EVAL_TDA48416_1.2VOUT user guide

User guide for TDA48416 evaluation board

About this document

Scope and purpose

TDA48416 is a synchronous buck regulator, providing a compact, high-performance, and flexible solution in a small 3 mm x 4 mm QFN package.

Key features offered by TDA48416 include internal soft start, precision 0.6 V reference voltage, Power Good, thermal protection, programmable switching frequency in the range of 1200 kHz to 2 MHz, enable input, input undervoltage lockout (UVLO) and overvoltage lockout (OVLO) for proper startup, input overvoltage protection (Input OVLO), latched-off overvoltage protection (OVP), overcurrent protection (OCP) and pre-bias startup.

This user guide contains the schematic and bill of materials for the EVAL_TDA48416_1.2VOUT engineering evaluation board. It describes the operation and use of the evaluation board itself. Detailed application information for TDA48416 is available in the TDA48416 datasheet.

Intended audience

This document is intended for design engineers evaluating TDA48416 performance with the EVAL_TDA48416_1.2VOUT engineering evaluation board.

About this product group

Target applications

- Server power supply units (PSU)
- Energy storage systems
- Telecommunications infrastructure
- Integrated POL voltage regulators

Product family

Infineon's DC-DC regulators provide best-in-class power efficiency, safety features, and robust performance. The regulators support energy-conscious products, best load, and line-transient performance and reducing power consumption, making them a suitable choice for demanding applications. In specific, the synchronous buck converter family combine high efficiency, compact, power-dense packaging, high-frequency switching capabilities, robust control, as well as protection features. These optimizations reduce power loss, enhance thermal management, simplify design, and support modern performance requirements in a range of electronics applications.

Evaluation Board

EVAL_TDA48416_1.2VOUT board is available for design engineers to evaluate the performance of the TDA48416, including its efficiency, power loss, and other characteristics.

Important notice

“Evaluation Boards and Reference Boards” shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as “Reference Board”).

Environmental conditions have been considered in the design of the Evaluation Boards and Reference Boards provided by Infineon Technologies. The design of the Evaluation Boards and Reference Boards has been tested by Infineon Technologies only as described in this document. The design is not qualified in terms of safety requirements, manufacturing, and operation over the entire operating temperature range or lifetime.

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Safety precautions

Note: Please note the following warnings regarding the hazards associated with development systems

Table 1 Safety precautions

	**Caution:** *The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.*
	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*

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1 TDA48416 features

Features

- Input voltage range of 2.95 V to 6 V, 1.65 V to 6 V input voltage range with external bias supply
- Precision reference voltage (0.6 V +/- 1%)
- Adaptive fast COT control for ultrafast transient response
- Stable with ceramic output capacitors
- No external compensation
- Optional forced continuous conduction mode (FCCM) and diode emulation mode (DEM) for enhanced light-load efficiency
- Selectable switching frequency from 1.2 MHz to 2 MHz
- Programmable soft-start time with a typical of 1 ms and enhanced pre-bias startup
- Voltage tracking with external reference input (0.4 V to 1.2 V)
- Programmable overcurrent protection limit with internal thermal compensation
- Enable input with voltage monitoring capability
- Power Good output
- Non-latch OCP, output UVP, input voltage OVP, thermal shutdown, and latch-off output OVP
- Operating temperature: –40°C < T_j < 125°C
- Package: 3 mm x 4 mm QFN-21
- Pb-free, halogen-free, and RoHS compliant

Product validation

Qualified for industrial applications according to the relevant tests of the JEDEC47/20/22 standard.

2 Board information

2.1 Evaluation board

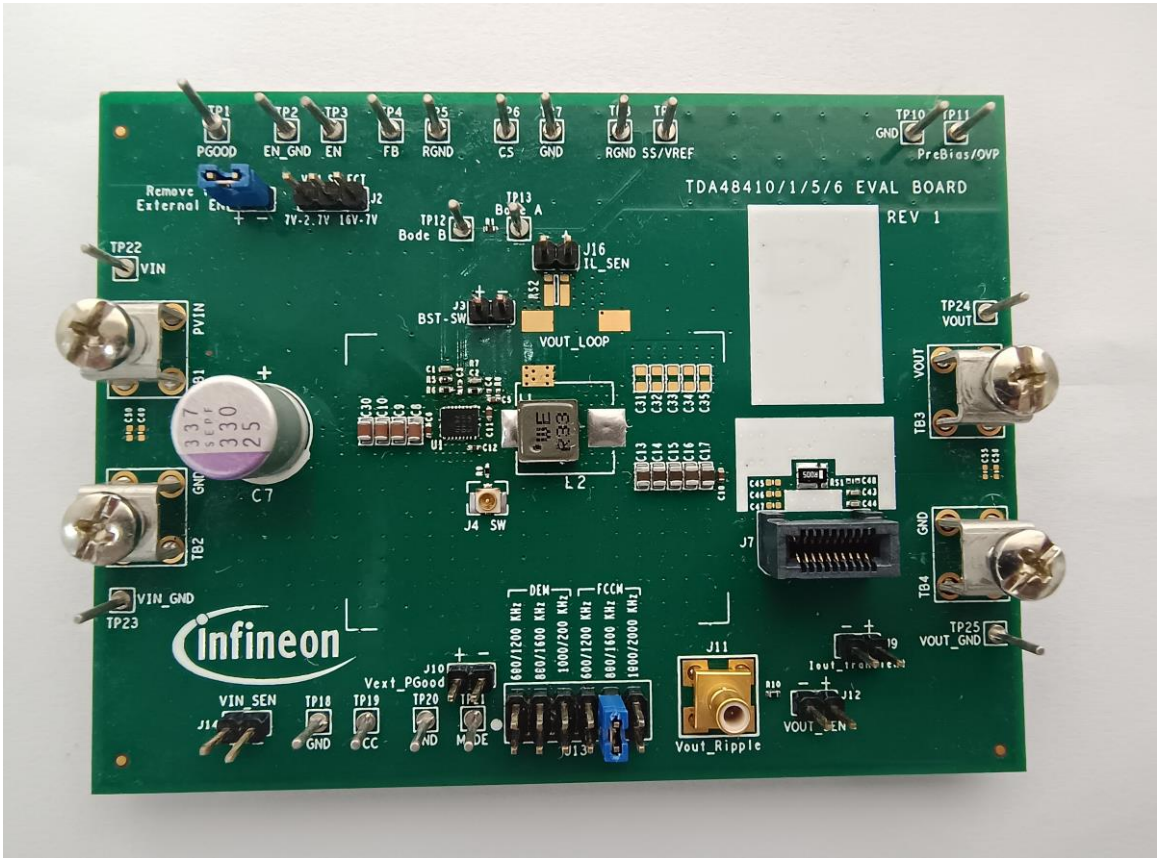


Figure 1 Evaluation board

2.2 Board features

V_{IN} = 5 V, V_{OUT} = 1.2 V at 0 to 15 A

F_{SW} = 1200 kHz/1600 kHz/2000 kHz

L = 150 nH

C_{IN} = 10 x 22 µF (25 V, ceramic 0805) + 1 x 2.2 µF (25 V, ceramic 0805) + 1 x 330 µF (25 V, electrolytic, optional)

C_{OUT} = 10 x 47 µF (6.3 V, ceramic 0805) + 1 x 2.2 µF (6.3 V, ceramic 0805)

2.3 Connections and operating instructions

The TDA48416 evaluation board requires a single +5 V for the input power and can deliver up to 15 A load current. The operation modes and OCP limits can be selected through jumpers.

