Getting started with the STEVAL-A6983NV1 synchronous step-down switching regulator evaluation board based on the A6983NQTR

Introduction

The STEVAL-A6983NV1 is based on the A6983NQTR synchronous step-down regulator, which implements the peak current mode architecture in a VQFN package with internal compensation, to minimize design complexity and size. The device is able to deliver up to 3 A DC to the load.

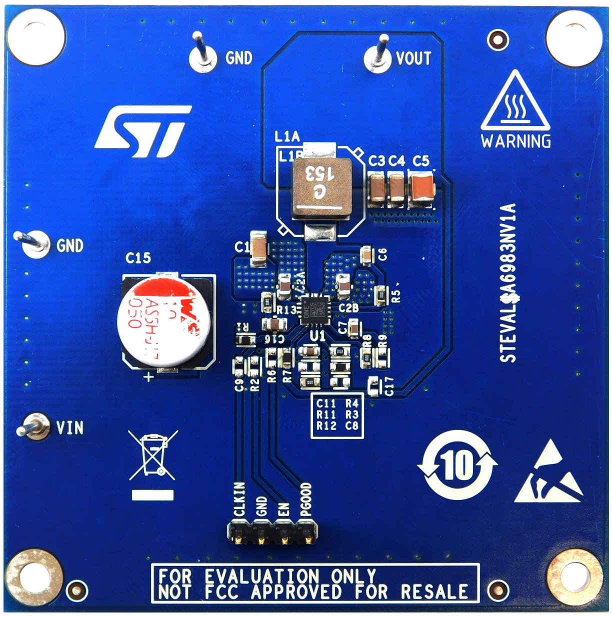
The STEVAL-A6983NV1 operates over an input voltage range of 6 to 38 V to provide a regulated 5 V output at a switching frequency of 400 kHz.

The board can be easily modified to obtain:

- the preferred switching frequency, modifying the resistor connected to the FSW pin
- the preferred power-up threshold, modifying the resistors partition
- the required output voltage, changing the feedback resistors partition

Use the eDesignSuite software to configure the A6983NQTR and satisfy the specifications.

Figure 1. STEVAL-A6983NV1 evaluation board



1 Getting started

1.1 Safety precautions

Caution: All operations involving transportation, installation, use, and maintenance of the board must be performed by skilled technical personnel who is familiar with the installation, use, and maintenance of power electronic systems.

A system architecture that supplies power to the evaluation board must be equipped with additional control and protective devices in accordance with the applicable safety requirements (that is, compliance with technical equipment and accident prevention rules).

The electrical installation has to be completed in accordance with the appropriate requirements (cross-sectional areas of conductors, fusing, and GND connections).

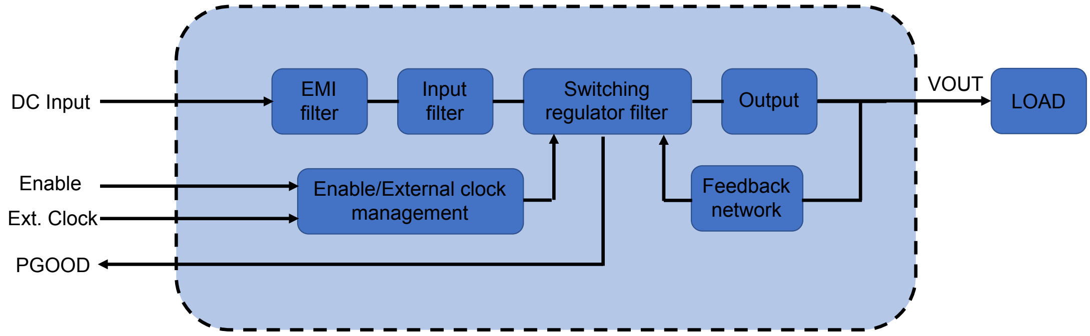
1.2 Overview

1.2.1 Features

- AEC-Q100 Grade 1 qualified
- Operating temperature range: -40 to +150°C for T_j
- 3.5 to 38 V operating input voltage
- Output voltage from 0.85 V to V_{IN}
- 3.3 and 5 V fixed output voltage versions
- 3 A DC output current
- Internal compensation network
- Noise sensitive applications
- 2 µA shutdown current
- Internal soft-start
- High voltage V_{IN} compatible enable
- Output overvoltage protection
- Output voltage sequencing
- Thermal protection
- 0.2 to 2.2 MHz programmable switching frequency
- Stable with low ESR capacitor min. 22 µF
- Optional spread spectrum for improved EMC
- Power good
- Synchronization with an external clock
- QFN16 (3 x 3 mm) package

1.2.2 Block diagram

Figure 2. **STEVAL-A6983NV1 functional block diagram**



1.2.3 Connectors and test points

V_{IN}: connect to the positive terminal of a supply voltage (from 6 V to 38 V with default 5 V V_{OUT}). The input voltage is filtered (see Section 1.2.4: Input EMI filter) to decrease the EMI. The supply voltage should be set with a current limitation compatible with the power board request.

Typically:

$$I_{\lim} > \frac{V_{OUT}}{V_{IN}} \cdot I_{OUT}$$

GND: return of the terminal of the input and output capacitors.

VOUT: connect to the positive terminal of the active load or to a power resistor between V_{OUT} and GND.

Important: For all the above connections, short wires are recommended to avoid oscillation between the cable parasitic inductance and the input capacitor.

CLKIN: input pin. The pin allows synchronizing the device by applying an external signal generator. Refer to the AC coupling synchronization paragraph of the online datasheet.

GND: signal GND.

EN: input pin. The pin allows enabling the device. It allows also synchronizing the device by applying an external signal generator. Refer to the DC coupling synchronization paragraph of the online datasheet.

PGOOD: output pin. It is an open collector. It is short to GND once V_{OUT} is lower than the regulator window (10%). Otherwise, it is short to the V_{OUT} voltage.

1.2.4 Input EMI filter

The STEVAL-A6983NV1 is compliant with CISPR16-4-2.

The suggested input filters help to reduce EMI.

The network consists of a double Pi filter with an inductor (L2), a ferrite bead (L5), MLCC capacitors (C18, C19, C20 and C30), and an electrolytic capacitor used for a bulk energy storage.

1.2.5 Switching frequency settings

By default, the switching frequency is equal to 400 [Khz]. It is possible to select the preferred switching frequency by selecting the resistor connected between ground and the RFSW pin, R8.

Table 1. Switching frequency settings

R8 [KΩ]	Fsw [MHz]
1.8	0.2
0	0.4
3.3	0.5
5.6	0.7
10	1
18	1.5
33	2
56	2.3

The spread spectrum is selectable by connecting the RFSW resistor to VCC. The internal dithering circuit changes the switching frequency in a range of ± 5%. Refer to the online datasheet for the spread spectrum full description.

1.2.6 EN settings

By default, the EN pin is directly connected to V_{IN} with the R1 resistor and, as soon as the V_{IN} rises over the UVLO voltage, the device turns on.

By correctly selecting the resistor partition connected to the EN pin, it is possible to program the power-up threshold:

$$V_{powerup} = 1.2\left(1 + \frac{R_1}{R_2}\right)$$

1.2.7 V_{OUT} settings

By default, the STEVAL-A6983NV1 is with V_{OUT} = 5 V. However, the output voltage can be managed from 0.85 V to a higher voltage by selecting the right output partition resistors (R3 and R4):

$$V_{OUT} = \frac{R_3 + R_4}{R_4} \cdot V_{FB}$$

Where: V_{FB} is equal to 0.85 V.

1.2.8 eDesignSuite

The eDesignSuite suite software tool helps you to configure ST products for power conversion applications.

You can use it to customize a PFC controller for a specific application. Start by entering the main specifications for your design. Then, generate an automatic design or follow a sequential process to build a highly customized design.

2 How to use the board

The STEVAL-A6983NV1 is configured with A6983 LNM with adjustable V_{OUT}. The board is set to deliver a 5 V output voltage with Fsw = 400 KHz.

This board is best suited for applications where the low output ripple is preferred on every load condition.

To use the board, follow the procedure below.

Step 1. Connect the voltage supply between V_{IN} and GND connectors.

Step 2. Connect the load (power resistor or active load) between V_{OUT} and GND connectors.

Note: For Step 1 and Step 2 short wires are recommended.

Step 3. Set the supply voltage V_{IN} from 6 to 38 V.

Step 4. By default, V_{OUT} is set equal to 5 V. Increase or decrease the output power resistor or active load to reach the suitable output current (max. 3 A).

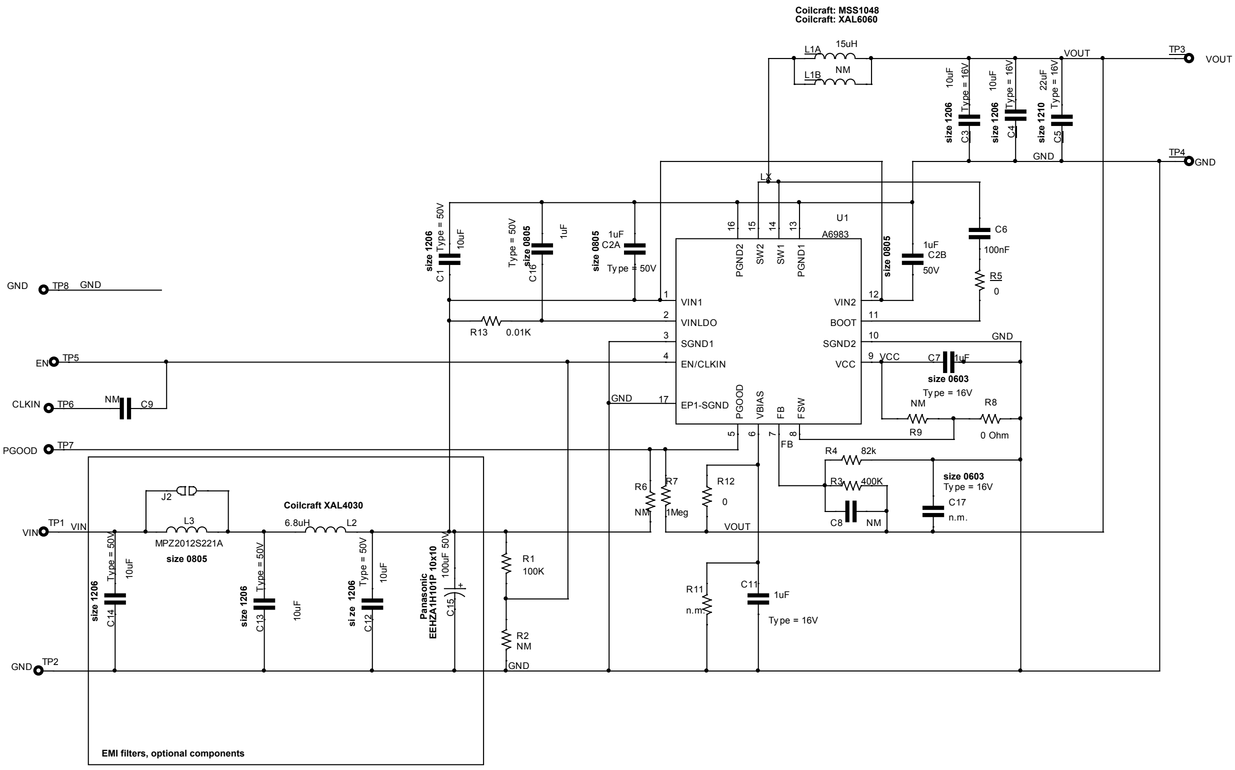
3 Application 1: V_{OUT} = 5 V, F_{SW} = 400 KHz

Application conditions:

- V_{IN} from 6.5 to 38 V
- V_{OUT} = 5 V
- F_{SW} = 0.4 MHz
- I_{OUT} = 3 A

Schematic:

Figure 3. STEVAL-A6983NV1 schematic - application 1



Bill of materials: see Section 10: Bill of materials.

3.1 Oscilloscope acquisitions for application 1

3.1.1 Power-up from EN

- Yellow = EN
- Green = inductor current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 4. V_{IN} = 6.5 V; V_{OUT}= 5 V; I_{OUT} = 2 A

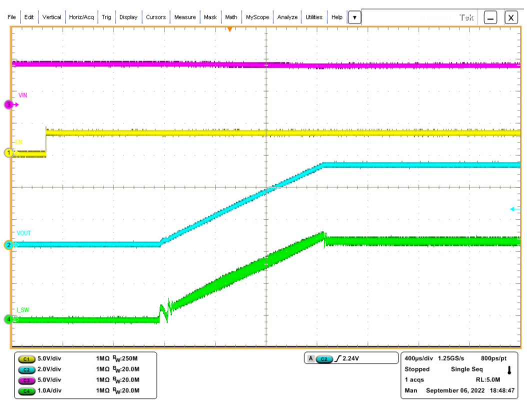


Figure 5. V_{IN} = 12 V; V_{OUT}= 5 V; I_{OUT} = 2 A

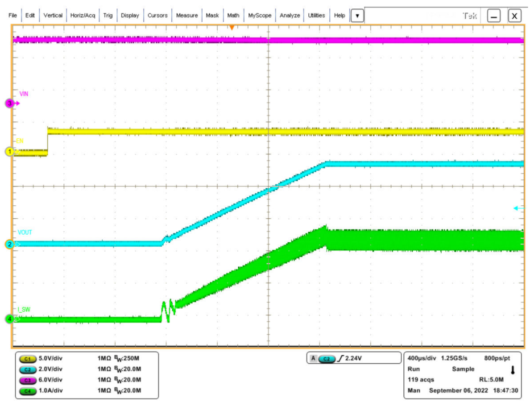


Figure 6. V_{IN} = 24 V; V_{OUT}= 5 V; I_{OUT} = 2 A

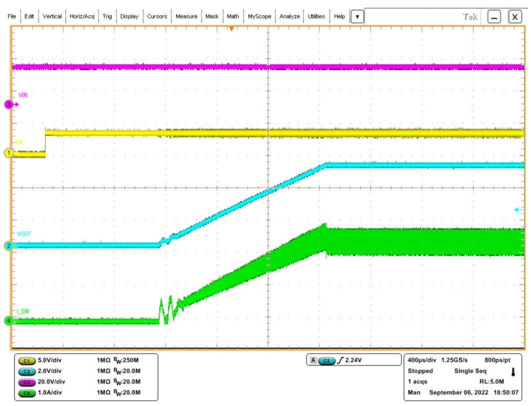
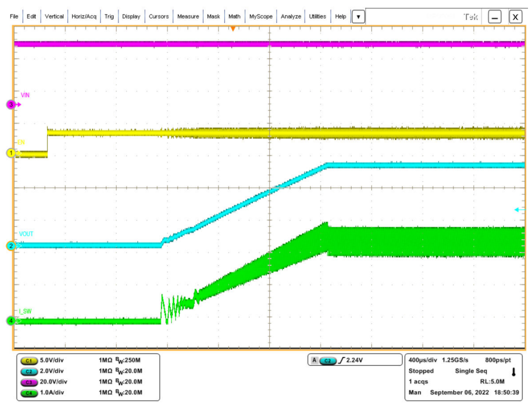


Figure 7. V_{IN} = 38 V; V_{OUT}= 5 V; I_{OUT} = 2 A



3.1.2 Power-up from V_{IN}

- Yellow = EN
- Green = inductor current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 8. V_{IN} = 6.5 V; V_{OUT}= 5 V; I_{OUT} = 2 A

