TEXAS INSTRUMENTS INCORPORATED

PMP11438 Rev A

Power Design Services Test Report

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4/8/2016

PMP11438 REVA is a power evaluation module showcasing three different implementations for a 12V input, 1.2V output power supply at 6-10A. The board contains three non-isolated buck power supplies controlled by TPS54A20, TPS62184 and TPS53515. Each design is optimized for various parameters including size, efficiency, and transient response to name a few. The output filters have been designed to satisfy DC regulation of +-3% and DC+AC regulation of +-5%.

PMP11438 Rev A Test Results

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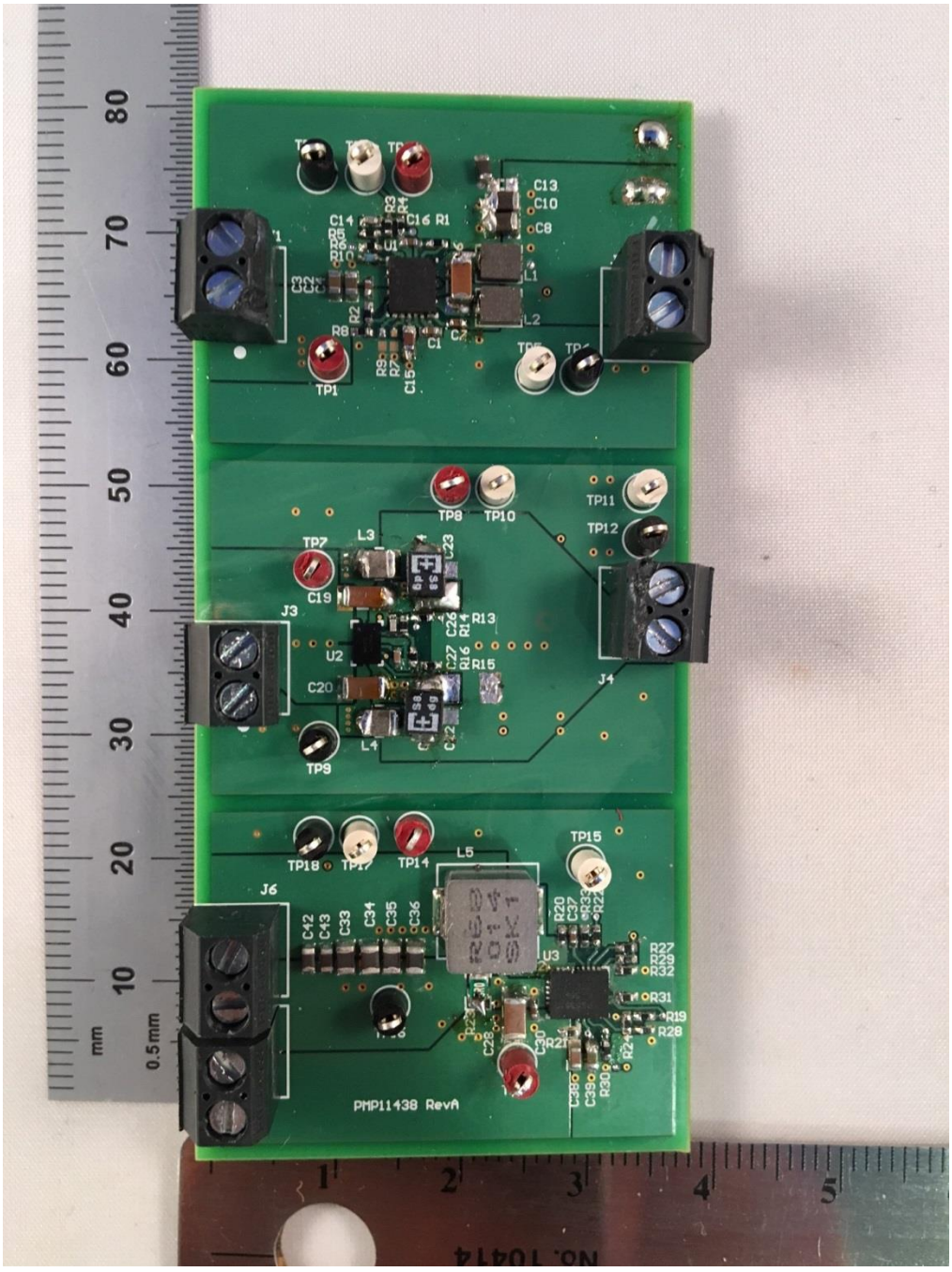
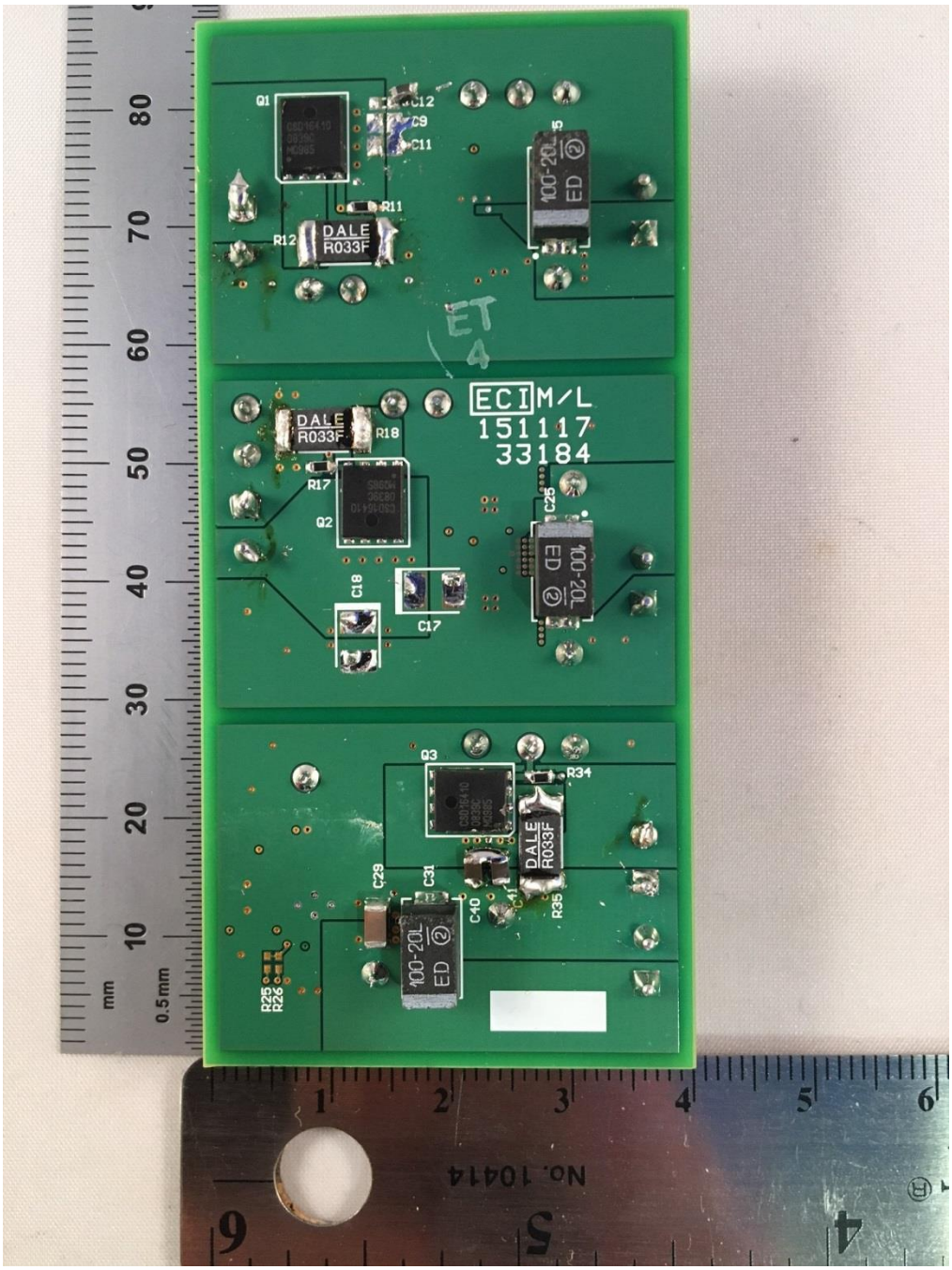
1 PMP11438 Board Photos

The front and back photos of PMP11438 are shown below. The board measures 3.2” x 1.5” and each circuit lies upon the same amount of PCB copper.

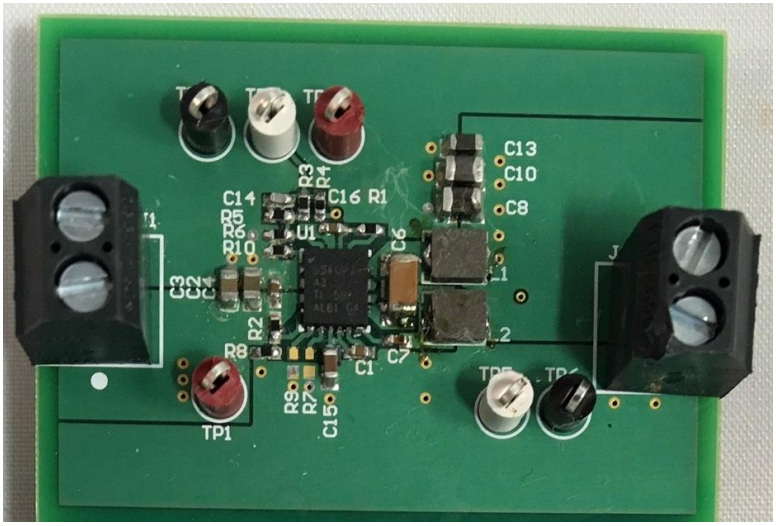


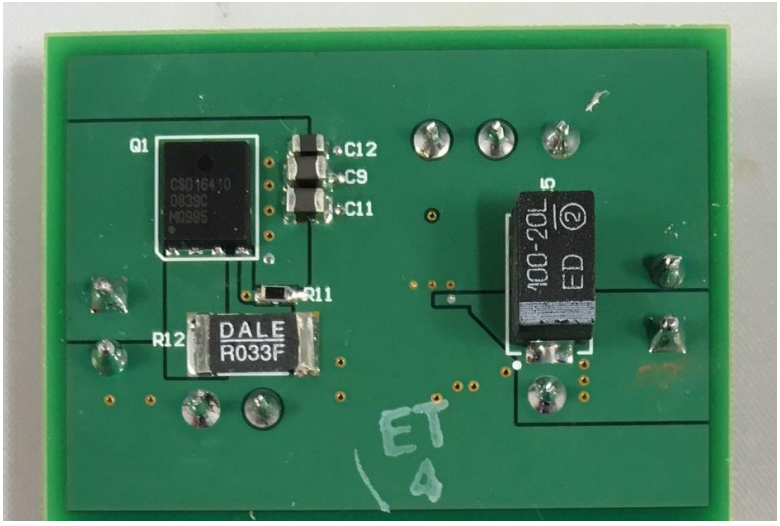

Q1
C12
C9
C11
R11
R12
DALE
R033F
ET
4
ECI M/L
151117
33184
R18
R17
Q2
C18
C17
C26
Q3
R34
C29
C31
C40
R35
R25
R26
mm
0.5mm
No. 10414

2 PMP11438 REVA 1.2V/10A – TPS54A20

2.1 Board Photos

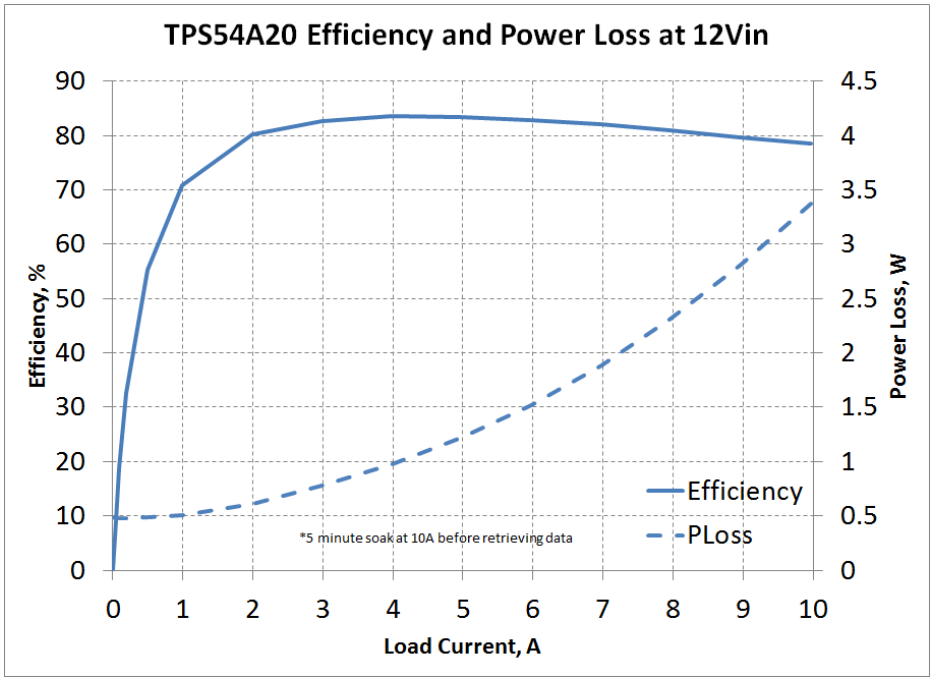
The top and bottom images of PMP11438 TPS54A20 are shown below.





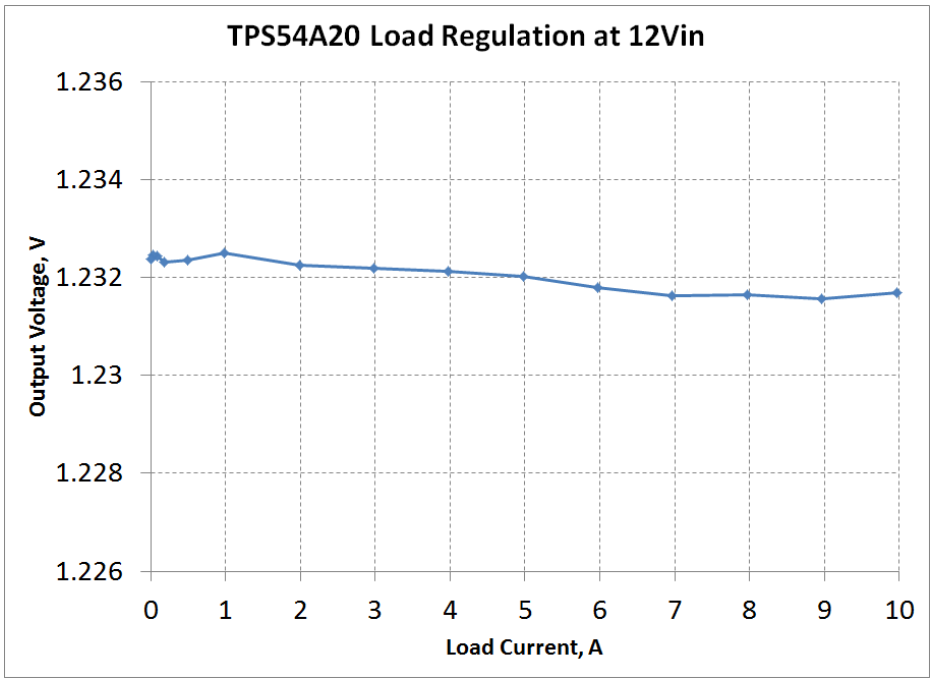
2.2 Efficiency and Power Loss

The efficiency and power loss of the power supply is shown below at 12Vin with natural convection.



