CY-SD1124
45W USB-C PD Power Adapter Solution (PAG1P-A3 and PAG1S-A1)
Test Report
Version 3.2

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Contents

1. Introduction

Cypress CYPAP111 part of PAG1P family is designed for a secondary controlled AC/DC flyback converter topology. In this topology, the voltage and current regulation is performed by the secondary controller. CYPAP111 is responsible for providing the start-up function, driving the primary side FET as well as responding to fault conditions

Cypress CYPAS111 part of PAG1S family is an integrated secondary-side synchronous flyback controller, synchronous rectifier (SR) controller, and charging port controller. CYPAS111 is designed to fit a secondary-controlled flyback system with a primary startup controller (CYPAP111) with secondary-side sensing and regulation. CYPAS111 is targeted towards mobile power adapters, it fits well into high-efficiency AC-DC flyback designs for USB Power Delivery, Qualcomm Quick Charge, and other standard charging protocols. CYPAS111 also supports USB Power Delivery (USB PD 3.0) Programmable Power Supply (PPS) mode.

The interface between CYPAP111 and CYPAS111 is through a Pulse Edged Transformer and its associated circuitry.

This document contains test results of PAG1P + PAG1S based 45W Power Adapter solution board. The tests were performed on this board which is equipped with Cypress CYPAP111A3-10SXQ on primary and CYPAS111A1-24LQXQ on secondary section of the converter.

Table 1-1. Test Specification

Parameter	Value
Input Voltage	90 – 265Vac
Rated Input Voltage for CY-SD1124	100 – 240Vac
Input Frequency	47 – 63Hz
Max Output Power	45W
Main Output Vo / Io	PDO-Fixed: 5V/3A; PDO-Fixed: 9V/3A; PDO-Fixed: 15V/3A; PDO-Fixed: 20V/2.25A; PDO-PPS: 3.3V – 11V / 3A; PDO-PPS: 3.3V – 21V / 2.25A
Efficiency	CoC Tier-2, DoE Level-6
Standby Power	CoC Tier-2, DoE Level-6
Protection	OVP, UVP, OCP, SCP, OTP

2. Test Setup

2.1 DUT (Device Under Test)

CY-SD1124 45W PAG1P-PAG1S Solution Kit:

Table 2-1. PAG1P-PAG1S Solution Kit Details

DUT contents	Description
CYPAP111A3 and CYPAS111A1	Primary and Secondary Devices
Firmware Versions	#2462

Figure 2-1. PAG1P-PAG1S Solution Demo Kit

Dimensions (in mm): 43(L) x 37.5(W) x 30.2(H)

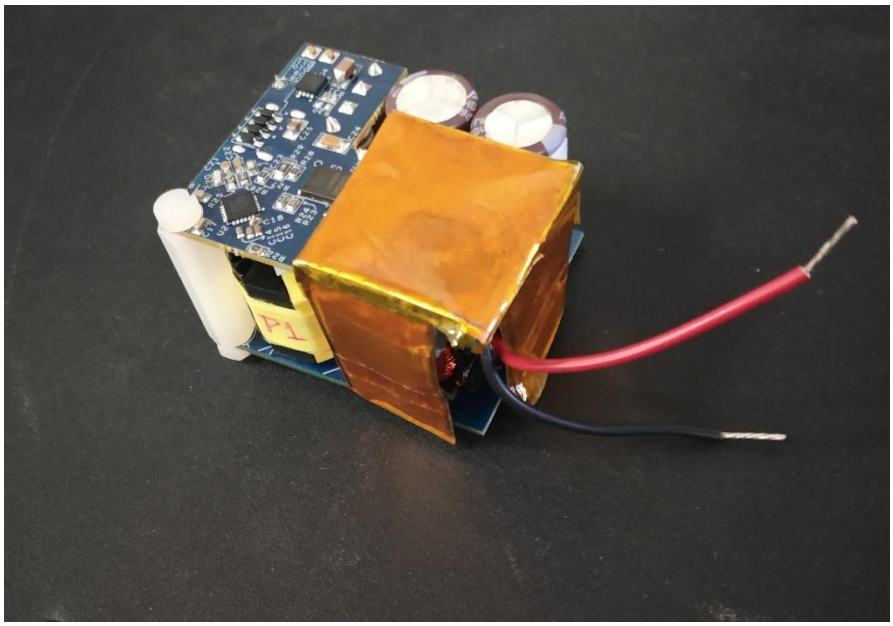


Figure 2-2.1. Top view of PAG1P-PAG1S Solution Demo Kit

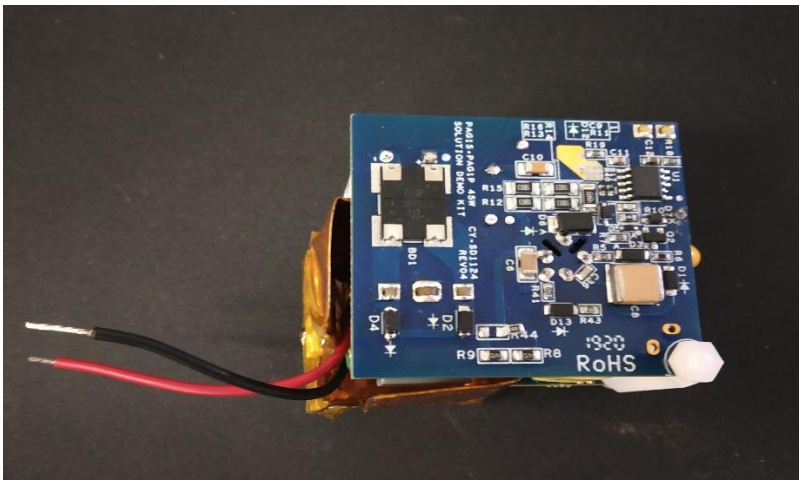


Figure 2-3.2. Bottom view of PAG1P-PAG1S Solution Demo Kit

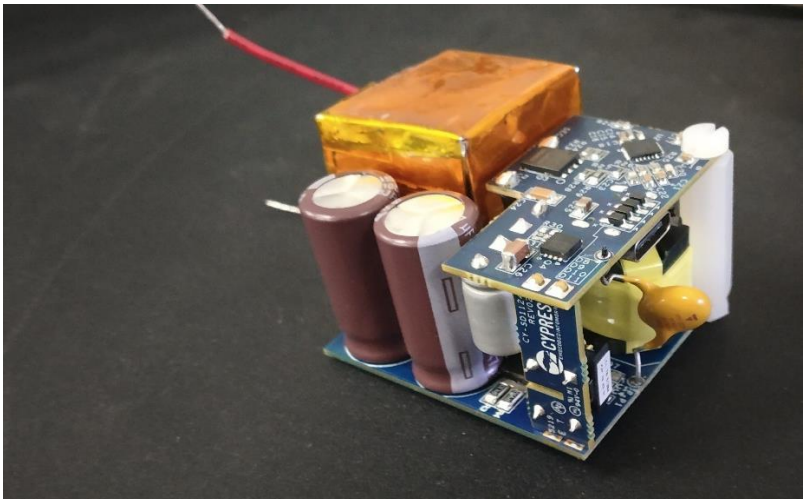


Figure 2-4.3. Side view showing Pulse transformer board

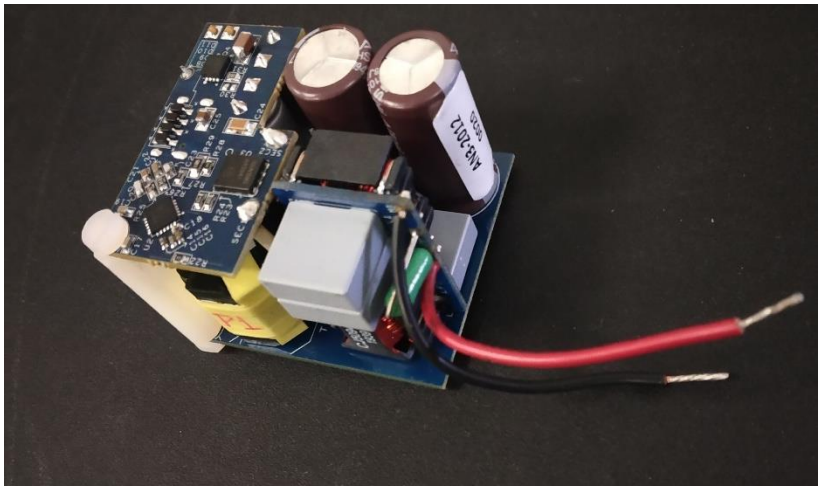


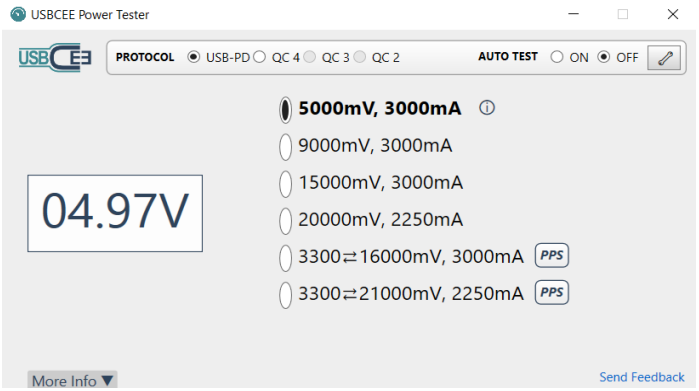
Figure 2-5.4. Side view showing EMI input filter board

Note: All the tests mentioned in this report are carried-out under open-frame condition.

2.2 DUT Setup

Figure 2-6. Test set-up

CCPROG PAT : USB-C POWER ADAPTER TESTER



The DUT is connected to PAT Tester (CCPROG PAT) using a USB Type-C cable. Once a successful connection is established PAT UI does a PDO discovery and displays the same on the UI. In our case, the solution kit is pre-configured with 6 PDOs:

PDO 1: 5V, 3A FIXED
PDO 2: 9V, 3A FIXED
PDO 3: 15V, 3A FIXED
PDO 4: 20V, 2.25A FIXED
PDO 5: 3.3V-11V, 0-3A PPS
PDO 6: 3.3V-21V, 0-2.25A PPS

One can either choose the suitable pre-configured PDO or configure a new one using Cypress EZ-PD Configuration Utility. For the Tests in the following sections, we use the pre-configured PDOs.

To know more about PAT Tester and UI, visit: USBCEE: https://www.usbcee.com/product-details/3

Type C-C cable (1meter long) used: Type C-C cable being used for all the tests mentioned in this report is 3027003-01M. Datasheet is available at: http://www.qualtekusa.com/images/Cable%20Assemblies/PDF_2/3027003-01M.pdf

2.3 Test Equipment

Table 2-2. Test Equipment List

Test setup	Description
Oscilloscope Name	Tektronix DPO 4104
Power Meter	Yokogawa WT310E
Digital Multimeter (Vo & Io)	Agilent 34411A
Programmable AC Source	Chroma 61501
Electronic Load	Chroma 63102A
Thermal Camera	Flir E75
Automation Software	LabView

3. Power Management Test Results

The results documented here are based on the test reports of CY-SD1124 PAG1P-PAG1S 45W Solution Demo Kit

3.1 Efficiency 4-pt average

3.1.1 Detailed Data

Table 3-1. Efficiency* Results

Parameter	Standard (Minimum value)			Unit	Test Condition	Test Result	
	DoE Level-6		CoCv5 Tier 2			115Vac 60Hz	230Vac 50Hz
Four-point Average Efficiency (Average of 25%, 50%, 75%, 100% load)	78.63%		78.93%	%	Vo = 3.3Vdc, Io = 3A	87.83	84.19
	81.39%		81.84%	%	Vo = 5Vdc, Io = 3A	89.65	87.23
	86.62%		87.3%	%	Vo = 9Vdc, Io = 3A	90.81	89.82
	87.73%		88.85%		Vo = 15Vdc, Io = 3A	91.26	90.79
	87.73%		88.85%	%	Vo = 20Vdc, Io = 2.25A	90.60	90.05
CoCv5 Tier2 10% load Efficiency			69.66%	%	Vo = 3.3Vdc, Io = 0.3A	81.88	73.60
			72.48%	%	Vo = 5Vdc, Io = 0.3A	84.32	75.16
			77.3%		Vo = 9Vdc, Io = 0.3A	86.78	80.95
			78.85%	%	Vo = 15Vdc, Io = 0.3A	87.09	83.17
			78.85%	%	Vo = 20Vdc, Io = 0.225A	83.88	81.14
	Standard (Maximum value)					Test Result	
Parameter	DoE Level-6		CoCv5 Tier 2		Test Condition	115Vac 60Hz	230Vac 50Hz
No load consumption	100		75	mW	No USB sink attached	25	30

- Peak Efficiency: **91.67%** (At 115Vac-60Hz, 15V-3A)

*** Vout for efficiency calculations is measured across Vbus_C at board end with 30 minutes' warmup**

*** Variation of ±1% in efficiency can be observed across units**

3.1.2 Graphs

Figure 3-1-1. Efficiency* at 115Vac 60Hz

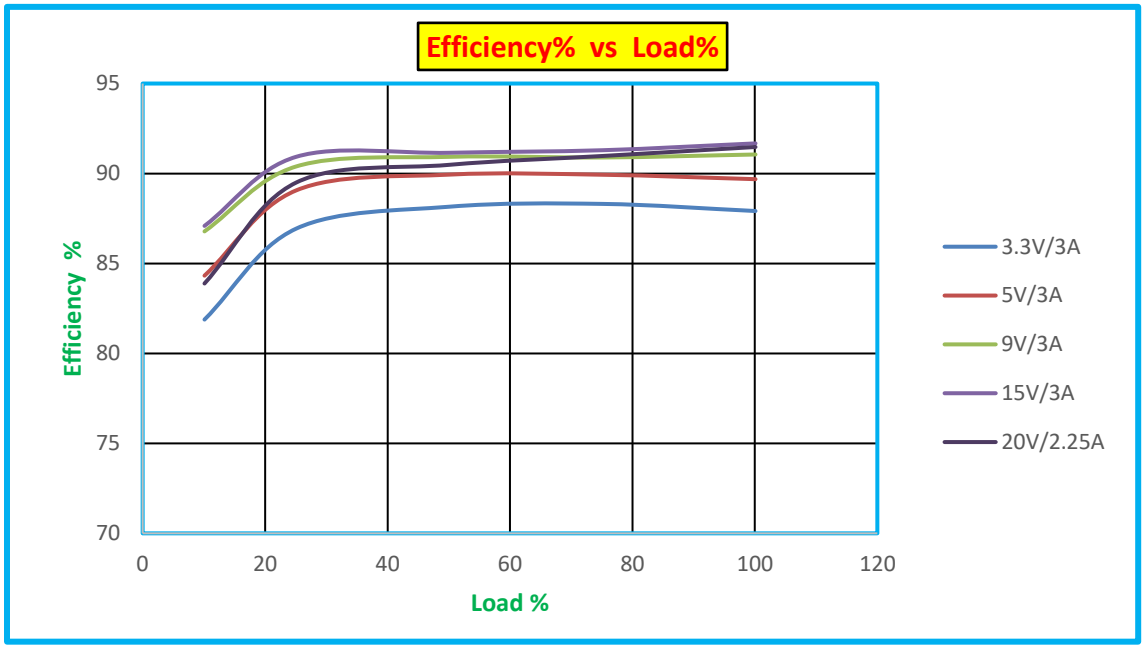
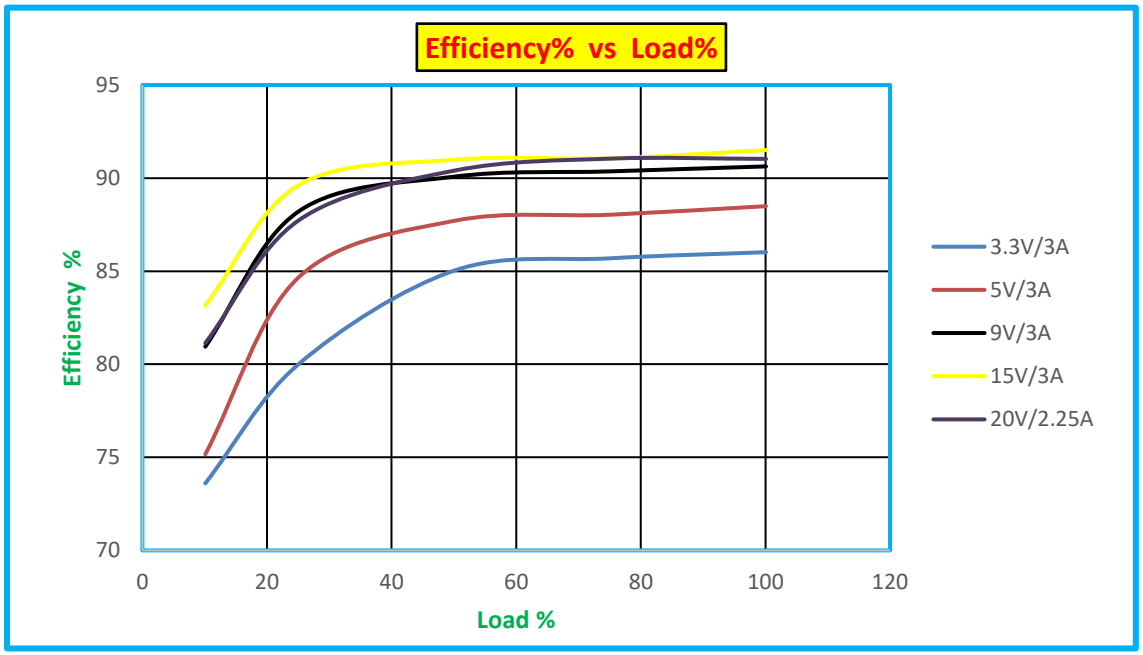


Figure 3-1-2. Efficiency* at 230Vac 50Hz



*** Vout for efficiency calculations is measured across Vbus_C at board end**

Figure 3-1-3. Efficiency* at 90Vac 47Hz

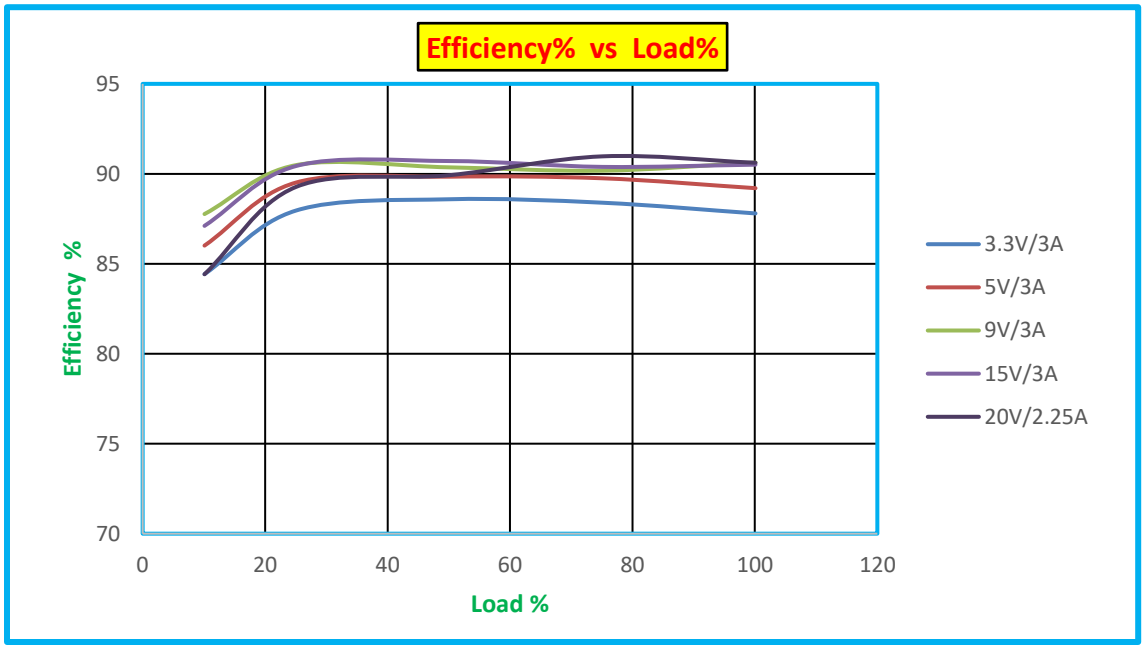
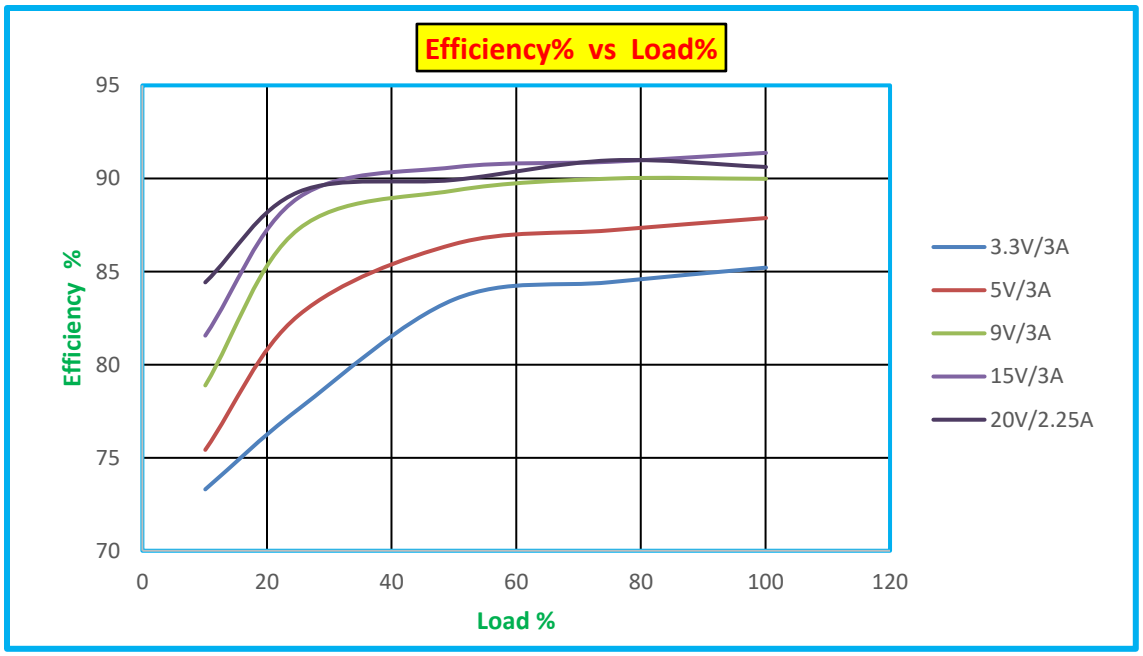


Figure 3-1-4. Efficiency* at 264Vac 63Hz



*** Vout for efficiency calculations is measured across Vbus_C at board end**

3.2 Output Voltage and Current Regulation

Figure 3-2-1. CV-CC regulation curve at 115Vac 60Hz

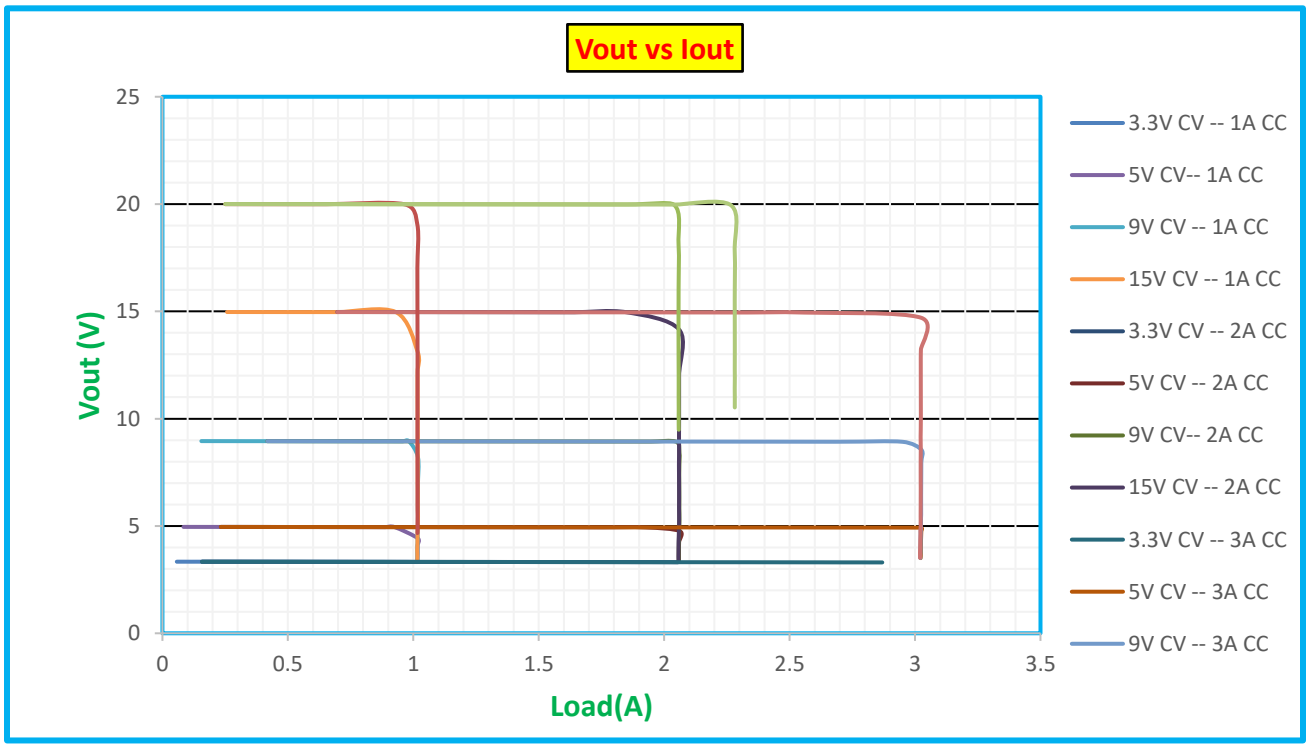
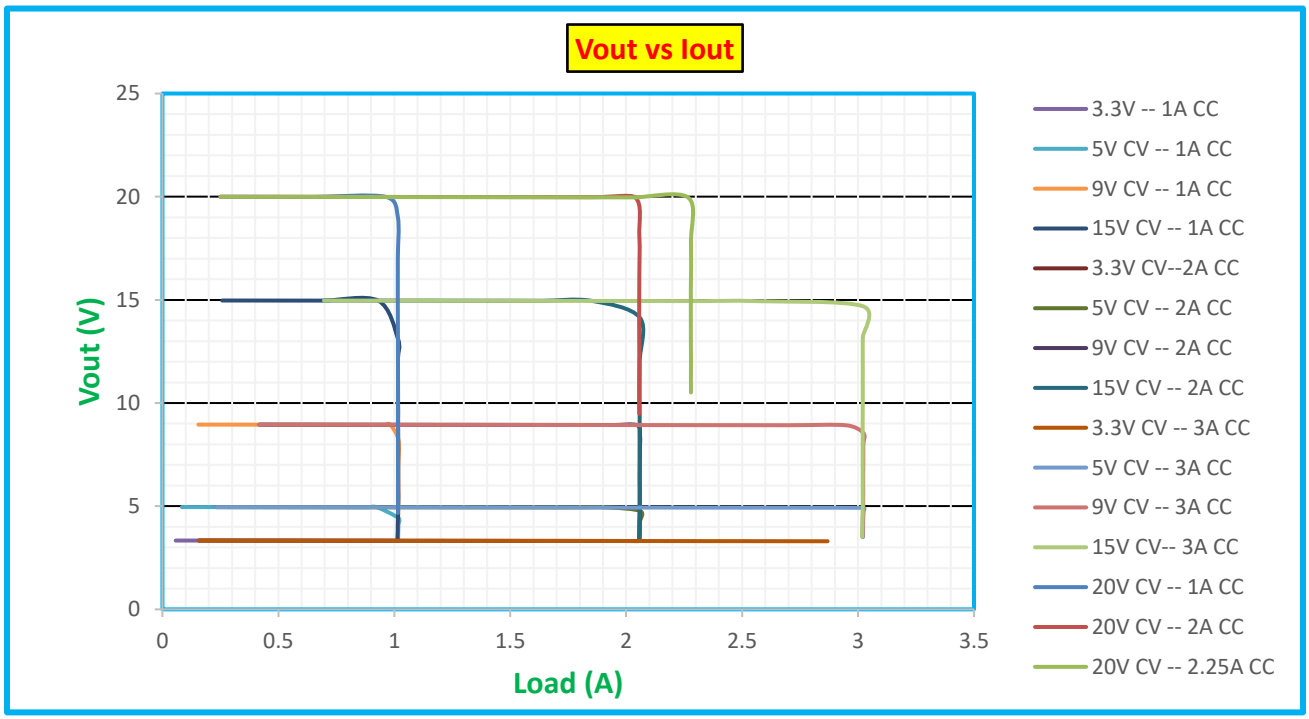