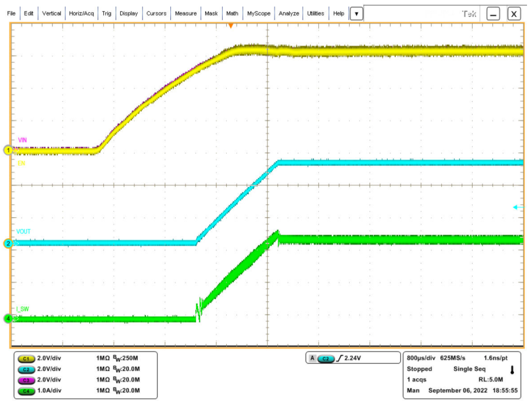


Figure 9. V_{IN} = 12 V; V_{OUT}= 5 V; I_{OUT} = 2 A

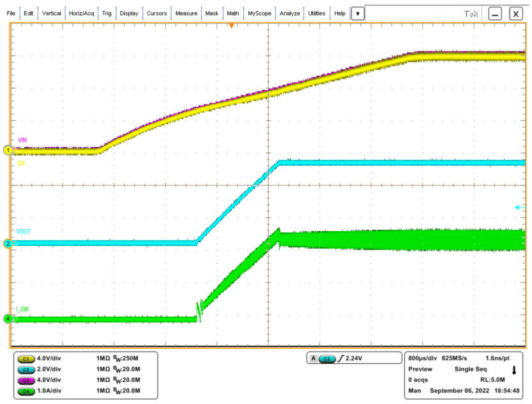


Figure 10. V_{IN} = 24 V; V_{OUT}= 5 V; I_{OUT} = 2 A

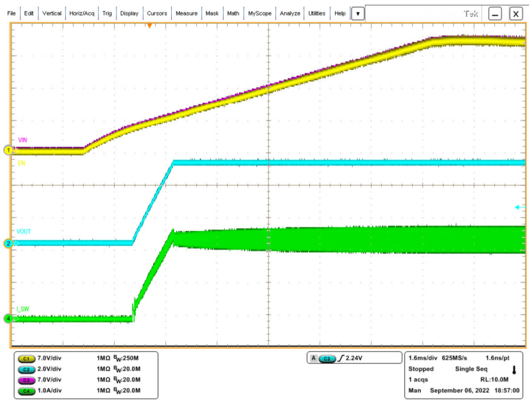
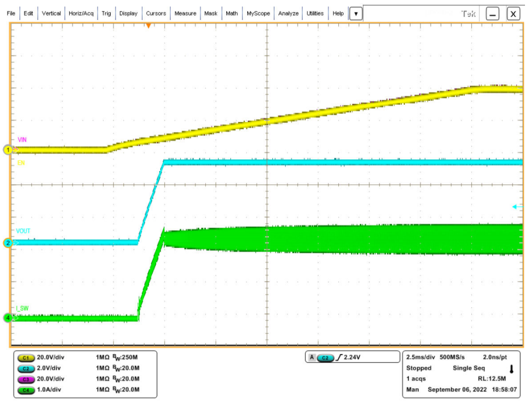


Figure 11. V_{IN} = 38 V; V_{OUT}= 5 V; I_{OUT} = 2 A



3.1.3 V_{OUT} ripple for no load operation

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 5 V)
- Violet = switching node

Figure 12. V_{IN} = 6.5 V; V_{OUT} = 5 V; no load; V_{OUT}, RIPPLE < 10 mV

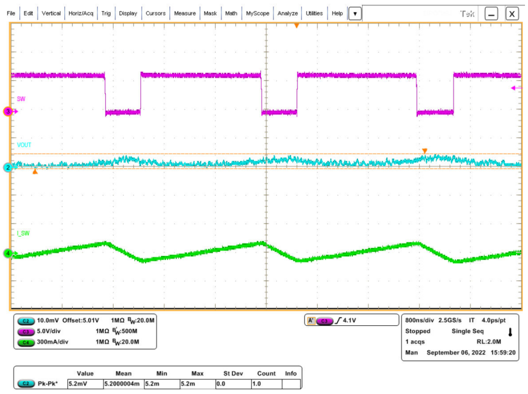


Figure 13. V_{IN} = 12 V; V_{OUT} = 5 V; no load; V_{OUT}, RIPPLE < 10 mV

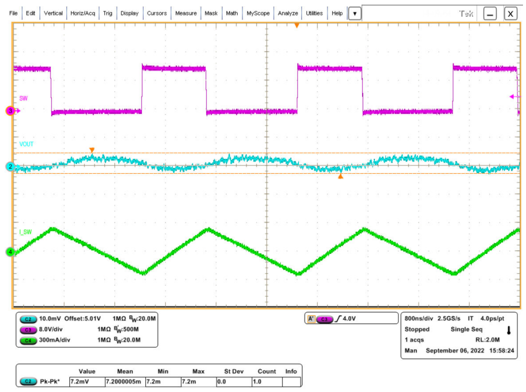


Figure 14. V_{IN} = 24 V; V_{OUT} = 5 V; no load; V_{OUT}, RIPPLE < 10 mV

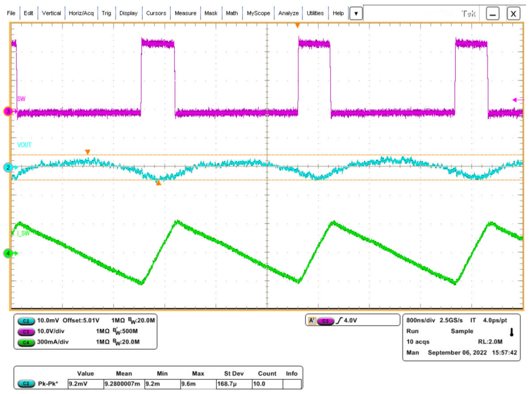
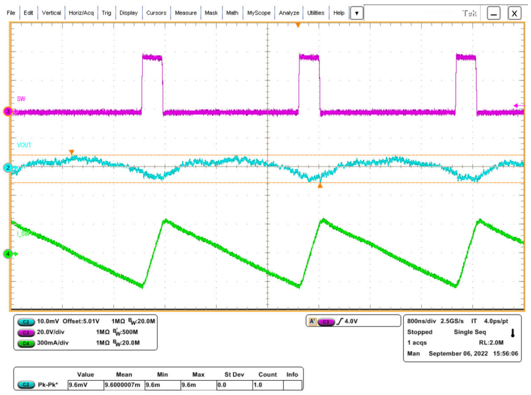


Figure 15. V_{IN} = 38 V; V_{OUT} = 5 V; no load; V_{OUT}, RIPPLE < 10 mV



3.1.4 V_{OUT} ripple for I_{OUT} = 3 A

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 5 V)
- Violet = switching node

Figure 16. V_{IN} = 6.5 V; V_{OUT} = 5 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 10 mV

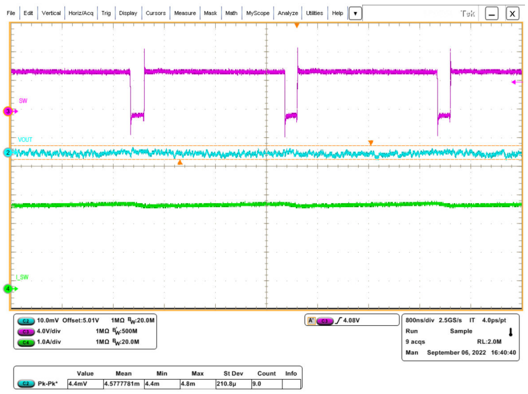


Figure 17. V_{IN} = 12 V; V_{OUT} = 5 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 10 mV

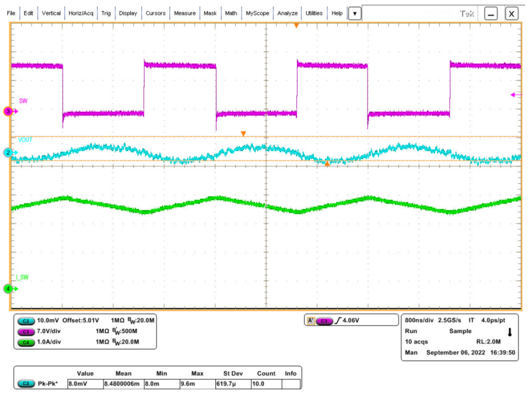


Figure 18. V_{IN} = 24 V; V_{OUT} = 5 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 10 mV

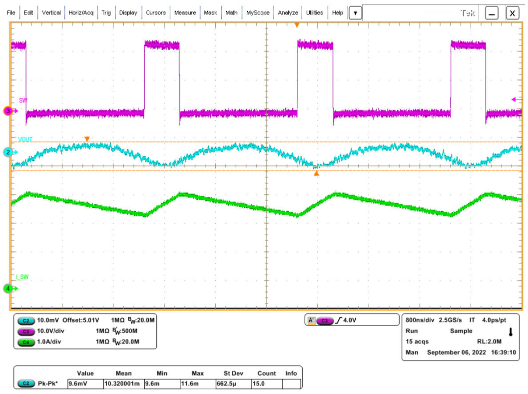
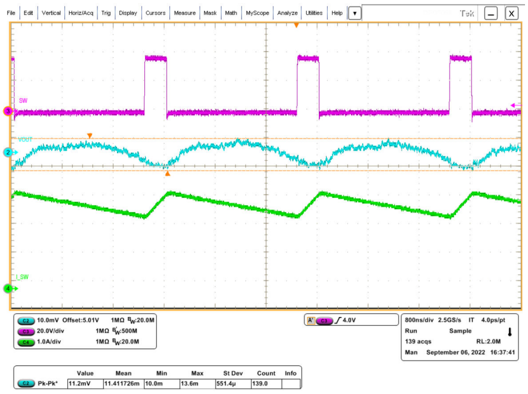


Figure 19. V_{IN} = 38 V; V_{OUT} = 5 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 15 mV



3.1.5 Load transition

- I_{OUT} from 0.3 to 3 A
- I_{SLOPE} = 0.1 A/µs
- Green = output current
- Blue = V_{OUT} ripple (DC offset = 5 V)
- Violet = switching node

Figure 20. V_{IN} = 8.5 V; V_{OUT} = 5 V; $V_{OUT\ MAX}$ = 5.145 A; $V_{OUT\ MIN}$ = 4.853 A

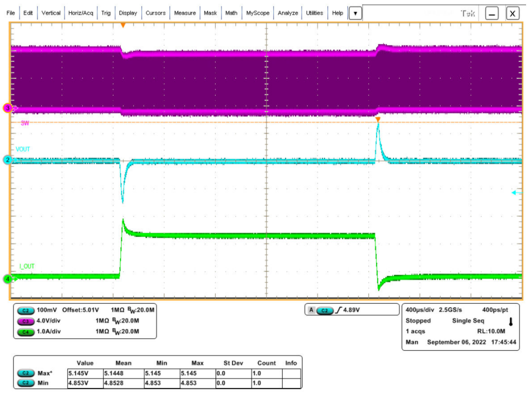


Figure 21. V_{IN} = 12 V; V_{OUT} = 5 V; $I_{OUT\ MAX}$ = 5.149 A; $I_{OUT\ MIN}$ = 4.857 A

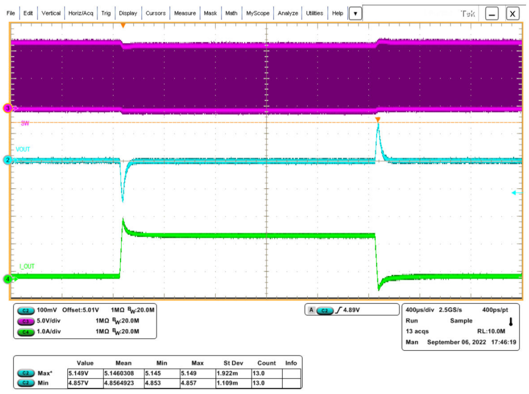


Figure 22. V_{IN} = 24 V; V_{OUT} = 5 V; $V_{OUT\ MAX}$ = 5.145 A; $V_{OUT\ MIN}$ = 4.853 A

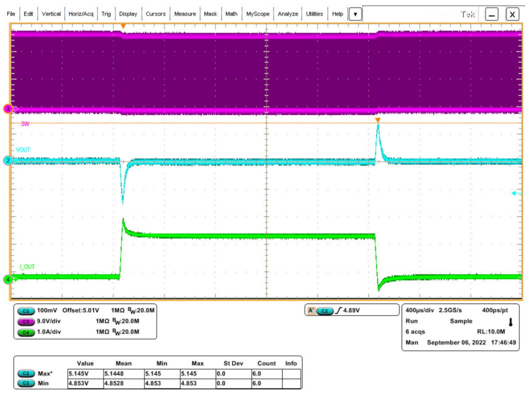
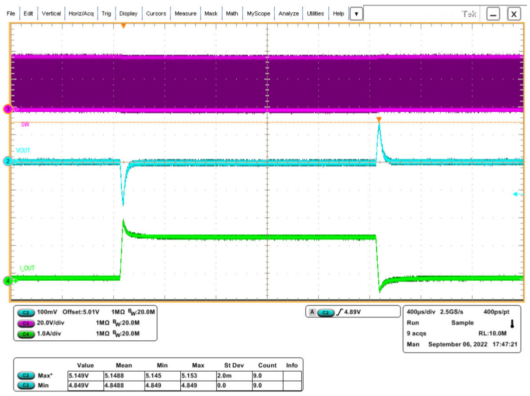


Figure 23. V_{IN} = 38 V; V_{OUT} = 5 V; $I_{OUT\ MAX}$ = 5.149 A; $V_{OUT\ MIN}$ = 4.849 A



3.1.6 Performance curves

Figure 24. Efficiency over I_{OUT}

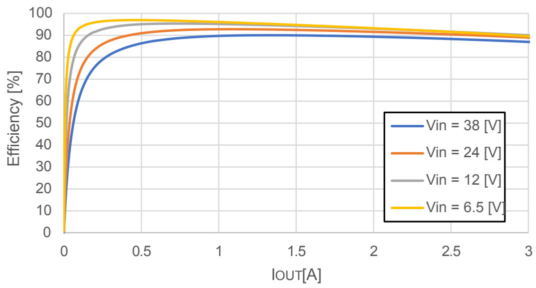


Figure 25. Efficiency over I_{OUT} log scale

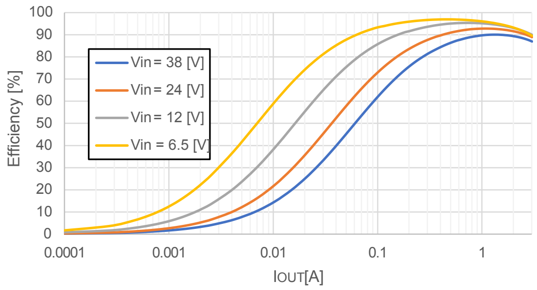


Figure 26. Power losses over I_{OUT}

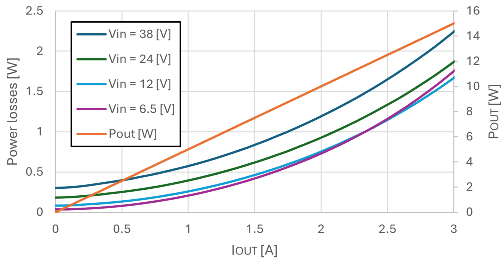
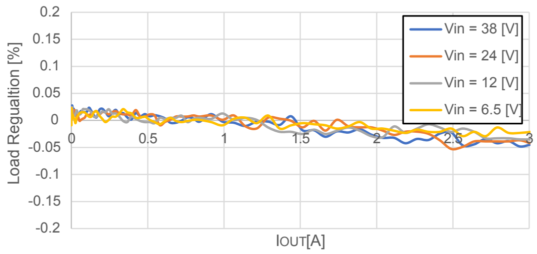


Figure 27. Load regulation



3.2 Thermal acquisitions

The measures have been acquired at the following conditions:

1. T_{AMB} = 25°C
2. I_{OUT} = 3 A

The measures have been acquired leaving the device with the reported V_{IN} and I_{OUT} for more than 5 minutes.

