C45 / ME45 / S45
(K45)
Level 2.5e

Repair Documentation

V 1.0

Table of Contents:

1 List of available level 2,5e parts C45 + K45

Phone type	ID-No	Type	Name(function)/Location	Rep-Code	Order No.
C45	D100	IC	Egold+	4EGO	L36810-G6132-D670
C45	Z100	Quarz	Quarz/Egold+/Logic	4OSC	L36145-F102-Y8
C45	V342	Transistor	Tran._Charge	4CHT	L36830-C1104-D670
C45	V306	Diode	Diode_AF	4DAF	L36840-D3084-D670
C45	V344	Diode	Diode_Charge	4DCH	L36840-D5061-D670
C45	D361	IC	ASIC	4SPA	L36145-J4682-Y29
C45	N386	IC	Volt.Regulator_ZUB	4REG	L36820-C6161-D670
C45	V442	Transistor	Tran._Vibra_Switch	4VIT	L36830-C1097-D671
C45	V880	Transistor	Tran._Diplexer_Switch	4TDI	L36820-C6047-D670
C45	V881	Transistor	Tran._Diplexer_Switch	4TDI	L36820-C6047-D670
C45	Z880	IC	Ant_Switch_Diplexer	4ANS	L36145-K280-Y181
C45	Z850	VCO	VCO_1.LO	4VC1	L36145-G100-Y69/Y93
C45	Z890	VCO	VCO_TX/RF	4VCT	L36145-G100-Y59/Y92
C45	V850	Transistor	Tran._VCO_Switch	4TLO	L36820-C6047-D670
C45	Z851	Filter	Filter_BALUN	4BAL	L36145-K260-Y31
C45	N840	IC	Volt.Regulator_RF	4REG	L36810-C6065-D670
C45	D800	IC	Transceiver IC	4DEM	L36820-L6081-D670
C45	Z900	PA	Power_Amplifier	4PAM	L36851-Z2002-A45
C45	V922	Transistor	Tran._PA_Control	4PAT	L36840-C4009-D670
C45	V950	Transistor	Tran._26MHz_Ampl.	4T26	L36840-C4049-D670
C45	R959	Resistor	Temp_Resistor	4TER	L36120-F4223-H
C45	Z950	Quarz	Oszillator_26MHz	4VCX	L36145-F260-Y16
C45	D920	IC	PA_Comperator	4COM	L36820-L6084-D670
C45	V951	Diode	Capa_Diode	4CAD	L36840-D61-D670
C45	V920	Diode	Feedback_Diode	4FED	L36840-D5049-D670
K45	D100	IC	Egold+	4EGO	L36810-G6132-D670
K45	Z100	Quarz	Quarz/Egold+/Logic	4OSC	L36145-F102-Y10
K45	V342	Transistor	Tran._Charge	4CHT	L36830-C1104-D670
K45	D361	IC	ASIC	4SPA	L36145-J4682-Y29
K45	V922	Transistor	Tran._PA_Control	4PAT	L36840-C4009-D670
K45	N920	IC	Op.Amp/PA_RF	4OPA	L36820-L6084-D670

K45	V880	Transistor	Tran._Diplexer_Switch	4TDI	L36820-C6047-D670
K45	V881	Transistor	Tran._Diplexer_Switch	4TDI	L36820-C6047-D670
K45	N840	IC	Volt.Regulator_RF	4REG	L36810-C6065-D670
K45	Z900	PA	Power_Amplifier	4PAM	L36851-Z2002-A45
K45	D800	IC	RF_Demod./Mod.	4DEM	L36820-L6081-D670
K45	Z851	Filter	Filter_BALUN	4BAL	L36145-K260-Y31
K45	Z950	Quarz	Oszillator_26MHz	4VCX	L36145-F260-Y16
K45	Z850	VCO	VCO_1.LO	4VC1	L36145-G100-Y69
K45	Z890	VCO	VCO_TX/RF	4VCT	L36145-G100-Y59
K45	V850	Transistor	Tran._VCO_Switch	4TLO	L36820-C6047-D670
K45	V950	Transistor	Tran._13MHz_Ampl.	4T13	L36840-C4049-D670
K45	N386	IC	Volt.Regulator_ZUB.	4REG	L36820-C6161-D670
K45	V344	Diode	Diode_Charge	4DCH	L36840-D5061-D670
K45	V306	Diode	Diode_AF	4DAF	L36840-D3084-D670
K45	Z880	IC	Ant_Switch_Diplexer	4ANS	L36145-K280-Y181
K45	V951	Diode	Capa_Diode	4CAD	L36840-D61-D670
K45	R959	Resistor	Temp_Resistor	4TER	L36120-F4223-H
K45	V920	Diode	Feedback_Diode	4FED	L36840-D5049-D670
K45	Inf. Z871	Filter	IF_360/RF	4IFF	L36145-K280-Y182
K45	Inf. D800	IC	Smarti+	4SMA	L36820-L6092-D670
K45	Inf. Z852	Filter	RX_PCN/RF	4FI1	L36145-K280-Y183
K45	Inf. Z851	Filter	RX_GSM/RF	4FI1	L36145-K280-Y172
K45	Inf. Z861	VCO	VCO_TX/RF	4VCT	L36145-G100-Y62
K45	Inf. Z880	VCO	VCO_1.LO	4VC1	L36145-G100-Y64
K45	Inf. V902	Transistor	Tran._Switch	4SWT	L36820-C6047-D670
K45	Inf. N901	PA	Power_Amplifier_PCN	4PAP	L36851-Z2002-A48
K45	Inf. N902	PA	Power_Amplifier_GSM	4PAG	L36851-Z2002-A47
K45	Inf. N970	IC	Volt.Regulator_RF	4REG	L36810-C6065-D670
K45	Inf. Z900	Diplexer	Diplexer	4DIP	
K45	Inf. D904	IC	Diplexer Switch	4SWI	L36810-B6101-D670
K45	Inf. D905	IC	Diplexer Switch	4SWI	L36810-B6101-D670
K45	Inf. Z1000	Quarz	Oszillator_13MHz	4VCX	L36145-F220-Y4
K45	Inf. D903	IC	Op.Amp/PA_RF	4OPA	L36820-L6084-D670
K45	Inf. V903	Diode	Feedback_Diode	4FED	L36840-D5049-D670

2 Required Equipment for Level 2,5e K45

GSM-Tester (CMU200 or 4400S incl. Options)
PC-incl. Monitor, Keyboard and Mouse
Bootadapter 2000/2002 (L36880-N9241-A200)
Troubleshooting Frame S/ME45 (F30032-P112-A1)
Troubleshooting Frame C45 (F30032-P135-A1)
Power Supply
Spectrum Analyser
Active RF-Probe incl. Power Supply
Oscilloscope incl. Probe
RF-Connector (N<>SMA(f))
Power Supply Cables
Dongle (F30032-P28-A1)
BGA Soldering equipment

Reference: Equipment recommendation V1.0

3 Required Software for Level 2,5e K45

Windows NT Version4
Winsui version1.22 or higher
Windows software for GSM-Tester (Cats(Acterna) or CMU-GO(Rohde&Schwarz))
Software for reference oscillator adjustment
Internet unblocking solution

4 Radio Part

The radio part of the K45 platform consists of two different chip-sets.
They are from the companies “Hitachi” and “Infineon” The following description will cover both chip-sets.
The logic part for both chipsets is the same.

The radio part is designed for Dual Band operation, covering EGSM900 as well as GSM 1800 frequencies, and can be divided into 4 Blocks.
Power supply for RF-Part
Transmitter
Receiver
Synthesizer,

The RF-Part has it´s own power supply realised by a voltage regulator which is directly to the battery. The voltages for the logic part are generated by the Power-Supply ASIC

The transmitter part converts the I/Q base band signals supplied by the I logic (EGOLD+) into RF-signals with characteristics as defined in the GSM recommendation (www.etsi.org) After amplification by a power Amplifier the signal is radiated via the internal or external antenna.

The receiver part converts the received GMSK signal supplied by the antenna into IQ base band signals which can then be further processed by the logic (EGOLD+).

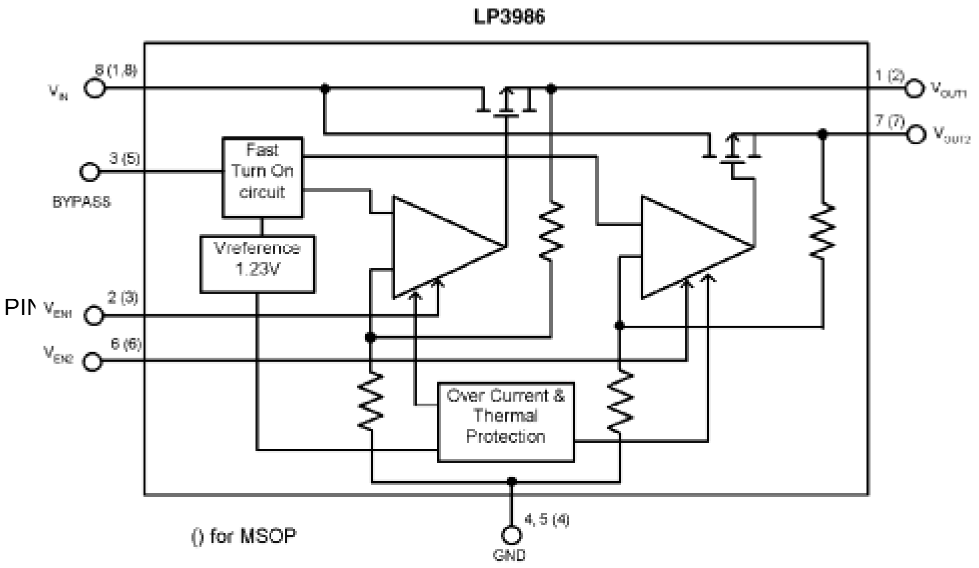
The synthesizer generates the required frequencies for the transmitter and Receiver. A 13MHz oscillator is acting as a reference frequency.

Restrictions:
The mobile phone can never transmit and receive in both bands simultaneously. Only the monitor time slot can be selected independently of the frequency band.
Transmitter and receiver can of course never operated simultaneously.

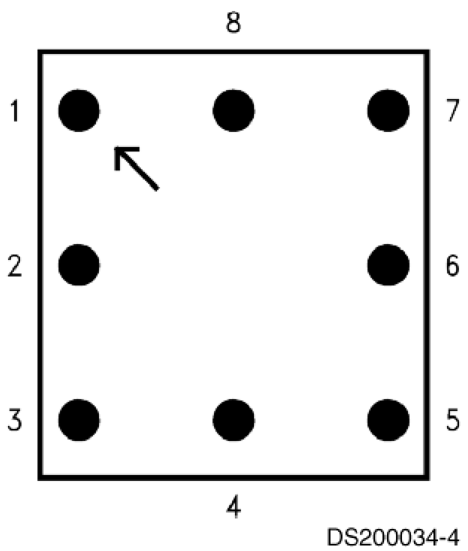
4.1 Power Supply RF-Part

A directly to Batt+ connected voltage regulator, with a nominal output voltage of 2.8V is used, to perform the required "RF-Voltages" named VCC2_8 and VCC_SYN.
The voltage regulator is activated as well as deactivated via SLEEPQ and VCXOEN provided by the EGOLD+
The temporary deactivation is used to extend the stand by time.

Blockdiagram

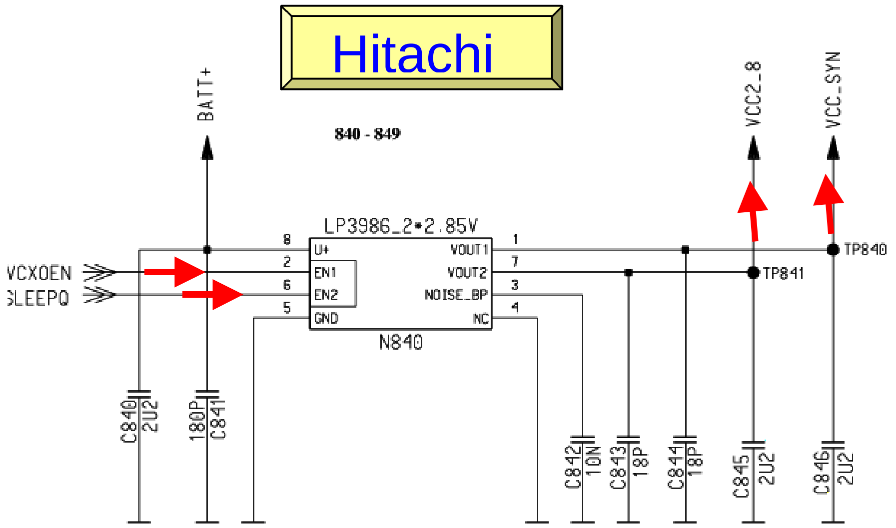


PIN-OUT

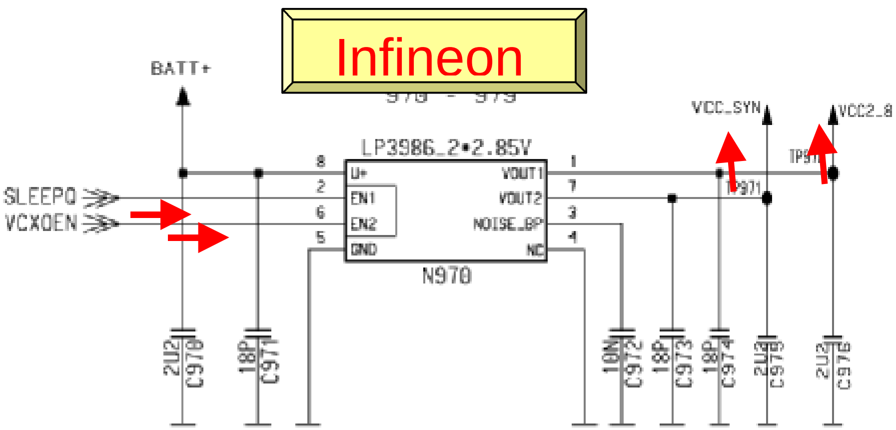


Top View

Circuit diagram



Type	Part No.	Signal	Source	Output
Hitachi	N840	Pin 2 SleepQ	EGOLD+ L11	Pin 1 VCC2_8
		Pin 6 VCXOEN	EGOLD+ P7	Pin 7 VCC_SYN
Infineon	N970	Pin 2 SleepQ	EGOLD+ L11	Pin 1 VCC2_8
		Pin 6 VCXOEN	EGOLD+ P7	Pin 7 VCC_SYN



4.2 Frequency generation

4.2.1 Synthesizer: The discrete VCXO (13MHz)

K45 mobiles are using two different reference frequencies. 13MHz for the Infineon- and 26MHz for the Hitachi chip set.
The generation of the 13/26MHz signal is done via a discrete “Colpitts” VCXO .
This oscillator consists mainly of:

	Infineon	Hitachi
A 13MHz crystal	Z1000	Z950 26MHz
An oscillator switch	V1000	V950
A capacity diode	V1002	V951
TP 1005		TP 951 after dividing by two

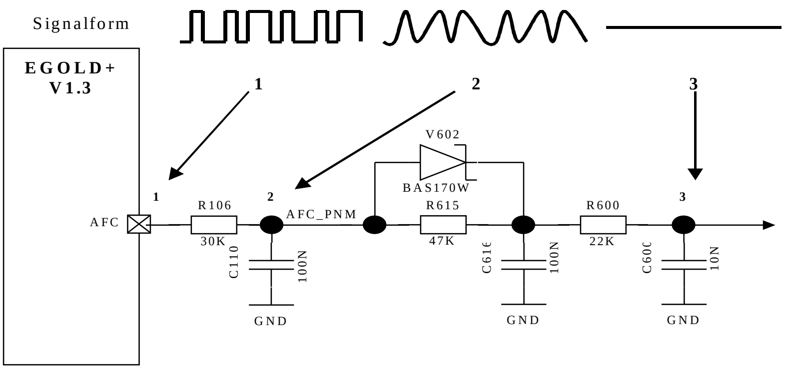
Infineon
The oscillator output signal is splited in two reference signals. One (VCXO) for the PLL inside the SMARTi IC, and the other (SIN13MHZ_BB) for the EGOLD+ (functional M14). A de-coupling circuit C1000-C1004, L1000 is needed to block interference signals coming from the logic.
To compensate frequency drifts (e.g. caused by temperature) the oscillator frequency is controlled by the (AFC_PNM) signal, generated through the internal EGOLD+ (D100 (functional R3)) PLL via the capacity diode V800.
Reference is the base station frequency.
To compensate a temperature caused frequency drift, the temperature-depending resistor R1012 is placed near the VCXO to measure the temperature. The measurement result TVCXO is reported to the EGOLD+(baseband I4) via R136

The required voltage VCC_SYN is provided by the N970

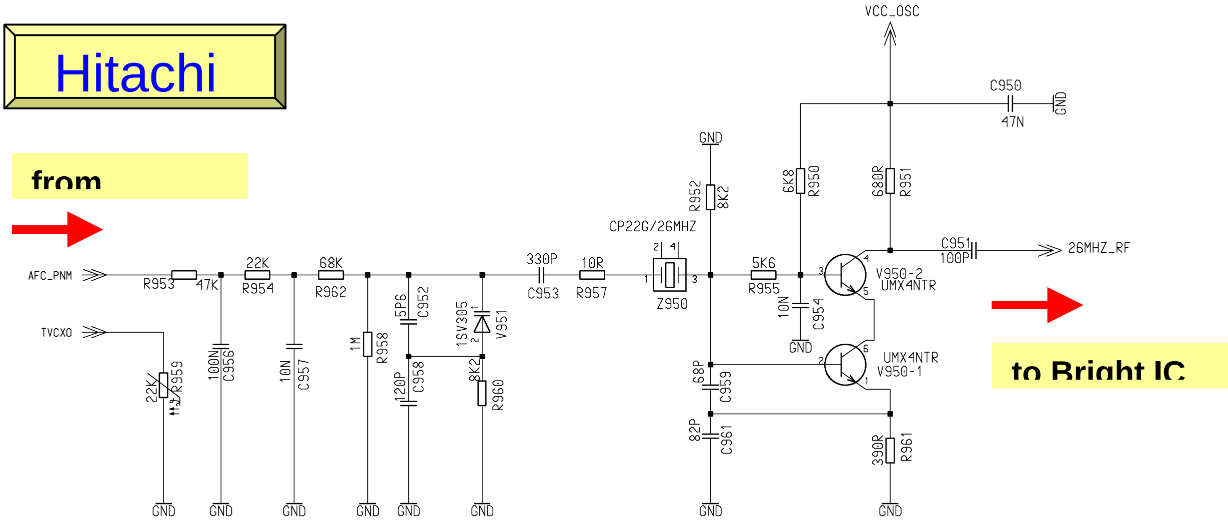
Hitachi
The oscillator works similar like the “Infineon”, with one exception. The oscillator output signal (26MHz_RF) is not splited. It is directly connected to the BRIGHT IC, (pin 40) to be divided by 2. This so gained signal SIN13MHZ_BB is used from the EGOLD+ in the same way (generating the AFC_PNM) as the Infineon.

