



Customer:	onsemi Customer
Board Info:	30V to 60V BLDC Motor Drive
Power Rail:	48V, 1200W
Date:	9/8/2021

Design Summary			
Design Name/OPN:	STR-30-60V-BLDC-MDK-GEVB		
	Controller		Xilinx
	Driver		NCP81075
	Power Stage 3x	HS x 1	NTMF56H800N
		LS x 1	NTMF56H800N
	Efficiency		NA
	Control		6-Step Trapezoidal
	Switch Type		Unipolar
	Switching		20kHz

Design Notes:	Generic Reference Design
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Summary

Specifications	Value	Unit	Comments
Input Ripple	3.48	V	At 1200W
Bootstrap Ripple	2307	mV	At 1200W
Max Efficiency	NA	%	At W
Max Temperature	78	°C	At 1200W
OCF Limit (HW)	82	A	Adjustable SW OCP
Test Speed	3000	RPM	
PWM Frequency	20	kHz	At 1200W Load
Max Power	1200	W	Power Stage Output
Test Voltage	48	V	

U-Phase			
Dead Time (ON)	79.5	ns	
Dead Time (OFF)	72.6	ns	
Max SWN Ring	58	V	

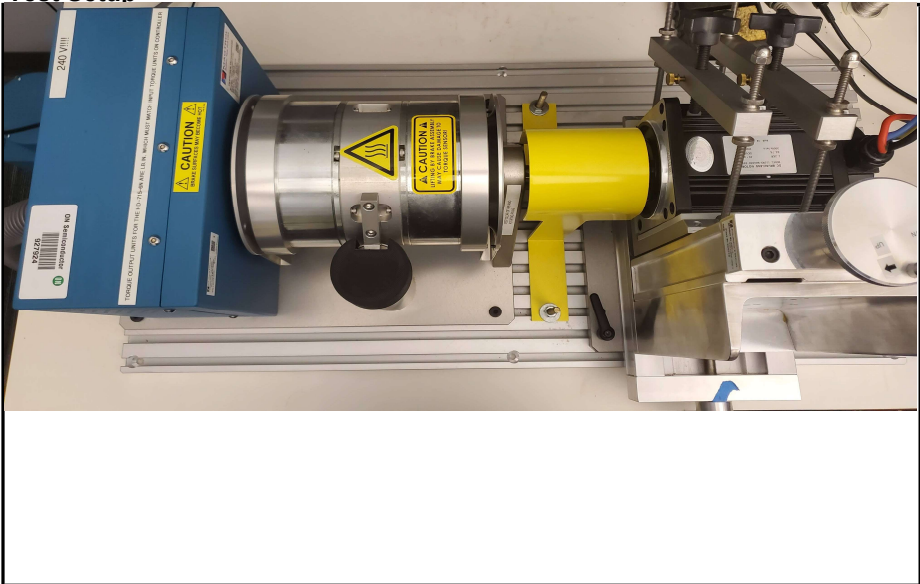
V-Phase			
Dead Time (ON)	79.4	ns	
Dead Time (OFF)	72.9	ns	
Max SWN Ring	54.8	V	

W-Phase			
Dead Time (ON)	79	ns	
Dead Time (OFF)	73.5	ns	
Max SWN Ring	53.6	V	

Test Power Supply

Chroma - 62012P-80-60
From measured data
Design information
Overwrite for custom configuration
Not applicable

Test Setup



Test Motor

Test Motor #1	MFR	MFRPN	
	ATO	110WD-M0430-48V	
Specifications	Value	Unit	Comments
Rated Voltage	48	V	
BEMF/Torque Constant	0.127	V-s/rad	
Stator Inductance	0.085	mL	
Stator Resistance	0.433	mΩ	
Pole Pairs	4		
Rated Speed	3000	RPM	
Rated Torque	4	N-m	
Rated Power	1200	W	
Rotor Inertia			
Winding Type	Wye		
Shaft Diameter	20	mm	
Sensors	Hall		

Test Motor #2	MFR	MFRPN	Comments
	MotorMFR	MOTOR_P#	
Specifications	Value	Unit	
BEMF/Torque Constant		N-m	
Stator Inductance		mL	
Stator Resistance		mΩ	
Pole Pairs			
Rated Speed		RPM	
Rated Torque		N-m	
Rated Power		W	
Rotor Inertia			
Winding Type			
Shaft Diameter		mm	
Sensors			

