Non-Isolated Buck DC-DC Converter

Reference Guide

RD205-RGUIDE-01

TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

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1. Introduction

This reference guide describes the specifications, use, and various properties of the Non-Isolated Buck DC-DC Converter (hereafter referred to as this power supply). This reference design consists of 24 types of DC-DC converter designs in total. All take DC12 V as inputs and generate 8 different outputs which are DC 5 V/5 A, DC 5 V/8 A, DC 5 V/12 A, DC 3.3 V/10 A, DC 3.3 V/13.3 A, DC 3.3 V/18.2 A, DC 1.5 V/10 A, DC 1.05 V/10 A, and each one further optimized in 3 ways, i.e. for: 50 % load efficiency, 100 % load efficiency, and area. Since small components are selected, they can be applied to Point of Load power supplies of various sizes and applications. Our power MOSFETs are used as switching elements, which allows high-speed switching and high-efficiency.

2. Specifications

This section lists the electrical specifications and main components of all 24 types of this power supply.

2.1. Electrical Specifications Overview

Table 2.1 shows the schematic I/O characteristic specifications of all 24 types of this power supply, and Fig. 2.1 shows the block diagram of all 24 types of this power supply.

Table 2.1 Specifications of all 24 Types of Non-Isolated Buck DC-DC Converters

Parameters	Condition	5.0 V/ 5.0 A	5.0 V/ 8.0 A	5.0 V/ 12 A	3.3 V/ 10 A	3.3 V/ 13.3 A	3.3 V/ 18.2 A	1.5 V/ 10 A	1.05 V /10 A	Unit
Dc Input Voltage		12.0±5 %								V
Output Voltage And Accuracy		5.0±5 %			3.3±5 %			1.5 ±5 %	1.05± 2 %	V
Output Current (Maximum Value)		5.0	8.0	12.0	10.0	13.3	18.2	10.0	10.0	A
Output Power (Maximum Value)		25.0	40.0	60.0	33.0	43.9	60.1	15.0	10.5	W
Output Ripple Voltage	Ta = 25 ℃	Less than 300.0			Less than 200.0			Less than 90.0	Less than 20.0	mV

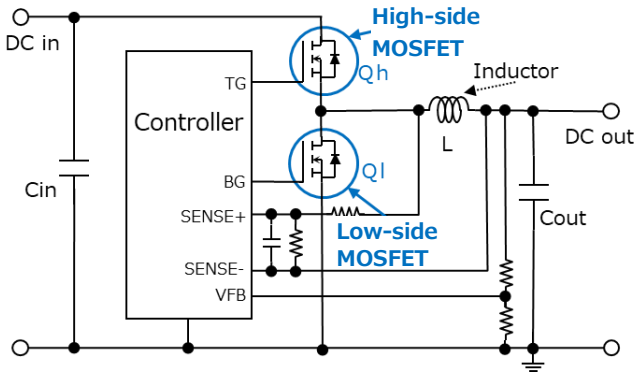

Fig. 2.1 Block Diagram of All 24 Types of Non-Isolated Buck DC-DC Converters

The electrical specifications and main components of all 24 types of this power supply are shown for each of the eight output ratings in the following sections.

2.2. 5.0 V/5.0 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 5.0 V/5.0 A output DC-DC converter which are optimized for 100 % load efficiency, 50 % load efficiency and area.

Table 2.2 5.0 V/5.0 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 100 % Load	Circuit Optimized for Efficiency at 5 0% Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		5.0±5 %			V
Output Current (Maximum Value)		5.0			A
Output Power (Maximum Value)		25.0			W
Output Ripple Voltage	Ta=25 ℃	Below 300.0			mV
Overcurrent Protection setting (Average)		11.11		7.32	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH11003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=12.6 mΩ $Q_{g(Typ)}$=3.3 nC SOP Advance Package		TPN11003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=12.6 mΩ $Q_{g(Typ)}$=3.3 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPH8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC SOP Advance Package	TPH11003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=12.6 mΩ $Q_{g(Typ)}$=3.3 nC SOP Advance Package	TPN8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	74439370068 (Würth Elektronik) L=6.8 μH $I_{R(Max)}$=15 A $R_{DC(Typ)}$=4.1 mΩ 15.4 mm×16.4 mm		744314200 (Würth Elektronik) L=2.0 μH $I_{R(Max)}$=11.5 A $R_{DC(Typ)}$=5.85 mΩ 6.9 mm×6.9 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		230 μF (220 μF/6.3 V/3216 size/Ceramic)×1 (10 μF/6.3 V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

2.3. 5.0 V/8.0 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 5.0 V/8.0 A output DC-DC converter which are optimized for 100 % load efficiency, 50 % load efficiency and area.

Table 2.3 5.0 V/8.0 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 100 % Load	Circuit Optimized for Efficiency at 50 % Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		5.0±5 %			V
Output Current (Maximum Value)		8.0			A
Output Power (Maximum Value)		40.0			W
Output Ripple Voltage	Ta=25 ℃	Below 300.0			mV
Overcurrent Protection setting (Average)		12.47		9.89	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH4R003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=4.9 mΩ $Q_{g(Typ)}$=6.8 nC SOP Advance Package	TPH8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC SOP Advance Package	TPN8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPH2R903PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=3.0 mΩ $Q_{g(Typ)}$=12.0 nC SOP Advance Package	TPH4R803PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=4.7 mΩ $Q_{g(Typ)}$=10.0 nC SOP Advance Package	TPN5R203PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=4.9 mΩ $Q_{g(Typ)}$=10.0 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	74439369033 (Würth Elektronik) L=3.3 μH $I_{R(Max)}$=15 A $R_{DC(Typ)}$=3.4 mΩ 10.5 mm×11.6 mm		7443340150 (Würth Elektronik) L=1.5 μH $I_{R(Max)}$=16.5 A $R_{DC(Typ)}$=5.3 mΩ 8.4 mm×7.9 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		230 μF (220 μF/6.3 V/3216 size/Ceramic)×1 (10 μF/6.3 V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

2.4. 5.0 V/12.0 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 5.0 V/12.0 A output DC-DC converter which are optimized for 100 % load efficiency, 50% load efficiency and area.

Table 2.4 5.0 V/12.0 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 100% Load	Circuit Optimized for Efficiency at 50% Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		5.0±5 %			V
Output Current (Maximum Value)		12.0			A
Output Power (Maximum Value)		60.0			W
Output Ripple Voltage	Ta=25 ℃	Below 300.0			mV
Overcurrent Protection setting (Average)		16.15		18.61	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH4R003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=4.9 mΩ $Q_{g(Typ)}$=6.8 nC SOP Advance Package		TPN4R303NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=5.1 mΩ $Q_{g(Typ)}$=6.8 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPH2R003PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=1.7 mΩ $Q_{g(Typ)}$=41.0 nC SOP Advance Package	TPH4R803PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=4.7 mΩ $Q_{g(Typ)}$=10.0 nC SOP Advance Package	TPN2R903PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=3.0 mΩ $Q_{g(Typ)}$=12.0 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	74439369033 (Würth Elektronik) L=3.3 μH $I_{R(Max)}$=15 A $R_{DC(Typ)}$=3.4 mΩ 10.5 mm×11.6 mm		7443340100 (Würth Elektronik) L=1.0 μH $I_{R(Max)}$=17 A $R_{DC(Typ)}$=3.6 mΩ 8.4 mm×7.9 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		230 μF (220 μF/6.3 V/3216 size/Ceramic)×1 (10 μF/6.3 V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

2.5. 3.3 V/10.0 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 3.3 V/10.0 A output DC-DC converter which are optimized for 100 % load efficiency, 50 % load efficiency and area.

Table 2.5 3.3 V/10.0 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 100 % Load	Circuit Optimized for Efficiency at 50 % Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		3.3±5 %			V
Output Current (Maximum Value)		10.0			A
Output Power (Maximum Value)		33.0			W
Output Ripple Voltage	Ta=25 ℃	Below 200.0			mV
Overcurrent Protection setting (Average)		21.97		11.91	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH4R003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=4.9 mΩ $Q_{g(Typ)}$=6.8 nC SOP Advance Package		TPN4R303NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=5.1 mΩ $Q_{g(Typ)}$=6.8 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPH2R003PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=1.7 mΩ $Q_{g(Typ)}$=41.0 nC SOP Advance Package	TPH4R803PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=4.7 mΩ $Q_{g(Typ)}$=10.0 nC SOP Advance Package	TPN2R903PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=3.0 mΩ $Q_{g(Typ)}$=12.0 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	7443630310 (Würth Elektronik) L=3.1 μH $I_{R(Max)}$=26 A $R_{DC(Typ)}$=2.3 mΩ 21.5 mm×21.8 mm		744311100 (Würth Elektronik) L=1.0 μH $I_{R(Max)}$=15 A $R_{DC(Typ)}$=4.6 mΩ 7.0 mm×6.9 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		230 μF (220 μF/6.3 V/3216 size/Ceramic)×1 (10 μF/6.3 V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

2.6. 3.3 V/13.3 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 3.3 V/13.3 A output DC-DC converter which are optimized for 100 % load efficiency, 50 % load efficiency and area.

Table 2.6 3.3 V/13.3 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 10 0% Load	Circuit Optimized for Efficiency at 50 % Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		3.3±5 %			V
Output Current (Maximum Value)		13.3			A
Output Power (Maximum Value)		43.9			W
Output Ripple Voltage	Ta=25 ℃	Below 200.0			mV
Overcurrent Protection setting (Average)		21.97		26.11	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH4R003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=4.9 mΩ $Q_{g(Typ)}$=6.8 nC SOP Advance Package		TPN4R303NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=5.1 mΩ $Q_{g(Typ)}$=6.8 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPHR9203PL1 (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=0.91 mΩ $Q_{g(Typ)}$=38.0 nC SOP Advance(N) Package	TPH2R903PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=3.0 mΩ $Q_{g(Typ)}$=12.0 nC SOP Advance Package	TPN2R903PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=3.0 mΩ $Q_{g(Typ)}$=12.0 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	7443630310 (Würth Elektronik) L=3.1 μH $I_{R(Max)}$=26 A $R_{DC(Typ)}$=2.3 mΩ 21.5 mm×21.8 mm		7443340068 (Würth Elektronik) L=0.68 μH $I_{R(Max)}$=19 A $R_{DC(Typ)}$=2.65 mΩ 8.4 mm×7.9 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		230 μF (220 μF/6.3 V/3216 size/Ceramic)×1 (10 μF/6.3 V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

2.7. 3.3 V/18.2 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 3.3 V/18.2 A output DC-DC converter which are optimized for 100 % load efficiency, 50 % load efficiency and area.