Table 2 Connections

Label		Description
Input	PVIN	Connect input power (+5V) to this pin
	GND	Return of input power
	PVIN, PGND_SNS	Sense pins for the input voltage
Output	VOUT	V_{OUT} (+1.2V), connect a DC load (15A max.) to this pin
	PGND	Return of V_{OUT}
	VOUT, PGND_SNS	Sense pins for the output voltage
Enable	EN	Connect a scope probe to this pin to monitor the enable signal. Alternatively, an external enable signal can be applied to this pin to overdrive the onboard enable signal
	GND	
Bode	BODE_A	For Bode plot measurement
	BODE_B	
Soft-start	SS/VREF	Connect a capacitor to this pin to get different soft-start times
Mode	FCCM	Use a jumper to select FCCM or DEM, and switching frequency. Three preset switching frequencies are: 1200 kHz, 1600 kHz, and 2000 kHz
	DEM	
CS		By default, connected to GND. Use a resistor to connect to CS to configure the current limit
P_{GOOD}	PGOOD	Connect a scope probe to this pin to monitor the Power Good signal
	GND	GND
R_{GND}	RGND	Differential remote sense negative input. Connect this pin directly to the negative side of the voltage sense point. Short to GND if remote sense is not used
V_{CC}	VCC	Standard evaluation board is configured to use the internal low-dropout regulator (LDO). Connect a scope probe to this pin to monitor the output of the internal LDO
	GND	

2.4 Layout

The PCB is a six-layer board using FR4 material. Top and bottom layers use 2 oz. copper and inner layers use 1 oz. copper. The PCB thickness is 1.6 mm. The TDA48416 device and other major power components are mounted on the top side of the board.

