Test Report: PMP41130

PMP41130 1.2kW Hard-Switching, Full Bridge (HSFB) Telecom Power Supply Unit

Description

The PMP41130 demonstrates a symmetrical hard-switching full-bridge DC-DC power converter with digital control using the UCD3138064, LMG3100, and LMG2175 devices. This Reference design includes required control functions for a hard-switched full bridge (HSFB) converter. PMP41130 accepts a DC input from 36VDC to 60VDC, and outputs a nominal 48VDC with full output load power 1200W, or full output current 25A. Peak efficiency of 96.7% achieved with 36V input voltage and 600W output condition.

Resources

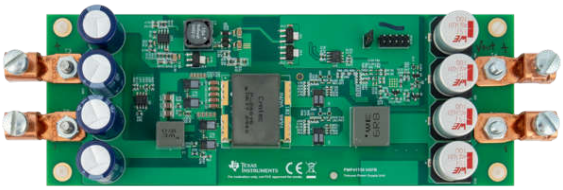
PMP41130	Design Folder
UCD3138064	Product Folder
LMG3100	Product Folder
LMG2175	Product Folder

Features

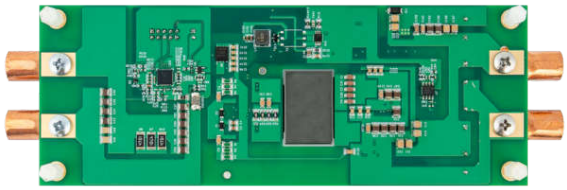
- Digitally controlled and standalone hard-switching full bridge DC-DC power conversion - voltage mode control.
- Protection: overvoltage, undervoltage, overcurrent, and over-temperature.
- Constant soft-start time.
- Using GaN FETs to achieve high efficiency with high switching frequency.

Applications

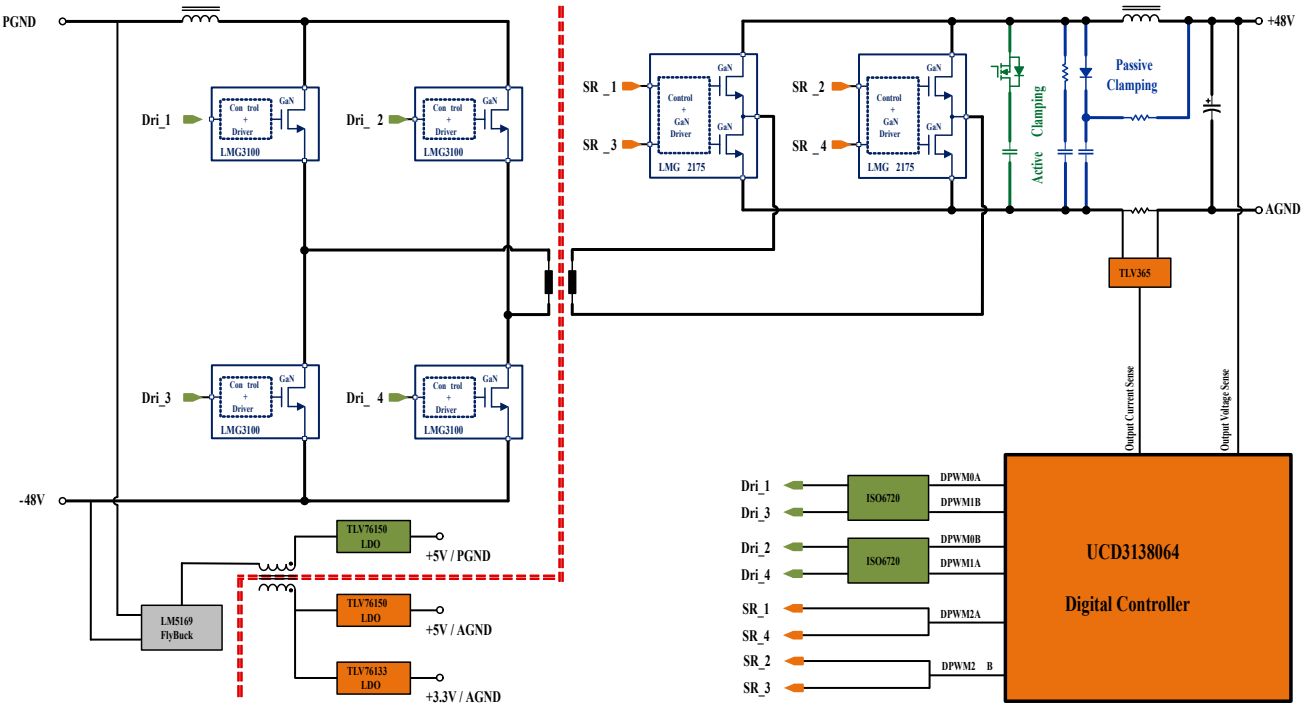
- Power delivery
- Telecome DC/DC modules



PMP41130 top view



PMP41130 bottom view



Simplified schematic

PMP41130 evaluation board

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input Voltage	-36VDC to -60VDC
Output Voltage	48VDC
Output current	25AMAX
Switching frequency	300kHz

1.2 Required Equipment

- UCD3138 development tools
- DC source: Chroma 62150H-1000S
- Electronic load: Chroma 63203A-600-210
- Oscilloscope: Tektronix MDO3024

1.3 Dimensions

Length × Width × Height: 200mm × 73mm × 29mm

1.4 Test Setup

1. Connect the GPIO to USB with PMP41130 main board, configure parameters and download the code.
2. Connect input DC source and output electronic load.
3. Consider using an extra cooling fan and heatsink to minimize the temperature of the power board.
4. Power on the DC source higher than 33V. The 48V output automatically starts up

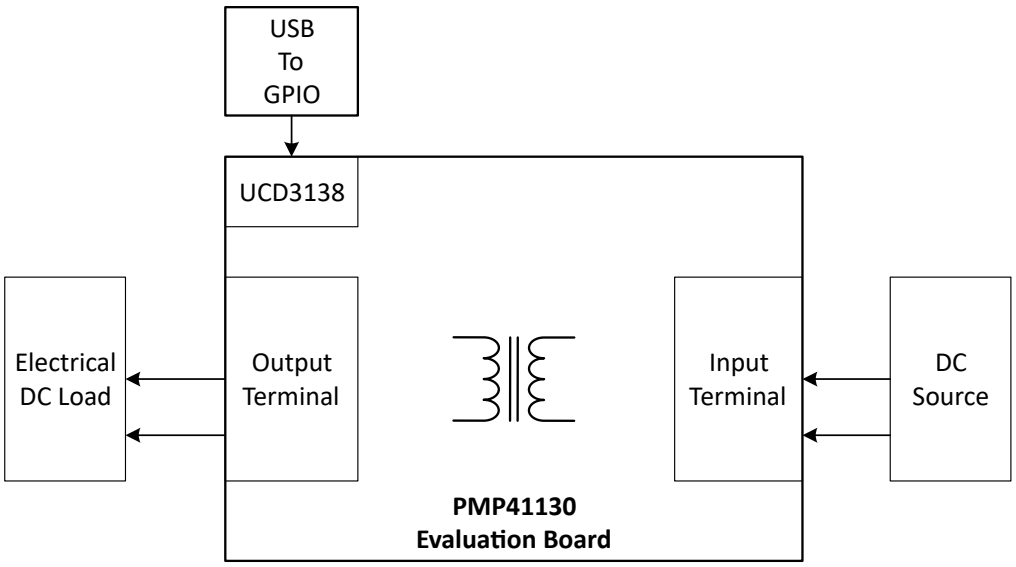


Figure 1-1. Test Setup diagram

2 Testing and Results

2.1 Efficiency Graphs

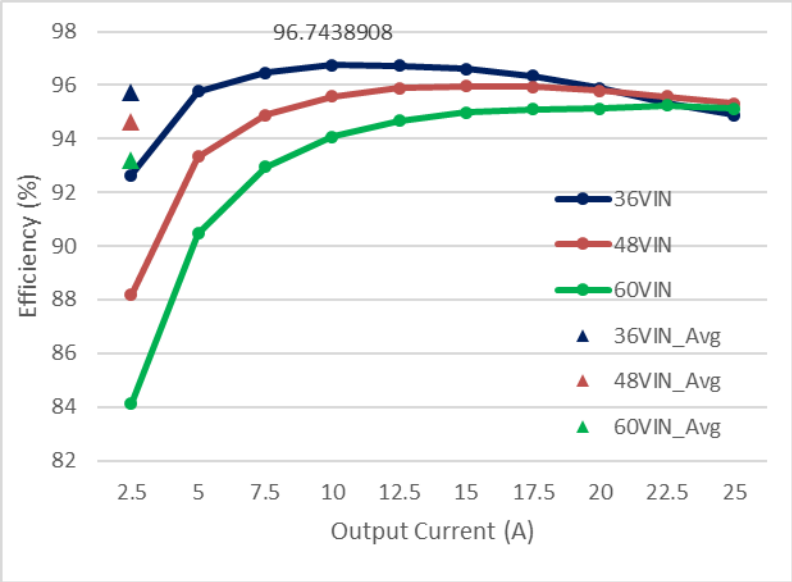


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

Table 2-1. Efficiency Test Results at 36V Input voltage

V_{IN} (V)	I_{IN} (A)	V_{OUT} (V)	I_{OUT} (A)	P_{IN} (W)	P_{OUT} (W)	P_{LOSS} (W)	Efficiency (%)
35.9965	0.221	48.5056	0	7.9552	0	7.955227	-
35.911	3.6129	48.4411	2.4814	129.7430	120.5894	9.541106	92.64614
35.8222	7.0283	48.3965	4.9817	251.7690	241.9162	10.67232	95.76107
36.2348	10.3538	48.3596	7.4828	375.1680	363.0789	13.30266	96.45421
36.1437	13.7994	48.3338	9.9831	498.7610	484.2698	16.24022	96.74389
36.3621	17.1477	48.3016	12.4851	623.5260	605.3299	20.47608	96.71609
36.2667	20.6449	48.2696	14.9856	748.7220	726.1446	25.37348	96.6111
36.1891	24.187	48.2212	17.4867	875.3060	846.9522	32.0761	96.33544
36.1342	27.7988	48.1892	19.9891	1004.49	967.6079	41.22866	95.89555
36.0538	31.2576	47.7635	22.4871	1126.96	1088.027	52.89266	95.30659
35.9999	34.6753	47.4058	24.9877	1248.31	1208.295	63.74542	94.89345

Table 2-2. Efficiency Test Results at 48V Input voltage

V_{IN} (V)	I_{IN} (A)	V_{OUT} (V)	I_{OUT} (A)	P_{IN} (W)	P_{OUT} (W)	P_{LOSS} (W)	Efficiency (%)
48.004	0.2484	48.6378	0	11.92419	0	11.92419	-
47.9445	2.8526	48.5895	2.4818	136.7665	120.5894	16.17706	88.17177
47.8898	5.4123	48.5522	4.9826	259.194	241.9162	17.27777	93.33404
47.8338	8.0003	48.5218	7.4828	382.6848	363.0789	19.60583	94.87677
47.7772	10.6063	48.5075	9.9834	506.7393	484.2698	22.46954	95.56586
47.7198	13.2302	48.4869	12.4844	631.3425	605.3299	26.01264	95.87979
47.6619	15.8768	48.4581	14.985	756.7185	726.1446	30.57383	95.95968
47.6048	18.5436	48.4338	17.4868	882.7644	846.9522	35.8122	95.94318
47.5467	21.2425	48.4092	19.9881	1010.011	967.6079	42.40284	95.80174
47.4874	23.9722	48.3862	22.4863	1138.377	1088.027	50.35084	95.57696

