# 300W Isolated DC-DC Converter

# Reference Guide

## RD024-RGUIDE-03

TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

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# 1. Introduction

This reference guide describes the specifications, operating procedure, and efficiency characteristics of a 300W isolated DC-DC converter. This converter operates over an input voltage range of 36 to 75VDC and provides 300W power at 12VDC output. This converter is suitable for various applications, including telecommunication equipment with 48VDC lines and industrial systems powered by 48V batteries. This reference design provides various design information, which help 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

This converter uses Toshiba's latest small surface-mount power MOSFETs as switching devices and small surface-mount components for other types of devices on both the primary and secondary sides. Consequently, despite the use of a general-purpose winding transformer, small PCB size (82mm x 82mm) and high efficiency (94%) are achieved. The winding transformer simplifies design as a basis for actual applications and helps to constitute a power supply circuit on PCB instead of using an external power supply module.

# 2. Specifications

## 2.1. Specifications

Table 2.1 shows the input and output specifications of the 300W isolated DC-DC converter.

**Table 2.1 Input and output specifications of the 300W isolated DC-DC converter**

| Parameter | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Input characteristics | | | | | |
| Input voltage | | 36 | | 75 | V |
| Input current | Vin = 48V, Iout = 25A | | | 12 | A |
| | | | | | |
| Output characteristics | | | | | |
| Output voltage | | 11.4 | 12.0 | 12.6 | V |
| Output current | | | | 25 | A |
| Output power | | | | 300 | W |
| Output ripple voltage | | | | 200 | mV |
| Switching frequency | | | 185 | | kHz |

## 2.2. Outline

Figure 2.1 shows the outline of the 300W isolated DC-DC converter.

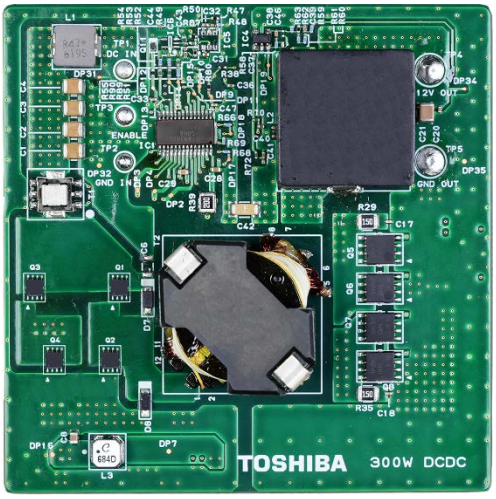


**Figure 2.1 300W isolated DC-DC converter**

Dimensions: 82mm x 82mm x 24mm

## 2.3. Block diagram

Figure 2.2 shows the block diagram of the 300W isolated DC-DC converter.
Refer to RD024-SCHEMATIC-01 for circuit diagrams and RD024-BOM-01 for a bill of materials.

