33W USB-PD Power Adapter Solution (PAG1P-A1 and PAG1S-A1) Test Report Version 4.2

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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 33W Power Adapter solution board. The tests were performed on this board which is equipped with Cypress CYPAP111A1-10SXQ on primary and CYPAS111A1-24LQXQ on secondary section of the converter.

Table 1-1. Test Specification

Parameter	**Value**
Input Voltage	90 – 265Vac
Input Frequency	47 – 63Hz
Total Output Power	33W
Main Output Vo / Io	PDO-Fixed: 5V/3A, 9V/3A; PDO-PPS: 3.3V – 11V / 3A
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)

33W PAG1P-PAG1S Solution Kit: (CYPAP111A1-CYPAS111A1)

Table 2-1. PAG1P-PAG1S Solution Kit Details

DUT contents	Description
CYPAP111A1-CYPAS111A1	Primary and Secondary Devices
Firmware Version	#2083

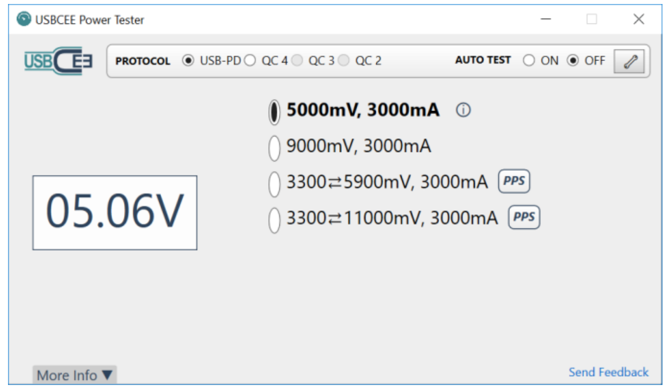
Figure 2-1. PAG1P-PAG1S Solution Demo Kit

Dimensions (in mm): 67(L) x 26(W) x 40(H)

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

2.2 DUT Setup

Figure 2-2. Test set-up



The DUT is connected to PAT Tester (CCPROG PAT) using a USB Type-C cable (0.5m). 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 4 PDOs:

PDO 1: 5V, 3A FIXED
PDO 2: 9V, 3A FIXED
PDO 3: 3.3V-5.9V, 0-3A PPS
PDO 4: 3.3V-11V, 0-3A 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

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 C2
Automation Software	LabView

3. Power Management Test Results

The results documented here are based on the test reports of PAG1P-PAG1S 33W Solution Demo Kit

3.1 Efficiency 4-pt average

3.1.1 Detailed Data

Table 3-1. Efficiency Results

Parameter	Test Condition	Criteria			Unit	Test Result	
		Min	Typ	Max		115Vac 60Hz	230Vac 50Hz
DoE Level-6 Four-point Average Efficiency (Average of 25%, 50%, 75%, 100% load)	Vo = 3.3Vdc, Io = 3A	77.96%			%	89.17	86.98
	Vo = 5Vdc, Io = 3A	81.39%			%	90.12	88.74
	Vo = 9Vdc, Io = 3A	86.62%			%	90.82	90.22
	Vo = 11Vdc, Io = 3A	87.21%			%	90.70	90.38
DoE No load consumption	No USB sink attached			100	mW	22	25
CoCv5 Tier2 Four-point Average Efficiency (Average of 25%, 50%, 75%, 100% load)	Vo = 3.3Vdc, Io = 3A	78.19%			%	89.17	86.98
	Vo = 5Vdc, Io = 3A	81.76%			%	90.12	88.74
	Vo = 9Vdc, Io = 3A	87.30%			%	90.82	90.22
	Vo = 11Vdc, Io = 3A	88.03%			%	90.70	90.38
CoCv5 Tier2 10% load Efficiency	Vo = 3.3Vdc, Io = 0.3A	68.98%			%	85.21	77.76
	Vo = 5Vdc, Io = 0.3A	72.48%			%	86.90	81.75
	Vo = 9Vdc, Io = 0.3A	77.30%			%	87.70	84.61
	Vo = 11Vdc, Io = 0.3A	78.03%			%	87.65	85.13
CoCv5 Tier2 No load consumption	No USB sink attached			75	mW	22	25

- Peak Efficiency: **91.22%** (At 230Vac-50Hz, 11V-3A)

