# LM27403 Synchronous Buck Converter

## TI reference design number: PMP8000

## Input: 12V
## Output: 5V @ 30A

## DC – DC Test Results

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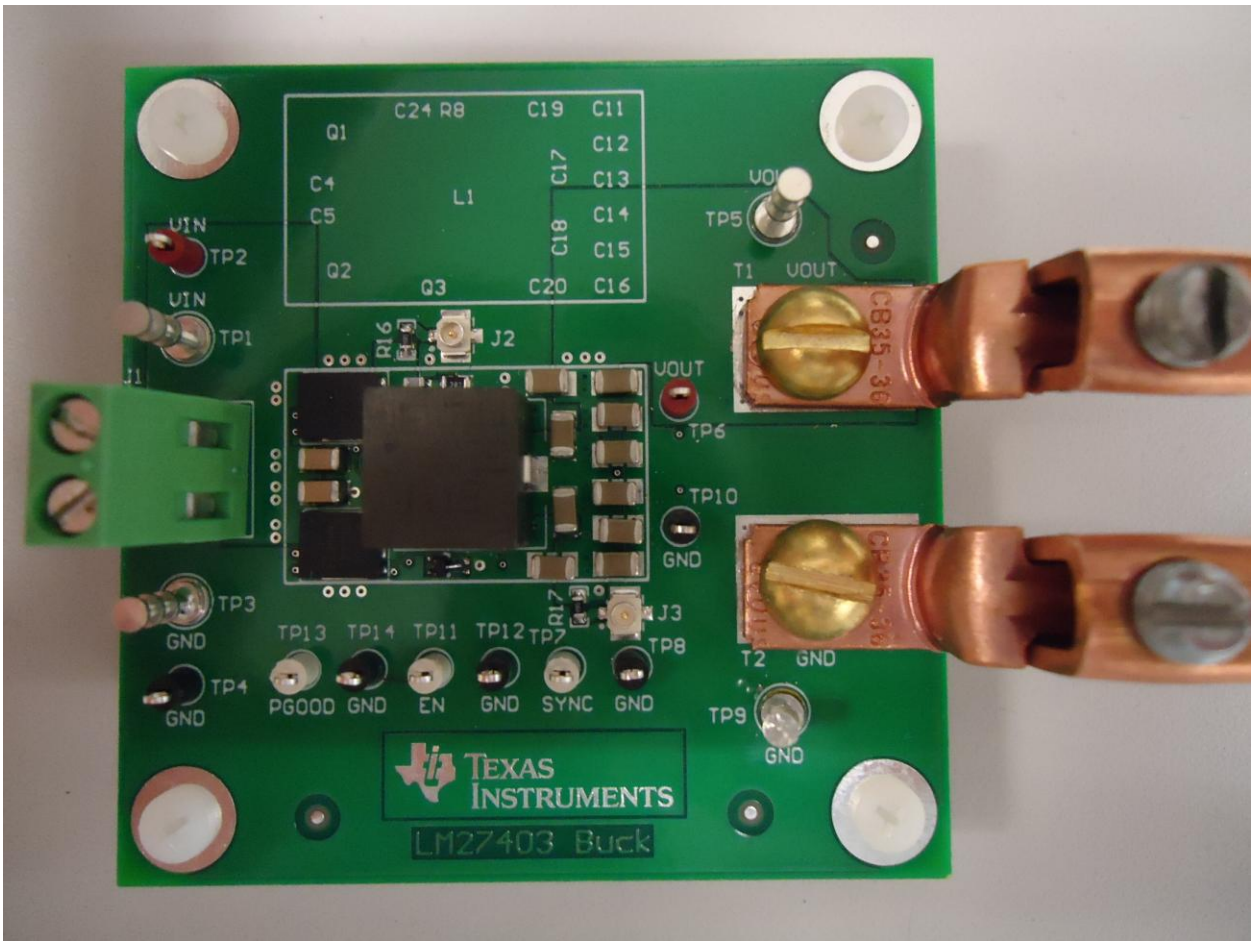
# 1 Circuit Description

PMP8000 is a single-phase synchronous buck converter rated for 5V output at 30A from an input voltage of 12V. This design uses the LM27403 synchronous buck controller at a switching frequency of 500 kHz. CSD87350Q5D power block MOSFETs provide maximum efficiency when combined with a 250nH ferrite output inductor. The design solution uses all ceramic capacitors to fit into a minimum board area.