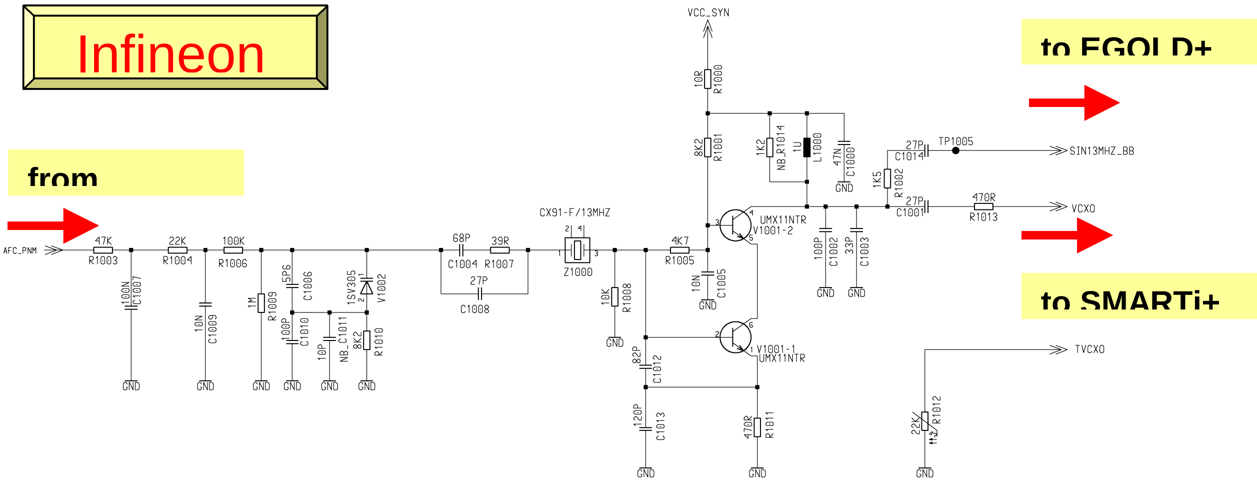
The required voltage VCC_OSC is provided by the N840 (VCC_SYN) through R863 and R861

Waveform of the AFC_PNM signal from EGOLD+ to Oscillator



Circuit diagram





4.2.2 Synthesizer: LO1

The first local oscillator is needed to generate frequencies which enable the transceiver IC to mix an "IF" and to perform the channel selection in the TX part.
To do so, a control voltage for the LO1 is used. Gained by a comparator (located inside the Transceiver -IC).
This control voltage is a result of the comparison of the divided LO1 and a reference Signal. The division ratio of the dividers is programmed by the EGOLD+, according to the network channel requirements.

Infineon

The first local oscillator (LO1) is part of the PLL , which consists of the comparator inside the Smarti (D800), a loop filter and a VCO (Z880) module.
This LO1 circuit generates frequencies from:

EGSM RX = 1285-1320MHz	EGSM TX = 1304-1339MHz
PCN RX = 1445-1520MHz	PCN TX = 1286-1361MHz
IF = 360MHz	IF = 424 / 428MHz
Ref. Freq. = 13MHz	Ref. Freq. = 13MHz

Formula to calculate the frequencies:

1st LO freq. RX	EGSM = Ch. + IF	1st LO freq. TX	EGSM = Ch. + IF
	PCN = Ch. – IF		PCN = Ch. – IF

The VCO module is switched on by the EGOLD+ signal PLLON (TDMA-Timer J12)
On demand of the network, the VCO-Module is switched with OSW (SMARTi+ (pin 21))
between GSM900 and GSM1800.
The channel programming of the PLL happens via the EGOLD+ signals SYGCCL, SYGCDT, SYNSTR (RF Control K14, K15, M15).

The required voltage VCC_SYN is provided by the N970

Hitachi
The first local oscillator (LO1) is part of the PLL which consists of the comparator inside the Bright (D800), a loop filter and the VCO (Z850) module.
This LO1 circuit generates frequencies from:

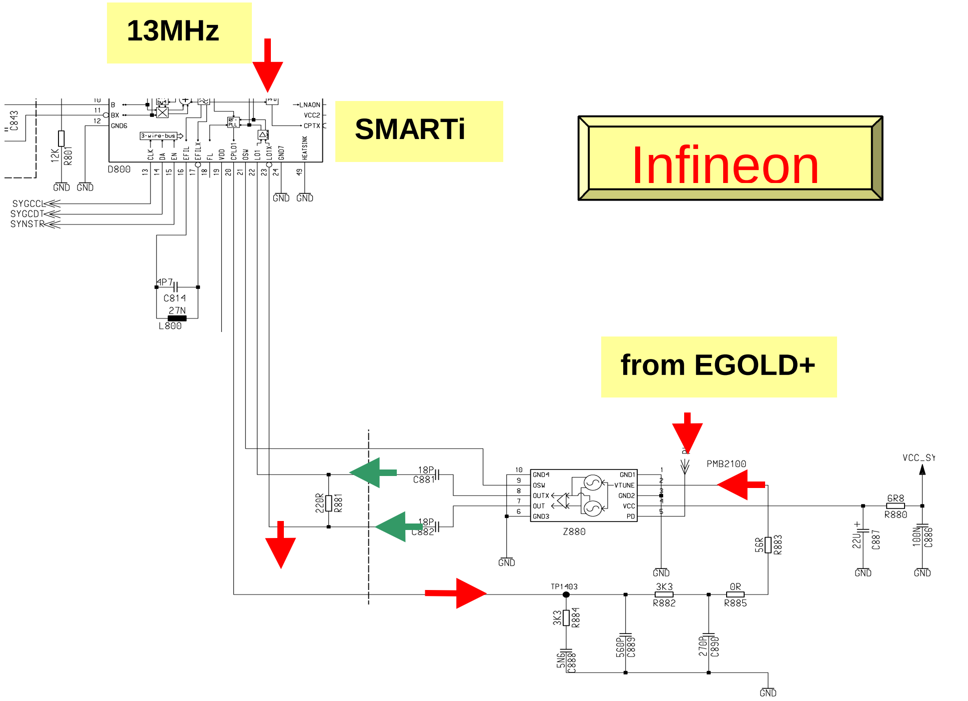
EGSM RX = 3520-3556MHz	EGSM TX = 3608-3760MHz
PCN RX = 3610-3760MHz	PCN TX = 3708-3848MHz
IF = no IF required	IF-GSM = 47 or 48MHz
	IF-PCN = 94 or 95MHz
Ref. Freq. = 26MHz	Ref. Freq. = 26MHz

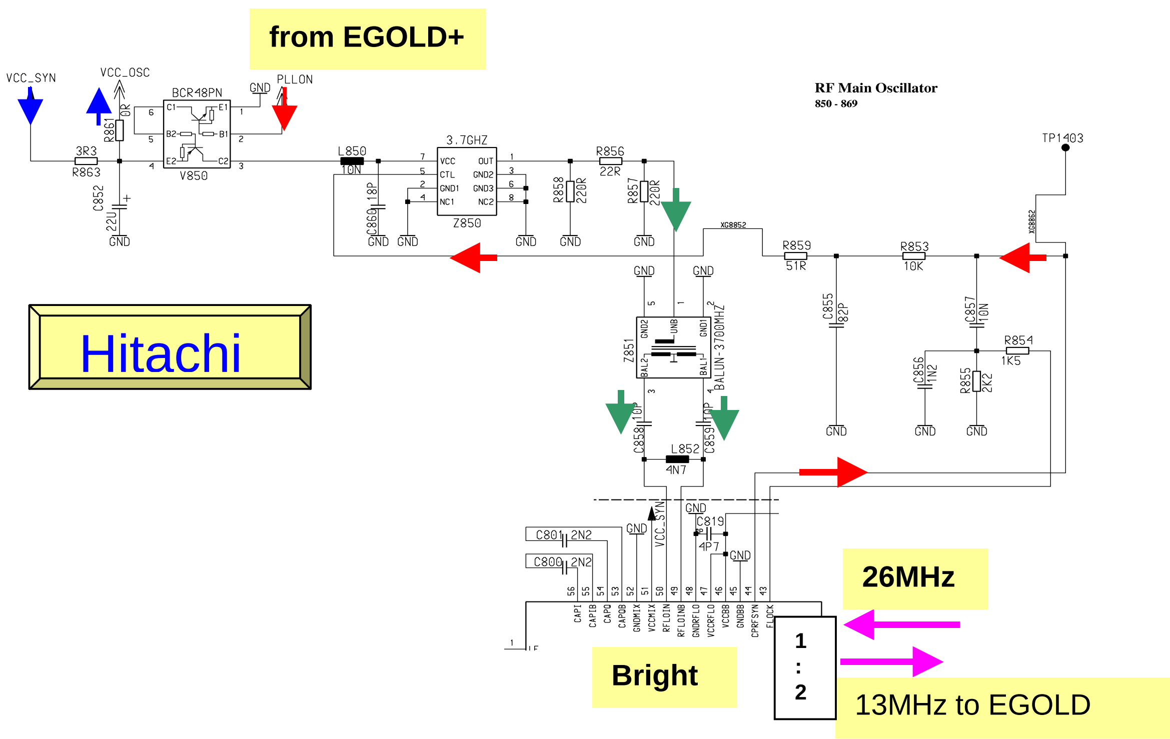
Formula to calculate the frequencies:

1st LO freq. RX	EGSM = Ch. * 4	1st LO freq. TX	EGSM = Ch. / 4
	PCN = Ch. * 2		PCN = Ch. / 2

The VCO (Z850) is switched on by the EGOLD+ signal PLLON (TDMA-Timer J12) via V850 and therefore supplied with VCC_SYN. The VCO guarantees by using the control voltage at pin5 a coverage of the GSM900 and GSM1800 band.
The channel programming of the PLL happens via the EGOLD+ signals SYGCCL, SYGCDT, SYNSTR (RF Control K14, K15, M15).

The required voltage VCC_SYN is provided by the N840


13MHz
SMARTi
Infineon
from EGOLD+
D800
PMB2100
Z880
VCC_SY
R880
R881
R882
R883
R884
R885
C814
L800
C881
C882
C887
C888
C889
C890
TP1403
GND


from EGOLD+
VCC_SYN
VCC_OSC
BCR48PN
PLLON
V850
R861
R863
C852
L850
3.7GHZ
Z850
R856
R858
R857
C860
RF Main Oscillator
850 - 869
TP1403
R859
R853
C855
C857
C856
R854
R855
Z851
BALUN-3700MHZ
C858
C859
L852
C819
C801
C800
Hitachi
26MHz
Bright
1
:
2
13MHz to EGOLD

4.2.3 Synthesizer: LO2

Notes

The second local oscillator (LO2) is required to generate IF-Frequencies for:
The receiver part (the demodulator) only Infineon
The transmitter part (the modulator)
To ensure the frequency stability, a control voltage is gained with a PLL circuit consisting of the 2nd LO VCO, a comparator/divider and a loop-filter.

Infineon
The second local oscillator (LO2) as a part of the PLL is located mainly inside the the SMARTi (D800). Only an external loop filter (C800,801, and R800) is required.
This LO2 circuit generates the frequencies for:

The demodulator frequency, to get the baseband signals MOD_A and MOD_B as well as the inverted signals MOD_AX and MOD_BX

2nd LO freq. RX EGSM = 1440MHz divided by 4 = 360MHz
PCN = 1440MHz divided by 4 = 360MHz

The modulator, to get the modulator IF-Frequency for the up-conversion loop

2nd LO freq. TX EGSM = 1696MHz divided by 4 = 424MHz
EGSM = 1712MHz divided by 4 = 428MHz
PCN = 1696MHz divided by 4 = 424MHz
PCN = 1712MHz divided by 4 = 428MHz

The LO2 PLL is using the same control-unit like the LO1, so the programming and the RX/TX-Switching is done in the same way, (via the SYGCCL, SGCDT, SYNSTR signals).
The SMARTi and therefore the 2nd LO is switched on by the EGOLD+ signal PLLON (TDMA-Timer J12)

The required voltage VCC_SYN is provided by the N970

Hitachi
The second local oscillator circuit (LO2) of the Hitachi chipset consists of:
The VCO, and a comparator/divider inside the Bright IC,
And an external part (loop-filter (C830,832, and R831) and capacity diodes V830,831).
Not requiring a RX frequency, the LO2 generates only the TX-Frequencies for the modulator:

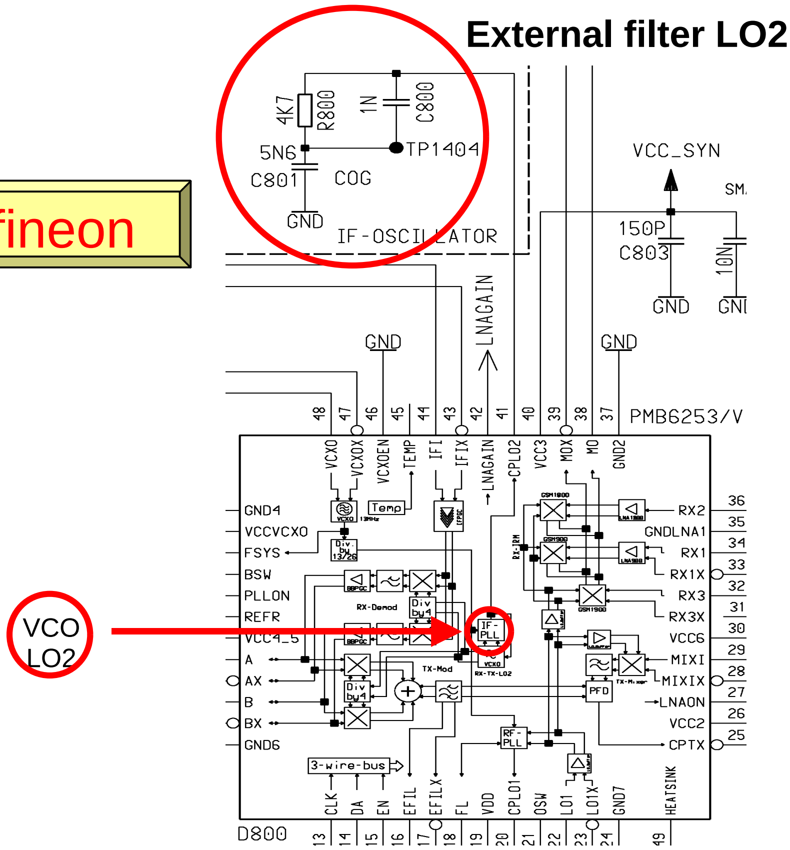
2nd LO freq. TX EGSM = 376 or 384MHz divided by 4 = 47 or 48MHz
PCN = 376 or 380MHz divided by 2 = 94 or 95MHz

To ensure frequency stability the gained control voltage is guided to the capacity diodes.
The Hitachi version is programmed in the same way with the same signals as described at the Infineon chipset.

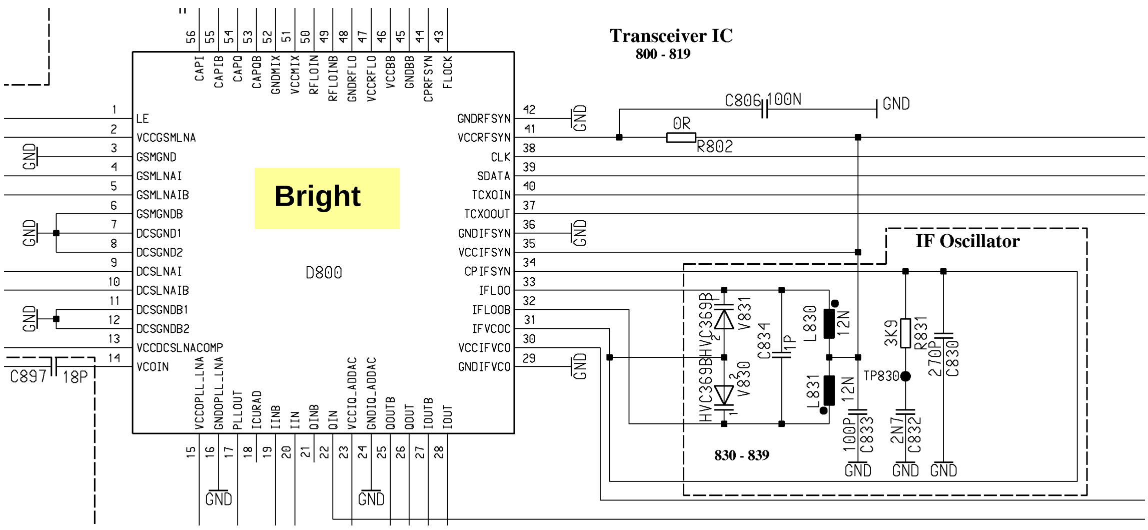
The required voltage VCC_SYN is provided by the N840