Table 2-2. Efficiency Test Results at 48V Input voltage (continued)

V_{IN} (V)	I_{IN} (A)	V_{OUT} (V)	I_{OUT} (A)	P_{IN} (W)	P_{OUT} (W)	P_{LOSS} (W)	Efficiency (%)
47.4238	26.7331	48.3556	24.9877	1267.785	1208.295	59.48996	95.30757

Table 2-3. Efficiency Test Results at 60V Input voltage

V_{IN} (V)	I_{IN} (A)	V_{OUT} (V)	I_{OUT} (A)	P_{IN} (W)	P_{OUT} (W)	P_{LOSS} (W)	Efficiency (%)
60.0003	0.3036	48.6778	0	18.21609	0	18.21609	-
59.9543	2.3911	48.6334	2.4797	143.3567	120.5962	22.76048	84.12318
59.9092	4.4649	48.5961	4.9803	267.4886	242.0232	25.46543	90.47981
59.8635	6.5298	48.5663	7.4807	390.8967	363.3099	27.58676	92.9427
59.8173	8.6135	48.5502	9.9826	515.2363	484.6572	30.57909	94.06504
59.7712	10.7091	48.5345	12.4842	640.0958	605.9144	34.18135	94.65996
59.7239	12.8155	48.5176	14.9847	765.3916	727.0217	38.36996	94.98689
59.6771	14.9392	48.4951	17.4843	891.5281	847.9029	43.62526	95.10669
59.6302	17.0762	48.4725	19.9851	1018.257	968.7278	49.52946	95.13586
59.5828	19.2086	48.4834	22.4817	1144.502	1089.989	54.51292	95.23698
59.5351	21.3897	48.4882	24.9833	1273.438	1211.395	62.04268	95.12794

3 Waveforms

3.1 Switching

CH1 (Dark Blue): LMG2175 switching node voltage

CH2 (Light Blue): Differential voltage of primary side transformer terminals.

CH3 (Red): LMG2175 switching node voltage.