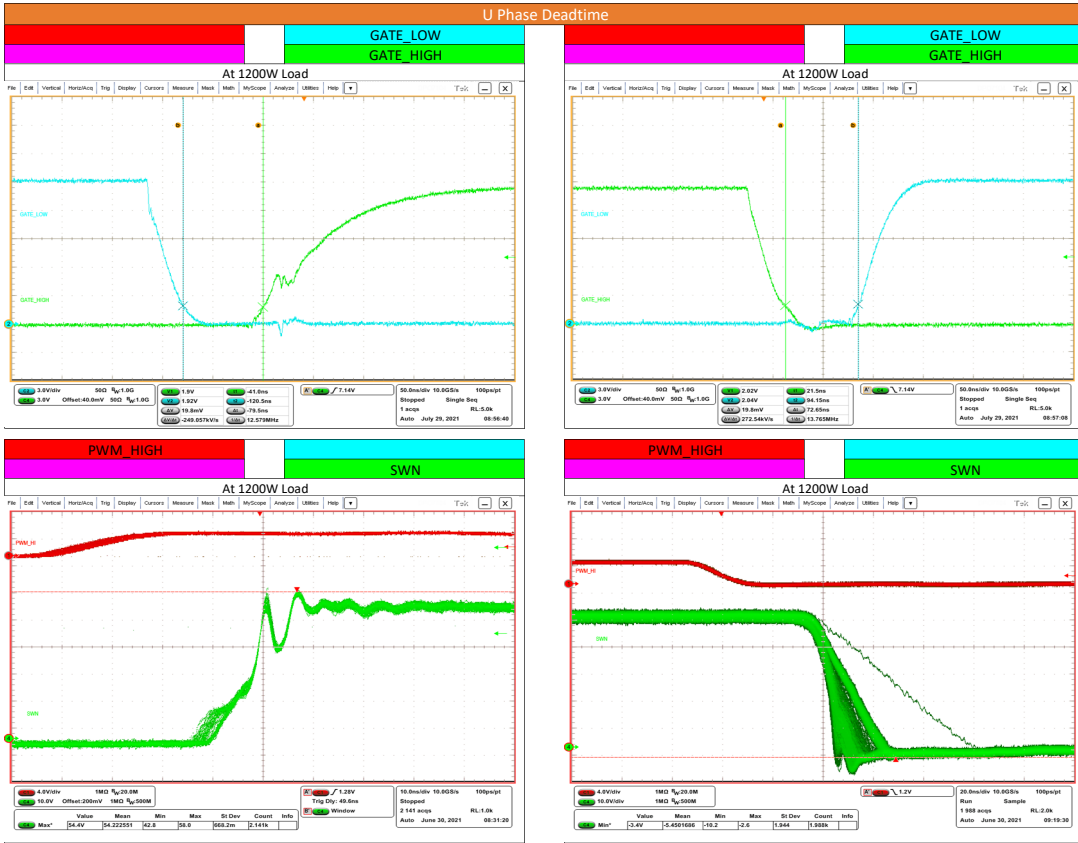
Test Motor #3	MFR	MFRPN	Comments
	MotorMFR	MOTOR_P#	
Specifications	Value	Unit	
BEMF/Torque Constant		N-m	
Stator Inductance		mL	
Stator Resistance		mΩ	
Pole Pairs			
Rated Speed		RPM	
Rated Torque		N-m	
Rated Power		W	
Rotor Inertia			
Winding Type			
Shaft Diameter		mm	
Sensors			

