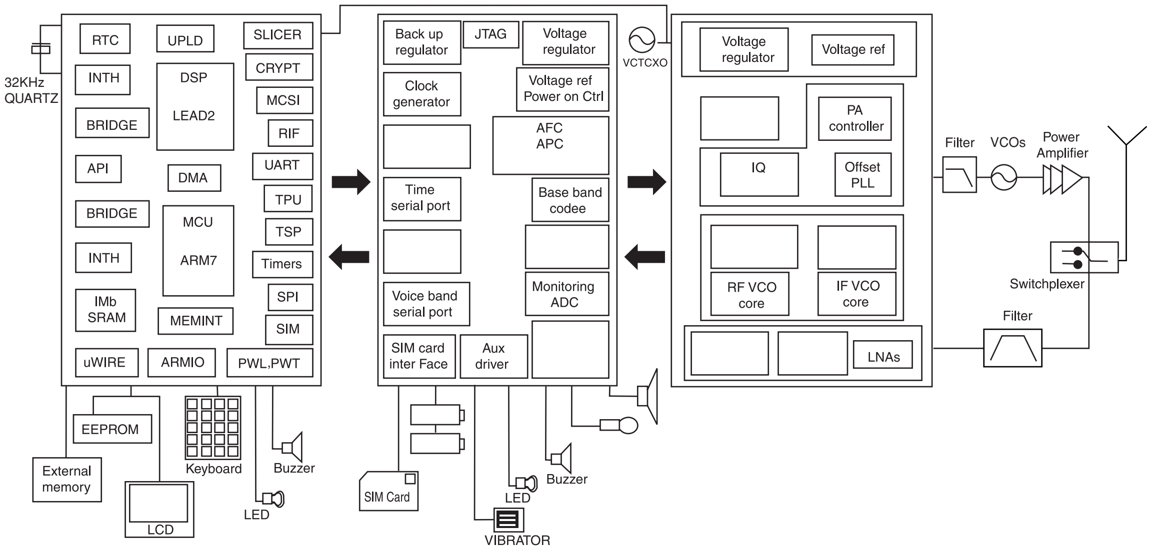
2. TECHNICAL BRIEF

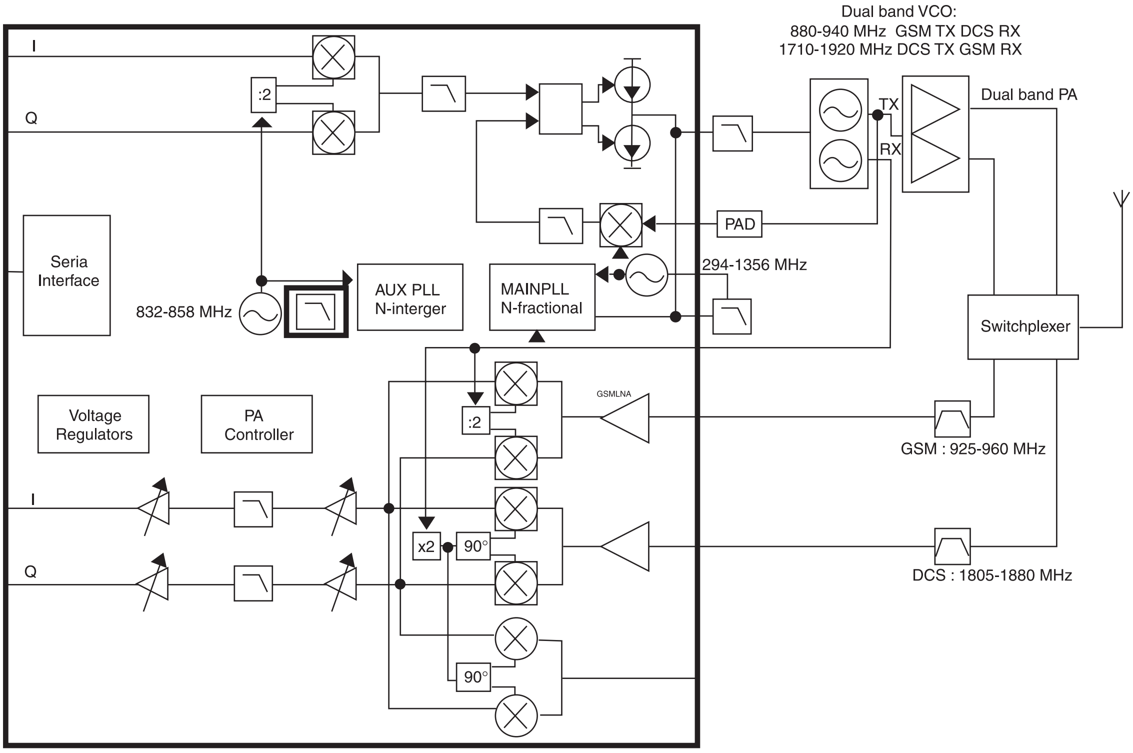
<Circuit description>

2-1 The RF Chipset

The A316 RF integrates the TRF6150 transceiver IC, TX/RX VCO, Power amplifier(RF3110), Front End Module 8450T(switchplexer, RF-SAW filter), for dulaband transmitting and receiving function.



2-1-1 The Receiver



The RF receive signal(EGSM 925Mhz – 960MHz, DCS 1805Mhz – 1880Mhz) is input via the antenna or coaxial connector.

An antenna matching circuit is between the antenna and the connector.

2-1-2 The TX IF Modulator

The TX I & Q signals from baseband IC are fed to Pin#18-21 of the TRF6150, where they are then modulated onto a TX IF by the modulator inside TRF6150. The TX IF frequency is listed as below.

