PMP4497 Test Results

1 General

1.1 PURPOSE

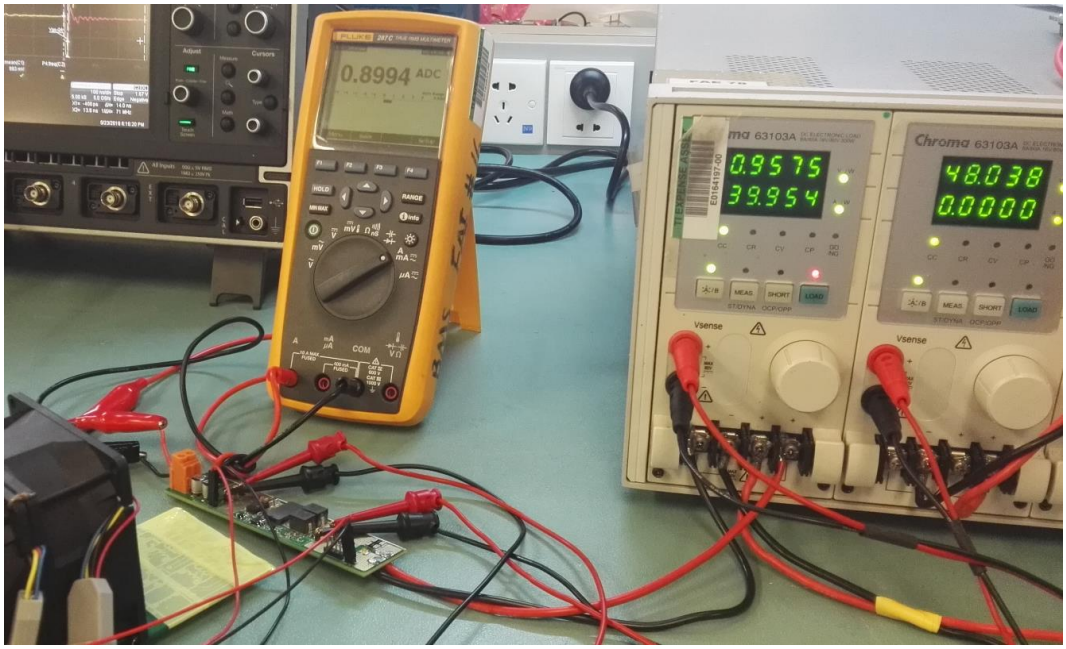
This report provides the detailed data and waveforms for evaluating and verifying the PMP4497. The PMP4497 is the 48V to 1.0V/40A DC-DC converter with the GaN module LMG5200 and the D-Cap+ controller TPS53632. It delivers up to 1.0V/40A output power. The converter could provide high efficiency with the good performance, which makes it an ideal choice for computer & server, FPGA and ASIC power supply. For testing applications, cooling airflow is required.

1.3 TEST EQUIPMENTS

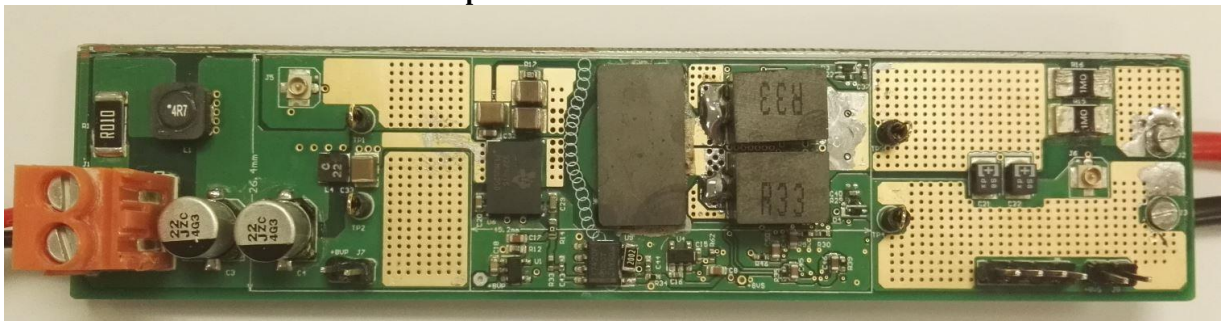
Multi-meter: Fluke Multimeter 287C, Agilent 34401A
DC Source: TDK-Lambda
Oscilloscope: WaveSurfer 104Mxs-B

