Technical Note
Globe6 HW Design Handbook

Edition 2006

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1 Document Mission/Scope

1.1 Mission

The purpose for this paper is to give an overview of Globe6 implementation and some ideas for HW design.

1.2 Scope

To provide customers with some guidelines, so they can in a fast way to reach the market with a proven product with a minimum effort.

2 List of Acronyms

Abbreviation / Term	Explanation / Definition
EMC	Electromagnetic Compatibility
ESD	Electro Static Discharge
SSC	Synchronous Serial Controller
PEC	Peripheral Event Controller
CAPCOM	Capture Compare
RTC	Real Time Clock
PA	Power Amplifier
CIF	Common Intermediate Format (ITU video standard)
GPIO	General Purpose Input Output
JTAG	Joint Test Action Group
RF	Radio frequency
GSM	Global System for Mobile Communications
GPRS	General Packet Radio Service

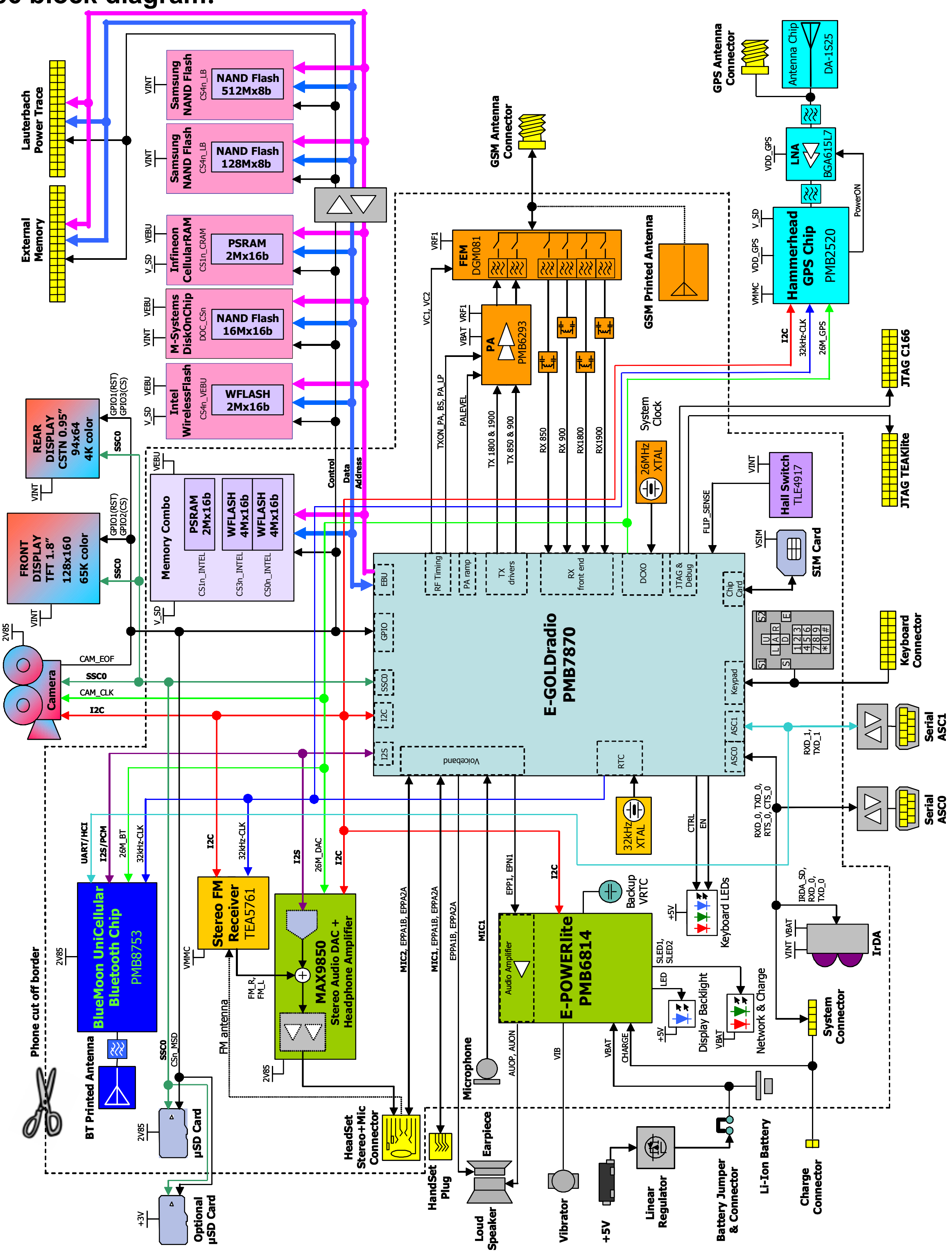
3 Introduction

This document gives a comprehensive introduction of how to most efficiently design products based on the Globe6 platform. The Globe6 reference platform targets the complete range of low to high products. The HW platform provides the basis for building a cost effective attractive form factor products in either “clamshell” or “candy-bar” formats. The basic platforms can easily be extended to support high end features.
The platforms are capable of running either a GSM or GSM/GPRS SW stack. Dual, triple and quad band RF is supported.

This note is supposed to change many times in future because of new ideas and new market solutions.

4 Globe6 design handbook

Globe6 block diagram:



4.1 E-GOLDradio resources

One of the most important issues in designing products based on the Globe6 reference platform is the optimum usage of the E-GOLDradio HW resources. The E-GOLDradio provides a very powerful set of HW features, which if used correctly, enables a low component count and cost effective design. The HW drivers supplied by NEONSEVEN uses these resources in a specific manner, and hence it is important that the choices made by the customers are compliant to this.

To assist in the assignment of ports for various functions, a port allocation table is provided (see docID xxxx.HW.GW.000001). It is an Excel spreadsheet outlining the available pins on the E-GOLDradio and their usage of these pins in the Globe6 reference design. **It is strongly recommended that the costumer refers to this table during product design to ensure compatibility with the NEONSEVEN HW drivers.** An example printout of the table can be found in the following table.

The table consists of a section specifying the E-GOLDradio ports, with primary and alternate functions, together with information of reset state of ports and pull-up and pull-down functions. Another section specifies how the ports are setup in the Globe6 reference design.