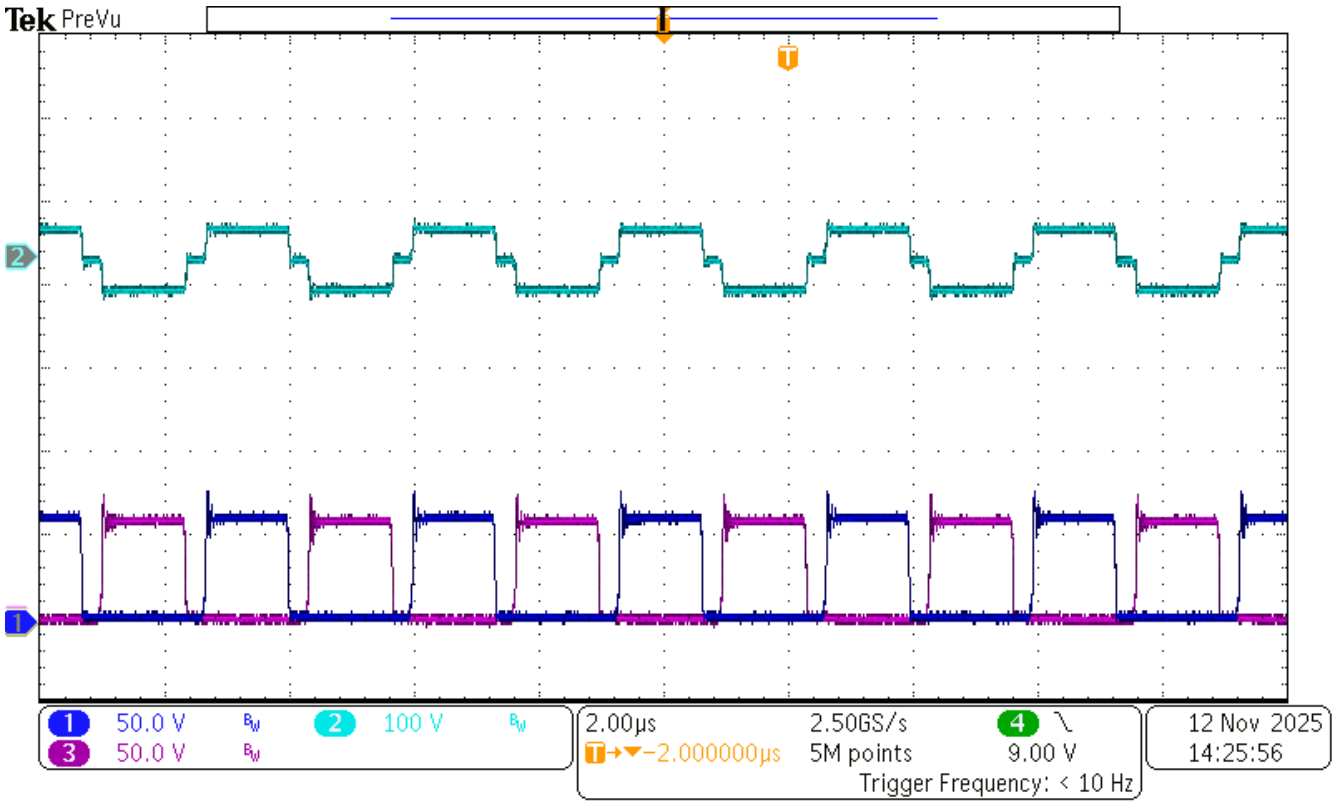


Figure 3-1. 36VIN No Load

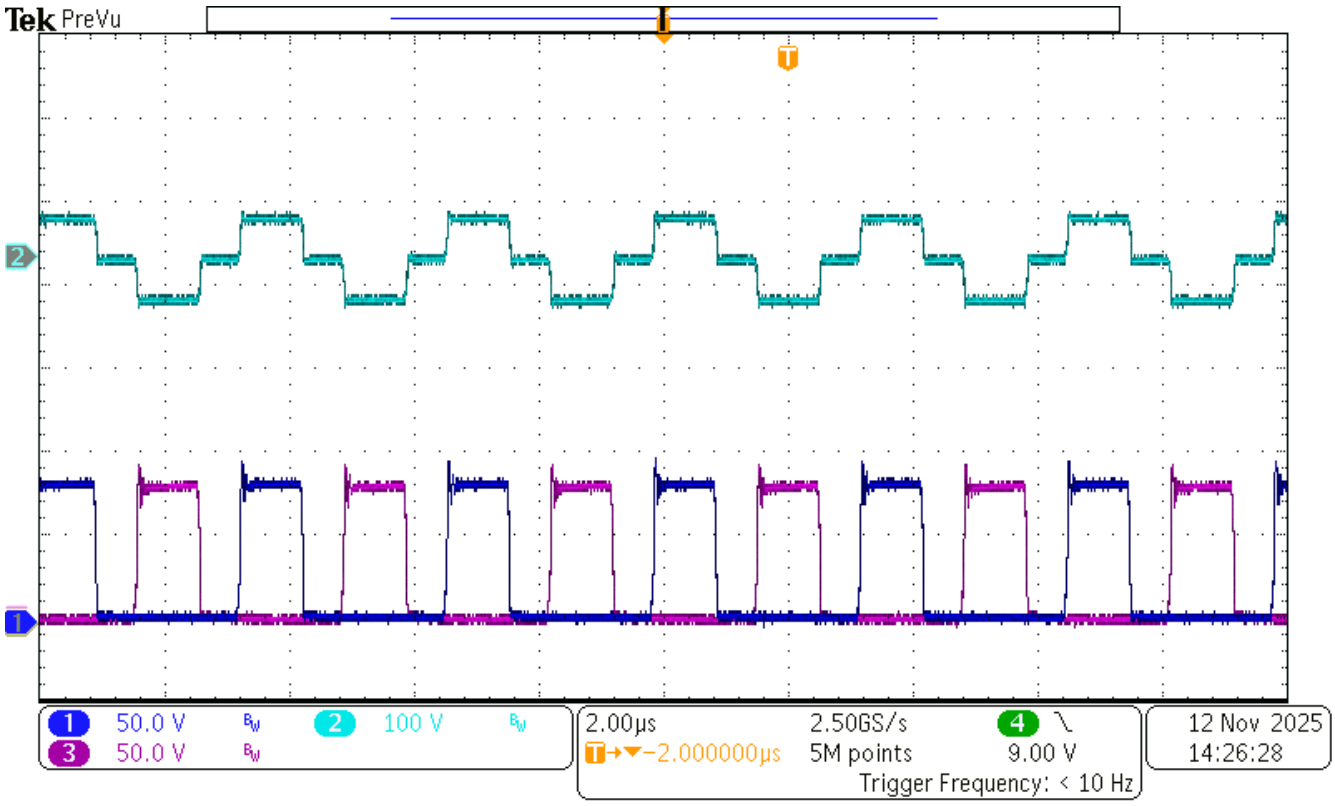


Figure 3-2. 48VIN No Load

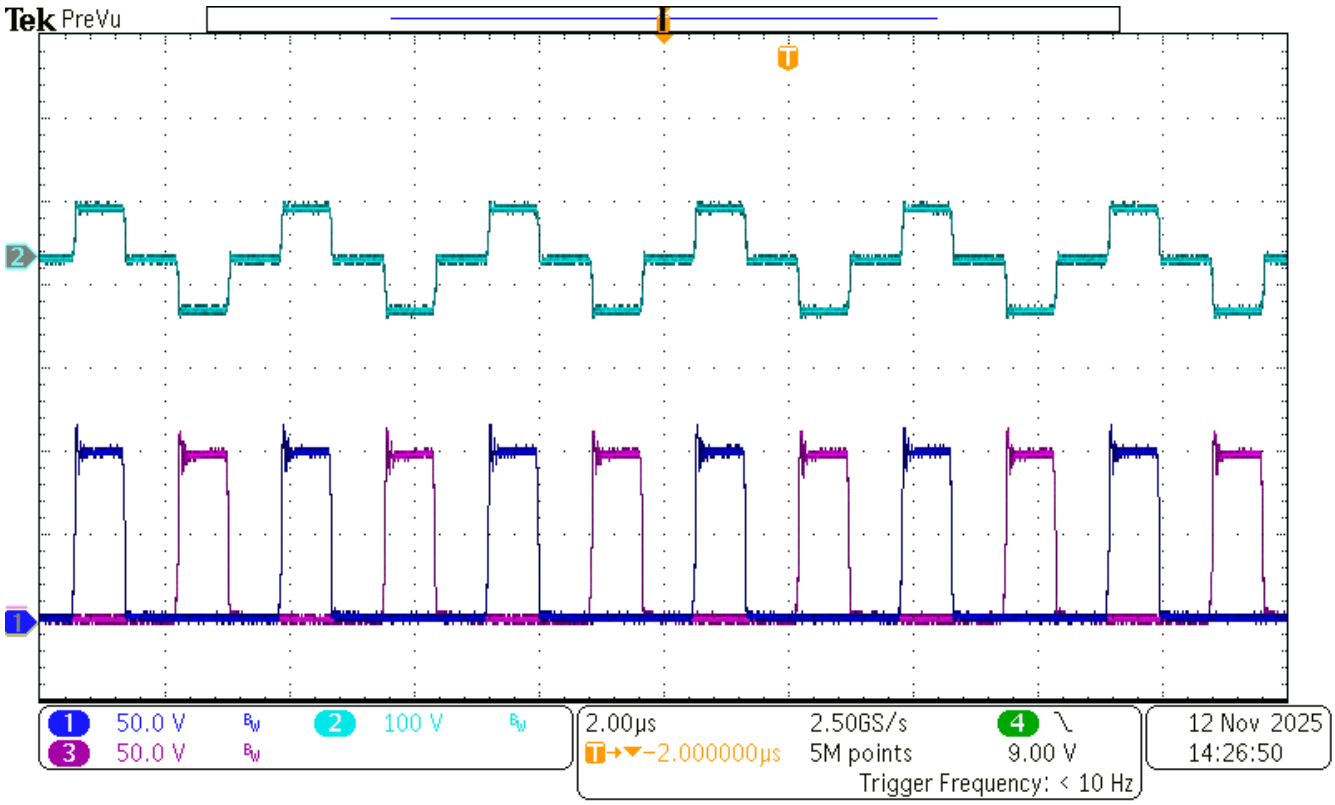


Figure 3-3. 60VIN No Load

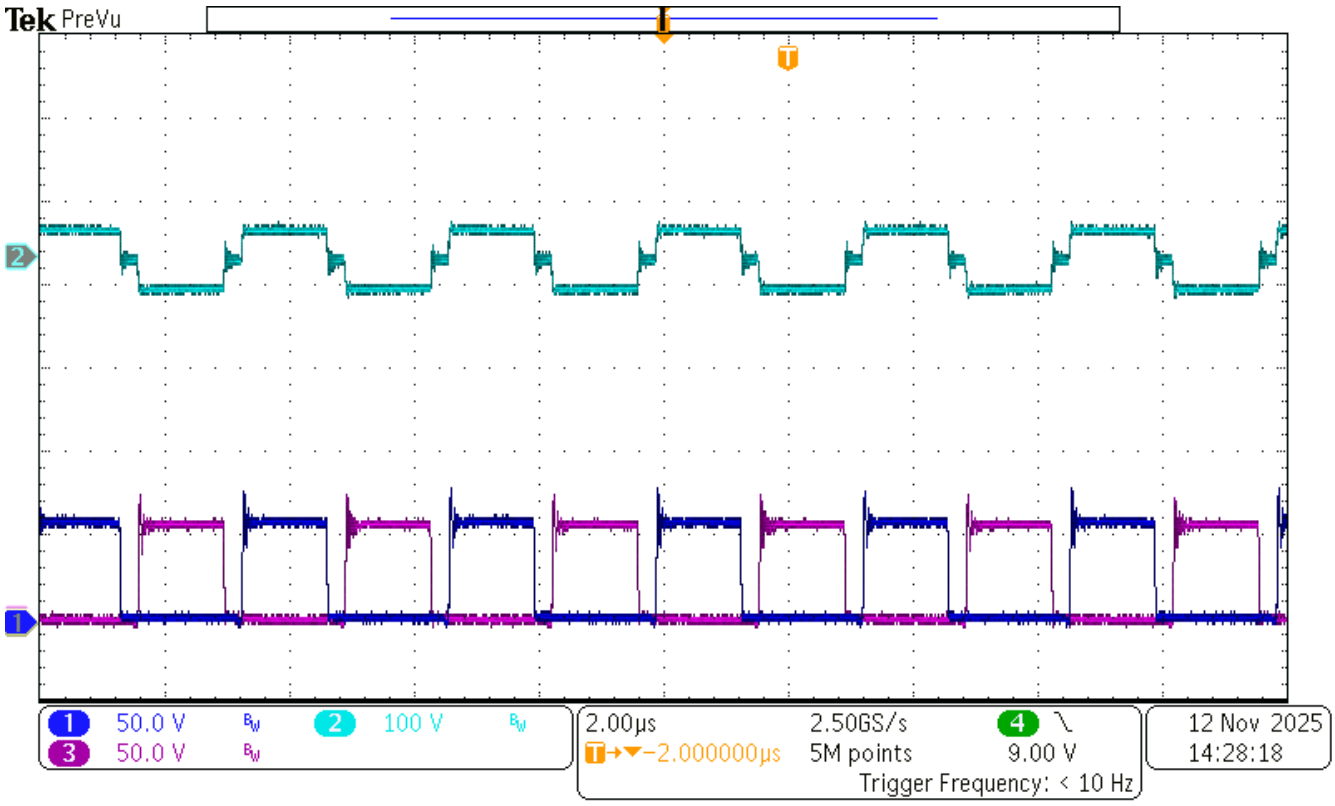


Figure 3-4. 36VIN 1200W Full Load

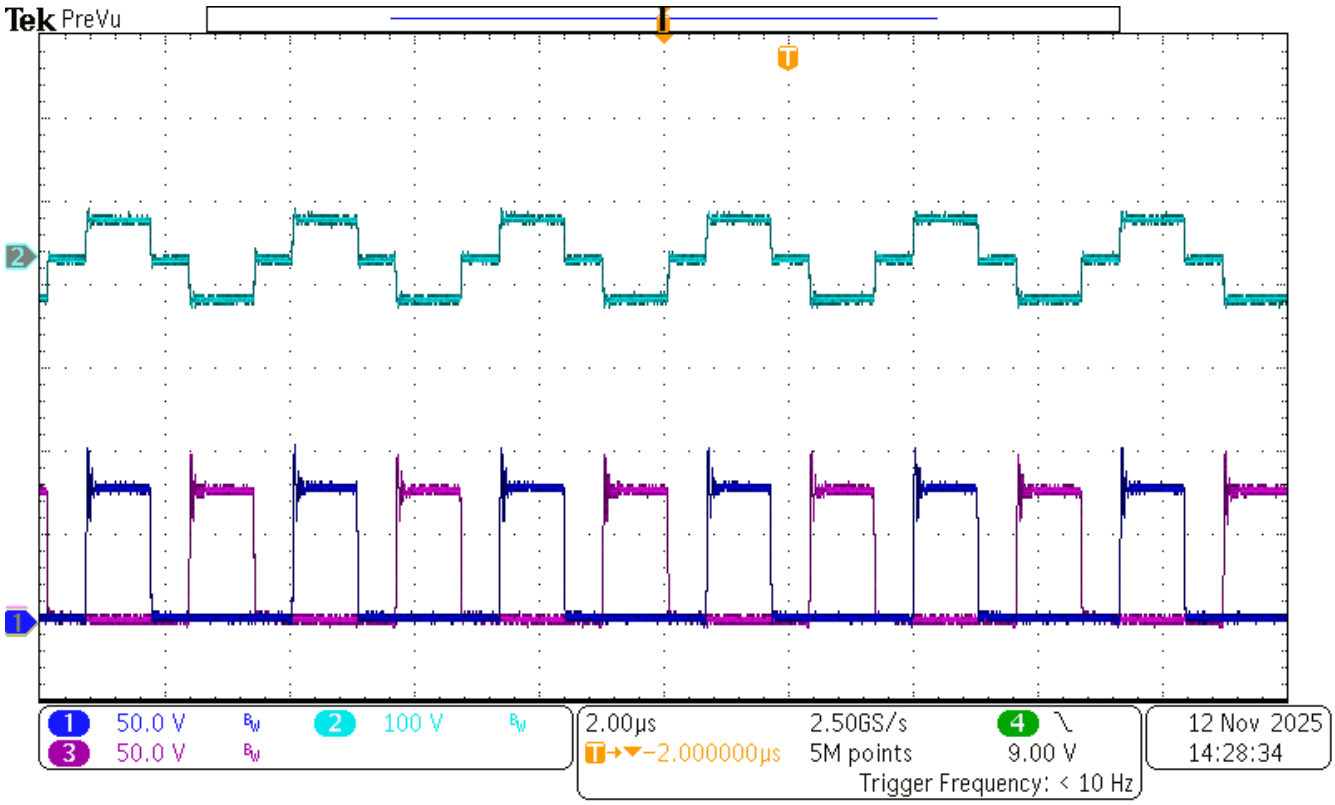


Figure 3-5. 48VIN 1200W Full Load

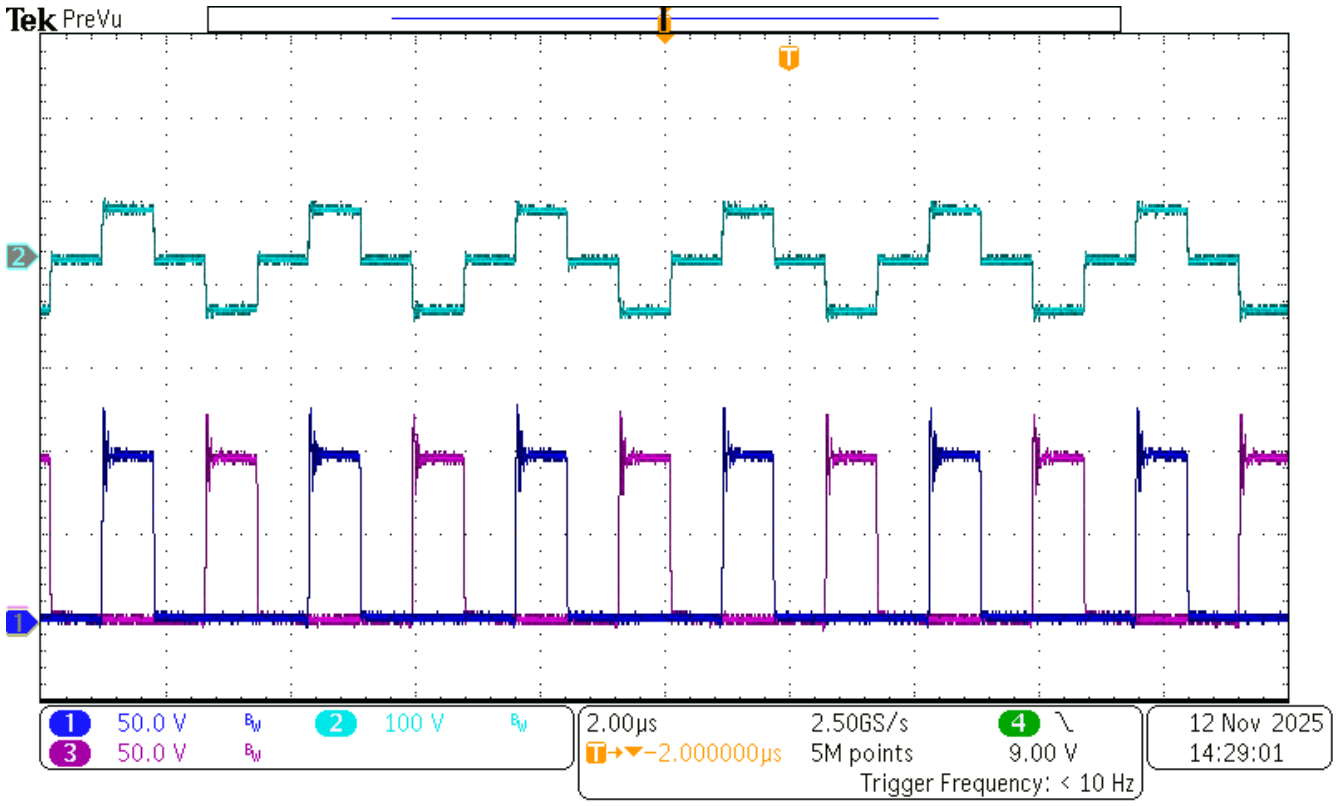


Figure 3-6. 60VIN 1200W Full Load

3.2 Output Voltage Ripple

CH1 (Dark Blue): LMG2175 switching node voltage.

