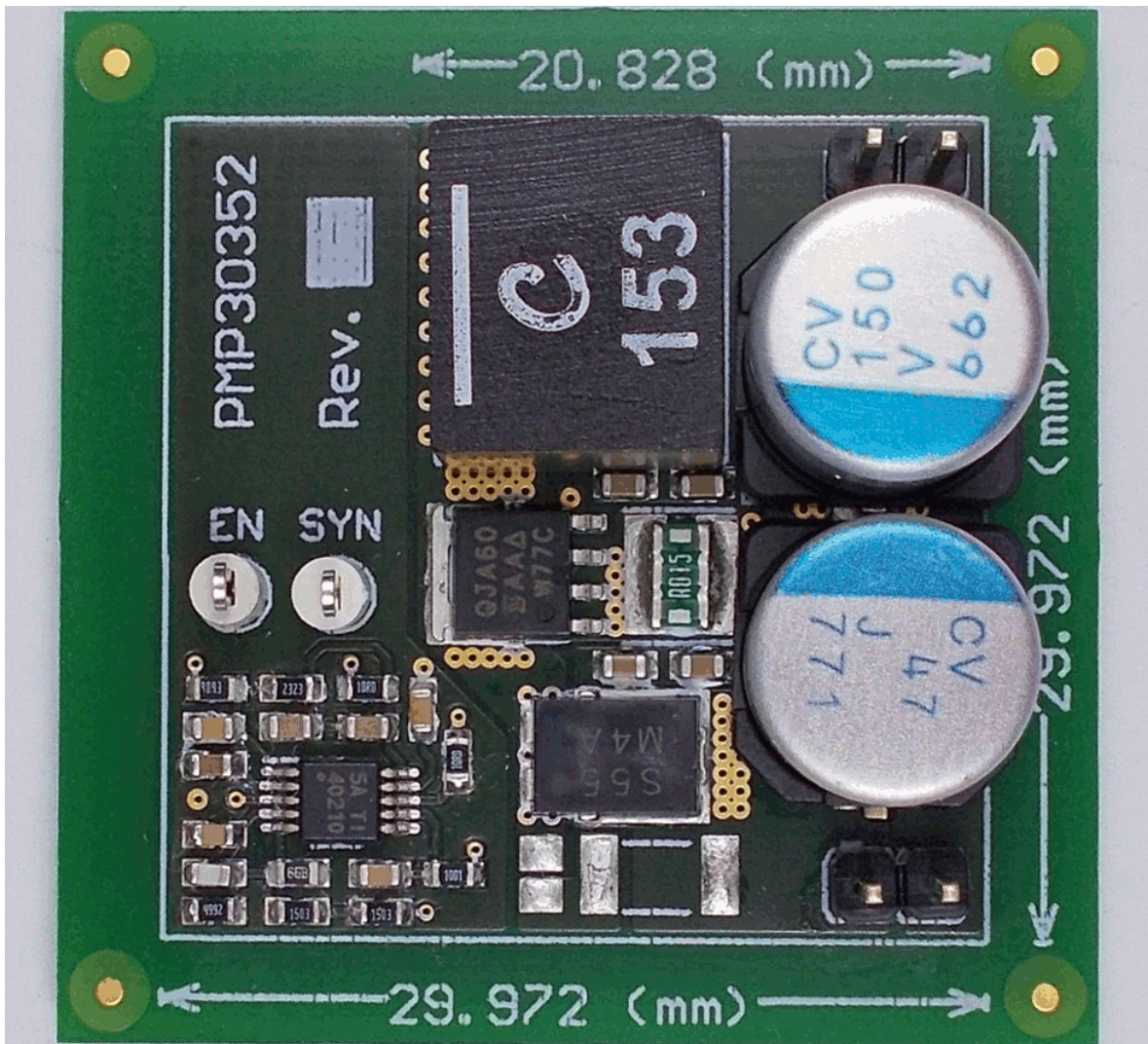


Test Report: PMP30352 Pre-Regulator Reference Design for Automotive LED-Headlamp Drivers



Description

This pre-regulator reference design delivers up to 45 W output power for automotive LED-headlamp drivers. For an input voltage range of 9.0 V to 16.0 V the design can support an output voltage of 45.0V with a load current of 1.0 A. An optional external dithering function is also available.



