

LX7714-EVB Evaluation Board User Guide

Introduction

The [LX7714-EVB evaluation board](#) is a hardware platform intended to speed up the development process for the [LX7714](#) family of radiation-hardened by design quad 14V to 46V, 2.5A or 1.25A power switches for spacecraft power distribution. The LX7714-EVB supports the following evaluation scenarios:

- Fitment of an LX7714 part by either direct soldering (optional heatsink included) or using the included ZIF socket
 - The LX7714-EVB kit does not include an LX7714 part. For general purpose evaluation, order an LX7714-25MFB-ES to evaluate the quad 2.5A version, or an LX7714-12MFB-ES to evaluate the quad 1.25A version.
- Configuration of the LX7714's 4 sections as independent or paralleled blocks. Independent 2.5A or 1.25A power switch sections are galvanically isolated, and do not share power or ground rails unless wired that way externally
- Power switch on/off control is provided by on-board switches for manual control, and/or by remote signals. Plug-in configuration boards (included) allow a single on-board switch to manually control multiple power switches together
- On-board status LEDs can be switched to the LX7714's open-drain status outputs

Kit Contents

- LX7714-EVB evaluation board
- FP-20+8x3-2_54-01Q-01c ZIF socket
- XSD1705-008 heatsink 37 x 37 x 12.5mm plus 6x C9161 plastic sprung rivets 3 x 12.5mm (2 for heatsink, 4 spares)
- [T62](#) thermal pad 37 x 37mm for heatsink

Ordering Information

Product	Order Number
LX7714-EVB Evaluation Board	LX7714-EVB

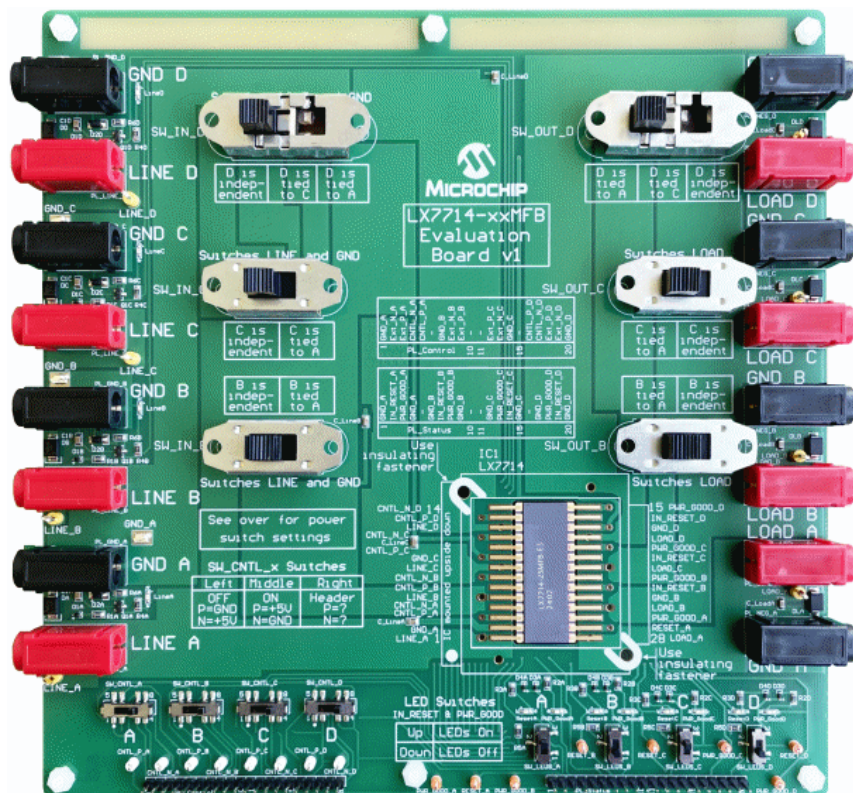


Figure 1. LX7714-EVB Evaluation Board

1 LX7714-EVB Evaluation Board Overview

The LX7714-EVB kit does *not* include an LX7714 part. For general purpose evaluation, order an LX7714-25MFB-ES to evaluate the quad 2.5A version, or an LX7714-12MFB-ES to evaluate the quad 1.25A version.

When fitting an LX7714 part, the important point is that it is fitted upside down with pin 1 at the bottom left. The LX7714-EVB architecture provides two alternative methods for fitting LX7714 devices:

- Fit the ZIF socket supplied with the EVB, allowing LX7714 parts to be interchanged quickly and reliably
 - Forced air cooling will need to be provided when switching higher current loads
- Directly solder a LX7714 part to the board
 - Fit the included heatsink and thermal pad (or alternative thermal management) when switching higher current loads. The heatsink mounts on the top side of the LX7714-EVB (onto the LX7714 package base) using two spring-loaded plastic rivets. To remove the heatsink, squeeze each rivet's barb to release it from the PCB hole. Extra rivets are included as they are easy to damage

The LX7714-EVB supports the following evaluation scenarios:

- Configuration of the LX7714's 4 sections as independent or paralleled blocks
 - Independent power switch sections are galvanically isolated, and do not share power or ground rails unless wired that way externally
- Power switch on/off control is provided by on-board switches for manual control, and/or by remote signals
 - Plug-in configuration boards allow a single on-board switch to manually control multiple power switches together
- Optional status LEDs on the open-drain `PWR_GOOD_x` and `IN_RESET_x` outputs, which can be switched out to allow the status outputs to be pulled up to alternate supplies

2 Independent Power Switch Sections

Since each power switch section is independent and galvanically isolated, they can be operated with different GND and/or LINE input potentials. The LX7714-EVB provides each of the 4 power switch sections with an individual ~5-6V voltage regulator powered by the section's 14V to 46V LINE input supply. The ~5-6V rails are used to generate local control signals and to operate the status LEDs.. Each regulator input is protected against LINE voltage fluctuations and possible high dV/dt rise times by a series diode and resistor. Regulator outputs are protected against inadvertent overloads by series resistors, and draw about 1mA from each LINE per lit LED.