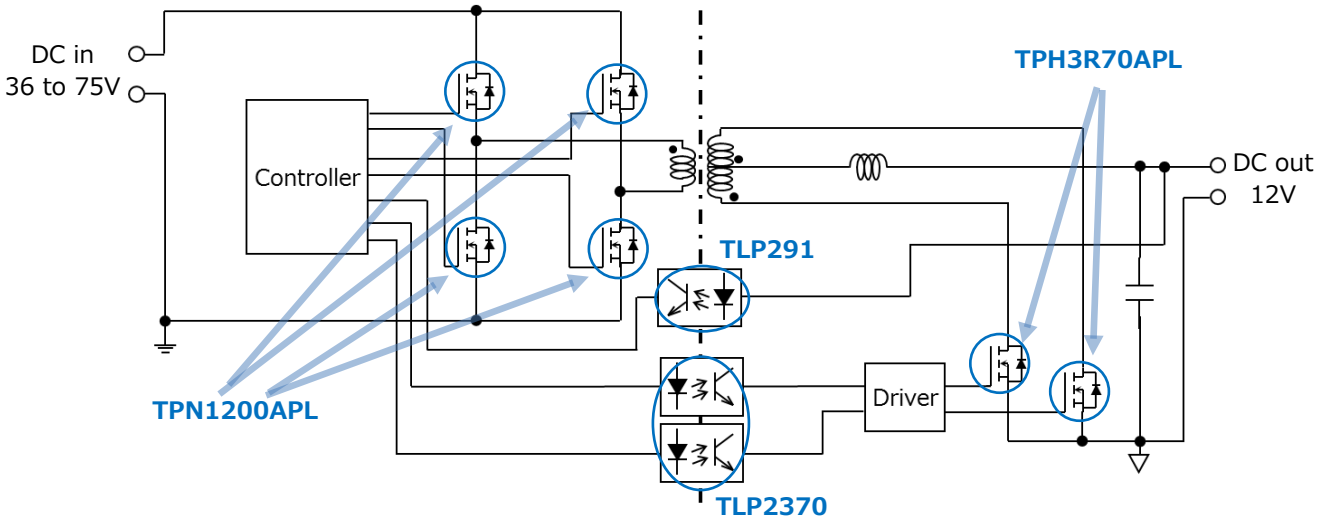


**Figure 2.2 Block diagram**

## 2.4. Components layout

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

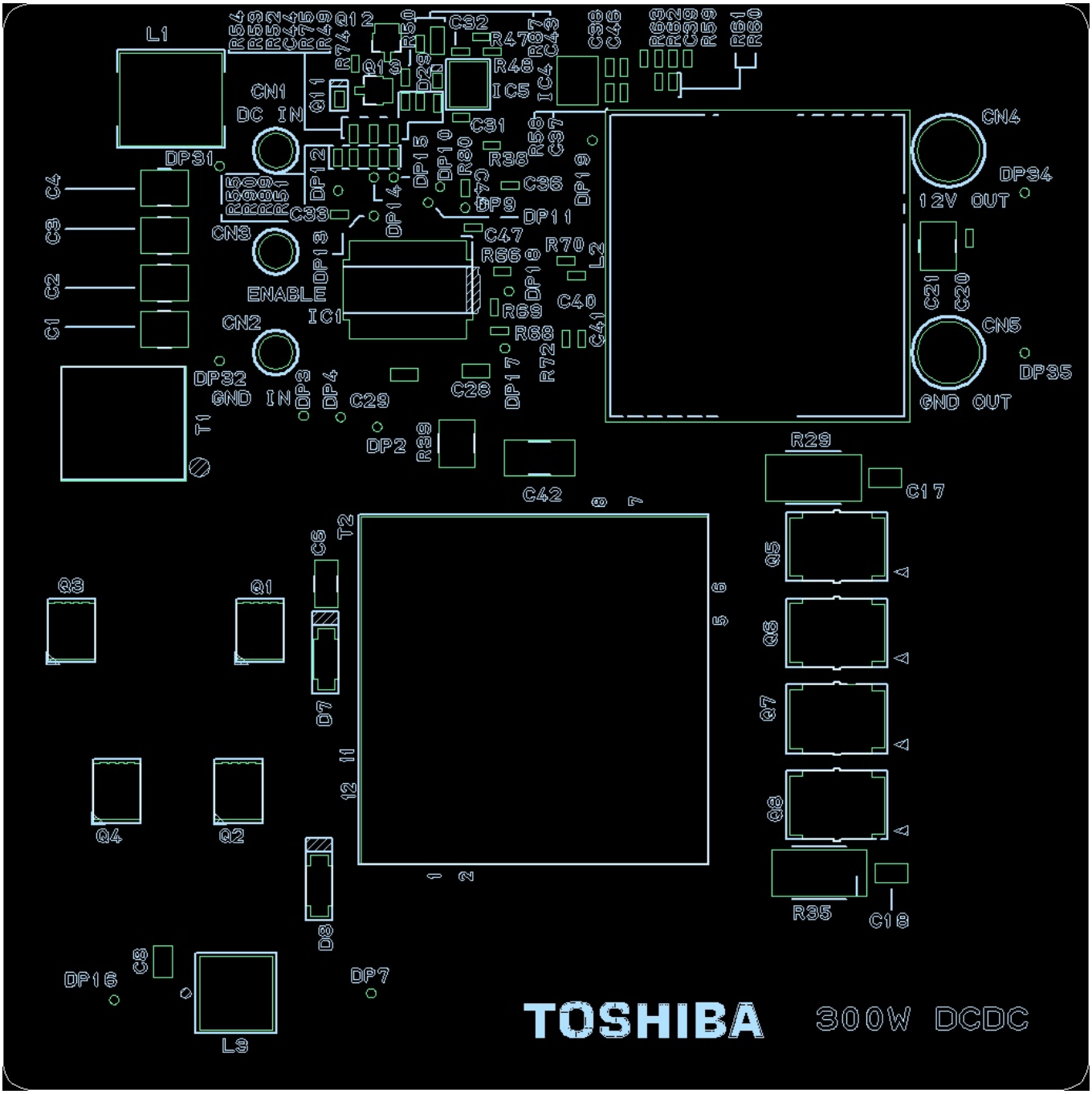


**Figure 2.3 Components layout (Top surface