



TI reference design number: PMP9379 Rev A

Input: 18-42V

Output 1: +15Vout @ 0.5A

Output 2: -15Vout @ 0.5A

DC-DC Converter Test Results

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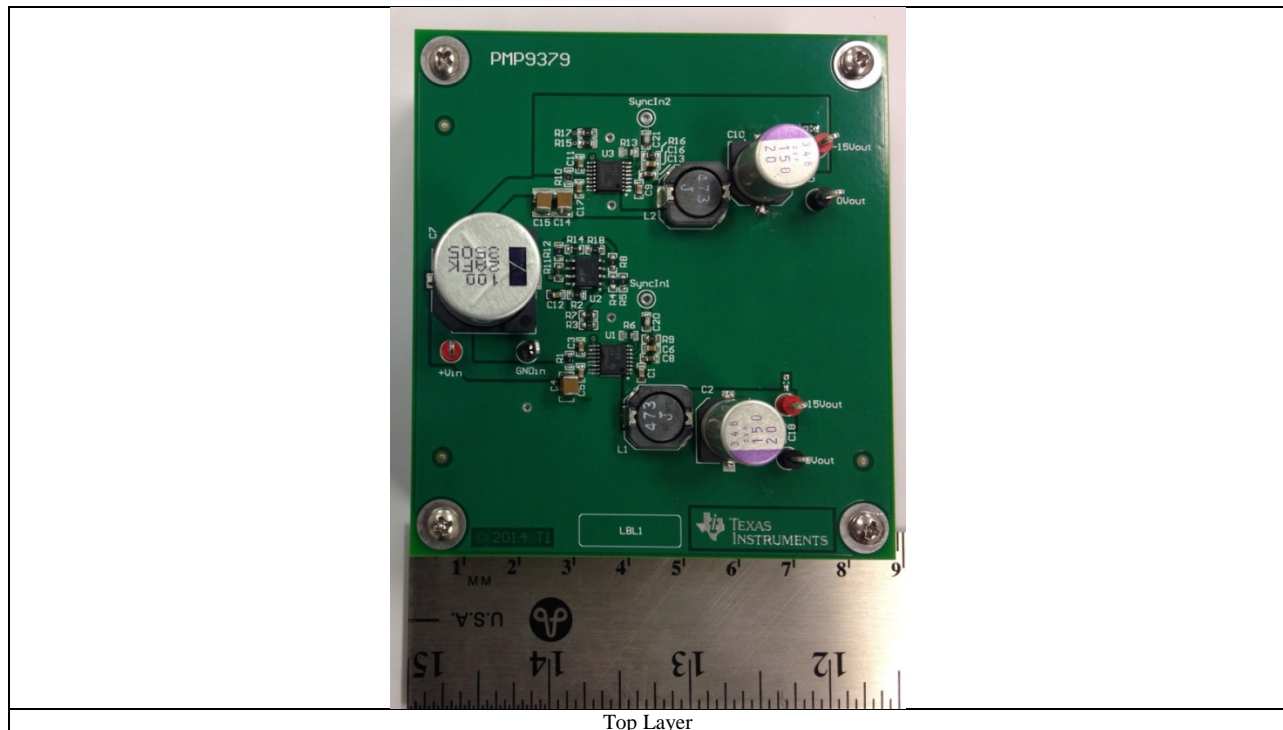
10.6 42Vin -15Vout No Load 36Vin -15Vout 0.5A Load 29

1. Design Specifications

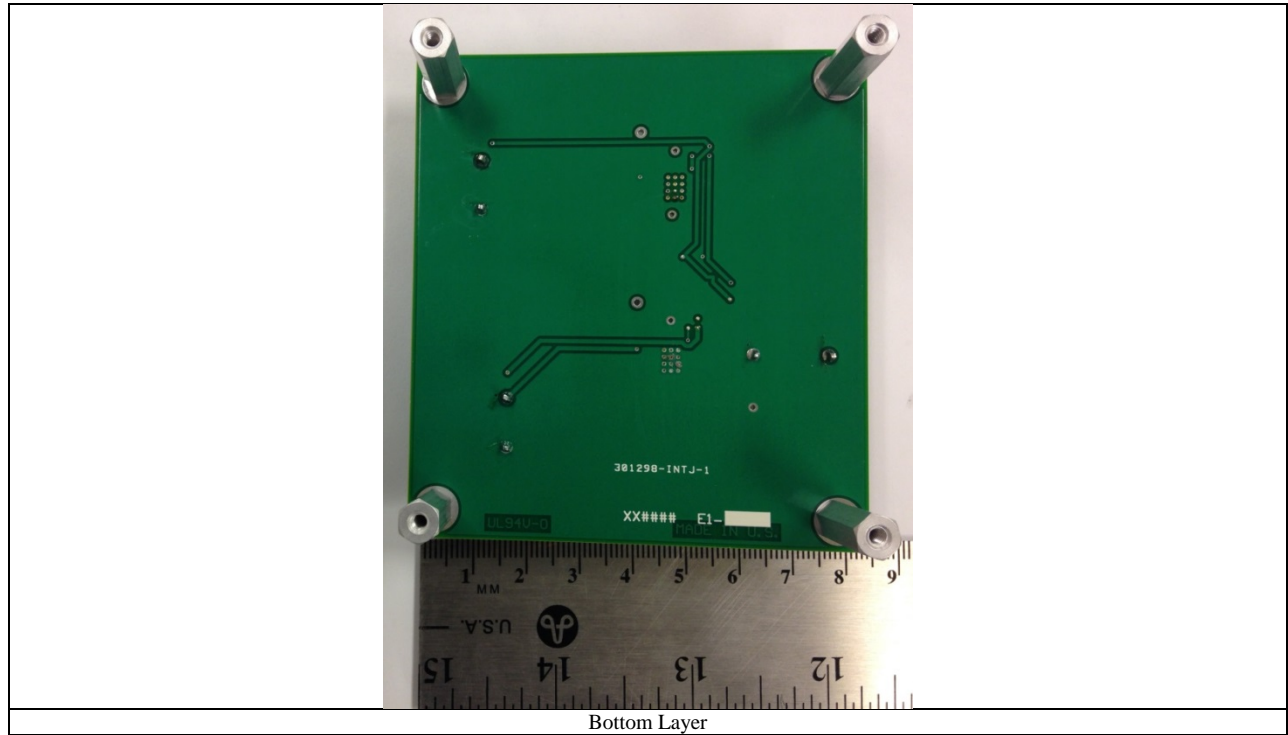
V_{in} Min.	18VDC
V_{in} Max.	42VDC
V_{out1}	+15VDC
I_{out1}	0.5A
V_{out2}	-15VDC
I_{out2}	0.5A
Switching Frequency	500 kHz

2. Description

PMP9379 is a positive and negative 15V output supply capable of delivering 0.5A per rail. The input voltage range is 18V to 42V in. PMP9379 uses external circuitry to ensure that the +/-15V output track each other, i.e. the output voltage above and below 0V are well controlled and accurately balanced. This board has the capability to externally synchronize the regulators to an external clock. It is recommended that the synchronization clock pulse is AC coupled and is no less than 2V peak relative to the regulators Reference (0V for the Buck, -15V for the Buck boost inverter). The abs max for the synchronization clock pulse is 5.5V. Please refer to Datasheet for more details regarding clock synchronization. Synchronization is an option not a recommendation. The PMP9379 is a four layer board with overall dimensions of 3.1" (78mm) x 3.4" (86mm). The copper weight is 1 oz. on the outer layers and 0.5 oz. the inner layers.

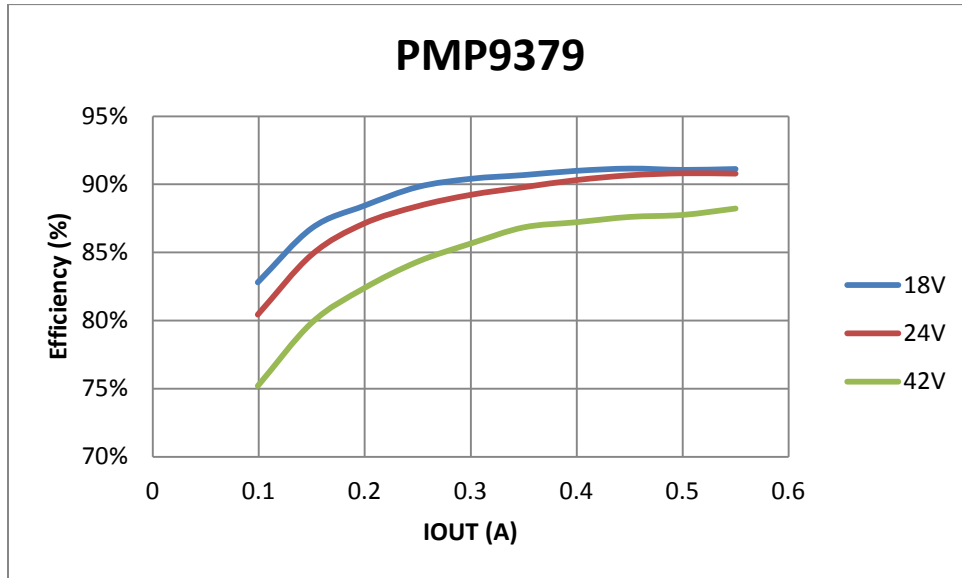


LM46002 Positive and Negative Tracking Bias Supply



LM46002 Positive and Negative Tracking Bias Supply

3. Efficiency



3.1 18VIN

Vin (V)	Iin (A)	Vout - (V)	Iout 1 (A)	Vout + (V)	Iout 2 (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
18	0.011	15.278	0.000	15.284	0.000	0.201	0.000	0.00%	0.201
18	0.105	15.157	0.050	15.156	0.050	1.890	1.510	79.87%	0.380
18	0.202	15.153	0.100	15.151	0.099	3.636	3.011	82.80%	0.625
18	0.291	15.150	0.150	15.155	0.150	5.238	4.546	86.78%	0.692
18	0.380	15.147	0.200	15.145	0.199	6.840	6.048	88.42%	0.792
18	0.470	15.146	0.252	15.143	0.250	8.460	7.598	89.81%	0.862
18	0.558	15.141	0.300	15.143	0.300	10.044	9.081	90.41%	0.963
18	0.649	15.138	0.350	15.136	0.350	11.685	10.596	90.68%	1.089
18	0.742	15.135	0.403	15.135	0.400	13.356	12.153	91.00%	1.203
18	0.830	15.133	0.450	15.132	0.450	14.940	13.619	91.16%	1.321
18	0.922	15.132	0.499	15.128	0.500	16.598	15.115	91.06%	1.483
18	1.015	15.130	0.550	15.129	0.550	18.263	16.642	91.13%	1.620

