

User manual for IR3823A evaluation board

3 A single-phase buck regulator with 1.2 V output

About this document

Scope and purpose

The IR3823A is a synchronous buck converter, providing a compact, high-performance and flexible solution in a small 3.5 mm x 3.5 mm power QFN package.

Key features offered by the IR3823A include internal digital soft-start, precision 0.6 V reference voltage, power good (P_{good}), thermal protection, programmable switching frequency in the range of 600 kHz to 2 MHz, enable input, input undervoltage lockout (UVLO) for proper start-up, latched-off overvoltage protection (OVP) and pre-bias start-up.

Output overcurrent protection (OCP) function is implemented by sensing the voltage developed across the on-resistance of the synchronous MOSFET for optimum cost and performance, and the current limit is thermally compensated.

This user manual contains the schematic and bill of materials for the EVAL_3823A_1.2Vout engineering evaluation board. The manual describes operation and use of the evaluation board itself. Detailed application information for IR3823A is available in the IR3823A datasheet.

Intended audience

This document is intended as a guide for design engineers evaluating IR3823A performance with the engineering EVAL_3823A_1.2Vout demo board.

Table of contents

About this document.....	1
Table of contents.....	1
1. Board information.....	2
1.1 Board features.....	2
1.2 Connections and operating instructions.....	2
1.3 Layout.....	3
1.4 PCB layout.....	5
1.5 Bill of materials.....	8
2. Typical operating waveforms.....	10
Revision history.....	15

1. Board information

1.1 Board features

$V_{in} = +12\text{ V}$, $V_{out} = +1.2\text{ V}$ at 0 A to 3 A

$F_{sw} = 1000\text{ kHz}$

$L = 1.5\text{ }\mu\text{H}$ (4.0 mm x 4.0 mm x 2.1 mm, DCR = 14.4 m Ω)

$C_{in} = 4 \times 22\text{ }\mu\text{F}$ (25 V, ceramic 0805) + 1 x 4.7 μF (6.3 V, ceramic 0603) + 1 x 0.1 μF (50 V, ceramic 0402) + 2 x 100 μF (25 V, electrolytic, optional)

$C_{out} = 1 \times 47\text{ }\mu\text{F}$ (6.3 V, ceramic 0805) + 1 x 4.7 μF (6.3 V, ceramic 0603) + 1 x 0.1 μF (50 V, ceramic 0402)

1.2 Connections and operating instructions

The IR3823A demo board requires a single +12 V for the input power and can deliver up to 3 A load current. The operation modes, switching frequency and soft-start time can be selected through jumpers. Figure 1 highlights the demo board I/O connections and jumper configurations for power-up.

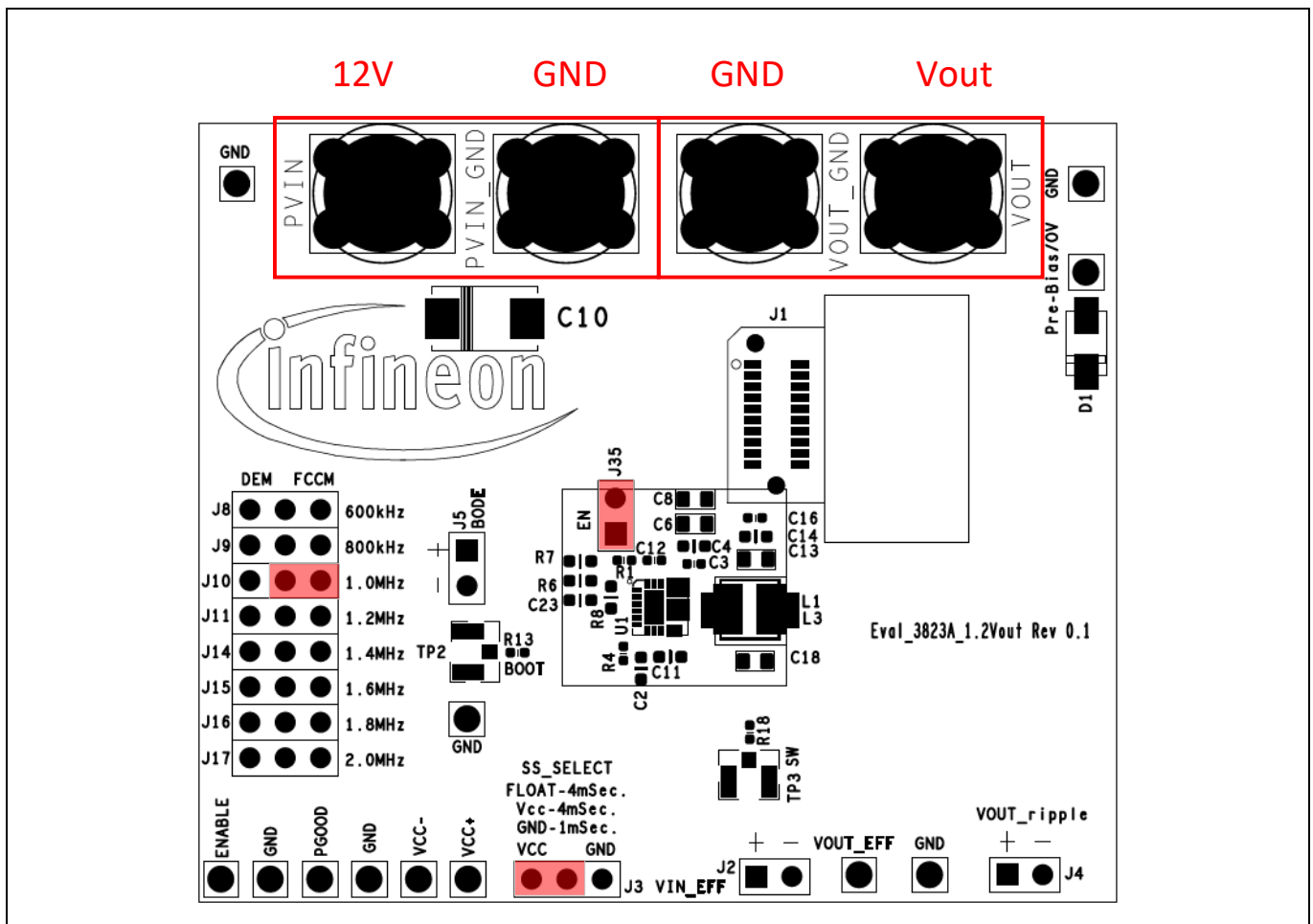


Figure 1 IR3823A evaluation board connections

Table 1 Connections

Label		Description
Input	PVIN	Connect input power (+12 V) to this pin
	PVIN_GND	Return of input power
	VIN_EFF	Sense pins for the input voltage
Output	VOUT	Connect a load (3 A max.) to this pin
	VOUT_GND	Return of V_{out}
	VOUT_EFF, GND	Sense pins for the output voltage
	VOUT_ripple	
Enable	ENABLE	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 onboard enable signal.
	EN1	Use a jumper to connect P_{VIN} to enable through a resistor divider. Remove jumper if using an external enable.
Bode	BODE+	For bode plot measurement
	BODE-	
Soft-start	SS_SELECT FLOAT/VCC- 4 ms GND- 1 ms	Use a jumper to make one of two soft-start time selections (GND- 1 ms and VCC- 4 ms). Not using a jumper will set the soft-start time to 4 ms.
$T_{on}/Mode$	FCCM	Use a jumper to select FCCM or DEM, and switching frequency.
	DEM	Eight preset switching frequencies are 600 kHz, 800 kHz, 1000 kHz, 1200 kHz, 1400 kHz, 1600 kHz, 1800 kHz and 2000 kHz.
P_{good}	PGOOD	Connect a scope probe to this pin to monitor power good signal
	GND	GND
V_{CC}	VCC+	IR3823A supports operation only with the internal LDO. Connect a scope probe to this pin to monitor the output of the internal LDO.
	VCC-	