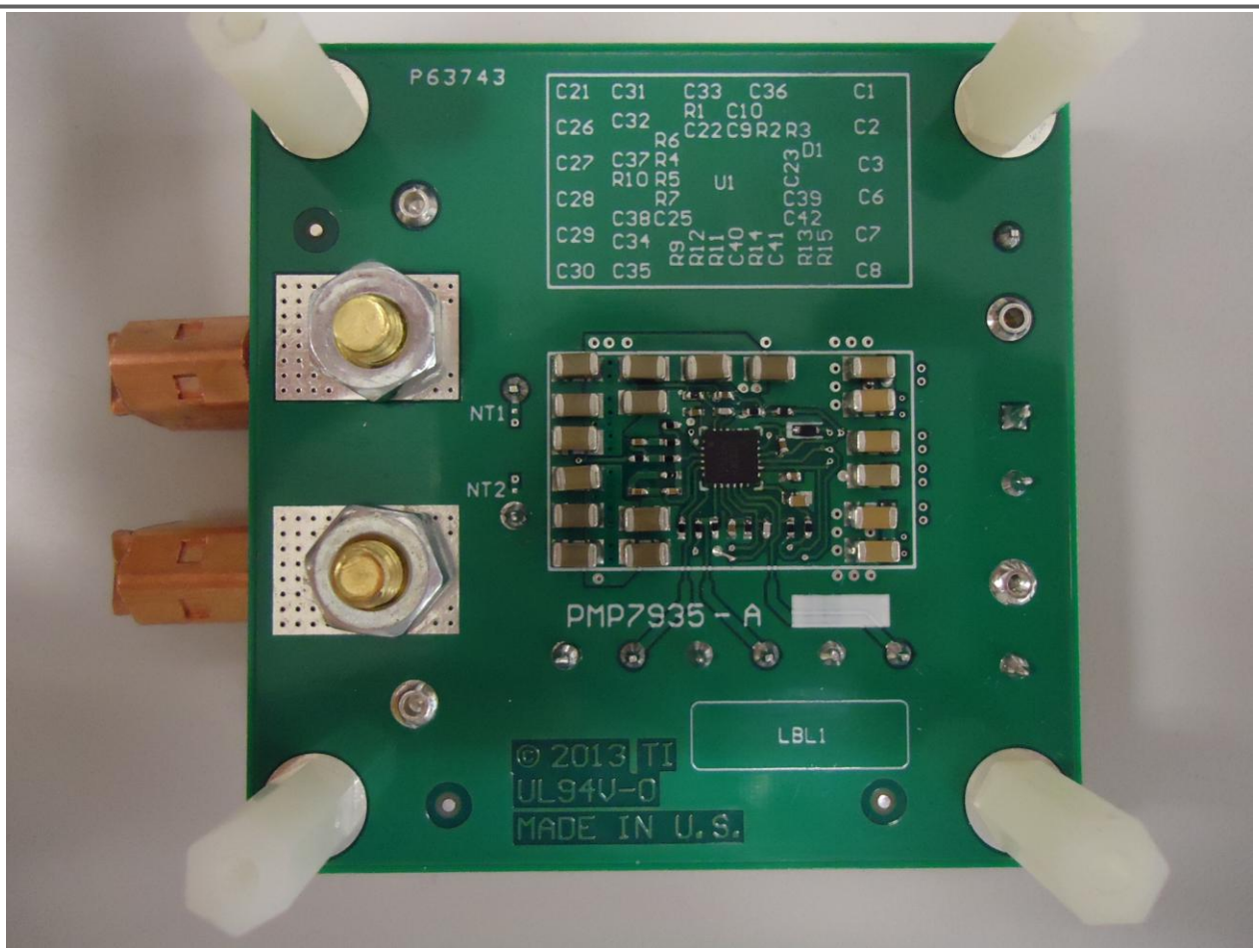
All tests were performed at room temperature on an open bench. A 470µF, 25V aluminum electrolytic input capacitor was used for input filter damping.

# 2 Photos

The photographs below show the PMP8000 Rev A assembly as built on PMP7935-A printed circuit board. This is a 4 layer board using 2 ounce copper on external layers and 1 ounce copper on internal layers. Power components are mounted on the top side of the board, with the control circuit on the bottom. The overall board dimensions are 2.5" x 2.5". The solution size component area is 1.1" x 0.65". The maximum component height is set by the inductor at 9.4 mm.