3.2 24VIN

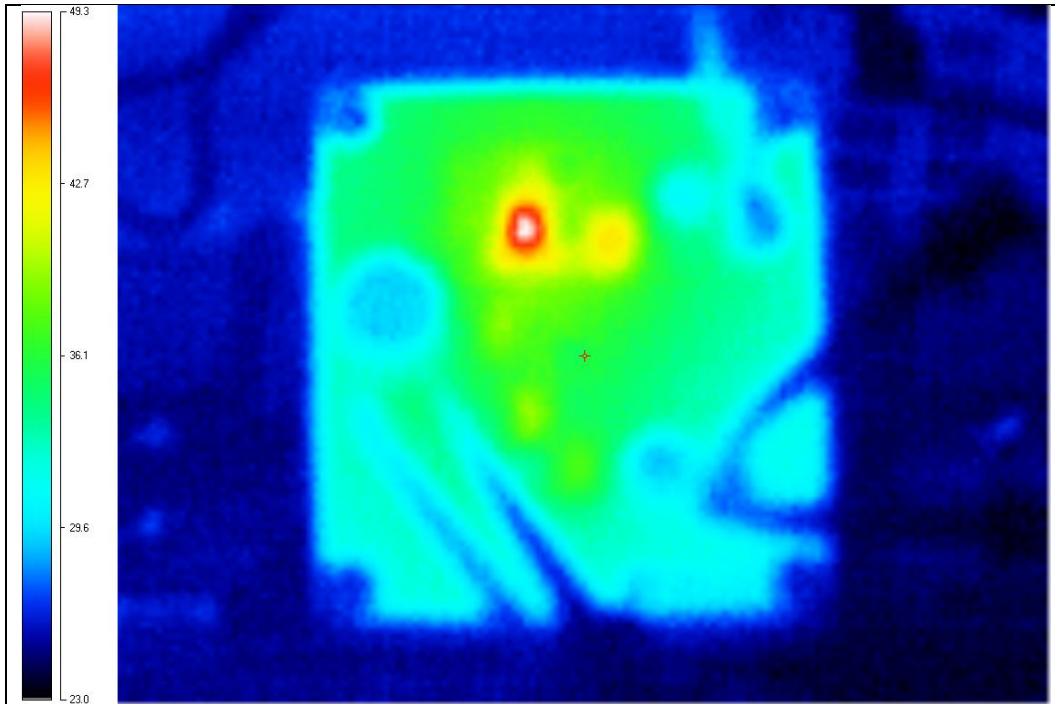
Vin (V)	Iin (A)	Vout - (V)	Iout 1 (A)	Vout + (V)	Iout 2 (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
24	0.011	15.332	0.000	15.312	0.000	0.263	0.000	0.00%	0.263
24	0.078	15.159	0.050	15.157	0.050	1.881	1.510	80.25%	0.372
24	0.157	15.153	0.100	15.150	0.100	3.767	3.030	80.44%	0.737
24	0.223	15.153	0.150	15.147	0.150	5.354	4.542	84.84%	0.812
24	0.290	15.148	0.200	15.145	0.200	6.955	6.059	87.11%	0.896
24	0.357	15.145	0.249	15.141	0.251	8.557	7.564	88.39%	0.993
24	0.424	15.144	0.299	15.140	0.300	10.165	9.070	89.23%	1.095
24	0.492	15.138	0.350	15.141	0.350	11.802	10.598	89.79%	1.205
24	0.558	15.138	0.399	15.132	0.400	13.389	12.093	90.32%	1.296
24	0.626	15.134	0.450	15.130	0.450	15.021	13.619	90.67%	1.402
24	0.695	15.132	0.499	15.127	0.502	16.677	15.145	90.81%	1.532
24	0.764	15.128	0.550	15.125	0.550	18.327	16.639	90.79%	1.688

3.3 42 VIN

Vin (V)	Iin (A)	Vout - (V)	Iout 1 (A)	Vout + (V)	Iout 2 (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
42	0.004	15.345	0.000	15.343	0.000	0.176	0.000	0.00%	0.176
42	0.055	15.149	0.050	15.144	0.050	2.330	1.515	65.02%	0.815
42	0.095	15.154	0.099	15.150	0.099	3.486	3.000	75.20%	0.486
42	0.136	15.146	0.150	15.144	0.150	5.691	4.544	79.84%	1.147
42	0.175	15.144	0.200	15.139	0.200	7.354	6.057	82.36%	1.298
42	0.214	15.140	0.250	15.134	0.251	8.988	7.579	84.32%	1.409
42	0.252	15.136	0.299	15.132	0.300	10.583	9.065	85.65%	1.518
42	0.290	15.133	0.349	15.129	0.350	12.179	10.577	86.84%	1.603
42	0.330	15.132	0.399	15.126	0.400	13.859	12.088	87.22%	1.771
42	0.370	15.129	0.450	15.123	0.450	15.539	13.613	87.61%	1.925
42	0.410	15.128	0.499	15.123	0.500	17.219	15.110	87.76%	2.108
42	0.449	15.126	0.550	15.122	0.550	18.857	16.636	88.23%	2.220

4. Thermal

4.1 Steady State Temperature, 24Vin and dual 0.5A output.



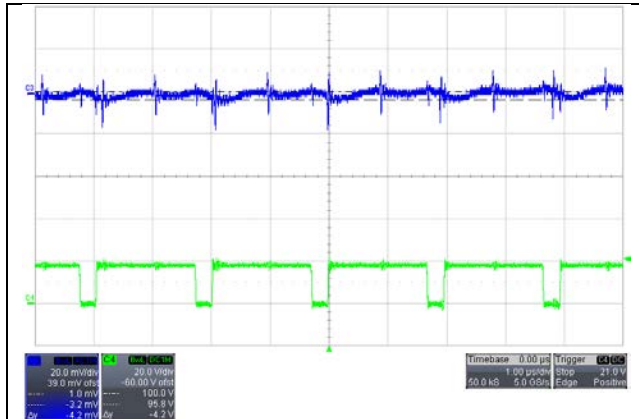
Top View

The U3 is the warmest component. The image displays a 26°C temperature rise.

5. Switching and Ripple

Both channels were loaded with 0.5A while these ripple measurements were taken.

5.1 18VIN +15Vout @ 0.5A Load

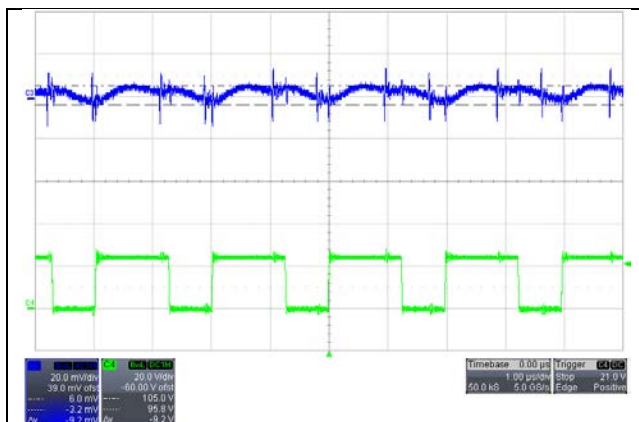


The cursors indicate less than 4mV ripple.

Channel 3 +15Vout_{ripple}

Channel 4 V_{SW}

5.2 24VIN +15Vout @ 0.5A Load

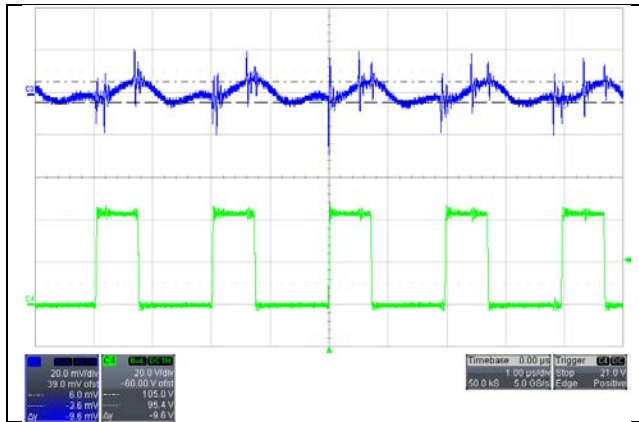


The cursors indicate less than 9mV ripple.

Channel 3 +15Vout_{ripple}

Channel 4 V_{SW}

5.3 42VIN +15Vout @ 0.5A Load

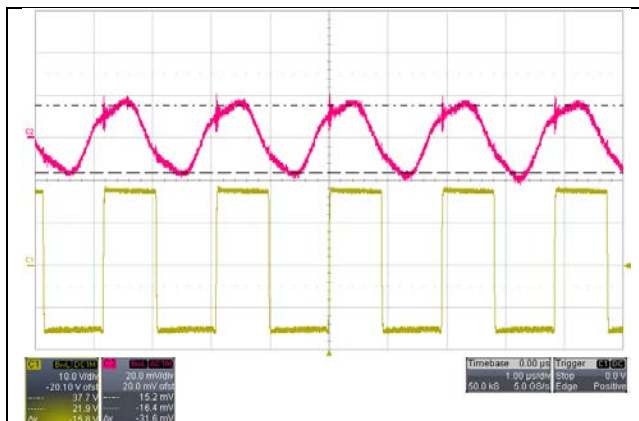


The cursors indicate less than 9mV ripple.

Channel 3 +15Vout_{ripple}

Channel 4 V_{SW}

5.4 18VIN -15Vout @ 0.5A Load

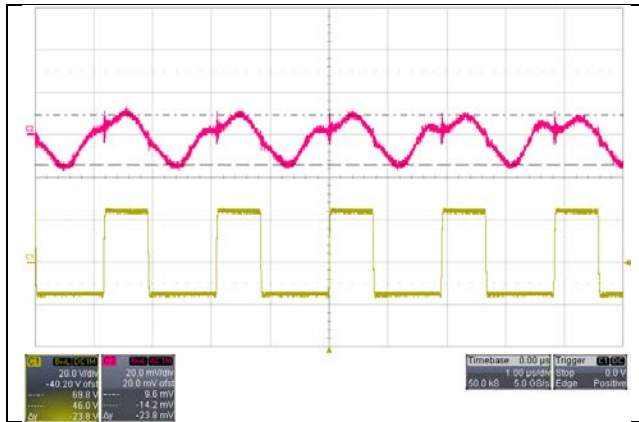


The cursors indicate less than 31mV ripple.

