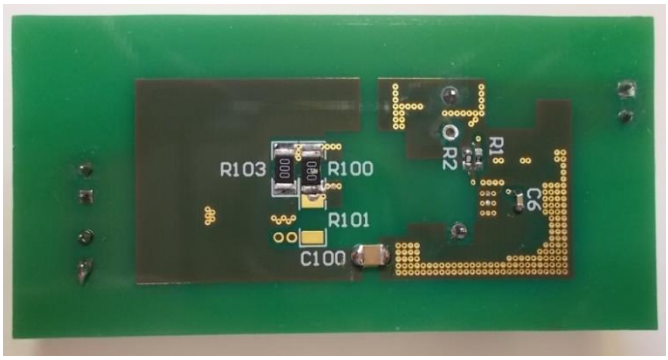
Test Report: PMP30629

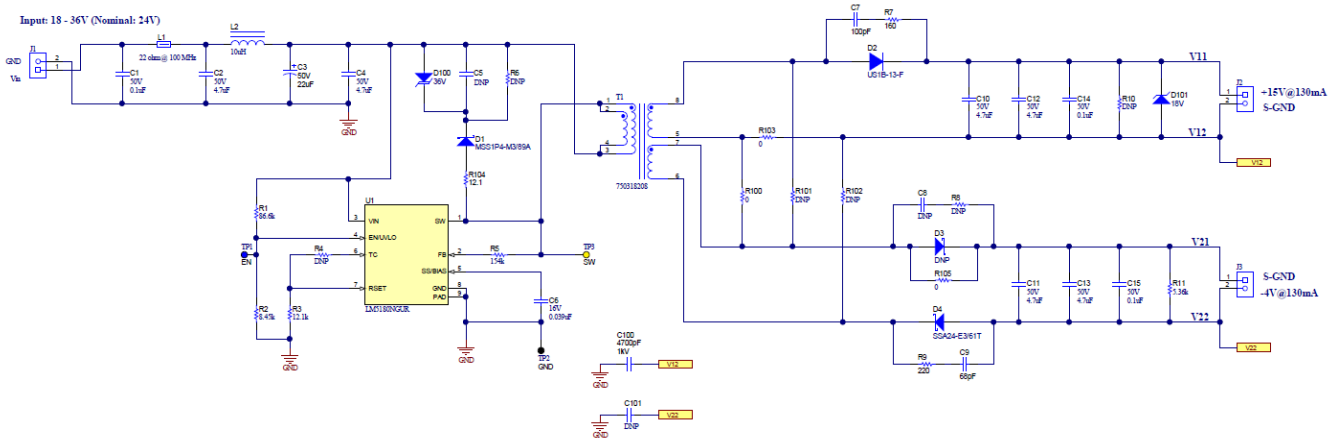
Isolated 2.5-W SiC & IGBT Gate-Drive Reference Design With Integrated Switch PSR Flyback Converter

Description

This reference design provides two isolated voltages from a 24-V DC input supply. By means of zero Ohm resistors, it is possible to configure the two independent outputs as +15-V and +4-V, or +15-V and -4-V with common ground with a total power of 2.5 W. The integration of a 100-V rated primary-side switch, together with the elimination of an auxiliary winding in the transformer, enables a compact solution.

The PMP30629 Rev_B Reference Design has been built on PMP30629 Rev_A PCB.





1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input Voltage Range	18V – 36V (DC)
Output #1, Voltage	15 V, -2%.... +10%
Output #1, Current	130 mA
Output #2, Voltage	-4 V, +9%…. +20%
Output #2, Current	130 mA

1.2 Required Equipment

- 0…40 V, (min. 300 mA), constant voltage source (VS1)
- 0…20 V, (0…200 mA), electronic load #1
- 0…20 V, (0…200 mA), electronic load #2, with separate ground from load #1
- Oscilloscope (min. 100 MHz bandwidth)