CH3 (Red): LMG2175 switching node voltage.

CH4 (Green): Output voltage (AC coupling).

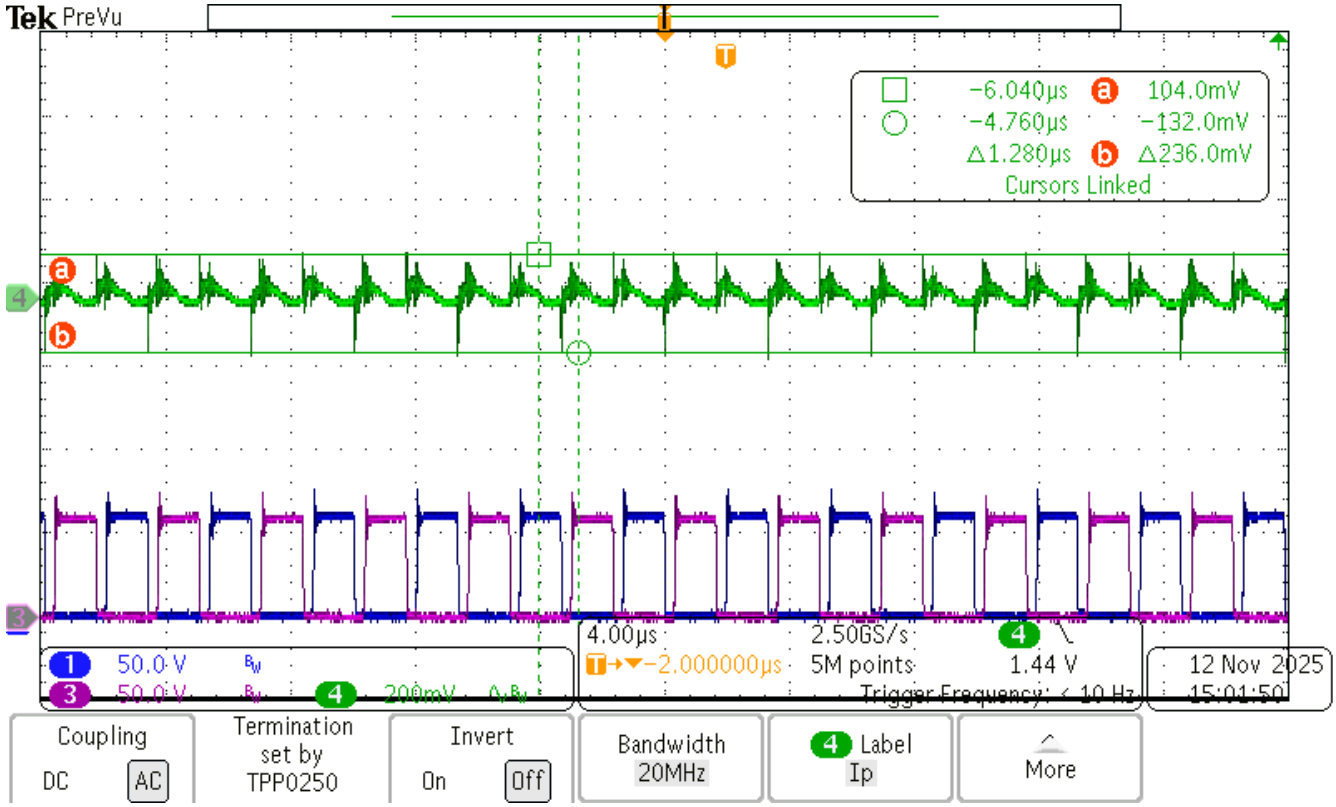


Figure 3-7. 36VIN No Load

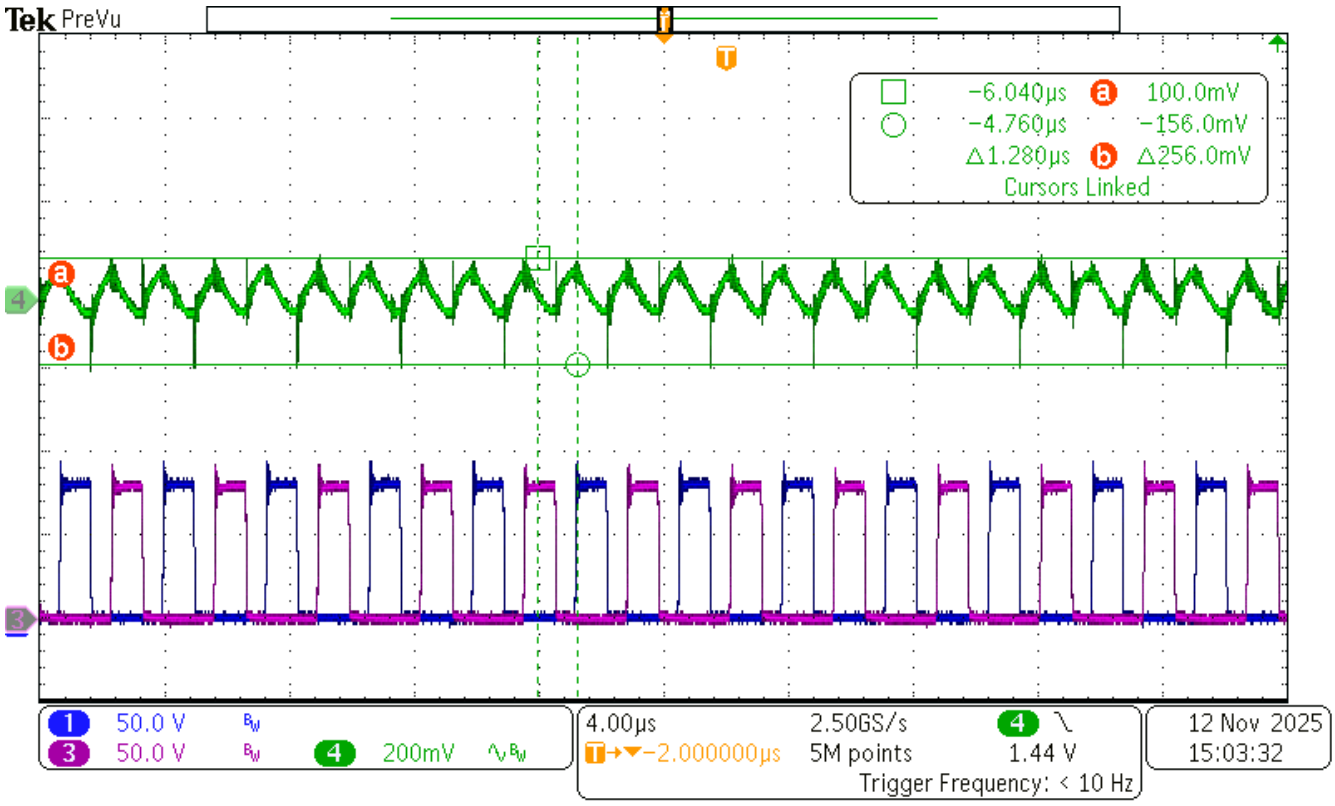


Figure 3-8. 48VIN No Load

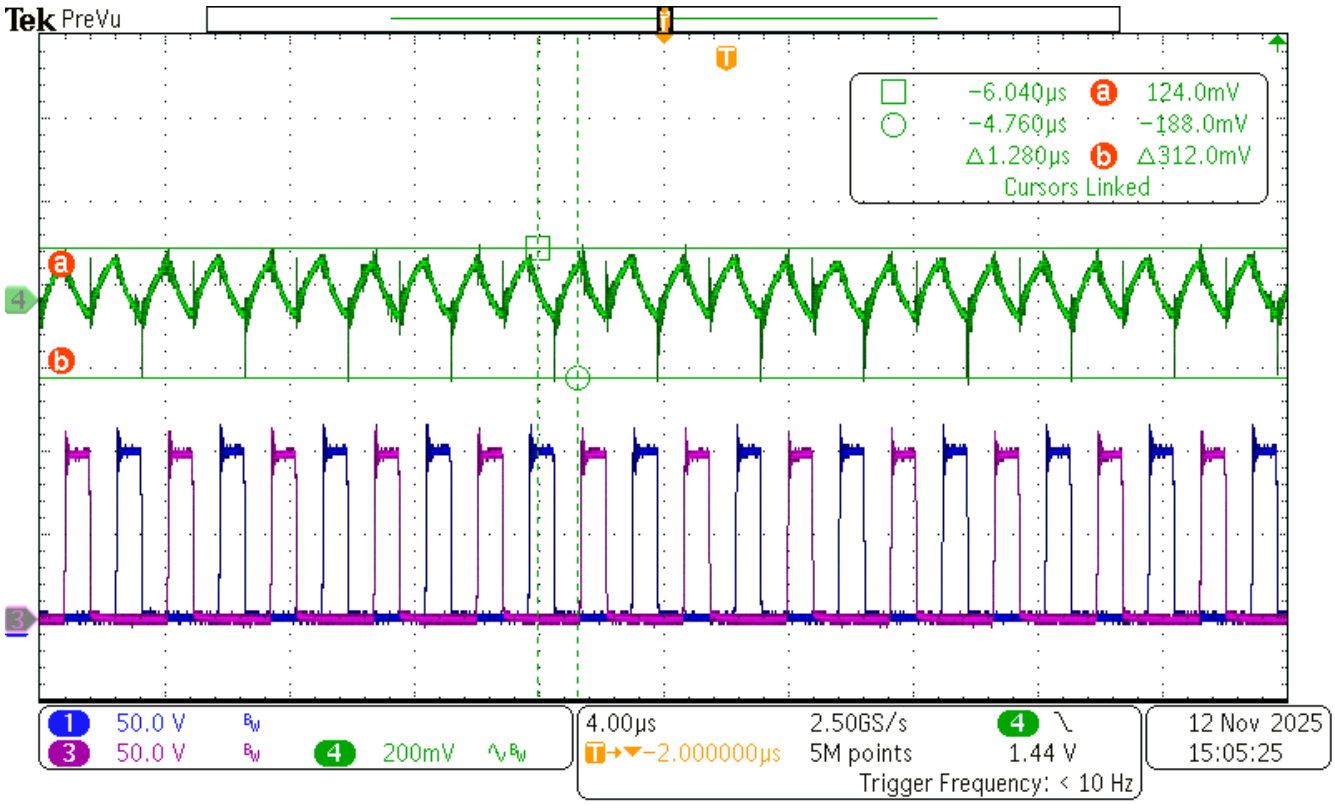


Figure 3-9. 60VIN No Load

