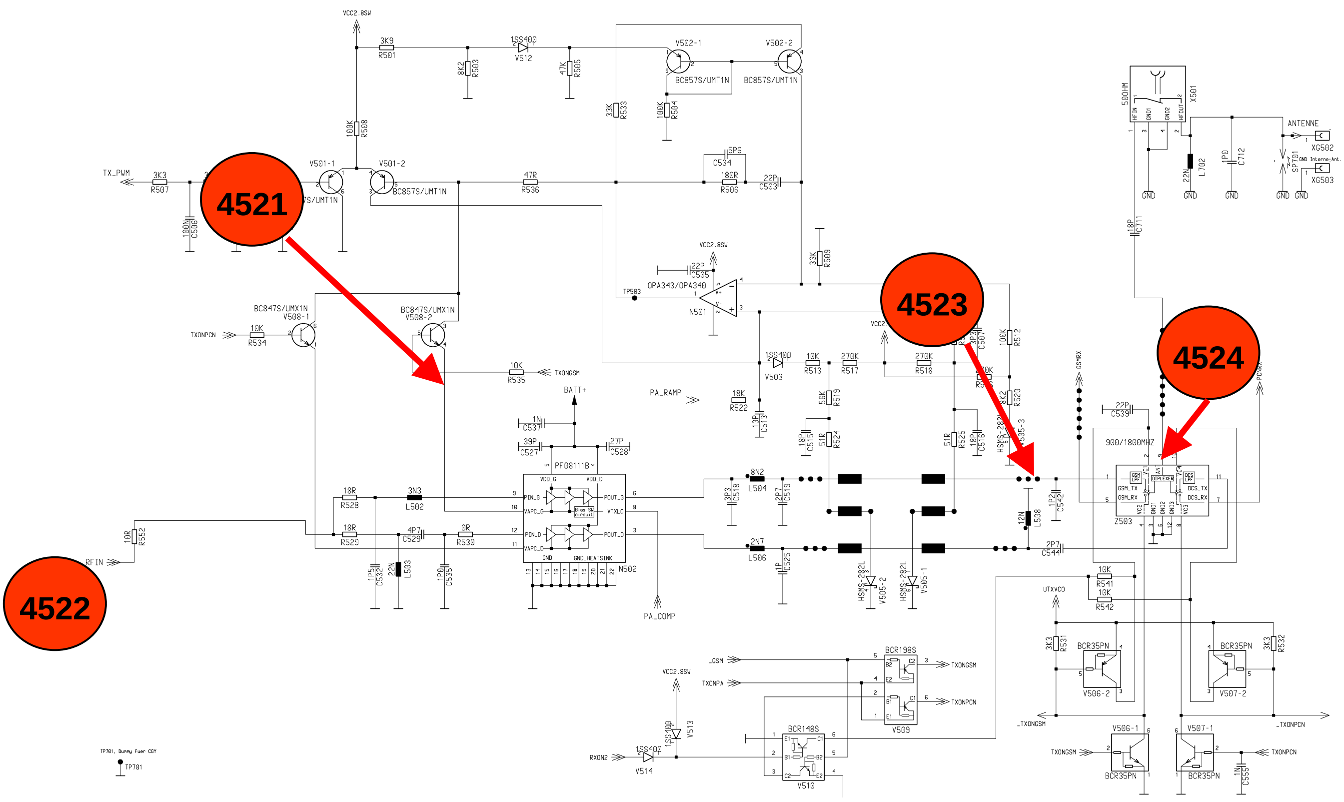


4.5.2 Transmitter : Power Amplifer Amplifier and Antenna Switch

Notes

Splited by a discrete circuit into GSM900 GSM1800 the TXVCO output signal arrives at the power amplifier. The dual band power amplifier module (N502) is assembled on a ceramic substrate in one housing. The module amplifies the output signal of the TXVCO to the required PCL (controlled by the feedback circuit according to settings from the logic) .The different amplifiers are switched on by the TXONPCN/TXONGSM via the transistor (V508). The signal PA_Comp is required for the operation point setting of low GSM PCLs. The power amplifier is feeded directly from the battery (BATT+).
After amplification the signal passes on the way to the antenna the diplexer (Z503) and antenna connector (X501)
A part of the TX output signal is decoupled via a directional coupler (realised by conductive tracks) and is equalised at a detector diode (V505).
This so gained voltage is compared by an operation amplifier (N501) with the PA_RAMP signal provided by the GAIM, to ensure that the PA is working within the required PCL´s
For temperature compensation the other part of the detector diode (V505) is used.

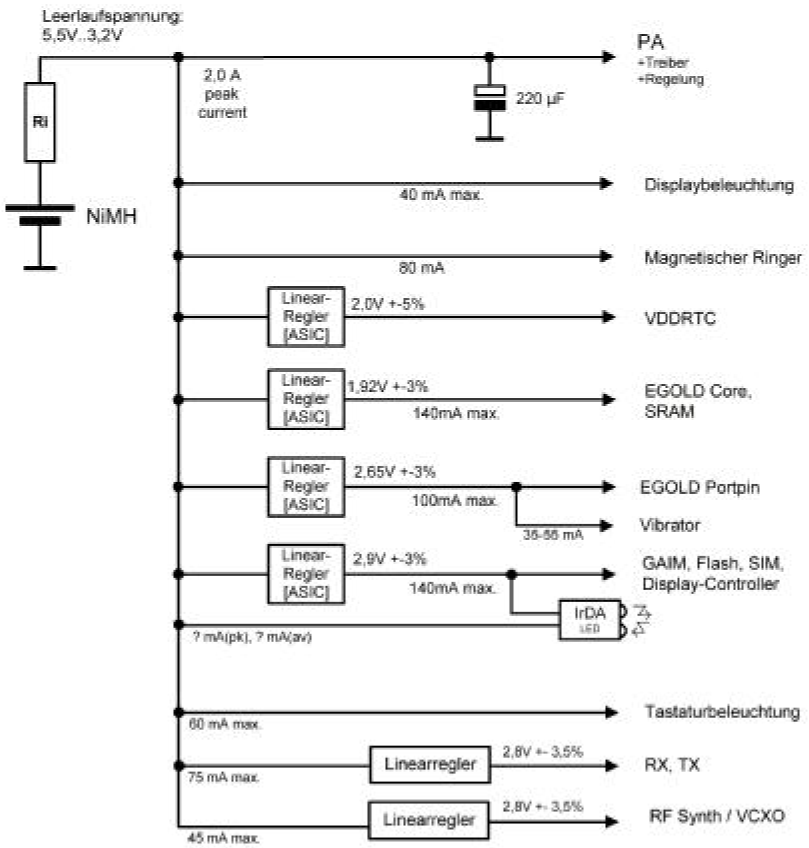
The required voltage BATT+ is provided by the battery.
The required voltage VCC2,8SW is provided by transistor V481.