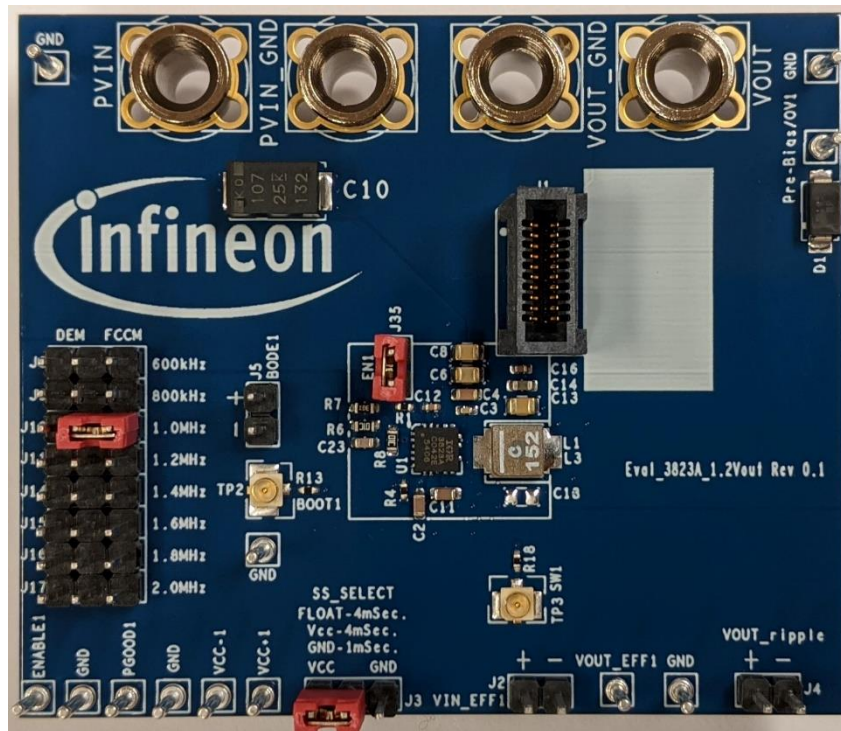
1.3 Layout

The PCB is a four-layer board (2.6 in. x 2.2 in.) using FR4 material. The top, bottom and inner layers use 2 oz. copper. The PCB thickness is 0.062 in. The IR3823A and other major power components are mounted on the top side of the board.

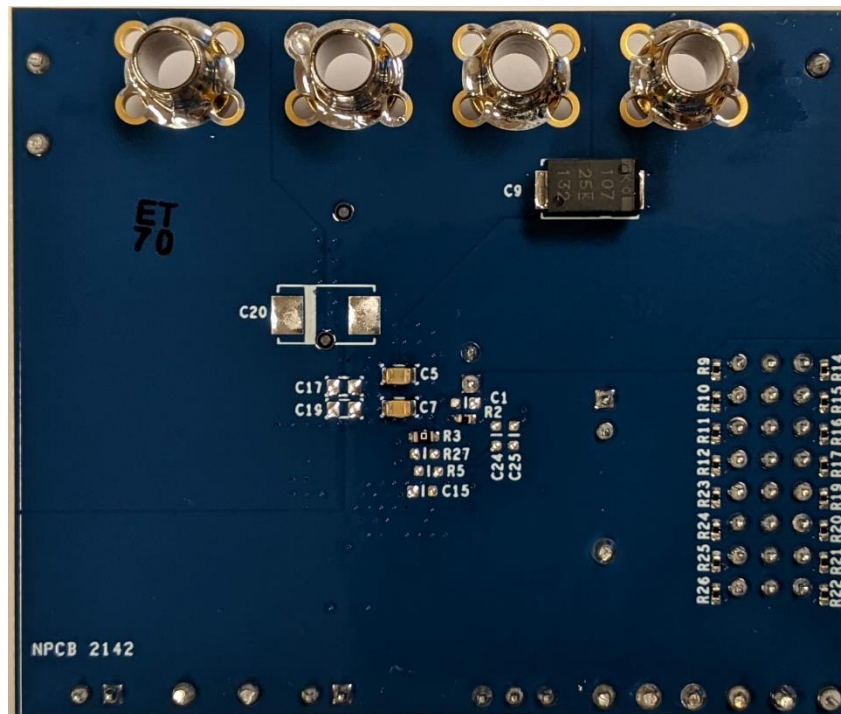
User manual for IR3823A evaluation board

