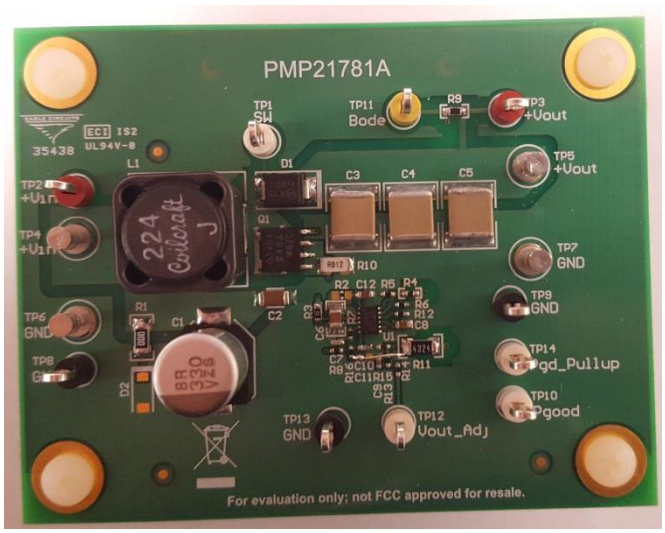
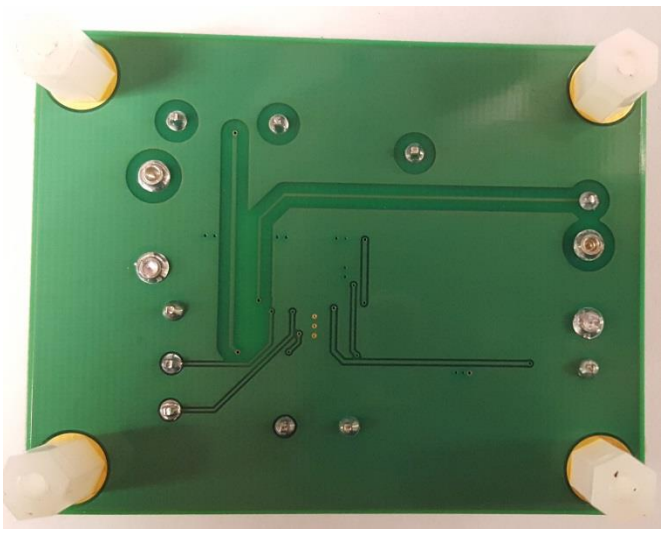
Test Report: PMP21781

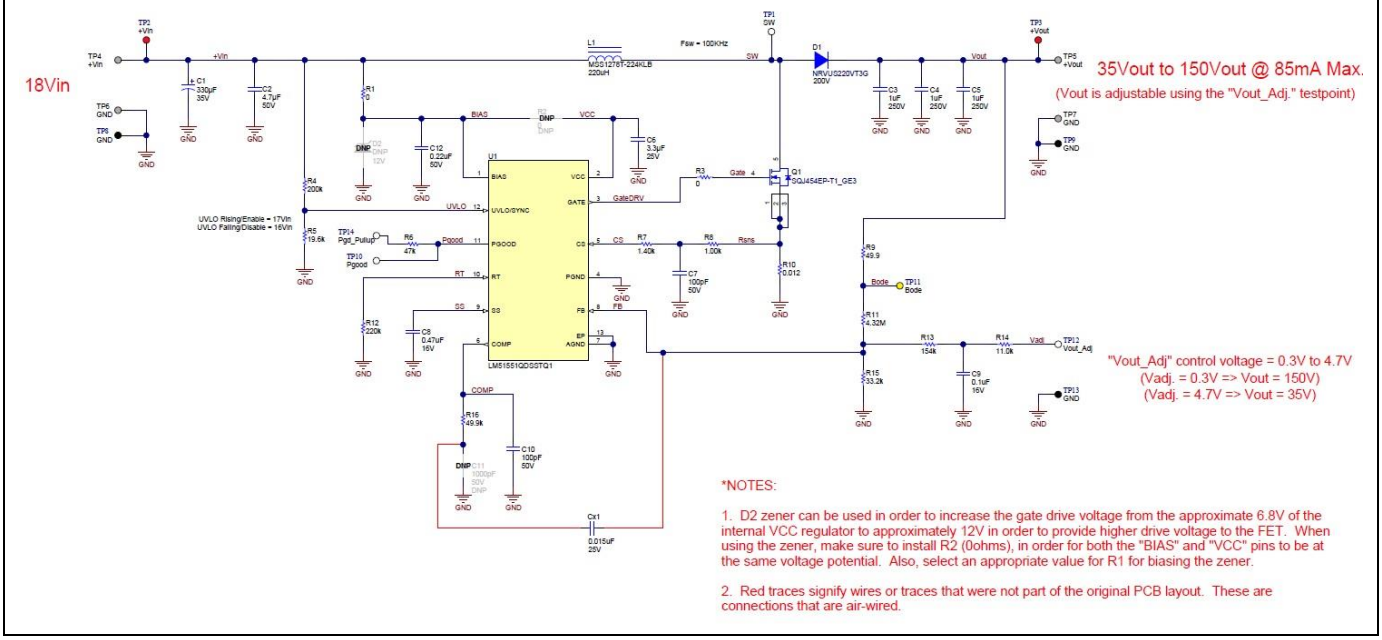
30-V to 150-V Adjustable Output Voltage Boost Reference Design for LiDAR Applications

Description

This reference design utilizes a non-synchronous boost controller to provide an adjustable output of between 35 V and 150 V capable of delivering a maximum of 85 mA of current to the load. This is an Automotive design intended to power various applications such as LiDAR systems, which require an adjustable voltage supply.







1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
V_{in}	18VDC
V_{out}	35VDC to 150VDC (adjustable)
I_{out}	0.085 A Maximum
F_{sw}	100KHz Nominal

1.2 Required Equipment

- Power Supply
- Load Resistors
- DMMs
- Oscilloscope
- Auxiliary Power Supply (for providing DC signal that controls the output voltage)

1.3 Considerations

Using electronic loads may exhibit undesirable behavior due to the interaction of the regulation loop of the electronic load with the low output capacitance of the boost converter. It is recommended to use resistor loads instead.

2 Testing and Results

2.1 Efficiency Graphs

Figure 1 shows the converter efficiency for a 18-V input with 35-V, 100-V, and 150-V outputs.

