1.6 kW Server Power Supply (Upgraded)

Reference Guide

RD240-RGUIDE-01

Toshiba Electronic Devices & Storage Corporation

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1. Introduction

This Reference Guide describes the specifications, usage, and characteristics of the 1.6 kW Server Power Supply (Upgraded) (hereafter referred to as this power supply). This power supply takes input of AC 90 to 264 V and output DC 12 V (Max. 1.6 kW) by using a semi-bridgeless PFC circuit and a phase-shift full-bridge (Phase Shift Full Bridge: PSFB) circuit. ORing output-circuit enables redundant operation. It also has a built-in auxiliary power supply circuit that is required to supply power for the operation of this circuit. Components for mounting on the board are selected considering the height, and they can be applied to 1U server power supply applications.

The power MOSFET TK125N60Z1 (under development) and SiC schottky barrier diode (SBD) TRS6E65H are used for semi-bridgeless PFC in this power supply. PSFB circuit uses the high-speed diode-type power MOSFET TK095N65Z5 in the primary-side full-bridge section, the power MOSFET TPH2R408QM in the secondary-side synchronous rectifier section, and the digital isolator DCL540C01 for isolated gate-signal transmission from the secondary-side controller. In addition, the power MOSFET TPHR6503PL1 is used in the ORing output-circuit. By using these latest Toshiba devices, this upgraded power supply has better efficiency and compact size compared to the existing reference design (1.6kW, 80Plus Platinum Class, High efficiency Server AC-DC Power supply), even though both of them uses the same circuit topology.

2. Specifications and Appearance

2.1. Power Supply Specifications

Table 2.1 lists the main specifications of this power supply.

Table. 2.1 Specifications of the 1.6 kW Server Power Supply (Upgraded)

Parameters	Conditions	Min.	Typ.	Max.	Unit
Input Specifications					
AC Input Voltage (rms)		90		264	V
AC Input Current (rms)	Vin = AC 90 V, Iout = 66.7 A			12	A
Input Frequency		47		63	Hz
Internal Specifications (Semi-Bridgeless PFC Circuit)					
Output Voltage			380		V
Output Current	Vin = AC 230 V		4.7		A
	Vin = AC 115 V		2.4		
Maximum Output Power	Vin = AC 230 V			1.77	kW
	Vin = AC 115 V			0.89	kW
Switching Frequency			60		kHz
Output Specifications (PSFB Circuit)					
Output Voltage		11.4	12.0	12.6	V
Output Current	Vin = AC 230 V			133	A
	Vin = AC 115 V			66.7	A
Maximum Output Power	Vin = AC 230 V			1.6	kW
	Vin = AC 115 V			0.8	kW
Output Ripple Voltage	Ta = 25 ℃			200	mV
Switching Frequency			60		kHz

2.2. Block Diagram

Fig. 2.1 shows a block diagram of this power supply.

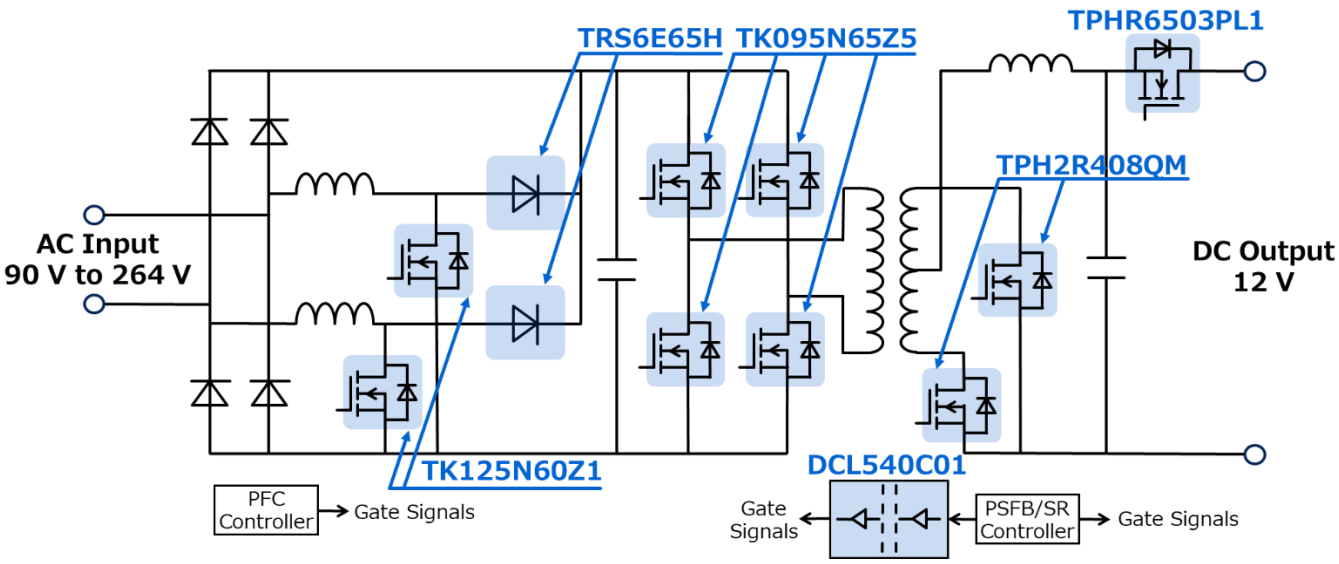


Fig. 2.1 Block Diagram of the 1.6 kW Server Power Supply (Upgraded)

2.3. Appearance

Fig. 2.2 and 2.3 show the appearance of this power supply.

