48 V Bus Compatible 1.2 V/100 A Double Step-Down DC-DC Converter

Reference Guide

RD231-RGUIDE-01

Toshiba Electronic Devices & Storage Corporation

Table of Contents

1. Introduction

This reference guide describes the specifications, usage, and characteristics of the 48 V Bus Compatible 1.2 V/100 A Double Step-Down DC-DC Converter (hereafter referred to as this power supply).

In recent years, the amount of power consumed by data-centers has been increasing, and therefore 48 V power supply bus for server equipment is becoming popular in order to reduce power dissipation. This is a high-efficiency DC-DC converter that takes input power from 48 V bus lines and delivers 1.2 V, 100 A for powering CPU, GPU, ASIC and other devices on the board.
This power supply has two stages of step-down to achieve an efficient step-down from 50 V(Typ.) to 1.2 V, and the first step-down changes the voltage to 12 V. The power MOSFET TPH1400ANH is used as a high-side switching device in the first-stage, and the power MOSFET TPH5R60APL is used as a low-side switching device (synchronous rectification). This step-down circuit operates in two phases. The power MOSFET TPH8R903NL is used as the high-side switching device in the second-stage and the power MOSFET TPHR9203PL1 is used as a low-side switching device (synchronous rectification). This step-down circuit operates in 5 phases. By using these Toshiba semiconductor devices, we have realized a highly efficient Double step-down DC-DC converter.

2. Specifications and Appearance

2.1. Power Supply Specifications

Table 2.1 lists the main specifications of this power supply.

Table. 2.1 Main Specifications of This Power Supply

Parameters	Conditions	Min.	Typ.	Max.	Unit
External Specifications					
Input Voltage		40	50	59.5	V
Output Voltage	Vout setting = 1.2 V	1.176	1.2	1.224	V
Output Voltage Variable Range	According to the on-board DIP setting	0.50		1.60	V
Output Current	Vout = 1.2 V			100	A
Output Ripple Voltage	Vout = 1.2 V			20	mV
Board Size	151 × 198 mm				
Board Configuration	FR-4, 6 layers, 1.6mm thick Copper foil thickness: Outer layer 35 μm, Inner layer 35 μm				
Cooling System	Convection cooling				
Internal Specifications (First-Stage)					
Output Voltage			12		V
Switching Frequency			100		kHz
Input Low Voltage Error Detection Voltage			35		V
Overheat Error Detection Temperature	IC1 junction temperature		180		℃
Internal Specifications (Second-Stage)					
Input Voltage			12		V
Switching Frequency			400		kHz
Input Low Voltage Error Detection Voltage			10		V

2.2. Block Diagram

Figure 2.1 shows a block diagram of this power supply.

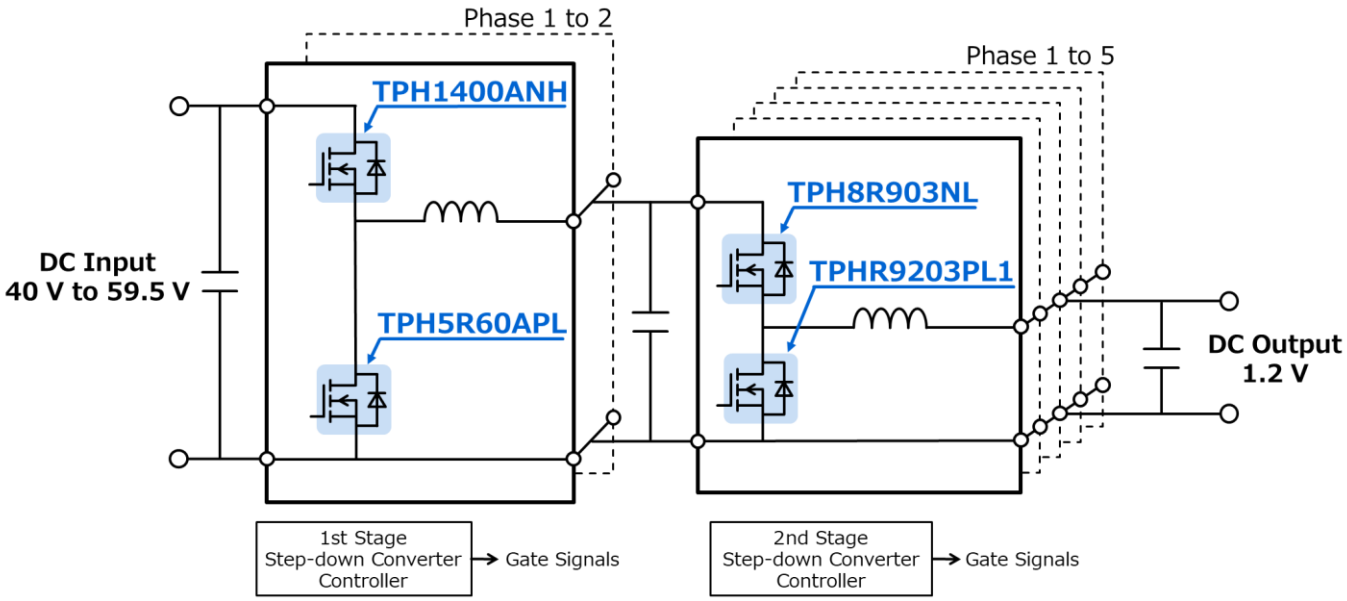


Fig. 2.1 Block Diagram

2.3. Appearance

Figure 2.2 shows the appearance of this power supply.

