PAMS Technical Documentation
NSW-6 Series Transceivers

System Module SE2

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AMENDMENT RECORD SHEET

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Schematics/ Layouts

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Transceiver NSW–6

Introduction

The NSW–6 is a dual band triple mode radio transceiver designed for the DAMPS and TDMA1900 networks, with 9 power levels and a maximum output of 480mW.

The transceiver comprises of a System/RF module SE2 with integrated user interface and assembly parts.

The transceiver features a full graphic display and a two soft–key based user interface. The antenna is internal. External antenna connection is not included. The transceiver also features a leakage tolerant earpiece and a noise cancelling microphone.

External Connectors and Main Interfaces

External and Internal Connectors

Supply Voltages and Power Consumption

Connector	Line Symbol	Minimum	Typical / Nominal	Maximum/ Peak	Unit / Notes
Charging	VIN	7.1	8.4	9.3	V/ Travel charger, ACT–1
Charging	VIN	7.25	7.6	7.95	V/ Travel charger. ACP–7, ACP–8
Charging	I / VIN	720	800	850	mA/ Travel charger, ACT–1
Charging	I / VIN	320	370	420	mA/ Travel charger, ACP–7

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Battery contact signals

Pin	Line Symbol	Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
1	BVOLT	Battery voltage	3.0	3.6	5.3	V/ Maximum voltage in idle mode with a charger connected
2	BSI	Input voltage	0		2.85	V/ Battery size indication Phone has 100k pull up resistor
		Battery indication resistor		18 ± 1%		kohm/ Ni battery
			20	22	24	kohm/ service battery
			27		51	kohm/ 4.1V Li battery
			68		91	kohm/ 4.2V Li battery
3	BTEMP	Input voltage Input voltage	0 2.1		1.4 3	V/ Battery temp. indication V/ Phone power up (pulse)
4	BGND		0		0	V

Contacts Description

The transceiver electronics consist of the Radio Module ie. RF + System blocks, the keyboard PCB, the display module and audio components. The keypad and the display module are connected to the Radio Module with connectors. System blocks and RF blocks are interconnected with PCB wiring. The Transceiver is connected to accessories via charger connector (includes jack and plates), and headset connector.

The System blocks provide the MCU, DSP and Logic control functions in MAD ASIC, external memories, audio processing and RF control hardware in COBBA ASIC. Power supply circuitry CCONT ASIC delivers operating voltages both for the System and the RF blocks.

The RF block is designed for a handportable phone which operates in the TDMA system. The purpose of the RF block is to receive and demodulate the radio frequency signal from the base station and to transmit a modulated RF signal to the base station

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Battery Connector

Battery contact signals

Pin	Name	Min	Typ	Max	Unit	Notes
4	BVOLT	3.0	3.6	4.5	V	Battery voltage
				5.0		Maximum voltage in call state with charger
				5.3		Maximum voltage in idle state with charger
3	BSI	0		2.85	V	Battery size indication Phone has 100kohm pull up resistor. SIM Card removal detection (Threshold is 2.4V@VBB=2.8V)
			18 ± 1%		kohm	Battery indication resistor (Ni battery)
		20	22	24	kohm	Battery indication resistor (service battery)
				33+/1	kohm	Battery indication resistor (4.1V 600 mAh Lithium battery)
				47+/–10%	kohm	Battery indication resistor (Flash adapter)
2	BTEMP	0		1.4	V	Battery temperature indication Phone has a 100k (+–5%) pullup resistor, Battery package has a NTC pulldown resistor: 47k+–5%@+25C , B=4050+–3%
		2.1		3	V	Phone power up by battery (input)
		1	10	20	ms	Power up pulse width
		1.9		2.85	V	Battery power up by phone (output)
		90	100	200	ms	Power up pulse width
1	BGND	0		0	V	Battery ground

Charging Connector

Contact	Line Symbol	Function
DC–jack side contact (DC–plug ring)	L_GND	Charger ground
DC–jack center pin	VIN	Charger input voltage
DC–jack side contact (DC–plug jacket)	CHRG_CTRL	Charger control output (from phone)

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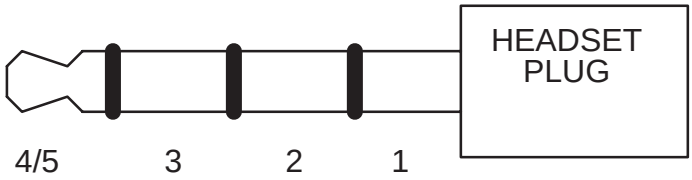
Pin	Name	Min	Typ	Max	Unit	Notes
2, b	VIN	7.25	7.6	7.95	V	Unloaded ACP–7 Charger (5kohms load)
				16.9	V	
		3.25	3.6	3.95	V	Peak output voltage (5kohms load)
		320	370	420	mA	Loaded output voltage (10ohms load)
						Supply current
		7.1	8.4	9.3	V	Unloaded ACP–9 Charger
		3.25	3.6	3.95	V	Loaded output voltage (10ohms load)
		720	800	850	mA	Supply current
3, a	L_GND	0		0	V	Supply ground
4, c	CHRG_ CTRL	0		0.5	V	Charger control PWM low
		2.0		2.85	V	Charger control PWM high
			32		Hz	PWM frequency for a fast charger
		1		99	%	PWM duty cycle

Headset Connector

The contacts of the headset connector are listed below, with the help of the diagram of the headset plug.



Contact	Line Symbol
1. contact (plug ring 1)	XMICN
2. contact (plug ring 2)	XEARN
3. contact (plug ring 3)	XMICP
4. and 5. contact (center pin)	XEARP (4) / HEADSETINT (5)

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Baseband Module, Functional Description

Modes of Operation

The phone has the following main operating modes

- Analog mode, on 800 MHz band
  - Analog Control Channel ACCH
  - Analog Voice Channel AVCH
- Digital mode, on 800 MHz band
  - Digital Control Channel DCCH
  - Digital Traffic Channel DTCH
- Digital mode, on 1900 MHz band
  - Digital Control Channel DCCH
  - Digital Traffic Channel DTCH
- Out Of Range –mode OOR
- Locals mode

Analog Control Channel mode (ACCH*)*

On analog control channel the phone receives continuous signalling messages on Forward Control Channel (FOCC) from base station, being most of the time in IDLE mode. Only the receiver part is on. Occasionally the phone re–scans control channels in order to find the stronger or otherwise preferred control channel.

Also registration (TX on) happens occasionally, whereby the phone sends its information on Reverse Control Channel (RECC) to base station and the phone's location is updated in the switching office.

If a call is initiated, either by the user or base station, the phone moves to analog voice channel or digital traffic channel mode depending on the orders by the base station.

Analog Voice Channel Mode (AVCH)

The phone receives and transmits analog audio signal. All circuitry is powered up except digital rx–parts. In this mode the DSP does all the audio processing and in the Hands Free (HF) mode it also performs echo–cancellation and the HF algorithm. COBBA performs the AD–conversion for the MIC signal, and the DA–conversion for the EAR signal.

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With audio signal also SAT (Supervisory Audio Tone) is being received from the base station. The SAT signal can be 5970 Hz, 6000Hz or 6030 Hz, the frequency being defined by the base station. DSP's DPLL phase lock loops to SAT, detects if the SAT frequency is the expected one and examines the signal quality. DSP reports SAT quality figures to MCU regularly. The received SAT signal is transponded (transmitted back) to base station.

The base station can send signalling messages on Forward Voice Channel (FVC) to the phone, by replacing the audio with a burst of Wide Band Data (WBD). Typically these are handoff or power level messages. System Logic RX–modem is used for receiving the signalling message burst, after which it gives interrupt to MCU for reading the data. During the burst audio path must be muted; MCU gives message to DSP about this. MCU can acknowledge the messages on Reverse Voice Channel (RVC), where DSP sends the WBD to transmitter RF.

Also Signalling Tone (ST) can be transmitted to acknowledge messages from base station. DSP sends ST after MCU's command.

On Analog Voice Channel MCU uses sleep mode (HW DEEP SLEEP) most of the time, but other circuits are fully operational.

Digital Control Channel Mode (DCCH)

On digital control channel (DCCH) DSP receives the paging information from the Paging channels. DSP sends messages to MCU for processing them.

Each Hyperframe (HFC) comprises two Superframes (SF), the first as the Primary (p) and the second as the Secondary (s) paging frame. The assigned Page Frame Class (PFC) defines the frames which must be received, and thus it also defines when the receiver must be on; i.e. the basic power consumption is defined at the same time.

The phone employs sleep mode between received time slots. Then DSP sets the sleep clock timer and MCU, DSP and RF including VCXO are powered down. Only sleep clock and necessary timers are running.

From DCCH phone may be ordered to analog control channel or to analog or digital traffic channel.

Digital Traffic Channel Mode (DTCH)

Digital Voice Channel

On digital voice channel DSP processes speech signal in 20 ms time slots. DSP performs the speech and channel functions in time shared fashion and sleeps whenever possible. Rx and tx are powered on and off according to the slot timing. MCU is waken up mainly by DSP, when there is signalling information for the Cellular Software.

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Digital Data Channel

Digital Data Channel is supported in the product.

Out of Range mode (OOR)

If the phone cannot find signal from the base station on any control channel (analog or digital) it can go into OOR mode for power saving.

All RF circuits are powered off and baseband circuits are put into low power mode, VCXO is stopped and only sleep clock is running in MAD and CCONT. After the programmable timer in MAD has elapsed the phone turns receiver on and tries to receive signalling data from base station. If it succeeds, the phone goes to standby mode on analog or digital control channel. If the connection can not be established the phone will return to out of range mode, until the timer elapses again.

Locals Mode

Locals mode is used by product development, production and after sales, for testing purposes. MCU's Cellular Software is stopped (no signalling to base station), and the phone is controlled by MBUS messages from test PC.

Technical Summary

List of Submodules

Submodule	Function
CTRLU	Control Unit for the phone, comprising MAD ASIC (MCU, DSP, System Logic) and Memories
PWRU	Power supply, comprising CCONT and CHAPS
AUDIO_RF_IF	Audio coding and RF–BB interface, COBBA
UI	User Interface components

These blocks are only functional blocks and therefore have no type nor material codes. For block diagram, see baseband schematics.

The battery voltage range in DCT3 family is 3.0V to 4.5V depending on the battery charge and used cell type (Li–Ion or NiMH). Because of the battery voltage the baseband supply voltage is a nominal of 2.8V.

The baseband is running from a 2.8V power rail which is supplied by a power controlling asic (CCONT). In the CCONT there are seven individually controlled regulator outputs for the RF section, one 2.8V output for the baseband plus a core voltage for MAD1. In addition there is one +5V power supply output(V5V). A real time clock function is integrated into the CCONT which utilizes the same 32KHz clock supply as the sleep clock. A backup power supply is provided for the RTC which keeps the

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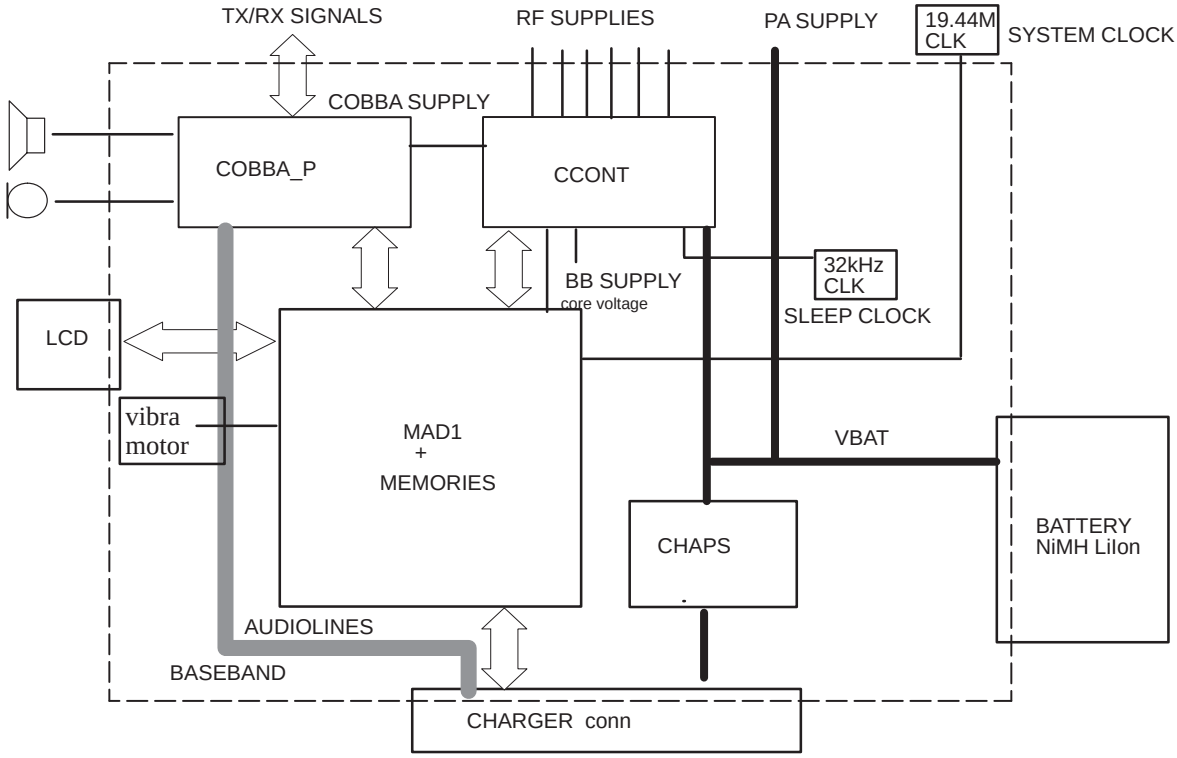
real time clock running when the main battery is removed. The backup power supply is a rechargeable polyacene battery with a backup time of ten minutes.

The interface between the baseband and the RF section is handled by a specific asic. The COBBA_D 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_D and the MAD is implemented using serial connections. Digital speech processing is handled by the MAD asic. The COBBA_D asic is a dual supply voltage circuit, the digital parts are running from the baseband supply VBB and the analog parts are running from the analog supply VCOBBA (VR6).

Block diagram for the phone is below.



Baseband Submodules

CTRLU

CTRLU comprises MAD ASIC (MCU, DSP, System Logic) and Memories.

The environment consists of two memory circuits; (FLASH, SRAM), 22–bit address bus, and 16–bit data bus. Also there are ROM1SELX, ROM2SELX, and RAMSELX signals for chip selection.

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MCU main features

System control

Cellular Software (CS)

Cellular Software communicates with the switching office, and performs call build–up, maintenance and termination.

Communication control

M2BUS is used to communicate to external devices. This interface is also used for factory testing, service and maintenance purposes.

User Interface (UI)

PWR–key, keyboard, LCD, backlight, mic, ear and alert (buzzer, vibra, led) control. Serial interface from MAD to LCD (same as for CCONT).

Authentication

Authentication is used to prevent fraud usage of cellular phones.

RF monitoring

RF temperature monitoring by VCXOTEMP, ADC in CCONT. Received signal strength monitoring by RSSI, ADC in CCONT. False transmission detection by TXF signal, digital IO–pin.

Power up/down and Watchdog control

When power key is pressed, initial reset (PURX) has happened and default regulators have powered up in CCONT, MCU and DSP take care of the rest of power up procedures (LCD, COBBA, RF). The MCU must regularly reset the Watchdog counter in CCONT, otherwise the power will be switched off.

Accessory monitoring

Accessory detection by EAD (HEADSETINT), AD–converter in CCONT.

Battery and charging monitoring

MCU reads the battery type (BTYPE), temperature (BTEMP) and voltage (VBAT) values by AD–converter in CCONT, and phone's operation is allowed only if the values are reasonable. Charging current is controlled by writing suitable values to PWM control in CCONT.

MCU reads also charger voltage (VCHAR) and charging current values (ICHAR).

Production/after sales tests and tuning

Flash loading, baseband tests, RF tuning

Control of CCONT via serial bus

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MCU writes controls (regulators on/off, Watchdog reset, charge PWM control) and reads AD–conversion values. For AD–conversions MCU gives the clock for CCONT (bus clock), because the only clock in CCONT is sleep clock, which has a too low frequency.

