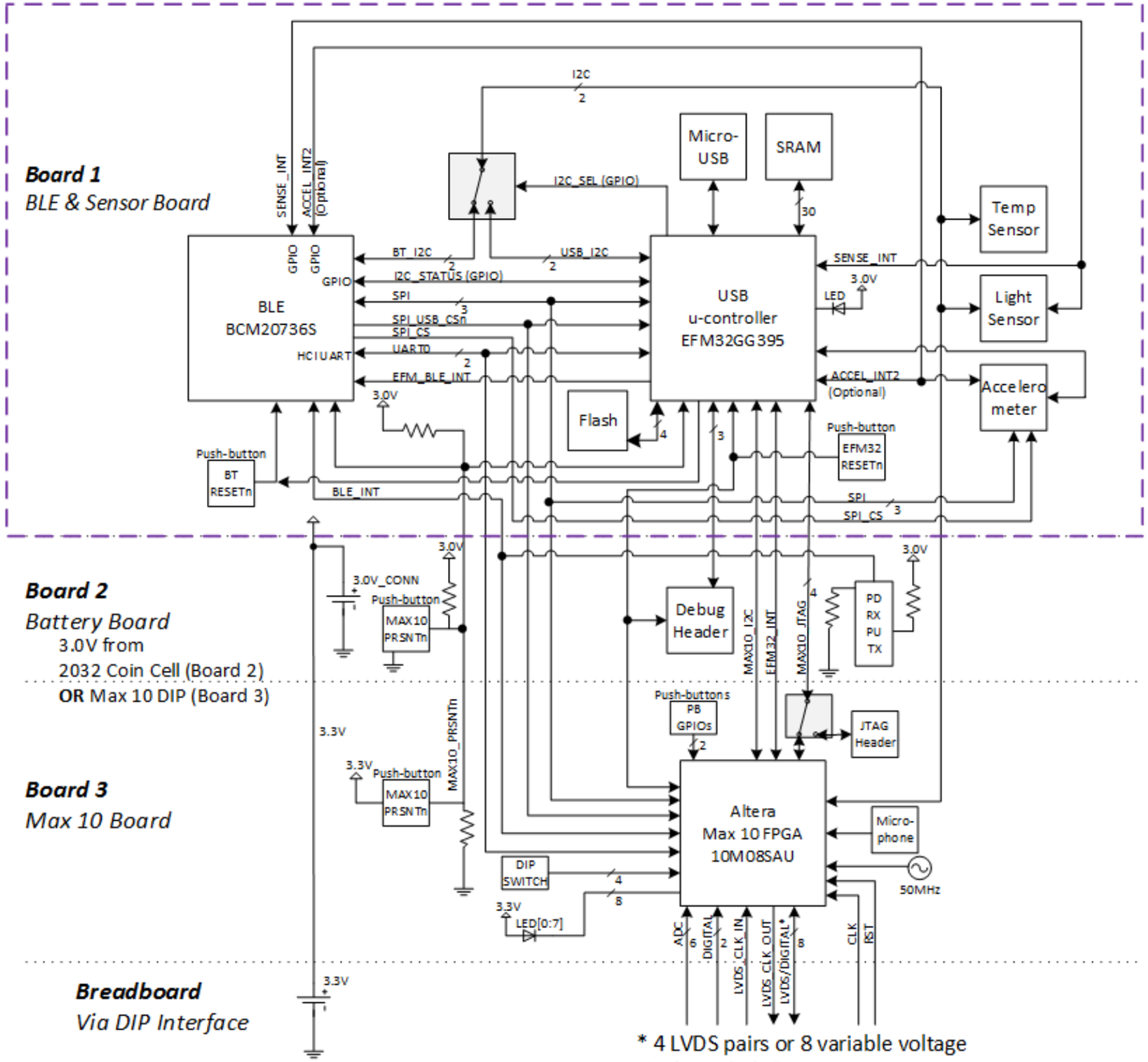
IoT Development Kit
BLE and Sensor board

This schematic is "Board 1" of the complete demonstration board, shown in the block diagram below.

