TDA38806 P3V3 user guide

User guide for TDA38806 evaluation board

About this document

Scope and purpose

The TDA38806 is a synchronous buck regulator, providing a compact, high performance and flexible solution in a small 2mm X 3mm QFN package.

Key features offered by the TDA38806 include internal Soft Start, precision 0.6V reference voltage, Power Good, thermal protection, programmable switching frequency in the range of 600 kHz to 2 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_TDA38806_3V3 VOUT engineering evaluation board. The guide describes operation and use of the evaluation board itself. Detailed application information for TDA38806 is available in the TDA38806 data sheet.

Intended audience

This document is intended as a guide for design engineers evaluating TDA38806 performance with the engineering EVAL_TDA38806_3V3 VOUT demo board

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1 TDA38806 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 +/- 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, 1100 kHz, and 2 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 < T_j < 125 °C
- Small Size: 2 mm x 3 mm QFN-14
- Lead-free, Halogen-free and RoHS Compliant

Potential applications

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

Product validation

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

Description

The TDA38806 is a 6 A fully integrated and highly efficient DC - DC Buck regulator. It uses a fast Constant On-Time (COT) control scheme, which simplifies the design efforts and achieves fast control response during the transients while maintaining excellent line and load regulation. It can operate over a wide range of input voltage (2.7 V to 16 V) using an external bias supply.

TDA38806 is a versatile regulator, offering switching frequency selectable from 600 kHz, 1.1 MHz and 2 MHz, programmable current limit and soft-start time with a minimum of 1 ms, Forced Continuous Conduction Mode (FCCM) and Diode Emulation Mode (DEM) operation using jumper settings. The EVAL board can be turned on or off via a remote on/off input (EN) that is referenced to ground. This input is compatible with logic devices.

2 Board information

2.1 Evaluation Board



2.2 Board features

V_{in} = +12 V, Vout = +3V3 @ 0- 6 A

F_s=600 kHz/1100 kHz/2000 kHz

L= 1uH

C_{in}= 2x 10uF (25 V, ceramic 0805) + 2 x 4.7 uF (25 V, ceramic 0805)

C_{out}=6x 47 uF (6.3 V, ceramic 0805)

2.3 Connections and operating instructions

TDA38806 demo board requires a single +12 V for the input power and can deliver up to 6A load current. The operation modes and OCP limits can be selected through jumpers and resitors

Label		Descriptions
Input	VIN	Connect input power (+12 V) to this pin
	GND	Return of input power
	VIN_TP2 GND_TP10	Sense pins for the input voltage
Output	VOUT	V_{out} (+3V3), connect a DC load (6A max) to this pin
	GND	Return of Vout
	VOUT_TP4, GND_TP5	Sense pins for the output voltage
Enable	EN	Connect a scope probe to this pin to monitor Enable Signal Or, an external Enable signal can be applied to this Pin to overdrive the on-board Enable signal
	GND	
Soft Start	TK/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, 1100kHz, 2000kHz.
	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
GND	GND	Board Ground
Vcc	Vcc	Standard demo board is configured to use the internal LDO. Connect a scope probe to this pin to minitor the output of the internal LDO.
	GND	

2.4 Layout

The PCB is a 4-layer board using FR4 material. Top and bottom layers use 2Oz copper and inner layers use 1Oz. copper. The PCB thickness is 1.6mm. The TDA38806 and other major power components are mounted on the top side of the board.

