PMP30082 Rev. B

LM5017 – Fly-Buck +48V/12V/24V

LMR23610 – Buck - +12V/5V

TPS62125 – Buck - +12V/3.3V

1 LM5017 - +48V/12V/24V Fly-Buck Converter

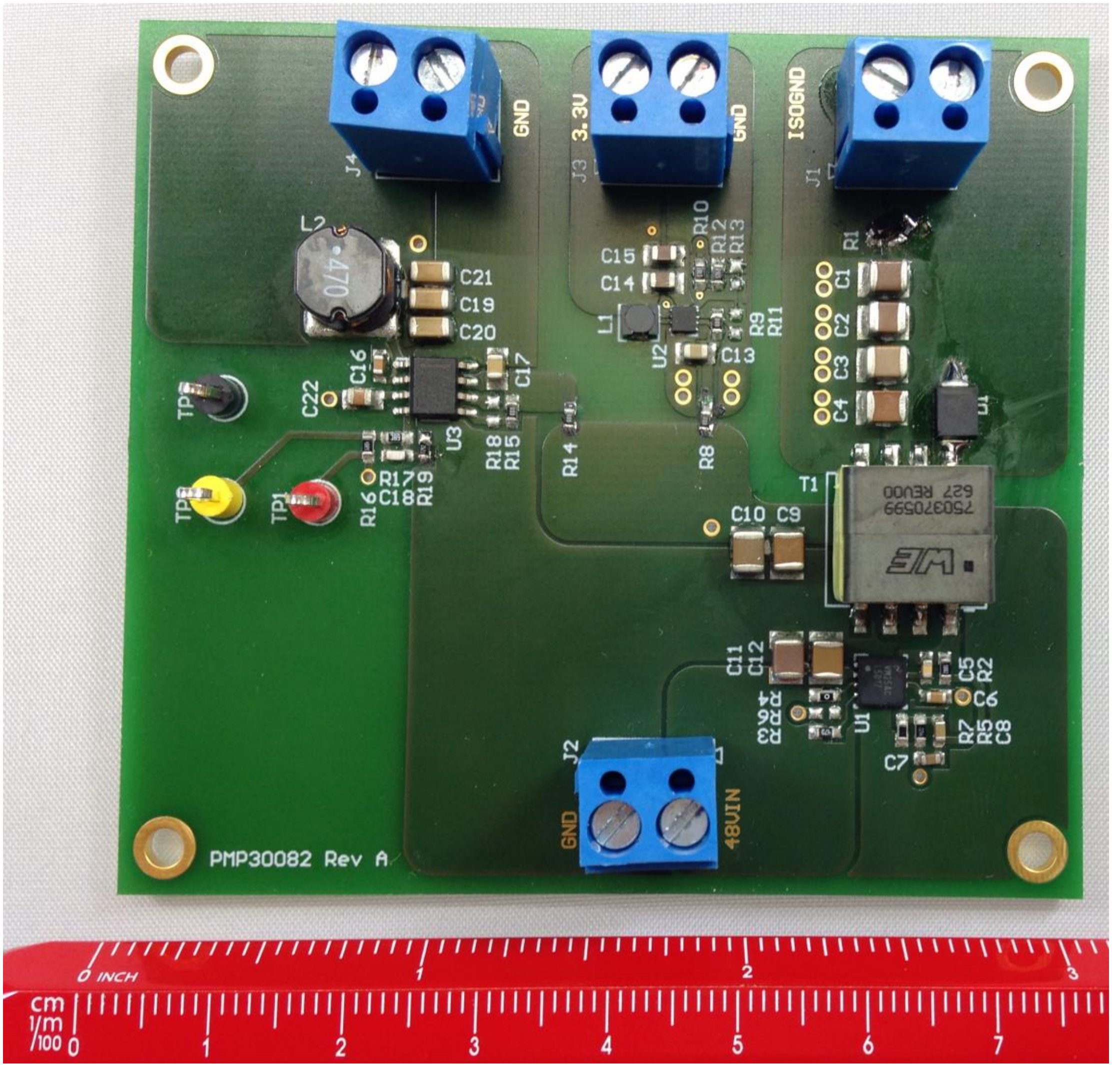

Figure 1: PCB Top

1.1 Output voltage ripple

The output ripple of the 24V LM5017 Fly-Buck converter is shown in Figure 2.

Channel Ch1: **48V input voltage**, 31.2mV peak-peak
10mV/div, 20us/div

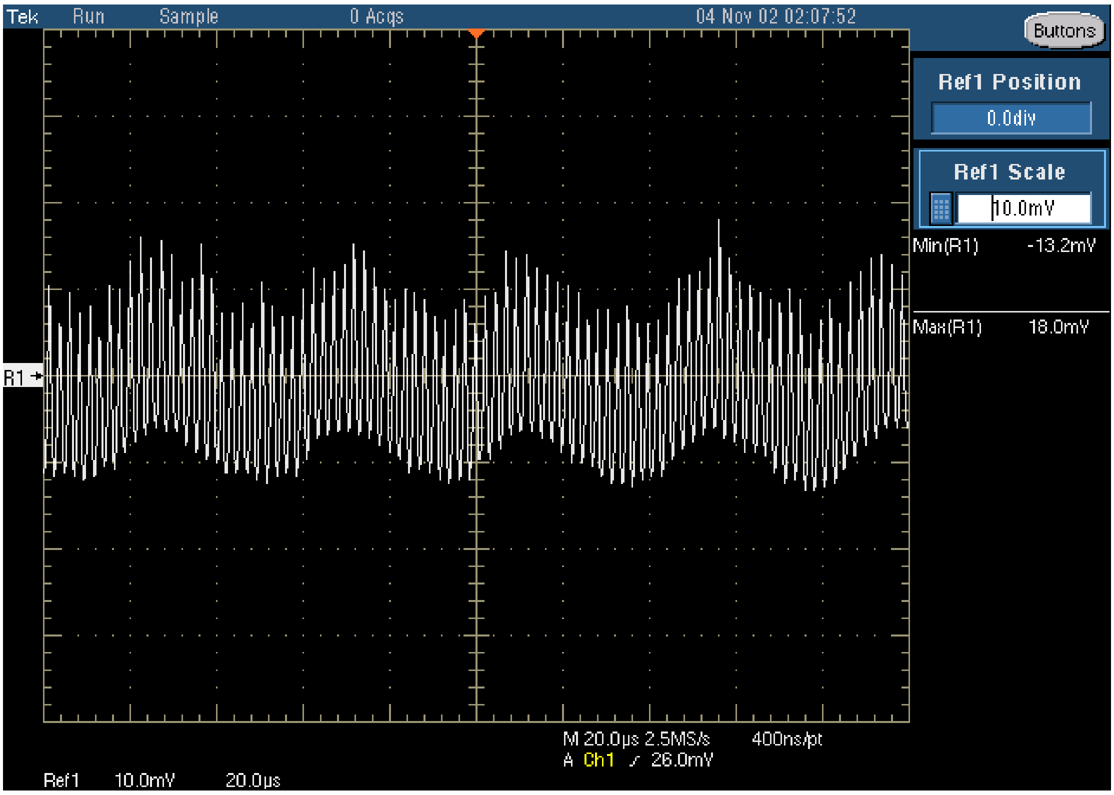

Figure 2

The output ripple of the 24V LM5017 Fly-Buck converter is shown in Figure 3.