3 A single-phase buck regulator with 1.2 V output

Board information



Top



Bottom

Figure 2 Top and bottom view of IR3823A evaluation board

User manual for IR3823A evaluation board

3 A single-phase buck regulator with 1.2 V output

Board information

1.4 PCB layout

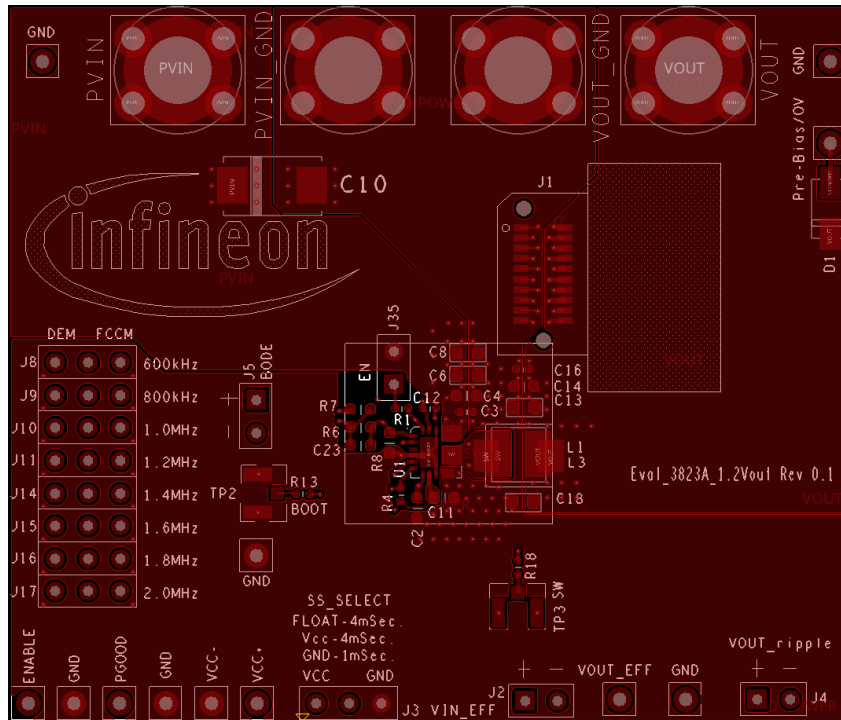


Figure 3 Top layer

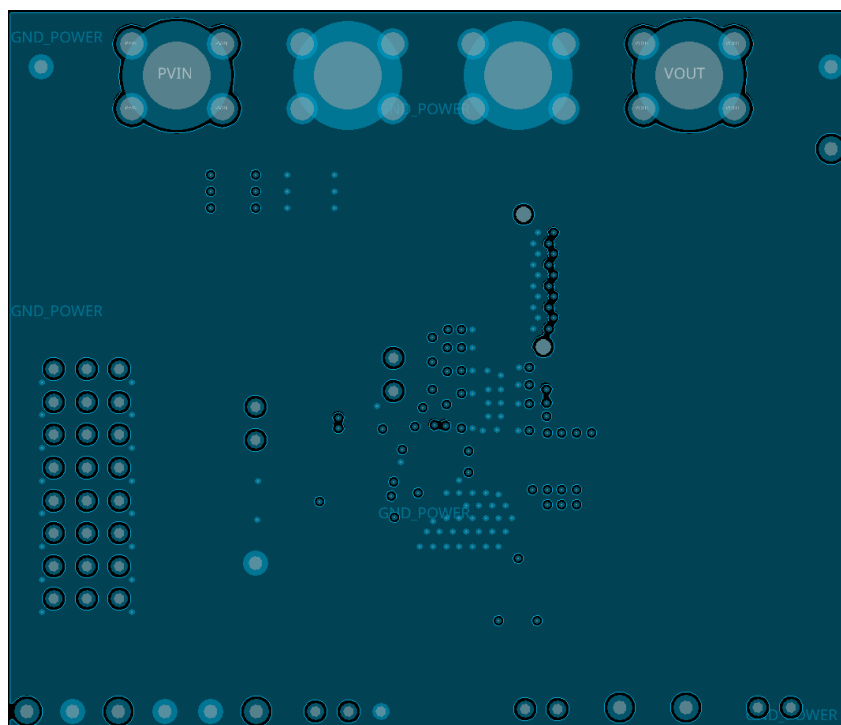


Figure 4 Bottom layer

User manual for IR3823A evaluation board

3 A single-phase buck regulator with 1.2 V output

Board information

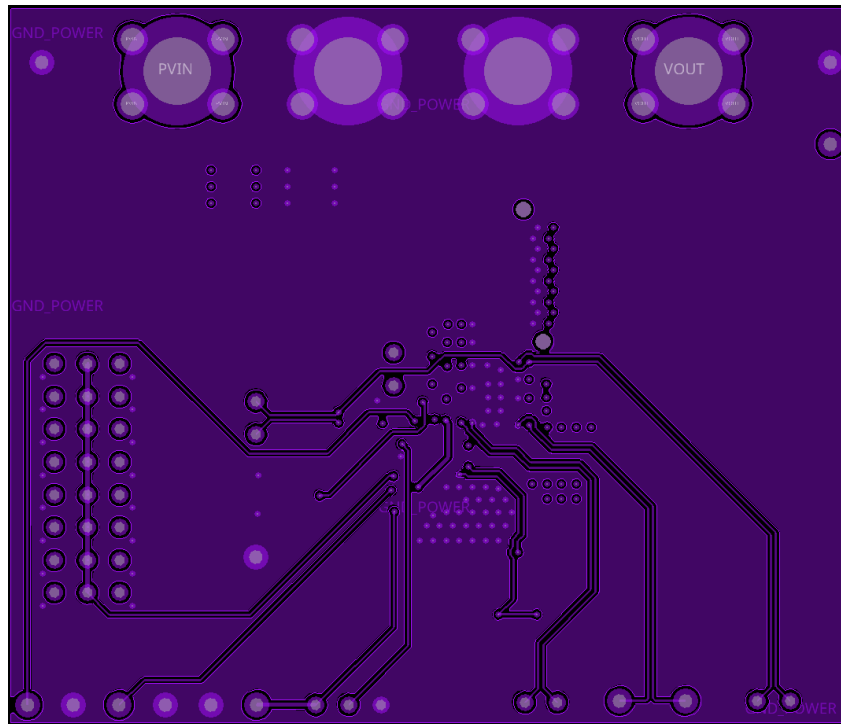


Figure 5 Mid layer 1

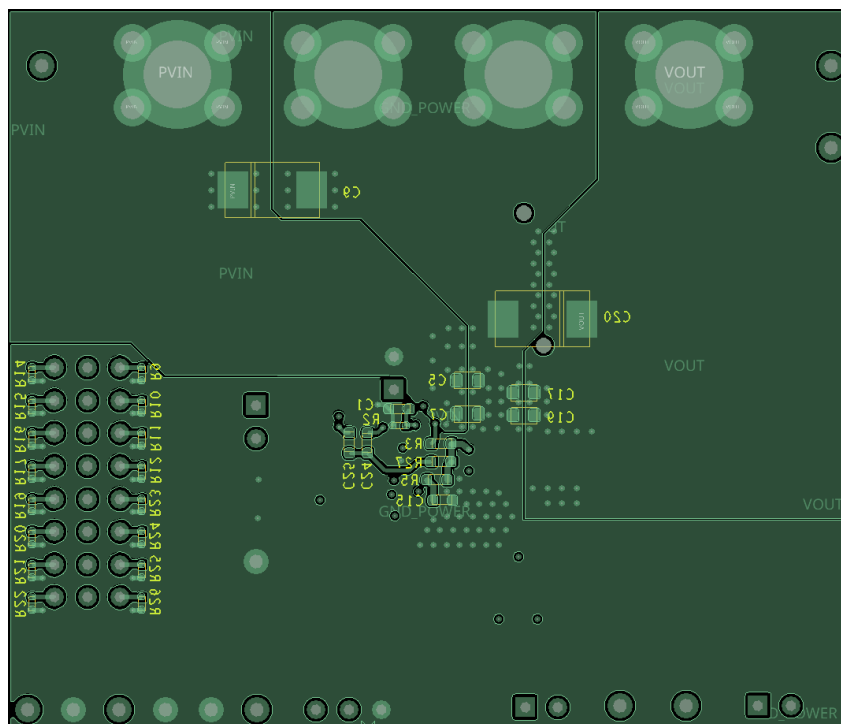


Figure 6 Mid layer 2

1.5 Bill of materials

Table 2 Bill of materials

Qty	Reference	Value	Manufacturer	Part number	Description
1	C3	1 nF	Samsung	CL05B102KB5NNNC	1 nF, 0402, 50 V, X7R, 10%
2	C12, C16	0.1 μ F	TDK	C1005X7R1H104K050B B	0.1 μ F, 0402, 50 V, X7R, 10%
2	C2, C4	4.7 μ F	Murata	GRM188C81E475KE11D	4.7 μ F, 0603, 25 V, X6S, 20%
1	C11	10 μ F	Murata	GRM188C81C106MA73 D	10 μ F, 0603, 16 V, X6S, 20%
1	C14	4.7 μ F	Samsung	CL10A475MQ8NNNC	4.7 μ F, 0603, 6.3 V, X5R, 20%
1	C23	150 pF	Samsung	CL10C151JB8NNNC	150 pF, 0603, 50 V, C0G, 5%
4	C5, C6, C7, C8	22 μ F	Murata	GRM21BR61E226ME44L	22 μ F, 0805, 25 V, X5R, 20%
1	C13	47 μ F	Murata	GRM21BR60J476ME11L	47 μ F, 0805, 6.3 V, X5R, 20%
2	C9, C10	100 μ F	Kemet	T521X107M025ATE030	Capacitor PolyTan 100 μ F, 25 V, 20%, 2917
2	TP2, TP3	BOOT1	TE Conn./Amp	1909763-1	UMCC receptor style A
1	J1	Conn. 20-pin	Samtec Inc.	HSEC8-110-01-S-DV-A-K-TR	Edge connector dual female 20-pos.
2	R1, R4	49.9K	Yageo	RC0402FR-0749K9L	Resistor, 0402, 1/16 W, 0.1%
1	R2	7.5K	Yageo	RC0402FR-077K5L	Resistor, 0402, 1/16 W, 0.1%
1	R9	0	Yageo	RC0402FR-070RL	Resistor, 0402, 1/16 W, 0.1%
1	R10	1.5K	Yageo	RC0402FR-071K5L	Resistor, 0402, 1/16 W, 0.1%
1	R11	2.49K	Yageo	RC0402FR-072K49L	Resistor, 0402, 1/16 W, 0.1%
1	R12	3.48K	Yageo	RC0402FR-073K48L	Resistor, 0402, 1/16 W, 0.1%
2	R13, R18	953	Yageo	RC0402FR-07953RL	Resistor, 0402, 1/16 W, 1%