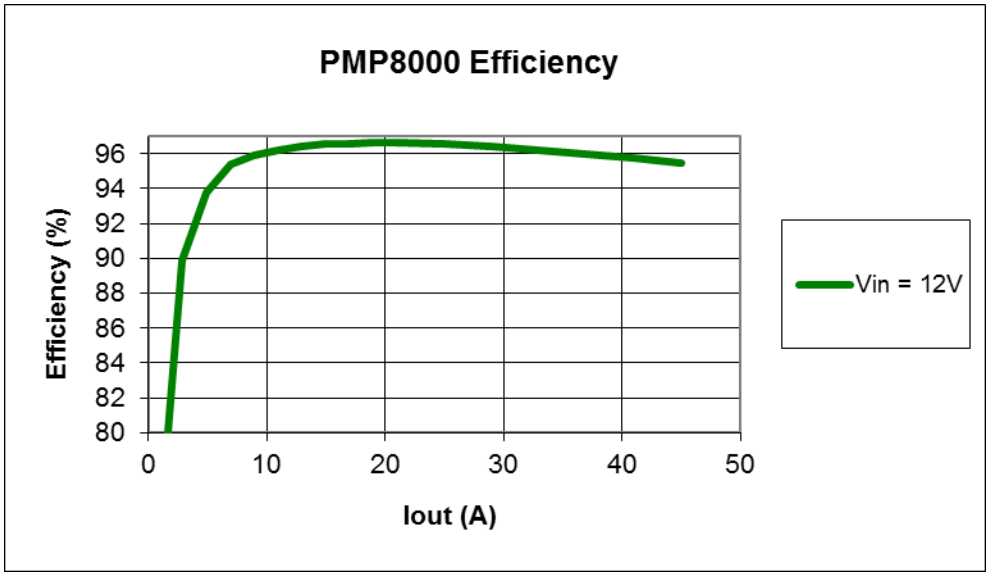


# PMP8000 Test Results



## 3 Efficiency

The efficiency data is shown in the tables and graph below.



