System Module

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Glossary of Terms

AFC	Automatic Frequency Control
AGC	Automatic Gain Control
CCONT	Multifunction power management IC for DCT3
CHAPS	Charge Control Switch IC
COBBA_GJP	Mixed signal baseband IC for DCT3, includes RFI and PCM-CODEC, this version further supports PHS and Direct Conversion
CTSI	Control, Timing, Sleep mode and Interrupt module of MAD2WD1. This module takes care of a lot of basic control, e.g. the trigging of events at exact clock tic's as programmed in the registers of the CTSI.
DCT3	Digital Core Technology, third generation of cellular technologies
DiCo or DICO	Direct Conversion, will in this document be used for the GEMINI Rfconcept based on the HAGAR ASIC
ECI	External Control Interface, general interface concept that allows various accessories to be connected independent of the transmission bus. The selection of bus is controlled by the connectivity layer part of the ISA concept.
EEPROM	Electrical Erasable Programmable Read Only Memory
E-GSM	Extended GSM, the ordinary GSM band is extended 10 MHz in the low frequency side
FLASH	Re-programmable ROM memory
GEMINI	DCT4 engine program, basic engine design for cellular phones
HAGAR	RF ASIC for the GEMINI Direct Conversion. RF concept. Most RF functions are contained in a single ASIC.
HSCSD	High Speed Circuit Switched Data, data protocol which allows more than one data channel to be assigned to a single user.
ISA	Intelligent Software Architecture, new modular architecture. The resources are organised in logical groups. These groups are controlled by servers handling the tasks asked for by the applications. New applications as well as new resources can in a simple way be added to an existing pool
LNA	Low Noise Amplifier, the first stage of the receive chain. The gain may be reduced in one step
MAD2WD1	Version of MAD2PR1 modified for HSCSD & GPRS, same pin out as MAD2PR1

MFI	Module of MAD2WD1 that takes care of communication with the COBBA, the ASIC containing the RF and the Audio AD and DA converters
PA	Power Amplifier
PHS	Personal Handheld System, a digital cordless phone system originated in Japan
RTC	Real Time Clock
SIM	Subscriber Identity Module, the intelligent card of the GSM
UIF	User Interface module, a module of the MAD2WD1 that controls the interface to various user interface hardware, e.g. keyboard.
VC(TC)XO	Voltage Control (Temperature Compensated) Crystal Oscillator

Baseband

The baseband architecture is a combination of the HD945 and Santeri/HD914 baseband architecture.

The baseband differ from the HD945 phone in not having a slide and roller.

The system specific MCU and DSP are integrated into one ASIC, called the MAD2WD1 Compared to MAD2PR1 from HD945 it holds the following changes:

Flexpool: synthEna2X added to flexpool.

The ARM on the part is able to run at 26MHz, a PLL is included to double the frequency.

A new concept in this product is that only LCD, earpiece, buzzer, vibra and backup battery are placed on the top side of the PCB and they are all connected to the PCB through spring connectors allowing SMD soldering only on the bottom side of the PCB thus doubling the capacity of the production line as only half a SMD line is needed compared to previous programs.

The DICO RF is using 26Mhz to support HSCSD and the BB is using 13Mhz, so in order to derive 13Mhz for the MAD2WD1 it is necessary to add a divider externally to the MAD2WD1.

The HSCSD makes some demands on the power supply as it is using more than one timeslot in a burst. HSCSD is using 2+2 timeslot or 3+1 for data transmission, (Rx+Tx).

The baseband is powered from a 2.8V power rail supplied from a power controlling ASIC (CCONT).

In the CCONT ASIC there are 7 individually controlled regulator outputs for the RF-section and one 2.8V output for the base-band plus a programmable core voltage for MAD2WD1. In addition there is one +5V power supply output. The CCONT also provides a SIM interface supporting 3V and 5V SIM-cards.

The baseband architecture supports a power saving mode called "sleep mode", where a 32kHz clock generated in the CCONT takes over from the VCTCXO.

A real time clock (RTC) function is integrated into the CCONT utilising the same 32kHz clock supply used in sleep mode. A backup power supply is provided for the RTC keeping the real time clock running even when the main battery is removed. The backup power supply is a rechargeable polyacene battery.

The CCONT also supplies backup voltage to the SRAM from this backup battery. The backup time with this battery is min. ten minutes.

The COBBA_GJP ASIC provides A/D and D/A conversion of the in-phase and quadrature receive and transmit signal paths and also A/D and D/A conversions of received and transmitted audio signals to and from the UI parts.

Data transmission between the COBBA_GJP and the MAD2WD1 uses a serial bus structure to exchange RF and Audio signals.

The COBBA_GJP is a triple supply voltage circuit, the digital parts are running from the baseband supply VBB and the analogue parts (RF and Audio) are running from the analogue supply VCOBBA.

COBBA_GJP supports three external microphone inputs and two external earpiece outputs. The inputs can be taken from an internal microphone, a headset microphone or from an external microphone signal source.

Input and output signal source selection and gain control is performed inside the COBBA_GJP ASIC according to control messages from the MAD2WD1.

Keypad tones, DTMF, and other audio tones are generated and encoded by the MAD2WD1 and transmitted to the COBBA_GJP for decoding.

Digital speech processing is handled by the MAD2WD1 ASIC.

MAD2WD1 generates two separate PWM outputs one for a Buzzer and one for an internal VIBRA motor. (A battery pack with vibra will be driven in parallel).

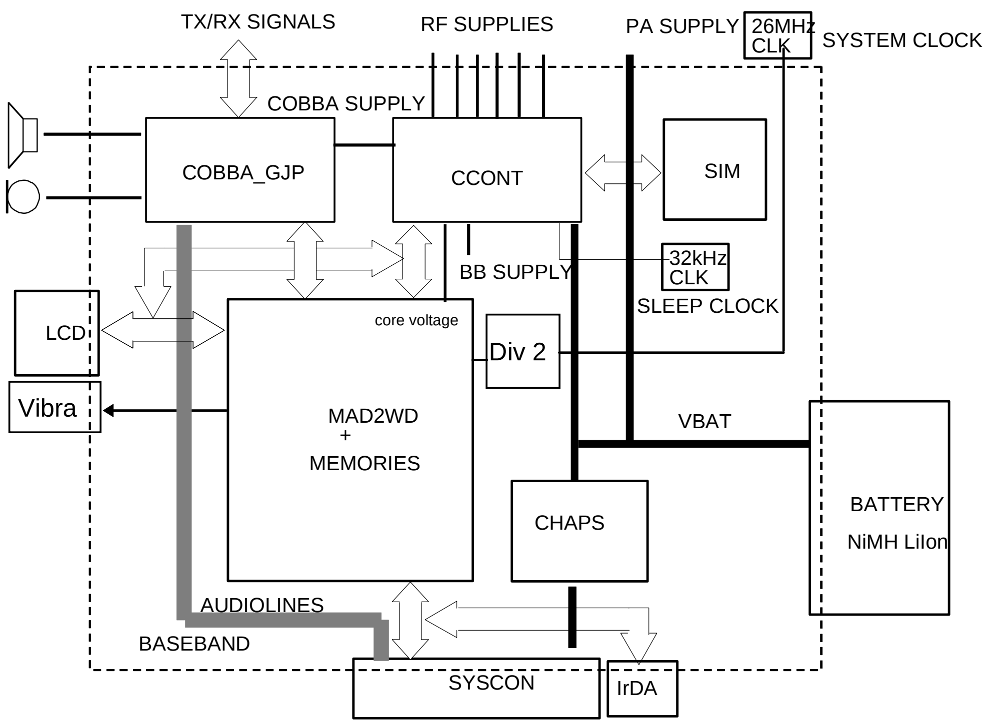


Figure 1: Baseband Block Diagram

The memory configuration in Hda13 is 32Mbit FLASH and 4Mbit RAM.

The EEPROM will be emulated in FLASH as in the HD945 phone. The charger IC, CHAPS, will handle the charging control.

Audio parts

The **Earpiece** is the same 13mm part from Philips as used by HD940, used in an acoustical leak insensitive design based on front-holes and leak-holes. It is driven directly by the COBBA_GJP.

The **Microphone** assembly is based on the one used in HD940 and HD945

The microphone is placed in the system connector and connected to COBBA_GJP in the usual way as HD940.

The **Buzzer** is custom made and is driven from a PWM port on the MAD2WD1through a transistor allowing large current through the coil.

Power consumption

The power consumption of this baseband is not higher than the baseband power consumption in the HD940 phone.

Vibra power specification

The Vibra motor is not allowed to draw more current than 128 mA at a voltage of 1.7V
The maximum voltage across the Vibra must not exceed 5V.

Best performance is obtained at 9000 rpm, typ 1.3V and typ 100mA. Starting voltage min. 0.63V max. 0.78V.

Electrical Interfaces

Contains interface descriptions BB-RF, BB-CONN, BB-LPRF in table form.

Shielding.

Almost all baseband components must be shielded - the only exceptions are specified below:

SIM reader.	Signals to be ESD/EMI protected.
System Connector inputs.	Signals to be ESD/EMI protected.
Battery connections.	Signals to be ESD/EMI protected.
IrDA module.	Signals to be ESD/EMI protected.
Keypads.	Signals to be ESD/EMI protected.
LCD module.	Signals to be ESD/EMI protected.
LED's.	Signals to be ESD/EMI protected.
Buzzer	Signals to be ESD/EMI protected.
Speaker.	Signals to be ESD/EMI protected.
Back-up battery	

Filtering components are to be introduced on all of the above non-shielded signals in order to eliminate ESD and EMC problems.

System Connector

The system connector is re-used form the HD940 and HD945 programs includes the following parts:

DC connector for external plug-in charger and a desktop charger

System connector for accessories and intelligent batteries.