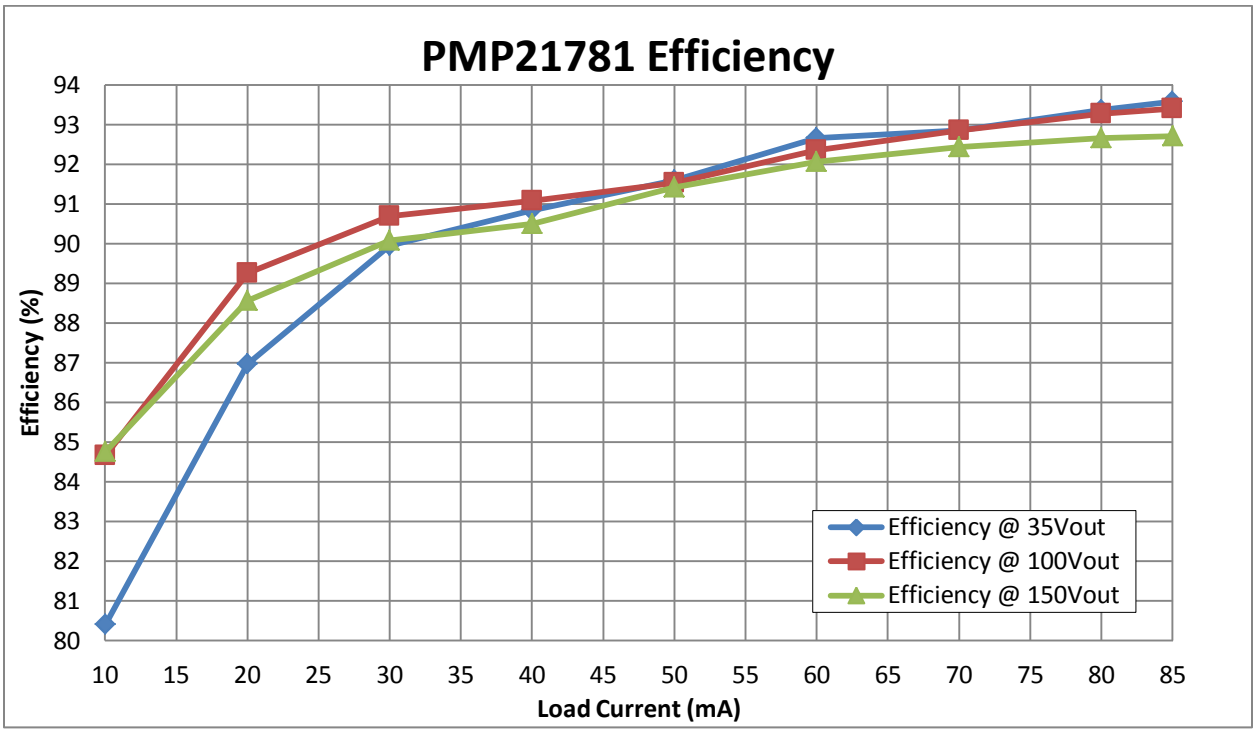


Figure 1. Converter Efficiency 18-V Input, 35-V, 100-V, and 150-V Outputs

2.2 Efficiency Data

Table 2, Table 3, and Table 4 show the efficiency data for 35-V, 100-V, and 150-V outputs with a 18-V input.

Table 2. Efficiency Data 18-V input, 35-V Output

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Ploss (W)	Efficiency (%)
18	670.000E-6	35.02	000.000E+0	0.0121	0.0000	0.0121	0.0
18	24.220E-3	35.018	10.010E-3	0.4360	0.3505	0.0854	80.4
18	44.780E-3	35.017	20.020E-3	0.8060	0.7010	0.1050	87.0
18	64.907E-3	35.019	30.010E-3	1.1683	1.0509	0.1174	90.0
18	85.670E-3	35.018	40.000E-3	1.5421	1.4007	0.1413	90.8
18	106.200E-3	35.02	50.000E-3	1.9116	1.7510	0.1606	91.6
18	126.000E-3	35.02	60.010E-3	2.2680	2.1016	0.1664	92.7
18	146.700E-3	35.02	70.020E-3	2.6406	2.4521	0.1885	92.9
18	166.700E-3	35.021	80.000E-3	3.0006	2.8017	0.1989	93.4
18	176.700E-3	35.02	85.000E-3	3.1806	2.9767	0.2039	93.6

Table 3. Efficiency Data 18-V Input, 100-V Output

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Ploss (W)	Efficiency (%)
18	5.378E-3	100.022	000.000E+0	0.0968	0.0000	0.0968	0.0
18	65.832E-3	100.019	10.030E-3	1.1850	1.0032	0.1818	84.7
18	124.500E-3	100.018	20.000E-3	2.2410	2.0004	0.2406	89.3
18	183.810E-3	100.021	30.000E-3	3.3086	3.0006	0.3080	90.7
18	244.070E-3	100.02	40.010E-3	4.3933	4.0018	0.3915	91.1
18	303.550E-3	100.015	50.010E-3	5.4639	5.0018	0.4621	91.5
18	361.000E-3	100.012	60.010E-3	6.4980	6.0017	0.4963	92.4
18	419.000E-3	100.013	70.020E-3	7.5420	7.0029	0.5391	92.9
18	476.600E-3	100.011	80.010E-3	8.5788	8.0019	0.5769	93.3
18	505.700E-3	100.008	85.010E-3	9.1026	8.5017	0.6009	93.4

Table 3. Efficiency Data 18-V Input, 150-V Output

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Ploss (W)	Efficiency (%)
18	6.527E-3	150	000.000E+0	0.1175	0.0000	0.1175	0.0
18	98.530E-3	150.02	10.020E-3	1.7735	1.5032	0.2703	84.8
18	188.180E-3	150.01	20.000E-3	3.3872	3.0002	0.3870	88.6
18	277.600E-3	150	30.010E-3	4.9968	4.5015	0.4953	90.1
18	368.400E-3	150	40.010E-3	6.6312	6.0015	0.6297	90.5
18	455.800E-3	150	50.000E-3	8.2044	7.5000	0.7044	91.4
18	543.100E-3	150	60.000E-3	9.7758	9.0000	0.7758	92.1
18	631.100E-3	150	70.010E-3	11.3598	10.5015	0.8583	92.4
18	719.400E-3	149.98	80.010E-3	12.9492	11.9999	0.9493	92.7
18	764.000E-3	149.97	85.020E-3	13.7520	12.7504	1.0016	92.7

2.3 Thermal Images

The thermal images in Figure 2, Figure 3, and Figure 4 show operation at 18-V input and 35-V, 100-V, and 150-V outputs at 85 mA load, with no airflow. The thermals images show the component-side of the board and were captured/taken with the board having reached thermal equilibrium.

