



Customer:	onsemi Customer
Board Info:	16V to 30V BLDC Motor Drive
Power Rail:	24V, 1000W
Date:	9/9/2021

Design Summary		
Design Name/OPN:	STR-16-30V-BLDC-MDK-GEVB	
	Controller	Xilinx
	Driver	NCP81075
	Power	HS x 1
	Stage 3x	LS x 1
		NTMF55C604NL
	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	4.08	V	At 1000W
Bootstrap Ripple	168	mV	At 1000W
Max Efficiency	NA	%	At W
Max Temperature	97	°C	At 1000W
OCP Limit (HW)	117	A	Adjustable SW OCP
Test Speed	3000	RPM	
PWM Frequency	20	kHz	At 1000W Load
Max Power	1000	W	Power Stage Output
Test Voltage	24	V	

U-Phase			
Dead Time (ON)	51	ns	
Dead Time (OFF)	69	ns	
Max SWN Ring	29.4	V	

V-Phase			
Dead Time (ON)	51	ns	
Dead Time (OFF)	59	ns	
Max SWN Ring	29	V	

W-Phase			
Dead Time (ON)	52.5	ns	
Dead Time (OFF)	58.5	ns	
Max SWN Ring	31	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	D110BLD1000-24A-30S	
Specifications	Value	Unit	Comments
Rated Voltage	24	V	
BEMF/Torque Constant	0.0607658	V-s/rad	
Stator Inductance	0.0375	mL	
Stator Resistance	434	mΩ	
Pole Pairs	4		
Rated Speed	3000	RPM	
Rated Torque	3.18	N-m	
Rated Power	1000	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			