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1 Test Prerequisites

1.1 Voltage and Current Requirements

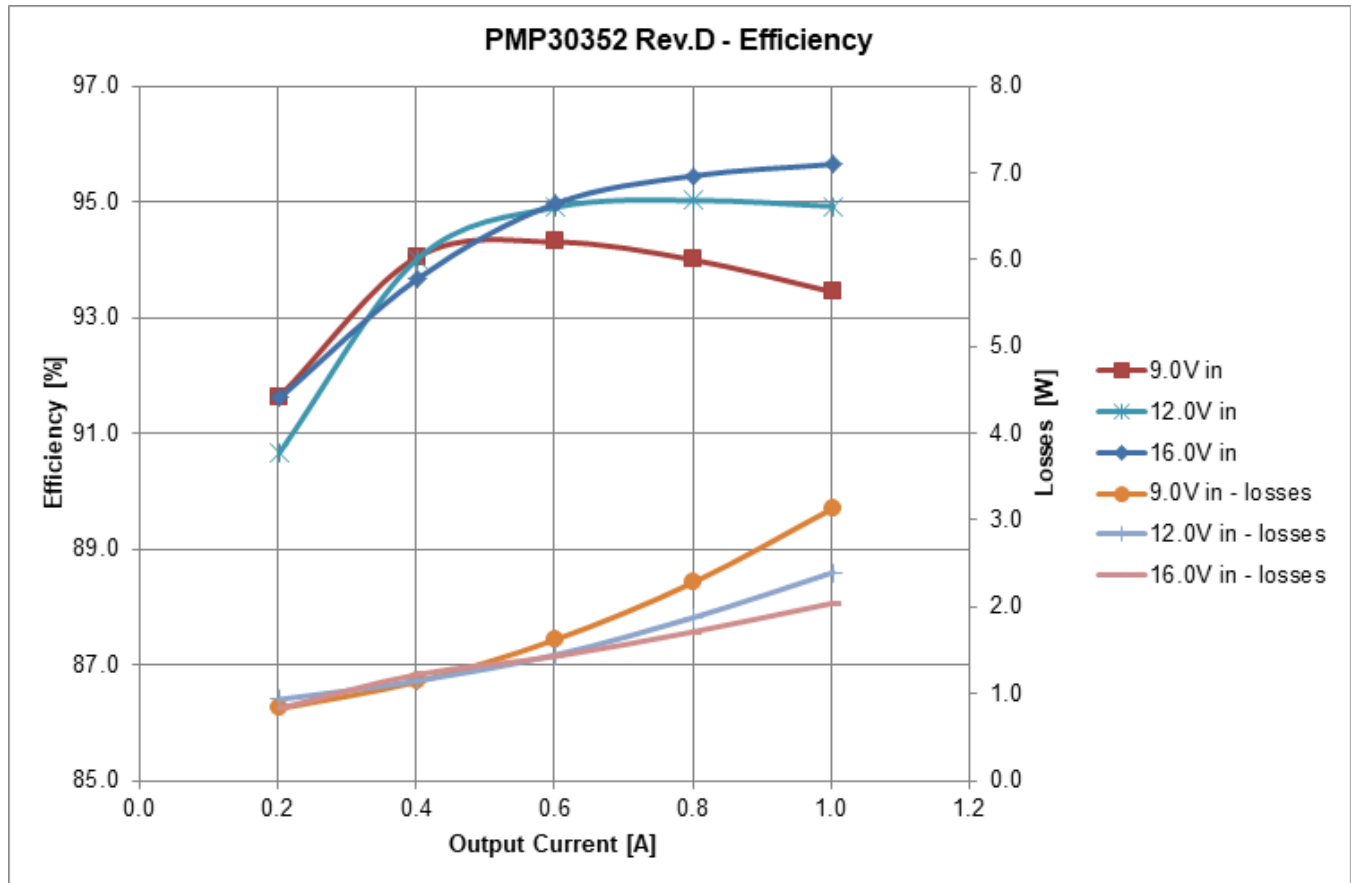
Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
V_{IN}	9.0 V - 16.0 V (5.0 V - 24.0 V operational)
V_{OUT}	45.0V @ 1.0 A
Nominal switching frequency	350 kHz (up to 390 kHz with dithering)

2 Testing and Results

2.1 Efficiency Graphs

Figure 1. Efficiency at 9.0 V, 12.0 V and 16.0 V in



2.2 Efficiency Data

Table 2. Efficiency data for the 9.0 V input

Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
8.998	1.0997	9.8951	44.93	0.2018	9.0669	0.828	91.6
8.998	2.126	19.1297	44.82	0.4014	17.9907	1.139	94.0
8.997	3.167	28.4935	44.71	0.601	26.8707	1.623	94.3
8.997	4.225	38.0123	44.63	0.8006	35.7308	2.282	94.0
8.997	5.317	47.8370	44.57	1.0029	44.6993	3.138	93.4