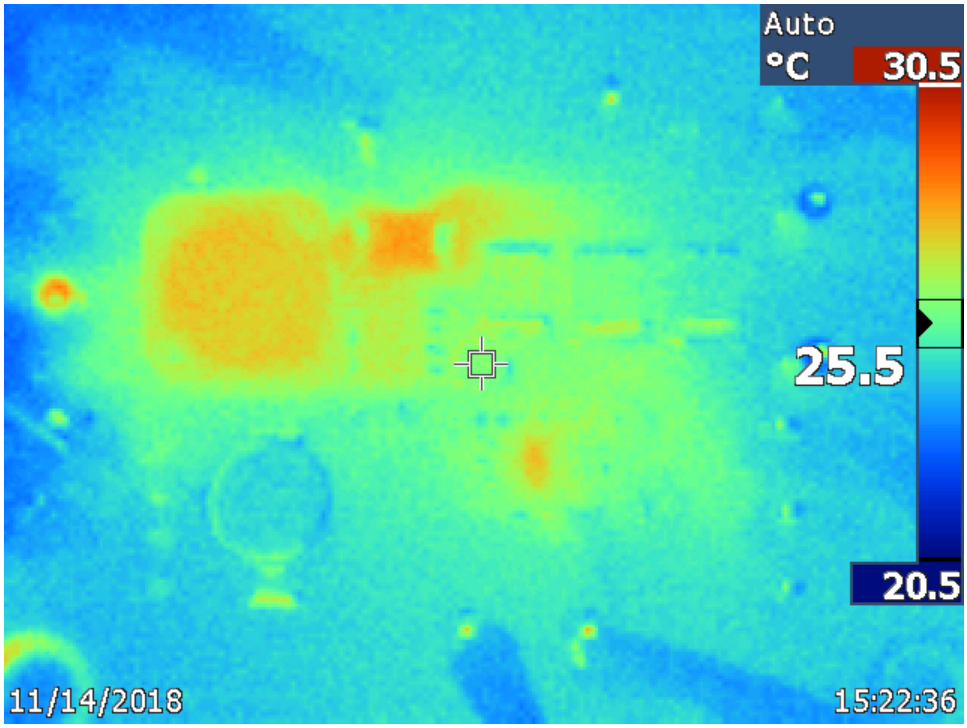


Figure 2. Thermal Image, 18-V Input, 35-V Output at 85 mA Load

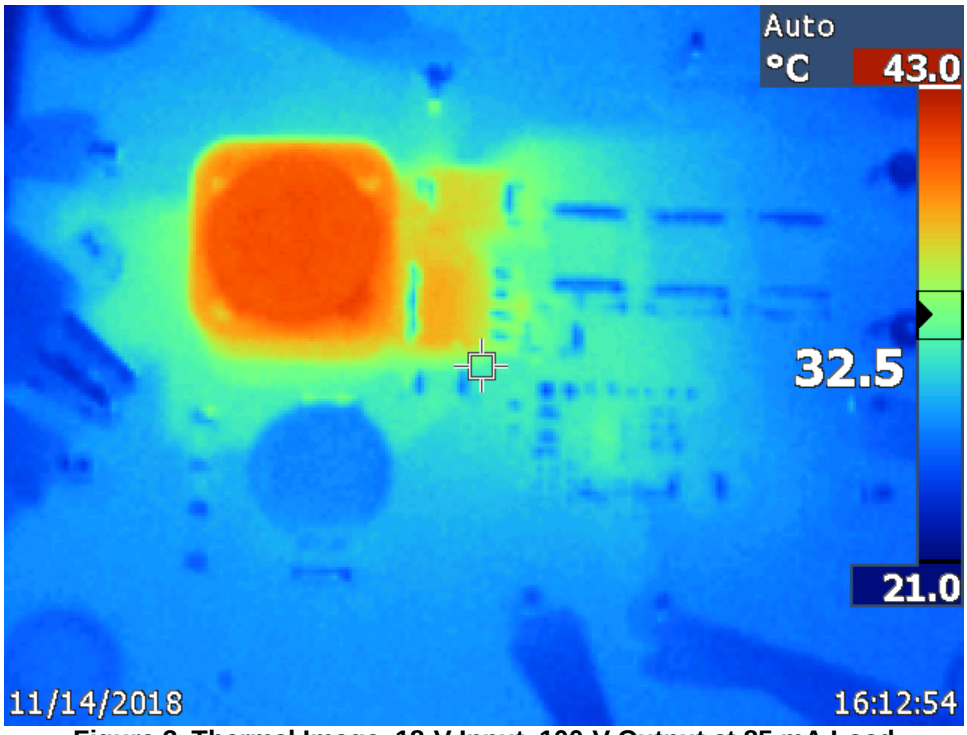


Figure 3. Thermal Image, 18-V Input, 100-V Output at 85 mA Load

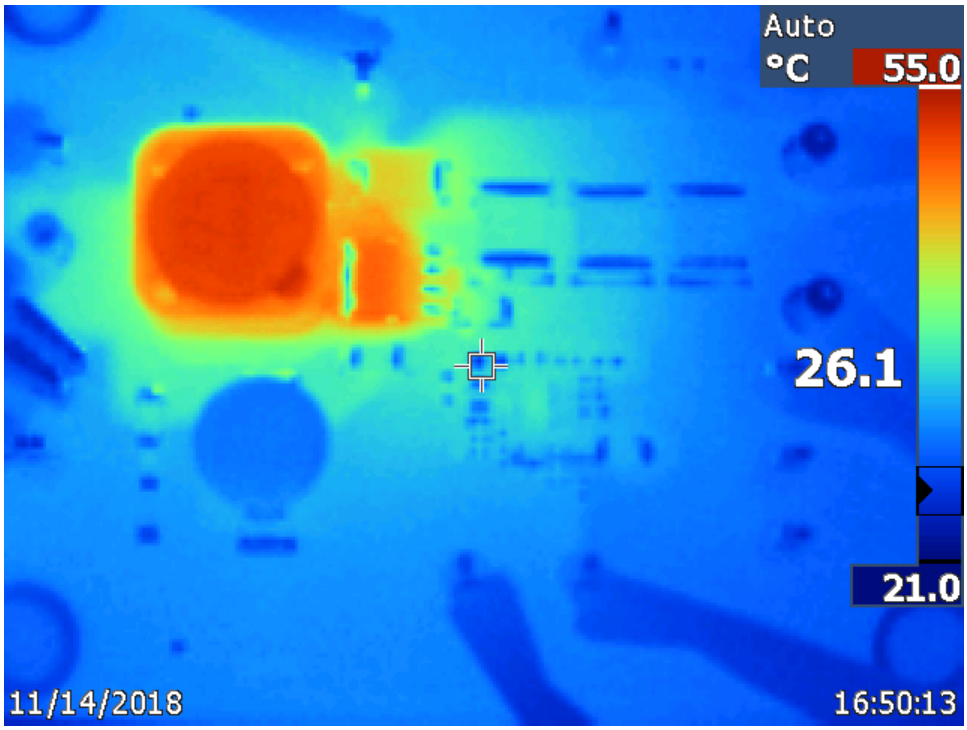


Figure 4. Thermal Image, 18-V Input, 150-V Output at 85 mA Load

2.4 Dimensions

Figure 5 and Figure 6 present the top and bottom photos of the PMP21781 board. The board dimensions are 2.7" x 2.1" (68.58mm x 53.34mm).