Figure 3-2-1. CV-CC regulation curve at 230Vac 50Hz



3.3 Standby Power Consumption

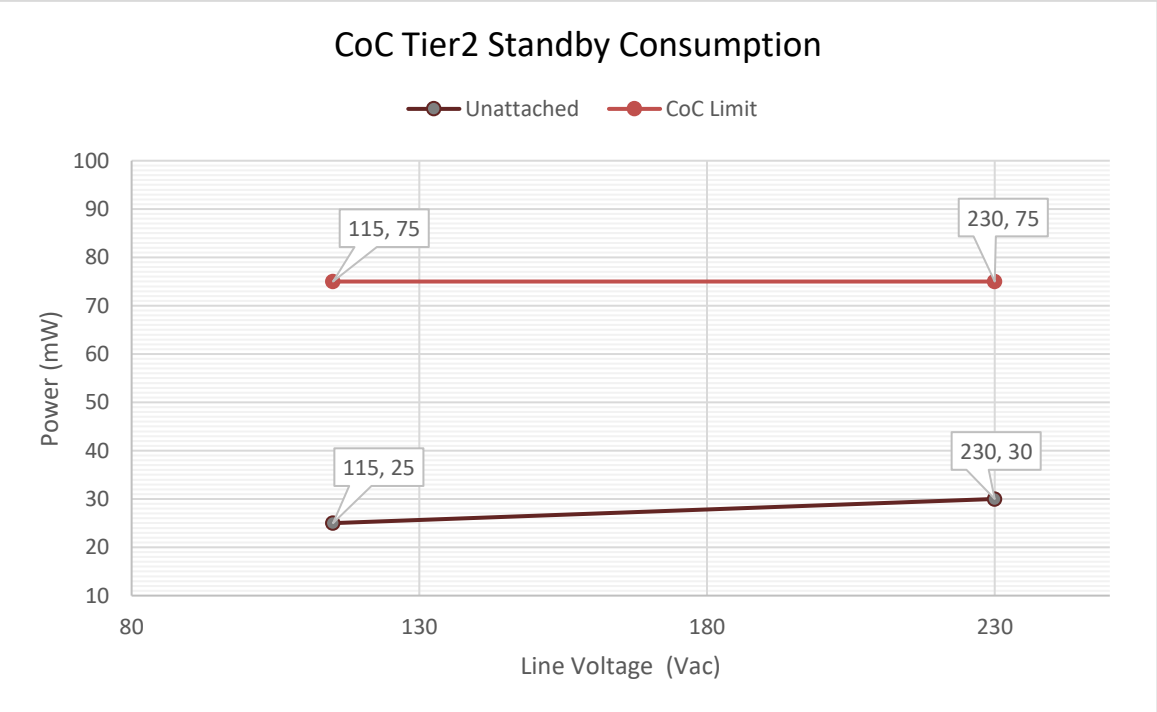
3.3.1 Detailed Data

Table 3-2-1. Standby Power Results*

Vin (Vac)	115Vac, 60Hz	230Vac, 50Hz
Input Power (mW)	25	30

3.3.2 Graph

Figure 3-3-1. Standby Power Vs CoC Tier2 criteria



*** There should be 15 minutes of warmup-up time before starting to measure standby power**

3.3.3 Details

Figure 3-3-2. Detailed Power Measurement Results @115Vac, 60Hz

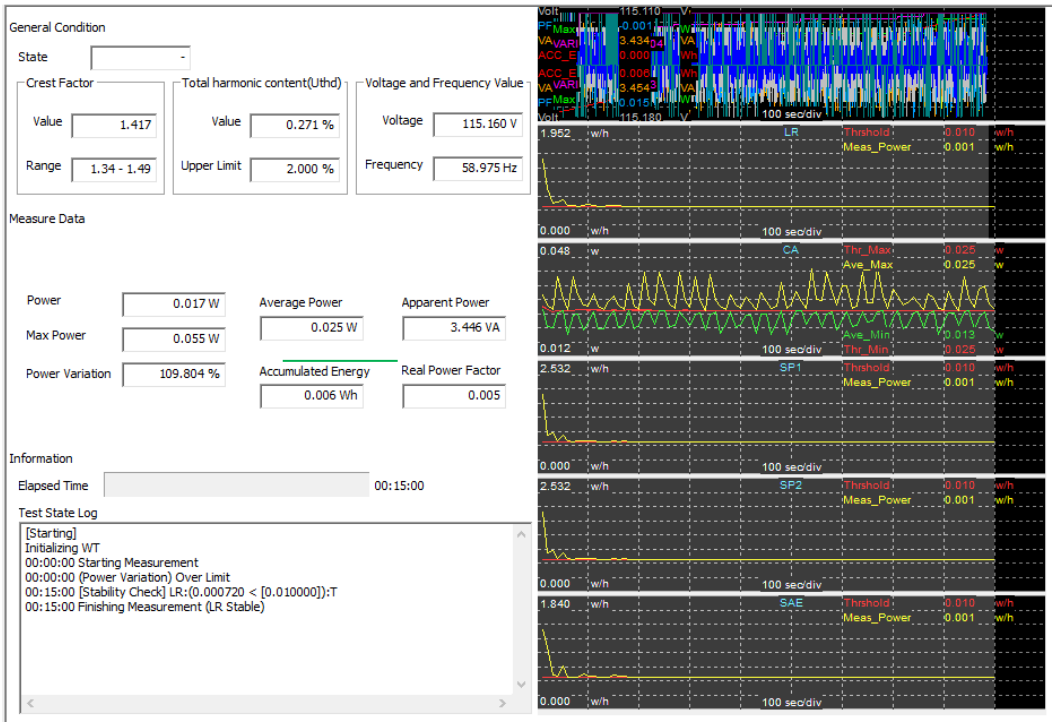
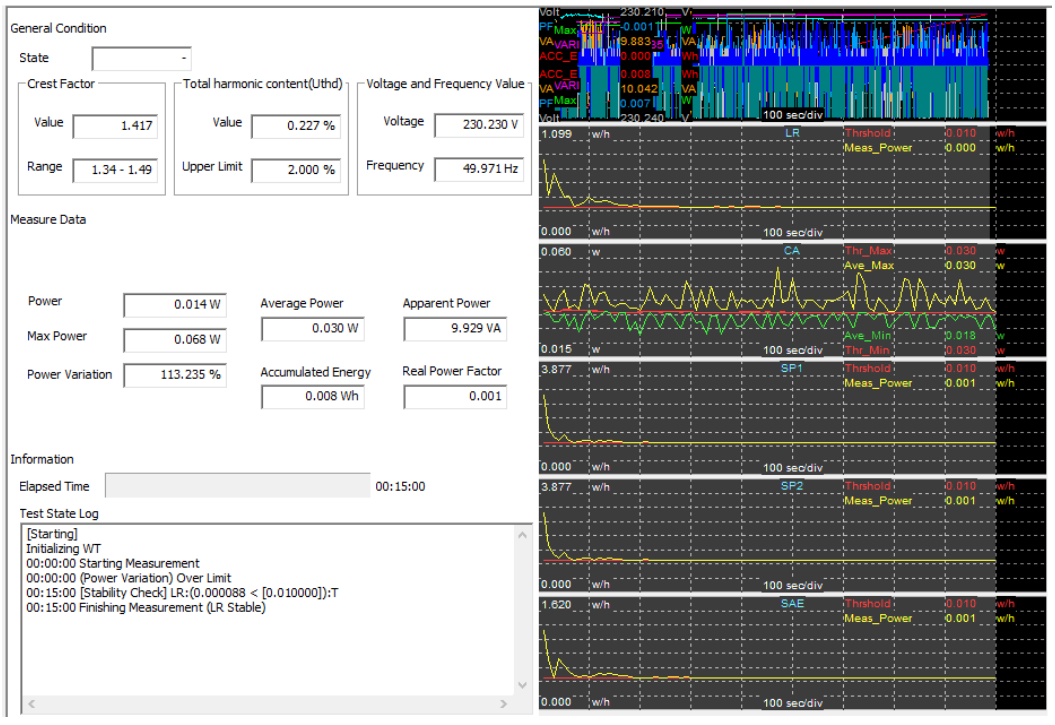


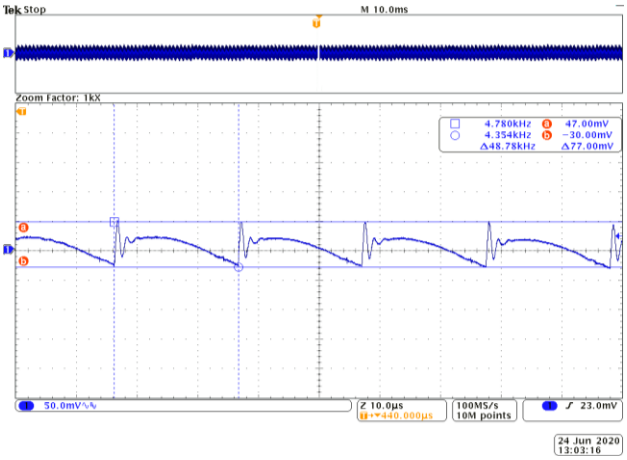
Figure 3-3-3. Detailed Power Measurement Results @230Vac, 50Hz



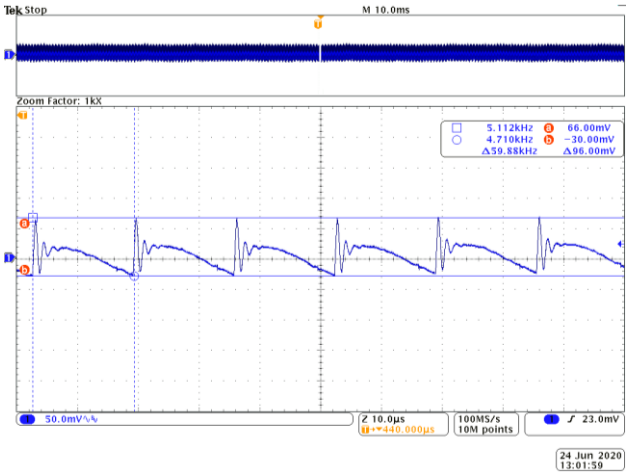
3.4 Output Voltage Ripple Peak-Peak

Figure 3-4-1. Ripple* at 115Vac 60Hz (**CH1:** Vbus_c)

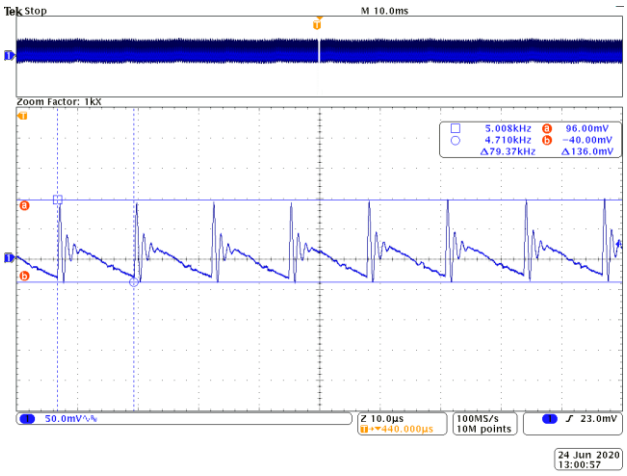
3.3V, 3A, Ripple (p-p) = 77mV



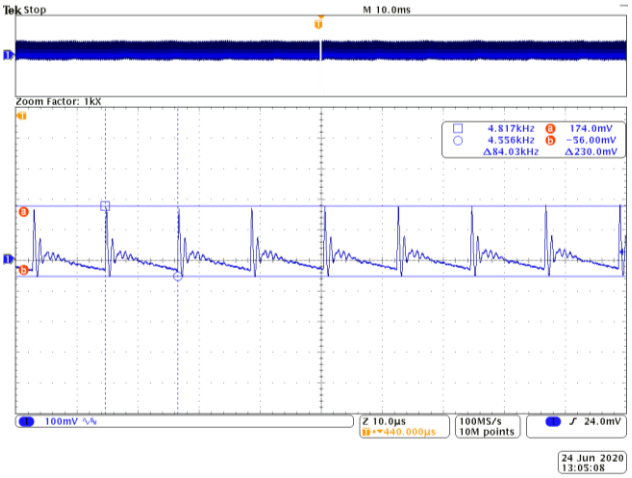
5V, 3A, Ripple (p-p) = 96mV



9V, 3A, Ripple (p-p) = 136mV



15V, 3A, Ripple (p-p) = 230mV



20V, 2.25A, Ripple (p-p) = 218mV

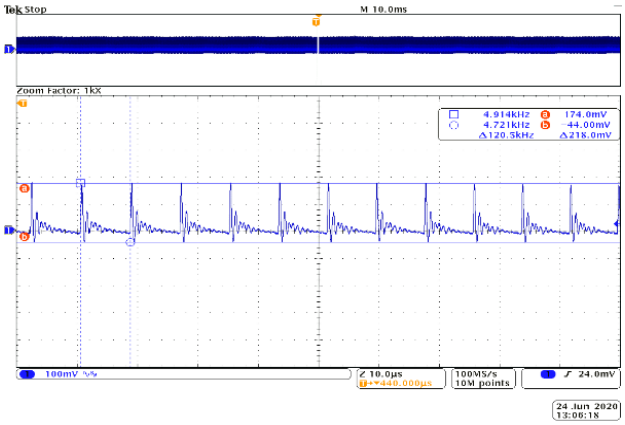
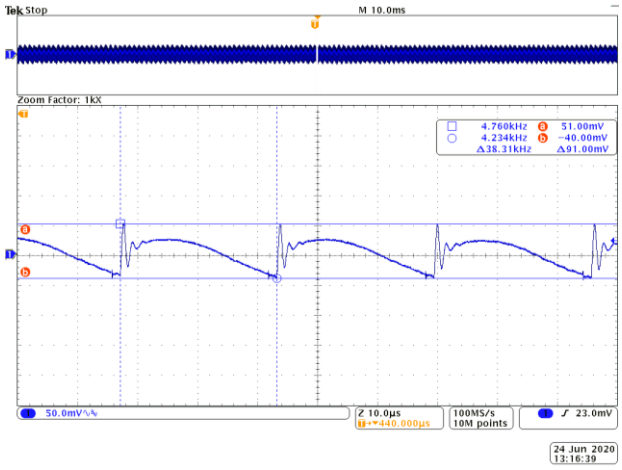
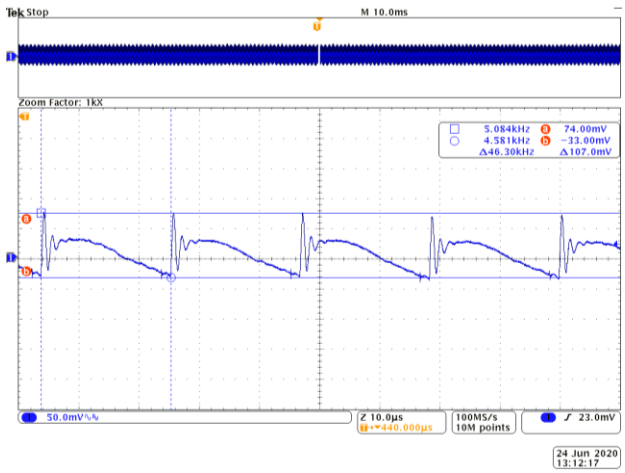


Figure 3-4-2. Ripple* at 230Vac 50Hz (**CH1:** Vbus_c)

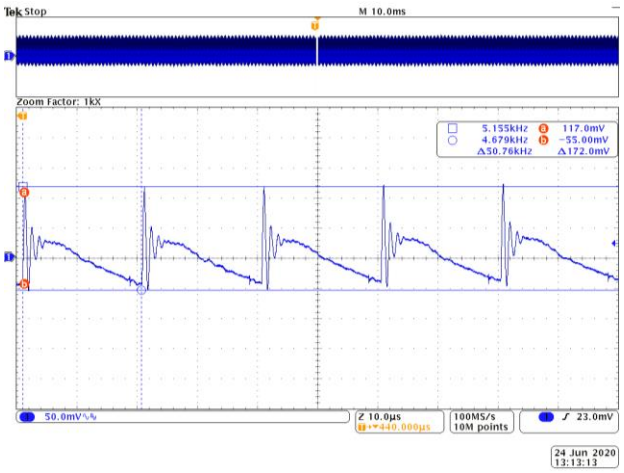
3.3V, 3A, Ripple (p-p) = 91mV



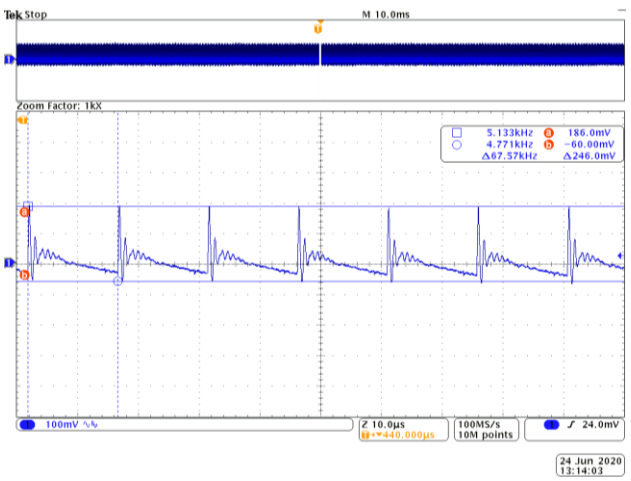
5V, 3A, Ripple (p-p) = 107mV



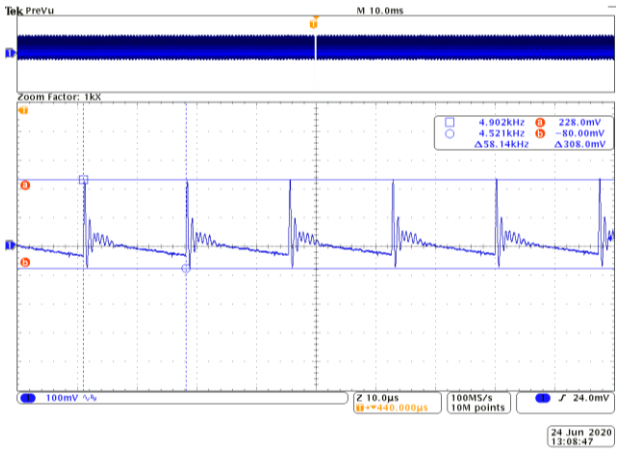
9V, 3A, Ripple (p-p) = 172mV



15V, 3A, Ripple (p-p) = 246mV



20V, 2.25A, Ripple (p-p) = 308mV



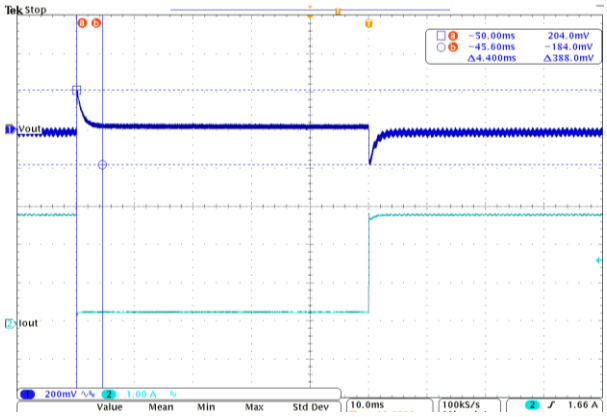
***Waveforms have been taken by keeping the oscilloscope in 20MHz Bandwidth limitation**

NOTE: RIPPLE MEASUREMENT IS DONE AT BOARD END USING LECROY PROBE ADAPTER PK6-5MM-105

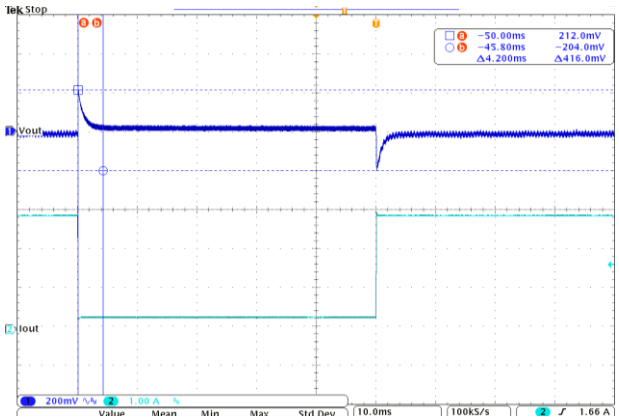
3.5 Output Dynamic Response Settling Time

Figure 3-5-1. Settling time for 115Vac, 60Hz Load Transition 10% to 100% load (**CH1:** Vbus_c, **CH2:** Iout)

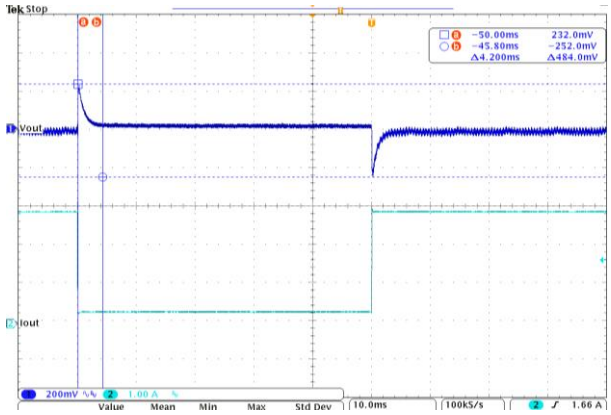
3.3V – 0.3A to 3A, Settling time = 4.4ms



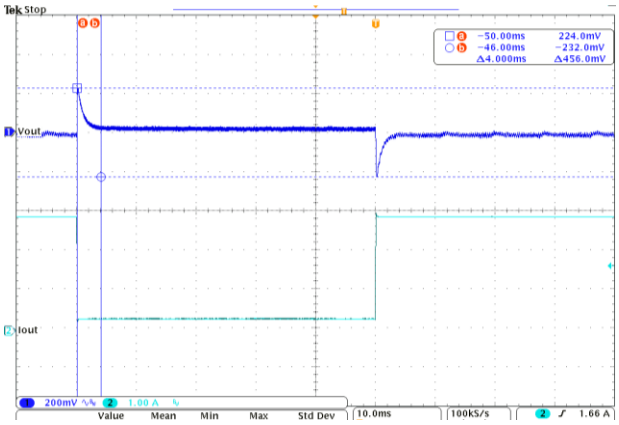
5V – 0.3A to 3A, Settling time = 4.2ms



9V – 0.3A to 3A, Settling time = 4.2ms



15V – 0.3A to 3A, Settling time = 4ms



20V – 0.225A to 2.25A, Settling time = 4ms

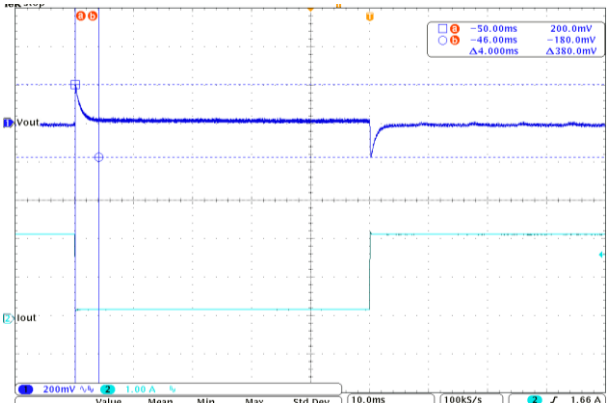
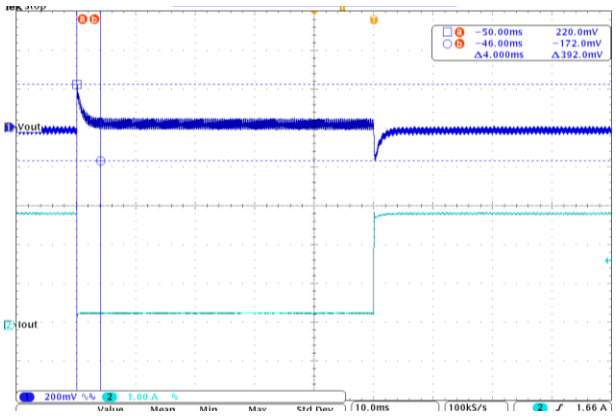
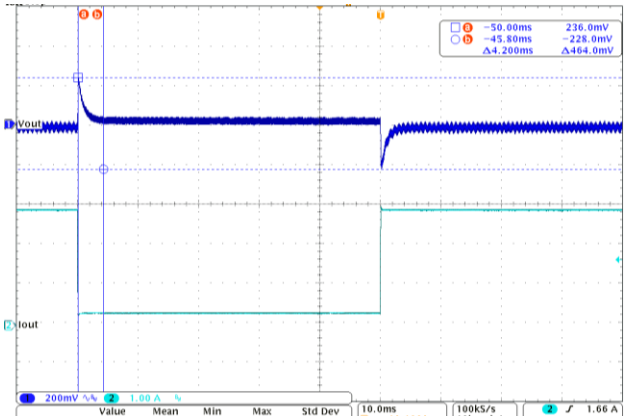


Figure 3-5.2. Settling time for 230Vac, 50Hz; Load Transition 10% to 100% load (**CH1:** Vbus_c, **CH2:** Iout)

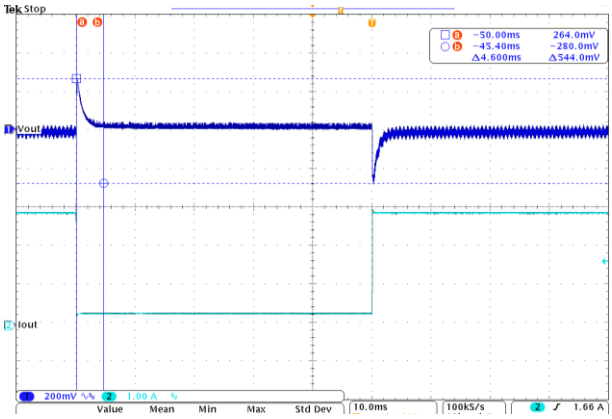
3.3V – 0.3A to 3A, Settling time = 4ms



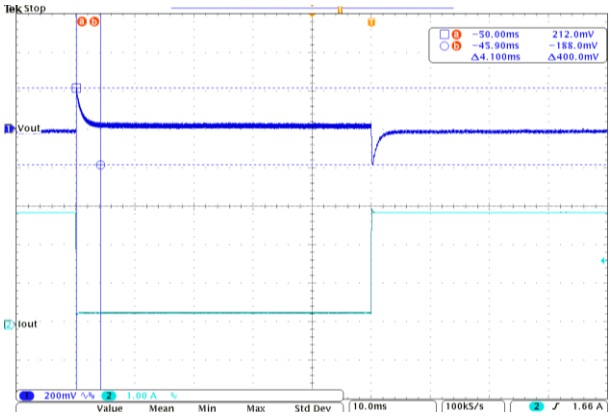
5V – 0.3A to 3A, Settling time = 4.2ms



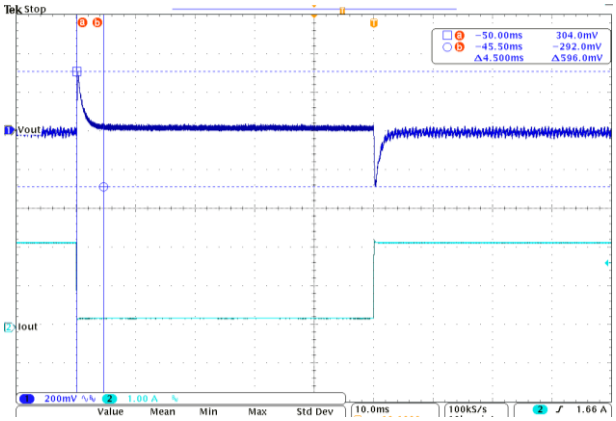
9V – 0.3A to 3A, Settling time = 4.6ms



15V – 0.3A to 3A, Settling time = 4.1ms



20V – 0.225A to 2.25A, Settling time = 4.5ms

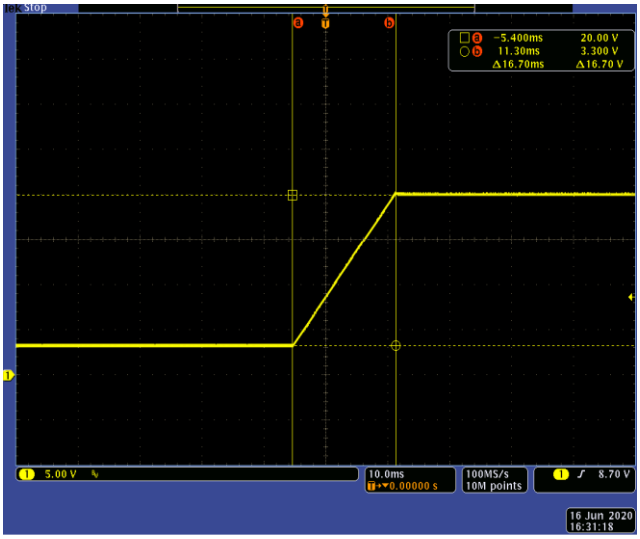


3.6 Output Voltage Transition

Figure 3-6-1. Output voltage transition for 115Vac, 60Hz; (**CH1:** Vbus_c)

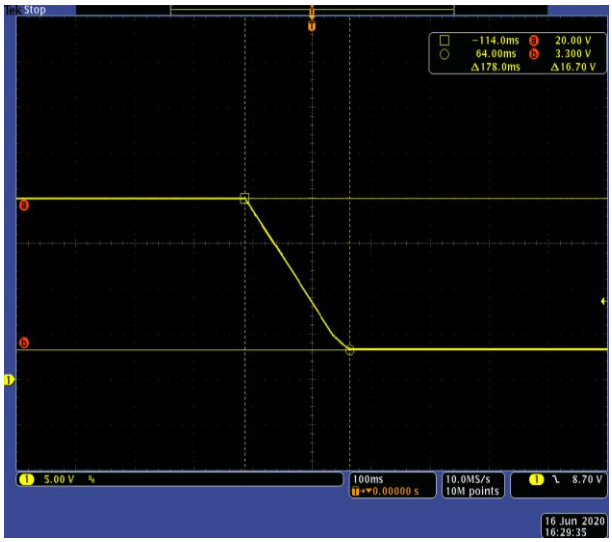
Vout = 3.3V to 20V, Iout = 0A

Transition time: 16.7ms



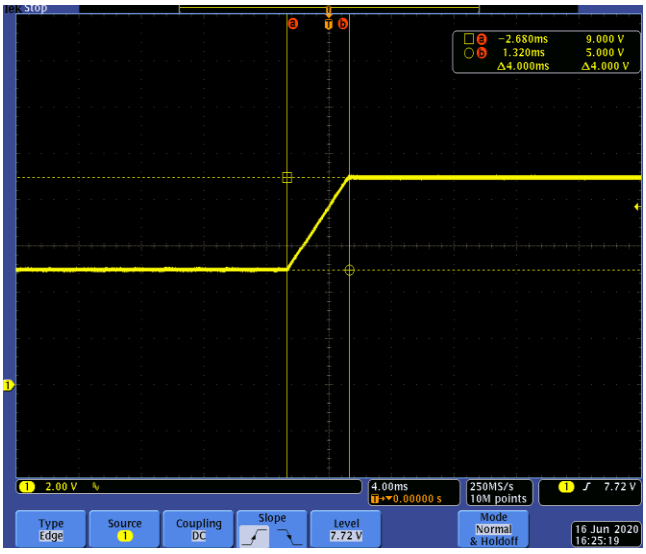
Vout = 20V to 3.3V, Iout = 0A

Transition time: 178ms



Vout = 5V to 9V, Iout = 0A

Transition time: 4ms



Vout = 9V to 5V, Iout = 0A

Transition time: 38.4ms

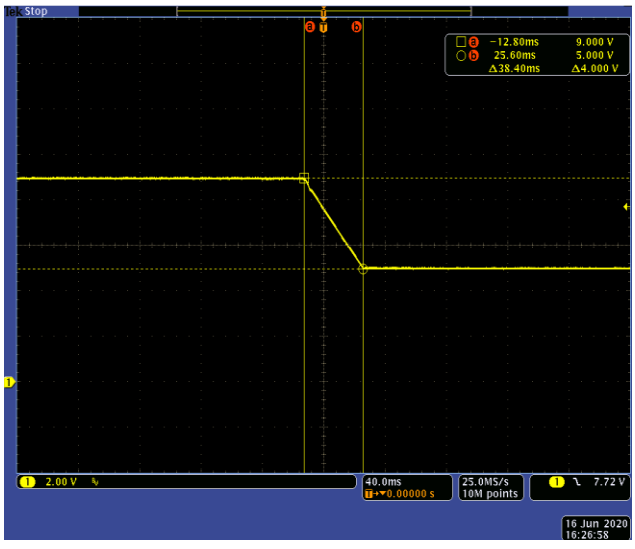
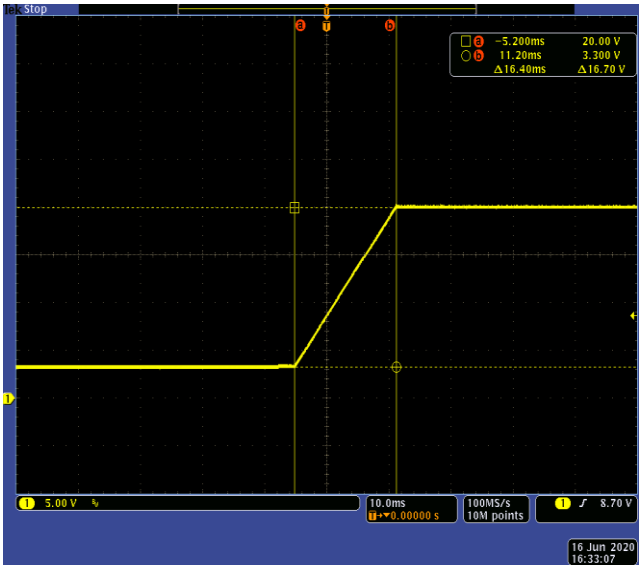


Figure 3-6-2. Output voltage transition for 230Vac, 50Hz; (**CH1:** Vbus_c)

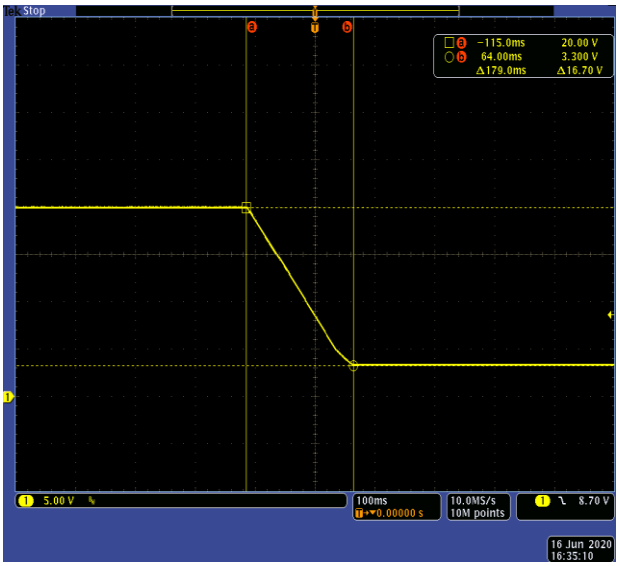
Vout = 3.3V to 20V, Iout = 0A

Transition time: 16.4ms



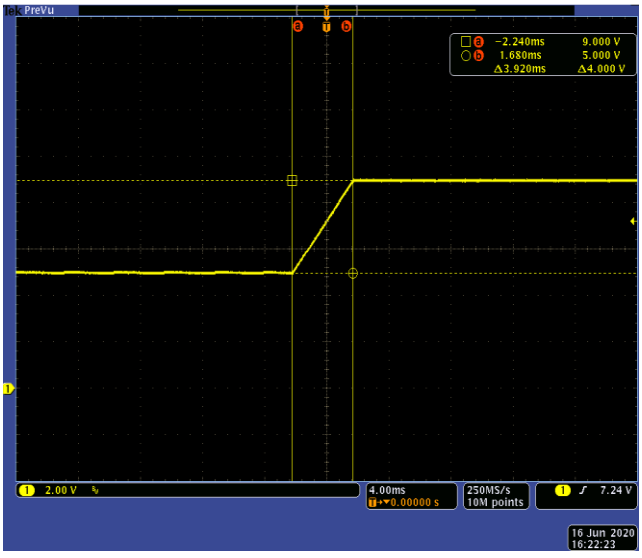
Vout = 20V to 3.3V, Iout = 0A

Transition time: 179ms



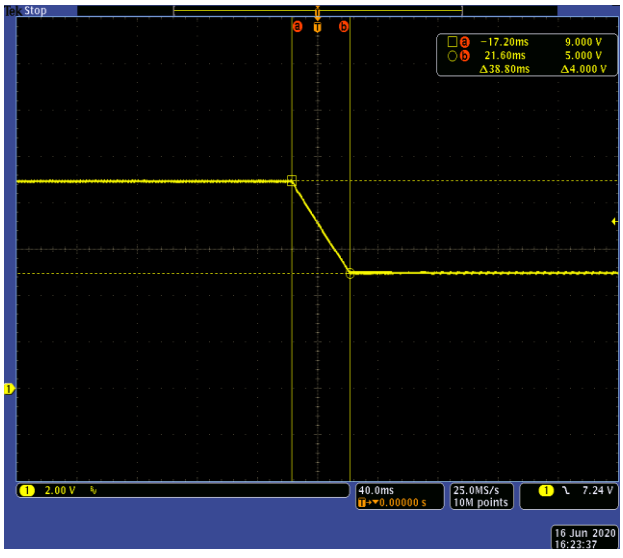
Vout = 5V to 9V, Iout = 0A

Transition time: 3.92ms



Vout = 9V to 5V, Iout = 0A

Transition time: 41.6ms



3.7 Start-up Turn-on Delay

Figure 3-7-1. Start-up Turn-on Delay at 90Vac, 47Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