Circuit diagram

Infineon



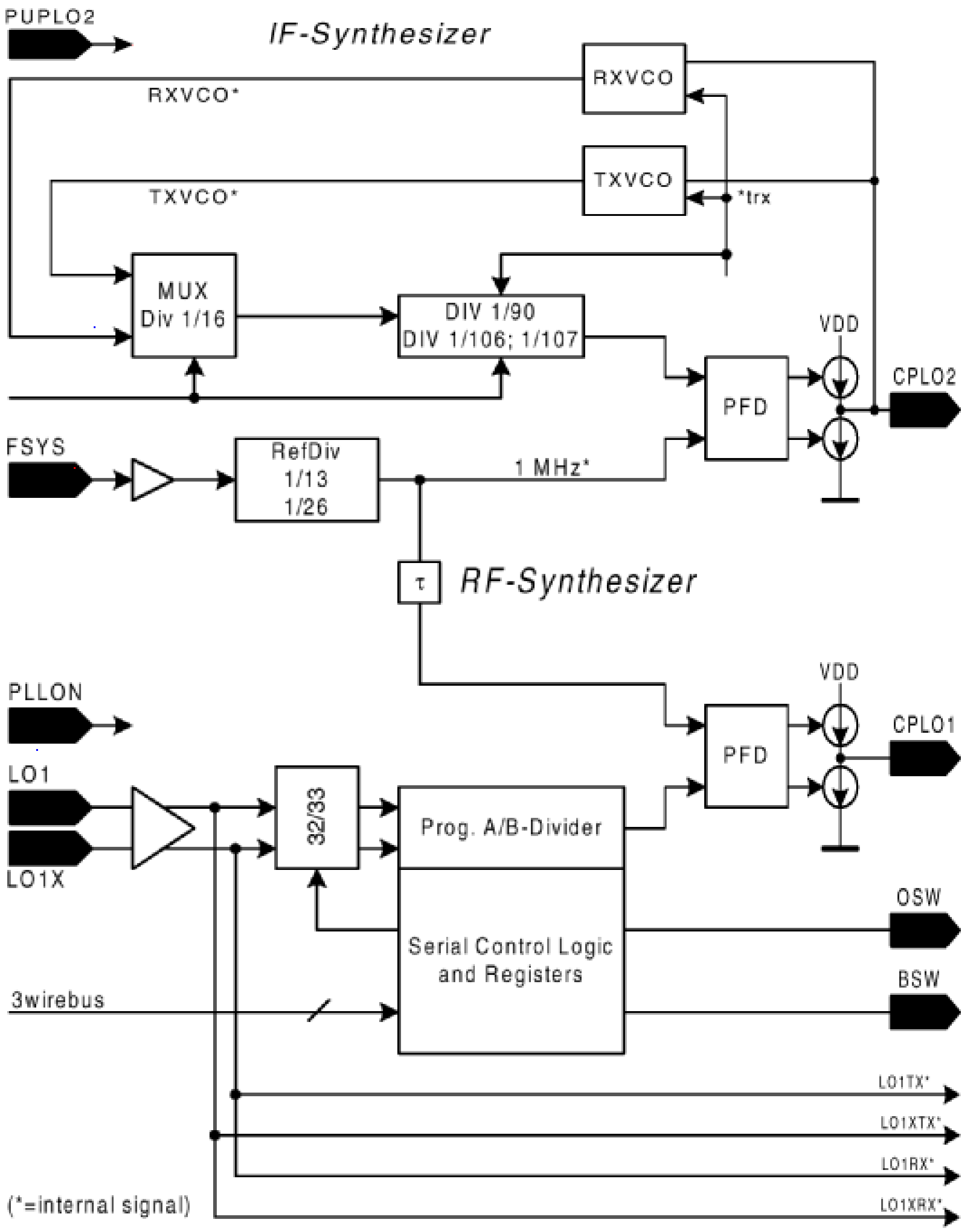
Hitachi



4.2.4 Synthesizer: PLL

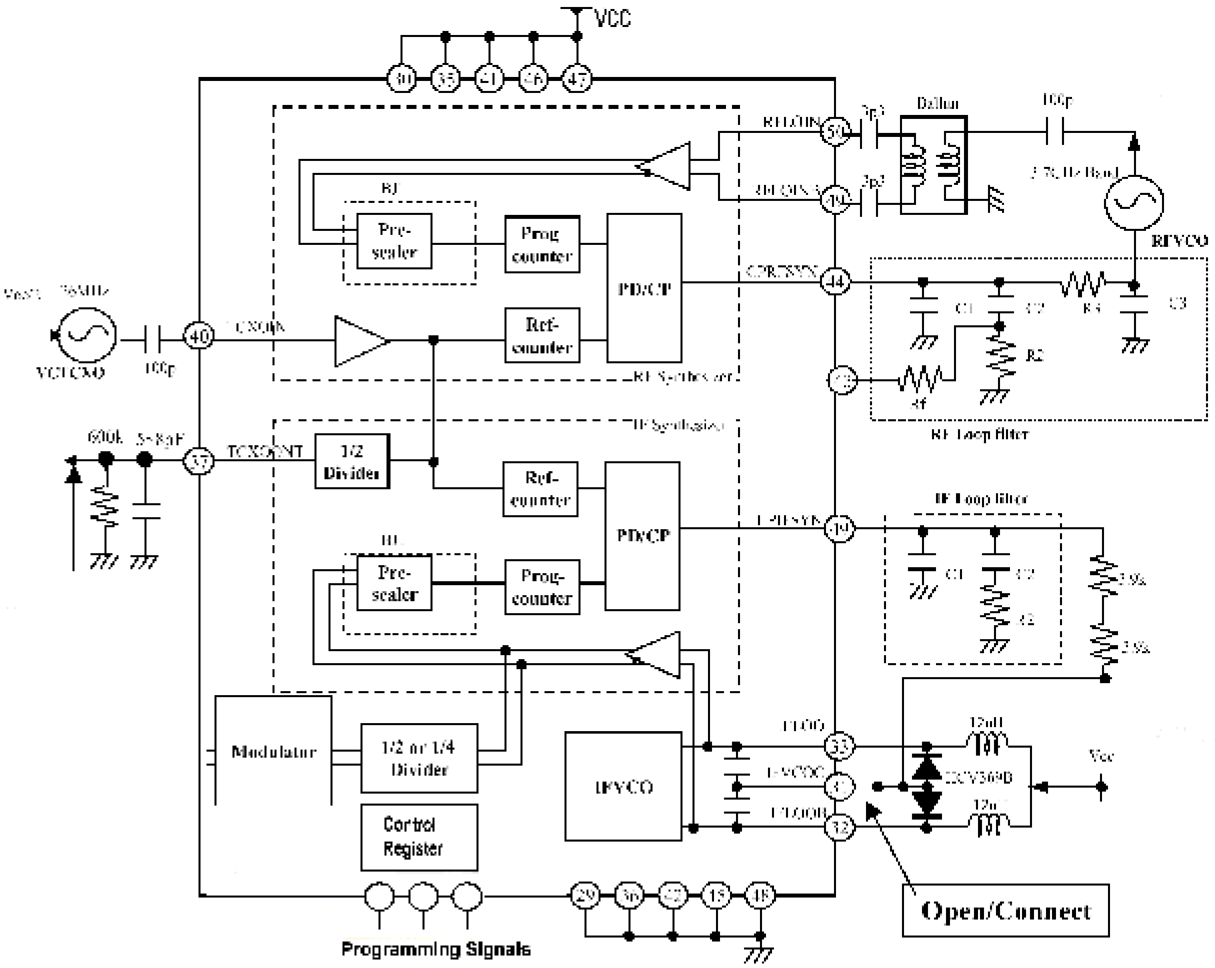
PLL as a part of the PMB6253 (SMARTi+) IC

Blockdiagram



PLL as a part of the BRIGHT IC

Blockdiagram



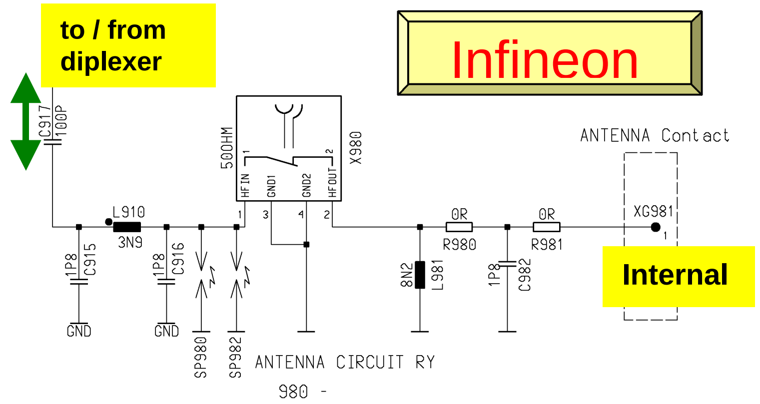
4.3 Antenna switch (electrical/mechanical)

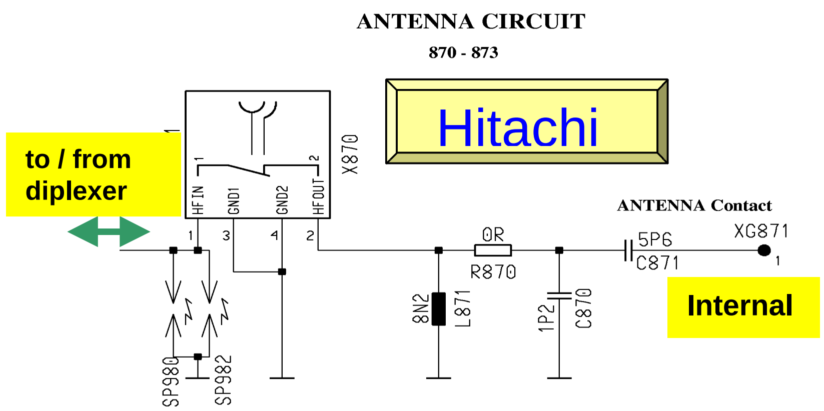
Internal/External <> GSM900/1800 <> Receiver/Transmitter

Notes

The K45 mobile has two antenna switches.

a) The mechanical antenna switch for the differentiation between the internal and external antenna

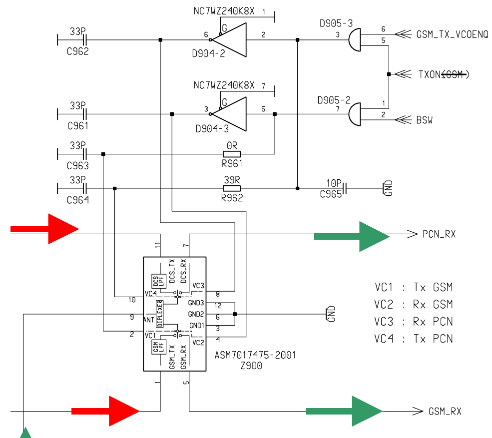




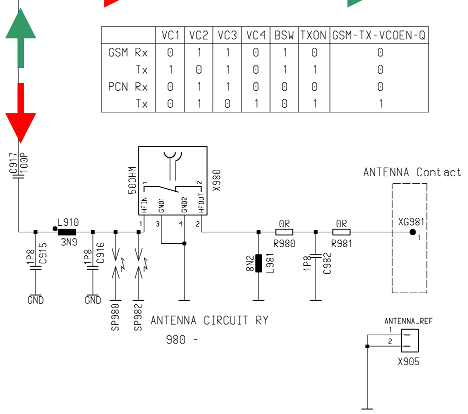
b) The electrical antenna switch, for the differentiation between the receiving and transmitting signals, just like the differentiation between GSM900 and GSM1800.
To activate the correct settings of this diplexer, some logical switches and switching signals are required

Infineon	Hitachi
D904	V880
D905	V881

Infineon

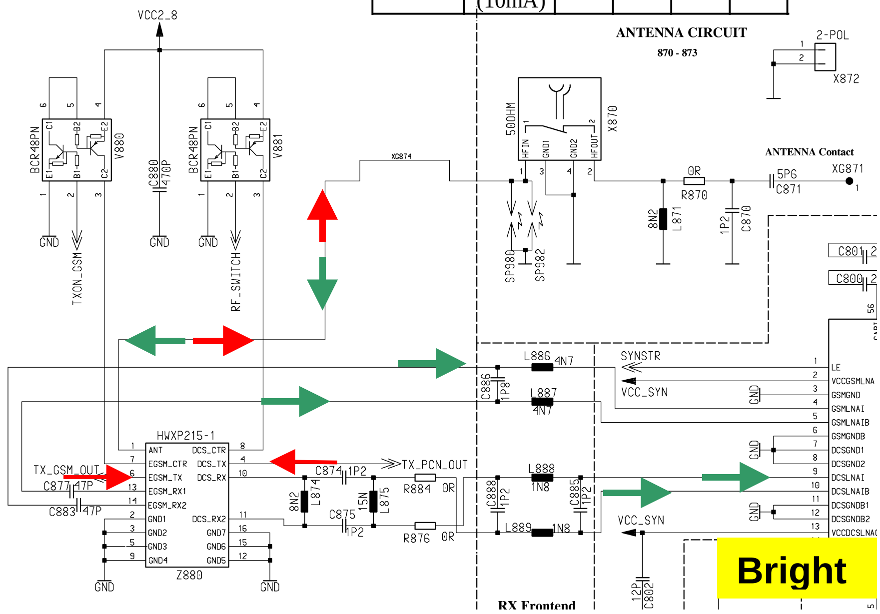


	VC1	VC2	VC3	VC4	BSW	TXON	GSM-TX-VCOEN-Q
GSM Rx	0	1	1	0	1	0	0
Tx	1	0	1	0	1	1	0
PCN Rx	0	1	1	0	0	0	0
Tx	0	1	0	1	0	1	1



Hitachi

		EGSM		DCS	
		Rx	Tx	Rx	Tx
Vc (EGSM)	0V	on	off	-	-
	2.5V (10mA)	off	on	-	-
Vc (DCS)	0V	-	-	on	off
	2.5V (10mA)	-	-	off	on



4.4 Receivers

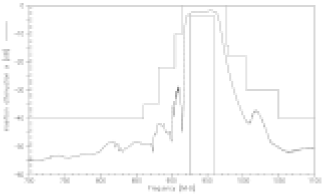
4.4.1 Receiver: GSM900/1800 –Filter to Demodulator

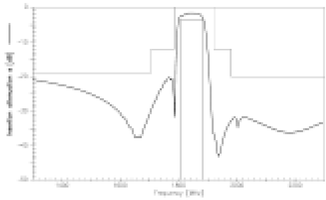
From the antenna switch, up to the demodulator the received signal passes the following blocks to get the demodulated baseband signals for the EGOLD+:

Infineon

Filter	>>>> LNA	>>>> IF-Mixer	>>>> IF-Filter	>>>> PGC	>>>> Demodulator
Z852 PCN	Smarti	Smarti	Z871	Smarti	Smarti
Z851 GSM					

Filter: The GSM900 filter is an EGSM band centered SAW-Filter (Z851) with a center frequency of 945,5MHz. The symmetrical filter output is adapted to the balanced LNA input of the SMARTi+.
For GSM1800 a ceramic filter (Z852) centered to 1842,5MHz with a non symmetrical output is used and connected to the SMARTi+ LNA input.

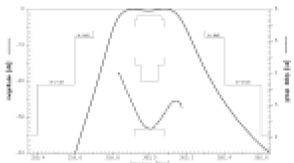




LNA: The LNA is located inside the SMARTi+ and is able to perform an amplification from ~ 20dB. The LNA is switchable ("On/Off") and controlled by the SMARTi+

Mixer: The two mixers (GSM900/1800) are using for down conversion the LO1 signal. On the joint output of both mixers there will be an interference signal of 360MHz.

IF-Filter: The IF-Signal (360MHz) is passing a symmetrical SAW-Filter to filter out interference signals and undesired mix products.



PGC: There are 2 PGC amplifier used. The first on (before the demodulation) has a dynamic range from 80dB (-22dB up to 58dB) and can be switched in steps of 2dB. The programming of this PGC is done via the EGOLD+ with the signals (SYGCCL, SYGCDT, SYNSTR).

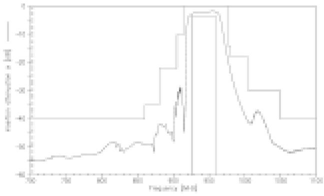
Demodulator: The demodulation is done via a Gilbert cell mixer, with help of the LO2 signal (1440MHz) divided by 4. The gained "I" and "Q" signals are amplified through an other PGC amplifier (10-16dB in 2dB steps) and after passing an internal switch, ready for further operation through the EGOLD+.

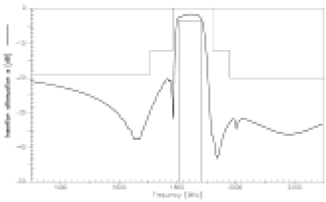
The required voltage VCC_SYN is provided by the N970

Hitachi

Filter >>>>>>>> LNA >>>>>>>> Demodulator>>>>>>>> PGC
Z880 Bright Bright Bright

Filter: The EGSM900 and the GSM1800 filter are located inside the frontend module. The EGSM900-Filter is centered to a frequency of 945,5MHz and the GSM1800 to 1842,5MHz. Both symmetrical filter outputs are matched via LC-Combinations to the LNA input of the BRIGHT (D800)


EGSM 900


GSM1800

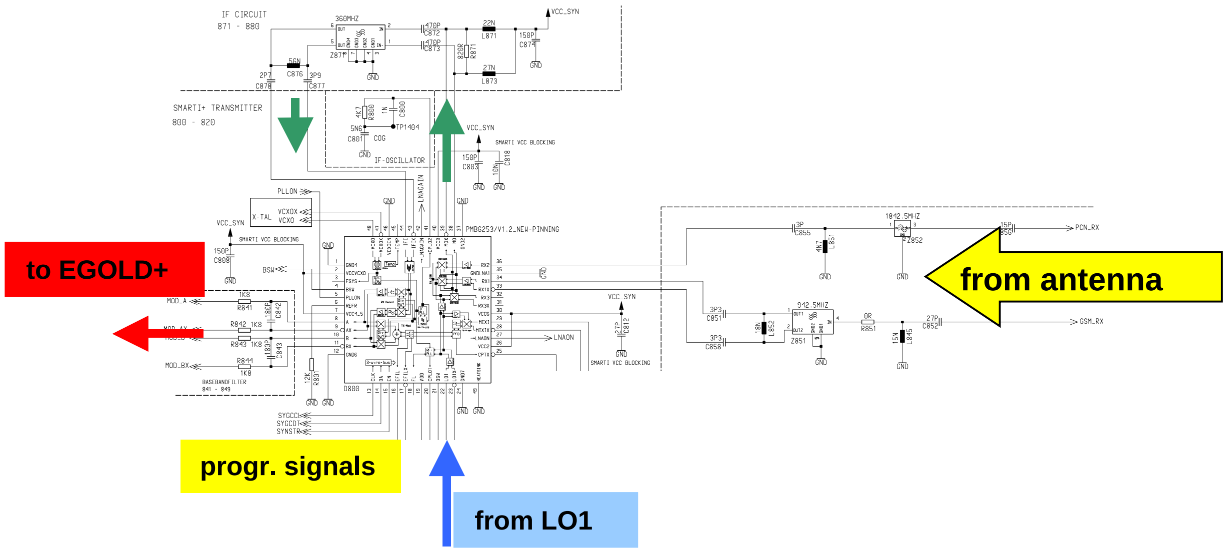
LNA: The LNA´s is located inside the BRIGHT and is able to perform an amplification from ~ 20dB. The LNA is switchable ("On/Off") and controlled by the Bright.

Demodulator: In opposite to the Infineon concept, the Hitachi chipset is not using an IF before demodulation. The Bright IC performs a direct demodulation of the received EGSM900 and GSM1800 Signals. To do so the LO1 is required. The channel depending frequencies for 900/1800MHz band are divided by 4 for EGSM900 and by 2 for GSM1800 internally.

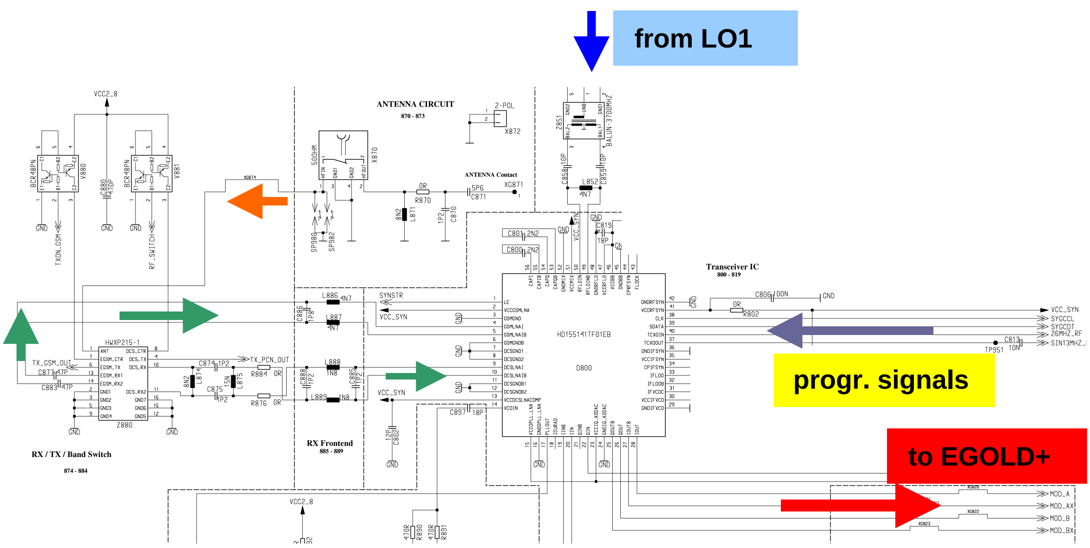
PGC: After demodulation the "I" and "Q" signals are amplified by the internal PGC-Amplifier whereby die "I" and the "Q" path are amplified independently From each other. The performance of this PGC is 80dB (-22 up to 58dB), switchable in steps of 2dB. The control is realised through the EGOLD+ signals (SYGCCL, SYGCDT, SYNSTR).
After passing an internal switch, the signals are ready for further processing through EGOLD+

