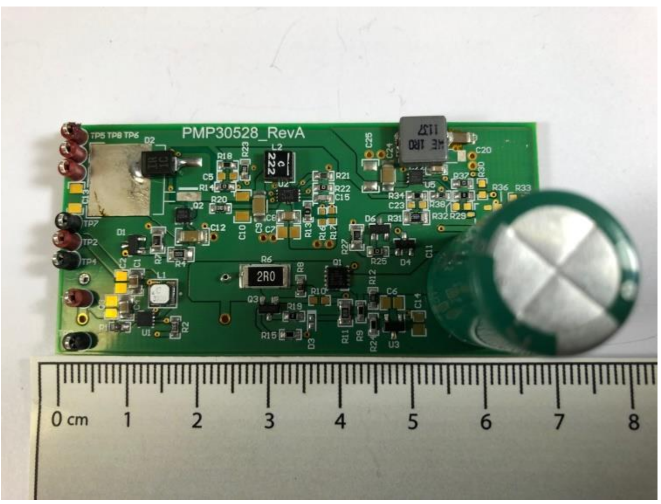
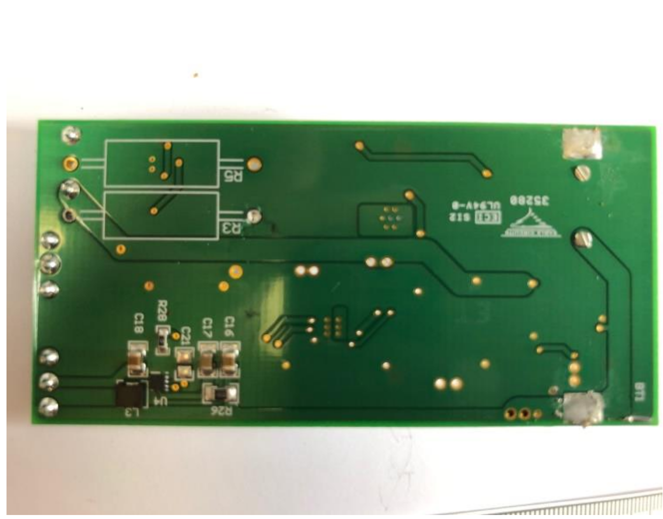
Test Report: PMP30528
Supercapacitor backup power supply for E-Meters reference design

Description

This reference design automatically provides back-up voltages to an E-Meter during a power interruption. While the input voltage is between 10 V to 12 V two buck controller (TPS62147, TPS62173) generate 3.9 V at 2 A and 5 V at 150 mA. An optional synchronous boost generates 3.3 V at 50mA. A discrete charge circuit charges a supercapacitor with a constant current up to an adjustable voltage of 2.7 V. When the input voltage fails a synchronous boost (TPS61022) takes over and boost the supercap voltage to 3.9 V. The supercap capacitance and voltage defines the energy which is available for the backup. The PMP30528 provides a stable backup output of 3.9 V at 200mA for about 70 s until the output voltage drops.





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1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input	10V – 12V
3.9Vout	2A
5Vout	150mA
3.3Vout	50mA

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1.2 Considerations*

General Texas Instruments High Voltage Evaluation (TI HV EVM) User Safety Guidelines

WARNING:

Always follow TI's set-up and application instructions, including use of all interface components within their recommended electrical rated voltage and power limits. Always use electrical safety precautions to help ensure your personal safety and those working around you. Contact TI's Product Information Center http://support/ti./com for further information.

Save all warnings and instructions for future reference.

Failure to follow warnings and instructions may result in personal injury, property damage or death due to electrical shock and burn hazards.

The term TI HV EVM refers to an electronic device typically provided as an open framed, unenclosed printed circuit board assembly. It is intended strictly for use in development laboratory environments, solely for qualified professional users having training, expertise and knowledge of electrical safety risks in development and application of high voltage electrical circuits. Any other use and/or application are strictly prohibited by Texas Instruments. If you are not suitable qualified, you should immediately stop from further use of the HV EVM.

1. Work Area Safety:
a. Keep work area clean and orderly.
b. Qualified observer(s) must be present anytime circuits are energized.
c. Effective barriers and signage must be present in the area where the TI HV EVM and its interface electronics are energized, indicating operation of accessible high voltages may be present, for the purpose of protecting inadvertent access i
d. All interface circuits, power supplies, evaluation modules, instruments, meters, scopes and other related apparatus used in a development environment exceeding
50Vrms/75VDC must be electrically located within a protected Emergency Power Off
EPO protected power strip.
e. Use stable and non conductive work surface.
f. Use adequately insulated clamps and wires to attach measurement probes and instruments. No freehand testing whenever possible.

2. Electrical safety:
As a precautionary measure, it is always a good engineering practice to assume that the entire EVM may have fully accessible and active high voltages.
a. De-energize the TI HV EVM and all its inputs, outputs and electrical loads before performing any electrical or other diagnostic measurements. Revalidate that TI HV EVM
power has been safely de-energized.
b. With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment hook-ups and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
c. Once EVM readiness is complete, energize the EVM as intended.

WARNING: WHILE THE EVM IS ENERGIZED, NEVER TOUCH THE EVM OR ITS ELECTRICAL CIRCUITS AS THEY COULD BE AT HIGH VOLTAGES CAPABLE OF CAUSING ELECTRICAL SHOCK HAZARD.

3. Personal Safety
a. Wear personal protective equipment e.g. latex gloves or safety glasses with side shields or protect EVM in an adequate lucent plastic box with interlocks from accidental touch.
Limitation for safe use:
EVMs are not to be used as all or part of a production unit.

