200 W Active Clamp Forward DC-DC Converter

Reference Guide

RD175-RGUIDE-01

TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

Table of Contents

1. Introduction

This reference guide provides information on the specifications, use, and efficiency of the 200 W Active Clamp Forward DC-DC Converter (hereafter referred to as this power supply). This power supply can provide 200 W of power at the outgoing DC 24 V. The input-voltage range is from DC 38 5 to 60 V and can be used in a variety of applications, including industrial equipment and communication related equipment. It provides various design information including a reference design, and contributes to labor saving in designing according to actual specifications.

2. Specifications

2.1. Power Supply Specifications

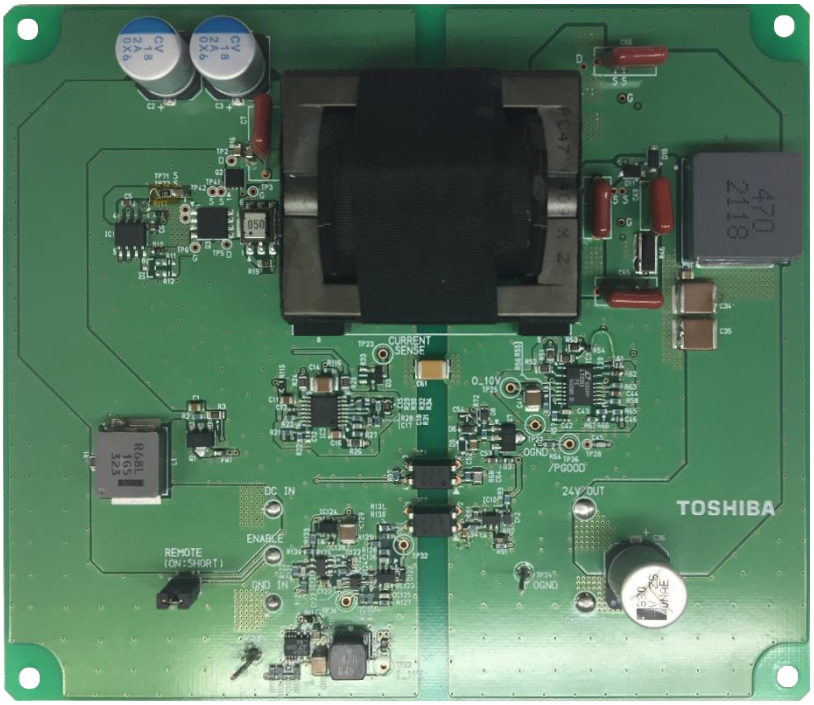
Table 2.1 lists the I/O characteristics of this power supply.

Table 2.1 200 W Active Clamp Forward DC-DC Converter Specifications

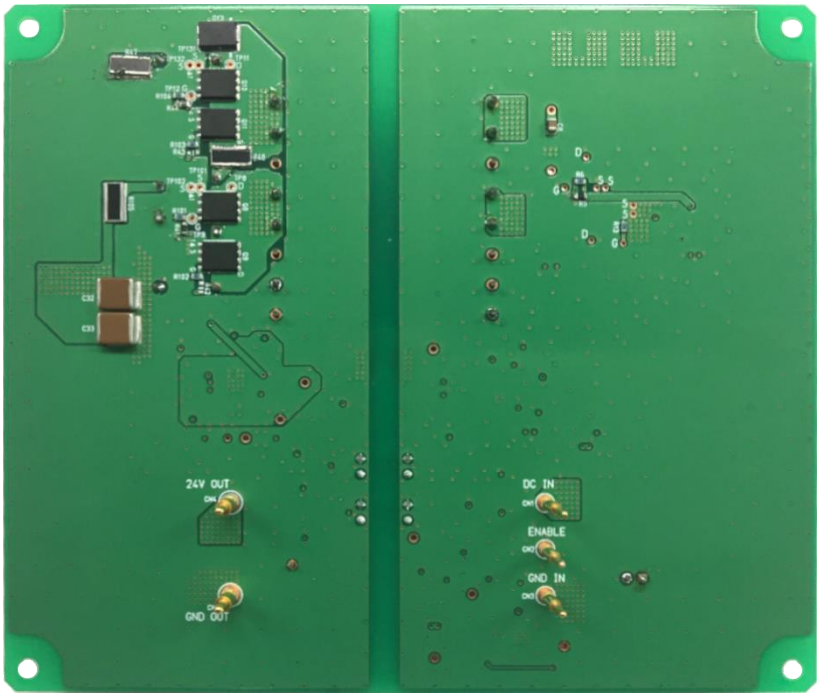
Parameters	Conditions	Minimum	Typical	Maximum	Unit
Input Characteristics					
Input Voltage		38.5	48	60	V
Input Current	DC 38.5 V input			5.8	A
Output Characteristics					
Output Voltage			24		V
Output Current		0.4		8.3	A
Output Power		10		200	W
Output Ripple Voltage				150	mV
Switching Frequency			200		kHz

2.2. External View of Power Supply

Fig. 2.1 shows the appearance of this power supply.



Front Side



Back Side

Fig. 2.1 External View of 200 W Active Clamp Forward DC-DC Converter

External dimensions: 130 mm x 115 mm x 30 mm (excluding input/output terminals on the back side)

2.3. Block diagram

Fig. 2.2 shows the block diagram of this power supply to understand the function operation.

Refer to RD175-SCHEMATIC-01 for the actual schematic and to RD175-BOM-01 for the bill of materials.