Each power switch section has its own pair of 4mm LINE and GND input sockets on the left, and 4mm LOAD and GND output sockets on the right. The GND connections are straight through, so a load output can be connected directly to the LOAD and GND output sockets (4-wire connection) if convenient. Alternatively, the high current wiring from supply GND to load GND can run external to the EVB. In this case, a single (low current) GND wire to either the input or the output GND socket is also required to provide the supply GND reference to the power switch.

Cautionary Note: The LOAD A and GND A outputs are in reverse order compared with the other power connections.

2.1 LINE and GND Power Input Switches, LOAD Power Output Switches

Three power slide switches on the left side of the board connect or isolate the LINE and GND power inputs between sections. Three power slide switches on the right side of the board connect or isolate the LOAD power outputs between sections. The 4 GND connectors on the left route to the 4 GND connectors on the right, so power switching can be through the board (4-wire) or 3-wire, where just one of the GND sockets is wired up to provide the necessary GND reference for the LX7714.

Switch positions select between one permutation of the five combinations for paralleling power switch sections (Table 1 on page 3). The switches serve to connect LINE and GND between power switch sections, but don't disconnect connections from the 4mm LINE and GND input sockets.

2.2 Operating The LX7714 As Four Independent Power Switches

Follow the first row in Table 1 on page 3 to configure four independent and galvanically isolated power switches. Set the 3 LINE and GND switches to their leftmost positions and the 3 LOAD switches to their rightmost positions, marked 'x is independent'. If the LX7714 evaluation board is used to switch several different LINE input supplies, be aware that an inadvertent change of these switch positions can short external rails together.

2.3 Combining The LX7714's Power Switches In Various Combinations

Table 1 below shows the four switchable paralleling options. The IN and OUT switches are set to mirror positions in each case. Regard the switching as a convenience to minimize external power wiring, particularly in lower current setups. Using separate cables to each 4mm socket will reduce the overall series resistance of a test setup, but isn't mandatory. Check connections and switch positions before powering up, to avoid shorting intended independent sections together through incorrect switching.

The kit includes three headers (Header_4, Header_3+1, and Header_2+2) to optionally parallel on-board control signals for parallel switch connections (Figure 6 on page 6). Table 1 identifies the appropriate parallel combinations.

Table 1. On-board Switchable Parallel Power Switch Combinations

Independent and/or Parallel Power Switch Combination	SW_B _IN	SW_C _IN	SW_D _IN	SW_B _OUT	SW_C _OUT	SW_D _OUT
A, B, C, D are independent and galvanically isolated from each other	Left	Left	Left	Right	Right	Right
A, B, C, D are paralleled together.						
Plugging Header_4 into the PL_Control 20-pin header routes the on-board A control switch signals to the other 3 switches B, C, and D for synchronized switching. Move control switches B, C, and D right to the Header position to accept the master control from control switch A.	Right	Right	Right	Left	Left	Left
A, B, C are paralleled together. D is independent and galvanically isolated from the paralleled sections.						
Plugging Header_3+1 into the PL_Control 20-pin header routes the on-board A control switch signals to the 2 switches B, and C for synchronized switching. Move control switches B and C right to the Header position to accept the master control from control switch A. On-board D control switch will still manage power switch D independently with the header fitted.	Right	Right	Left	Left	Left	Right
A, B are paralleled together. C, D are independently paralleled together. Each paralleled pair is galvanically isolated from the other paralleled pair.						
Plugging Header_2+2 into the PL_Control 20-pin header routes the on-board A control switch signals to switch B for synchronized switching. It also routes the on-board D control switch signals to switch C for synchronized switching. Move control switches B and C right to the Header position to accept the master control from control switches A and D respectively.	Right	Left	Middle	Left	Right	Middle
A, B are paralleled together. C, D are independent and galvanically isolated from each other and the paralleled pair.	Right	Left	Left	Left	Right	Right

3 Status LEDs

Each of the 4 power switch channels has green LED near the LINE input socket which lights when power is applied to that channel. Each power switch channel also has a green LED which optionally lights when the PWR_GOOD signal is active low, and a red LED which optionally lights when the IN_RESET signal is active low. These two status LEDs draw power from each power switch's ~5-6V local supply. The status signal LEDs can be left switched in if any status signals are pulled up externally with resistors to higher voltages than 5V, and can be switched out if the control signals are pulled up to a different voltage externally via the PL_Status header.

4 Control and Status Connectors

Connector PL_Control is a 20 pin 0.1" header that accepts external CTRL_P_x and CTRL_N_x control signals for the four power switches (Table 2 on page 4). The four sets of external CTRL_P_x and CTRL_N_x signals are individually switched to the LX7714 by the respective four SW_CNTL_x slide switches in their rightmost positions. If a pair of external CTRL_P_x and CTRL_N_x signals is open circuit, the LX7714 interprets that as ON. The left and middle switch positions select manual OFF and ON control. PL_Control mirrors: reversing the connection safely reverses the ABCD signal order to DCBA.

Connector PL_Status is a 20 pin 0.1" header providing the two open-drain status signals from each power switch (Table 2 on page 4). Status signals can be switched to on-board status LEDs via the four SW_LEDS_x switches, operating from the on-board +5V supplies. PL_Status mirrors: reversing the connection safely reverses the ABCD signal order to DCBA.

