Digital Controlled Two-Transistor Interleaved Forward Converter Reference Design

Bosheng Sun *HPCS*

1 Introduction

TI design TIDA-00351 is a standalone two-transistor interleaved forward DC-DC power converter. The converter is used together with a control card, the UCD3138064EVM-166, which is an EVM placed on the UCD3138064. The TIDA-00351, together with the UCD3138064EVM-166, evaluates a two-transistor interleaved forward DC-DC power converter. Each EVM is delivered without requiring additional work, from either hardware or firmware. This EVM combination allows for some of the design parameters to be retuned using Texas Instruments' graphical user interface (GUI) based tool, Fusion Digital Power™ Designer. Loading custom firmware with user-designed definition and development is also possible.

Three EVMs are included in the kit: the TIDA-00351, UCD3138064EVM-166, and USB-TOGPIO.

This user's guide provides basic evaluation instruction with a focus on system operation in a standalone two-transistor interleaved forward DC-DC power converter.

2 Description

The TIDA-00351, along with the UCD3138064EVM-166, demonstrates a two-transistor interleaved forward DC-DC power converter with digital control using the UCD3138064 device. The UCD3138064 device is located on the UCD3138064EVM-166 board. The UCD3138064EVM-166 is a daughter-card with preloaded firmware providing the required control functions for a two-transistor interleaved forward converter. Please contact TI for details on the firmware. The TIDA-00351 accepts a DC input from 370 to 400 VDC, and outputs a typical 12 VDC with full-load output power at 360 W, or full output current of 30 A.

2.1 Typical Applications

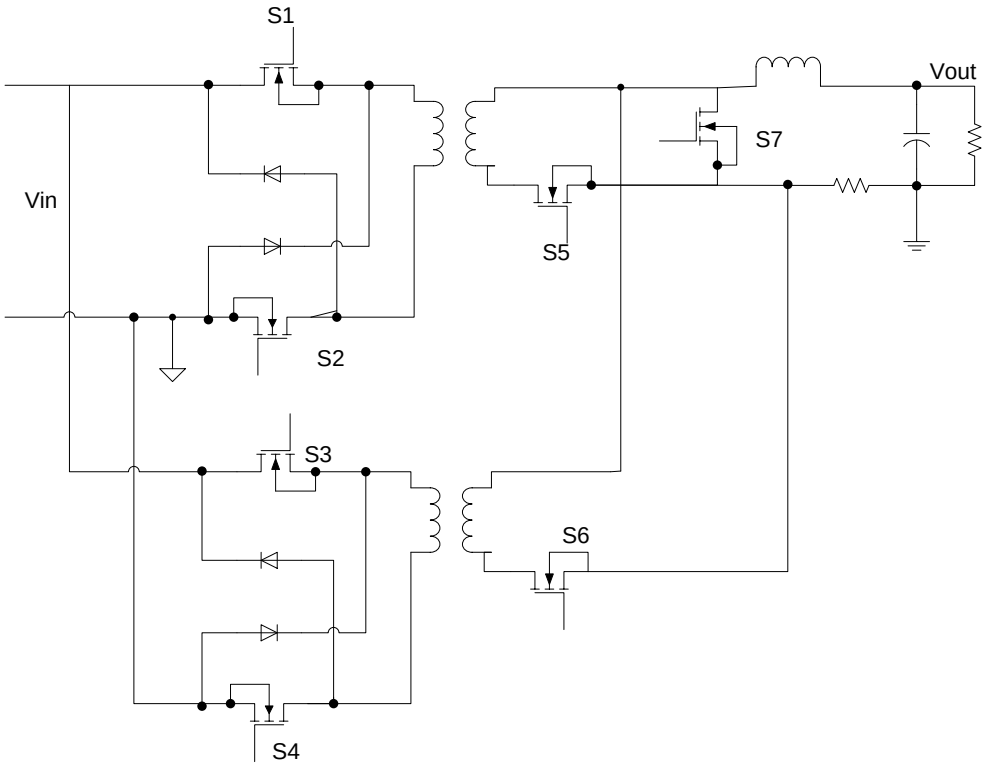
- Offline DC-DC power conversions
- Servers
- Telecommunication systems

2.2 Features

- Digital controlled two-transistor interleaved forward DC-DC power conversion

- DC input from 370 to 400 VDC
- 12-VDC regulated output from no load to full load
- Full-load power at 360 W, or full-load current at 30 A
- Peak current mode control
- Synchronize rectifier control
- Overvoltage, overcurrent, over temperature, and brownout protection
- Cycle by cycle input current protection
- Burst mode at light load
- Constant power constant current control
- Current sharing