Test Motor

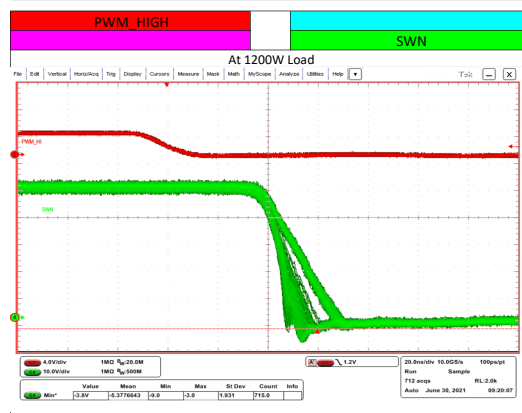
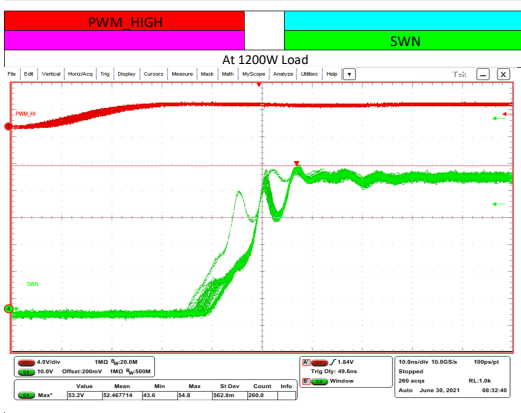
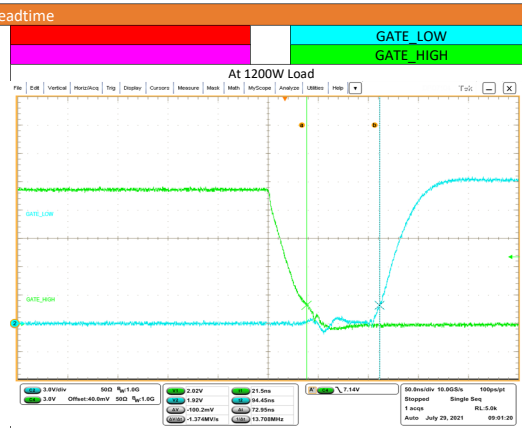
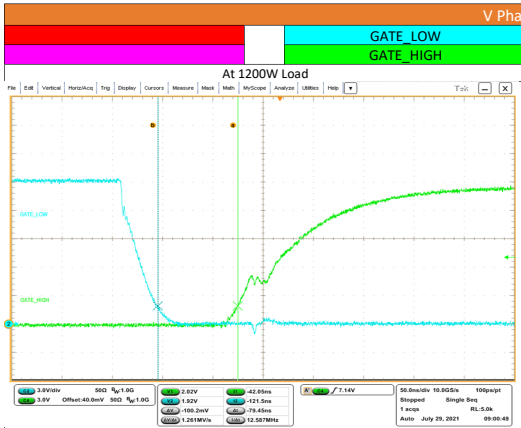


Switching Waveforms

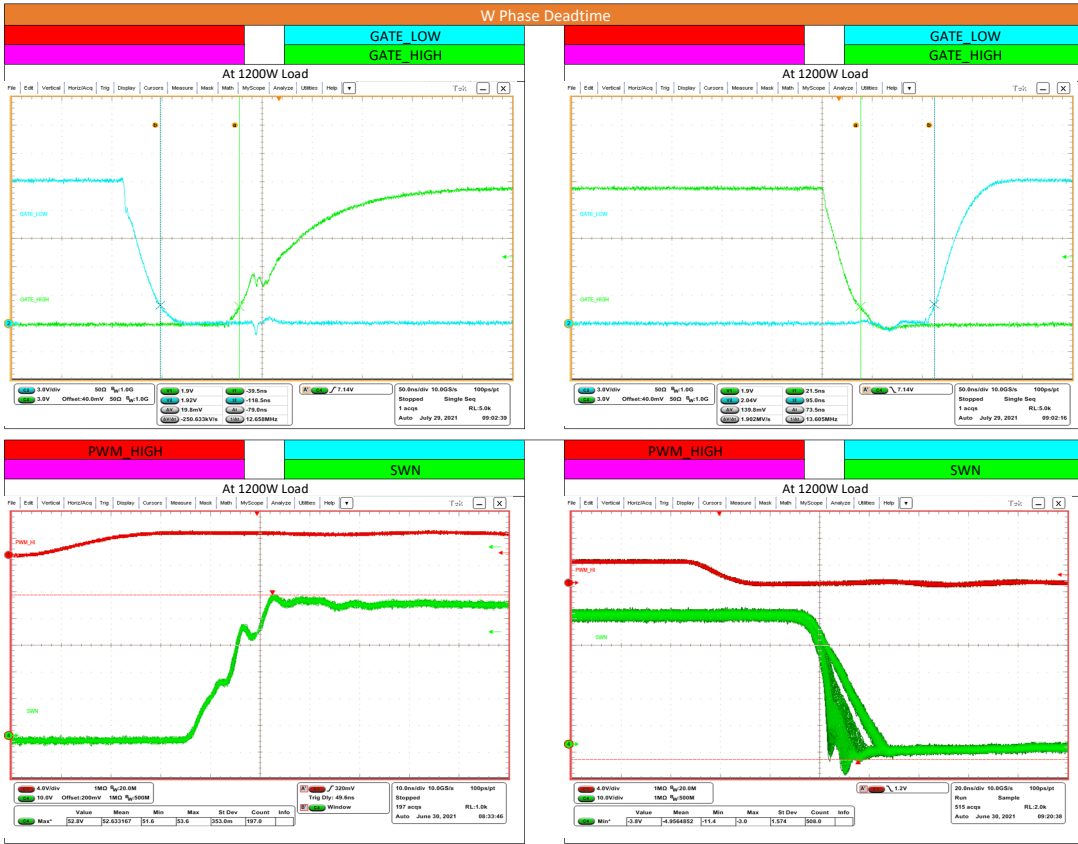
Phase	Deadline		Max Ringing	Min Ringing
	OFF	ON		
U	73 ns	80 ns	58.00 V	-10.2 V
V	73 ns	79 ns	54.80 V	-9.0 V
W	74 ns	79 ns	53.60 V	-11.4 V