5. Power Supply

5.1 Overview and Voltages

Notes



The following restrictions must be observed:

- The phone cannot be operated without battery.
- The phone will be damaged if the battery is inserted the wrong way round (the mechanics of the phone prevent the battery from being put in the wrong way round. The electric system assumes that the battery as been inserted correctly.

5.2 STV-ASIC

The power supply ASIC contains the following functions:

Notes

- Control of “**switching on**” the mobile phone via
  1.The ON/OFF Key. (ON_OFF)
  2.The bottom connector with (External Power)
  3.The **R**eal **T**ime **C**lock RTC (ON_OFF2)

- Watchdog monitor
  1.Control of “**switching off**” the mobile phone via WATCHDOG_µP.
  2. Watchdog observation

- Switch off of mobile phone in the case of overvoltage at battery connection.
- Generation of RESET signal for E-GOLD, E-GAIM, Flash and MMI components
- Generation of 2.90 V via linear controller for the logic IC.
- Generation of 2.65 V via linear controller for the logic IC.
- Generation of 2.20 V via linear controller for the logic IC.

- Battery charge support:
- Low battery detector
  A low voltage comparator in the ASIC will monitor the battery voltage. If the voltage drops below 3.05 V ± 60mV, then a high signal will be created at output LOW_BATTERY.

If the phone has not been used for a longish time (longer than approx. 1 month), the battery could be totally self-discharged (battery voltage too low), so that it is not possible to charge the battery via the normal charging circuit.
Only trickle charging is possible below a level of 3.2 V (charging current <10mA).
After approx. 2 hours of trickle charging it is possible to charge the phone via the “normal” charging circuit.

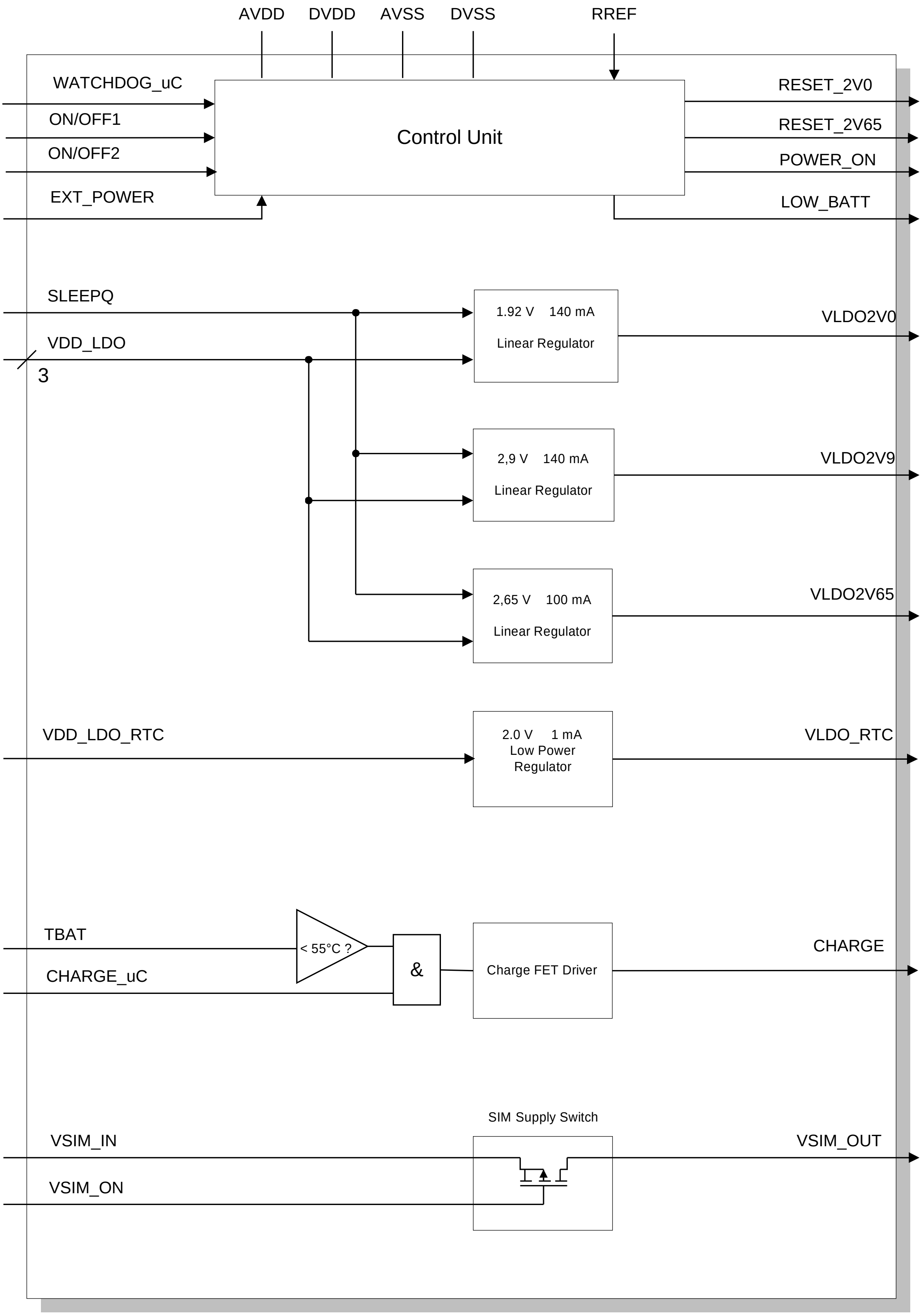
All internal timers and pulses are derived from a 900 kHz ± 10% internal oscillator.
Responsible for the frequency stability is an external resistor (R228) (1%) at the RREF pin

Pin Configuration in accordance with Component Specifications:

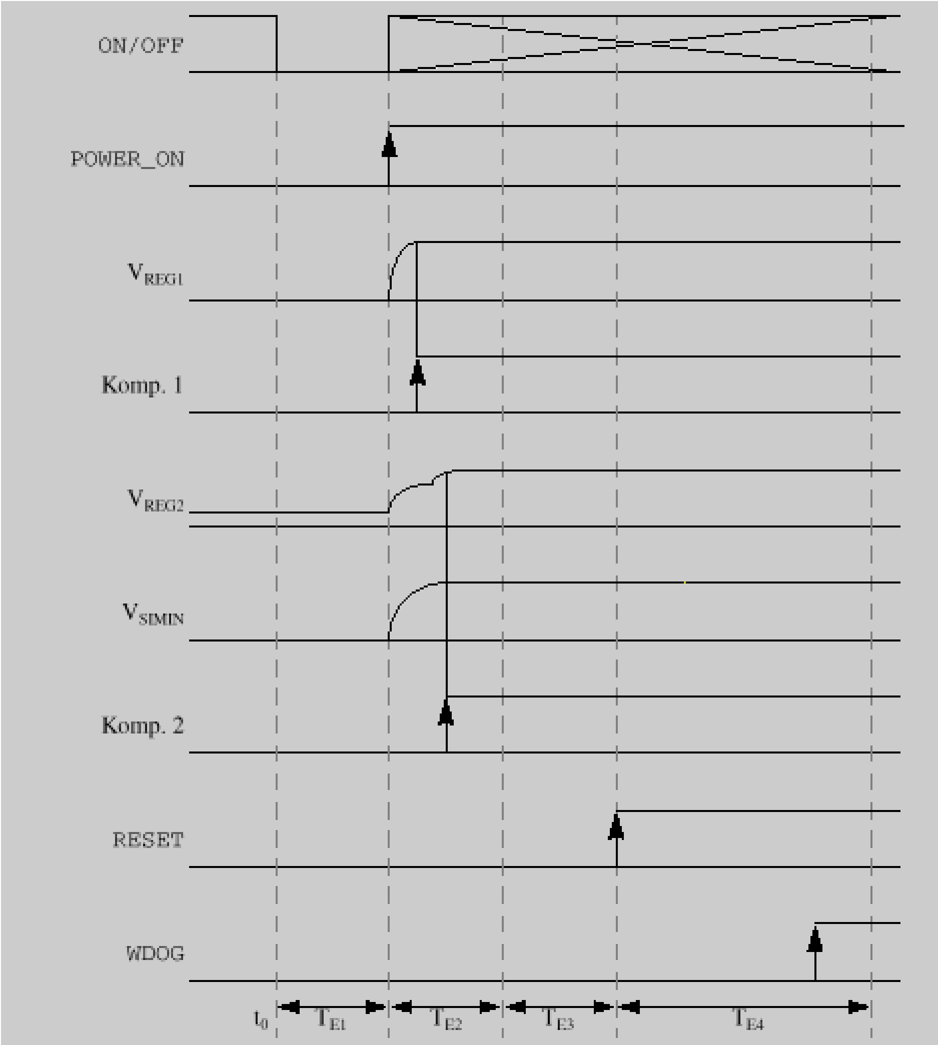
Functions	Pin Requirements	Implementation / Explanation
"**Switching on**" the mobile phone	ON_OFF EXT_POWER ON_OFF2	The following 3 "**switch on**" conditions will be accepted: • Falling slope to ON_OFF • Rising slope to EXT_POWER • Rising slope to ON_OFF2 If one of this 3 conditions is recognised, then the ASIC switches into the POWER-Up state and the internal oscillator starts. After T1 (approx. 60ms) the source of the "switch on" signal is checked again. If the required level is no longer present, then the mobile phone will not switch on and the ASIC switches to the POWER-DOWN mode. If the required level is still there, the mobile phone will "switch on". To do so VCXOEN (internal SLEEP) will go to HIGH and the 3 voltage regulators VREG1 (2,9V), VREG2 (2,0V)and VREG3 (2,65V) will switch on. After T2 (approx. 60ms) counted from switch on (i.e. 120ms from initial recognition of the switch on condition) the supply voltages for 1V92, 2V65 and 2V9 will be checked. If the 1V92 and 2V9 voltages are in order, then timer T3 will start and will enable the RESET after approx. 60ms. To ascertain by what signal the phone was switched on. The E-Gold checks the following signals. **KB7** >>>>>>>>>>> to check the "On-Off Keypad button" **RTC_INT**>>>>>>>> to check the timer "on-off" **EXT_Power**_m**c**>>> to check ON-OFF via accessory

Functions	Pin Requirements	Implementation / Explanation
Watchdog monitoring	WATCHDOG_UP	The first Watchdog Impulse of the E-GOLD • must be operated at the latest 800ms after the rising edge of the "Reset" signal and • the WD-Signal must have a rising edge. If one of these conditions is not fulfilled, the mobile phone will switch off. If this conditions are fulfilled, rising and falling edges are evaluated alternately to reset the WD-Timer. With each edge at the WATCHDOG_UP pin WD-Timer will be reseted. The next (inverted to the previous one) edge must have to occur within a time of 0.4s...2.6s. If the next slope is recognised before expiry of 0.4s or after an expiry of 2.6s or if the next recognised edge is not inverted, then the mobile phone will switch off.
Regular switch off of the mobile phone	WATCHDOG_UP	Switching off of the phone is possible, as described in the watchdog monitoring control, if the E-GOLD is not longer serving the WATCHDOG_UP pin. **Switching off of the phone means**: RESET to LOW POWER_ON to LOW CHARGE to HIGH-Z. Regulator 1V92, 2V65 and 2V9 OFF The ASIC goes into the POWER-DOWN mode.
Low Voltage Detector	LOWVDD	If the measured battery voltage is below the limit of 3.05V ±60 mV, then a HIGH signal will be generated at the LOWVDD output pin. This signal causes an interrupt at the E-GOLD.
Reset Signal	RESET	**Power-Up:** During the entire switch on procedure the RESET signal is on "LOW-Level". If the switch on conditions are fulfilled the change to "HIGH-Level" is taken place after 180ms. **Power Fail:** In the "unit on" mode the voltage levels of the 1.92V and 2.9V voltage supply shall be monitored. If one of this voltages drops below a certain level for longer than 10µs, the RESET signal switches to "LOW-Level".
Switch off of the phone in the case of overvoltage at the battery	VDD	In the case of a too high voltage at the VDD,(voltage level 5.8V ± 0.2V within 1µs), the mobile phone will switch off.
Voltage Supply for the Logic	VREG2 U2V0	The linear controller is designed for 1.92V(±3%) and a maximum current of 140 mA. It consists basically of an internal operation amplifier, an integrated p-channel output transistor as well as an external capacitor (C = 2.2µF) for stabilising the voltage. This regulated voltage is measured internally. In case of an internally measured voltage >3.1V , the output transistor will switch off.