Table 3. Efficiency data for the 12.0 V input

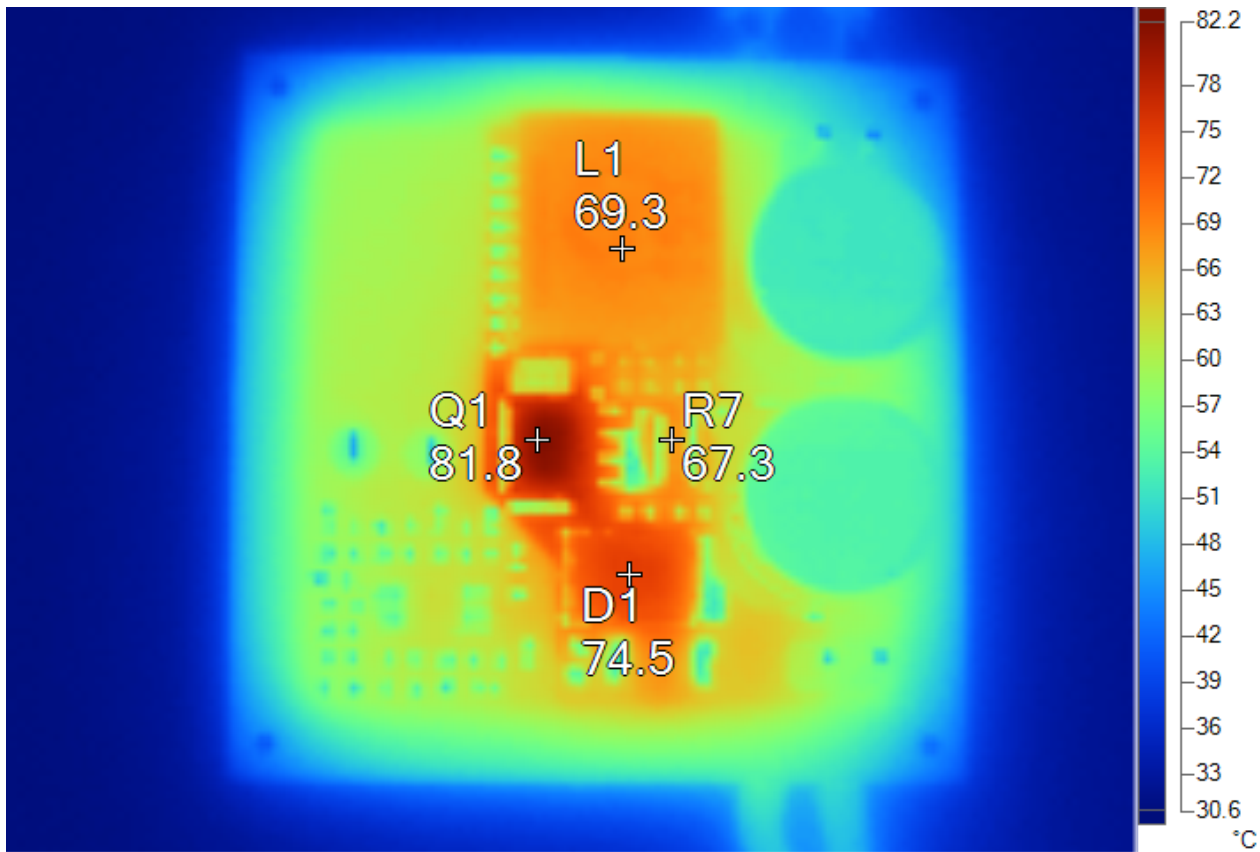
Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
12	0.8349	10.0188	45.01	0.2018	9.0830	0.936	90.7
12	1.599	19.1880	44.94	0.4014	18.0389	1.149	94.0
12	2.367	28.4040	44.86	0.6009	26.9564	1.448	94.9
12	3.144	37.7280	44.78	0.8006	35.8509	1.877	95.0
12	3.937	47.2440	44.72	1.0028	44.8452	2.399	94.9

Table 4. Efficiency data for the 16.0 V input

Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
15.99	0.6205	9.9218	45.04	0.2018	9.0891	0.833	91.6
15.99	1.206	19.2839	45.01	0.4013	18.0625	1.221	93.7
15.99	1.779	28.4462	44.95	0.601	27.0150	1.431	95.0
15.99	2.355	37.6565	44.9	0.8005	35.9425	1.714	95.4
15.99	2.94	47.0106	44.84	1.0028	44.9656	2.045	95.6

2.3 Thermal Images

Figure 2. Thermal image of the PCB's top side at 12.0 V in, 45.0 V out and 1.0 A load current.



