3-Phase AC 400V Input Vienna Rectifier PFC Power Supply

Reference Guide

RD207-RGUIDE-01

Toshiba Electronic Devices & Storage Corporation

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1. Introduction

This reference guide describes the specifications and operation procedure of the 3-Phase AC Input Vienna Rectifier PFC Power Supply (hereinafter referred to as “this Design”).

3-phase AC power is provided to industrial facilities, etc., and 400V (line voltage) systems are widely used outside Japan. When using such 3-phase AC 400V system inputs for EV chargers and other equipment, a PFC (Power Factor Correction) power supply that rectifies AC to DC with a high power-factor is essential. This design is a PFC power supply that inputs a 3-phase AC 400V and outputs a DC 750V. A Vienna rectifier topology is used to achieve high-efficiency in 3-level operation, and power can be supplied to 5kW.

The bi-directional switching section uses 650V a power MOSFET TK065N65Z, and the rectifier section uses a 1200V SiC Schottky barrier diode TRS15N120HB. Thanks to hose our latest power devices, it achieves low power-loss. In addition, the driver coupler TLP5774H is used for the insulated drive of MOSFET, and the isolation amplifier TLP7920F is used for the insulated sensing of the input and output voltages.

2. Appearance and Specifications

2.1. Specifications

Table 2.1 lists the main specifications of this design.

Table 2.1 Specifications of This Design

Item	Conditions	Min.	Typ.	Max.	Unit
Input AC voltage (rms)	3-phase AC	360	400	440	V
Input AC current (rms)	3-phase AC			8.2	A
Input frequency	3-phase AC	49.8	50	50.2	Hz
	3-phase AC	59.7	60	60.3	Hz
Output voltage		740	750	760	V
Maximum output power				5	kW
Switching frequency			200		kHz
Protection function	Input overcurrent protection, input overvoltage protection, and output overvoltage protection				
Board layer configuration	FR-4 4 layered configuration, copper foil thickness: 70μm				

2.2. Block Diagram

Fig. 2.1 shows the block diagram of this design.