The DLR-3 data cable shall be supported

Omni-directional Microphone

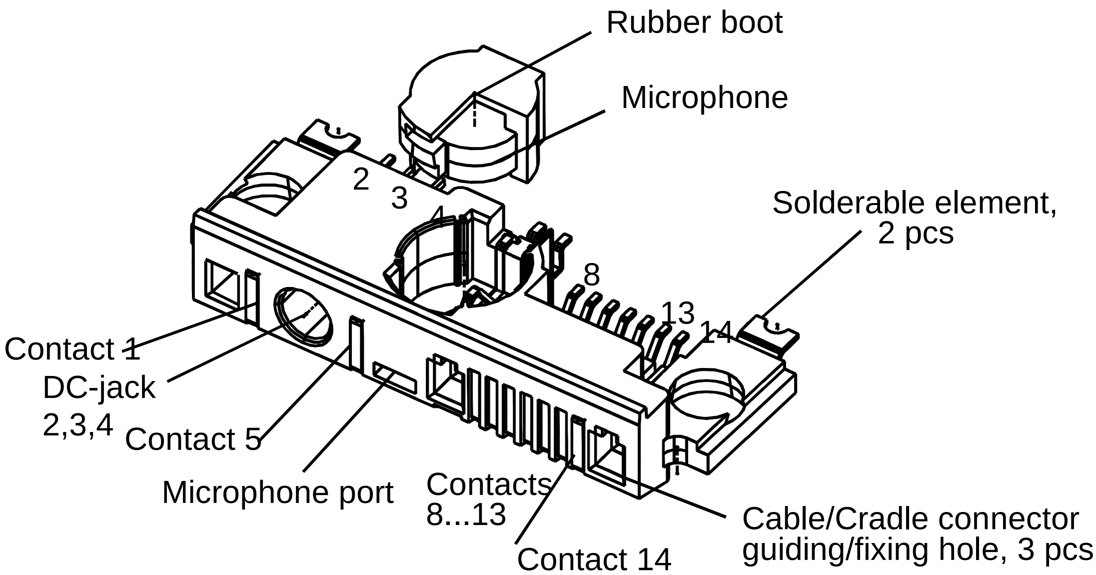


Figure 2: System Connector

Table 1. Signals of the system connector

Pin	Name	Min	Typ	Max	Unit	Notes
1	VIN	0 0		8.5 850	V mA	Unloaded Fast Charger Supply current
		0		15.0 1.0	Vpeak Apeak	Unloaded Standard Charger Supply current
2	GND	0	0	0	V	Supply ground DC Jack
3	VIN	0 0		8.5 850	V mA	Unloaded Fast Charger DC Jack Supply current
4	CHRG_ CTRL	0 1.7		0.8 2.9	V	Charger control (PWM) *dig. Low* DC Jack Charger control (PWM) *dig. High*
		1	32	37	Hz	PWM frequency for a fast charger
		1		99	%	PWM duty cycle
5	CHRG_ CTRL	0 1.7		0.8 2.9	V	Charger control (PWM) *dig. Low* Bottom charger contacts Charger control (PWM) *dig. High*
		1	32	37	Hz	PWM frequency for a fast charger
		1		99	%	PWM duty cycle
6	MICP	0	2	100	mV	Connected to COBBA_GJP MIC2P input.
7	MICN	0	2	100	mV	Connected to COBBA_GJP MIC2N input.
8	XMIC	2.0		2.2	kΩ	Input AC impedance
				1	Vpp	Maximum signal level
		0		1.55	V	Mute (output DC level)
		2.5		2.9	V	Unmute (output DC level)
		100		600	µA	Bias current
	HMIC			200	Ohm- Vpp	Microphone signal Connected to COBBA_GJP MIC3N + 1N input
9	SGND		47		Ohm	Output AC impedance (ref. GND)
			380		Ohm	Resistance to phone ground, return path for XMIC/HMIC. Also used for DLR3 data cable.
10	XEAR		47		Ohm	Output AC impedance (ref. GND)
			10		µF	Series output capacitance
		16		300	Ohm	Load AC impedance to GND (Headset) pin #14
		4.7	10		kΩ	Load AC impedance to GND (Accessory) pin #14
			1.0		Vpp	Maximum output level (no load)

			10		kΩ	Load DC resistance to GND (Accessory) pin #14
		16		1500	Ohm	Load DC resistance to GND (Headset) pin #14
			2.8		V	DC voltage (47k pull-up to VBB)
	HEAR	0	14	220	mV	Earphone signal Connected to COBBA_GJP HF output
11	MBUS	0 2.0		0.8 2.8	V	Serial bidirectional control bus. Baud rate 9600 Bit/s Phone has 4.7kΩ pull up resistor
12	FBUS_RX	0 2.0		0.8 2.8	V	Fbus receive. Serial Data Baud rate 9.6k-230.4kBit/s Phone has 220kΩ pull down resistor
13	FBUS_TX	0.1 1.7		0.8 2.8	V	Fbus transmit. Serial Data Baud rate 9.6k-230.4kBit/s Phone has 47kΩ pull up resistor
14	GND	0		0	V	Supply ground

Interface Base-band to RF

The interface signals between the baseband and the RF section are shown in Table 6 as a logical interface. On the physical board level, baseband supplies voltages from CCONT to the separate RF-subblocks. The maximum values specified for the digital signals in the table are the absolute maximum values from the RF interface point of view.

Table 2. AC and DC Characteristics of RF/BB signal

Signal name	From	Parameter	Min	Typ	Max	Unit	Function
1. VBAT-TRF	BATTERY	Voltage	3.0	3.6	5.0/ 6.0	V	Supply voltage for RF PA
		Current			2500	mA	PA current
2. VREF	CCONT	Voltage	1.478	1.5	1.523	V	Used in HAGAR for the 1.35V reference.
		Current			100	uA	
		Source resistance		10		ohm	
3. SLE	MAD2WD1 SynthEna	Logic high ”1”	2.0		2.8	V	Serial enable, prog HAGAR PCN/GSM TX/RX and synth.

		Logic low "0"	0		0.5	V	
		Current			50	uA	
		Load capacitance			10	pF	
4. SDATA	MAD2WD1 SyntData	Logic high "1"	2.0		2.8	V	Serial data , prog HAGAR PCN/GSM TX/RX and synth.
		Logic low "0"	0		0.5	V	
		Load impedance	10			kohm	
		Load capacitance			10	pF	
		Data rate fre-quency		3.25		MHz	
5. SCLK	MAD2WD1 SynthClk	Logic high "1"	2.0		2.8	V	Serial clk, prog HAGAR PCN/GSM TX/RX and synth.
		Logic low "0"	0		0.5	V	
		Load impedance	10			kohm	
		Load capacitance			10	pF	
		Data rate fre-quency		3.25		MHz	
6. AFC	COBBA_GJP AFCOut	Voltage	0.046		2.254	V	Automatic fre-quency con-trol signal for VCTCXO
		Resolution	11			bits	
		Load resistance (dynamic)	10			kohm	
		Load resistance (static)	1			Mohm	
		Noise voltage			500	uV RMS	10...10000Hz
		Settling time			0.5	ms	

7. RFC	VCTCXO To MAD2WD1 (via divider)	Frequency		26 ±1ppm		MHz	High stability clock signal for the logic circuits
		Signal amplitude	0.5	1.0	2.0	Vpp	
		Load resistance	10			kohm	
		Load capacitance			10	pF	
		Settling time			5	mS	From power on
8/9 . RXI /RXQ	HAGAR COBBA_GJP	Output level		50	1344	MVpp	Differential RX 13 MHz signal to baseband
	RXIP/RXQP	Source impedance			Tbd.	ohm	
		Load resistance		1		Mohm	
		Load capacitance			Tbd.	pF	
10.VREF_RX	COBBA_GJP	Voltage		1.2		V	RX signal reference.
	RxRef	Current		100		uA	Sink or source
		Source resistance			200	ohm	
11/12. TXIP/TXIN	COBBA_GJP	Differential voltage swing	1.022	1.1	1.18	Vpp	Differential in-phase TX baseband signal for the RF modulator
		DC level	0.784	0.8	0.816	V	
		Differential offset voltage (corrected)			+/-2.0	mV	
		Diff. offset voltage temp. dependence			+/-1.0	mV	
		Source impedance			200	ohm	
		Load resistance	40			kohm	
		Load capacitance			10	pF	

		DNL			+/- 0.9	LSB	
		INL			+/-1	LSB	
		Group delay missmatch			100	ns	
13/14. TXQP/ TXQN	COBBA_ GJP	Differential voltage swing	1.022	1.1	1.18	Vpp	Differential quadrature phase TX baseband signal for the RF modulator
		DC level	0.784	0.8	0.816	V	
		Differential offset voltage (corrected)			+/- 2.0	mV	
		Diff. offset voltage temp. dependence			+/- 1.0	mV	
		Source impedance			200	ohm	
		Load resistance	40			kohm	
		Load capacitance			10	pF	
		Resolution	8			bits	
		DNL			+/- 0.9	LSB	
		INL			+/-1	LSB	
		Group delay mismatch			100	ns	
15. TXP	MAD2WD1	Logic high ”1”	2.0		2.8	V	Transmitter power control enable
		Logic low ”0”	0		0.5	V	
		Load Resistance	50			kohm	
		Load Capacitance			10	pF	
		Timing inaccuracy			1	us	

16. TXC	COBBA_ GJP TxCOut	Voltage Min	0.12		0.18	V	Transmitter power control
		Voltage Max	2.27		2.33	V	
		Vout temperature dependence			10	LSB	
		Source impedance active state			200	ohm	
		Source impedance power down state	high Z				
		Input resistance	10			kohm	
		Input capacitance			10	pF	
		Settling time			10	us	
		Noise level			500	uV RMS	0...200 kHz
		Resolution	10			bits	
		DNL			+/-0.9	LSB	
		INL			+/- 4	LSB	
		Timing inaccuracy			1	us	
17. HAGAR RESETX	MAD2WD1	Logic high ”1”	2.0		2.8	V	Active low
		Logic low ”0”	0		0.5	V	
		Load Resistance	50			kohm	
		Load Capacitance			10	pF	
		Timing inaccuracy			1	us	
18. RFTemp	HAGAR	Voltage @ 25°C		1.7		V	
		Temp. coefficient		-2.67		mV/°C	
		Temp. coefficient variation	-10		10	%	

