Lattice Sentry Demo Board for Mach-NX

Evaluation Board User Guide

FPGA-EB-02045-1.2

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Acronyms in This Document

A list of acronyms used in this document.

Acronym	Definition
BMC	Baseboard Management Controllers
CPLD	Complex Programmable Logic Device
DC	Direct Current
ECP5	Lattice FPGA device
ESD	Electrostatic Discharge
eSPI	Enhanced Serial Peripheral Interface
FPGA	Field Programmable Gate Array
FTDI	Future Technology Devices International
I^2C	Inter-Integrated Circuit
JTAG	Joint Test Action Group
LDO	Low-Drop Out
OOB	Out-Of-Band
PCH	Platform Controller Hub
PFR	Platform Firmware Resiliency
QSPI	Quad Serial Peripheral Interface
SFB	SoC Function Block
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

1. Introduction

The purpose of this document is to introduce the hardware resources and basic functions of the Lattice Sentry™ Demo Board for Mach™-NX.

This user guide includes functional descriptions of the various hardware modules of Lattice Sentry Demo Board for Mach-NX. It also provides descriptions of the onboard connectors, status LEDs, switches, push buttons, and JTAG function enablement.

1.1. Overview

The Lattice Sentry Demo Board for Mach-NX is a single-board, system-level demo environment for the Lattice Platform Firmware Resiliency (PFR) system security solution. The demo board includes three main devices:

- Mach-NX LFMNX-50-5FBG484C
- This device is a next generation FPGA with enhanced security features including hardware root-of-trust and dual boot flash comprised of SoC Function Block (SFB) and FPGA partitions. For a complete description of the Mach-NX device, refer to Mach-NX Device Family Data Sheet (FPGA-DS-02084).
- ECP5™ LFE5U-85F-8BG381C
- This device is part of the ECP5 family of FPGA devices that are optimized to deliver high performance through advanced in-device architecture and the use of 40 nm technology. These make the device suitable for high-volume, high-speed, affordable applications. For a complete description of the ECP5 device, refer to ECP5 and ECP-5G Family Data Sheet (FPGA-DS-02012).
- The demo board features two ECP5 devices:
  - ECP5 (BMC), which simulates the baseboard management controllers (BMC) behavior
  - ECP5 (PCH), which simulates the platform controller hub (PCH) behavior

The Lattice Sentry Demo Board for Mach-NX demonstrates the Lattice PFR system security capability on a hardware platform that can be controlled through a dedicated user interface on a PC workstation. This board allows you to take advantage of the enhanced security features and greater configurability of the Mach-NX device.

The Mach-NX device authenticates the boot code of the ECP5 (BMC) and ECP5 (PCH) devices. It detects illegal flash operations, blocks them, and automatically recovers damaged boot images. Before the system boots up and throughout its operation, these functions provide security at the hardware level. For more details on using the Lattice Sentry Demo Board for Mach-NX, refer to Lattice Propel 1.1 Root-of-Trust Reference Design (FPGA-RD-02243) and Lattice Sentry Demo Board for Mach-NX Walkthrough User Guide (FPGA-UG-02167).

Figure 1.1 and Figure 1.2 show the top view and the bottom view of the Lattice Sentry Demo Board for Mach-NX respectively.

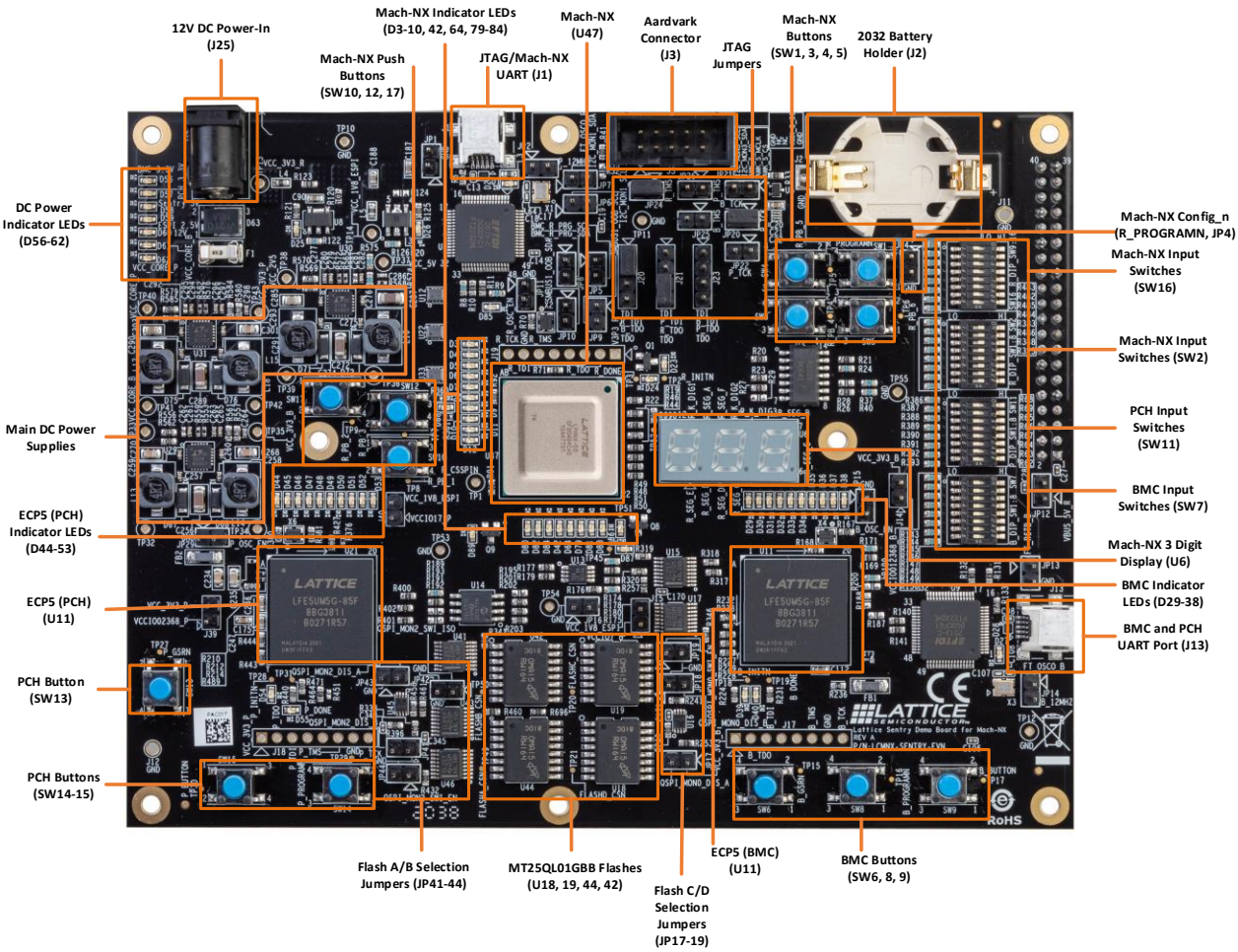


Figure 1.1. Lattice Sentry Demo Board for Mach-NX, Top View

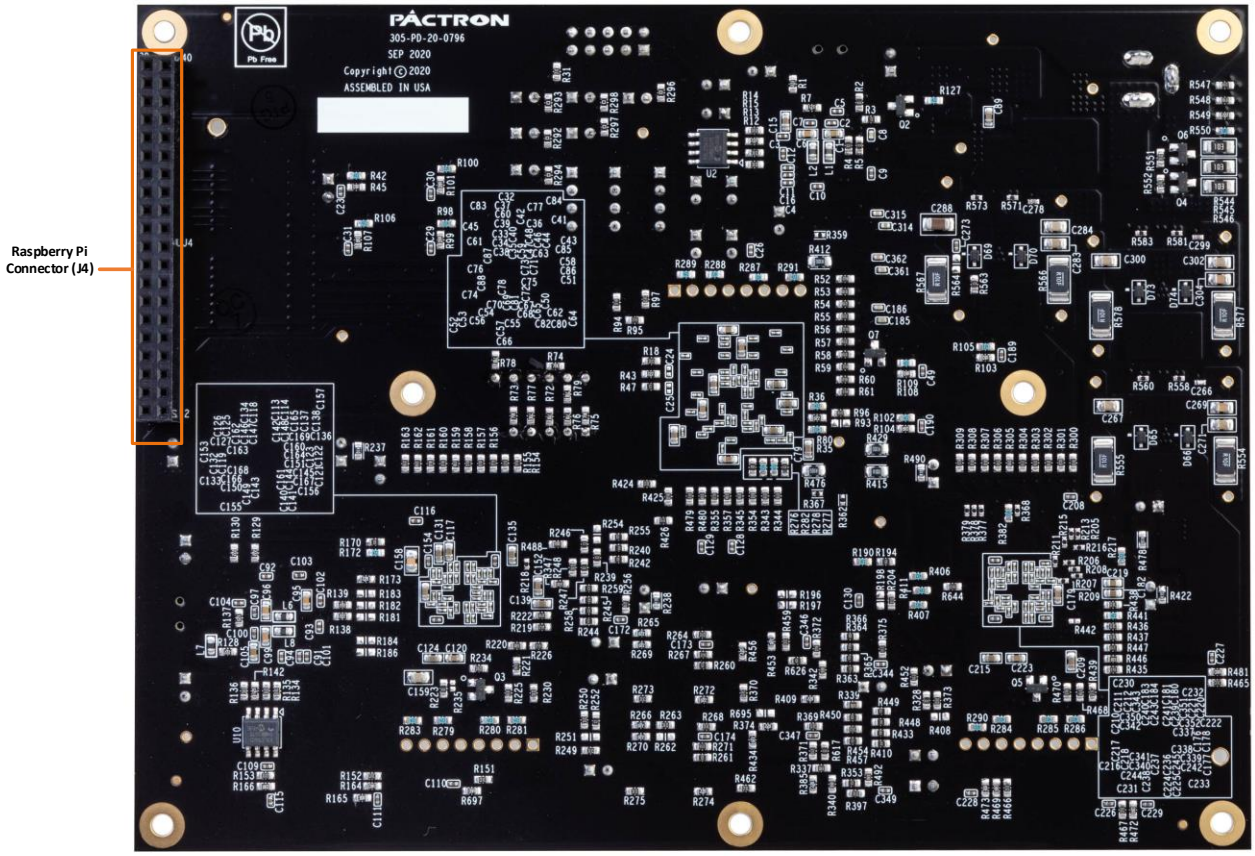


Figure 1.2. Lattice Sentry Demo Board for Mach-NX, Bottom View

2. Features

The key features of the Lattice Sentry Demo Board for Mach-NX are:

- Lattice security solution PFR demo support
- PFR system-level behavior validation
- USB connection for device programming
- USB connection for UART communication to PFR firmware
- Four 1 Gb SPI/QSPI flash devices for device configuration and firmware image storage (two flash devices per ECP5 device)
- Flexible expansion Raspberry Pi header
- LEDs, switches and push buttons for all three FPGAs
- Lattice Diamond® programming support
- Lattice Propel SDK, Builder, and PFR interface support

Caution:

The Lattice Sentry Demo Board for Mach-NX contains ESD-sensitive components. ESD safe practices should be followed while handling and using the demo board.

To prevent power surge impact on the USB port, remove the USB cable before you plug in or remove the 12 V DC power cable.

Note:

This document describes the production Lattice Sentry Demo Board for Mach-NX, which is labeled *Rev B* on the board. Earlier prototypes labeled as *Rev A* shows the P/N differently as LCMNX-SENTRY-EVN. In addition, Rev B has an architectural improvement, which allows the Mach-NX to monitor the BMC SPI path internally.

3. Power Supply

The Lattice Sentry Demo Board for Mach-NX comes ready to power up. This board can power up using a 12 V DC power source input. The power supply can be connected with the right-angle DC power input jack J25, which is fused with a surface mounted fuse F1.

The Lattice Sentry Demo Board for Mach-NX contains three logic devices. It works within appropriate power supply conditions. Using an incorrect power supply may cause permanent device and board damage. The recommended operating conditions can be found in Mach-NX Device Family Data Sheet (FPGA-DS-02084) and ECP5 and ECP-5G Family Data Sheet (FPGA-DS-02012). The 10 A fuse prevents the crashed current from flowing into the internal circuits and cause serious damage.

The power supply architecture is shown below in Figure 3.1.

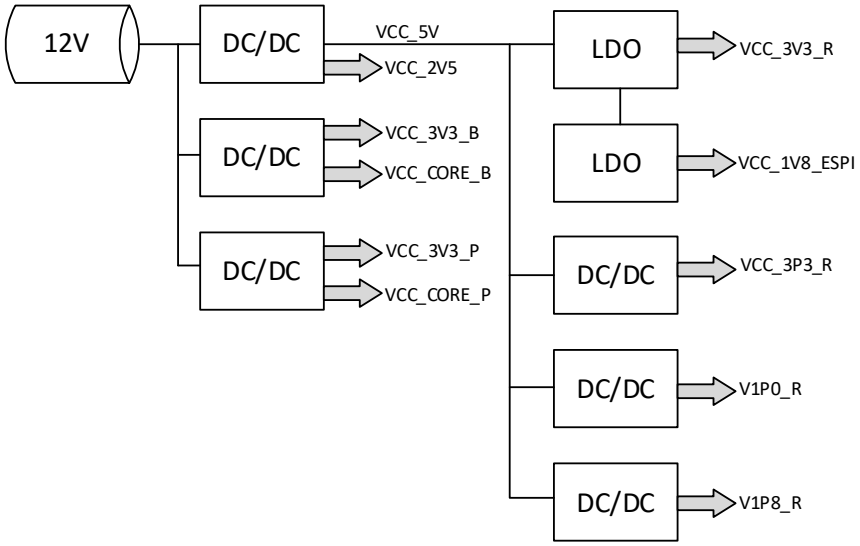


Figure 3.1. Power Supply Architecture

The board LEDs provide a visual indication of power status as listed in Table 3.1.

Table 3.1. Power Status LEDs

LED Designator	Color	Description
D1	Green	J1 USB header plug in
D25, D85	Green, Blue	Mach-NX 3.3 V power on
D26	Green	1.8 V power on
D27	Green	J13 USB header plug in
D56	Green	ECP5 (BMC) 3.3 V power on
D57	Green	ECP5 (PCH) 3.3 V power on
D58	Green	5 V power on
D59	Green	2.5 V power on
D60	Green	12 V power on
D61	Green	ECP5 (BMC) 1.1 V power on
D62	Green	ECP5 (PCH) 1.1 V power on
D88	Green	Mach-NX 1.8 V power on
D89	Green	Mach-NX 1.0 V power on

4. Programming and Configuration

The Lattice Sentry Demo Board for Mach-NX has a built-in download controller for programming the Mach-NX, ECP5 (BMC), and ECP5 (PCH) devices. The built-in module consists of a Mini-USB connector and an FTDI device. This module translates USB format data into JTAG type stream and allows you to configure the FPGA directly through a USB cable. To use the built-in download controller, connect a standard Mini-B USB to a type-A USB cable from J1 to your PC (with Diamond programming software installed). The USB hub on the PC detects the addition of the USB function and allows you to use the built-in download controller with the Diamond programming software.

4.1. Setting Configuration Mode

The Mach-NX, ECP5 (BMC), and ECP5 (PCH) devices support a variety of configuration modes, including 1149.1 JTAG and Master SPI. For detailed information, refer to the Mach-NX Programming and Configuration Usage Guide (FPGA-TN-02231) and ECP5 and ECP5-5G sysCONFIG Usage Guide (FPGA-TN-02039).

The Lattice Sentry Demo Board for Mach-NX supports various JTAG chain options to scan individual or certain combinations of devices. The jumper setting to scan all devices in the JTAG chain is shown in Figure 4.1. The configuration to scan the Mach-NX only is shown in Figure 4.2. Some useful JTAG jumper settings are provided in Figure 4.3 and Table 4.1.

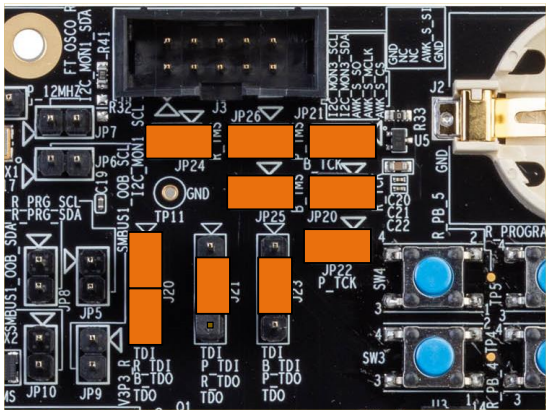


Figure 4.1. All Device JTAG Chain Jumper Setting

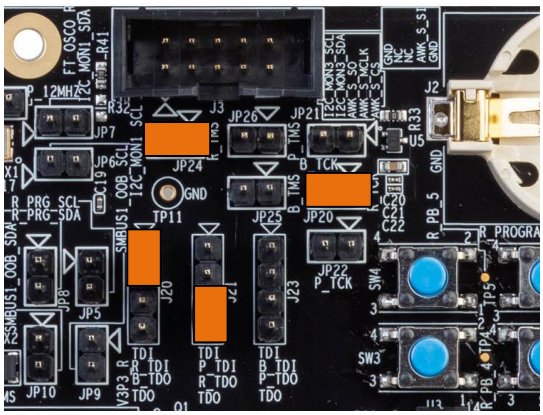


Figure 4.2. Mach-NX JTAG Chain Jumper Setting

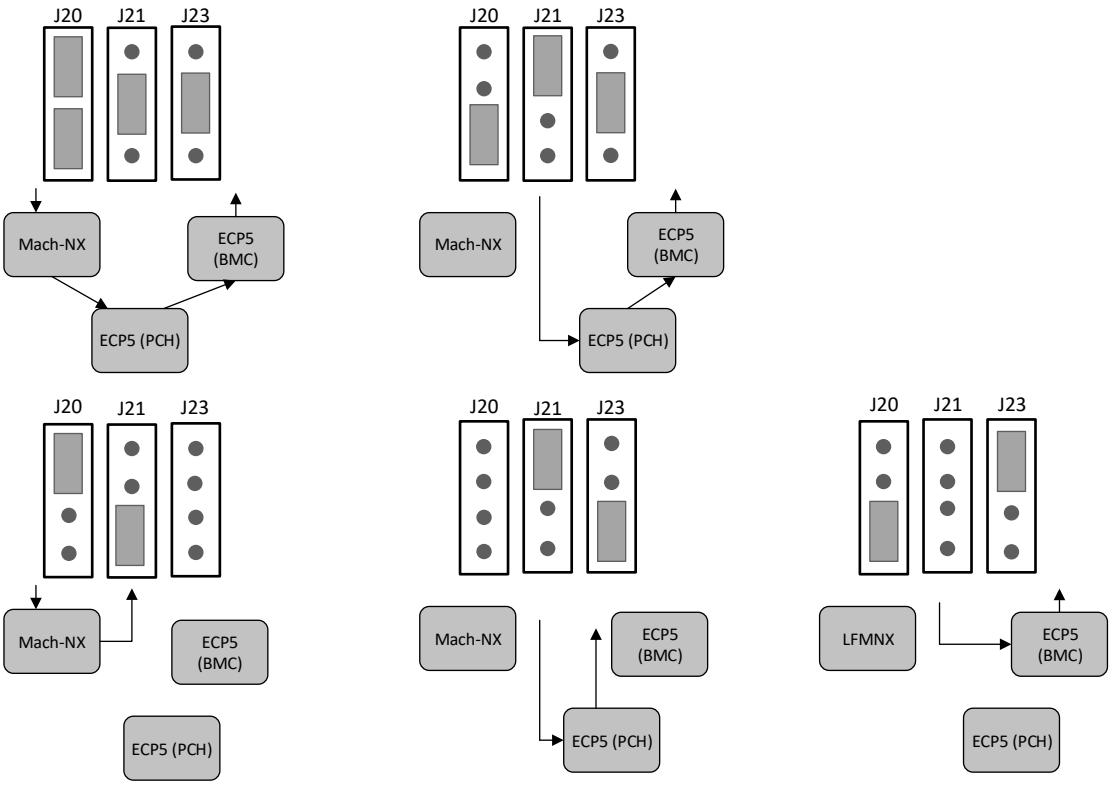


Figure 4.3. JTAG Chain Jumper Diagram

Table 4.1. JTAG Jumper Settings

Jumper	Function	Description
JP20	Mach-NX TCK	Placing jumper allows board TCK to drive Mach-NX TCK
JP21	ECP5 (BMC) TCK	Placing jumper allows board TCK to drive BMC TCK
JP22	ECP5 (PCH) TCK	Placing jumper allows board TCK to drive PCH TCK
JP24	Mach-NX TMS	Placing jumper allows board TMS to drive Mach-NX TMS
JP25	ECP5 (BMC) TMS	Placing jumper allows board TMS to drive BMC TMS
JP26	ECP5 (PCH) TMS	Placing jumper allows board TMS to drive PCH TMS

4.2. Programming LEDs and Buttons

There are individual programing buttons for each device and LEDs that indicate programming status, as shown in Figure 4.4 and Table 4.2.

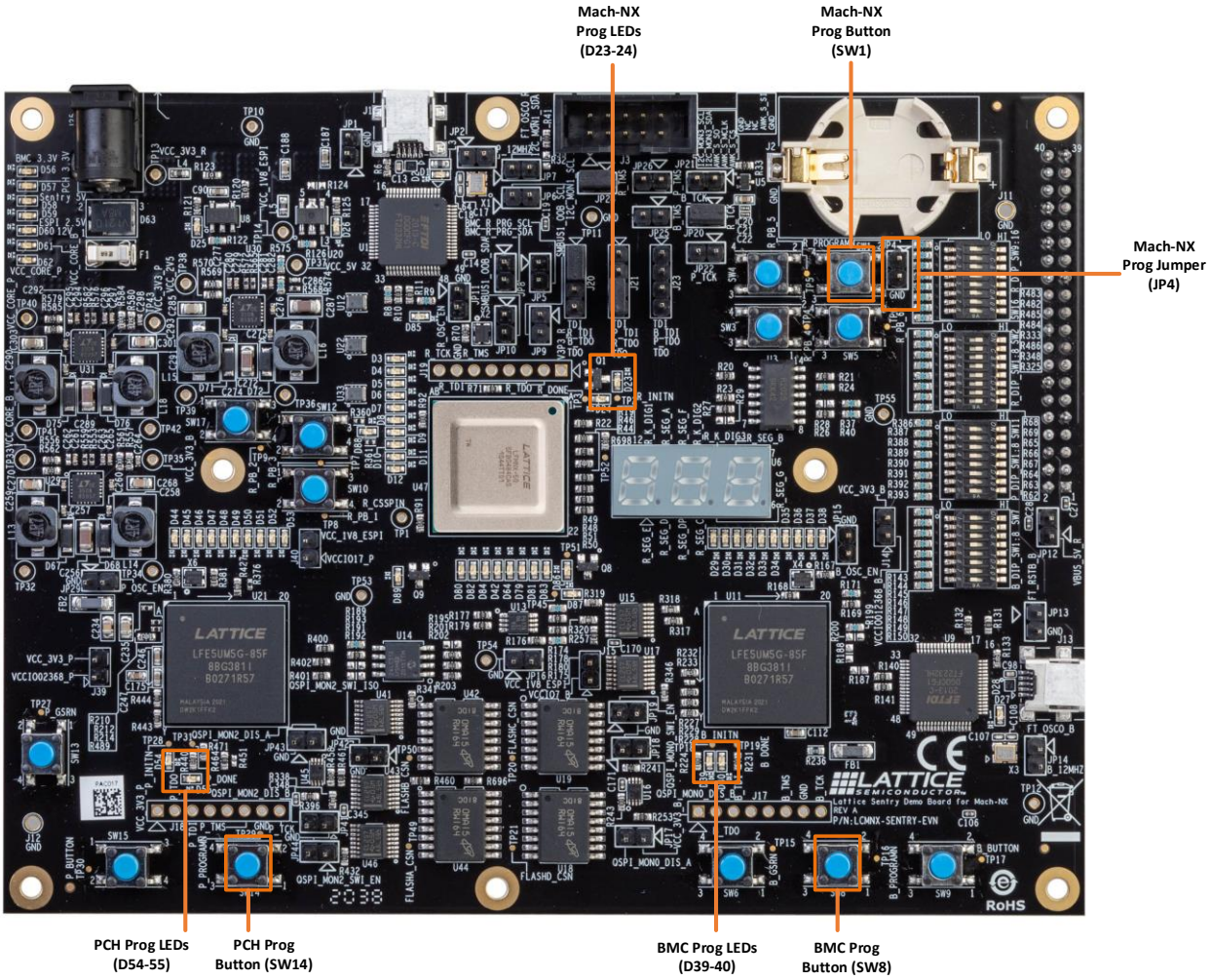


Figure 4.4. Location of Configuration Buttons and LEDs

Table 4.2. Programming Status LED Definitions

LED Designator	Color	Description
D23	Green	Indicates that the programming of the Mach-NX device is aborted or reinitialized, driving the INITN output low.
D24	Green	Indicates that the configuration of the Mach-NX device is successful completed by releasing the open collector DONE output pin.
D39	Green	Indicates that the programming of the ECP5 (BMC) device is aborted or reinitialized, driving the INITN output low.
D40	Green	Indicates that the configuration of the ECP5 (BMC) device is successful completed by releasing the open collector DONE output pin.
D54	Green	Indicates that the programming of the ECP5 (PCH) device is aborted or reinitialized, driving the INITN output low.
D55	Green	Indicates that the configuration of the ECP5 (PCH) device is successful completed by releasing the open collector DONE output pin.