of the PCB)**

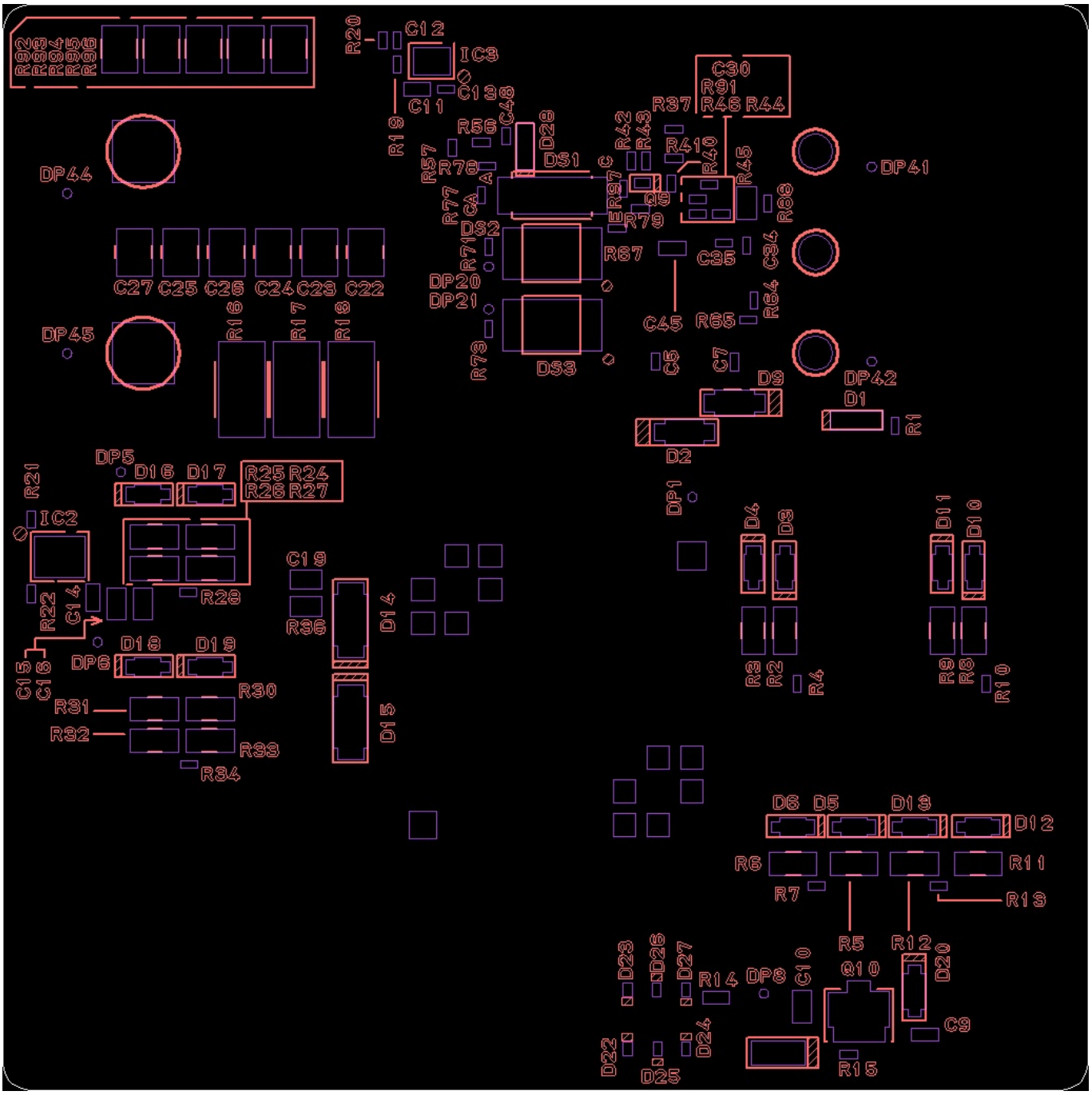


**Figure 2.4 Components layout (Bottom surface of the PCB)**

## 2.5. PCB traces

The PCB design files for the 300W isolated 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.