Table 2.7 3.3 V/18.2 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 100 % Load	Circuit Optimized for Efficiency at 50 % Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		3.3±5 %			V
Output Current (Maximum Value)		18.2			A
Output Power (Maximum Value)		60.1			W
Output Ripple Voltage	Ta=25 ℃	Below 200.0			mV
Overcurrent Protection setting (Average)		21.97		22.74	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH3R203NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=3.8 mΩ $Q_{g(Typ)}$=9.5 nC SOP Advance Package	TPH4R003NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=4.9 mΩ $Q_{g(Typ)}$=6.8 nC SOP Advance Package	TPN4R303NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=5.1 mΩ $Q_{g(Typ)}$=6.8 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPHR6503PL1 (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=0.6 mΩ $Q_{g(Typ)}$=52.0 nC SOP Advance(N) Package	TPH2R003PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=1.7 mΩ $Q_{g(Typ)}$=41.0 nC SOP Advance Package	TPN1R603PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=1.8 mΩ $Q_{g(Typ)}$=20.0 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	7443630310 (Würth Elektronik) L=3.1 μH $I_{R(Max)}$=26 A $R_{DC(Typ)}$=2.3 mΩ 21.5 mm×21.8 mm		7443320047 (Würth Elektronik) L=0.47 μH $I_{R(Max)}$=26 A $R_{DC(Typ)}$=1.35 mΩ 12.1 mm×11.4 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		230 μF (220 μF/6.3 V/3216 size/Ceramic)×1 (10 μF/6.3 V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

2.8. 1.5 V/10.0 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 1.5 V/10.0 A output DC-DC converter which are optimized for 100 % load efficiency, 50 % load efficiency and area.

Table 2.8 1.5 V/10.0 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 100 % Load	Circuit Optimized for Efficiency at 50 % Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		1.5±5 %			V
Output Current (Maximum Value)		10.0			A
Output Power (Maximum Value)		15.0			W
Output Ripple Voltage	Ta=25 ℃	Below 90.0			mV
Overcurrent Protection setting (Average)		15.63		19.69	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC SOP Advance Package		TPN8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPH2R003PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=1.7 mΩ $Q_{g(Typ)}$=41.0 nC SOP Advance Package	TPH4R803PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=4.7 mΩ $Q_{g(Typ)}$=10.0 nC SOP Advance Package	TPN2R903PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=3.0 mΩ $Q_{g(Typ)}$=12.0 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	7443310150 (Würth Elektronik) L=1.5 μH $I_{R(Max)}$=18.5 A $R_{DC(Typ)}$=2.8 mΩ 12.1 mm×11.4 mm		744323033 (Würth Elektronik) L=0.33 μH $I_{R(Max)}$=18 A $R_{DC(Typ)}$=2.17 mΩ 10.6 mm×10.6 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		230 μF (220 μF/6.3 V/3216 size/Ceramic)×1 (10 μF/6.3 V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

2.9. 1.05 V/10.0 A Output DC-DC Converter Specifications and Main Components

This section shows the electrical specifications and main components of three designs of 1.05 V/10.0 A output DC-DC converter which are optimized for 100 % load efficiency, 50 % load efficiency and area.

Table 2.9 1.05 V/10.0 A Output DC-DC Converter Specifications and Main Components

Parameters	Conditions	Circuit Optimized for Efficiency at 100 % Load	Circuit Optimized for Efficiency at 50 % Load	Circuit Optimized for Compactness	Unit
DC Input Voltage		12.0±5 %			V
Switching Frequency		197.9		596.8	kHz
Output Voltage and Precision		1.05±2 %			V
Output Current (Maximum Value)		10.0			A
Output Power (Maximum Value)		10.5			W
Output Ripple Voltage	Ta=25 ℃	Below 20.0			mV
Overcurrent Protection setting (Average)		21.62		16.47	A
Controller		LTC7803EUD #PBF (Analog Devices)			
High-Side MOSFET Qh	Ta=25 ℃ V_{GS}=4.5 V	TPH8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC SOP Advance Package		TPN8R903NL (TOSHIBA U-MOSVIII-H) RDS(ON)(Typ)=10.2 mΩ $Q_{g(Typ)}$=4.4 nC TSON Advance Package	-
Low-Side MOSFET Ql	Ta=25 ℃ V_{GS}=4.5 V	TPH2R003PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=1.7 mΩ $Q_{g(Typ)}$=41.0 nC SOP Advance Package	TPH4R803PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=4.7 mΩ $Q_{g(Typ)}$=10.0 nC SOP Advance Package	TPN2R903PL (TOSHIBA U-MOSIX-H) RDS(ON)(Typ)=3.0 mΩ $Q_{g(Typ)}$=12.0 nC TSON Advance Package	-
Inductor L	Ta=20 ℃ F_{SW}=100 kHz ΔT=40 K	74439369022 (Würth Elektronik) L=2.2 μH $I_{R(Max)}$=16 A $R_{DC(Typ)}$=2.2 mΩ 10.5 mm×11.6 mm		744316047 (Würth Elektronik) L=0.47 μH $I_{R(Max)}$=15 A $R_{DC(Typ)}$=2.75 mΩ 5.6 mm×5.3 mm	-
Input Capacitor Cin		144 μF (100 μF/16 V/3225 size/Ceramic)×1 (22 μF/16 V/3225 size/Ceramic)×2			-
Output Capacitor Cout		670 μF (220 μF/6.3V/3216 size/Ceramic)×3 (10 μF/6.3V/1608 size/Ceramic)×1			-
Input Connector	Cable= AWG#16	B2P-VH (JST Mfg.)×1 Post with base/3.96 mm Pitch/2pin/ 10 A max			
Output Connector		OT-007 (Osada) × 2 Screw terminal block/Applicable M3 screw/ 25 A max			

3. PCB

This section shows the appearance of PCB, component layout, and PCB patterns of 3.3 V/18.2 A output power supply optimized for efficiency at 100% load. This power supply has the largest rated current of all 24 types of these DC-DC converters.

3.1. Appearance

Fig. 3.1 and 3.2 show the external view of 3.3 V/18.2 A output power supply optimized for efficiency at 100% load.

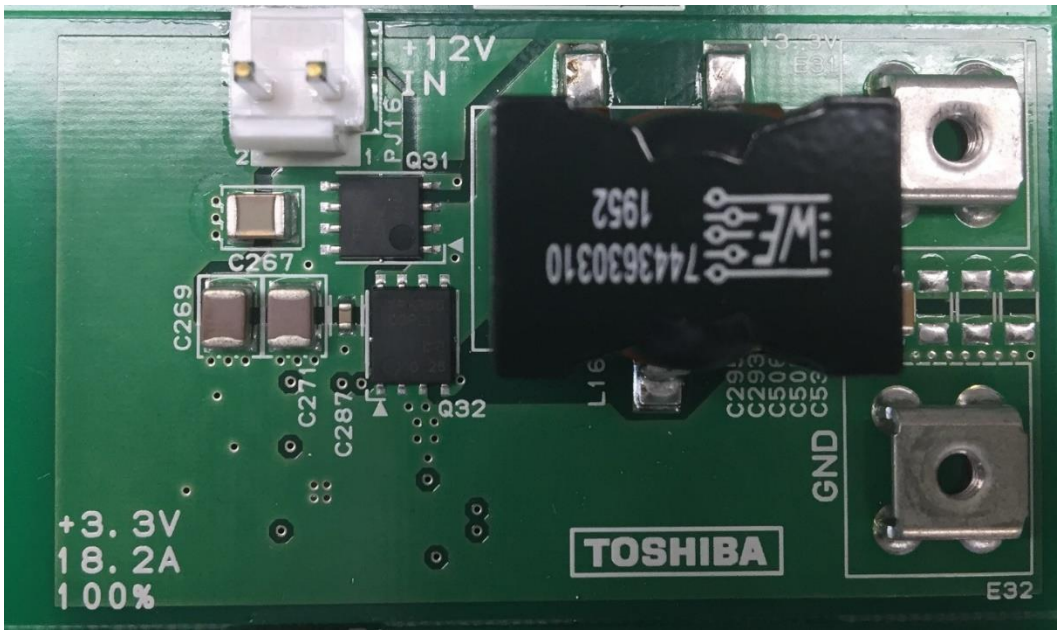

Fig. 3.1 External View of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Front Side)

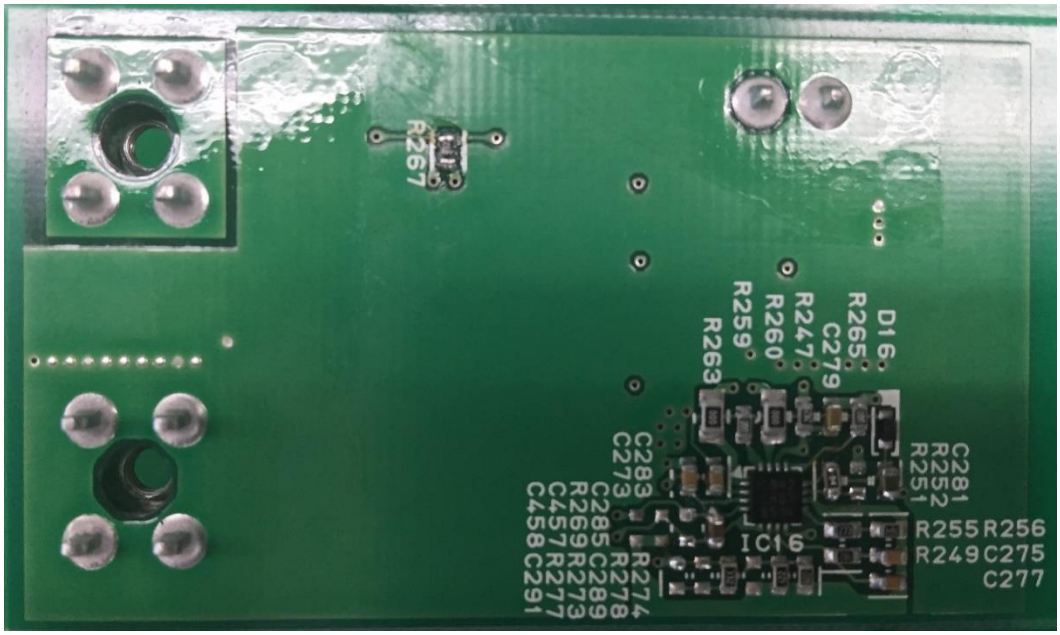

Fig. 3.2 External View of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Back Side)

3.2. Component Arrangement

Fig. 3.3 and 3.4 show the components of 3.3 V/18.2 A output power supply optimized for efficiency at 100 % load.