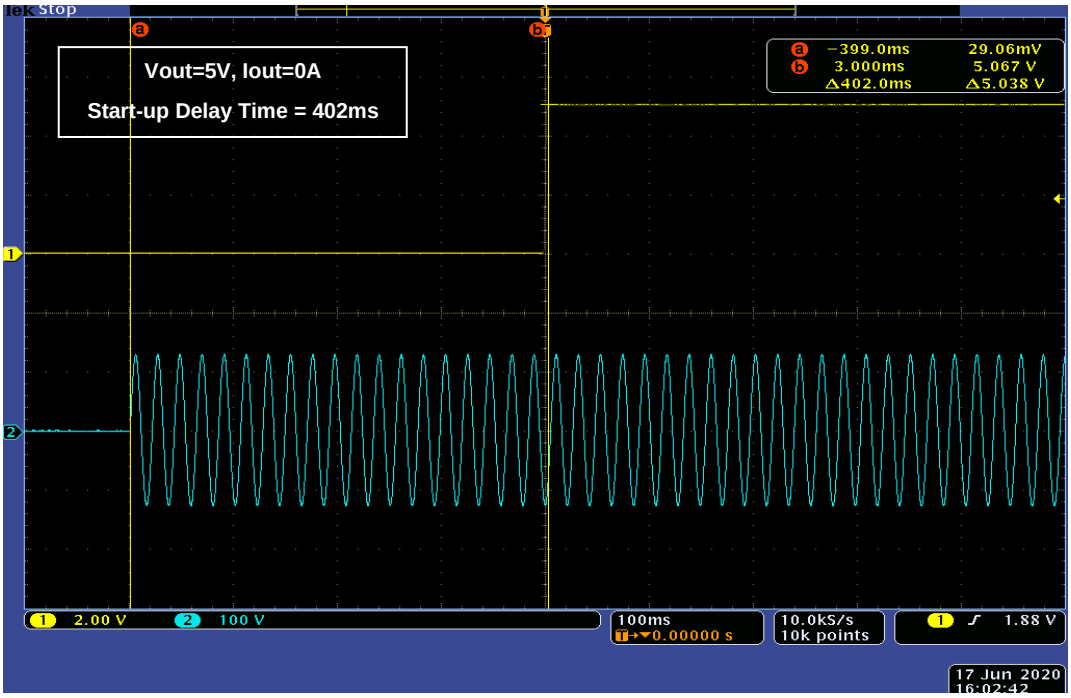


Figure 3-7-2. Start-up Turn-on Delay at 115Vac, 60Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

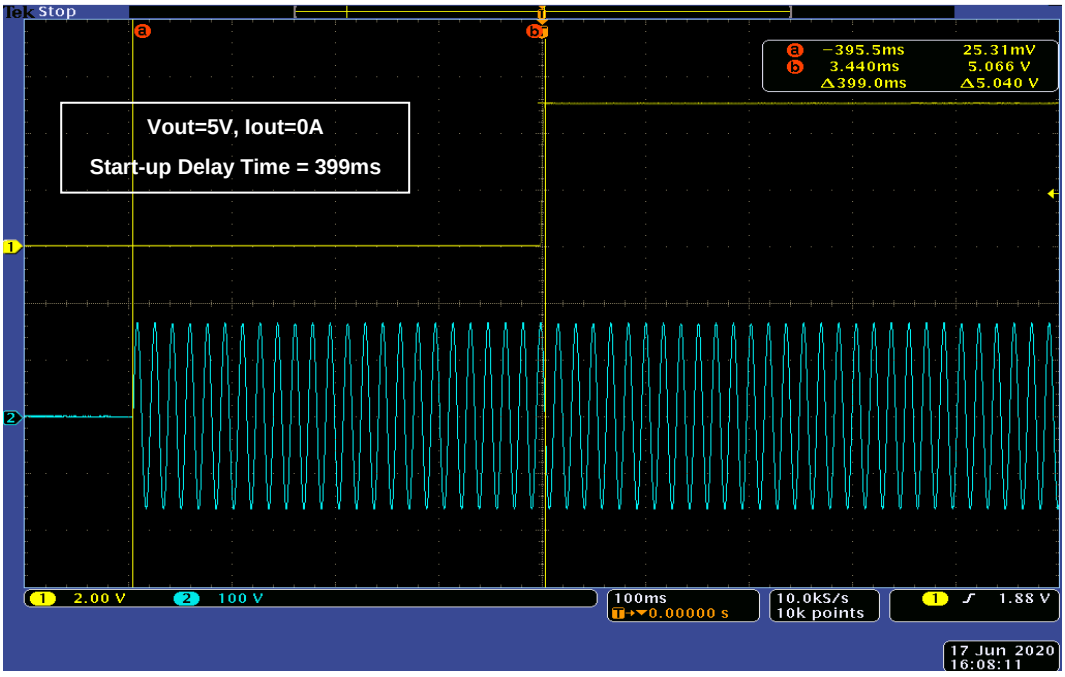


Figure 3-7-3. Start-up Turn-on Delay at 230Vac, 50Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

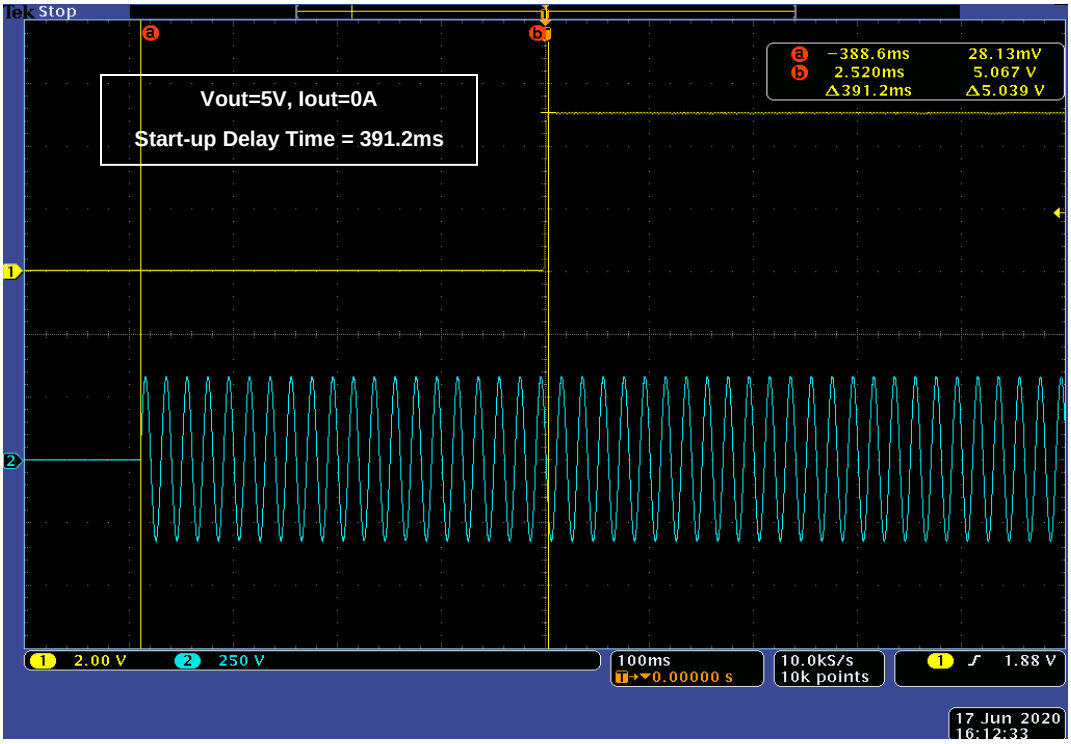
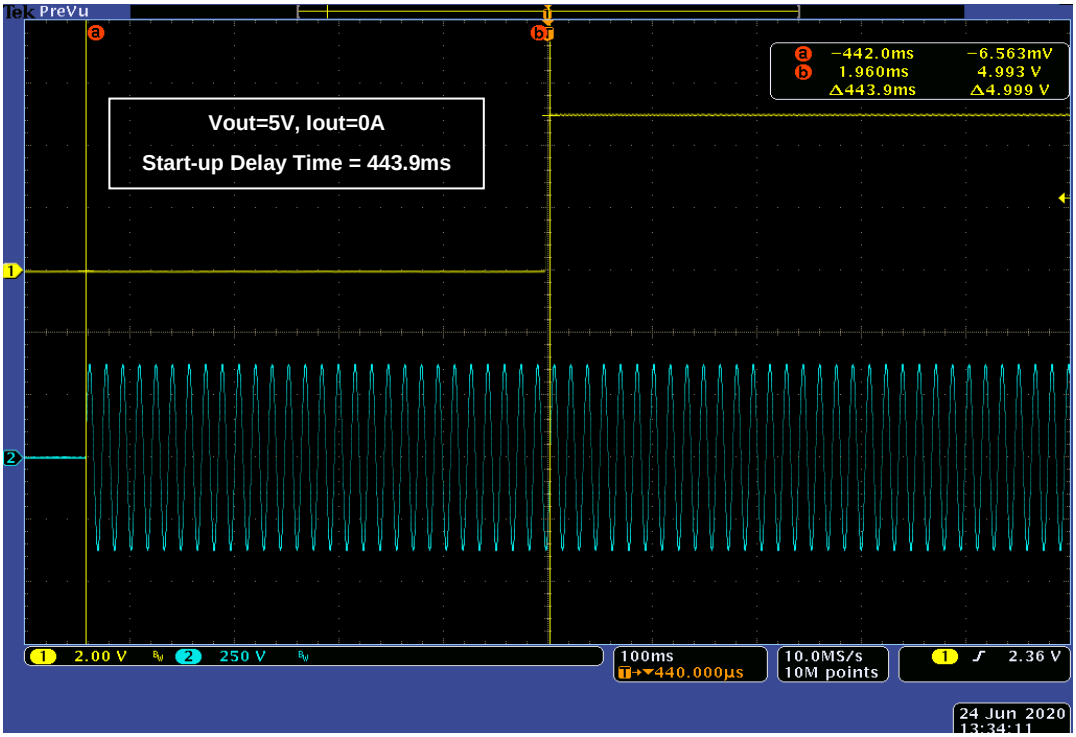


Figure 3-7-4. Start-up Turn-on Delay at 264Vac, 63Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)



3.8 Start-up Rise Time

Figure 3-8-1. Start-up Rise time at 90Vac, 47Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

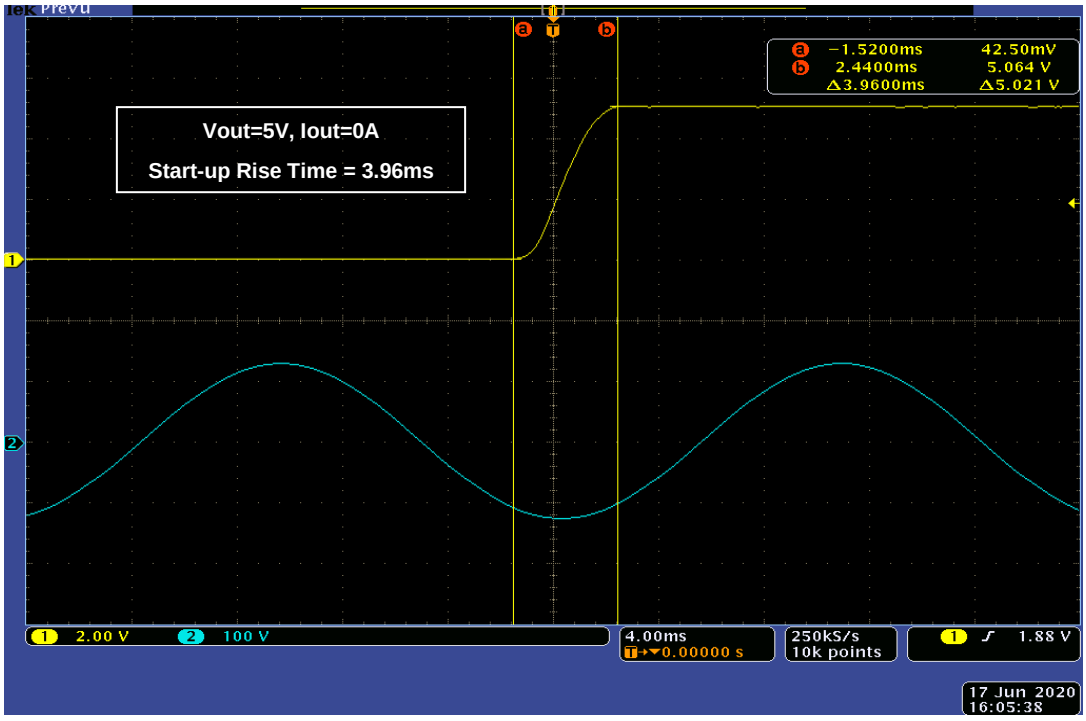


Figure 3-8-2 Start-up Rise time at 115Vac, 60Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

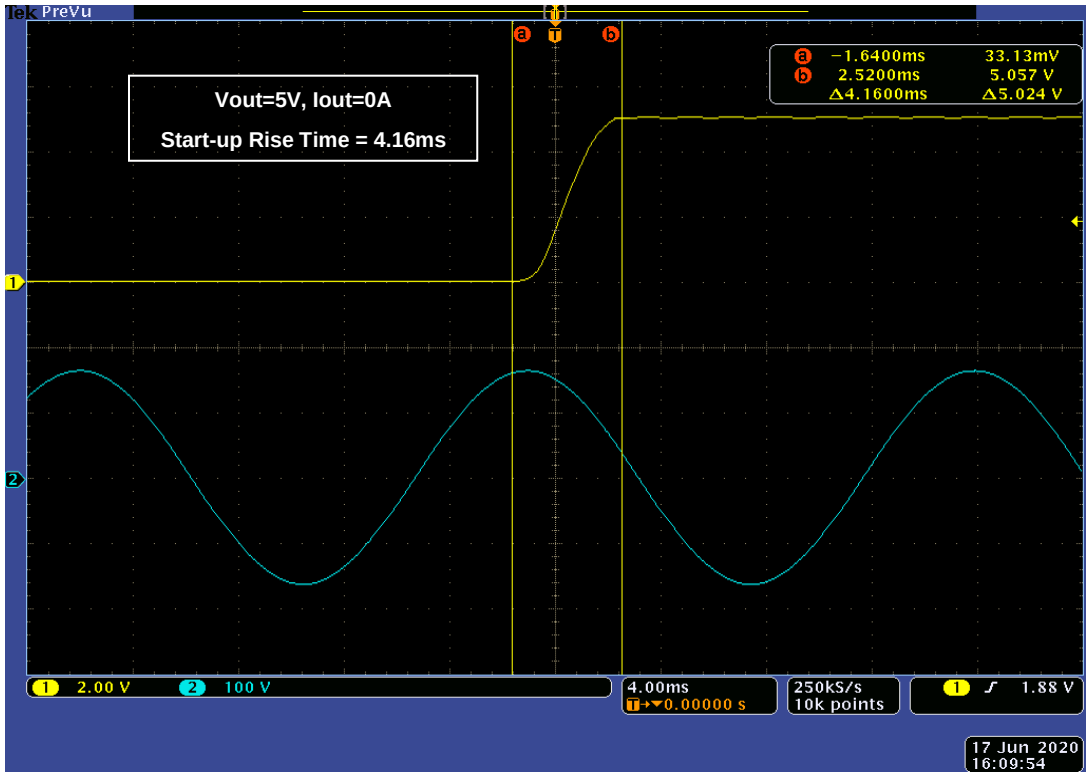


Figure 3-8-3. Start-up Rise time at 230Vac, 50Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

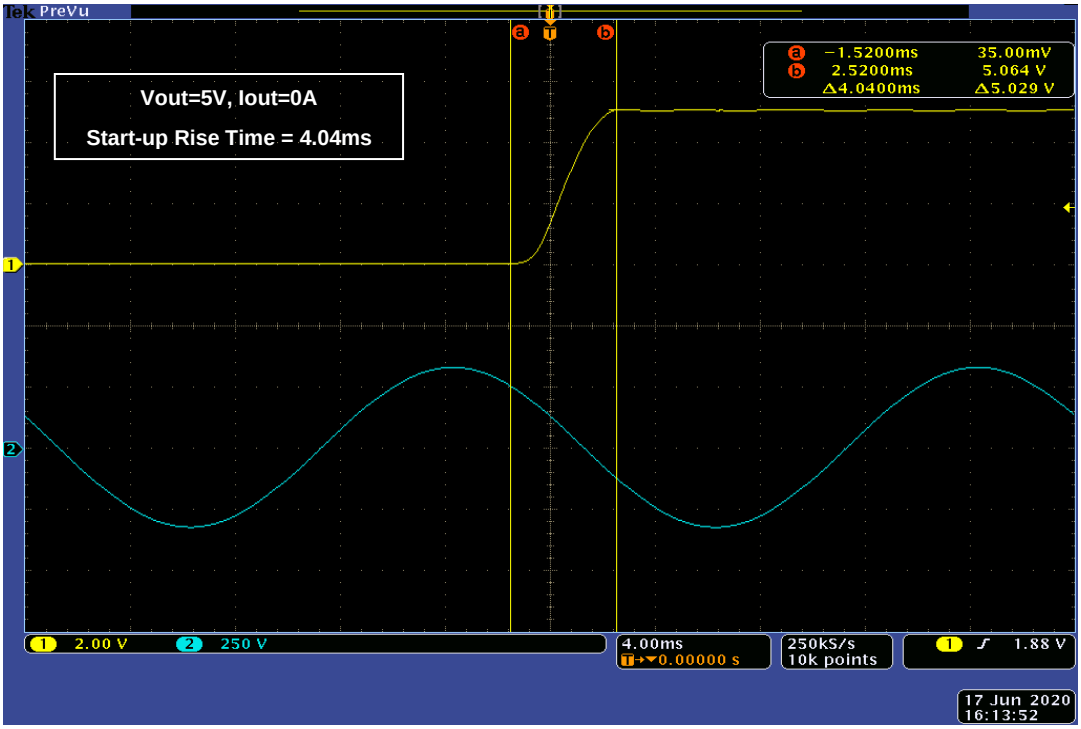
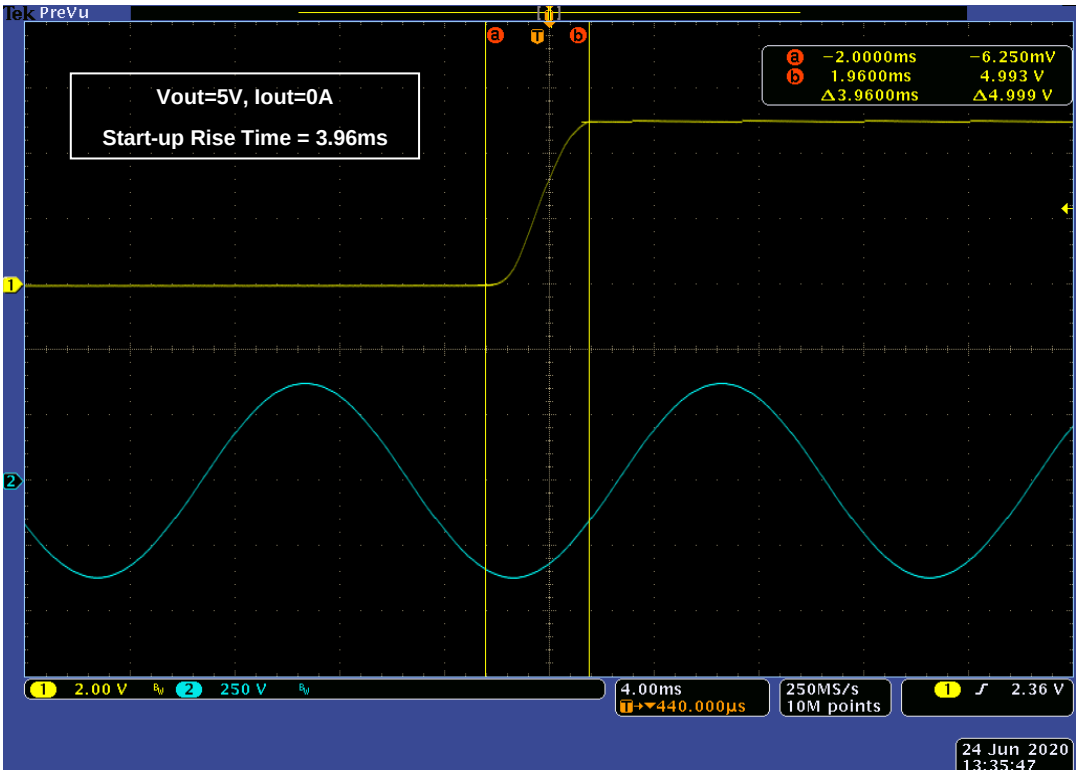


Figure 3-8-4 Start-up Rise time at 264Vac, 63Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)



3.9 Hold-up Time

Figure 3-9-1. Hold-up time at 90Vac, 47Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

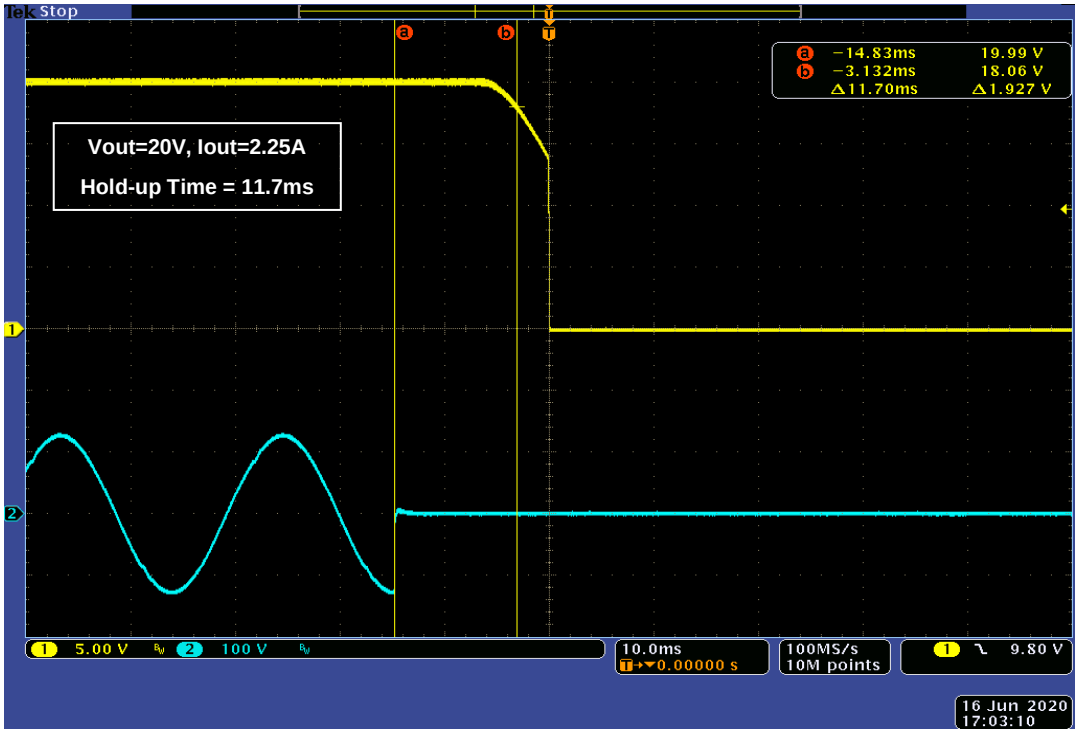


Figure 3-9-2. Hold-up time at 115Vac, 60Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

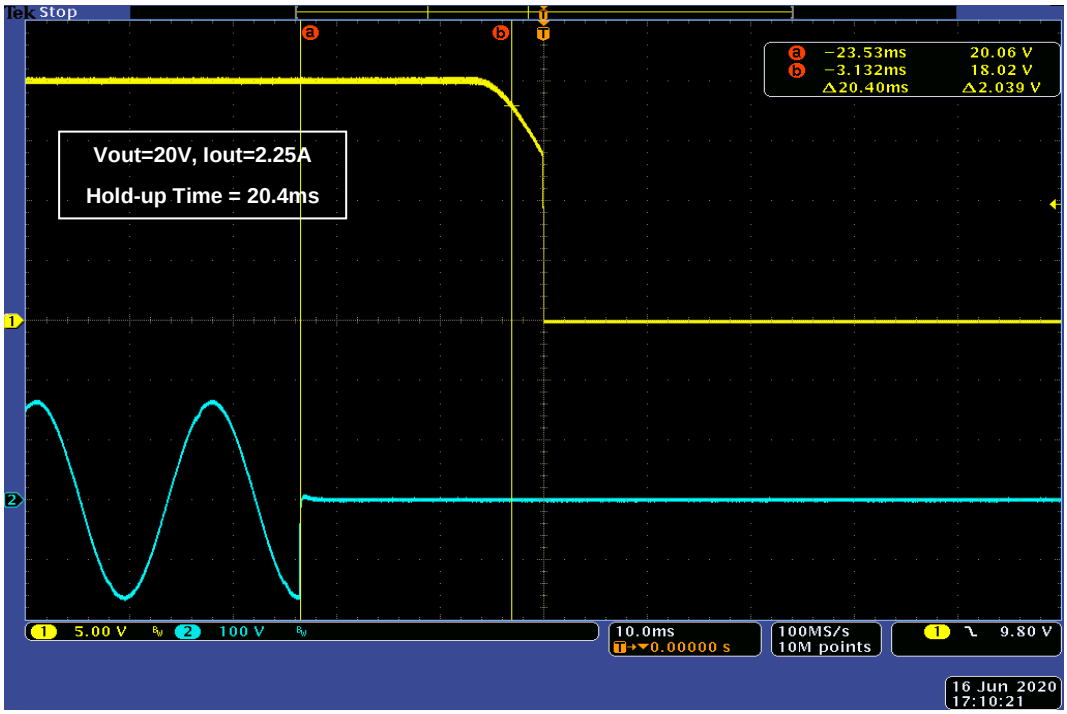


Figure 3-9-3. Hold-up time at 230Vac, 50Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

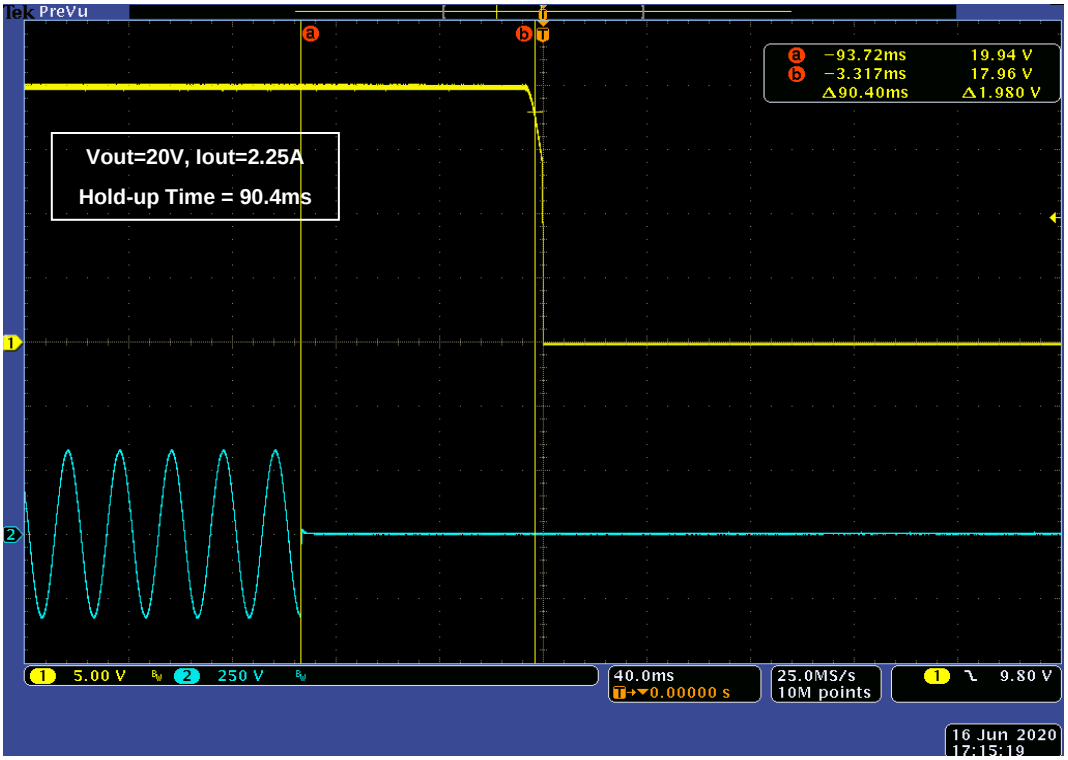
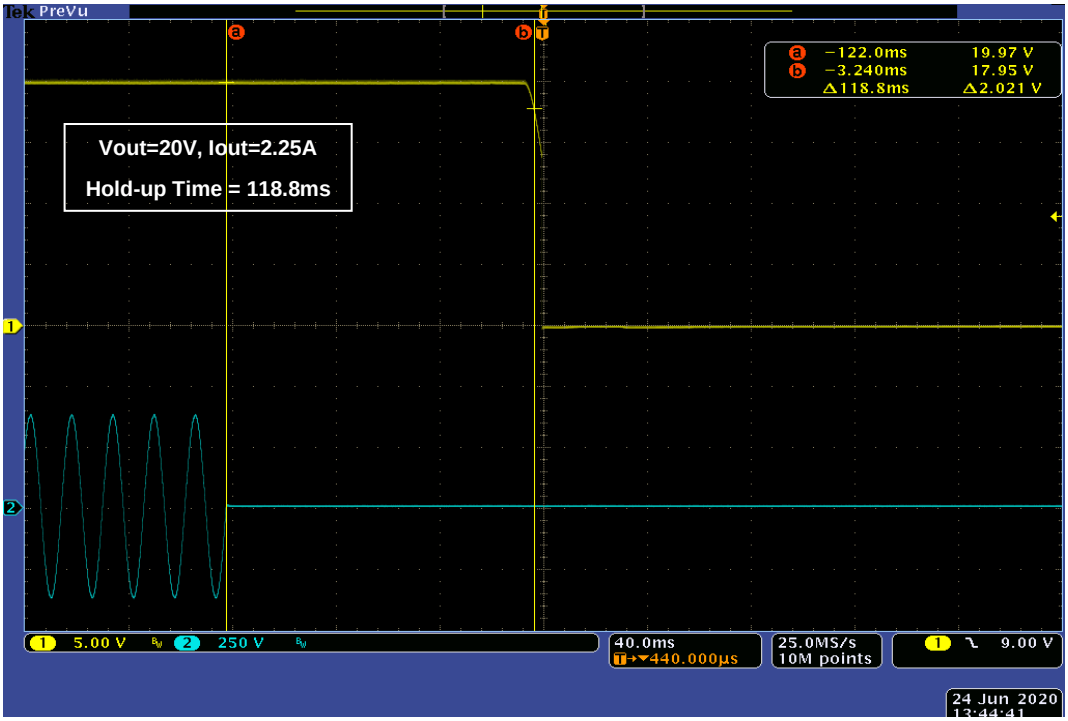


Figure 3-9-4. Hold-up time at 264Vac, 63Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)



3.10 Shut-down Fall Time

Figure 3-10-1. Shut-down Fall time at 90Vac, 47Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

