

Getting started with the STEVAL-A6983CV1 synchronous step-down switching regulator evaluation board based on A6983C

Introduction

The **STEVAL-A6983CV1** is based on A6983C synchronous step-down regulator which implements 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.

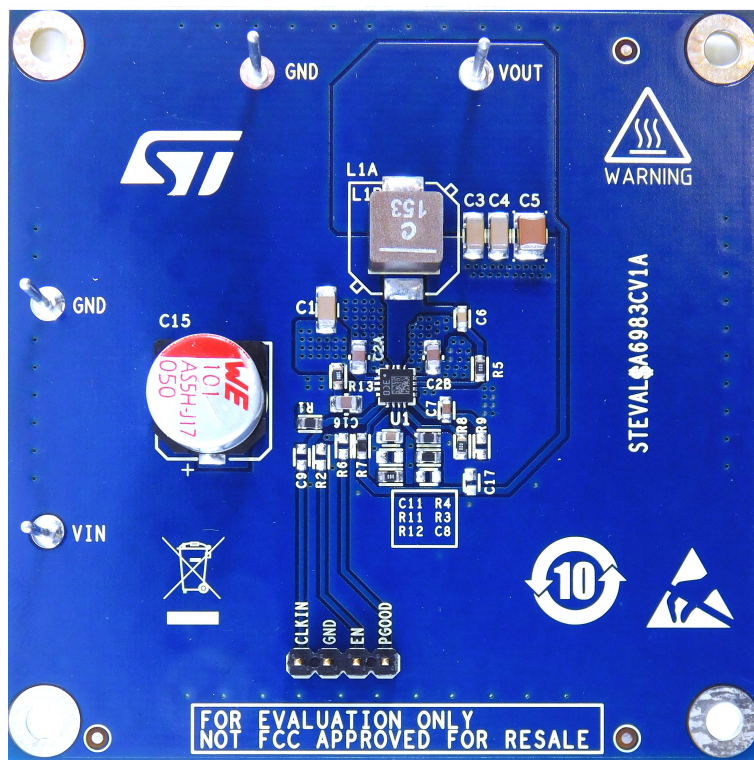
The **STEVAL-A6983CV1** operates over an input voltage range of 6 V to 38 V to provide a regulated 5 V output at 400 KHz switching frequency.

The board can be easily modified in order 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

It is possible to use the **eDesignSuite** software available on the ST website to configure A6983C to satisfy the specification.

Figure 1. STEVAL-A6983CV1 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 are 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).

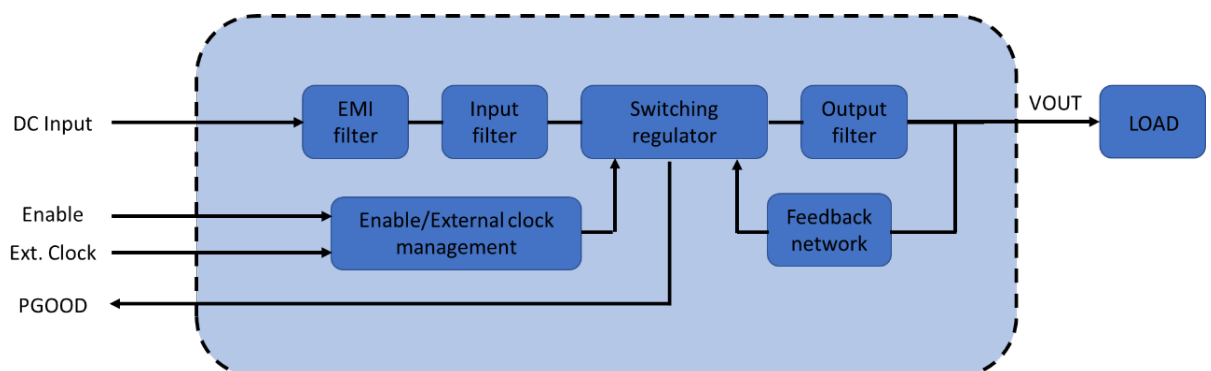
The electrical installation shall be completed in accordance with the appropriate requirements (for example: cross-sectional areas of conductors, fusions, and GND connections).

1.2 Overview

- AECQ100 Grade 1 qualified
- Operating junction temperature range: -40 °C to 150 °C
- Wide 3.5 V to 38 V input voltage range
- Output voltage from 0.85 V to VIN
- 3 A DC output current
- 22 µA operating quiescent current
- Low consumption mode for high efficiency at light load
- Internal compensation network
- 2 µA shutdown current
- Internal soft-start
- High voltage VIN compatible Enable
- Output overvoltage protection
- Output voltage sequencing
- Thermal protection
- 200 kHz to 2.2 MHz programmable switching frequency
- Optional spread spectrum for improved EMC
- Power good
- QFN16 (3 x 3 mm) package

1.3 Block diagram

Figure 2. STEVAL-A6983CV1 functional block diagram



1.4 Connectors and test points

Vin: connect to the positive terminal of a supply voltage (from 6 V to 38 V with default 5 V VOUT). Input voltage is filtered (see [Section 1.5: 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 VOUT 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 to synchronize the device applying an external signal generator. Please refer to the AC coupling synchronization paragraph of the online datasheet.

GND - Signal GND.

EN - Input pin. The pin allows to enable the device. It also allows to synchronize the device applying an external signal generator. For more details refer to the DC coupling synchronization paragraph of the online datasheet.

PGOOD - Output pin. Output signal. It is an open collector. It is short to GND once VOUT is lower than the regulator window (10%). Otherwise, it is short to the VOUT voltage.

1.5 Input EMI filter

The STEVAL-A6983CV1 is compliant with CISPR16-4-2.

The suggested input filters help to reduce EMI.

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

1.6 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 the ground and the RFSW pin, R8.

Table 1. Switching frequency settings table

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 the VCC. The internal dithering circuit changes the switching frequency in a range of ± 5%. Refer to the online datasheet to the spread spectrum full description.

1.7 EN settings

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

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

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

1.8 VOUT settings

By default, the **STEVAL-A6983CV1** is with VOUT = 5 V but 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.

1.9 eDesignSuite

The eDesignSuite software tool developed by STMicroelectronics helps you configure ST products for power conversion applications. You can use it to customize your board for a specific application. After entering the main specifications for your design, you can generate an automatic design or follow a sequential process to build a highly customized design.

2 How to use the board

The STEVAL-A6983CV1 is configured with the A6983 LCM, which has an adjustable V_{OUT} . The board is set to deliver a 5 V output voltage with $F_{SW} = 400$ kHz.

This board is best suited for applications where high efficiency for light load is preferred.

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 PCB layout.

Figure 3. STEVAL-A6983CV1 evaluation board - PCB layout (top layer)

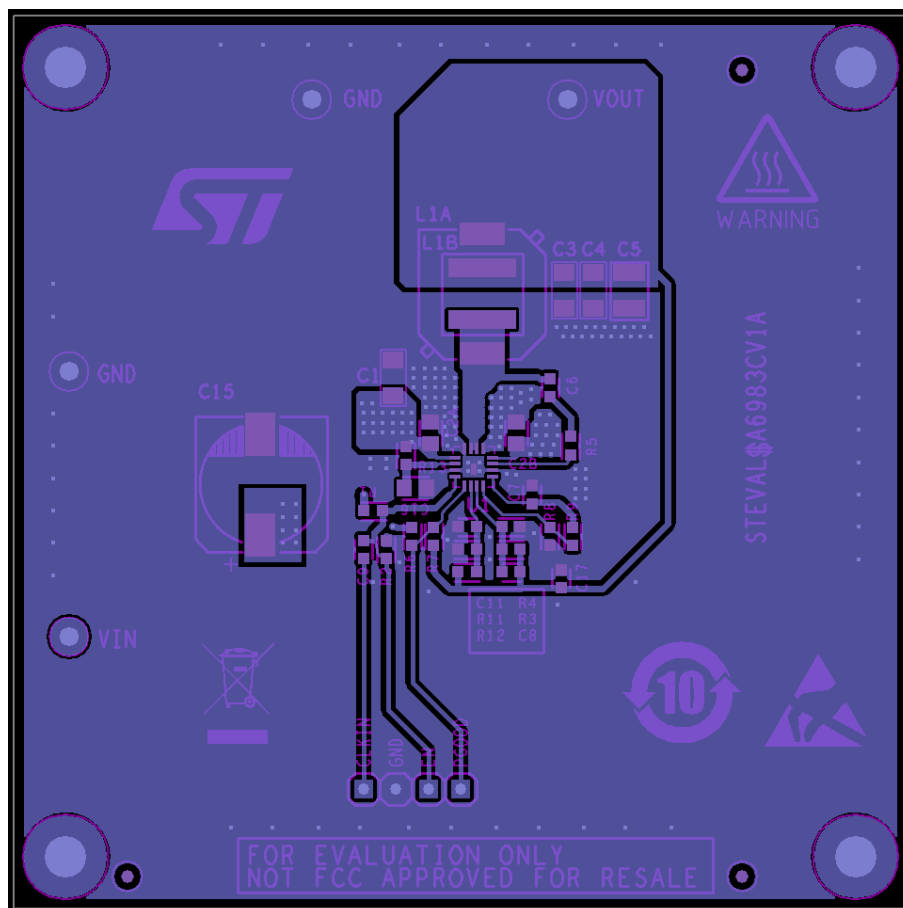
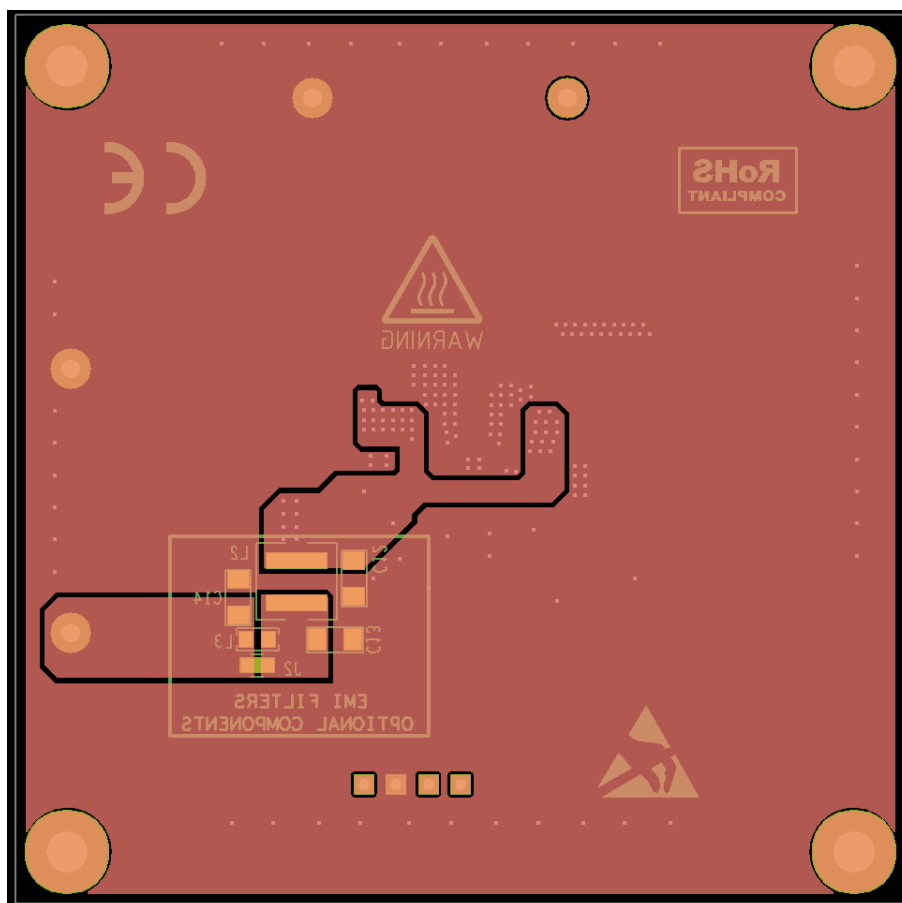
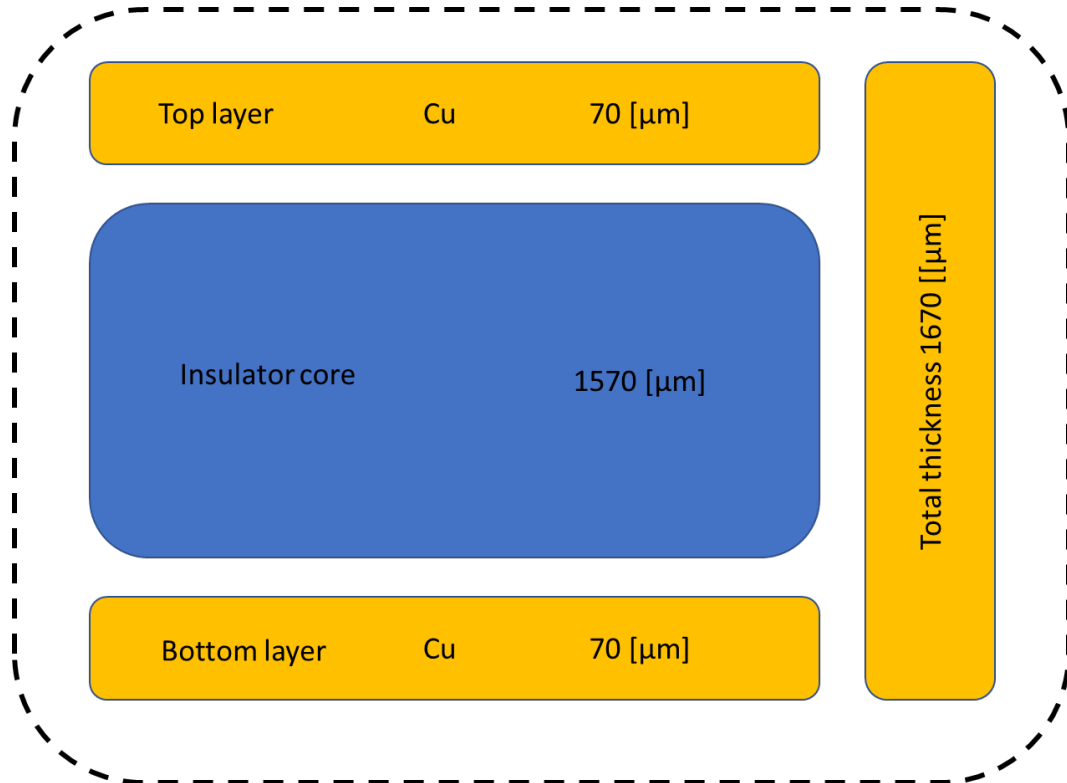


Figure 4. STEVAL-A6983CV1 evaluation board - PCB layout (bottom layer)



4 Stack up layers

Figure 5. STEVAL-A6983CV1 stack up layer



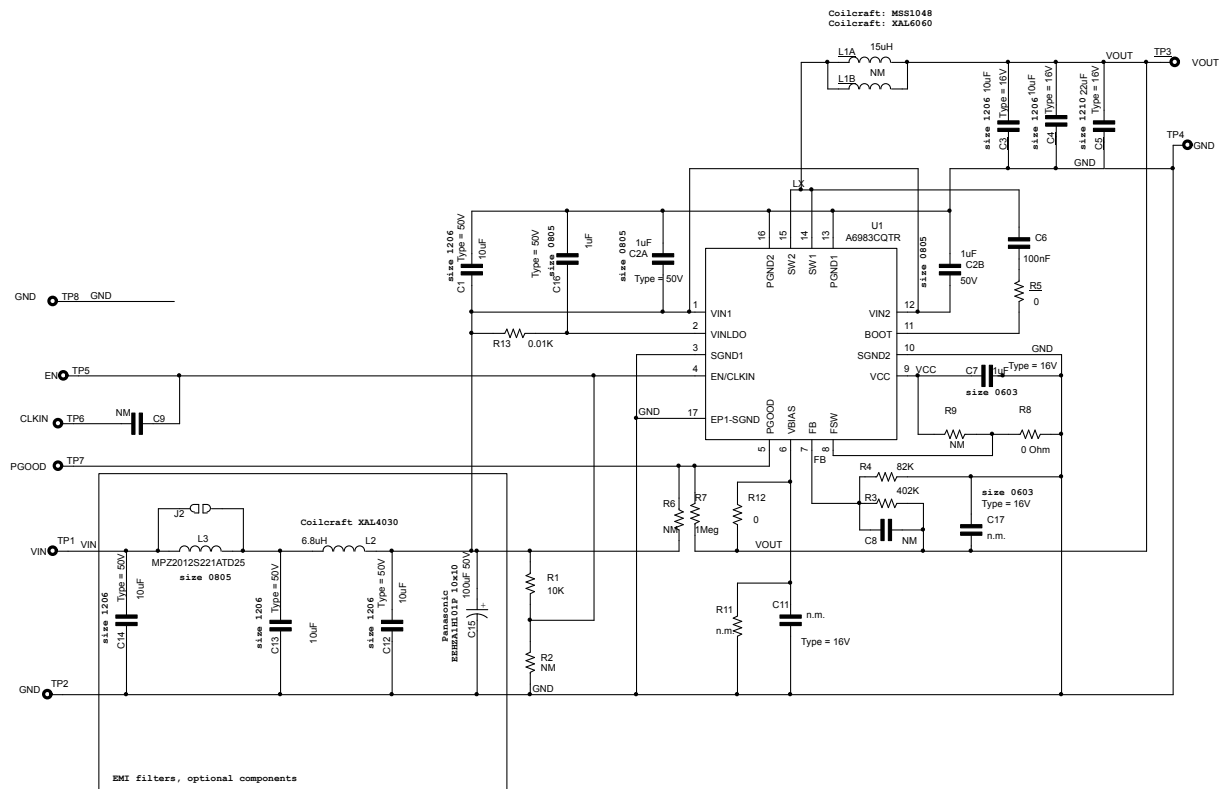
5 Application 1 (V_{OUT} = 5 V, F_{SW} = 400 KHz)

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 6. STEVAL-A6983CV1 schematic - application 1

