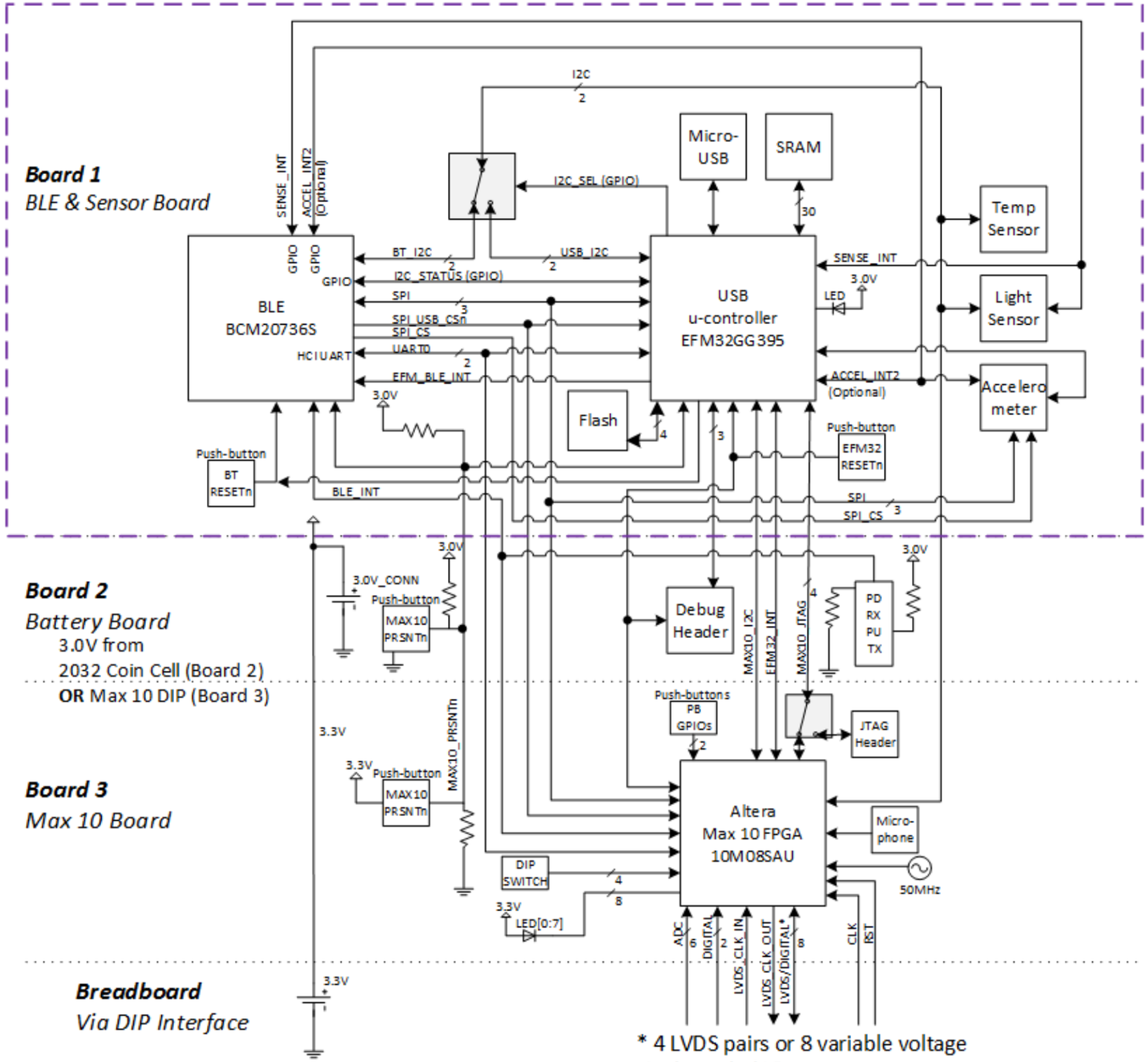
IoT Development Kit
BLE and Sensor board

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.
C3	06/18/2015	5	Update LED reference designator numbers in the notes describing the use cases with the Si1147.