The camera selected to acquire the measures is the FLIR ETS320.

Figure 28. V_{IN} = 6.5 V; V_{OUT} = 5 V

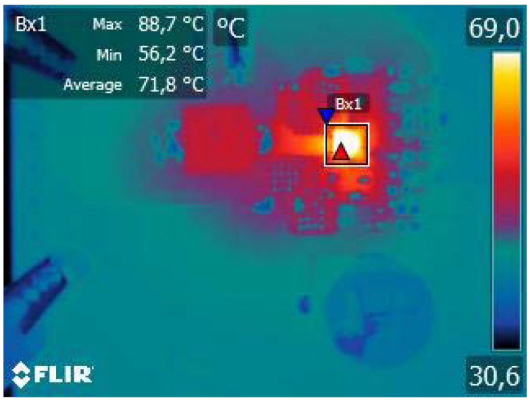


Figure 29. V_{IN} = 12 V; V_{OUT} = 5 V

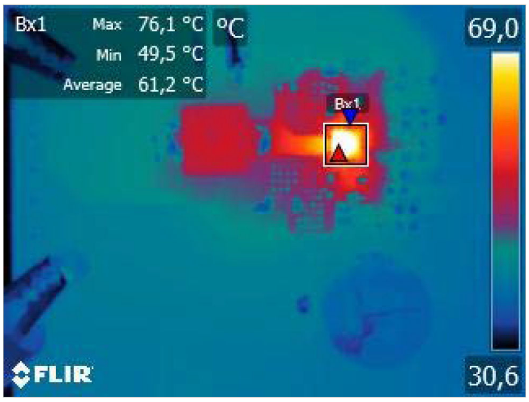


Figure 30. V_{IN} = 24 V; V_{OUT} = 5 V

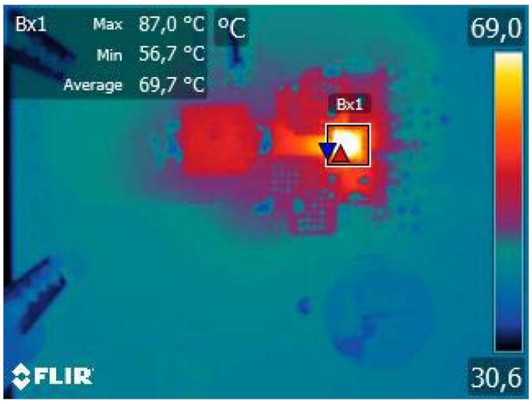
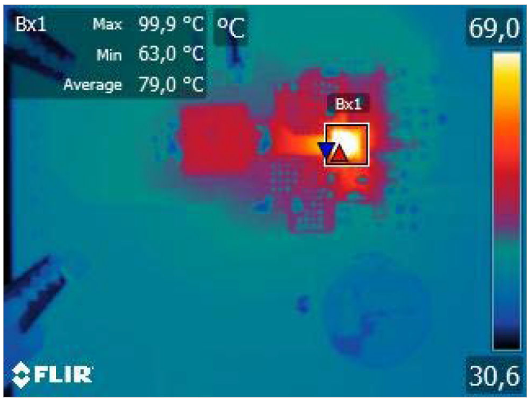


Figure 31. V_{IN} = 38 V; V_{OUT} = 5 V



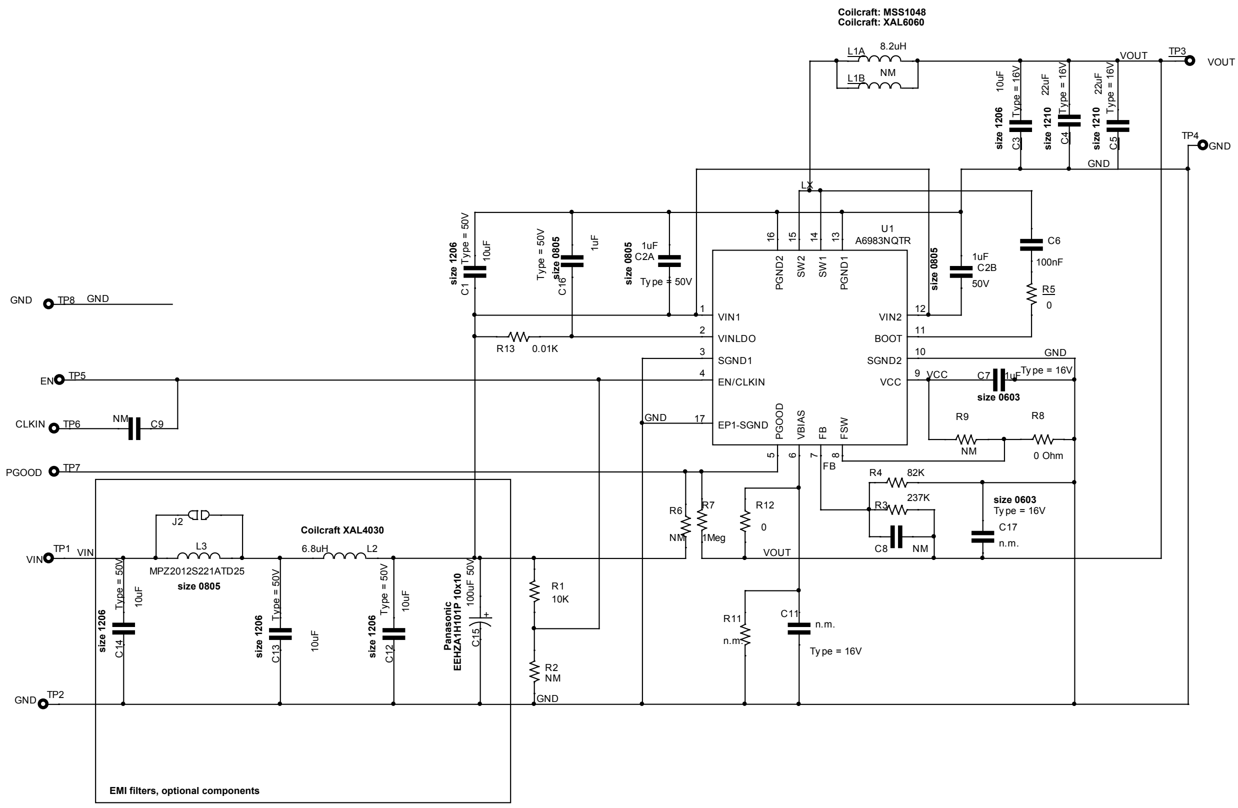
4 Application 2: V_{OUT} = 3.3 V, F_{SW} = 400 KHz

Application conditions:

- V_{IN} from 6.5 to 38 V
- V_{OUT} = 3.3 V
- F_{SW} = 0.4 MHz
- I_{OUT} = 3 A

Schematic:

Figure 32. STEVAL-A6983NV1 schematic - application 2



Bill of materials: see Section 10: Bill of materials.

4.1 Oscilloscope acquisitions for application 2

4.1.1 Power-up from EN

- Yellow = EN
- Green = inductor current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 33. Power-up from EN: V_{IN} = 6.5 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A

Figure 34. Power-up from EN: V_{IN} = 12 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A

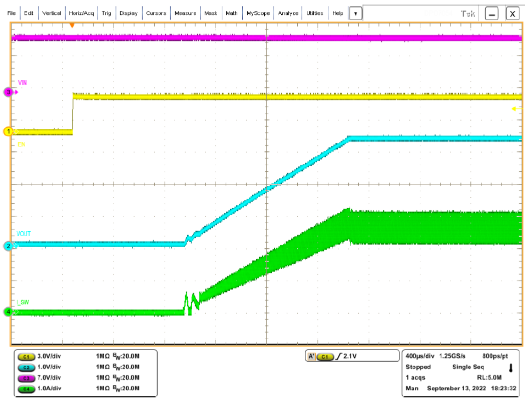


Figure 35. Power-up from EN: V_{IN} = 24 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A

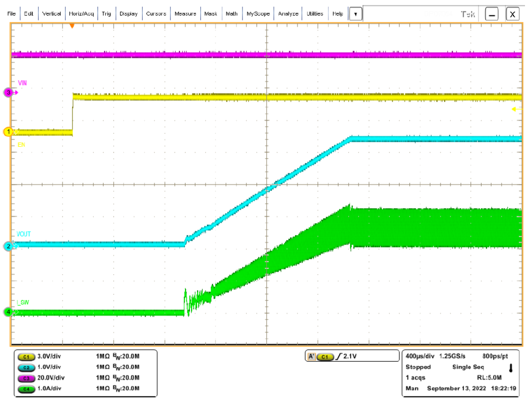


Figure 36. Power-up from EN: V_{IN} = 38 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A

4.1.2 Power-up from V_{IN}

- Yellow = EN
- Green = inductor current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 37. V_{IN} = 6.5 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A

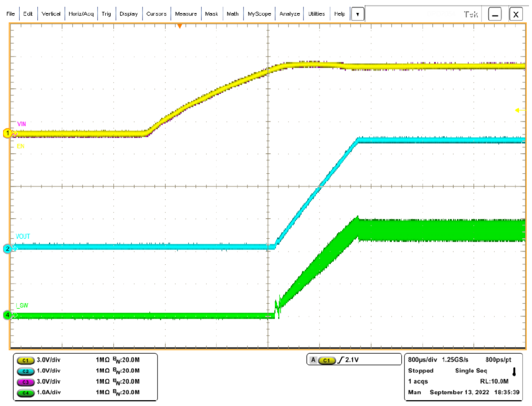


Figure 38. V_{IN} = 12 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A

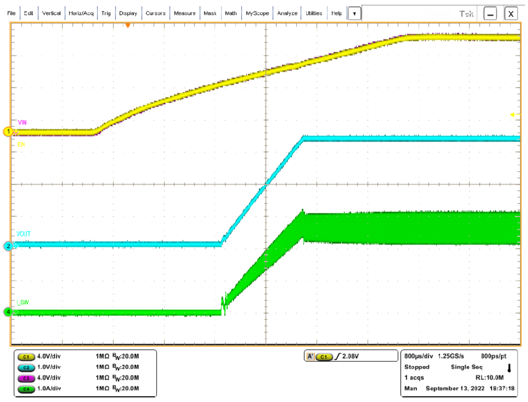


Figure 39. V_{IN} = 24 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A

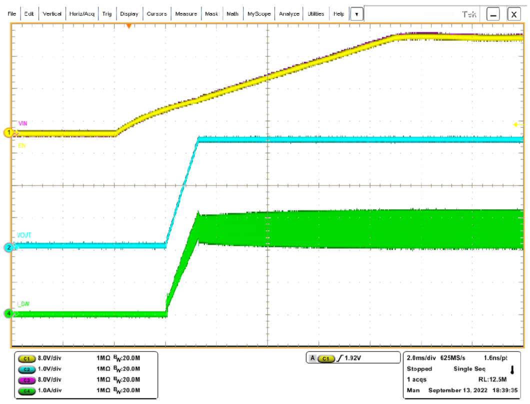
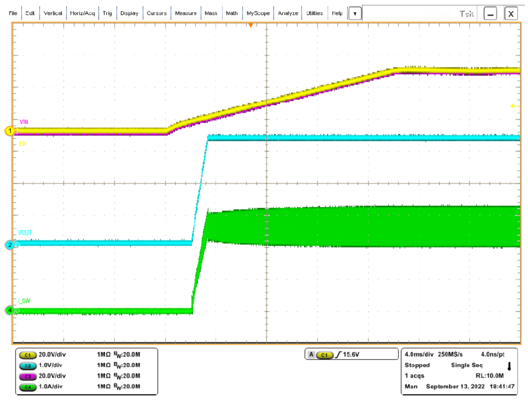


Figure 40. V_{IN} = 38 V; V_{OUT}= 3.3 V; I_{OUT} = 3 A



4.1.3 V_{OUT} ripple for no load operation

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 3.3 V)
- Violet = switching node

Figure 41. V_{IN} = 6.5 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 10 mV

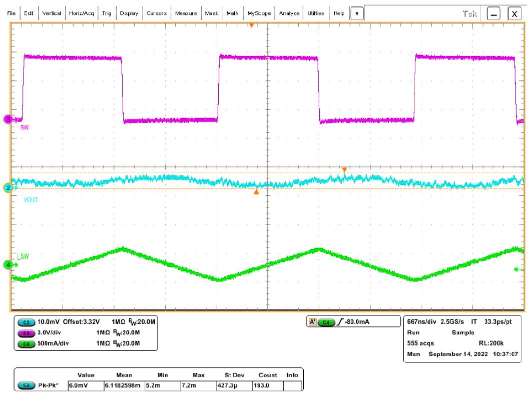


Figure 42. V_{IN} = 12 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 10 mV

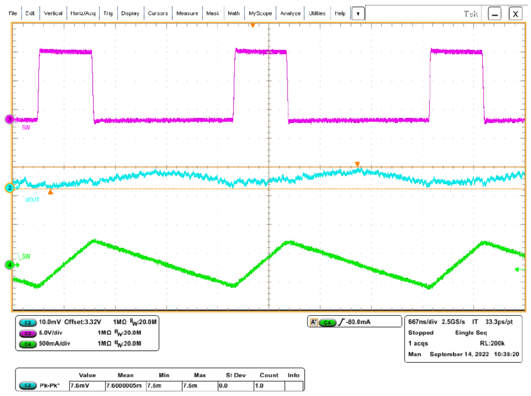


Figure 43. V_{IN} = 24 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 10 mV

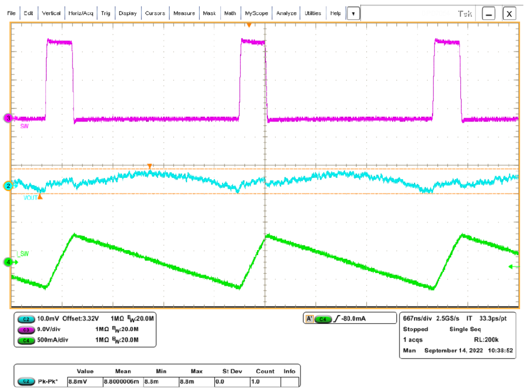
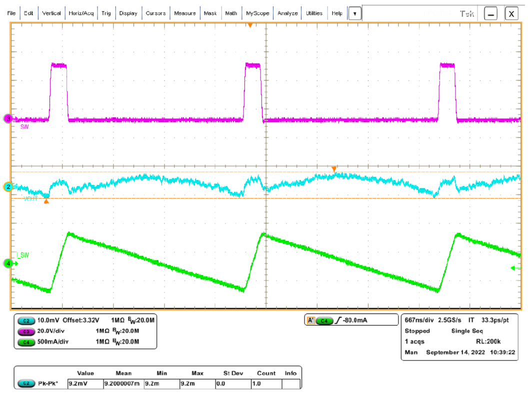


Figure 44. V_{IN} = 38 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 10 mV



4.1.4 V_{OUT} ripple for I_{OUT} = 3 A

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 3.3 V)
- Violet = switching node

Figure 45. V_{IN} = 6.5 V; V_{OUT} = 3.3 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 10 mV

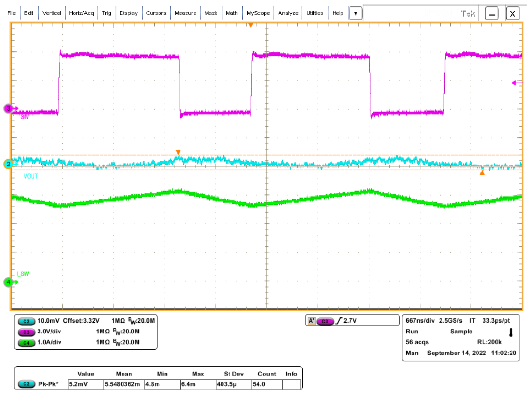


Figure 46. V_{IN} = 12 V; V_{OUT} = 3.3 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 10 mV

