

Freescle QE128 血压计参考设计方案

Freescle 公司的血压计(BPM)参考设计采用 MC9S08QE128 作为微控制器,具有控制,数据保持,模拟采集和连接功能以及能和用户接口. 参考设计具有多种优势:采用 MC9S08JM60 作为 USB 通信的桥,采用 MC13202 ZigBee 收发器进行 2.4GHz 通信,采用 MRAM 来存储用户数据和通信,MRAM 驱动器能存取 MRAM 存储器,采用 OLED 作为用户显示, MPR083 接近式传感器用作用户接口,以及用两个定时 PWM 模块作为音频反馈. 本文首先介绍了 MC9S08QE128 主要特性和方框图.接着介绍了血压计(BPM)参考设计的硬件方框图和软件架构流程图,以及详细电路图和所用材料清单.

MC9S08QE128 主要特性:

- 8-Bit HCS08 Central Processor Unit (CPU)
 - Up to 50.33-MHz HCS08 CPU above 2.4V, 40-MHz CPU above 2.1V, and 20-MHz CPU above 1.8V, across temperature range
 - HC08 instruction set with added BGND instruction
 - Support for up to 32 interrupt/reset sources
- On-Chip Memory
 - Flash read/program/erase over full operating voltage and temperature
 - Random-access memory (RAM)
 - Security circuitry to prevent unauthorized access to RAM and flash contents
- Power-Saving Modes
 - Two low power stop modes; reduced power wait mode
 - Peripheral clock enable register can disable clocks to unused modules, reducing currents; allows clocks to remain enabled to specific peripherals in stop3 mode
 - Very low power external oscillator can be used in stop3 mode to provide accurate clock to active peripherals
 - Very low power real time counter for use in run, wait, and stop modes with internal and external clock sources

- 6 μ s typical wake up time from stop modes
- Clock Source Options
 - Oscillator (XOSC) — Loop-control Pierce oscillator; Crystal or ceramic resonator range of 31.25 kHz to 38.4 kHz or 1 MHz to 16 MHz
 - Internal Clock Source (ICS) — FLL controlled by internal or external reference; precision trimming of internal reference allows 0.2% resolution and 2% deviation; supports CPU freq. from 2 to 50.33 MHz
- System Protection
 - Watchdog computer operating properly (COP) reset with option to run from dedicated 1-kHz internal clock source or bus clock
 - Low-voltage detection with reset or interrupt; selectable trip points
 - Illegal opcode detection with reset
 - Flash block protection
- Development Support
 - Single-wire background debug interface
 - Breakpoint capability to allow single breakpoint setting during in-circuit debugging (plus two more breakpoints)
 - On-chip in-circuit emulator (ICE) debug module containing two comparators and nine trigger modes. Eight deep FIFO for storing change-of-flow addresses and event-only data. Debug module supports both tag and force breakpoints.
- ADC — 24-channel, 12-bit resolution; 2.5 μ s conversion time; automatic compare function; 1.7 mV/ $^{\circ}$ C temperature sensor; internal bandgap reference channel; operation in stop3; fully functional from 3.6V to 1.8V
- ACMPx — Two analog comparators with selectable interrupt on rising, falling, or either edge of comparator output; compare option to fixed internal bandgap reference voltage; outputs can be optionally routed to TPM module; operation in stop3
- SCIx — Two SCIs with full duplex non-return to zero (NRZ); LIN master extended break generation; LIN slave extended break detection; wake up on active edge

- SPIx— Two serial peripheral interfaces with Full-duplex or single-wire bidirectional; Double-buffered transmit and receive; MSB-first or LSB-first shifting
- IICx — Two IICs with; Up to 100 kbps with maximum bus loading; Multi-master operation; Programmable slave address; Interrupt driven byte-by-byte data transfer; supports broadcast mode and 10 bit addressing
- TPMx — One 6-channel and two 3-channel; Selectable input capture, output compare, or buffered edge- or center-aligned PWMs on each channel
- RTC — 8-bit modulus counter with binary or decimal based prescaler; External clock source for precise time base, time-of-day, calendar or task scheduling functions; Free running on-chip low power oscillator (1 kHz) for cyclic wake-up without external components
- Input/Output
 - 70 GPIOs and 1 input-only and 1 output-only pin
 - 16 KBI interrupts with selectable polarity
 - Hysteresis and configurable pull-up device on all input pins; Configurable slew rate and drive strength on all output pins.
 - SET/CLR registers on 16 pins (PTC and PTE)