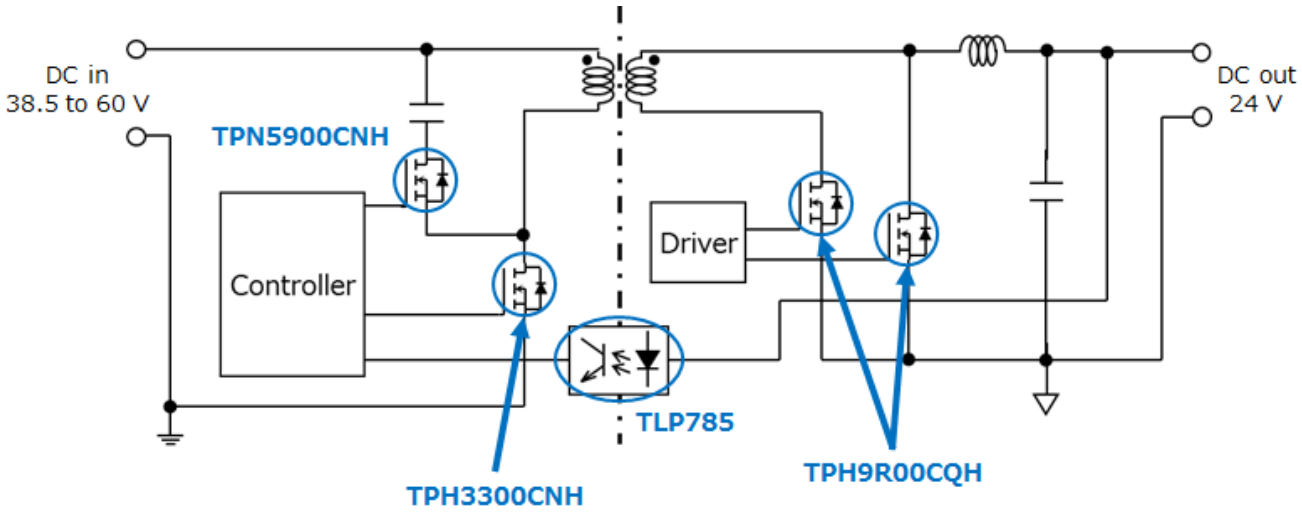


Fig. 2.2 Block Diagram

2.4. Component Layout

Fig. 2.3 and Fig. 2.4 show the layout of components on the PCB of this power supply.

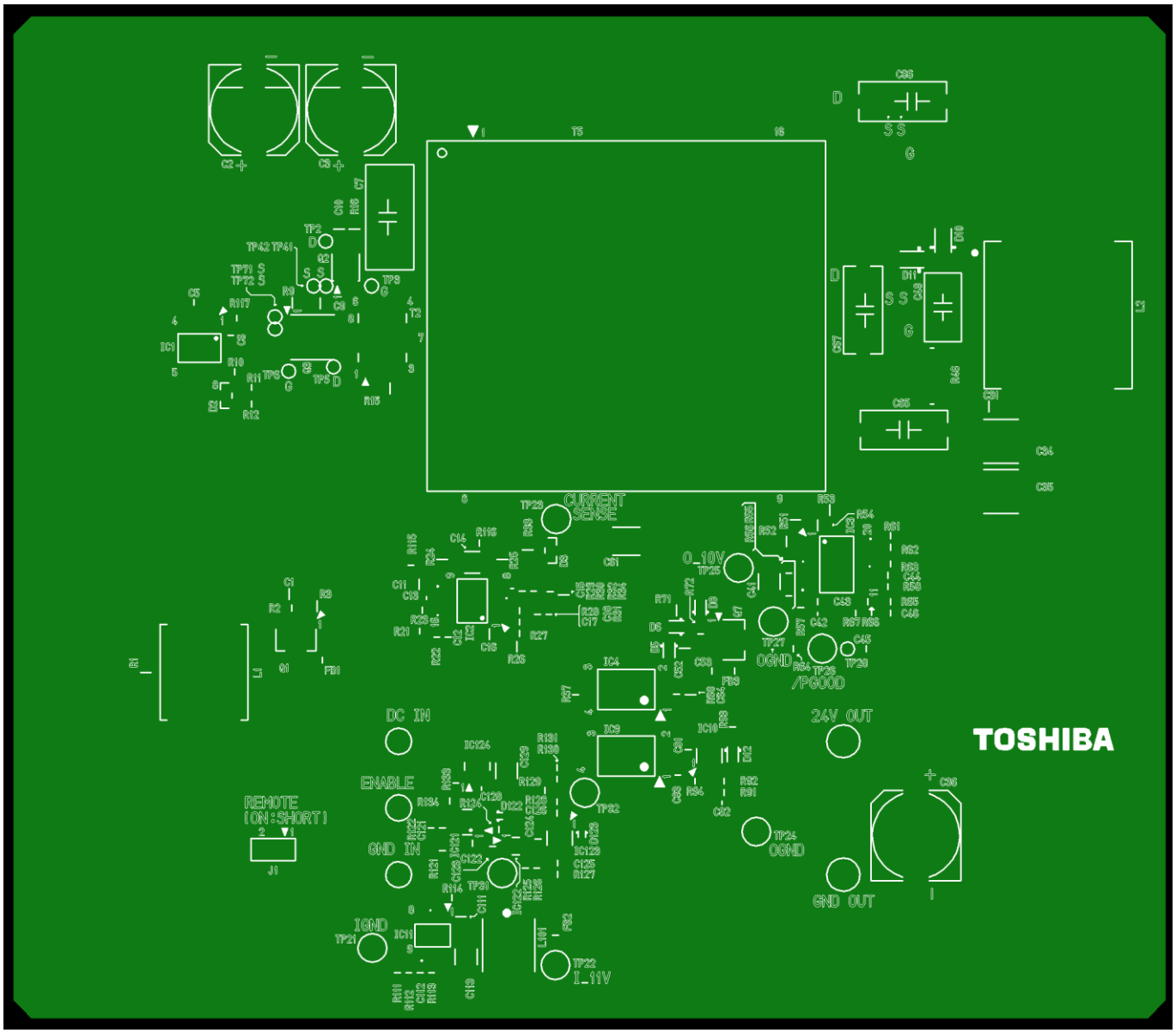


Fig. 2.3 PCB Component Layout (Front Side)

