

# TDA38812 P3V3 user guide

## User guide for TDA38812 evaluation board

### About this document

#### Scope and purpose

The TDA38812 is a synchronous buck regulator, providing a compact, high performance and flexible solution in a small 3mm X 4mm QFN package.

Key features offered by the TDA38812 include internal Soft Start, precision 0.6V reference voltage, Power Good, thermal protection, programmable switching frequency in the range of 600 kHz to 1 MHz, softstart, Enable input, input under-voltage lockout for proper start-up, latched off over voltage protection, over current protection and pre-bias start-up.

This user guide contains the schematic and bill of materials for the EVAL\_TDA38812\_3.3VOUT engineering evaluation board. The guide describes operation and use of the evaluation board itself. Detailed application information for TDA38812 is available in the TDA38812 data sheet.

#### Intended audience

This document is intended as a guide for design engineers evaluating TDA38812 performance with the engineering EVAL\_TDA38812\_3.3VOUT demo board.

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# **1 TDA38812 Features**

## **Features**

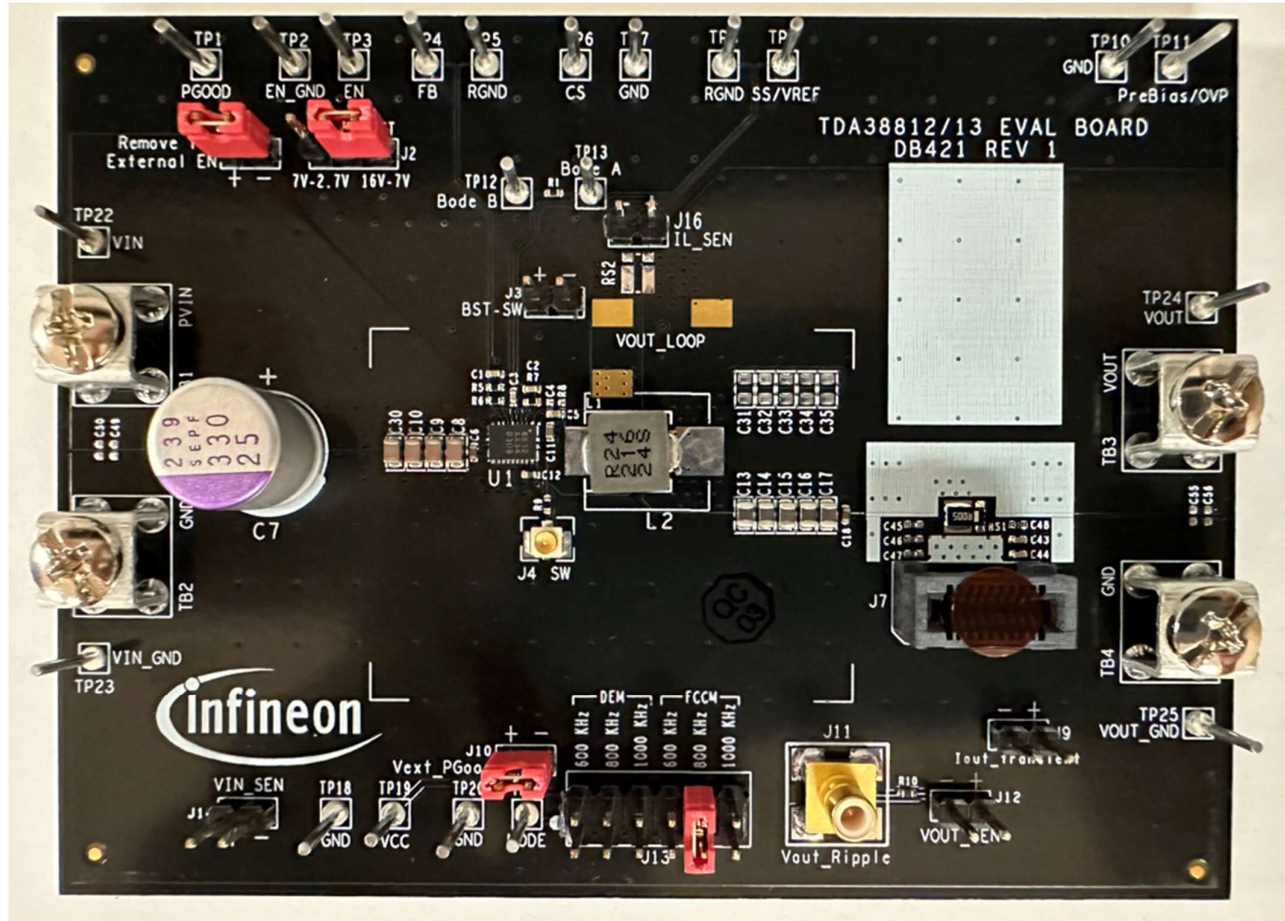
- Wide Input Voltage Range: 4 V to 16 V with internal bias and 2.7 V to 16 V with external VCC (3.3 V)
- Precision Reference Voltage (0.6 V $\pm$ 0.5%)
- Stable with Ceramic Output Capacitors
- No External Compensation
- Optional Forced Continuous Conduction Mode and Diode Emulation for Enhanced Light Load Efficiency
- Selectable Switching Frequency from 600 kHz, 800 kHz, and 1 MHz
- Programmable Soft-Start Time with a minimum of 1 ms & Enhanced Pre-Bias Start-Up
- Voltage Tracking with External Reference Input
- Programmable Over Current Protection Limit with internal thermal compensation
- Enable input with Voltage Monitoring Capability
- Power Good Output
- Non-Latch OCP, UVP, Thermal Shutdown, and Latch-Off OVP
- Operating Temp: -40 °C < Tj < 125 °C
- Small Size: 3 mm x 4 mm QFN-21
- Lead-free, Halogen-free and RoHS Compliant

## **Potential applications**

- Server Applications
- Storage Applications
- Telecom & Datacom Applications
- Distributed Point of Load Power Architectures

## 2 Board information

### 2.1 Evaluation Board



### 2.2 Board features

$V_{in} = +12\text{ V}$ ,  $V_{out} = +3.3\text{ V}$  @ 0- 12 A

$F_s = 600\text{ kHz}/800\text{ kHz}/1000\text{ kHz}$

$L = 820\text{ nH}$

$C_{in} = 3 \times 10\mu\text{F}$  (25 V, ceramic 0805) +  $2 \times 1\mu\text{F}$  (25 V, ceramic 0805) +  $1 \times 100\mu\text{F}$  (25V, Electrolytic , optional)

$C_{out} = 10 \times 100\mu\text{F}$  (6.3 V, ceramic 0805) +  $1 \times 2.2\mu\text{F}$  (6.3 V, ceramic 0805)

## 2.3 Connections and operating instructions

TDA38812 demo board requires a single +12 V for the input power and can deliver up to 12A load current. The operation modes and OCP limits can be selected through jumpers.

**Table 1 Connections**

Label		Descriptions
Input	PVIN	Connect input power (+12 V) to this pin
	GND	Return of input power
	PVIN, PGND_SNS	Sense pins for the input voltage
Output	VOUT	$V_{out}$ (+3.3V), connect a DC load (12A max) to this pin
	PGND	Return of Vout
	VOUT, PGND_SNS	Sense pins for the output voltage
Enable	EN	Connect a scope probe to this pin to monitor Enable Signal
	GND	Or, an external Enable signal can be applied to this Pin to overdrive the on-board Enable signal
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: 600kHz, 800kHz, 1000kHz.
	DEM	
CS		Use a resistor to connect to CS to configure the current limit
PGood	PGOOD	Connect a scope probe to this pin to monitor Power Good Signal
	GND	GND
RGND	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.
Vcc	Vcc	Standard demo board is configured to use the internal LDO. Connect a scope probe to this pin to monitor the output of the internal LDO.
	GND	

## 2.4 Layout

The PCB is a 6-layer board using FR4 material. Top and bottom layers use 20z copper and inner layers use 10z. copper. The PCB thickness is 1.6mm. The TDA38812 and other major power components are mounted on the top side of the board.