1	R14	10.5K	Yageo	RC0402FR-0710K5L	Resistor, 0402, 1/16 W, 0.1%
1	R15	12.1K	Yageo	RC0402FR-0712K1L	Resistor, 0402, 1/16 W, 0.1%
1	R16	14K	Yageo	RC0402FR-0714KL	Resistor, 0402, 1/16 W, 0.1%

Qty	Reference	Value	Manufacturer	Part number	Description
1	R17	16.2K	Bourns Inc.	CR0402-FX-1622GLF	Resistor, 0402, 1/16 W, 0.1%
1	R19	18.7K	Yageo	RC0402FR-0718K7L	Resistor, 0402, 1/16 W, 0.1%
1	R20	21.5K	Yageo	RC0402FR-0721K5L	Resistor, 0402, 1/16 W, 0.1%
1	R21	24.9K	Yageo	RC0402FR-0724K9L	Resistor, 0402, 1/16 W, 0.1%
1	R22	28.7K	Yageo	RC0402FR-0728K7L	Resistor, 0402, 1/16 W, 0.1%
1	R23	4.53K	Yageo	RC0402FR-074K53L	Resistor, 0402, 1/16 W, 0.1%
1	R24	5.76K	Yageo	RC0402FR-075K76L	Resistor, 0402, 1/16 W, 0.1%
1	R25	7.32K	Yageo	RC0402FR-077K32L	Resistor, 0402, 1/16 W, 0.1%
1	R26	8.87K	Yageo	RC0402FR-078K87L	Resistor, 0402, 1/16 W, 0.1%
1	R3	0	Yageo	RC0603FR-070RL	Resistor, 0603, 1/10 W, 1%
2	R6, R8	10K	Yageo	RC0603FR-0710KL	Resistor, 0603, 1/10 W, 1%
1	R7	20	Yageo	RC0603FR-0720RL	Resistor, 0603, 1/10 W, 1%
9	J3, J8, J9, J10, J11, J14, J15, J16, J17	–	Harwin	M20-9990346	Header, 1x3, TH, 0.025 sq, 0.1 inch space
4	J35, J2, J4, J5	–	Harwin	M20-9990246	Header, 1x2, TH, 0.025 sq, 0.1 inch space
4	J6, J7, J12, J13	P _{Vin}	Keystone Electronics	575-8	Connector banana jack solder
1	L1	1.5 µH	Coilcraft	XFL4020-152ME	Inductor
1	D1	SMAT70A	Diodes, Inc.	SMAT70A	Transient voltage suppressor, SMA, 3.5 V, 40 A
4	TB1, TB2, TB3, TB4	Label	Keystone	7693	Terminal block, 1 pos, 15 A, 300 V
12	TP1, TP4, TP8, TP10, TP11, TP13, TP17, TP9, TP12, TP14, TP15, TP16	Pre-bias/OV1	Vector	K24C/M	Test point V1055_ND
1	U1	IR3823A	Infineon	IR3823A	IR3823A PQFN

User manual for IR3823A evaluation board

3 A single-phase buck regulator with 1.2 V output

Typical operating waveforms

2. Typical operating waveforms

$V_{in} = 12.0\text{ V}$, $V_{out} = 1.2\text{ V}$, $I_{out} = 0\text{ to }3\text{ A}$, room temperature with no airflow.

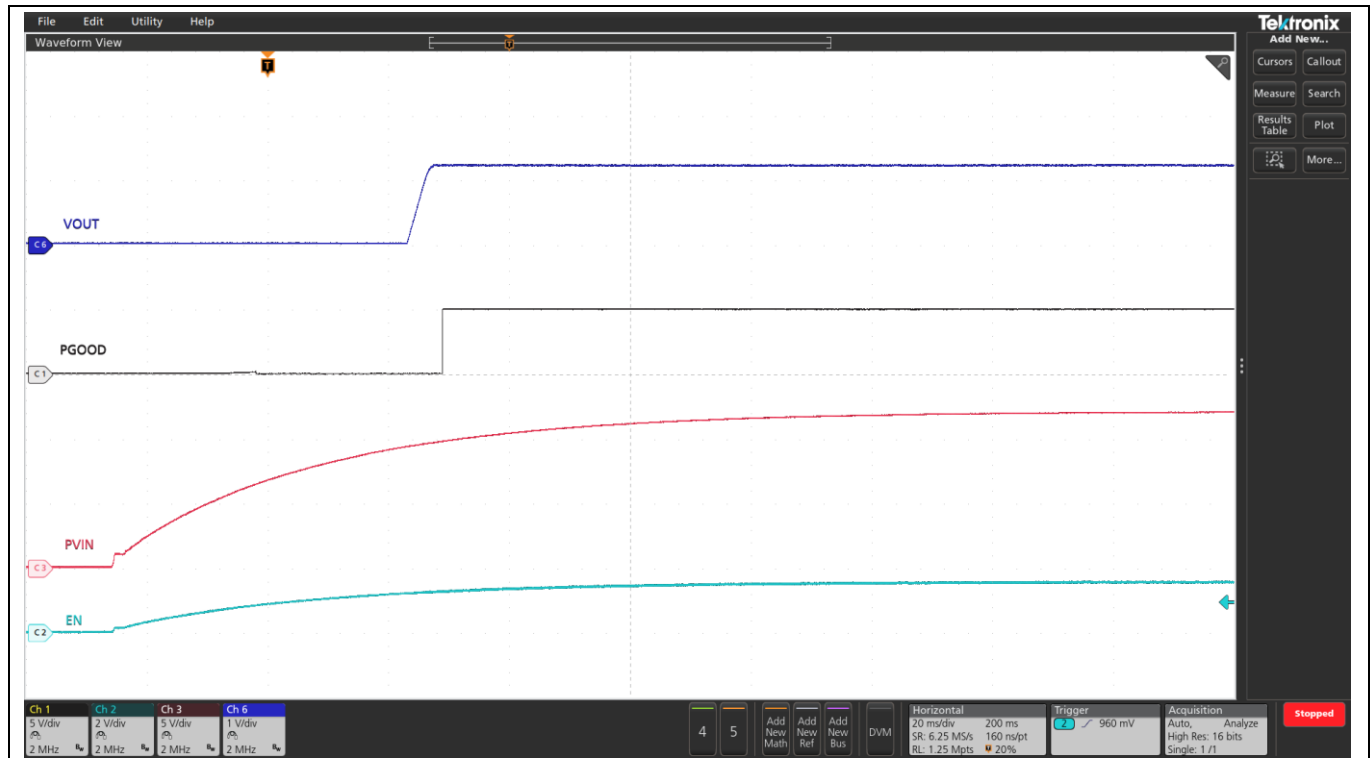


Figure 8 Start-up at 3 A load (Ch1: P_{good}, Ch2: EN, Ch3: P_{Vin}, Ch6: V_{out})