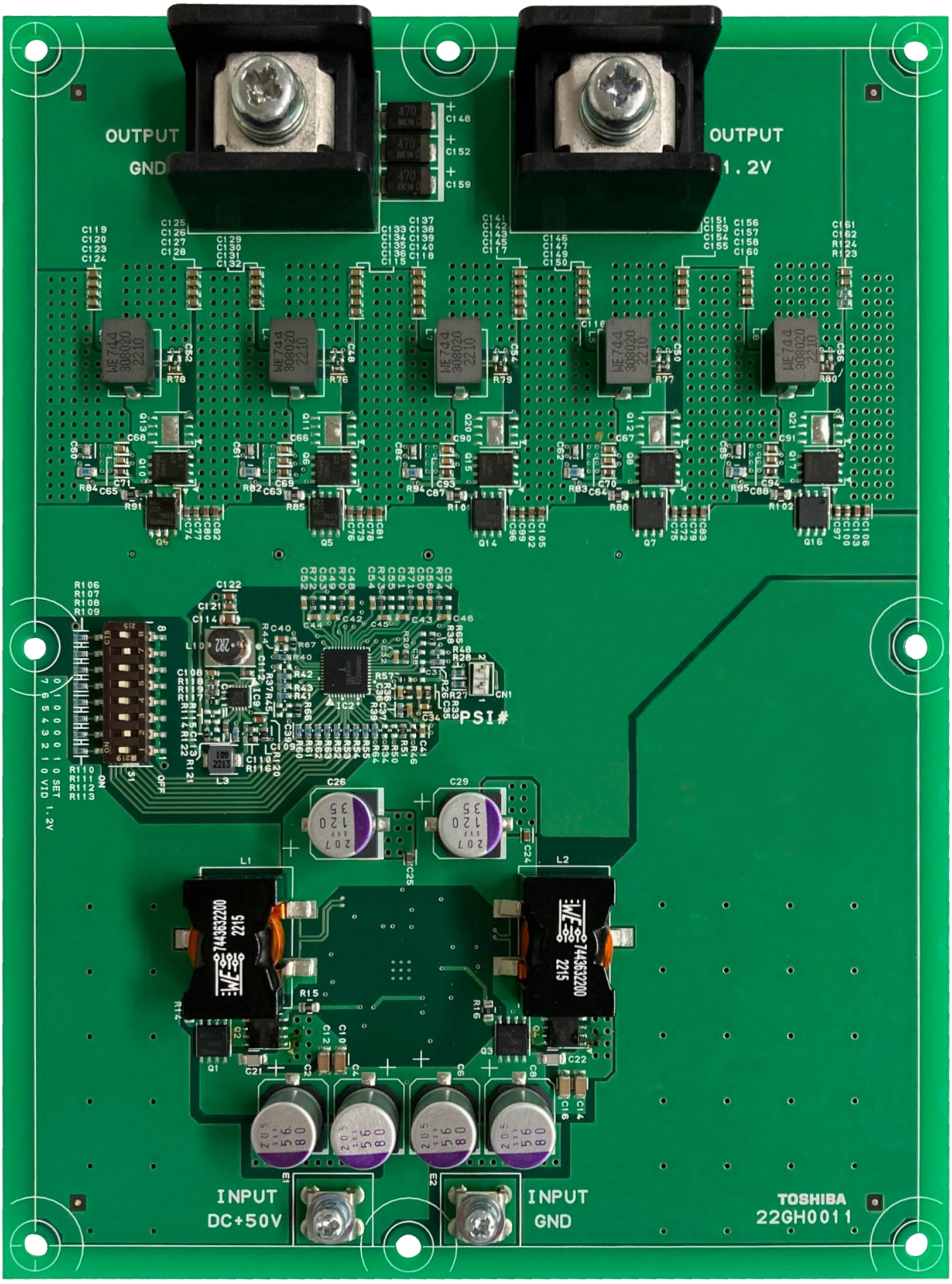
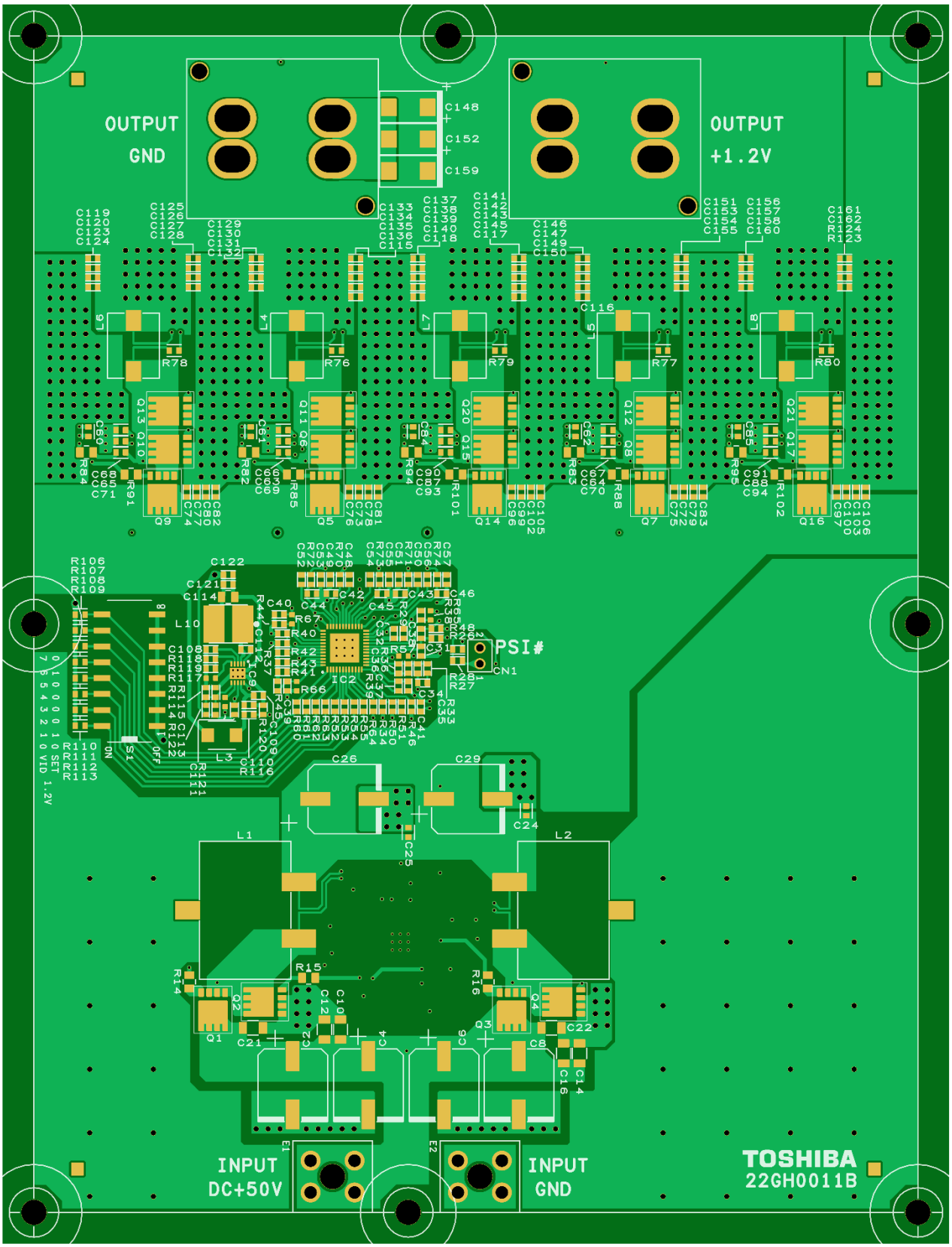