1.4 Testing Setup Photos

Testing Setup



Top View of the Board

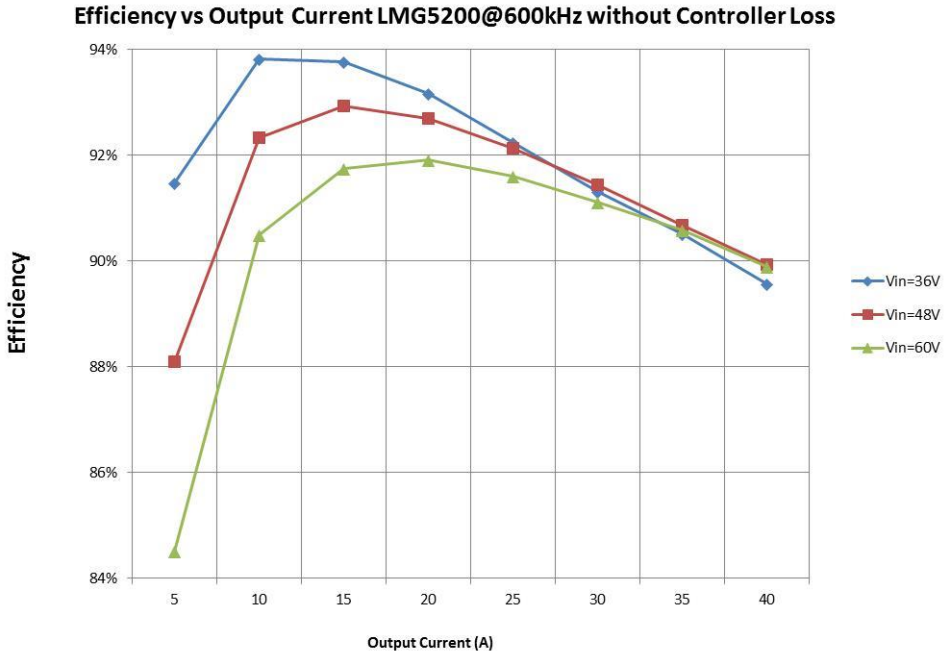


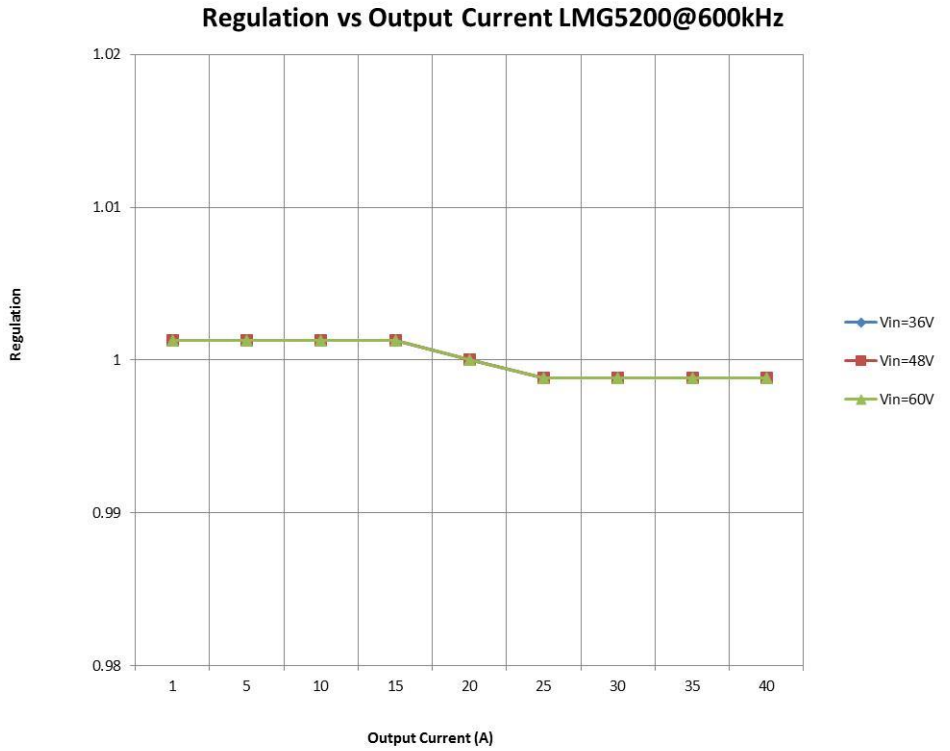
2 INPUT & Output CHARACTERISTICS

2.1: Efficiency vs Output Current

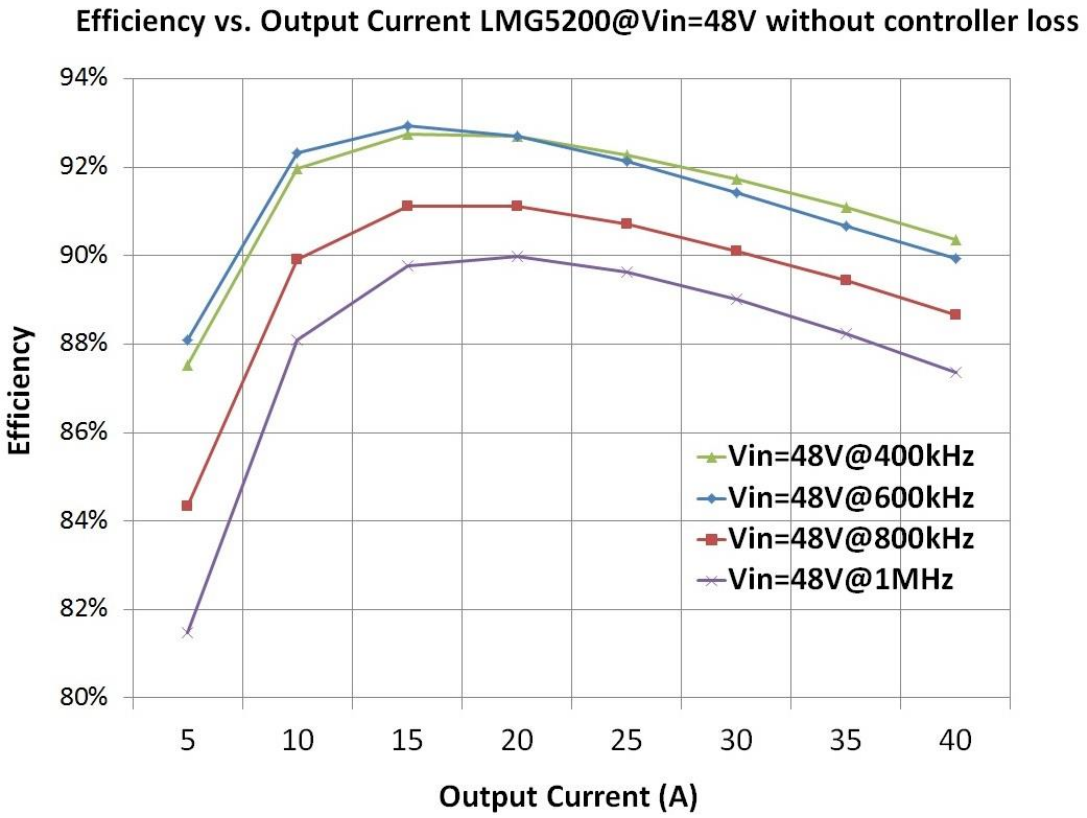
1.0V/40A Output Efficiency, @600kHz, without Controller Loss