Channel 2 -15Vout_{ripple}

Channel 4 V_{SW}

5.5 24VIN -15Vout @ 0.5A Load

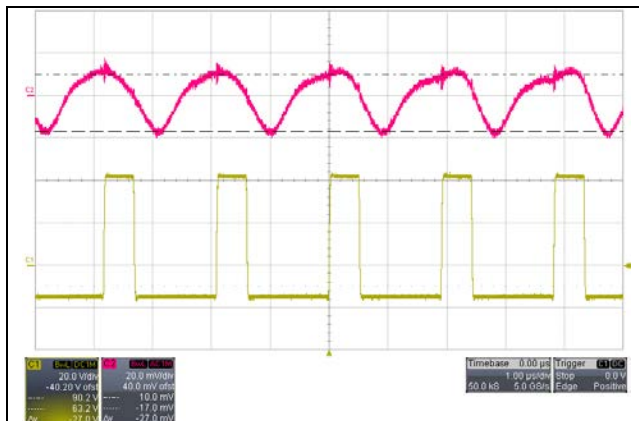


The cursors indicate less than 23mV ripple.

Channel 2 -15Vout_{ripple}

Channel 4 V_{sw}

5.6 42VIN -15Vout @ 0.5A Load



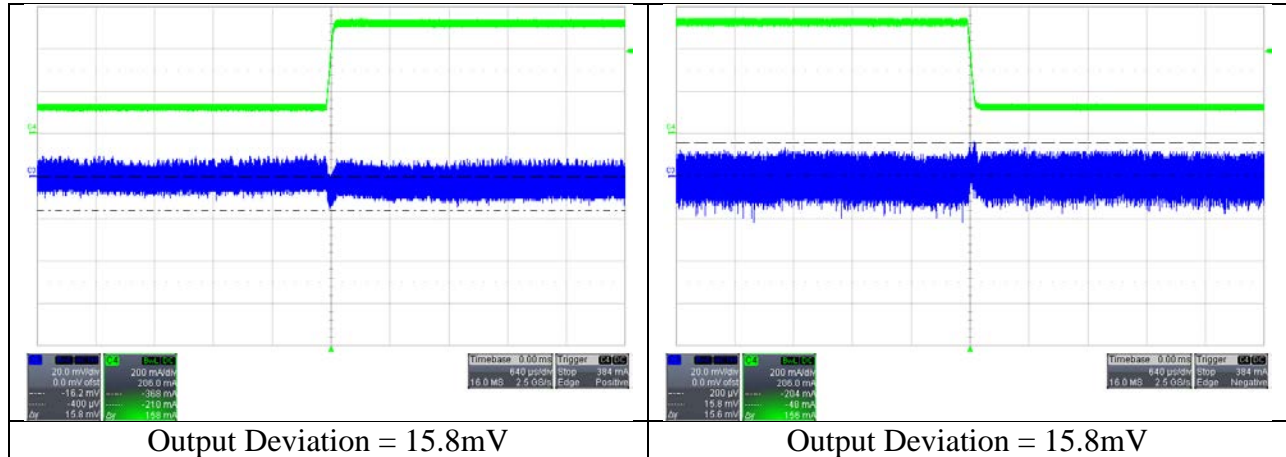
The cursors indicate less than 27mV ripple.