## 2.5 PCB Layout

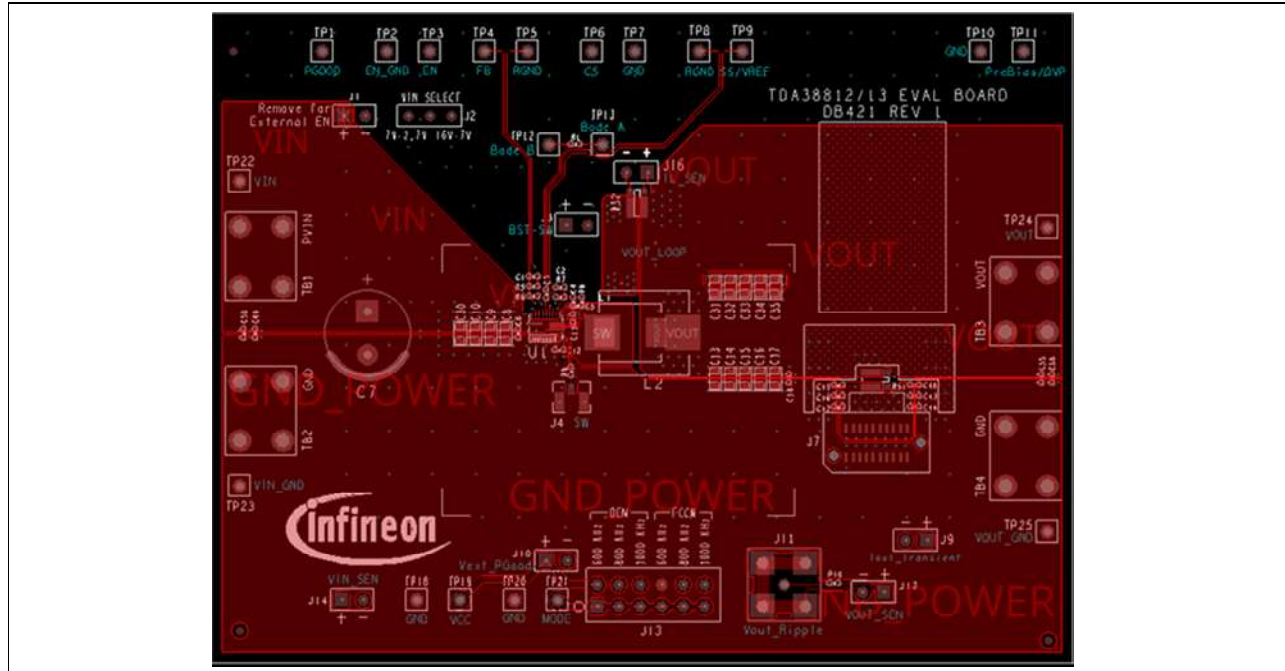


Figure 1 Top Layer

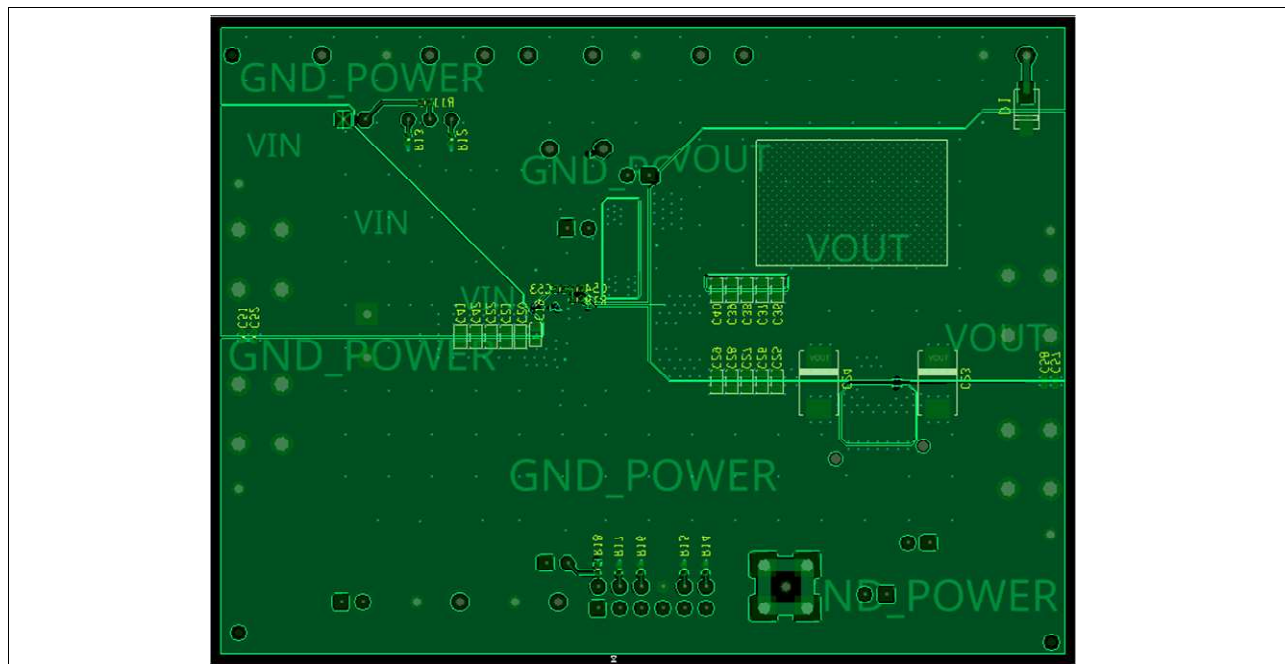


Figure 2 Bottom Layer



Figure 3 Inner Layer 1

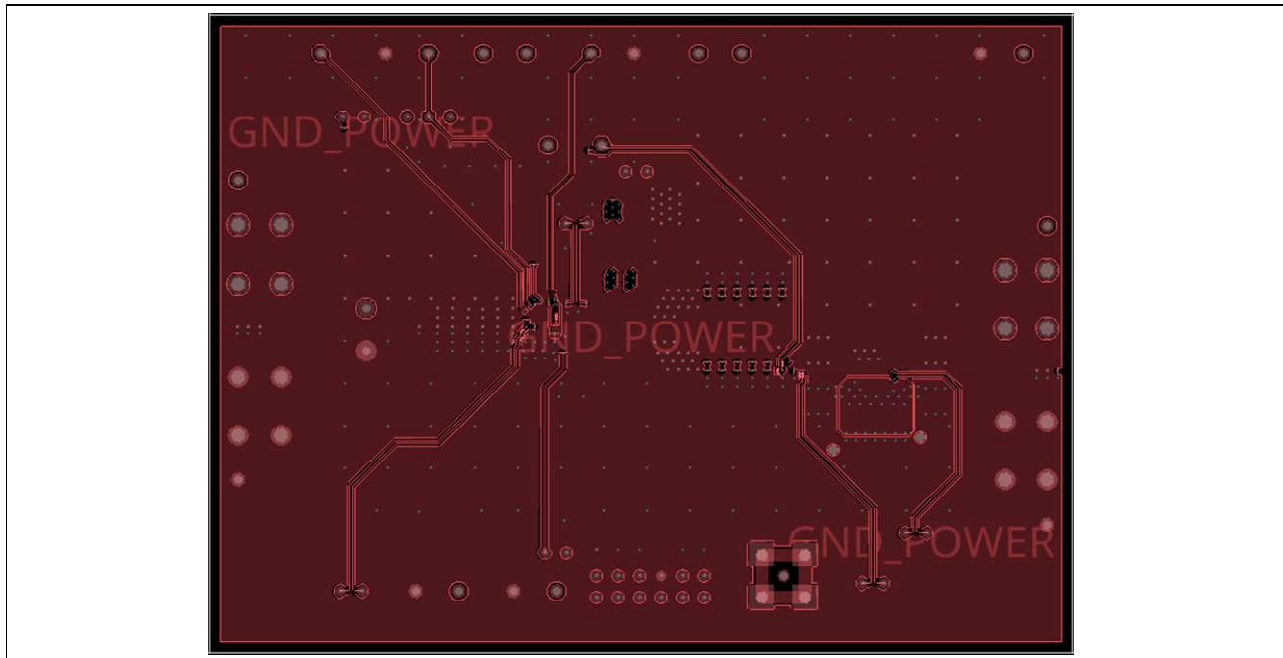


Figure 4 Inner Layer 2

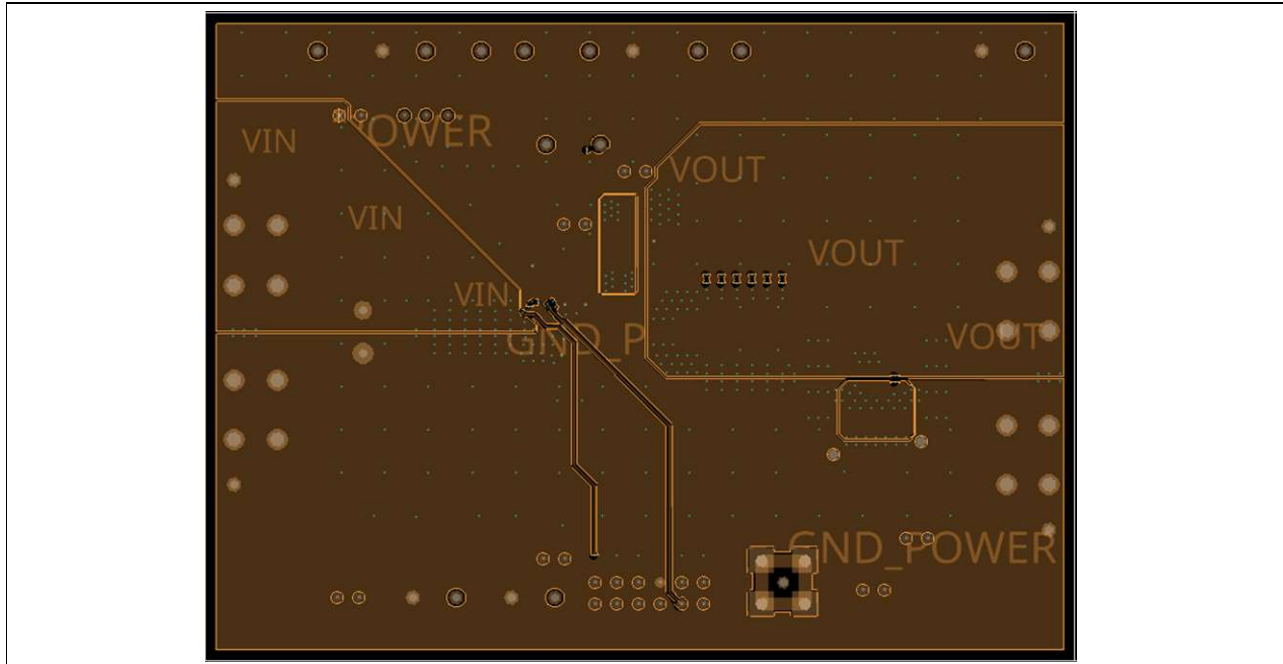


Figure 5 Inner Layer 3

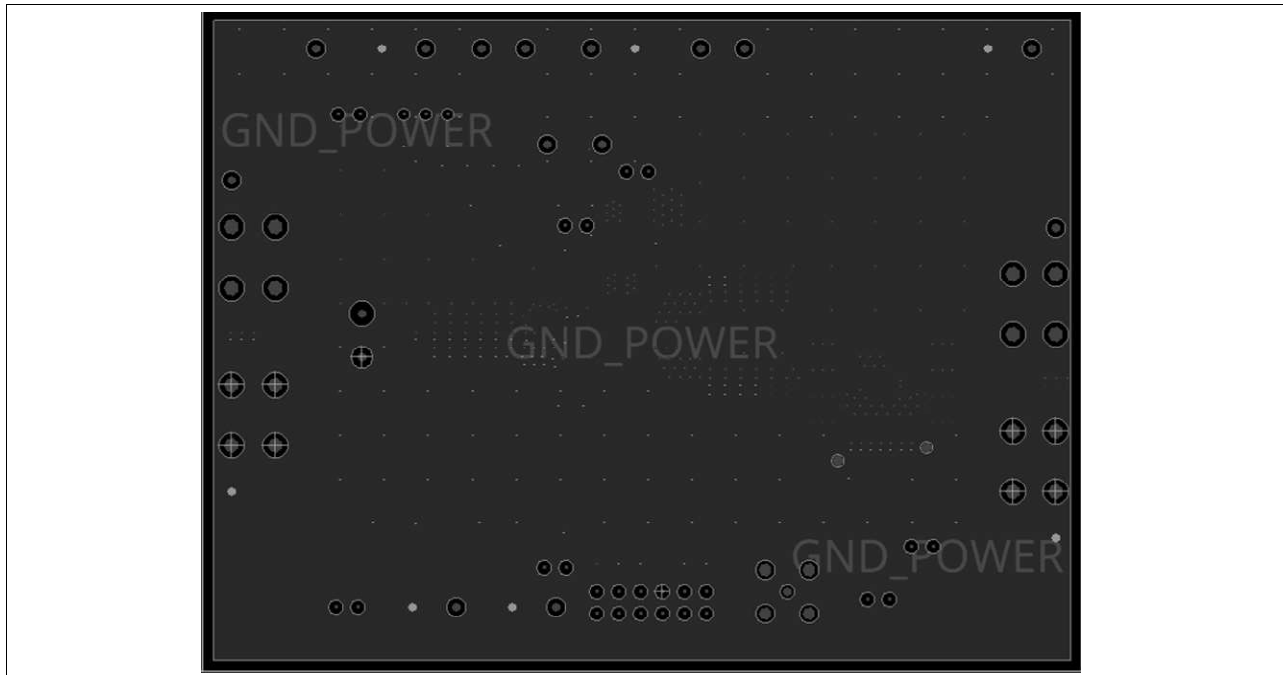


Figure 6 Inner Layer 4



## 2.6 Schematic

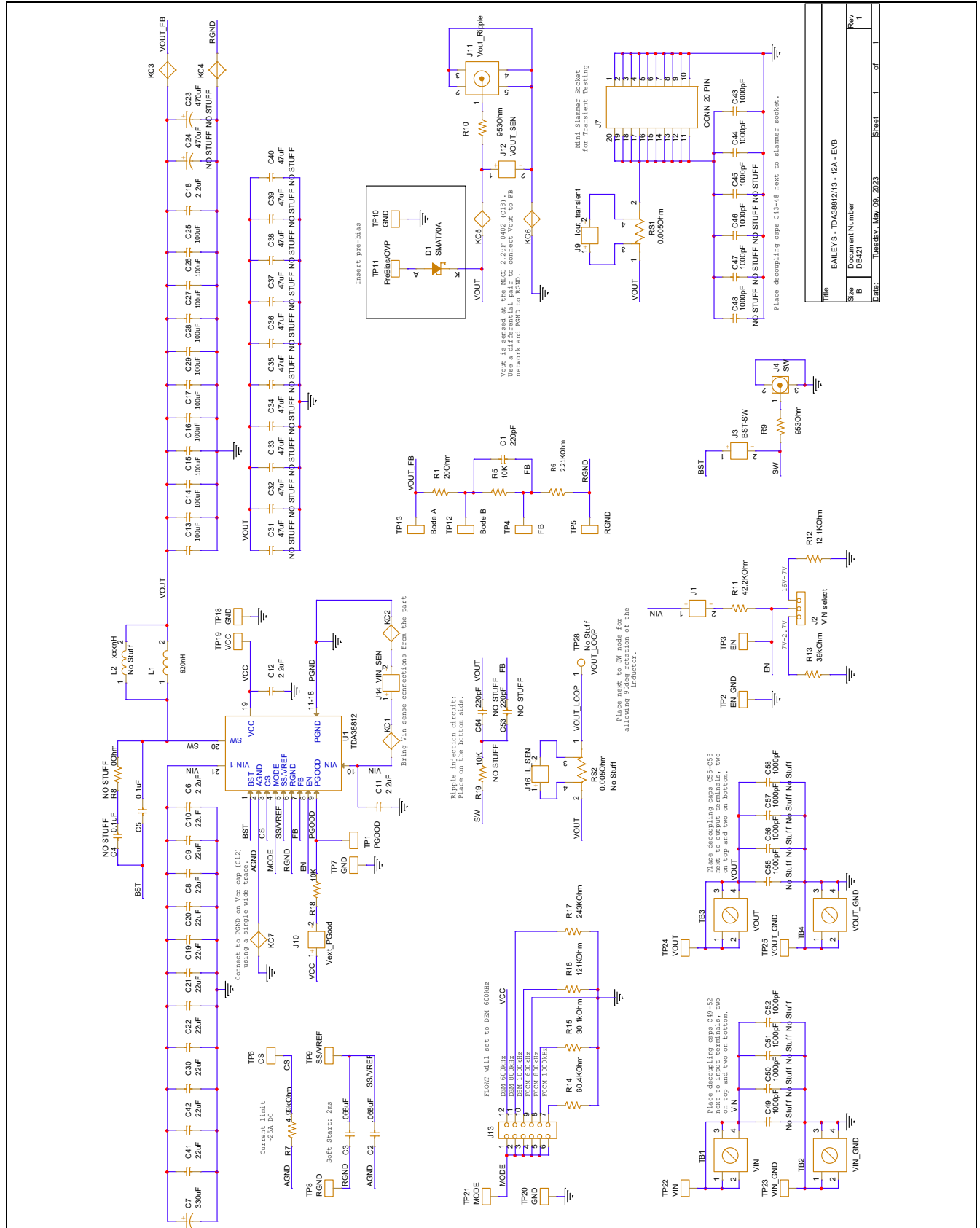


Figure 7 Schematic of the TDA38812 evaluation board  $V_{in} = 12\text{ V}$ ,  $V_O = 3.3\text{ V}$ ,  $I_{Outmax} = 12\text{ A}$

## 2.7 Bill of materials

Table 2 Bill of Materials

Item #	Qty	Value	Part Reference	Description	Manufacturer	PART_NUMBER
1	1	220pF	C1	CAP CER 220pF 50V X7R 0402 10%	TDK Corporation	C1005X7R1H221K050BA