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Eff. (%)
36V Input				
36.249	0.0119	1.001	0.0	0.4(W)
36.240	0.0391	1.001	1.0	70.7%
36.221	0.1511	1.001	5.0	91.5%
36.190	0.2949	1.001	10.0	93.8%
36.160	0.4430	1.001	15.0	93.8%
36.131	0.5942	1.000	20.0	93.2%
36.099	0.7499	0.999	25.0	92.2%
36.071	0.9097	0.999	30.0	91.3%
36.036	1.0718	0.999	35.0	90.5%
36.000	1.2391	0.999	40.0	89.6%
48V Input				
48.183	0.0138	1.001	0.0	0.7(W)
48.175	0.0340	1.001	1.0	61.1%
48.159	0.1180	1.001	5.0	88.1%
48.140	0.2253	1.001	10.0	92.3%
48.115	0.3359	1.001	15.0	92.9%
48.094	0.4486	1.000	20.0	92.7%
48.069	0.5638	0.999	25.0	92.1%
48.045	0.6821	0.999	30.0	91.4%
48.024	0.8028	0.999	35.0	90.7%
47.998	0.9255	0.999	40.0	89.9%
60V Input				
60.034	0.0154	1.001	0.0	0.9(W)
60.033	0.0317	1.001	1.0	52.6%
60.016	0.0987	1.001	5.0	84.5%
60.003	0.1844	1.001	10.0	90.5%
59.983	0.2729	1.001	15.0	91.8%
59.963	0.3629	1.000	20.0	91.9%
59.948	0.4547	0.999	25.0	91.6%
59.931	0.5487	0.999	30.0	91.1%
59.906	0.6442	0.999	35.0	90.6%
59.886	0.7421	0.999	40.0	89.9%

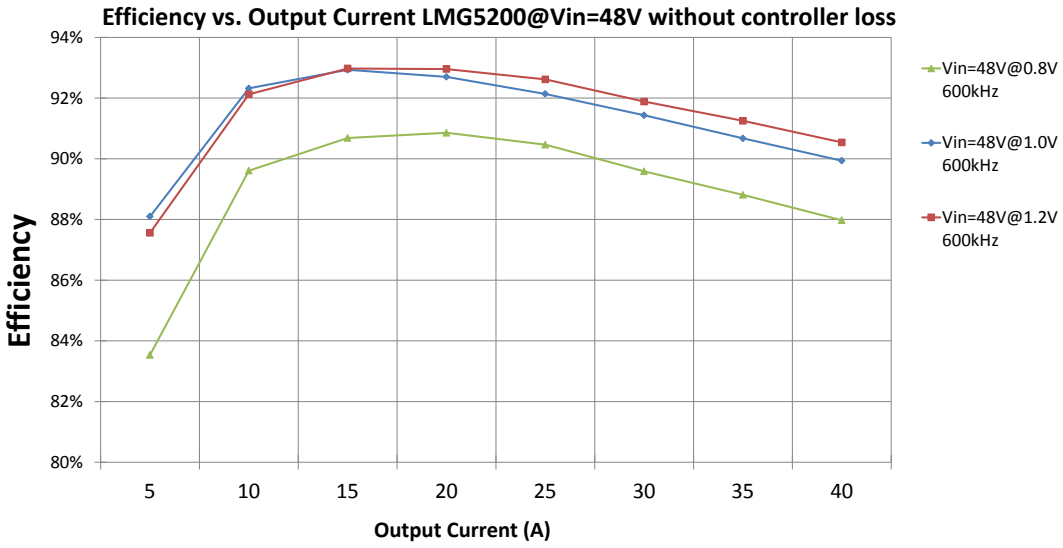

Efficiency vs Output Current LMG5200@600kHz without Controller Loss
94%
92%
90%
88%
86%
84%
Efficiency
5
10
15
20
25
30
35
40
Output Current (A)
Vin=36V
Vin=48V
Vin=60V


Regulation vs Output Current LMG5200@600kHz
1.02
1.01
1
0.99
0.98
Regulation
1
5
10
15
20
25
30
35
40
Output Current (A)
Vin=36V
Vin=48V
Vin=60V