3 Block Diagram



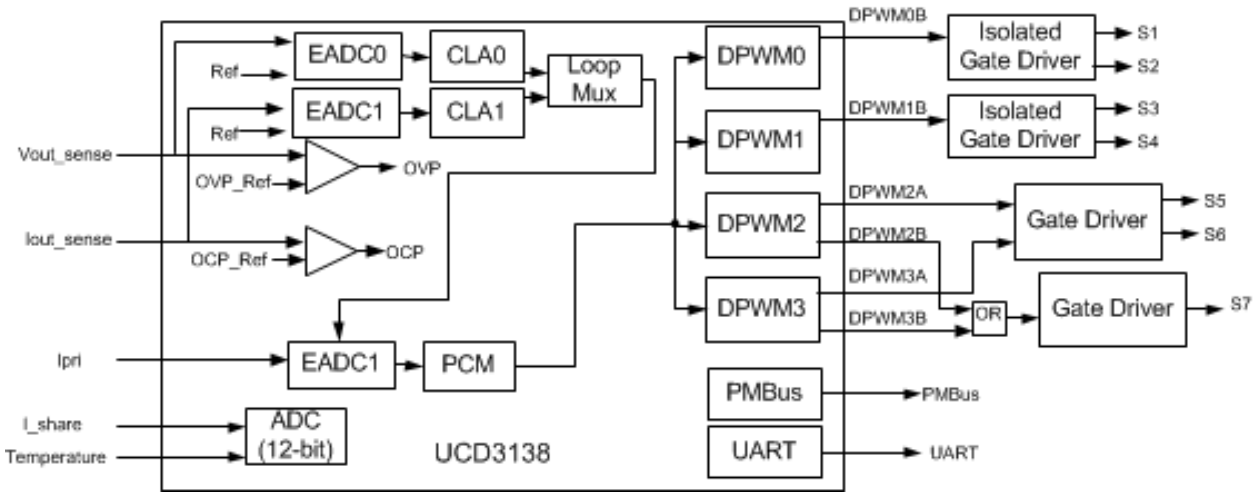


Figure 1, Block Diagram

Figure 1 shows the block diagram. There are three loops: a voltage loop regulates output voltage during normal operation; a current loop regulates output current during overload condition; and a peak current control loop which controls input peak current cycle by cycle.