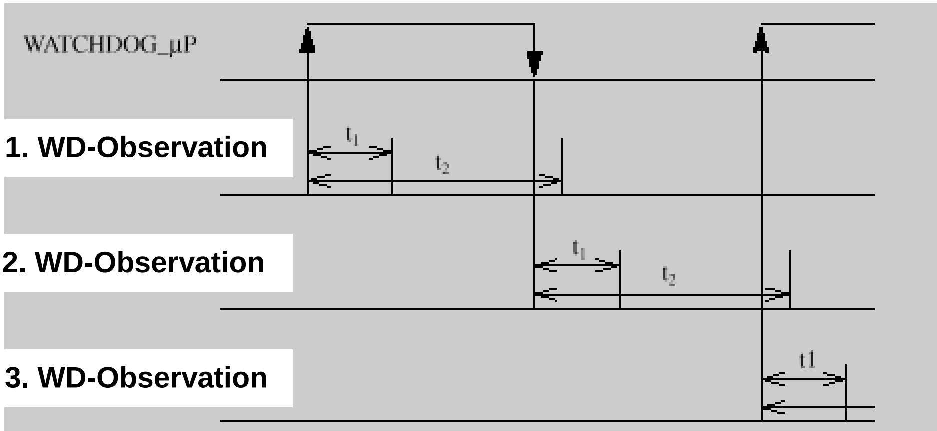
Voltage Supply for the Logic	VREG3 U2V65	The linear controller is designed for 2.65V(±3%) and a maximum current of 100 mA. It consists basically of an internal operation amplifier, an integrated p-channel output transistor as well as an external capacitor (C = 2.2µF) for stabilising the voltage. This regulated voltage is measured internally. In case of an internally measured voltage >3.1V , the output transistor will switch off.
Voltage Supply for the Logic	VREG1 U2V9	The linear controller is designed for 1.92V(±3%) and a maximum current of 140 mA. It consists basically of an internal operation amplifier, an integrated p-channel output transistor as well as an external capacitor (C = 2.2µF) for stabilising the voltage. This regulated voltage is measured internally. In case of an internally measured voltage >3.3V , the output transistor will switch off.
Voltage Supply for SIM-CARD	CCVZQ CCVCC	The voltage supply for the SIM-CARD (**CCVCC**) is switched by the signal CCVZQ from the E-GOLD via a "LOW" at pin 12 The output signal CCVCC can be measured at pin 13 (3V) The picture **5212** shows the CCVCC depending on the signal **5211** CCVCZQ from EGOLD
Charge Support	CHARGE, CHARGE_uP, TBAT	For controlling the battery charge function, a charge support is integrated in the ASIC. It consists basically of an internal current source, a temperature sensor, an external charge FET with a Pull-Up resistor between the source and the gate of the charge FET. The current source is switched on trough a rising edge of the CHARGE_UP signal and generates an "LOW" at pin 3 (Charge). With this "LOW" the charge FET becomes conducting. **Exceptions**: a) The temperature comparator does give a signal for high temperature b) An overvoltage is present at the VDD. C) A falling edge at the CHARGE_UP.


AVDD
DVDD
AVSS
DVSS
RREF
WATCHDOG_uC
ON/OFF1
ON/OFF2
EXT_POWER
Control Unit
RESET_2V0
RESET_2V65
POWER_ON
LOW_BATT
SLEEPQ
VDD_LDO
3
1.92 V 140 mA
Linear Regulator
VLDO2V0
2,9 V 140 mA
Linear Regulator
VLDO2V9
2,65 V 100 mA
Linear Regulator
VLDO2V65
VDD_LDO_RTC
2.0 V 1 mA
Low Power
Regulator
VLDO_RTC
TBAT
< 55°C ?
CHARGE_uC
&
Charge FET Driver
CHARGE
SIM Supply Switch
VSIM_IN
VSIM_ON
VSIM_OUT

Example of a timing diagram (switch on by the keypad)



Example of a timing diagram (Watchdog Observation)



Battery

A NiMH battery with a nominal capacity of 500mAh is used for C35(i) and M35(i)
A temperature sensor (NTC 103HAT) is integrated to monitor the charge.

For S35(i) a LiIon battery is used with a nominal capacity of 600mAh

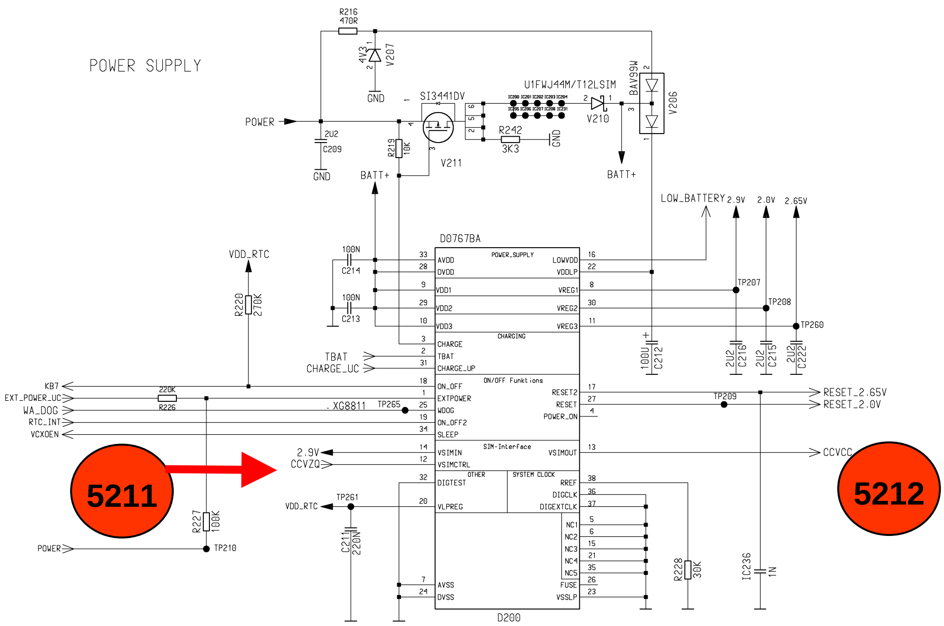
Notes.

Charging Concept

General

The battery is charged in the unit itself. The hardware and software is designed for both for NiMH batteries and for Li-Ion batteries.
As soon as the phone is connected to an external charger, charging starts.
(The customer can see this via the “Charge” symbol in the display).
During normal use the phone is being charged (restrictions: see below).
Charging is enabled via an MOS-FET switch. This MOS-FET switch activates the circuit for the external charger to the battery. The processor takes over the steering of this switch depending on the charge level of the battery, whereby a disable function in the STV-ASIC hardware can interrupt the charging in the case of too high temperature of the battery, or an overvoltage at VDDLP(D200).

A line (SB) is used for recognition and control of the S25 charger.
The P35 external power supply is equiped with a high Ohm input and will therefore be recognised as a rapid charger. The charging software is able to charge the battery within a range from 400-700mA.
If the MOS-FET is switched off, only trickle charging is active.
For controlling the charging process it is necessary to measure the battery cell temperature (only NiMH), the ambient (phone) temperature and the battery voltage.
The temperature sensor is a NTC resistor with a nominal resistance of 10kΩ at 25°C.
The determination of the temperature is achieved via a voltage measurement on a voltage divider consisting of the NTC and 2 other resistors(D100). The NTC for measuring the battery cell temperature is assembled in the battery pack. The NTC for the ambient temperature is soldered on the PCB(R673).



Measurement of Battery and Ambient Temperature

The voltage equivalent of the temperature on the voltage divider is measured as the difference against a reference voltage of the EGAIM. For this, the integrated ΣΔ converter of the EGAIM of the RX-I base band branch is used.
Via an analog multiplexer, either the RX-I base band signal,(the battery temperature Voltage) or the ambient temperature voltage can be switched to the input of the converter. The 1-Bit current of the converter will be subjected to a data reduction via the DSP circuit so that the measured voltage (for battery and ambient temperature) will be available at the end as a 10-bit data word.