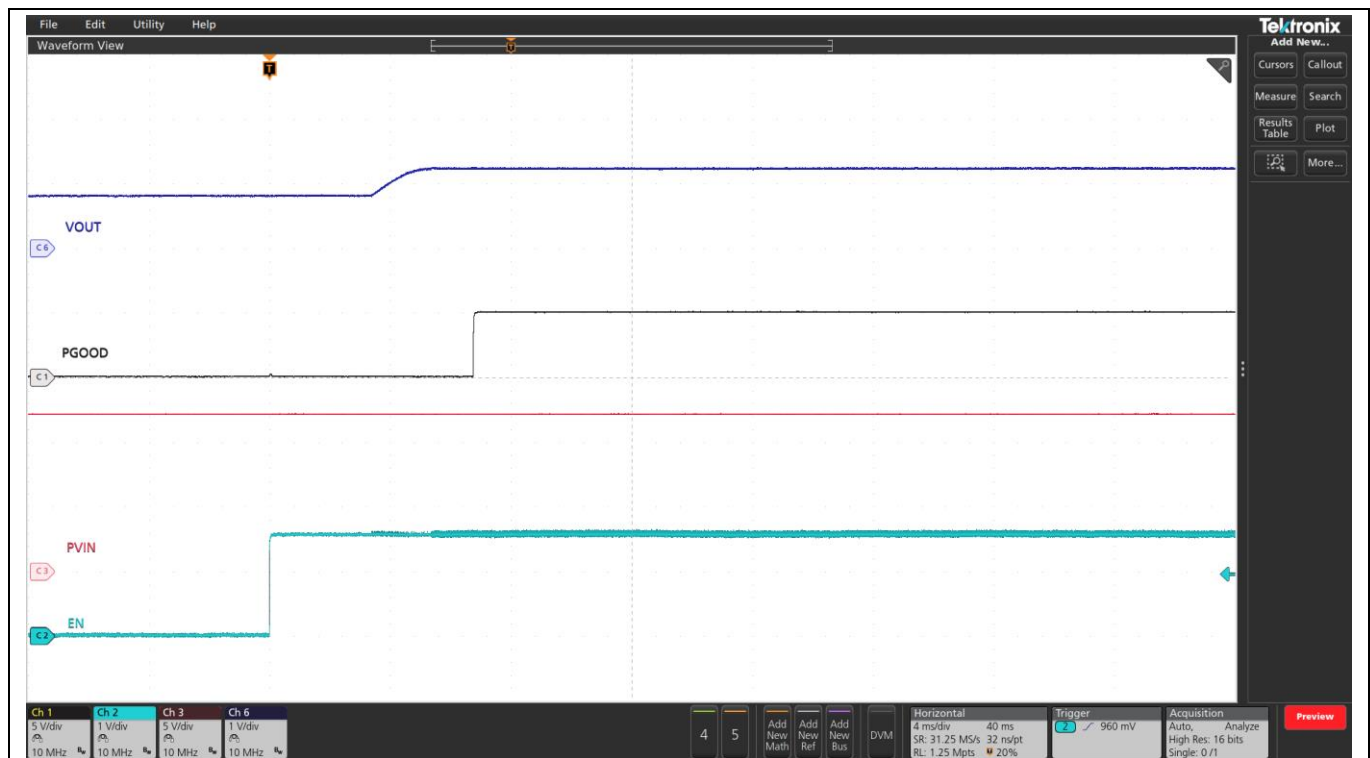


Figure 9 Pre-bias start-up at 0 A load (Ch1: P_{good}, Ch2: EN, Ch3: P_{Vin}, Ch6: V_{out})

User manual for IR3823A evaluation board

3 A single-phase buck regulator with 1.2 V output

Typical operating waveforms

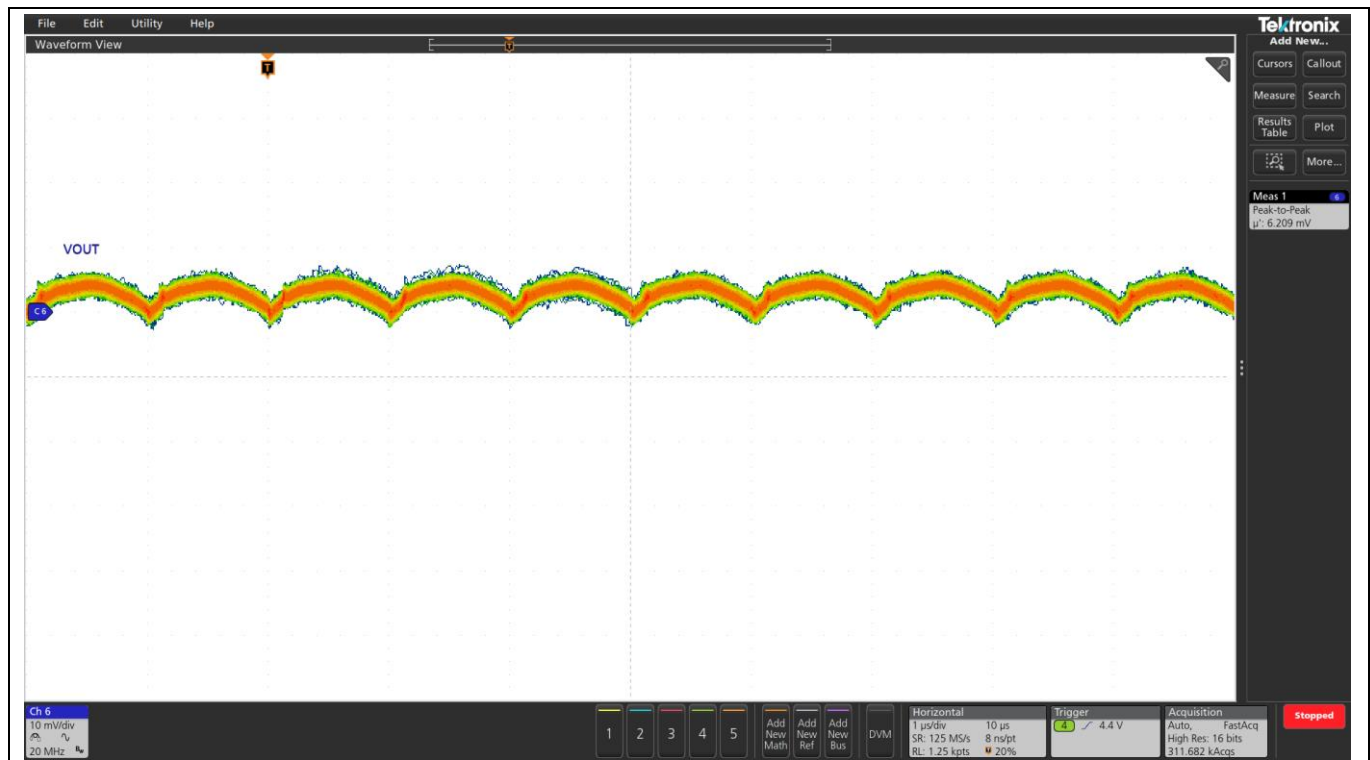


Figure 10 V_{out} ripple at 3 A load, $F_{sw} = 600$ kHz (Ch6: V_{out})