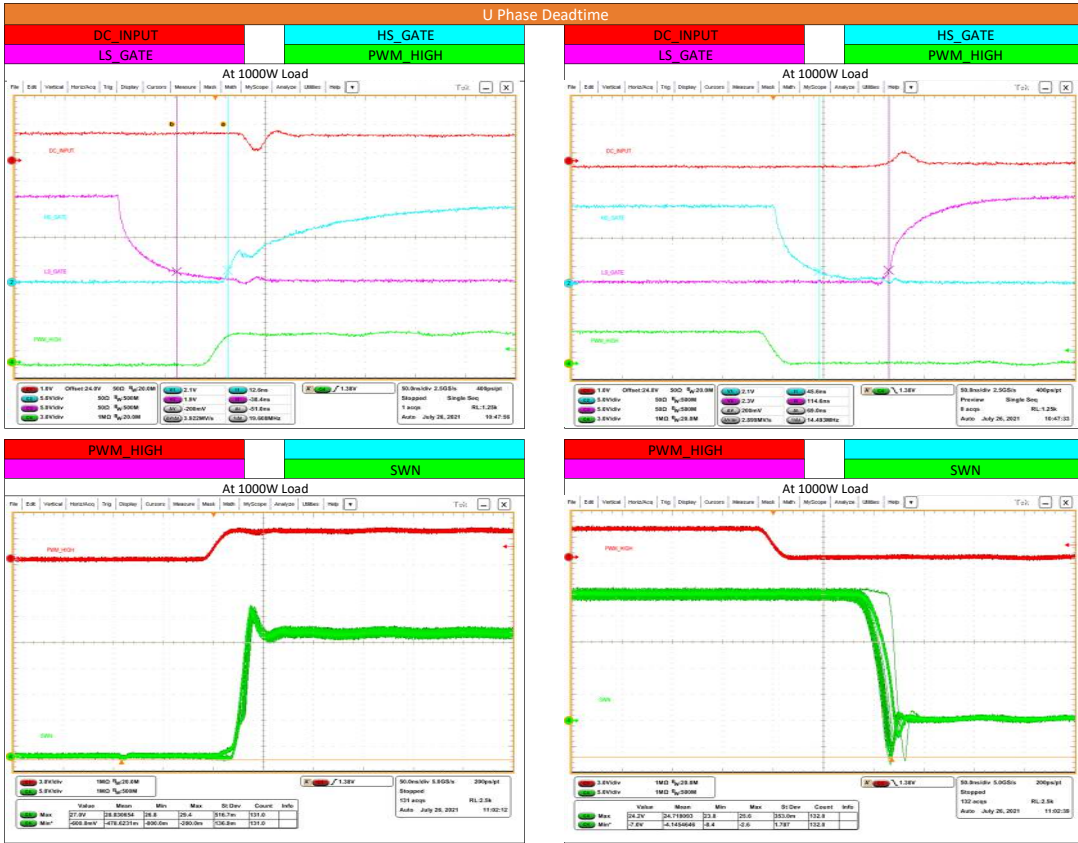
Test Motor



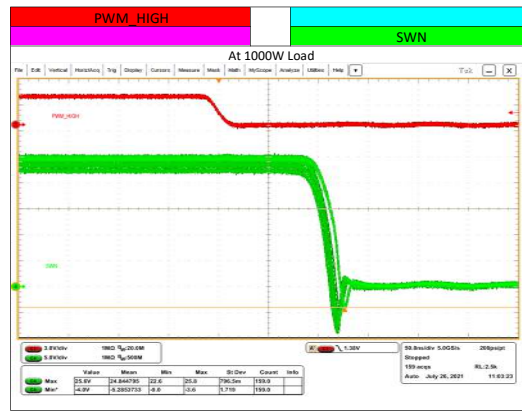
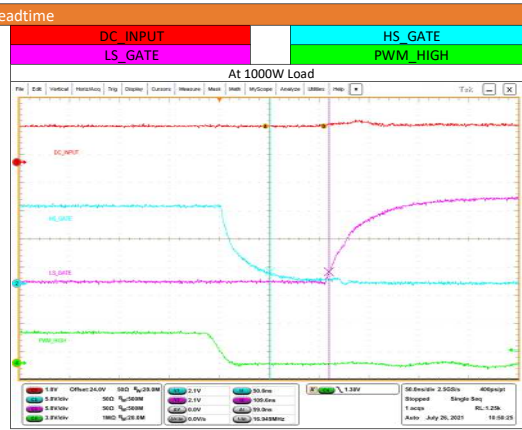
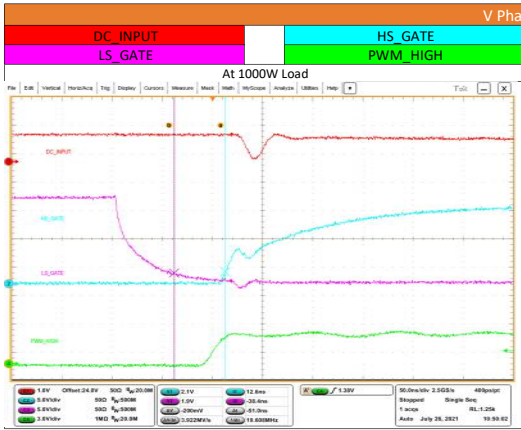
Switching Waveforms

Phase	Deadtime		Max Ringing	Min Ringing
	OFF	ON		
U	69 ns	51 ns	29.40 V	-8.4 V
V	59 ns	51 ns	29.00 V	-9.0 V
W	59 ns	53 ns	33.00 V	-8.6 V