4.3. Programming Flash Memory

In the Lattice Sentry Demo Board for Mach-NX, the Mach-NX device programs its internal flash memory and the two ECP5 devices program their four external SPI flash. Of the four SPI flash devices, Flash A (U44) and Flash B (U42) belong to the ECP5 (PCH) device and Flash C (U19) and Flash D (U18) belong to the ECP5 (BMC) device. Before starting to program external SPI flash, configure the jumpers as indicated in Table 4.3. The jumpers are located next to the four flash devices.

Table 4.3. Jumper Description

Jumper Designator	Description
JP19	Asserts/de-asserts the enable logic on quick switches U15 and U17. Closing the jumper drives a logic level *0* to the enable device. When programming the ECP5 (BMC) flashes, JP19 must be closed.
JP42, JP44	Asserts/de-asserts the enable logic on quick switches U46, U43 and U41. Closing the jumper drives a logic level *0* to the enable device. When programming the ECP5 (PCH) flashes, JP42 and JP44 must be closed.
JP17	Asserts/de-asserts the CS logic on Flash C. Closing the jumper drives a logic level 1 to the selected device. When programming Flash C, JP17 must be open.
JP18	Asserts/de-asserts the CS logic on Flash D. Closing cap drives a logic level 0 to the selected device. When programming Flash D, JP18 must be closed. JP17 and JP18 are alternative.
JP43	Asserts/de-asserts the CS logic on Flash A. Closing the jumper drives a logic level 0 to the device selection device. When programming Flash A, JP43 must be closed.
JP41	Asserts/de-asserts the CS logic on external Flash B. Close the jumper cap drives a logic level 0 to the selected device. When programming Flash B, JP8 must be closed. JP41 and JP43 are alternative.

Note: When running the demonstration program, the above jumpers must not be installed.

Table 4.4. Programming Jumper Selection

Target Flash Programming	JP19	JP17	JP18	JP42 & JP44	JP43	JP41
Flash A – PCH Primary	Open	Open	Open	Closed	Closed	Open
Flash B – PCH Backup	Open	Open	Open	Closed	Open	Closed
Flash C – BMC Primary	Closed	Open	Open	Open	Open	Open
Flash D – BMC Backup	Closed	Closed	Closed	Open	Open	Open
PFR Demo	Open	Open	Open	Open	Open	Open

Four SPI (16-pin SO16W, 1 Gb) flash memory devices, are onboard for non-volatile configuration memory storage. The Micron MT25QL01GBBB device is populated on current PCB version. When programming external flash, the Lattice Diamond Programmer locates and indicates the device in the Device Properties dialog box. The SPI flash memory device can be configured through the USB cable. The Master SPI configuration mode enables the three main devices to be programmed at power-up or assertion of PROGRAMN by the bitstream stored in the internal and external memories.

5. FPGA/CPLD Resources

The Lattice Sentry Demo Board for Mach-NX supports various development resources including 38 LEDs, 18 of which belong to Mach-NX device, 10 belong to ECP5 (BMC) device, and 10 belong to ECP5 (PCH) device. There is a 3-digit 7-segment LED, which belongs to the Mach-NX device. There are 16 switches for the Mach-NX, and eight each for the ECP5 (BMC) and ECP5 (PCH) devices. There are seven push buttons located near the Mach-NX device, three each for the ECP5 (BMC) and ECP5 (PCH) device. Among Mach-NX, ECP5 (BMC), and ECP5 (PCH) devices, there are some reserved GPIO connections. You can utilize these resources through the FPGA/CPLD logic coding.

5.1. General Purpose LEDs

The Lattice Sentry Demo Board for Mach-NX has 38 LEDs that are connected to general purpose I/O. These green LEDs are visual status indicators for user designs. The LEDs are illuminated when the FPGA/CPLD output is driven LOW. Table 5.1 shows the Mach-NX LEDs and associated pins name. Table 5.2 shows the ECP5 (BMC) LEDs and associated pins name. Table 5.3 shows the ECP5 (PCH) LEDs and associated pins name. These pins are within an I/O bank connected to 3.3 V and you should program these pins to be LVCMOS33 type output in your design.

Table 5.1. Mach-NX LED Definitions

LED Designator	Mach-NX U47 Pin Number	Signal Name
D3	T2	R_LED_0
D4	T1	R_LED_1
D5	U1	R_LED_2
D6	V1	R_LED_3
D7	W1	R_LED_4
D8	Y1	R_LED_5
D9	AA1	R_LED_6
D10	Y2	R_LED_7
D11	W2	R_LED_8
D12	V3	R_LED_9
D80	L18	R_LED_10
D82	L19	R_LED_11
D84	M19	R_LED_12
D42	M20	R_LED_13
D64	K18	R_LED_14
D79	K22	R_LED_15
D81	L22	R_LED_16
D83	K21	R_LED_17

Table 5.2. ECP5 (BMC) LED Definitions

LED Designator	ECP5 (BMC) U11 Pin Number	Signal Name
D29	E8	B_LED_1
D30	D8	B_LED_2
D31	D9	B_LED_3
D32	E9	B_LED_4
D33	D10	B_LED_5
D34	E10	B_LED_6
D35	E6	B_LED_7
D36	D6	B_LED_8
D37	E7	B_LED_9
D38	D7	B_LED_10

Table 5.3. ECP5 (PCH) LED Definitions

LED Designator	ECP5 (PCH) U21 Pin Number	Signal Name
D44	C6	P_LED_1
D45	C7	P_LED_2
D46	E8	P_LED_3
D47	D8	P_LED_4
D48	C8	P_LED_5
D49	C11	P_LED_6
D50	E6	P_LED_7
D51	D6	P_LED_8
D52	E7	P_LED_9
D53	D7	P_LED_10

5.2. 7-Segment LEDs

The Lattice Sentry Demo Board for Mach-NX has 3-digit 7-segment LEDs that are connected to the Mach-NX device general purpose I/O. These LEDs are visual status indicators for user designs. The LEDs are illuminated for the digit when the FPGA/CPLD output is driven LOW, and for each segment when the FPGA/CPLD output is driven HIGH. Table 5.4 shows the Mach-NX 7-Segment LEDs and associated pins name. These pins are within an I/O bank connected to 3.3 V and you should program these pins to be LVCMOS33 type output in your design.

Table 5.4. Mach-NX 7-Segment LED Definitions

LED Designator	Mach-NX U47 Pin Number	Signal Name
U6.3	AA10	R_SEG_DP
U6.5	AB7	R_SEG_G
U6.10	Y7	R_SEG_F
U6.1	U7	R_SEG_E
U6.2	U8	R_SEG_D
U6.4	R8	R_SEG_C
U6.7	AA8	R_SEG_B
U6.11	Y10	R_SEG_A
U6.12	AB6	R_K_DIG1
U6.9	V6	R_K_DIG2
U6.8	U6	R_K_DIG3

5.3. General Purpose DIP Switches

General purpose FPGA/CPLD pins are available for user applications. FPGA/CPLD pins are connected to DIP switches SW2, SW16, SW11, and SW7. SW2 and SW16 belong to the Mach-NX device, SW7 belongs to the ECP5 (BMC) device, and SW11 belong to the ECP5 (PCH) device. Switch position OFF is indicated with the logic 1 input. The switches are connected to logic level 0 input when moved to the ON position. You should program these pins to be LVCMOS33 type output in your design. Table 5.5, Table 5.6, and Table 5.7 show the switches and associated FPGA/CPLD pins.

Table 5.5.Mach-NX Pins to DIP Switch Position

SW2/SW16 DIP Switch Position	Mach-NX U47 Pin Number	Signal Name
SW2.1	P4	R_DIP_SW1
SW2.2	P5	R_DIP_SW2
SW2.3	P7	R_DIP_SW3
SW2.4	P8	R_DIP_SW4
SW2.5	R1	R_DIP_SW5
SW2.6	R2	R_DIP_SW6
SW2.7	R3	R_DIP_SW7
SW2.8	T3	R_DIP_SW8
SW16.1	H21	R_DIP_SW9
SW16.2	H20	R_DIP_SW10
SW16.3	H22	R_DIP_SW11
SW16.4	J19	R_DIP_SW12
SW16.5	F22	R_DIP_SW13
SW16.6	K18	R_DIP_SW14
SW16.7	J20	R_DIP_SW15
SW16.8	L21	R_DIP_SW16

Table 5.6. ECP5 (BMC) Pins to DIP Switch Position

SW7 DIP Switch Position	ECP5 (BMC) U11 Pin Number	Signal Name
1	L4	B_DIP_SW1
2	L5	B_DIP_SW2
3	M5	B_DIP_SW3
4	M4	B_DIP_SW4
5	N5	B_DIP_SW5
6	N3	B_DIP_SW6
7	M3	B_DIP_SW7
8	L3	B_DIP_SW8

Table 5.7. ECP5 (PCH) Pins to DIP Switch Position

SW11 DIP Switch Position	ECP5 (PCH) U21 Pin Number	Signal Name
1	C18	P_DIP_SW1
2	D17	P_DIP_SW2
3	E16	P_DIP_SW3
4	F16	P_DIP_SW4
5	D18	P_DIP_SW5
6	E17	P_DIP_SW6
7	E18	P_DIP_SW7
8	F18	P_DIP_SW8

5.4. General Purpose Clock Sources

There are five clock sources available on the board, as shown in Table 5.8.

Table 5.8. FPGA/CPLD Clock Source

Clock Source	Clock Frequency (MHz)	Mach-NX U47 Pin Number	ECP5 (BMC) U11 Pin Number	ECP5 (PCH) U21 Pin Number	Comment
X1	12	—	—	H2	Closing JP2 to enable clock input.
X2	25	L3	—	—	Closing JP11, or output *0* to pin M1 of the U47 device to disable clock output.
X3	12	—	A10	—	Closing JP14 to enable clock input.
X4	25	—	B11	—	Closing JP15, or output *0* to pin C11 of the U11 device to disable clock output.
X6	25	—	—	A10	Closing JP29, or output *0* to pin C9 of the U21 device to disable clock output.

5.5. Push Buttons

The Lattice Sentry Demo Board for Mach-NX has 13 push buttons for general or dedicated purpose FPGA/CPLD pins. Table 5.9, Table 5.10, and Table 5.11 below describe the function and connections of the push buttons. When a push button is pressed, the logic *0* is sent to FPGA/CPLD. You must program inputs to be the LVCMOS33 type in the design for the push buttons.

Table 5.9. Push Buttons to Mach-NX Pins Position

Push Button Designator	Mach-NX U47 Pin Number	Signal Name
SW1	G9	R_PROGRAMN
SW10	U16	R_PB_1
SW17	U17	R_PB_2
SW12	V17	R_PB_3
SW3	J22	R_PB_4
SW4	E22	R_PB_5
SW5	G21	R_PB_6

Table 5.10. Push Buttons to ECP5 (BMC) Pins Position

Push Button Designator	ECP5 (BMC) U11 Pin Number	Signal Name
SW6	G2	B_GSRN
SW8	W3	B_PROGRAMN
SW9	P4	B_BUTTON

Table 5.11. Push Buttons to ECP5 (PCH) Pins Position

Push Button Designator	ECP5 (PCH) U21 Pin Number	Signal Name
SW13	G2	P_GSRN
SW14	W3	P_PROGRAMN
SW15	J4	P_BUTTON

6. Board Interface Connections

This section describes the major board interfaces, which include chip-to-chip communication, quick switch control, I^2C, SPI, Reset, OOB, eSPI, UART, and Raspberry Pi.

6.1. SPI/QSPI Monitor Connections

The Lattice Sentry Demo Board for Mach-NX provides two SPI/QSPI monitor paths. The Mach-NX device can detect and block illegal data transaction by these paths. The signal definitions of the Mach-NX device are provided in Table 6.1 and Table 6.2.

Table 6.1. Mach-NX and ECP5 (BMC) SPI/QSPI Monitor Interface Definitions

Mach-NX U47 Pin Number	Signal Name	Signal Comment
R15	QSPI_MON0_SWI_EN	Quick switch enable signal
T17	QSPI_MON0_DIS_A	Flash C selection signal
T16	QSPI_MON0_DIS_B	Flash D selection signal
K15	B_FLASH_CLK	Flash clock signal
H14	B_FLASH_CS	Flash CS signal
J13	B_FLASH_DQ0	Flash data0 signal
K12	B_FLASH_DQ1	Flash data1 signal
H15	B_FLASH_DQ2	Flash data2 signal
J12	B_FLASH_DQ3	Flash data3 signal
F17/P16	B_CSSPIN/B_FLASH_PRE_CS	BMC MSPI CS signal
G19	B_DQ0_MOSI	BMC MSPI data0 signal
H17	B_DQ1_MISO	BMC MSPI data1 signal
W4	R_FLASHC_RSTN	Flash C reset signal
Y4	R_FLASHD_RSTN	Flash D reset signal

Table 6.2. Mach-NX and ECP5 (PCH) SPI/QSPI Monitor Interface Definitions

Mach-NX U47 Pin Number	Signal Name	Signal Comment
E20	P_FLASH_CLK	Flash clock signal
E18	P_FLASH_CS	Flash CS signal
D19	P_FLASH_DQ0	Flash data0 signal
D18	P_FLASH_DQ1	Flash data1 signal
B22	P_FLASH_DQ2	Flash data2 signal
C21	P_FLASH_DQ3	Flash data3 signal
E21	P_FLASH_PRE_CS	Pre switch Flash CS signal
C22	QSPI_MON2_DIS_A	Flash A selection signal
D22	QSPI_MON2_DIS_B	Flash B selection signal
AB4	R_FLASHA_RSTN	Flash A reset signal
AA4	R_FLASHB_RSTN	Flash B reset signal
J18	QSPI_MON2_SWI_ISO	Quick switch enable signal
D20	QSPI_MON2_SWI_EN	Quick switch enable signal

6.2. ECP5 (BMC) SPI/QSPI and Control Interface

The ECP5 (BMC) device has two SPI/QSPI data paths to access to external flash. The signal definitions of the ECP5 (BMC) device are provided in Table 6.3.

Table 6.3. ECP5 (BMC) SPI/QSPI and Control Interface Definitions

ECP5 (BMC) U11 Pin Number	Signal Name	Signal Comment
U3	B_MCLK	MSPI clock signal
R2	B_CSSPIN	MSPI CS signal
W2	B_DQ0_MOSI	MSPI data0 signal
V2	B_DQ1_MISO	MSPI data1 signal
Y2	B_DQ2	MSPI data2 signal
W1	B_DQ3	MSPI data2 signal
A6	B_QSBMC_SPI_CLK	GPIO SPI clock signal
B8	B_QSBMC_SPI_CS	GPIO SPI CS signal
B9	B_QSBMC_SPI_IO0	GPIO SPI data0 signal
B6	B_QSBMC_SPI_IO1	GPIO SPI data1 signal
B10	B_QSBMC_SPI_IO2	GPIO SPI data2 signal
A11	B_QSBMC_SPI_IO3	GPIO SPI data3 signal
P19	B_QSBMC_SEL	Quick switch selection signal (BMC Flash)
L19	B_QSPCH00_QSPI_CLK	QSPI clock signal
L20	B_QSPCH00_QSPI_CS	QSPI CS signal
M20	B_QSPCH00_QSPI_IO0	QSPI data0 signal
L18	B_QSPCH00_QSPI_IO1	QSPI data1 signal
M19	B_QSPCH00_QSPI_IO2	QSPI data2 signal
N18	B_QSPCH00_QSPI_IO3	QSPI data3 signal
A9	B_QSPCH0_SEL	Quick switch selection signal (PCH Flash)

6.3. ECP5 (PCH) SPI/QSPI and Control Interface

The ECP5 (PCH) device has one SPI/QSPI data path to access to external flash. The signal definitions of the ECP5 (PCH) device are provided in Table 6.4.

Table 6.4. ECP5 (CPH) SPI/QSPI and Control Interface Definitions

ECP5 (PCH) U21 Pin Number	Signal Name	Signal Comment
U3	P_MCLK	MSPI clock signal
R2	P_CSSPIN	MSPI CS signal
W2	P_DQ0_MOSI	MSPI data0 signal
V2	P_DQ1_MISO	MSPI data1 signal
Y2	P_DQ2_MOSI	MSPI data2 signal
W1	P_DQ3_MISO	MSPI data3 signal

6.4. Reset Signals

The Lattice Sentry Demo Board for Mach-NX has three reset signals among the three main chips. The signal definitions of reset signals are provided in Table 6.5.

Table 6.5. Reset Signals Definitions

Mach-NX U4 Pin Number	ECP5 (BMC) U11 Pin Number	ECP5 (PCH) U21 Pin Number	Signal Name
P13	W3	—	QSPI_MON0_RST (PROGRAMN)
—	K4	K20	B_P_RESETN
P14	—	—	QSPI_MON2_RST (PROGRAMN)

6.5. OOB Interface

The Lattice Sentry Demo Board for Mach-NX has one OOB data path between the Mach-NX and ECP5 (BMC) devices, and the data can be encrypted transmitted. The signal definitions of OOB path are provided in Table 6.6.

Table 6.6. OOB Interface Definitions

Mach-NX U47 Pin Number	ECP5 (BMC) U11 Pin Number	Signal Name
N21	F19	SMBUS1_OOB_SCL
N20	E20	SMBUS1_OOB_SDA
N19	F20	SMBUS1_OOB_ALERTN
C8	R18	B_R_RND_SIDEBAND
A8	K18	B_R_SIDEBAND_00
A7	J19	B_R_SIDEBAND_01
C7	K19	B_R_SIDEBAND_02
D7	J20	B_R_SIDEBAND_03
E7	K20	B_R_SIDEBAND_04

6.6. I²C Interface

The Lattice Sentry Demo Board for Mach-NX has multiple I²C paths. They can implement various types of I²C functions. In addition, several of the I²C paths can be monitored through an Aardvark connector, as discussed in the Expansion Signals section. The signal definitions of the I²C paths are provided in Table 6.7, Table 6.8, Table 6.9, and Table 6.10.

Table 6.7. I²C between Mach-NX and ECP5 (PCH) Signal Definitions

Mach-NX U47 Pin Number	ECP5 (PCH) U21 Pin Number	Signal Name	Comment
N22	G19	R_PCH_P2P_SDA	ECP5 (PCH) to Mach-NX I²C SDA signal
M22	H20	R_PCH_P2P_SCL	ECP5 (PCH) to Mach-NX I²C SCL signal
M21	G20	R_PCH_P2P_ALERTN	ECP5 (PCH) to Mach-NX I²C ALERTN signal

Table 6.8. Interconnections among Mach-NX, ECP5 (BMC), and Repeater Signal Definitions

Mach-NX U47 Pin Number	ECP5 (BMC) U11 Pin Number	Repeater U13 Pin Number	Signal Name	Comment
L13	—	3	I2C_MON1_SDA	ECP5 (BMC)/Mach-NX to repeater I²C SDA signal
L14	—	2	I2C_MON1_SCL	ECP5 (BMC)/Mach-NX to repeater I²C SCL signal
R13	U18	6	I2C_MON2_SDA	ECP5 (BMC)/Mach-NX to repeater I²C SDA signal
R14	U17	7	I2C_MON2_SCL	ECP5 (BMC)/Mach-NX to repeater I²C SCL signal
E11	T20	—	BMC_R_PRG_SDA	ECP5 (BMC) to Mach-NX program I²C SDA signal
D11	U20	—	BMC_R_PRG_SCL	ECP5 (BMC) to Mach-NX program I²C SCL signal
U4	C20	—	R_BMC_P2P_SDA	ECP5 (BMC) to Mach-NX SDA I²C signal
T4	D19	—	R_BMC_P2P_SCL	ECP5 (BMC) to Mach-NX SCL I²C signal

Table 6.9. Interconnections among ECP5 (PCH), and EEPROM Signal Definitions

ECP5 (PCH) U21 Pin Number	EEPROM U32 Pin Number	Signal Name	Comment
T20	5	I2C_MON1_SDA_R	ECP5 (PCH)/Mach-NX to EEPROM I²C SDA signal (=I2C_MON1_SDA)
U20	6	I2C_MON1_SCL_R	ECP5 (PCH)/Mach-NX to EEPROM I²C SCL signal (=I2C_MON1_SDA)

Table 6.10. Interconnections between Mach-NX and RTC Signal Definitions

Mach-NX U47 Pin Number	ECP5 (BMC) U11 Pin Number	RTC U3 Pin Number	Signal Name	Comment
P15	P20	13	I2C_MON3_SDA	ECP5 (BMC)/Mach-NX to RTC I²C SDA signal
R12	R20	2	I2C_MON3_SCL	ECP5 (BMC)/Mach-NX to RTC I²C SCL signal
F12	—	3	R_RTC_S_32KCLKOUT	RTC 32.768 kHz clock output signal
C12	—	7	R_RTC_CLKOUT_CTL	RTC 32.768 kHz clock output control signal
H7	—	10	RTC_R_INTA	RTC interrupt output signal

6.7. eSPI Interface

The Lattice Sentry Demo Board for Mach-NX has two eSPI paths on this demo board. They can implement eSPI data transition functions. The signal definitions of eSPI paths describe as Table 6.11 and Table 6.12.

Note: eSPI interface is not available for Sentry 2.2.