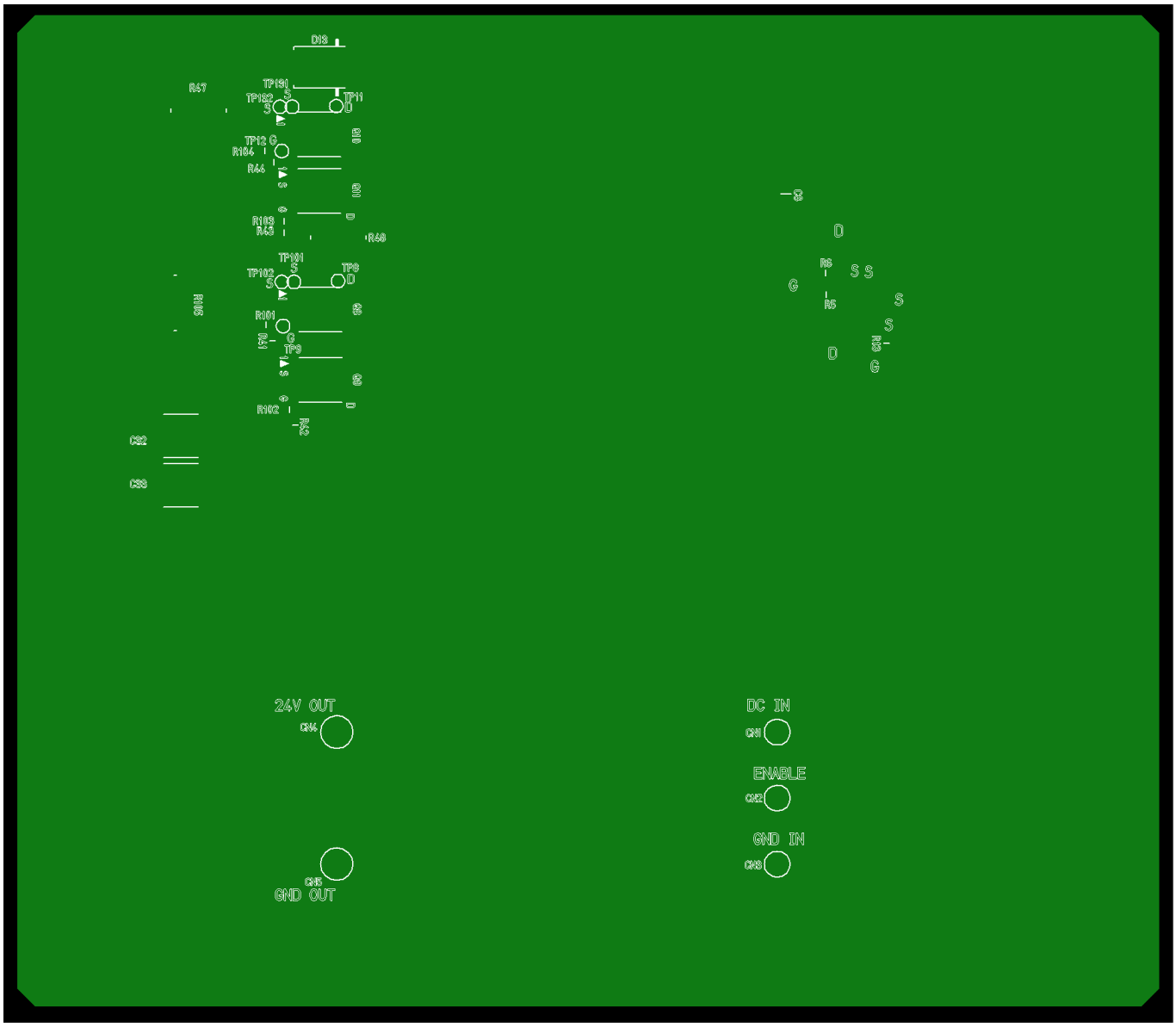


Fig. 2.4 PCB Component Layout (Back Side)

2.5. PCB Pattern

PCB-design data of this power supply compatible with various EDA (Electronic Design Automation) tools is provided in the design files. Please refer to them for more information.

Fig. 2.5 shows Layer 1 of the PCB.