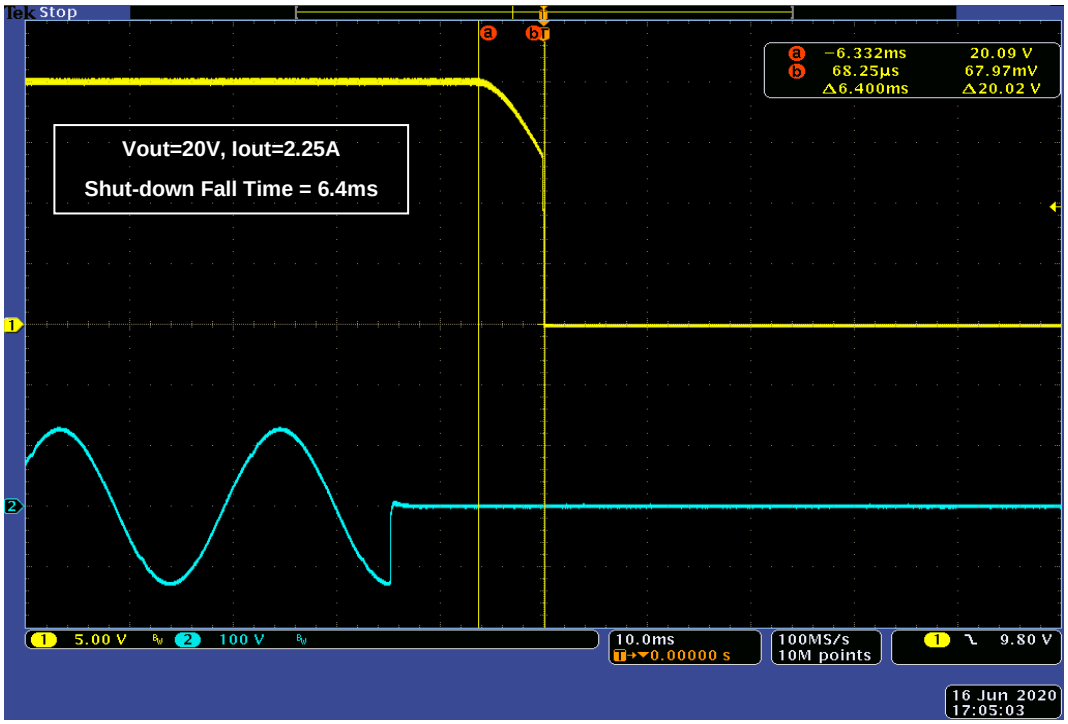


Figure 3-10-2. Shut-down Fall time at 115Vac, 60Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

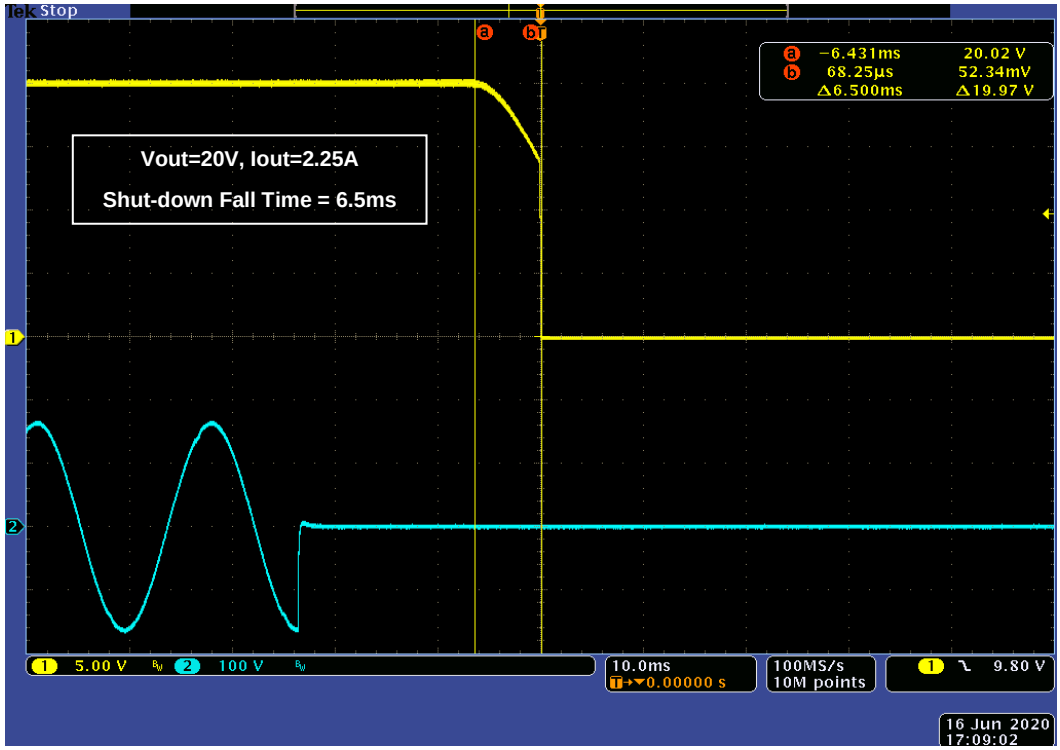


Figure 3-10-3. Shut-down Fall time at 230Vac, 50Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)

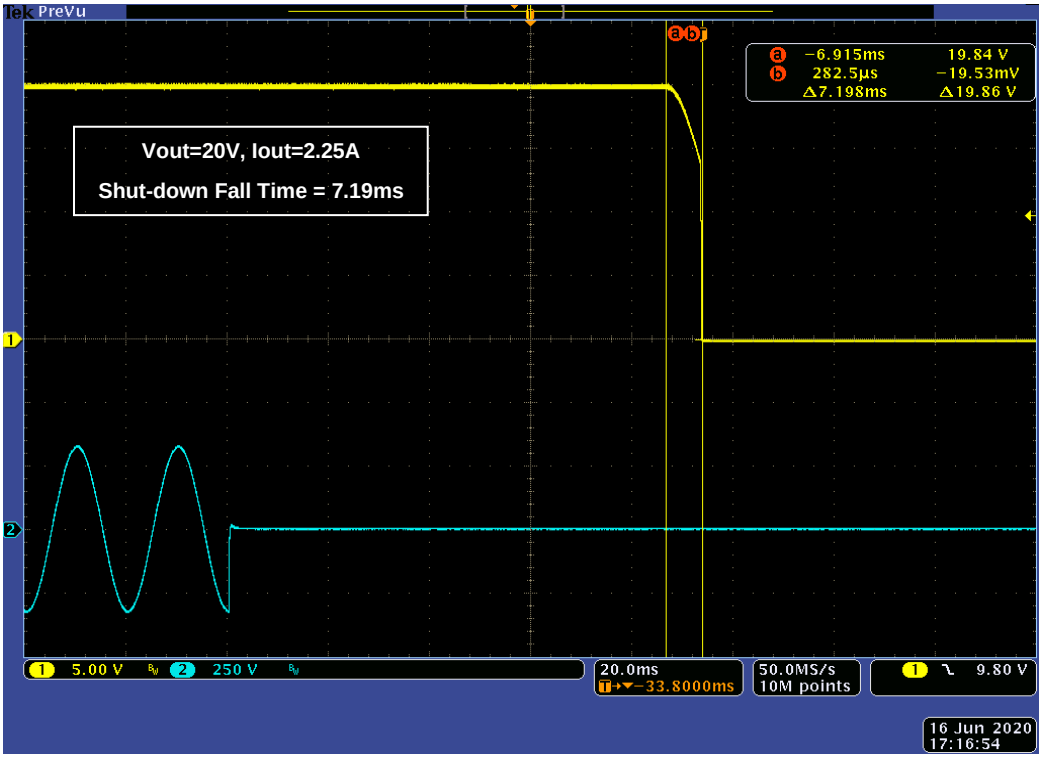
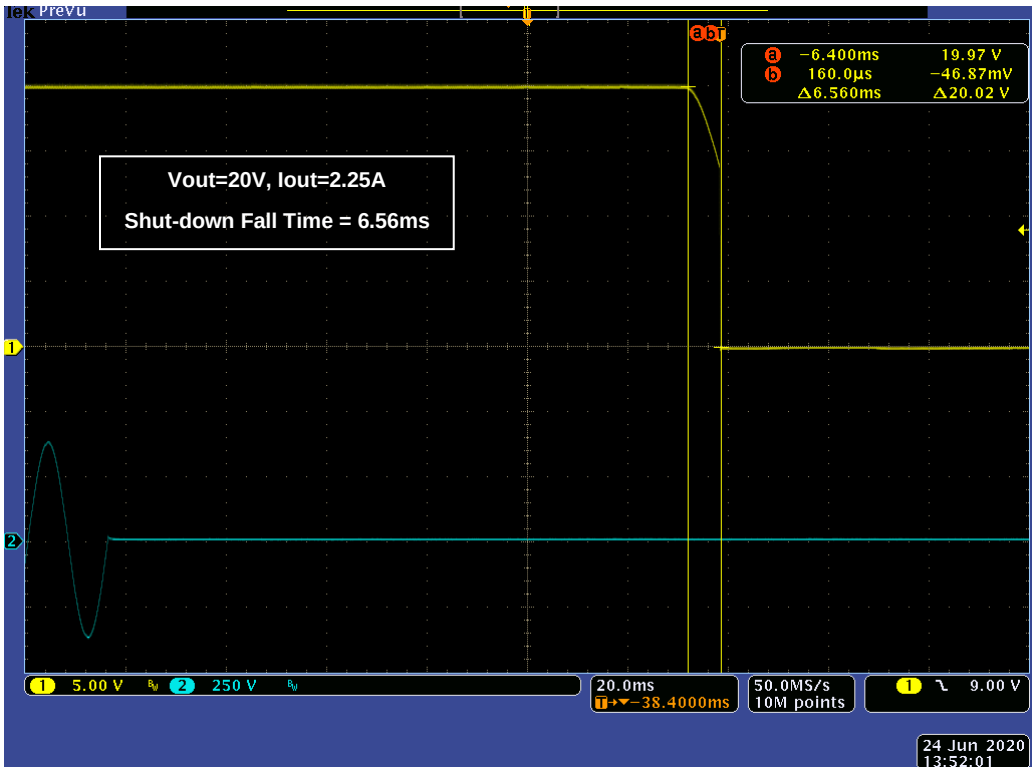


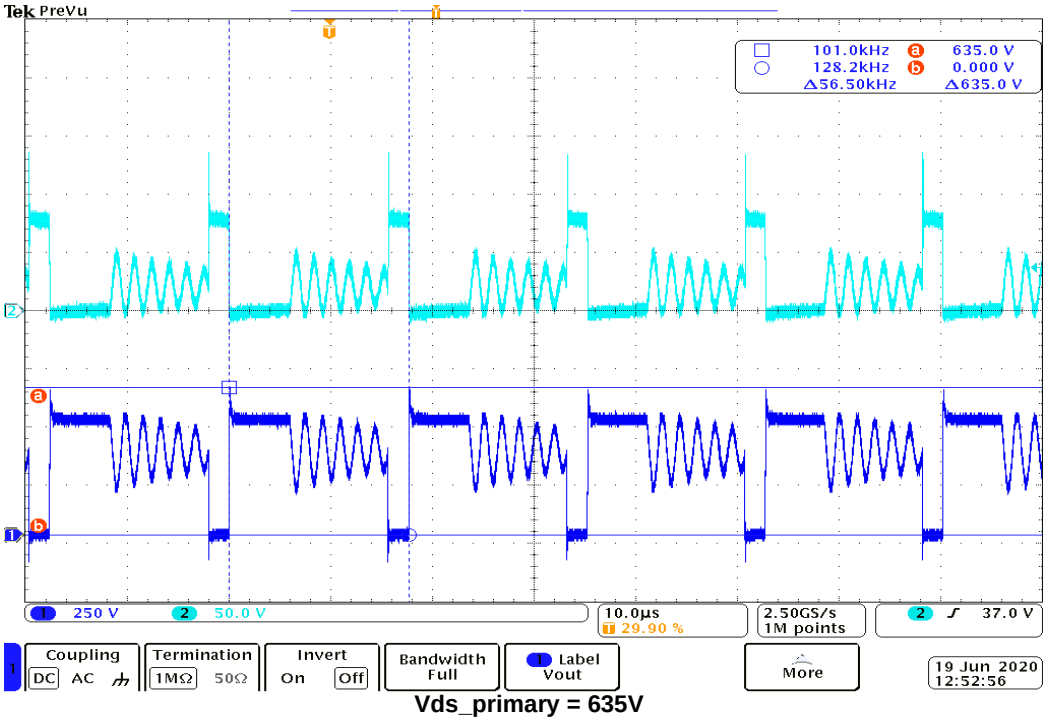
Figure 3-10-4. Shut-down Fall time at 264Vac, 63Hz (**CH1:** Vbus_c**, CH2:** Vin_ac)



3.11 Switch Voltage Stress

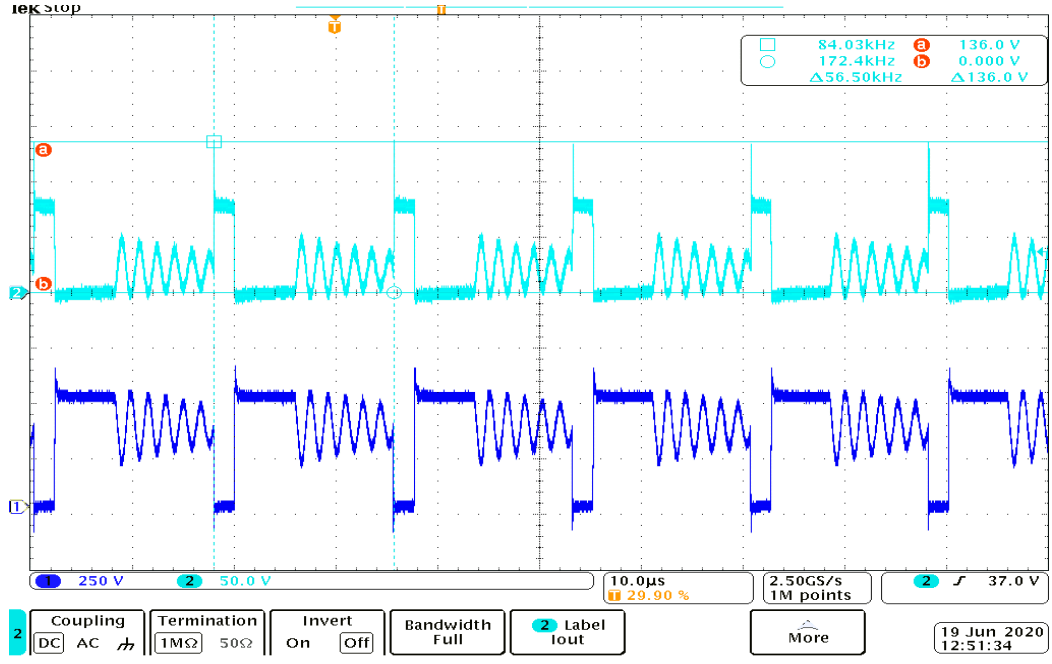
Condition: Vin = 265Vac, 63Hz, Vout=20V & Iout=2.25A

Figure 3-11-1. Voltage Stress on Primary FET (**CH2:** Vds_secondary**, CH1:** Vds_primary)



Vds_primary = 635V

Figure 3-11-2. Voltage Stress on Secondary FET (**CH2:** Vds_secondary**, CH1:** Vds_primary)

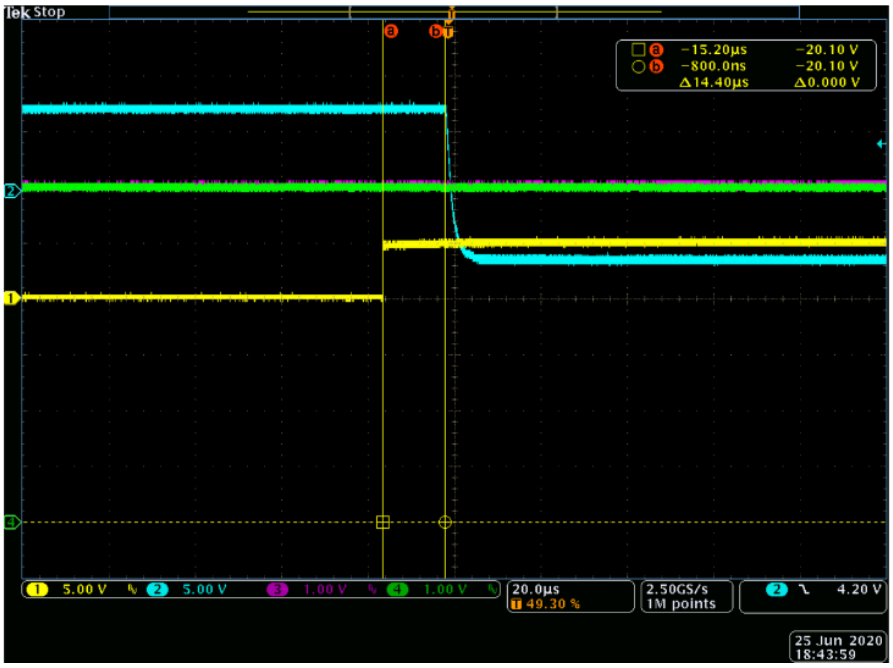


Vds_secondary = 136V

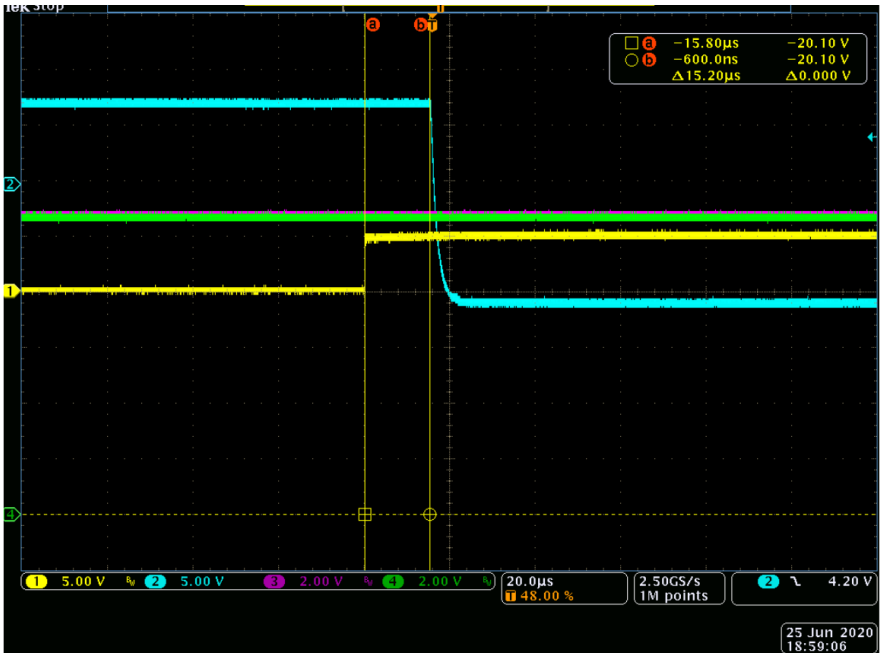
3.12 Over Voltage Protection (OVP)

Figure 3-12-1. OVP at 115Vac, 60Hz (**CH1**: GPIO; **CH2**: NGDO[1] wrt source; **CH3**: Vbus_C; **CH4**: Vbus_in)

Vout = 5V, OVP_Voltage = 6V, Response Time = 14.4us



Vout = 9V, OVP_Voltage = 10.7V, Response Time = 15.2us



1. NGDO: NFET Gate driver output (Provider/Output MOSFET)

Vout = 15V, OVP_Voltage = 17.9V, Response Time = 15.2us

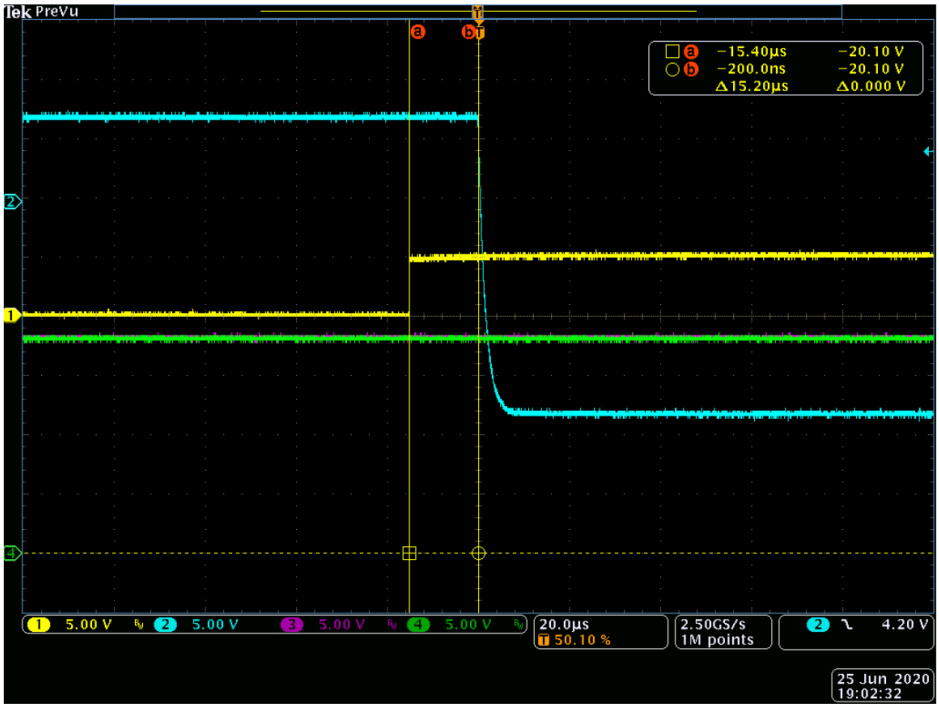
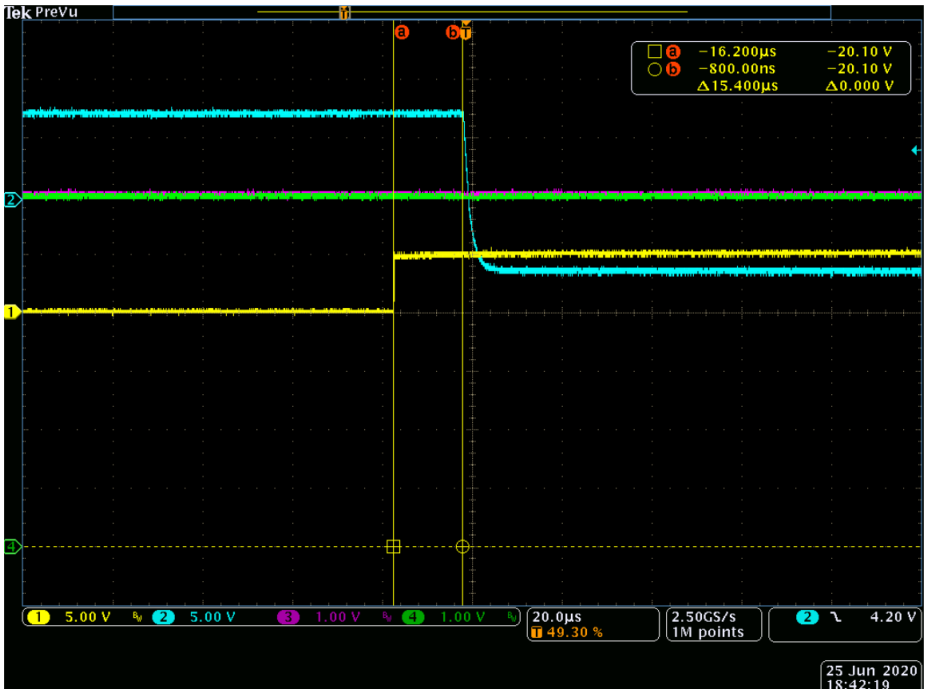
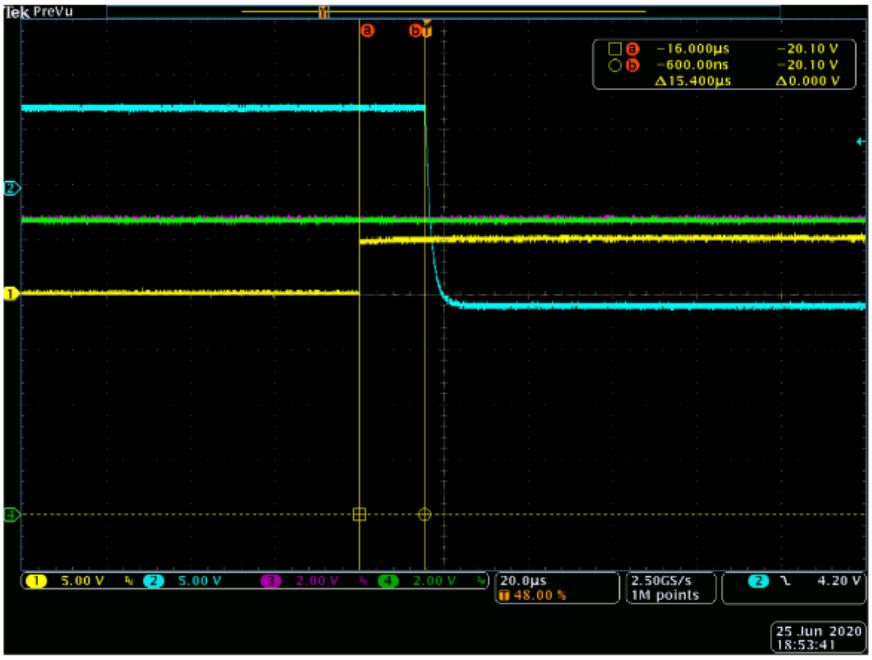


Figure 3-12-2. OVP at 230Vac, 50Hz (**CH1**: GPIO; **CH2**: NGDO[1] wrt source; **CH3**: Vbus_C; **CH4**: Vbus_in)

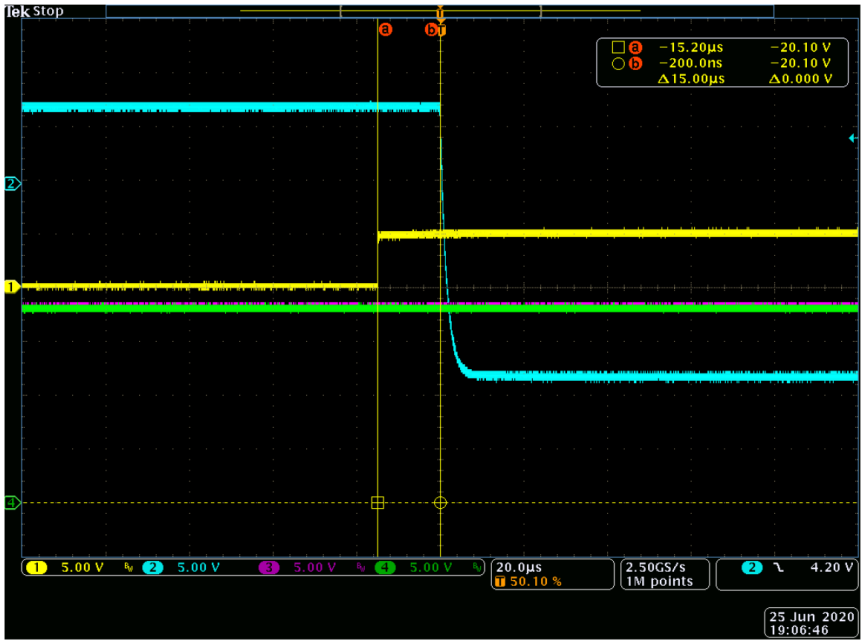
Vout = 5V, OVP_Voltage = 6V, Response Time = 15.4us



Vout = 9V, OVP_Voltage = 10.7V, Response Time = 15.4us



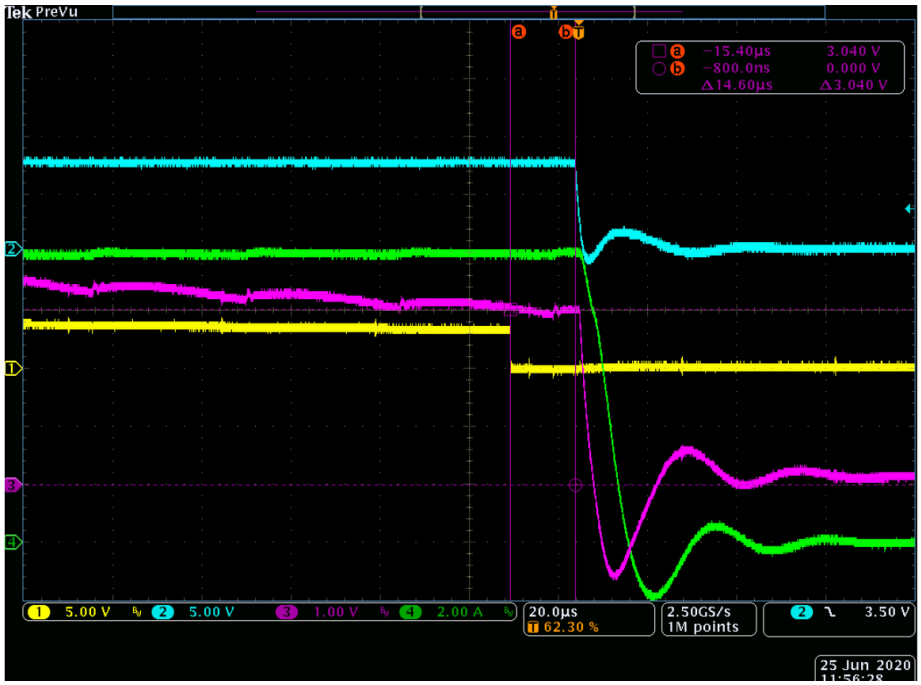
Vout = 15V, OVP_Voltage = 17.9V, Response Time = 15us



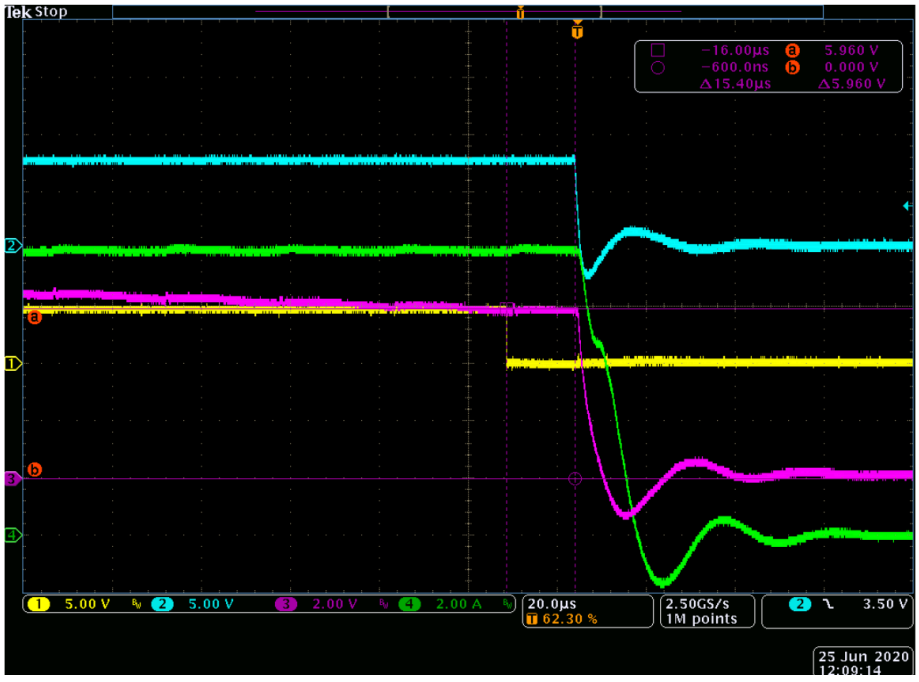
3.13 Under Voltage Protection (UVP)

Figure 3-13-1. UVP at 115Vac, 60Hz (**CH1**: GPIO; **CH2**: NGDO[1] wrt source; **CH3**: Vbus_C; **CH4**: Vbus_Iout)

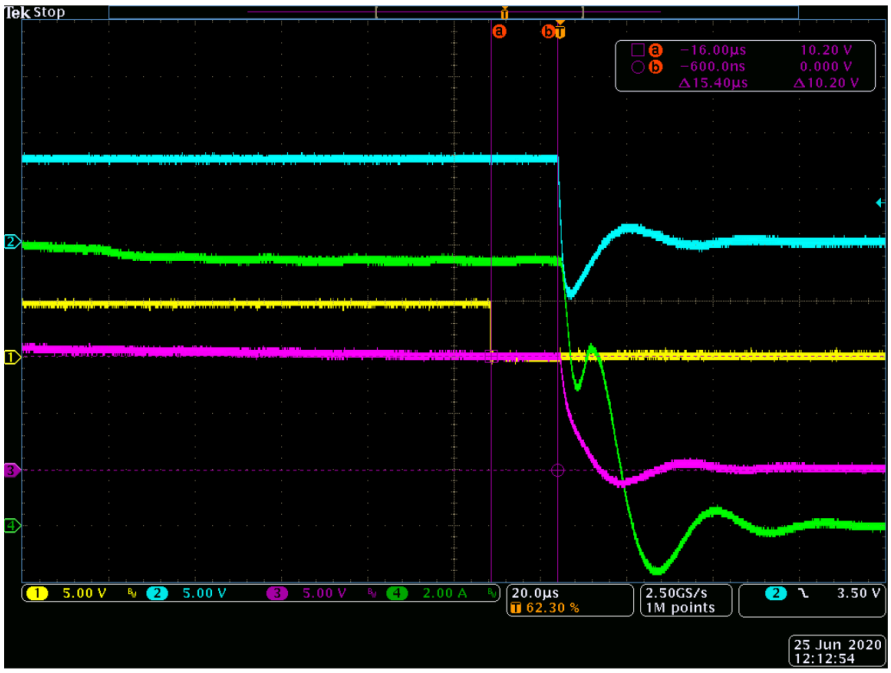
Vout = Fixed 5V, UVP_Voltage = 3.08V, System Response = 14.6us