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DSP Main Features

DSP (Digital Signal Processor) is in charge of the channel and speech coding according to the IS–136 specification. The block consists of a DSP and internal ROM and RAM memory. The input clock is 9.72 MHz, and DSP has its own internal PLL–multiplier. Main interfaces are to MCU, and via System Logic to COBBA and RF.

System Logic main Features

– MCU related clocking, timing and interrupts (CTIM)
– DSP related clocking, timing and interrupts (CTID)
– DSP general IO–port
–reset and interrupts to MCU and DSP
– interface between MCU and DSP (API)

– MCU interface to System Logic (MCUif)
– MCU controlled PWMs, general IO–port and USART for MBUS (PUP)
– Receive Modem (Rxmodem)
– Interface to Keyboard, CCONT and LCD Drivers (UIF)
– Interface to MCU memories, address lines and chip select decoding (BUSC)

– DSP interface to System Logic (DSPif)
– serial accessory interface (AccIf, DSP–UART)
– Modulation, transmit filter and serial interface to COBBA (MFI)
– Serial interface for RF synthesizer control (SCU)

Memories

The speed of FLASH and SRAM is 120 ns.

FLASH

– size 1024k * 16 bit, contains the main program code for the MCU, and is able to emulate EEPROM.

SRAM

– size 128k * 16 bit

AUDIO–RF

Audio interface and baseband–RF interface converters are integrated into COBBA circuit.

COBBA Main Features

The codec includes microphone and earpiece amplifier and all the necessary switches for routing. There are two different possibilities for routing;

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internal and external devices. There are also all the AD– and DA– converters for the RF interface.

DEMO block is used for FM–demodulation in analog mode.

A slow speed DA–converter provides automatic frequency control (AFC). In addition, there is a DA–converters for transmitter power control (TXC).

COBBA also passes the RFC (19.44 MHz) to MAD as COBBACLK (9.72 MHz).

COBBA is connected to MAD via two serial buses:

– RXTXSIO, for interfacing the RF–DACs and DEMO; and also for audio codec and general control. Signals used: COBBACLK (9.72 MHz, from COBBA), COBBACSX, COBBASD (bi–directional data) and COBBADAX (data ready flag for rx–samples).
– Codec SIO, for interfacing the audio ADCs / DACs (PCM–samples). Signals: PCMDCLK (data clock 1.08 MHz / 1.215 MHz), PCMSCLK (frame sync 8.0 kHz / 8.1 kHz), PCMTxdata and PCMRxdata.

PWRU

PWRU comprises CCONT circuit and CHAPS circuit.

CCONT Main Features

CCONT generates regulated supply voltages for baseband and RF. There are seven 2.8 V linear regulators for RF, one 2.8 V regulator for baseband, one special switched output (VR1_SW), one programmable 2 V output (V2V), one 3/5 V output, one 5 V output, and one 1.5 V +/– 1.5 % reference voltage for RF and COBBA.

Other functions include:

– power up/down procedures and reset logic
– charging control (PWM), charger detection
– watchdog
– sleep clock (32.768 kHz) and control
– 8–channel AD–converter.

CHAPS Main Features

CHAPS comprises the hardware for charging the battery and protecting the phone from over–voltage in charger connector.

The main functions include

– transient, over–voltage and reverse charger voltage protection
– limited start–up charge current for a totally empty battery
– voltage limit when battery removed
– with SW protection against too high charging current

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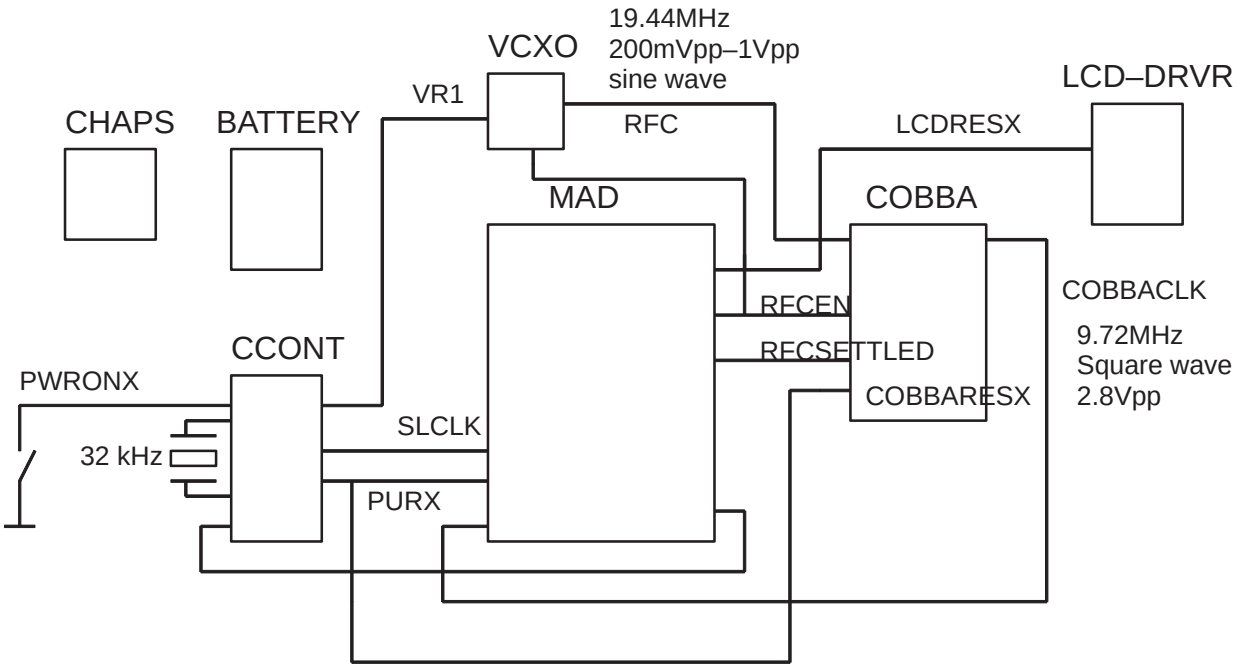
Clocking

System Clock



. Clocking and resets

VCXO on RF provides the system clock for baseband (RFC). COBBA squares the clock and divides it by two for MAD (COBBACLK).

This clock can be stopped by cutting supply voltage from VCXO (CCONT regulator VR1) and started again by powering on the same regulator. MAD controls it through RFCEN. It can be stopped only when both MCU and DSP request that. It is always stopped in SLEEP–mode on control channels. When the VCXO is stopped time is measures in MAD by using the sleep clock SLCLK; when the programmable timer expires it gives interrupt to DSP/MCU and MAD also starts the VCXO power supply by RFCEN signal.

The same sleep clock is also used in the MBUS interface, to detect if there is communication on the bus during sleep periods.

Inside MAD System Logic parts provide clock signal to both DSP and MCU, and both internal clocks can be stopped individually for power saving. MCU can use either CLOCK STOP or HW STANDBY sleep mode.

Sleep Clock

CCONT makes 32.768 kHz sleep clock for MAD. This crystal oscillator in CCONT_2' starts to run only after the battery is connected and the phone

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has been started once. The SLCLK output is enabled only when the baseband parts are powered up.

After the sleep periods, when the VCXO is restarted (by RFCEN), MAD takes care that the clock is not used before it is properly settled. MAD output RFCSETTLED prevents COBBA from using the clock during the settling time (RFCSETTLED rises later than RFCEN), as well MAD internally inhibits DSP and MCU during the same time. This settling time can be programmed before going to sleep mode, and the sleep clock is used for measuring the time.

Resets

Power–up reset

CCONT gives the power–up reset (PURX) to MAD and COBBA. Also display is reset via MAD output pin. During this reset the VCXO clock has enough time to settle so that it can be used as the system clock after reset.

Other reset

COBBA can be also internally reset; there are two internal reset bits in COBBA registers which can be written by MAD.

LCD reset is possible also by by MCU SW, because the control pin pin is controlled by MCU.

There are also MAD internal reset possibilities

– MCU can reset system logic parts
– MCU can reset DSP
– SW–watchdog can reset the whole MAD

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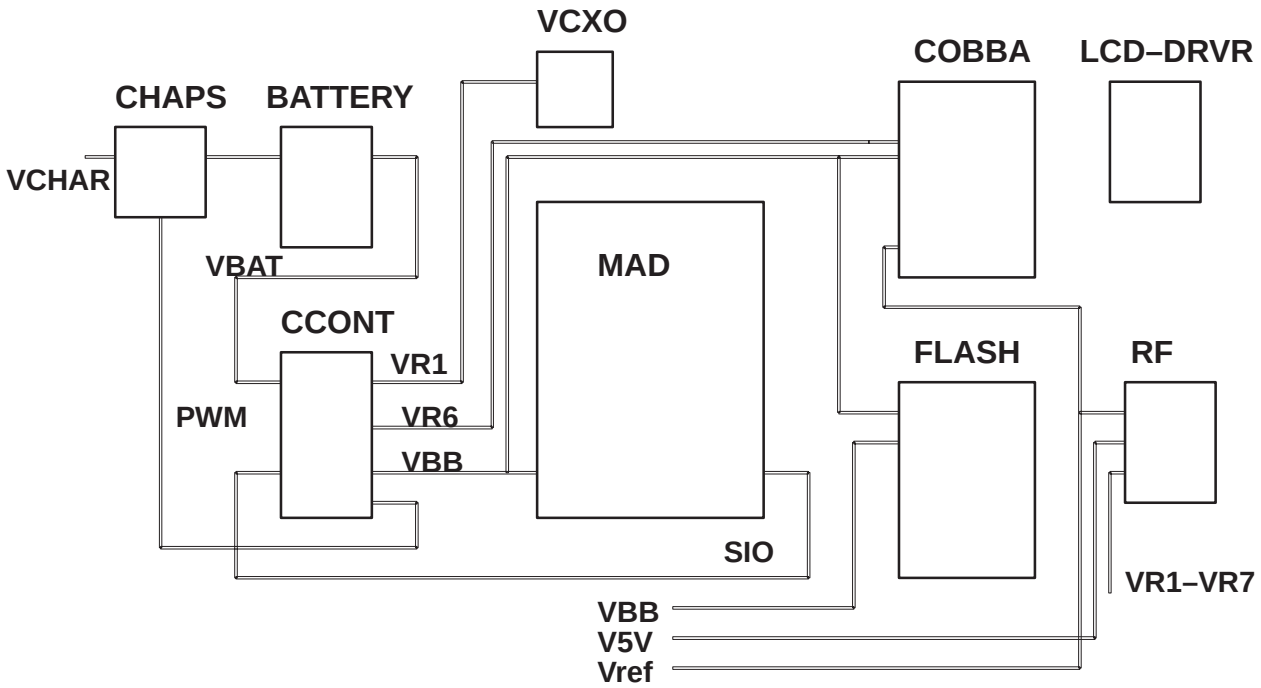
Power Distribution

In normal operation the baseband is powered from the phone‘s battery. The battery consists of one Lithium–Ion cell. There is also a possibility to use batteries consisting of three Nickel Metal Hydride cells or one Solid state cell. An external charger can be used for recharging the battery and supplying power to the phone. The charger can be either performance charger, which can deliver supply current up to 850 mA or a standard charger that can deliver approx. 300 mA.

The figure below is a simplified block diagram of the power distribution.

The power management circuitry provides protection against overvoltages, charger failures and pirate chargers etc. that could cause damage to the phone.



Battery voltage VBAT is connected to CCONT which regulates all the supply voltages VBB, VR1–VR7, VSIM and V5V. CCONT enables automatically VR1, VBB, VR6 and Vref in power–up.

VBB is used as baseband power supply for all digital parts. It is constantly on when the phone is powered up.

VSIM is used as programming voltage for the Flash memory whenever a partial re–flashing is needed, e.g. when the Flash emulates EEPROM.

V5V is used for RF parts only. In CCONT_2’ it also can be switched off by using RFCEN signal.

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VR1 is used for the VCXO supply, and VR6 is used in COBBA for analog parts. RFCEN signal to CCONT controls both VR1 and VR6 regulators; they can be switched off in sleep modes, and during standby. However, VR6 output is not switched off, but connected to VBB inside CCONT, in order to avoid false accessory interrupts.

CCONT regulators are controlled either through SIO from MAD or timing sensitive regulators are controlled directly to their control pins. These two control methods form a logical OR–function, i.e. the regulator is enabled when either of the controls is active. Most of the regulators can be individually controlled.

CHAPS connects the charger voltage (VCHAR) to battery. MCU of MAD controls the charging through CCONT. MAD sets the parameters to PWM–generator in CCONT and PWM–output controls the charging voltage in charger.

When battery voltage is under 3.0 V, CHAPS controls independently the charging current.

Power Up

When the battery is connected to phone, the 32.768 kHz crystal oscillator of CCONT is not started, since CCONT2 version F, until the power–button is pressed. (Oscillator start may take up to 1 second). The regulators are not started. After the crystal has started, the phone is ready to be powered up by any of the ways described below.

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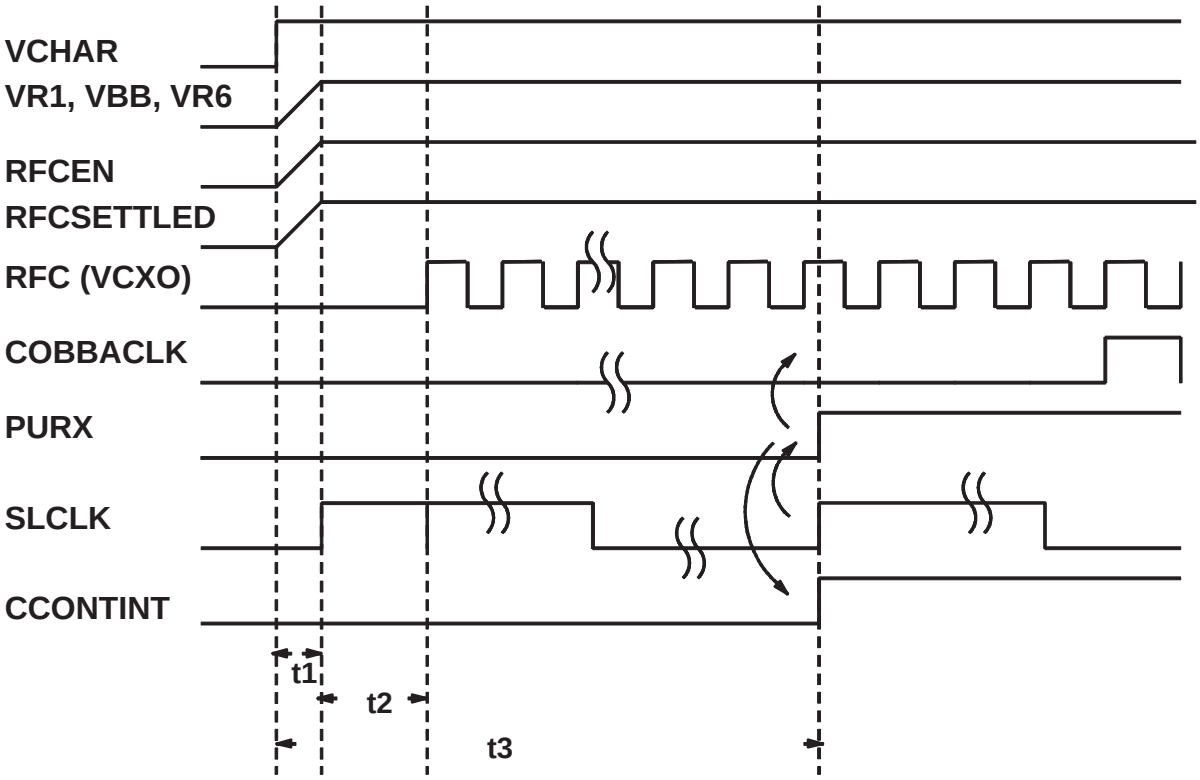
Power up with a charger

Normal Battery voltage



The power up procedure is similar to process described in the previous chapter with the exception that the rising edge of VCHAR triggers the power up in CCONT.