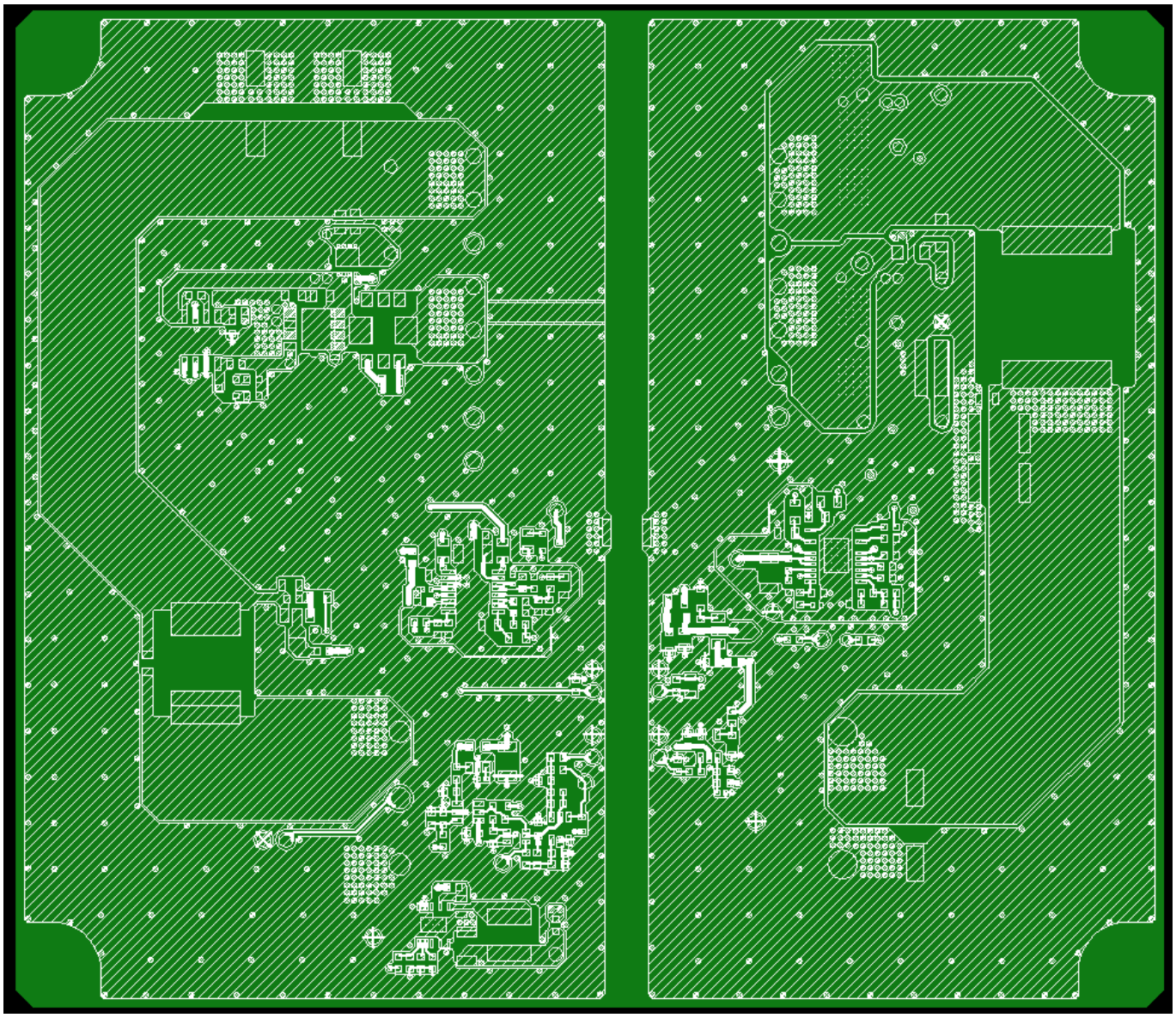


Fig. 2.5 Layer 1 (Front Side)

Fig. 2.6 shows Layer 2 of the PCB.

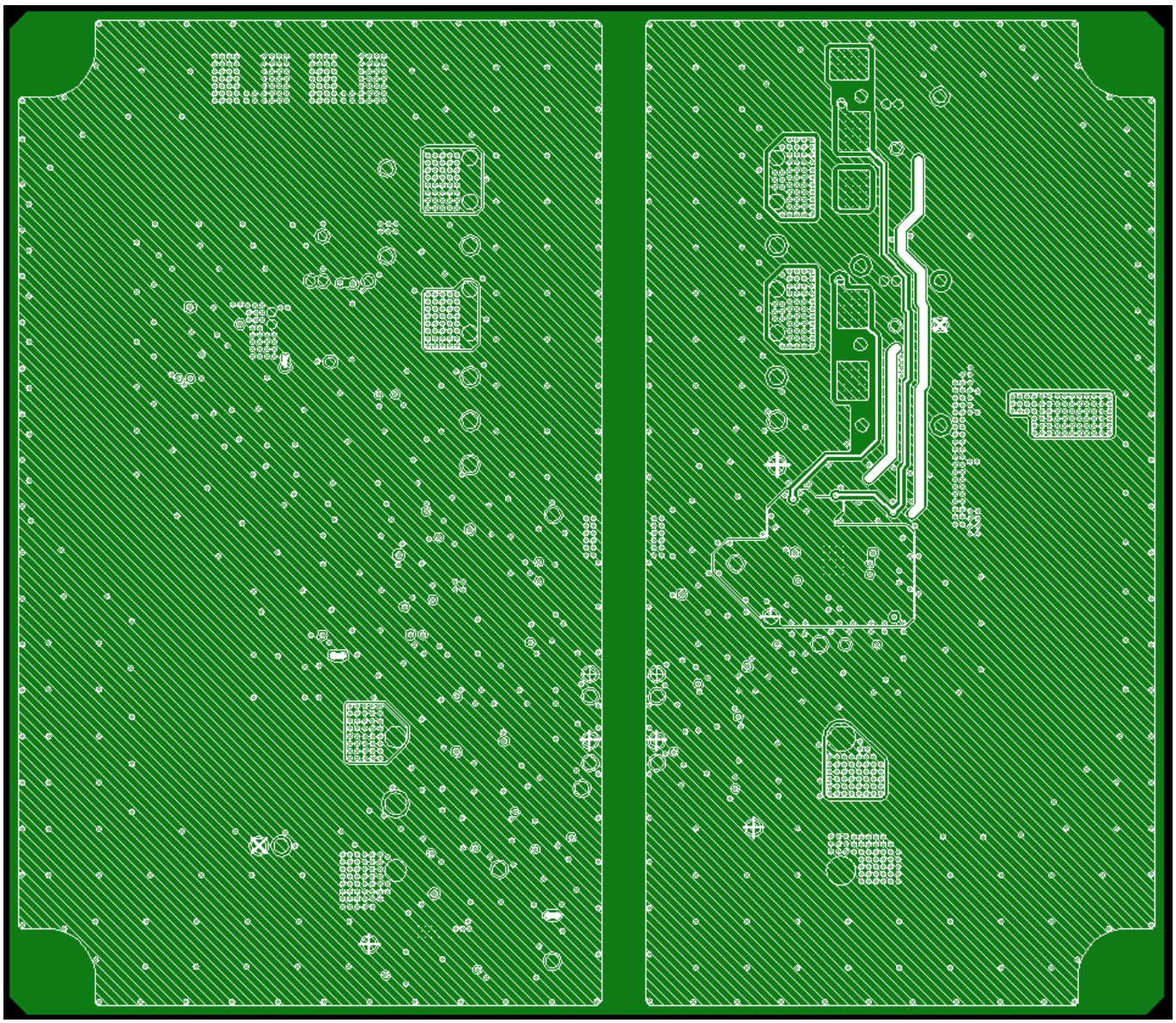


Fig. 2.6 Layer 2

Fig. 2.7 shows Layer 3 of the PCB.

