

**Test Data  
For PMP10532  
10/21/2014**



## Overview

The PMP10532 reference design is an isolated Fly-Buck power supply for industrial applications. It takes 24V nominal input and provides three isolated outputs: +5V@1A and +/-15V@200mA. The design is suitable for providing isolated power supply to MCU and control circuits, and positive/negative bias to Op Amps in PLC applications. The cross regulation of each output over line and load variation maintains about +/-5% tolerance, and the input voltage range of the supply is from 19V to 30V. The design features the LM5160 synchronous buck converter configured as a Fly-Buck regulator. The LM5160 has a wide Vin range of 4.5V to 65V and 1.5A output current capability with integrated switch FETs. It employs the Constant On-Time (COT) control scheme suitable for the Fly-Buck. With the benefit of primary side regulation, the Fly-Buck converter makes a compact and cost effective solution for multiple isolated output power supply without the opto-coupler feedback.

## Power Specification

Nominal Vin:	24V
Vin Range:	19V – 30V
Outputs:	Isolated +5V@1A, Isolated ±15V@200mA
Output Power:	11W max
Switching Frequency:	250 kHz

### Board Photo

Board Size: 75x50mm (Solution Size: 60x30mm)

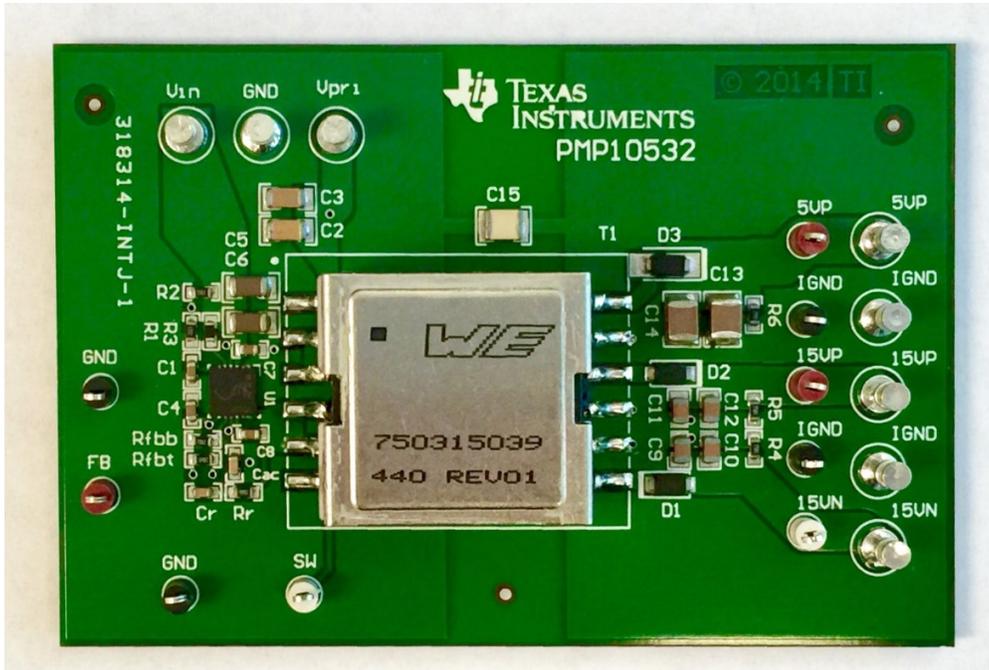


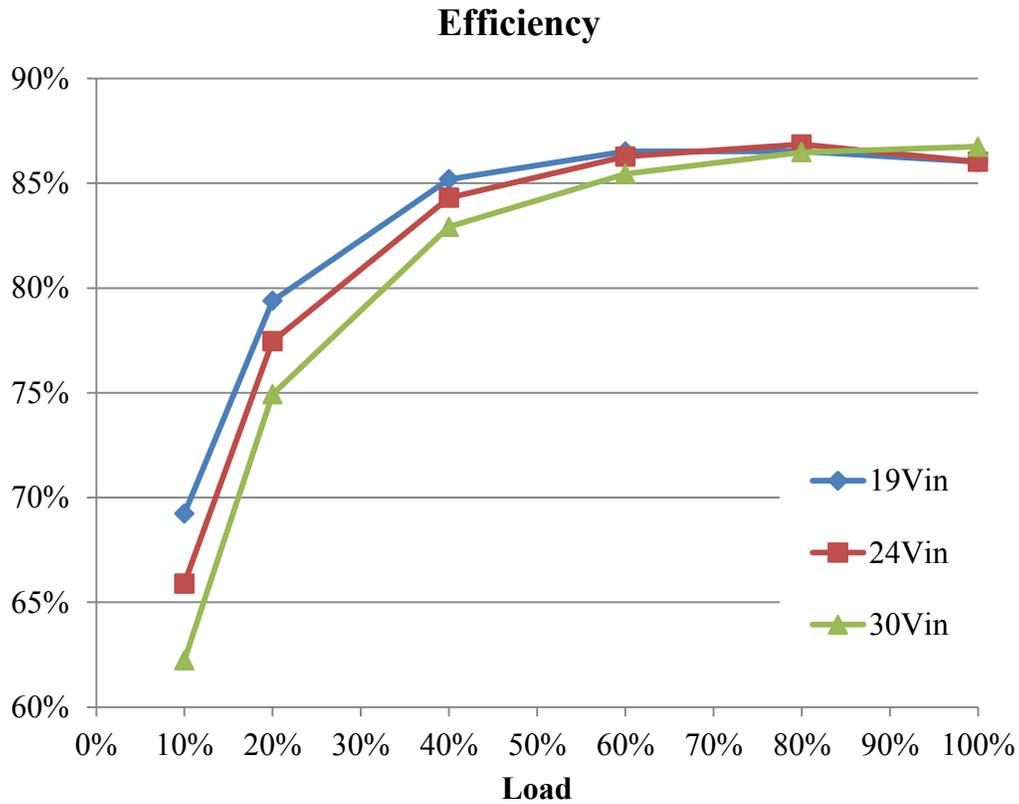
Figure 1 Board front



Figure 2 Board back

## Efficiency

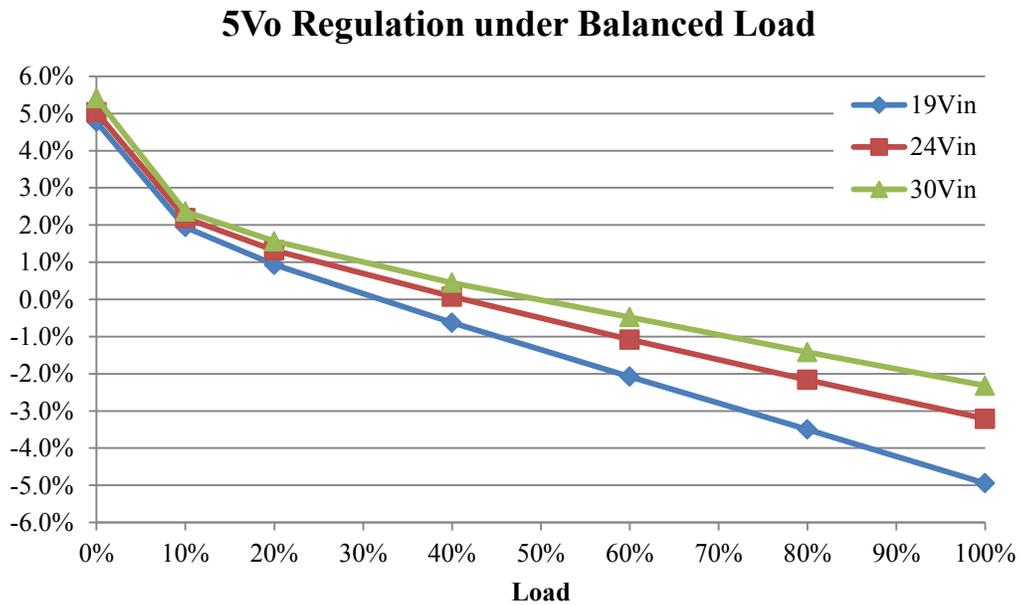
The efficiency measurement was taken as all three outputs are loaded at the same percentage current in respect of their full load.



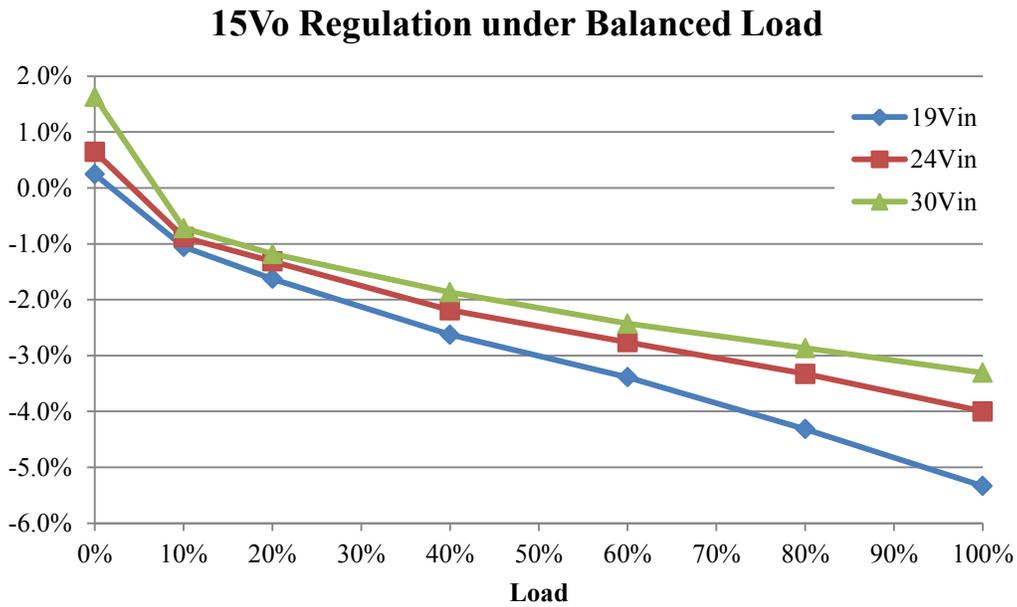
**Figure 3 Total efficiency under balanced load**

## Cross Regulation

The regulation under balanced load condition was tested as all three outputs were loaded with the same percentage of current in respect of their full load at different input voltage condition. Since the +15V and -15V outputs are symmetrical, only the +15V output regulation are shown.