Baseband Pinout (docID xxx.HW.GW.000001) printout example

Ball position	Ball name	Bump Name Alt 0	Dir	Bump Outpu Alt 1	Dir	Bump Nan Alt 2	Dir	GPIO	ext_peripheral GLOBE 2	ext_peripheral GLOBE 1	BP2 function Globe 2	Direction I	Direction	Meaning BP2 0	1	Supply Name	Voltage updated 8	Note sept 2003
#Keypad																		
E12	KP0	KP0	O	T2EUD	I	EX0IN	I	GPIO_00	Keyboard	Keyboard	KP0	O	O			VINT	2.72	TBP2
D15	KP2	KP2	O	CC20IOb	I/O	A/D_0	O	GPIO_01	Keyboard	Keyboard	KP2	O	O			VINT	2.72	TBP2
E14	KP3	KP3	O	CC16IOb	I/O	A/D_1	O	GPIO_02	Keyboard	Keyboard	KP3	O	O			VINT	2.72	TBP2
F14	KP4	KP4	O	CC01IOa	I/O	A/D_2	O	GPIO_03	Keyboard	Keyboard	KP4	O	O			VINT	2.72	TBP2
E15	KP5	KP5	O	CC02IO	I/O	A/D_3	O	GPIO_04	Keyboard	Keyboard	KP5	O	O			VINT	2.72	TBP2
E13	KP6	KP6	I	EX5IN	I	A/D_4	O	GPIO_05	Keyboard	Keyboard	KP6	I	I			VINT	2.72	TBP2
F13	KP7	KP7	I	T7IN	I	A/D_5	O	GPIO_06	Keyboard	Keyboard	KP7	I	I			VINT	2.72	TBP2
F15	KP8	KP8	I	CC22IOa	I/O	A/D_6	O	GPIO_07	Keyboard	Keyboard	KP8	I	I			VINT	2.72	TBP2
G15	KP9	KP9	I	CC18IOa	I/O	A/D_7	O	GPIO_08	Keyboard	Keyboard	KP9	I	I			VINT	2.72	TBP2
#ASC																0	0	
C11	RXD	RXD	I/O	EX1IN	I	T5EUD	I	GPIO_09	ASC	ASC	RXD	I	I			VINT	2.72	TBP2
C14	TXD	TXD	O	CC04IO	I/O	NA	NA	GPIO_10	ASC	ASC	TXD	O	O			VINT	2.72	TBP2
D13	ASC_RTS_n	ASC_RTS_n	O	CC18IOb	I/O	DSP_INT3	I	GPIO_11	ASC	ASC	ASC_RTS_n	O	O			VINT	2.72	
D14	ASC_CTS_n	ASC_CTS_n	I	CAPIN	I	CC00IOb	I/O	GPIO_12	ASC	ASC	ASC_CTS_n	I	I			VINT	2.72	
#SSC0																0	0	
C13	SSC0_CLK	SSC0_CLK	I/O	CC00IO	I/O	T2IN	I	GPIO_13	Display (clock)	Display (clock)	SSC0_CLK	GPIO Outp	O			VINT	2.72	TBP2
B15	SSC0_MRST	SSC0_MRST	I/O	LPAOUT1	O	DSP_INT4	I	GPIO_14	Camera(Data_read)	CAMERA (on/off)	GPIO_14	I	I			VINT	2.72	
C15	SSC0_MTSR	SSC0_MTSR	I/O	CC17IO	I/O	T6IN	I	GPIO_15	Display (Data)	Display (Data)	SSC0_MTSR	GPIO Input	O			VINT	2.72	TBP2
#I2C																0	0	
B13	SCL	B13	I/O	NA	NA	NA	NA	GPIO_16	Camera-FM Radio-BW display(I2C SCL)	Camera-FM Radio-BW display(I2C SCL)	GPIO_16/SCL	GPIO Input	O/O			VINT	2.72	
B14	SDA	B14	I/O	NA	NA	NA	NA	GPIO_17	Camera-FM Radio-BW display(I2C SDA)	Camera-FM Radio-BW display(I2C SDA)	GPIO_17/SDA	GPIO Input	I/(O/OD)			VINT	2.72	
#Sim	Card	I/F														0	0	
L4	CCIO	CCIO	I/O	NA	NA	NA	NA	NA	SIM (I/O)	SIM (I/O)	CCIO		I/O			VSIM	2.85	TBP2
J2	CCVZ_n	CCVZ_n	O	CC16IOa	I/O	TTRACE	O	GPIO_18	5V_EN	Backligh rear display (enable)	GPIO_18	GPIO Outp	O			VSIM	2.85	
L2	CCLK	CCLK	O	NA	NA	NA	NA	NA	SIM	SIM	CCLK		O			VSIM	2.85	TBP2
K2	CCRST	CCRST	O	NA	NA	NA	NA	NA	SIM	SIM	CCRST		O			VSIM	2.85	TBP2
M2	CCIN	CCIN	I	T6OUT	O	CCIOSW	O	GPIO_19	NOT USED	SIM	CCIN	GPIO Input	I/PD			VSIM	2.85	TBP2
#I2S1:	DAI-PCM															0	0	
R2	I2S1_CLK0	I2S1_CLK0	I/O	CC05IO	I/O	TXD1	O	GPIO_20	ASC1(TX)-CLK0_DAI(Out)	ASC1(TX)	TXD1		O			VINT	2.72	TBP2
R3	I2S1_RX	I2S1_RX	I	CC06IOa	I/O	DSPIN1	I	GPIO_21	Backlight PWM (red)-RXD_DAI(Input)	Backlight PWM (red)	CC06IOa	GPIO Outp	O	RED_LED	RED_LE	VINT	2.72	
N5	I2S1_TX	I2S1_TX	O	CC06IOb	I/O	A23	O	GPIO_22	HS amplifier (shutdown)	HS amplifier (shutdown)	GPIO_22	GPIO Outp	O	Amplifier s	Amplifie	VINT	2.72	
R4	I2S1_WA0	I2S1_WA0	I/O	DSPOUT2	O	RXD1	I/O	GPIO_23	ASC1(RX)-WA0_DAI(Input)	ASC1(RX)	RXD1		I			VINT	2.72	TBP2
#I2S2:	Digital	Audio	I/F													0	0	
P5	I2S2_CLK0	I2S2_CLK0	I/O	EX6IN	I	SSC1_CLK	I/O	GPIO_24	Flip Sense	HS detection	EX6IN	GPIO Input	I			VINT	2.72	
R5	I2S2_RX	I2S2_RX	I	CC07IO	I/O	SSC1_MTS	I/O	GPIO_25	Camera Output Disable	Display front (chip select)	GPIO_25	GPIO Outp	O	Camera O	Camera	VINT	2.72	TBP2
P7	I2S2_TX	I2S2_TX	O	EX4BIN	I	SSC1_MR	I/O	GPIO_26	HS detection	Flip Sense	EX4BIN	GPIO Input	I	Headset P	No Hea	VINT	2.72	
N7	I2S2_WA0	I2S2_WA0	I/O	T3OUT	O	T0IN	I	GPIO_27	Polyphonic AND display (reset)	Polyphonic (reset)	GPIO_27	GPIO Outp	O	device und	normal (	VINT	2.72	
#I2S3:	Digital	BB	I/F													0	0	
P6	I2S3_CLK	I2S3_CLK	I/O	CC05IO	I/O	I2S2_CLK1	I/O	GPIO_28	Backlight PWM (green)	HS Volume Control (clock)	GPIO_28/I2S3_CLK	GPIO Outp	O	GREEN_L	GREEN	VINT	2.72	
M6	I2S3_TX	I2S3_TX	O	CC06IOa	I/O	NA	NA	GPIO_29	HS Volume Control (data U/D) AND Front di	HS Volume Control (data)	GPIO_29/I2S3_TX	GPIO Outp	O	Volume -3	Volume	VINT	2.72	
R8	I2S3_WA	I2S3_WA	I/O	CC06IOb	I/O	I2S2_WA1	I/O	GPIO_30	Display (R_Wn)	Backlight keyboard (enable)	GPIO_30	GPIO Outp	O	Rear Displ	Rear Di	VINT	2.72	
#Jtag/Debug																0	0	
B12	TDO	TDO	O	NA	NA	NA	NA	NA	JTAG	JTAG	TDO		O			VINT	2.72	TBP2
B11	TDI	TDI	I	NA	NA	NA	NA	NA	JTAG	JTAG	TDI		I			VINT	2.72	TBP2
A14	TMS	TMS	I	NA	NA	NA	NA	NA	JTAG	JTAG	TMS		I			VINT	2.72	TBP2
C10	TCK	TCK	I	NA	NA	NA	NA	NA	JTAG	JTAG	TCK		I			VINT	2.72	TBP2
A12	TRST_n	TRST_n	I	NA	NA	NA	NA	NA	JTAG	JTAG	TRST_n		I			VINT	2.72	TBP2
C9	TRIG_OUT	TRIG_OUT	O	NA	NA	NA	NA	NA	JTAG	JTAG	TRIG_OUT		O			VINT	2.72	TBP2
A11	TRIG_IN	TRIG_IN	I	NA	NA	NA	NA	NA	JTAG	JTAG	TRIG_IN		I			VINT	2.72	TBP2
D11	MON1	MON1	I/O	NA	NA	NA	NA	NA	FM radio (clock)	FM radio (clock)	MON1		O			VINT	2.72	TBP2
B10	MON2	MON2	I/O	NA	NA	NA	NA	NA	Polyphonic (clock)	Polyphonic (clock)	MON2		O			VINT	2.72	TBP2
#EXternal	Bus	I/F														0	0	
G3	D0	D0	I/O	NA	NA	NA	NA	NA	Mem	Mem	D0		I/O			V_SD	1.8	TBP2
E1	D1	D1	I/O	NA	NA	NA	NA	NA	Mem	Mem	D1		I/O			V_SD	1.8	TBP2
F1	D2	D2	I/O	NA	NA	NA	NA	NA	Mem	Mem	D2		I/O			V_SD	1.8	TBP2
F2	D3	D3	I/O	NA	NA	NA	NA	NA	Mem	Mem	D3		I/O			V_SD	1.8	TBP2
G2	D4	D4	I/O	NA	NA	NA	NA	NA	Mem	Mem	D4		I/O			V_SD	1.8	TBP2
H2	D5	D5	I/O	NA	NA	NA	NA	NA	Mem	Mem	D5		I/O			V_SD	1.8	TBP2
G1	D6	D6	I/O	NA	NA	NA	NA	NA	Mem	Mem	D6		I/O			V_SD	1.8	TBP2
H4	D7	D7	I/O	NA	NA	NA	NA	NA	Mem	Mem	D7		I/O			V_SD	1.8	TBP2
H3	D8	D8	I/O	NA	NA	NA	NA	NA	Mem	Mem	D8		I/O			V_SD	1.8	TBP2
J3	D9	D9	I/O	NA	NA	NA	NA	NA	Mem	Mem	D9		I/O			V_SD	1.8	TBP2
H1	D10	D10	I/O	NA	NA	NA	NA	NA	Mem	Mem	D10		I/O			V_SD	1.8	TBP2
J1	D11	D11	I/O	NA	NA	NA	NA	NA	Mem	Mem	D11		I/O			V_SD	1.8	TBP2
K1	D12	D12	I/O	NA	NA	NA	NA	NA	Mem	Mem	D12		I/O			V_SD	1.8	TBP2
L1	D13	D13	I/O	NA	NA	NA	NA	NA	Mem	Mem	D13		I/O			V_SD	1.8	TBP2
J4	D14	D14	I/O	NA	NA	NA	NA	NA	Mem	Mem	D14		I/O			V_SD	1.8	TBP2
K4	D15	D15	I/O	NA	NA	NA	NA	NA	Mem	Mem	D15		I/O			V_SD	1.8	TBP2
D9	A0	A0	O	NA	NA	NA	NA	NA	Mem	Mem	A0		O			V_SD	1.8	TBP2
A6	A1	A1	O	NA	NA	NA	NA	NA	Mem	Mem	A1		O			V_SD	1.8	TBP2
A5	A2	A2	O	NA	NA	NA	NA	NA	Mem	Mem	A2		O			V_SD	1.8	TBP2
C7	A3	A3	O	NA	NA	NA	NA	NA	Mem	Mem	A3		O			V_SD	1.8	TBP2
B7	A4	A4	O	NA	NA	NA	NA	NA	Mem	Mem	A4		O			V_SD	1.8	TBP2
B6	A5	A5	O	NA	NA	NA	NA	NA	Mem	Mem	A5		O			V_SD	1.8	TBP2
B5	A6	A6	O	NA	NA	NA	NA	NA	Mem	Mem	A6		O			V_SD	1.8	TBP2
C6	A7	A7	O	NA	NA	NA	NA	NA	Mem	Mem	A7		O			V_SD	1.8	TBP2
B4	A8	A8	O	NA	NA	NA	NA	NA	Mem	Mem	A8		O			V_SD	1.8	TBP2
D7	A9	A9	O	NA	NA	NA	NA	NA	Mem	Mem	A9		O			V_SD	1.8	TBP2
A4	A10	A10	O	NA	NA	NA	NA	NA	Mem	Mem	A10		O			V_SD	1.8	TBP2
D6	A11	A11	O	NA	NA	NA	NA	NA	Mem	Mem	A11		O			V_SD	1.8	TBP2
A3	A12	A12	O	NA	NA	NA	NA	NA	Mem	Mem	A12		O			V_SD	1.8	TBP2
C4	A13	A13	O	NA	NA	NA	NA	NA	Mem	Mem	A13		O			V_SD	1.8	TBP2
B3	A14	A14	O	NA	NA	NA	NA	NA	Mem	Mem	A14		O			V_SD	1.8	TBP2
A2	A15	A15	O	NA	NA	NA	NA	NA	Mem	Mem	A15		O			V_SD	1.8	TBP2
C3	A16	A16	O	NA	NA	NA	NA	NA	Mem	Mem	A16		O			V_SD	1.8	TBP2
B1	A17	A17	O	NA	NA	NA	NA	NA	Mem	Mem	A17		O			V_SD	1.8	TBP2
C2	A18	A18	O	NA	NA	NA	NA	NA	Mem	Mem	A18		O			V_SD	1.8	TBP2
D5	A19	A19	O	NA	NA	NA	NA	NA	Mem	Mem	A19		O			V_SD	1.8	TBP2
E3	A20	A20	O	NA	NA	NA	NA	NA	Mem	Mem	A20		O			V_SD	1.8	TBP2
D2	A21	A21	O	NA	NA	NA	NA	NA	Mem	Mem	A21		O			V_SD	1.8	TBP2
C1	A22	A22	O	DSPOUT0	O	NA	NA	GPIO_31	Mem	Mem	A22		O			V_SD	1.8	TBP2
F4	CS0_n	CS0_n	O	NA	NA	NA	NA	NA	Mem (chip select Flash 1)	Mem (chip select Flash 2)	CS0_n		O			V_SD	1.8	
C5	CS1_n	CS1_n	O	EX4IN	I	NA	NA	GPIO_32	Mem (chip select RAM)	Mem (chip select RAM)	CS1_n		O			V_SD	1.8	
D4	CS3_n	CS3_n	O	NMI_n	I	HLDA_n	O	GPIO_33	Mem (chip select Flash 2)	Mem (chip select Flash 1)	CS3_n		O			V_SD	1.8	
F3	RD_n	RD_n	O	NA	NA	NA	NA	NA	Mem (read)	Mem (read)	RD_n		O			V_SD	1.8	
D1	WR_n	WR_n	O	NA	NA	NA	NA	NA	Mem (write)	Mem (write)	WR_n		O			V_SD	1.8	
E2	BHE_n	BHE_n	O	NA	NA	NA	NA	GPIO_34	Mem (8/16 bit device byte select)	Mem (8/16 bit device byte select)	BHE_n		O			V_SD	1.8	
G4	ADV_n	ADV_n	O	CC20IOa	I/O	HOLD_n	I	GPIO_35	Mem (page mode memory ADV)	Mem (page mode memory ADV)	ADV_n		O			V_SD	1.8	
E4	OE_n	OE_n	O	CC21IO	I/O	CS2_n	O	GPIO_36	Mem (Output enable)	Mem (Output enable)	OE_n		O			V_SD	1.8	