Channel 2 -15Vout_{ripple}

Channel 4 V_{sw}

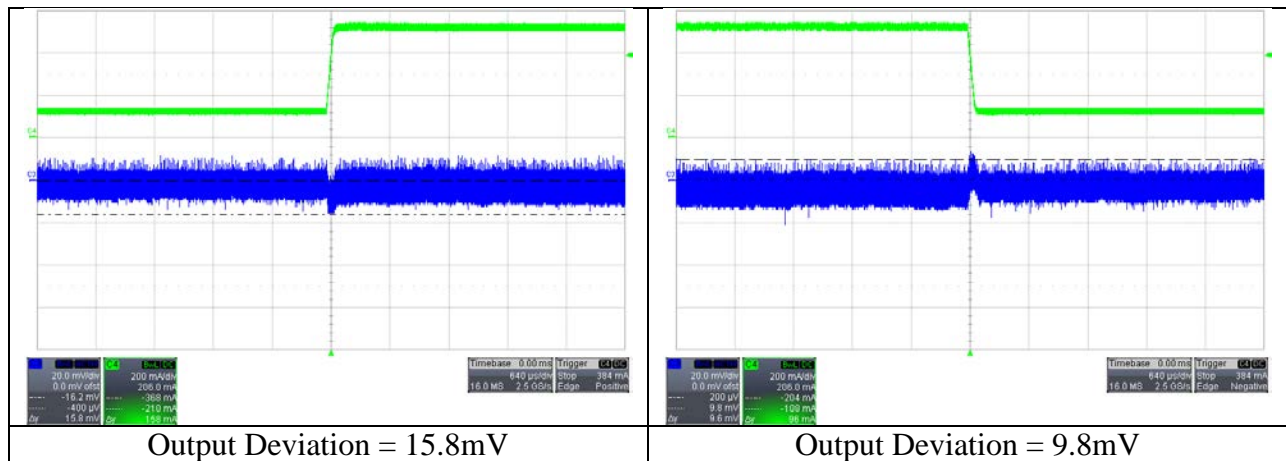
6. Transient Response

6.1 18V Input – 0.250 to 0.5A Step, 50mA/μs, 100 Hz. +15Vout



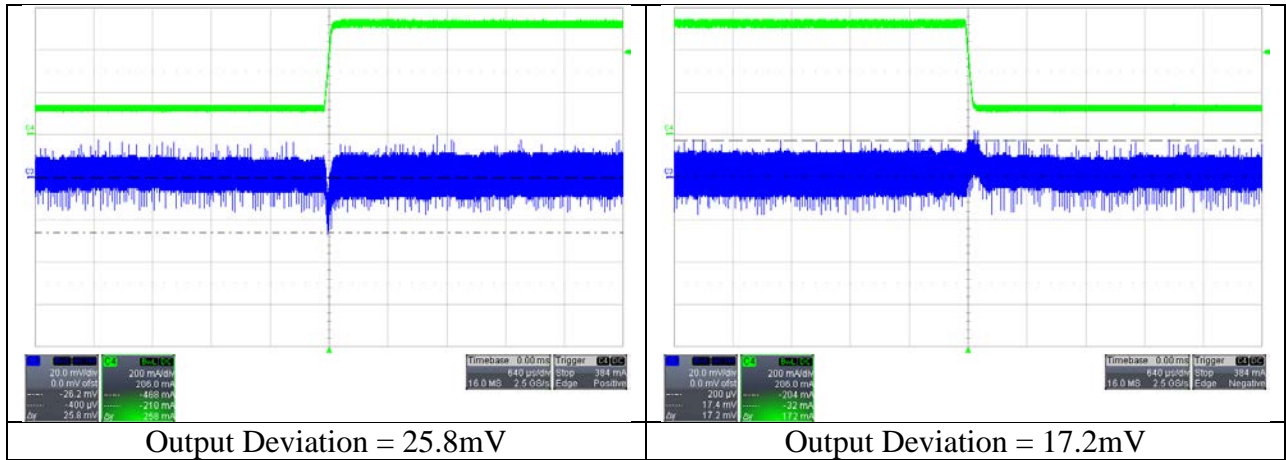
Channel 3 +15V
Channel 4 IOUT

6.2 24V Input – 0.250 to 0.5A Step, 50mA/μs, 100 Hz. +15Vout



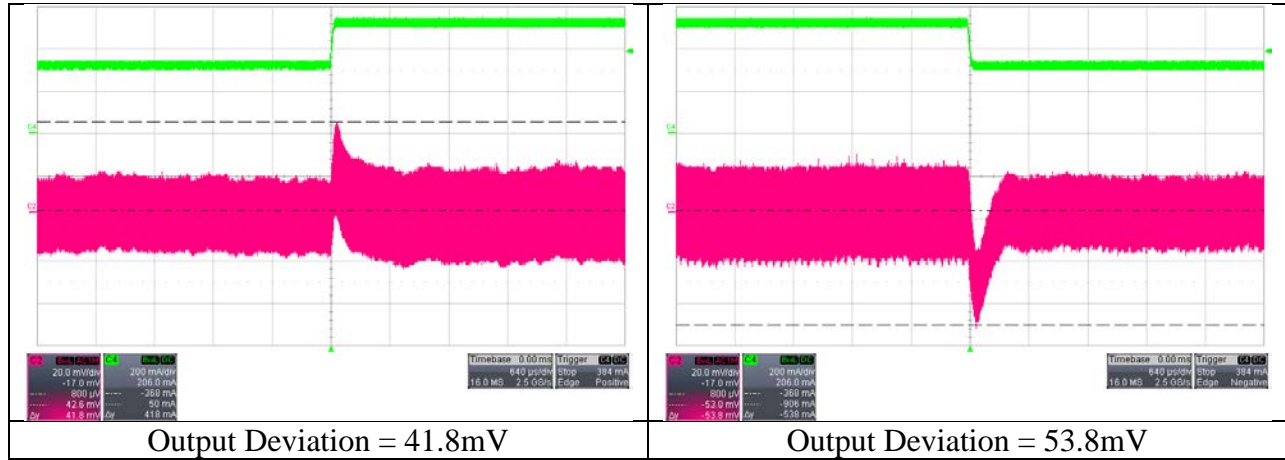
Channel 3 +15V
Channel 4 IOUT

6.3 42V Input – 0.250 to 0.5A Step, 50mA/μs, 100 Hz. +15Vout



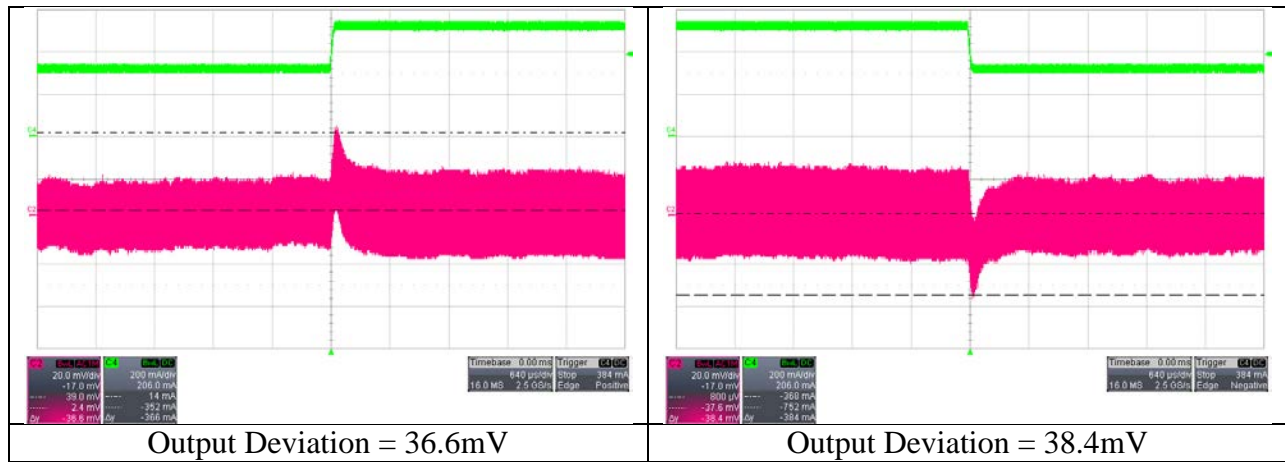
Channel 3 +15V
Channel 4 IOU

6.4 18V Input – 0.250 to 0.5A Step, 50mA/μs, 100 Hz. -15Vout



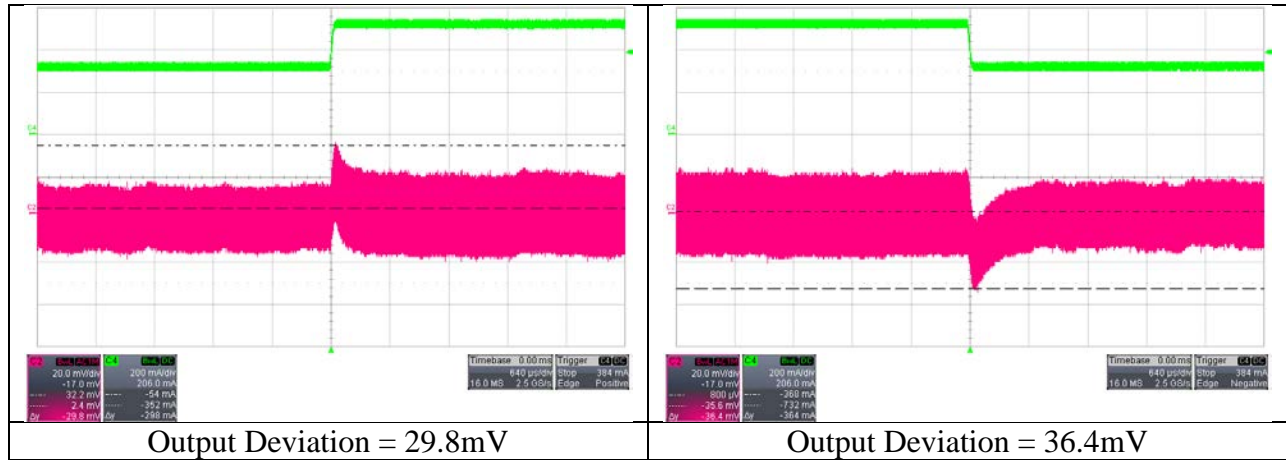
Channel 3 -15V
Channel 4 IOUT

6.5 24V Input – 0.250 to 0.5A Step, 50mA/μs, 100 Hz. -15Vout



Channel 3 -15V
Channel 4 IOUT

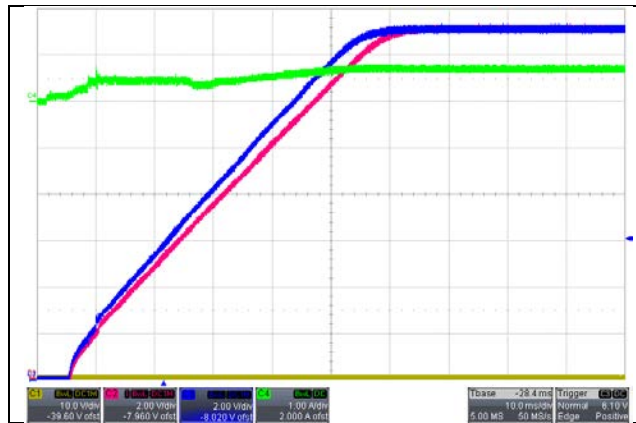
6.6 42V Input – 0.250 to 0.5A Step, 50mA/μs, 100 Hz. -15Vout



Channel 3 -15V
Channel 4 IOU

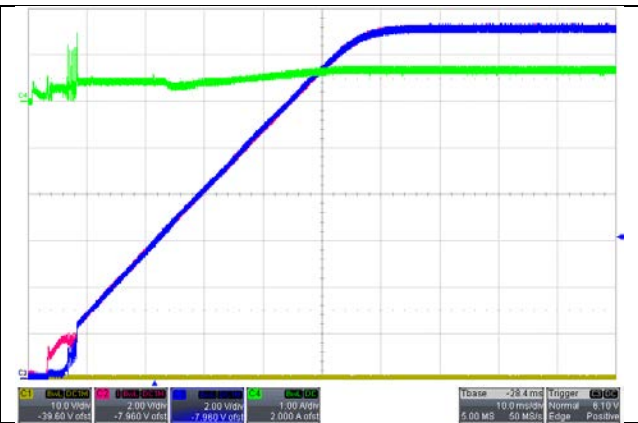
7. Tracking

7.1 Without Tracking Circuit



Channel 2 15.1VOUT (Blue)
Channel 3 15.15VOUT (Red)
Channel 4 IIN

With Tracking Circuit



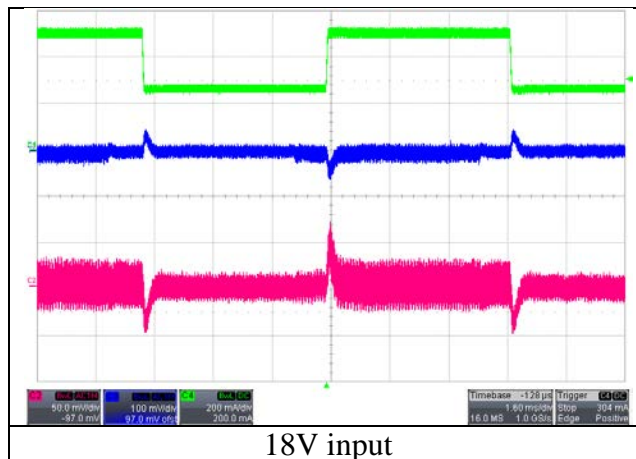
Channel 2 15.1Vout (Blue)
Channel 3 15.1Vout (Red)
Channel 4 IIN

Channel 3(RED) is inverted to better highlight tracking circuit.

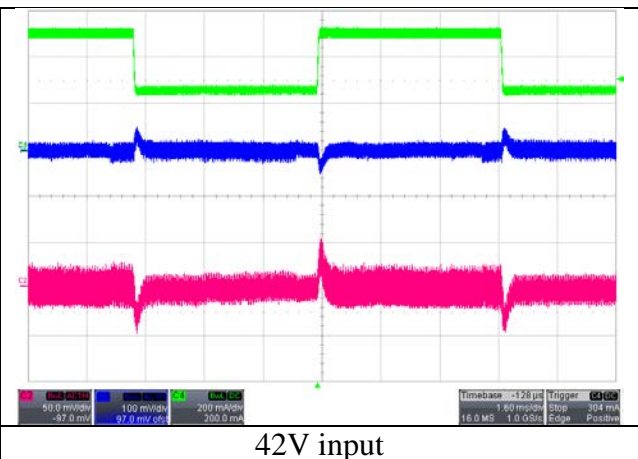
7.2 18V input

42Vinput

A load step was applied and both loop responses were observed, as one can see, one channel compensates for the other during the step on and off, indicative of tracking.