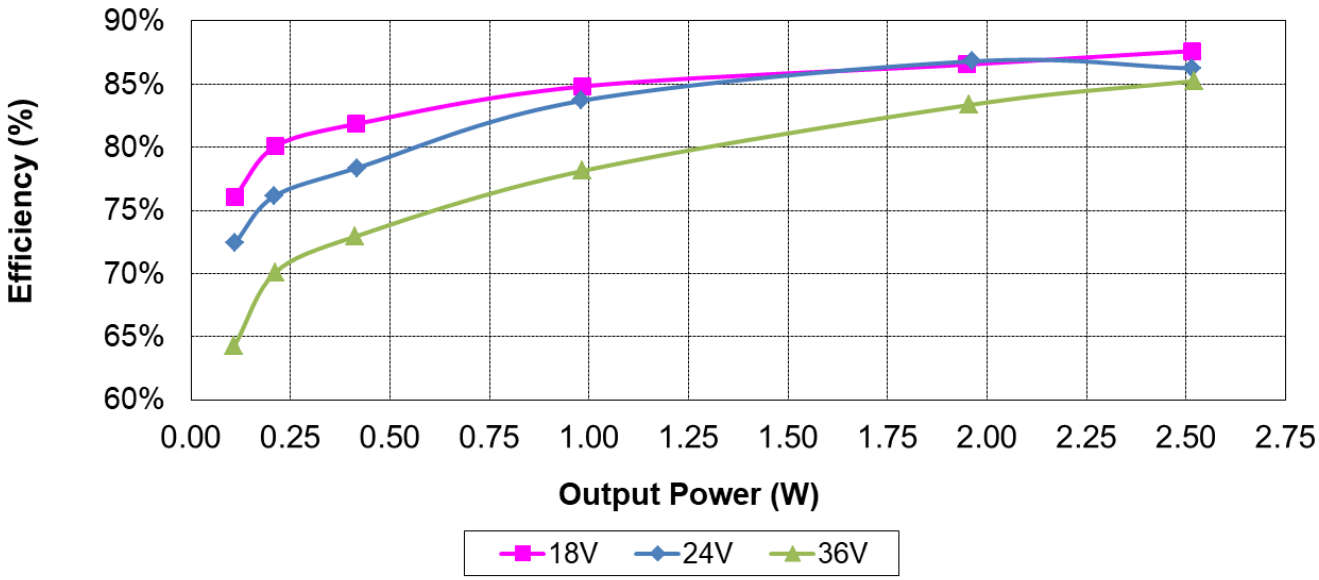
1.3 Considerations

a) Connect the source VS1 to pin 1 & 2 of J1.
b) Connect the load #1 to J2 (pin 1 & 2) with its negative terminal to pin 2, set to CR mode.
c) Connect the load #2 to J3 (pin 1 & 2) with its negative terminal to pin 2, set to CR mode.
d) Connect an oscilloscope probe to TP3 versus primary ground.
e) Connect two oscilloscope probes to the anode of D2 and the cathode of D4, referred to secondary side ground (potentials “V12” or “V21”).

2 Testing and Results

2.1 *Efficiency Graphs:*

The efficiency graphs, versus output currents, are shown below. The load current on each output has been increases by the same value. The voltage of power source has been set to 18 V, 24 V and 36 V.



2.2 *Efficiency Data:*

The efficiency graph reports the data from the tables shown below:

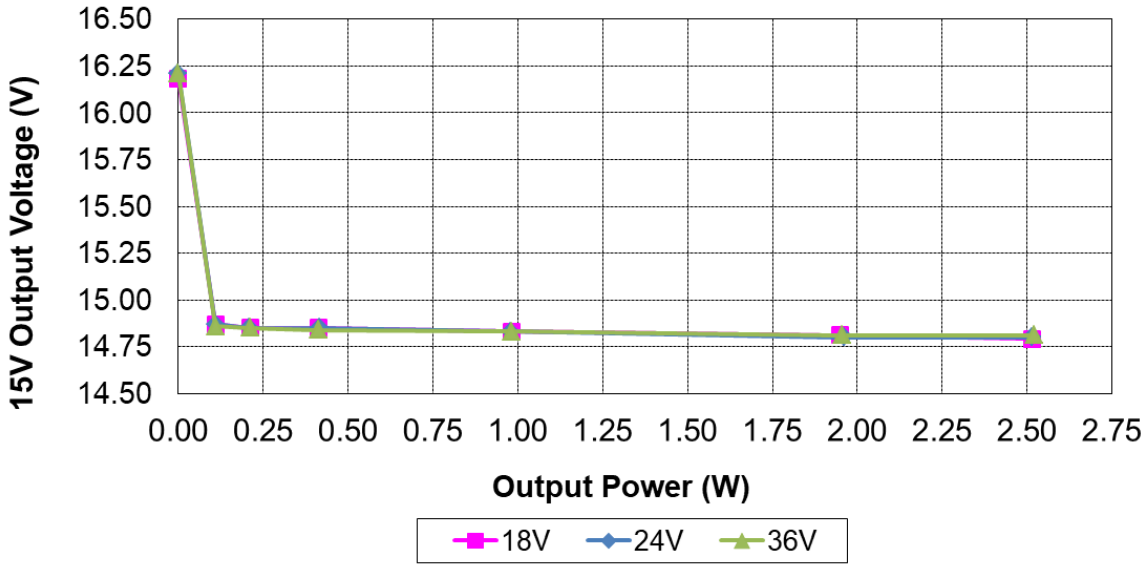
Vin(V)	Iin(mA)	Pin (W)	V15 (V)	I15 (mA)	V4 (V)	I4 (mA)	Pout (W)	η (%)
18.05	1.8	0.032	16.18	0	4.800	0	0	0%
18.03	8.0	0.144	14.87	5.7	4.381	5.7	0.110	76.08%
18.04	14.6	0.263	14.85	11.1	4.385	10.5	0.211	80.06%
18.06	28.0	0.506	14.85	21.9	4.388	20.2	0.414	81.84%
18.05	64.2	1.159	14.83	51.3	4.379	50.7	0.983	84.81%
18.03	124.9	2.252	14.81	102.1	4.370	100.0	1.949	86.55%
18.02	159.2	2.869	14.79	131.4	4.363	130.7	2.514	87.62%

