

### EVALPM8803-FWD: IEEE802.3at compliant demonstration kit with synchronous active clamp forward converter

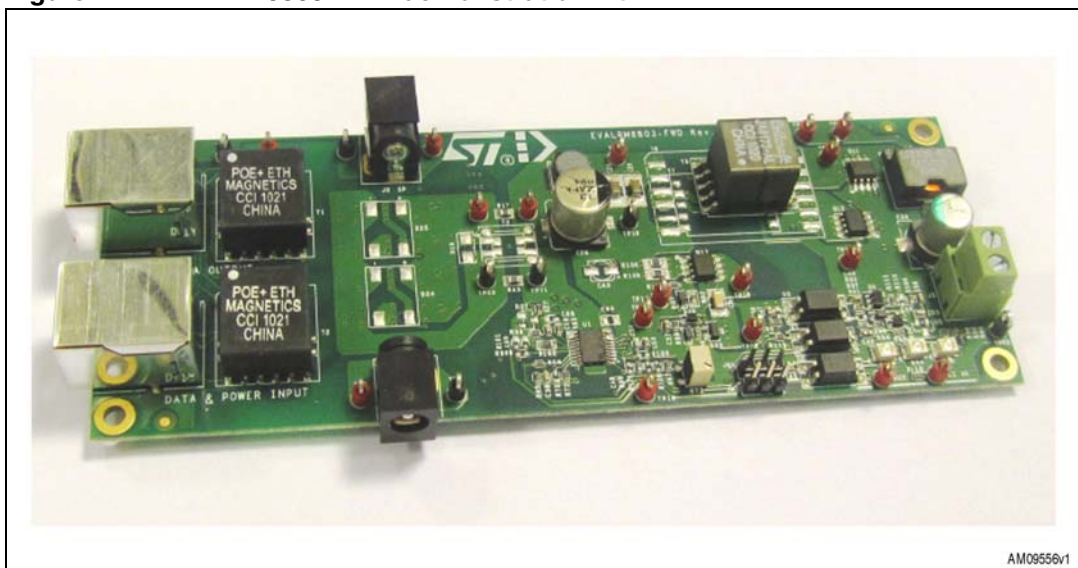
#### Introduction

The PM8803 is a highly integrated device embedding an IEEE802.3at-2009 compliant powered device (PD) interface together with a PWM controller and support for auxiliary sources. [Figure 1](#) is an image of the EVALPM8803-FWD PoE+ demonstration board. The same PCB can be populated with different components to support various configurations and options (active clamp forward both with synchronous rectification or with diode rectification).

This document focuses on a reference design for PoE+ based on AC forward topology with synchronous rectification, with the PM8803 as the main controller.

The schematics and board layout of the PoE+ section are given in [Section 2](#) and [3](#) while the related bill of material is detailed in [Section 5](#). In [Section 7](#) efficiency measurements together with main waveforms of the PoE interface and AC forward converter are shown.

**Figure 1. EVALPM8803-FWD demonstration kit**



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# 1 Electrical specifications

**Table 1. Specifications for 3.3 V output**

| Parameter                     | Description                                   | Min. | Typ. | Max. | Unit |
|-------------------------------|---|------|------|------|------|
| Input voltage range           | Applied at J3 connector                       | 0    |      | 57   | V    |
| Operative input voltage       |   | 42   |      | 57   | V    |
| UVLO                          | Vin rising edge                               |      |      | 36   | V    |
|                               | Vin falling edge                              | 30   |      |      | V    |
| Auxiliary input voltage range |   | 35   |      | 60   | V    |
| Output voltage (Vout)         | Vin= 42 V to 57 V, Iout 0 to I <sub>max</sub> | 3.25 | 3.35 | 3.45 | V    |
| Output current (Iout)         | Vin= 42 V to 57 V                             | 0    |      | 6    | A    |
| Peak-to-peak output ripple    | 48 Vin, Iout=I <sub>max</sub>                 |      | 30   | 40   | mVpp |
| Inrush current limit          |   |      | 140  |      | mA   |
| DC current limit              |   |      | 640  |      | mA   |
| 3.3 V efficiency DC-DC only   | Vin=48 V, Iout=I <sub>max</sub>               |      | 92   |      | %    |
| 3.3 V overall efficiency      | Vin=48 V, Iout=I <sub>max</sub>               |      | 89   |      | %    |
| Switching frequency           |   |      | 200  |      | kHz  |

**Table 2. Specifications for 5 V output**

| Parameter                     | Description                                   | Min. | Typ. | Max. | Unit |
|-------------------------------|---|------|------|------|------|
| Input voltage range           | Applied at J3 connector                       | 0    |      | 57   | V    |
| Operative input voltage       |   | 42   |      | 57   | V    |
| UVLO                          | Vin rising edge                               |      |      | 36   | V    |
|                               | Vin falling edge                              | 30   |      |      | V    |
| Auxiliary input voltage range |   | 35   |      | 60   | V    |
| Output voltage (Vout)         | Vin= 42 V to 57 V, Iout 0 to I <sub>max</sub> | 4.95 | 5.1  | 5.25 | V    |
| Output current (Iout)         | Vin= 42 V to 57 V                             | 0    |      | 4    | A    |
| Peak-to-peak output ripple    | 48Vin, Iout=I <sub>max</sub>                  |      | 30   | 40   | mVpp |
| Inrush current limit          |   |      | 140  |      | mA   |
| DC current limit              |   |      | 640  |      | mA   |
| 5 V efficiency DC-DC only     | Vin=48 V, Iout=I <sub>max</sub>               |      | 92   |      | %    |
| 5 V overall efficiency        | Vin=48 V, Iout=I <sub>max</sub>               |      | 89   |      | %    |
| Switching frequency           |   |      | 200  |      | kHz  |

## 2 Demonstration kit schematic

Figure 2. Demonstration kit schematic: detail of the PoE+ input section including data transformer, diode bridges, protection, and optional CM choke

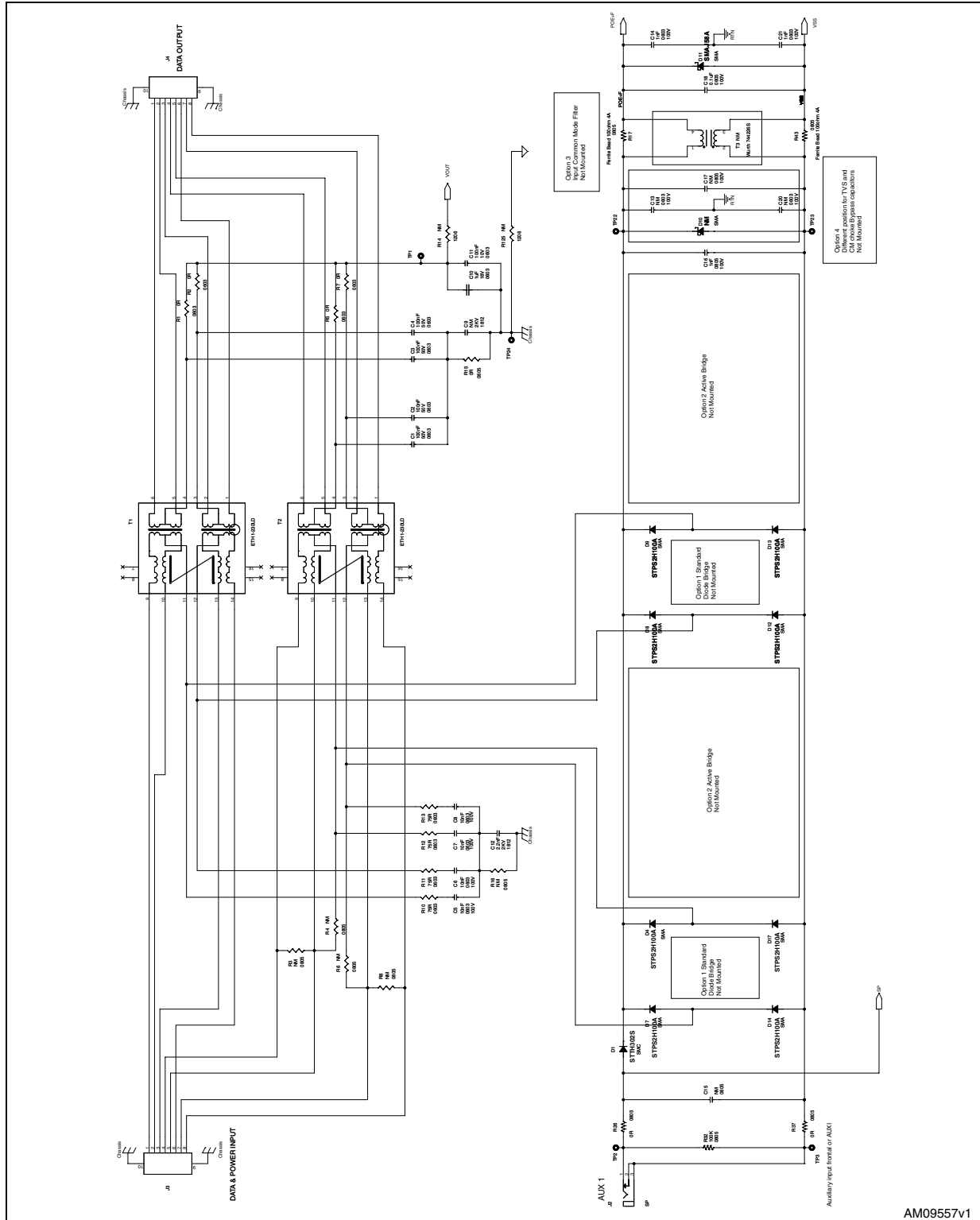
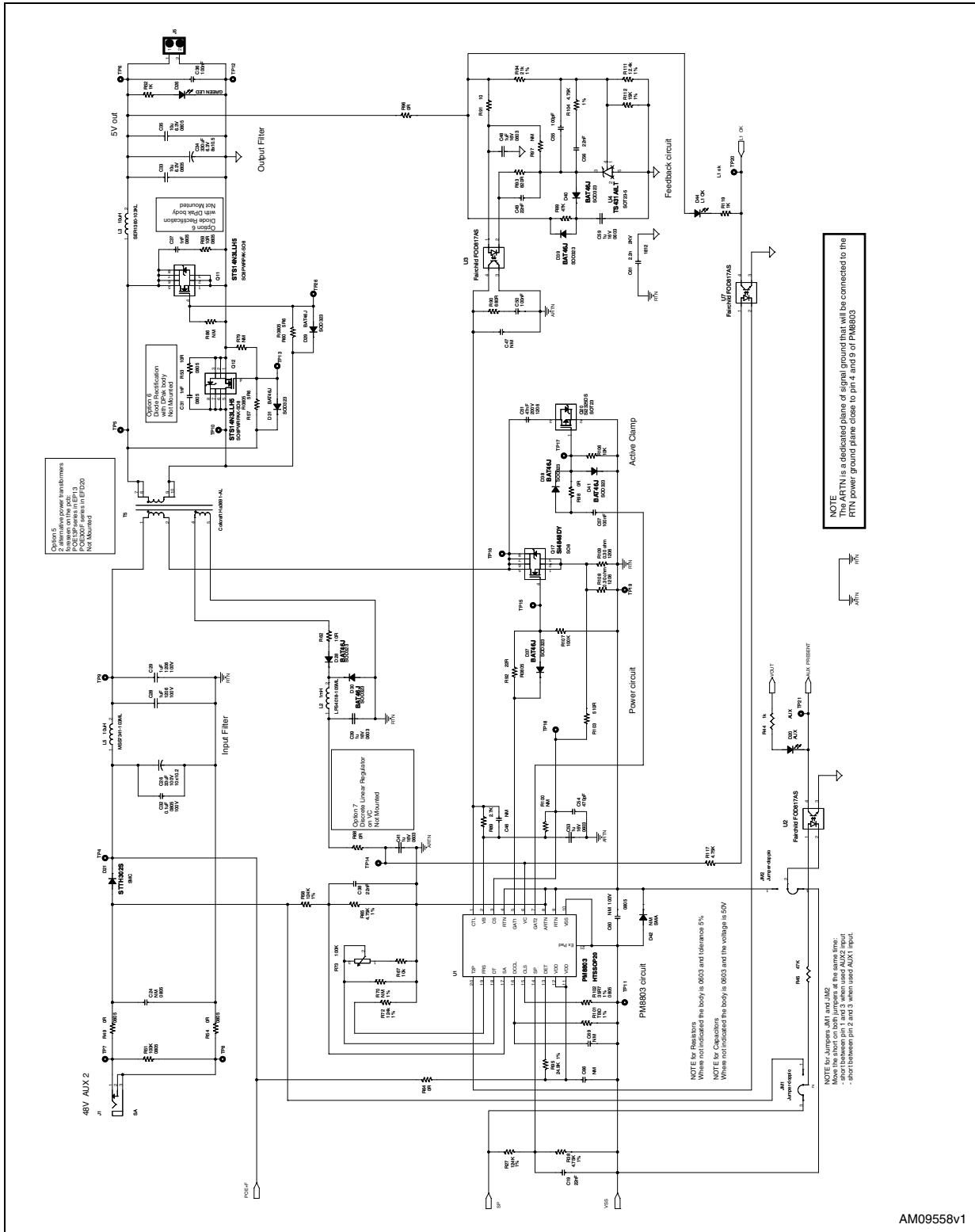


