

High power Poe PD, 3V3 up to 20 A active clamp forward evaluation board

Introduction

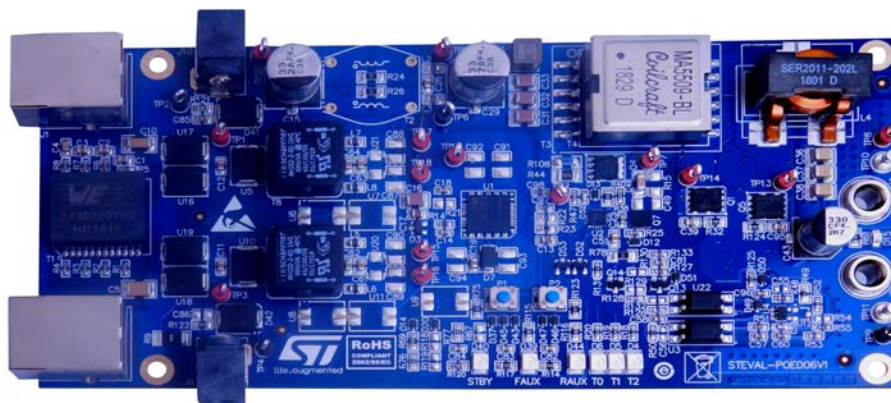
The **STEVAL-POE006V1** evaluation board allows an easy verification of a PD interface compliant with the new IEEE802.3bt standard based on **PM8805** and of a DC-DC active clamp forward converter based on **PM8804** controller.

The PM8805 is a highly integrated device embedding two active bridges and an IEEE802.3bt compliant powered device (PD) interface. It can be successfully used in all medium to high power, 2P and /or 4P high efficiency PoE/ PoE+ applications.

The PM8804 is a PWM controller that integrates all the circuitry required to design a smart and efficient 48 V converter.

It features a programmable oscillator for the switching frequency, adjustable slope compensation, dual complementary low-side drivers with programmable dead time and soft start, soft turn off and a programmable current sense blanking time.

Figure 1. STEVAL-POE006V1 evaluation board



1 STEVAL-POE006V1 evaluation board overview

1.1 Specifications, connectors and LEDs

Table 1. STEVAL-POE006V1 specifications

Parameter	Specs
V _{IN} at RJ45 connector	From 41.2 to 57 V
I _{IN} at RJ45 connector	1.0 A max. each pair
V _{OUT}	3.3 V ± 2%
I _{OUT}	20 A total max.
Max. output power	66 W max. ⁽¹⁾
Efficiency overall peak	>90% at I _{OUT} =10 A, at V _{IN} = 48 V >89% at I _{OUT} =20 A, at V _{IN} = 48 V
V _{IN} at Frontal Jack connector (J9)	48 V ±2 V
I _{IN} at Frontal Jack connector (J9)	1.5 A total max.
V _{IN} at Rear Jack connector (J10)	48 V ±2 V
I _{IN} at Rear Jack connector (J10)	1.5 A total max.
Operating temperature	0°C - 50°C 20 A full load 50°C - 85°C linearly decrease to 15 A

1. Max. power cannot be maintained at high ambient temperature ($T_{amb}>50^{\circ}\text{C}$) for a long time.

Table 2. STEVAL-POE006V1 connectors

Reference	Type	Specs
J1	RJ45 connector	Data and power input
J2	RJ45 connector	Data output
J9	Power jack	Front Aux
J10	Power jack	Rear Aux
J4, TP10	Banana jack/turret	Positive of V _{OUT}
J6, TP11	Banana jack/turret	Negative of V _{OUT} (Sec GND)
TP8	Test point	Monitor of V _{OUT}
TP9	Test point	Monitor of Sec GND
P1	Push button	SLEEP/WKUP
P2	Push button	SHDN

Table 3. STEVAL-POE006V1 LEDs

Reference	Type	Function	Logic
D4	Green LED	Monitor of T2 signal	LED on when T2 is low
D5	Green LED	Monitor of T1 signal	LED on when T1 is low
D6	Green LED	Monitor of T0 signal	LED on when T0 is low
D15	Green LED	Monitor of V _{OUT}	LED on when V _{OUT} is present
D39	Green LED	Monitor of FAUX signal	LED on when frontal aux is present
D40	Green LED	Monitor of STBY signal	LED on when STBY is high
D44	Green LED	Monitor of RAUX signal	LED on when rear aux is present

Table 4. Tx signal possible configurations

Classification	T0	T1	T2	Bridges	Finger number	Notes
Type 1 (13 W)	1	1	1	1	0 or 1	Legacy type
Type 2 (25.5 W)	0	1	1	1	2, 3	Legacy type
Type 3 (51 W)	1	0	0	2	4	New PD type
Type 4 (71 W)	0	0	0	2	≥ 5	New PD type
Type 3 on 4 pairs (13 W), or legacy 4 pairs (type 1 class)	1	1	0	2	0 or 1	New PD type
Type 3 on 4 pairs (25.5 W), or legacy 4 pairs (type 2 class)	0	1	0	2	2, 3	New PD type
Rear AUX	0	0	1	any	N.A.	Aux present
Front AUX				0		

The STEVAL-POE006V1 evaluation board is classified as type 4 and class 8. The default status of Tx signal is 000.

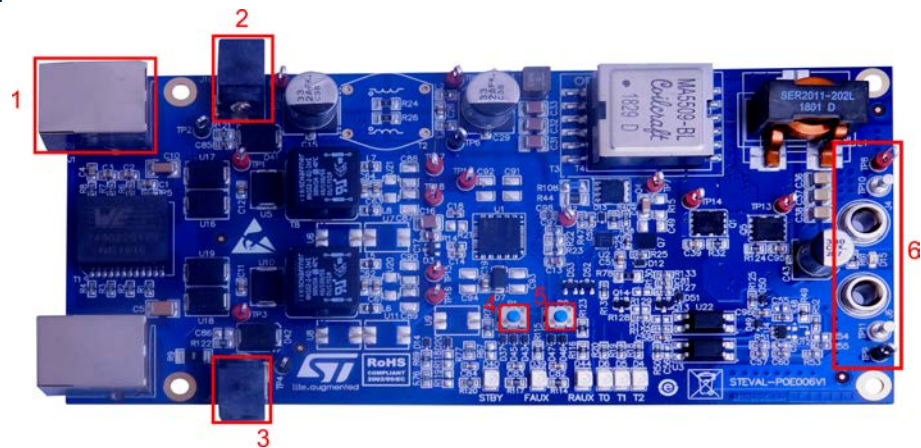
Note: Level 0 or low means the corresponding LED is on; level 1 or high means the LED is off.

1.2 Board setup

The **STEVAL-POE006V1** evaluation board combines the **PM8805** PD interface, compliant with the IEEE 802.3bt PoE standard, and the **PM8804** PWM controller for an active clamp forward.

Figure 2. STEVAL-POE006V1 evaluation board: components view

- 1. POE IN
- 2. RAUX IN
- 3. FAUX IN
- 4.SLEEP and WAKEUP
- 5.SHUTDOWN
- 6.OUTPUT



When you use a bench power supply, follow the steps below.

- Step 1.** Set the power supply current limit to 0.2 A
- Step 2.** Apply 10 V and check the input current is 350-400 μ A
- Step 3.** Apply 20 V and check the input current is within the selected Class range (the default is Class 8, 39 mA)
- Step 4.** Apply 48 V and check the input current is <50 mA and the output voltage is 3.3 V (without load)
- Step 5.** Change the current limit to 3 A
- Step 6.** Connect an electronic load between V_{OUT} and the secondary GND
- Step 7.** Turn the power supply on (48 V) and check the input current is coherent with the load current setting and the converter expected efficiency.
 For example, $3.3\text{ V} \times 10\text{ A} = 33\text{ W}$ $\rightarrow$ expected efficiency is 91% so $P_{IN} = 33/0.91=36.2\text{ W}$, which, with 48 V as input voltage, gives $I_{input} = 36.2/48 = 0.75\text{ A}$
- Step 8.** Change the load current as needed

2 Configurations

2.1 PM8805 configurations

Table 5. PM8805 control signal description

PM8805 behavior, standard operations	INPUTS			OUTPUTS				
	FAUX	RAUX	STBY	PGD	Hot swap	Charge pump	Active bridge	MPS
Normal POE operation	0	0	0	1 after 85ms hot swap enabled	Closes at UVLO	On @ UVLO	Enabled	Off
Stby PoE operation	0	0	1	1 when hot swap closed	Closes at UVLO	Off	LS enabled HS OFF	On
Front Aux operation	1	0	x	1 when hot swap closed	Closed	On	Enabled	Off
Rear Aux operation	0	1	0	1	Open	Off	Off	Off
Additional non standard operations								
Sleep mode/Wake up	1	1	1	0	Open	Off	LS enabled HS OFF	On
Rear Aux with MPS	0	1	1	1	Open	Off	LS enabled HS OFF	On
Shutdown/reboot	1	1	0	0	Open	Off	Off	Off

2.2 PoE

The [STEVAl-POE006V1](#) evaluation board default operation mode is the PoE (0,0,0). The selected class resistors are 36.5 ohm for CLS1 and 51.1 ohm for CLS2, so the board is class 8; that is, the Tx LED configuration is 000 or all LEDs on.

The other classes can be adjusted using the following table.

Table 6. PM8805 class description

PD class	CLS1 resistor (Ω)	CLS2 resistor (Ω)	Min. (mA)	Max. (mA)
Class 0	2 K	2 K	0	4.0
Class 1	150	150	9.0	12.0
Class 2	80.6	80.6	17.0	20.0
Class 3	51.1	51.1	26.0	30.0
Class 4	36.5	36.5	36.0	44.0
Class 5	36.5	2 K	36/0	44/4
Class 6	36.5	150	36/9	44/12
Class 7	36.5	80.6	36/17	44/20
Class 8	36.5	51.1	36/26	44/30

Classification phase is valid only for PoE devices, so it is not required when connected to any non-PoE power source such as a wall adapter: in those cases, the CLS buffers are never turned on.

Depending on the PD type and class, the relevant PD electrical parameters are summarized in the table below.

Table 7. PM8805 PD main parameters

PD type	Class	CLS1 sign.	CLS2 sign.	Pin (W)	Vin min. (V)	Vin max. (V)	I _{IN} max. (mA)	P _{peak} (W) for 50 ms
1	0	0	0	13.0	37.0	57	350	14.4
	1	1	1	3.84	42.1		90	5.00
	2	2	2	6.49	40.8		160	8.36
	3	3	3	13.0	37.0		350	14.4
2	4	4	4	25.5	42.5		600	28.05
3	1	1	1	3.84	42.1		90	5.00
	2	2	2	6.49	40.8		160	8.36
	3	3	3	13.0	37.0		350	14.4
	4	4	4	25.5	42.5		600	28.05
	5	4	0	40.0	44.3		900	42
	6	4	1	51.0	42.5		1200	53.55
4	7	4	2	62.0	42.9		1440	65.10
	8	4	3	71.3	41.2		1730	74.86

2.3 FAUX connector

A voltage applied at J9 connector (FAUX) sets automatically the correct input configuration (FAUX=1, RAUX=0, STBY=do not care).

If the [STEVAL-POE006V1](#) evaluation board is already powered by a PSE, the following conditions apply:

1. FAUX voltage lower than PSE voltage: the evaluation board is still powered from PSE and T0,T1,T2 signal configuration remains the same according to [Table 4. Tx signal possible configurations](#)
2. FAUX voltage is greater than PSE voltage, but the difference is less than 2 V: a current sharing occurs between PSE and FAUX to supply the evaluation board. T0,T1,T2 signal configuration remains unchanged as in the previous case
3. FAUX voltage is greater than PSE voltage and the difference is greater than 2 V: the evaluation board is powered by FAUX, PSE is disconnected as its load has significantly decreased (~3 mA) and PD does not ensure MPS condition.

The [PM8805](#) device works in Front aux mode (T0=0,T1=0,T2=1). When the FAUX connector (J9) is unplugged, PSE is not connected and the output voltage is interrupted as a new detection/classification procedure must be done before PSE powers the board again.

