



LM5122 4-Phase Boost Converter

TI reference design number: PMP7966 Rev A

Input: 6V to 42V

Output: 52V @ 2.5A

DC – DC Test Results

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PMP7966 Rev A Test Results

1 Circuit Description

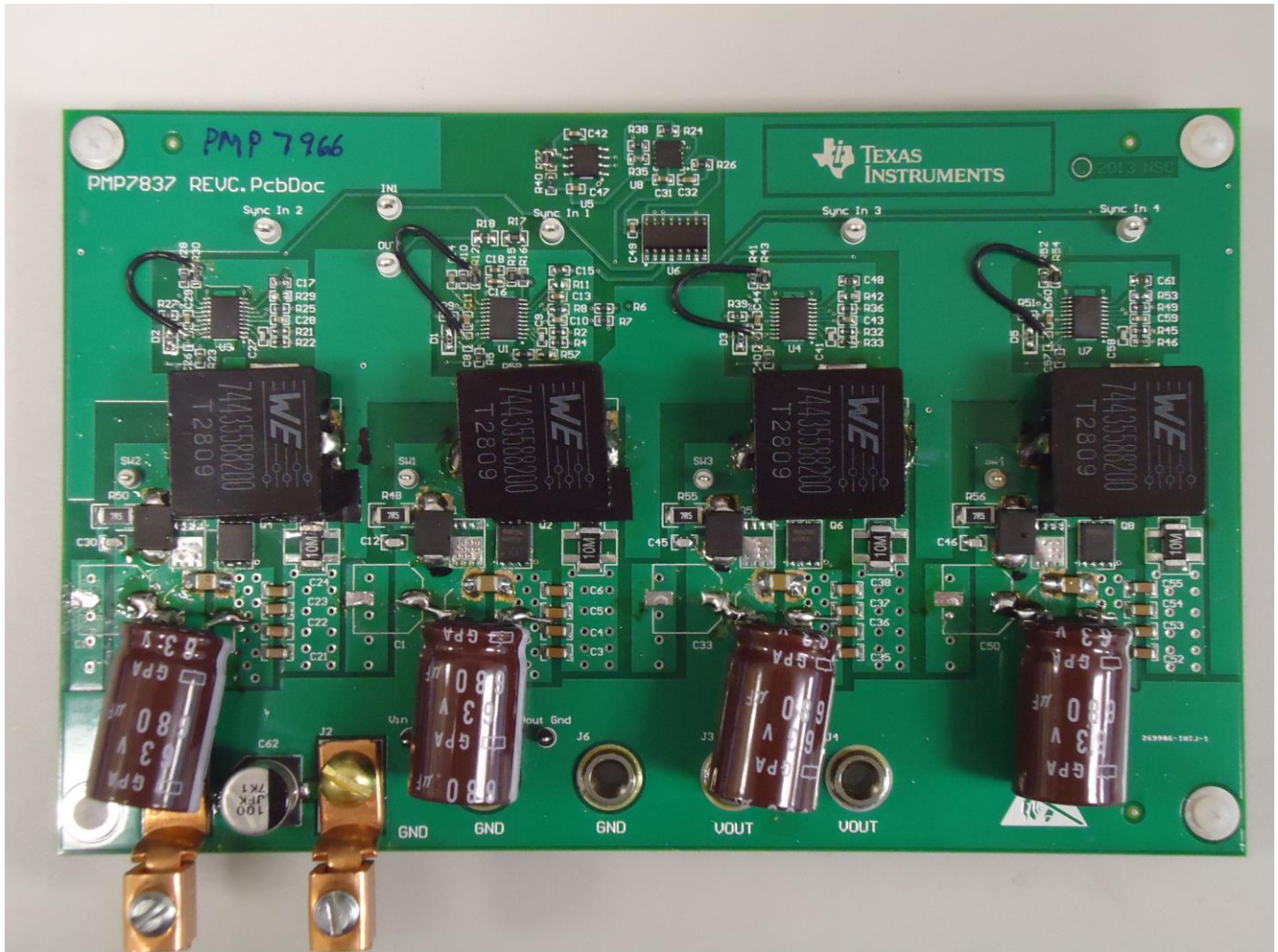
PMP7966 is a 4-phase boost converter rated for 52V output at 2.5A from an input voltage of 6V to 42V. This design uses LM5122 boost controllers at a switching frequency of 100 kHz each phase, resulting in 400 kHz input and output ripple. 680µF aluminum electrolytic capacitors are used at the output of each phase, providing hold-up to support large transient currents.

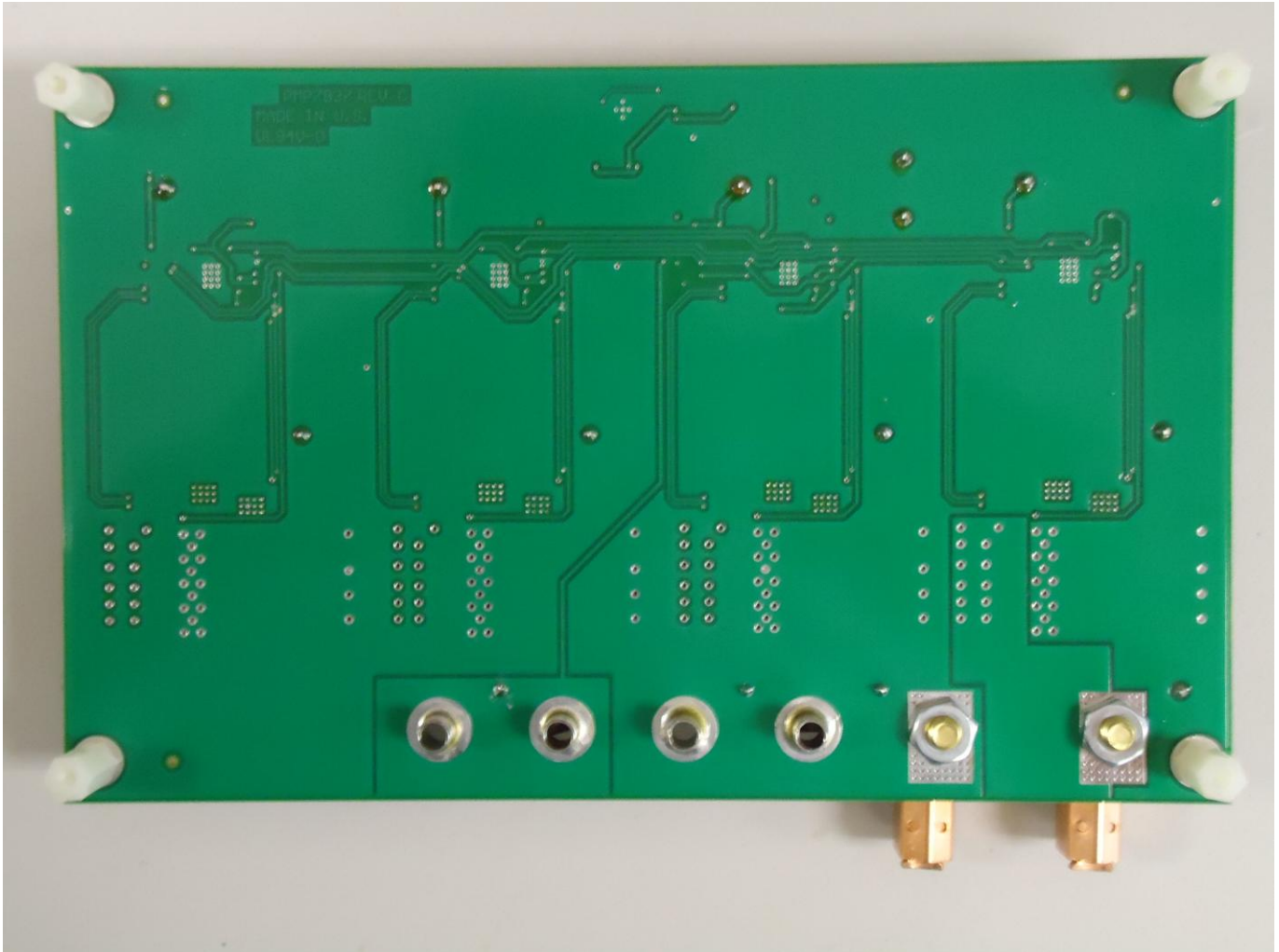
An LMC555 timer and CD4017 decade counter are powered by an LP2951 linear regulator, providing the system clock and synchronization to each controller.