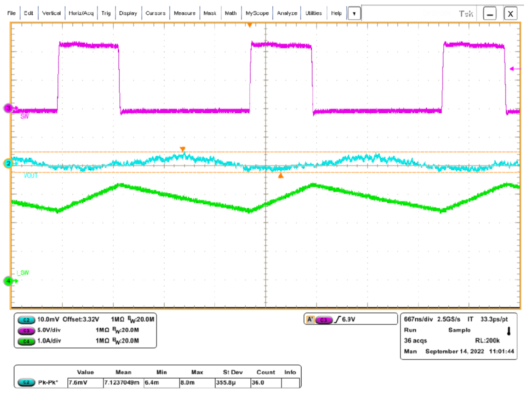


Figure 47. V_{IN} = 24 V; V_{OUT} = 3.3 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 10 mV

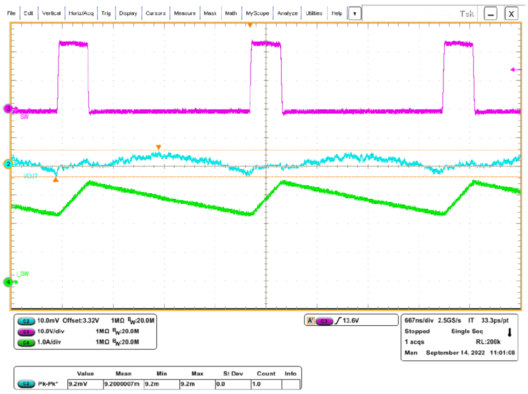
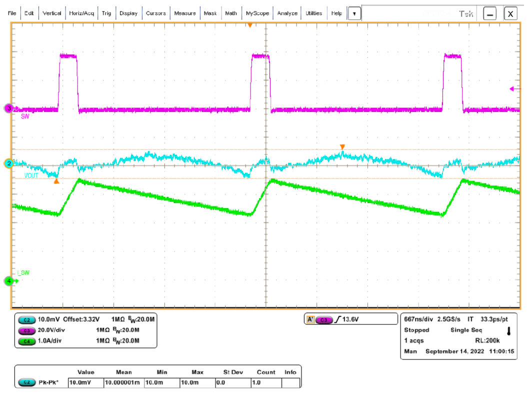


Figure 48. V_{IN} = 38 V; V_{OUT} = 3.3 V; I_{OUT} = 3 A; V_{OUT}, RIPPLE < 15 mV



4.1.5 Load transition

- I_{OUT} from 0.3 to 3 A
- I_{SLOPE} = 0.1 A/µs
- Green = output current
- Blue = V_{OUT} ripple (DC offset = 5 V)
- Violet = switching node

Figure 49. V_{IN} = 6.5 V; V_{OUT} = 3.3 V; $I_{OUT\ MAX}$ = 3.407 A; $I_{OUT\ MIN}$ = 3.211 A

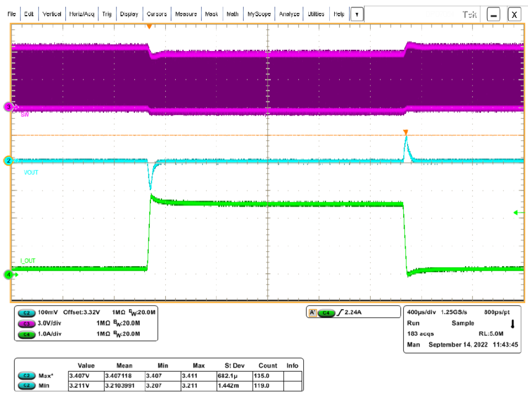


Figure 50. V_{IN} = 12 V; V_{OUT} = 5 V; $I_{OUT\ MAX}$ = 3.407 A; $I_{OUT\ MIN}$ = 3.211 A

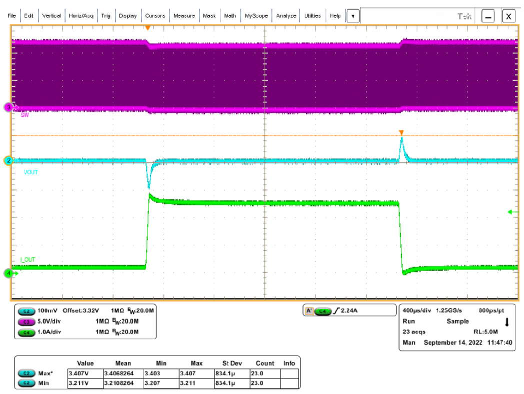


Figure 51. V_{IN} = 24 V; V_{OUT} = 5 V; $I_{OUT\ MAX}$ = 3.407 A; $I_{OUT\ MIN}$ = 3.207 A

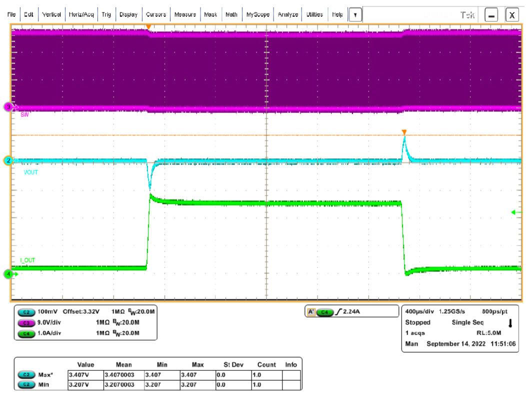


Figure 52. V_{IN} = 38 V; V_{OUT} = 5 V; $I_{OUT\ MAX}$ = 3.407 A; $I_{OUT\ MIN}$ = 3.207 A

4.1.6 Performance curves

Figure 53. Efficiency over I_{OUT}

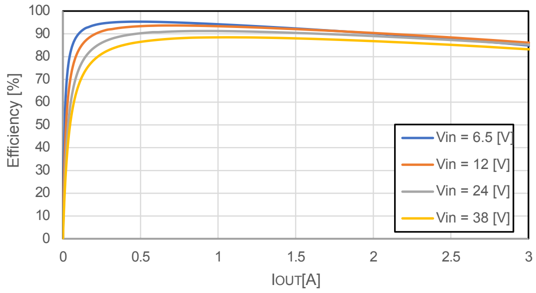


Figure 54. Efficiency over I_{OUT} log scale

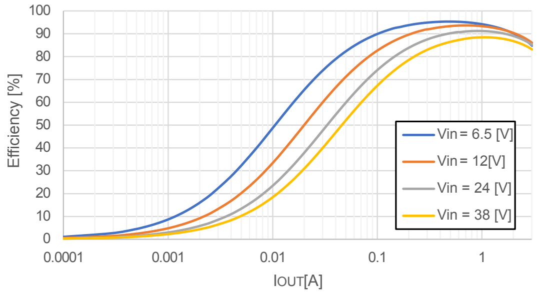


Figure 55. Power losses over I_{OUT}

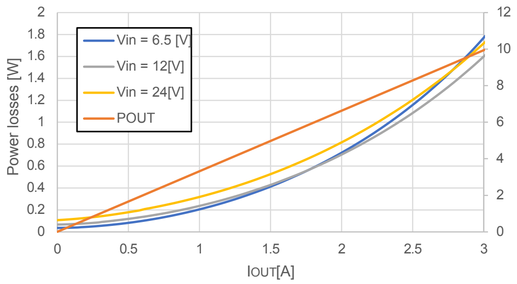
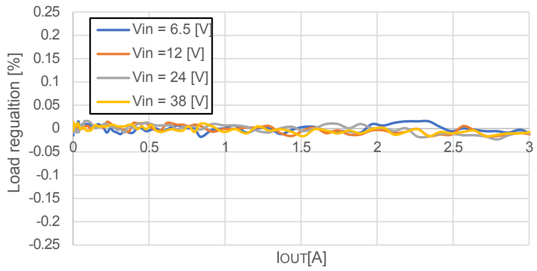


Figure 56. Load regulation



4.2 Thermal acquisitions

The measures have been acquired at the following conditions:

1. T_{AMB} = 25°C
2. I_{OUT} = 3 A

The measures have been acquired leaving the device with the reported V_{IN} and I_{OUT} for more than 5 minutes.

The camera selected to acquire the measures is the FLIR ETS320.

Figure 57. V_{IN} = 6.5 V; V_{OUT} = 3.3 V

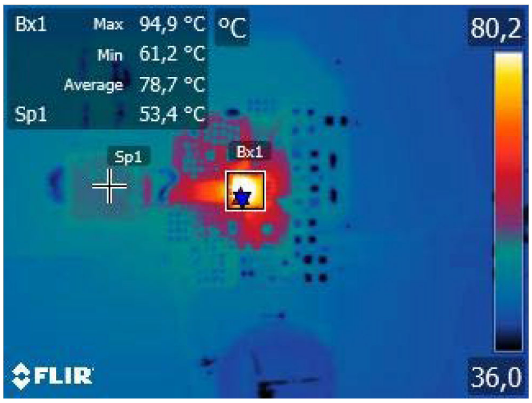


Figure 58. V_{IN} = 12 V; V_{OUT} = 3.3 V

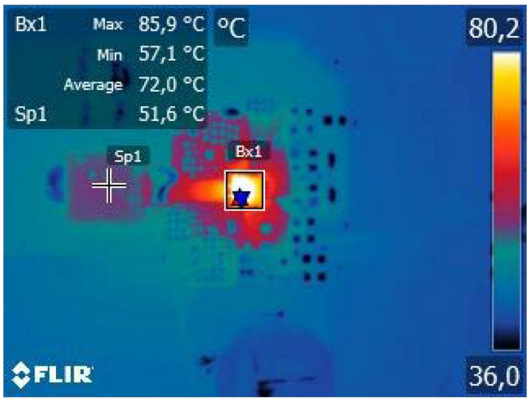


Figure 59. V_{IN} = 24 V; V_{OUT} = 3.3 V

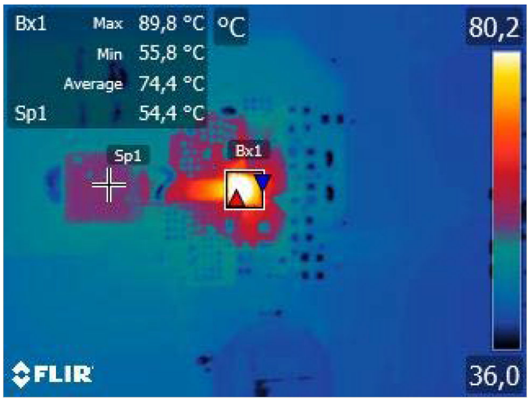
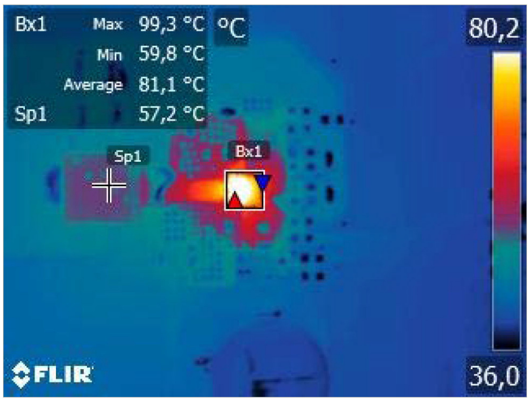


Figure 60. V_{IN} = 38 V; V_{OUT} = 3.3 V



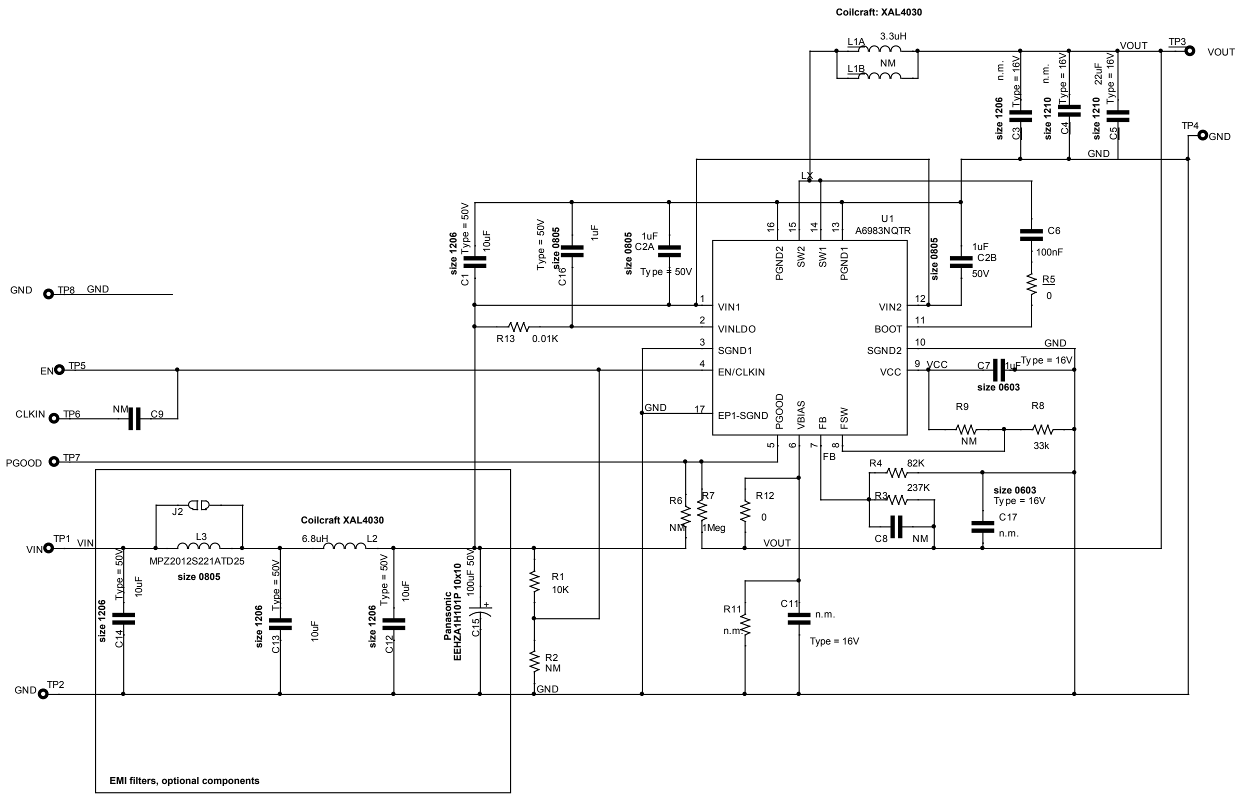
5 Application 3: V_{OUT} = 3.3 V, F_{SW} = 2 MHz

Application conditions:

- V_{IN} from 6.5 to 24 V
- V_{OUT} = 3.3 V
- F_{SW} = 2.0 MHz
- I_{OUT} = 2 A

Schematic:

Figure 61. STEVAL-A6983NV1 schematic - application 3



Bill of materials: see Section 10: Bill of materials.