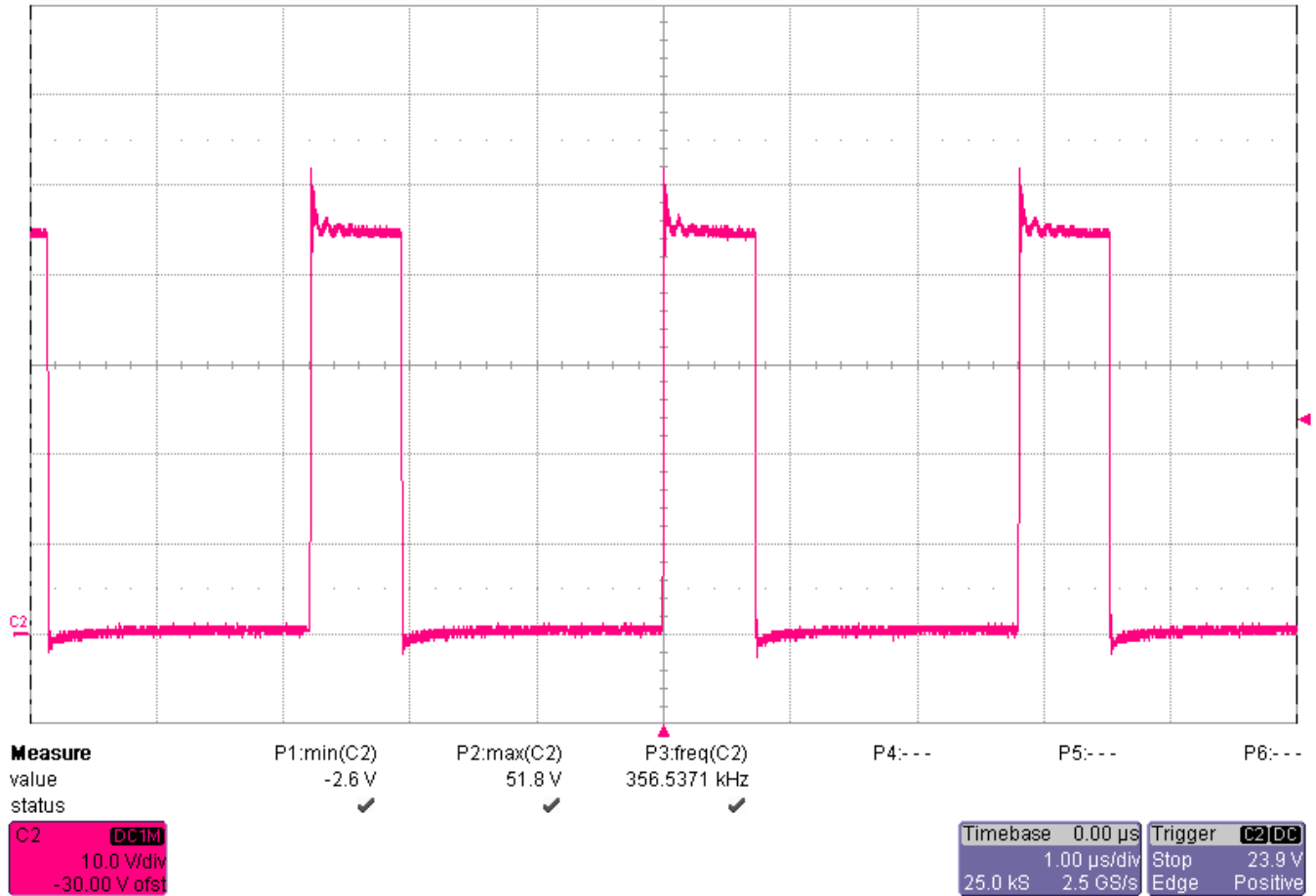
2.4 Dimensions

Circuit: smaller than 30 mm x 30 mm

3 Waveforms

3.1 Switching

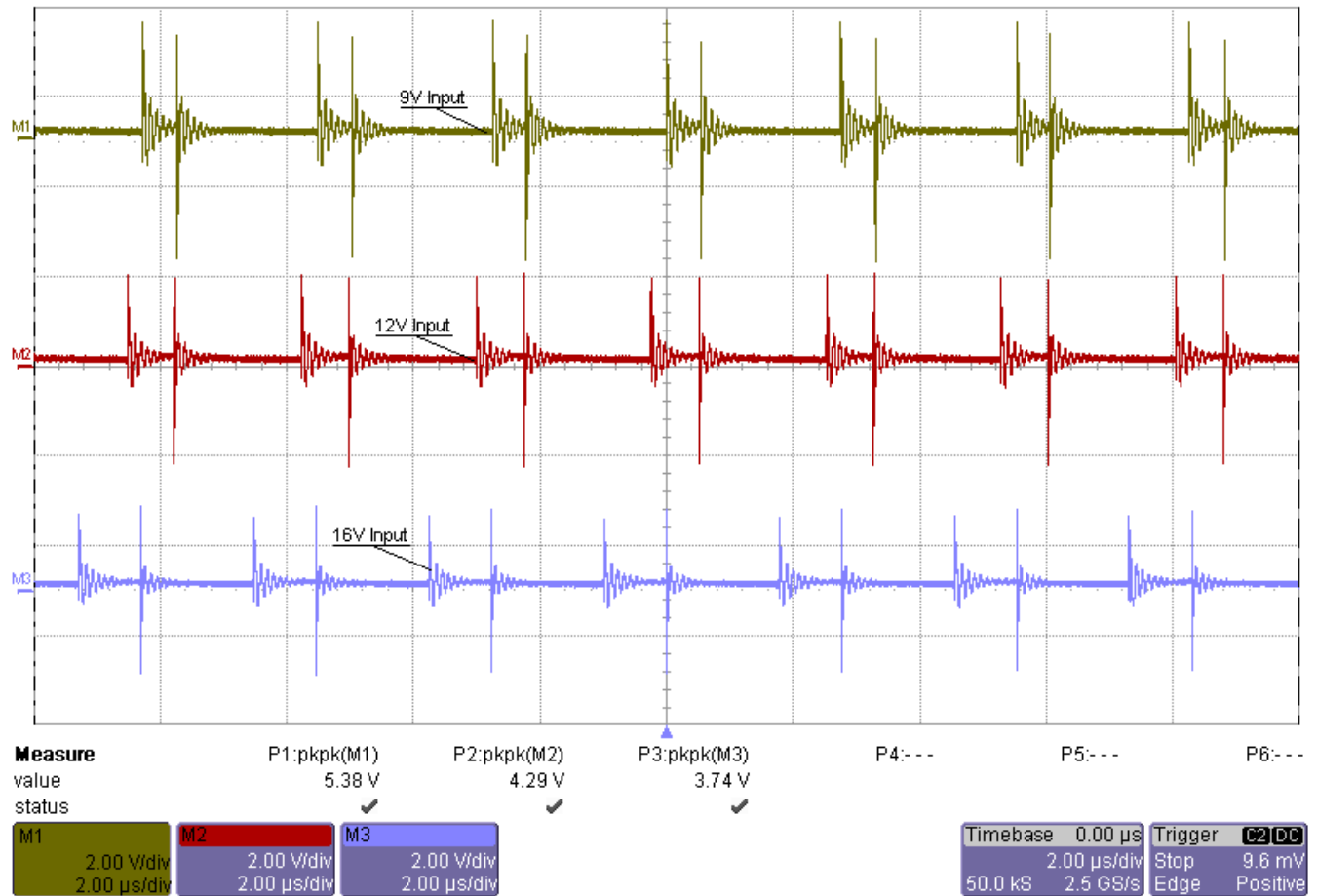
Figure 3. Switching Node at 12.0 Vin, 45.0 V out and 1.0 A load current.