2.5 PCB layout

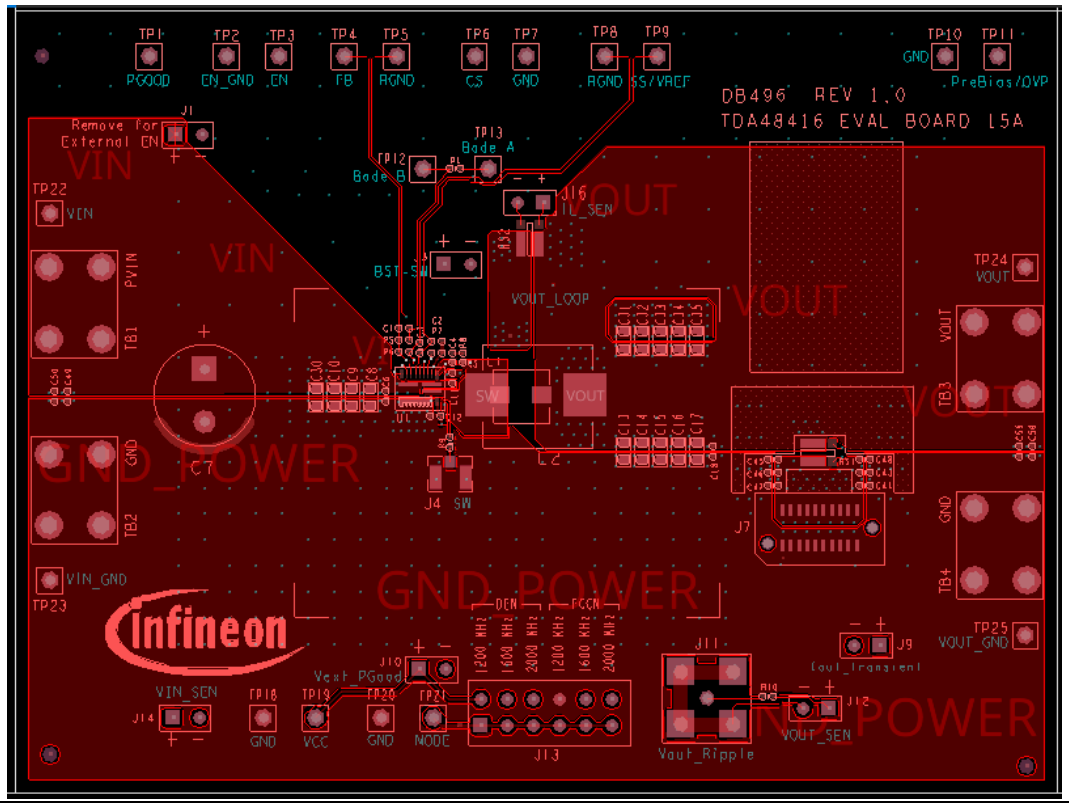


Figure 2 Top layer

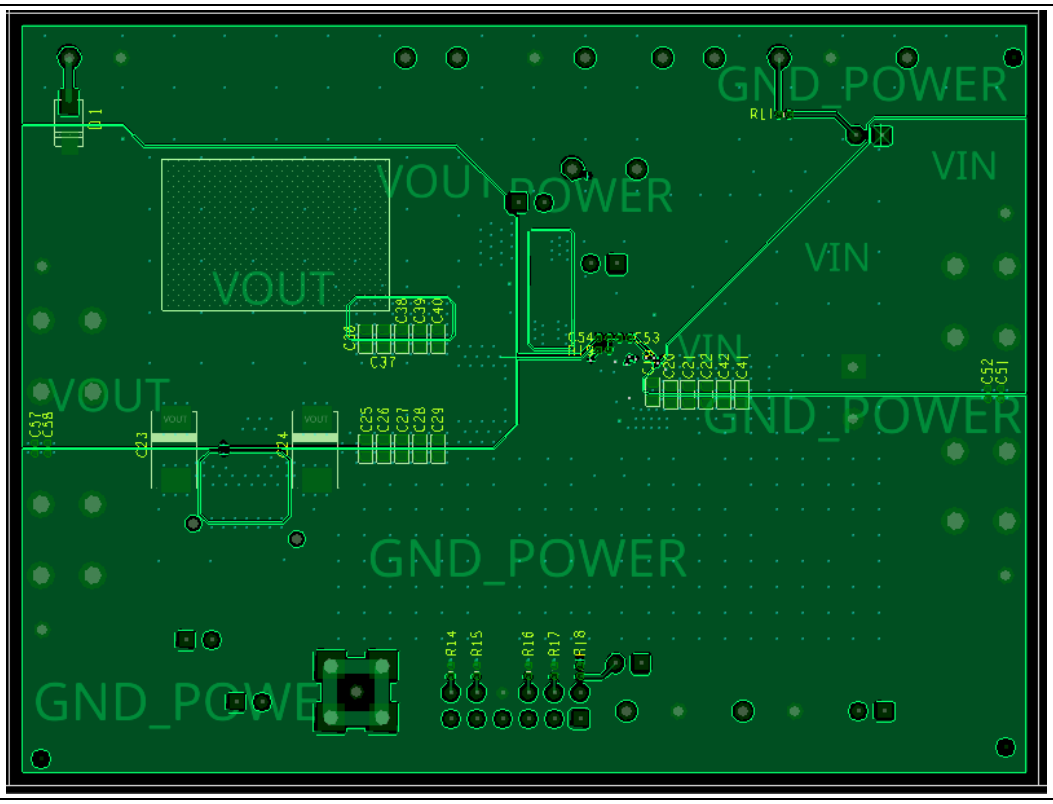


Figure 3 Bottom layer

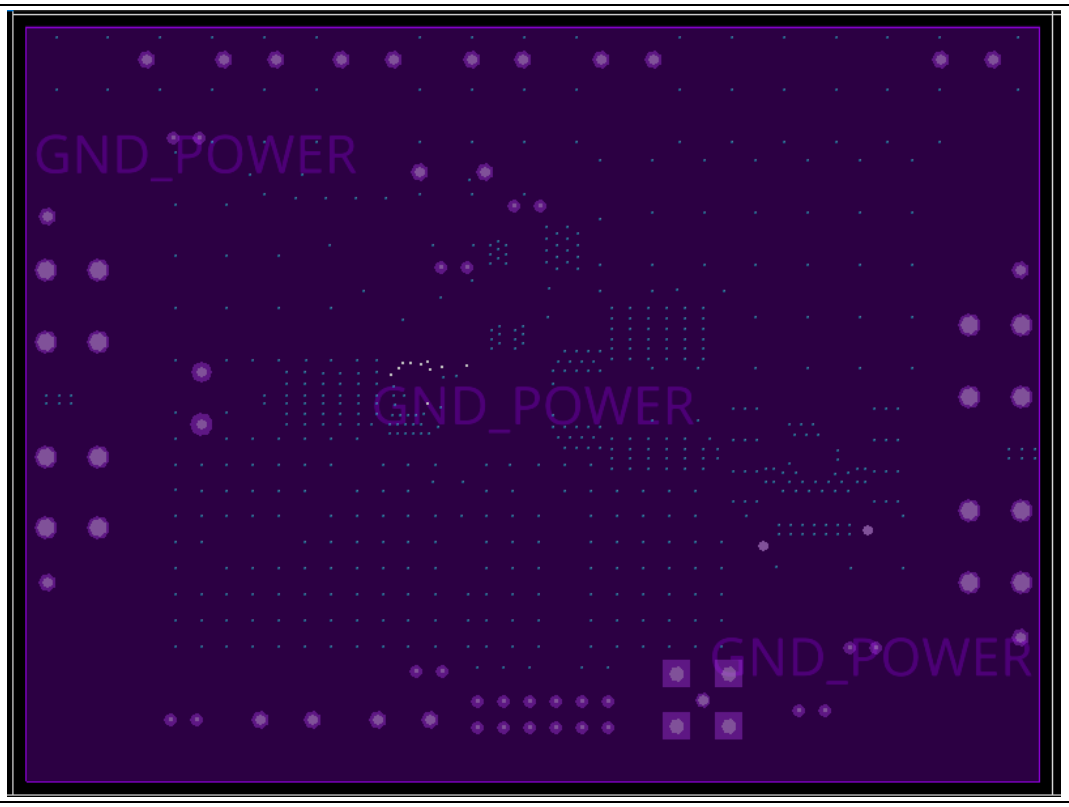


Figure 4 Inner layer 1

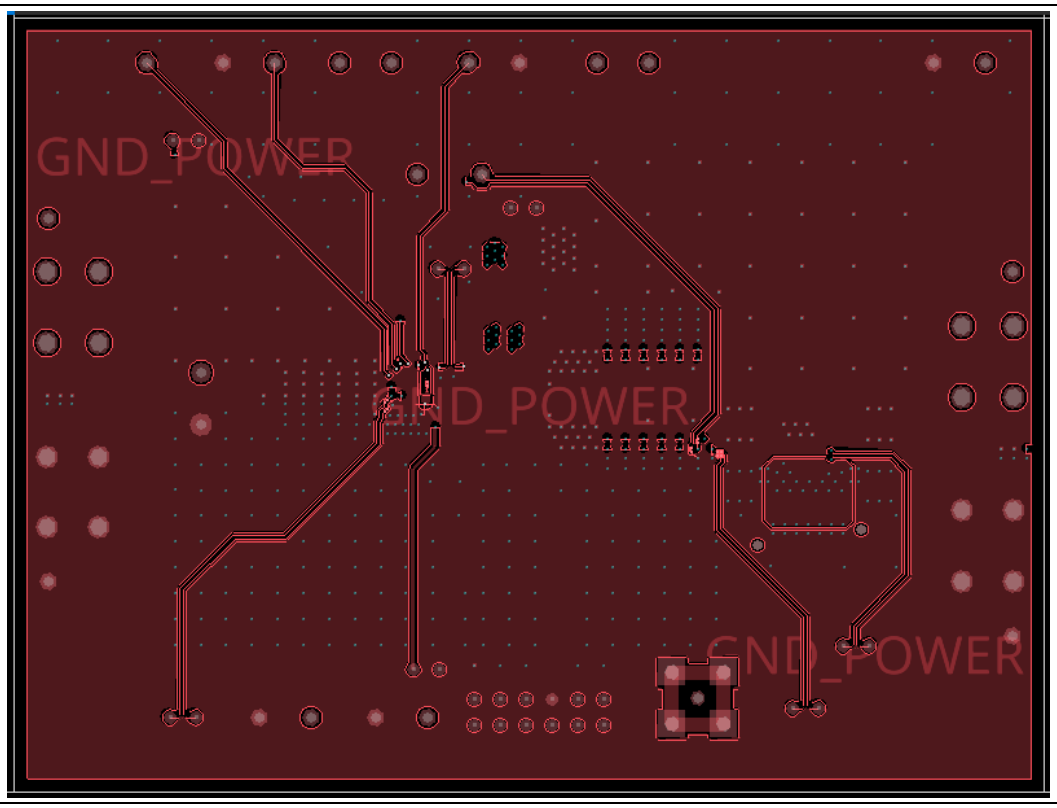


Figure 5 Inner layer 2

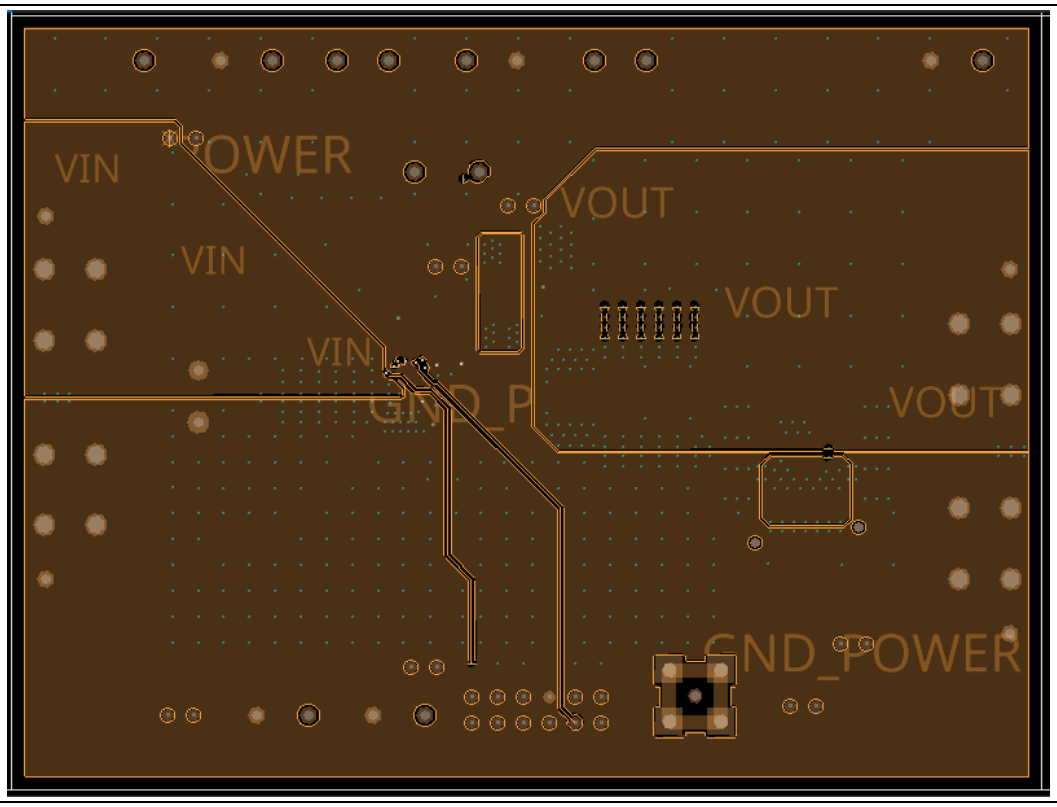


Figure 6 Inner layer 3

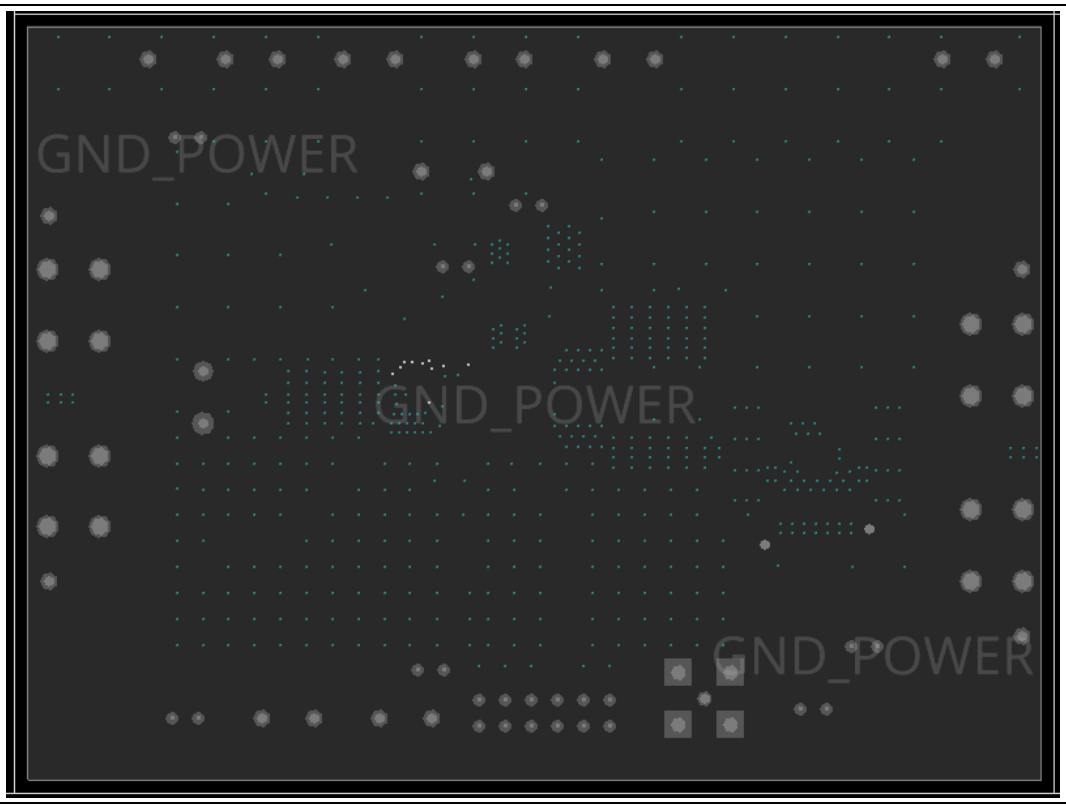


Figure 7 Inner layer 4

2.6 Schematic

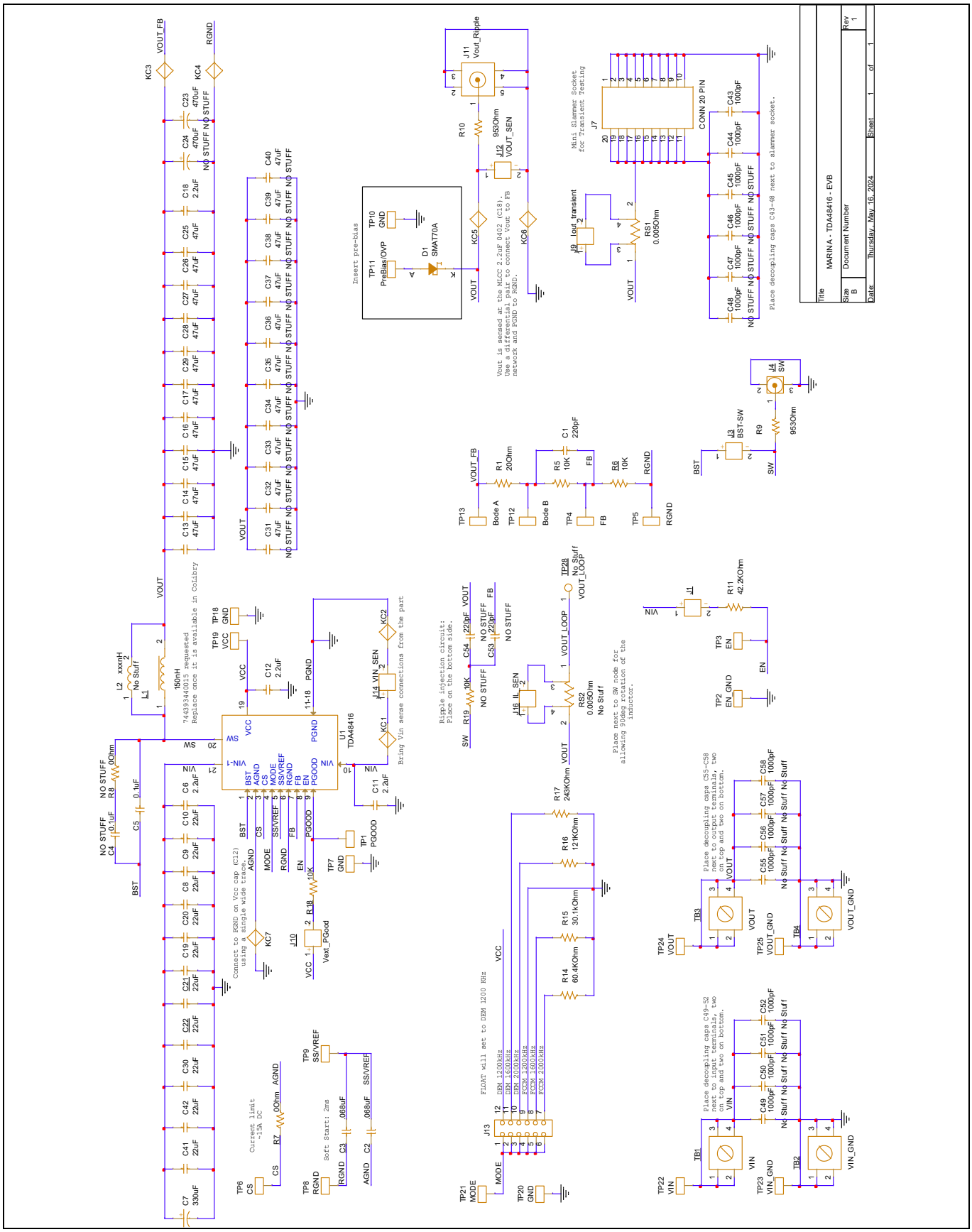


Figure 8 Schematic of the TDA48416 evaluation board V_{IN} = 5 V, V_{OUT} = 1.2 V, I_{OUTmax} = 15 A

2.7 Bill of materials (BOM)

Table 3 Bill of materials

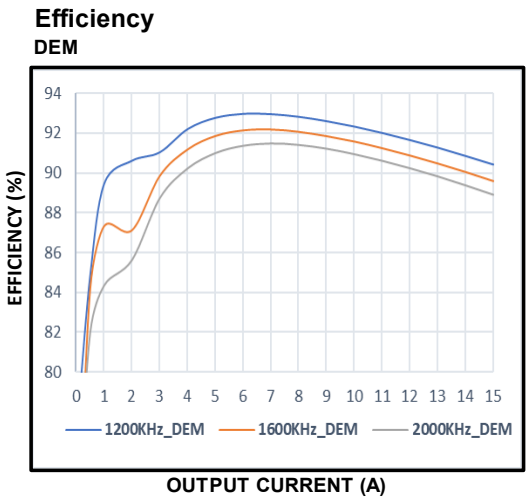
Sl. No	Qty	Reference	Value	Manufacturer	Part number
1	3	C1,C53,C54	220 pF	TDK Corporation	C1005X7R1H221K050BA
2	2	C2,C3	.068 uF	Yageo	CC0402KRX7R7BB683
3	2	C4,C5	0.1 uF	Murata	GRM155R71C104KA88D
4	3	C6,C11,C18	2.2 uF	Murata	GRM155R61E225KE11D
5	1	C7	330 uF	Panasonic Electronic Components	25SEPF330M
6	10	C8,C9,C10,C19,C20,C21,C22,C30,C41,C42	22 uF	Murata	GRM21BR61E226ME44L
