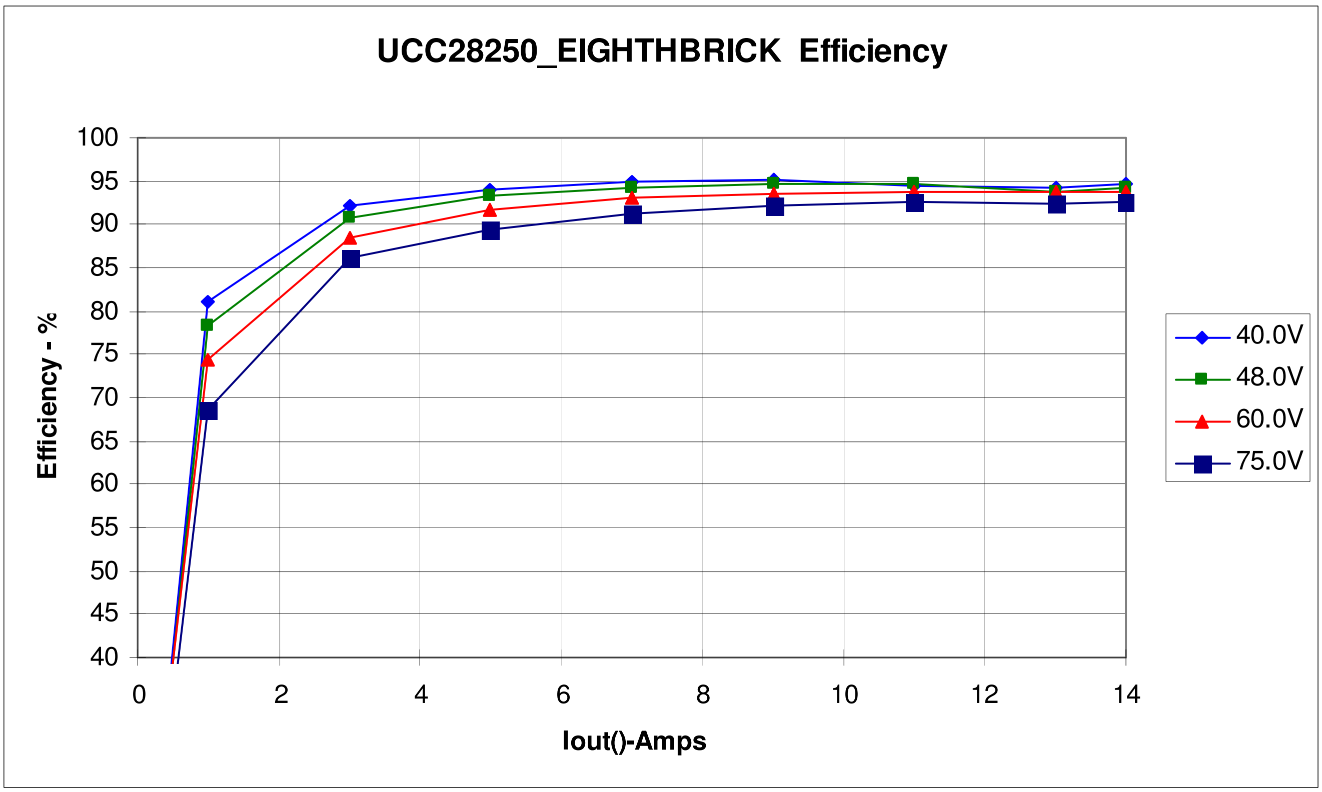
UCC28250 1/8th Brick Reference Design

40-75V input, 12V/15A Output

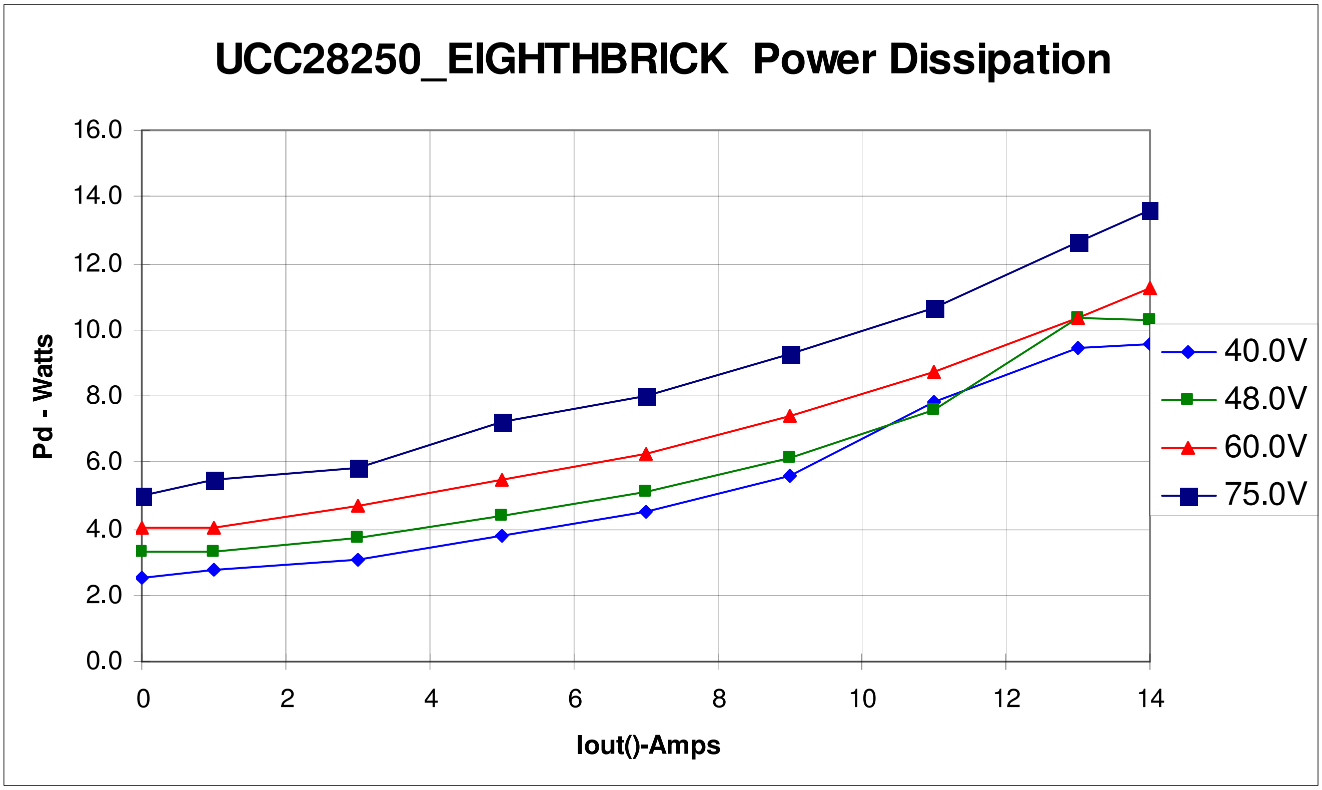
Test Report

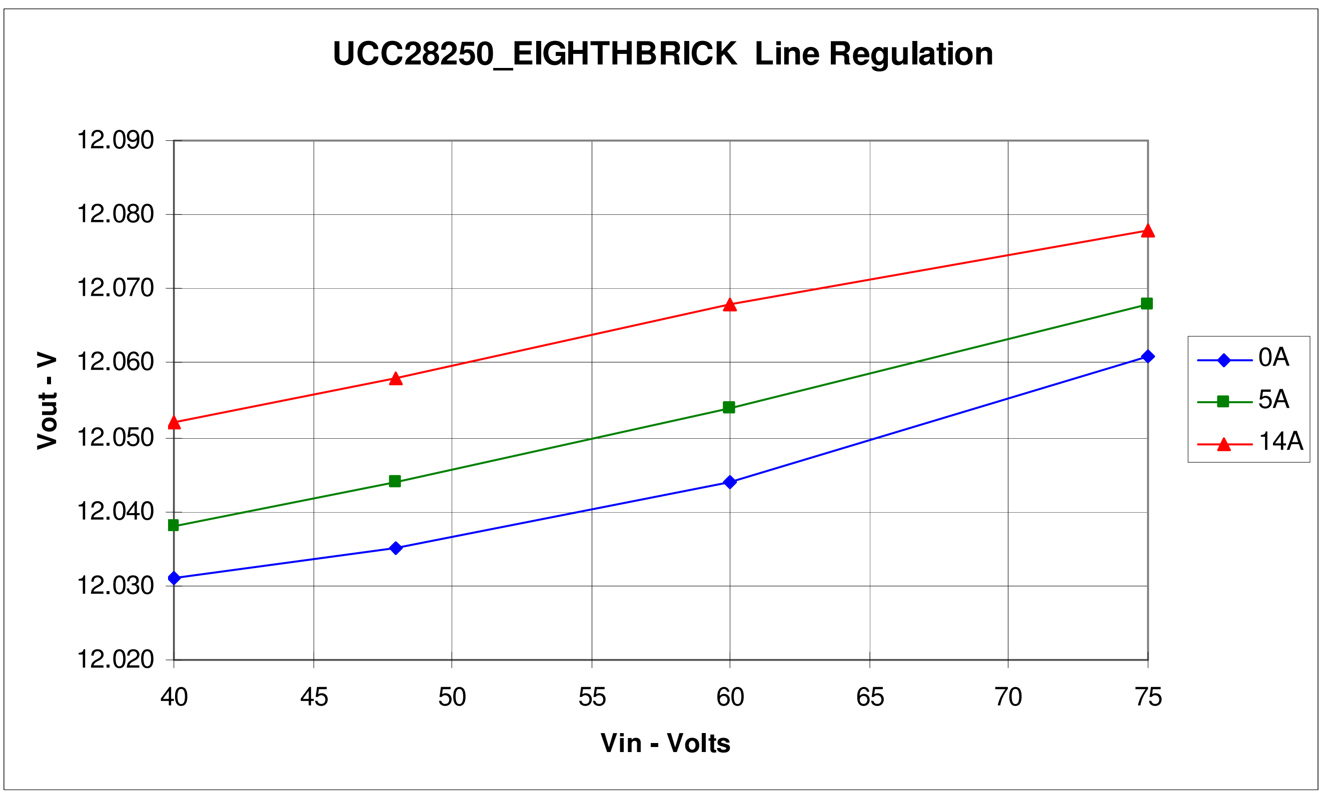
This document refers to test results for a standard Eighth Brick reference design featuring Texas Instruments parts.
Design criteria: Vout=12v @ 15 Amps, Vin range=40-75 Volts DC. Secondary side control.