Preliminary

4 PWM Waveform

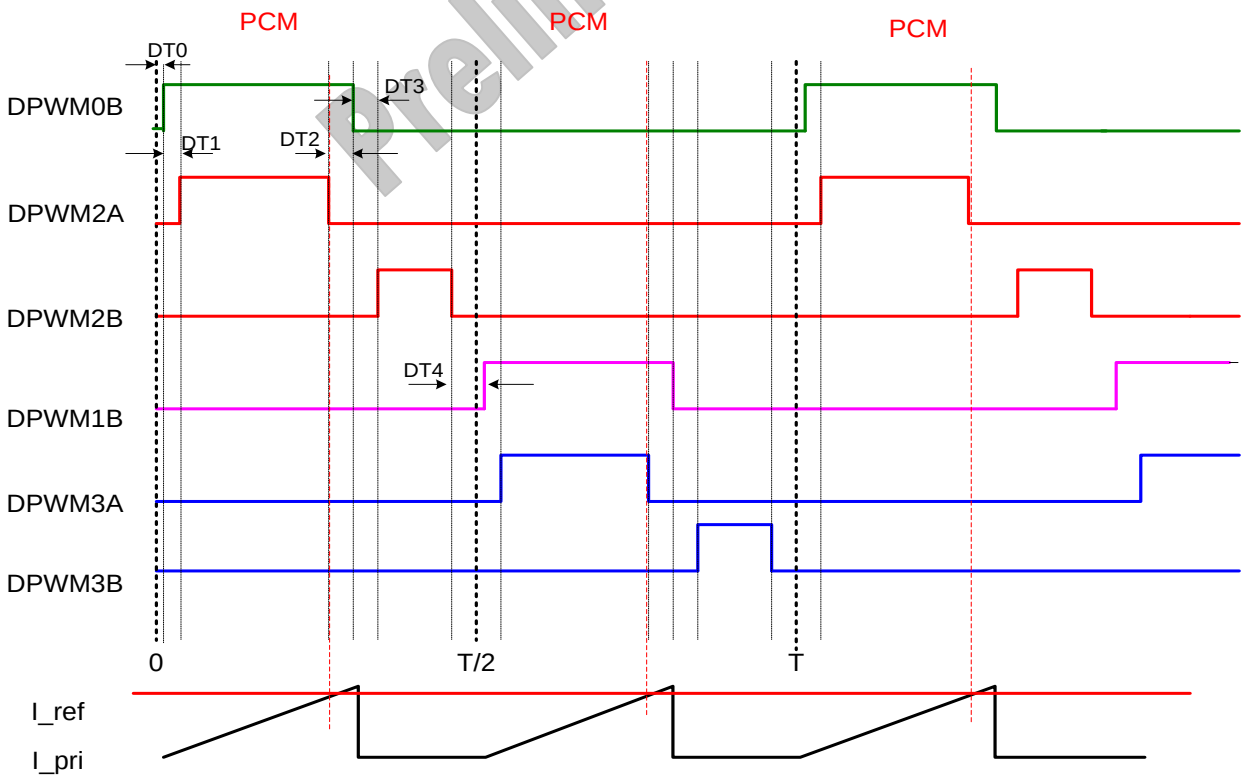
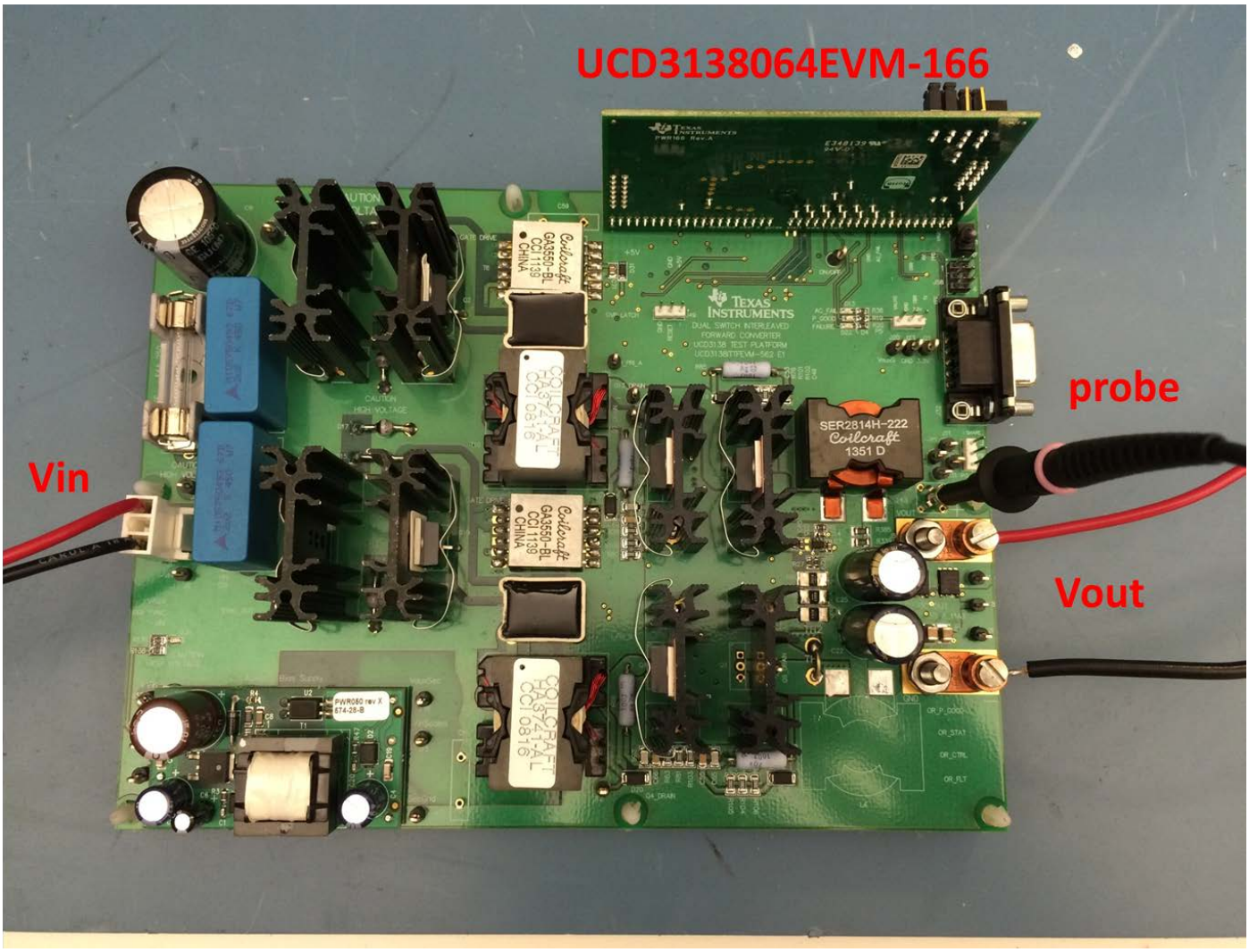