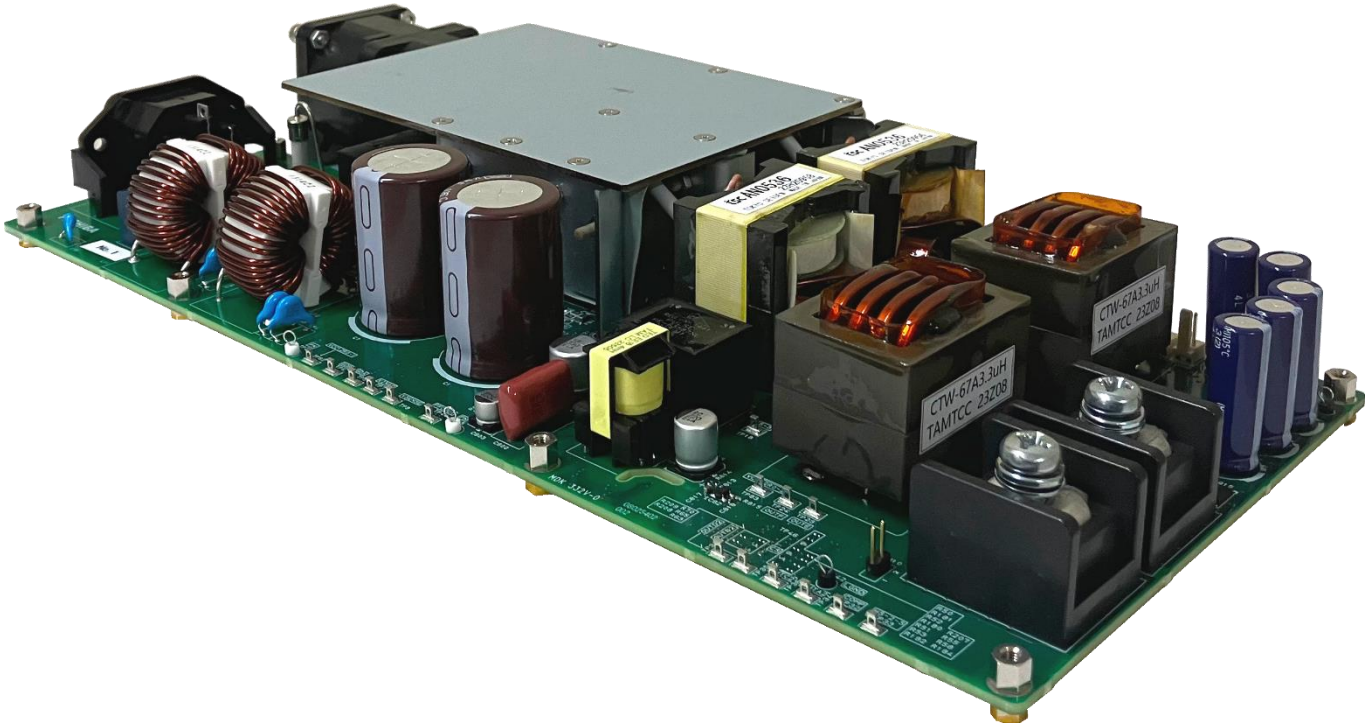


Fig. 2.2 Side View of the 1.6 kW Server Power Supply (Upgraded)