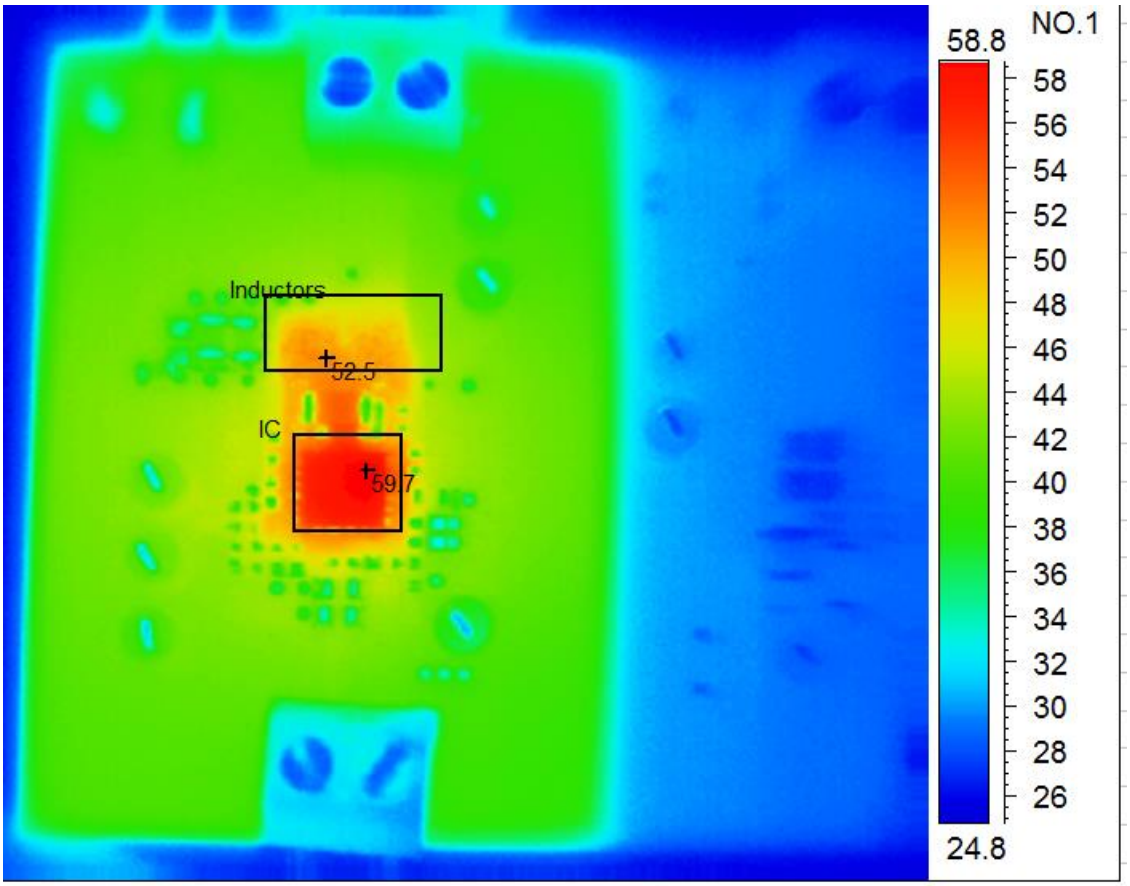
2.3 Load Regulation

The load regulation of the power supply is shown below at 12Vin.



2.4 Thermal

The thermal image of the power supply is shown at room temperature with 12Vin, 6Aout, and natural convection. The power supply soaked for 10min at 6A before the measurement was taken. The IC, which has integrated MOSFETs, is the hottest component at 59.7°C.

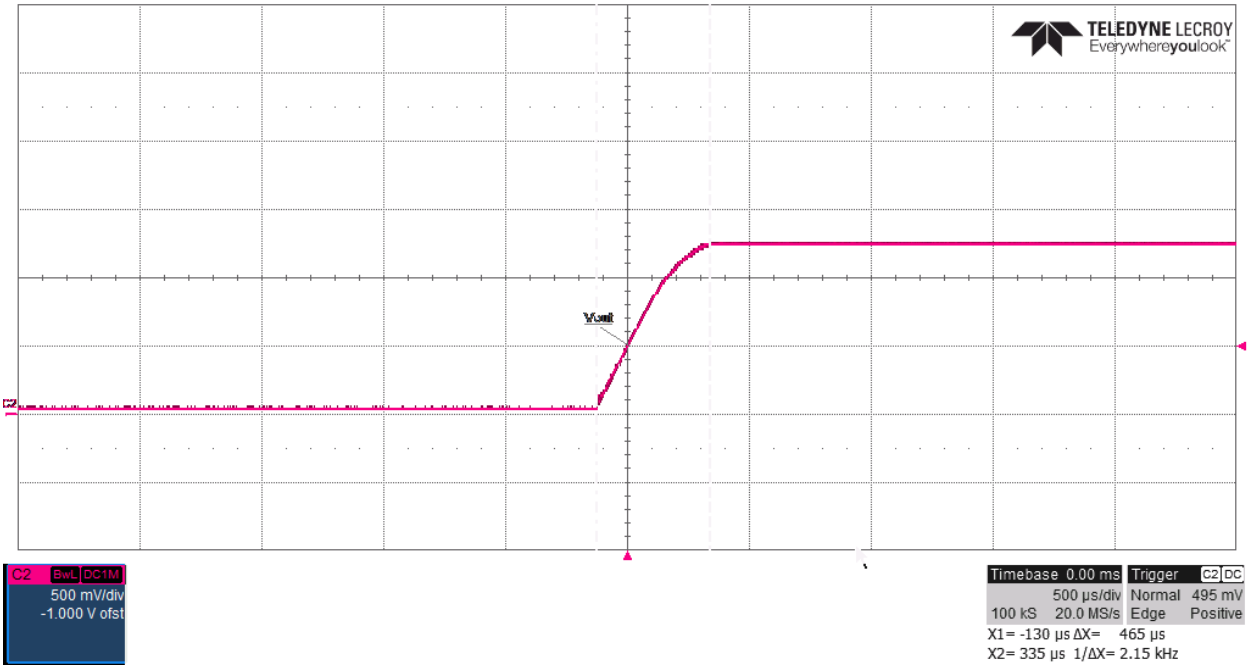


NO.1

Area analysis	Value
IC Max	59.7°C
Inductors Max	52.5°C

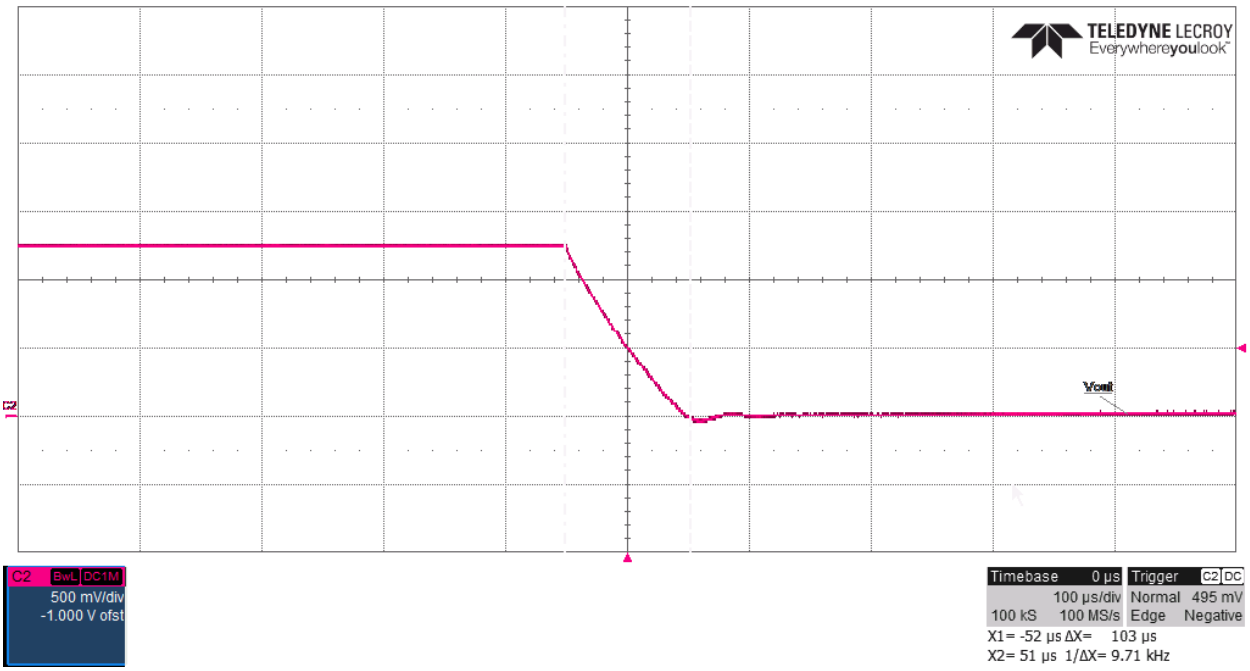
2.5 Startup

The power supply startup at 0A is shown below. The startup time is 500µs.



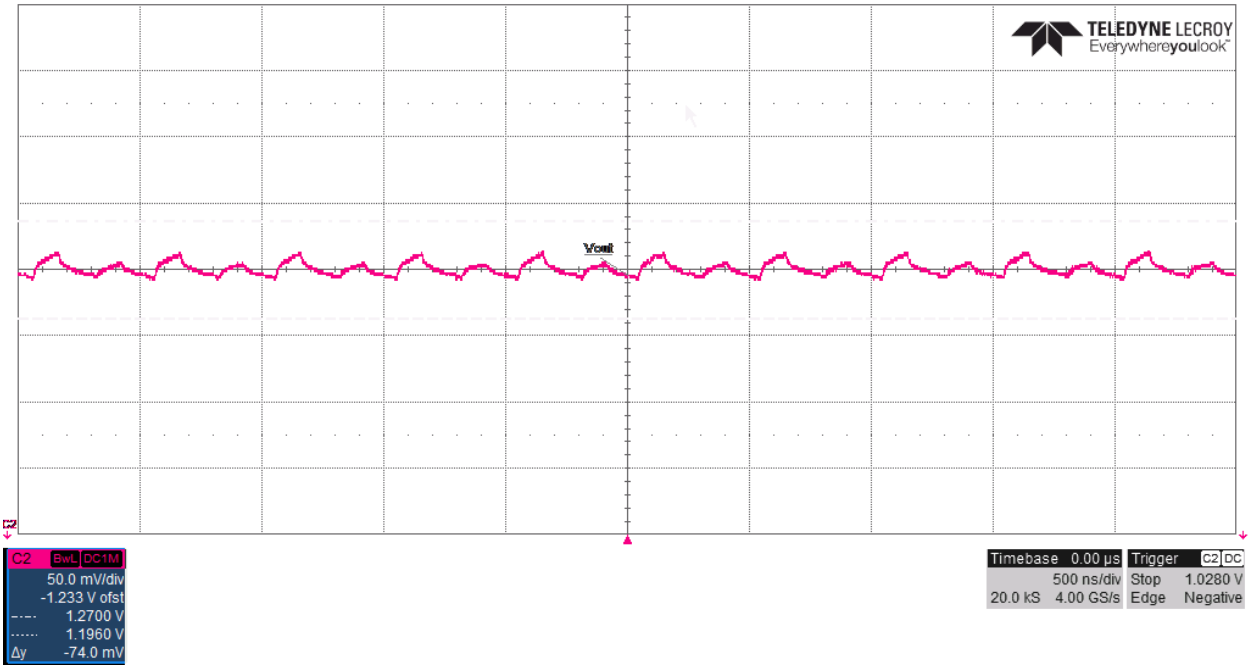
2.6 Shutdown

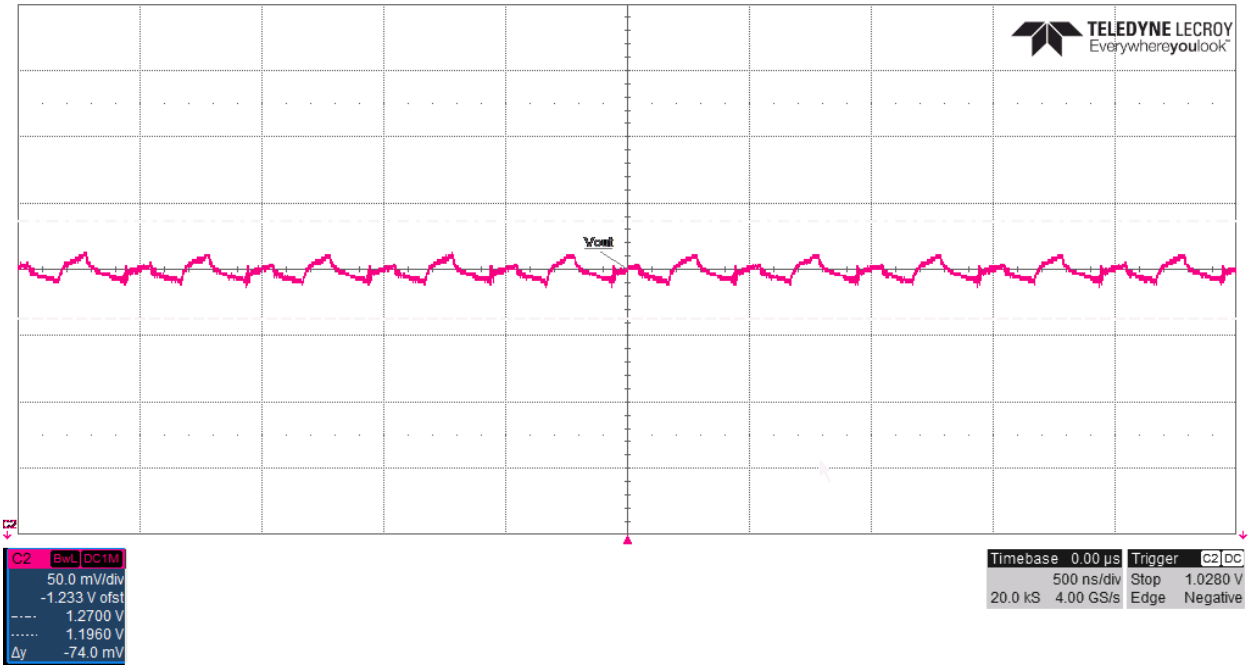
The shutdown of the power supply with 1.2Ω constant-resistance load is shown below.