Channel Ch1: **72V input voltage**, 44.8mV peak-peak
10mV/div, 40us/div

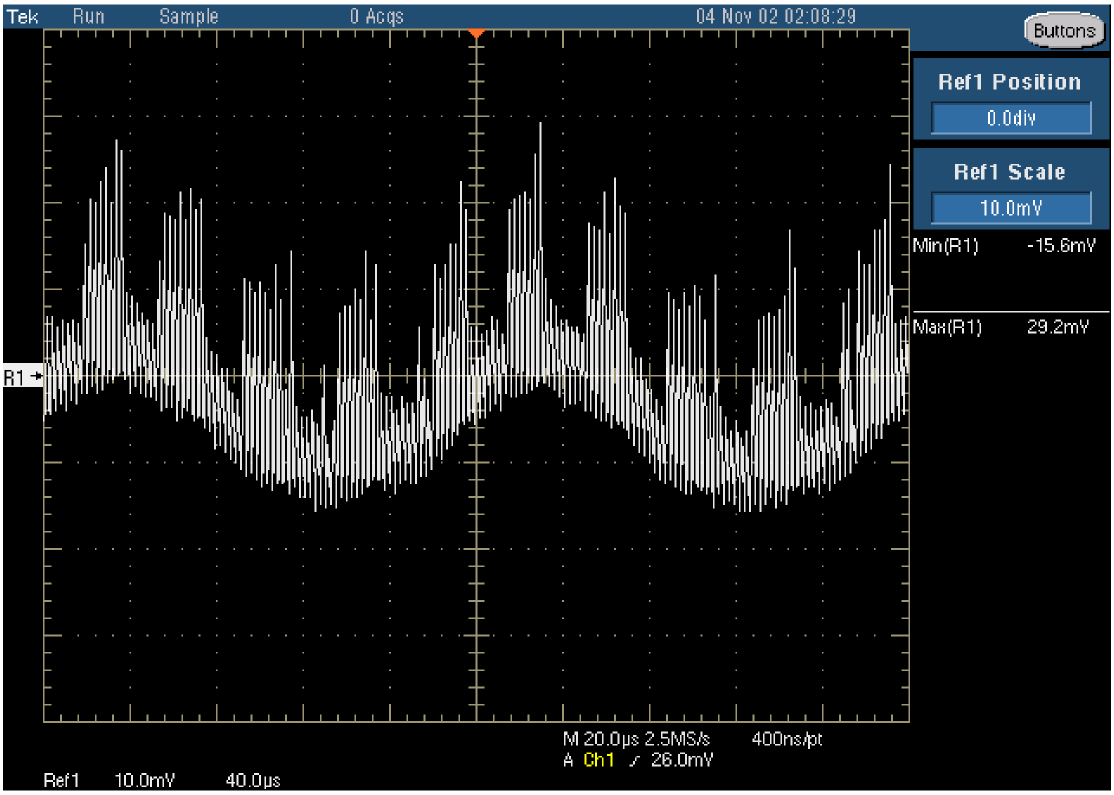

Figure 3

1.2 Input voltage ripple

The input ripple of the 12V/24V LM5017 Fly-Buck converter is shown in Figure 4.

Reference R1: **48V input voltage**, 192.0mV peak-peak
100mV/div, 2.0us/div

Reference R2: **72V input voltage**, 224.0mV peak-peak
100mV/div, 2.0us/div

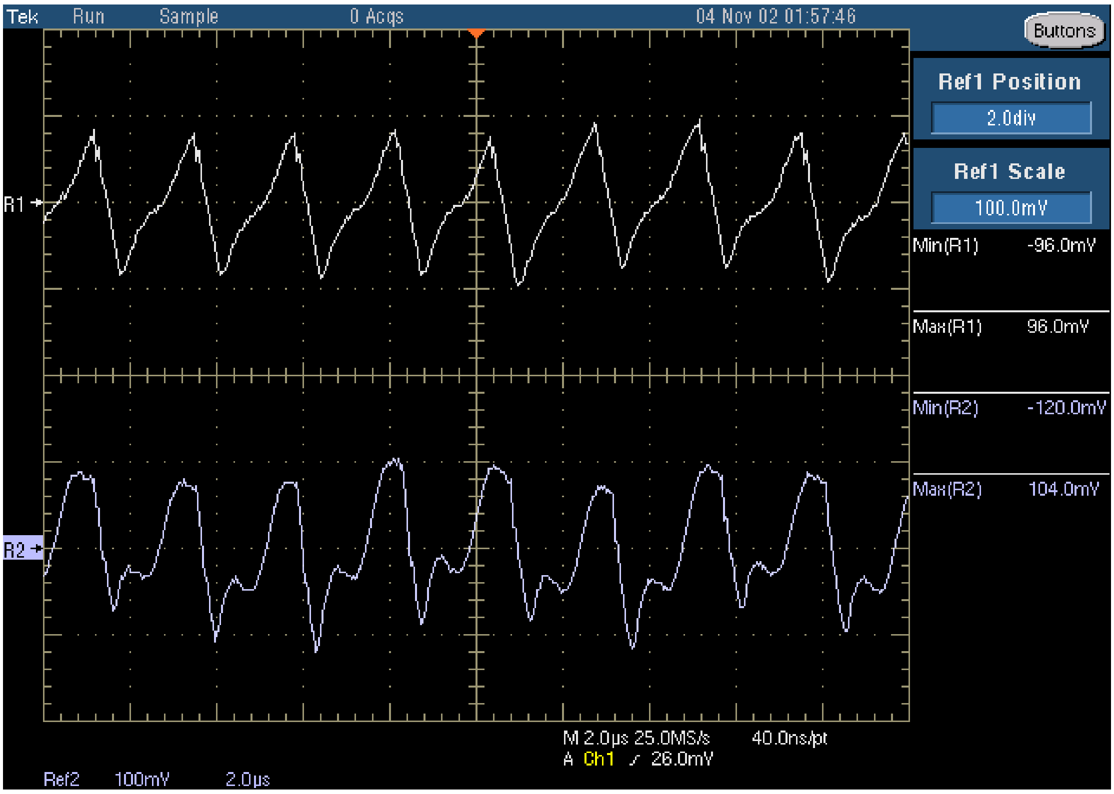

Figure 4

1.3 Switching node

The switching node is shown in Figure 5.
The input voltage is set to 72V with a 160mA load at the 24V isolated output, 100mA at the 3.3V output and 400mA at the 5V output.

Channel Ch1: **Switching node**, -1.6V min, 74.4V max
20V/div, 1.0us/div

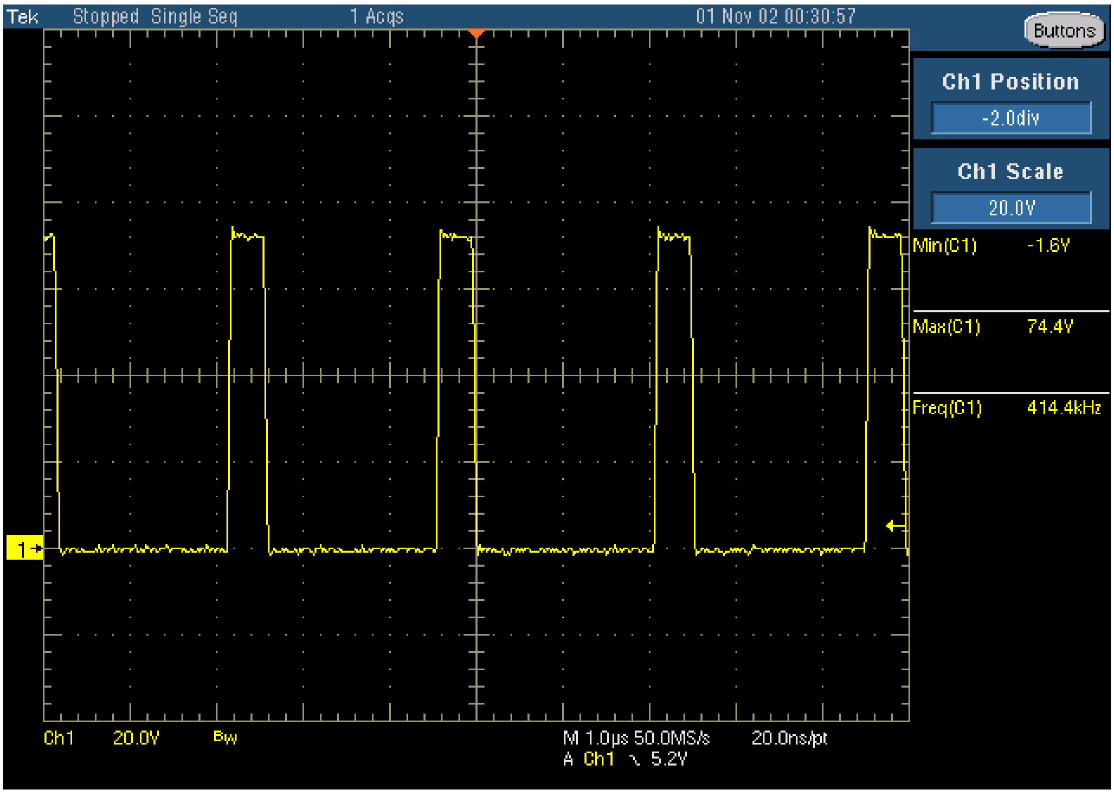

Figure 5

1.4 Start up

Figure 6 shows the startup behavior of the 24V LM5017-Fly-Buck converter, the 5V LMR23610 Buck converter and the 3.3V TPS62125 Buck converter with no loads attached.