2.5 PCB Layout

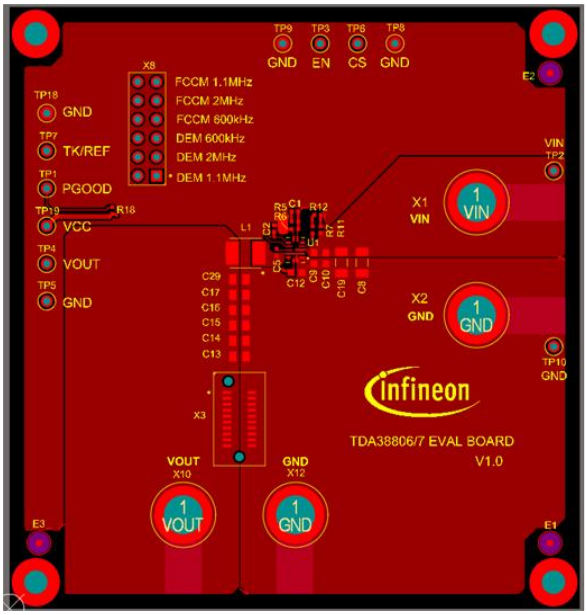


Figure 1 Top Layer

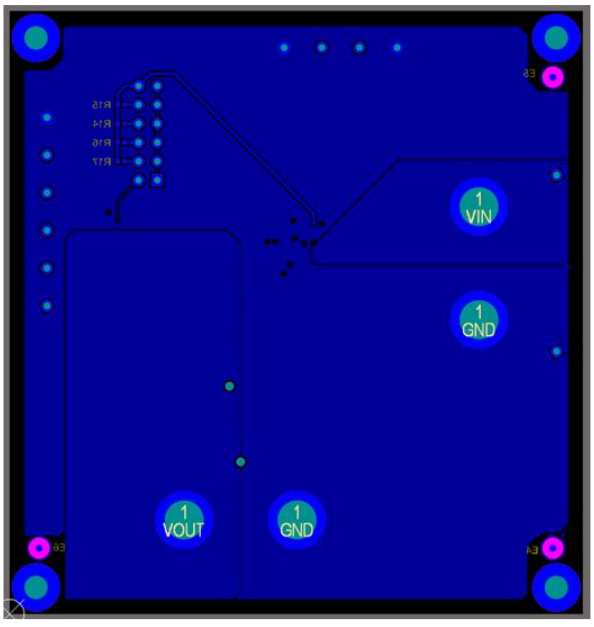


Figure 2 Bottom Layer

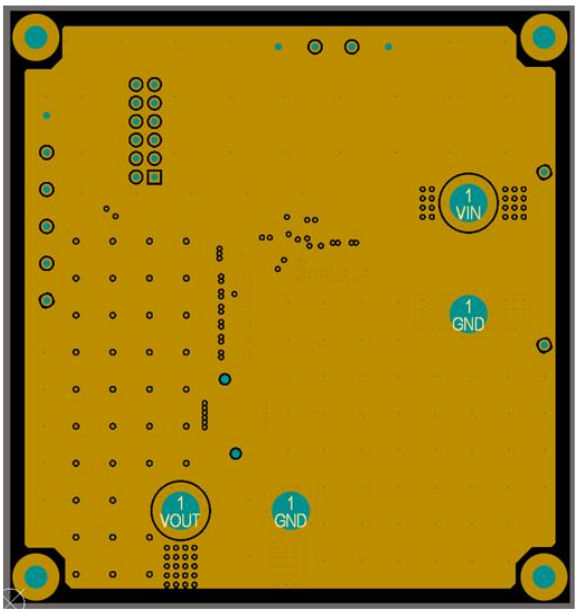


Figure 3 Inner Layer 1

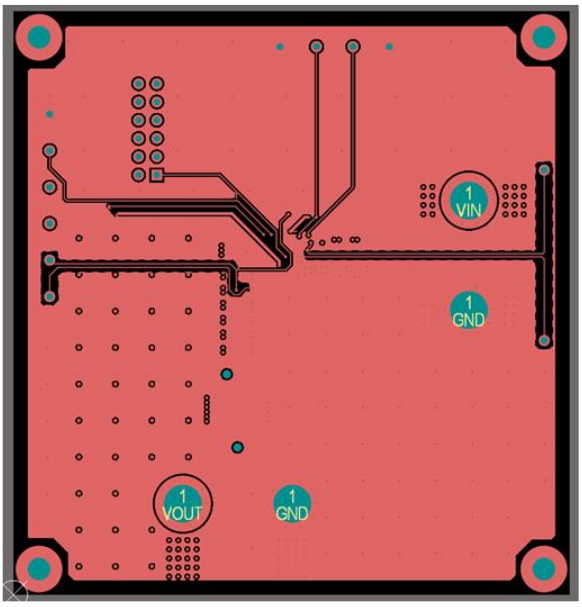


Figure 4 Inner Layer2

2.6 Schematic

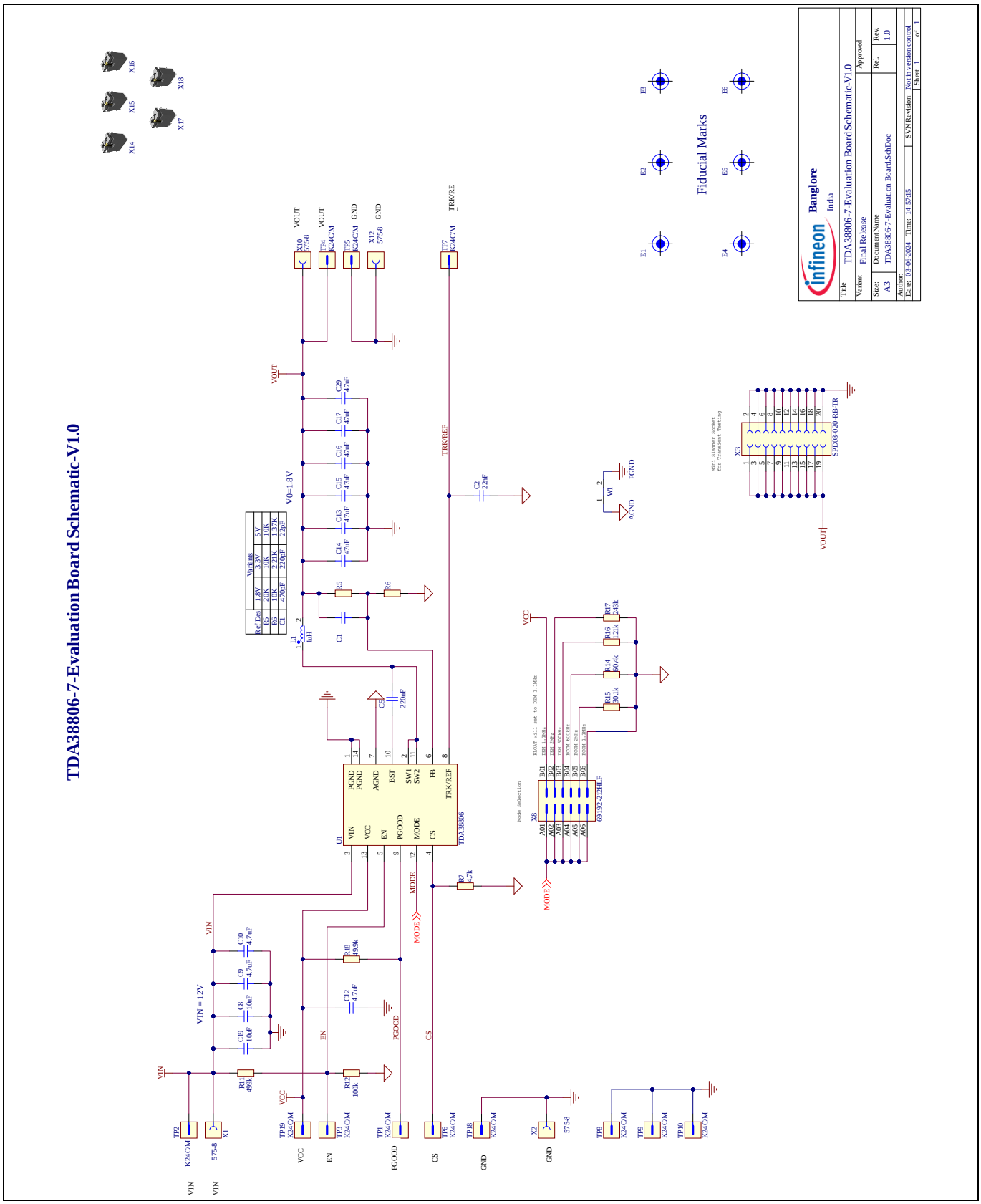


Figure 5 Schematic of the TDA38806 evaluation board Vin = 12 V, Vo = 3V3, Ioutmax = 6A

2.7 Bill of materials

Table 1 Bill of Materials

Sr. No.	Quantity	Designator	Value	Description	Manufacturer	Manufacturer Order Number
1	1	C1	220pF	CAP CER 220PF 50V C0G/NP0 0402	MuRata	GRM1555C1H221JA01D
2	1	C2	22nF	CAP CER 0.022UF 16V X7R 0402	Samsung	CL05B223KO5VPNC
3	1	C5	220nF	CAP CER 0.22UF 16V X7R 0402	TDK Corporation	C1005X7R1C224K050BC
4	2	C8, C19	10uF	CAP CER 10UF 25V X7R 1206	MuRata	GRM31CR71E106KA12
5	3	C9, C10, C12	4.7uF	CAP CER 4.7UF 25V X6S 0603	MuRata	GRT188C81E475KE13D
6	6	C13, C14, C15, C16, C17, C29	47uF	CAP CER 47UF 6.3V X5R 0805	MuRata	GRT21BR60J476ME13L
7	1	L1	1uH	FIXED IND 1UH 8.9A 10.5MOHM SMD	Cyntec	VCHA042A-1R0MS6
8	1	R5	10k	RES 10K OHM 5% 1/16W 0402	Yageo	RC0402JR-0710KL
9	1	R6	2.21k	RES 2.21K OHM 1% 1/16W 0402	Yageo	RC0402FR-072K21L
10	1	R7	4.99k	RES 4.99K OHM 1% 1/16W 0402	Vishay	CRCW04024K99FK
11	1	R11	499k	RES 499K OHM 1% 1/16W 0402	Yageo	RC0402FR-07499KL
12	1	R12	100k	RES 100K OHM 5% 1/16W 0402	Yageo	RC0402JR-07100K
13	1	R14	60.4k	RES 60.4K OHM 1% 1/16W 0402	Yageo	RC0402FR-0760K4L
14	1	R15	30.1k	RES 30.1K OHM 1% 1/16W 0402	Yageo	RC0402FR-0730K1L
15	1	R16	121k	RES 121K OHM 1% 1/16W 0402	Yageo	RC0402FR-07121KL
16	1	R17	243k	RES 243K OHM 1% 1/16W 0402	Yageo	RC0402FR-07243KL
17	1	R18	49.9k	RES 49.9K OHM 1% 1/16W 0402	Yageo	RC0402FR-0749K9L
18	12	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP18, TP19	K24C/M	PIN INBOARD .042" HOLE PKG/100	Vector	K24C/M