Also CCONT sets output CCONTINT. MAD detects the interrupt, and after that reads CCONT status register to find out the reason for the interrupt (charger in this case). The phone will remain in the ”acting dead” state, which means that the user interface is not activated unless the power button is pressed. Only the charging activity is indicated on the display.

CCONTINT is generated both in the case the charger is connected, and in the case the charger is disconnected.

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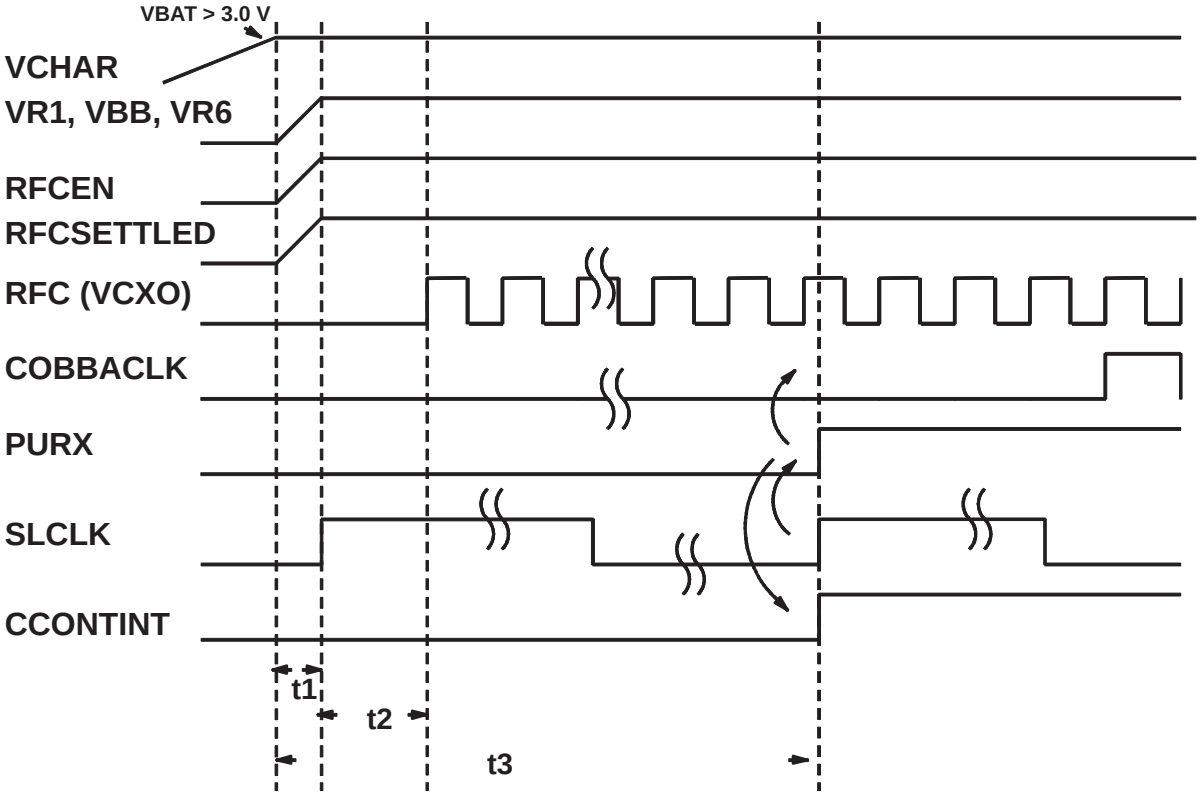
Empty Battery

Before battery voltage voltage rises over 3.0 V CHAPS gives an initial charge (with limited current) to the battery. After battery voltage reaches that voltage limit the power up procedure is as described in the previous chapters.



Before battery voltage voltage rises over 3.0 V CHAPS gives an initial charge (with limited current) to the battery. After battery voltage reaches that voltage limit the power up procedure is as described in the previous chapters.

Anyway, if the standard charger is connected and power–up requested from the power button, the current consumption should be kept in the minimum in the beginning because the charger output current is rather low and the battery voltage is on the minimum limit. Thus, at least the phone receiver parts and the user interface lights should not be powered up immediately, but after a small delay.

Power Up by IBI

Phone can be powered up by external device (accessory or similar) by providing a start pulse to the battery signal BTEMP; this is detected by

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CCONT. After that the power–up procedure is similar to pushing power–button. NSW-6 does not have any IBI accessories.

Mixed Trigger to power up

It is possible that PWR–key is pushed during charger initiated power–up procedure or charger is connected during PWR–key initiated power up procedure. In this kind of circumstances the power–up procedure (in HW point of view) continues as nothing had happened.

Power Down

Controlled Power Down

Power Down pushing PWR key

MAD (MCU SW) detects that PWR–key is pressed long enough time. After that the lights and LCD are turned off. MCU stops all the activities it was doing (e.g. ends a call), sends power off command to CCONT (i.e. gives a short watchdog time) and goes to idle–task. After the delay CCONT cuts all the supply voltages from the phone.

Note that the phone does not go to power off (from HW point of view) when the charger is connected and PWR–key is pushed. It is shown to user that the phone is in power off, but in fact the phone is just acting being powered off (this state is usually called ”acting dead”).

Power Down when the battery voltage is discharged too low

During normal discharge the phone indicates the user that the battery will drain after some time. If not recharged, SW detects that battery voltage is too low and shuts the phone off through a normal power down procedure.

Anyway, if the SW fails to power down the phone, CCONT will make a reset and power down the phone if the battery voltage drops below 2.8 V.

Power Down with fault in transmitter

If the MAD receives fault indication, from the line TXF, that the transmitter is on although it should not be, the control SW will power down the phone.

Uncontrolled Power Down

Power Down when Watchdog expires

If the SW fails to update the watchdog, the watchdog will eventually expire and CCONT cuts all the supply voltages from the phone.

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Battery Disconnected

When battery is disconnected, immediate and totally uncontrolled power–down happens. Therefore a power off procedure in this case can not be described. One possible risk is that if the MCU is writing something to Flash exactly at the same moment, the memory contents may be corrupted.

Battery Disconnected when charger is connected

From hardware point of view the phone could otherwise continue functioning normally, but if the charger voltage is higher than the maximum allowed battery voltage, this can damage the RF parts. Therefore, there must be hardware protection against this in CHAPS.

If the user presses the PWR–key, the phone can wake up to detect that the battery is not present (no BTYPE and /or BTEMP). After that the phone either turns off or goes to low current mode (can be decided by MCU SW).

This state does not harm the phone. The phone can not be used only from the charger without the battery.

Sleep Mode

Entering the Sleep mode

The phone can enter SLEEP only when both MCU and DSP request it. A substantial amount of current is saved in SLEEP. When going to SLEEP following things will happen

1. Both MCU and DSP enable sleep mode, set the sleep timer and enter sleep mode (MCU: HW DEEP SLEEP, DSP: IDLE3; both the core, peripherals and PLL stop)
2. RFCEN and RFCSETTLED –> 0 –> COBBACLK will stop (gated in COBBA). Also VR1 is disabled –> VCXO supply voltage is cut off –> RFC stops.
3. LCD display remains the same, no changes
4. Sleep clock (SLCLK) and watchdog in CCONT running
5. Sleep counter in MAD running, uses SLCLK

Waking up from the Sleep mode

In the typical case phone leaves the SLEEP–mode when the SLEEP–counter in MAD expires. After that MAD enables VR1 ⇒ VCXO starts running ⇒ after a pre–programmed delay RFCSETTLED rises => MAD receives COBBACLK clock ⇒ MAD operation re–starts.

There are also many other cases when the SLEEP mode can be interrupted, in these cases MAD enables the VR1 and operation is started similarly

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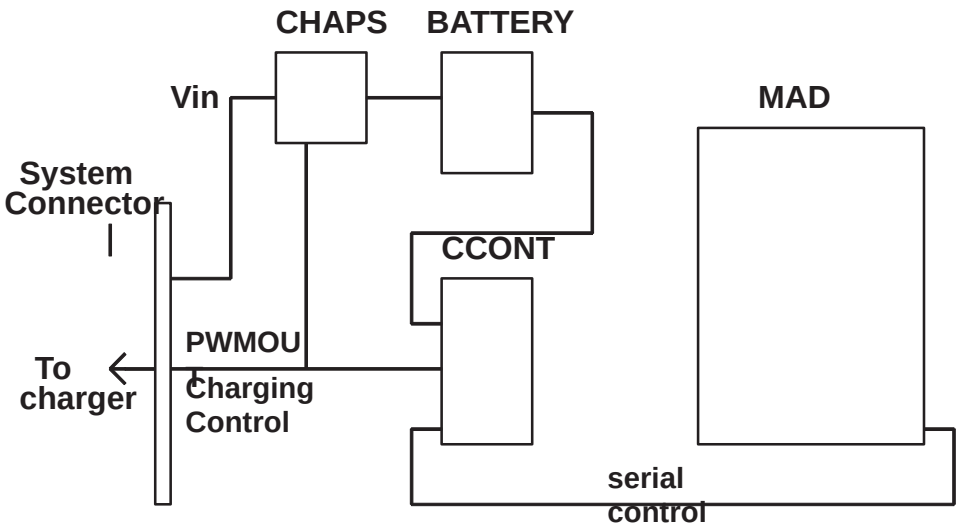
– some MCU or DSP timer expires
– DSP regular event interrupt happens
– MBUS activity is detected
– FBUS activity is detected
– Charger is connected, Charger interrupt to MAD
– any key on keyboard is pressed, interrupt to MAD
– HEADSETINT, from the switch of the headset connector (EAD)
– HOOKINT, from XMIC lines

Charging Control

Charging is controlled by MCU SW, which writes control data to CCONT via serial bus. CCONT output pin PWMOUT (Pulse Width Modulation) can be used to control both the charger and the CHAPS circuit inside phone.



Two–wire Charging

With 2–wire charging the charger provides constant output current, and the charging is controlled by PWMOUT signal from CCONT to CHAPS. PWMOUT signal frequency is selected to be 1 Hz, and the charging switch in CHAPS is pulsed on and off at this frequency. The final charged energy to battery is controlled by adjusting the PWMOUT signal duty cycle.

Pulse width is controlled by the MCU which writes these values to CCONT.

Three–wire Charging

With 3–wire charging the charger provides adjustable output voltage, and the charging is controlled by PWMOUT signal from CCONT to Charger,

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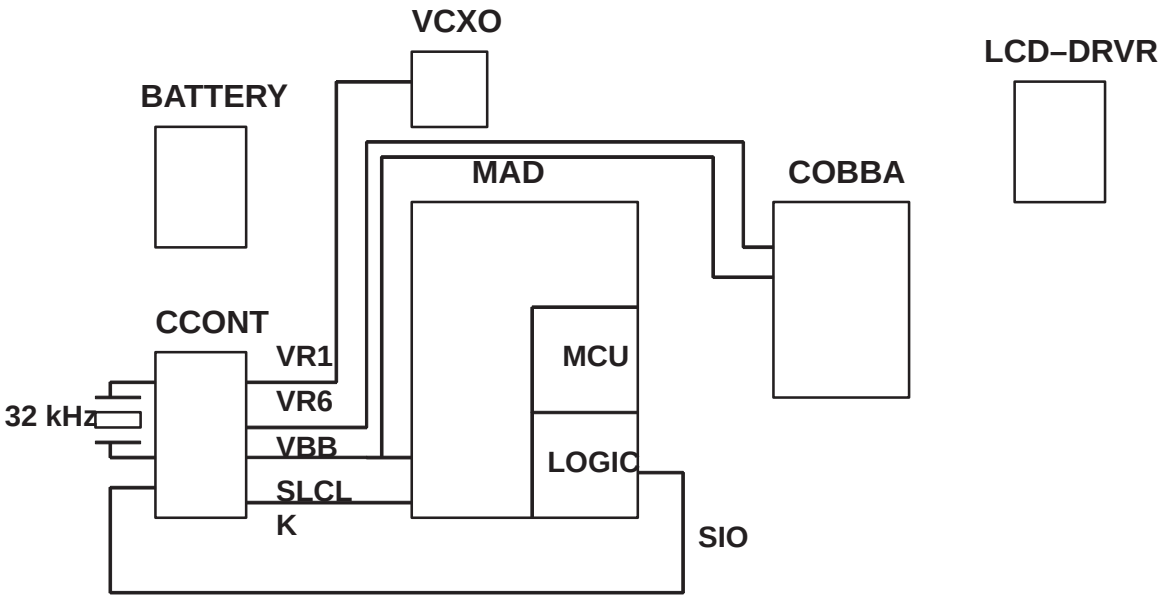
with the charger connector signal. PWMOUT signal frequency is selected to be 32 Hz, and the charger output voltage is controlled by adjusting the PWMOUT signal pulse width. The charger switch in CHAPS is constantly on in this case.

Watchdog

Both MAD and CCONT include a watchdog, and both use the 32 kHz sleep clock. The watchdog in MAD is the primary one, and this is called SW–watchdog. MCU has to update it regularly. If it is not updated, logic inside MAD gives reset to MAD. After the reset, MCU can read an internal status bit to see the reason for reset, whether it was from MAD or CCONT. The SW–watchdog delay can be set between 0 and 63 seconds at 250 millisecond steps; and after power–up the default value is the max. time.



MAD must reset CCONT watchdog regularly. CCONT watchdog time can be set through SIO between 0 and 63 seconds at 1 second steps. After power–up the default value is 32 seconds. If watchdog elapses, CCONT will cut off all supply voltages.

After total cut–off the phone can be re–started through any normal power–up procedure.

Battery Overvoltage Protection

Output overvoltage protection is used to protect phone from damage. This function is also used to define the protection cutoff voltage for different battery types (Li or Ni). The power switch is immediately turned OFF if the voltage in VOUT rises above the selected limit VLIM1 or VLIM2.

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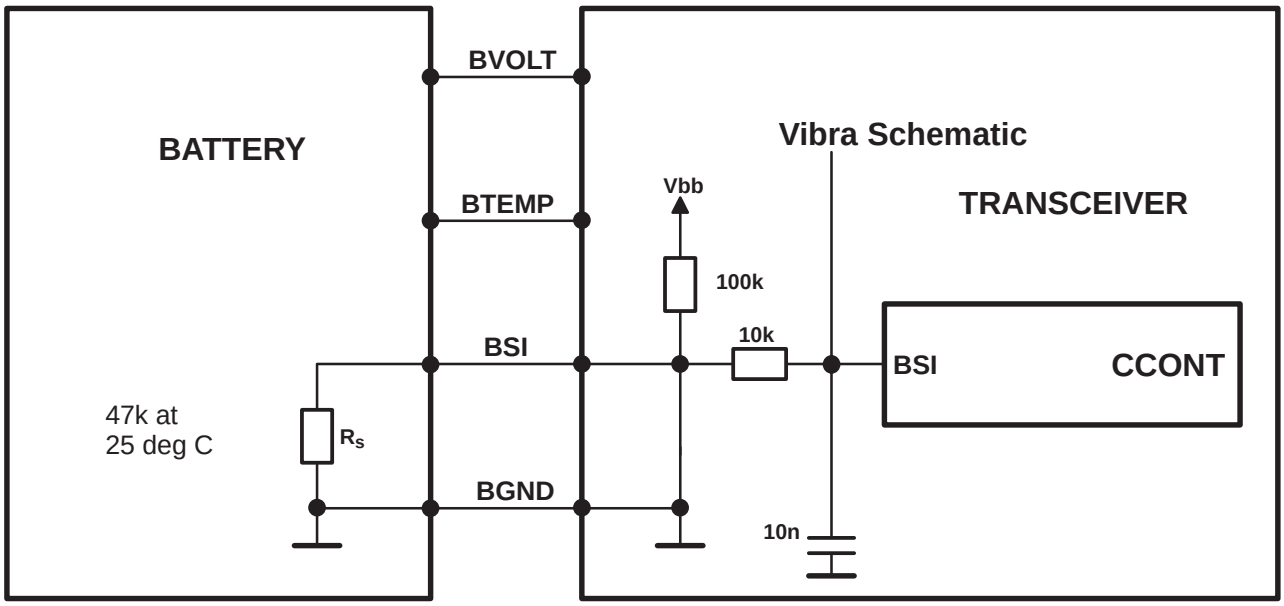
Parameter	Symbol	LIM input	Min	Typ	Max	Unit
Output voltage cutoff limit (during transmission or Li–battery)	VLIM1	LOW	4.4	4.6	4.8	V
Output voltage cutoff limit (no transmission or Ni–battery)	VLIM2	HIGH	4.8	5.0	5.2	V

The voltage limit (VLIM1 or VLIM2) is selected by logic LOW or logic HIGH on the CHAPS LIM– input pin. Default value is lower limit VLIM1.