3.1.2 Graphs

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

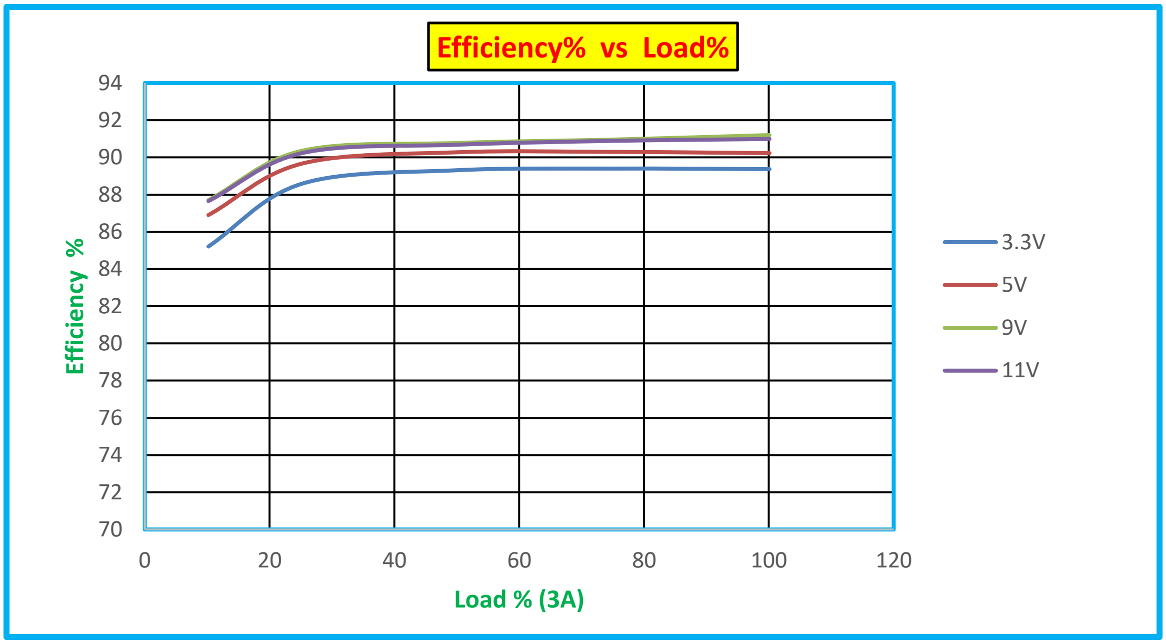


Figure 3-1-2. Efficiency at 230Vac 50Hz

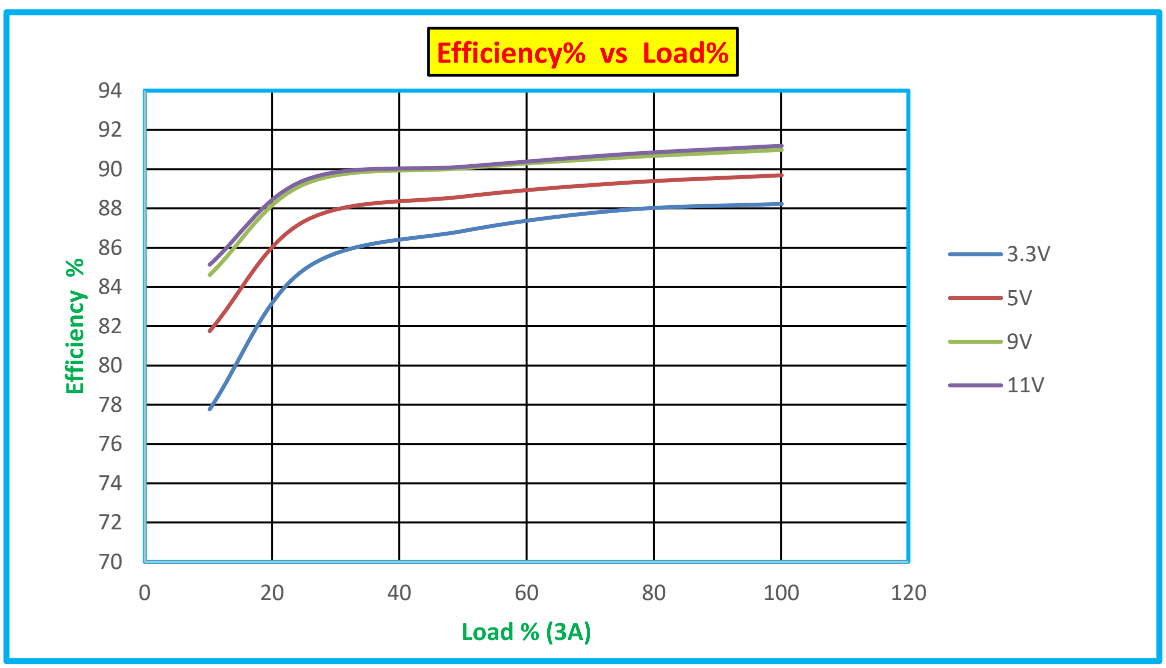


Figure 3-1-3. Efficiency at 90Vac 47Hz

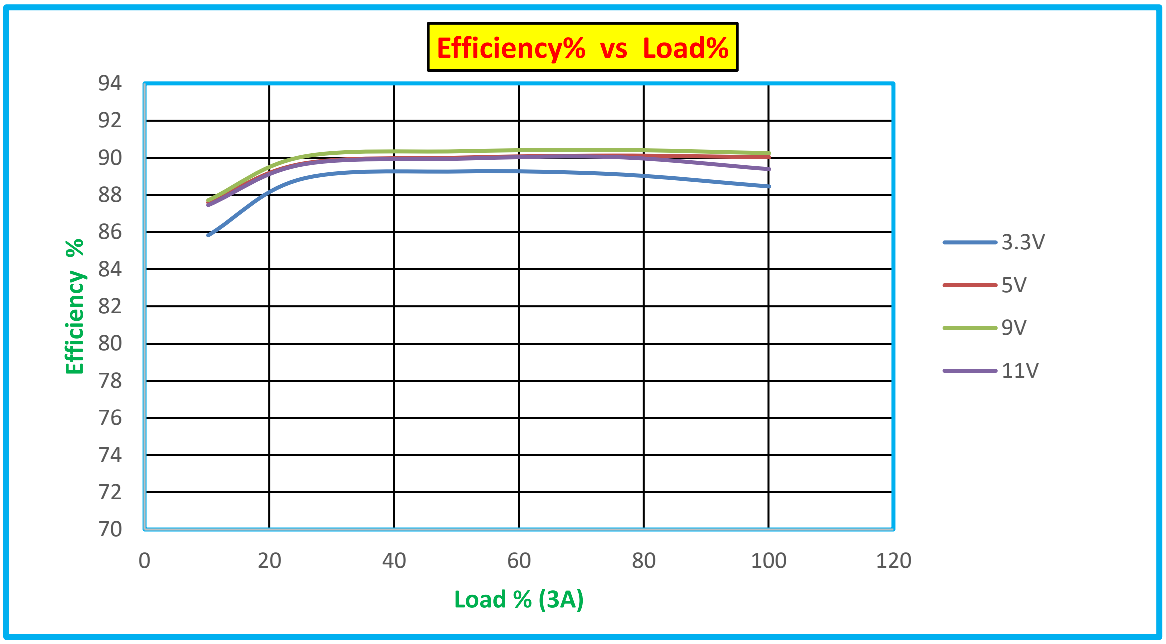
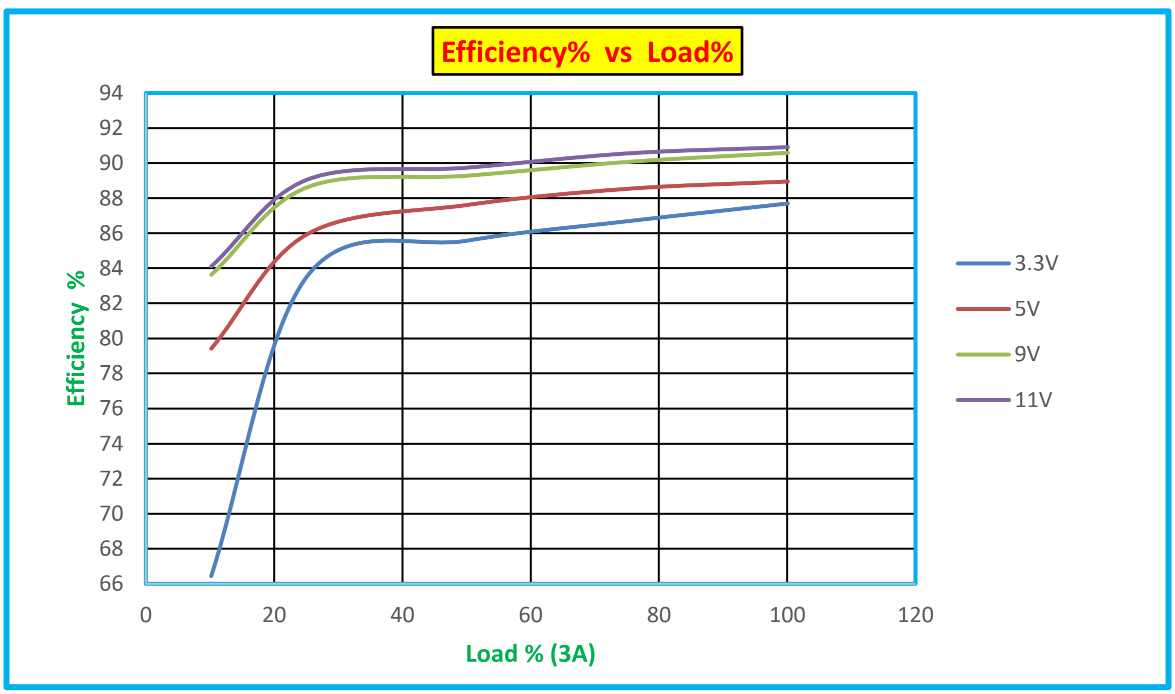


Figure 3-1-4. Efficiency at 265Vac 63Hz



3.2 Standby Power Consumption

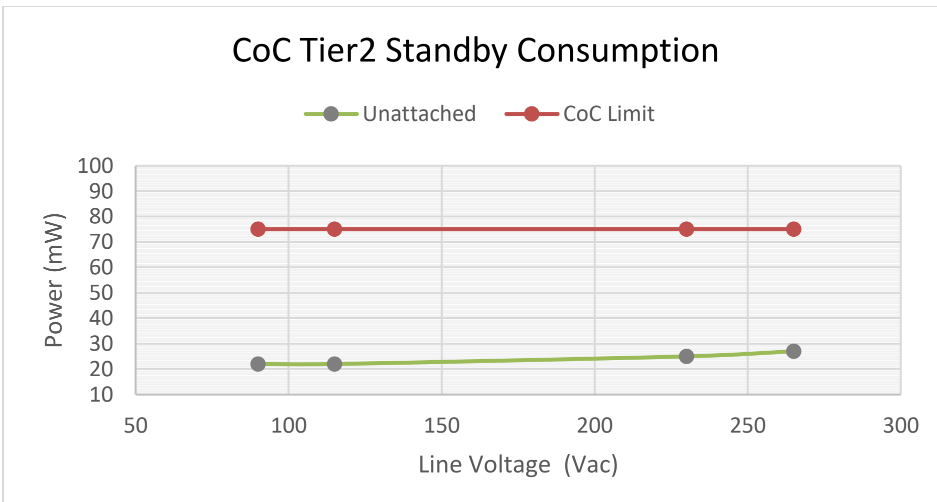
3.2.1 Detailed Data

Table 3-2. Standby Power Results

Vin (Vac)	90Vac, 60Hz	115Vac, 60Hz	230Vac, 50Hz	265Vac, 63Hz
Input Power (mW)	22	22	25	27

3.2.2 Graph

Figure 3-2-1. Standby Power Vs CoC Tier2 criteria



3.2.3 Details

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

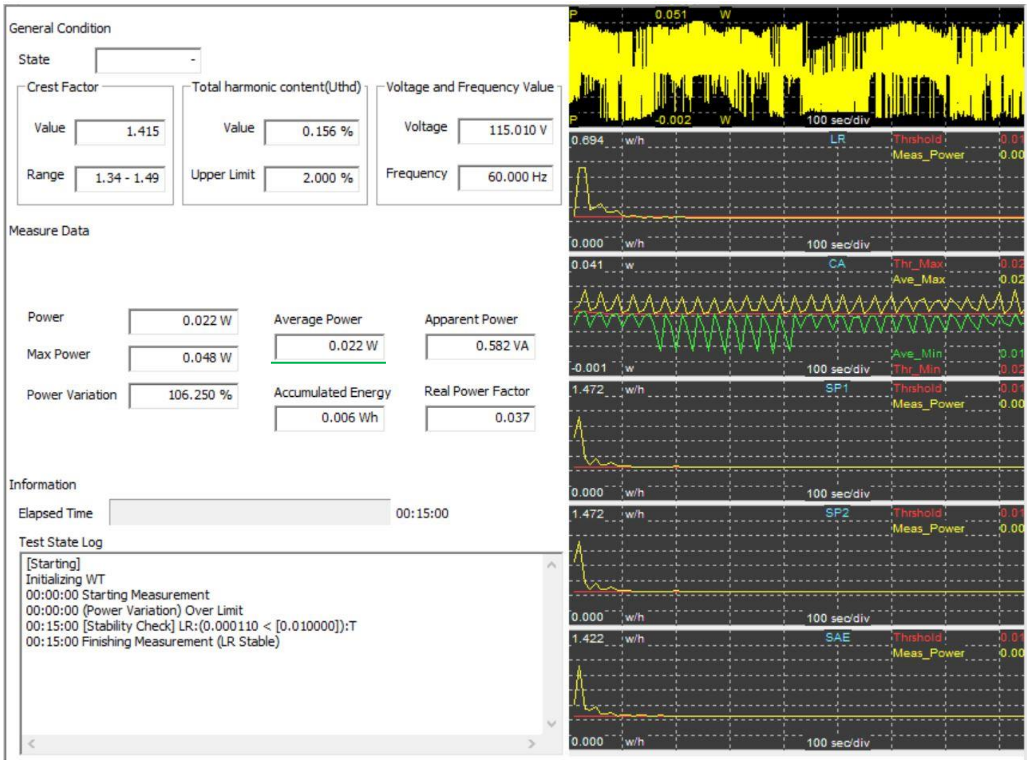
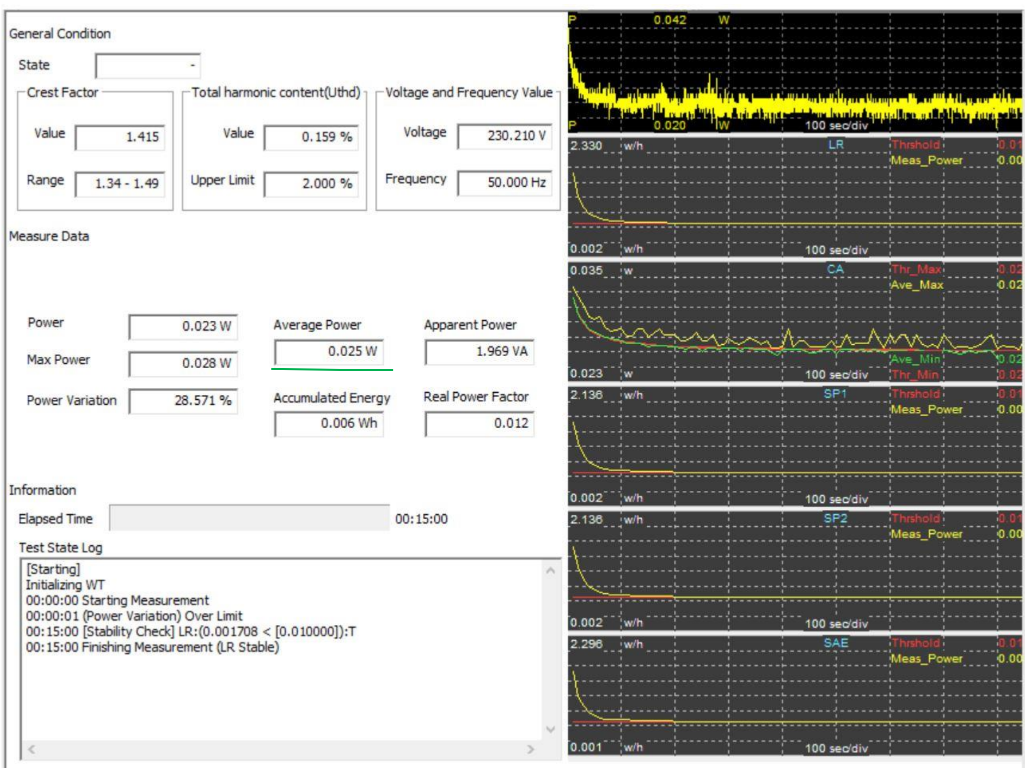