Channel Ch1: **Input Voltage**, 48V, 20V/div, 10ms/div

Channel Ch2: **Output Voltage**, 3.3V, 2V/div, 10ms/div

Channel Ch3: **Output Voltage**, 5V, 5V/div, 10ms/div

Channel Ch4: **Output Voltage**, 24V, 20V/div, 10ms/div

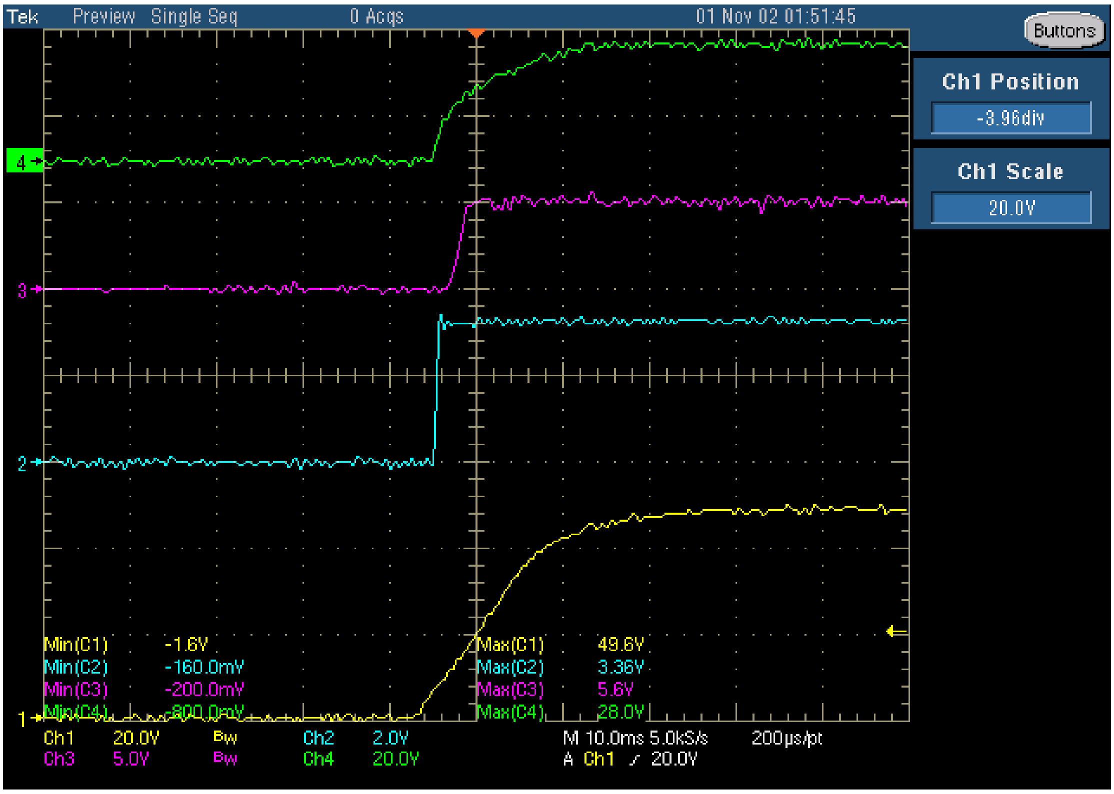

Figure 6

1.5 Shut down

Figure 7 shows the shutdown behavior of the 24V LM5017-Fly-Buck converter, the 5V LMR23610 Buck converter and the 3.3V TPS62125 Buck converter under full load conditions.

Channel Ch1: **Input Voltage**, 48V, 20V/div, 20ms/div

Channel Ch2: **Output Voltage**, 3.3V, 2V/div, 20ms/div

Channel Ch3: **Output Voltage**, 5V, 5V/div, 20ms/div

Channel Ch4: **Output Voltage**, 24V, 20V/div, 20ms/div

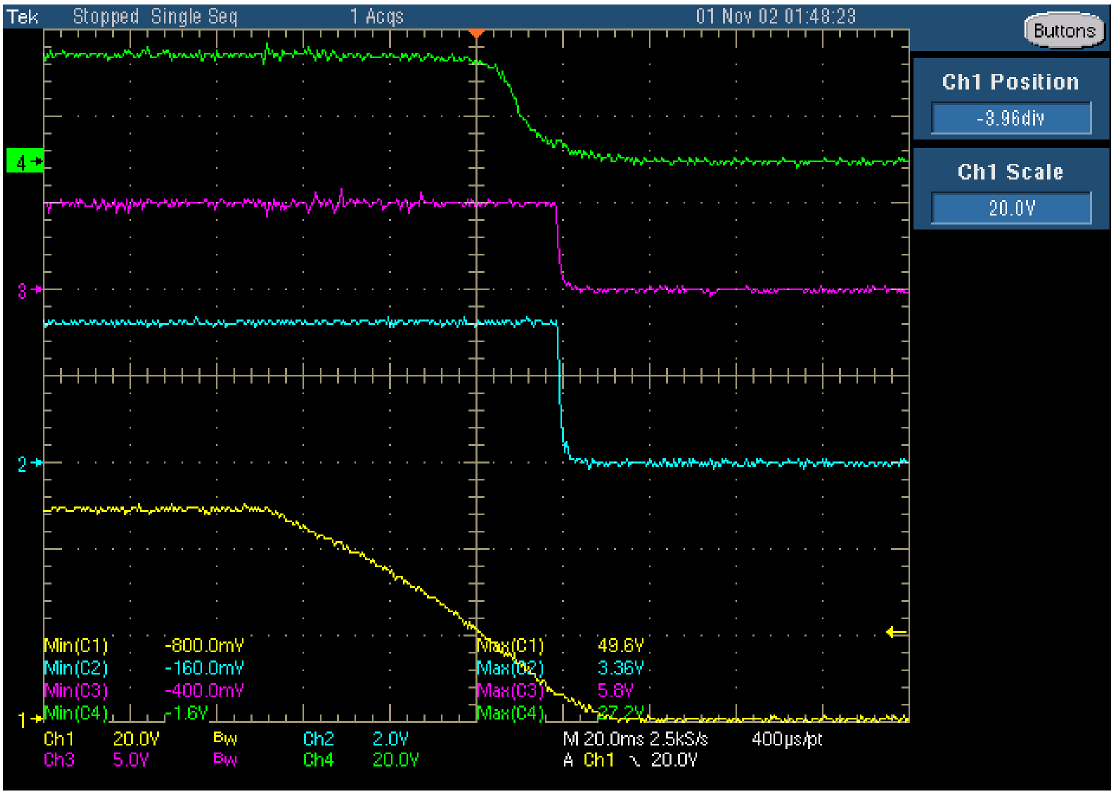

Figure 7

1.6 Efficiency (24V LM5017 Fly-Buck Converter)

The efficiency of the primary 12V output at 48V and 72V input voltage is shown in Figure 8. The secondary output had no load besides the bleeding resistor/diode network.

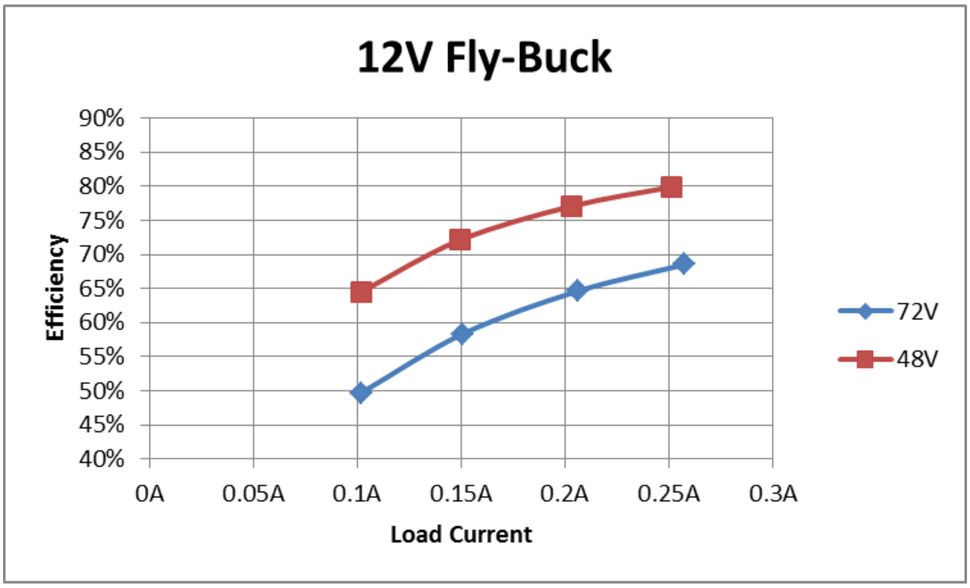

Figure 8

The efficiency of the 12V output at 48V and 72V input voltage is shown in Figure 9. The two Buck converters on the primary output had no load attached.