2.4 RAUX with MPS

A voltage applied at J10 connector (RAUX) sets automatically the correct input configuration (FAUX=0; RAUX=1; Stby=1).

The hot swap is opened to give prevalence of the RAUX source over the PoE interface.

The [STEVAL-POE006V1](#) evaluation board is configured to put the PSE in MPS mode triggering the STBY pin threshold by a proper divider (R69, R76 and R120) supplied by the RAUX input voltage. When STBY pin is pulled up, MPS current is enabled and drawn from the PSE.

The RAUX voltage can be in one of the following ranges, depending on the PSE voltage available at RJ45 connector (J1):

- RAUX voltage lower than PSE input voltage of less than 8 V: when RAUX voltage is applied and the evaluation board is already powered by PSE, switching between the two power supply sources works properly. The [PM8805](#) device goes in Rear auxiliary with MPS mode and PSE remains connected to the evaluation board (T0=0,T1=0, T2=1)

Figure 3. PSE to RAUX switchover at $V_{PSE}=55\text{ V}$, $V_{RAUX}=48\text{ V}$, $I_{OUT}=17\text{ A}$

- Ch1: VDC input voltage (TP5); Ch2: PSE input current (J1 twisted pairs)
- Ch3: RAUX signal (pin 11 U1 - PM8805); Ch4: RAUX input current (J10)



When RAUX power supply is unplugged from J10, PSE is immediately available to supply the evaluation board, without causing output voltage interruptions, and the PM8805 device goes back to normal operating mode.

As shown in the figure below, there is a delay of about 200 μs between the time the RAUX source is unplugged and the hot swap MOSFET of PM8805 is turned on again, during which the forward converter is supplied only by input capacitors C29 and C15.

Figure 4. RAUX to PSE switchover at $V_{PSE}=55\text{ V}$, $V_{RAUX}=48\text{ V}$, $I_{OUT}=17\text{ A}$

- Ch1: VDC input voltage (TP5); Ch2: PSE input current (J1 twisted pairs)
- Ch3: Raux signal (pin 11 U1 – PM8805); Ch4: RAUX input current (J10)



- RAUX voltage lower than PSE input voltage of more than 12 V: when RAUX voltage is applied and the evaluation board is already powered by PSE, switching between the two power supply sources works properly as in the previous case. When RAUX power supply is unplugged from J10, during the switchover, the PM8805 hot swap MOSFET drop between drain and source might be greater than the datasheet parameter **Vds_fail** (12 V min./16 V max.), or the hot swap MOSFET current might be greater than the datasheet parameter **Short** (4 A min./6 A max.).
If the above mentioned failures occur, the power good signal is forced to low level according to the datasheet parameter **Tretry** (9 min./11 max. msec), stopping the forward converter switching, then it is released causing an output voltage interruption as shown in the following figure.

Figure 5. RAUX to PSE switchover at $I_{OUT}=17\text{ A}$

- Ch1: VDC input voltage (TP5); Ch2: PGD signal (TP19)
- Ch3: RAUX signal (pin 11 U1-PM8805); Ch4: Vout output voltage (TP8)



- RAUX voltage is greater than PSE input voltage of at least a diode forward voltage: when RAUX voltage is applied and the evaluation board is already powered by PSE, switching between the two power supply sources works properly as reported in the previous cases, but in this condition MPS current is drawn by RAUX source, then PSE is no more able to stay connected to evaluation board. In this case, when RAUX source is removed, the output voltage goes to zero until PSE has successfully completed detection and classification phases, and the voltage is reapplied to the PD interface.

2.5 Soft stop

An important feature of the [PM8804](#) is the soft stop that can be controlled via the MODE pin, used to select the converter operation mode.

By connecting this pin to AGND, you can turn GATE2 off when not used and disable the soft stop feature.

Pull up MODE pin if GATE2 is used and soft stop desired. Leave this pin open when not used.

In case of normal shutdown or thermal fault, the device features a soft stop procedure which helps to reduce the stress and the overvoltage on the power MOSFET and it is achieved discharging slowly the soft start capacitor with a $10\text{ }\mu\text{A}$ current sink. On the [STEVAL-POE006V1](#) evaluation board the MODE pin is left open, as GATE2 must be available to implement the active clamp forward converter and, during normal shutdown, the soft stop procedure is implemented.

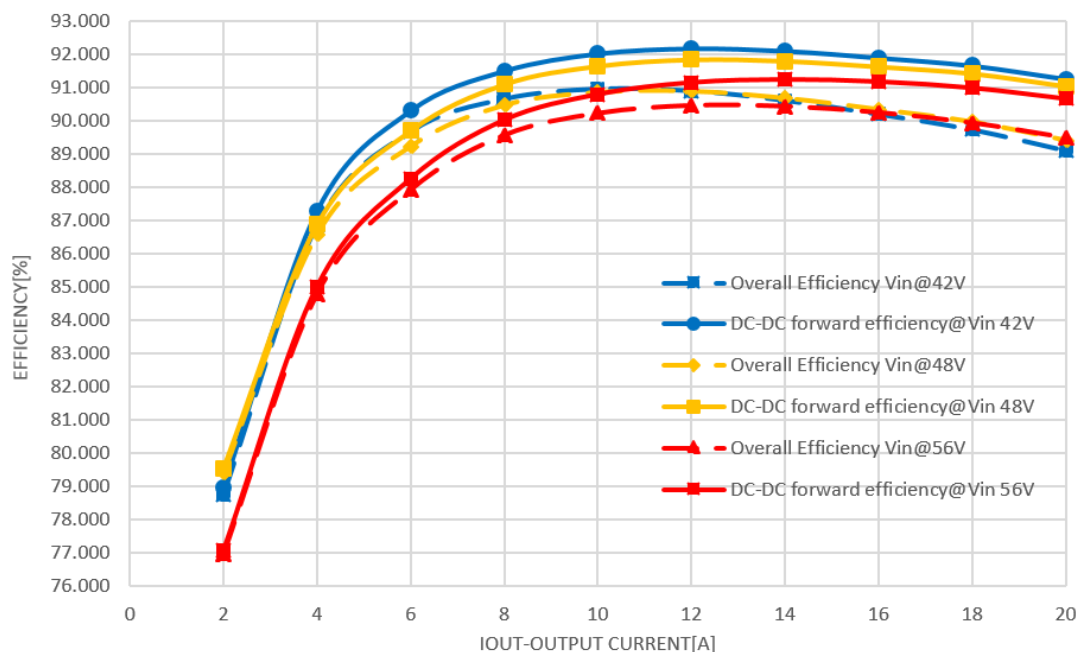
3 Measurements

3.1 Efficiency

The STEVAL-POE006V1 evaluation board is composed of a PoE interface compliant with the last standard IEEE802.3bt, with the PM8805 interface and a forward active clamp DC-DC converter that receives DC voltage from the PoE interface.

The figure below shows the efficiency of a single forward converter and the overall efficiency which also includes the PoE interface power losses.

Figure 6. STEVAL-POE006V1 overall and DC-DC forward efficiency



The dotted lines indicate the STEVAL-POE006V1 efficiency at different DC input voltages applied to RJ45 connector J1. The continuous line indicates the DC-DC forward efficiency, that does not include the following losses of the associated POE interface section:

- RJ45 connector J1
- PoE data transformer T1
- common chokes T7 and T8 placed on the two power supply pairs
- PM8805 interface that integrates the dual power MOS bridges and a hot swap MOSFET
- Forward converter input filter

This efficiency is measured between output test points TP8/TP9 and input test points TP5/TP6 of the forward converter.

3.2 Output voltage ripple

Figure 7. Output voltage ripple: $I_{OUT} = 2\text{ A}$

- Ch1: Vout ripple; Ch2: Primary MOSFET gate voltage; Ch3: I_{OUT}

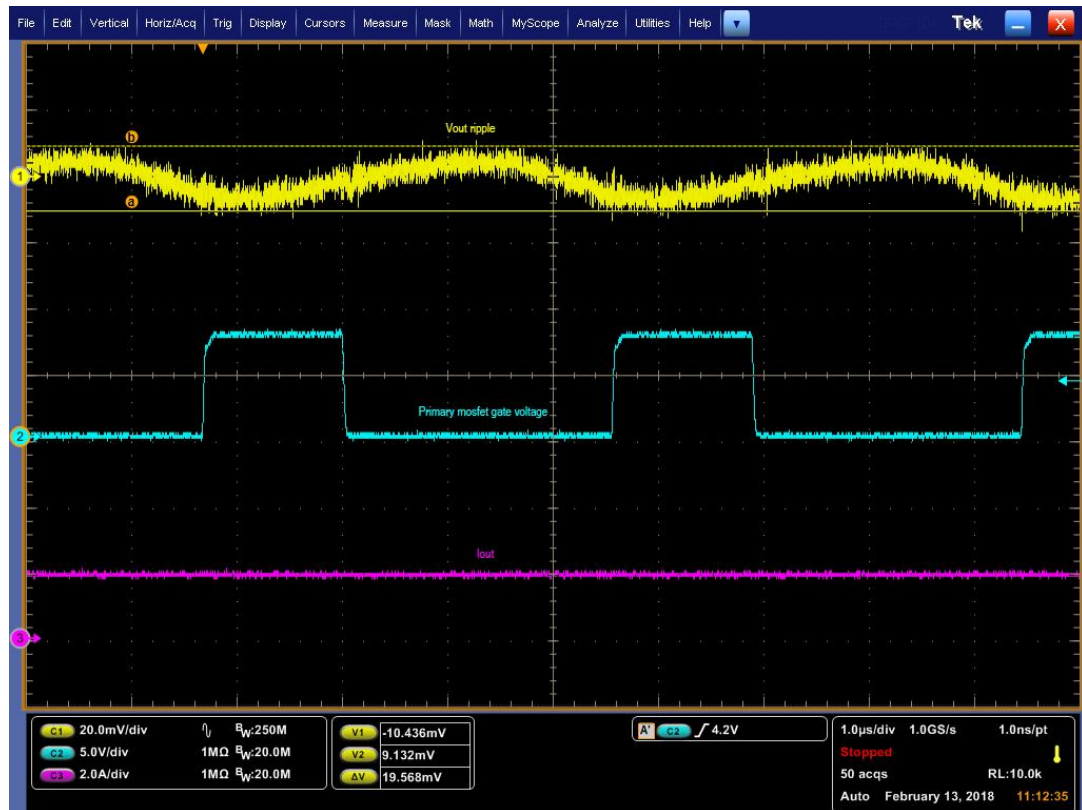
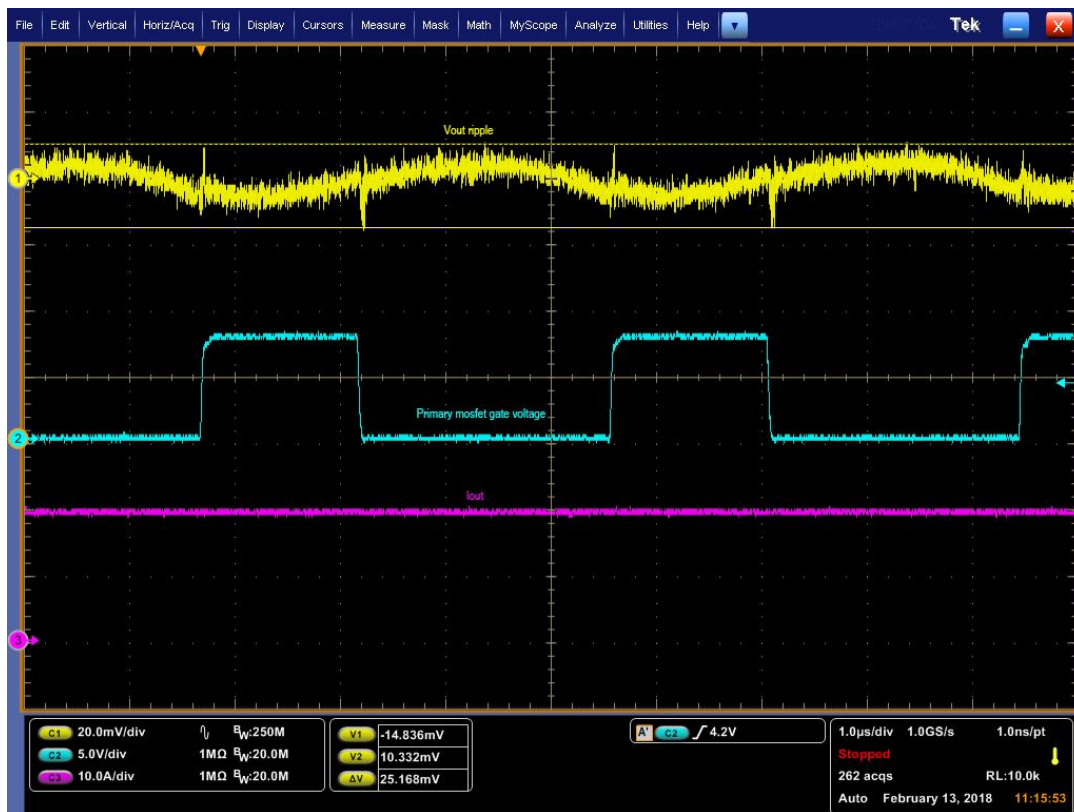