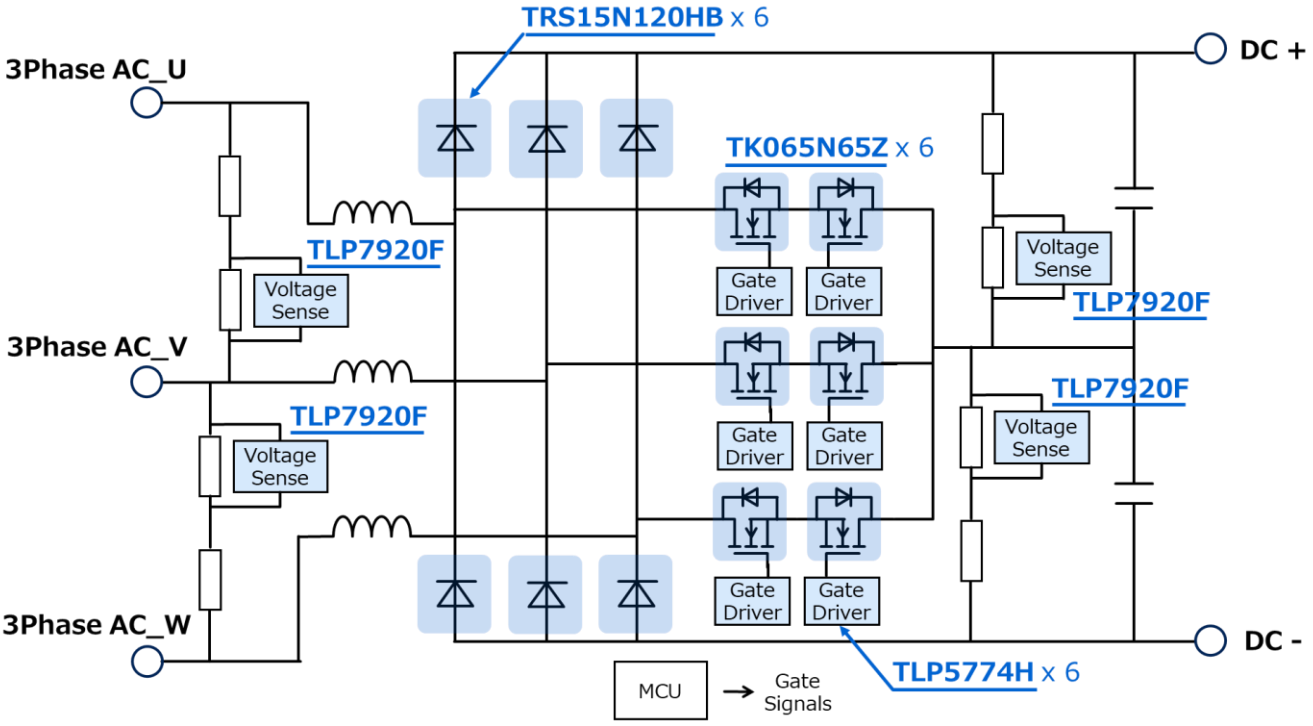


Fig. 2.1 Block Diagram

2.3. appearance

Fig. 2.2 and 2.3 show the appearnce of this design.

Fig. 2.2 Appearnce of This Design (1)

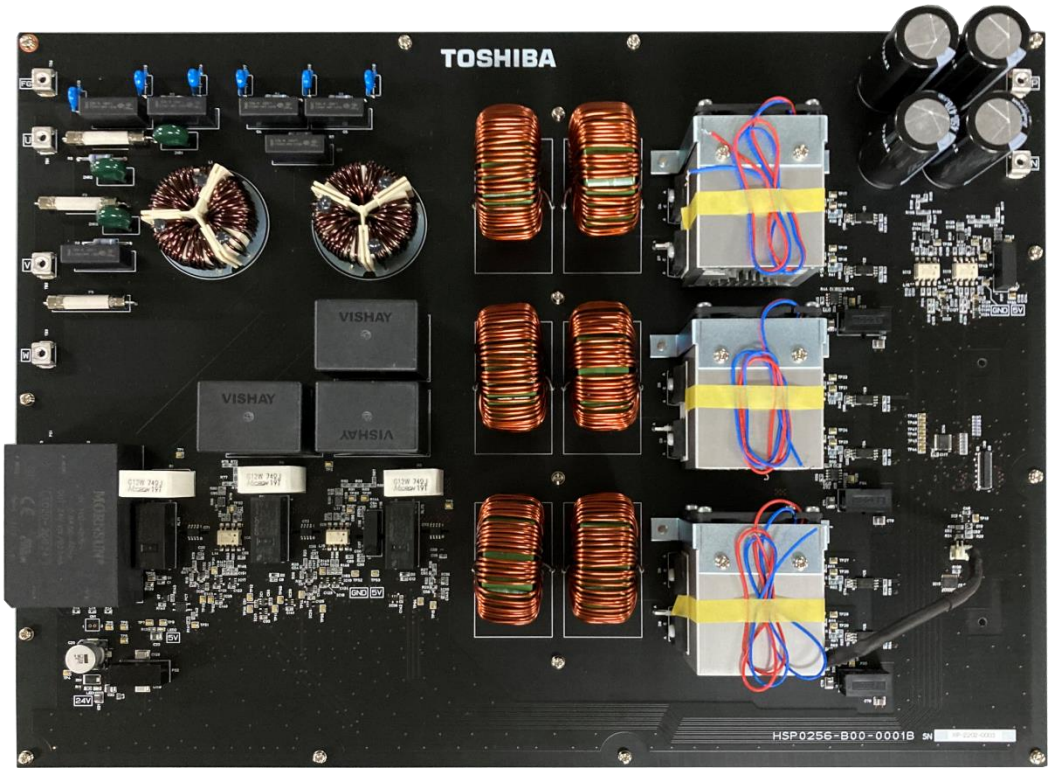
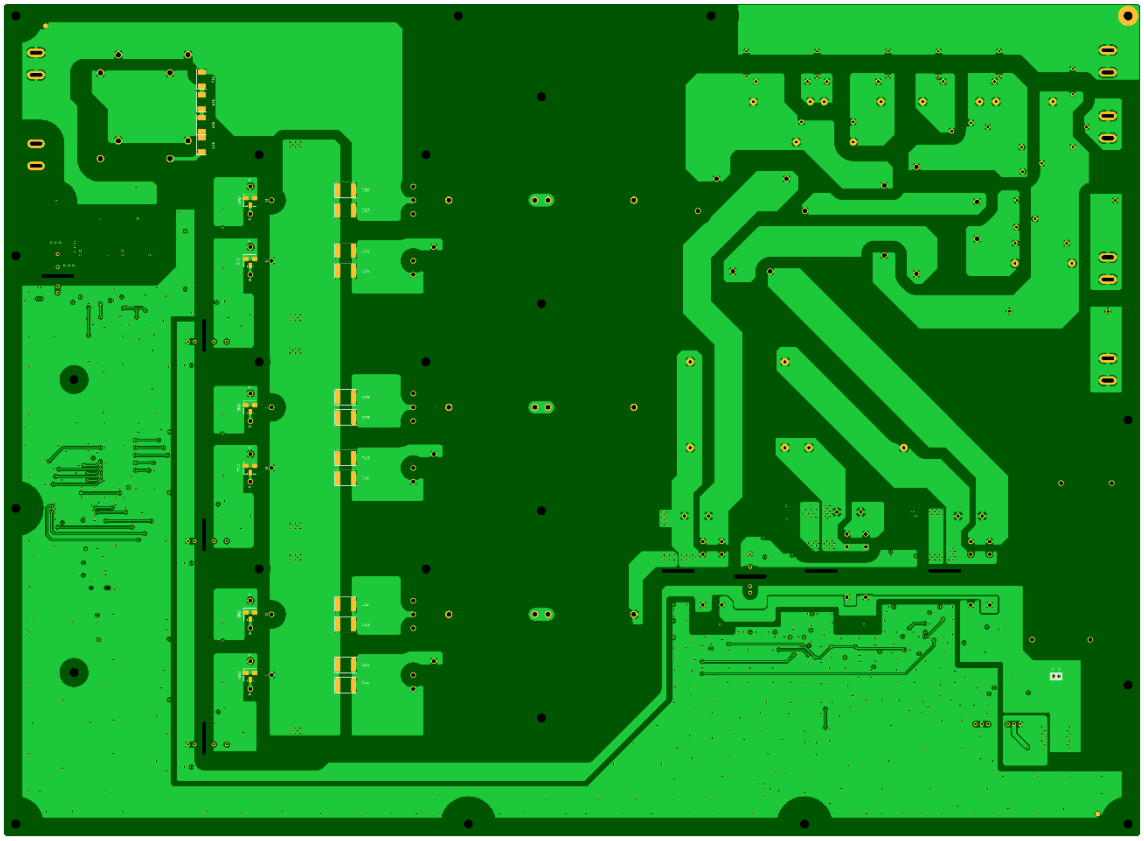