Power supplies for RF/BB							
1. VXO	CCONT VR1	Voltage Current	2.7	2.8 10	2.85 100	V mA	Vvctcxo
2.VRX	CCONT VR2	Voltage Current	2.7	2.8 20	2.85 100	V mA	
3.RAM_ BCK	CCONT VR3	Voltage Current	2.7	2.8	2.85 50	V mA	Backup for RAM
4.VSYN_2	CCONT VR4	Voltage Current	2.7	2.8 50	2.85 100	V mA	
5.VSYN_1	CCONT VR5	Voltage Current	2.7	2.8 20	2.85 100	V mA	
6.VCOBBA	CCONT VR6	Voltage Current	2.7	2.8	2.85 100	V mA	VCOBBA
7.VTX	CCONT VR7	Voltage Current	2.7	2.8 70	2.85 150	V mA	Depends on ext. trans
8. VCP	CCONT V5V	Voltage Current	4.8	5.0	5.2 30	V mA	VSIM and V5V total max 30 mA!
9.VBB	CCONT VBB	Voltage Current	2.7	2.8	2.85 125	V mA	Vbb
10.VIRDA	CCONT VR1_SW	Voltage Current	2.7	2.8	2.85 10	V mA	VIrDA
11.VREF	VREF	Voltage Current	1.478	1.5	1.523 150	V µA	

Maximun total current from all regulators is 330 mA rms!

Serial RF interface

The 20pin parallel MAD2--COBBA_GJ interface is changed to a 5pin serial interface between MAD2WD1 and COBBA_GJP .

Table 3. Serial interface signals

Pin	Width	Purpose
RFIclk	1	13MHz Clock to COBBA_GJP
COBBACSX	1	Chip select for general serial interface
COBBASD	1	Serial data for general interface
Idata	1	Bidirectional transfer of I samples 8bit Tx / 12Bit Rx
Qdata	1	Bidirectional transfer of Q samples 8bit Tx / 12Bit Rx

Flash Programming connections.

Table 4. Flash Programming via the system connector.

Pin	Name	Parameter	Min	Typ	Max	Unit	Remark
1	VIN	Supply Voltage	6.8	7.8	8.8	V	Supply Voltage
2	GND	GND	0		0	V	Supply ground
11	MBUS	Serial clock from the Prommer	2.0 0		2.8 0.8	V	Prommer detection and Serial Clock for synchronous commu-nication
12	FBUS_RX	Serial data from the Prommer	2.0 0		2.8 0.8	V	Receive Data from Prommer to Baseband
13	FBUS_TX	Data acknowl-edge to the Prommer	2.0 0		2.8 0.8	V	Transmit Data from Baseband to Prommer
14	GND	GND	0		0	V	Supply ground

Battery connector

The battery connector and their position in the phone is made so DCT3 battery and accessory packs fit into the phone, and therefore the electrical specification is the same as for HD943, HD941 and HD945 phones.

The electrical specifications for the battery connector are shown overleaf.

The BSI contact on the battery connector is used to detect when the battery is released from the locked position and about to be removed. This will enable shut down of the operations of the SIM card before the power is lost, if the battery is removed with power on.

Table 5. Battery Connector Electrical Specifications

Pin	Name	Min	Typ	Max	Unit	Notes
1	BVOLT	3.0	3.6	4.5 5.0 5.3	V	Battery voltage Maximum voltage in call state with charger Maximum voltage in idle state with charger
2	BSI	0		2.8	V	Battery size indication Phone has 100kohm pull up resistor. SIM Card removal detection (Threshold is 2.4V@VBB=2.8V)
		0	1	1.5	kΩ	Battery size indication resistor (Alkaline)
		2.2		18	kΩ	Battery size indication resistor (NiMH battery)
		20	22	24	kΩ	Battery size indication resistor (service battery)
		27		82	kΩ	Battery voltage indication resistor (Lithium battery)
		-5		5	%	Indication resistor tolerance (pull-down in battery)
		-1		1	%	Pull-up resistor tolerance (100kΩ in phone)
3	BTEMP	0.1		1.4	V	Battery temperature indication Phone has 100kΩ ±1% pull-up resistor, Battery package has NTC pull down resistor: @+25C 47k 5%, B=4050±1.5%
		2.1 0 5	 10	3 0.5 20	V V ms	Phone power up by accessory (input) Input low no action Power up pulse width
		1.9 0 90	 100	3.0 1.4 200	V V ms	Accessory power up by phone (output) Accessory low input, no action Power up pulse width
		0		1	kΩ	Fast power up (in production) Pull-down in battery
		20	22	25	kHz	PWM control to VIBRA BATTERY
4	GND	0		0	V	Battery ground

The vibra in the battery is controlled with one PWM signal by the MAD2WD1 via the BTEMP battery terminal.

SIM card connector

Only small 3 and 5V SIM cards are supported.

Table 6. SIM Connector Electrical Specifications

Pin	Name	Parameter	Min	Typ	Max	Unit	Notes
1	GND	GND	0		0	V	Ground
2	VSIM	3V SIM Card 5V SIM Card	2.8 4.8	3.0 5.0	3.2 5.2	V	Supply voltage
3	DATA	3V Vin/Vout 5V Vin/Vout	2.8 0 4.0 0		VSIM 0.5 VSIM 0.5	V	Vhigh Vlow SIM data Trise/Tfall max 1us Vhigh Vlow SIM data Trise/Tfall max 1us
4	SIMRST	3V SIM Card 5V SIM Card	2.8 4.0		VSIM VSIM	V	SIM reset
5	SIMCLK	Frequency Trise/Tfall		3.25	 25	MHz ns	SIM clock
6	VPP	3V SIM Card 5V SIM Card	2.8 4.8	3.0 5.0	3.2 5.2	V	Programming voltage pin6 and pin2 tied together

VSIM supply voltages are specified to meet type approval requirements regardless of the tolerances of the components used.

Infrared interface module

The IrDA module TFDU4100 from HDS940 and HD945 is also used here.

The module is activated through the Virda power signal from the CCONT. (standby current in shut down mode is specified to 10uA maximum).

The RX and TX signals are connected to the MAD2WD1 accessory interface AccIf via FBUS. The AccIf in MAD2WD1 performs pulse encoding and shaping for transmitted data and detection and decoding for received data pulses.

The data is transferred over the IR link using serial FBUS data at speeds 9.6, 19.2, 38.4, 57.6 or 115.2 kbits/. The used IR module complies with the IrDA SIR specification (Infra-Red Data Association), which is based on the HP SIR (Hewlett-Packard's Serial InfraRed) concept, IrDA 1.0.

The FBUS cannot be used for real cable accessory communication when the infrared mode is selected. The infrared communication reserves the FBUS completely

Interface Base-band to LCD module

The LCD is based on a HD940 type of LCD module but with a higher resolution of 96x60 pixels. The driver has the same interface as the HD940 driver but is able to address the extra pixels.

Table 7. Requested module interface

Pin	Signal	Sym-bol	Parameter	Min.	Typ.	Max.	Unit	Notes
1	VL		Supply voltage	2.7	2.8	3.3	V	
						250	µA	+25 °C, VL=2.85 V, LCDCSX is dis-abled with Special Test Pattern –
						250	µA	+25 °C, Worst case, Checker-board - s
2	SCLK	f_{EXT}	Serial clock input	0		4.00	MHz	
		tscyc		250			ns	
		tshw		100			ns	
		tslw		100			ns	
3	SDA	tsds	Serial data input	100			ns	
		tsdh		100			ns	
4	LCDCDX	tsas	Control/display data flag input	100			ns	Setup time
		tsah		100			ns	Hold time
				LOW				Control data
						HIGH		Display data
5	LCDCSX	tcss	Chip select input	60			ns	
		tcsh		100			ns	
				0.7xVL			V	Logic high
						0.3xVL	V	Logic low, active
6	UDGND	GND	Ground		0		V	In LCD interface
7	VOUT		LCD output voltage			9	V	
8	LCDRSTX		Reset			0.3xVL	V	Logic low, active
		trw		100			ns	for valid reset

Real Time Clock

The real time functions in the CCONT are the basic clock and alarm functions. The calendar functions are implemented in MCU software.