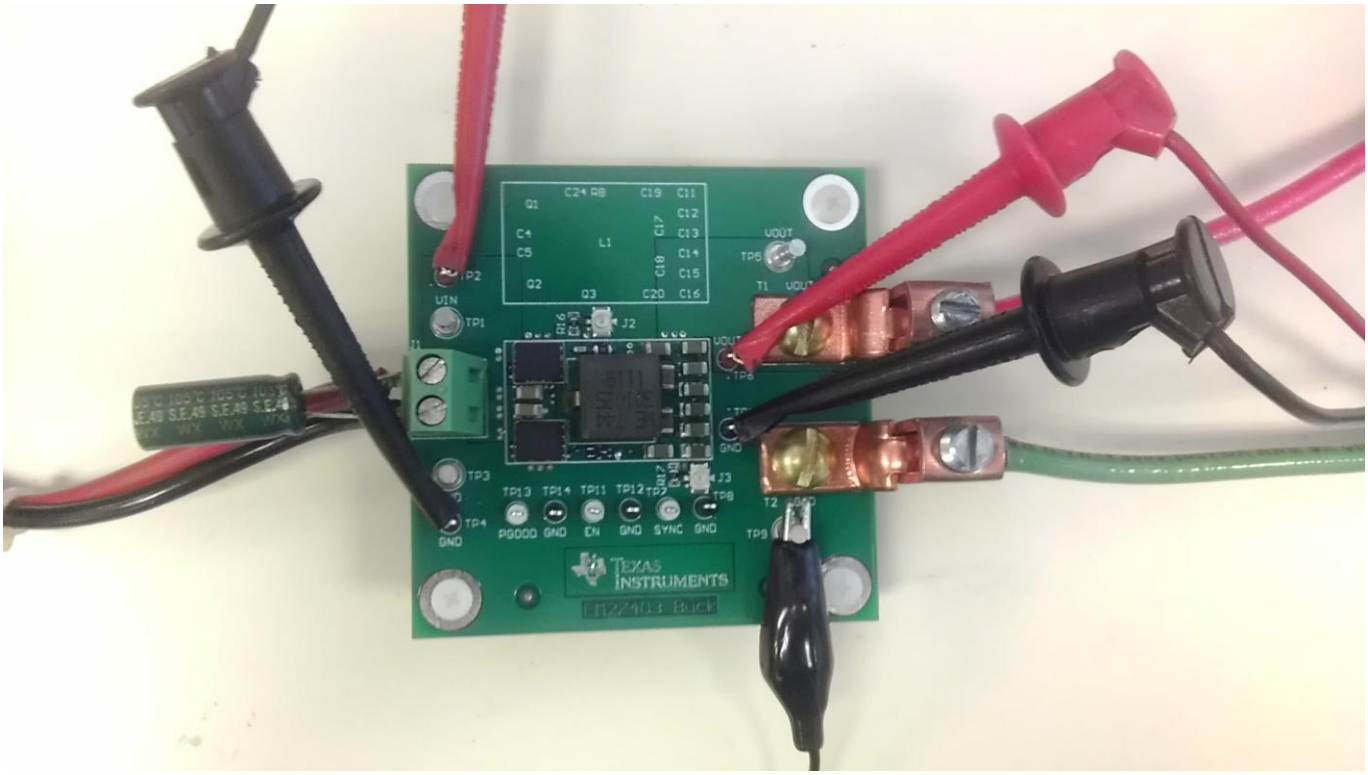

| Vin(V) | Iin(A) | Vout(V) | Iout(A) | Efficiency(%) | Pin(W) | Pout(W) | Pdis(W) |
|---|---|---|---|---|---|---|---|
| 12.000 | 0.135 | 5.017 | 0.00 | 0.000 | 1.62 | 0.00 | 1.62 |
| 12.000 | 0.510 | 5.018 | 0.90 | 73.794 | 6.12 | 4.52 | 1.60 |
| 12.000 | 1.350 | 5.020 | 2.90 | 89.864 | 16.20 | 14.56 | 1.64 |
| 12.000 | 2.195 | 5.021 | 4.92 | 93.786 | 26.34 | 24.70 | 1.64 |
| 12.000 | 3.045 | 5.024 | 6.94 | 95.420 | 36.54 | 34.87 | 1.67 |
| 12.000 | 3.905 | 5.026 | 8.94 | 95.887 | 46.86 | 44.93 | 1.93 |
| 12.0000 | 4.755 | 5.028 | 10.92 | 96.225 | 57.06 | 54.91 | 2.15 |
| 11.999 | 5.625 | 5.030 | 12.94 | 96.435 | 67.49 | 65.09 | 2.41 |
| 11.999 | 6.495 | 5.031 | 14.96 | 96.574 | 77.93 | 75.26 | 2.67 |
| 11.999 | 7.365 | 5.032 | 16.96 | 96.571 | 88.37 | 85.34 | 3.03 |
