Test Report: PMP23476

Compact 6W, Triple Output, Auxiliary Bias Supply Reference Design

Description

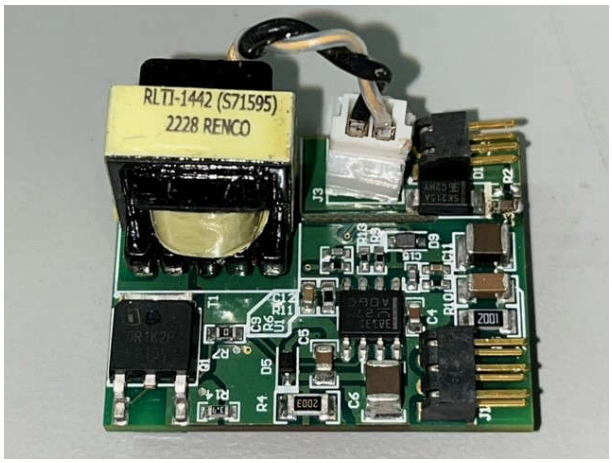
This reference design demonstrates a primary-side regulated flyback with two non-isolated 12V outputs and one isolated 12V output. The total size of the bias supply is 24.5mm × 32mm × 17mm.

Features

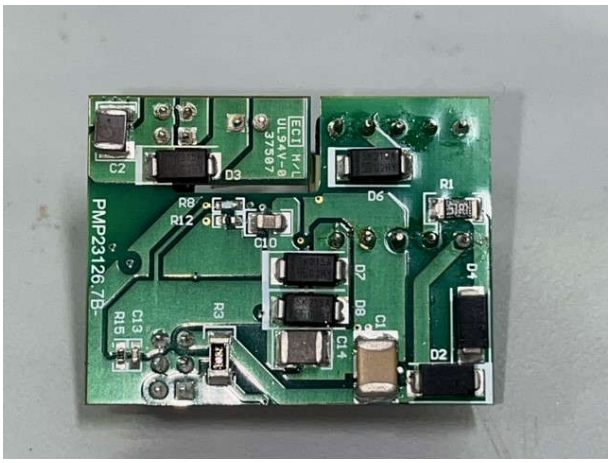
- Primary-side regulation with no optocoupler
- Compact design size of 24.5mm × 32mm × 17mm
- Pluggable interface

Applications

- Industrial AC-DC



Top of Board



Bottom of Board

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
V_{IN}	100V–400V
V_{OUT}	12V, 12V, 12V
Maximum Output Current	0.25A, 0.25A, 0.01A

1.2 Dimensions

The total size of the bias supply is 24.5mm × 32mm × 17mm.

2 Testing and Results

2.1 Efficiency Graphs

Efficiency is shown in the following figure. Total output power is considering a combination of all three regulated and non-regulated outputs.