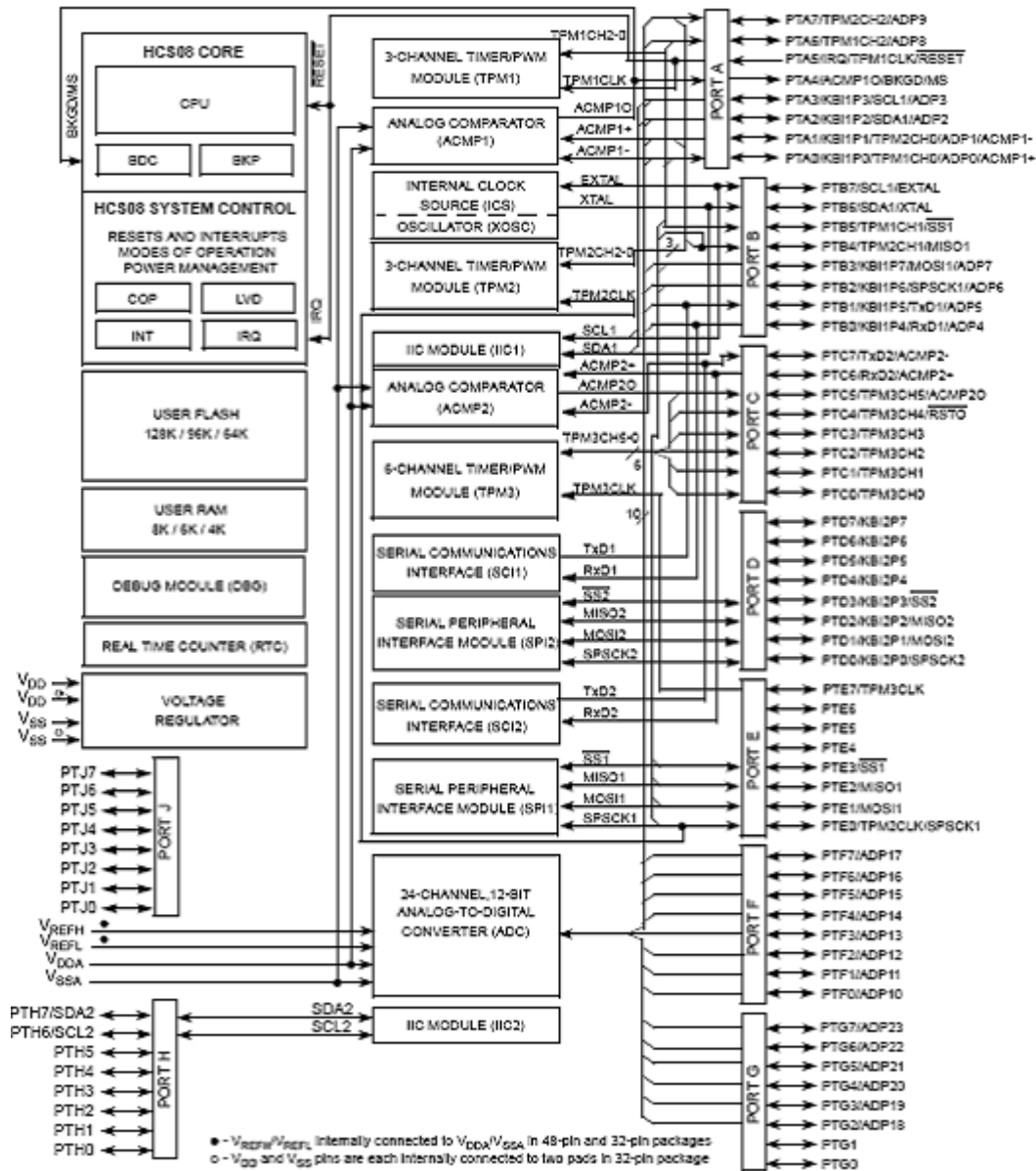


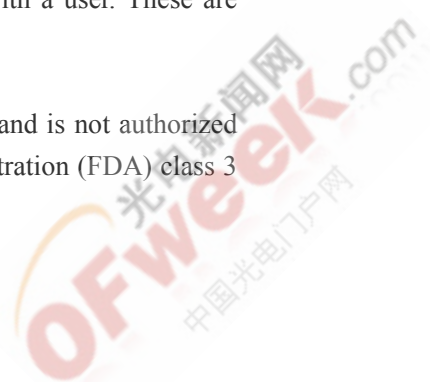
图 1.MC9S08QE128 系列方框图

采用 QE128 系列的血压计参考设计

Blood Pressure Monitor Using the Flexis QE128 Family

The blood pressure monitor (BPM) reference design shows how to implement a system that can measure arterial blood pressure values. The system demonstrates control, data retention, analog acquisition, and connectivity functions, as well as the ability to interface with a user. These are achieved by using several Freescale devices.

This reference design serves only as a proof of concept for this application and is not authorized for use in safety-critical applications such as a U.S. Food and Drug Administration (FDA) class 3 application.



Manufacturers and designers who incorporate Freescale (FSL) technology must have all necessary expertise in the safety and regulatory ramifications involved in the application of this design, and they are solely responsible for all legal, regulatory, and safety-related requirements concerning their products and the use of Freescale devices in safety-critical applications.

采用 QE128 系列的血压计参考设计优势

The BPM reference design elements can be referenced for later development as:

- USB communication using the MC9S08JM60 as a bridge
- 2.4 GHz communication using the MC13202 ZigBee transceiver
- MRAM communications
- Use of MRAM to store user data
- MRAM driver to access MRAM memory
- User display using an OLED display
- User interface using the MPR083 proximity sensor
- Audio feedback using two timer pulse-width modulator (TPM) modules

The main benefit from this solution is that developers are able to take any piece of hardware and/or software and reuse it for their own applications, thus enhancing the design cycle and providing faster development time.