Fig. 2.2 Top View of the 48 V Bus Compatible 1.2 V/100 A Double Step-Down DC-DC Converter

2.4. PCB Component Layout

Fig. 2.3 shows the component layout of this power supply.



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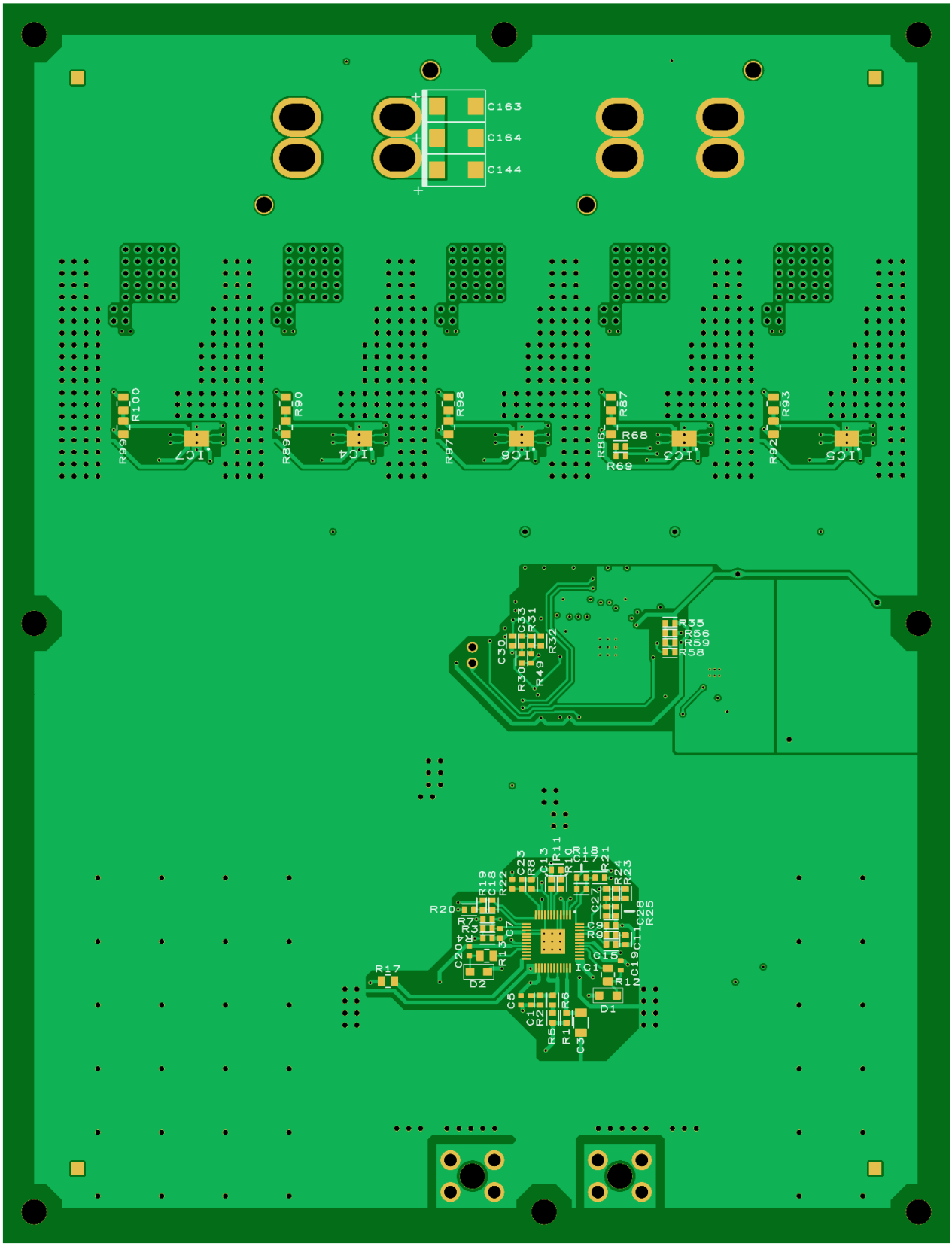

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Fig. 2.3 Component Layout of the 48 V Bus Compatible 1.2 V/100 A Double Step-Down DC-DC Converter

3. Schematic, Bill of Materials, and PCB Pattern

3.1. Schematic

Refer to the following file for the circuit diagram of this power supply.