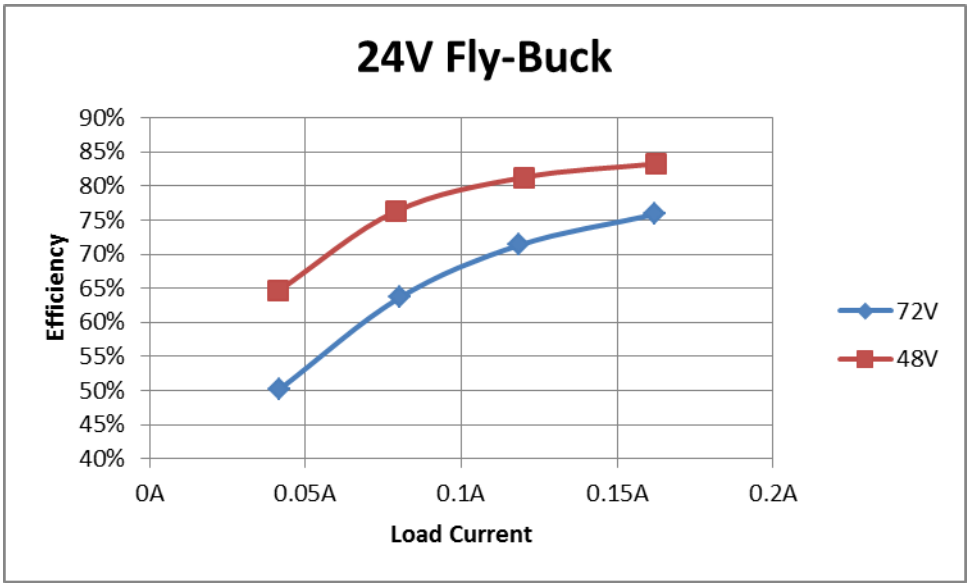

Figure 9

1.7 Load regulation (24V LM5017 Fly-Buck Converter)

The load regulation of the 12V output of the LM5017 Fly-Buck converter is shown in Figure 10. The secondary output had no load besides the bleeding resistor/diode network.

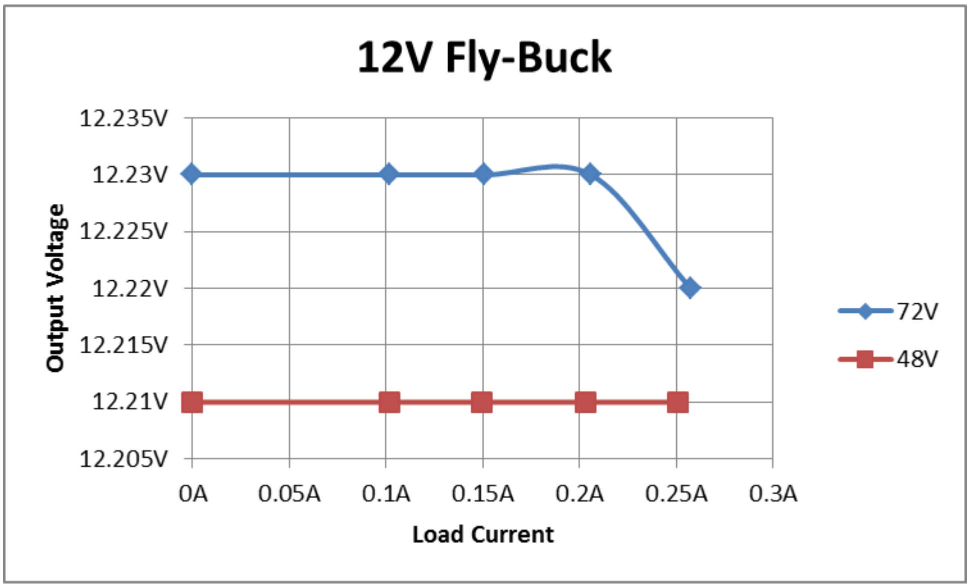

Figure 10

The load regulation of the 24V output of the LM5017 Fly-Buck converter is shown in Figure 11. The two Buck converters on the primary output had no load attached.

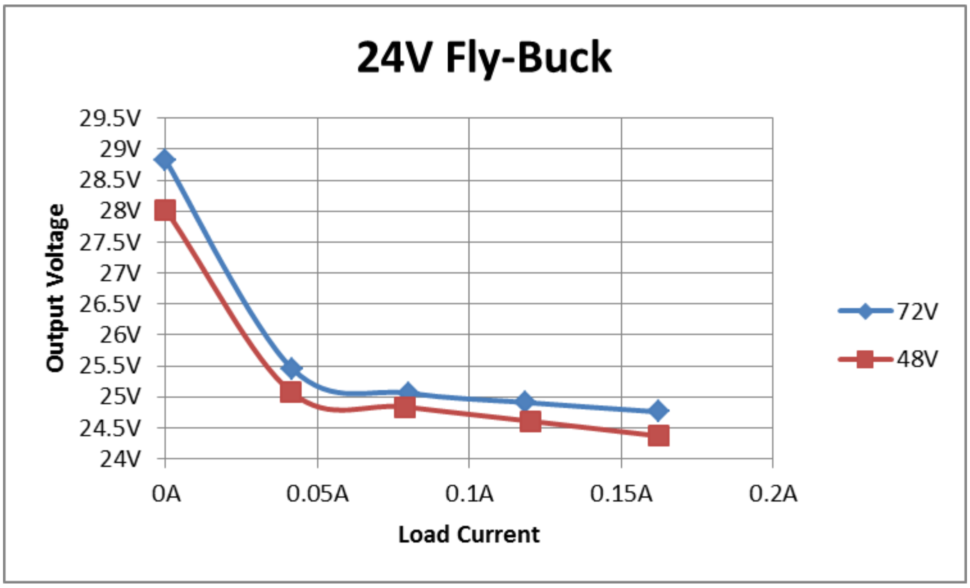

Figure 11

Transient response (24V LM5017 Fly-Buck Converter)

The response to a 50% load step is shown in Figure 12. The other outputs were fully loaded.

Channel Ch1: **Output voltage**, -264.0mV undershoot, 240.0mV overshoot
100mV/div, 10ms/div, AC coupled

Channel Ch3: **Load current**, load step 80mA to 160mA and vice versa @ 48V input
100mA/div, 10ms/div