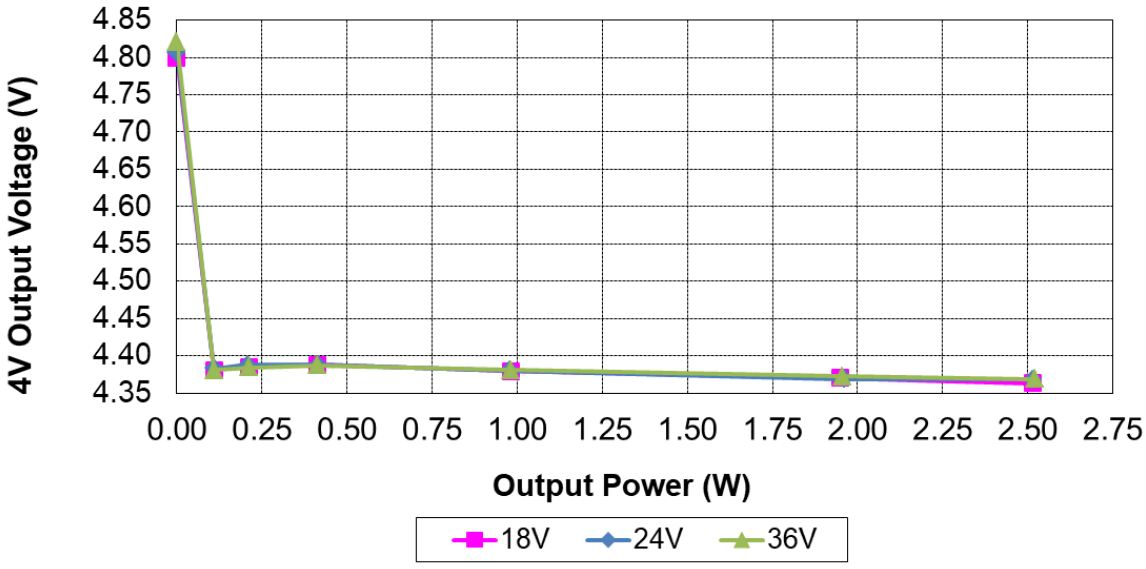
Vin(V)	Iin(mA)	Pin (W)	V15 (V)	I15 (mA)	V4 (V)	I4 (mA)	Pout (W)	η (%)
24.07	1.5	0.036	16.21	0	4.807	0	0	0%
24.06	6.3	0.152	14.87	5.7	4.383	5.7	0.110	72.40%
24.05	11.4	0.274	14.85	11.1	4.388	10.0	0.209	76.13%
24.04	22.1	0.531	14.85	21.8	4.388	21.1	0.416	78.36%
24.04	48.7	1.171	14.83	51.2	4.380	50.3	0.980	83.67%
24.02	94.1	2.260	14.80	102.1	4.369	103.2	1.962	86.80%
24.01	121.4	2.915	14.80	131.4	4.368	130.3	2.514	86.24%

Vin(V)	Iin(mA)	Pin (W)	V15 (V)	I15 (mA)	V4 (V)	I4 (mA)	Pout (W)	η (%)
36.02	1.4	0.050	16.21	0	4.820	0	0	0%
36.02	4.7	0.169	14.86	5.7	4.381	5.5	0.109	64.27%
36.03	8.4	0.303	14.85	11.1	4.384	10.8	0.212	70.11%
36.03	15.7	0.566	14.84	21.8	4.387	20.3	0.413	72.93%
36.03	34.9	1.257	14.83	51.2	4.381	50.9	0.982	78.12%
36.02	65.1	2.345	14.81	102.0	4.372	101.5	1.954	83.35%
36.02	82.1	2.957	14.81	131.4	4.369	131.6	2.521	85.25%