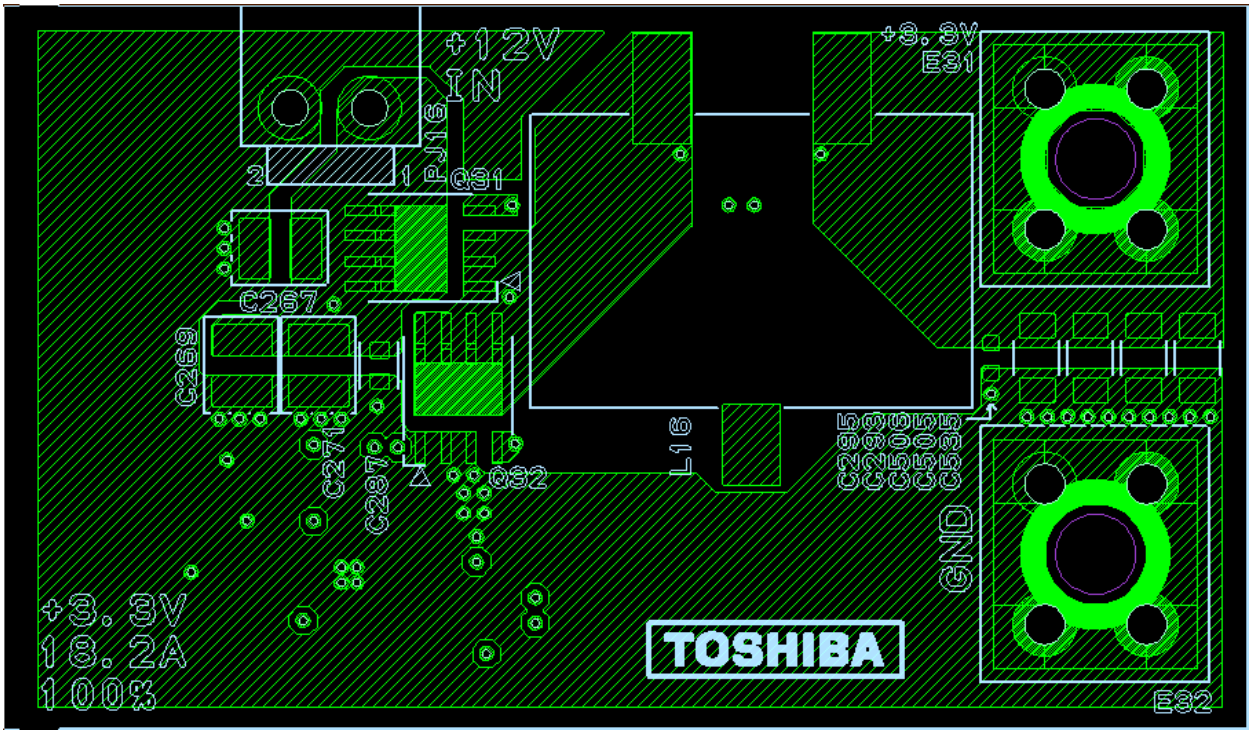

Fig. 3.3 Components Arrangement of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Front Side)

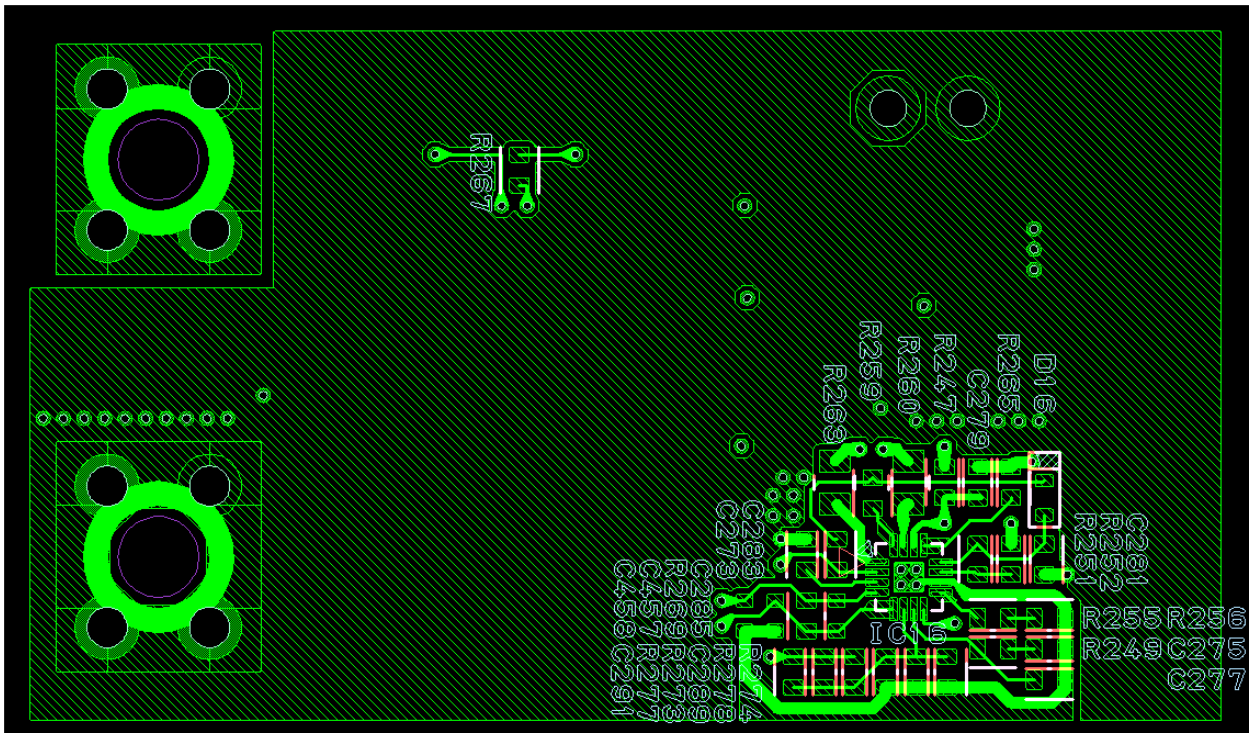

Fig. 3.4 Components Arrangement of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Back Side)

3.3. PCB Pattern

Figs. 3.5 to 3.10 show the PCB patterns of 3.3 V/18.2 A output power supply optimized for efficiency at 100 % load.

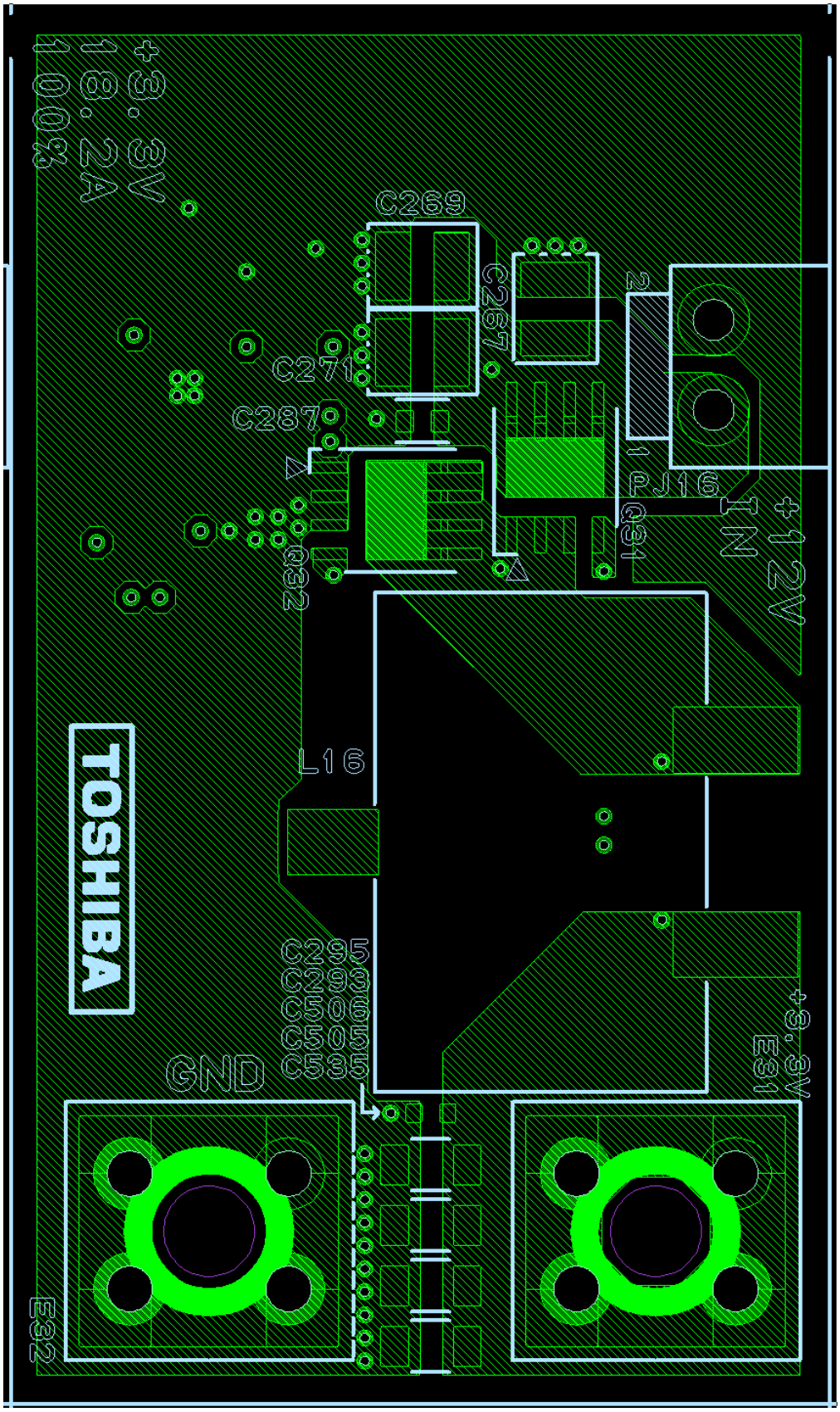

Fig. 3.5 PCB Pattern of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Layer 1, Front Side)

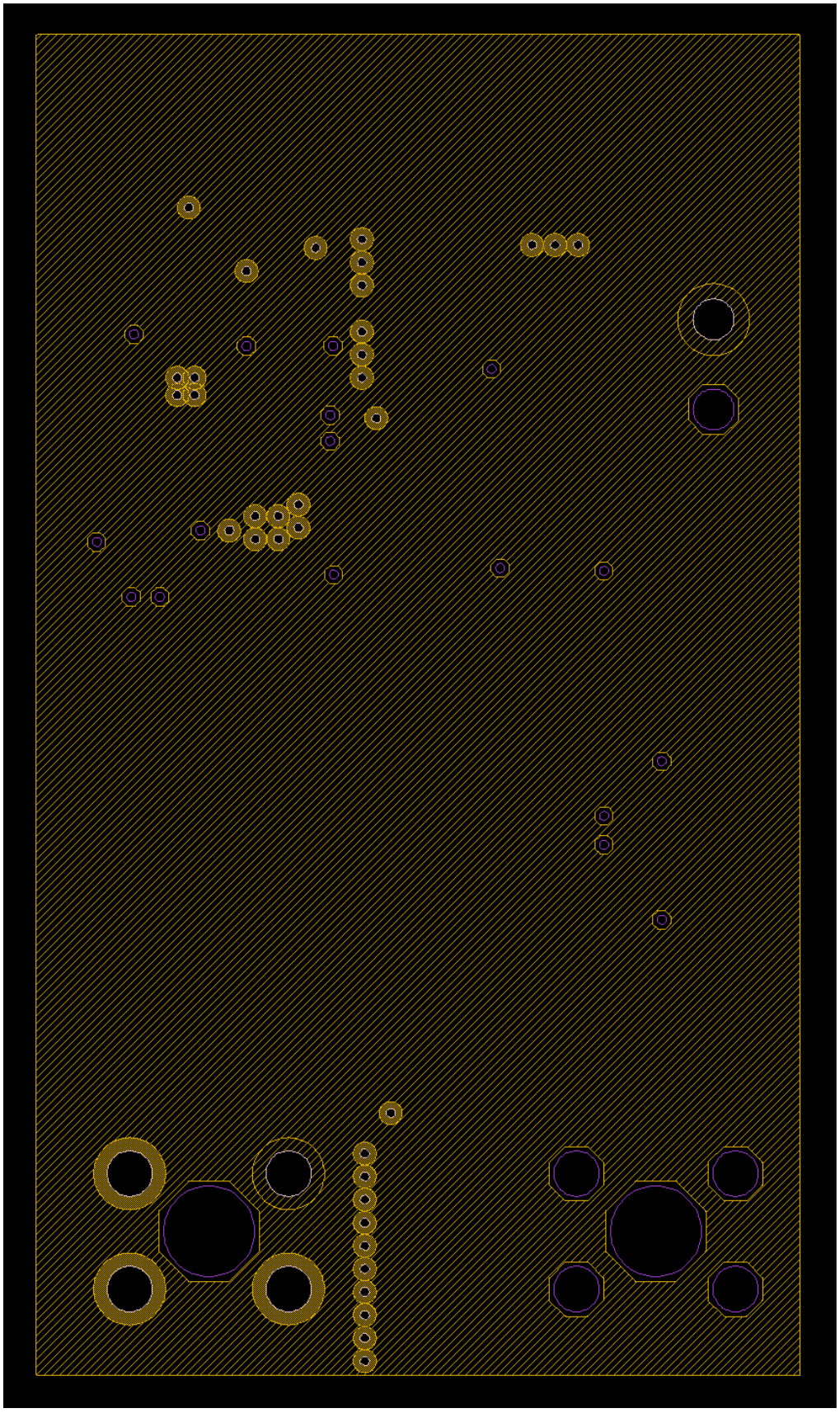

Fig. 3.6 PCB Pattern of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Layer 2)