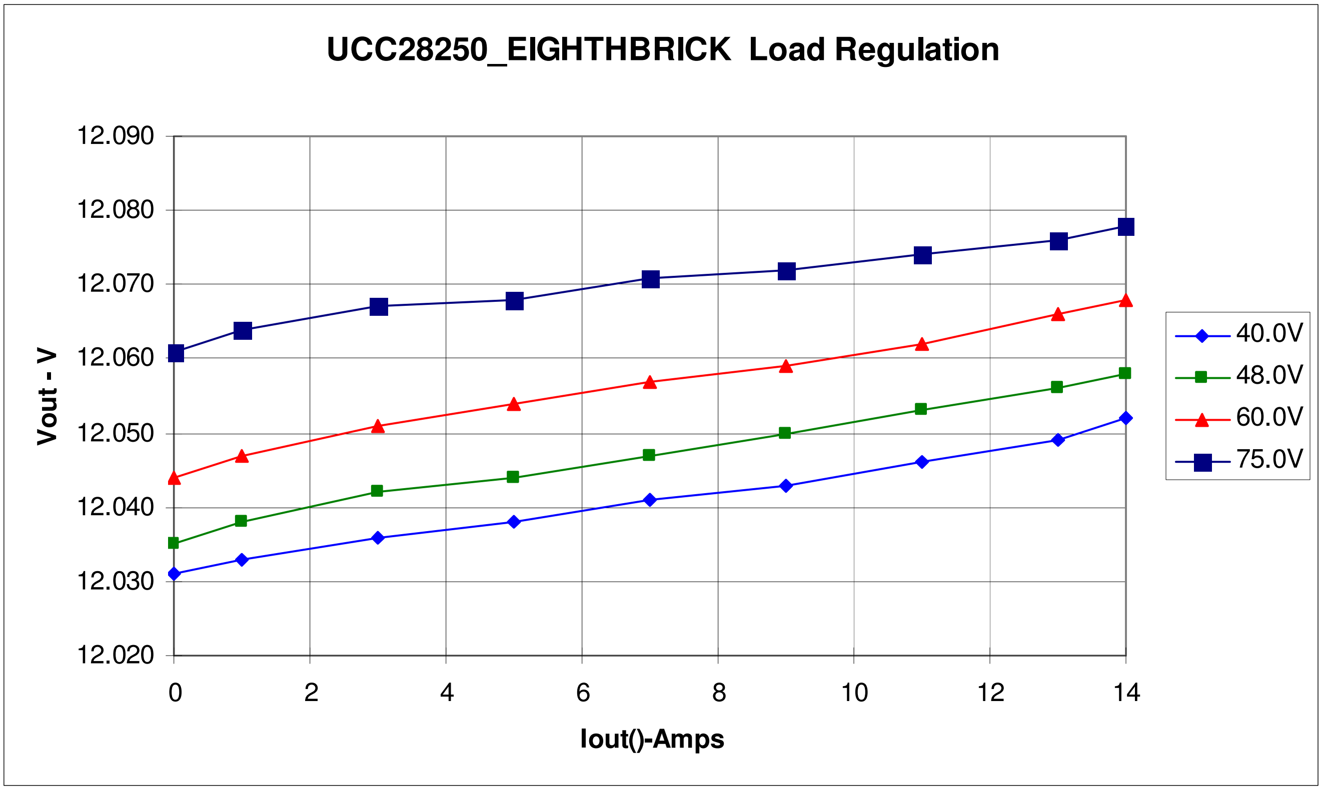
TI content: UCC28250 PWM controller, UCC27201 High and Low side Mosfet Driver, UCC27324 Low side Mosfet Driver, UCC25230 Bias PWM Contoller, ISO7220 Digital Isolator, OPA365 High Performance Op Amp, TPS76201 Linear regulator, LM4041 Shunt Regulator



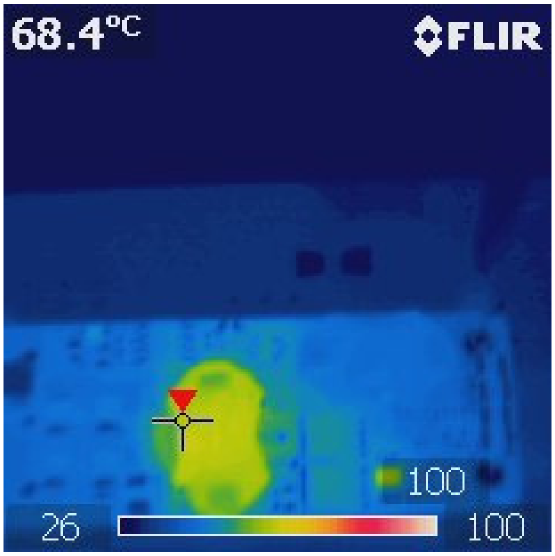
TEXAS INSTRUMENTS



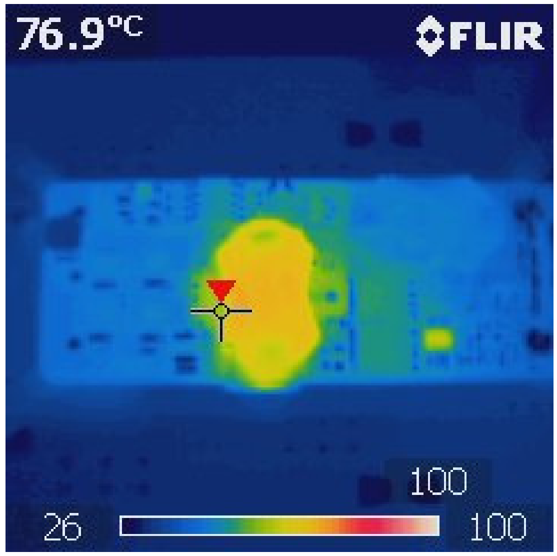




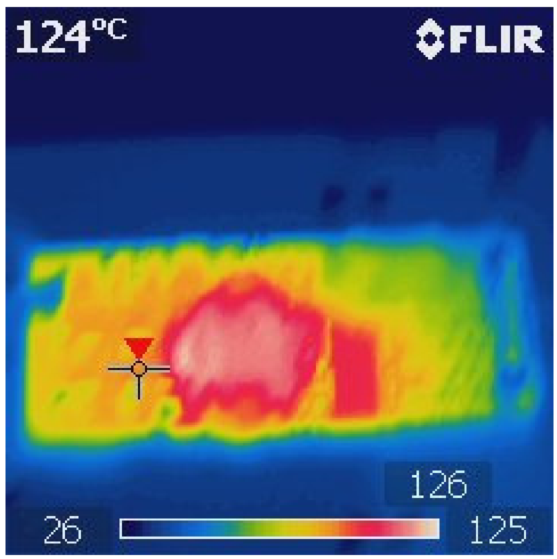
Thermal images of top side.