7	1	C12	2.2 uF	TDK	C1005X5R1C225K050BC
8	20	C13,C14,C15,C16,C17,C25,C26,C27,C28,C29,C31,C32,C33,C34,C35,C36,C37,C38,C39,C40	47 uF	TDK	C2012X5R0J476M
9	2	C23,C24	470 uF	Panasonic	6TPF470MAH
10	14	C43,C44,C45,C46,C47,C48,C49,C50,C51,C52,C55,C56,C57,C58	1000 pF	Kemet	C0402C102K5RAC7867
11	1	D1	SMAT70A	Diodes Incorporated	SMAT70A-13
12	2	J1,J16	IL_SEN	Harwin Inc.	M20-9990246
13	1	J3	BST-SW	Harwin Inc.	M20-9990246
14	1	J4	SW	TE Connectivity AMP Connectors	1909763-1
15	1	J7	CONN 20 PIN	Samtec Inc.	HSEC8-110-01-S-DV-A-K-TR
16	1	J9	Iout_transient	Harwin Inc.	M20-9990246
17	1	J10	Vext_PGood	Harwin Inc.	M20-9990246
18	1	J11	Vout_Ripple	Cinch Connectivity Solutions Johnson	131-3701-261
19	1	J12	VOUT_SEN	Harwin Inc.	M20-9990246
20	1	J13		Harwin Inc.	M20-9760646
21	1	J14	VIN_SEN	Harwin Inc.	M20-9990246
22	1	L1	330 nH	Würth Elektronik	744393440015
23	2	RS1,RS2	0.005 Ohms	Delta Electronics	RL1632T4F-R005-FNH
24	1	R1	20 Ohm	Yageo	RE0402FRE0720RL
25	4	R5,R6,R18,R19	10K	YAGEO	AC0402FR-0710KL
26	2	R7,R8	0 Ohms	Yageo	RC0402FR-070RL