Vout = Fixed 9V, UVP_Voltage = 5.96V, Response Time = 15.4us



Vout = Fixed 15V, UVP_Voltage = 10.2V, System Response = 15.4us



Vout = Fixed 20V, UVP_Voltage = 13.8V, System Response = 14.2us

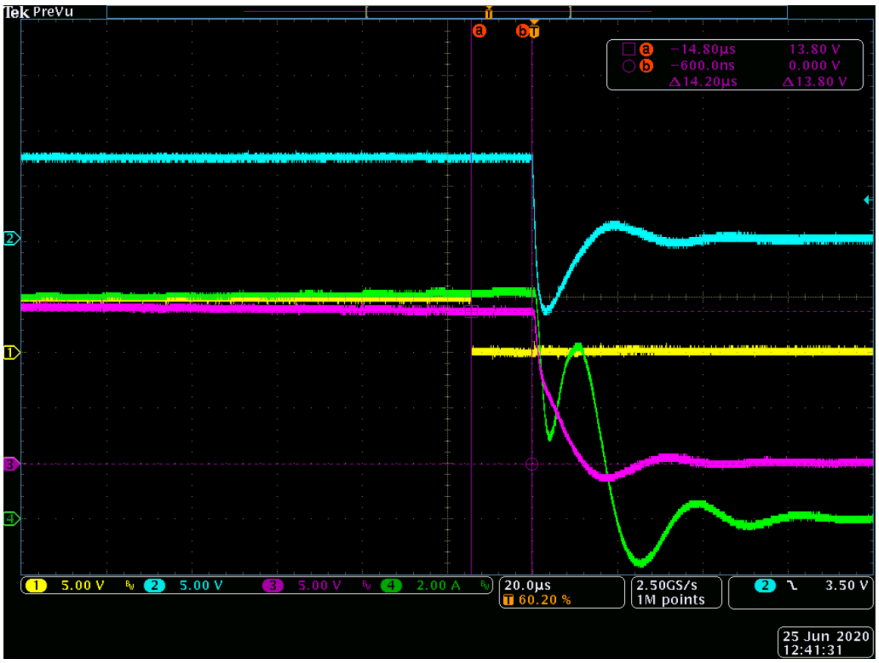
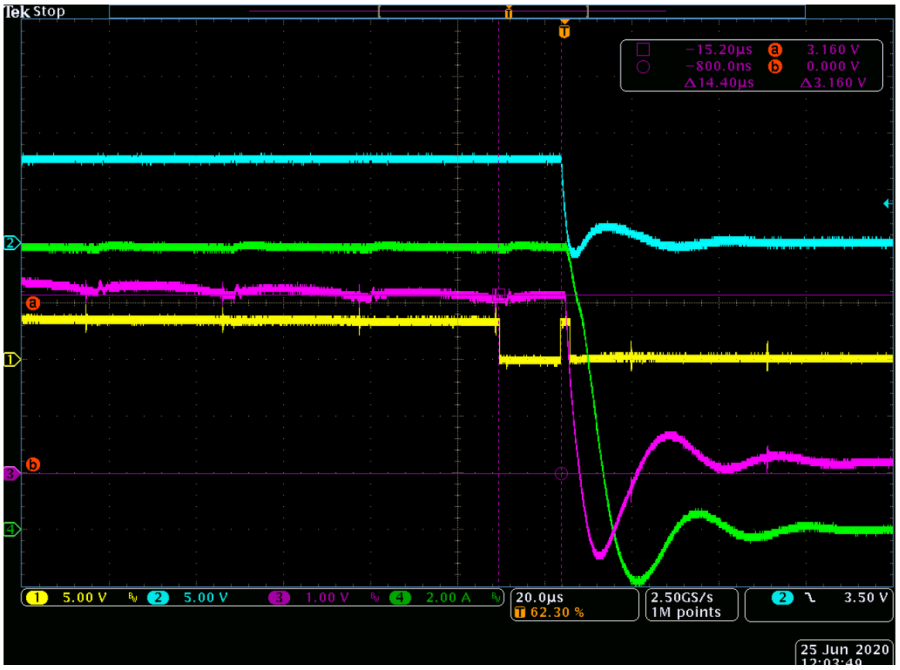
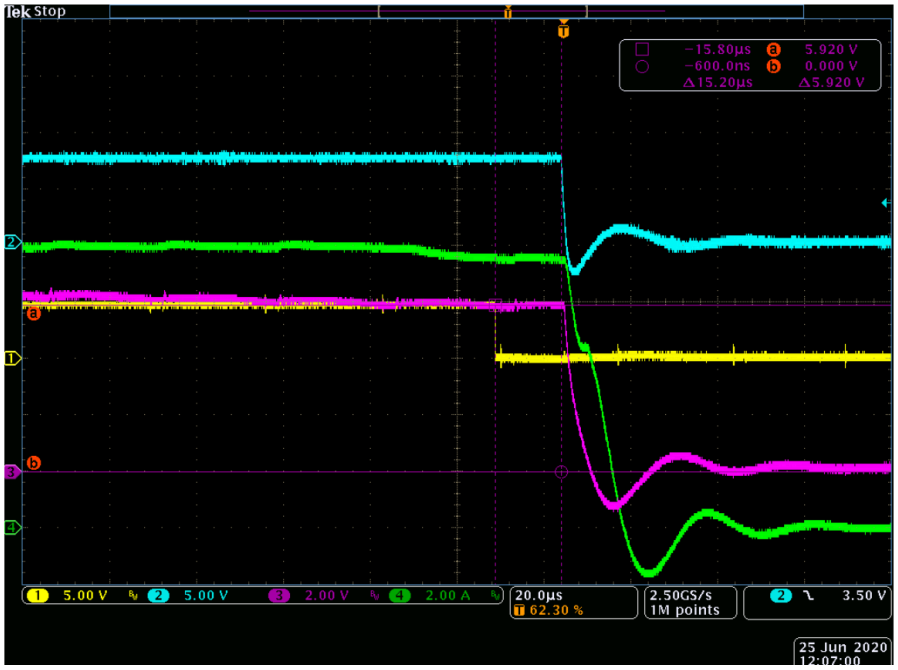


Figure 3-13-2. UVP at 230Vac, 60Hz (**CH1**: GPIO; **CH2**: NGDO[1] wrt source; **CH3**: Vbus_C; **CH4**: Vbus_Iout)

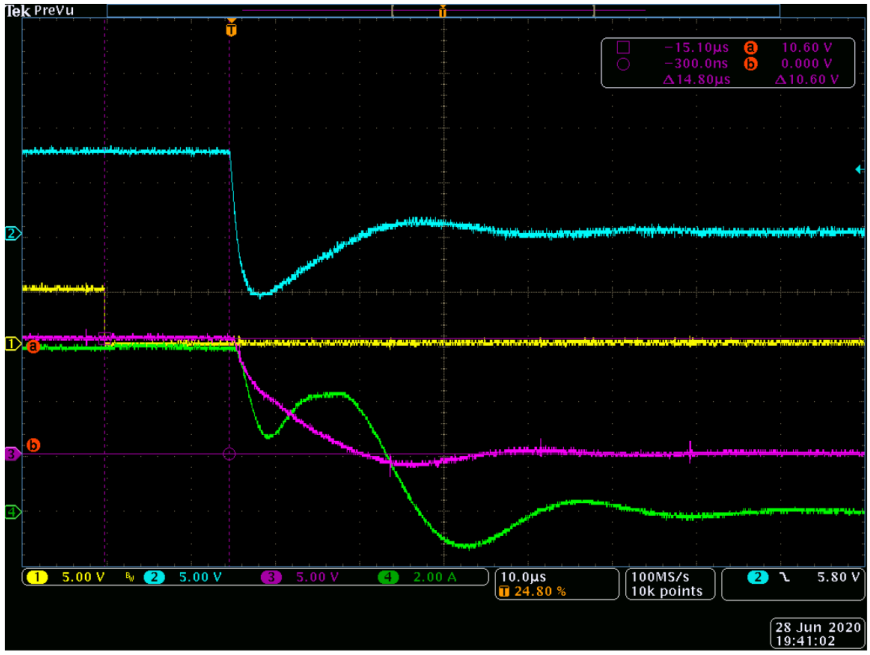
Vout = Fixed 5V, UVP_Voltage = 3.16V, System Response = 14.4us



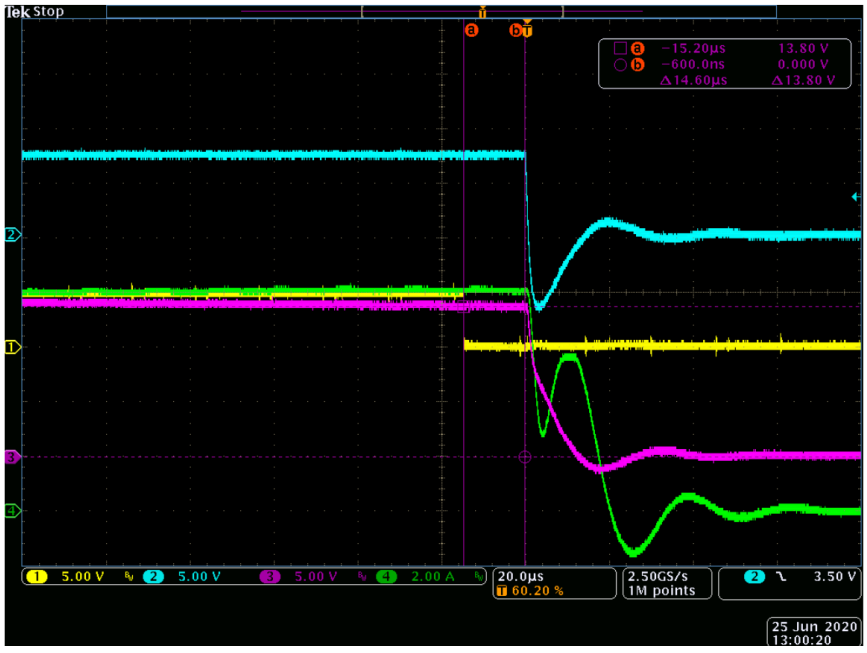
Vout = Fixed 9V, UVP_Voltage = 5.92V, Response Time = 15.2us



Vout = Fixed 15V, UVP_Voltage = 10.6V, System Response = 14.8us



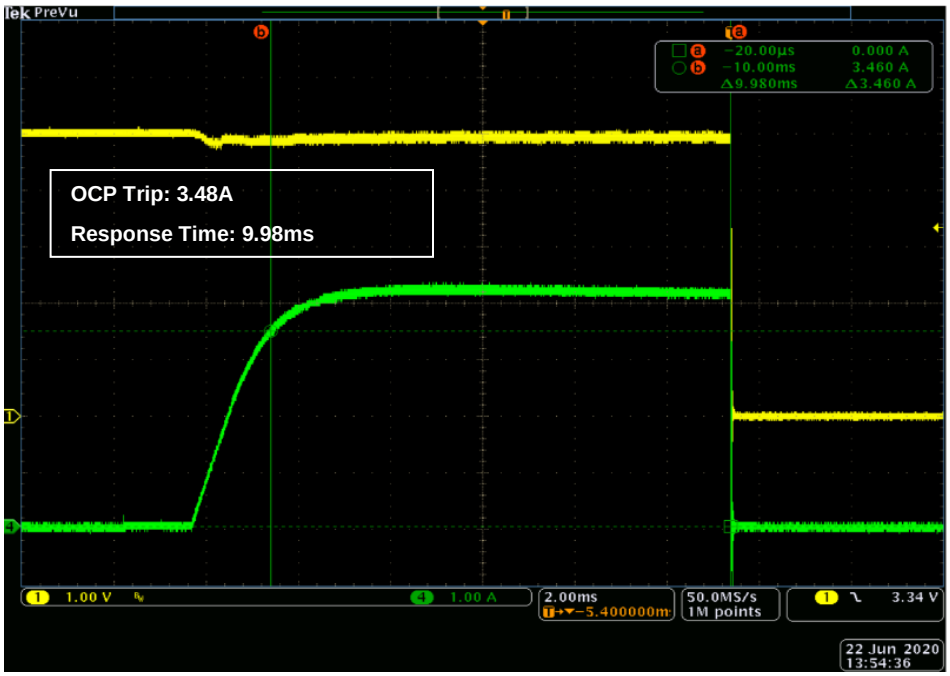
Vout = Fixed 20V, UVP_Voltage = 13.8V, System Response = 14.6us



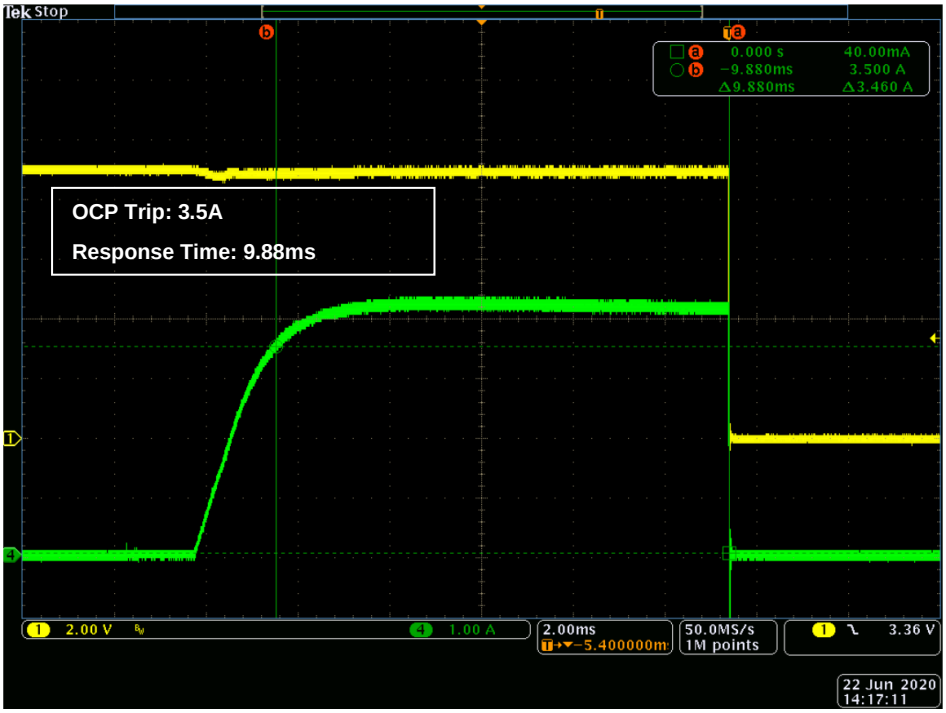
3.14 Over Current Protection (OCP)

Figure 3-14-1. OCP at 115V, 60Hz (**CH1**: Vbus_c, **CH4**: Iout)

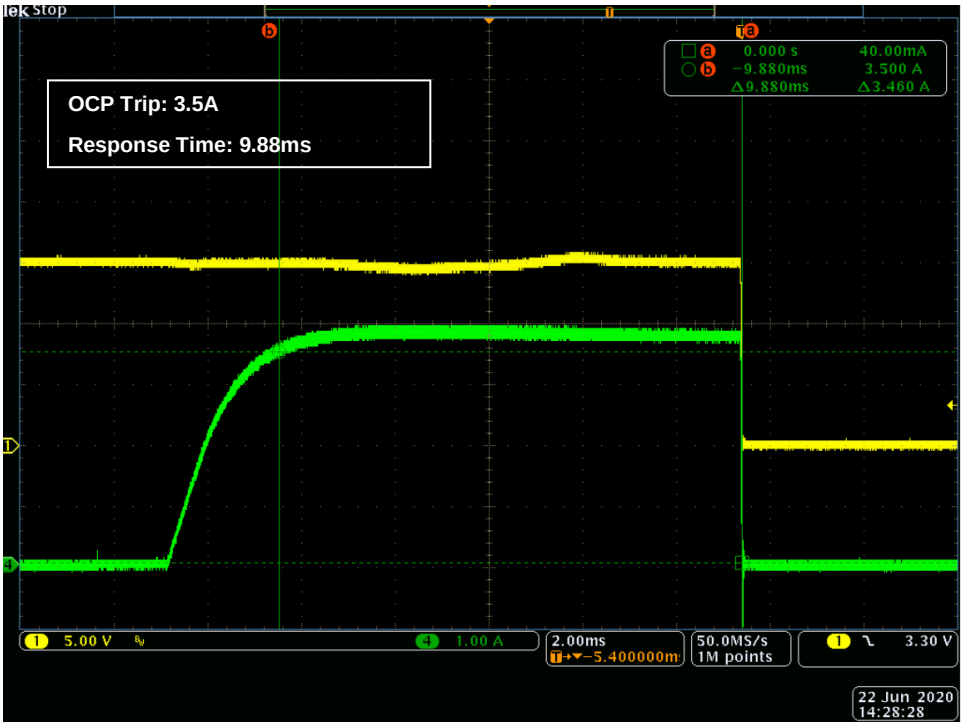
Fixed-PDO: 5V, 3A



Fixed-PDO: 9V, 3A



Fixed-PDO: 15V, 3A



Fixed-PDO: 20V, 2.25A

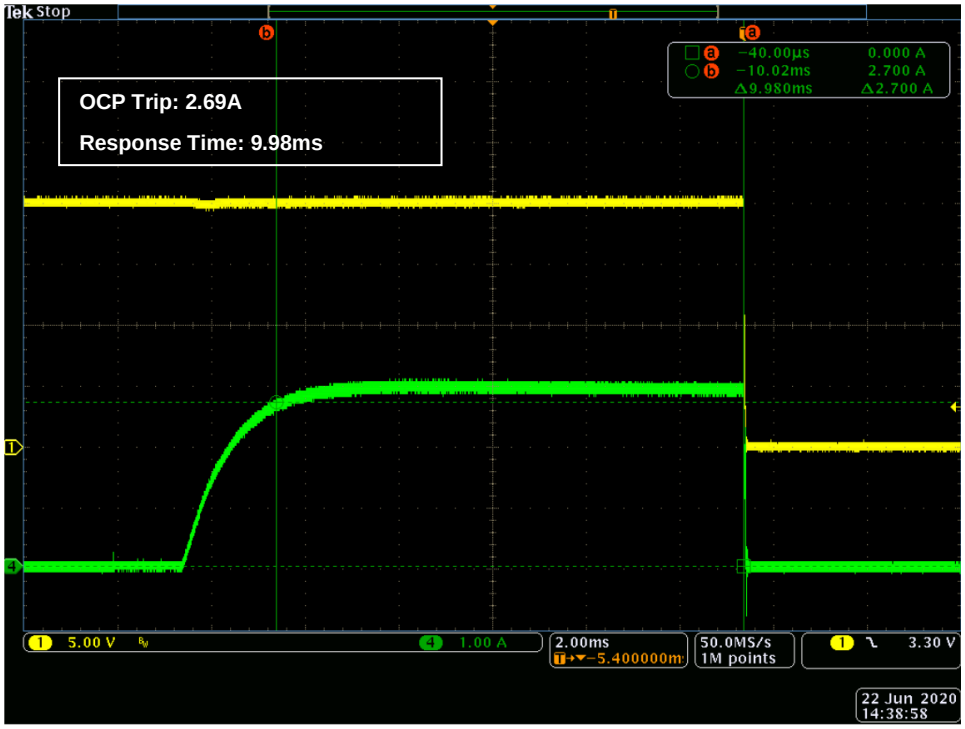
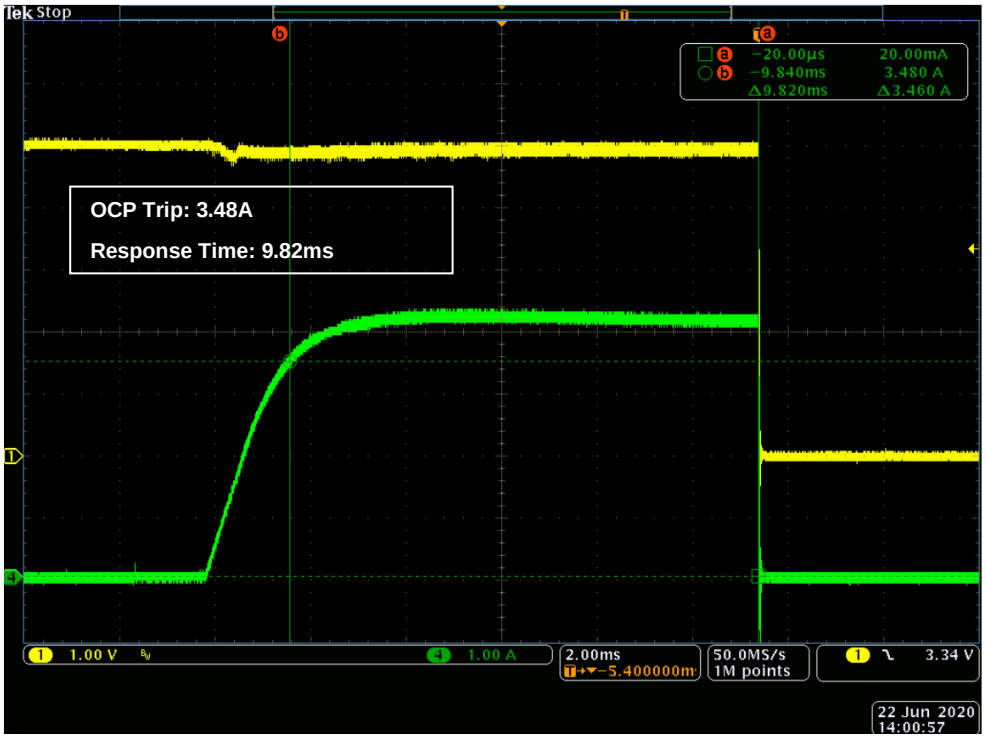
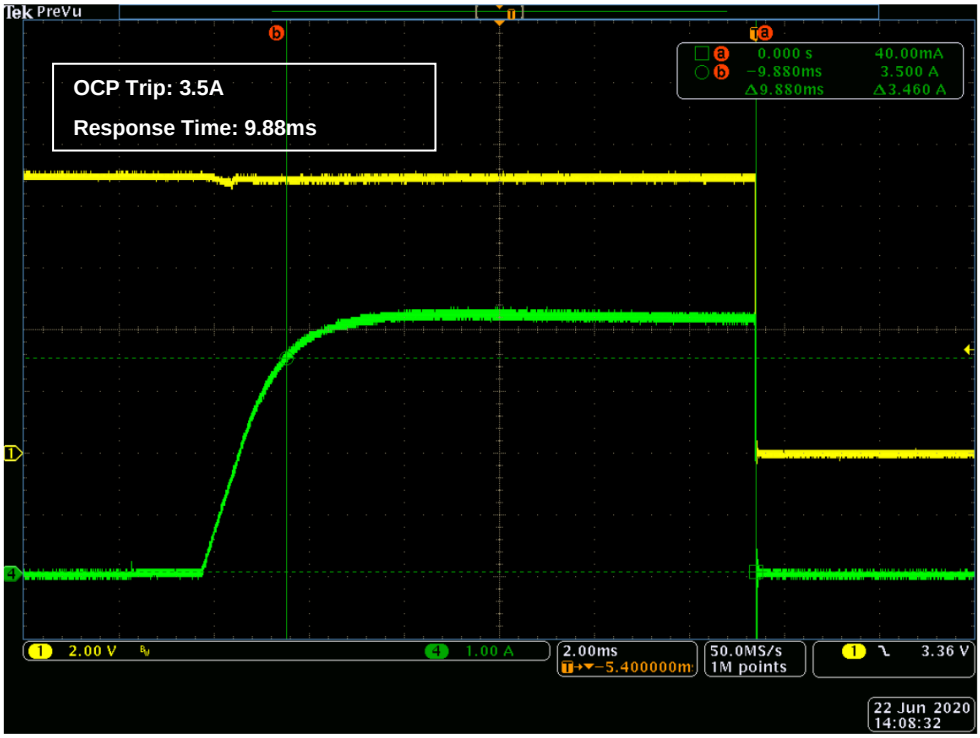


Figure 3-14-2. OCP at 230V, 50Hz (**CH1**: Vbus_c, **CH4**: Iout)

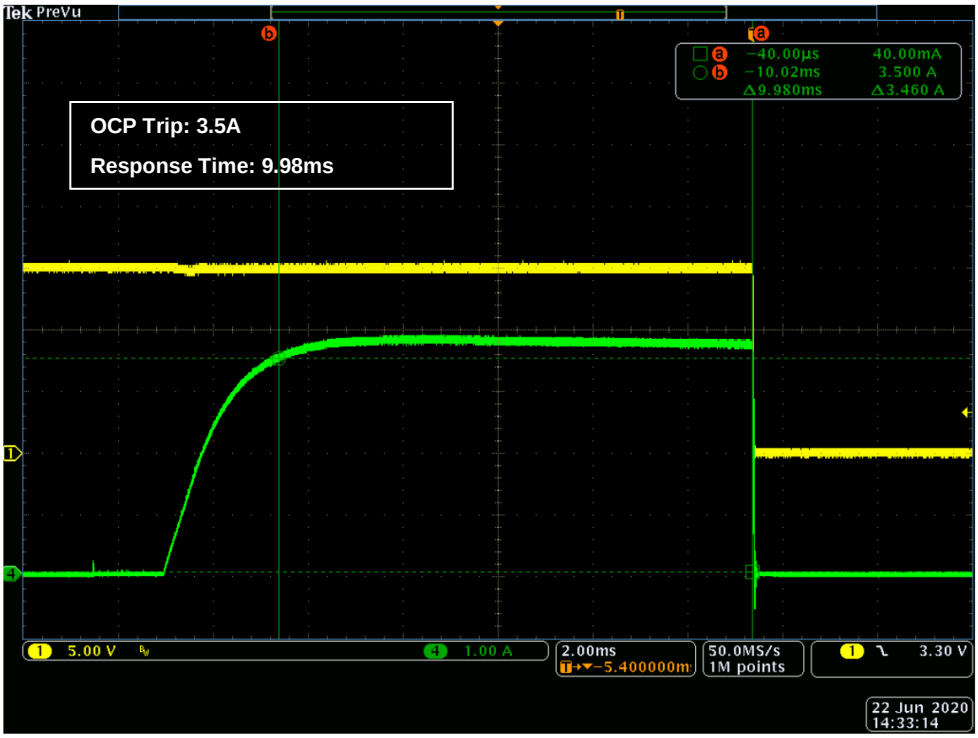
Fixed-PDO: 5V, 3A



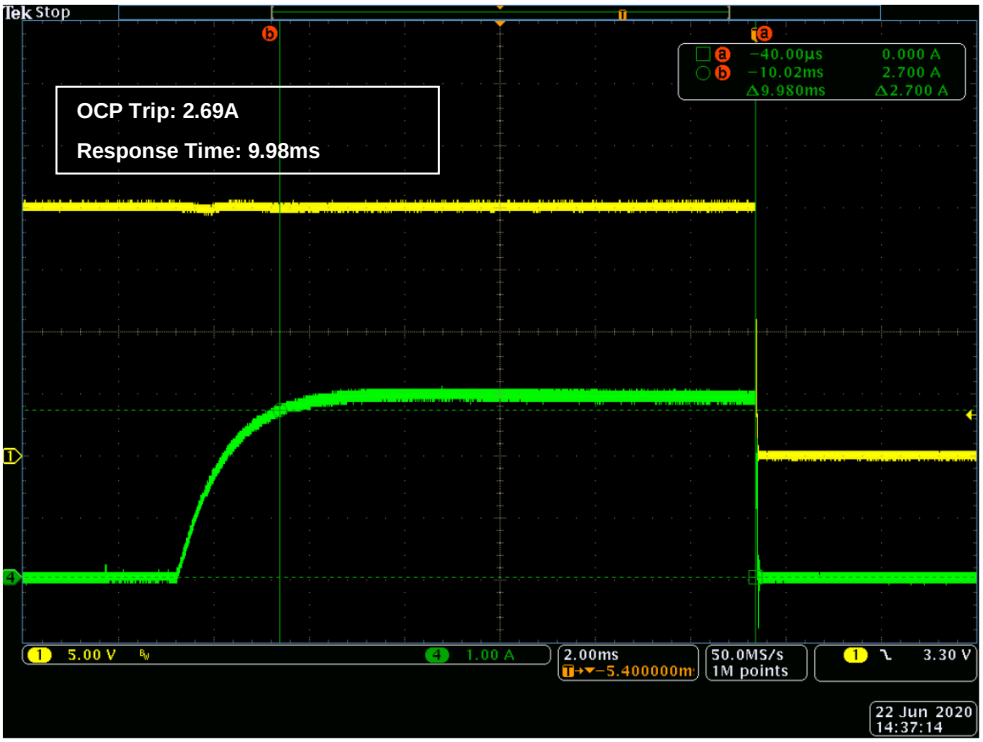
Fixed-PDO: 9V, 3A



Fixed-PDO: 15V, 3A



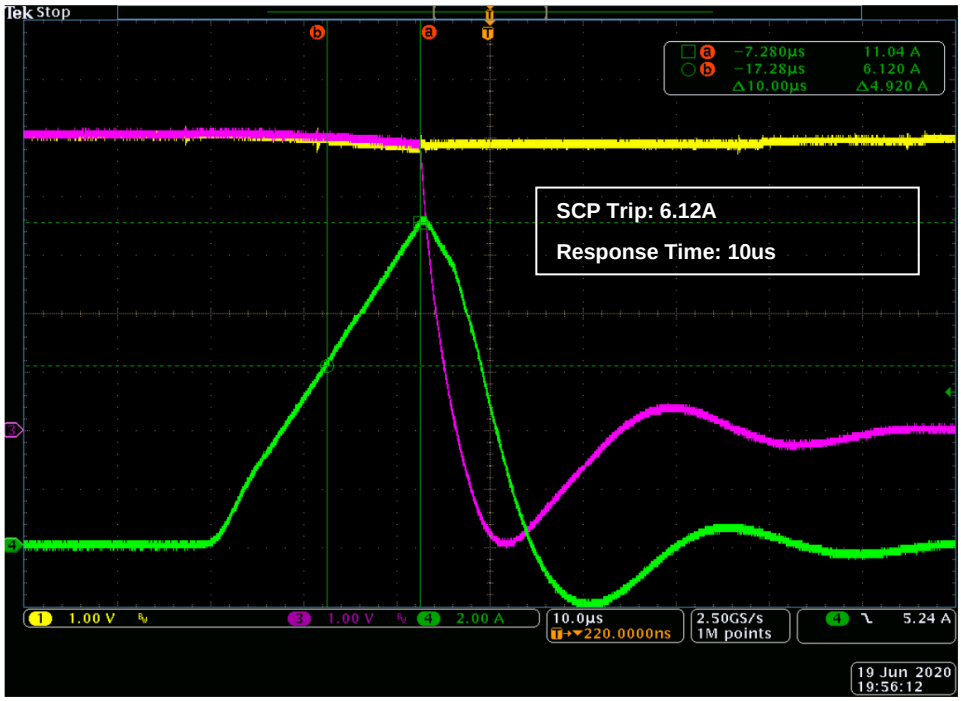
Fixed-PDO: 20V, 2.25A



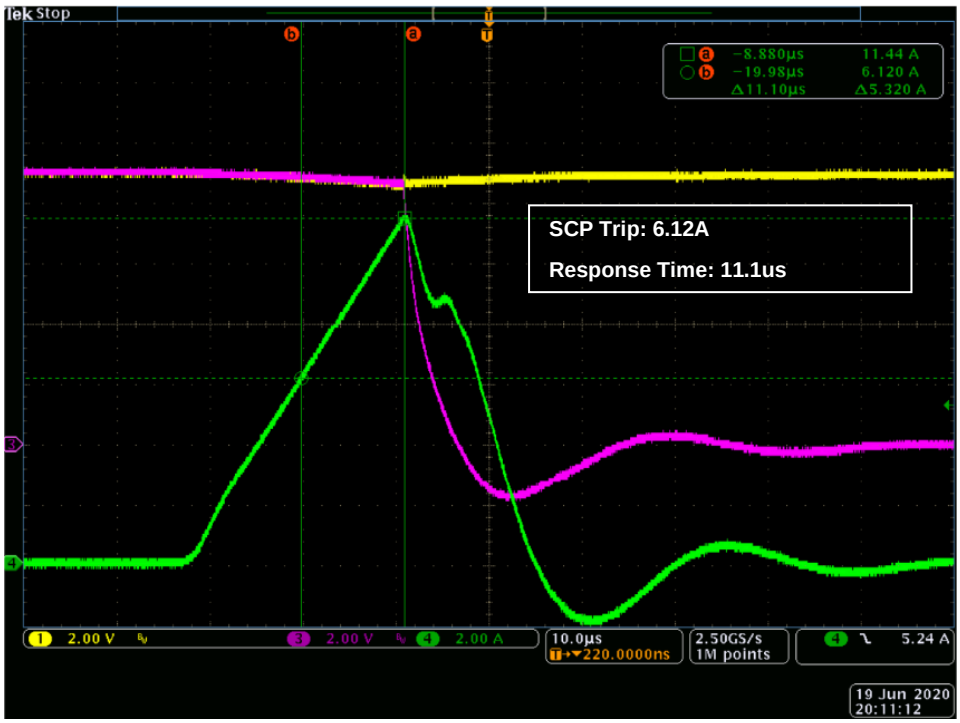
3.15 Short-Circuit Protection (SCP)