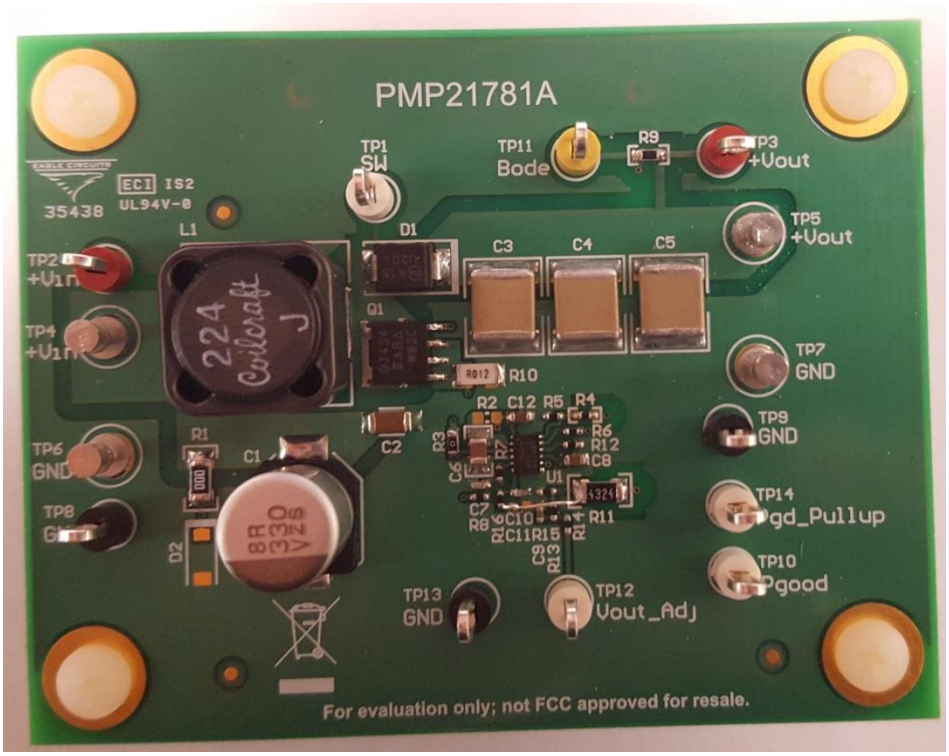


Figure 5. Top of PMP21781 Board

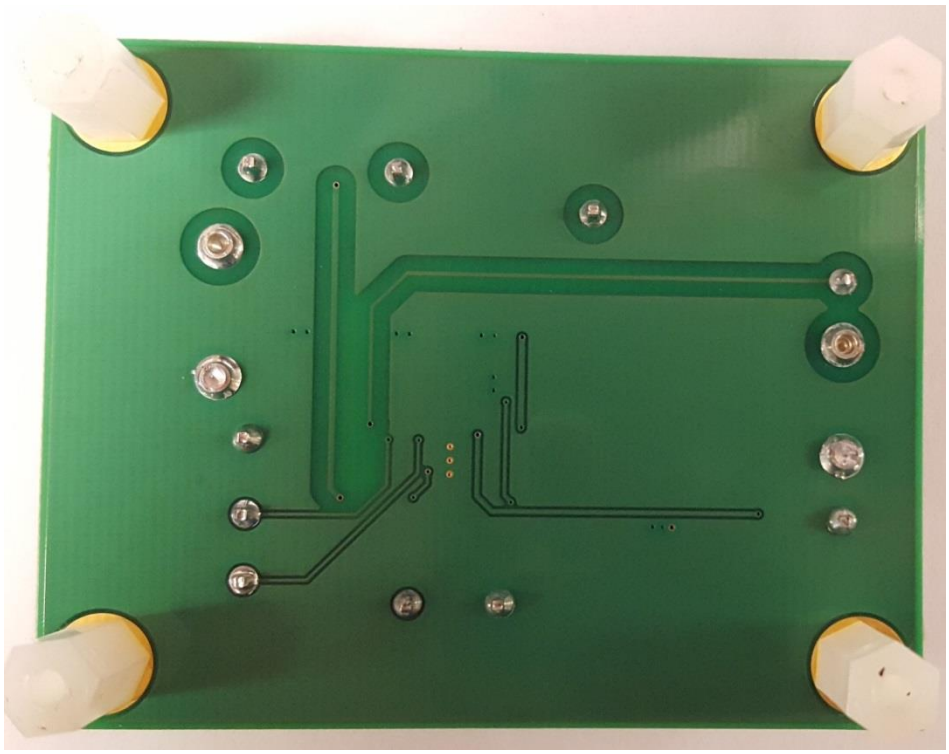


Figure 6. Bottom of PMP21781 Board

3 Waveforms

3.1 Switching

Figure 7, Figure 8, and Figure 9 show the switch node voltage of the converter at 18-V input and 35-V, 100-V, and 150-V output.