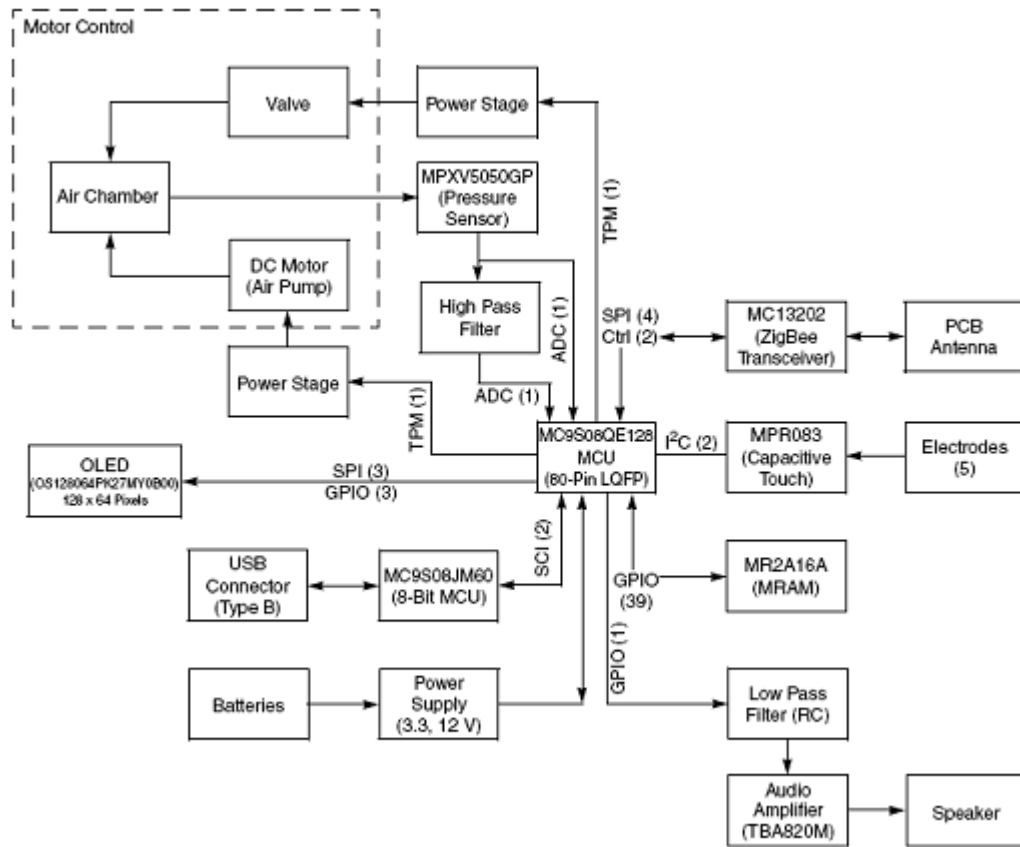


图 2.Flexis BPM 参考设计方框图

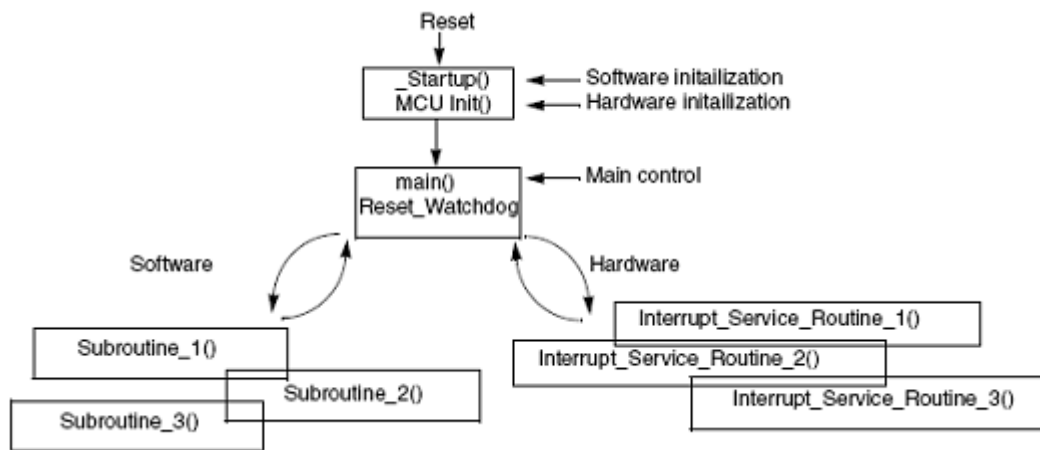


图 3.血压计软件架构流程图

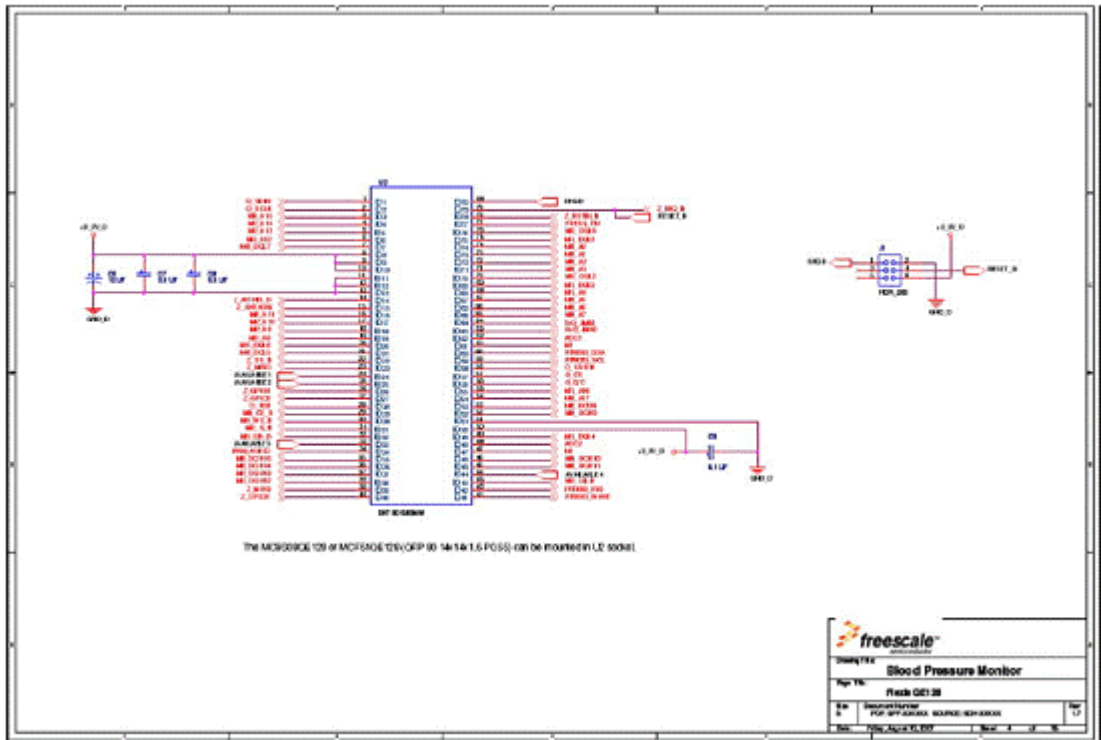


图 4.血压计参考设计电路图(1)

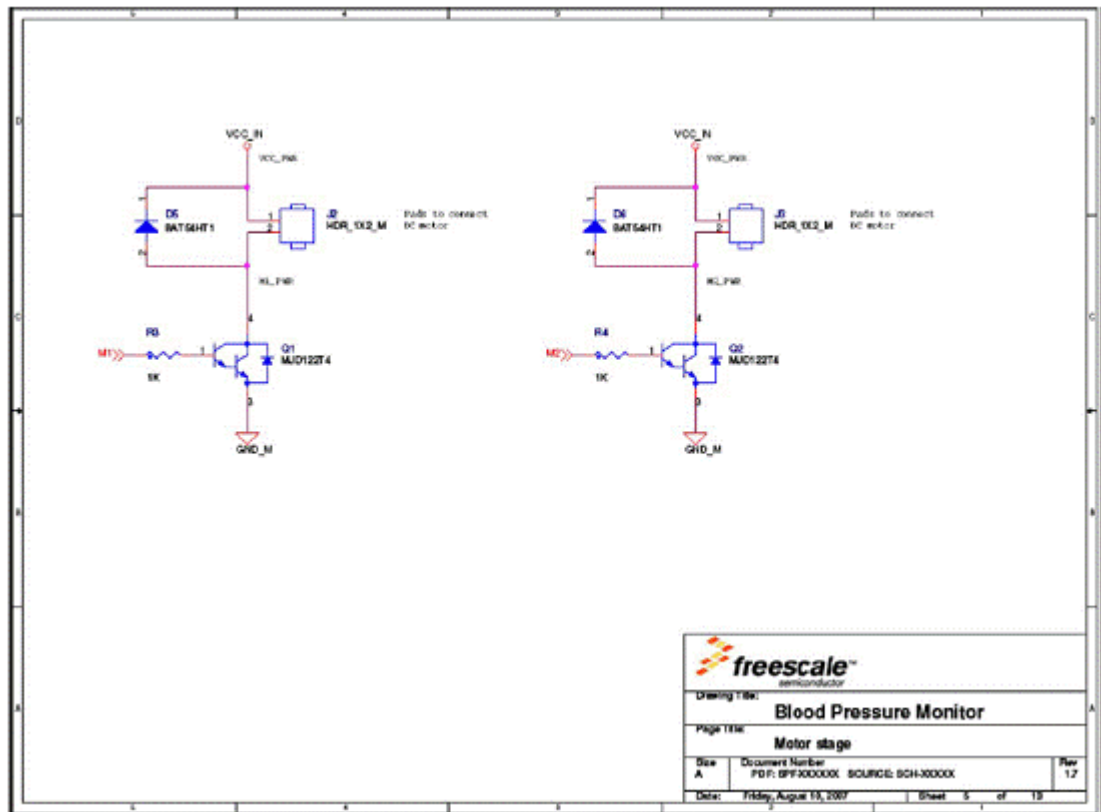


图 5.血压计参考设计电路图(2)