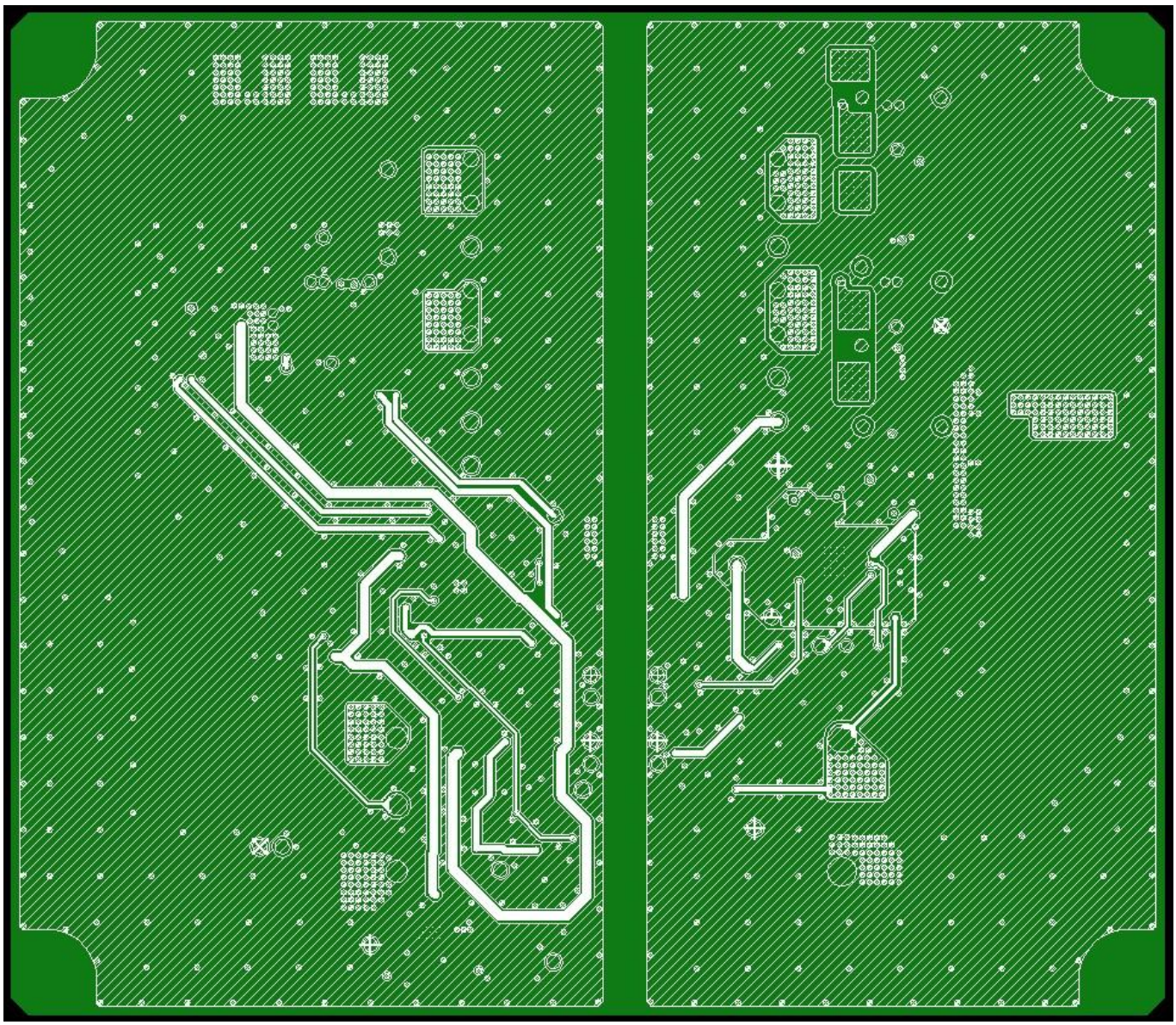


Fig. 2.7 Layer 3

Fig. 2.8 shows Layer 4 of the PCB.

