1.6 kW 48 V Output Telecommunication Equipment Power Supply

Reference Guide

RD171-RGUIDE-01

TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

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1. Introduction

This reference guide describes the specifications, operating method and performance of the 1.6 kW 48 V Output Telecommunication Equipment Power Supply (this power supply). This power supply provides 1.6 kW power at the outputting DC 48 V. The AC input (90 to 264 V) is converted into 48 VDC through the semi-bridgeless PFC circuit and the isolated phase-shifted full-bridge (PSFB) circuit. This power supply contains an ORing circuit and can be used for the designing of a power supply that requires N+1 redundant operation. This power supply is designed to fit in a 1U rack shelf and is suitable for power supply applications of various sizes and purposes, including general-purpose 1U server power supplies. Incorporating Toshiba's fast switching MOSFETs as switching devices, this power supply provides high efficiency.

2. Specification

2.1. Specification

Table 2.1 shows the input and output specification of this power supply.

Table 2.1 Power Supply Specification

Parameter	Conditions	Min.	Typ.	Max.	Unit
Input Characteristics					
AC input voltage (rms)		90		264	V
AC input current (rms)	VinAC = 90 V, Iout =16.67 A			10	A
AC Input frequency		47		63	Hz
Semi-Bridgeless PFC Circuit Output Characteristics (Internal Characteristics)					
Output voltage			390		V
Output current	VinAC = 230 V		4.5		A
	VinAC = 115 V		2.2		
Switching frequency			60		kHz
Output Characteristics (PSFB Circuit)					
Output voltage		45.6	48.0	50.4	V
Output current	VinAC = 230 V			33.33	A
	VinAC = 115 V			16.67	A
Output power	VinAC = 230 V			1.6	kW
	VinAC = 115 V			0.8	kW
Output ripple voltage	Ta=25℃			480	mV
Switching frequency			97.05		kHz

2.2. Outline

Fig. 2.1 shows an overview of this power supply.

Fig. 2.1 External View of This Power supply2.21

Outline size
318 mm x 127 mm x 43 mm
(including the base plate under PCB and the cover plate over heatsimk)

2.3. Block Diagram

Fig. 2.2 shows a simple block diagram to understand function and operation of this power supply. Refer to RD171-SCHEMATIC-01 for actual schematics.

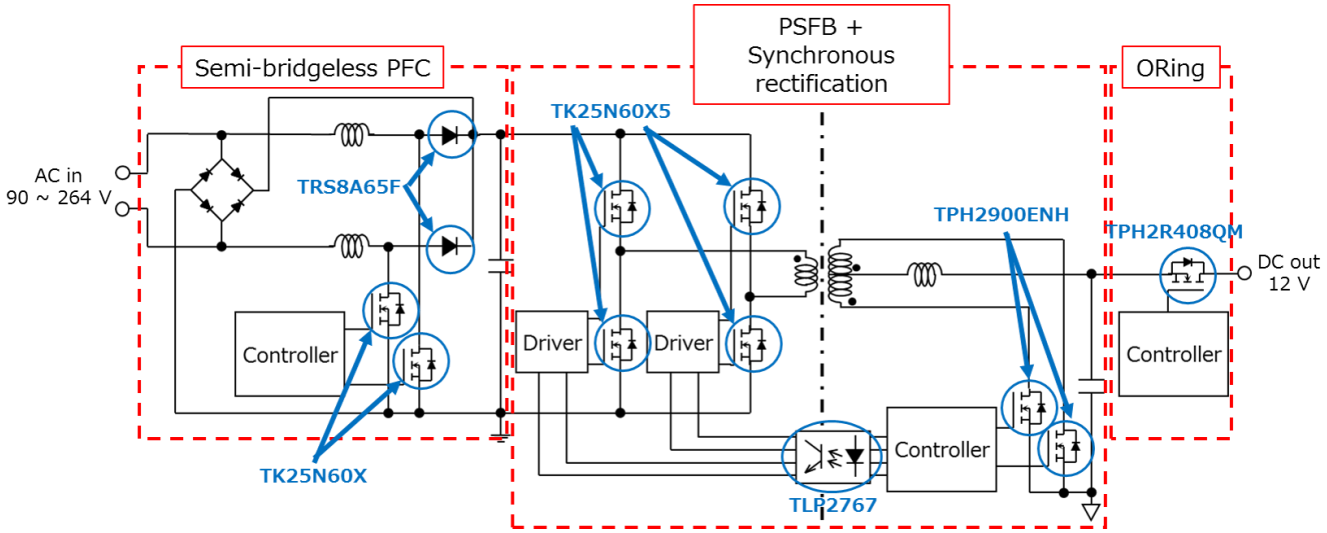

Fig. 2.2 Block Diagram

2.4. PCB Pattern

Fig. 2.3 shows the layout of Layer1 of the PCB of this power supply.