Table 6.11. eSPI between ECP (BMC) and ECP (PCH) Definitions

ECP5 (BMC) U11 Pin Number	ECP5 (PCH) U21 Pin Number	Signal Name	Comment
F2	F2	B_P_ESPI_CLK	ECP5 (BMC) to ECP5 (PCH) eSPI clock signal
H3	B1	B_P_ESPI_CS	ECP5 (BMC) to ECP5 (PCH) eSPI CS signal
G3	D2	B_P_ESPI_ALERT	ECP5 (BMC) to ECP5 (PCH) eSPI alert signal
H5	C2	B_P_ESPI_DATA0	ECP5 (BMC) to ECP5 (PCH) eSPI data0 signal
G5	E1	B_P_ESPI_DATA1	ECP5 (BMC) to ECP5 (PCH) eSPI data1 signal
H4	B2	B_P_ESPI_DATA2	ECP5 (BMC) to ECP5 (PCH) eSPI data2 signal
E1	D1	B_P_ESPI_DATA3	ECP5 (BMC) to ECP5 (PCH) eSPI data3 signal
D2	G5	B_P_ESPI_DATA4	ECP5 (BMC) to ECP5 (PCH) eSPI data4 signal
D1	C1	B_P_ESPI_DATA5	ECP5 (BMC) to ECP5 (PCH) eSPI data5 signal
C1	H5	B_P_ESPI_DATA6	ECP5 (BMC) to ECP5 (PCH) eSPI data6 signal
C2	G3	B_P_ESPI_DATA7	ECP5 (BMC) to ECP5 (PCH) eSPI data7 signal
B2	H3	B_P_ESPI_DATA8	ECP5 (BMC) to ECP5 (PCH) eSPI data8 signal
B1	H4	B_P_ESPI_DATA9	ECP5 (BMC) to ECP5 (PCH) eSPI data9 signal

Table 6.12. eSPI between Mach-NX and ECP (PCH) Definitions

Mach-NX U47 Pin Number	ECP5 (PCH) U21 Pin Number	Signal Name	Comment
U22	B12	R_P_ESPI_CLK	Mach-NX to ECP5 (PCH) eSPI clock signal
T21	C12	R_P_ESPI_CS	Mach-NX to ECP5 (PCH) eSPI CS signal
Y22	E14	R_P_ESPI_ALERT	Mach-NX to ECP5 (PCH) eSPI alert signal
W22	E12	R_P_ESPI_RSTN	Mach-NX to ECP5 (PCH) eSPI reset signal
V21	D14	R_P_ESPI_DATA0	Mach-NX to ECP5 (PCH) eSPI data0 signal
U21	C14	R_P_ESPI_DATA1	Mach-NX to ECP5 (PCH) eSPI data1 signal

6.8. UART Interface

The Lattice Sentry Demo Board for Mach-NX has three UART interfaces. The PC can communicate with the Mach-NX device with serial terminal software, through connector J1 and a USB cable. It can connect to the ECP5 (BMC) and the ECP5 (PCH) devices through connector J6 and a USB cable in the same way. The devices can input order and output information with UART interface. The signal definitions are described in Table 6.13, Table 6.14, and Table 6.15.

Table 6.13. Mach-NX UART Definitions

Mach-NX U47 Pin Number	FTDI U1 Pin Number	Signal Name
G20	38	R_UART_TXD
F21	39	R_UART_RXD

Table 6.14. ECP5 (BMC) UART Definitions

ECP5 (BMC) U11 Pin Number	FTDI U9 Pin Number	Signal Name
P2	16	B_UART_TXD
P3	17	B_UART_RXD

Table 6.15. ECP5 (PCH) UART Definitions

ECP5 (PCH) U21 Pin Number	FTDI U9 Pin Number	Signal Name
P1	38	P_UART_TXD
P2	39	P_UART_RXD

6.9. Expansion Signals

The Lattice Sentry Demo Board for Mach-NX has two expansion connectors. The connector J4 is the Raspberry PI connector. It is installed on the bottom side of the board. The connector J3 is Aardvark connector. The expansion signals of these connectors are LVCMOS33 power level. These expansion signals are available for user functions and observing I^2C traffic. The signal definitions are described in Table 6.16 and Table 6.17.

Table 6.16. Raspberry PI Connector Signal Definitions

Mach-NX U47 Pin Number	Raspberry PI Connector J4 Pin Number	Signal Name
B4	33	S_RASP_IO02
A4	32	S_RASP_IO03
A3	7	S_RASP_IO04
E4	23	S_RASP_IO05
D4	21	S_RASP_IO06
H1	15	S_RASP_IO07
G1	16	S_RASP_IO08
C4	27	S_RASP_IO09
C3	26	S_RASP_IO10
D3	29	S_RASP_IO11
L7	13	S_RASP_IO12
D1	37	S_RASP_IO13
E1	24	S_RASP_IO14
E2	12	S_RASP_IO15
L6	10	S_RASP_IO16
B3	40	S_RASP_IO17
F2	5	S_RASP_IO18
D2	36	S_RASP_IO19
L5	11	S_RASP_IO20
L4	3	S_RASP_IO21
B1	31	S_RASP_IO22
G4	18	S_RASP_IO23
G3	19	S_RASP_IO24
G2	38	S_RASP_IO25
F1	22	S_RASP_IO26
C1	35	S_RASP_IO27
H2	8	S_RASP_ID_SC
C2	28	S_RASP_ID_SD

Table 6.17. Aardvark Connector Signal Definitions

Mach-NX U47 or ECP5 (BMC) U11 Pin Num	Aardvark Connector J13 Pin Num	Signal Name
U47.N21 and U11.F19 or U47.D11 and U11.U20 or U47.L14	1	SMBUS1_OOB_SCL or BMC_R_PRG_SCL or I2C_MON1_SCL (jumper options)
U4.N20 and U11.E20 or U4.E11 and U11.T20 or U47.L13	3	SMBUS1_OOB_SDA or BMC_R_PRG_SDA or I2C_MON1_SDA (jumper options)
C14	5	AWK_R_SO
D14	7	AWK_R_MCLK
C13	8	AWK_R_SI
B13	9	AWK_R_CS

7. Ordering Information

Table 7.1 Ordering Information

Description	Ordering Part Number	China RoHS Environment-Friendly Use Period (EFUP)
Lattice Sentry Demo Board for Mach-NX	LFMNX-SENTRY-EVN	

Appendix A. Lattice Sentry Demo Board for Mach-NX Schematics

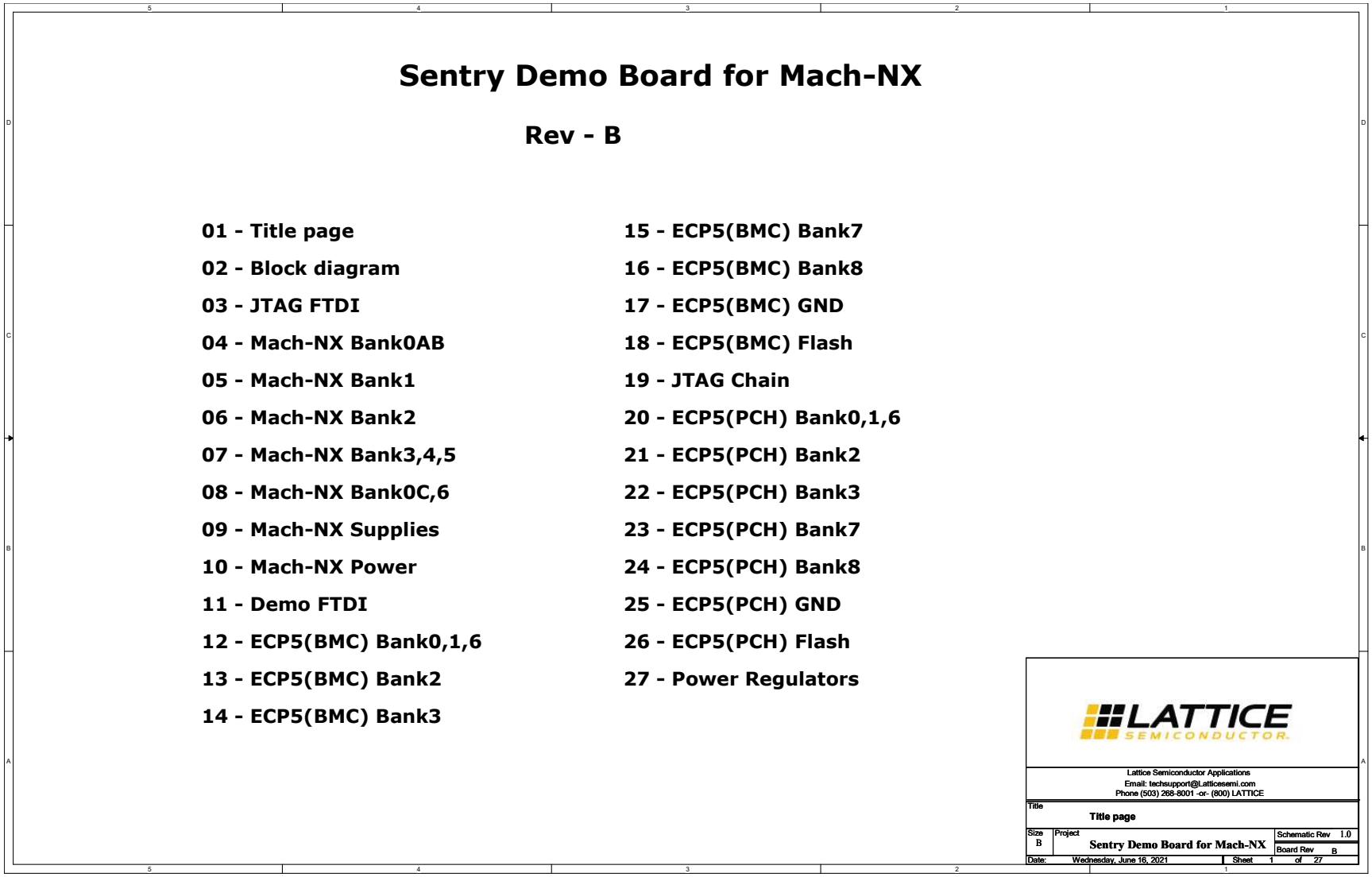


Figure A.1. Title Page

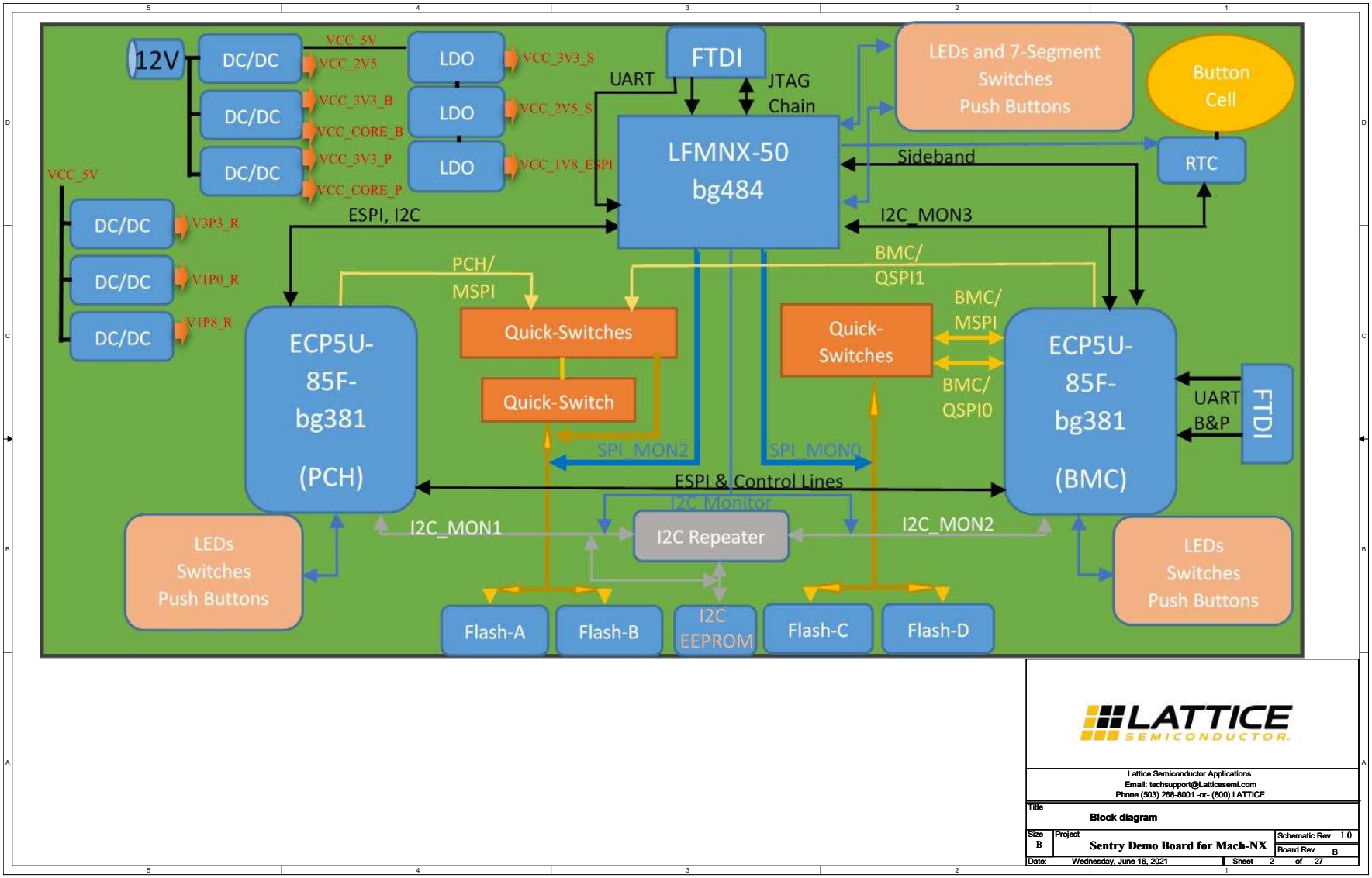


Figure A.2. Block Diagram

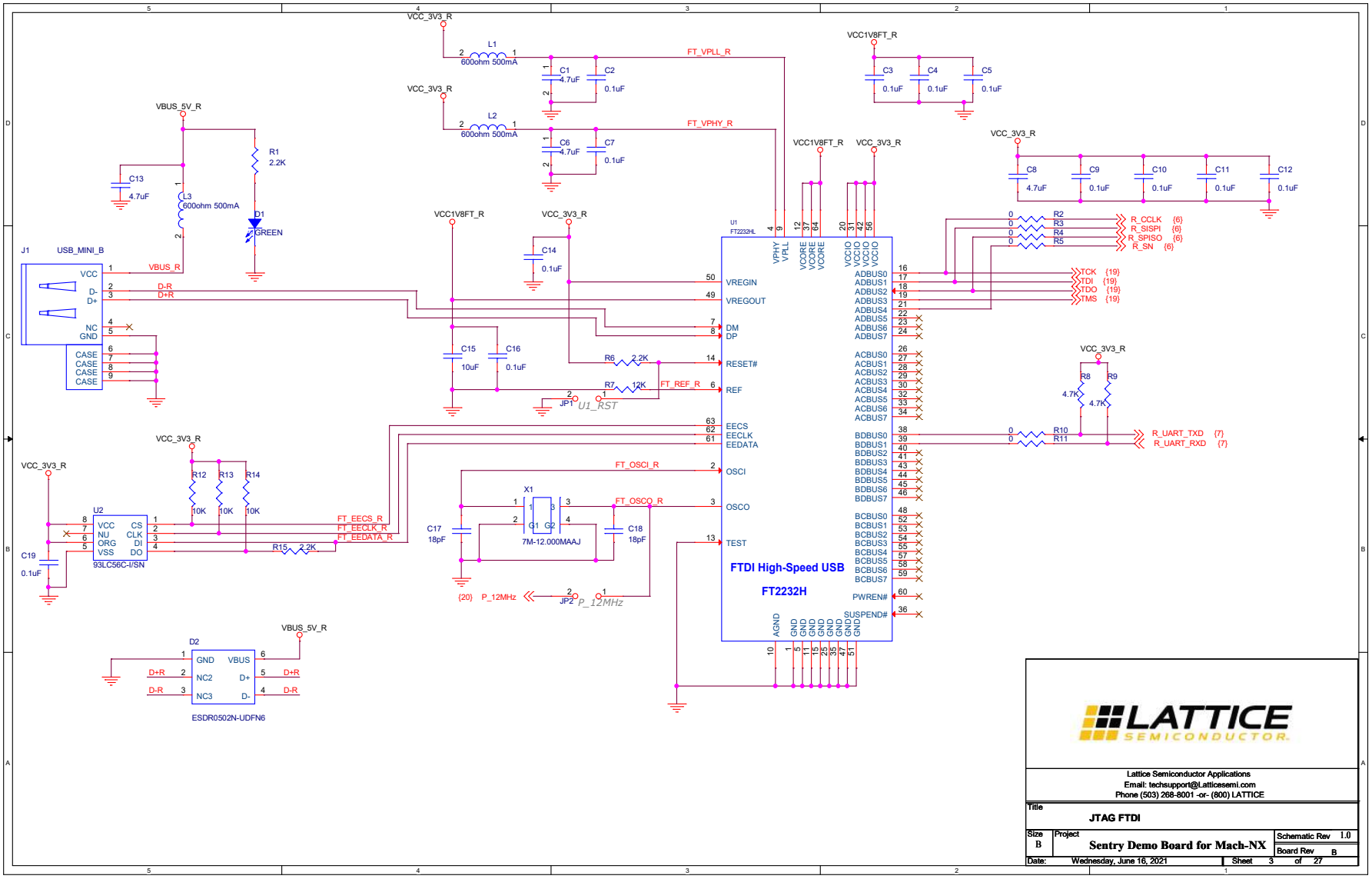


Figure A.3. JTAG FTDI

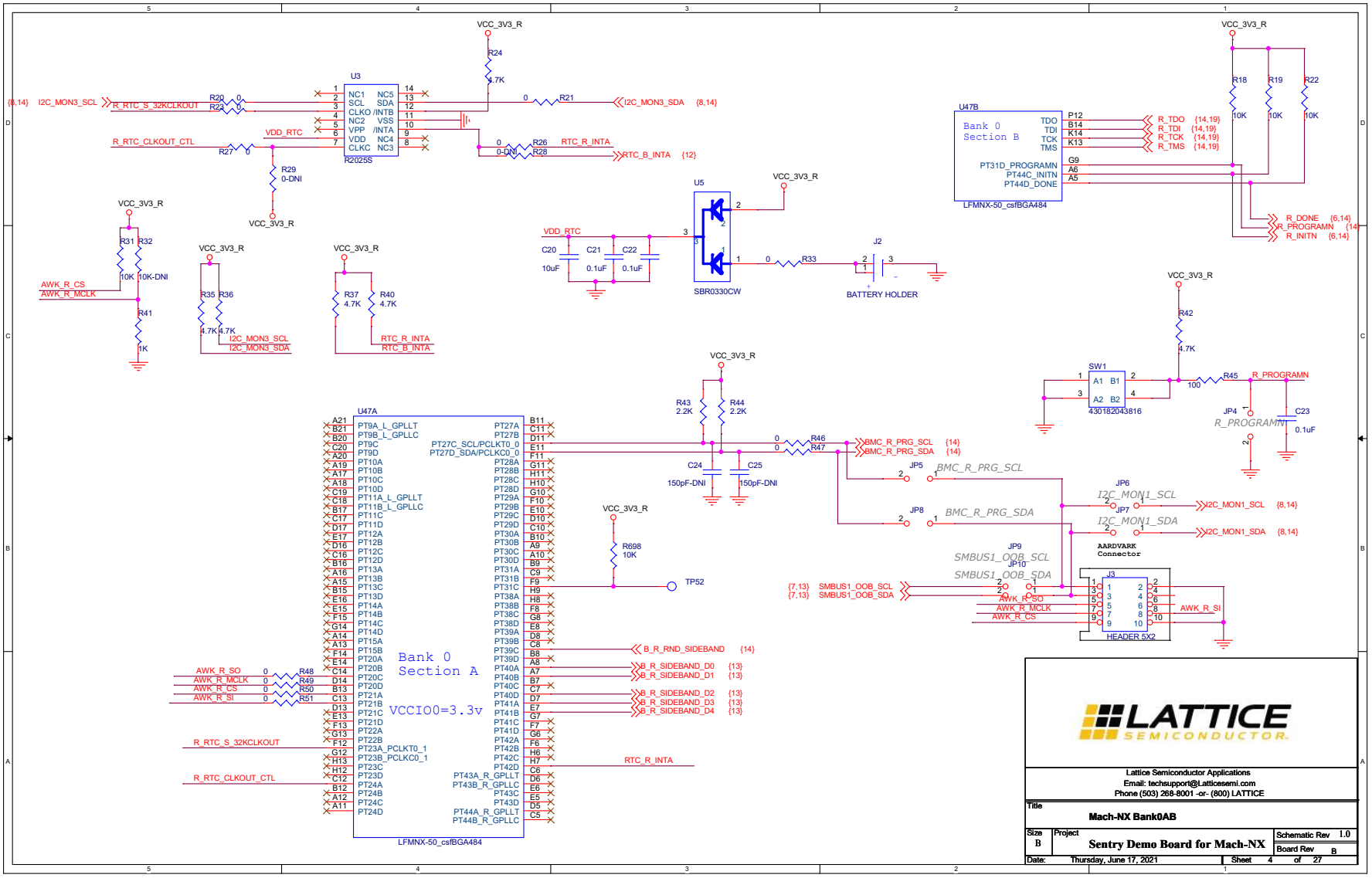
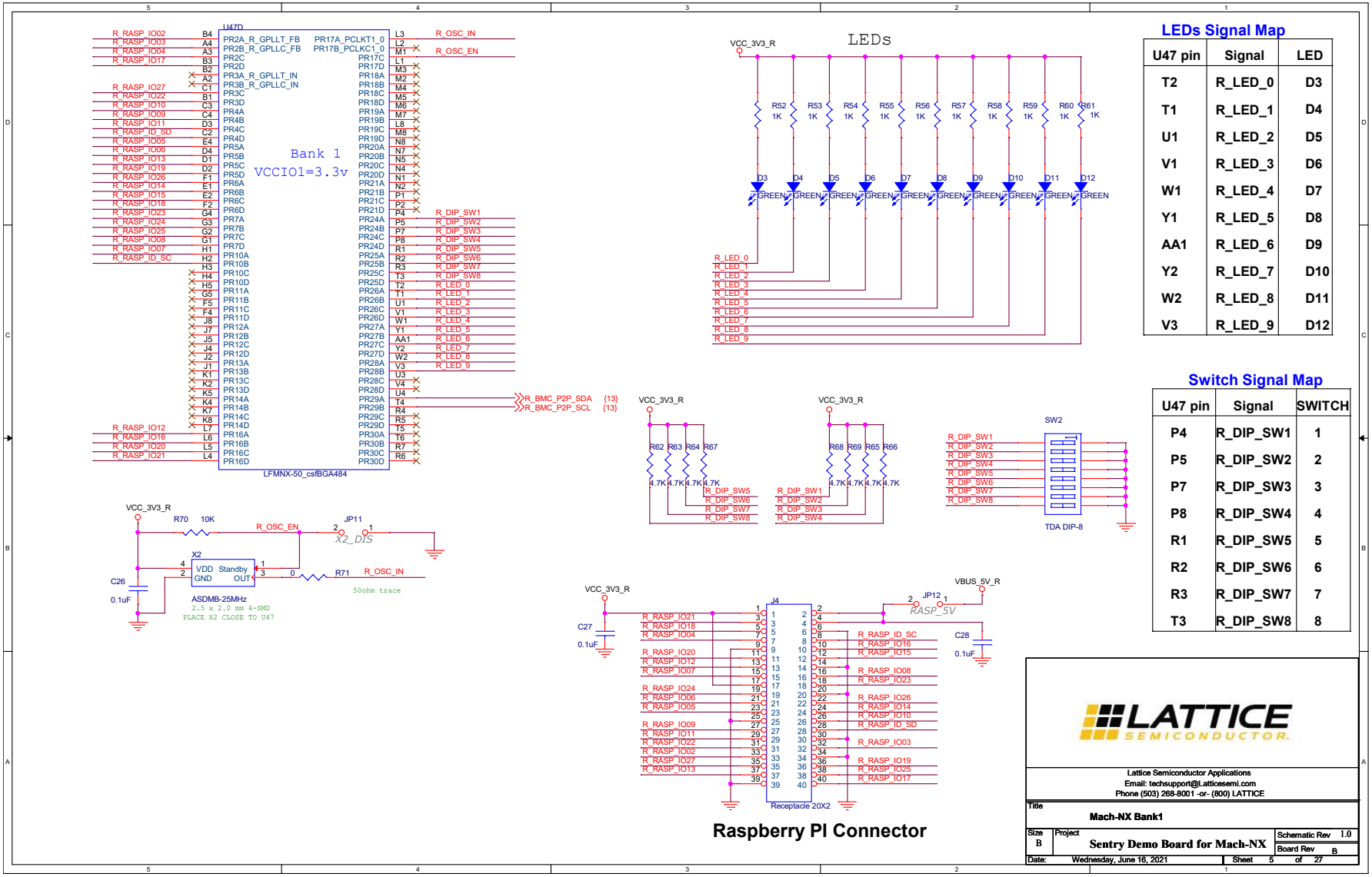