EGSM Band

From	To	AUX VCO= 2 x IF Frequency
CH 1	CH 26	858 MHz
CH 27	CH 43	852.8 MHz
CH 44	CH 91	858 MHz
CH 92	CH 108	842.4 MHz
CH 109	CH 985	858 MHz
CH 986	CH 1002	842.4 MHz
CH 1003	CH 1024	858 MHz

DCS Band

From	To	AUX VCO= 2 x IF Frequency
CH 512	CH 532	832 MHz
CH 533	CH 549	837.2 MHz
CH 550	CH 575	832 MHz
CH 576	CH 597	858 MHz
CH 598	CH 614	837.2 MHz
CH 615	CH 662	858 MHz
CH 663	CH 679	852.8 MHz
CH 680	CH 727	858 MHz
CH 728	CH 744	852.8 MHz
CH 745	CH 792	858 MHz
CH 793	CH 809	847.6 MHz
CH 810	CH 857	858 MHz
CH 858	CH 874	847.6 MHz
CH 875	CH 885	858 MHz

The signal TX LO IF (416 ~ 429Mhz) is produced by the AUX VCO (832 ~ 858MHz), which has been divided down by a factor of 2 .

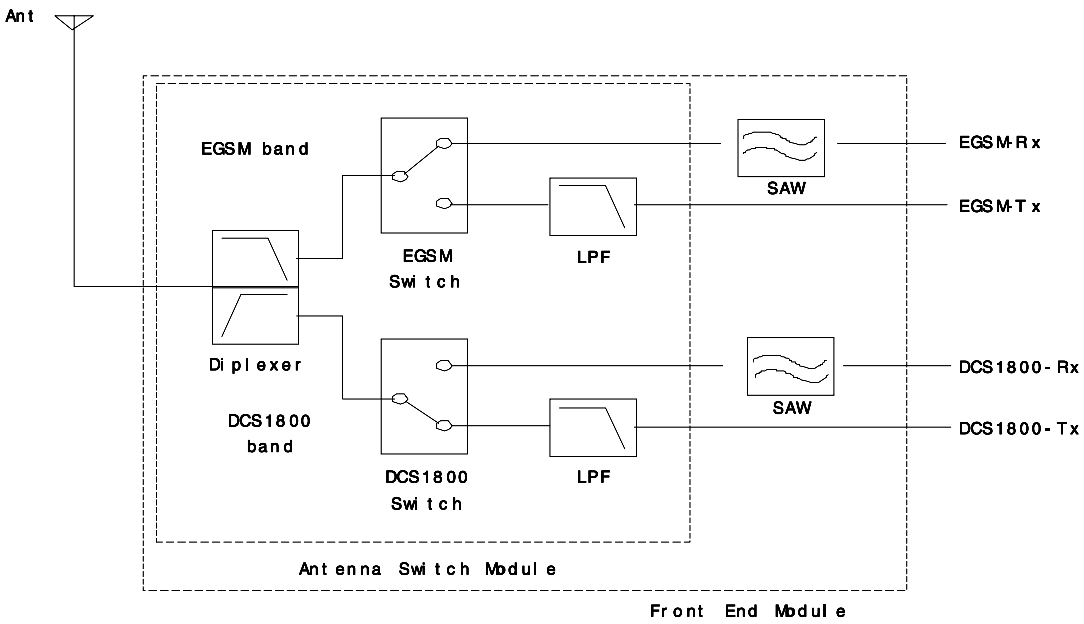
2-1-3 The Translation Loop Transmitter

The translation loop approach has many advantages over a traditional upconverter solution. A typical upconverter transmitter usually consists of an IF modulator followed by a mixer for upconversion to RF. In the translation loop transmitter, the RF transmit signal is instead generated directly by a voltage controlled oscillator (VCO), the phase of which is locked to the modulated IF reference in a fast phase-locked-loop. Because a VCO is inherently a lower-noise source than a mixer, the translation loop transmitter produces a low noise floor, so no subsequent high-selectivity filtering is necessary, and the diplexer or other post-PA filter of the conventional approach is eliminated. This saves power and cost, as the insertion loss of the duplexer is eliminated, and the output level of the power amplifier can be reduced.

The transmit signal is generated directly by a external TX/RX VCO (VON1885C28DKB). In the feedback path, the RF transmit signal is mixed with the off-chip main VCO to produce the desired TXIF (416 ~ 429Mhz). This TXIF signal from the feedback path is then compared to the TXIF signal from the IF modulator at the detector. The resulting signal after passing a low pass filter drives the external TX/RX VCO.

A high side injection, i.e. RF = LO - IF, is used in the EGSM band upconversion while a low side injection, i.e. RF = LO + IF, is used in the DCS band upconversion. This upconversion scheme, with appropriate TXIFs, allows for a single wide-band VCO to be used.

2-2 Front End Module



The switchplexer is used to control the Rx and Tx paths. And the control signals is connected to Switchplexer(Diplexer) of Front End

Module(FEM8450T) to switch either Rx or Tx path on. When the Rx path is turned on, the RF receive signal then feeds into two paths, EGSM Rx and DCS1800 Rx.

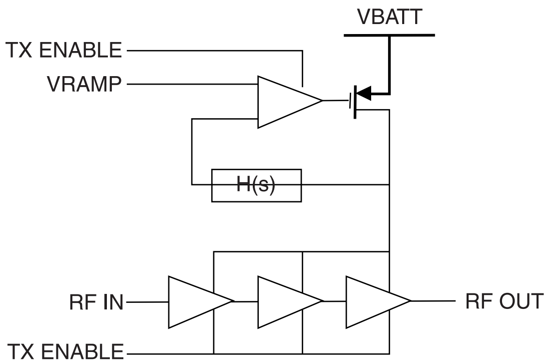
This Front End Module contains two RF SAW filters, DCS SAW Filter to filter any unwanted signal apart from the DCS Rx band. And the GSM SAW filter in the Front End Module is to filter out unwanted signal beyond the GSM Rx band. These two paths are then connected to the GSMLNA and DCSLNA of TRF6150 respectively.

The RF receive signal is amplified by LNAs in TRF6150, and then the signal then feeds into quadrature demodulator for mixing with LO which is produced by the main synthesiser of TRF6150 and external TX/RX VCO. TX/RX VCO will generate 2 times of RX frequency in EGSM band and half times of RX frequency in DCS band to minimize the DC offset generated by self mixing.

In TRF6150, the quadrature demodulator produce baseband(I/Q) signal . This I/Q signal is amplified by two variable gain amplifiers and filtered by low pass filter, and then fed to baseband IC in differential mode.