19	1	U1		High Efficiency, Synchronous, Step-Down Converter with Adjustable Current Limit	Infineon Technologies	TDA38806
20	4	X1, X2, X10, X12	575-8	CONN BANANA JACK SOLDER	Keystone Electronics Corp.	575-8
21	1	X3	SPD08-020-RB-TR	SPD08 High Speed Card Edge Connector, 0.8MM Pitch SMD, 20Pins, 1.2A, 250V	3M	SPD08-020-RB-TR
22	1	X8	69192-212HLF	CONN HEADER VERT 12POS 2.54MM	Amphenol	69192-212HLF

3 Evaluation Board Test Results

All Performance curves and Waveforms are tested on the evaluation board.

VIN = 12 V, VCC = internal LDO, Iout = 0 A – 6A, Fsw = 1100 kHz, room temperature, natural convection. Note that the efficiency and power loss curves include losses of the TDA38806, inductor losses, losses of the input and output capacitors, and PCB trace losses. Error! Reference source not found. shows the inductors used for each of the output voltages in the efficiency measurement.

Table 2 Inductors for VIN = 12 V, Fsw = 1100 kHz

Vout (V)	Lout (nH)	P/N	DCR (mΩ)	Size (mm)
3.3V	1000	VCHA042A-1R0MS6	10.5	4.2 L X 4.0 W X 2.1 H