Figure A.4. Mach-NX Bank0AB



LEDs Signal Map

U47 pin	Signal	LED
T2	R_LED_0	D3
T1	R_LED_1	D4
U1	R_LED_2	D5
V1	R_LED_3	D6
W1	R_LED_4	D7
Y1	R_LED_5	D8
AA1	R_LED_6	D9
Y2	R_LED_7	D10
W2	R_LED_8	D11
V3	R_LED_9	D12

Switch Signal Map

U47 pin	Signal	SWITCH
P4	R_DIP_SW1	1
P5	R_DIP_SW2	2
P7	R_DIP_SW3	3
P8	R_DIP_SW4	4
R1	R_DIP_SW5	5
R2	R_DIP_SW6	6
R3	R_DIP_SW7	7
T3	R_DIP_SW8	8

Figure A.5. Mach-NX Bank1

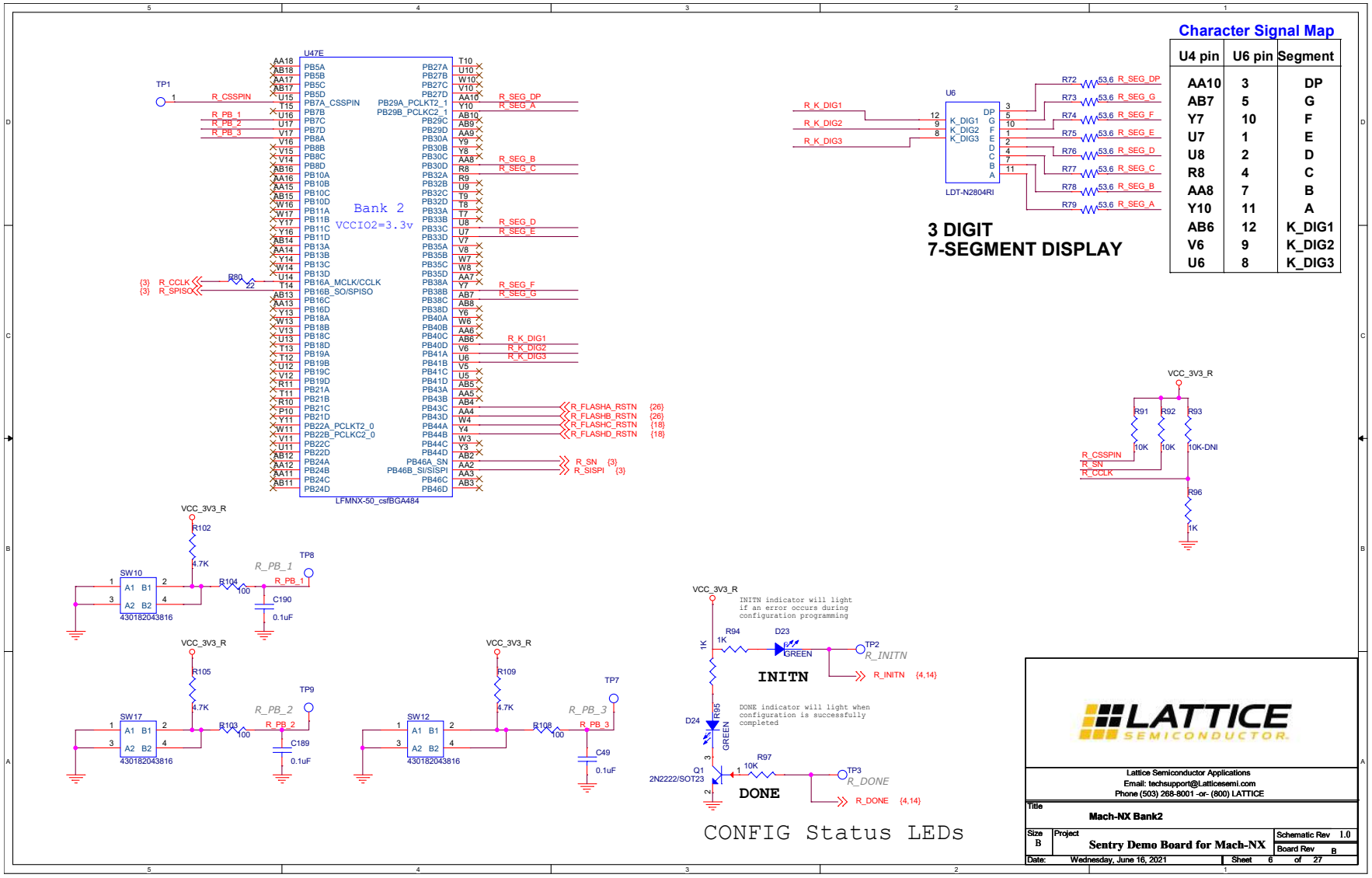


Figure A.6. Mach-NX Bank2

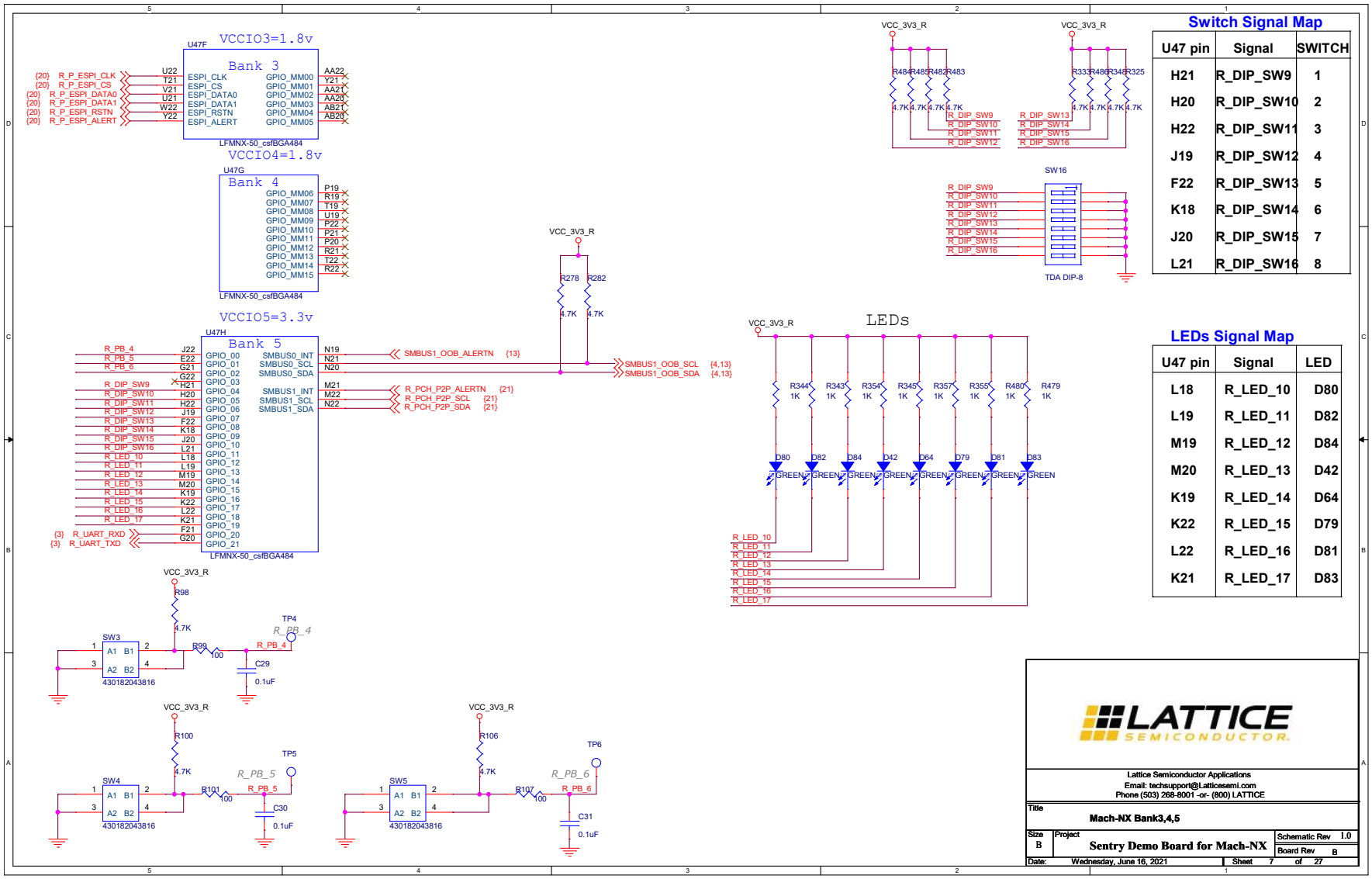


Figure A.7. Mach-NX Bank3,4,5

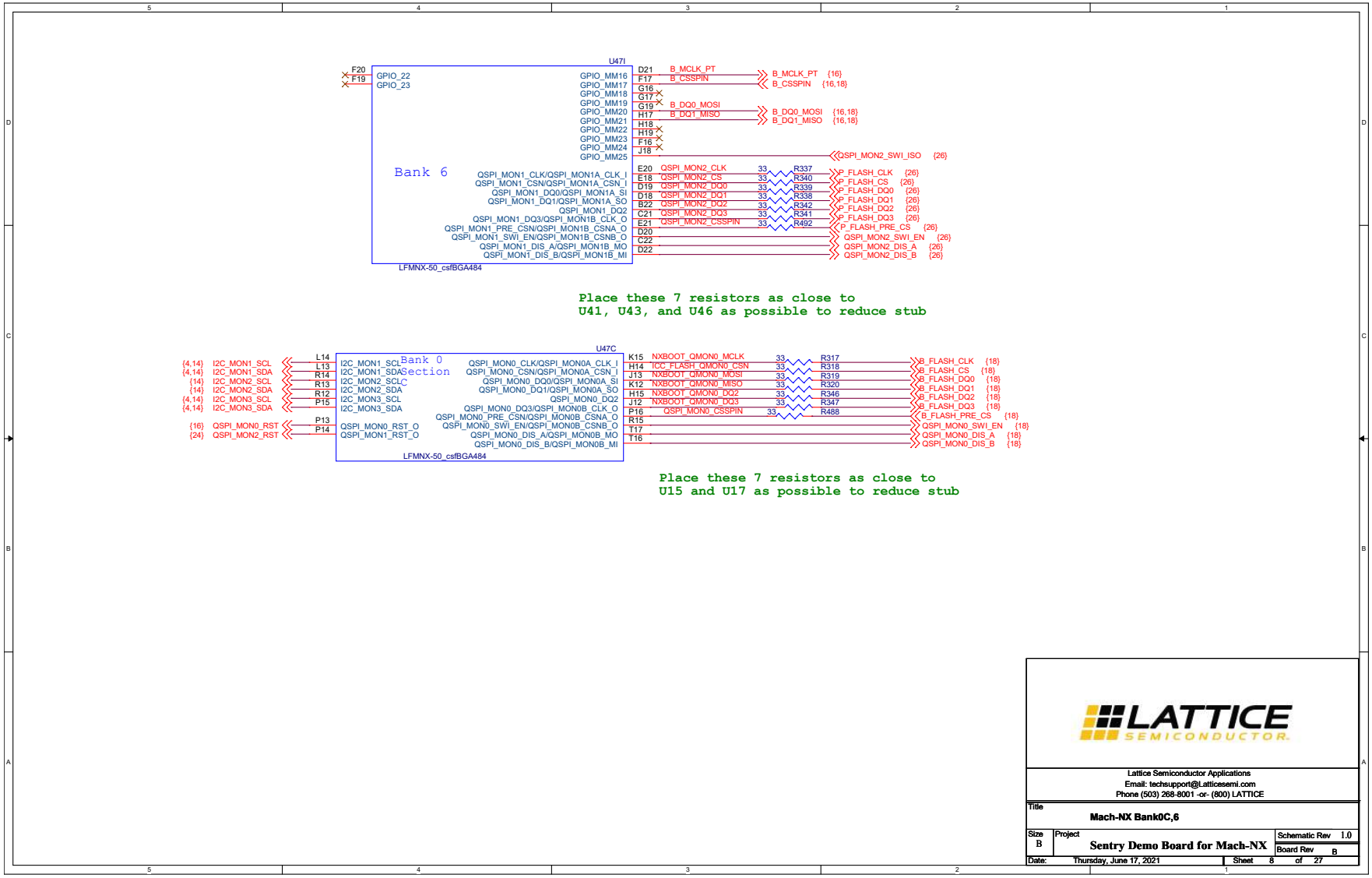


Figure A.8. Mach-NX Bank0C,6

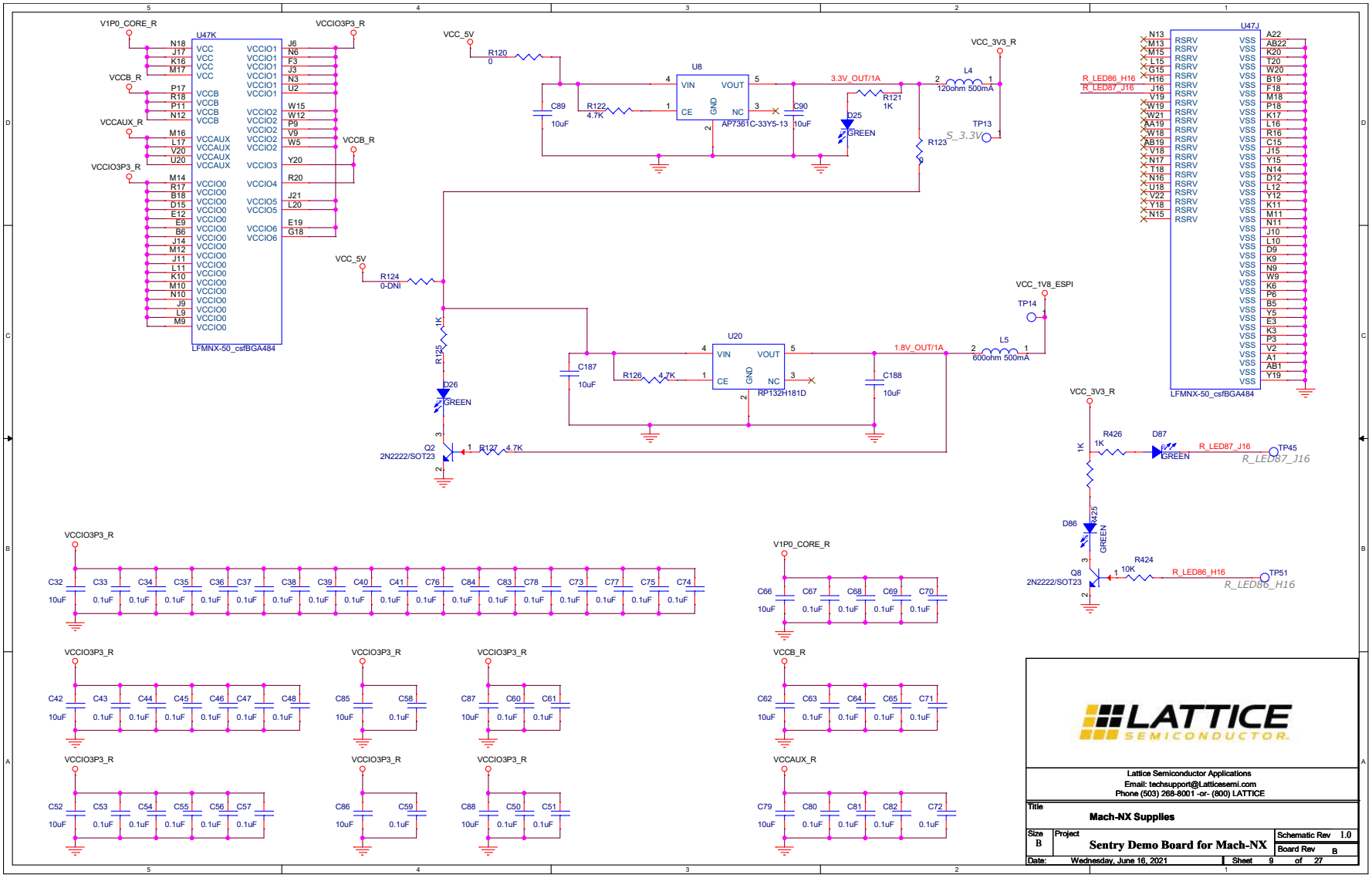


Figure A.9. Mach-NX Supplies

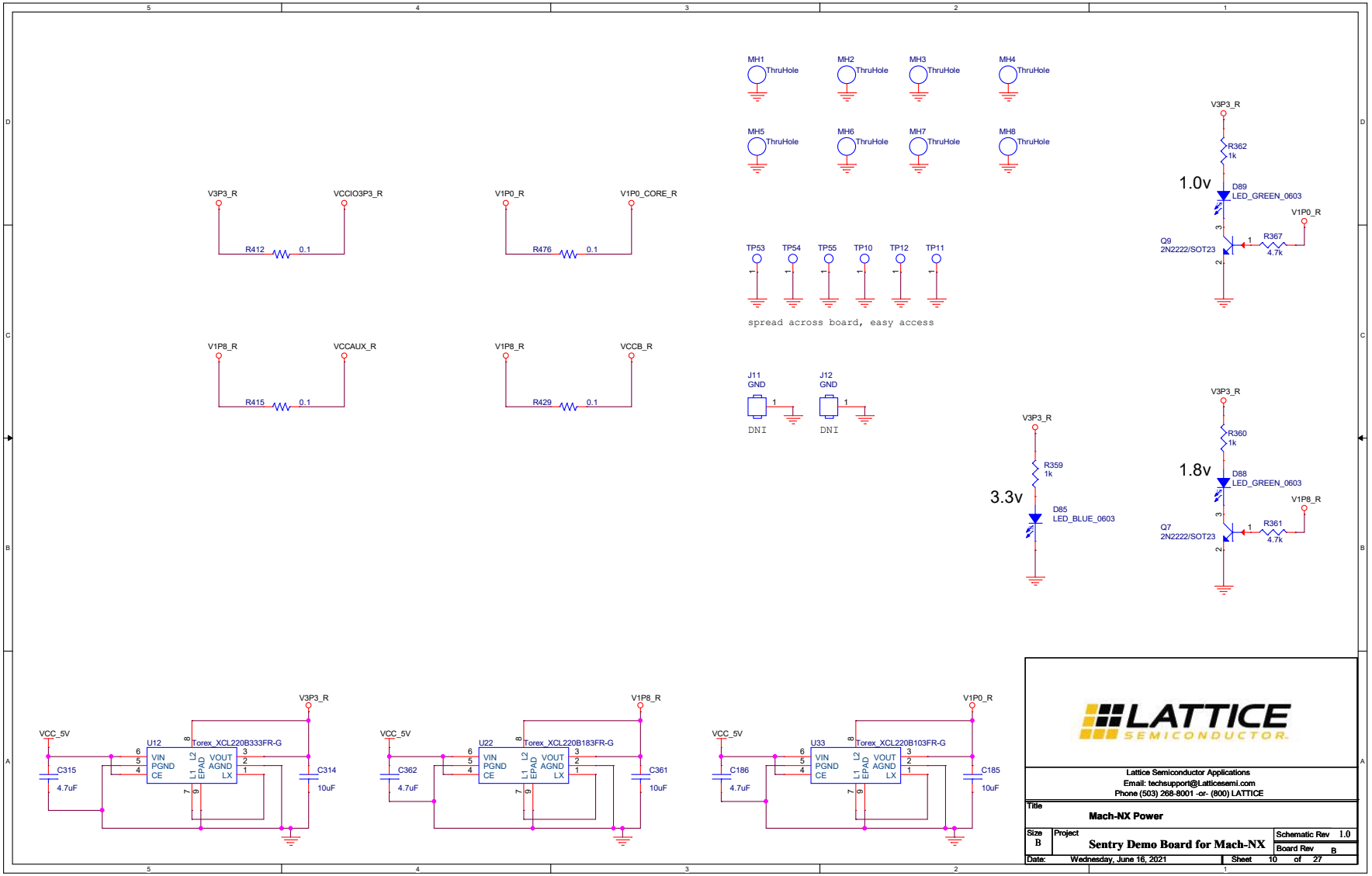


Figure A.10. Mach-NX Power

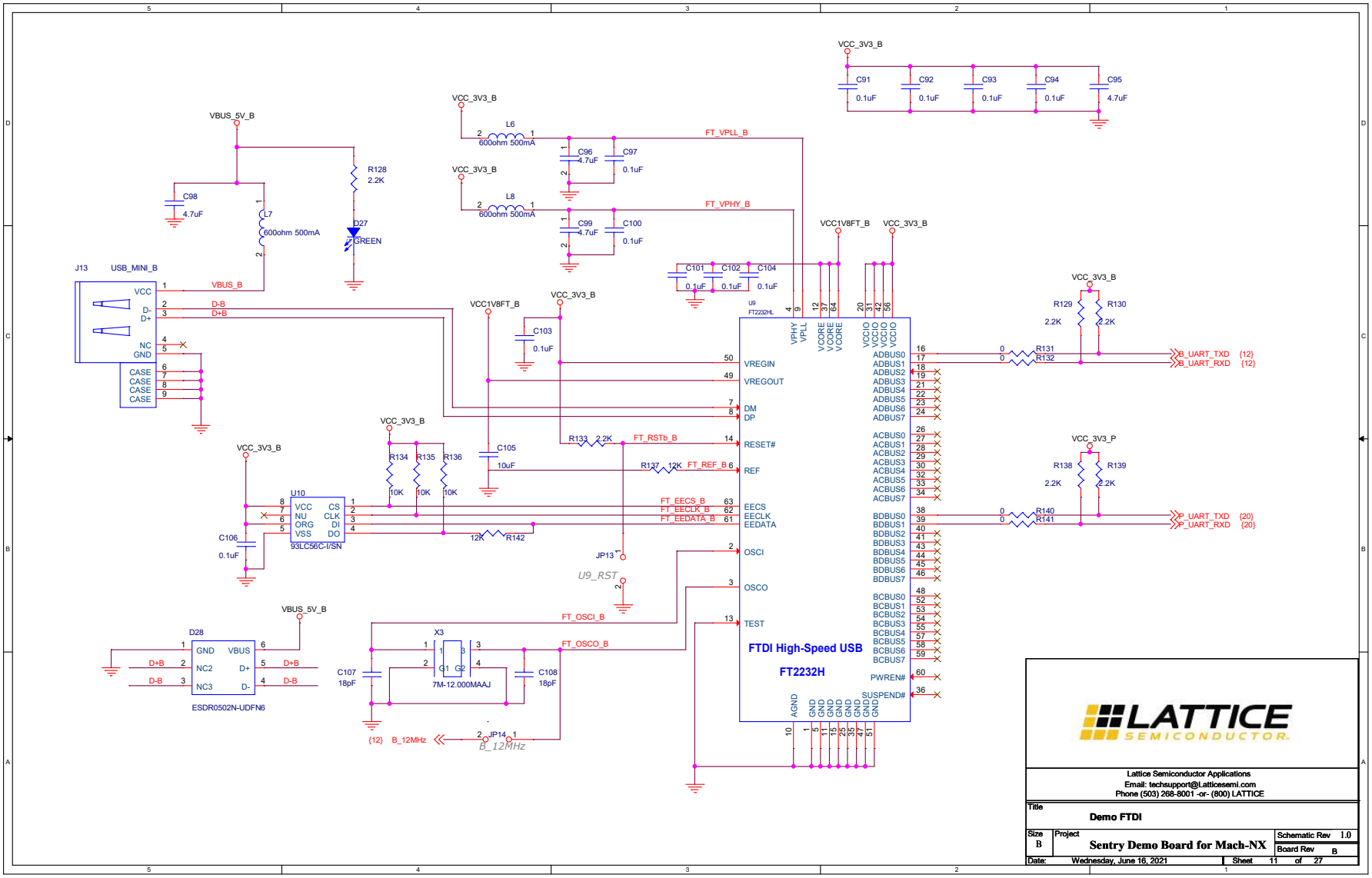
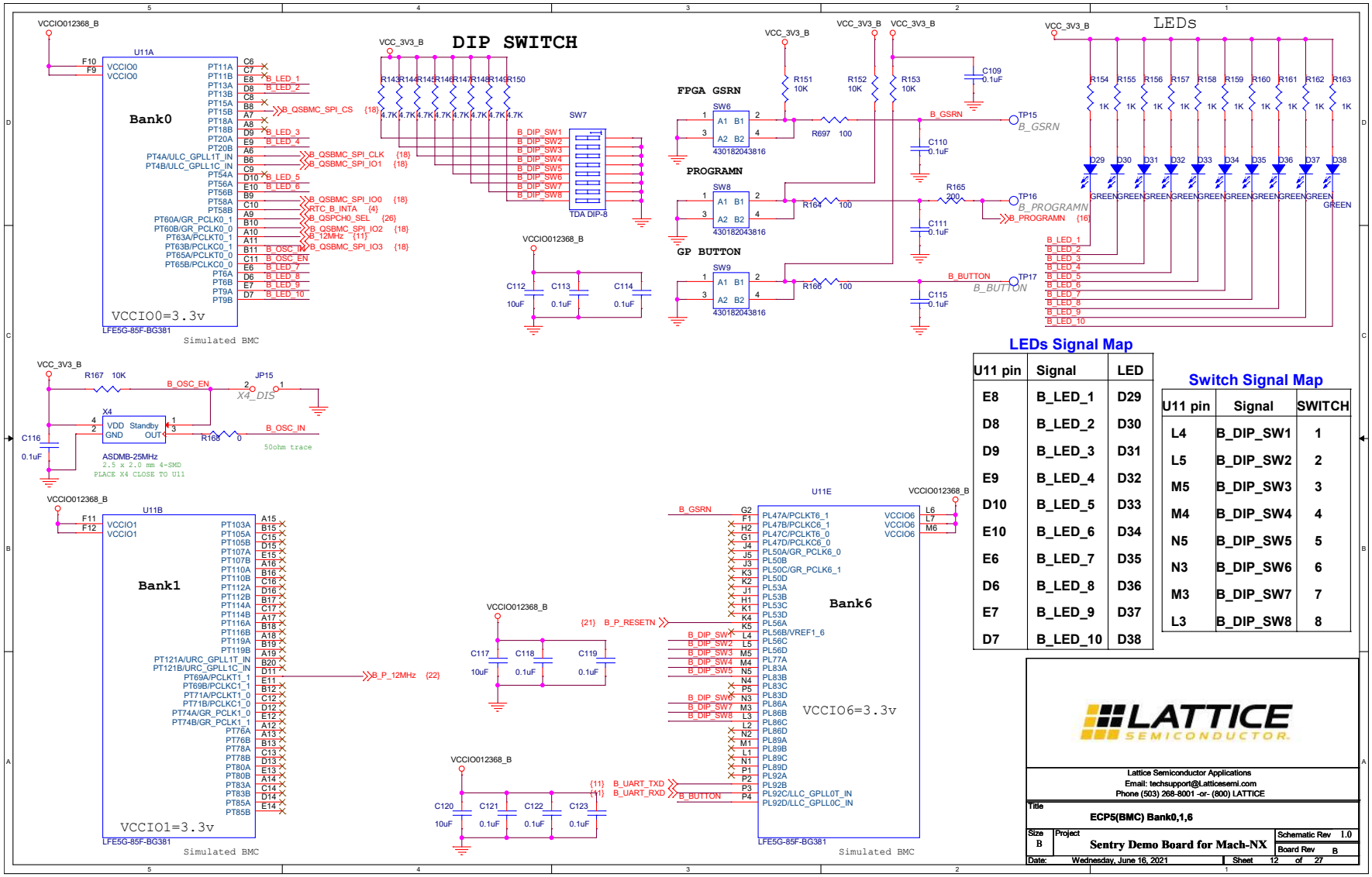


Figure A.11. Demo FTDI



LEDs Signal Map

U11 pin	Signal	LED
E8	B_LED_1	D29
D8	B_LED_2	D30
D9	B_LED_3	D31
E9	B_LED_4	D32
D10	B_LED_5	D33
E10	B_LED_6	D34
E6	B_LED_7	D35
D6	B_LED_8	D36
E7	B_LED_9	D37
D7	B_LED_10	D38

Switch Signal Map

U11 pin	Signal	SWITCH
L4	B_DIP_SW1	1
L5	B_DIP_SW2	2
M5	B_DIP_SW3	3
M4	B_DIP_SW4	4
N5	B_DIP_SW5	5
N3	B_DIP_SW6	6
M3	B_DIP_SW7	7
L3	B_DIP_SW8	8