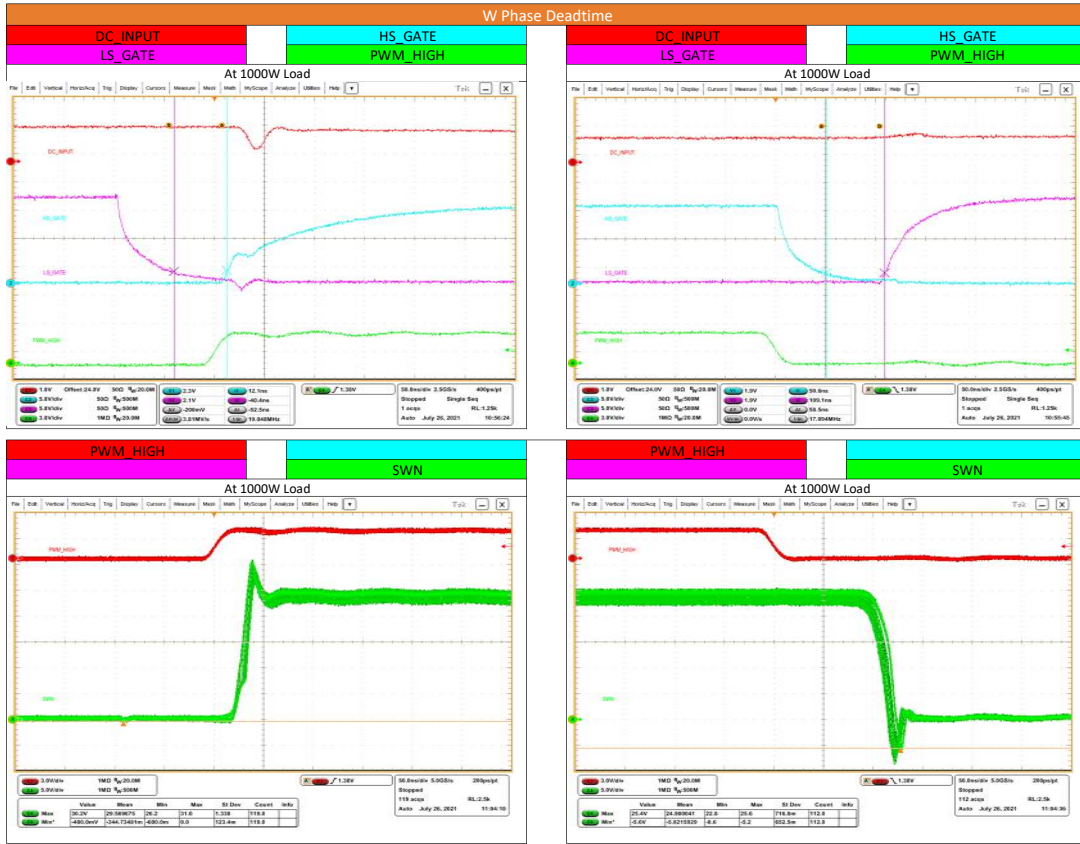
U Phase Deadtime



V Phase Deadtime

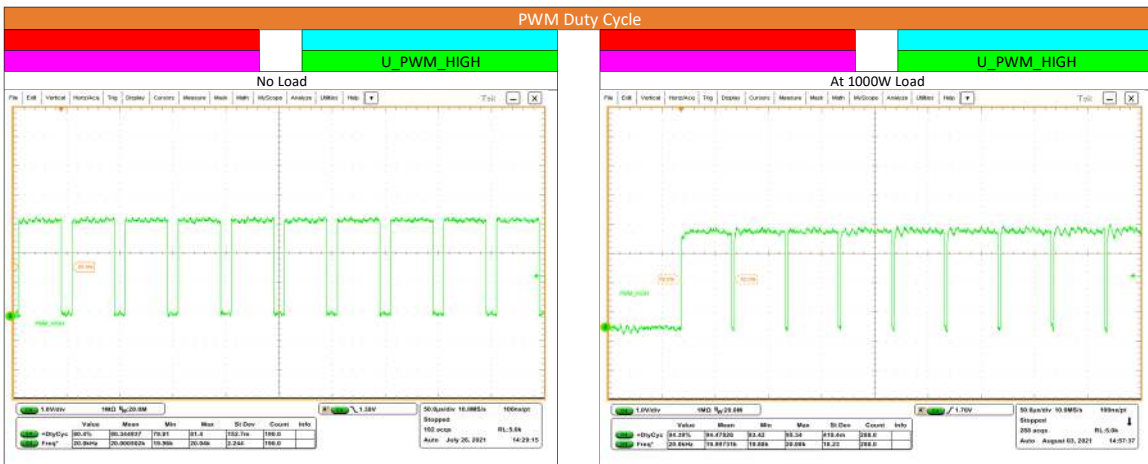
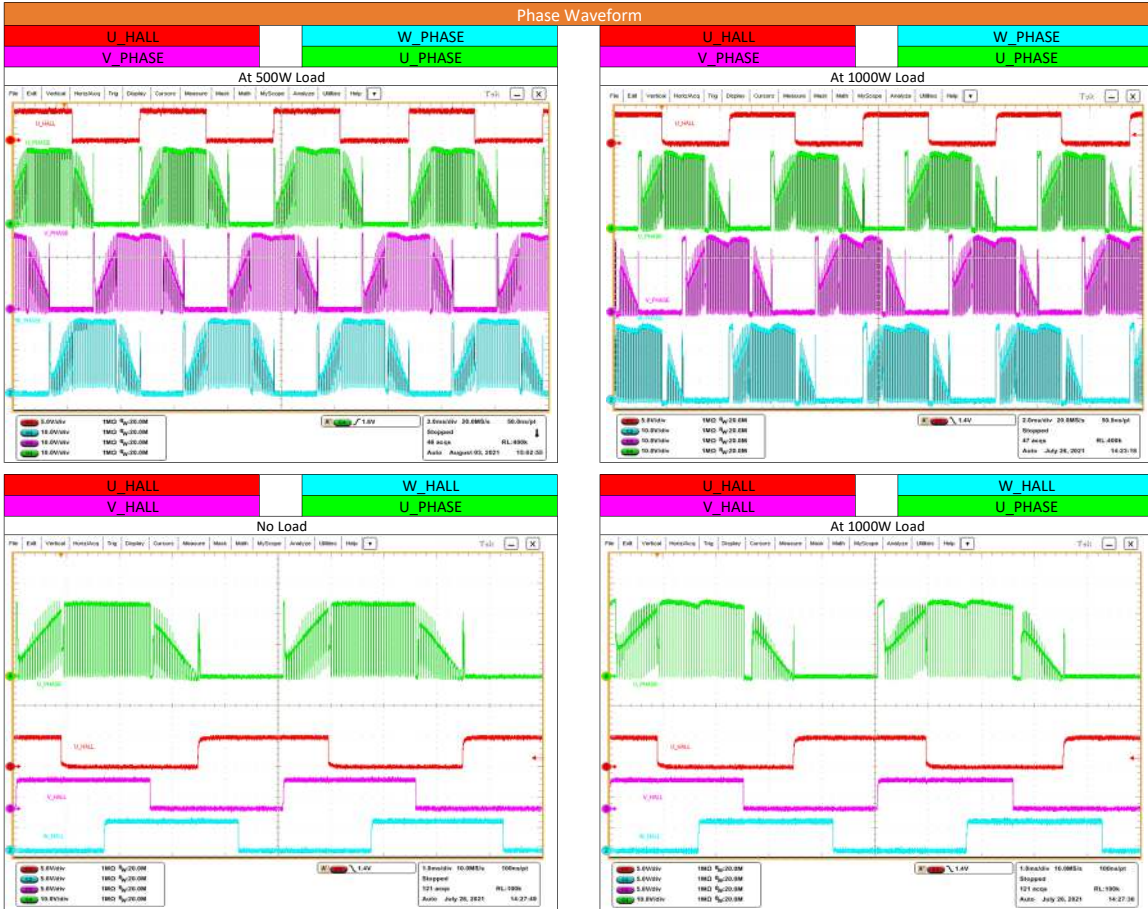


W Phase Deadtime



Modulation