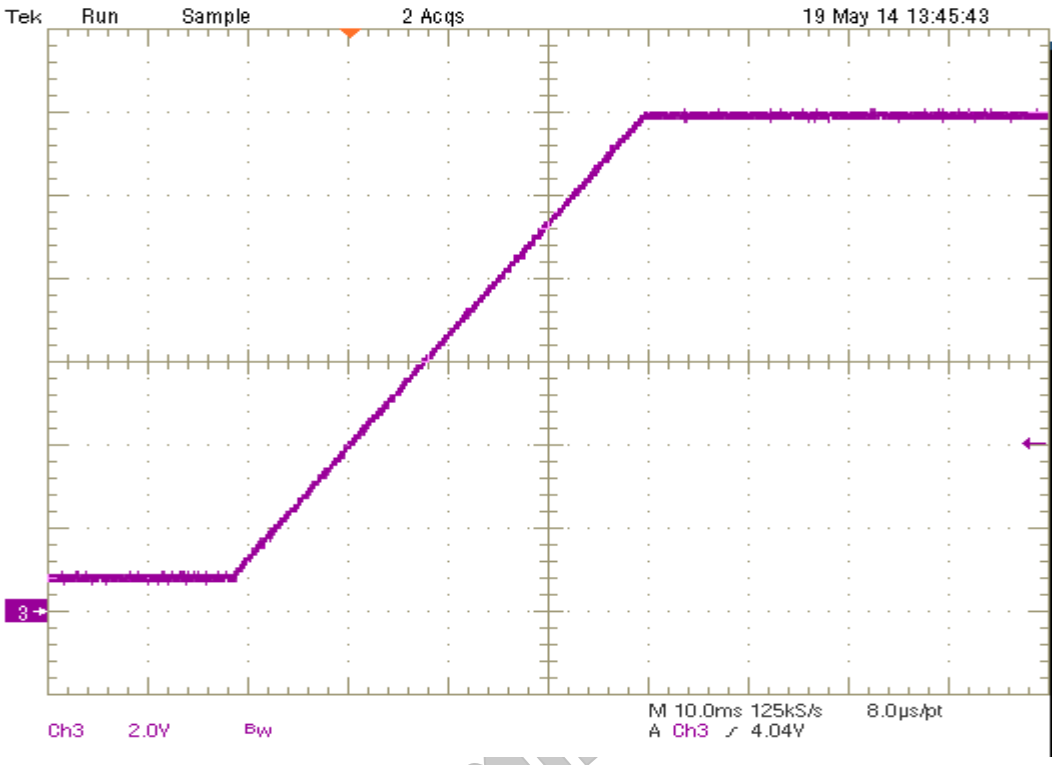
Figure 2, PWM waveform

5 Test

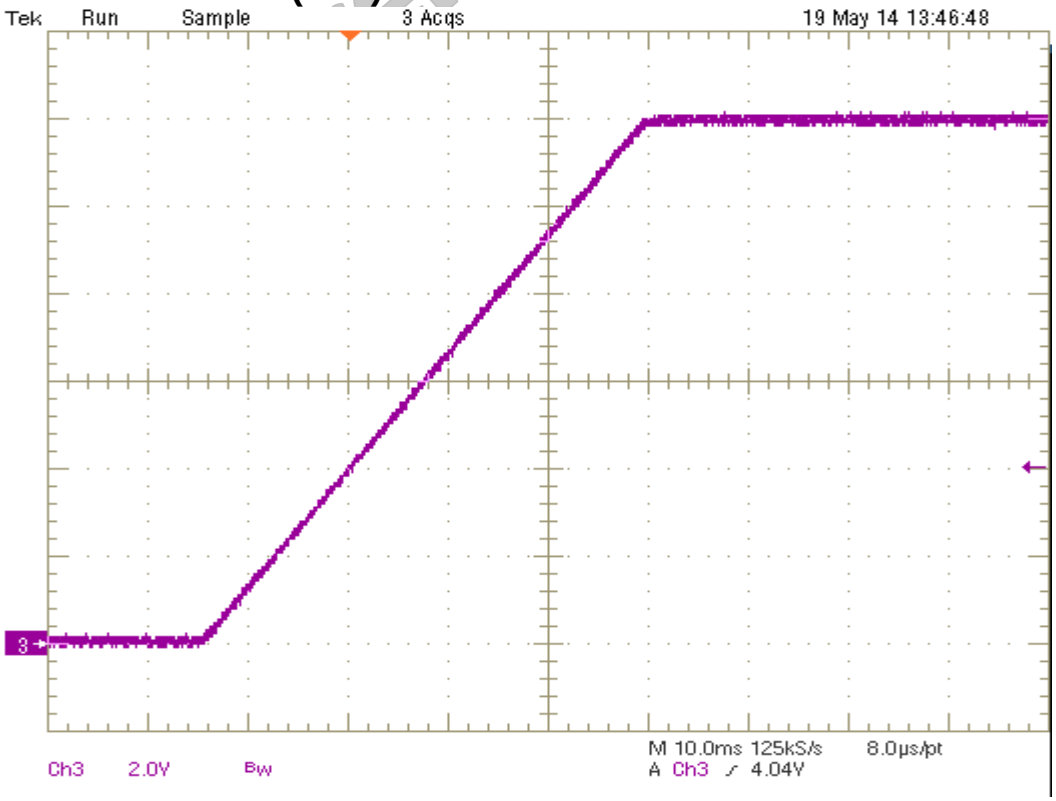
5.1 Test set up