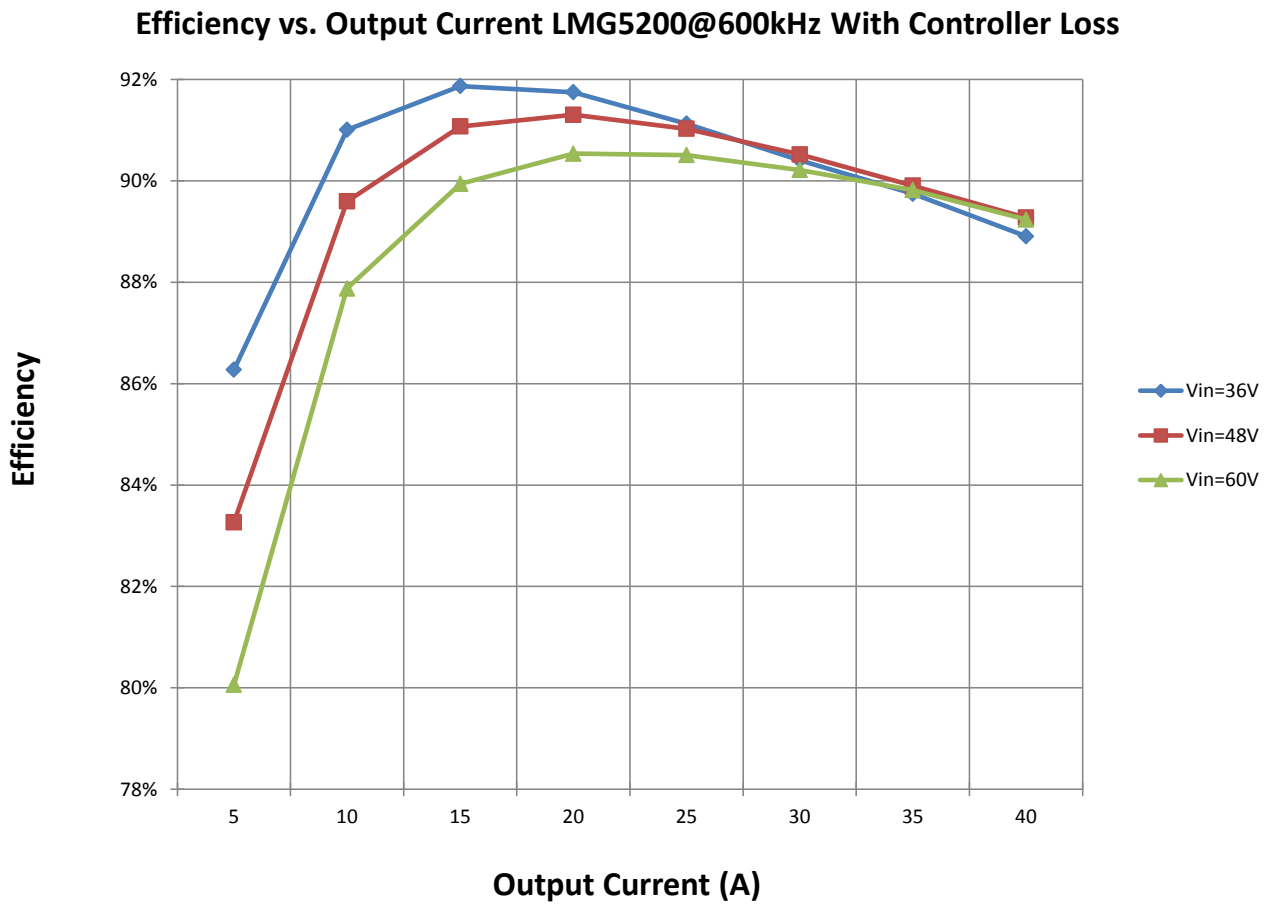
Efficiency Curve without Controller Loss vs. Frequency



Efficiency Curve without Controller Loss vs. Output Voltage

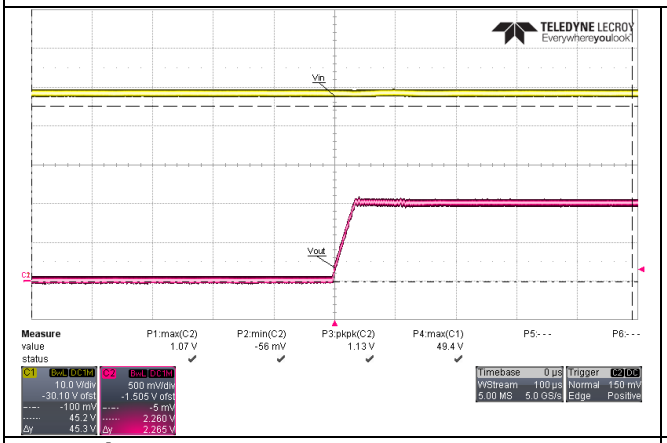
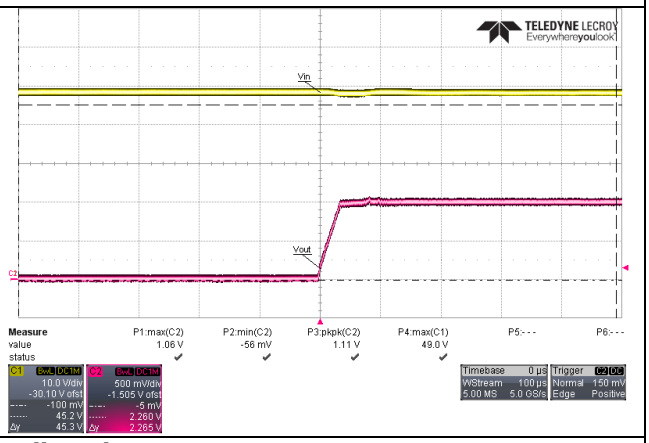
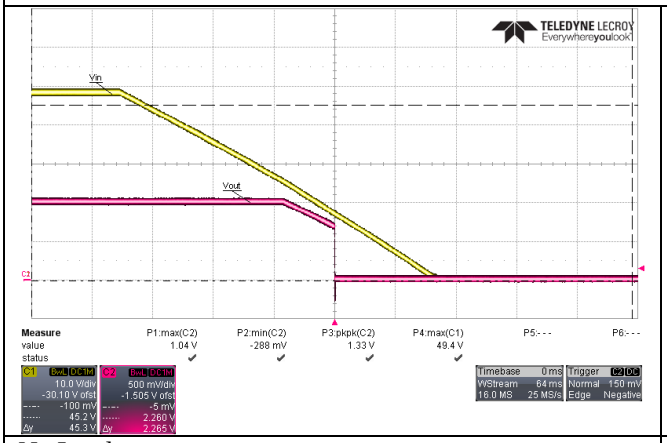
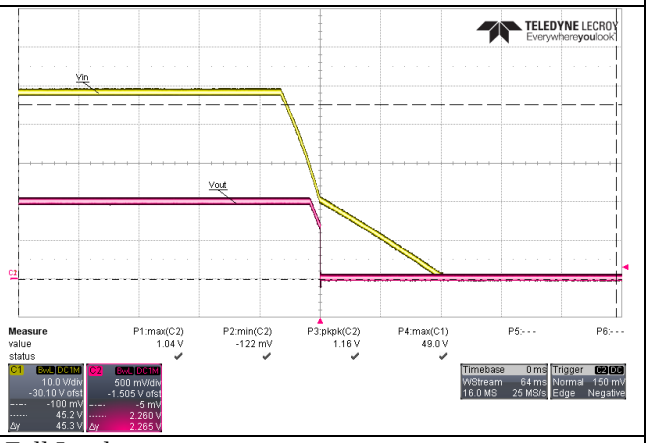