- Ch2: Switching node signal [scale: 10.0V/div, 1.0us/div]

3.2 Output Voltage Ripple

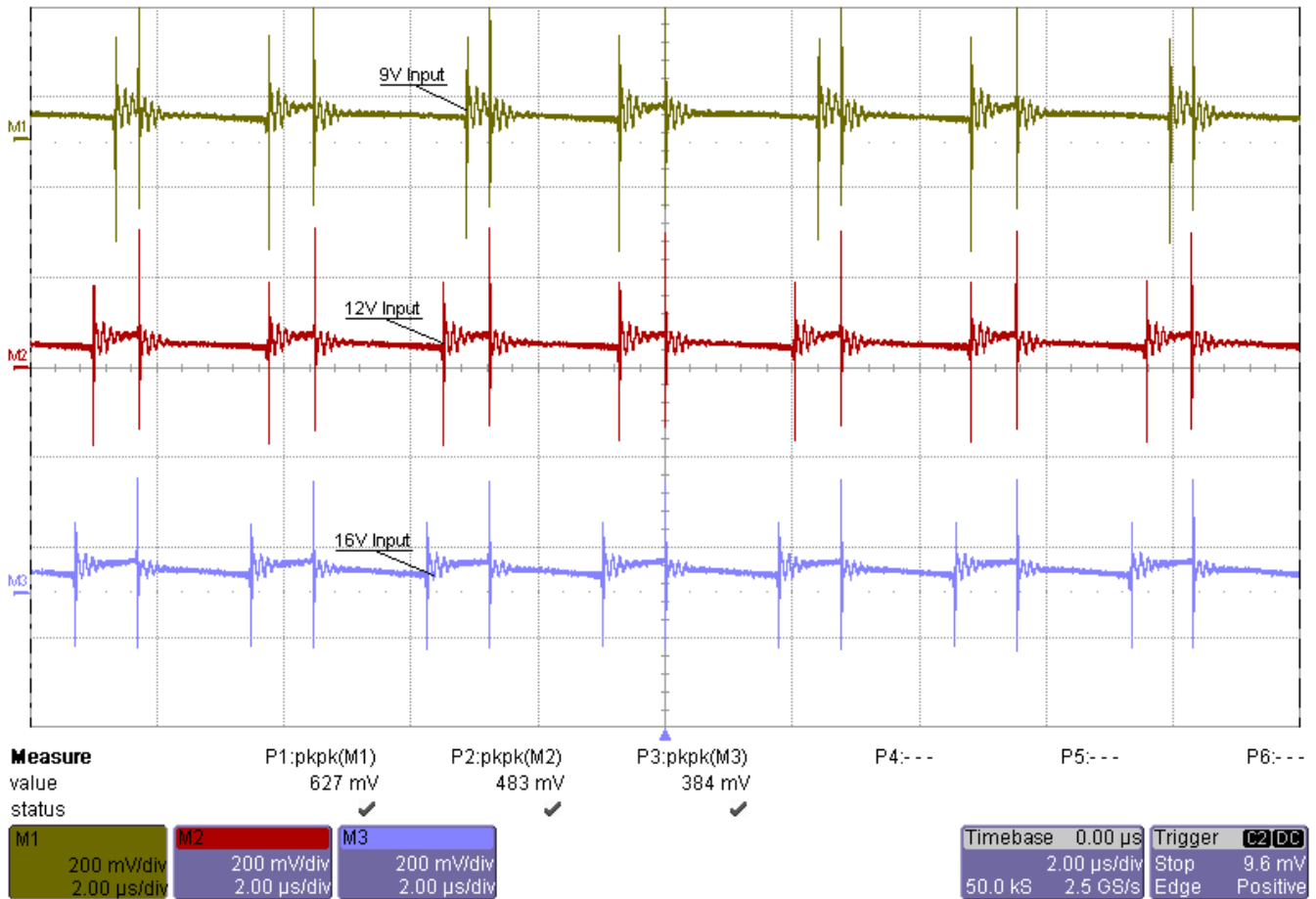
Figure 4. AC-coupled output voltage signal at 9.0V, 12.0V and 16.0V in.