5.1 Oscilloscope acquisitions for application 3

5.1.1 Power-up from EN

- Yellow = EN
- Green = output current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 62. Power-up from EN: V_{IN} = 6.5 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A

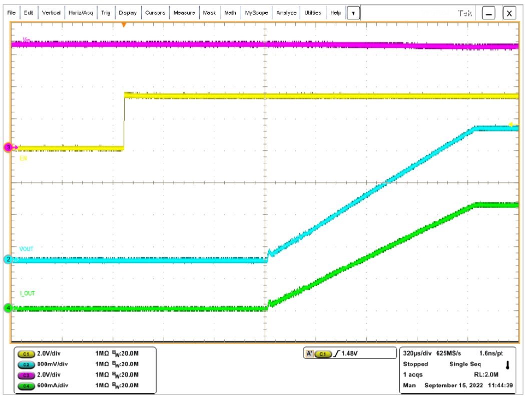


Figure 63. Power-up from EN: V_{IN} = 12 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A

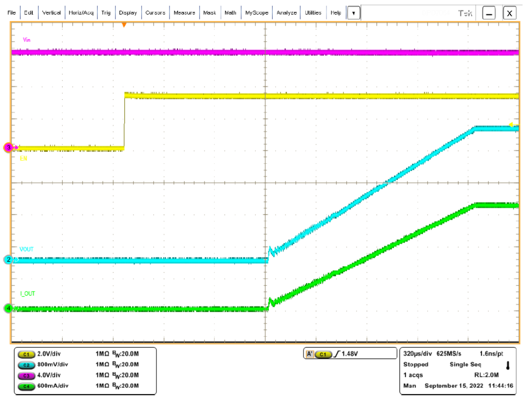


Figure 64. Power-up from EN: V_{IN} = 15.5 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A

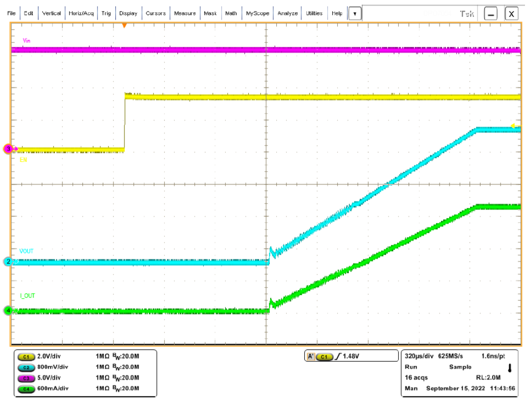
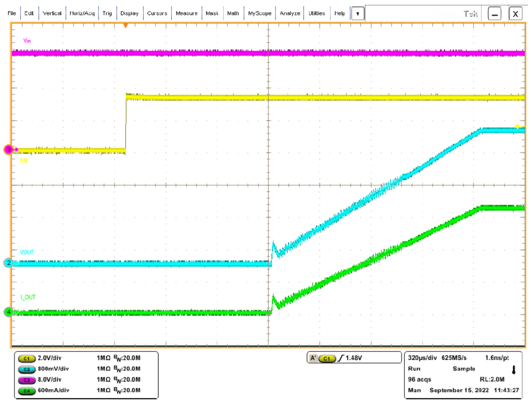


Figure 65. Power-up from EN: V_{IN} = 24 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A



5.1.2 Power-up from V_{IN}

- Yellow = EN
- Green = output current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 66. V_{IN} = 6.5 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A

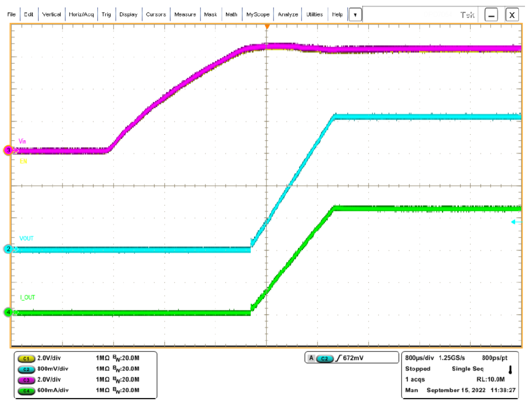


Figure 67. V_{IN} = 12 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A

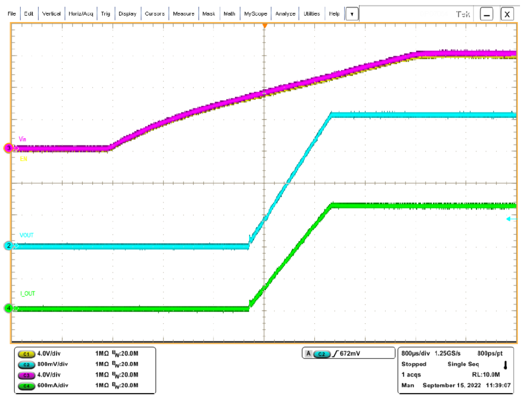


Figure 68. V_{IN} = 15.5 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A

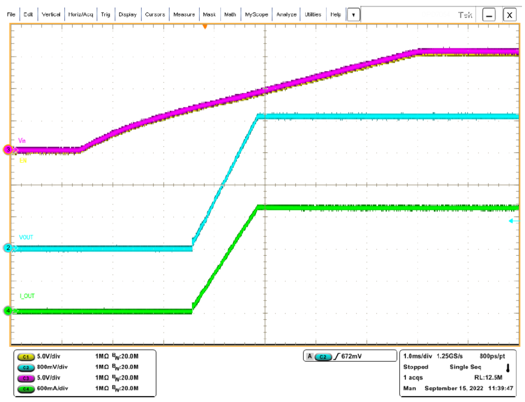
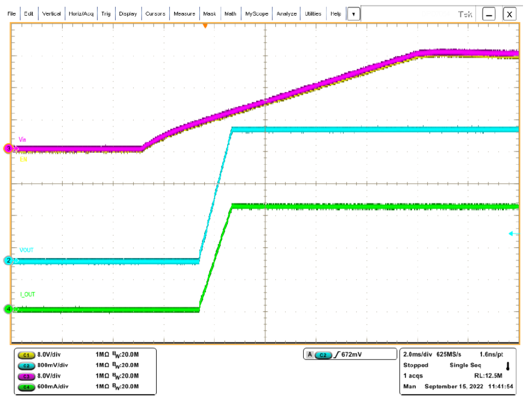


Figure 69. V_{IN} = 24 V; V_{OUT}= 3.3 V; I_{OUT} = 2 A



5.1.3 V_{OUT} ripple for no load operation

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 3.3 V)
- Violet = switching node

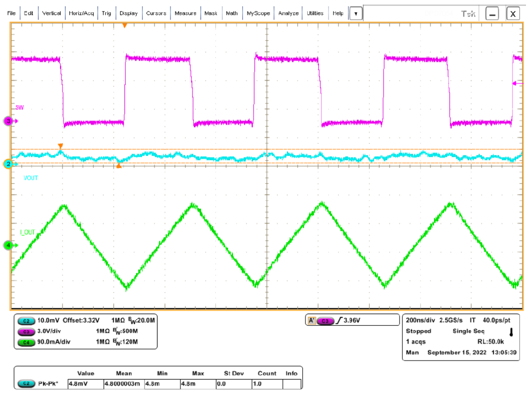


Figure 70. V_{IN} = 6.5 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 6 mV

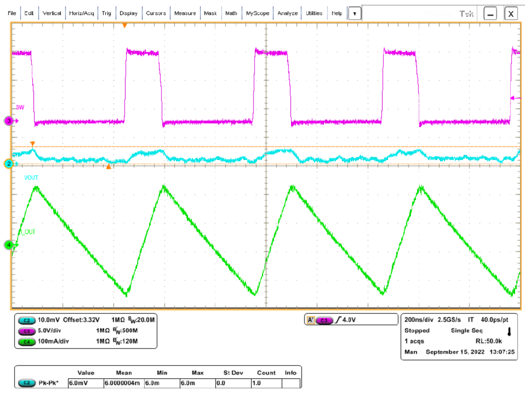


Figure 71. V_{IN} = 12 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 8 mV

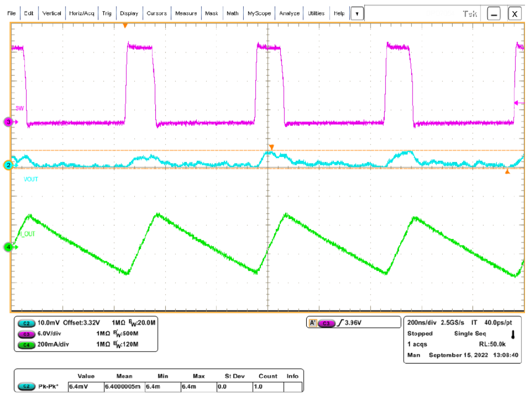


Figure 72. V_{IN} = 15.5 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 8 mV

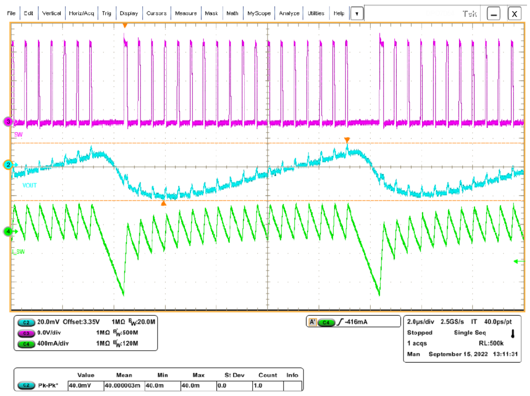


Figure 73. V_{IN} = 24 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 50 mV

5.1.4 V_{OUT} ripple for I_{OUT} = 2 A

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 3.3 V)
- Violet = switching node

Figure 74. V_{IN} = 6.5 V; V_{OUT} = 3.3 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 10 mV

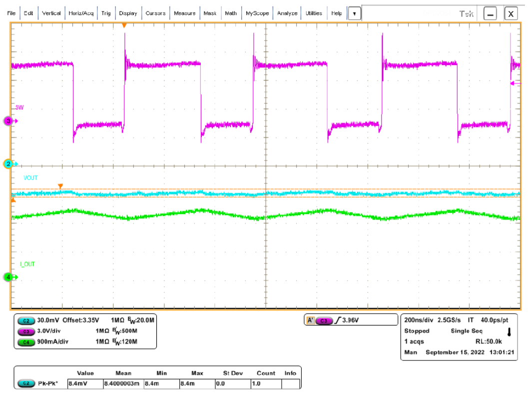


Figure 75. V_{IN} = 12 V; V_{OUT} = 3.3 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 10 mV

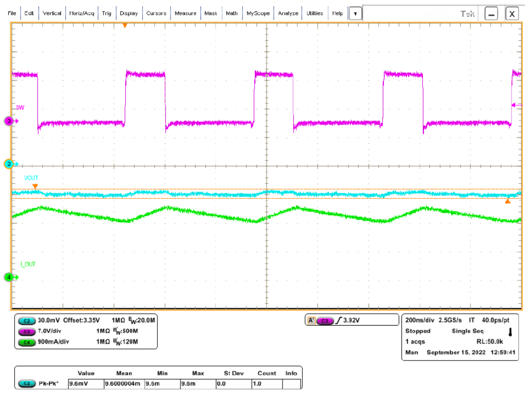


Figure 76. V_{IN} = 15.5 V; V_{OUT} = 3.3 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 10 mV

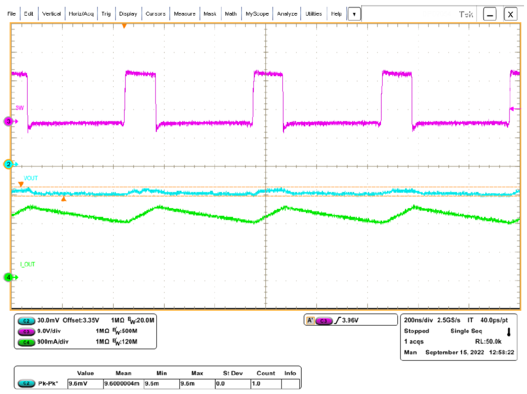
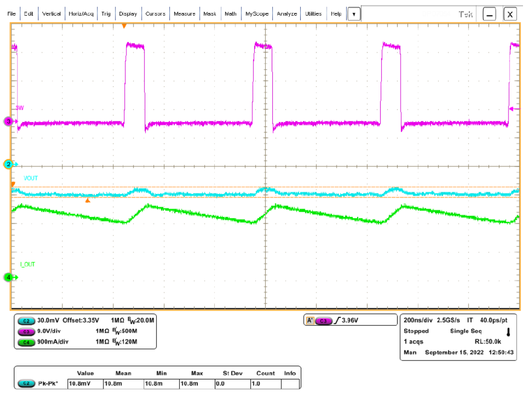


Figure 77. V_{IN} = 24 V; V_{OUT} = 3.3 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 15 mV



5.1.5 Load transition

- I_{OUT} from 0.3 to 3 A
- I_{SLOPE} = 0.1 A/µs
- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 3.3 V)
- Violet = switching node

Figure 78. V_{IN} = 6.5 V; V_{OUT} = 3.3 V; $V_{OUT\ MAX}$ = 3.407 A; $V_{OUT\ MIN}$ = 3.211 A

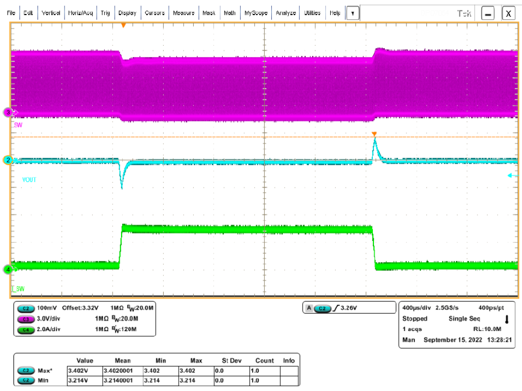


Figure 79. V_{IN} = 12 V; V_{OUT} = 3.3 V; $V_{OUT\ MAX}$ = 3.406 A; $V_{OUT\ MIN}$ = 3.214 A

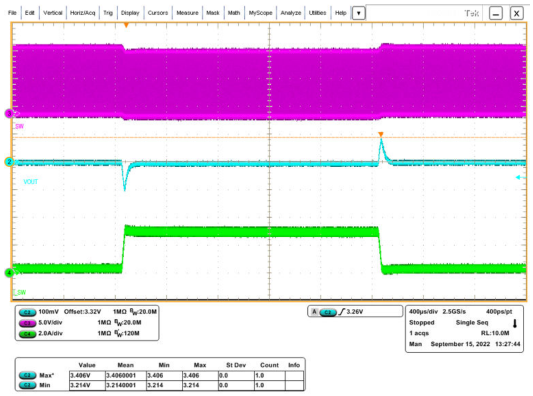
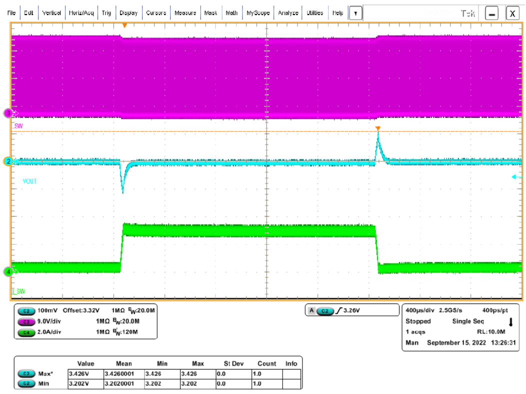


Figure 80. V_{IN} = 15.5 V; V_{OUT} = 3.3 V; $V_{OUT\ MAX}$ = 3.406 A; $V_{OUT\ MIN}$ = 3.214 A

Figure 81. V_{IN} = 24 V; V_{OUT} = 3.3 V; $V_{OUT\ MAX}$ = 3.426 A; $V_{OUT\ MIN}$ = 3.202 A



5.1.6 Performance curves

Figure 82. Efficiency over I_{OUT}

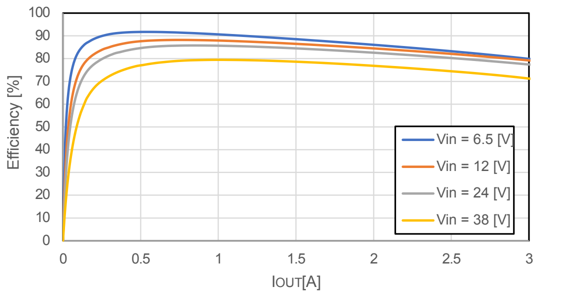


Figure 83. Efficiency over I_{OUT} log scale

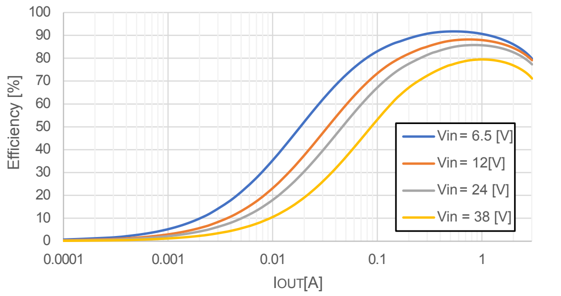


Figure 84. Power losses over I_{OUT}

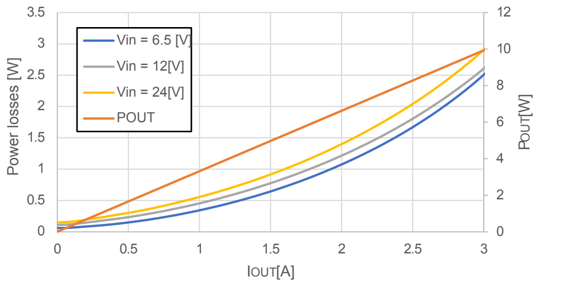
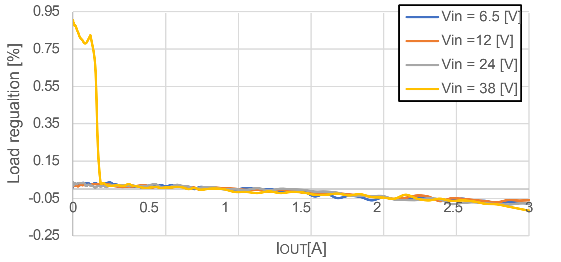


Figure 85. Load regulation



5.2 Thermal acquisitions

The measures have been acquired at the following conditions:

1. T_{AMB} = 25°C
2. I_{OUT} = 2 A

The measures have been acquired leaving the device with the reported V_{IN} and I_{OUT} for more than 5 minutes.