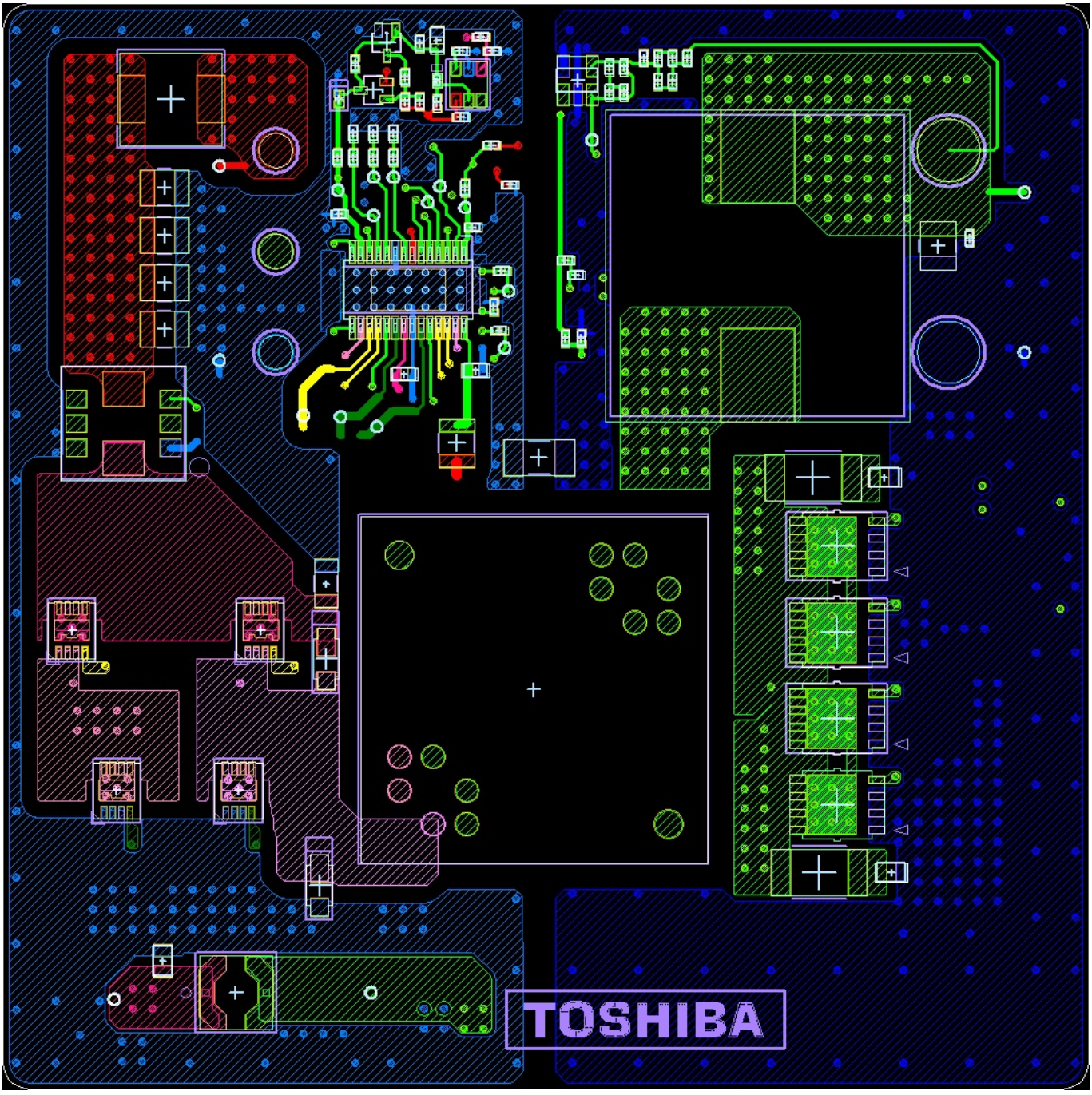


**Figure 2.5 Layer 1**

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

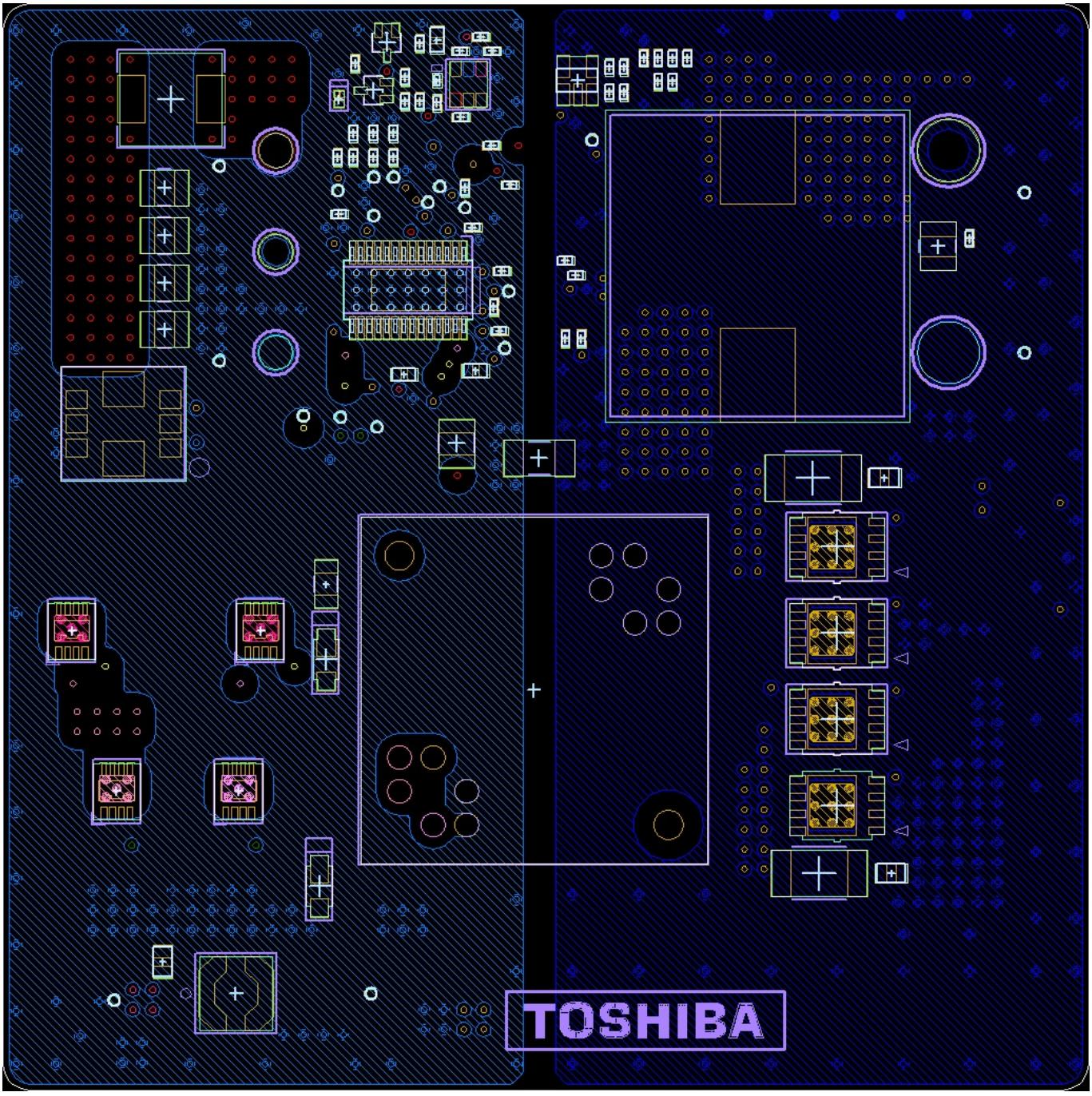


**Figure 2.6 Layer 2**

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