Figure 8. Output voltage ripple: $I_{OUT} = 20\text{ A}$

- Ch1: Vout ripple; Ch2: Primary MOSFET gate voltage; Ch3: I_{OUT}



3.3 Input voltage ripple

Figure 9. Input voltage ripple before and after forward input filter: $V_{IN} = 48\text{ V}$, $I_{OUT} = 2\text{ A}$

- Ch1: Vin ripple before input filter (TP5); Ch2: Primary MOSFET gate voltage
- Ch4: Vin ripple after input filter (C33); Ch3: Input current (J1 connector pairs)

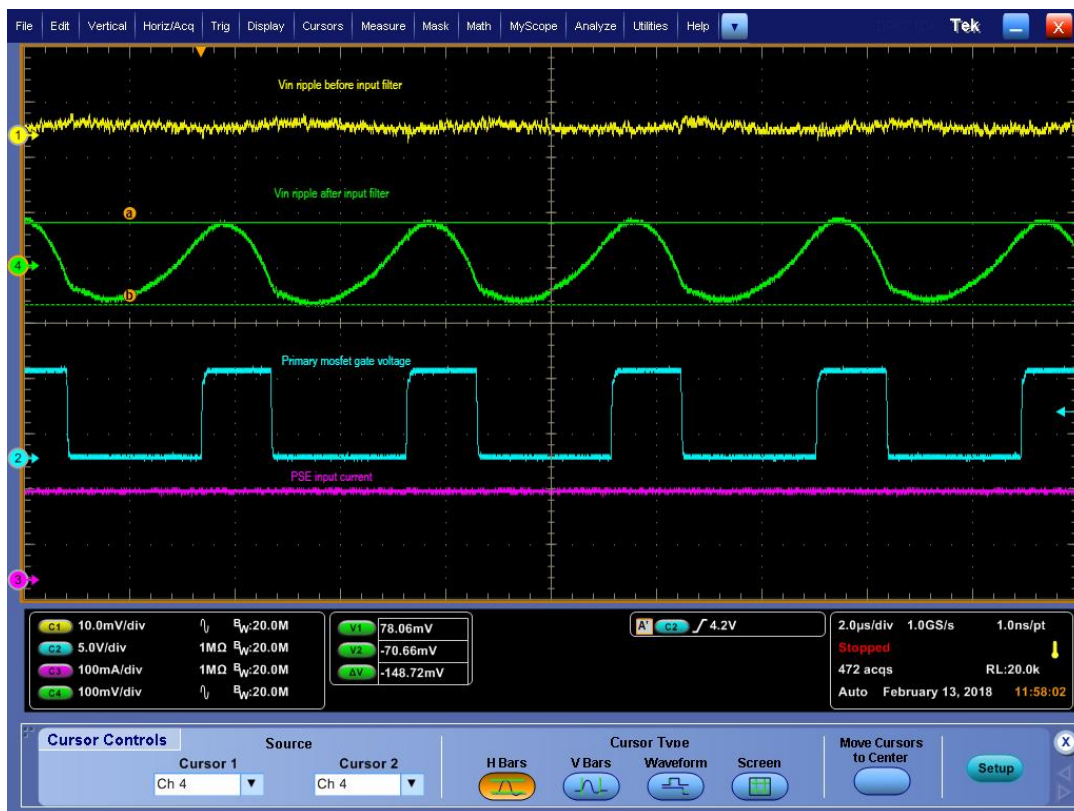
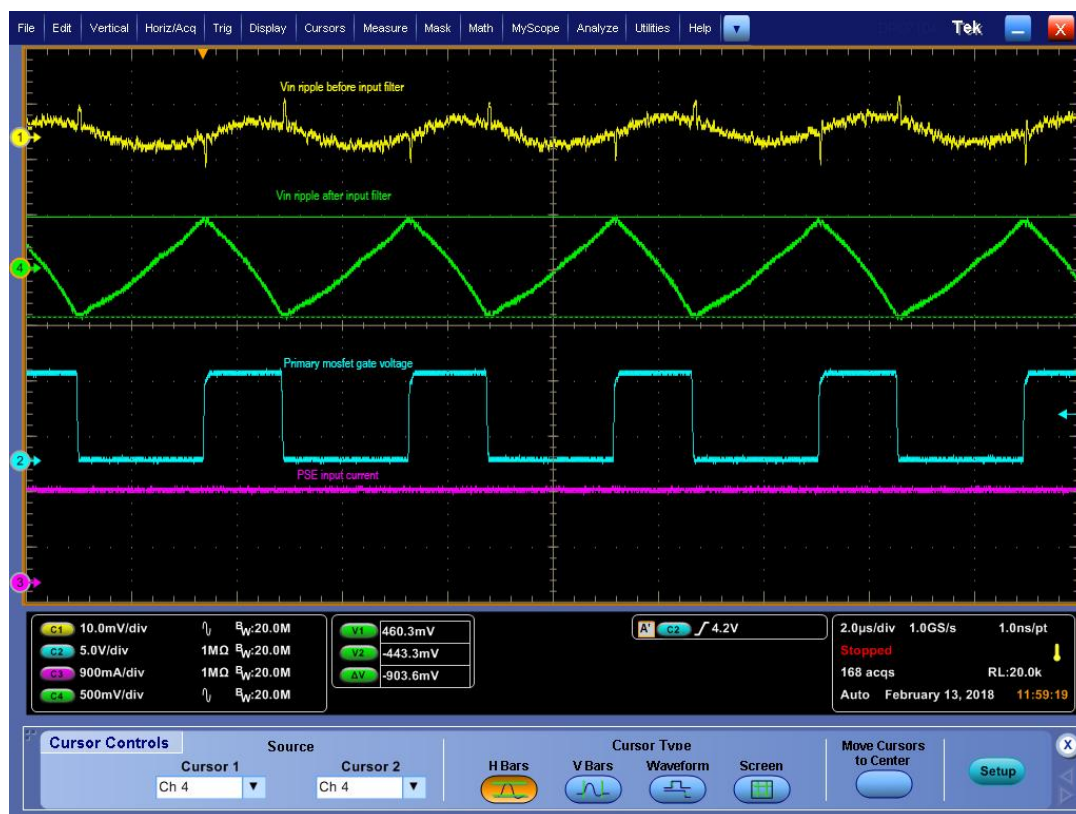


Figure 10. Input voltage ripple before and after forward input filter: $V_{IN} = 48\text{ V}$, $I_{OUT} = 20\text{ A}$

- Ch1: Vin ripple before input filter (TP5); Ch2: Primary MOSFET gate voltage
- Ch4: Vin ripple after input filter (C33); Ch3: Input current (J1 connector pairs)



3.4 Startup

Figure 11. Output voltage at startup: I_{out} at no load, V_{in}= 48 V

- Ch1: V_{out}; Ch2: Soft start voltage (C53); Ch4: primary MOSFET gate voltage



Figure 12. Output voltage at startup: $I_{out}=20\text{ A}$, $V_{in}=48\text{ V}$

- Ch1: Output voltage; Ch2: Soft start voltage (C53);
Ch4: Output current; Ch3: primary MOSFET gate voltage



3.5 PoE connector unplugged power off

Figure 13. Power off at primary side: $I_{out}=20\text{ A}$, $V_{in}=42\text{ V}$

- Ch1: Primary Q4 MOSFET drain voltage; Ch2: Forward input voltage (TP5)
- Ch3: Soft start voltage (C53); Ch4: Power good (TP19)



Figure 14. Power off at secondary side (Q1): $I_{out}=20\text{ A}$, $V_{in}=42\text{ V}$

- Ch1: Primary Q4 MOSFET drain voltage; Ch2: Secondary Q1 MOSFET gate voltage
- Ch3: Secondary Q1 MOSFET drain voltage; Ch4: Power good (TP19)

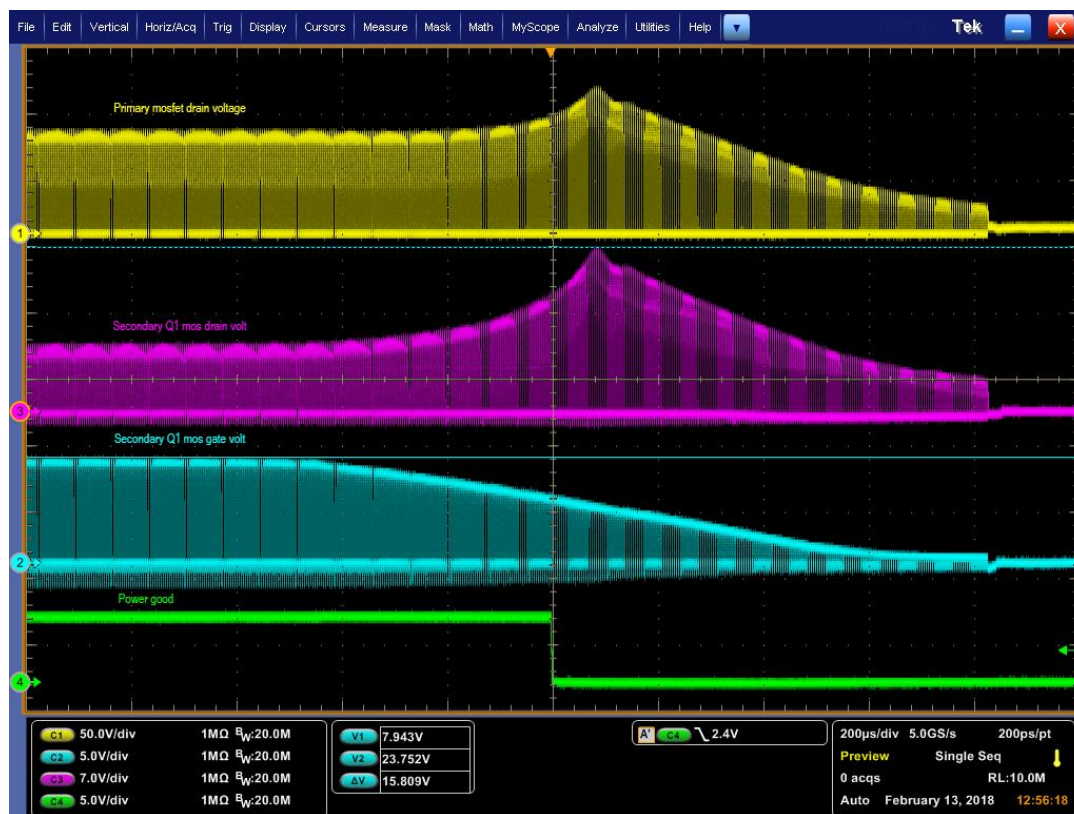
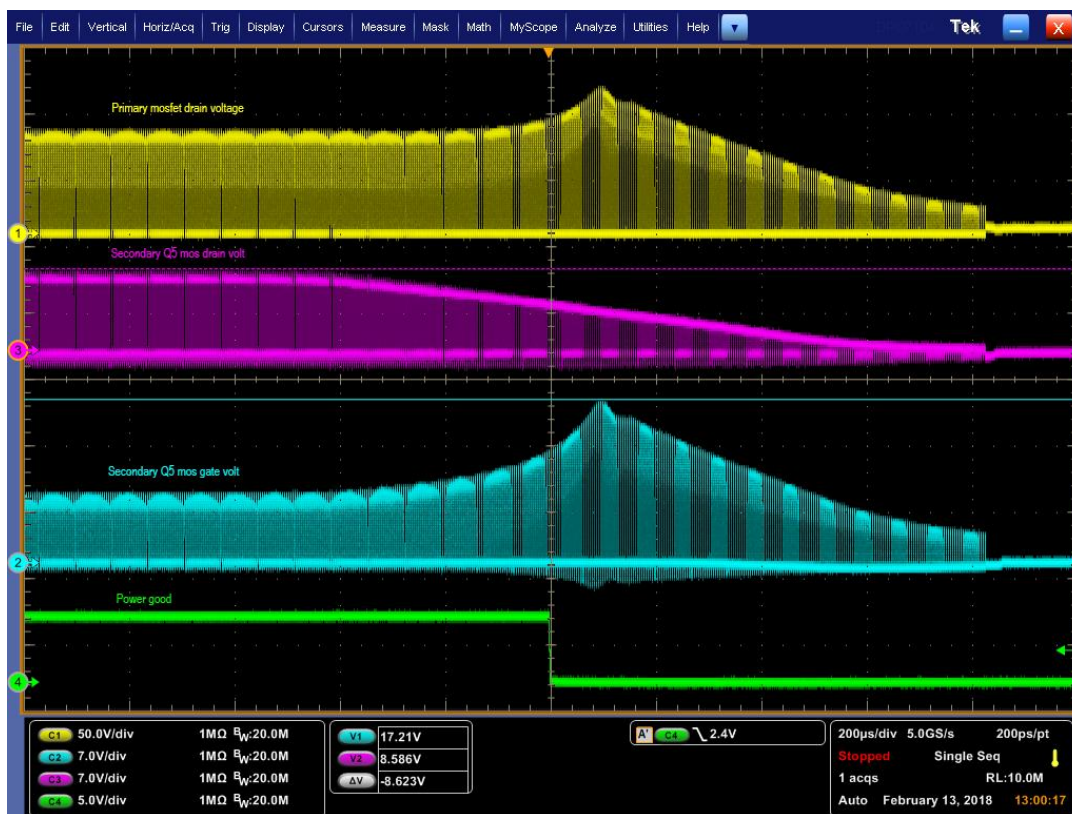