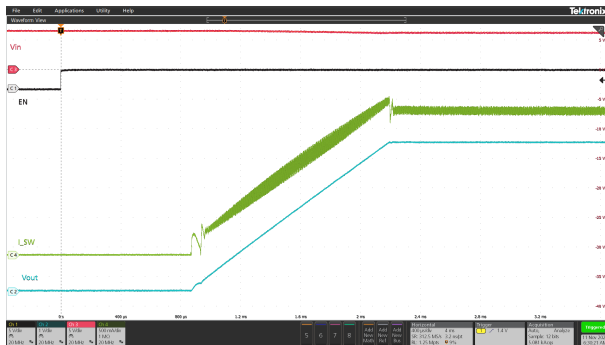
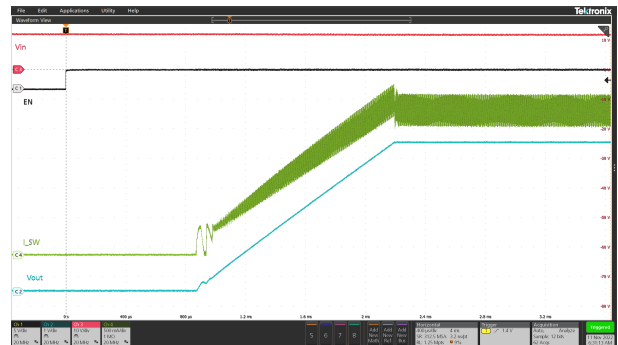
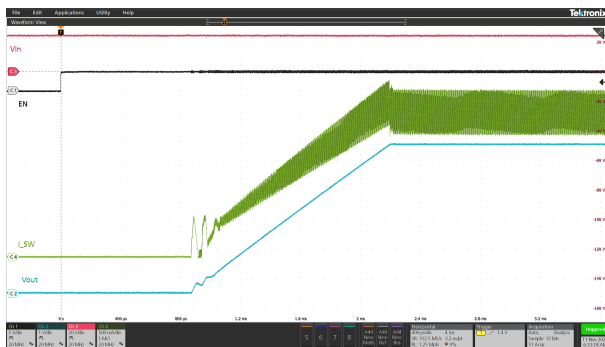
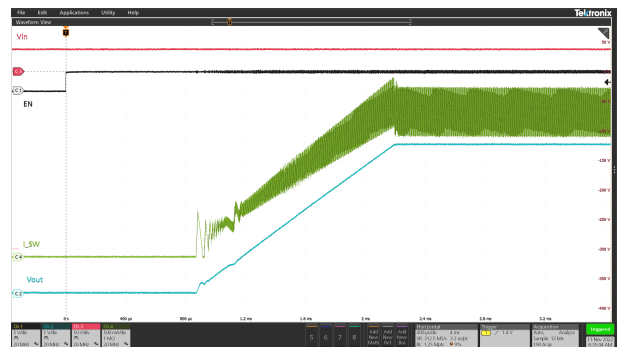


Bill of materials: see [Section 10: Bill of materials](#)

5.1 Oscilloscope ack

Power up from EN

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

Figure 7. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

Figure 8. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

Figure 9. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

Figure 10. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$


Power up from V_{IN}

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

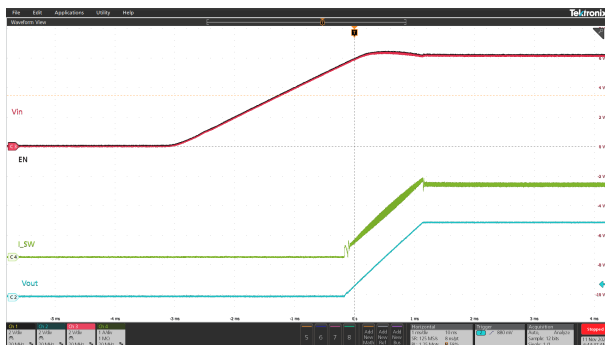
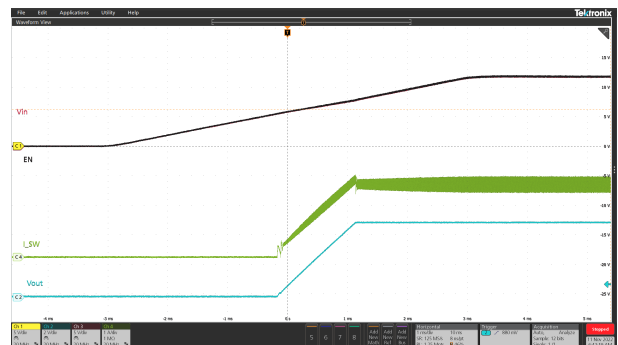
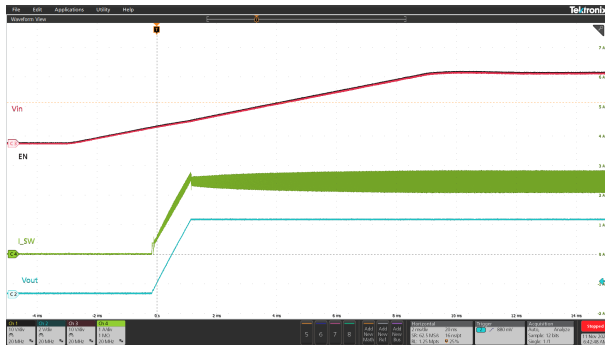
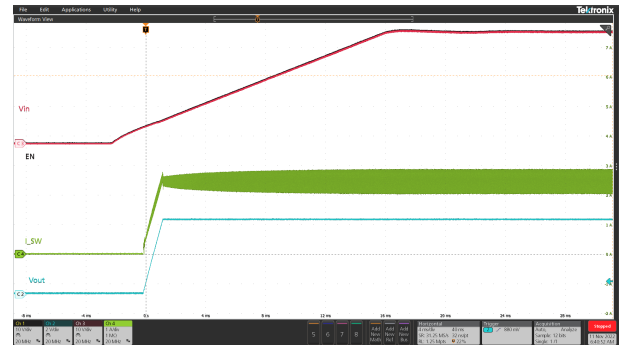
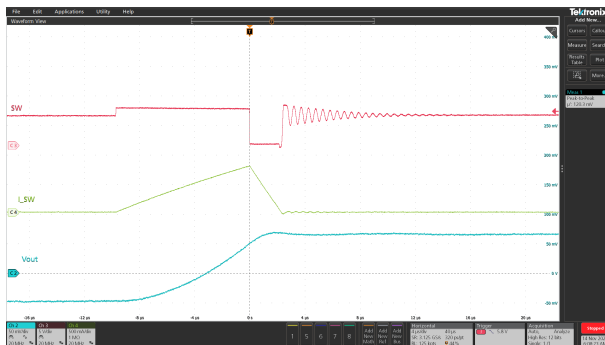
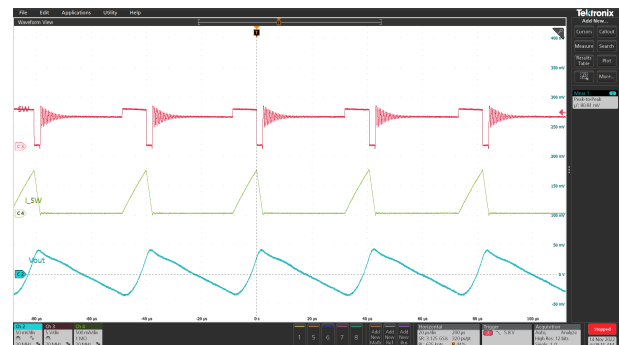
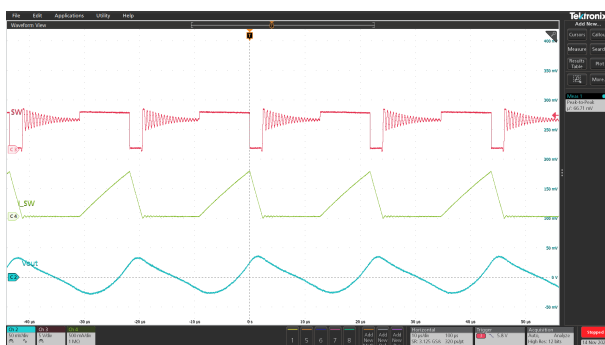
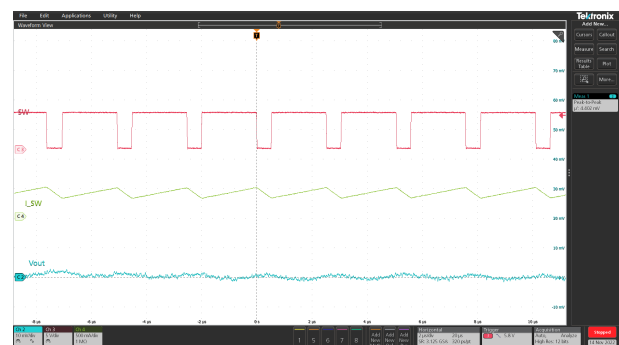
Figure 11. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

Figure 12. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$


Figure 13. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

Figure 14. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$


V_{OUT} ripple for light load operation

$V_{IN} = 6.5\text{ V}$

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

Figure 15. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE ~ 135 mV

Figure 16. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE ~ 80 mV

Figure 17. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.3\text{ A}$; V_{OUT} , RIPPLE ~ 70 mV

Figure 18. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.4\text{ A}$; V_{OUT} , RIPPLE ~ 5 mV


V_{OUT} ripple for light load operation

$V_{IN} = 12\text{ V}$

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

Figure 19. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 45\text{ mV}$

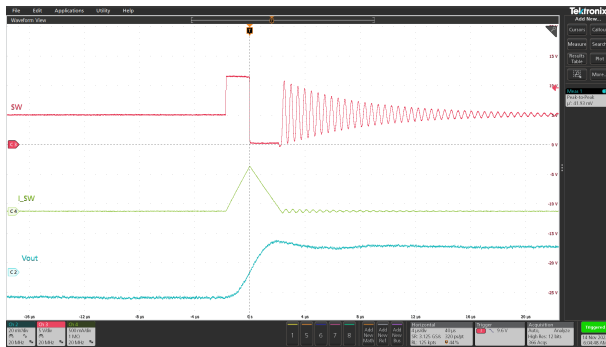


Figure 20. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 35\text{ mV}$

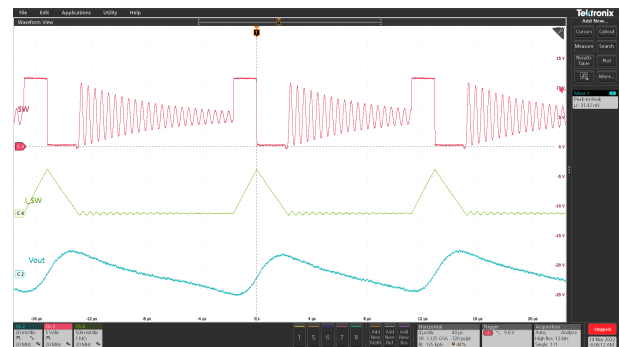


Figure 21. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} , RIPPLE $\sim 30\text{ mV}$

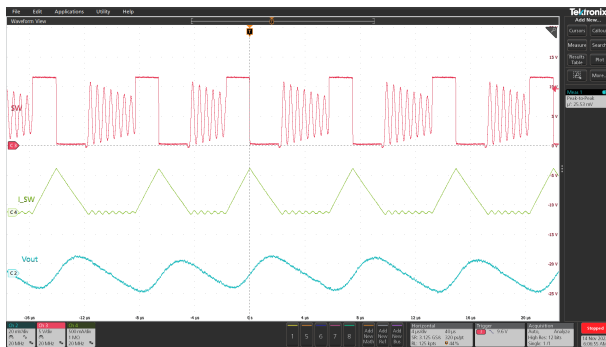
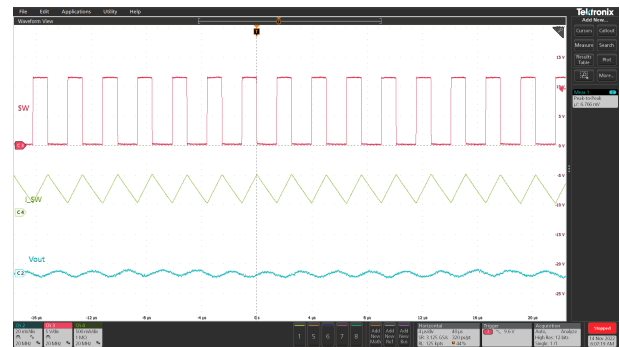


Figure 22. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.4\text{ A}$; V_{OUT} , RIPPLE $\sim 10\text{ mV}$



V_{OUT} ripple for light load operation

$V_{IN} = 24\text{ V}$

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

Figure 23. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 40\text{ mV}$

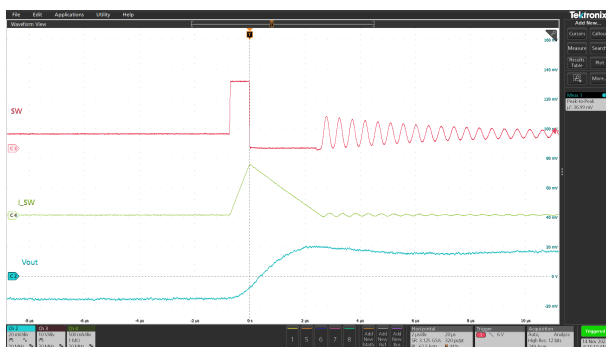


Figure 24. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 40\text{ mV}$

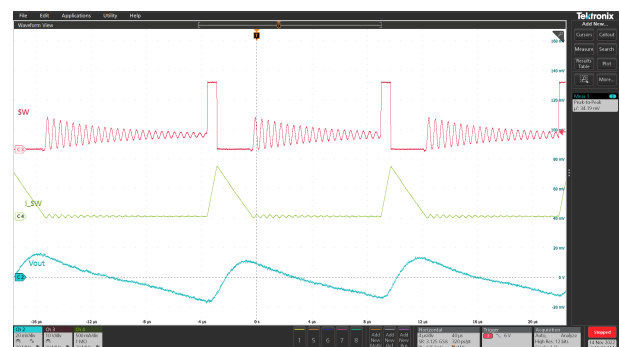


Figure 25. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} ,
RIPPLE $\sim 30\text{ mV}$

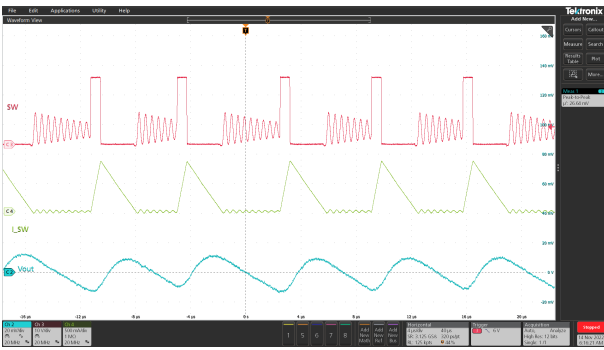
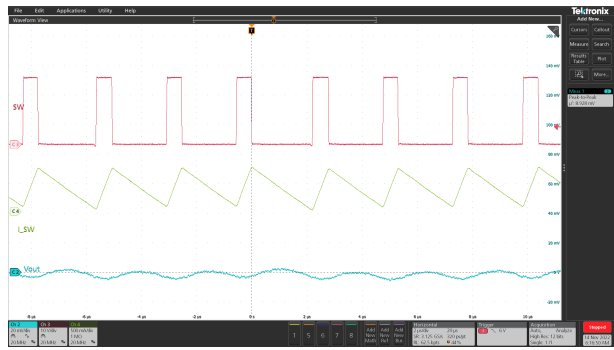


Figure 26. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.4\text{ A}$; V_{OUT} ,
RIPPLE $\sim 10\text{ mV}$



V_{OUT} ripple for light load operation

$V_{IN} = 38\text{ V}$

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

Figure 27. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 40\text{ mV}$

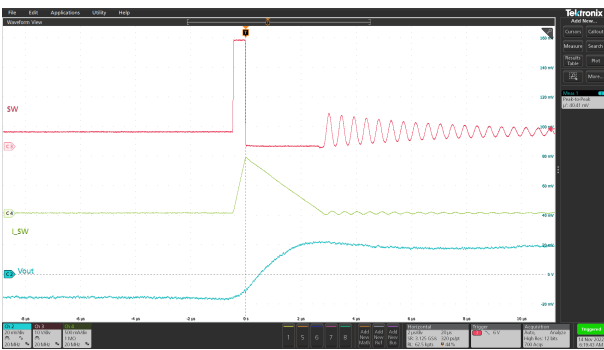


Figure 28. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} ,
RIPPLE $\sim 40\text{ mV}$

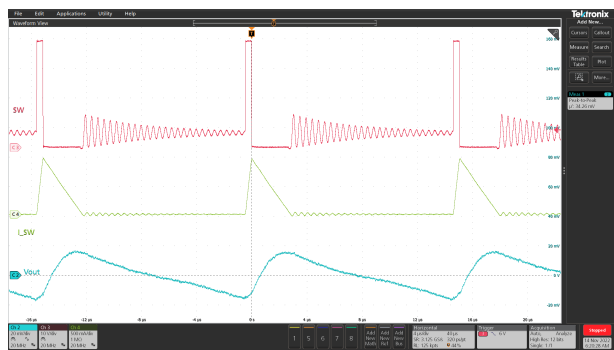


Figure 29. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} ,
RIPPLE $\sim 30\text{ mV}$

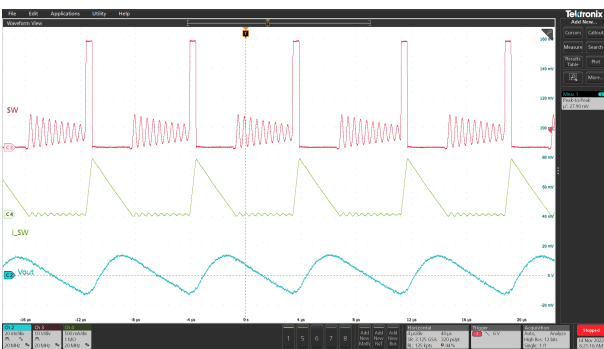
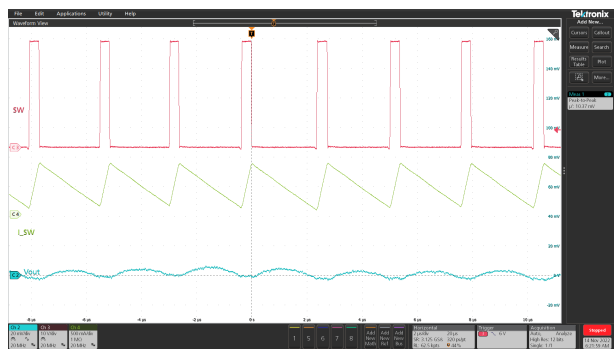