Vin=40V Iout=0A, Hot spot is Transformer core. 0 cfm

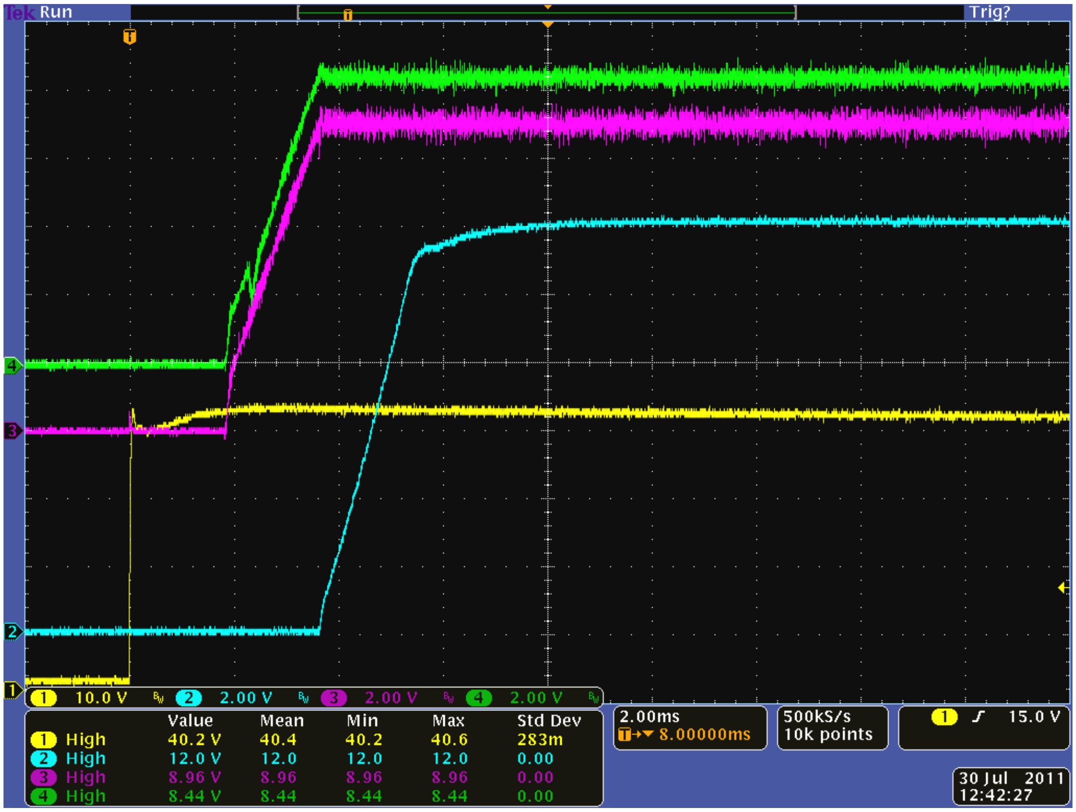


Vin=60V Iout=0A, Hot spot is Transformer core. 0 cfm

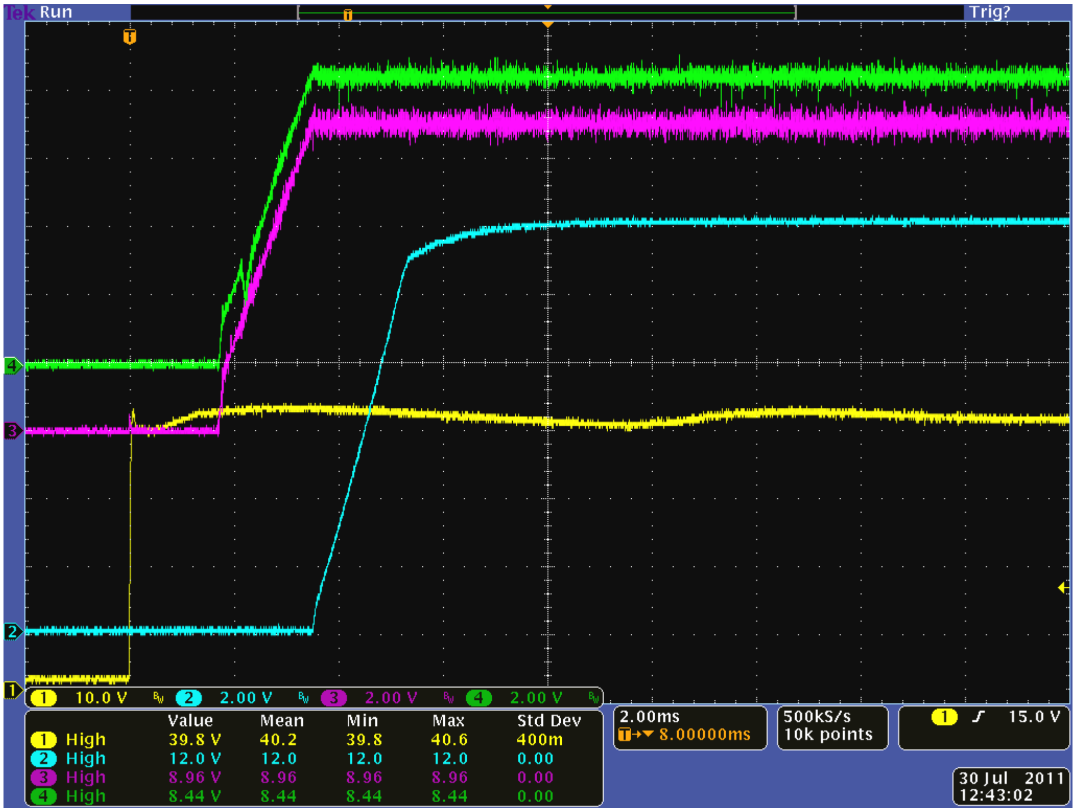


Vin=40V Iout=15A, Hot spot is PCB near primary mosfets. 0 cfm

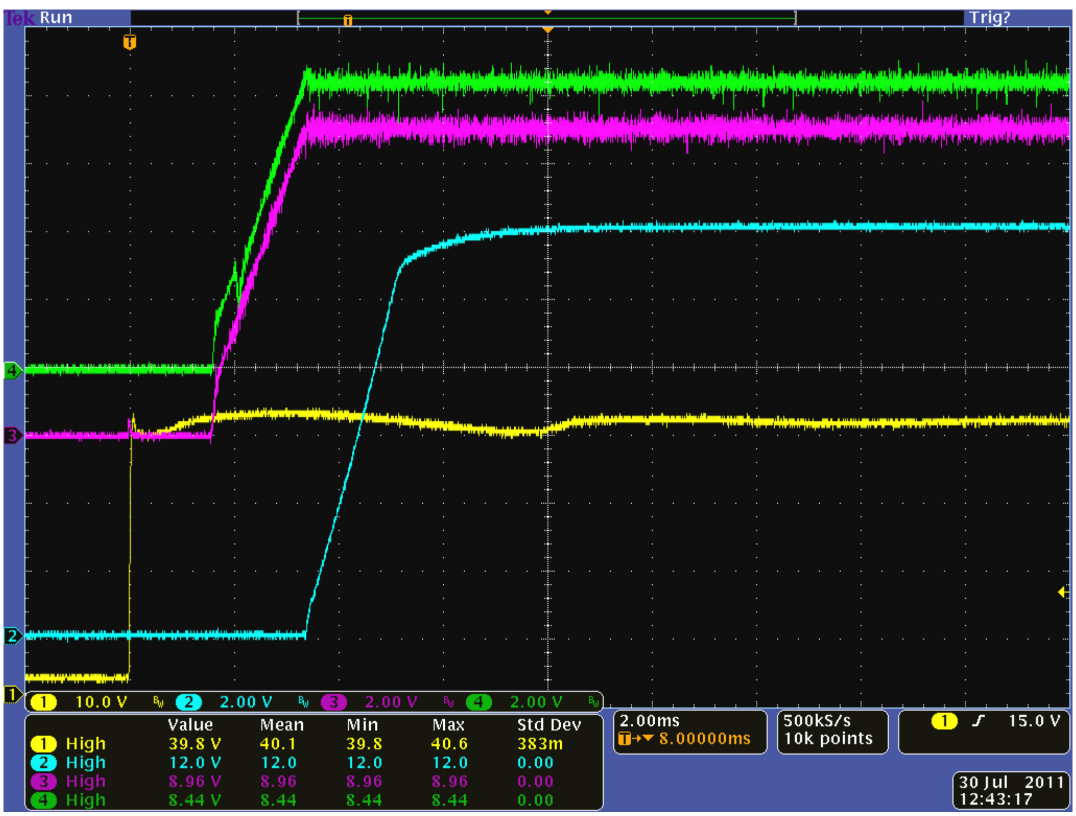
Start Up



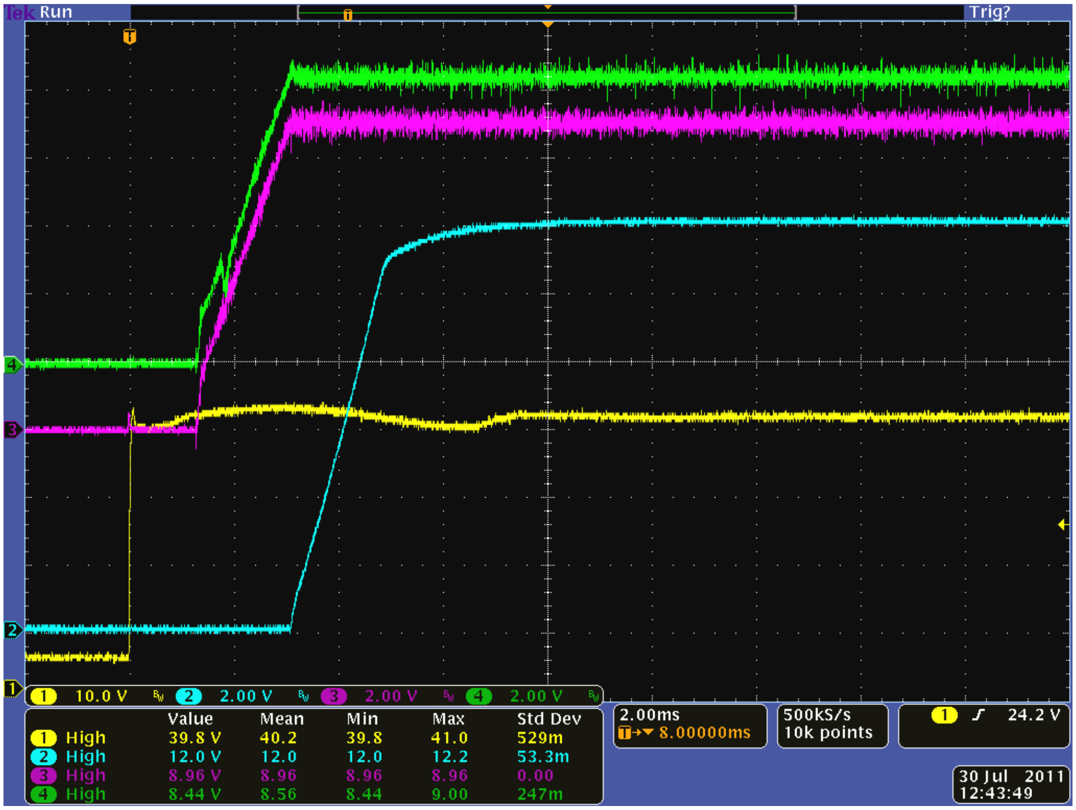
Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel 4)=secondary bias; **Vin=40V Iout= 0A** External capacitance=150uf



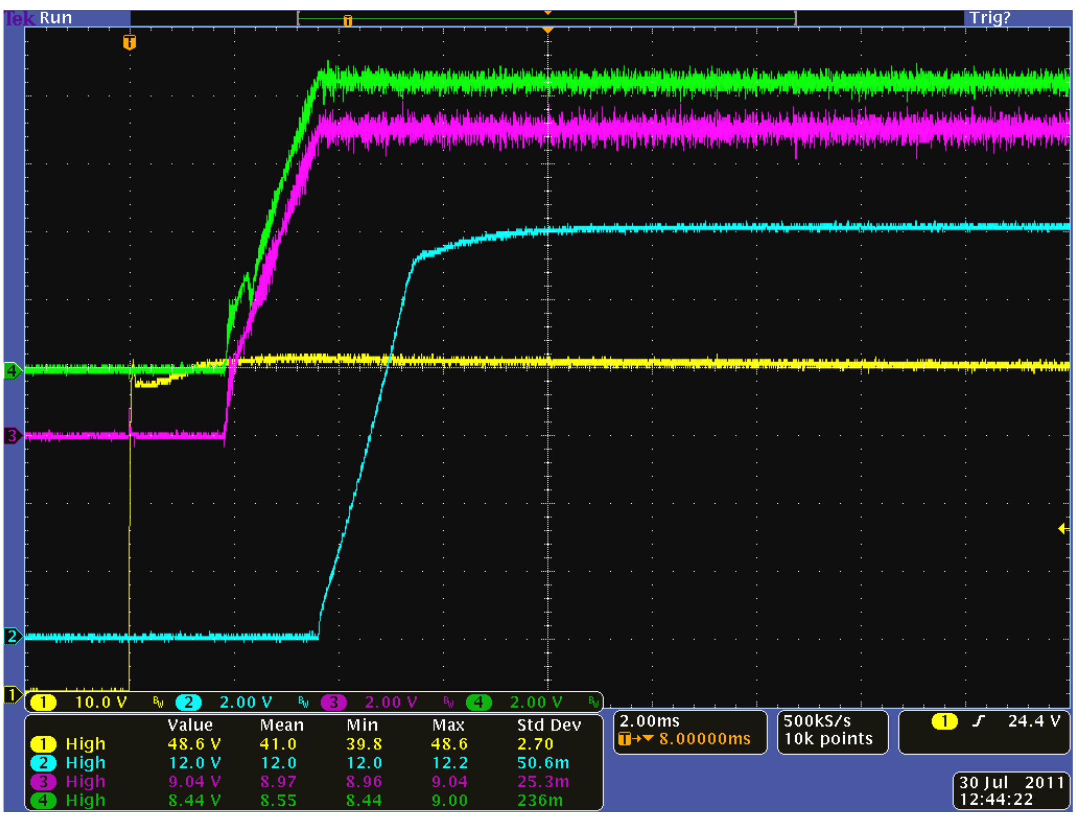
Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel 4)=secondary bias; **Vin=40V Iout= 5A** External capacitance=150uf



Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel 4)=secondary bias; **Vin=40V Iout= 10A** External capacitance=150uf

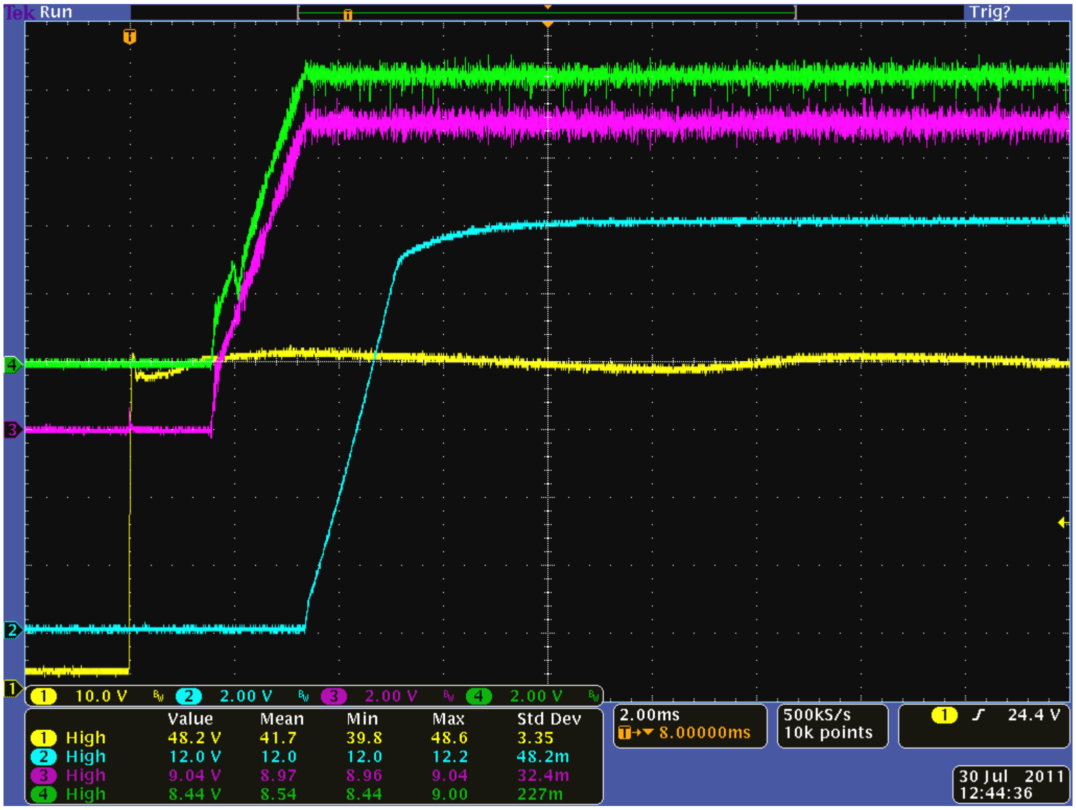


Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel 4)=secondary bias; **Vin=40V Iout= 15A** External capacitance=150uf