Efficiency Curve with Controller Loss vs. Output Current



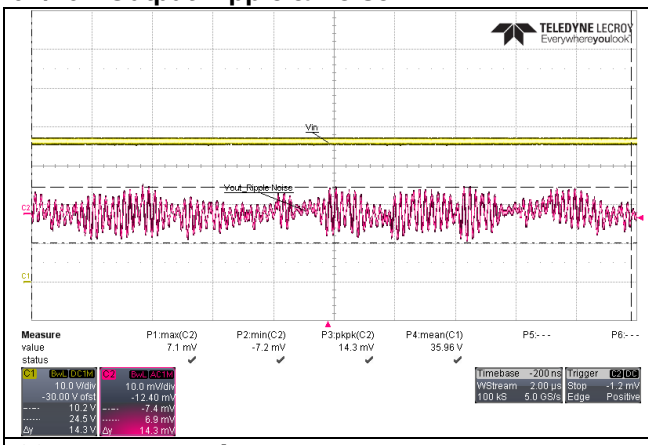
2.2: Start Up & Shut Down Waveforms

48V Input with Full Load & No Load

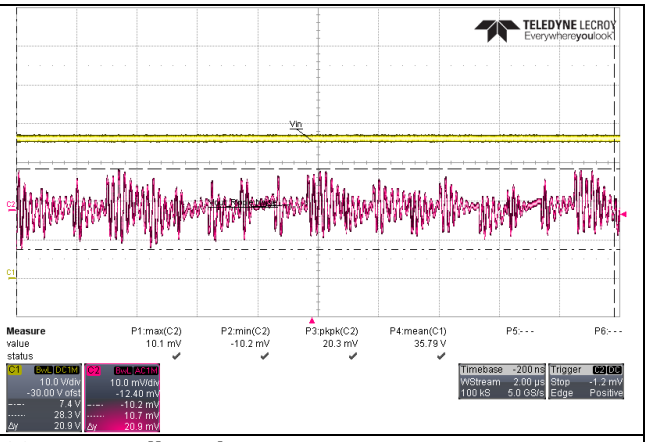
Start Up	
	
No Load C1: 48V Input Voltage 10.0V/Div C2: 1.0V Output Voltage 500mV/Div	Full Load C1: 48V Input Voltage 10.0V/Div C2: 1.0V Output Voltage 500mV/Div
Shunt Down	
	
No Load C1: 48V Input Voltage 10.0V/Div C2: 1.0V Output Voltage 500mV/Div	Full Load C1: 48V Input Voltage 10.0V/Div C2: 1.0V Output Voltage 500mV/Div

2.3: Output Ripple & Noise

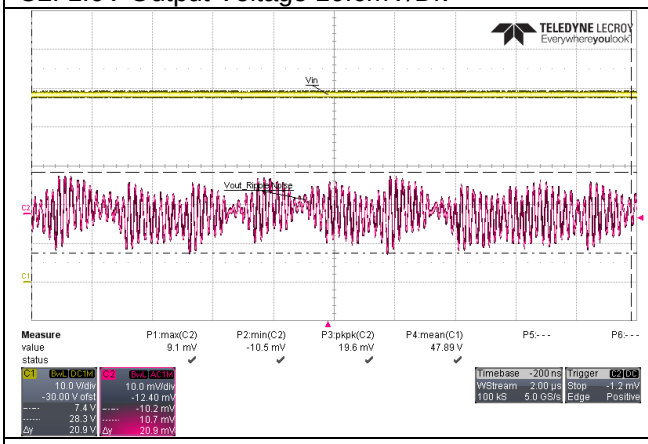
1.0V/40A Output Ripple & Noise



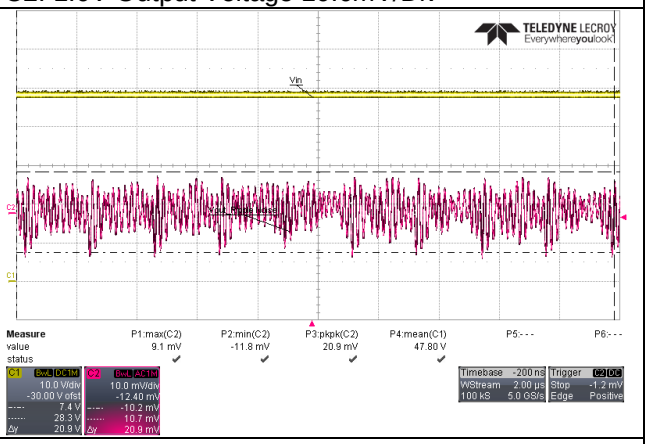
36V Input No Load
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 10.0mV/Div



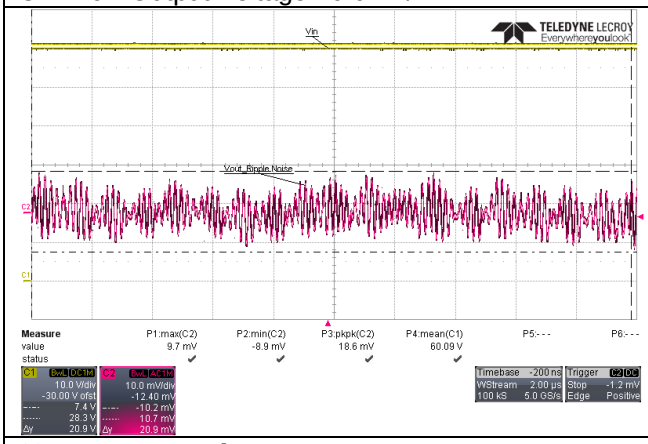
36V Input Full Load
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 10.0mV/Div