Audio connections

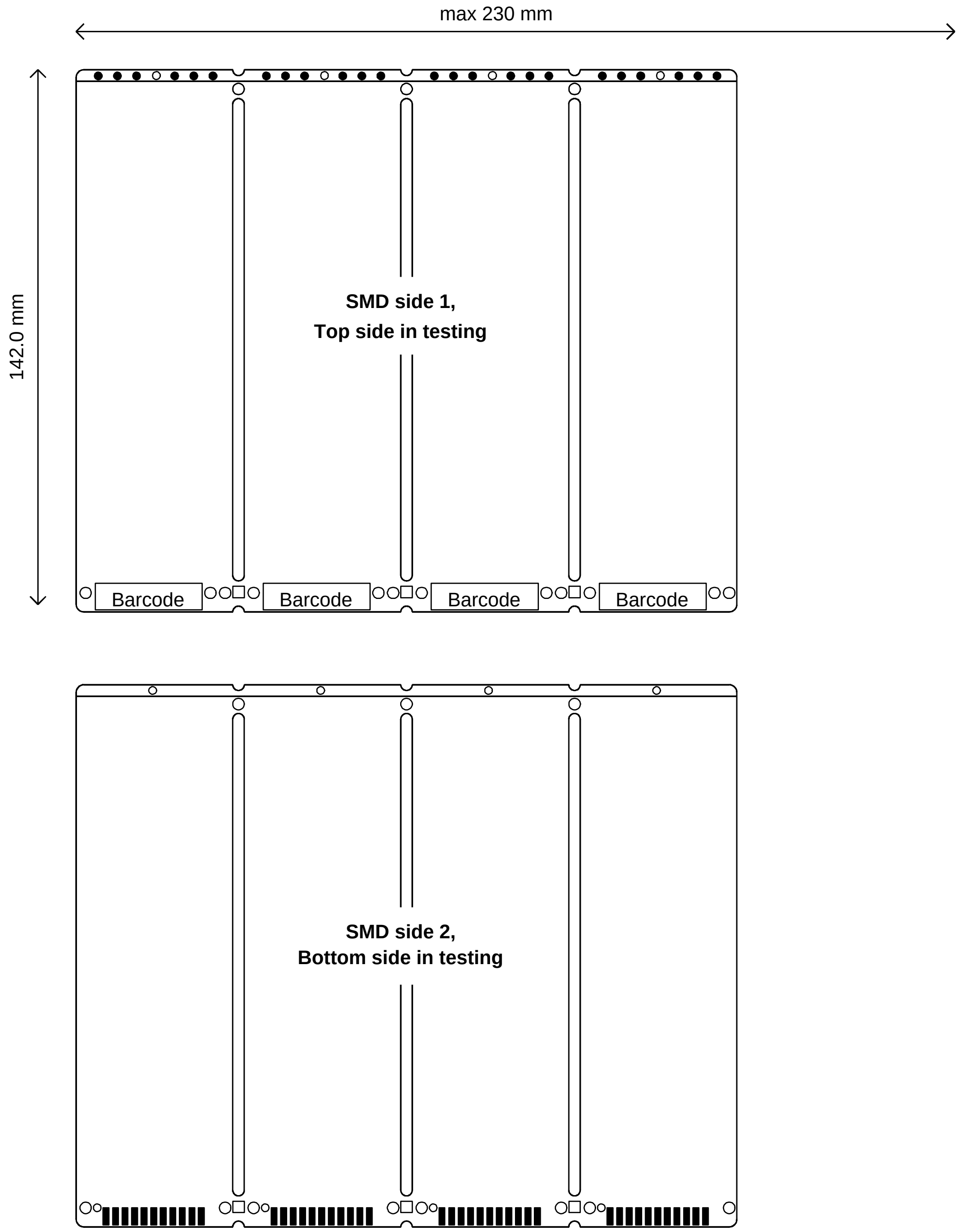
Table 8. Internal Audio, Electrical specifications

Pin	Name	Min	Typ	Max	Unit	Remark
n/a	EARN	0	14	220	mV	Connected to COBBA_GJP EARN output. Typical level corresponds to -16 dBm0 network level with volume control giving nominal RLR (=+2dB) 8 db below max. Max level is 0dBmO with max. volume (codec gain -11 dB)
n/a	EARP	0	14	220	mV	Connected to COBBA_GJP EARP output. Typical level corresponds to -16 dBm0 network level with volume control giving nominal RLR (=+2dB) 8 db below max. Max level is 0dBmO with max. volume (codec gain -11 dB)
6 on sys. conn.	MICP	0	2	12.5	mV	Connected to COBBA_GJP MIC2P input. The maximum value corresponds to1 kHz, 0 dBm0 network level with input amplifier gain set to 32 dB. Typical value is maximum value - 16 dB.
7on sys. conn.	MICN	0	2	12.5	mV	Connected to COBBA_GJP MIC2N input. As above.

Note: Table 9 and 10 are for production use and are included for information purposes only

Table 9. Production Test interface. (for production use only)

Pin	Name	Description
1	FBUS_TX	Serial Data Out / Flash Programming Transmit Data.
2	FBUS_RX	Serial Data In / Flash Programming Input Data.
3	MBUS	Bidirectional Serial Bus / Flash Programming Serial Clock.
4	XEAR	Analog Audio Output.
5	SGND	Audio Signal Ground.
6	XMIC	Analog Audio Input.
7	L_GND	Charger Ground.
8	VPP_GND	FLASH VPP Ground. To be grounded whenever 12V applied to VPP
9	V_IN	Charging Voltage.
10	VPP	Flash Programming Voltage.
11	WDDIS	Watchdog Disable.



The Flash is controlled by the MAD as a write enable signal. This control will handle EEPROM access and all re-programming in After Sales. The programming can be made through the standard DCT3 connector in the bottom and IBI connectors. No external programming voltage source is needed.

On the production line during FlashAlignment the Vpp is routed to the panel contacts and can be “isolated” from the MAD-Vpp by means of two resistors with their midpoint grounded in the production tester. This solution allows 12 V flashing voltage to be used to speed up the Flash programming in production.

Table 10. Flash programming signals with respective system connector pins (for production use only)

Pin	Name	Min	Typ	Max	Description	
14	GND	0 V		0 V		Digital ground.
	VDD	3.0 V		5.3 V	Connected to VBAT	Supply voltage.
11	SCLK	0 V		0.8 V	Low level	Serial clock.
		2.0 V		2.8 V	High level	
13	TXDBF	0 V		0.8 V	Low level	Data transmission from engine to Flash programmer.
		2.0 V		2.8 V	High level	
12	TXDFB	0 V		0.8 V	Low level	Data reception from Flash programmer to engine.
		2.0 V		2.8 V	High level	
	VPP	0 V		1.2 V	Inactive	
		1.65 V	12 V	12.6 V	Active	External 12 V programming voltage or internal logic enable.
	WDGD	0 V		0.8 V		Watchdog disable.

RF Module

This RF module takes care of all RF functions of EGSM/DCS1800 dualband engine. RF circuitry is located on one side of the 8-layer transceiver-PCB. PCB area for the RF circuitry is about 15 cm2. The RF design is based on the first dualband direct conversion RF-IC "Hagar". So there is no intermediate frequency and that means the number of component is much lower than before and therefore much less interference problems than previously.

EMC emissions are taken care of using metal shielding cans, which screens the whole transceiver. Internal screening is realized by separating different sections of the RF by shielding cans. The VCO is isolated from Hagar and external components by a wall in the Hagar shielding can and PA, RX/TX Switch and LNA's are located in a separate can. The baseband circuitry is located on the same side of the same board, but in a separate shielding can.

Maximum Ratings

Parameter	Rating
Battery voltage, idle mode	5.2 V (charging)
Regulated supply voltage	2.8 +/- 3% V
Voltage reference	1.5 +/- 1.5% V
Operating temperature range	-10...+55 deg. C
Absolute maximum battery voltage	4.2 V (charging)

RF Characteristics

Item	Values (EGSM / DCS1800)
Receive frequency range	925 ... 960 MHz / 1805 ... 1880 MHz
Transmit frequency range	880 ... 915 MHz / 1710 ... 1785 MHz
Duplex spacing	45 MHz / 95 MHz
Channel spacing	200 kHz
Number of RF channels	174 / 374
Power class	4 (EGSM900) / 1 (DCS1800)
Number of power levels	15 / 16