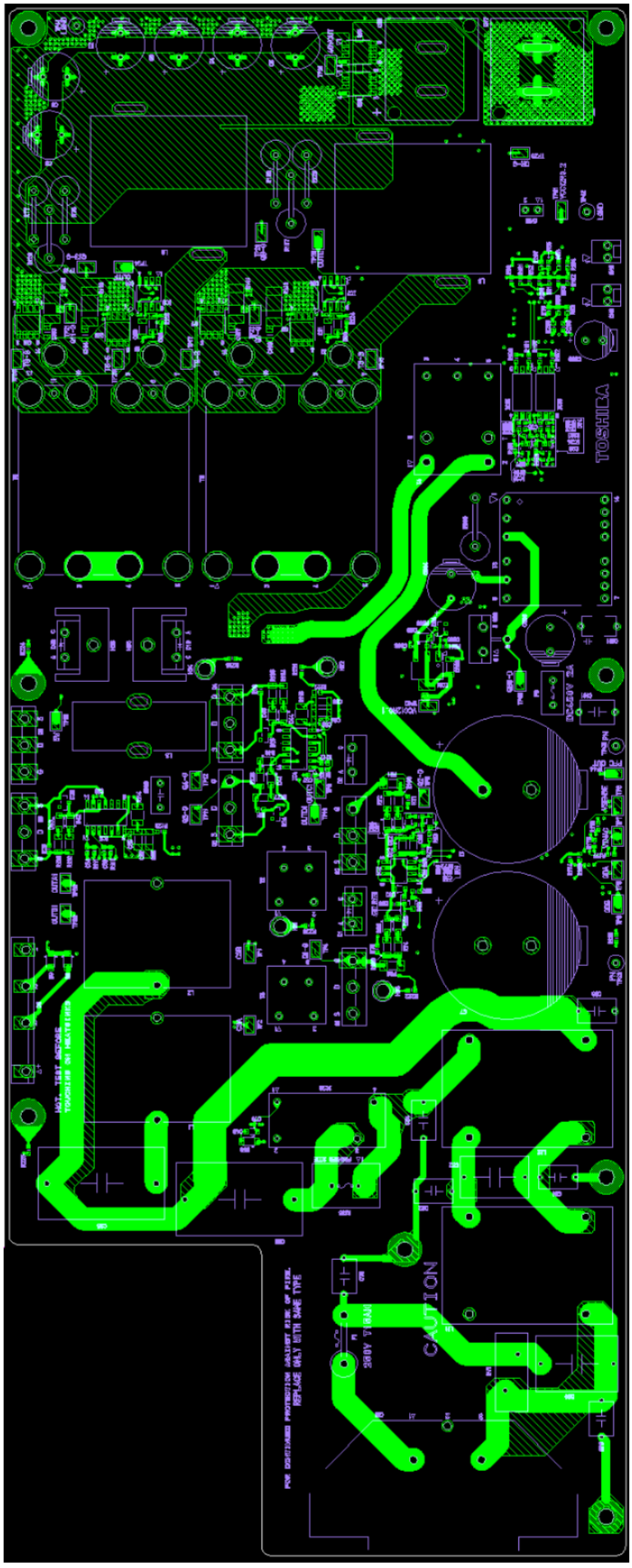

Fig. 2.3 Layer1

Fig. 2.4 shows the layout of Layer2 of the PCB of this power supply.

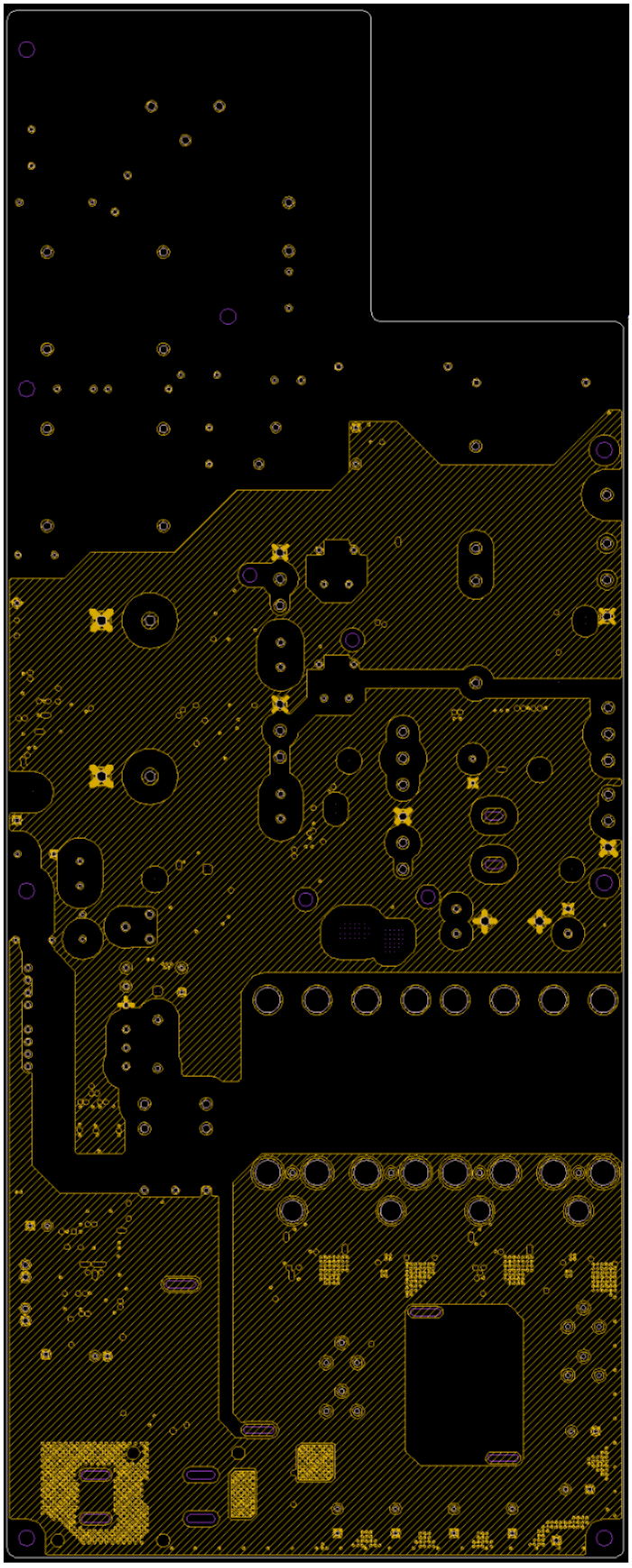

Fig. 2.4 Layer2

Fig. 2.5 shows the layout of Layer3 of the PCB of this power supply.