At tests were performed at room temperature on an open bench.

2 Photos

The photographs below show the PMP7966 Rev A assembly as built on PMP7837-C printed circuit board. This is a 4 layer board using 1 ounce copper on external layers and 0.5 ounce copper on internal layers. All components are mounted on the top side of the board. The overall board dimensions are 4.455" x 7.055".

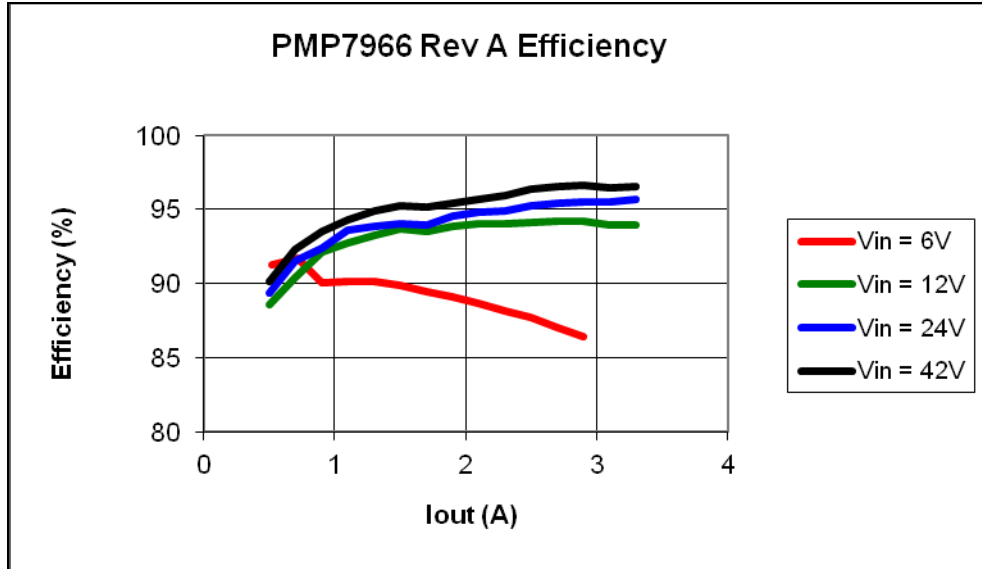




PMP7966 Rev A Test Results

3 Efficiency

The efficiency data is shown in the tables and graph below.



| Vin (V) | Iin (A) | Vout (V) | Iout (A) | Efficiency (%) | Pin (W) | Pout (W) | Losses (W) |
|---------|---------|----------|----------|----------------|---------|----------|------------|
| 5.999 | 0.080 | 51.485 | 0.000 | 0.000 | 0.48 | 0.00 | 0.48 |
| 5.999 | 4.890 | 51.486 | 0.520 | 91.265 | 29.34 | 26.77 | 2.56 |
| 5.998 | 6.740 | 51.487 | 0.720 | 91.699 | 40.43 | 37.07 | 3.36 |
| 5.998 | 8.580 | 51.486 | 0.900 | 90.041 | 51.46 | 46.34 | 5.13 |
| 5.998 | 10.470 | 51.487 | 1.100 | 90.186 | 62.80 | 56.64 | 6.16 |
| 5.998 | 12.380 | 51.487 | 1.300 | 90.139 | 74.26 | 66.93 | 7.32 |
| 5.998 | 14.320 | 51.487 | 1.500 | 89.916 | 85.89 | 77.23 | 8.66 |
| 5.998 | 16.320 | 51.487 | 1.700 | 89.417 | 97.89 | 87.53 | 10.36 |
| 5.998 | 18.300 | 51.487 | 1.900 | 89.124 | 109.76 | 97.83 | 11.94 |
| 5.998 | 20.320 | 51.487 | 2.100 | 88.713 | 121.88 | 108.12 | 13.76 |
| 5.998 | 22.390 | 51.487 | 2.300 | 88.179 | 134.30 | 118.42 | 15.88 |
| 5.998 | 24.470 | 51.488 | 2.500 | 87.701 | 146.77 | 128.72 | 18.05 |
| 5.998 | 26.620 | 51.488 | 2.700 | 87.067 | 159.67 | 139.02 | 20.65 |
| 5.998 | 28.810 | 51.488 | 2.900 | 86.408 | 172.80 | 149.32 | 23.49 |
| 5.998 | 6.640 | 9.297 | 3.100 | 72.365 | 39.83 | 28.82 | 11.01 |
| 5.999 | 6.560 | 5.283 | 3.300 | 44.301 | 39.35 | 17.43 | 21.92 |

| Vin (V) | Iin (A) | Vout (V) | Iout (A) | Efficiency (%) | Pin (W) | Pout (W) | Losses (W) |
|---------|---------|----------|----------|----------------|---------|----------|------------|
| 12.004 | 0.050 | 51.494 | 0.000 | 0.000 | 0.60 | 0.00 | 0.60 |
| 12.004 | 2.420 | 51.495 | 0.500 | 88.633 | 29.05 | 25.75 | 3.30 |
| 12.004 | 3.320 | 51.496 | 0.700 | 90.450 | 39.85 | 36.05 | 3.81 |
| 12.004 | 4.190 | 51.497 | 0.900 | 92.148 | 50.30 | 46.35 | 3.95 |
| 12.004 | 5.090 | 51.498 | 1.100 | 92.713 | 61.10 | 56.65 | 4.45 |