Battery Identification

Different battery types are identified by a pulldown resistor inside the battery pack. The BSI line inside transceiver has a 100k pullup to VBB. The MCU can identify the battery by reading the BSI line DC–voltage level with a CCONT A/D–converter.



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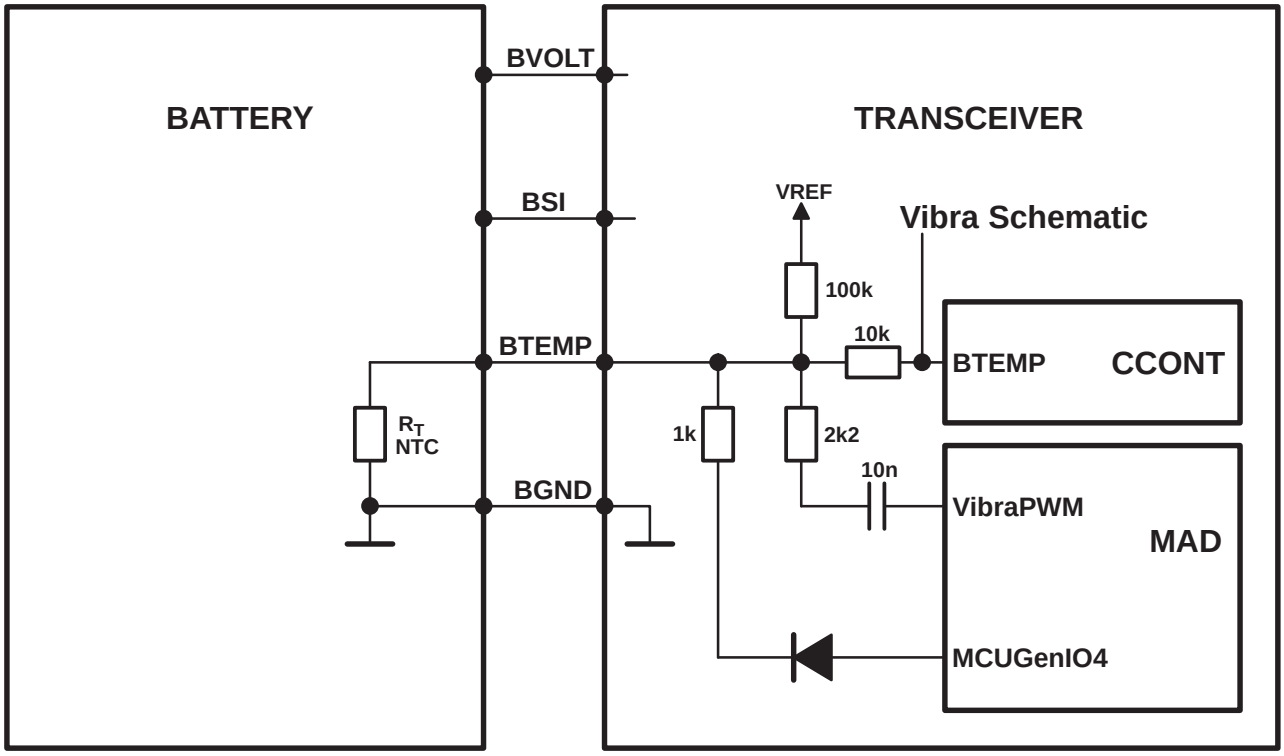
Battery Temperature

The battery temperature is measured with a NTC inside the battery pack. The BTEMP line inside transceiver has a 100k pullup to VREF. The MCU can calculate the battery temperature by reading the BTEMP line DC–voltage level with a CCONT A/D–converter.



Supply Voltage Regulators

The heart of the power distribution is the CCONT. It includes all the voltage regulators and feeds the power to the whole system. The baseband digital parts are powered from the VBB regulator which provides 2.8V baseband supply. The baseband regulator is active always when the phone is powered on. The VBB baseband regulator feeds MAD and memories, COBBA digital parts and the LCD driver in the UI section. VSIM supplies programming voltage to the FLASH memory. The COBBA analog parts are powered from a dedicated 2.8V supply VCOBBA. The CCONT supplies also 5V for RF. The CCONT features a real time clock function, which is powered from a RTC backup when the main battery is disconnected.

The RTC backup is rechargeable polyacene battery, which has a capacity of 50uAh (@3V/2V) The battery is charged from the main battery voltage

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by the CHAPS when the main battery voltage is over 3.2V. The charging current is 200uA (nominal).

Operating mode	Vref	RF REG	VCOB-BA	VBB	VSIM	SIMIF
Power off	Off	Off	Off	Off	Off	Pull down
Power on	On	On/Off	On	On	On	On/Off
Reset	On	Off VR1 On	On	On	Off	Pull down
Sleep	On	Off	On	On	On	On/Off

Note: *CCONT includes also five additional 2.8V regulators providing power to the RF section. These regulators can be controlled either by the direct control signals from MAD or by the RF regulator control register in CCONT which MAD can update. Below are the listed the MAD control lines and the regulators they are controlling.*

- *TxPwr controls VTX regulator (VR5)*
- *RxPwr controls VRX regulator (VR2)*
- *SynthPwr controls VSYN_1 and VSYN_2 regulators (VR4 and VR3)*
- *VCXOPwr controls VXO regulator (VR1)*

CCONT generates also a 1.5 V reference voltage VREF to COBBA and EROTUS. The VREF voltage is also used as a reference to the CCONT A/D converter.

In addition to the above mentioned signals MAD includes also TXP control signal which goes to PLUSSA power control block and to the power amplifier. The transmitter power control TXC is led from COBBA to PLUSSA.

Audio Control

The audio control and processing is taken care by the COBBA_D, which contains the audio and RF codecs, and the MAD1, which contains the MCU, ASIC and DSP blocks handling and processing the audio signals.

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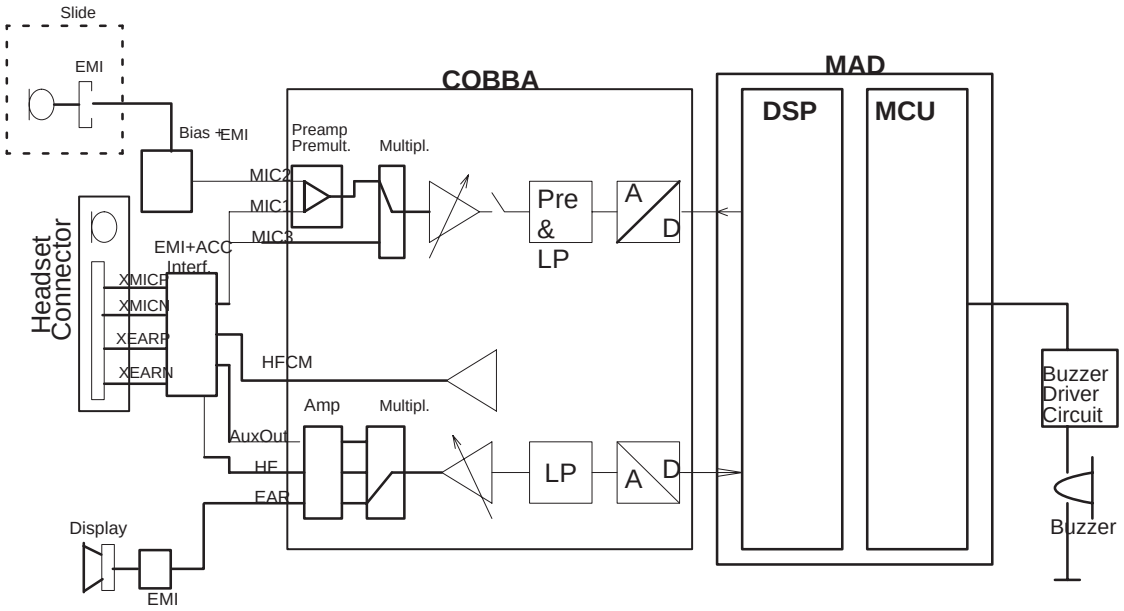

The baseband supports three microphone inputs and two earphone outputs. The inputs can be taken from an internal microphone, a headset microphone or from an external microphone signal source. The microphone signals from different sources are connected to separate inputs at the COBBA_D asic. Inputs for the microphone signals are differential type.

The MIC1 inputs are used for a headset microphone that can be connected directly to the headset connector. The internal microphone is connected to MIC2 inputs and an external pre–amplified microphone (handset/handfree) signal is connected to the MIC3 inputs. In COBBA there are also three audio signal outputs of which dual ended EAR lines are used for internal earpiece and HF line for accessory audio output. The third audio output AUXOUT is used only for bias supply to the headset microphone. As a difference to DCT3 generation both external MIC & EAR are fully differential (4–wire IF). No common mode line (SGND) is used.

The output for the internal earphone is a dual ended type output capable of driving a dynamic type speaker. Input and output signal source selection and gain control is performed inside the COBBA_D asic according to control messages from the MAD1. Keypad tones, DTMF, and other audio tones are generated and encoded by the MAD1 and transmitted to the COBBA_D for decoding.

Internal Microphone and Earpiece

The baseband supports three microphone inputs and two earphone outputs. The inputs can be taken from an internal microphone, a headset microphone or from an external microphone signal source. The microphone signals from different sources are connected to separate inputs to the COBBA_D asic. Inputs for the microphone signals are of a differential type.

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External Audio Connections

The external audio connections are presented in the figure on the previous page. A headset can be connected directly to the headset connector. The headset microphone bias is supplied from COBBA AUXOUT output and fed to microphone through XMIC line.

Audio Accessory Detection

When the MCU–SW receives a headset–interrupt, generated by the switch in the headset–connector, it will start the accessory–detection sequence.

At first it will measure the voltage at XMICP–pin (divided in half by 2 resistors) via EAD AD–converter in CCONT. If it detects a voltage it will start the sequence for the active accessory detection. The only specified active accessory for NSW–6 is the PPH–3 handsfree kit.

If there is no active voltage detected at XMICP, AUXOUT–pin of COBBA_D is switched to 1.5V and the voltage at XMICP is measured again. The voltage at XMICP depends on the impedance which is connected between XMICP and XMICN ath the accessory end.

Connector	Line Symbol	Minimum	Typical / Nominal		Unit / Notes
Connection State	HOOKDET (MAD1 pin C10)	HEADSETINT (MAD1 pin B11)	Voltage at XMICP	EAD–value	Notes
No accessory connected	’1’	’0’	0V	0	
Headset HDC–5 with button not pressed	’1’	’1’	1.1V	390	When AUXOUT at 1.5V
Headset HDC–5 with button pressed	’0’	’1’	0.75V	255	When AUXOUT at 1.5V
PPH–3 (connected correctly)	’0’	’1’	2.6V	900	when muted
PPH–3 with external microphone (connected correctly)	’0’	’1’	2.2V	750	when muted
Audio box JBA-6	’1’	’1’	~0.9V	330 – 350	when AUXOUT at 1.5V

Internal Audio Connections (speech processing)

The speech coding functions are performed by the DSP in the MAD1 and the coded speech blocks are transferred to the COBBA_D for digital to analog conversion, down link direction. In the up link direction the PCM coded speech blocks are read from the COBBA_D by the DSP.

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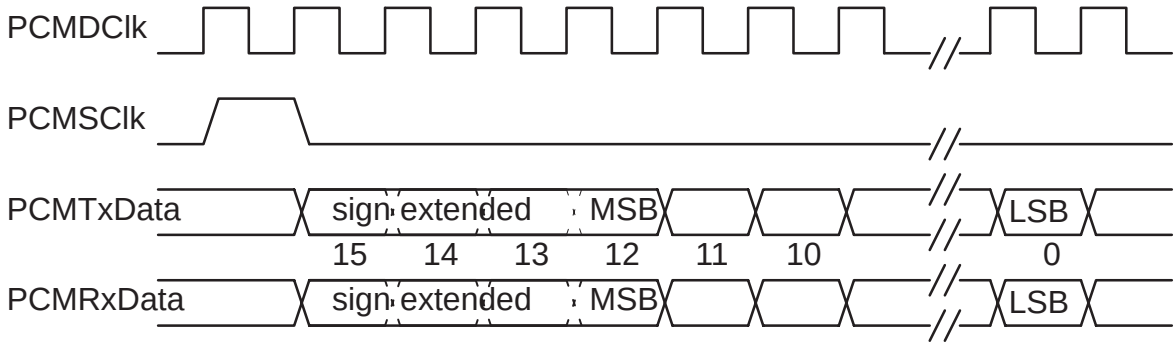
4–wire PCM Serial Interface

The interface consists of following signals: a PCM codec master clock (PCMDClk), a frame synchronization signal to DSP (PCMSClk), a codec transmit data line (PCMTX) and a codec receive data line (PCMRX). The COBBA_D generates the PCMDClk clock, which is supplied to DSP SIO. The COBBA_D also generates the PCMSClk signal to DSP by dividing the PCMDClk. The PCMDClk frequency is 1.000 MHz and is generated by dividing the RFIClk 13 MHz by 13. The COBBA_D further divides the PCMDClk by 125 to get a PCMSClk signal, 8.0 kHz.



The output for the internal earphone is a dual ended type output capable of driving a dynamic type speaker. The output for the external accessory and the headset is single ended with a dedicated signal ground SGND. Input and output signal source selection and gain control is performed inside the COBBA_D asic according to control messages from the MAD1PR1. Keypad tones, DTMF, and other audio tones are generated and encoded by the MAD1PR1 and transmitted to the COBBA_D for decoding. MAD1PR1 generates two separate PWM outputs, one for a buzzer and one for vibra (internal and external via BTEMP).

Speech Processing

The speech coding functions are performed by the DSP in the MAD1 and the coded speech blocks are transferred to the COBBA_D for digital to analog conversion, down link direction. In the up link direction the PCM coded speech blocks are read from the COBBA_D by the DSP.

There are two separate interfaces between the MAD and the COBBA: 2 serial buses. The first serial interface is used to transfer all the COBBA control information (both the RFI part and the audio part). The second serial interface between the MAD and COBBA includes transmit and receive data, clock and frame synchronization signals. It is used to transfer the PCM samples. The frame synchronization frequency is 8 kHz (the sample rate is in digital mode 8.0 kHz and in analog mode 8.1 kHz) which indicates the rate of the PCM samples and the clock frequency is 1 MHz. The COBBA is generating both clocks.

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Alert Signal Generation

A buzzer is used for giving alerting tones and/or melodies as a signal of an incoming call. Also keypress and user function response beeps are generated with the buzzer. The buzzer is controlled with a BuzzerPWM output signal from the MAD1. A dynamic type of buzzer is used since the supply voltage available can not produce the required sound pressure for a piezo type buzzer. The low impedance buzzer is connected to the UI–switch ASIC. The alert volume can be adjusted either by changing the pulse width causing the level to change or by changing the frequency to utilize the resonance frequency range of the buzzer.

A vibra alerting device is used for giving a silent signal to the user of an incoming call. The device is controlled with a Vibra output signal from the MAD1.

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Digital Control

MAD

The baseband functions are controlled by the MAD asic, which consists of a MCU, a system ASIC and a DSP.