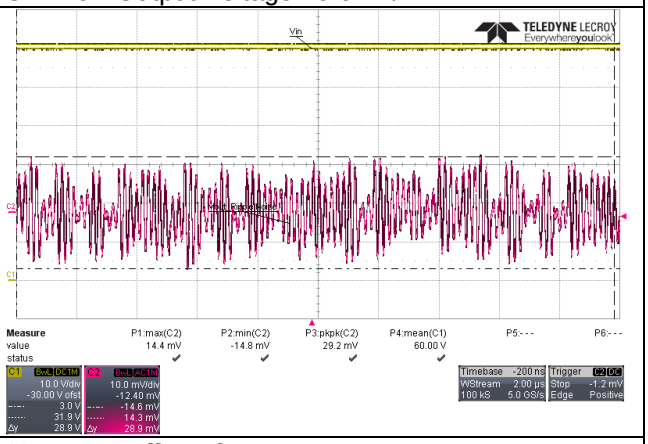
48V Input No Load
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 10.0mV/Div



48V Input Full Load
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 10.0mV/Div



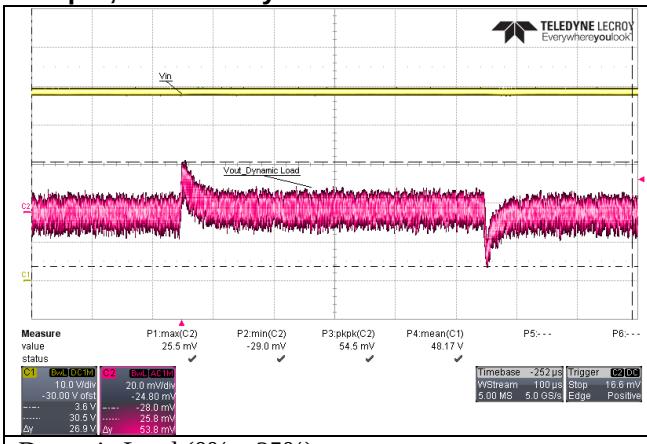
60V Input No Load
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 10.0mV/Div



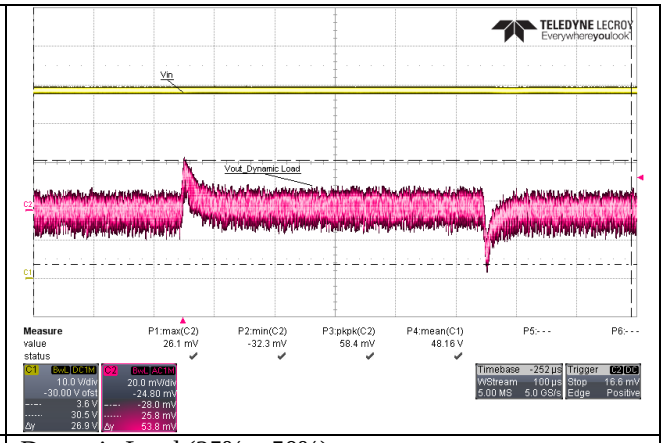
60V Input Full Load
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 10.0mV/Div

2.4: Dynamic Load Waveforms

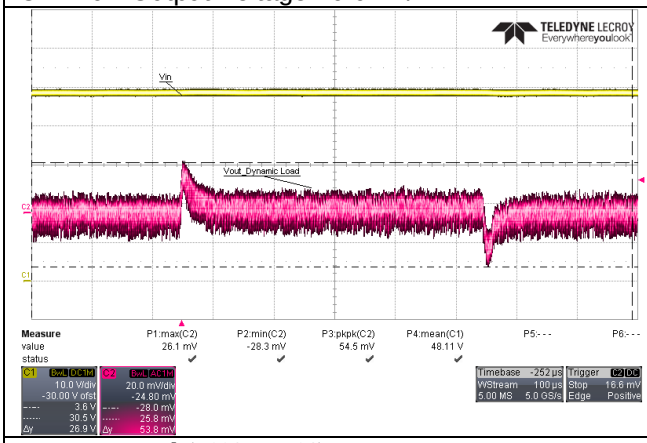
48V Input, 1.0V/40A Dynamic Load Waveforms



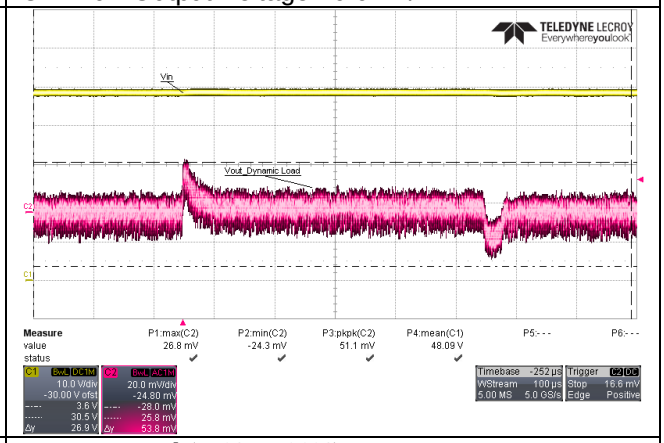
Dynamic Load (0% – 25%)
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 20.0mV/Div