Figure 3-2-3. Detailed Power Measurement Results @230Vac, 50Hz



3.3 Output Voltage and Current Regulation

Figure 3-3-1. Regulation at 115Vac 60Hz

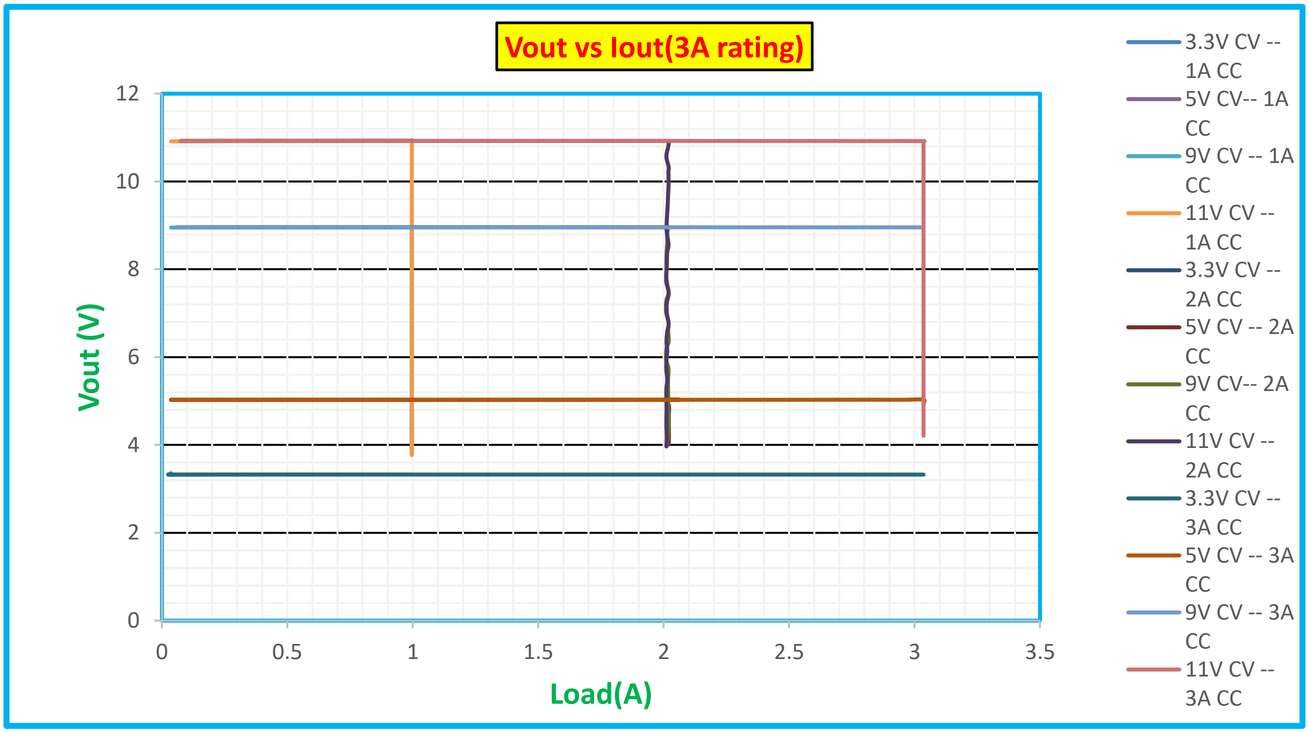
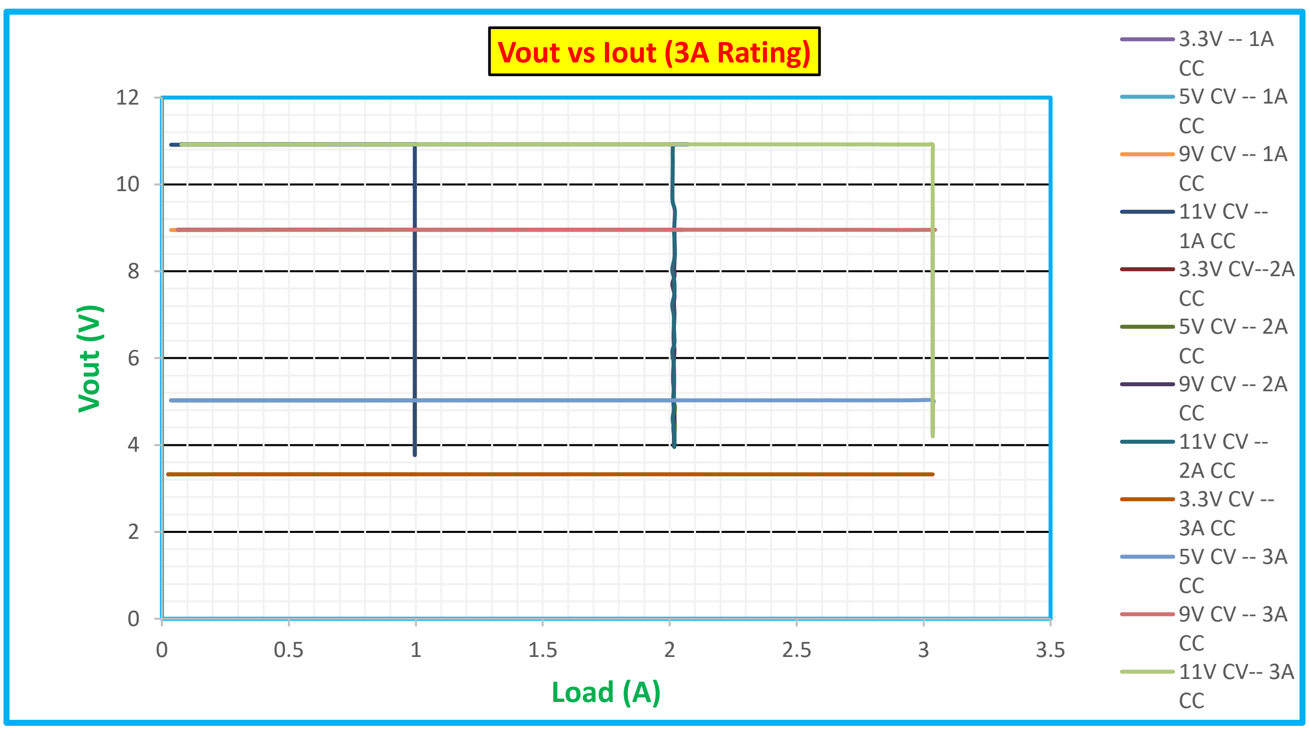