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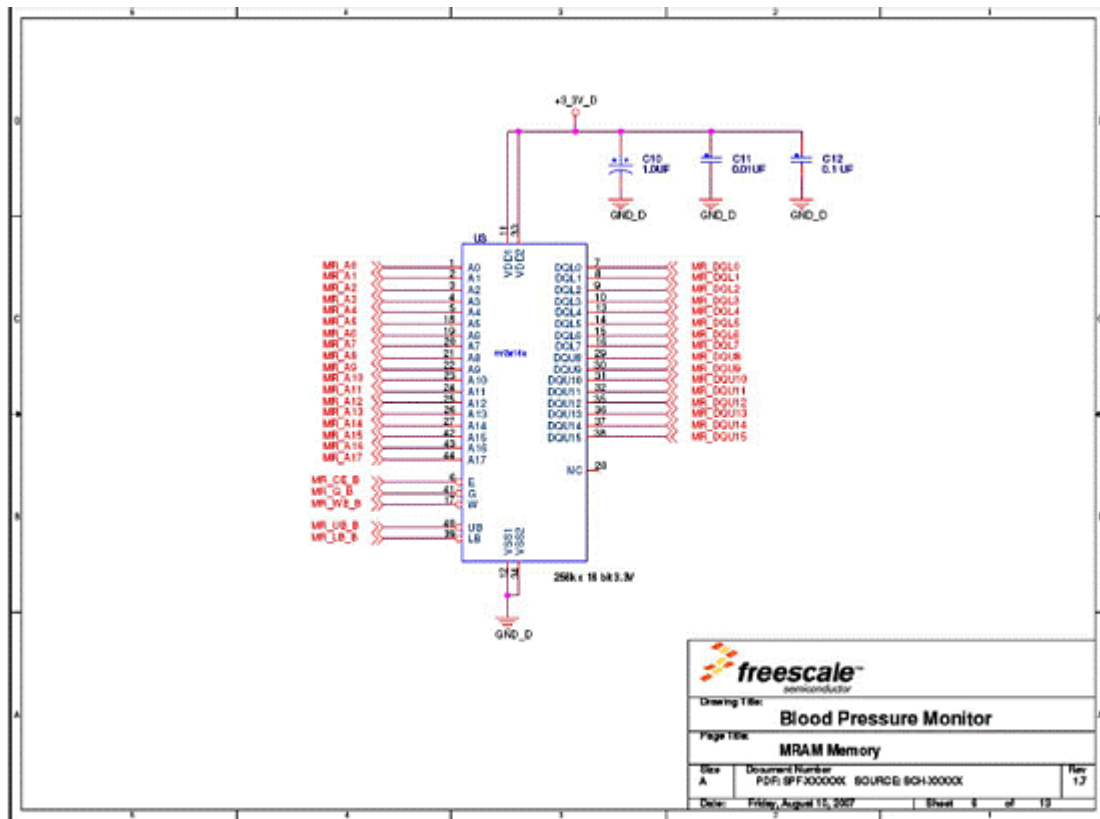


图 6.血压计参考设计电路图(3)

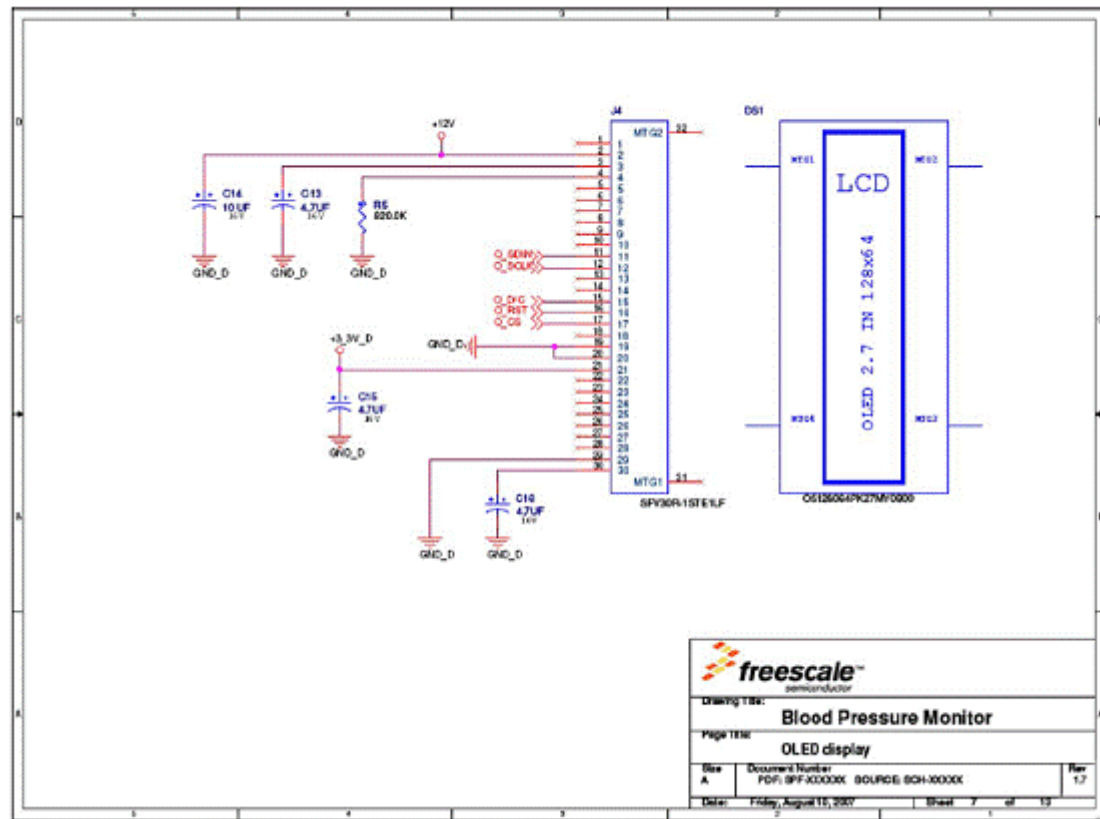


图 7.血压计参考设计电路图(4)