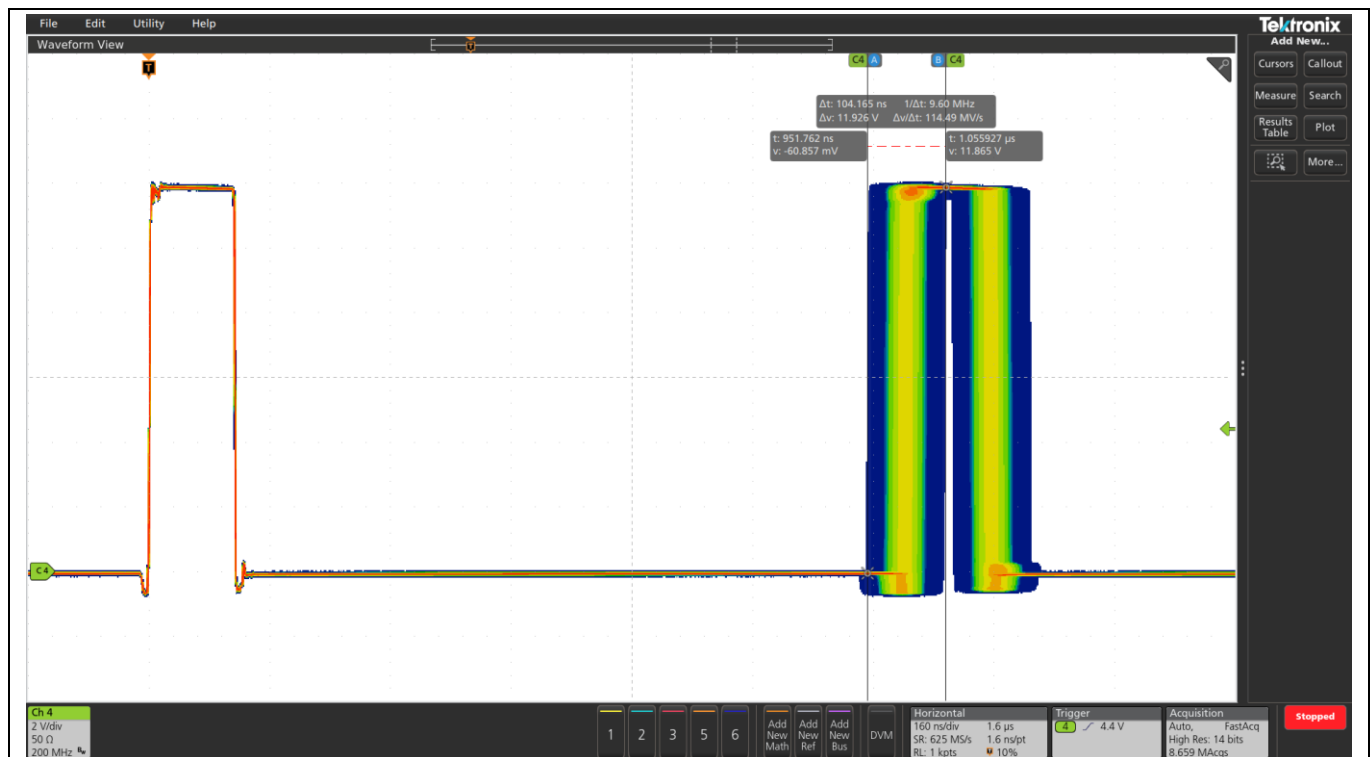


Figure 11 SW node, 3 A load, $F_{sw} = 1000$ kHz (Ch4: SW)

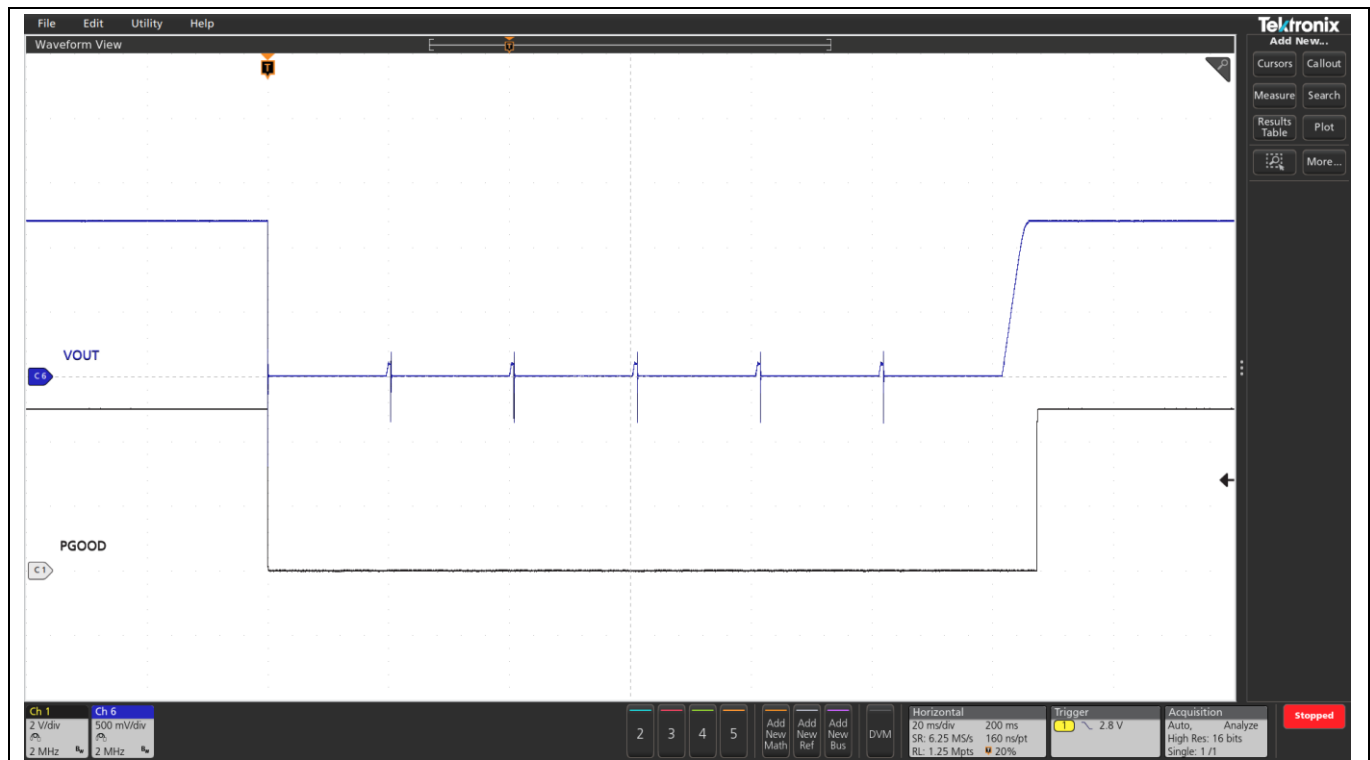


Figure 12 Short-circuit and UVP (hiccup and recovery, Ch1: P_{good} , Ch6: V_{out})