Figure A.12. ECP5(BMC) Bank0,1,6

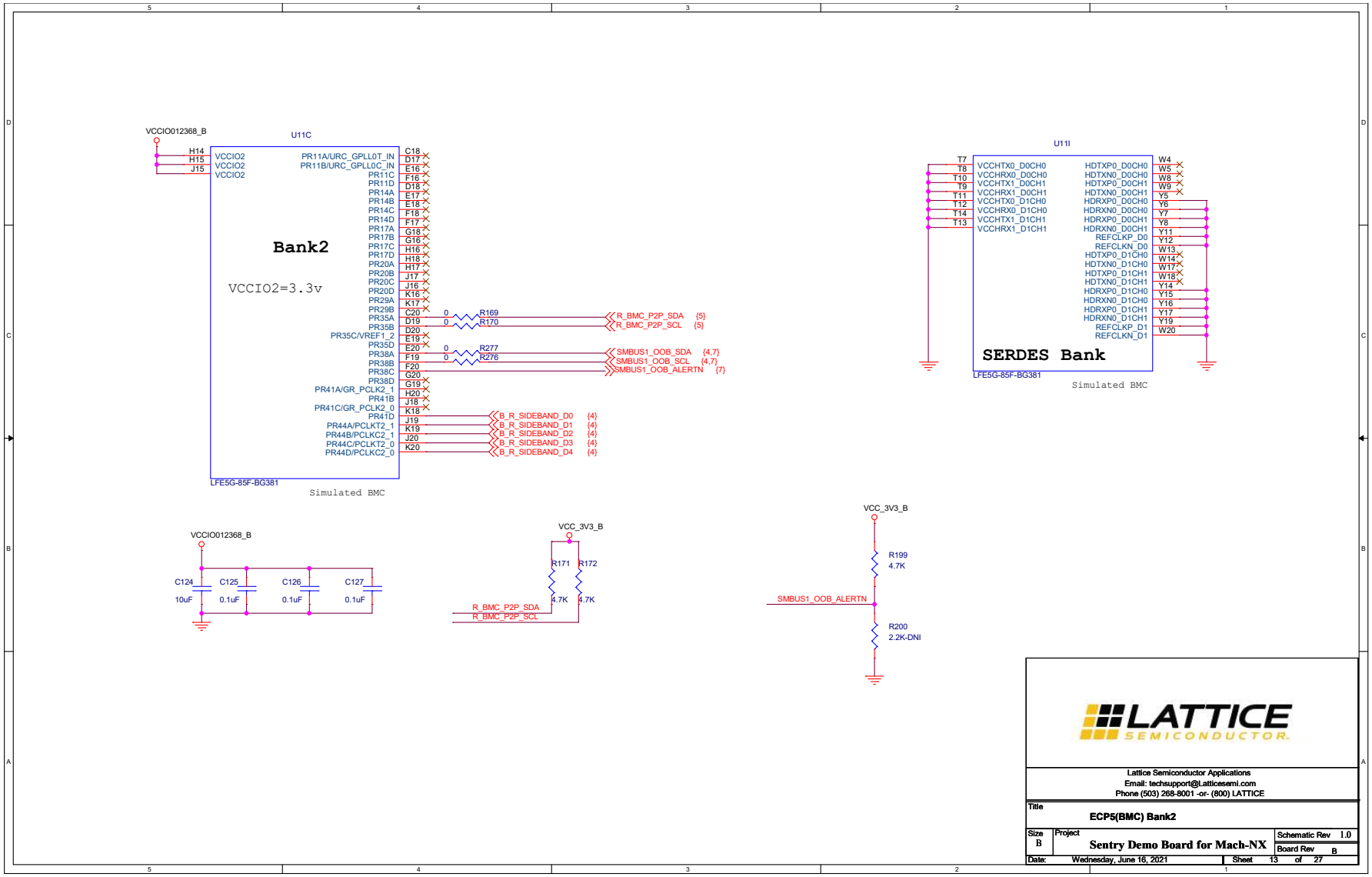


Figure A.13. ECP5(BMC) Bank2

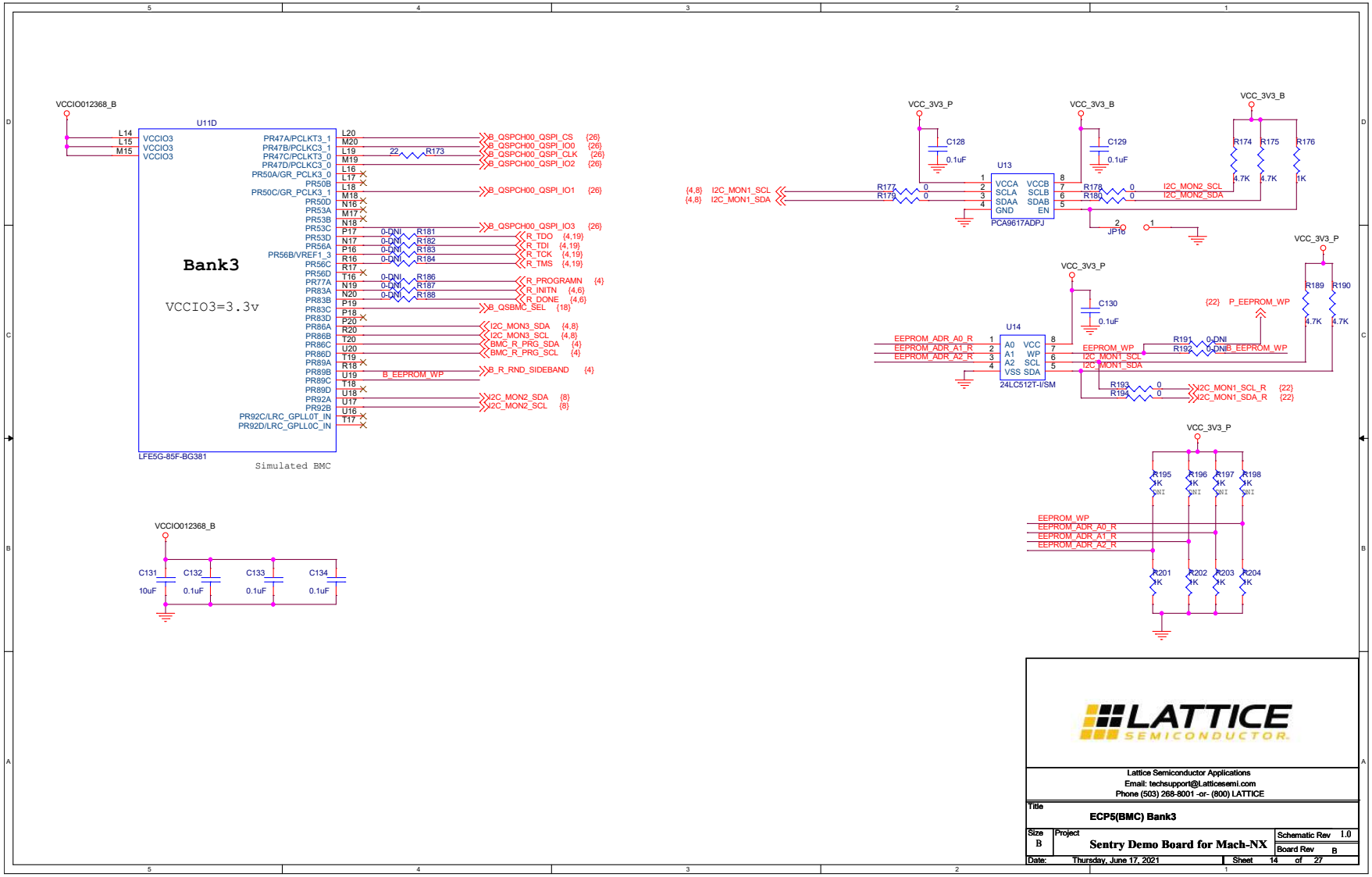


Figure A.14. ECP5(BMC) Bank3

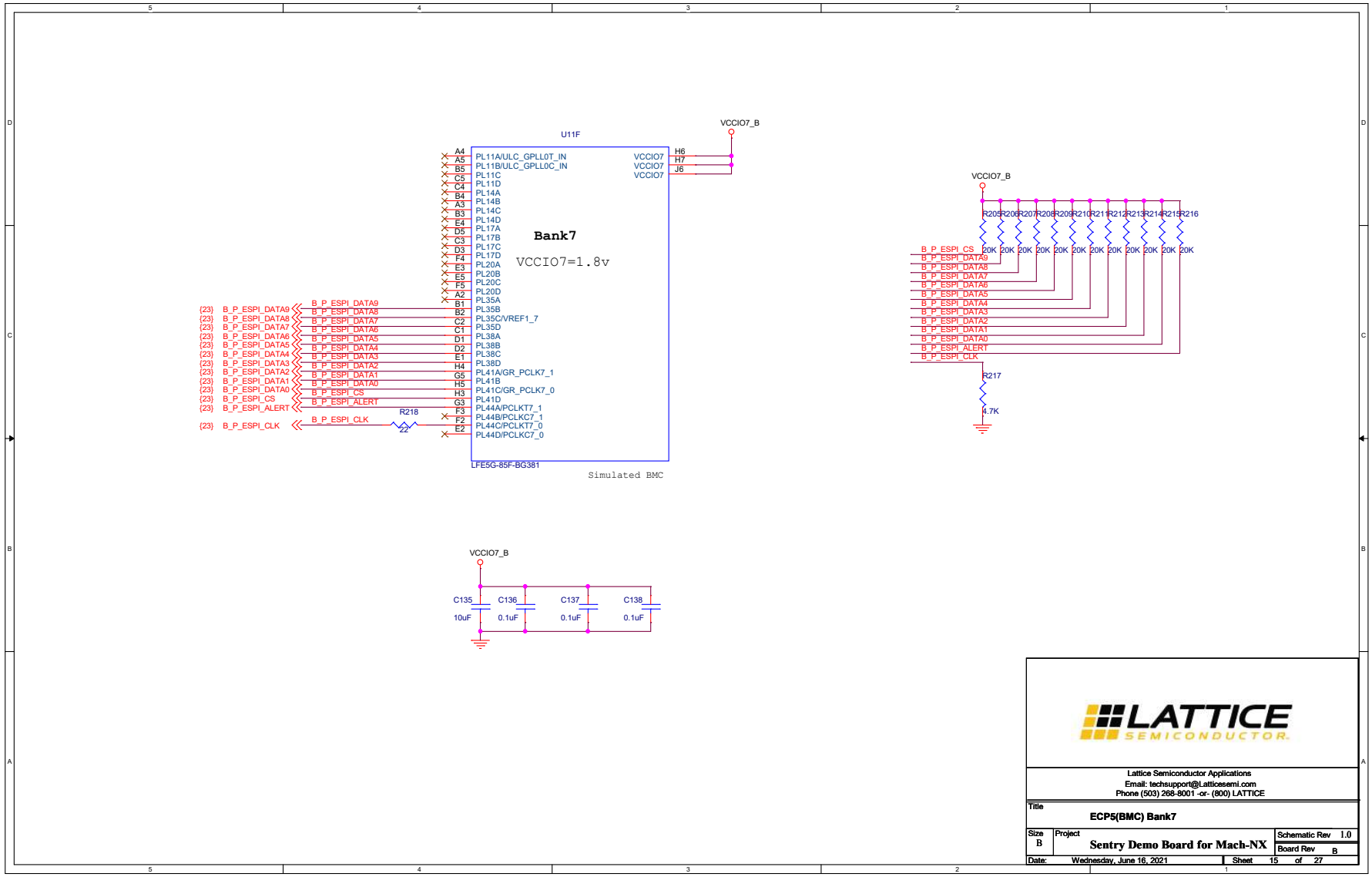


Figure A.15. ECP5(BMC) Bank7

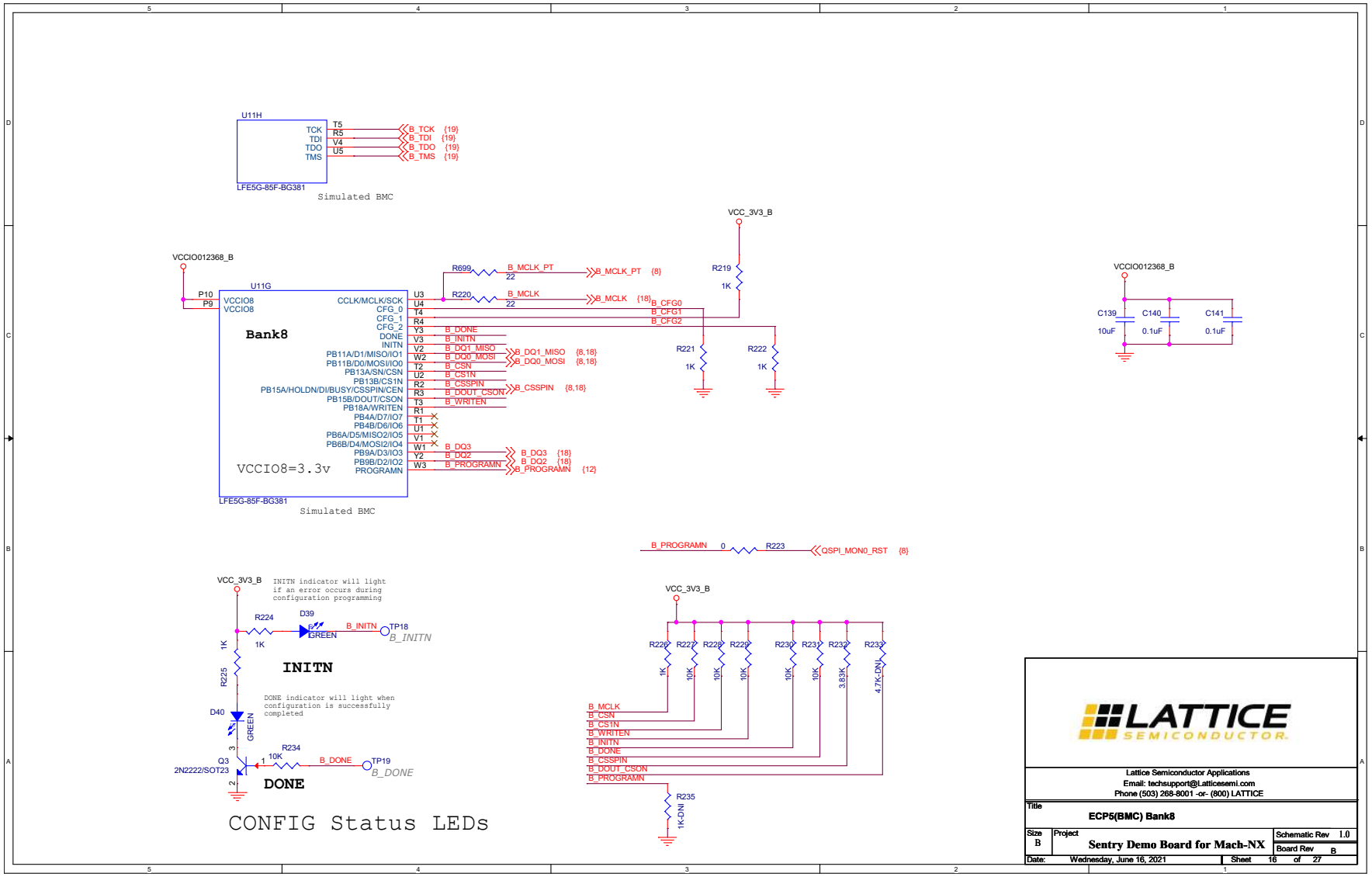


Figure A.16. ECP5(BMC) Bank8

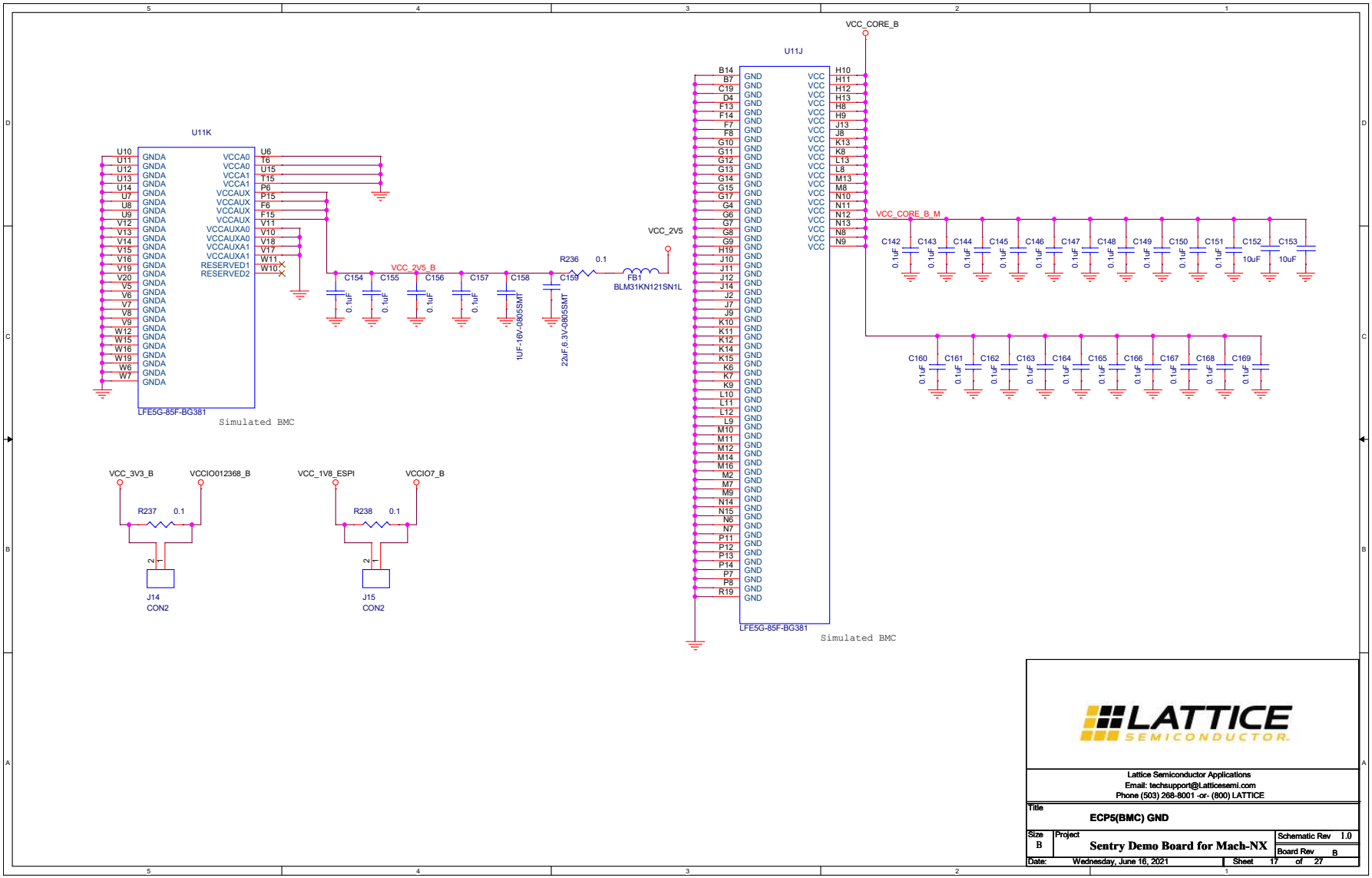


Figure A.17. ECP5(BMC) GND

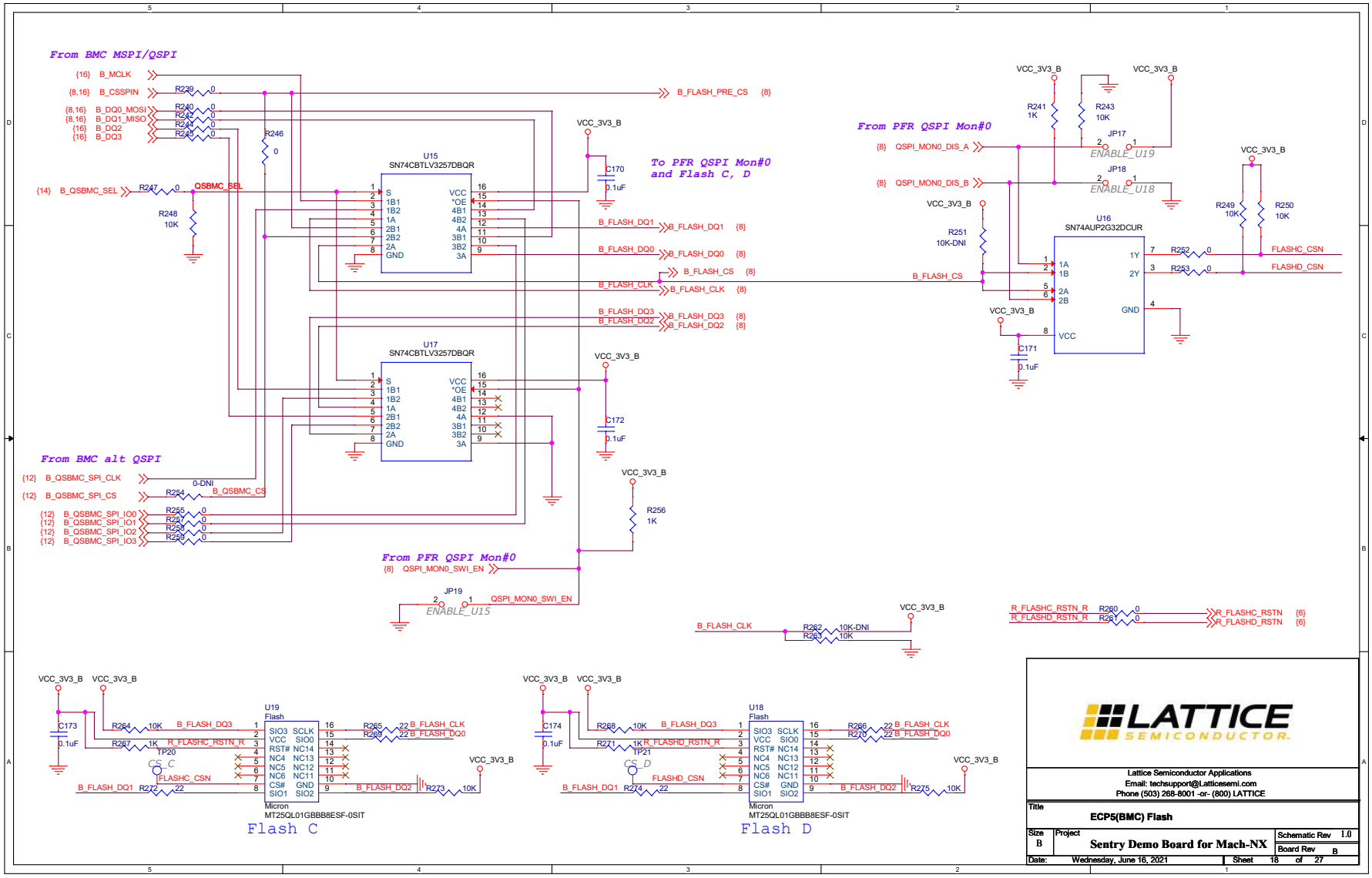


Figure A.18. ECP5(BMC) Flash

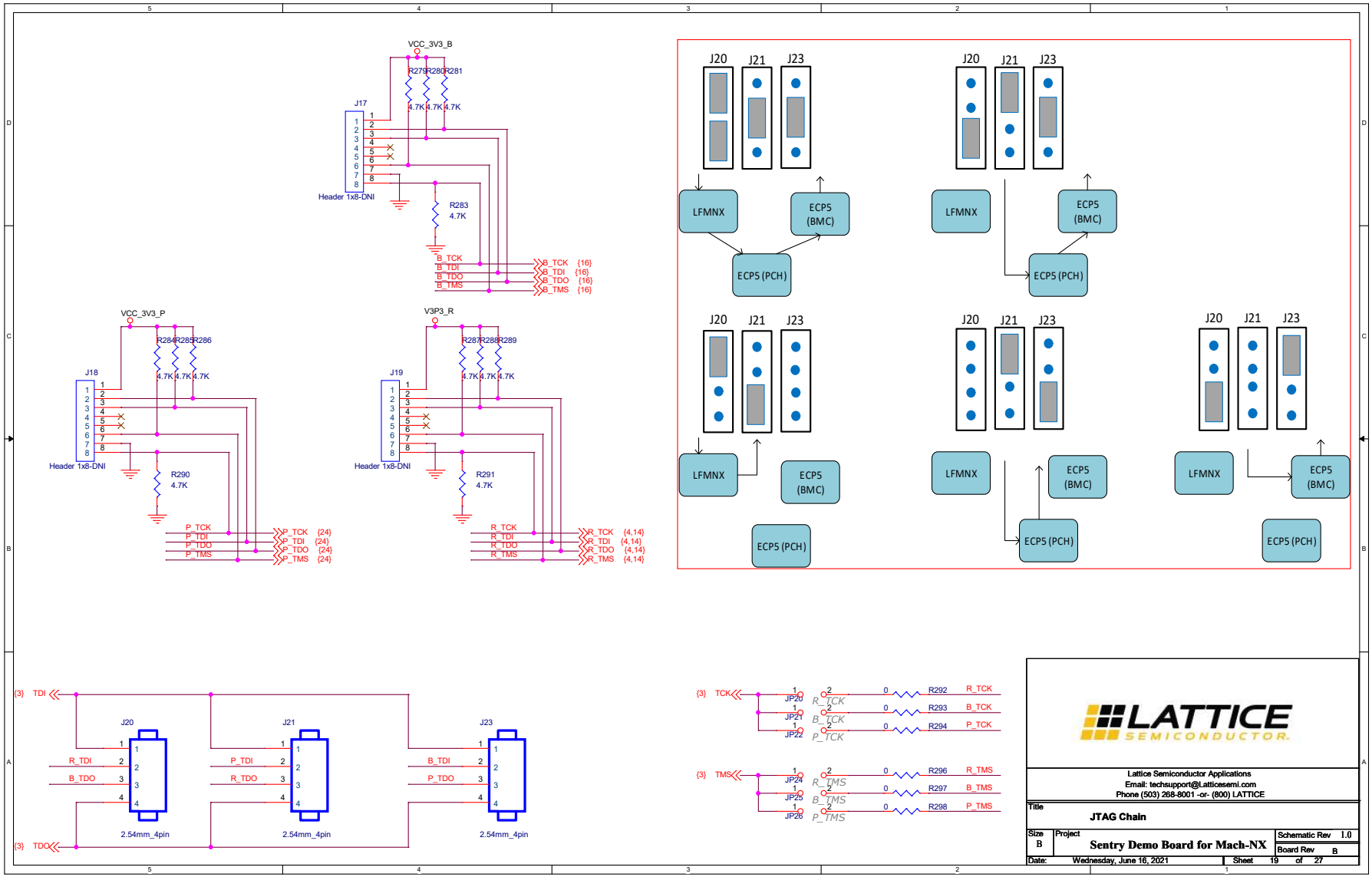


Figure A.19. JTAG Chain

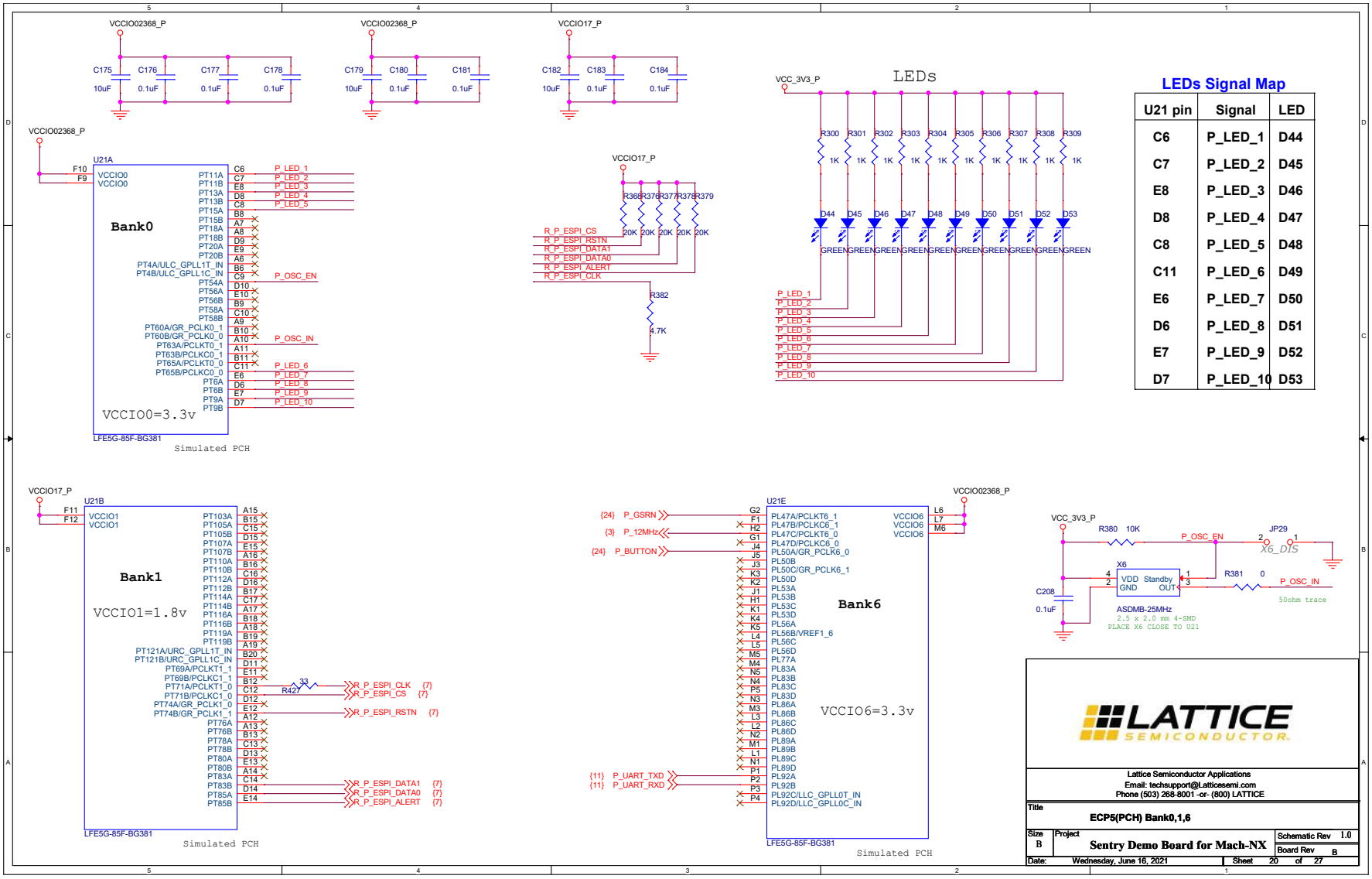


Figure A.20. ECP5(PCH) Bank0,1,6

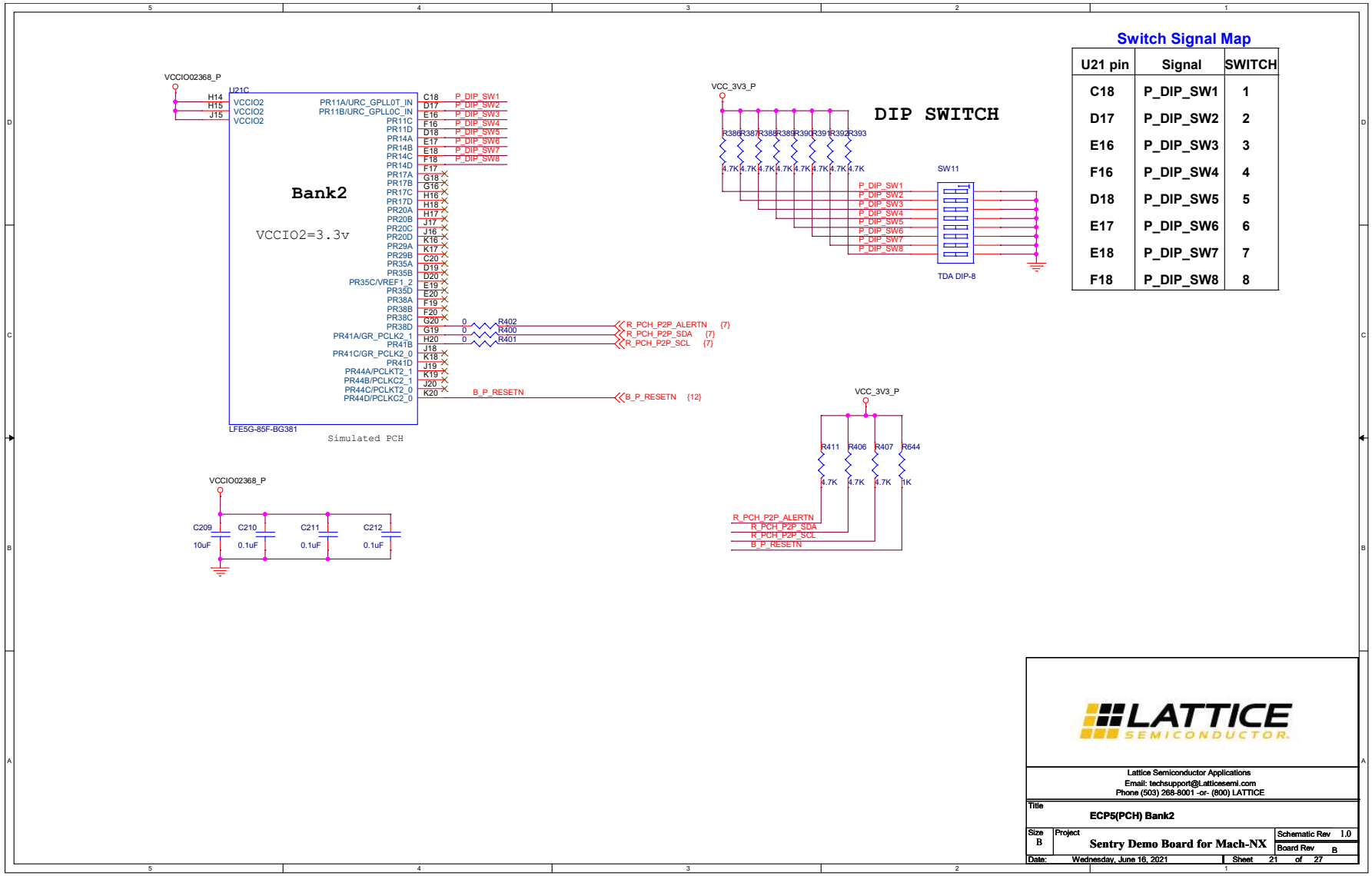


Figure A.21. ECP5(PCH) Bank2

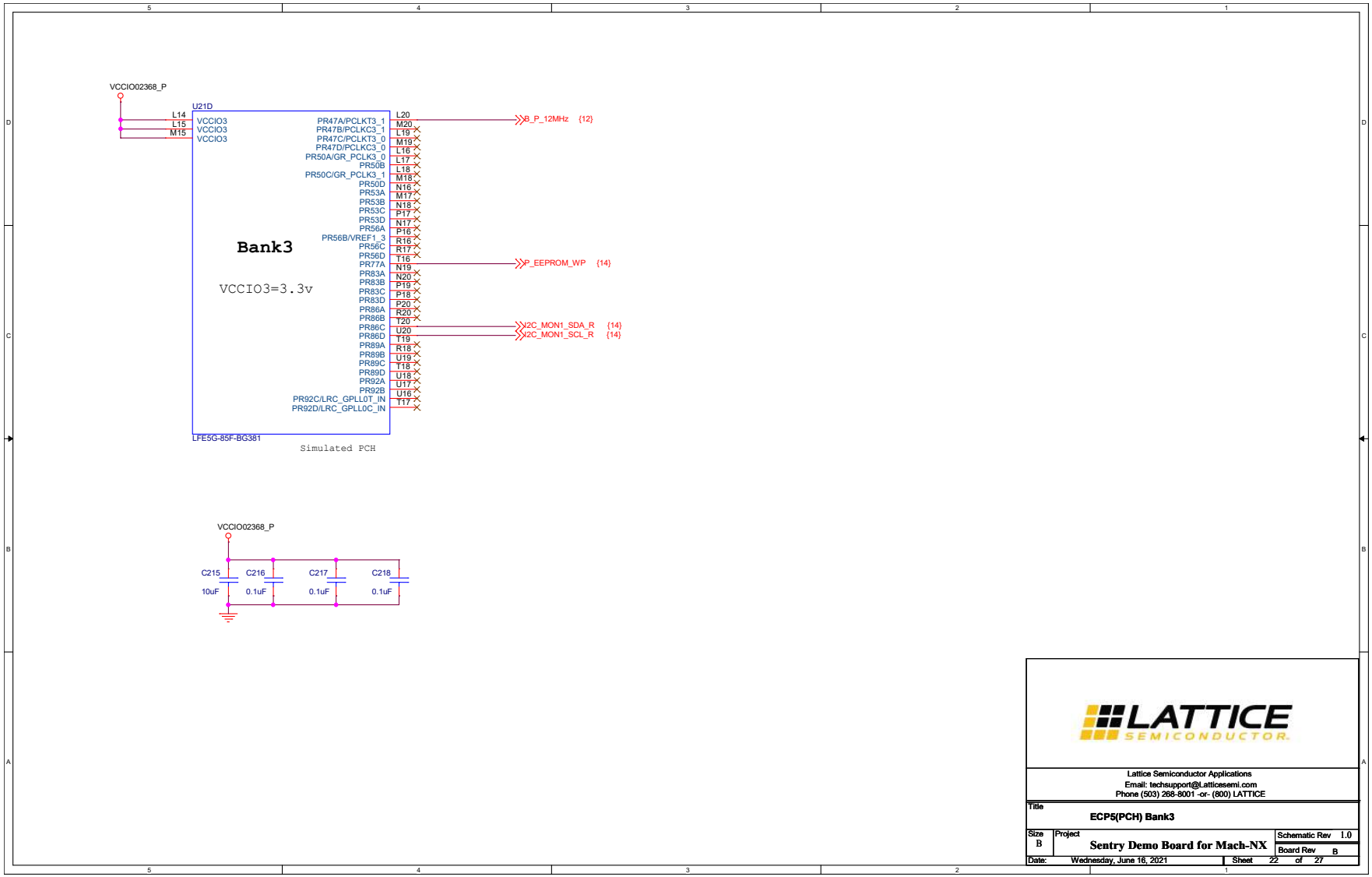


Figure A.22. ECP5(PCH) Bank3

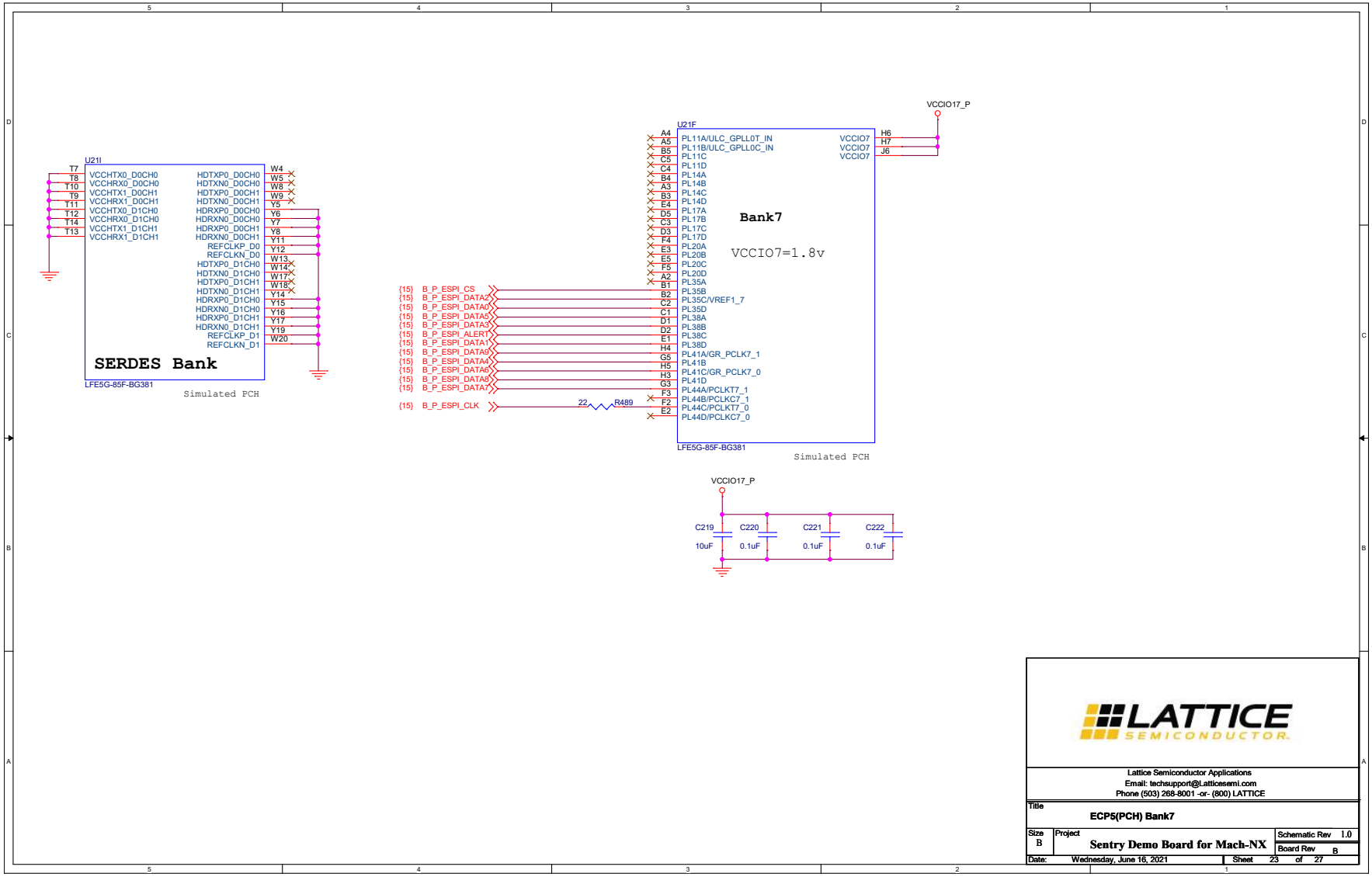


Figure A.23. ECP5(PCH) Bank7

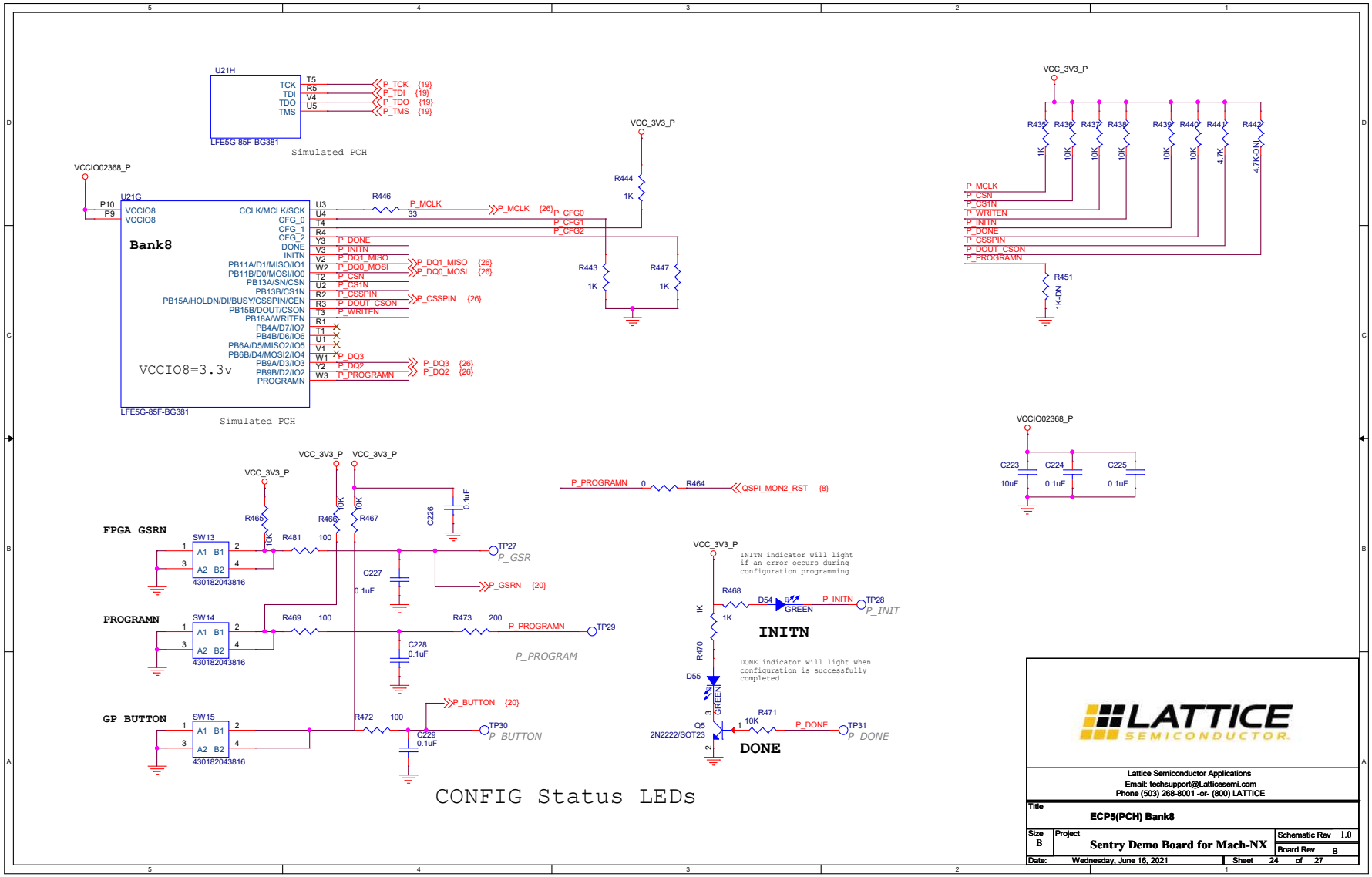


Figure A.24. ECP5(PCH) Bank8

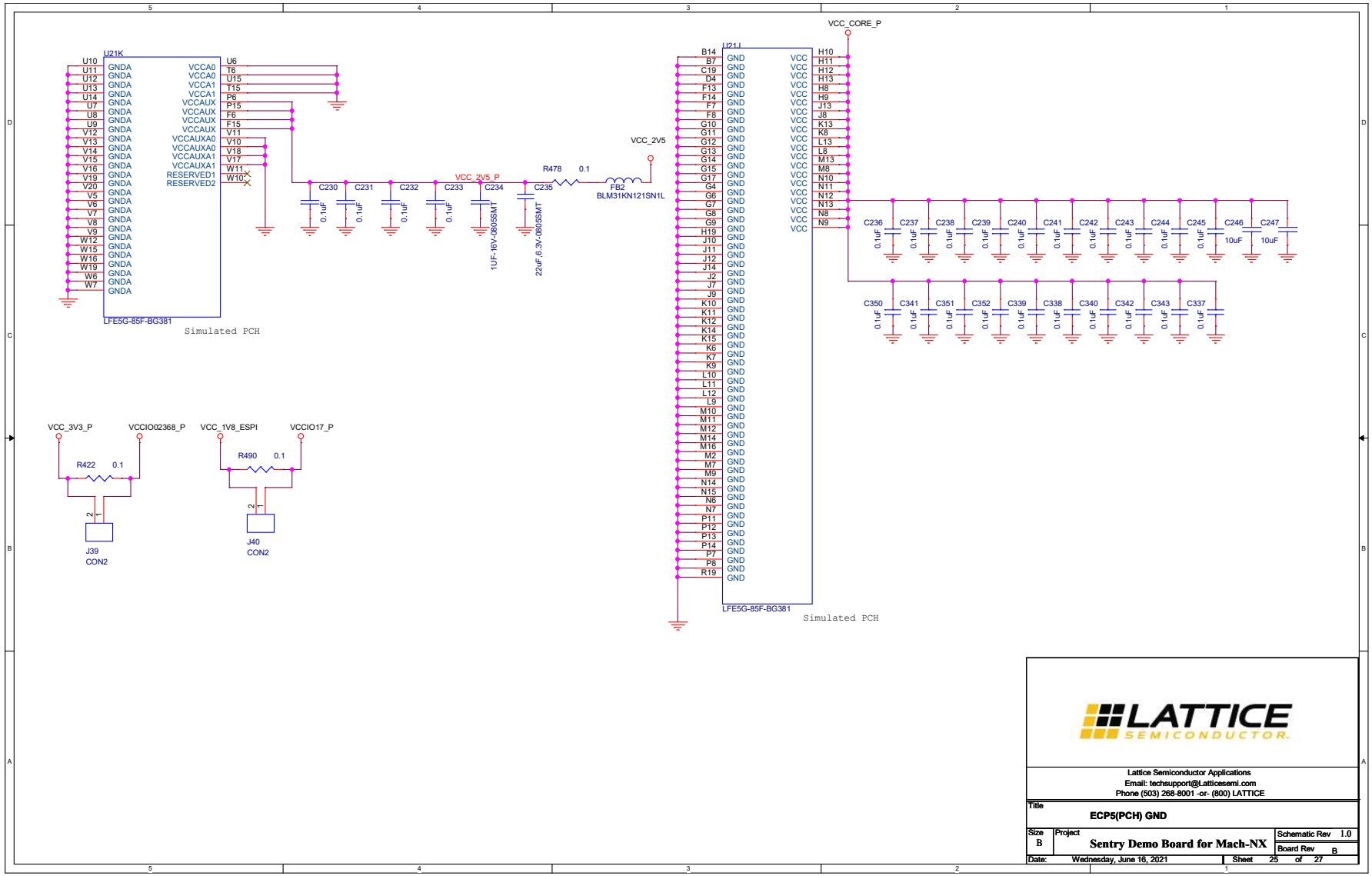


Figure A.25. ECP5(PCH) GND

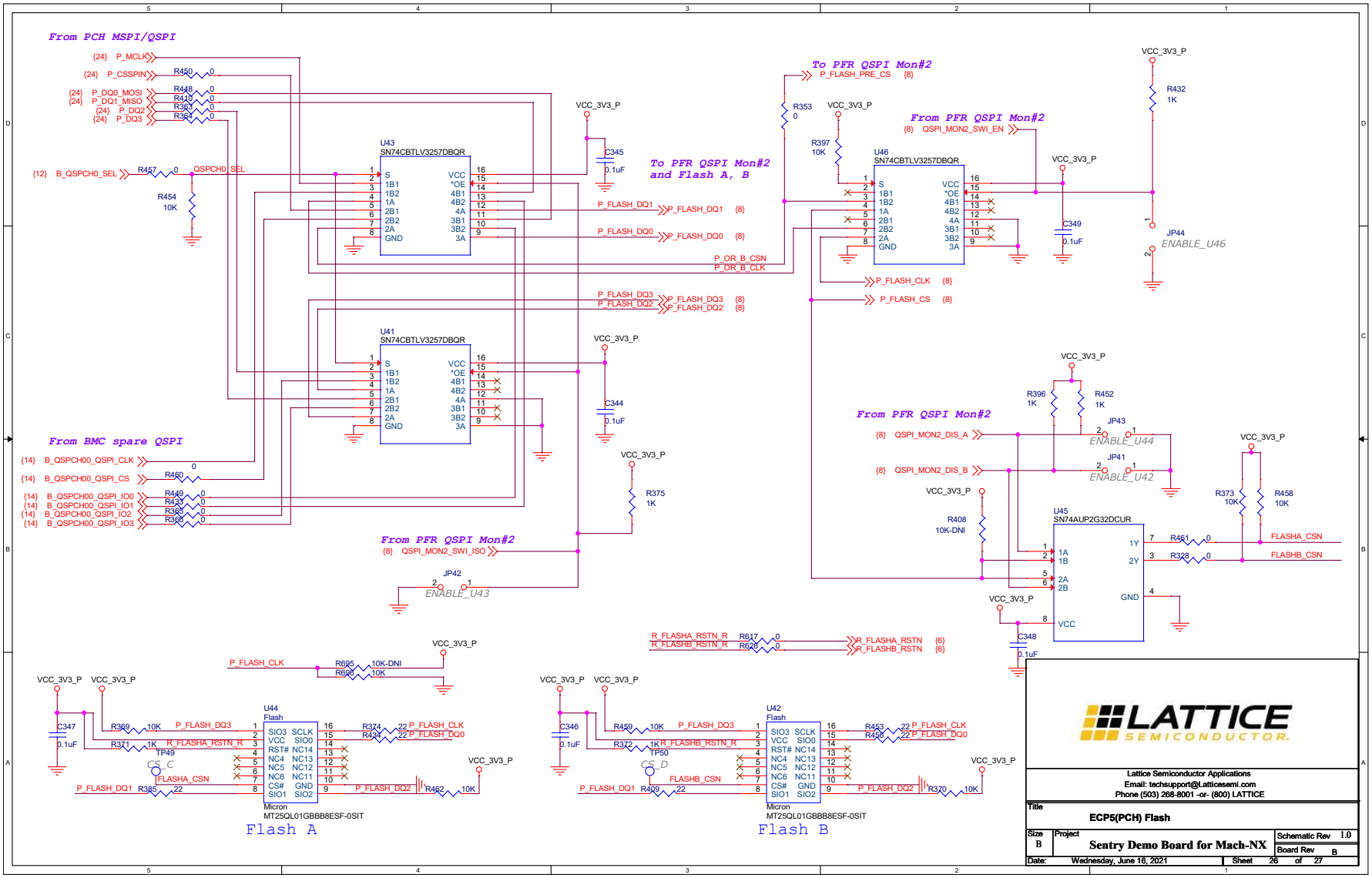


Figure A.26. ECP5(PCH) Flash

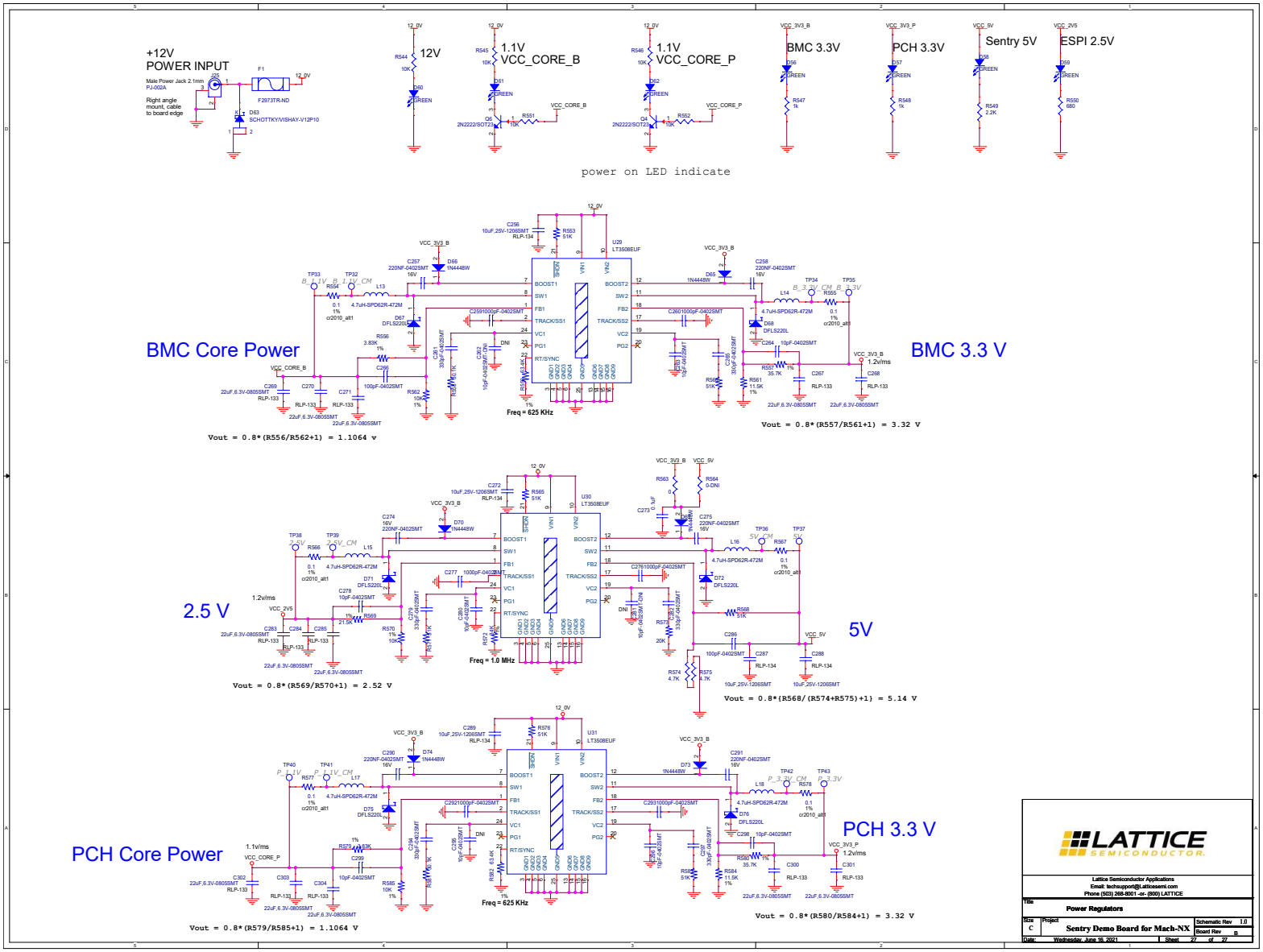


Figure A.27. Power Regulators

Appendix B. Bill of Materials

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
1	C1,C6,C96,C99	4	4.7uF	C0603	—	CL10A475KA8NQNC	Samsung	CAP CER 4.7UF 25V X5R 0603
2	C2,C3,C4,C5,C7,C9,C10,C11,C12,C14,C16,C19,C23,C26,C29,C30,C31,C49,C91,C92,C93,C94,C97,C100,C101,C102,C103,C104,C106,C116,C128,C129,C130,C189,C190,C208	36	0.1uF	C0402	—	CL05B104KA5NNNC	Samsung	CAP CER 0.1UF 25V 10% X7R 0402
3	C8,C13,C98	3	4.7uF	C0402	—	CL05A475MP5NRNC	Samsung	CAP CER 4.7UF 10V X5R 0402
4	C15,C89,C105,C187	4	10uF	C0603	—	CL10A106KO8NNNC	Samsung	CAP CER 10UF 10V X5R 0603