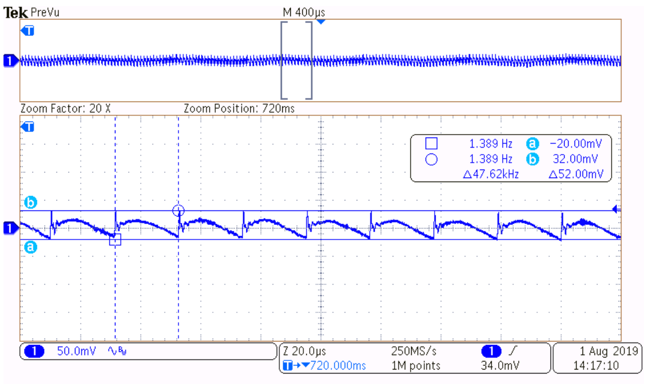
Figure 3-3-2. Regulation at 230Vac 50Hz



3.4 Output Voltage Ripple Peak-Peak

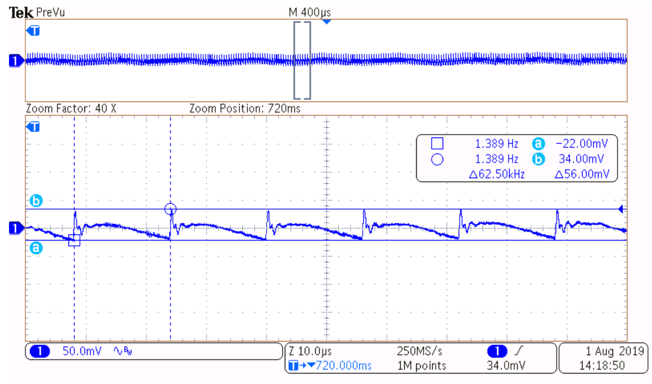
Figure 3-4-1. Ripple at 115Vac 60Hz (**CH1:** Vbus_c)

3.3V, 3A



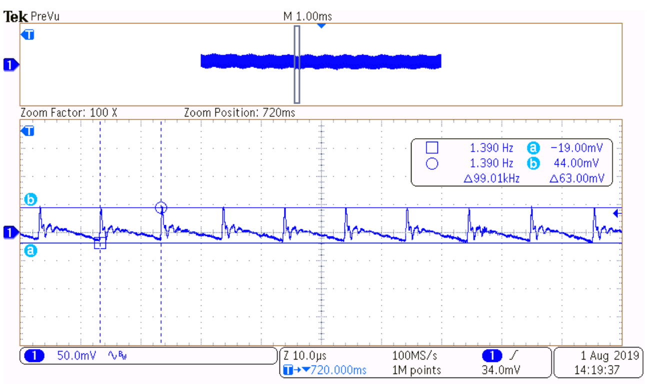
Ripple (p-p) = 52mV

5V, 3A



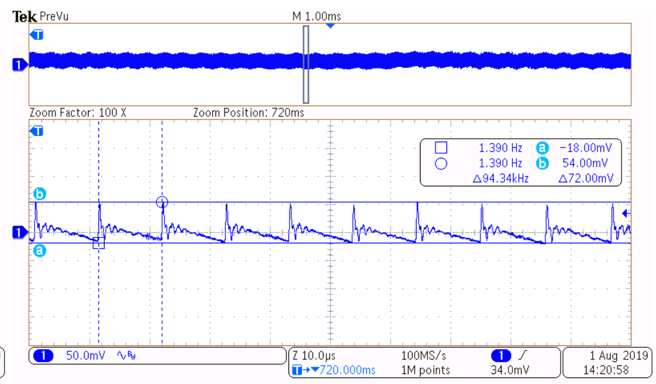
Ripple (p-p) = 56mV

9V, 3A



Ripple (p-p) = 63mV

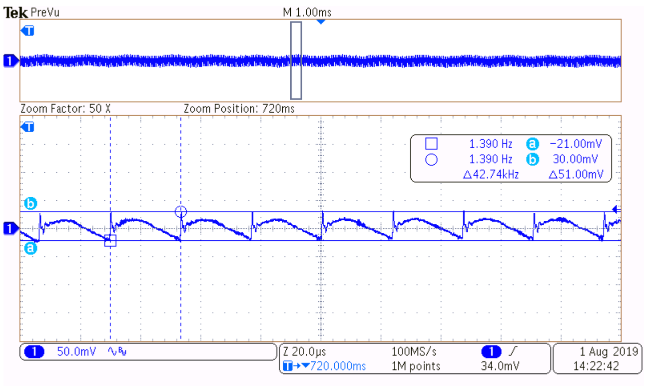
11V, 3A



Ripple (p-p) = 72mV

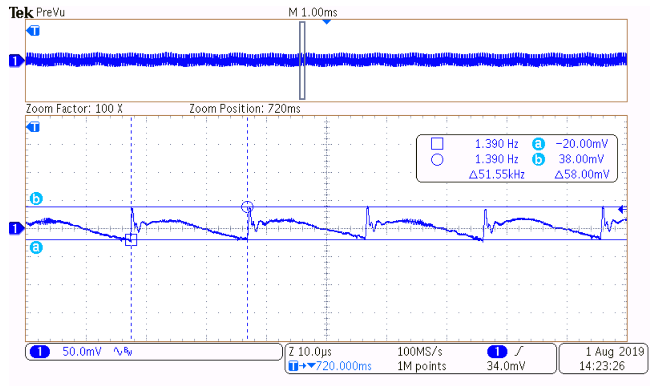
Figure 3-4-2. Ripple at 230Vac 50Hz (**CH1:** Vbus_c)

3.3V, 3A



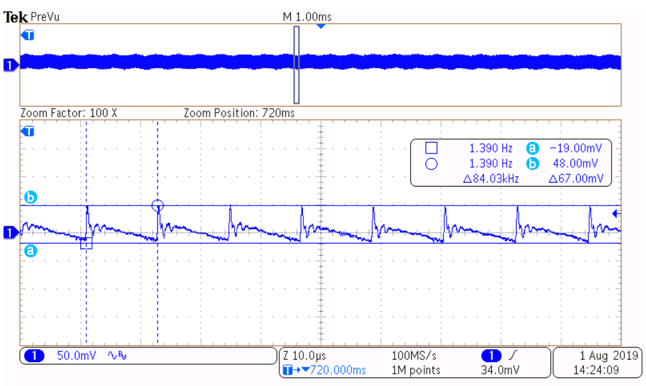
Ripple (p-p) = 51mV

5V, 3A



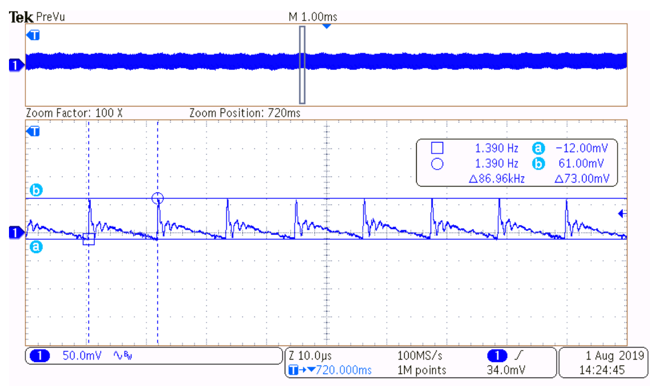
Ripple (p-p) = 58mV

9V, 3A



Ripple (p-p) = 67mV

11V, 3A

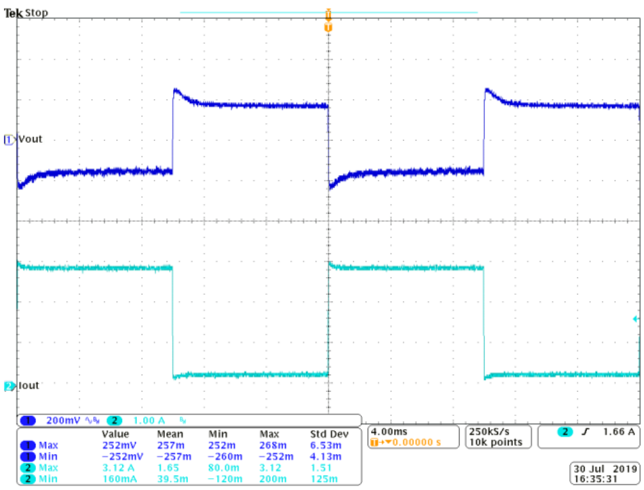


Ripple (p-p) = 73mV

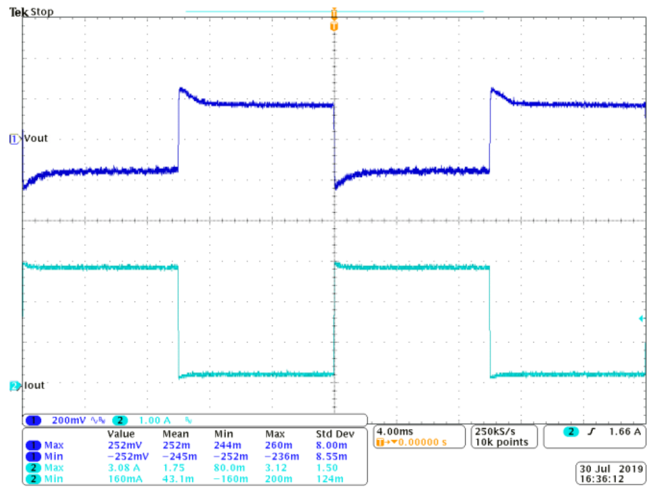
3.5 Output Dynamic Response Settling Time

Figure 3-5-1. Settling time for 115Vac, 60Hz Load Transition 0.3A-3A (**CH1:** Vbus_c, **CH2:** Iout)