Fig. 2.3 Appearance of This Design (2)

2.4. PCB Component Layout

Fig. 2.4 shows the component layout of this design.



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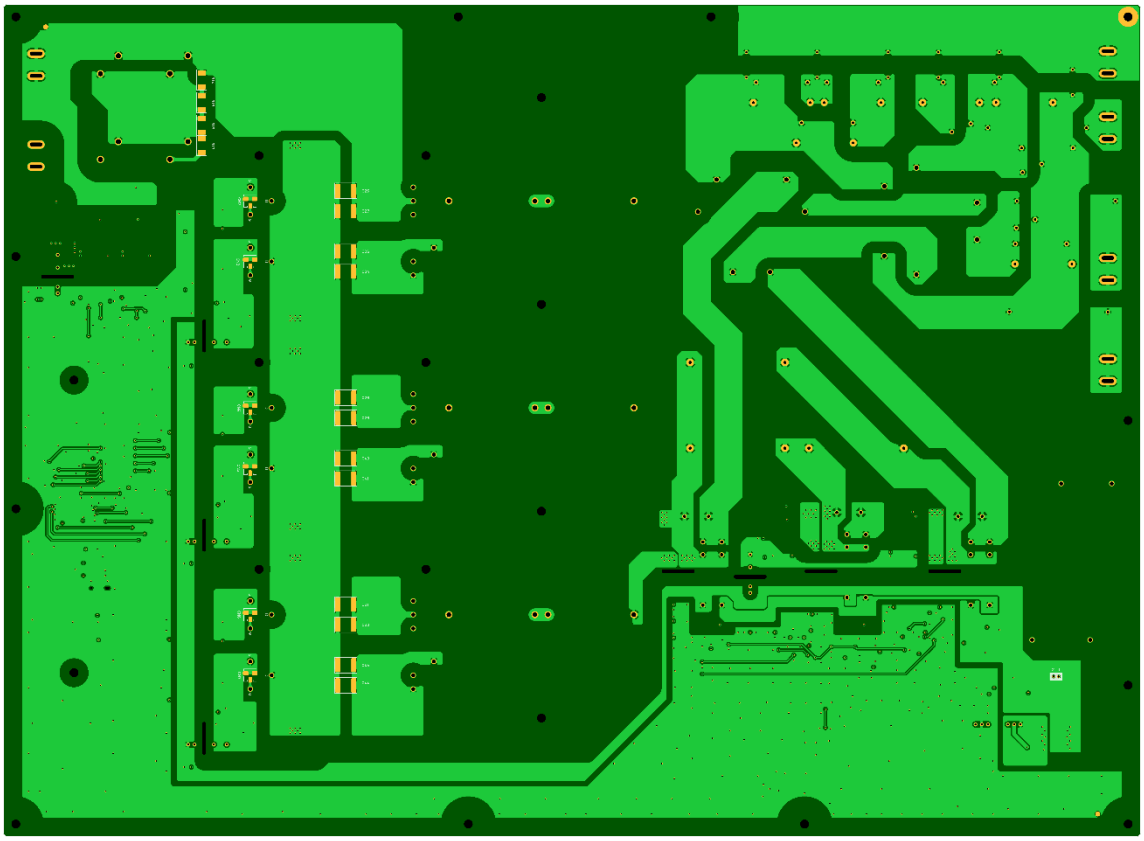