Figure 15. Power off at secondary side (Q5): $I_{out}=20\text{ A}$, $V_{in}=42\text{ V}$

- Ch1: Primary Q4 MOSFET drain voltage; Ch2: Secondary Q5 MOSFET gate voltage
- Ch3: Secondary Q5 MOSFET drain voltage; Ch4: Power good (TP19)



3.6 Primary side waveforms

Figure 16. Primary steady state: $I_{out}=2\text{ A}$, $V_{in}=48\text{ V}$

- Ch1: Primary Q4 MOSFET drain voltage; Ch2: Primary current sense voltage
- Ch4: Primary MOSFET gate voltage



Figure 17. Primary steady state: $I_{out}=20\text{ A}$, $V_{in}=48\text{ V}$

- Ch1: Primary Q4 MOSFET drain voltage; Ch2: Primary current sense voltage
- Ch4: Primary MOSFET gate voltage



3.7 Secondary side waveforms

Figure 18. Secondary steady state: $I_{out}=2\text{ A}$, $V_{in}=48\text{ V}$

- Ch1: Secondary Q1 MOSFET drain voltage; Ch2: Secondary Q5 MOSFET drain voltage
- Ch3: Secondary Q1 MOSFET gate voltage; Ch4: Secondary Q5 MOSFET gate voltage

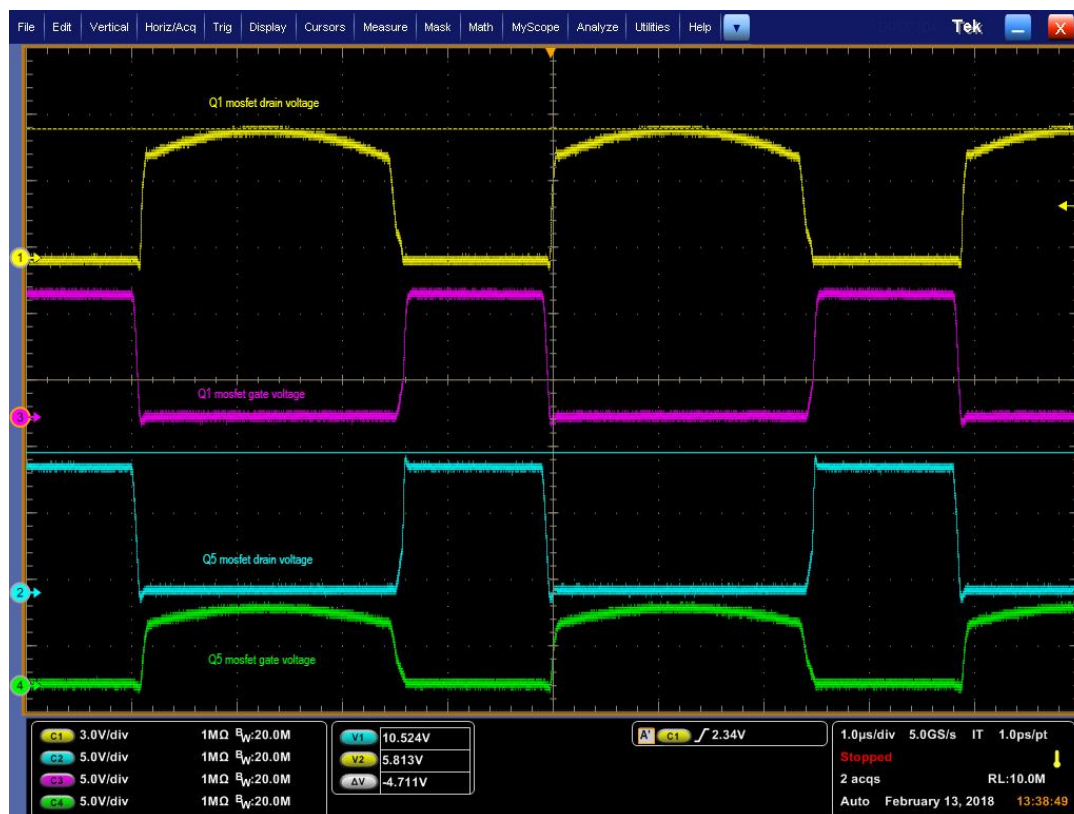
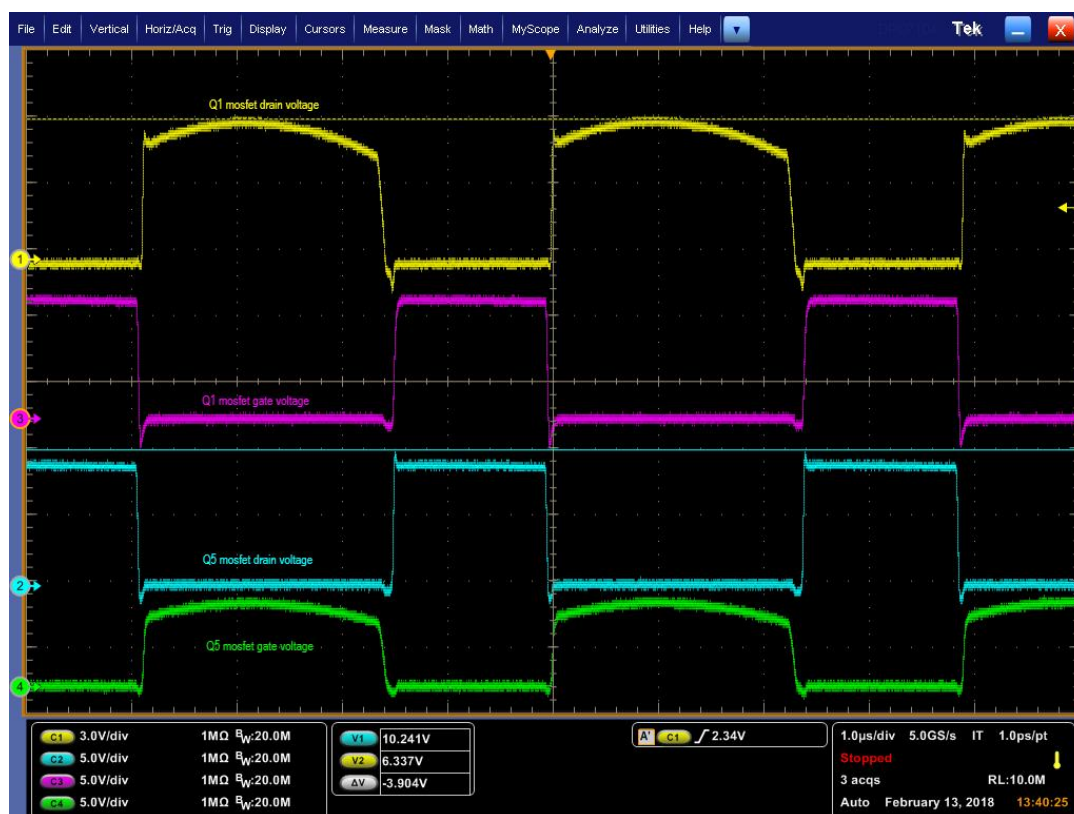


Figure 19. Secondary steady state: $I_{out}=20\text{ A}$, $V_{in}=48\text{ V}$

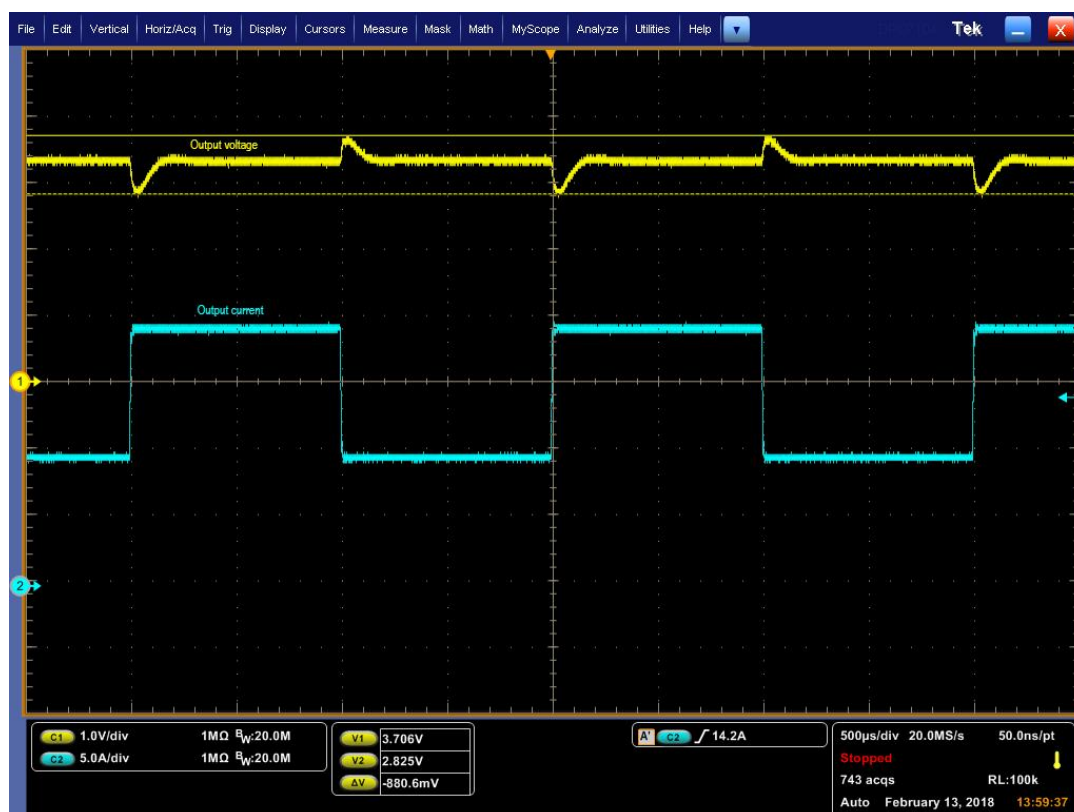
- Ch1: Secondary Q1 MOSFET drain voltage; Ch2: Secondary Q5 MOSFET drain voltage
- Ch3: Secondary Q1 MOSFET gate voltage; Ch4: Secondary Q5 MOSFET gate voltage