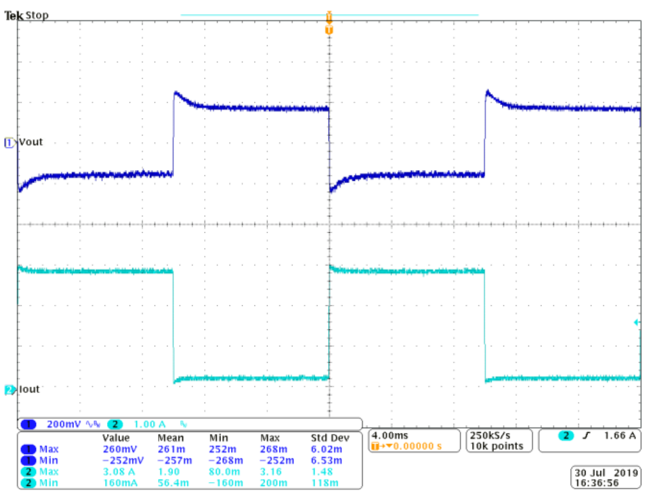
3.3V



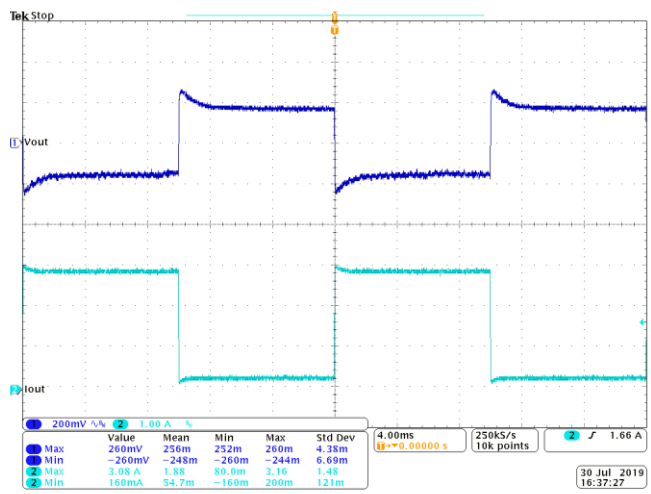
5V



9V



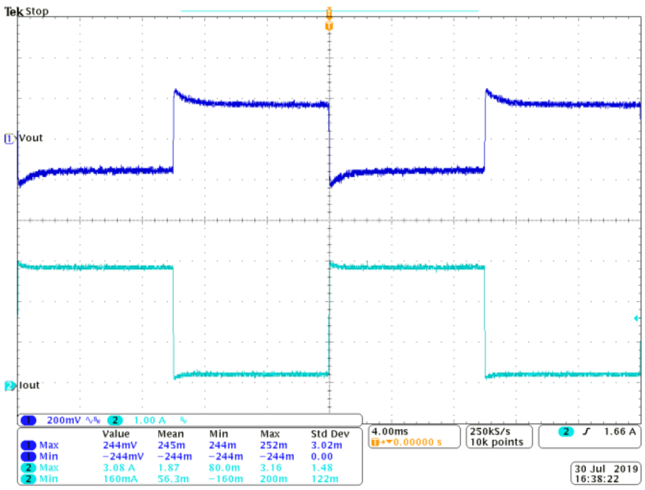
11V



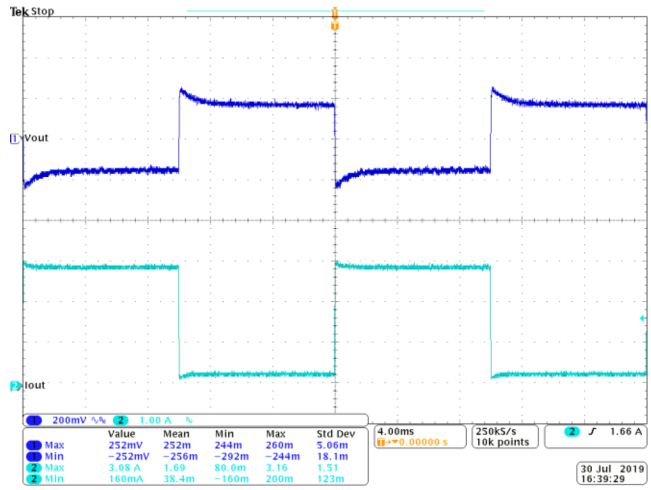
Settling Time ~2ms

Figure 3-5.2. Settling time for 230Vac, 50Hz; Load Transition 0.3A-3A (**CH1:** Vbus_c, **CH2:** Iout)