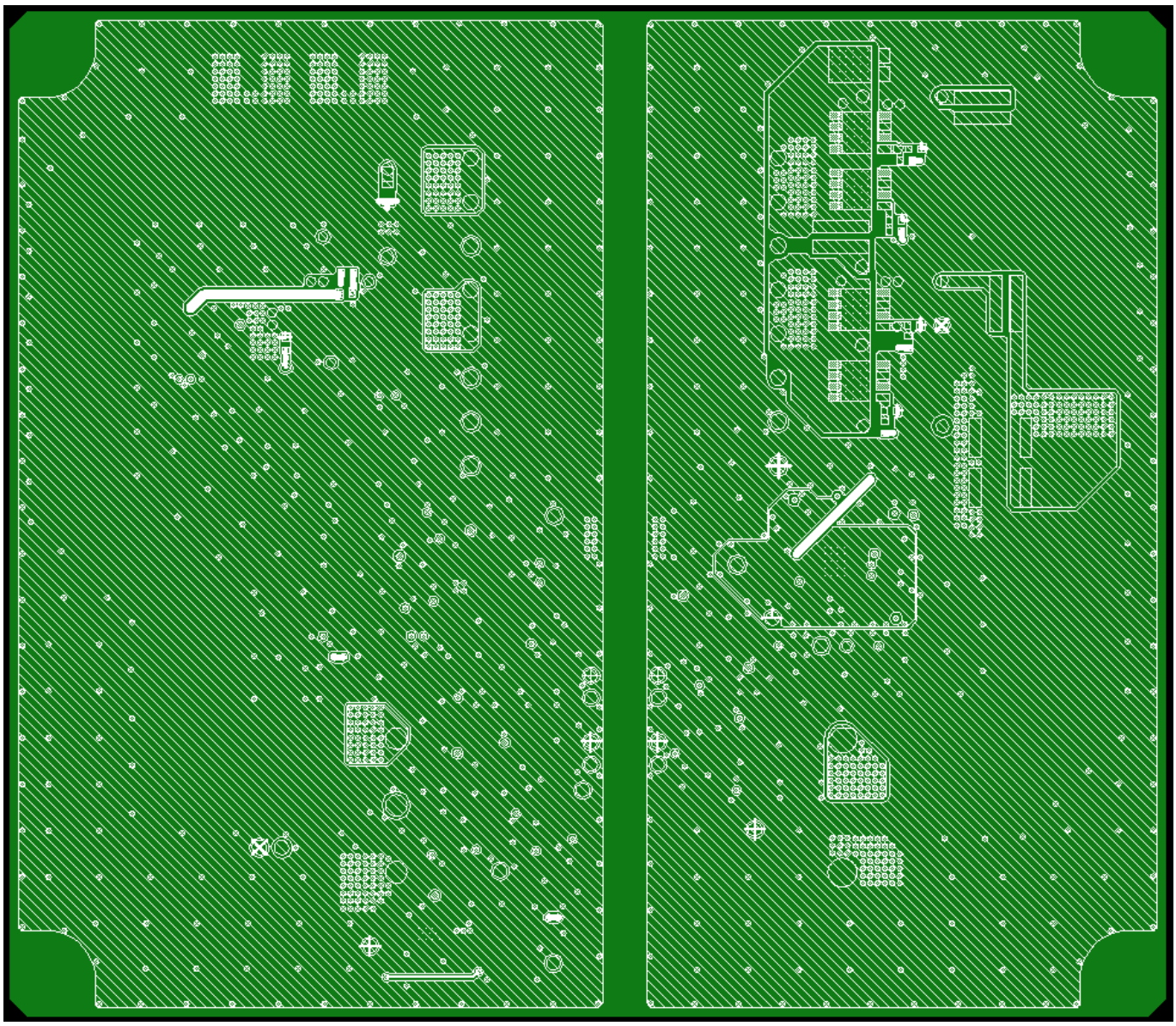


Fig. 2.8 Layer 4 (Back Side)

3. Operating Procedure

3.1. Connecting to External Devices

Fig. 3.1 shows the external connection terminals on the back of the board. The area enclosed in red shows input terminals. Connect a DC stabilized power supply to Input (+) and Input (-) terminals. Use power supplies, cables, leads, and connectors that satisfy the power supply specifications described in Section 2.1. For Enable terminal, connect a jumper with selectable connection/release to GND. The area enclosed in blue shows output terminals. Connect the load unit to Output (+) and Output (-) terminals. Use load devices, cables, and connectors that satisfy the power supply specifications described in Section 2.1.

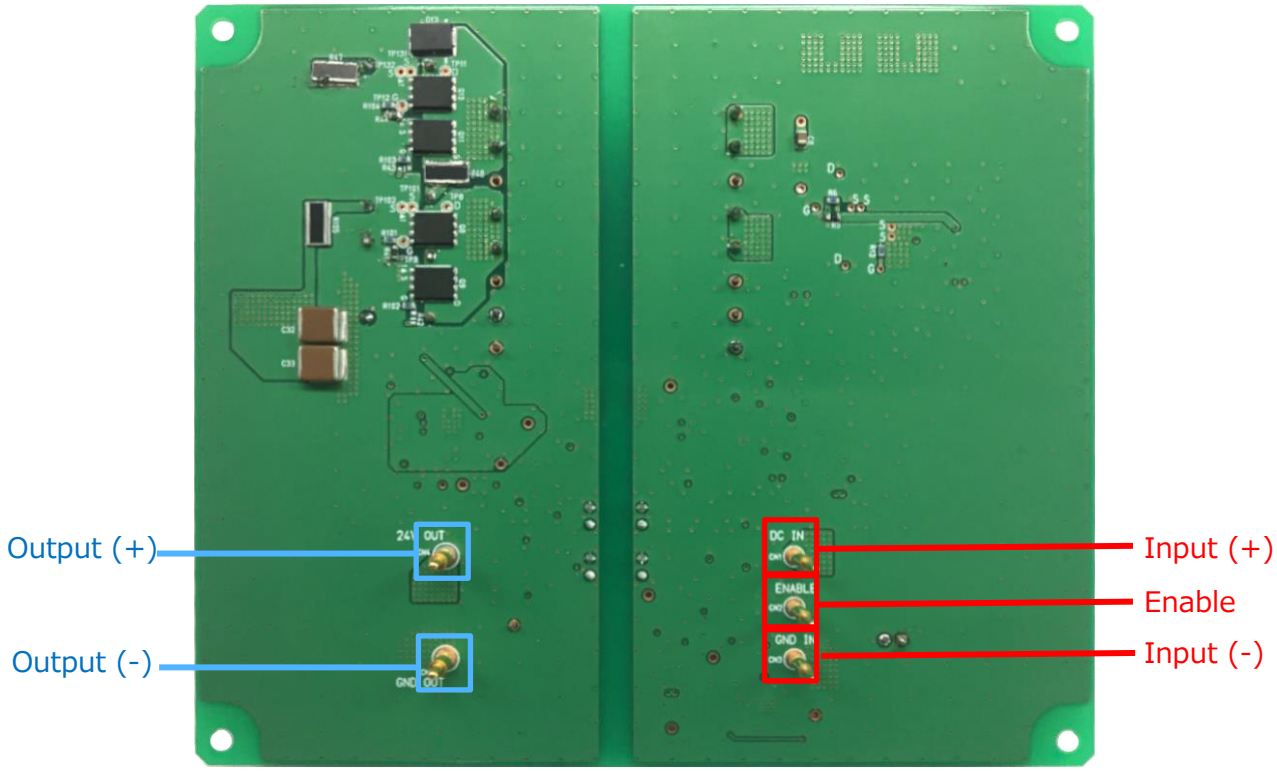


Fig. 3.1 External Connection Pins

3.2. Start and Stop Procedures

Before starting the power supply, check that all of the following terminal voltages are 0 V.
Input (+) terminal, Input (-) terminal, Output (+) terminal, and Output (-) terminal

[Startup Procedure]

1. Turn on the external stabilized DC power supply
2. Connect the Enable terminal to GND

[Stop Procedure]

1. Release the connection between Enable terminal and GND
2. Turn off the external stabilized DC power supply

3.3. Precautions for Evaluation (To Prevent Electric Shock, Burn Injury, etc.)

Fig. 3.2 shows the primary and secondary areas of this power supply. After this power supply is stopped, there is a risk of electric shock due to the residual charge of various capacitors. Before touching the board, check that the voltage of each component has decreased sufficiently. Semiconductor and Transformer of this power supply generate heat according to the load current. Fig. 3.3 shows the components with large heat generation using a red broken line frame. This power supply is designed to be used with forced air-cooling. Use an air-cooling device that ensures that the temperature of these components stay within the rated temperature range at high loads. Also, do not touch these areas while the power supply is running, as there is a risk of burns.