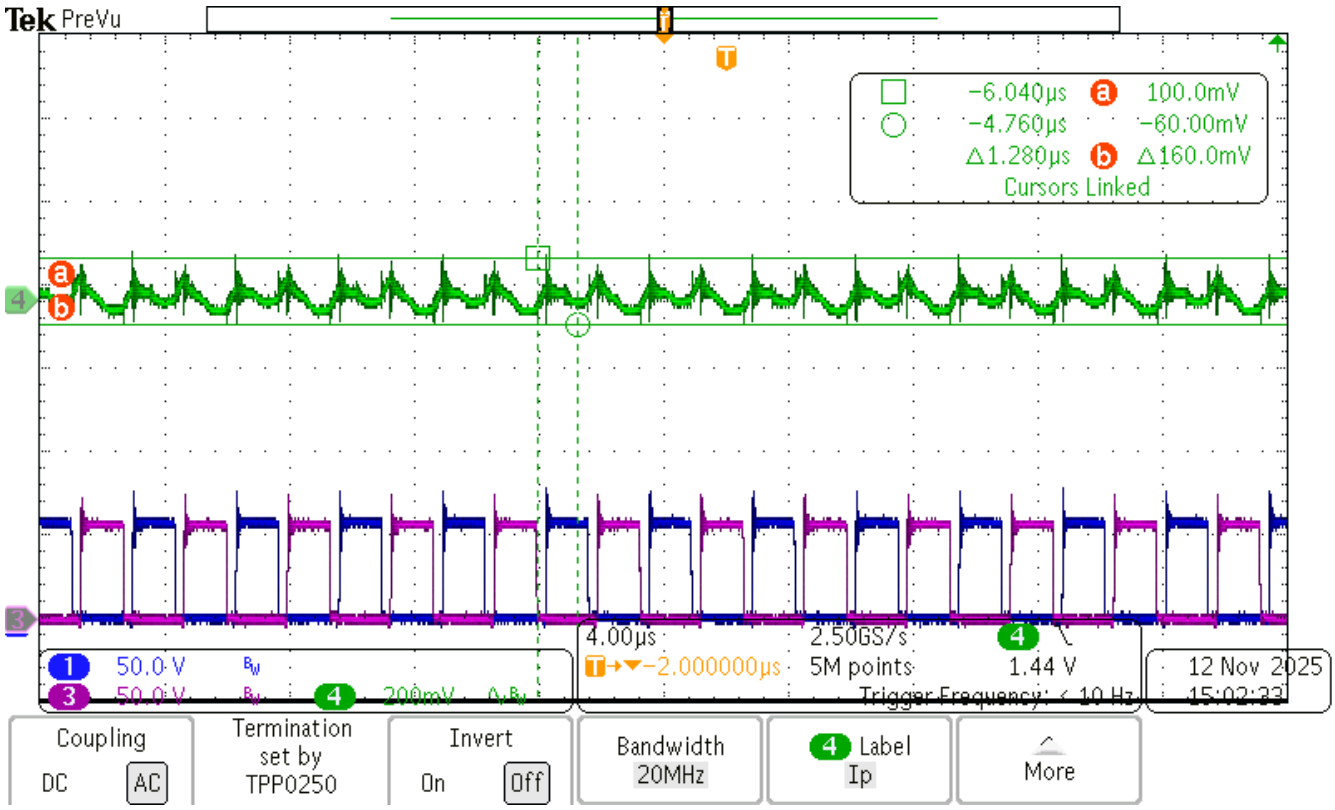


Figure 3-10. 36VIN 1200W Full Load

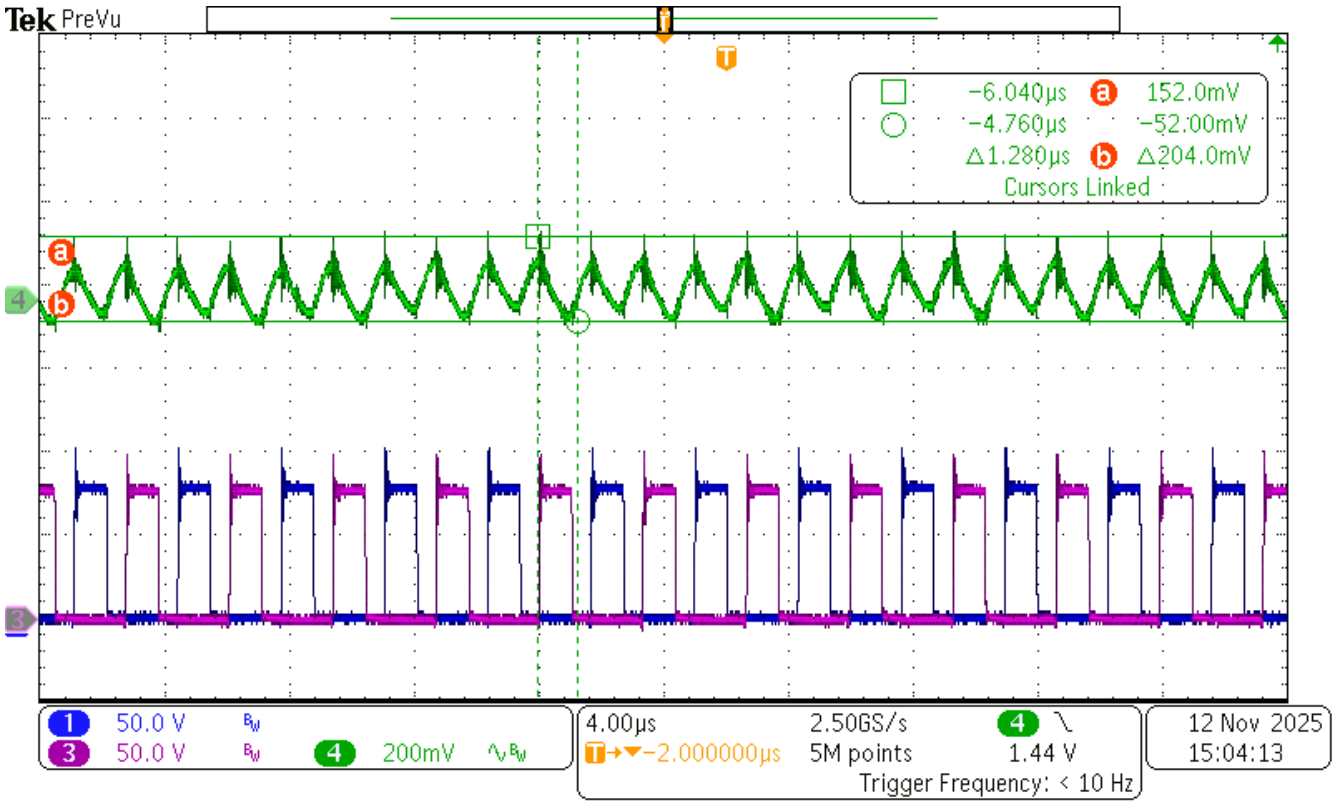


Figure 3-11. 48VIN 1200W Full Load

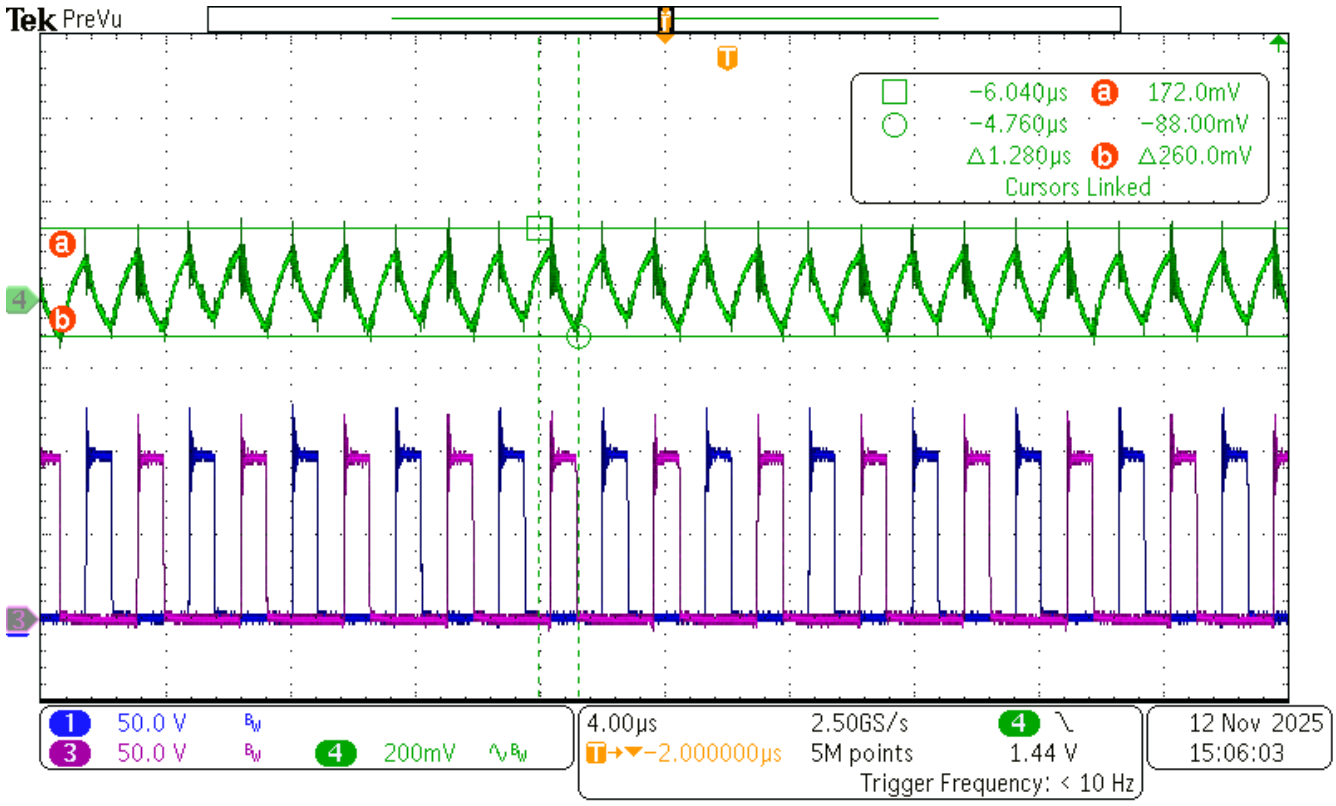


Figure 3-12. 60VIN 1200W Full Load

3.3 Load Transients

CH2 (Light Blue): Output current

CH4 (Green): Output voltage (DC coupling)