5	C17,C18,C107,C108	4	18pF	C0402	—	CL05C180JA5NNNC	Samsung	CAP CER 18PF 25V 10% NP0 0402
6	C20,C32,C42,C52,C62,C66,C79,C85,C86,C87,C88,C112,C117,C120,C124,C131,C135,C139,C152,C153,C175,C179,C182,C209,C215,C219,C223,C246,C247	29	10uF	C0603	—	CL10A106KO8NNNC	Samsung	CAP CER 10UF 10V X5R 0603
7	C21,C22,C33,C37,C43,C47,C53,C57,C63,C67,C78,C80,C113,C114,C118,C119,C121,C122,C123,C125,C126,C127,C132,C133,C134,C136,C137,C138,C140,C141,C142,C143,C144,C145,C146,C147,C148,C149,C150,C151,C156,C160,C161,C162,C163,C164,C165,C166,C167,C168,C169,C176,C177,C178,C180,C181,C183,C184,C210,C211,C212,C216,C217,C218,C220,C221,C222,C224,C225,C232,C236,C237,C238,C239,C240,C241,C242,C243,C244,C245,C337,C338,C339,C340,C341,C342,C343,C350,C351,C352	90	0.1uF	C0201	—	C0603X5R1C104K030BC	TDK	CAP CER 0.1UF 16V 10% X5R 0201
8	C24,C25	2	150pF-DNI	C0402	DNL	—	—	—
9	C27,C28	2	0.1uF	C0402	—	CL05B104KA5NNNC	Samsung	CAP CER 0.1UF 25V 10% X7R 0402
10	C34,C35,C36,C38,C39,C40,C41,C44,C45,C46,C48,C50,C51,C54,C55,C56,C58,C59,C60,C61,C64,C65,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C81,C82,C83,C84	36	0.1uF	C0201	—	C0603X5R1C104K030BC	TDK	CAP CER 0.1UF 16V 10% X5R 0201
11	C90,C188	2	10uF	C0603	—	CL10A106KO8NNNC	Samsung	CAP CER 10UF 10V X5R 0603
12	C95	1	4.7uF	C0603	—	CL10A475KA8NQNC	Samsung	CAP CER 4.7UF 25V X5R 0603

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
13	C109,C110,C111,C115,C154,C155,C157, C226,C227,C228,C229,C230,C231,C233, C273	15	0.1uF	C0402	—	CL05B104KA5NNNC	Samsung	CAP CER 0.1UF 25V 10% X7R 0402
14	C158,C234	2	1UF-16V-0805SMT	RLP-133	—	CL21B105KOFNNNG	Samsung	CAP CER 1UF 16V X7R 0805
15	C159,C235,C267,C268,C269,C270,C271, C283,C284,C285,C300,C301,C302,C303, C304	15	22uF,6.3V-0805SMT	RLP-133	—	CL21A226MQQNNNE	Samsung	CAP CER 22UF 6.3V X5R 0805