V Phase Deadtime

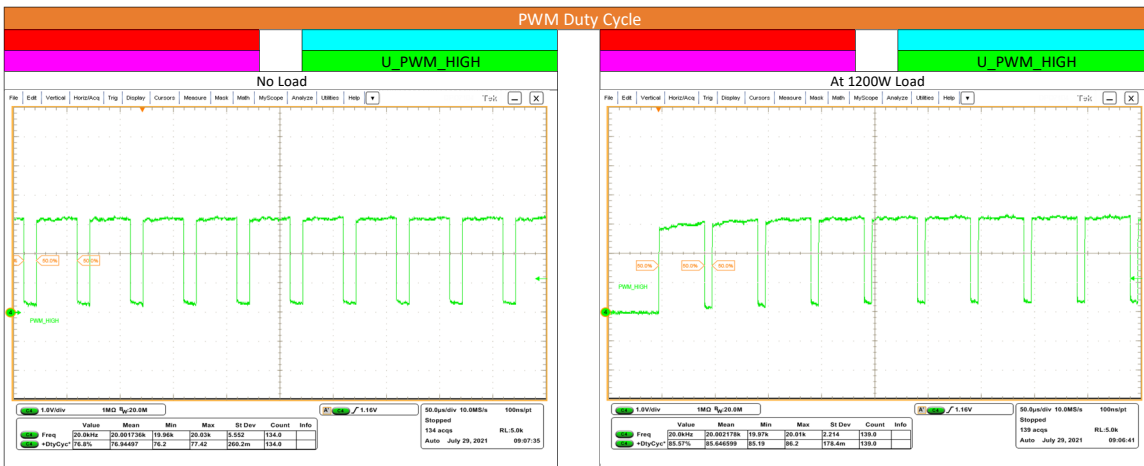
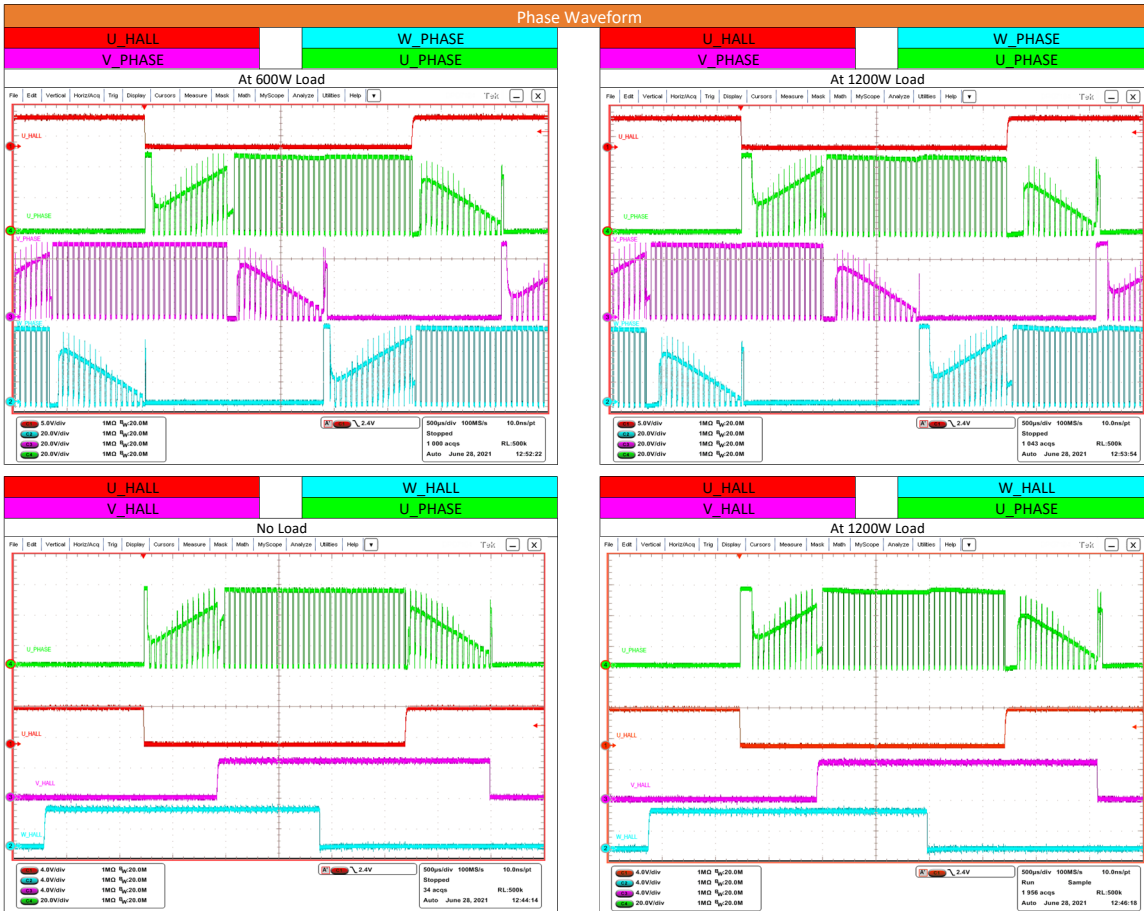