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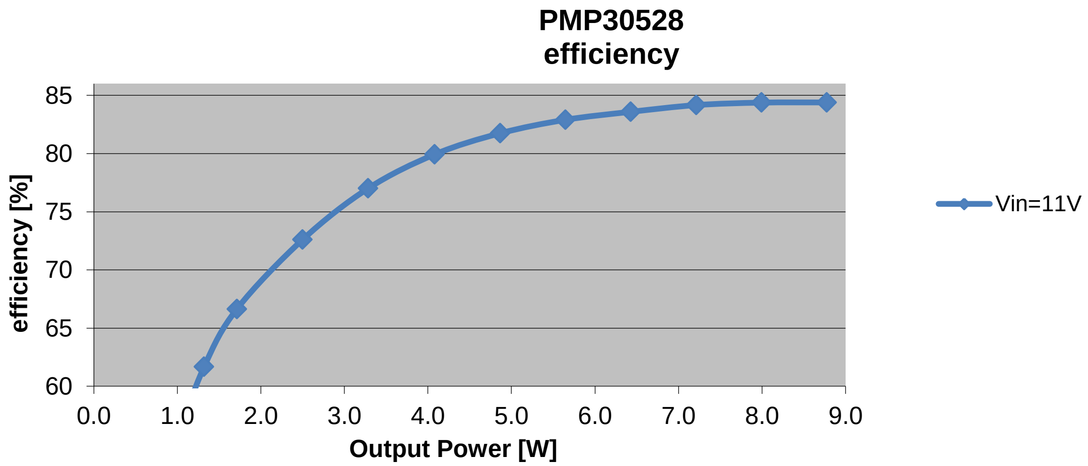
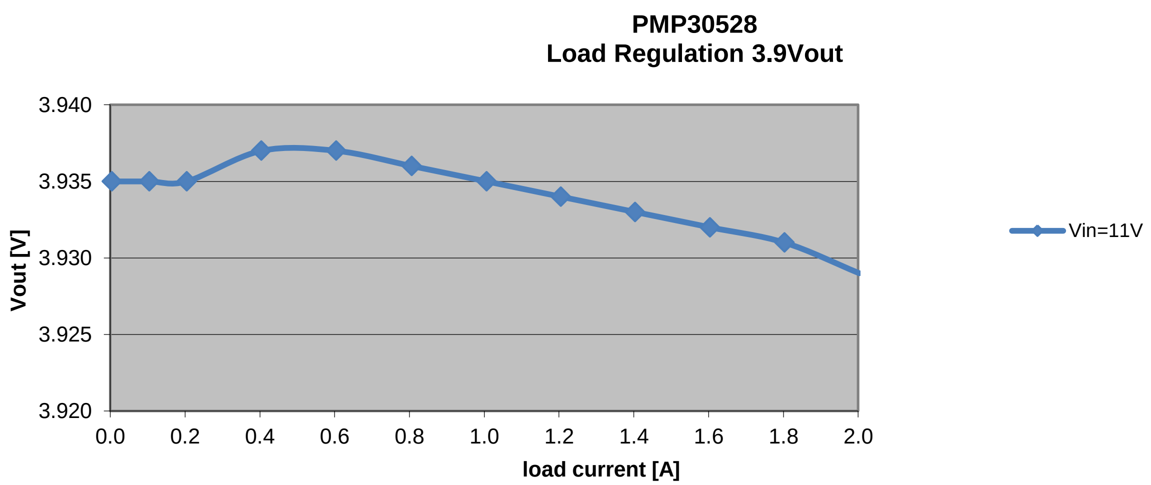
1.3 Efficiency Graph



1.4 Load Regulation 3.9Vout (normal operation)

Input Voltage	= 11V
Load Current 3.9Vout	= 0 – 2A



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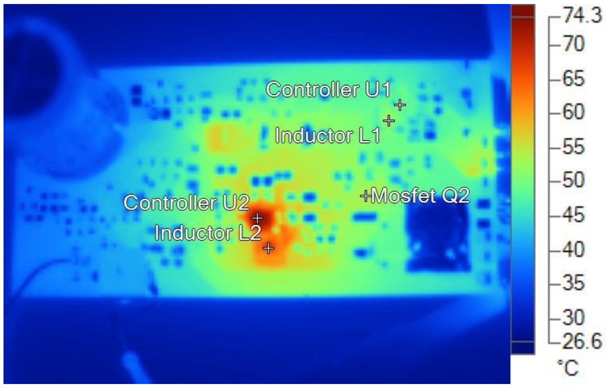
1.5 Thermal Images

Input Voltage = 11V
3.9Vout = 2A
5Vout = 150mA
3.3Vout = 50mA



Vin=11V full load Top

Name	Temperature
Controller U2	74.3°C
Inductor L2	68.3°C
Inductor L1	51.5°C
Controller U1	48.7°C
Mosfet Q2	53.9°C

1.6 Dimension

7.0cm x 3.4cm

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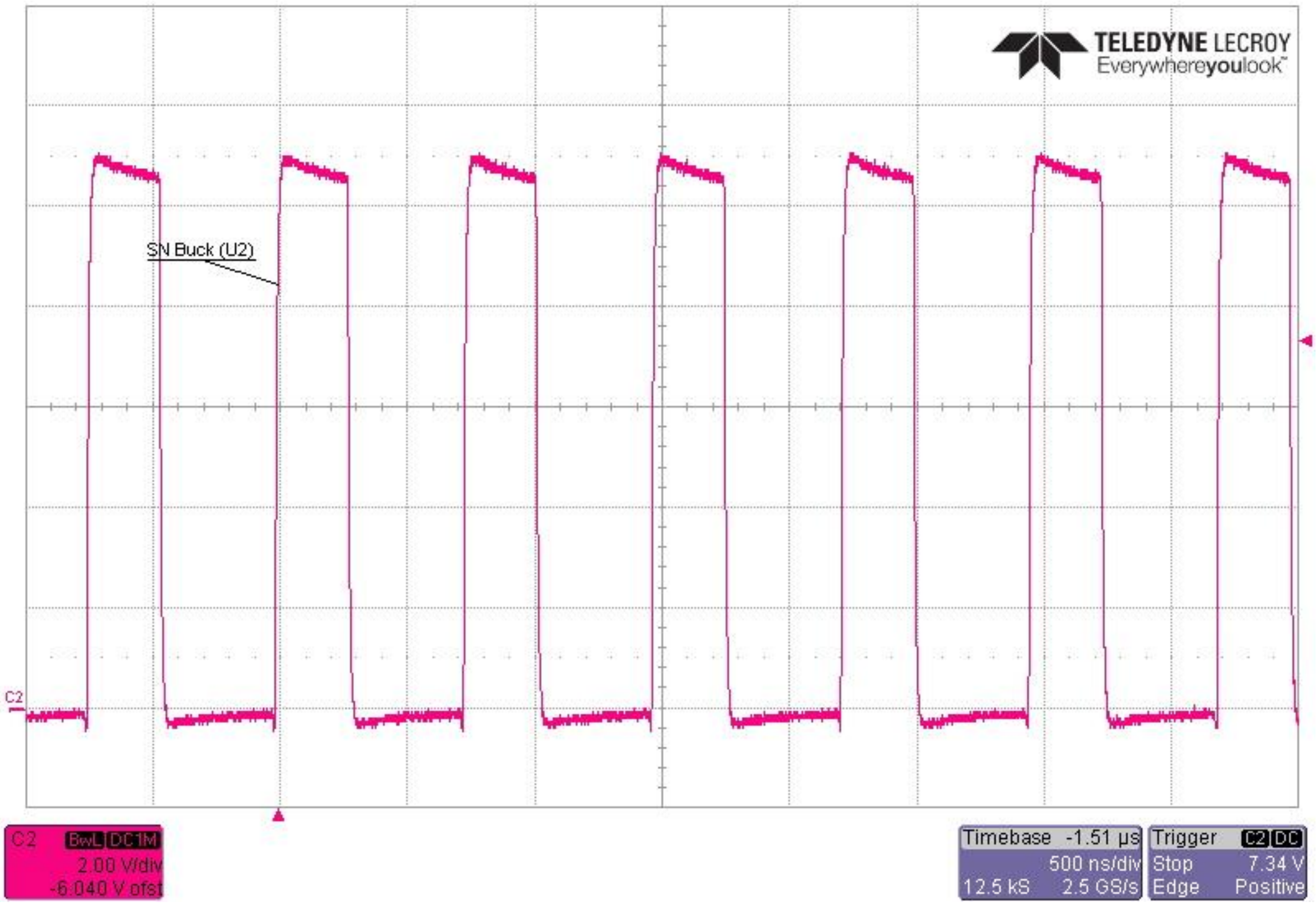
2 Waveforms