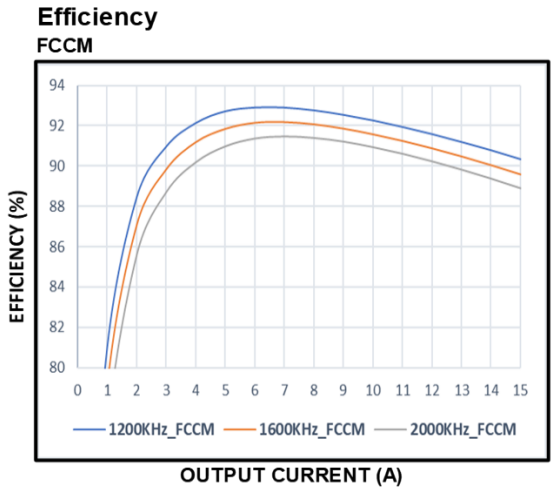
Sl. No	Qty	Reference	Value	Manufacturer	Part number
27	2	R9,R10	953 Ohms	Yageo	RC0402FR-07953RL
28	1	R11	42.2 KOhm	Yageo	RC0402FR-0742K2L
29	1	R14	60.4 KOhm	Yageo	RC0402FR-0760K4L
30	1	R15	30.1 kOhm	Vishay	CRCW040230K1FKED
31	1	R16	121 KOhm	Yageo	RC0402FR-07121KL
32	1	R17	243 KOhm	Yageo	RC0402FR-07243KL
33	1	TB1	VIN	Keystone Electronics	7693
34	1	TB2	VIN_GND	Keystone Electronics	7693
35	1	TB3	VOUT	Keystone Electronics	7693
36	1	TB4	VOUT_GND	Keystone Electronics	7693
37	1	TP1	PGOOD	Vector Electronics	K31C/M
38	1	TP2	EN_GND	Vector Electronics	K31C/M
39	1	TP3	EN	Vector Electronics	K31C/M
40	1	TP4	FB	Vector Electronics	K31C/M
41	2	TP5,TP8	RGND	Vector Electronics	K31C/M
42	1	TP6	CS	Vector Electronics	K31C/M
43	4	TP7,TP10,TP18,TP20	GND	Vector Electronics	K31C/M
44	1	TP9	SS/VREF	Vector Electronics	K31C/M
45	1	TP11	PreBias/OVP	Vector Electronics	K31C/M
46	1	TP12	Bode B	Vector Electronics	K31C/M
47	1	TP13	Bode A	Vector Electronics	K31C/M
48	1	TP19	VCC	Vector Electronics	K31C/M
49	1	TP21	MODE	Vector Electronics	K31C/M
50	1	TP22	VIN	Vector Electronics	K31C/M
51	1	TP23	VIN_GND	Vector Electronics	K31C/M
52	1	TP24	VOUT	Vector Electronics	K31C/M
53	1	TP25	VOUT_GND	Vector Electronics	K31C/M
54	1	U1	TDA48416	Infineon Technologies	TDA48416

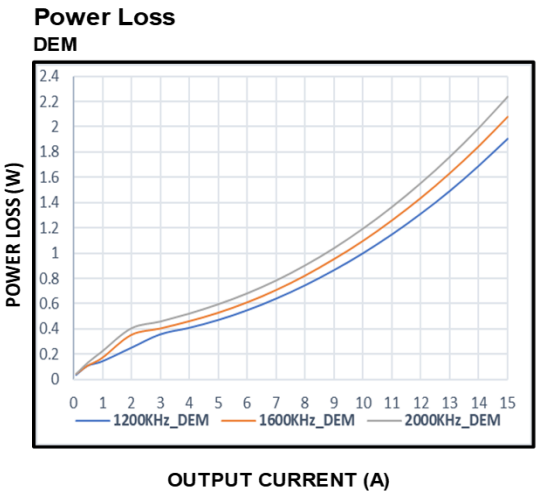
3 Evaluation board test results

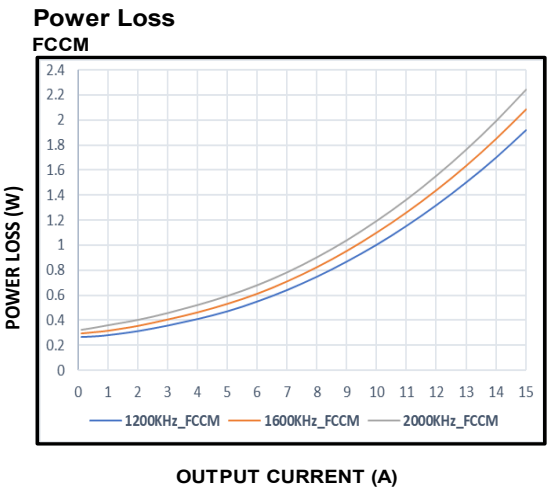
3.1 Typical efficiency and power loss curves

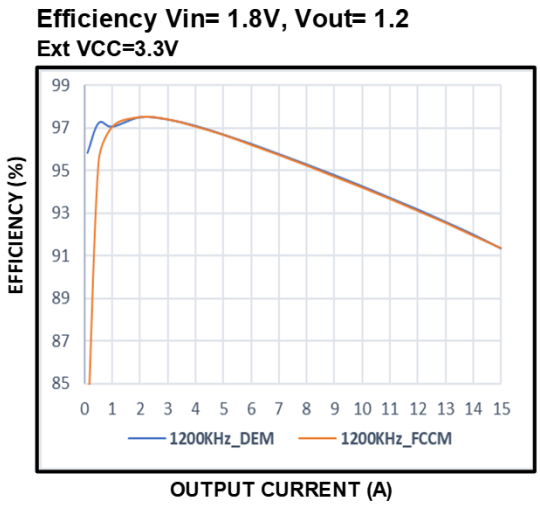
V_{IN} = 5 V, V_{CC} = internal LDO, I_{OUT} = 0 A – 15 A, F_{SW} = 1600 kHz, L=150 nH, room temperature, natural convection. Note that the efficiency and power loss curves include losses of the TDA48416 device, inductor losses, losses of the input and output capacitors, and PCB trace losses.

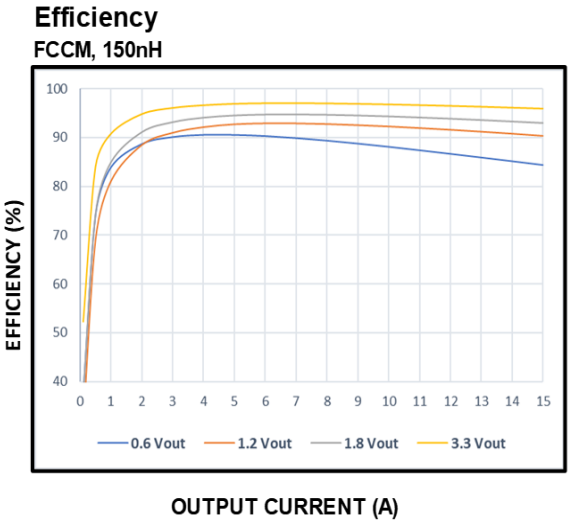

Efficiency
DEM
EFFICIENCY (%)
94
92
90
88
86
84
82
80
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1200KHz_DEM
1600KHz_DEM
2000KHz_DEM
OUTPUT CURRENT (A)


Efficiency
FCCM
EFFICIENCY (%)
94
92
90
88
86
84
82
80
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1200KHz_FCCM
1600KHz_FCCM
2000KHz_FCCM
OUTPUT CURRENT (A)