Figure 30. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.4\text{ A}$; V_{OUT} ,
RIPPLE $\sim 10\text{ mV}$



Load transition

I_{OUT} from 0.3 to 3 A; $I_{SLOPE} = 0.1\text{ A}/\mu\text{s}$

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

Figure 31. $V_{IN} = 8.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.168\text{ V}$;
 $V_{OUT, MIN} = 4.853\text{ V}$

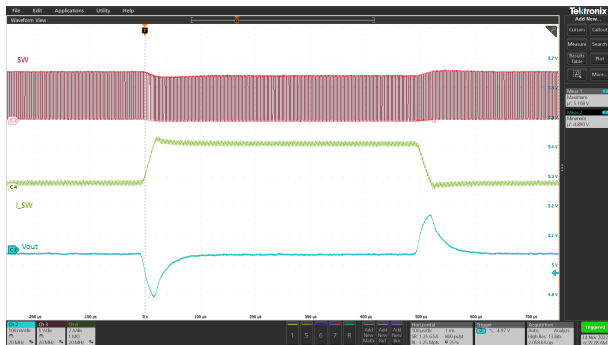


Figure 32. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.168\text{ V}$;
 $V_{OUT, MIN} = 4.887\text{ V}$

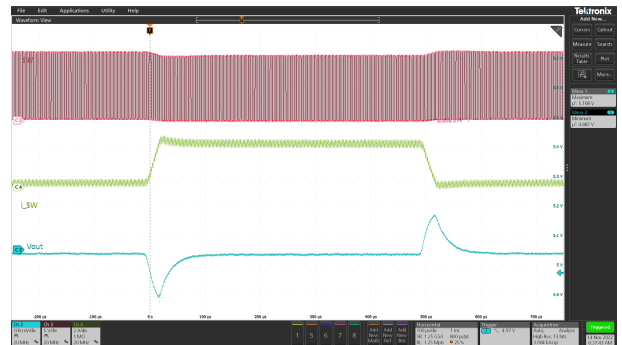


Figure 33. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.165\text{ V}$;
 $V_{OUT, MIN} = 4.889\text{ V}$

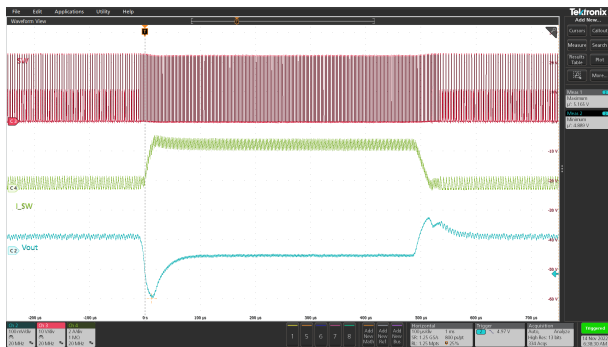
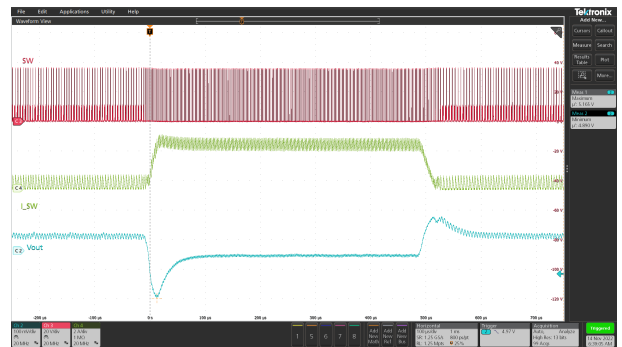
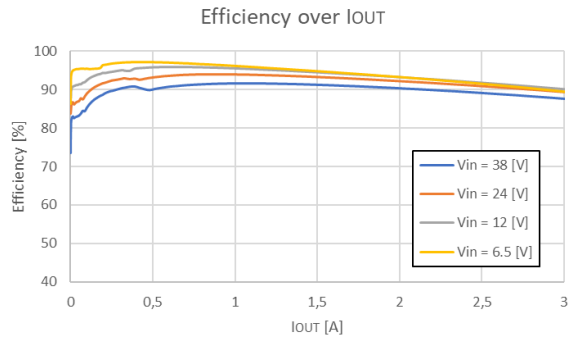
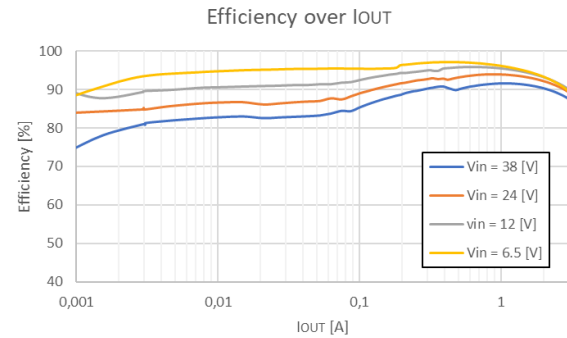
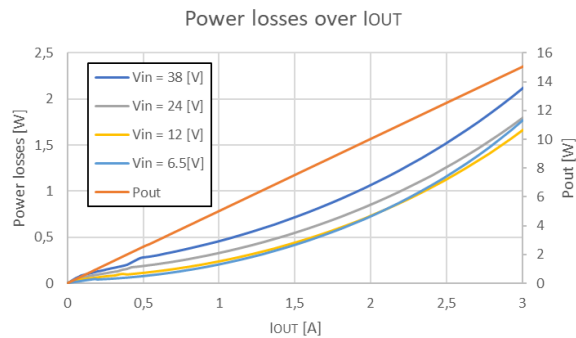
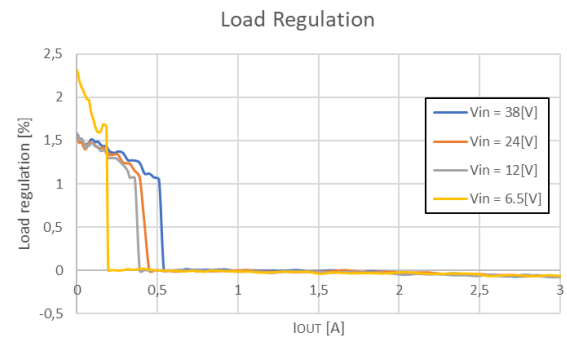


Figure 34. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.165\text{ V}$;
 $V_{OUT, MIN} = 4.890\text{ V}$



5.2 Performance curves

Figure 35. Efficiency measures

Figure 36. Efficiency measures log scale

Figure 37. Power losses

Figure 38. Load regulation


5.3 Thermal acquisitions

The measures have been acquired with:

1. $T_{AMB} = 25\text{ }^{\circ}\text{C}$
2. $I_{OUT} = 3\text{ A}$

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 39. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5.0\text{ V}$

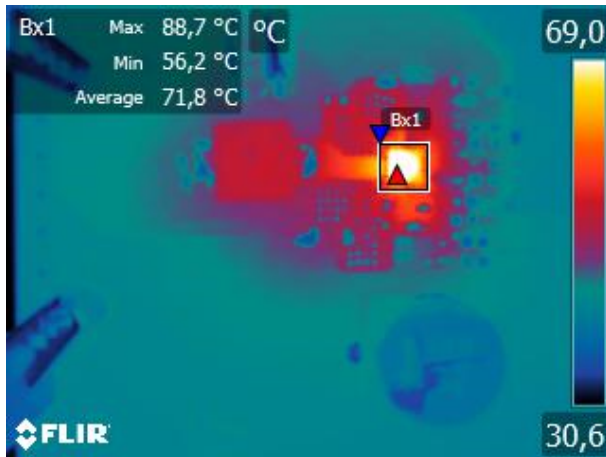


Figure 40. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5.0\text{ V}$

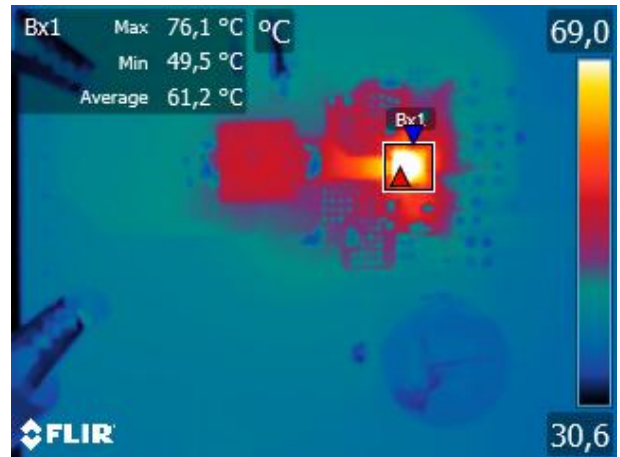


Figure 41. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5.0\text{ V}$

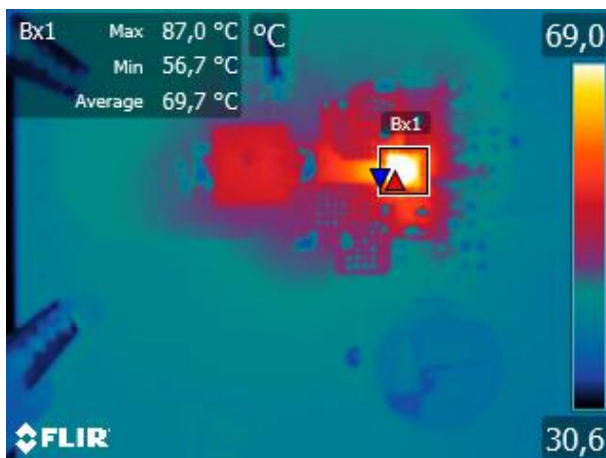
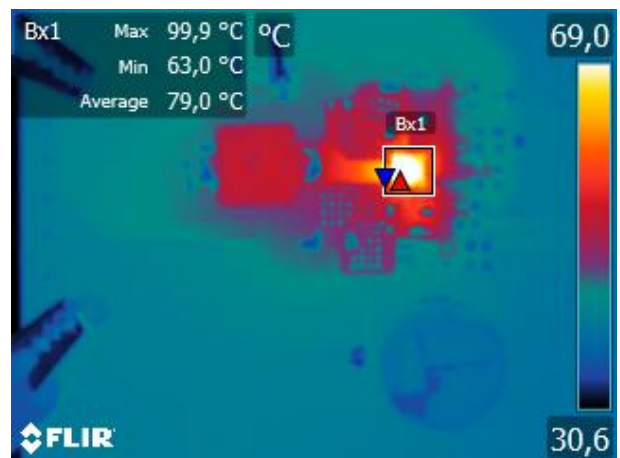


Figure 42. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5.0\text{ V}$



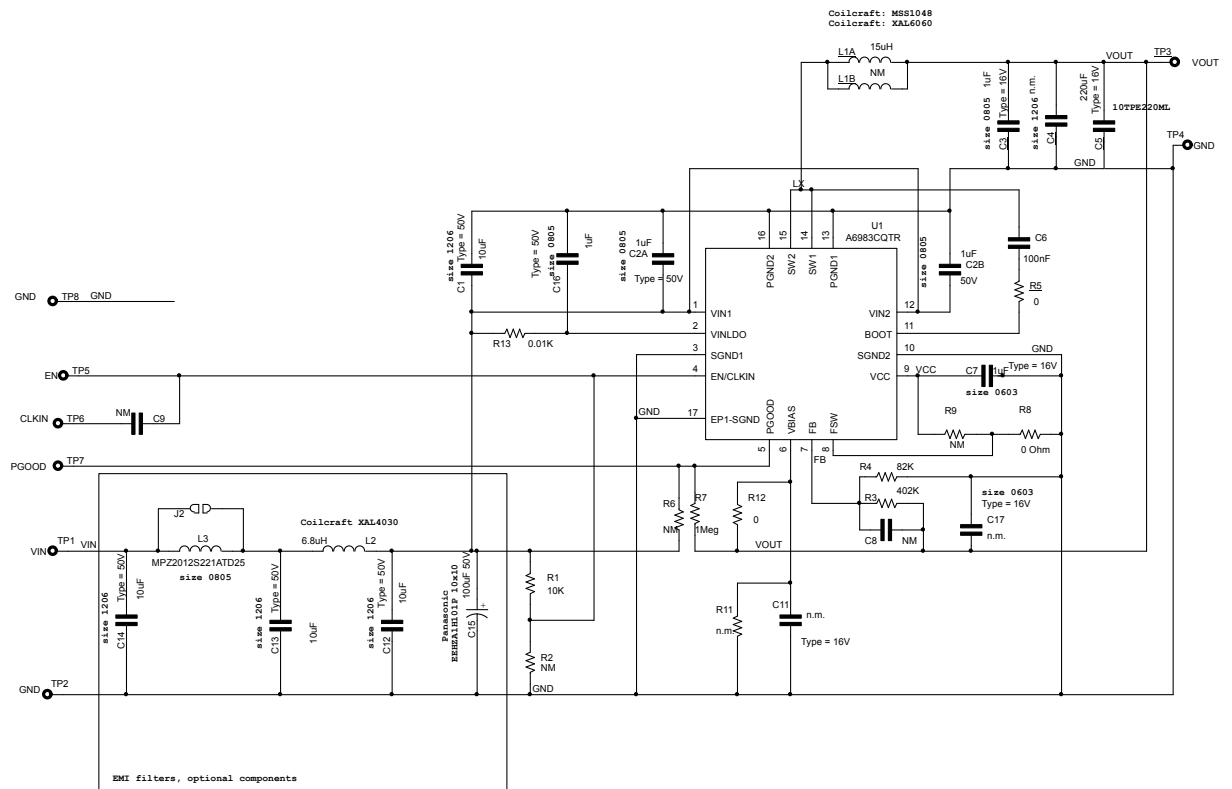
6 Application 2 ($V_{OUT} = 5\text{ V}$, $F_{SW} = 400\text{ KHz}$, low AC ripple)

Application conditions:

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

Schematic:

Figure 43. STEVAL-A6983CV1 schematic - application 2



Bill of materials: see [Section 10: Bill of materials](#)

6.1 Oscilloscope ack

Power up from EN

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

Figure 44. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

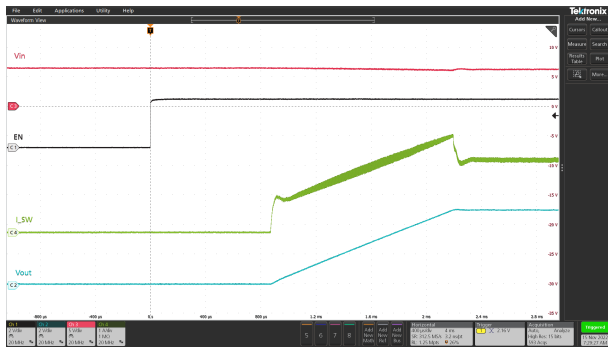


Figure 45. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

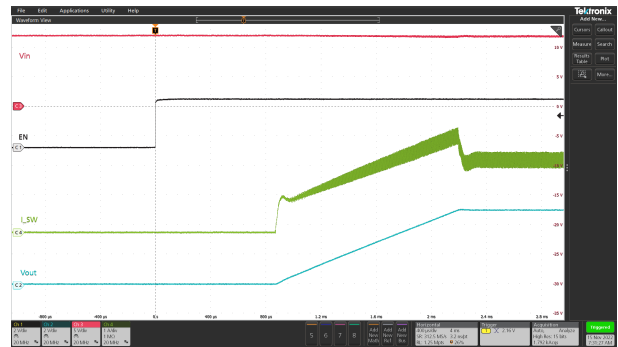


Figure 46. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

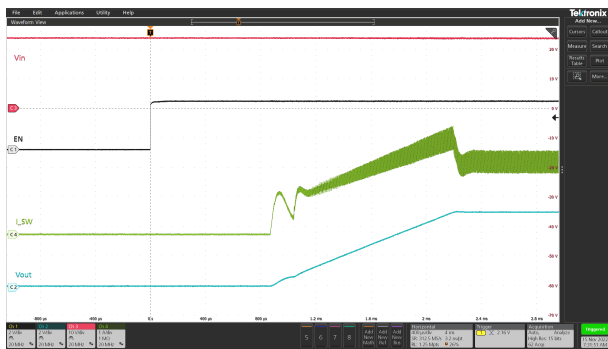
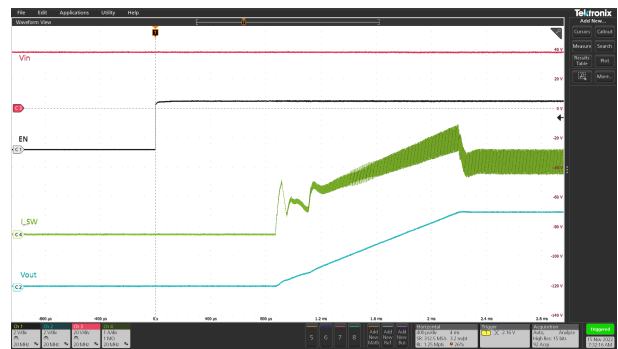


