1.2V/100A Output DC-DC Converter Compliant with 48V Bus Voltage

Reference Guide

RD040-RGUIDE-02

TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

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1. Introduction

This reference guide shows the specifications, usage, and efficiency characteristics of a 1.2V/100A isolated DC-DC converter. Its input voltage range is compliant with the 48V bus for server applications recommended by the Open Compute Project (OCP), which is specified to be in the range of 40VDC to 59.5VDC. This 1.2V/100A DC-DC converter can supply 1.2V directly from a 48V bus. Although the 1.2V/100A DC-DC converter is designed to supply power to the loads on a 48V server motherboard, it is well suited to various applications, including communication equipment with 48VDC lines and industrial systems powered by 48V batteries. This reference design provides various design information, which helps to reduce the time and effort to design a DC-DC converter according to actual required specifications.

For various information on this reference design → Click Here

The 1.2V/100A DC-DC converter has Toshiba's latest small surface-mount power MOSFETs that are good for use as switching devices on the primary and secondary sides of a DC-DC converter. It also has small surface-mount parts for other types of devices. In addition, a general-purpose winding transformer is placed to provide electrical isolation between the primary and secondary sides to realize a DC-DC converter board with a small footprint (160mm x 100mm) and a high efficiency (91%). The use of a winding transformer simplifies the use of the reference design as a basis for actual applications and makes it possible to configure a power supply circuit on various system boards instead of using an external power supply module.

2. Specifications

2.1. Specifications

Table 2.1 shows the input and output specifications of the 1.2V/100A DC-DC converter.

Table 2.1 Input and output characteristics of the 1.2V/100A DC-DC converter

Parameter	Condition	Min.	Typ.	Max.	Unit
Input characteristics					
Input voltage		40	54.5	59.5	V
Input current	Vin = 54.5 V, Iout = 100 A			2.8	A
Output characteristics					
Output voltage		1.18	1.2	1.22	V
Output current	Vin = 48V			100	A
Putput power	Vin = 48V			120	W
Ripple				10	mV
Switching frequency			302		kHz

2.2. Outline

Figure 2.1 shows the outline of the 1.2V/100A DC-DC converter.

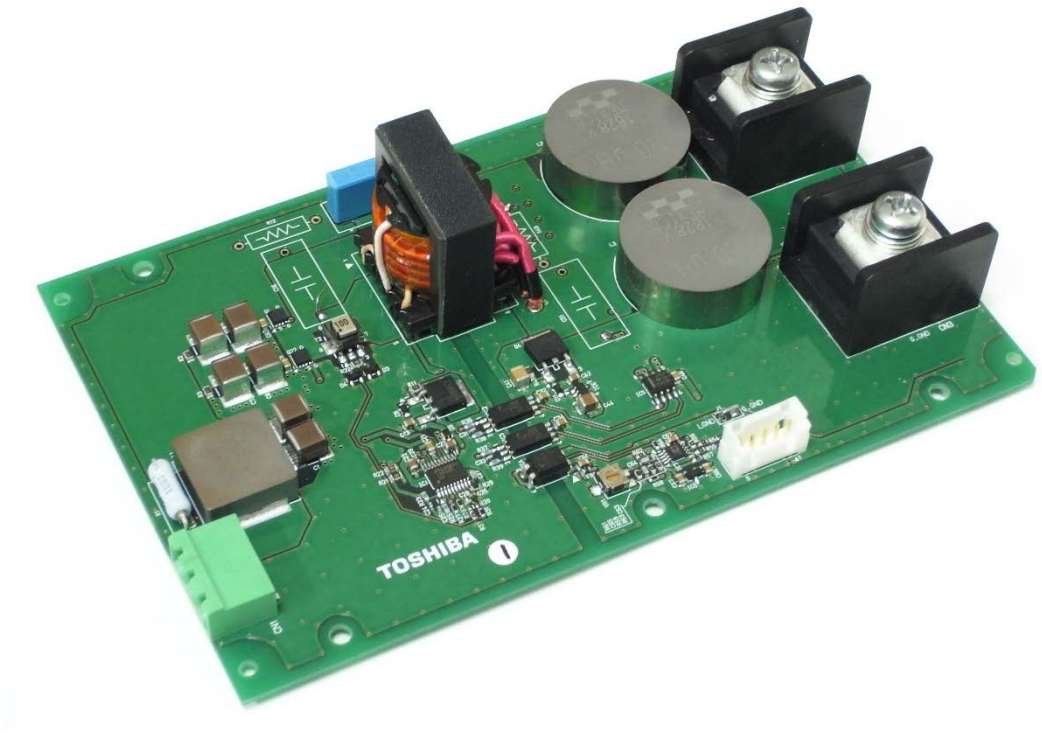

Figure 2.1 1.2V/100A isolated DC-DC converter

Dimensions: 160mm x 100mm x 30mm

2.3. Block diagram

Figure 2.2 shows a functional block diagram of the 1.2V/100A DC-DC converter.
See RD040-SCHEMATIC-01 for circuit drawings. See RD040-BOM-01 for a bill of materials.