REV	DATE	PAGES	DESCRIPTION
C1	09/18/2014	1	Change J2 pinout so that the mating connector on the Battery or Max 10 board will have pin 1 at the notch, instead of pin 2.
C2	10/24/2014	4-5	BOM update to change R5, R7, R13, and R15 to 4.7K-ohm resistors.

PAGE	DESCRIPTION
1	Title, Notes, Block Diagram, Rev. History
2	Power & Connector
3	USB
4	Bluetooth
5	Sensors



* 4 LVDS pairs or 8 variable voltage single-ended IOs

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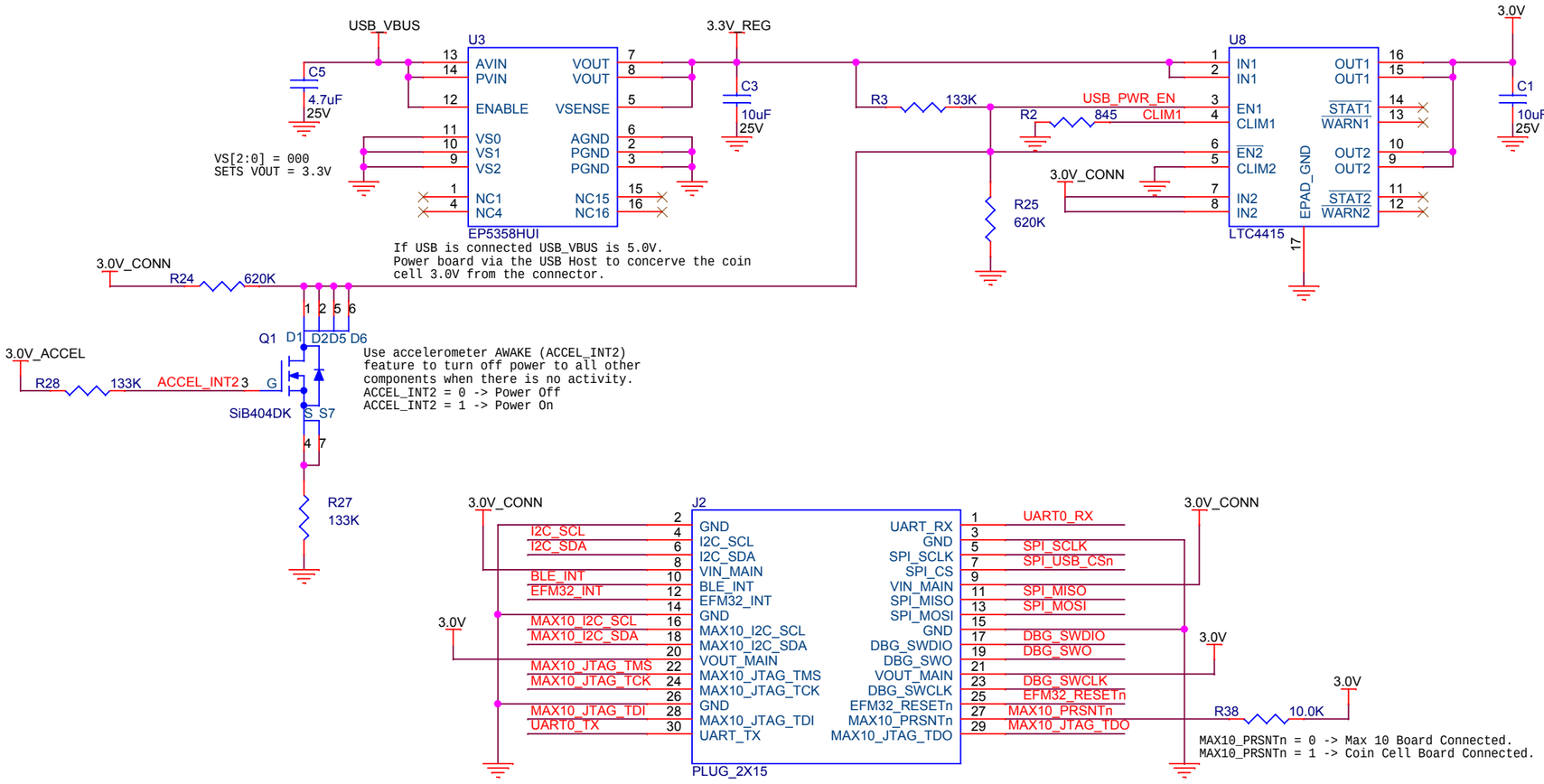
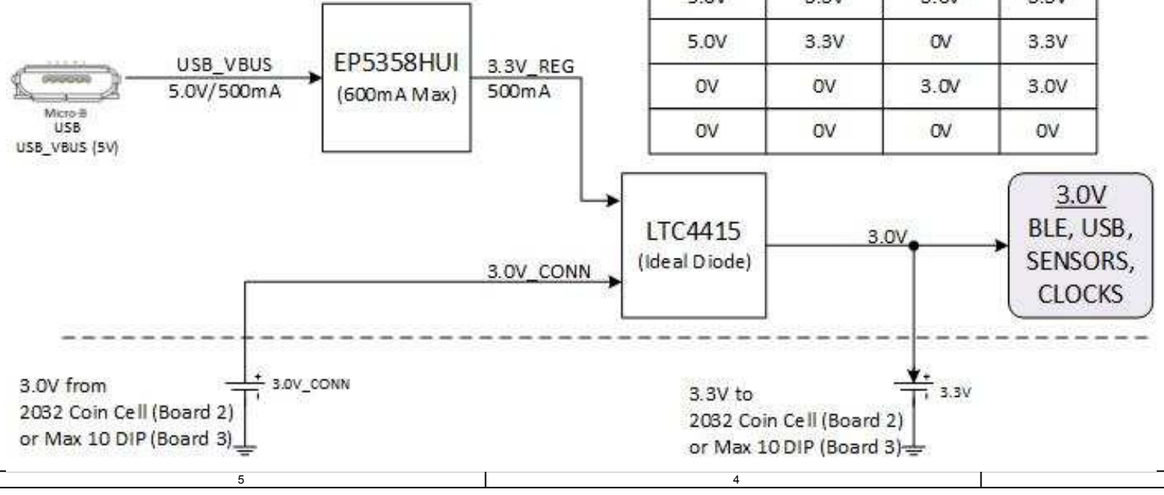
Power & Connector