| 11.999 | 8.240 | 5.033 | 18.98 | 96.616 | 98.87 | 95.53 | 3.35 |
| 11.998 | 9.100 | 5.034 | 20.96 | 96.639 | 109.18 | 105.51 | 3.67 |
| 11.998 | 10.865 | 5.038 | 24.98 | 96.541 | 130.36 | 125.85 | 4.51 |
| 11.997 | 12.635 | 5.043 | 28.98 | 96.414 | 151.58 | 146.15 | 5.44 |
| 11.996 | 14.44 | 5.051 | 33.00 | 96.225 | 173.22 | 166.68 | 6.54 |
| 11.995 | 16.265 | 5.057 | 37.02 | 95.957 | 195.10 | 187.21 | 7.89 |
| 11.995 | 18.08 | 5.061 | 41.02 | 95.727 | 216.87 | 207.60 | 9.27 |
| 11.993 | 19.92 | 5.063 | 45.04 | 95.453 | 238.90 | 228.04 | 10.86 |

# 4 Thermal Tests

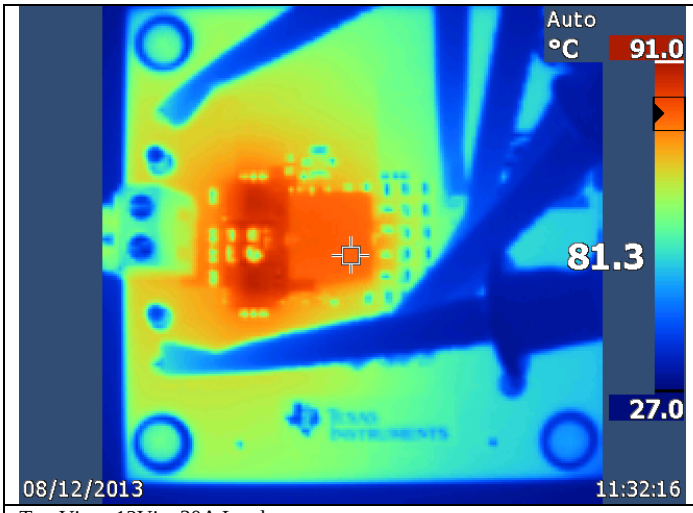
All tests were performed at room temperature on an open bench.

## 4.1 Test Setup

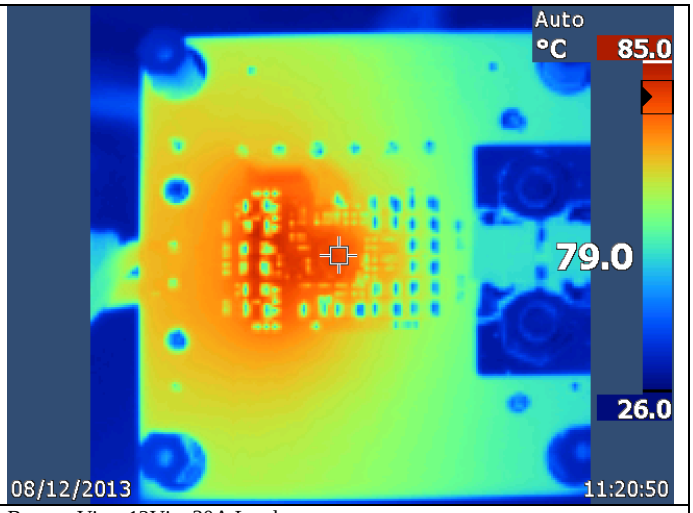
Thermal data was taken with a Fluke handheld thermal camera.