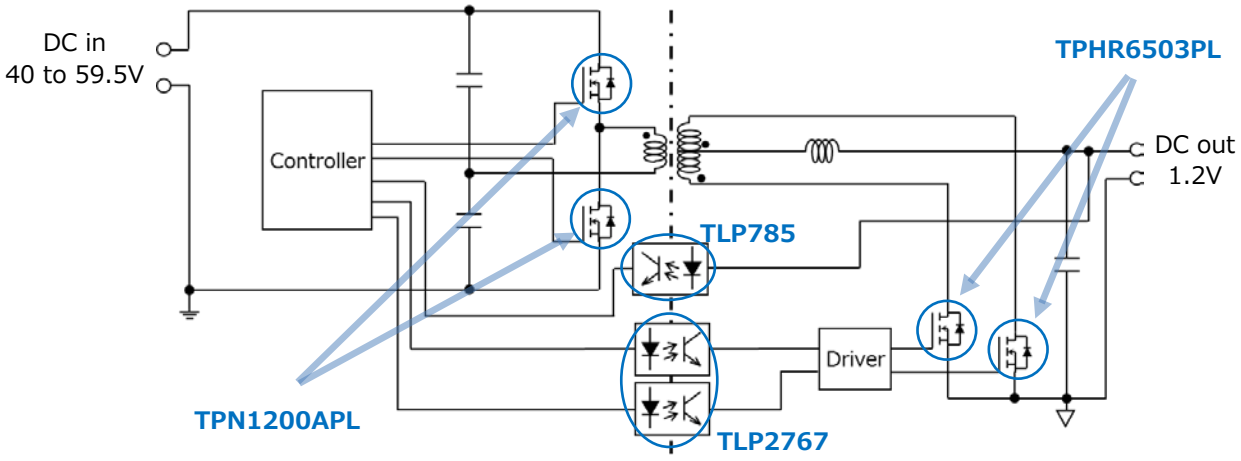

Figure 2.2 Block diagram

2.4. Components layout

Figure 2.3 and Figure 2.4 show the components layout on the printed circuit board (PCB).

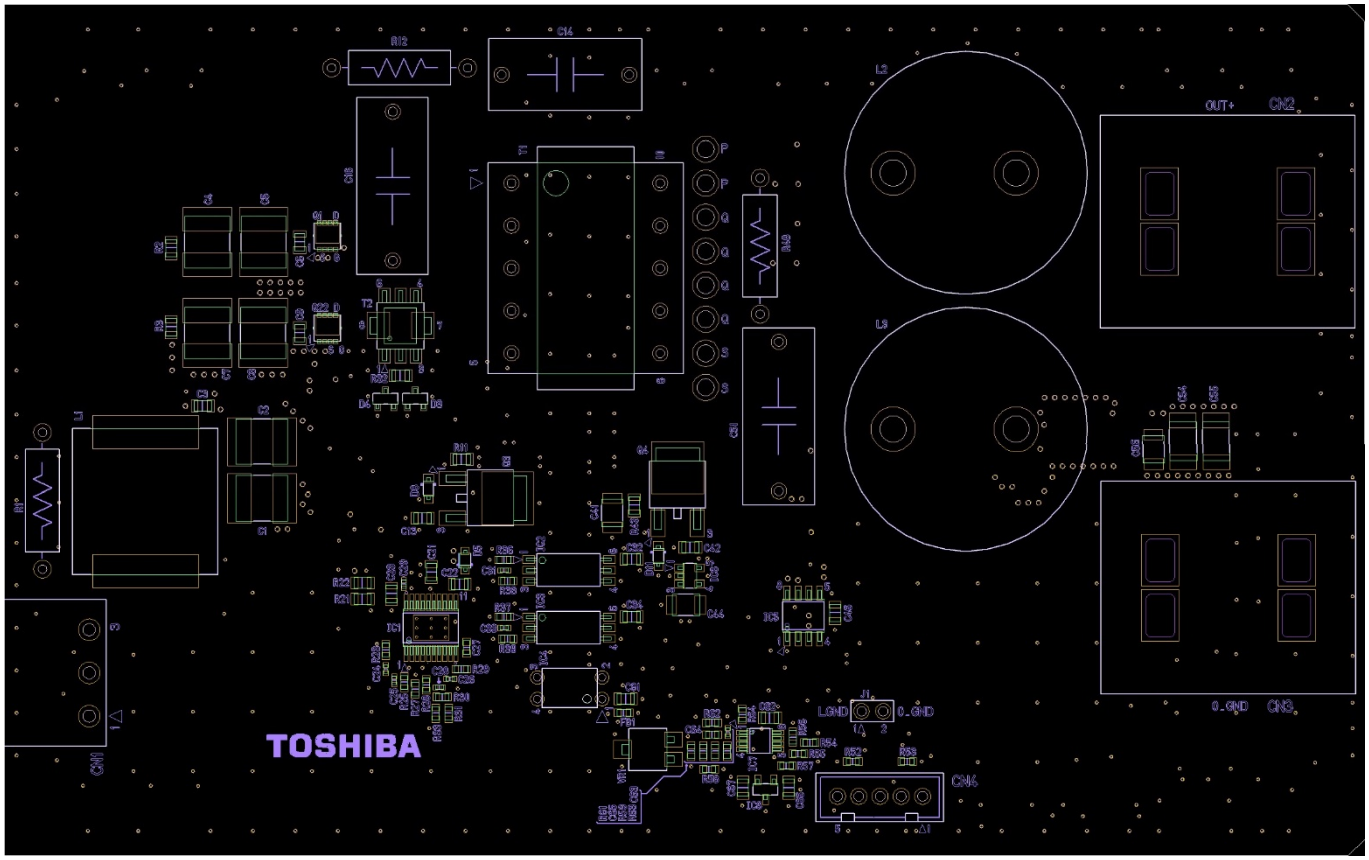

Figure 2.3 Components layout (Top side)