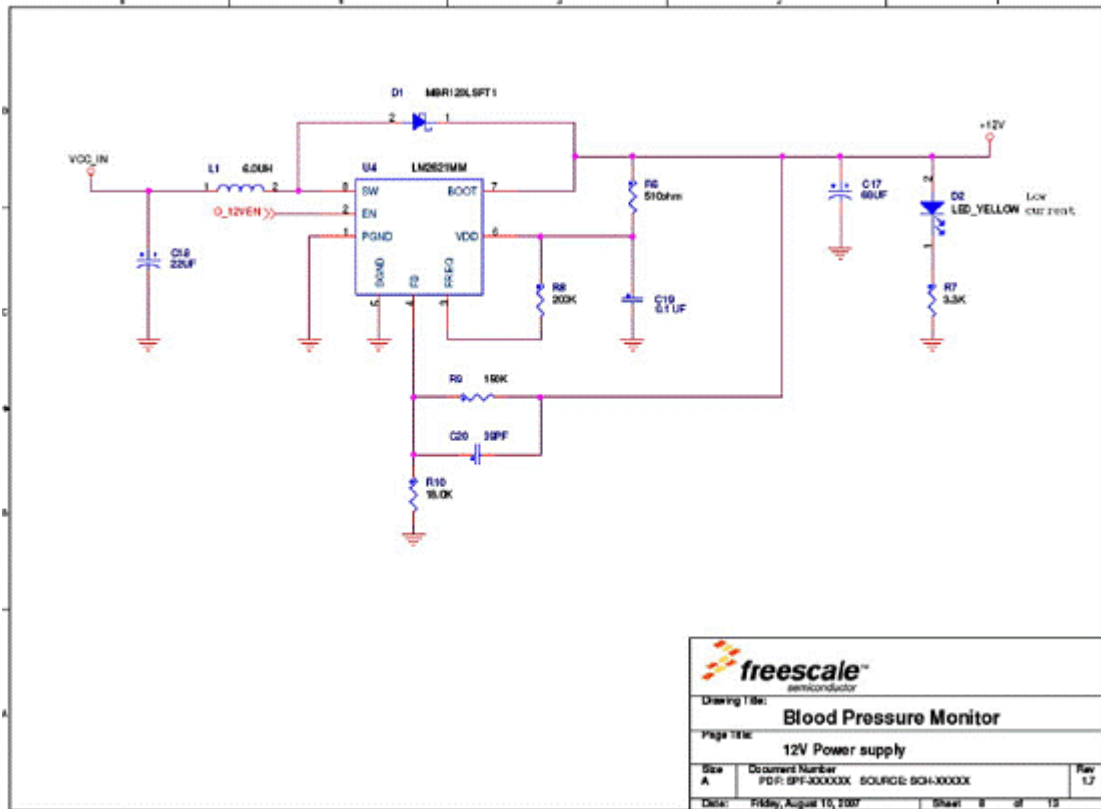


图 8.血压计参考设计电路图(5)

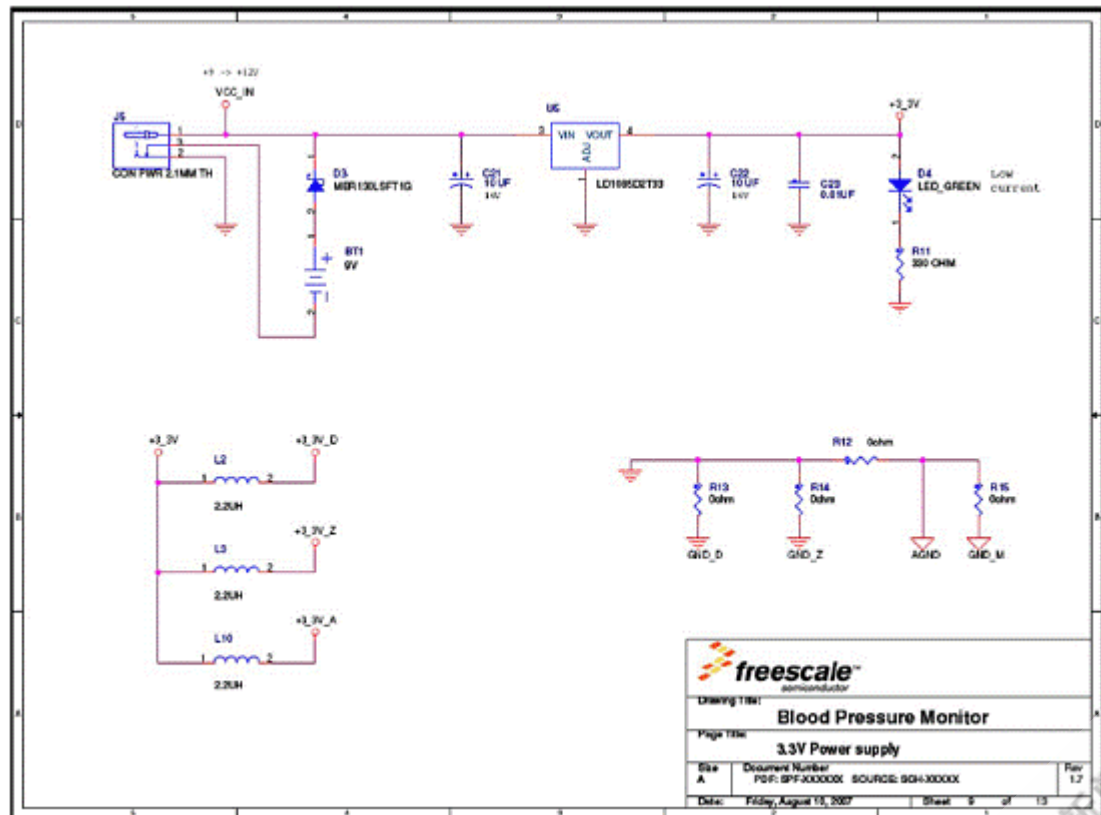


图 9.血压计参考设计电路图(6)