2	1	2.2uF	C12	CAP CER 2.2uF 16V X5R 0402 10%	TDK	C1005X5R1C225K050BC
3	10	100uF	C13 C14 C15 C16 C17 C25 C26 C27 C28 C29	CAP CER 100uF 6.3V X5R 0805 20%	TDK	CM21X5R107M06AT
4	2	.068uF	C2 C3	CAP CER .068uF 16V X7R 0402 10%	Yageo	CC0402KRX7R7BB683
5	2	1000pF	C43 C44	CAP CER 1000pF 50V X7R 0402 10%	Kemet	C0402C102K5RAC7867
6	1	0.1uF	C5	CAP CER 0.1uF 16V X7R 0402 10%	Murata	GRM155R71C104KA88D
7	3	2.2uF	C6 C11 C18	CAP CER 2.2uF 25V X5R 0402 10%	Murata	GRM155R61E225KE11D
8	1	330uF	C7	CAP ALUM POLY 330UF 20% 25V T/H	Panasonic Electronic Components	25SEPF330M
9	10	22uF	C8 C9 C10 C19 C20 C21 C22 C30 C41 C42	CAP CER 22uF 25V X5R 0805 20%	Murata	GRM21BR61E226ME44L
10	1	SMAT70A	D1	TVS DIODE 70VWM 100VC SMA	Diodes Incorporated	SMAT70A-13-F