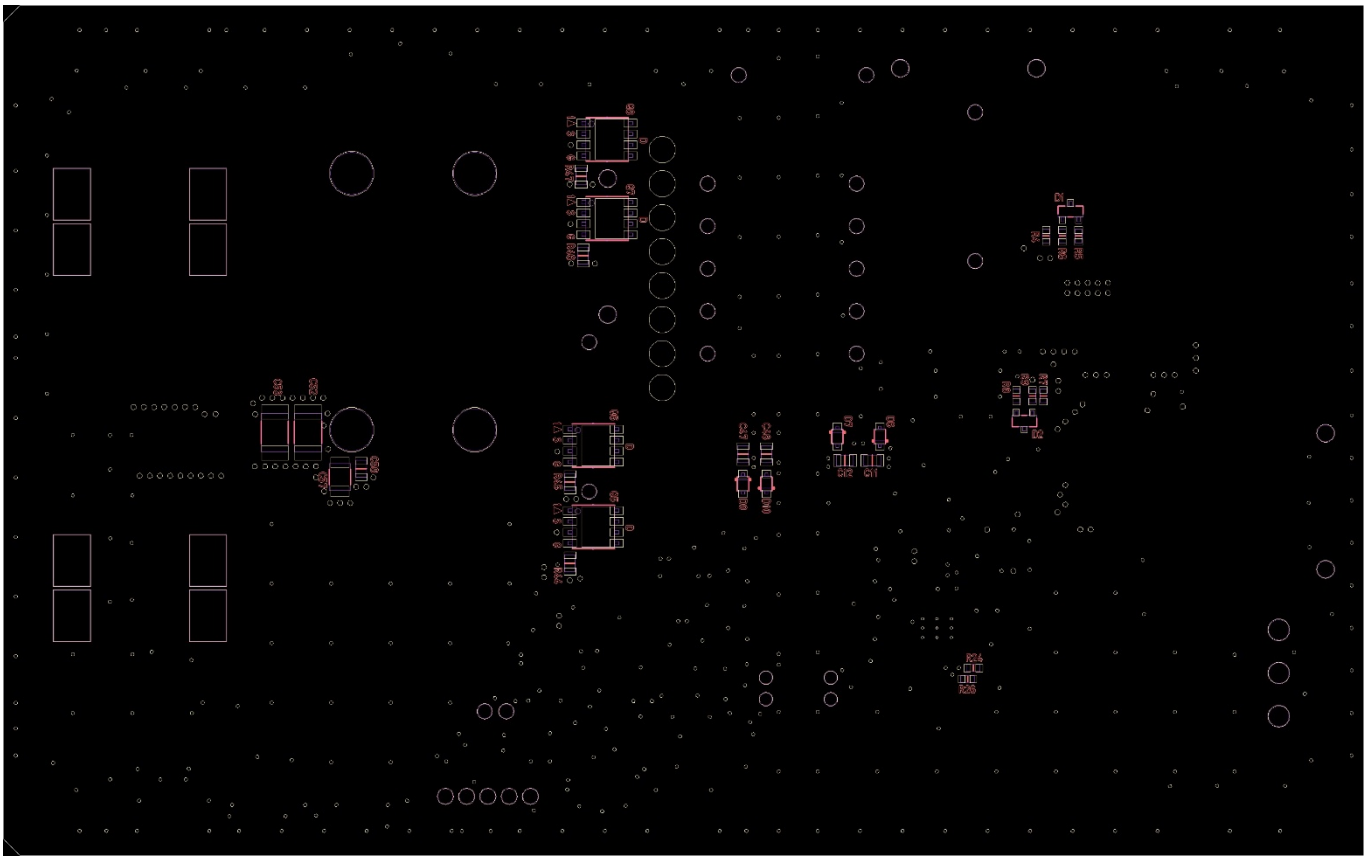

Figure 2.4　Components layout (Bottom side)

2.5. PCB layout

The PCB design files for the 1.2V/100A DC-DC converter are available in formats for various electronic design automation (EDA) tools. For details, refer to the PCB design file for your EDA tool.

Figure 2.5 shows the Layer 1 of the PCB of this converter.

