Test Report
For PMP15012
04/05/2016

1. Design Specifications

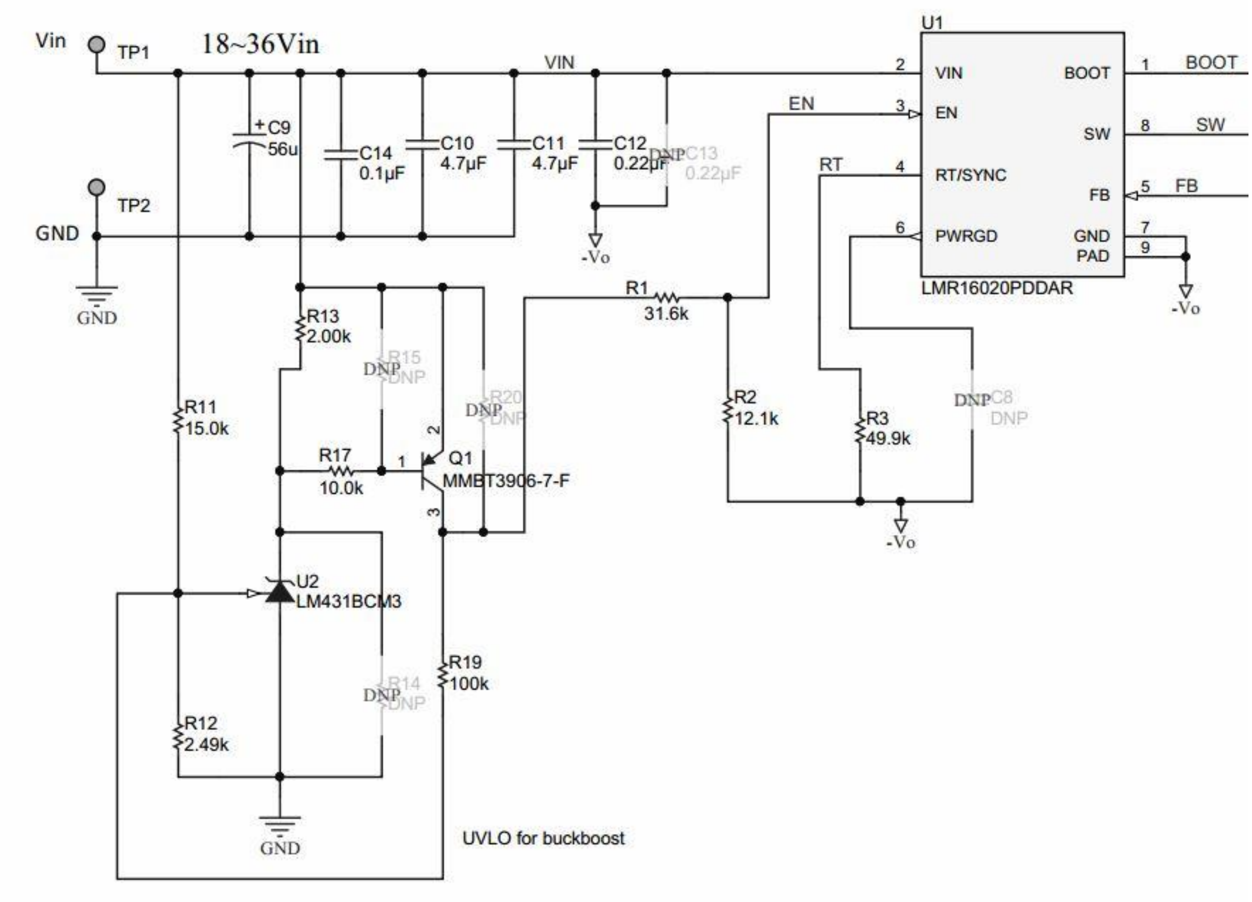
Vin Min	**18VDC**
Vin Max	**36VDC**
Vout	**-15VDC**
Iout	**200mA**
Target Switching Frequency	**500kHz**

2. Circuit Description

PMP15012 is buck-boost solution which accepts an input voltage of 18 to 36V_{IN} and provides negative 15V/200mA output to the load. This reference design adds an external UVLO circuit to narrow the UVLO hysteresis because buck-boost converter is hard to shut down. This LMR16020 buck-boost reference design can be used for supplying the DAC/ADC/OA in industrial application.

3. External UVLO Circuit Principle

The detail UVLO circuit is as below.