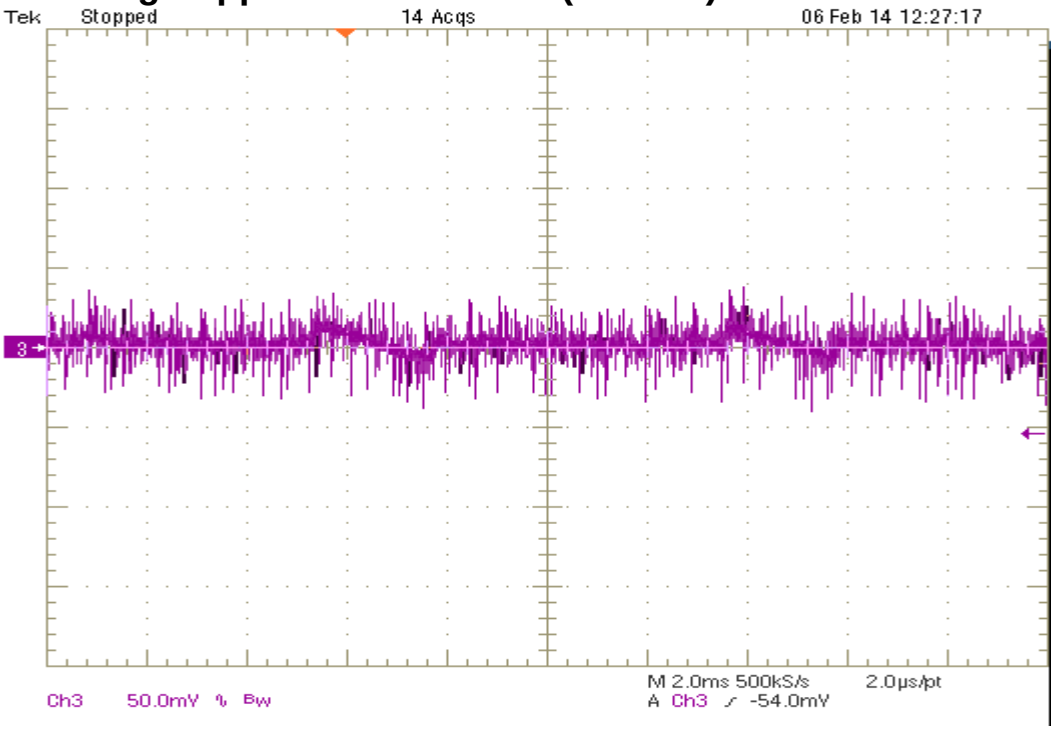
5.2 Soft start at no load



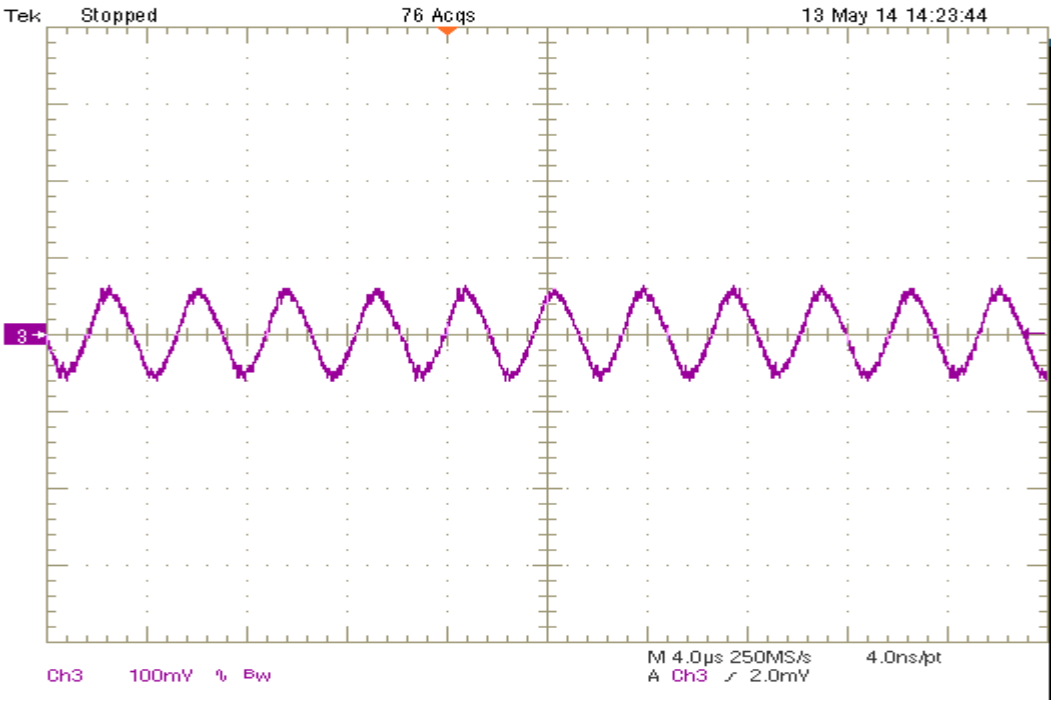