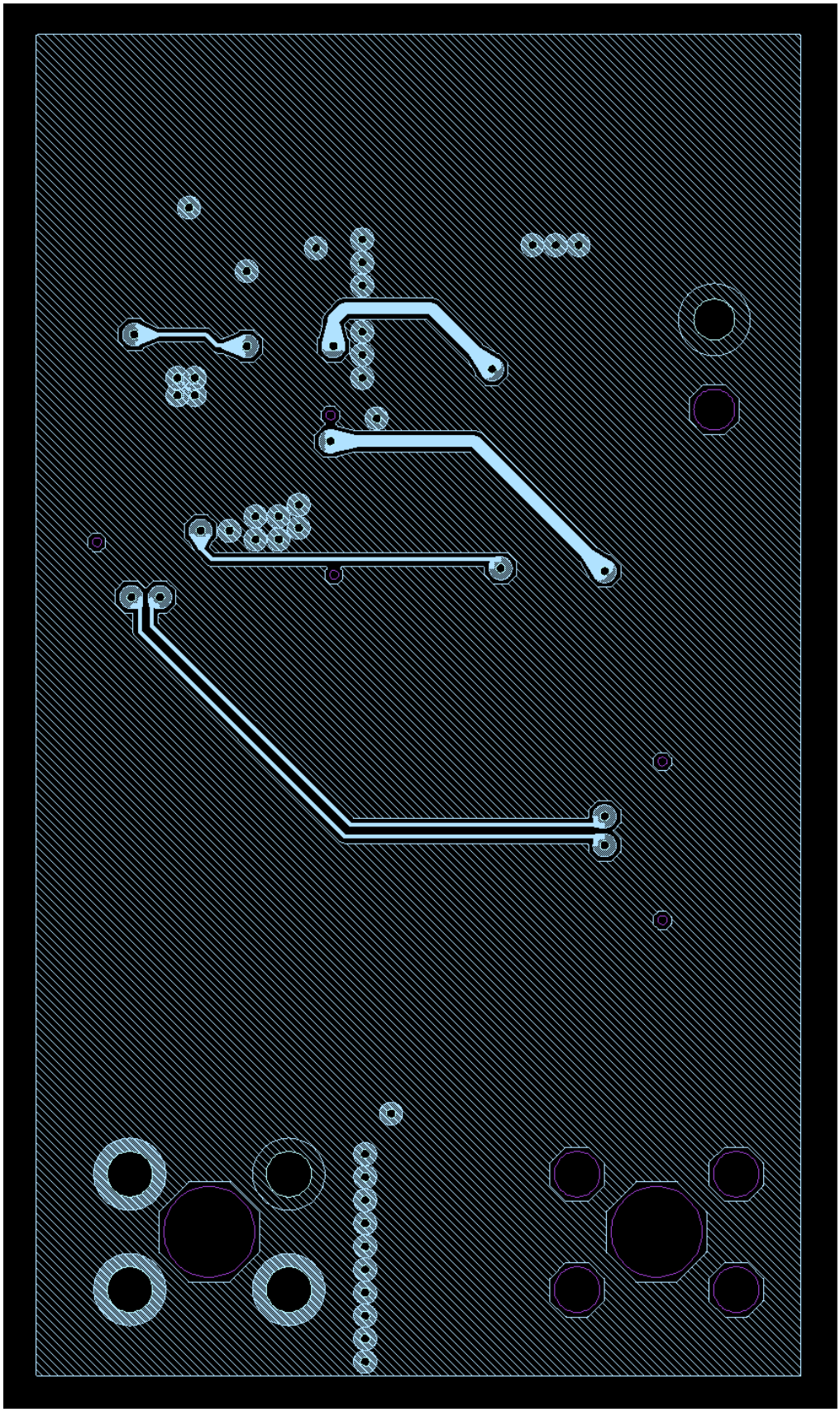

Fig. 3.7 PCB Pattern of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Layer 3)

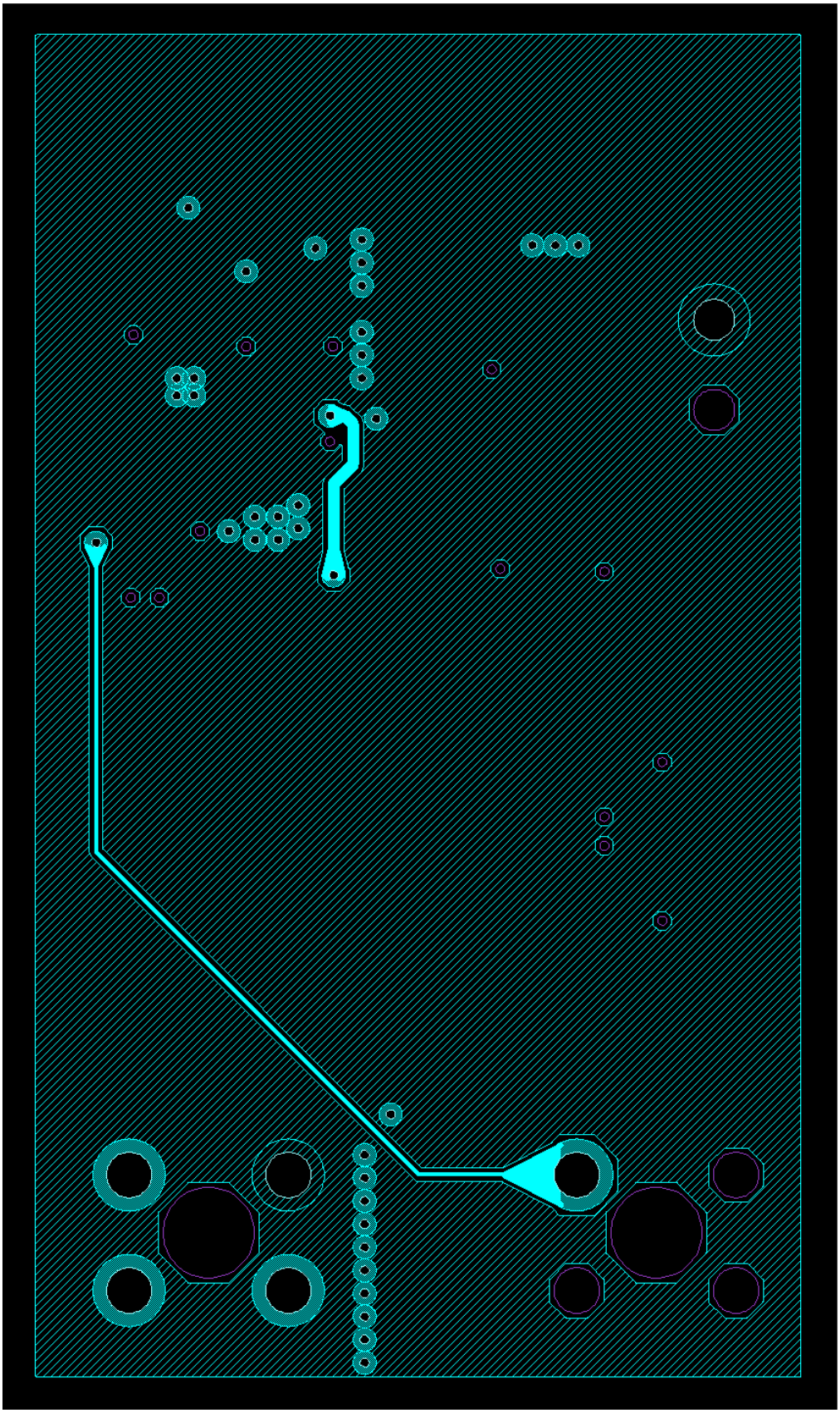

Fig. 3.8 PCB Pattern of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Layer 4)

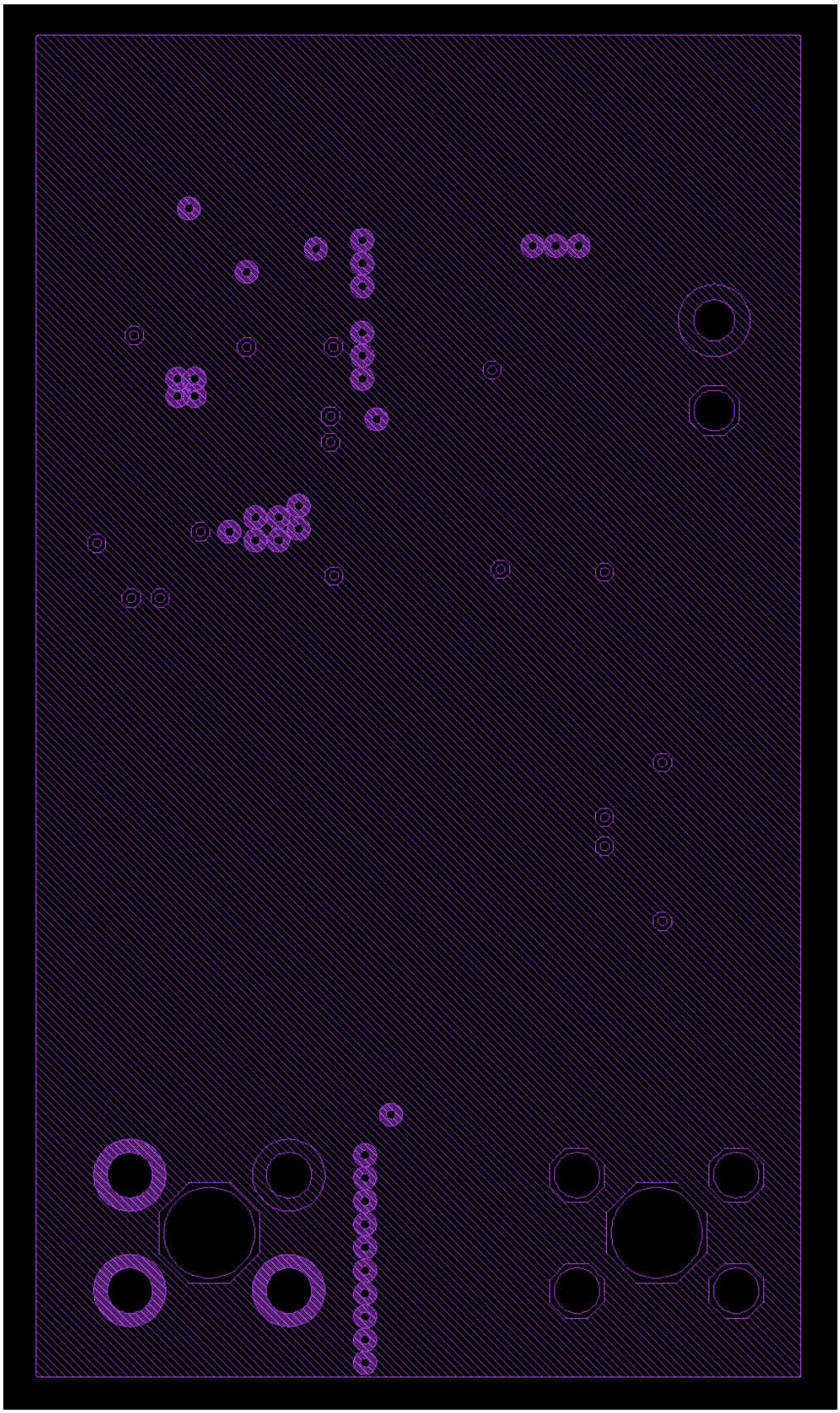

Fig. 3.9 PCB Pattern of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Layer 5)