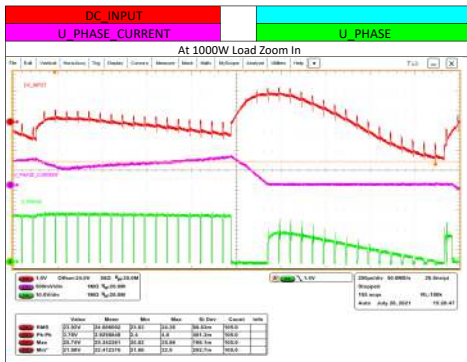
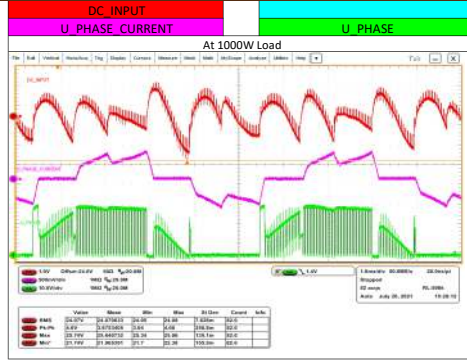
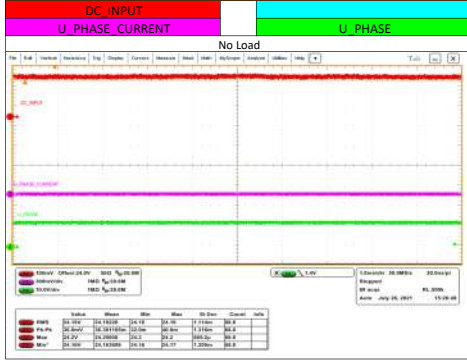
	PWM Frequency	Duty Cycle
No load	20.0 kHz	80.3 %
1000 W	20.0 kHz	94.5 %