USB_VBUS	3.3V_REG	3.0V_CONN	3.0V
5.0V	3.3V	3.0V	3.3V
5.0V	3.3V	0V	3.3V
0V	0V	3.0V	3.0V
0V	0V	0V	0V

MH1 MH_SPACER
MH2 MH_SPACER
MH3 MH_SPACER
MH4 MH_SPACER

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USB

EFM32 USB
SiLabs AN0046 - USB data pair should be routed as diff 90-ohm
SiLabs AN0002 - Hardware Design Considerations
SiLabs AN0016 - Oscillator Design Considerations

LAYOUT NOTES:
USB Data lines should be routed as 90-ohm differential pairs:
D_P/D_N, USB_D_P/USB_D_N
Match the USB data P/N within +/-10 mils.
Place 15-ohm series resistors near EFM32GG395
Place VBUS ferrite bead and 0.1uF capacitor near USB connector.

U6A
I/O
EFM32GG395

EBI_A1	C2	PA0/EBI_AD09 (2)	
EBI_A2	C1	PA1/EBI_AD10 (2)	
EBI_A3	D2	PA2/EBI_AD11 (2)	
EBI_A4	D1	PA3/EBI_AD12 (2)	
EBI_A5	E3	PA4/EBI_AD13 (2)	
EBI_A6	E2	PA5/EBI_AD14 (2)	
EBI_A7	E1	PA6/EBI_AD15 (2)	
	L3	PA7	
	M3	PA8	
SENSE_PULSE_SEL	N3	PA9/GPIO	
	M4	PA10	
	N4	PA11	
	N5	PA12	
	M5	PA13	
	M6	PA14	
EBI_A0	B1	PA15/EBI_AD08 (2)	
EBI_A16	F1	PB0/EBI_A16 (2)	
EBI_A17	F2	PB1/EBI_A17 (2)	
EBI_A18	F3	PB2/EBI_A18 (2)	
FLASH_SPI_MOSI	G1	PB3/US2_TX (1)	
FLASH_SPI_MISO	G2	PB4/US2_RX (1)	
FLASH_SPI_CLK	H1	PB5/US2_CLK (1)	
FLASH_SPI_CSn	H2	PB6/US2_CS (1)	
	M1	PB7/LFXTAL_P	
	N1	PB8/LFXO_N	
	L8	PB9	
MAX10_I2C_SDA	L9	PB10	
MAX10_I2C_SCL	N6	PB11/I2C1_SDA (1)	
HFXTAL_P	N7	PB12/I2C1_SCL (1)	
HFXTAL_N	N9	PB13/HFXO_P	
	N10	PB14/HFXO_N	
	D3	PB15	
I2C_STATUS	K1	PC0/GPIO	
I2C_SEL	K2	PC1/GPIO	
MAX10_PRSNTn	L1	PC2/GPIO	
SENSE_INT	L2	PC3/GPIO	
ACCEL_INT1	M2	PC4/GPIO	
ACCEL_INT2	N2	PC5/GPIO	
USB_I2C_SDA	J12	PC6/I2C0_SDA (2)	
USB_I2C_SCL	H13	PC7/I2C0_SCL (2)	
EBI_A15	F12	PC8/EBI_A15 (2)	
EBI_A9	F13	PC9/EBI_A09 (2)	
EBI_A10	E12	PC10/EBI_A10 (2)	
	E13	PC11	
EFM_BLE_INT	D12	PC12/GPIO	
EFM32_INT	D13	PC13/GPIO	
	C12	PC14	
	C13	PC15	
	L10	PD0/US1_TX (1)	SPI_MOSI
	L11	PD1/US1_RX (1)	SPI_MISO
	N12	PD2/US1_CLK (1)	SPI_SCLK
	M12	PD3/US1_CS (1)	SPI_USB_CSn
	L12	PD4	
	N13	PD5/GPIO	MAX10_JTAG_TCK
	M13	PD6/GPIO	MAX10_JTAG_TMS
	L13	PD7/GPIO	MAX10_JTAG_TDI
	K13	PD8/GPIO	MAX10_JTAG_TDO
	A6	PD9/EBI_CS0 (2)	EBI_CS0n
	B6	PD10	
	A5	PD11	
	B5	PD12	
	C4	PD13	
	J1	PD14	
	J2	PD15	
	G11	PE0	
EBI_A8	G12	PE1/EBI_A08 (2)	
	H12	PE2	
LED	G13	PE3/GPIO	
EBI_A11	C11	PE4/EBI_A11 (2)	
EBI_A12	D11	PE5/EBI_A12 (2)	
EBI_A13	E11	PE6/EBI_A13 (2)	
EBI_A14	F11	PE7/EBI_A14 (2)	
EBI_DATA0	B4	PE8/EBI_AD00 (2)	
EBI_DATA1	A4	PE9/EBI_AD01 (2)	
EBI_DATA2	C3	PE10/EBI_AD02 (2)	
EBI_DATA3	B3	PE11/EBI_AD03 (2)	
EBI_DATA4	A3	PE12/EBI_AD04 (2)	
EBI_DATA5	B2	PE13/EBI_AD05 (2)	
EBI_DATA6	A2	PE14/EBI_AD06 (2)	
EBI_DATA7	A1	PE15/EBI_AD07 (2)	
DBG_SWCLK	C10	PF0/DBG_SWCLK (0)	
DBG_SWDIO	B10	PF1/DBG_SWDIO (0)	
DBG_SWO	A10	PF2/DBG_SWO (0)	
	B9	PF3	
EBI_WEn	A9	PF4/EBI_WEn (2)	
EBI_REn	A8	PF5/EBI_REn (2)	
UART0_RX	B8	PF6/U0_TX (0)	
UART0_TX	A7	PF7/U0_RX (0)	
	B7	PF8	
	C7	PF9	
USB_TERM_D_N	B13	PF10/USB_DM	
USB_TERM_D_P	A13	PF11/USB_DP	
BT_RESETn	B11	PF12/GPIO	
EFM32_RESETn	M7	RESETn	