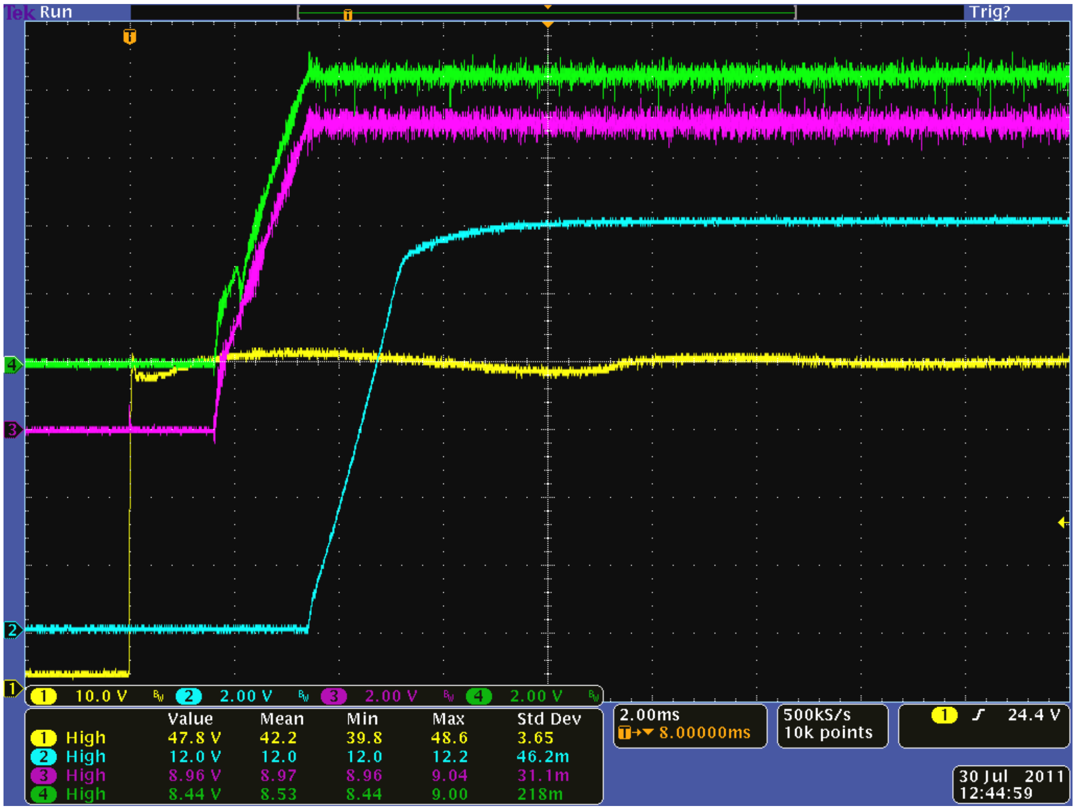


Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel

4)=secondary bias; **Vin=48V Iout= 0A** External capacitance=150uf



Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel 4)=secondary bias; **Vin=48V Iout= 5A** External capacitance=150uf



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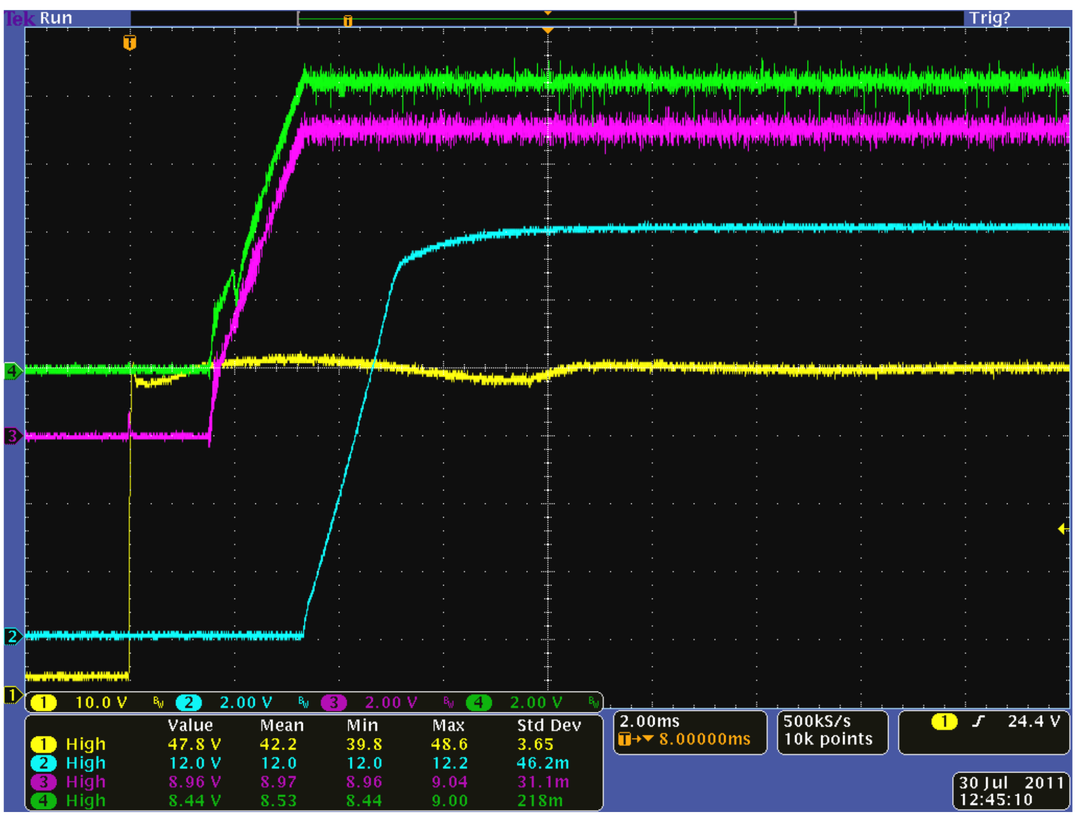

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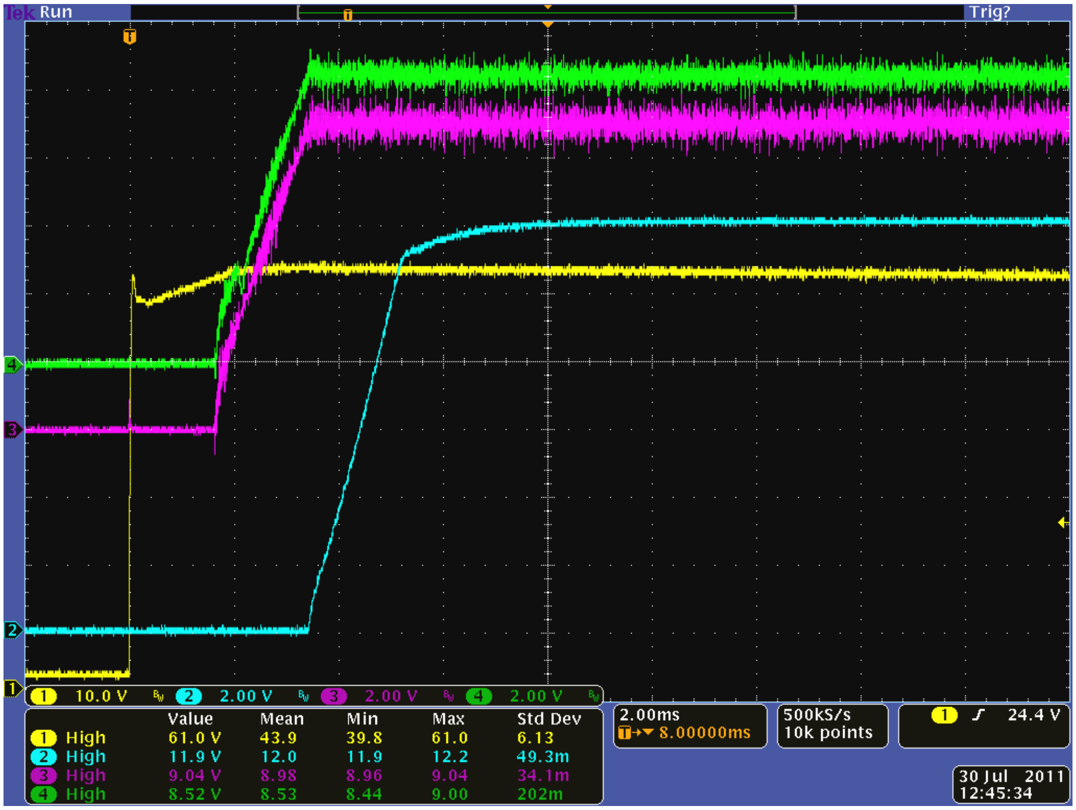
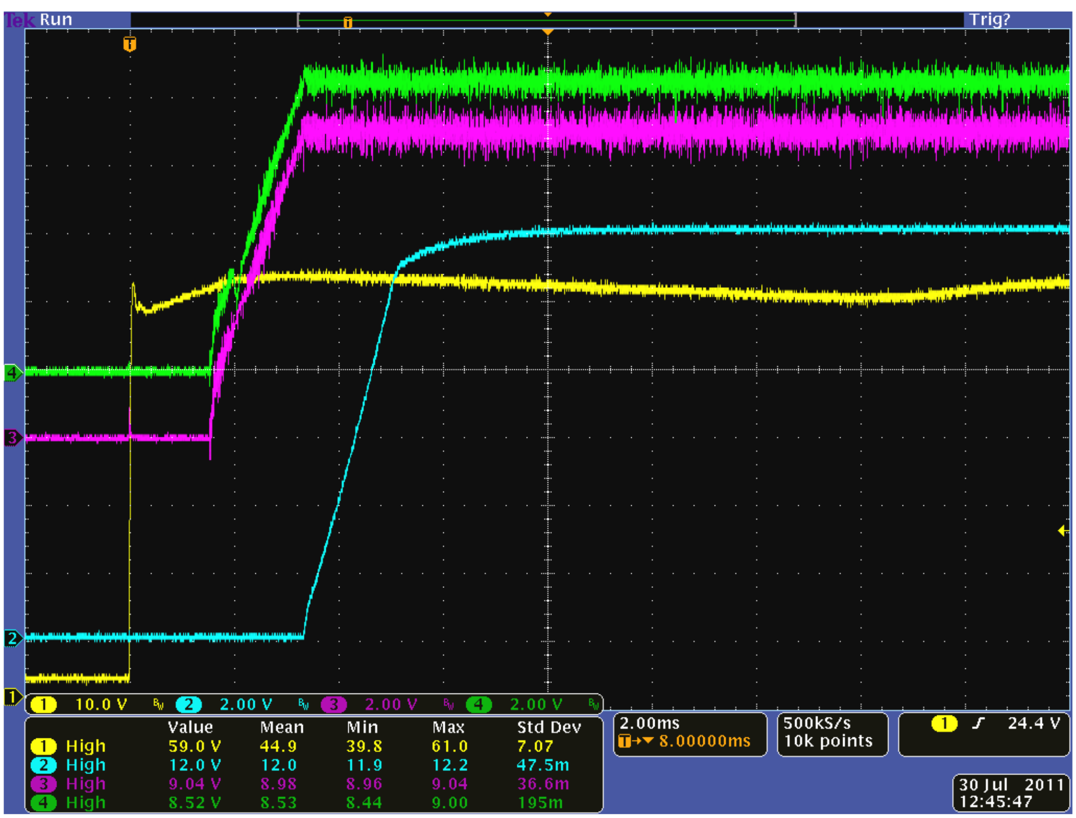


Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel 4)=secondary bias; **Vin=60V Iout= 0A** External capacitance=150uf



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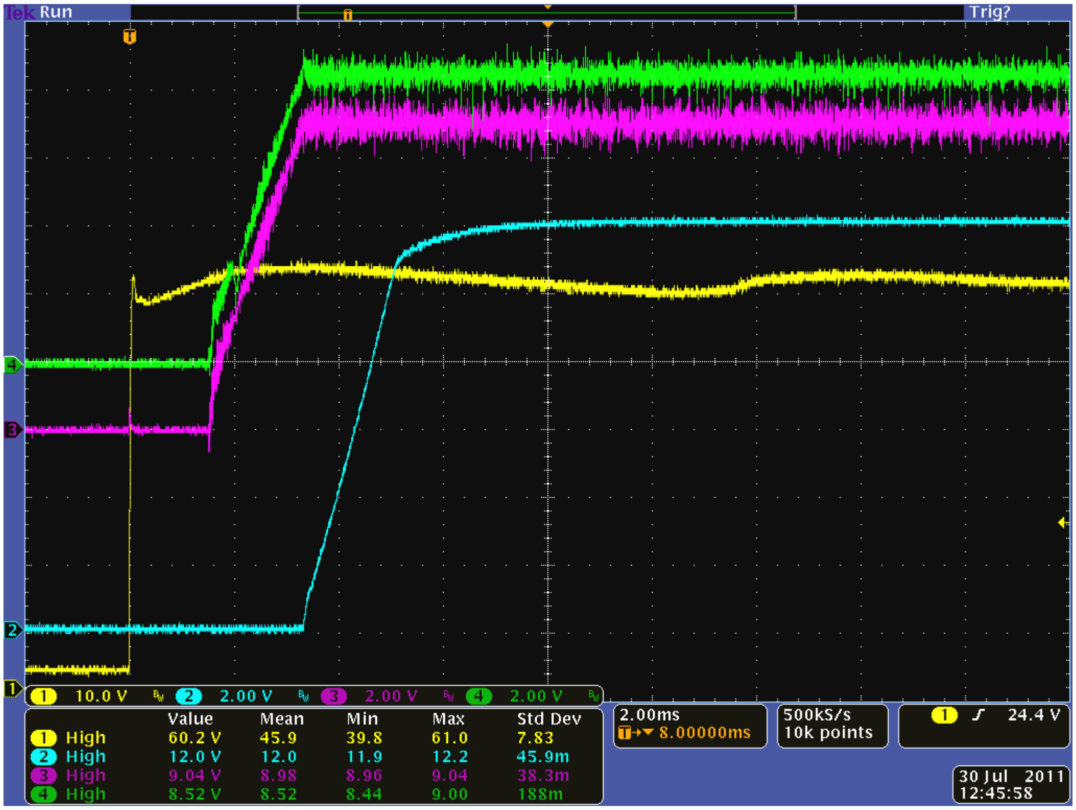

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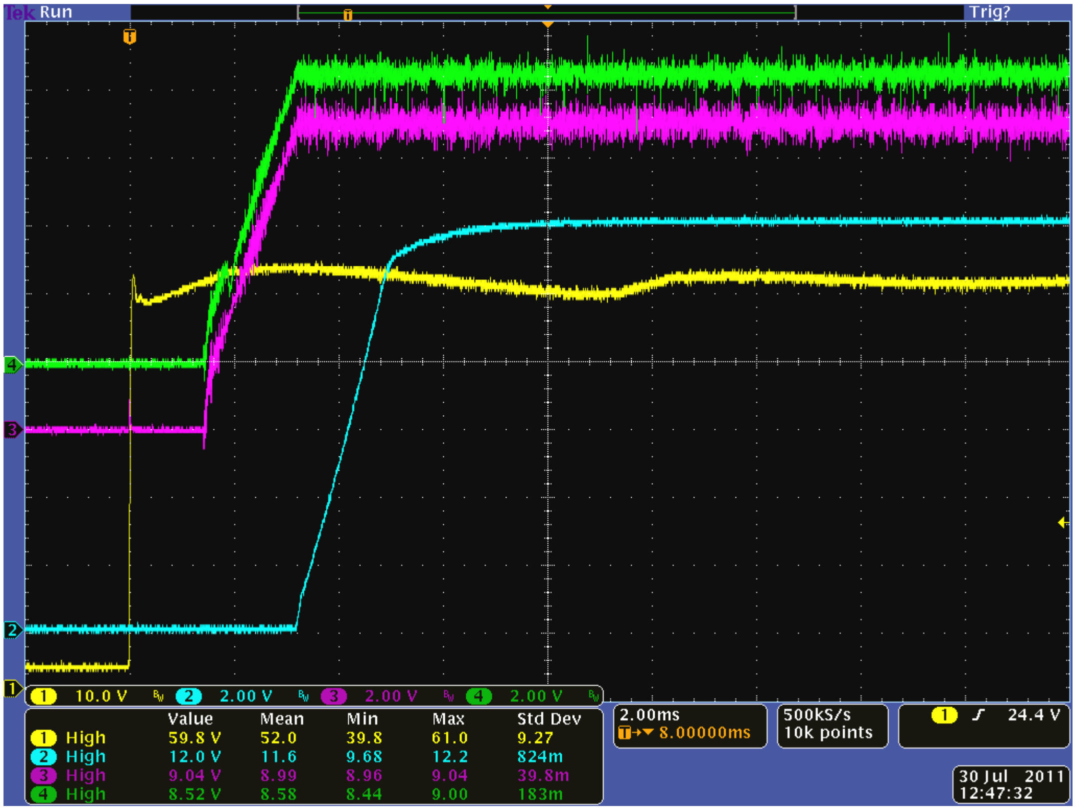
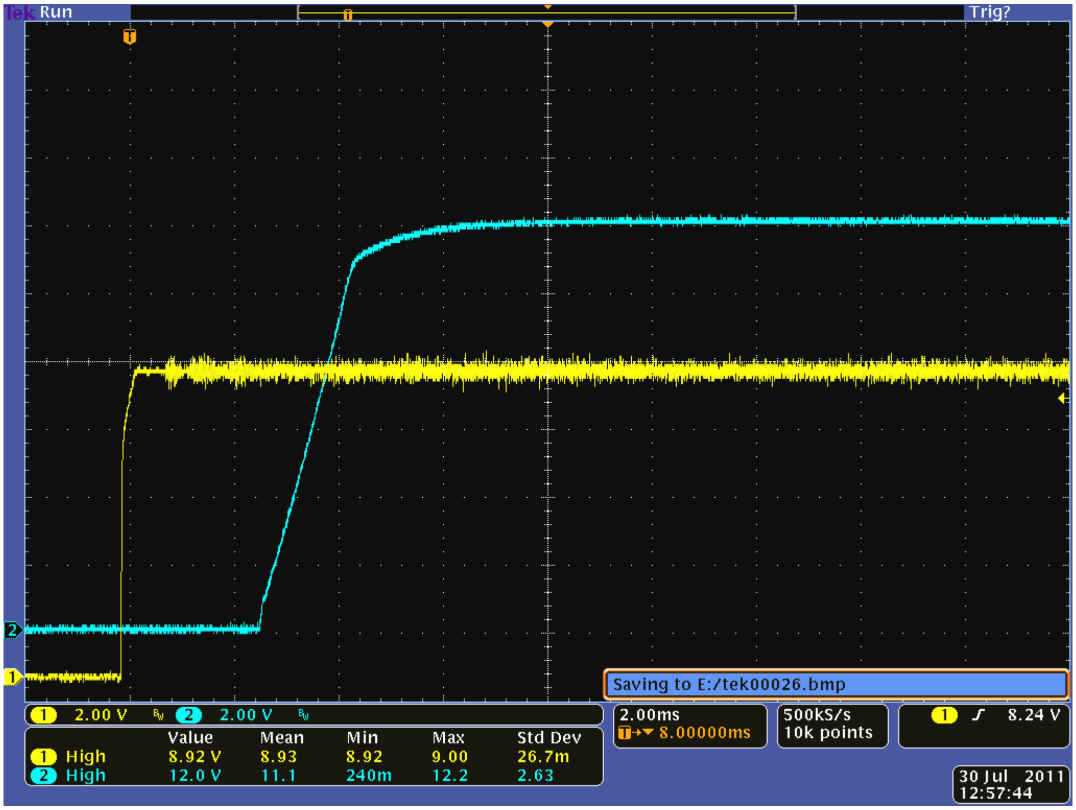
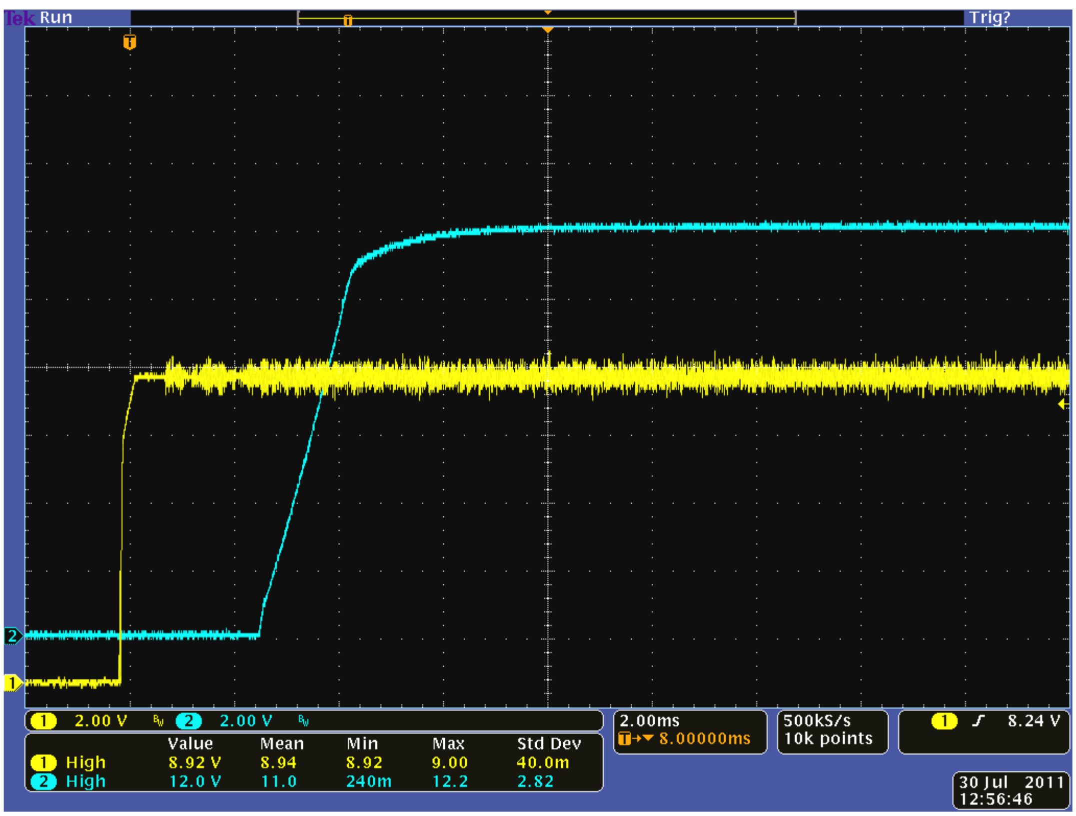