The control and status connectors bring out the four individual GND connections for the four power switches. Ensure that any GND connections joined together via these connectors are matched by positions on the LINE and GND switches

Table 2. LX7714 Control Connector PL_Control and Status Output Connector PL_Status

PL_Control			PL_Status	
Pin	Signal	Signal Direction	Pin	Signal
1	GND_A		1	GND_A
2	Remote CTRL_N_A	To LX7714-EVB from user system	2	IN_RESET_A
3	Remote CTRL_P_A	To LX7714-EVB from user system	3	PWR_GOOD_A
4	CTRL_N_A	From LX7714-EVB switch SW_CNTL_A	4	GND_A
5	CTRL_P_A	From LX7714-EVB switch SW_CNTL_A	5	-
6	-		6	GND_B
7	GND_B		7	IN_RESET_B
8	Remote CTRL_N_B	To LX7714-EVB from user system	8	PWR_GOOD_B
9	Remote CTRL_P_B	To LX7714-EVB from user system	9	GND_B
10	-		10	-
11	-		11	-
12	Remote CTRL_P_C		12	GND_C
13	Remote CTRL_N_C	To LX7714-EVB from user system	13	PWR_GOOD_C
14	GND_C	To LX7714-EVB from user system	14	IN_RESET_C
15	-		15	GND_C
16	CTRL_P_D	From LX7714-EVB switch SW_CNTL_D	16	-
17	CTRL_N_D	From LX7714-EVB switch SW_CNTL_D	17	GND_D
18	Remote CTRL_P_D	To LX7714-EVB from user system	18	PWR_GOOD_D
19	Remote CTRL_N_D	To LX7714-EVB from user system	19	IN_RESET_D
20	GND_D		20	GND_D

4.1 Parallel Configuration Header Boards

Connector PL_Control provides the outputs of the SW_CNTL_A slide switch (CTRL_N_A, CTRL_P_A) and the SW_CNTL_D slide switch (CTRL_N_D, CTRL_P_D). This allows the A and D slide switches to control multiple power switches when they have been paralleled. The LX7714-EVB includes three header boards (Header_4, Header_3+1, Header_2+2) with pre-wired configurations to optionally parallel on-board control signals for parallel switch connections (Figure 6 on page 6, Table 1 on page 3).

4.1.1 A, B, C, AND D PARALLELED TOGETHER

- Move all three SW_IN_x slide switches to the right to parallel all 4 power switch inputs
- Move all three SW_OUT_x slide switches to the left to parallel all 4 power switch outputs
- Plug Header_4 into PL_Control to control all 4 power switches together with the SW_CNTL_A control switch
- Set SW_CNTL_B, SW_CNTL_C, SW_CNTL_D to Header
- Signals from the A control switch SW_CNTL_A now control all 4 power switches together

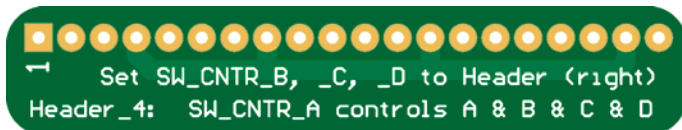


Figure 2. Header_4 Header Board

4.1.2 A, B, AND C PARALLELED TOGETHER, WHILE D IS INDEPENDENT

- Move SW_B_IN and SW_C_IN slide switches to the right to parallel LINE_A, LINE_B, and LINE_C inputs
- Move SW_B_OUT and SW_C_OUT slide switches to the left to parallel LOAD_A, LOAD_B, and LOAD_C outputs
- Plug Header_3_1 into PL_Control to control power switches A, B, & C together with the SW_CNTL_A control switch
- Set SW_CNTL_B, SW_CNTL_C to Header
- Signals from the A control switch SW_CNTL_A now control power switches A, B, & C together
- The D control switch SW_CNTL_D controls power switch D independently with the header fitted



Figure 3. Header_3_1 Header Board

4.1.3 A AND B ARE PARALLELED TOGETHER; C AND D ARE INDEPENDENTLY PARALLELED TOGETHER

- Move SW_B_IN slide switch to the right and SW_B_OUT slide switch to the left to parallel LINE_A and LINE_B
- Move SW_D_IN slide switch to the right and SW_D_OUT slide switch to the left to parallel LINE_C and LINE_D
- Plug Header_2_2 into PL_Control to control power switches A and B together with the SW_CNTRL_A control switch, and power switches C and D together with the SW_CNTRL_D control switch
- Set SW_CNTRL_B, SW_CNTRL_C to Header
- Signals from the A control switch SW_CNTRL_A now control power switches A and B together
- Signals from the D control switch SW_CNTRL_D now control power switches C and D together



Figure 4. Header_2_2 Header Board

5 Schematics

Figure 5 below shows the status output connector, control input connector and control switches.

Figure 6 on page 6 shows the paralleled power switch control configuration boards.

Figure 7 on page 6 shows the ~5-6V regulators, status LEDs and status LED switches.

Figure 8 on page 6 shows the control input, line, and load test points.

Figure 9 on page 7 shows the LX7714, power input/output connectors and power path switches.