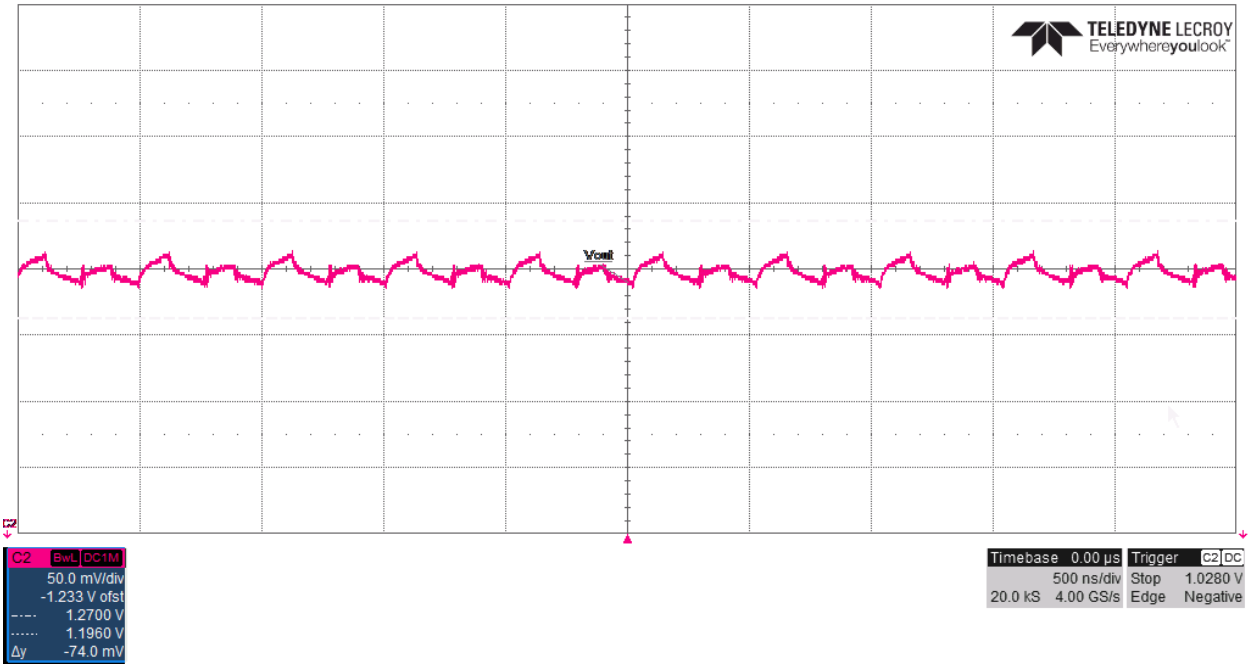


2.7 Output Ripple

The 1.2V output ripple is shown in red below, DC coupled with offset, for 0A, 6A and 10A, respectively.

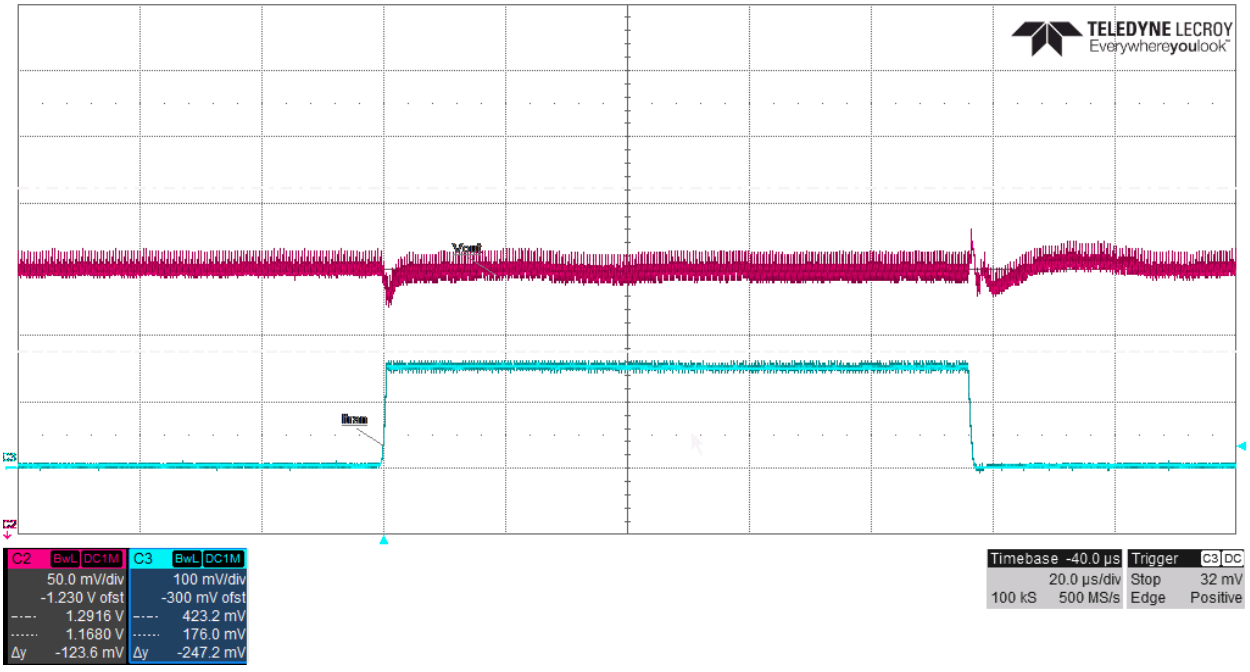






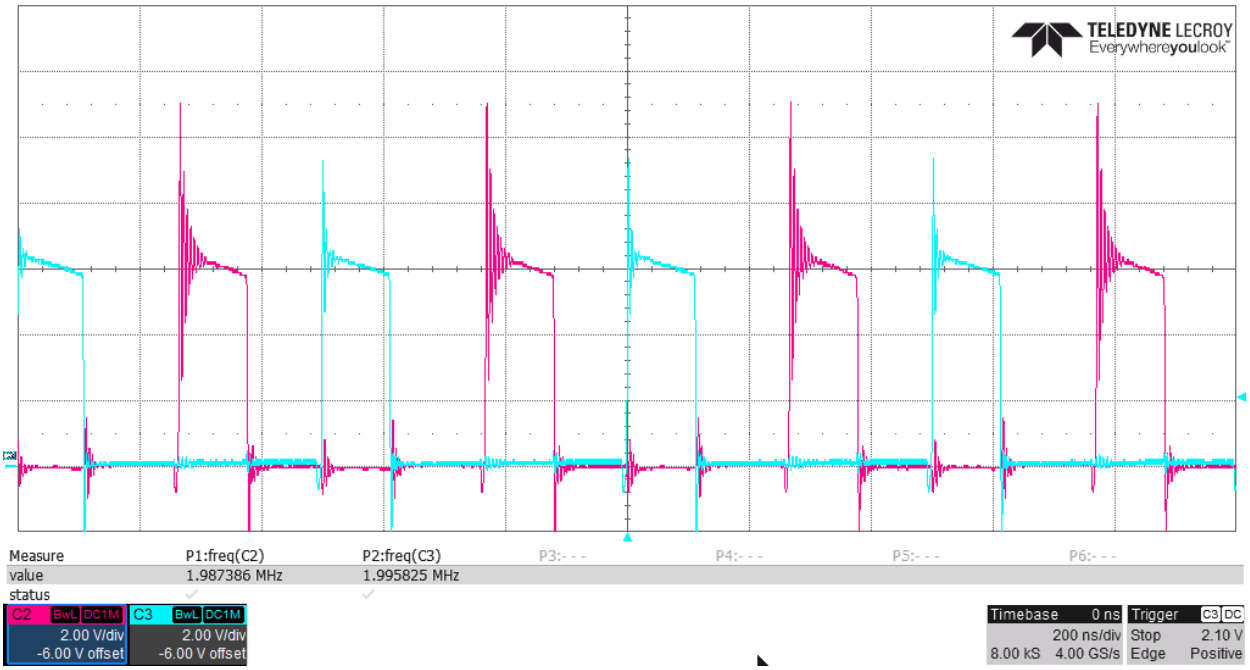
2.8 Transient response

The transient response is shown in the plot below where the red trace is the DC offset output voltage. The current step is 1A-6A-1A at 5A/us slew rate.



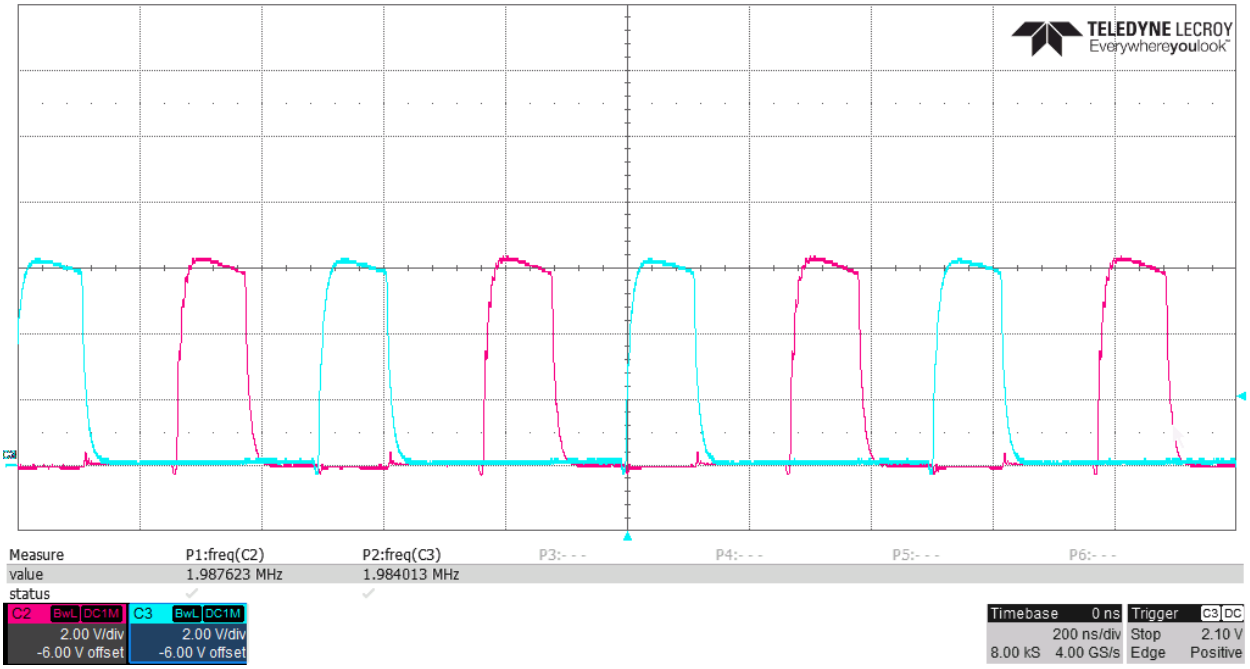
2.9 Synchronous Rectifier Stress

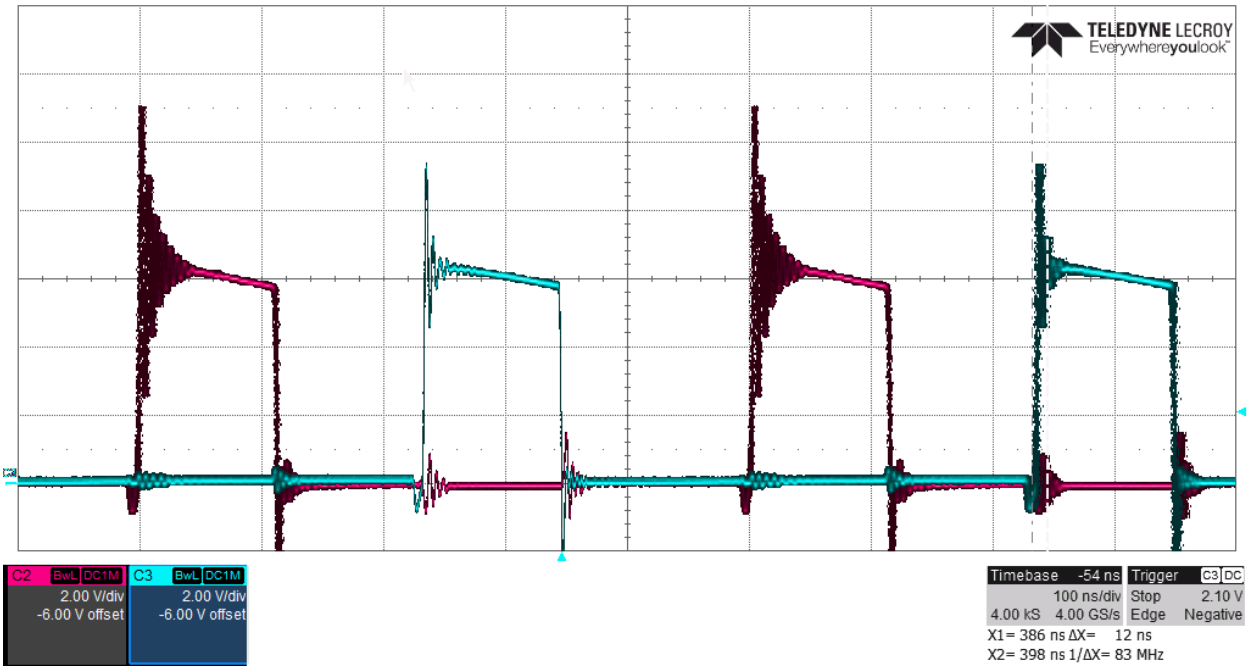
The voltage stresses on the synchronous MOSFETs are shown below. The image is taken at 12Vin and 6A with 200MHz of bandwidth limit.