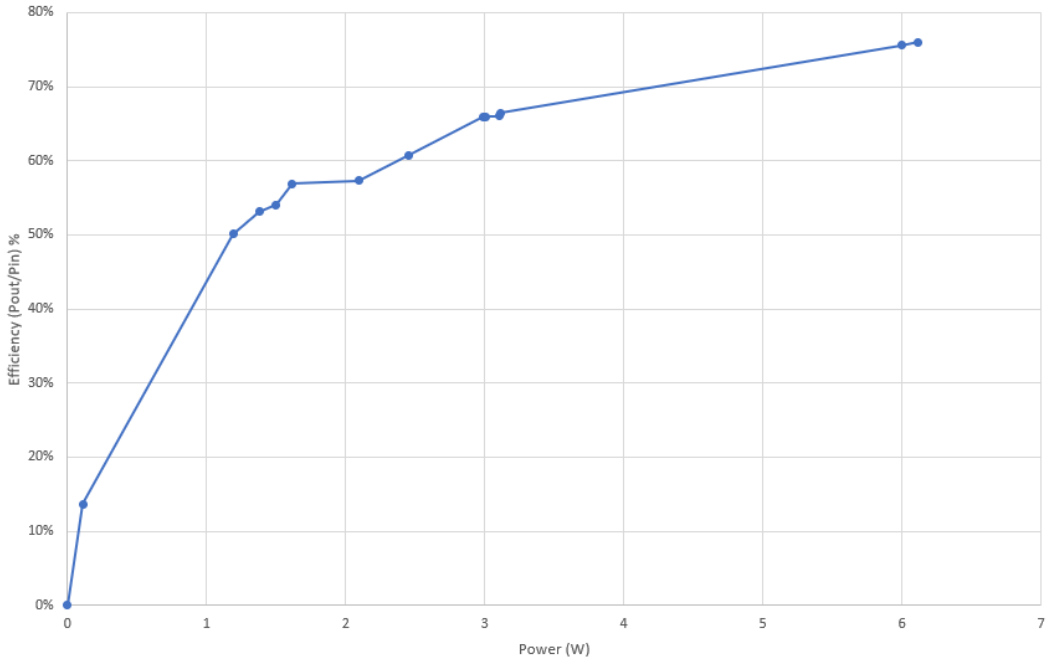


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

Efficiency data is shown in the following table.

V_{IN} (V)	I_{IN} (A)	V_{OUT} (V)			I_{OUT} (A)			P_{IN} (W)	P_{OUT} (W)	P_{LOSS} (W)	Efficiency (%)
		12Vp	12Vp_h	12Vs	12Vp	12Vp_h	12Vs				
400.14	0.00165	12.02	11.78	12.01	0	0	0	0.6602	0	0.6602	0
400.14	0.00912	12.01	11.42	8.37	0	0	0.25	3.6493	2.0925	1.5568	57
400.14	0.002	12.01	11.61	11.97	0	0.0094	0	0.8003	0.1091	0.6911	14
400.14	0.0101	12.01	10.91	9.41	0	0.0094	0.25	4.0414	2.4551	1.5864	61
400.14	0.01138	12.01	12.72	12.81	0.25	0	0	4.5536	3.0025	1.5511	66
400.14	0.01981	12.01	12.84	11.97	0.25	0	0.25	7.9268	5.995	1.9318	76
400.14	0.01172	12	12.36	12.68	0.25	0.0094	0	4.6897	3.1162	1.5734	66
400.14	0.02012	12.01	12.45	11.99	0.25	0.0094	0.25	8.0508	6.1170	1.9338	76
400.14	0.00595	11.99	11.44	9.55	0	0	0.125	2.3808	1.1938	1.1871	50
400.14	0.00648	11.99	11.02	10.19	0	0.0094	0.125	2.5929	1.3773	1.2156	53
400.14	0.00693	11.99	12.46	12.55	0.125	0	0	2.7730	1.4988	1.2742	54
400.14	0.01134	11.99	12.58	11.94	0.125	0	0.125	4.5376	2.9913	1.5463	66
400.14	0.00709	11.99	12.26	12.5	0.125	0.0094	0	2.8370	1.6140	1.2230	57
400.14	0.01176	11.99	12.27	11.95	0.125	0.0094	0.125	4.7056	3.1078	1.5978	66

2.3 Thermal Images

The following thermal images show a top and bottom view of the board. The ambient temperature was 20°C with no forced air flow.

The following conditions apply to these thermal images.

- 400V_{DC}: P_{IN} = 8.1W, V_{OUT1} = 12.01V, 0.25A; V_{OUT2} = 12.45V, 0.0094A; V_{OUT3} = 11.99V, 0.25A; Efficiency = 76%

