1 Description

TIDA-00512 (3138ALLCEVM-150) together with 3138ACC32EVM-149 is an EVM of LLC resonant half-bridge DC-DC power converter with digital control using UCD3138A device. UCD3138A device is located on the board of 3138ACC32EVM-149. 3138ACC32EVM-149 is a daughter card and serves all LLC resonant converter required control functions with preloaded firmware. For details of firmware please contact TI. TIDA-00512 accepts DC line input from 350Vdc to 400Vdc, and outputs nominal 12Vdc with full load output power 340W, or full output current 29A.

2 Performance Specification

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Characteristics					
Voltage operation range		350		400	VDC
Input UVLO On			325		VDC
Input UVLO Off			310		VDC
Input current	Input = 350VDC, Full Load = 29A			1.2	A
Input current	Input = 380VDC, Full Load = 29A			1.1	A
Input current	Input = 400VDC, Full Load = 29A			1.0	A
Output Characteristics					
Output voltage, VOUT	No Load to Full Load		12		VDC
Output load current, IOUT	350 to 400VDC			29	A
Output voltage ripple	380VDC and Full Load = 29A		200		mVpp
Output over current	Operation 10s then latch-off shutdown	30			A
Systems Characteristics					
Switching frequency	Resonant Mode	35		150	kHz
	PWM Mode		150		kHz
Peak efficiency	380VDC, Full Load = 20A		94.85		%
Full load efficiency	380VDC, Load = 29A		94.20		%
Operating temperature	Natural Convection		25		ºC
Firmware					
Device ID (Version)	UCD3138A				
Filename	3138ALLCEVM_150_150205.x0				

3 Test Setup

3.1 Test Equipment

DC Voltage Source: capable of 350 to 400Vdc, adjustable, with minimum power rating 400W, or current rating not less than 2A, with current limit function. The DC voltage source to be used should meet IEC60950 reinforced insulation requirement.

DC Multimeter: 1 unit capable of 0 to 400VDC input range, four digits display preferred; and 1 unit capable of 0 to 15VDC input range, four digits display preferred.

Output Load: DC load capable of receiving 0 to 15VDC, 0 to 30A, and 0 to 360W or greater, with display such as load current and load power.

Current-meter, DC, optional in case the load has no display, 1 unit, capable of 0 to 30A.

Oscilloscope: capable of 500MHz full bandwidth, digital or analog, if digital 5Gs/s or better

Fan: 200 to 400 LFM forced air cooling is recommended, but not a must

Recommended Wire Gauge: capable of 30A, or better than #14 AWG, with the total length of wire less than 8 feet (4 feet input and 4 feet return).

4 Performance Data and Typical Characteristic Curves

Figure 1 through 14 present typical performance curves for TIDA-00512.