11	7	-	J1 J3 J9 J10 J12 J14 J16	CONN HEADER VERT 2POS 2.54MM	Harwin Inc.	M20-9990246
12	1	-	J11	CONN SMB JACK STR 50 OHM PCB	Cinch Connectivity Solutions Johnson	131-3701-261
13	1		J13	CONN HEADER VERT 12POS 2.54MM	Adam Tech	PH2-12-UA
14	1	-	J2	CONN HEADER R/A 3POS 2.54MM	Harwin Inc.	M20-9960345
15	1	-	J4	CONN UMCC JACK STR 50OHM SMD	TE Connectivity AMP Connectors	1909763-1
16	1	CONN 20 PIN	J7	CONN EDGE DUAL FEMALE 20POS 0.031	Samtec Inc.	HSEC8-110-01-S-DV-A- K-TR
17	1	820 nH	L1	FIXED IND 820NH 18A SMD	Delta Electronics/Cyntec	CMLE063T-R82MS
18	1	200Ohm	R1	RES Thick Film 20.0 Ohm 1/16W 1% SMD 0402	Yageo	RE0402FRE0720RL
19	1	42.2KOhm	R11	RES Thick Film 42.2K Ohm 1/16W 1% 0402	Yageo	RC0402FR-0742K2L
20	1	12.1KOhm	R12	RES Thick Film 12.1K Ohm 1/10W 1% 0402	Panasonic	ERJ-2RKF1212X
21	1	39kOhm	R13	RES Thick Film 39 kOhm 5.0 % 1/16 W SMD 0402	Panasonic	ERJ-2GEJ393X
22	1	60.4KOhm	R14	RES Thick Film 60.4K Ohm 1/10W 1% 0402	Yageo	RC0402FR-0760K4L
23	1	30.1kOhm	R15	RES Thick Film 30.1 kOhm 1.0 % 1/16 W SMD 0402	Vishay	CRCW040230K1FKED
24	1	121KOhm	R16	RES Thick Film 121K Ohm 1/10W 1% 0402	Yageo	RC0402FR-07121KL

25	1	243KOhm	R17	RES Thick Film 243K Ohm 1/16W 1% 0402	Yageo	RC0402FR-07243KL
26	2	10KOhm	R5, R18	RES SMD 10K OHM 1% 1/16W 0402	YAGEO	AC0402FR-0710KL
27	1	2.21KOhm	R6	RES Thick Film 2.21K Ohm 1/16W 1% 0402	Yageo	RC0402FR-072K21L
28	1	4.99kOhm	R7	RES Thick Film 4.99K Ohm 1/16W 1% 0402	Yageo	RC0402FR-074K99L
29	2	953Ohm	R9 R10	RES Thick Film 953 Ohm 1/10W 1% 0402	Yageo	RC0402FR-07953RL
30	1	0.005Ohm	RS1	RES Thick Film 0.005 Ohm 1W 1% SMD 1632	Delta Electronics	RL1632T4F-R005-FNH
31	4	-	TB1 TB2 TB3 TB4	TERM SCREW 6-32 4 PIN PCB	Keystone Electronics	7693
32	21	-	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP18 TP19 TP20 TP21 TP22 TP23 TP24 TP25	PIN INBOARD .042" HOLE 1000/PKG	Vector Electronics	K30C/M
33	1	TDA38812	U1	TDA38812 12A Single-voltage Synchronous Buck Regulator	Infineon	TDA38812

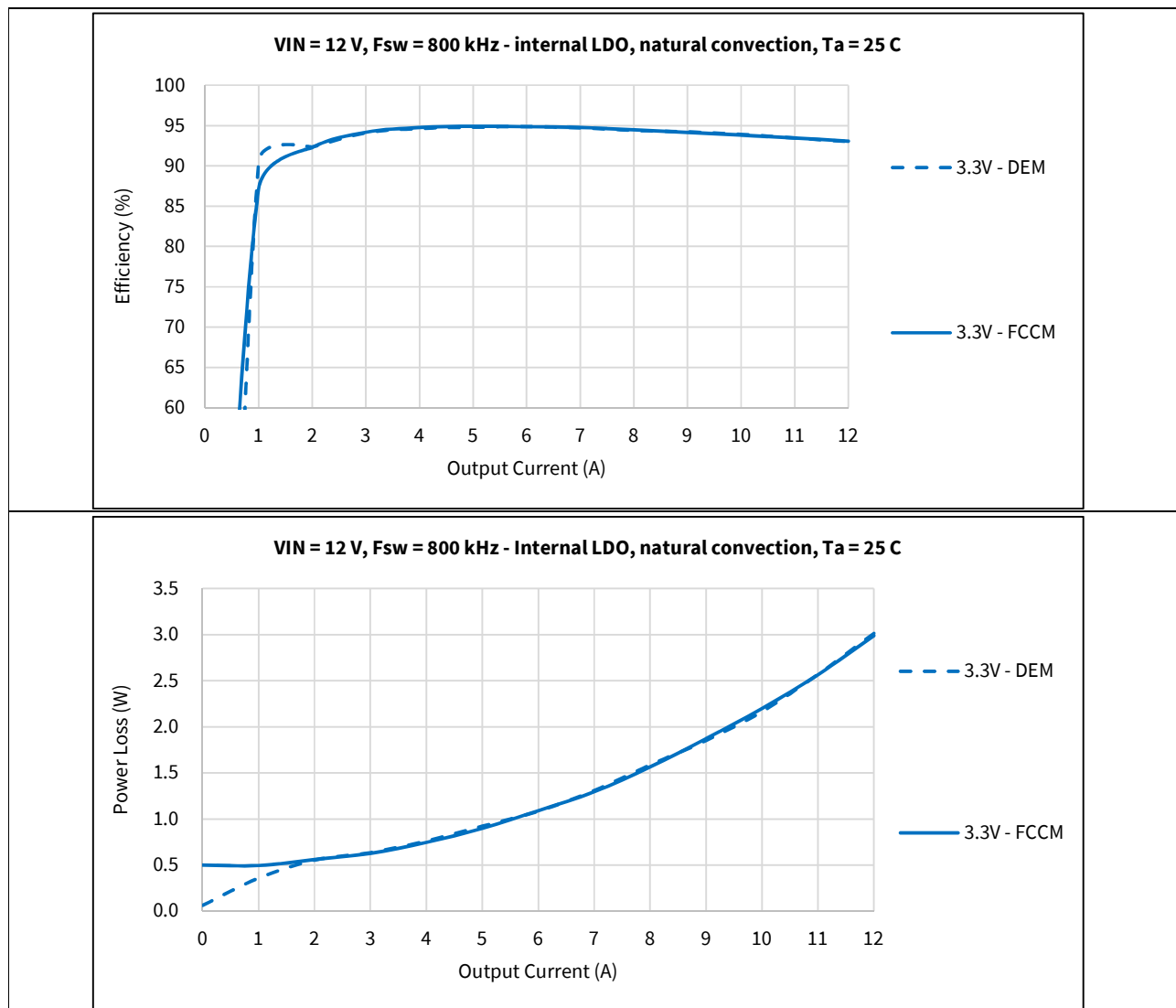
### 3 Evaluation Board Test Results

#### 3.1 Typical Efficiency and Power loss curves

VIN = 12 V, VCC = internal LDO, Iout = 0 A – 12 A, Fsw = 800 kHz, room temperature, natural convection. Note that the efficiency and power loss curves include losses of the TDA38812, inductor losses, losses of the input and output capacitors, and PCB trace losses. [Table 3](#) shows the inductors used for each of the output voltages in the efficiency measurement.