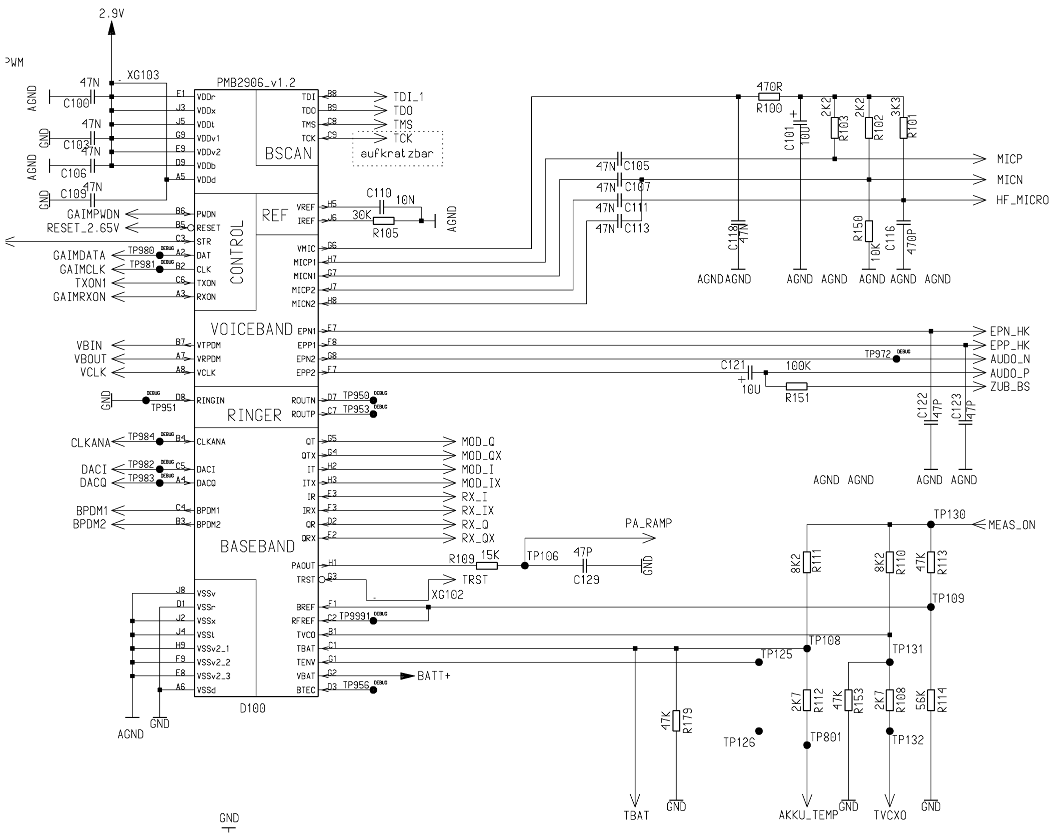
Measurement of the Battery Voltage

Analog to the I-branch either the RX-Q base band signal or the battery voltage can be measured in the Q-branch. The processing in the DSP circuit is done similar to the I-branch. The GAIM is specified for voltages measurement s at the input pin G2 (VBAT) from 3V...5.5V.

Timing of the Battery Voltage Measurement

Unless the battery is going to be charged, the measurements are made in the TX time slot. While charging the measurement is done after the TX time slot.
At the same time, either the battery temperature (in the I-branch) and the battery voltage (in the Q-branch) or the ambient temperature in the I-branch can be measured
Other combinations are not possible. For the time of the measurement the multiplexer in the EGAIM must be programmed (EGOLD) to the corresponding measurement.

Notes



Recognition of the Battery Type

The integrated NTC in the battery pack is used as a coding element for the NiMH battery pack.
If no resistance is recognised, then the battery is charged via the Li-Ion charging process.

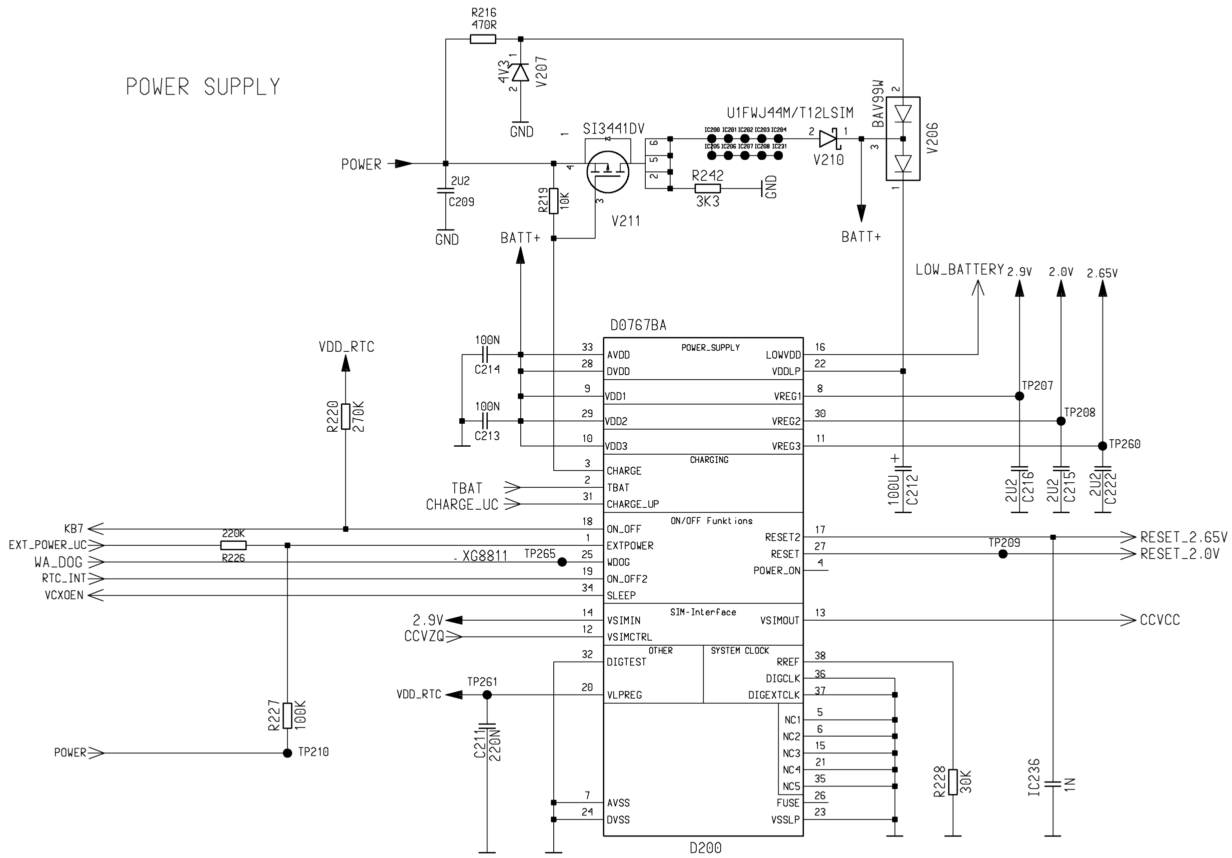
Charging Characteristic of Lithium-Ion Cells

Li-Ion batteries are charged with a U/I characteristic, i.e. the charging current is regulated in relation to the battery voltage until a minimal charging current has been achieved. The maximum charging current is approx. 700mA, the minimum current is around 100mA. The battery voltage may not go above 4.2V ±50mV. The allowed starting temperature for charging the phone is within the range from 5...40°C, and the allowed temperature while charging is taking place is from 0...45°C. Outside this temperature range the battery will not be charged.