Yellow(channel 1)=Vin, Blue(channel 2)=Vout, Pink(channel 3)=primary bias, Green(channel 4)=secondary bias; **Vin=60V Iout= 15A** External capacitance=150uf

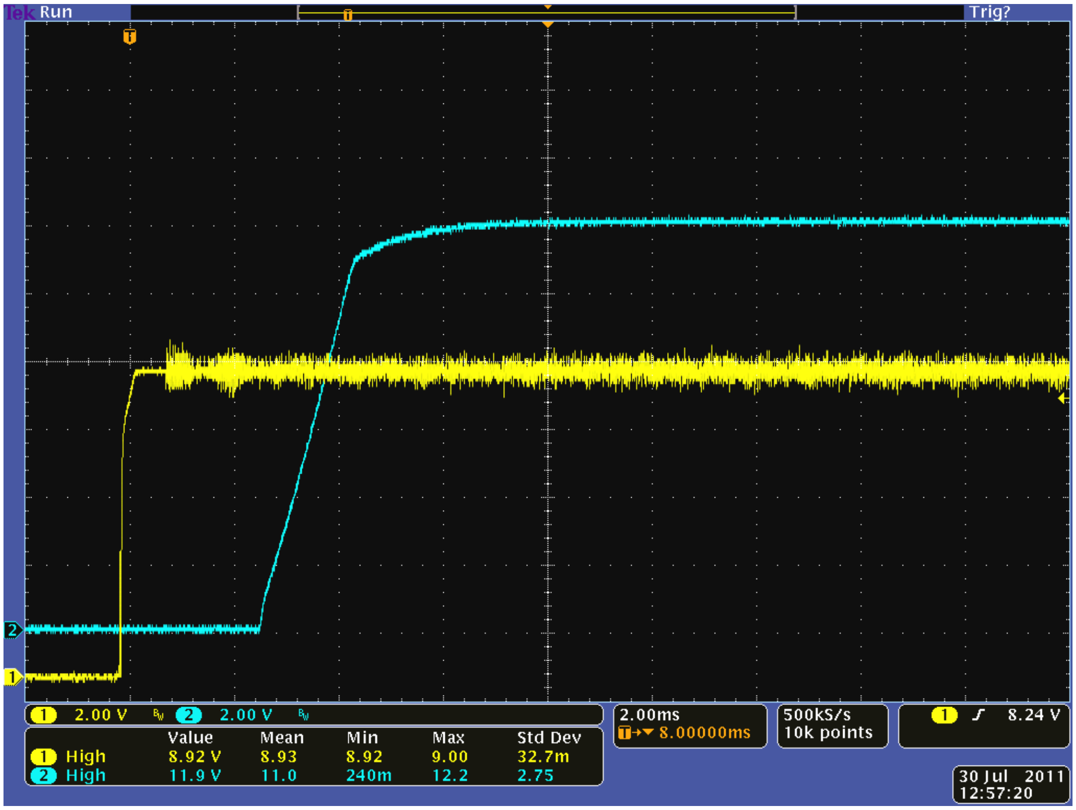
Enable vs Vout



Yellow(channel 1)=Vin, Blue(channel 2)=Vout; Vin=40V Iout=5A External capacitance=150uf

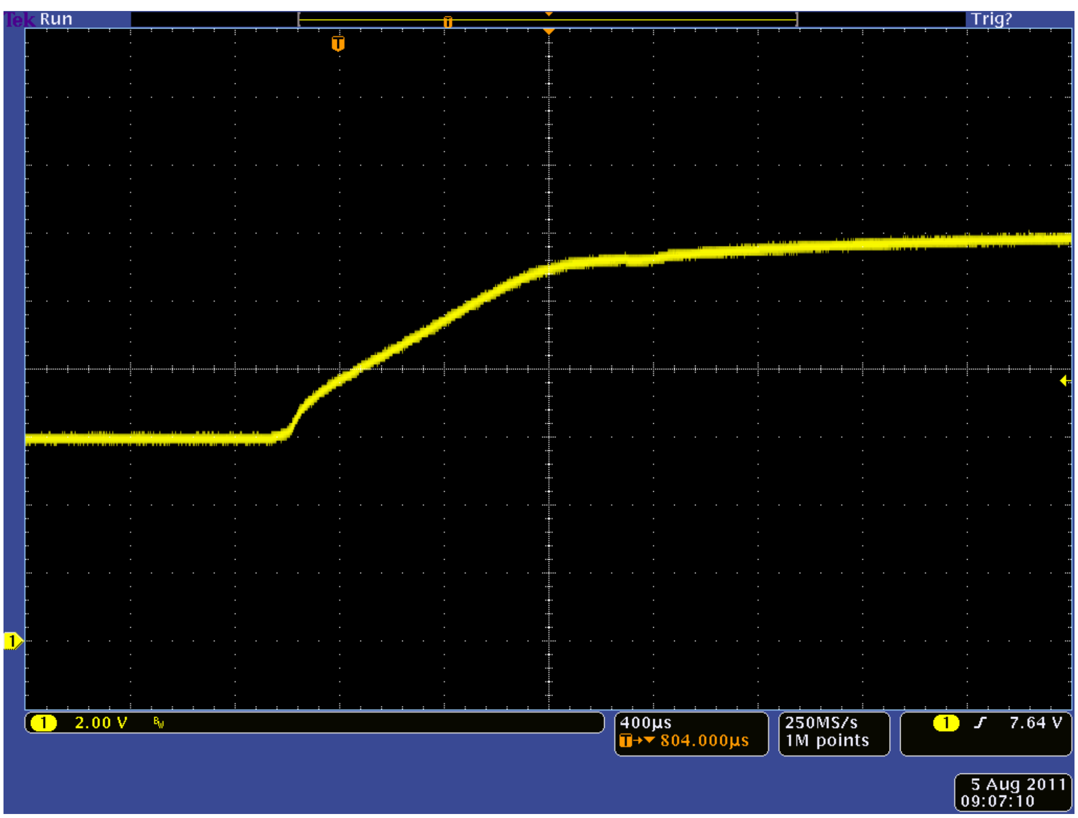


Yellow(channel 1)=Vin, Blue(channel 2)=Vout; Vin=48V Iout=5A External capacitance=150uf



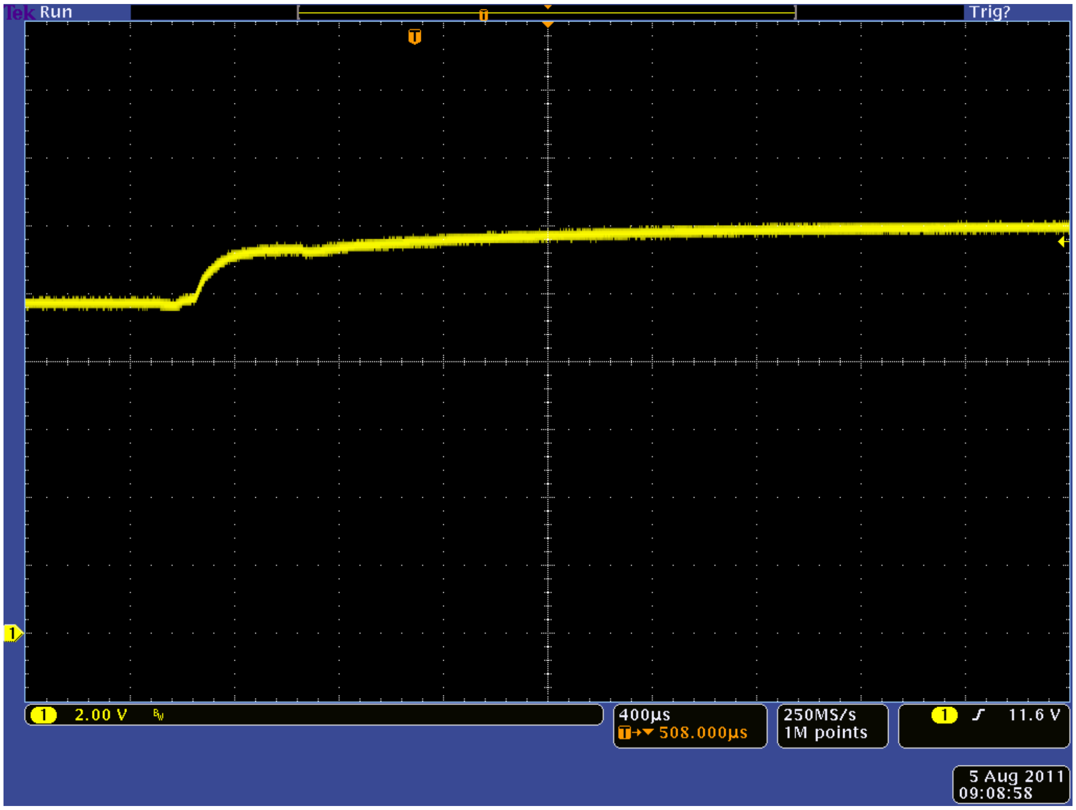
Yellow(channel 1)=Vin, Blue(channel 2)=Vout; Vin=60V Iout=5A External capacitance=150uf

Vout with 6v Prebias



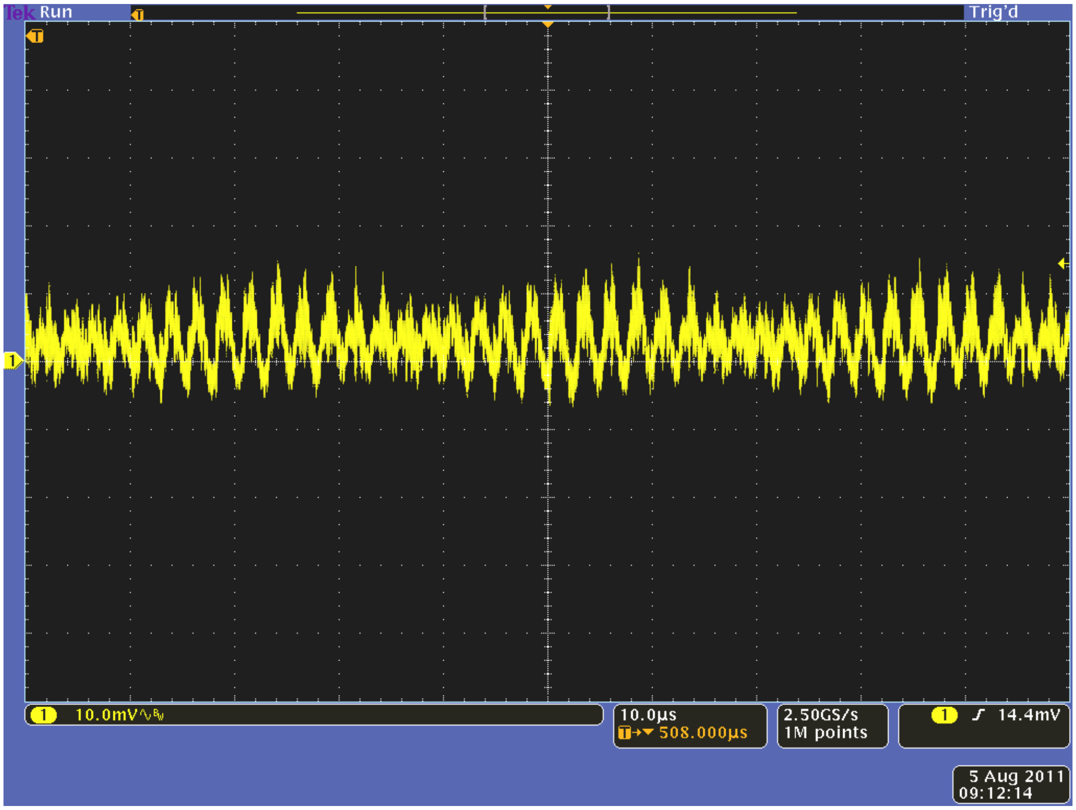
Yellow(channel 1)=Vout; Vin=48V Iout=0A External capacitance=150uf