<Back>

Fig. 2.4 Component Layout

3. Schematic, Bill of Materials, and PCB Pattern Diagram

3.1. Schematics

Refer to the following files:

RD207-SCHEMATIC-xx.pdf

(xx is the revision number.)

3.2. Bill of Materials

Refer to the following files:

RD207-BOM-xx.pdf

(xx is the revision number.)

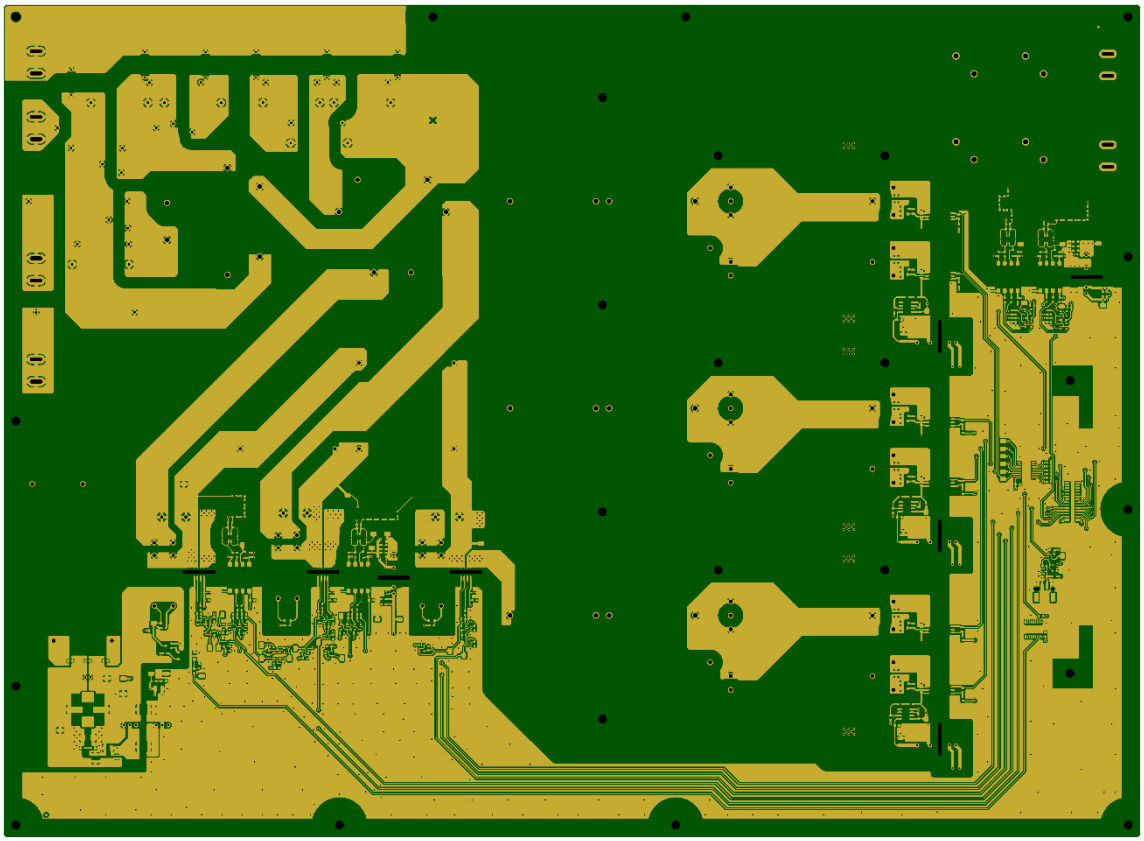
3.3. PCB Pattern Diagram

Fig. 3.1 shows the PCB pattern diagram.