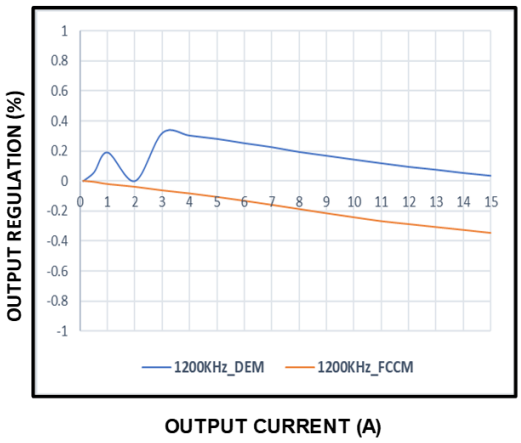

Power Loss
DEM
POWER LOSS (W)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1200KHz_DEM
1600KHz_DEM
2000KHz_DEM
OUTPUT CURRENT (A)


Power Loss
FCCM
POWER LOSS (W)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1200KHz_FCCM
1600KHz_FCCM
2000KHz_FCCM
OUTPUT CURRENT (A)

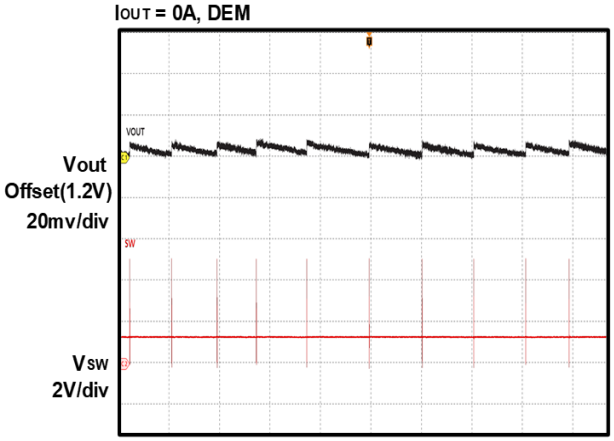

Efficiency Vin= 1.8V, Vout= 1.2
Ext VCC=3.3V
EFFICIENCY (%)
99
97
95
93
91
89
87
85
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1200KHz_DEM
1200KHz_FCCM
OUTPUT CURRENT (A)


Efficiency
FCCM, 150nH
EFFICIENCY (%)
100
90
80
70
60
50
40
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0.6 Vout
1.2 Vout
1.8 Vout
3.3 Vout
OUTPUT CURRENT (A)

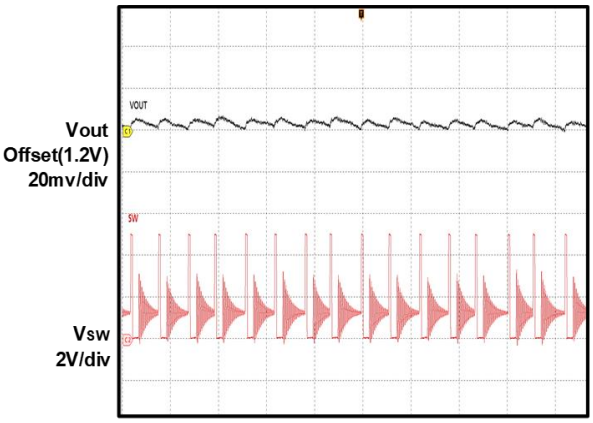
Load Regulation



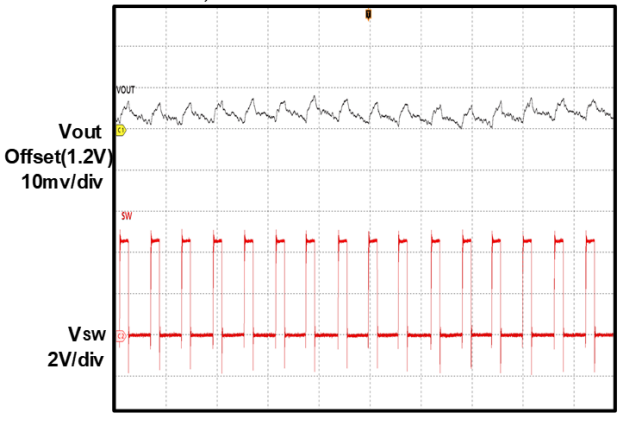
Steady State
IOUT = 0A, DEM



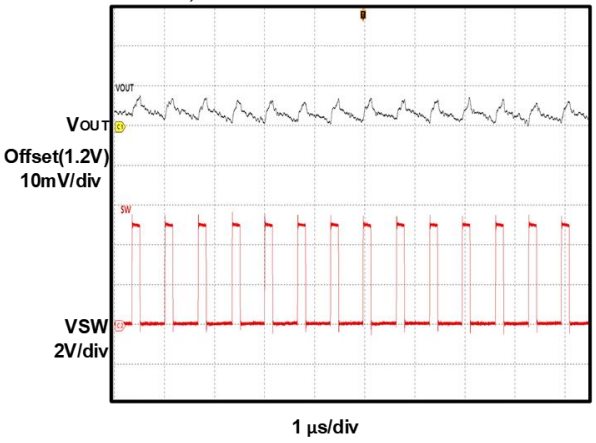
Steady State
IOUT = 0.5A, DEM



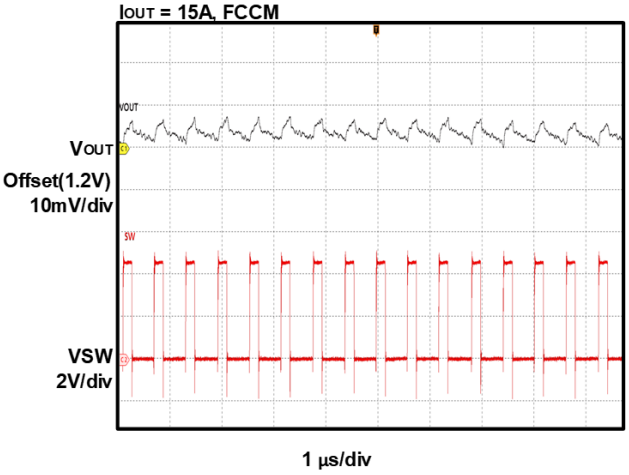
Steady State
IOUT = 15A, DEM



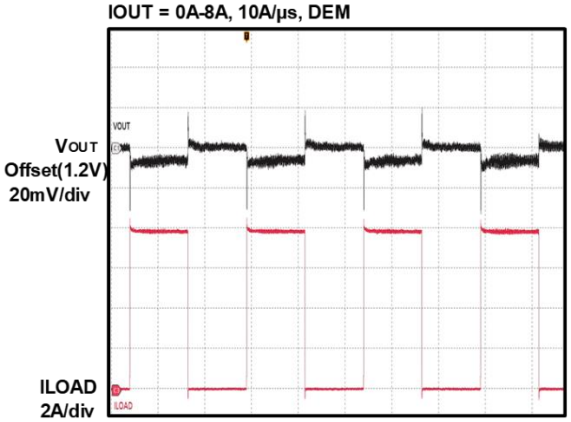
Steady State
IOUT =0A,FCCM



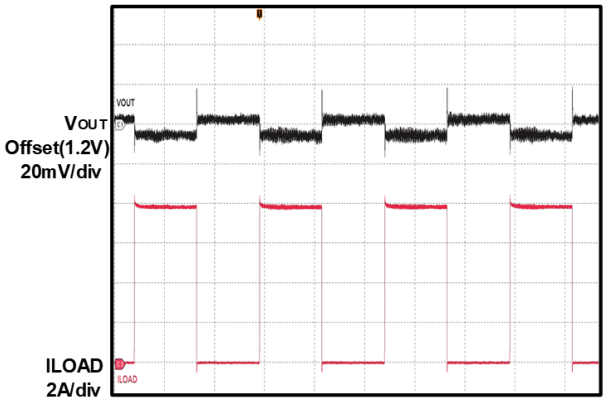
Steady State
IOUT = 15A, FCCM



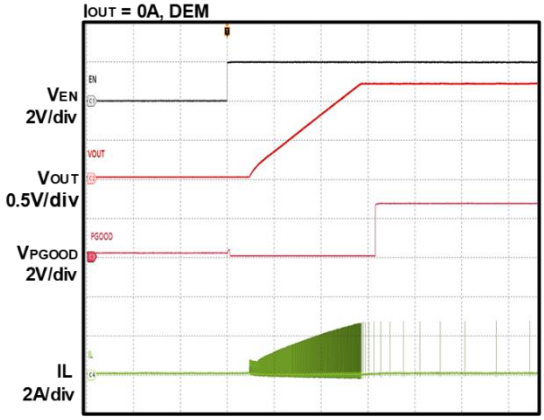
Load Transient
IOUT = 0A-8A, 10A/µs, DEM