2.1 Switching

2.1.1 Switchnode U2

Input Voltage = 11V
3.9Vout = 2A
5Vout = 150mA
3.3Vout = 50mA



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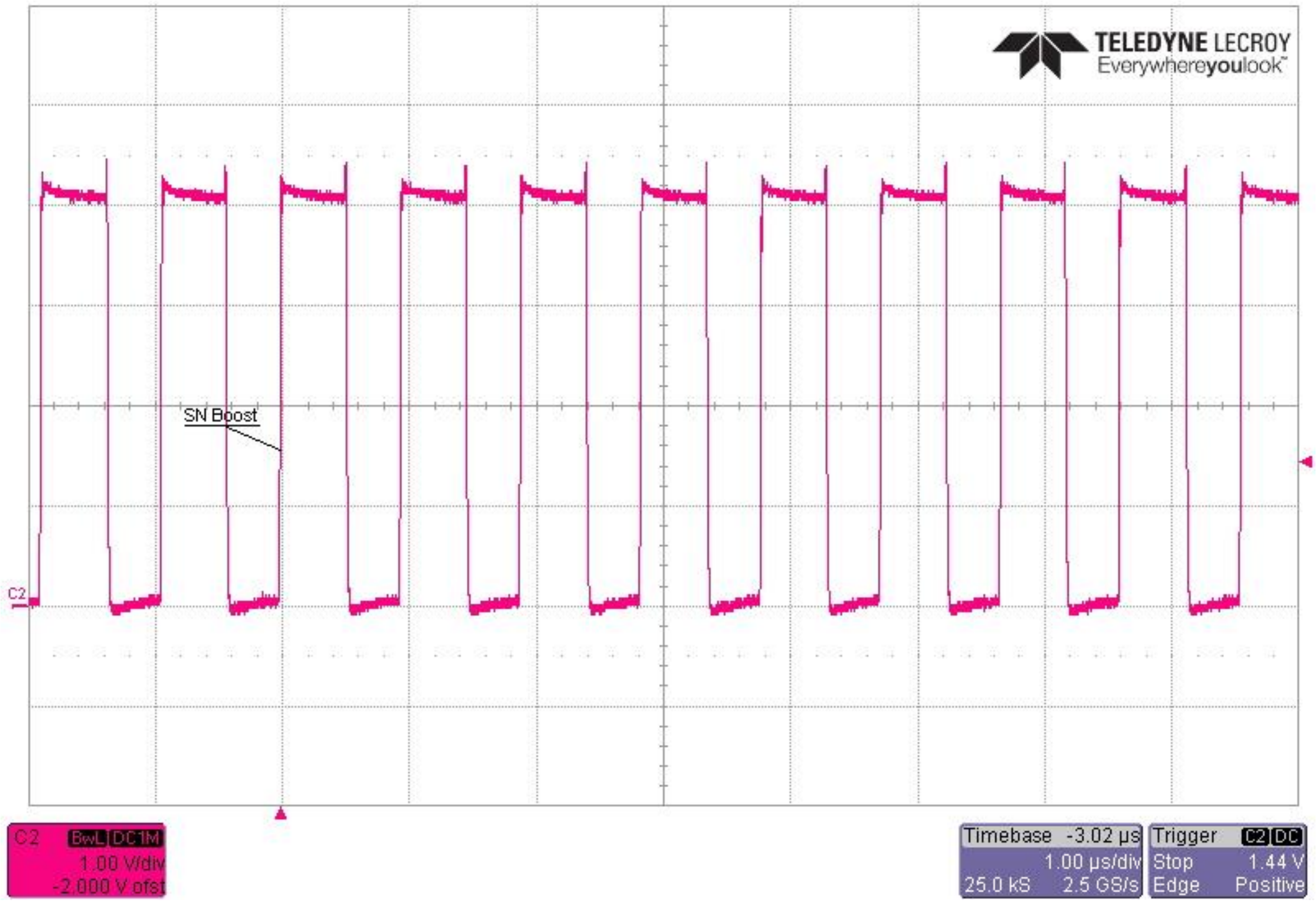
2.1.2 Switchnode U5

Input Voltage	= 0V
Backup Voltage	= 2.7V
3.9Vout	= 2A
5Vout	= 150mA
3.3Vout	= 50mA



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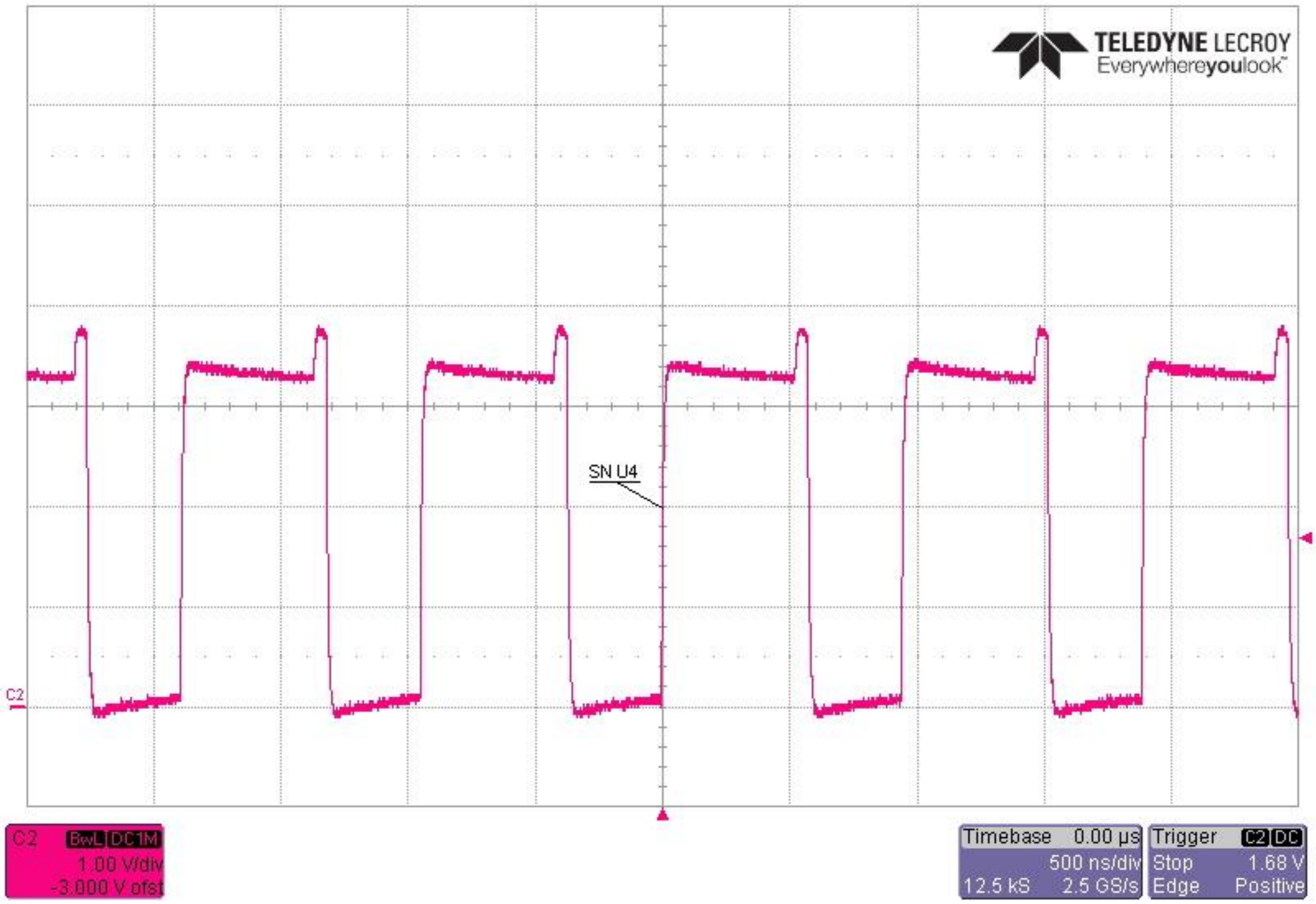
2.1.3 Switchnode U4