**Table 3 Inductors for VIN = 12 V, Fsw = 800 kHz**

Vout (V)	Lout (nH)	P/N	DCR (mΩ)	Size (mm)
3.3	820 nH	CMLE063T-R82MS	4.7	7.25 x 6.6 x 2.8



**Figure 8 Efficiency and Power Loss**

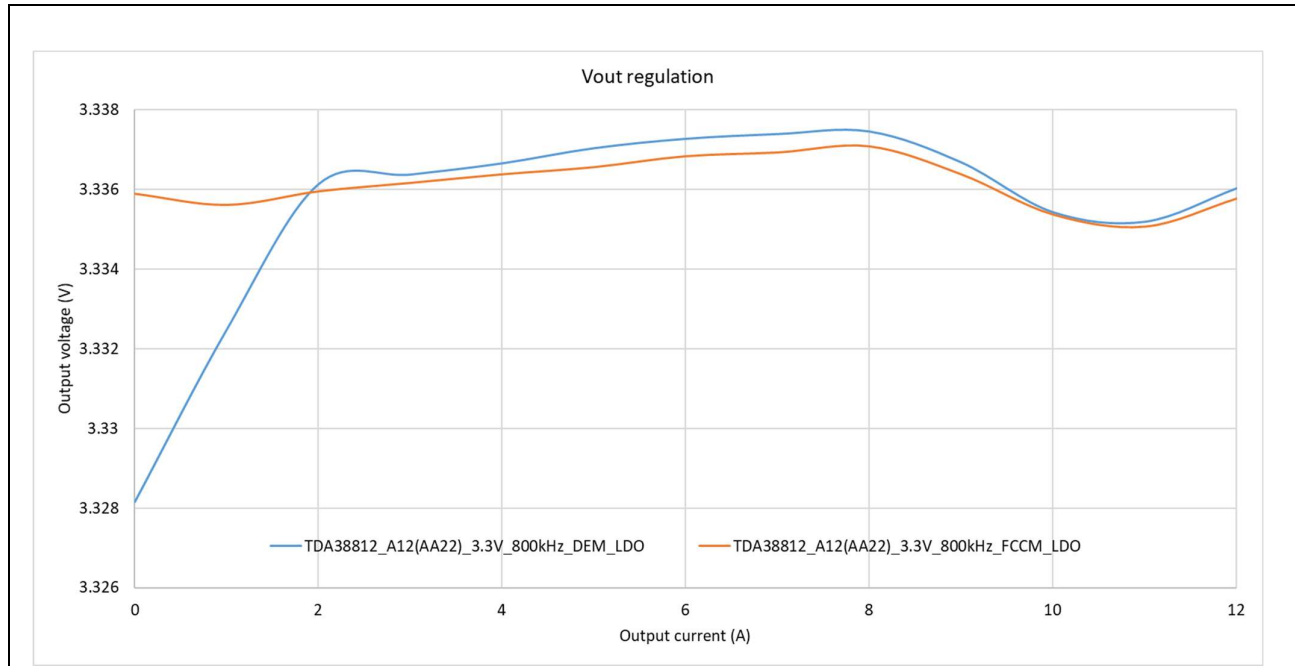


Figure 9 Output Voltage Regulation

### 3.2 Typical Operating Waveforms

$PV_{in} = V_{in} = 12.0\text{ V}$ ,  $V_o = 3.3\text{ V}$ ,  $I_o = 12\text{ A}$ ,  $f_{sw} = 800\text{ kHz}$ , Room Temperature, no airflow

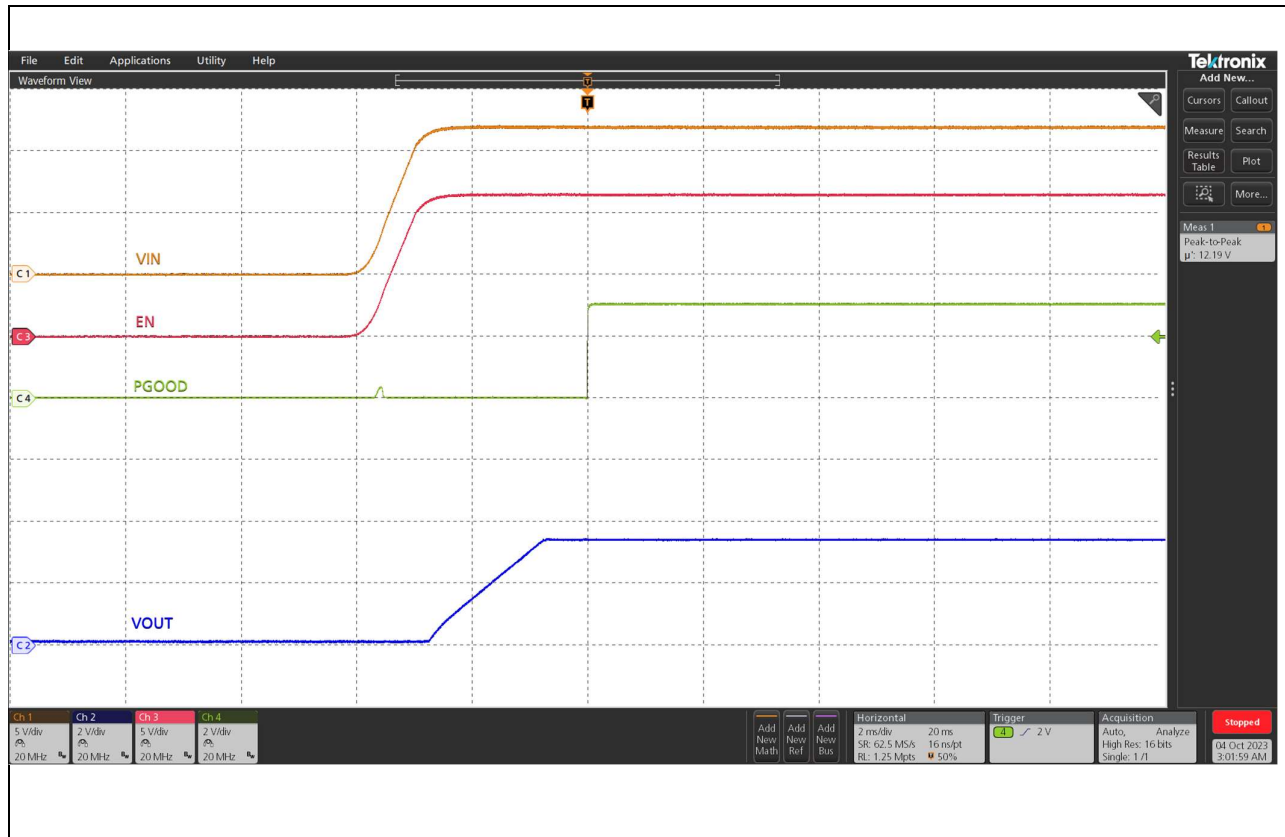


Figure 10 Start up at 12 A Load, (Ch1: Vin, Ch2: Vout, Ch4:PGood ,Ch3:Enable)

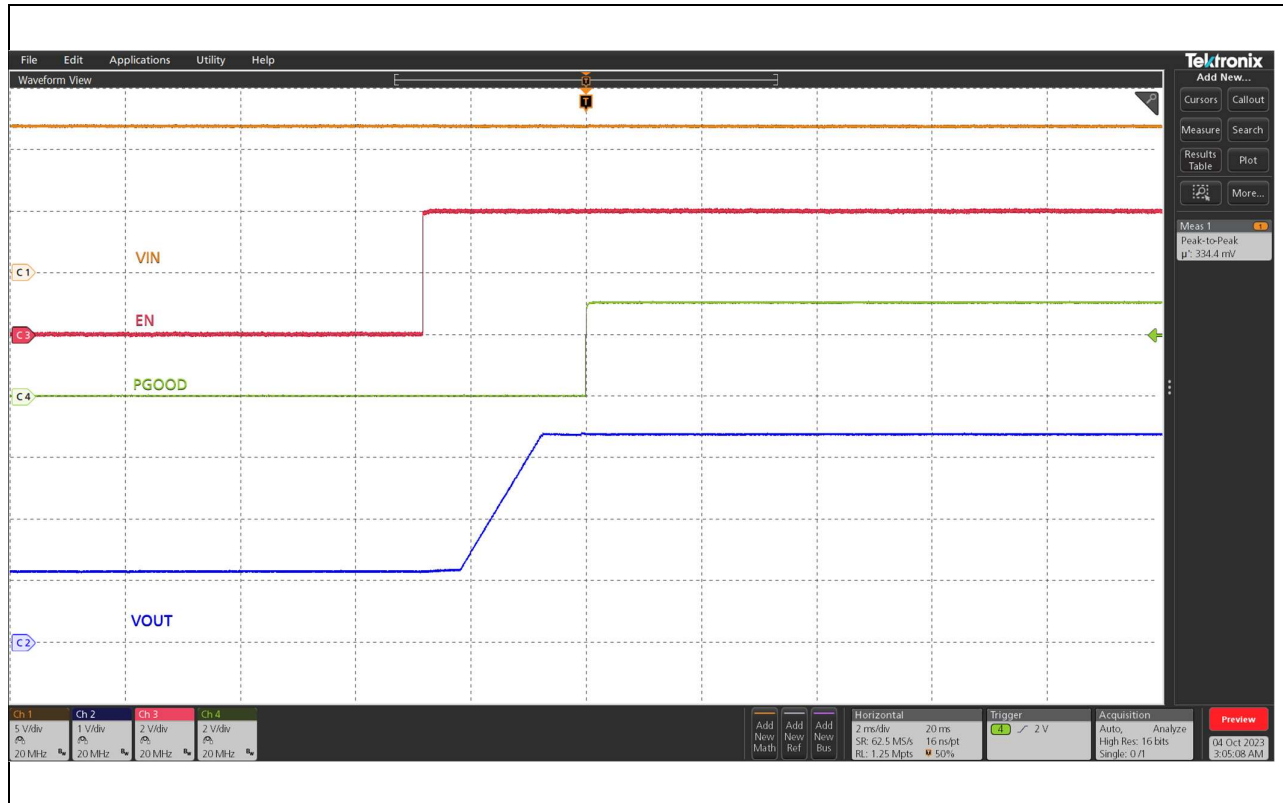


Figure 11 Pre-bias Start up at 0 A Load, (Ch1: Vin, Ch2: Vout, Ch4:PGood ,Ch3:Enable)