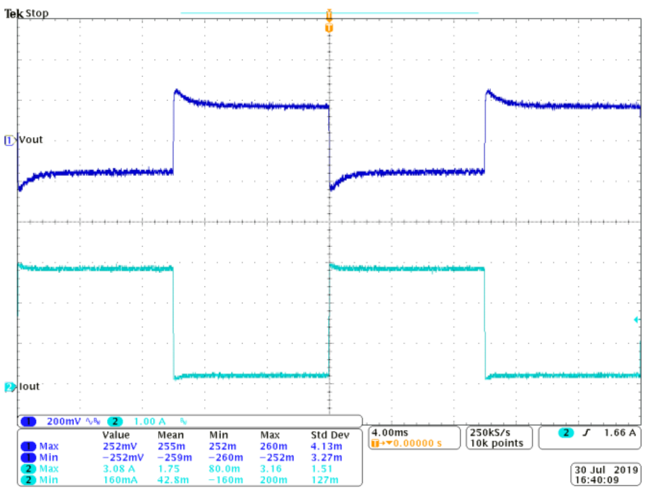
3.3V



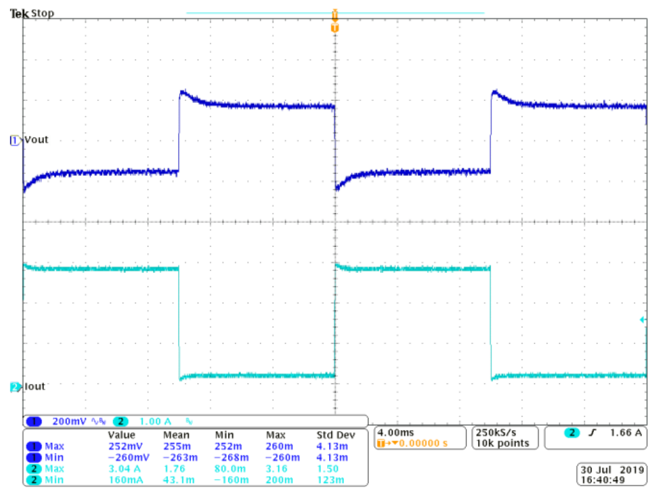
5V



9V



11V



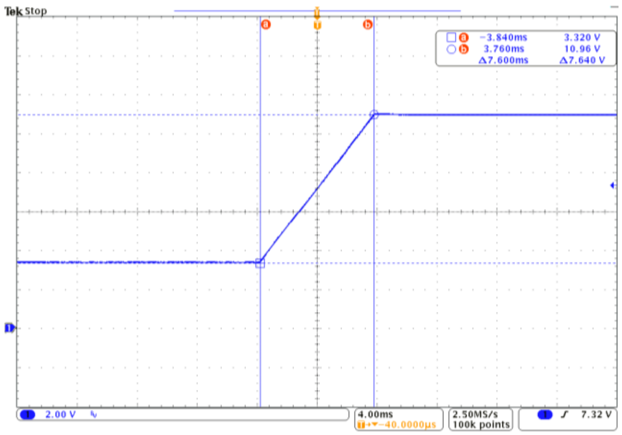
Settling Time ~2ms

3.6 Output Voltage Transition

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

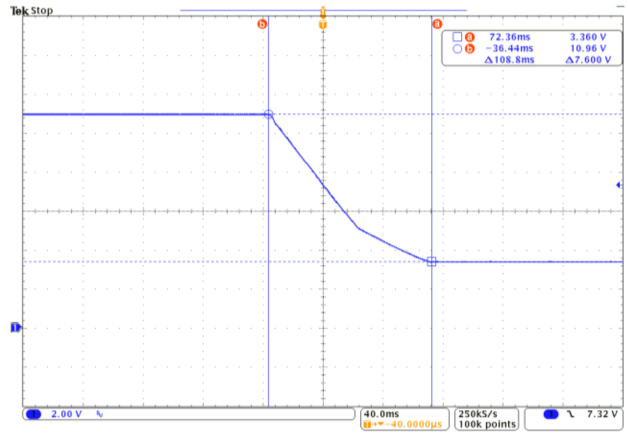
Vout = 3.3V to 11V, Iout = 0A

Transition time: 7.6ms



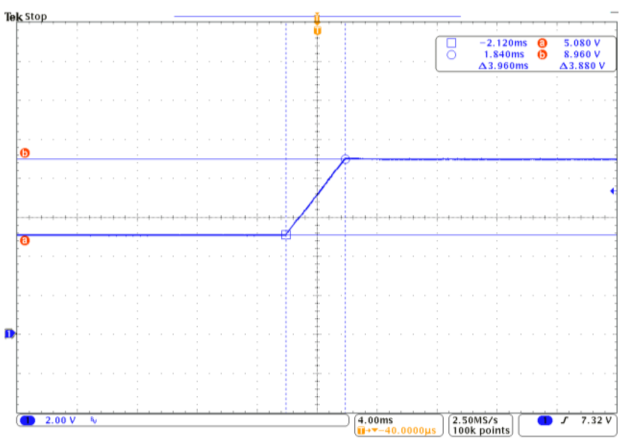
Vout = 11V to 3.3V, Iout = 0A

Transition time: 108.8ms



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

Transition time: 3.96ms



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

Transition time: 41.6ms

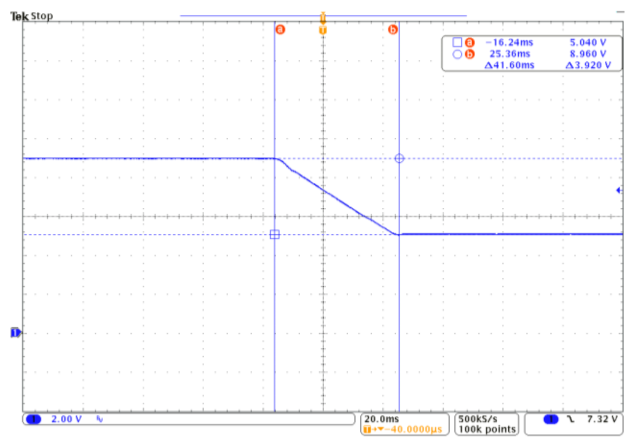
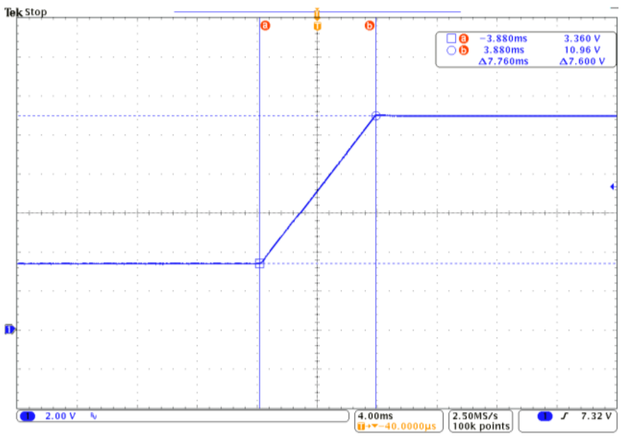


Figure 3-6-2. Output voltage transition for 230Vac, 50Hz; (**CH2:** Vbus_c)

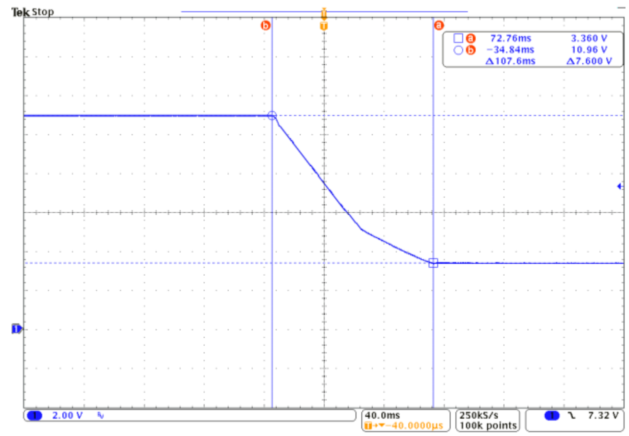
Vout = 3.3V to 11V, Iout = 0A

Transition time: 7.76ms



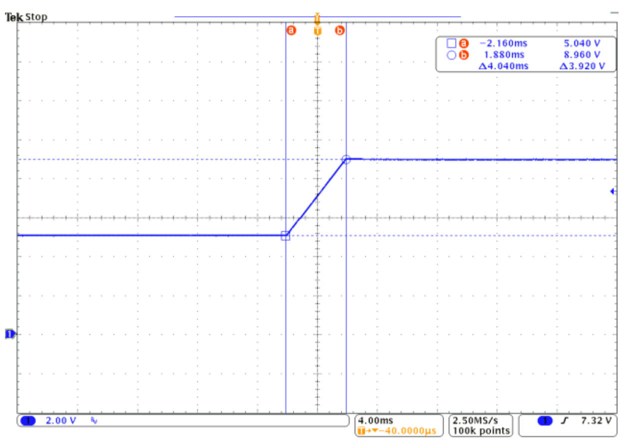
Vout = 11V to 3.3V, Iout = 0A

Transition time: 107.6ms



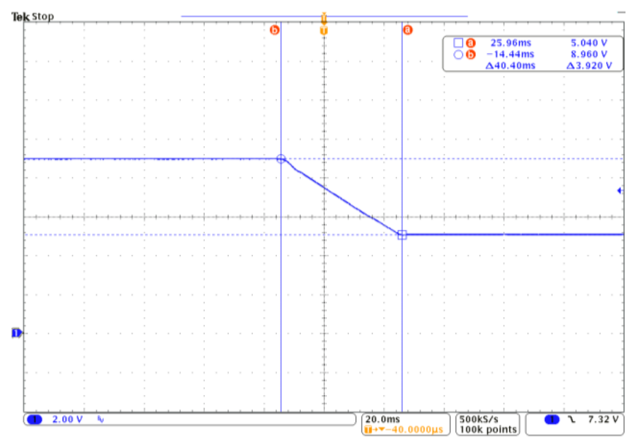
Vout = 5V to 9V, Iout = 0A

Transition time: 4.04ms



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

Transition time: 40.4ms

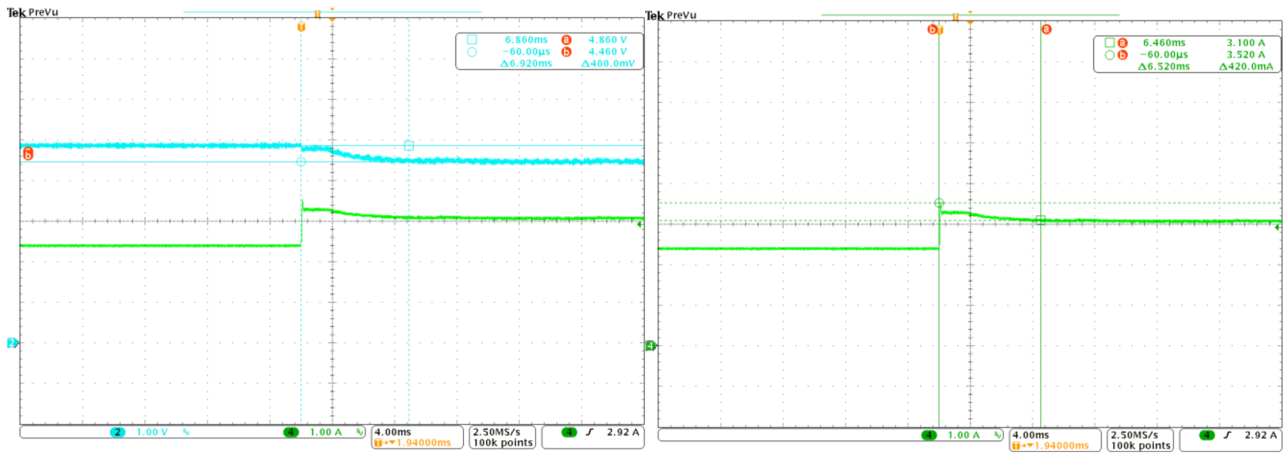


3.7 Output Current Dynamic Response

Figure 3-7. Output current dynamic response for 115Vac, 60Hz; **(CH2:** Vbus_c**, CH4:** Iout**)**

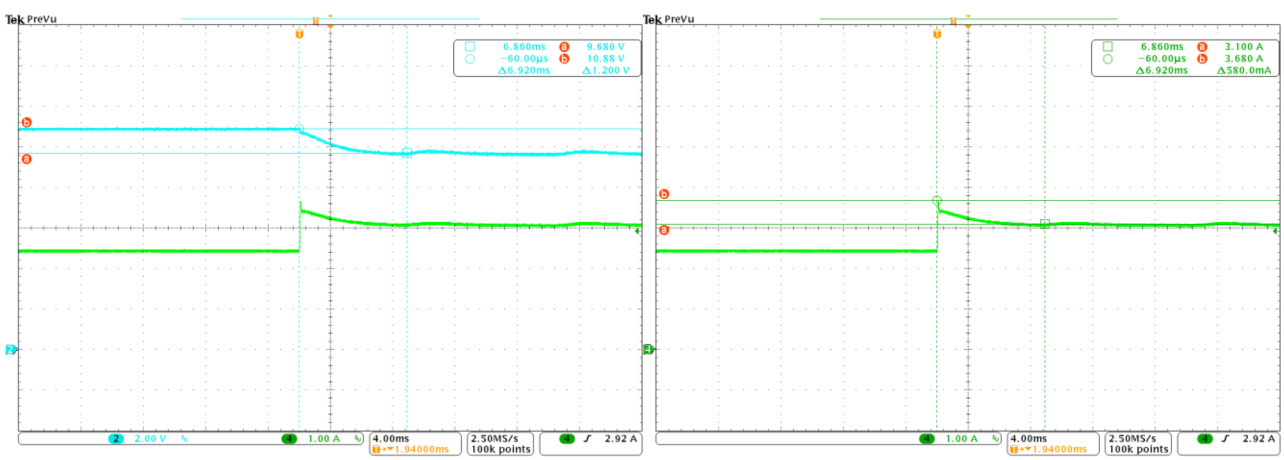
Vo = 5V; Io= 2.4A to 3.7A

(CR Mode*: R=1.85Ω to 1.25 Ω)



Vo = 11V; Io= 2.4A to 3.7A

(CR Mode*: R=4.1Ω to 2.7 Ω)



Settling Time = ~7ms

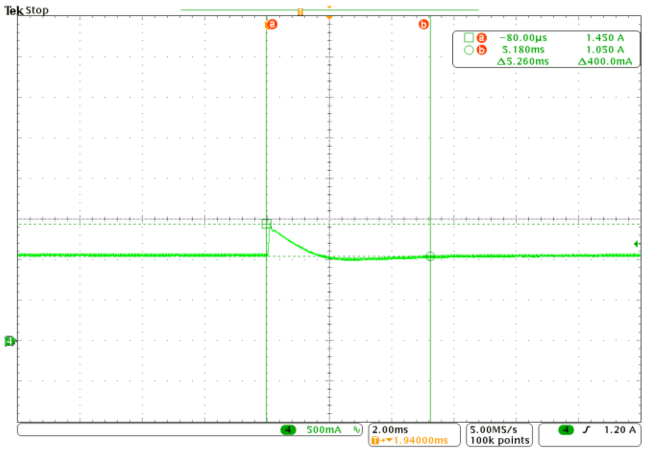
***CR Mode**: This is the mode the Electronic load should be set at.