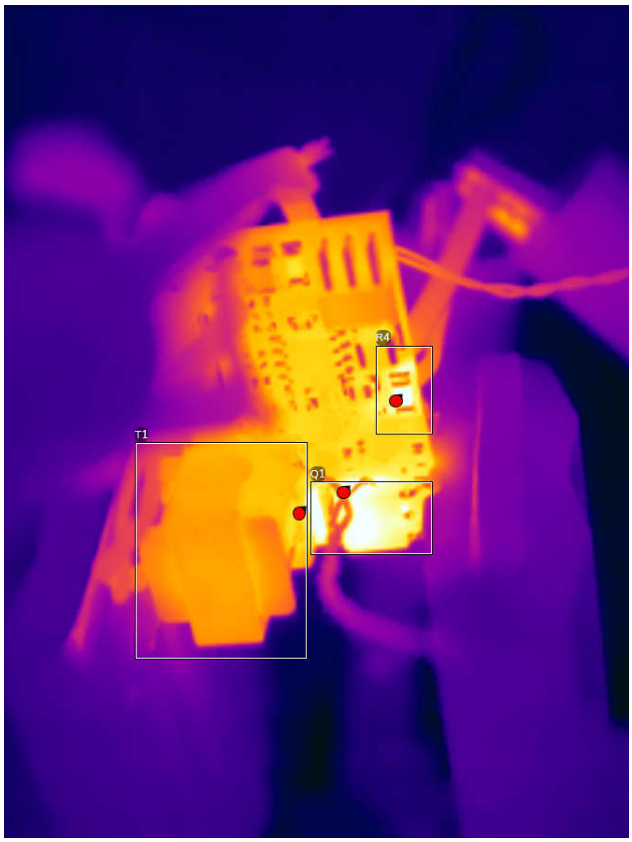


Figure 2-2. Top Side Thermal Image

Component	Temperature (°C)
R4	68
Q1	62.7
T1	59.3

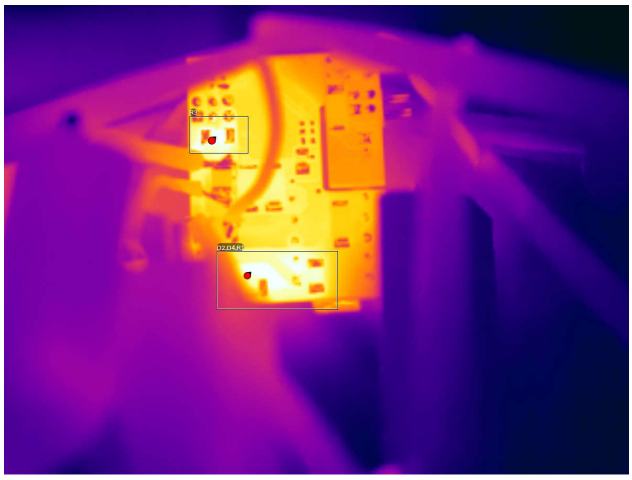


Figure 2-3. Bottom Side Thermal Image

Component	Temperature (°C)
R3	68.3
D2, D4, R1	59.4

3 Waveforms

3.1 Switching

The images below show key switching waveforms. The waveforms are measured with 12V, 0.25A; 12V, 0.0094A; and 12V, 0.25A full load.