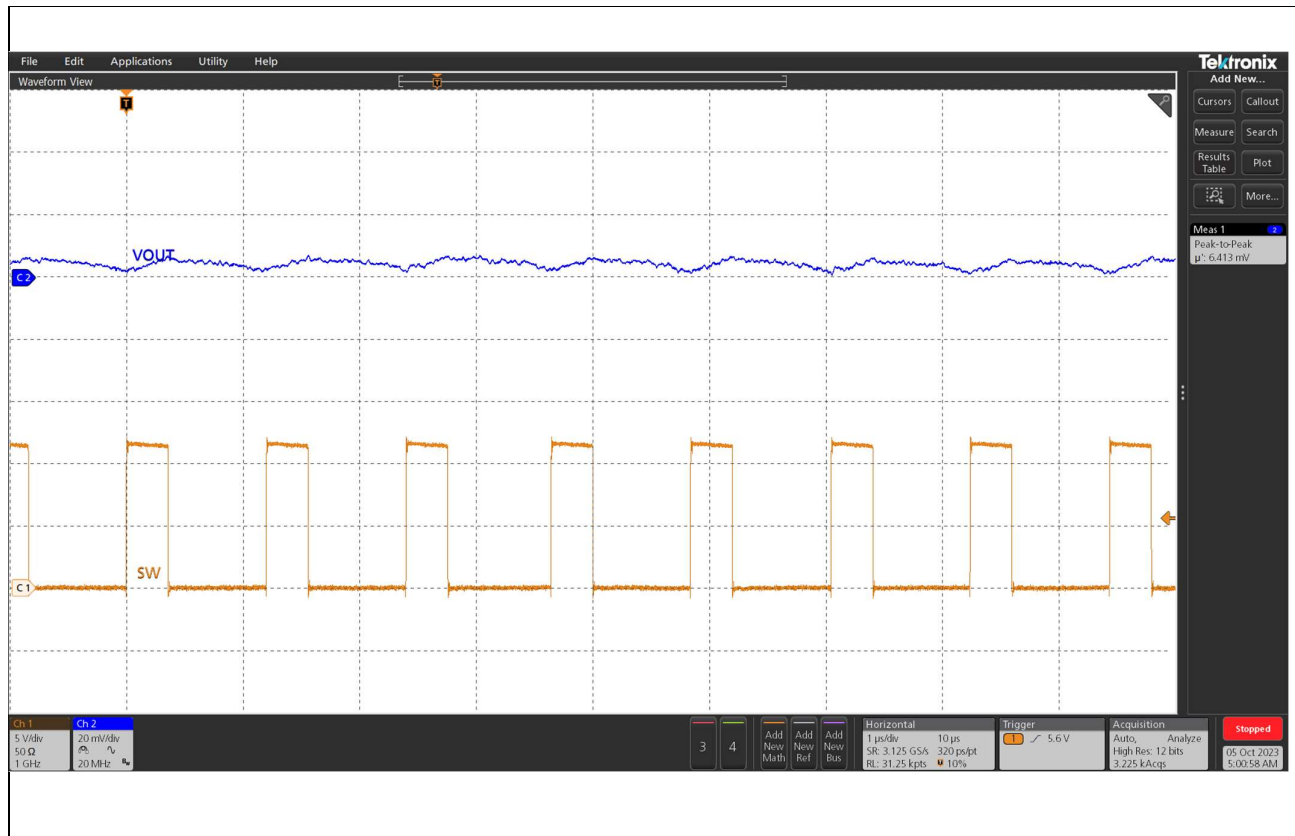


Figure 12 Vout ripple at 12A Load, fsw = 800 kHz, (Ch1: Vo; Ch5: SW)