Figure 47. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$



Power up from V_{IN}

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

Figure 48. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

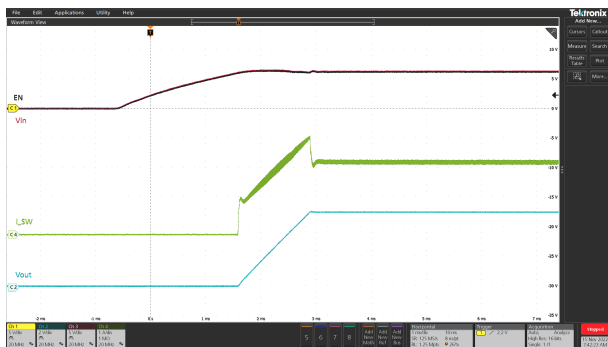


Figure 49. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

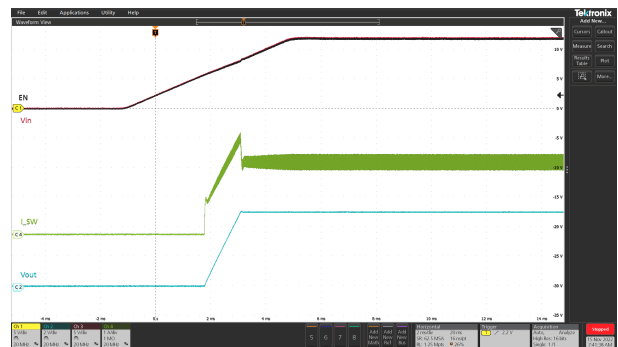
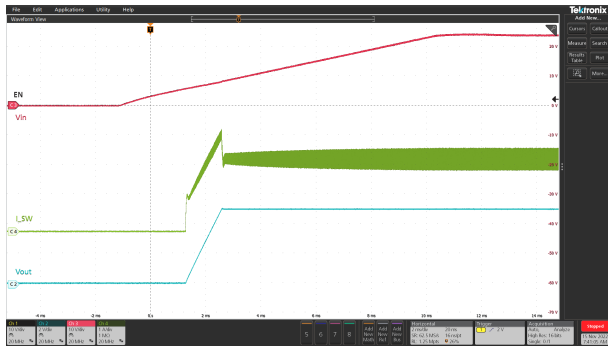
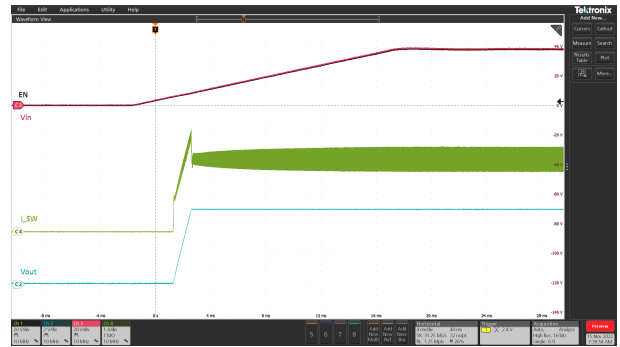
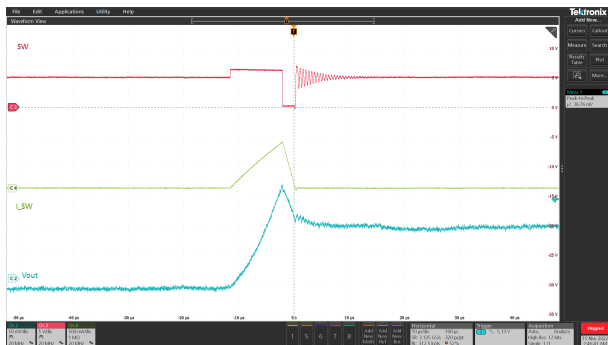
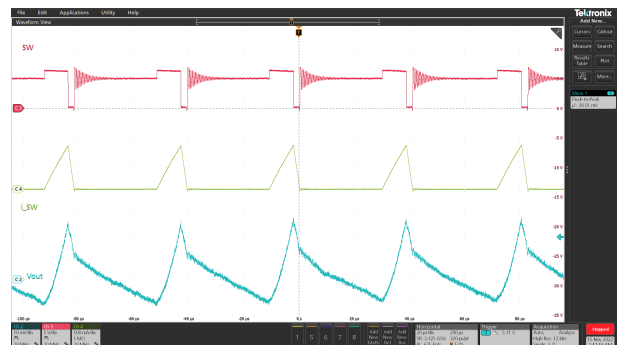
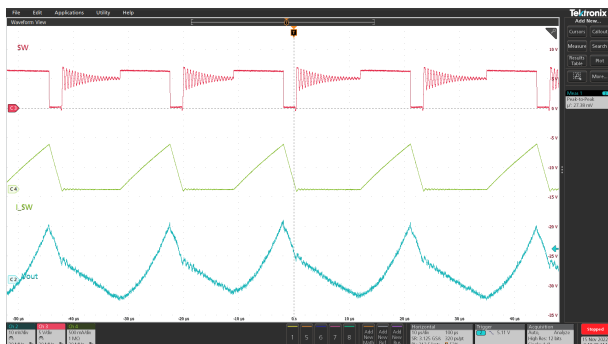
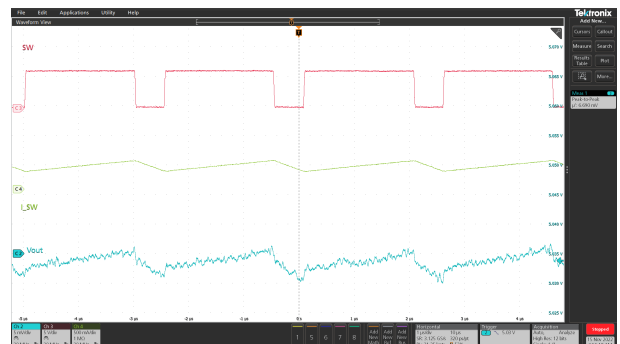


Figure 50. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$

Figure 51. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 2.5\text{ A}$


V_{OUT} ripple for light load operation

$V_{IN} = 6.5\text{ V}$

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

Figure 52. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 40\text{ mV}$

Figure 53. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 30\text{ mV}$

Figure 54. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} , RIPPLE $\sim 30\text{ mV}$

Figure 55. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.4\text{ A}$; V_{OUT} , RIPPLE $\sim 10\text{ mV}$


V_{OUT} ripple for light load operation

$V_{IN} = 12\text{ V}$

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

Figure 56. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 30\text{ mV}$

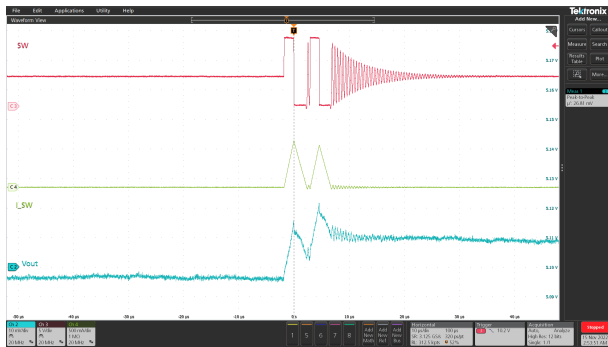


Figure 57. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 25\text{ mV}$

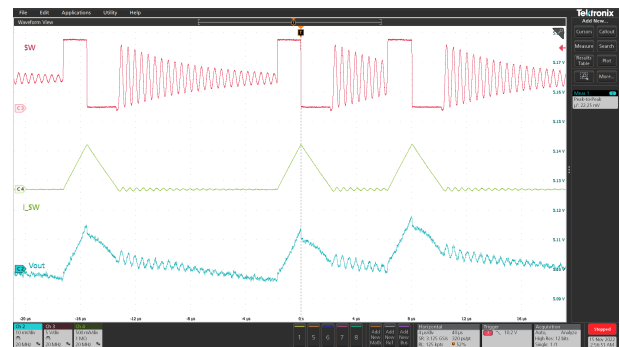


Figure 58. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} , RIPPLE $\sim 25\text{ mV}$

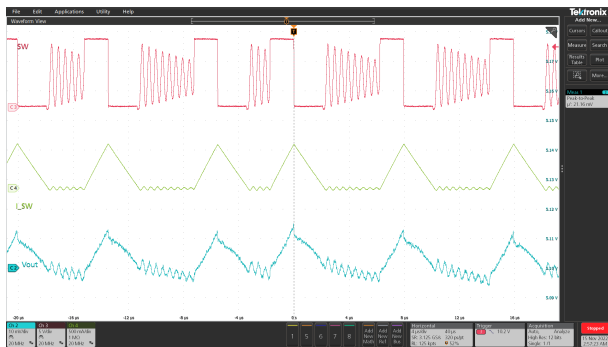
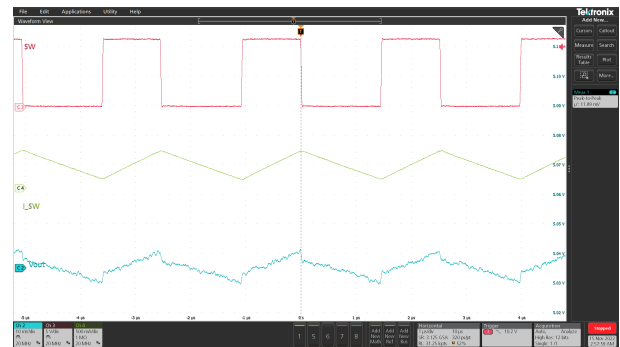


Figure 59. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.4\text{ A}$; V_{OUT} , RIPPLE $\sim 15\text{ mV}$



V_{OUT} ripple for light load operation

$V_{IN} = 24\text{ V}$

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

Figure 60. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 30\text{ mV}$

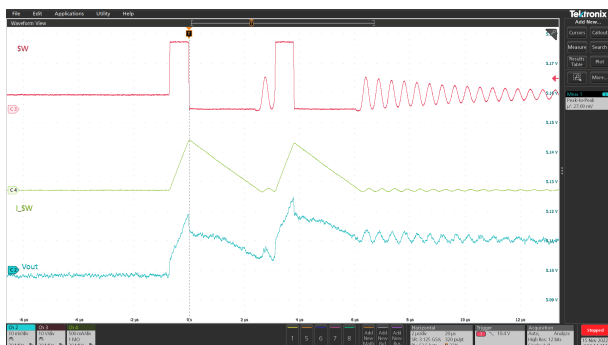


Figure 61. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 25\text{ mV}$

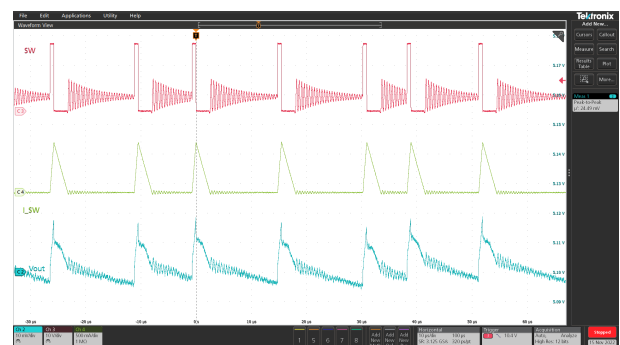


Figure 62. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} ,
RIPPLE $\sim 25\text{ mV}$

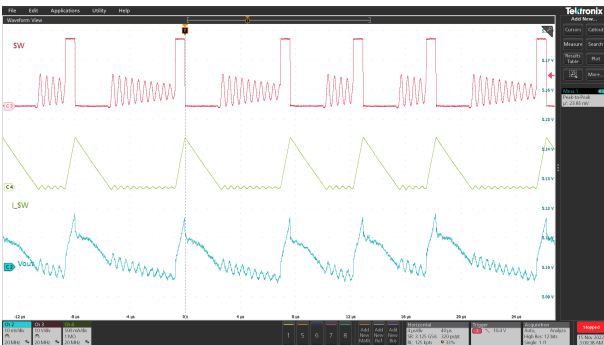
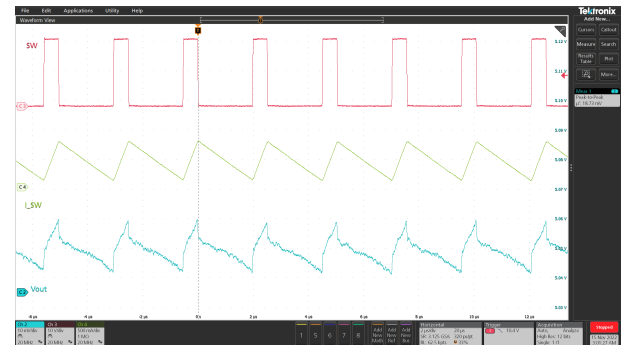


Figure 63. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.45\text{ A}$; V_{OUT} ,
RIPPLE $\sim 20\text{ mV}$



V_{OUT} ripple for light load operation

$V_{IN} = 38\text{ V}$

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

Figure 64. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 35\text{ mV}$

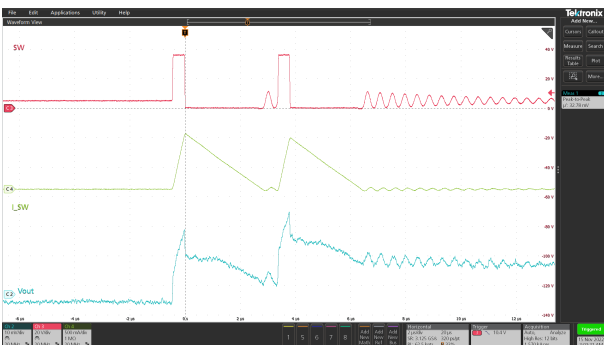


Figure 65. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} ,
RIPPLE $\sim 40\text{ mV}$

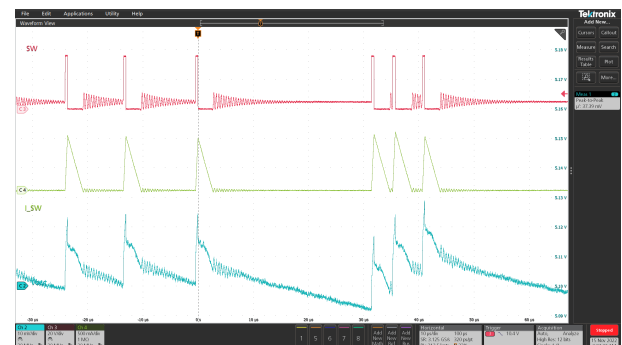


Figure 66. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} ,
RIPPLE $\sim 30\text{ mV}$

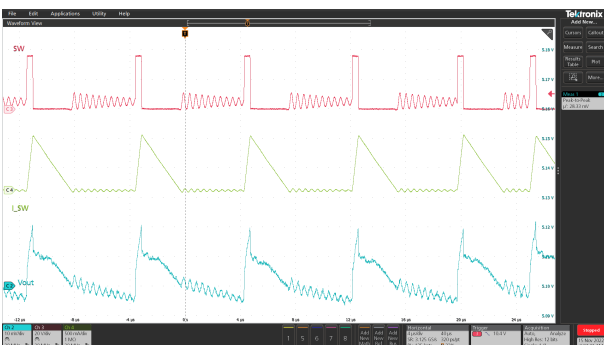
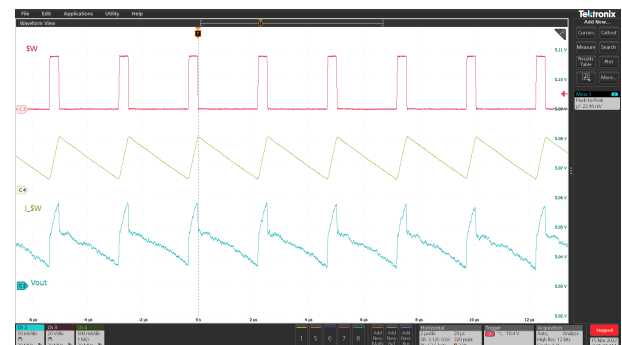


Figure 67. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.4\text{ A}$; V_{OUT} ,
RIPPLE $\sim 25\text{ mV}$



Load transition

I_{OUT} from 0.3 to 3 A; $I_{SLOPE} = 0.1\text{ A}/\mu\text{s}$

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

Figure 68. $V_{IN} = 8.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.168\text{ V}$;
 $V_{OUT, MIN} = 4.853\text{ V}$

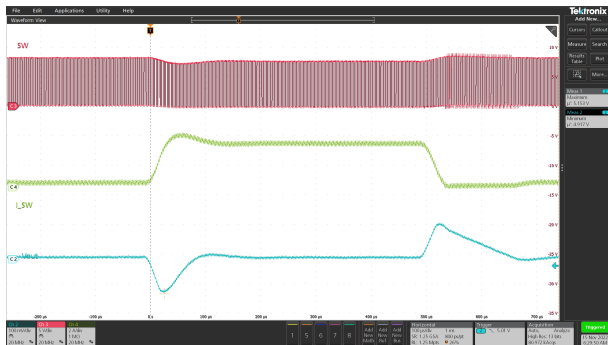


Figure 69. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.168\text{ V}$;
 $V_{OUT, MIN} = 4.887\text{ V}$

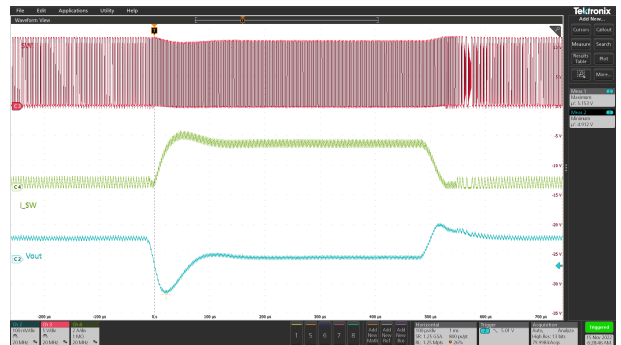


Figure 70. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.165\text{ V}$;
 $V_{OUT, MIN} = 4.889\text{ V}$