4.1 Efficiency

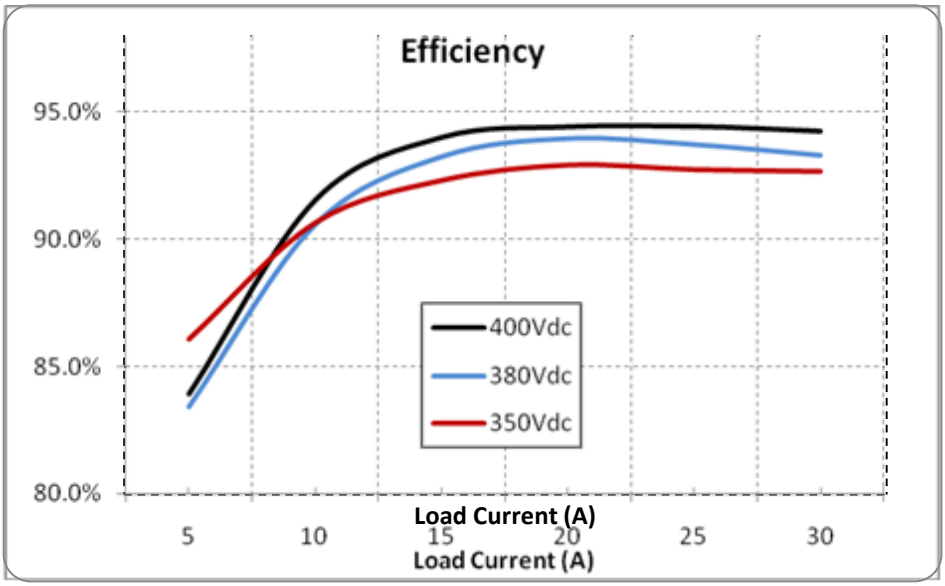

Figure 1. TIDA-00512 Efficiency

4.2 Load Regulation

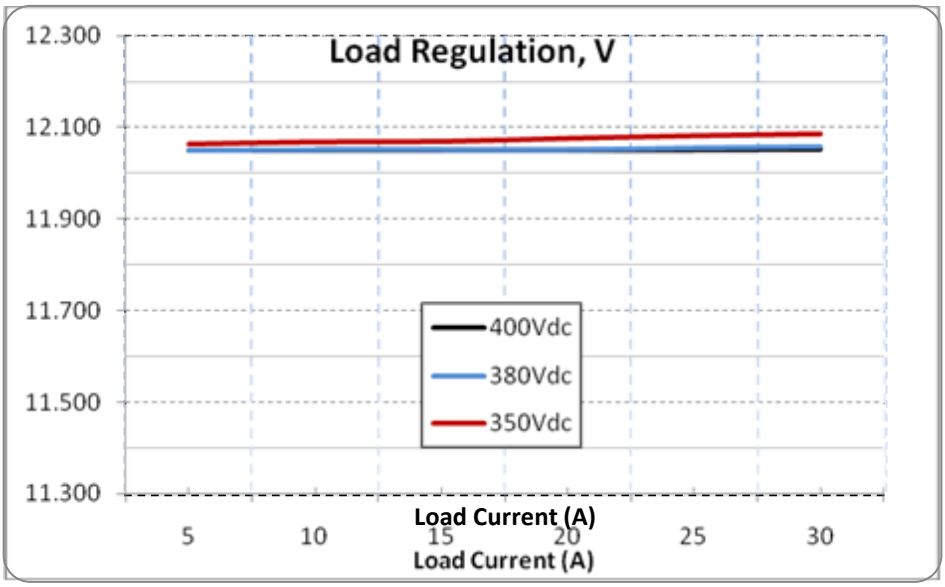

Figure 2. TIDA-00512 Load Regulation

4.3 Switching Frequency Control

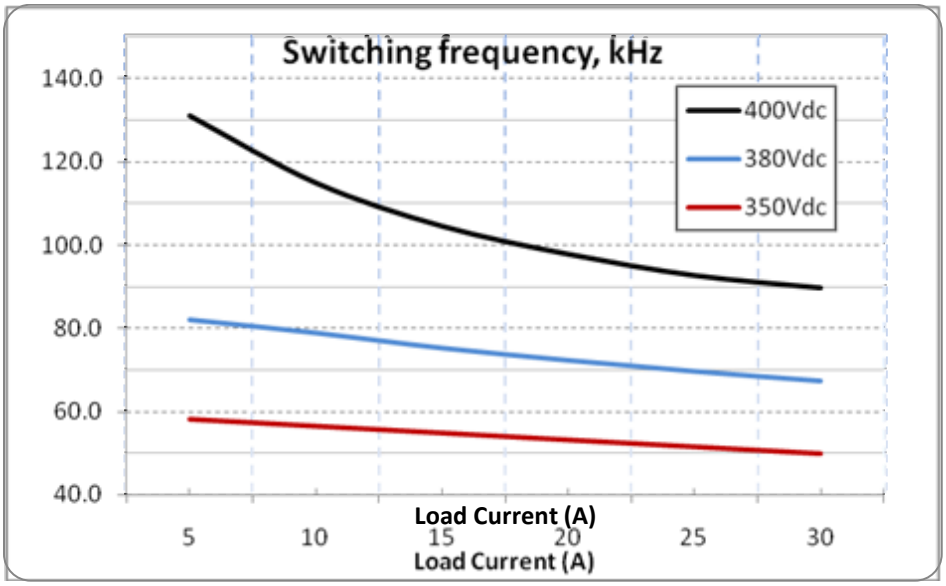

Figure 3. Switching Frequency Control in LLC Mode

4.4 Load Operation with LLC and PWM

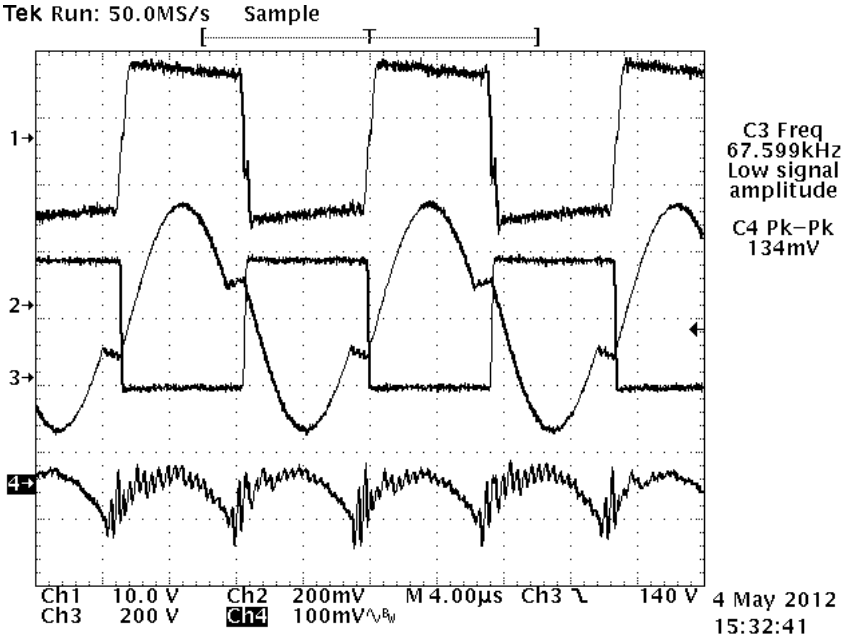