- M1: 5.38 V peak-peak ripple [scale: 2.0 V/div, 2.0us/div]
- M2: 4.29 V peak-peak ripple [scale: 2.0 V/div, 2.0us/div]
- M3: 3.74 V peak-peak ripple [scale: 2.0 V/div, 2.0us/div]

3.3 Input Voltage Ripple

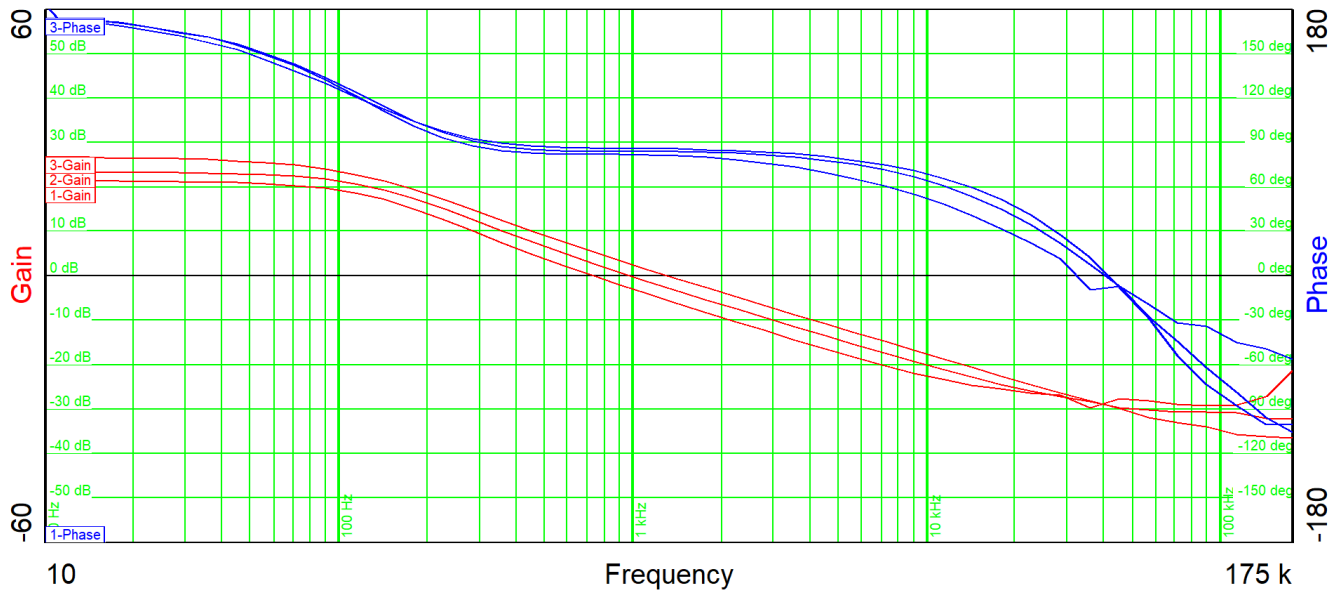
Figure 5. AC-coupled input voltage signal at 9.0V, 12.0V and 16.0V in.



- M1: 627 mV peak-peak ripple [scale: 200 mV/div, 2.0us/div]
- M2: 483 mV peak-peak ripple [scale: 200 mV/div, 2.0us/div]
- M3: 384 mV peak-peak ripple [scale: 200 mV/div, 2.0us/div]

3.4 Bode Plot

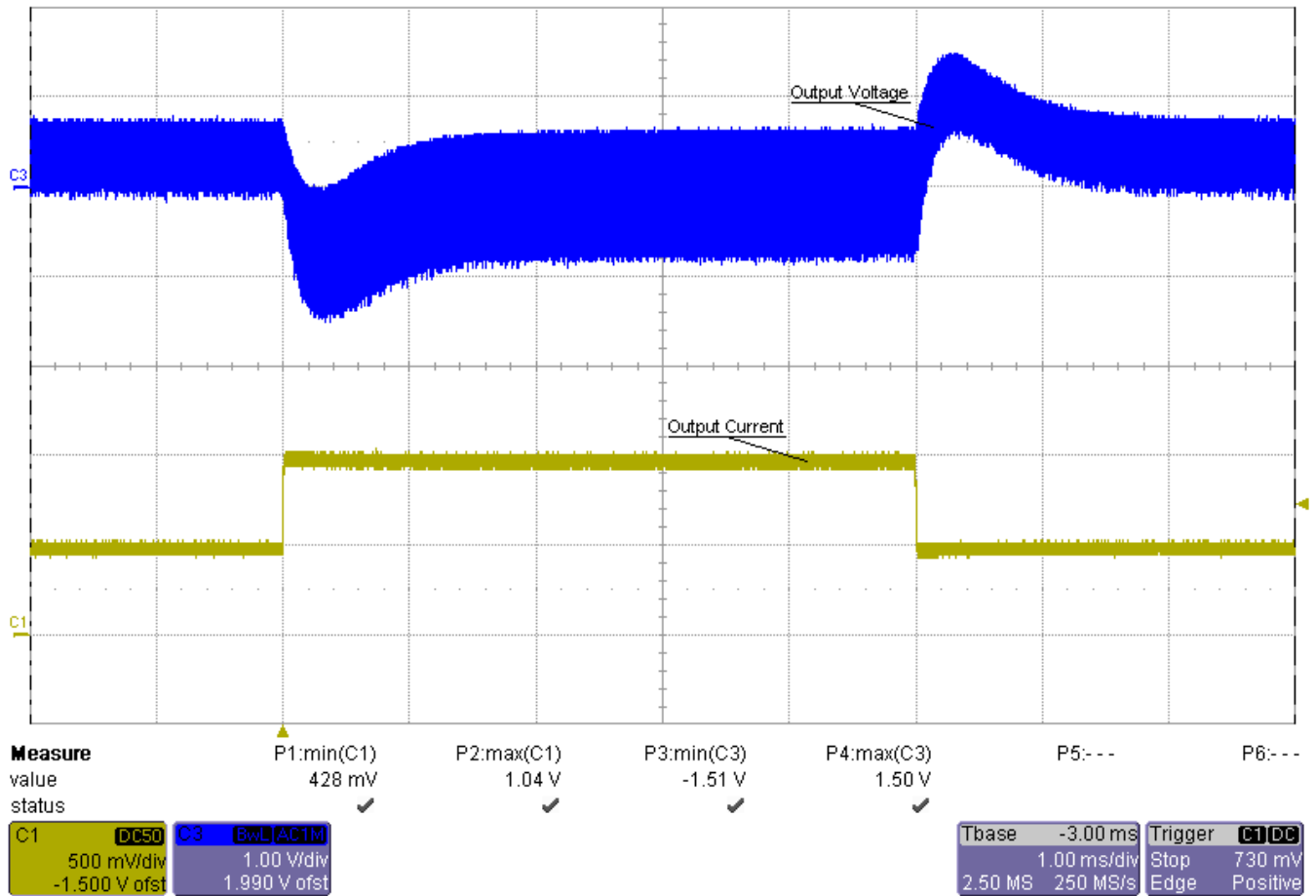
Figure 6. Bode plot at 9.0 V, 12.0 V and 16.0 V in.