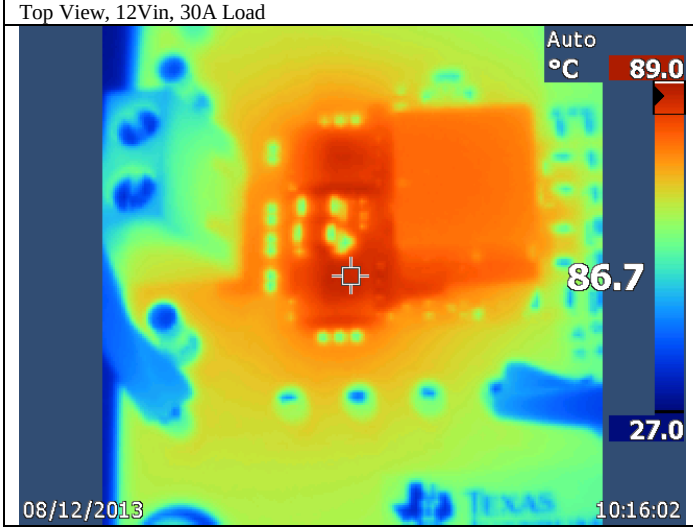
### 4.2 30A Load, No Airflow

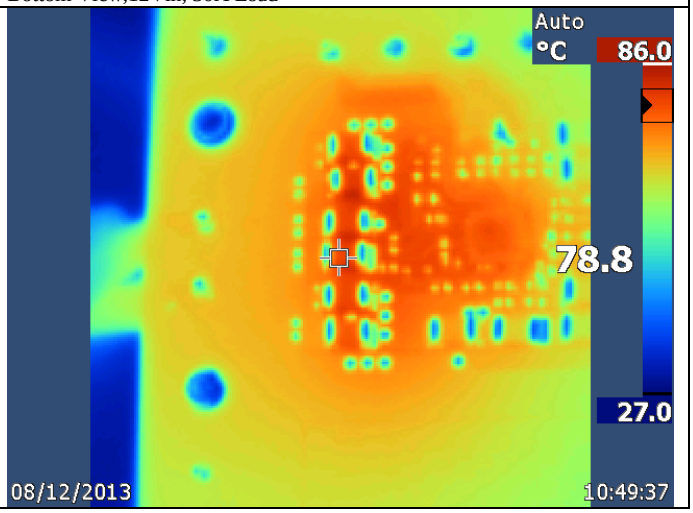



Top View, 12Vin, 30A Load




Bottom View,12Vin, 30A Load

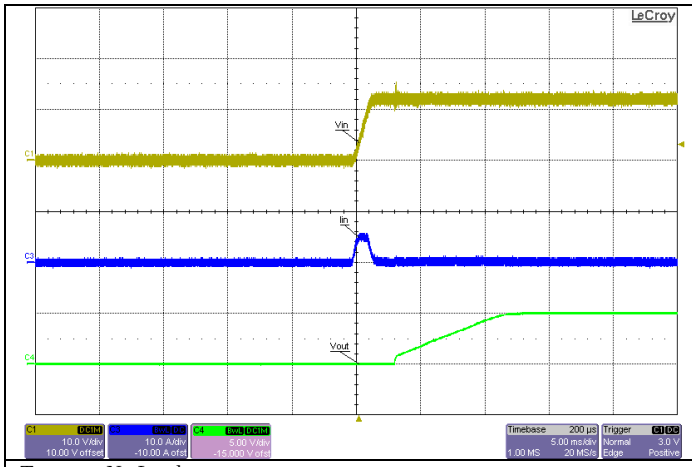


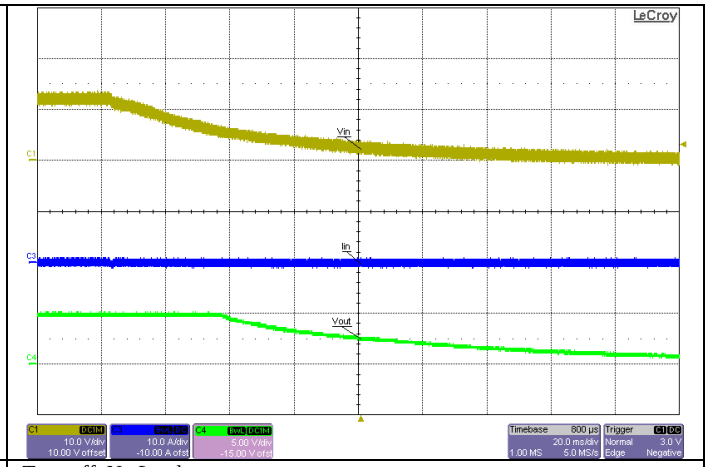
# 5 Startup and Shutdown Behavior

## 5.1 Turn-on and Turn-off from Vin

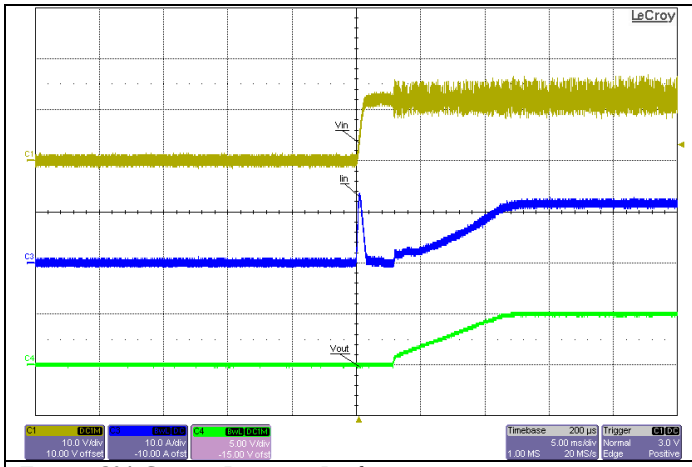
The output voltage is well controlled at turn-on, showing no evidence of over-shoot.