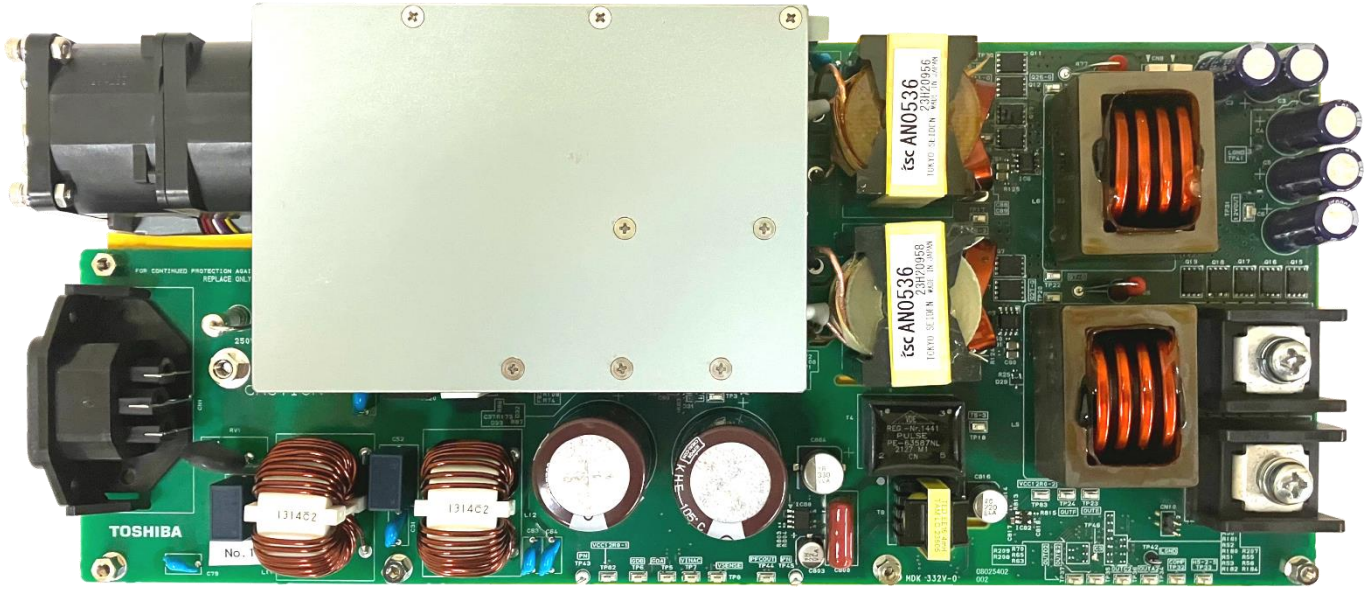
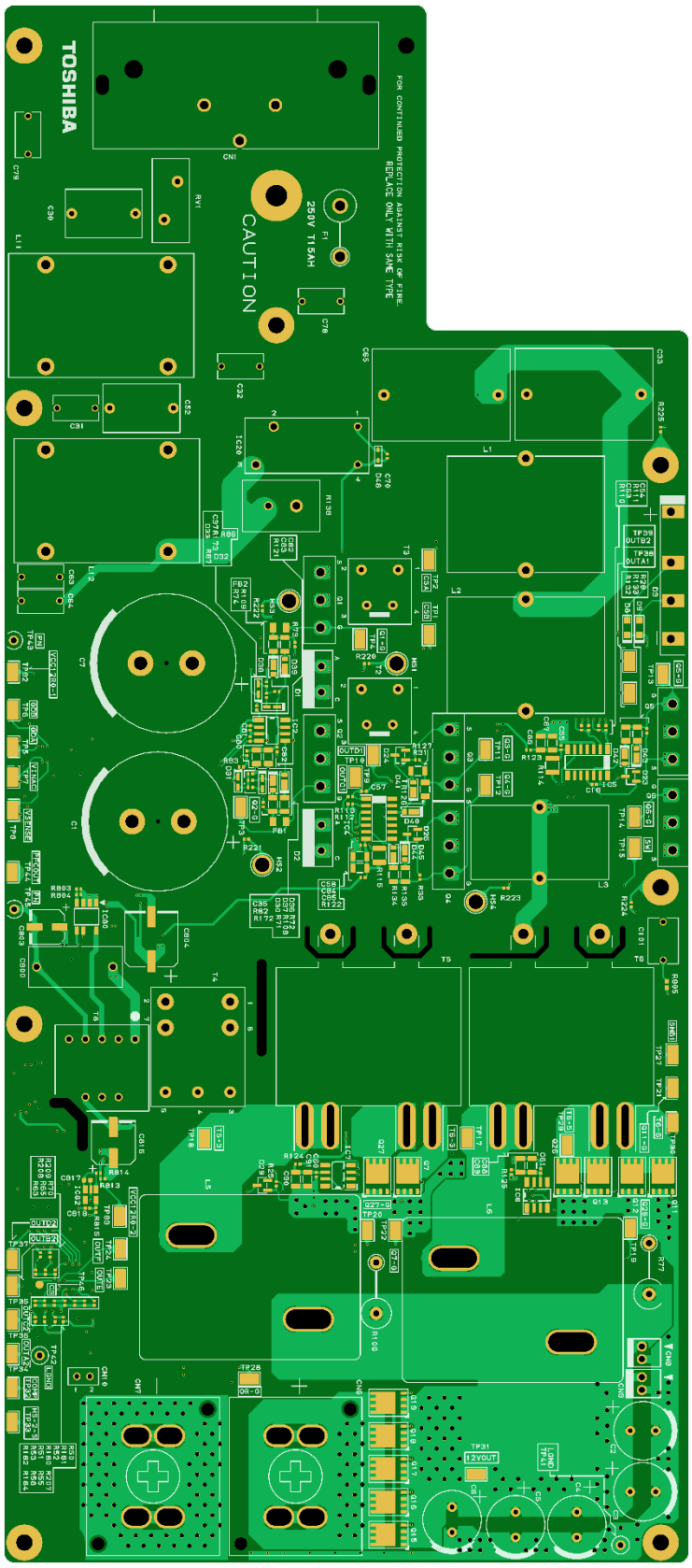


Fig. 2.3 Front View of the 1.6 kW Server Power Supply (Upgraded)

2.4. PCB Component Layout

Fig. 2.4 shows the layout of components of this power supply.



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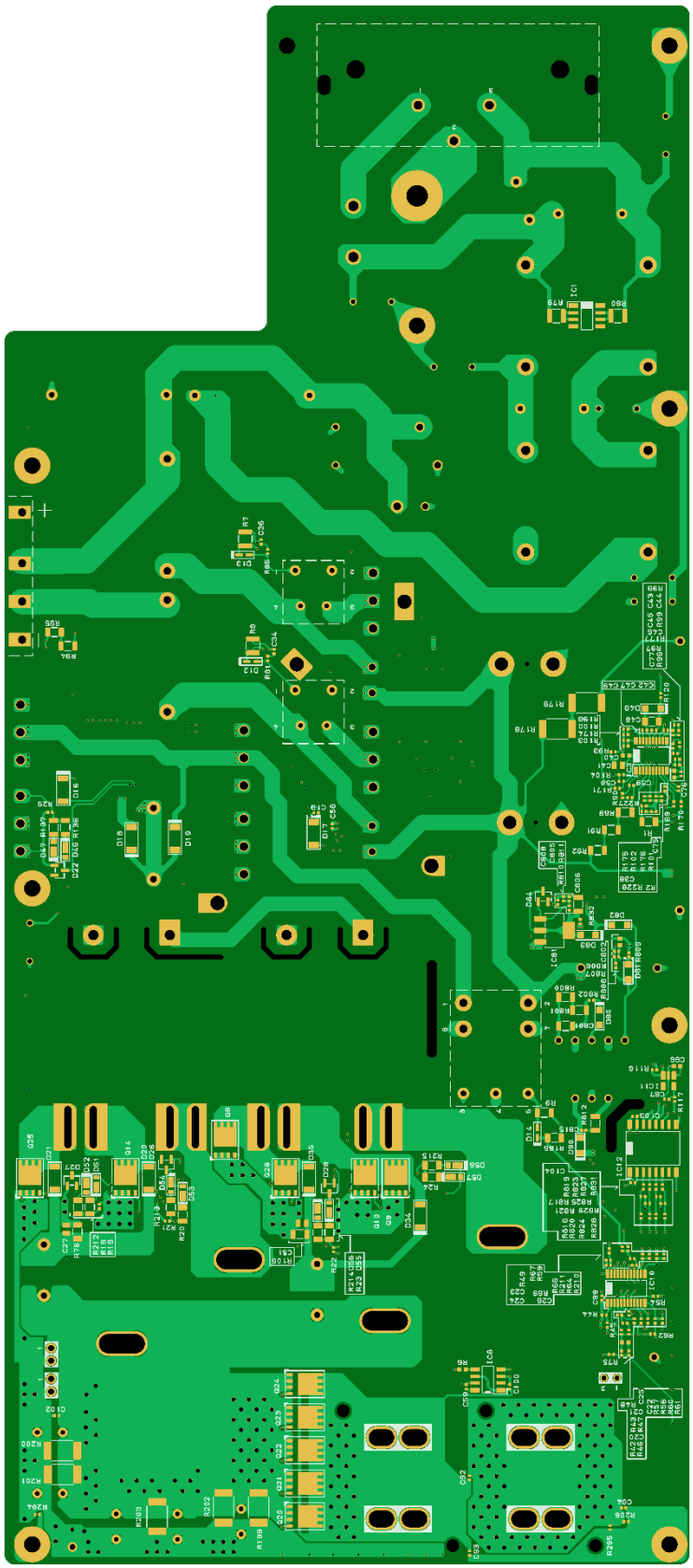