2.10 Frequency Characteristics

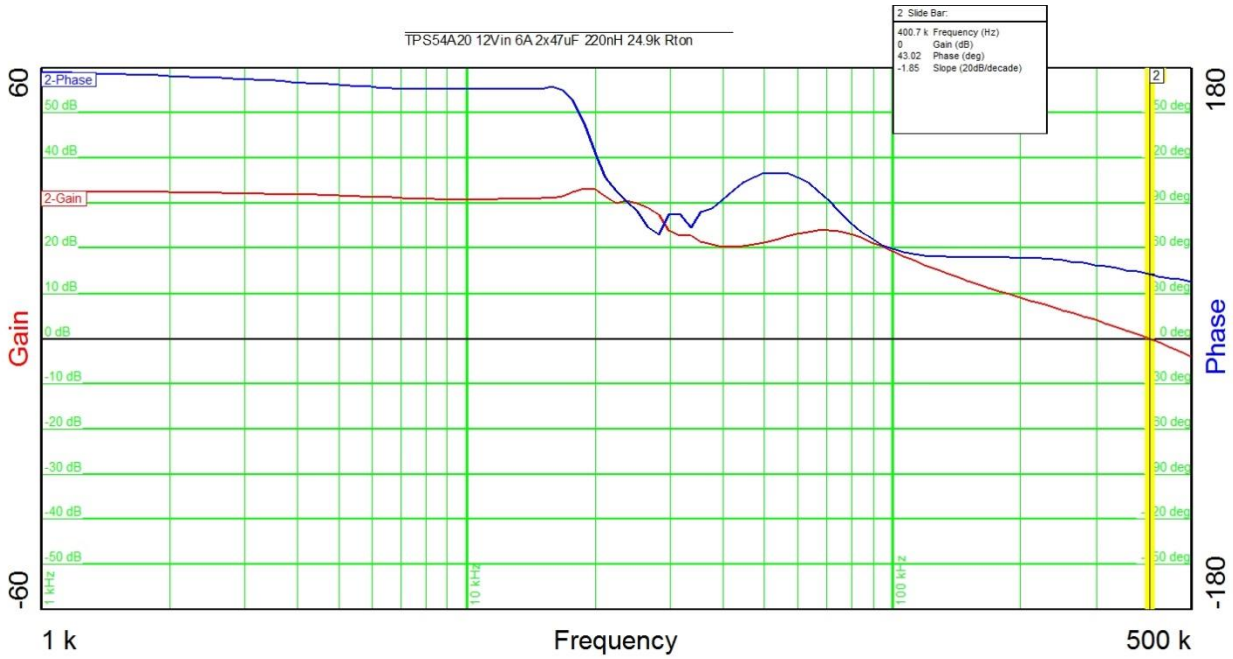
The switch nodes are shown below in blue and red and measured on the inductor. The first image illustrates the power supply switching frequency of ~2MHz per phase. The second image shows frequency jitter of 12ns. Both images are taken with 12Vin and 6Aout.





2.11 Loop Response

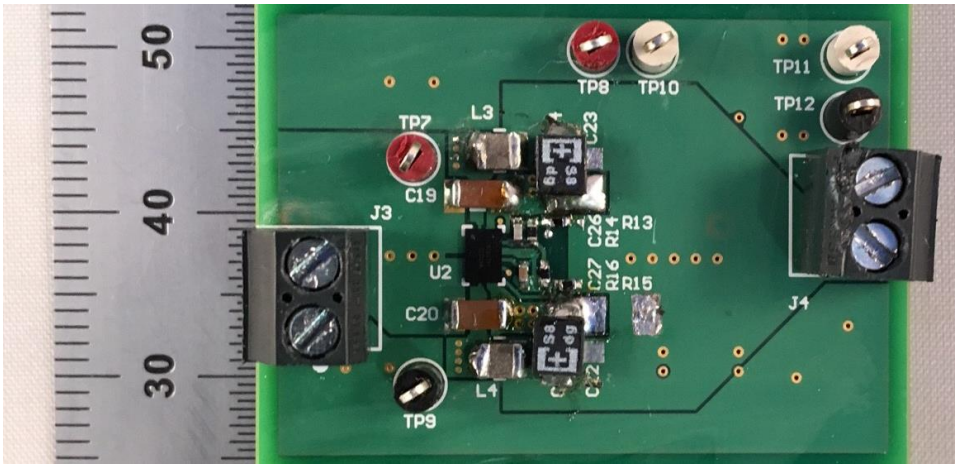
The loop response of the power supply at 12Vin and 6A load current is shown below. The bandwidth is 400kHz with ~45° of phase margin.

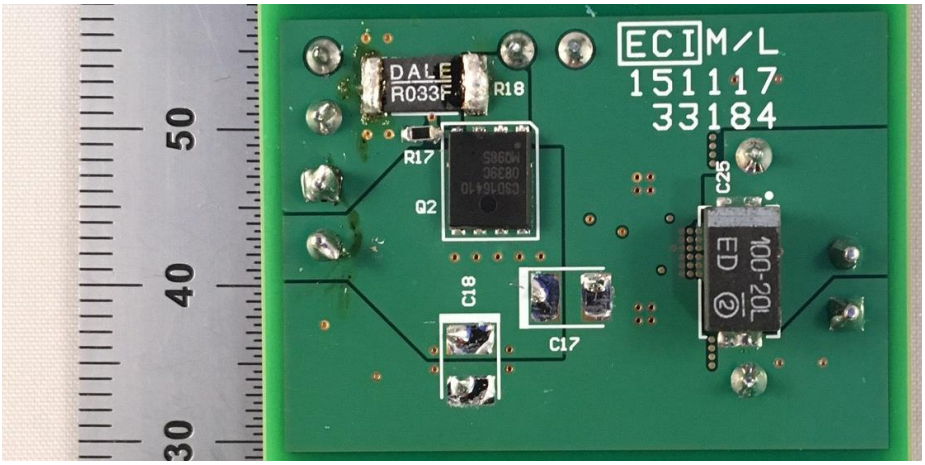


3 PMP11438 REVA 1.2V/6A – TPS62184

3.1 Board Photos

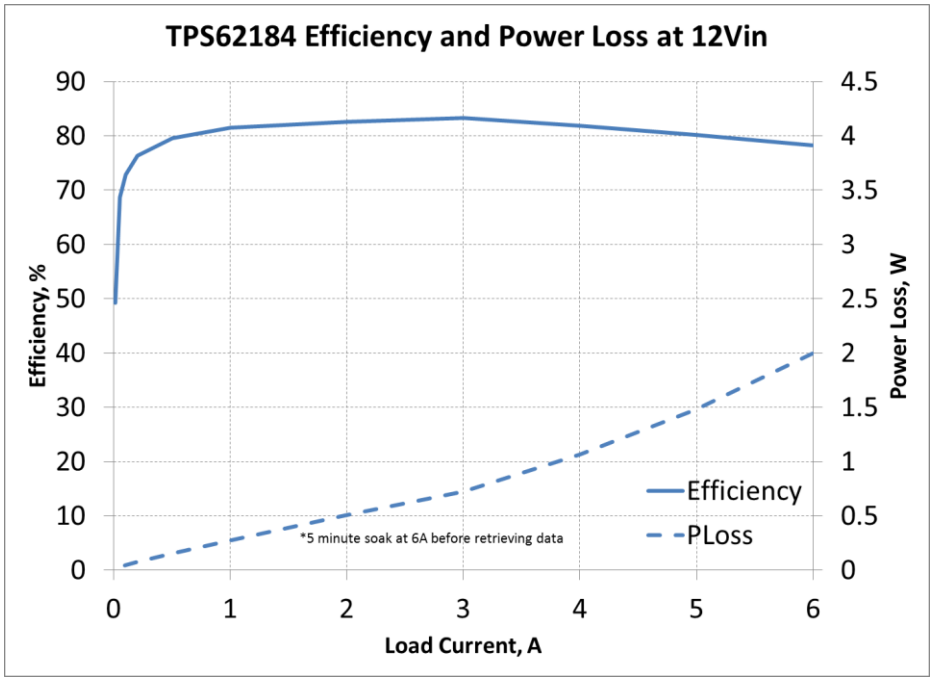
The top and bottom images of PMP11438 TPS62184 are shown below.





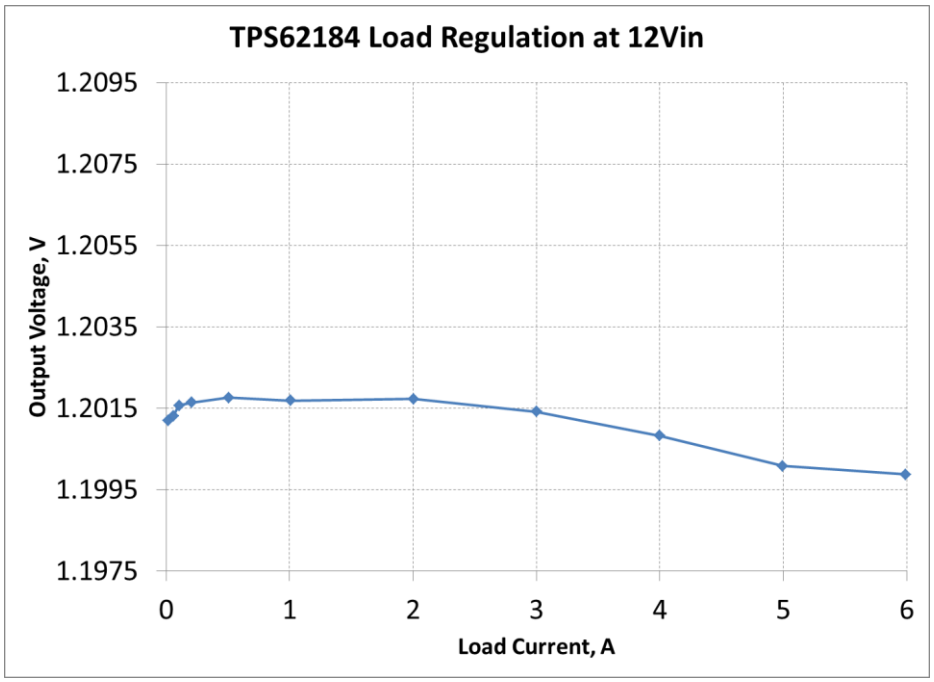
3.2 Efficiency and Power Loss

The efficiency and power loss of the power supply is shown below at 12Vin with natural convection.



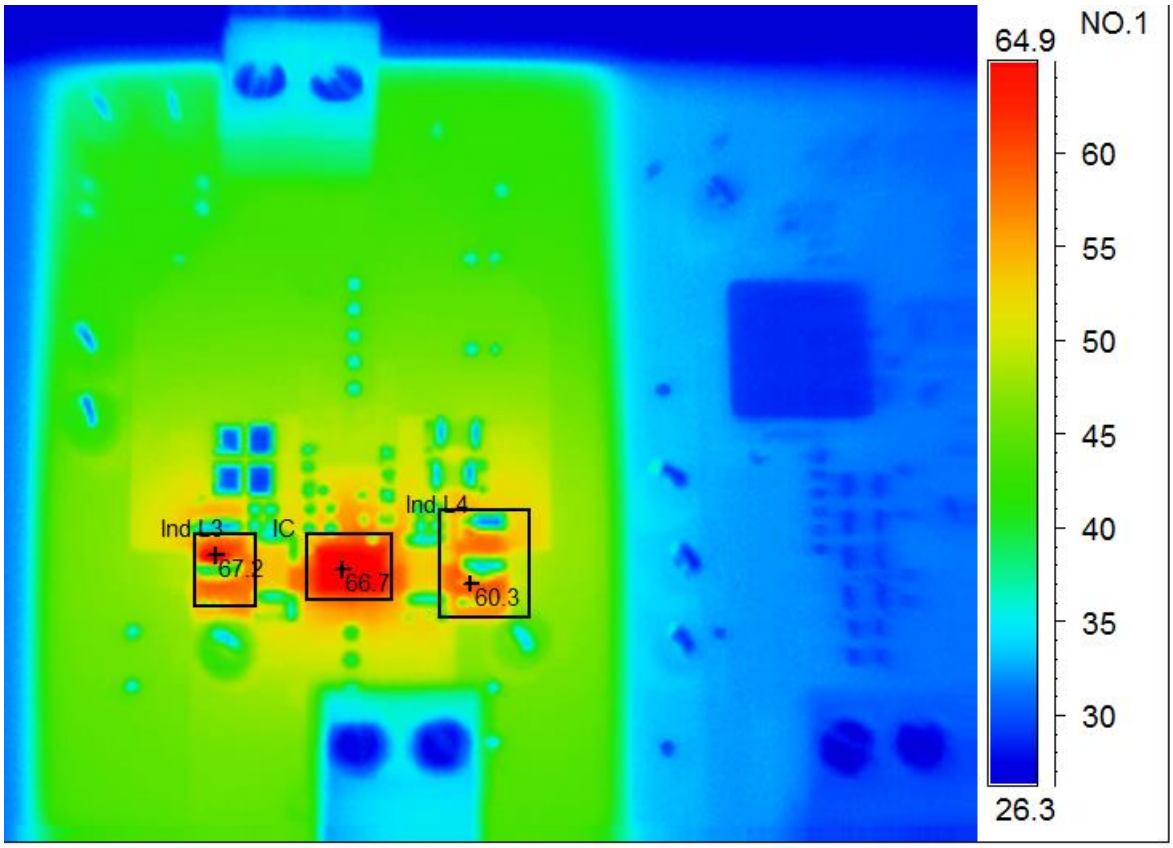
3.3 Load Regulation

The load regulation of the power supply is shown below at 12Vin.



3.4 Thermal

The thermal image of the power supply is shown at room temperature with 12Vin, 6Aout, and natural convection. The power supply soaked for 10min at 6A before the measurement was taken. The IC, which has integrated MOSFETs, is one of the hottest components at 66.7°C.

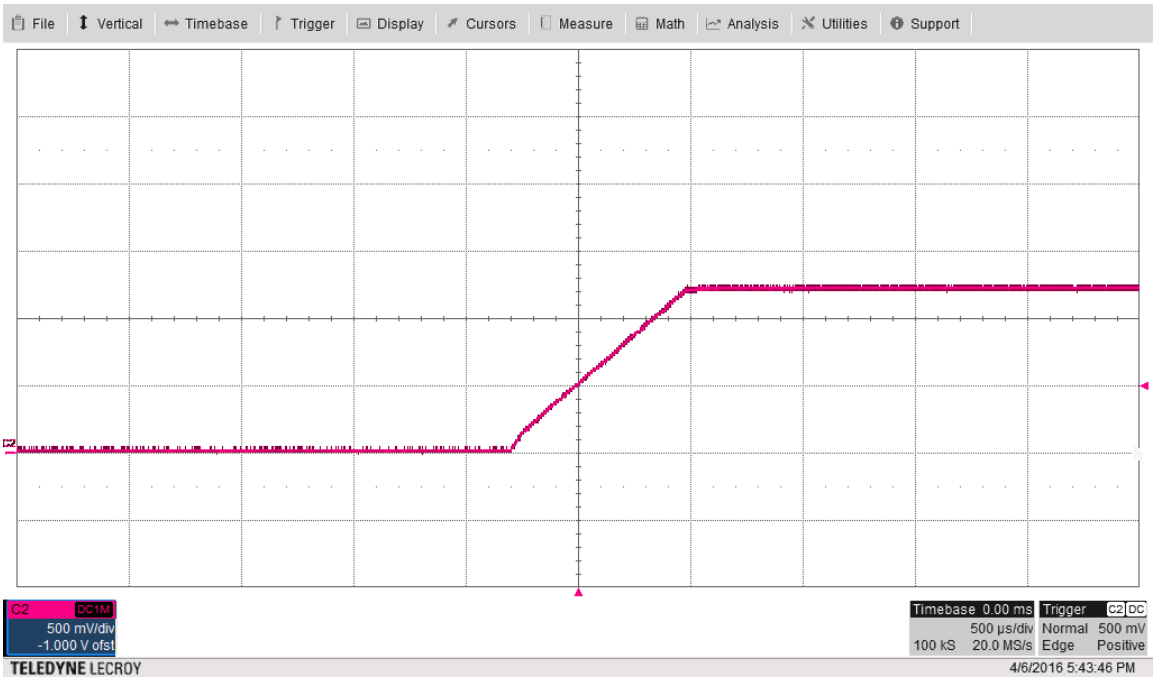


NO.1

Area analysis	Value
IC Max	66.7°C
Ind L3 Max	67.2°C
Ind L4 Max	60.3°C

3.5 Startup

The power supply startup at 0A is shown below. The startup time is 750µs.