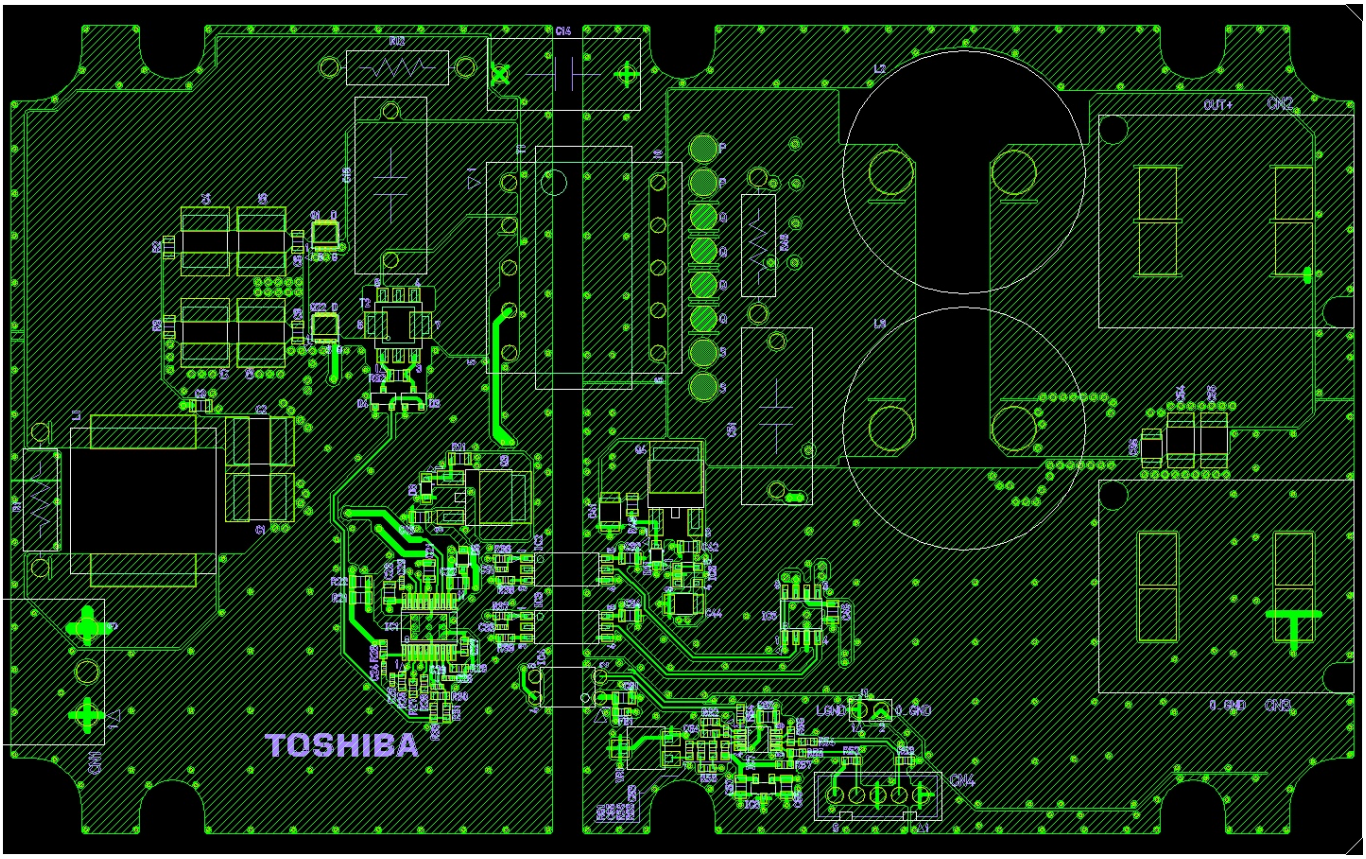

Figure 2.5 Layer 1

Figure 2.6 shows the Layer 2 of the PCB of this converter.

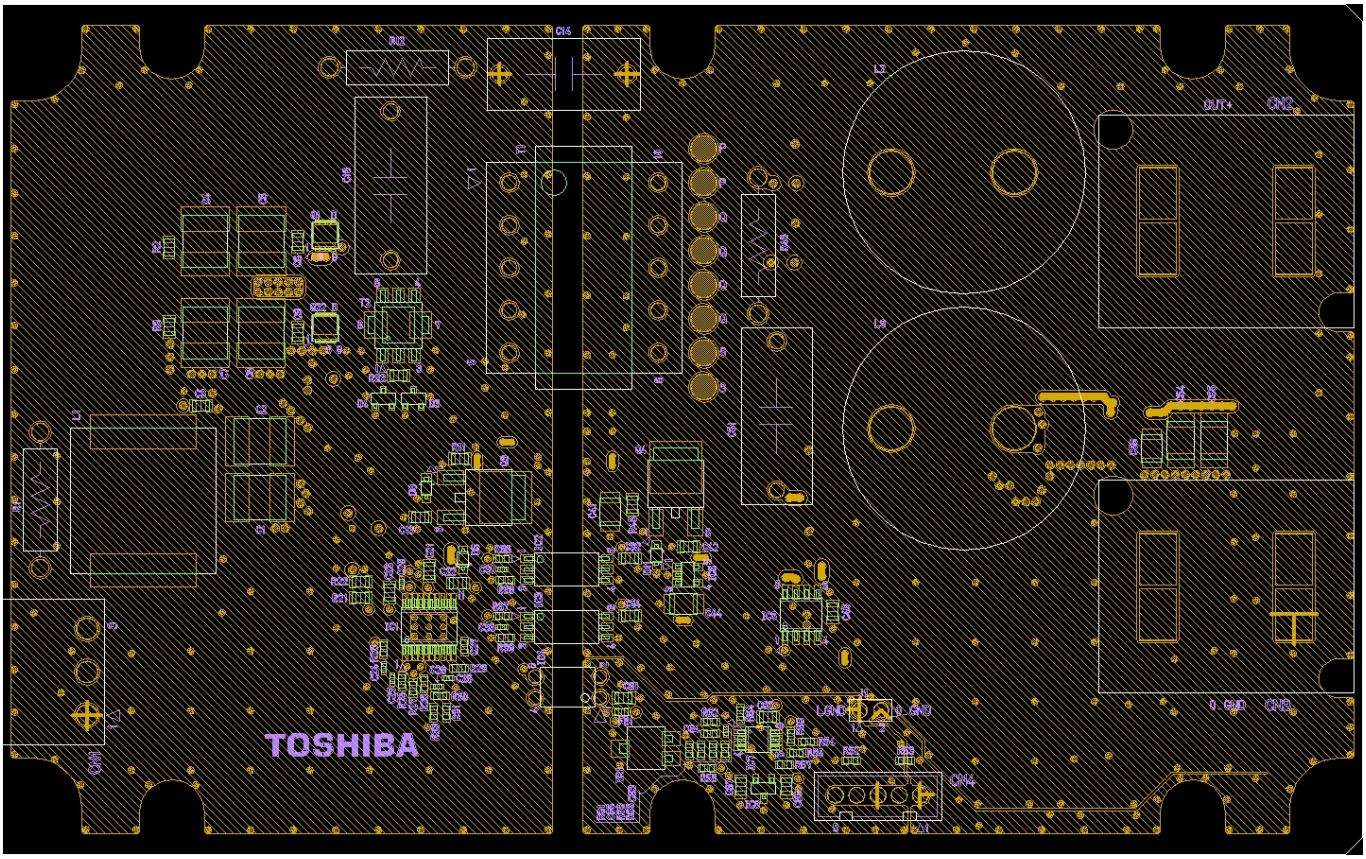

Figure 2.6 Layer 2

Figure 2.7 shows the Layer 3 of the PCB of this converter.