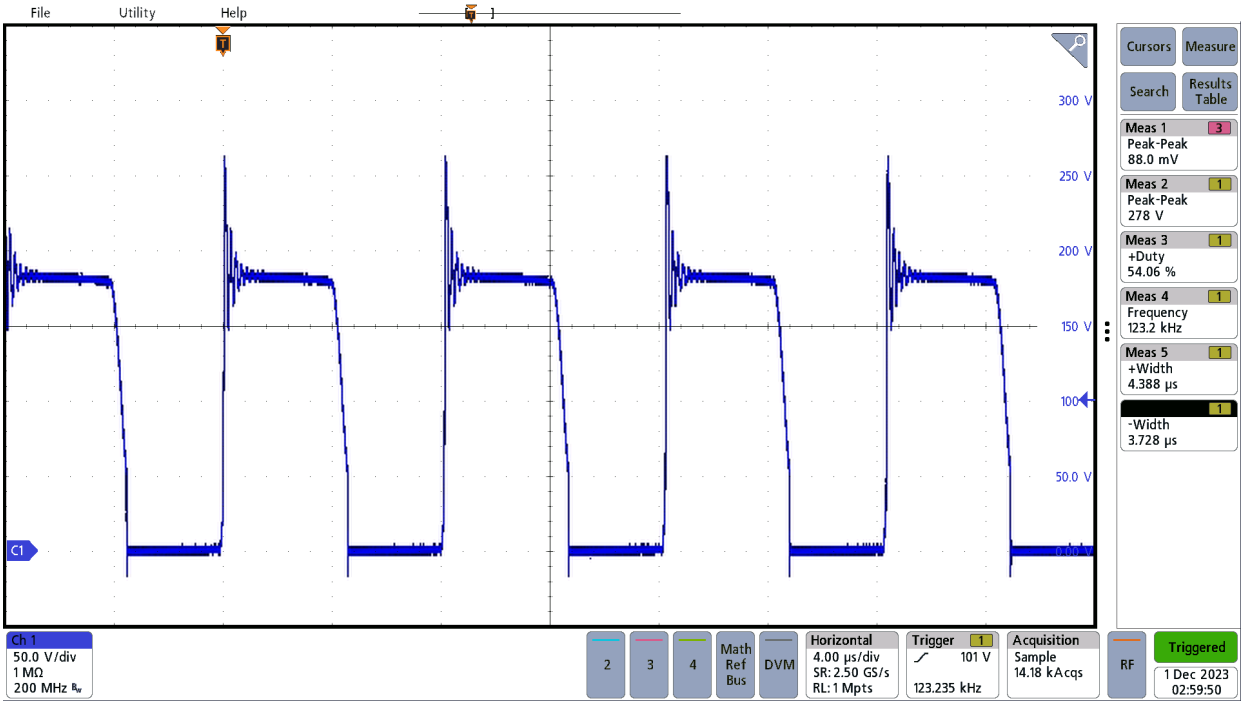


Figure 3-1. Primary Switch Node - Full Load, 100V_{DC} In