RD231-SCHEMATIC-xx.pdf (xx is the revision number)

3.2. Bill of Materials

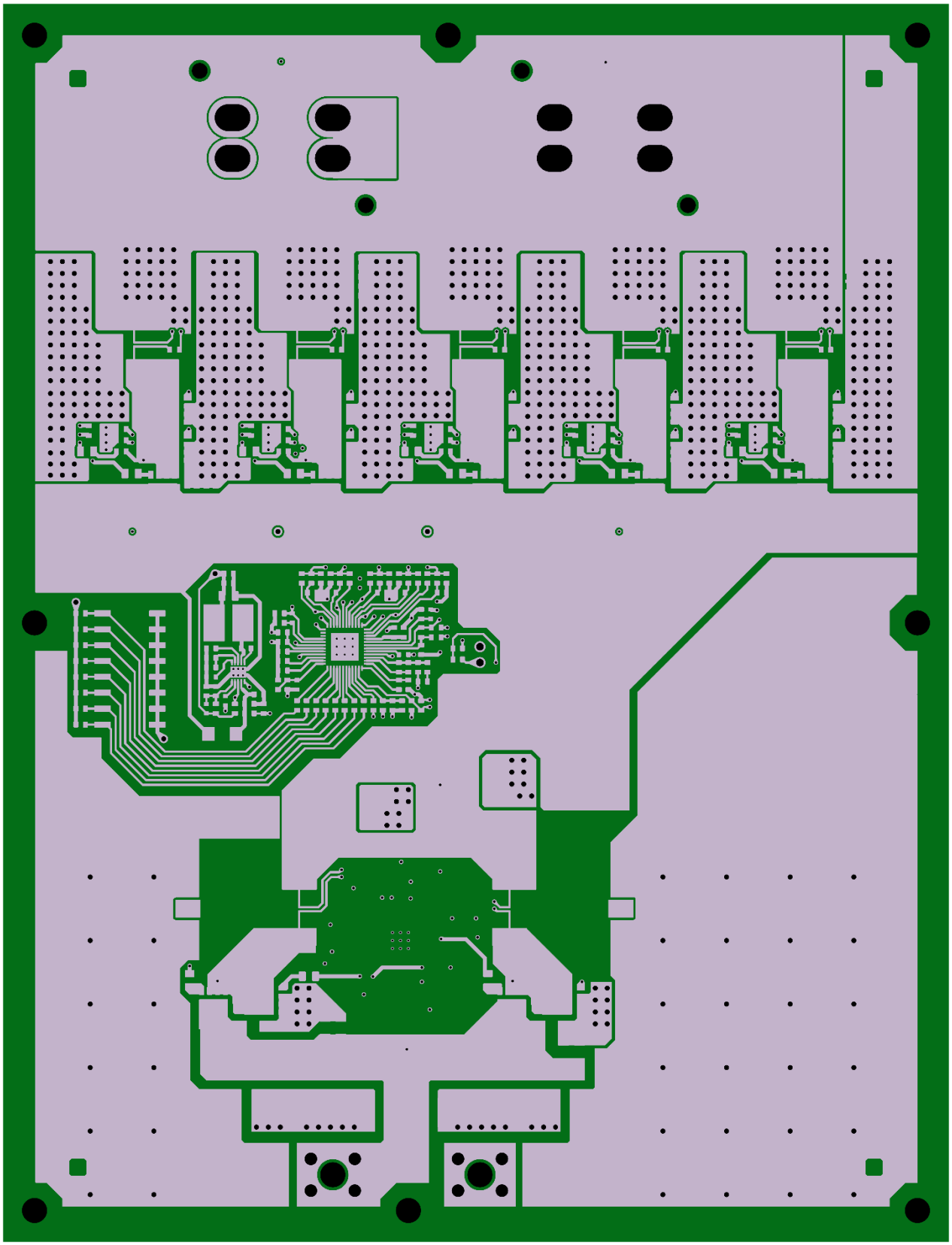
Refer to the following file for the Bill of Materials (BOM) of this power supply.

RD231-BOM-xx.pdf (xx is the revision number)

3.3. PCB Pattern

The PCB pattern of the main circuit board of this power supply is shown in Figure 3.1. Following file can also be referred.

RD231-LAYER-xx.pdf (xx is the revision number)



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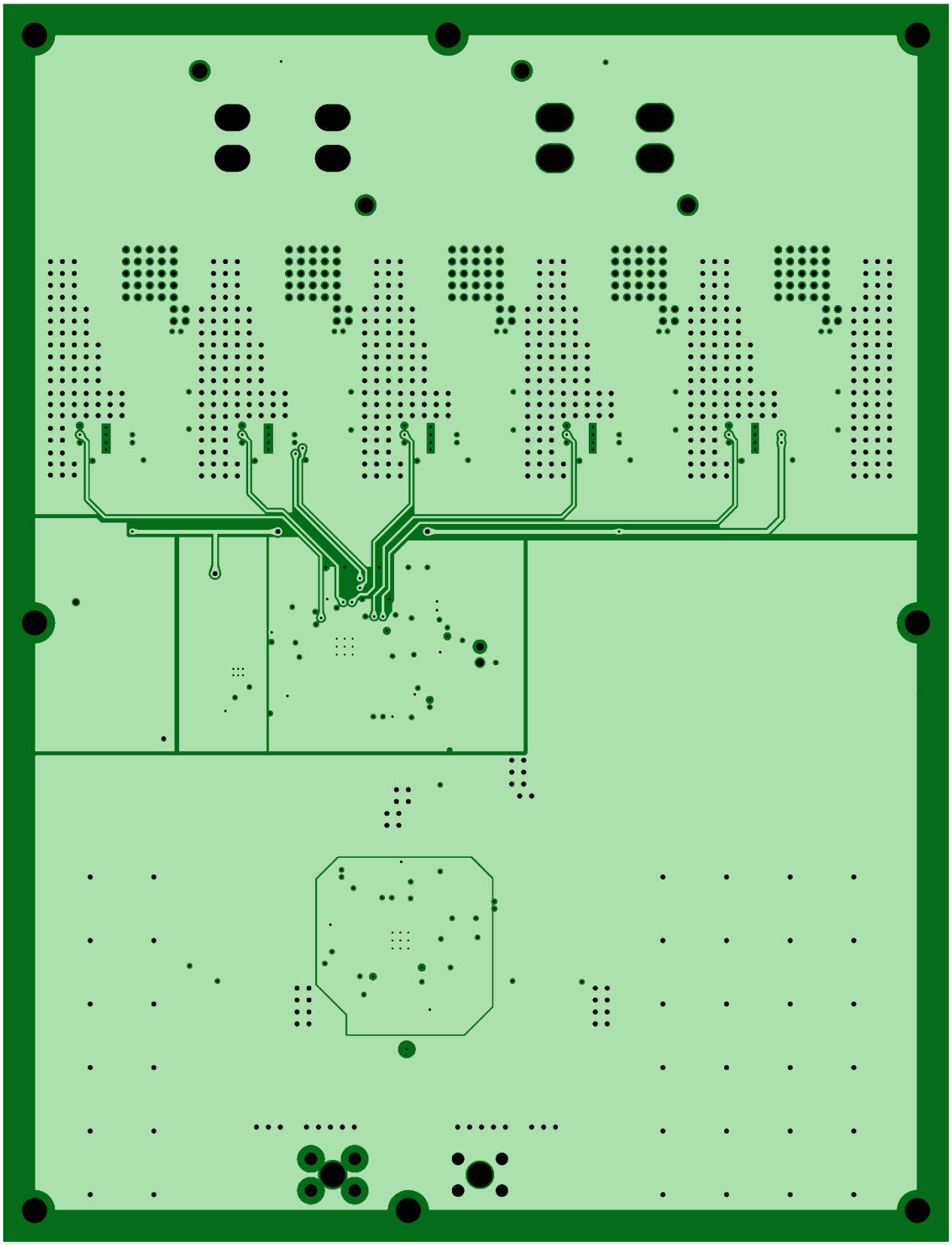