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Fig. 2.5 Component Layout of the 1.6 kW Server Power Supply (Upgraded)

3. Schematic, Bill of Materials, and PCB Pattern

3.1. Schematic

Refer to the following file for the schematic of this power supply.

RD240-SCHEMATIC-xx.pdf (xx is the revision number)

3.2. Bill of Materials

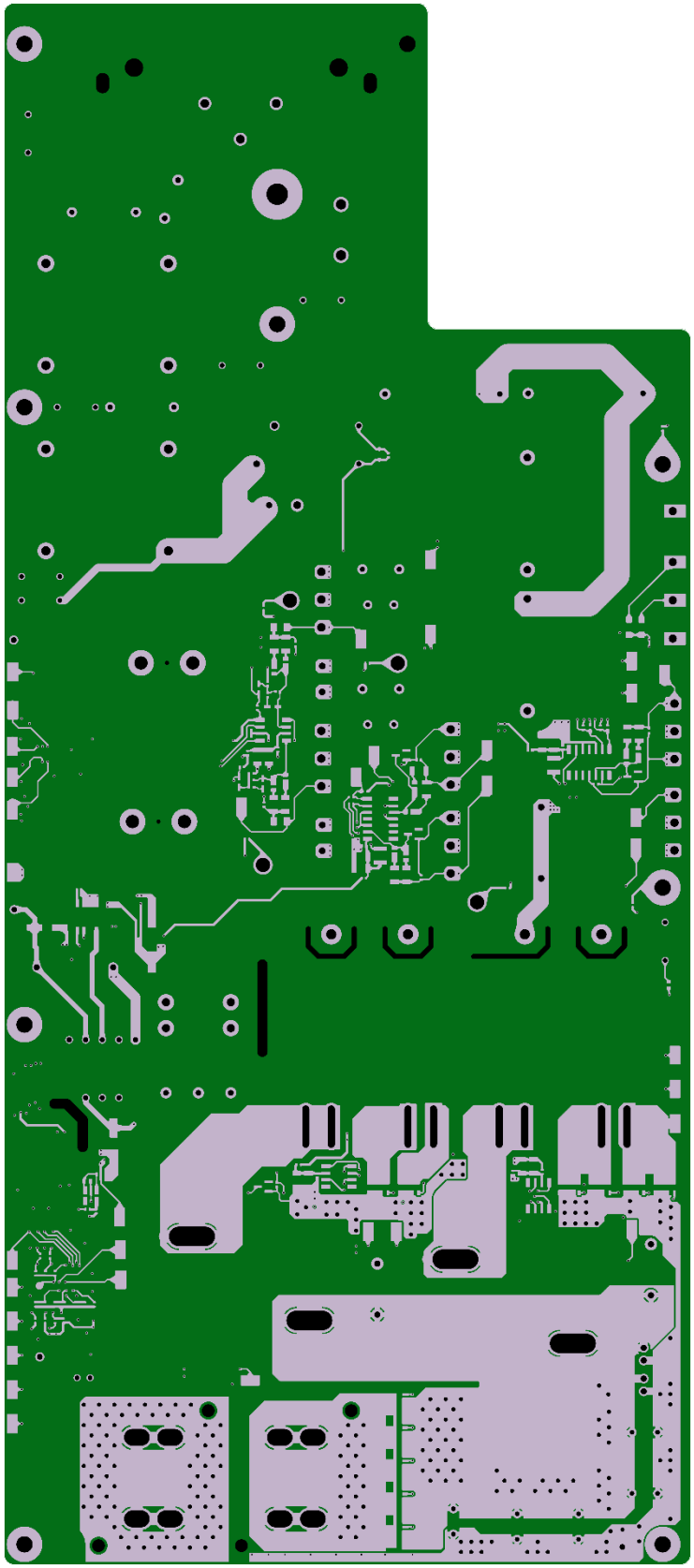
Refer to the following file for the Bill of Materials (BOM) of this power supply.