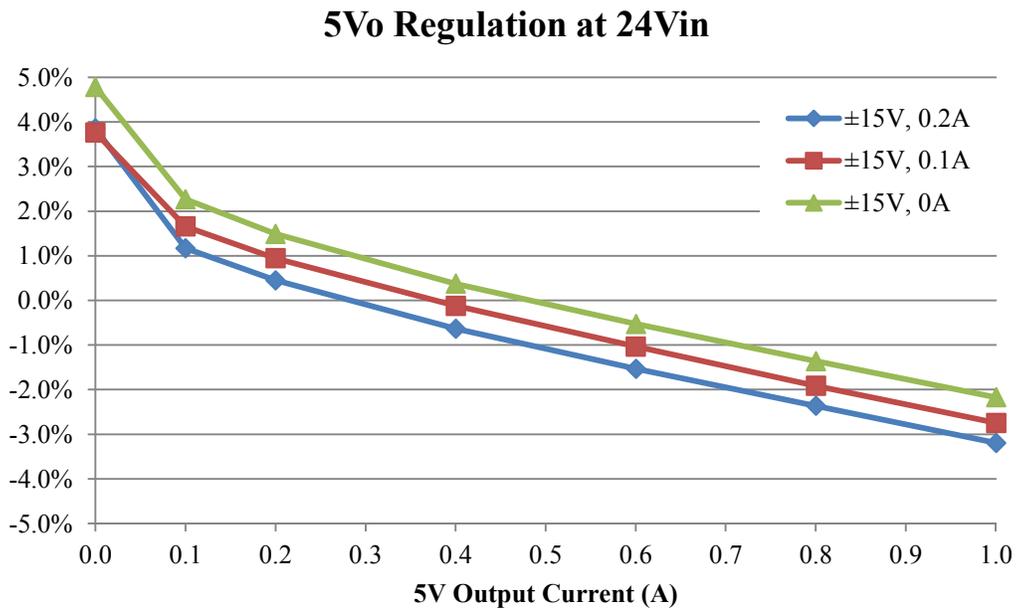


**Figure 4 5V output regulation under balanced load**



**Figure 5 15V output regulation under balanced load**

The regulation under unbalanced load was tested by sweeping different load current on the 5V output while the +/-15V output were loaded with 0A, 0.1A and 0.2A at 24V input. Since the +15V and -15V outputs are symmetrical, only the +15V output regulation are shown.



**Figure 6 5V output regulation under unbalanced load**

### 15Vo Regulation at 24Vin

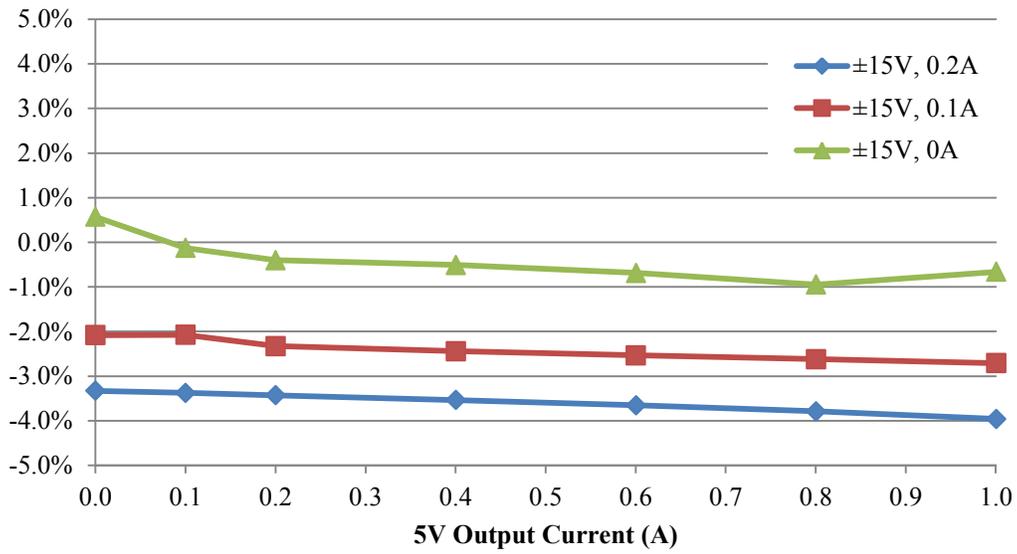


Figure 7 15V output regulation under unbalanced load

## Start Up

The board was tested under no load and full load at 24V input. Ch1 (yellow) is the input voltage, Ch2 (green) is the 5V output, Ch3 (purple) is the +15V output, and Ch4 (magenta) is the -15V output.