Figure 3-15-1. SCP at 115V, 60Hz (**CH3**: Vbus_c; **CH1**: Vbus_in; **CH4**: Iout)

Fixed-PDO: 5V, 3A



Fixed-PDO: 9V, 3A



Fixed-PDO: 15V, 3A

Fixed-PDO: 20V, 2.25A

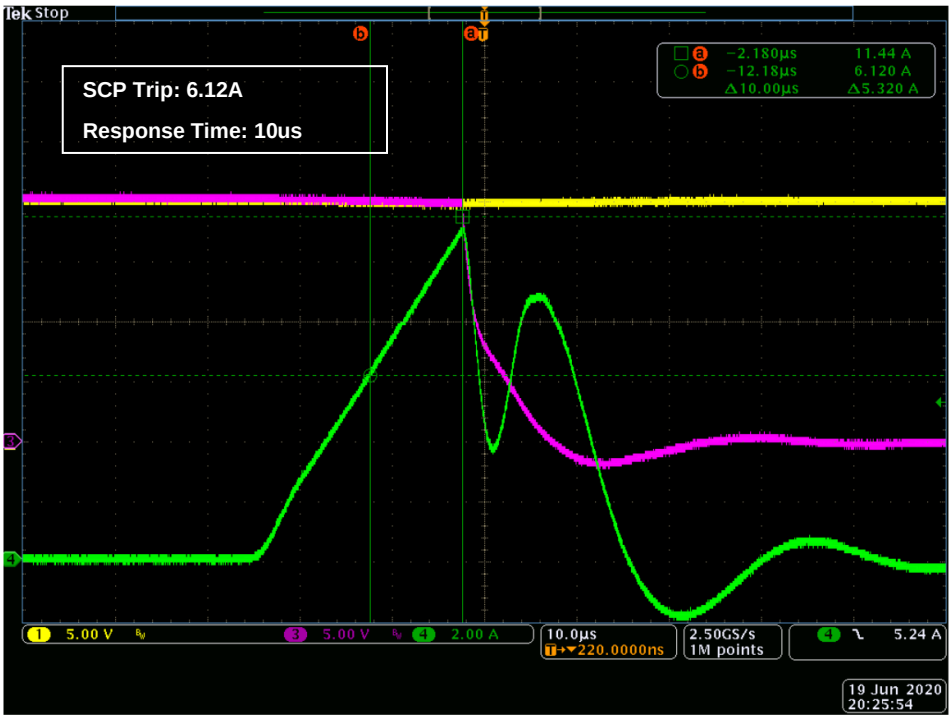
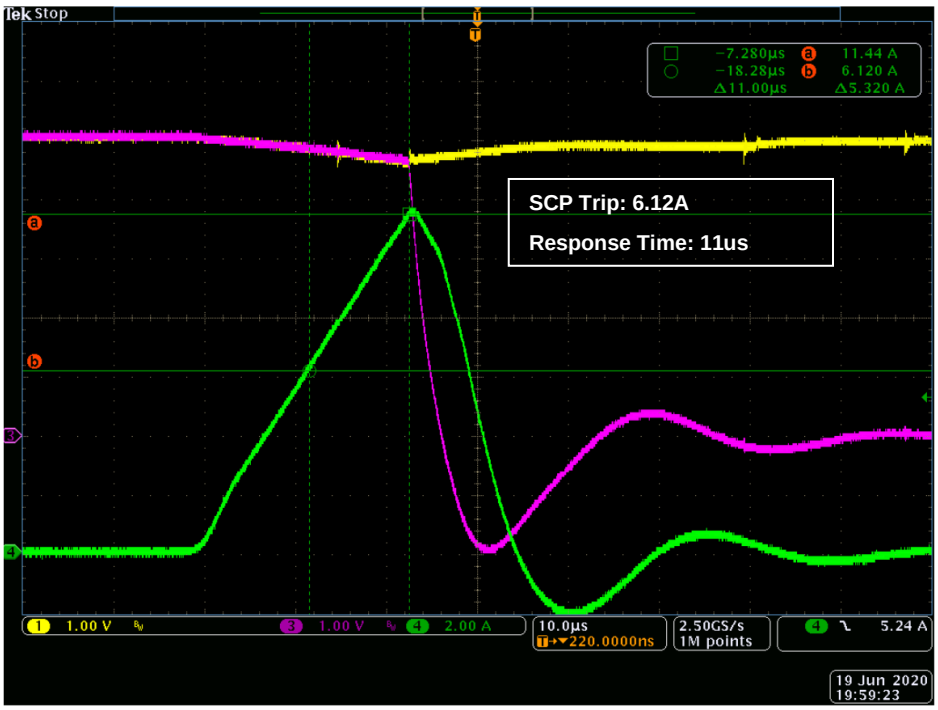


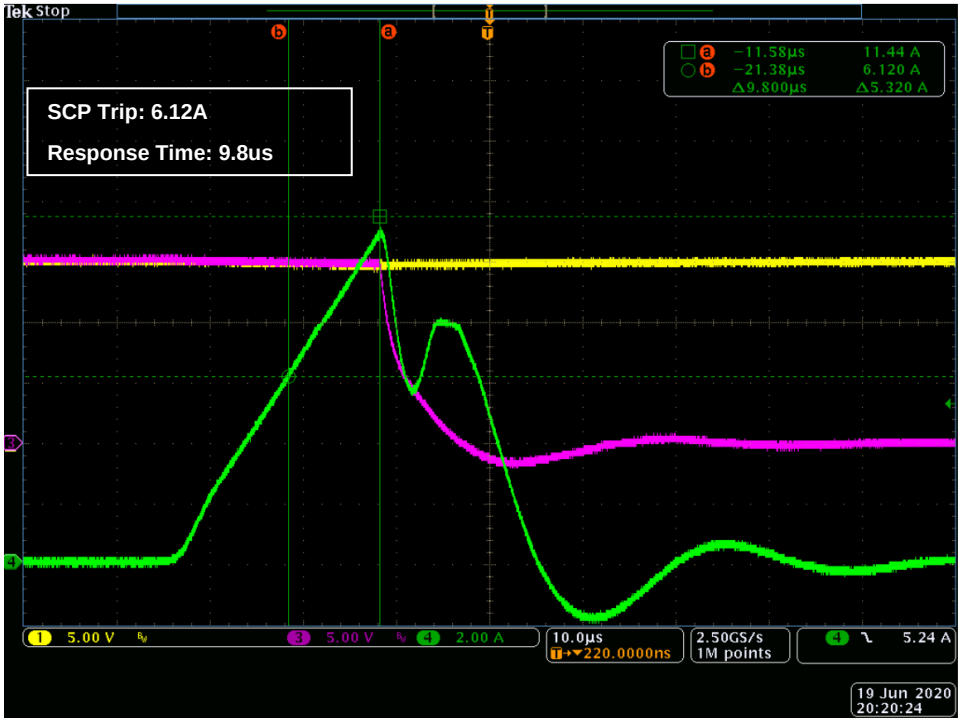
Figure 3-15-2. SCP at 230V, 50Hz (**CH3**: Vbus_c; **CH1**: Vbus_in; **CH4**: Iout)

Fixed-PDO: 5V, 3A

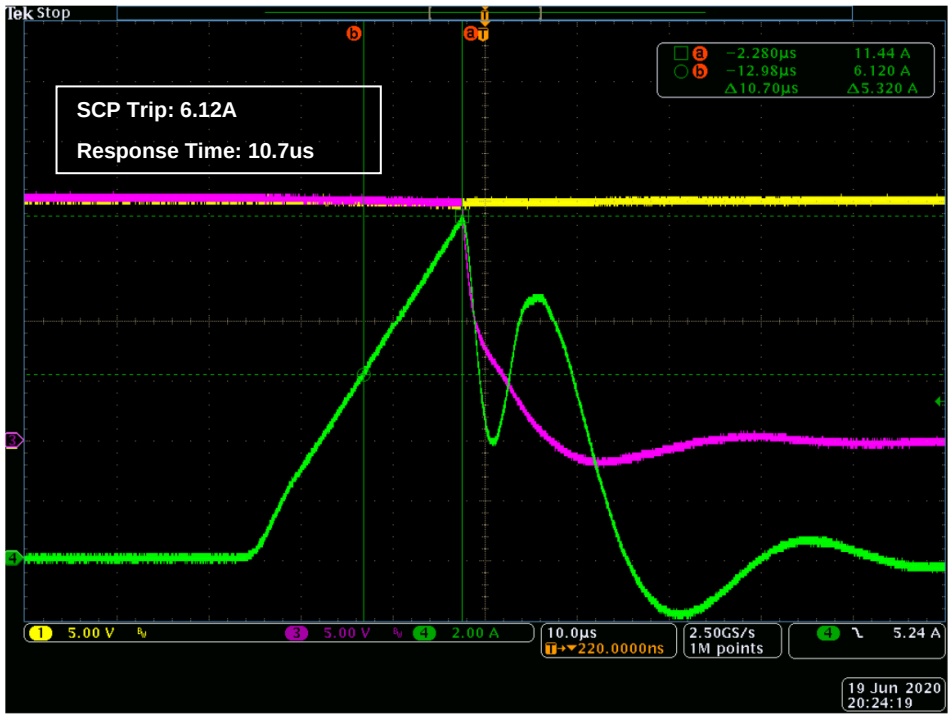


Fixed-PDO: 9V, 3A

Fixed-PDO: 15V, 3A



Fixed-PDO: 20V, 2.25A



3.16 Thermal Captures

Test Condition: Vin_ac = 90Vac-47Hz, Vout = 20V, Iout = 2.25A, **Run time:** 45 minutes

Lab Ambient Temperature: 25°C and in Open-frame

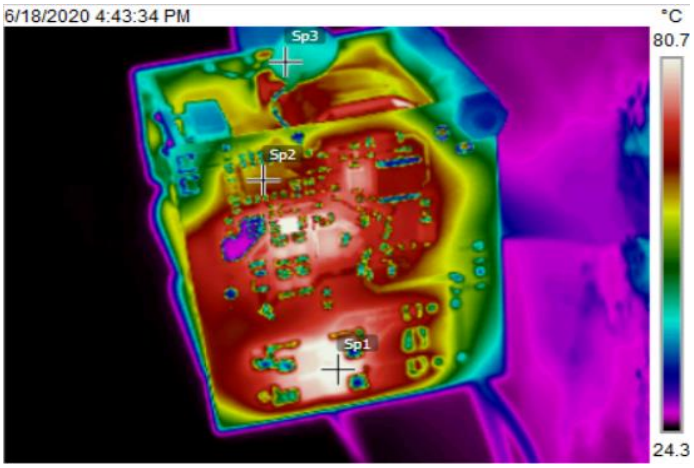


Figure 3-16-1. Thermal Capture – 1

Symbol	Description	Temperature
Sp1	Input Bridge (BD1)	81.4 °C
Sp2	CYPAP111-A3 (U1)	64.7°C
Sp3	Y-cap	44.0°C

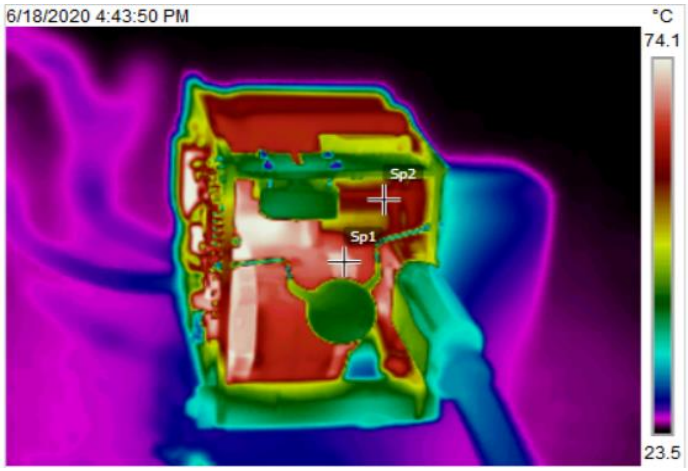


Figure 3-16-2. Thermal Capture – 2

Symbol	Description	Temperature
Sp1	Transformer (T1)	71.9°C
Sp2	Output Caps (C34, C35)	62.3°C

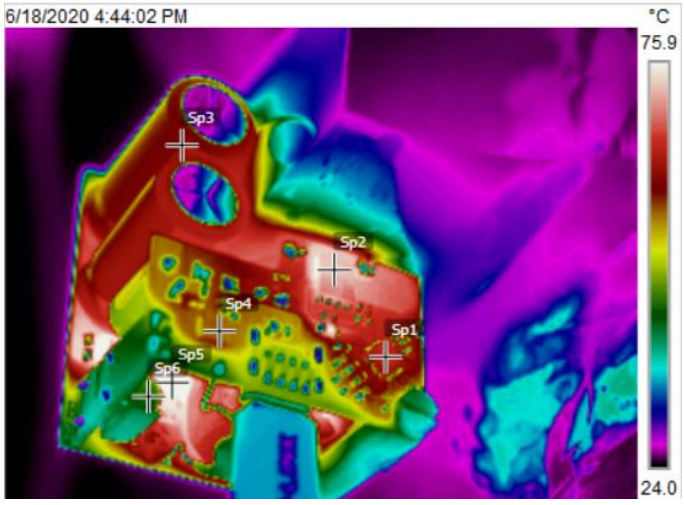


Figure 3-16-3. Thermal Capture – 3

Symbol	Description	Temperature
Sp1	CYPAS111-A1 (U2)	66.4°C
Sp2	Secondary FET (Q3)	73.6°C
Sp3	Primary Caps (C3, C5)	62.3°C
Sp4	Provider FET (Q4)	58.7°C
Sp5	Primary FET (Q1)	76.1°C
Sp6	Pulse Transformer (T2)	47.1°C

3.17 Conducted Emission (CE)

Conducted Emission on AC Mains Port, Spectral Diagram, 0.15-30MHz*

Figure 3-17-1. CE at 115Vac: NEUTRAL(N)

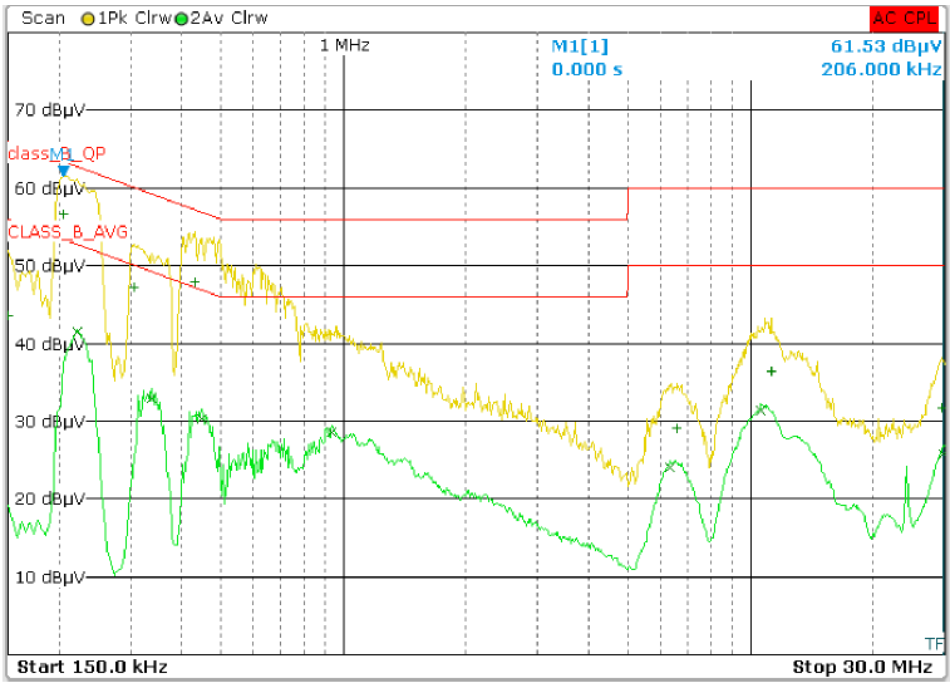


Table 3.2 CE at 115Vac, 150kHz-30MHz, Quasi Peak and Average Data, Neutral (N)

Meas Time	1.0 s
Margin	6.0 dB
Peaks	25

Trace	Frequency	Level (dBµV)	Phase	Detector	Delta Limit/dB
1	206.000000000 kHz	56.68		Quasi Peak	-6.69
1	430.000000000 kHz	47.92		Quasi Peak	-9.33
2	222.000000000 kHz	41.42		Average	-11.32
1	306.000000000 kHz	47.21		Quasi Peak	-12.87
2	338.000000000 kHz	32.99		Average	-16.26
2	450.000000000 kHz	30.34		Average	-16.54
2	938.000000000 kHz	28.65		Average	-17.35
2	10.602000000 MHz	31.40		Average	-18.60
1	150.000000000 kHz	43.64		Quasi Peak	-22.36
1	11.238000000 MHz	36.38		Quasi Peak	-23.62
2	29.670000000 MHz	25.77		Average	-24.23
2	6.354000000 MHz	24.01		Average	-25.99
1	29.598000000 MHz	31.77		Quasi Peak	-28.23
1	6.606000000 MHz	29.08		Quasi Peak	-30.92

*** All CE data has been taken from TUV Rheinland Test Report**

Figure 3-17-2. CE at 115Vac: LINE (L)

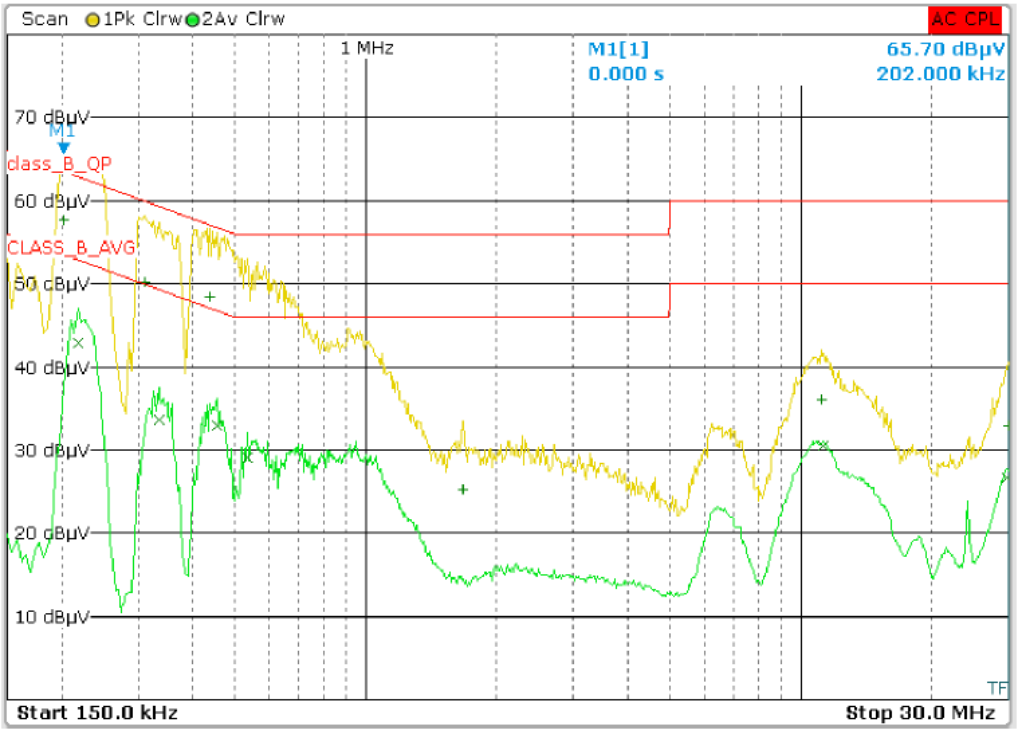


Table 3.3 CE at 115Vac, 150kHz-30MHz, Quasi Peak and Average Data, Line (L)

Meas Time	1.0 s
Margin	6.0 dB
Peaks	25

Trace	Frequency	Level (dBµV)	Phase	Detector	Delta Limit/dB
1	202.000000000 kHz	57.69		Quasi Peak	-5.84
1	438.000000000 kHz	48.42		Quasi Peak	-8.68
1	310.000000000 kHz	50.21		Quasi Peak	-9.76
2	218.000000000 kHz	42.87		Average	-10.02
2	454.000000000 kHz	32.99		Average	-13.81
2	334.000000000 kHz	33.62		Average	-15.73
2	534.000000000 kHz	29.10		Average	-16.90
2	11.254000000 MHz	30.56		Average	-19.44
2	29.838000000 MHz	26.60		Average	-23.40
1	11.206000000 MHz	36.06		Quasi Peak	-23.94
1	29.886000000 MHz	32.91		Quasi Peak	-27.09
1	1.670000000 MHz	25.21		Quasi Peak	-30.79

Figure 3-17-3. CE at 230Vac: NEUTRAL(N)

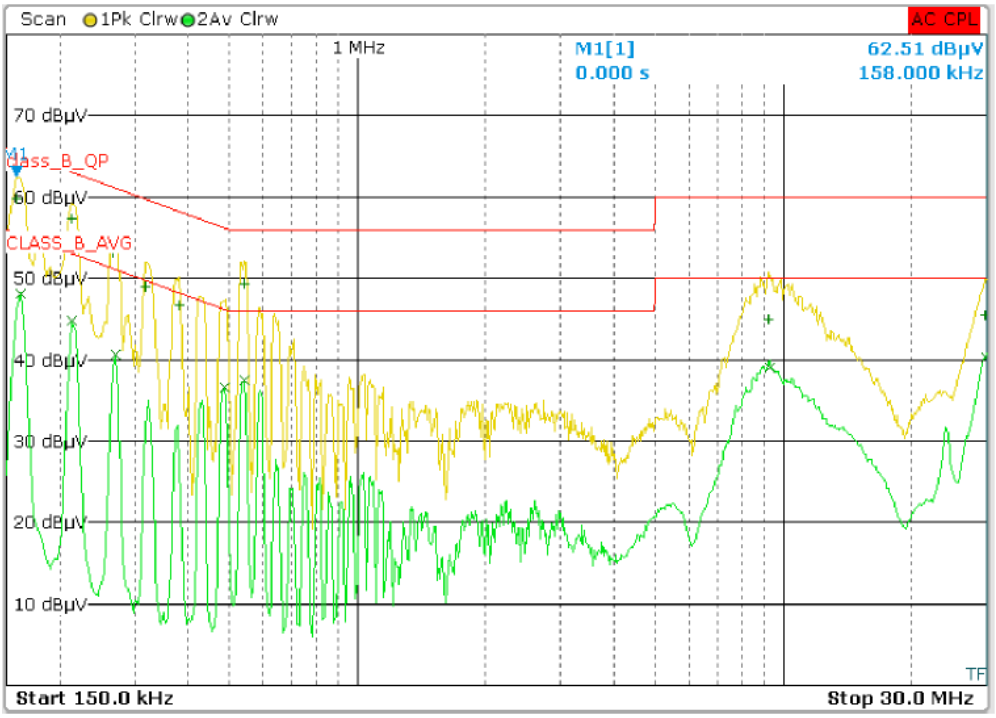


Table 3.4 CE at 230Vac, 150kHz-30MHz, Quasi Peak and Average Data, Neutral (N)

Meas Time		1.0 s			
Margin		6.0 dB			
Peaks		25			
Trace	**Frequency**	**Level (dBµV)**	**Phase**	**Detector**	**Delta Limit/dB**
1	214.000000000 kHz	57.39		Quasi Peak	-5.66
1	158.000000000 kHz	59.80		Quasi Peak	-5.77
1	542.000000000 kHz	49.24		Quasi Peak	-6.76
2	162.000000000 kHz	48.11		Average	-7.25
1	266.000000000 kHz	53.16		Quasi Peak	-8.08
2	214.000000000 kHz	44.77		Average	-8.28
2	542.000000000 kHz	37.44		Average	-8.56
2	29.958000000 MHz	40.33		Average	-9.67
2	486.000000000 kHz	36.54		Average	-9.70
2	486.000000000 kHz	36.53		Average	-9.71
2	270.000000000 kHz	40.53		Average	-10.59
1	318.000000000 kHz	48.93		Quasi Peak	-10.83
2	9.282000000 MHz	39.10		Average	-10.90
1	382.000000000 kHz	46.72		Quasi Peak	-11.52
1	29.834000000 MHz	45.53		Quasi Peak	-14.47
1	9.206000000 MHz	44.99		Quasi Peak	-15.01

Figure 3-17-4. CE at 230Vac: LINE(L)

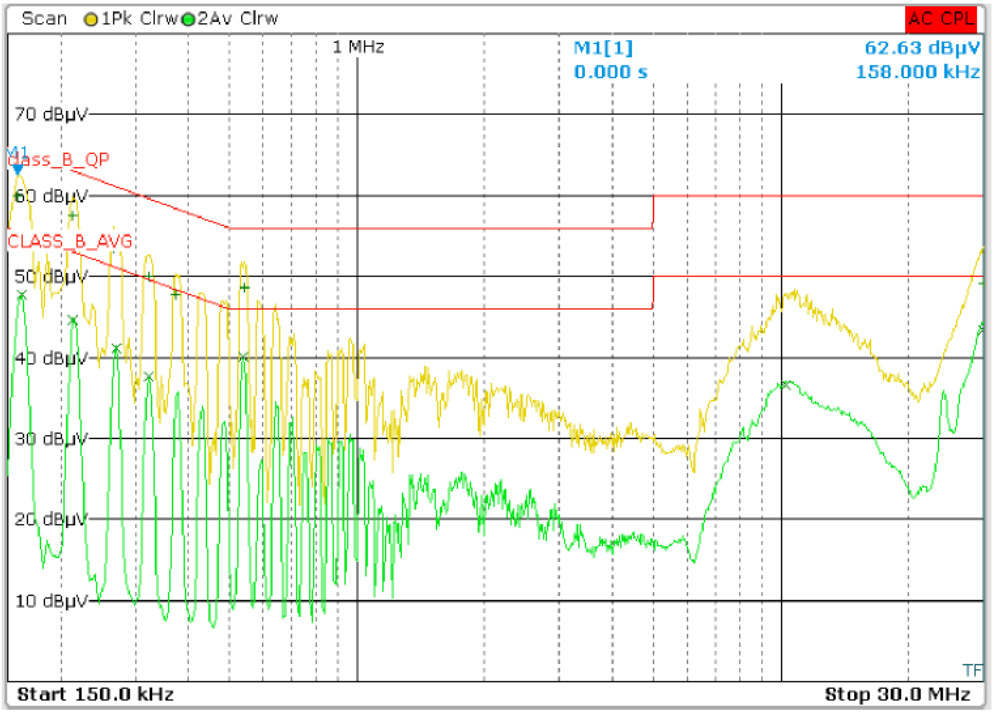


Table 3.5 CE at 230Vac, 150kHz-30MHz, Quasi Peak and Average Data, Line (L)

Meas Time	1.0 s
Margin	6.0 dB
Peaks	25

Trace	Frequency	Level (dBµV)	Phase	Detector	Delta Limit/dB
1	214.000000000 kHz	57.45		Quasi Peak	-5.60
1	158.000000000 kHz	59.96		Quasi Peak	-5.61
2	538.000000000 kHz	40.09		Average	-5.91
2	29.902000000 MHz	43.44		Average	-6.56
1	542.000000000 kHz	48.55		Quasi Peak	-7.45
2	162.000000000 kHz	47.68		Average	-7.68
1	266.000000000 kHz	53.55		Quasi Peak	-7.69
2	214.000000000 kHz	44.60		Average	-8.45
1	322.000000000 kHz	50.06		Quasi Peak	-9.60
2	270.000000000 kHz	41.19		Average	-9.93
1	374.000000000 kHz	47.75		Quasi Peak	-10.66
1	29.950000000 MHz	49.20		Quasi Peak	-10.80
2	322.000000000 kHz	37.63		Average	-12.03
2	10.250000000 MHz	36.67		Average	-13.33

4. USB PD Source Test Results (using Quadramax)

4.1 Test Setup

Figure 4-1. Quadramax Test Setup

- QuadDraw Version: 0.8.7438
- QM#108 HWRev:1.4.4 FWST:0.0.1376 FWCCG1:0.10

4.2 Test Results

Test Input Voltage Conditions: 115Vac,60Hz and 230Vac,50Hz

Table 4-1 USB PD Source Test Results

Test	Description	Result
TD SPT.1	Load Test	PASS
TD SPT.2	Capabilities Test	PASS
TD SPT.3	Hard Reset Test	PASS
TD SPT.6	PPS Voltage Step Test	PASS
TD SPT.7	PPS Current Limit Test	PASS