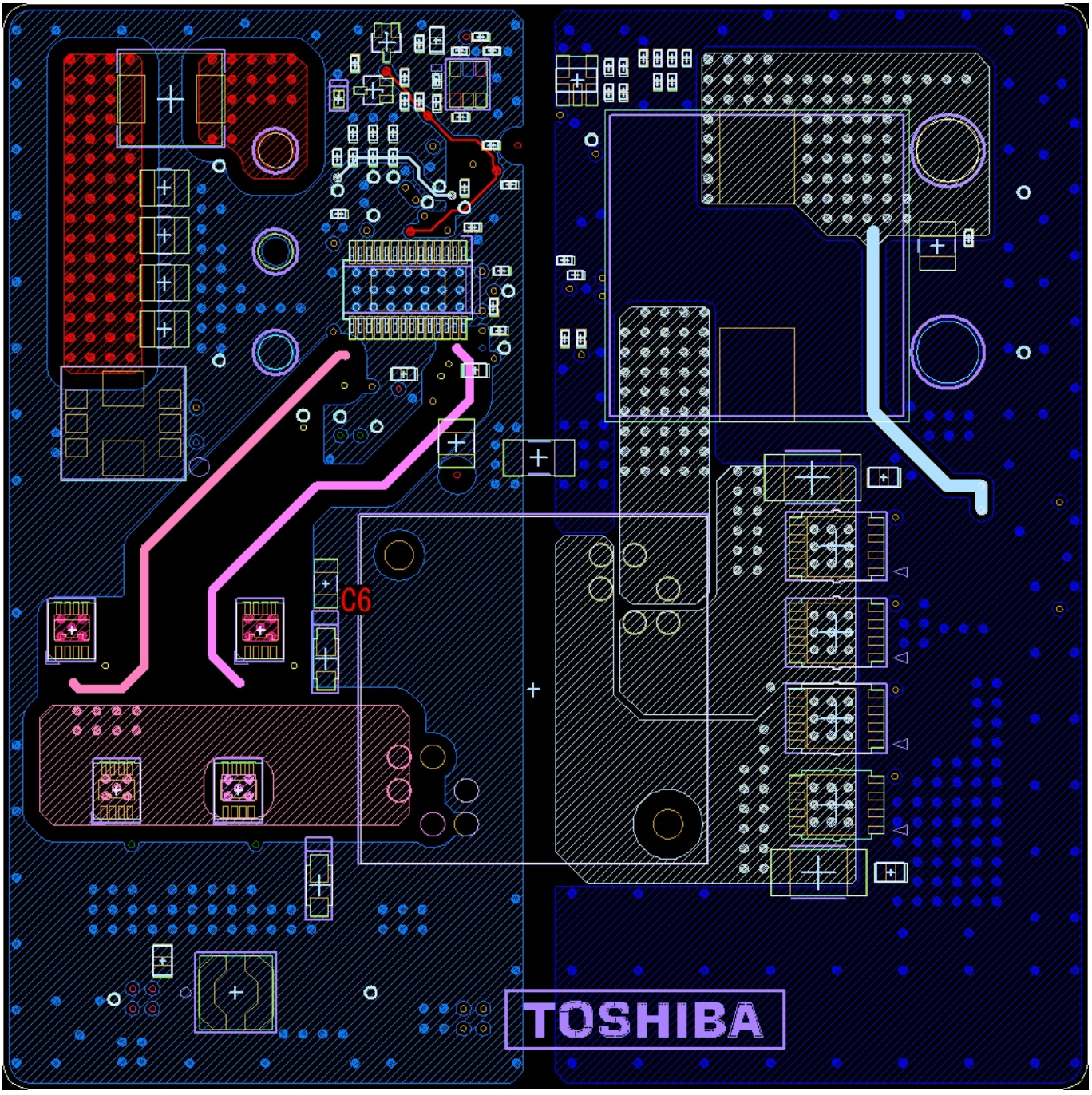


**Figure 2.7 Layer 3**

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

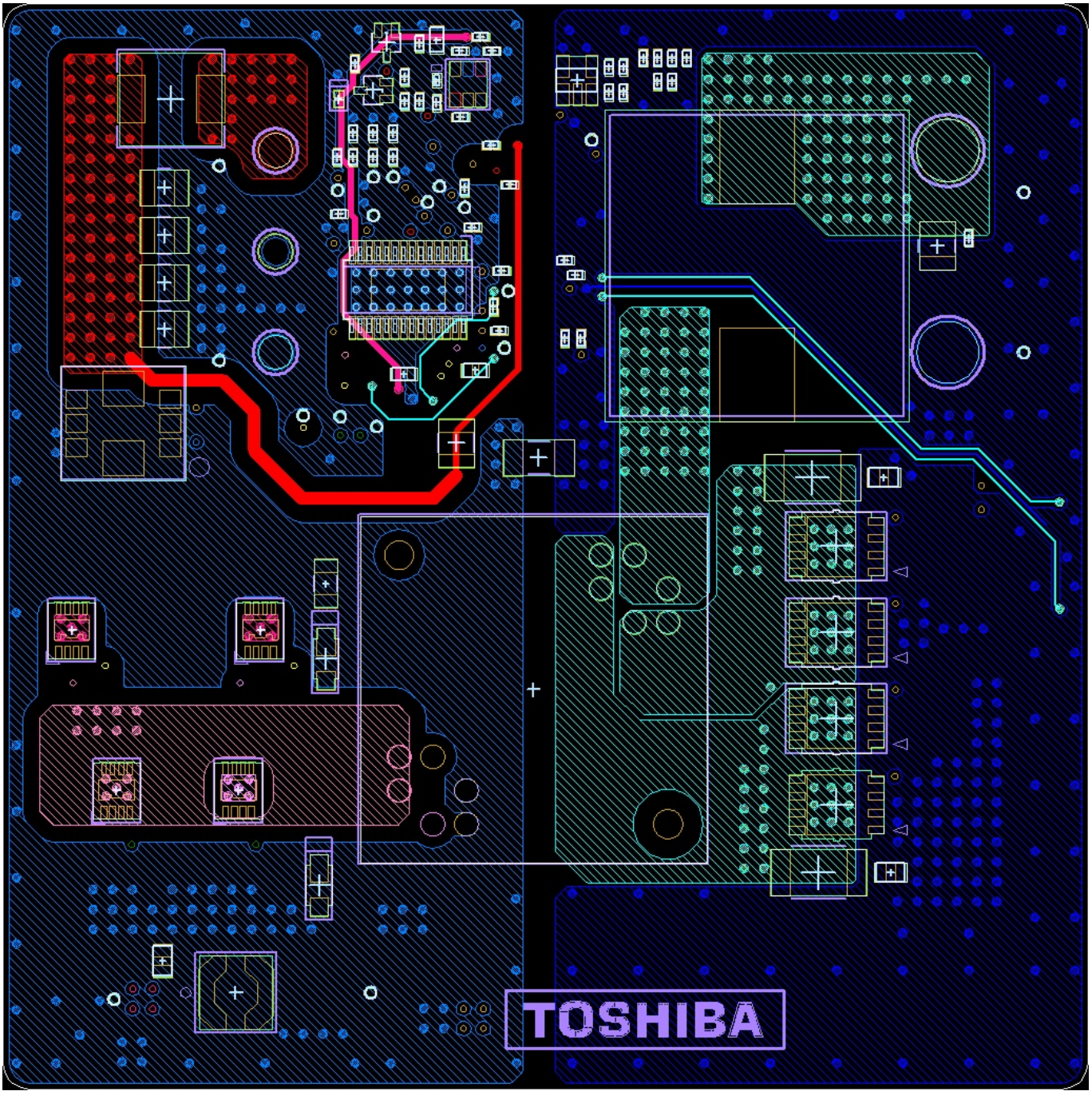


**Figure 2.8 Layer 4**

Figure 2.9 shows the Layer 5 of the PCB of this converter.