RD240-BOM-xx.pdf (xx is the revision number)

3.3. PCB Pattern

The PCB pattern of this power supply is shown in Fig. 3.1. It is also available in the following file:

RD240-LAYER-xx.pdf (xx is the revision number)



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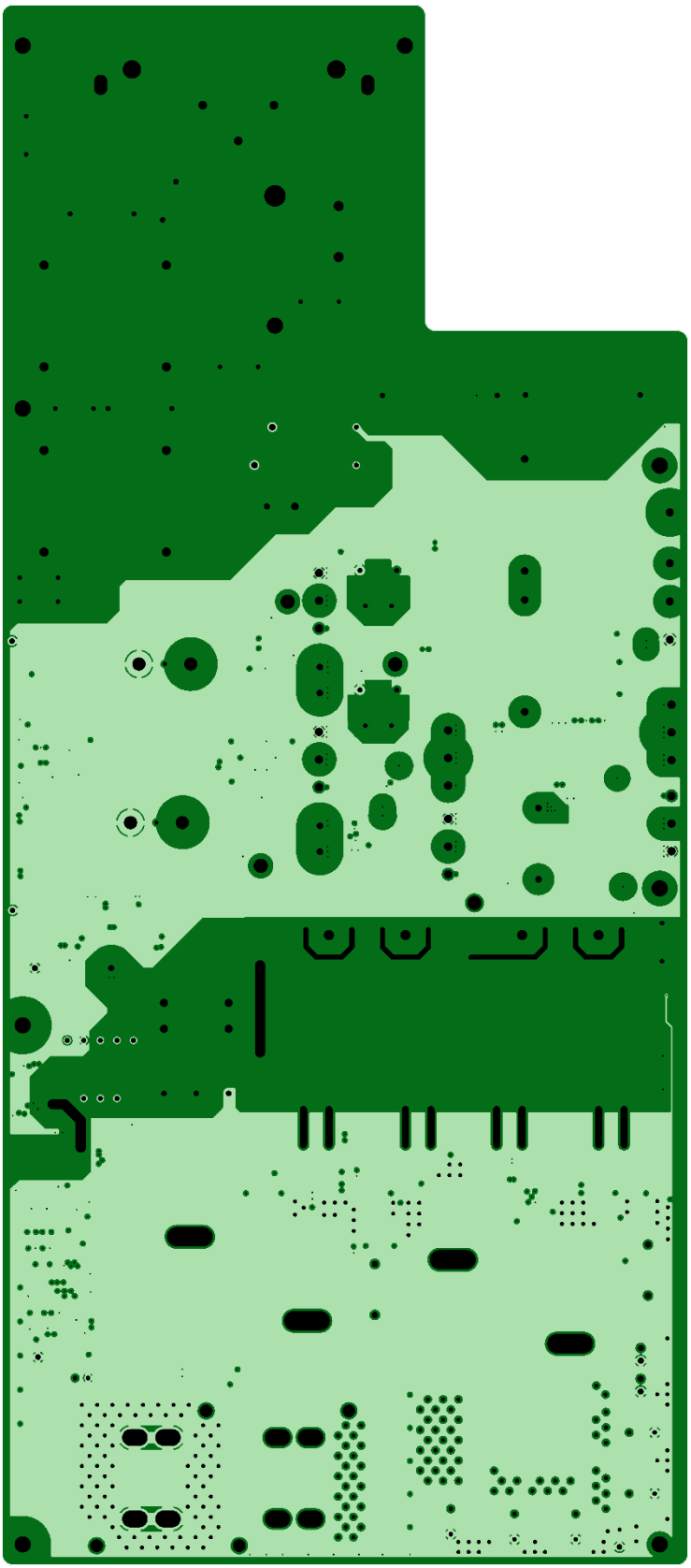

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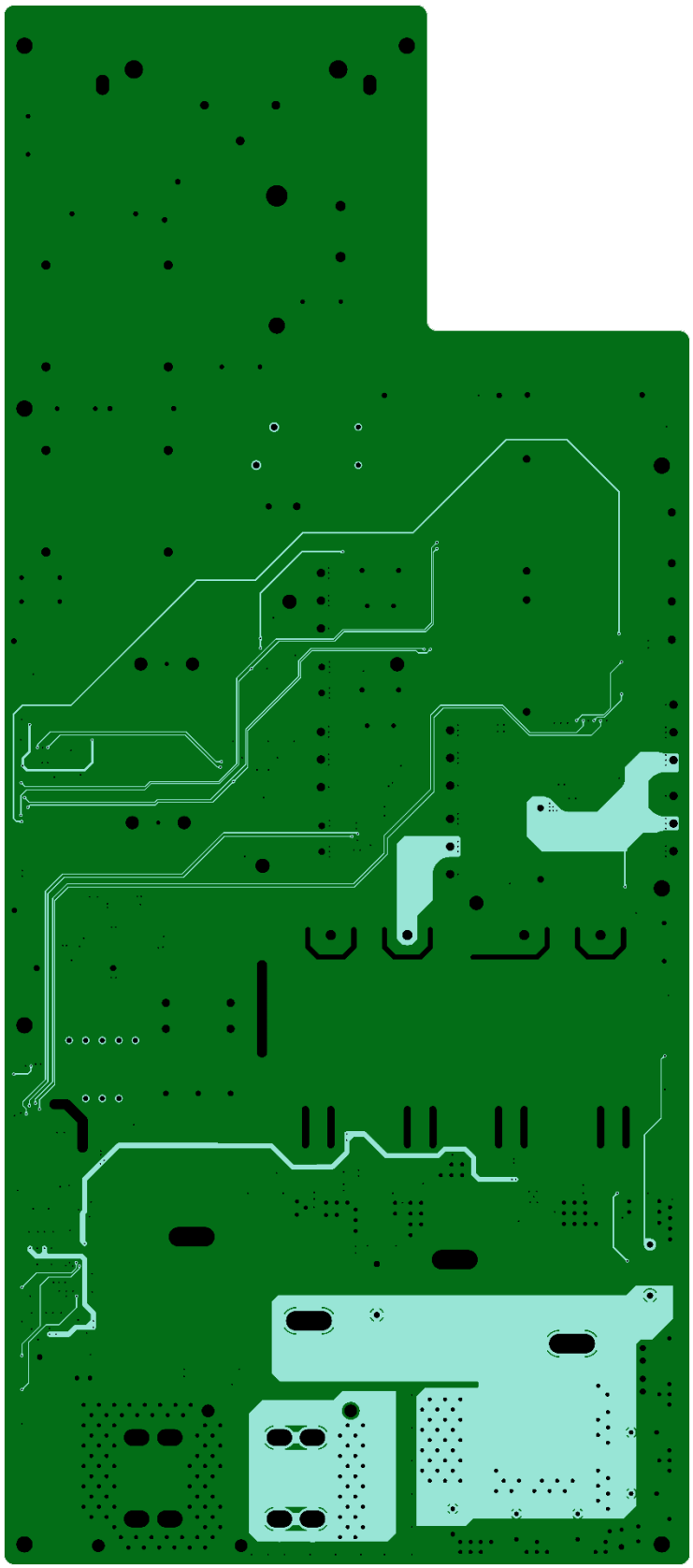