The camera selected to acquire the measures is the FLIR ETS320.

Figure 86. V_{IN} = 6.5 V; V_{OUT} = 3.3 V

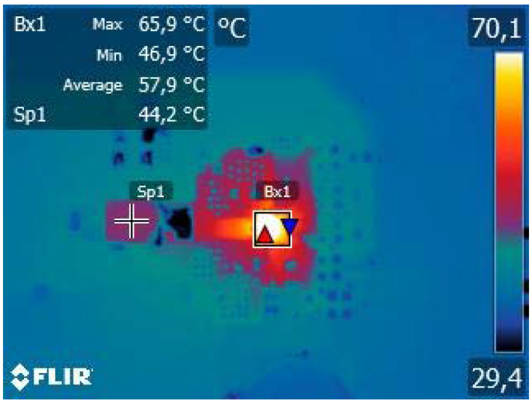


Figure 87. V_{IN} = 12 V; V_{OUT} = 3.3 V

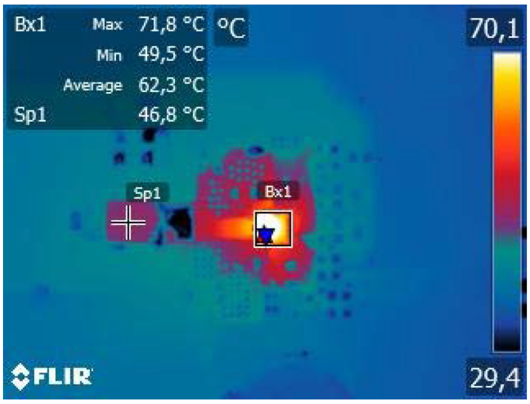


Figure 88. V_{IN} = 15.5 V; V_{OUT} = 3.3 V

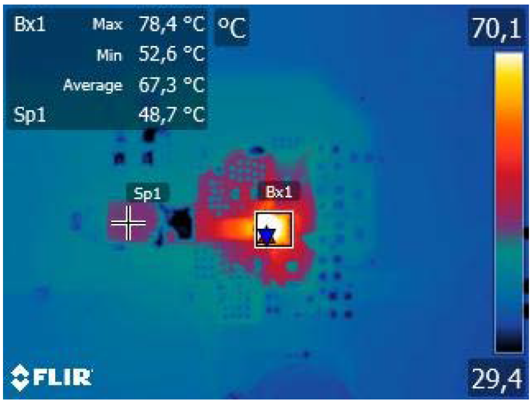
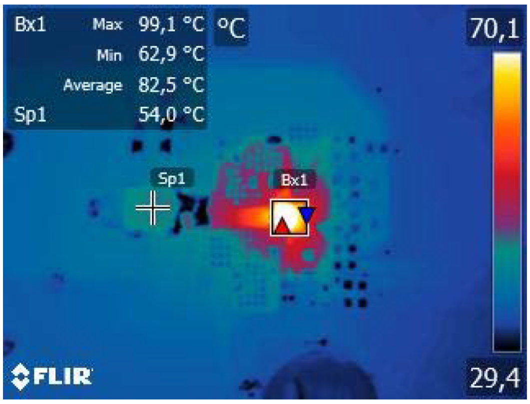


Figure 89. V_{IN} = 24 V; V_{OUT} = 3.3 V



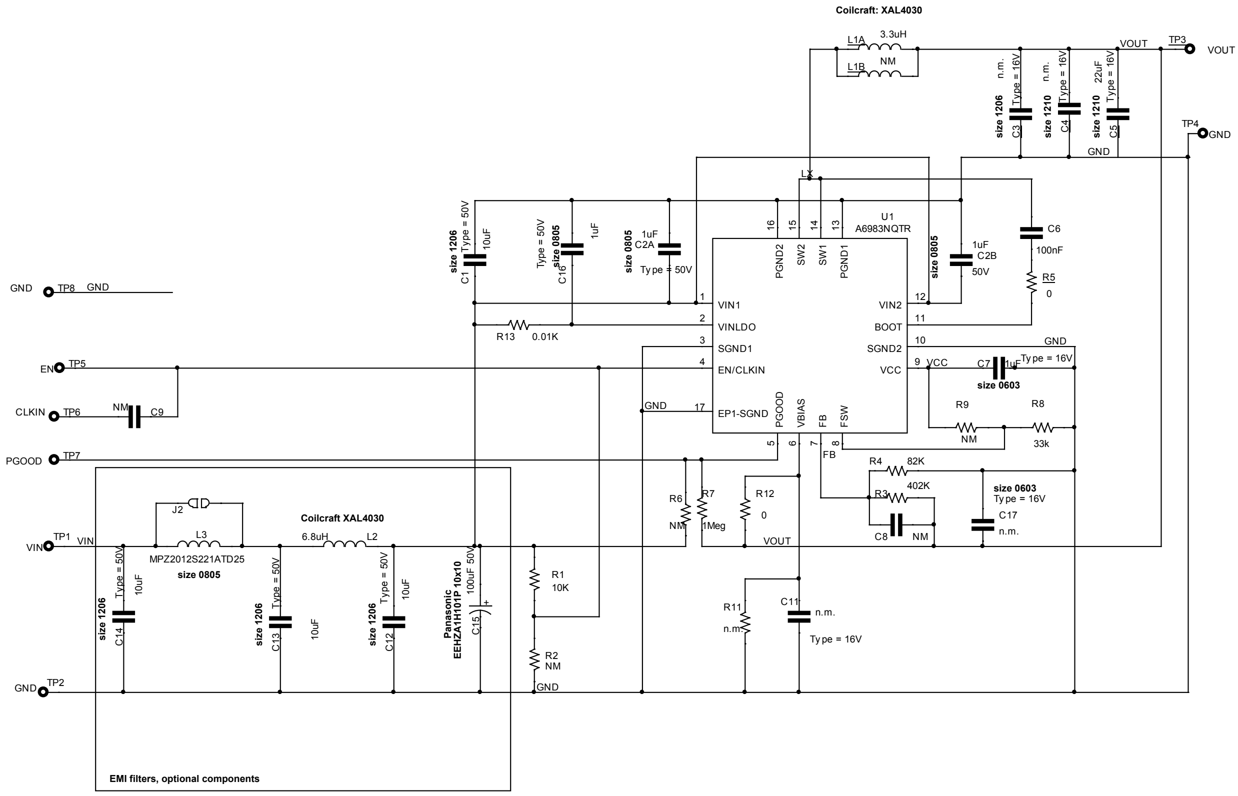
6 Application 4: V_{OUT} = 5 V, F_{SW} = 2 MHz

Application conditions:

- V_{IN} from 6.5 to 24 V
- V_{OUT} = 5.0 V
- F_{SW} = 2.0 MHz
- I_{OUT} = 2 A

Schematic:

Figure 90. STEVAL-A6983NV1 schematic - application 4



Bill of materials: see Section 10: Bill of materials.

6.1 Oscilloscope acquisitions for application 4

6.1.1 Power-up from EN

- Yellow = EN
- Green = output current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 91. Power-up from EN: V_{IN} = 6.5 V; V_{OUT}= 5 V

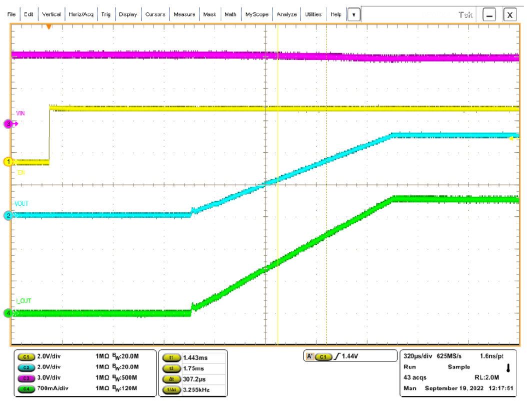


Figure 92. Power-up from EN: V_{IN} = 8.5 V; V_{OUT}= 5 V

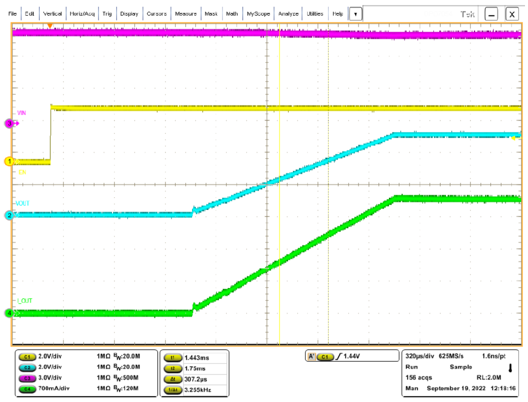


Figure 93. Power-up from EN: V_{IN} = 12 V; V_{OUT}= 5 V

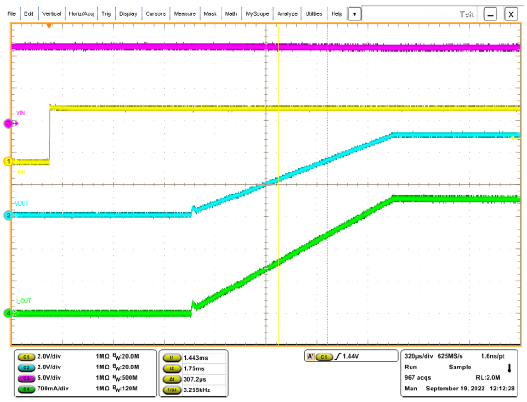
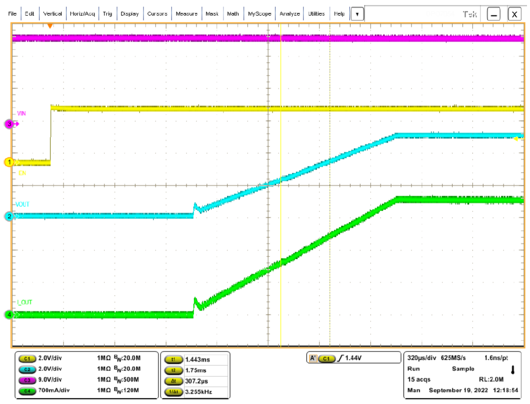


Figure 94. Power-up from EN: V_{IN} = 24 V; V_{OUT}= 5 V



6.1.2 Power-up from V_{IN}

- Yellow = EN
- Green = I_{OUT} current
- Blue = V_{OUT}
- Violet = V_{IN}

Figure 95. V_{IN} = 6.5 V; V_{OUT}= 5 V; I_{OUT} = 2.5 A

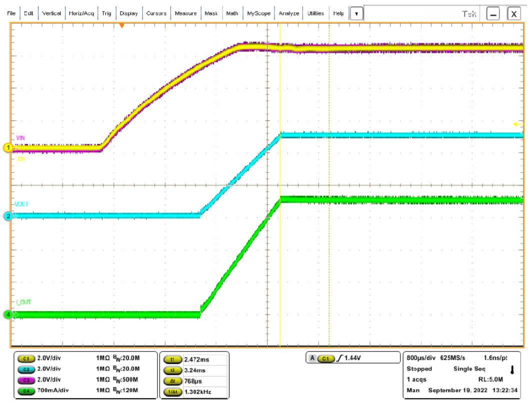


Figure 96. V_{IN} = 8.5 V; V_{OUT}= 5 V; I_{OUT} = 2.5 A

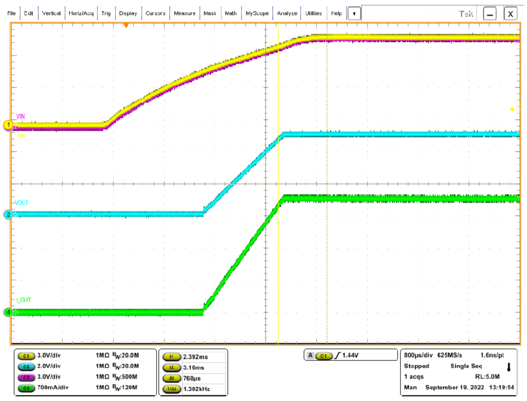


Figure 97. V_{IN} = 12 V; V_{OUT}= 5 V; I_{OUT} = 2.5 A

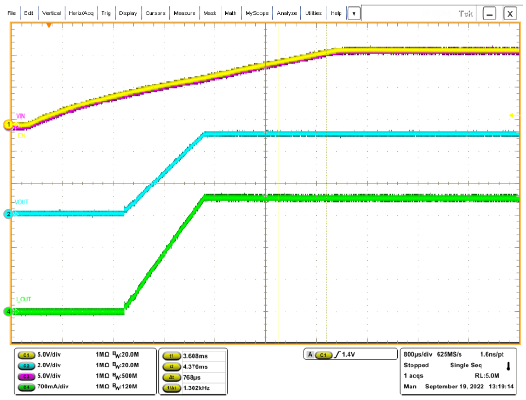
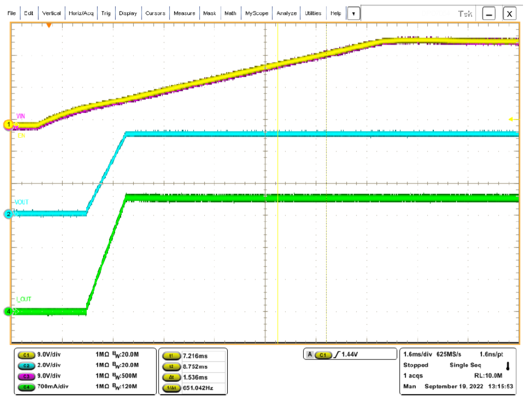


Figure 98. V_{IN} = 24 V; V_{OUT}= 5 V; I_{OUT} = 2.5 A



6.1.3 V_{OUT} ripple for no load operation

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 5.0 V)
- Violet = switching node