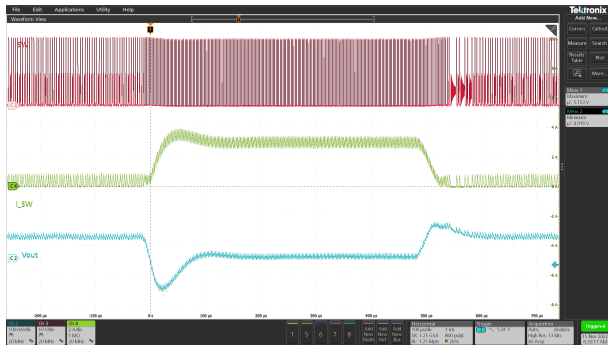
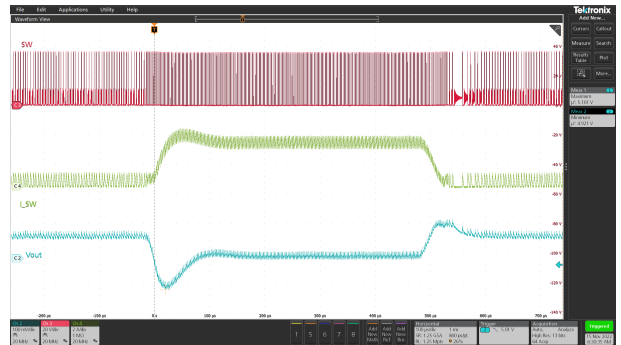
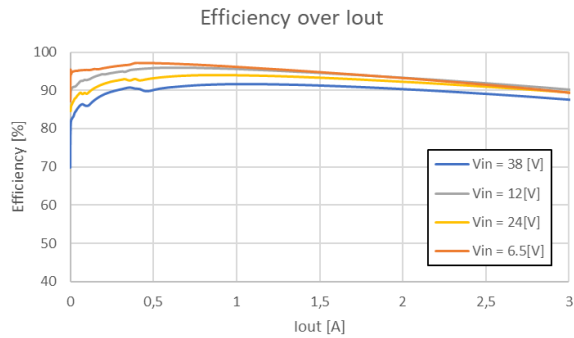
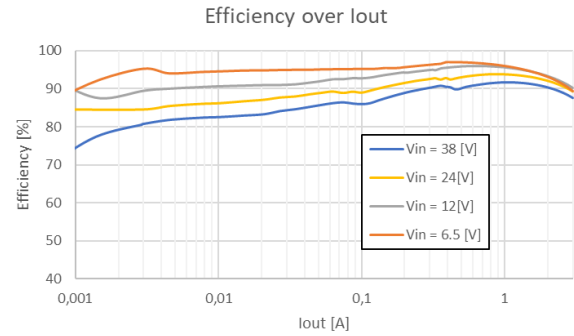
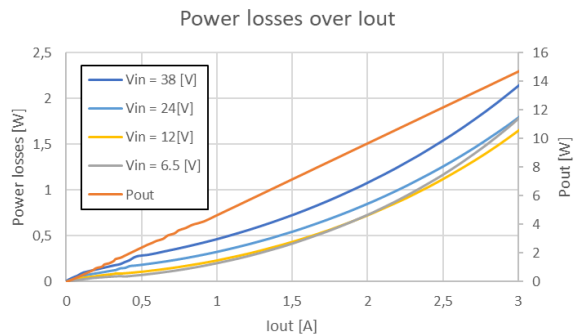
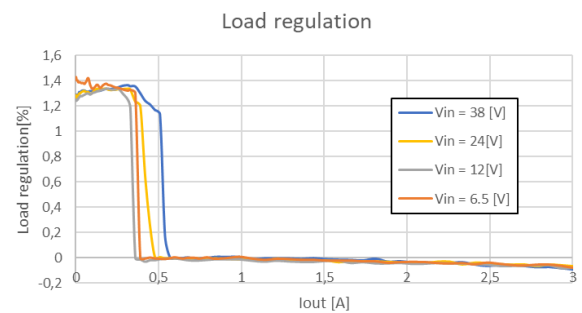


Figure 71. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $V_{OUT, MAX} = 5.165\text{ V}$;
 $V_{OUT, MIN} = 4.890\text{ V}$



6.2 Performance curves

Figure 72. Efficiency measures

Figure 73. Efficiency measures log scale

Figure 74. Power losses

Figure 75. Load regulation


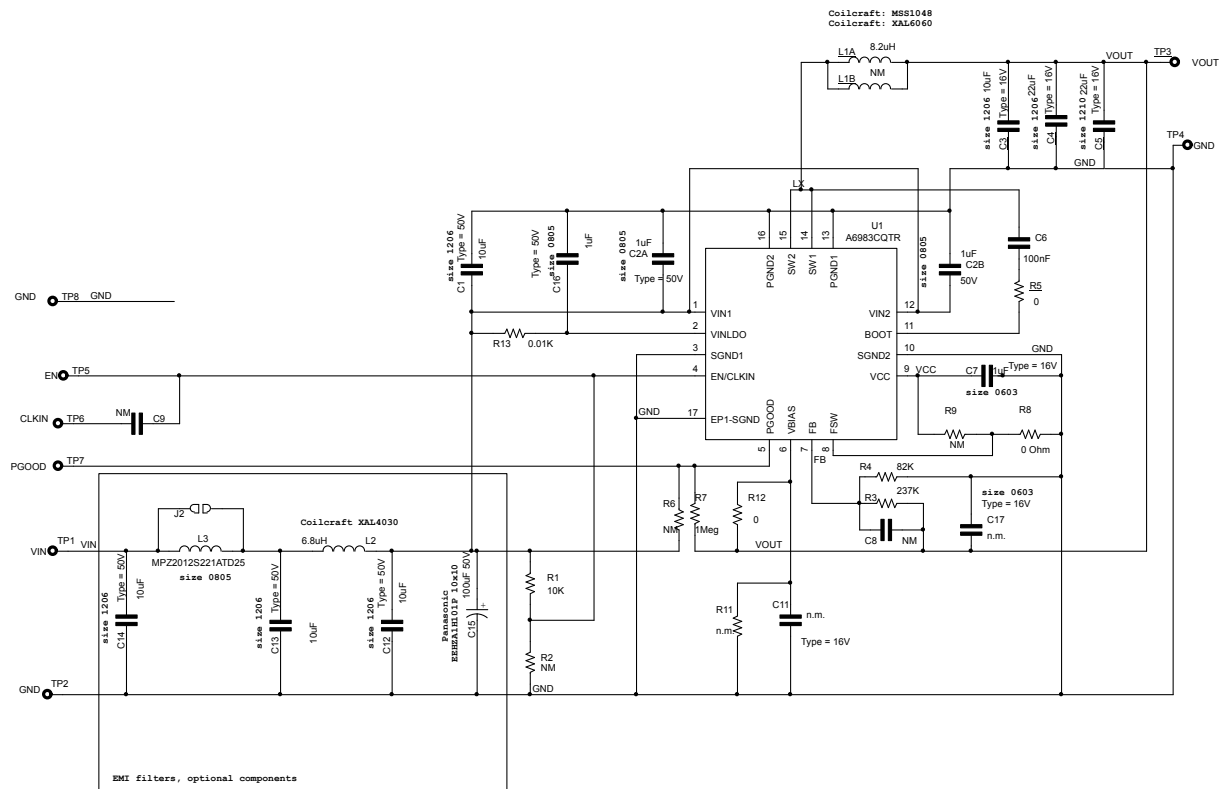
7 Application 3 (V_{OUT} = 3.3 V, F_{SW} = 400 KHz)

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 76. STEVAL-A6983CV1 schematic - application 3



Bill of materials: see [Section 10: Bill of materials](#)

7.1 Oscilloscope ack

Power up from EN

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

Figure 77. V_{IN} = 6.5 V; V_{OUT} = 5 V; I_{OUT} = 3.0 A

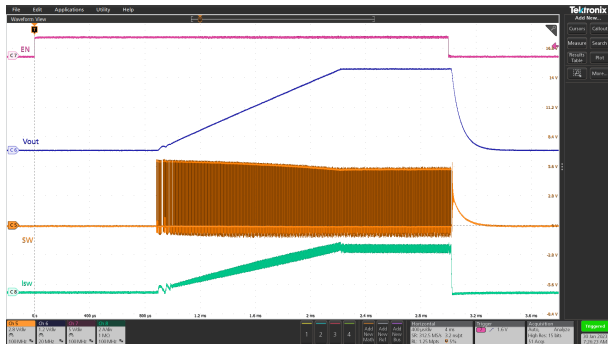


Figure 78. V_{IN} = 12 V; V_{OUT} = 5 V; I_{OUT} = 3.0 A

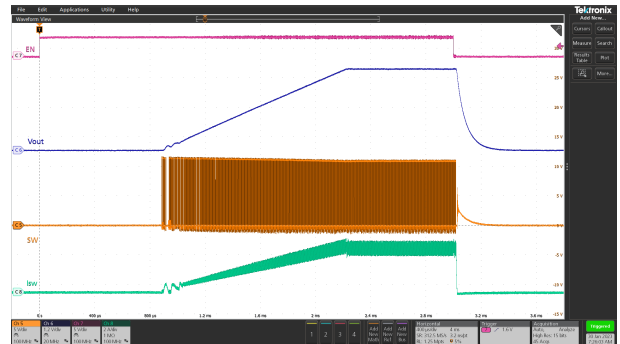


Figure 79. V_{IN} = 24 V; V_{OUT} = 5 V; I_{OUT} = 3.0 A

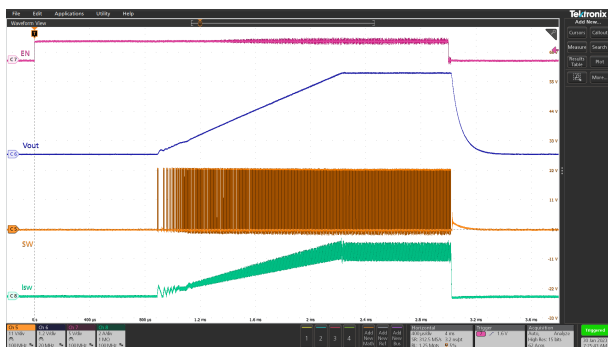
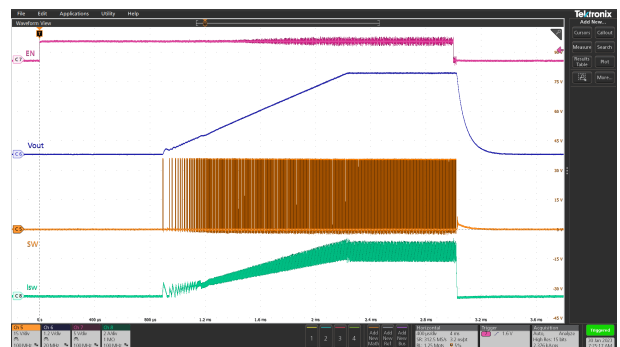


Figure 80. V_{IN} = 38 V; V_{OUT} = 5 V; I_{OUT} = 3.0 A



Power up from V_{IN}

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

Figure 81. V_{IN} = 6.5 V; V_{OUT} = 5 V; I_{OUT} = 3.0 A

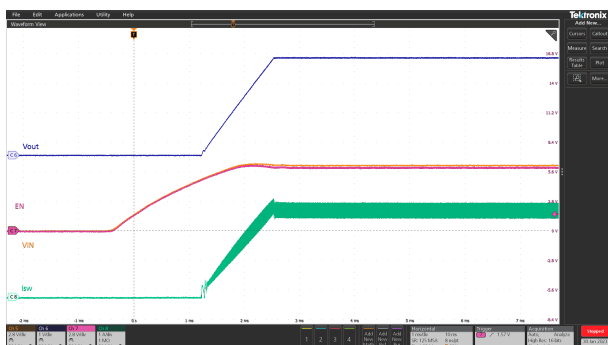


Figure 82. V_{IN} = 12 V; V_{OUT} = 5 V; I_{OUT} = 3.0 A

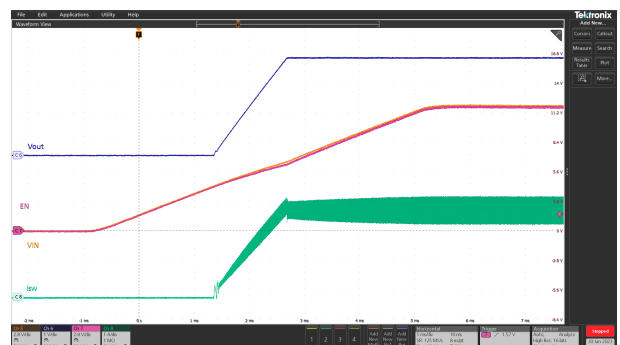
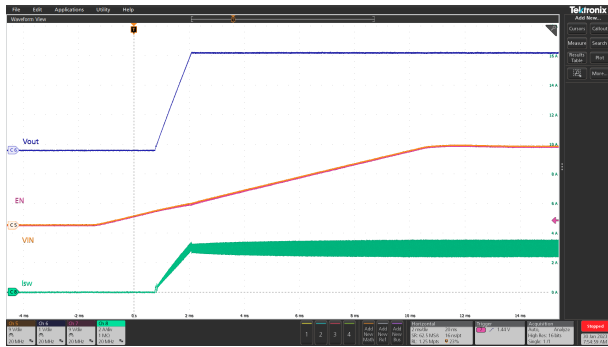
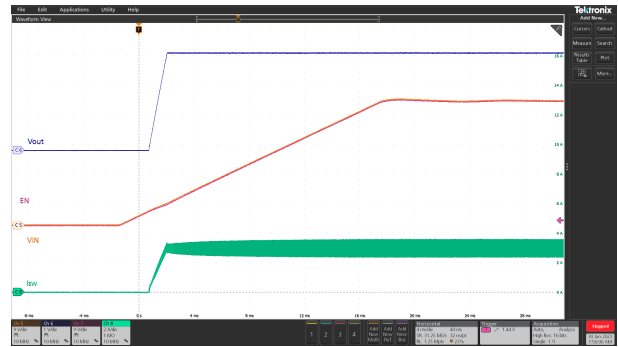
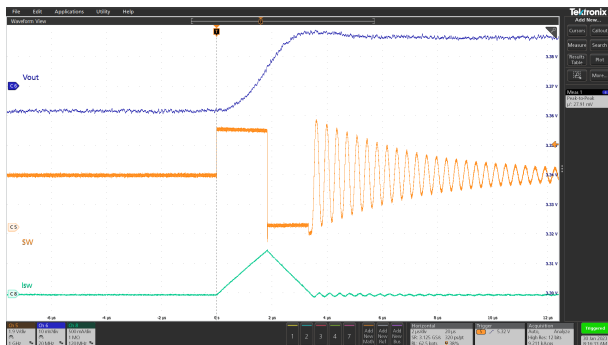
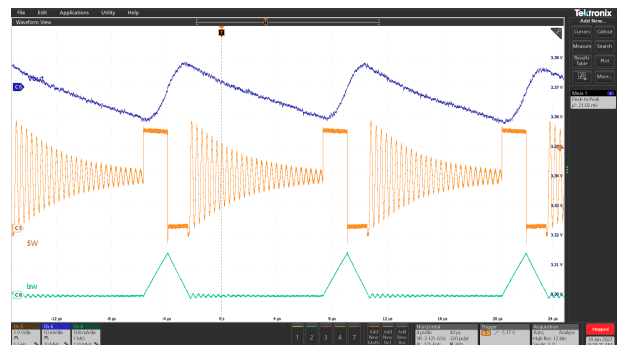
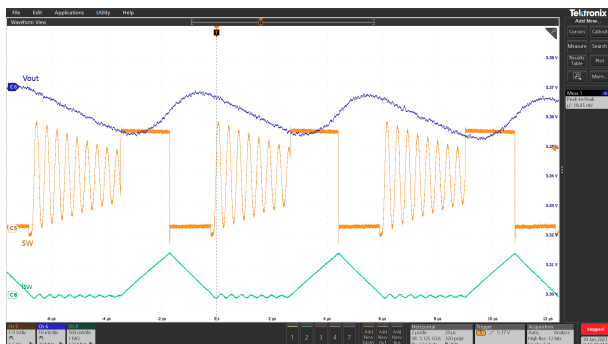
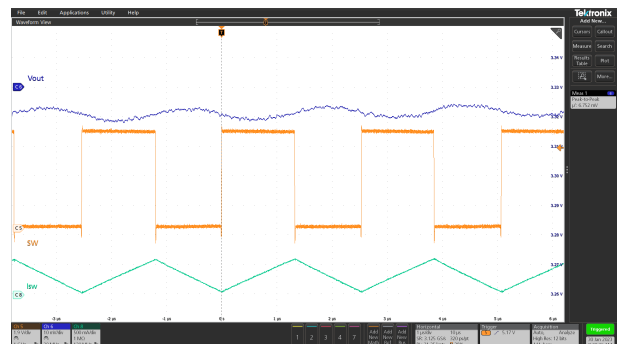


Figure 83. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$

Figure 84. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$


V_{OUT} ripple for light load operation

$V_{IN} = 6.5\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = I_{SW}

Figure 85. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} , RIPPLE ~ 30 mV

Figure 86. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE ~ 25 mV

Figure 87. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} , RIPPLE ~ 20 mV

Figure 88. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.35\text{ A}$; V_{OUT} , RIPPLE ~ 10 mV


$V_{IN} = 12\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = I_{SW}

Figure 89. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 25\text{ mV}$

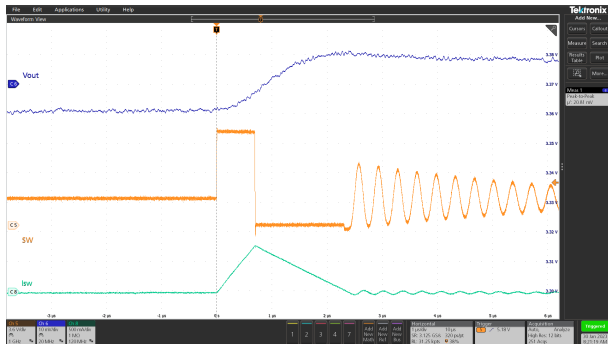


Figure 90. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 20\text{ mV}$

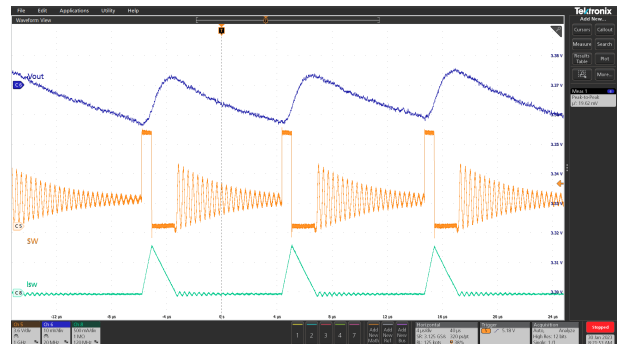


Figure 91. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} , RIPPLE $\sim 20\text{ mV}$