2.3 *Output Voltage Regulation*

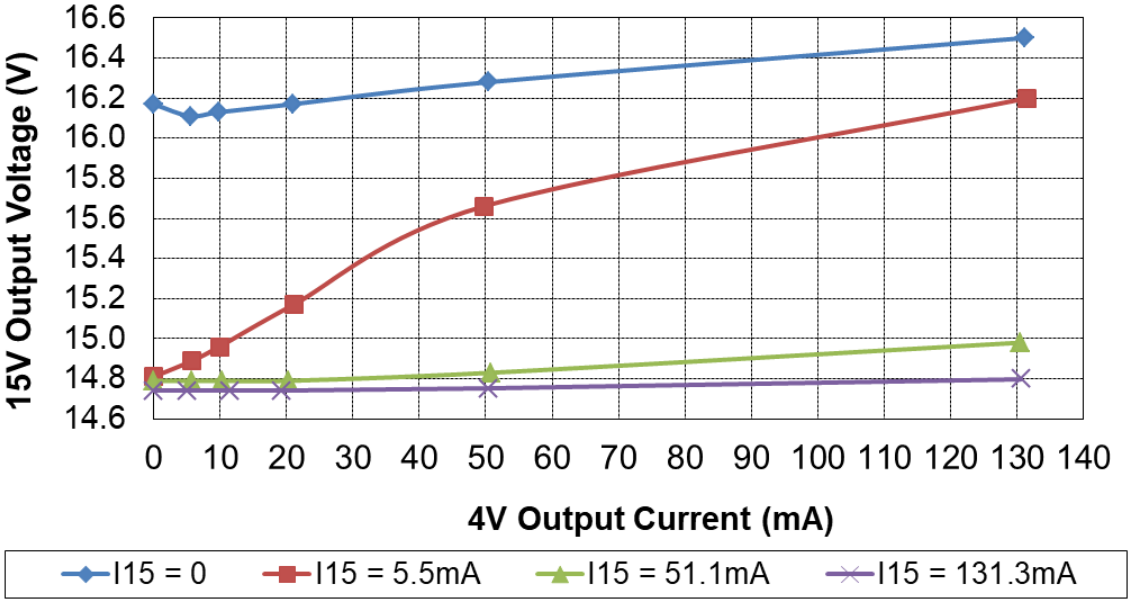
The output voltage regulation graphs, for each output, are shown below. Both outputs have been equally loaded from zero to 130mA.

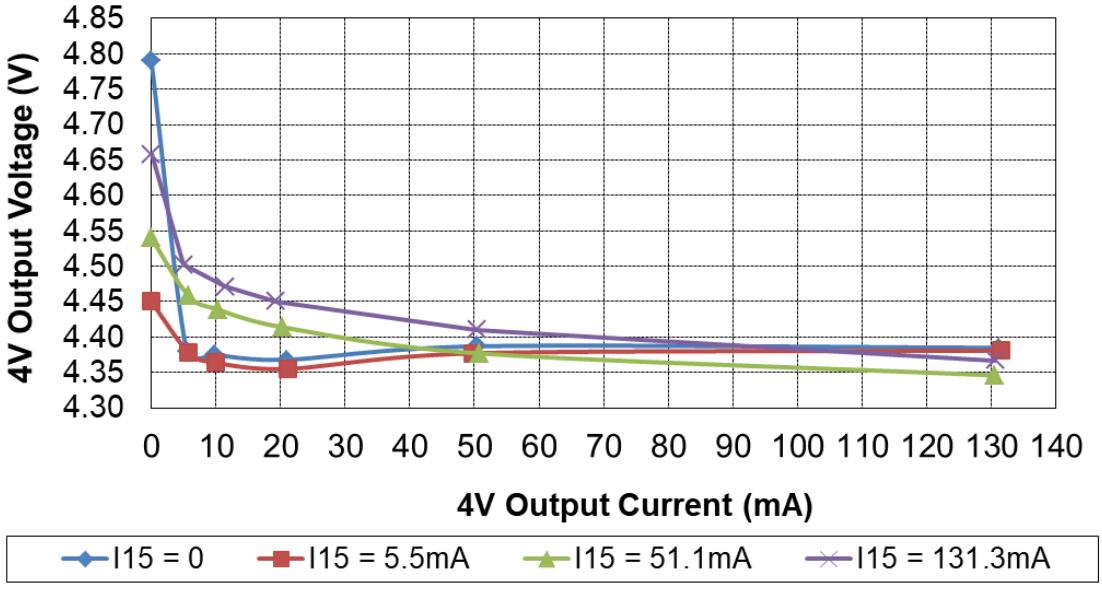




2.4 Cross Regulation

While the 15V output of the converter was loaded at constant fixed current (0, 5.5 mA, 51 mA and 131.3 mA), on the 4V output the load current has been varied from 0 to 100 % and the cross-regulation performance has been measured. The input voltage of the converter was 24 V.





2.5 Dimensions

The board dimensions, excluding the connectors, are 55.5 mm x 25.8 mm, height = 12 mm.

The following is a table showing the deliverable power versus minimum Vin range and transformer part number.