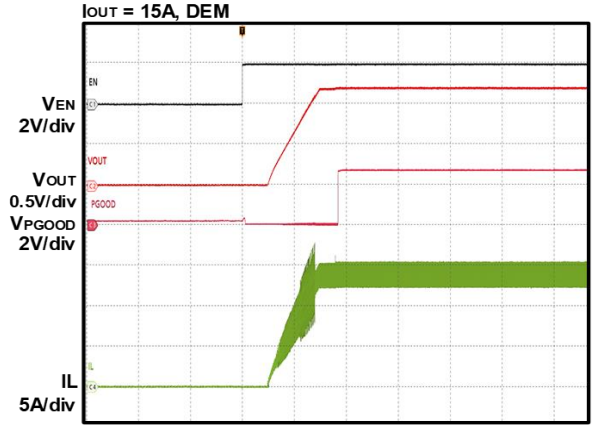
Load Transient
IOUT = 0A-8A, 10A/µs, FCCM



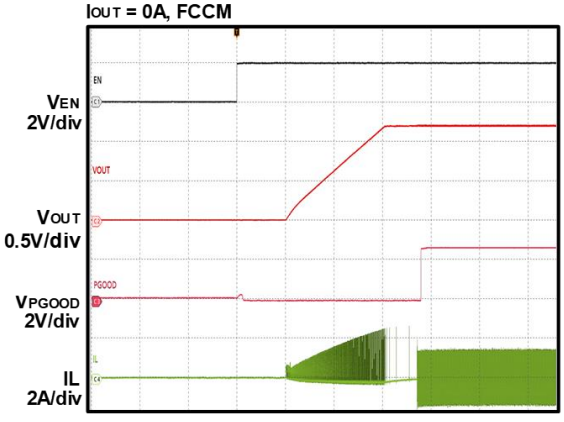
Power-Up through EN
IOUT = 0A, DEM



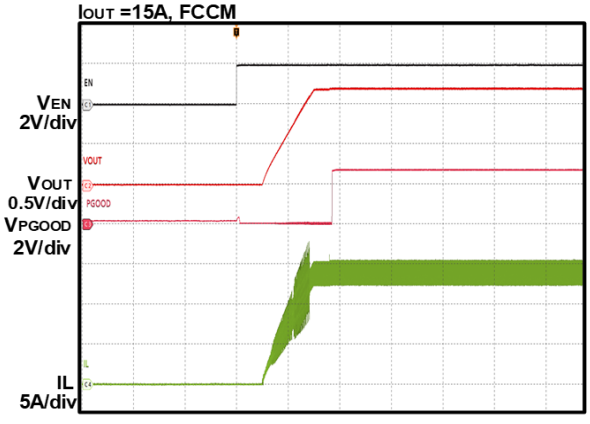
Power-Up through EN
IOUT = 15A, DEM



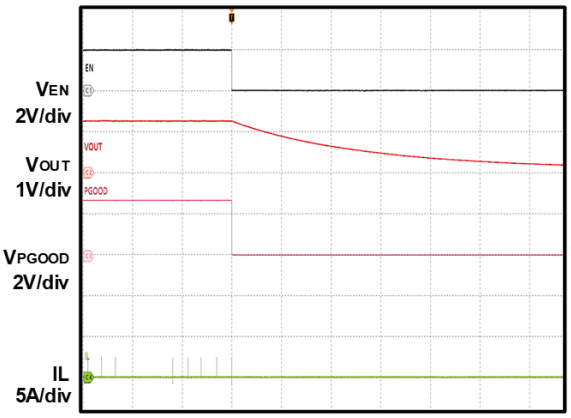
Power-Up through EN
IOUT = 0A, FCCM



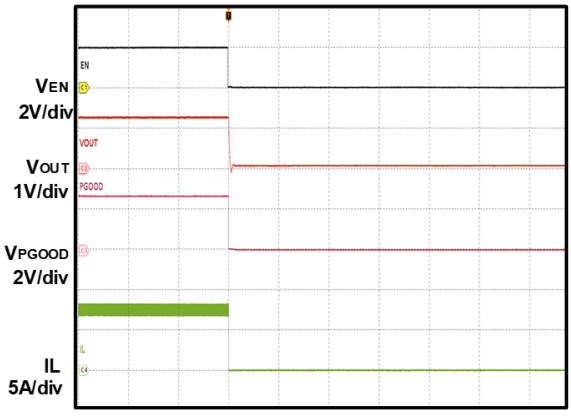
Power-Up through EN
IOUT =15A, FCCM



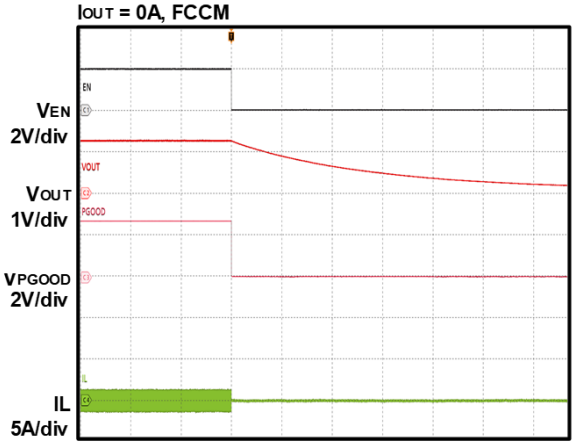
Power-Down through EN
I_{OUT} = 0A, DEM



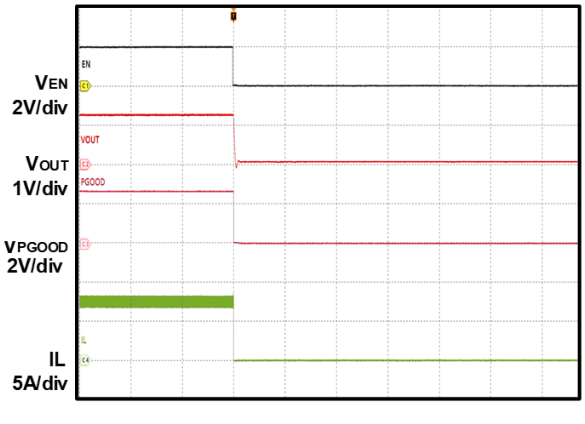
Power-Down through EN
I_{OUT} = 15A, DEM



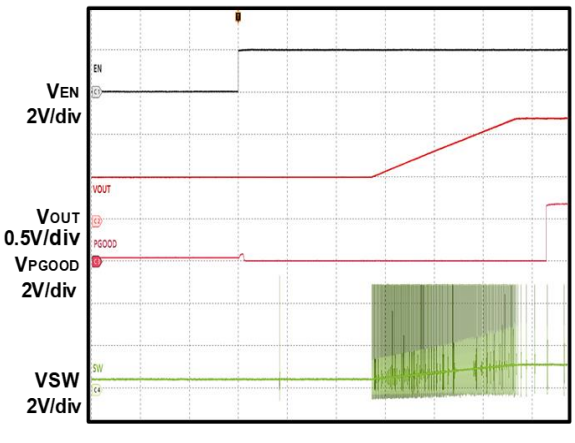
Power-Down through EN
I_{OUT} = 0A, FCCM



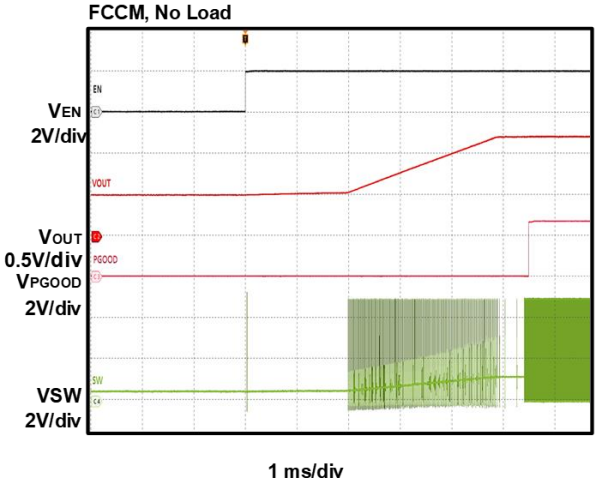
Power-Down through EN
I_{OUT} = 15A, FCCM