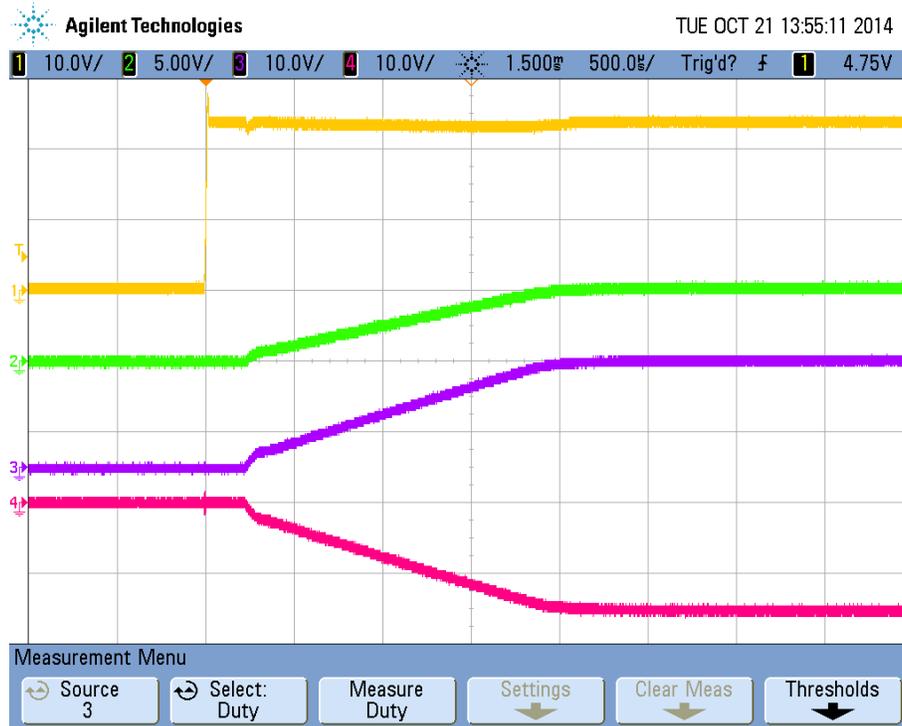


Figure 8 Start up into no load at 24Vin

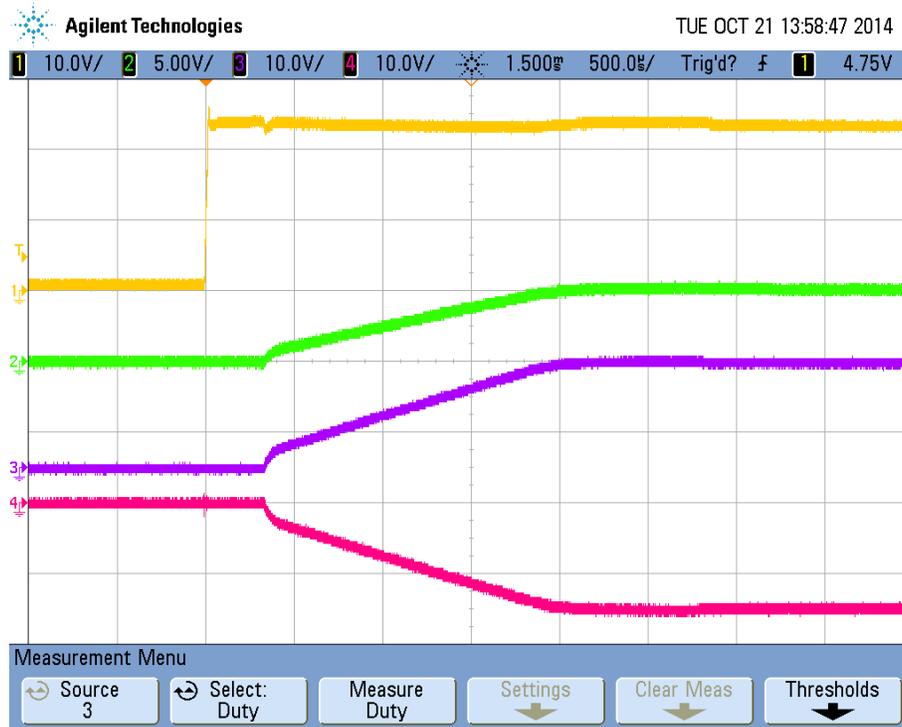


Figure 9 Start up into full load at 24Vin

## Switching Waveforms

The primary side switch node voltage was measured at no load and full load condition at 24V input. Ch1 (yellow) is the switch node voltage.

