



Thunderboard Sense

EFR32MG12P332F1024GL125

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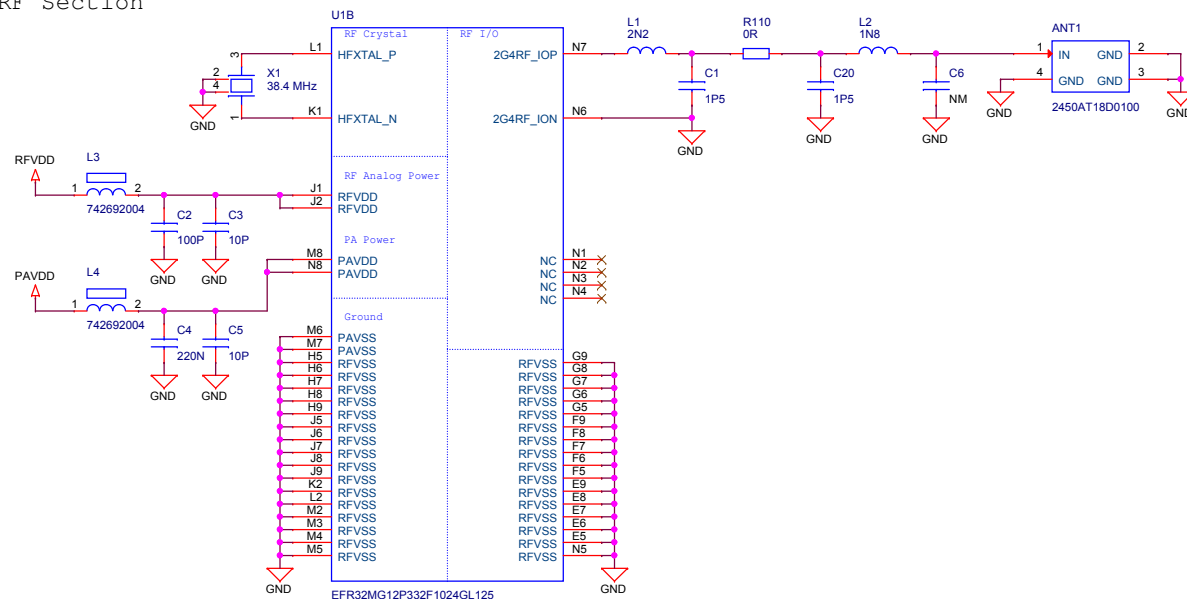
Revision History

Rev.	Description
A00	Initial prototype version.
B00	Updated EFR32 and debugger IC revisions. Replaced analog microphone with an I2S-based digital one.
B01	Changed microphone to Knowles SPH0645LM4H-B
C00	Updated microphone and SPI Flash pinout. Changed to Invensense microphone and 9-axis IMU.
C01	updated hall effect sensor (Si7210) revision.
D00	Changed back to Invensense 6-axis IMU.
D01	Updated EFR32MG12 to IC rev. C.
D02	Changed P/N for J-Link LED.

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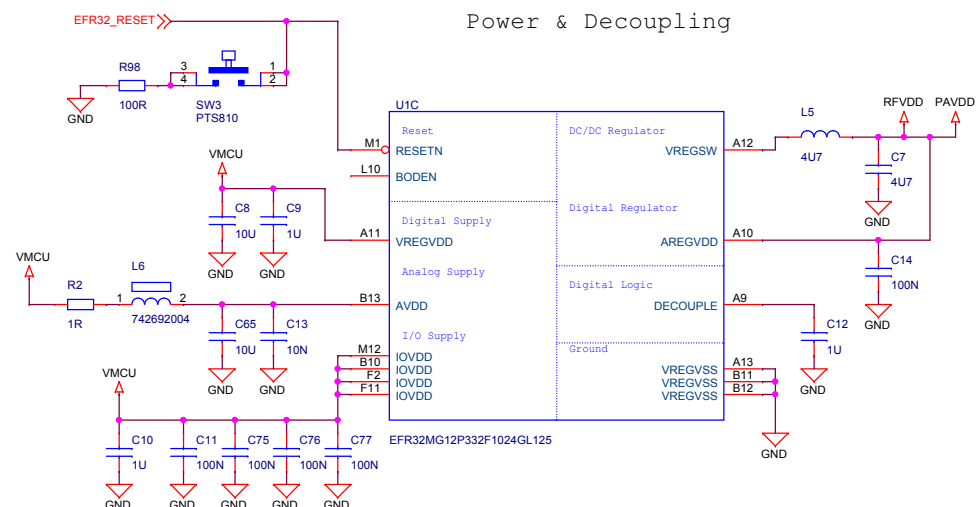


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Design Created Date: Wednesday, November 30, 2016		Sheet Created Date Wednesday, November 30, 2016		Sheet Modified Date Tuesday, January 07, 2020	Sheet 1 of 7