3.8 Load transient side waveforms

Figure 20. Load transient: $I_{OUT}=10$ to 20 A, $V_{in}=48$ V

- Ch1: Output voltage; Ch2: Output current



3.9 Gloop measurements

Figure 21. Gloop plot ($V_{IN}=48\text{ V}$, $I_{OUT}=1\text{ A}$)

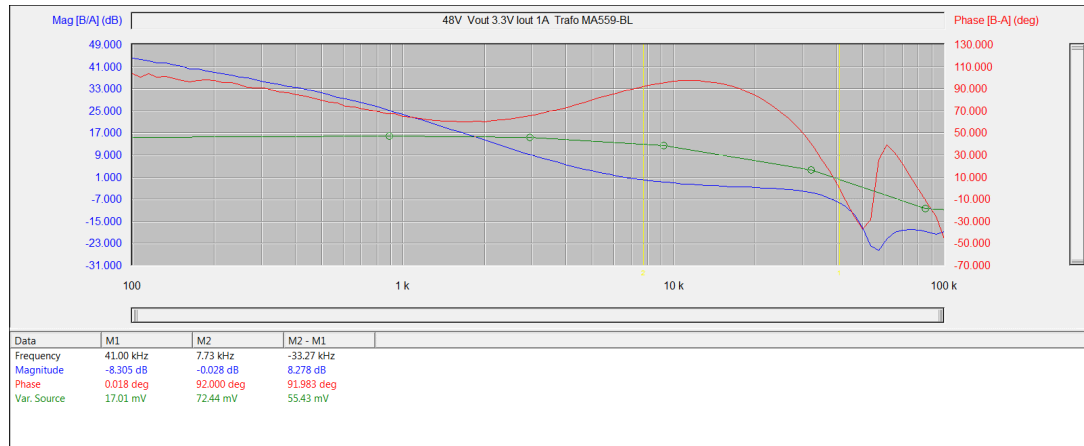


Figure 22. Gloop plot ($V_{IN}=48\text{ V}$, $I_{OUT}=10\text{ A}$)

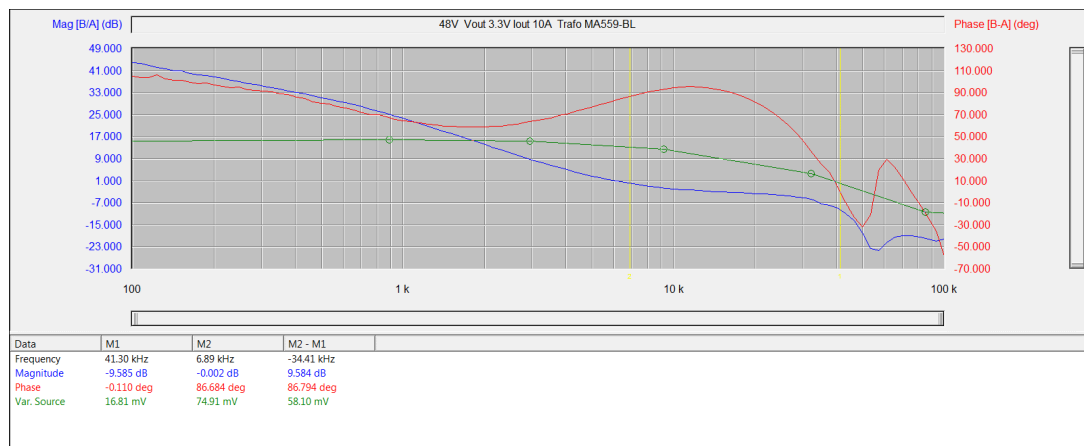
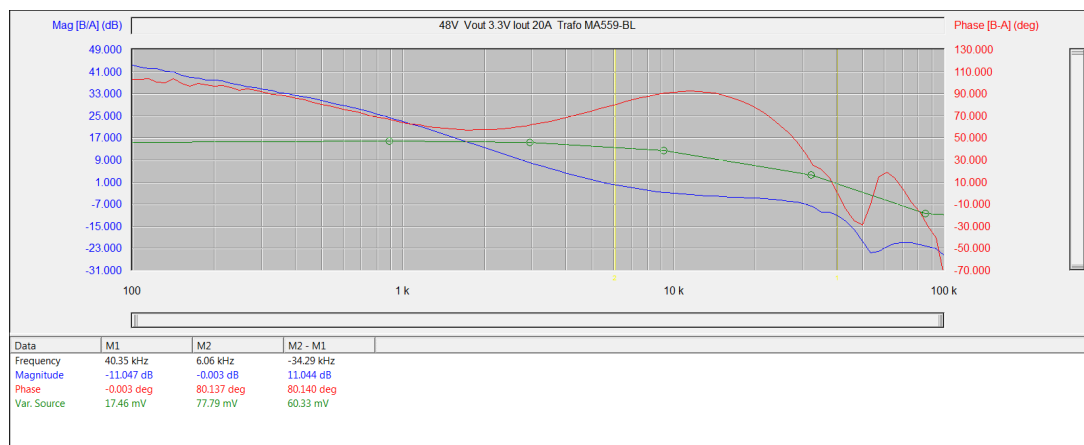


Figure 23. Gloop plot ($V_{IN}=48\text{ V}$, $I_{OUT}=20\text{ A}$)



3.10 Thermal analysis

Thermal analysis has been performed by supplying the STEVAL-POE006V1 evaluation board via a power supply at 48 V, setting different levels of load current.

The emissivity is 0.95, the reflected temperature is 20.0 °C.

Figure 24. STEVAL-POE006V1 thermography at $I_{OUT}=20\text{ A}$, $V_{IN}=41\text{ V}$

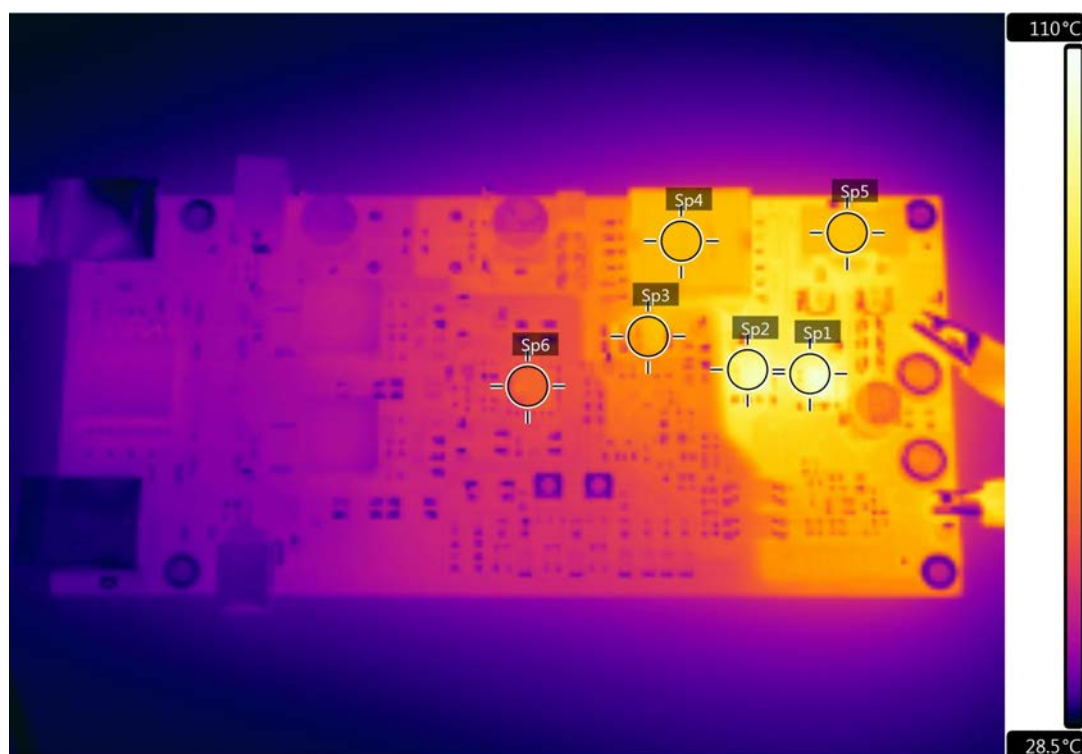


Table 8. STEVAL-POE006V1 measurements for $I_{OUT}=20\text{ A}$, $V_{IN}=41\text{ V}$

Measurements	Temperature
Sp1 -Q5 secondary freewheeling MOSFET	103.7 °C
Sp2- Q1 secondary rectifier MOSFET	100.3 °C
Sp3 - Q4 primary main MOSFET	78.2 °C
Sp4- T3 forward transformer	78.5 °C
Sp5- L4 output inductor	79.8 °C
Sp6 - U1 PM8805	60.0 °C

Figure 25. STEVAL-POE006V1 thermography at $I_{OUT}=20\text{ A}$, $V_{IN}=56\text{ V}$

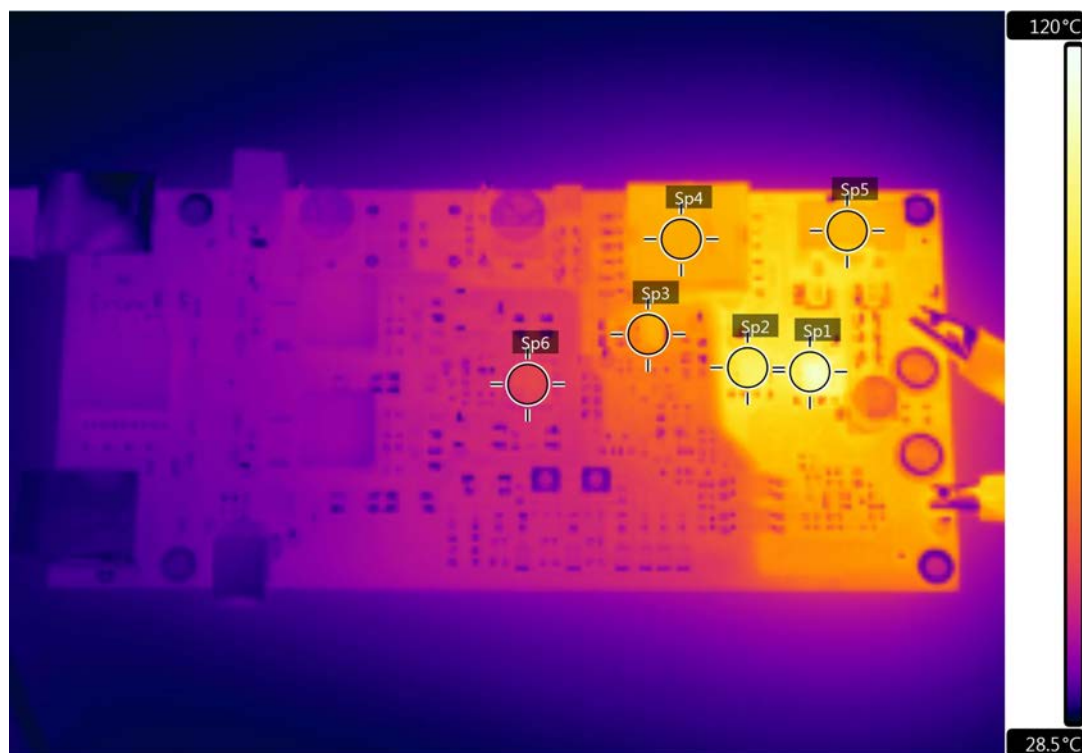


Table 9. STEVAL-POE006V1 measurements for $I_{OUT}=20\text{ A}$, $V_{IN}=56\text{ V}$