RF Frequency Plan

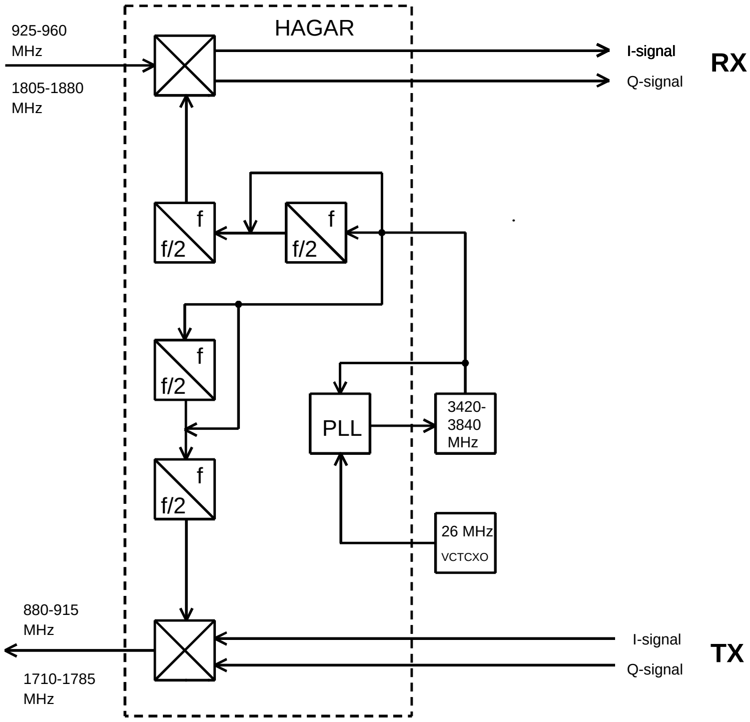


Figure 3: RF Fequency Plan

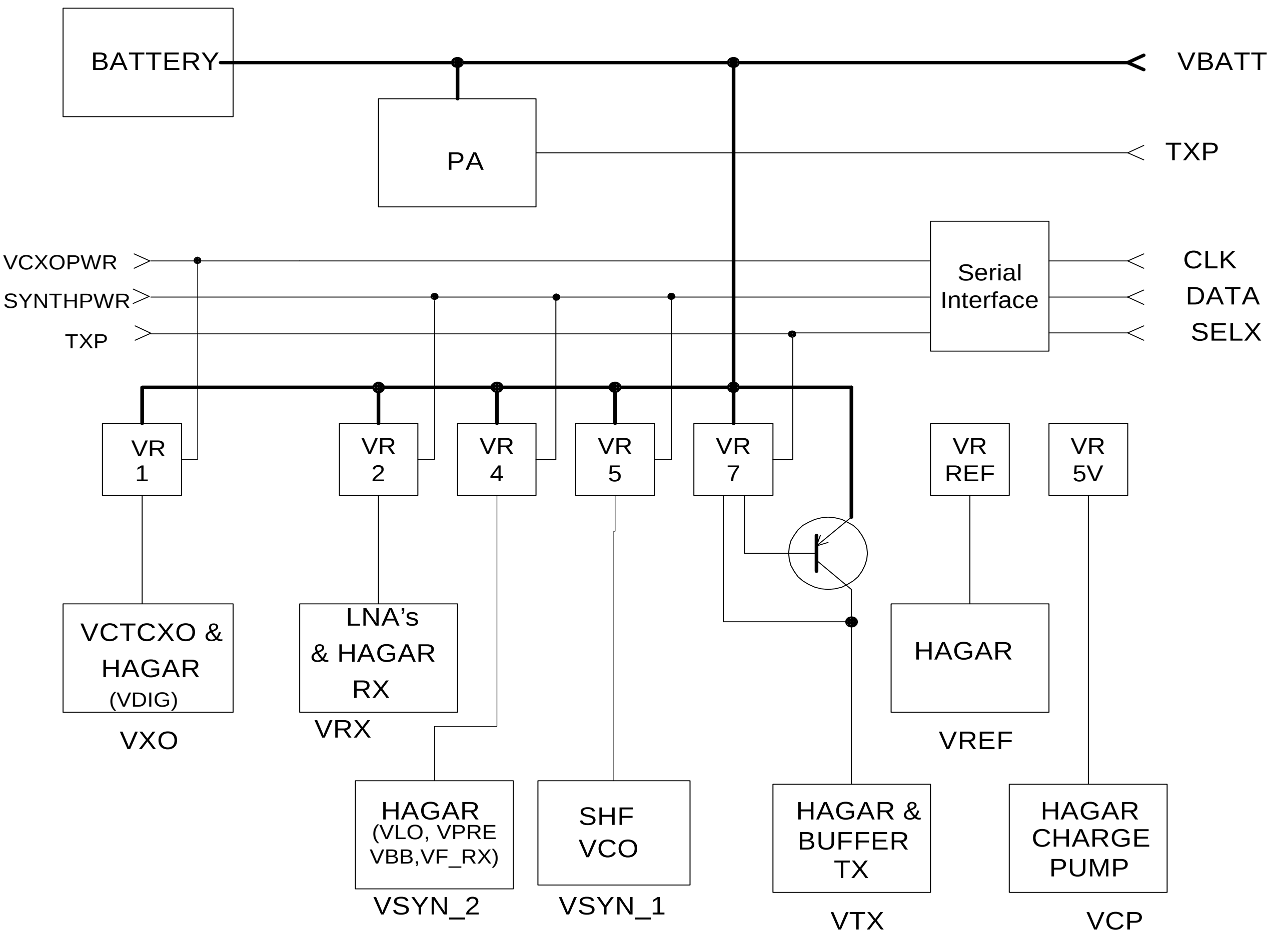
DC characteristics

Regulators

Transceiver has a multi function power management IC at baseband section, which contains among other functions, also 7 peace's of 2.8 V regulators. All regulators can be controlled individually with 2.8 V logic directly or through control register. In GSM direct controls are used to get fast switching, because regulators are used to enable RF-functions.

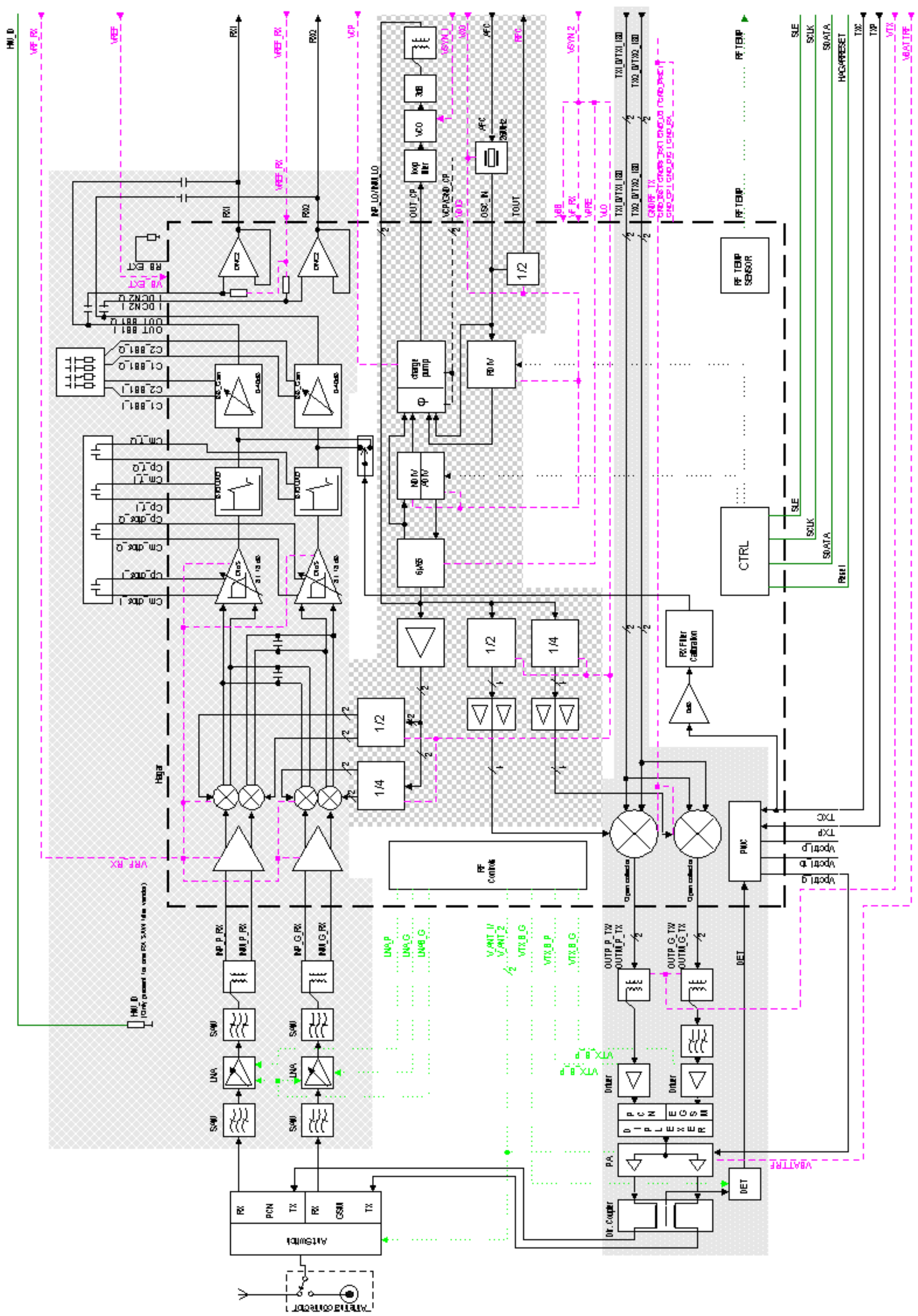
VREF from CCONT IC and VREF RX from COBBA IC are used as the reference voltages for HAGAR RF-IC, VREF (1.5V) for bias reference and VREF RX (1.2V) for RX ADC's reference.

Power Distribution Diagram



RF Functional Description-Diagram

Architecture contains one RF-IC, dualband PA module, VCO-module, VCTCXO module and discrete LNA stages for both receive bands.



Frequency Synthesizer

VCO frequency is locked with PLL into stable frequency source, which is a VCTCXO-module (voltage controlled temperature compensated crystal oscillator). VCTCXO is running at 26 MHz. Temperature effect is controlled with AFC (Automatic Frequency Control) voltage. VCTCXO is locked into frequency of the base station. AFC is generated by baseband with an 11 bit conventional DAC in COBBA.

PLL is located in HAGAR RF-IC and is controlled via serial bus from COBBA-IC (baseband).

There are 64/65 (P/P+1) prescaler, N- and A-divider, reference divider, phase detector and charge pump for the external loop filter. SHF local signal, generated by a VCO-module (VCO = voltage controlled oscillator), is fed to prescaler. Prescaler is a dual modulus divider. Output of the prescaler is fed to N- and A-divider, which produce the input to phase detector. Phase detector compares this signal to reference signal (400kHz), which is divided with reference divider from VCTCXO output. Output of the phase detector is connected into charge pump, which charges or discharges integrator capacitor in the loop filter depending on the phase of the measured frequency compared to reference frequency.

Loop filter filters out the pulses and generates DC control voltage to VCO. Loop filter defines step response of the PLL (settling time) and effects to stability of the loop, that's why integrator capacitor has got a resistor for phase compensation. Other filter components are for sideband rejection. Dividers are controlled via serial bus. SDATA is for data, SCLK is serial clock for the bus and SENA1 is a latch enable, which stores new data into dividers.

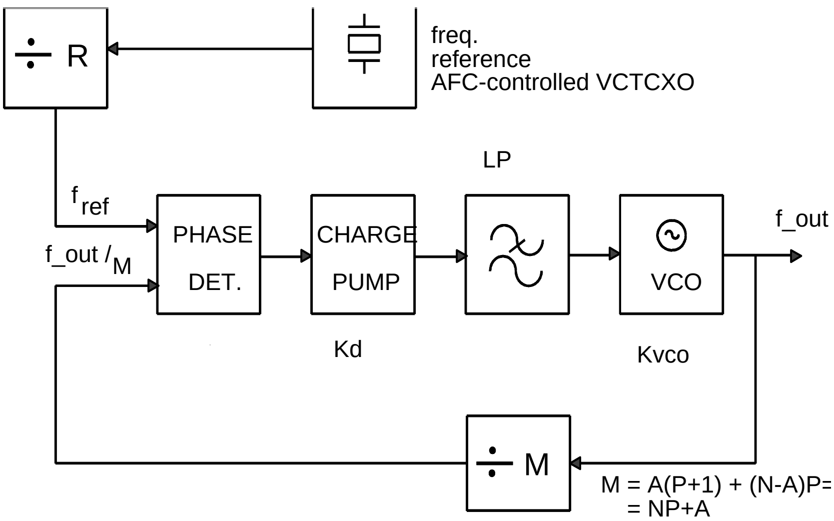


Figure 4: Frequency Synthesiser

LO-signal is generated by SHF VCO module. VCO has double frequency in DCS1800 and x 4 frequency in EGSM compared to actual RF channel frequency. LO signal is divided by two or four in HAGAR (depending on system mode).