1) In usual situation (connect R_{20}), start up voltage is

$$\frac{V_{in1}}{R_1 + R_2} \cdot R_2 = V_{EN} \qquad (1)$$

Shut down voltage is

$$\frac{V_{in2} - V_o}{R_1 + R_2} \cdot R_2 = V_{EN} \qquad (2)$$

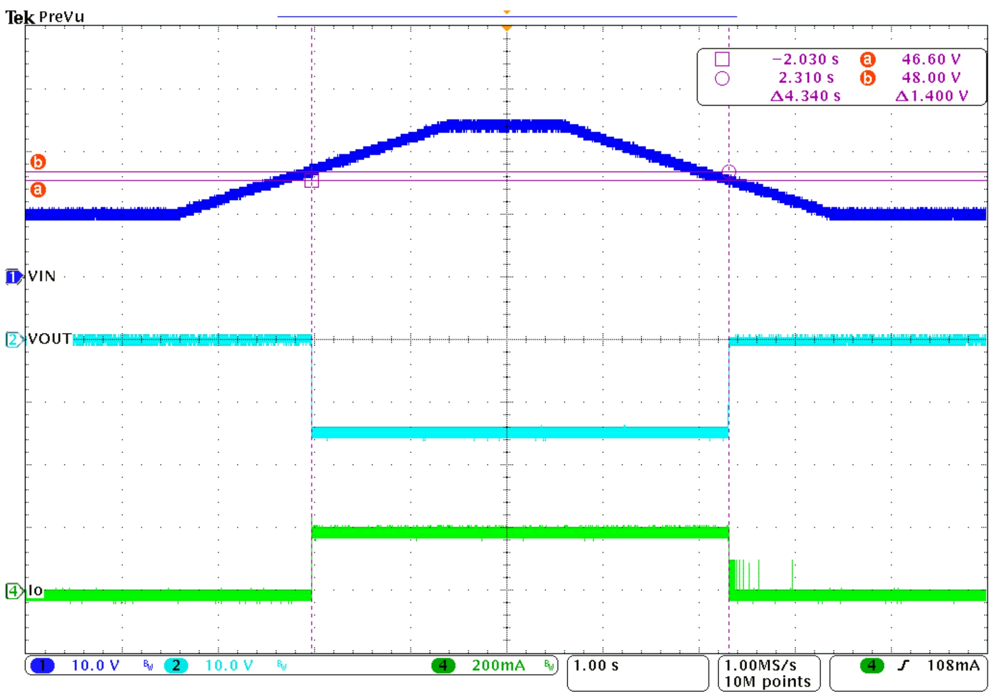
The UVLO hysteresis is

$$V_{hys} = V_{in1} - V_{in2} = -V_o \qquad (3)$$

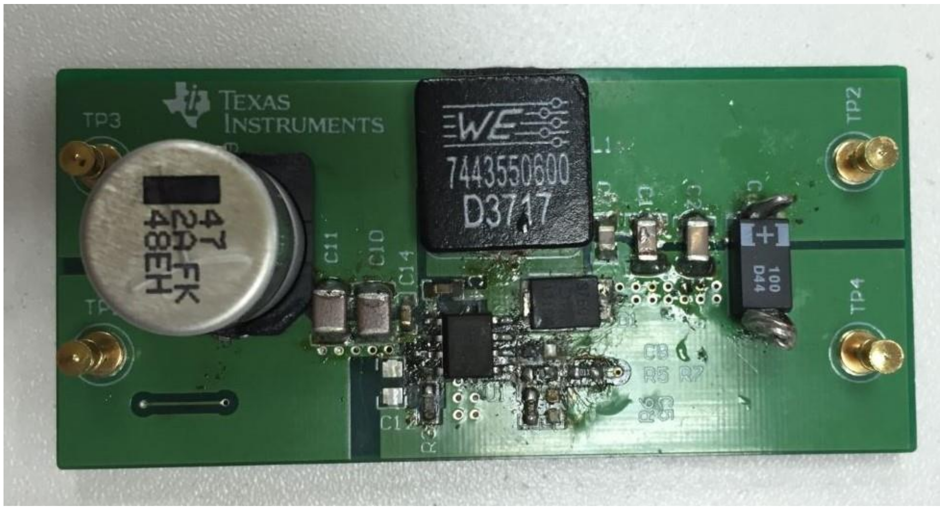
In this situation, the UVLO hysteresis is relative to output voltage, if the Vout is high, the hysteresis will be large, which is not reasonable in real application.

2) Add the external UVLO circuit (disconnect R_{20}). In this situation, start up voltage is decided by R_{11} and R_{12}. Once V_{IN} exceeds $2.5(R_{11}+R_{12})/R_{12}$, output of LM431 goes low and Q_1 conducts. Collector voltage of Q_1 is equal to V_{IN} so IC start up as usual buck converter. Once V_{IN} decreases below $2.5(R_{11}+R_{12})/R_{12}$, output of LM431 goes high and Q_1 disabled. The UVLO divide path is R_{11}- R_{12}- R_{19}- R_1- R_2. Choosing a large R_{19} could shut down the IC immediately. Adjusting R_{13} and R_{17} could adjust the DC operate point of Q_1.