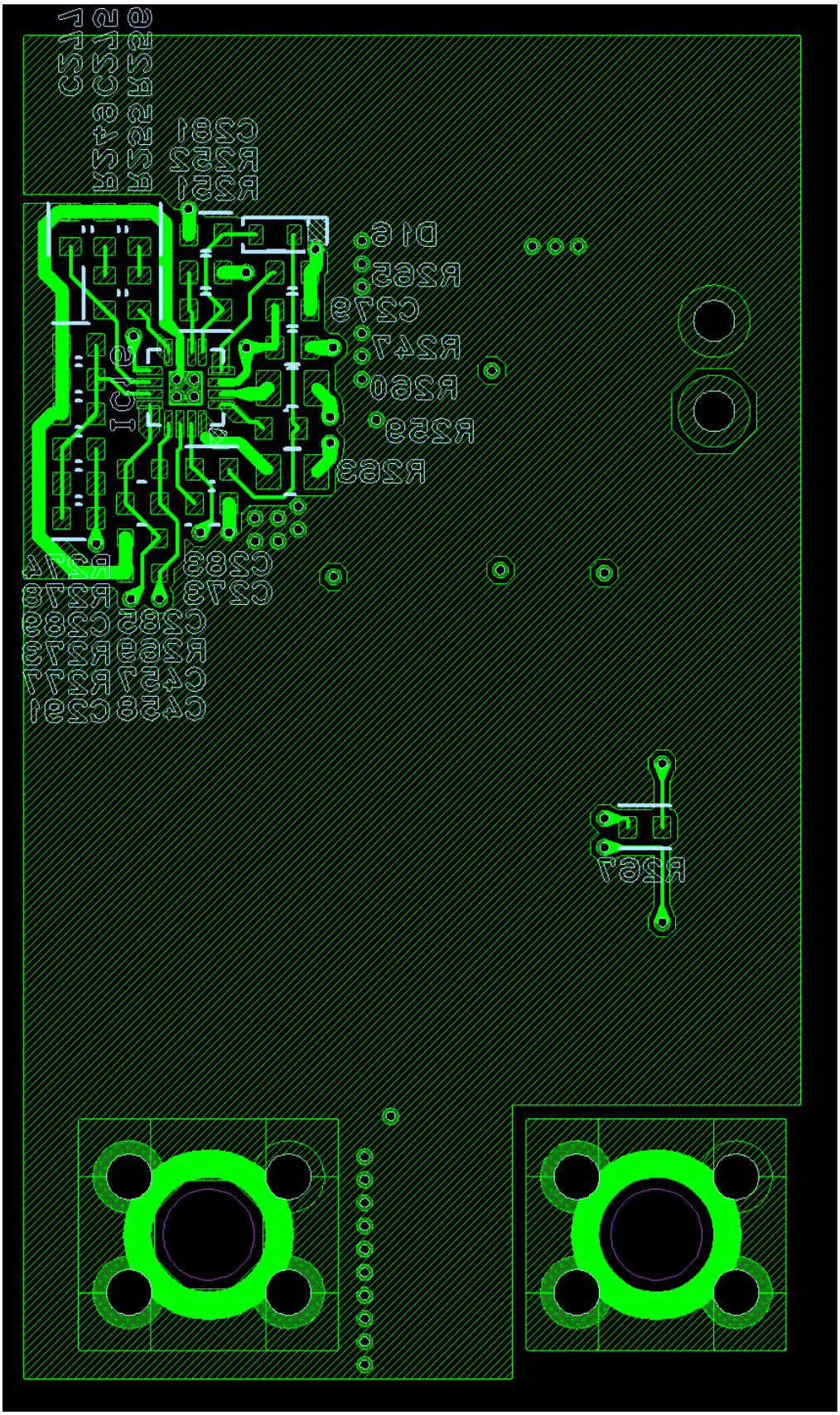

Fig. 3.10 PCB Pattern of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load (Layer 6, Back Side)

4. Operating Procedure

This section describes the operation steps of 3.3 V/18.2 A output power supply optimized for efficiency at 100% load. This power supply has the largest rated current of all 24 types of these DC-DC converters.

4.1. Connecting to External Devices

Fig. 4.1 shows the external connection pins. The area enclosed in red is the input terminal and is manufactured by Japan Solderless Terminal Manufacturing Co., Ltd.
B2P-VH (post with 3.96 mm pitch-base) is adopted for all 24 power supplies. Use a wire with housing that fits the connector and connect it to a stabilized DC power supply. The part enclosed in blue is the output terminal. Connect the load unit to Output (DC+3.3V) terminal and Output (GND) terminal. Use load devices, cables and connectors that meet the electrical specifications of 3.3 V/18.2 A output DC-DC converter mentioned in section 2.7.

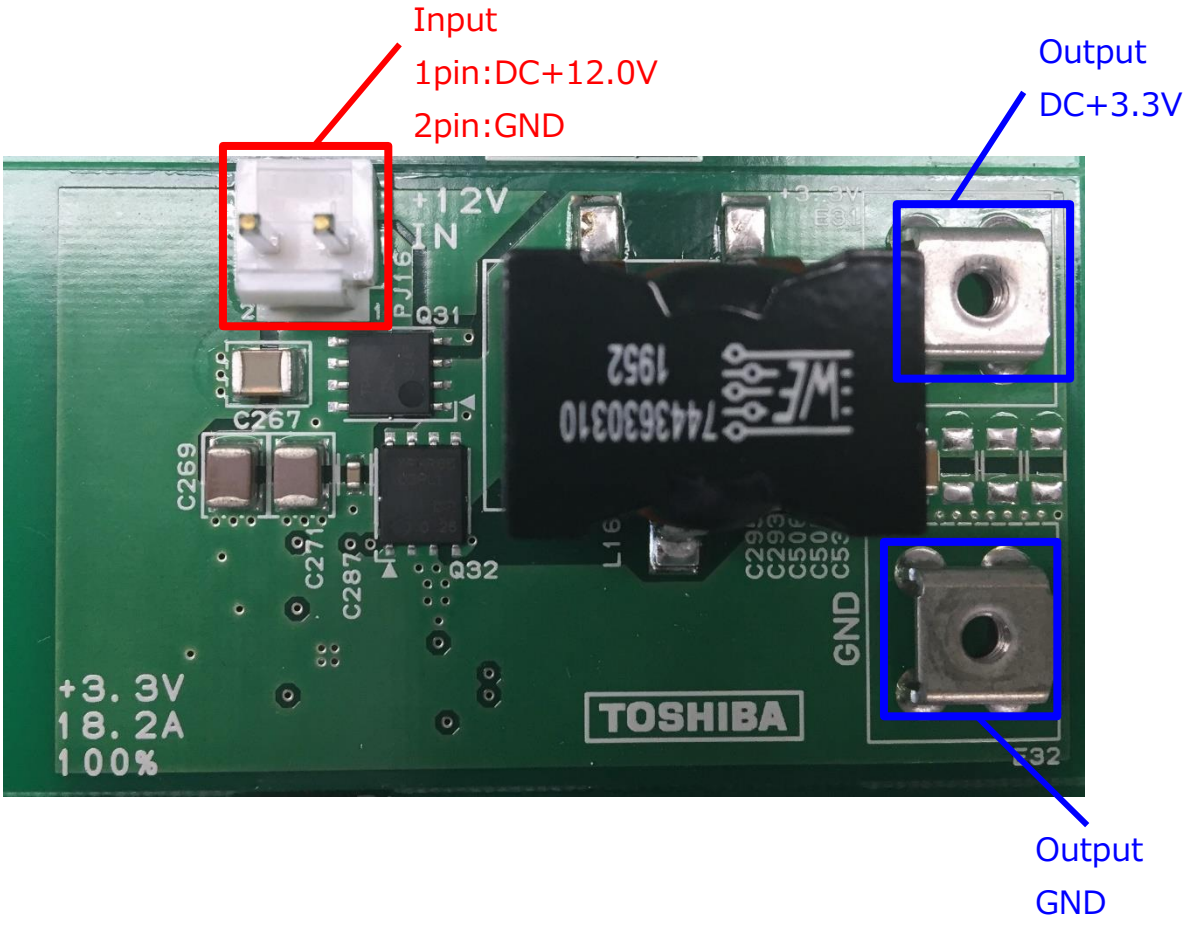

Fig. 4.1 External Connection Pins of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load

4.2. Start and Stop Procedures

Before starting the power supply, check that all of the following terminal voltages are 0 V. Between Input connector pin1 (DC+12.0 V) and pin2 (GND), between Output (DC+3.3 V) terminal and Output (GND) terminal

[Startup Procedure]
Turn on the stabilized DC power supply.

[Stop Procedure]
Turn off the stabilized DC power supply.

4.3. Precautions for Evaluation (To Prevent Electric Shock, Burn Injury, etc.)

Be careful of an electric shock when the DC stabilized power supply is connected. There is a risk of electric shock due to the residual charge of various capacitors even after the power supply is stopped. Confirm that the voltage of each part has decreased sufficiently before touching the board.

In addition, the semiconductor or inductor of this power supply generates heat according to the load current. Fig. 4.2 shows the components with may generate large heat, as these are indicated by a red broken line frame. Do not touch these components while this power supply is in operation, as there is a risk of burns.

Be very careful when observing the waveform while power supply is in operation.