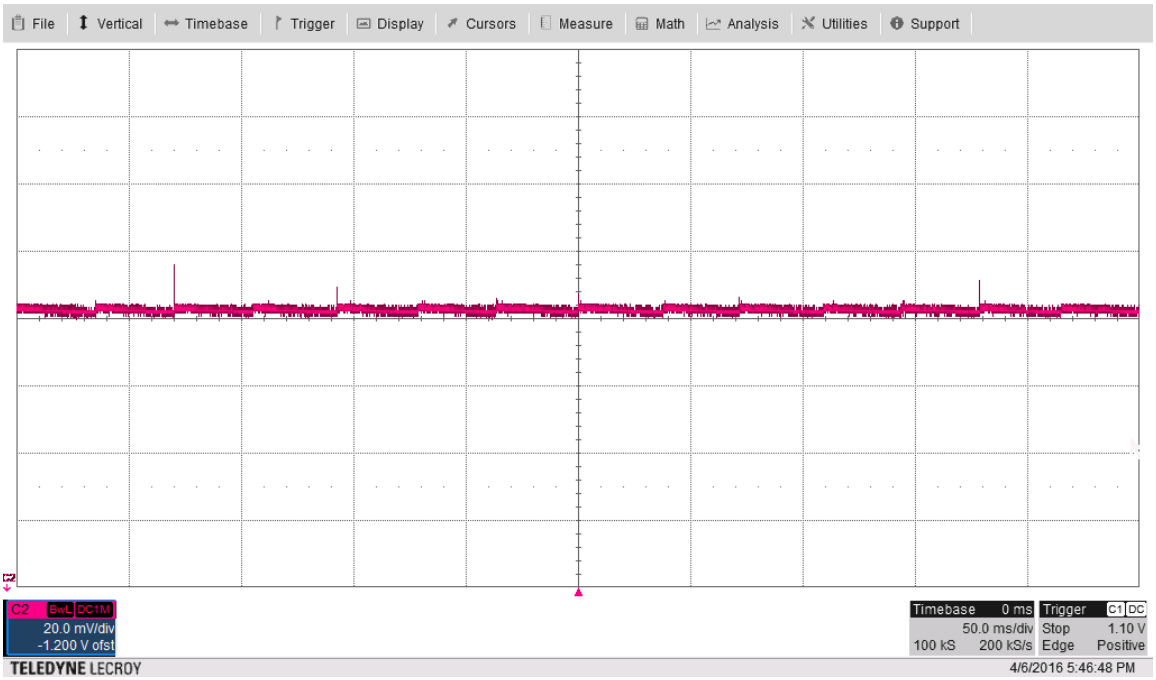


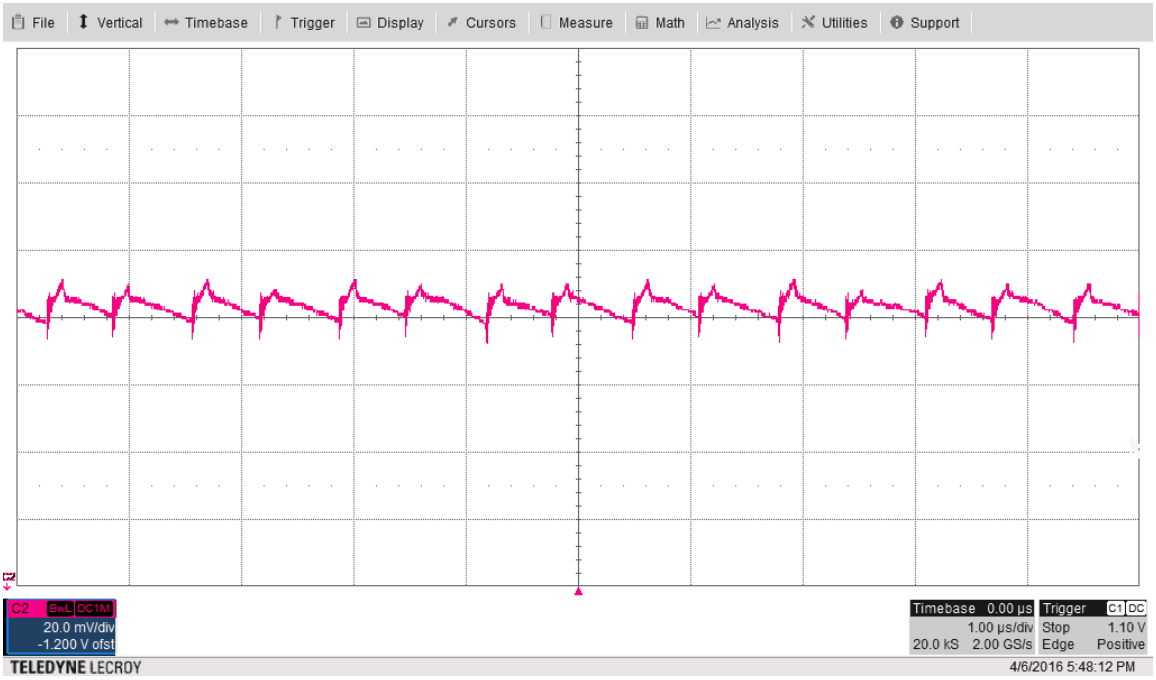
3.6 Shutdown

The shutdown of the power supply with 1.2Ω constant-resistance load is shown below.

3.7 Output Ripple

The 1.2V output ripple is shown in red below, DC coupled with offset, for 0A, 3A and 6A, respectively.





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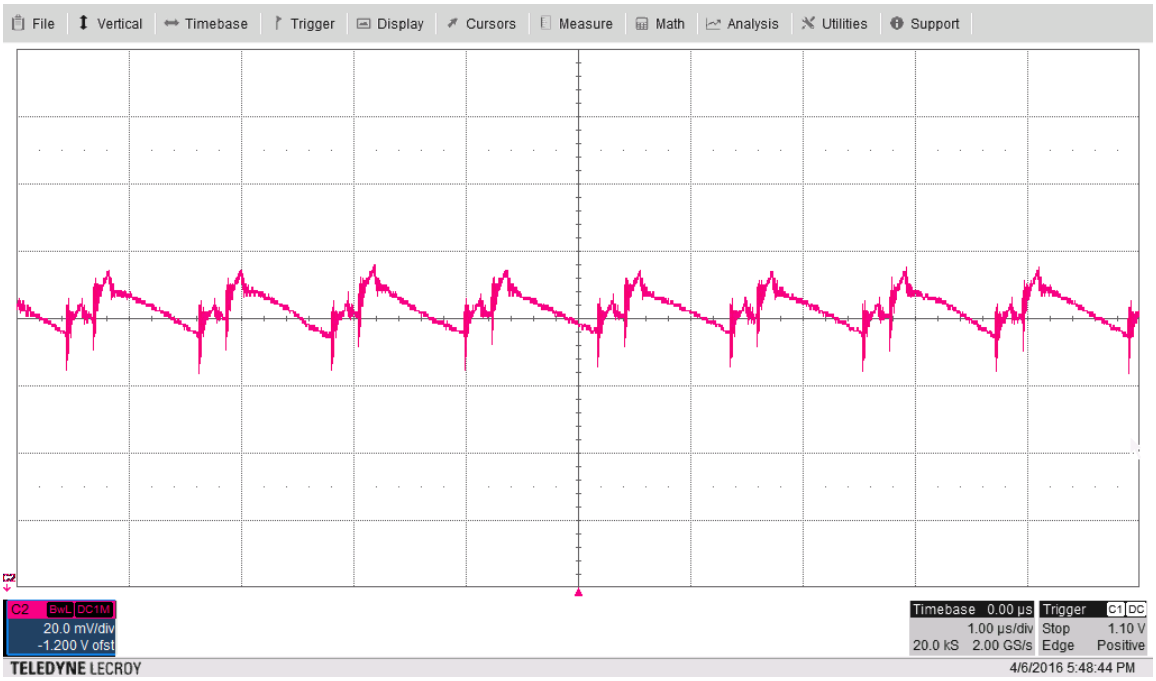
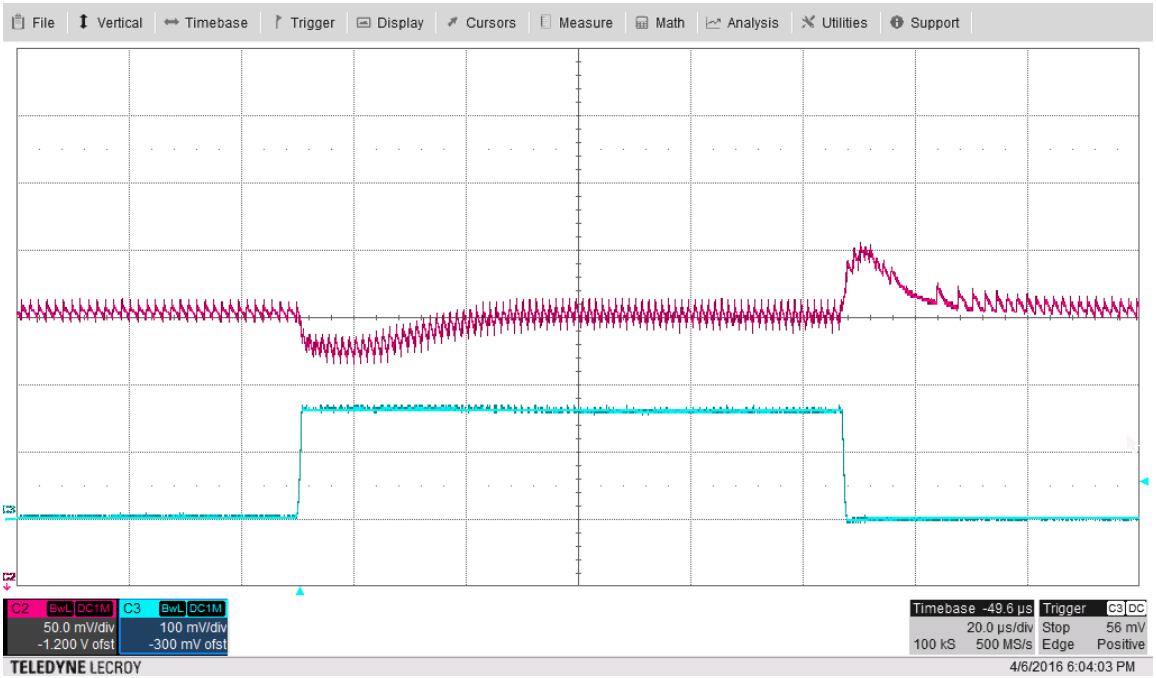


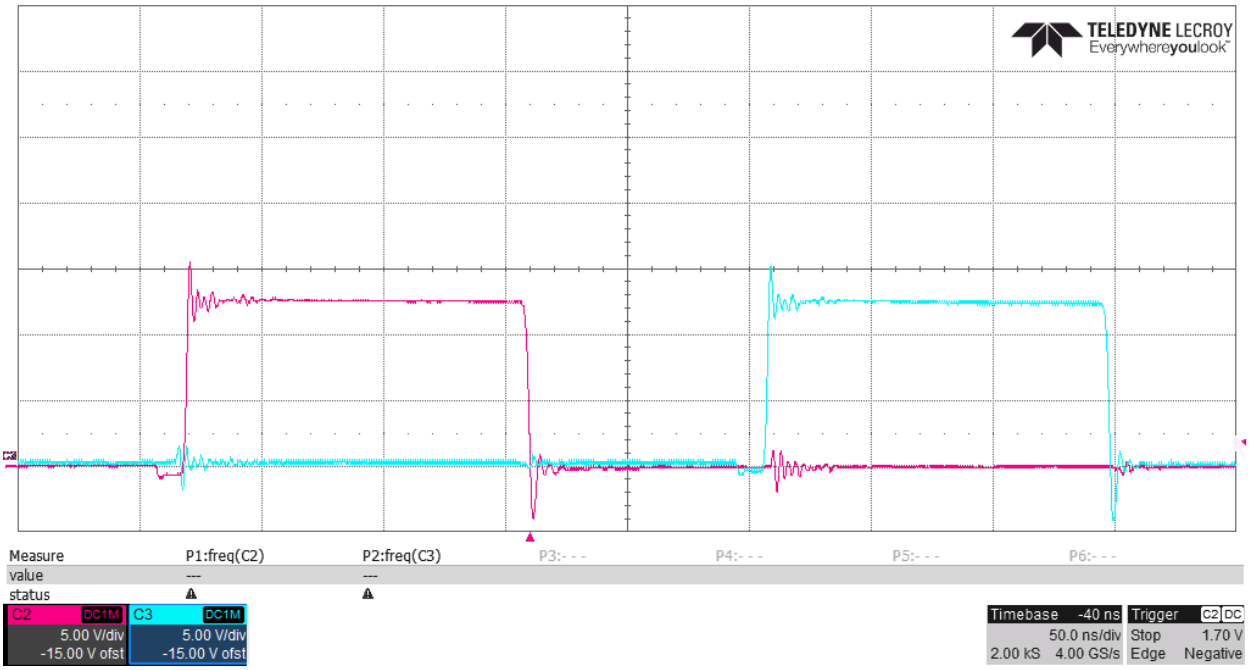
3.8 Transient response

The transient response is shown in the plot below where the red trace is the DC offset output voltage. The current step is 1A-6A-1A at 5A/us slew rate.