3.0V
R21 10.0K

J1
USB Micro-B
VBUS
D-
D+
ID
GND

USB_VBUS
L1 BEAD
C6 0.1uF 25V
VBUS
USB_D_N
USB_D_P
USB_ID R33 DNI

ID connectivity:
Host -> Connect to GND
Device -> Not Connected

D2
82400152
USB_D_N
USB_D_P

3.0V
D1 GREEN LED
R22 39.00

U6B
POWER

3.0V_IOVDD	H11	VDD_DREG	
		IOVDD_0	C6
		IOVDD_1	C9
		IOVDD_2	G3
		IOVDD_3	J11
		IOVDD_4	K3
		IOVDD_5	L4
		IOVDD_6	L7
USB_VREGO	A12	USB_VREGO	
USB_VBUS	A11	USB_VREGI	
	B12	USB_VBUS	
		DECOUPLE	J13
3.0V_AVDD	N11	AVDD_0	
	M10	AVDD_1	
	M9	AVDD_2	
	M11	AVSS_0	
	M8	AVSS_1	
	N8	AVSS_2	
		VSS	C5
		VSS	C8
		VSS	H3
		VSS	J3
		VSS	K11
		VSS	K12
		VSS	L5
		VSS	L6

C17 1uF 16V
C14 4.7uF 25V
C30 1uF 16V

3.0V_IOVDD
Place near EFM32GG395 IOVDDx and VDD_DREG pins.
C18 10uF 25V
C24 C23 C22 C27 C28 C19 C29 C21 0.1uF 25V

3.0V_AVDD
Place near EFM32GG395 AVDDx pins.
C33 10uF 25V
C31 C35 10nF 25V
C32 10nF 25V

U10
VDD CLK_OUT GND GND
32.768KHz
LFXTAL_N

Y2
48MHz
C34 16pF 50V
C26 16pF 50V

I2C support for
10Kbit/sec - 1Mbit/sec.

Would like to go to a dedicated debug header, but there is no space. Header on coin cell board.

R8 15.00 USB_D_N
R6 15.00 USB_D_P

3.0V
R40 10.0K
S2
PB-SPST-NO

3.0V
L2 BEAD
R34 1
R39 1
3.0V_IOVDD
3.0V_AVDD

U2
CY62148EV30

C12 0.1uF 25V	D6	VCC	
C11 0.1uF 25V	E1	VCC	
EBI_A0	A1	A0	
EBI_A1	A2	A1	
EBI_A2	B2	A2	
EBI_A3	A4	A3	
EBI_A4	B4	A4	
EBI_A5	C4	A5	
EBI_A6	A5	A6	
EBI_A7	B5	A7	
EBI_A8	A6	A8	
EBI_A9	H1	A9	
EBI_A10	H2	A10	
EBI_A11	H3	A11	
EBI_A12	H4	A12	
EBI_A13	H5	A13	
EBI_A14	H6	A14	
EBI_A15	G5	A15	
EBI_A16	G4	A16	
EBI_A17	F4	A17	
EBI_A18	F3	A18	
	B6	IO0	EBI_DATA0
	C6	IO1	EBI_DATA1
	F6	IO2	EBI_DATA2
	G6	IO3	EBI_DATA3
	B1	IO4	EBI_DATA4
	C1	IO5	EBI_DATA5
	F1	IO6	EBI_DATA6
	G1	IO7	EBI_DATA7
	A3	NC1	
	C3	NC2	
R23 10.0K EBI_CS0n	G3	CE	
EBI_REn	G2	OE	
EBI_WEn	B3	WE	
	D1	VSS	
	E6	VSS	