Refer to the following files:

RD207-LAYER-xx.pdf

(xx is the revision number.)



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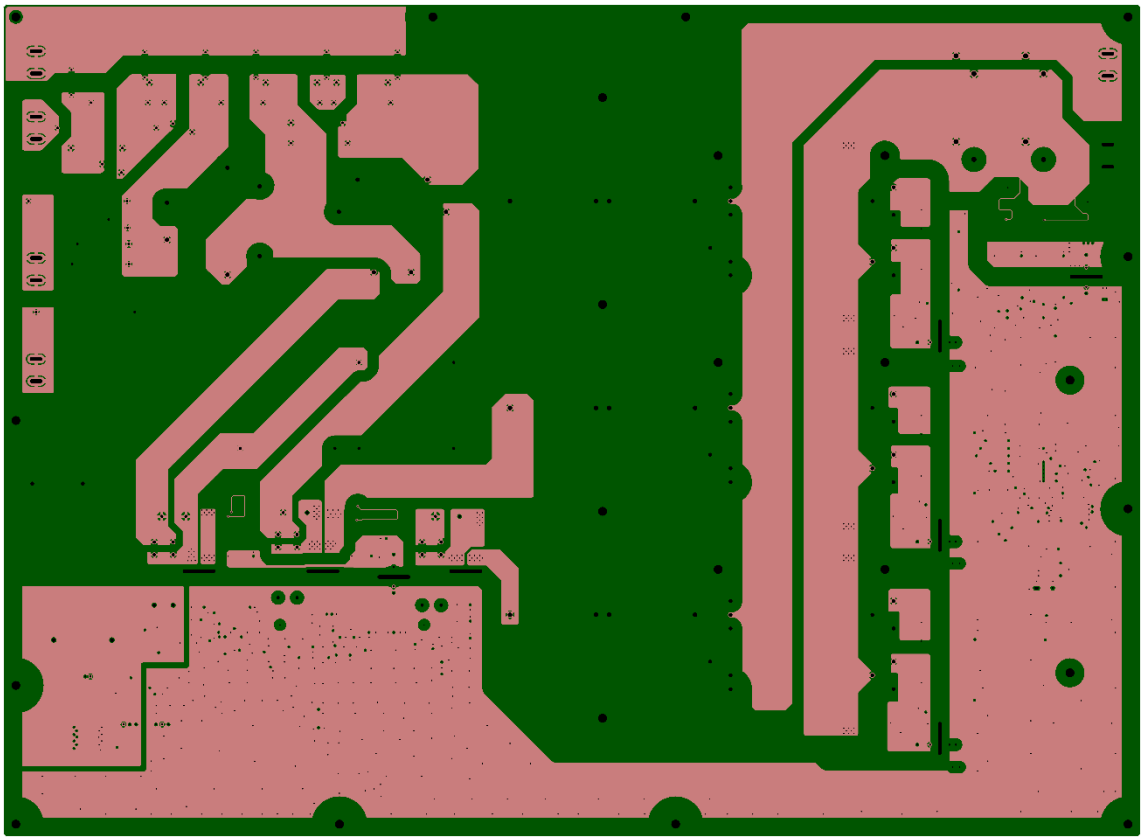