Voltage_equivalence_tabl Egoldpad	Epower	Voltage	Current
VDDP_DIGA	VINT	2.72	
VDDP_SIM	VSIM	2.85	
VDDP_DIGB	VINT	2.72	
VDDP_EBU	V_SD	1.8	
VDDD	VANA	2.65	
VDD_PLL	VBB1*	1.5	
VDD_RTC	VRTC	2.11	
VDDA_VBR	VANA	2.65	
VDDA_VBT	VANA	2.65	
VDDBG	VANA	2.65	
VDDA_BB	VANA	2.65	
VDDM	VANA	2.65	
VDD_MAIN	VBB1	1.5	
VDD_DSP	VBB2	1.5	
.			
VSSP_DIGA		GROUND	
VSSP_SIM		GROUND	
VSSP_DIGB		GROUND	
VSSP_EBU		GROUND	
VSSD		GROUND	
VSS_PLL		GROUND	
VSS_RTC		GROUND	
VSSA_VBR		GROUND	
VSSA_VBT		GROUND	
VSSBG		GROUND	
VSSA_BB		GROUND	
VSSM		GROUND	
VSS_MAIN		GROUND	
VSS_DSP		GROUND	
NA			

4.2 Basic features

The following lists the features included in the Globe6 reference platforms. Each feature is described together with relevant design issues.

4.2.1 Memory

The E-GOLDradio has a physical address space of 128Mbit / 16Mbyte. The actual amount of memory needed depends on the features included in the product. The number of features also has an influence on the required memory access speed. The memory data bus is 16 bit wide. The SRAM utilizes the BHEn signal to support both 8 and 16 bit access for more efficient use.
The memory interface of the E-GOLDradio supports 1.8V or 2.6V operation, allowing flexibility on the choice of memory components. 2.6V is compatible to most memory devices designed for nominal 3.0V operation.

The memory interface voltage level is selected by connecting the VDDP_EBU supply on E-GOLDradio to either V_SD (1.8V) or to VINT (2.65V).

Remark: All devices connected to the address/data bus MUST share the same voltage level on the bus. It is not possible to mix 1.8V with 2.6V devices; default configuration on Globe6 is 1.8V.

4.2.2 LCD display

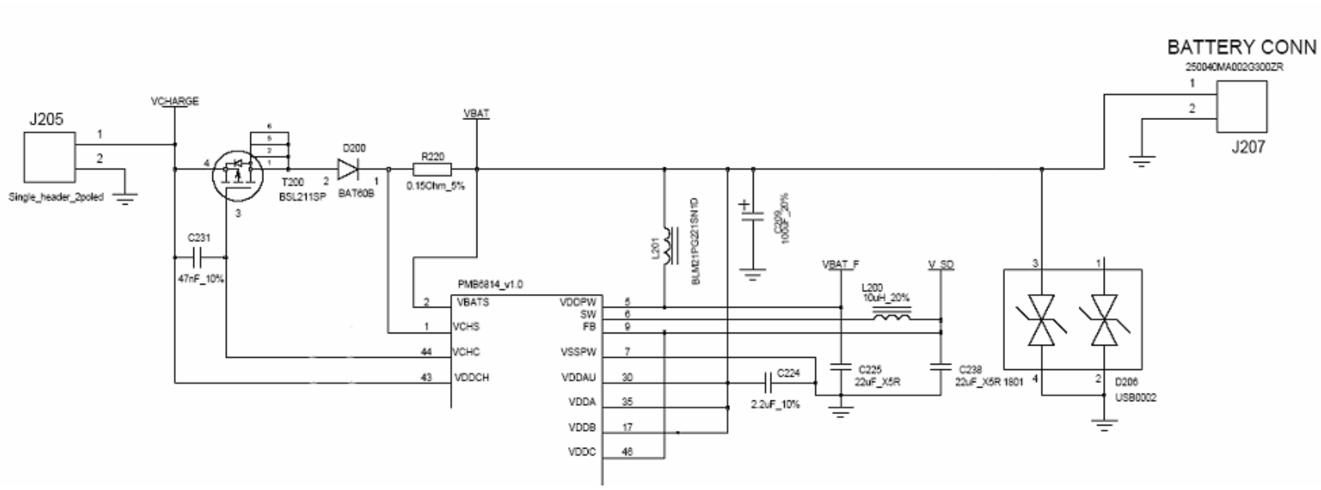
The Globe6 platform supports a variety of LCD controllers. The interface can be either serial (SSC) or parallel. In general, the serial format is preferred due to lower number of interconnections, which means that filtering for EMC and ESD becomes simpler. The speed provided by a serial interface is sufficient for driving grey-scale or color LCD's of moderate resolution with a satisfactory frame rate. The SSC-Synchronous Serial Controller block together with the PEC-Peripheral Event Controller is used for data transfer in serial mode.