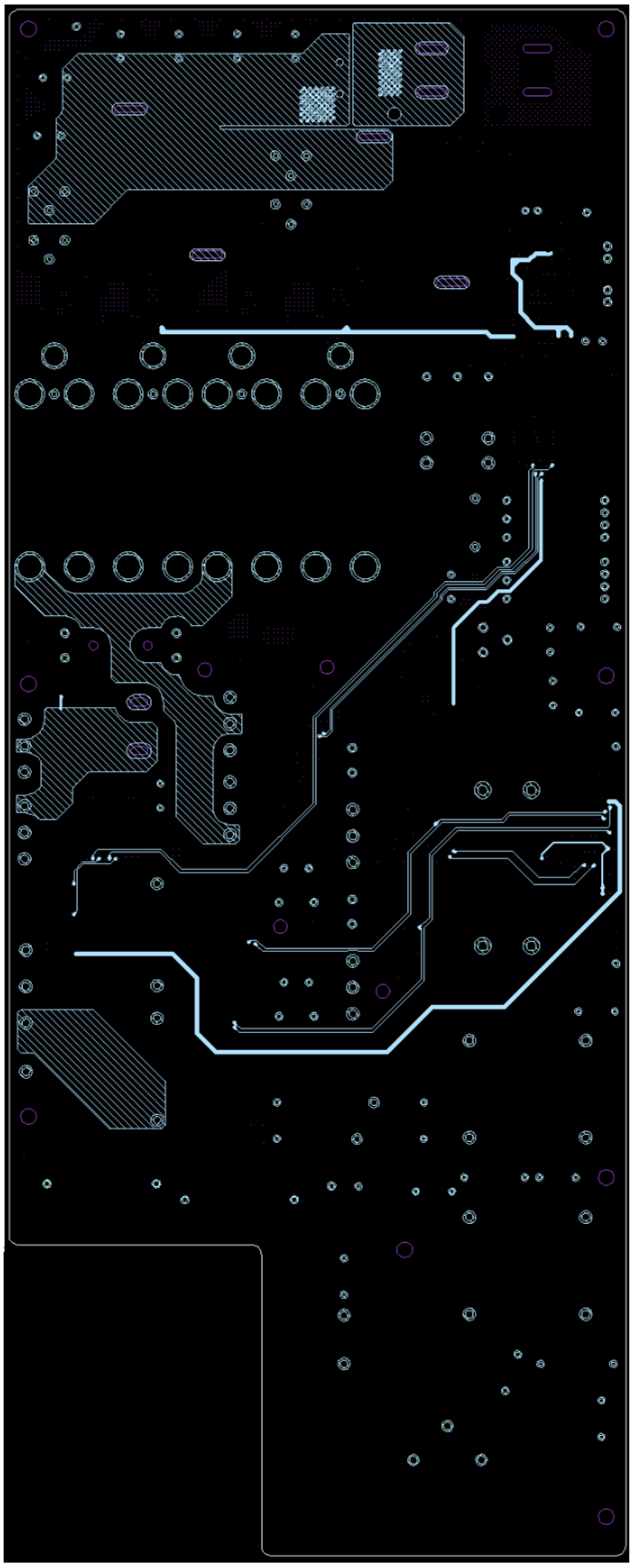

Fig. 2.5 Layer3

Fig. 2.6 shows the layout of Layer4 of the PCB of this power supply.

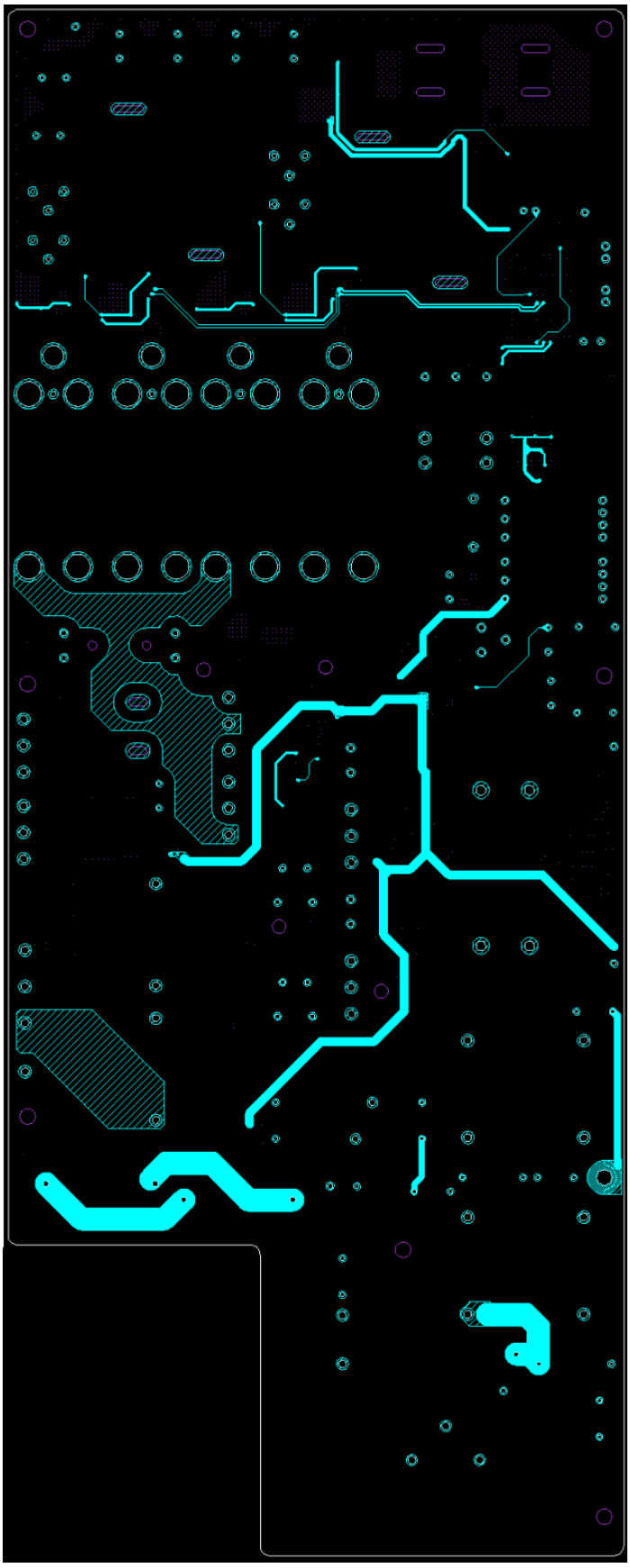

Fig. 2.6 Layer4

Fig. 2.7 shows the layout of Layer5 of the PCB of this power supply.