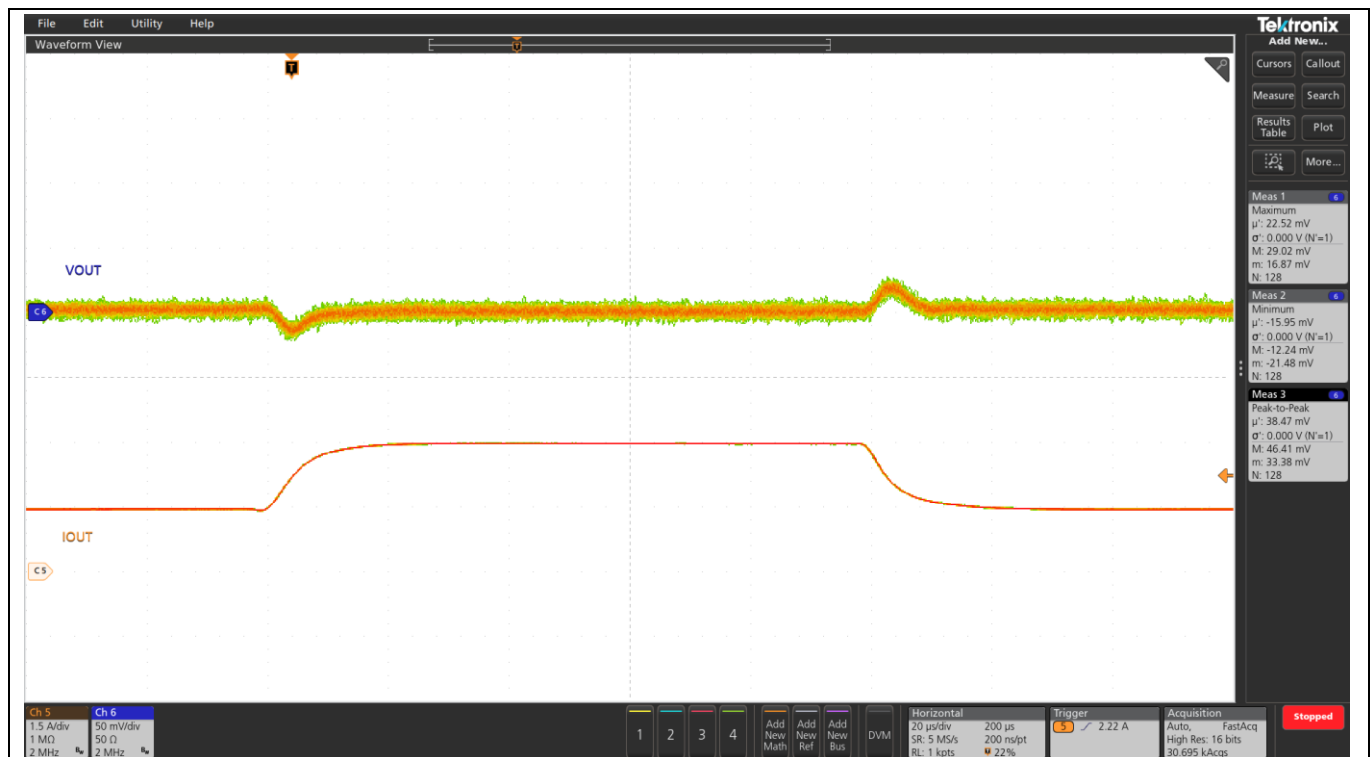


Figure 13 Transient response at 1.5 A step-load current: $I_{out} = 1.5 \text{ A to } 3 \text{ A}$ (Ch1: I_{out} , Ch4: V_{out}) pk-pk: 38.5 mV, $F_{sw} = 1000 \text{ kHz}$

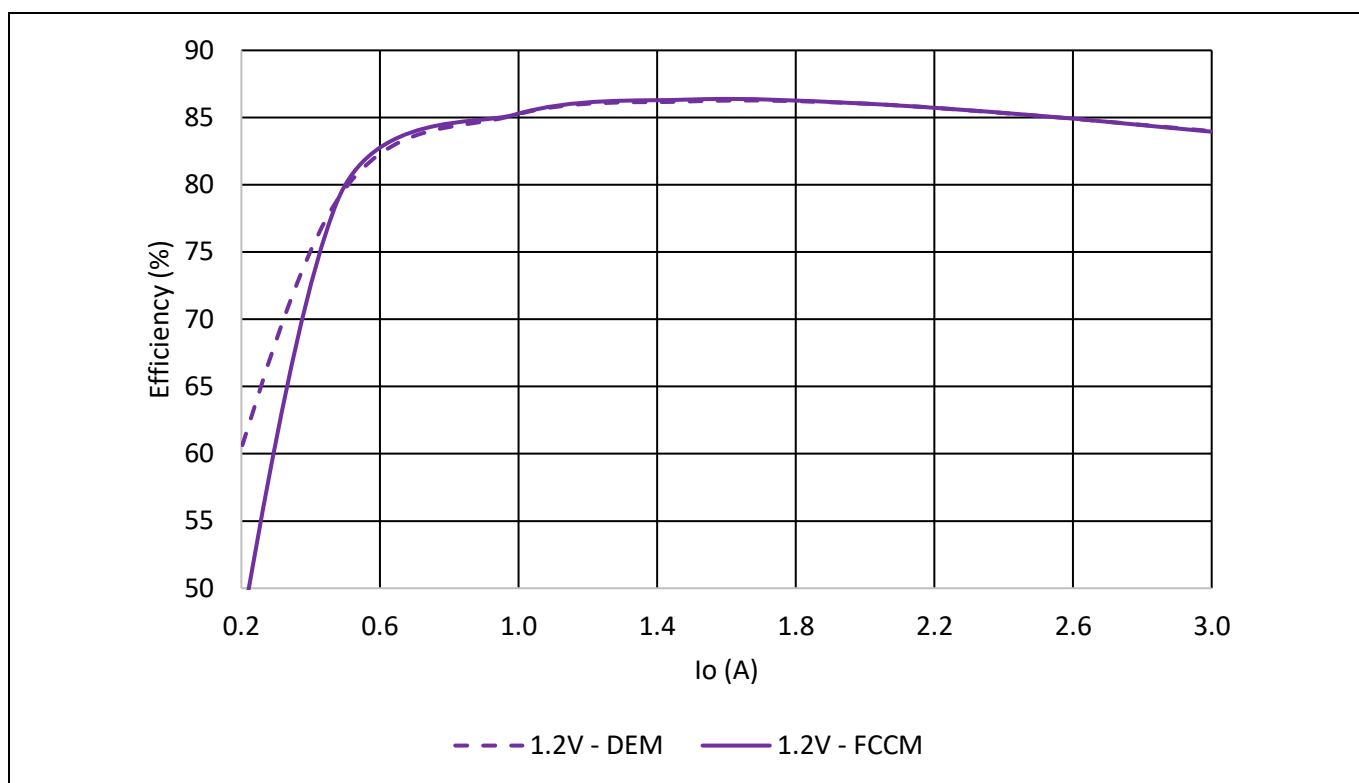


Figure 14 Efficiency vs. load current natural convection (12 V_{in}, 1.2 V_{out}, 1.5 μH, 1000 kHz, T_a = 25°C, FCCM: solid line, DEM: dashed line)