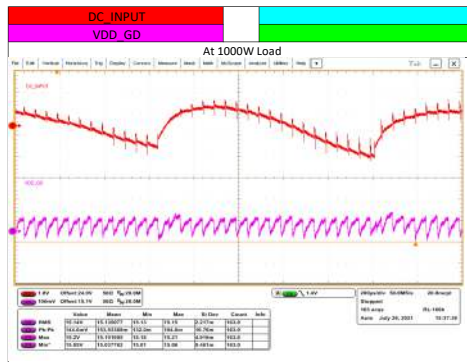
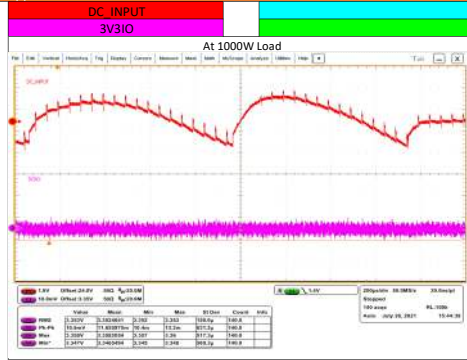
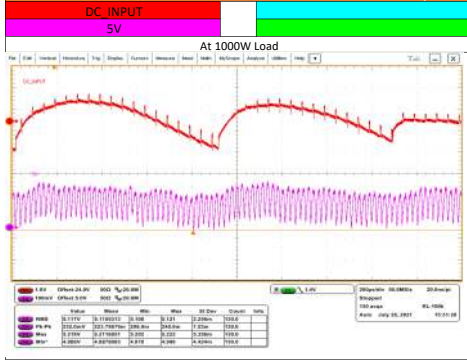
DC Voltages

DC Input Voltage Ripples			Bootstrap Capacitor Voltages at 1000W		
Load	Vout RMS	Vout PKPK	Phase	Vout RMS	Vout PKPK
No Load	24.18V	0.04V	U	14.46V	164mV
			V	14.44V	160mV
			W	14.43V	158mV
1000W	24.07V	4.08V			