3.1 Performance Curves and Regulation

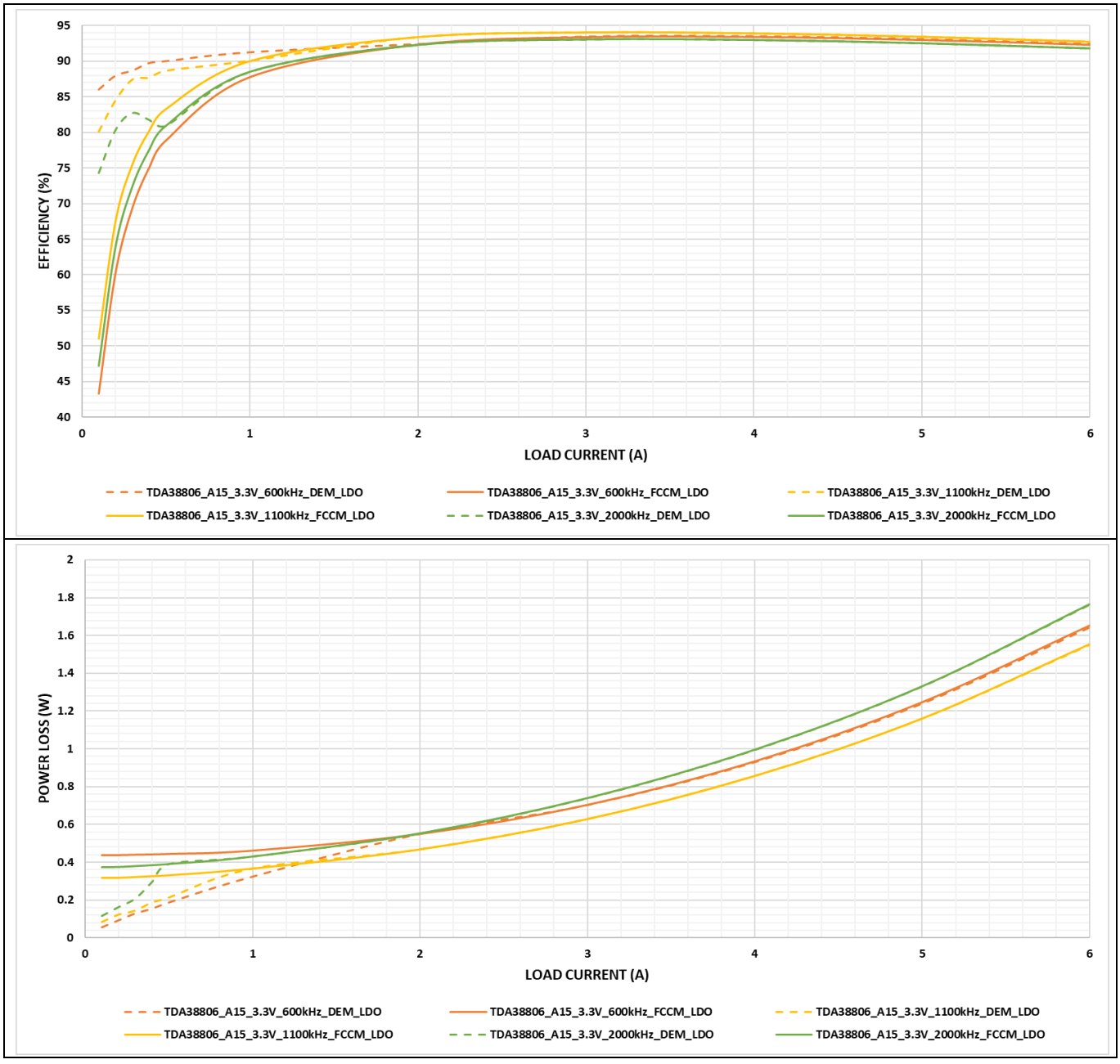


Figure 6 Efficiency and Power Loss

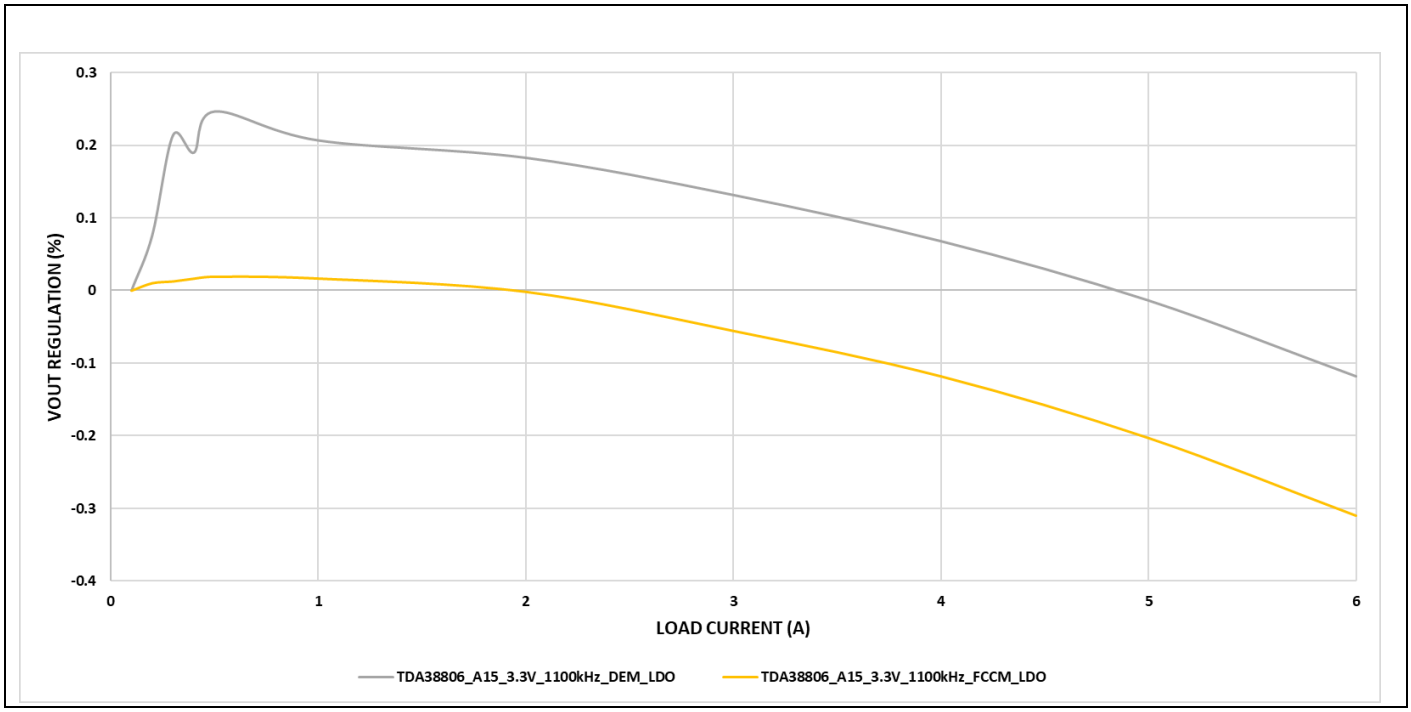


Figure 7 Output Voltage Regulation

3.2 Typical Operating Waveforms

V_{in} = 12.0 V, Vo = 3.3V, I_o = 0 A, F_{sw} = 1100 kHz, Room Temperature, no airflow

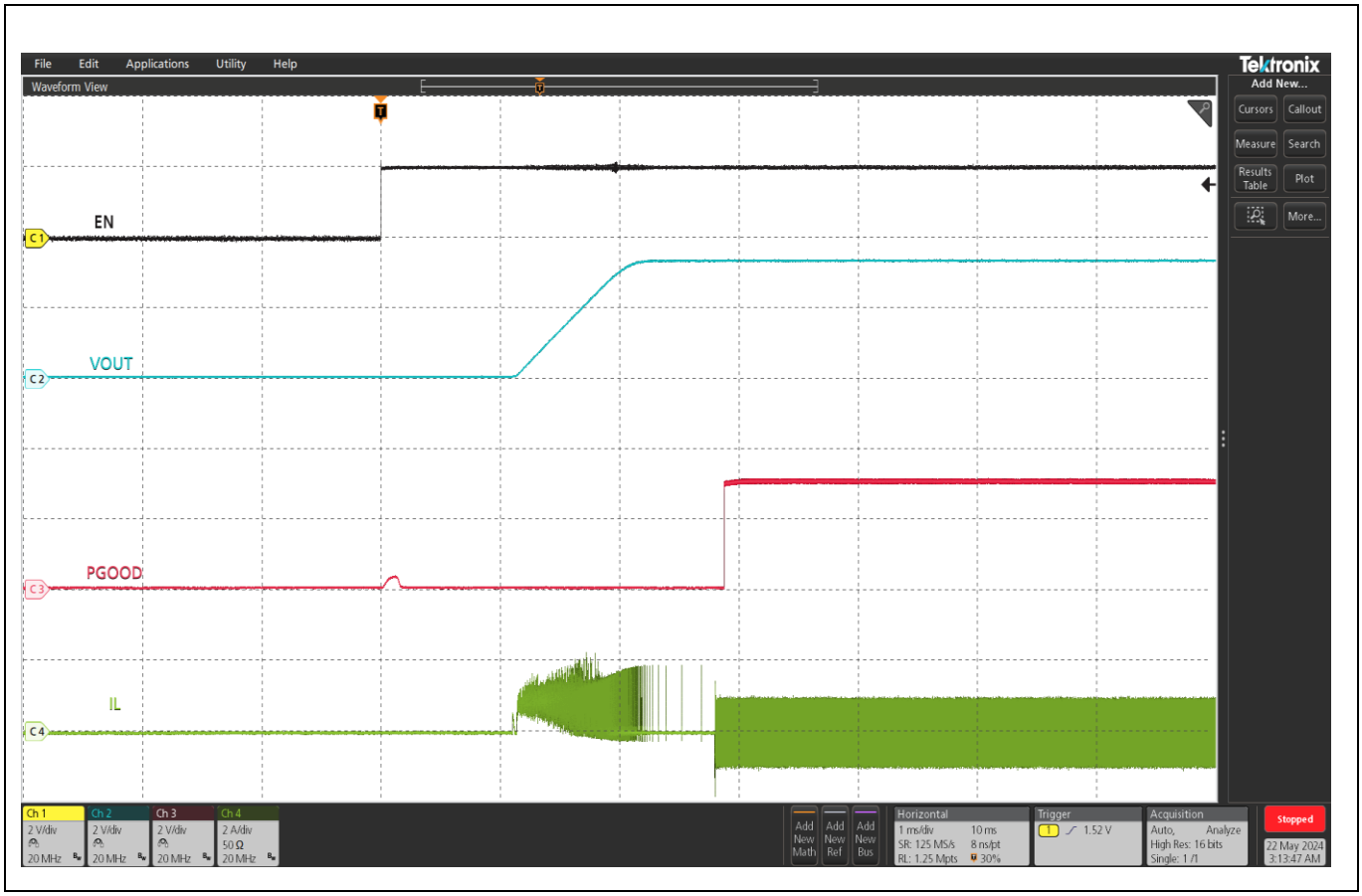


Figure 8 Start up at 0A Load, (Ch1: Enable, Ch2: Vout, Ch3:PGood ,Ch4: Inductor Current)