Figure 99. V_{IN} = 6.5 V; V_{OUT} = 5 V; no load; V_{OUT}, RIPPLE < 5 mV

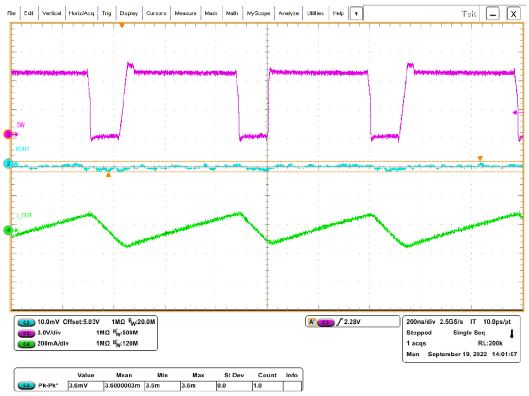


Figure 100. V_{IN} = 8.5 V; V_{OUT} = 3.3 V; no load; V_{OUT}, RIPPLE < 5 mV

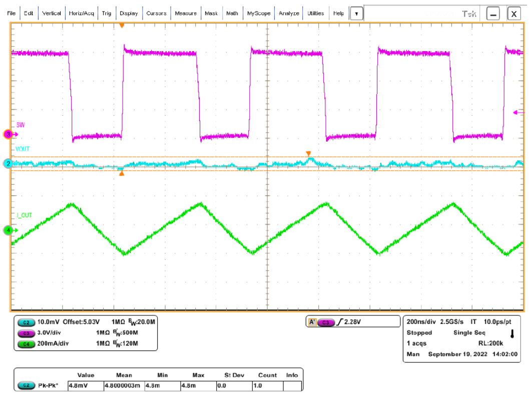


Figure 101. V_{IN} = 12 V; V_{OUT} = 5 V; no load; V_{OUT}, RIPPLE < 8 mV

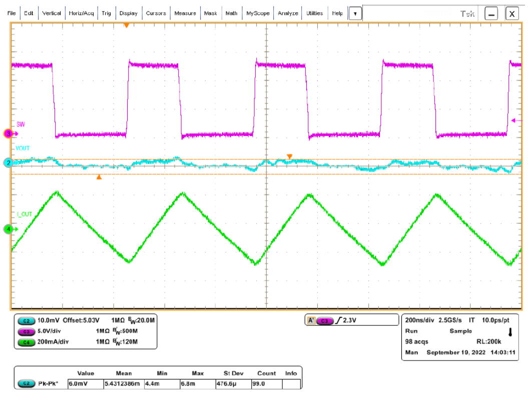
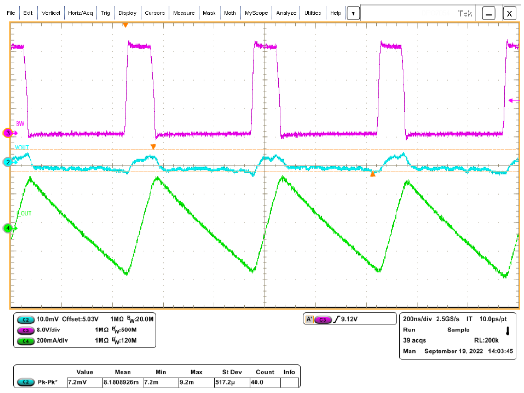


Figure 102. V_{IN} = 24 V; V_{OUT} = 5 V; no load; V_{OUT}, RIPPLE < 10 mV



6.1.4 V_{OUT} ripple for I_{OUT} = 2 A

- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 5.0 V)
- Violet = switching node

Figure 103. V_{IN} = 6.5 V; V_{OUT} = 5 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 15 mV

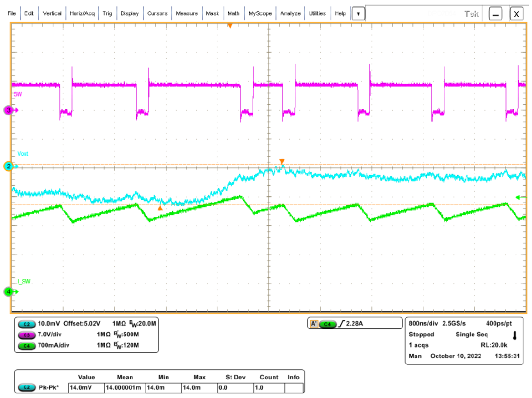


Figure 104. V_{IN} = 8.5 V; V_{OUT} = 5 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 8 mV

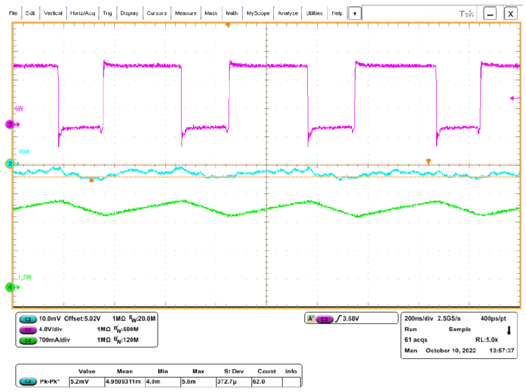


Figure 105. V_{IN} = 12 V; V_{OUT} = 5 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 8 mV

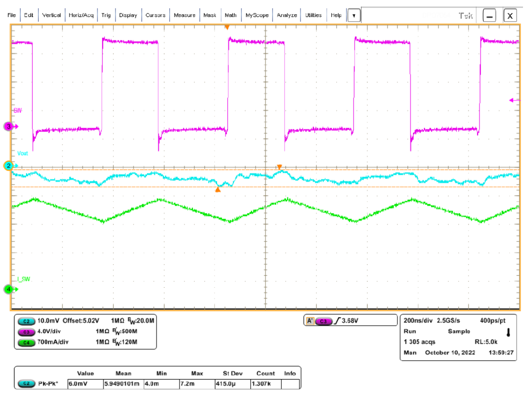
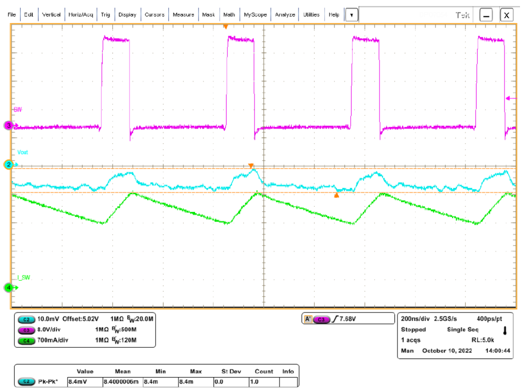


Figure 106. V_{IN} = 24 V; V_{OUT} = 5 V; I_{OUT} = 2 A; V_{OUT}, RIPPLE < 10 mV



6.1.5 Load transition

- I_{OUT} from 0.3 to 3 A
- I_{SLOPE} = 0.1 A/µs
- Green = inductor current
- Blue = V_{OUT} ripple (DC offset = 5 V)
- Violet = switching node

Figure 107. V_{IN} = 6.5 V; V_{OUT} = 5 V; $V_{OUT\ MAX}$ = 5.151 A; $V_{OUT\ MIN}$ = 4.875 A

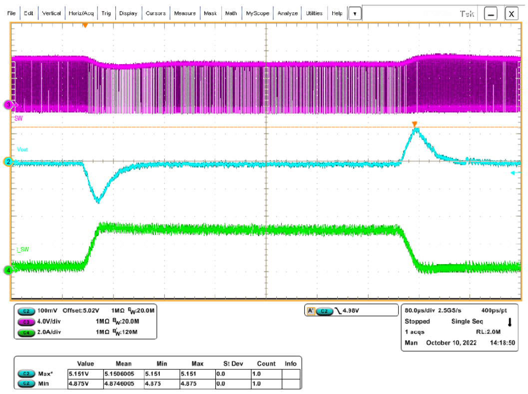


Figure 108. V_{IN} = 8.5 V; V_{OUT} = 5 V; $V_{OUT\ MAX}$ = 5.151 A; $V_{OUT\ MIN}$ = 4.875 A

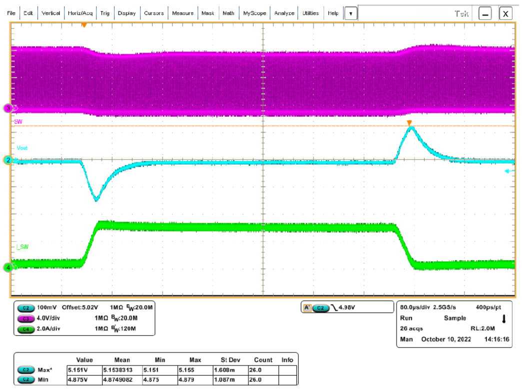


Figure 109. V_{IN} = 12 V; V_{OUT} = 5 V; $V_{OUT\ MAX}$ = 5.155 A; $V_{OUT\ MIN}$ = 4.875 A

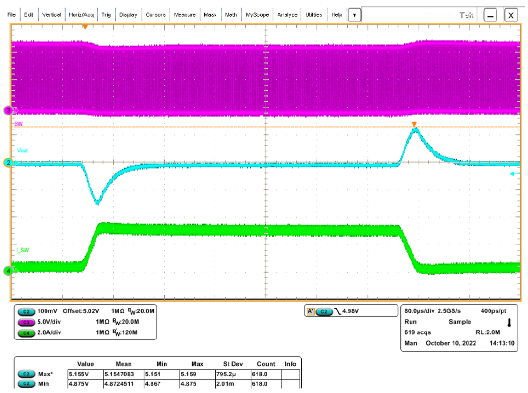
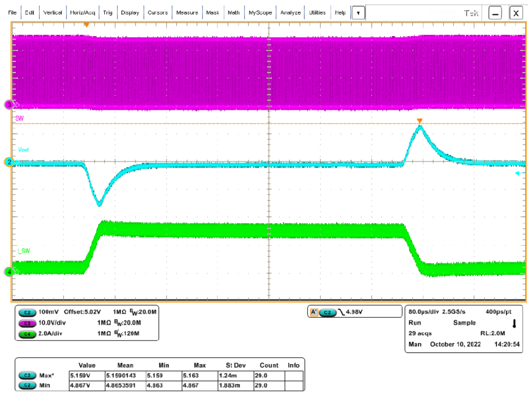


Figure 110. V_{IN} = 24 V; V_{OUT} = 5 V; $V_{OUT\ MAX}$ = 5.159 A; $V_{OUT\ MIN}$ = 4.867 A



6.1.6 Performance curves

Figure 111. Efficiency over I_{OUT}

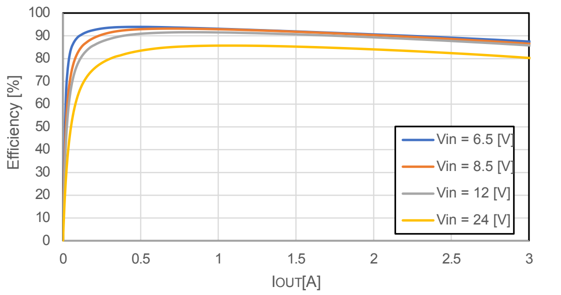


Figure 112. Efficiency over I_{OUT} log scale

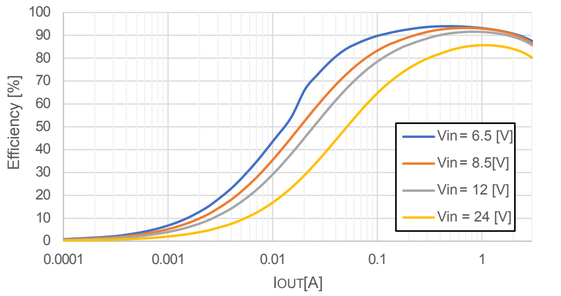


Figure 113. Power losses over I_{OUT}

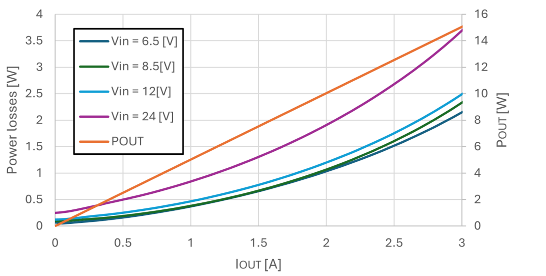
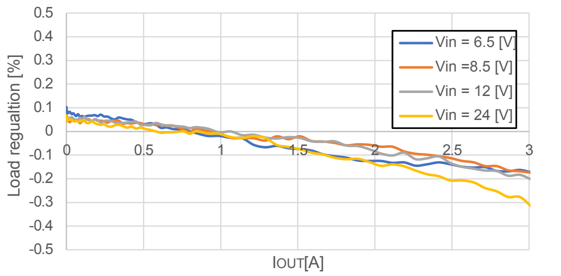


Figure 114. Load regulation



6.2 Thermal acquisitions

The measures have been acquired at the following conditions:

1. T_{AMB} = 25°C
2. I_{OUT} = 2 A

The measures have been acquired leaving the device with the reported V_{IN} and I_{OUT} for more than 5 minutes.

The camera selected to acquire the measures is the FLIR ETS320.

Figure 115. V_{IN} = 6.5 V; V_{OUT} = 5 V

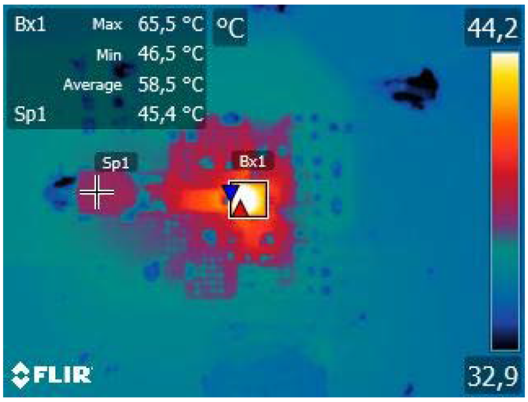


Figure 116. V_{IN} = 8.5 V; V_{OUT} = 5 V

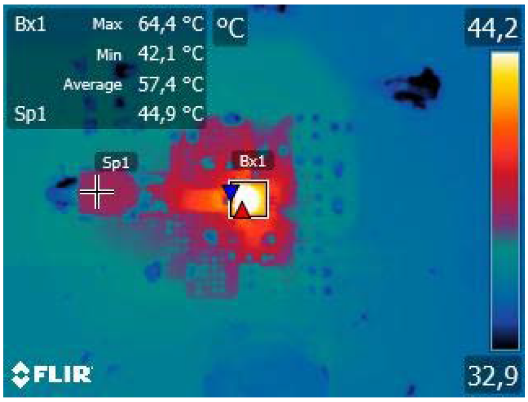


Figure 117. V_{IN} = 12 V; V_{OUT} = 5 V

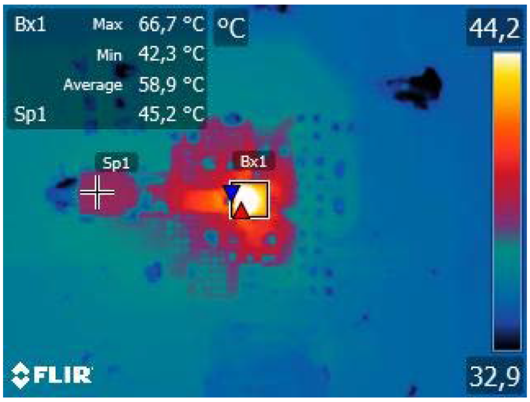
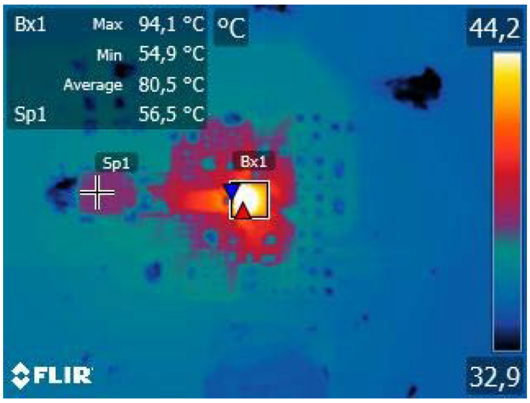