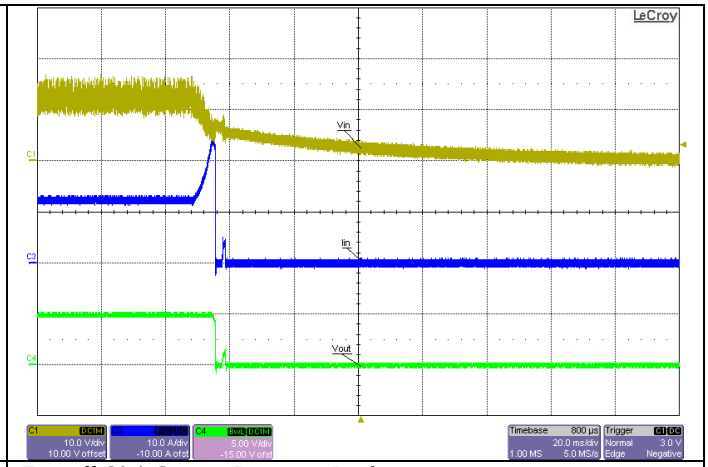

Turn-on, No Load




Turn-off, No Load



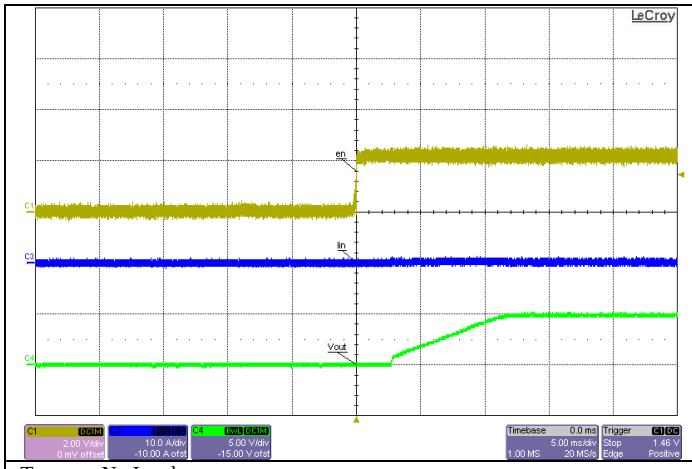

Turn-on, 30A Constant Resistance Load



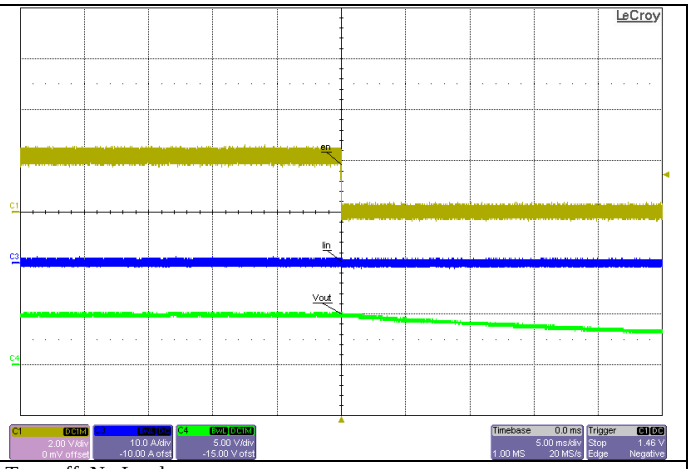

Turn-off, 30 A Constant Resistance Load

## 5.2 Turn-on and Turn-off from EN

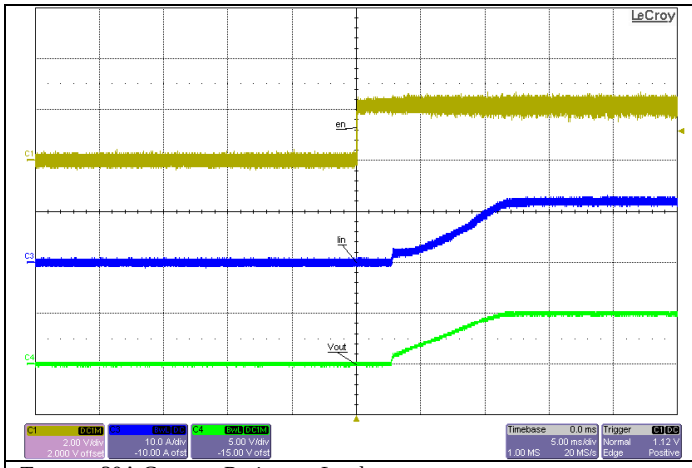
The output voltage is well controlled at turn-on, showing no evidence of over-shoot. Some ringing occurs at turn-off with load due to the output filter resonance.



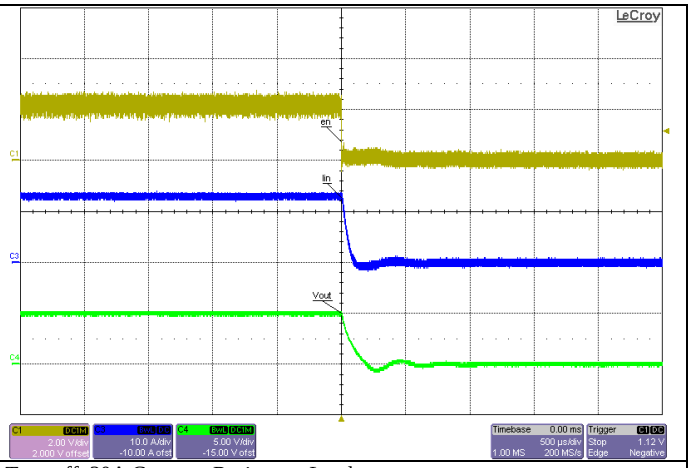

Turn-on, No Load




Turn-off, No Load




Turn-on, 30A Constant Resistance Load

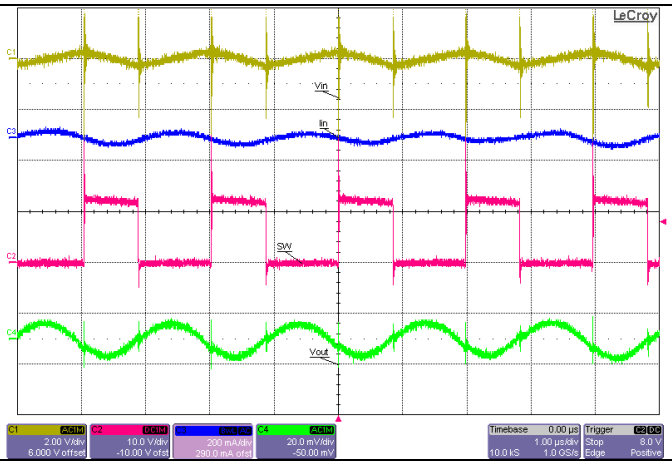



Turn-off, 30A Constant Resistance Load

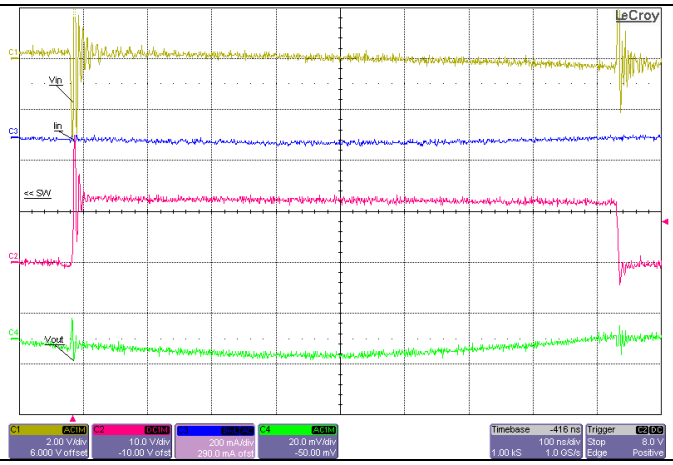
# 6 Switching and Ripple

## 6.1 Switching and Ripple

Switching and ripple tests were made with a 470µF, 25V aluminum electrolytic input capacitor for input filter damping.