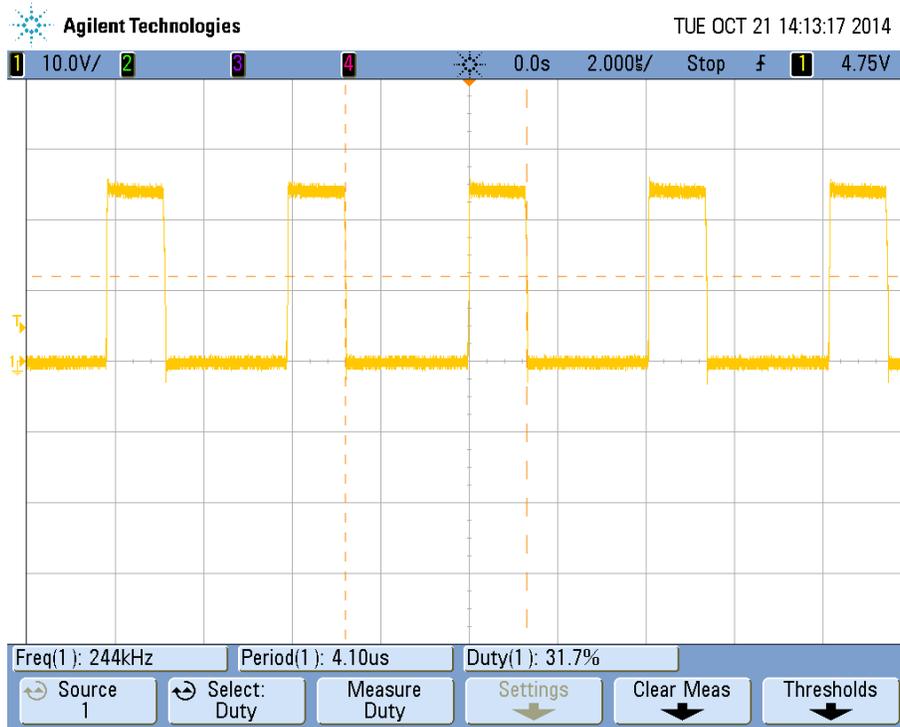


Figure 10 Switching waveform at no load, 24Vin

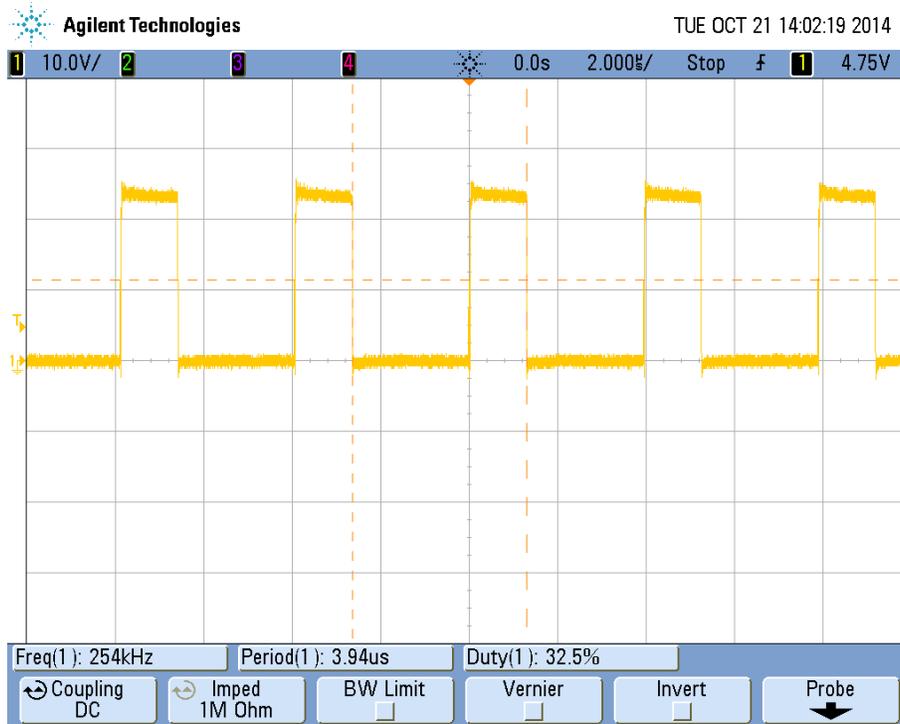
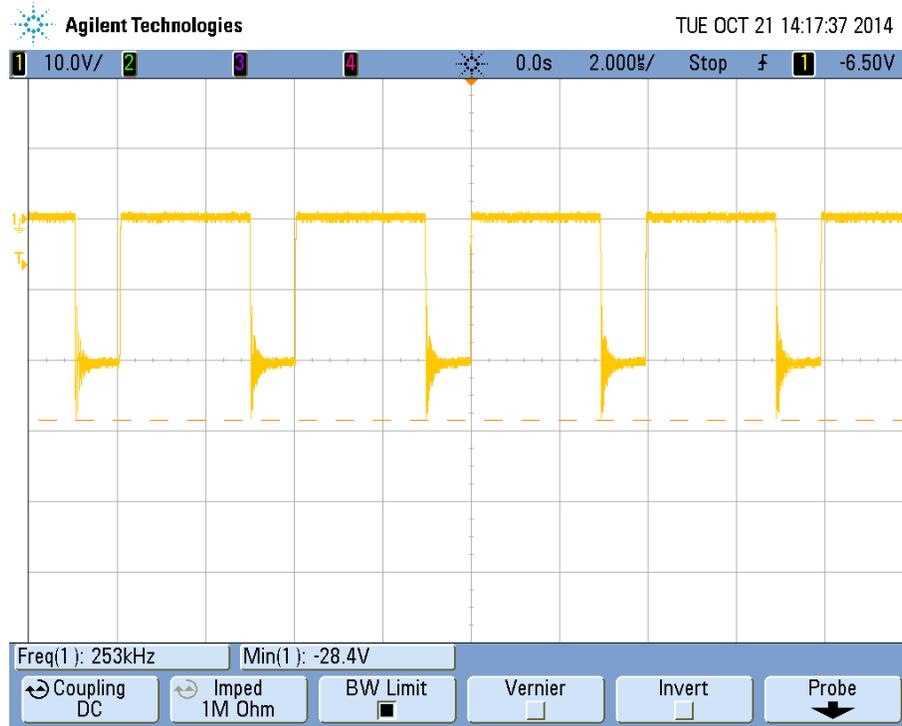