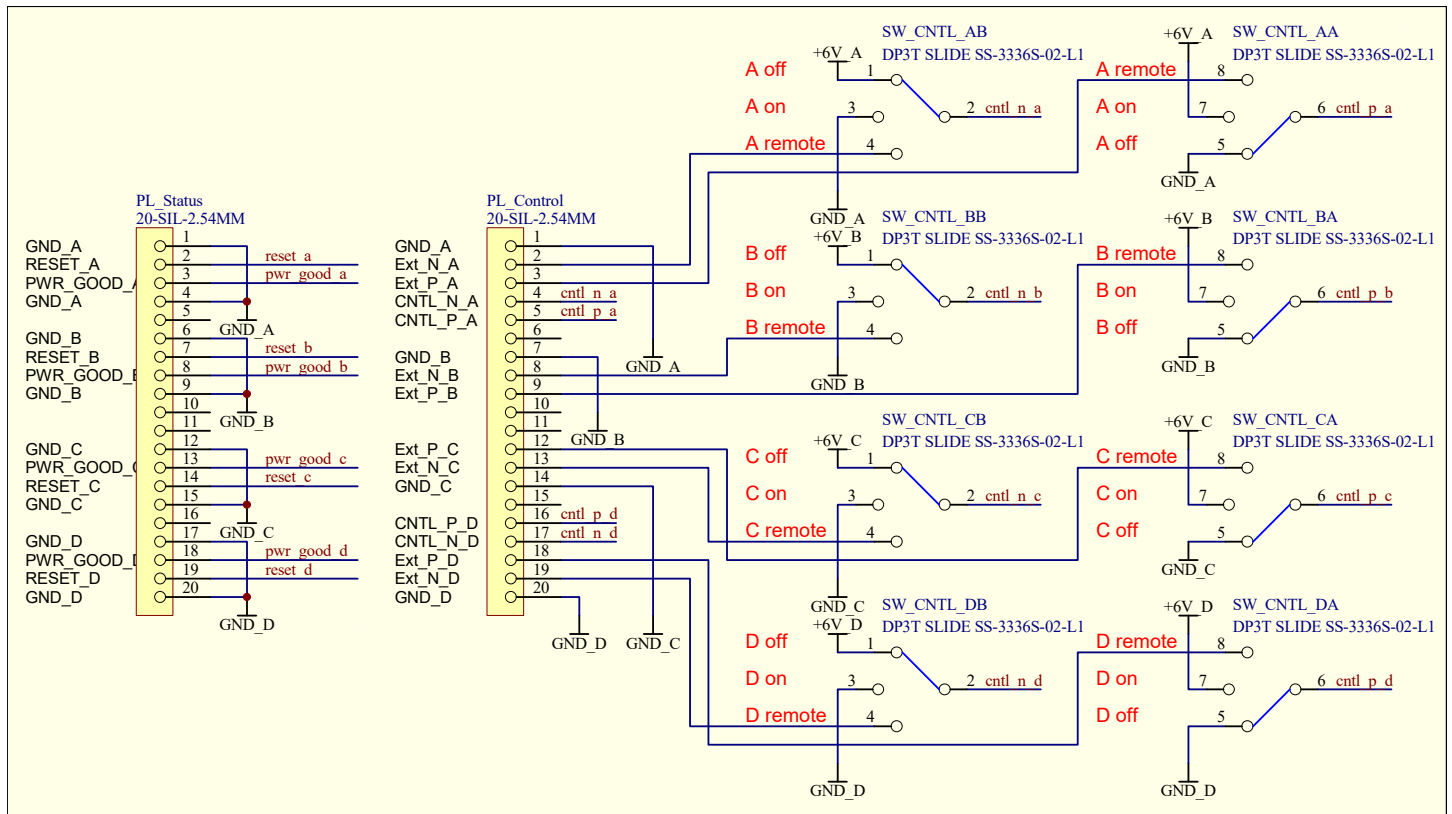


Figure 5. LX7714 Status Output Connector, Control Input Connector and Control Switches