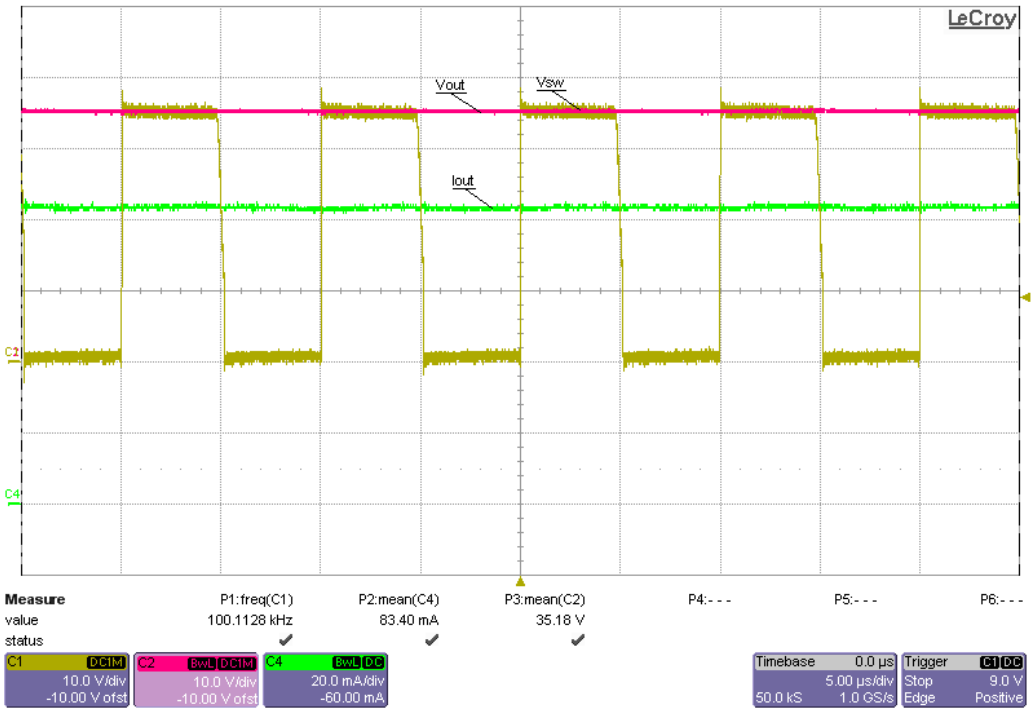


Figure 7. Switch Node Voltage, 18-V Input, 35-V Output, 85 mA Resistive Load

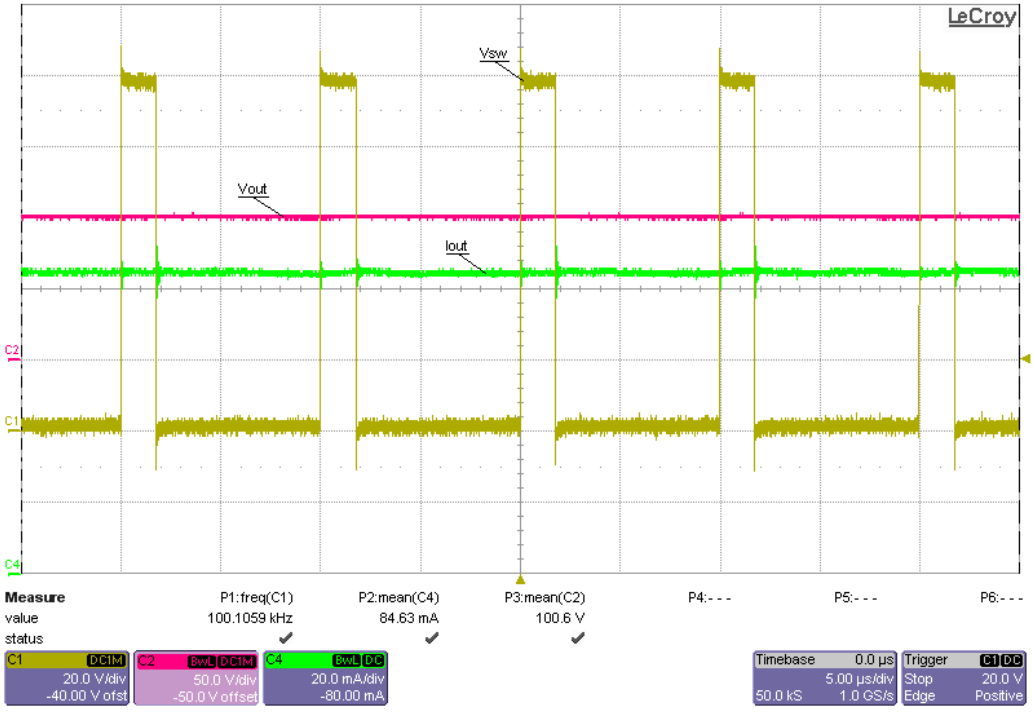


Figure 8. Switch Node Voltage, 18-V Input, 100-V Output, 85 mA Resistive Load

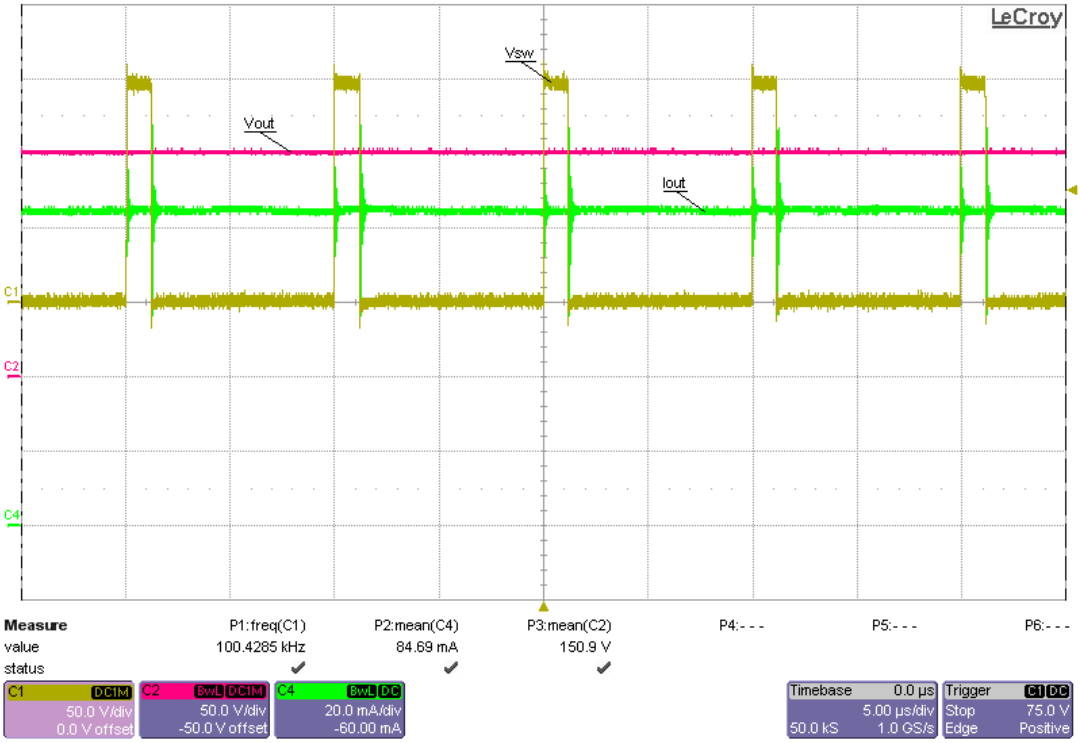


Figure 9. Switch Node Voltage, 18-V Input, 150-V Output, 85 mA Resistive Load

3.2 Output Voltage Ripple

Figure 10, Figure 11, and Figure 12 show the output voltage ripple. The images are taken at 18-V input, 35-V, 100-V, and 150-V outputs loaded at 85 mA.