Input Voltage	= 11V
3.9Vout	= 2A
5Vout	= 150mA
3.3Vout	= 50mA



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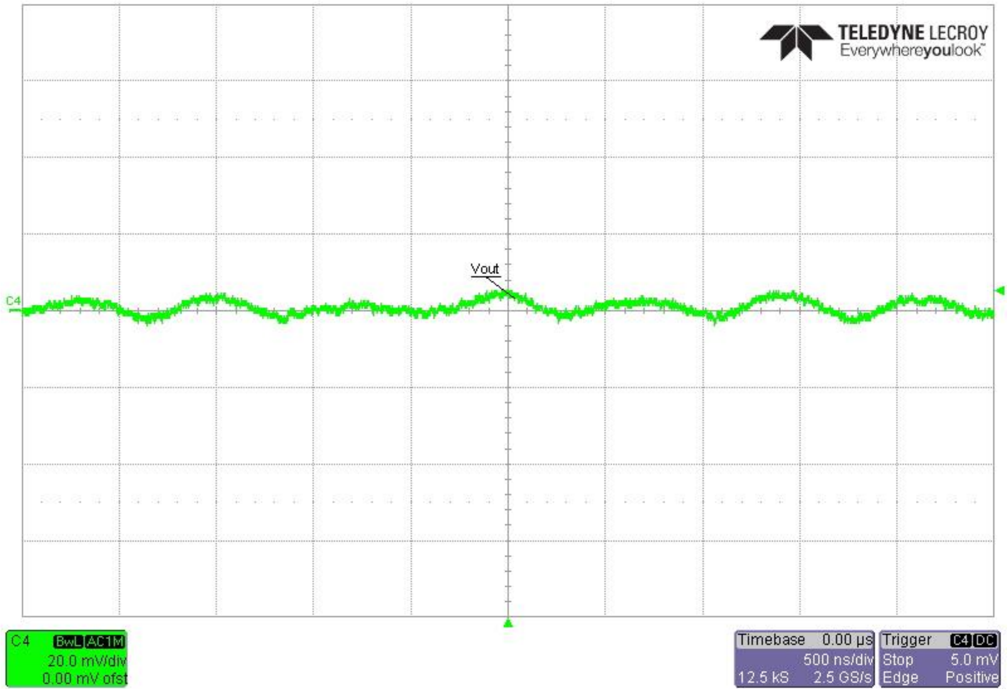
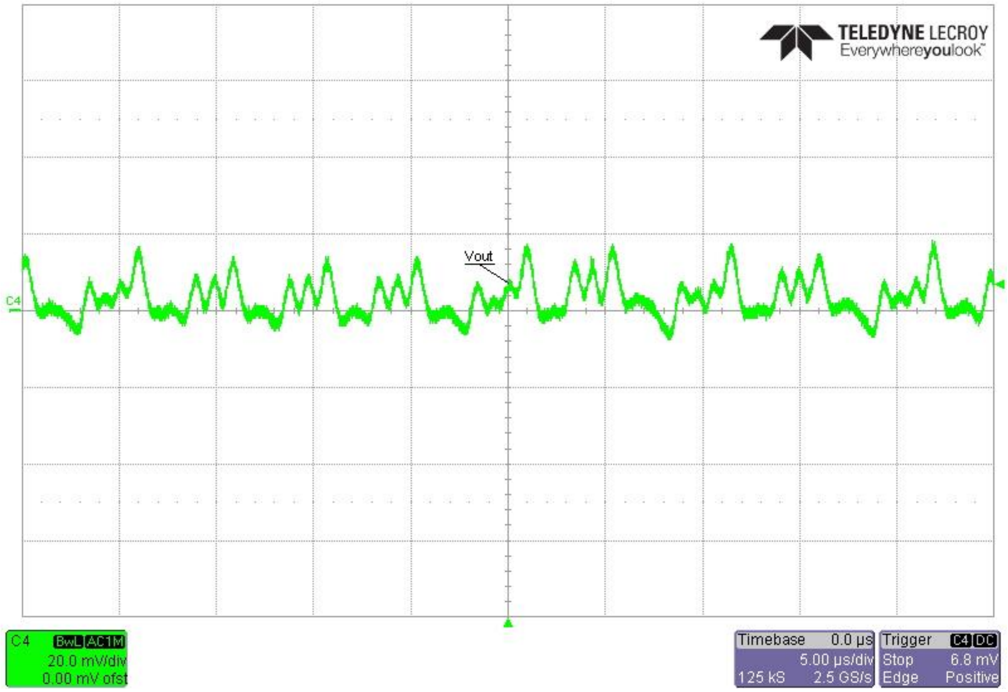
2.2 Output Voltage Ripple