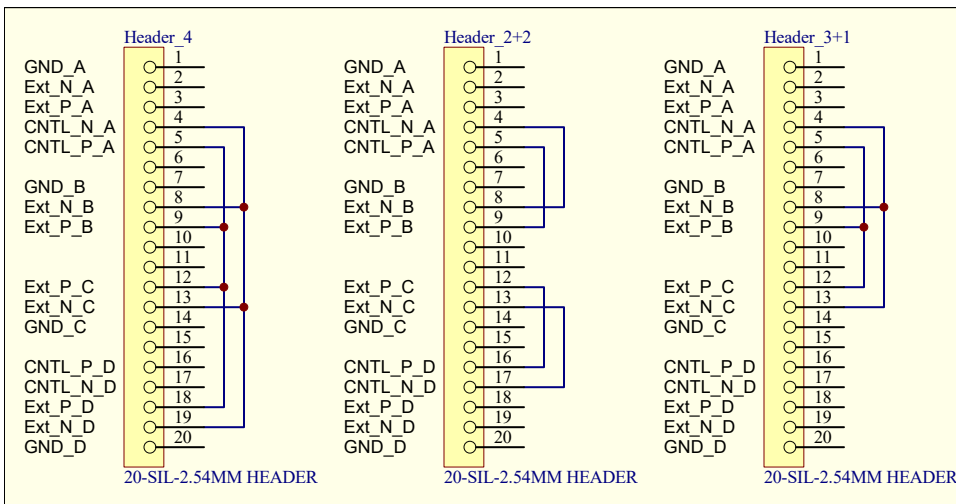


Figure 6. LX7714 Paralleled Power Switch Control Configuration Header Boards

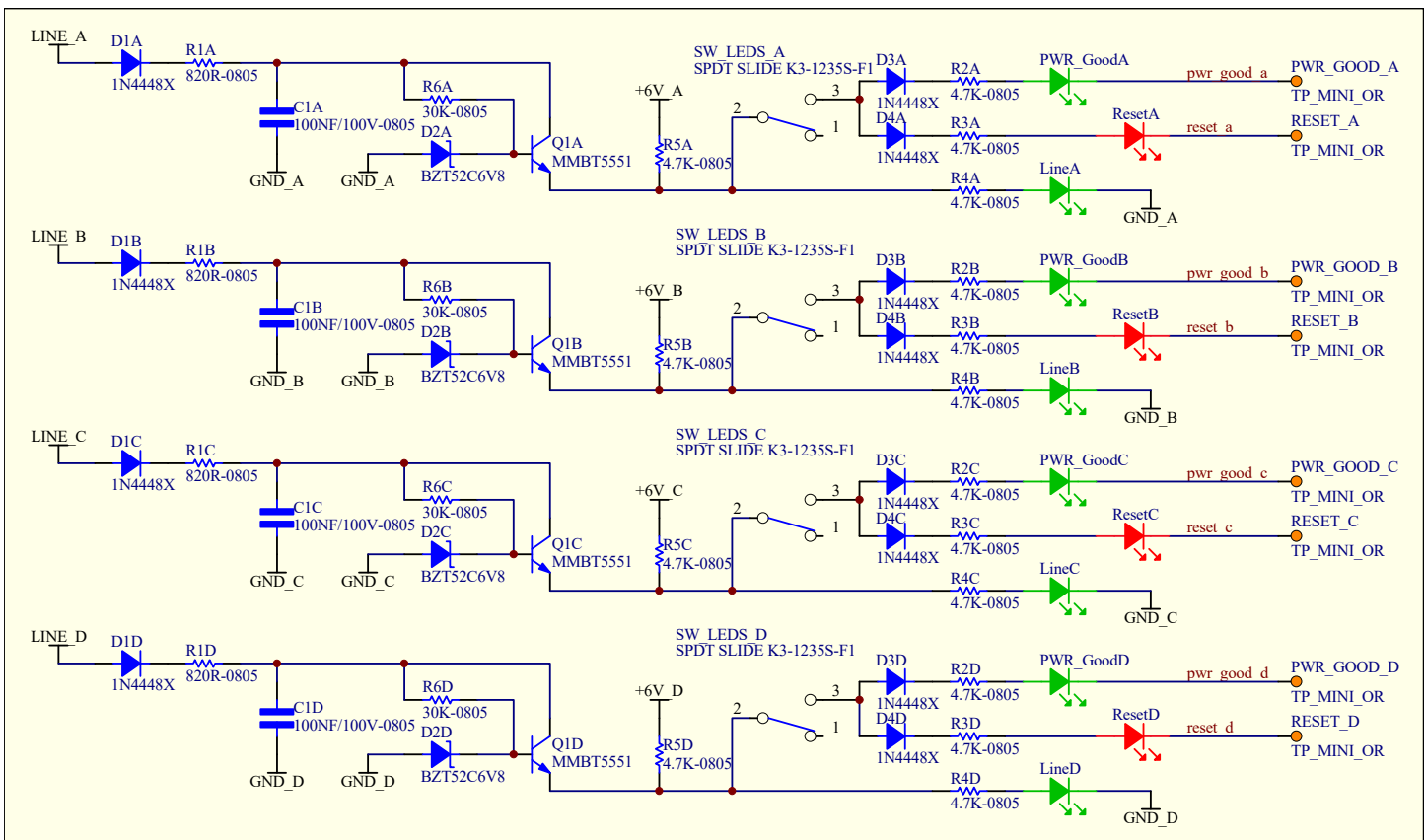


Figure 7. ~5-6V Regulators, Status LEDs, and Status LED Switches

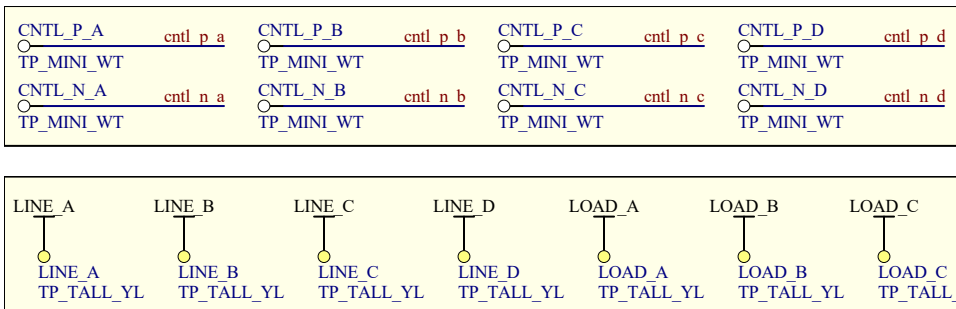