Figure 11 Switching waveform at full load, 24Vin

The secondary side rectifier diodes' voltage stress was checked at full load and 30V input. Ch1 (yellow) shows the voltage across the diode.



**Figure 12 5V output diode anode (+) to cathode (-) voltage at full load, 30Vin**

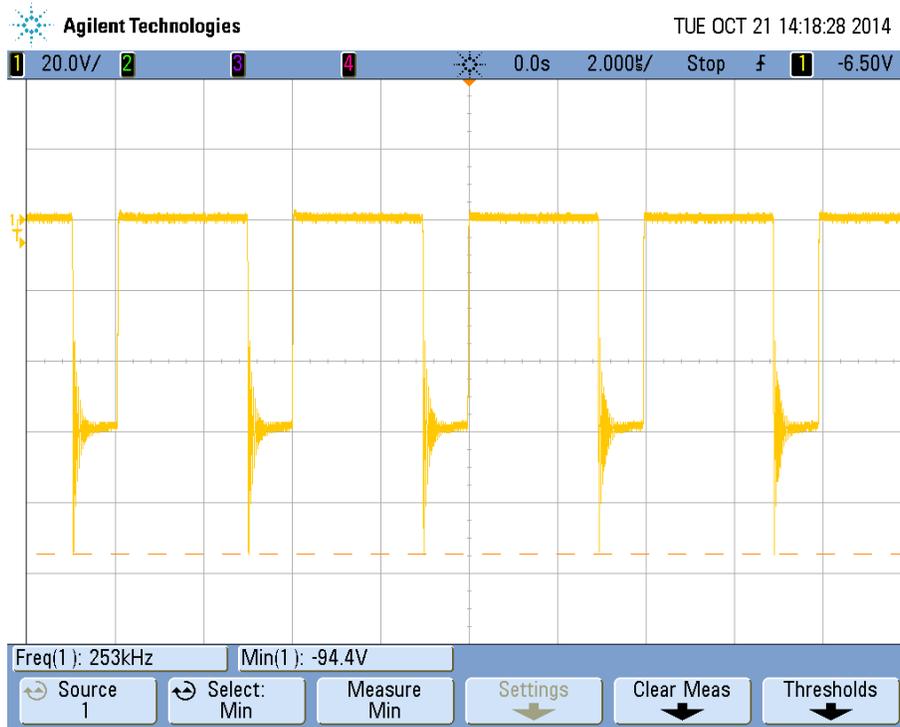


Figure 13 +15V output diode anode (+) to cathode (-) voltage at full load, 30Vin

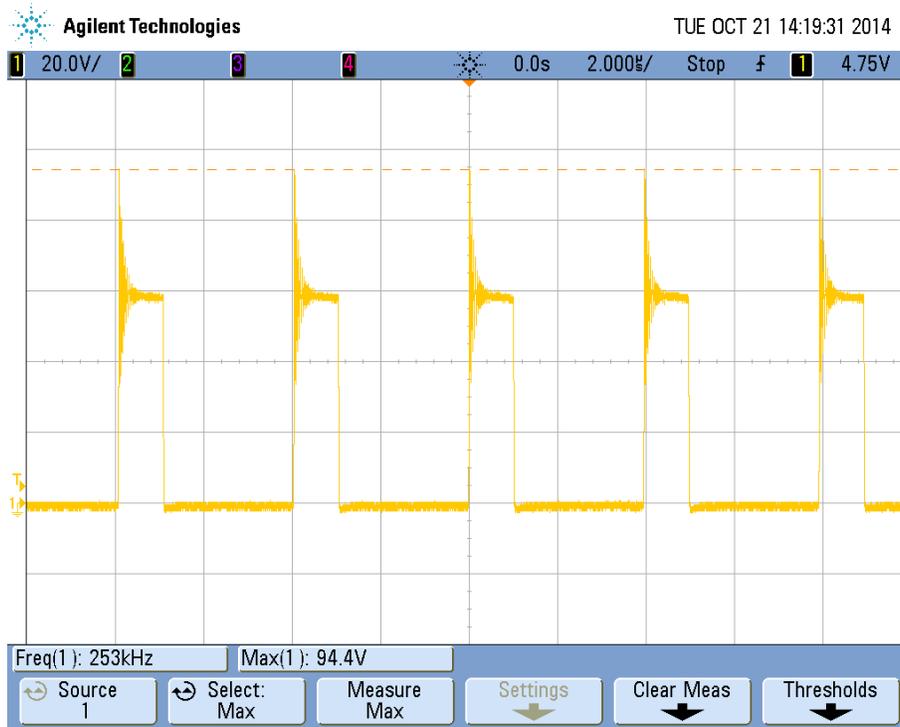


Figure 14 -15V output diode cathode (-) to anode (+) voltage at full load, 30Vin

## Load Transients

The load transient response was tested by adding load step on one output while no load on the other two outputs. The  $V_{in}$  was set at 24V. Ch1 (yellow) is the output voltage in AC mode, and Ch4 (magenta) is the output current.