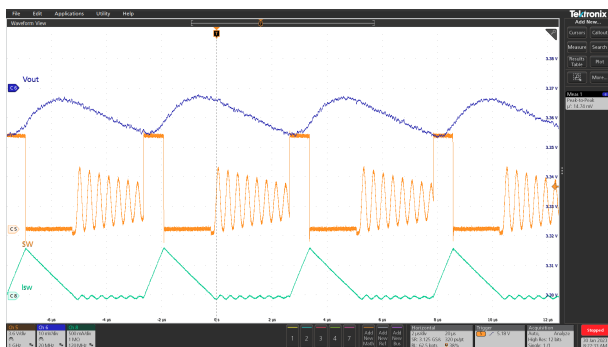
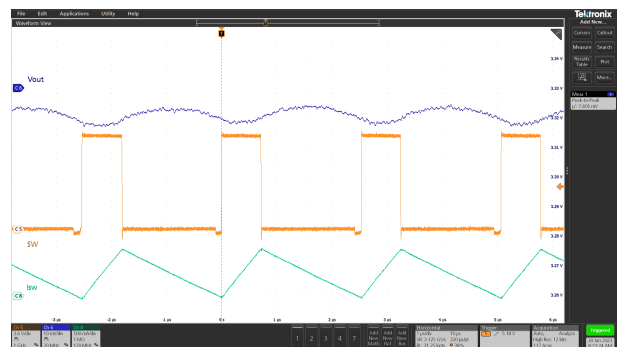


Figure 92. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.35\text{ A}$; V_{OUT} , RIPPLE $\sim 10\text{ mV}$



$V_{IN} = 24\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = $I_{_}SW$

Figure 93. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 25\text{ mV}$

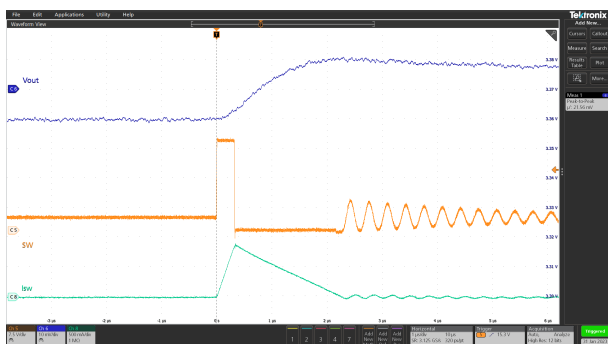


Figure 94. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 25\text{ mV}$

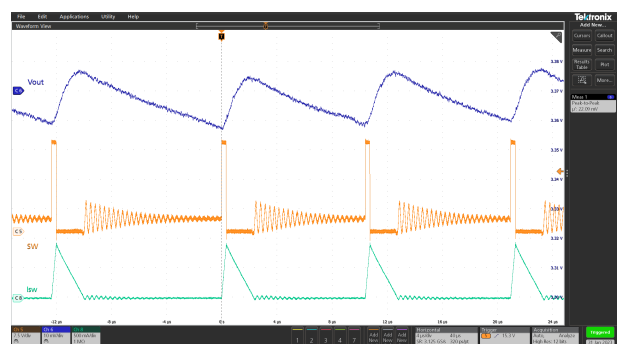


Figure 95. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} ,
RIPPLE $\sim 15\text{ mV}$

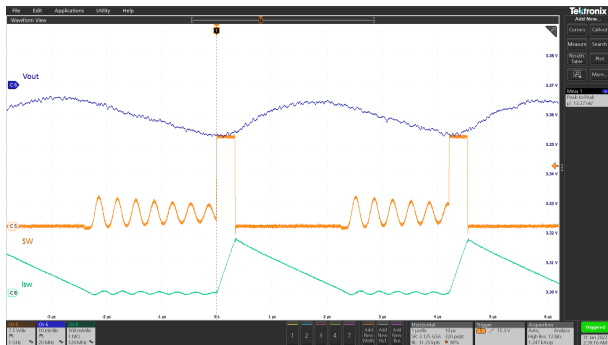
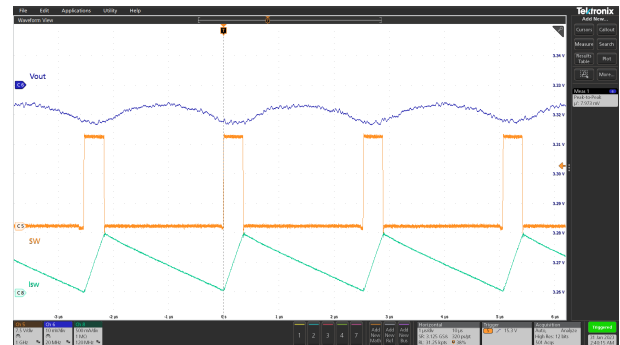


Figure 96. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.35\text{ A}$; V_{OUT} ,
RIPPLE $\sim 10\text{ mV}$



$V_{IN} = 38\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = I_{SW}

Figure 97. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 30\text{ mV}$

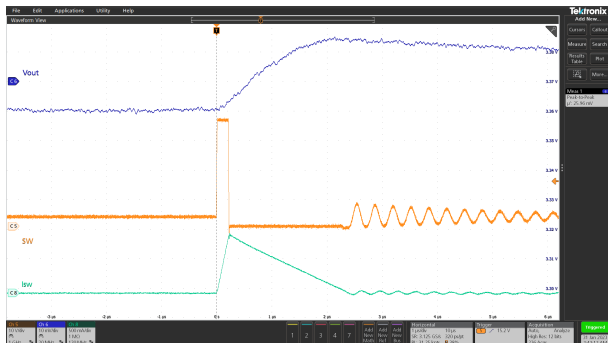


Figure 98. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} ,
RIPPLE $\sim 25\text{ mV}$

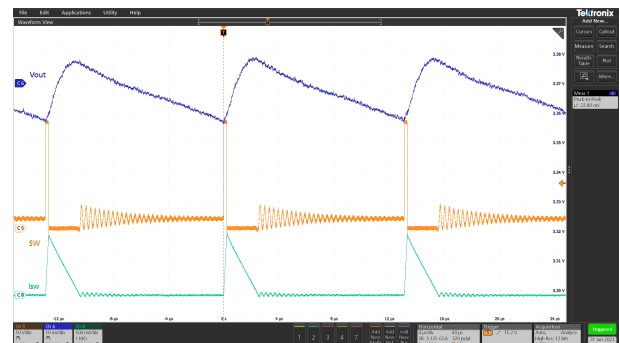


Figure 99. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.25\text{ A}$; V_{OUT} ,
RIPPLE $\sim 20\text{ mV}$

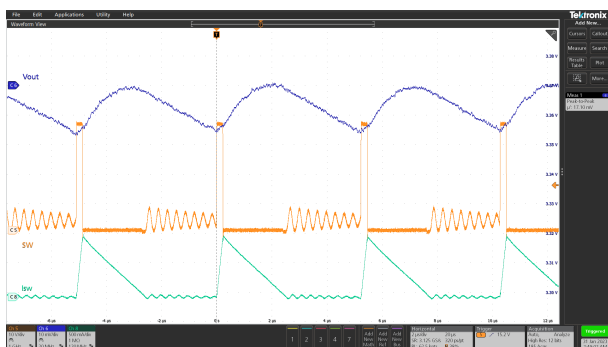
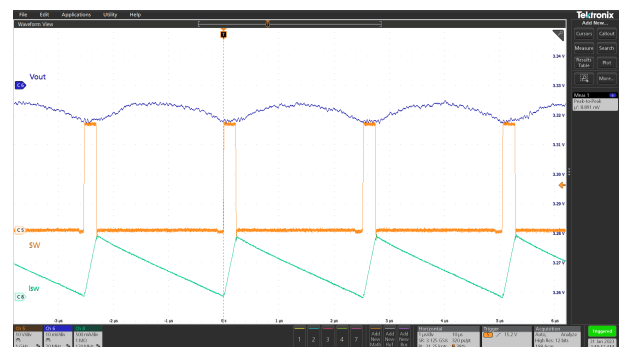


Figure 100. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.5\text{ A}$; V_{OUT} ,
RIPPLE $\sim 10\text{ mV}$



Load transition

I_{OUT} from 0.3 to 3 A; $I_{SLOPE} = 0.1\text{ A}/\mu\text{s}$

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

Figure 101. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.41\text{ V}$;
 $V_{OUT, MIN} = 3.224\text{ V}$

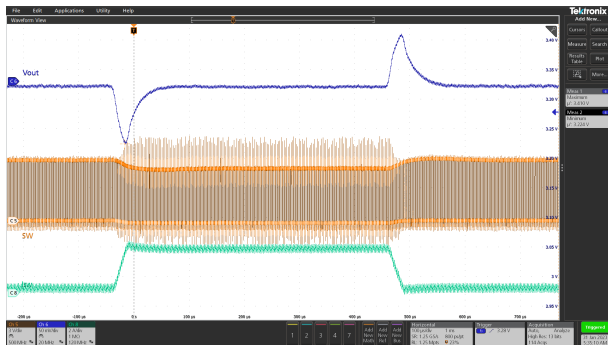


Figure 102. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.409\text{ V}$;
 $V_{OUT, MIN} = 3.223\text{ V}$

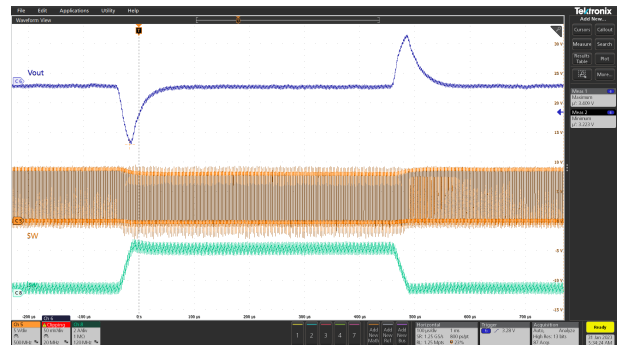


Figure 103. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.411\text{ V}$;
 $V_{OUT, MIN} = 3.215\text{ V}$

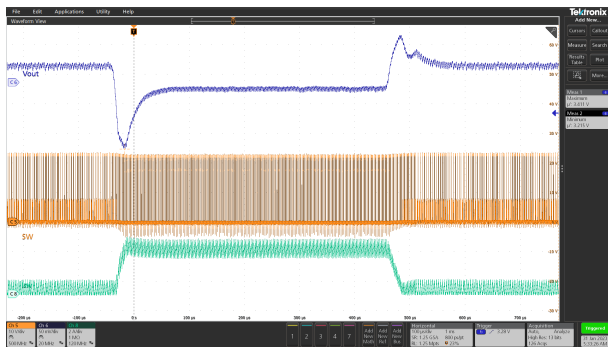
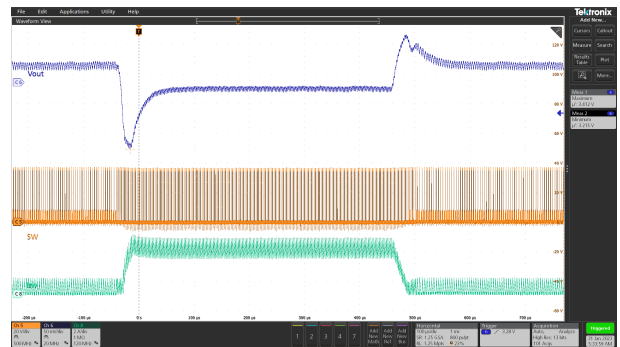
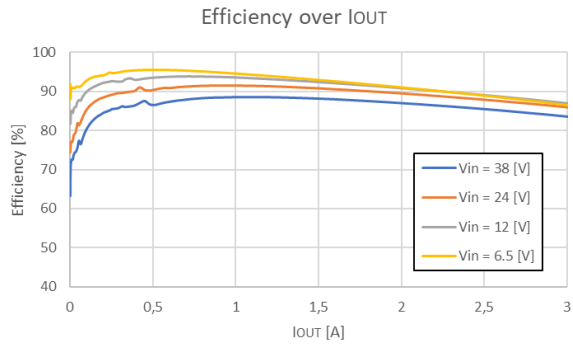
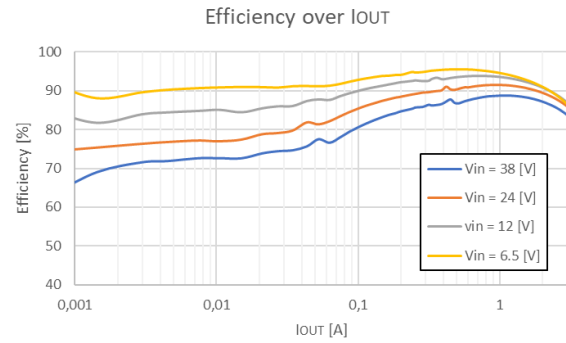
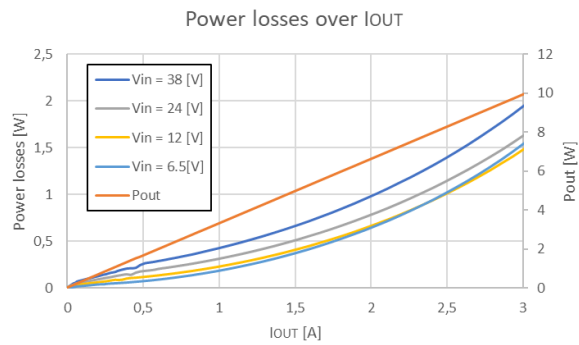
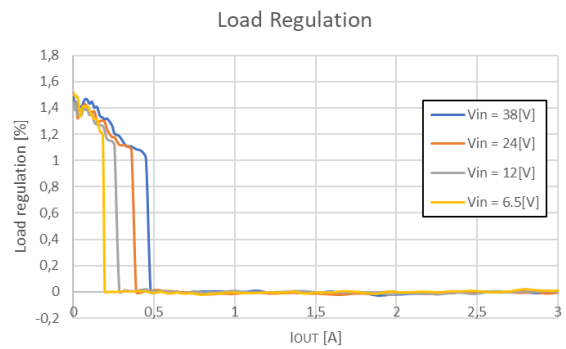


Figure 104. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.412\text{ V}$;
 $V_{OUT, MIN} = 3.215\text{ V}$



7.2 Performance curves

Figure 105. Efficiency measures

Figure 106. Efficiency measures log scale

Figure 107. Power losses

Figure 108. Load regulation


7.3 Thermal acquisitions

The measures have been acquired with:

1. $T_{AMB} = 25\text{ }^{\circ}\text{C}$
2. $I_{OUT} = 3\text{ A}$

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 109. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$

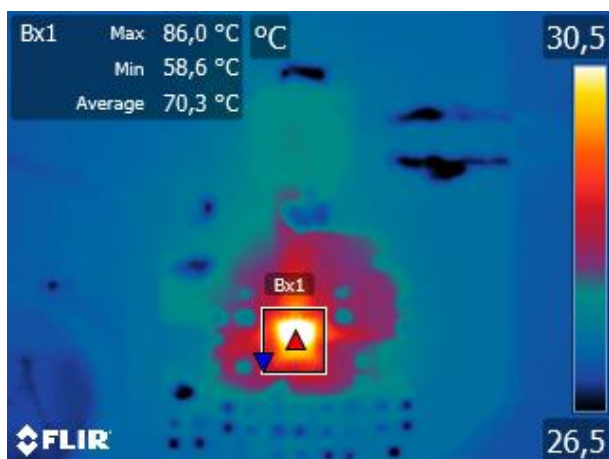


Figure 110. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$

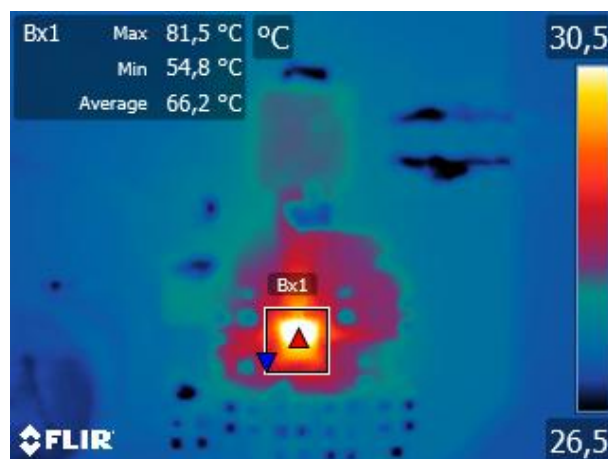


Figure 111. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$

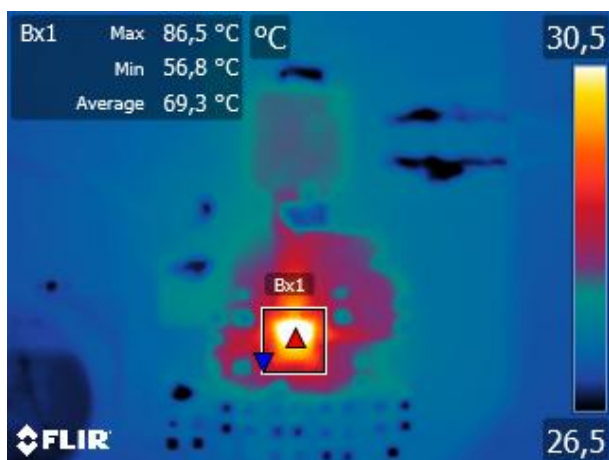
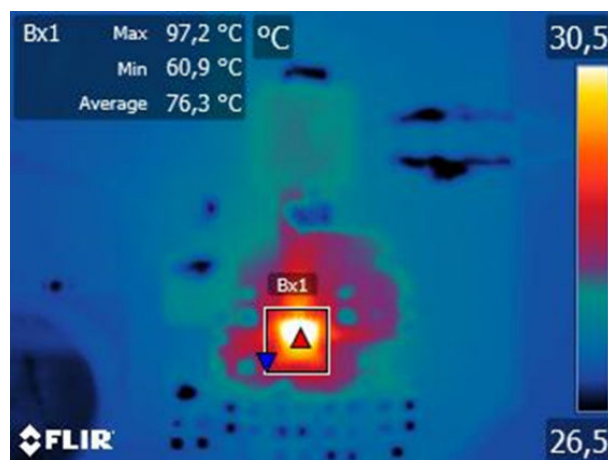