Figure 8. Control Input, Line, and Load Test Points

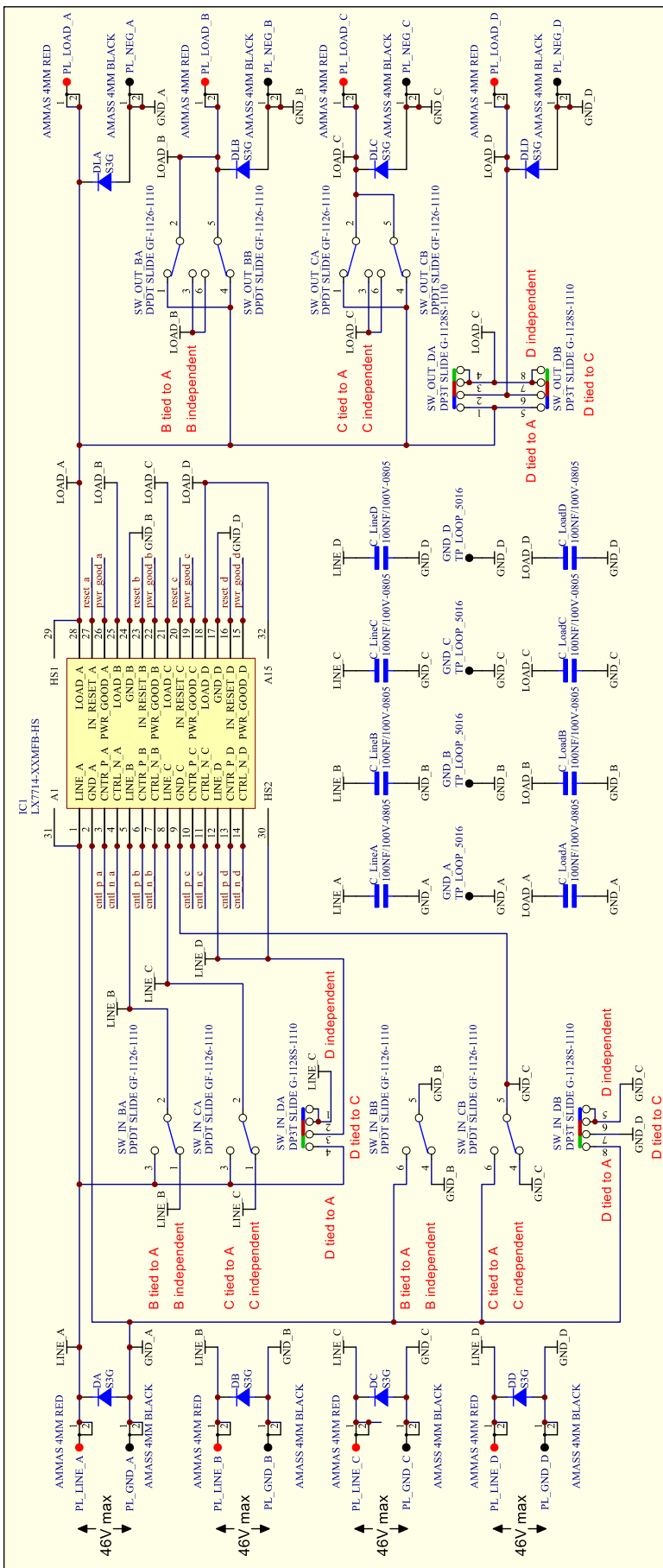


Figure 9. LX7714, Power Input/Output Connectors, and Power Path Switches

6 PCB Layout

The PCB is doubled-sided 1.6mm FR-4 with 1-oz (35µm) copper and 1µm ENIG finish.