3.8 Output Current Overshoot and Settling time

Figure 3-8. Io Overshoot and Settling Time for 115Vac, 60Hz; **(CH4:** Iout**)**

Vo = 5V; Io= 1.05A to 1.42A

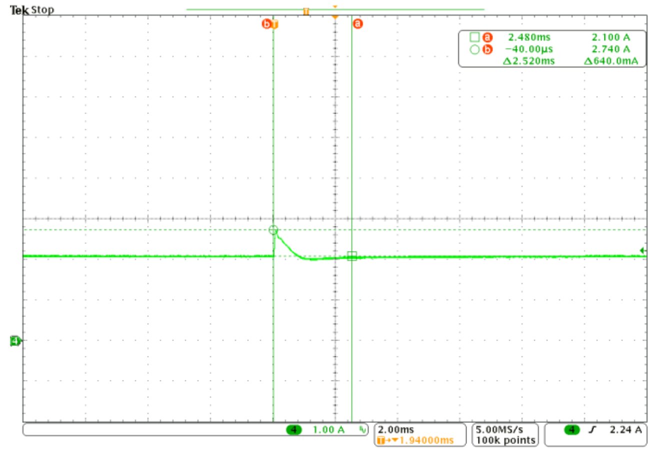
Io(limit) = 1A; (CR Mode: R=4.5Ω to 3.22 Ω)



Io Overshoot = 400mA, Settling time = 5.26ms

Vo = 5V; Io= 2.1A to 2.8A

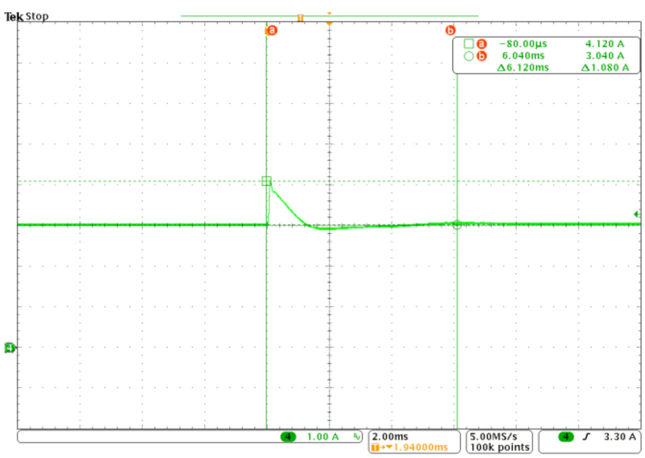
Io(limit) = 2A; (CR Mode: R=2.2Ω to 1.6 Ω)



Io Overshoot = 640mA, Settling time = 2.52ms

Vo = 5V; Io= 3.1A to 4.1A

Io(limit) = 3A; (CR Mode: R=1.47Ω to 1.07 Ω)



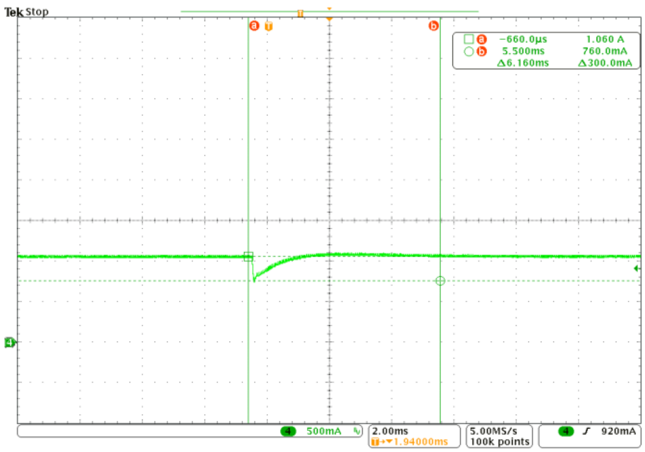
Io Overshoot = 760mA, Settling time = 6.12s

3.9 Output Current Undershoot and Settling Time

Figure 3-9. Io Undershoot and Settling Time for 115Vac, 60Hz; **(CH4:** Iout**)**

Vo = 5V; Io= 1.42A to 1.05A

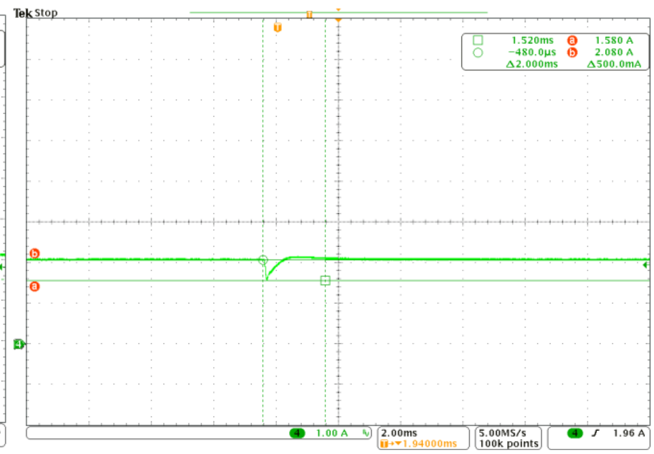
Io(limit) = 1A; (CR Mode: R=3.22Ω to 4.5 Ω)



Io Undershoot = 300mA, Settling time = 6.16ms

Vo = 5V; Io= 2.8A to 2.1A

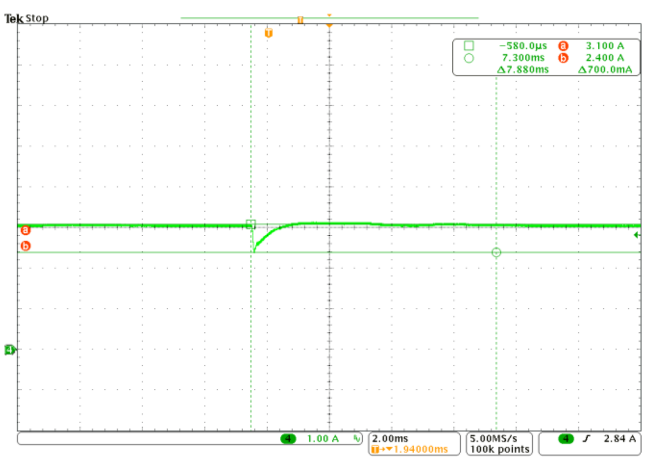
Io(limit) = 2A; (CR Mode: R=1.6Ω to 2.2Ω)



Io Undershoot = 500mA, Settling time = 2ms

Vo = 5V; Io= 3.1A to 2.24A

Io(limit) = 3A; (CR Mode: R=1.07Ω to 1.47 Ω)



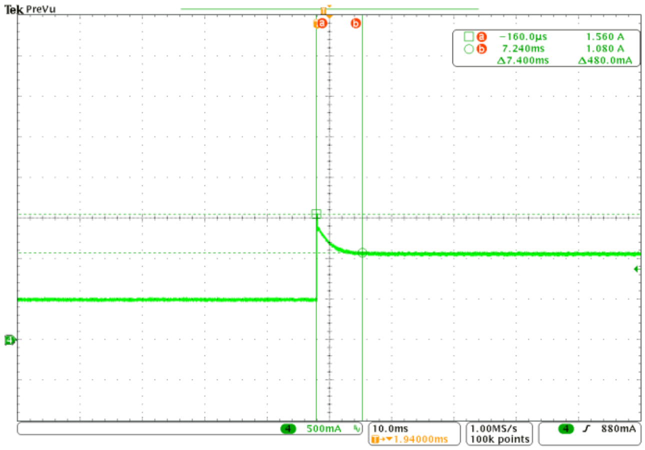
Io Undershoot = 700mA, Settling time = 7.88ms

3.10 CV-CC Transition Time

Figure 3-10. CC-CV Transition Time for 115Vac, 60Hz; **(CH4:** Iout**)**

Vo = 5V; Io= 0.66A to 1.42A

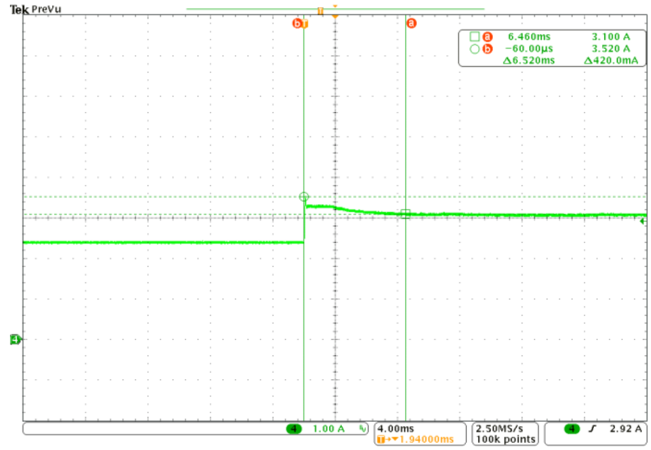
Io(limit) = 1A; (CR Mode: R=7.14Ω to 3.22 Ω)