Switching and Ripple, 30A Load



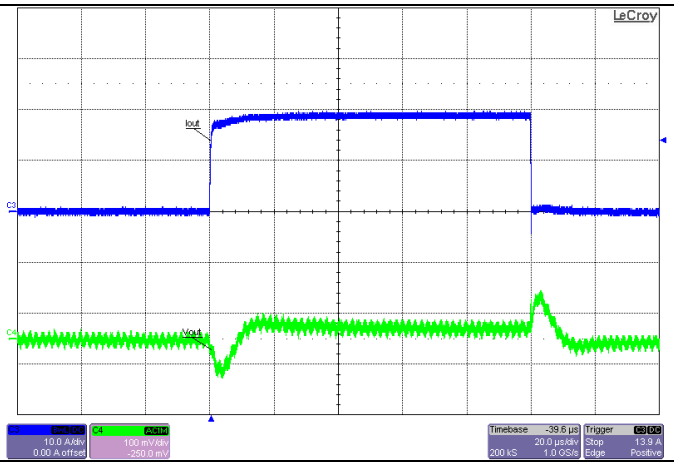

Switching and Ripple, 30A Load

# 7 Load Transient Response

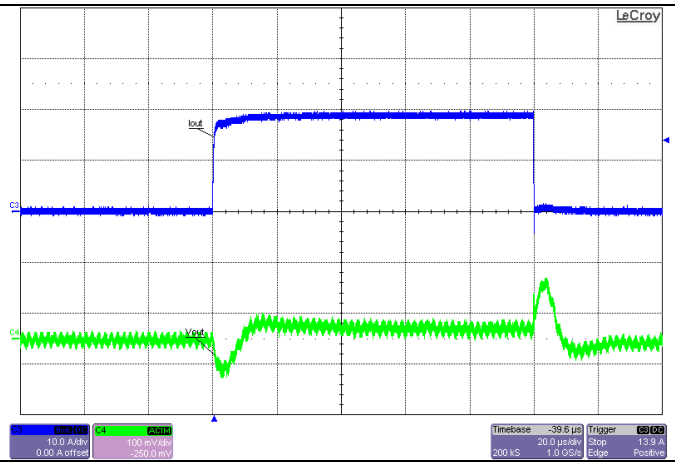
Load transient response for each condition was taken at two points to represent the minimum and maximum deviation. This difference occurs when the transient step coincides with either the converter off-time or on-time interval.

## 7.1 Load Transient Response

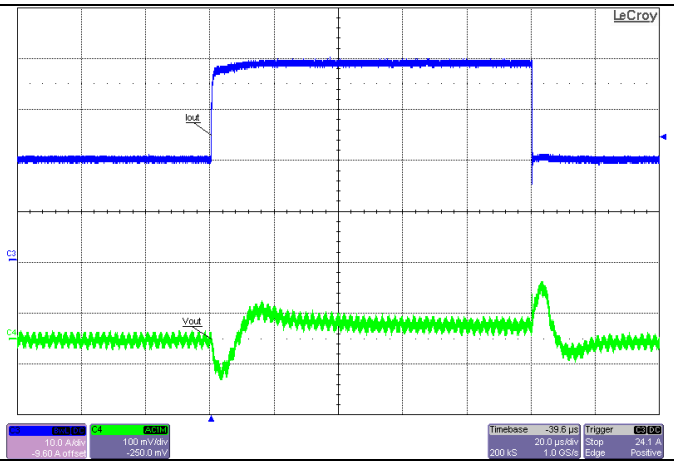
The output voltage transient is within 100mV for a 20A load step.



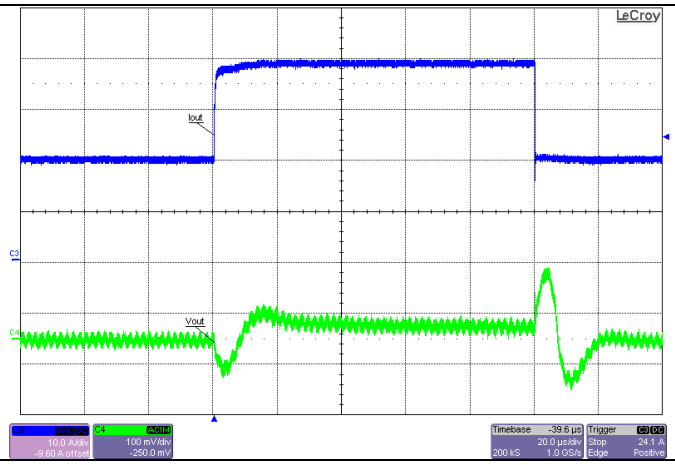

0A to 20A Load Step




0A to 20A Load Step




20A to 40A Load Step




20A to 40A Load Step

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