- 9.0V in, 1.0A load current: fco 726Hz, 82deg phase margin, -29dB gain margin
- 12.0V in, 1.0A load current: fco 974Hz, 84deg phase margin, -29dB gain margin
- 16.0V in, 1.0A load current: fco 1.31kHz, 86deg phase margin, -29dB gain margin

3.5 Load Transients

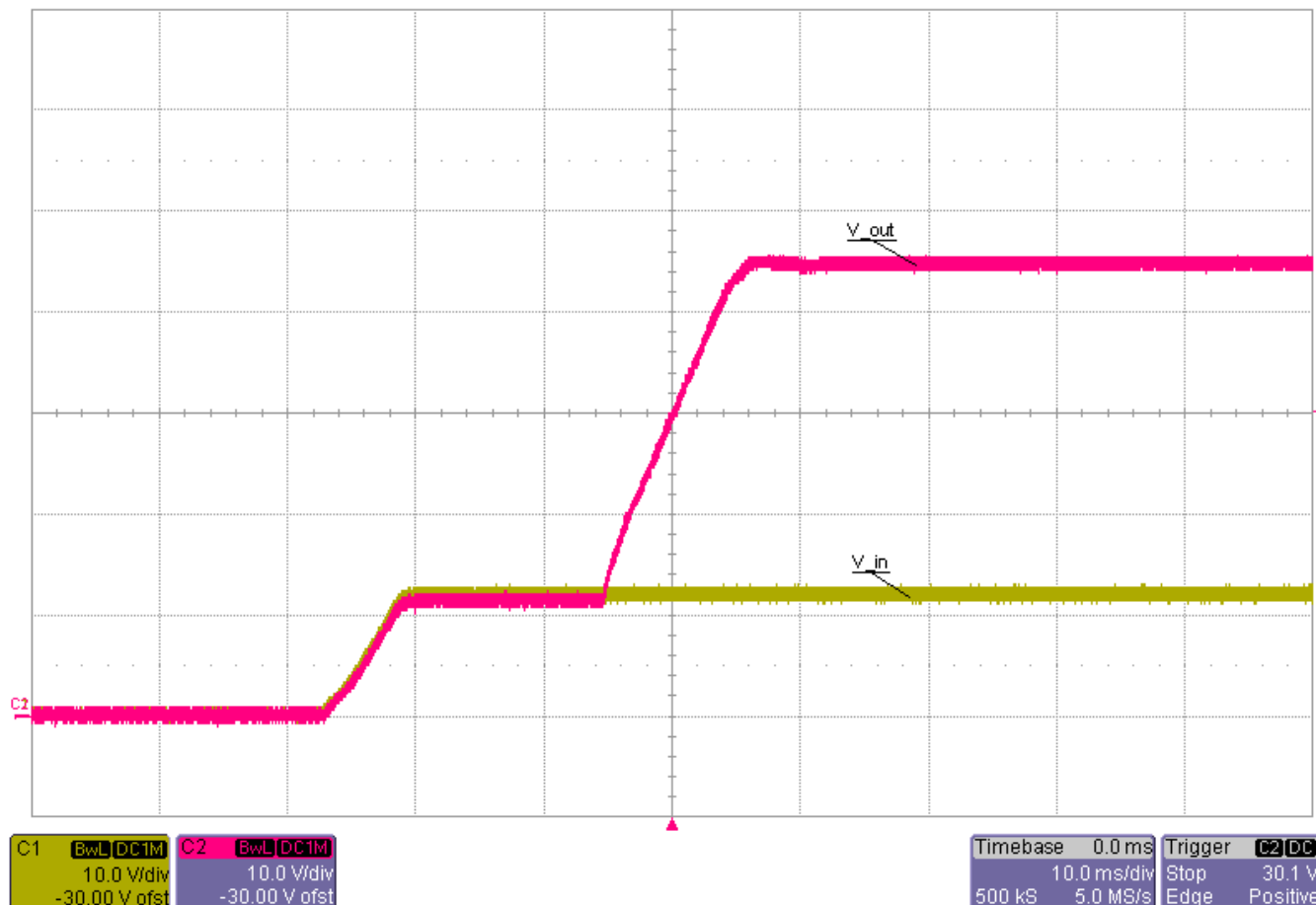
Figure 7. Load transient from 0.5 A to 1.0 A at 12.0 V in results in 1.51 V undershoot (3.3%) and 1.50 V overshoot (3.3%).