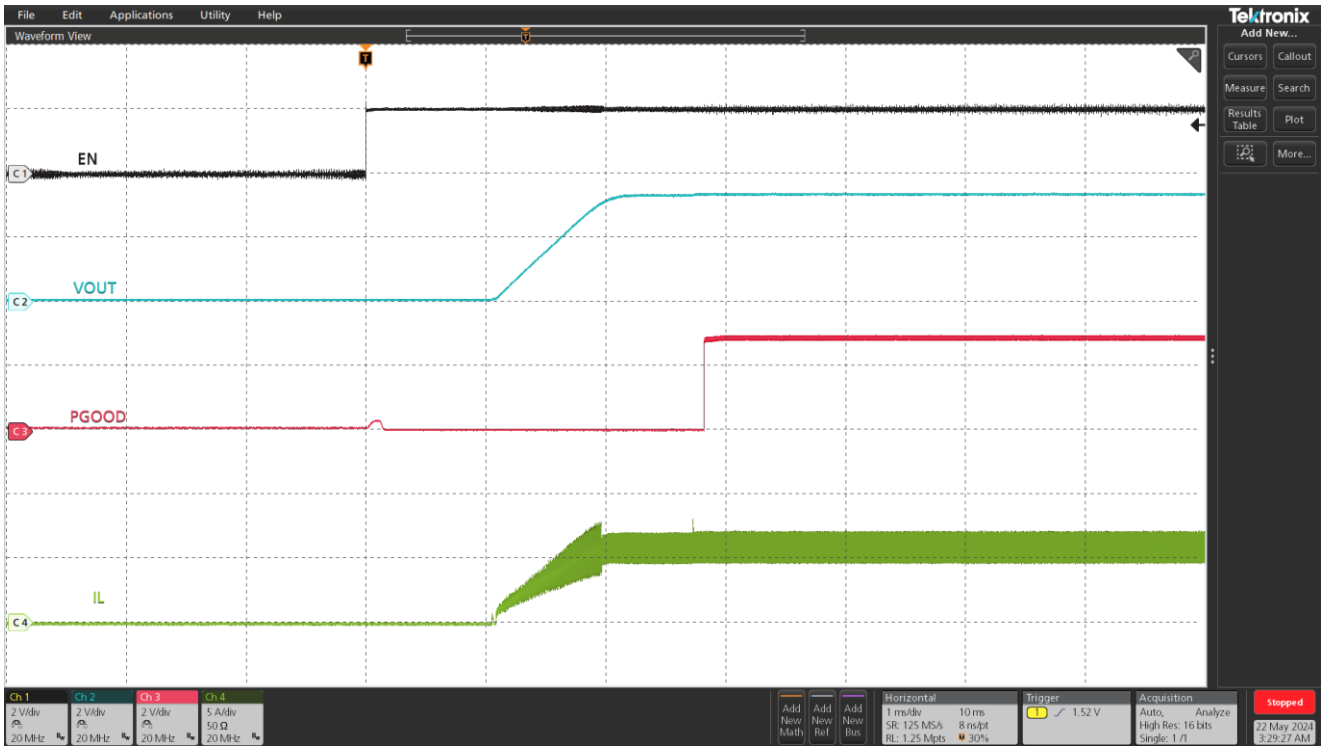


Figure 9 Start up at 6A Load, (Ch1: Enable, Ch2: Vout, Ch3:PGood ,Ch4: Inductor Current)

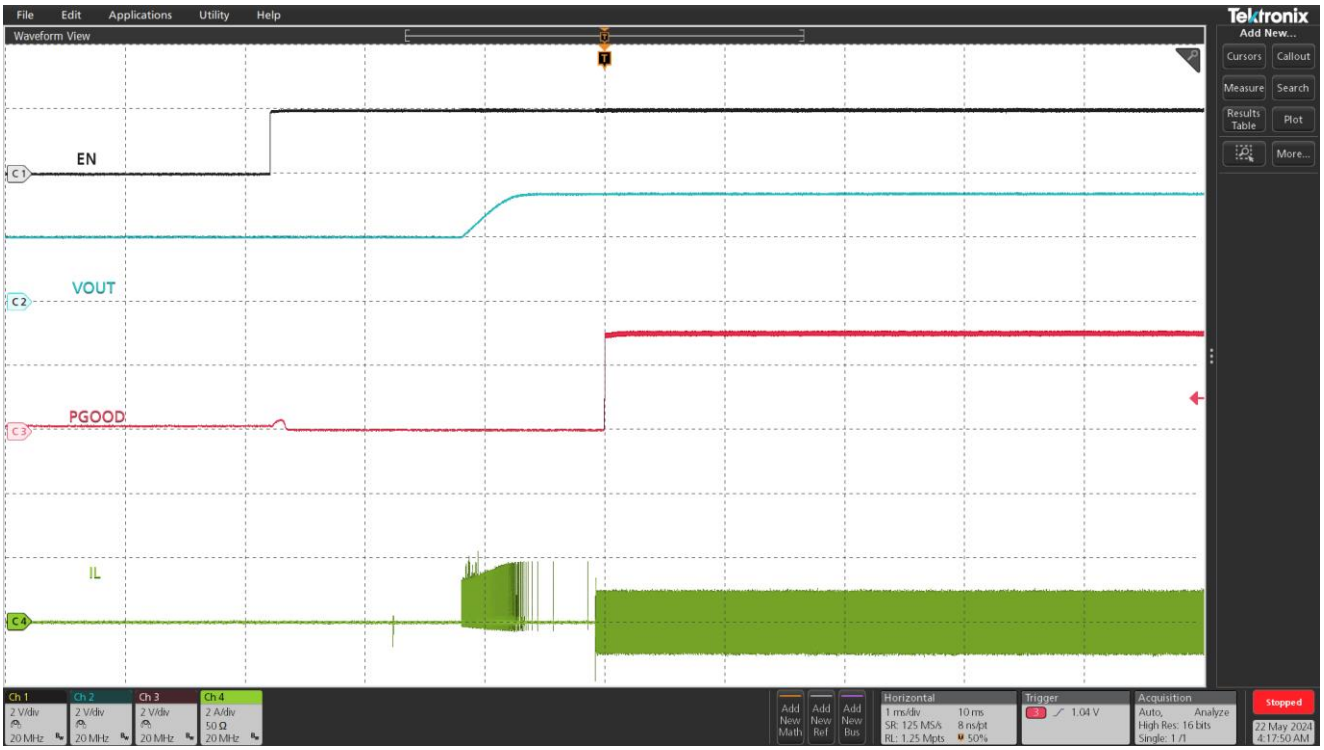


Figure 10 Pre-bias Start up at 0 A Load , (Ch1: Enable, Ch2: Vout, Ch3:PGood ,Ch4: Inductor Current)