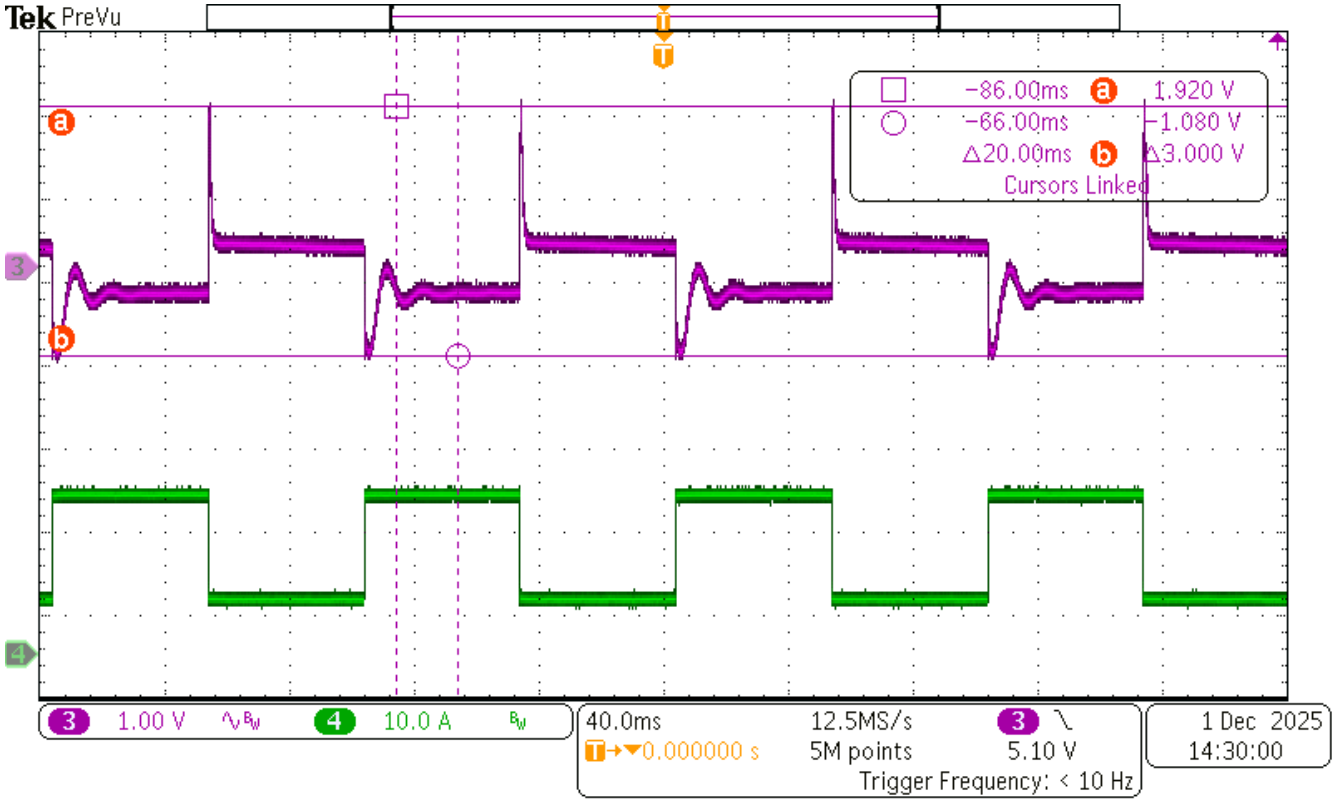


Figure 3-13. 36VIN 25% - 75% CCD Load, 50mS-50mS, 1A/uS

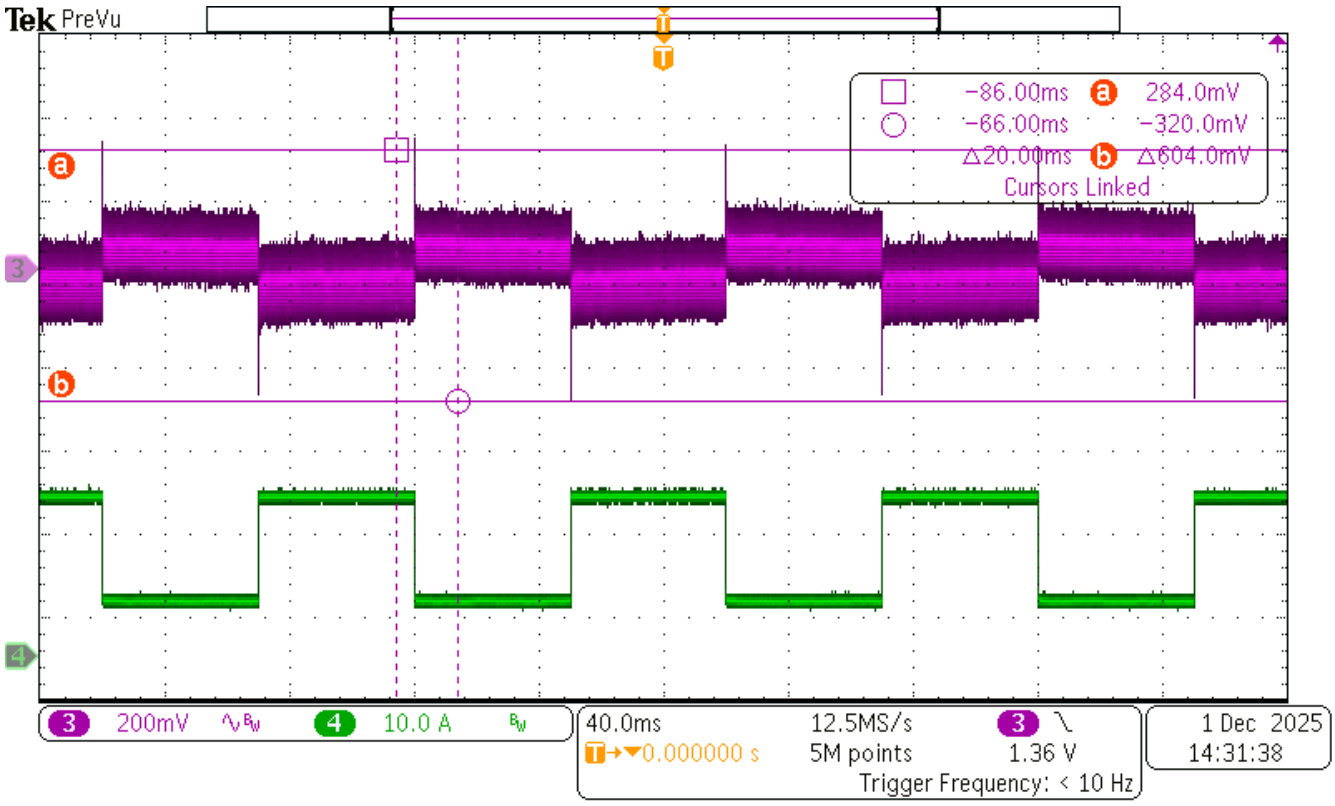


Figure 3-14. 48VIN 25% - 75% CCD Load, 50mS-50mS, 1A/uS

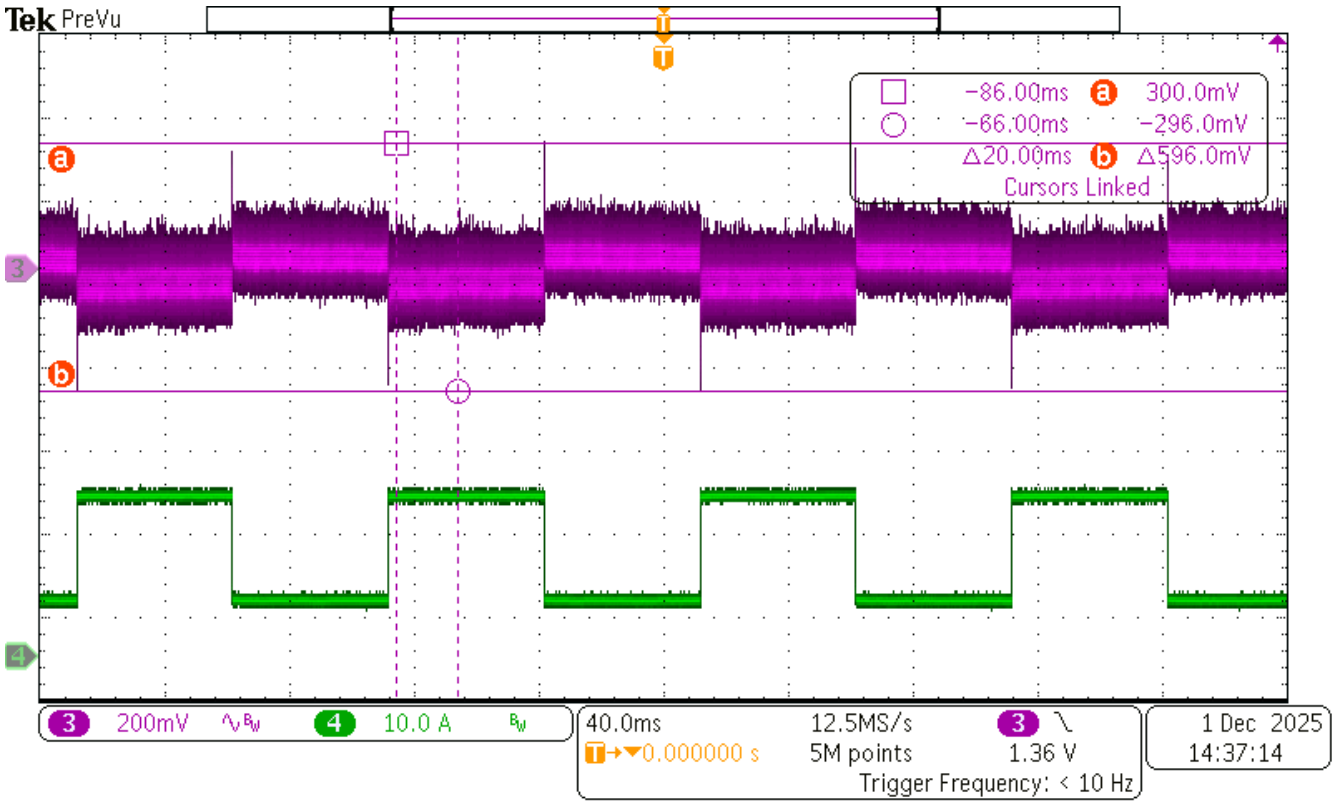


Figure 3-15. 60VIN 25% - 75% CCD Load, 50mS-50mS, 1A/uS

3.4 Start-up Sequence

CH1 (Dark Blue): LMG2175 switching node voltage

CH2 (Light Blue): Differential voltage of primary side transformer terminals.

CH3 (Red): LMG2175 switching node voltage

CH4 (Green): Output voltage (DC coupling)