Figure 3. Demonstration kit schematic: detail of the PoE+ section based on AC forward topology with synchronous rectification



Caution: Only use power transformers designed with the PSE2300F series in EFT/230 NOT INCLUDING

NOTE: EFTN is a dedicated plane of signal ground that will be connected to the RTN power ground plane close to pin 4 and 9 of PM8903

NOTE for Feedback: Where not indicated the body is 0603 and tolerance 5%  
NOTE for Capacitors: Where not indicated the body is 0805 and the voltage is 50V

NOTE for Jumpers: J1 and J2 Move the short on both jumpers at the same time: - short between pin 2 and 3, when used AUX1 input.

### 3 Board layout

Board size: 6 x 16 cm. Layer copper thickness: 70 micron.

Figure 4. Assembly view: top layer

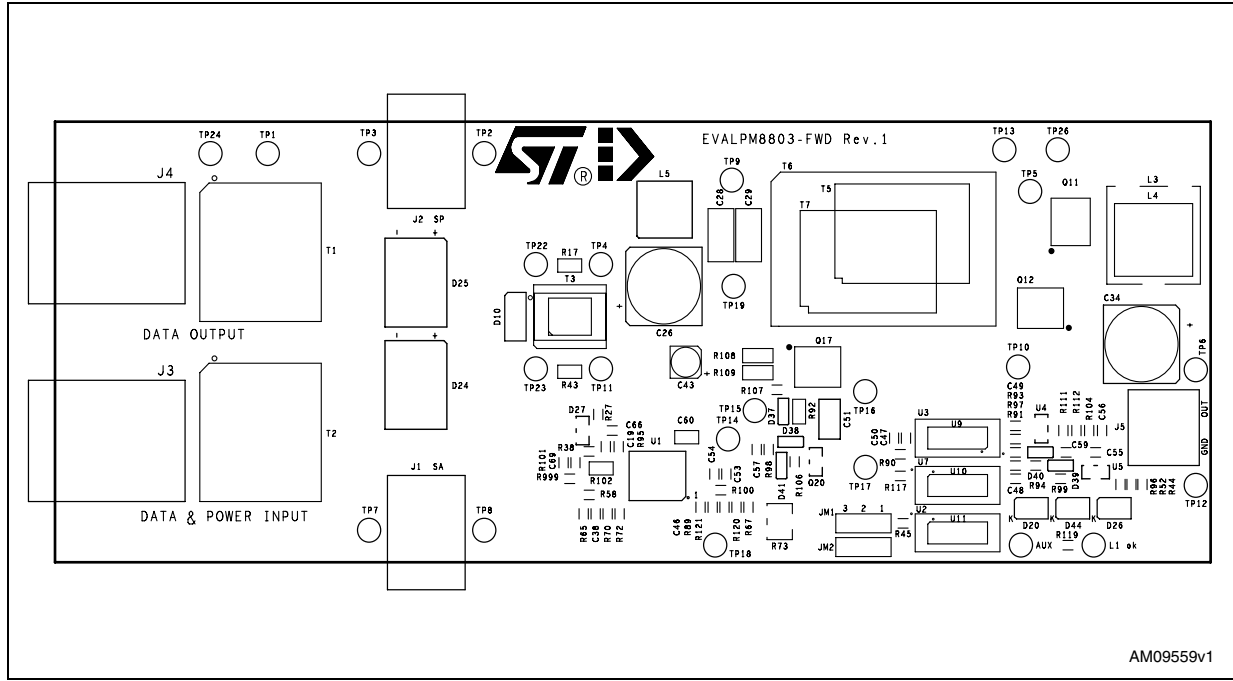


Figure 5. Assembly view: bottom layer

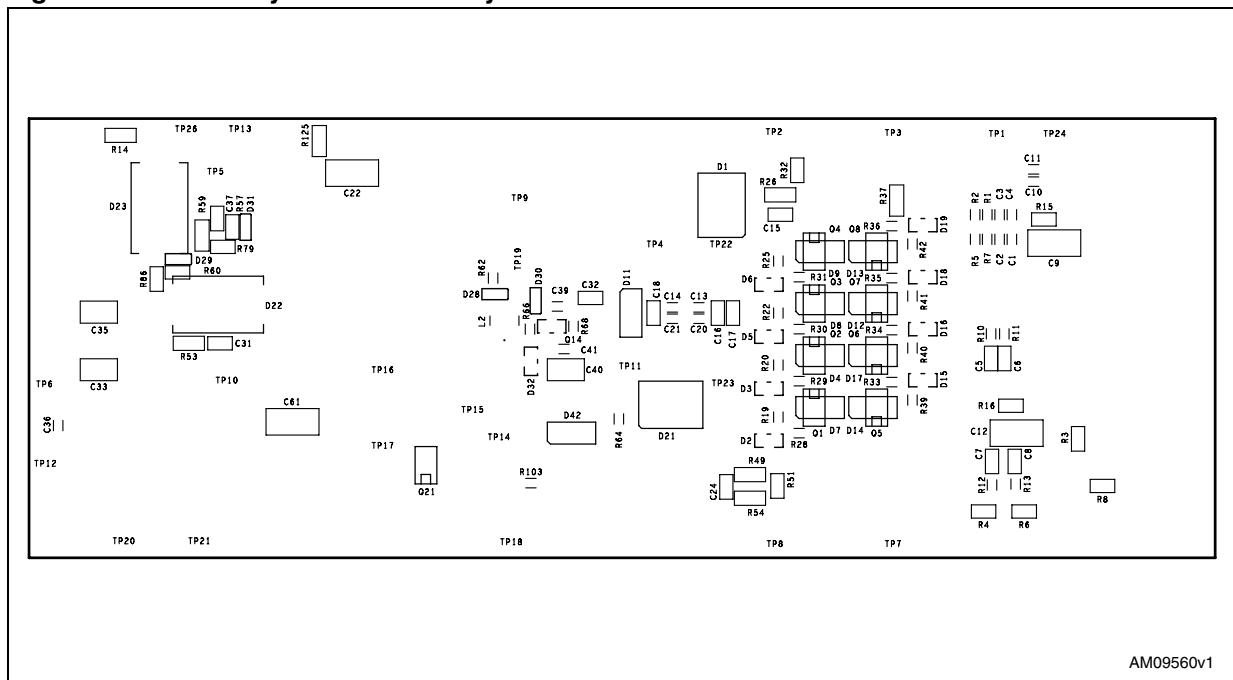


Figure 6. Top layer

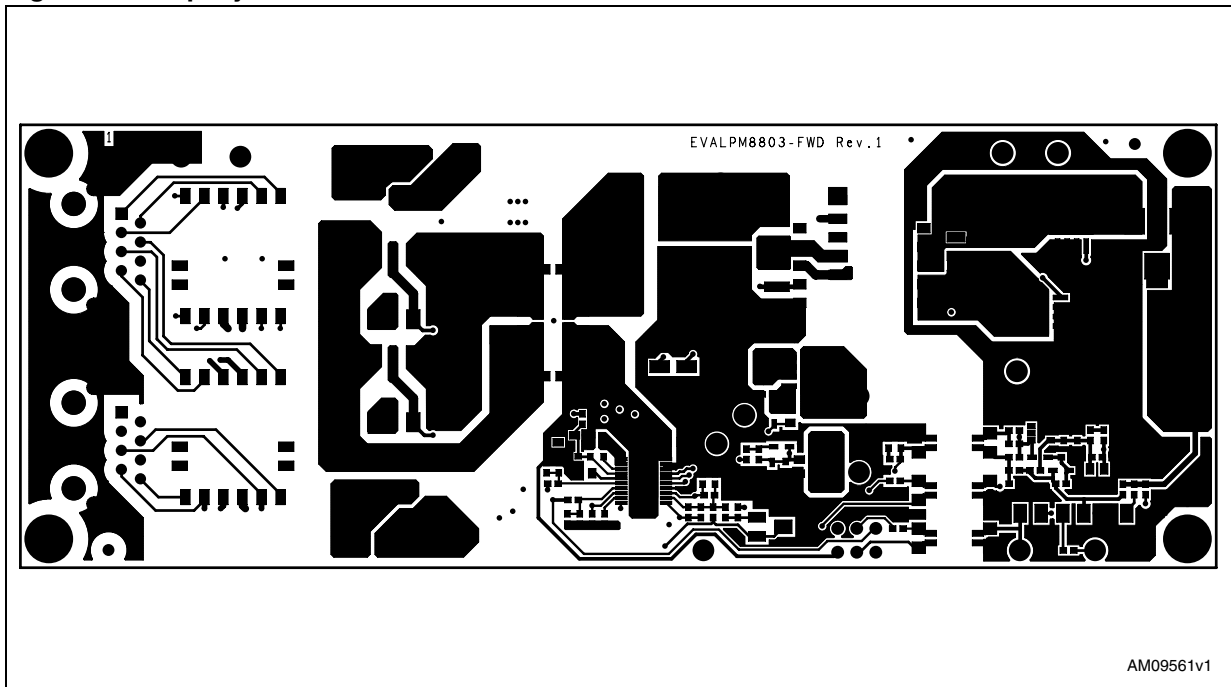


Figure 7. Inner layer 1

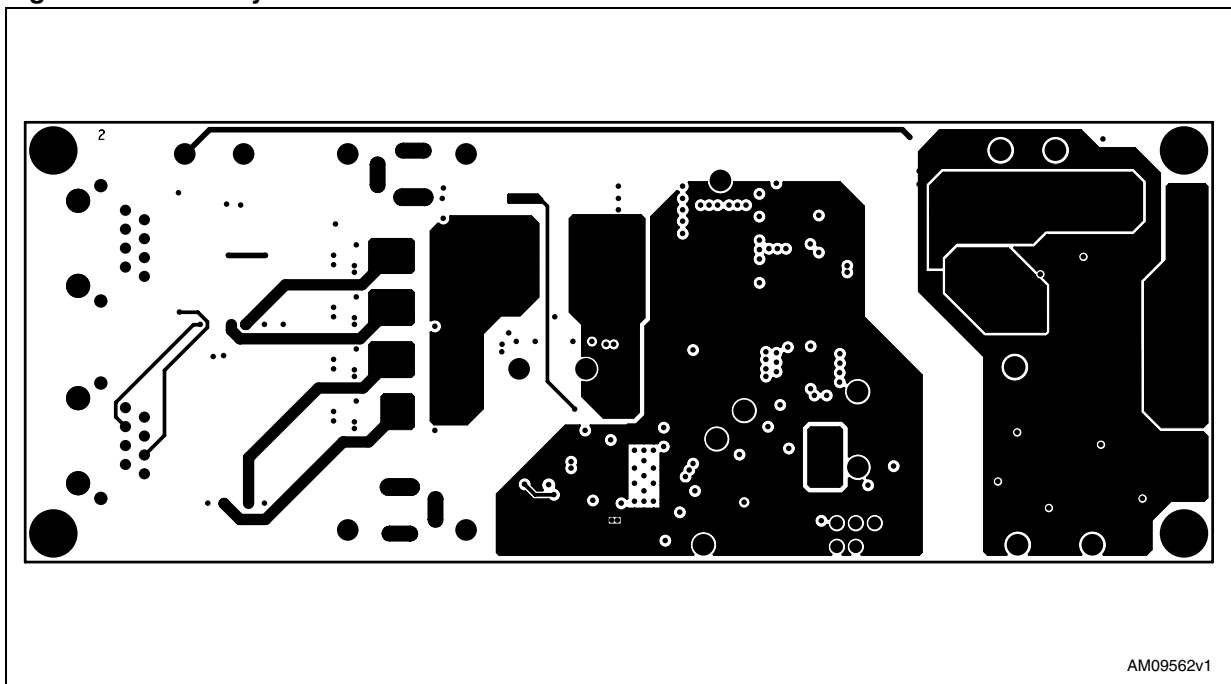


Figure 8. Inner layer 2

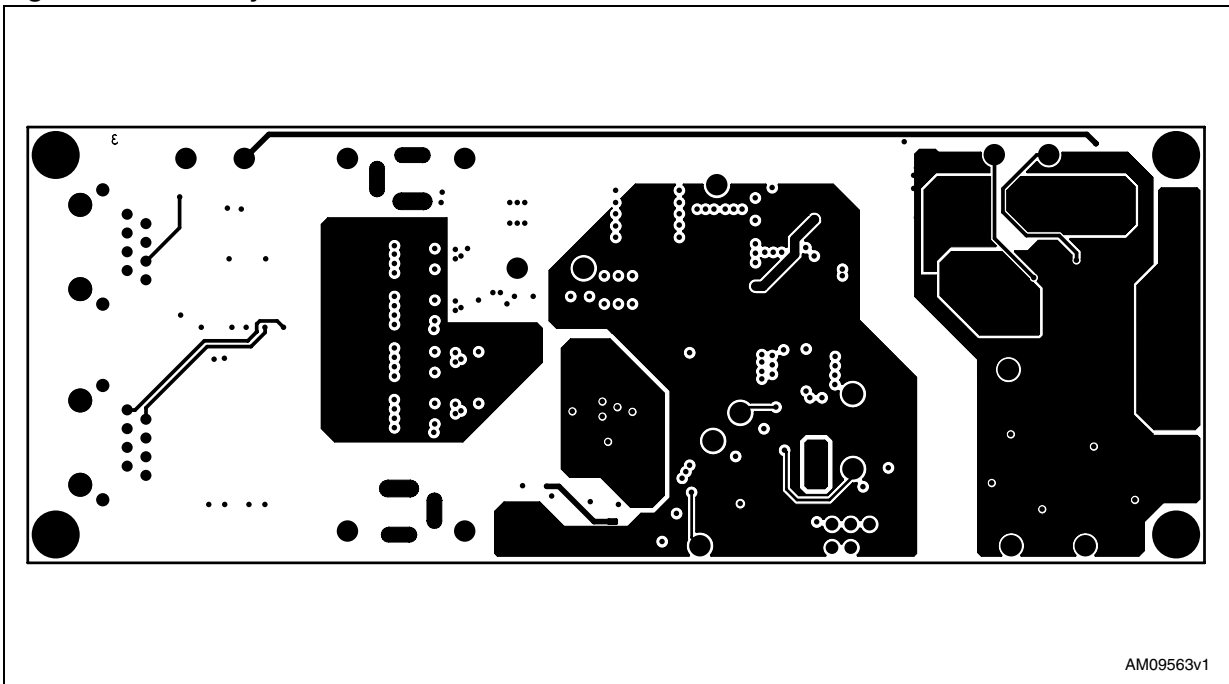
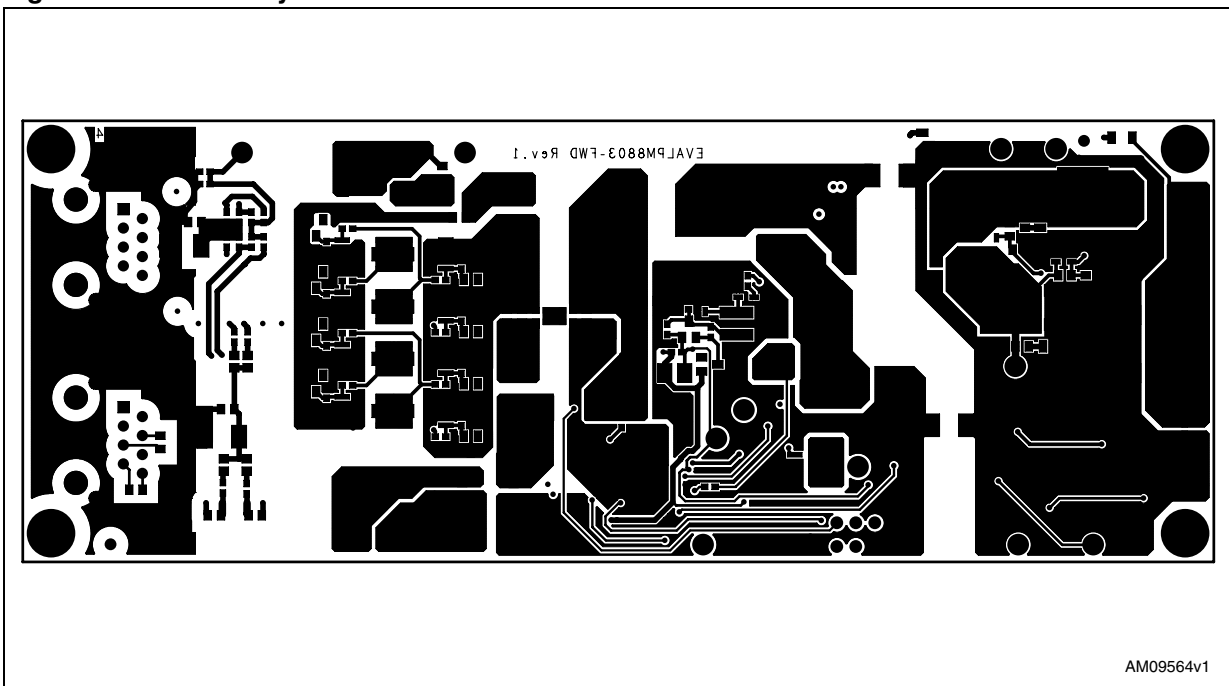