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| | | | | | | | |
|--------|--------|--------|-------|--------|--------|--------|-------|
| 12.004 | 5.980 | 51.498 | 1.300 | 93.262 | 71.78 | 66.95 | 4.84 |
| 12.004 | 6.870 | 51.498 | 1.500 | 93.670 | 82.47 | 77.25 | 5.22 |
| 12.004 | 7.800 | 51.498 | 1.700 | 93.502 | 93.63 | 87.55 | 6.08 |
| 12.004 | 8.680 | 51.498 | 1.900 | 93.907 | 104.19 | 97.85 | 6.35 |
| 12.004 | 9.580 | 51.498 | 2.100 | 94.041 | 115.00 | 108.15 | 6.85 |
| 12.004 | 10.490 | 51.498 | 2.300 | 94.063 | 125.92 | 118.45 | 7.48 |
| 12.004 | 11.390 | 51.497 | 2.500 | 94.161 | 136.73 | 128.74 | 7.98 |
| 12.004 | 12.290 | 51.497 | 2.700 | 94.247 | 147.53 | 139.04 | 8.49 |
| 12.003 | 13.210 | 51.497 | 2.900 | 94.186 | 158.56 | 149.34 | 9.22 |
| 12.004 | 14.150 | 51.497 | 3.100 | 93.986 | 169.86 | 159.64 | 10.22 |
| 12.004 | 15.070 | 51.497 | 3.300 | 93.941 | 180.90 | 169.94 | 10.96 |

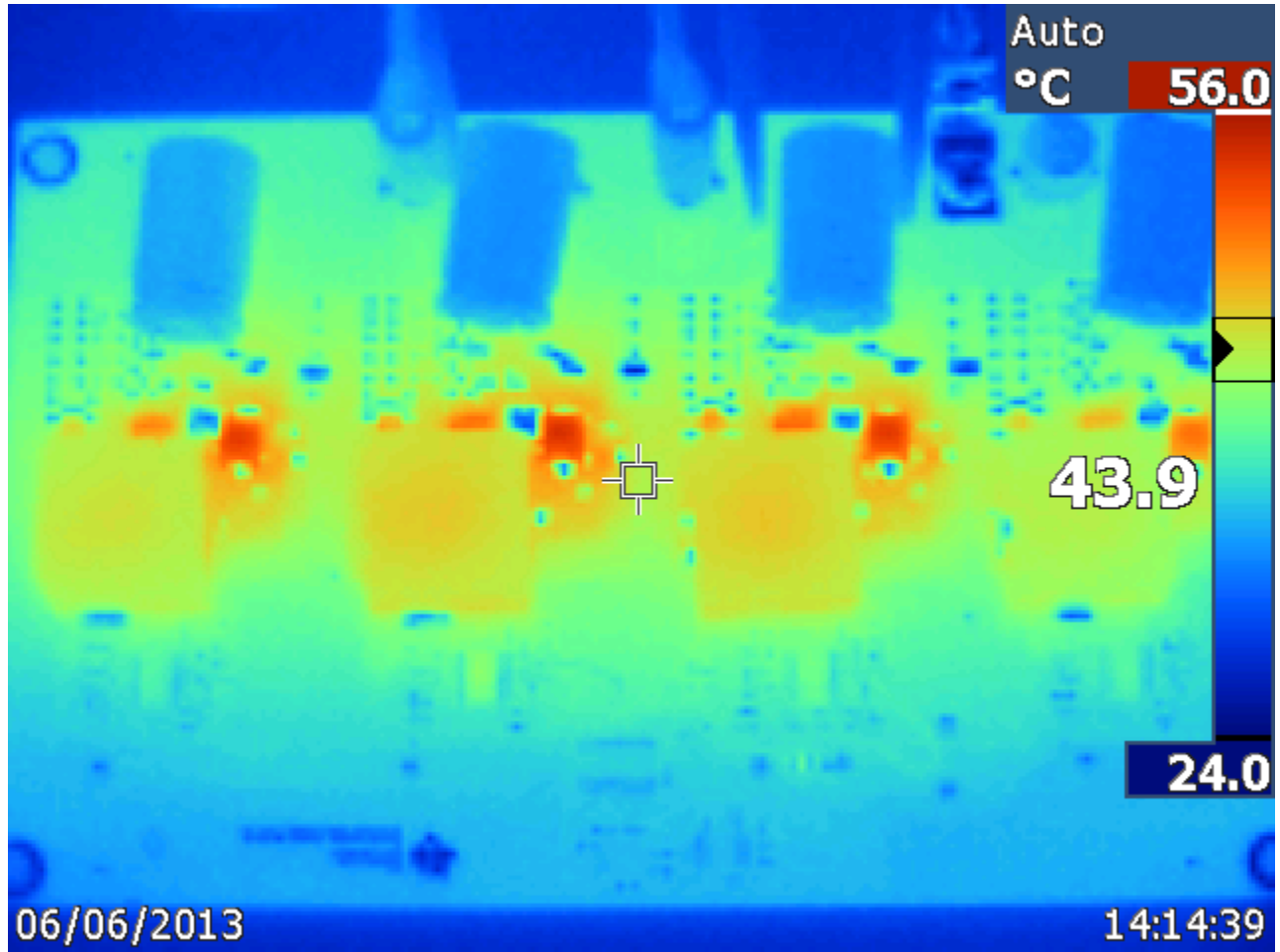
| Vin (V) | Iin (A) | Vout (V) | Iout (A) | Efficiency (%) | Pin (W) | Pout (W) | Losses (W) |
|---------|---------|----------|----------|----------------|---------|----------|------------|
| 24.012 | 0.020 | 51.499 | 0.000 | 0.000 | 0.48 | 0.00 | 0.48 |
| 24.012 | 1.200 | 51.500 | 0.500 | 89.365 | 28.81 | 25.75 | 3.06 |
| 24.012 | 1.640 | 51.500 | 0.700 | 91.545 | 39.38 | 36.05 | 3.33 |
| 24.012 | 2.090 | 51.501 | 0.900 | 92.360 | 50.19 | 46.35 | 3.83 |
| 24.012 | 2.520 | 51.501 | 1.100 | 93.622 | 60.51 | 56.65 | 3.86 |
| 24.011 | 2.970 | 51.502 | 1.300 | 93.886 | 71.31 | 66.95 | 4.36 |
| 24.011 | 3.420 | 51.502 | 1.500 | 94.076 | 82.12 | 77.25 | 4.86 |
| 24.011 | 3.880 | 51.502 | 1.700 | 93.979 | 93.16 | 87.55 | 5.61 |
| 24.011 | 4.310 | 51.502 | 1.900 | 94.556 | 103.49 | 97.85 | 5.63 |
| 24.011 | 4.750 | 51.503 | 2.100 | 94.830 | 114.05 | 108.16 | 5.90 |
| 24.011 | 5.200 | 51.503 | 2.300 | 94.874 | 124.86 | 118.46 | 6.40 |
| 24.011 | 5.630 | 51.502 | 2.500 | 95.246 | 135.18 | 128.76 | 6.43 |
| 24.011 | 6.070 | 51.503 | 2.700 | 95.411 | 145.75 | 139.06 | 6.69 |
| 24.011 | 6.510 | 51.503 | 2.900 | 95.552 | 156.31 | 149.36 | 6.95 |
| 24.011 | 6.960 | 51.503 | 3.100 | 95.538 | 167.12 | 159.66 | 7.46 |
| 24.011 | 7.400 | 51.503 | 3.300 | 95.654 | 177.68 | 169.96 | 7.72 |