Figure 4. LLC Resonant Mode Operation at Full Load

(Ch1 = Vgs of Q7, Ch2 = Current in Resonant Network, 2A/div, Ch3 = Vds of Q7, Ch4 = Vo Ripple)

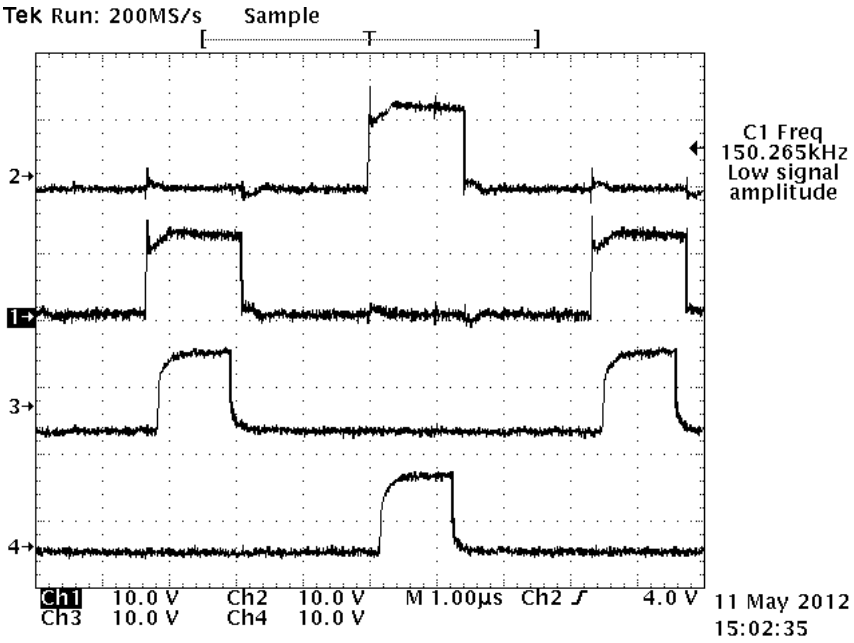

Figure 5. PWM Mode Operation after Fsw = 150kHz

(Ch1 = Vgs of Q7, Ch2 = Vgs of Q6, Ch3 = Vgs of SR2, Ch4 = Vgs of SR3)

4.5 Very Light Load Operation at High Line of Input

(Ch1 = Vgs, Q7, Ch2 = Vgs, Q6, Ch3 = Vgs, SR1, Ch4 = Vgs, SR2)