Figure 15 5V output load transient

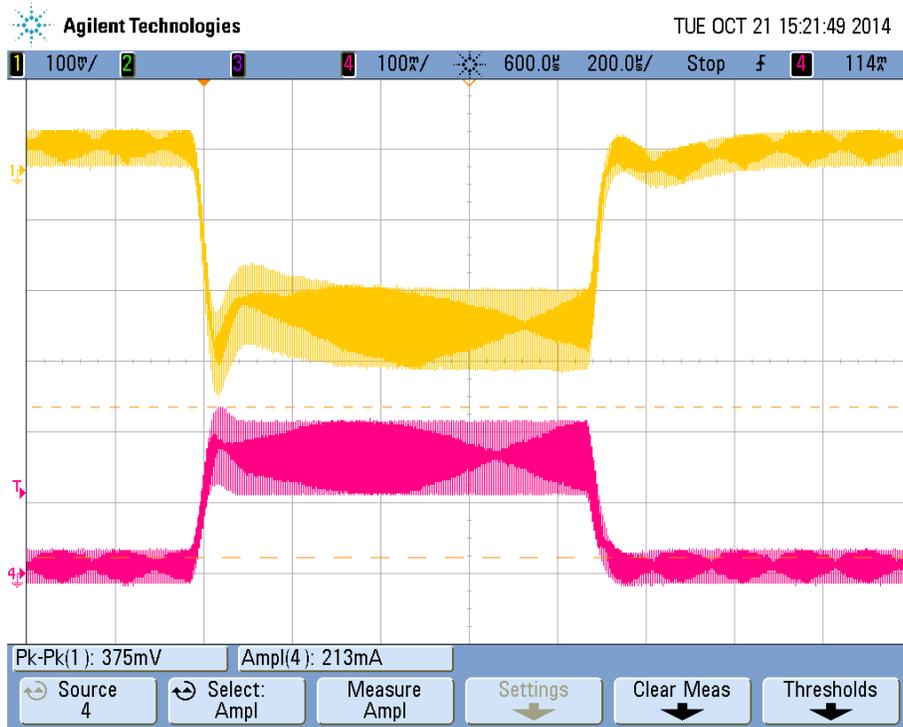


Figure 16 +15V output load transient

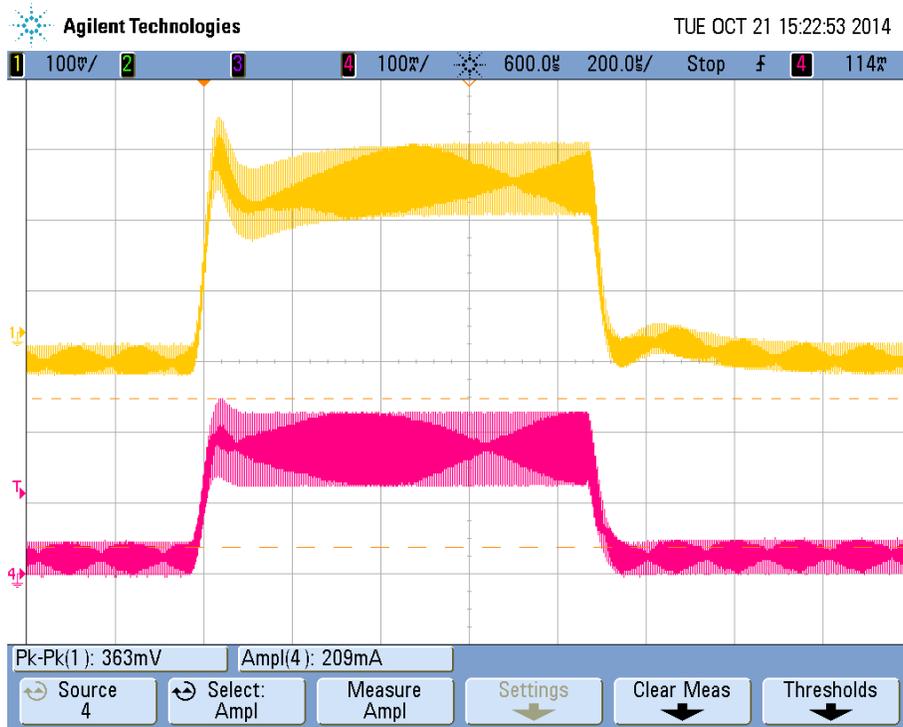
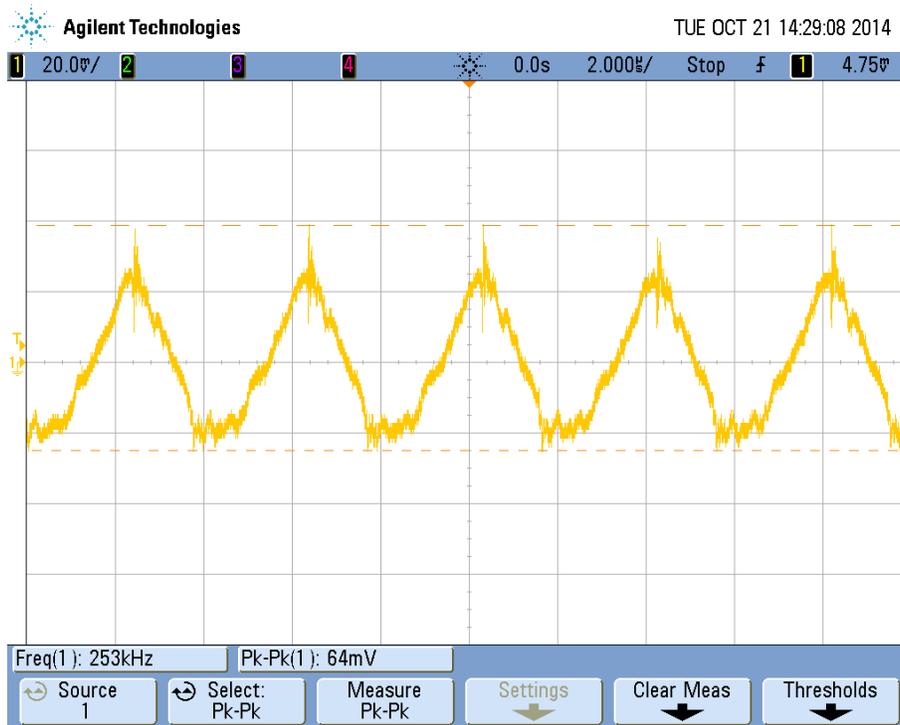


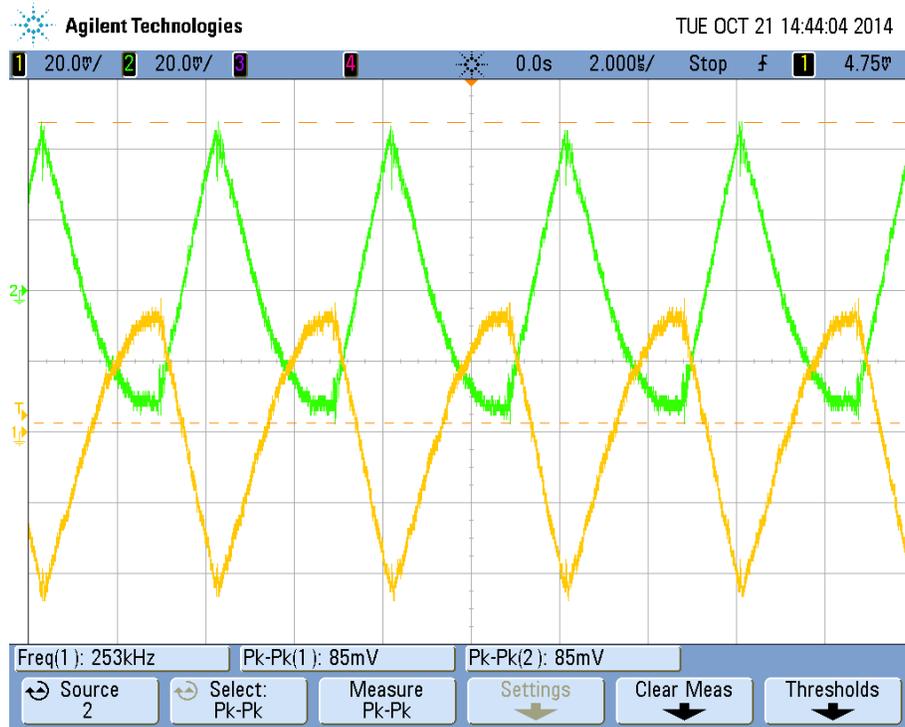
Figure 17 -15V output load transient

## Output Voltage Ripples

The output ripples were measured directly at the output capacitors, as all outputs were fully loaded. The input voltage was set at 24V. In Figure 18, Ch1 (yellow) is the 5V output ripple in AC mode; in Figure 19, Ch1 (yellow) is the +15V output ripple, and Ch2 (green) is the -15V output ripple, both in AC mode.



**Figure 18 5V output ripple at full load, 24Vin**



**Figure 19 +/-15V output ripples at full load, 24Vin**

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