Trickle Charging

A special circuit permits charging the battery if the normal charging circuit is not working due to a low level of battery voltage.
This charging current will be about 10mA max. This trickle charging circuit is voltage-restricted, so that a battery can not be overcharged under no circumstances.
Trickle charging is a way to charge completely discharged batteries up to a voltage which allows the logic to switch to normal charging automatically.

Notes



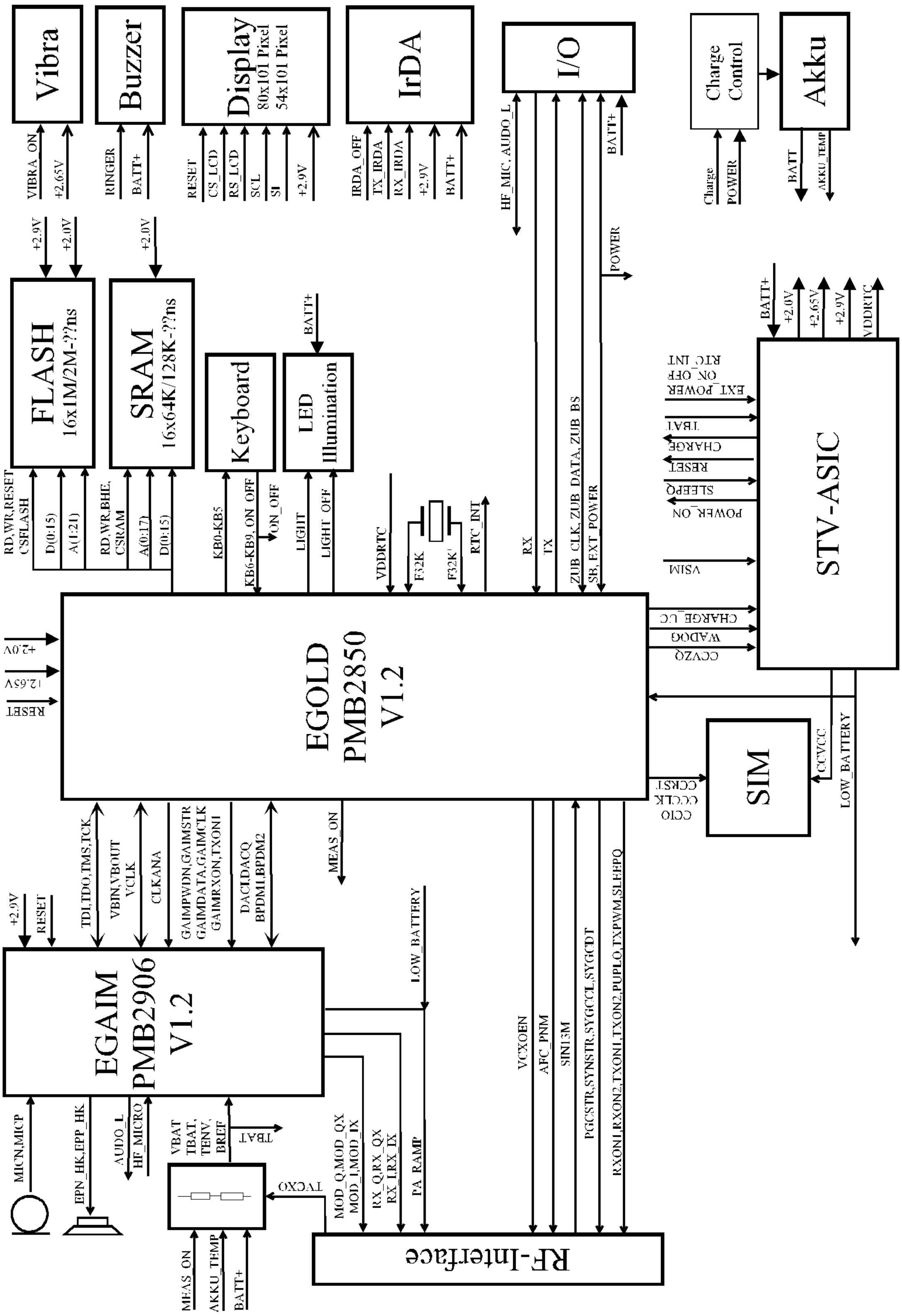
Restrictions:

Notes

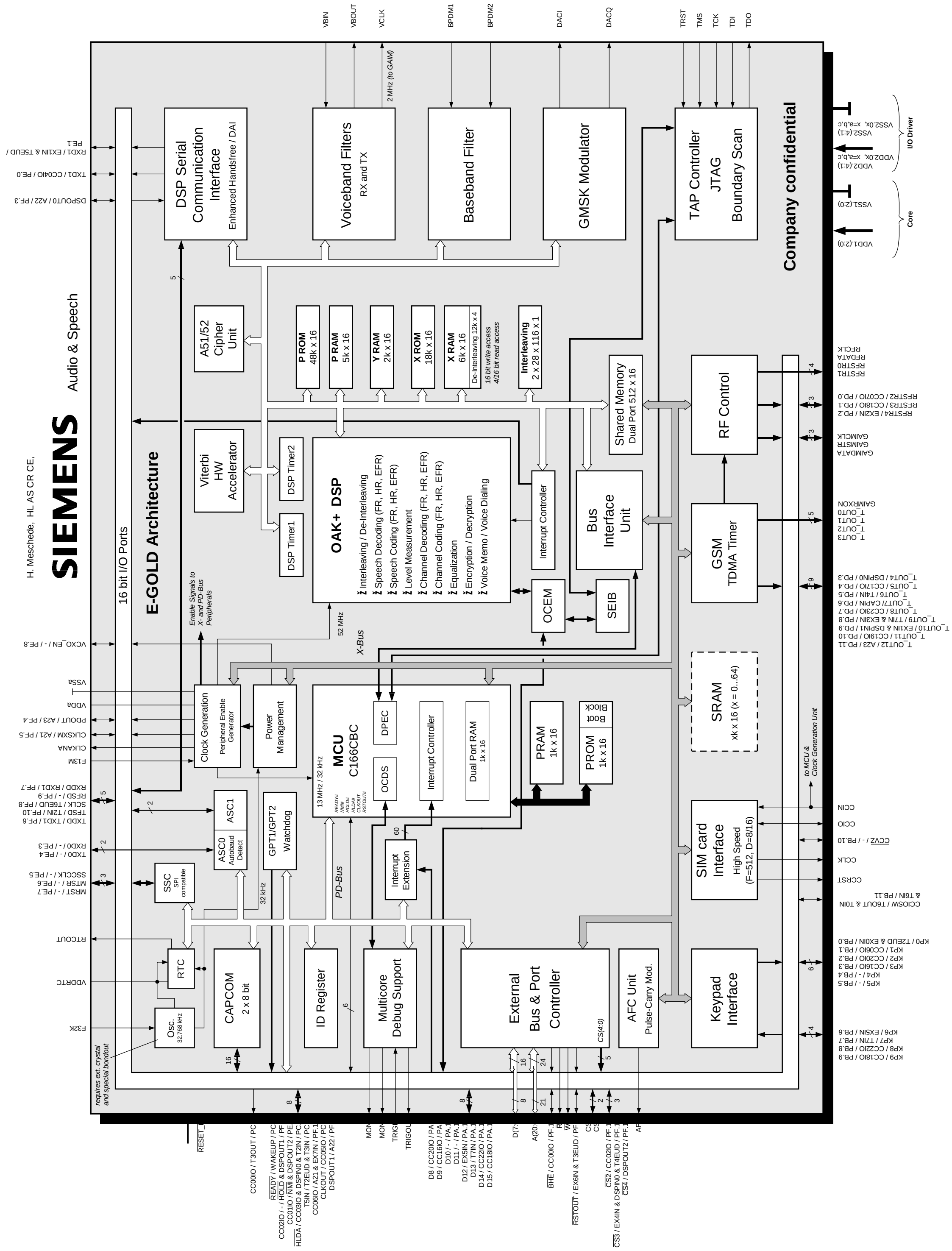
- A battery which is completely discharged can not be charged quickly (normal). In this case the battery is charged via a trickle charging with approx. 10mA. However, the charging symbol is not shown in the display due to the not working logic.
  The charging time for the trickle charging (until the battery can be recharged quickly) is approx. 4 hours. If, within this time, a voltage of 3.2V is exceeded, the ASIC switches into the Charge-Only Mode.
  In some circumstances it can happen that, after switching on, the voltage collapses so strongly that the mobile phone switches off again. In this case trickle charging continues until the user breaks off the trickle charging in order to activate the rapid charge and starts recharging again (e.g. by pulling out the plug from the mains supply and plugging in again!).
- A phone with a fully charged Li-Ion battery cannot be charged in the standby or talk modus in the beginning, because any input current would cause an increase off the battery voltage above the maximum permissible value. If, through using the phone, the battery has been discharged down to 95% the battery can be charged again.
- The phone cannot be operated without a battery.
- The phone would be destroyed if the battery were wrongly poled:
  - ⇒ This is prevented mechanically by the design.
  - ⇒ electrically, a correctly poled battery is presumed, i.e. correct poling must be guaranteed by suitable QA measures at the supplier. If an unsuitable charger is connected, the mobile phone can be destroyed:
  - ⇒ a charger voltage >15V can destroy resistors or capacitors in the current supply path.
  - ⇒ a charger voltage >20V can destroy the MOS-FET switch transistor in the current supply.