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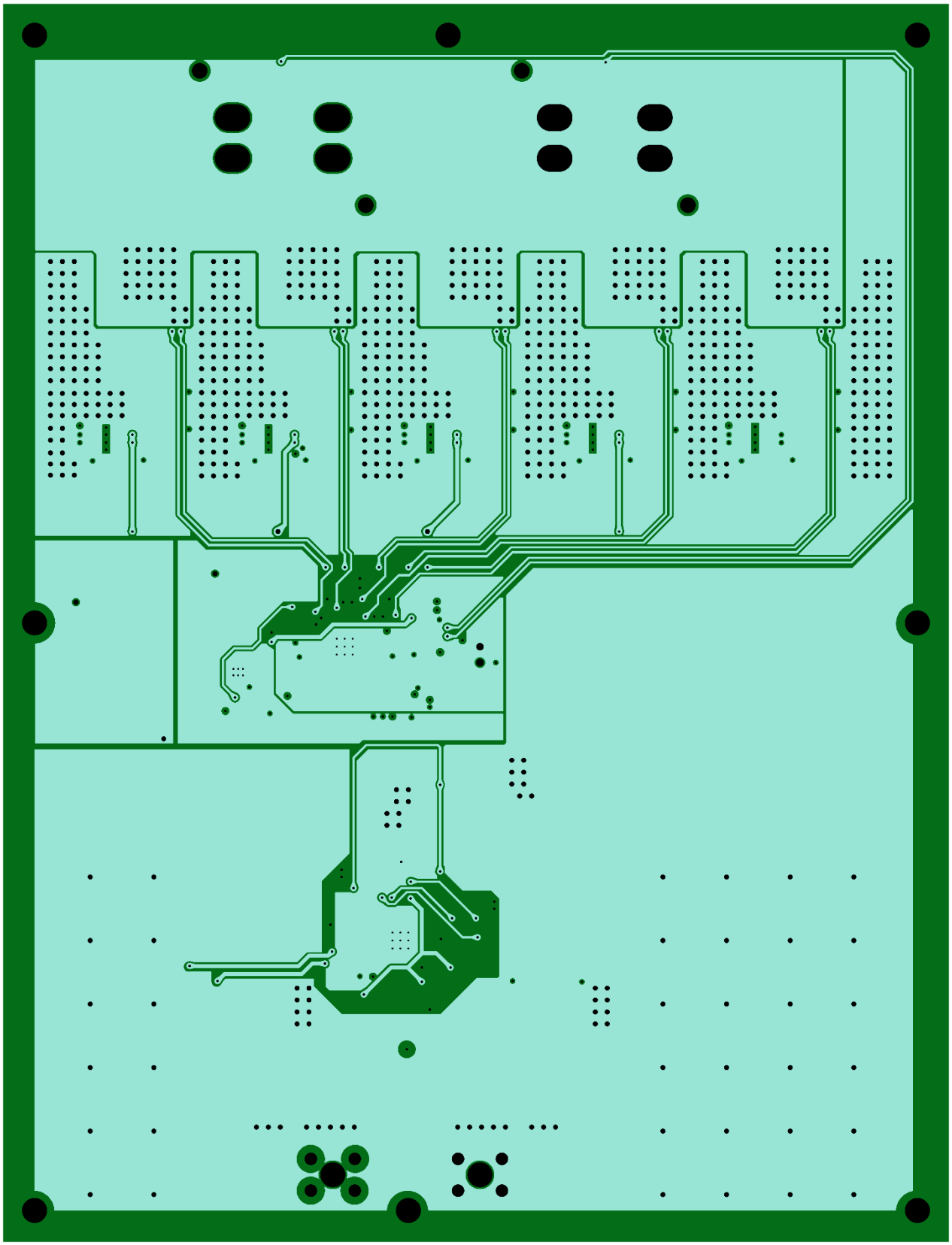