5. Appendix

5.1 Schematics

Figure 5-1-1. Schematic of Primary board

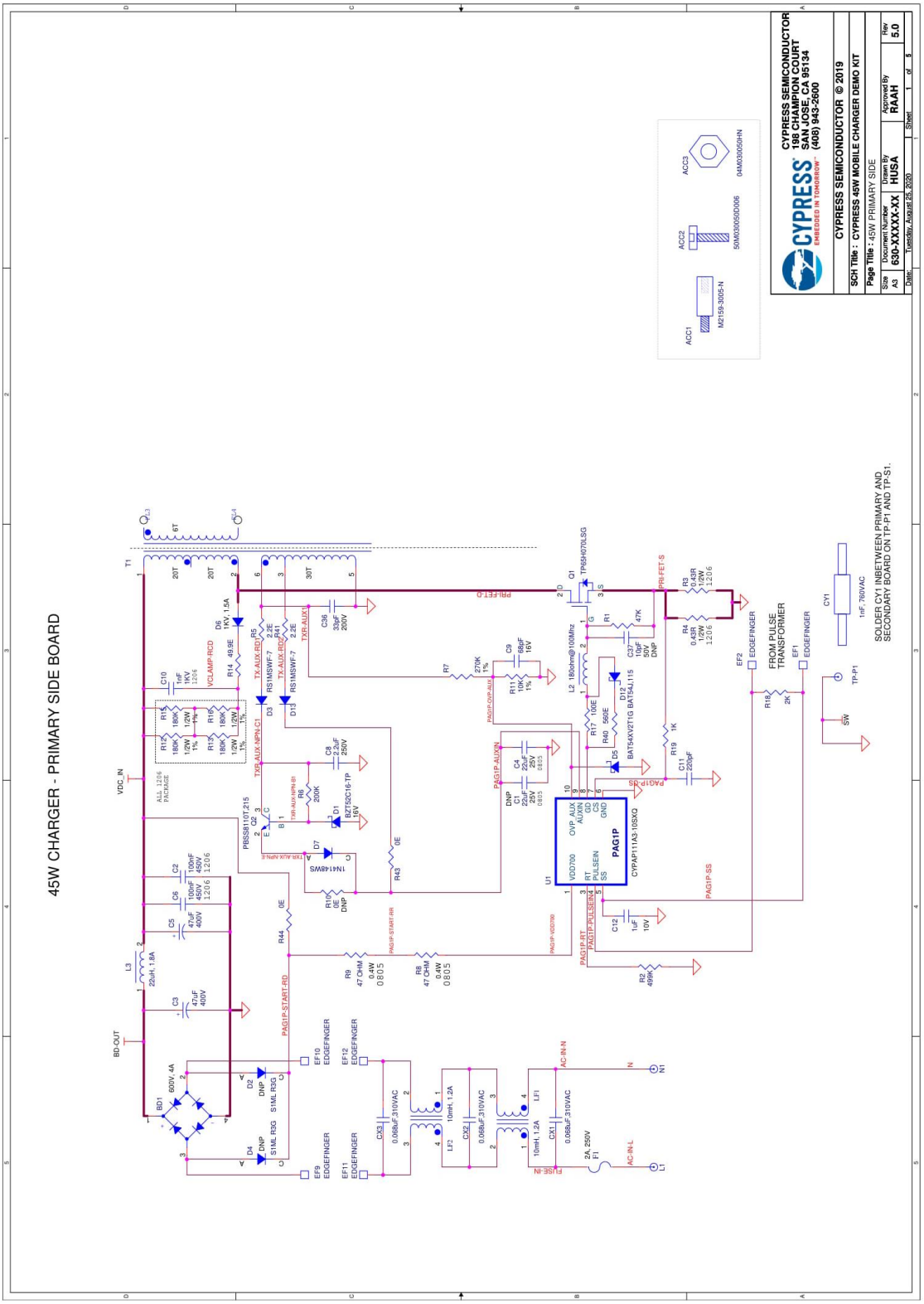


Figure 5-1-2. Schematic of Secondary board

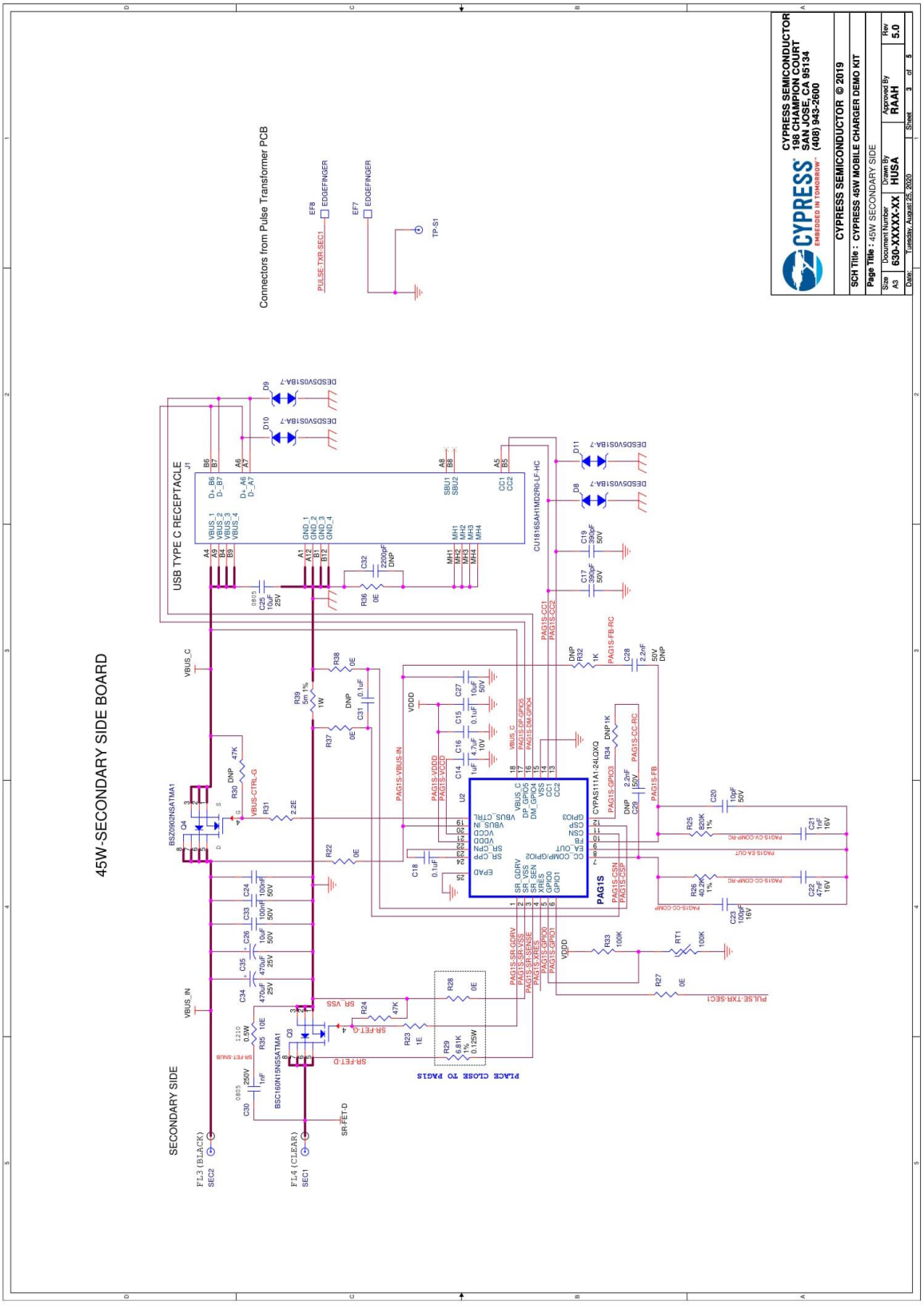
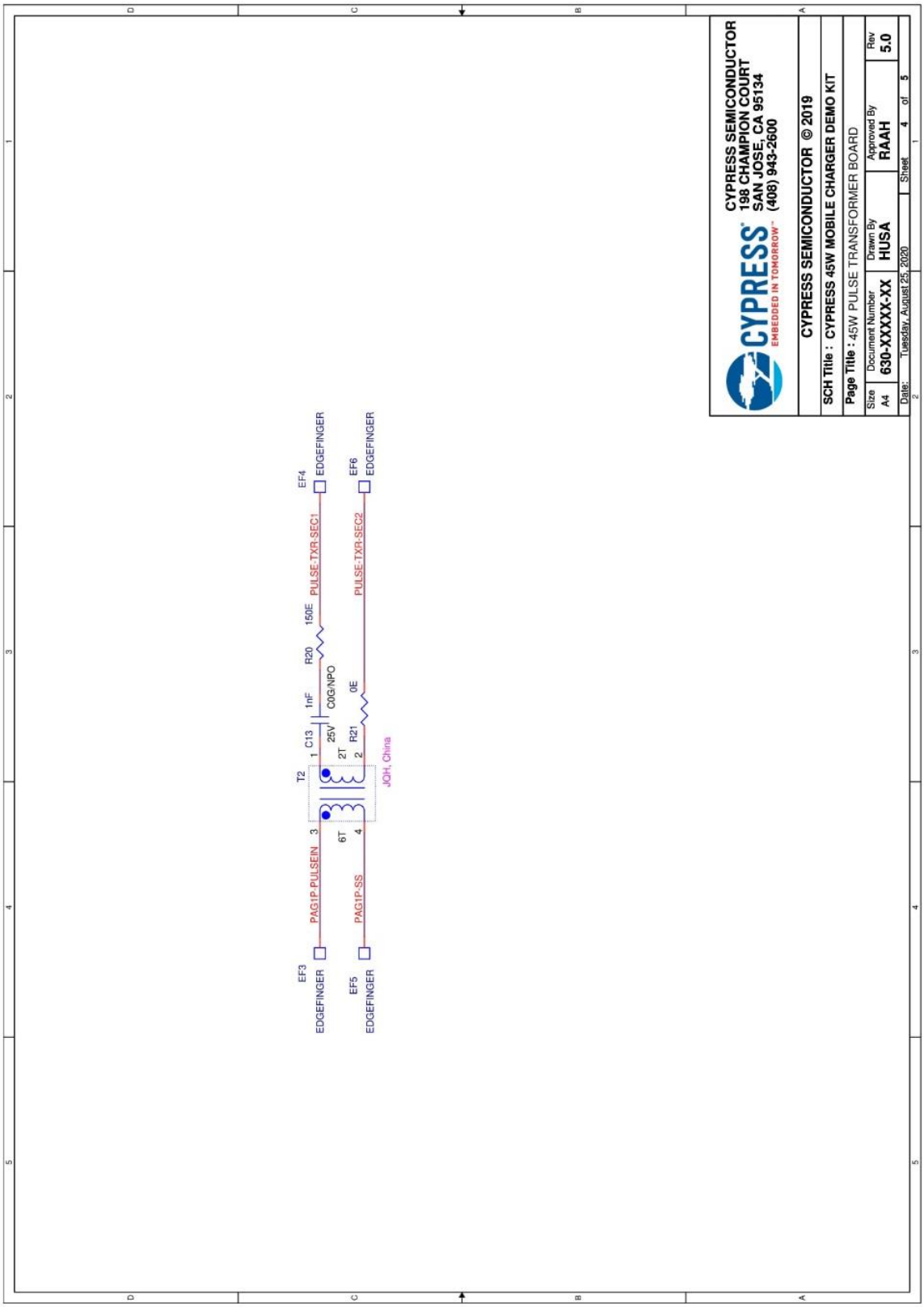


Figure 5-1-3. Schematic of Pulse Transformer board



5.2 Bill of Materials

Table 5-1. Bill of Materials (Primary + Secondary + Pulse transformer + EMI filter boards)

S. No	Qty	Reference	Value	Description	Manufacturer	MFG Part Number
1	1	BD1	Z4DGP406L-HF	BRIDGE RECT 1PHASE 600V 4A Z4-D	Comchip Technology	Z4DGP406L-HF
2	1	C10	1nF	CAP CER 1206 1NF 1000V X7R 10%	KEMET	C1206C102KDRACAUTO
3	1	C11	220pF	CAP CER 220PF 10V C0G/NP0 0603	KEMET	C0603C221J8GAC7867
4	1	C12	1uF	CAP CER 0603 1UF 10V X7R 10%	KEMET	C0603C105K8RACAUTO
5	2	C2,C6	100nF	CAP CER 100nF 450V X7T 1206	TDK Corporation	C3216X7T2W104K160AA
6	1	C36	33pF	CAP CER 33PF 200V C0G/NP0 0603	KEMET	C0603C330J2GACTU
7	1	C4	22uF	CAP CER 22UF 25V X5R 0805	Murata Electronics North America	GRM21BR61E226ME44K
8	1	C8	2.2uF	CAP CER 2.2UF 250V X7T 2220	TDK Corporation	C5750X7T2E225K250KA
9	1	C9	68pF	CAP CER 68PF 16V C0G/NP0 0603	Wurth Electronics Inc.	8.85012E+11
10	1	D1	BZT52C16-TP	DIODE ZENER 16V 200MW SOD123	Micro Commercial Co	BZT52C16-TP
11	1	D12	BAT54J,115	DIODE SCHOTTKY 30V 200MA SOD323F	Nexperia USA Inc.	BAT54J,115
12	2	D3,D13	RS1MSWF-7	DIODE GEN PURP 1KV 1A SOD123F	Diodes Incorporated	RS1MSWF-7
13	1	D5	BAT54XV2T1G	DIODE SCHOTTKY 30V 200MA SOD523	ON Semiconductor	BAT54XV2T1G
14	1	D6	RS2MA-13-F	DIODE GEN PURP 1KV 1.5A SMA	Diodes Incorporated	RS2MA-13-F
15	1	D7	1N4148WS	DIODE GEN PURP 75V 150MA SOD323F	ON Semiconductor	1N4148WS
16	1	L2	180ohm@100Mhz	FERRITE BEAD 180 OHM 0603 1LN	TDK Corporation	MMZ1608S181ATA00
17	1	L3	22uH, 1.8A	FIXED IND 22UH 1.8A 130 MOHM TH	Wurth Electronics Inc.	7447462220
18	1	Q1	TP65H070LSG	650 V 25 A GAN FET	TRANSPHORM	TP65H070LSG
19	1	Q2	PBSS8110T,215	TRANS NPN 100V 1A SOT23	Nexperia USA Inc.	PBSS8110T,215
20	1	R1	47K	RES SMD 47K OHM 1% 1/10W 0603	Yageo	RC0603FR-0747KL
21	1	R11	10K	RES SMD 10K OHM 1% 1/10W 0603	Yageo	RC0603FR-0710KL
22	4	R12,R13,R15,R16	180K	CRGP 1206 180K 1% 1/2W	TE Connectivity Passive Product	CRGP1206F180K
23	1	R14	49.9E	RES SMD 49.9 OHM 1% 1/4W 1206	Yageo	RC1206FR-0749R9L
24	1	R17	100E	RES SMD 100 OHM 1% 1/16W 0402	Yageo	RC0402FR-07100RL
25	1	R18	2K	RES SMD 2K OHM 1% 1/10W 0603	Yageo	RC0603FR-072KL
26	1	R19	1K	RES SMD 1K OHM 1% 1/10W 0603	Yageo	RC0603FR-071KL
27	1	R2	499K	RES SMD 499K OHM 1% 1/8W 0603	Vishay Beyschlag	MCT06030C4993FP500
28	2	R3,R4	0.43R	RES 0.43 OHM 1% 1/2W 1206	Vishay Dale	RCWE1206R430FKEA
29	1	R40	560E	RES SMD 560 OHM 1% 1/16W 0402	Yageo	RC0402FR-07560RL
30	2	R5,R41	2.2E	RES SMD 2.2 OHM 1% 1/10W 0603	Yageo	RC0603FR-072R2L
31	1	R6	200K	RES SMD 200K OHM 1% 1/10W 0603	Panasonic Electronic Components	ERJ-3EKF2003V
32	1	R7	270K	RES 270K OHM 1% 1/10W 0603	Stackpole Electronics Inc	RMCF0603FT270K
33	2	R8,R9	47 OHM	RES SMD 47 OHM 5% 0.4W 0805	Rohm Semiconductor	ESR10EZPJ470
34	1	C14	1uF	CAP CER 1UF 16V X5R 0402	Samsung Electro-Mechanics	CL05A105MO5NNNC
35	2	C15,C18	0.1uF	CAP CER 0.1UF 25V X7R 0402	KEMET	C0402C104K3RAC7867
36	1	C16	4.7uF	CAP CER 4.7UF 10V X5R 0402	Murata Electronics	GRM155R61A475MEAAD
37	2	C17,C19	390pF	CAP CER 390PF 50V X7R 0603	Yageo	CC0603KRX7R9BB391
38	1	C20	10pF	CAP CER 10PF 50V NP0 0603	TDK Corporation	C1608NP01H100D080AA

39	1	C21	1nF	CAP CER SMD 0603 1000PF 10% X7R	KEMET	C0603C102K4RACAUTO
40	1	C22	47nF	CAP CER 0.047UF 16V X7R 0603	Yageo	CC0603KRX7R7BB473
41	1	C23	100pF	CAP CER 100PF 16V X7R 0603	KEMET	C0603C101K4RAC7867
42	2	C24,C33	100nF	CAP CER 0.1UF 50V X7R 1206	KEMET	C1206C104K5RAC7867
43	1	C25	10uF	CAP CER 10UF 25V X5R 0805	TDK Corporation	C2012X5R1E106M125AB
44	1	C26	10uF	CAP CER 10UF 50V X7R 1206	TDK Corporation	CGA5L1X7R1H106K160AE
45	1	C27	10uF	CAP CER 10UF 50V X7R 1206	TDK Corporation	CGA5L1X7R1H106K160AC
46	1	C30	1nF	CAP CER 1000PF 250V X7R 0805	TDK Corporation	C2012X7R2E102K085AA
47	2	C34,C35	470uF	CAP ALUM POLY 470UF 20% 25V THT	Illinois Capacitor	477AVG025MFBJ
48	4	D8,D9,D10,D11	DESD5V0S1BA-7	TVS DIODE 5V 14V SOD323	Diodes Incorporated	DESD5V0S1BA-7
49	1	Q3	BSC160N15NS5ATMA1	MOSFET N-CH 150V 56A 8TDSON	Infineon Technologies	BSC160N15NS5ATMA1
50	1	Q4	BSZ0902NSATMA1	MOSFET N-CH 30V 40A TSDSON-8	Infineon Technologies	BSZ0902NS
51	1	R23	1E	RES SMD 1 OHM 1% 1/10W 0603	Yageo	RC0603FR-071RL
52	1	R24	47K	RES SMD 47K OHM 1% 1/10W 0603	Yageo	RC0603FR-0747KL
53	1	R25	820K	RES SMD 820K OHM 1% 1/10W 0603	Yageo	RC0603FR-07820KL
54	1	R26	40.2K	RES SMD 40.2K OHM 1% 1/10W 0603	Yageo	RC0603FR-0740K2L
55	1	R29	6.81K	RES SMD 6.81K OHM 1% 1/8W 0805	Yageo	RC0805FR-076K81L
56	1	R31	2.2E	RES SMD 2.2 OHM 1% 1/10W 0603	Yageo	RC0603FR-072R2L
57	1	R33	100K	RES SMD 100K OHM 1% 1/10W 0603	Panasonic Electronic Components	ERJ-3EKF1003V
58	1	R35	10E	RES SMD 10 OHM 5% 1/2W 1210	Vishay Dale	CRCW121010R0JNEA
59	1	R39	5m	RES 0.005 OHM 1% 1W 1206	Stackpole Electronics Inc.	CSRF1206FT5L00
60	1	RT1	100K	THERM NTC 100KOHM 4250K 0805	Murata Electronics North America	NCP21WF104J03RA
61	1	C13	1nF	CAP CER 1000PF 25V C0G/NP0 0603	KEMET	C0603C102J3GACTU
62	1	R20	150E	RES SMD 150 OHM 1% 1/10W 0603	Yageo	RC0603FR-07150RL
63	1	T2	1:3	Pulse transformer, 1:3, 4.8uH, 3KV isolation voltage	JQH, China	LCL-T6-5138A
64	3	CX1,CX2,CX3	0.068uF,310VAC	CAP FILM 0.068UF 20% 630VDC RAD	Vishay BC Components	BFC233820683
65	1	F1	2A Fuse	Fuses with Leads (Through Hole) 2A 250V Epoxy Coated	Coiltronics / Eaton	C310FH-2-RE-TR1
66	2	LF1,LF2	10mH, 1.2A	CMC 10mH 1.2A 2LN SMD	coilcraft	CJ5094-CL
67	1	CY1	VY1102M35Y5UQ6TV0	CAP CER 1000PF 760VAC Y5U RADIAL	Vishay BC Components	VY1102M35Y5UQ6TV0
68	2	C3,C5	47uF	CAP ALUM 47UF 20% 400V RADIAL	AISHI	EHS2GM470W25OT
69	1	T1	RM8 CORE	POWER TRANSFORMER_RM8 CORE	JQH, China	BCK0RM4268B1
70	1	J1	CU1816SAH1MD2R0-LF-HC	CU18 USB Type-C Receptacle Connector	CviLux Corporation	CU1816SAH1MD2R0-LF-HC
71	1	U1	PAG1P	PRIMARY SIDE STARTUP CONTROLLER	CYPRESS SEMICONDUCTOR	CYPAP111A3-10SXQ
72	1	U2	PAG1S	USB-PD Power Adapter Secondary Side Controller	CYPRESS SEMICONDUCTOR	CYPAS111A1-24LQXQ

Total Components (BOM Count) = 91

For Test and Debug Purpose

73	1	ACC1	M2159-3005-N	6MM HEX X 24MM X M3 THD	RAF Electronic Hardware	M2159-3005-N
74	1	ACC2	50M030050D006	CHEESE HEAD SLOTTED SCREW, NATUR	Essentra Components	50M030050D006
75	1	ACC3	04M030050HN	HEX NUT, NATURAL, NYLON, M3 X .5	Essentra Components	04M030050HN
76	1	R43	0E	RES SMD 0 OHM JUMPER 1/4W 0603	Vishay Dale	CRCW06030000Z0EAHP
77	1	R44	0E	RES SMD 0 OHM JUMPER 0.4W 0805	Vishay Dale	RCS080500000Z0EA
78	6	R22,R27,R28,R36,R37,R38	0E	RES SMD 0 OHM JUMPER 1/4W 0603	Vishay Dale	CRCW06030000Z0EAHP
79	1	R21	0E	RES SMD 0 OHM JUMPER 1/4W 0603	Vishay Dale	CRCW06030000Z0EAHP

DNP						
80	1	C1	22uF	CAP CER 22UF 25V X5R 0805	Murata Electronics North America	GRM21BR61E226ME44K
81	1	C37	10pF	CAP CER 10PF 50V NPO 0603	Yageo	CC0603KRNPO9BN100
82	2	D2,D4	S1ML R3G	DIODE GEN PURP 1KV 1A SUB SMA	Taiwan Semiconductor Corporation	S1ML R3G
83	1	R10	0E	RES SMD 0 OHM JUMPER 1/4W 0603	Vishay Dale	CRCW06030000Z0EAHP
84	2	C28,C29	2.2nF	CAP CER SMD 0603 2200PF 10% X7R 50V	KEMET	C0603C222K5RAC7411
85	1	C31	0.1uF	CAP CER 0.1UF 35V X7R 0603	Taiyo Yuden	GMK107B7104KAHT
86	1	C32	2200pF	CAP CER 2200PF 500V X7R 0603	KEMET	C0603C222KCRAC7867
87	1	R30	47K	RES SMD 47K OHM 1% 1/10W 0603	Yageo	RC0603FR-0747KL
88	2	R32,R34	1K	RES SMD 1K OHM 1% 1/10W 0603	Yageo	RC0603FR-071KL

5.3 PCB Layout

Figure 5-2-1. Primary Board Top view

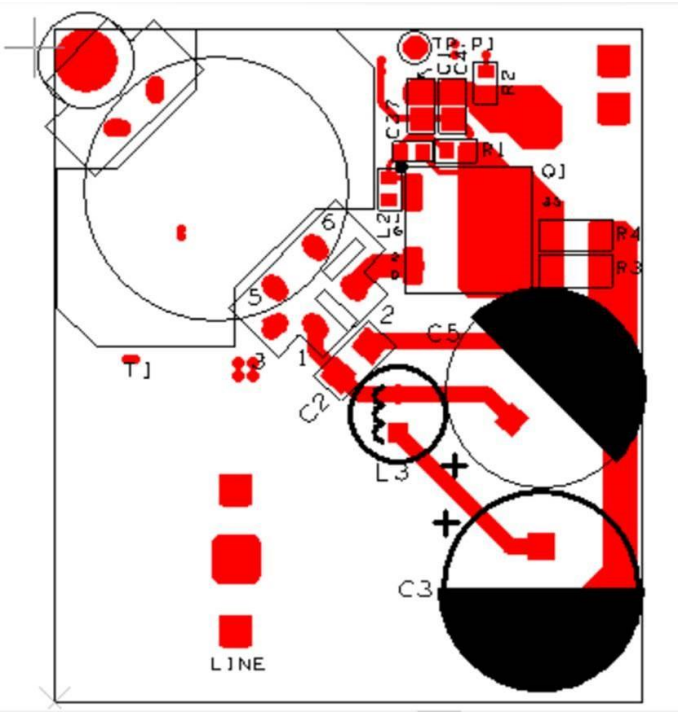


Figure 5-2-2. Primary Board Bottom view

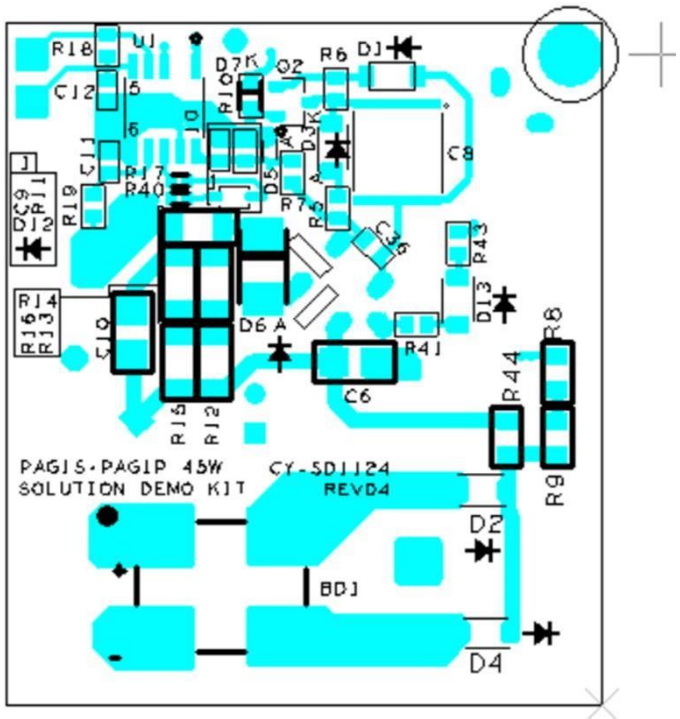


Figure 5-2-3. Secondary Board Top view

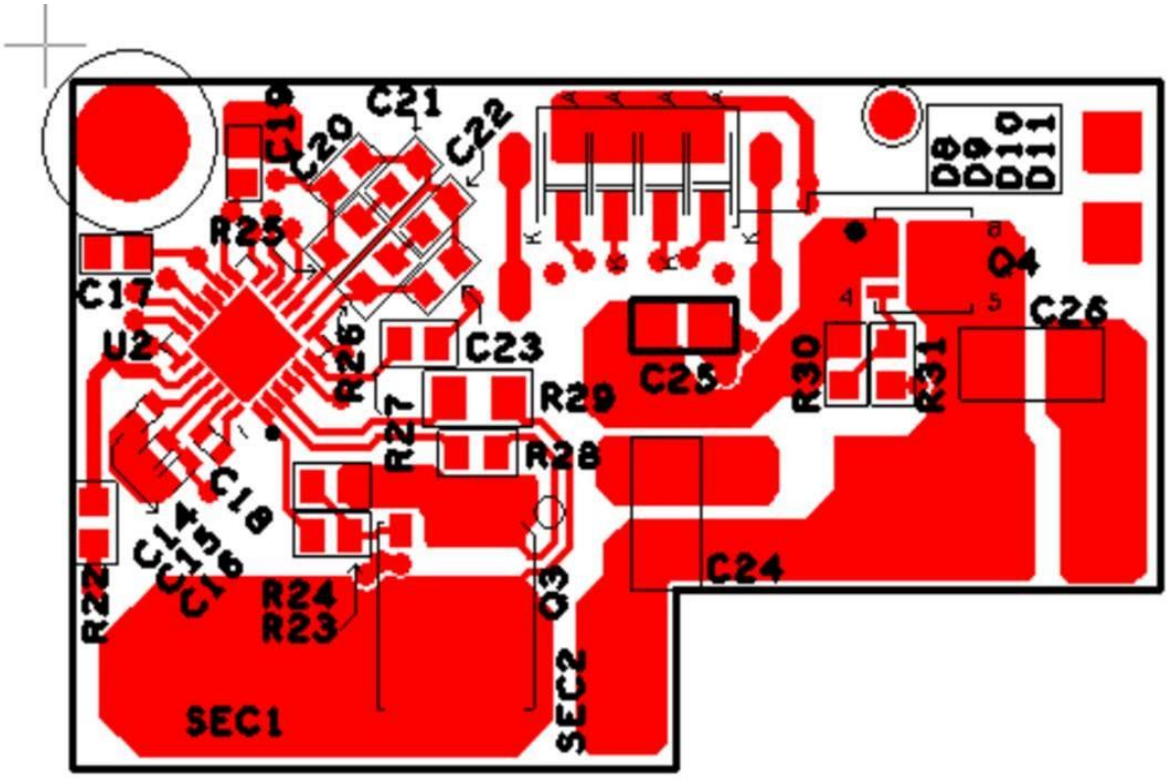


Figure 5-2-4. Secondary Board Bottom View

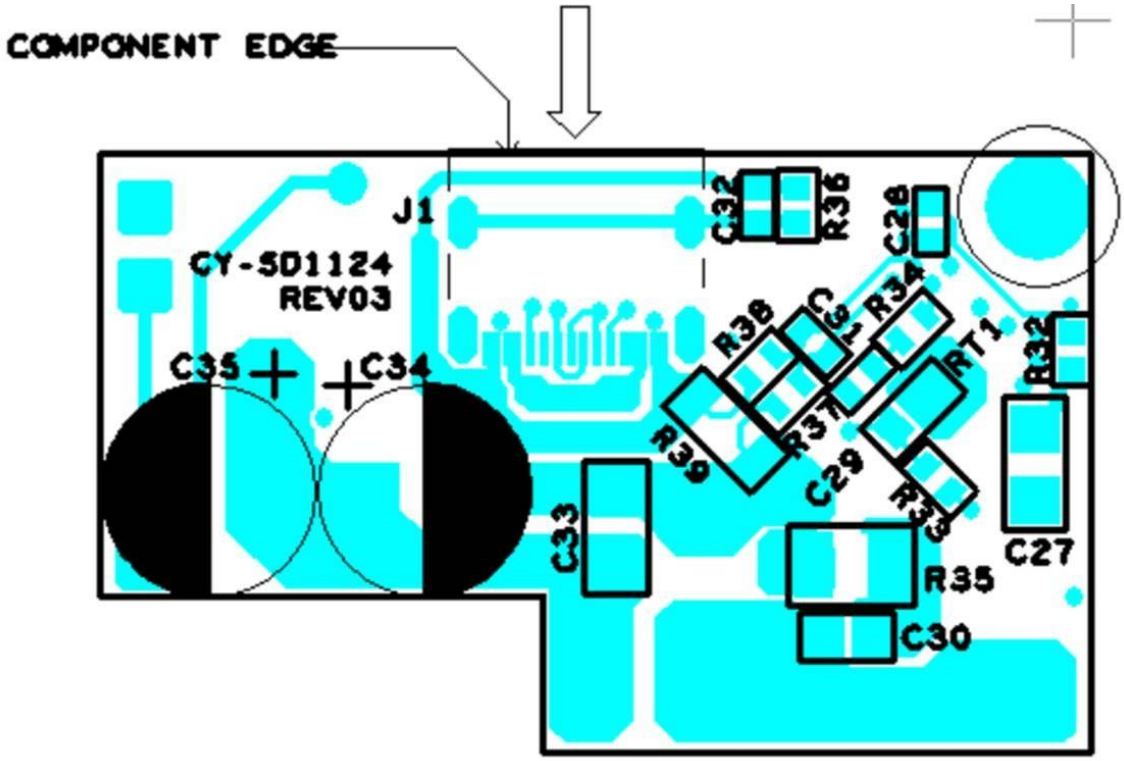
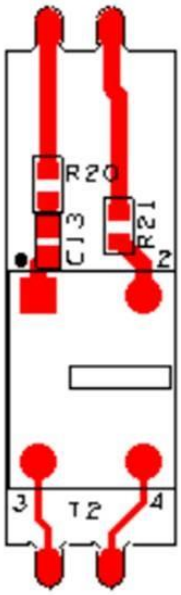


Figure 5-2-5. Pulse Transformer Board Top view

a) Top View

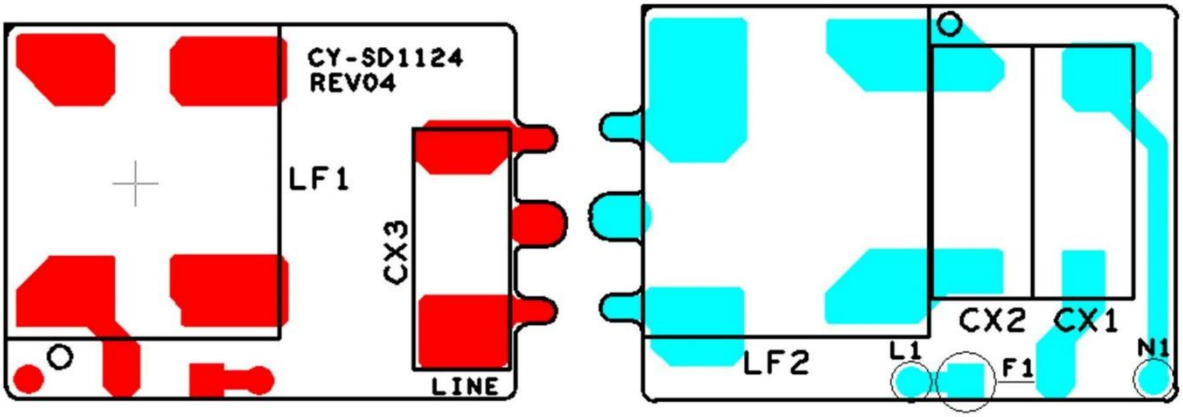


b) Bottom View

Figure 5-2-6. EMI Filter Board Top view

a) Top View

b) Bottom View

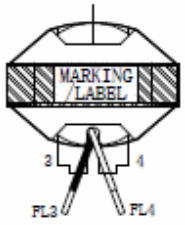


5.4 Transformer Specifications (T1)

Figure 5-3. Transformer Datasheet

顾　　客 CUSTOMER	SA00169	产品名称 DESCRIPTION	RM8 TRANSFORMER	02版
部　品　号 PART NO.	45W RM8	型　　号 MODEL	BCK-RM8-4268B	页修改号: 0

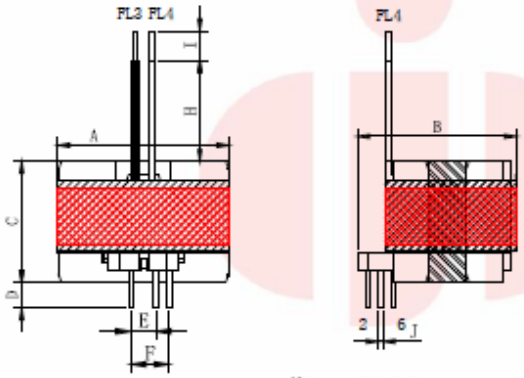
1. 外观图示(单位:mm)/DIMENSION(UNIT:mm)

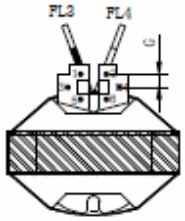


MARKING/LABEL:

BCK-RM8-4268B
JQH YY WW **

组别/NO.(01, 02...)
周/WEEK(1:01, 2:02...)
年/YEAR(2018, 18;2019, 19…)





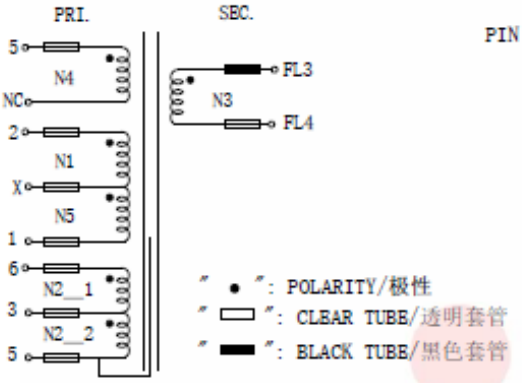
NOTE:
1. 骨架拔除PIN4 。
/removing PIN4 .
2. N3从顶部出线。
/ The wire of N3 is out from the BOBBIN top .
3. 磁芯开单气隙，装于PIN端，磁芯结合处点胶，磁芯外包3Ts胶带固定。
/The core has a single air gap and is installed at the PIN end. Magnetic core junction glue fix, and the core is wrapped with 3Ts tape to fix.
4. 沿绕制方向在磁芯包2Ts胶带，再绕一圈0.05mm/t*8mm/W铜箔，将导线接PIN5脚。焊接铜箔后包2Ts胶带;
/Wrap 2Ts tape along the Wrapping direction outside the magnetic core, and then Wrap a circle of 0.05mm/t * 8mm / W spare copper foil, and connect the lead to Pin5 pin. After Welding the copper foil, Wrap 2Ts tape.
5. 产品需真空含浸。
/The part must be Vacuum Varnished.