3.0V
C8 0.1uF 25V

U9
M25PX16_SO8

FLASH_SPI_MOSI	5	DQ0	
		VCC	8
FLASH_SPI_MISO	2	DQ1	
R20 10.0K FLASH_SPI_CSn	1	CS#	
R18 10.0K FLASH_Wn	3	W#/VPP	
R14 10.0K FLASH_HOLDn	7	HOLD#	
FLASH_SPI_CLK	6	CLK	
	4	VSS	

SENSE_INT 4,5
ACCEL_INT1 5
ACCEL_INT2 2,4,5
EFM32_RESETn 2
BT_RESETn 4
SPI_SCLK 2,4,5
SPI_USB_CSn 2,4,5
SPI_MOSI 2,4,5
SPI_MISO 2,4,5
EFM_BLE_INT 4
EFM32_INT 2
MAX10_I2C_SCL 2
MAX10_I2C_SDA 2
DBG_SWCLK 2
DBG_SWDIO 2
DBG_SWO 2
UART0_TX 2,4
UART0_RX 2,4
USB_I2C_SCL 5
USB_I2C_SDA 5
I2C_SEL 5
I2C_STATUS 4
MAX10_JTAG_TCK 2
MAX10_JTAG_TMS 2
MAX10_JTAG_TDI 2
MAX10_JTAG_TDO 2
MAX10_PRSNTn 2,4
SENSE_PULSE_SEL 5

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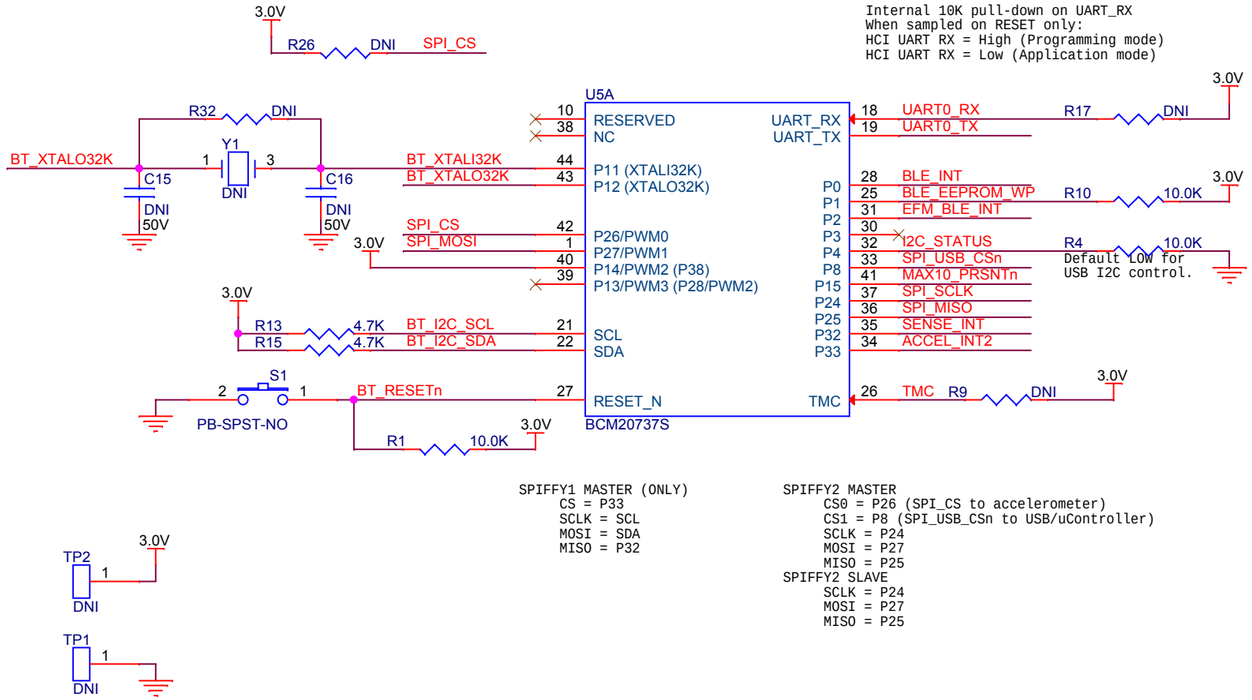
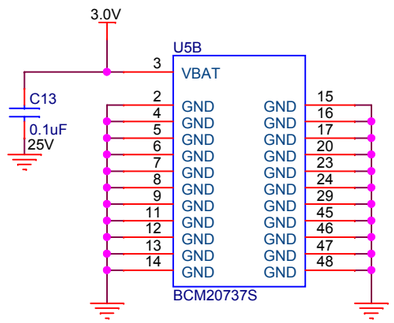
Bluetooth