Figure 112. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$



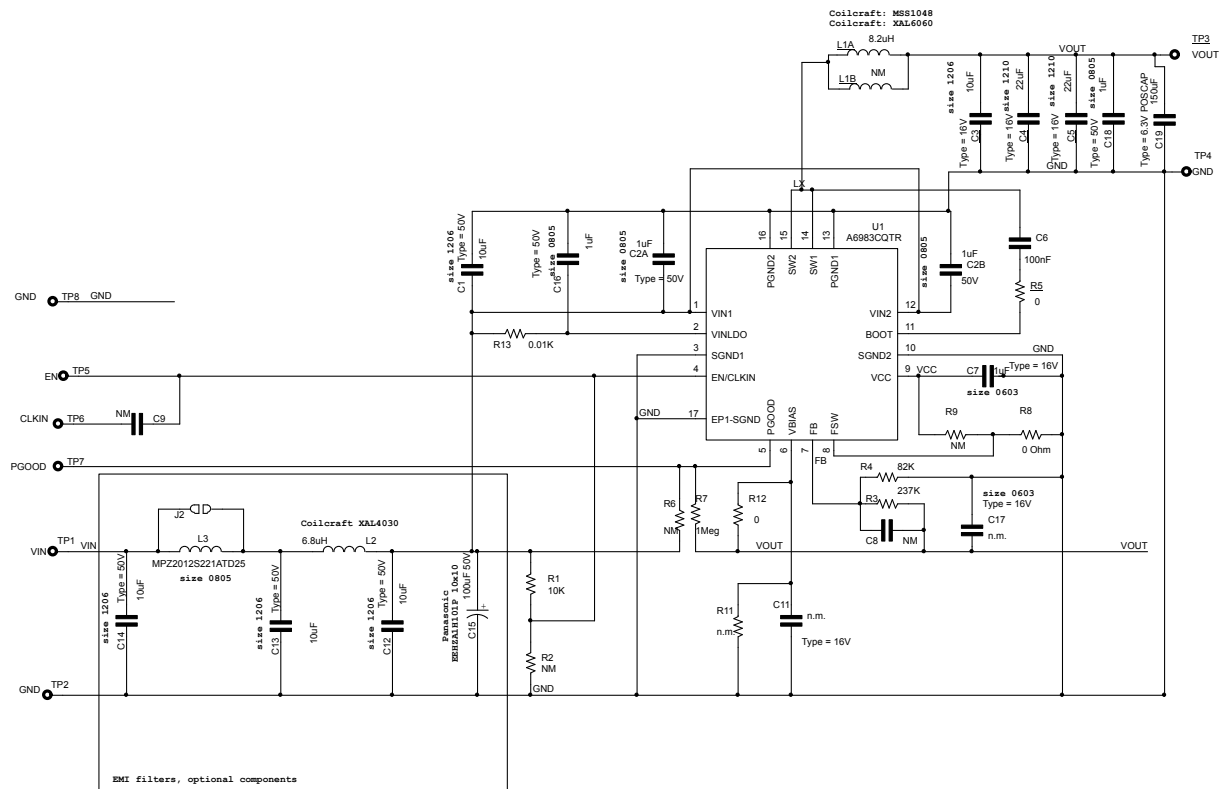
8 Application 4 ($V_{OUT} = 3.3\text{ V}$, $F_{SW} = 400\text{ KHz}$, low AC ripple)

Application conditions:

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

Schematic:

Figure 113. STEVAL-A6983CV1 schematic - application 4



Bill of materials: see [Section 10: Bill of materials](#)

8.1 Oscilloscope ack

Power up from EN

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

Figure 114. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$

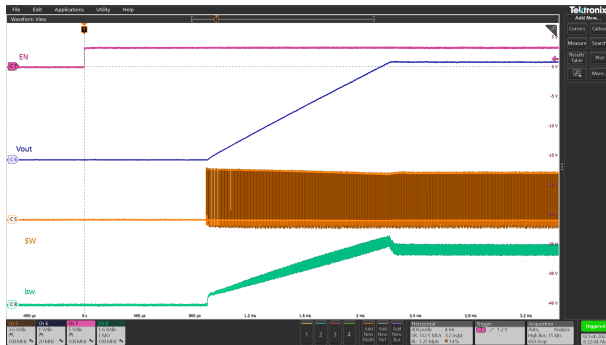


Figure 115. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$

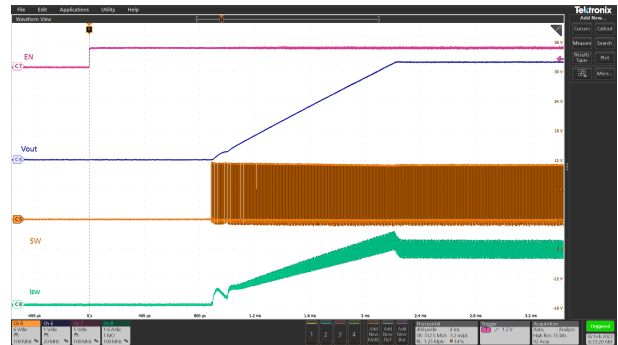


Figure 116. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$

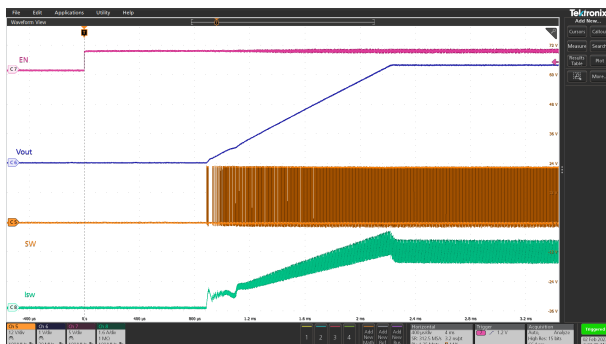
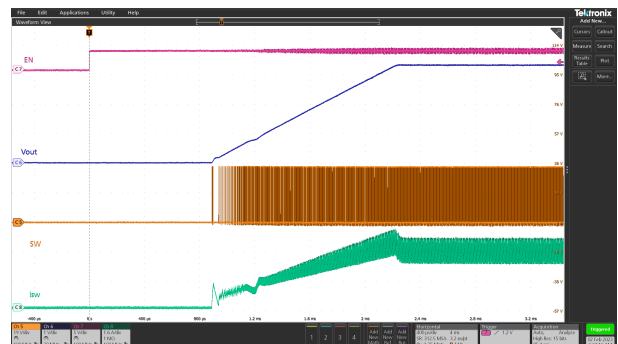


Figure 117. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$



Power up from V_{IN}

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

Figure 118. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$

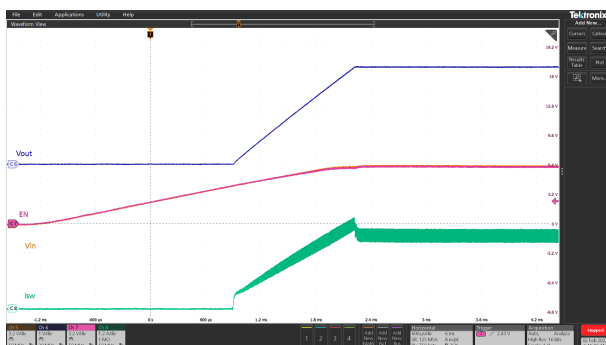


Figure 119. $V_{IN} = 12\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$

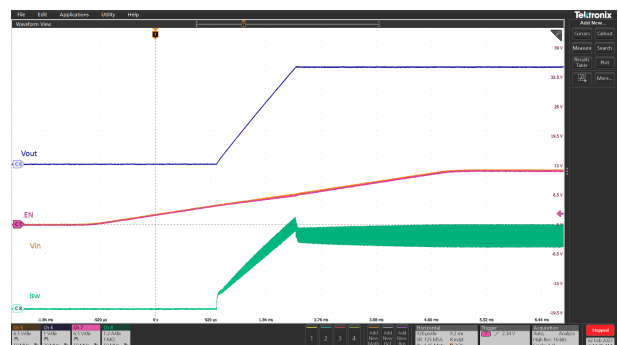
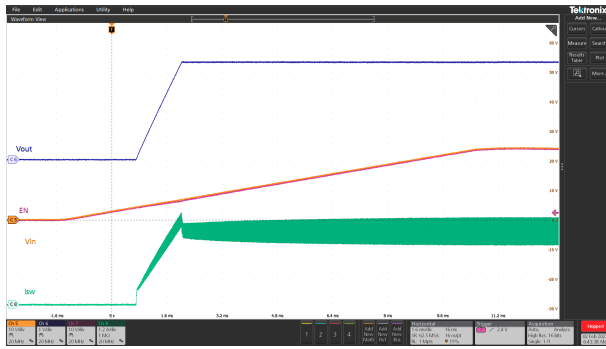
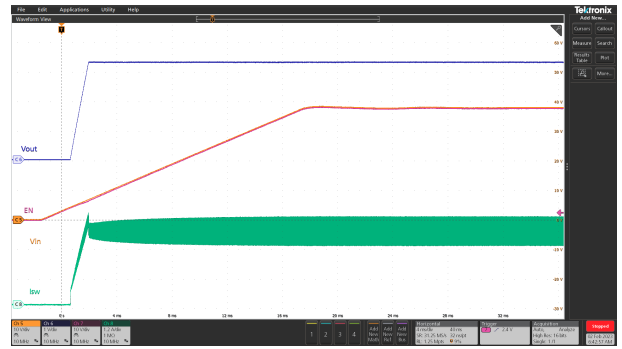
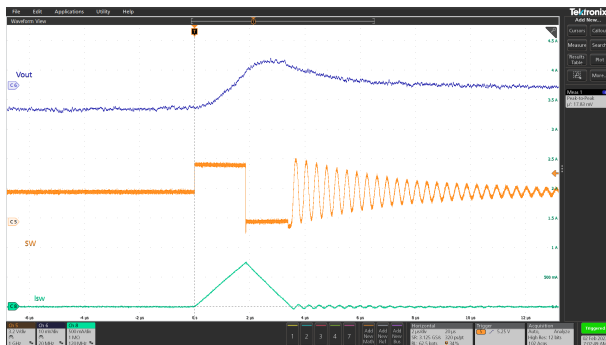
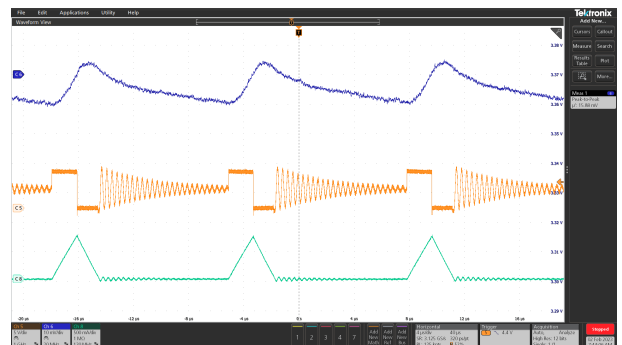
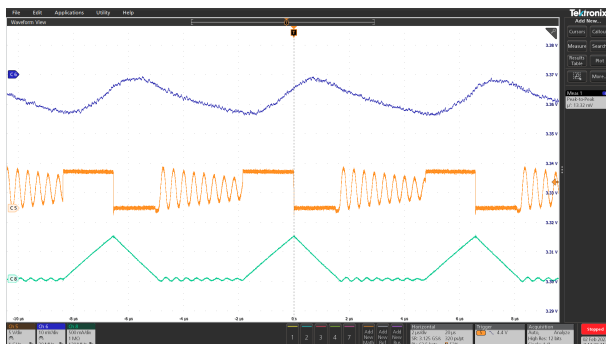
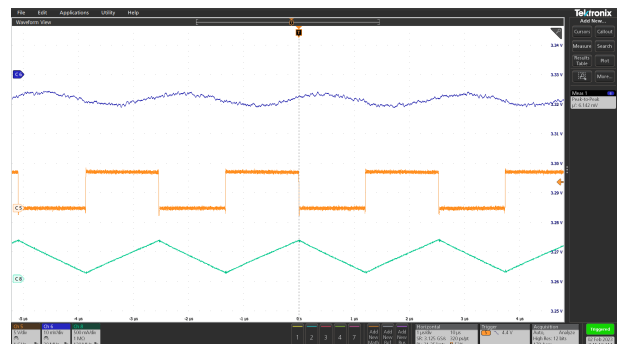


Figure 120. $V_{IN} = 24\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$

Figure 121. $V_{IN} = 38\text{ V}$; $V_{OUT} = 5\text{ V}$; $I_{OUT} = 3.0\text{ A}$


V_{OUT} ripple for light load operation

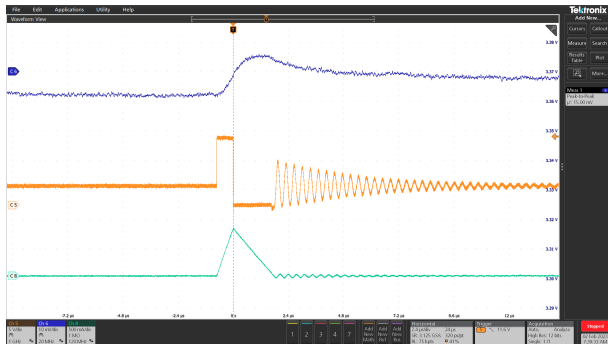
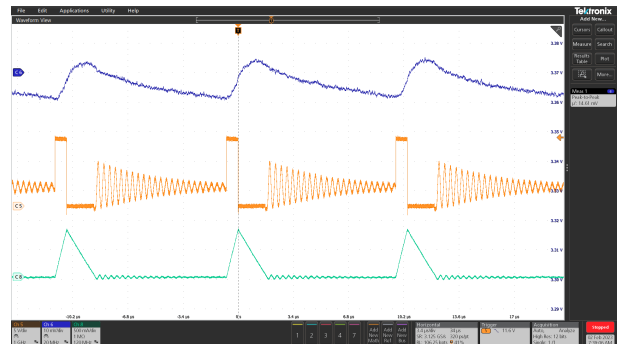
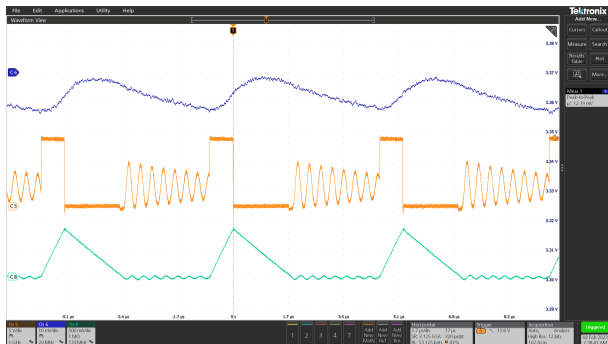
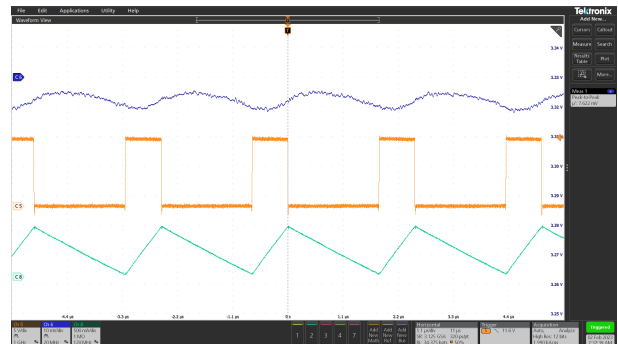
$V_{IN} = 6.5\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = I_{SW}

Figure 122. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} , RIPPLE ~ 18 mV

Figure 123. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE ~ 16 mV

Figure 124. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} , RIPPLE ~ 14 mV

Figure 125. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.35\text{ A}$; V_{OUT} , RIPPLE ~ 10 mV


$V_{IN} = 12\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = I_{SW}

Figure 126. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 15\text{ mV}$

Figure 127. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 15\text{ mV}$

Figure 128. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} , RIPPLE $\sim 12\text{ mV}$

Figure 129. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.35\text{ A}$; V_{OUT} , RIPPLE $\sim 10\text{ mV}$