Measurements	Temperature
Sp1 - Q5 secondary freewheeling MOSFET	113.0 °C
Sp2- Q1 secondary rectifier MOSFET	101.1 °C
Sp3 - Q4 primary main MOSFET	79.9 °C
Sp4- T3 forward transformer	79.3 °C
Sp5- L4 output inductor	82.1 °C
Sp6 - U1 PM8805	56.1 °C

4 STEVAL-POE006V1 schematic diagrams

Figure 26. STEVAL-POE006V1 circuit schematic (1 of 3)

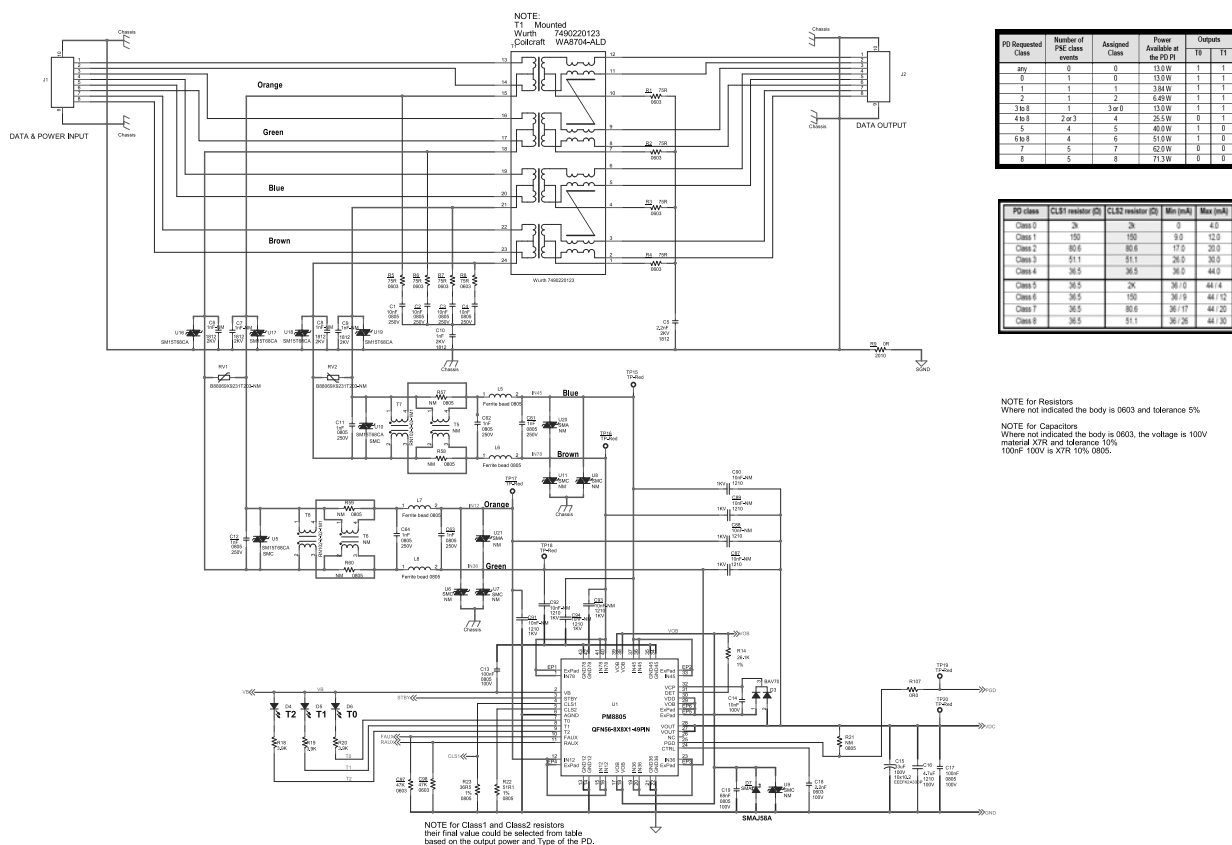


Figure 27. STEVAL-POE006V1 circuit schematic (2 of 3)

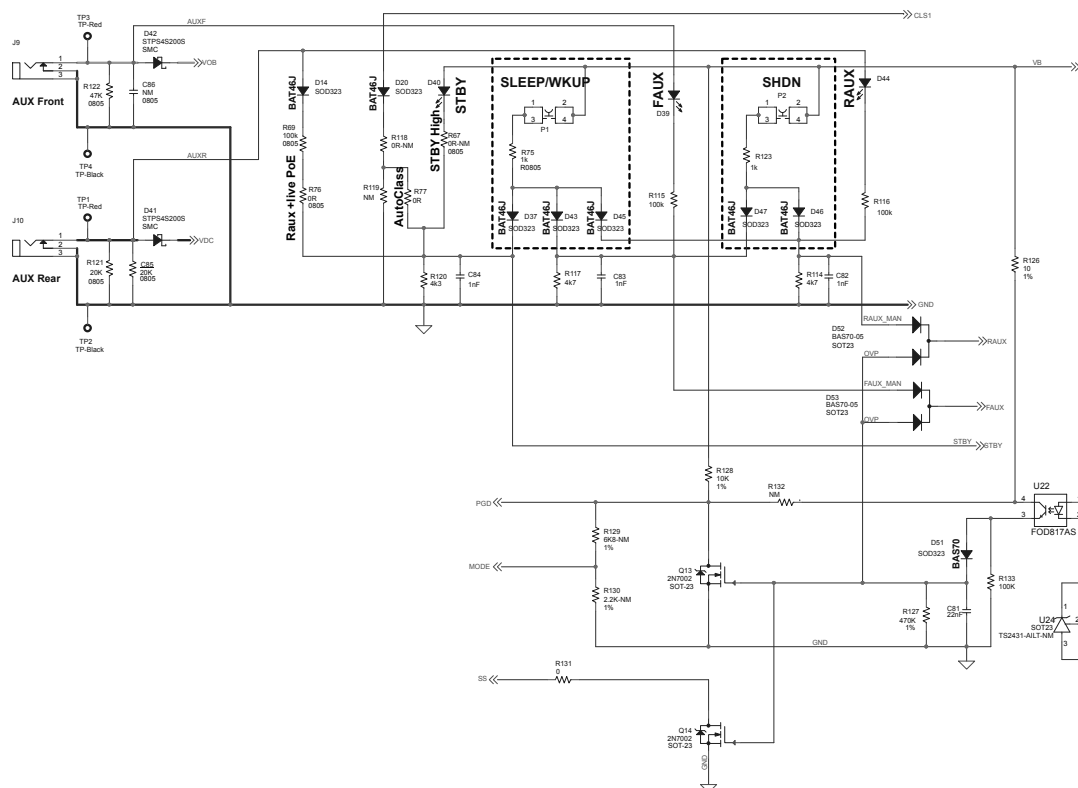
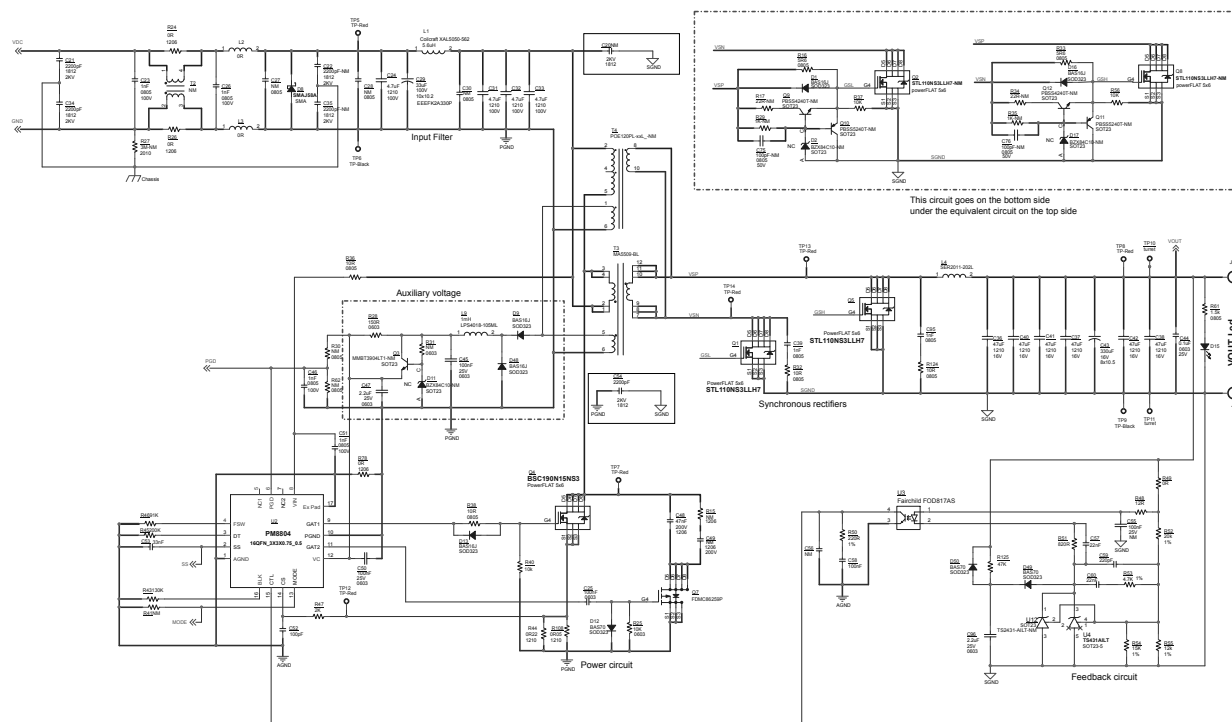


Figure 28. STEVAL-POE006V1 circuit schematic (3 of 3)



5 Bill of materials

Table 10. STEVAL-POE006V1 bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	C43	330 μ F, 16 V	Aluminium Electrolytic capacitor	Panasonic	EEEFK1C331GP
2	2	C15, C29	33 μ F, 100 V	Aluminium Electrolytic capacitor	Panasonic	EEEFK2A330P
3	2	C11, C12	1 nF, 250 V, C0805	Capacitor	Any	
4	2	C13, C17	100 nF, 100 V, C0805	Capacitor	Any	
5	5	C25, C44, C45, C50, C58	100 nF, 25 V, C0603	Capacitor	Any	
6	1	C52	100 pF, 25 V, C0603	Capacitor	Any	
7	4	C1, C2, C3, C4	10 nF, 250 V	Capacitor	TDK	C2012X7R2E103K125 AA
8	1	C14	10 nF, 100 V, C0603	Capacitor	Any	
9	1	C10	1 nF, 2KV, C1812	Capacitor	Any	
10	6	C23, C26, C39, C46, C51, C95	1 nF, 100 V, C0805	Capacitor	Any	
11	4	C61, C62, C63, C64	1 nF, 250 V, C0805	Capacitor	Any	
12	3	C82, C83, C84	1 nF, 100 V, C0603	Capacitor	Any	
13	1	C5	2.2 nF, 2KV, C1812	Capacitor	Any	
14	1	C18	2.2 nF, 100 V, C0603	Capacitor	Any	
15	2	C47, C96	2.2 μ F, 25 V, C0603	Capacitor	Any	
16	4	C21, C34, C35, C54	2200 pF, 2KV, C1812	Capacitor	Any	
17	1	C59	220 pF, COG, 25 V, C0603	Capacitor	Any	
18	3	C57, C60, C81	22 nF, COG, 25 V, C0603	Capacitor	Any	
19	1	C53	33 nF, 25 V, C0603	Capacitor	Any	
20	5	C16, C24, C31, C32, C33	4.7 μ F, 100 V, C1210	Capacitor	Any	
21	1	C48	47 nF, 200 V, C1206	Capacitor	Any	