BT_RESETn 3

BT_I2C_SCL 5
BT_I2C_SDA 5

I2C_STATUS 3

SPI_SCLK 2,3,5
SPI_CS 5
SPI_USB_CSn 2,3,5
SPI_MOSI 2,3,5
SPI_MISO 2,3,5

UART0_RX 2,3
UART0_TX 2,3

EFM_BLE_INT 3
BLE_INT 2

MAX10_PRSNTn 2,3

SENSE_INT 3,5
ACCEL_INT2 2,3,5

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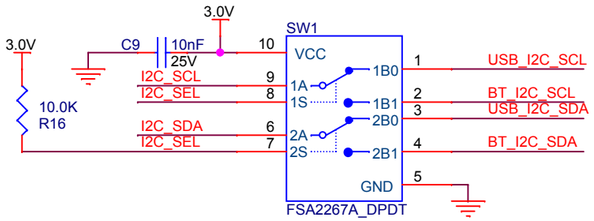
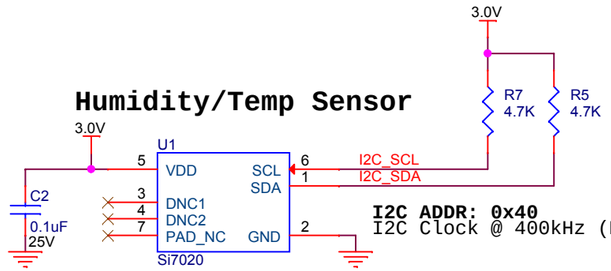
Sensors



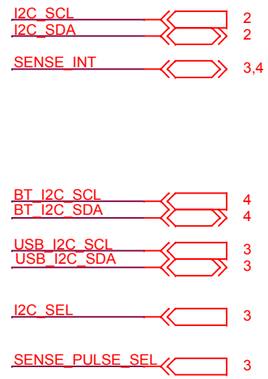

```
ISC_SEL = 0 -> Connect A to B0 (USB I2C)
ISC_SEL = 1 -> Connect A to B1 (BT I2C)
```