Figure 9. Bottom layer



## 4 I/O connectors and test points

This section provides a description of input/output connectors ([Table 3](#)), LED indicators and commands ([Table 4](#)), as well as the available test points ([Table 5](#)).

**Table 3. Connectors**

| Connector | Label                | Description   |
|-----------|----------------------|---|
| J3        | Data and power input | Power and Ethernet data input port  |
| J4        | Data output          | Ethernet data output port   |
| J2        | SP                   | Wall adapter input. Use this input jack to connect auxiliary source without priority of the auxiliary source wrt PoE.   |
| J1        | SA                   | Wall adapter input. Use this input jack to connect auxiliary source with priority of the auxiliary source wrt PoE.  |
| J5        | -                    | Output voltage connector  |
| JM1       | -                    | Move the short on both jumpers at the same time: short between pin 1 and 2 when SA auxiliary source is used on J1 connector; short between pin 2 and 3 when SP auxiliary source is used on J2 connector |
| JM2       | -                    | Move the short on both jumpers at the same time: short between pin 1 and 2 when SA auxiliary source is used on J1 connector; short between pin 2 and 3 when SP auxiliary source is used on J2 connector |

**Table 4. LEDs**

| LED | Label     | Description  |
|-----|-----------|--|
| D20 | AUX       | ON when an auxiliary source is applied to the board; proper selection of the auxiliary source connection is done with jumpers JM1 and JM2  |
| D44 | L1_OK     | ON when T2P is asserted. This is achieved when a 2-finger event is detected. If, after a successful PoE+ layer-1 classification, an auxiliary voltage is connected, the T2P signal is de-asserted and the L1_OK LED is turned off. |
| D26 | GREEN LED | ON when output voltage is present.   |

**Table 5. Test points**

| Test point | Color | Description                              |
|------------|-------|--|
| TP1        | Red   | Data transformer bias voltage            |
| TP2        | Red   | Positive of auxiliary source AUX 1 on J2 |
| TP3        | Black | Auxiliary source AUX 1 ground on J2      |
| TP4        | Red   | Input voltage VDD                        |
| TP5        | Red   | Secondary winding output                 |
| TP6        | Red   | Output voltage on J5                     |

**Table 5. Test points (continued)**

| Test point | Color | Description   |
|------------|-------|---|
| TP7        | Red   | Positive of auxiliary source AUX 2 on J1                  |
| TP8        | Black | Auxiliary source AUX 2 ground on J1                       |
| TP9        | Red   | Input of the primary side winding                         |
| TP10       | Red   | Secondary winding output                                  |
| TP11       | Red   | VSS - I/F ground voltage                                  |
| TP12       | Black | Output voltage ground                                     |
| TP13       | Red   | Gate drive of the secondary side MOSFET                   |
| TP14       | Red   | VC supply voltage   |
| TP15       | Red   | Gate drive of the primary side MOSFET                     |
| TP16       | Red   | Drain of the primary side MOSFET                          |
| TP17       | Red   | Gate drive of the MOSFET connected to GAT2                |
| TP18       | Red   | Current sense input                                       |
| TP19       | Black | RTN - DC-DC ground voltage                                |
| TP20       | Red   | L1 status indicator - referred to output voltage ground   |
| TP21       | Red   | Aux present indicator - referred to output voltage ground |
| TP22       | Red   | PoE voltage after the input diode bridges                 |
| TP23       | Black | Ground of the PoE voltage after the input diode bridges   |
| TP24       | Black | Chassis ground of the RJ45 connectors                     |
| TP26       | Red   | Gate drive of the secondary side MOSFET                   |

## 5 Bill of material

With minimal BOM changes it is possible to switch from 3.3 V to 5 V output voltage.

**Table 6. EVALPM8803-FWD BOM**

| 3.3 V | 5 V | Reference                    | Description         | Value       | Tol. | Voltage | Body    | Vendor |
|-------|-----|------------------------------|---------------------|-------------|------|---------|---------|--------|
| 1     | 1   | EVALPM8803-FWD<br>ACFWD rev1 | Board PCB           |             |      |         |         |        |
| 7     | 7   | C1,C2,C3,C4,C11C36,<br>C57   | Ceramic capacitor   | 100 nF      |      | 50 V    | 603     | Std    |
| 4     | 4   | C5,C6,C7,C8                  | Ceramic capacitor   | 10 nF       | 10%  | 100 V   | 603     | TDK    |
| NM    | NM  | C9,C22                       | Ceramic capacitor   | NM          |      |         | 1812    | NM     |
| 6     | 6   | C10,C39,C41,<br>C48,C53,C59  | Ceramic capacitor   | 1 $\mu$ F   | 20%  | 16 V    | 603     | Std    |
| 1     | 1   | C12                          | Ceramic capacitor   | 2.2 nF      |      | 2 kV    | 1812    | TDK    |
| NM    | NM  | C13,C20                      | Ceramic capacitor   | NM          |      | 100 V   | 603     | NM     |
| 3     | 3   | C14,C16,C21                  | Ceramic capacitor   | 1 nF        | 10%  | 100 V   | 603     | TDK    |
| NM    | NM  | C15,C17,C24,C60              | Ceramic capacitor   | NM          |      | 100 V   | 805     | NM     |
| 2     | 2   | C18,C32                      | Ceramic capacitor   | 0.1 $\mu$ F | 10%  | 100 V   | 805     | TDK    |
| 2     | 2   | C19, C38                     | Ceramic capacitor   | 22 nF       |      | 50 V    | 603     | Std    |
| NM    | NM  | C42,C46,C56,C66C69           | Ceramic capacitor   | NM          |      |         | 603     | NM     |
| 1     | 1   | C26                          | Aluminium capacitor | 33 $\mu$ F  | 20%  | 100 V   | 10x10.2 | Std    |
| 2     | 2   | C33,C35                      | Ceramic capacitor   | 10 $\mu$ F  | 20%  | 6.3 V   | 805     | Std    |
| 2     | 2   | C28,C29                      | Ceramic capacitor   | 1 $\mu$ F   | 20%  | 100 V   | 1206    | TDK    |
| 2     | 2   | C31,C37                      | Ceramic capacitor   | 1 nF        | 10%  | 100 V   | 805     | Std    |
| 1     | 1   | C34                          | Aluminium capacitor | 330 $\mu$ F |      | 6.3 V   | 8x10.5  | Suncon |
| NM    | NM  | C40                          | Ceramic capacitor   | NM          |      |         | 805     | NM     |
| NM    | NM  | C43                          | Aluminium capacitor | NM          |      |         | 4x6     | NM     |

**Table 6. EVALPM8803-FWD BOM (continued)**

| 3.3 V | 5 V | Reference                                  | Description       | Value      | Tol. | Voltage | Body   | Vendor             |
|-------|-----|--|-------------------|------------|------|---------|--------|--------------------|
| NM    | NM  | C47  | Ceramic capacitor | NM         |      |         | 603    | NM                 |
| 1     | 1   | C49  | Ceramic capacitor | 22 nF      |      | 50 V    | 603    | Std                |
| 1     | 1   | C50  | Ceramic capacitor | 100 nF     |      | 50 V    | 603    | Std                |
| 1     | 1   | C51  | Ceramic capacitor | 47 nF      |      | 200 V   | 1206   | Syfer              |
| 1     | 1   | C54  | Ceramic capacitor | 470 pF     |      | 50 V    | 603    | Std                |
| 1     | 1   | C55  | Ceramic capacitor | 100 pF     |      | 50 V    | 603    | Std                |
| 1     | 1   | C56  | Ceramic capacitor | 22 nF      |      | 50 V    | 603    | Std                |
| 1     | 1   | C61  | Ceramic capacitor | 2.2 nF     |      | 2 kV    | 1812   | TDK                |
| 1     | 1   | D1, D21                                    | Std diode         | STTH302S   |      | 200 V   | SMC    | STMicroelectronics |
| NM    | NM  | D2,D3,D5,D6,<br>D15D16,D18,D19             | Zener diode       | (BZX84C10) |      |         | SOT23  | NM                 |
| 1     | 1   | D32  | Zener diode       | BZX84C10   |      |         | SOT23  | Std                |
| 8     | 8   | D4,D7,D8,D9,<br>D12D13,D14, D17            | Schottky diode    | STPS2H100A |      | 100 V   | SMA    | STMicroelectronics |
| NM    | NM  | D10  | TVS diode         | NM         |      |         | SMA    | NM                 |
| 1     | 1   | D11  | TVS diode         | SMAJ58A    |      |         | SMA    | STMicroelectronics |
| 1     | 1   | D20  | LED diode         | AUX        |      | 2.2 V   | PLCC-2 | Std                |
| NM    | NM  | D22,D23                                    | Schottky diode    | NM         |      |         | Dpak   | Option diode rect. |
| NM    | NM  | D24,D25                                    | Bridge rectifier  | NM         |      |         | SDIP   | NM                 |
| 1     | 1   | D26  | LED diode         | Green LED  |      | 2.2 V   | PLCC-2 | Std                |
| NM    | NM  | D27  | Zener diode       | NM         |      |         | SOT23  | NM                 |
| 9     | 9   | D28,D29,D30,<br>D31D37,D38, D39,<br>D40D41 | Schottky diode    | BAT46J     |      | 100 V   | SOD323 | STMicroelectronics |
| NM    | NM  | D42  | Schottky diode    | NM         |      |         | SMA    | NM                 |
| 1     | 1   | D44  | LED diode         | L1 OK      |      | 2.2 V   | PLCC-2 | Std                |