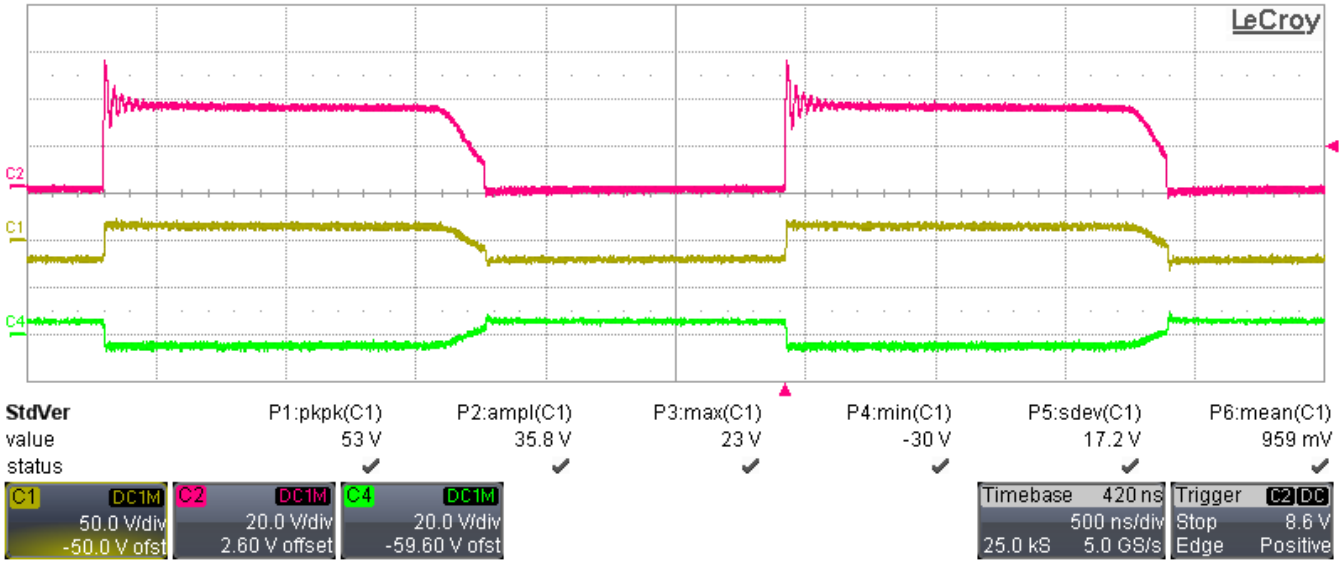
Maximum output power vs. Vin(min)									
Part Number	Vin (V)	Vout1 (V)	Iout1 (mA)	Vout2 (V)	Iout2 (mA)	Pout (limit) (W)	R1 (KΩ)	R2 (KΩ)	Rfb (KΩ)
750 317 893 - R2	9.0	20.5	154.4	0	0	3.2	35.7	8.45	105
750 317 894 - R3	9.0	15.5	146	4.94	148	3.0	35.7	8.45	105
750 318 207 - R0	18.0	19.2	289.1	0	0	5.6	86.6	8.45	160
750 318 208 - R2	18.0	14.7	273	4.33	272	5.2	86.6	8.45	150
750 318 212 - R0	18.0	19.1	289	0	0	5.5	86.6	8.45	160
750 318 213 - R1	18.0	15.0	284	4.152	278.3	5.4	86.6	8.45	150

3 Waveforms

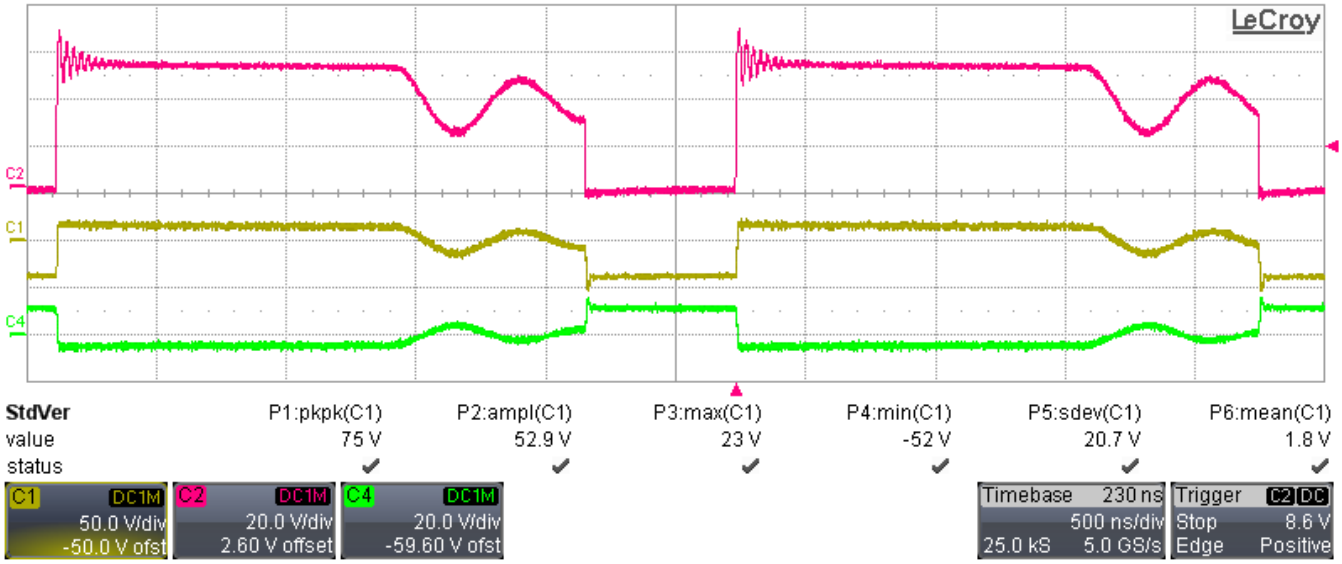
3.1 Switching

The switching waveforms have been measured by supplying the converter respectively at 18 V and 36V, in full load condition (130 mA on both outputs), with waveforms referred to primary ground and to secondary potential “V12” (or “V21”).