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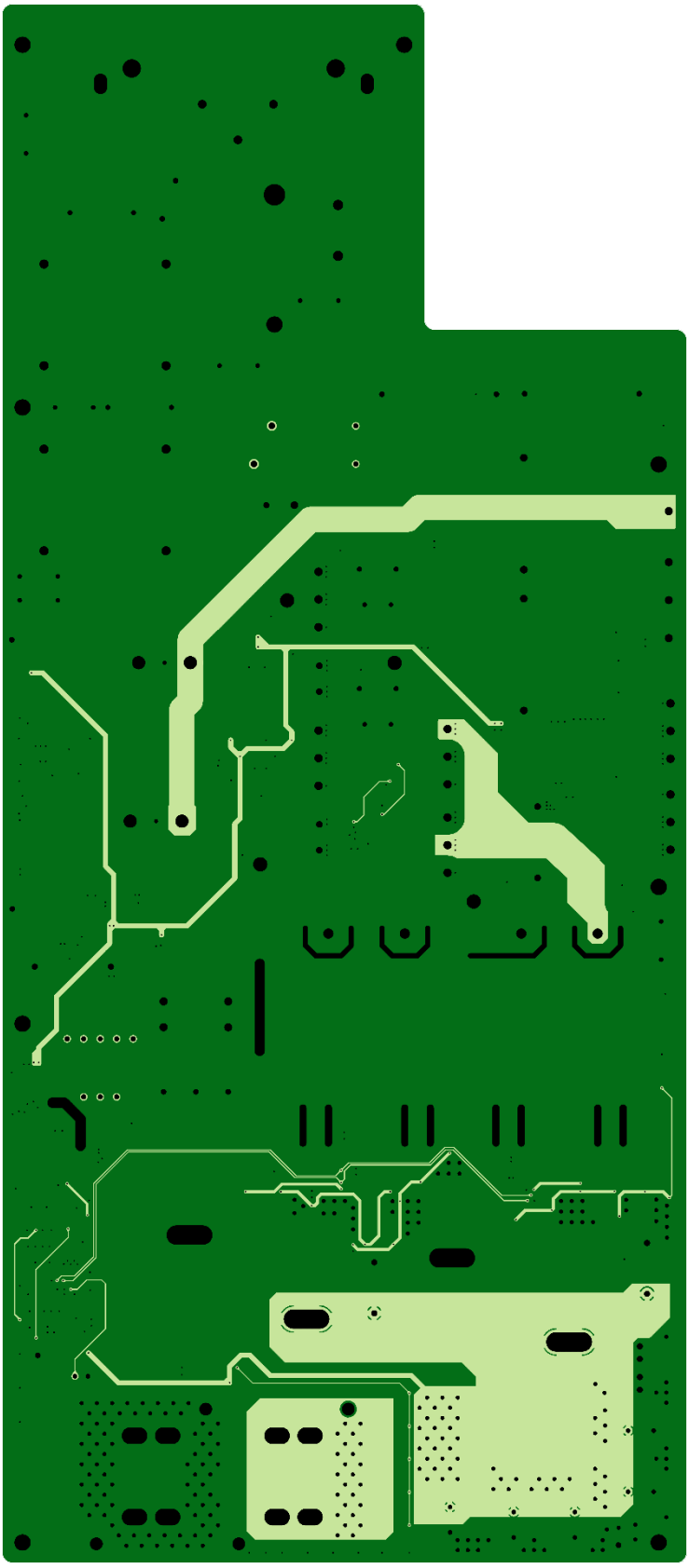