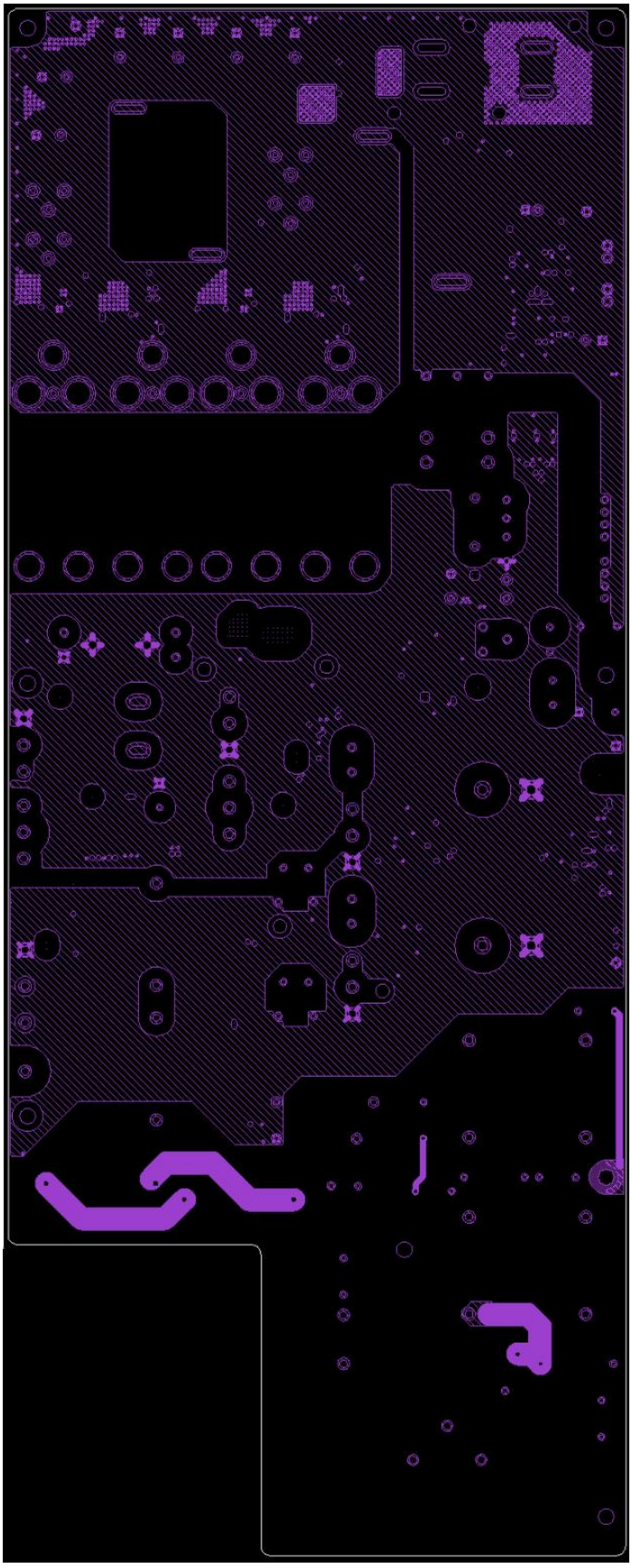

Fig. 2.7 Layer5

Fig. 2.8 shows the layout of Layer6 of the PCB of this power supply.

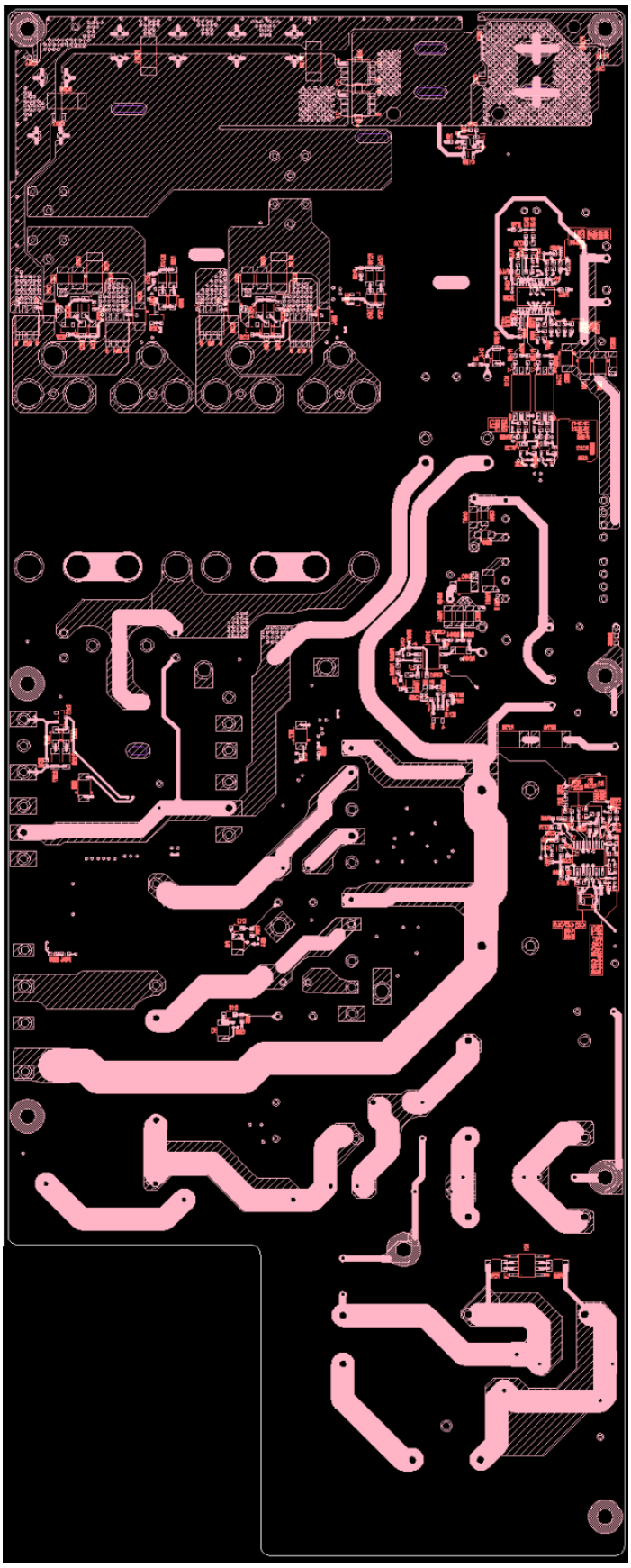

Fig. 2.8 Layer6

3. Operating Procedure

This section describes the operting procedure of this power supply.

3.1. Connection with External Equipment

Fig. 3.3 shows the connections of this power supply with external equipment. The part enclosed by a solid red line is the external power connection terminal. Connect an AC plug to the AC inlet, and connect the AC plug to an AC stabilized power supply. The power supply, cables, lead wires, and connectors to be connected must meet the 2.1 Power Supply Specification. Connect the load unit using the 48 V output terminals that are surrounded by a solid blue line. Load units, cables, and connectors to be connected must satisfy 2.1 Power Supply Specifications. The areas marked with a red dashed line are the output voltage check terminals of the PFC and measurement terminals of 12 V voltage for primary-side control. The portions marked by the blue dashed line are measurement terminals of the 12 V voltage for secondary-side control.