18V input

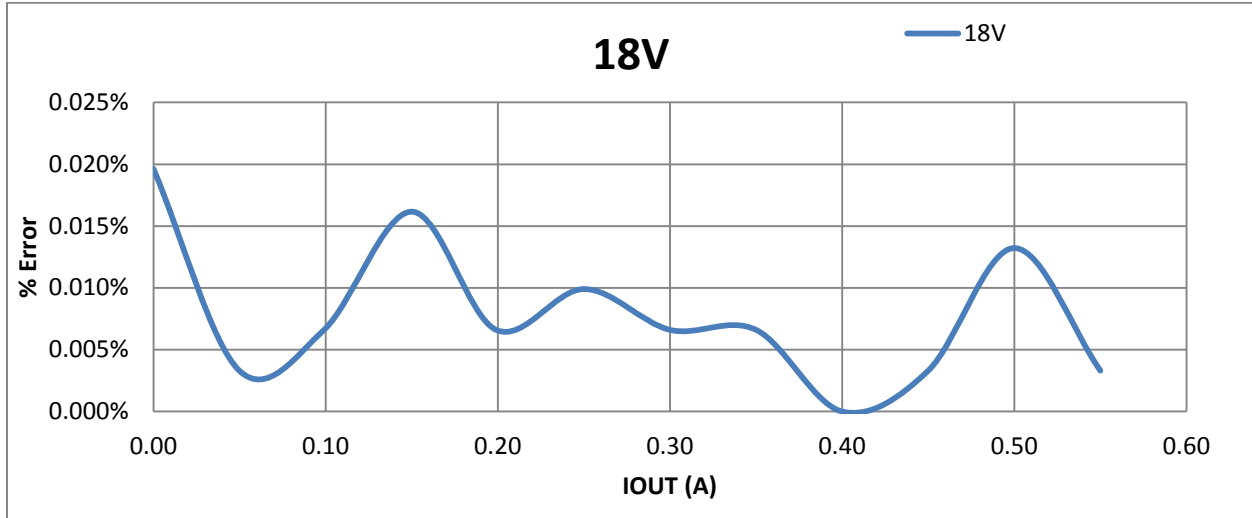


42V input

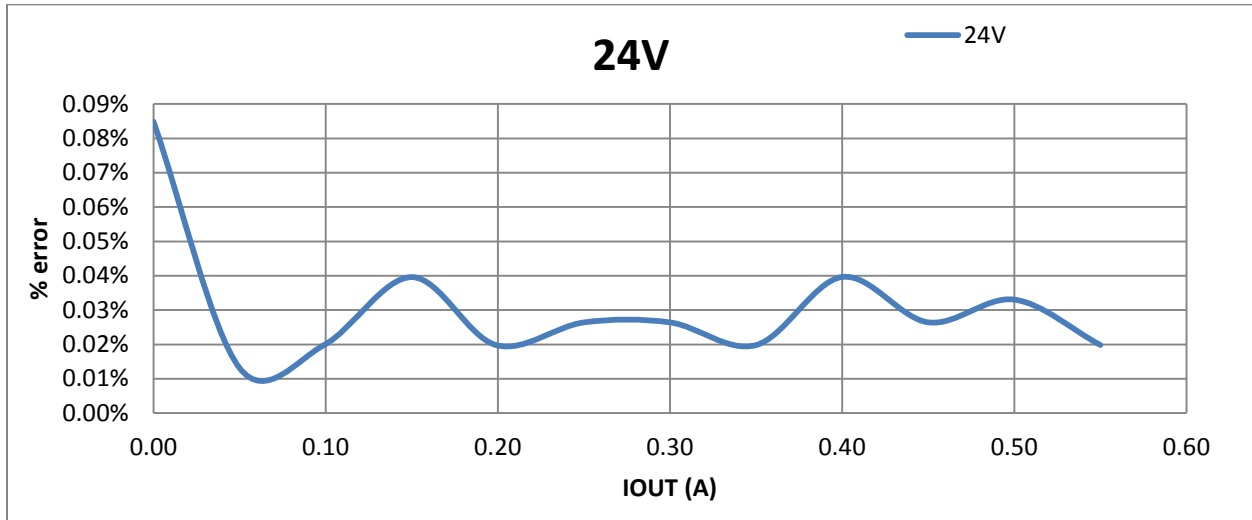
Channel 2 +15.1VOUT (Blue)
Channel 3 -15.1VOUT (Red)
Channel 4 IOUT

7.3 Load Regulation Tracking

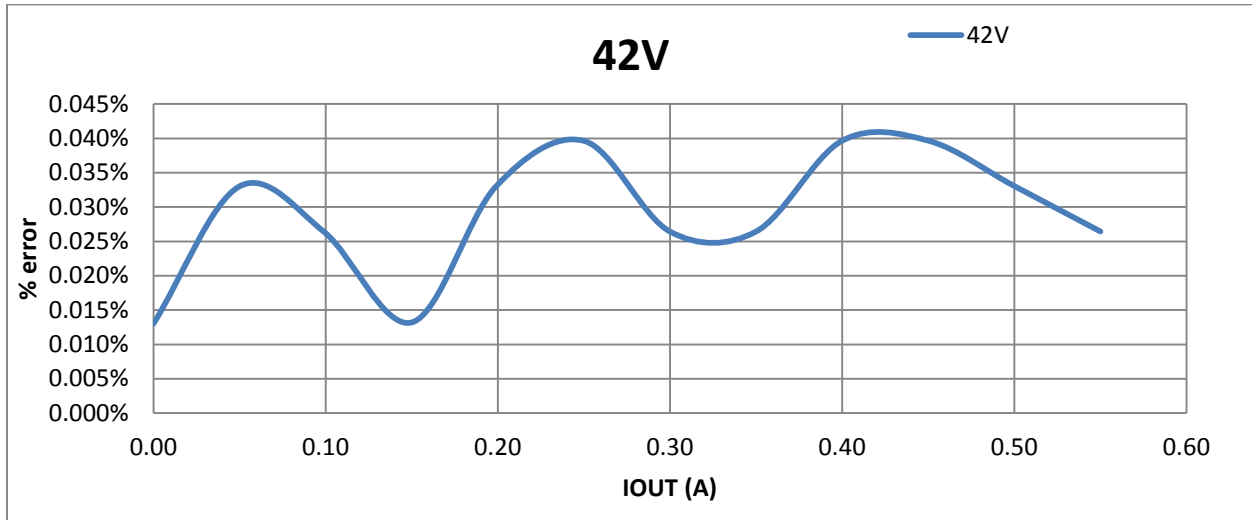
These graphs display the percent error between channels from no load to full load.



Measure	VIN	IIN	-15V	IOU2 1	+15V	IOU2 2
1	18	0.0112	15.278	0.000	15.284	0.000
2	18	0.105	15.157	0.050	15.156	0.050
3	18	0.202	15.153	0.100	15.151	0.099
4	18	0.291	15.150	0.150	15.155	0.150
5	18	0.38	15.147	0.200	15.145	0.199
6	18	0.47	15.146	0.252	15.143	0.250
7	18	0.558	15.141	0.300	15.143	0.300
8	18	0.6491	15.138	0.350	15.136	0.350
9	18	0.742	15.135	0.403	15.135	0.400
10	18	0.83	15.133	0.450	15.132	0.450
11	18	0.9221	15.132	0.499	15.128	0.500
12	18	1.0146	15.130	0.550	15.129	0.550



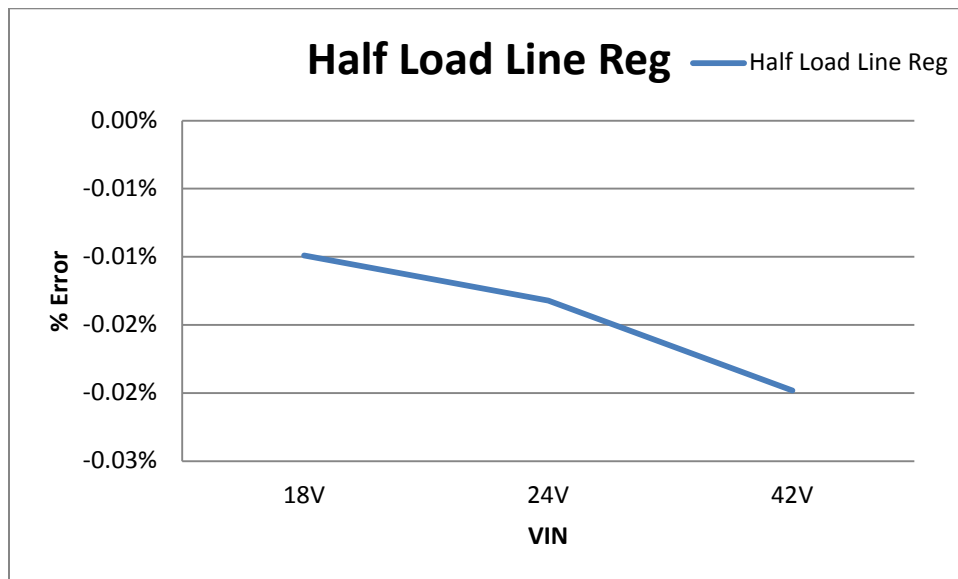
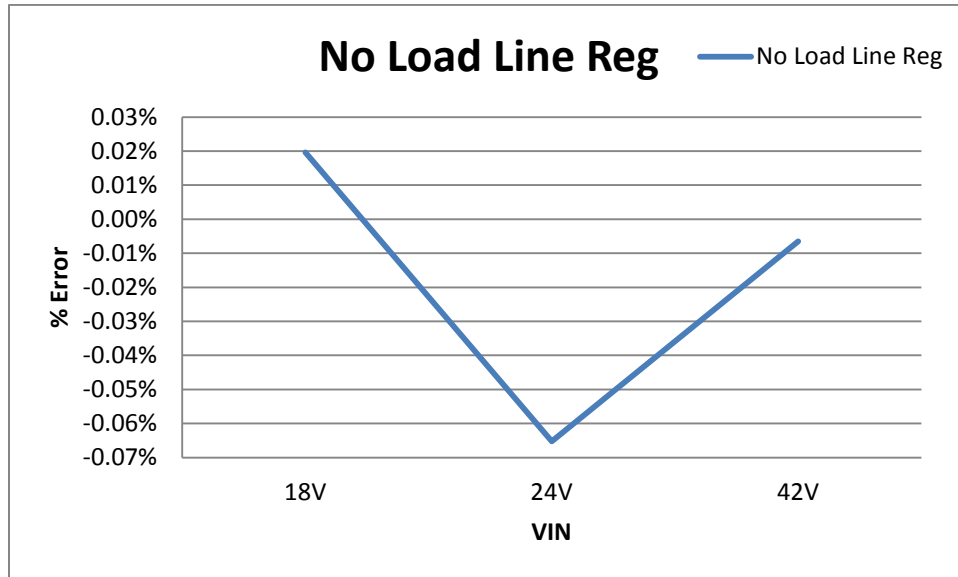
Measure	VIN	IIN	-15V	IOU T 1	+15V	IOU T 2
1	23.996	0.011	15.325	0.000	15.312	0.000
2	23.995	0.0784	15.159	0.050	15.157	0.050
3	23.996	0.157	15.153	0.100	15.150	0.100
4	23.996	0.2231	15.153	0.150	15.147	0.150
5	23.996	0.2898	15.148	0.200	15.145	0.200
6	23.996	0.3566	15.145	0.249	15.141	0.251
7	23.996	0.4236	15.144	0.299	15.140	0.300
8	23.996	0.4919	15.138	0.350	15.141	0.350
9	23.995	0.558	15.138	0.399	15.132	0.400
10	23.995	0.626	15.134	0.450	15.130	0.450
11	23.995	0.695	15.132	0.499	15.127	0.502
12	23.995	0.7638	15.128	0.550	15.125	0.550