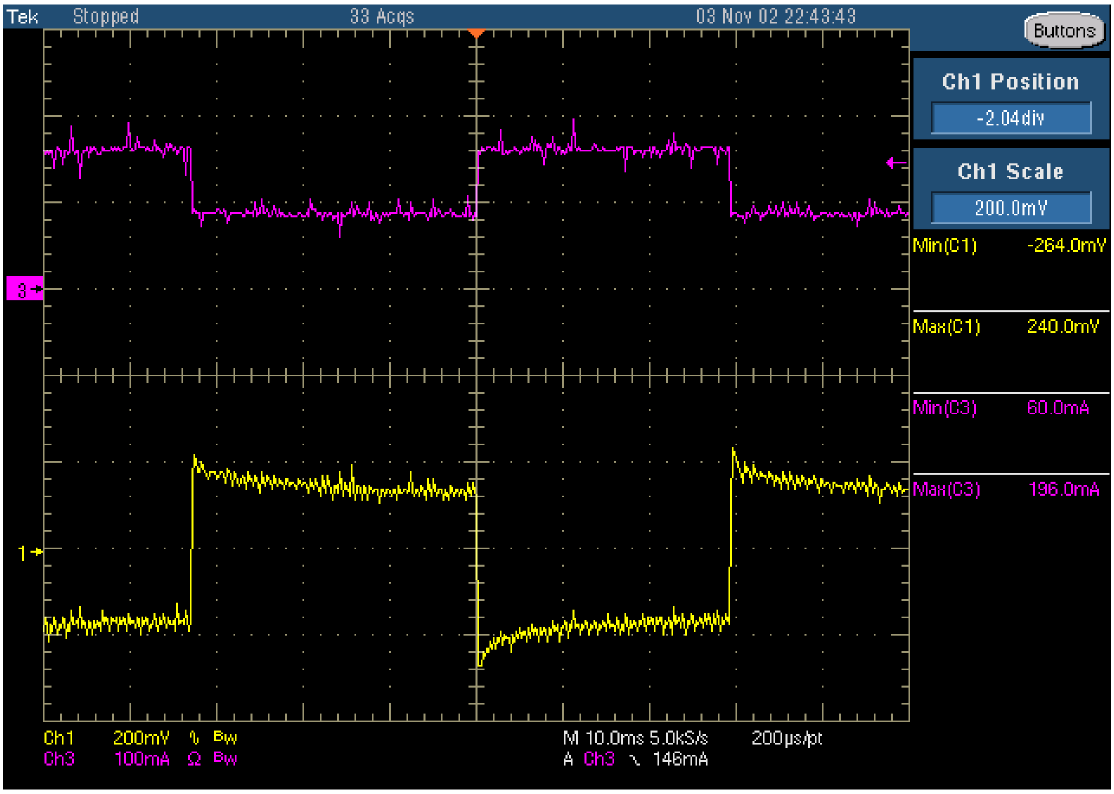

Figure 12

1.8 Thermal measurement

The thermal image (Figure 13) shows the circuit at an ambient temperature of 21 °C with an input voltage of 48V and 160mA load @ 24V output, 400mA load @ 5V output and 100mA load @ 3.3V output.

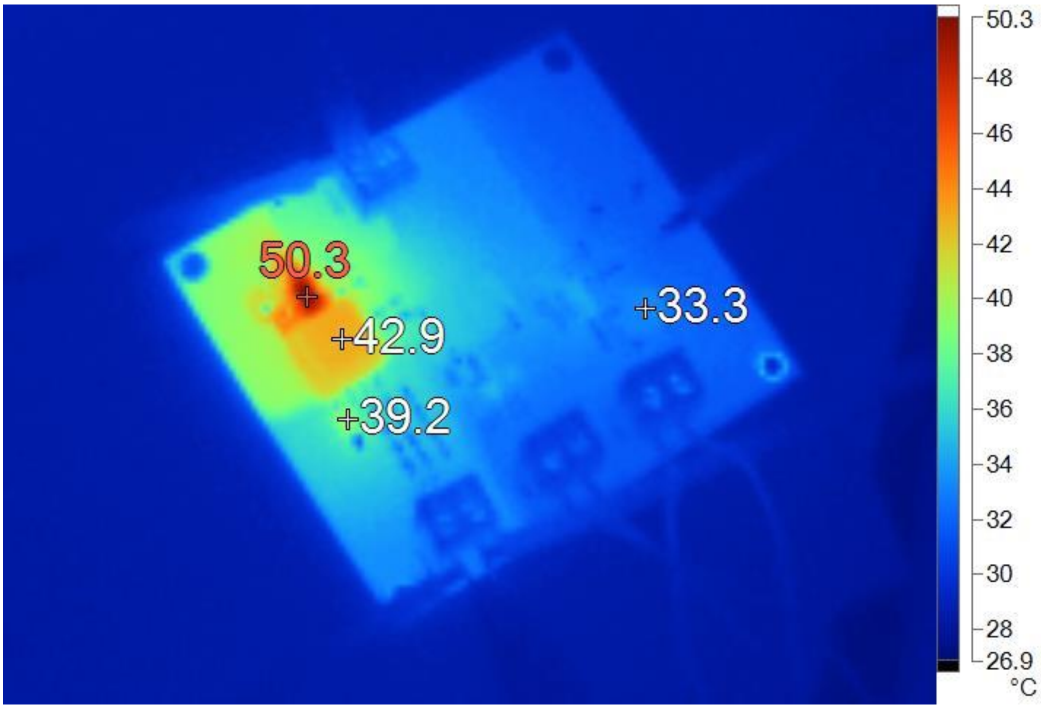

Figure 13: PCB top

The thermal image (Figure 14) shows the circuit at an ambient temperature of 21 °C with an input voltage of 72V and 160mA load @ 24V output, 400mA load @ 5V output and 100mA load @ 3.3V output.

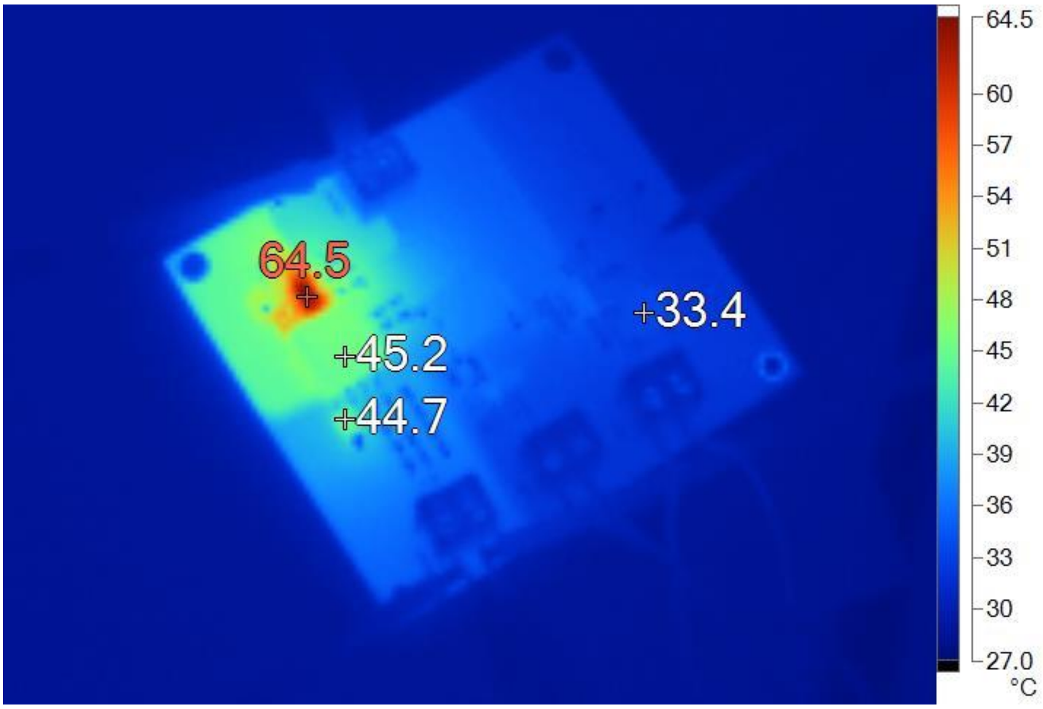

Figure 14: PCB top

2 LMR23610 - +12V/5V Buck Converter

2.1 Output voltage ripple

The output ripple of the 5V LMR23610 Buck converter is shown in Figure 15.