2.2.1 Output Ripple 3.9Vout (U2)

Input Voltage = 11V
3.9Vout = 2A



Input Voltage = 11V
3.9Vout = 0.2A



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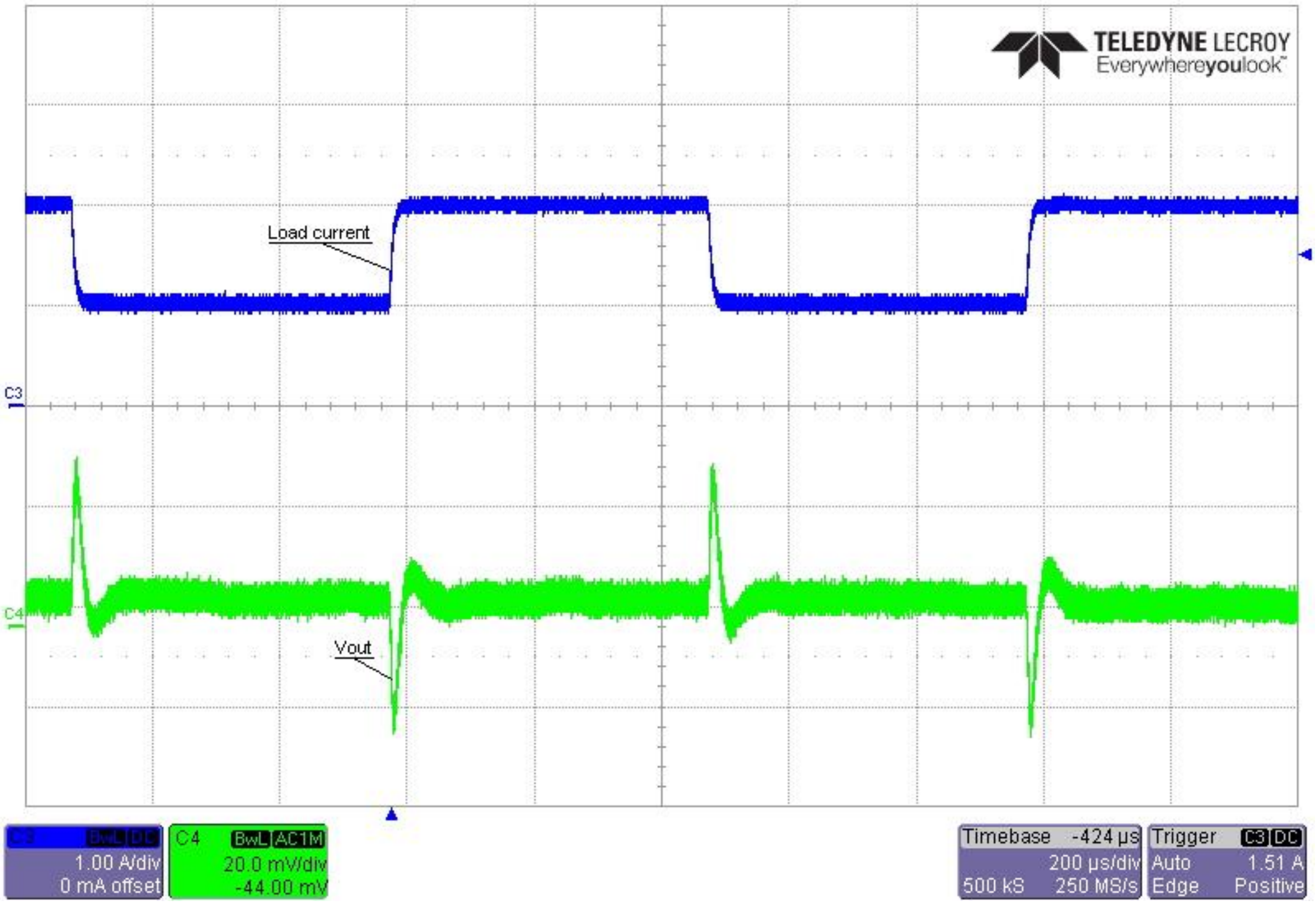
2.3 *Loadstep*

2.3.1 Loadstep 3.9Vout (U2)

Input Voltage = 11V
3.9Vout = 1A – 2A



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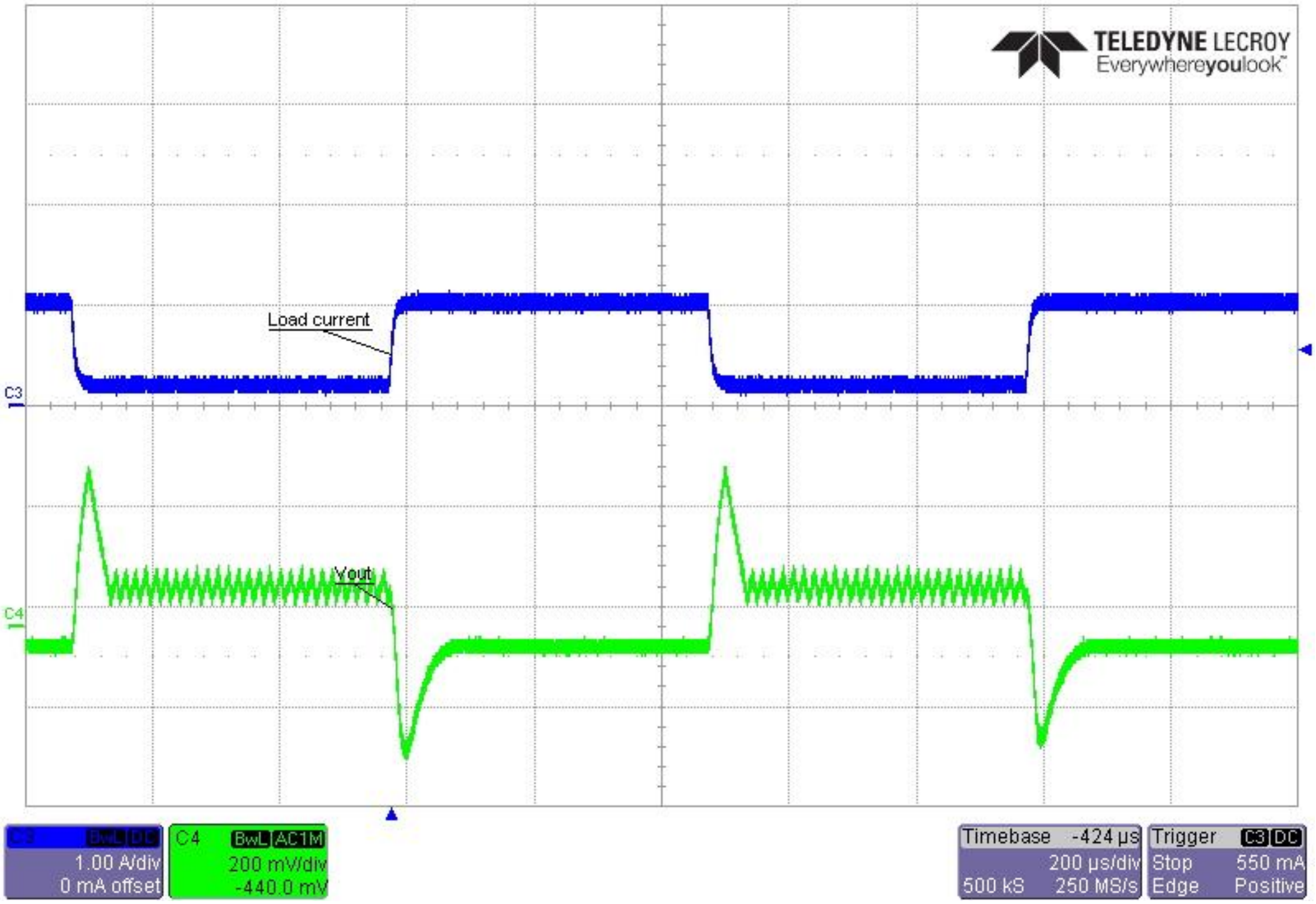
2.3.2 Loadstep 3.9Vout (U5) (Backup Condition)