2-3 The PA Circuit

The RF3110 is a triple-band GSM/DCS/PCS power amplifier module that incorporates an indirect closed loop method of power control. This simplifies the phone design by eliminating the need for the complicated control loop design. The indirect closed loop is fully self contained and required does not require loop optimization. It can be driven directly from the DAC out-put in the baseband circuit.



The indirect closed loop is essentially a closed loop method of power control that is invisible to the user. Most power control systems in GSM sense either for-ward power or collector/drain current. The RF3110 does not use a power detector. A high-speed control loop is incorporated to regulate the collector voltages of the amplifier while the stages are held at a constant bias. The V RAMP signal is multiplied and the collector voltages are regulated to the multiplied V RAMP voltage.

2-4 Penpheral Citcult

Temperature Sensor

When the chip is not transmitting or receiving, its temperature can be measured by sensing the voltage on the external resistor from pin 31 to ground. From –40 to +85 C, the resistor voltage varies linearly from 0.9V to 1.35V.

Regulator and Serial Data Interface

TRF6150 built in 3 voltage regulators to supply internal functions and external RF components.

The serial interface of TRF6150 consists of a 3-wire serial bus, comprising DATA, CLOCK and STROBE signals. These signals are used to enter control words into the chip. The control words contain information for programming the regulators, the synthesizers and the receiver.

13 MHz Clock

The 13 MHz-clock consists of a TCXO (TOA1300VPM4DKG-SM2) which oscillates at a frequency of 13MHz. It acts as time base of all synthesizers and Baseband.

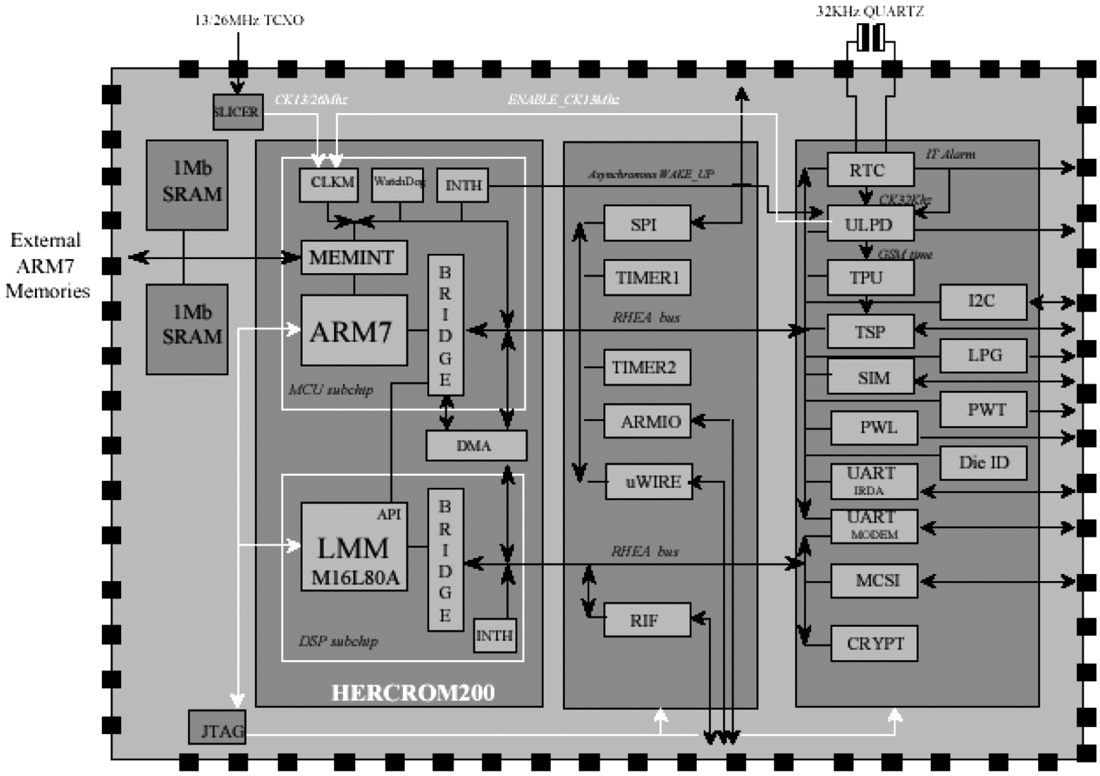
2-5 Digital Baseband Chip : HERCROM20, F741529

HERCROM20 is a chip implementing the digital baseband processing of a GSM mobile phone. It combines a TMS320C54X (LEAD2) DSP, a micro controller ARM7TDMIE, an internal 2Mbit RAM memory, and their associated application peripherals.

The HERCROM20 supports the following features:

- CPU & DSP
- Memory Interface (MEMINT)
- Interrupt Controller
- I2C / Micro Wire Interface
- Serial Port Interface (SPI)
- UART Control/Interface
- Display Interface
- SIM Card Interface
- I/O System Connector Interface
- Radio Interface (RIF)
- JTAG Interface
- Real Time Clock (RTC)
- General Timers / Watch Dog Timer
- Keypad Control
- Backlight Control
- Vibrator Control