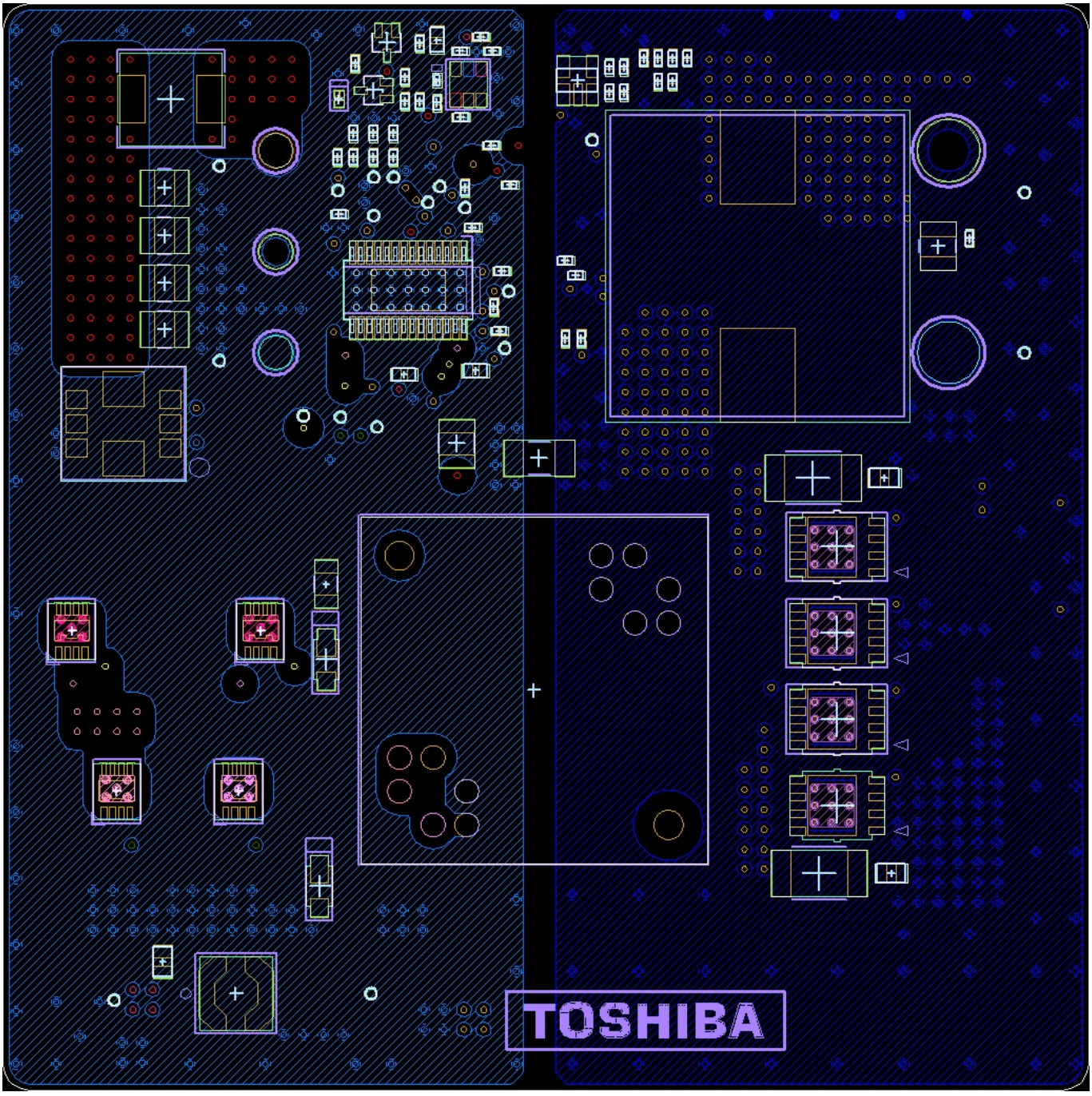


**Figure 2.9 Layer 5**

Figure 2.10 shows the Layer 6 of the PCB of this converter.

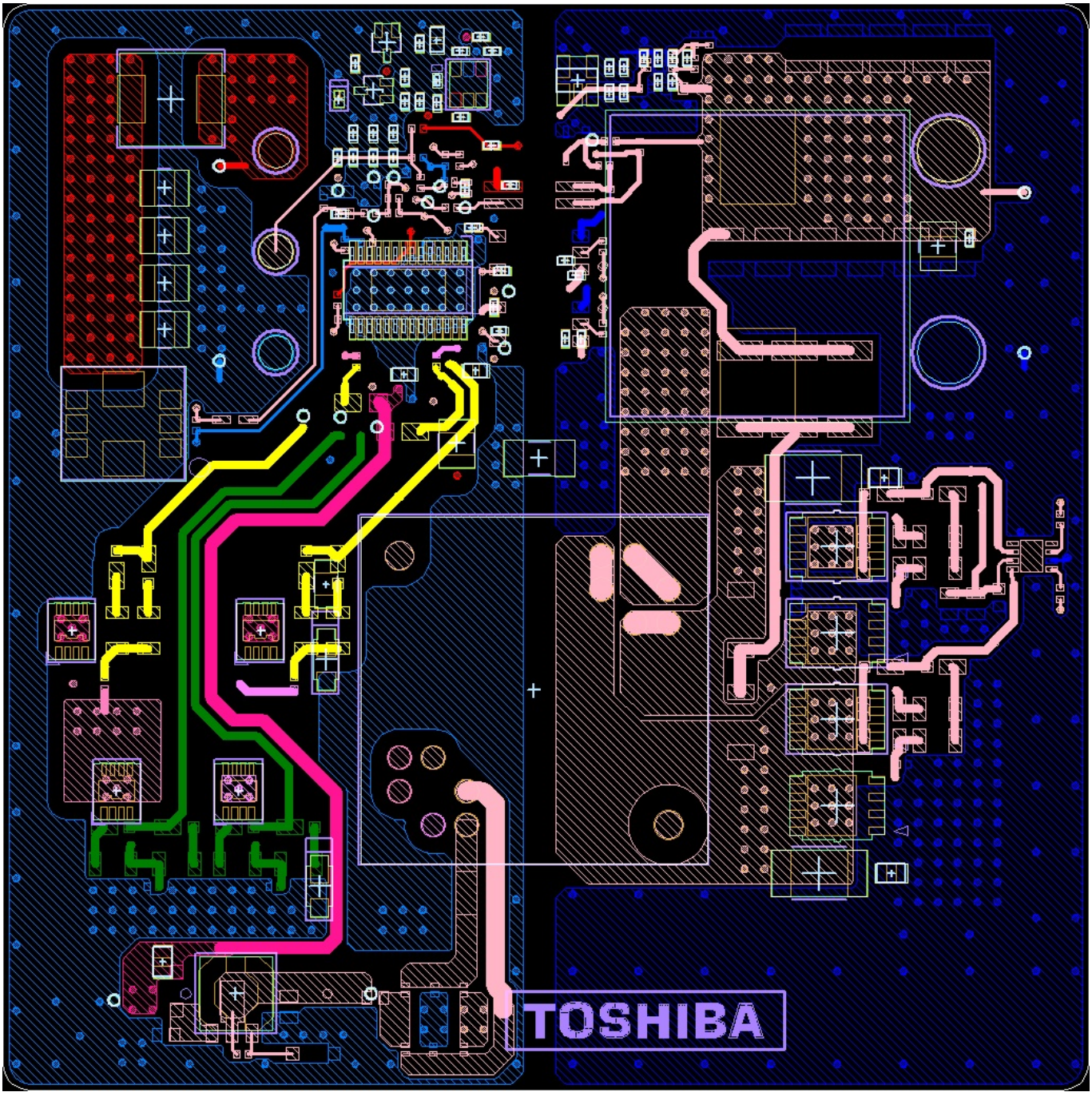


**Figure 2.10 Layer 6**

# 3. Operating procedure

This section describes the operating procedure of the 300W isolated DC-DC converter.

## 3.1. Connections with external equipment

Figure 3.1 shows the external connection pins.

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 meet the specification shown in Section 2.1. The Enable pin controls the operating state of this converter. To disable the converter, open the Enable pin. To enable the converter, short the Enable pin to the Input(-) pin. The pins enclosed in the blue box are output pins. Connect the Output(+) and Output(-) pins to a load equipment. Use a load equipment, cables, and connectors meet the specification shown in Section 2.1.