M1 2.2 MM

M2 2.2 MM



Power & Decoupling

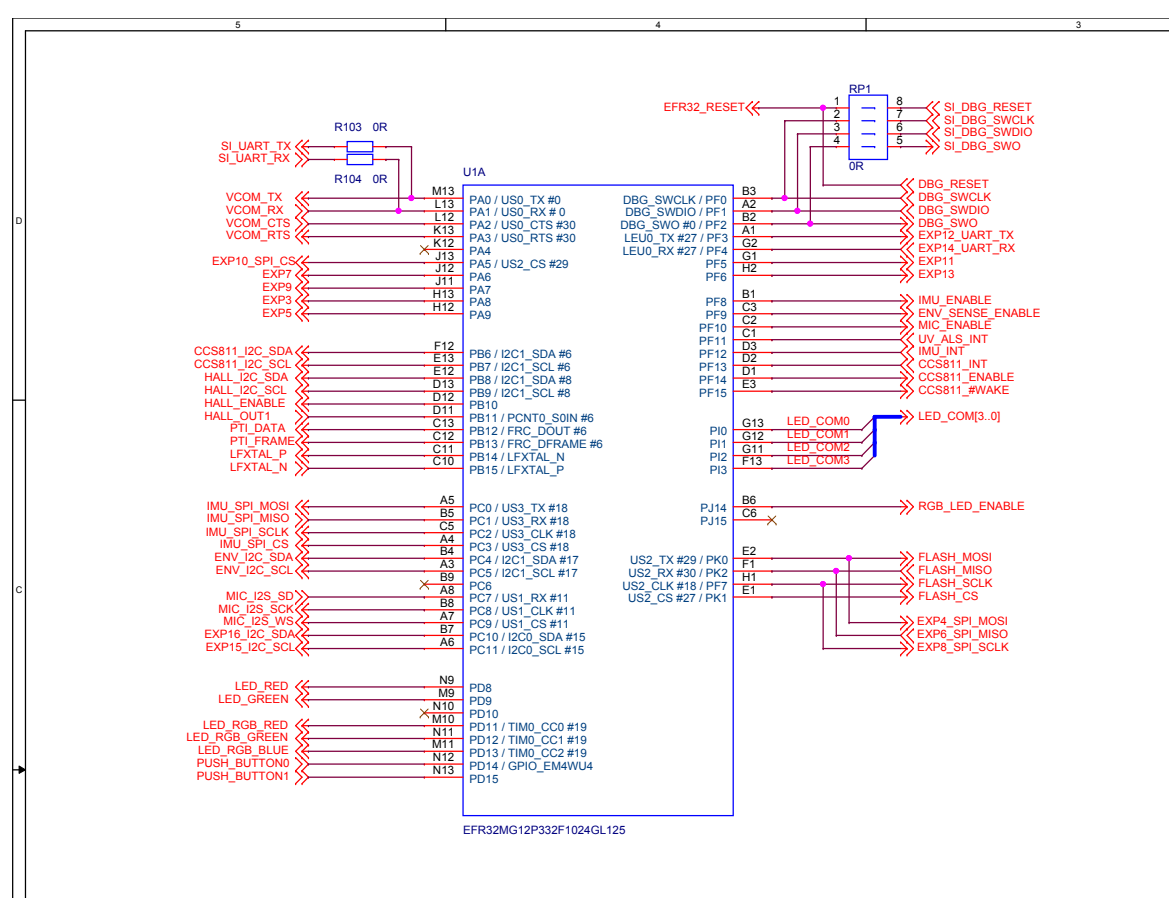
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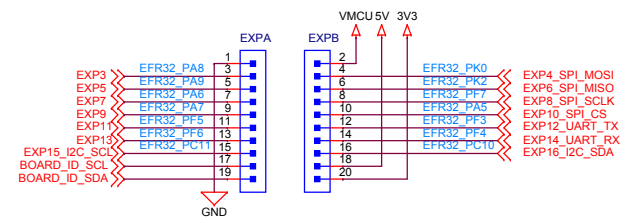
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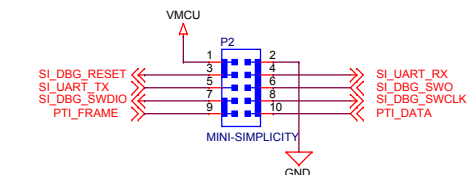
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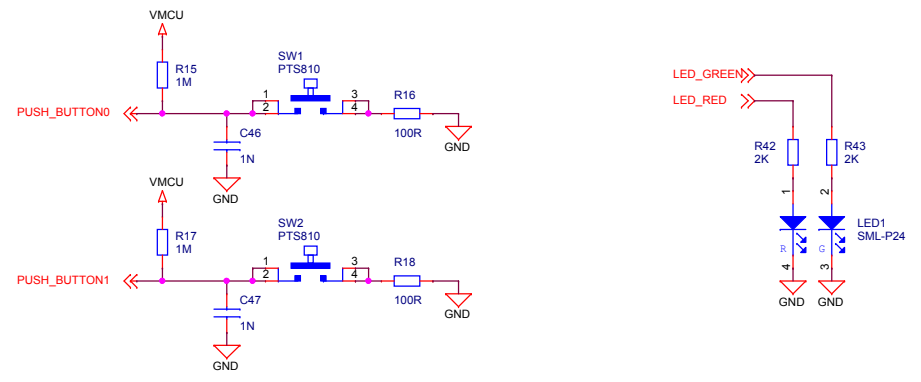
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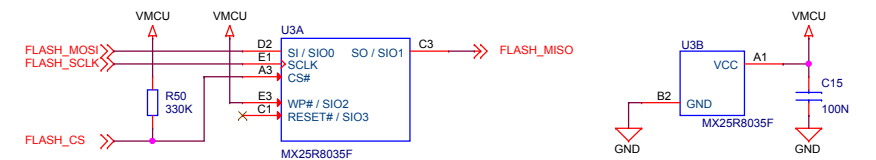
Mini Simplicity Connector