Vout with 10v Prebias

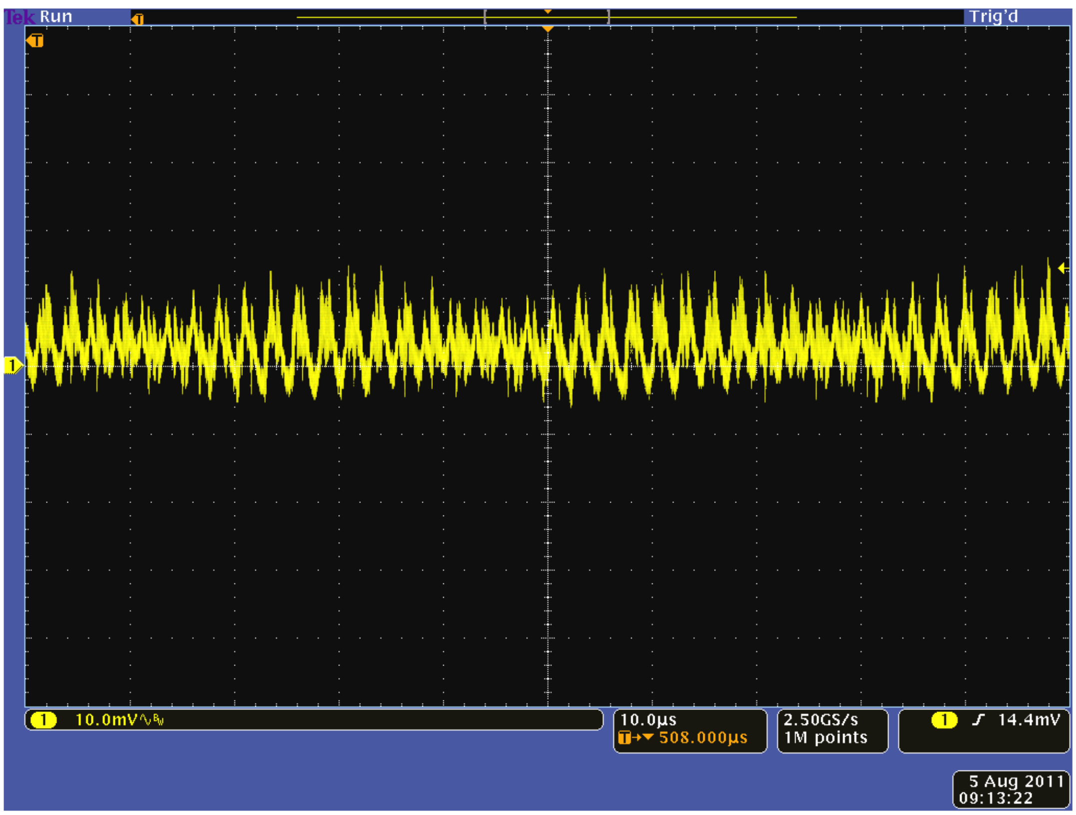


Yellow(channel 1)=Vout; Vin=48V Iout=0A External capacitance=150uf

Output Ripple



Vin=48V Iout=0A External capacitance=150uf

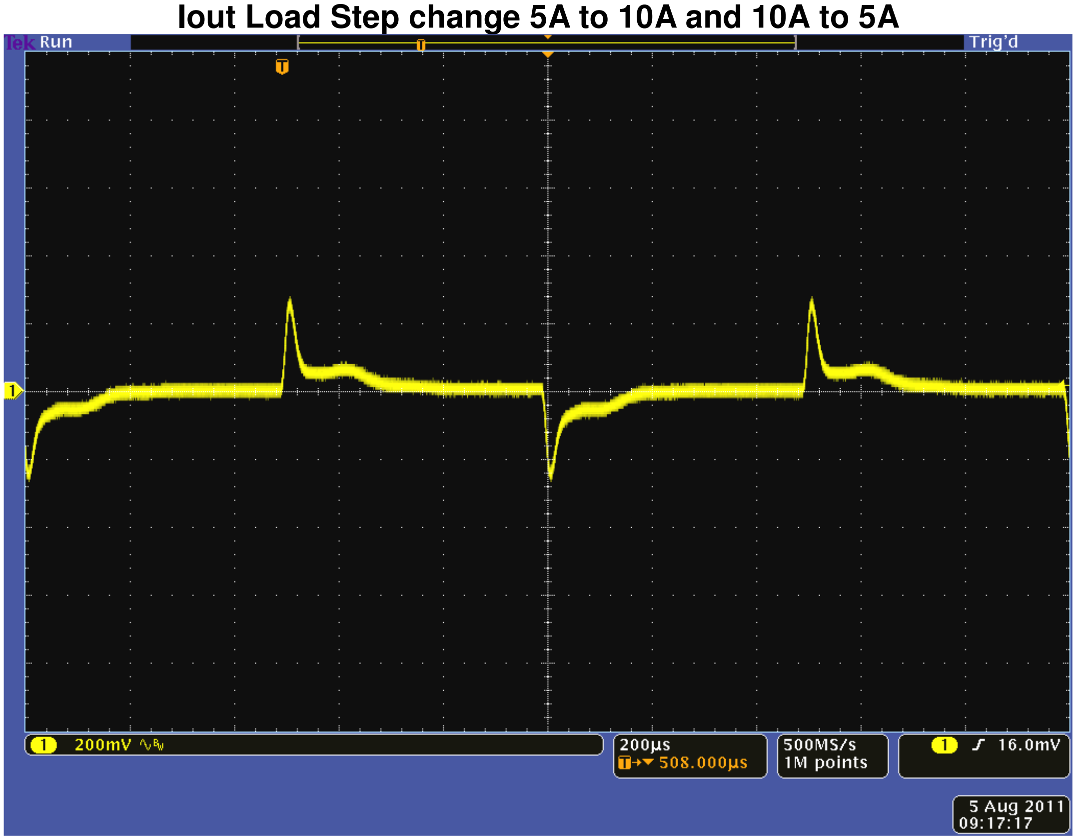


Vin=48V Iout=15A External capacitance=150uf

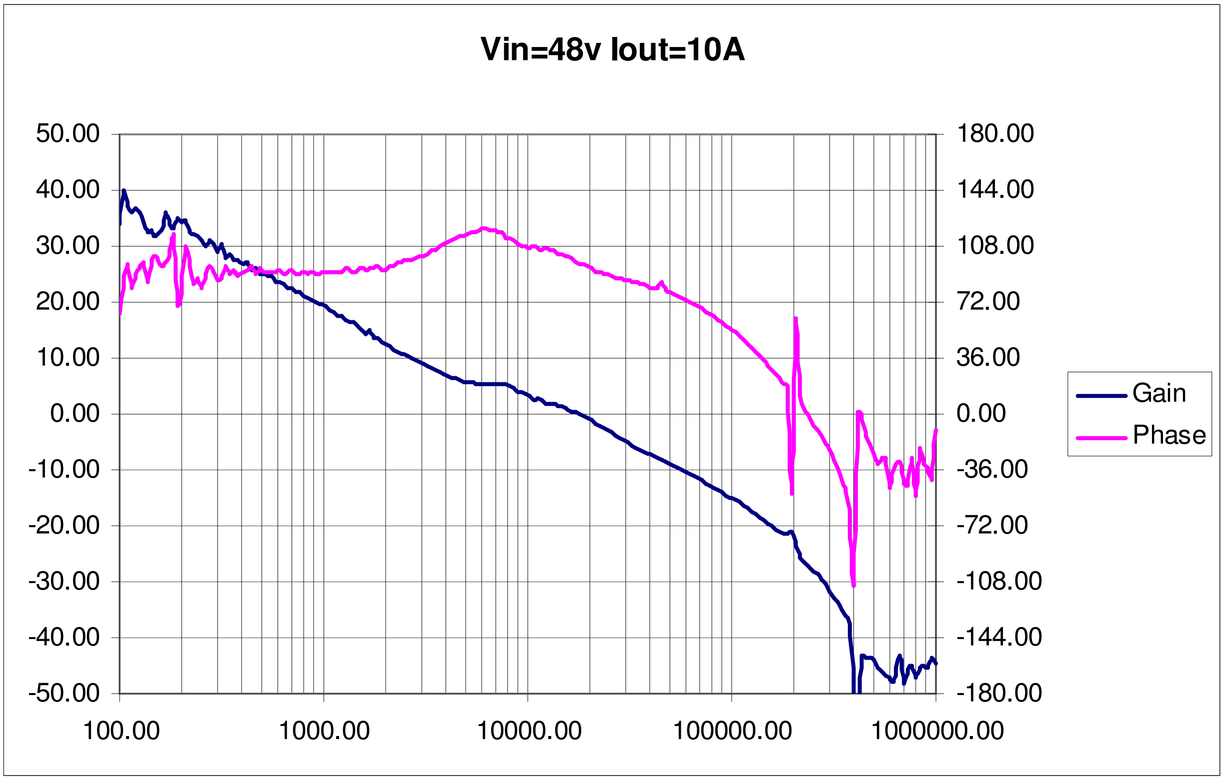
Vin Step change 40v to 60v

Yellow(channel 1)=Vin, Blue(channel 2)=Vout; Iout=5A 400mv deviation External capacitance=150uf