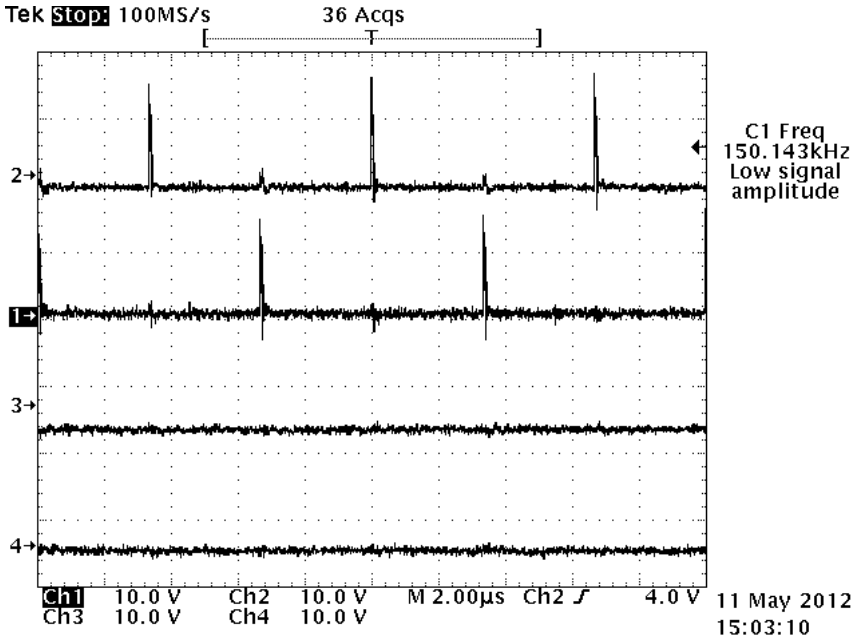

Figure 6. PWM Control at 400VDC Input and Light Load (SR off)