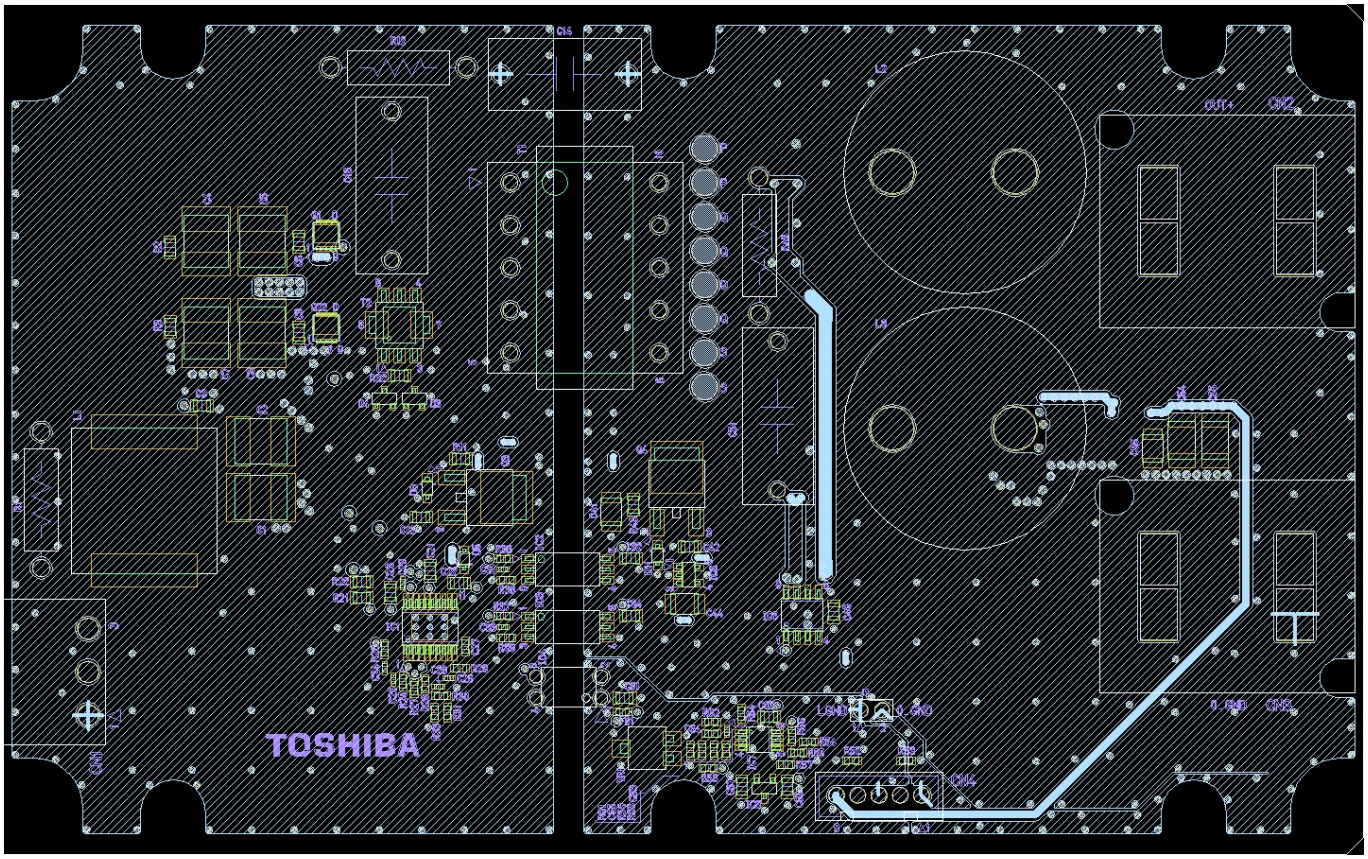

Figure 2.7 Layer 3

Figure 2.8 shows the Layer 4 of the PCB of this converter.