Iout Load Step change 5A to 10A and 10A to 5A

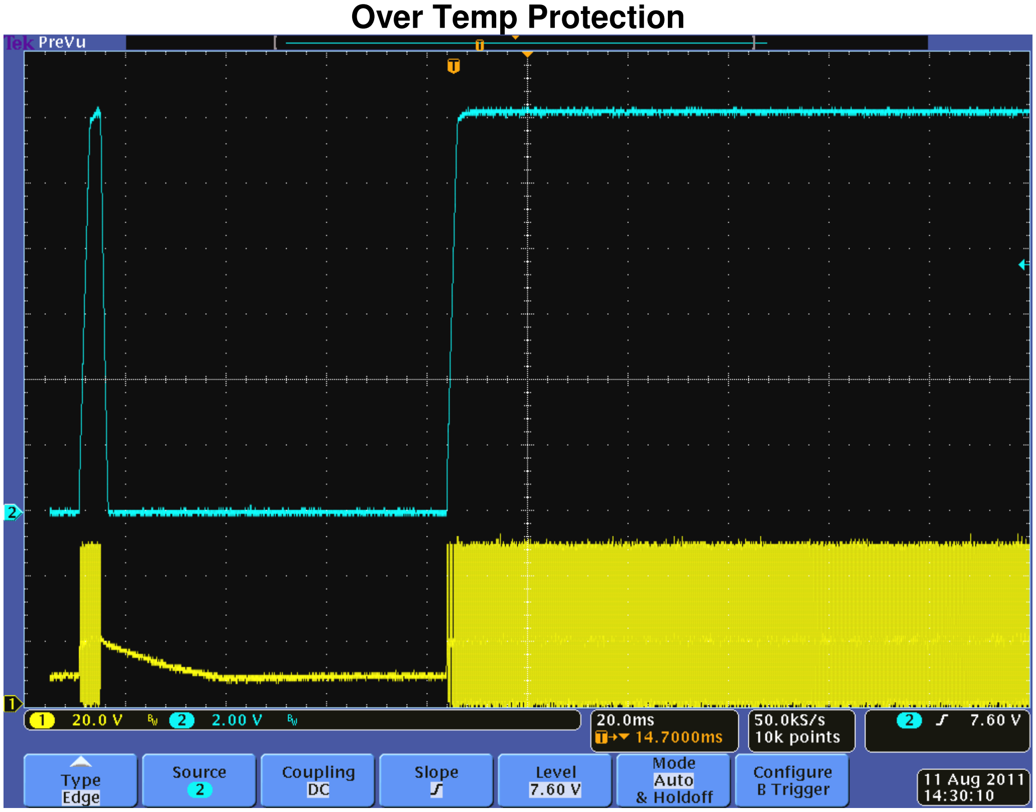


Vout response with 50% step change in load. External capacitance=150uf



External capacitance=150uf

Over Temp Protection

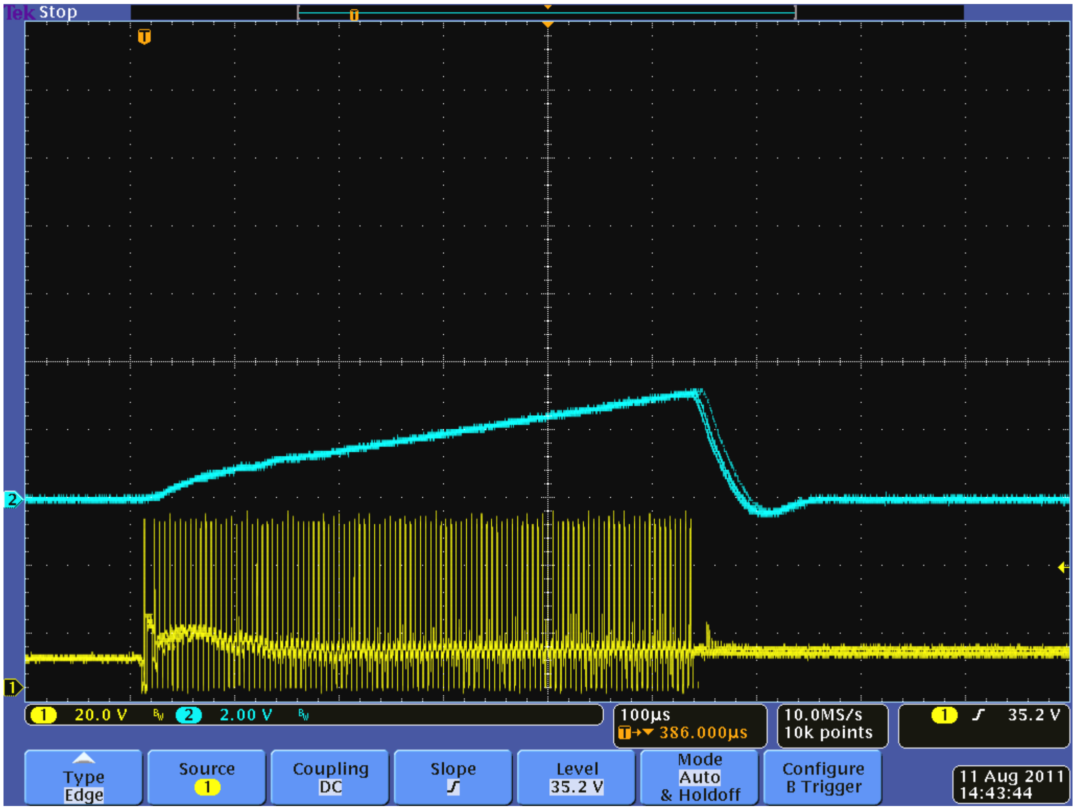


Yellow(channel 1)=Transformer Primary Voltage, Blue(channel 2)=Vout; External capacitance=150uf

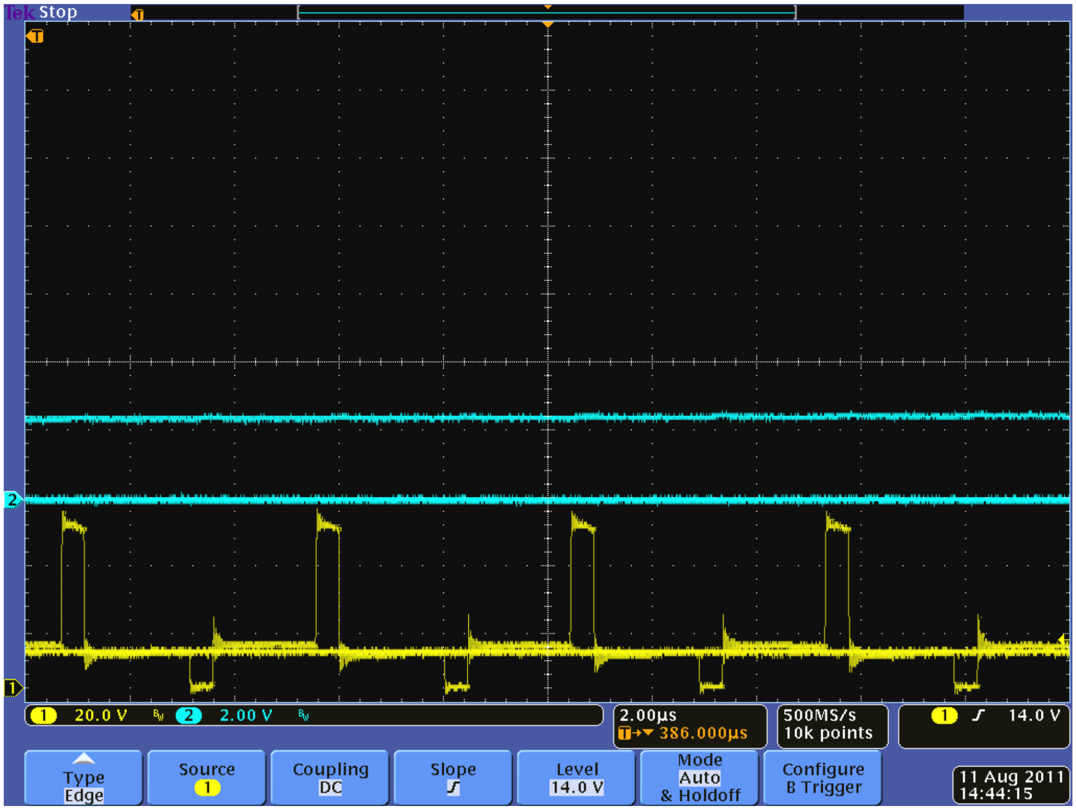
The board was externally heated in the area of the sense thermistor for the Over temp detection circuit. The waveforms show the hiccup delay before switching resumes and the output returning with no overshoot after the temperature is reduced.

Yellow(channel 1)=Transformer Primary Voltage External capacitance=150uf
Expanded view of the primary voltage of the power transformer showing no asymmetry during the hiccup recovery period.

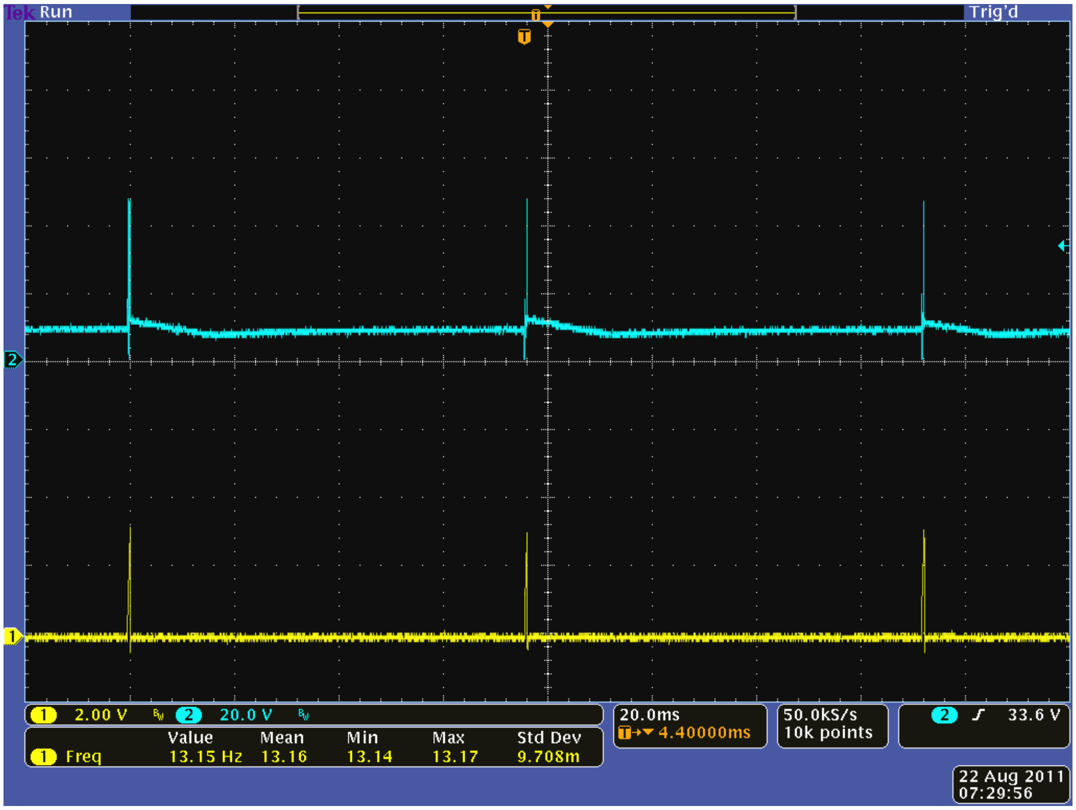
Over Current



Yellow(channel 1)=Transformer Primary Voltage, Blue(channel 2)=Vout; Iout=20A External capacitance=150uf



Yellow(channel 1)=Transformer Primary Voltage, Blue(channel 2)=Vout; Iout=20A External capacitance=150uf Expanded view of the primary voltage of the power transformer showing no asymmetry during the hiccup recovery period.



Yellow(channel 1)= Vout, Blue(channel 2)= Transformer Primary Voltage; Iout=20A
External capacitance=150uf. Converter in Hiccup mode during Over current condition.
Featuring very low power dissipation when exhibiting an over current fault.

Summary

The intent of this design was to highlight some of features of the UCC28250 PWM controller, such as a programmable hiccup timer for fault conditions, prebias startup capability, adjustable timing on gate drive signals for synchronous rectifiers and the ability to have feed forward compensation with a secondary side controller.

The secondary side bias power and startup is provided by Texas Instruments UCC25230 bias supply controller with built in power devices. This device is capable of 75v operation with 100v surges and up to 250mA of peak current. By utilizing a forward flyback topology allows for simpler magnetic design for the bias supply to provide controller power for both primary and secondary side circuitry.

As can be observed by the previous data, a high efficiency eighth brick reference design can be achieved using Texas Instruments comprehensive line of power solutions.

Notes:

All data was taken at room ambient approximately 25 degrees C, minimal airflow of 200LFM unless otherwise noted. No data was taken at extreme cold or elevated temperatures. The design would need to be optimized for specific applications and specifications.

Over current sensing is done by amplifying a differential voltage across an embedded copper trace on the secondary side.

This reference design does not have any compensation for temperature or input voltage changes for the current sensing method used. It would need to be modified for an end user application to allow for input voltage range, printed circuit board materials and temperature variations.

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