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Bill of material

**Table 6. EVALPM8803-FWD BOM (continued)**

| 3.3 V | 5 V | Reference       | Description          | Value                | Tol. | Voltage               | Body          | Vendor             |
|-------|-----|-----------------|----------------------|----------------------|------|-----------------------|---------------|--------------------|
| 2     | 2   | JM1,JM2         | Connector            | Jumper 3 pins male   |      |                       | Pitch 2.54 mm | Std                |
| 2     | 2   | Jumper          |                      | Jumper 2 pins female |      |                       | Pitch 2.54 mm | Std                |
| 2     | 2   | J1, J2          | Power jack           | SA, SP               |      |                       |               | Std                |
| 1     | 1   | J3              | RJ45 connector       | Data and power input |      |                       |               | Std                |
| 1     | 1   | J4              | RJ45 connector       | Data output          |      |                       |               | Std                |
| 1     | 1   | J5              | Terminal block 2-way | MOR-10X10.5-P5-2PIN  |      |                       |               | Std                |
| 1     | 1   | L2              | SMT inductor         | 1 mH                 |      |                       | LPS4018-105ML | Coilcraft          |
| NM    | 1   | L3              | SMT inductor         | 10 $\mu$ H           |      |                       | SER1360-103KL | Coilcraft          |
| 1     | NM  | L3              | SMT inductor         | 6 $\mu$ H            |      |                       | SER1360-602KL | Coilcraft          |
| 1     | 1   | L5              | SMT inductor         | 10 $\mu$ H           |      |                       | MSS7341-103ML | Coilcraft          |
| NM    | NM  | Q1,Q2,Q3,Q4     | MOSFET, P-ch         | IRF6216PbF           |      | 100 V                 | SO8           | IR                 |
| NM    | NM  | Q5,Q6,Q7,Q8     | MOSFET, N-ch         | STS4NF100            |      | 100 V                 | SO8           | STMicroelectronics |
| 2     | 2   | Q11,Q12         | MOSFET, N-ch         | STS14N3LLH5          |      | 30 V                  | SO8           | STMicroelectronics |
| 1     | 1   | Q14             | Transistor, NPN      | MMBT3904LT1          |      | 40 V                  | SOT23         | Std                |
| 1     | 1   | Q17             | MOSFET, N-ch         | Si4848DY             |      | 150 V                 | SO8           | Vishay             |
| 1     | 1   | Q20             | MOSFET, P-ch         | Si2325DS             |      | 150 V                 | SOT23         | Vishay             |
| NM    | NM  | Q21             | MOSFET, P-ch         | IRF6216PbF           |      | 150 V                 | SO8           | NM                 |
| 4     | 4   | R1,R2,R5,R7     | Chip resistor        | 0                    |      |                       | 603           | Std                |
| NM    | NM  | R3,R4,R6,R8,R16 | Chip resistor        | NM                   |      |                       | 805           | NM                 |
| 4     | 4   | R10,R11,R12,R13 | Chip resistor        | 75 $\Omega$          |      |                       | 603           | Std                |
| NM    | NM  | R14,R125        | Chip resistor        | NM                   |      |                       | 1206          | NM                 |
| 1     | 1   | R15             | Chip resistor        | 0                    |      |                       | 805           | Std                |
| 2     | 2   | R17,R43         | Ferrite bead         | MPZ012101A           |      | 100 $\Omega$ ,<br>4 A | 805           | TDK                |
| 4     | 4   | R26,R37,R49,R54 | Chip resistor        | 0                    |      |                       | 805           | Std                |

**Table 6. EVALPM8803-FWD BOM (continued)**

| 3.3 V | 5 V | Reference   | Description      | Value   | Tol. | Voltage | Body | Vendor |
|-------|-----|---|------------------|---------|------|---------|------|--------|
| NM    | NM  | R19,R20,R22,R25R39,<br>R40,R41,R42                                | Chip resistor    | NM      |      |         | 603  | NM     |
| 2     | 2   | R27,R58   | Chip resistor    | 124 kΩ  | 1%   |         | 603  | Std    |
| NM    | NM  | R28,R29,R30,R31R33,<br>R34,R35,R36R70,R100<br>,R104,<br>R120,R121 | Chip resistor    | NM      |      |         | 603  | NM     |
| 2     | 2   | R32,R51   | Chip resistor    | 100 kΩ  |      |         | 805  | Std    |
| 3     | 3   | R38,R65,R117  | Chip resistor    | 4.75 kΩ | 1%   |         | 603  | Std    |
| 3     | 3   | R44,R52,R119  | Chip resistor    | 1 kΩ    |      |         | 603  | Std    |
| 2     | 2   | R45,R99   | Chip resistor    | 47 kΩ   |      |         | 603  | Std    |
| 2     | 2   | R53,R59   | Chip resistor    | 10 Ω    |      |         | 805  | Std    |
| 2     | 2   | R57,R60   | Chip resistor    | 5.6 Ω   |      |         | 805  | Std    |
| 1     | 1   | R62   | Chip resistor    | 10 Ω    |      |         | 603  | Std    |
| 3     | 3   | R64,R68,R98   | Chip resistor    | 0       |      |         | 603  | Std    |
| NM    | NM  | R66,R97   | Chip resistor    | NM      |      |         | 603  | NM     |
| 2     | 2   | R67,R106  | Chip resistor    | 10 kΩ   |      |         | 603  | Std    |
| 1     | 1   | R72   | Chip resistor    | 124 kΩ  | 1%   |         | 603  | Std    |
| 1     | 1   | R73   | Trimmer resistor | 100 kΩ  |      |         |      | Vishay |
| NM    | NM  | R79,R86   | Chip resistor    | NM      |      |         | 805  | NM     |
| 1     | 1   | R89   | Chip resistor    | 2.7 kΩ  |      |         | 603  | Std    |
| 1     | 1   | R90   | Chip resistor    | 680 Ω   |      |         | 603  | Std    |
| 1     | 1   | R91   | Chip resistor    | 10 Ω    |      |         | 603  | Std    |
| 1     | 1   | R92   | Chip resistor    | 22 Ω    |      |         | 603  | Std    |
| 1     | NM  | R93   | Chip resistor    | 680 Ω   |      |         | 603  | Std    |
| NM    | 1   | R93   | Chip resistor    | 820 Ω   |      |         | 603  | Std    |



Table 6. EVALPM8803-FWD BOM (continued)

| 3.3 V | 5 V | Reference  | Description       | Value              | Tol. | Voltage | Body     | Vendor             |
|-------|-----|--|-------------------|--------------------|------|---------|----------|--------------------|
| 1     | 1   | R94  | Chip resistor     | 21 k $\Omega$      | 1%   |         | 603      | Std                |
| 1     | 1   | R95  | Chip resistor     | 24.9 k $\Omega$    | 1%   |         | 603      | Std                |
| 1     | 1   | R96  | Chip resistor     | 0                  |      |         | 603      | Std                |
| NM    | NM  | R101   | Chip resistor     | NM                 |      |         | 603      | NM                 |
| 1     | 1   | R102   | Chip resistor     | 35.7 $\Omega$      | 1%   |         | 805      | Std                |
| 1     | 1   | R103   | Chip resistor     | 510 $\Omega$       |      |         | 603      | Std                |
| 1     | 1   | R104   | Chip resistor     | 4.75 k $\Omega$    | 1%   |         | 603      | Std                |
| 1     | 1   | R107   | Chip resistor     | 100 k $\Omega$     |      |         | 603      | Std                |
| 2     | 2   | R108,R109  | Chip resistor     | 0.30 $\Omega$      |      |         | 1206     | Std low value      |
| 1     | 1   | R111   | Chip resistor     | 12.4 k $\Omega$    | 1%   |         | 603      | Std                |
| NM    | 1   | R112   | Chip resistor     | 15 k $\Omega$      | 1%   |         | 603      | Std                |
| 18    | 18  | TP1,TP2,TP4,TP5,TP6,<br>TP7,TP9,<br>TP10,TP13,TP14,TP15,<br>TP16,TP17,TP18,TP20,<br>TP21,TP22,TP26 | Test points       | Red                |      |         |          | Std                |
| 7     | 7   | TP3,TP8,TP11,<br>TP12,TP19,TP23,TP24   | Test points       | Black              |      |         |          | std                |
| 2     | 2   | T1,T2  | PoE+ magnetics    | ETH1-230LD         |      |         |          | Coilcraft          |
| NM    | NM  | T3   | CM choke          | NM                 |      |         |          | NM                 |
| NM    | 1   | T5   | Power transformer | HA3691-AL          |      |         |          | Coilcraft          |
| 1     | NM  | T5   | Power transformer | JA4173-AL          |      |         |          | Coilcraft          |
| NM    | NM  | T6   | Power transformer | (PoE300F)          |      |         |          | NM                 |
| NM    | NM  | T7   | Power transformer | (PoE13P)           |      |         |          | NM                 |
| 1     | 1   | U1   | PoE+ controller   | PM8803             |      |         | HTSSOP20 | STMicroelectronics |
| 3     | 3   | U2,U3,U7   | SMT optocoupler   | Fairchild FOD817AS |      |         | 4PDIP    | Fairchild          |



**Table 6. EVALPM8803-FWD BOM (continued)**

| <b>3.3 V</b> | <b>5 V</b> | <b>Reference</b> | <b>Description</b> | <b>Value</b> | <b>Tol.</b> | <b>Voltage</b> | <b>Body</b> | <b>Vendor</b>      |
|--------------|------------|------------------|--------------------|--------------|-------------|----------------|-------------|--------------------|
| 1            | 1          | U4               | Shunt regulator    | TS431AILT    |             |                | SOT23-5     | STMicroelectronics |
| NM           | NM         | U5               | Shunt regulator    | TS2431AILT   |             |                | SOT23       | NM                 |

## 6 Power-up sequence

It is recommended to apply power at PoE input first, slowly increasing the voltage to verify the absence of abnormal input current levels.