The required voltage VCC_SYN is provided by the N840

Infineon

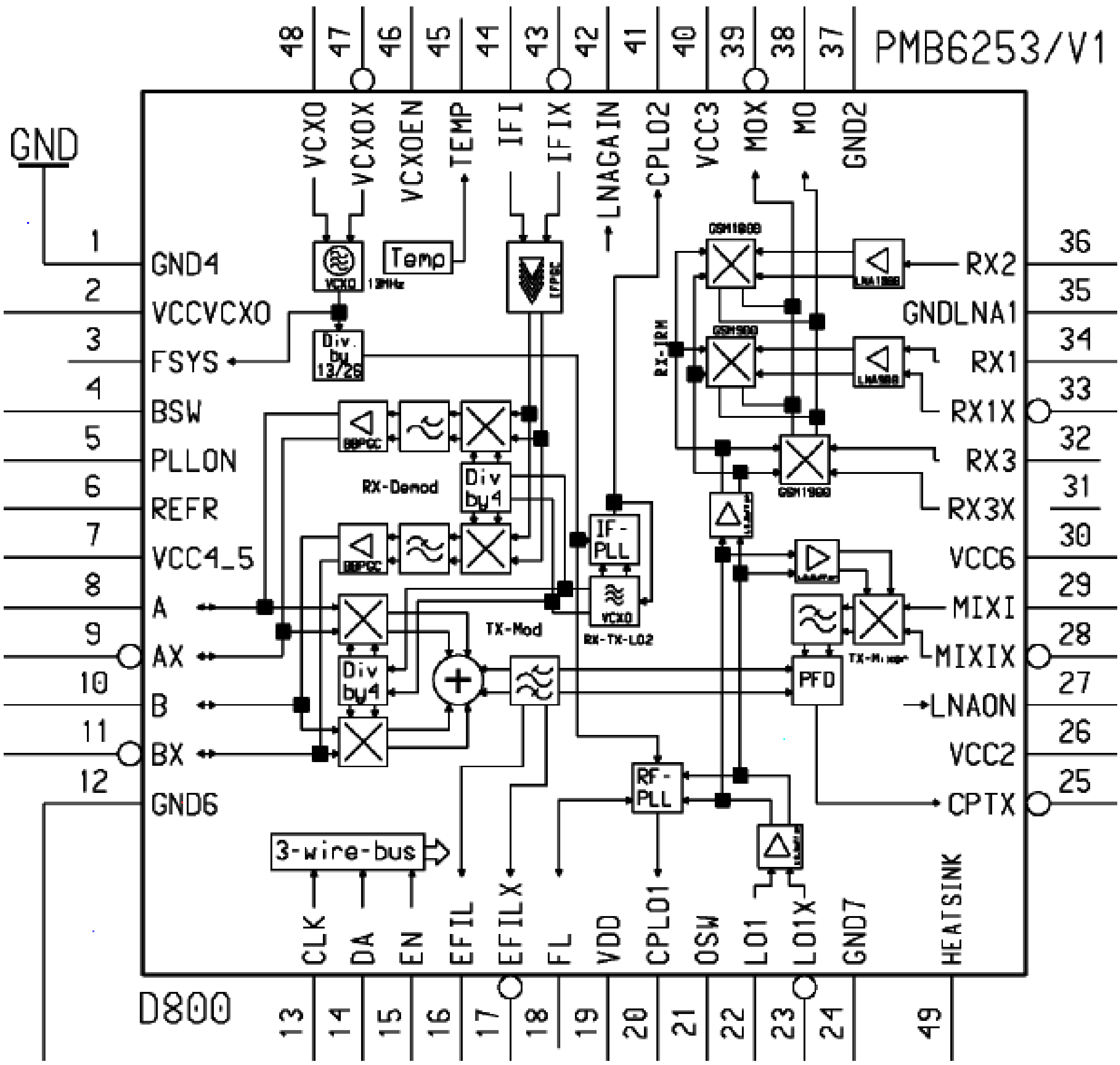


Hitachi



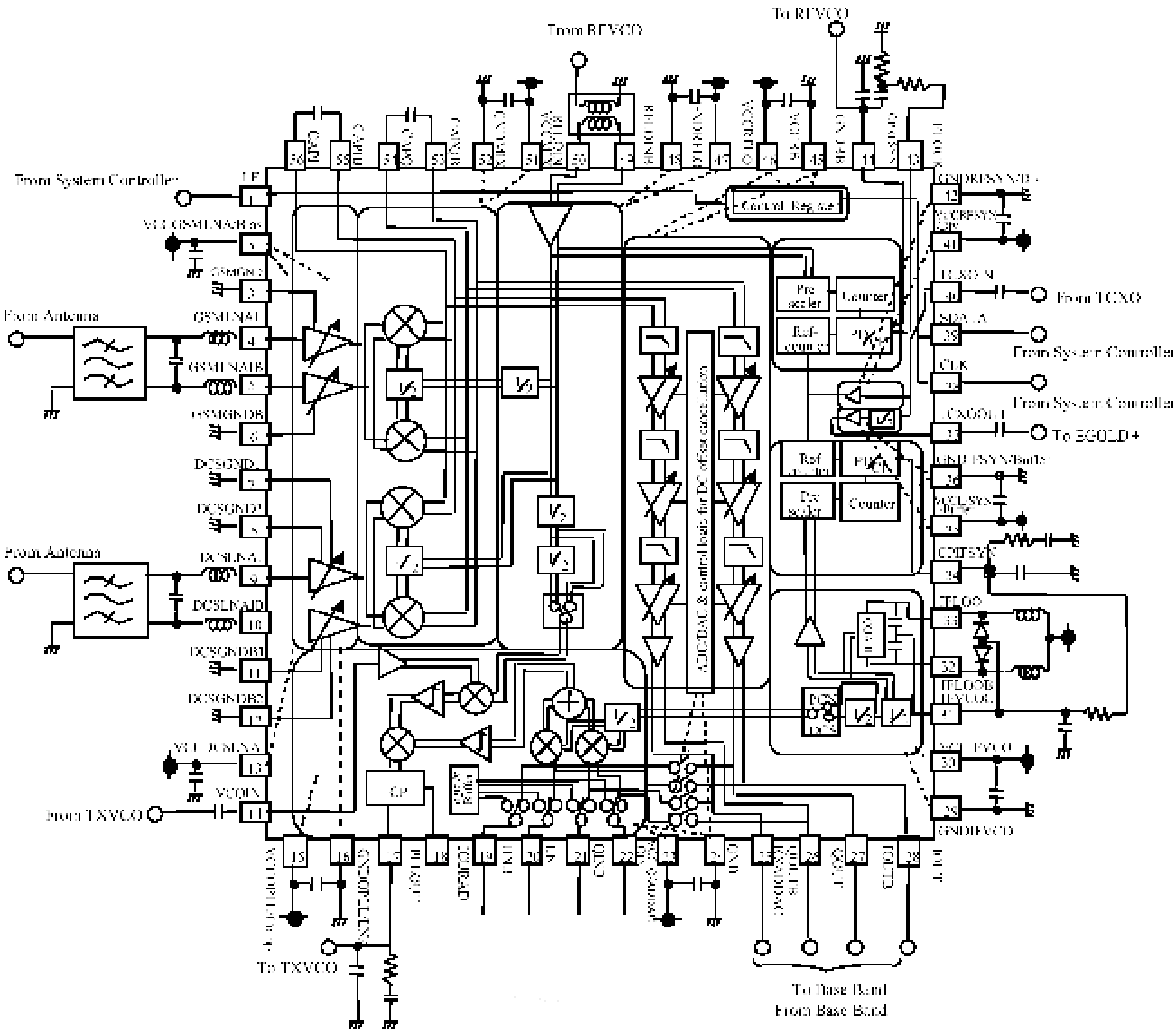
4.4.2 IC Overview

SMARTi+



IC Overview

BRIGHT IV



4.5 Transmitter

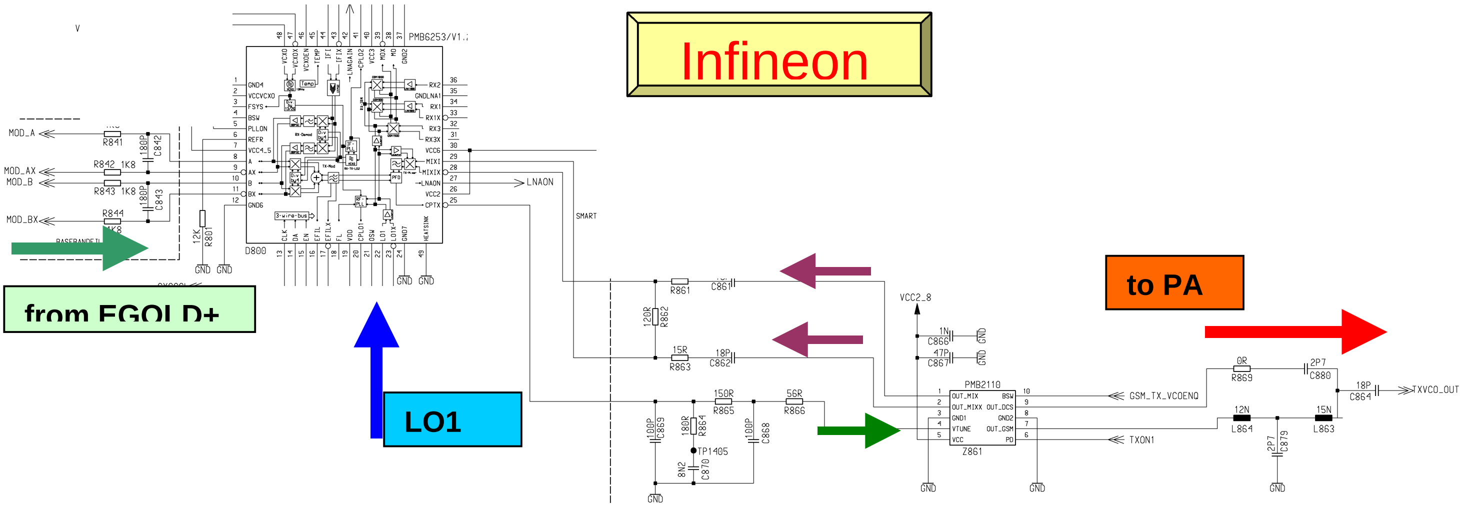
4.5.1 Transmitter: Modulator and Up-conversion Loop

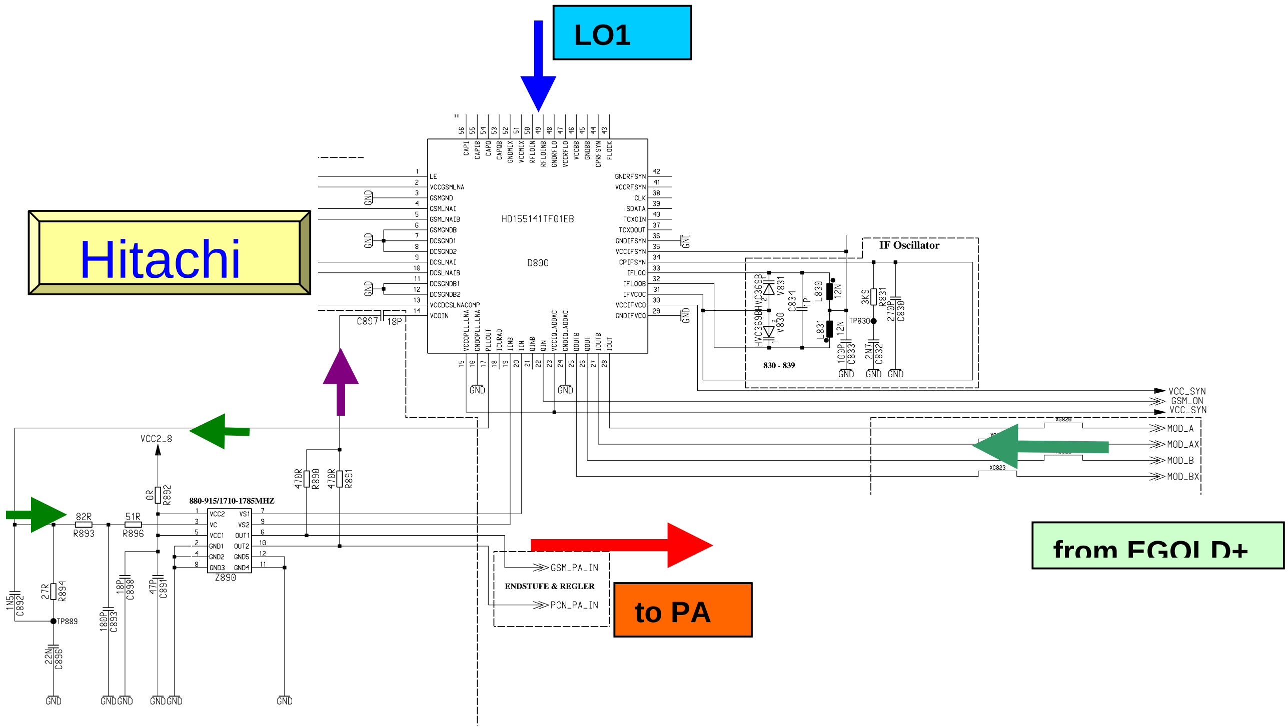
Infineon:
The K45 modulation is based on the principle of the "up-conversion modulation phase locked loop" and is accomplished via the SMARTi+ IC(D800).
The internal TX IF-LO provides the quadratic modulator working with the TX IF frequencies (GSM/PCN 424/428 MHz), by generating 1696 or 1712MHz frequencies, which are divided by 4.
This so generated IF GMSK RF signal is compared in a phase detector with the down mixed GMSK RF output from the TX-VCO (Z861) TXVCO_OUT.
To get the comparison signal, the TXVCO_OUT signal appearing at Pin 1and 2 of the (Z861)is mixed with LO1 signal.
The output (tune) signal of the phase detector passes a discrete loop filter realised by capacitors and resistors, to set the TXVCO to the required frequency.
The large loop band width (~1,5MHz) 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 GSM900-VCO and the GSM1800-VCO in one housing.
The TXVCO is switched from GSM to PCN by using the signal GSM_TX_VCOENQ from the EGOLD+ (TDMA Timer J13)

The required voltage VCC_SYN and VCC2_8 is provided by the N970

Hitachi:
The Hitachi version works similar to the Infineon. The modulation is also based on the principle of the "up-conversion modulation phase locked loop" and is accomplished via the BRIGHT IC(D800).
The internal TX IF-LO provides the quadratic modulator with the TX IF frequencies (GSM 45/46MHz / PCN 90/92 MHz) by generating 376/380/384MHz frequencies, which are divided 4 (GSM) or 2 (PCN).
This so generated IF GMSK RF signal is compared in a phase detector with the down mixed GMSK RF output from the TX-VCO (Z861).
To get the comparison signal, the GSM_PA_IN and PCN_PA_IN signal appearing at Pin 6and 10 of the (Z890) is mixed with the LO1 signal (divided by 2PCN or 4GSM).
The output (PLLOUT) signal of the phase detector passes a discrete loop filter realised by capacitors and resistors to set the TXVCO to required frequency.
The large loop band width (~1,5MHz) 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 GSM900-VCO and the GSM1800-VCO in one housing.

The required voltage VCC_SYN and VCC2_8 is provided by the N840


Infineon
to PA
LO1
from EGOLD+


LO1
Hitachi
to PA
from EGOLD+

4.5.2 Transmitter: Power Amplifier

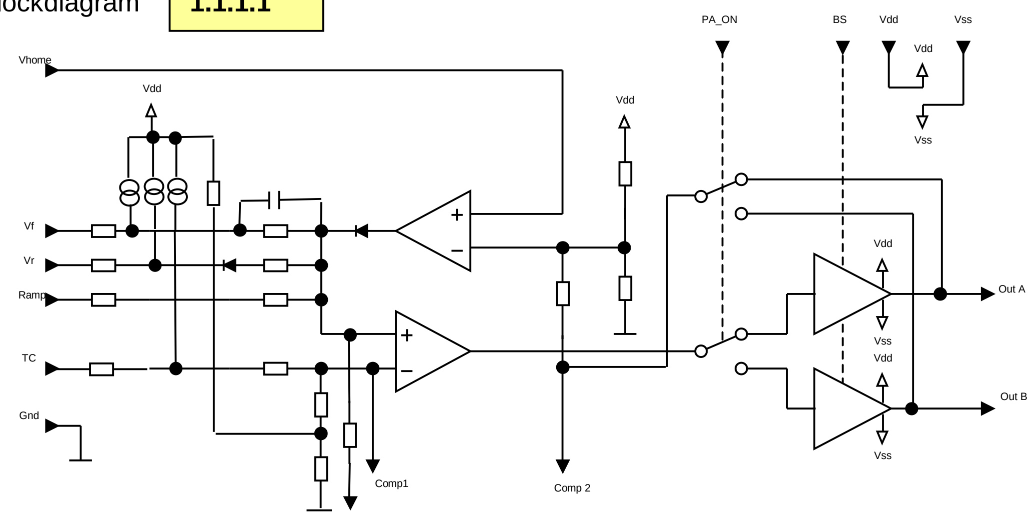
Infineon:
The TXVCO_OUT signal from the TX-VCO is led to a driver stage (V901), activated by TXONPA, to ensure that both power amplifiers (N901 for PCN) and (N902 for GSM) get their required input level.
The amplifiers are connected via L901 and L909 to Batt+. After amplification, a part of the TX output signal is decoupled via a directional coupler (realised by conductive tracks) and is equalised with the detector diode (V903). This so gained voltage is compared by D903 with the PA_RAMP signal provided by the EGOLD+ (GAIM/BASEBAND H2). The resulting voltages VAPC_GSM and VAPC_PCN are used to ensure that the PA is working within the required PCL´s.
D903 is activated through the signal TXONPA and switched to PCN by PCN_TX_VCOENQ (EGOLD+ (TDMA Timer K12))..
After decoupling the signal passes on the way to the antenna the diplexer (Z900) and the antenna connector (X980).

The required voltage BATT+ is provided by the battery.
The required voltage VCC2_8SW is provided N970.

Hitachi:
The two output signals (PCN_PA_IN and GSM_PA_IN) from the TX-VCO are led to the power amplifier (Z900) passing a matching circuit. The PA is a "two in one" PA and, is connected directly to Batt+.
The signal GSM_ON defines the used amplifier (PCN or GSM).
After amplification, a part of the two output signals (TX_PCN_OUT and TX_GSM_OUT) is decoupled via a directional coupler. The other part runs through the antenna switch (Z880) and the antenna connector (X870) to the Antenna.
The decoupled part is equalised by the detector diode (V920) and used from the (N920) to get a PA control voltage by comparing this voltage with the PA_RAMP signal provided from the EGOLD+ (GAIM/BASEBAND H2).
The (N920) is activated through the signal TXONPA and TXON1.

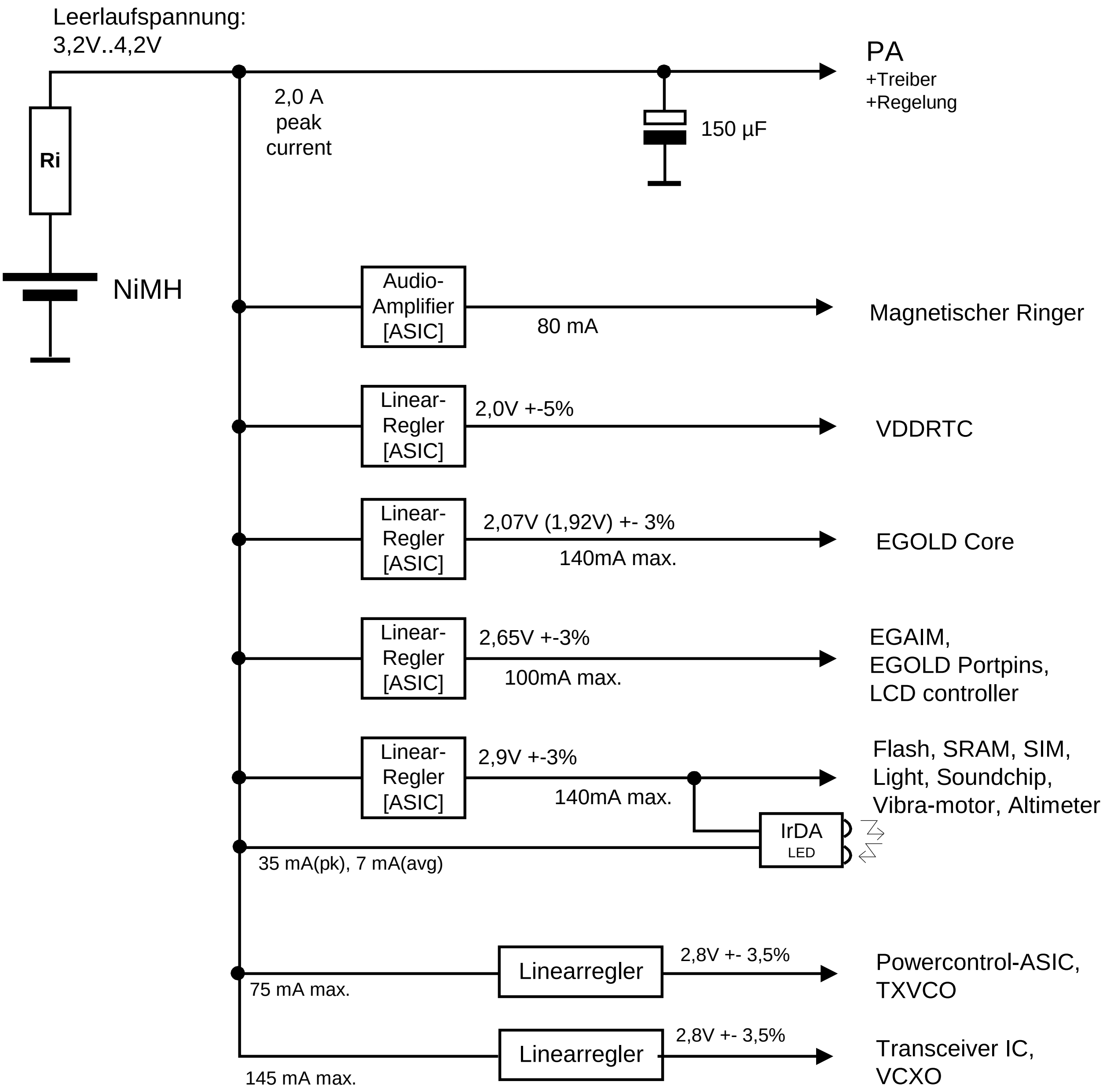
The required voltage BATT+ is provided by the battery.
The required voltage VCC2_8 is provided by N840.