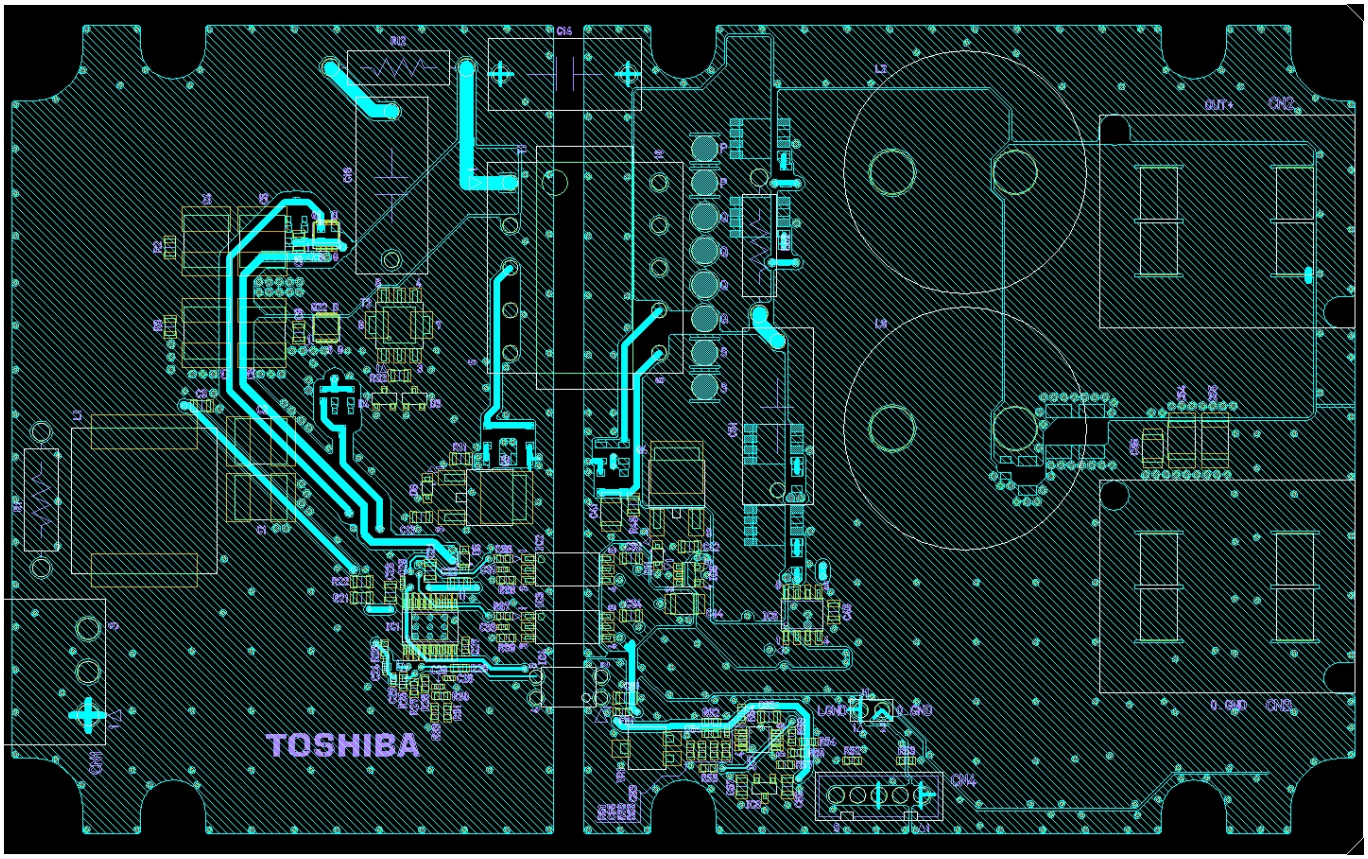

Figure 2.8　Layer 4

3. Operating procedure

This section describes the operating procedure of the 1.2V/100A DC-DC converter.

3.1. Connections with external equipment

Figure 3.1 shows the external pin assignments. Those enclosed in the red box are input pins. Connect the Input(+) and Input(-) pins directly to a regulated DC power supply. Use a power supply, cables, leads, and connectors compliant with Section 2.1, “Specification.” The pins enclosed in the blue box are output pins. Connect the Output(+) and Output(-) pins to a load system. Use a load system, cables, and connectors compliant with Section 2.1, “Specification.” The 1.2V/100A DC-DC converter supports the remote output voltage sensing function, which cancels out the effect of voltage drop caused by the trace resistance under heavy load by sensing the voltage at a position close to the load. To use this remote sensing function, connect the V+_SENSE and V-_SENSE pins to the power supply and GND lines close to the load, respectively. When the remote sensing function is not used, connect the V+_SENSE and V-_SENSE pins to the Output(+) and Output(-) pins, respectively. When the V+_SENSE and V-_SENSE pins are open, care should be exercised because the output voltage falls below the set voltage.