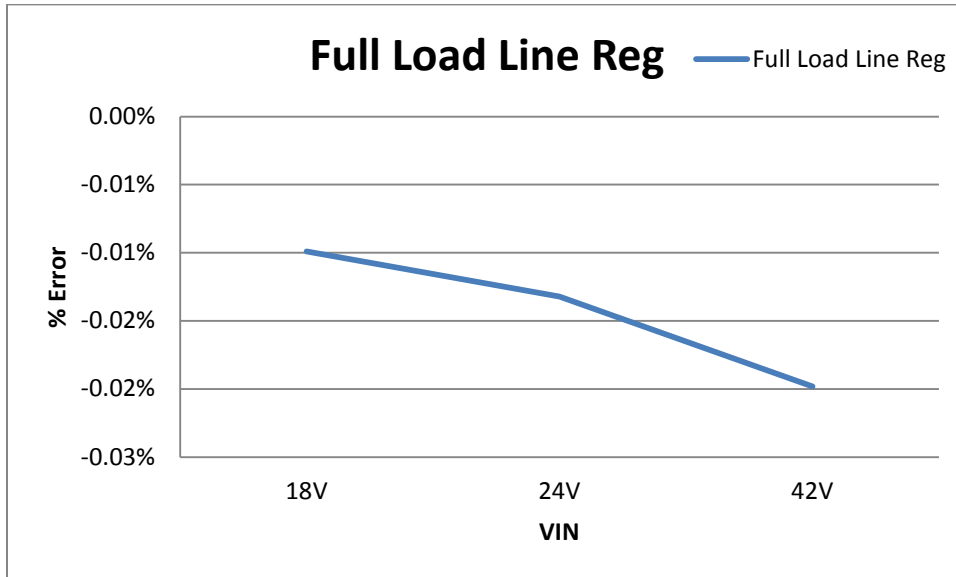


Measure	VIN	IIN	-15V	IOU 1	+15V	IOU 2
1	42	0.0042	15.345	0.000	15.343	0.000
2	41.998	0.0555	15.149	0.050	15.144	0.050
3	41.997	0.095	15.154	0.099	15.150	0.099
4	41.998	0.1355	15.146	0.150	15.144	0.150
5	41.998	0.1751	15.144	0.200	15.139	0.200
6	41.998	0.214	15.140	0.249	15.134	0.251
7	41.998	0.252	15.136	0.299	15.132	0.300
8	41.997	0.29	15.133	0.349	15.129	0.350
9	41.997	0.33	15.132	0.399	15.126	0.400
10	41.997	0.37	15.129	0.450	15.123	0.450
11	41.997	0.41	15.128	0.499	15.123	0.500
12	41.997	0.449	15.126	0.550	15.122	0.550

7.4 Line Regulation Tracking

This graph displays the percent error between channels over a range of voltages in.

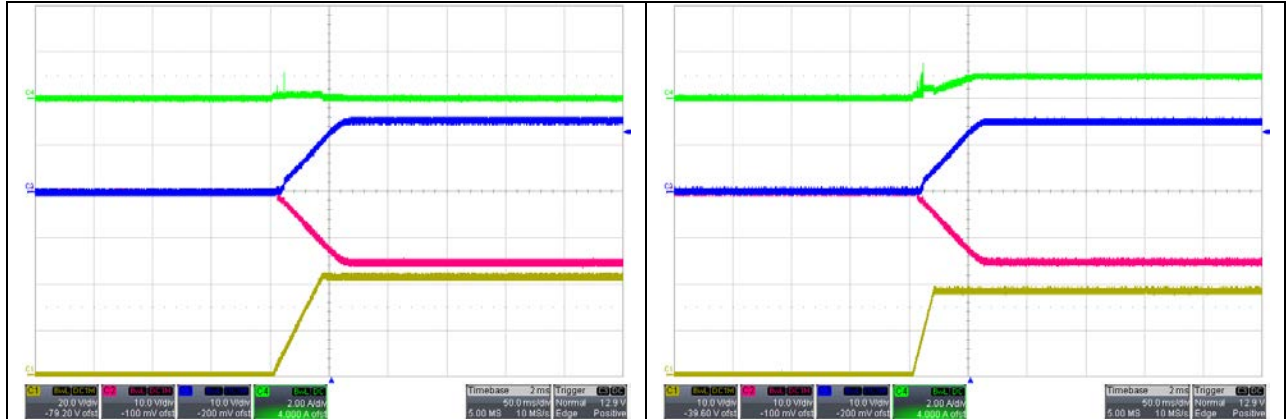




8. Power Up

8.1 Power Up at 18V Input – No Load

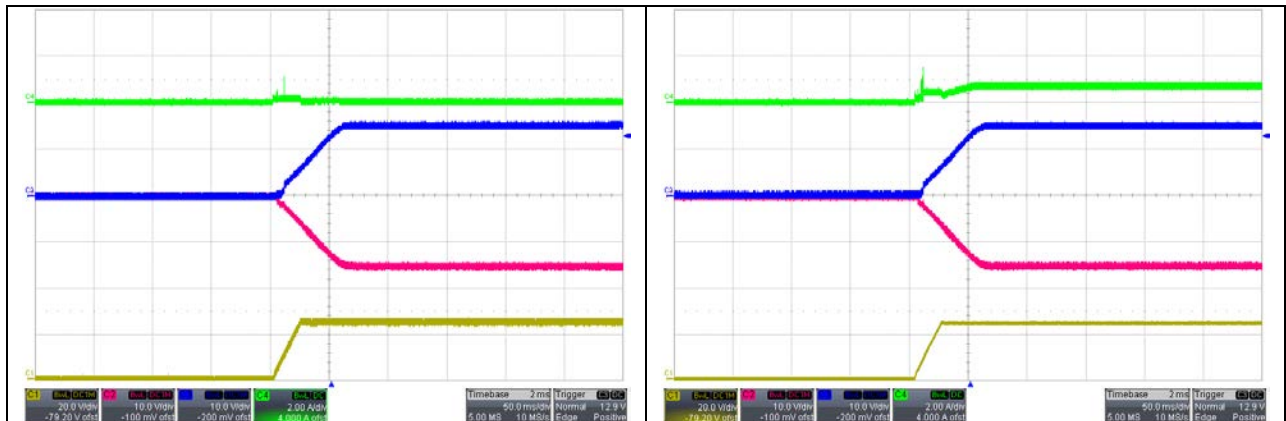
18V Input –Dual 0.5A Load



Channel 1 VIN
Channel 2 -15Vout
Channel 3 +15Vout
Channel 4 IIN

8.2 Power Up at 24V Input – No Load

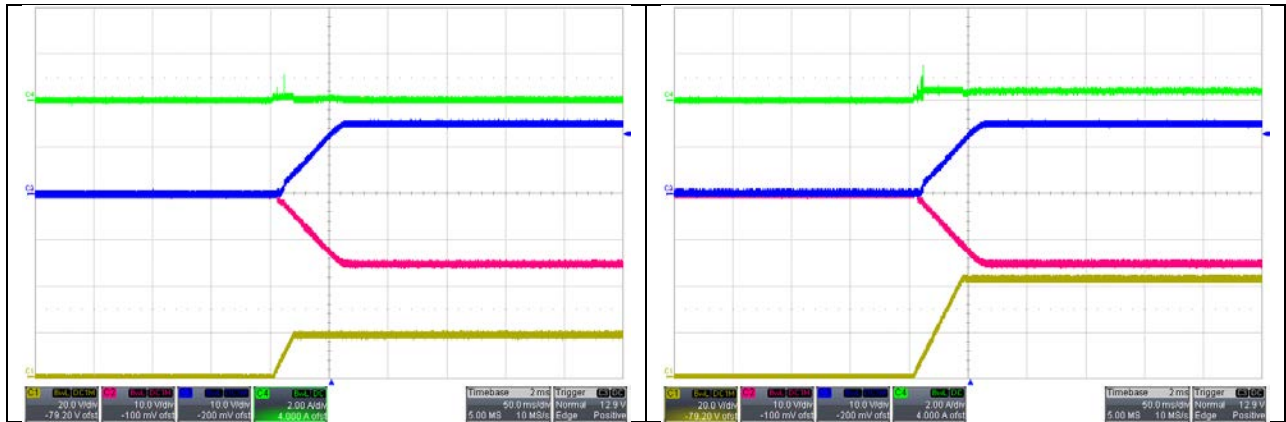
24V Input –Dual 0.5A Load



Channel 1 VIN
Channel 2 -15Vout
Channel 3 +15Vout
Channel 4 IIN

8.3 Power Up at 42V Input – No Load

42V Input –Dual 0.5A Load

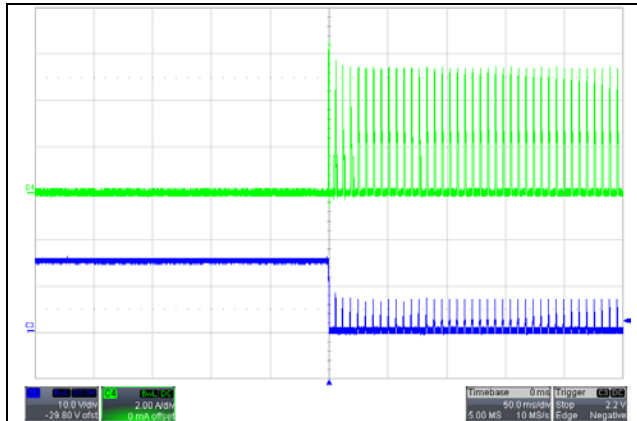


Channel 1 VIN
Channel 2 -15Vout
Channel 3 +15Vout
Channel 4 IIN

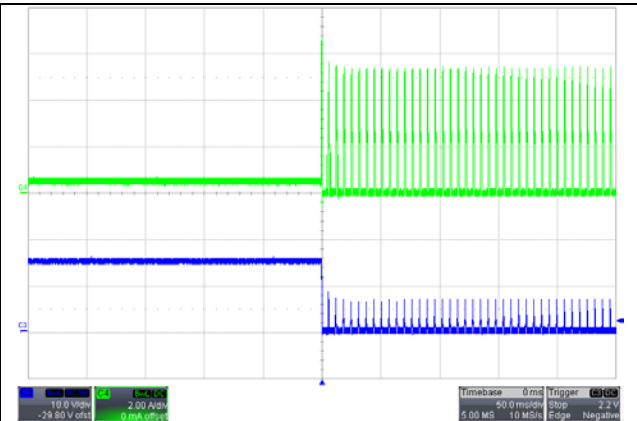
9 Short Circuit Tests

A short circuit was applied to each of the outputs using an electronic load.