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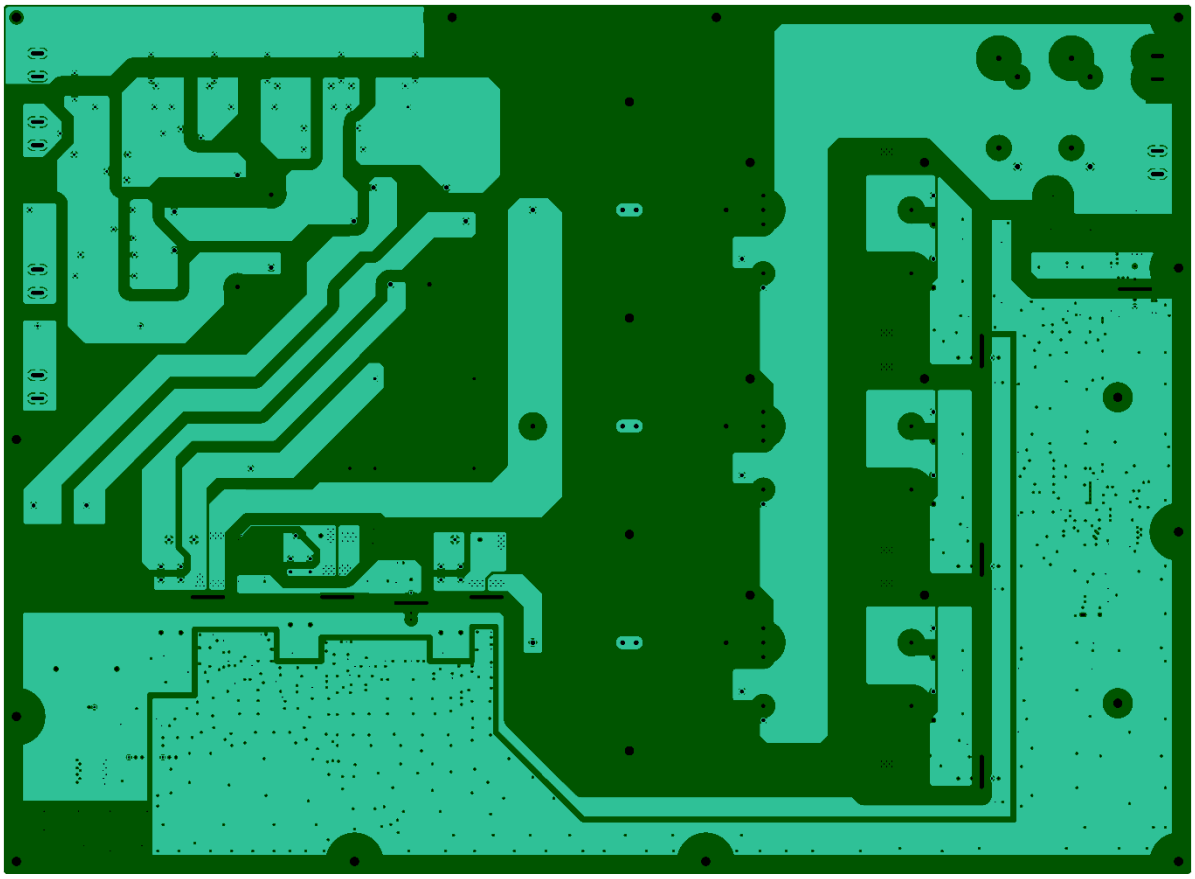
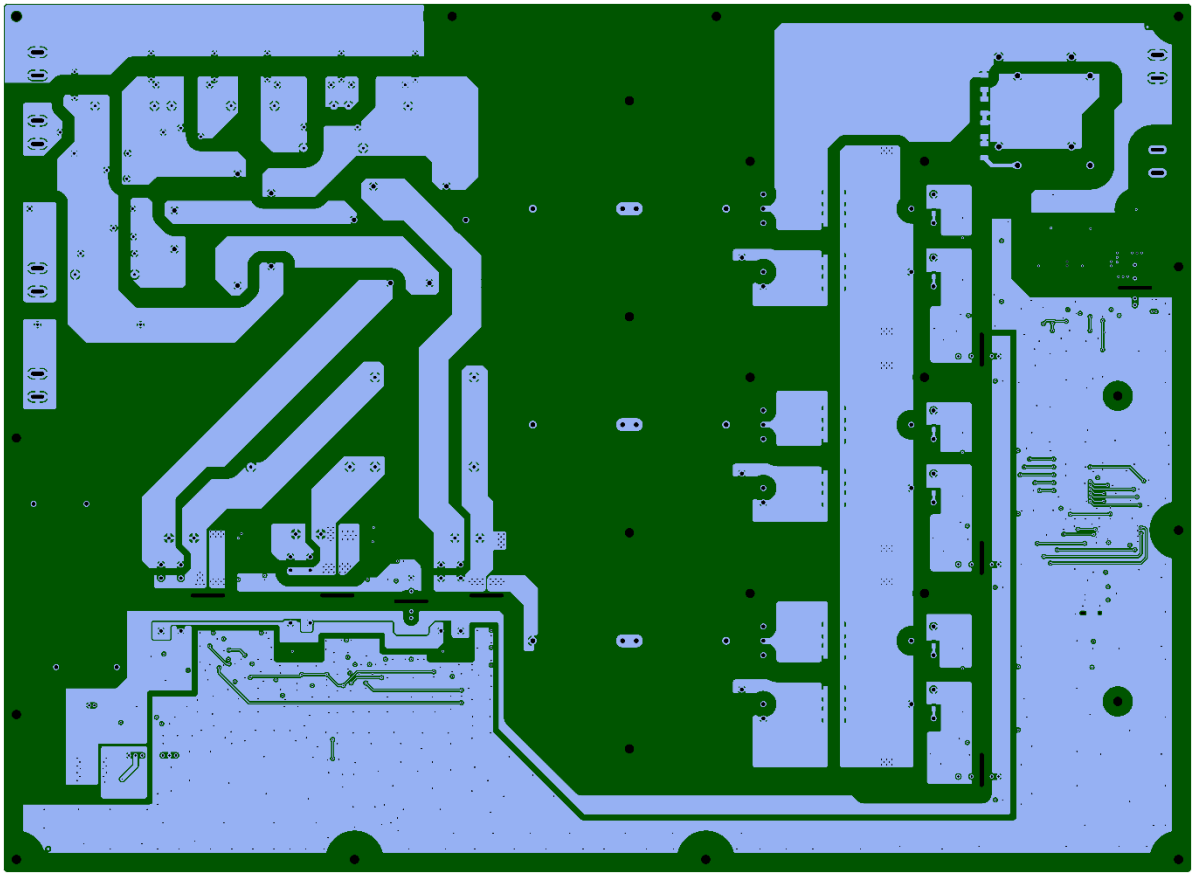