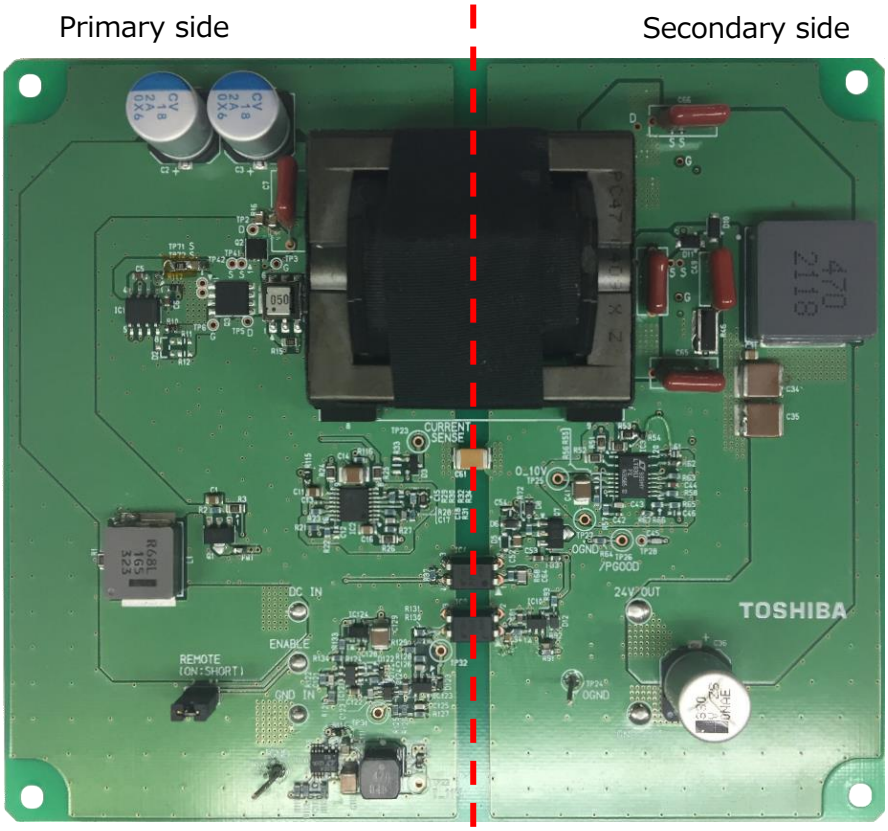


Fig. 3.2 Primary and Secondary Areas

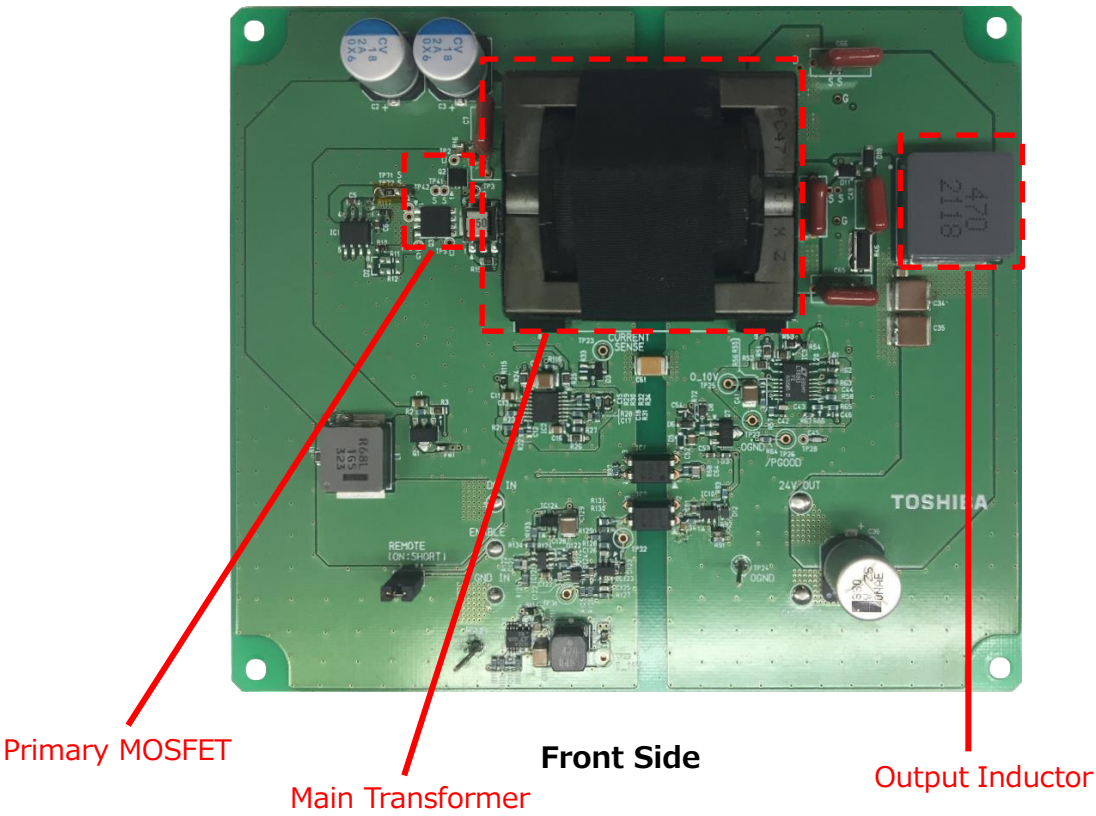


Fig. 3.3 Components with Large Heat Generation

4. Power Characteristics

The power supply efficiency measurement results of this power supply are described below.