System Block Diagram of Hercrom20



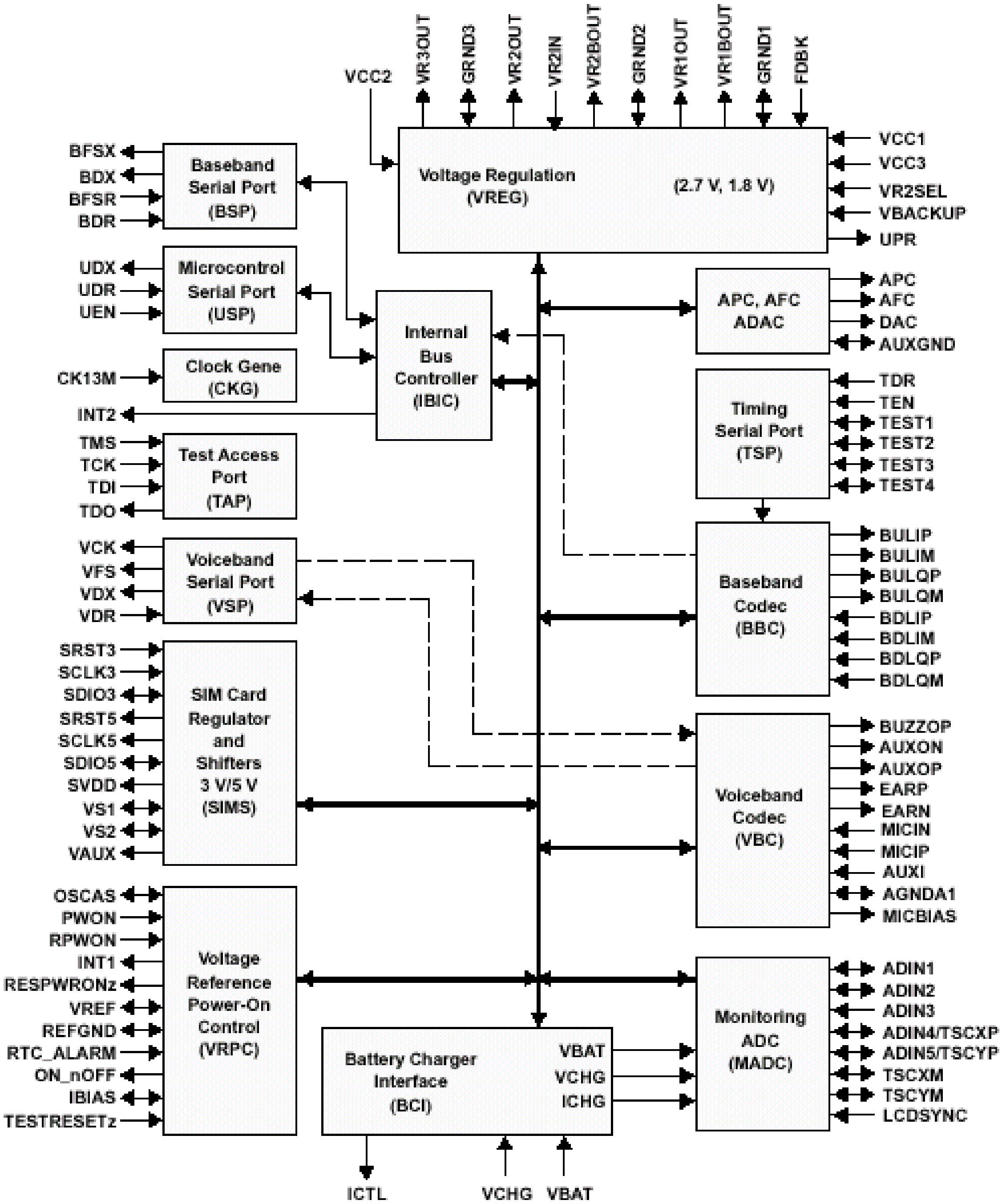
2-6 Analog Baseband Chip : Nausica_CS, TWL3012B

The TWL3012B device includes a complete set of baseband functions that perform the interface and processing of the following, voice signals, the baseband in-phase (I) and the quadrature (Q) signals, which support both the single-slot and multislot modes. The TWL3012B device also includes associated auxiliary RF control features, supply voltage regulation, battery charging controls, and switch on/off system analysis.

The TWL3012B device supports the following features.

- Voiceband Coder / Decoder (codec)
- Baseband codec single and multislot with I/Q RF interface
- Automatic Power Control(APC) and Automatic Frequency Control (AFC)
- Voiceband Serial Port (VSP), Baseband Serial Port (BSP), and MCU Serial Port(USP), Timing Serial Port(TSP).
- SIM Card Interface
- Battery Charging Interface (BCI)
- Six Low-Dropout, Low-Noise, Linear Voltage Regulators (VREG)
- Voltage Reference and Power On Control (VRPC)
- Five-channel analog-to-digital converter (MADC)

System Block Diagram of Nausica_CS



2-7 CPU Memories

Flash ROM

An 16Mbit programmable ROM which is capable of being written to while still in circuit. Contains all the main command software for the mobile.

SRAM

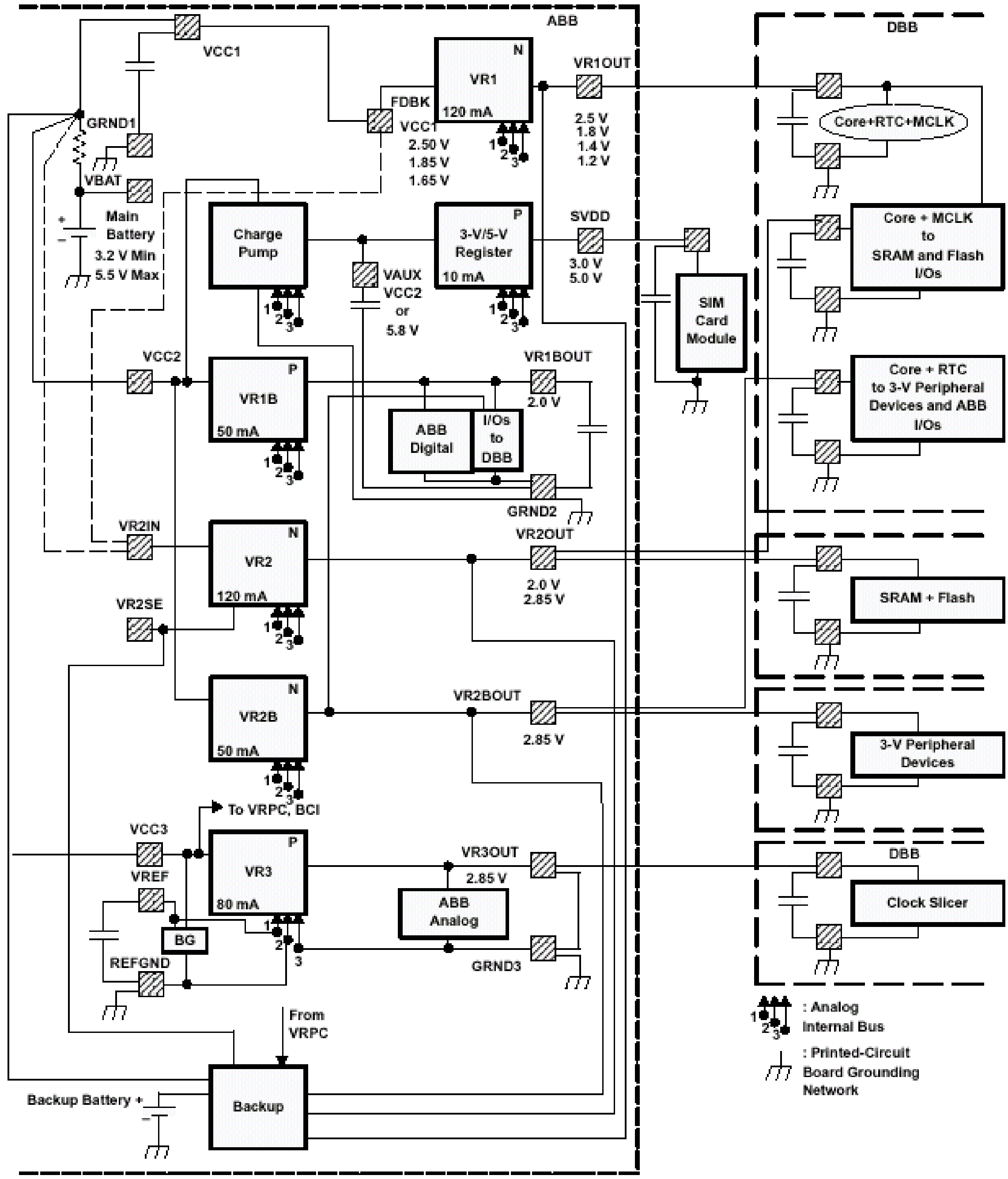
A 2MBit SRAM memory is embedded in the HERCROM20 which is used for ARM7 & DSP execution.