Input Voltage = 2.7V Backup
3.9Vout = 0.2A – 1A



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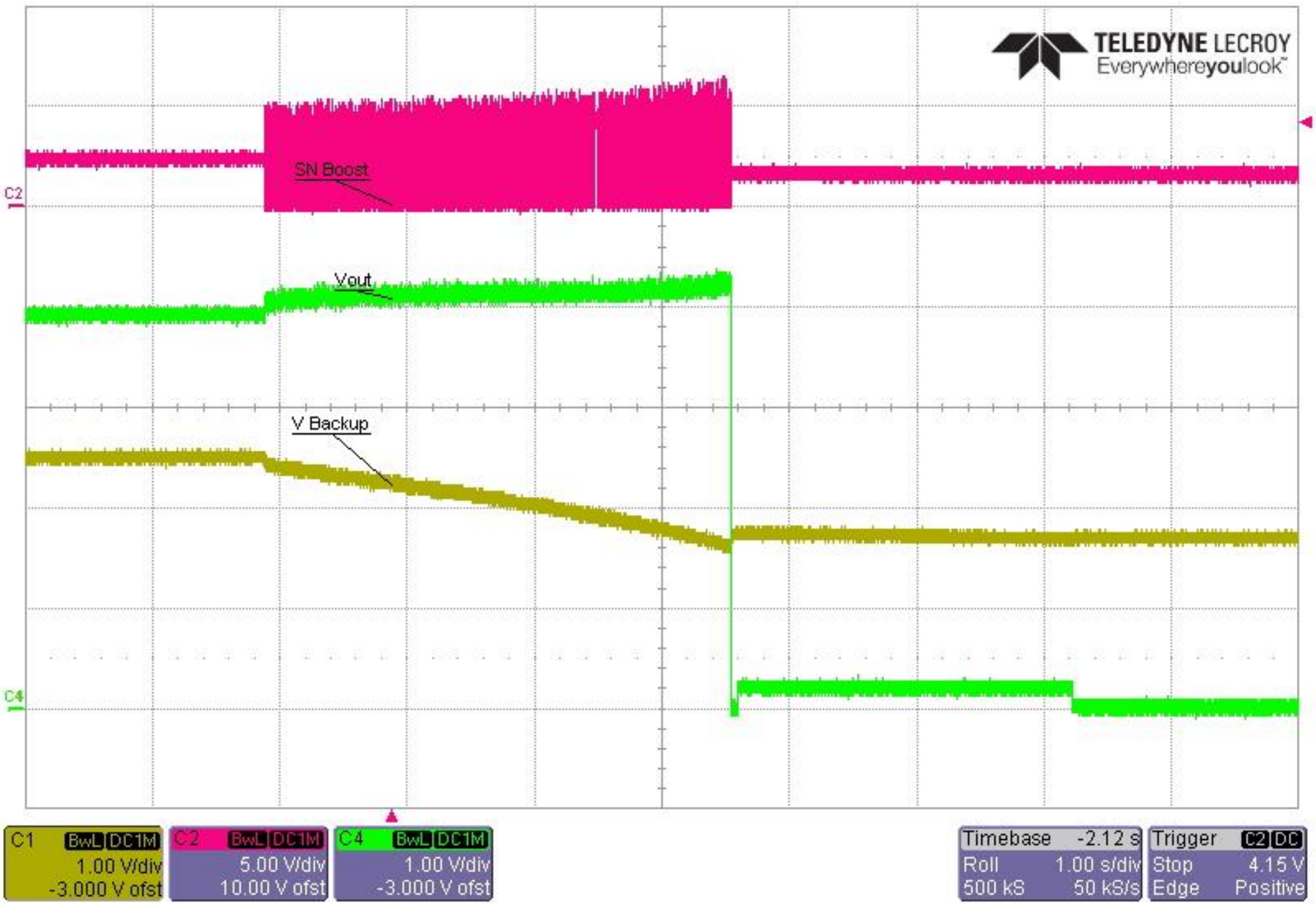
2.4 Transition normal operation to backup

For the measurements a 470uF bulk capacitor was connected to the input of the board to avoid an input voltage drop due to the high impedance input.

2.4.1 3.9Vout Load current 2A:

Input Voltage = 11V
3.9Vout = 2A
5Vout = 150mA
3.3Vout = 50mA



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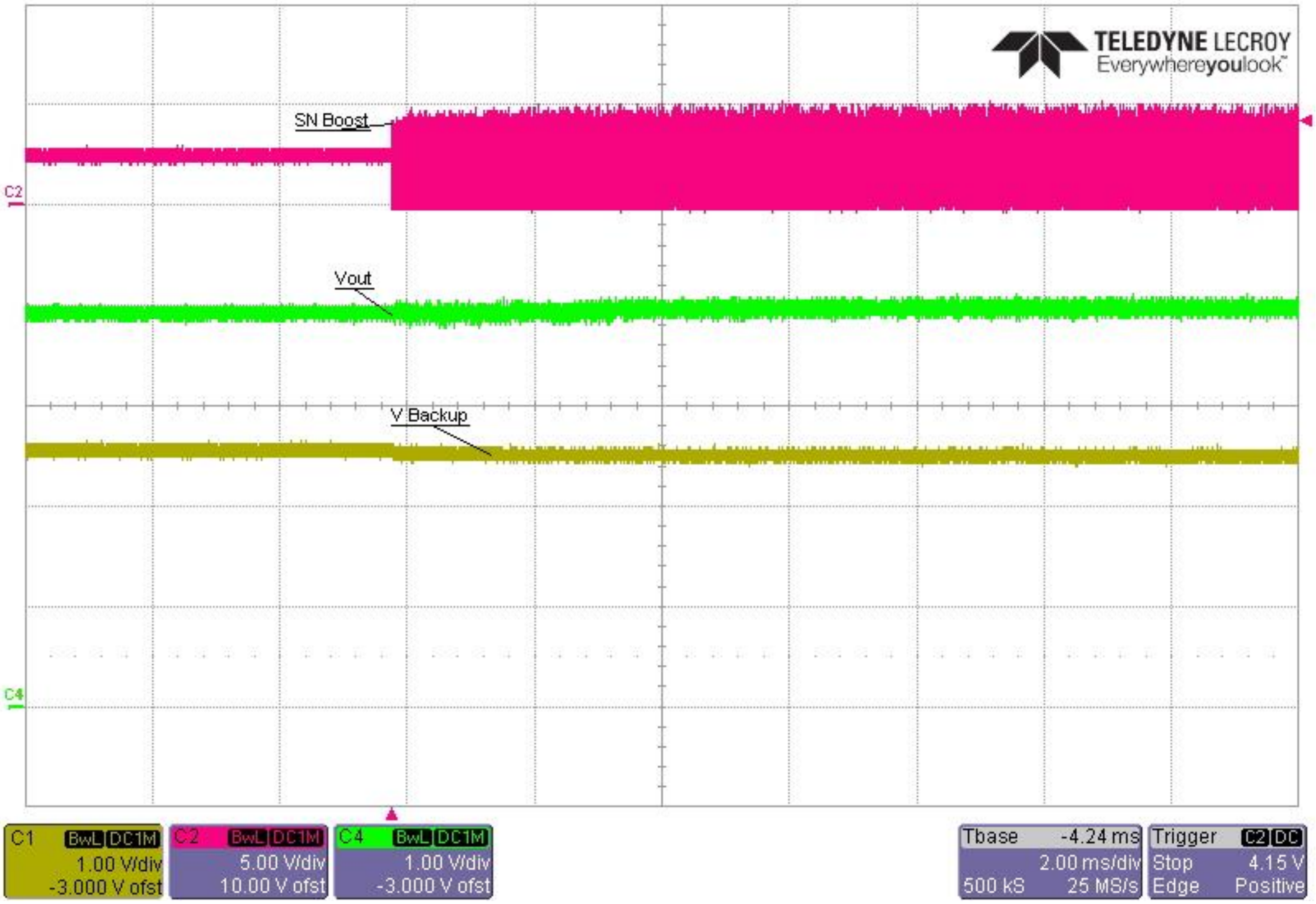