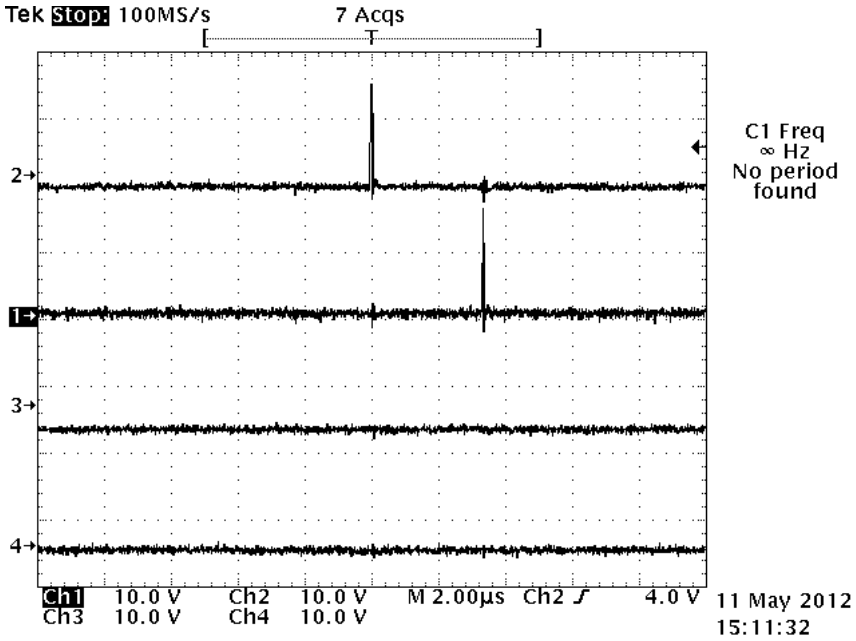

Figure 7. PWM Control with SR Off and Pulse Skipping

4.6 Output Voltage Ripple

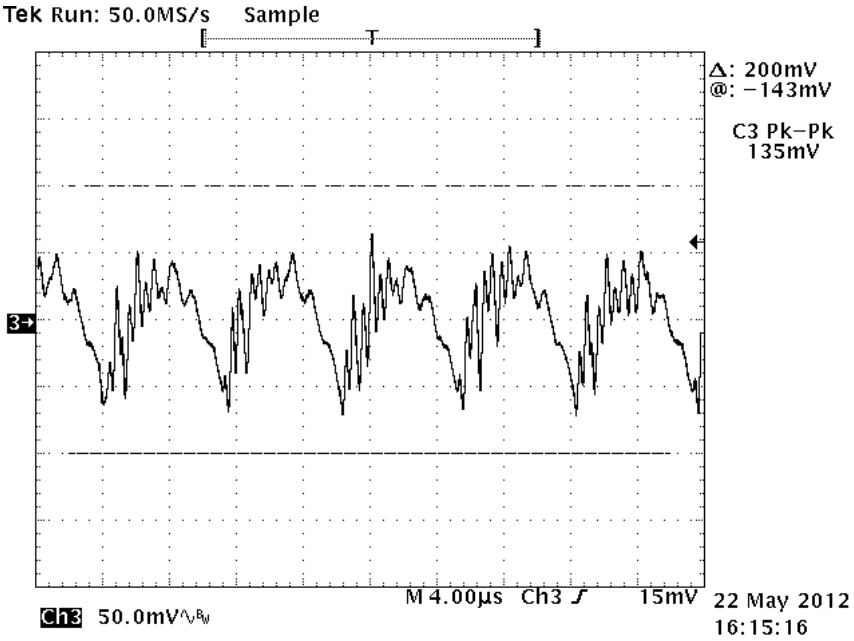

Figure 8. Output Voltage Ripple 380VDC and Full Load

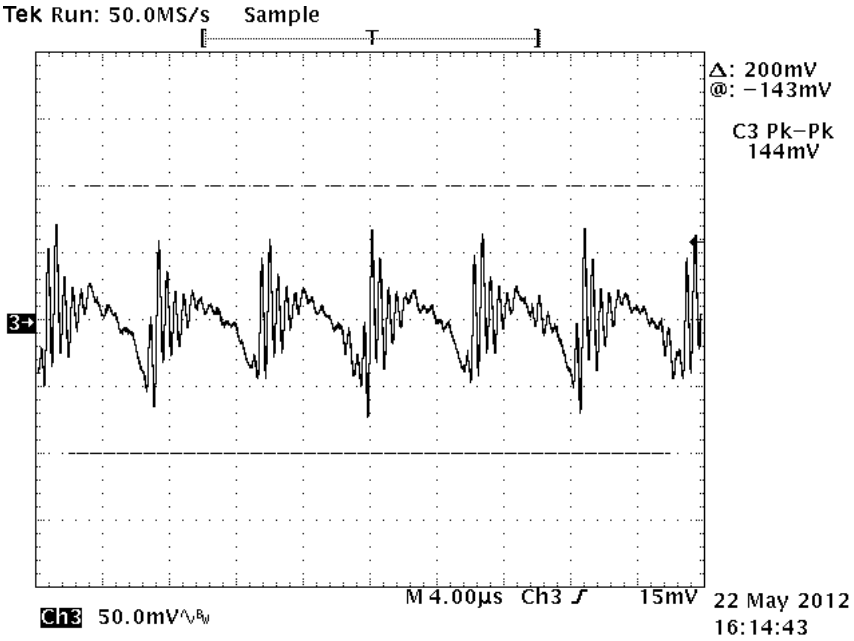

Figure 9. Output Voltage Ripple 380VDC and Half Load

4.7 Output Turn On