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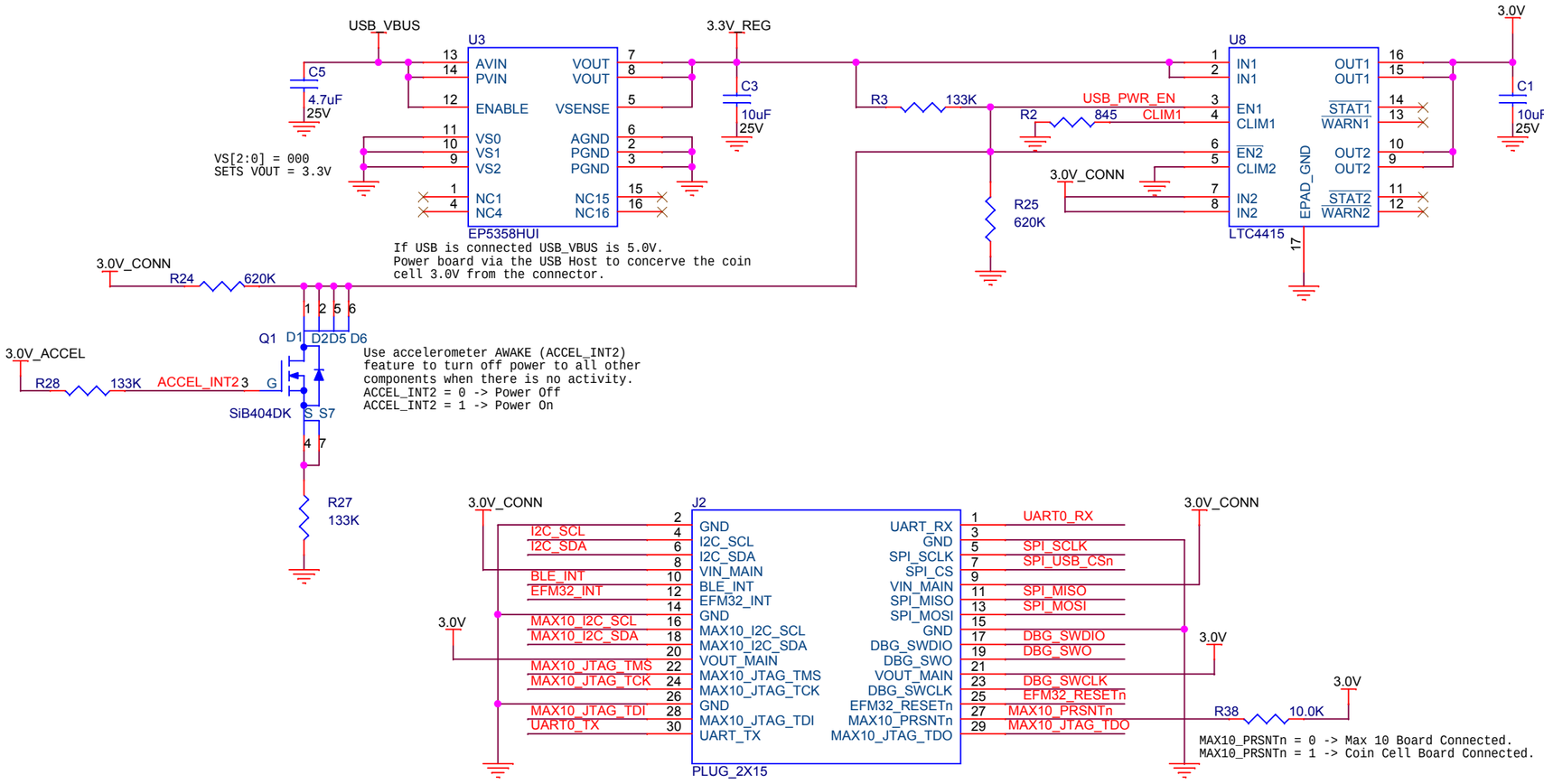
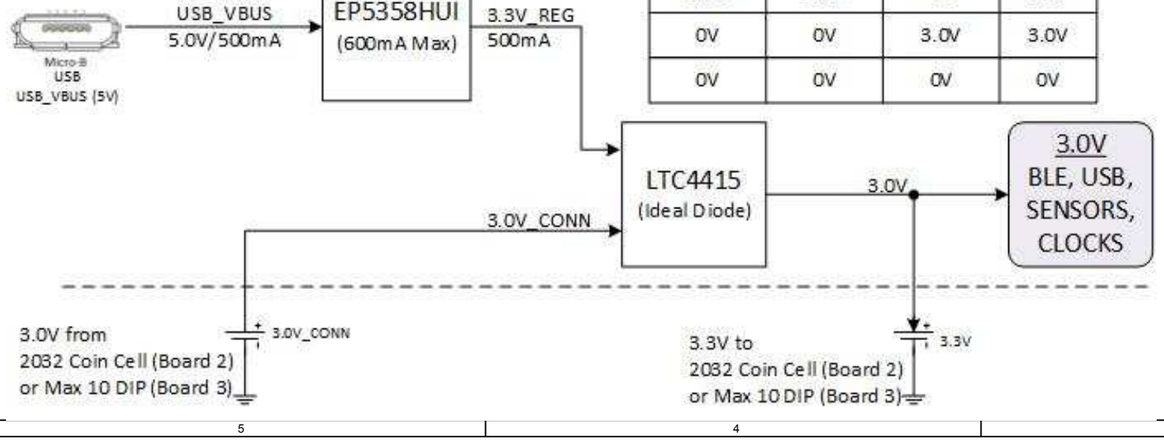
Power & Connector