2-8 Power Supplies

There are six regulators in the Nausica_CS . Those regulators are dedicated power supplies, which provides most of the power requirements for the Baseband and RF circuits. Each of these regulators can be controlled by Nausica_CS internal registers. These are configured as shown in the following Figure and table .

Power Supply

Regulator	Voltage	Powers	Permanent
Regulator VR1	1.8V+/-0.15	Digital Core & RTC	Permanent
Regulator 1B VR1B	2.0V+/-0.2	Nausica_CS Internal logic	On/Off
Regulator VR2	2.9V+/-0.1	Memory device	Permanent
Regulator VR2B	2.85V+/-0.15	Peripheral	Permanent
Regulator VR3	2.85V+/-0.15	Nausica _CS analog supply	ON/Off
SIM Regulator	3V+/-0.35V+/-0.5	SIM Card	On/Off



Power supply

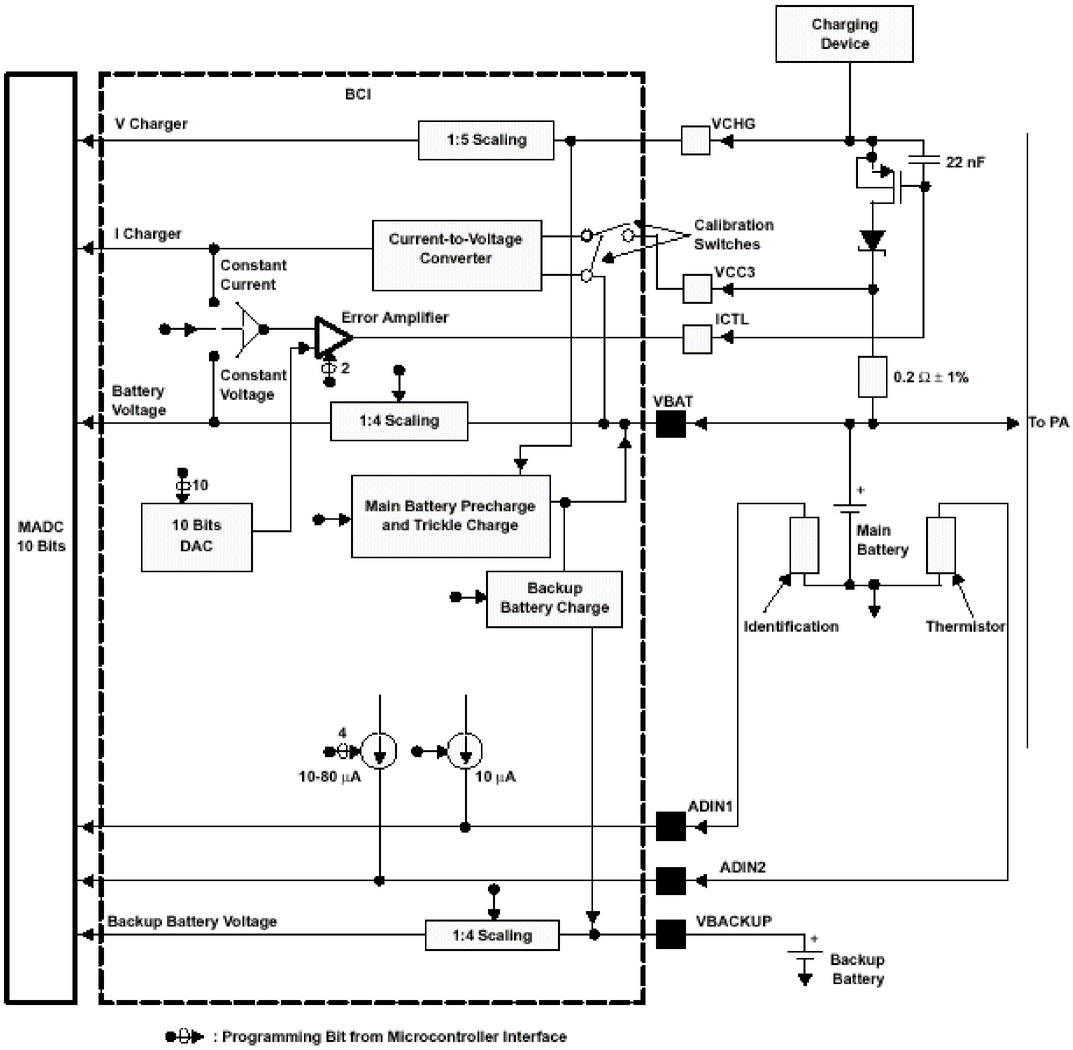
2-9 Battery Charge Interface

The charging device is a dc voltage source of 7 V absolute maximum. An external PMOS power transistor in series with a power Schottky diode connected between VCHG and VCC3 of the TWL3012B device controls the current flow from the charging device to the main battery. The role of the Schottky diode is to prevent reverse leakage current from the main battery in case the charging device is connected to the mobile phone without delivering any voltage at its output (charging device not plugged into the ac wall outlet, for example).