From about 2 V to about 12 V input, the demonstration kit performs the detection signature. At 10 V input the current drawn is about 400  $\mu$ A.

In the range of 14 V to 23 V, the demonstration kit performs a class-4 classification, and the current drawn is about 40 mA.

After those two steps are verified, the voltage can be increased to 48 V typical. The PoE converter starts operations at about 36 V input.

Three green LEDs indicate proper operation of the PoE and DC-DC section of the PM8803 demonstration kit:

- D44 is the T2P LED and is ON when the PM8803 has successfully recognized a type 2 PSE or a 802.3at compliant injector; using a bench power supply to power up the PM8803 demonstration board, this LED is OFF.
- D26 indicates the presence of the output voltage.
- D20 is the AUX LED and indicates the presence of an auxiliary voltage applied to the converter; proper selection of the auxiliary voltage is done with jumper JM1 and JM2: put a short between pin 1 and 2 when SA auxiliary source on J1 connector is used; put the short between pin 2 and 3 when SP auxiliary source on J2 connector is used.

*Note:* Set the R73 trimmer at a value around 10 k $\Omega$ .

*Adjust this value for best converter performances in terms of efficiency over its actual load range.*

*Note:* In the case of SA external auxiliary source tests, it is strongly recommended to change the position of the 100 nF, 100 V from C18, at the input filter, where it is soldered to C60, across the internal hot-swap MOSFET. This change of position, that has no impact on the standard compliance, permits an optimal behavior of the PM8803 device during the change of ground reference consequent to the power jack insertion/removal.

## 7 Test results

### 7.1 Efficiency measurement with 3.3 V output

Figure 10. Efficiency measurements at 48 V input

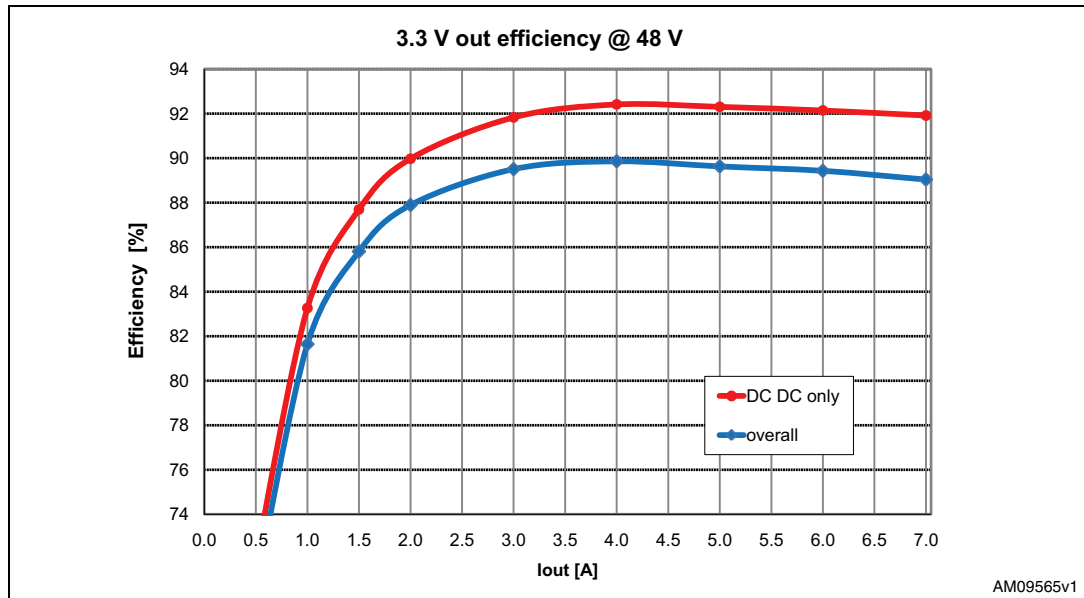


Figure 11. DC-DC only efficiency measurements at different input voltages

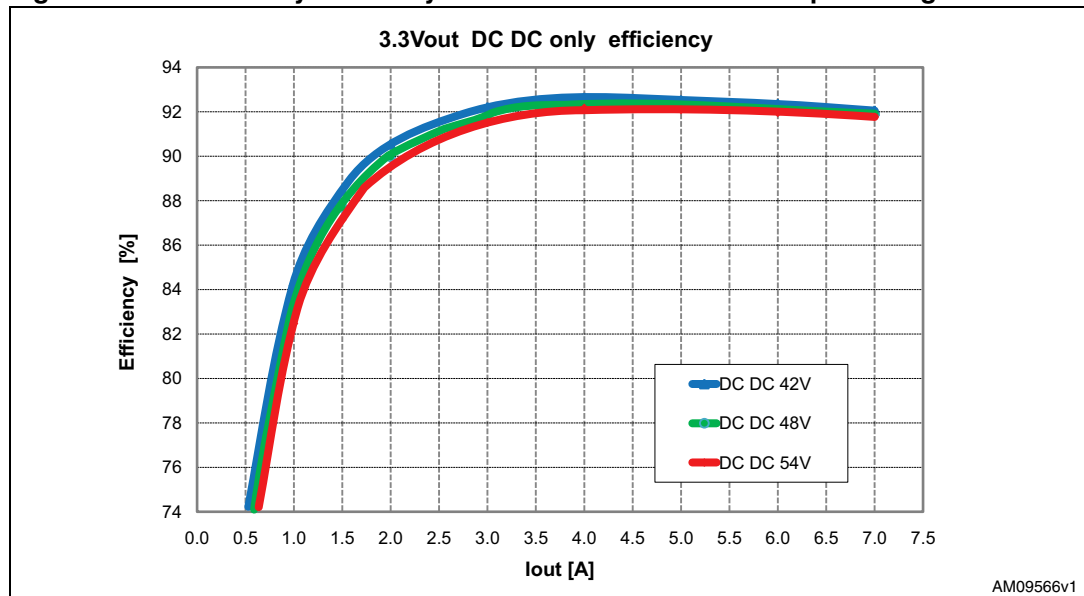
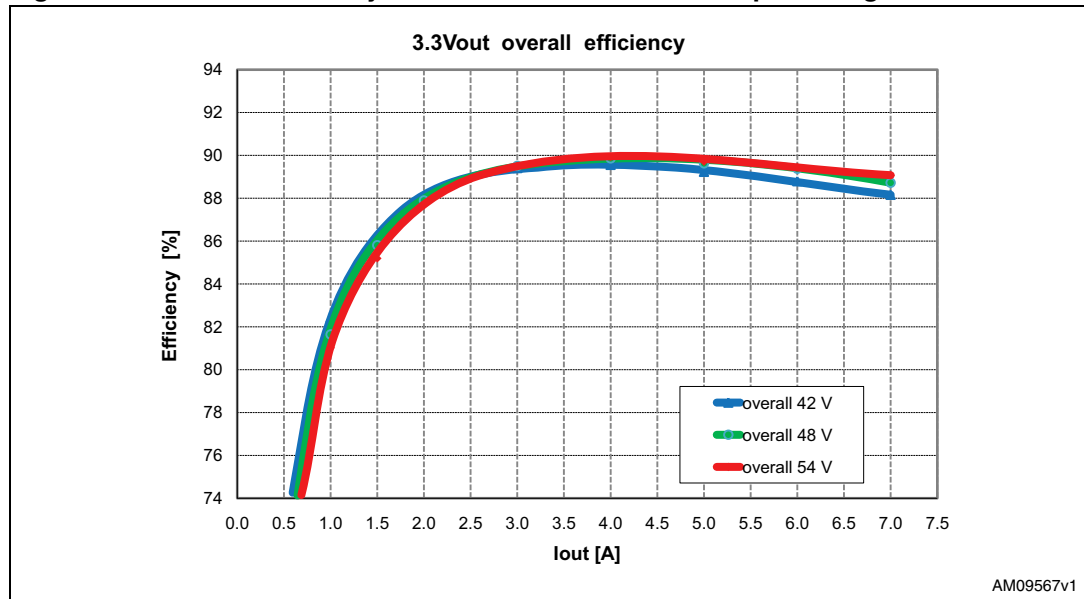