- Ch1: output current) [scale: 0.5A/div, 1.0ms/div]
- Ch3: AC-coupled output voltage, bw limited (20MHz) [scale: 1.0V/div, 1.0ms/div]

3.6 Start-up Sequence

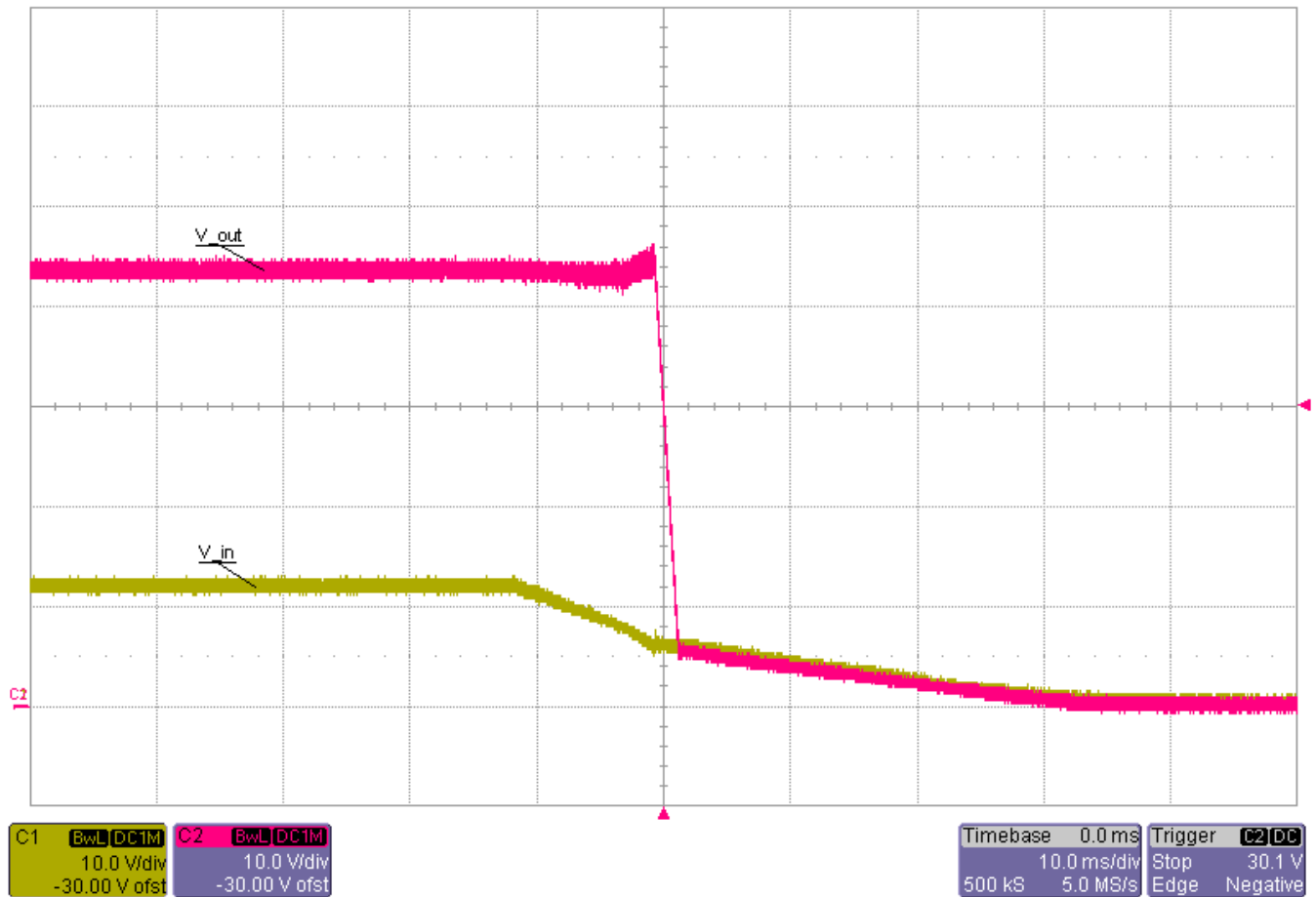
Figure 8. Start-up sequence at 12.0 V in with no load attached.



- Ch1: input voltage [scale: 10.0V/div, 10.0ms/div]
- Ch2: output voltage [scale: 10.0V/div, 10.0ms/div]

3.7 Undervoltage Protection

Figure 9. Undervoltage protection with a 1.0 A load attached.



- Ch1: input voltage [scale: 10.0V/div, 10.0ms/div]
- Ch2: output voltage [scale: 10.0V/div, 10.0ms/div]

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