W Phase Deadtime



Modulation

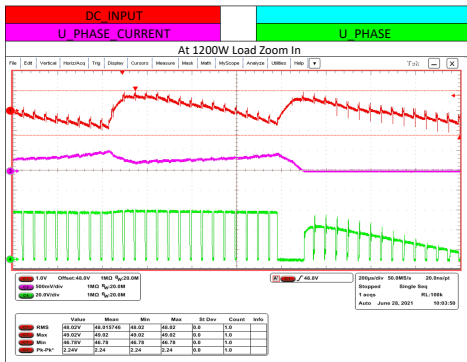
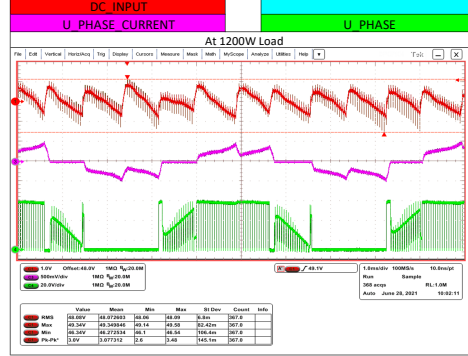
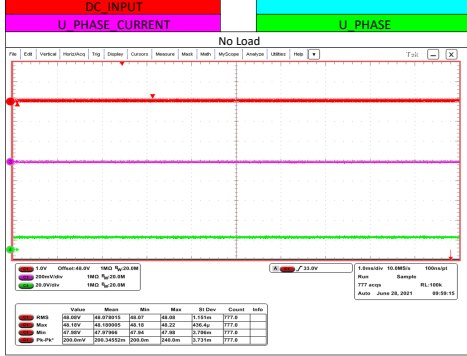
	PWM Frequency	Duty Cycle
No load	20.0 kHz	76.9 %
1200 W	20.0 kHz	85.6 %



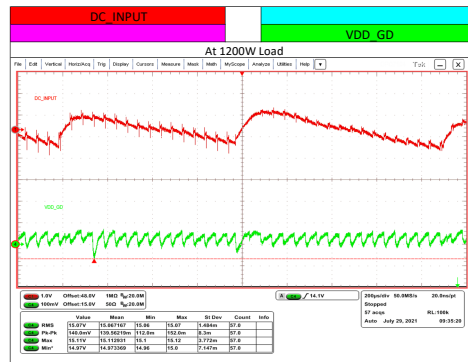
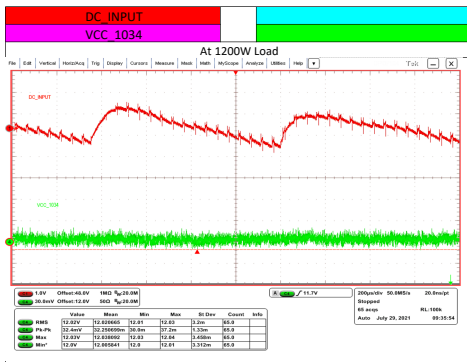
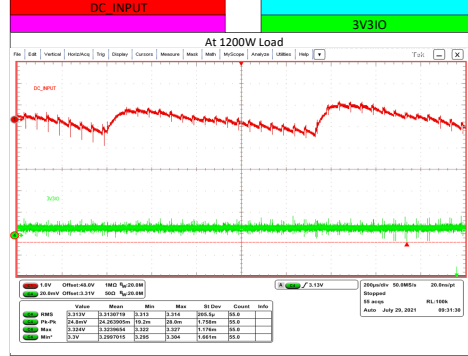
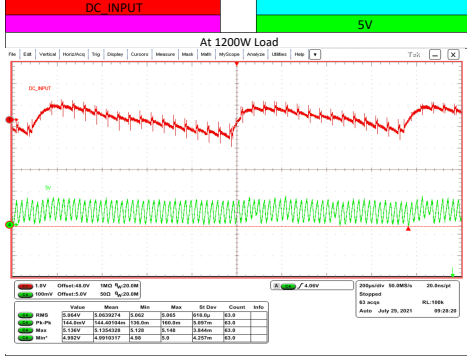
DC Voltages