Figure 12. Overall efficiency measurements at different input voltages



## 7.2 Efficiency measurement with 5 V output

Figure 13. Efficiency measurements at 48 V input

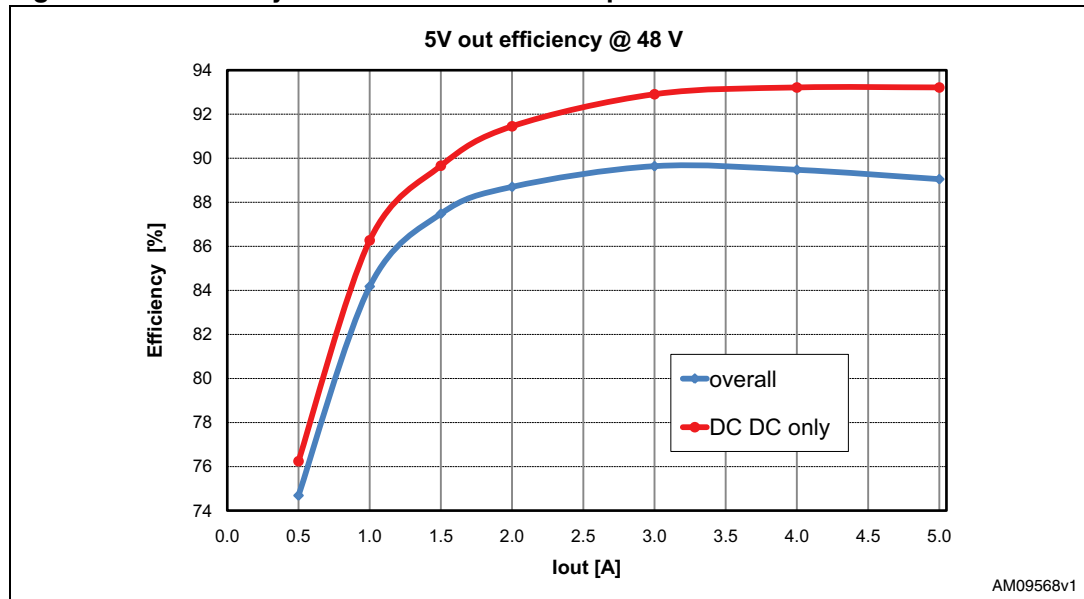


Figure 14. DC-DC only efficiency measurements at different input voltages

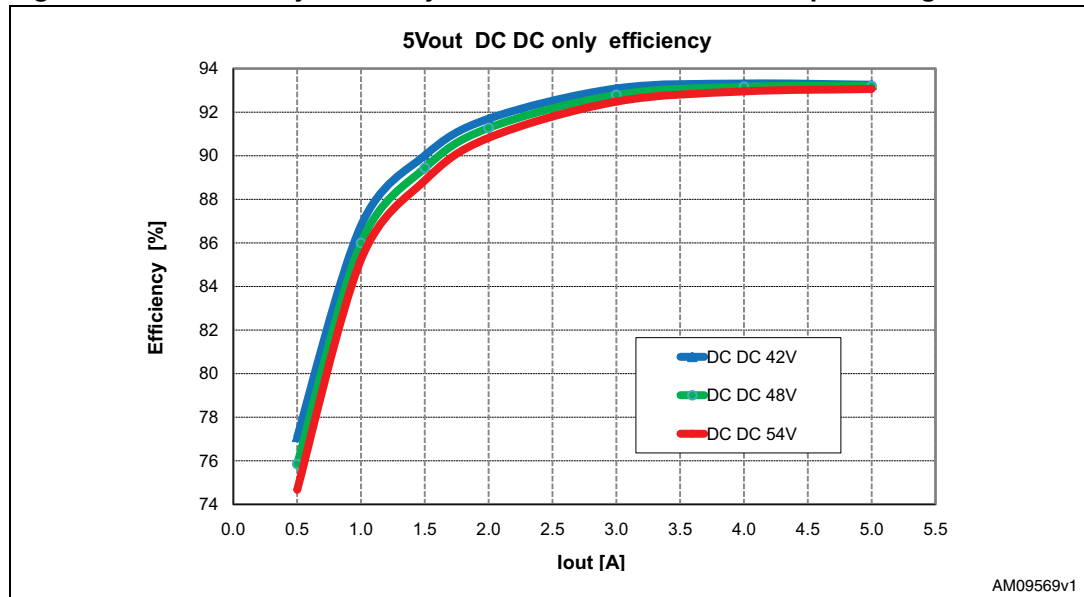
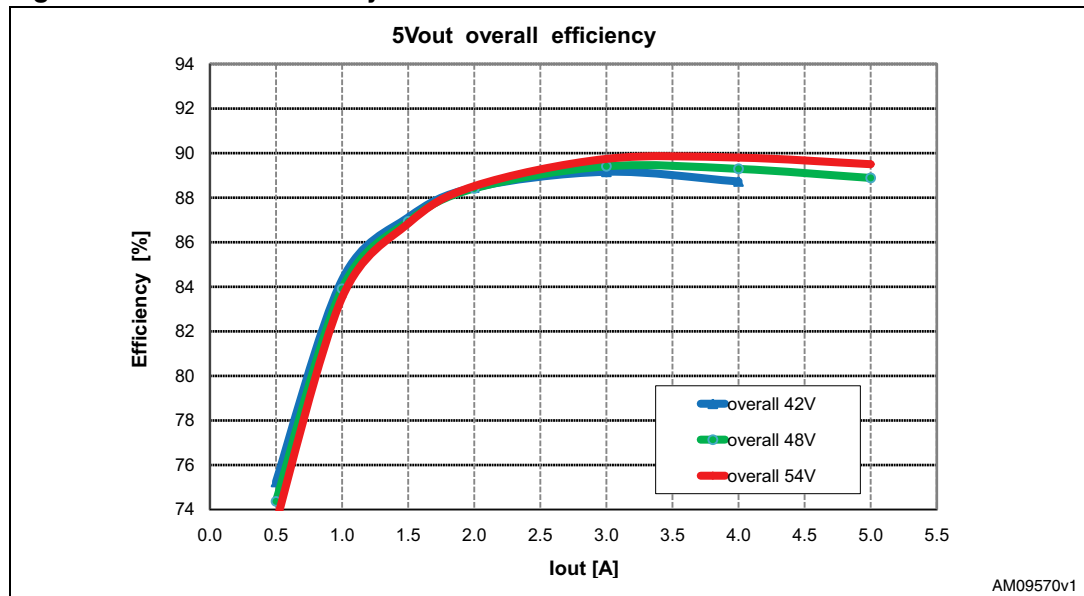


Figure 15. Overall efficiency measurements



### 7.3 Waveforms

The following images were taken on a 5 V output demonstration board. Similar waveforms are also applicable for the 3.3 V output version.

#### 7.3.1 Startup sequence from PoE/PoE+ injectors

Figure 16. Startup from an IEEE 802.3af injector with 2 A load



Note the inrush current limited at about 140 mA and the T2P signal not asserted.

Figure 17. Startup from an IEEE 802.3at injector with 4 A load



Note, in this case, the presence of the 2-finger during the classification phase and the T2P signal now asserted (T2P is valid low).

### 7.3.2 Transition from PoE to auxiliary and auxiliary to PoE

Figure 18 shows the behavior of the PM8803 when commuting sources. The image depicts the transition from PoE to an auxiliary source whose voltage is ~10 V lower than PoE. It can be seen that when the auxiliary voltage is applied (SA pin goes above its threshold) the current drawn from the PoE drops to a few milliAmps. Smooth transition occurs as can be seen from the output voltage (blue line).

Figure 18. Switching between PoE and auxiliary source



### 7.3.3 Primary side MOSFET

Figure 19. Primary side power MOSFET waveforms at 0 A load



Figure 20. Primary side power MOSFET waveforms at 4 A load



### 7.3.4 Secondary side MOSFET

Figure 21. Secondary side power MOSFET waveforms at 0 A load

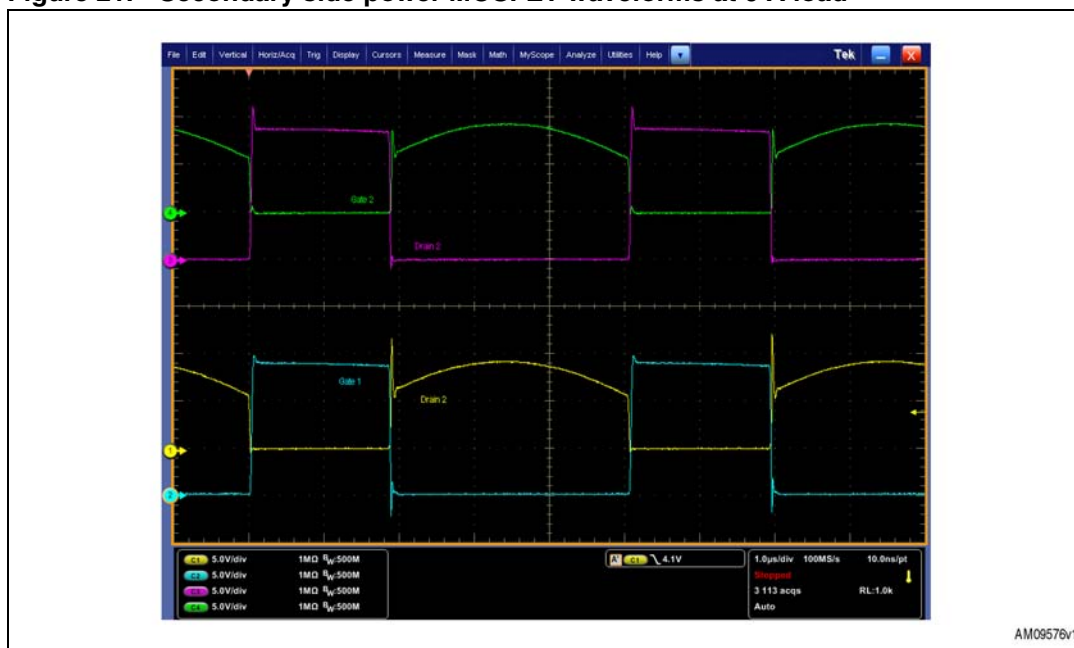
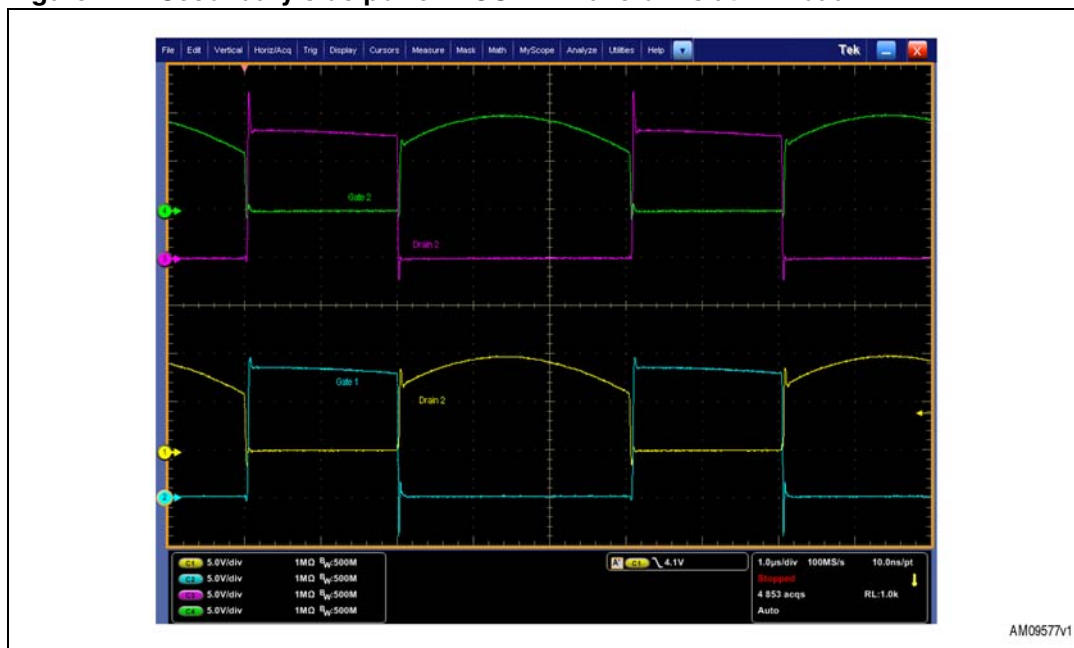