When using a parallel interface the LCD controller is connected to the lower 8 bits of the data-bus, and access is controlled by the DISP1_CS signal.

4.2.3 E-POWERlite circuit

The circuit around the E-POWERlite in general follows the E-POWERlite application note. The important design issues are mostly PCB layout related, for reference please consult the power management training presentations. One important rule MUST be obeyed: all MLCC capacitors MUST be X5R / X7R types! The tolerance, voltage and temperature characteristics of the cheaper and smaller Y5V and Z5U types prevent the use of these types.

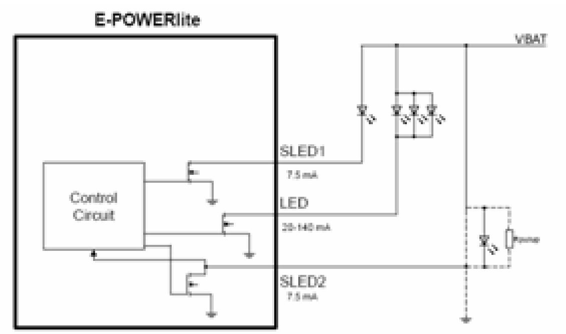
Battery charging:
The charge circuit in the Globe6 platform allows charging of NiMH (optional), Li-Ion and Li-Polymer batteries. The charge current is determined by the external wall adapter, since no charge current control is provided in the HW. The diode in the charge input can be used to protect the E-POWERlite against reverse polarity at the input. The use of this diode is optional, since the design of the connector can include protection against reverse polarity. The 47nF capacitor is mandatory for circuit stability. The BAT60B diode prevents the battery voltage to erroneously cause a detection of charger connection by blocking the path through the body diode of the MOS-FET. The 0.15 Ohm resistor is used for charge current sensing in the E-POWERlite.

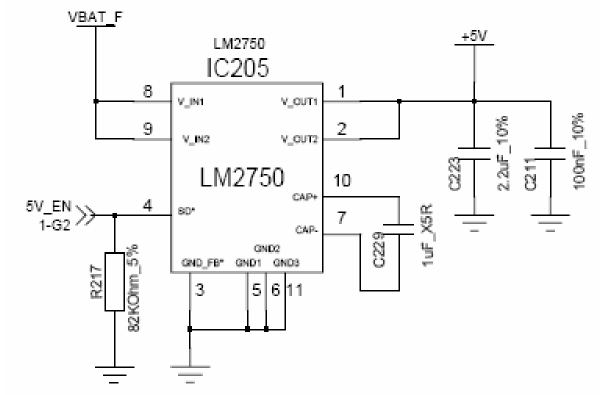


The most important design issue is to ensure sufficient cooling of the pass MOSFET in the constant voltage section when charging Li-Ion batteries. This is accomplished by providing a good heat sink in the PCB, connected to the 4 drain pins. App. 20 – 30 mm^2 of copper area are sufficient for this purpose.

4.2.4 Backlight

The built in backlight LED driver is suitable for driving most commercially available LEDs. The driver is a switchable low side constant current source. It is programmable in 7 steps in the range from 20 mA to 140 mA with a step width of 20 mA. The anode of the LEDs can be attached directly to the battery.
The backlight LED driver in the Globe6 has been provided by E-POWERlite and a step up charge pump booster which supply +5V instead of battery voltage that is around 3.8V. This +5V is used to supply the two 3 color led as well.

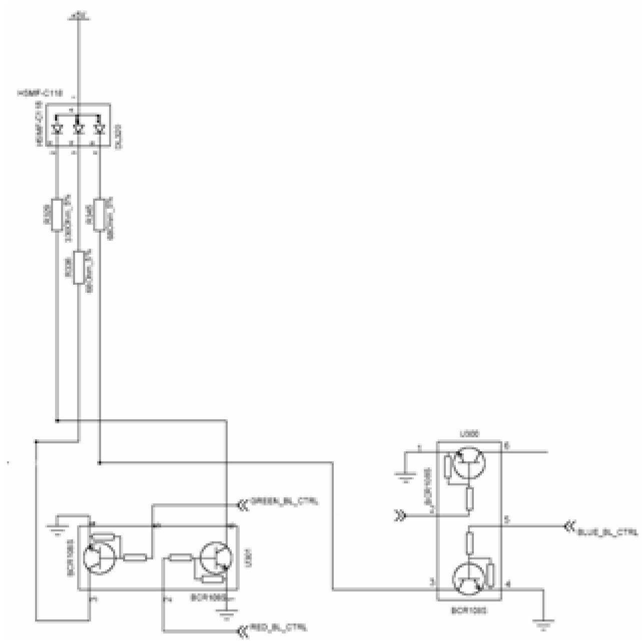




Soft dimming:
The LED driver function consists of a PWM control with a fundamental frequency of about 60 Hz generated from the internal clock frequency of 500 kHz by division by 8192. Using E-POWERlite the duty cycle of the LED current can be set in 63 steps in the range from 0.5% to 100%. By sending a sequence of appropriate commands to E-POWERlite a soft dim function can easily be implemented.

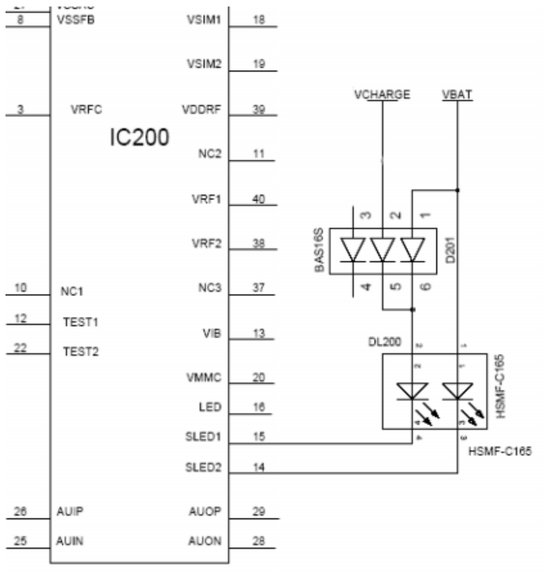
Driving three color LED’s:

According to datasheet of most popular blue and white LED’s, the forward voltage drop is much larger than the red, yellow and green types. Worst case forward voltage is typically specified at up to app. 4.0V. This means that at low battery voltage, the LED anode connected to VBAT is not able to drive the full current through the diodes hence it is necessary to use a voltage boost circuit, which could be either a charge pump type or a inductor based boost converter type.



Driving a LED during charge of deeply discharged battery:

When charging a battery which is deeply discharged (voltage < 3.0V), the baseband circuit is deactivated. This means that no visible indication to the user is given, which again might lead the user to believe the phone is not working properly. To overcome this situation, the circuit below will activate a LED during precharge. When the battery voltage is sufficient for normal operation, the LED is controlled by the E-POWERlite SLED1 and SLED2 pins. If the LED is only intended to be used when a charger is connected, the double Schottky diode can be omitted and the anode of the LED connected directly to the VCHARGE. Schottky diodes are preferred because of lower forward voltage drop.



PMB6814_v1.0

4.2.5 Ringer driver

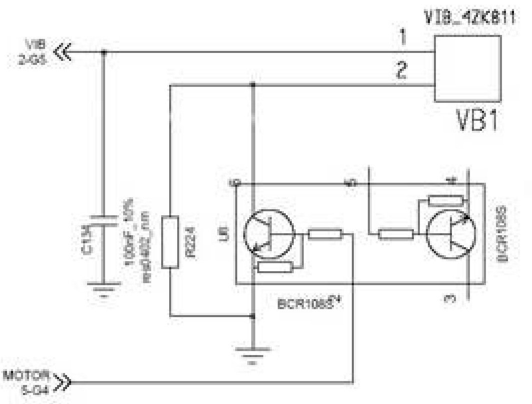
The ringer tone might be generated by EGOLDradio built-in generator or can be used a Polyphonic ringer chip. Then it might be amplified by E-POWERlite amplifier before being applied on the loudspeaker connector. Otherwise, the generated ringer signal might be applied to the Stereo audio amplifier that serves the head-set external device.