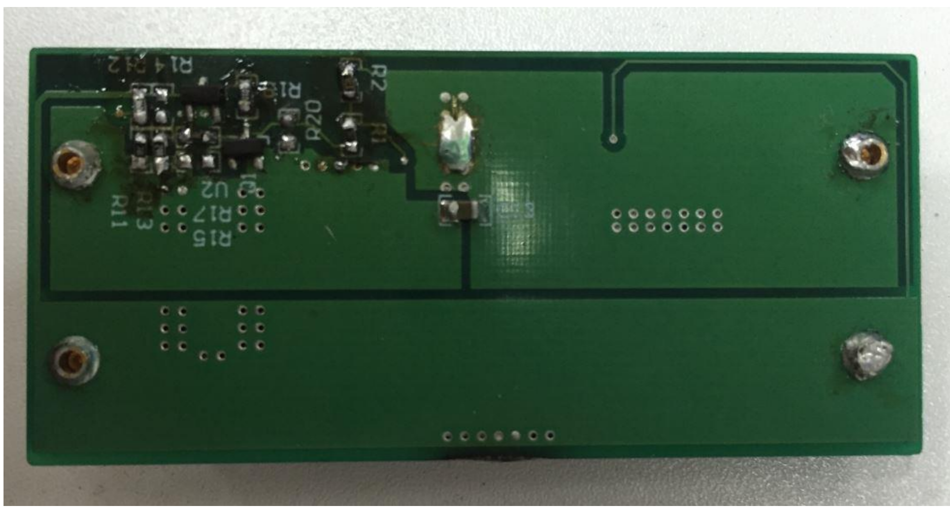
The startup and shut down waveform is as below. Test condition is: V_{IN}: 10V-24V-10V, I_o=200mA, the UVLO hysteresis is about 1.4V.



4. Board Photos

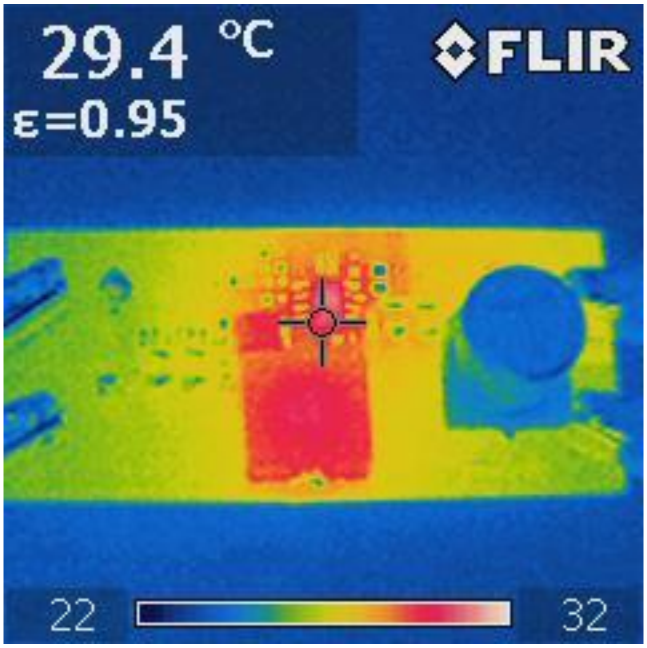


Top (66.29x33.48mm^2)

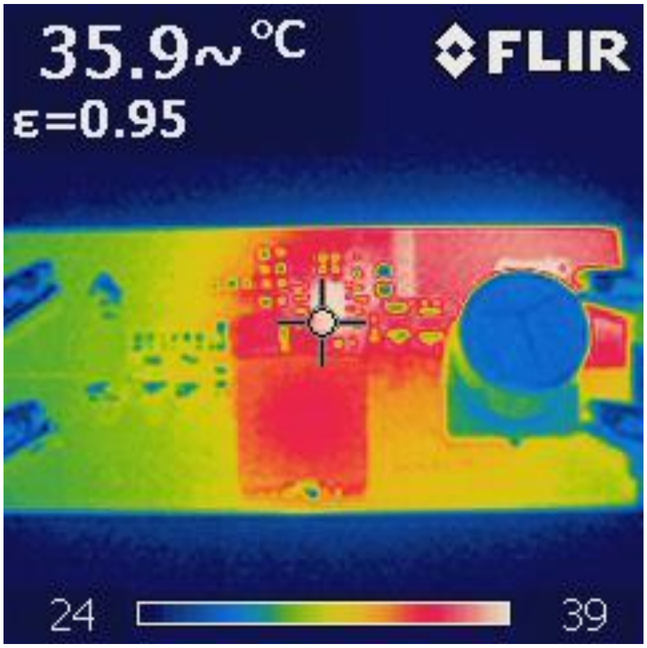


Bottom (66.29x33.48mm^2)