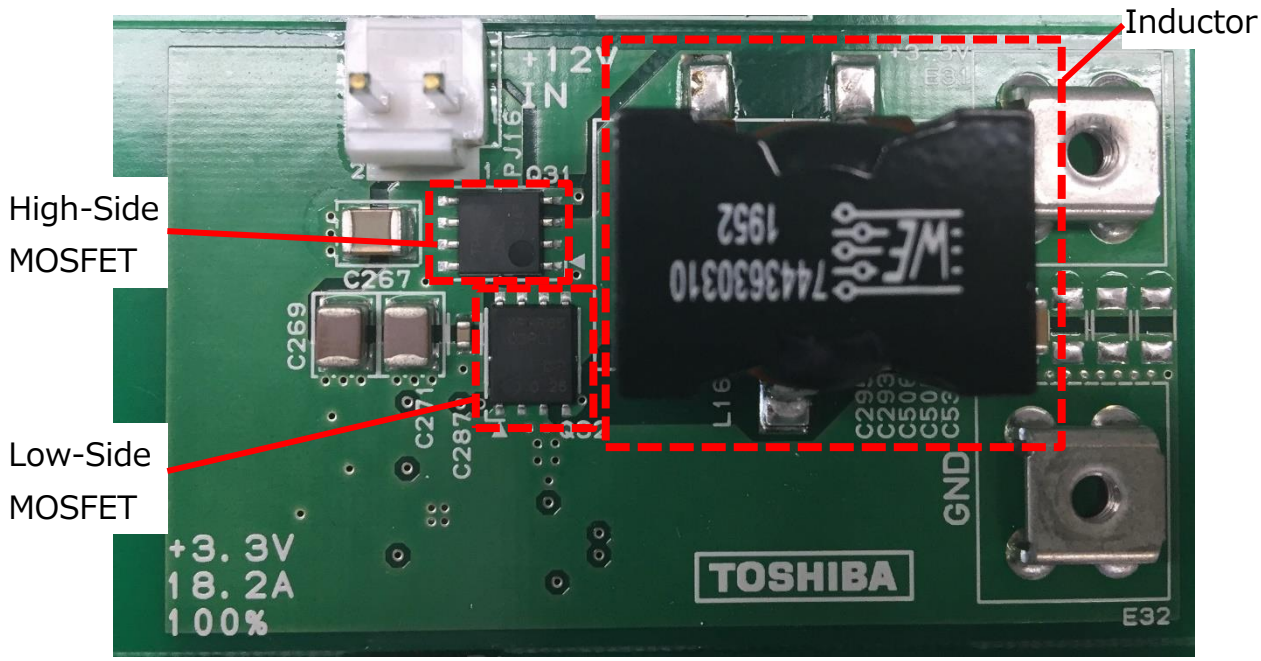

Fig. 4.2 Components with Large Heat Generation (of 3.3 V/18.2 A Output Power Supply Optimized for Efficiency at 100 % Load)

5. Power Characteristics

This section shows the power supply efficiency measurement results.