The main function of the battery charger interface is the charging control of both Ni-MH/Ni-Cd/Li-Ion cell battery with the support of the microcontroller. In case of a rechargeable backup battery, it also delivers a trickle charge current to the backup battery from the main battery. The charging scheme for the Li-Ion battery is constant current first (typical current is 1xC) followed by constant voltage charging once a certain voltage threshold is reached (4.2 V typical). Charging is stopped when the charging current at constant voltage has decreased down to C/20 (typical).

In addition to the above charging schemes, another scheme is systematically applied when a battery charger is connected to a switched-off mobile phone: a constant charging current (typically C/20) is applied to the battery when the battery voltage is lower than 3.6 V.

If the battery voltage is lower than 3.2 V (battery partially discharged or fully discharged) the mobile phone is not started until the battery gets sufficiently recharged to greater than 3.2 V; when this happens, the micro-controller is started to control the fast charge cycle of the main battery, and the C/20 current is switched off.



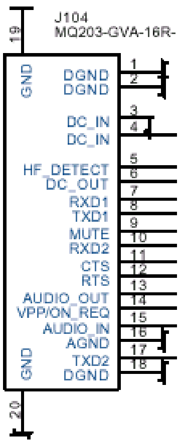
Battery Charge Control Circuit

2-10 System Connector

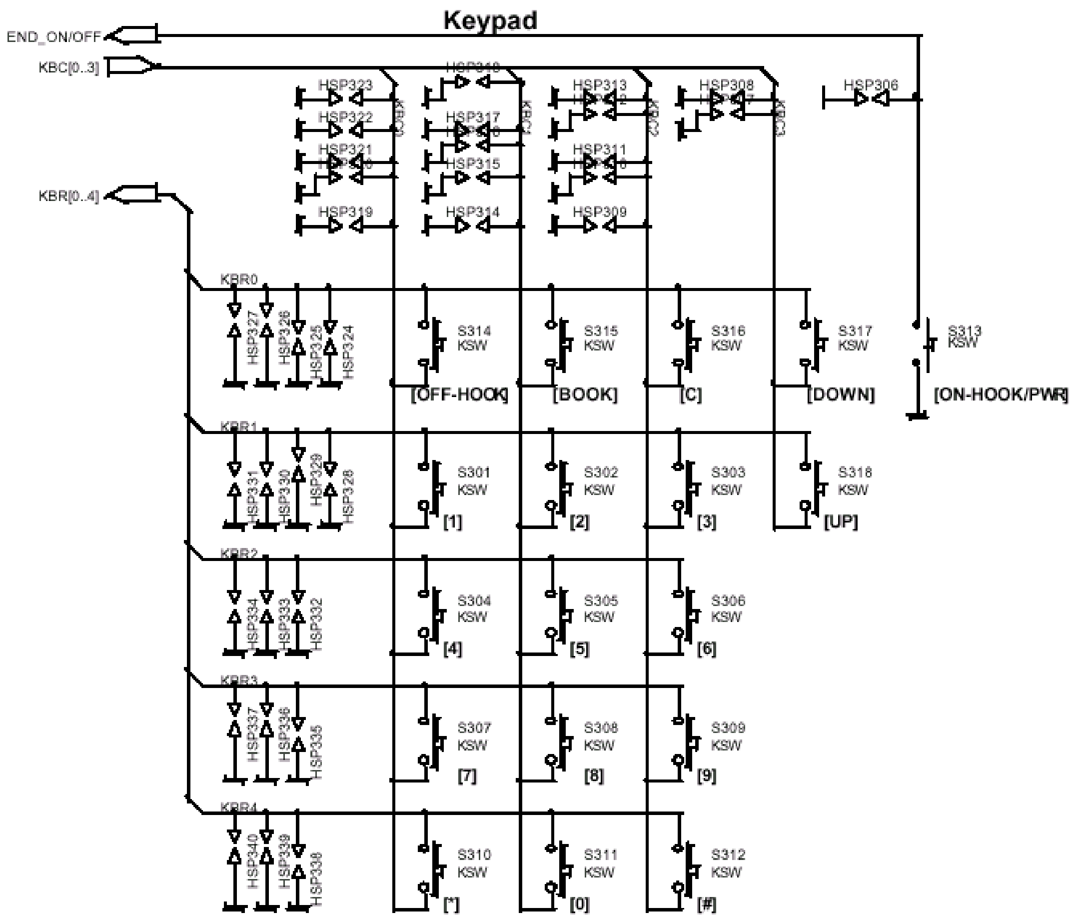
This Phone is equipped with a LG standard system connector MQ203-GVA-16R-PWJ for travel/desk charger, accessories connection and data access (trace•debug and SW download).

