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, 20μs/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](image-url)
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](image-url)
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](image-url)
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.

![12V Fly-Buck](image)

**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.

![24V Fly-Buck](image)

**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.

![12V Fly-Buck](image1)

**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.

![24V Fly-Buck](image2)

**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

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**Figure 16**
2.3 Efficiency (5V LMR23610 Buck Converter)
The efficiency at 12V input voltage is shown in Figure 17.

![Figure 17](image-url)
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.
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](image-url)
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.

![3.3V Buck Efficiency Graph](image_url)
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.
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](image-url)
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   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.
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