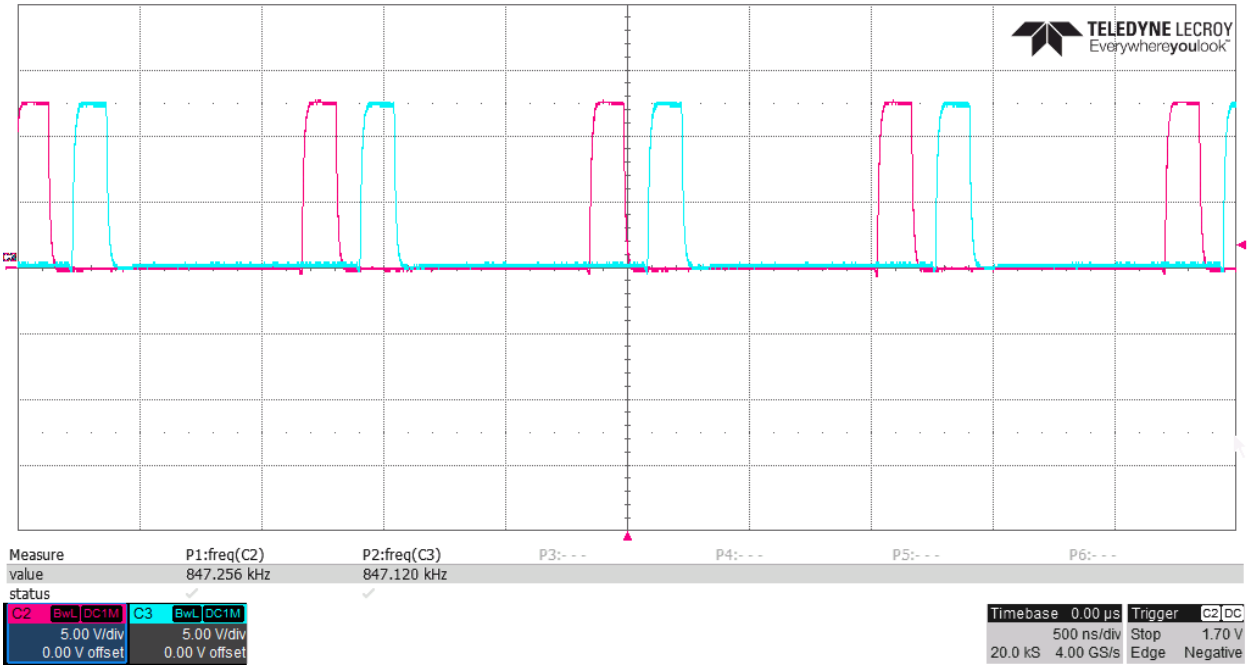
3.9 Synchronous Rectifier Stress

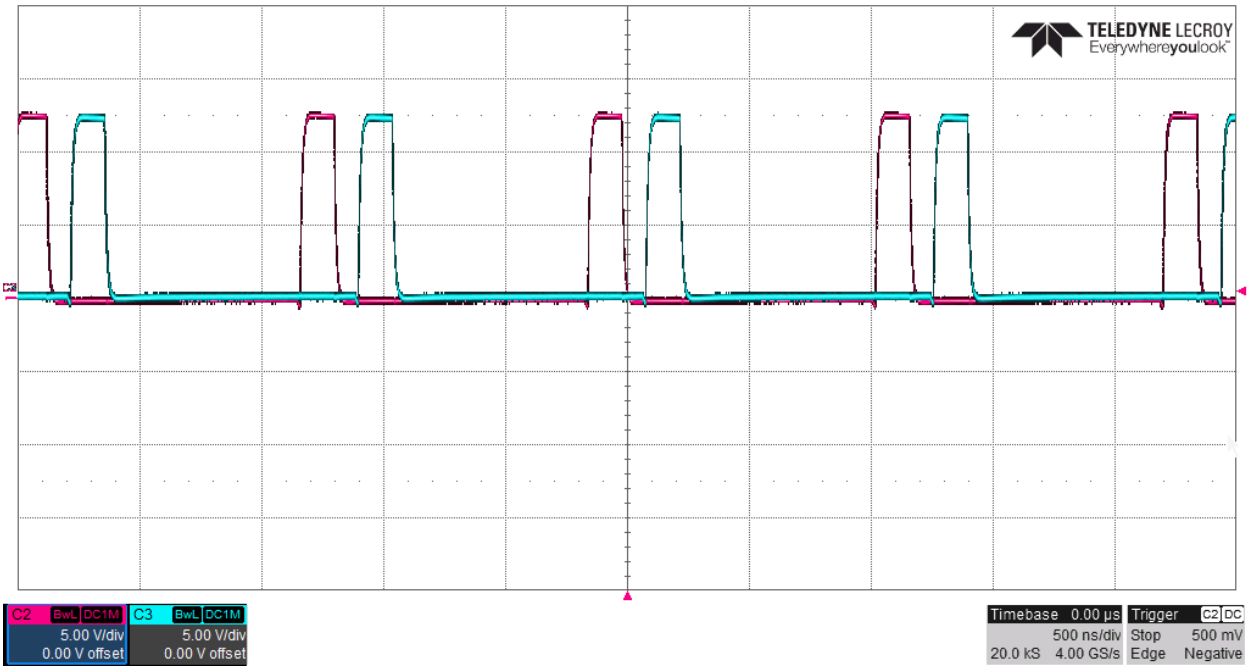
The voltage stresses on the synchronous MOSFETs are shown below. The image is taken at 12Vin and 6A with 200MHz of bandwidth limit.



3.10 Frequency Characteristics

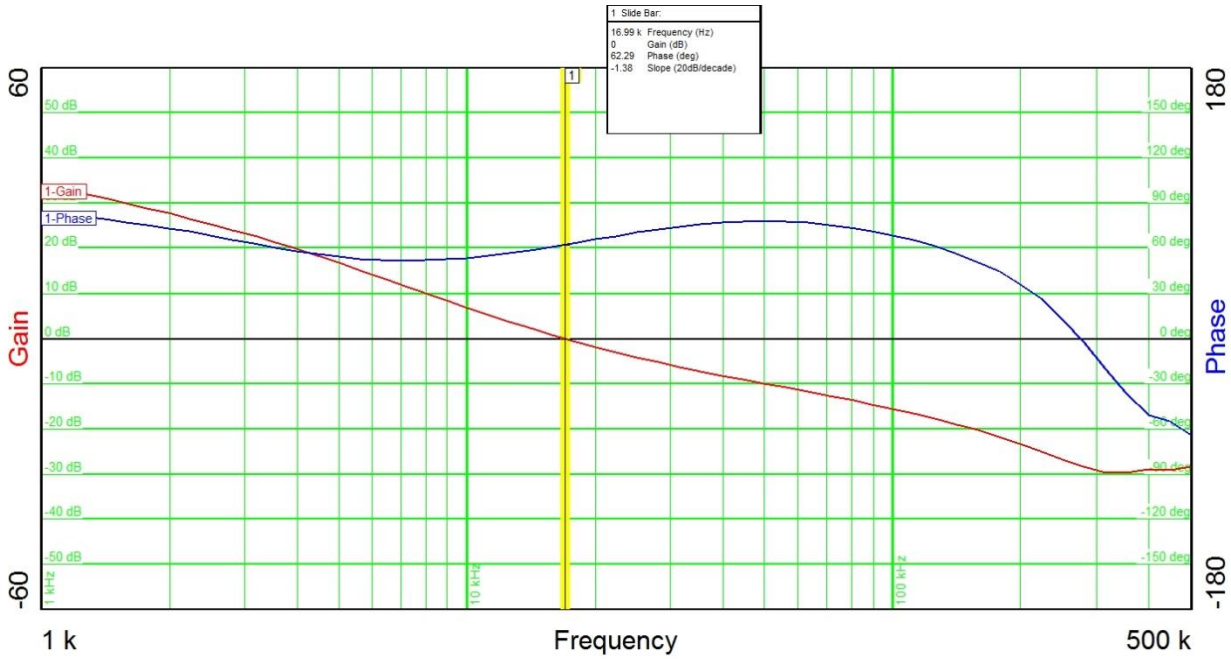
The switch nodes are shown below in blue and red and measured on the inductor. The first image illustrates the power supply switching frequency of ~850kHz per phase. The second image shows negligible frequency jitter. Both images are taken with 12Vin and 6Aout.





3.11 Loop Response

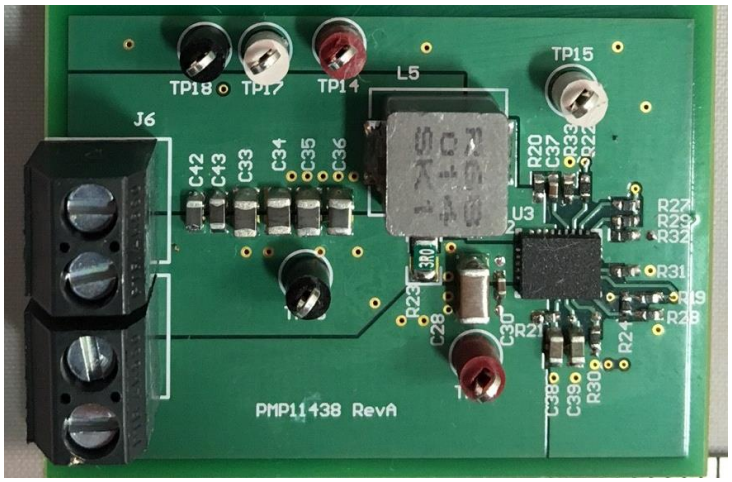
The loop response of the power supply at 12Vin and 6A load current is shown below. The bandwidth is 17kHz with ~62° of phase margin.

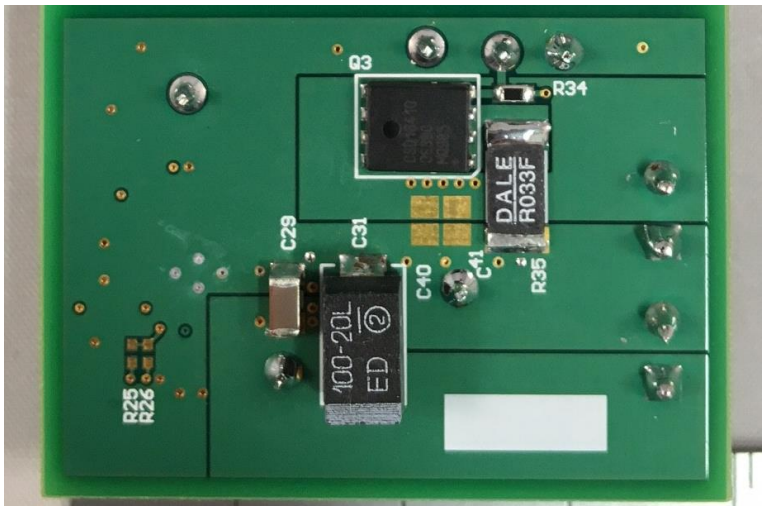


4 PMP11438 REVA 1.2V/6A – TPS53515

4.1 Board Photos

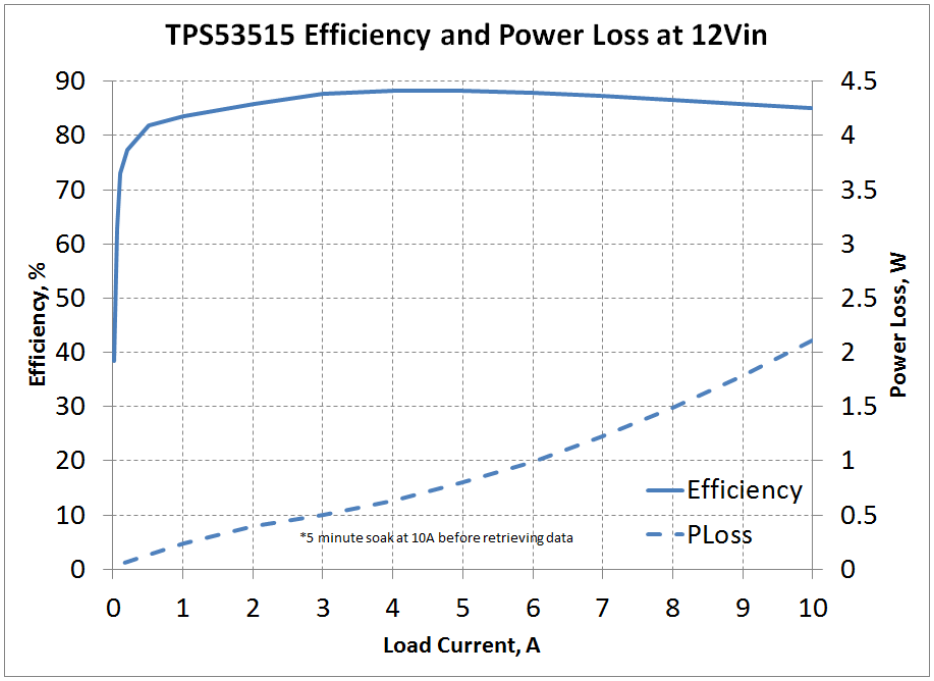
The top and bottom images of PMP11438 TPS53515 are shown below.





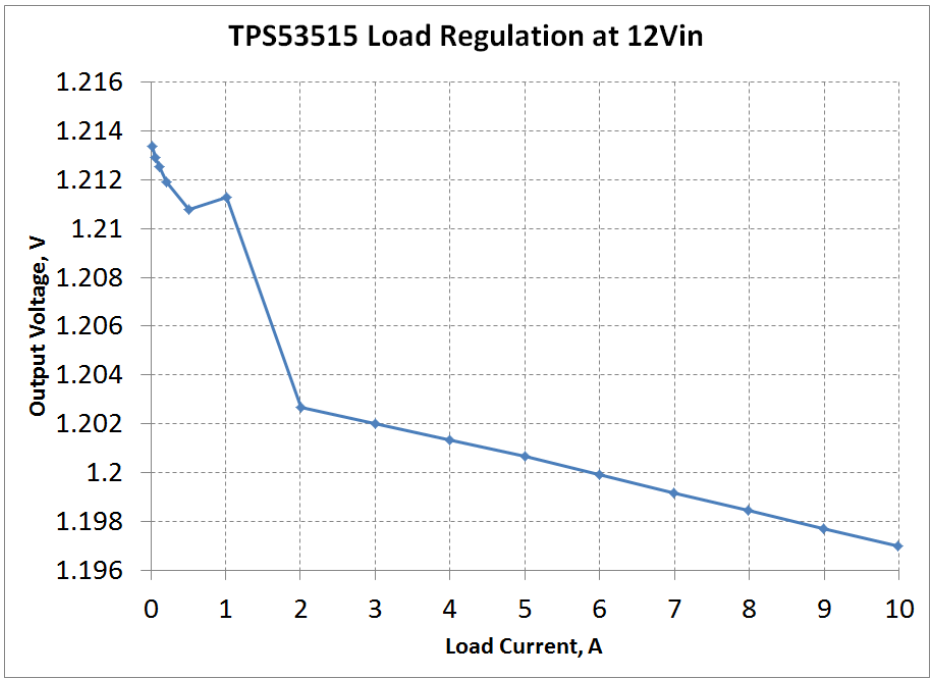
4.2 Efficiency and Power Loss

The efficiency and power loss of the power supply is shown below at 12Vin with natural convection.