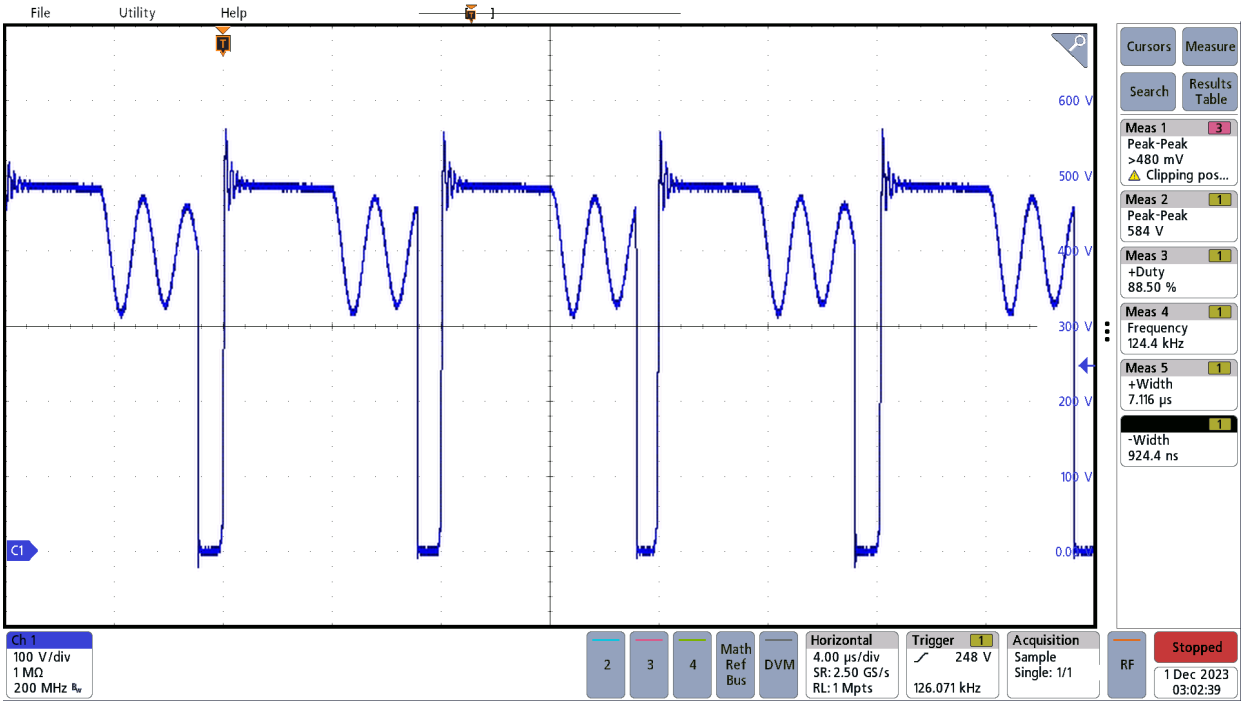
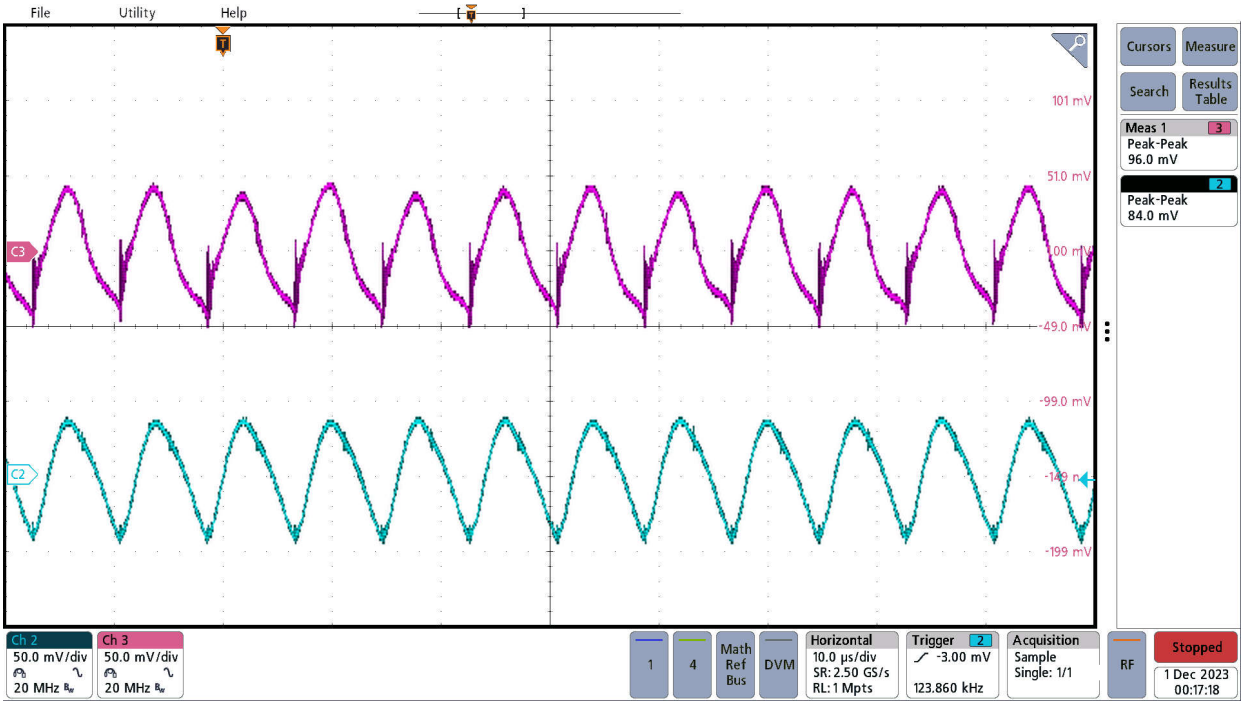