C2: Switch Node of U1 (pin 1) (20 V/div, 500 nsec/div, no BWL)
C1: Anode of D2 (50 V/div, no BWL)
C4: Cathode of D4 (20 V/div, no BWL)
Vin = 18V



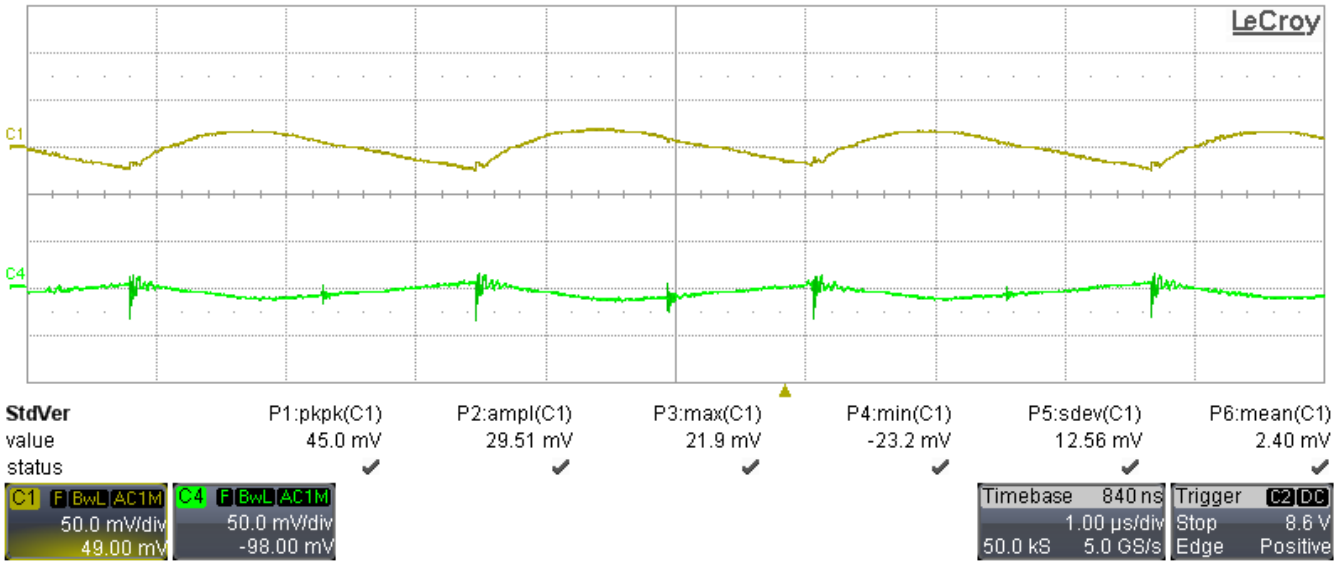
C2: Switch Node of U1 (pin 1) (20 V/div, 500 nsec/div, no BWL)
C1: Anode of D2 (50 V/div, no BWL)
C4: Cathode of D4 (20 V/div, no BWL)
Vin = 36V