Receiver

The receiver is a direct conversion, dualband linear receiver. Received RF-signal from the antenna is fed via RX/TX switch to 1st RX SAW filter and LNA's (low noise amplifier), separate branches for EGSM900 and DCS1800. Gain selection control of LNA's comes from HAGAR IC. Gain step is activated when RF-level at the antenna (or RF connector) is about -45 dBm.

After the LNA the amplified signal (with low noise level) is fed to bandpass filter (2nd RX SAW filter). RX bandpass filters defines how good supperssion of blocking signals outside receive band and the protection against spurious responses.

After the bandpass filters the signals are fed to baluns which converts the single ended signal to ballanced. The ballanced signal is fed to the RF input of Hagar. Differential RX signal is amplified and mixed directly down to BB frequency in HAGAR. Local signal is generated with external VCO. VCO signal is divided by 2 (DCS1800) or by 4 (EGSM900). PLL and dividers are in HAGAR-IC.

From the mixer output to ADC input RX signal is divided into I- and Q-signals. Accurate phasing is generated in LO dividers. After the mixer DTOS amplifiers convert the differential signals to single ended. DTOS has two gain stages. The first one has constant gain of 12dB and 85kHz cut off frequency. The gain of second stage is controlled with control signal g10. If g10 is high (1) the gain is 6dB and if g10 is low (0) the gain of the stage is -4dB.

The active channel filters in HAGAR provides selectivity for channels (-3dB @ +/-100 kHz typ.). The integrated base band filter is an active-RC-filter with two off-chip capacitors. Large RC-time constants are needed in the channel select filter of the direct conversion receiver. These are produced with large off-chip capacitors. The Baseband filter consists of two stages, DTOS and BIQUAD. The DTOS is a differential to single-ended converter having 8dB or 18dB gain. The BIQUAD is modified Sallen-Key Biquad.

Integrated resistors and capacitors are tunable. These are controlled with a digital control word via Hagar serial interface. The correct control words that compensate for the process variations of integrated resistors and capacitors and of tolerance of off chip capacitors are found during RX filter calibration.

Next stage in the receiver chain is the AGC-amplifier, also integrated into HAGAR. The AGC has digital gain control via serial mode bus from COBBA IC. The AGC-stage provides gain control range (40 dB, 10 dB steps) for the receiver and also the necessary DC compensation. One 10 dB AGC step is implemented in DTOS stages.

DC compensation is made during DCN1 and DCN2 operations (controlled via serial bus). DCN1 is carried out by charging the large external capacitors in the AGC stages to a voltage which cause a zero dc-offset. DCN2 set the signal offset to constant value (VREF RX 1.2 V). The VREF RX signal (from COBBA GJP) is used as a zero level to RX ADCs.

Single ended filtered I/Q-signal is then fed to ADCs in COBBA-IC. Input level for ADC is 1.4 Vpp max.

Transmitter

Transmitter chain consists of final frequency IQ-modulator, dualband power amplifier and a power control loop.

I- and Q-signals are generated by baseband also in COBBA-ASIC. After post filtering (RC-network) they go into IQ-modulator in HAGAR. LO-signal for modulator is generated by VCO and is divided by 2 or by 4 depending on system mode, EGSM/DCS1800. After modulator the TX-signal is amplified and buffered. There are separate outputs for both EGSM and DCS1800. HAGAR TX output level is 5 dBm minimum.

Next TX signals are converted to single ended by discrete baluns. Then TX signals are amplified and buffered in discrete buffers. After the buffers EGSM and DCS1800 signals are combined in a diplexer. In EGSM branch there is a SAW filter after the balun to attenuate unwanted signals and wideband noise from the Hagar IC.

The final amplification is realized with dualband power amplifier. It has one 50 ohm input and two 50 ohm outputs. There is also a gain control, which is controlled with a power control loop in HAGAR. PA is able to produce over 2 W (3 dBm input level) in EGSM band and over 1 W (6 dBm input level) in DCS1800 band into 50 ohm output. Gain control range is over 35 dB to get desired power levels and power ramping up and down.

Harmonics generated by the nonlinear PA are filtered out with the diplexer inside the RX/TX switch-module. Finally the TX signals goes through the DCT-3 RF connector to the internal antenna.

Power control circuit consists of discrete power detector (common for EGSM and DCS1800) and error amplifier in HAGAR. There is a directional coupler connected between PA output and RX/TX switch. It is a dualband type and has input and outputs for both systems. Dir. coupler takes a sample from the forward going power with certain ratio. This signal is rectified in a schottky-diode and it produces a DC-signal after filtering.

This detected voltage is compared in the error-amplifier in HAGAR to TXC-voltage, which is generated by DA-converter in COBBA. TXC has got a raised cosine form ($\cos^4$ - function), which reduces switching transients, when pulsing power up and down. Because dynamic range of the detector is not wide enough to control the power (actually RF output voltage) over the whole range, there is a control named TXP to work under detected levels. Burst is enabled and set to rise with TXP until the output level is high enough, that feedback loop works. Loop controls the output via the control pin in PA to the desired output level and burst has got the waveform of TXC-ramps. Because feedback loops could be unstable, this loop is compensated with a dominating pole. This pole decreases gain on higher frequencies to get phase margins high enough. Power control loop in HAGAR has two outputs, one for each freq. band.

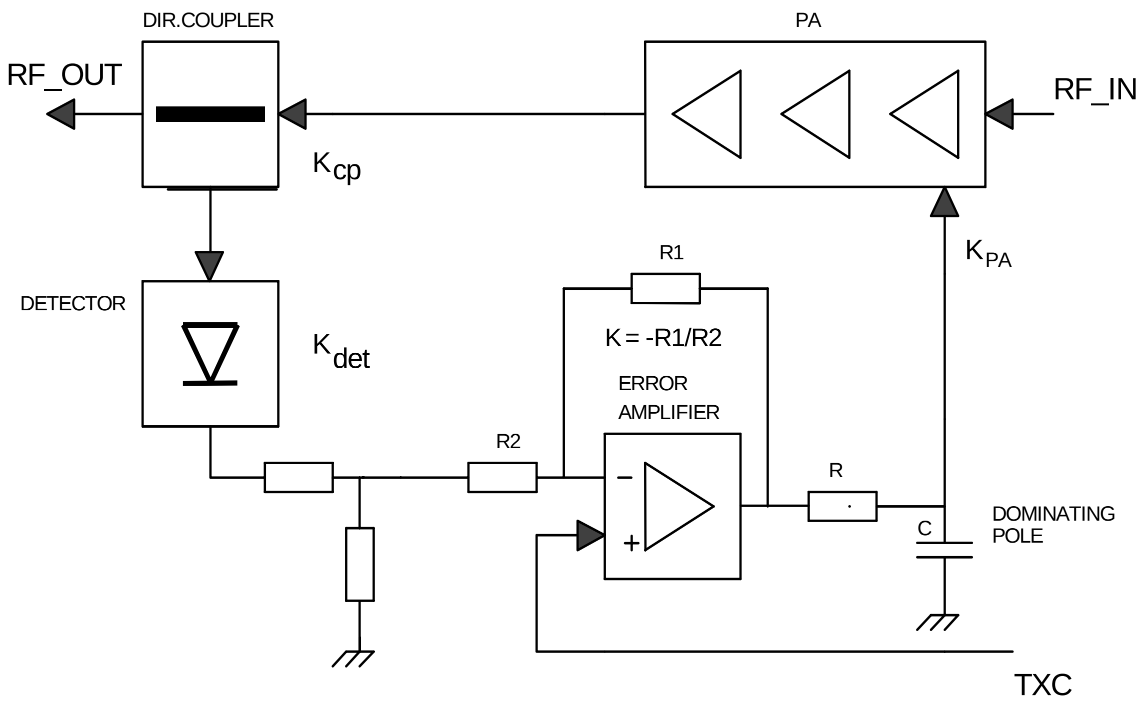


Figure 5: Transmitter

AGC strategy

AGC-amplifier is used to maintain output level of the receiver in certain range. AGC has to be set before each received burst, to do this pre-monitoring is used to give an estimate of the signal level.

There is 50 dB accurate gain control (10 dB steps) and one larger step (~30 dB) in LNA. LNA AGC step size depends on channel with some amount.

RSSI must be measured accurately on range -48...-110 dBm. At levels higher than -48 dBm the RX level reported by the MS to the base station is always 63.

Production calibration is done with two RF-levels, the LNA gain step is not calibrated.

AFC function

AFC is used to lock the transceiver frequency to the frequency of the base station. AFC-voltage is generated in COBBA with 11 bit DA-converter. There is a RC-filter in AFC control line to reduce the noise from the converter. Settling time requirement for the RC-network comes from signaling, how often PSW (pure sine wave) slots occur. They are repeated after 10 frames, meaning that there is PSW in every 46 ms. AFC tracks base station frequency continuously, so transceiver has got a stable frequency, because changes in VCTCXO-output don't occur so fast (temperature).

Settling time requirement comes also from the start up-time allowed. When transceiver is in sleep mode and "wakes" up to receive mode, there is only about 5 ms for the AFC-voltage to settle. When the first burst comes in system clock has to be settled into +/-0.1 ppm frequency accuracy. The VCTCXO-module requires also 5 ms to settle into final frequency. Amplitude rises into full swing in 1...2 ms, but frequency settling time is higher so this oscillator must be powered up early enough.

DC-compensation

DC compensation is made during DCN1 and DCN2 operations (controlled via serial bus). DCN1 is carried out by charging the large external capacitors in AGC stages to a voltage which cause a zero dc-offset. DCN2 set the signal offset to constant value (VREF RX 1.2 V).