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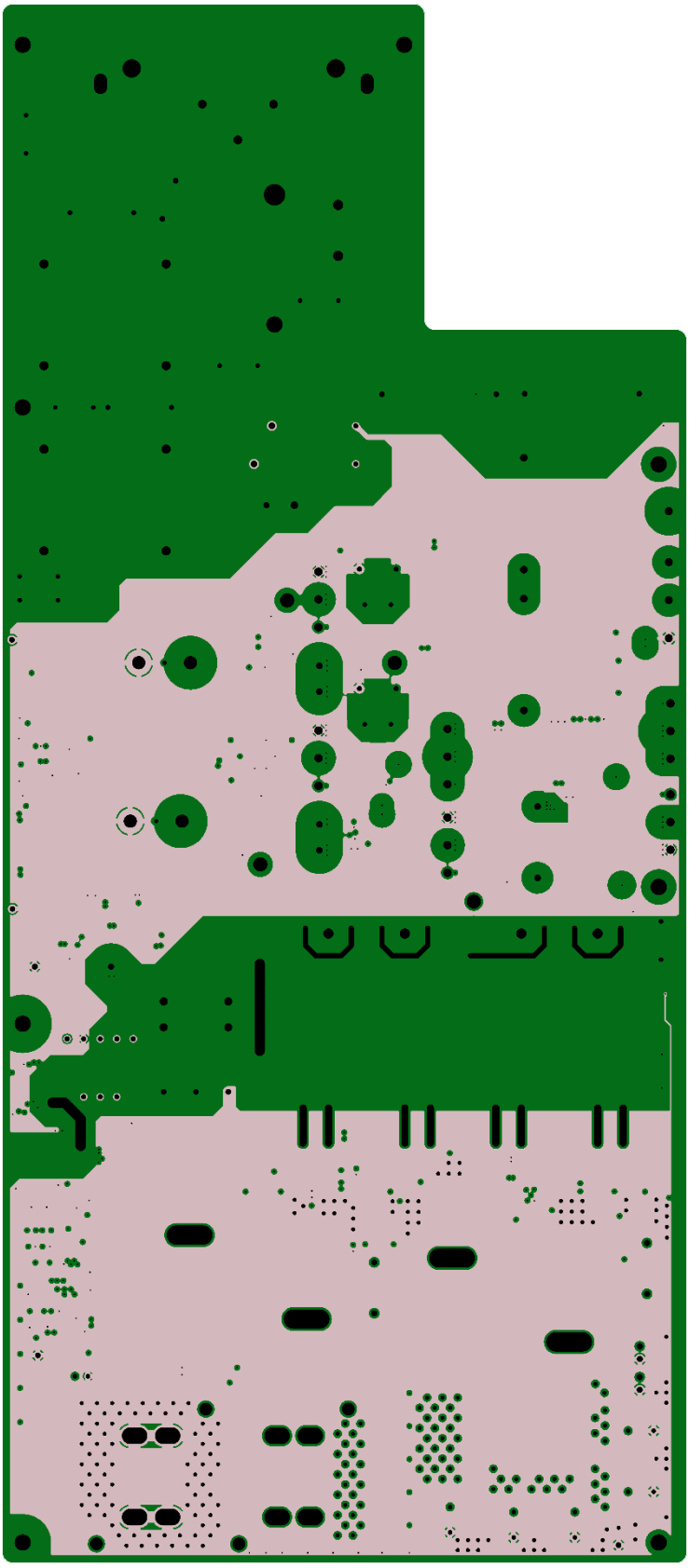

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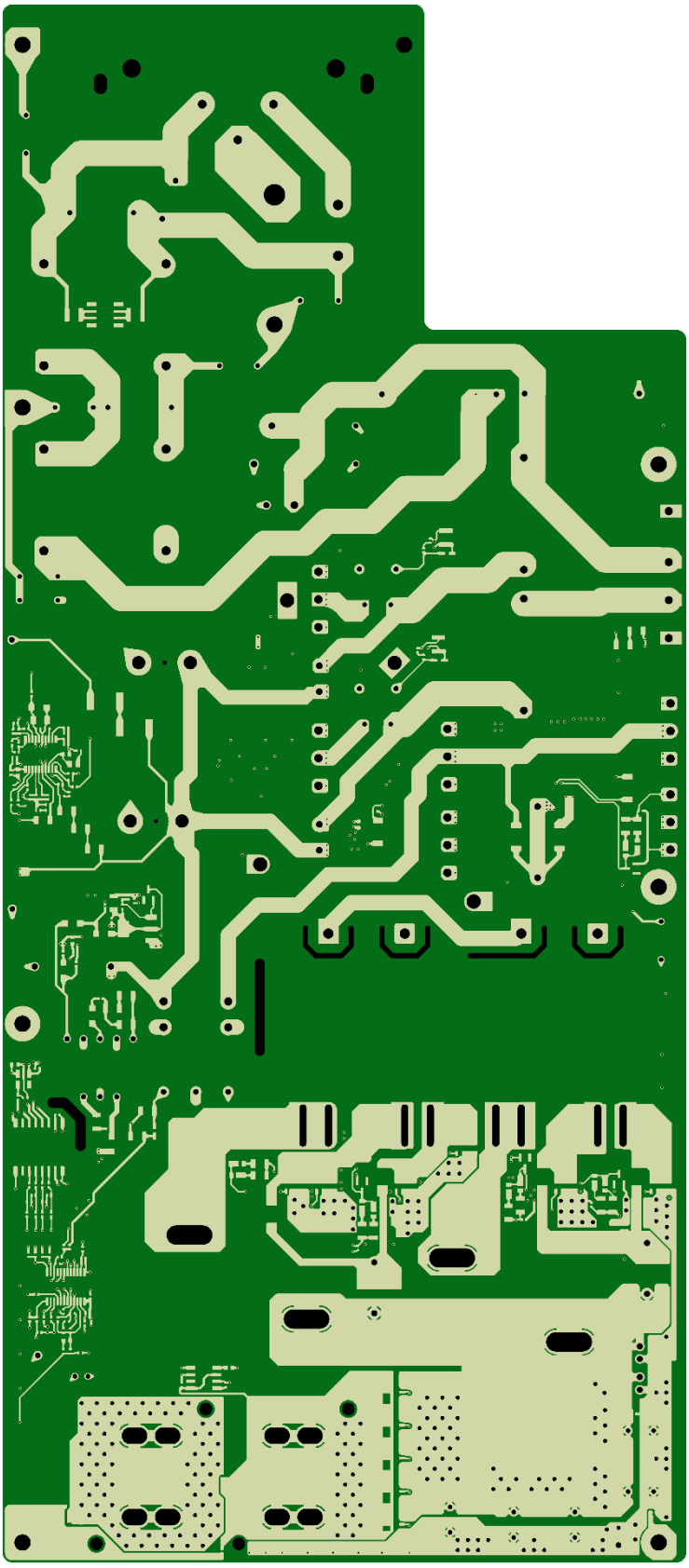

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Fig. 3.1 PCB Pattern of the 1.6 kW Server Power Supply (Upgraded) (Front View)

4. Operation Procedure

4.1. External Connections

Fig. 4.1 shows the external connection pins of this power supply. The component enclosed in the red box is the AC IN terminal, and the components enclosed in blue boxes are the DC OUT terminals. Connect the positive side of the DC load to CN6 DC OUT terminal (OP-1100, made by Osada) and the negative side of the DC load (GND potential) to CN7. In addition, CN1 is the IEC3 pin AC input connector (AC-P05CP24, made by Echo Electric), connect the N (Neutral) of the AC stabilized power supply to the N terminal (pin 1) of CN1, connect the L (Live) of the AC stabilized power supply to the L pin (pin 3), and connect the ground (frame ground) to the E pin (pin 2) if required. Use load devices and cables that meet the power supply specifications.