Magnetic transducer can be attached directly to the analog output EPPAxx of E-GOLDradio. The analog part of EGOLDradio is supplied with VANA=2.6V.So we have to chose the right magnetic transducer.
If buzzer is wonted, SW driver can use the CAPCOM to generate the PWM signal to drive the buzzer hence the port selected for this purpose must have a CcxIO function as one of the alternate functions. If a polyphonic ringer IC is included in the design, the buzzer circuit can be omitted.

4.2.6 Vibrator driver

The vibrator is driven with E-POWERlite, VIB signal.
The universal voltage source is a voltage-step programmable, switchable high side constant voltage source. The driver provides average load current limiting. The low side of the load can be connected directly to ground.
The circuit has a built-in soft startup and shutdown function and does not need any external circuitry. If needed, a bypass filtering capacitor (100nF) at the output can be added.
A short-circuit current limitation is included.

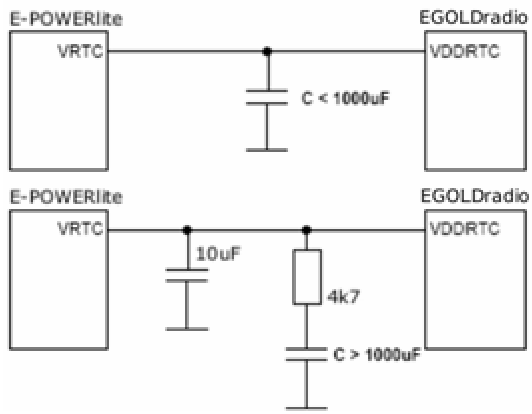
On the picture we have vibrator controlled with polyphonic chip, MOTOR signal and can follow the rhythm. A 0Ohm resistor R224 should be placed and BCR108S not mounted if MOTOR signal is not used.



The advantage of the constant voltage driver is a more accurate control of rotation speed, since the speed of a DC motor is controlled by voltage, while the torque is controlled by the current.

4.2.7 RTC

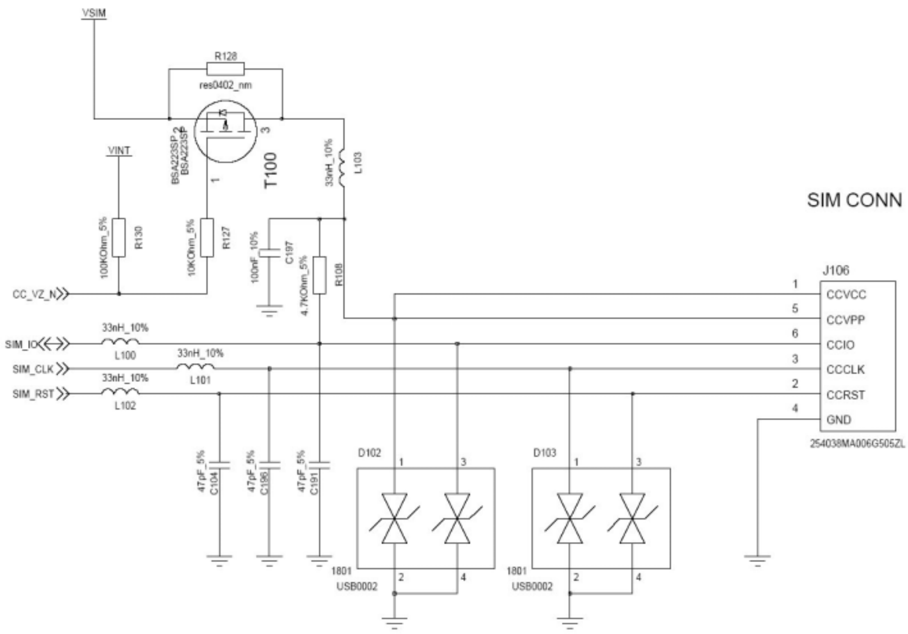
The integrated RTC in the E-GOLDradio consumes only app. 2uA, hence backup can be provided simply by adding a large capacitance on the RTC supply. In backup mode (E-GOLDradio powered off) with only the RTC running, the RTC will operate down to app. 1V. If very large backup capacitors or rechargeable batteries are used, it is advisable to insert a 4.7K series resistor to avoid that initial charging of the capacitor clamps the RTC supply, preventing the RTC circuit to work during E-GOLDradio initialization. In this configuration, a 10uF decoupling capacitor directly on VRTC is necessary to ensure stability of the regulator. Rechargeable batteries of the most popular types (LiMn2) can not be used, since the VRTC voltage is not compatible with the charge voltage. However new types with modified electrode materials, which are compatible with the charge/discharge voltage range of the Globe6 can be used. (Seiko Instruments TS type, VARTA V6HR). Double layer backup capacitor types (Panasonic Gold capacitor, Kanebo PAS types, Seiko Instruments XC types) are also recommended for extended backup times.



Backup time (capacitor, linear discharge):
t = C x (VDDRTC – 1V) / I = C x (2.1 – 1) / 2uA = 0.55sec / uF ≈ 1 min / 100uF

Backup time (battery):
t = Capacity / I = Capacity / 2uA ≈ 500h / mAh

4.2.8 SIM



The E-GOLDradio features a GSM 11.11 phase 2/2+ compliant SIM interface, providing support for 3V normal and high-speed SIM cards. 1.8V cards are supported inherently, as 1.8V cards according to specifications, must be able to work also at 3V. The components necessary are a 4.7K pull-up and a 47pF decupling capacitor on the SIM_IO data line and a 100nF decoupling capacitor placed close the VCC terminal, 47pF on SIM_RST line and SIM_CLK line. Three inductor are used here, to prevent disturb from near placed PCB antenna. Mosfet T100 is used to switch on power supply to SIM (needed when used with EPOWERlite and be complained with SIM specification). For applications where it is possible to remove the SIM card without powering down the terminal, it is strongly recommended to use the SIM detect functionality of the SIM interface. This works in conjunction with a mechanical switch placed in the SIM card holder which signals a high level when the SIM card is inserted and a low level when the SIM card is removed. This ensures a SIM shut down sequence compliant to GSM 11.12.

4.2.9 Side connector/charging – serial IO

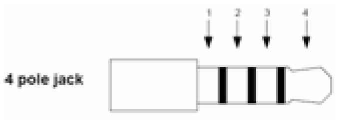
This side connector is provided mostly for programming the phone, serial access and to charge the battery on phone when a phone shape is cut out. Connected accessories can be powered from that connector. For details on pinout and signal, please refer to the Globe6 manual.