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

MACNICA AMERICAS

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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	
	L9	PB10	
MAX10_I2C_SDA	N6	PB11/I2C1_SDA (1)	
MAX10_I2C_SCL	N7	PB12/I2C1_SCL (1)	
HFXTAL_P	N9	PB13/HFXO_P	
HFXTAL_N	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

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

U10
VDD CLK_OUT
GND GND
LFXTAL_N
32.768KHz

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

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

U6B
POWER
EFM32GG395

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	
		VSS	C5
		VSS	C8
	M11	AVSS_0	H3
	M8	AVSS_1	J3
	N8	AVSS_2	K11
		VSS	K12
		VSS	L5
		VSS	L6

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

3.0V
L2 BEAD
R34
R39
3.0V_IOVDD
3.0V_AVDD

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

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

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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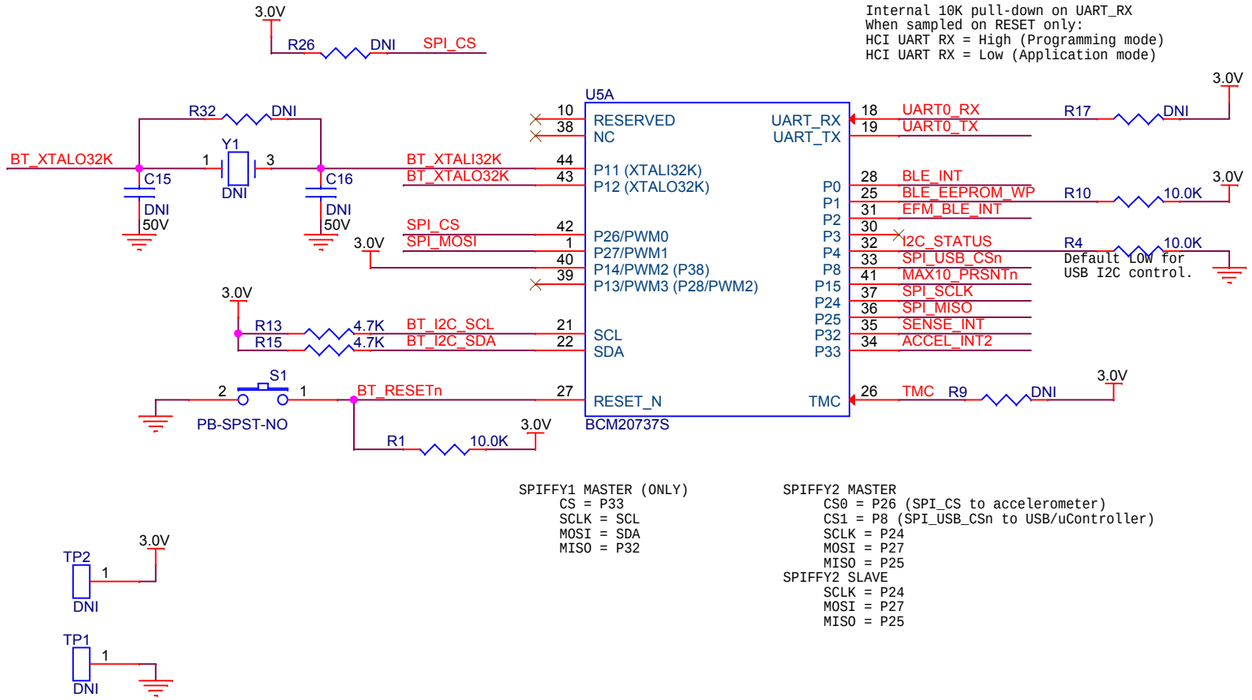
Bluetooth