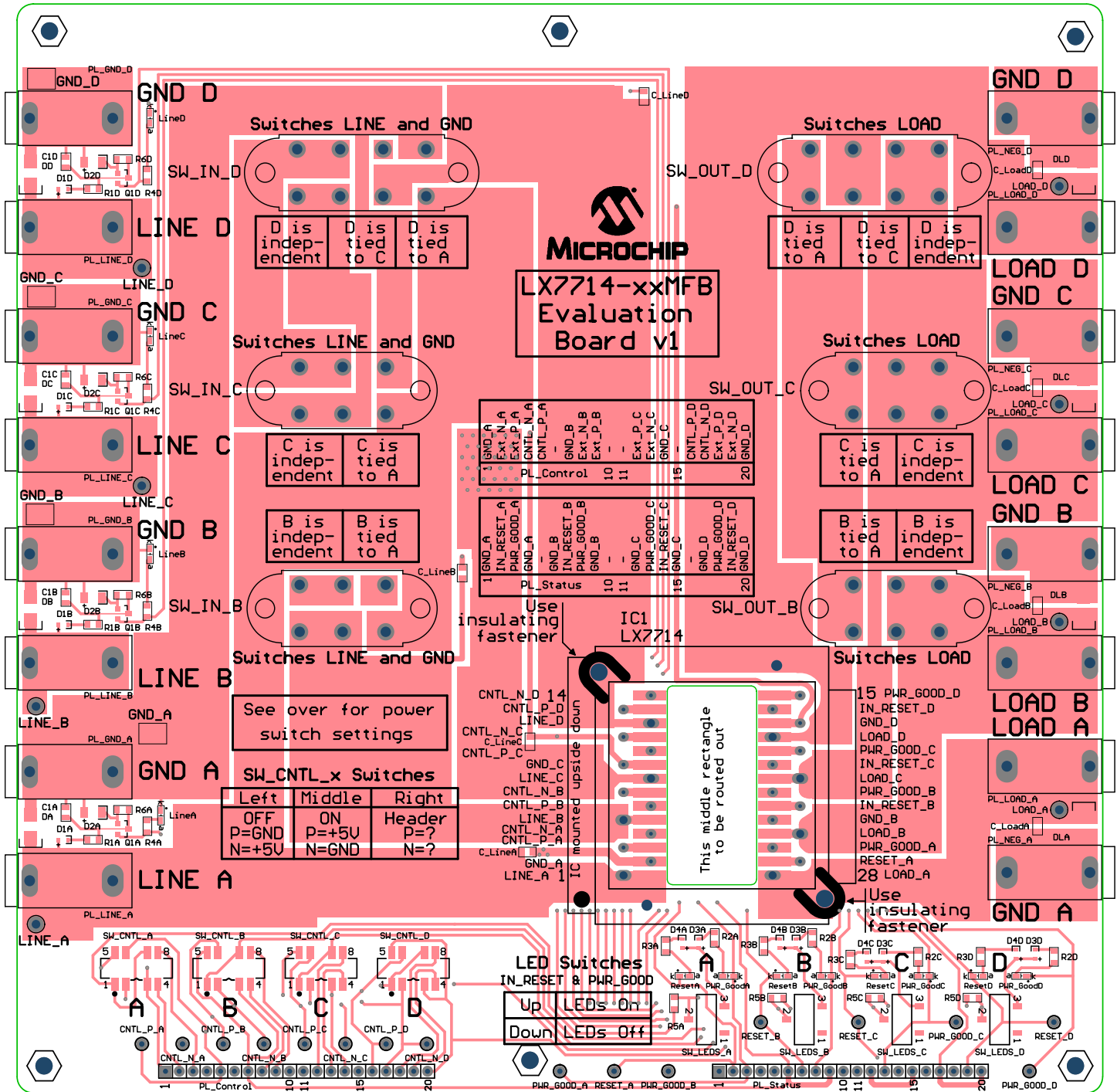


Figure 10. PCB Top Copper Layer And Top Legends

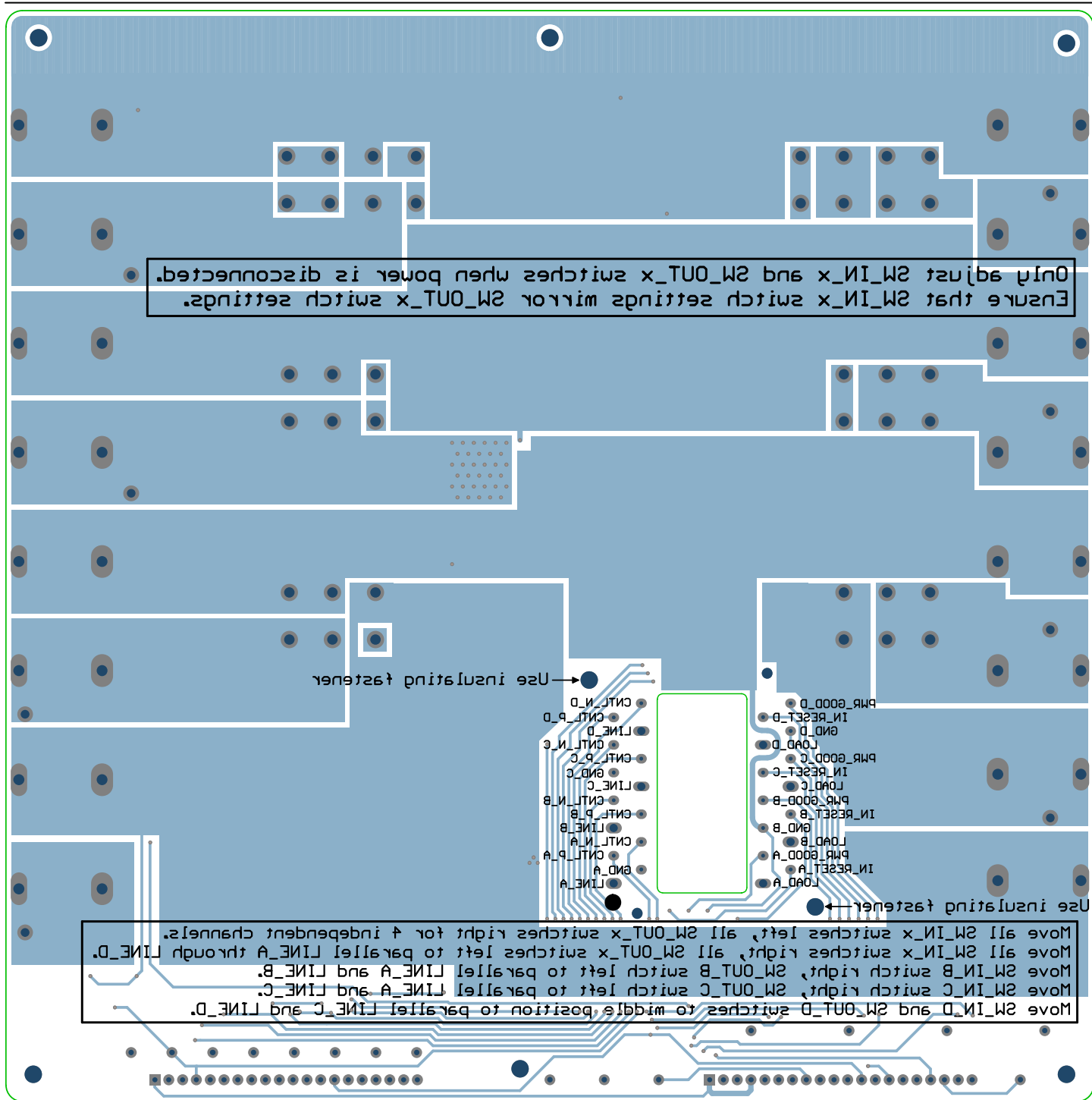


Figure 11. PCB Bottom Copper Layer And Bottom Legends (through-board view)