DC Input Voltage Ripples			Bootstrap Capacitor Voltage at		
Load	Vout RMS	Vout PKPK	Phase	Vout RMS	Vout PKPK
No Load	48.07V	0.24V	U	14.67V	2039mV
1200W	48.00V	3.48V	V	14.69V	2264mV
			W	14.68V	2307mV

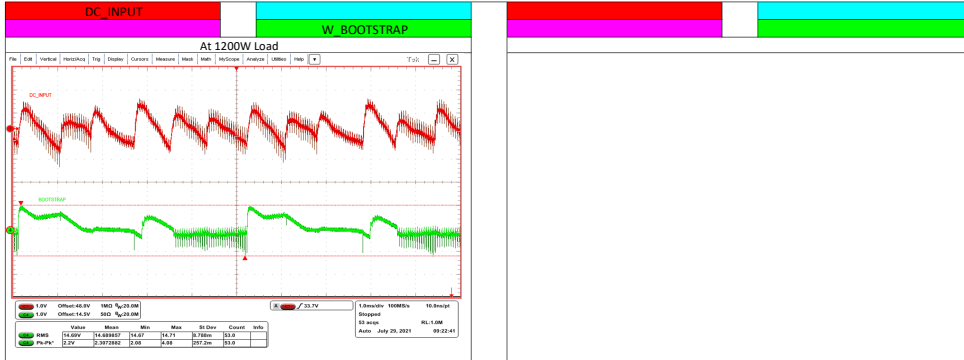
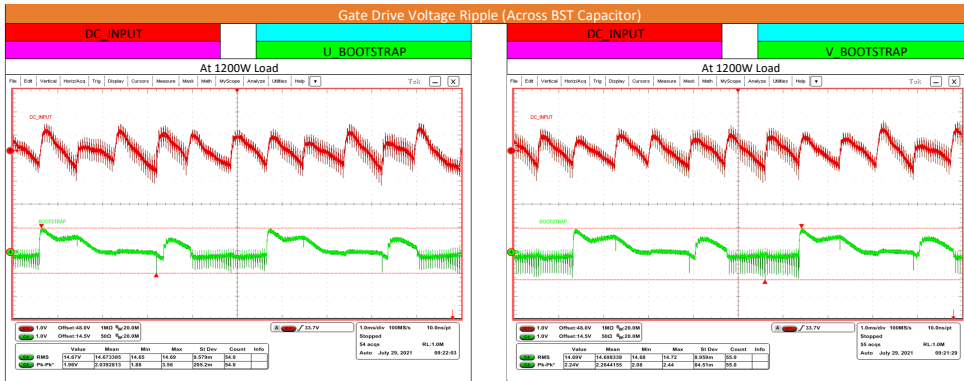
DC Input Ripple