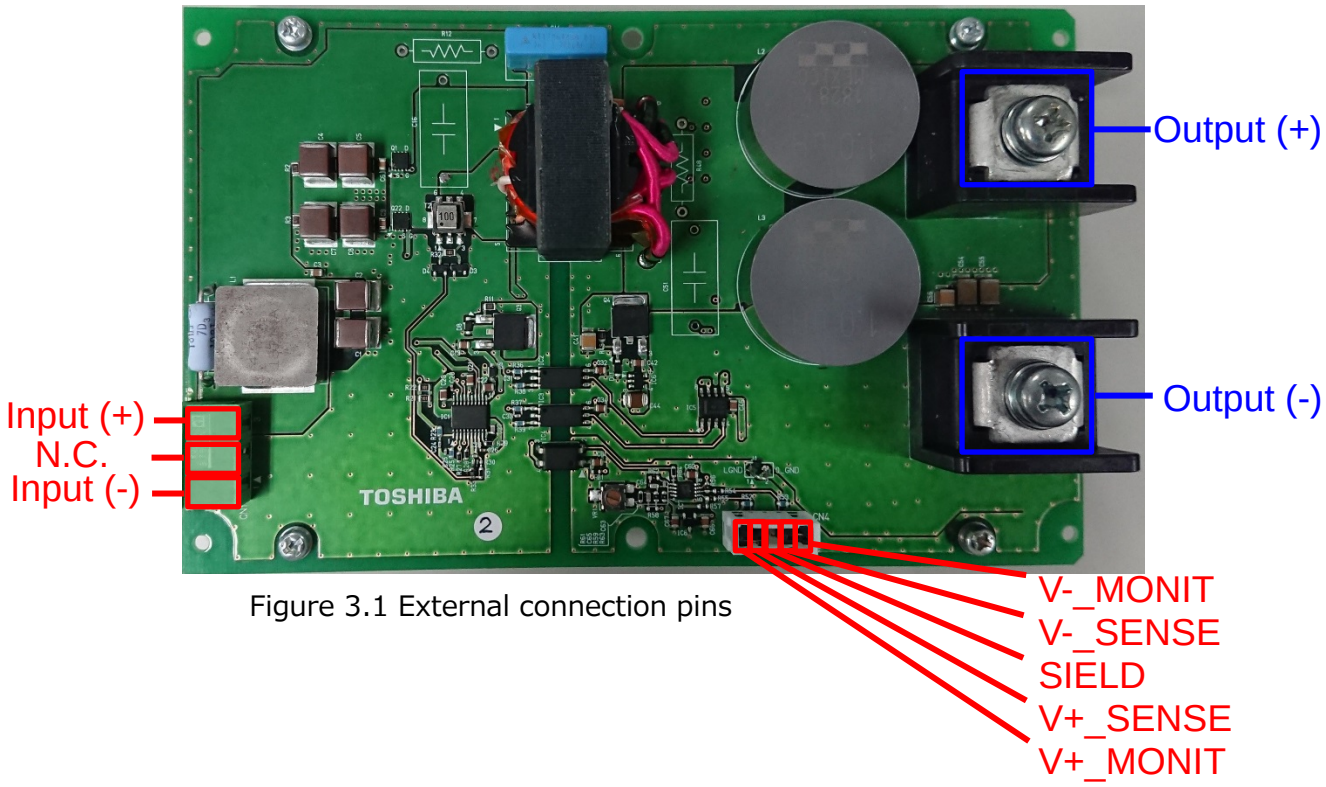

Figure 3.1 External connection pins

3.2. Enabling and disabling procedures

Before enabling the 1.2V/100A DC-DC converter, make sure that the following pins are at zero volt:

Input (+), Input (-), Output (+), Output (-), V+_SENSE, V-_SENSE

Enabling procedure: Apply voltage to the input pins from the external regulated DC power supply.
Disabling procedure: Disable the output of the external regulated DC power supply.

3.3. Precautions for evaluation (electric shock, burn injury, etc.)

Figure 3.2 shows the input and output sides of the 1.2V/100A DC-DC converter. This DC-DC converter has no node that is exposed to a dangerously high voltage (more than 60VDC). However, take extreme care when observing input waveforms. Even after the 1.2V/100A DC-DC converter is disabled, there is an electric shock hazard due to the residual charge on capacitors. Before touching the board, make sure that the voltages at each section of the board have sufficiently decreased.

The semiconductor devices, transformer, and other components generate heat, depending on the load current. In Figure 3.3, the components that generate much heat are highlighted in red boxes. This converter is designed to be used with forced air cooling. Use an air cooling device to ensure that the temperatures of these components remain below their rated maximum temperatures under high load operating condition. These components pose a risk of burns. Never touch any of them while this converter is active.