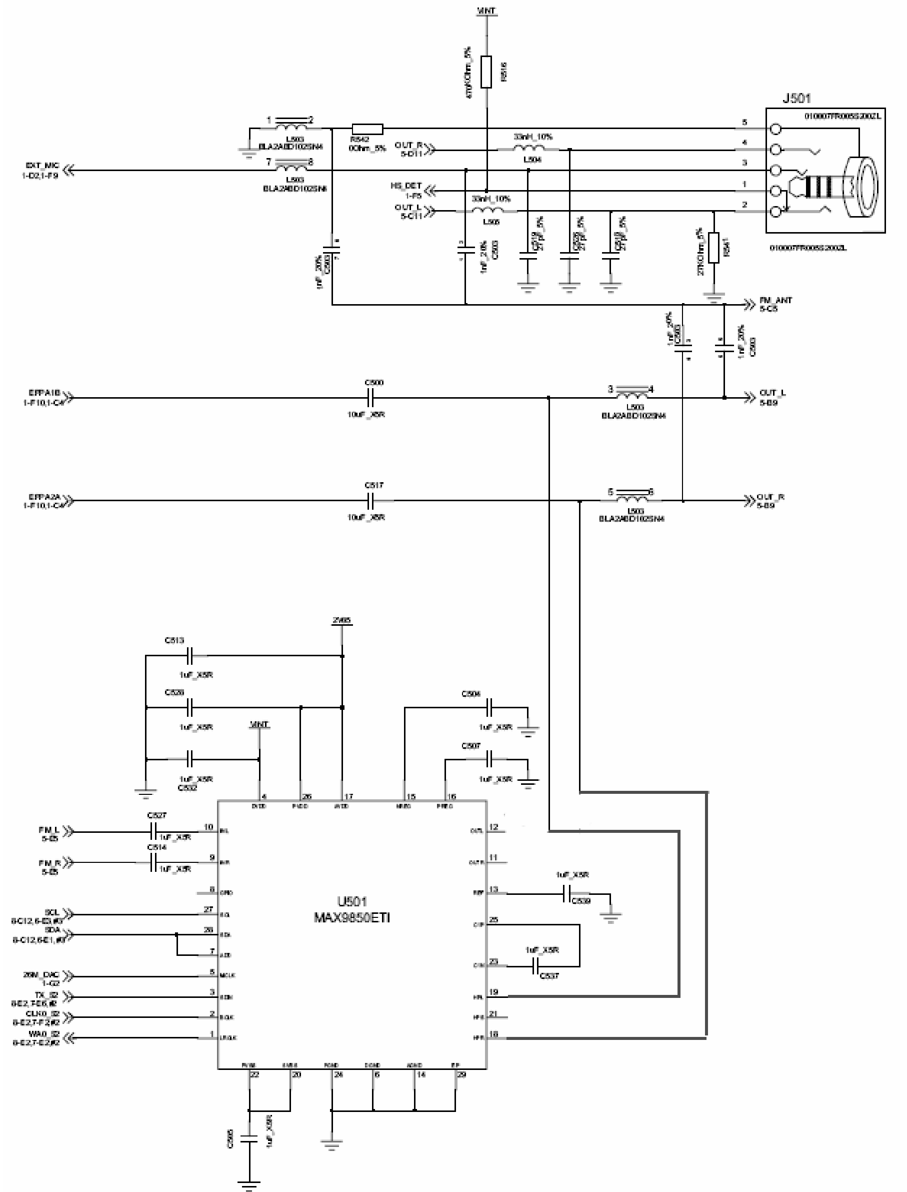
4.2.10 Headset

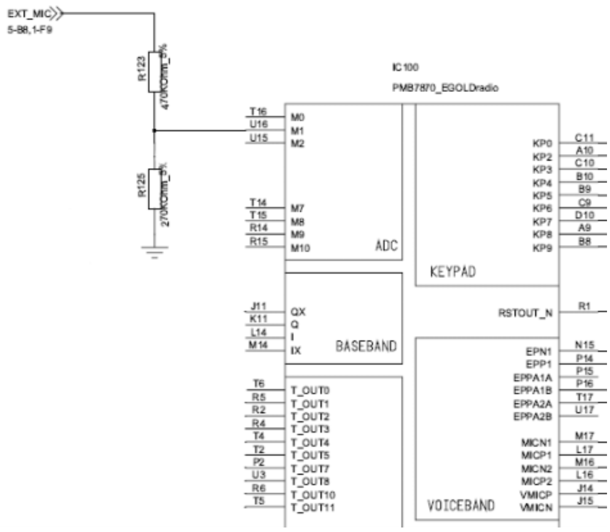
The Globe6 has an audio connector. This allows external audio devices like headset and in-car hands-free equipment to be connected to the connector.

Headsets hook key and headsets detection:
When a jack plug is inserted in the connector, a high level on GPIO is detected due to opening of the switch in the connector. This detection is preformed in code routine.
The handset detect is a switch, which shorts the OUT_L line to ground. When the jack is inserted the HS_DET line is going high and generates an interrupt request. The internal pull-up on pin EX4IN can be enabled. The circuit is optimized for low power and low cost.
Hook detection subroutine start running when the headset is detected. When hook key is pressed, it short the line EXT_MIC to ground, we detect this by measuring the voltage on this line with the EGOLDradio analog input. This circuit is shown in two figures below.

Connector configuration:
Pin 1: GND
Pin 2: OUT_R
Pin 3: OUT_L
Pin 4: EXT_MIC

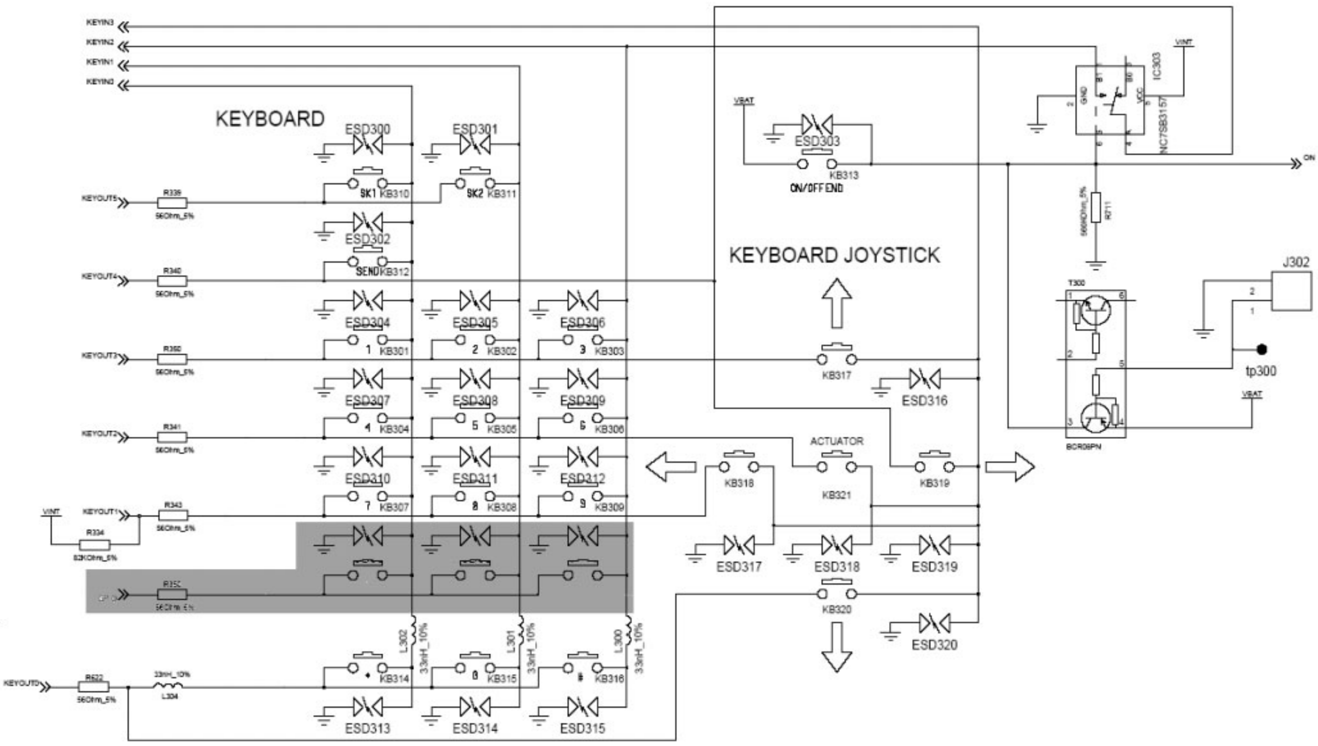






4.2.11 Keyboard

The keyboard interface on the E-GOLDradio is a 6 x 4 scan matrix. The keyboard interface provides an interrupt driven key detect function, where a key press can be detected without actively scanning the matrix, thus enabling fast key response, even when the micro-controller is in idle. A key press on any key will force on of the key row inputs low, thus generating an interrupt. The following active key scan will then determine which key has been pressed. If there is a need to support more than 24 keys, the key matrix can be extended by adding scan column outputs using GPIO, as indicated in the example schematic below.

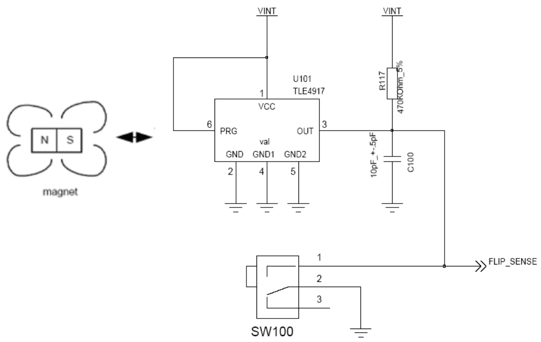


The maximum key resistance is 2kOhm; leakage between any two key matrix lines must be kept below 5uA. A variety of key types can be used: metal domes, carbon coated polymer etc. It is important that the physical PCB layout of the key contact area ensures a reliable contact when a key is pressed.

On/Off key:
In the Globe6 the On/Off key is mapped into the key matrix using an analog switch. This allows an easy and straightforward detection of the key without using additional GPIO ports.