MAD(1) contains following building blocks:

- ARM RISC processor with both 16–bit instruction set (THUMB mode) and 32–bit instruction set (ARM mode)
- DSP core with peripherals:
    - API (Arm Port Interface memory) for MCU–DSP communication, DSP code download, MCU interrupt handling vectors (in DSP RAM) and DSP booting
    - Serial port (connection to PCM)
    - Timer
    - DSP memory
- BUSC (BusController for controlling accesses from ARM to API, System Logic and MCU external memories, both 8– and 16–bit memories)
- System Logic
    - CTSI (Clock, Timing, Sleep and Interrupt control)
    - MCUIF (Interface to ARM via BusC). Contains MCU BootROM
    - DSPIF (Interface to DSP)
    - MFI (Interface to COBBA_D AD/DA Converters)
    - CODER (Block encoding/decoding and A51&A52 ciphering)
    - AccIF(Accessory Interface)
    - SCU (Synthesizer Control Unit for controlling 2 separate synthesizer)
    - UIF (Keyboard interface, serial control interface for COBBA_D PCM Codec, LCD Driver and CCONT)
    - UIF+ (roller/ slide handling)
    - PUP (Parallel IO, USART and PWM control unit for vibra and buzzer)
    - FLEXPOOL (DAS00308 FlexPool Specification)
    - SERRFI (DAS00348 COBBA_D Specifications)

The MAD1 operates from a 13 MHz system clock, which is generated from the 13Mhz VCXO frequency. The MAD1PR1 supplies a 6,5MHz or a 13MHz internal clock for the MCU and system logic blocks and a 13MHz clock for the DSP, where it is multiplied to TBD MHz DSP clock. The system clock can be stopped for a system sleep mode by disabling the

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VCXO supply power from the CCONT regulator output. The CCONT provides a 32kHz sleep clock for internal use and to the MAD1PR1, which is used for the sleep mode timing. The sleep clock is active when there is a battery voltage available i.e. always when the battery is connected.

Memories

The MCU program code resides in an external program memory, size is16Mbits. MCU work (data) memory size is 2Mbits (128k x16). A special block in the flash is used for storing the system and tuning parameters, user settings and selections, a scratch pad and a short code memory.

The BusController (BUSC) section in the MAD1 decodes the chip select signals for the external memory devices and the system logic. BUSC controls internal and external bus drivers and multiplexers connected to the MCU data bus. The MCU address space is divided into access areas with separate chip select signals. BUSC supports a programmable number of wait states for each memory range.

Program Memory 16MBit Flash

The MCU program code resides in the flash program memory. The program memory size is 16Mbits (1Mx16) . The default package is uBGA48.

SRAM Memory

The work memory size is 2Mbits (128kx16) static ram in a 48 ball BGA package. Vcc is 2.8V and access time is 100 ns The work memory is supplied from the common baseband VBB voltage and the memory contents are lost when the baseband voltage is switched off. All retainable data is stored into the flash memory when the phone is powered down.

EEPROM Emulated in FLASH Memory

A block in flash is used for a nonvolatile data memory to store the tuning parameters and phone setup information. The short code memory for storing user defined information is also implemented in the flash. The EEPROM space allocated is about 32kbyte The memory is accessed through the parallel bus.

Flash Programming

The program execution starts from the BOOT ROM and the MCU investigates in the early start–up sequence if the flash prommer is connected. This is done by checking the status of the MBUS–line. Normally this line is high but when the flash prommer is connected the line is forced low by the prommer. The flash prommer serial data receive line is in receive mode waiting for an acknowledgement from the phone.

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The data transmit line from the baseband to the prommer is initially high. When the baseband has recognized the flash prommer, the FBUS TX–line is pulled low. This acknowledgement is used to start the data transfer of the first two bytes from the flash prommer to the baseband on the FBUS RX–line. The data transmission begins by starting the serial transmission clock (MBUS–line) at the prommer.

The 2.8V programming voltage is supplied inside the transceiver from the CCONT.

The following table lists out the flash programming pads under the battery, (holes are provided in the shield)

Name	Parameter	Min	Typ	Max	Unit	Remark
MBUS	Serial clock from the Prommer	2.0 0		2.8 0.8	V	Prommer detection and Serial Clock for synchronous communication
FBUS_RX	Serial data from the Prommer	2.0v 0v		2.8 0.8	V	Receive Data from Prommer to Baseband
FBUS_TX	Data acknowledge to the Prommer	2.0 0,1		2.8 0.8	V	Transmit Data from Baseband to Prommer
GND	GND	0		0	V	Supply ground

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RF Module

Technical Summary

The RF module converts the signal received by the antenna to a baseband signal and vice versa.

It consists of a conventional superheterodyne receiver and a transmitter for each band and also two frequency synthesizers for the required mixing.

The RF module includes one integrated circuit, the EROTUS a BiCMOS ASIC.

The dual–band RF–module is capable for seamless operation between 800 MHz and 1900 MHz bands. In practise this means capability to cross–band hand–offs and maho–measurements.

The EROTUS includes:

- Limiter amplifier for the analog receiver
- An AGC amplifier for the digital receiver
- A receiver mixer for the 450kHz down conversion
- PLLs for the 1GHz UHF and VHF synthesizers
- IQ–modulators for the transmitter
- A power control circuit for the transmitter and the AGC amplifier

The power amplifiers (PAs) are GaAs HBT MMICs. They comprise two 800 MHz and three 1900 MHz amplifier stages with input and interstage matching.

The LNA MMICs include:

- A LNA for each band with a step AGC
- Down converters for the receiver
- A prescaler for the LO buffer

On the next page is a graphical presentation of the used Frequency Plan.

RF Frequency Plan

Intermediate frequencies of the RX are the same in all operation modes. RX/TX LO and TX IF modulator frequencies are different in TDMA800 and TDMA1900 operation modes. See figure below for details.

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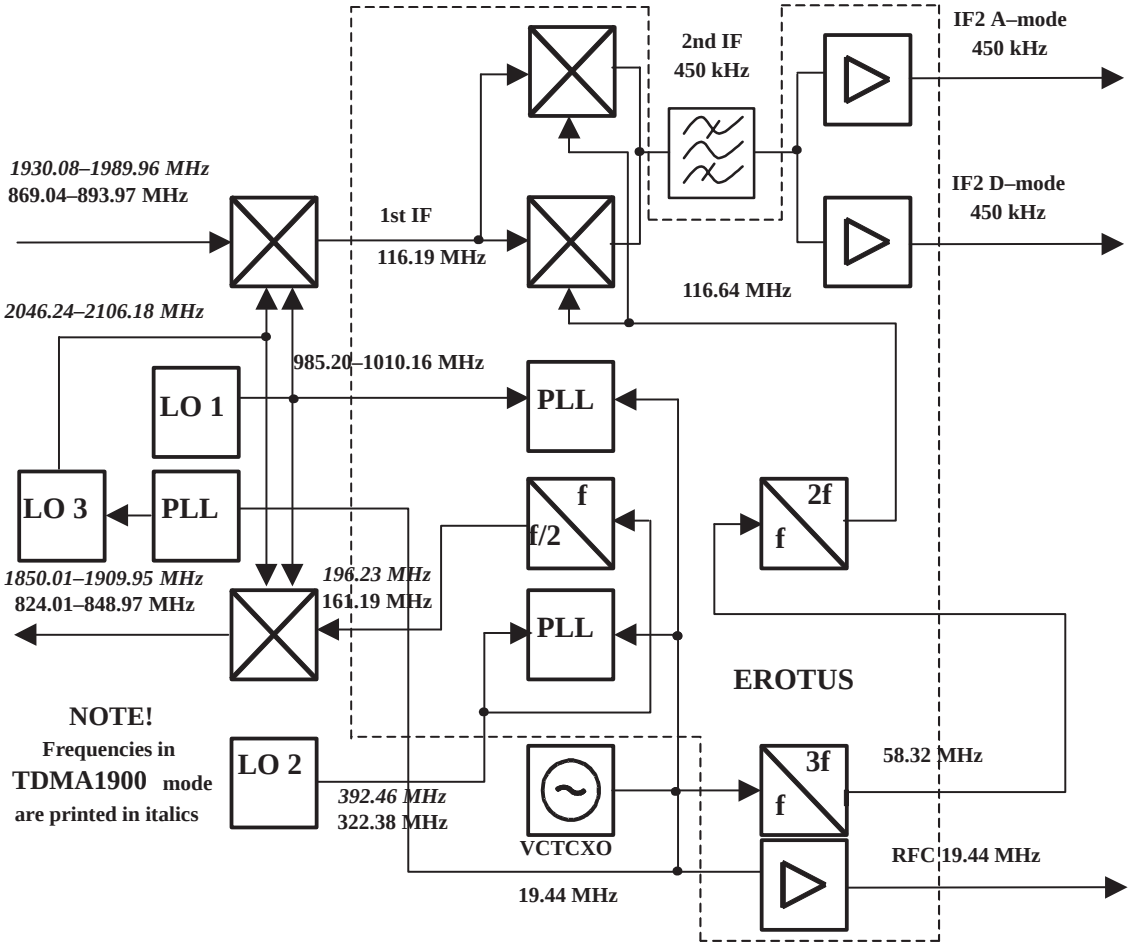

DC Characteristics

Power Distribution Diagram

There are two options for power distribution. 1st option is a dual band phone, which is presented in the diagram next page. Current consumptions in the diagrams are only suggestive.

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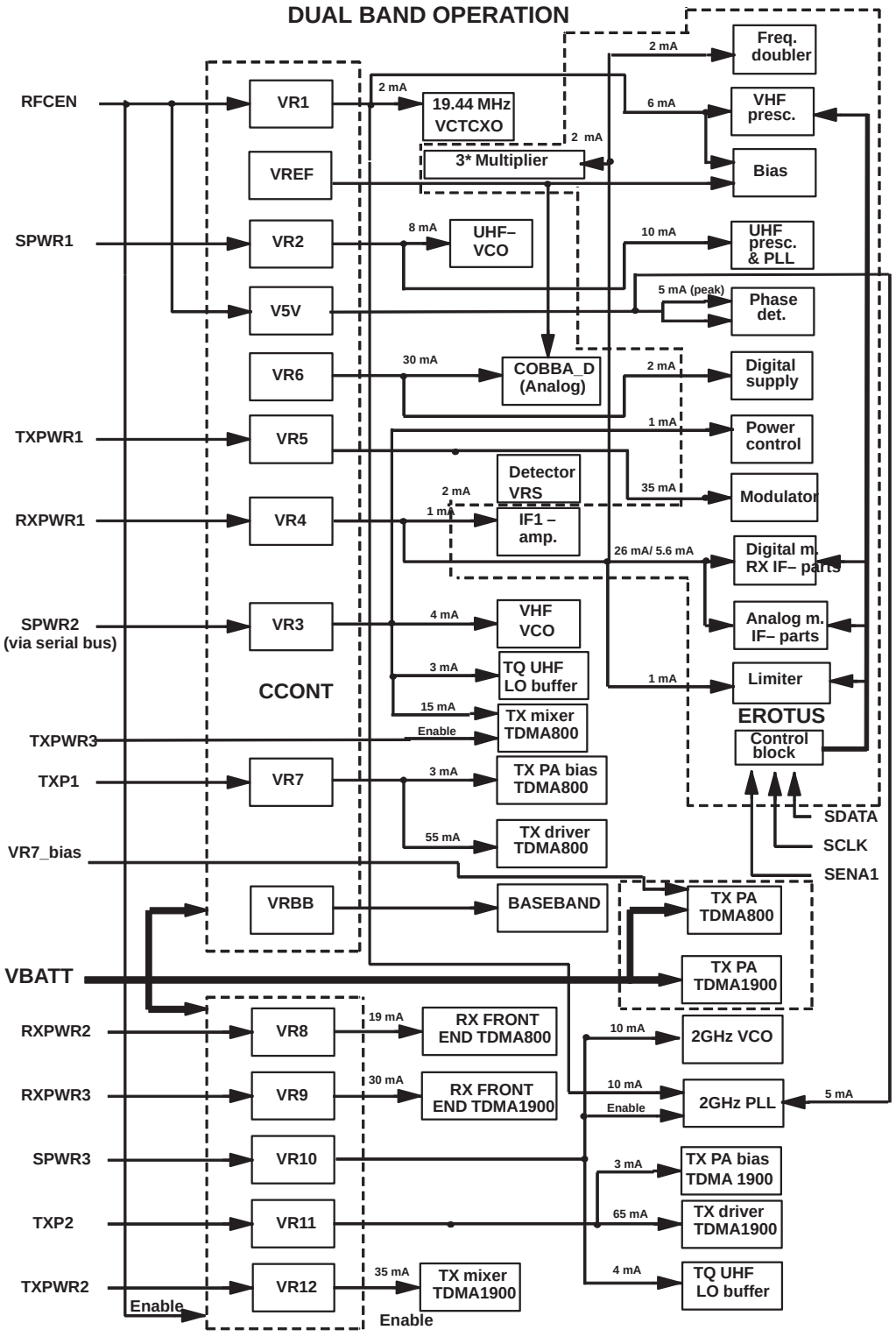

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Current consumption in different operation modes can be seen in the table below:.

	800 MHz Ext. Standby [mA]	800 MHz Analog Control Channel [mA]	800 MHz Analog Traffic Channel [mA]	800 MHz Digital Control Channel [mA]	800 MHz Digital Traffic Channel [mA]	1900 MHz Digital Control Channel [mA]	1900 MHz Digital Traffic Channel [mA]
VR1	9.0 / 0.0	9.0	9.0	9.0 / 0.0	9.0	19.0 / 0.0	19.0
VR2	16.0 / 0.0	16.0	16.0	16.0 / 0.0	16.0	0.0	0.0
VR3	0.0	0.0	23.0	0.0	13.0	0.0	8.0
VR4	11.6 / 0.0	11.6	11.6	32 / 0.0	12.8*	32 / 0.0	12.8*
VR5	0.0	0.0	37.0	0.0	13.0 **	0.0	13.0 **
VR6	2.0 / 0.1	2.0	32.0 ***	2.0 / 0.1	32.0 ***	2.0 / 0.1	32.0 ***
VR7	0.0	0.0	58.0	0.0	19.2 ’	0.0	0.0
VR8	19.0 / 0.0	19.0	19.0	19.0 / 0.0	7.6 ’’	0.0	0.0
VR9	0.0	0.0	0.0	0.0	0.0	30.0 / 0.0	12.0 ’’’
VR10	0.0	0.0	0.0	0.0	0.0	10.0 / 0.0	10.0
VR11	0.0	0.0	0.0	0.0	0.0	0.0	22.5^
VR12	0.0	0.0	0.0	0.0	0.0	0.0	12.9^^
V5V	5.0 / 0.0	5.0	5.0	5.0 / 0.0	5.0	5.0 / 0.0	5.0
Total	62.6 / 0.1	62.6	210.6	83.0 / 0.1	127.6	98.0 / 0.1	147.2

NOTES: * Mean value (ON/OFF=8/20ms), peak current 32.0 mA
** Mean value (ON/OFF=7/20ms), peak current 37.0 mA
*** Cobba_D mean current consumption estimated to be 30 mA
’ Mean value (ON/OFF=6.6/20ms), peak current 180.0 mA
’’ Mean value (ON/OFF=8/20ms), peak current 10.0 mA
’’’ Mean value (ON/OFF=8/20ms), peak current 15.0 mA when AGC2=1
^ Mean value (ON/OFF=6.6/20ms), peak current 68.0 mA
^^ Mean value (ON/OFF=6.6/20ms), peak current 39.0 mA

Regulators

Most of the RF voltage regulation functions are located in the regulator IC CCONT. It has 8 separate regulators with power on/off controls (see fig 2). Regulator VR6 is used also for the COBBA_D IC and the rest of the regulators VR1–VR7 are reserved for the RF blocks only. VR7_bias controls the 800MHz PA bias to boost better efficiency in analog mode and at power levels 6 to 10 in digital mode. VSIM voltage is used for the PLL charge pump supply. In dual band phone there is a need for 5 additional regulators, which are integrated in Penta regulator IC.

Receiver

DAMPS800 RX

The receiver is a double conversion receiver. Most of the RX functions are integrated in two ICs, namely receiver front end and EROTUS. Re-

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ceiver front end contains a LNA and the 1st mixer. Analog and digital IF–parts are integrated in the EROTUS.