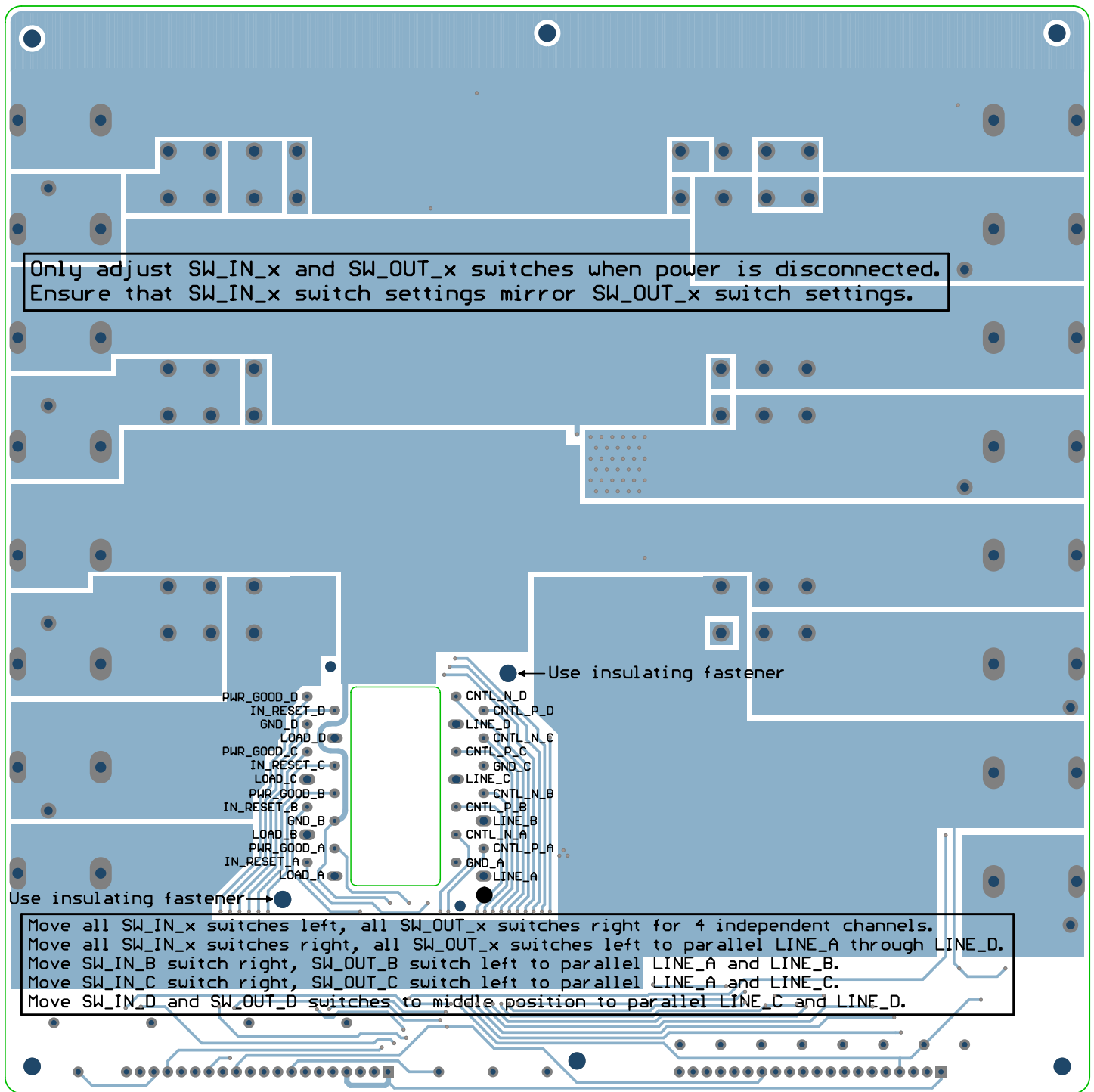


Figure 12. PCB Bottom Copper Layer And Bottom Legends (bottom view)

7 PCB Parts List

Table 3. Bill of Materials

Designators	Part	Quantity	Part Type
C1A, C1B, C1C, C1D, C_LineA, C_LineB, C_LineC, C_LineD, C_LoadA, C_LoadB, C_LoadC, C_LoadD	100nF/100V-0805	12	Capacitor MLCC X7R ±20%
D1A, D1B, D1C, D1D, D3A, D3B, D3C, D3D, D4A, D4B, D4C, D4D	1N4448X	12	Diode silicon 1N4448X 75V 150mA
D2A, D2B, D2C, D2D	BZT52C6V8	4	Diode zener BZT52C6V8 6.8V 500mW
DA, DB, DC, DD, DLA, DLB, DLC, DLD	S3G-SMB	4	Diode silicon S3G 400V 3A
Q1A, Q1B, Q1C, Q1D	MMBT5551	4	NPN MMBT5551 160V 600mA SOT-23
IC1	LX7714-xxMFB-xx	1	Any LX7714 in CFP-28L package
Line_A, Line_B, Line_C, Line_D, PWR_Good_A, PWR_Good_B, PWR_Good_C, PWR_Good_D	LED green 0603	8	LED green 0603
Reset_A, Reset_B, Reset_C, Reset_D	LED red 0603	4	LED red 0603
PL_Control, PL_Status	20SIL-2.54MM	2	Connector 20 pin single row pin header 2.54mm
Header_2+2, Header_3+1, Header_4	20SIL-2.54MM-SKT	3	Connector 20 pin single row socket header 2.54mm
PL_GND_A, PL_GND_B, PL_GND_C, PL_GND_D, PL_NEG_A, PL_NEG_B, PL_NEG_C, PL_NEG_D	DELTRON 4MM BLACK	8	4mm black socket Deltron 571-0100 or AMASS/Multicomp 24.243.2
PL_LINE_A, PL_LINE_B, PL_LINE_C, PL_LINE_D, PL_LOAD_A, PL_LOAD_B, PL_LOAD_C, PL_LOAD_D	DELTRON 4MM RED	8	4mm red socket Deltron 571-0500 or AMASS/Multicomp 24.243.1
R1A, R1B, R1C, R1D	820Ω-0805	4	Resistor 0805 ±1% 125mW
R2A, R2B, R2C, R2D, R3A, R3B, R3C, R3D, R4A, R4B, R4C, R4D, R5A, R5B, R5C, R5D	4.7kΩ-0805	16	Resistor 0805 ±1% 125mW
R6A, R6B, R6C, R6D	30kΩ-0805	4	Resistor 0805 ±1% 125mW
SW_IN_B, SW_OUT_B, SW_IN_C, SW_OUT_C	DPDT SLIDE GF-1126-1110	4	Switch DPDT slide CWI GF-1126-1110
SW_IN, SW_OUT_D	DP3T SLIDE G-1128S-1110	2	Switch DP3T slide CWI G-1128S-1110
SW_LEDS_A, SW_LEDS_B, SW_LEDS_C, SW_LEDS_D	SPDT SLIDE K3-1235S-F1	4	Switch SPDT slide HRO K3-1235S-F1
SW_CNTL_A, SW_CNTL_B, SW_CNTL_C, SW_CNTL_D	DP3T SLIDE SS-3336S-02-L1	4	Switch DP3T slide XKB SS-3336S-02-L1
GND_A, GND_B, GND_C, GND_D	TP_LOOP_5016	4	Testpoint Keystone 5016 SMC loop
LINE_A, LINE_B, LINE_C, LINE_D, LOAD_A, LOAD_B, LOAD_C, LOAD_D	TP_TALL_YL	8	Testpoint Keystone 5014 tall wire loop, yellow
PWR_GOOD_A, PWR_GOOD_B, PWR_GOOD_C, PWR_GOOD_D, RESET_A, RESET_B, RESET_C, RESET_D	TP_MINI_OR	8	Testpoint Keystone 5003 mini wire loop, orange
CNTL_N_A, CNTL_N_B, CNTL_N_C, CNTL_N_D, CNTL_P_A, CNTL_P_B, CNTL_P_C, CNTL_P_D	TP_MINI_WT	8	Testpoint Keystone 5002 mini wire loop
ST1, ST2, ST3, ST4, ST5, ST6	Standoff	6 + 6	20mm hex nylon standoff with 6mm M3 thread, plus M3 nut

8 Revision History

8.1 Revision 1 - April 2024

First release.

8.2 Revision 1.1 - May 2024

Rewrite of introductory paragraph, and minor document style elements updated.

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