9.1 18Vin No Load

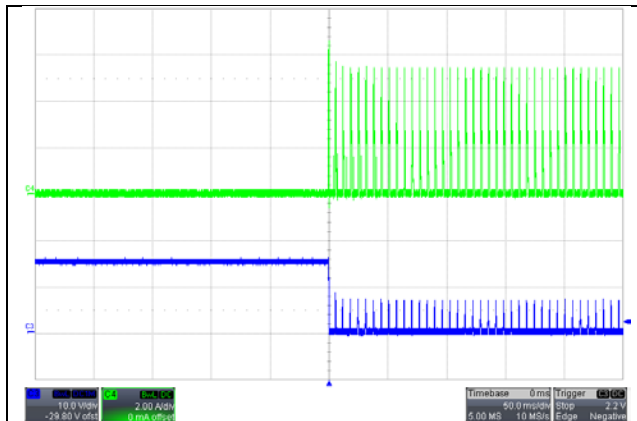


18Vin 0.5A Load

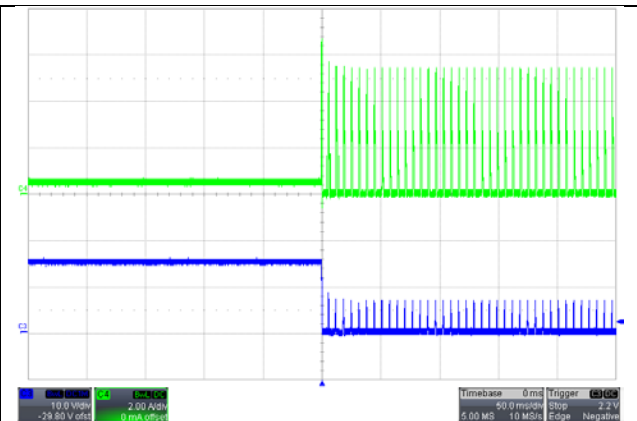


Channel 3 +15Vout
Channel 4 IOU

9.2 24Vin No Load

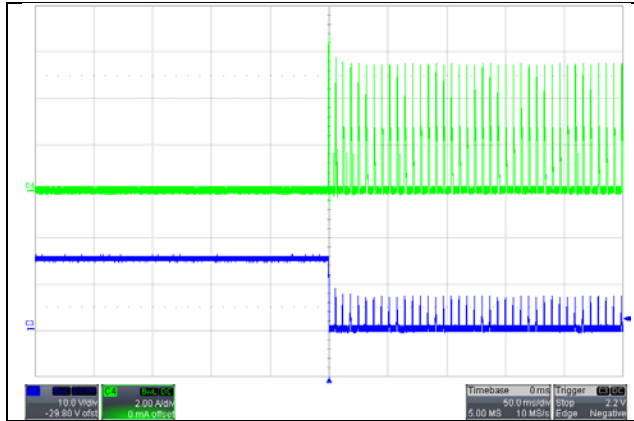


24Vin 0.5A Load

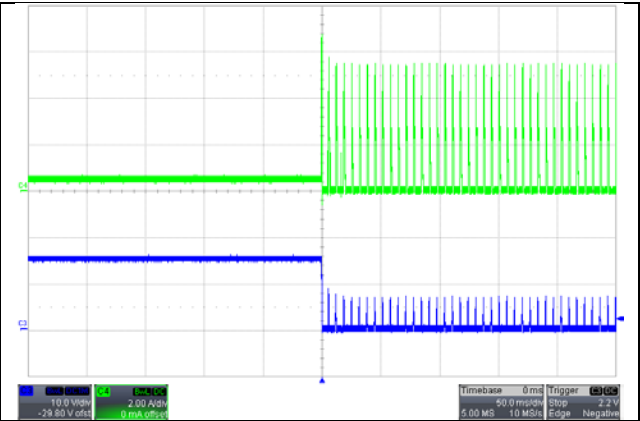


Channel 3 +15Vout
Channel 4 IOU

9.3 42Vin No Load

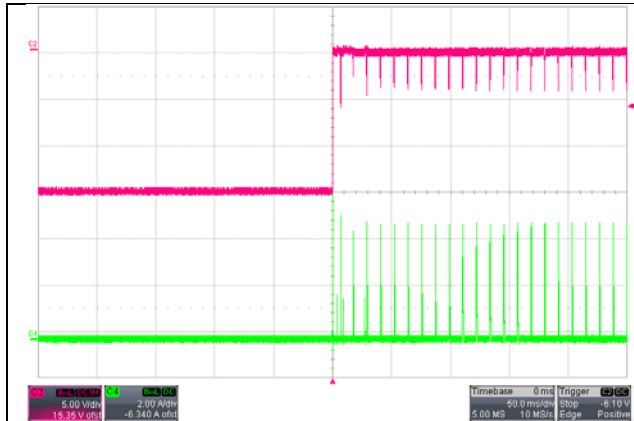


42Vin 0.5A Load

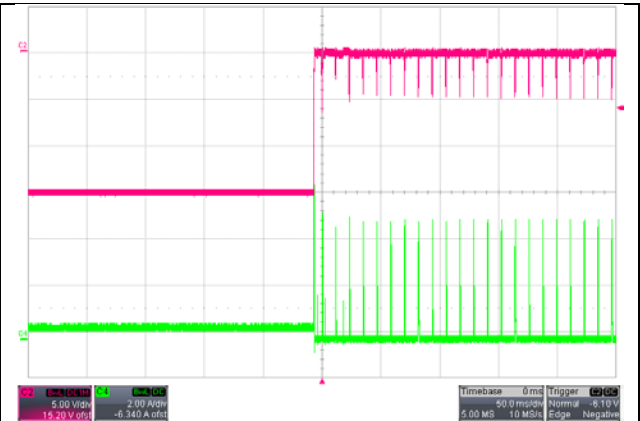


Channel 3 +15Vout
Channel 4 IOU

9.4 18Vin No Load

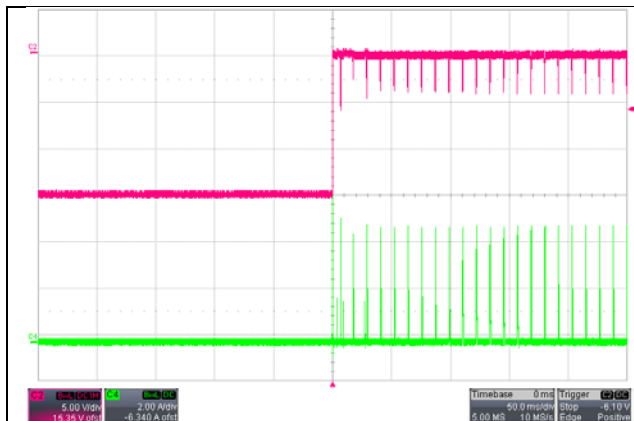


18Vin 0.5A Load

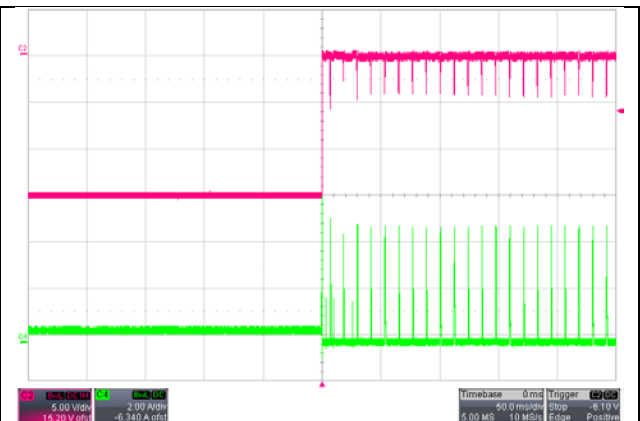


Channel 3 -15Vout
Channel 4 IOU

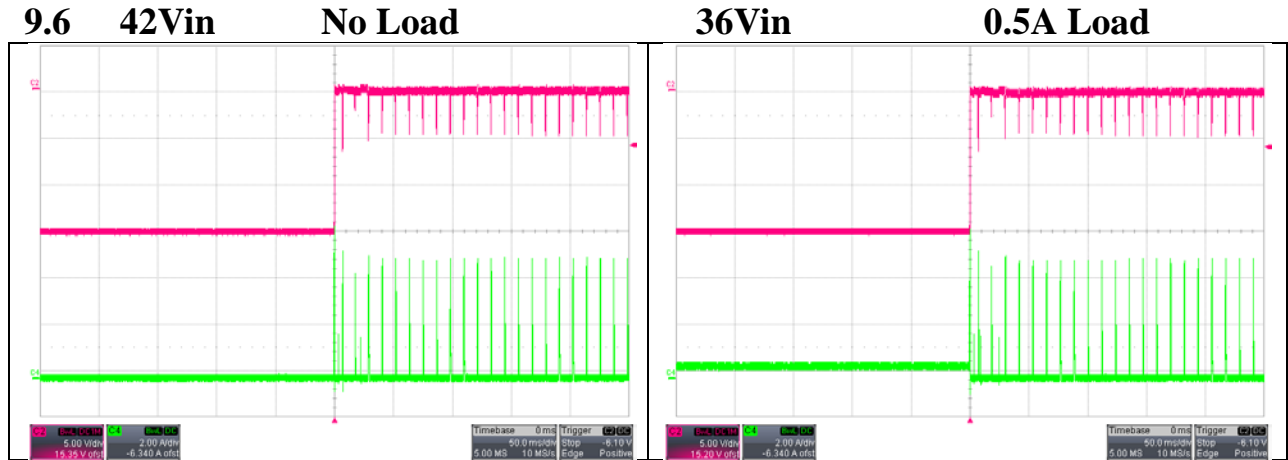
9.5 24Vin No Load



24Vin 0.5A Load



Channel 3 -15Vout
Channel 4 IOU

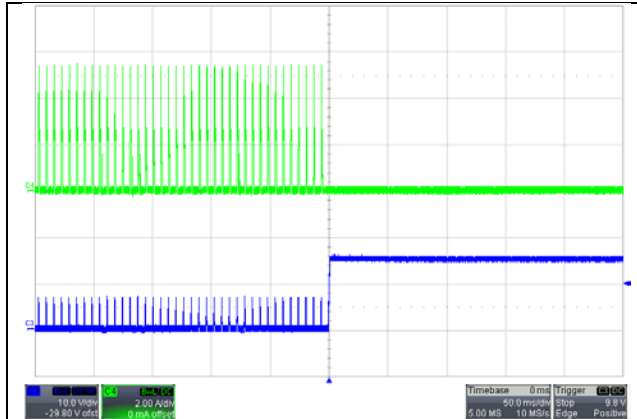


Channel 3 -15Vout
Channel 4 IOU

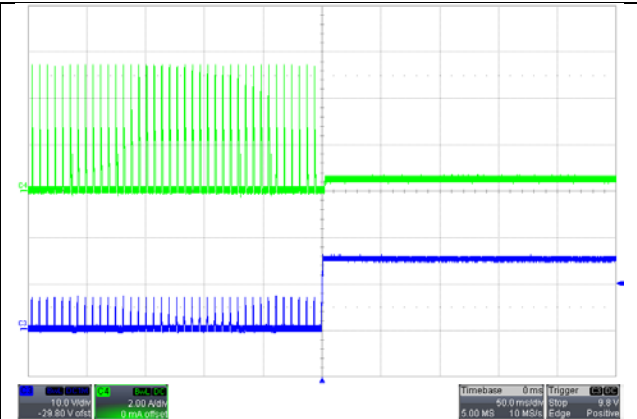
10. Short Circuit Recovery Tests

A short circuit was applied to each of the outputs using an electronic load and then allowed to restart.