Blockdiagram **1.1.1.1**



5 Power Supply

5.1 Overview and Voltages



Overview of HW Structure

All power supply functions of the mobile phone, except the RF-Part, are carried out by the power supply ASIC (D361)

General:
The pin POWER of the I/O-Connector is used for charging the battery.
For accessories, which provide a variable charging current, the current will be set via a pin SB (current byte) (e.g. S25 chargers corresponding to Car Kits etc.).

- The S45/ME45 power supply is unregulated and cannot be controlled by the SB signal.
- The SB signal is used to distinguish between various chargers.

The following restrictions must be considered:

- The phone cannot be operated without battery.
- The phone will be damaged if the battery is inserted the wrong way
- In the charging branch a fuse element is inserted against over current.

5.2 Power Supply ASIC

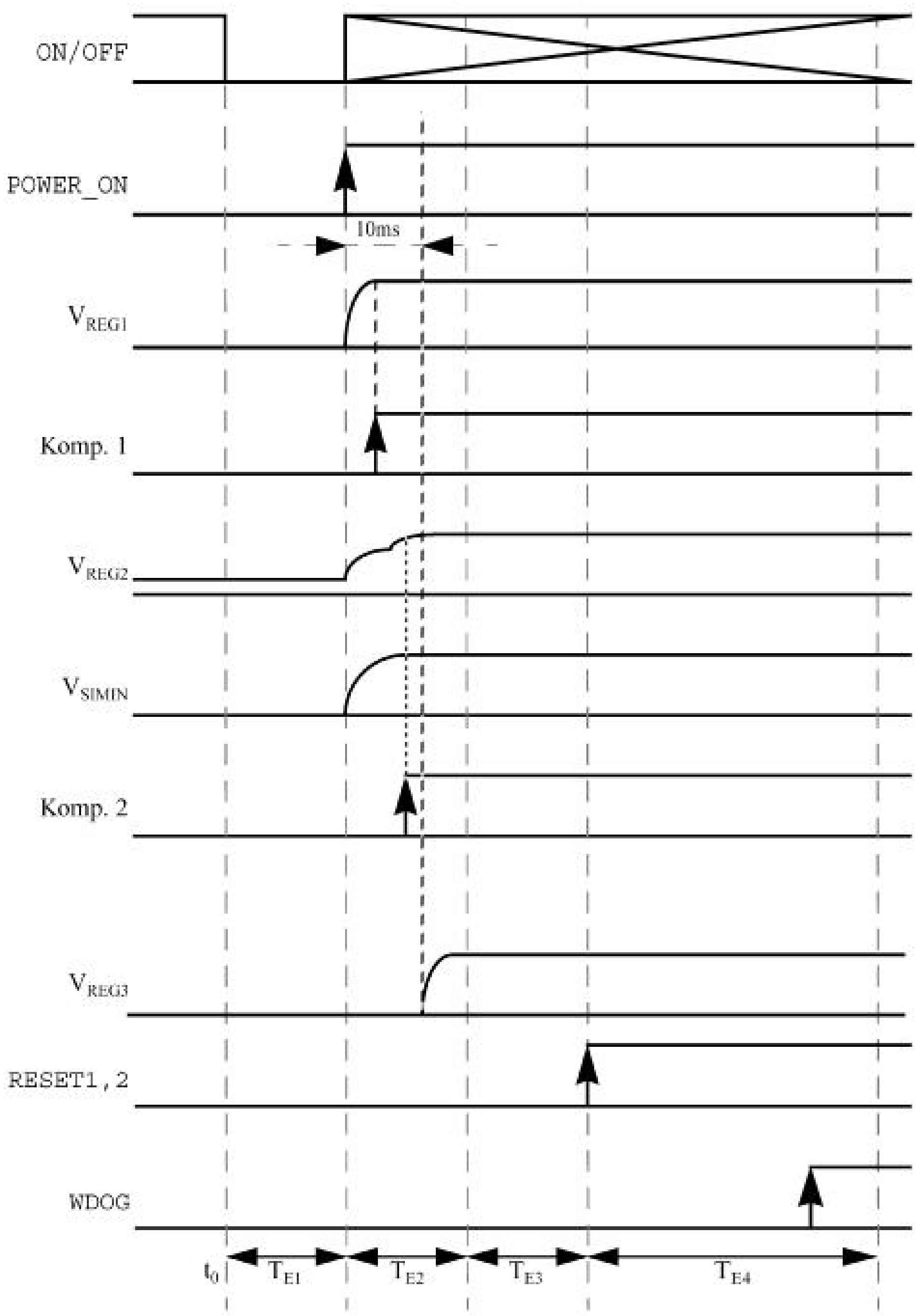
The power supply ASIC (D361) contains the following functions:

- Control of “Switch On” of the mobile phone via the ON/OFF switch.
- Recognition of external chargers connected on POWER.
- Control of “Switch On” of the mobile phone via the ON/OFF1 (RTC)
- Watchdog monitoring
- Control of mobile phone “SWITCH OFF” via WATCHDOG_µP connection.
- “Switch off “of mobile phone in the case of overvoltage at battery connection.
- Generation of RESET signal for EGOLD+ and Flash
- Voltage generation via “Linear regulator 2.90 V “
- Voltage generation via “Linear regulator 2.65 V “
- Voltage generation via “Linear regulator 2.07 V “
- Battery charge support: interrupted if there is an over-temperature
- Software-controlled switching of voltage supply for the accessories
- Light switching
- Voltage generation for “SIM-CARD”
- VIBRA switching
- Ringer tone switching
- Audio switching

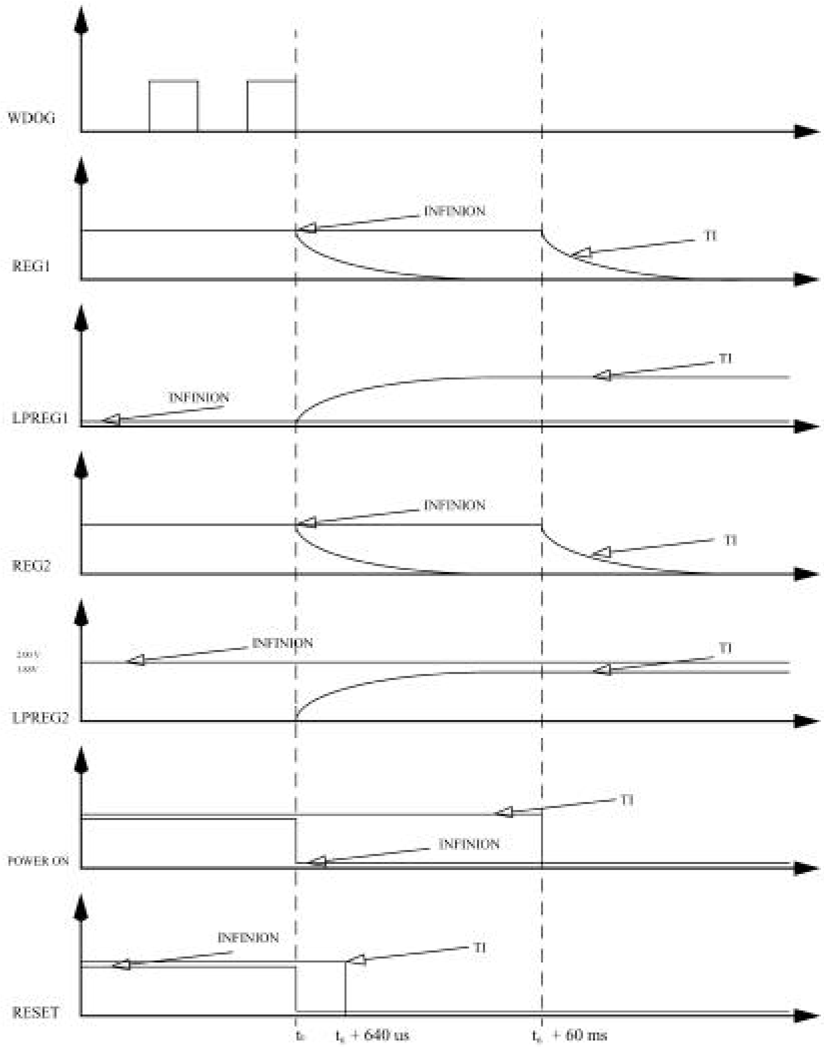
Switch “ON” sequence

- Falling edge recognition KB7, or RTC_INT
- Generation of the “2,07; 2,65; 2,9” voltages
- Generation of the “RESET_2,0V and RESET_2,65V”
- 32,768 KHz oscillator
- Generation of the “Watch Dog” signal through the EGOLD+ after “POWER_ON”
- 13MHz oscillator

"Switch-On" timing



“Switch-Off” timing



“PIN-OUT” ASIC D361

8	7	6	5	4	3	2	1	
vlpreg2	light_ disable	vbatlp	rref	vdd_ charge	charge	lightout (double bond)	vddref (double bond)	A
avdd	sense_in	vspgsout	ref_osc	tbat	vibraout (double bond)	power_o n	vss_sw (double bond)	B
vsimout	sleepn	vsimctrl	**avss**	avss	**avss**	**vrefex**	vreg1	C
vreg2	**audi_a1**	**ringin**	avss	avss	avss	**avss**	vbat1	D
vbat2	**audi_b1**	avss	avss	avss	avss	**audi_a2**	vbat3 (double bond)	E
audi_c1	chargeup	avss	on_off2	on_off	resetn2	**audi_b2**	vreg3 (double bond)	F
resetn	fuse	i2c_clk	i2c_data	i2c_int	outport	watch- dogup	**audi_c2**	G
gndaudi o1	**audo1**	**vddaudi o1**	**vddau- dio**	**vddaudi o2**	**audo2**	**gndaudi o2**	exon2	H

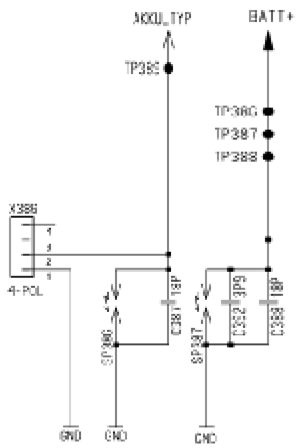
bottom view

5.3 Battery and Charging

5.3.1 Battery

A LiIon battery with a nominal capacity of 840mAh is used for the S/ME45 series and a NiMH battery with a nominal capacity of 550mAh for the C45. A temperature sensor (22kΩ at 25°C) is integrated to monitor the battery temperature.

Battery connector:



5.3.2 Charging Concept

The battery is charged in the unit itself. The hardware and software is designed for Li-Ion or NiMH with 4.2V technology.
The battery will be charged as long as the GAIM part of the EGOLD+ measures changes in the values of the battery voltages during the charging process.
There are two ways to charge the battery:
Normal charging also called “fast charging”
Trickle charging

Normal Charging
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
Charging is enabled via a FET-Switch (V342) in the phone. This FET-Switch activates the circuit form the external charger to the battery. The EGOLD+ takes over the steering of this switch depending on the charge level of the battery, whereby a disable function in the ASIC (D361) hardware can override/interrupt the charging in the case of overvoltage of the battery (only in case of NEC batteries).
The charging software is able to charge the battery with an input current within the range of 350-600mA. If the FET-Switch is switched off, no charging current will flow into the battery (exception is trickle charging, see below).
For controlling the charging process it is necessary to measure the ambient (phone) temperature and the battery voltage.

For temperature detection, a NTC resistor (22kΩ at 25°) is assembled in the battery pack. Via the pin 2 of the battery connector connected to the EGOLD+ (GAIM L3) is carrying out the measurement.

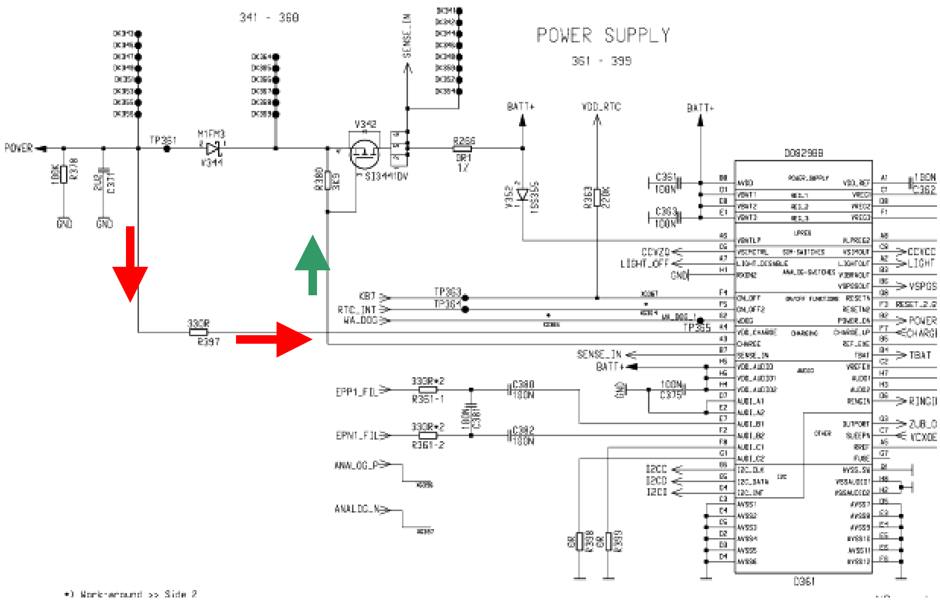
The voltage is measured from the GAIM-part of the EGOLD+ (see description In chapter 7)

Trickle charge

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 less then 3,2V), so that it is not possible to charge the battery via the normal charging circuit. In this case only trickle charge is possible.
The STV-ASIC (D361) controls the charging circuit himself.

- Battery voltage below 2,8 Volt charging current 20mA.
- Battery voltage below 3,2 Volt charging current 50mA.
- Battery voltage over 3,2 Volt “Normal charging”.

Power supply for the ASIC (D361) in this mode is the external charger. (VDD_CHARGE)
The switch into normal charging mode, is done automatically if the required voltage is reached.



Trickle Charging Power Supply

“Normal/Trickle” charging activation

!! Attention!!

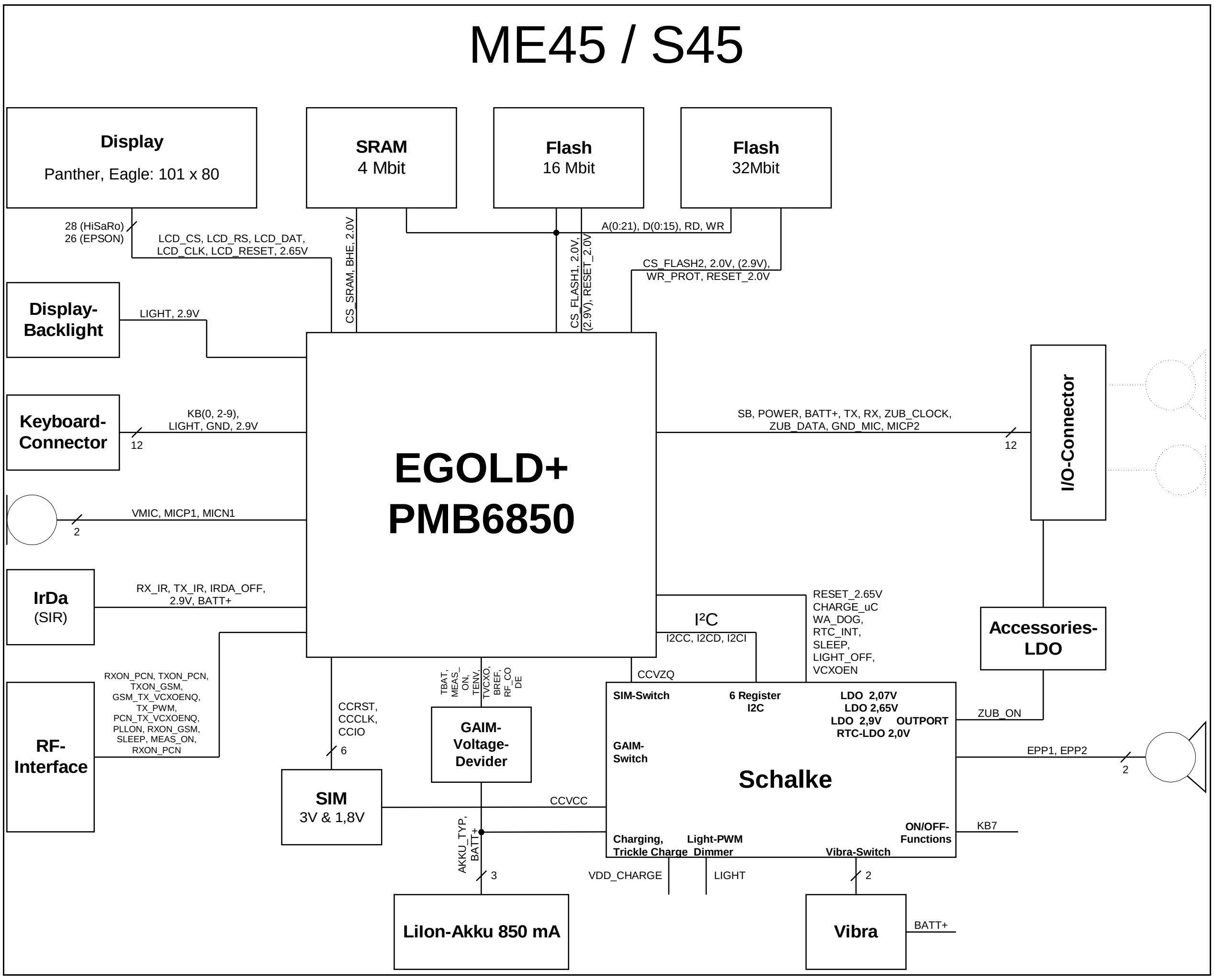
- a charger voltage >15V can destroy resistors or capacitors in the charging path
- a charger voltage >20V can destroy the MOS-FET switch transistor in the charging path.