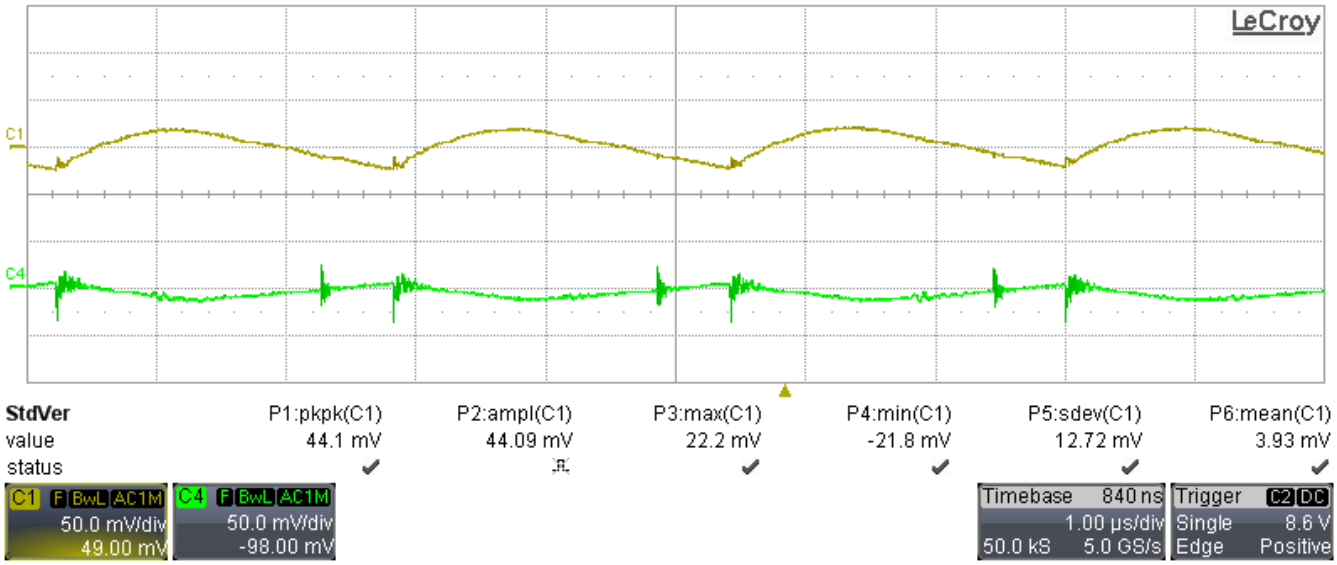
3.2 *Output Voltage Ripple*

The output voltage ripple has been measured by supplying the converter respectively at 18 V and 36V, in full-load condition.

C1: 15V Output Voltage (50 mV/div, 1 usec/div, AC coupling, 20 MHz BWL)
C4: 4V Output Voltage (50 mV/div, AC coupling, 20 MHz BWL)
Vin = 18V



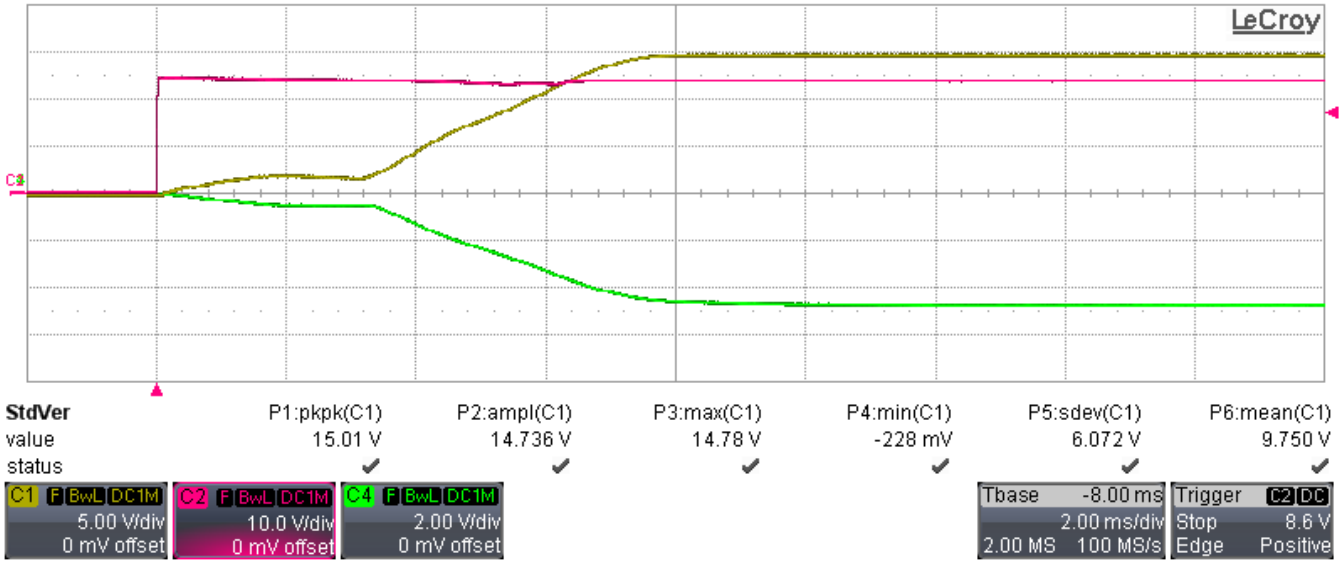
C1: 15V Output Voltage (50 mV/div, 1 usec/div, AC coupling, 20 MHz BWL)
C4: 4V Output Voltage (50 mV/div, AC coupling, 20 MHz BWL)
Vin = 36V