| Vin (V) | Iin (A) | Vout (V) | Iout (A) | Efficiency (%) | Pin (W) | Pout (W) | Losses (W) |
|---------|---------|----------|----------|----------------|---------|----------|------------|
| 42.011 | 0.010 | 51.503 | 0.000 | 0.000 | 0.42 | 0.00 | 0.42 |
| 42.011 | 0.680 | 51.504 | 0.500 | 90.144 | 28.57 | 25.75 | 2.82 |
| 42.011 | 0.930 | 51.504 | 0.700 | 92.277 | 39.07 | 36.05 | 3.02 |
| 42.011 | 1.180 | 51.505 | 0.900 | 93.508 | 49.57 | 46.35 | 3.22 |
| 42.011 | 1.430 | 51.505 | 1.100 | 94.307 | 60.08 | 56.66 | 3.42 |
| 42.011 | 1.680 | 51.505 | 1.300 | 94.868 | 70.58 | 66.96 | 3.62 |
| 42.011 | 1.930 | 51.505 | 1.500 | 95.284 | 81.08 | 77.26 | 3.82 |
| 42.011 | 2.190 | 51.506 | 1.700 | 95.170 | 92.00 | 87.56 | 4.44 |
| 42.010 | 2.440 | 51.506 | 1.900 | 95.470 | 102.50 | 97.86 | 4.64 |
| 42.011 | 2.690 | 51.506 | 2.100 | 95.711 | 113.01 | 108.16 | 4.85 |
| 42.011 | 2.940 | 51.506 | 2.300 | 95.913 | 123.51 | 118.46 | 5.05 |
| 42.011 | 3.180 | 51.506 | 2.500 | 96.385 | 133.59 | 128.77 | 4.83 |
| 42.011 | 3.430 | 51.507 | 2.700 | 96.510 | 144.10 | 139.07 | 5.03 |
| 42.011 | 3.680 | 51.507 | 2.900 | 96.617 | 154.60 | 149.37 | 5.23 |
| 42.010 | 3.940 | 51.507 | 3.100 | 96.467 | 165.52 | 159.67 | 5.85 |
| 42.010 | 4.190 | 51.506 | 3.300 | 96.562 | 176.02 | 169.97 | 6.05 |

4 Thermal Test

All tests were performed at room temperature on an open bench.