5. Thermal Data



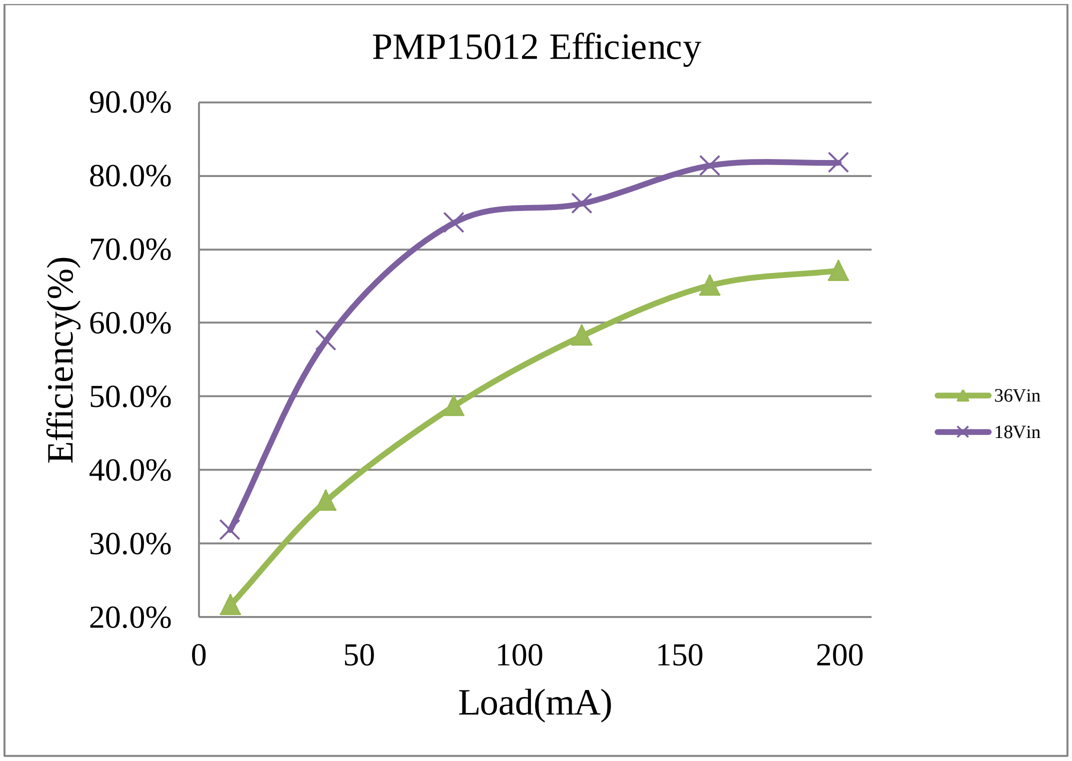
IR thermal image taken at steady state at 200mA load and V_{IN} = 18V for two minutes with no airflow (4 Layer board, 1 Oz copper layer)



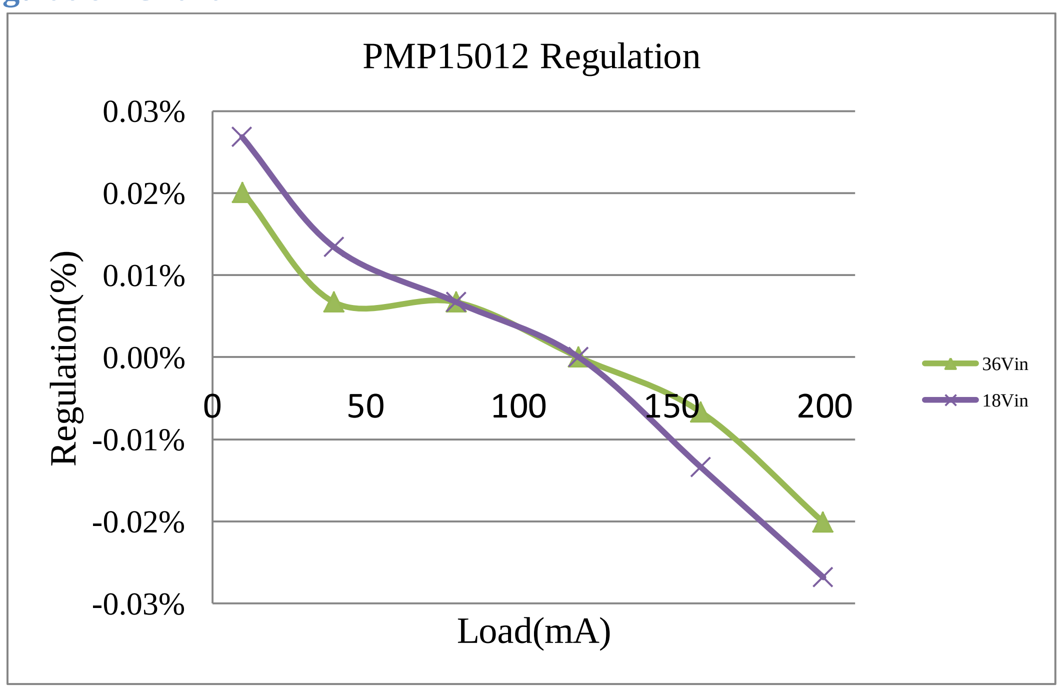
IR thermal image taken at steady state at 200mA load and VIN = 36V for two minutes with no airflow (4 Layer board, 1 Oz copper layer)