4.1. Efficiency

Fig. 4.1 shows the power supply efficiency measurement results of this power supply. This data is measured by setting the input voltage to 38.5 V, 48 V, and 60 V.

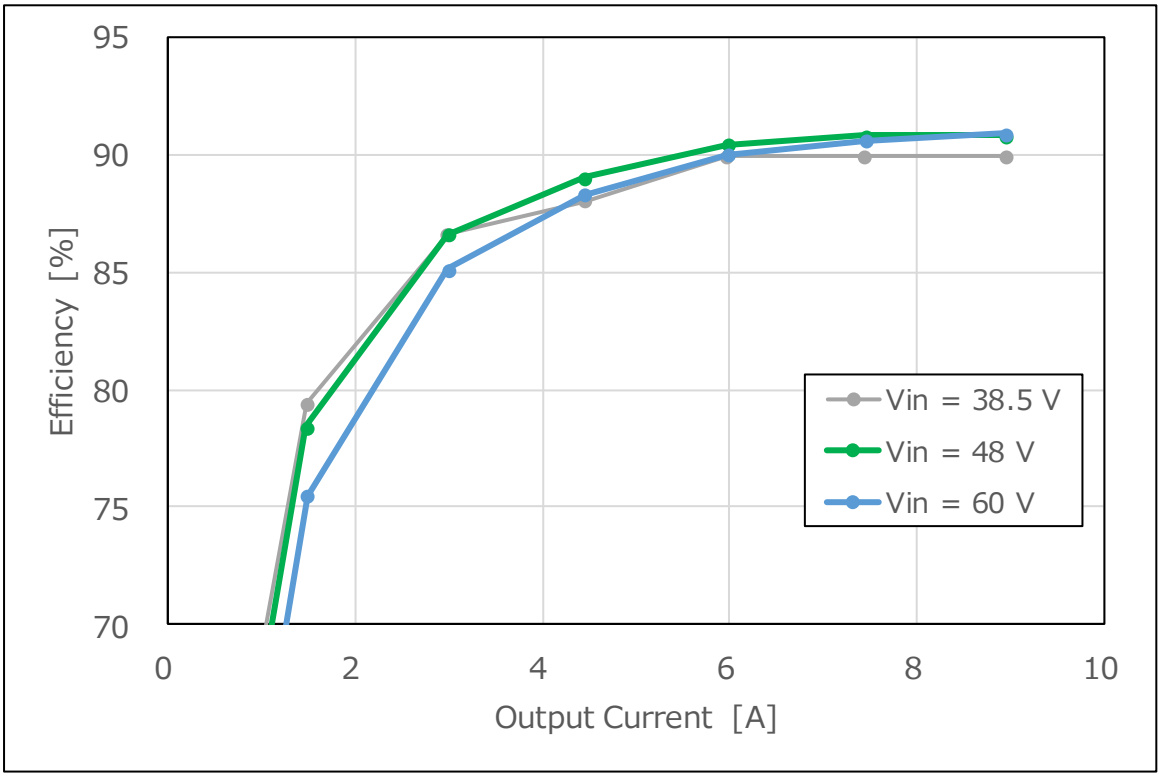


Fig. 4.1 Efficiency (Vin = 38.5 V, Vin = 48 V, Vin = 60 V)

Terms of Use

This terms of use is made between Toshiba Electronic Devices and Storage Corporation (“We”) and customers who use documents and data that are consulted to design electronics applications on which our semiconductor devices are mounted (“this Reference Design”). Customers shall comply with this terms of use. Please note that it is assumed that customers agree to any and all this terms of use if customers download this Reference Design. We may, at its sole and exclusive discretion, change, alter, modify, add, and/or remove any part of this terms of use at any time without any prior notice. We may terminate this terms of use at any time and for any reason. Upon termination of this terms of use, customers shall destroy this Reference Design. In the event of any breach thereof by customers, customers shall destroy this Reference Design, and furnish us a written confirmation to prove such destruction.

1. Restrictions on usage

1. This Reference Design is provided solely as reference data for designing electronics applications. Customers shall not use this Reference Design for any other purpose, including without limitation, verification of reliability.
2. This Reference Design is for customer's own use and not for sale, lease or other transfer.
3. Customers shall not use this Reference Design for evaluation in high or low temperature, high humidity, or high electromagnetic environments.
4. This Reference Design shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.

2. Limitations

1. We reserve the right to make changes to this Reference Design without notice.
2. This Reference Design should be treated as a reference only. We are not responsible for any incorrect or incomplete data and information.
3. Semiconductor devices can malfunction or fail. When designing electronics applications by referring to this Reference Design, customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of semiconductor devices could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Customers must also refer to and comply with the latest versions of all relevant our information, including without limitation, specifications, data sheets and application notes for semiconductor devices, as well as the precautions and conditions set forth in the "Semiconductor Reliability Handbook".
4. When designing electronics applications by referring to this Reference Design, customers must evaluate the whole system adequately. Customers are solely responsible for all aspects of their own product design or applications. WE ASSUME NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.
5. No responsibility is assumed by us for any infringement of patents or any other intellectual property rights of third parties that may result from the use of this Reference Design. No license to any intellectual property right is granted by this terms of use, whether express or implied, by estoppel or otherwise.
6. THIS REFERENCE DESIGN IS PROVIDED "AS IS". WE (a) ASSUME NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (b) DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO THIS REFERENCE DESIGN, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.

3. Export Control

Customers shall not use or otherwise make available this Reference Design for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). This Reference Design may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of this Reference Design are strictly prohibited except in compliance with all applicable export laws and regulations.

4. Governing Laws

This terms of use shall be governed and construed by laws of Japan.