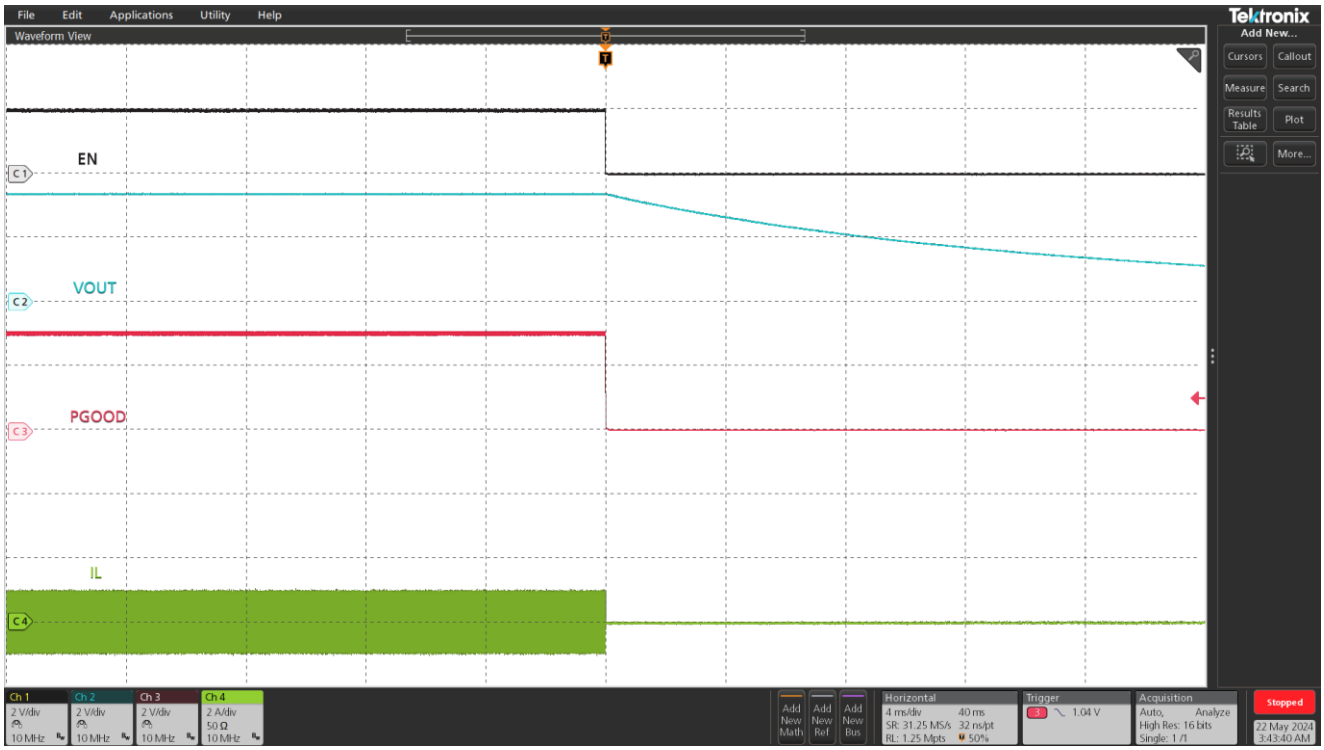


Figure 11 Shutdown at 0A Load, (Ch1: Enable, Ch2: Vout, Ch3:PGood ,Ch4: Inductor Current)

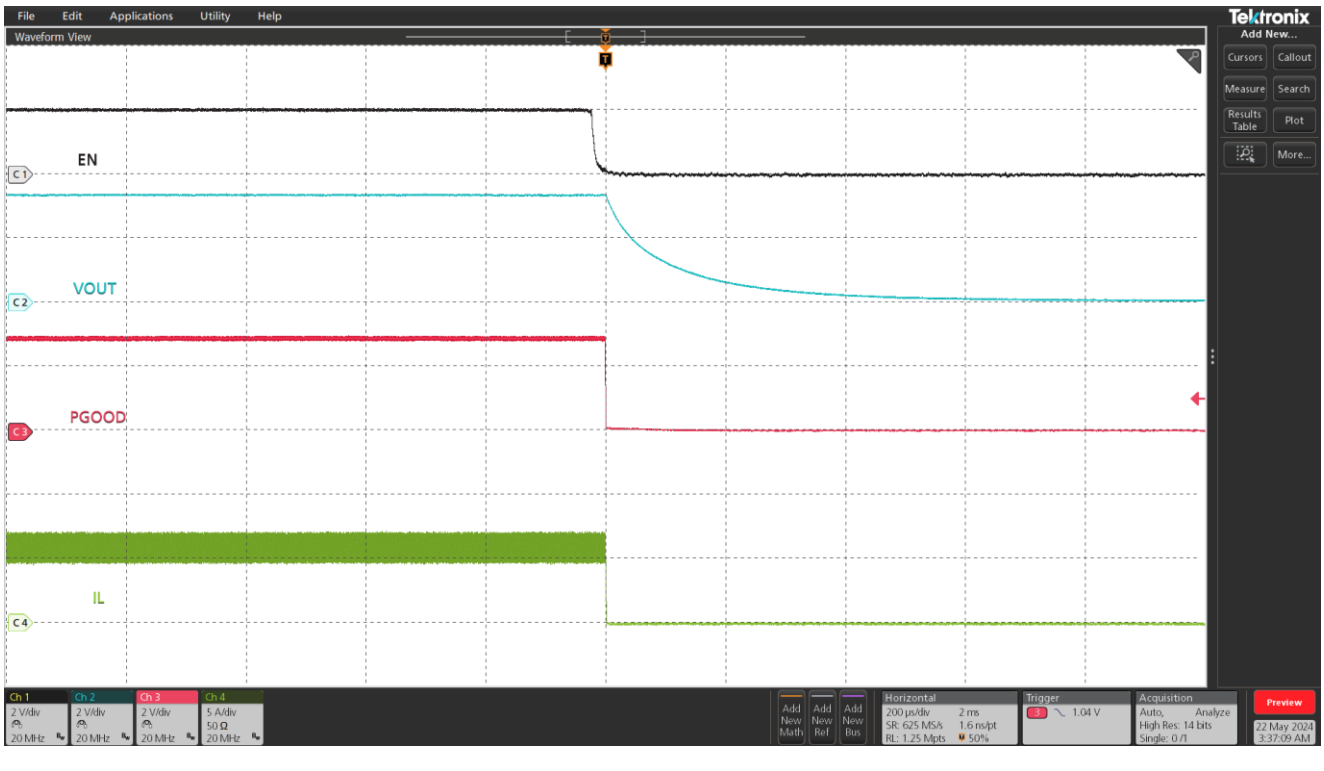


Figure 12 Shutdown at 6A Load, (Ch1: Enable, Ch2: Vout, Ch3:PGood ,Ch4: Inductor Current)