16	C170,C171,C172,C173,C174,C344,C345, C346,C347,C348,C349	11	0.1uF	C0402	—	CL05B104KA5NNNC	Samsung	CAP CER 0.1UF 25V 10% X7R 0402
17	C185,C314,C361	3	10uF	C0402	—	CL05A106MP8NUB8	Samsung	CAP CER 10UF 10V X5R 0402
18	C186,C315,C362	3	4.7uF	C0402	—	CL05A475MP5NRNC	Samsung	CAP CER 4.7UF 10V X5R 0402
19	C256,C272,C287,C288,C289	5	10uF,25V-1206SMT	RLP-134	—	TMK316B7106KL-TD	Taiyo Yuden	CAP CER 10UF 25V X7R 1206
20	C257,C258,C274,C275,C290,C291	6	220NF-0402SMT	RLP-130-A	—	CL05A224KO5NNNC	Samsung	CAP CER 0.22UF 16V X5R 0402
21	C259,C260,C276,C277,C292,C293	6	1000pF-0402SMT	RLP-130-A	—	CL05B102KB5NFNC	Samsung	CAP CER 1000PF 50V X7R 0402
22	C261,C265,C279,C282,C294,C297	6	330pF-0402SMT	RLP-130-A	—	CL05B331KB5NNNC	Samsung	CAP CER 330PF 50V X7R 0402
23	C262,C281	2	10pF-0402SMT-DNI	RLP-130-A	DNL	—	—	—
24	C263,C264,C278,C280,C296,C298,C299	7	10pF-0402SMT	RLP-130-A	—	CL05C100CB5NNNC	Samsung	CAP CER 10PF 50V C0G/NP0 0402
25	C266,C286	2	100pF-0402SMT	RLP-130-A	—	CL05C101JB51PNC	Samsung	CAP CER 100PF 50V C0G/NP0 0402
26	C295	1	10pF-0402SMT	RLP-130-A	DNL	—	—	—
27	D1,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12, D23,D24,D25,D26,D27,D29,D30,D31,D32, D33,D34,D35,D36,D37,D38,D39,D40,D42, D44,D45,D46,D47,D48,D49,D50,D51,D52, D53,D54,D55,D56,D57,D58,D59,D60,D61, D62,D64,D79,D80,D81,D82,D83,D84,D86, D87	57	GREEN	APT1608	—	APT1608SGC	Kingbright	LED GREEN CLEAR 0603 SMD
28	D2,D28	2	ESDR0502N-UDFN6	UDFN6_040	—	ESDR0502NMUTBG	ON semi	TVS DIODE 5.5VWM 6UDFN
29	D63	1	SCHOTTKY/VISHAY-V12P10	V12P10	—	V12P10-M3/86A	Vishay	DIODE SCHOTTKY 100V 12A TO277A
30	D65,D66,D69,D70,D73,D74	6	1N4448W	1N4448W	—	1N4448WS	On Semi	DIODE GEN PURP 75V 150MA SOD323F