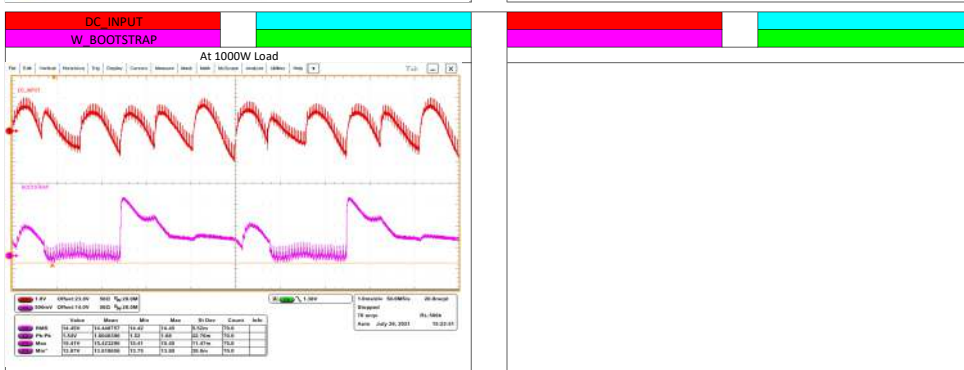
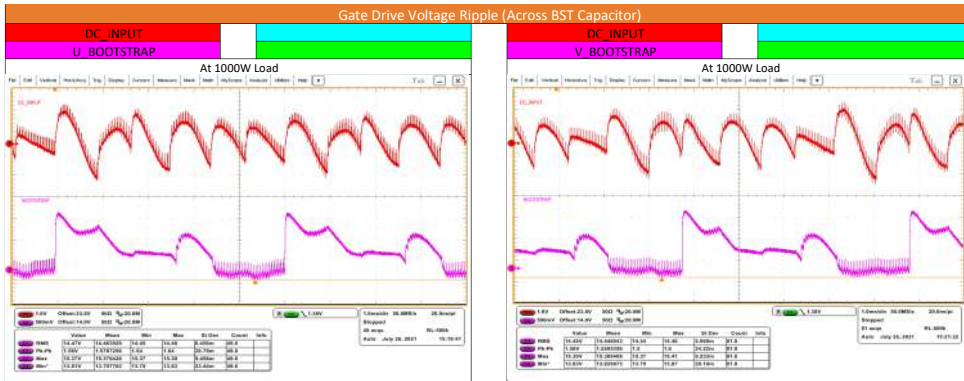
DC Input Ripple



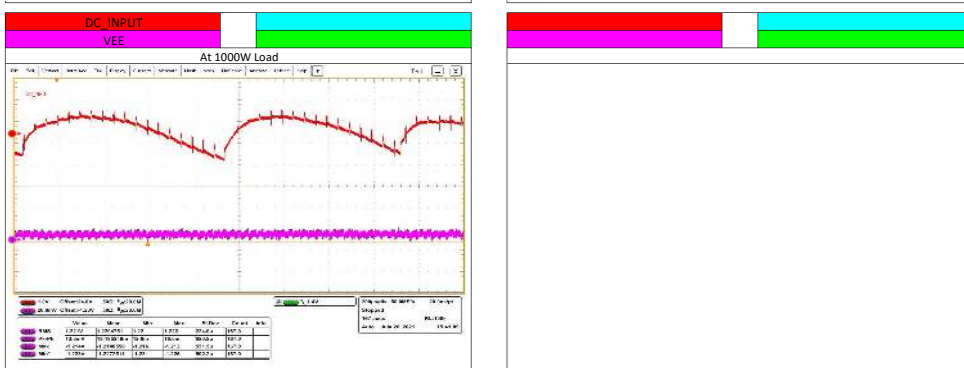
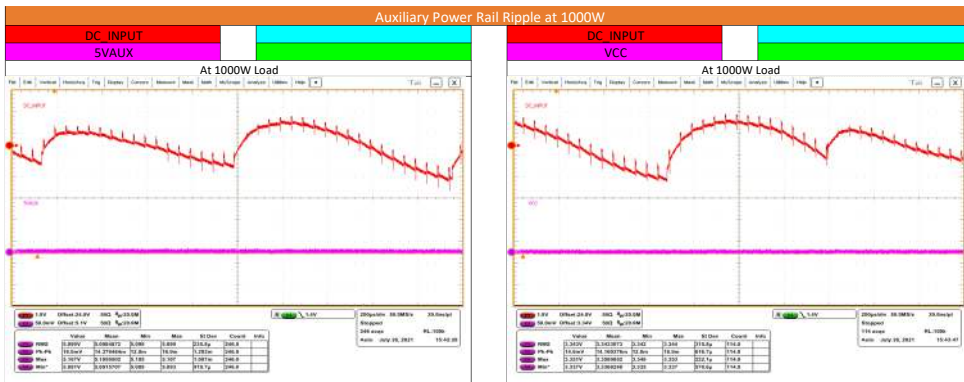
Auxiliary Power Rail Ripple at 1000W



Gate Drive Voltage Ripple (Across BST Capacitor)