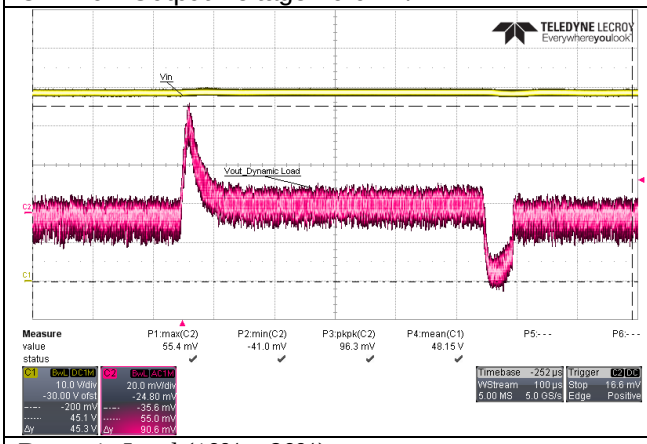
Dynamic Load (25% – 50%)
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 20.0mV/Div



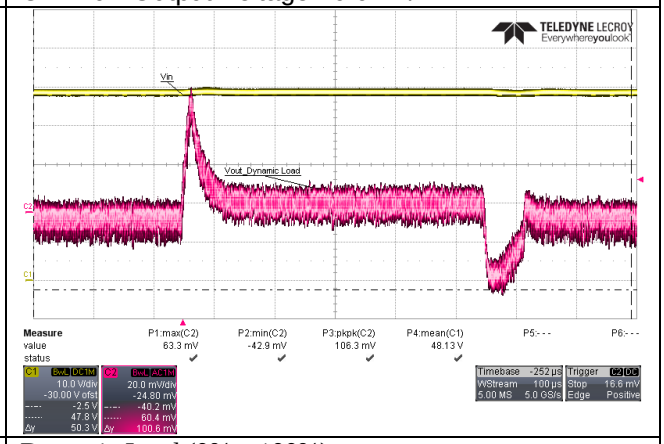
Dynamic Load (50% – 75%)
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 20.0mV/Div



Dynamic Load (75% – 100%)
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 20.0mV/Div

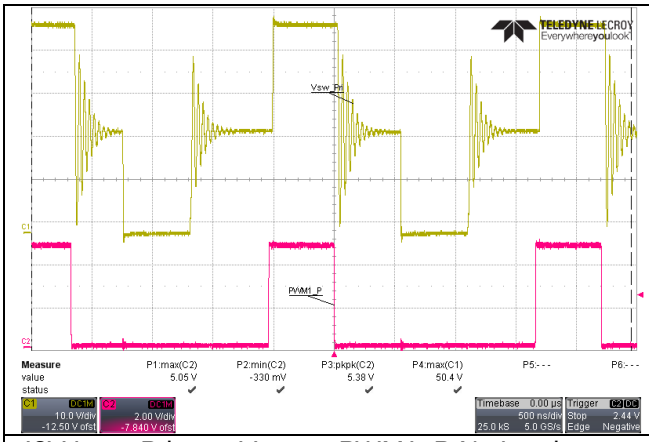


Dynamic Load (10% – 90%)
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 20.0mV/Div

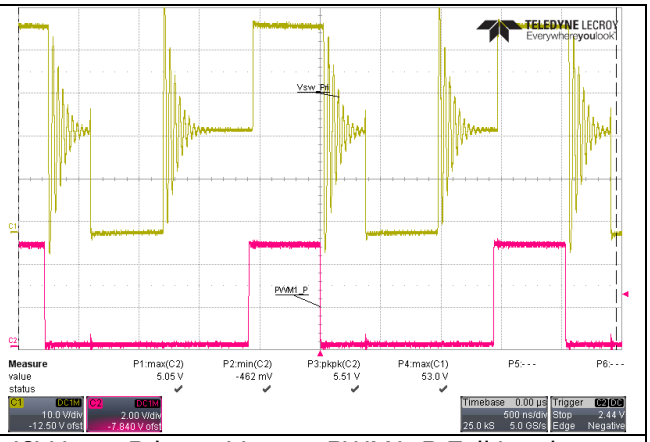


Dynamic Load (0% – 100%)
C1: 48V Input Voltage 10.0V/Div
C2: 1.0V Output Voltage 20.0mV/Div

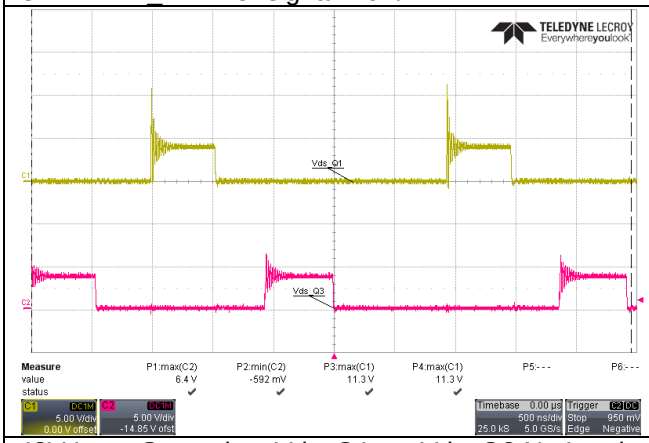
48V Input, Switching Node Waveforms (Full Bandwidth)



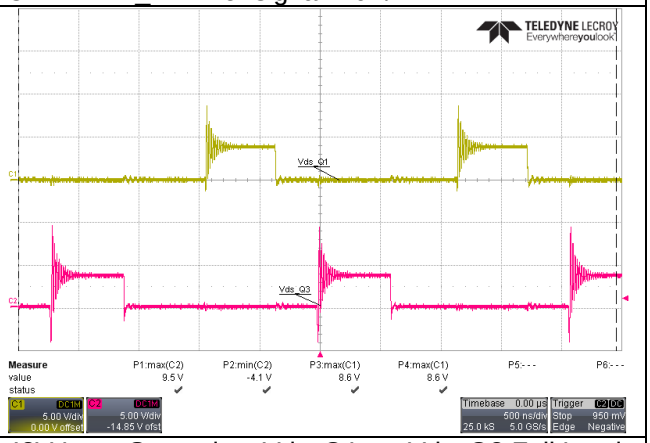
48V Input Primary Vsw vs. PWM1_P No Load
C1: Vsw Switching Node 10V/Div
C2: PWM1_P Driver signal 2.0V/Div