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
31	D67,D68,D71,D72,D75,D76	6	DFLS220L	DFLS220L	—	DFLS220L-7	Diodes Incorporated	DIODE SCHOTTKY 20V 2A POWERDI123
32	D85	1	LED_BLUE_0603	APT1608	—	APG1608QBC/D	Kingbright	LED BLUE CLEAR CHIP SMD
33	D88,D89	2	LED_GREEN_0603	APT1608	—	APT1608SGC	Kingbright	LED GREEN CLEAR 0603 SMD
34	FB1,FB2	2	BLM31KN121SN1L	BLM41P	—	BLM41PG600SN1L	Murata	FERRITE BEAD 60 OHM 1806 1LN
35	F1	1	F2973TR-ND	0157010_DR	ALTERNATE PART NUMBER : 0157008.DR	0157010.DR	Littelfuse	FUSE BRD MNT 10A 125VAC/VDC SMD
36	JP1,JP2,JP4,JP5,JP6,JP7,JP8,JP9,JP10,JP11, JP12,JP13,JP14,JP15,JP16,JP17,JP18,JP19, JP20,JP21,JP22,JP24,JP25,JP26,JP29,JP41, JP42,JP43,JP44	29	JUMPER	Header_1x2	REGULAR 100MIL HEADER	—	—	—
37	J1,J13	2	USB_MINI_B	usb2-0-rec-240-0001-9	—	UX60-MB-5ST	Hirose	CONN RECEPT MINI USB2.0 5POS
38	J2	1	BATTERY HOLDER	CR2032	—	BU2032SM-FH-GTR	MPD	CR2032 BATTERY HOLDER SURFACE MOUNT
39	J3	1	HEADER 5X2	HDR254-2X5_SHROUDED	—	30310-6002HB	3M	CONN HEADER 10POS DL STR GOLD
40	J4	1	Receptacle 20X2	HDR254-2X20_socket	—	PPTC202LFBN-RC	Sullins	CONN HEADER FEM 40POS .1" DL TIN
41	J11,J12	2	GND	TUR_TH	DNL	1573-2	Keystone Electronics	TERM TURRET SINGLE L=4.72MM TIN
42	J14,J15,J39,J40	4	CON2	CON2	DEFAULT : OPEN	—	—	General 100 mils 2 Position header
43	J17,J18,J19	3	Header 1x8-DNI	hdr_amp_87220_8_1x8_100	DNL	22284081	Molex	CONN HEADER 8POS .100 VERT TIN
44	J20,J21,J23	3	2.54mm_4pin	HDR100-4X1	REGULAR 100MIL HEADER	—	—	—
45	J25	1	PJ-002A	pj_002a_3p	—	PJ-002A	CUI Inc.	CONN PWR JACK 2X5.5MM SOLDER
46	L1,L2,L3,L5,L6,L7,L8	7	600ohm 500mA	fb0603	—	BLM18AG601SN1D	Murata	FERRITE CHIP 600 OHM 500MA 0603
47	L4	1	120ohm 500mA	fb0603	—	BLM18BB121SN1D	Murata	FERRITE BEAD 120 OHM 0603 1LN
48	L13,L14,L15,L16,L17,L18	6	4.7uH-SPD62R-472M	SPD62R	—	SPD62R-472M	API Delevan Inc.	FIXED IND 4.7UH 2A 150 MOHM SMD
49	MH1,MH2,MH3,MH4,MH5,MH6,MH7,MH8	8	ThruHole	MTG125	DNL	—	—	—

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
50	Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9	9	2N2222/SOT23	MMBT2222ALT-1	—	MMBT2222ALT1G	ON Semiconductor	TRANS NPN 40V 0.6A SOT23
51	R1,R6,R15,R128,R133	5	2.2K	RLP-101	—	RC0603FR-072K2L	yageo	RES SMD 2.2K OHM 1% 1/10W 0603
52	R2,R3,R4,R5,R10,R11,R177,R178,R179, R180,R193,R194	12	0	RLP-101	—	RC0603FR-070RL	yageo	RES SMD 0 OHM JUMPER 1/10W 0603
53	R7,R137,R142	3	12K	RLP-101	—	RC0603FR-0712KL	yageo	RES SMD 12K OHM 1/10W 1% 0603
54	R8,R9,R24,R35,R36,R37,R40,R42,R62,R63, R64,R65,R66,R67,R68,R69,R98,R100,R102, R105,R106,R109,R122,R143,R144,R145, R146,R147,R148,R149,R150,R171,R172, R174,R175,R189,R190,R217,R278,R279, R280,R281,R282,R284,R285,R286,R287, R288,R289,R325,R333,R348,R382,R386, R387,R388,R389,R390,R391,R392,R393, R406,R407,R411,R482,R483,R484,R485, R486	69	4.7K	RLP-101	—	RC0603FR-074K7L	yageo	RES SMD 4.70K OHM 1/10W 1% 0603
55	R12,R13,R14,R18,R19,R22,R31,R91,R92, R134,R135,R136,R264,R268,R273,R275, R369,R370,R459,R462,R698	21	10K	RLP-101	—	RC0603FR-0710KL	Yageo	RES SMD 10K OHM 1% 1/10W 0603
56	R20,R21,R23,R26,R27,R33,R46,R47,R48, R49,R50,R51,R169,R170,R276,R277,R400, R401,R402	19	0	RLP-101	—	RC0603FR-070RL	yageo	RES SMD 0 OHM JUMPER 1/10W 0603
57	R28	1	0-DNI	RLP-101	DNL	—	—	—
58	R29	1	0-DNI	RLP-101	DNL	—	—	—
59	R32,R93	2	10K-DNI	RLP-101	DNL	—	—	—
60	R41,R96	2	1K	RLP-101	—	RC0603FR-071KL	Yageo	RES 1K OHM 1/10W 1% 0603 SMD
61	R43,R44	2	2.2K	RLP-101	—	RC0603FR-072K2L	yageo	RES SMD 2.2K OHM 1% 1/10W 0603
62	R45	1	100	RLP-101	—	RC0603FR-07100RL	Yageo	RES SMD 100 OHM 1% 1/10W 0603
63	R52,R53,R54,R55,R56,R57,R58,R59,R60, R61,R121,R125,R154,R155,R156,R157, R158,R159,R160,R161,R162,R163,R300, R301,R302,R303,R304,R305,R306,R307, R308,R309,R343,R344,R345,R354,R355, R357,R425,R426,R479,R480	42	1K	RLP-101	—	RC0603FR-071KL	Yageo	RES 1K OHM 1/10W 1% 0603 SMD
64	R70,R167,R380	3	10K	RLP-101	—	RC0603FR-0710KL	Yageo	RES SMD 10K OHM 1% 1/10W 0603
65	R71,R131,R132,R140,R141,R223,R464	7	0	RLP-101	—	RC0603FR-070RL	yageo	RES SMD 0 OHM JUMPER 1/10W 0603

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
66	R72,R73,R74,R75,R76,R77,R78,R79	8	53.6	RLP-101	—	RC0603FR-0753R6L	yageo	RES SMD 53.6 OHM 1% 1/10W 0603
67	R80	1	22	RLP-101	—	RC0603FR-0722RL	yageo	RES SMD 22 OHM 1% 1/10W 0603
68	R94,R95,R219,R221,R222,R224,R225,R226, R241,R256,R375,R396,R432,R435,R443, R444,R447,R452,R468,R470,R547,R548, R644	23	1K	RLP-101	—	RC0603FR-071KL	Yageo	RES 1K OHM 1/10W 1% 0603 SMD
69	R97,R151,R152,R153,R227,R228,R229, R230,R231,R234,R243,R248,R249,R250, R373,R397,R424,R436,R437,R438,R439, R440,R454,R458,R465,R466,R467,R471, R551,R552,R562,R570,R585	33	10K	RLP-101	—	RC0603FR-0710KL	Yageo	RES SMD 10K OHM 1% 1/10W 0603
70	R99,R101,R103,R104,R107,R108	6	100	RLP-101	—	RC0603FR-07100RL	Yageo	RES SMD 100 OHM 1% 1/10W 0603
71	R120	1	0	RLP-101	—	RC0603JR-070RL	Yageo	RES 0.0 OHM 1/10W JUMP 0603 SMD
72	R123,R292,R293,R294,R296,R297,R298	7	0	RLP-101	—	RC0603JR-070RL	Yageo	RES 0.0 OHM 1/10W JUMP 0603 SMD
73	R124	1	0-DNI	RLP-101	DNL	—	—	—
74	R126	1	4.7K	RLP-101	—	RC0603FR-074K7L	yageo	RES SMD 4.70K OHM 1/10W 1% 0603
75	R127,R441,R574,R575	4	4.7K	RLP-101	—	RC0603FR-074K7L	yageo	RES SMD 4.70K OHM 1/10W 1% 0603
76	R129,R130,R138,R139,R549	5	2.2K	RLP-101	—	RC0603FR-072K2L	yageo	RES SMD 2.2K OHM 1% 1/10W 0603
77	R164,R166	2	100	RLP-101	—	RC0603FR-07100RL	Yageo	RES SMD 100 OHM 1% 1/10W 0603
78	R165	1	200	RLP-101	—	RC0603FR-07200RL	Yageo	RES SMD 200 OHM 1% 1/10W 0603
79	R168,R381	2	0	RLP-101	—	RC0603FR-070RL	yageo	RES SMD 0 OHM JUMPER 1/10W 0603
80	R173,R489	2	22	RLP-101	—	RC0603FR-0722RL	yageo	RES SMD 22 OHM 1% 1/10W 0603
81	R176	1	1K	RLP-101	—	RC0603FR-071KL	Yageo	RES 1K OHM 1/10W 1% 0603 SMD
82	R181,R182,R183,R184,R186,R187,R188, R191,R192	9	0-DNI	RLP-101	DNL	—	—	—
83	R195,R196,R197,R198	4	1K	RLP-101	DNL	—	—	—
84	R199	1	4.7K	RLP-101	—	RC0603FR-074K7L	yageo	RES SMD 4.70K OHM 1/10W 1% 0603
85	R200	1	2.2K-DNI	RLP-101	DNL	—	—	—

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
86	R201,R202,R203,R204	4	1K	RLP-101	—	RC0603FR-071KL	Yageo	RES 1K OHM 1/10W 1% 0603 SMD
87	R205,R206,R207,R208,R209,R210,R211, R212,R213,R214,R215,R216,R368,R376, R377,R378,R379	17	20K	RLP-100	—	ERJ-2RKF2002X	Panasonic	RES SMD 20K OHM 1% 1/10W 0402
88	R218, R220, R699	1	22	RLP-100	—	ERJ-2RKF22R0X	Panasonic	RES SMD 22 OHM 1% 1/10W 0402
89	R446	3	33	RLP-101	—	RC0603FR-0733RL	yageo	RES SMD 33 OHM 1% 1/10W 0603
90	R232,R556,R579	3	3.83K	RLP-101	—	ERJ-3EKF3831V	Panasonic	RES SMD 3.83K OHM 1/10W 1% 0603
91	R233,R442	2	4.7K-DNI	RLP-100	DNL	—	—	—
92	R235,R451	2	1K-DNI	RLP-100	DNL	—	—	—
93	R236,R237,R238,R422,R478,R490	6	0.1	R0603	—	RL0603FR-070R1L	Yageo	RES 0.1 OHM 1% 1/10W 0603
94	R239,R240,R242,R244,R245,R246,R247, R252,R253,R255,R257,R258,R259,R260, R261,R328,R353,R363,R364,R365,R366, R410,R433,R448,R449,R450,R457,R460, R461,R617,R626	31	0	RLP-101	—	RC0603FR-070RL	yageo	RES SMD 0 OHM JUMPER 1/10W 0603
95	R251,R408	2	10K-DNI	RLP-101	DNL	—	—	—
96	R254	1	0-DNI	RLP-101	DNL	—	—	—
97	R262,R695	2	10K-DNI	RLP-101	DNL	—	—	—
98	R263,R696	2	10K	RLP-101	—	RC0603FR-0710KL	Yageo	RES SMD 10K OHM 1% 1/10W 0603
99	R265,R266,R269,R270,R272,R274,R374, R385,R409,R434,R453,R456	12	22	RLP-101	—	RC0603FR-0722RL	yageo	RES SMD 22 OHM 1% 1/10W 0603
100	R267,R271,R371,R372	4	1K	RLP-101	—	RC0603FR-071KL	Yageo	RES 1K OHM 1/10W 1% 0603 SMD
101	R283,R290,R291	3	4.7K	RLP-101	—	RC0603FR-074K7L	yageo	RES SMD 4.70K OHM 1/10W 1% 0603
102	R317,R318,R319,R320,R346,R347,R488	7	33	RLP-101	—	RC0603FR-0733RL	yageo	RES SMD 33 OHM 1% 1/10W 0603
103	R337,R338,R339,R340,R341,R342,R492	7	33	RLP-101	—	RC0603FR-0733RL	yageo	RES SMD 33 OHM 1% 1/10W 0603
104	R359,R360,R362	3	1k	R0402	—	ERJ-2RKF1001X	Panasonic	RES SMD 1K OHM 1% 1/10W 0402
105	R361,R367	2	4.7k	R0402	—	ERJ-2GEJ472X	Panasonic	RES SMD 4.7K OHM 5% 1/10W 0402
106	R412,R415,R429,R476	4	0.1	R0805	—	RL0805FR-070R1L	Yageo	RES 0.1 OHM 1% 1/8W 0805
107	R427	1	33	RLP-101	—	RC0603FR-0733RL	yageo	RES SMD 33 OHM 1% 1/10W 0603
108	R469,R472,R481,R697	4	100	RLP-101	—	RC0603FR-07100RL	Yageo	RES SMD 100 OHM 1% 1/10W 0603

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
109	R473	1	200	RLP-101	—	RC0603FR-07200RL	Yageo	RES SMD 200 OHM 1% 1/10W 0603
110	R544,R545,R546	3	10K	RLP-103	—	RC1206JR-0710KL	yageo	RES SMD 10K OHM 5% 1/4W 1206
111	R550	1	680	RLP-101	—	ERJ-3EKF6800V	Panasonic	RES SMD 680 OHM 1% 1/10W 0603
112	R553,R560,R565,R568,R571,R576,R583	7	51K	RLP-100	—	RC0402FR-0751KL	yageo	RES SMD 51K OHM 1% 1/16W 0402
113	R554,R555,R566,R567,R577,R578	6	0.1	cr2010_alt1	—	WSL2010R1000FEA	Vishay Dale	RES 0.1 OHM 1% 1/2W 2010
114	R557,R580	2	35.7K	RLP-101	—	RC0603FR-0735K7L	yageo	RES SMD 35.7K OHM 1% 1/10W 0603
115	R558,R581	2	30.1K	RLP-100	—	ERJ-2RKF3012X	Panasonic	RES SMD 30.1K OHM 1% 1/10W 0402
116	R559,R582	2	63.4K	RLP-100	—	ERJ-2RKF6342X	Panasonic	RES SMD 63.4K OHM 1% 1/10W 0402
117	R561,R584	2	11.5K	RLP-101	—	RC0603FR-0711K5L	yageo	RES SMD 11.5K OHM 1% 1/10W 0603
118	R563	1	0	RLP-101	—	RC0603FR-070RL	yageo	RES SMD 0 OHM JUMPER 1/10W 0603
119	R564	1	0-DNI	RLP-101	DNL	—	—	—
120	R569	1	21.5K	RLP-101	—	RC0603FR-0721K5L	yageo	RES SMD 21.5K OHM 1% 1/10W 0603
121	R572	1	34K	RLP-100	—	RC0402FR-0734KL	yageo	RES SMD 34K OHM 1% 1/16W 0402
122	R573	1	20K	RLP-100	—	ERJ-2RKF2002X	Panasonic	RES SMD 20K OHM 1% 1/10W 0402
123	SW1,SW3,SW4,SW5,SW6,SW8,SW9,SW10, SW12,SW13,SW14,SW15,SW17	13	430182043816	430182043816	—	PTS645SM43SMTR92 LFS	C&K Components	SWITCH TACTILE SPST-NO 0.05A 12V
124	SW2,SW7,SW11,SW16	4	TDA DIP-8	TDA08H0SB1	—	TDA08H0SB1	C&K Components	SWITCH SLIDE DIP SPST 25MA 24V
125	TP1,TP10,TP11,TP12,TP13,TP14,TP53,TP54, TP55	9	TestPoint_Hole	TP	DNL	—	—	—
126	TP2,TP3,TP15,TP16,TP17,TP18,TP19,TP21, TP27,TP28,TP29,TP30,TP31,TP45,TP50, TP51,TP52	17	TestPoint_SMT	TPC32	DNL	—	—	—
127	TP4,TP5,TP6,TP7,TP8,TP9,TP20,TP49	8	TestPoint_SMT	TPC32	DNL	—	—	—
128	TP32,TP33,TP34,TP35,TP36,TP37,TP38, TP39,TP40,TP41,TP42,TP43	12	TestPoint_hole	TP	DNL	—	—	—
129	U1,U9	2	FT2232HL	tqfp64_0p5_12p2x12p2_h1p6	—	FT2232HL-REEL	FTDI	IC USB HS DUAL UART/FIFO 64-LQFP

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
130	U2,U10	2	93LC56C-I/SN	so8_50_244	—	93LC56C-I/SN	Microchip Technology	IC EEPROM 2KBIT 3MHZ 8SOIC
131	U3	1	R2025S	SOP14	—	R2025S-E2-FE	RICOH	IC High precision I2C-Bus Real-Time Clock Module SOP14
132	U5	1	SBR0330CW	SOT323	—	SBR0330CW-7	Diodes Incorporated	0.3A SBR SUPER BARRIER RECTIFIER
133	U6	1	LDT-N2804RI	display_12P-PTH	—	LDT-N2804RI	Lumex Opto/Components Inc.	DISPLAY 7SEG 0.28" TRP RED 12DIP
134	U8	1	AP7361C-33Y5-13	SOT89-5_AP7361C	—	AP7361C-33Y5-13	Diodes Incorporated	Linear Voltage Regulator IC 1 Output 1A SOT-89-5
135	U11,U21	2	LFE5G-85F-BG381	LFE5G-85F-BG381	Customer Supplied (LFE5*-85F-8BG381* is equivalent to LFE5U-85F-8BG381C)	LFE5U-85F-8BG381C	Lattice	83.6K LUTS, 205 /O, 1.1V, -8 SPE
136	U12	1	Torex_XCL220B333FR-G	XCL220B123FR-G	—	XCL220B333FR-G	Torex Semiconductor Ltd	DC DC CONVERTER 3.3V 1A
137	U13	1	PCA9617ADPJ	TSSOP8	—	PCA9617ADPJ	NXP	IC I2C-bus repeater 2 channel Level translating
138	U14	1	24LC512T-I/SM	SOIJ	—	24LC512T-I/SM	Microchip	IC I2C Serial EEPROM 512 Kbit SOIJ Package
139	U15,U17,U41,U43,U46	5	Multiplexer	SSOP16-25-150	—	SN74CBTLV3257DBQR	TI	IC LV DUAL FET MUX/DEMUX 16SSOP
140	U16,U45	2	OR-Gate	VSSOP_8	—	SN74AUP2G32DCUR	TI	IC GATE OR 2CH 2-INP US8
141	U18,U19,U42,U44	4	Flash	16_pin_300mil soic	—	MT25QL01GBBB	Micron	IC FLASH 1GBIT SPI/QUAD 16SOP
142	U20	1	RP132H181D	SOT89-5	—	RP132H181D-T1-FE	RICOH	IC 1A LDO Regulator 1.8V OUTPUT SOT-89-5
143	U22	1	Torex_XCL220B183FR-G	XCL220B123FR-G	—	XCL220B183FR-G	Torex Semiconductor Ltd	DC DC CONVERTER 1.8V 1A
144	U29,U30,U31	3	LT3508EUF	LT3508EUF	ALTERNATE PART NUMBER : LT3508IUF#PBF	LT3508EUF#PBF	Linear Technology/Analog Devices	IC REG BUCK ADJ 1.4A DL 24QFN

Item	Reference	Qty	Part	PCB Footprint	Comment	Part Number	Manufacturer	Description
145	U33	1	Torex_XCL220B103FR-G	XCL220B123FR-G	—	XCL220B103FR-G	Torex Semiconductor Ltd	DC DC CONVERTER 1V 1A
146	U47	1	LFMNX-50	LFMNX-50	Customer Supplied	—	—	Mach-NX FPGA
147	X1,X3	2	7M-12.000MAAJ	xtal_4p_7m	—	7M-12.000MAAJ-T	TXC	CRYSTAL 12MHZ 18PF SMD
148	X2,X4,X6	3	ASDMB-25MHz	x4-2520	—	ASDMB-25.000MHZ-LR-T	Abracon LLC	25MHz XO (Standard) LVCMOS Oscillator 1.8V ~ 3.3V Standby (Power Down) 4-SMD, No Lead
149	Lattice Sentry Demo Board for Mach-NX	1	—	—	—	305-PD-21-0112	PACTRON	—

References

- Mach-NX Device Family Data Sheet (FPGA-DS-02084)
- ECP5 and ECP-5G Family Data Sheet (FPGA-DS-02012)
- Mach-NX Programming and Configuration Usage Guide (FPGA-TN-02231)
- ECP5 and ECP5-5G sysCONFIG Usage Guide (FPGA-TN-02039)
- Lattice Propel 1.1 Root of Trust Reference Design (FPGA-RD-02243)
- Mach-NX family devices web page
- Lattice Insights for training series and learning plans

Technical Support Assistance

Submit a technical support case through www.latticesemi.com/techsupport.

For frequently asked questions, refer to the Lattice Answer Database at www.latticesemi.com/Support/AnswerDatabase.

Revision History

Revision 1.2, January 2024

Section	Change Summary
Disclaimers	Updated this section.
Inclusive Language	Added this section.
Introduction	Added reference to Lattice Sentry Demo Board for Mach-NX Walkthrough User Guide (FPGA-UG-02167).
Features	General update to the features of the Lattice Sentry Demo Board for Mach-NX.
Board Interface Connections	In Table 6.16. Raspberry PI Connector Signal Definitions, changed Raspberry PI Connector J4 Pin Number from *24* to *36* for the S_RASP_IO19 signal.
Ordering Information	Added this section.
References	Added links to Mach-NX family devices web page and Lattice Insights for training series and learning plans.
Technical Support Assistance	Added the link to Lattice Answer Database.

Revision 1.1, August 2022

Section	Change Summary
Appendix A. Lattice Sentry Demo Board for Mach-NX Schematics	Updated the Mach-NX device name from PFR-csfBGA484 to LFMNX-50_csfBGA484 in Figure A.4, Figure A.5, Figure A.6, Figure A.7, Figure A.8, Figure A.9 in the Lattice Sentry Demo Board for Mach-NX Schematics section.

Revision 1.0, June 2021

Section	Change Summary
All	Initial release

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