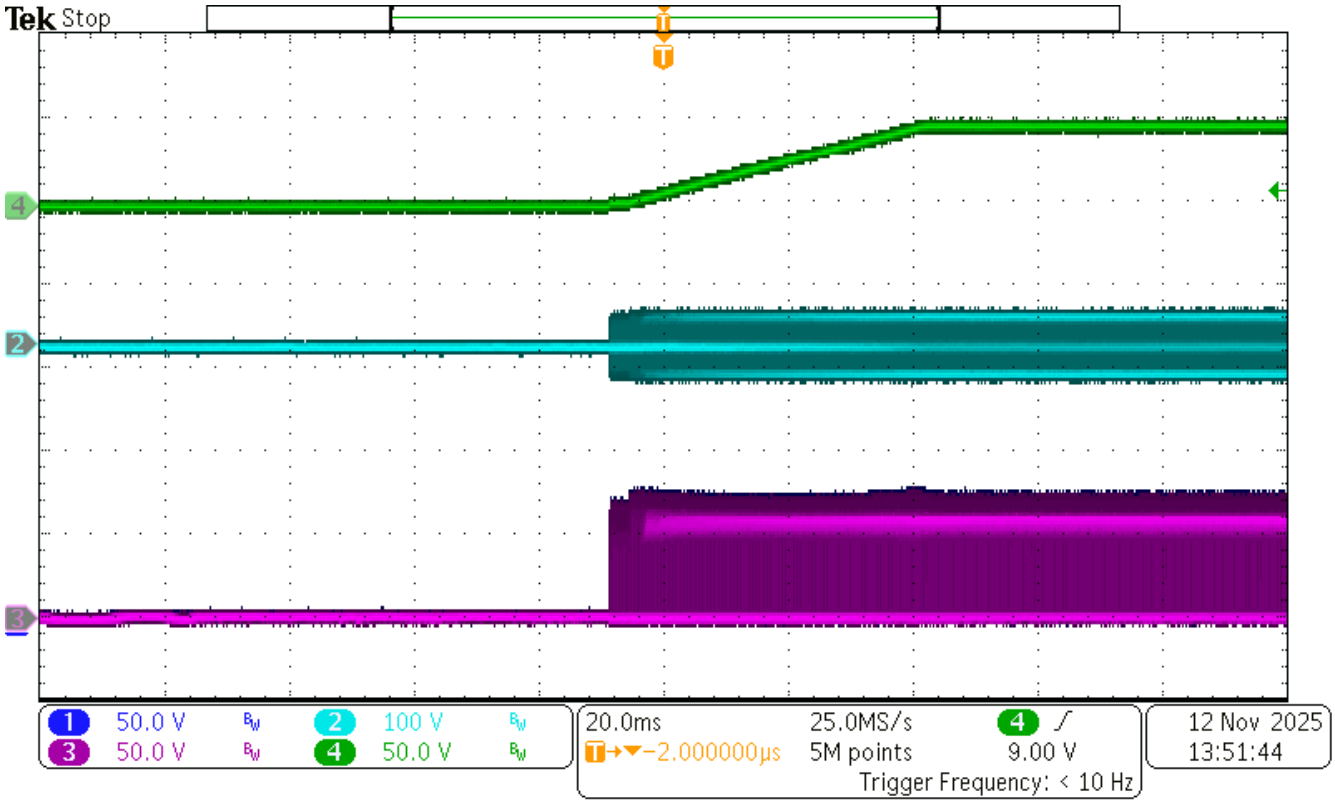


Figure 3-16. 36VIN No load

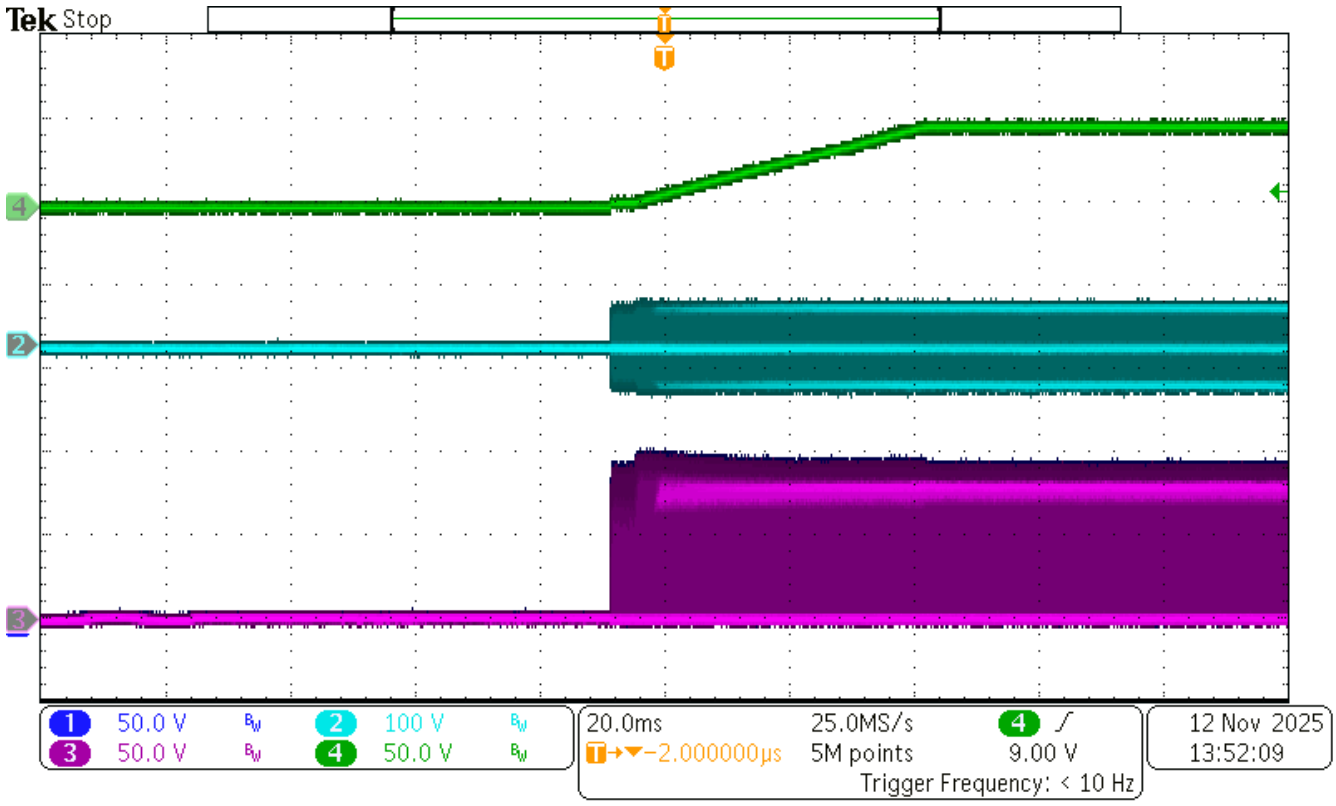


Figure 3-17. 48VIN No load

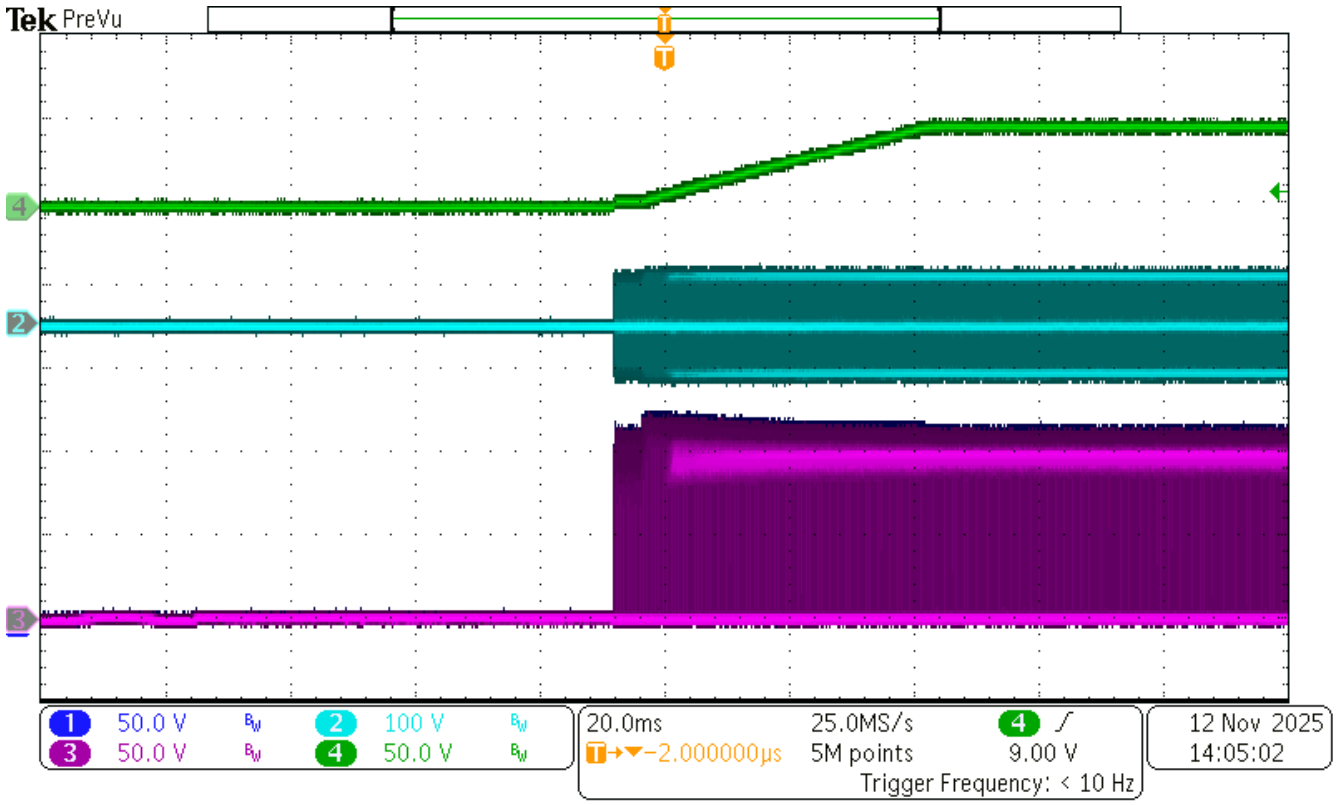


Figure 3-18. 60VIN No load

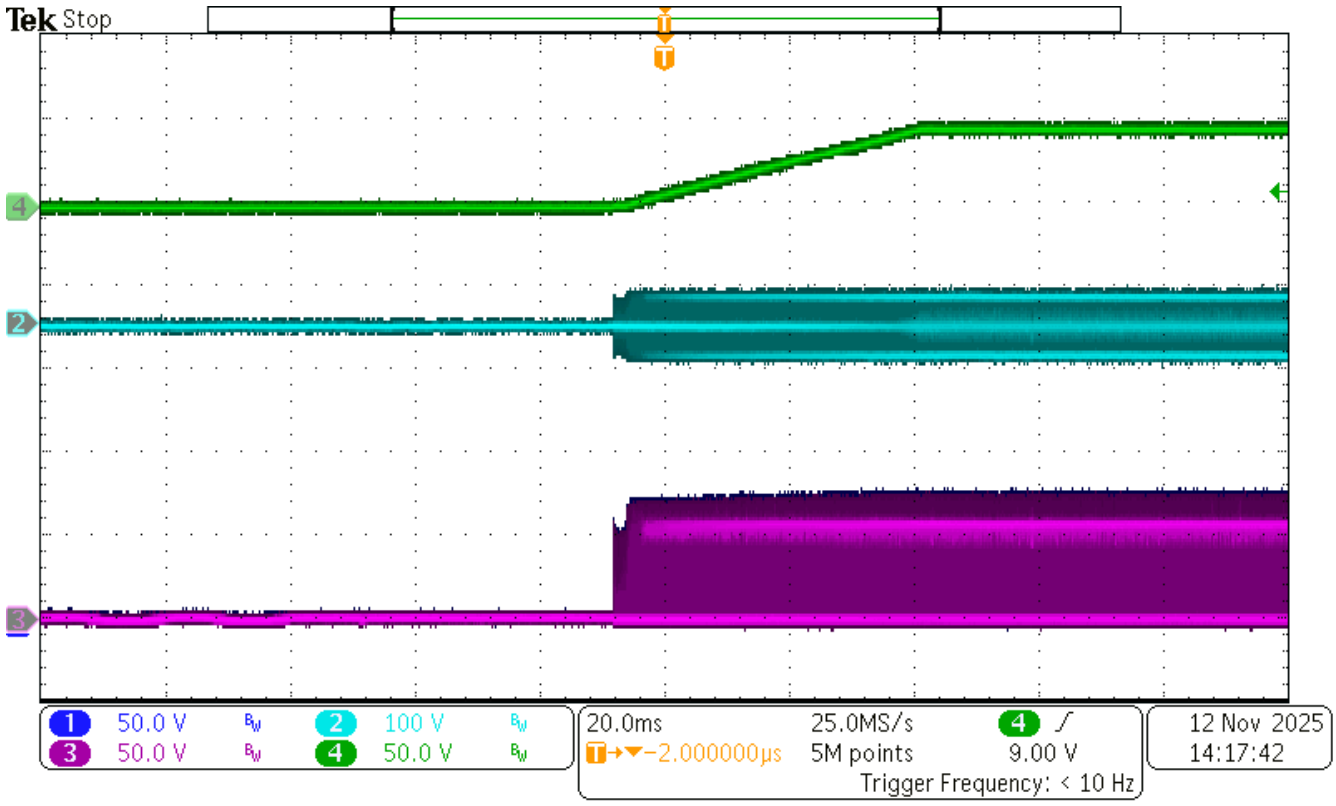


Figure 3-19. 36VIN 1200W Full load

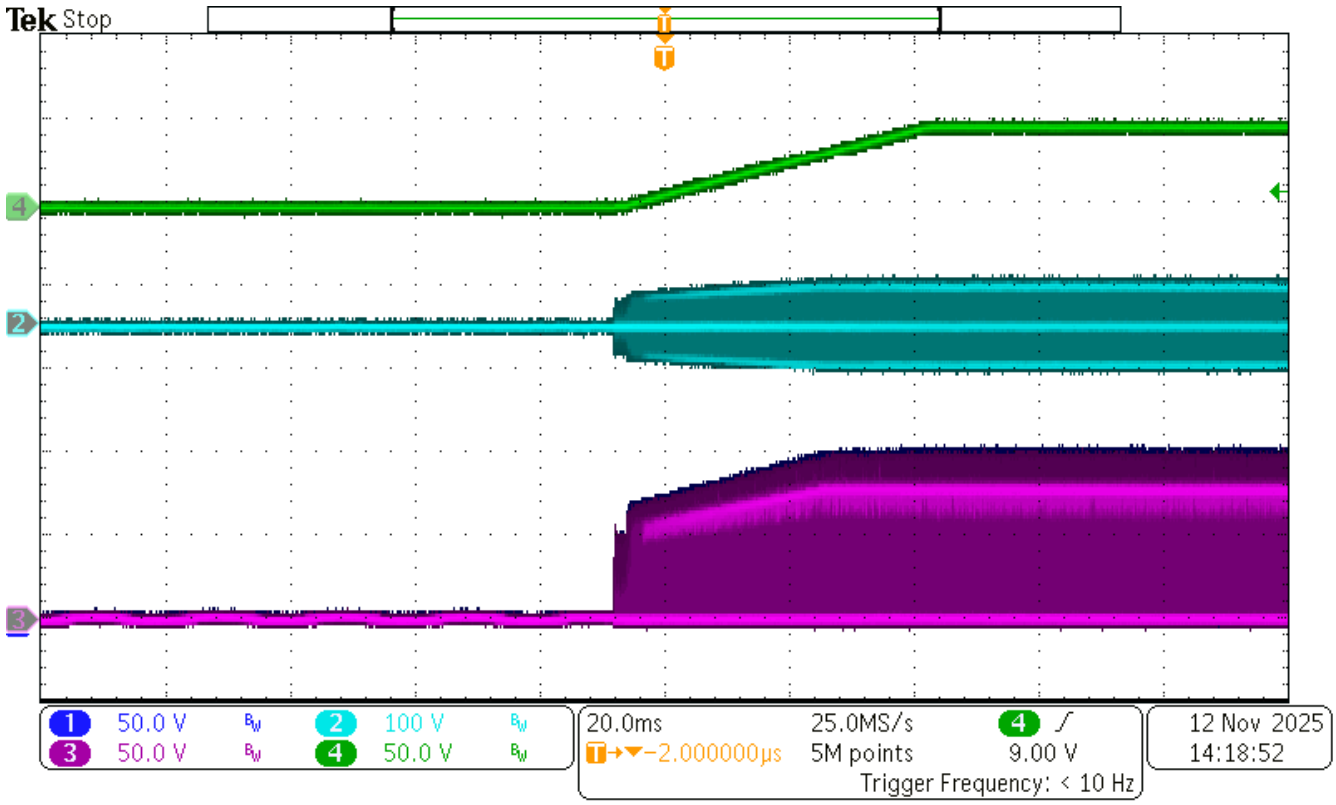


Figure 3-20. 48VIN 1200W Full load

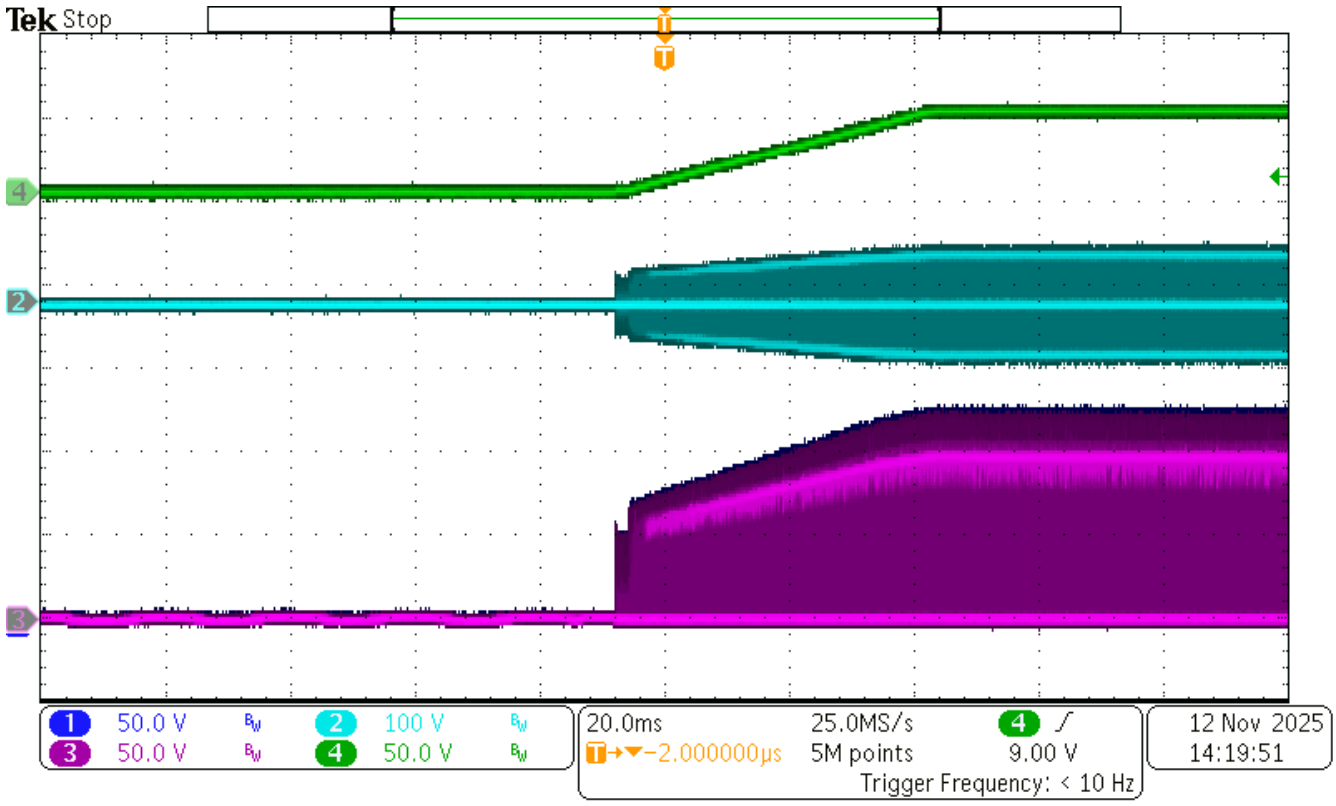