Figure 3-2. Primary Switch Node - Full Load, 400V_{DC} In

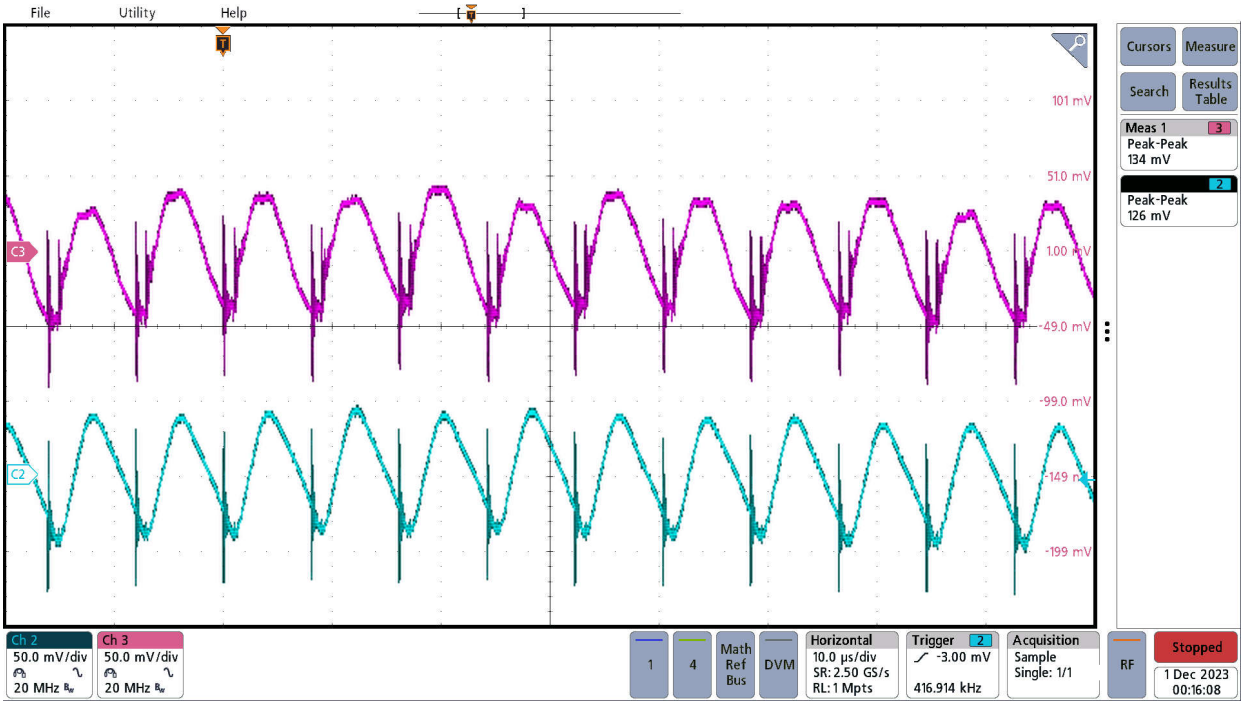
3.2 Output Voltage Ripple

The output ripple voltages are shown in the plots below at 12V, 0.25A; 12V, 0.094A; 12V, 0.25A full load.



Ch3: Vp (Regulated Output)
Ch2: Vs (Unregulated Output)

Figure 3-3. Output Ripple - Full Load, 100V_{DC} In



Ch3: Vp (Regulated Output)
Ch2: Vs (Unregulated Output)

Figure 3-4. Output Ripple - Full Load, 400V_{DC} In

3.3 Start-Up Sequence

Start-up behavior is shown in the following figures.