Push Buttons & LEDs



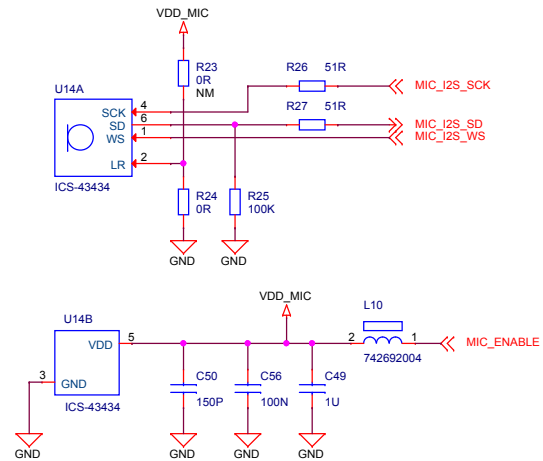
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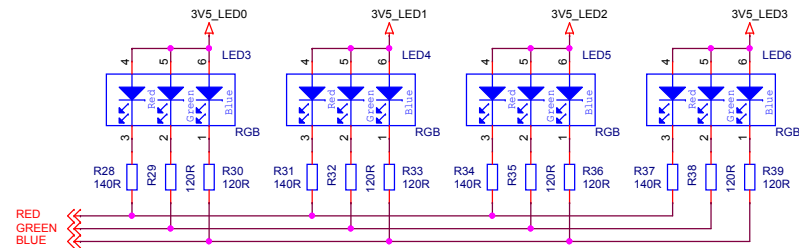
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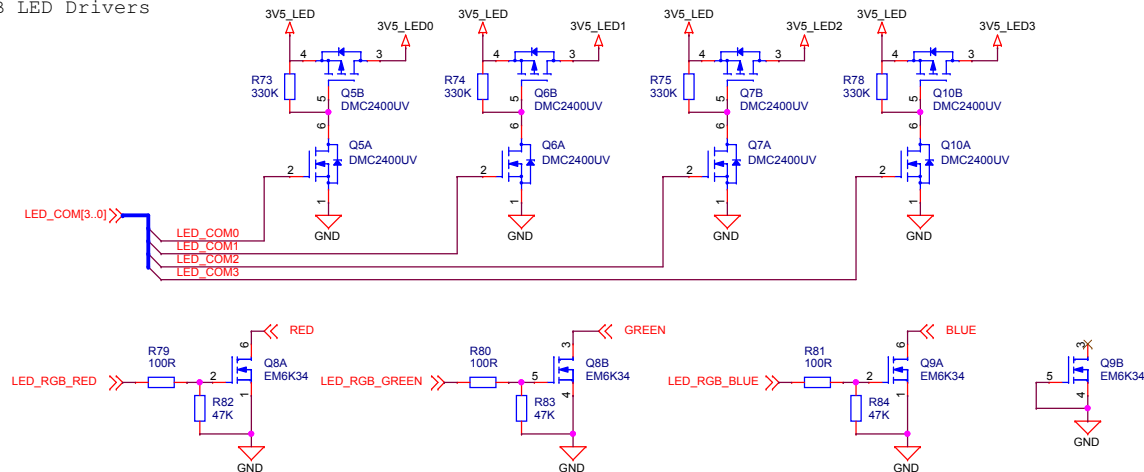
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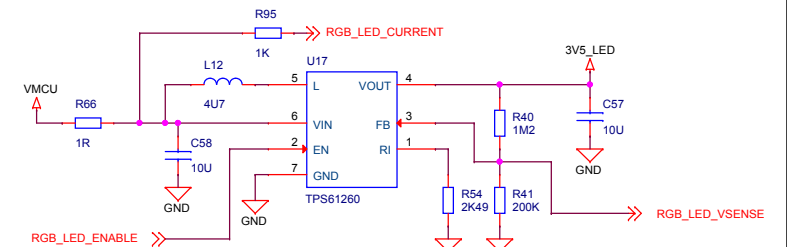
RGB LEDs