Figure 118. V_{IN} = 24 V; V_{OUT} = 5 V



7 PCB layout

Figure 119. STEVAL-A6983CNV1 evaluation board - PCB layout (top layer)

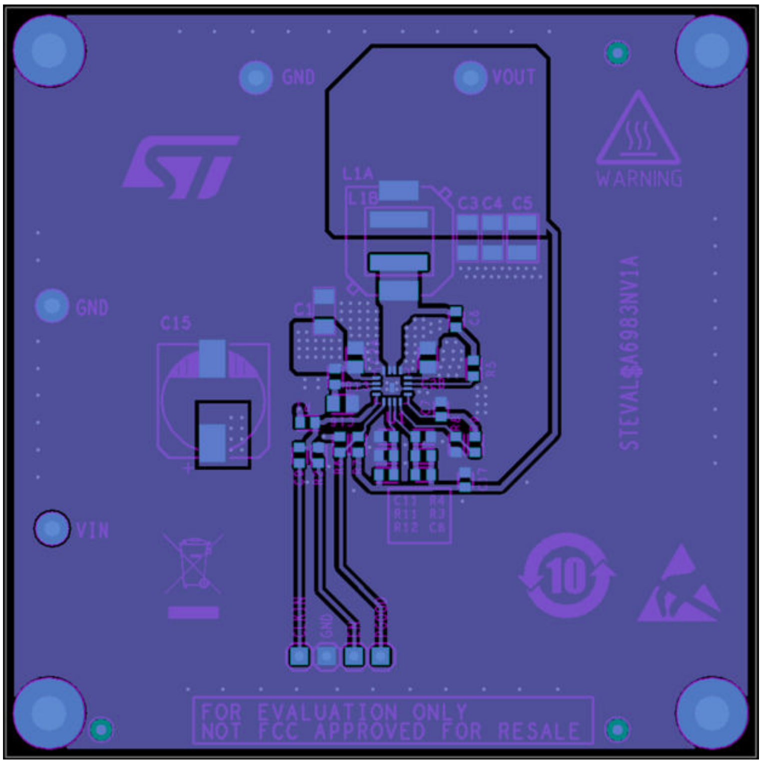
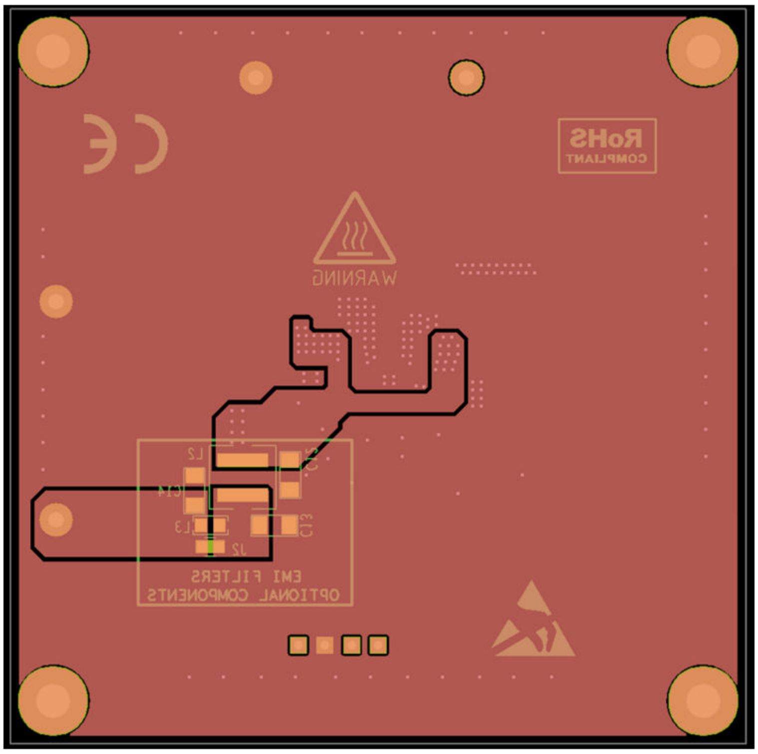


Figure 120. STEVAL-A6983CNV1 evaluation board - PCB layout (bottom layer)



8 Stack-up layers

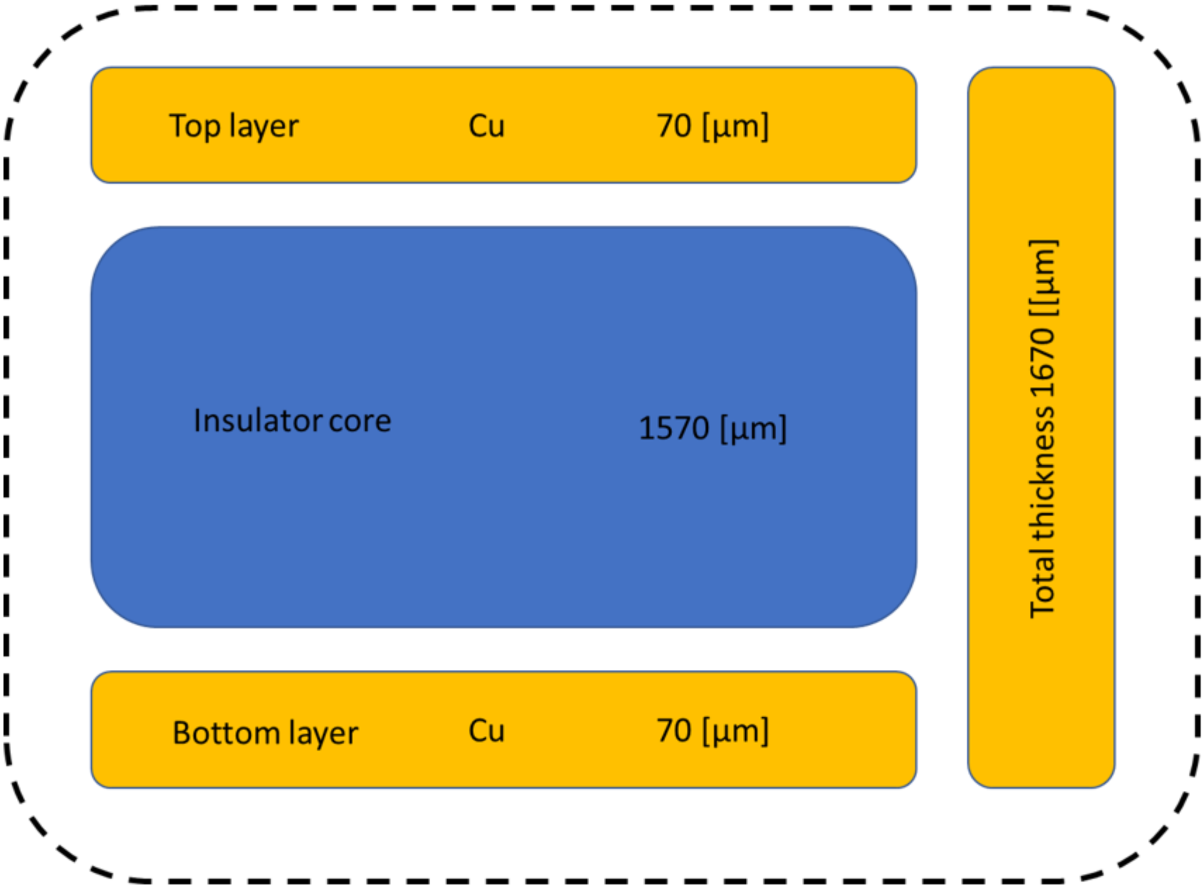
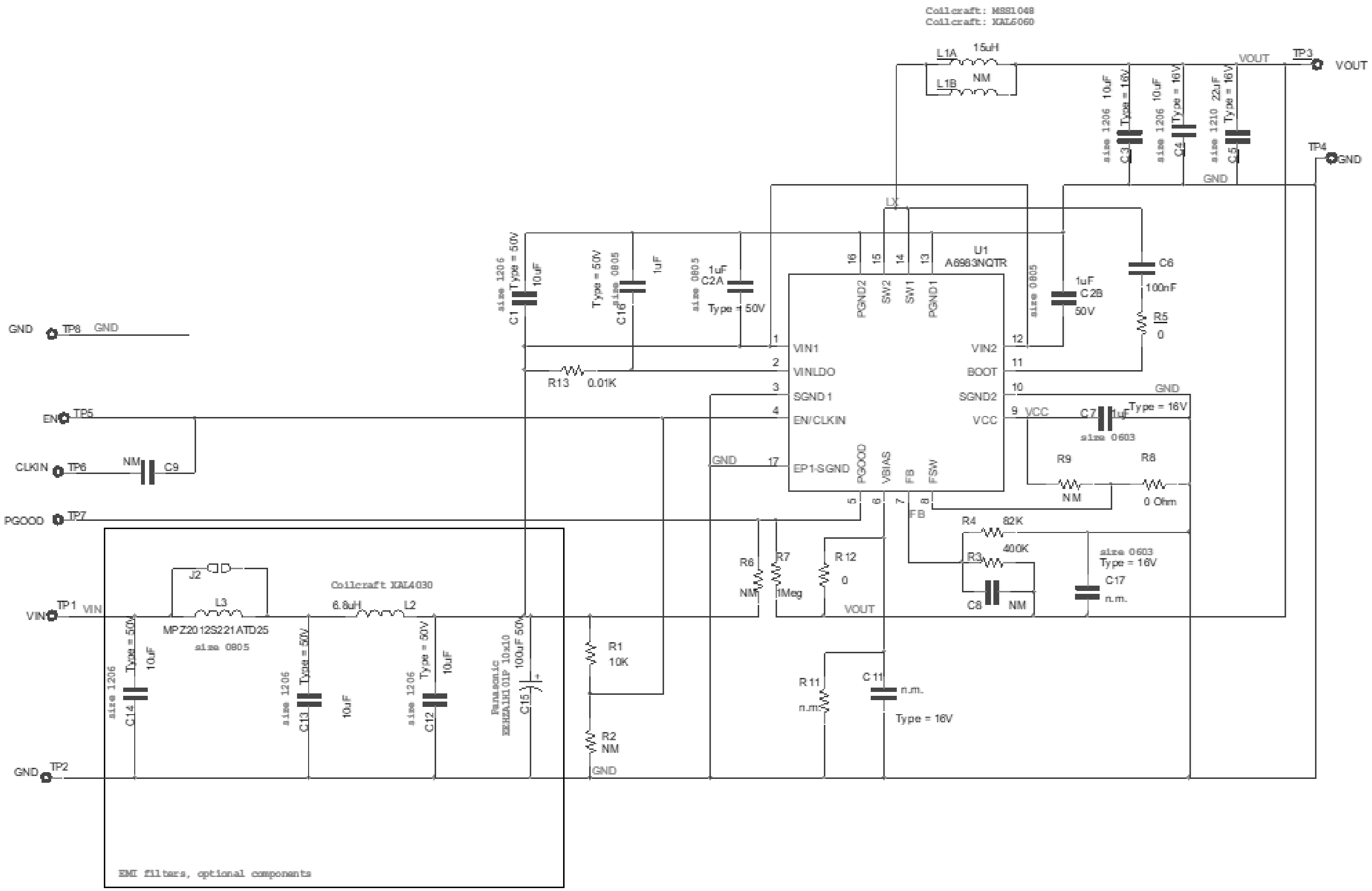


Figure 121. STEVAL-A6983CNV1 stack-up layers

9 Schematic diagrams

Figure 122. **STEVAL-A6983NV1 schematic diagrams**



10 Bill of materials

Table 2. **STEVAL-A6983NV1 bill of materials**

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	6	C1, C3, C4, C12, C13, C14	10µF 50V, 1206 (3216 metric), 50 V, 10 %	X7R ceramic capacitor	TDK	CGA5L1X7R1H106K160AC
2	3	C2A,C2B, C16	1µF 50V, 0805(2012 metric), 50 V, 0.2 %	X7R ceramic capacitor	TDK	CGA4J3X7R1H105M125AB
3	1	C5	22µF 25V, 1210(2225 metric), 50 V, 0.2 %	X7R ceramic capacitor	TDK	CGA6P3X7R1E226M250AB
4	1	C6	100nF 50V, 0603(1608 metric), 50 V, 10 %	X7R ceramic capacitor	TDK	CGA3E2X7R1H104K080AA
5	2	C7,C11	1µF 16V, 0603(1608 metric), 16 V, 10 %	X7R ceramic capacitor	TDK	CGA3E1X7R1C105K080AC
6	3	C8, C9, C17 Not Mounted	0603(1608 metric)			
7	1	C15	100µF 50V, 10x10mm, 50 V, 0.2 %	Electrolytic Capacitors	Panasonic	EEHZA1H101P
8	1	L1A	15µH 60V, XAL6060, 60 V, 0.2 %	Shielded power inductors	Coilcraft	XAL6060-153ME_
9	1	L1B Not Mounted	MSS1048	L1B	-	-
10	2	L2	6.8µH 60V, XAL4030, 60 V, 0.2 %	Shielded power inductors	Coilcraft	XAL4030-682ME_
11	1	L3	-	Ferrite bead	TDK	MPZ2012S221ATD25
12	1	R1	220Ω at 100KHz, 0603(1608 metric), 0.01 %	Resistor	ROHM	MCR006YZPF1002
13	4	R2, R6, R9, R11 Not Mounted	0603(1608 metric)	Resistors	-	-
14	1	R3	402KΩ, 0603(1608 metric), 0.01 %	Resistor	PANASONIC	ERJ1GNF4023C
15	1	R4	82KΩ, 0603(1608 metric), 0.01 %	Resistor	MULTICOMP PRO	MCRE000186
16	3	R5, R8, R12	0 Ω, 0603(1608 metric), 0.01 %	Resistor	MULTICOMP PRO	MCRE000086
17	1	R7	1MΩ, 0603(1608 metric), 0.01 %	Resistor	PANASONIC	ERJ-U01F1004C

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
18	1	R13	10Ω, 0603(1608 metric), 0.01 %	Resistor	PANASONIC	ERJ-U01F10R0C
19	4	TP1, TP2, TP3, TP4,	Single Male Header, 1mm	Test points	ETTINGER	13.14.145
21	1	U1	A6983NQTR, 38 V, 3 A	DC-DC converter buck regulator	ST	A6983NQTR

11 Board versions

Table 3. **STEVAL-A6983NV1 versions**

PCB version	Schematic diagrams	Bill of materials
STEVAL$A6983NV1A [1]	STEVAL$A6983NV1A schematic diagrams	STEVAL$A6983NV1A bill of materials

1. *This code identifies the STEVAL-A6983NV1 evaluation board first version.*

12 Regulatory compliance information

Notice for US Federal Communication Commission (FCC)

For evaluation only; not FCC approved for resale

FCC NOTICE - This kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and

(2) Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter 3.1.2.

Notice for Innovation, Science and Economic Development Canada (ISED)

For evaluation purposes only. This kit generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to Industry Canada (IC) rules.

À des fins d'évaluation uniquement. Ce kit génère, utilise et peut émettre de l'énergie radiofréquence et n'a pas été testé pour sa conformité aux limites des appareils informatiques conformément aux règles d'Industrie Canada (IC).

Notice for the European Union

This device is in conformity with the essential requirements of the Directive 2014/30/EU (EMC) and of the Directive 2015/863/EU (RoHS).

Notice for the United Kingdom

This device is in compliance with the UK Electromagnetic Compatibility Regulations 2016 (UK S.I. 2016 No. 1091) and with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK S.I. 2012 No. 3032).

Revision history

Table 4. **Document revision history**

Date	Revision	Changes
09-Feb-2024	1	Initial release.

Contents

List of tables

List of figures