5.3 Soft start at full load (30A)



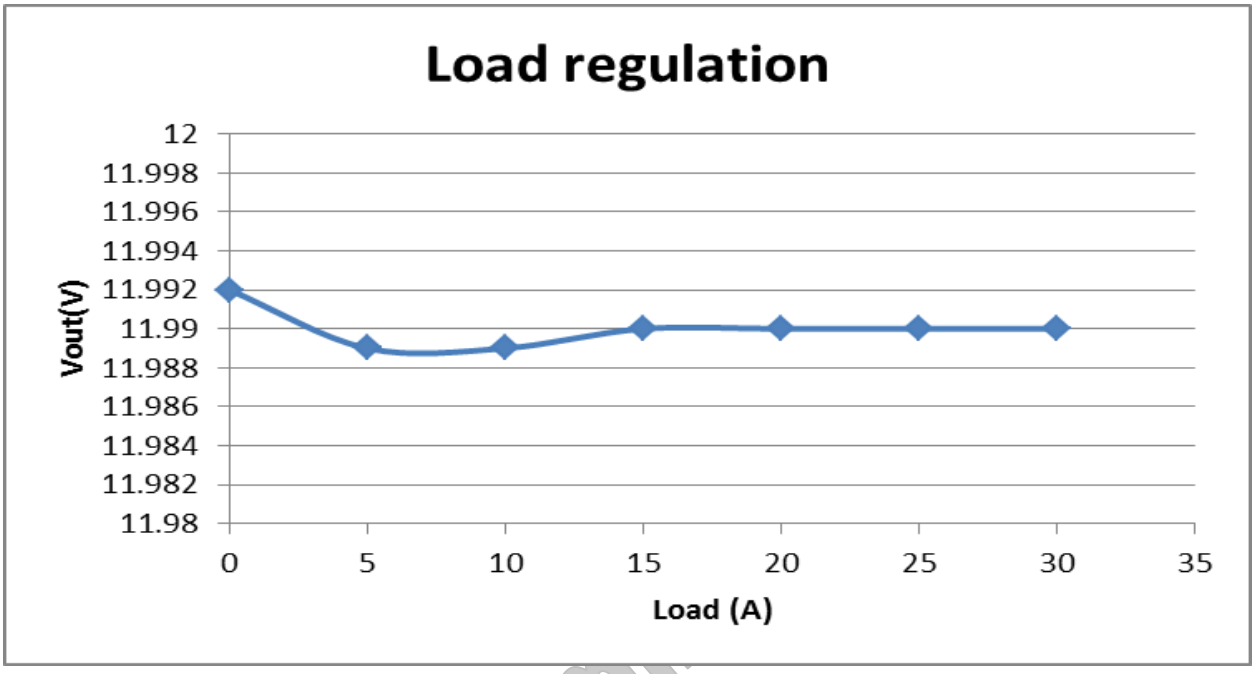
5.4 Output voltage ripple at burst mode (no load)