6 Logic Part

6.1 Overview Logic/control

Overview to the HW structure

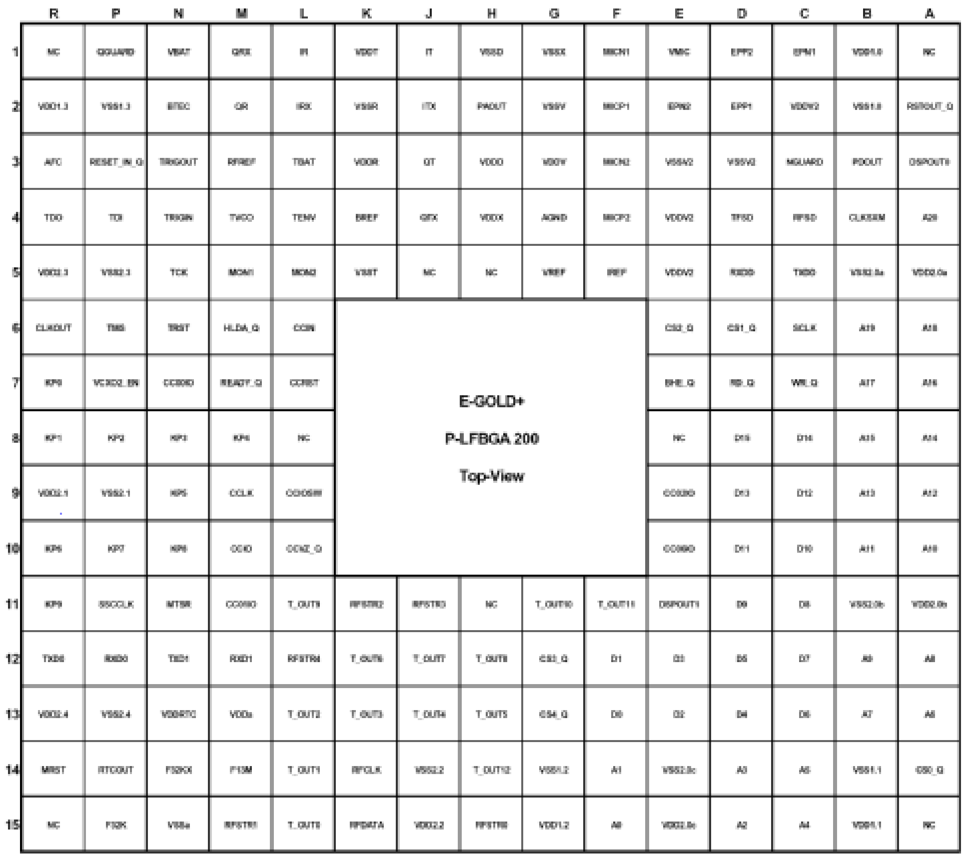
The hardware in the K45 can be split up into two function groups:
At first there is the baseband chipset with its periphery comprising the EGOLD+, Flash and power supply ASIC. This function group is basis for all equipment variants.



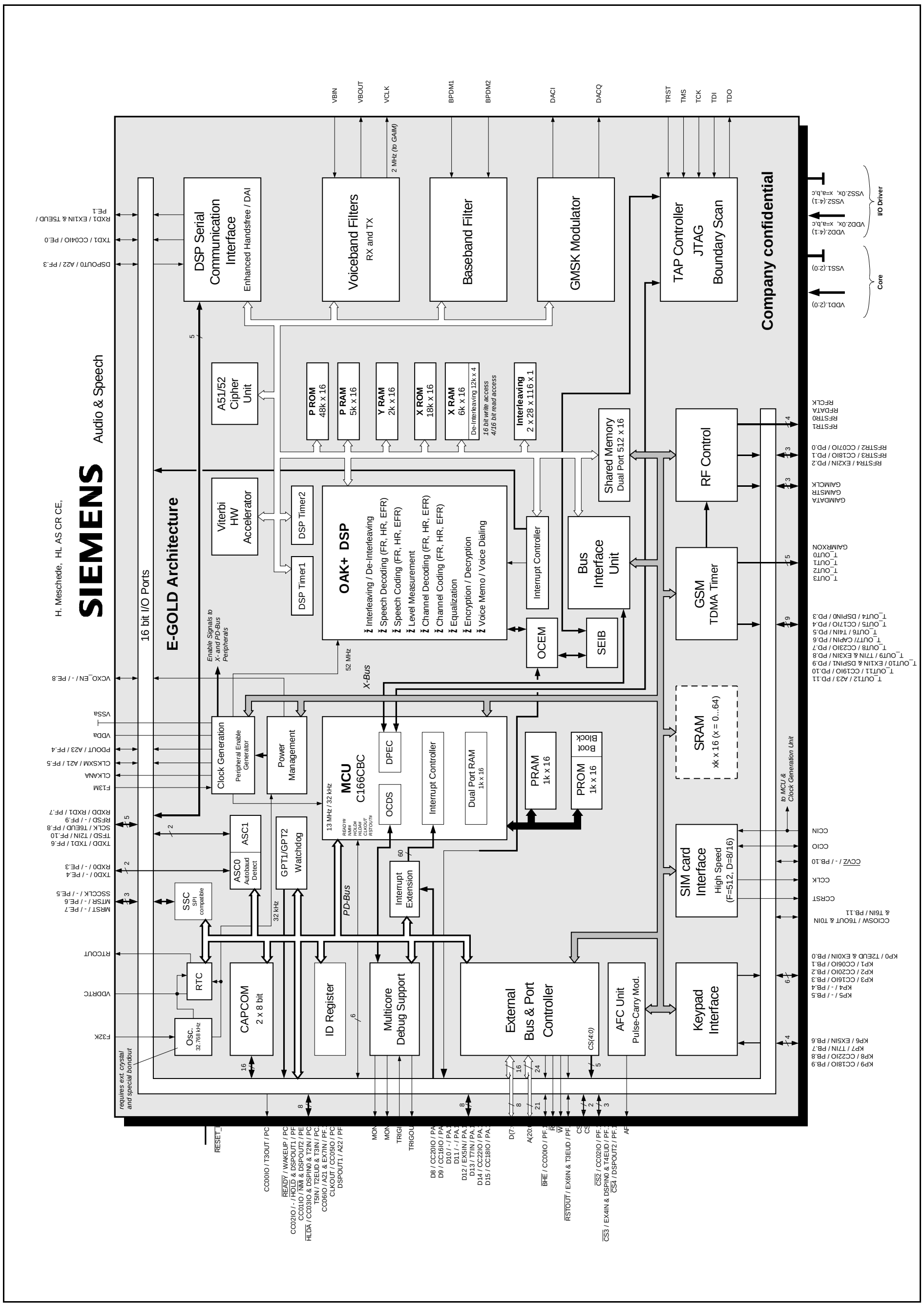
The logic part of the K45 consists of:

The EGOLD+

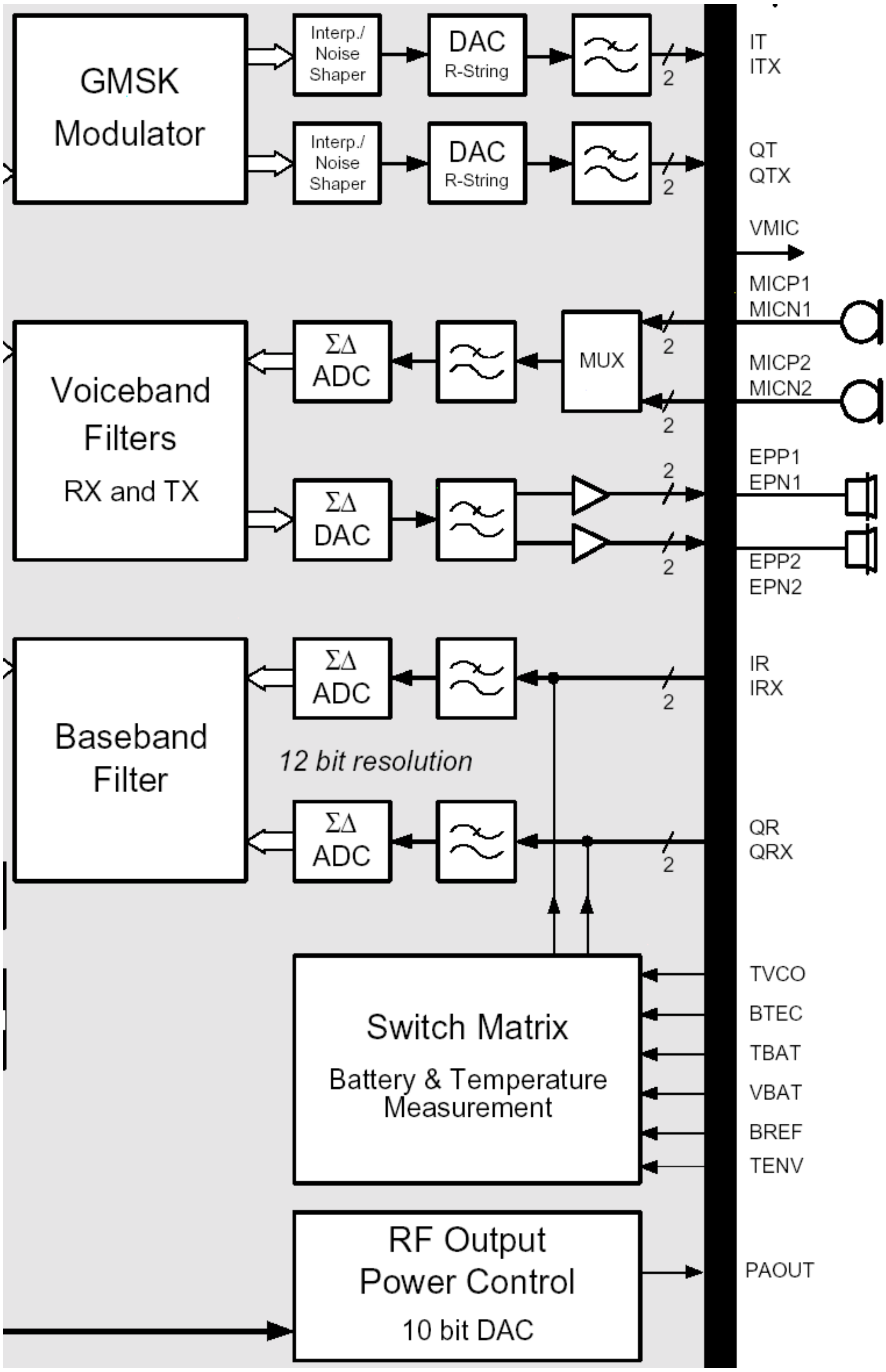
Hardware µC-part
Software µC-part
Software SP (Signal Processor) part Equaliser
EGAIM inside the EGOLD+
RTC (Real Time Clock)



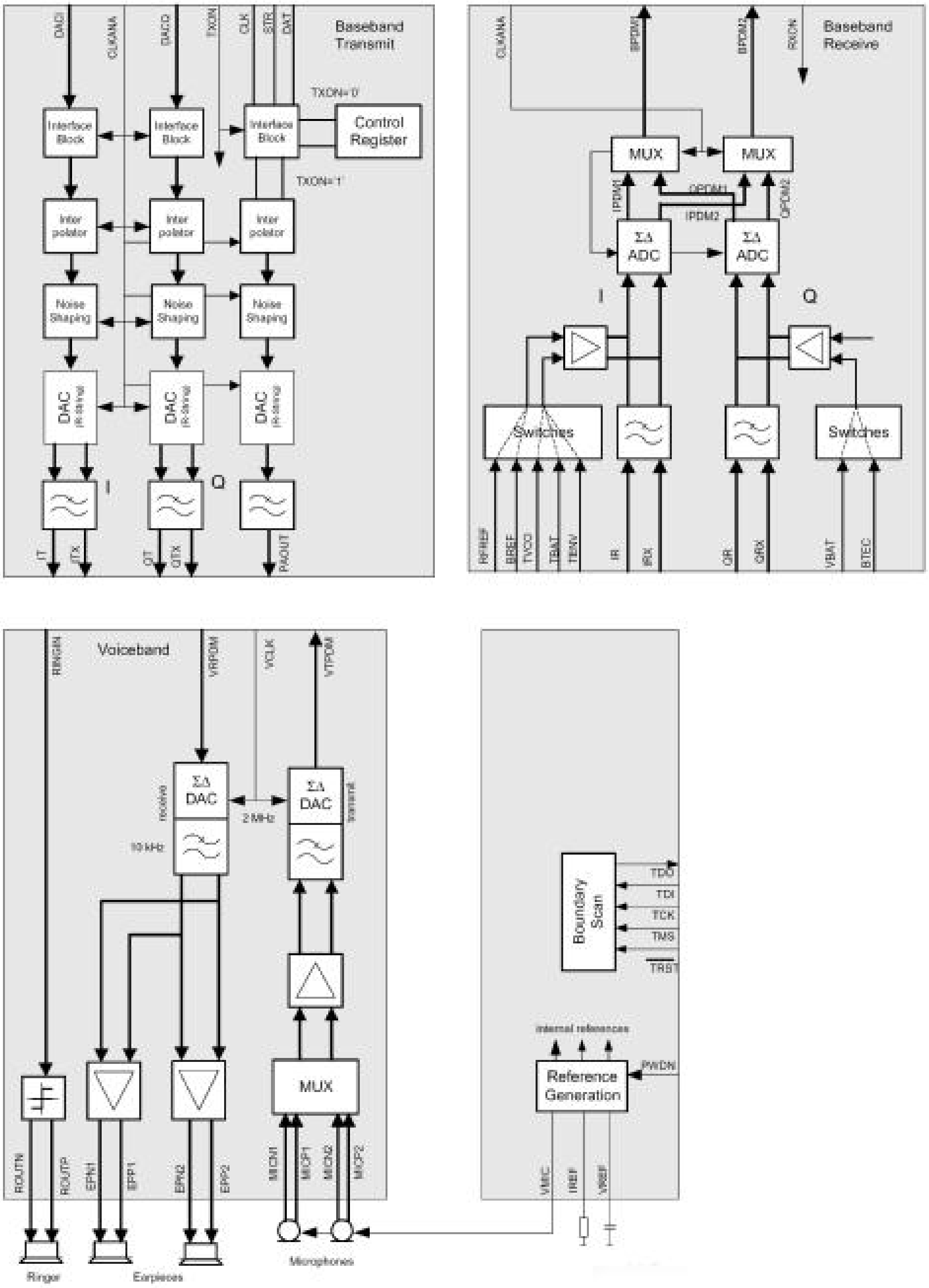
6.2 EGOLD (PMB6850) V1.3c/V2.x



6.3 EGAIM inside the EGOLD+



EGAIM inside the EGOLD+

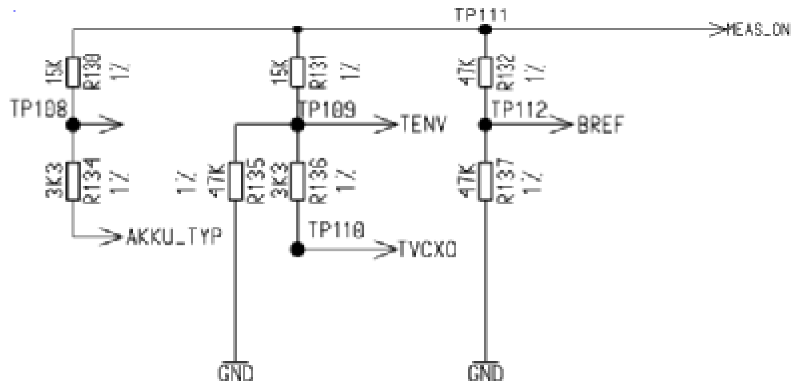


6.3.1 Tasks of the EGAIM inside the EGOLD+

- Measurement of Battery and Ambient temperature
- Measurement of Battery Voltage
- A/D conversion of MIC-Path signals incl. coding
- D/A conversion of EP-Path signals incl. decoding
- Generating of the PA-Control Signal “PA_Ramp”

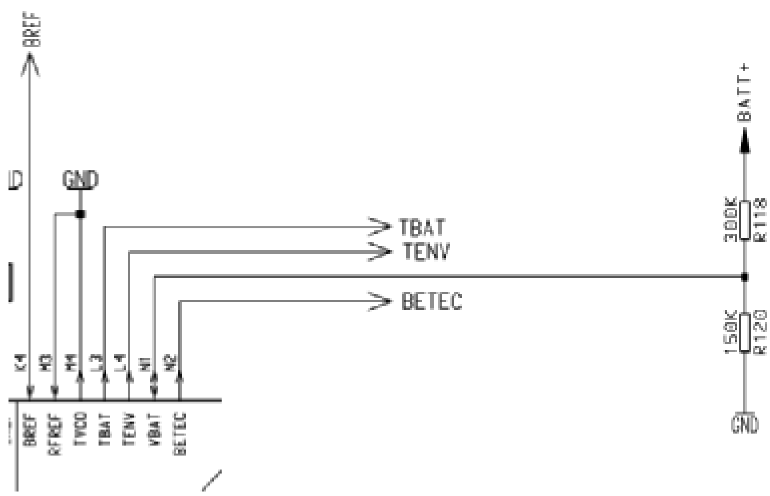
Measurement of Battery and Ambient Temperature

The temperature is measured as a voltage equivalent of the temperature on the voltage dividers R131,R136,R135 for the ambient temperature by the EGAIM. The battery temperature is measured directly at (l3) of the EGOLD+. For this, the integrated ΣΔ converter of the EGAIM of the RX-I base band branch is used. This ΣΔ converter compares the voltage of TBAT and TENV internally with a reference voltage BREF.
Via an analog multiplexer, either the RX-I base band signal, or the TBAT signal and the TENV signal can be switched to the input of the converter.
The signal MEAS_ON from the EGOLD+(GSM TDMA-TIMER G11) activates the measurement and is used to generate to BREF by the help of R137,R132



Measurement of the Battery Voltage

The measurement of the battery voltage is done in the Q-branch of the EGAIM. for this BATT+ is connected via a voltage divider R118, R120 to the EGOLD+ (GAIM N2) (Input limitation 1.33V to 5.91V) .An analog multiplexer does the switching between the baseband signal processing and the voltage measurement.



A/D conversion of MIC-Path signals incl. coding

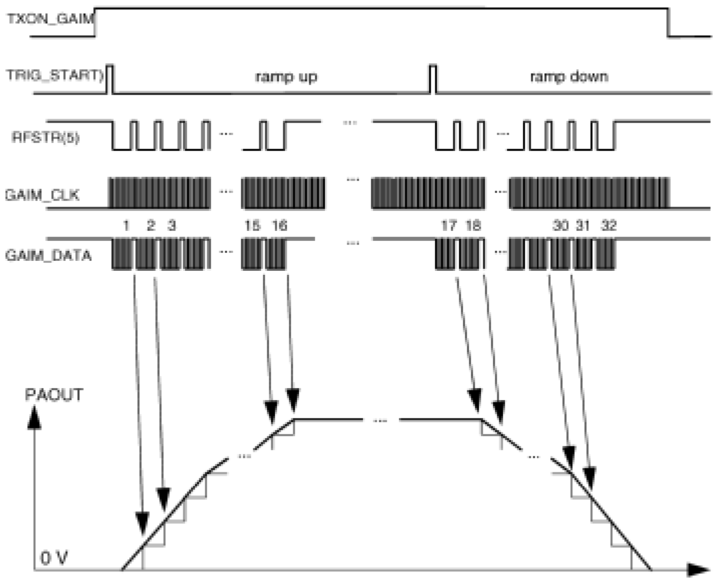
The Microphone signals (MICN2, MIpN2, MICP1, MICN1) arrive at the voiceband part of the EGAIM. For further operations the signals will be converted into digital information, filtered, coded and finally formed into the GMSK-Signal by the internal GMSK-Modulator.
This so generated signals (MOD_A, MOD_AX, MOD_B, MOD_BX) are given to the SMARI IC / Bright IC in the transmitter path.