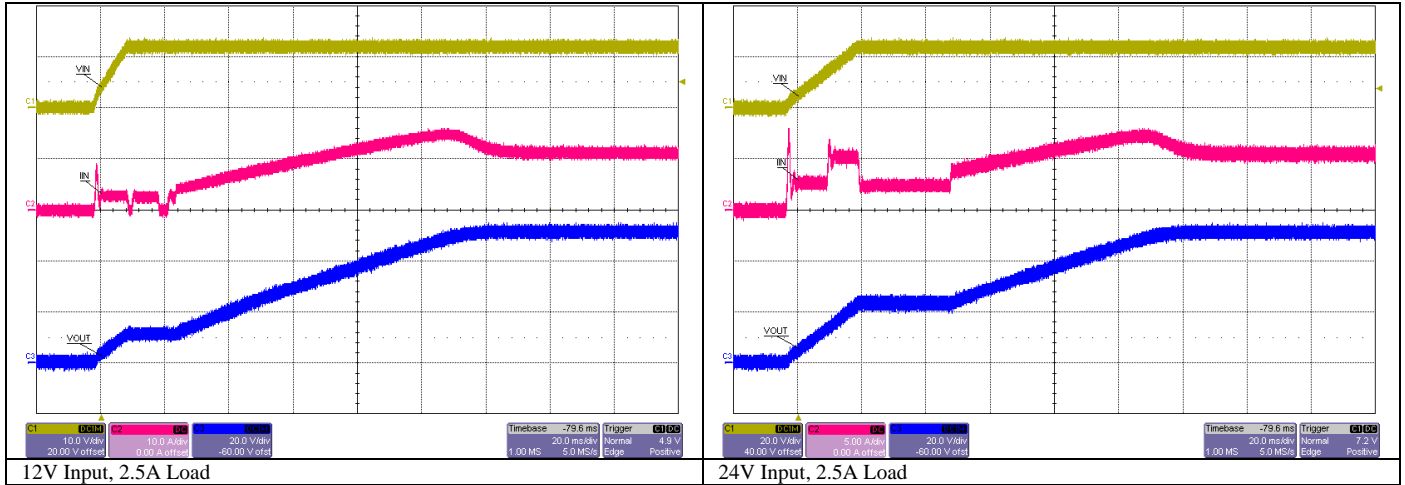
4.1 12V Input, 2.5A Load, No Airflow



5 Startup Behavior

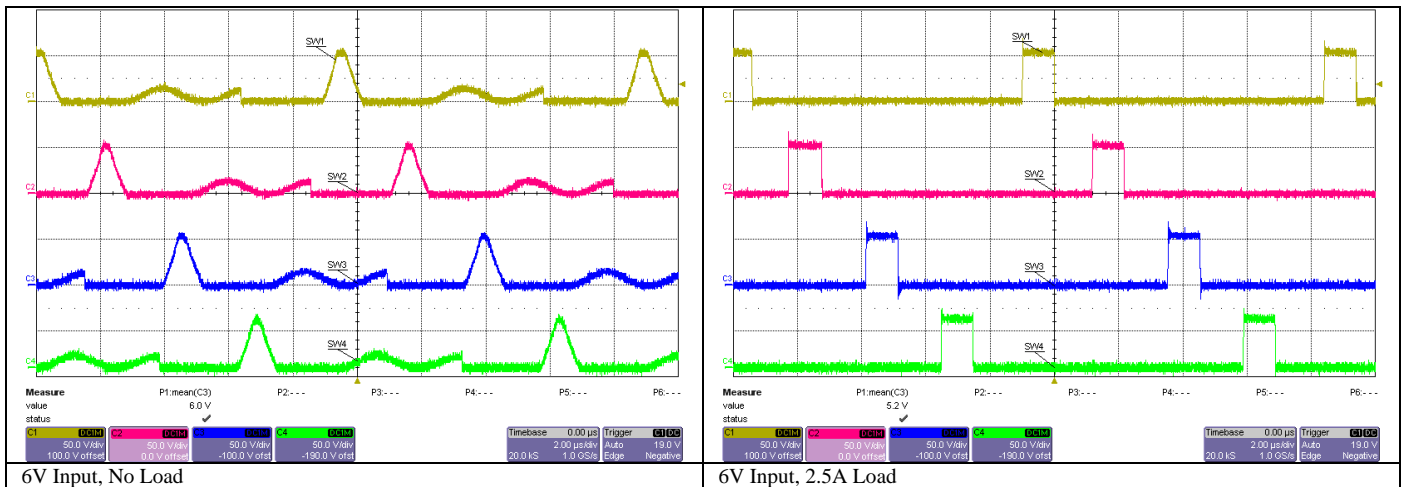
5.1 Turn-on from Vin

The output voltage is well controlled at turn-on, showing no evidence of over-shoot.