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
22	6	C36, C37, C38, C40, C41, C42	47 μ F, 16 V C1210	Capacitor	Murata	GRM32ER61C476ME15
23	1	C19	68 nF, 100 V, R0805	Capacitor	Any	
24	4	C6, C7, C8, C9	1 nF, 2KV, C1812	Capacitor (not mounted)	TDK	
25	1	C55	100 nF, 25 V, C0603	Capacitor (not mounted)	Any	
26	2	C75, C76	100 pF, 50 V, C0805	Capacitor (not mounted)	Any	
27	8	C87, C88, C89, C90, C91, C92, C93, C94	10 nF, 1 KV, C1210	Capacitor (not mounted)	AVX	1210AC103KAT1A
28	2	C20, C22	2200 pF, 2KV, C1812	Capacitor (not mounted)	AVX	
29	4	C27, C28, C30, C86	100 V, C0805	Capacitor (not mounted)	Any	
30	1	C49	200 V, C1206	Capacitor (not mounted)	Any	
31	1	C56	C0603	Capacitor (not mounted)	Any	
32	1	C78	25 V, C0603	Capacitor (not mounted)	Any	
33	2	T7, T8	RN102	Common Choke	Schaffner	RN 102-2-02-1M1
34	1	T2	RN112	Common Choke (not mounted)	Schaffner	RN 112-4-02-0M7
35	2	T5, T6		Common Choke (not mounted)	Würth Elektronik	744272471
36	2	J4, J6	BANANA-JACK	Connector	Any	
37	1	J1	DATA & POWER INPUT	Connector	Bell Stewart	SS-7188S-A-NF
38	1	J2	DATA OUTPUT	Connector	Bell Stewart	SS-7188S-A-NF
39	1	U1		IEEE802.3bt PoE-PD interface with integrated dual-active-bridge	ST	PM8805TR
40	1	U2		PWM peak current mode controller for PoE and telecom systems	ST	PM8804TR
41	1	T1	POE Trafo	Data Trafo	Würth Elektronik	7490220123
42	1	T1	POE Trafo	Data Trafo	Coilcraft	WA8704-ALD
43	12	D1, D9, D13, D16, D48, D14, D20, D37, D43, D45, D46, D47	SOD-323	Small signal Schottky diode	ST	BAT46J

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
44	1	D3	SOT23	Low capacitance, low series inductance and resistance Schottky diodes	ST	BAS70
45	4	D12, D49, D50, D51	SOD-323	Diode	ST	BAS70
46	2	D41, D42	SMC	Power Schottky rectifier	ST	STPS4S200S
47	1	D2, D17	SOT23	Diode (not mounted)	Any	
48	2	D7, D8	SMA	400 W TVS in SMA	ST	SMAJ58A
49	2	D52, D53	SOT-23	Dual Diode Common Anodes	ST	BAS70-05FILM
50	4	L5, L6, L7, L8	220 R, 0805	Ferrite beads	TDK	MPZ2012S221AT000
51	1	L4	2.0 μ H	Inductor	TDK	SER2011-202L
52	1	L1	POWER INDUCTOR	Inductor	Coilcraft	XAL5050-562
53	1	L1	POWER INDUCTOR	Inductor (not mounted)	Würth Elektronik	74439346056
54	1	D39	FAUX	LED Diode	Kingbright	AA3528CGSK
55	1	D44	RAUX	LED Diode	Kingbright	AA3528CGSK
56	1	D40	STBY	LED Diode	Kingbright	AA3528CGSK
57	3	D4, D5, D6	T0, T1, T2	LED Diode	Kingbright	AA3528CGSK
58	1	D15	VOUT LED	LED Diode	Any	
59	1	L9		Low Profile Power inductor	Coilcraft	LPS4018-105ML
60	2	Q13, Q14	2N7002 SOT23	N channel Mosfet	Any	
61	1	U3		Optocoupler	Fairchild	FOD817AS
62	1	U22		Optocoupler	Fairchild	FOD817AS
63	1	T4		Planar Power Trafo (not mounted)	Coilcraft	
64	1	J9	AUX Front	Power Jack	Switchcraft	P-JACK-RAPC722
65	1	J10	AUX Rear	Power Jack	Switchcraft	P-JACK-RAPC722
66	1	Q4	BSC190N15NS3 SiJ494DP	Power MOSFET	Infineon Siliconix	BSC190N15NS3 SiJ494DP
67	2	Q1, Q5	STL110NS3LLH7	Power MOSFET	ST	STL110NS3LLH7
68	2	Q2, Q8	STL110NS3LLH7	Power MOSFET (not mounted)	ST	STL110NS3LLH7
69	1	T3		Power Trafo	Coilcraft	MA5509-BL
70	1	P2	SHDN	Push Button	Bourns	push-7914-bourns
71	1	P1	SLEEP/WKUP	Push Button	Bourns	push-7914-bourns
72	1	R126	10 R, 0603	Resistor	Any	
73	2	R76, R77	0 R, R0805	Resistor	Any	

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
74	1	R78	0 R, R1206	Resistor	Any	
75	2	L2, L3	0R0, 0805	Resistor	Any	
76	1	R9	0R0, R1210	Resistor	Any	
77	2	R24, R26	0R0, R1206	Resistor	Any	
78	2	R49, R131	0R0, R0603	Resistor	Any	
79	1	R107	0R0, R0805	Resistor	Any	
80	1	R108	0R050, R1210	Resistor	Any	
81	1	R44	0R220, R1210, $\pm 1\%$	Resistor	Any	
82	3	R69, R115, R116	100 k, R0805	Resistor	Any	
83	1	R133	100 K, R0603	Resistor	Any	
84	1	R102	100 R, R0603	Resistor	Any	
85	4	R25, R37, R40, R56	10 K, R0603	Resistor	Any	
86	1	R128	10 K, R0603, $\pm 1\%$	Resistor	Any	
87	4	R32, R36, R38, R124	10 R, R0805	Resistor	Any	
88	1	R55	12 K, R0603, $\pm 1\%$	Resistor	Any	
89	1	R48	12 R, R0603, $\pm 1\%$	Resistor	Any	
90	1	R43	130 K, R0603, $\pm 1\%$	Resistor	Any	
91	1	R28	150 R, R0603	Resistor	Any	
92	1	R101	15 K, R0603, $\pm 1\%$	Resistor	Any	
93	2	R75, R123	1 K, R0805	Resistor	Any	
94	1	R61	1K5, R0805	Resistor	Any	
95	1	R45	200 K $\pm 1\%$ R0603	Resistor	Any	
96	2	C85, R121	20 K, 100 V, R0805	Resistor	Any	
97	1	R52	20 k, $\pm 1\%$, R0603	Resistor	Any	
98	1	R50	220 R, $\pm 1\%$, R0603	Resistor	Any	
99	1	R14	26.1 K, $\pm 1\%$, R0603	Resistor	Any	
100	1	R104	27 K, $\pm 1\%$, R0603	Resistor	Any	
101	1	R47	2 K, R0603	Resistor	Any	
102	3	R18, R19, R20	3.9 K, R0603	Resistor	Any	
103	1	R53	4.7 K, $\pm 1\%$, R0603	Resistor	Any	
104	1	R127	470 K, $\pm 1\%$, R0603	Resistor	Any	
105	2	C97, C98	47 K, 100 V, C0603	Resistor	Any	
106	1	R122	47 K, R0805	Resistor	Any	

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
107	1	R125	47 K, R0603	Resistor	Any	
108	1	R120	4k3, R0805	Resistor	Any	
109	2	R114, R117	4k7, R0805	Resistor	Any	
110	1	R22	51R1, $\pm 1\%$, R0805	Resistor	Any	
111	2	R16, R33	5R6	Resistor	Any	
112	8	R1, R2, R3, R4, R5, R6, R7, R8	75 R, R0603	Resistor	Any	
113	1	R51	820 R, $\pm 1\%$, R0603	Resistor	Any	
114	1	R103	82 k $\pm 1\%$, R0603	Resistor	Any	
115	1	R46	91 K $\pm 1\%$, R0603	Resistor	Any	
116	2	R67, R118	0 R, R0805	Resistor (not mounted)	Any	
117	4	R57, R58, R59, R60	0R0, R0805	Resistor (not mounted)	Any	
118	1	R132	0R0, R0603	Resistor (not mounted)	Any	
119	1	R119	100 k, R0603	Resistor (not mounted)	Any	
120	2	R21, R30	10 K, R0805	Resistor (not mounted)	Any	
121	1	R54	15 K, R0603, $\pm 1\%$	Resistor (not mounted)	Any	
122	2	R29, R35	1 K, R0805	Resistor (not mounted)	Any	
123	2	R17, R34	22 R, R0805	Resistor (not mounted)	Any	
124	1	R130	2K2, R0603, $\pm 1\%$	Resistor (not mounted)	Any	
125	1	R23	36R5, $\pm 1\%$, R0805	Resistor (not mounted)	Any	
126	1	R27	3Mega, R2010	Resistor (not mounted)	Any	
127	1	R62	5K6, R0805	Resistor (not mounted)	Any	
128	1	R129	6K8, $\pm 1\%$	Resistor (not mounted)	Any	
129	1	R15	R1206	Resistor (not mounted)	Any	
130	3	R31, R41, R105	R0603	Resistor (not mounted)	Any	
131	2	RV1, RV2	1812	Surge arrester (not mounted)	TDK	B88069X9231T203
132	1	Q7	POWERFLAT_3X 3_SGD	Switching MOSFET P channel	Fairchild-ON Semiconductor	FDMC86259P

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
133	2	Q9, Q12	SOT23_BEC_T	Switching transistor NPN (not mounted)	Any	
134	2	Q10, Q11	SOT23_BEC_T	Switching transistor PNP (not mounted)	Any	
135	1	Q3		Switching transistor NPN (not mounted)	Any	MMBT3904LT1
136	4	TP2, TP4, TP6, TP9		Test point black	Keystone	KEYSTONE_5011
137	14	TP1, TP3, TP5, TP7, TP8, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20		Test point red	Keystone	KEYSTONE_5010
138	2	TP10, TP11		Test point turret		MILLMAX_2501
139	6	U5, U10, U16, U17, U18, U19	Diode TVS	Transil 1500 W	ST	SM15T68CA
140	7	U6, U7, U8, U9, U11, U20, U21	Diode TVS	Transil (not mounted)	ST	SM15T68CA
141	2	U4, U23	SOT-23-5LEAD	Low voltage adjustable shunt reference	ST	TS431-AILT
142	2	U12, U24	SOT-23-3L	Low voltage adjustable shunt reference (not mounted)	ST	TS2431-AILT
143	1	D11	SOT23-D	Zener diode (not mounted)	Any	