5.1. 5.0 V/5.0 A Output Circuit Power Conversion Efficiency

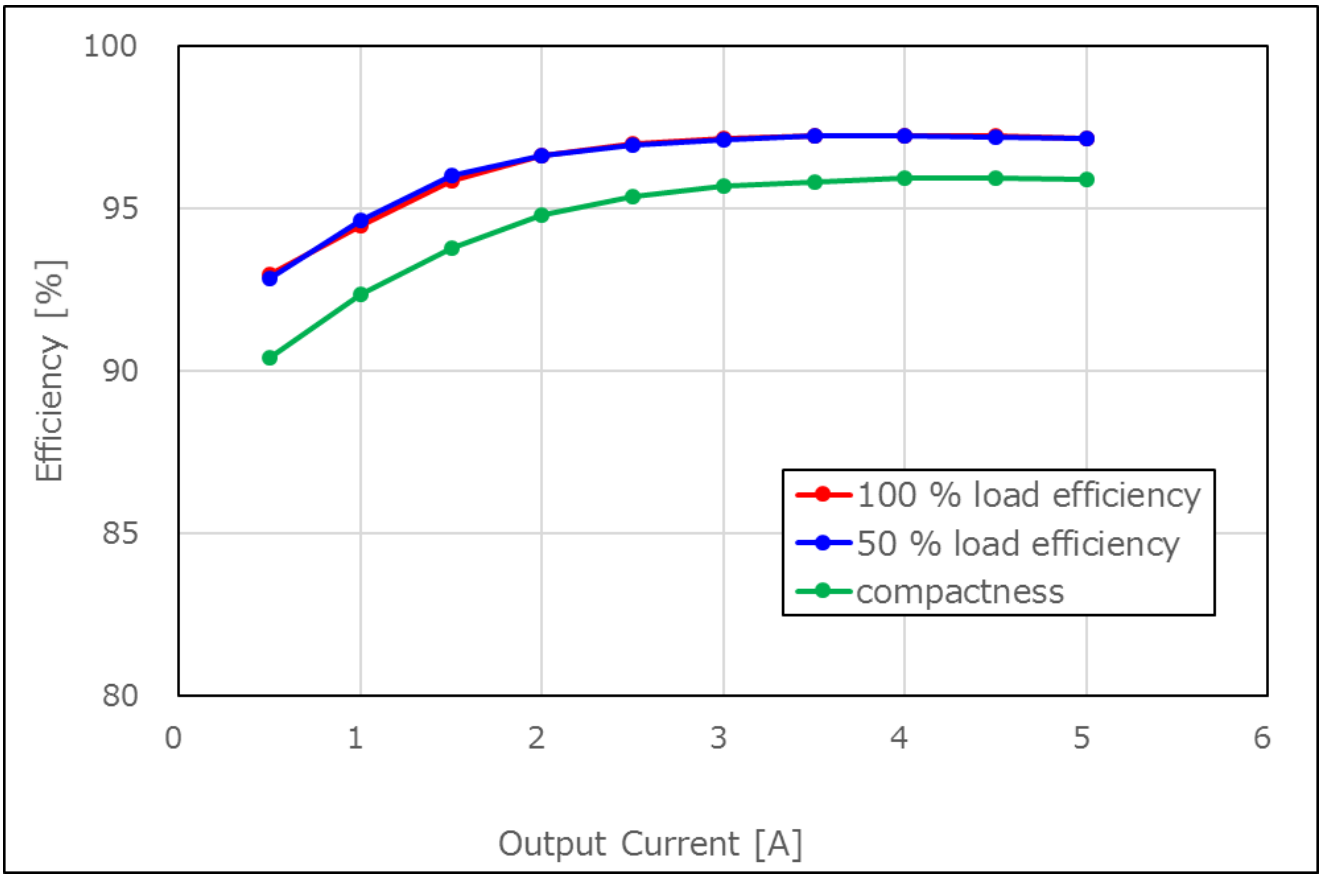

Fig. 5.1 5.0 V/5.0 A Output Circuit Power Conversion Efficiency

5.2. 5.0 V/8.0 A Output Circuit Power Conversion Efficiency

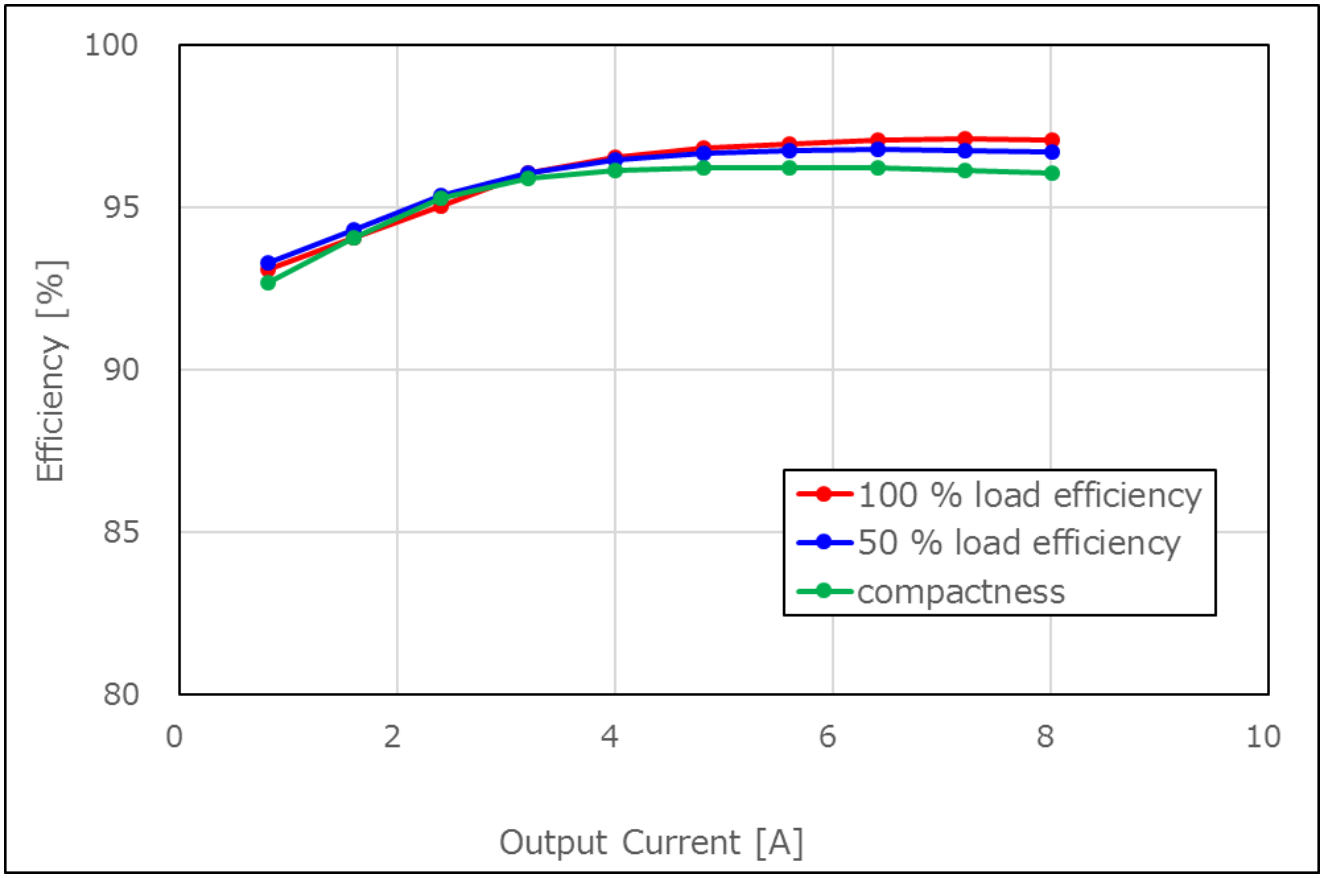

Fig. 5.2 5.0 V/8.0 A Output Circuit Power Conversion Efficiency

5.3. 5.0 V/12.0 A Output Circuit Power Conversion Efficiency

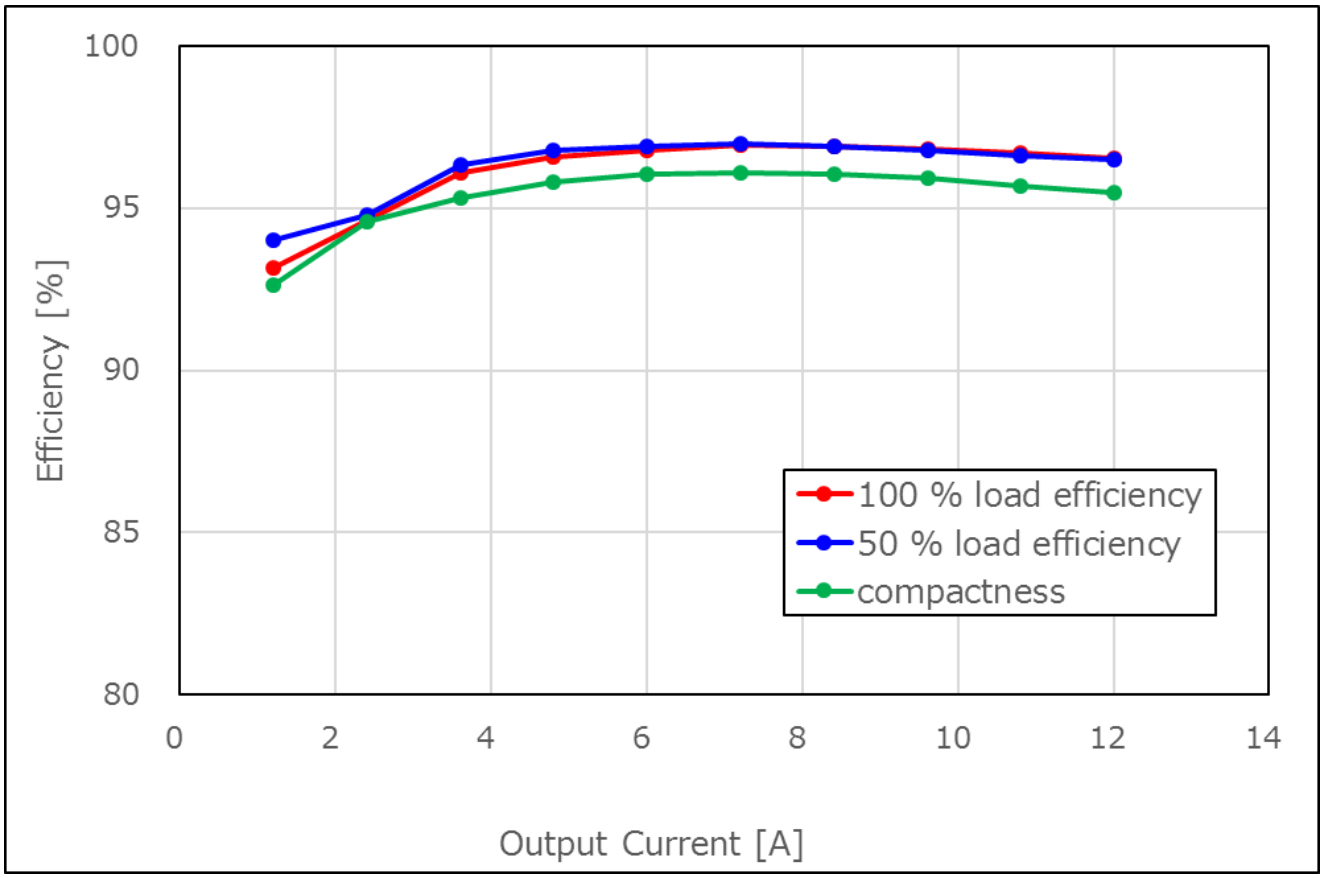

Fig. 5.3 5.0 V/12.0 A Output Circuit Power Conversion Efficiency

5.4. 3.3 V/10.0 A Output Circuit Power Conversion Efficiency

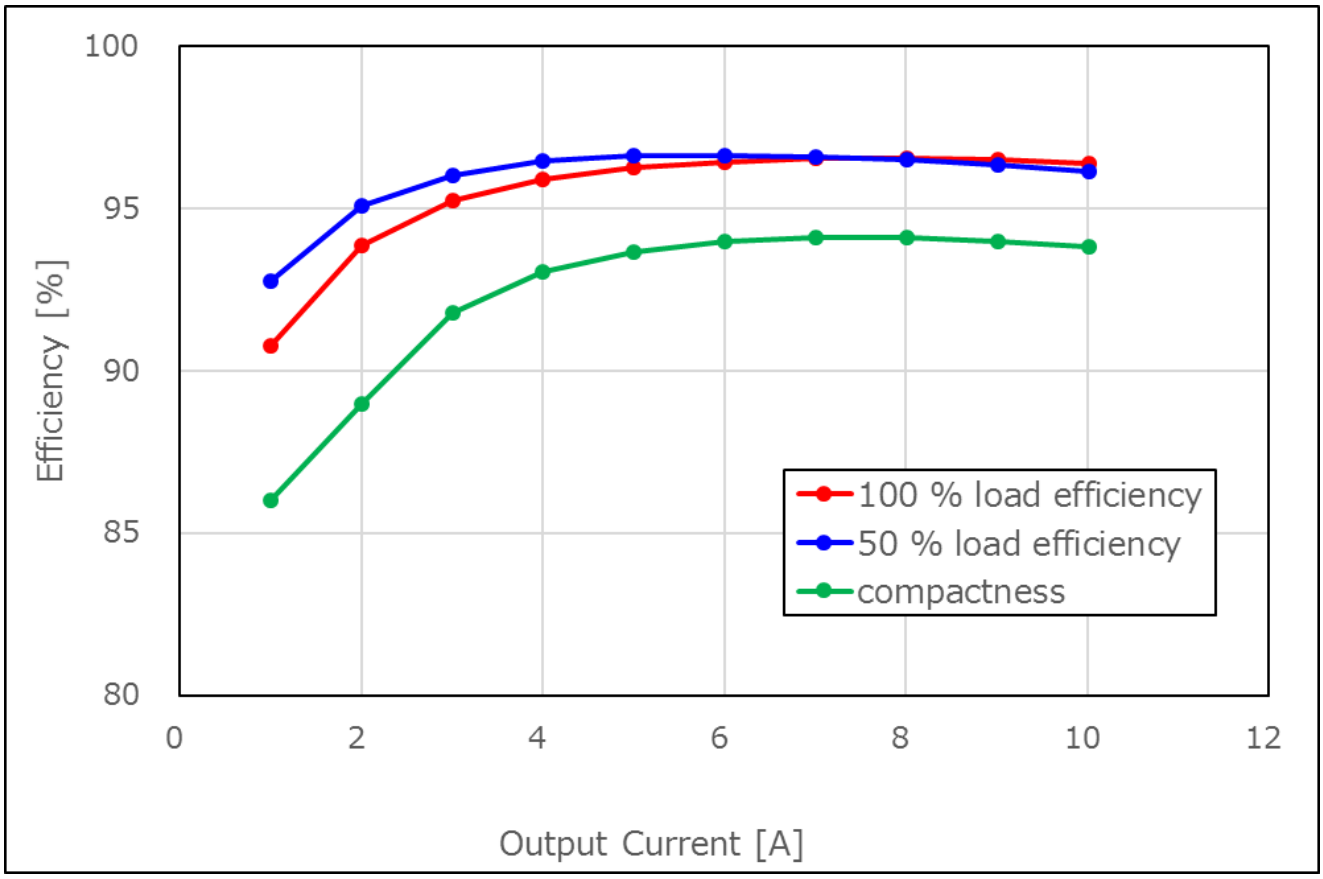

Fig. 5.4 3.3 V/10.0 A Output Circuit Power Conversion Efficiency