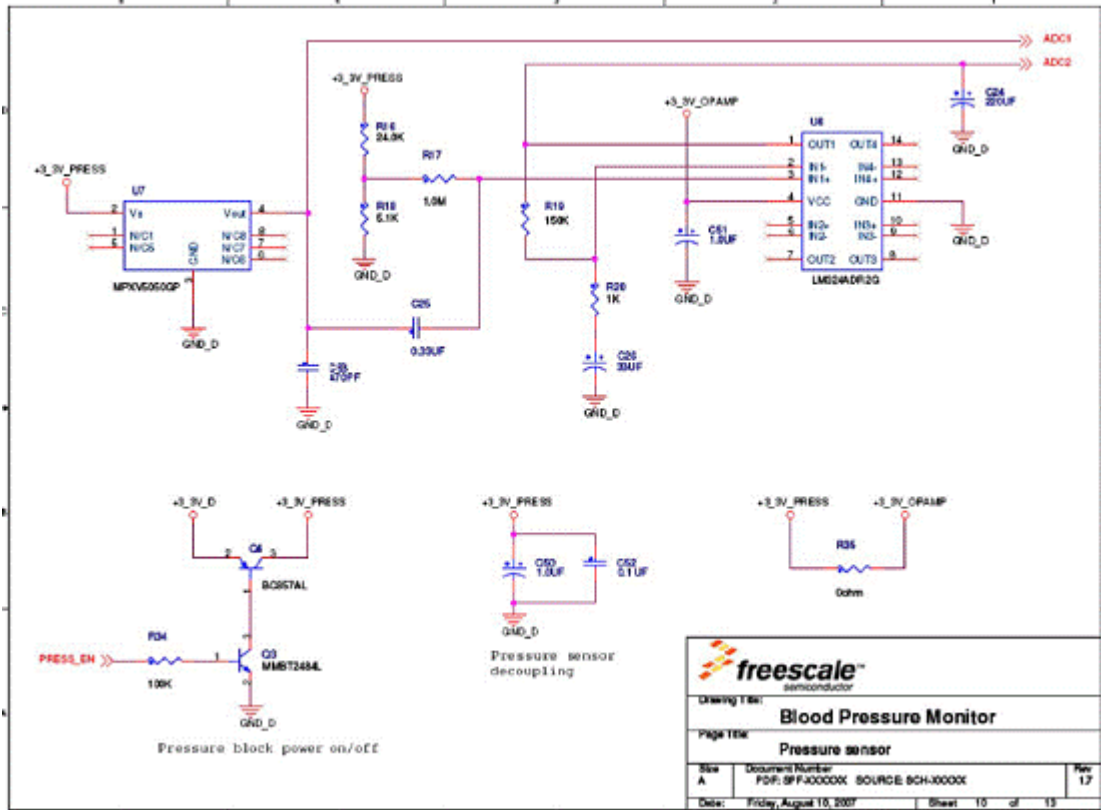


图 10.血压计参考设计电路图(7)

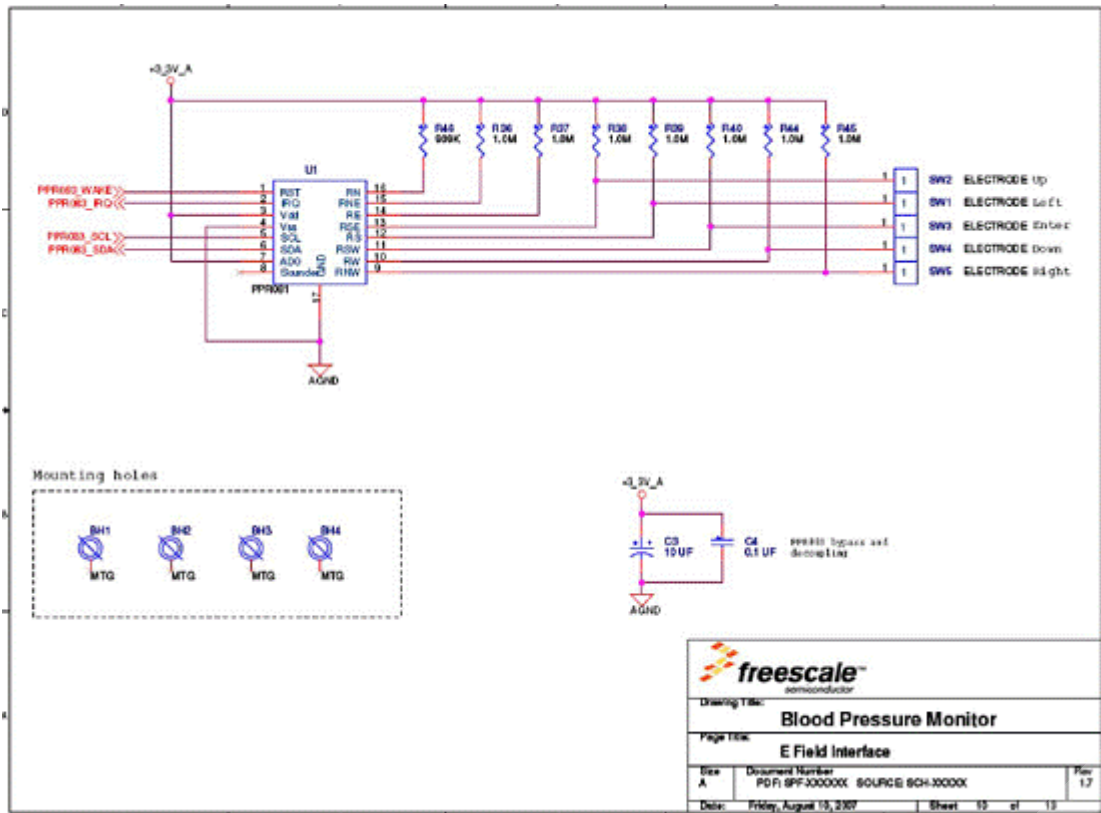


图 11.血压计参考设计电路图(8)