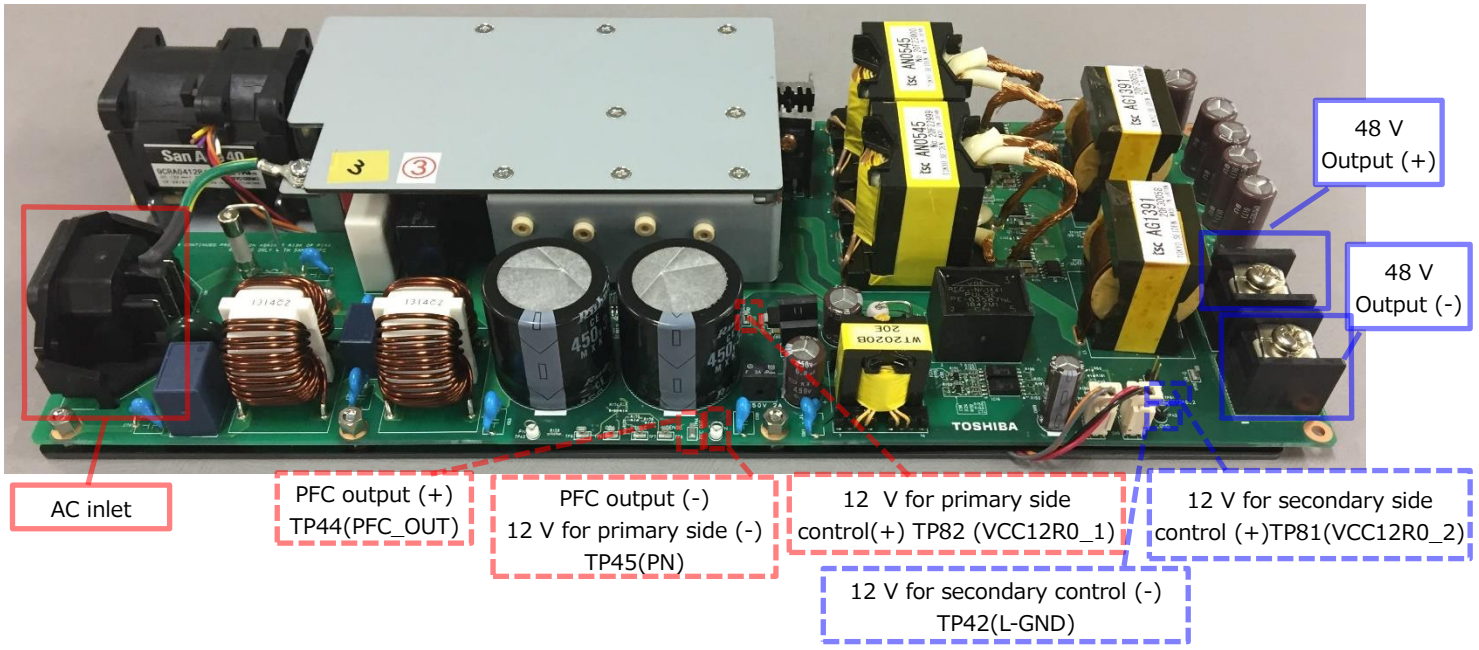

Fig. 3.1 Terminals for External Equipment

3.2. Power-Up and Power-Off Procedure

Before starting this power supply, make sure voltage of the all termainals listed bleow are 0 V.

1. Terminals of 12 V for the primary side control (+) (-)
2. Terminals of 12 V for the secondary side control (+) (-)
3. PFC output terminal (+) TP44 (PFC_OUT)
4. PFC output terminal (-) TP45 (PN)
5. 48 V output terminal (+) (-)

After checking the above, connect to an AC stabilized power supply.
Disconnect the AC stabilized power supply when stopping.

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

Be careful of electric shock when connecting an AC stabilized power supply. Fig. 3.2 shows the primary and secondary sides of this power supply. Do not touch the primary side regardless of the supply of the primary 12 V power supply and the secondary 12 V power supply. Be very careful when observing the waveform. Even after this power supply is stopped, there is a risk of electric shock due to the remained charge of various capacitors. Check that the voltage of each part has decreased sufficiently, and then touch the board.

In addition, semiconductor devices, transformers and other components of this power supply generate heat according to the load current. The portions highlighted by red dashed lines in Fig. 3.3 dissipate much heat. Do not touch these areas while the power is on, as there is a risk of burn hazard.