Receiver characteristics

Item	Values
Type	Direct conversion, Linear, DualBand, FDMA/TDMA
LO frequencies	3700 ... 3840 MHz / 3610 ... 3760 MHz
Typical 3 dB bandwidth	+/- 104 kHz
Sensitivity	min. - 102 / - 100 dBm (EGSM/PCN) , S/N >8 dB
Total typical receiver voltage gain (from antenna to RX ADC)	90 dB
Receiver output level (RF level -95 dBm)	350 mVpp , single ended I/Q-signals to RX ADCs
Typical AGC dynamic range	80 dB
Accurate AGC control range	50 dB
Typical AGC step in LNA	30 dB
Usable input dynamic range	-102 ... -10 dBm
RSSI dynamic range	-110 ... -48 dBm
Compensated gain variation in receiving band	+/- 1.0 dB

Transmitter characteristics

Item	Values
Type	Direct conversion, dualband, non-linear, FDMA/ TDMA
LO frequency range	3520 ... 3660 / 3420 ... 3570 MHz
Output power	2 W / 1 W peak
Gain control range	min. 30 dB
Maximum phase error (RMS/peak)	max 5 deg./20 deg. Peak

Parts List -GX3

Version: SD4_19 (EDMS 6.1)

Cmp Ref	Code	Description	Value	Type
R001	1620105	Res network 0w06 2x2k2 j 0404		0404
R101	1825005	Chip varistor vwm14v vc30v 0805		0805
R102	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R103	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R105	1430710	Chip resistor	22	5 % 0.063 W 0402
R106	1419003	Chip resistor	0.22	5 % 1210
R110	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R111	1430826	Chip resistor	680 k	5 % 0.063 W 0402
R112	1430830	Chip resistor	1.0 M	5 % 0.063 W 0402
R113	1430830	Chip resistor	1.0 M	5 % 0.063 W 0402
R120	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R121	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R122	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R123	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R124	1620031	Res network 0w06 2x1k0 j 0404		0404
R127	1430830	Chip resistor	1.0 M	5 % 0.063 W 0402
R128	1430826	Chip resistor	680 k	5 % 0.063 W 0402
R160	1620017	Res network 0w06 2x100r j 0404		0404
R171	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R172	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R201	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R203	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R210	1430718	Chip resistor	47	5 % 0.063 W 0402
R211	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R212	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R213	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R214	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R220	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402

Cmp Ref	Code	Description	Value	Type
R221	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R222	1430740	Chip resistor	330	5 % 0.063 W 0402
R226	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R227	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R228	1430780	Chip resistor	12 k	5 % 0.063 W 0402
R230	1620031	Res network 0w06 2x1k0 j 0404		0404
R233	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R240	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R241	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R245	1430700	Chip resistor	10	5 % 0.063 W 0402
R246	1430700	Chip resistor	10	5 % 0.063 W 0402
R247	1620103	Res network 0w06 2x22r j 0404		0404
R300	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R301	1430726	Chip resistor	100	5 % 0.063 W 0402
R305	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R306	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R370	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R371	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R380	1430693	Chip resistor	5.6	5 % 0.063 W 0402
R381	1430693	Chip resistor	5.6	5 % 0.063 W 0402
R382	1430693	Chip resistor	5.6	5 % 0.063 W 0402
R383	1430693	Chip resistor	5.6	5 % 0.063 W 0402
R401	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R410	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R420	1430718	Chip resistor	47	5 % 0.063 W 0402
R421	1430718	Chip resistor	47	5 % 0.063 W 0402
R422	1430714	Chip resistor	33	5 % 0.063 W 0402
R423	1430714	Chip resistor	33	5 % 0.063 W 0402
R424	1430740	Chip resistor	330	5 % 0.063 W 0402
R425	1430730	Chip resistor	150	5 % 0.063 W 0402
R426	1430738	Chip resistor	270	5 % 0.063 W 0402
R427	1430756	Chip resistor	1.2 k	5 % 0.063 W 0402

Cmp Ref	Code	Description	Value	Type
R430	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R440	1411275	Chip resistor	3.9	5 % 0.063 W 0402
R444	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R501	1620019	Res network 0w06 2x10k j 0404		0404
R502	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R503	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R508	1620003	Res network 0w03 4x100r j 0804		0804
R509	1620019	Res network 0w06 2x10k j 0404		0404
R510	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R511	1430846	Chip resistor	2.7 k	1 % 0.063 W 0402
R512	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R513	1620033	Res network 0w06 2x5k6 j 0404		0404
R514	1430848	Chip resistor	12 k	1 % 0.063 W 0402
R515	1430861	Chip resistor	110 k	1 % 0.063 W 0402
R516	1620033	Res network 0w06 2x5k6 j 0404		0404
R518	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R601	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R603	1430690	Chip jumper		0402
R604	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R605	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R606	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R607	1430740	Chip resistor	330	5 % 0.063 W 0402
R608	1620507	Res network 0w04		3DB ATT 0400404
R611	1430700	Chip resistor	10	5 % 0.063 W 0402
R612	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R700	1430718	Chip resistor	47	5 % 0.063 W 0402
R701	1430732	Chip resistor	180	5 % 0.063 W 0402
R702	1620507	Res network 0w04		3DB ATT 0400404
R703	1430690	Chip jumper		0402
R705	1430714	Chip resistor	33	5 % 0.063 W 0402
R706	1430718	Chip resistor	47	5 % 0.063 W 0402
R708	1430778	Chip resistor	10 k	5 % 0.063 W 0402

Cmp Ref	Code	Description	Value	Type
R709	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R800	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R801	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R802	1430722	Chip resistor	68	5 % 0.063 W 0402
R803	1430722	Chip resistor	68	5 % 0.063 W 0402
R804	1430718	Chip resistor	47	5 % 0.063 W 0402
R805	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R806	1430730	Chip resistor	150	5 % 0.063 W 0402
R807	1430730	Chip resistor	150	5 % 0.063 W 0402
R808	1430732	Chip resistor	180	5 % 0.063 W 0402
R809	1430726	Chip resistor	100	5 % 0.063 W 0402
R810	1430726	Chip resistor	100	5 % 0.063 W 0402
R811	1430726	Chip resistor	100	5 % 0.063 W 0402
R812	1430726	Chip resistor	100	5 % 0.063 W 0402
R813	1430700	Chip resistor	10	5 % 0.063 W 0402
R814	1430738	Chip resistor	270	5 % 0.063 W 0402
R815	1430738	Chip resistor	270	5 % 0.063 W 0402
R816	1430846	Chip resistor	2.7 k	1 % 0.063 W 0402
R817	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R818	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R820	1430714	Chip resistor	33	5 % 0.063 W 0402
R821	1430700	Chip resistor	10	5 % 0.063 W 0402
R822	1430700	Chip resistor	10	5 % 0.063 W 0402
R823	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R824	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R900	1430830	Chip resistor	1.0 M	5 % 0.063 W 0402
R910	1430728	Chip resistor	120	5 % 0.063 W 0402
R911	1430728	Chip resistor	120	5 % 0.063 W 0402
C001	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C101	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C102	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C103	2320783	Ceramic cap.	33 n	10 % 10 V 0402

Cmp Ref	Code	Description	Value	Type
C104	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C105	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C106	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C110	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C111	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C112	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C113	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C120	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C121	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C122	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C123	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C124	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C126	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C127	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C131	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C133	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C135	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C137	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C139	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C140	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C141	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C142	2320481	Ceramic cap.	5R 1 u	10 % 0603
C144	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C146	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C147	2313213	Ceramic cap.	10 u	10 % 1206
C149	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C150	2313213	Ceramic cap.	10 u	10 % 1206
C152	2610031	Tantalum cap.	10 u	20 % 10 V (2610003)A
C153	2310793	Ceramic cap.	2.2 u	10 % 10 V 0805
C155	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C157	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C160	2320546	Ceramic cap.	27 p	5 % 50 V 0402

Cmp Ref	Code	Description	Value	Type
C161	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C162	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C163	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C164	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C171	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C180	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C181	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C182	2611745	Tantalum cap.	150 u	20 % 10 V 7.3x4.3x2.0
C202	2320481	Ceramic cap.	5R 1 u	10 % 0603
C203	2610205	Tantalum cap.	10 u	20 % 4 V 2.0x1.3x1.2
C211	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C212	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C213	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C214	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C215	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C220	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C221	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C222	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C223	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C224	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C225	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C226	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C227	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C228	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C229	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C230	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C231	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C232	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C233	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C234	2320481	Ceramic cap.	5R 1 u	10 % 0603
C236	2610205	Tantalum cap.	10 u	20 % 4 V 2.0x1.3x1.2
C237	2320805	Ceramic cap.	100 n	10 % 10 V 0402

Cmp Ref	Code	Description	Value	Type
C238	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C240	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C242	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C243	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C244	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C245	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C246	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C247	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C248	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C249	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C250	2320481	Ceramic cap.	5R 1 u	10 % 0603
C252	2320481	Ceramic cap.	5R 1 u	10 % 0603
C254	2320481	Ceramic cap.	5R 1 u	10 % 0603
C256	2320481	Ceramic cap.	5R 1 u	10 % 0603
C302	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C321	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C322	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C323	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C324	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C325	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C326	2320481	Ceramic cap.	5R 1 u	10 % 0603
C327	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C331	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C332	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C333	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C334	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C335	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C340	2320481	Ceramic cap.	5R 1 u	10 % 0603
C341	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C349	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C370	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C371	2320131	Ceramic cap.	33 n	10 % 16 V 0603

Cmp Ref	Code	Description	Value	Type
C372	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C373	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C374	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C375	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C381	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C440	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C441	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C443	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C444	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C450	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C451	2310003	Ceramic cap.	470 n	10 % 16 V 0805
C452	2320481	Ceramic cap.	5R 1 u	10 % 0603
C500	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C501	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C502	2320481	Ceramic cap.	5R 1 u	10 % 0603
C503	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C504	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C505	2320779	Ceramic cap.	100 n	10 % 16 V 0603
C506	2320779	Ceramic cap.	100 n	10 % 16 V 0603
C507	2320779	Ceramic cap.	100 n	10 % 16 V 0603
C508	2320779	Ceramic cap.	100 n	10 % 16 V 0603
C509	2320576	Ceramic cap.	470 p	5 % 50 V 0402
C510	2320576	Ceramic cap.	470 p	5 % 50 V 0402
C511	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C513	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C514	2320576	Ceramic cap.	470 p	5 % 50 V 0402
C515	2320576	Ceramic cap.	470 p	5 % 50 V 0402
C517	2320631	Ceramic cap.	180 p	5 % 25 V 0402
C518	2320631	Ceramic cap.	180 p	5 % 25 V 0402
C519	2320781	Ceramic cap.	47 n	20 % 16 V 0603
C521	2320781	Ceramic cap.	47 n	20 % 16 V 0603
C522	2320805	Ceramic cap.	100 n	10 % 10 V 0402