The received RF signal from the antenna is fed through a duplex filter to the receiver unit. The signal is amplified by a low noise preamplifier. In digital mode the gain of the amplifier is controlled by the AGC2 control line. The nominal gain of 19 – 20 dB is reduced in the strong signal condition about 14 – 16 dB (in digital mode). After the preamplifier the signal is filtered with a SAW RF filter. The filter rejects spurious signals coming from the antenna and spurious emissions coming from the mixer and IF parts.

The filtered RF–signal is downconverted by an active mixer. The frequency of the first IF is 116.19 MHz. The first local signal is generated in the UHF synthesizer. The IF signal is fed through a SAW IF–filter. The filter rejects intermodulating signals and the second IF image signal. The filtered 1st IF is fed to the receiver section of the integrated RF circuit EROTUS, which has separate IF paths for analog and digital modes of operation.

In digital mode the IF1 signal is amplified by an AGC amplifier, which has a gain control range of 57 dB. The gain is controlled by an analog signal with AGC1–line. The amplified IF signal is down converted to a second IF in the mixer of EROTUS. The second local signal is the 6th overtone of the 19.44 MHz VCTCXO. LO frequency multiplier is implemented in two stages. First multiplication by 3 is done with a EROTUS multiplier with an external trap and the second multiplication by 2 is done in the integrated doubler in EROTUS.

The second IF frequency is 450 kHz. The second IF is filtered by two ceramic filters. The filter rejects signals on the adjacent channels. The filtered second IF is fed back to EROTUS, where it is amplified and fed balanced out to COBBA_D via IF2D lines.

In analog mode the filtered and amplified IF1 signal is fed to a mixer. This mixer has been optimized for low current consumption. After this the mixer down converted signal is fed through the same IF2 filter as in digital mode and finally it is amplified in the limiter amplifier. The limited IF2 signal is fed via balanced IF2A lines to COBBA_D, which has a digital FM–detector. The limiter amplifier produces also a RSSI voltage for analog mode field strength indication.

TDMA 1900 RX

On 1900 MHz band the receiver operates only in digital mode. There is a separate front end for this band. IF–parts are common for both bands. Operation of the receiver is similar to digital mode operation on 800 MHz band.

Frequency Synthesizers

The stable frequency reference for the synthesizers and base band circuits is a voltage controlled temperature compensated crystal oscillator

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VCTCXO. Frequency of the oscillator is 19.44 MHz. It is controlled by an AFC voltage, which is generated in the base band circuits. In digital mode operation, the receiver is locked to base station frequency by AFC. Next to detector diode, there is a sensor for temperature measurement. Voltage RFTEMP from this sensor is fed to baseband for A/D conversion. This information of the RF PA–block temperature is used as input for compensation algorithms.

The ON/OFF switching of the VCTCXO is controlled by the sleep clock in the baseband via RFCEN. Other parts of the synthesizer section are 1 GHz VCO, 2 GHz VCO, VHF VCO, PLL for 2 GHz VCO and PLL sections of the EROTUS IC.

DAMPS 800 operation

1GHz UHF synthesizer generates the down conversion injection for the receiver and the up conversion injection for the transmitter. UHF frequency is 985.20 ... 1010.16 MHz, depending on the channel which is used. 1GHz UHF VCO is a module. The PLL circuit is dual PLL, common for both UHF and VHF synthesizers. These PLLs are included in the EROTUS IC.

LO signal for the 2nd RX mixer is multiplied from the VCTCXO frequency as described above.

VHF synthesizer is running only on digital or analog traffic channel. 322.38 MHz signal (divided by 2 in EROTUS) is used as a LO signal in the I/Q modulator of the transmitter chain.

TDMA 1900 operation

2 GHz VCO with external PLL circuit generates 2046.24 ... 2106.18 MHz injection signals for 1st RX mixer and TX upconverter.

VHF synthesizer is running only on digital traffic channel. Operating frequency 392.46 MHz is fed to EROTUS modulator, where it is divided by 2 and used as modulator LO signal.

Transmitter

DAMPS800 TX

The TX intermediate frequency is modulated by an I/Q modulator contained in the transmitter section of EROTUS IC. The TX I and TXQ signals are generated in the COBBA_D interface circuit and they are fed differentially to the modulator.

Intermediate frequency level at the modulator output is controlled by power control.

The output signal from EROTUS modulator is filtered to reduce harmonics and RX–band noise. The final TX signal is achieved by mixing the

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UHF VCO signal and the modulated TX intermediate signal in an active mixer. After the mixing TX signal is amplified by a driver stage. From driver stage the signal is fed trough the TX filter to PA MMIC.

The PA amplifies the TX signal by 28–32 dB. Amplified TX signal is filtered in the duplex filter. Then signal is fed to the antenna, where the maximum output level is typically 480 mW.

The power control loop controls the gain of the EROTUS gain control stage. The power detector consists of a directional coupler and a diode rectifier. The output voltage of the detector is compared to TXC voltage in EROTUS. The power control signal (TXC), comes from the RF interface circuit, COBBA_D. TXP signal sets driver power down to ensure off–burst level requirements.

False transmission indication is used to protect transmitter against false transmission caused by component failure. Protection circuit is in EROTUS. The level for TXF is set by internal resistor values in EROTUS.

TDMA1900 TX

See 800 MHz digital mode transmitter.

DAMPS800/TDMA1900 operation

Supply voltages in different modes of operation

	800 MHz Ext. Stadby	800 MHz Analog Control Channel	800 MHz Analog Traffic Channel	800 MHz Digital Control Channel	800 MHz Digital Traffic Channel	1900 MHz Digital Control Channel	1900 MHz Digital Traffic Channel
VR1	ON/OFF	ON	ON	ON/OFF	ON	ON/OFF	ON
VR2	ON/OFF	ON	ON	ON/OFF	ON	ON/OFF*	ON/OFF*
VR3	OFF	OFF	ON	OFF	ON	OFF	OFF
VR4	ON/OFF	ON	ON	ON/OFF	ON/OFF	ON/OFF	ON/OFF
VR5	OFF	OFF	ON	OFF	ON/OFF	OFF	ON/OFF
VR6	ON	ON	ON	ON	ON	ON	ON
VR7	OFF	OFF	ON	OFF	ON/OFF	OFF	OFF
VR8	ON/OFF	ON	ON	ON/OFF	ON/OFF	OFF	OFF
VR9	OFF	OFF	OFF	OFF	OFF	ON/OFF	ON/OFF
VR10	OFF	OFF	OFF	ON/OFF*	ON/OFF*	ON	ON
VR11	OFF	OFF	OFF	OFF	OFF	OFF	ON/OFF
VR12	OFF	OFF	OFF	OFF	OFF	OFF	ON/OFF
VSIM	ON/OFF	ON	ON	ON/OFF	ON	ON/OFF	ON
NOTE: * ON during interband MAHO							

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Software Compensations

Power Levels (TXC) vs. Temperature

Because of wide temperature range, it is necessary to compensate the effect of temperature on the output power. To monitor this environment change, temperature measurement is done by using NTC resistor. A Factor table is used for temperature compensation. The table values are defined without factory measurements. Temperature is measured and right compensation value is added to TXC–value. Requirement for compensation update is for every 1 minutes or after every 5 degrees C of temperature change. This means that the output power is reduced linearly from level 2 to –1dB when temperature inside the phone is above +80 C in analog mode and above +65 C in digital mode.

Power Levels (TXC) vs. Channel

Duplexer frequency response ripple is compensated by software. Power levels are calibrated on four channels in production. Values for channels between these tuned channels are calculated using linear interpolation.

Power levels vs. Battery Voltage

To extend battery duration in digital mode, the output power is decreased linearly from level 2 to –1dB when battery voltage drops below 3.3V.

TX Power Up/Down Ramps

Transmitter output power up/down ramps are controlled by SW. A special ramp tables are used for that. Requirement is for nine different ramps in digital mode for both operating bands and one ramp for analog mode. Separate ramps are used in power up and power down ramps.

Digital Mode RSSI

Digital mode RSSI vs. input signal is calibrated in production, but RSSI vs. temperature and RSSI vs. channel are compensated by software.

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RF Block Specifications

Receiver

DAMPS 800MHz RX Front End

Receiver front end is integrated in the IC. It has RF amplifier with a gain step and an active mixer. RX interstage filter is a SAW filter.

Parameter	Min	Typ/ Nom	Max	Unit
Supply voltage	2.7	2.8	2.85	V
RF amplifier current cons.		10.0	11.0	mA
Mixer current consumption		3.0	5.0	mA
LO buffer current consumption		2.0	3.0	mA
2nd buffer current consumption		2.0	3.0	mA
RF amplifier frequency range	869 – 894			MHz
RF amplifier insertion gain	18	19	20	dB, AGC2 = H
RF amplifier gain variation			±1.0	dB, temp –30...+85 C
RF amplifier absolute gain red.		15		dB, AGC2 = L
RF amplifier noise figure		1.7	2.0	dB, AGC2 = H
RF amplifier noise figure			15	dB, AGC2 = L
RF amplifier reverse isolation	15			dB
RF amplifier IIP3	–7	–6		dBm
RF amp input VSWR			2.0	(Zo=50 ohms)
RF amp output VSWR			2.0	(Zo=50 ohms)
Mixer input frequency range	869 – 894			MHz
Mixer power gain	4	5	6	dB
Mixer NF, SSB		8	9	dB
Mixer IIP3	5	7	10	dBm
Mixer single input resistance		50		Ω
Mixer bal. output resistance		900		Ω (open collector)
LO level in mixer RF–input	–3	–0	+3	dBm
Mixer RF–IF isolation	20	40		dB
LO signal frequency range	985		1011	MHz
LO input resistance		50		Ω
Value(s) based on NMP specification nr.19190				

TDMA 1900MHz RX Front End

Receiver front end is integrated in the IC. It has RF amplifier with a gain step and an active mixer. RX interstage filter is a dielectric filter.

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Parameter	Min	Typ/ Nom	Max	Unit
Supply voltage	2.7	2.8	2.85	V
RF amplifier current cons.		15.0	17.0	mA
Mixer current consumption		11.0	15.0	mA
RF amplifier frequency range	1930 – 1990			MHz
RF amplifier insertion gain	18	19	20	dB, AGC2 = H
RF amplifier gain variation			±1.0	dB, temp –30...+85 C
RF amplifier absolute gain red.		15		dB, AGC2 = L
RF amplifier noise figure		1.7	2.0	dB, AGC2 = H
RF amplifier noise figure			15	dB, AGC2 = L
RF amplifier reverse isolation	15			dB
RF amplifier IIP3	–7			dBm
Mixer input frequency range	1930 – 1990			MHz
Mixer power gain	4	5	6	dB
Mixer NF, SSB		8	9	dB
Mixer 1/2 IF Spurious rejection		–70	–68	dBc
Mixer IIP3	5	7	10	dBm
LO level in mixer RF–input	–10	–6	–4	dBm
Mixer RF–IF isolation	20	30		dB
LO signal frequency range	2046.2		2106.2	MHz
LO single ended input level	200			mVpp
LO input resistance		50		Ω
* Value(s) based on NMP specification nr.19191				

SAW Filter

The 1st IF filter is a SAW filter. The function of the filter is to provide attenuation for the intermodulating signals

Analog IF parts

Analog mode IF–parts are included in EROTUS. Functional blocks: IF1 amplifier, a 2x–multiplier for LO signal, a mixer and a limiter amplifier with RSSI. Specifications for analog mode IF–parts are in table 5. IF2 filter is a double 450 kHz ceramic filter.

Parameter	Min	Typ/ Nom	Max	Unit
Supply voltage	2.7	2.8	2.9	V
IF1 amp + mixer current cons.		6	8	mA (+0.6 mA in d–mode)
6x freq. multipl. current cons.		1.8		mA
Limiter + RSSI current cons.		1.3		mA

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Parameter	Min	Typ/ Nom	Max	Unit
Power up time			2	ms
RF input impedance single end		900//–1		kohm//pF
RF input frequency range	45	116.19	120	MHz
Noise figure, IF1 amp + mixer			8	dB, RF = 116 MHz
Conversion gain @ Rl=1.5kohm	25		33	dB
Conversion gain variation			TBD	dB, temp –30...+85 C
3rd order input intercept point	20			mV_{rms}
Mixer output frequency range		450		kHz
Mixer out to limiter in isolation	70	80		dB, @ 450 kHz
Limiter input frequency		450		kHz
Limiter input limiting range	30			uV_{rms}
Limiter output voltage		0.3		V_{pp}
Limiter output resistive load	10			kW
Limiter output capacitive load			5	pF
RSSI dynamic range	65	70		dB
RSSI starting level @ LIMIN1	30		60	uVrms
RSSI voltage slope	5	10		mV/dB
RSSI voltage range	0.1		1.5	V
RSSI output capacitive load			50	pF
RSSI output resistive load	500			kΩ
Freq. multiplier input frequency		19.44		MHz
Input signal spurious levels	–8	–10		dBc, (19.44 MHz spurs)
Input signal level	50		tbd	mV_{peak}

Digital IF parts

The digital IF–parts of EROTUS comprise AGC Amplifer with 57 dB control range, a mixer and a buffer amplifier for the last IF.

Parameter	Min	Typ/ Nom	Max	Unit
Supply voltage	2.7	2.8	2.9	V
Current consumption		43		mA
RF input frequency range	45	116.19	120	MHz
Local frequency (6x19.44 MHz)		116.64		MHz
IF frequency		450		kHz
Max voltage gain, AGC + mixer	47			dB
Min voltage gain, AGC + mixer			–10	dB
Gain change, AGC + mixer			±5	dB, temp –30...+85 C

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Parameter	Min	Typ/ Nom	Max	Unit
Noise figure @ max gain			8	dB
Control voltage for min gain		0.5		V
Control voltage for max gain		1.4	1.45	V
AGC gain control slope	TBD	90	TBD	dB/V
Mixer output 1dB compr. point	0.8			V_{pp}
Gain of the last IF buffer	34	36	38	dB, single ended
Max IF2–buffer output level		1.4		V_{pp}
IF2–buffer output impedance			300	ohm, single ended

Transmitter

RF Characteristics of the transmitter:

Item	DAMPS	TDMA1900
TX frequency range	824.01...848.97 MHz	1850.01...1909.95 MHz
Type	Upconversion	
Intermediate frequency	161.19 MHz	196.23 MHz
Nominal power on highest power level	480mW (≈ 26.8 dBm) / 400mW (≈ 26 dBm)	
Power control range	65 dB	
Maximum rms error vector	12.5 %	

TX Power levels

Power level	Analog mode	Digital mode 800 MHz	Digital mode 1900 MHz	Design target (**	Unit / Notes
	Class III	Class IV	Class IV	Class IV	dBm
0	28 +2 ,–4	28 +2 ,–4	28 +2 ,–4		dBm
1	28 +2 ,–4	28 +2 ,–4	28 +2 ,–4		dBm
2 Reduced 2 (*	28 +2 ,–4 26 +2 ,–2	28 +2 ,–4 26 +2 ,–2	28 +2 ,–4 26 +2 ,–2	28 +0.5 ,–1 26 +1 ,–1	dBm
Power level	**Analog mode**	**Digital mode 800 MHz**	**Digital mode 1900 MHz**	**Design target (****	**Unit / Notes**
3	24 +2 ,–4	24 +2 ,–4	24 +2 ,–4	24 +2 ,–2	dBm
4	20 +2 ,–4	20 +2 ,–4	20 +2 ,–4	20 +2 ,–2	dBm
5	16 +2 ,–4	16 +2 ,–4	16 +2 ,–4	16 +2 ,–2	dBm
6	12 +2 ,–4	12 +2 ,–4	12 +2 ,–4	12 +2 ,–2	dBm
7	8 +2 ,–4	8 +2 ,–4	8 +2 ,–4	8 +2 ,–2	dBm
8	–	4 +2 ,–4	4 +2 ,–6	4 +2 ,–2	dBm
9	–	0 +2 ,–6	0 +2 ,–8	0 +2 ,–2	dBm
10	–	–4 +2 ,–8	–4 +2 ,–10	–4 +2 ,–2	dBm