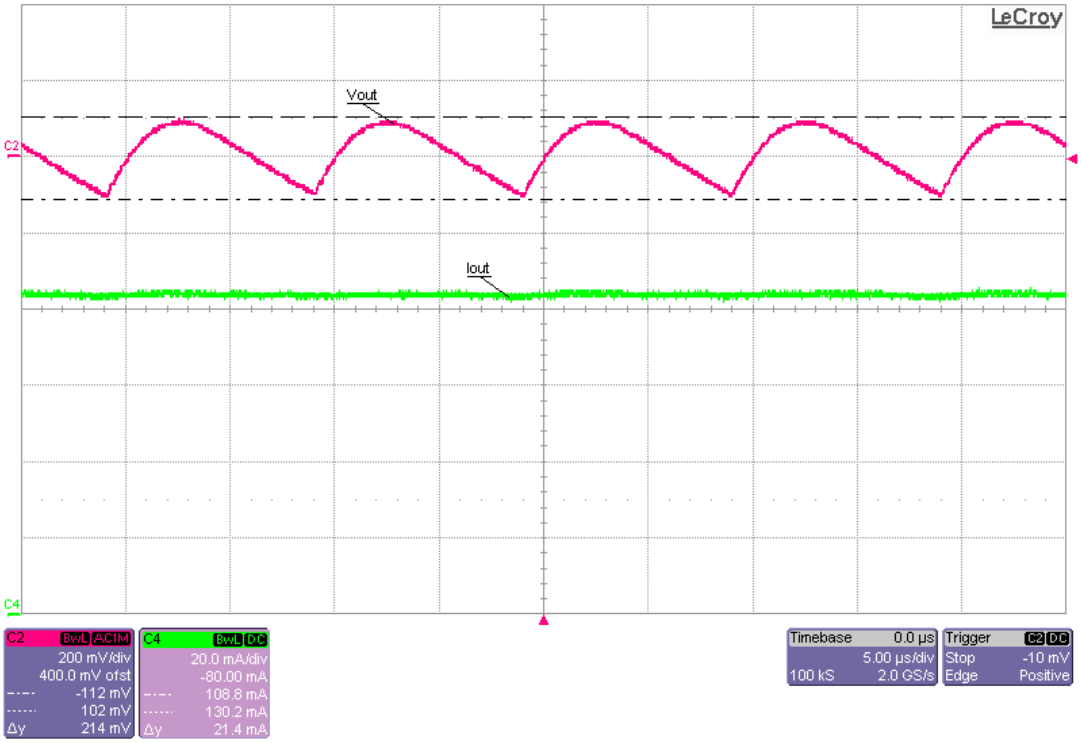


Figure 10. Output Voltage Ripple, 18-V Input, 35-V Output, 85mA Resistive Load

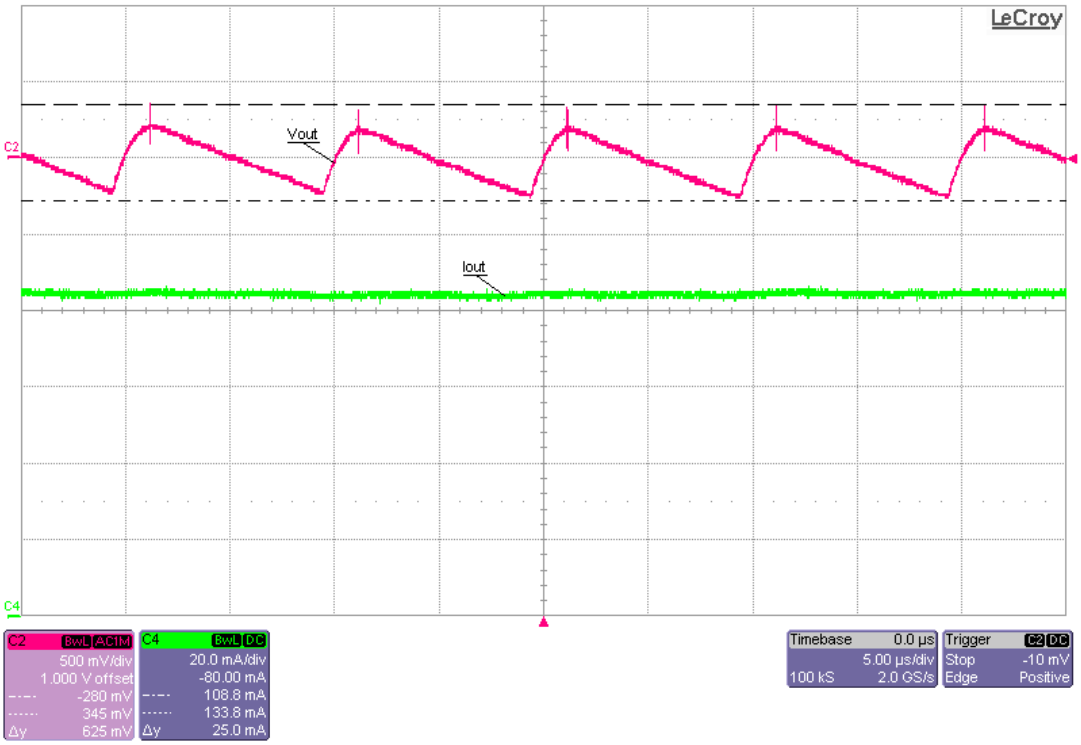


Figure 11. Output Voltage Ripple, 18-V Input, 100-V Output, 85mA Resistive Load

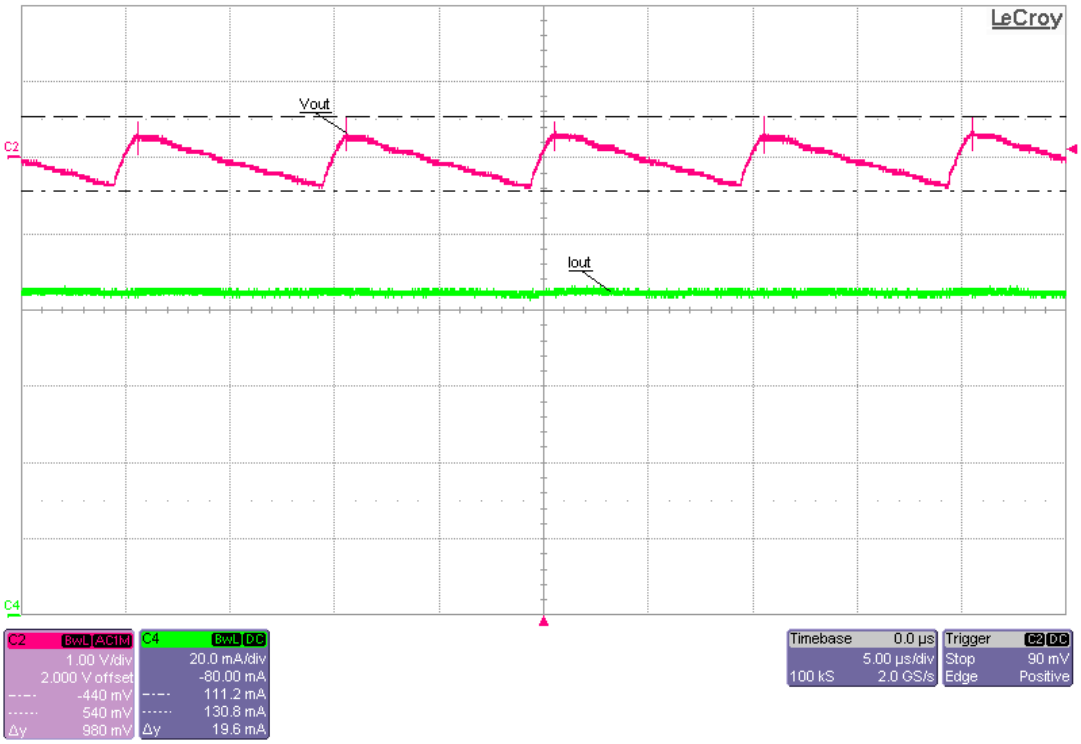


Figure 12. Output Voltage Ripple, 18-V Input, 150-V Output, 85mA Resistive Load

3.3 Load Transients

Figure 13, Figure, 14, and Figure 15 show the load transient response of the converter at 18-V input and 35-V, 100-V, and 150-V outputs. The load is stepped from 50% to 100% of the load, corresponding to about 42.5 mA to 85 mA steps.

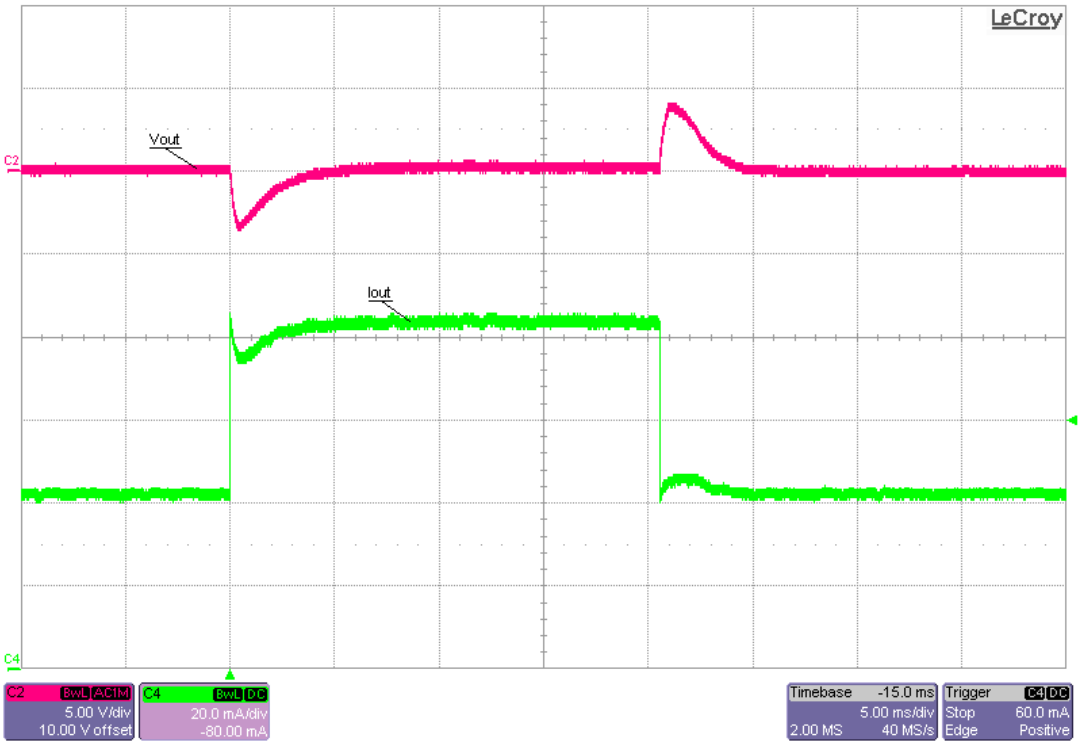


Figure 13. Load Transient Response, 18-V Input, 35-V Output, 50% to 100% Load Step