System Connector Specification

Pin	Name	Description	I /O
1	DGND	Digital ground.	In / Out
2			
3	DC_In	DC input for Charger. (5V / 650mA)	In
4			
5	HF_Det	Headset/HandsFree car-kit detection.	In
6	DC_Out	DC output for External accessories. (3V / 200 mA)	Out
7	RXD1	Primary serial data in.	In
8	TXD1	Primary serial data out.	Out
9	Mute (DTR)	MS off-hook indicator. Active high.	Out
10	RXD2 (DCD)	Secondary serial data in.	In
11	CTS	Clear to Send.	In
12	RTS	Request to send.	Out
13	Audio_Out	Audio output.	Out
14	Vflash / On_Req	Vpp for flash memory. (12V / 25 mA) / MS On request.	In / In
15	Audio_In	Audio input / Off_Hook detection for advanced headset.	In
16	AGND	Analog ground.	In / Out
17	TXD2	Secondary serial data out.	Out
18	DGND	Digital ground.	In / Out

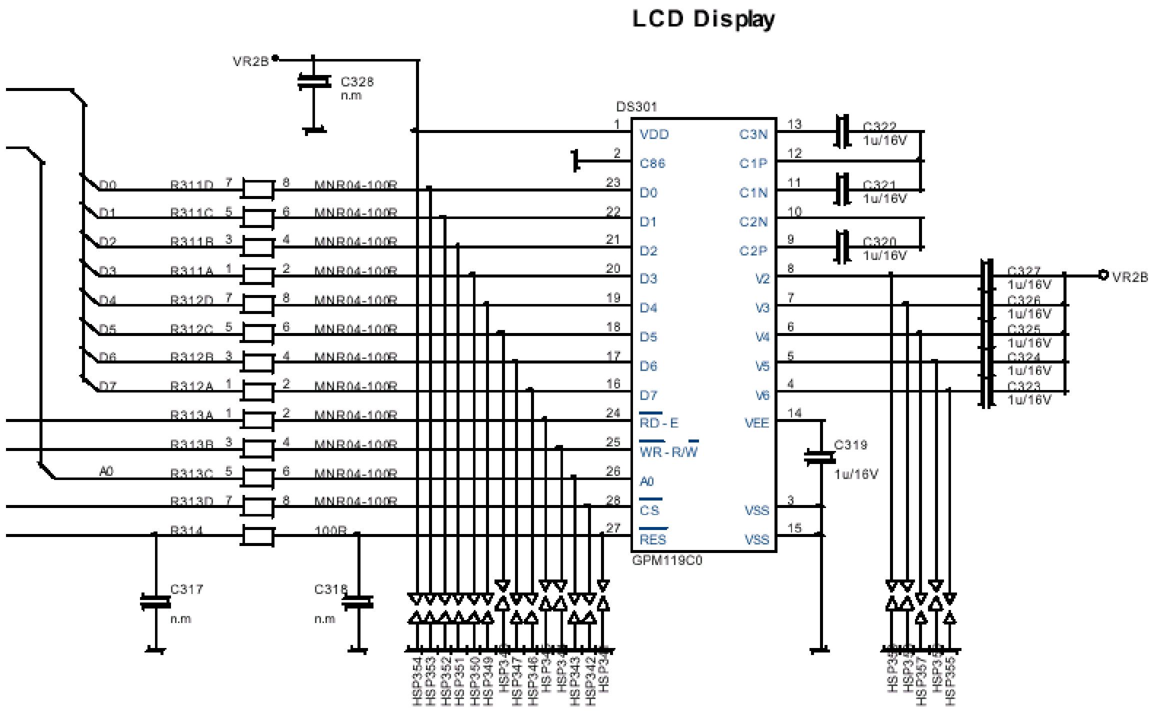


2-11 Keypad Switches and Scanning



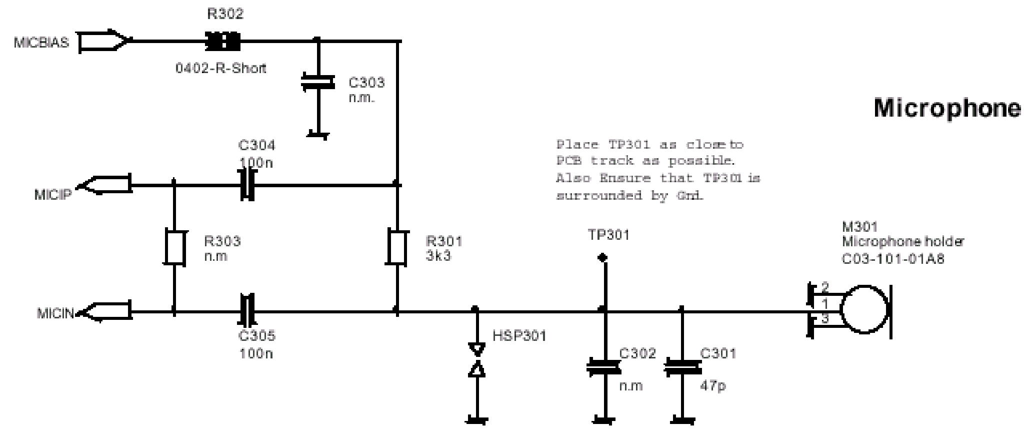
The key switches are metal domes which make contact between two concentric pads on the top layer of the PCB when pressed. There are 18 switches (S301-318), connected in a matrix of 5 rows by 4 columns, as shown in Figure, except for the power switch(S313) which is connected independently. Functions, the row and column lines of the keypad are connected to ports of Hercrom20. The rows are outputs with pull-up resistors embedded in chipset, while the columns are inputs. When a key is pressed, the corresponding row and column are connected together, causing the row output to go low and generate an interrupt. The columns/rows are then scanned by Hercrom20 to identify the pressed key.

2-12 Display Interface



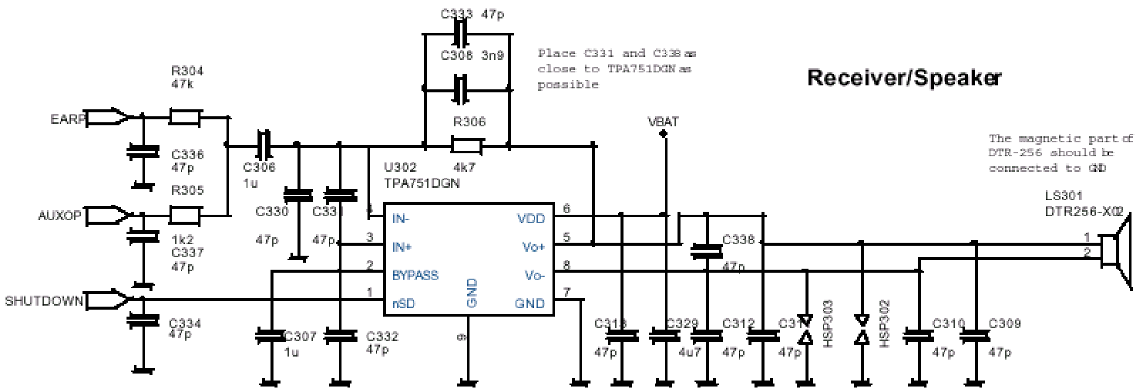
Power to the LCD is supplied by VR2B of Nausica_CS. The LCD can be reseted by RES. A low on this output reset the LCD. There is also the control output CS which is also derived from Hercrom20, this acts as the chip select enable for the LCD module. Hercrom20 uses data line D0-D7 to send serial data for displaying graphical text onto the LCD.