6. Efficiency and Regulation

6.1 Efficiency Chart

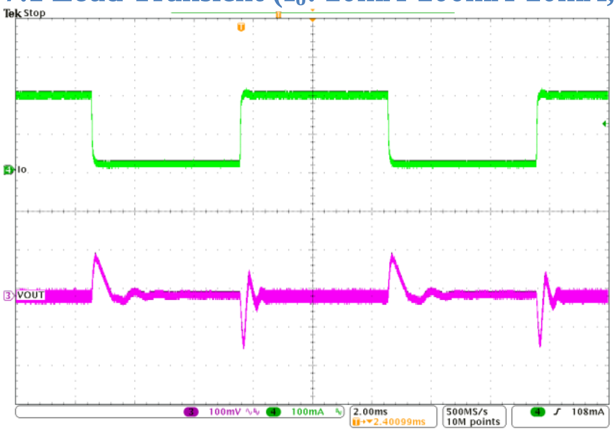


6.2 Regulation Chart

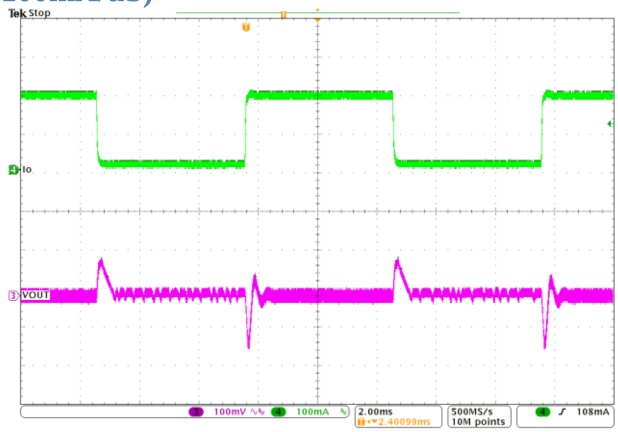


7. Waveform

7.1 Load Transient (I_0: 20mA-200mA-20mA, 100mA/uS)

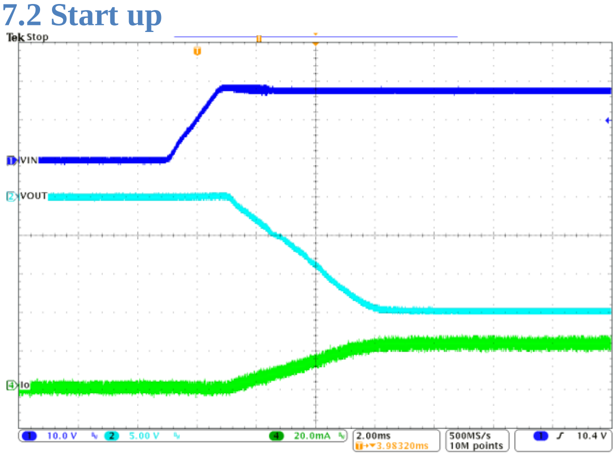


V_{IN}=18V

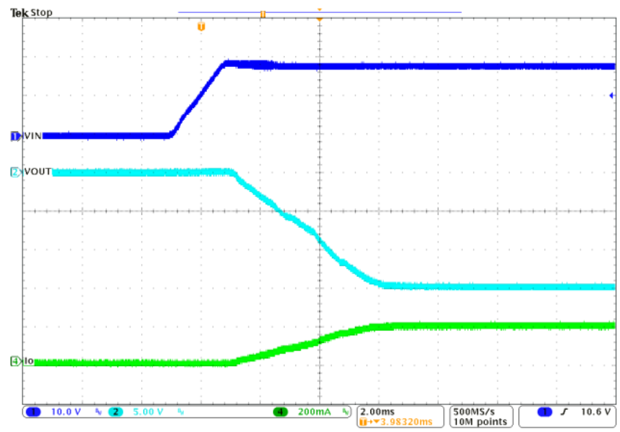