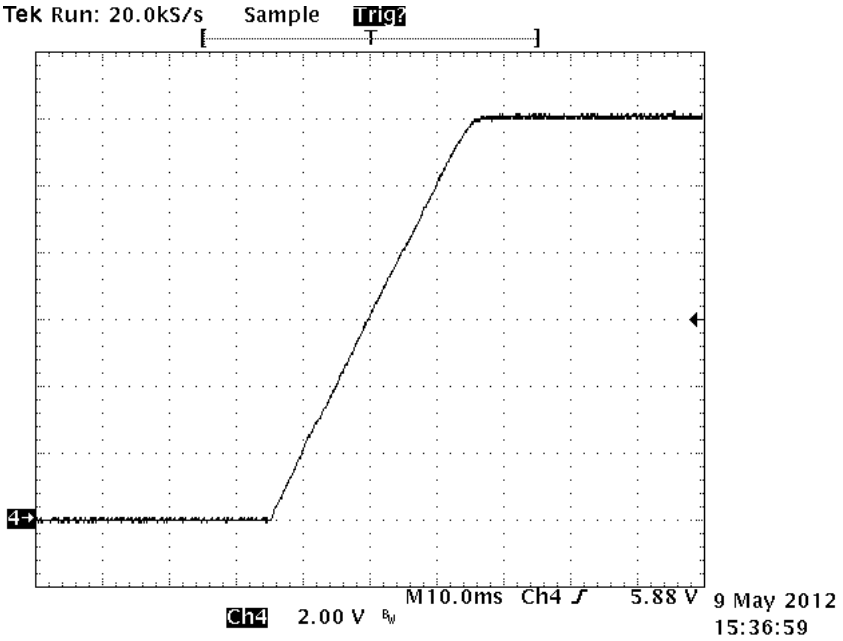

Figure 10. Output Turn On 380VDC with Load Range

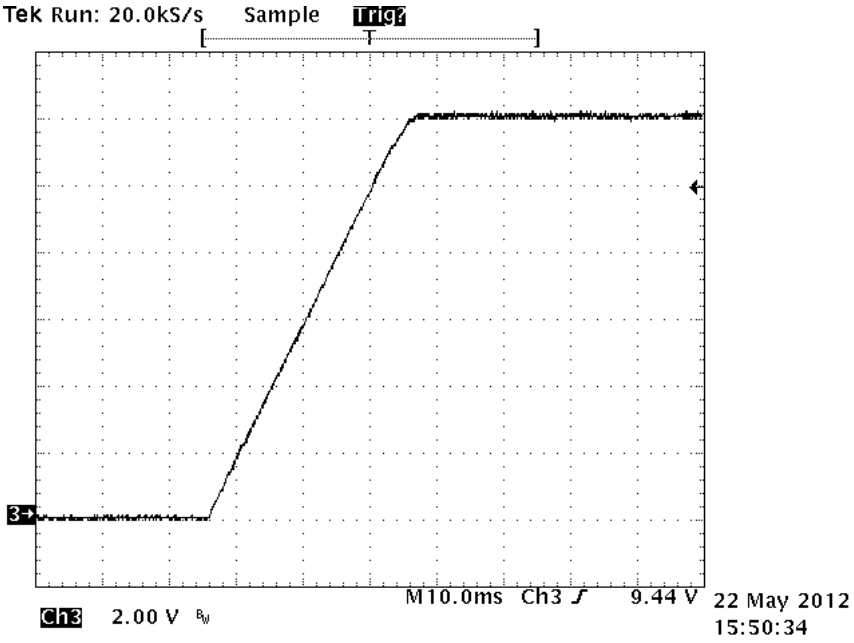

Figure 11. Output Turn On 350VDC with Load Range

4.8 Other Waveforms

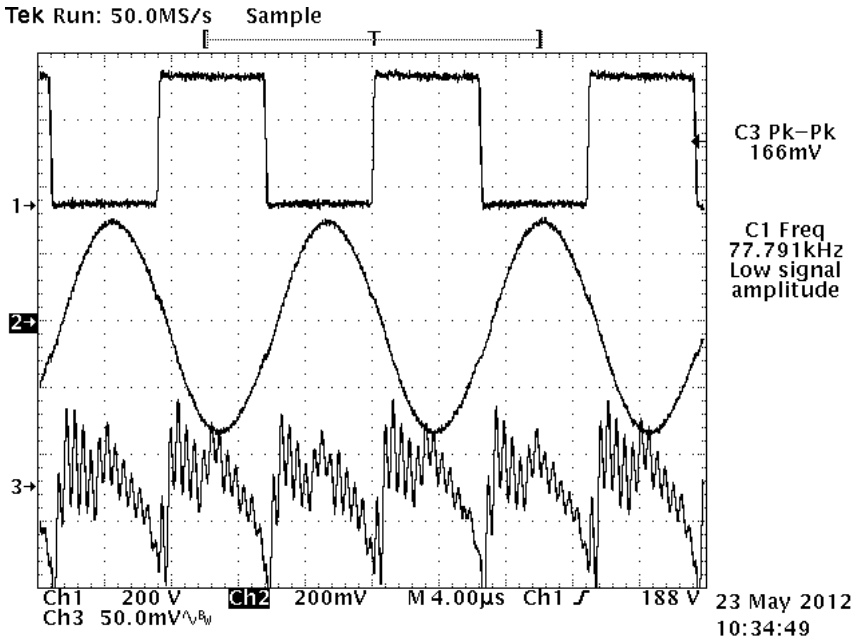

Figure 12. 380VDC and 30A before OCP Latch-off Shutdown

(Ch1 = Vds of Q7, Ch2 = Current of Resonant Network, Ch3 = Vo Ripple)