6 Board layout

Figure 29. STEVAL-POE006V1 PCB top assembly

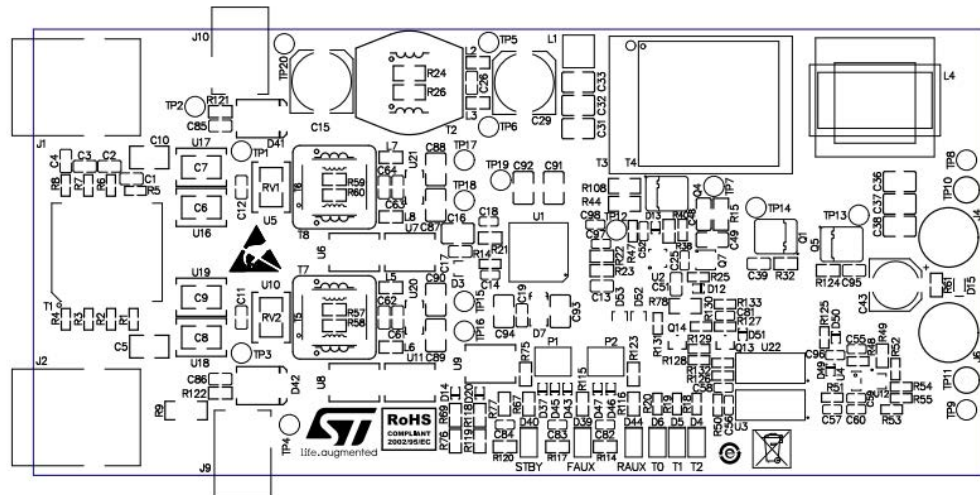


Figure 30. STEVAL-POE006V1 PCB bottom assembly

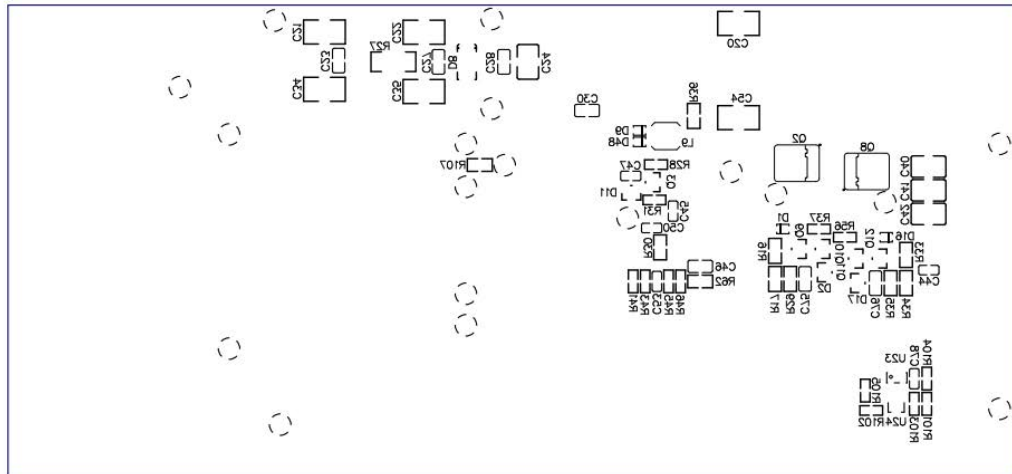


Figure 31. STEVAL-POE006V1 PCB layer 1 top

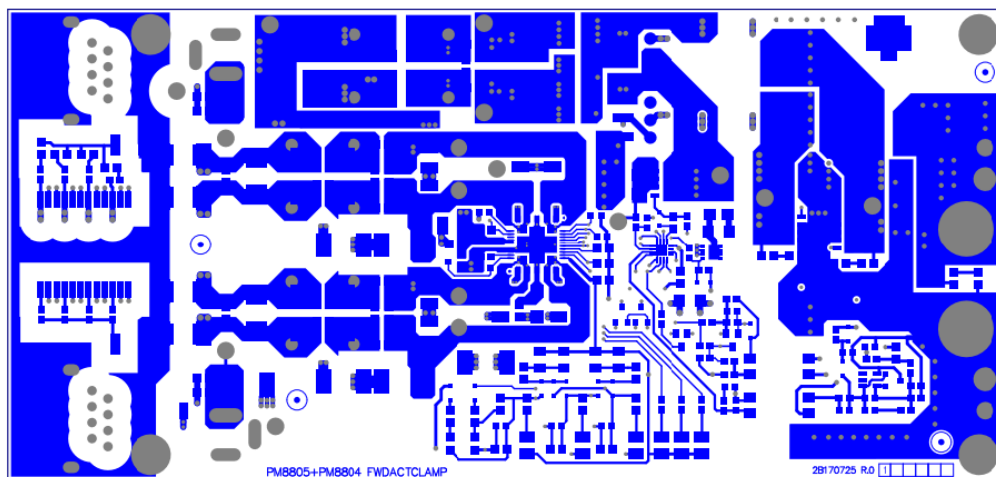


Figure 32. STEVAL-POE006V1 PCB layer 2

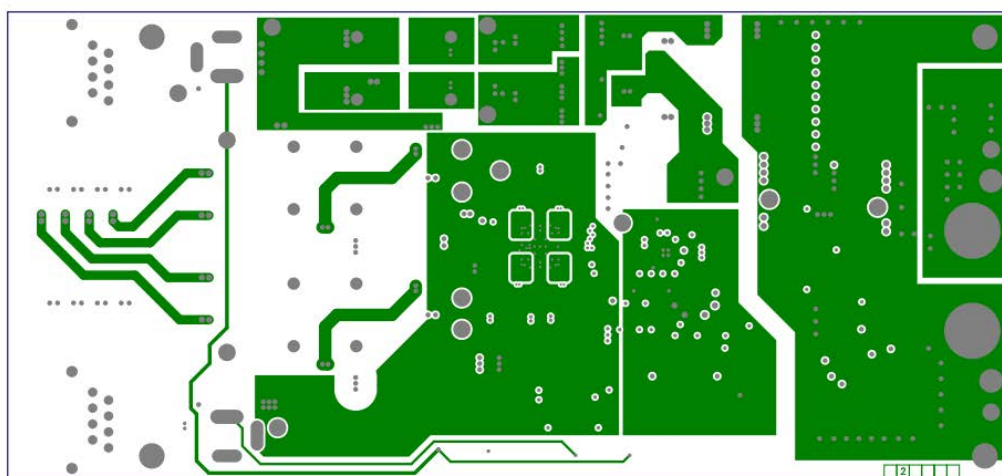


Figure 33. STEVAL-POE006V1 PCB layer 3

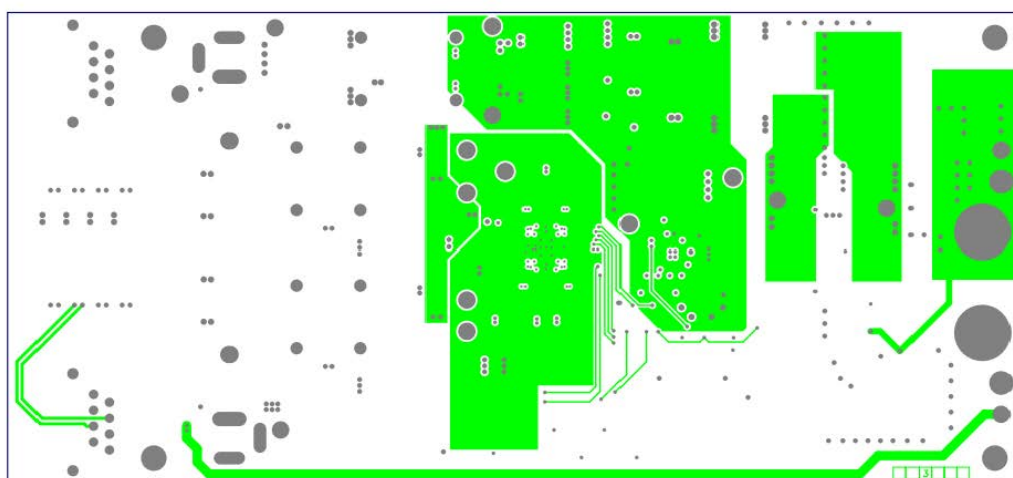


Figure 34. STEVAL-POE006V1 PCB layer 4

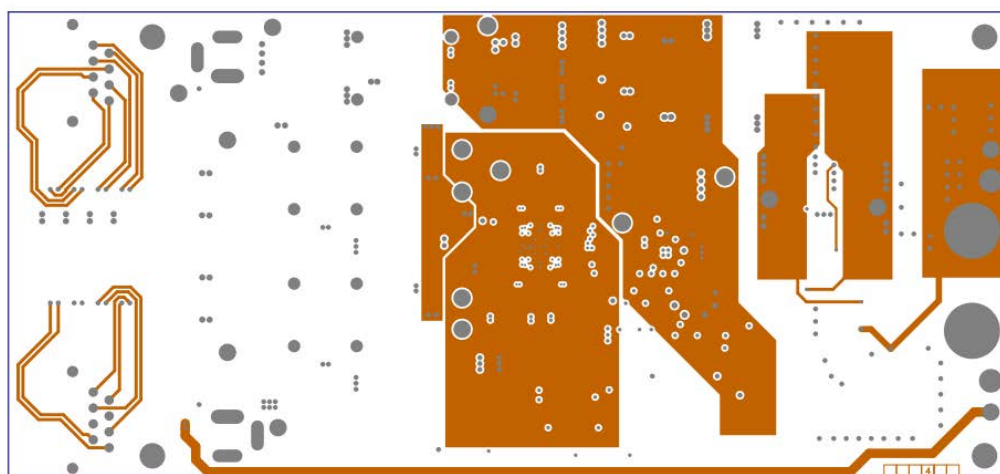


Figure 35. STEVAL-POE006V1 PCB layer 5

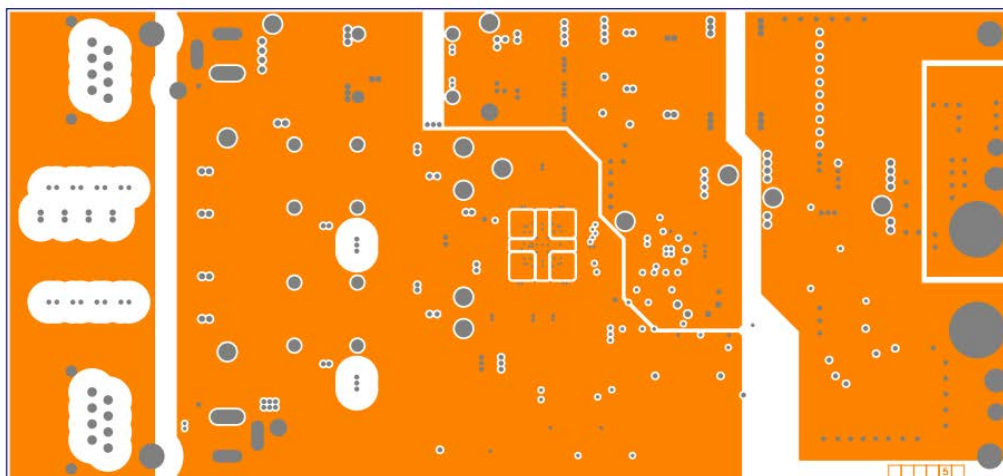
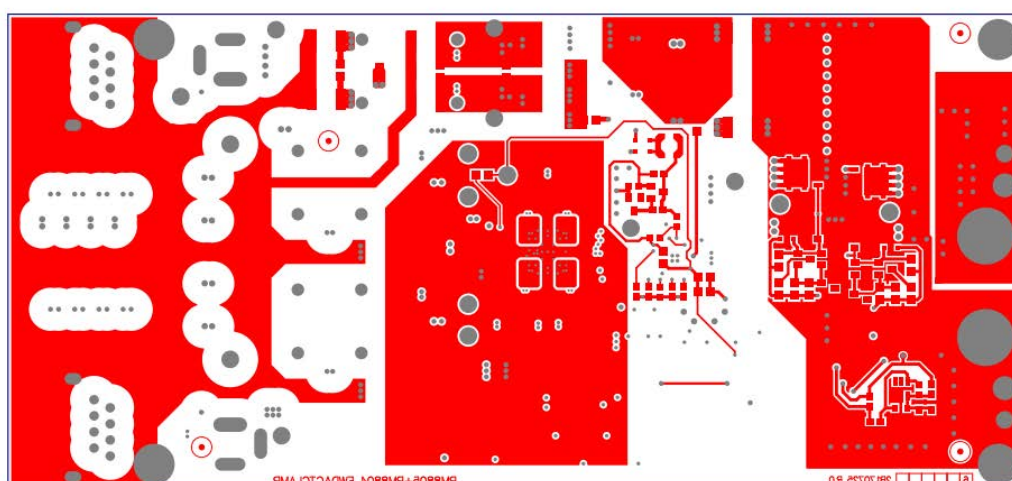


Figure 36. STEVAL-POE006V1 PCB layer 6



A References

Freely available on www.st.com:

1. [PM8804](#) datasheet
2. [PM8805](#) datasheet

Revision history

Table 11. Document revision history

Date	Version	Changes
20-Dec-2018	1	Initial release.

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