RGB LED Drivers



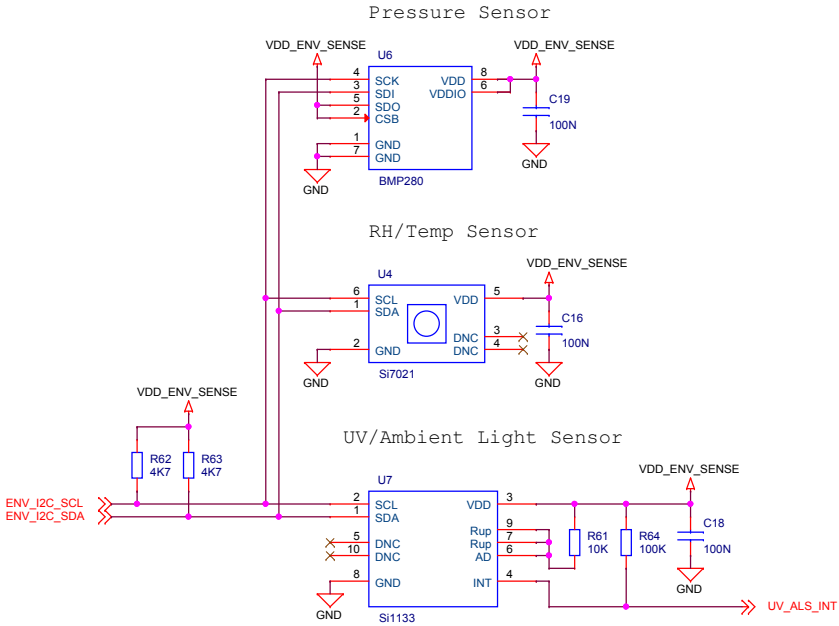
RGB LED power supply



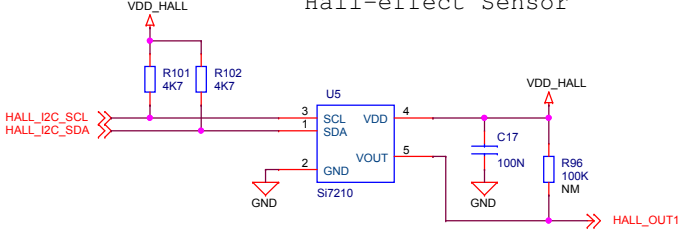
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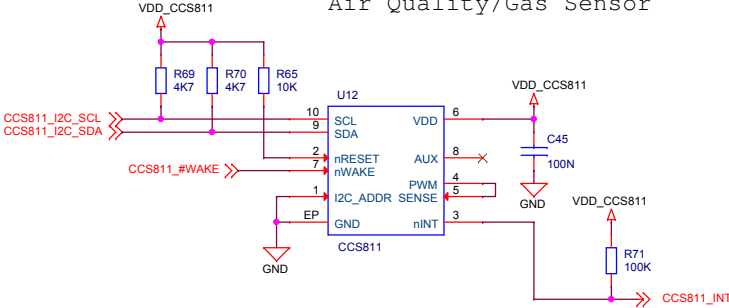
Environmental Sensors



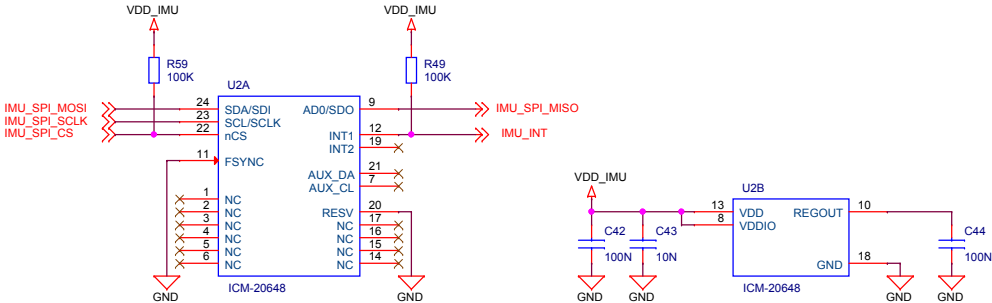
Hall-effect Sensor



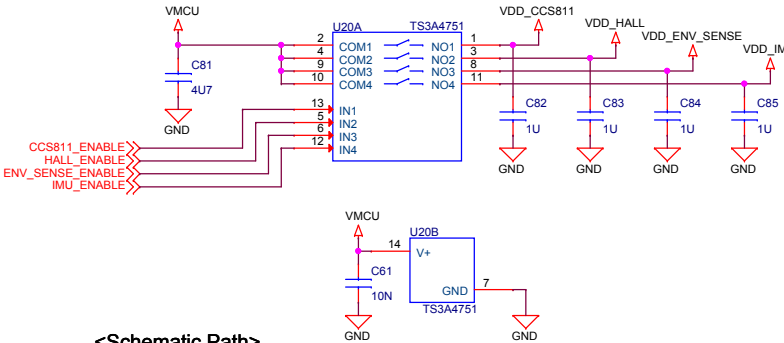
Air Quality/Gas Sensor



6-axis inertial sensor



Sensor Power Control



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Debug MCU Connections

The diagram illustrates the debug connections for the EFM32GG395F1024 microcontroller. It includes a USB-to-UART bridge (U9A) and a USB-to-UART bridge (U9C). The microcontroller is connected to a bootloader (TP999) and a debugger (EFM32GG395F1024). The connections are as follows:

- U9A (USB-to-UART Bridge):**
 - PA0 / EBI_AD09 #0,1,2 / GPIO_EM4WU0 / I2C0_SDA #0 / LEU0_RX #4 / PRS_CH0 #0 / TIM0_CC0 #0,1,4
 - PA1 / CMU_CLK1 #0 / EBI_AD10 #0,1,2 / I2C0_SCL #0 / PRS_CH1 #0 / TIM0_CC1 #0,1
 - PA2 / CMU_CLK0 #0 / EBI_AD11 #0,1,2 / ETM_TD0 #3 / TIM0_CC2 #0,1
 - PA3 / EBI_AD12 #0,1,2 / ETM_TD1 #3 / LES_ALTEX2 / TIM0_CDTI0 #0 / U0_TX #2
 - PA4 / EBI_AD13 #0,1,2 / ETM_TD2 #3 / LES_ALTEX3 / TIM0_CDTI1 #0 / U0_RX #2
 - PA5 / EBI_AD14 #0,1,2 / ETM_TD3 #3 / LES_ALTEX4 / LEU1_TX #1 / TIM0_CDTI2 #0
 - PA6 / EBI_AD15 #0,1,2 / ETM_TCLK #3 / GPIO_EM4WU1 / LEU1_RX #1
 - PA7 / EBI_CSTFT #0,1,2
 - PA8 / EBI_DCLK #0,1,2 / TIM2_CC0 #0
 - PA9 / EBI_DTEN #0,1,2 / TIM2_CC1 #0
 - PA10 / EBI_VSNS #0,1,2 / TIM2_CC2 #0
 - PA11 / EBI_HSNCR #0,1,2
 - PA12 / EBI_A00 #0,1,2 / TIM2_CC0 #1
 - PA13 / EBI_A01 #0,1,2 / TIM2_CC1 #1
 - PA14 / EBI_A02 #0,1,2 / TIM2_CC2 #1
 - PA15 / EBI_AD08 #0,1,2 / TIM2_CC2 #0
 - PB0 / EBI_A16 #0,1,2 / TIM1_CC0 #2
 - PB1 / EBI_A17 #0,1,2 / TIM1_CC1 #2
 - PB2 / EBI_A18 #0,1,2 / TIM1_CC2 #2
 - PB3 / EBI_A19 #0,1,2 / PCNT0_S0IN #1 / US2_TX #1
 - PB4 / EBI_A20 #0,1,2 / PCNT1_S1IN #1 / US2_RX #1
 - PB5 / EBI_A21 #0,1,2 / US2_CLK #1
 - PB6 / EBI_A22 #0,1,2 / US2_CS #1
 - PB7 / LFX TAL_P / TIM1_CC0 #3 / US0_TX #4 / US1_CLK #0
 - PB8 / LFX TAL_N / TIM1_CC1 #3 / US0_RX #4 / US1_CS #0
 - PB9 / EBI_A03 #0,1,2 / U1_TX #2
 - PB10 / EBI_A04 #0,1,2 / U1_RX #2
 - PB11 / DAC0_OUT0 / OPAMP_OUT0 / I2C1_SDA #1 / LETIMO_OUT0 #1 / TIM1_CC2 #3
 - PB12 / DAC0_OUT1 / OPAMP_OUT1 / I2C1_SCL #1 / LETIMO_OUT1 #1
 - PB13 / HFX TAL_P / LEU0_TX #1 / US0_CLK #4,5
 - PB14 / HFX TAL_N / LEU0_RX #1 / US0_CS #4,5
 - PB15 / ETM_TD2 #1
- U9C (USB-to-UART Bridge):**
 - PE0 / EBI_A07 #0,1,2 / I2C1_SDA #2 / PCNT0_S0IN #1 / TIM3_CC0 #1 / U0_TX #1
 - PE1 / EBI_A08 #0,1,2 / I2C1_SCL #2 / PCNT0_S1IN #1 / TIM3_CC1 #1 / U0_RX #1
 - PE2 / ACMP0_O #1 / BU_VOUT / EBI_A09 #0 / TIM3_CC2 #1 / U1_TX #3
 - PE3 / ACMP1_O #1 / BU_STAT / EBI_A10 #0 / U1_RX #3
 - PE4 / EBI_A11 #0,1,2 / US0_CS #1
 - PE5 / EBI_A12 #0,1,2 / US0_CLK #1
 - PE6 / EBI_A13 #0,1,2 / US0_RX #1
 - PE7 / EBI_A14 #0,1,2 / US0_TX #1
 - PE8 / EBI_AD00 #0,1,2 / PCNT2_S0IN #1 / PRS_CH3 #1
 - PE9 / EBI_AD01 #0,1,2 / PCNT2_S1IN #1
 - PE10 / BOOTLOADER_TX / EBI_AD02 #0,1,2 / TIM1_CC0 #1 / US0_TX #0
 - PE11 / BOOTLOADER_RX / EBI_AD03 #0,1,2 / LES_ALTEX5 / TIM1_CC1 #1 / US0_RX #0
 - PE12 / CMU_CLK1 #2 / EBI_AD04 #0,1,2 / I2C0_SDA #6 / LES_ALTEX6 / TIM1_CC2 #1 / US0_CLK #0 / US0_RX #3
 - PE13 / ACMP0_O #0 / EBI_AD05 #0,1,2 / GPIO_EM4WU5 / I2C0_SCL #6 / LES_ALTEX7 / US0_CS #0 / US0_TX #3
 - PE14 / EBI_AD06 #0,1,2 / LEU0_TX #2 / TIM3_CC0 #0
 - PE15 / EBI_AD07 #0,1,2 / LEU0_RX #2 / TIM3_CC1 #0
 - PF0 / DBG_SWCLK #0,1,2,3 / I2C0_SDA #5 / LETIMO_OUT0 #2 / LEU0_TX #3 / TIM0_CC0 #5 / US1_CLK #2
 - PF1 / DBG_SWIDIO #0,1,2,3 / GPIO_EM4WU3 / I2C0_SCL #5 / LETIMO_OUT1 #2 / LEU0_RX #3 / TIM0_CC1 #5 / US1_CS #2
 - PF2 / ACMP1_O #0 / DBG_SWO #0 / EBI_ARDY #0,1,2 / GPIO_EM4WU4 / LEU0_TX #4 / TIM0_CDTI0 #5
 - PF3 / EBI_ALE #0 / ETM_TD3 #1 / PRS_CH0 #1 / TIM0_CDTI0 #2,5
 - PF4 / EBI_VEN #0,2 / PRS_CH1 #1 / TIM0_CDTI1 #2,5
 - PF5 / EBI_VEN #0,2 / PRS_CH2 #1 / TIM0_CDTI2 #2,5 / USB_VBUSEN
 - PF6 / EBI_BLO #0,1,2 / TIM0_CC0 #2 / U0_TX #0
 - PF7 / EBI_BLI #0,1,2 / TIM0_CC1 #2 / U0_RX #0
 - PF8 / EBI_VEN #1 / ETM_TCLK #1 / TIM0_CC2 #2
 - PF9 / EBI_VEN #1 / ETM_TD0 #1
 - PF10 / U1_TX #1 / USB_DM
 - PF11 / U1_RX #1 / USB_DP
 - PF12 / USB_ID
- TP999 (Bootloader Halt pin):**
 - EFM32GG395F1024