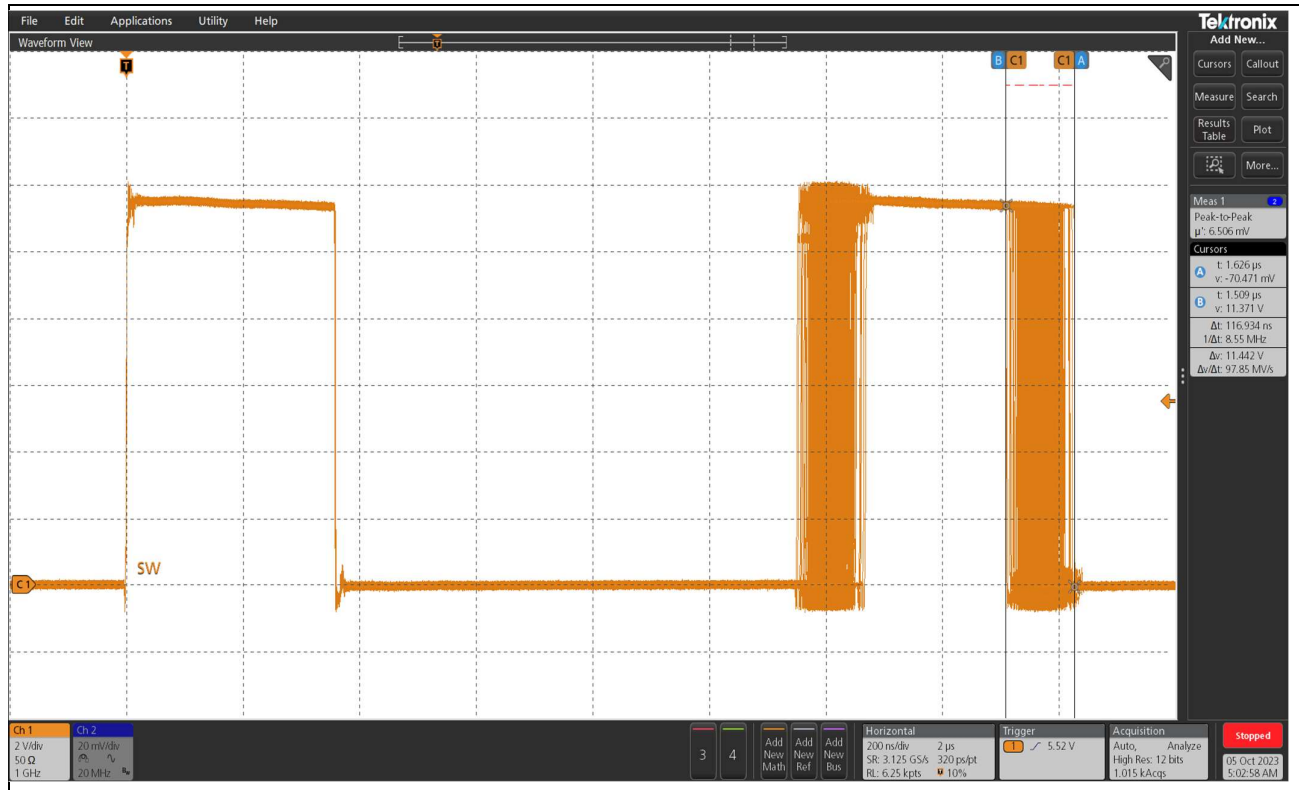


Figure 13 SW node Jitter, 12A load, fsw = 800 kHz

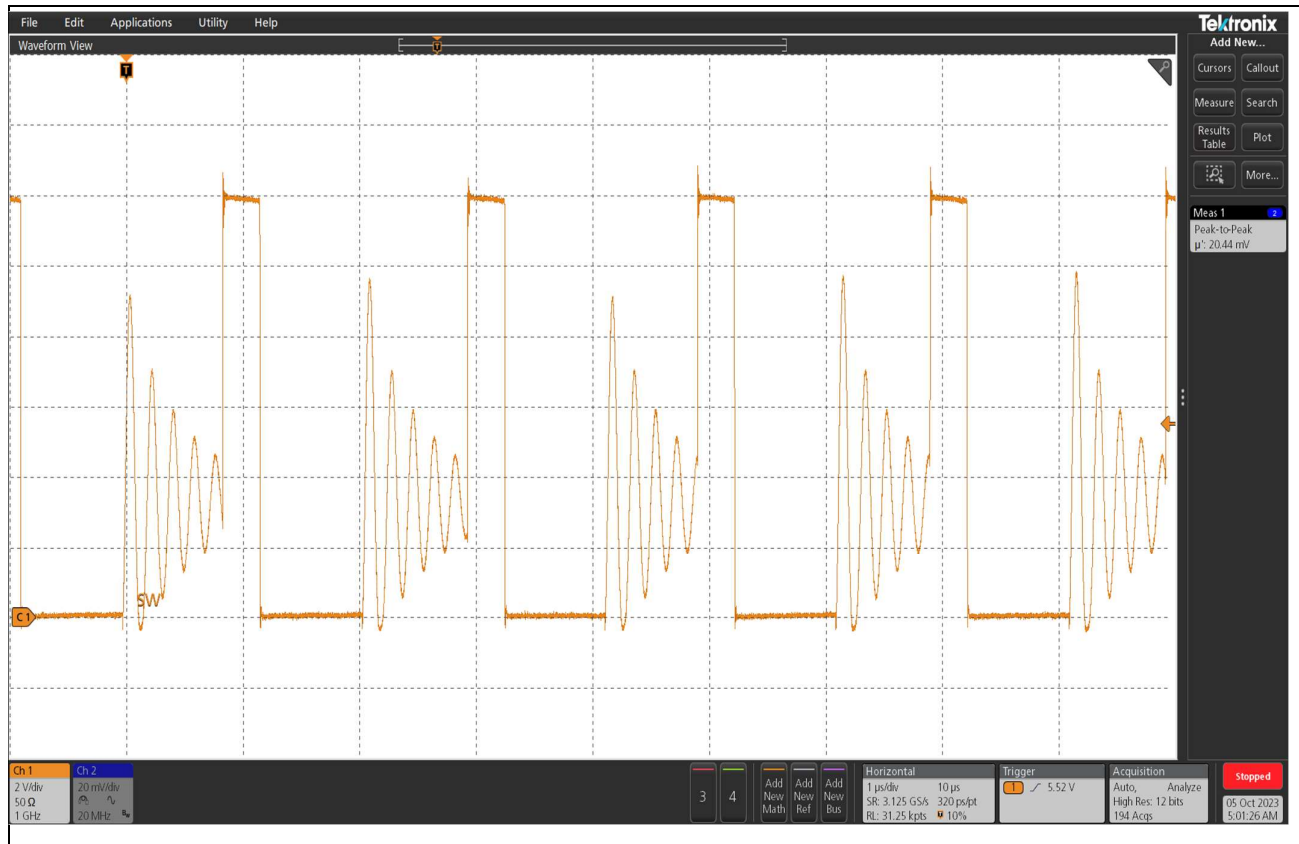


Figure 14 SW node (in DEM), 1 A load



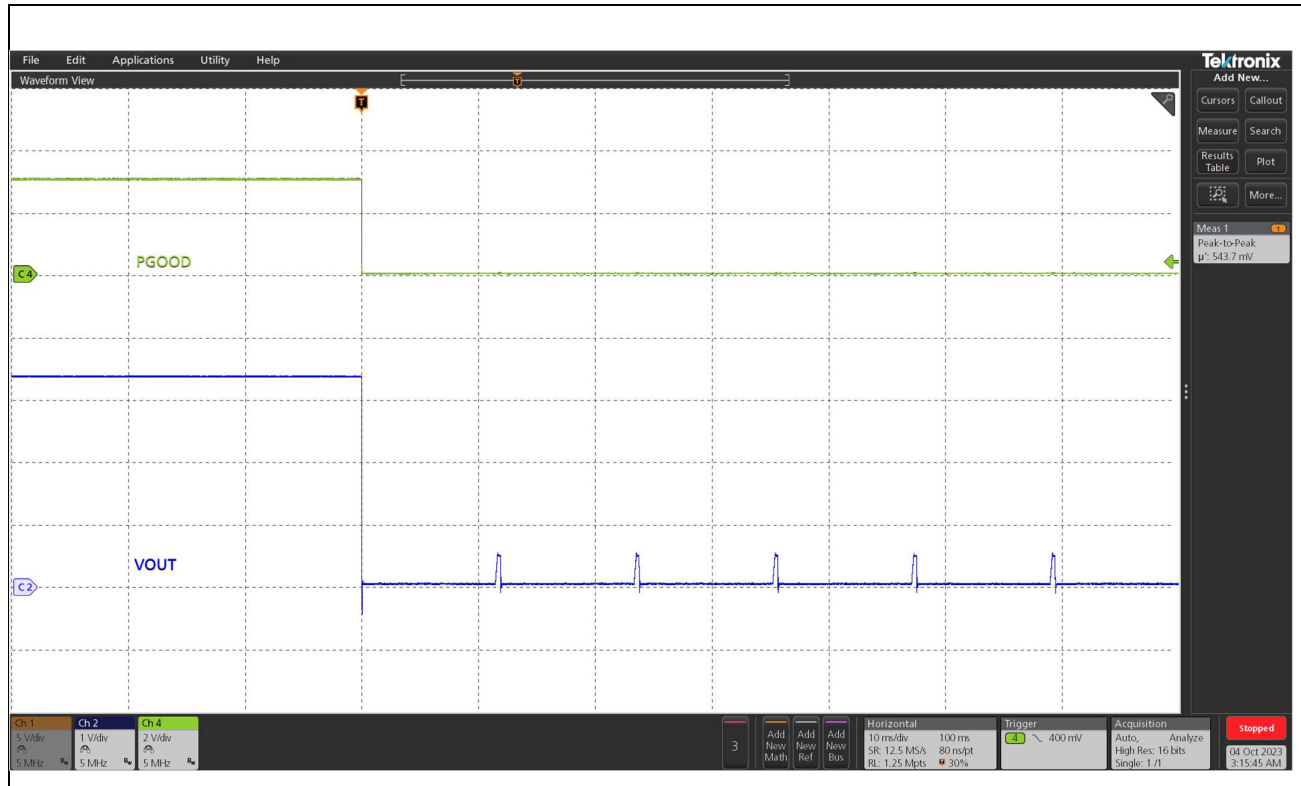


Figure 15 Short circuit and UVP (Hiccup), (Ch2: Vo, Ch3:PGood)

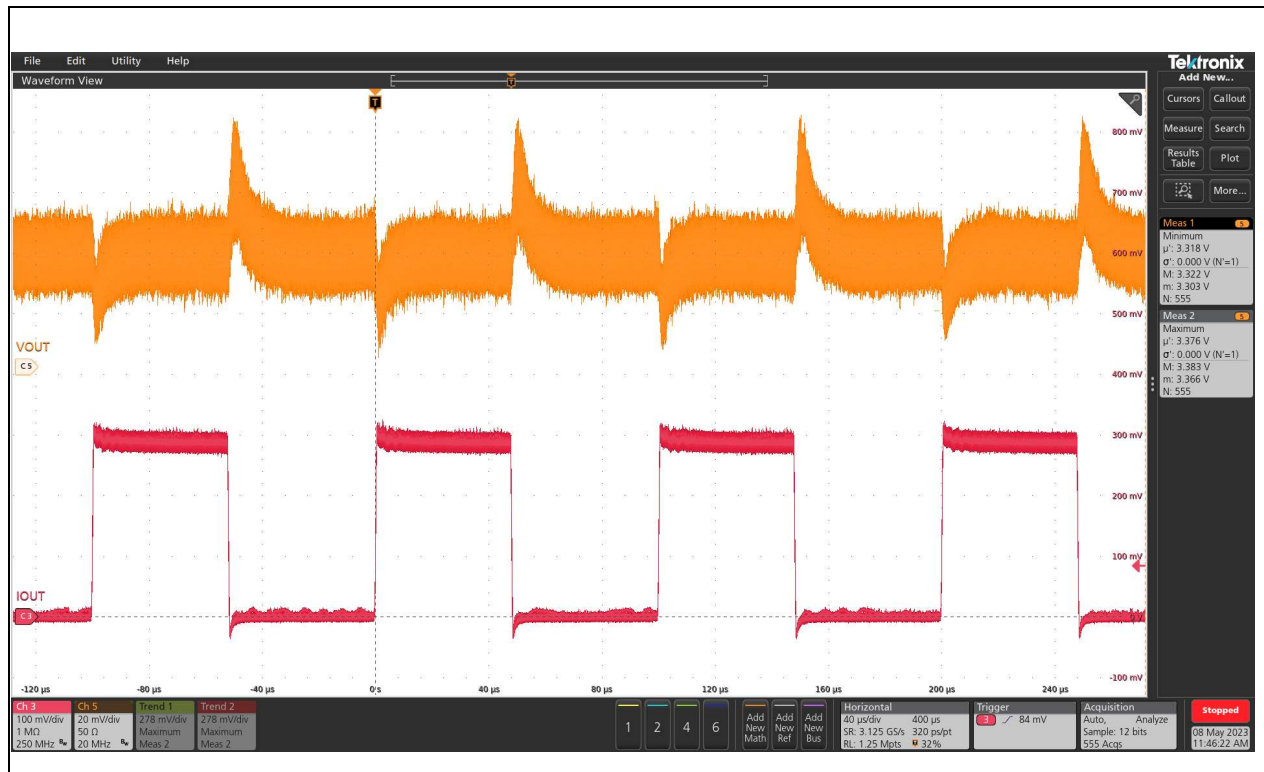


Figure 16 Transient response at 4 A step load current @ 10 A/μs slew rate:  $I_o = 4\text{ A} - 8\text{ A}$ , (Ch5: Vo, Ch3: Io), pk-pk: 58mV, fsw = 800 kHz