10.1 18Vin +15Vout No Load



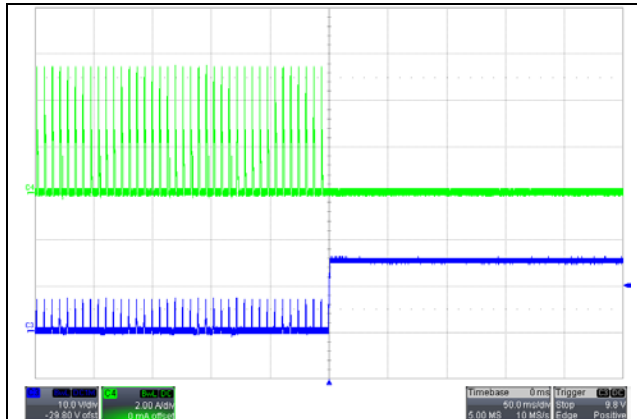
18Vin +15Vout



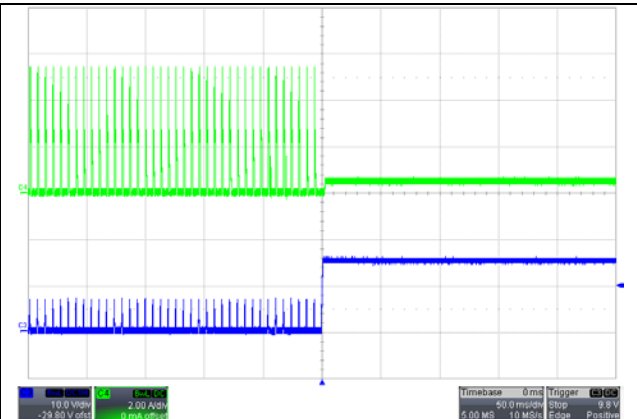
0.5A Load

Channel 3 +15Vout
Channel 4 IOU

10.2 24Vin +15Vout No Load



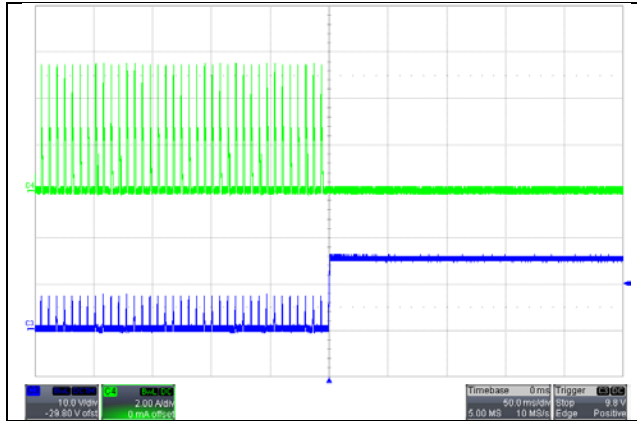
24Vin +15Vout



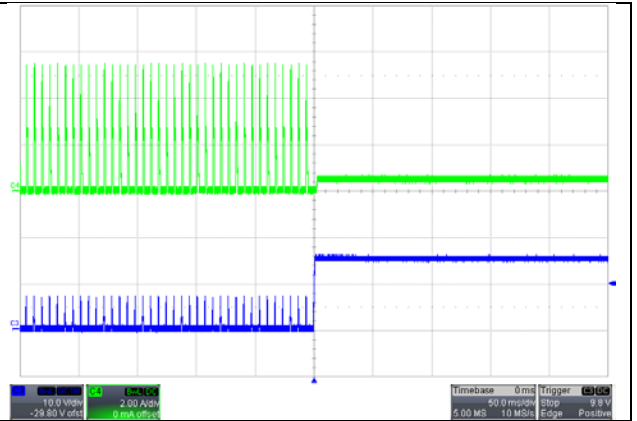
0.5A Load

Channel 3 +15Vout
Channel 4 IOU

10.3 42Vin +15Vout No Load



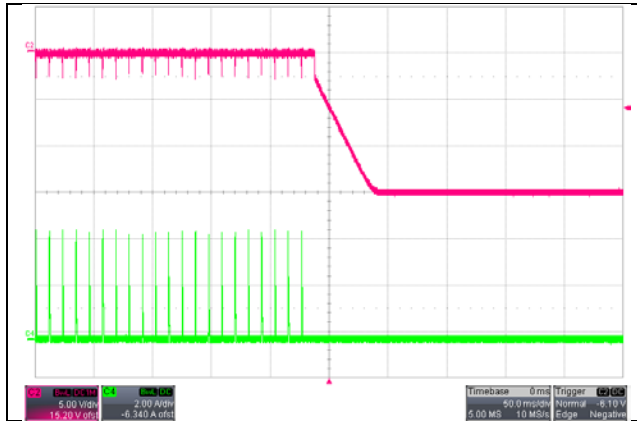
36Vin +15Vout



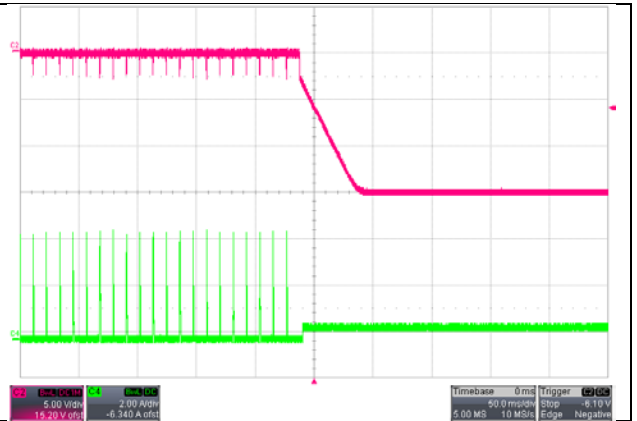
0.5A Load

Channel 3 +15Vout
Channel 4 IOU

10.4 18Vin -15Vout No Load



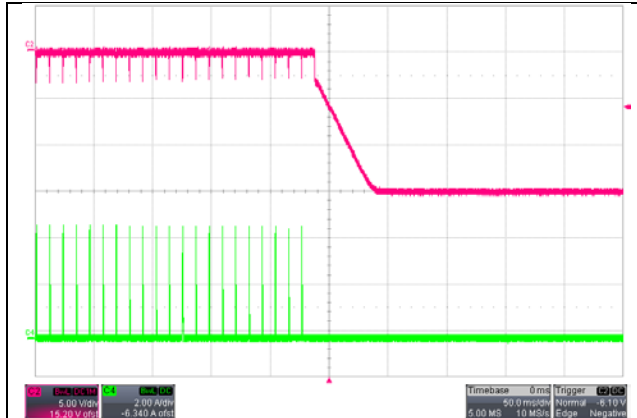
18Vin -15Vout



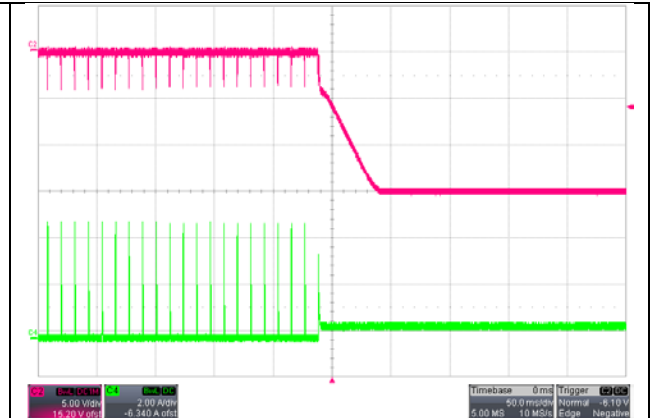
0.5A Load

Channel 3 -15Vout
Channel 4 IOU

10.5 24Vin -15Vout No Load

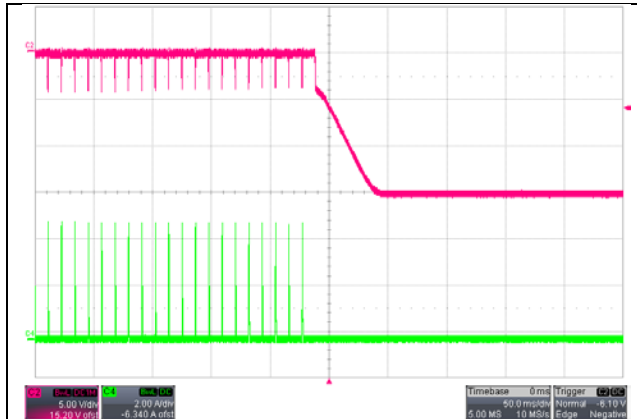


24Vin -15Vout 0.5A Load

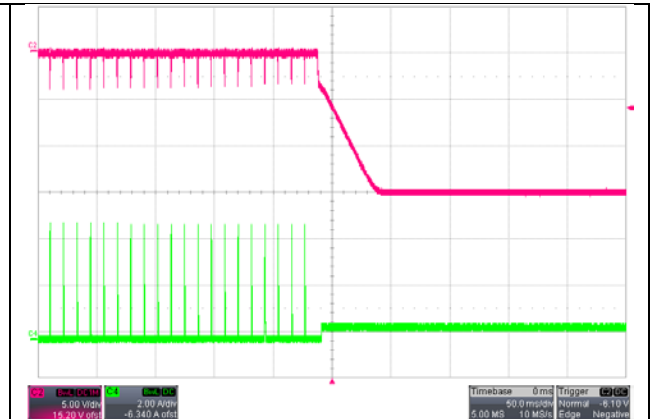


Channel 3 -15Vout
Channel 4 IOU

10.6 42Vin -15Vout No Load



36Vin -15Vout 0.5A Load



Channel 3 -15Vout
Channel 4 IOU

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