The diagram illustrates the PCB layout for an EFM32GG395F1024 microcontroller, focusing on the decoupling of the MCU and the debug MCU. The layout includes various components like capacitors, resistors, and connectors, with labels for power planes, ground planes, and signal traces.

MCU Decoupling:

- MCU:** EFM32GG395F1024 (U9D)
- Power Planes:** VBUS, 3V3_USB, VDD_DREG, VDD_0, VDD_2, VDD_3, VDD_4, VDD_5, VDD_6, VSS, VSS_0, VSS_1, VSS_2.
- Ground Planes:** GND, GND_0, GND_1, GND_2, GND_3, GND_4, GND_5, GND_6, GND_7, GND_8, GND_9, GND_10, GND_11, GND_12, GND_13, GND_14, GND_15, GND_16, GND_17, GND_18, GND_19, GND_20, GND_21, GND_22, GND_23, GND_24, GND_25, GND_26, GND_27, GND_28, GND_29, GND_30, GND_31, GND_32, GND_33, GND_34, GND_35, GND_36, GND_37, GND_38, GND_39, GND_40, GND_41, GND_42, GND_43, GND_44, GND_45, GND_46, GND_47, GND_48, GND_49, GND_50, GND_51, GND_52, GND_53, GND_54, GND_55, GND_56, GND_57, GND_58, GND_59, GND_60, GND_61, GND_62, GND_63, GND_64, GND_65, GND_66, GND_67, GND_68, GND_69, GND_70, GND_71, GND_72, GND_73, GND_74, GND_75, GND_76, GND_77, GND_78, GND_79, GND_80, GND_81, GND_82, GND_83, GND_84, GND_85, GND_86, GND_87, GND_88, GND_89, GND_90, GND_91, GND_92, GND_93, GND_94, GND_95, GND_96, GND_97, GND_98, GND_99, GND_100, GND_101, GND_102, GND_103, GND_104, GND_105, GND_106, GND_107, GND_108, GND_109, GND_110, GND_111, GND_112, GND_113, GND_114, GND_115, GND_116, GND_117, GND_118, GND_119, GND_120, GND_121, GND_122, GND_123, GND_124, GND_125, GND_126, GND_127, GND_128, GND_129, GND_130, GND_131, GND_132, GND_133, GND_134, GND_135, GND_136, GND_137, GND_138, GND_139, GND_140, GND_141, GND_142, GND_143, GND_144, GND_145, GND_146, GND_147, GND_148, GND_149, GND_150, GND_151, GND_152, GND_153, GND_154, GND_155, GND_156, GND_157, GND_158, GND_159, GND_160, GND_161, GND_162, GND_163, GND_164, GND_165, GND_166, GND_167, GND_168, GND_169, GND_170, GND_171, GND_172, GND_173, GND_174, GND_175, GND_176, GND_177, GND_178, GND_179, GND_180, GND_181, GND_182, GND_183, GND_184, GND_185, GND_186, GND_187, GND_188, GND_189, GND_190, GND_191, GND_192, GND_193, GND_194, GND_195, GND_196, GND_197, GND_198, GND_199, GND_200, GND_201, GND_202, GND_203, GND_204, GND_205, GND_206, GND_207, GND_208, GND_209, GND_210, GND_211, GND_212, GND_213, GND_214, GND_215, GND_216, GND_217, GND_218, GND_219, GND_220, GND_221, GND_222, GND_223, GND_224, GND_225, GND_226, GND_227, GND_228, GND_229, GND_230, GND_231, GND_232, GND_233, GND_234, GND_235, GND_236, GND_237, GND_238, GND_239, GND_240, GND_241, GND_242, GND_243, GND_244, GND_245, GND_246, GND_247, GND_248, GND_249, GND_250, GND_251, GND_252, GND_253, GND_254, GND_255, GND_256, GND_257, GND_258, GND_259, GND_260, GND_261, GND_262, GND_263, GND_264, GND_265, GND_266, GND_267, GND_268, GND_269, GND_270, GND_271, GND_272, GND_273, GND_274, GND_275, GND_276, GND_277, GND_278, GND_279, GND_280, GND_281, GND_282, GND_283, GND_284, GND_285, GND_286, GND_287, GND_288, GND_289, GND_290, GND_291, GND_292, GND_293, GND_294, GND_295, GND_296, GND_297, GND_298, GND_299, GND_300, GND_301, GND_302, GND_303, GND_304, GND_305, GND_306, GND_307, GND_308, GND_309, GND_310, GND_311, GND_312, GND_313, GND_314, GND_315, GND_316, GND_317, GND_318, GND_319, GND_320, GND_321, GND_322, GND_323, GND_324, GND_325, GND_326, GND_327, GND_328, GND_329, GND_330, GND_331, GND_332, GND_333, GND_334, GND_335, GND_336, GND_337, GND_338, GND_339, GND_340, GND_341, GND_342, GND_343, GND_344, GND_345, GND_346, GND_347, GND_348, GND_349, GND_350, GND_351, GND_352, GND_353, GND_354, GND_355, GND_356, GND_357, GND_358, GND_359, GND_360, GND_361, GND_362, GND_363, GND_364, GND_365, GND_366, GND_367, GND_368, GND_369, GND_370, GND_371, GND_372, GND_373, GND_374, GND_375, GND_376, GND_377, GND_378, GND_379, GND_380, GND_381, GND_382, GND_383, GND_384, GND_385, GND_386, GND_387, GND_388, GND_389, GND_390, GND_391, GND_392, GND_393, GND_394, GND_395, GND_396, GND_397, GND_398, GND_399, GND_400, GND_401, GND_402, GND_403, GND_404, GND_405, GND_406, GND_407, GND_408, GND_409, GND_410, GND_411, GND_412, GND_413, GND_414, GND_415, GND_416, GND_417, GND_418, GND_419, GND_420, GND_421, GND_422, GND_423, GND_424, GND_425, GND_426, GND_427, GND_428, GND_429, GND_430, GND_431, GND_432, GND_433, GND_434, GND_435, GND_436, GND_437, GND_438, GND_439, GND_440, GND_441, GND_442, GND_443, GND_444, GND_445, GND_446, GND_447, GND_448, GND_449, GND_450, GND_451, GND_452, GND_453, GND_454, GND_455, GND_456, GND_457, GND_458, GND_459, GND_460, GND_461, GND_462, GND_463, GND_464, GND_465, GND_466, GND_467, GND_468, GND_469, GND_470, GND_471, GND_472, GND_473, GND_474, GND_475, GND_476, GND_477, GND_478, GND_479, GND_480, GND_481, GND_482, GND_483, GND_484, GND_485, GND_486, GND_487, GND_488, GND_489, GND_490, GND_491, GND_492, GND_493, GND_494, GND_495, GND_496, GND_497, GND_498, GND_499, GND_500, GND_501, GND_502, GND_503, GND_504, GND_505, GND_506, GND_507, GND_508, GND_509, GND_510, GND_511, GND_512, GND_513, GND_514, GND_515, GND_516, GND_517, GND_518, GND_519, GND_520, GND_521, GND_522, GND_523, GND_524, GND_525, GND_526, GND_527, GND_528, GND_529, GND_530, GND_531, GND_532, GND_533, GND_534, GND_535, GND_536, GND_537, GND_538, GND_539, GND_540, GND_541, GND_542, GND_543, GND_544, GND_545, GND_546, GND_547, GND_548, GND_549, GND_550, GND_551, GND_552, GND_553, GND_554, GND_555, GND_556, GND_