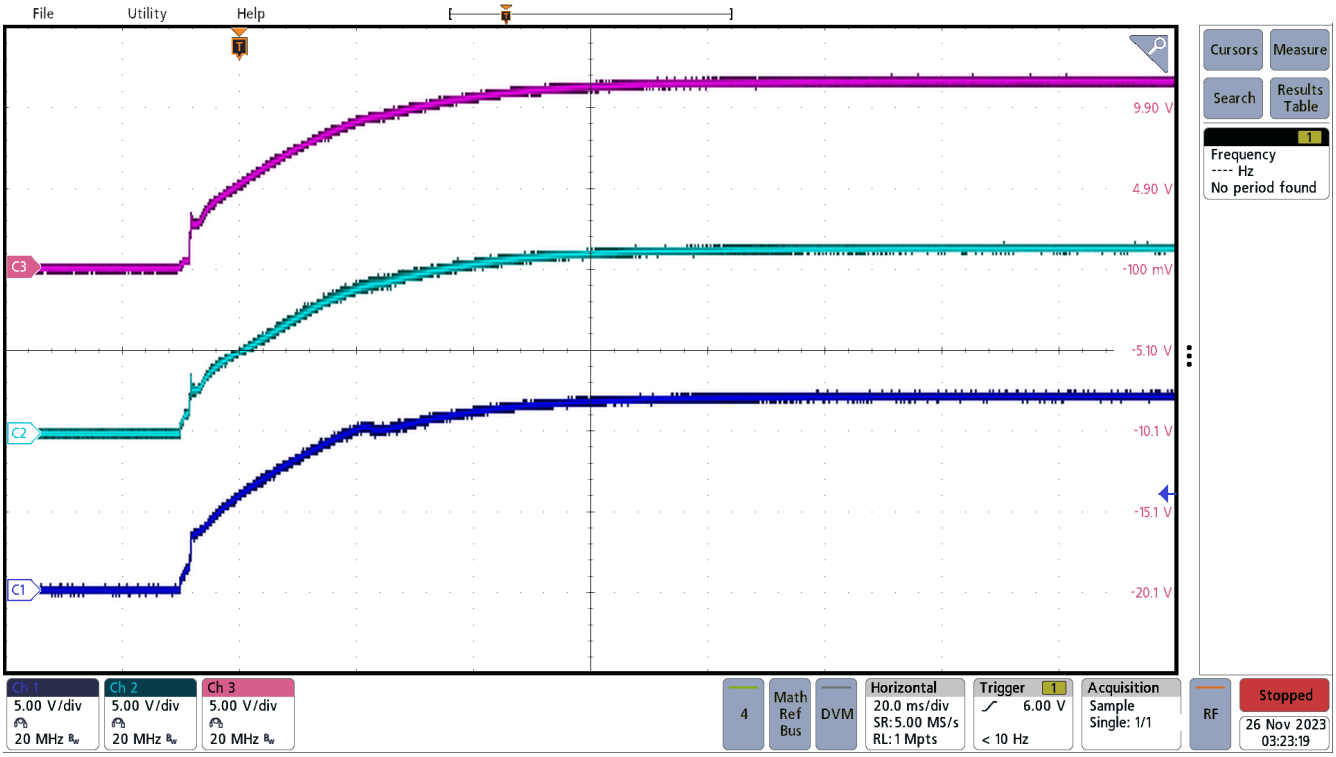


Figure 3-5. Start-Up - 100V_{DC} In

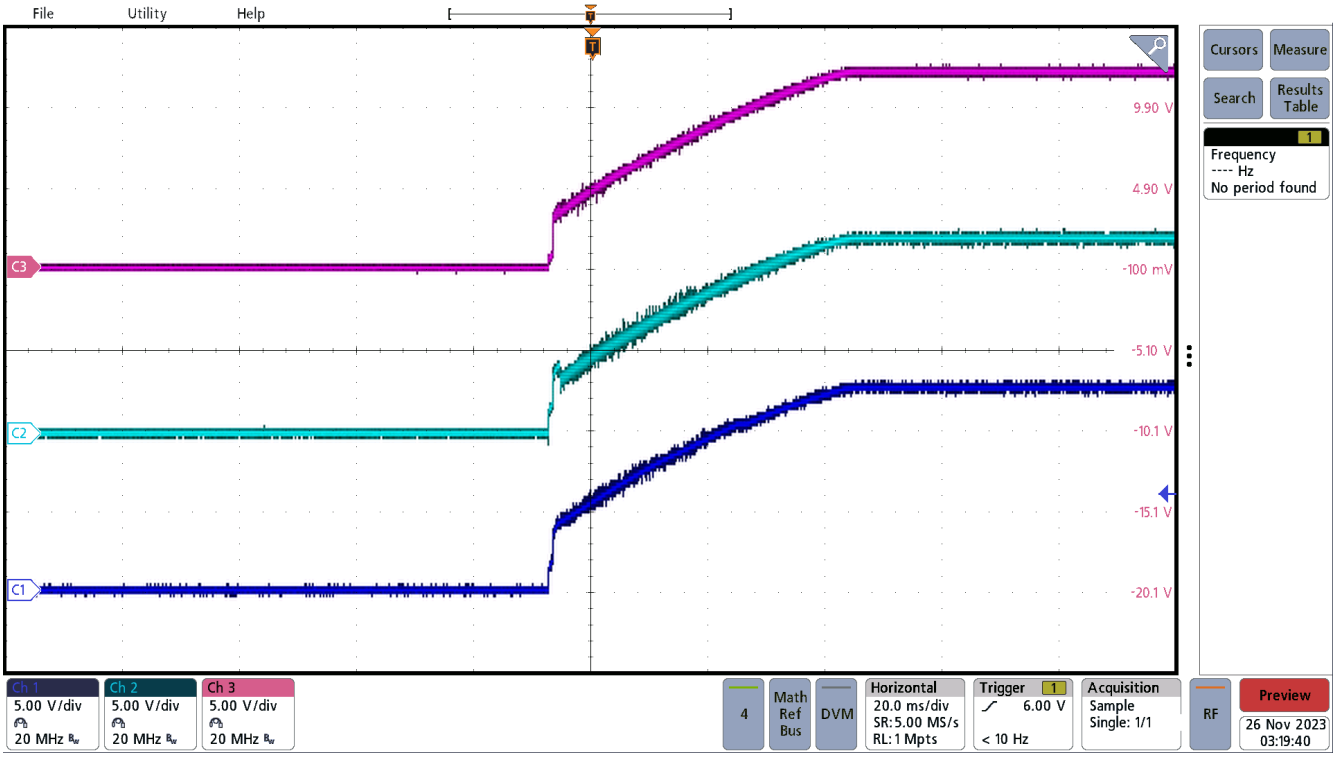


Figure 3-6. Start-Up - 400V_{DC} In

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