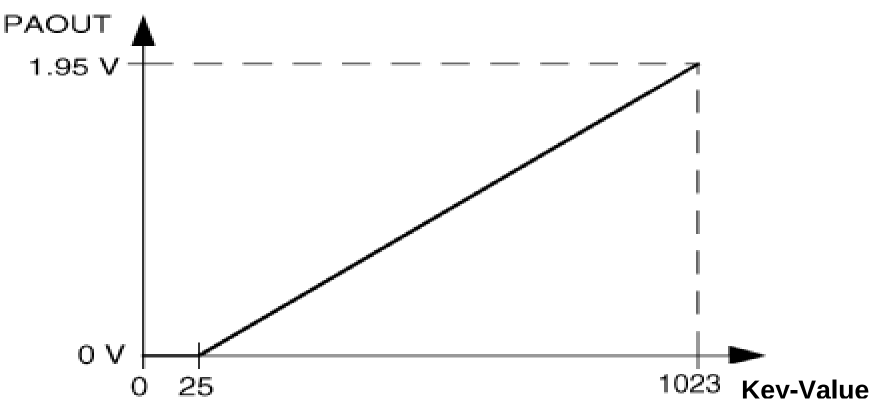
D/A conversion of EP-Path signals incl. decoding

Arriving at the Baseband-Part the demodulated signals (MOD_A, MOD_AX, MOD_B, MOD_BX) will be filtered and A/D converted. In the voiceband part after decoding (with help of the uC part) and filtering the signals will be D/A converted amplified and given as (EPP1, EPN1, EPP2, EPN2) to the internal earpiece or the external loudspeaker.

Generation of the PA Control Signal (PA_RAMP)

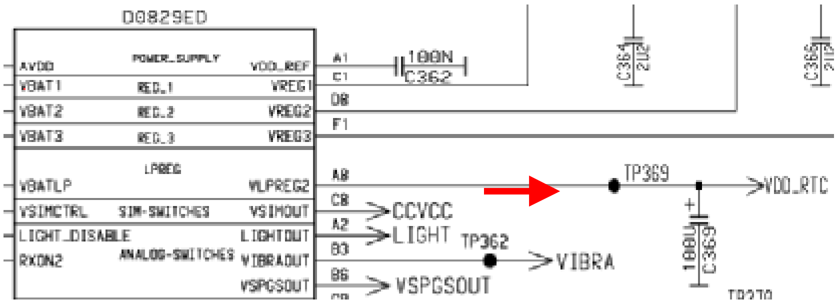
The RF output power amplifier needs an analog ramp up/down control voltage. For this the system interface on EGOLD+ generates 10 bit digital values which have to be transferred serially to the power ramping path. After loading into an 10 bit latch the control value will be converted into the corresponding analog voltage with a maximum of ~2V

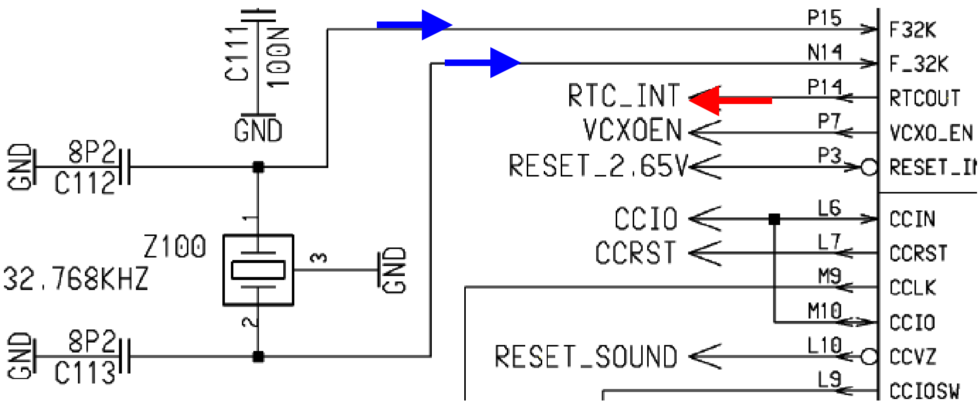




6.4 Real Time Clock (integrated in the EGOLD+)

The real time clock is powered via its own voltage regulator inside the ASIC (D361) directly from the battery. The so gained voltage VDD_RTC is buffered by a capacitor (C369) to keep the data (e.g. clock) in the internal RAM during a battery change for at least 30 seconds.
An alarm function is also integrated which allows to switch the phone on and off. via RTC_INT
The reference oscillator for the RTC is (Z100)

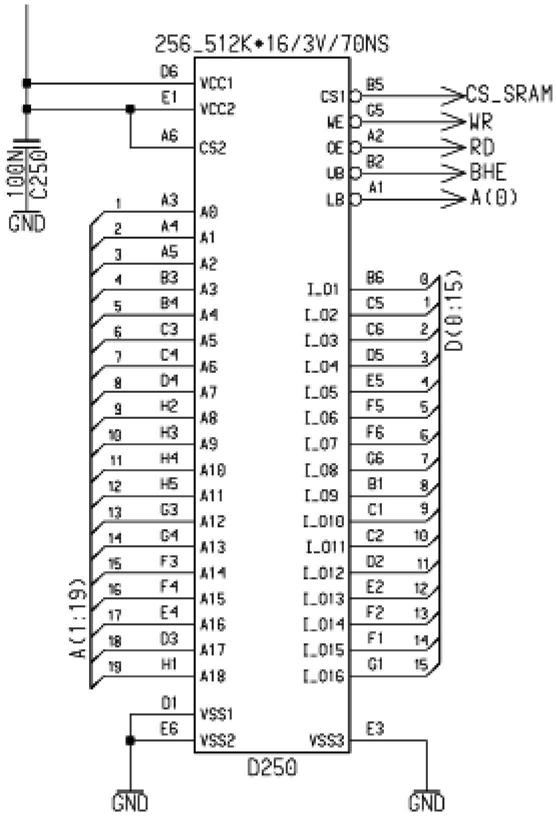




6.5 SRAM

Memory for volatile data.
Memory Size: 4Mbit
Data Bus: 16Bit
Access Time: 70ns

The SRAM (D250) is provided with 2.07V from the ASIC (D361) . It is used from the EGOLD+ to store temporally data.
The communication is controlled and activated from the EGOLD+.

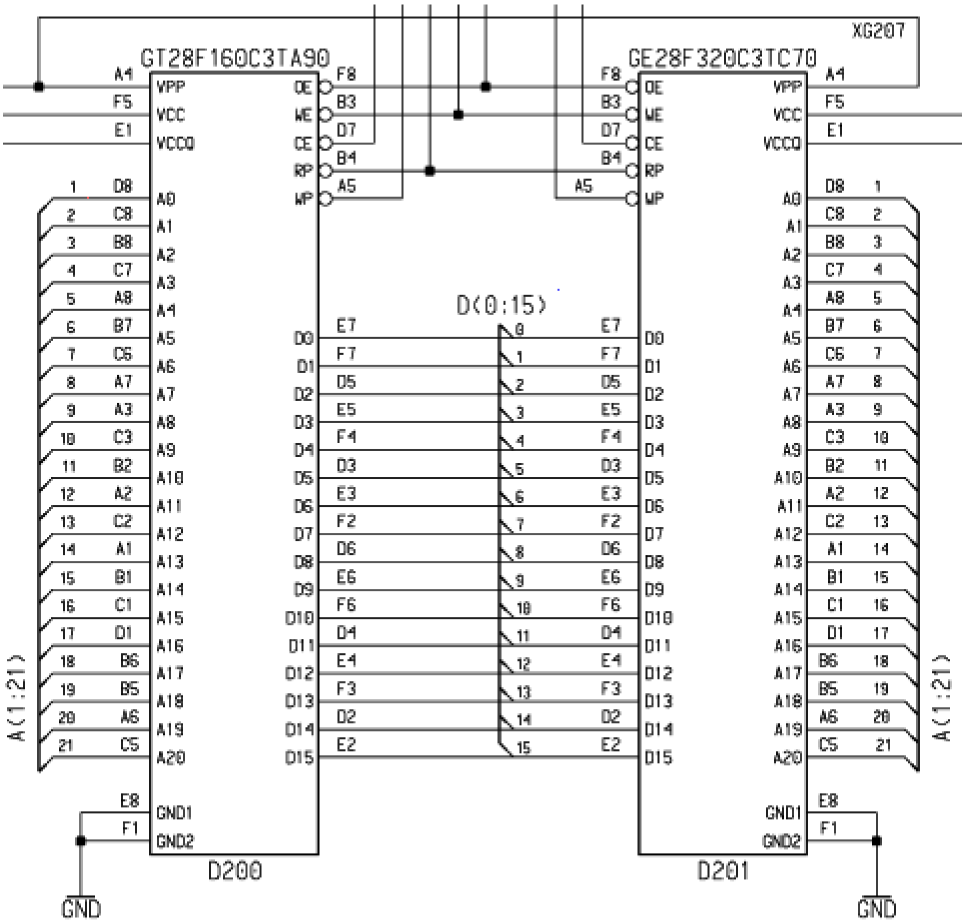


6.6 FLASH

Non-volatile but erasable and re-programmable (software update) program memory (Flash) for the EGOLD and for saving user data (menu settings), linguistic data (voice memo) and mobile phone matching data.
There is a serial number on the flash which cannot be forged.

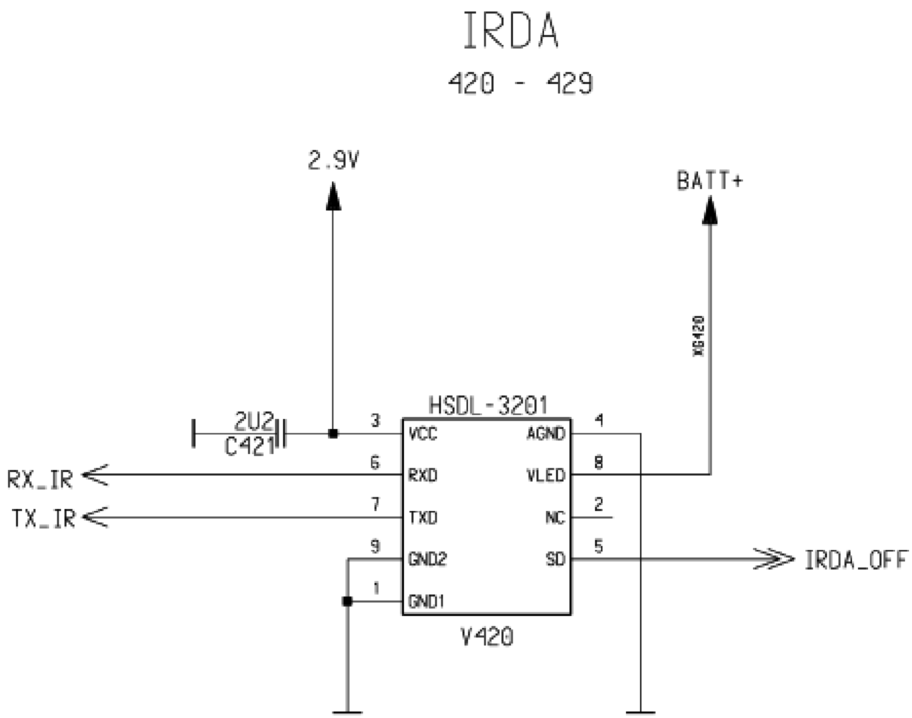
Memory Size: 48 Mbit (32 Mbit + 16 Mbit)

Data Bus: 16 Bit
Access Time: 70ns (32 Mbit)
90ns (16Mbit)
Boot Block: Top



6.7 IRDA

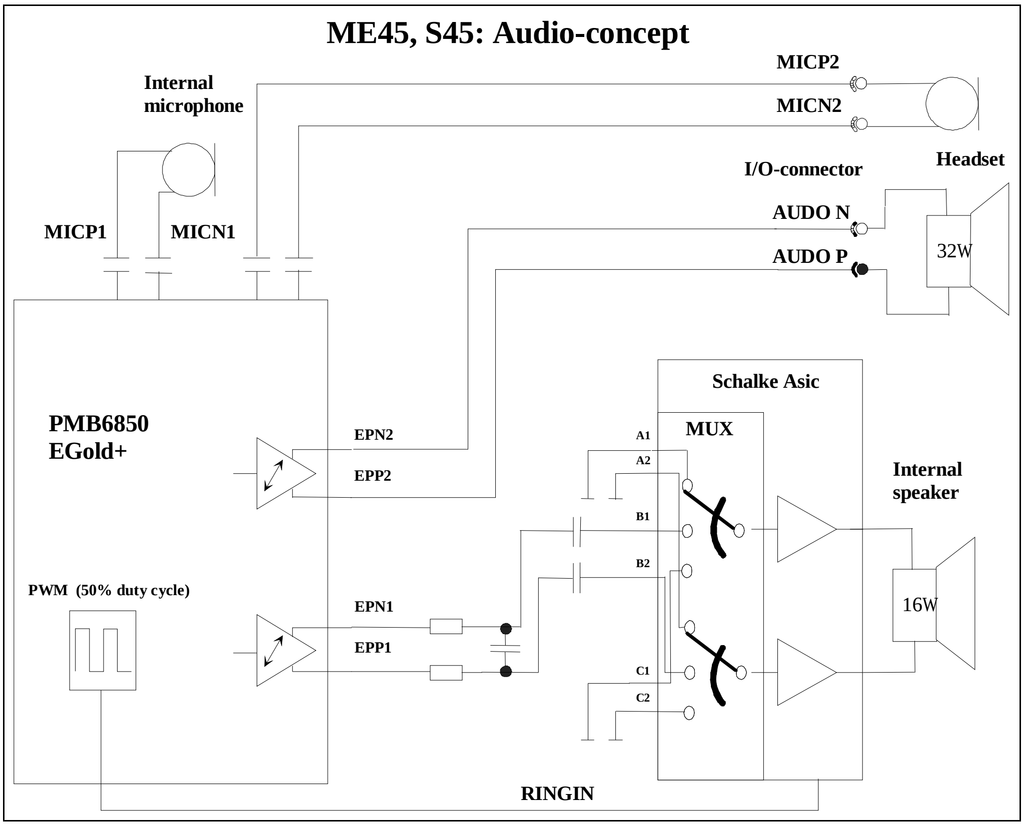
Infrared data interface, compatible with the IrDA-Standard Version 1.2, Low-Power, with a maximum transmission rate of 115.2kbps and a maximum transmission distance of at least 0.3m.



7 Acoustics

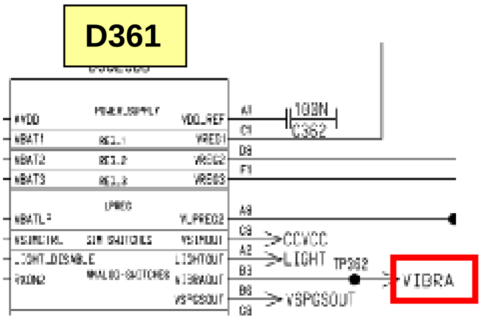
7.1 General

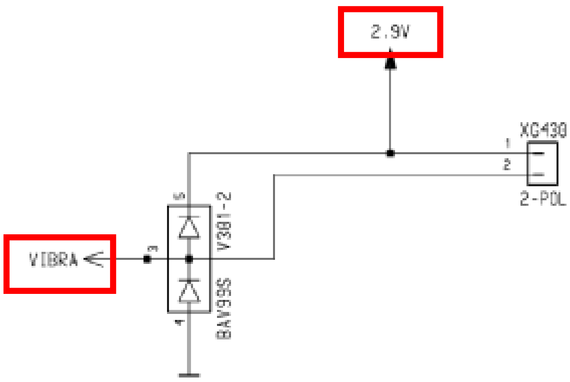
The Electro-Acoustic components are: a) The Vibra
b) The Microphone
c) The Loudspeaker/Ringer

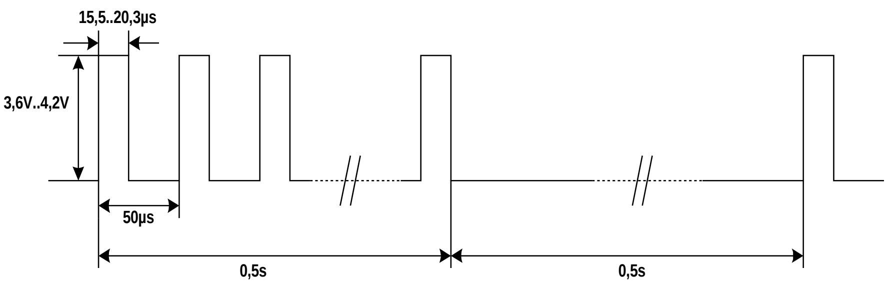


7.2 Vibra

The vibrator is assembled in the lower case shell. The electrical connection is carried out via spring contacts The Vibra is driven and controlled from the power supply ASIC (pin B3)via the signal VIBRA
The vibrator is directly connected to the ASIC´s 2,9V. The diode V301 is used to protect the circuit against over voltage and switching spikes.