5.5. 3.3 V/13.3 A Output Circuit Power Conversion Efficiency

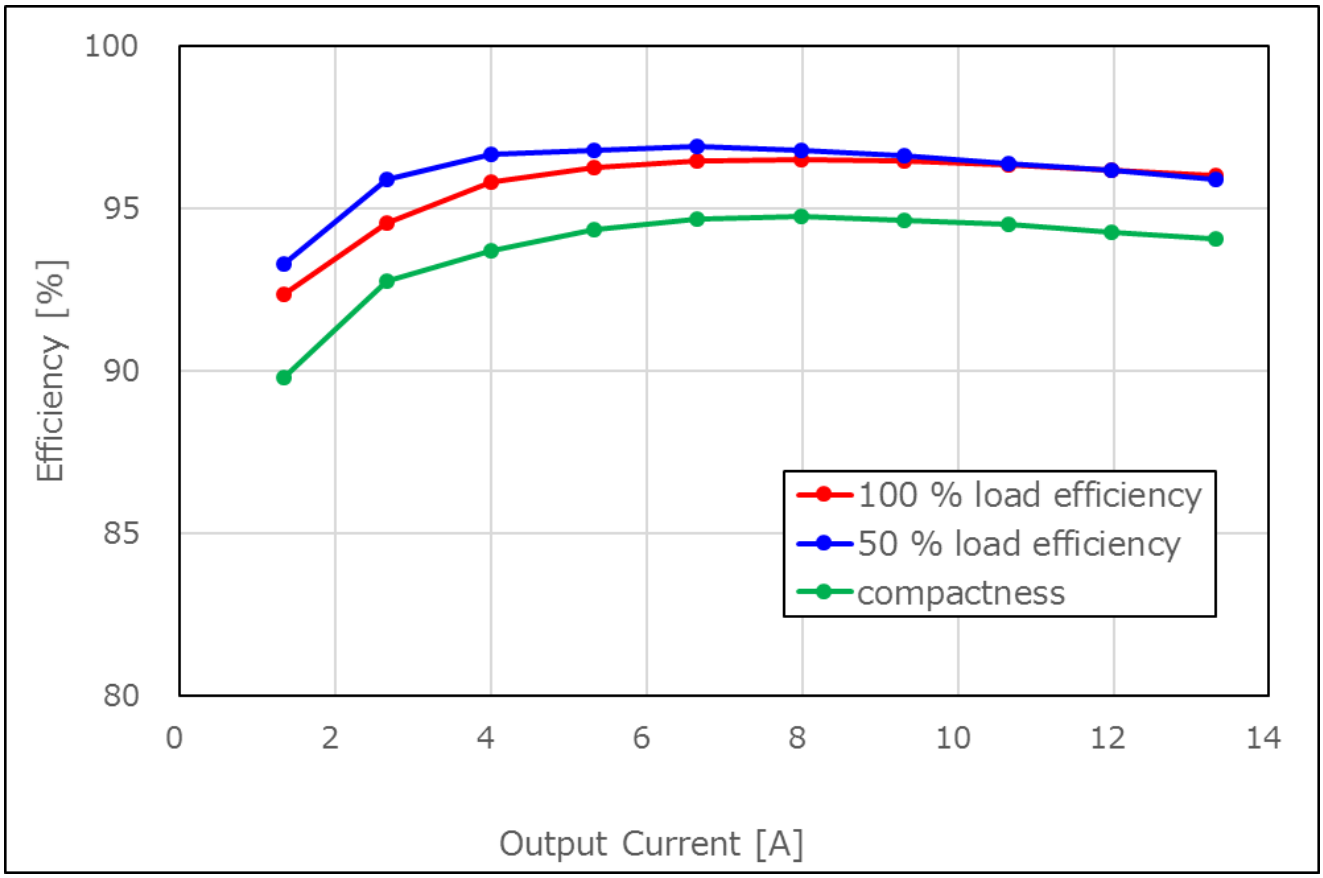

Fig. 5.5 3.3 V/13.3 A Output Circuit Power Conversion Efficiency

5.6. 3.3 V/18.2 A Output Circuit Power Conversion Efficiency

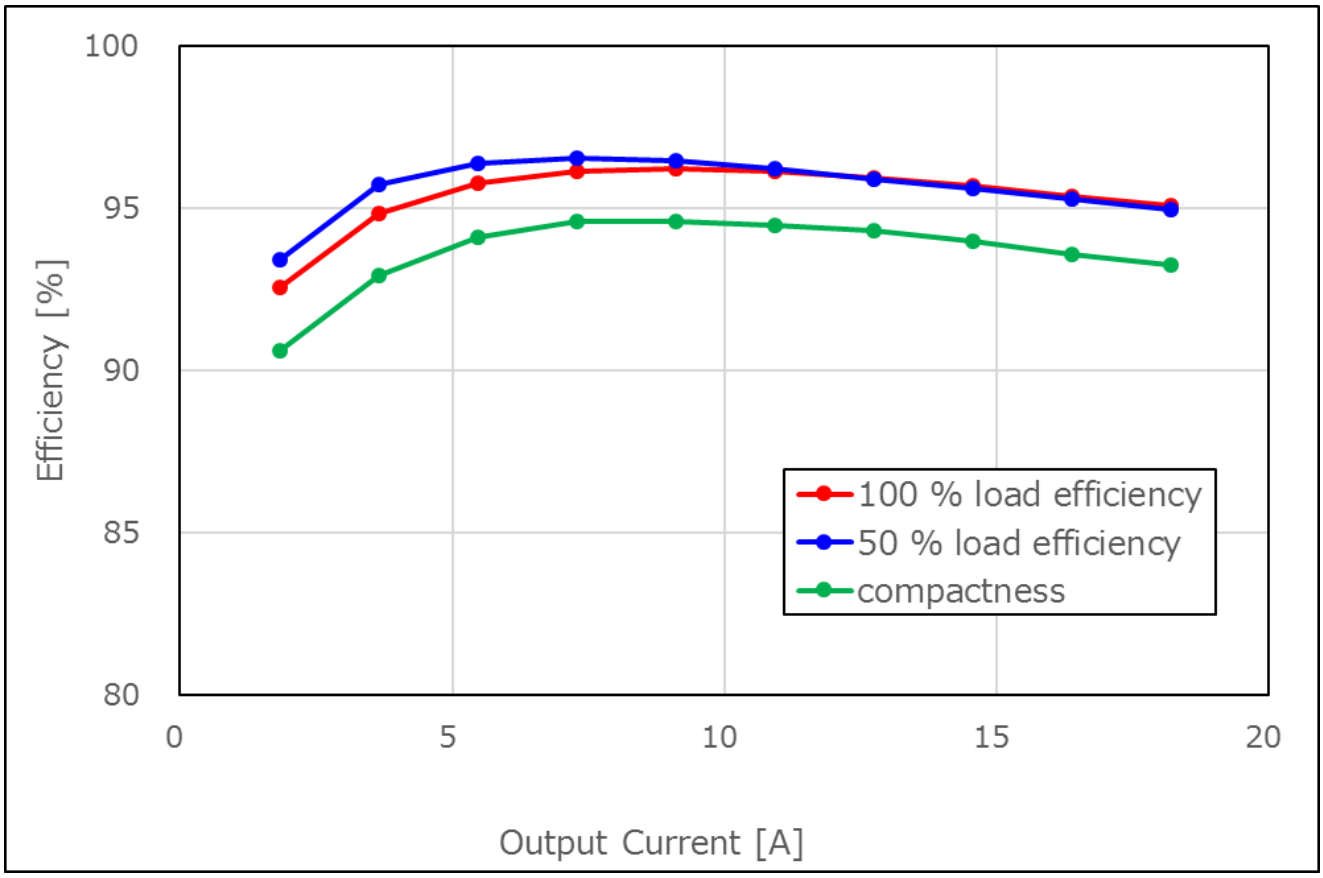

Fig. 5.6 3.3 V/18.2 A Output Circuit Power Conversion Efficiency

5.7. 1.5 V/10.0 A Output Circuit Power Conversion Efficiency

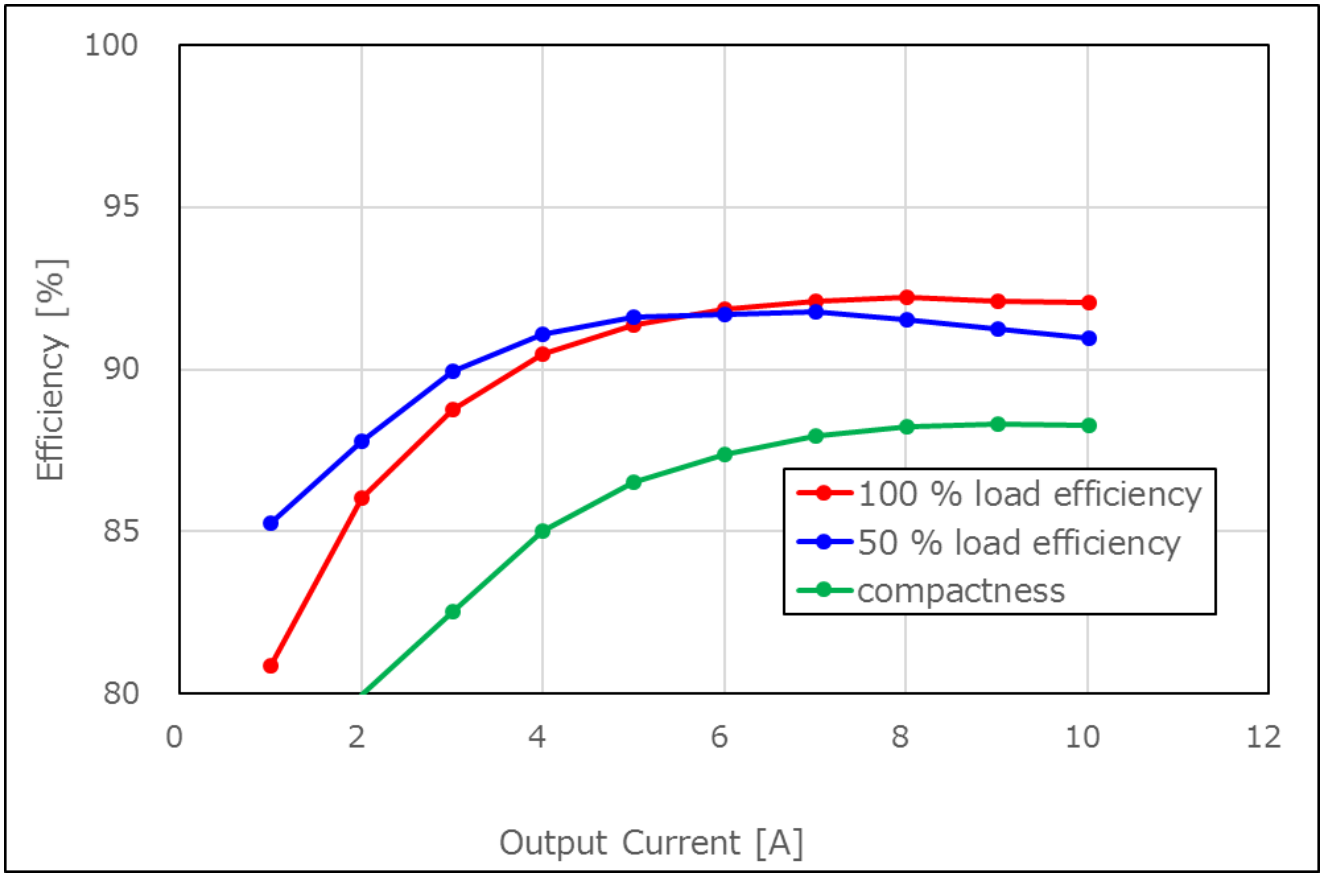

Fig. 5.7 1.5 V/10.0 A Output Circuit Power Conversion Efficiency

5.8. 1.05 V/10 A Output Circuit Power Conversion Efficiency

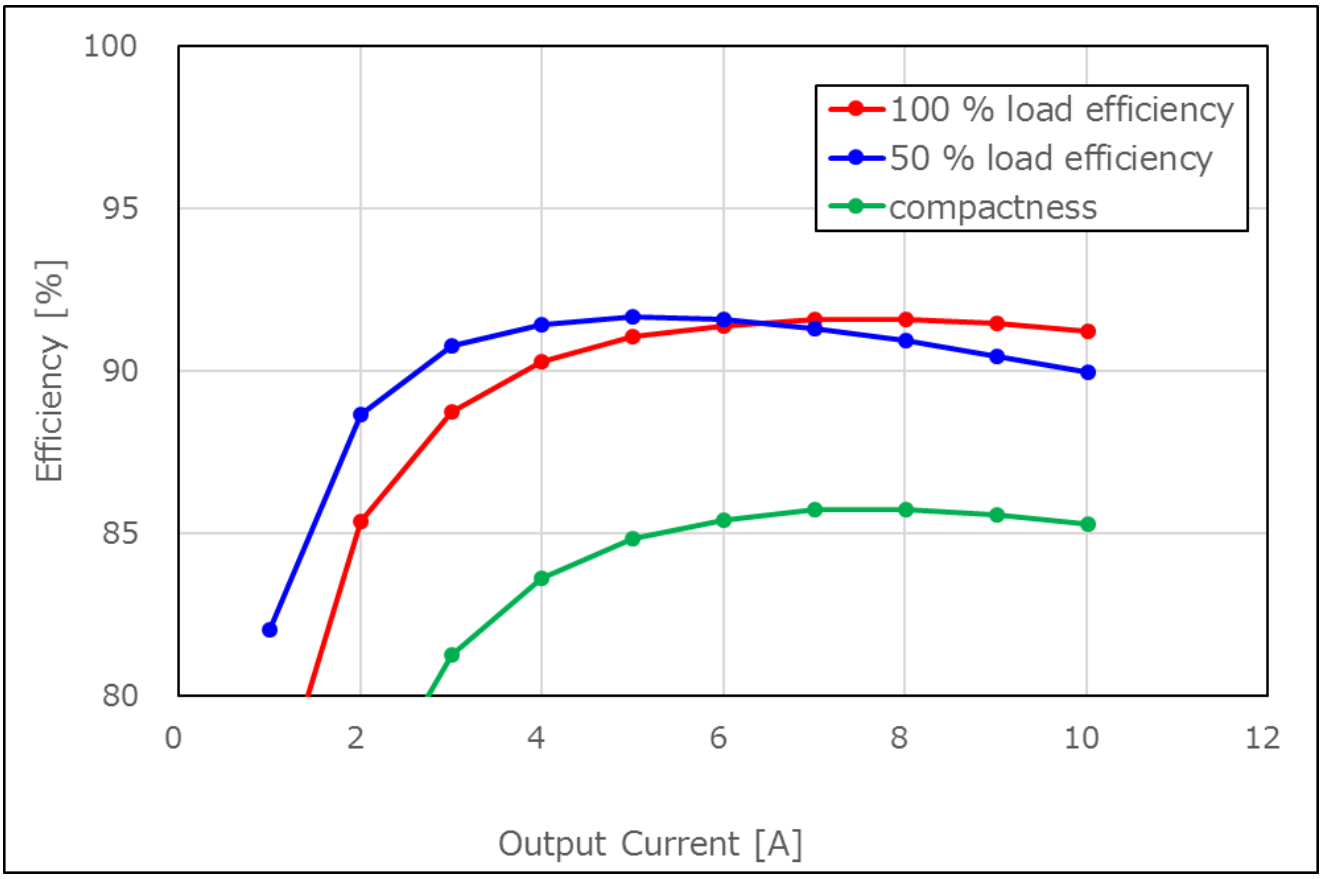

Fig. 5.8 1.05 V/10.0 A Output Circuit Power Conversion Efficiency

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