2-13 Microphone



A microphone holder is mounted on PCB and is used to hold the microphone between frond cover and PCB. The audio signal is passed to the MICIN of Nausica_CS. The voltage supply MICBIAS is coming from Nausica_CS., and is a bias voltage for both the MICIP and AUDIO_IN lines form system connector. The MICIN and AUDIO_IN signal is then A/D converted by the voiceband codec of Nausica_CS. The digitized speech is then passed to the DSP of Hercrom20 for processing (coding, interleaving etc.).

2-14 Receiver/Speaker/Buzzer



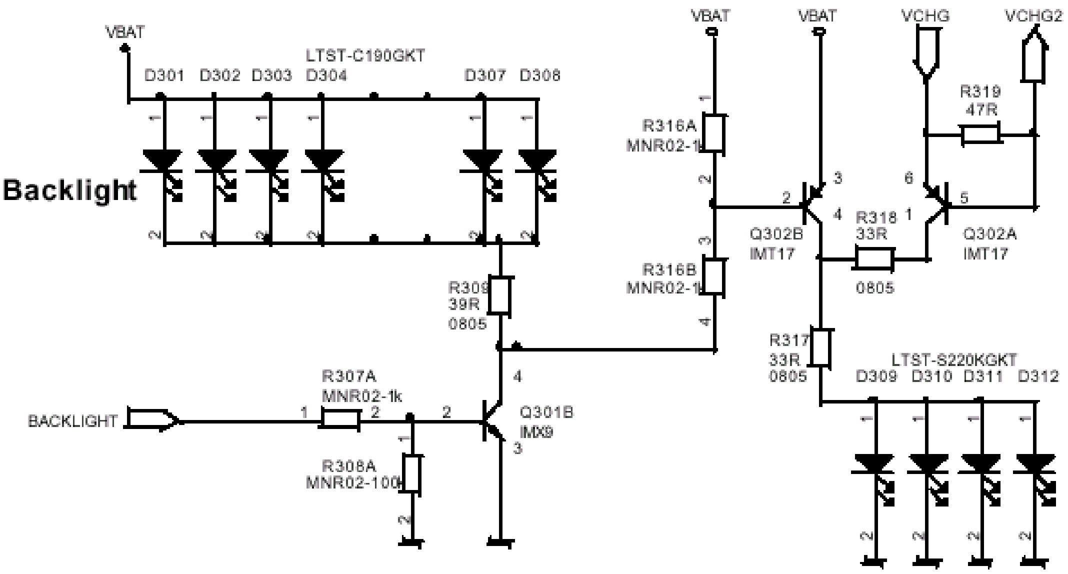
The low impedance speaker is driven by an audio amplifier. The audio amplifier is controlled by the SHUTDOWN pin form Hercrom20. In normal off-hook, the audio amplifier is turned on, when the headset is plugged in , the audio amplifier is turned off. When on-hook, the audio amplifier is turned off for power saving. There are two audio path (EARP & AUXOP) coming from Nausica_CS. In Receiver mode, the audio input is fed with EARP, In Speaker/Buzzer mode, the audio input is fed with AUXOP.

2-15 Headset Interface

The audio input of the headset is connected to AUXIN pin of Nausica_CS, the microphone is biased by MICBIAS pin form Nausica_CS, too.

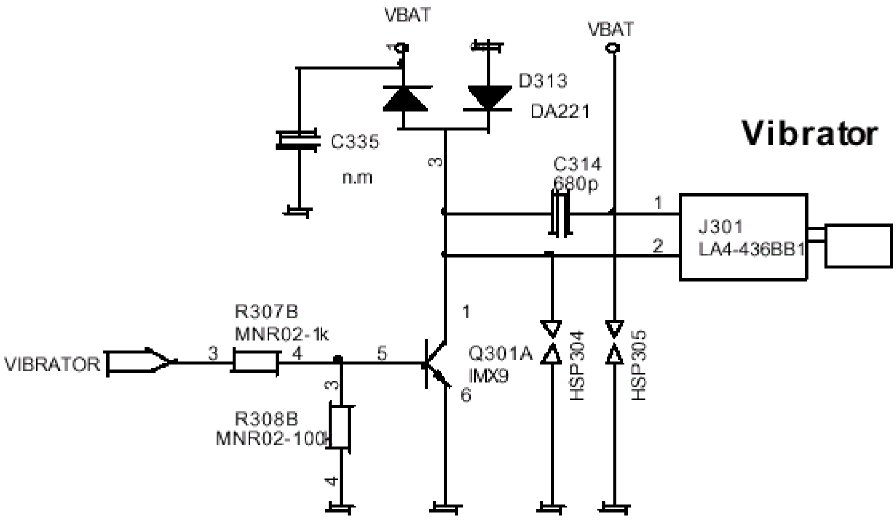
The audio out to the headset kit is fed with EARN pin of Nausica_CS,

2-16 Back-light Illumination



In Back-Light illumination, there are 10 green LEDs (six for keys and four for the LCD), which are driven by BACKLIGH line from Hercrom20. The purpose of Q302A, R319 and R318 is used for the indication of pre-charge.

2-17 Vibrator



The vibrator is driven by the signal VIBRATOR, which is output from Hercrom20. The signal is amplified by the transistor Q301A (IMX9) and is supplied from Vbat.