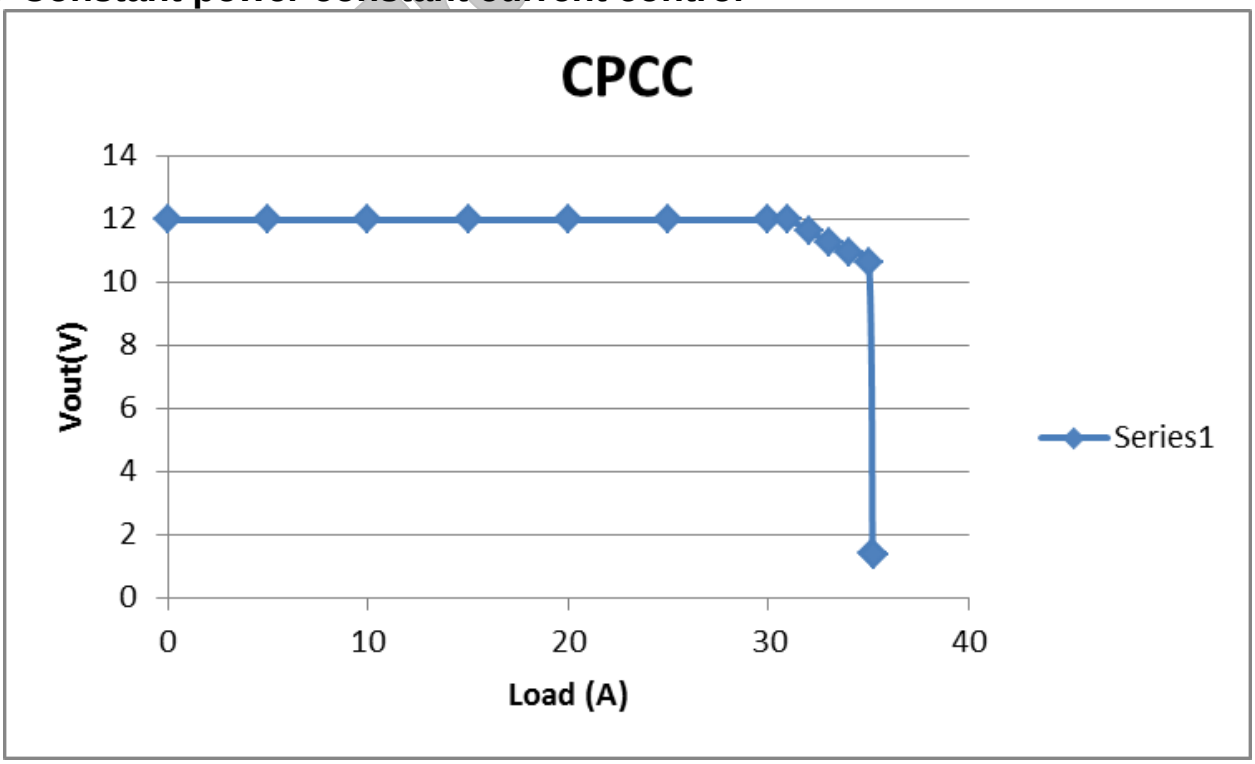
5.5 Output voltage ripple at full load (30A)