<Layer3>



<Layer4, Bottom>

Fig. 3.1 PCB Pattern Diagram (Top View)

4. Operation Procedure

4.1. Connection to External Devices

Fig. 4.1 shows the external connection terminals.

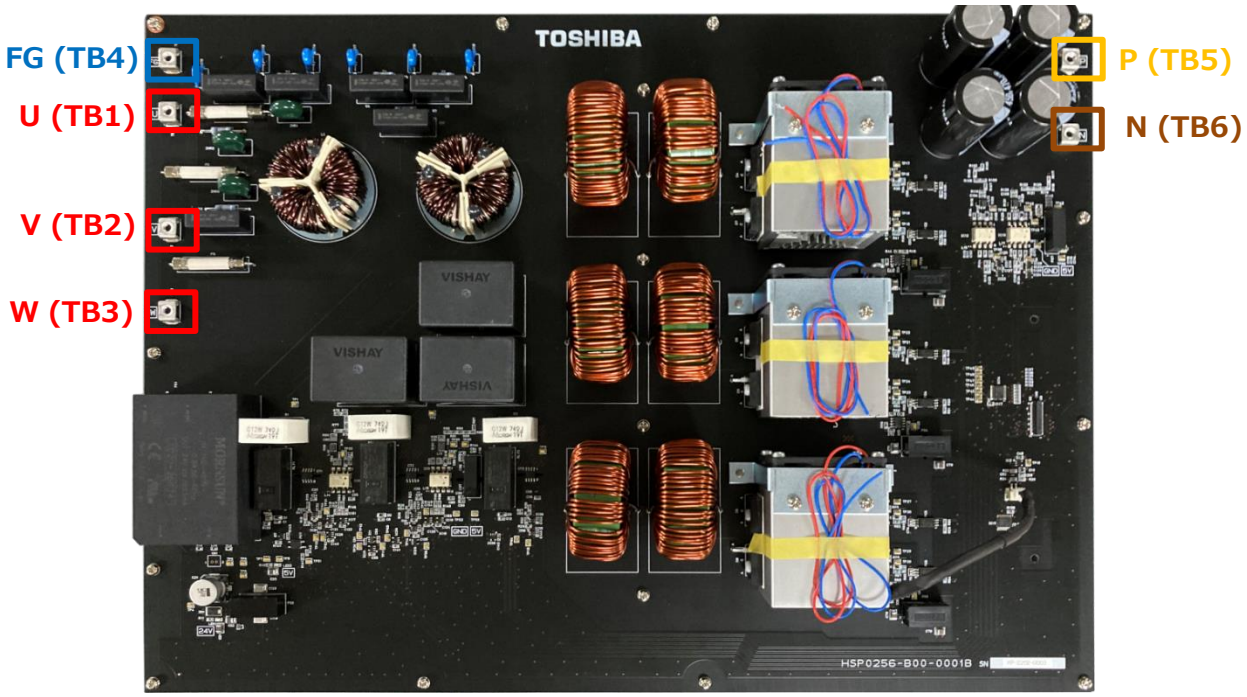


Fig. 4.1 External Connection Terminals

For the preparation, set each terminal as follows.