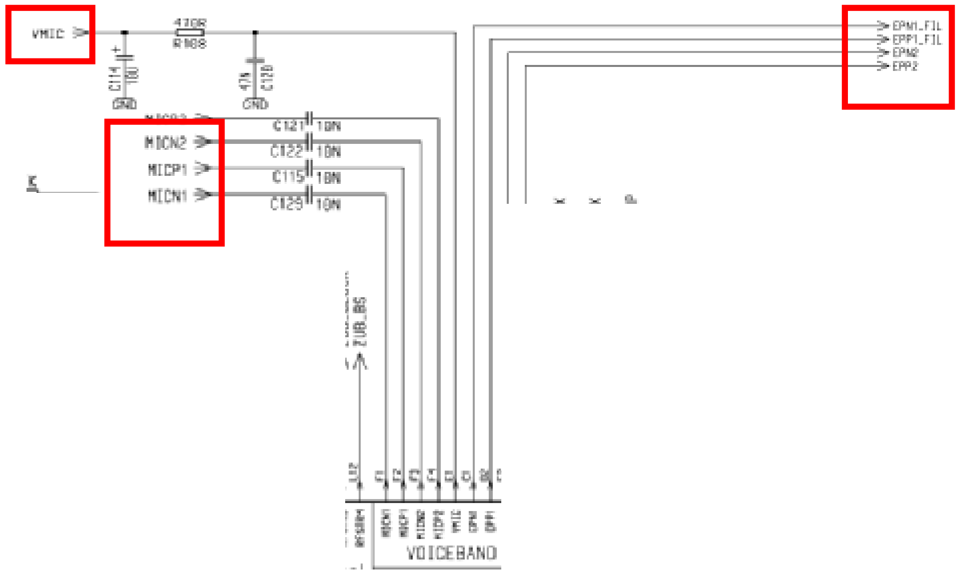


Vibra-Timing

7.3 Microphone and Loudspeaker (Ringer)

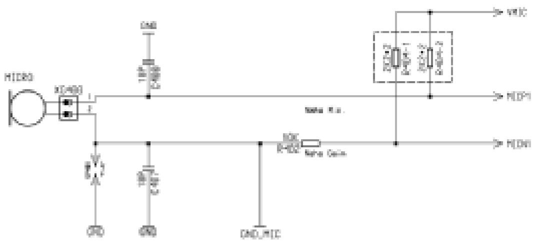
7.3.1 Loudspeaker

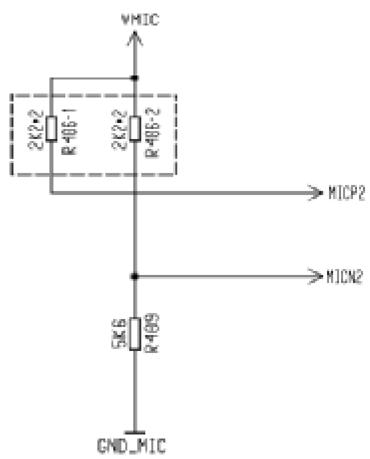
Loudspeaker (EPP1_FIL, EPN1_FIL, EPP2, EPN2) and Microphone (MIC2, MICN2-MICP1, MICN1) are connected directly to the Voiceband-Part of EGOLD+



7.3.2 Microphone

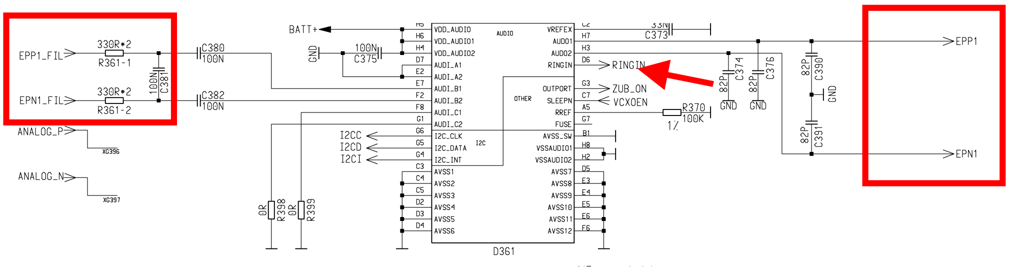
Both Microphones are directly connected to the EGOLD+.(Voiceband F1-F4) via the signals MICN1, MICP1 (Internal Microphone)and MICN2, MICP2 (External Microphone/Headset). Power supply for the Microphone is VMIC (Voiceband E1)

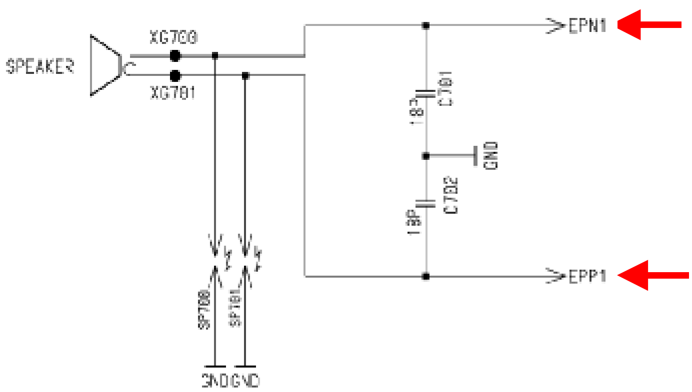




7.3.3 Loudspeaker/Ringer

The internal Loudspeaker (Earpiece) is connected to the voiceband part of the EGOLD+ (VOICEBAND D1,E2) via the mono audio amplifier inside the ASIC (D361). Input EPN1_FIL - EPP1_FIL Output to earpiece EPN1 - EPP1
The ringing tones are generated with the loudspeaker too. To activate the ringer, the signal RINGIN from the EGOLD+ (Miscellaneous,E9) is used

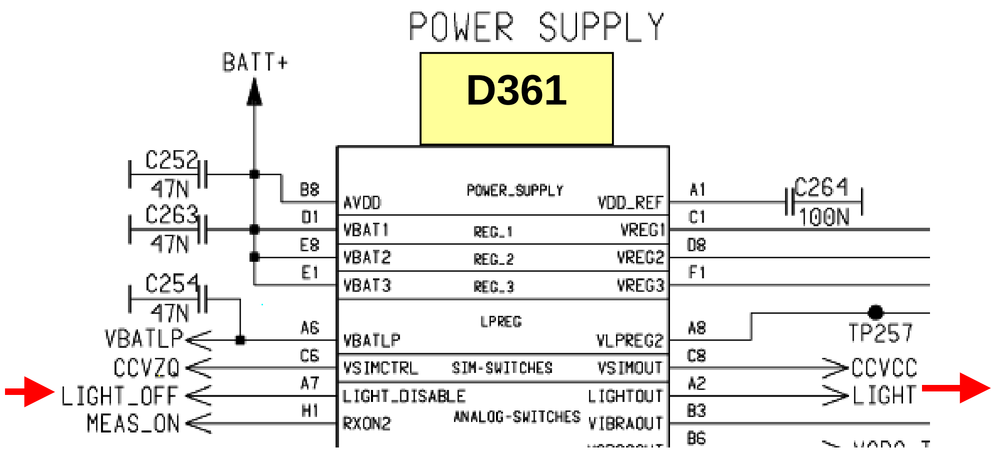


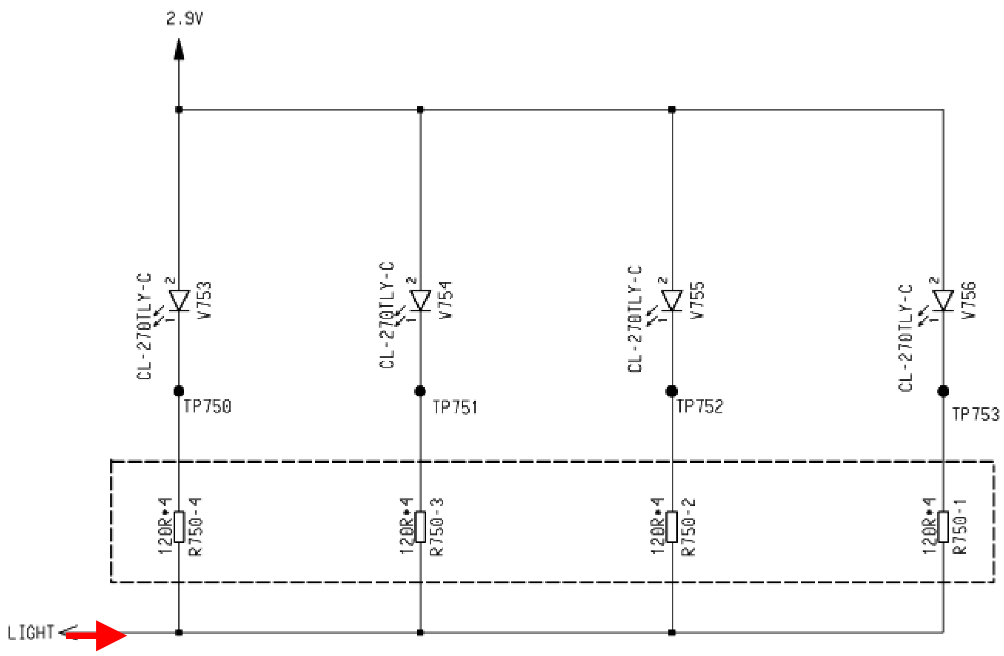


8 Illumination:

8.1 Illumination

The Light is switched via an analogue switch inside the ASIC (D361). It is controlled from the EGOLD+ (TDMA-TIMER,L15) with the signal LIGHT_OFF. Output is the signal LIGHT, which is connected via the MMI connector X550 to the keypad LED´s. and directly to display backlight section

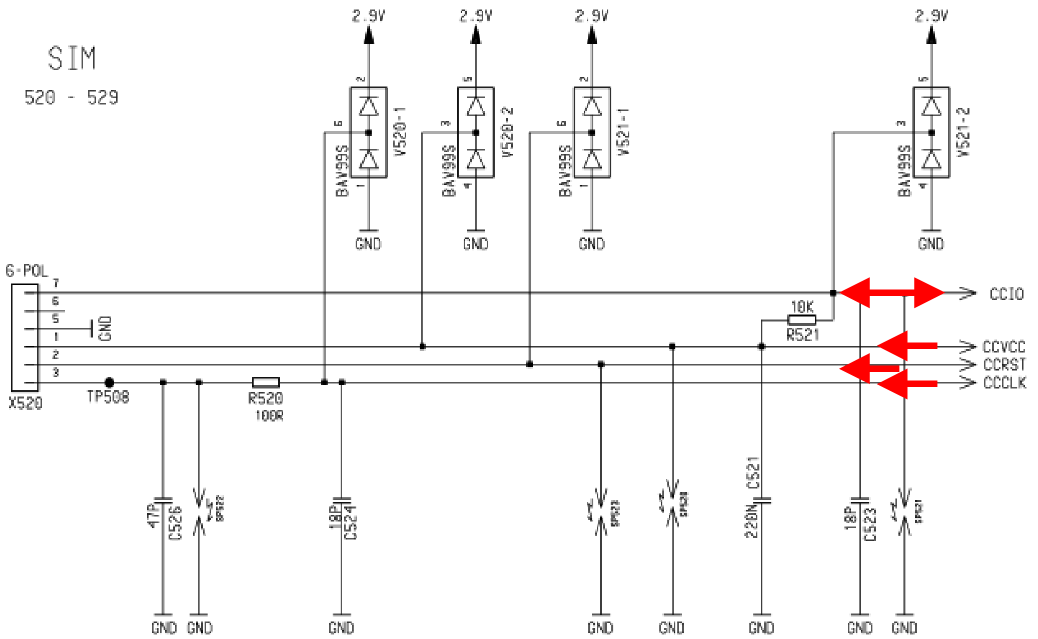


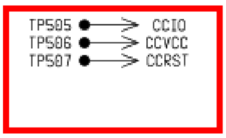


9 SIM-CARD and Connectors

9.1 SIM-Card

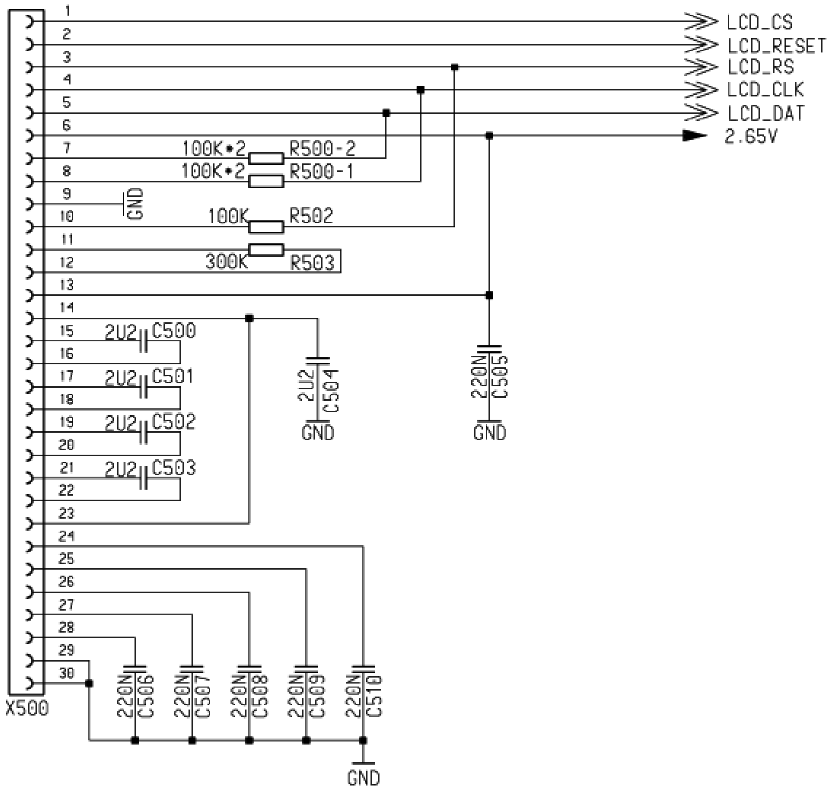
The SIM-CARD is supplied via X520 at pin2 with CCVCC (2,9V) The CCVCC is a ASIC (D361) switched 2,9V voltage, activated by CCVZQ from the EGOLD+(Address-Data G13)
If no SIM-CARD is connected, or if there is no response (CCIO) from the SIM-CARD, the EGOLD+ tries 3 times to connect the SIM-CARD. After this time the EGOLD+ stops trying. That means, if the EGOLD+ is losing the connection while normal operation of the mobile phone, the mobile must be switched off and on again.
The communication between the EGOLD+ and the SIM-CARD is done via the CCIO X520 pin5 by using CCCLK as a clock signal.
The diodes V520/521 are used to protect signal lines versus switching peaks.





9.2 Display connector

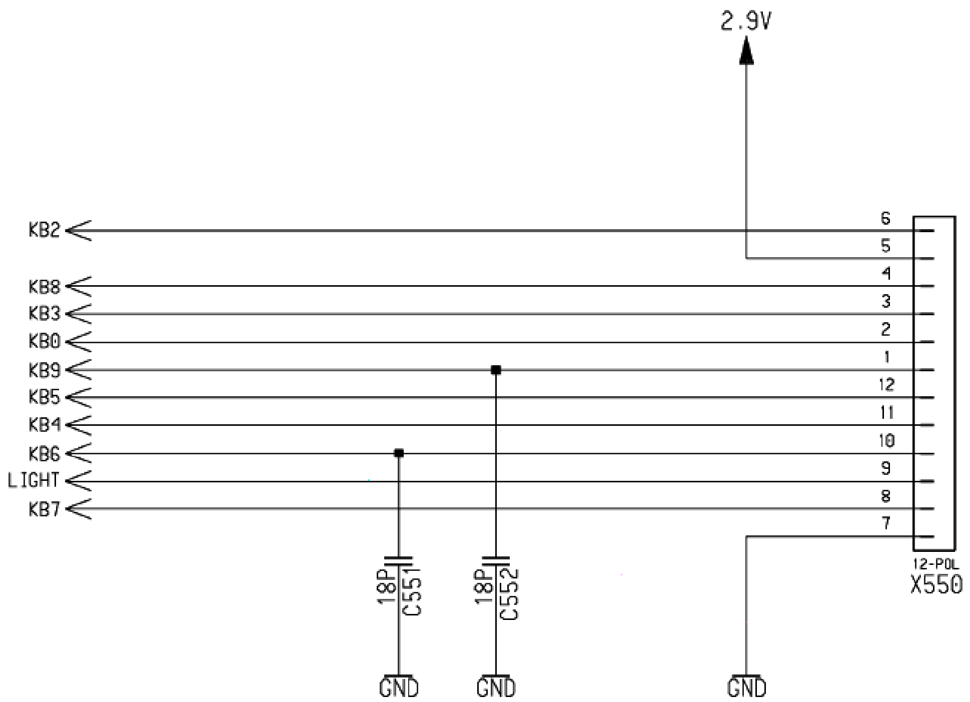
The display is provided with 2,65V from the ASIC (D361). The communication with the EGOLD+ by the LCD-Signals, directly connected to the EGOLD+



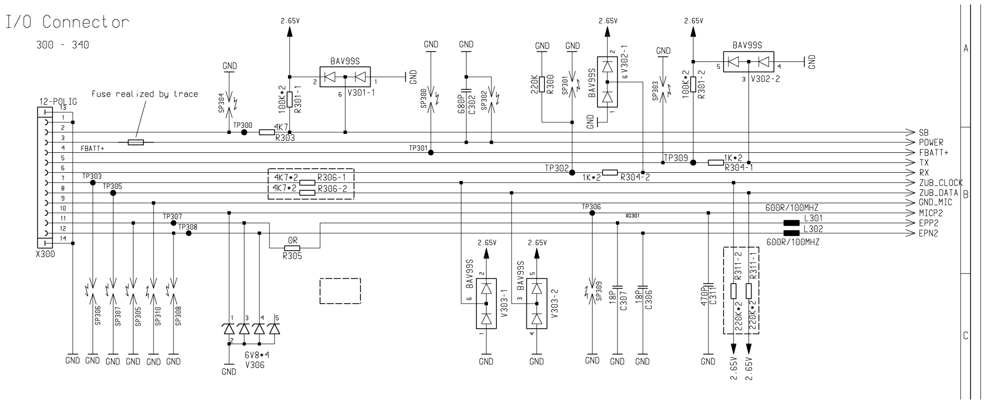
LCD_CS	SIM L9
LCD_RESET	Miscellaneous N7
LCD_RS	Serial-Interface R14
LCD_CLK	Serial-Interface P11
LCD_DAT	Serial-Interface N11

9.3 MMI-Connector

The MMI-Connector is used to connect the additional Keypad-Board with the RF-Board.
Via this connection the Keypad-Board is supplied with 2,9V and the LIGHT Signal for the Keypad-LEDs.
The lines KB2 up to KB9 are directly connected to the EGOLD+ (Keypad)



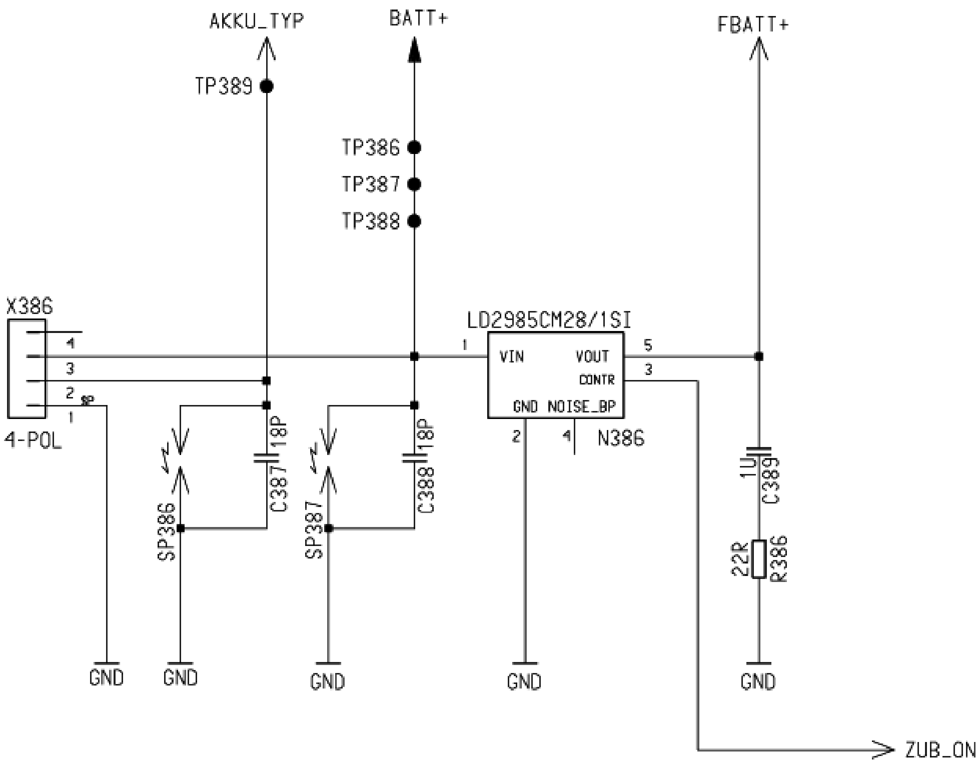
MMI-Connector



Pin	Name	IN/OUT	Notes
1	GND		
2	SB	O	Control line for external power supply
3	POWER	I	Power input from external power supply
4	FBatt+	O	Voltage for external accessories.
5	TX	O	Serial interface
6	RX	I	Serial interface
7	ZUB_CLK	I/O	Clock line for accessory bus Use as DTC In data operation
8	ZUB_DATA	I/O	Data line for accessory bus. Use as CTS in data operation
9	GND_MIC		For external microphone
10	MICP2	I	External microphone
11	EPP2	O	For external loudspeaker
12	EPN2	O	For external loudspeaker

9.4 Battery Connector

The battery is connected via the battery connector (assembled in the lower case shell) to the battery contacts (XG346) on the RF-Board.
Directly connected to battery, there is a voltage regulator (N386). This regulator Is used to provide the external accessories with the required voltage.
To extend STAND-BY time, the regulator is switched on with the signal ZUB_On only if accessories are recognised.
Responsible for the ZUB_ON signal is the ASIC (D361).



Pin	Name	IN/OUT	Notes
1	GND		
2	Akku_Temp	O	Temperature control of the battery pack.
3	Battt +	I/O	Battery voltage