$V_{IN} = 24\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = I_{SW}

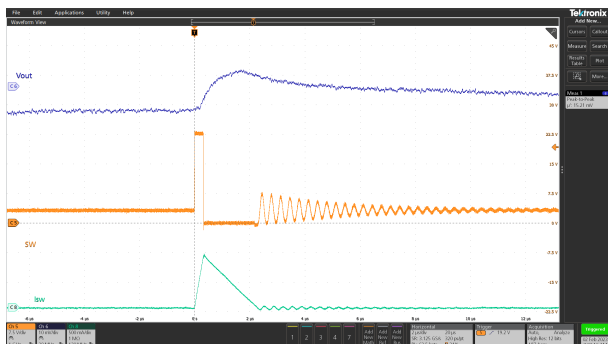
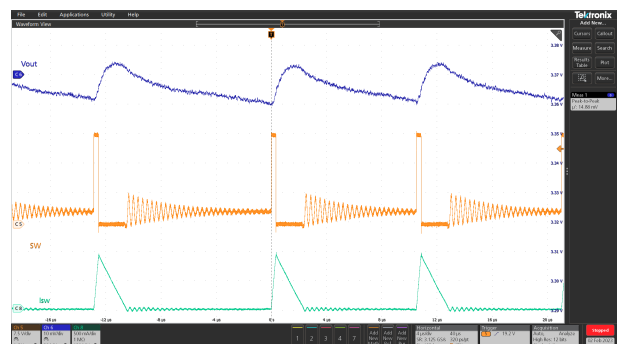
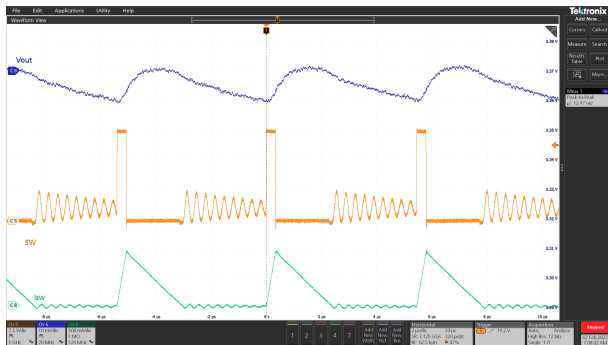
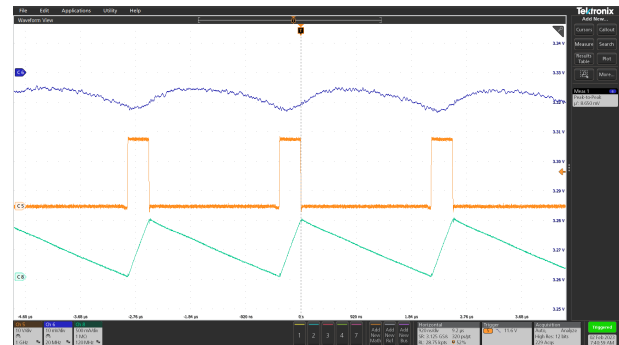
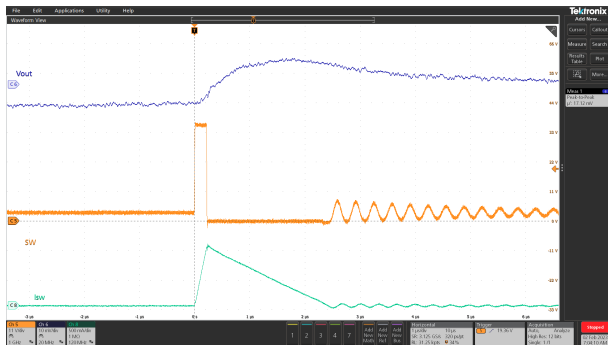
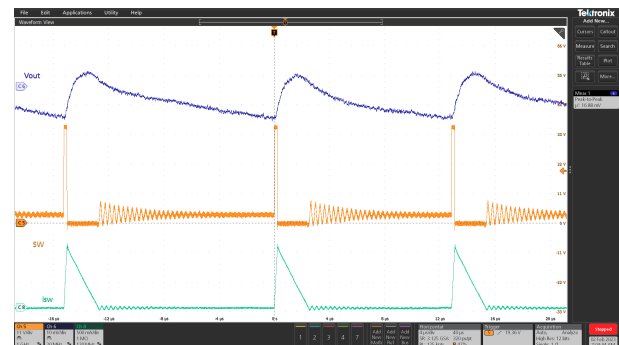
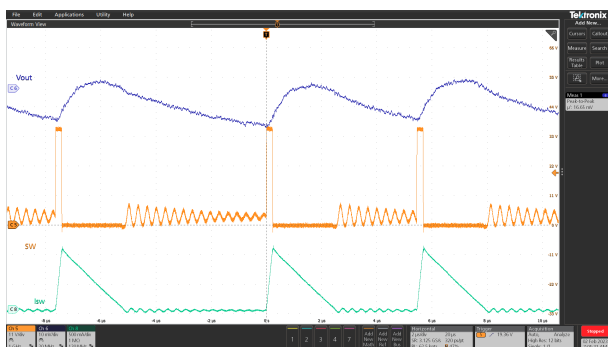
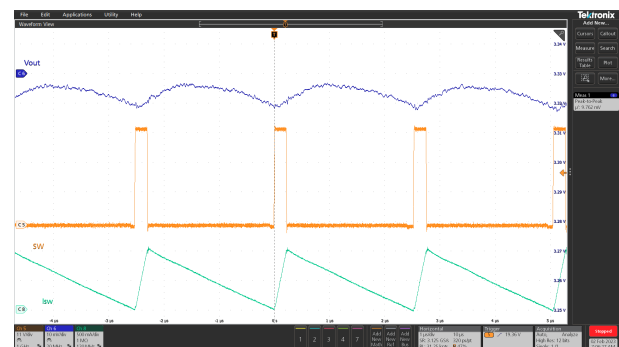
Figure 130. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} , RIPPLE $\sim 15\text{ mV}$

Figure 131. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} , RIPPLE $\sim 15\text{ mV}$


Figure 132. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.2\text{ A}$; V_{OUT} ,
RIPPLE $\sim 12\text{ mV}$

Figure 133. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.35\text{ A}$; V_{OUT} ,
RIPPLE $\sim 10\text{ mV}$


$V_{IN} = 38\text{ V}$

- Yellow = SW
- Blue = V_{OUT}
- Green = I_{SW}

Figure 134. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; no load; V_{OUT} ,
RIPPLE $\sim 18\text{ mV}$

Figure 135. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.1\text{ A}$; V_{OUT} ,
RIPPLE $\sim 18\text{ mV}$

Figure 136. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.25\text{ A}$; V_{OUT} ,
RIPPLE $\sim 18\text{ mV}$

Figure 137. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $I_{OUT} = 0.5\text{ A}$; V_{OUT} ,
RIPPLE $\sim 10\text{ mV}$


Load transition

I_{OUT} from 0.3 to 3 A; $I_{SLOPE} = 0.1\text{ A}/\mu\text{s}$

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

Figure 138. $V_{IN} = 6.5\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.41\text{ V}$;
 $V_{OUT, MIN} = 3.23\text{ V}$

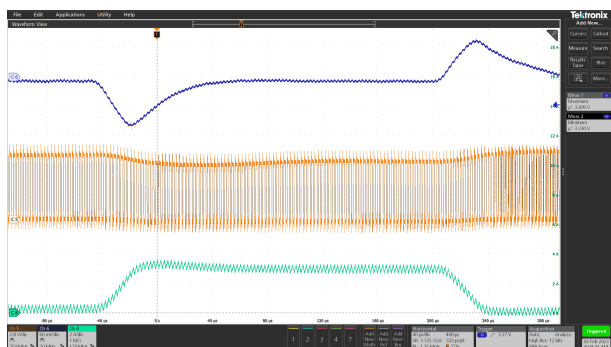


Figure 139. $V_{IN} = 12\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.41\text{ V}$;
 $V_{OUT, MIN} = 3.22\text{ V}$

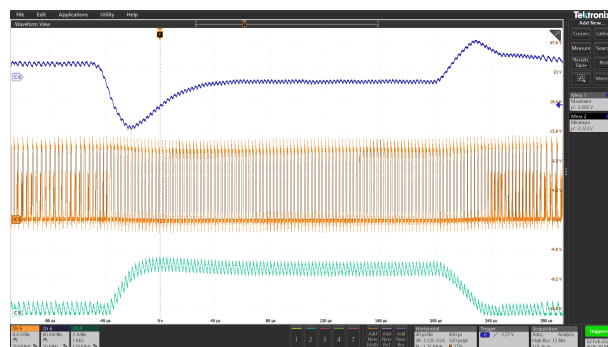


Figure 140. $V_{IN} = 24\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.41\text{ V}$;
 $V_{OUT, MIN} = 3.22\text{ V}$

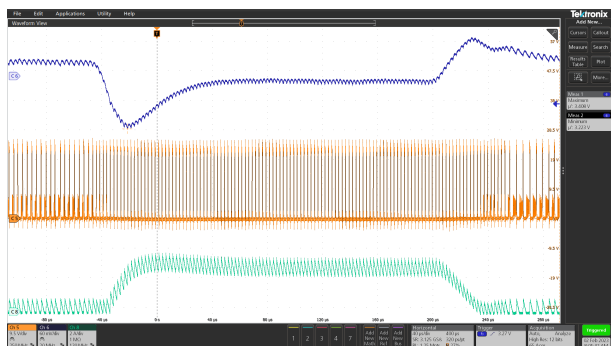
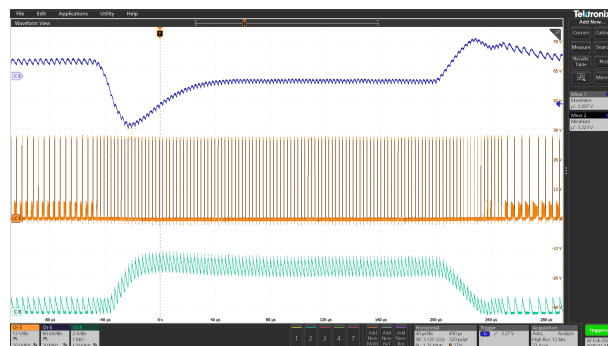


Figure 141. $V_{IN} = 38\text{ V}$; $V_{OUT} = 3.3\text{ V}$; $V_{OUT, MAX} = 3.41\text{ V}$;
 $V_{OUT, MIN} = 3.22\text{ V}$



8.2 Performance curves

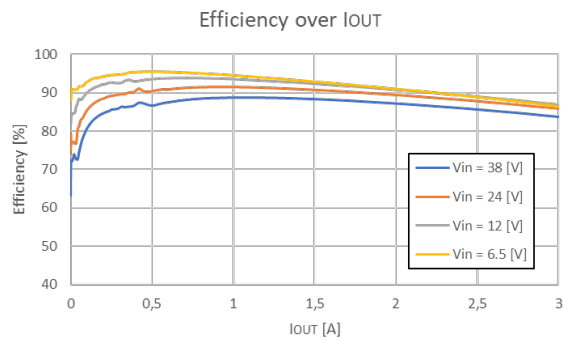
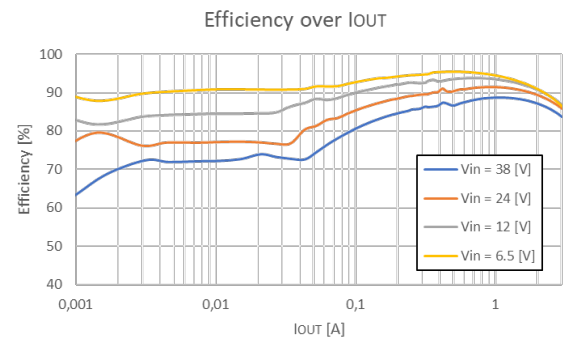
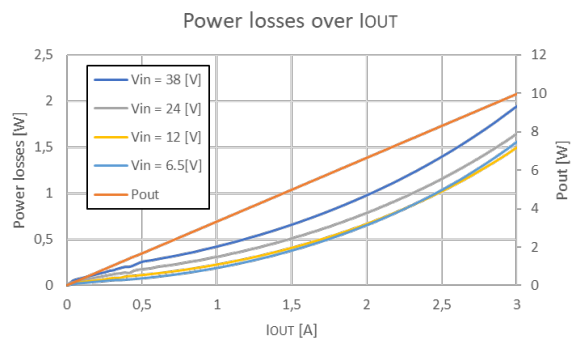
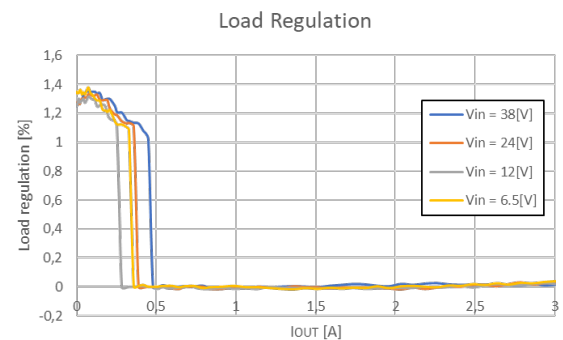
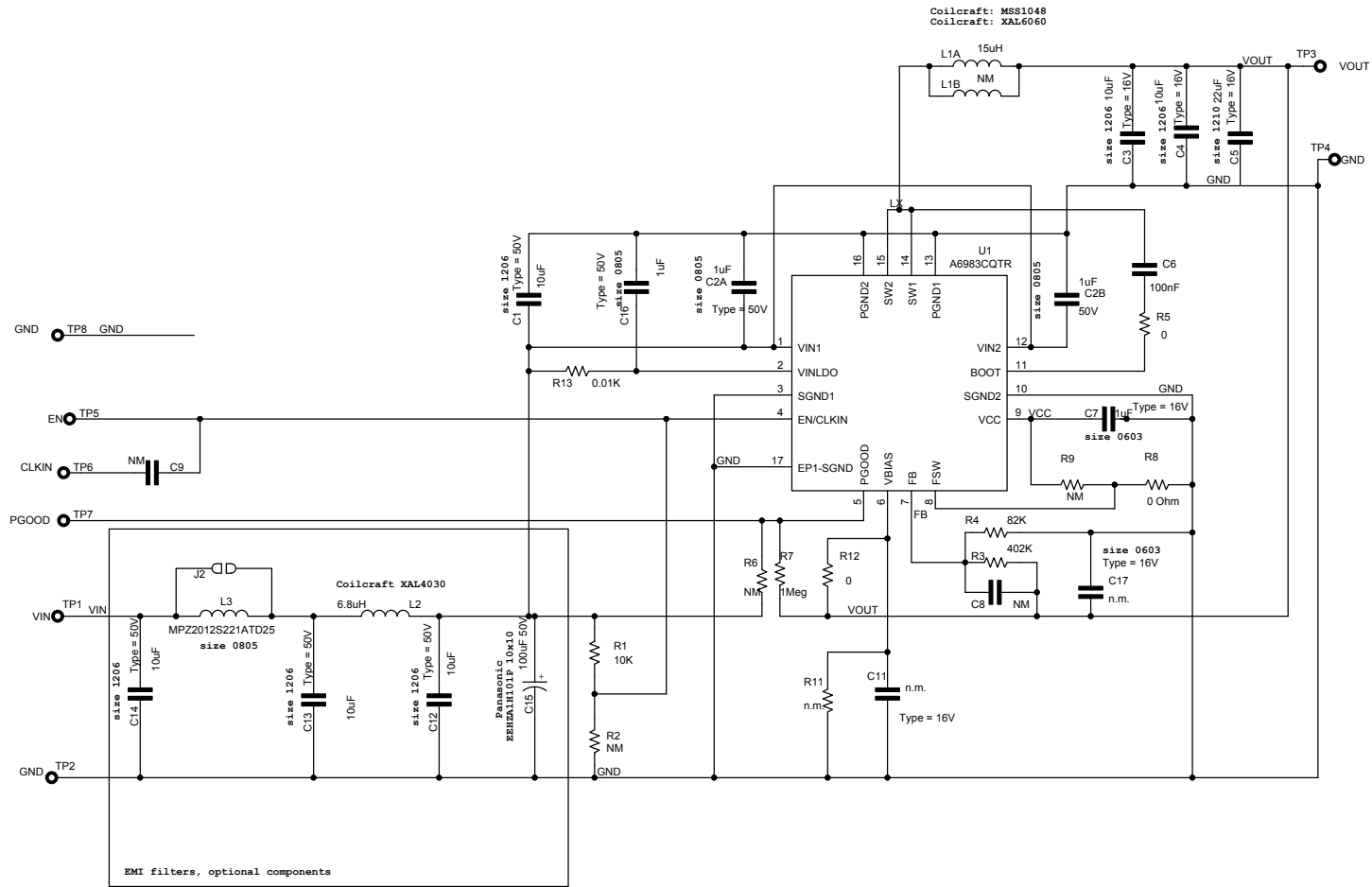
Figure 142. Efficiency measures

Figure 143. Efficiency measures log scale

Figure 144. Power losses

Figure 145. Load regulation


Figure 146. STEVAL-A6983CV1 schematic diagrams



10 Bill of materials

Table 2. STEVAL-A6983CV1 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, +/- 20%	X7R ceramic capacitor	TDK	CGA4J3X7R1H105M125AB
3	1	C5	22µF 25V, 1210(2225 metric), 50 V, +/-20%	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	0603(1608 metric)	(not mounted)		
7	1	C15	100µF 50V, 10x10mm, 50 V, +/- 20%	Electrolytic Capacitors	Panasonic	EEHZA1H101P
8	1	L1A	15µH 60V, XAL6060, 60 V, +/- 20 %	Shielded power inductors	Coilcraft	XAL6060-153ME_
9	1	L1B	MSS1048	(not mounted)		
10	2	L2	6.8µH 60V, XAL4030, 60 V, +/- 20%	Shielded power inductors	Coilcraft	XAL4030-682ME_
11	1	L3	220Ω at 100KHz, 0805(2012 metric), 3 A, +/- 25%	Ferrite Bead	TDK	MPZ2012S221ATD25
12	1	R1	10KΩ, 0603(1608 metric), +/- 1%	Resistor	ROHM	MCR006YZPF1002
13	4	R2, R6, R9, R11	0603(1608 metric)	(not mounted)		
14	1	R3	402KΩ, 0603(1608 metric), +/- 1%	Resistor	PANASONIC	ERJ1GNF4023C
15	1	R4	82KΩ, 0603(1608 metric), +/- 1%	Resistor	MULTICOMP PRO	MCRE000186
16	3	R5, R8, R12	0 Ω, 0603(1608 metric), +/-1	Resistor	MULTICOMP PRO	MCRE000086
17	1	R7	1MΩ, 0603(1608 metric), +/-1 %	Resistor	PANASONIC	ERJ-U01F1004C

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
18	1	R13	10Ω, 0603(1608 metric), +/-1%	Resistor	PANASONIC	ERJ-U01F10R0C
19	4	TP1, TP2, TP3, TP4,	1mm	Single Male Header	ETTINGER	13.14.145
20	4	TP5, TP6, TP7, TP8		Strip line 4 pin	AMPHENOL COMMUNICATIONS SOLUTIONS	78511-204HLF
21	1	U1	38 3	DCDC	ST	A6983CQTR

11 Board versions

Table 3. STEVAL-A6983CV1 versions

PCB version	Schematic diagrams	Bill of materials
STEVAL\$A6983CV1A ⁽¹⁾	STEVAL\$A6983CV1A schematic diagrams	STEVAL\$A6983CV1A bill of materials

1. This code identifies the STEVAL-A6983CV1 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
01-Feb-2024	1	Initial release.

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