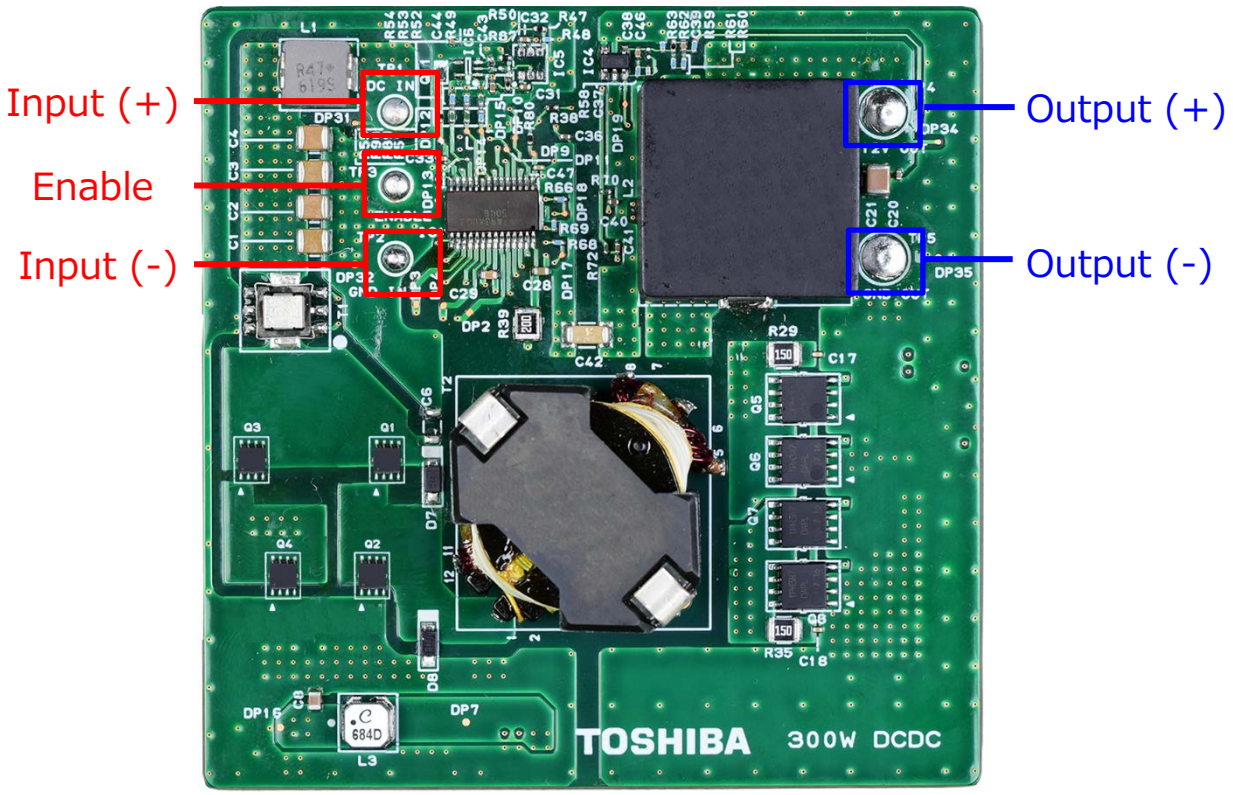


**Figure 3.1 External connection pins**

## 3.2. Enabling and disabling procedures

Before enabling the 300W isolated DC-DC converter, make sure that the following pins are at zero volt:
Input(+), Input(-), Output(+), Output(-)

Enabling procedure: Ensure an interval of more than 500ms between the following steps.

1. Apply the output of an external regulated DC power supply to the Input(+) and Input(-) pins.
2. Connect the Enable pin to the GND pin.

Disabling procedure: Ensure an interval of more than 500ms between the following steps.

1. Open the Enable pin.
2. Disable the output of the external regulated DC power supply.

Table 3.1 shows the connections of the Enable pin versus the operating states.

**Table 3.1 Connections of the Enable pin**

| Connection of the Enable pin | Operating state |
|---|---|
| GND | Enabled |
| Open | Disabled |

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

Figure 3.2 shows the input and output sides of the 300W isolated DC-DC converter. The input side may have a high voltage (more than 60V DC). Take extreme care when observing input waveforms. Even after this converter is disabled, there is an electric shock hazard due to the residual charge of the capacitors. Make sure that the voltages at each section of the board is low enough before touching the board.

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.