6. Logic Part

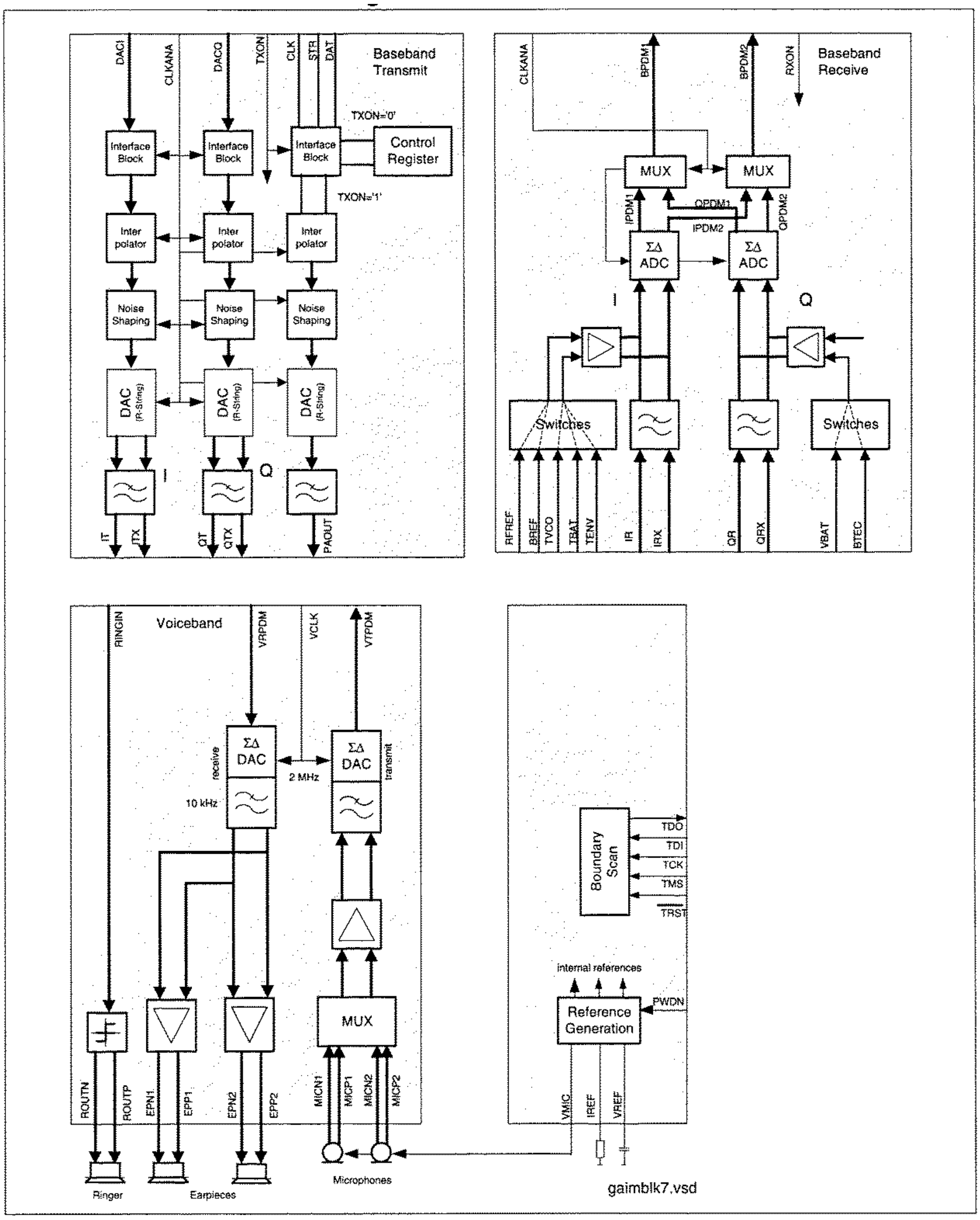
6.1 Overview Logic



6.2 Overview EGOLD



6.3 Overview EGAIM



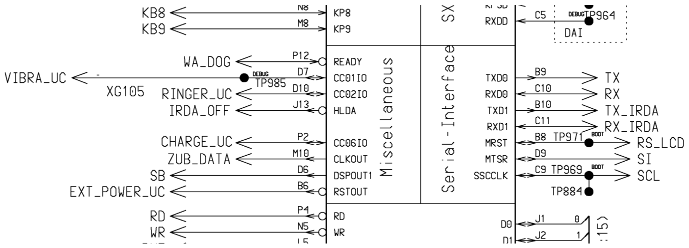
6.4 Acoustics and Illumination

6.4.1 General

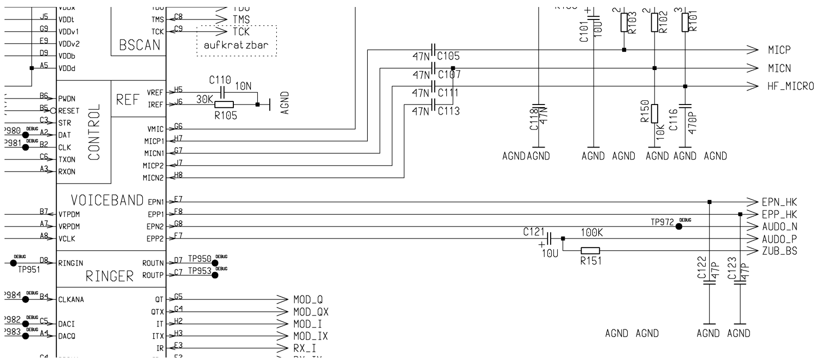
Notes

The Electro-Acoustic components are:
a) Loudspeaker
b) Microphone
c) Ringer
d) Vibra

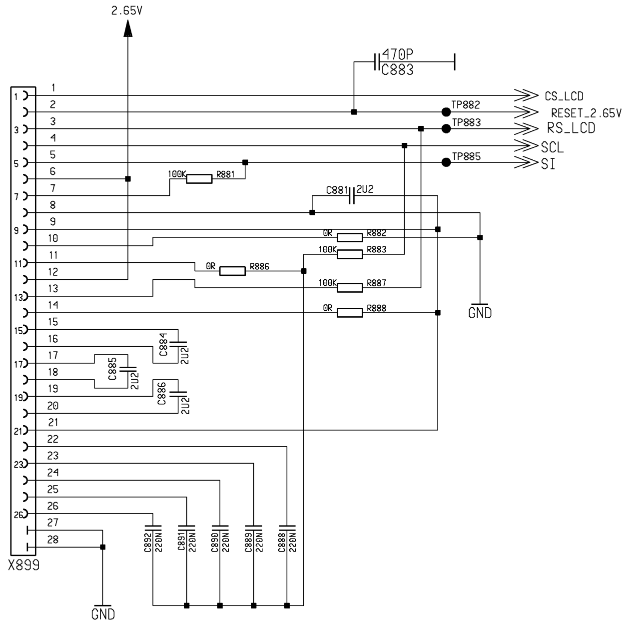
The Acoustic components are driven and controlled from the EGOLD (Ringer,Vibra) via the signals Ringer_µC and Vibra_µC

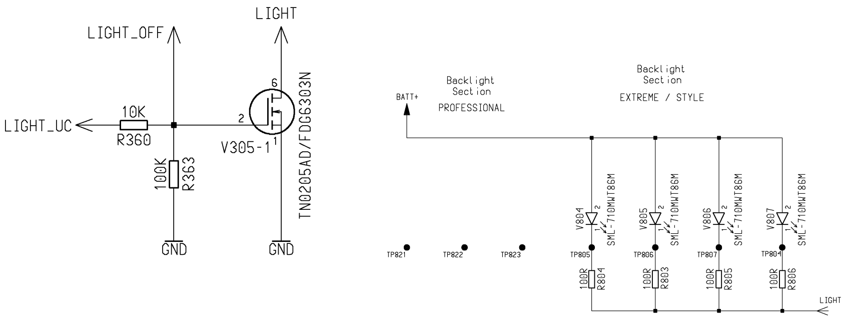


and from the EGAIM (Earpiece, Microphone) via the signals
EPP_HK, EPN_HK for the (Earpiece) and MICP,GND_MICRO for the (Microphone).



The Illumination: a) Display
b) Keypad

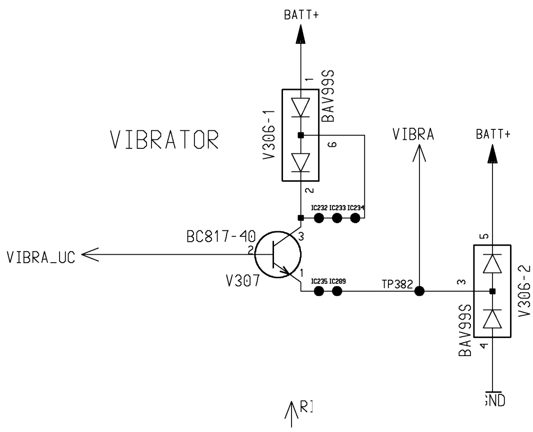




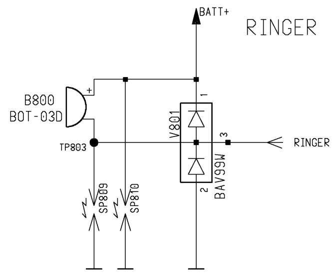
Notes

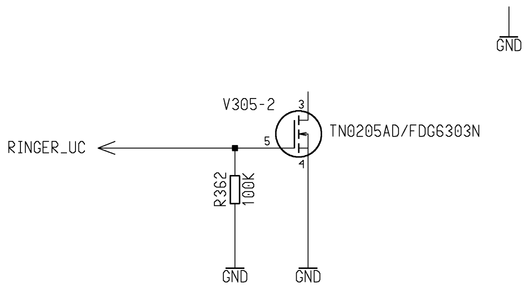
6.4.2 Ringer and Vibra

The vibrator is activated by the transistor V307 via the Signal Vibra_µC from Egold. Batt+ is required to provide the VIBRA. The diode V306 is used to protect the circuit against over voltage and switching spikes.



The ringer is connected to Batt+. The ringing tone is generated by a pulsing signal Ringer_µC from the EGold which is switching the FET V305-2 at the wanted frequency





Notes

6.4.3 Microphone and Loudspeaker

Notes