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Synthesizers

UHF Synthesizers specification

Parameter	UHF 800MHz analog mode rx/tx injection	UHF 800MHz digital mode rx/tx slot	UHF 1900MHz rx/tx slot	Unit/ Notes
Frequency range	985.20 ... 1010.16	985.20 ... 1010.16	2046.24 ... 2106.18	MHz
Reference frequency	30	30	30	kHz
Reference peaks @ 30 kHz @ 60 kHz	–31 –70	–38 –57	–38 –57	dBc, max
2 x fo level	–20	–20	–20	dBc
Phase noise, fo _ 60 kHz fo _120 kHz	–115	–101 –121	–101 –121	dBc/Hz, max
Phase error	–	4	4	°rms, max
Residual FM Filters: 300 Hz HP 3 kHz LP	150	–	–	Hz, max
Frequency settling time within _ 3 kHz within _ 30 Hz	 20	 1.4 2.0	 1.4 2.0	ms, max
Start up settling time	30	3	3	ms, max

VHF Synthesizers specification

Parameter	VHF 800MHz analog mode tx injection	VHF 800MHz digital mode rx/tx slot	VHF 1900MHz mode tx injection	Unit/ Notes
Frequency range	322.38	322.38	392.46	MHz
Reference frequency	30	30	30	kHz
Reference peaks @ 30 kHz @ 60 kHz	–31 –66	–41 –60	–41 –60	dBc, max
2 x fo level	–30	–30	–30	dBc
Phase noise, fo _ 60 kHz fo _120 kHz	–105	–105	–105	dBc/Hz, max
Phase error	2	2	2	°rms, max
Frequency settling time within _ 3 kHz within _ 30 Hz	 20	 20	 20	ms, max
Start up settling time	20	20	20	ms, max

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Output levels

Parameter	Min	Typ/ Nom	Max	Unit
2G UHF synthesizer to Lo buffer level resistive load parallel capacitance		 tbd tbd	–10	 dBm Ω pF
1G UHF synthesizer to TX mixer level impedance		 tbd	–5	 dBm Ω
VHF synthesizer to EROTUS level resistive load parallel capacitance	 100 1k	 tbd		 mV_{pp} Ω pF
VCTCXO 19.44 MHz level resistive load parallel capacitance	 600 1k		 20	 mV_{pp} Ω pF
VCTCXO 19.44 MHz to BB level resistive load parallel capacitance	 200	 10k tbd		 mV_{pp} Ω pF
VCTCXO 3 * fo level fo and 2xfo level harmonic suppression resistive load parallel capacitance	 50 –25 –25	 5k tbd	 100	 mV_{pp} dBc dBc Ω pF

RF/BB interface signals

CCONT (baseband) control signals are included in table below.. *These control signals are printed in italics.*

Signal name	From/ *Con-trol*	To	Parameter	Min	Typ	Max	Unit	Function
VBAT	battery	RF 2V8 regul.	Voltage	3.1	3.6	5.3	V	Supply voltage for discrete 2V8 regulators in dual band phone
			Voltage during TX	3.0	3.6	5.0	V	
			Current			1200	mA	
VREF	CCONT	Erotus	Voltage	1.478	1.50	1.523	V	EROTUS reference voltage
			Current			10	uA	
VR1	CCONT / *RFCEN*	Erotus, VCTCXO, 2GHz PLL	Voltage	2.7	2.8	2.85	V	Supply for VCTCXO, and Erotus VHF prescaler, VCO and bias, 2 GHz PLL

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Signal name	From/ *Control*	To	Parameter	Min	Typ	Max	Unit	Function
			Current, tdma 800	3.0	7	9	mA	
			Current, tdma1900	3.0	17	19	mA	
VR2	CCONT / *SPWR1*	Erotus, UHF VCO1	Voltage	2.7	2.8	2.85	V	Supply voltage for tdma 800 UHF VCO and prescaler
			Current, tdma800	14	16	20	mA	
			Current, tdma1900		off		mA	
VR3	CCONT / *SPWR2 (via serial bus)*	VHF–VCO, LO–buff, TX mixer	Voltage	2.7	2.8	2.85	V	Supply for VHF VCO, LO buffer, tdma800 TX mixer and TXF
			Current, tdma800	20	24	30	mA	
			Current, tdma1900	4	9	12	mA	
VR4	CCONT / *RXPWR1*	Erotus, VCTCXO IF1–amp	Voltage	2.7	2.8	2.85	V	Supply for Erotus IF–parts, IF1–amp., VCTCXO multiplier
			Current, anal.RX	10	12	15	mA	
			Current, digi.RX	30	32	34	mA	
VR5	CCONT / *TXPWR1*	Erotus, TX pwr control	Voltage	2.7	2.8	2.85	V	Supply for Erotus modulator, TX pwr control
			Current, TX–mode	33	37	41	mA	
VR6	CCONT	Erotus disc.PLL Cobba_D	Voltage	2.7	2.8	2.85	V	Erotus & disc PLL: digital supply, Cobba_D: analog supply
			Current (RF block)		2.0	3.0	mA	
VR7	CCONT *TXP1*	TX PA	Voltage	2.7	2.88	2.95	V	TX PA bias and TX driver regulator enable
			Current, tdma800		55	60	mA	
V5V	CCONT / *RFCEN*	EROTUS	Voltage	4.8	5.0	5.2	V	Erotus and discrete synthesizer phase det
			Current		3.0	5.0	mA	
RFTEMP	RF	CCONT	Voltage	0		1.5	V	RF temperature sensor (47 k NTC to GND)

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Signal name	From/ *Control*	To	Parameter	Min	Typ	Max	Unit	Function
AFC	Cobba_D	VCTCXO	Voltage Min	0.05	1.2	2.25	V	Automatic frequency control signal for VCTCXO. When DAC is switched OFF AFC output is in high–Z mode
			Resolution		11		bits	
			Load resistance (dynamic)		10		kΩ	
			Load resistance (DC)		110		kΩ	
AGC1	Cobba_D	EROTUS	Voltage Min	0.5		1.40	V	Digital mode receiver gain control. DSP
			Load resistance	10			kΩ	
			Load capacitance			10	pF	
			Resolution		10		bits	
			Timing inaccuracy			8	us	
AGC2	MAD (CTID AGC2, genpio)	RX LNA	Logic high ”1”	2.0			V	LNA gain switch. Polarity: 0=reduced 1=normal DSP
			Logic low ”0”			0.7	V	
			Sink/source curr.			20	uA	
			Load capacitance			10	pF	
			Timing inaccuracy			8	us	
BAND **Not in use**	Cobba_D		Logic high ”1”	2.1			V	TDMA800 operation
			Logic low ”0”	0		0.4	V	TDMA1900 operation
			Sink/source curr.			1.0	mA	DSP, MCU
			Load capacitance			10	pF	
			Timing inaccuracy			1	ms	
MODE	MAD	PA, (FM–detector)	Logic high ”1”	2.1			V	Digital 800 operation
			Logic low ”0”	0		0.4	V	Analog 800 operation
			Sink/source curr.			2.0	mA	DSP
			Load capacitance			tbd	pF	
			Timing inaccuracy				ms	

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Signal name	From/ *Control*	To	Parameter	Min	Typ	Max	Unit	Function
IF2AP/ IF2AN	ERO-TUS	Cobba_D	IF2 frequency		450		kHz	Differential IF2–signal from limiter to DEMO detector in Cobba_D
			Output level,		0.6		Vpp	
			Load resistance	10			kΩ	
			Load capacitance			5	pF	
IF2DP/ IF2DN	ERO-TUS	Cobba_D	IF2 frequency		450		kHz	Differential IF2–signal to RX A/D–converter, PGA = 0 dB
			Output level		170	1400	mVpp	
			Source imp.			600	Ω	
RFC	VCTCXO	Cobba_D	Frequency		19.44		MHz	High stability clock signal for the locig circuits
			Signal amplitude	0.2		1.0	Vpp	
			Load resistance	10			kΩ	
			Load capacitance			5	pF	
RFCEN	MAD (CTID, *RFCEN*)	CCONT, Cobba_D	Logic high ”1”	2.0			V	Supply voltage VR1 ON, RFC enable
			Logic low ”0”			0.5	V	Supply voltage VR1 OFF, RFC disable
			Current			100	uA	MCU, DSP
			timing inaccuracy			50	us	
RSSI	ERO-TUS	CCONT	Voltage	0.1		1.5	V	Analog mode field strength indicator voltage Digital mode
			Load resistance	1			MΩ	
			Load capacitance			50	pF	
			Voltage			0.1	V	
RXPWR1	MAD (CTID, LNA-SEL)	CCONT	Logic high ”1”	2.0			V	Supply voltage VR4 ON
			Logic low ”0”			0.5	V	Supply voltage VR4 OFF
			Current			100	uA	DSP
			timing inaccuracy			30	us	

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Signal name	From/ *Con-trol*	To	Parameter	Min	Typ	Max	Unit	Function
RXPWR2 **1)**	MAD (CTID, *DSP* FTC) MUX	RF block 2V8 regulator	Logic high ”1”	2.0			V	Supply voltage VR8 ON
			Logic low ”0”			0.5	V	Supply voltage VR8 OFF
			Current			100	uA	DSP
			timing inaccuracy			30	us	
RXPWR3 **1)**	MAD (CTID, *DSP* FTC) MUX	RF block 2V8 regulator	Logic high ”1”	2.0			V	Supply voltage VR9 ON
			Logic low ”0”			0.5	V	Supply voltage VR9 OFF
			Current			100	uA	DSP
			timing inaccuracy			30	us	

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Parts Lists

Engine Module SE2 (0201320)

(EDMS V 5.6)

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R113	1430726	Chip resistor	100	5 % 0.063 W 0402
R150	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R151	1430690	Chip jumper		0402
R153	1419007	Chip resistor	0.22	2 % 1210
R154	1430826	Chip resistor	680 k	5 % 0.063 W 0402
R158	1620025	Res network 0w06 2x100k j	0404	0404
R159	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R160	1620019	Res network 0w06 2x10k j	0404	0404
R161	1620025	Res network 0w06 2x100k j	0404	0404
R163	1620019	Res network 0w06 2x10k j	0404	0404
R165	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R166	1825005	Chip varistor vwm14v vc30v	0805	0805
R167	1430853	Chip resistor	2.2 M	5 % 0.063 W 0402
R170	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R200	1620025	Res network 0w06 2x100k j	0404	0404
R201	1620025	Res network 0w06 2x100k j	0404	0404
R202	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R209	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R210	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R211	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R212	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R220	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R250	1620019	Res network 0w06 2x10k j	0404	0404
R251	1430710	Chip resistor	22	5 % 0.063 W 0402
R252	1430710	Chip resistor	22	5 % 0.063 W 0402
R254	1620031	Res network 0w06 2x1k0 j	0404	0404
R255	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R256	1620025	Res network 0w06 2x100k j	0404	0404
R257	1620025	Res network 0w06 2x100k j	0404	0404
R259	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R260	1430826	Chip resistor	680 k	5 % 0.063 W 0402
R261	1430826	Chip resistor	680 k	5 % 0.063 W 0402
R262	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R264	1430145	Chip resistor	100 k	1 % 0.063 W 0402
R265	1430145	Chip resistor	100 k	1 % 0.063 W 0402
R266	1430726	Chip resistor	100	5 % 0.063 W 0402
R275	1620031	Res network 0w06 2x1k0 j	0404	0404
R305	1413829	Chip resistor	10	5 % 0.1 W 0805
R306	1413829	Chip resistor	10	5 % 0.1 W 0805
R307	1413829	Chip resistor	10	5 % 0.1 W 0805

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R308	1430726	Chip resistor	100	5 % 0.063 W 0402
R309	1430726	Chip resistor	100	5 % 0.063 W 0402
R310	1430784	Chip resistor	15 k	5 % 0.063 W 0402
R311	1430784	Chip resistor	15 k	5 % 0.063 W 0402
R312	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R313	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R314	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R331	1620031	Res network 0w06 2x1k0 j	0404	0404
R332	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R333	1620031	Res network 0w06 2x1k0 j	0404	0404
R335	1620031	Res network 0w06 2x1k0 j	0404	0404
R337	1620031	Res network 0w06 2x1k0 j	0404	0404
R339	1620031	Res network 0w06 2x1k0 j	0404	0404
R701	1430710	Chip resistor	22	5 % 0.063 W 0402
R721	1430718	Chip resistor	47	5 % 0.063 W 0402
R725	1430710	Chip resistor	22	5 % 0.063 W 0402
R744	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R750	1430690	Chip jumper		0402
R751	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R752	1430744	Chip resistor	470	5 % 0.063 W 0402
R756	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R758	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R760	1620047	Res network 0w03 4x4k7 j	0804	0804
R761	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R762	1430851	Chip resistor	15 k	2 % 0.063 W 0402
R763	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R764	1430744	Chip resistor	470	5 % 0.063 W 0402
R765	1430744	Chip resistor	470	5 % 0.063 W 0402
R767	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R768	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R770	1430700	Chip resistor	10	5 % 0.063 W 0402
R771	1430700	Chip resistor	10	5 % 0.063 W 0402
R774	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R775	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R779	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R781	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R782	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R786	1430726	Chip resistor	100	5 % 0.063 W 0402
R788	1430748	Chip resistor	680	5 % 0.063 W 0402
R789	1430748	Chip resistor	680	5 % 0.063 W 0402
R795	1430726	Chip resistor	100	5 % 0.063 W 0402
R796	1430700	Chip resistor	10	5 % 0.063 W 0402
R798	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R801	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R802	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R803	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R820	1430700	Chip resistor	10	5 % 0.063 W 0402
R821	1430726	Chip resistor	100	5 % 0.063 W 0402

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R822	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R823	1430726	Chip resistor	100	5 % 0.063 W 0402
R824	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R850	1430700	Chip resistor	10	5 % 0.063 W 0402
R851	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R852	1430690	Chip jumper		0402
R870	1430700	Chip resistor	10	5 % 0.063 W 0402
R871	1430772	Chip resistor	5.6 k	5 % 0.063 W 0402
R872	1430700	Chip resistor	10	5 % 0.063 W 0402
R880	1430700	Chip resistor	10	5 % 0.063 W 0402
R881	1430700	Chip resistor	10	5 % 0.063 W 0402
R883	1430764	Chip resistor	3.3 k	5 % 0.063 W 0402
R884	1430726	Chip resistor	100	5 % 0.063 W 0402
R885	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R900	1430718	Chip resistor	47	5 % 0.063 W 0402
R901	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R902	1430690	Chip jumper		0402
R903	1430718	Chip resistor	47	5 % 0.063 W 0402
R904	1430690	Chip jumper		0402
R905	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R906	1430732	Chip resistor	180	5 % 0.063 W 0402
R907	1430690	Chip jumper		0402
R925	1430718	Chip resistor	47	5 % 0.063 W 0402
R926	1430718	Chip resistor	47	5 % 0.063 W 0402
R933	1430718	Chip resistor	47	5 % 0.063 W 0402
R934	1620101	Res network 0w06 2x470r j	0404	0404
R936	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R937	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R938	1430784	Chip resistor	15 k	5 % 0.063 W 0402
R939	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R940	1800659	NTC resistor	47 k	10 % 0.12 W 0805
R941	1430718	Chip resistor	47	5 % 0.063 W 0402
R942	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R943	1430744	Chip resistor	470	5 % 0.063 W 0402
R944	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R945	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R961	1430690	Chip jumper		0402
R980	1430740	Chip resistor	330	5 % 0.063 W 0402
R984	1430732	Chip resistor	180	5 % 0.063 W 0402
R990	1430690	Chip jumper		0402
C100	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C101	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C102	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C112	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C151	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C152	2320778	Ceramic cap.	10 n	10 % 16 V 0402
C153	2320778	Ceramic cap.	10 n	10 % 16 V 0402
C154	2320548	Ceramic cap.	33 p	5 % 50 V 0402