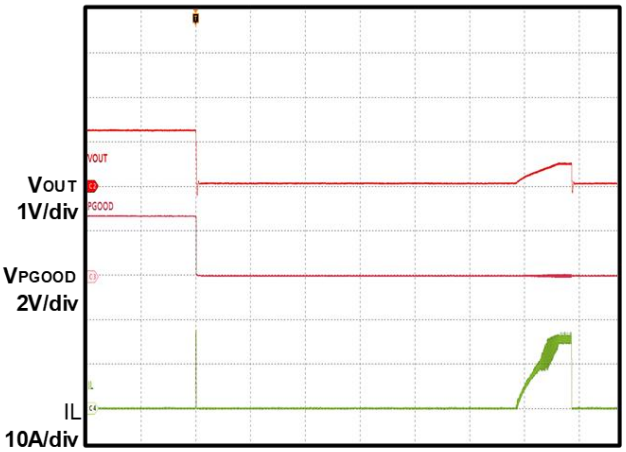
Pre-Bias Start-Up
DEM, No Load



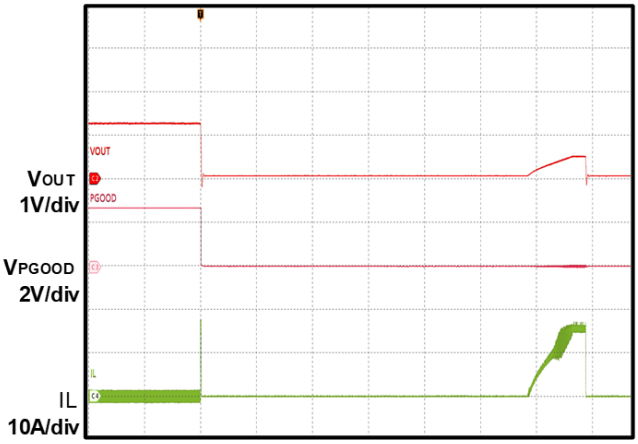
Pre-Bias Start-Up
FCCM, No Load



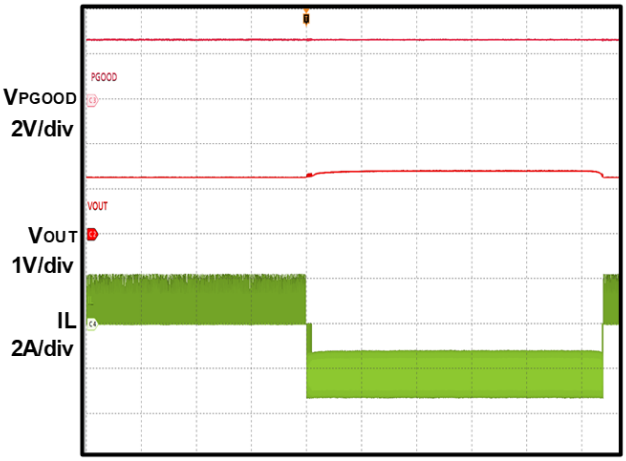
Over-Current Protection
DEM



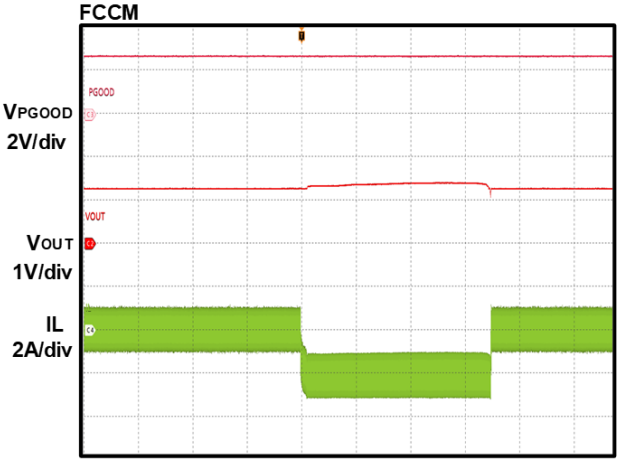
Over-Current Protection
FCCM



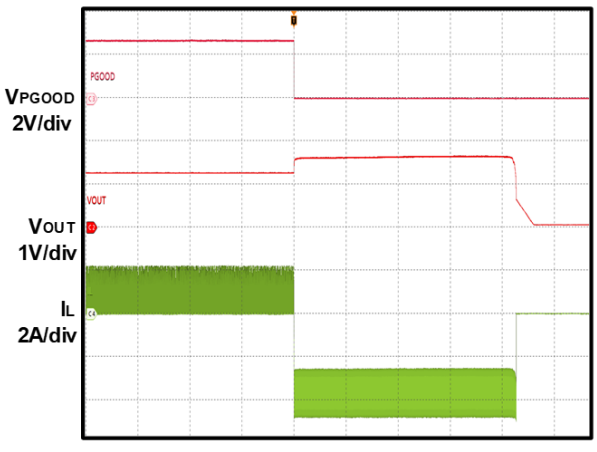
OSM Operation
DEM



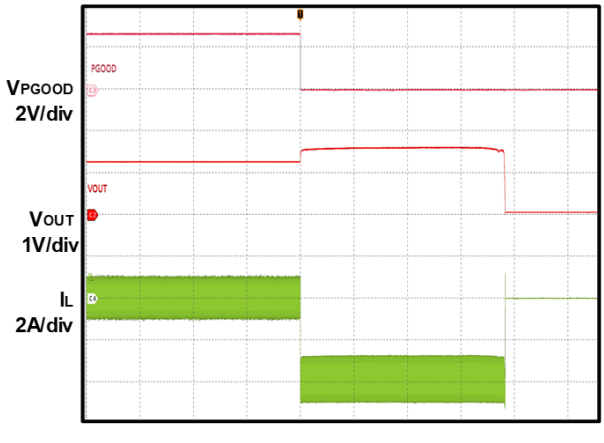
OSM Operation
FCCM



Over-Voltage Protection
DEM



Over-Voltage Protection
FCCM



4 Quick start guide

The EVAL Board can be tested from 2.95 V to 6 V input voltage by connecting the Jumper J1. A lower input voltage as low as 1.8 V with external 3.3 V VCC bias can be set by using an external VCC supply.

Do the following steps to start working on the evaluation board:

1. Connect the positive and negative terminals of the load to the VOUT and GND pins, respectively
2. Preset the power supply output voltage between 2.95 V and 6 V, and then turn off the power supply
3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins, respectively. Ensure that the power supply has a current limit high enough to supply the power
4. Turn the power supply on. The evaluation board will power up automatically
5. To use the enable function, apply a digital input to the EN pin. Drive EN above 1.2 V to turn on the regulator. Drive EN below 1 V to turn off the regulator
6. Use R5 and R6 to set the output voltage with VFB = 0.6 V
7. Use jumper J13 to select the operating frequency (1200 kHz, 1600 kHz, or 2000 kHz) and select FCCM or DEM mode

5 Related resources

- DC-DC converters
- Integrated POL voltage regulators

Revision history

Document revision	Date	Description of changes
V 1.0	2025-09-03	Initial release

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Safety & Operating Instructions:
Customer shall check the Evaluation Board for any physical damage which may have occurred during transport. If customer detects any damages or defects in the Evaluation Board, customer shall not connect the Evaluation Board to a power source. Customer shall contact Infineon for further support. If customer observes unusual operating behavior during the evaluation process, customer shall immediately shut off the power supply to the Evaluation Board and consult Infineon for support.
Customer shall not touch the Evaluation Board during operation and keep a safe distance.
Customer shall not touch the Evaluation Board after disconnecting the power supply, several components may still store electrical voltage and can discharge through physical contact. Several parts, like heat sinks and transformers, may still be very hot. Allow the components to cool before touching or servicing.
The electrical installation must be completed in accordance with the appropriate safety requirements.