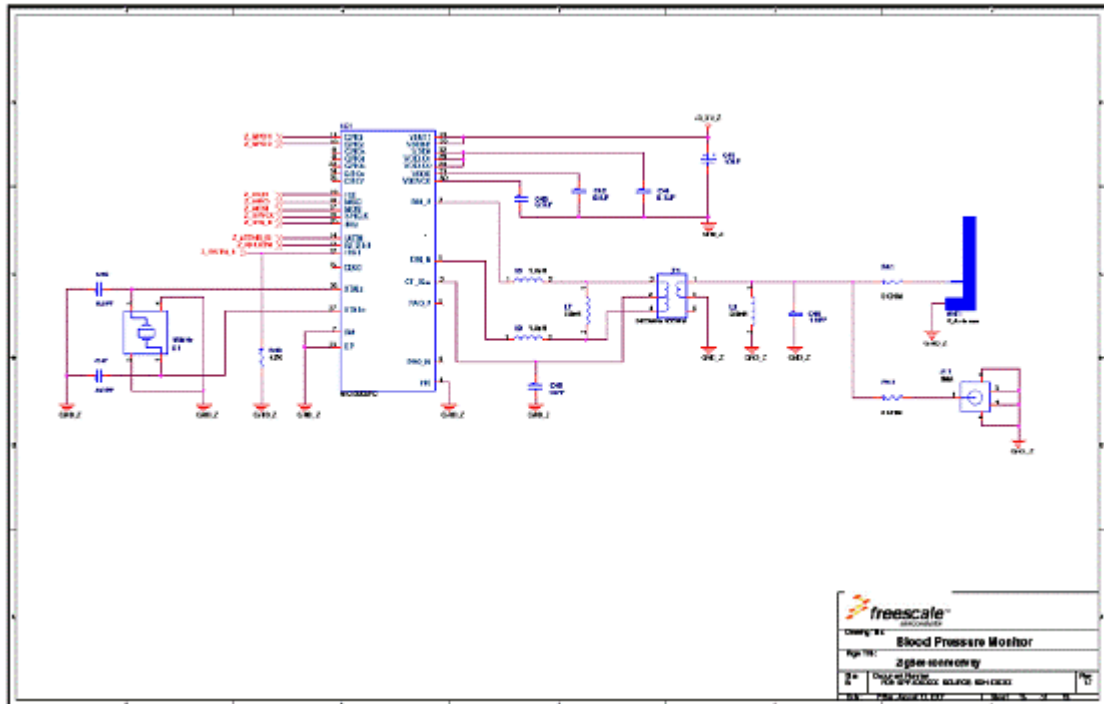


图 14.血压计参考设计电路图(11)

血压计参考设计材料清单(BOM):

QTY	Reference Designator	Value	Package	Description	Type
1	ANT1	F_Antenna	f_antena	PCB F Antenna for ZigBee	PCB
4	BH1, BH2, BH3, BH4	MTG	C280-130T	Mounting Hole 0.130 Inch	Oth
1	BT1	9 V	skt_bat_54x29mm_th	Holder Batt 9 V Univ Plastic PC	Oth
5	C3, C6, C14, C21, C22	10 μ F	CC3216	Cap Tant 10 μ F 16 V 20% SMD	Cap
10	C4, C7, C8, C9, C12, C19, C29, C31, C33, C52	0.1 μ F	CC0805	Cap 0.1 μ F 16 V Ceramic X7R 0805	Cap
4	C10, C41, C50, C51	1.0 μ F	3216-18	Capacitor Tant 1.0 μ F 16 V 20% SMD	Cap
2	C11, C23	0.01 μ F	CC0805	Cap 10000 pF 50 V Ceramic Chip 0805	Cap
3	C13, C15, C16	4.7 μ F	CC3216	Cap Tant 4.7 μ F 16 V 20% SMD	Cap
1	C17	68 μ F	CC7343-43	Cap Tant 68 μ F 16 V 10% Loesr SMD	Cap
1	C18	22 μ F	CC3216	Cap Tant 22 μ F 16 V 20% SMD	Cap
1	C20	39 pF	CC0805	Cap 39 pF 50 V Ceramic Chip 0805 SMD	Cap
2	C24, C37	220 μ F	cce63x55	Cap 220 μ F 16 V Elect MVE SMD	Cap
2	C25, C35	0.33 μ F	CC0805	Cap 0.33 μ F 16 V Ceramic X7R 0805	Cap
1	C26	33 μ F	CC3216	Cap Tant 33 μ F 6.3 V 20% SMD	Cap
2	C27, C28	22 pF	CC0805	Cap 22 pF 50 V Ceramic Chip 0805 SMD	Cap
2	C30, C49	4.7 μ F	CC2012-12	Cap Tant 4.7 μ F 10 V 20% SMD	Cap
3	C32, C34, C38	100 μ F	cce63x55	Cap 100 μ F 16 V Elect MVA SMD	Cap

QTY	Reference Designator	Value	Package	Description	Type
1	C36	220 pF	CC0805	Cap Ceramic 220 pF 50 V NP0 0805	Cap
1	C39	47 μ F	CCE63X57	Cap 47 μ F 16 V Elect MVE SMD	Cap
1	C40	0.22 μ F	CC0805	Cap Ceramic .22 μ F 50 V X7R 0805	Cap
3	C42, C43, C44	0.1 μ F	CC0603	Cap 0.1 μ F 50 V Ceramic Y5V 0603	Cap
2	C45, C47	8.0 pF	CC0603	Cap 8.0 pF 50 V Ceramic 0603 SMD	Cap
1	C46	1.0 pF	CC0402_25	Cap 1.0 pF 50 V Ceramic 0402 SMD	Cap
1	C48	10 pF	CC0402_25	Cap 10 pF 50 V Ceramic 0402 SMD	Cap
1	C53	470 pF	CC0603	Cap Ceramic 470 pF 50 V X7R 10% 0603	Cap
1	DS1	OS128064PK27MY0B00	os12806_4_th	Display OLED 128 X 64 2.7 Inch Yellow	Oth
1	D1	MBR120LSFT1	SOD-123	Diode Schottky 40 V 1 A SOD123	SC
1	D2	Yellow	LED_0603_C1	LED Amber SS Type Low Cur SMD	SC
1	D3	MBR130LSFT1G	SOD-123	Diode Schottky 30 V 1 A SOD123	SC
1	D4	Green	LED_0603_C1	LED Green SS Type Low Cur SMD	SC
2	D5, D6	BAT54HT1	SOD323	Diode Switch SW 75 V 500 mA SOT323	SC
1	F1	MFU0805FF00500P100	fuse_2x1p4	Fuse 0.50 A 0805 VFast SMD	Oth
1	IC1	MC13202FC	qfn32_5x5	IC TXRX RF 2.4 GHz 32-QFN	IC
2	J1, J7	HDR_2X3	HDR203	Conn Header 6 Pos 0.100 Inch Str Gold	Con
4	J2, J3, J9, J10	HDR_1X2_M	HDR102	Conn Header 2 Pos 0.100 Inch Str Tin	Con
1	J4	SFV30R-1STE1LF	con_30_sm_ra	Conn FPC/FFC 30 Pos .5 mm R/A SMD	Con
1	J5	CON PWR 2.1MM TH	PJ-202B	Conn Pwr Jack 2.1 X 5.5 mm High Cur	Con
1	J6	USB_TYPE_B	CON_USB_RA	Conn USB Rt Ang Recpt Type B	Con