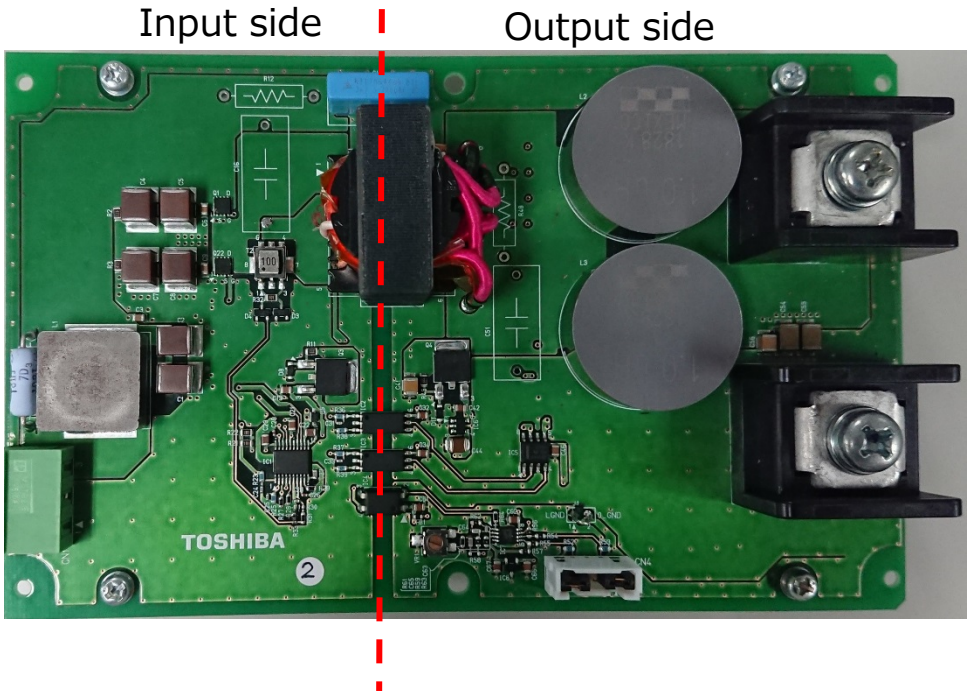

Figure 3.2 Input and output sides

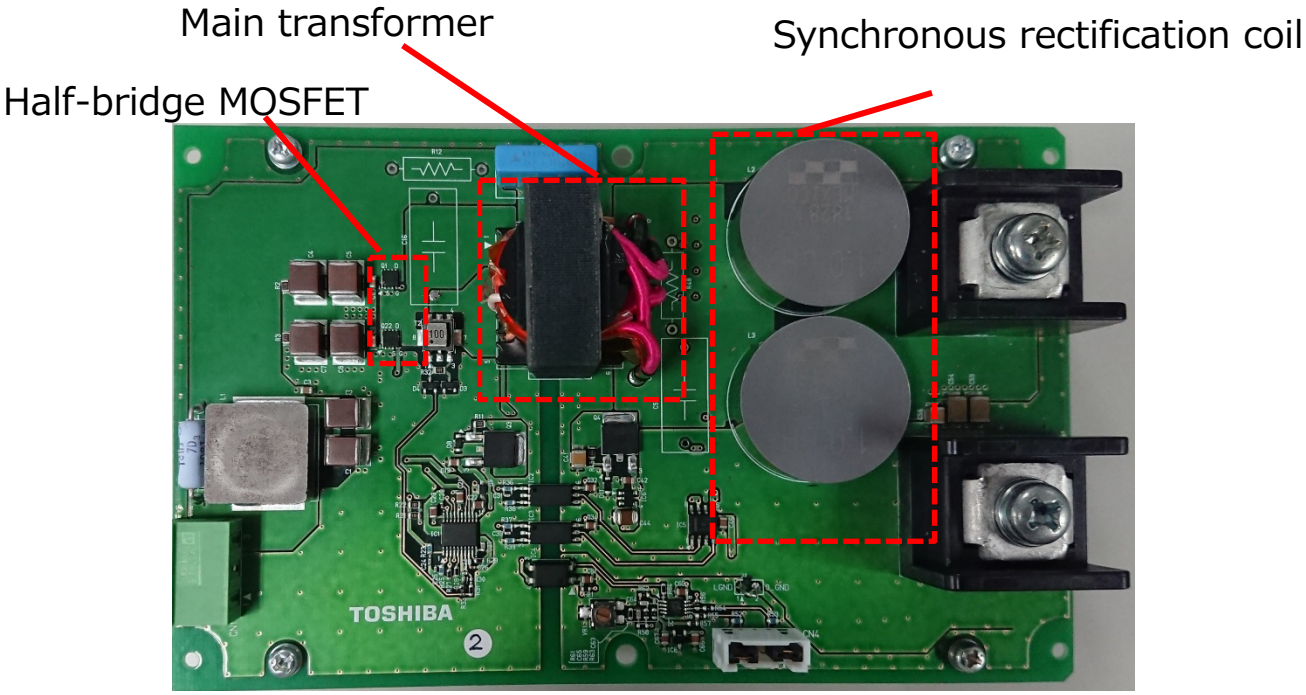

Figure 3.3 Components that generate much heat

4. Power supply characteristics

This section describes the results of efficiency measurements for the 1.2V/100A DC-DC converter.

4.1. Efficiency

Figure 4.1 shows the results of efficiency measurements for the 1.2V/100A DC-DC converter. It shows the efficiency measured when the input voltage of the DC-DC converter is 54.5V, and 59.5V.

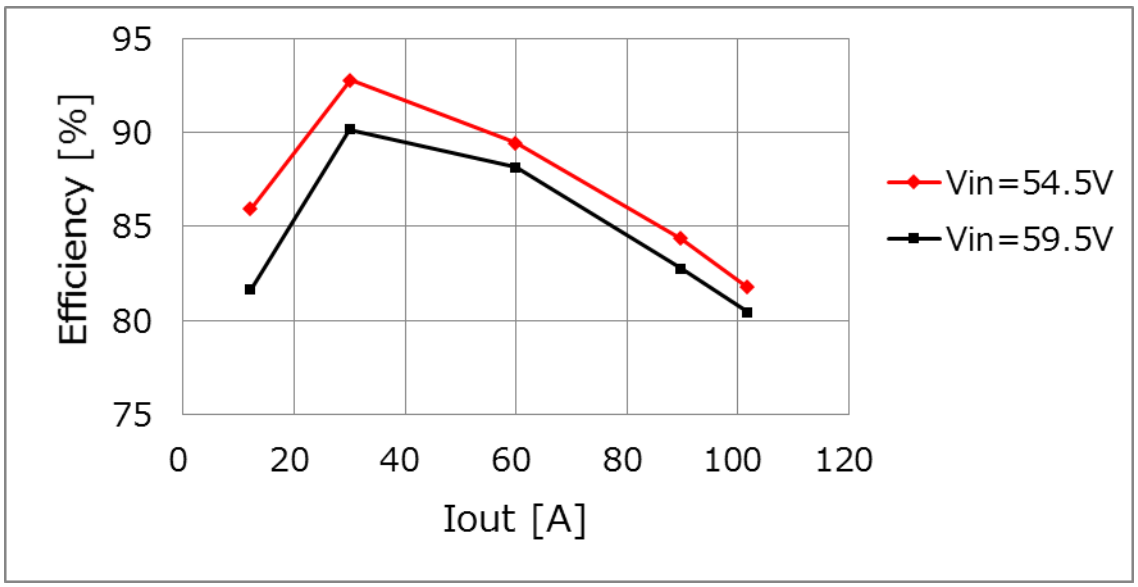

Figure 4.1 Efficiency measurement results (Vin=54.5V, Vin=59.5V)

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