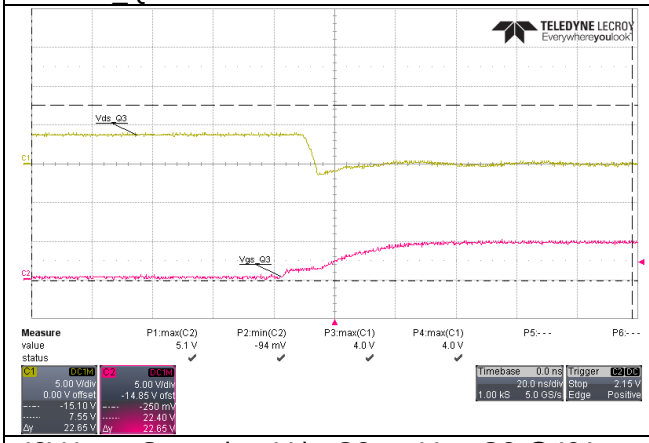
48V Input Primary Vsw vs. PWM1_P Full Load
C1: Vsw Switching Node 10V/Div
C2: PWM1_P Driver signal 2.0V/Div



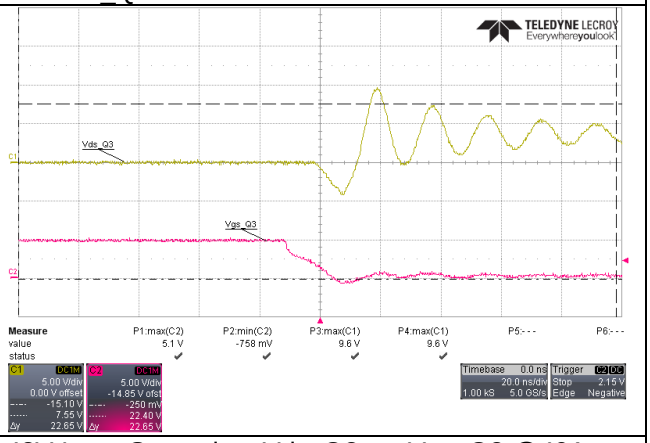
48V Input Secondary Vds_Q1 vs. Vds_Q3 No Load
C1: Vds_Q1 5.0V/Div
C2: Vds_Q3 5.0V/Div



48V Input Secondary Vds_Q1 vs. Vds_Q3 Full Load
C1: Vds_Q1 5.0V/Div
C2: Vds_Q3 5.0V/Div



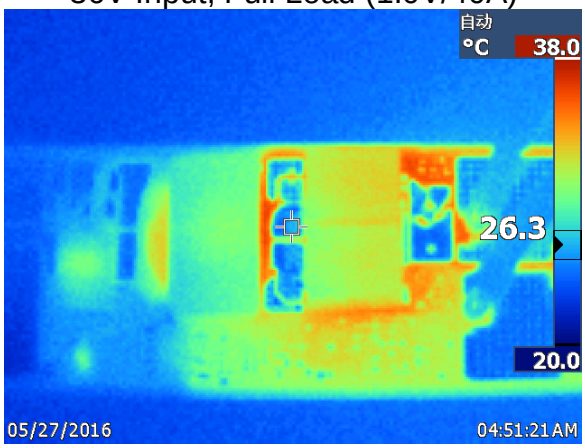
48V Input Secondary Vds_Q3 vs. Vgs_Q3 @40A
C1: Vds_Q3 5.0V/Div
C2: Vgs_Q3 5.0V/Div



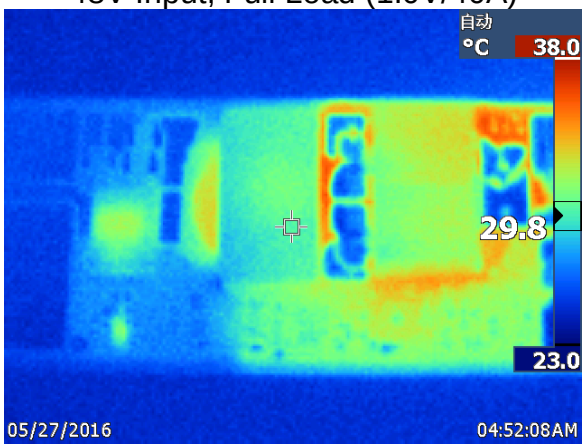
48V Input Secondary Vds_Q3 vs. Vgs_Q3 @40A
C1: Vds_Q3 5.0V/Div
C2: Vgs_Q3 5.0V/Div

3 IR Scan Thermal Gradient (With Fan Cooling, ≈1m/s)

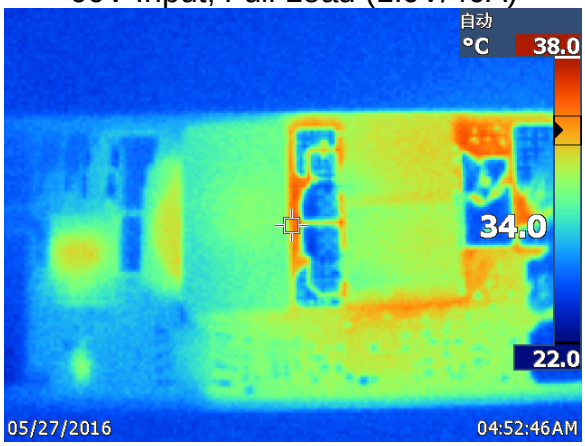
36V Input, Full Load (1.0V/40A)



48V Input, Full Load (1.0V/40A)



60V Input, Full Load (1.0V/40A)



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