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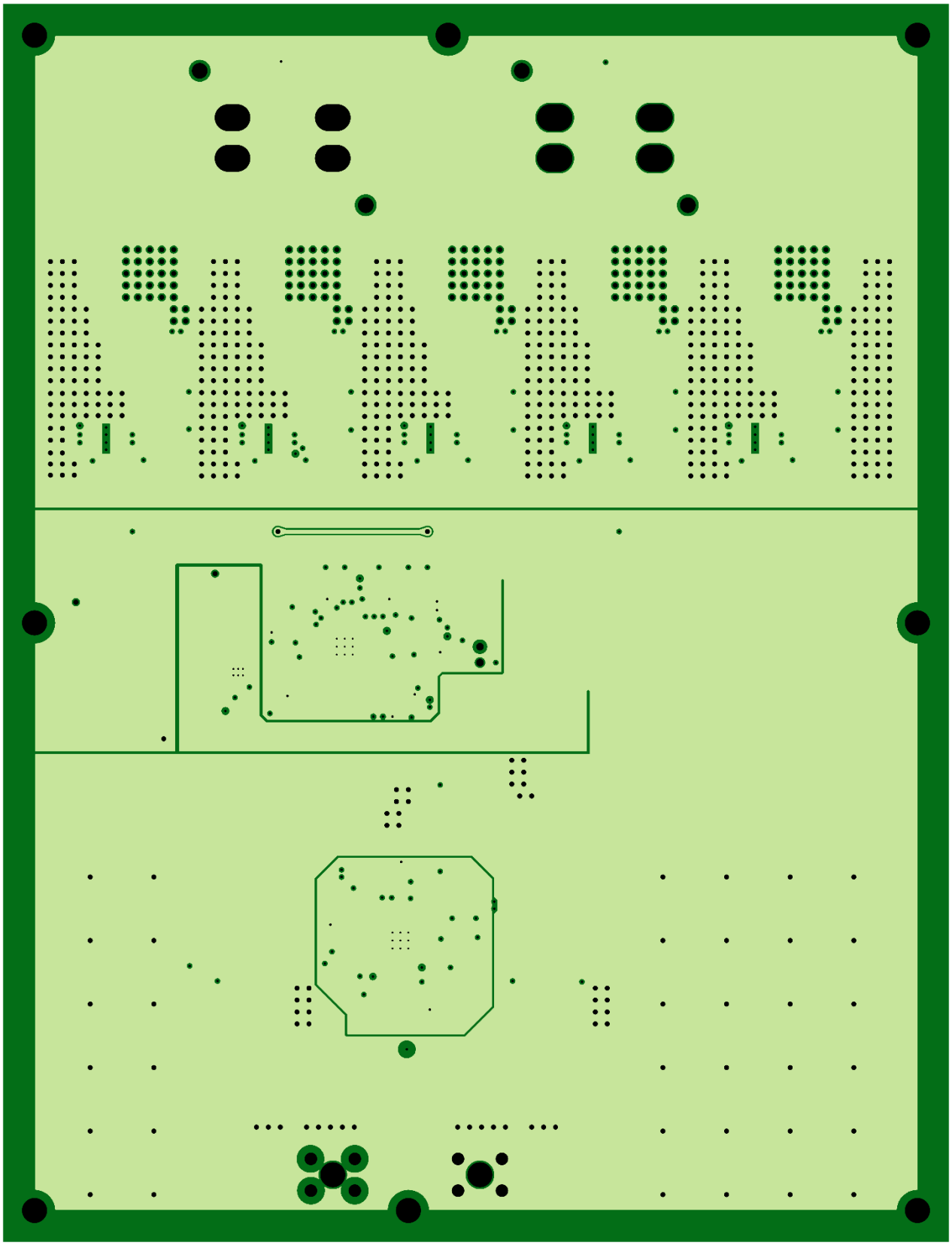

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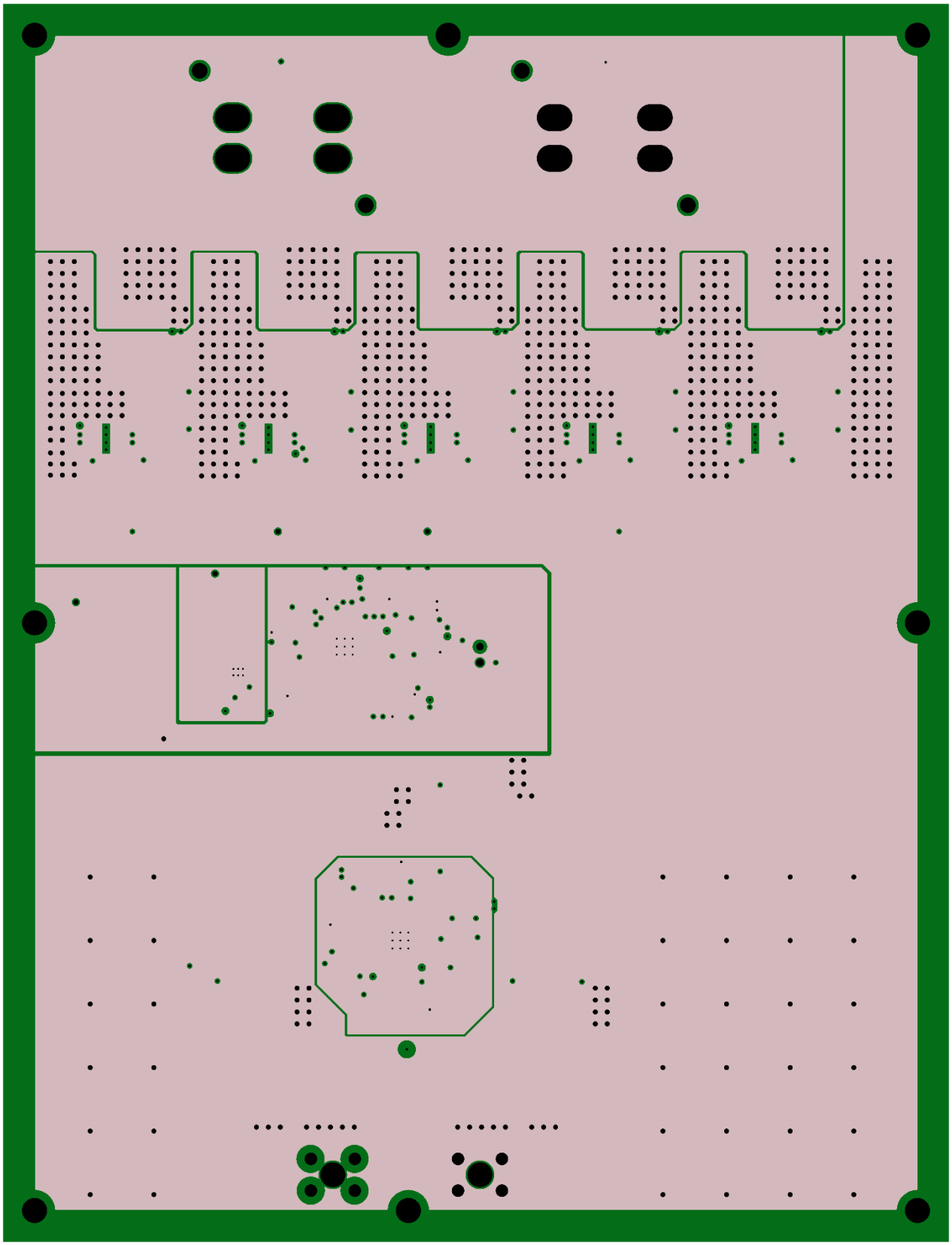