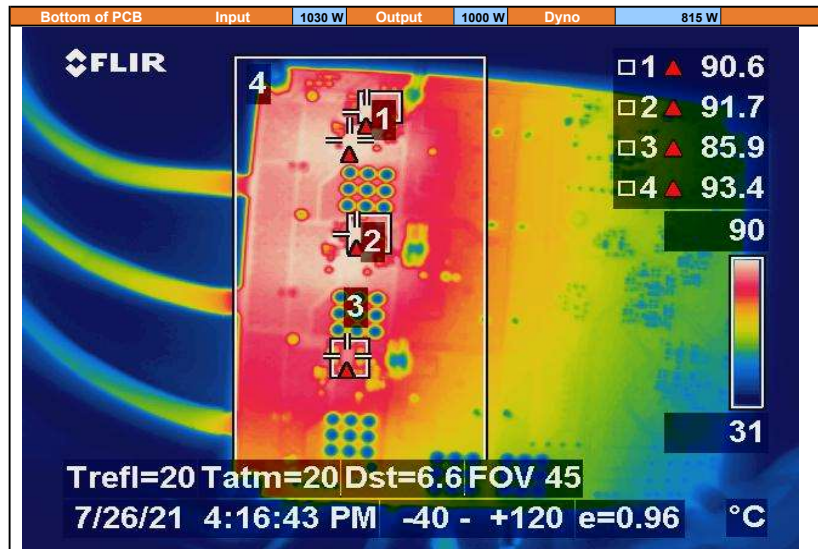
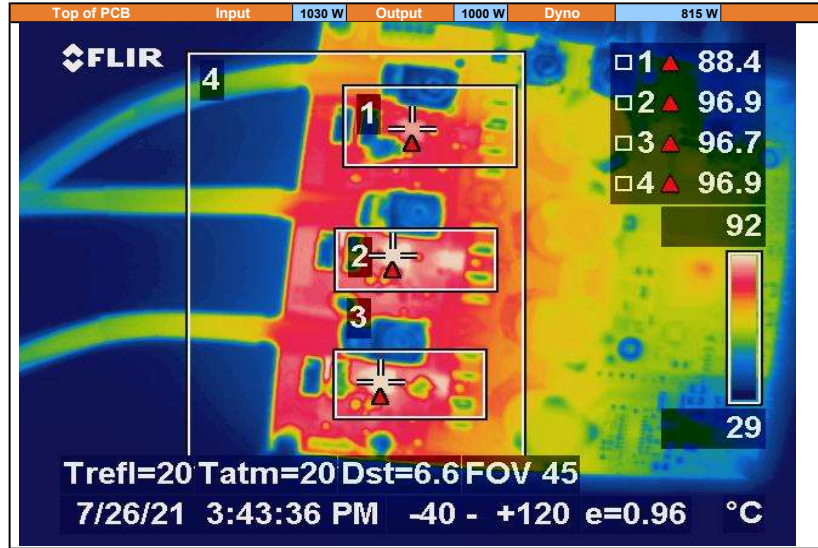
Auxiliary Power Rail Ripple at 1000W



Thermals

Tsoak =	10 min
Ambient =	23.0 °C
Load =	1000 W
Airflow =	0 lfm

Top of PCB					Bottom of PCB			
Area	Component	Temp	Rise		Area	Component	Temp	Rise
1	U Phase	HS FET	84.0 °C	61.0 °C	1	Driver (W)	90.6 °C	67.6 °C
		LS FET	88.4 °C	65.4 °C		2	Driver (V)	91.7 °C
2	V Phase	HS FET	91.8 °C	68.8 °C	3	Driver (U)	85.9 °C	62.9 °C
		LS FET	96.9 °C	73.9 °C		4	Entire Power Stage	93.4 °C
3	W Phase	HS FET	91.6 °C	68.6 °C				
		LS FET	96.7 °C	73.7 °C				
4	Entire Power Stage	HS FET	96.9 °C	73.9 °C				
		LS FET	96.9 °C	73.9 °C				
Max Temp / Rise =					Max Temp / Rise =		93.4 °C	70.4 °C