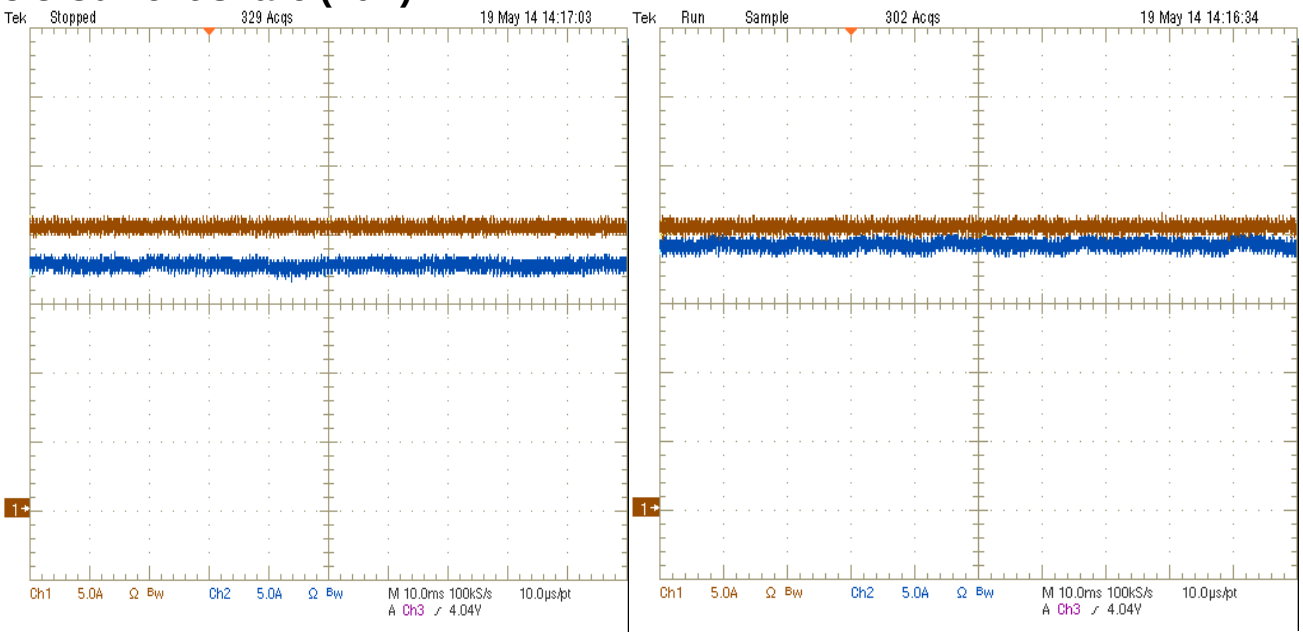
5.6 Load regulation



5.7 Constant power constant current control

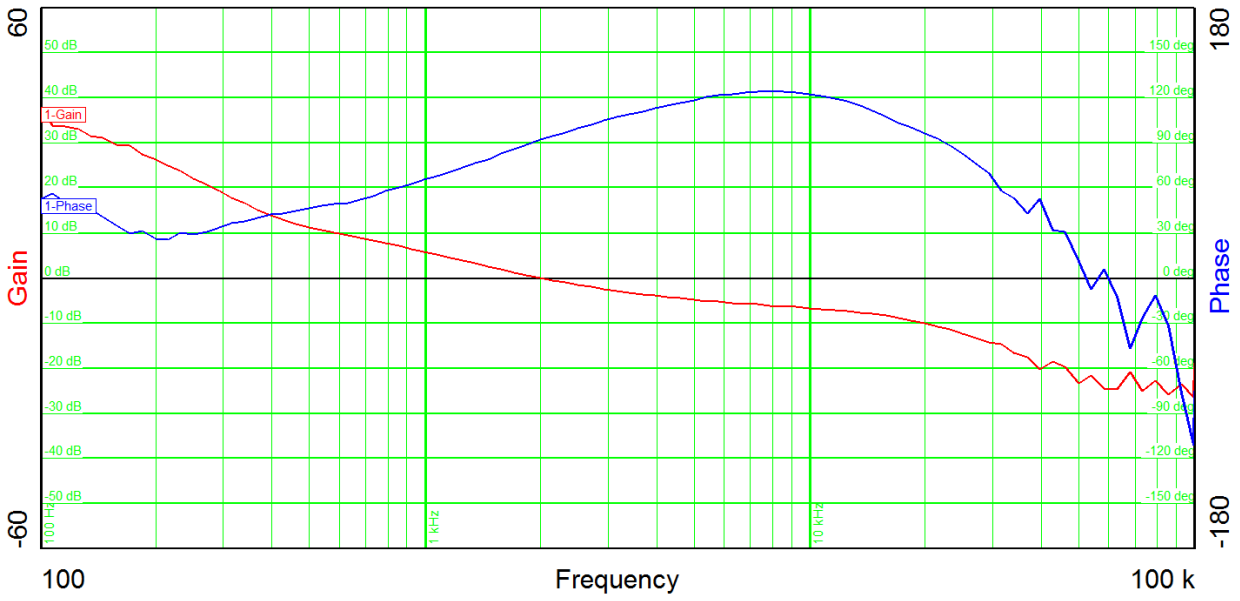


5.8 Current share (40A)



Current share disabled **Current share enabled**

5.9 Voltage Loop Bode Plot



6 Evaluating the EVM with GUI

The collective graphical user interface (GUI) is called TI's Fusion Digital Power Designer (FDPD). The GUI serves as the interface for several families of TI's digital-control ICs including the UCD31xx family, (such as UCD3138064). The GUI is divided into two main categories, Designer GUI and Device GUI. Each UCD31xx EVM relates to a particular Designer GUI allowing users to re-tune and re-configure a particular EVM with existing hardware and firmware. Device GUI relates to the accessing of internal registers and memories of a particular device.

7 Firmware Development for Two-Switch Interleaved Forward Converter

Please contact TI for additional information regarding the UCD3138064 firmware development for a digital controlled two-transistor interleaved forward DC-DC power converter.

8 References

1. UCD3138064 Datasheet (SLUSB72B)
2. UCD3138064EVM-166 User's Guide (SLUUAC6)
3. UCD3138064 Programmer's Manual (SLUUAD8B)
4. Fusion Digital Power Designer for UCD3138 Isolated Power Applications (slua676)

Preliminary