A	B	C	D	E	F	G	H	I	J
25.0 MAX	22.0 MAX	18.0 MAX	4.0 ±0.5	3.5 ±0.2	5.3 ±0.2	1.8 ±0.3	35.0 ±3.0	5.0 ±0.5	Ø0.6 ±0.1

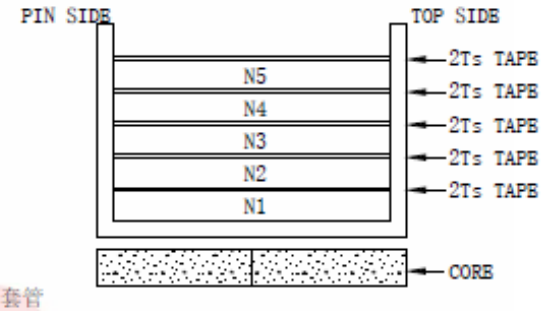
料　号 MATERIAL NO.	制　图 DRAWING	制　样 SAMPLE	校　核 CHECKED	QC 审 核 QC CHECKED	RD 审 核 RD CHECKED	批　准 APPROVED	日　期 DATE
BCK0RM4268B1	张 艳	----	张庆庭	唐天玲	袁志军	朱 勇	2020-04-21

顾　　客 CUSTOMER	SA00169	产品名称 DESCRIPTION	RM8 TRANSFORMER	02版
部　品　号 PART NO.	45W RM8	型　　号 MODEL	BCK-RM8-4268B	页修改号: 0

2. 电原理图/CIRCUIT DIAGRAM



3. 解剖图/CONSTRUCTION DIAGRAM



4. 绕组/WINDING

绕组 WINDING	漆包线 WIRE(mm)	起末端 S-F	圈数 TURNS(Ts)	胶带圈数 TAPE TURNS(Ts)	绕制方式 WINDING CONDITION
N1	Φ0.36mm*1P 2UEW-B	2-X	20	2	CLOSE/密绕
N2__1	Φ0.15mm*1P 2UEW-B	6-3	24	2	SPACE/散绕
N3	Φ0.40mm*4P TEX-B	FL3-FL4	6	2	CLOSE/密绕
N4	Φ0.15mm*1P 2UEW-B	5-NC	34	2	SPACE/散绕
N5	Φ0.36mm*1P 2UEW-B	X-1	20	2	CLOSE/密绕
N2__2	Φ0.15mm*1P 2UEW-B	3-5	6	2	SPACE/散绕

5. 电气特性/ELECTRICAL CHARACTERISTIC

序号 NO.	项目 ITEM	测量点 MEASURED POINT	技术要求 TECHNICAL DATA	测试条件及仪器 TESTING CONDITION & INSTRUMENT
1	电感量 INDUCTANCE	L(2-1)	364uH±10%	Agilent 4284A 100KHz/1V,AT 25℃
2	漏感 LEAKAGE INDUCTACE	LK(2-1) (SHORT OTHER/短路其他)	5.5uH MAX	
3	直流电阻 DC RESISTANCE	R(2-1)	TBDmΩ MAX	TH2512B AT 25℃
		R(6-5)	TBDmΩ MAX	
		R(FL3-FL4)	TBDmΩ MAX	
4	抗电强度 HI-POT	PRI-SEC	AC 3.75KV	CS9929 50Hz 5mA 3SEC
		COIL-CORE	AC 1.0KV	
5	绝缘阻抗 INSULATION RESISTANCE	COIL-COIL	100MΩ MIN	TH2681A DC500V 60S

料　　号 MATERIAL NO.	制　　图 DRAWING	制　　样 SAMPLE	校　　核 CHECKED	QC 审 核 QC CHECKED	RD 审 核 RD CHECKED	批　　准 APPROVED	日　　期 DATE
BCKORM4268B1	张 艳	----	张庆庭	唐天玲	袁志军	朱 勇	2020-04-21

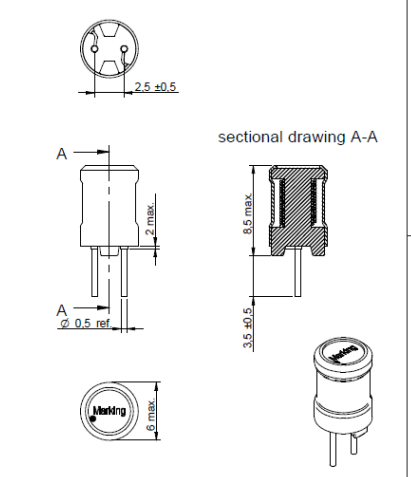
Note: **Transformer undergoes DIP and BAKE varnishing methodology.**

5.5 Inductor Specifications (L3)

PRODUCT: Wurth Electronics Inc. Inductor 22mH 1.8A 130mohm; MPN: 7447462220

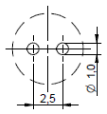
Figure 5-4: Inductor L3 datasheet

Dimensions: [mm]



Scale - 3:1

Recommended Hole Pattern: [mm]



Scale - 3:1

Schematic:

Electrical Properties:

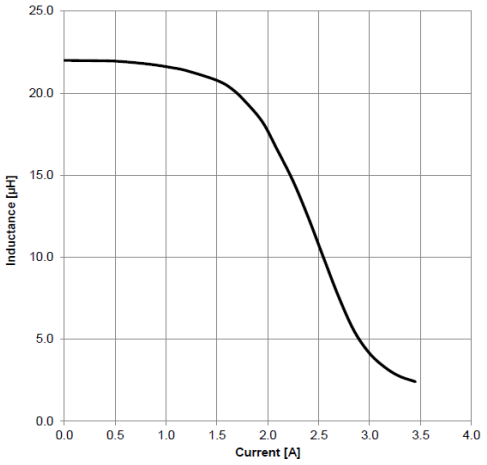
Properties		Test conditions	Value	Unit	Tol.
Inductance	L	100 kHz/ 5 mA	22	µH	±20%
Rated Current	I_R	ΔT = 40 K	1.8	A	max.
Saturation Current	I_{SAT}	ΔL/L| < 10 %	1.7	A	typ.
DC Resistance	R_{DC}	@ 20 °C	0.102	Ω	typ.
DC Resistance	R_{DC}	@ 20 °C	0.13	Ω	max.
Self Resonant Frequency	f_{res}		15	MHz	typ.

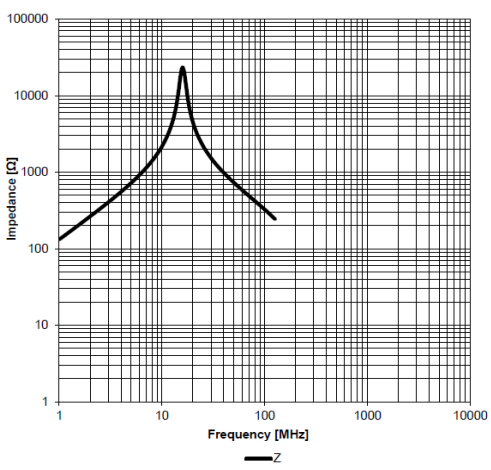
Certification:

RoHS Approval	Compliant [2011/65/EU&2015/863]
REACh Approval	Conform or declared [(EC)1907/2006]
Halogen Free	Conform [JEDEC JS709B]
Halogen Free	Conform [IEC 61249-2-21]

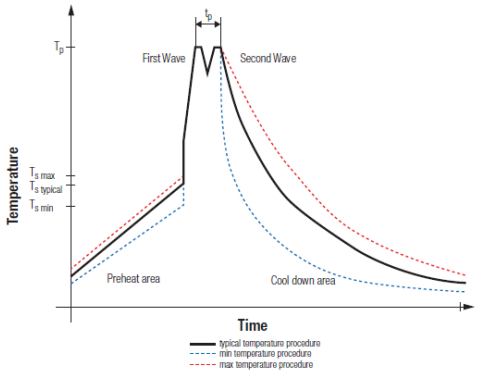
General Properties:

It is recommended that the temperature of the component does not exceed +125 °C under worst case conditions	
Ambient Temperature (referring to I_R)	-40 up to +85 °C
Operating Temperature	-40 up to +125 °C
Storage Conditions (in original packaging)	< 40 °C ; < 75 % RH
Moisture Sensitivity Level (MSL)	1
Test conditions of Electrical Properties: +20 °C, 33 % RH if not specified differently	





Classification Wave Soldering Profile:



Classification Wave Soldering Profile:

Profile Feature		Pb-Free Assembly	Sn-Pb Assembly
Preheat Temperature Min	$T_{s\,min}$	100 °C	100 °C
Preheat Temperature Typical	$T_{s\,typical}$	120 °C	120 °C
Preheat Temperature Max	$T_{s\,max}$	130 °C	130 °C
Preheat Time t_s from $T_{s\,min}$ to $T_{s\,max}$	t_s	70 seconds	70 seconds
Ramp-up Rate	Δ T	150 °C max.	150 °C max.
Peak Temperature	T_p	250 °C - 260 °C	235 °C - 260 °C
Time of actual peak temperature	t_p	max. 10 seconds max. 5 seconds each wave	max. 10 seconds max. 5 seconds each wave
Ramp-down Rate, Min		~ 2 K/ second	~ 2 K/ second
Ramp-down Rate, Typical		~ 3.5 K/ second	~ 3.5 K/ second
Ramp-down Rate, Max		~ 5 K/ second	~ 5 K/ second
Time 25 °C to 25 °C		4 minutes	4 minutes

refer to EN61760-1:2006

5.6 Common Mode Choke Specifications (LF1)

PRODUCT: Coilcraft CMC 10mH 1.2A 2LN SMD

Figure 5-5: Common Mode Choke datasheet

Part number[1]	Common mode impedance max (kOhms)	Inductance (mH)[2] nom	Inductance (mH)[2] min	Irms[3] (A)	DCR max[4] (mOhms)	Isolation[5] (Vrms)
CJ5094-CL_	28.28 @ 0.26 MHz	10.0	6.5	1.2	180	1000

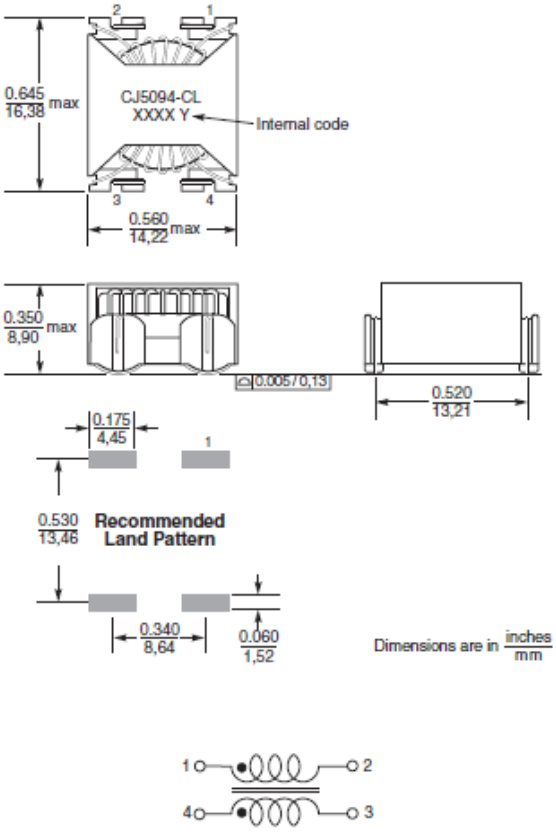
1. When ordering, please specify **packaging** code:

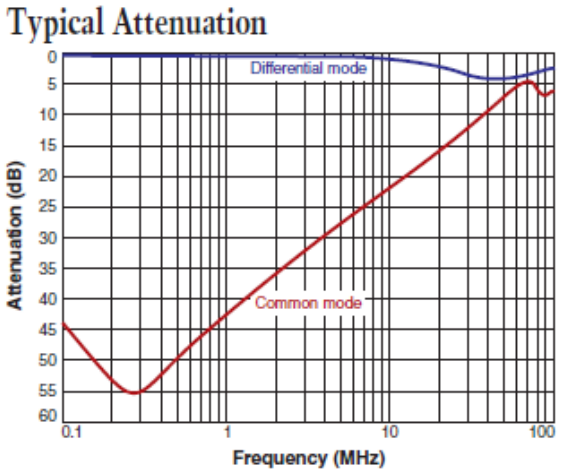
CJ5094-CLD

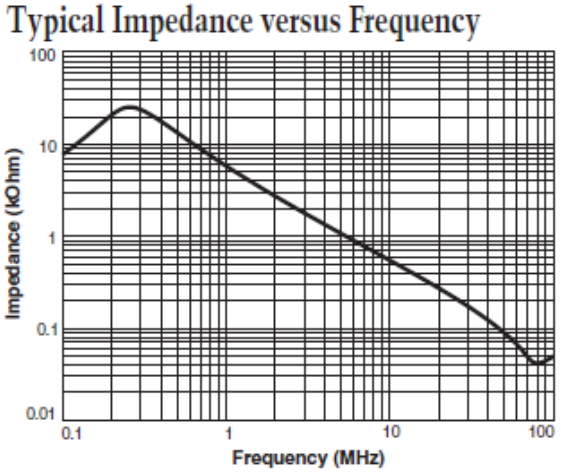
Packaging: **D** = 13″ machine-ready reel. EIA-481 embossed plastic tape (350 parts per full reel).
B = Less than full reel. In tape, but not machine ready. To have a leader and trailer added ($25 charge), use code letter D instead.

2. Inductance shown for each winding, measured at 10 kHz, 0.1 Vrms, 0 Adc on an Agilent/HP 4263B LCR meter or equivalent.
3. Current per winding that causes a 40°C rise from 25°C ambient. This information is for reference only and does not represent absolute maximum ratings.
4. DCR is specified per winding.
5. Isolation (hipot) measured for two seconds.
6. Electrical specifications at 25°C.

Refer to Doc 362 "Soldering Surface Mount Components" before soldering.







Core material Ferrite
Terminations RoHS compliant tin-silver-copper over copper
Weight 2.9 g
Ambient temperature –40°C to +85°C with Irms current
Maximum part temperature +125°C (ambient + temp rise)
Storage temperature Component: –40°C to +125°C.
Tape and reel packaging: –40°C to +80°C
Resistance to soldering heat Max three 40 second reflows at +260°C, parts cooled to room temperature between cycles
Moisture Sensitivity Level (MSL) 1 (unlimited floor life at <30°C / 85% relative humidity)
Failures in Time (FIT) / Mean Time Between Failures (MTBF) 38 per billion hours / 26,315,789 hours, calculated per Telcordia SR-332
Packaging 350/13″ reel Plastic tape: 24 mm wide, 0.4 mm thick, 24 mm pocket spacing, 8.6 mm pocket depth
PCB washing Tested to MIL-STD-202 Method 215 plus an additional aqueous wash. See Doc787_PCB_Washing.pdf.

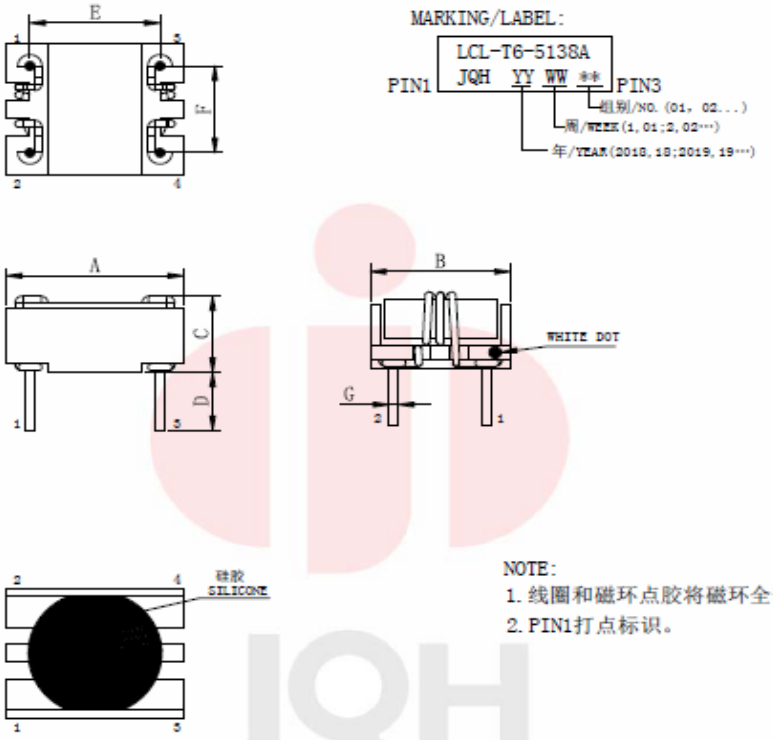
5.7 Pulse Transformer (T2)

PRODUCT: JQH China, 1:3, 4.8uH, 3KV isolation voltage; MPN: LCL-T6-5138A

Figure 5-6: Pulse Transformer datasheet

顾 客 CUSTOMER	SA00169	产品名称 DESCRIPTION	T6 FILTER	00 版
部 品 号 PART NO.		型 号 MODEL	LCL-T6-5138A	页修改号: 0

1. 外观图(单位:mm)/DIMENSION(UNIT:mm)



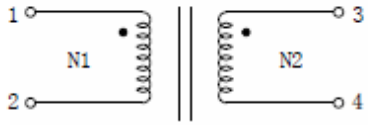
NOTE:
1. 线圈和磁环点胶将磁环全部封住。
2. PIN1打点标识。

A	B	C	D	E	F	G
10.4 MAX	8.0 MAX	6.0 MAX	3.5 ±0.3	8.0 ±0.15	5.0 ±0.15	Ø0.5 ±0.1

料 号 MATERIAL NO.	制 图 DRAWING	制 样 SAMPLE	校 核 CHECKED	QC 审 核 QC CHECKED	RD 审 核 RD CHECKED	批 准 APPROVED	日 期 DATE
LCL00T5138A1	赖彩玲	----	徐科	朱金金	张庆庭	袁志军	2019-08-17

顾　　客 CUSTOMER	SA00169	产品名称 DESCRIPTION	T6 FILTER	00 版
部　品　号 PART NO.		型　　号 MODEL	LCL-T6-5138A	页修改号: 0

2. 电原理图/CIRCUIT DIAGRAM



" ● ": POLARITY/极性

3. 绕组/WINDING

绕组 WINDING	漆包线 WIRE(mm)	起末端 S-F	圈数 TURNS(Ts)	绕制方式 WINDING CONDITION
N1	Φ0.2mm*1P T.I.W	1-2	3	CLOSE/密绕
N2	Φ0.2mm*1P 2UEW-F	3-4	9	CLOSE/密绕

4. 电气特性/ELECTRICAL CHARACTERISTIC

序号 NO.	项目 ITEM	测量点 MEASURED POINT	技术要求 TECHNICAL DATA	测试条件及仪器 TESTING CONDITION & INSTRUMENT
1	电感量 INDUCTANCE	L(1-2)	7.0uH MIN	Agilent 4284A 100KHz/0.3V, AT 25℃
2	耐压 HI-POT	N1-N2	3.0KV AC	CS9929 50Hz/60Hz 4mA 4S

5. 材料清单/MATERIAL LIST

序号 NO.	材料名称 ITEM	规格 TYPE	供应商 SUPPLIERS	认证号 UL NO.
1	磁芯 CORE	TYPE:T6*4*2.15 R10K	HENGDIAN GROUP DMEGC MAGNETICS CO.,LTD ACME	N/A
2	底座 BASE	TYPE:Phenolic (PF) MATERIAL:PM-9820/PM-9630 THERMAL RATING:150℃	SUMITOMO BAKELITE CO LTD	E41429
3	三层绝缘线 TRIPLE INSULATED WIRE	TYPE: FIW TYPE: FIW THERMAL RATING:155℃	HOI LUEN ELECTRICAL MFR CO LTD TAI-I COPPER (GUANZHOU) CO LTD	E257525 E234896
4	漆包线 WIRE	MARK DSG:xUEW/155, QA-x/155 ANSI TYPE:MW 79-C THERMAL RATING:155℃	DONG GUAN YIDA INDUSTRIAL CO LTD	E344055
5	硅胶 SILICONE	TYPE:3140 THERMAL RATING:200℃	DOW CORNING CORPORATION	

注:产品符合RoHS要求.

Note: The products comply with RoHS requirements.

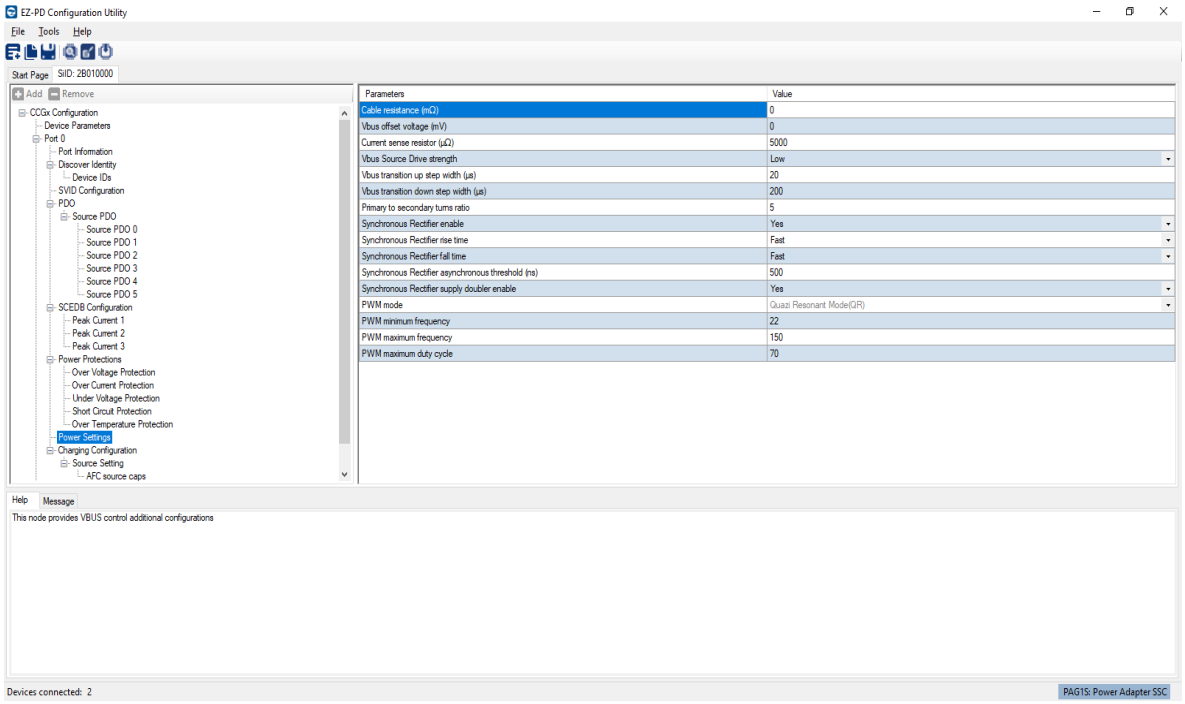
6. 产品单重/WEIGHT

Net Weight:***g/PC

料　号 MATERIAL NO.	制　图 DRAWING	制　样 SAMPLE	校　核 CHECKED	QC 审 核 QC CHECKED	RD 审 核 RD CHECKED	批　准 APPROVED	日　期 DATE
LCL00T5138A1	赖彩玲	----	徐科	朱金金	张庆庭	袁志军	2019-08-17

5.8 EZ-PD Configuration Utility

Figure 5-7. Utility Screenshot



The Cypress EZ-PD PAG1S controller is a highly configurable and programmable solution. The chip can be configured using parameters stored in the internal flash memory. These parameters are to be chosen and programmed by Cypress customers according to their use cases and requirements.

The Graphical User Interface (GUI) of EZ-PD Configuration Utility allows users to intuitively select and configure the parameters for their application.

Here are the default configured values with respect to Power Settings and Power Protections.

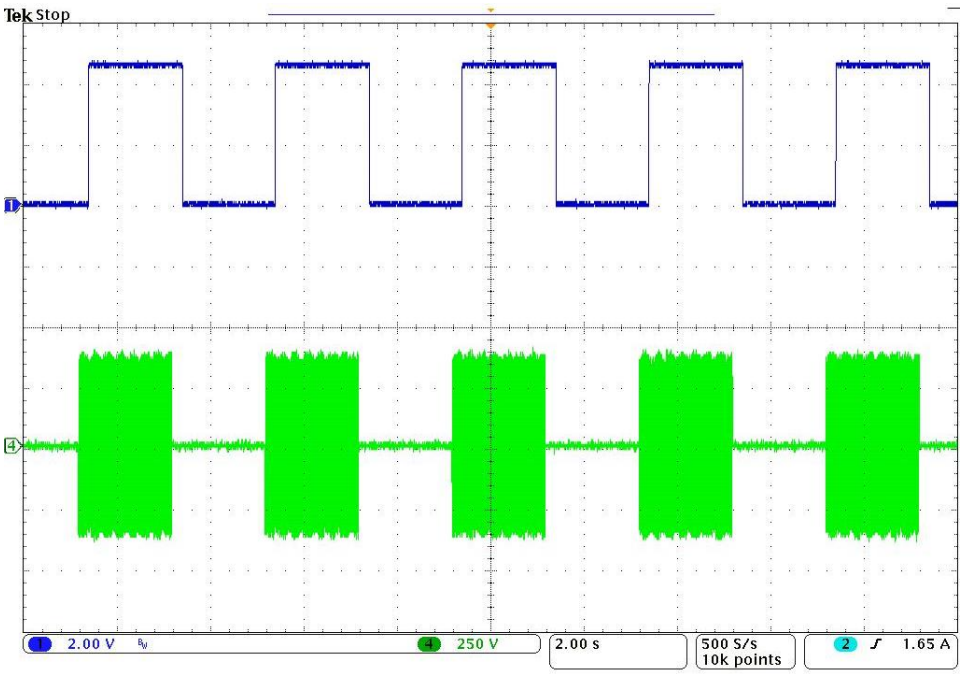
Table 4-2. Default Configuration Values

Parameters	Values
Power Settings	
Cable resistance (mΩ)	0
Vbus offset voltage (mV)	0
Current Sense resistor (μΩ)	5000
Vbus Source Drive strength	Low
Vbus transition up step width (μs)	20
Vbus transition down step width (μs)	200
Primary to secondary turns ratio	5
Synchronous Rectifier enable	Yes
Synchronous Rectifier rise time	Fast
Synchronous Rectifier fall time	Fast

Synchronous Rectifier async threshold (ns)	500
Synchronous Rectifier doubler enable	Yes
PWM mode	Quasi Resonant Mode (QR)
PWM minimum frequency (kHz)	22
PWM maximum frequency (kHz)	150
PWM maximum duty cycle (%)	70
Power Protections	
1. Over Voltage Protection	
Enable	Yes
OVP Threshold (%)	20
Debounce period (µs)	10
Retry count	2
2. Over Current Protection	
Enable	Yes
OCP Threshold (%)	20
Debounce period (ms)	10
Retry count	2
3. Under Voltage Protection	
Enable	Yes
UVP Threshold (%)	70
Debounce period (µs)	10
Retry count	2
4. Short Circuit Protection	
Enable	Yes
Debounce period (µs)	4
Retry count	2
5. Over Temperature Protection	
Enable	Yes
Thermistor type 1	NTC
Cutoff value 1	477
Restart value 1	909
Debounce period (ms)	10
Enable Thermistor 2	Yes
Thermistor type 2	NTC
Cutoff value 2	0
Restart value 2	0

5.9 DUT Burn-in Test

Figure 5.8. Stress Test at 265Vac, 63Hz; Vout = 5V and Iout = 3A (**CH1:** Vbus_c, **CH4**: Vin_ac)



The DUT undergoes an 8-hour burn-in test where the Programmable AC supply is programmed to toggle Voltage from 0-265Vac every 10sec ON-OFF each with default 5V Fixed PDO with 3A load.

Note: The above figure shows a faster toggling time (of 2sec) for waveform capture purpose only.

5.10 Glossary

Table 5-3. Glossary Table

Sr. No.	Acronyms	Full Names
1	CC Mode	Constant Current Mode in Electronic Load
2	CC-CV	Constant Current - Constant Voltage
3	CE	Conducted Emission
4	CH'x'	Oscilloscope Channel numbers
5	CR Mode	Constant Resistance Mode in Electronic Load
6	DUT	Device Under Test
7	FET	MOSFET (Metal Oxide Semiconductor Field Effect Transistor)
8	Io/Iout	Output Current of the DUT
9	NGDO	NFET Gate driver output – Q4
10	OCP	Over current protection
11	OVP	Over voltage protection
12	P-P	Peak to Peak
13	PPS-PDO	Programmable Power Supply - Power Delivery Output
14	SR	Synchronous Rectifier
15	UI	User Interface
16	USB PD	Universal Serial Bus Power Delivery
17	Vbus_c	Bus voltage at Type-C i.e. after Provider/NGDO FET
18	Vbus_in	Bus voltage before Provider/NGDO FET
19	Vin/Vin_ac	Input AC Voltage to the DUT
20	Vo/Vout	Output Voltage of the DUT

Revision History

Document Revision History

Document Title: CY-SD1124 45W USB-C PD Power Adapter Solution (PAG1P-PAG1S)			
Revision	**Issue Date**	**Origin of Change**	**Description of Change**
**	06/01/2020	MGUP	Initial Version **Hardware Changes :** 1. LF1 is shorted 2. RT2 is shorted 3. L1 is DNP 4. R86 = 0 ohm is populated 5. R5=R79=180kohm are populated 6. C5=1nF+680pF 7. R121 = 820 mohm 8. C7 = 1nF + 680pF 9. R7 = R117 = 10 ohm 10. D105 = DNP 11. Q3 = DNP 12. R123 = DNP 13. R25 = DNP 14. Q6 = BSC160N15NS5 is used in place of Q3 15. R122 = 2.2ohm is populated 16. C118 = DNP 17. C24 = 10uF
2.0	31/03/2020	MGUP	1. All the tests mentioned in report are re-run 2. Added Schematic and BOM 3. Datasheets of various components
3.0	24/06/2020	MGUP	1. All the tests mentioned in report are re-run 2. Updated Schematic and BOM 3. Updated datasheet of main transformer

			Firmware changes: 1. PDO-PPS values changed from 20V,3A to 3.3V - 21V, 2.25A 2. Added variable minimum width 3. Updated bootloader 4. Updated Calibration 5. Added digital peak as default peak generator 6. Changed the Maximum Frequency to 200kHz **Hardware Changes:** 1. EMI filter board added 2. CV compensation: R25 = 820kohm, C20 = 10pF 3. Primary Rsense: R3 = R4 = 0.43 ohm
3.1	04 Sept 2020	MGUP	1. Changed Solution board photos 2. Added CE data
3.2	21 Sept 2020	MGUP	1. Updated BOM 2. Updated Schematic 3. Added MPN CY-SD1124 4. Added component points in Thermal Capture