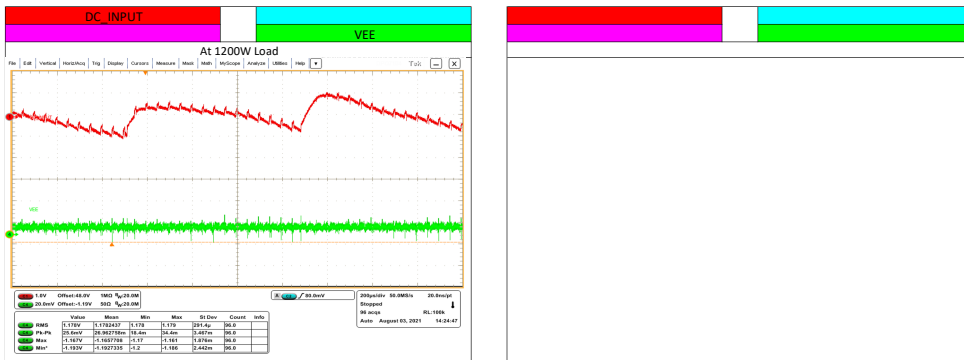
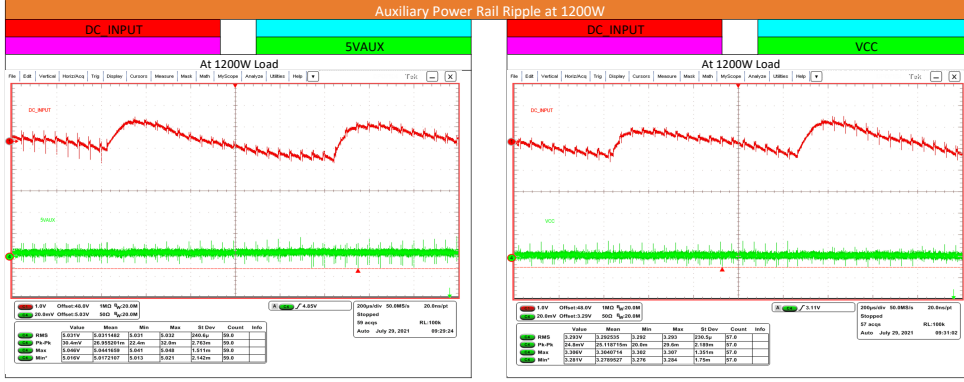
Auxiliary Power Rail Ripple at 1200W



Gate Drive Voltage Ripple (Across BST Capacitor)



Auxiliary Power Rail Ripple at 1200W



At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	14.43V	14.42325V	14.43	0.0176m	36.4	
V _{BOOT}	12.00V	11.99915V	12.00	100.12m	36.4	

At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	14.43V	14.42325V	14.43	0.0176m	36.4	
V _{BOOT}	12.00V	11.99915V	12.00	100.12m	36.4	

At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	14.43V	14.42325V	14.43	0.0176m	36.4	
V _{BOOT}	12.00V	11.99915V	12.00	100.12m	36.4	

At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	14.43V	14.42325V	14.43	0.0176m	36.4	
V _{BOOT}	12.00V	11.99915V	12.00	100.12m	36.4	

At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	0.025V	0.021146V	0.031	0.002	20436	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4
V _{DC}	0.000V	0.000000V	0.000	0.000	21000	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4

At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	0.225V	0.20225V	0.230	0.005	20436	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4
V _{DC}	0.225V	0.20225V	0.230	0.005	20436	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4

At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	0.170V	0.170247V	0.170	0.000	20436	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4
V _{DC}	0.170V	0.170247V	0.170	0.000	20436	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4

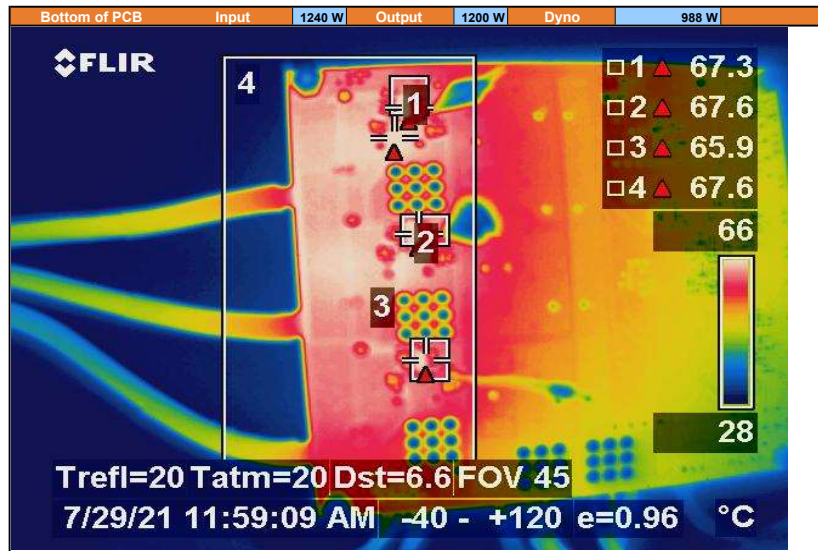
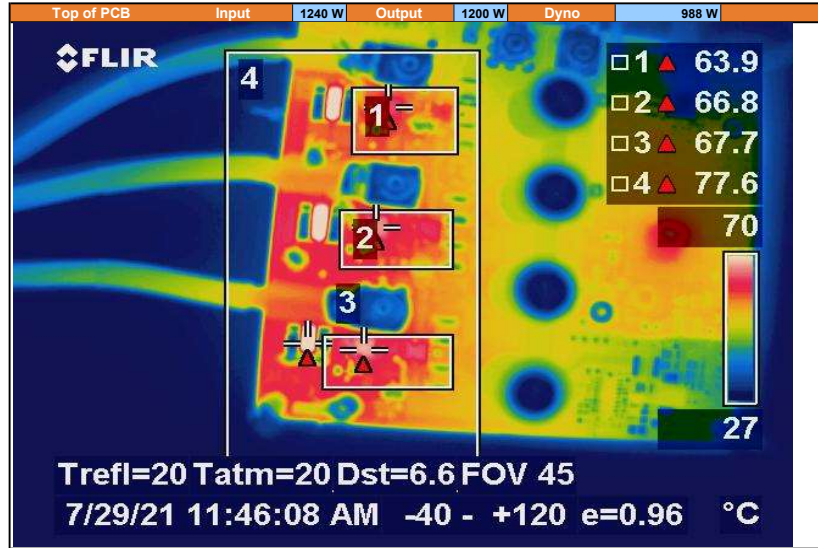
At 1200W Load