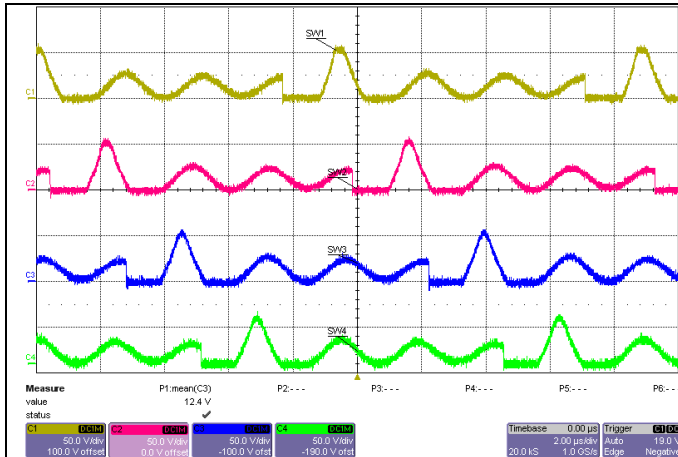


6 Switching Behavior

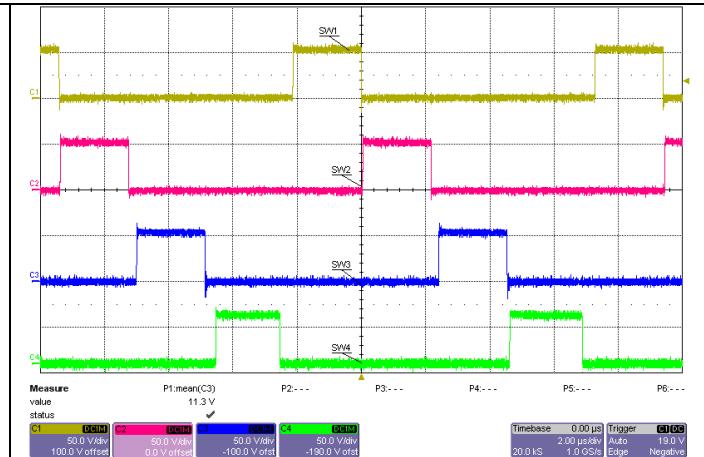
6.1 Switching at No Load and Full Load



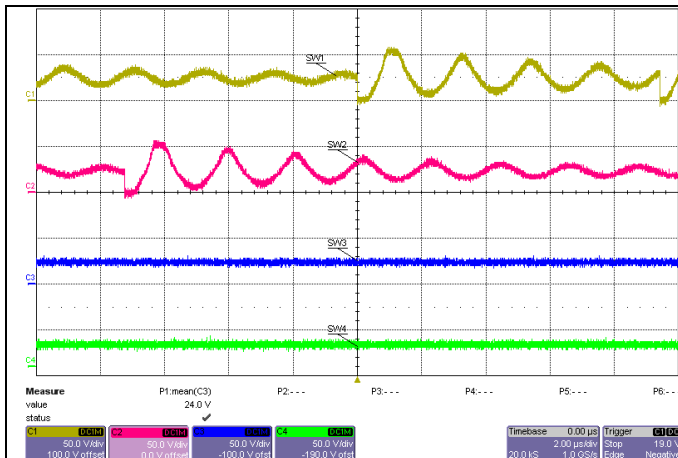
PMP7966 Rev A Test Results



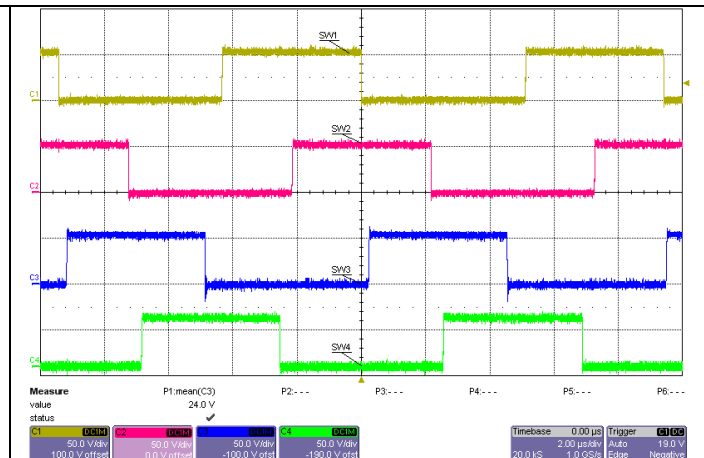
12V Input, No Load



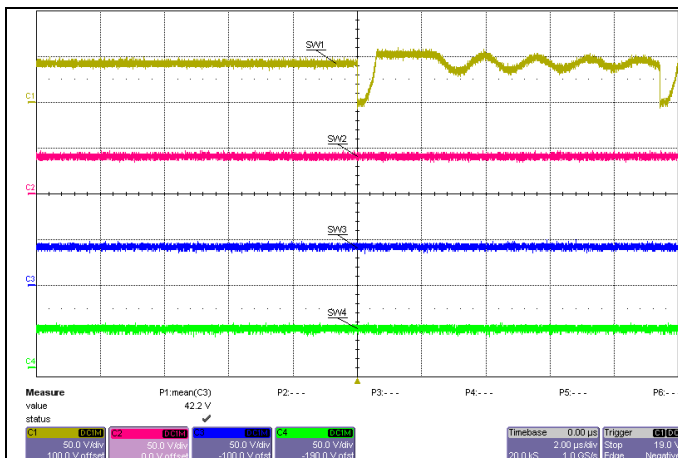
12V Input, 2.5A Load



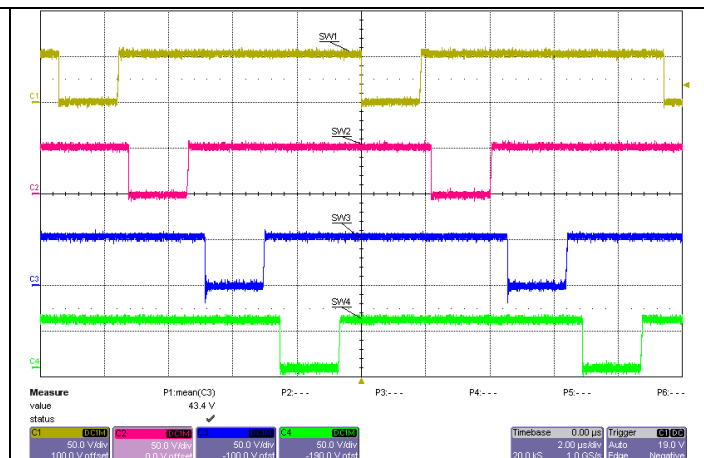
24V Input, No Load



24V Input, 2.5A Load



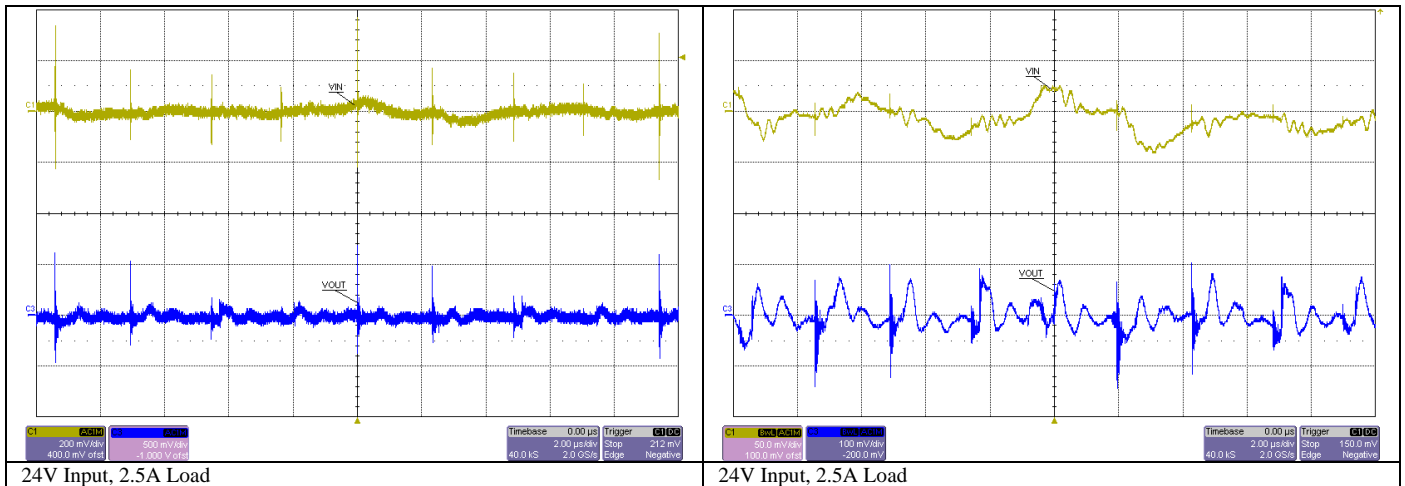
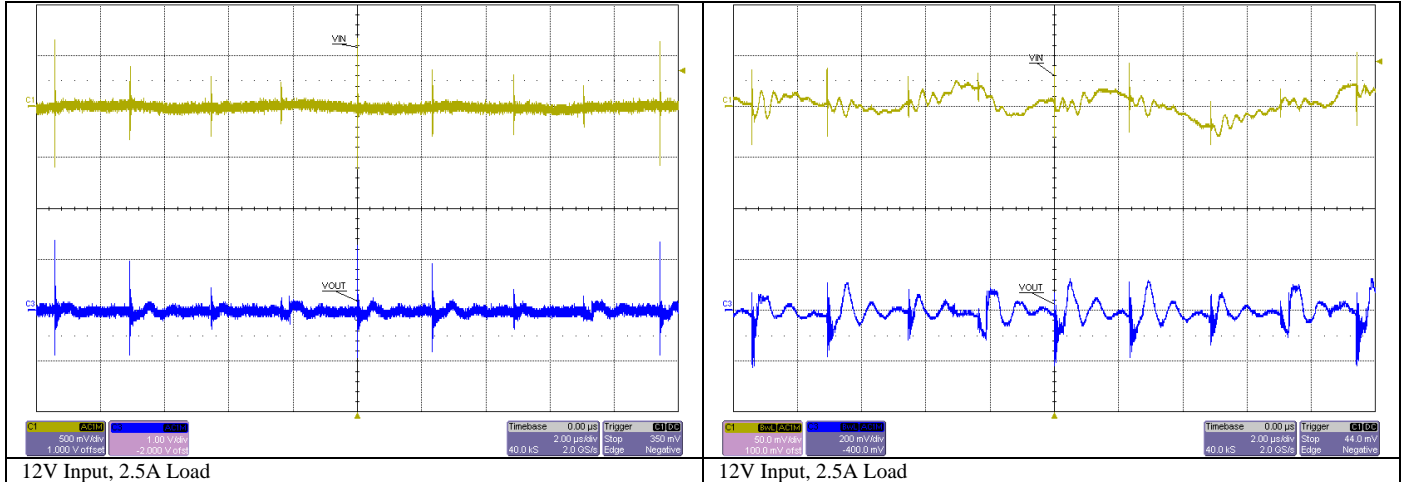
42V Input, No Load