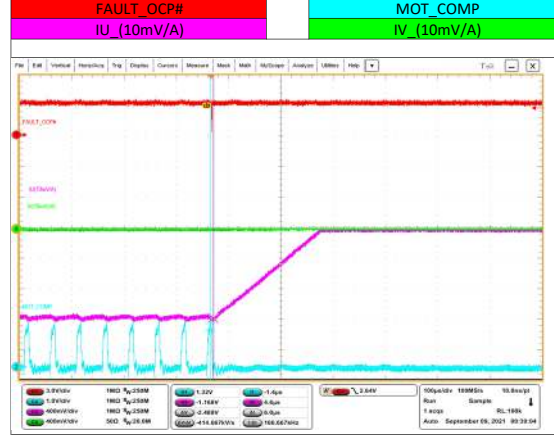
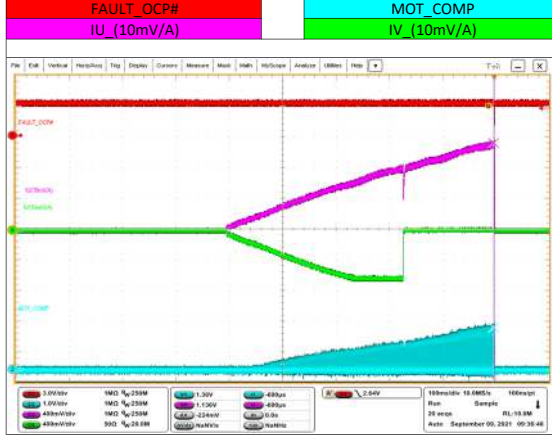
Start-up / Shut-down



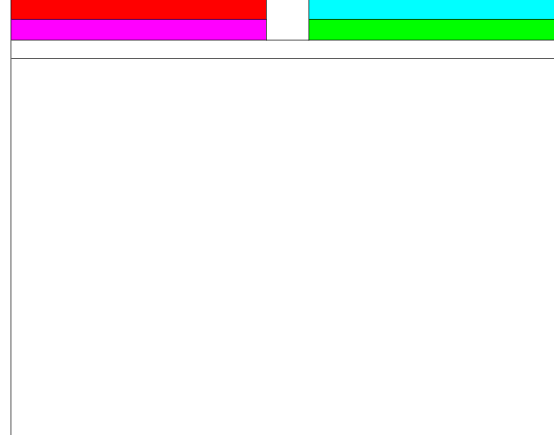
Protection

	Set Point	Current	Set Point	Trip Point	
NW	120 A	117 A	SW	26.0 V	25.18 V
SW	50 A	51 A	SW	26.0 V	27.26 V
					No Load
					1000 W

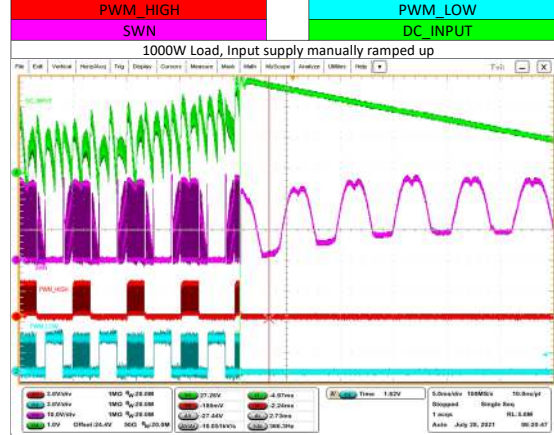
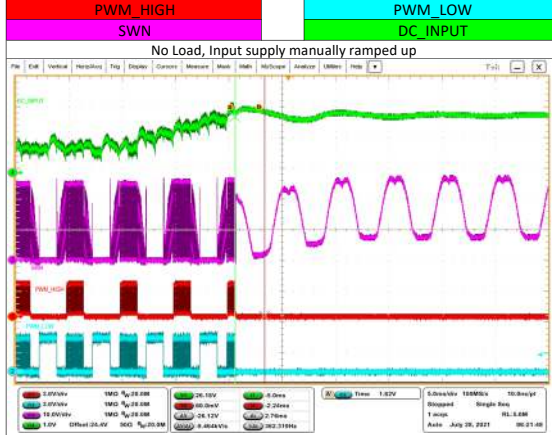
Hardware OCP



Software OCP



OVP



Current Sense