Channel Ch1: **12V input voltage**, 12.0mV peak-peak
10mV/div, 10us/div

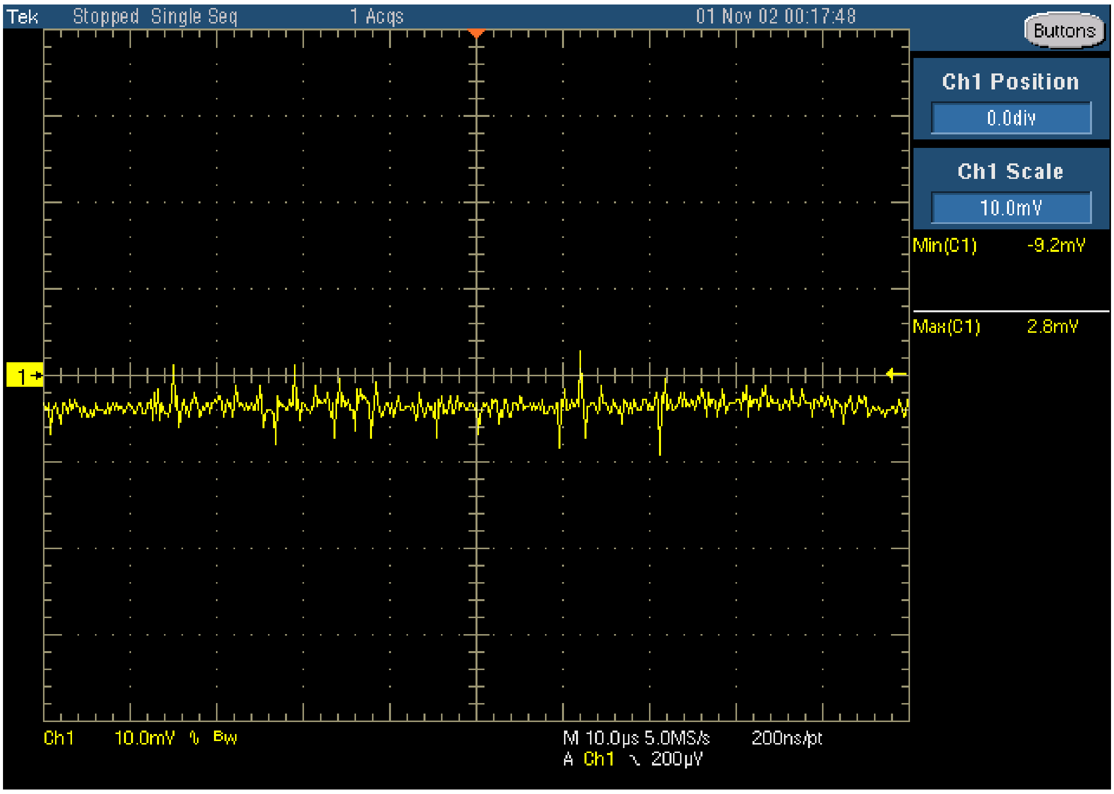

Figure 15

2.2 Switching node

The switching node is shown in Figure 16.
The input voltage is set to 12V with a 400mA load at the 5V output.

Channel Ch1: **Switching node**, -0.4V min, 12.6V max
5V/div, 1.0us/div

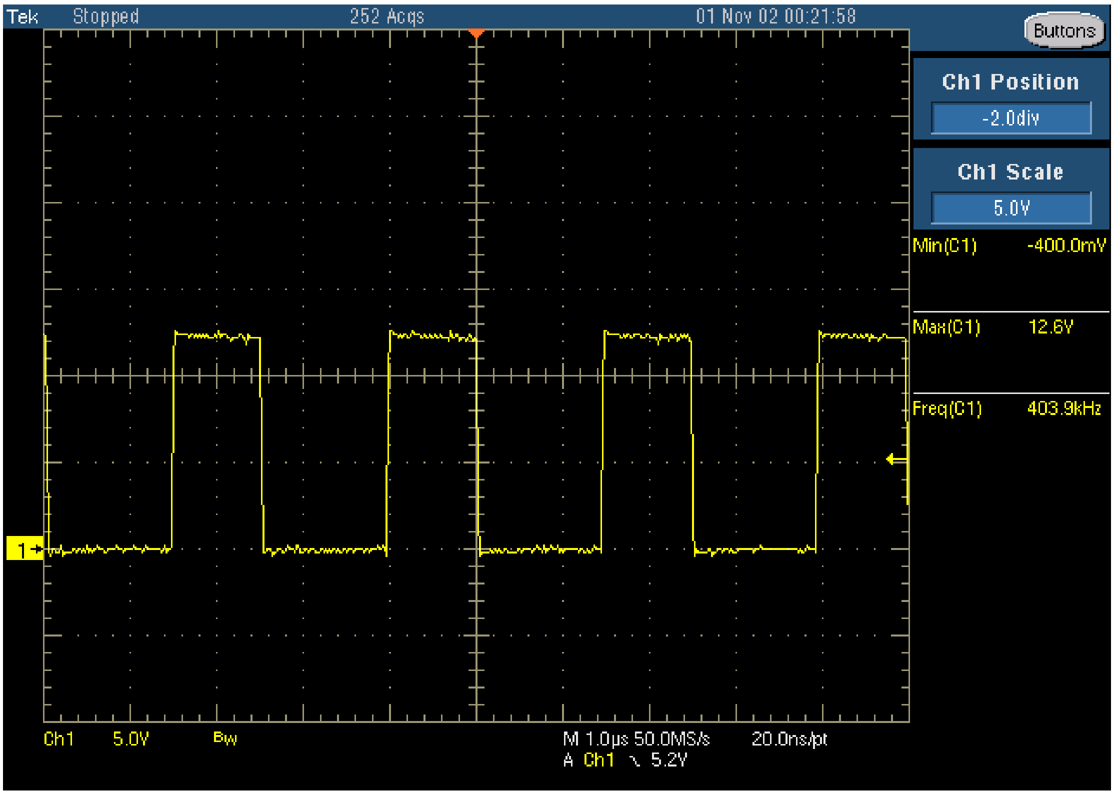

Figure 16

2.3 Efficiency (5V LMR23610 Buck Converter)

The efficiency at 12V input voltage is shown in Figure 17.

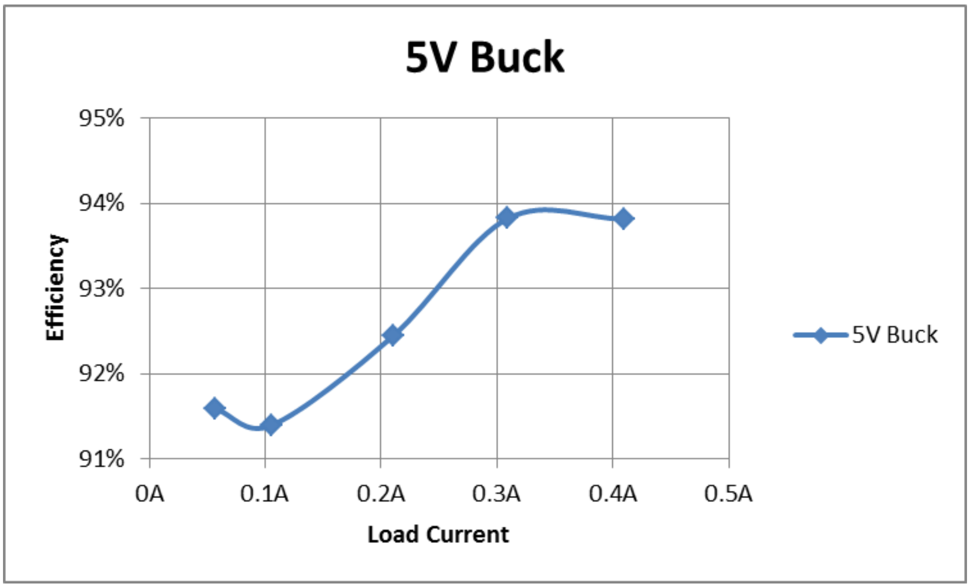

Figure 17

2.4 Load regulation (5V LMR23610 Buck Converter)

The load regulation of the 5V LMR23610 Buck converter at 12V input voltage is shown in Figure 18.

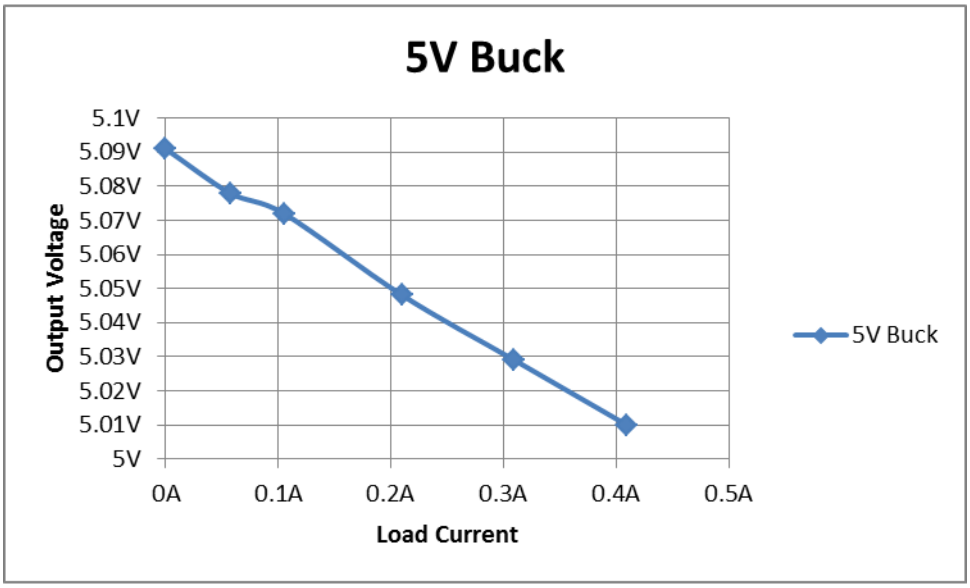

Figure 18

2.5 Transient response (5V LMR23610 Buck Converter)

The response to a 50% load step is shown in Figure 19. The other outputs were fully loaded.