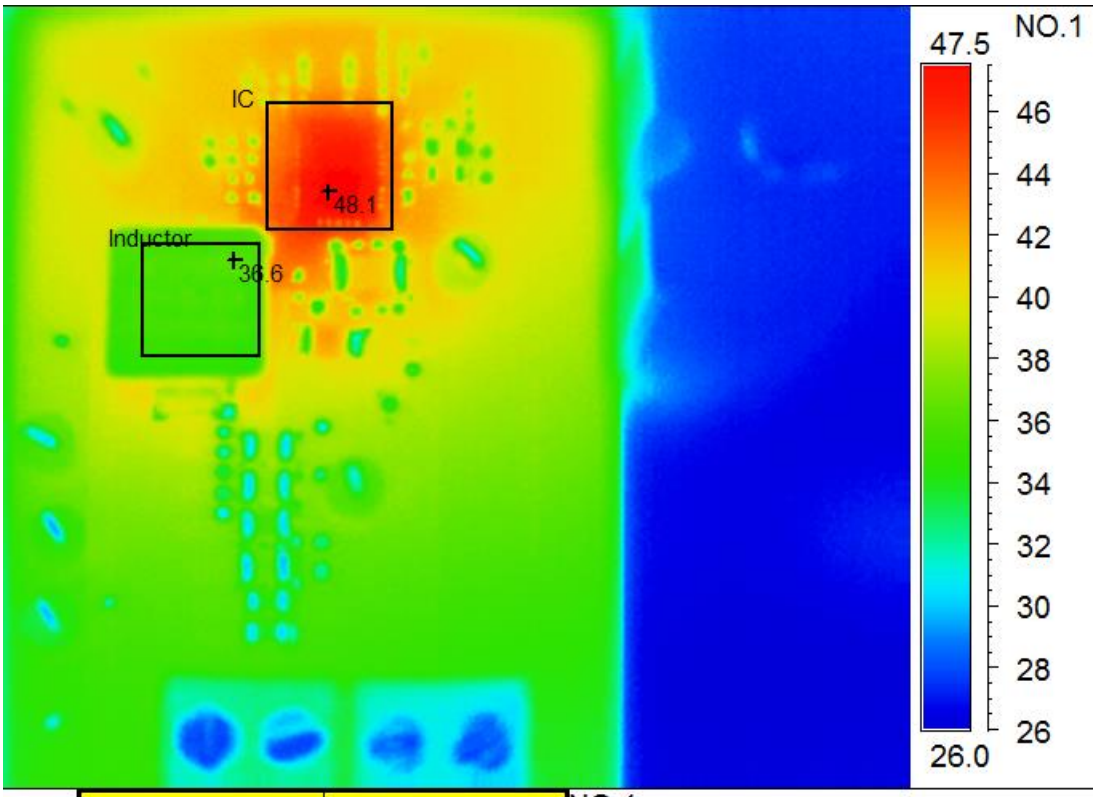
4.3 Load Regulation

The load regulation of the power supply is shown below at 12Vin.



4.4 Thermal

The thermal image of the power supply is shown at room temperature with 12Vin, 6Aout, and natural convection. The power supply soaked for 10min at 6A before the measurement was taken. The IC, which has integrated MOSFETs, is one of the hottest components at 48.1°C.

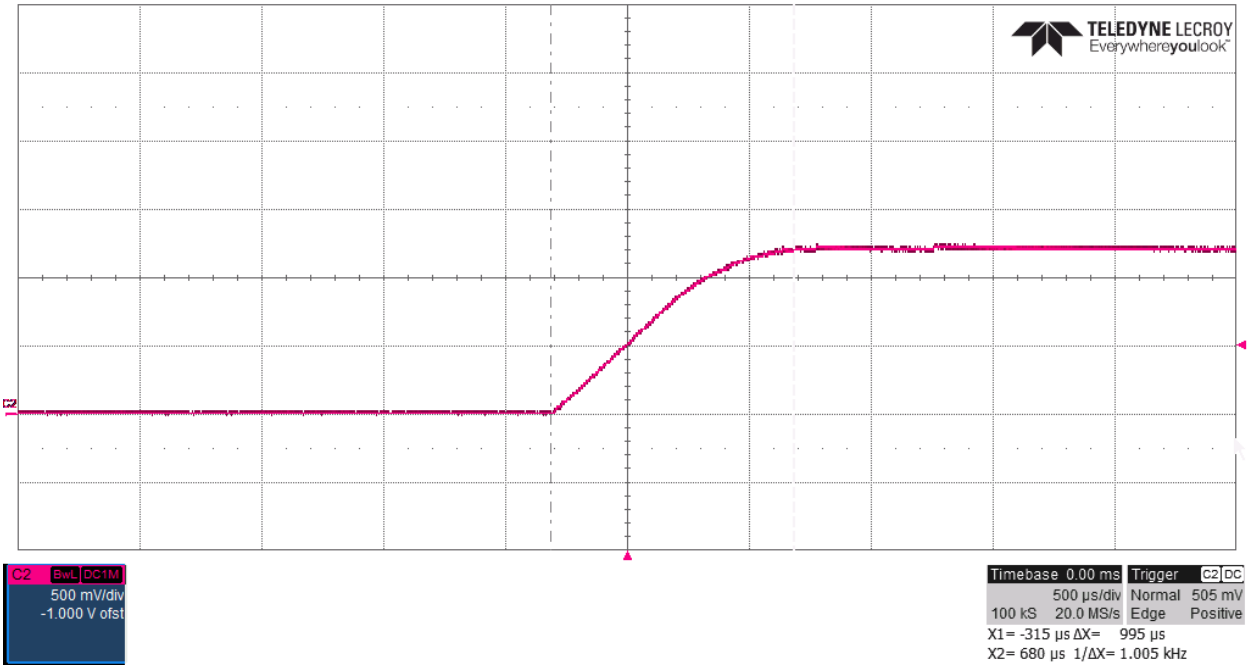


Area analysis	Value
Inductor Max	36.6°C
IC Max	48.1°C

NO.1

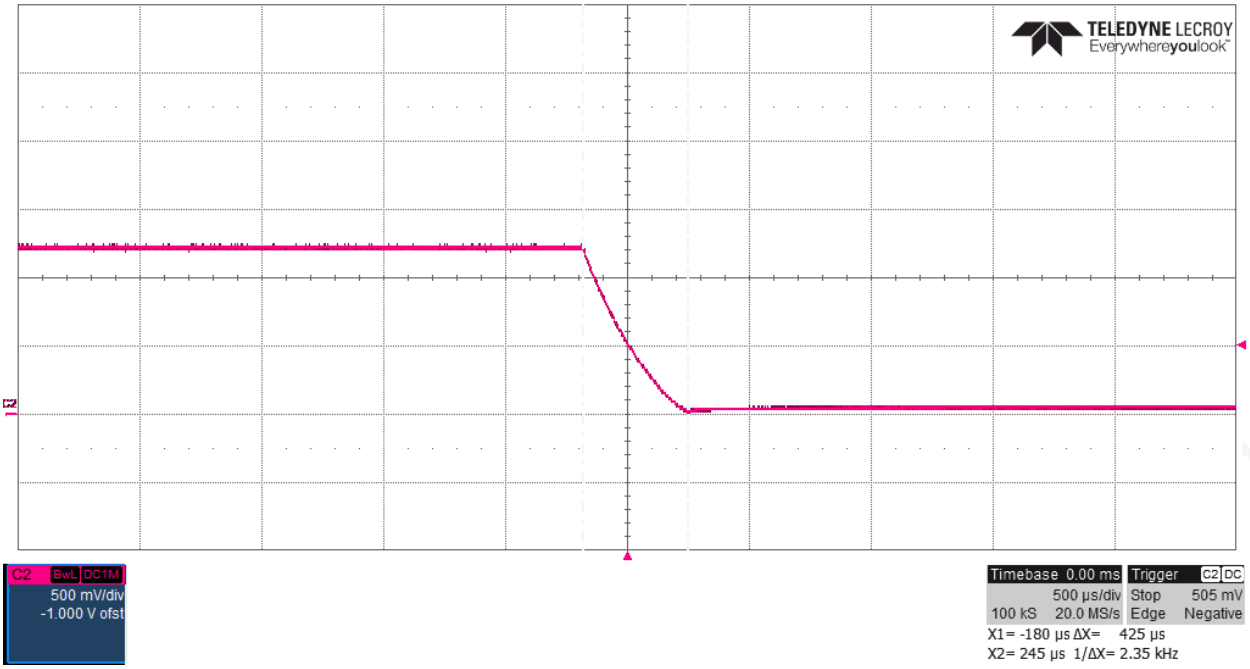
4.5 Startup

The power supply startup at 0A is shown below. The startup time is 750µs.



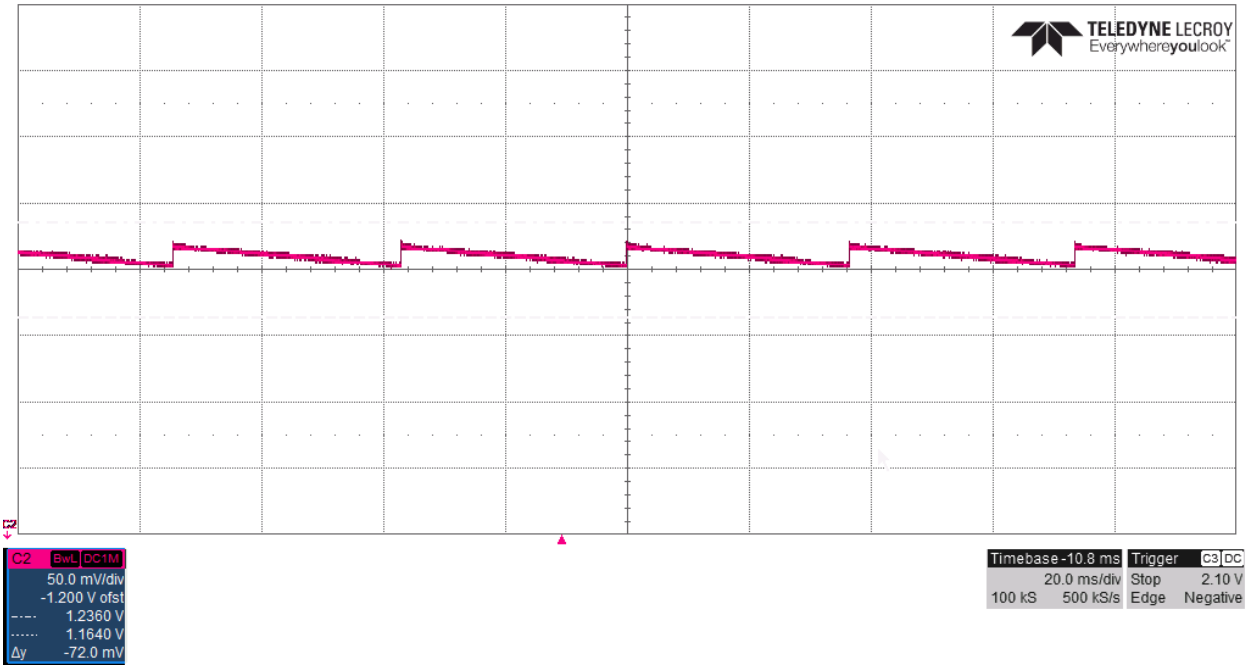
4.6 Shutdown

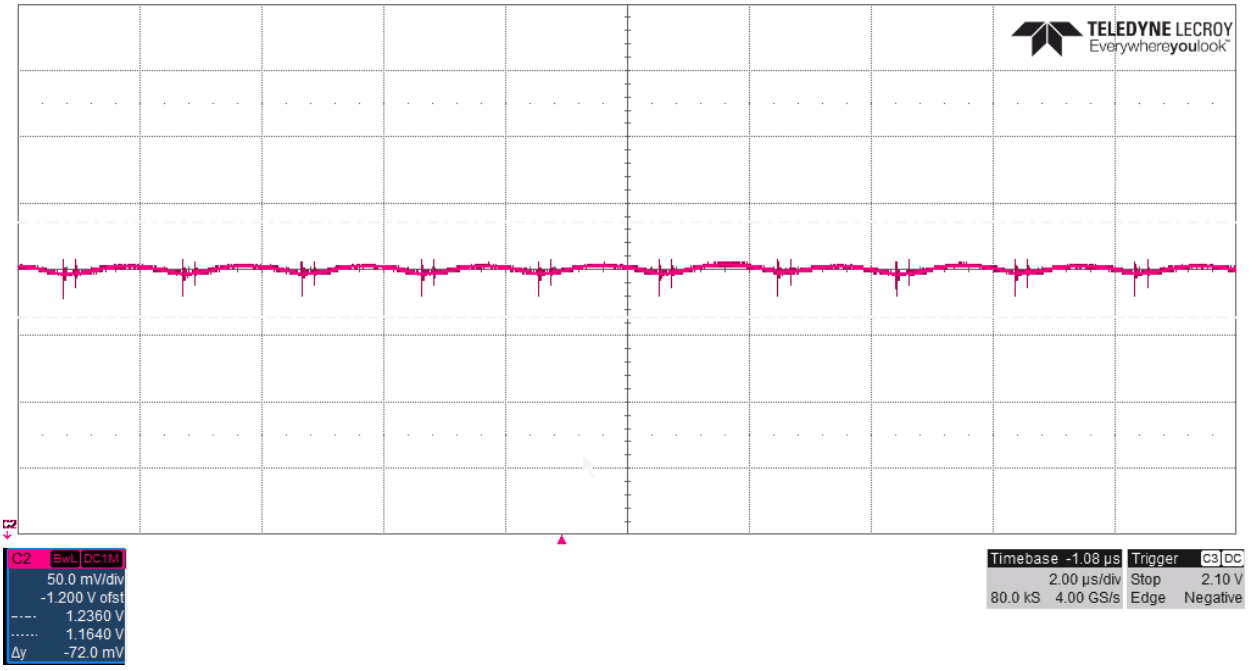
The shutdown of the power supply with 1.2Ω constant-resistance load is shown below.



4.7 Output Ripple

The 1.2V output ripple is shown in red below, DC coupled with offset, for 0A, 6A and 10A, respectively.