Figure 22. Secondary side power MOSFET waveforms at 4 A load



### 7.3.5 Line transient

Figure 23 depicts the effect of a line transient on the PoE converter. A 12 V step on a 42 V input PoE line (green trace) is shown. The hot-swap MOSFET (yellow trace) withstands the transient while the input current (pink trace) is limited during the input capacitor charge; the converter continues to work and the output voltage (blue trace) remains in regulation.

Figure 23. Effect of a 12 V line transient on the converter at 4 A load



AM09578v1

Figure 24. Effect of a 12 V line transient on the converter at 0 A load



AM09579v1

### 7.3.6 Load transient

Figure 25. Response of the converter to a 2 A - 4 A load transient

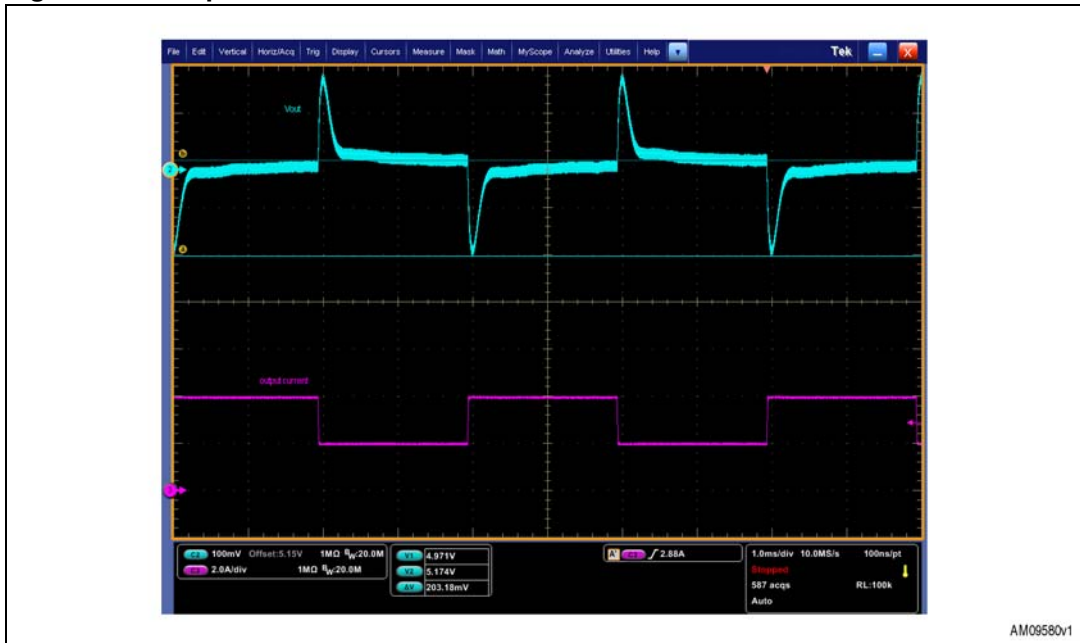
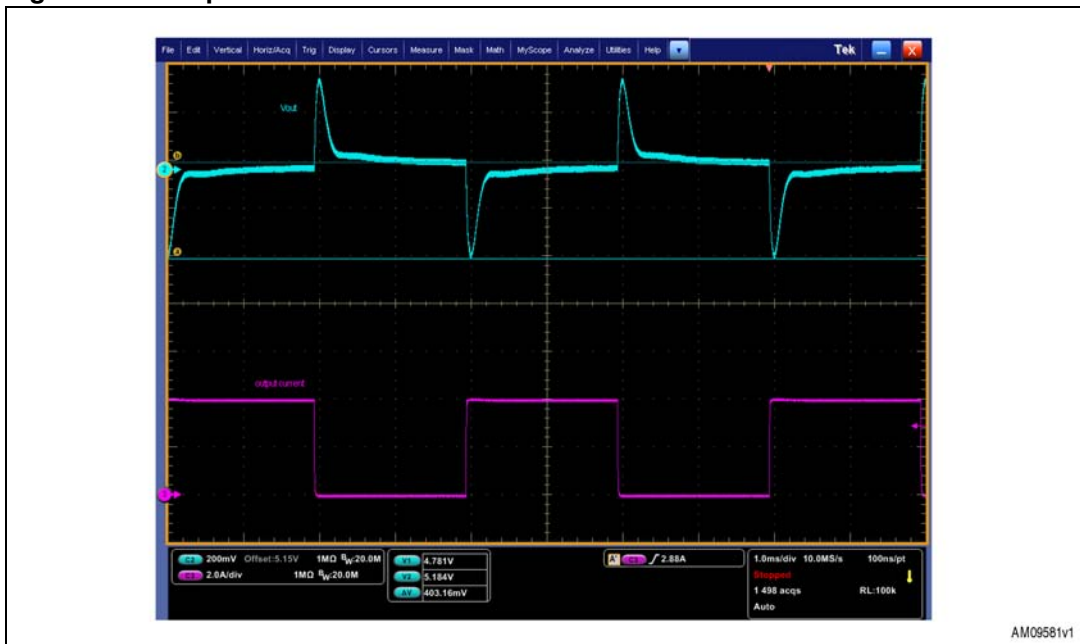
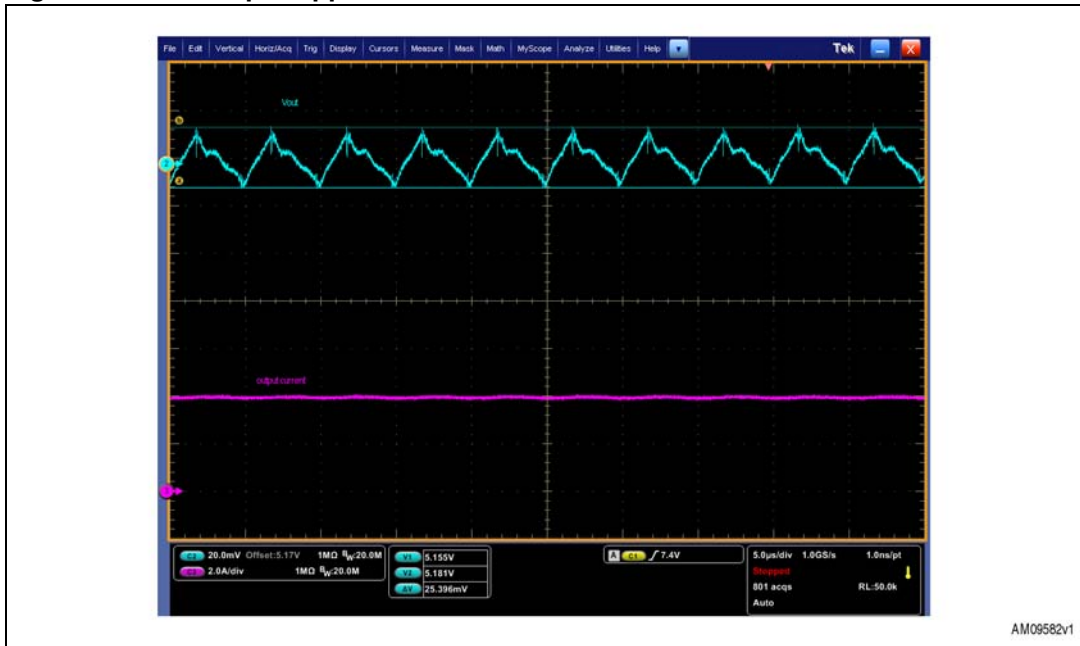


Figure 26. Response of the converter to a 0 A - 4 A load transient



### 7.3.7 Output ripple

Figure 27. 5 V output ripple measurement at 4 A



AM09582v1

Figure 28. 5 V output ripple measurement at 4 A with infinite persistence



AM09583v1

## 8 Revision history

**Table 7. Document revision history**

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 23-Mar-2011 | 1        | Initial release. |

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