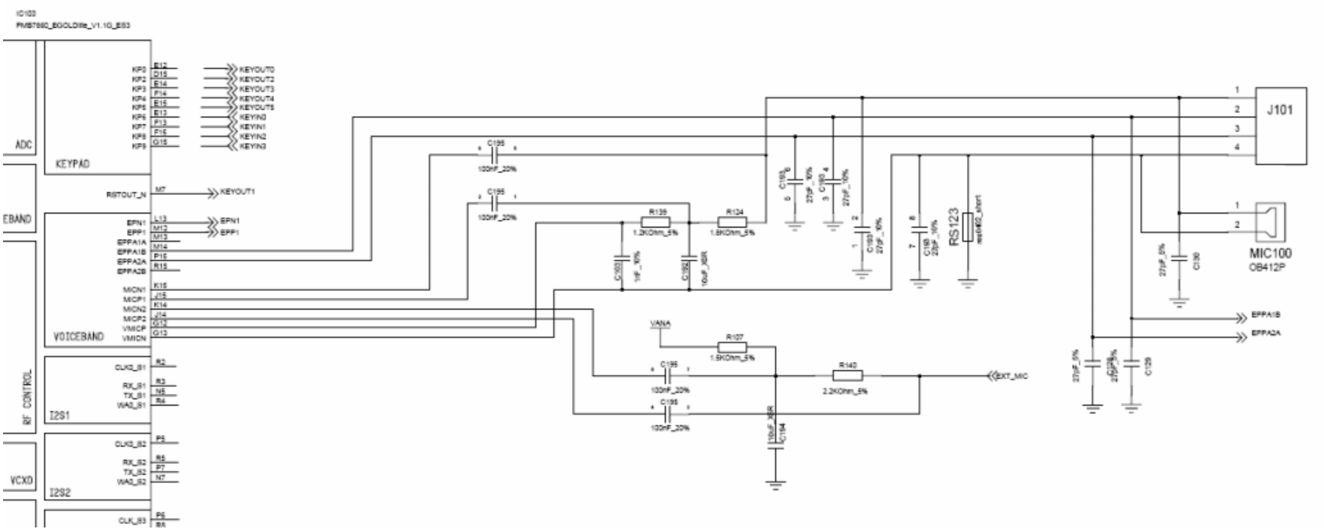
4.2.12 Flip sense

For clam shell type phones, a detection of the flip position is needed. This can be implemented as a mechanical switch activated by the flip and connected to an interrupt input of the E-GOLDradio, or by using a Hall-effect sensor which detects the presence of a magnetic field. The circuit below depicts the latter case, using an Infineon Hall-effect sensor IC with very low power consumption, which is connected to an interrupt input on the E-GOLDradio.



4.2.13 Speaker and Microphone

The speaker amplifier of E-GOLDradio drives directly a > 16Ohm speaker. The only recommended external component is a 27pF MLCC, which shunt the antenna signal from the audio output. This is necessary in most applications, since the speaker is normally placed close to the antenna.
The microphone bias voltage is generated by the VMICP output of E-GOLDradio, an additional filter cleans up the bias voltage and presents it to the microphone through a 1.8k feed resistor. The audio input is pseudo differentially coupled into the E-GOLDradio microphone inputs with two 100nF capacitors. All components related to the microphone signal refer to a separate analog ground signal, which is routed along with the audio signals to the microphone. The VMICN is connected to ground and shunted with 27pF capacitors to prevent RF signal pick. Also the microphone input signal is shunted with 27pF capacitors to prevent RF signal pickup.



4.2.14 Debug

For SW debug purposes, access to the JTAG interface block is required. It is therefore a requirement that a test-connector is provided with the following signals (mandatory signals **bold** marked):

TRIGOUT
TDO
TMS
TDI
TRST#
TCK
TRIG_IN
RESET#
VINT
GND

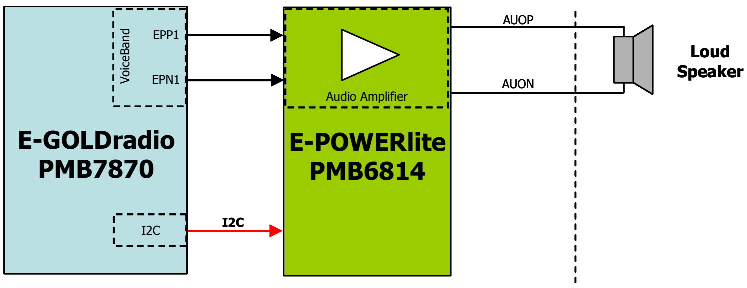
If it is not possible to find the board space for a connector, test-points on the PCB must be provided, allowing jumper wires to be soldered onto the PCB.
Special note on RESET#: The Lauterbach debugger features an open-drain driver for the RESET signal.
To allow the debugger to reset the target HW, it is necessary to insert a 1k resistor between the E-POWERlite RESET output and the system reset signal if connected directly, to allow the debugger to pull low the system reset signal RESET#. In our case we use some logic IC to manage reset.

4.3 Supplementary features

For high-end products, more features can be added to the Globe6 platform. The following describes integration of popular features like FM-radio, GPS, uSD interface and NAND flash. The description focuses on the integration aspects whereas specific circuit design issues related only to the individual 3rd party IC's must be found in the relevant datasheets.

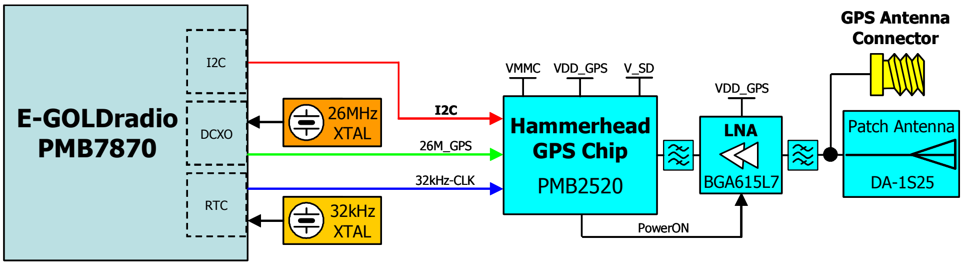
4.3.1 Polyphonic ringer

Polyphonic ringer is integrated in EGOLDradio and can use E-POWERlite amplifier for power output to speaker.



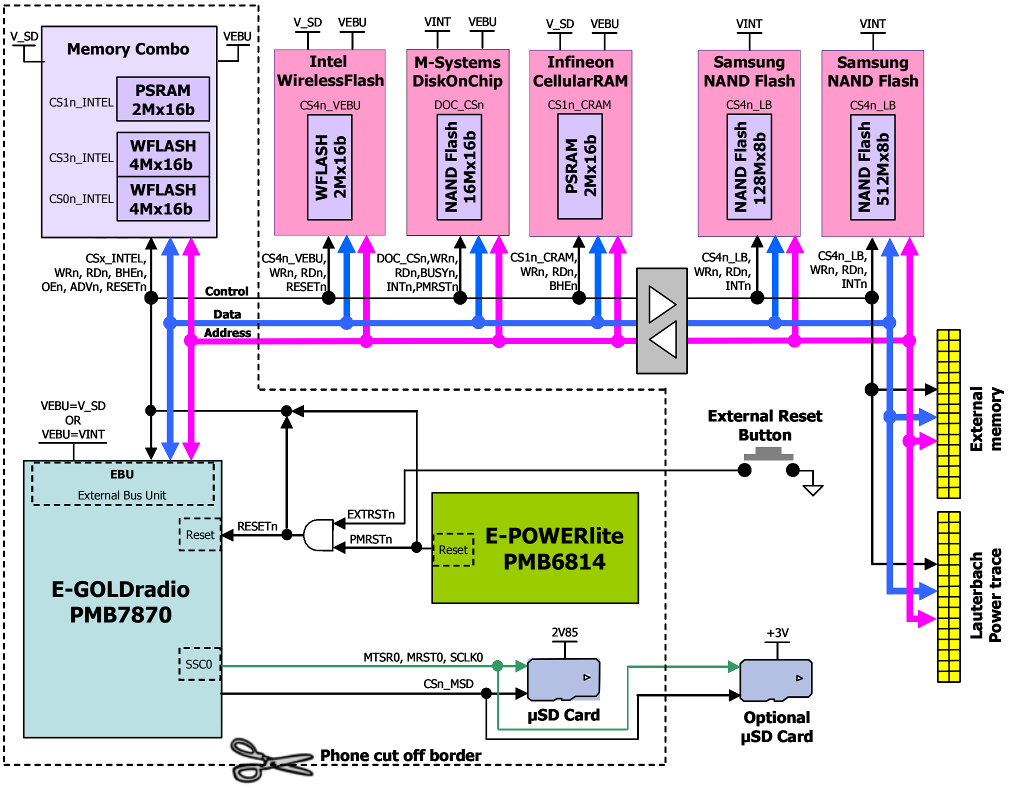
4.3.2 GPS

On the board (outside phone shape) there is a Hammerhead GPS Chip. This is a single chip solution, but in our case we for testing purpose use an external LNA with patch or external antenna. To put an active antenna, we need and inductor of about 100nH through which we bring the power supply to the antenna. All necessary libraries for work with Hammerhead are linked in SW. For better performance is always suggested to use a special XTCO (see Hammerhead specification). For this reason, we have a possibility to mount it on Globe6.