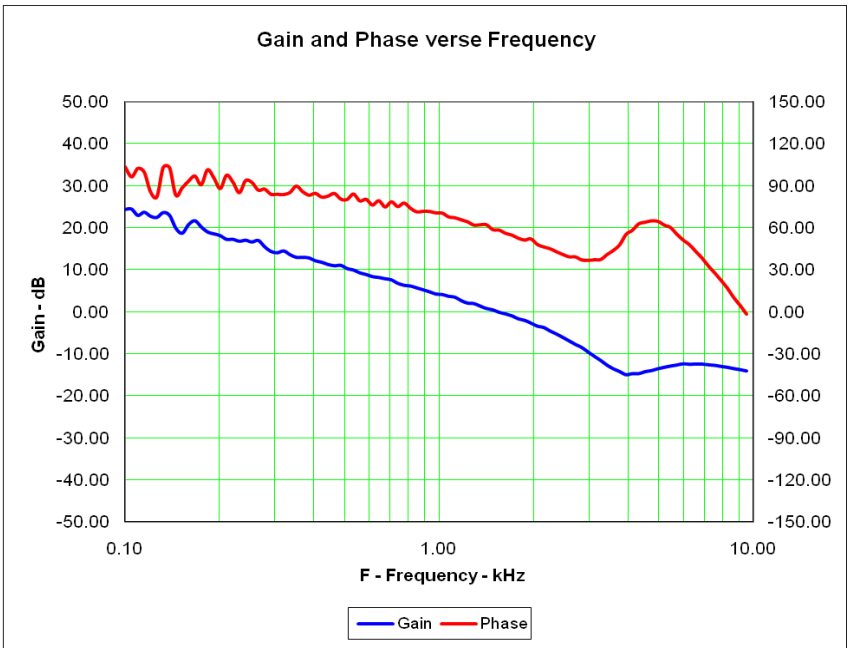

Figure 13. Control Loop Bode Plots at 380VDC and Full Load

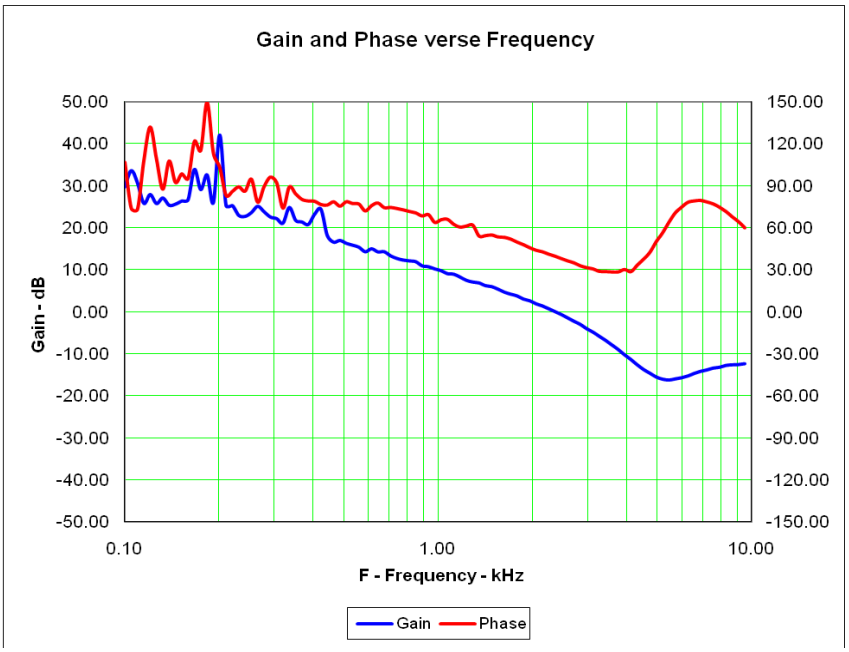

Figure 14. Control Loop Bode Plots at 400VDC and Full Load

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