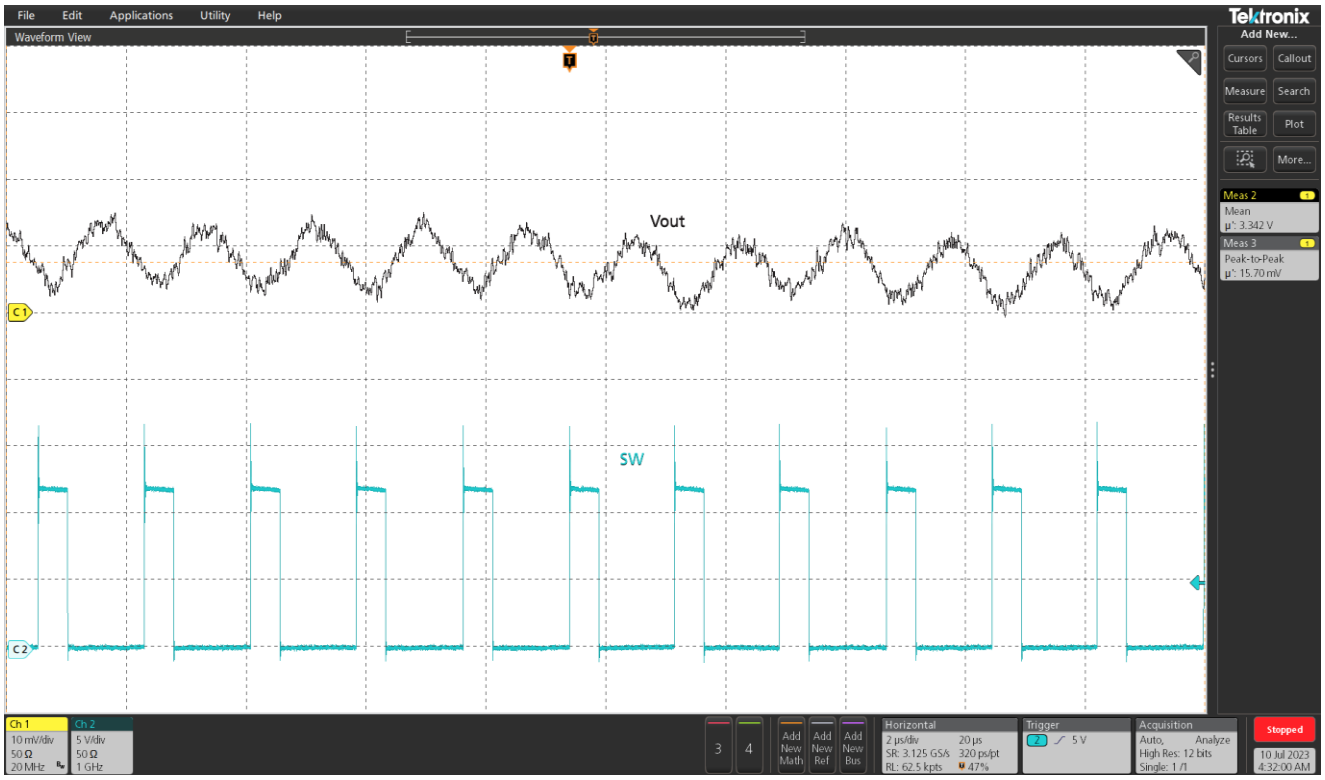


Figure 13 Vout ripple at 6A Load, fsw = 1100 kHz, (Ch1: Vo; Ch2: SW)

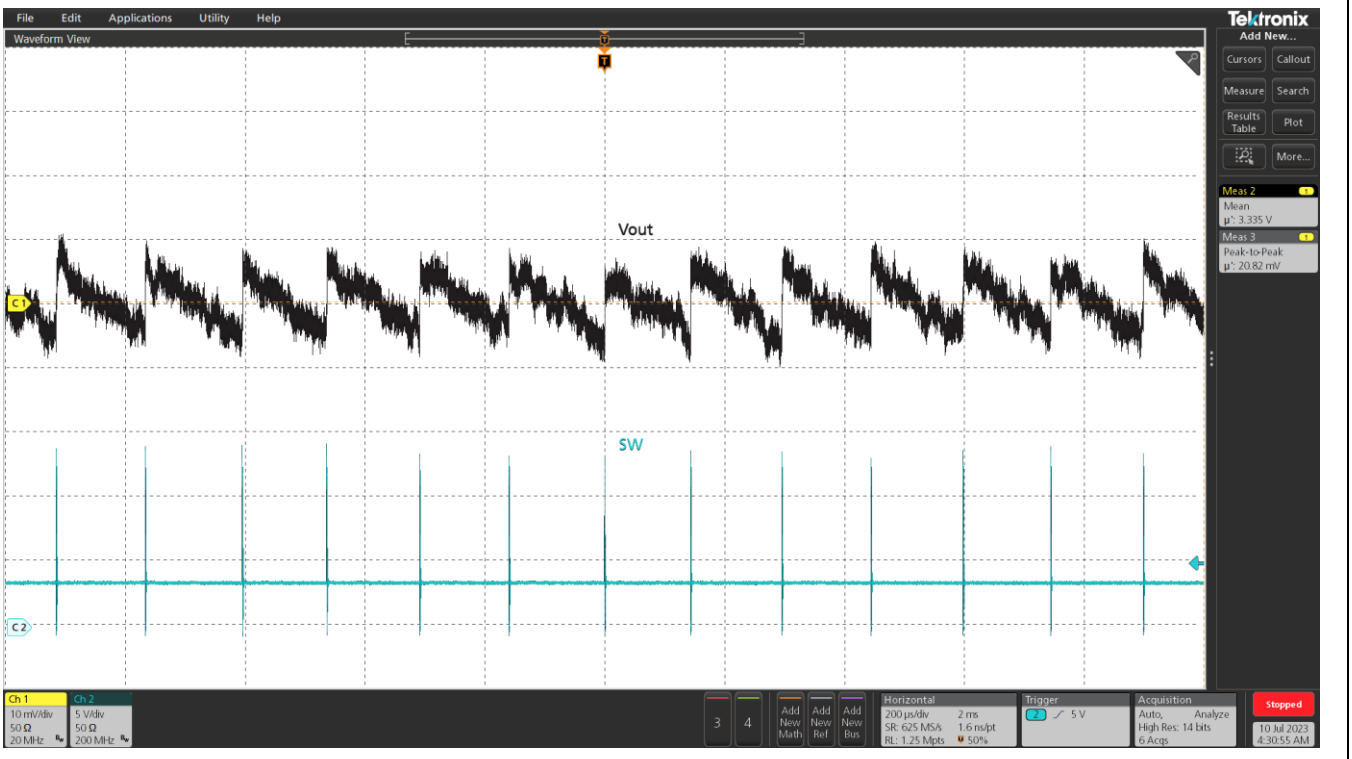


Figure 14 Vout ripple at 0A Load, fsw = 1100 kHz, DEM (Ch1: Vo; Ch2: SW)