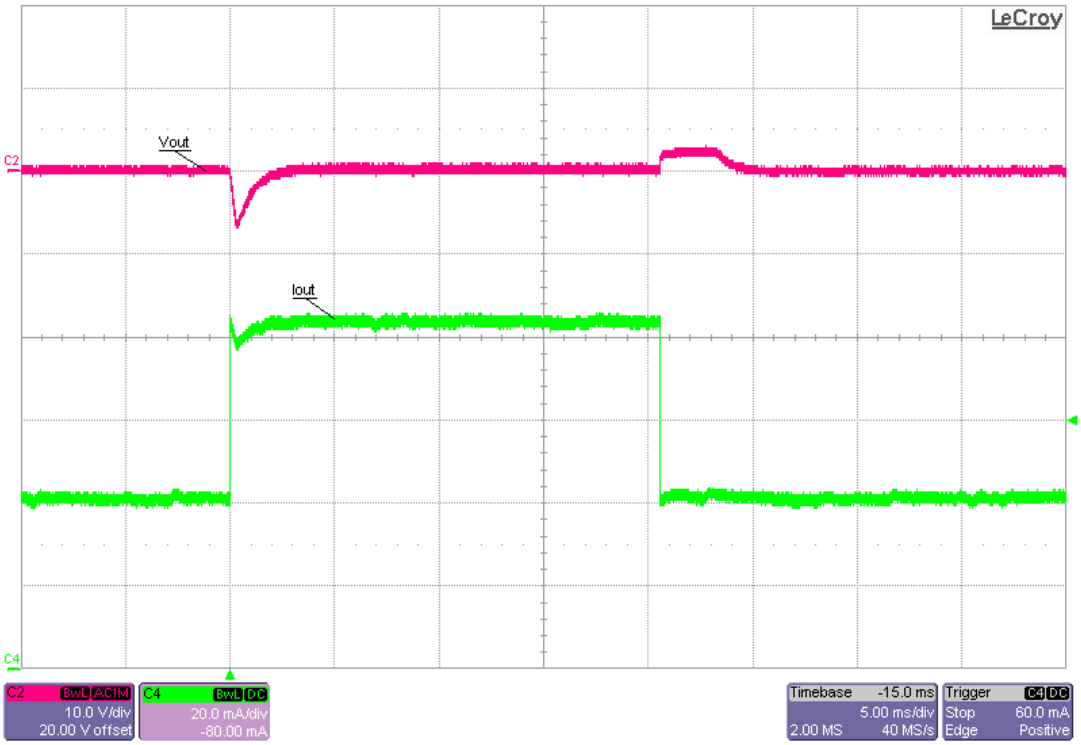


Figure 14. Load Transient Response, 18-V Input, 100-V Output, 50% to 100% Load Step

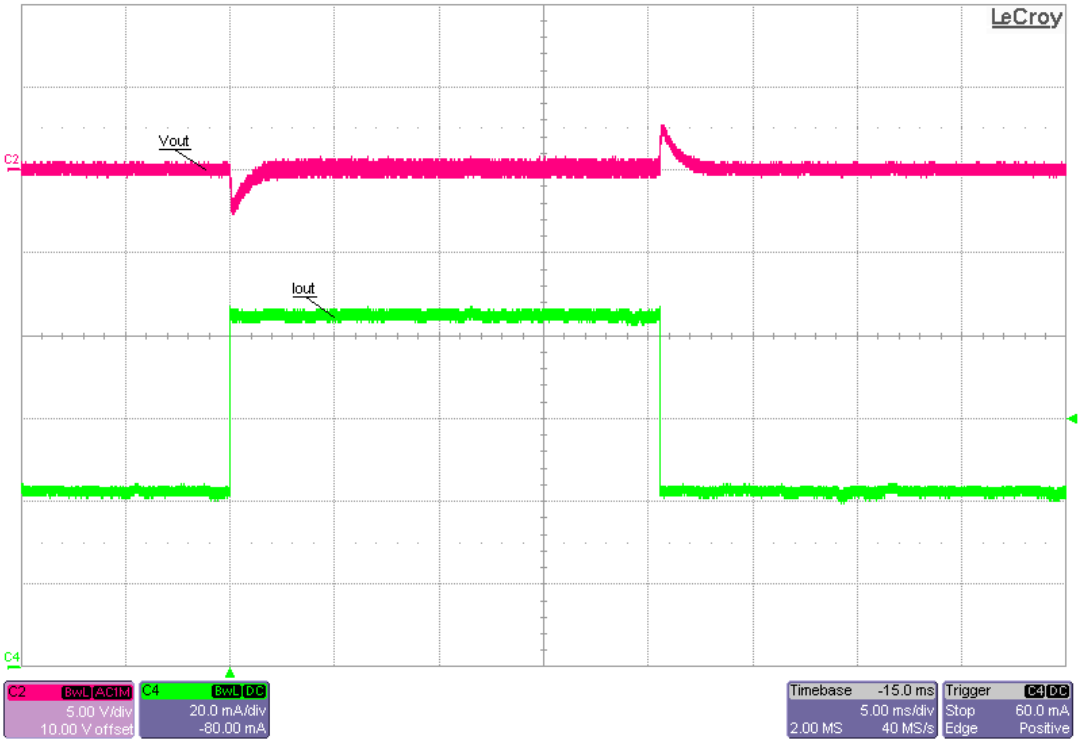


Figure 15. Load Transient Response, 18-V Input, 150-V Output, 50% to 100% Load Step

3.4 Start-up Sequence

Figure 16, Figure 17, and Figure 18 show the output voltage startup waveforms at 18-V input and 35-V, 100-V, and 150-V output with the converter starting up into no load. Figure 19, Figure 20, and Figure 21 show the output voltage startup waveforms at 18-V input and 35-V, 100-V, and 150-V output with the converter starting up into a 85 mA resistive load.