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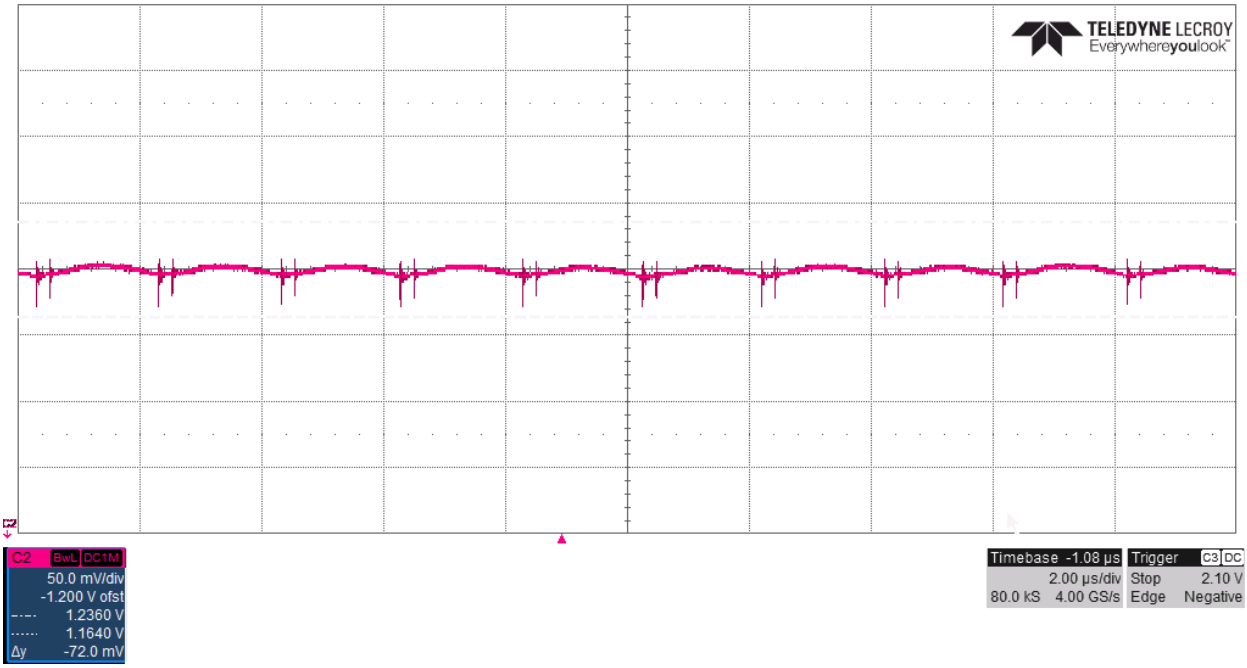
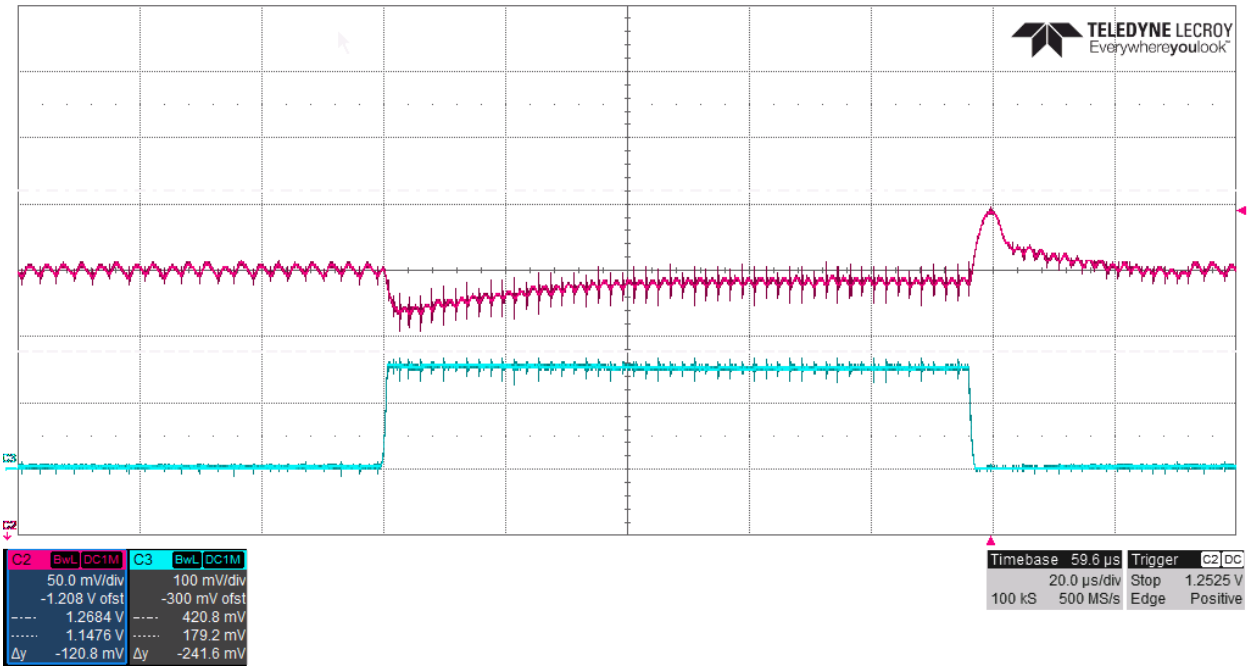


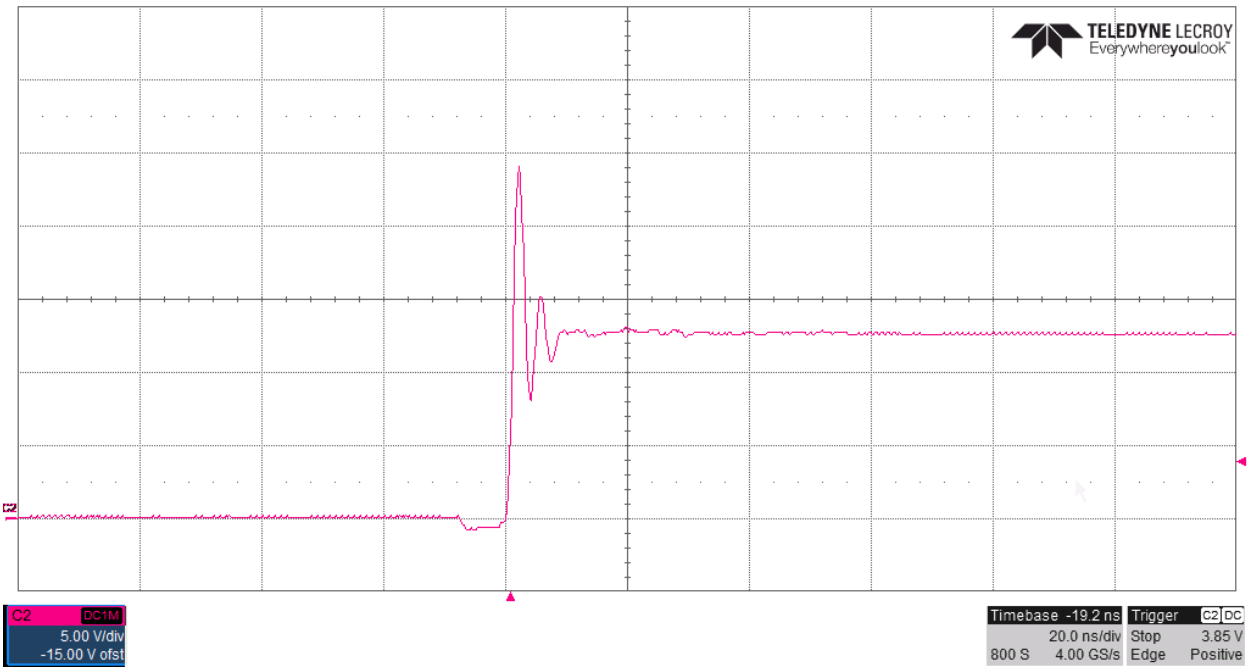
4.8 Transient response

The transient response is shown in the plot below where the red trace is the DC offset output voltage. The current step is 1A-6A-1A at 5A/us slew rate.



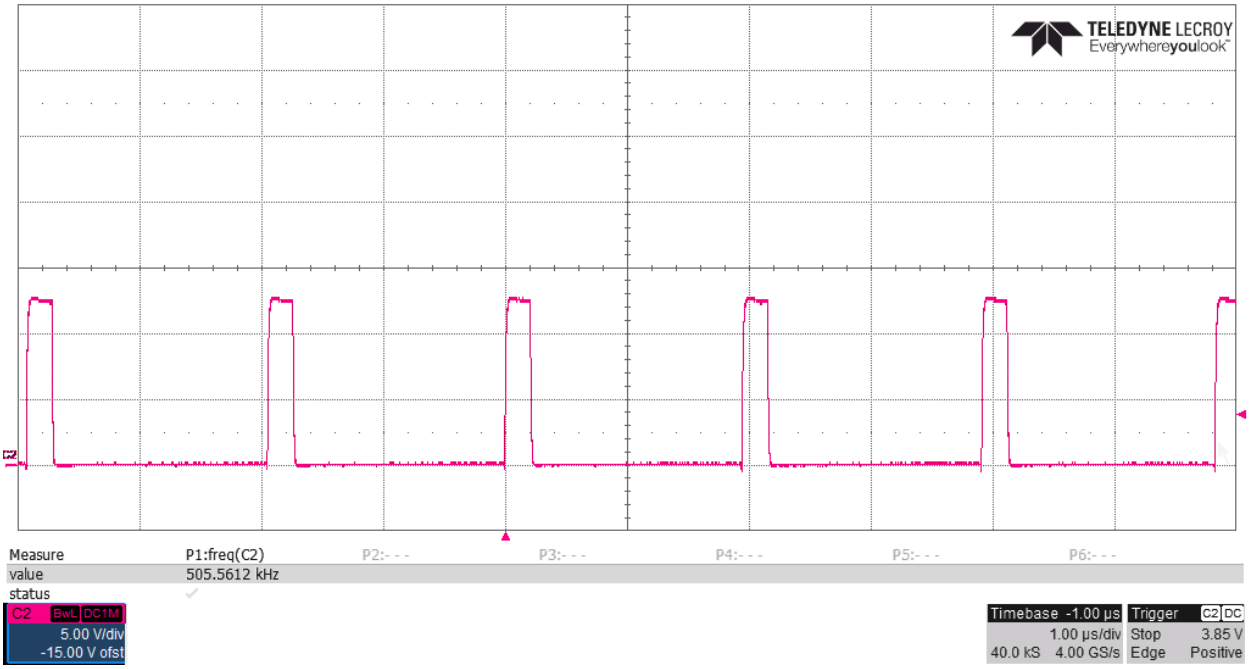
4.9 Synchronous Rectifier Stress

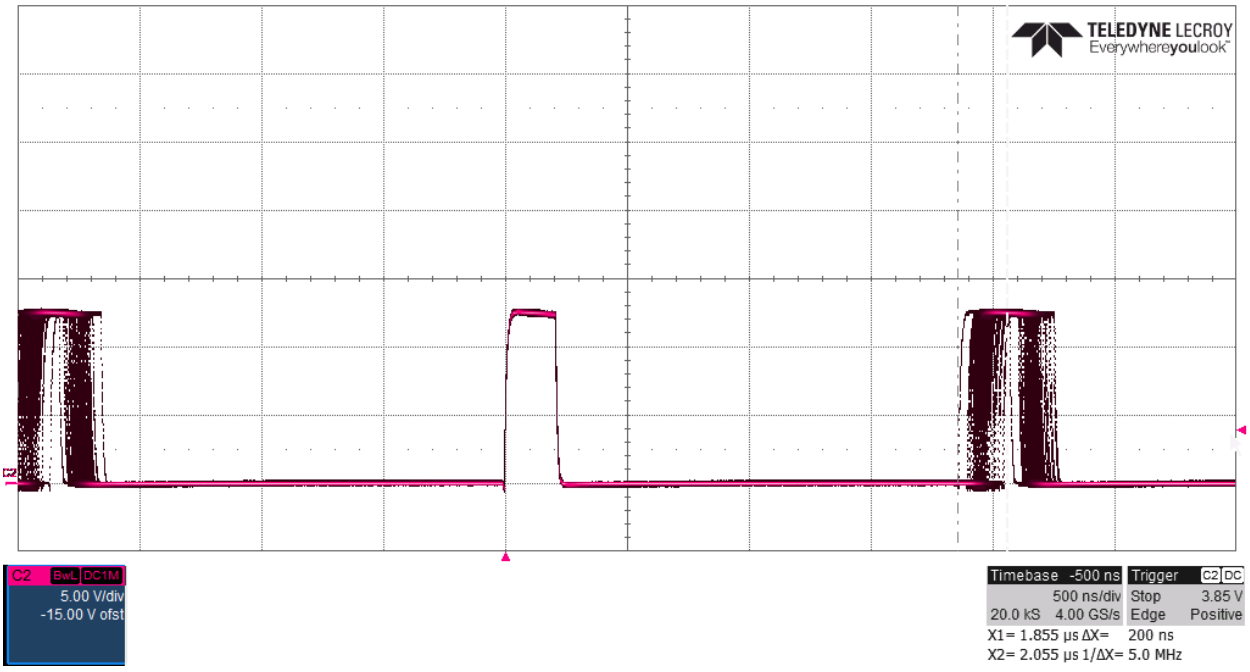
The voltage stresses on the synchronous MOSFETs are shown below. The image is taken at 12Vin and 6A with 200MHz of bandwidth limit.



4.10 Frequency Characteristics

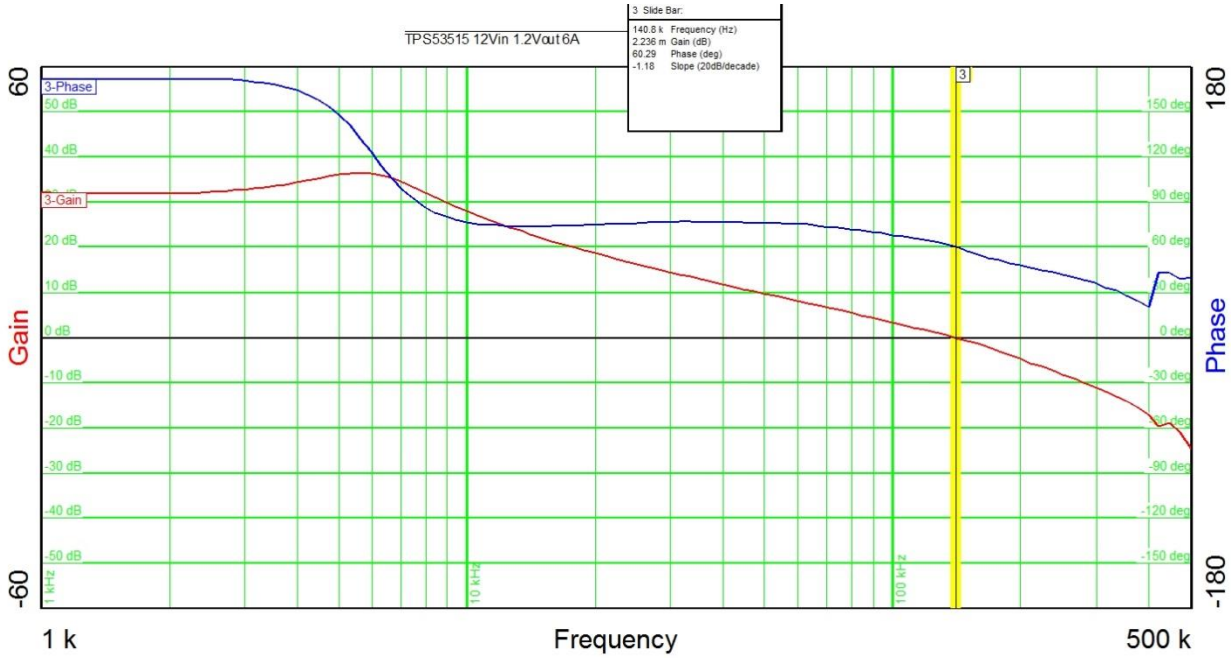
The switch node is shown below in red and measured on the inductor. The first image illustrates the power supply switching frequency of ~500kHz per phase. The second image shows ~200ns of frequency jitter. Both images are taken with 12Vin and 6Aout.





4.11 Loop Response

The loop response of the power supply at 12Vin and 6A load current is shown below. The bandwidth is 140kHz with ~60° of phase margin.



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