42V Input, 2.5A Load

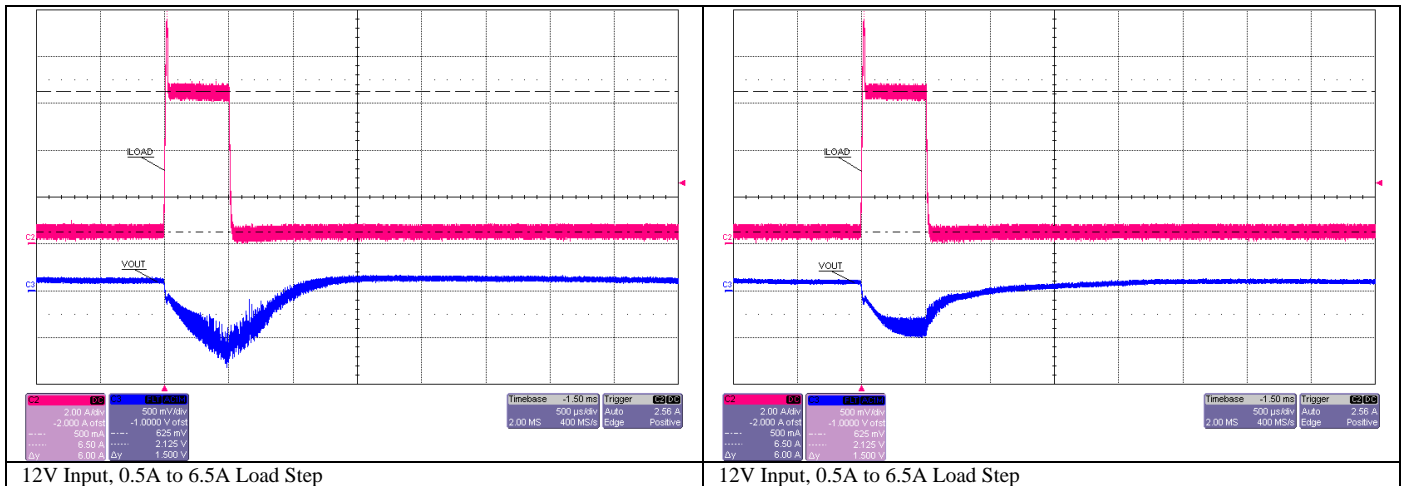
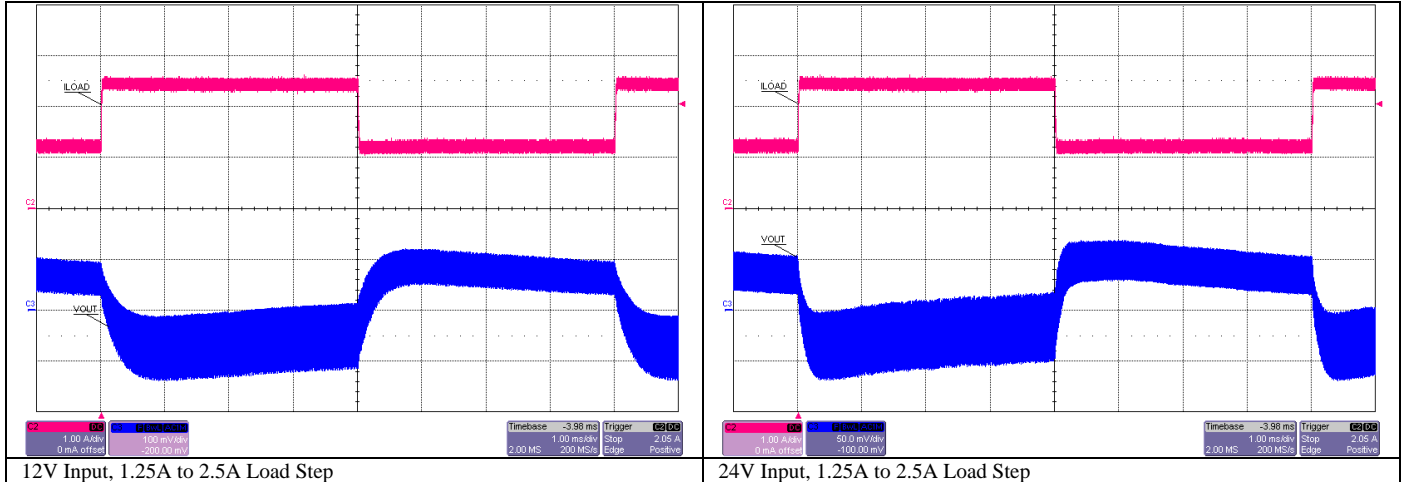
7 Ripple Voltage