Channel Ch1: **Output voltage**, -34.0mV undershoot, 42.0mV overshoot
50mV/div, 10ms/div, AC coupled

Channel Ch3: **Load current**, load step 200mA to 402mA and vice versa @ 12V input
200mA/div, 10ms/div

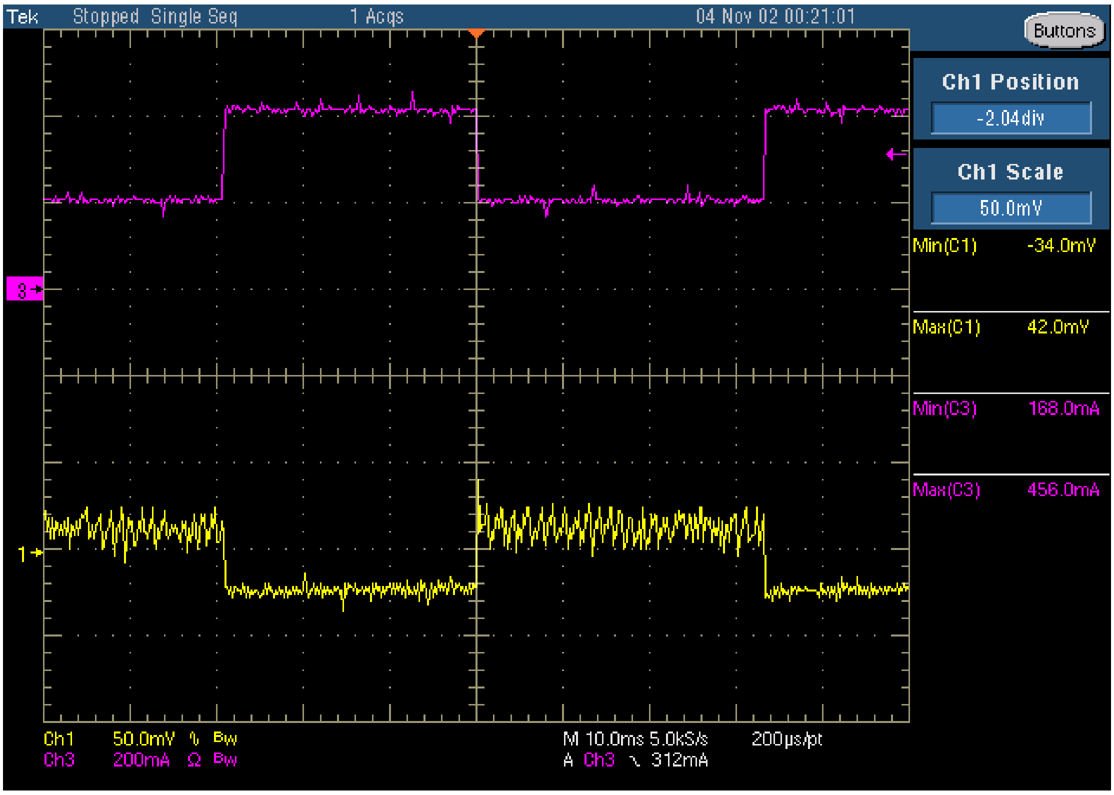

Figure 19

3 TPS62125 - +12V/3.3V Buck Converter

3.1 Output voltage ripple

The output ripple of the 3.3V TPS62125 Buck converter is shown in Figure 20.

Channel Ch1: **12V input voltage**, 12.4mV peak-peak
10mV/div, 4us/div

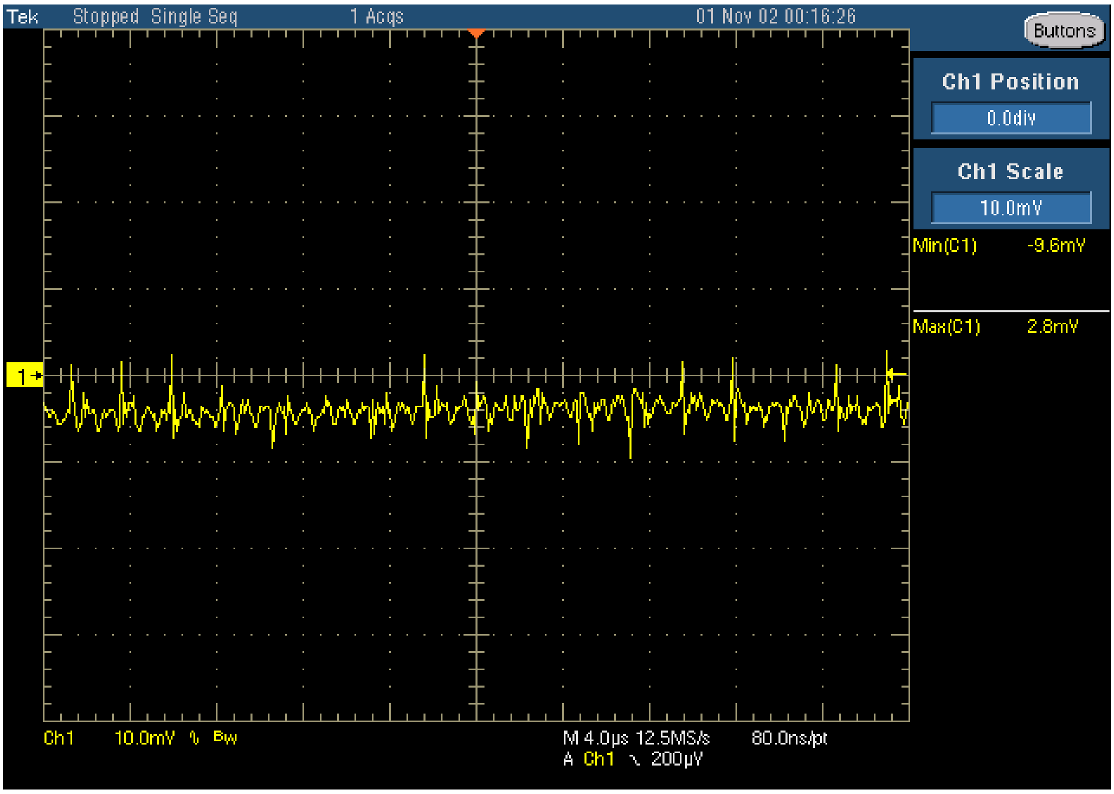

Figure 20

3.2 Switching node

The switching node is shown in Figure 21.
The input voltage is set to 12V with a 100mA load at the 3.3V output.