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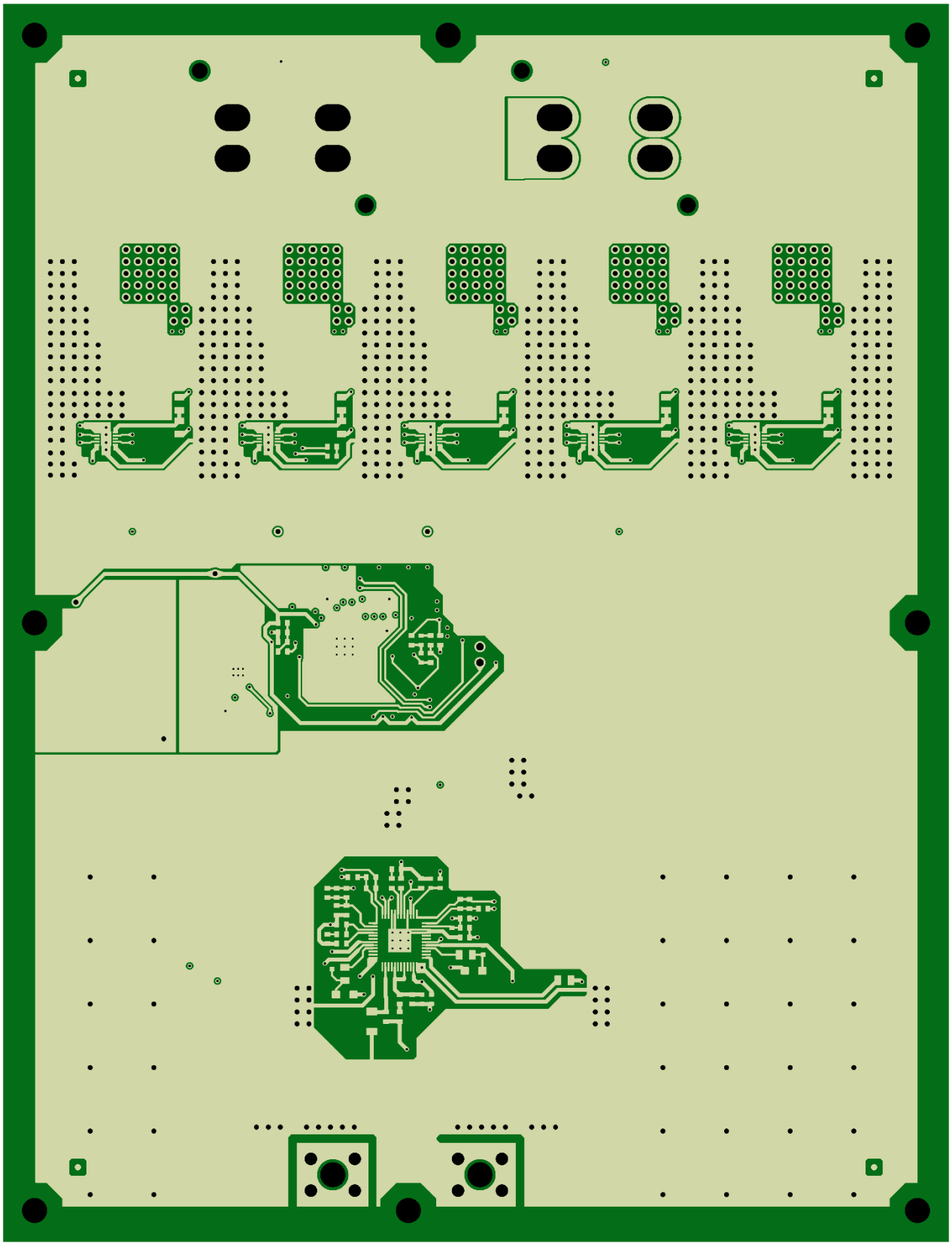

<Layer6, Back>

Fig. 3.1 PCB Pattern of the 48 V Bus Compatible 1.2 V/100 A Double Step-Down DC-DC Converter (Front View)

4. Operation Procedure

4.1. External Connections

Figure 4.1 shows the external connection pins of this power supply. The red boxes indicate DC IN terminals, and blue boxes indicate DC OUT terminals. Connect the (+) side (1.2 V) of the DC load to E7 of the DC Output terminal (made by OP-1100, Osada) and the (-) side (GND) of the DC load to E8. In addition, connect the (+) side of the DC power supply to E1 of the DC input terminal (made by OT-007, Osada) and the (-) side (GND) of the DC power supply to E2. Use load device and cables that meet the power supply specifications.