Humidity/Temp Sensor

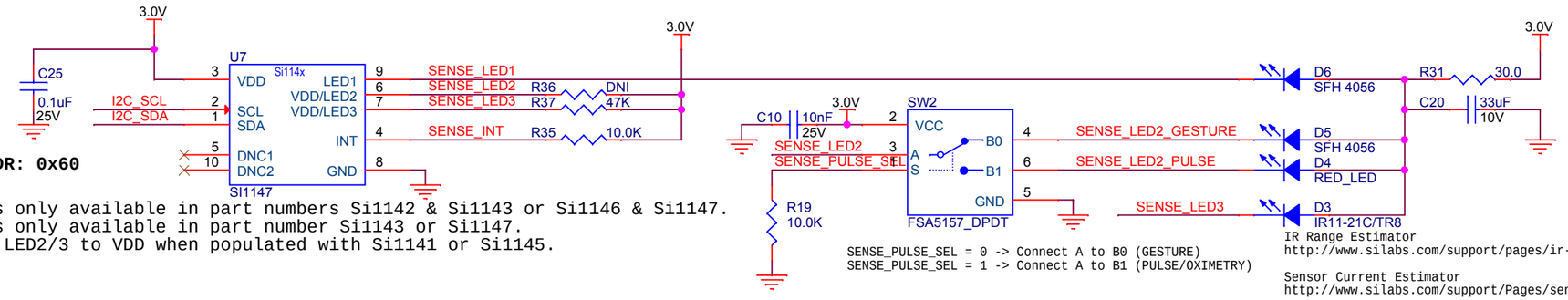


I2C ADDR: 0x40
I2C Clock @ 400kHz (Maximum)

LAYOUT NOTE:
DNC should be left floating or tied to VDD. (Solder to pads on PCB.)
PAD_NC should be electrically floating. (Solder to pads on PCB.)



Proximity/UV/Amb Light Sensor



I2C ADDR: 0x60

LED2 is only available in part numbers Si1142 & Si1143 or Si1146 & Si1147.
LED3 is only available in part number Si1143 or Si1147.
Tie to LED2/3 to VDD when populated with Si1141 or Si1145.

```
SENSE_PULSE_SEL = 0 -> Connect A to B0 (GESTURE)
SENSE_PULSE_SEL = 1 -> Connect A to B1 (PULSE/OXIMETRY)
```

IR Range Estimator
http://www.silabs.com/support/pages/ir-range-estimator.aspx

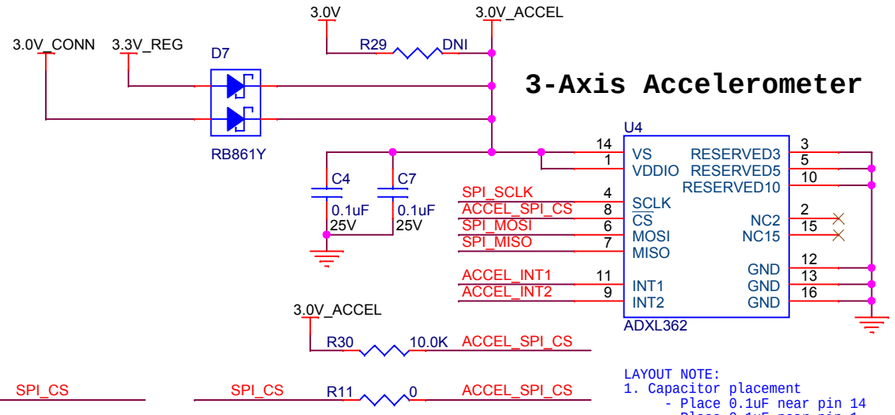
Sensor Current Estimator
http://www.silabs.com/support/Pages/sensor-current-estimator.aspx

Populate o-ring when SENSE_LED3 is installed.

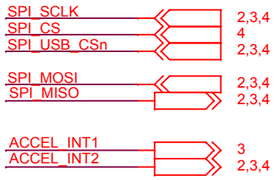
Si1147 Default - SENSE_PULSE_SEL = 0
Gesture functionality - 2 IR LEDs (SFH 4056-NQ) spaced as far away as possible. (D4 and D5) -
HRM functionality - 1 IR LED (IR11-21C/TR8) (D6) placed as close as possible. (D3)

Si1147 Optional Control - SENSE_PULSE_SEL = 1
Pulse/Ox - 1 0805 RED LED (new LED, doesn't exist on Rev A) and 1 IrLED placed as close as possible to each other and to the sensor.

3-Axis Accelerometer



LAYOUT NOTE:
1. Capacitor placement
   - Place 0.1uF near pin 14
   - Place 0.1uF near pin 1



By default the BLE masters the ADI SPI. Populate 0-ohm resistor to allow the uController to master the ADI SPI.

Remove 0-ohm resistor to allow a device other than the accelerometer to be the slave on the SPI chain.

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