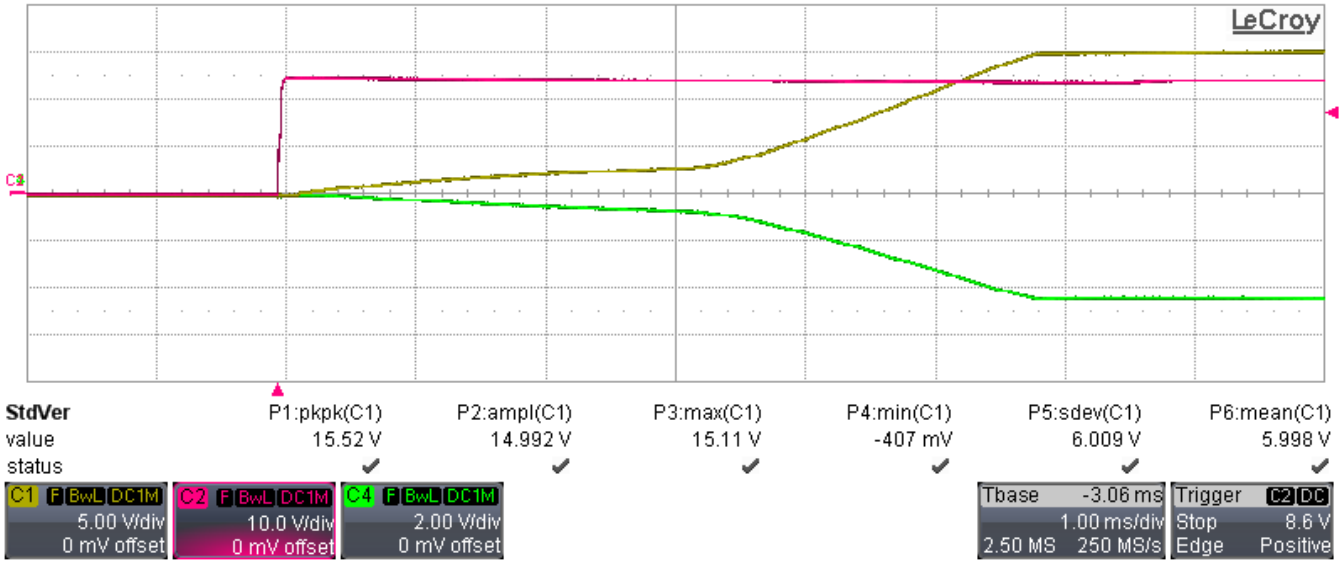
3.3 Startup

The behavior of the converter, showing Vin and output voltages, is shown below. The input voltage has been set to 24 V.

C1: 15V Output Voltage (5 V/div, 2 msec/div, 20 MHz BWL)
C2: Input Voltage (10 V/div, 20 MHz BWL)
C4: 4V Output Voltage (2 V/div, 20 MHz BWL)
Both outputs fully loaded.



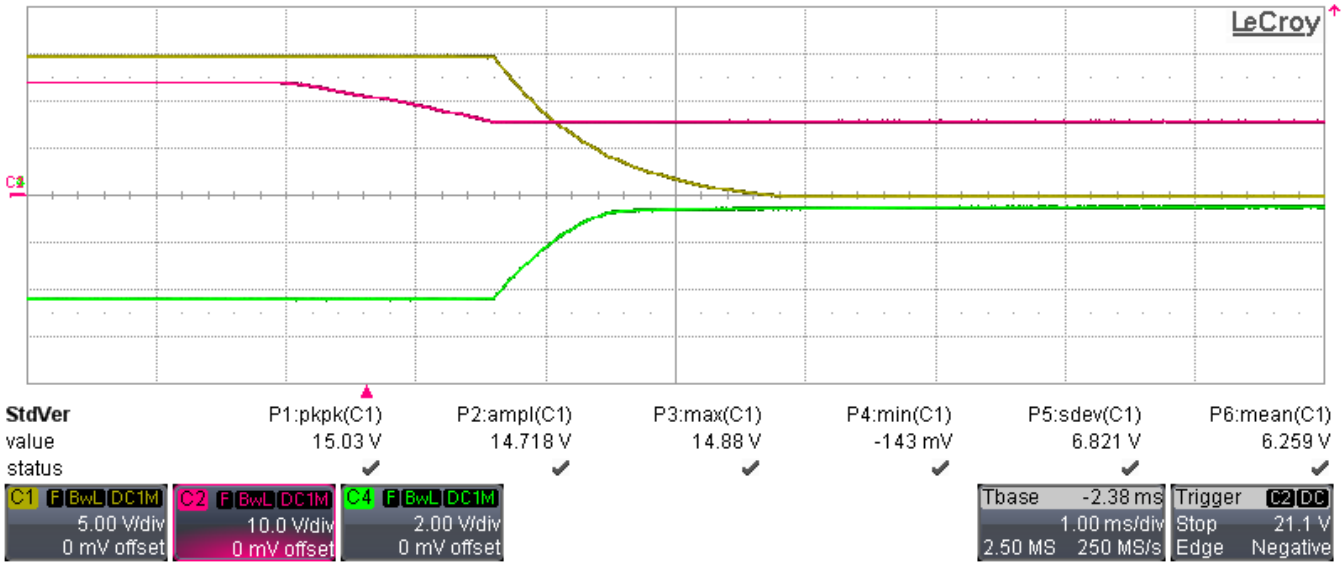
C1: 15V Output Voltage (5 V/div, 1 msec/div, 20 MHz BWL)
C2: Input Voltage (10 V/div, 20 MHz BWL)
C4: 4V Output Voltage (2 V/div, 20 MHz BWL)
Both outputs unloaded.



3.4 *Shut Down*

The behavior of the converter, during shut down, has been measured and shown below.

C1: 15V Output Voltage (5 V/div, 1 msec/div, 20 MHz BWL)
C2: Input Voltage (10 V/div, 20 MHz BWL)
C4: 4V Output Voltage (2 V/div, 20 MHz BWL)
Both outputs fully laded.



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