Cmp Ref	Code	Description	Value	Type
C523	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C524	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C525	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C526	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C527	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C528	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C529	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C531	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C532	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C600	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C601	2313213	Ceramic cap.	10 u	10 % 1206
C602	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C603	2320631	Ceramic cap.	180 p	5 % 25 V 0402
C604	2312221	Ceramic cap.	4.7 n	5 % 25 V 0805
C605	2320497	Ceramic cap.	560 p	5 % 50 V 0603
C607	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C608	2312211	Ceramic cap.	3.3 u	10 % 0805
C609	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C611	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C612	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C613	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C614	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C700	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C701	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C702	2320604	Ceramic cap.	18 p	5 % 50 V 0402
C703	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C704	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C705	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C706	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C707	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C708	2320604	Ceramic cap.	18 p	5 % 50 V 0402
C709	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402

Cmp Ref	Code	Description	Value	Type
C712	2320508	Ceramic cap.	1.0 p	0.25 % 50 V 0402
C714	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C715	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C716	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C717	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C718	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C719	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C720	2320508	Ceramic cap.	1.0 p	0.25 % 50 V 0402
C722	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C800	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C801	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C802	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C803	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C804	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C805	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C806	2320629	Ceramic cap.	1p	50 V 0402
C807	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C808	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C810	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C811	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C814	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C815	2611745	Tantalum cap.	150 u	20 % 10 V 7.3x4.3x2.0
C817	2312293	Ceramic cap.	4.7u	Y5 V 1206
C818	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C819	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C820	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C821	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C822	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C823	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C824	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C825	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C826	2320540	Ceramic cap.	15 p	5 % 50 V 0402

Cmp Ref	Code	Description	Value	Type
C827	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C828	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C829	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C830	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C910	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C911	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C912	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C913	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C915	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C916	2320629	Ceramic cap.	1p	50 V 0402
L101	3203701	Ferrite bead 33r/100mhz 0805		0805
L120	3203701	Ferrite bead 33r/100mhz 0805		0805
L121	3203701	Ferrite bead 33r/100mhz 0805		0805
L122	3203701	Ferrite bead 33r/100mhz 0805		0805
L123	3203701	Ferrite bead 33r/100mhz 0805		0805
L200	3203801	Chip bead array 2x1000r 0405		0405
L201	3203801	Chip bead array 2x1000r 0405		0405
L400	3646069	Chip coil	33.Q n	5 % Q=23/800 MHz 0402
L401	3646069	Chip coil	33.Q n	5 % Q=23/800 MHz 0402
L700	3645017	Chip coil	5. Q n	10 % Q=10/100 MHz 0603
L701	3645181	Chip coil	3. Q n	10 % Q=10/100 MHz 0603
L702	3645181	Chip coil	3. Q n	10 % Q=10/100 MHz 0603
L703	3645185	Chip coil	10.Q n	5 % Q=12/100 MHz 0603
L704	3645105	Chip coil	27 n	5 % Q=12/100 MHz 0603
L705	3645175	Chip coil	12.Q n	5 % Q=12/100 MHz 0603
L706	3645179	Chip coil	2.-0 n	Q=8/100M 0603
L800	4551013	Dir.coupl.897.5/1747.5mhz 2.1x1.3		2.1x1.3

Cmp Ref	Code	Description	Value	Type
L801	3646085	Chip coil	6. Q n	10 % Q=29/800 MHz 0402
L802	3645163	Chip coil	22.Q n	10 % Q=12/100 MHz 0603
L804	3645017	Chip coil	5. Q n	10 % Q=10/100 MHz 0603
L805	3646087	Chip coil	1.-0 n	Q=31/800M 0402
L806	3646051	Chip coil	3.-0 n	Q=28/800M 0402
L808	3646051	Chip coil	3.-0 n	Q=28/800M 0402
L900	3646065	Chip coil	12.Q n	5 % Q=31/800 MHz 0402
L901	3646069	Chip coil	33.Q n	5 % Q=23/800 MHz 0402
L902	3646069	Chip coil	33.Q n	5 % Q=23/800 MHz 0402
B110	4510293	Crystal	32.768 k	+-20PPM 12.5PF
G600	4350223	Vco 3420-3840mhz 2.7v 20ma		
G602	4510261	VCTCXO	26 M	+-5PPM 2.7V GSM
F101	5119019	SM, fuse f 1.5a 32v 0603		
Z201	3640035	Filt z>450r/100m 0r7max 0.2a 0603		0603
Z700	451P270	Saw filter	17.5 M	/3.5DB 3X3
Z701	4511129	Saw filter	37.5 M	
Z702	4511129	Saw filter	37.5 M	
Z703	451P270	Saw filter	17.5 M	/3.5DB 3X3
Z800	4550067	Dipl 880-960/1710-1880mhz 3.2x2.5		3.2x2.5
Z802	4511095	Saw filter	17.5 M	/3.5DB 3X3
Z900	4512131	Ant.swit.880-960/1710-1880mhz		7X5
T600	3640423	Transf balun 3.7ghz+/-300mhz		0805
T700	3640405	Transf balun 900mhz+/-100mhz		1210
T701	3640421	Transf balun 1.8ghz+/-100mhz		1206
T800	3640405	Transf balun 900mhz+/-100mhz		1210
T840	3640421	Transf balun 1.8ghz+/-100mhz		1206
V120	4110601	Diode	FAST	SOD323
V140	4210215	Transistor	MMBT589	pnp 30 V 1 A SOT23

Cmp Ref	Code	Description	Value	Type
V150	4110067	Schottky diode	MBR0520L	20 V 0.5 A SOD123
V160	4113671	Tvs quad 6v1 esda6v1w5 sot323-5		SOT323-5
V170	4113611	Emifilt/tvs emif01-10005w5 sot353		SOT353
V171	4113611	Emifilt/tvs emif01-10005w5 sot353		SOT353
V202	4210121	Transistor		SOT323
V210	4113671	Tvs quad 6v1 esda6v1w5		SOT323-5
V221	4211621	MosFet		SOT363
V231	4210121	Transistor		SOT323
V400	4110601	Diode	FAST	SOD323
V410	4110089	Diode x 2	BAV70W	70 V .5 A 4 ns SOT323
V411	4200836	Transistor	BCX19	npn 50 V 0.5 A SOT23
V420	4864291	Led	Green	1305
V421	4864291	Led	Green	1305
V422	4864291	Led	Green	1305
V423	4864291	Led	Green	1305
V424	4864301	Led	Green	1305
V425	4864301	Led	Green	1305
V426	4864301	Led	Green	1305
V427	4864301	Led	Green	1305
V428	4864301	Led	Green	1305
V429	4864301	Led	Green	1305
V430	4200843	Transistor	BCX18	pnp 25 V 0.5 A SOT23
V431	4200843	Transistor	BCX18	pnp 25 V 0.5 A SOT23
V432	4210100	Transistor	BC848W	npn 30 V SOT323
V433	4110072	Diode x 2	BAV99W	70 V 0.2 A SOT323
V440	4110089	Diode x 2	BAV70W	70 V .5 A 4 ns SOT323
V441	4200226	Darl. transistor	BCV27	npn 30 V 300 mA SOT23
V450	4113671	Tvs quad 6v1 esda6v1w5		SOT323-5
V600	4210100	Transistor	BC848W	npn 30 V SOT323
V700	4210271	Transistor		SCT598

Cmp Ref	Code	Description	Value	Type
V701	4210275	Transistor		SCT598
V800	4110079	Sch. diode x 2	HSMS282C	15 V SOT323
V801	4210183	Transistor	BFP193W	npn 8G V SOT343
V802	4210183	Transistor	BFP193W	npn 8G V SOT343
V803	4117971	Diode	LM4041CIM3-ADJ	SOT23
D001	4340767	IC, MCU	MC33460	
D302	4340845	1xinverter 1.8v-5.5v(7sz04)sc70-5		
D310	4340787	IC, SRAM		CSP48
D311	4340597	IC, flash mem.		UBGA48
D370	4340369	IC, dual bus buffer sso	TC7W126FU	SSOP8
N100	4370621	Chaps v2.0 u423v20g36t lbga6x6		
N102	4370719	Ccont 2m wfd163mg64t/8		
N240	4370643	Cobba_gjp v4.1 v257bg64t/8		BGA64
N371	4860031	Tfdu4100 irda tx/rx>2.7v 115kbits		115KBITS
N500	4370667	Hagar 3 sttza8hg80t lfbga80		LFBGA80
N501	4340797	IC, regulator	LP2980IM5X-4.7	4.7 V SOT23-5
N800	4350219	IC, pow.amp.		3.5 V
S400	5209001	SM, sw tact spst 12v 50ma side k		KEY
S401	5209001	SM, sw tact spst 12v 50ma side k		KEY
S402	5209001	SM, sw tact spst 12v 50ma side k		KEY
X001	5469061	SM, system conn 6af+3dc+mic+jack		
X120	5469069	SM, batt conn 2pol spr p3.5 100v		100V2A
X121	5469069	SM, batt conn 2pol spr p3.5 100v		100V2A
X160	5409145	SM, sim conn 2x3pol p2.54 h=1.95		H=1.95MM
X900	5429007	SM, coax conn m sw 50r 0.4-2ghz		
X901	9510434	Spring clip m3e14601 nsj-3 hd925		
X902	9510434	Spring clip m3e14601 nsj-3 hd925		
A001	9510613	Pa-shield assy dmc02107 hda13		
A002	9510614	RF shield assy dmc02108 hda13		
A003	9510615	Bb-shield assy dmc02109 hda13		