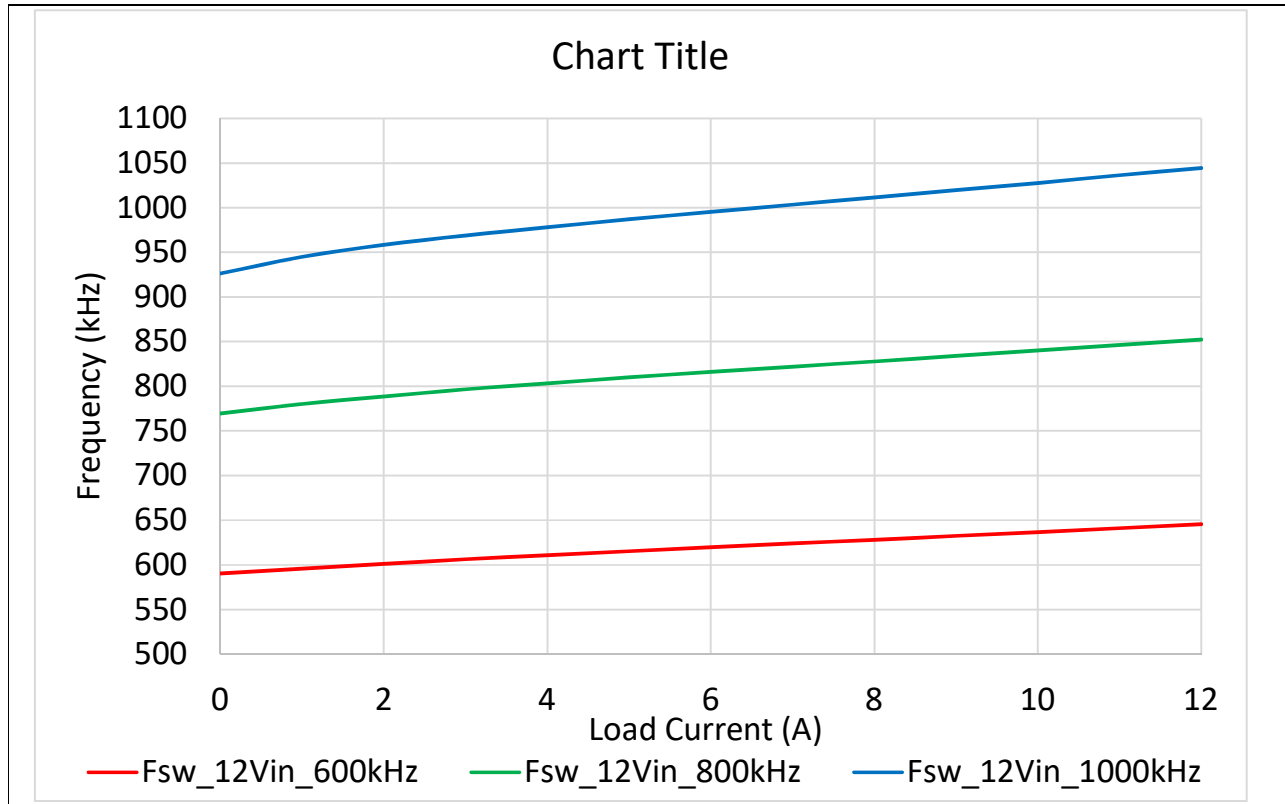


Figure 17 Switching Frequency vs Load Current

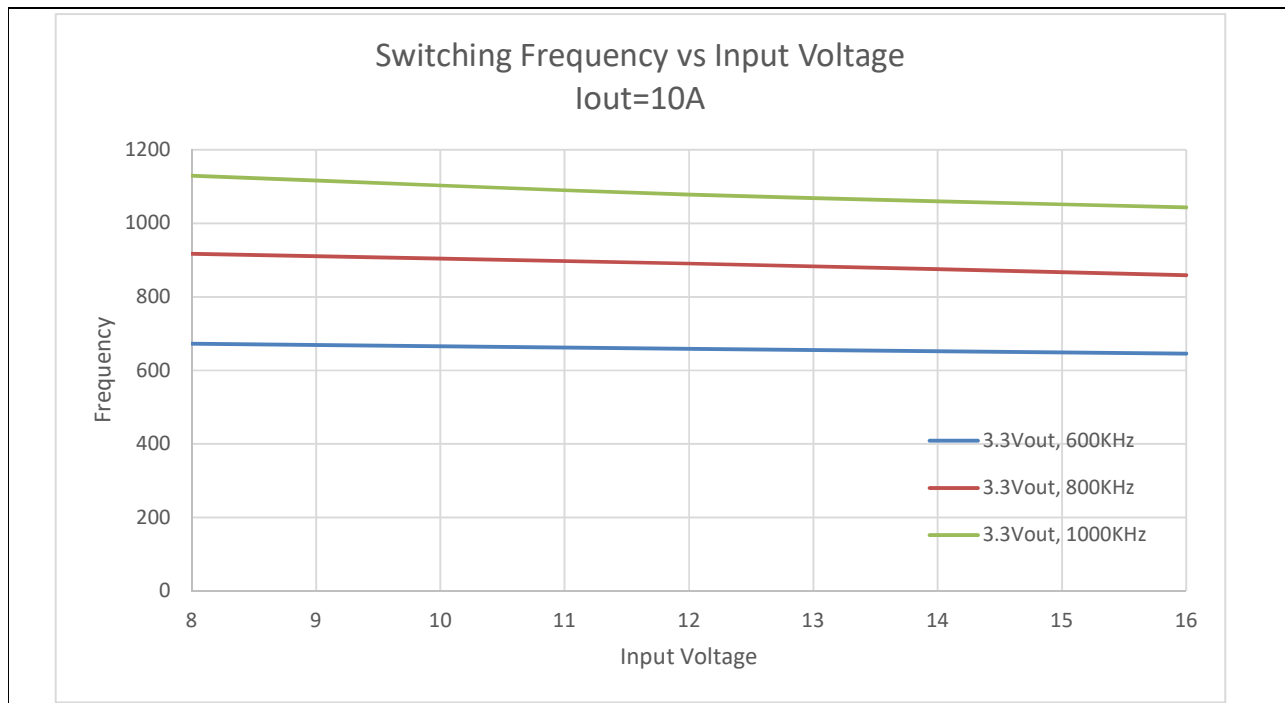


Figure 18 Switching Frequency vs Input Voltage

TDA38812 Thermal Images with no air flow and 25°C ambient

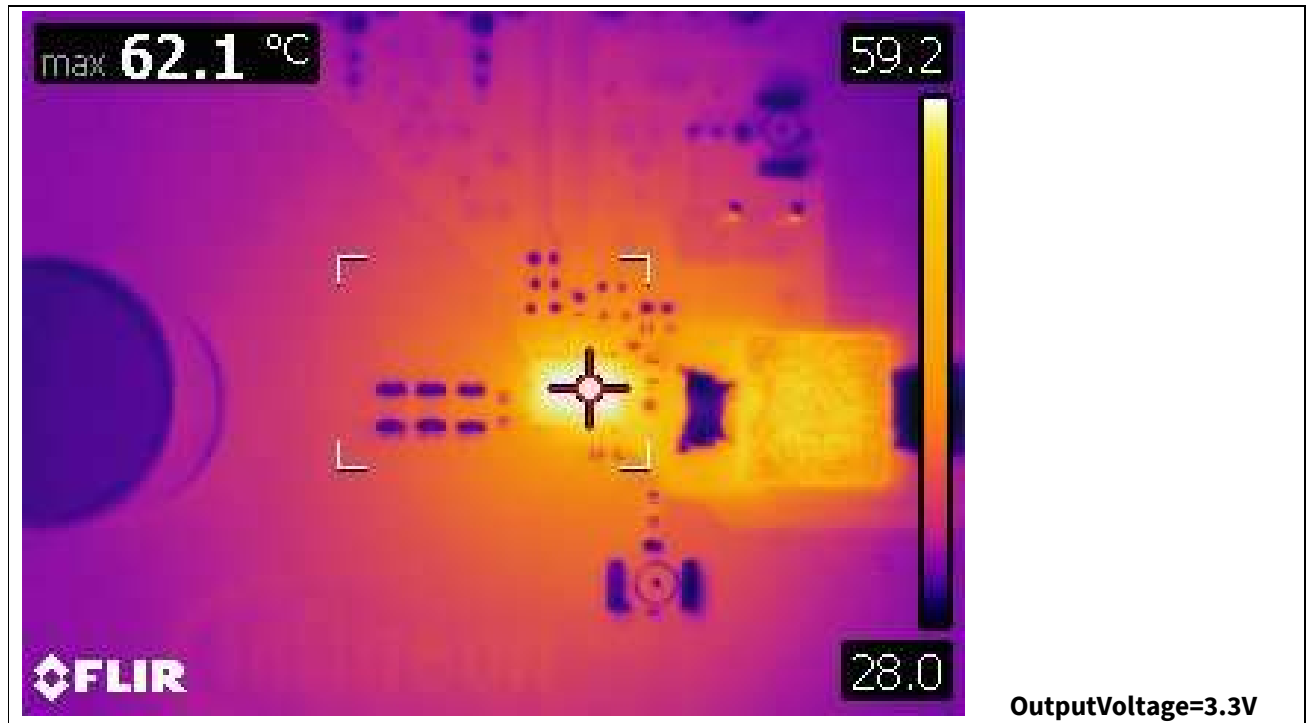


Figure 19 Thermal Performance of TDA38812 for 3.3V output voltage, 12A load, FCCM mode, 800kHz Switching Frequency, 12V Vin

## Revision history

Document version	Date of release	Description of changes
1.0	10-04-2024	Final User Guide

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