V_{IN}=36V

7.2 Start up



V_{IN}=18V, I_O=20mA



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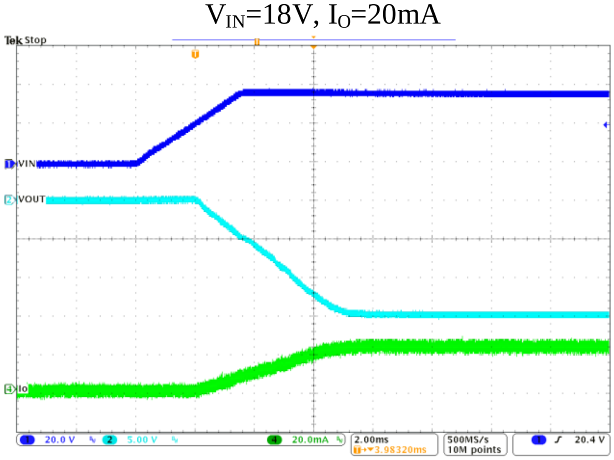
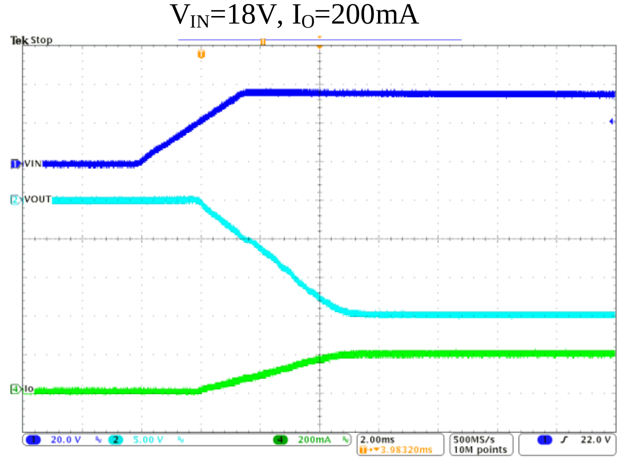
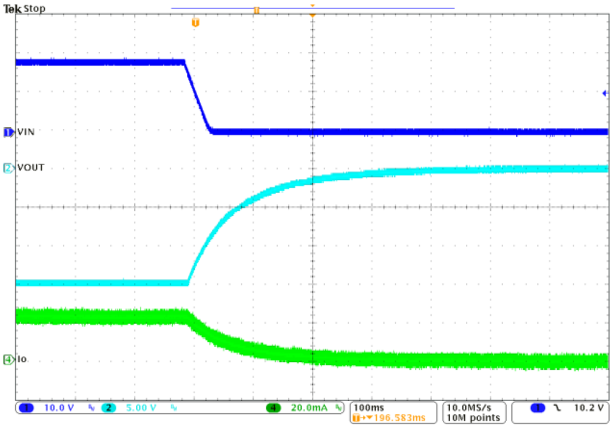


V_{IN}=36V, I_O=20mA

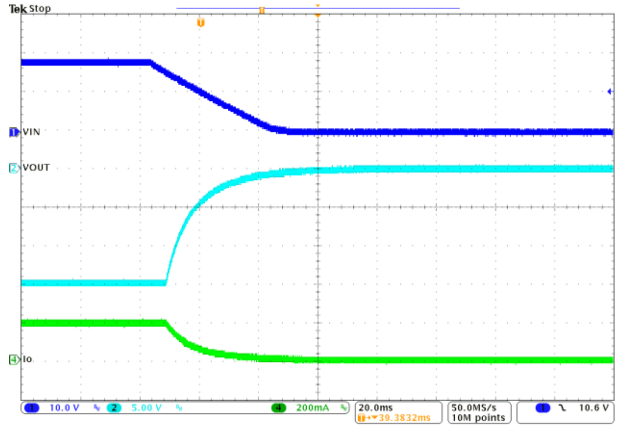


V_{IN}=36V, I_O=200mA;