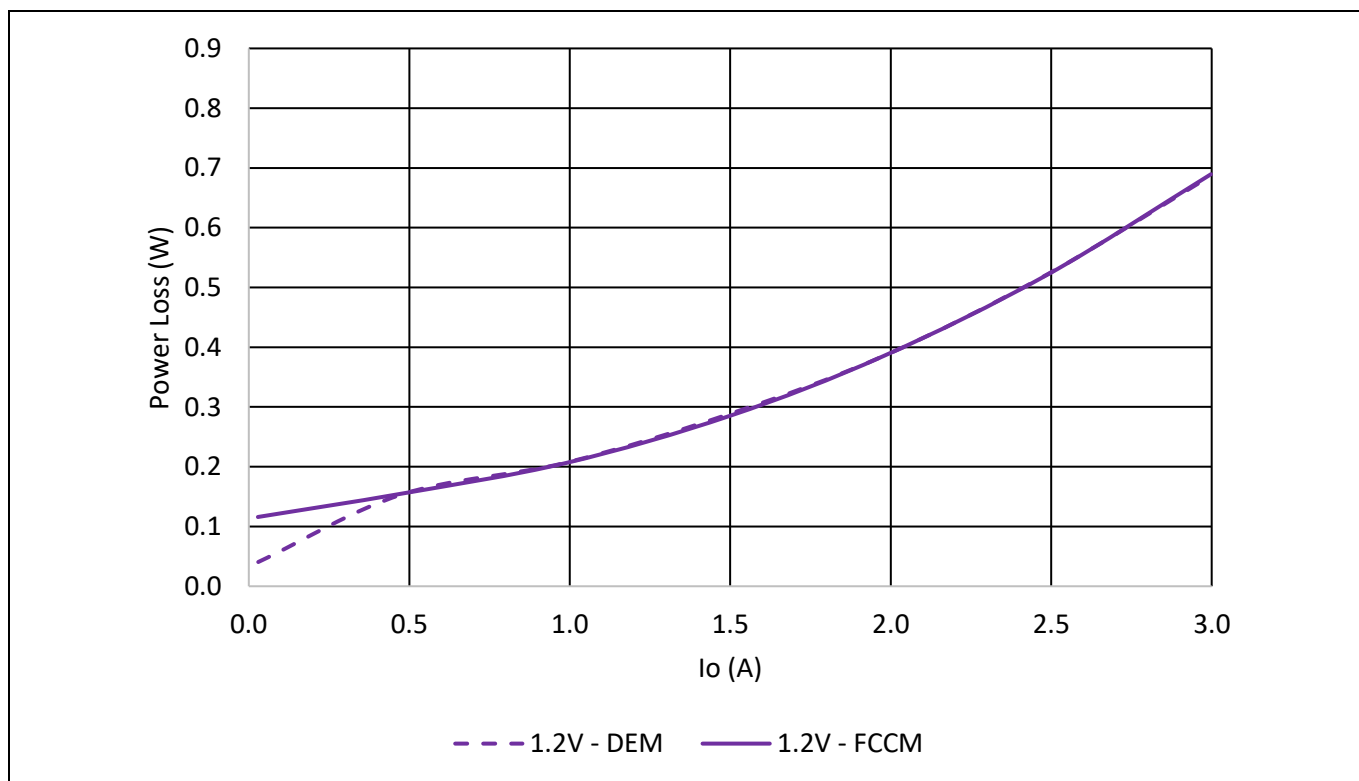


Figure 15 Power loss vs. load current natural convection (12 V_{in}, 1.2 V_{out}, 1.5 μH, 1000 kHz, T_a = 25°C, FCCM: solid line, DEM: dashed line)

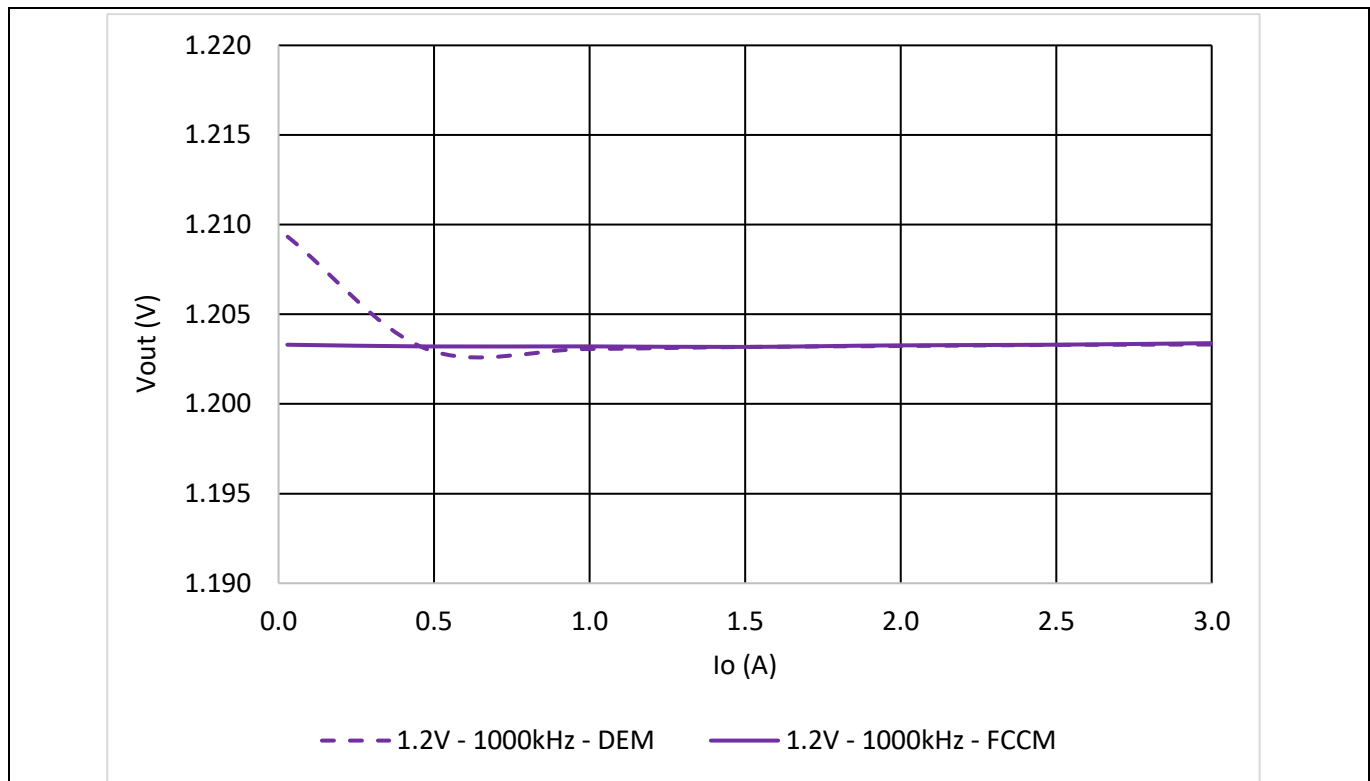


Figure 16 IR3823A V_{out} regulation (12 V_{in}, 1.2 V_{out}, 1.5 μ H, 1000 kHz, $T_a = 25^\circ\text{C}$, FCCM: solid line, DEM: dashed line)



Figure 17 Thermal image of the board at 3 A load IR3823A = 43.1°C, $F_{sw} = 1000$ kHz, $T_a =$ room temperature, natural convection

Revision history

Document version	Date of release	Description of changes
V 1.0	2022-07-28	Initial release

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