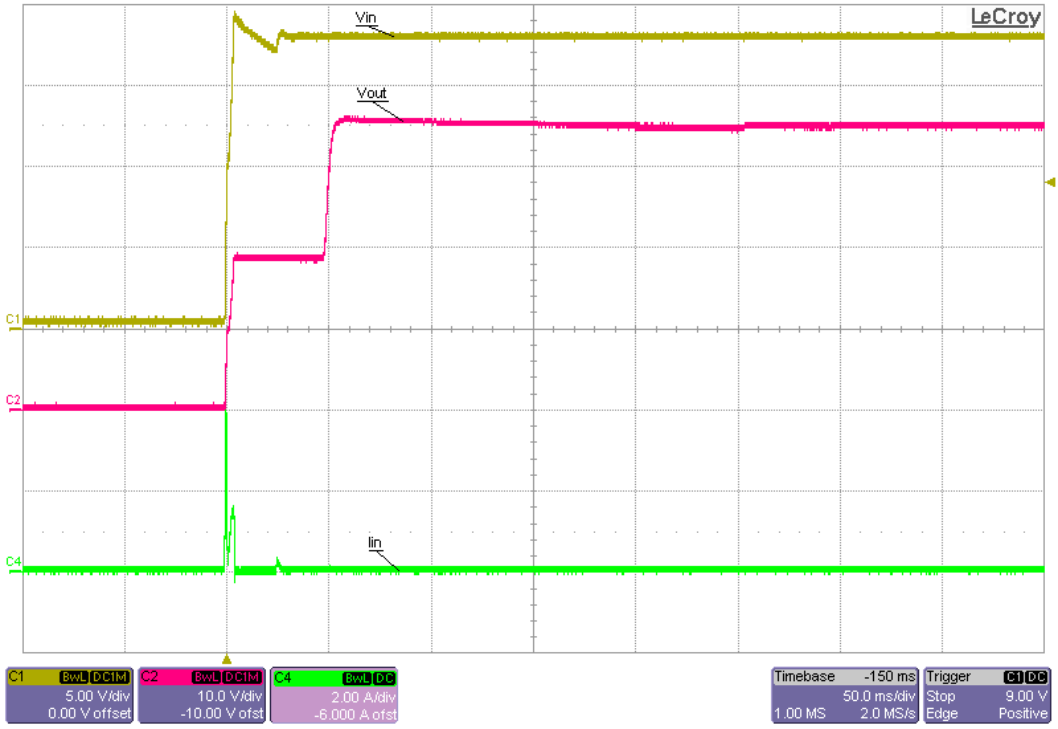


Figure 16. Startup Into No Load, 18-V Input, 35-V Output

Figure 17. Startup Into No Load, 18-V Input, 100-V Output

Figure 18. Startup Into No Load, 18-V Input, 150-V Output

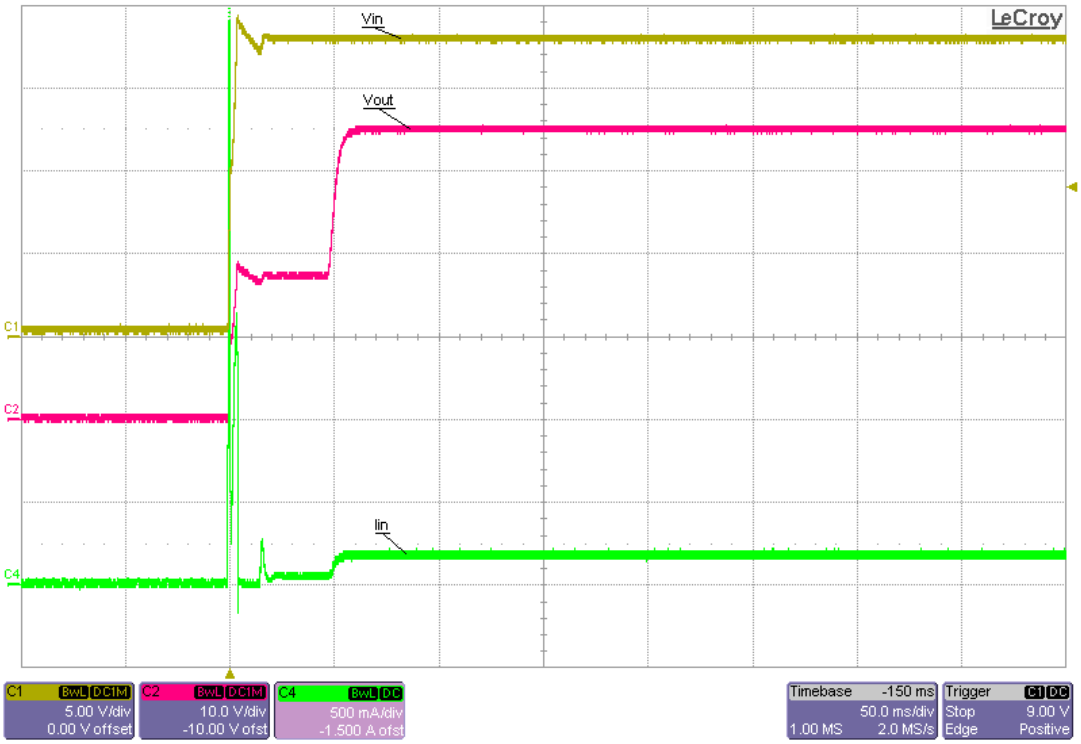


Figure 19. Startup Into 85 mA Resistive Load, 18-V Input, 35-V Output

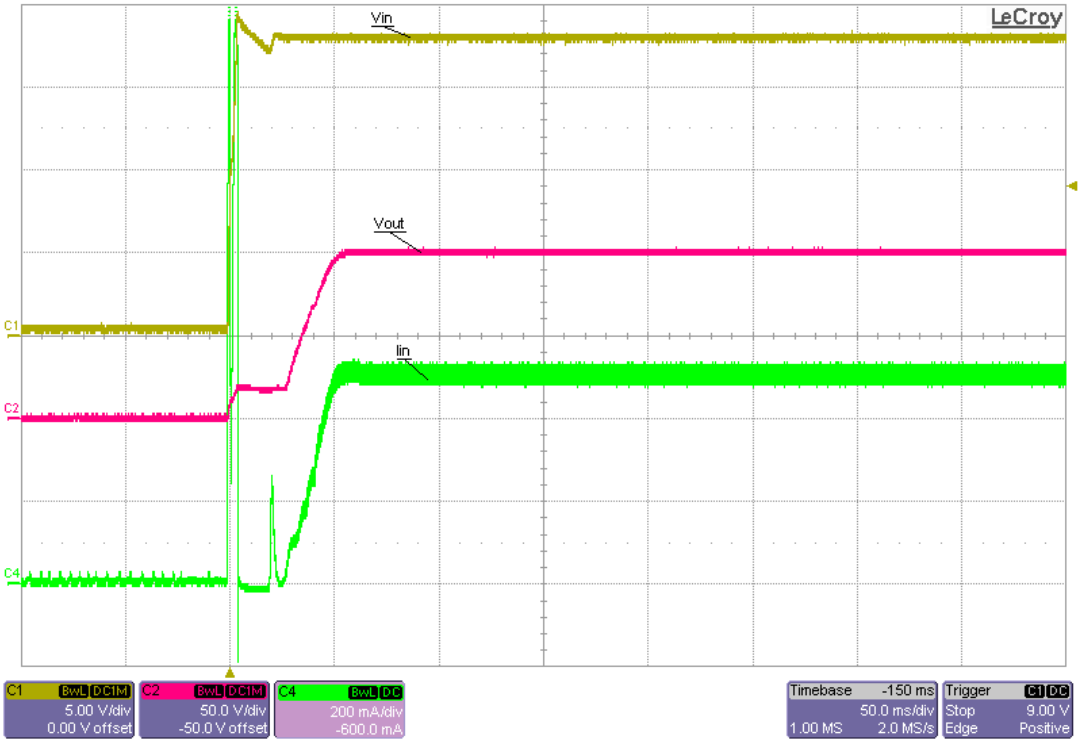


Figure 20. Startup Into 85 mA Resistive Load, 18-V Input, 100-V Output

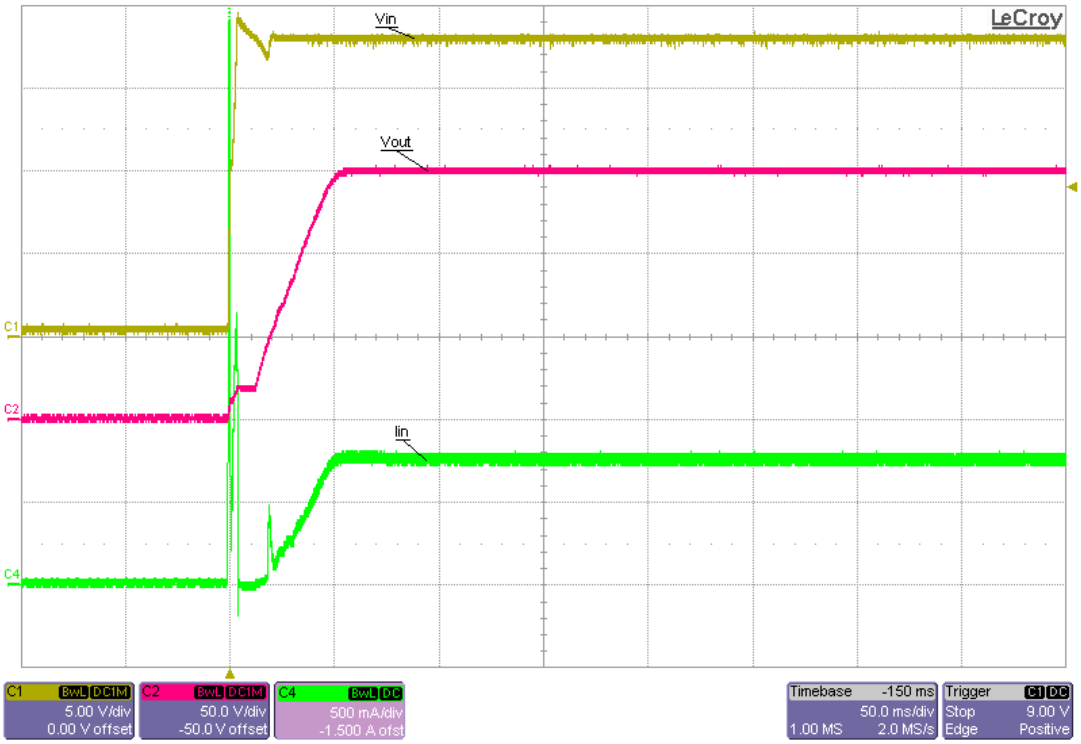


Figure 21. Startup Into 85 mA Resistive Load, 18-V Input, 150-V Output

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