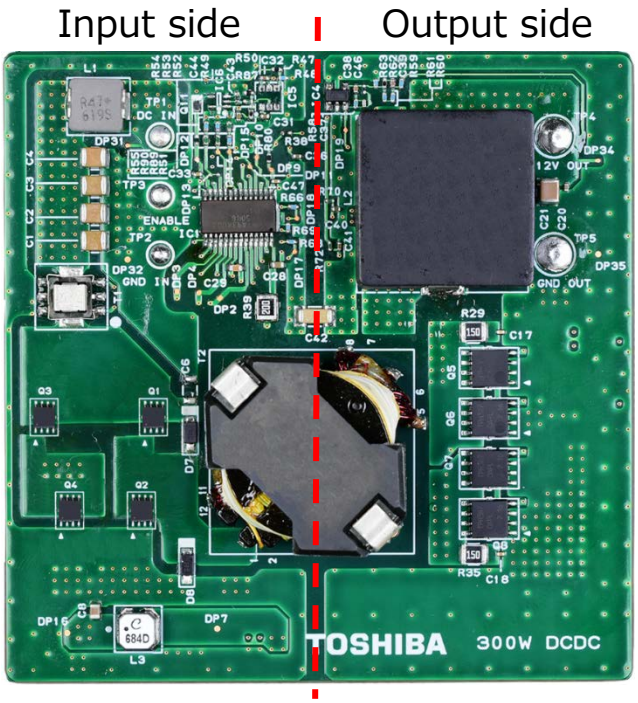


**Figure 3.2 Input and output sides**

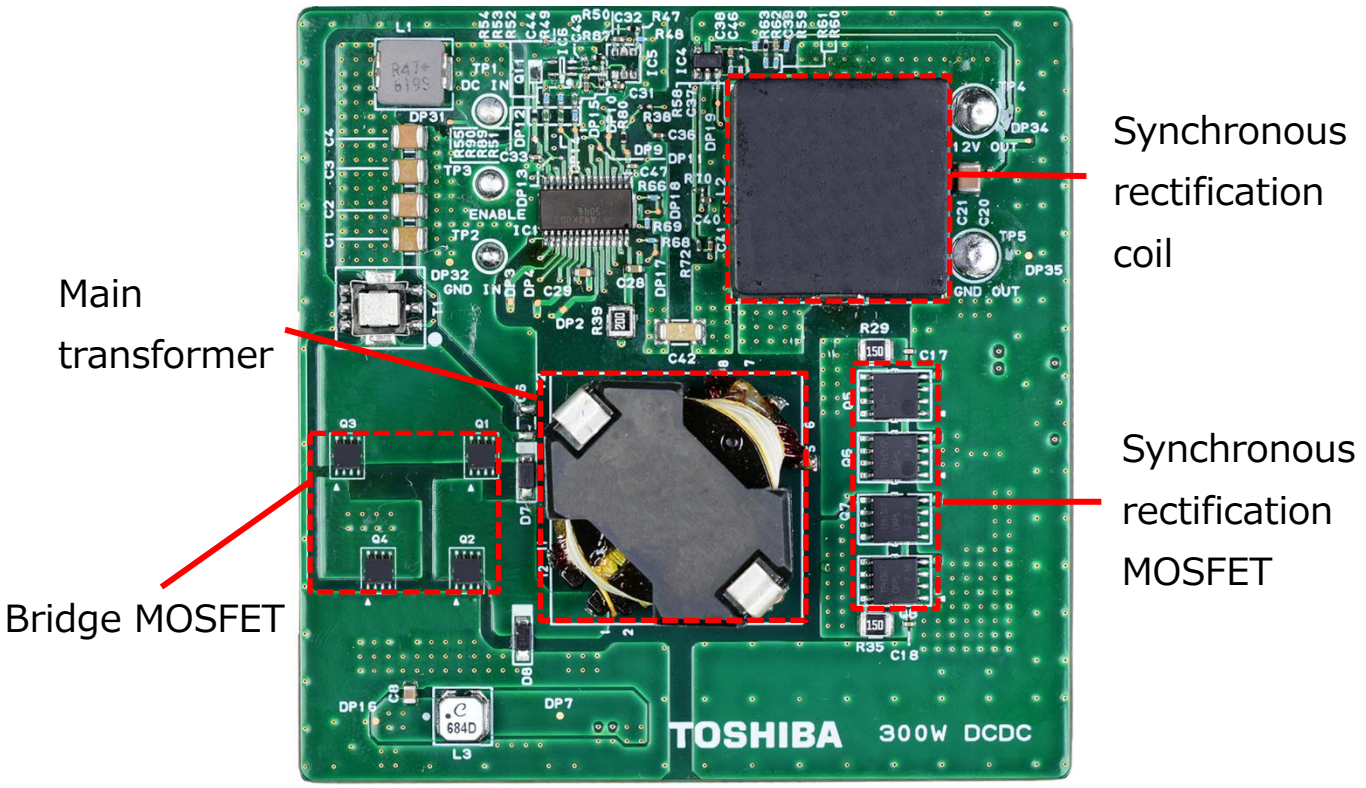


**Figure 3.3 Components that generate much heat**

# 4. Power supply characteristics

This section describes the results of efficiency measurements for the 300W isolated DC-DC converter.

## 4.1. Efficiency

Figure 4.1 shows the results of efficiency measurements for the 300W isolated DC-DC converter. It shows the efficiency measured when the input voltage of the 300W isolated DC-DC converter is 36V, 48V, and 75V.

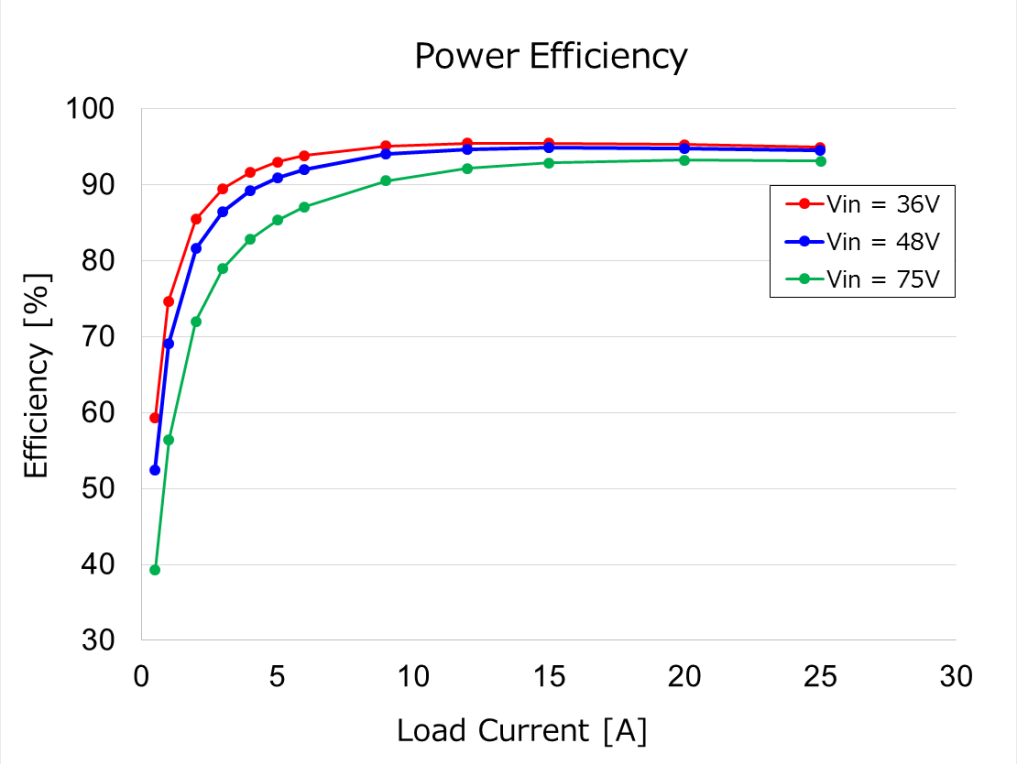


**Figure 4.1 Efficiency measurement results (when Vin=36V, Vin=48V, and Vin=75V)**

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