Connect DC fans to CN8, CN9 of the fan connector (5045-02A, made by Molex) as needed. Pin 1 is 12 V out and pin 2 is GND respectively.

Fig. 4.1 External Connections

4.2. Start and Stop Procedures

Make sure that CN1, CN6, and CN7 terminals are all 0 V prior to start-up.

[Start procedure]

1. Turn on the AC stabilized power supply input.

[Stop Procedure]

1. Turn off the AC stabilized power supply input.

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 has power. 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 or inductors of this power supply may generate heat according to the load current. This power supply assumes forced air cooling. Use an air-cooling device that enables heat-generating components to stay within the rated temperature range under high load. Do not touch any part of the power supply while the power supply is in operation. Doing so may cause burns.

5. Power Supply Characteristics

This section describes the efficiency measurement results of this power supply. These are measured by setting the line voltage of this power supply to AC 115 V or AC 230 V. The maximum output power of this power supply is 800 W when the input is AC 115 V and 1.6 kW when the input is AC 230 V. This power supply efficiency is for the whole power supply including all the basic functions required for AC-DC conversion, such as PFC circuit, PSFB circuit, auxiliary power supply circuit, and output ORing circuit. The power supply efficiency may be improved by redesigning the auxiliary power supply circuit, or by eliminating the ORing circuit.

5.1. Efficiency

Fig. 5.1 shows the measured efficiency of this upgraded power supply design with AC 230 V and AC 115 V inputs. The efficiency of the existing power supply reference design (1.6kW, 80Plus Platinum Class, High efficiency Server AC-DC Power supply) of equivalent specification is also shown in the figure.

High efficiency of 95.4 % (output: 0.8 kW) and 93.4 % (output: 1.6 kW) is achieved when input is 230 V.

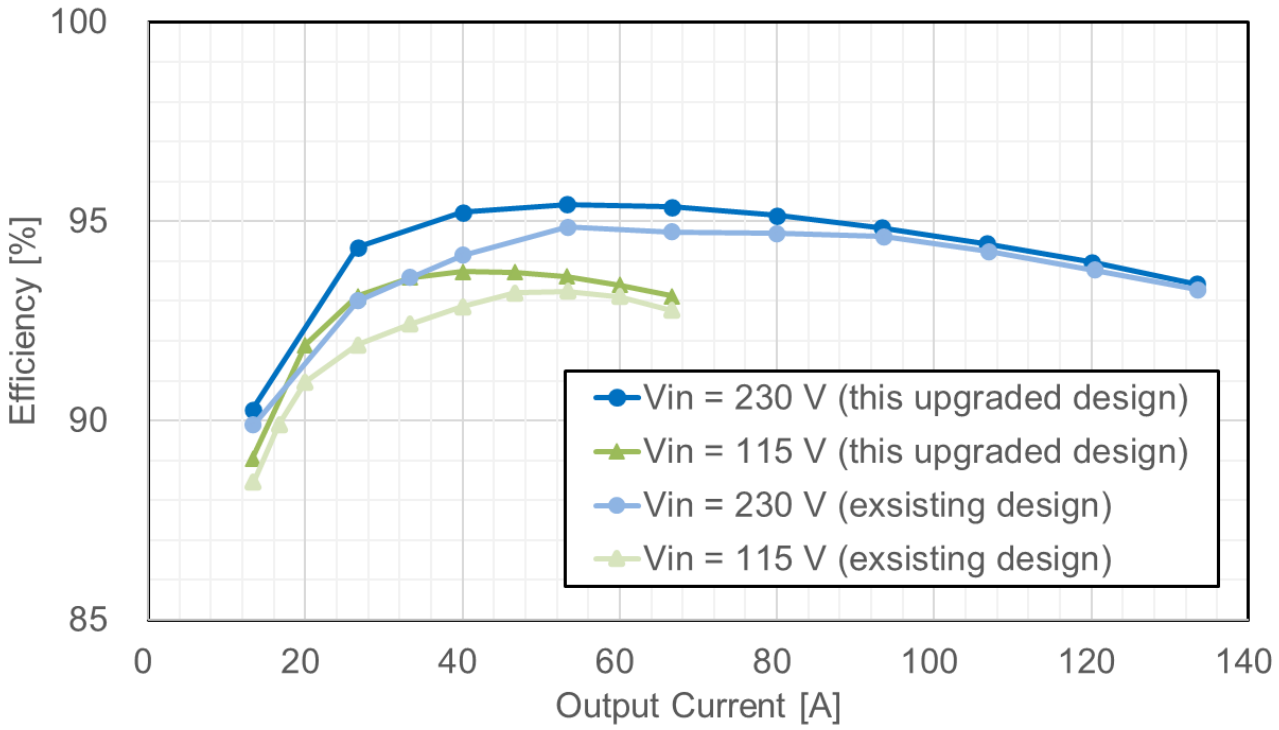

Fig. 5.1 Efficiency Measurement (When Input is AC 230 V or AC 115 V)

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