Value	Mean	Min	Max	St Dev	Count	Info
V _{DC}	0.170V	0.170247V	0.170	0.000	20436	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4
V _{DC}	0.170V	0.170247V	0.170	0.000	20436	36.4
V _{BOOT}	0.000V	0.000000V	0.000	0.000	21000	36.4

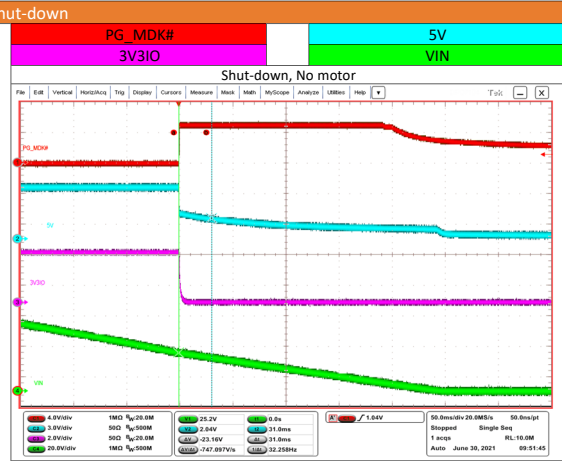
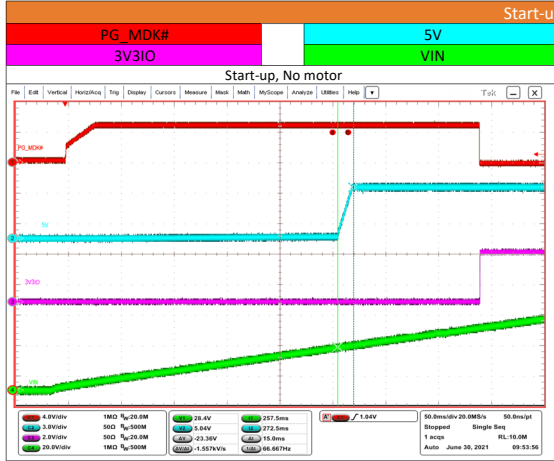
Thermals

Tsoak =	10 min
Ambient =	23.0 °C
Load =	1200 W
Airflow =	0 lfm

Top of PCB					Bottom of PCB				
Area	Component	Temp	Rise		Area	Component	Temp	Rise	
1	U Phase	HS FET	60.7 °C	37.7 °C	1	Driver (W)	67.3 °C	44.3 °C	
		LS FET	63.9 °C	40.9 °C	2	Driver (V)	67.6 °C	44.6 °C	
2	V Phase	HS FET	63.7 °C	40.7 °C	3	Driver (U)	65.9 °C	42.9 °C	
		LS FET	66.8 °C	43.8 °C	4	Entire Power Stage	67.6 °C	44.6 °C	
3	W Phase	HS FET	64.9 °C	41.9 °C					
		LS FET	67.7 °C	44.7 °C					
4	Entire Power Stage	77.6 °C	54.6 °C						
Max Temp / Rise =				77.6 °C	54.6 °C	Max Temp / Rise =		67.6 °C	44.6 °C



Start-up / Shut-down



Current Sense