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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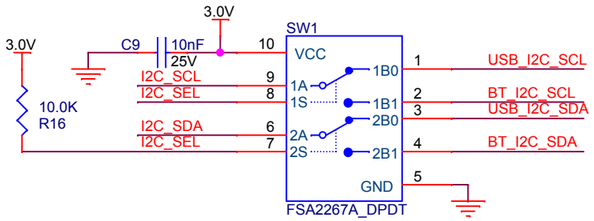
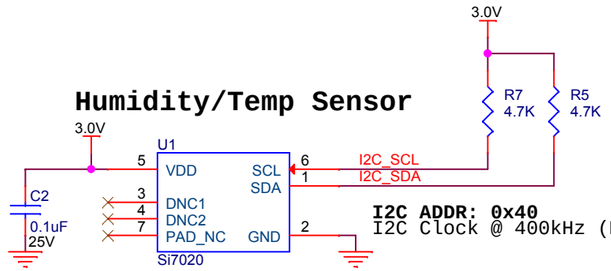
Sensors



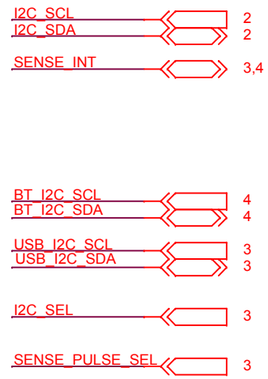
ISC_SEL = 0 -> Connect A to B0 (USB I2C)
ISC_SEL = 1 -> Connect A to B1 (BT I2C)

Humidity/Temp Sensor

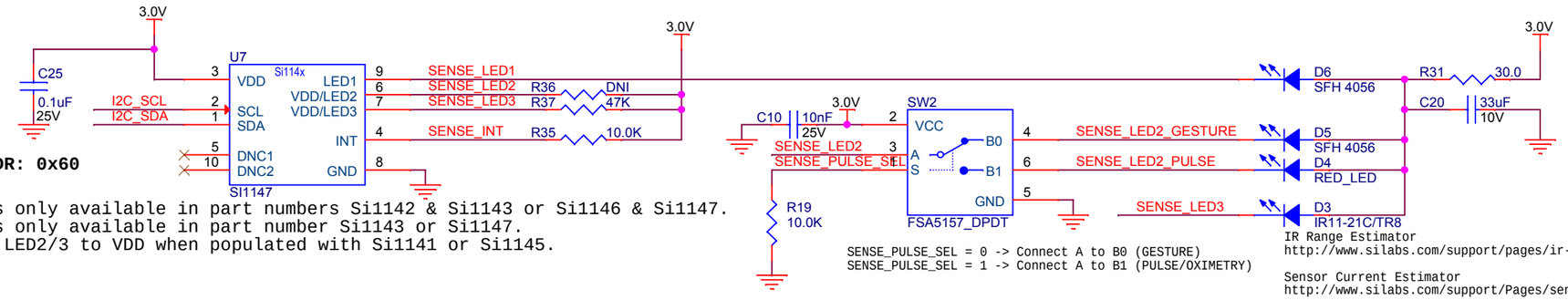


I2C ADDR: 0x40
I2C Clock @ 400kHz (Maximum)

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.

Populate o-ring when SENSE_LED3 is installed.

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

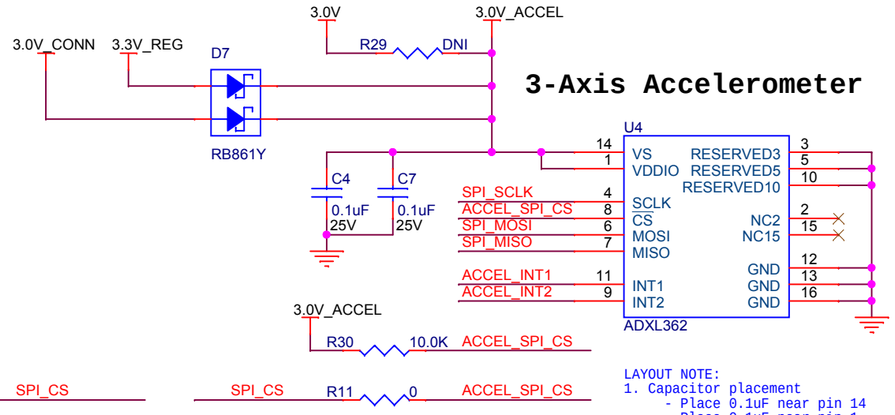
IR Range Estimator
http://www.silabs.com/support/pages/ir-range-estimator.aspx

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

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

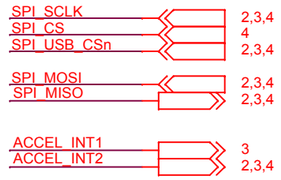
3-Axis Accelerometer



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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