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C155	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C157	2320778	Ceramic cap.	10 n	10 % 16 V 0402
C158	2320481	Ceramic cap.	5R 1 u	10 % 0603
C159	2320481	Ceramic cap.	5R 1 u	10 % 0603
C160	2320481	Ceramic cap.	5R 1 u	10 % 0603
C161	2320481	Ceramic cap.	5R 1 u	10 % 0603
C162	2320481	Ceramic cap.	5R 1 u	10 % 0603
C163	2320481	Ceramic cap.	5R 1 u	10 % 0603
C164	2320481	Ceramic cap.	5R 1 u	10 % 0603
C165	2320778	Ceramic cap.	10 n	10 % 16 V 0402
C166	2320481	Ceramic cap.	5R 1 u	10 % 0603
C167	2320778	Ceramic cap.	10 n	10 % 16 V 0402
C168	2320778	Ceramic cap.	10 n	10 % 16 V 0402
C169	2320481	Ceramic cap.	5R 1 u	10 % 0603
C170	2320481	Ceramic cap.	5R 1 u	10 % 0603
C171	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C175	2312405	Ceramic cap.	2.2 u	10 % 10 V 1206
C176	2320469	Ceramic cap.		Y5 V 0603
C179	2310791	Ceramic cap.	33 n	20 % 50 V 0805
C180	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C181	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C184	2320744	Ceramic cap.	1.0 n	10 % 50 V 0402
C185	2611727	Tantalum cap.	15 u	20 % 10 V 3.2x1.6x1.6
C186	2610029	Tantalum cap.	10 u	20 % 10 V 3.5x2.8x1.2
C187	2320481	Ceramic cap.	5R 1 u	10 % 0603
C189	2320481	Ceramic cap.	5R 1 u	10 % 0603
C190	2320629	Ceramic cap.		50 V 0402
C192	2610029	Tantalum cap.	10 u	20 % 10 V 3.5x2.8x1.2
C200	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C201	2320481	Ceramic cap.	5R 1 u	10 % 0603
C202	2320779	Ceramic cap.	100 n	10 % 16 V 0603
C203	2320481	Ceramic cap.	5R 1 u	10 % 0603
C210	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C214	2320481	Ceramic cap.	5R 1 u	10 % 0603
C217	2320481	Ceramic cap.	5R 1 u	10 % 0603
C218	2320481	Ceramic cap.	5R 1 u	10 % 0603
C219	2320481	Ceramic cap.	5R 1 u	10 % 0603
C220	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C221	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C225	2320481	Ceramic cap.	5R 1 u	10 % 0603
C255	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C256	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C257	2610029	Tantalum cap.	10 u	20 % 10 V 3.5x2.8x1.2
C258	2320805	Ceramic cap.	100 n	10 % 10 V 0402

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C259	2312295	Ceramic cap.		Y5 V 1206
C260	2312295	Ceramic cap.		Y5 V 1206
C263	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C264	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C265	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C266	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C274	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C275	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C276	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C277	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C285	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C286	2320481	Ceramic cap.	5R 1 u	10 % 0603
C303	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C304	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C305	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C306	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C307	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C330	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C331	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C332	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C333	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C334	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C335	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C336	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C337	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C338	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C339	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C340	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C341	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C343	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C344	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C701	2320629	Ceramic cap.		50 V 0402
C703	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C705	2320592	Ceramic cap.	2.2 n	5 % 50 V 0402
C706	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C707	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C708	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C709	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C710	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C713	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C715	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C716	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C717	2320612	Ceramic cap.		50 V 0402
C719	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C720	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C721	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C729	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C733	2320536	Ceramic cap.	10 p	5 % 50 V 0402

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C734	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C735	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C736	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C739	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C742	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C743	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C744	2320514	Ceramic cap.	1.2 p	0.25 % 50 V 0402
C745	2320617	Ceramic cap.	30 p	2 % 50 V 0402
C746	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C748	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C749	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C750	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C751	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C755	2320568	Ceramic cap.	220 p	5 % 50 V 0402
C756	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C757	2320576	Ceramic cap.	470 p	5 % 50 V 0402
C758	2320576	Ceramic cap.	470 p	5 % 50 V 0402
C759	2320783	Ceramic cap.	33 n	10 % 10 V 0402
C760	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C761	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C762	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C763	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C764	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C765	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C766	2320592	Ceramic cap.	2.2 n	5 % 50 V 0402
C767	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C768	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C769	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C770	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C772	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C773	2320618	Ceramic cap.	4.7 n	5 % 25 V 0402
C779	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C780	2320586	Ceramic cap.	1.2 n	5 % 50 V 0402
C781	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C782	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C783	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C784	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C785	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C786	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C787	2320564	Ceramic cap.	150 p	5 % 50 V 0402
C788	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C789	2320592	Ceramic cap.	2.2 n	5 % 50 V 0402
C790	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C791	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C792	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C793	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C794	2320481	Ceramic cap.	5R 1 u	10 % 0603
C795	2320805	Ceramic cap.	100 n	10 % 10 V 0402

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C796	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C797	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C798	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C799	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C820	2310793	Ceramic cap.	2.2 u	10 % 10 V 0805
C821	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C822	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C823	2320564	Ceramic cap.	150 p	5 % 50 V 0402
C824	2320564	Ceramic cap.	150 p	5 % 50 V 0402
C825	2320526	Ceramic cap.	3.9 p	0.25 % 50 V 0402
C826	2310248	Ceramic cap.	4.7 n	5 % 50 V 1206
C827	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C828	2310793	Ceramic cap.	2.2 u	10 % 10 V 0805
C850	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C851	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C854	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C855	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C870	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C871	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C872	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C873	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C874	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C875	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C880	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C881	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C882	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C883	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C884	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C885	2320564	Ceramic cap.	150 p	5 % 50 V 0402
C886	2320564	Ceramic cap.	150 p	5 % 50 V 0402
C887	2420017	Ceramic cap.	18 n	5 % 16 V 1206
C888	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C889	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C890	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C902	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C903	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C904	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C905	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C906	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C907	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C908	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C909	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C910	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C912	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C913	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C914	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C915	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C917	2320921	Ceramic cap.	3.9 p	5 % 16 V 0402

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C918	2320939	Ceramic cap.		16 V 0402
C919	2320921	Ceramic cap.	3.9 p	5 % 16 V 0402
C920	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C921	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C922	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C923	2320530	Ceramic cap.	5.6 p	0.25 % 50 V 0402
C931	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C932	2320629	Ceramic cap.		50 V 0402
C934	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C937	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C938	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C939	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C941	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C943	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C949	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C950	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C951	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C952	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C953	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C960	2312401	Ceramic cap.	1.0 u	10 % 10 V 0805
C961	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C962	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C963	2320481	Ceramic cap.	5R 1 u	10 % 0603
C965	2320903	Ceramic cap.	2.7 p	5 % 16 V 0402
C966	2320903	Ceramic cap.	2.7 p	5 % 16 V 0402
C967	2320532	Ceramic cap.	6.8 p	0.25 % 50 V 0402
C968	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C969	2320805	Ceramic cap.	100 n	10 % 10 V 0402
C981	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C982	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C983	2320536	Ceramic cap.	10 p	5 % 50 V 0402
C984	2320536	Ceramic cap.	10 p	5 % 50 V 0402
L701	3645213	Chip coil	22 n	5 % Q=38/250 MHz
0603				
L702	3643039	Chip coil	220 n	5 % Q=35/100 MHz
0805				
L703	3645241	Chip coil	12 n	5 % Q=35/250 MHz
0603				
L705	3641626	Chip coil	220 n	2 % Q=50/250 MHz
0805				
L721	3645249	Chip coil	3 n	5 % Q=22/250 MHz
0603				
L723	3645157	Chip coil	100 n	10 % Q=12/100 MHz
0603				
L724	3640701	Chip coil	470 n	5 % Q=32/100 MHz
1008				
L740	3645231	Chip coil	39 n	5 % Q=40/250 MHz
0603				

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L741	3645301	Chip coil	180 n	5 % Q=13/100 MHz 0603
L745	3645231	Chip coil	39 n	5 % Q=40/250 MHz 0603
L747	3645231	Chip coil	39 n	5 % Q=40/250 MHz 0603
L750	3641421	Chip coil	100 u	5 % Q=15/0.796M 1008
L761	3645029	Chip coil		10 % Q=45/10 MHz 0805
L762	3641626	Chip coil	220 n	2 % Q=50/250 MHz 0805
L820	3646053	Chip coil	4 n	Q=28/800M 0402
L850	3641421	Chip coil	100 u	5 % Q=15/0.796M 1008
L880	3645155	Chip coil	2 n	Q=32/800M 0603
L902	3646069	Chip coil	33 n	5 % Q=23/800 MHz 0402
L903	3646069	Chip coil	33 n	5 % Q=23/800 MHz 0402
L904	3646083	Chip coil	100 n	5 % Q=16/300 MHz 0402
L905	3646083	Chip coil	100 n	5 % Q=16/300 MHz 0402
L906	3643073	Chip coil	6 n	1.4 A Q=35 0805
L908	3646083	Chip coil	100 n	5 % Q=16/300 MHz 0402
L911	3640081	Dir.coupler 836.5+–12.5mhz	1206	1206
L930	3646085	Chip coil	6 n	10 % Q=29/800 MHz 0402
L931	3646083	Chip coil	100 n	5 % Q=16/300 MHz 0402
L940	3646063	Chip coil	22 n	5 % Q=28/800 MHz 0402
L941	3646053	Chip coil	4 n	Q=28/800M 0402
L951	3646069	Chip coil	33 n	5 % Q=23/800 MHz 0402
L960	3646085	Chip coil	6 n	10 % Q=29/800 MHz 0402
L961	3646043	Chip coil	1 n	Q=33/800M 0402
L962	3646069	Chip coil	33 n	5 % Q=23/800 MHz 0402
L964	3643073	Chip coil	6 n	1.4 A Q=35 0805
L966	4551003	Dir.coupler 1880+–30mhz 1		4DB
L975	3645157	Chip coil	100 n	10 % Q=12/100 MHz 0603
L981	3646069	Chip coil	33 n	5 % Q=23/800 MHz 0402

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B151	4510219	Crystal	32.768 k	+–30PPM 9PF
B301	5140087	Buzzer 85db 2600hz 3.6v 10x10x3.		10x10x3.5
G850	4510249	VCTCXO	19.44 M	+–2.5PPM 2.8V TDMA
G880	4350161	Vco 985.2–1010.2mhz 2.8v 10ma		
G881	4350159	Vco 2046–2106mhz 2.8v 11ma		
F150	5119019	SM, fuse f 1.5a 32v	0603	
Z300	3640035	Filt z>450r/100m 0r7max 0.2a 0603		0603
Z301	3640035	Filt z>450r/100m 0r7max 0.2a 0603		0603
Z303	3640035	Filt z>450r/100m 0r7max 0.2a 0603		0603
Z304	3640035	Filt z>450r/100m 0r7max 0.2a 0603		0603
Z701	4511125	Saw filter	881.5+–12.5 M	/4DB 3X3
Z726	4511113	Saw filter	1960+–30 M	/5DB 3X3
Z741	4511011	Saw filter	116.19+–0.015 M	9.3X5
Z750	4550085	Cer.filt 450+–11.5khz/8db 6.7x5.7		6.7x5.7
Z751	4550081	Cer.filt 450+–11.5khz/8db 6.7x5.7		6.7x5.7
Z791	3640085	Filt 470nf 16v 0r03 2a	0805	0805
Z900	4511111	Dual saw filt 161/196mhz 5.2x4.7		5.2x4.7
Z901	4511123	Saw filter	836.5+–12.5 M	/3.8DB 3X3
Z910	4512091	Dupl 824–849/869–894mhz 9.5x7.5		
Z920	3640085	Filt 470nf 16v 0r03 2a	0805	0805
Z950	4511023	Saw filter	1880+–30 M	/4.2DB 3X3
Z960	4512121	Dupl 1850–1910/1930–1990mhz 17x8		17X8
Z970	4550065	Dipl 824–894/1850–1990mhz 3.2x1.6		3.2x1.6
Z975	4511023	Saw filter	1880+–30 M	/4.2DB 3X3
V100	4110067	Schottky diode	MBR0520L	20 V 0.5 A SOD123
V101	4110067	Schottky diode	MBR0520L	20 V 0.5 A SOD123
V102	4113671	Tvs quad 6v1 esda6v1w5 sot323–5		SOT323–5
V110	4113611	Emifilt/tvs emif01–10005w5 sot353		SOT353
V150	4210037	Transistor	BCW30	pnp 32 V 0.1 A SOT23
V151	4110067	Schottky diode	MBR0520L	20 V 0.5 A SOD123
V152	4210043	Transistor	DTC143ZE	npn RB V EM3
V153	4211202	DM MosFet		p–ch 50 V 0.13 A SOT23
V154	4210043	Transistor	DTC143ZE	npn RB V EM3
V250	4210119	Transistor	BC849CW	npn 30 V 0.1 A SOT323
V251	4219904	Transistor x 2	UMX1	npn 40 V SOT363
V252	4113611	Emifilt/tvs emif01–10005w5 sot353		SOT353
V301	4113671	Tvs quad 6v1 esda6v1w5 sot323–5		SOT323–5
V302	4113671	Tvs quad 6v1 esda6v1w5 sot323–5		SOT323–5
V320	4860005	Led	Green	0603
V321	4860005	Led	Green	0603
V322	4860005	Led	Green	0603
V323	4860005	Led	Green	0603
V324	4860005	Led	Green	0603
V325	4860005	Led	Green	0603

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V336	4110601	Diode	FAST	SOD323
V723	4110911	Cap. diode	MA2SV01	1/3 V SOD523
V901	4210043	Transistor	DTC143ZE	npn RB V EM3
V902	4210043	Transistor	DTC143ZE	npn RB V EM3
V929	4110008	Schottky diode	HSMS2825	8 V SOT143
V930	4110008	Schottky diode	HSMS2825	8 V SOT143
V931	4112443	Pin diode	BAR64–03W	200 V 0.1 A SOD323
V932	4112443	Pin diode	BAR64–03W	200 V 0.1 A SOD323
D200	4340615	IC, SRAM		CSP48
D201	4340585	IC, flash mem.		UBGA48
D202	4370559	Mad1 v18 rom6 f731575 c07		UBGA144
N150	4370631	Ccont2i' wfd163ke64t/8		lfbga 8X8
N151	4370621	Chaps v2.0 u423v20g36t		lbga6x6
N250	4370603	Cobba_d b06 twl91302ggv		UBGA64
N310	4370433	Uiswitch sttm23av20t		TSSOP20
N700	4370571	Erotus 1g wfd170cg80t	80lbga	80LBGA
N701	4370063	Sc3918 tdma rec 869–894mhz		QSOP16
N702	4340247	IC, regulator MC33765	2.8 V	TSSOP16
N721	4370065	Sc3919 tdma rec 1930–1990		QSOP16
N770	4340233	Mrfic0916 rf amp 2500mhz	sot143	SOT143
N870	4340237	IC, PLL	UMA1021M	SSOP20
N900	4340171	IC, upconv 1.9ghz 3v	so uPC8106T	SO6S
N902	4340577	IC, RF amp.	21DB/900MHZ	SMM6
N903	4370615	Rf9130e3 pw amp 824–849mhz		tdma
N951	4340577	IC, RF amp.	21DB/900MHZ	SMM6
N960	4370617	Rf9131e4 pw amp tdma1900		
N980	4340381	Mrfic1813 upconvgaas 1.9g		TSSOP16
S100	5219015	SM, sw push button spst 5v s.key		
S330	5219005	IC, SWsp–no 30vdc 50ma	SW TACT	SMD
S331	5219005	IC, SWsp–no 30vdc 50ma	SW TACT	SMD
S332	5219005	IC, SWsp–no 30vdc 50ma	SW TACT	SMD
X303	5469081	SM, conn 2x7m p0.5 spr.50v		PCB/PCB
I001	9380753	Bar code label dmd03311		27x6.5
	9854340	PC board SE2 99.9x42.4x0.97 m8 4/pa		

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