7.1 Input and Output Ripple



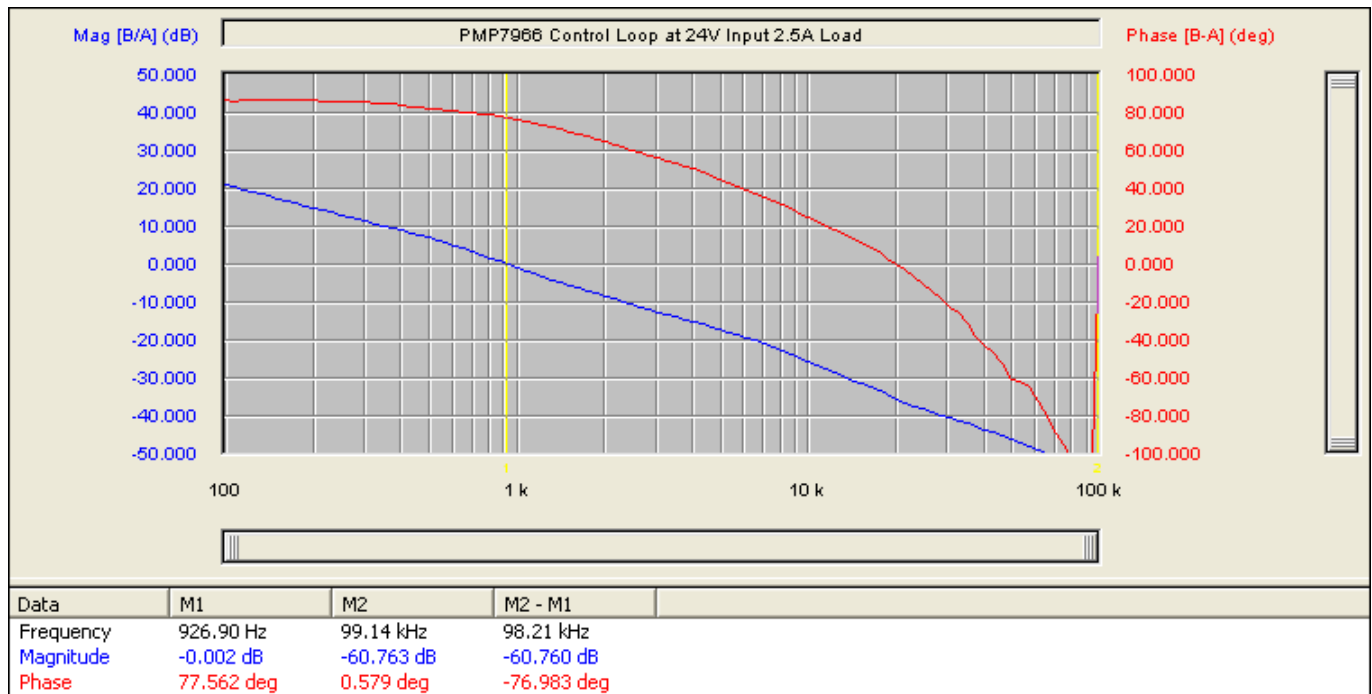
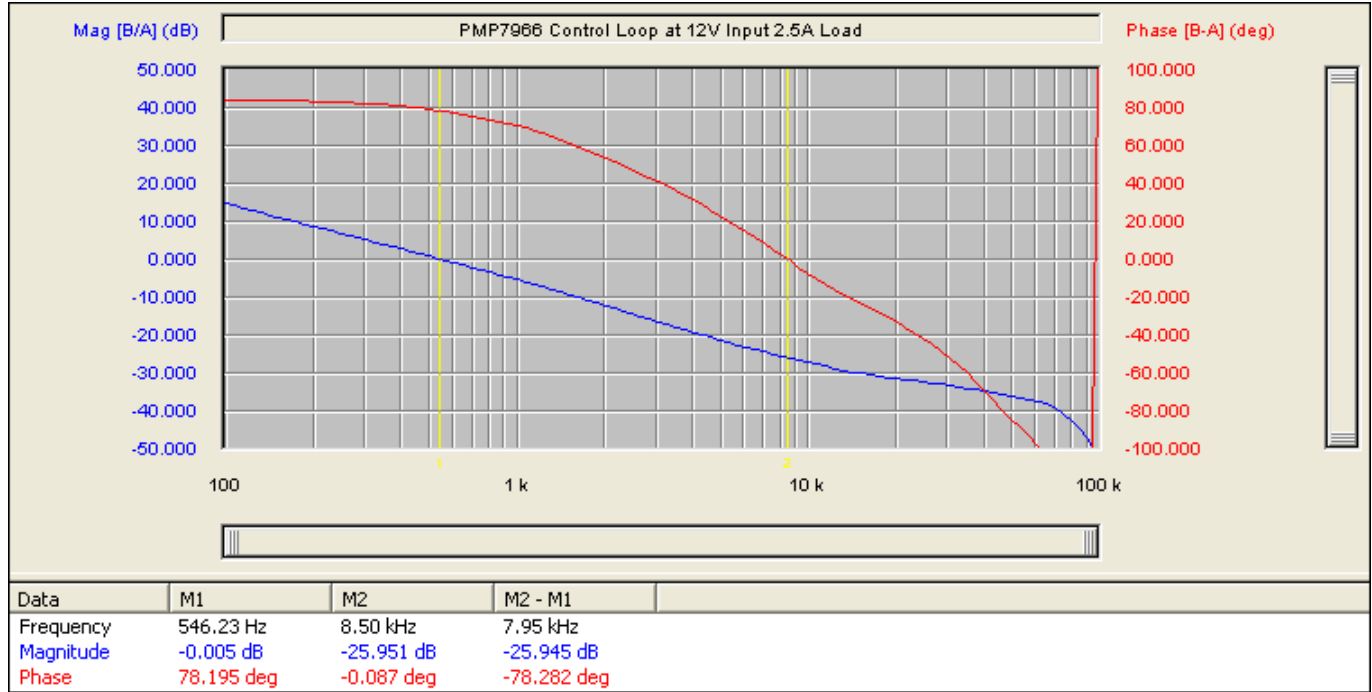
8 Load Transient Response

8.1 Load Transient at 12V and 24V Input



9 Frequency Response

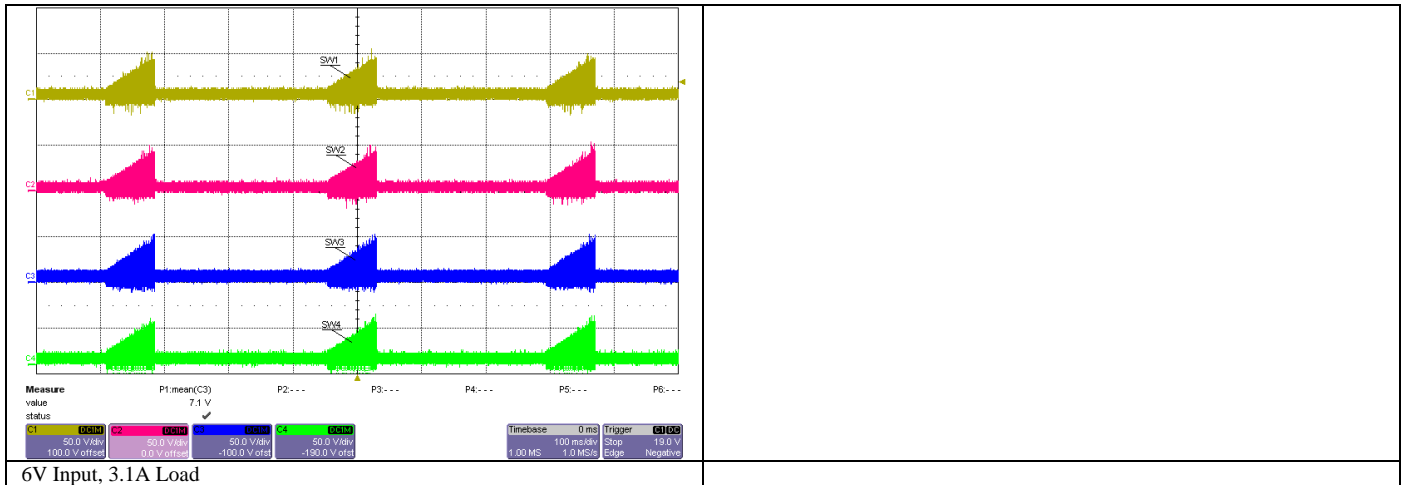
9.1 Frequency Response at 12V and 24V Input



10 Over-Current Protection

10.1 Current Limit Protection

Current limit test was performed at the minimum input voltage to check the current limit threshold. The measured threshold occurred at 31A of input current with 3.1A load. The results show current limit with hiccup protection.



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