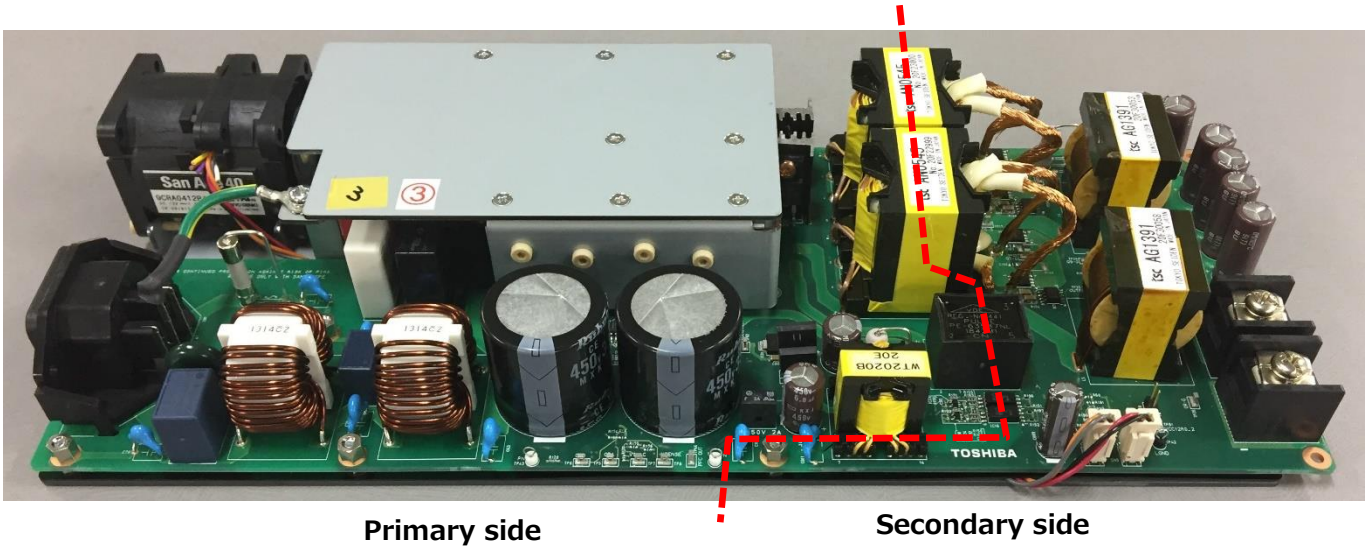

Fig. 3.2 Primary Side Area / Secondary Side Area

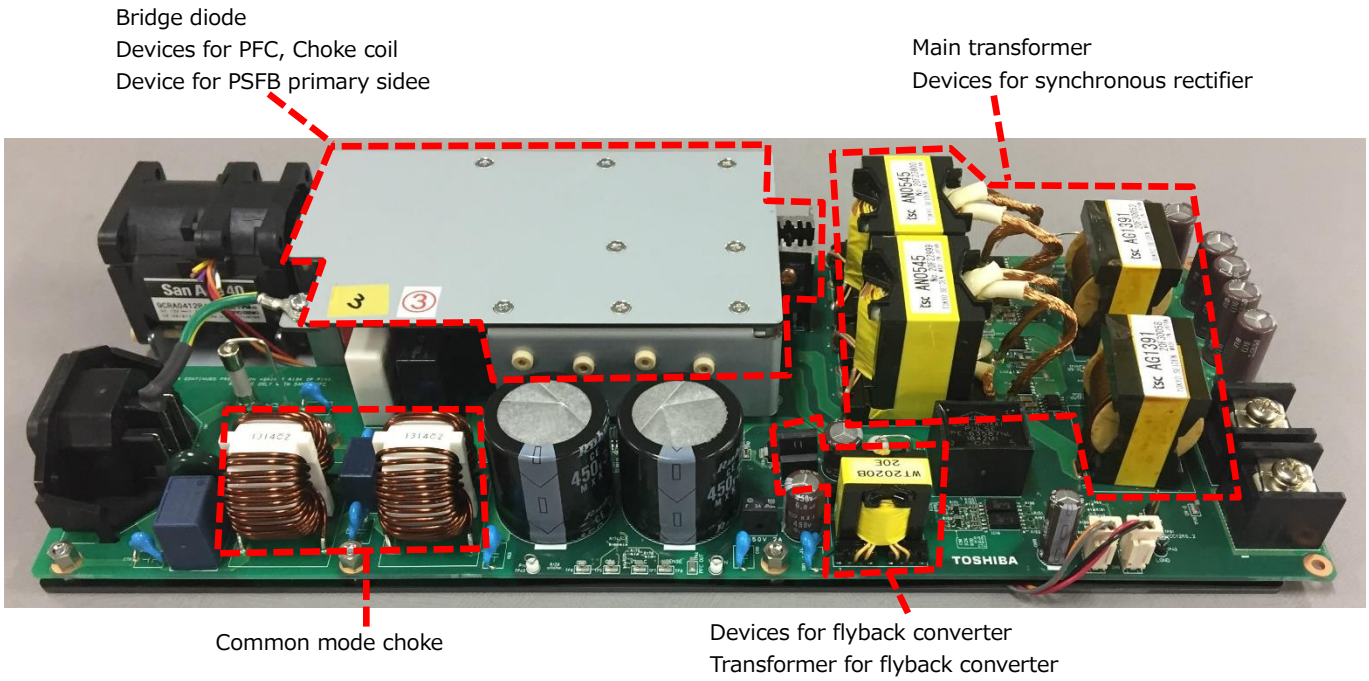

Fig. 3.3 Components Subject to High Temperature

4. Performance

This section describes the efficiency of this power supply.

4.1. Efficiency

Fig. 4.1 shows the power supply efficiency measurement results of this power supply. The output voltage of the AC stabilized power supply is set to 115 V or 230V for measurement. The maximum output power at VinAC = 115 V is 800 W, and the maximum output power at VinAC = 230 V is 1.6 kW according to this power supply specification. The efficiency at the 100 % load is 92.3 % for 115 V input and 94.7 % for 230 V input, achieving high efficiency. Efficiency measurement at this time is performed with the cooling FAN driven by an external power supply. The measurement result changes when the cooling FAN is driven by the internal power supply. In addition, this power supply is equipped with ORing circuit at the output section. When ORing circuit is deleted, the power supply efficiency of this power supply will be improved

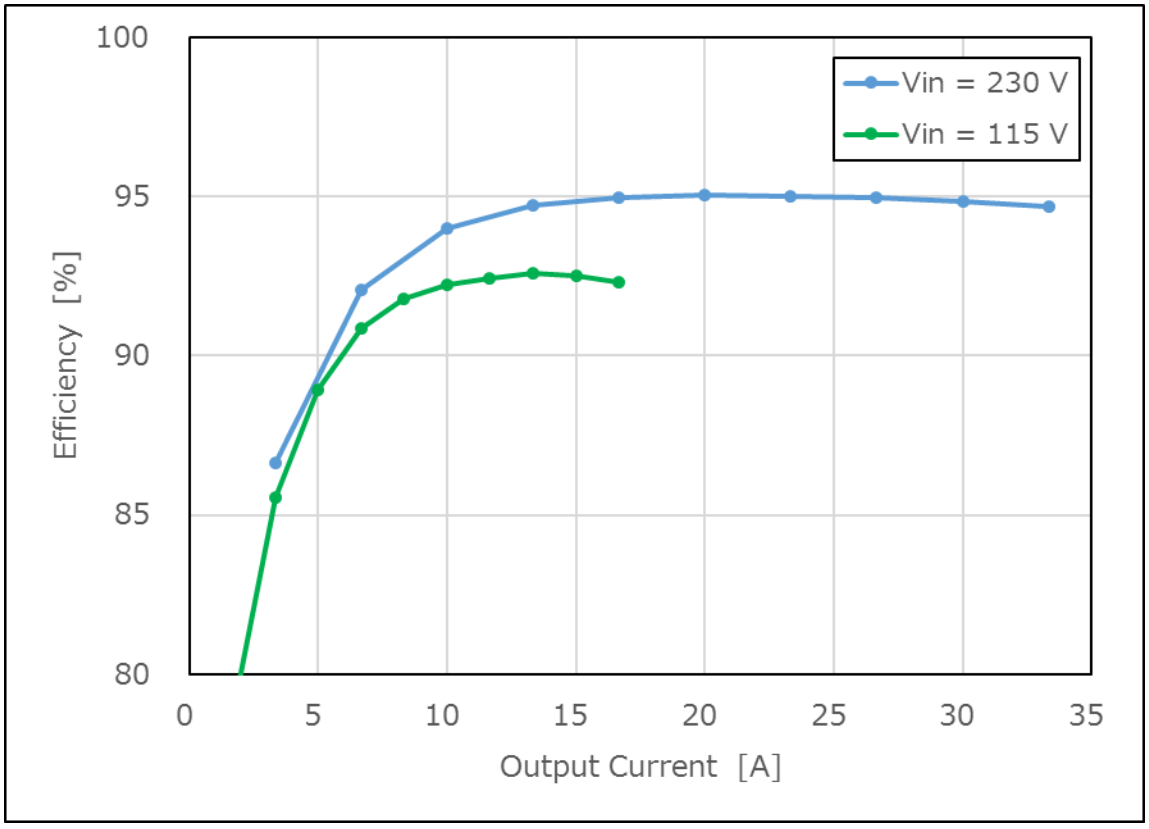

Fig. 4.1 Efficiency Result (Vin = 115 V, Vin = 230 V)

For reference, Fig. 4.2 to Fig. 4.5 show the measured power-efficiency of this power supply and the standard of 80 PLUS. The 80 PLUS standards in the chart are as of March 2021. The specification value may be updated. Please check it every time. This power supply is not certified for 80 PLUS. It is necessary to measure the power supply efficiency using the equipment that will be the final product and acquire the certification.