Channel Ch1: **Switching node**, -0.4V min, 12.8V max
5V/div, 0.4us/div

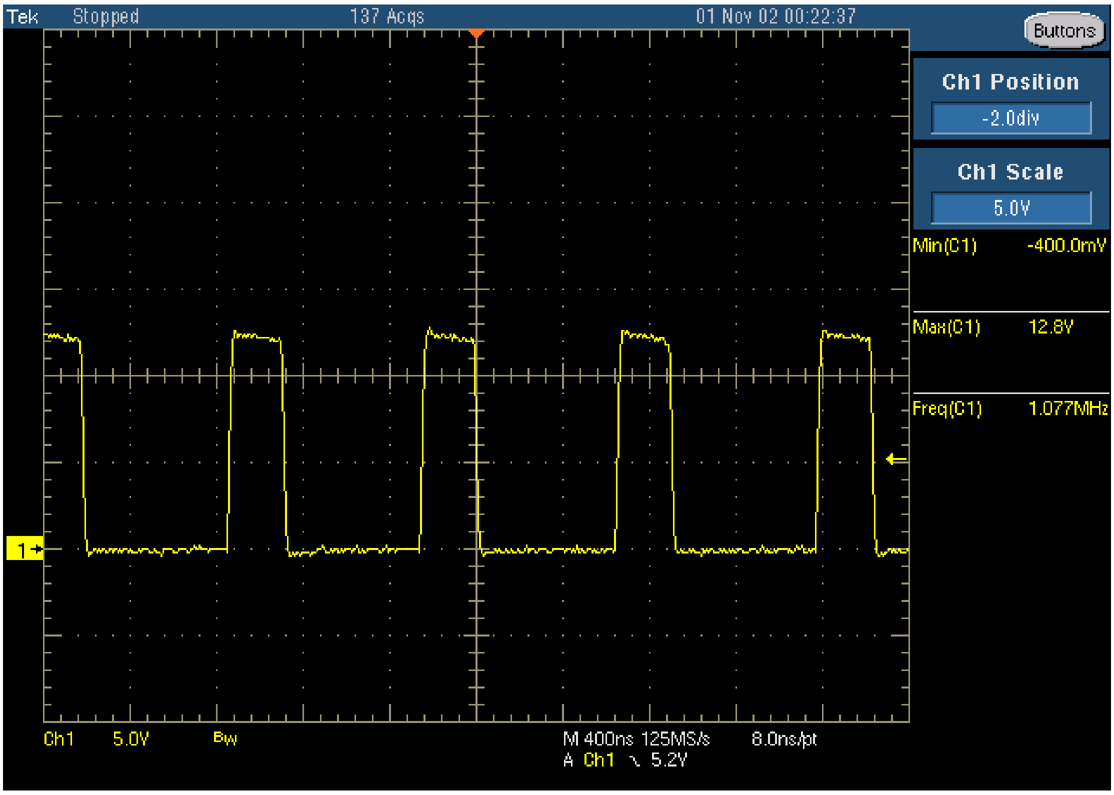

Figure 21

3.3 Efficiency (3.3V TPS62125 Buck Converter)

The efficiency at 12V input voltage is shown in Figure 22.

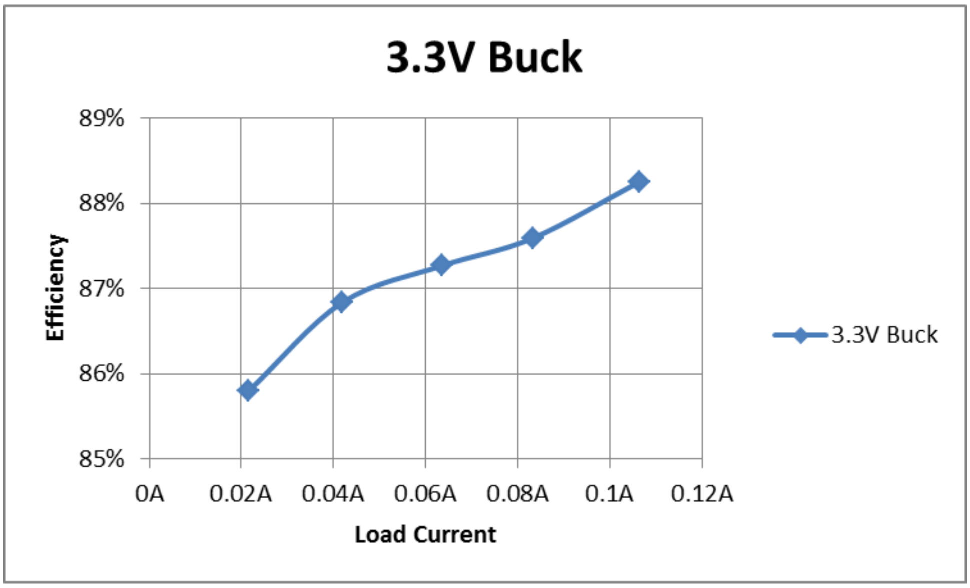

Figure 22

3.4 Load regulation (3.3V TPS62125 Buck Converter)

The load regulation of the 3.3V TPS62125 Buck converter at 12V input voltage is shown in Figure 23.

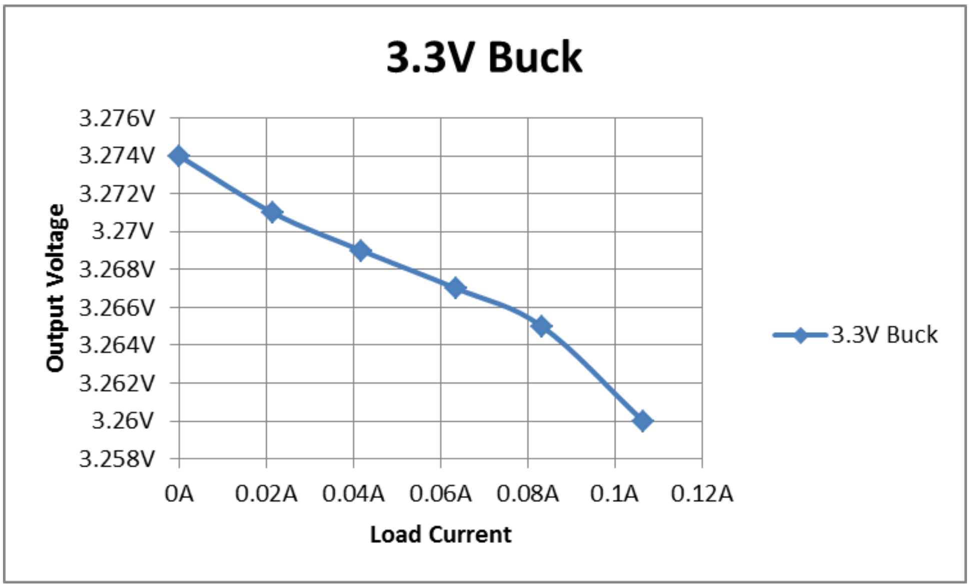

Figure 23

3.5 Transient response (3.3V TPS62125 Buck Converter)

The response to a 50% load step is shown in Figure 24. The other outputs were fully loaded.

Channel Ch1: **Output voltage**, -14.0mV undershoot, 6.8.0mV overshoot
10mV/div, 10ms/div, AC coupled

Channel Ch3: **Load current**, load step 48mA to 102mA and vice versa @ 12V input
50mA/div, 10ms/div

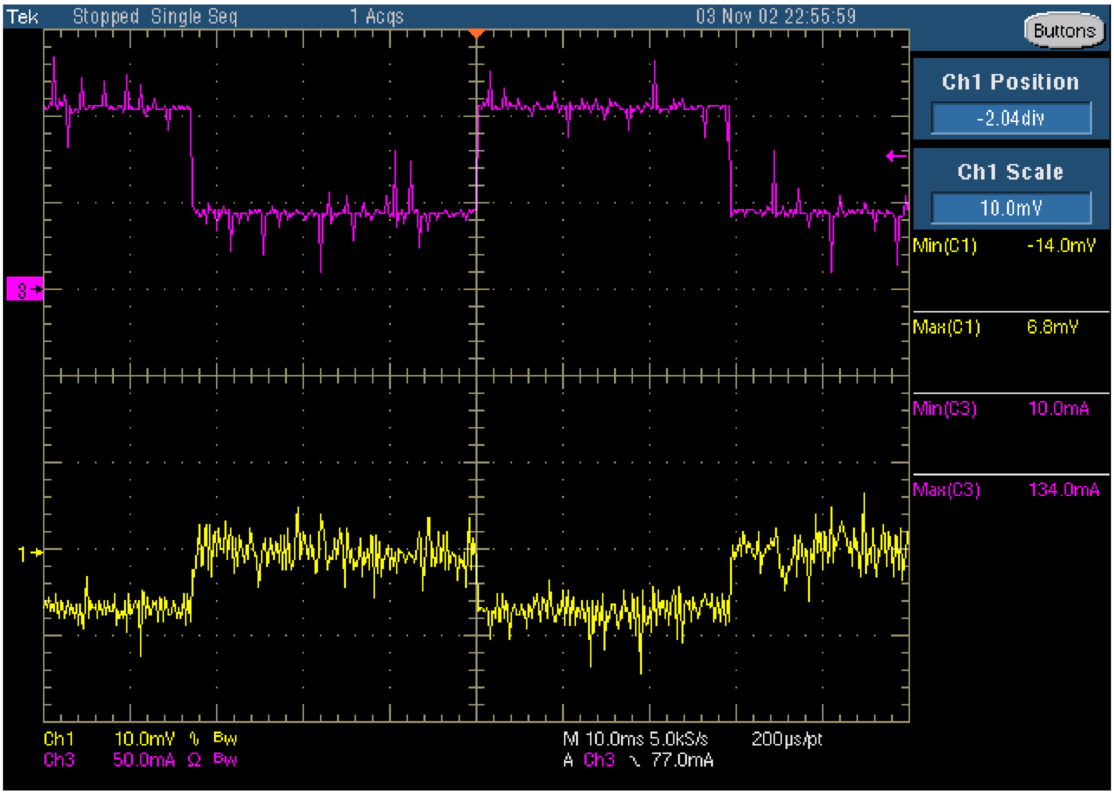

Figure 24

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.