・If necessary, connect terminal FG to GND rightly.

・Connect terminal P to + terminal of a DC load and terminal N to − terminal of the DC load.

・Connect terminal U, V, and W to a 3-phase AC 400V stabilized power supply.

Use a power supply, a load, and cables that satisfy the power specifications.

4.2. Starting and Stopping procedure

Make sure all external terminals are 0V before starting.

[Starting Procedure]

Turn on the connected power supply.

[Stopping Procedure]

Turn off the connected power supply.

4.3. Evaluation Precautions (To Prevent Electric Shocks, Burns, etc.)

Be careful of electric shock when connecting the power supply. Do not touch any component of the power supply directly while it is energized. 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 component has dropped sufficiently before touching the BOARD.

In addition, the semiconductor devices and inductors of this power supply may generate heat according to the load current.

5. Power Supply Characteristics

This section describes the power supply efficiency measurement result of this design. Efficiency was measured up to 5kW of the rated load at 2 conditions, 360V/50Hz input and 440V/50Hz input.

5.1. Efficiency

Fig. 5.1 shows the efficiency measurement results. The high efficiency of 98.3% is achieved at 5kW output in 360V input and the high efficiency of 98.7% is achieved at 5kW output in 440V input.

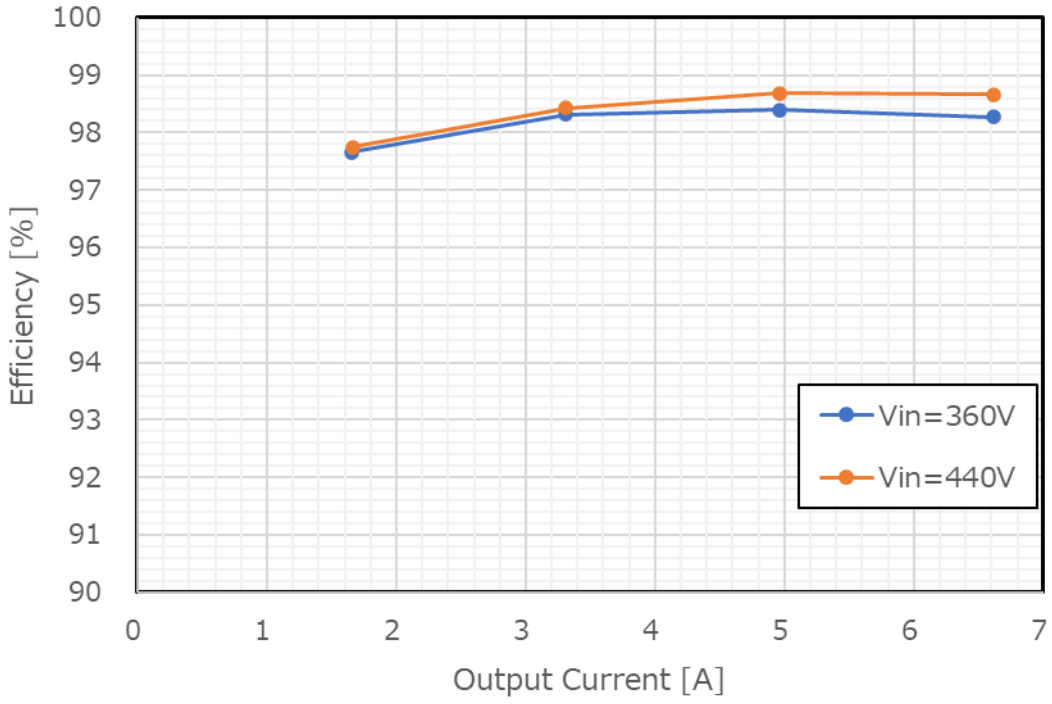


Fig. 5.1 Efficiency Measurement Results

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