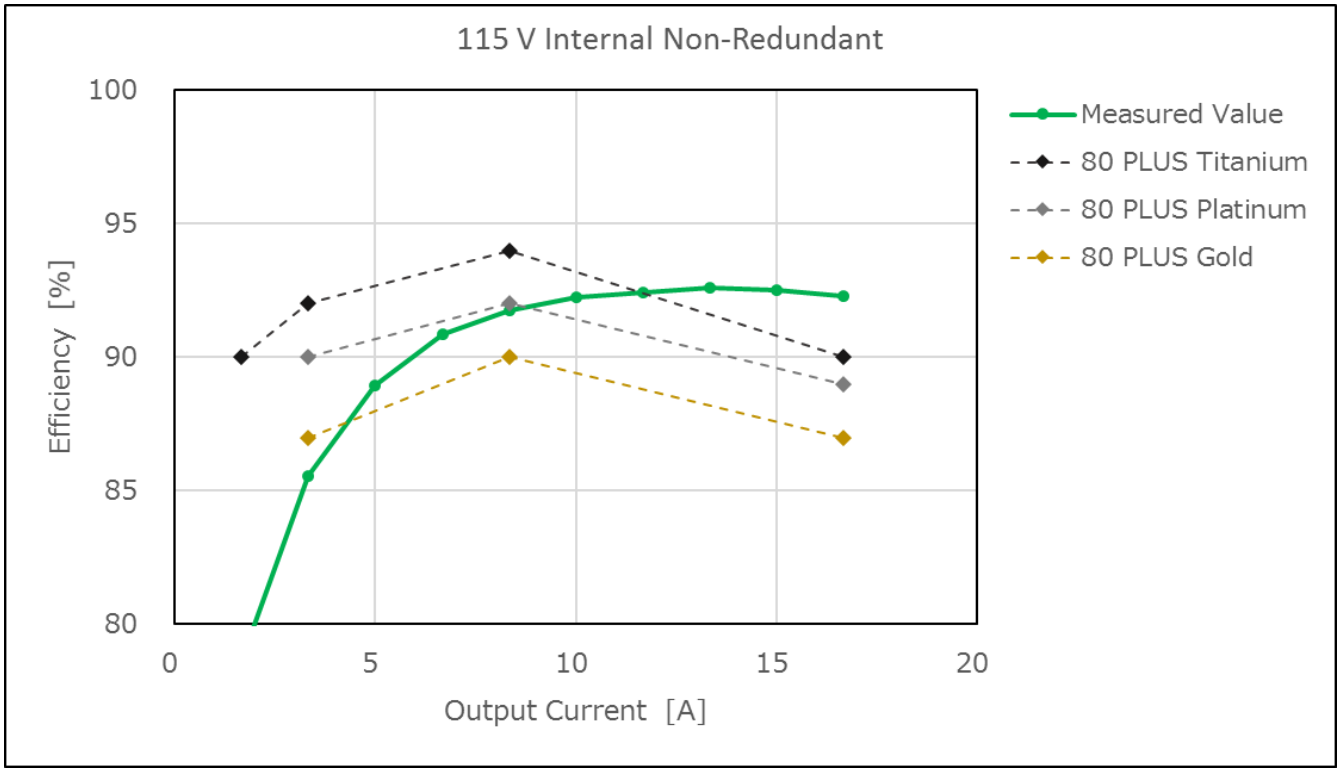

Fig. 4.2 Efficiency Result (80PLUS : 115 V Internal Non-Redundant)

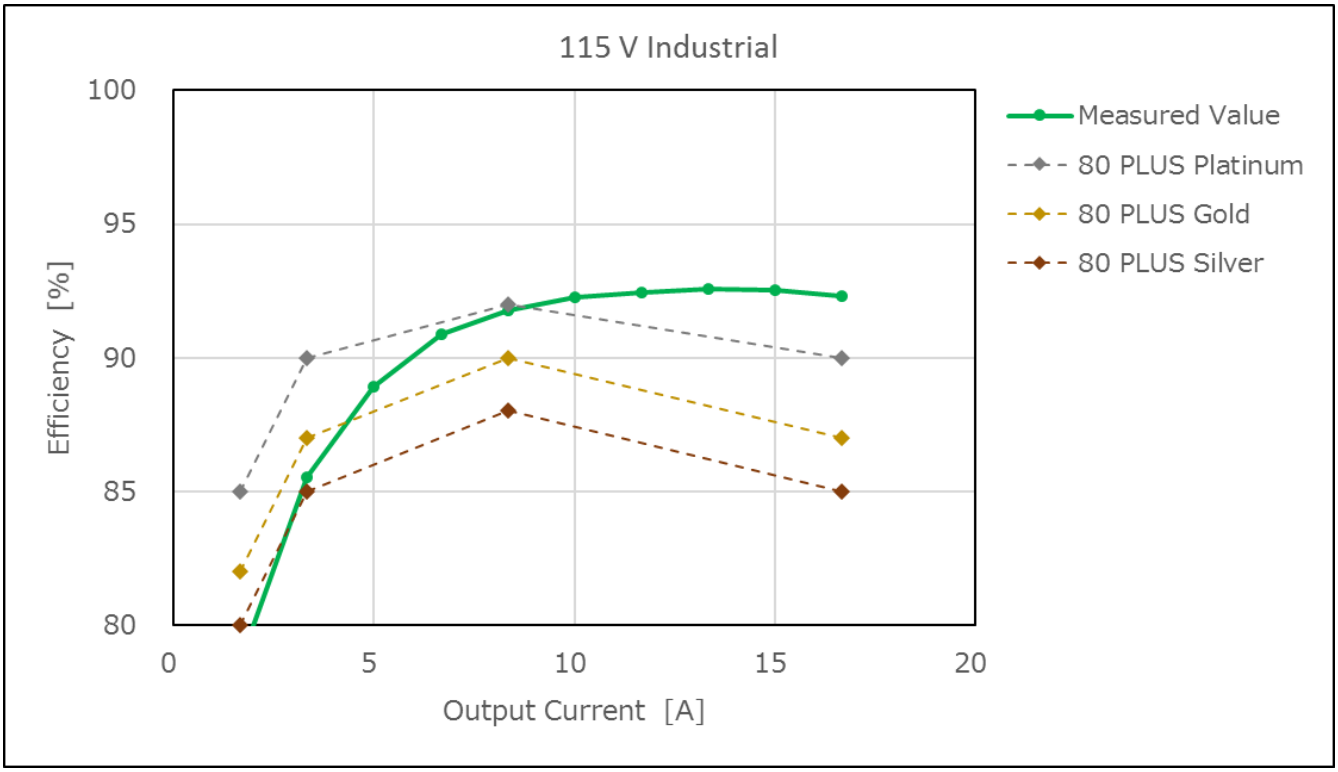

Fig. 4.3 Efficiency Result (80PLUS : 115 V Industrial)