Figure 3-21. 60VIN 1200W Full load

3.5 Undervoltage Protection

CH1 (Dark Blue): LMG2175 switching node voltage

CH2 (Light Blue): Differential voltage of primary side transformer terminals

CH3 (Red): LMG2175 switching node voltage

CH4 (Green): Output voltage (DC coupling)

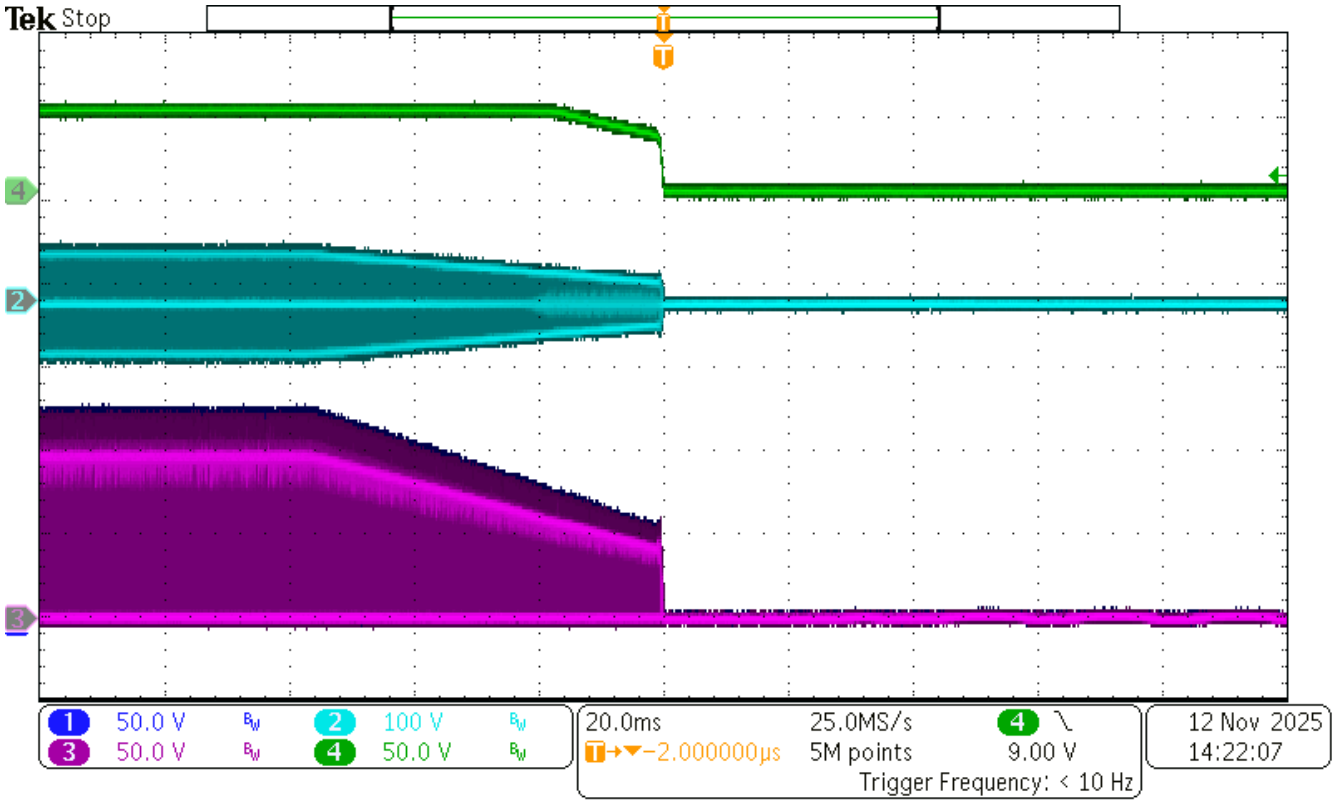


Figure 3-22. 60VIN 1200W Full load UVLO Protection

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