Debug MCU Connections to Mini Simplicity Header

Diagram illustrating the connection of an RP2 MCU to a Mini Simplicity Header for debugging.

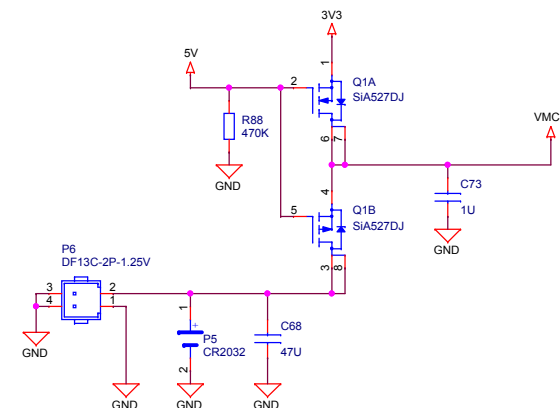
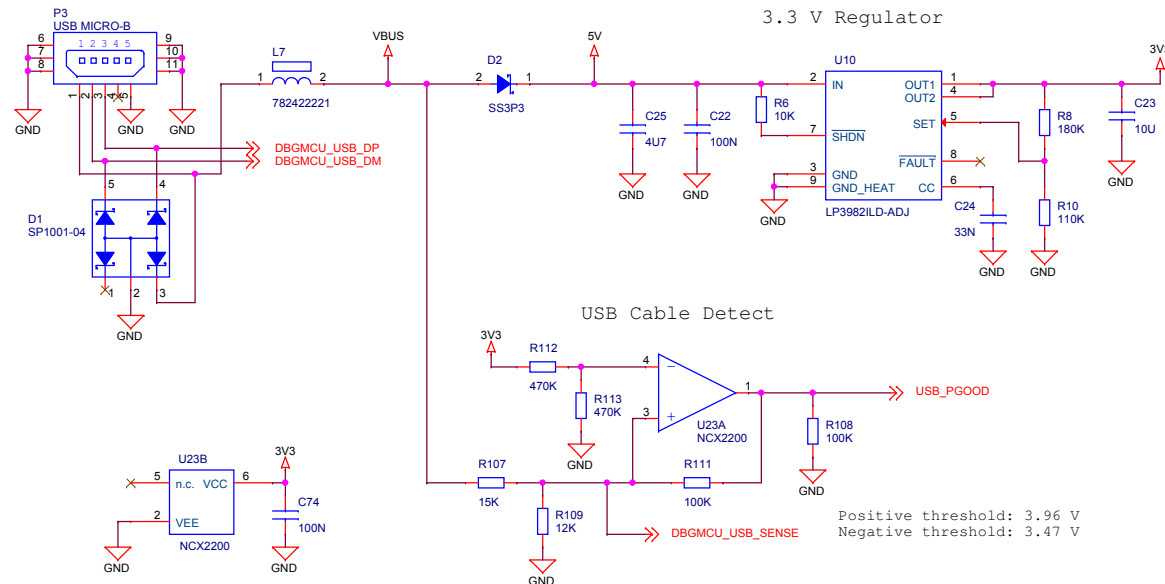
The RP2 MCU is connected to the header pins as follows:

- RP2 Pin 1: DBGMCU_SWDIO (connected to SI_DBG_SWDIO)
- RP2 Pin 2: DBGMCU_SWCLK (connected to SI_DBG_SWCLK)
- RP2 Pin 3: DBGMCU_SWO (connected to SI_DBG_SWO)
- RP2 Pin 4: DBGMCU_RESET (connected to SI_DBG_RESET)
- RP2 Pin 5: SI_DBG_RESET (connected to DBGMCU_RESET)
- RP2 Pin 6: SI_DBG_SWO (connected to DBGMCU_SWO)
- RP2 Pin 7: SI_DBG_SWCLK (connected to DBGMCU_SWCLK)
- RP2 Pin 8: SI_DBG_SWDIO (connected to DBGMCU_SWDIO)

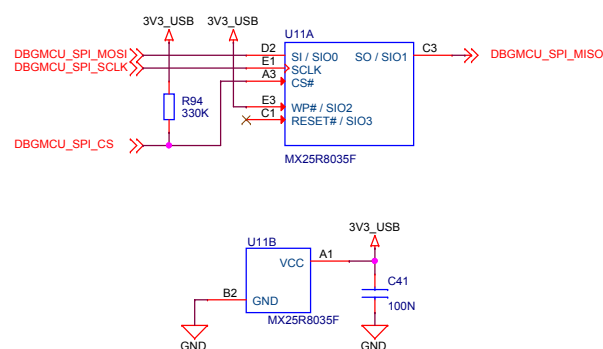
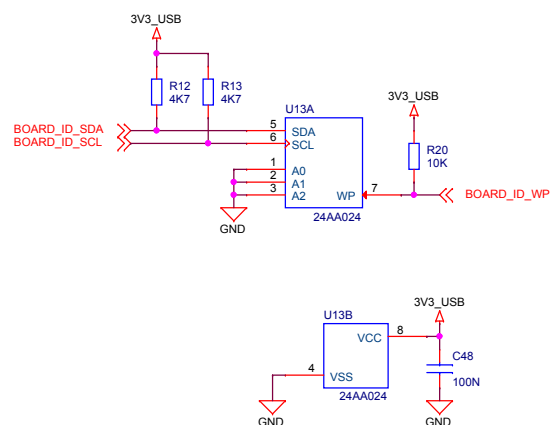
The header pins are labeled as follows:

- R105: OR NM (connected to SI_UART_TX)
- R106: OR NM (connected to SI_UART_RX)

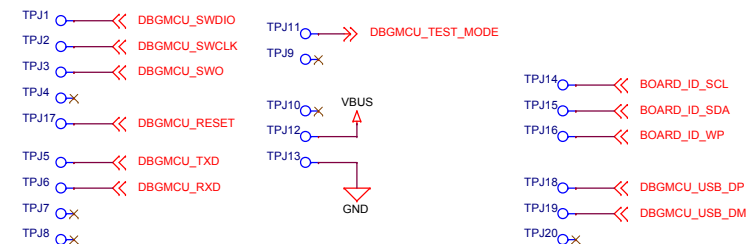
 SILICON LABS		Schematic Title Thunderboard Sense 2	
Designed: DDB		Approved: JNO	
Size A3		BOM Doc No: <Cage Code>	
Design Created Date: Wednesday, November 30, 2016		Document number BRD4166A	Revision D02
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Additionally, the Mini Simplicity Debug connector can supply power directly to the target voltage domain.



Test Points



 SILICON LABS		Schematic Title	
		Thunderboard Sense 2	
Page Title		Debug Misc. & Power	
Designed: DDB	Approved: JNO	Document number BRD4166A	
Size A3	BOM Doc No: -Cage Code-	Revision D02	
Design Created Date: Wednesday, November 30, 2016		Sheet Created Date Wednesday, November 30, 2016	Sheet Modified Date Tuesday, January 07, 2020
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