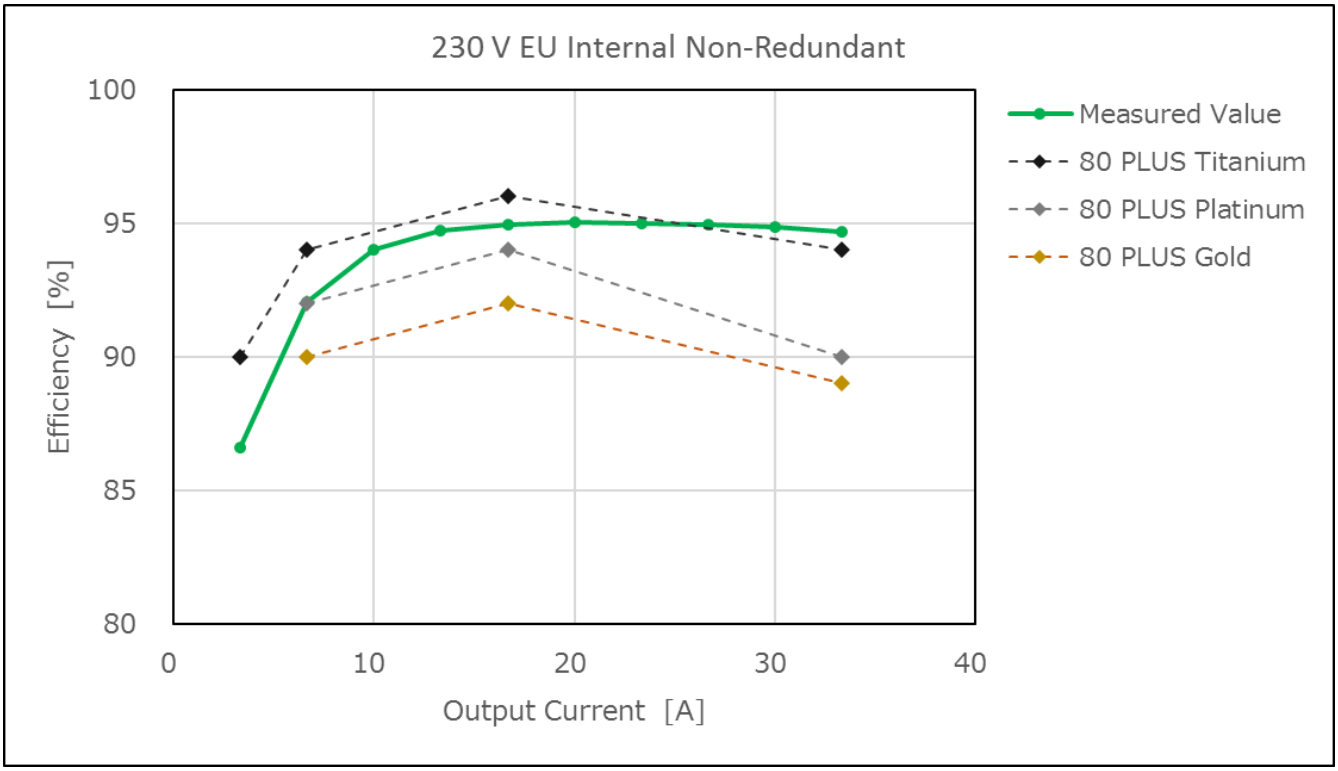

Fig. 4.4 Efficiency Result (80PLUS : 230 V EU Internal Non-Redundant)

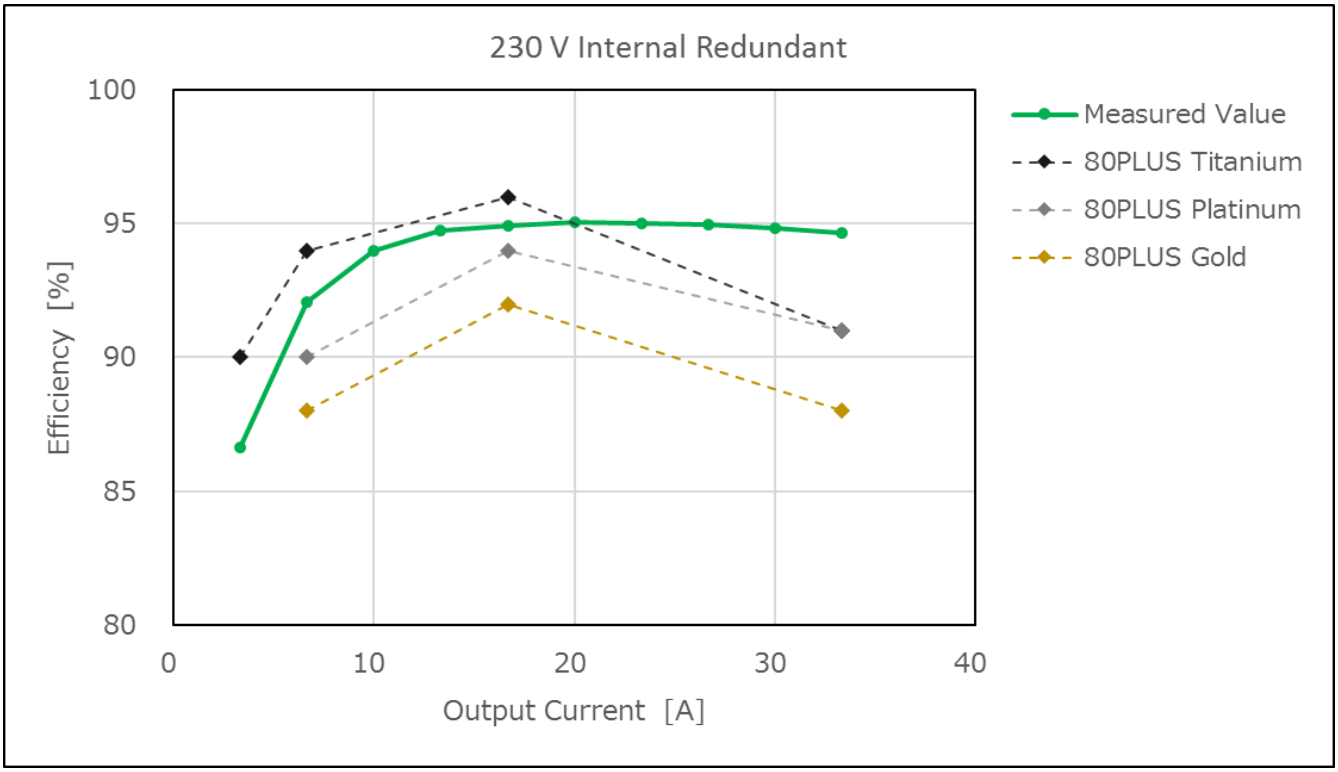

Fig. 4.5 Efficiency Result (80PLUS : 230 V Internal Redundant)

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