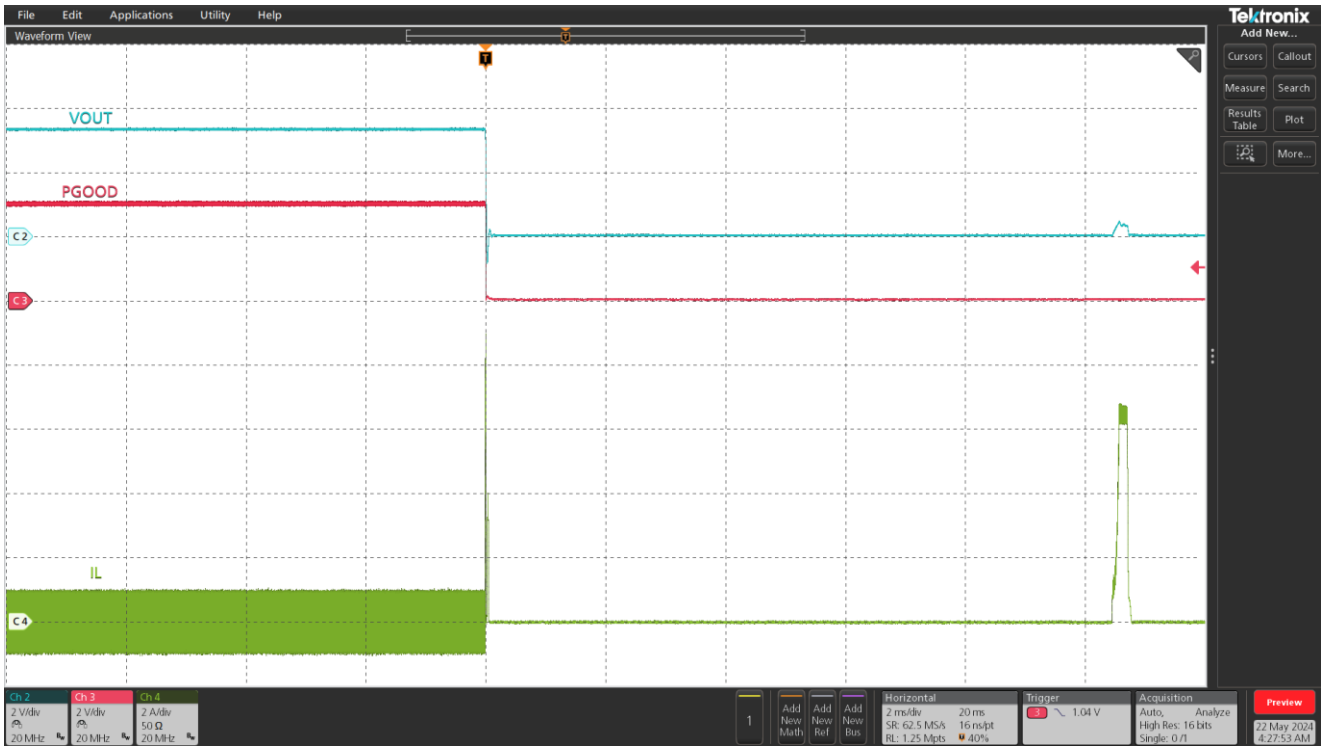
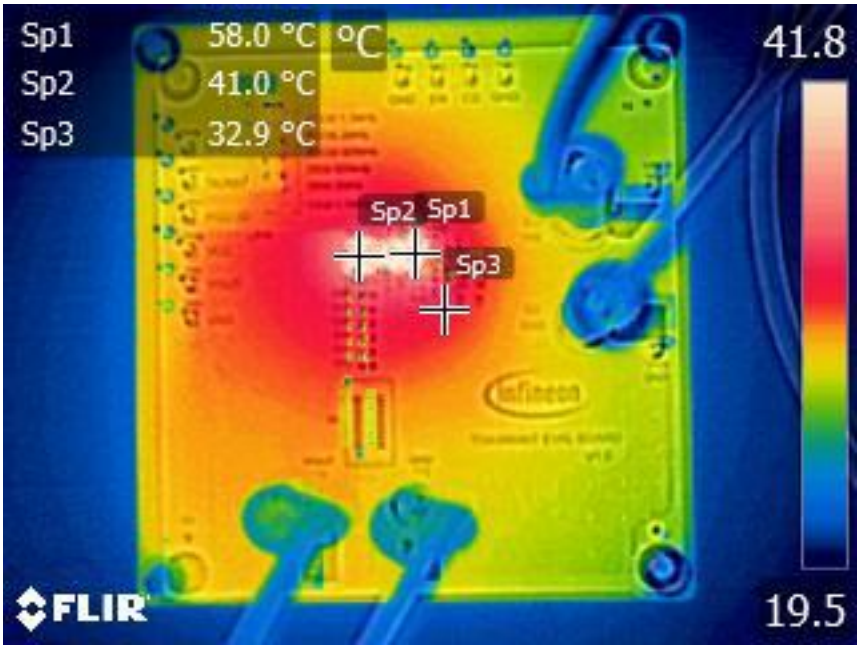


Figure 15 Short circuit (Ch2: Vout, Ch3:PGood , Ch4:Inductor Current)

TDA38806 Thermal Images with no air flow and 25°C ambient



Sp1: TDA38806 Sp2: Inductor Sp3: Board

Figure 16 Thermal Performance, 6A load, FCCM mode, 1100kHz

START GUIDE:

The EVAL Board can be tested from 8V to 16V Input voltage. The minimum 8V input voltage is limited by the EN signal, which is derived from VIN through a resistor divider (R11 and R12).

A lower input voltage (as low as 2.7V with external 3.3V VCC bias) can be set by adjusting the resistor divider values or by connecting EN with an external control signal.

The steps below outline the procedure to start and work on the EVAL Board

- Connect the positive and negative terminals of the load to the VOUT and GND pins, respectively.
- Preset the power supply output voltage between 8V and 16V, and then turn off the power supply.
- 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.
- Turn the power supply on. The EVAL Board will Power up automatically.
- To use the enable function, apply a digital input to the EN pin. Drive EN above 1.2V to turn on the regulator. Drive EN below 1V to turn off the regulator.
- Use R5 and R6 to set the output voltage with VFB = 0.6V.
- The X8 jumper can be used to select the operating frequency (600kHz, 1100kHz, or 2000kHz) and select FCCM or DEM mode

Revision history

Document version	Date of release	Description of changes
1.0	2024-06-03	Final User Guide

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