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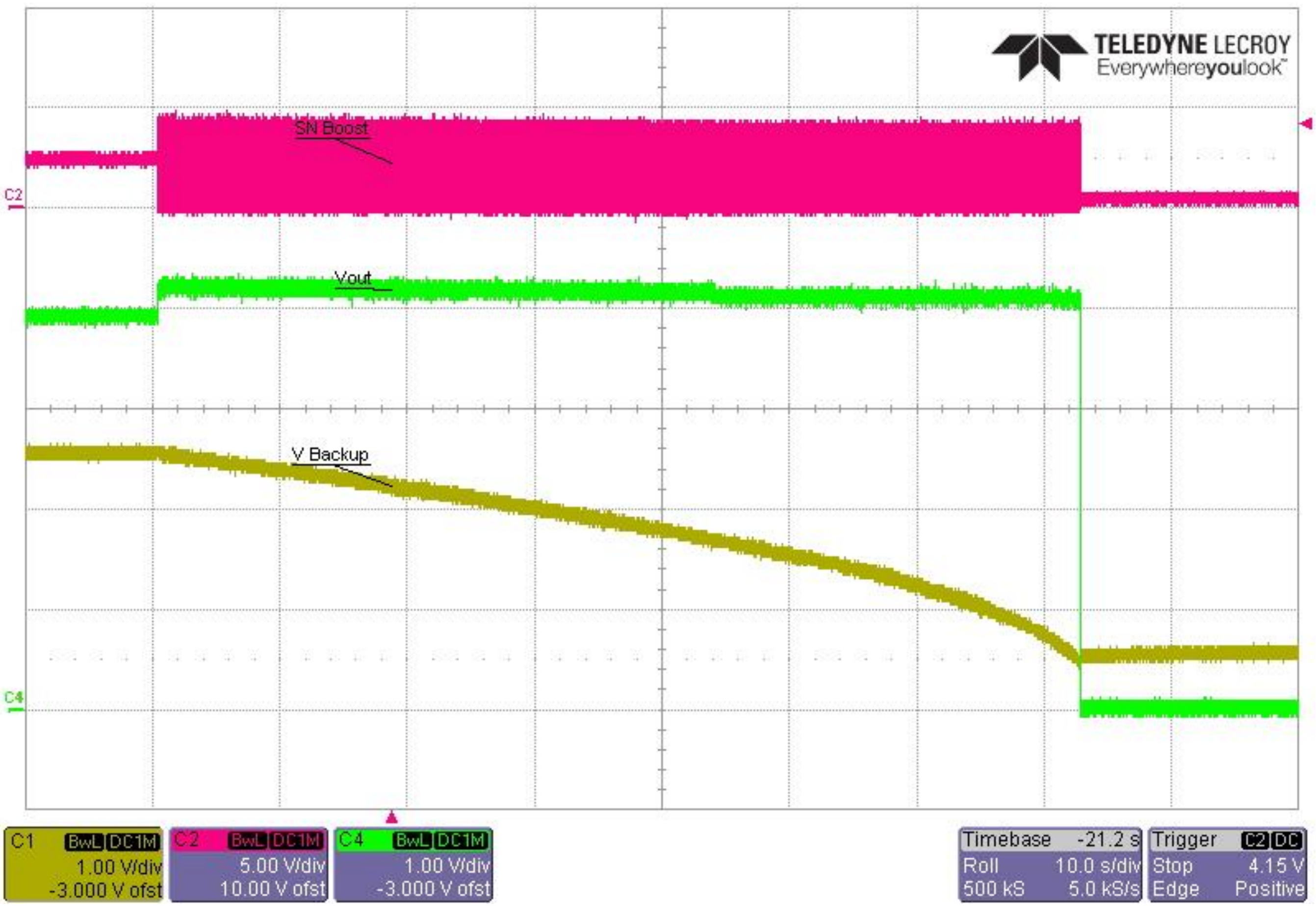
2.4.2 3.9Vout Load current 0.2A:

Input Voltage	= 11V
3.9Vout	= 200mA
5Vout	= 150mA
3.3Vout	= 50mA



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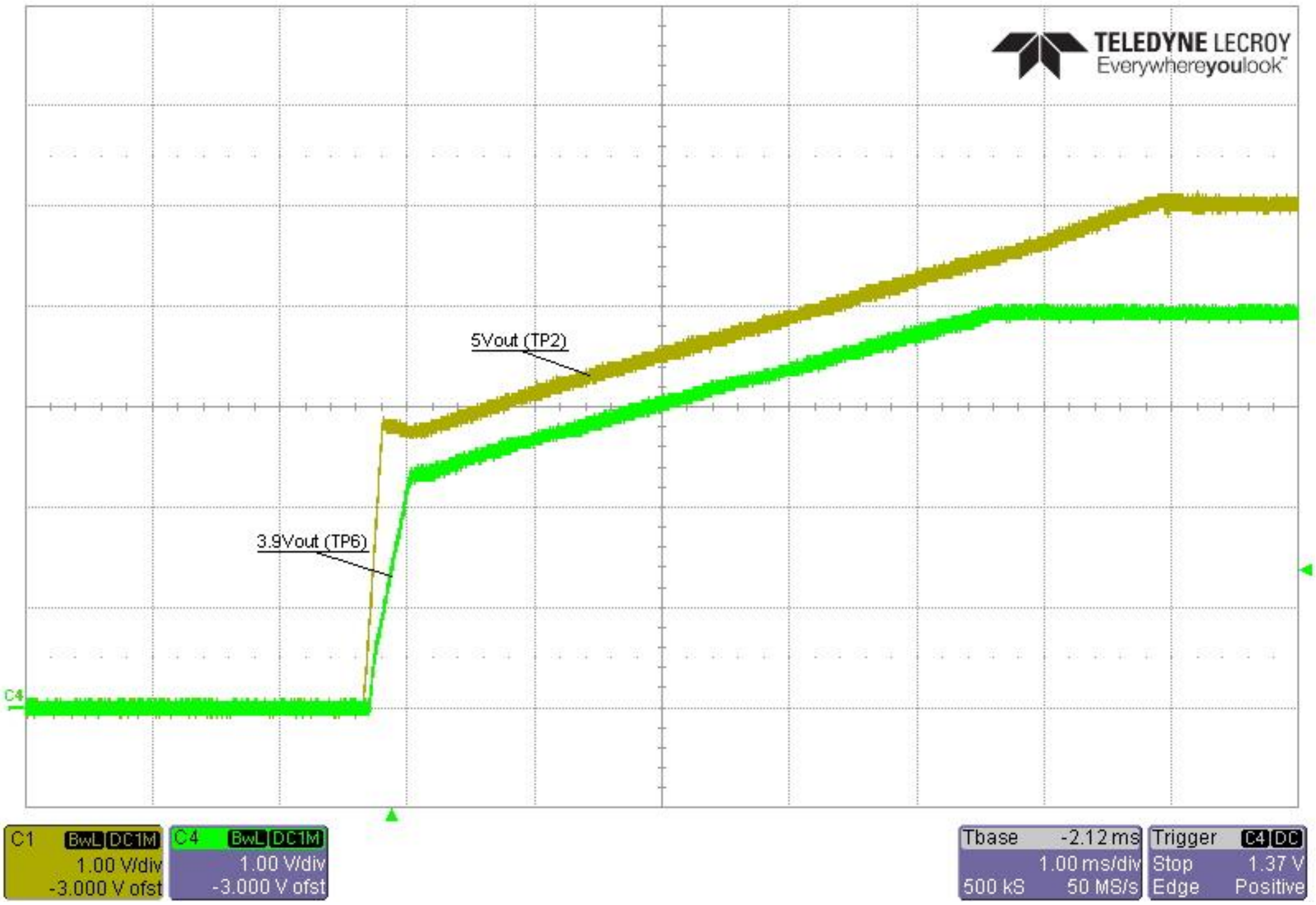
2.5 *Startup*

For the measurements a 470uF bulk capacitor was connected to the input of the board to avoid an input voltage drop due to the high impedance input.

2.5.1 Startup 3.9Vout / 5Vout

Input Voltage	= 11V
3.9Vout	= 2A
5Vout	= 150mA
3.3Vout	= 50mA



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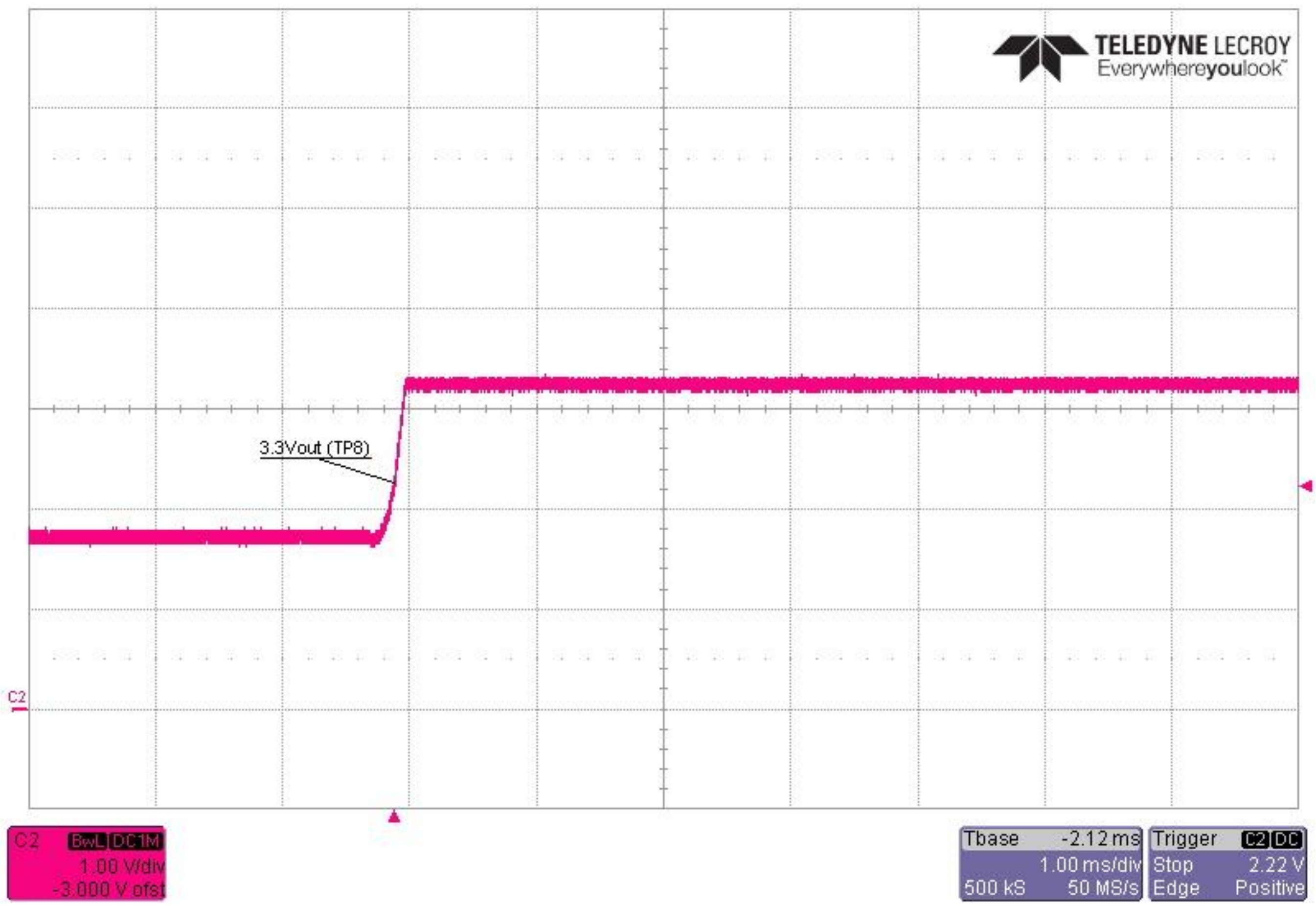
2.5.2 Startup 3.3Vout

Input Voltage	= 11V
3.9Vout	= 2A
5Vout	= 150mA
3.3Vout	= 50mA



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