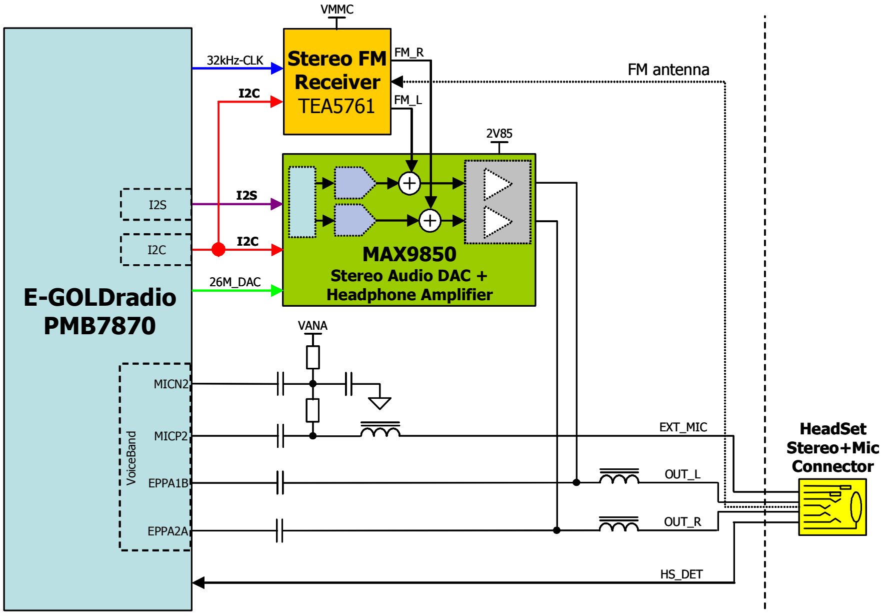
4.3.3 uSD card and NAND flash

This two are used only to demonstrate the possibility of storage some data (pictures, mp3s, etc), and to test the functionality.



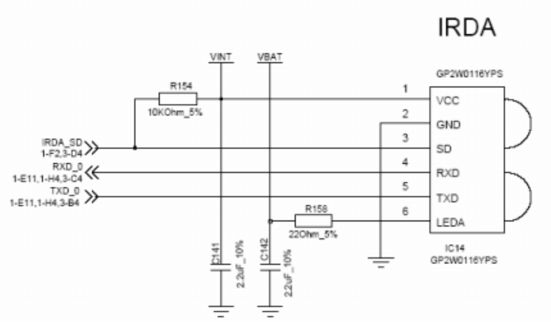
4.3.4 FM-Radio

The Philips TEA5761UK is the preferred device for stereo FM-radio applications. The IC features an I2C control interface which is connected to the I2C signals used also to control the camera, and can run on a 32 kHz clock signal. Please refer to the TEA5761UK datasheet for complete reference.
The Philips IC has no volume control or headset amplifier hence an external device must be used. The application example uses a MAX9850ETI headset amplifier (DAC) from Maxim. This IC contains a stereo headset amplifier. The control interface is two wires I2C. To allow mixing voice-band signals into the headset output, the E-GOLDradio is connected with I2S to the DAC and the FM radio output is connected to the analog input.
Polyphonic are send to DAC on I2S too.

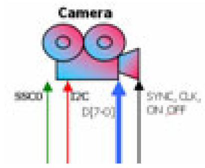


4.3.5 IrDA

Implementation of IrDA connectivity is straightforward, using an integrated IrDA transceiver. Below is depicted a solution using a GP2W0116YPS IrDA transceiver. Only three signals are needed to control the transceiver. When the IrDA transceiver is connected to ASC0 in the E-GOLDradio, it is mandatory that the port driving the shutdown pin (pin 3) on the transceiver has an external pull-up resistor, since the IrDA transceiver MUST be default disabled to enable the internal bootstrap flash loader in the E-GOLDradio to work properly. This can be accomplished either by using a GPIO with internal pull-up enabled during reset, or by using external pull-up resistor. The depicted solution uses a GPIO with internal pull-up.



4.3.6 Camera



Camera can be connected via 8 bit parallel port or through serial port and it use I2C to send commands to the camera. In Globe6 design is used an Agilent CIF camera ADCM-1700.The camera is connected so that can send the preview data directly formatted on the main display (parallel data transfer).

4.4 EMC design rules

Depending on the physical design of the plastic enclosure, a Globe6 based design will normally be able to pass the FTA EMC tests with only a minimum number of protection and filtering components necessary. The basic EMC standard for GSM/GPRS products is EN 301 489-7. However, due to internal requirements increased protection can be required.
Please note that on Globe6, no EMC protection components are used. It’s an evolution board concept with explanted by overall interface connectors, very difficult to protect against EMC zaps.

4.4.1 ESD protection

The test levels specified in EN 301 489-7 is 4kV contact discharge and 8kV air discharge. It is becoming more common to have internal more severe limits, typical 8kV contact and 15kV air discharge. Thus adding protection components to the design becomes an issue.
In general the clamping voltage of a ESD protection device is of less importance than the speed, which is mostly governed by the circuit inductance. Proper layout techniques must be employed to achieve the wanted protection levels. Short and wide connections to the ground plane are mandatory, alternatively connections with micro vias directly in the ground pad of the device connecting to the next layer ground plane is recommendable.

Speaker output:
The speaker outputs are protected by adding a tranzorber device to each output line, placed close to the speaker terminal. The device can be a varistor type or a zener diode type.
The capacitance is not critical, since the speaker output of E-GOLDradio is designed to drive large capacitive loads.

SIM contacts:
The SIM connections are protected by adding tranzorber devices to each line, placed close to the SIM terminal. The device can be a varistor type or a zener diode type. Packages with multiple devices are preferred due to the smaller physical size.
Due to the high speed communication, it is important that the capacitance is kept low on these pins, in general < 100pF is recommended in order preserve signal integrity. Due to the device capacitance, the 47pF capacitor on the CCIO line can be removed when an ESD protection device is mounted.

LCD interface:
The LCD connections are protected by adding tranzorber devices to each line. The devices can be varistor or zener diode types. Packages with multiple devices are preferred due to the smaller physical size. Due to the high speed communication, it is important that the capacitance is kept low on these pins, in general <100pF is recommended in order preserve signal integrity.

System connector:
Depending on the signals present in the system connector, various protection devices can be selected. For high speed serial communication, the capacitance must be limited to < 100pF.
For the charger input, a higher working voltage must be selected, based on the charger specifications, to limit leakage current in the protection device. Alternatively, a 100nF MLCC capacitor on the charger input usually solves any ESD problem.

PCB Layout:
The PCB layout plays a very important role in ESD immunity design. While it is hard to give a complete description of how to do a specific layout due to the product specific design constraints, a few general applicable rules can be given here:
1. Keep components away from PCB edge
2. Route an exposed ground trace along the edge of the PCB on both top and bottom layer
3. Use ground plane between keypads on keyboard, avoid signal traces

4.4.2 RF field Immunity 80 – 1000 MHz

Apart from ESD, normally only immunity to RF radiated fields can be a potential problem when using the headset. To solve the problems, three measures are strongly recommended:
- Add 27pF between the headset microphone terminals, placed directly on the microphone.
- Add 27pF between the speaker output and ground, placed close to the jack connector
- Connect AGND to the ground plane on the ground pin of the jack connector.

4.5 Layout guidelines

This section will give general guidelines for making the PCB layout. The guidelines aim at achieving a well performing PCB with a minimum effort in terms of number of iterations. In general well-known “best practice” approaches are used.

4.5.1 Component placement

An optimum placement of the components is mandatory to achieve a good PCB layout. Below are some briefly outlined considerations for determining the component placement.

RF:
In general it is recommended that the RF is taken as a 100% copy of the Globe6 reference design. This will ensure that the final performance is consistent with a minimum amount of effort. This means that also the component placement of the all components within the RF shield is fixed.

Power:
Power should be routed so that a short, low-impedance path is provided from the battery connector to the main load, which in this case is the PA. Placing the power entry point (battery connector) close to the PA, and placing the E-POWERLite directly below the PA, provides this low impedance path. The E-POWERLite is rotated so that the DC/DC converter is placed away from the RF.

Digital signals:
Noise emitting digital signals should be kept away from noise sensitive signals. This is accomplished by placing E-GOLDradio between the memory and the RF, thus keeping the data bus away from the analog baseband signals.

Analog signals:
The audio signals are susceptible for the electromagnetic field generated by the pulse current in the VBAT line, thus the signals are routed in the opposite side of the PCB, compared to the PA and VBAT.

5 Document change report

	Change Reference		Record of changes made to previous released version	
Rev	**Date**	**CR**	**Section**	**Comment**
1.0	30/01/2006	A. Luin		First release

6 Approval

Revision	Approver(s)	Date	Source/signature
1.0	Massimo Vlacci	10/02/2006	Document Stored on N7 Server

Annex

NA