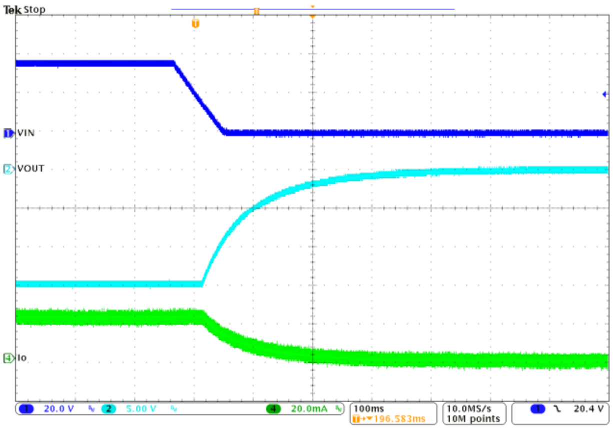
7.3 Shutdown



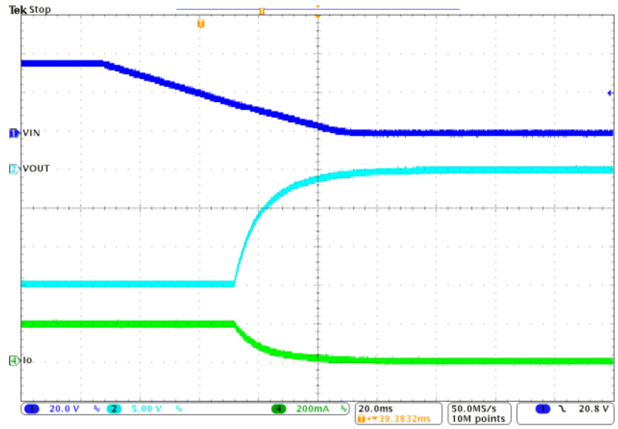
V_{IN}=18V, I_O=20mA



V_{IN}=18V, I_O=200mA

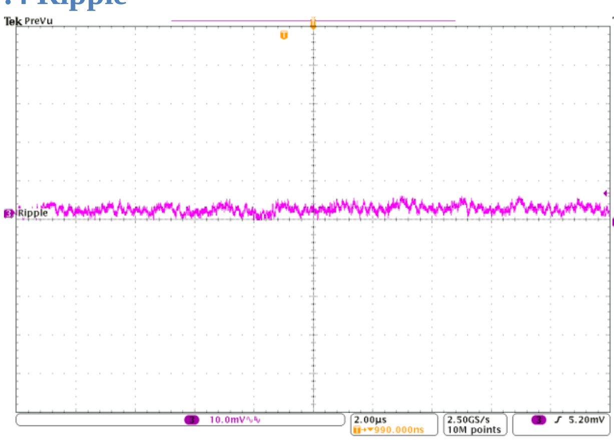


V_{IN}=36V, I_O=20mA

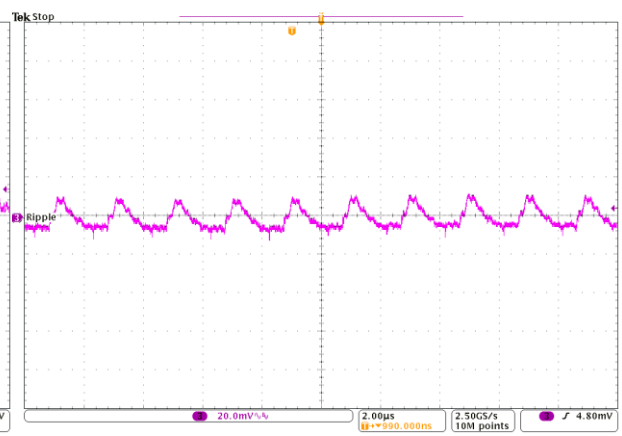


V_{IN}=36V, I_O=200mA

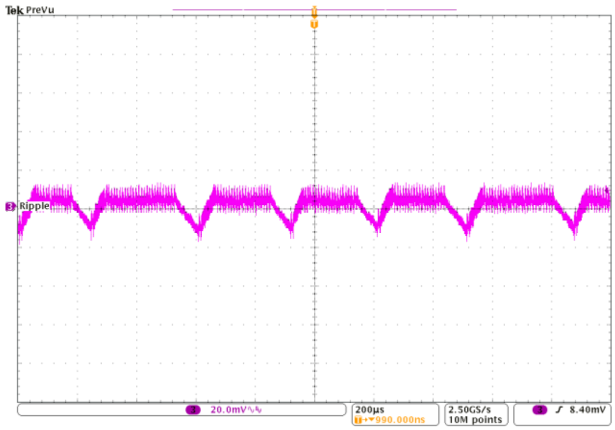
7.4 Ripple



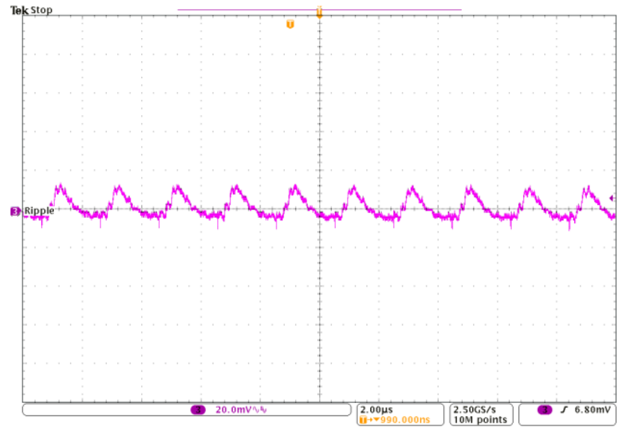
V_{IN}=18V, I_O=20mA



V_{IN}=18V, I_O=200mA