QTY	Reference Designator	Value	Package	Description	Type
1	J8	MJ1-3510-SMT	con3_jack_5x15_sm	Conn Jack Mono 3 Pos 3.5 mm SMD	Con
1	J11	SMA	CON_SMA_8363	Conn Sma Jack Straight PCB	Con
1	L1	6.0 μ H	IND_CDRH6D28	Power Inductor 6.0 μ H 2.25 A SMD	Ind
3	L2, L3, L10	2.2 μ H	ind_2016	Inductor 2.2 μ H 20% 0806 SMD	Ind
2	L4, L5	HI1812V101R-10	IND_ISC_1812	Ferrite 8 A 125 Ω 1812 SMD	Ind
2	L6, L9	1.8 nH	ind_0402	Inductor HI Freq 1.8 \pm 0.3 nH 0402	Ind
2	L7, L8	3.9 nH	IND_0402	Inductor HI Freq 3.9 \pm 0.3 nH	Ind
2	Q1, Q2	MJD122T4	DPAK	Trans Darl NPN 100 V 5 A DPAK	SC
1	Q3	MMBT2494L	SOT23	Trans GP SS NPN 30 V LN SOT23	SC
1	Q4	BC857AL	SOT23	Trans GP SS PNP LN 50 V SOT23	SC
3	R3, R4, R20	1 k	RC0805	Res 1.00 k Ω 1/8 W 1% 0805 SMD	Res
1	R5	820.0 k	RC0805	Res 820 k Ω 1/8 W 1% 0805 SMD	Res
1	R6	510 Ω	RC1206	Res 510 Ω 1/4 W 1% 1206 SMD	Res
1	R7	3.3 k	RC0805	Res 3.30 K Ω 1/8 W 1% 0805 SMD	Res
1	R8	200 k	RC0805	Res 200 k Ω 1/8 W 1% 0805 SMD	Res
2	R9, R19	150 k	RC0805	Res 150 k Ω 1/8 W 1% 0805 SMD	Res
1	R10	18.0 k	RC0805	Res 18.0 k Ω 1/8 W 1% 0805 SMD	Res
1	R11	330 Ω	RC0805	Res 330 Ω 1/8 W 1% 0805 SMD	Res
6	R12, R13, R14, R15, R33, R35	0 Ω	RC0805	Res 0.0 Ω 1/8 W 5% 0805 SMD	Res
1	R16	24.0 k	RC0805	Res 24.0 k Ω 1/8 W 1% 0805 SMD	Res
2	R17, R21	1.0 M	RC0805	Res 1.00 M Ω 1/8 W 1% 0805 SMD	Res

QTY	Reference Designator	Value	Package	Description	Type
1	R18	5.1 k	RC0805	Res 5.10 k Ω 1/8 W 1% 0805 SMD	Res
1	R22	1.5 k	RC0805	Res 1.50 k Ω 1/8 W 1% 0805 SMD	Res
2	R23, R24	33 Ω	RC0803	Res 33.0 Ω 1/10 W 1% 0603 SMD	Res
1	R25	56.2 Ω	RC0805	Res 56.2 Ω 1/8 W 1% 0805 SMD	Res
1	R26	5.0 k	pot3_3296y	Pot 5.0 k Ω Thumbwheel Ceramic ST	Res
1	R27	309.0 Ω	RC0805	Res 309 Ω 1/8 W 1% 0805 SMD	Res
1	R28	10 k	RC0805	Res 10.0 k Ω 1/8 W 1% 0805 SMD	Res
1	R29	120 Ω	RC0805	Res 120 Ω 1/8 W 1% 0805 SMD	Res
1	R30	1.0 Ω	RC1210	Res Anti-Surge 1.0 Ω 5% 1210	Res
3	R31, R32, R43	4.7 k	RC0805	Res 4.70 k Ω 1/8 W 1% 0805 SMD	Res
1	R34	100 k	RC0805	Res 100 k Ω 1/8 W 1% 0805 SMD	Res
7	R36, R37, R38, R39, R40, R44, R45	1.0 M	RC0603	Res 1.00 M Ω 1/10 W 1% 0603 SMD	Res
1	R41, R42	0 Ω	RC0603	Res 0.0 Ω 1/10 W 5% 0603 SMD	Res
1	R46	909 k	RC0603	Res 909 k Ω 1/10 W 1% 0603 SMD	Res
5	SW1, SW2, SW3, SW4, SW5	Electrode	e_button	Electrode Square 1 cm	Btn
1	U1	PPR081	qfn16_8mm		IC
1	U2	QFP SOCKET80_0.65MM	QFP80_PSOC_65MM_EN P	Con 80 Skt Th 0.65 mm Sp Au	Con
1	U2	MC9S08QE128CLK	qfp80_sq	IC MCU 8-Bit 3.3-5 V LQFP80	IC
1	U2	MCF51QE128CLK	qfp80_sq	IC MCU 32-Bit 3.3-5 V LQFP80	IC
1	U3	25 6k x 16-bit 3.3 V	tsop44_t2	IC Mem MRAM 256 K X 16 35 nS Async 3.3 V TSSOP44	IC

QTY	Reference Designator	Value	Package	Description	Type
1	U4	LM2621MM	so8_umax	IC Low Input Step-Up DC-DC8-MSOP	IC
1	U5	LD1085D2T33	d2pak	IC LDO Positive Reg 3.3 V D2PAK	IC
1	U6	LM324ADR2G	solc14	IC Opamp Quad Low Power 14SOIC	IC
1	U7	MPXV5050GP	8PINS_2p54_SM	IC Press Sensor 0-50 kPa 5 V Case 1369-01	IC
1	U9	TBA820M	pdip8_300	IC Audio Amp 1.2 W 8-Dip	IC
1	U10	MC9S08JM60CFGE	tqfp44	IC MCU 8-Bit 60K Flash 2.7-5.5V LQFP44	IC
1	X1	16 MHz	xtal3_2x2_5mm_4p	Crystal 16.000000 MHz SMD 8 pF	Xtal
1	Y1	12 MHz	XTL2_HCM49	Crystal 12.000 MHz 18 pF Fund SMD	Xtal
1	Z1	2400 MHz 50Ω	XFMR_HHM1525_2x1_25mm_6P	Cer Microwave Filter 2.4 MHz 50 Ω BalunmFmF	Xtal