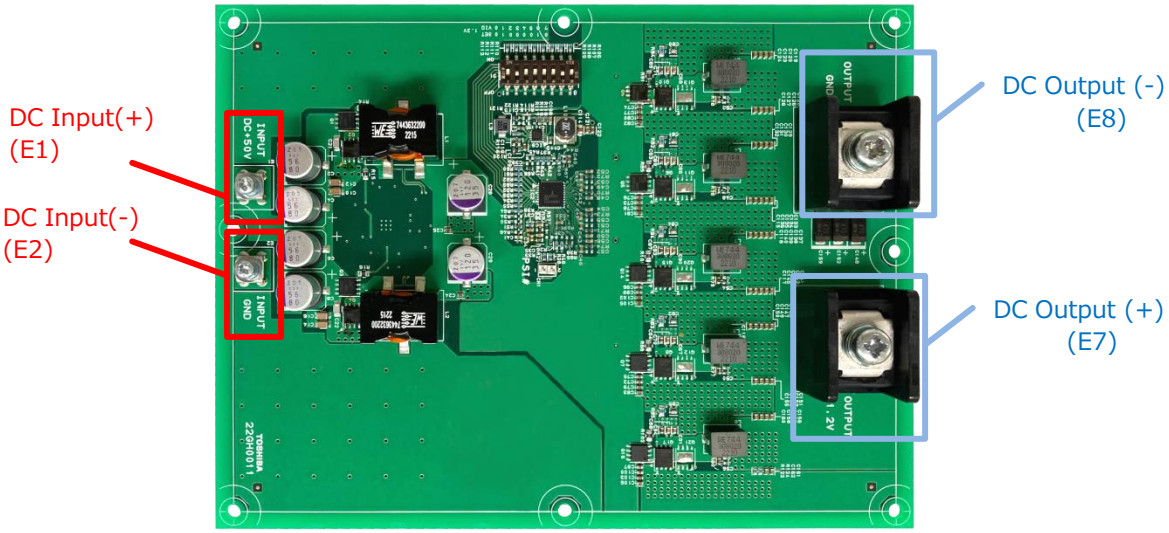

Fig.4.1 External Connections

4.2. Start and Stop Procedure

Before starting, make sure that all input and output terminals (E1, E2 and E7, E8) are at 0 V.

[Start procedure]

1. Turn on the input DC power supply.

[Stop Procedure]

1. Turn off the input DC power supply.

4.3. Precautions (To Prevent Electric Shock/Burns, etc.)

Be careful of electric shock when connecting the power supply. Do not touch any part of the power supply directly while it is in operation. Be very careful when observing waveforms. Even after this power supply is shut down, there is a danger of electric shock due to residual charge of various capacitors. Make sure that the voltage of each part has dropped sufficiently before touching the board.

In addition, the semiconductor devices and the inductors of this power supply generates heat according to the load current. Although this power supply is designed for convection cooling, the heat-generating components may exceed the rated temperature range under heavy load depending on the operating environment. In such a case, use the forced air-cooling system so that the component temperature stays within the rated temperature range. Do not touch any part of the power supply while the power supply is in operation. Doing so may cause burns.

5. Performance

This section describes the power supply efficiency measurement results of this power supply. Fig. 5.1 shows the measured efficiencies when the input-voltages are 40 V, 50 V and 59.5 V. High-efficiency of 83.0 % is achieved at 50 V input and 100 A output.

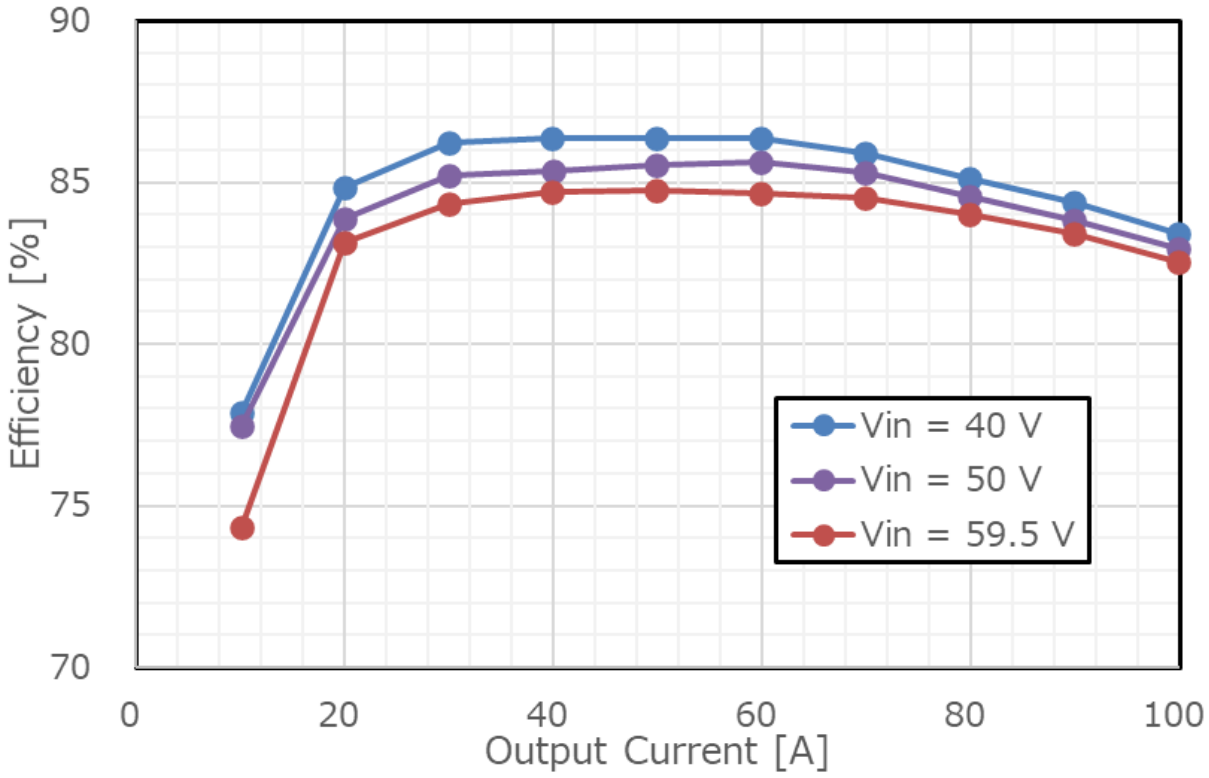

Fig. 5.1 Example of Efficiency Measurement Results

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