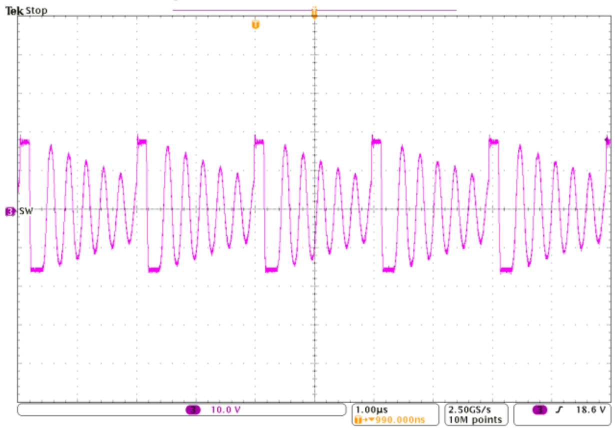


V_{IN}=36V, I_O=20mA

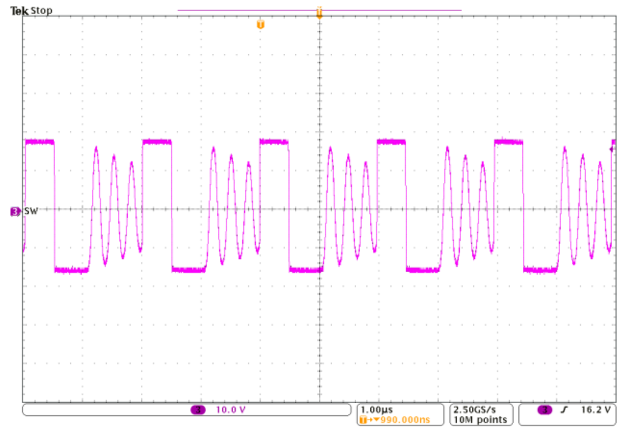


V_{IN}=36V, I_O=200mA

6.5 Switching



V_{IN}=18V, I_O=20mA



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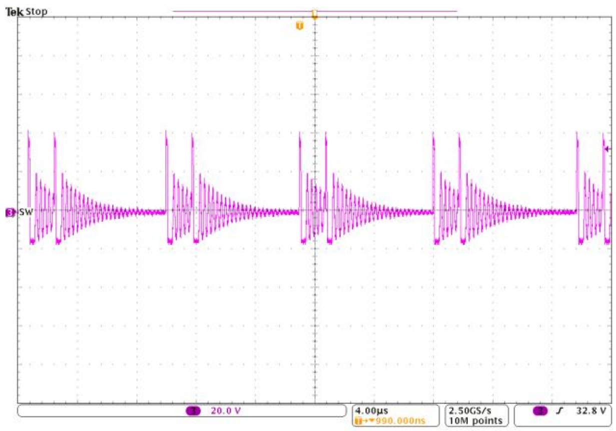
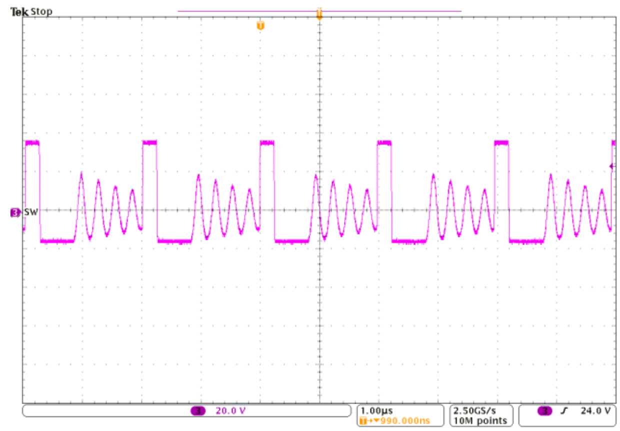


V_{IN}=36V, I_O=20mA



V_{IN}=36V, I_O=200mA

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