Transition time = 7.4ms

Vo = 5V; Io= 2.5A to 4.1A

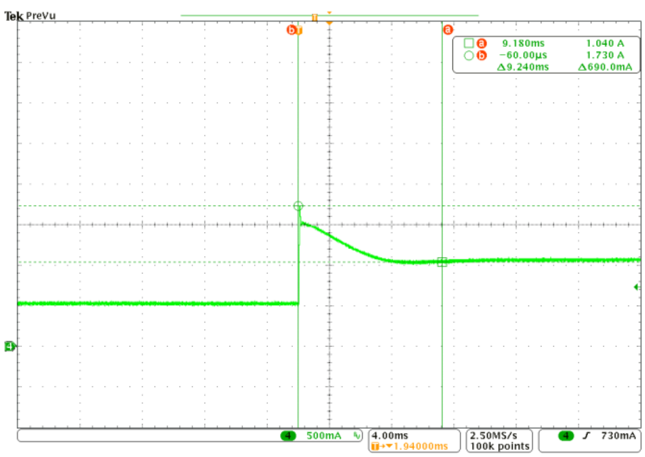
Io(limit) = 3A; (CR Mode: R=1.8Ω to 1.07Ω)



Transition time = 6.52ms

Vo = 11V; Io= 0.7A to 1.57A

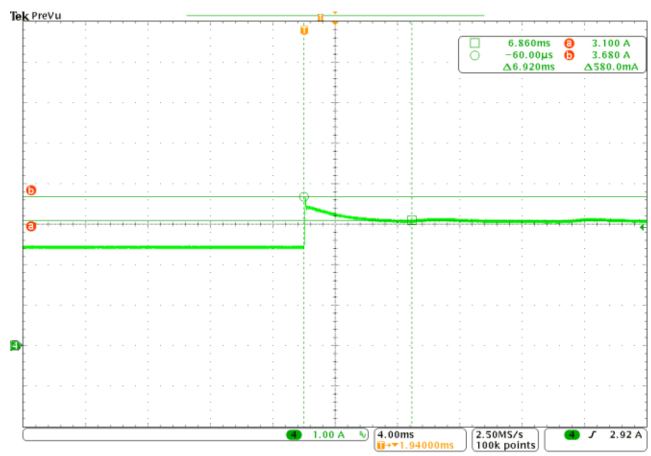
Io(limit) = 1A; (CR Mode: R=15Ω to 6.5 Ω)



Transition time = 9.24ms

Vo = 11V; Io= 2.5A to 3.54A

Io(limit) = 3A; (CR Mode: R=4.2Ω to 3Ω)



Transition time = 6.92ms

3.11 Start-up Turn-on Delay

Figure 3-11-1. Start-up Turn-on Delay at 90Vac, 47Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

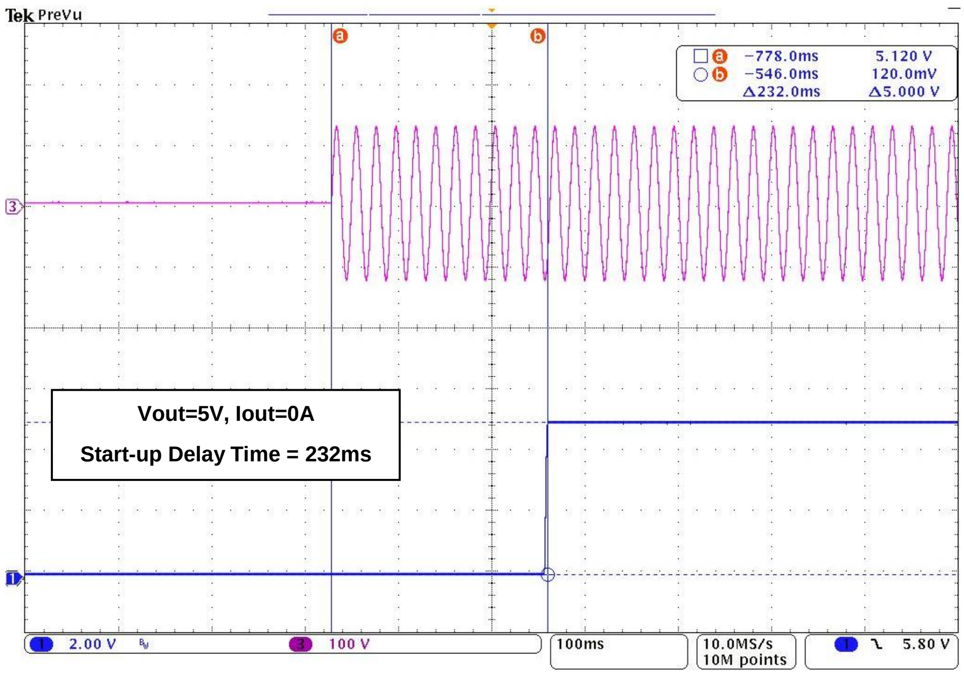


Figure 3-11-2. Start-up Turn-on Delay at 115Vac, 60Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

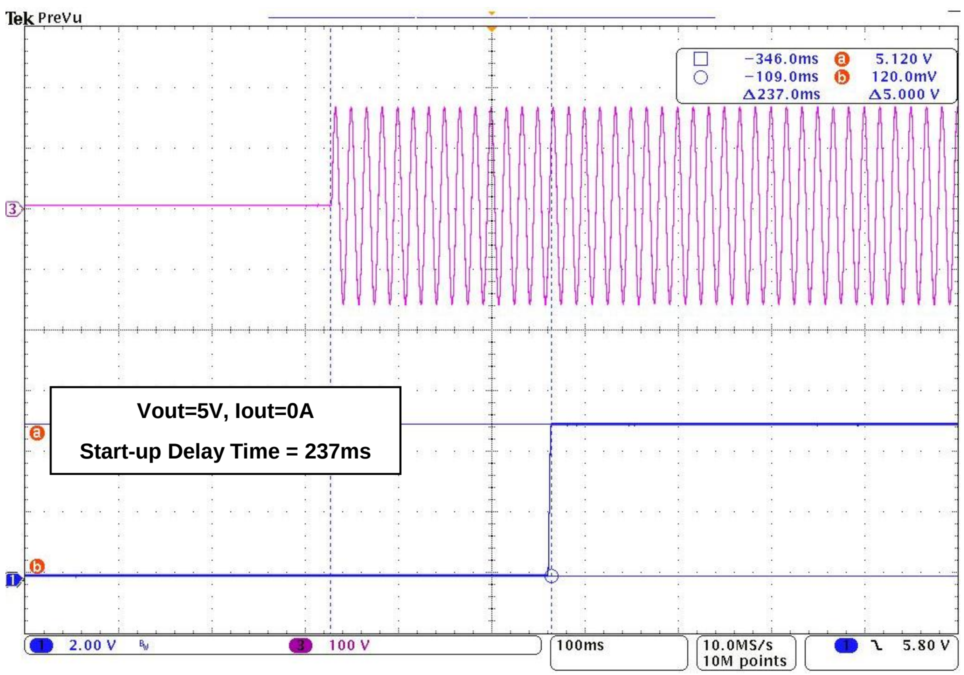


Figure 3-11-3. Start-up Turn-on Delay at 230Vac, 50Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

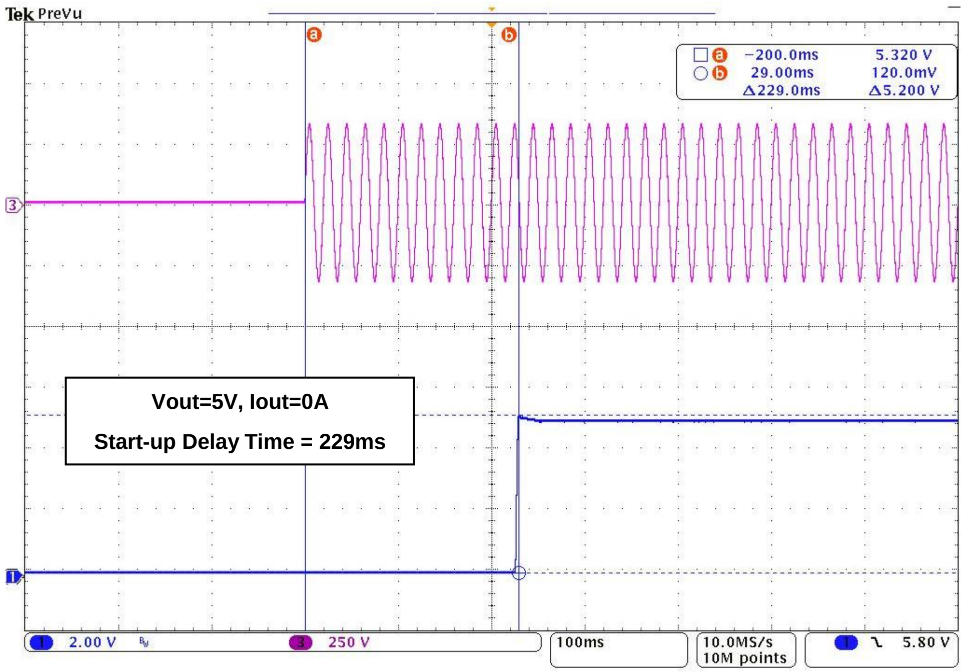
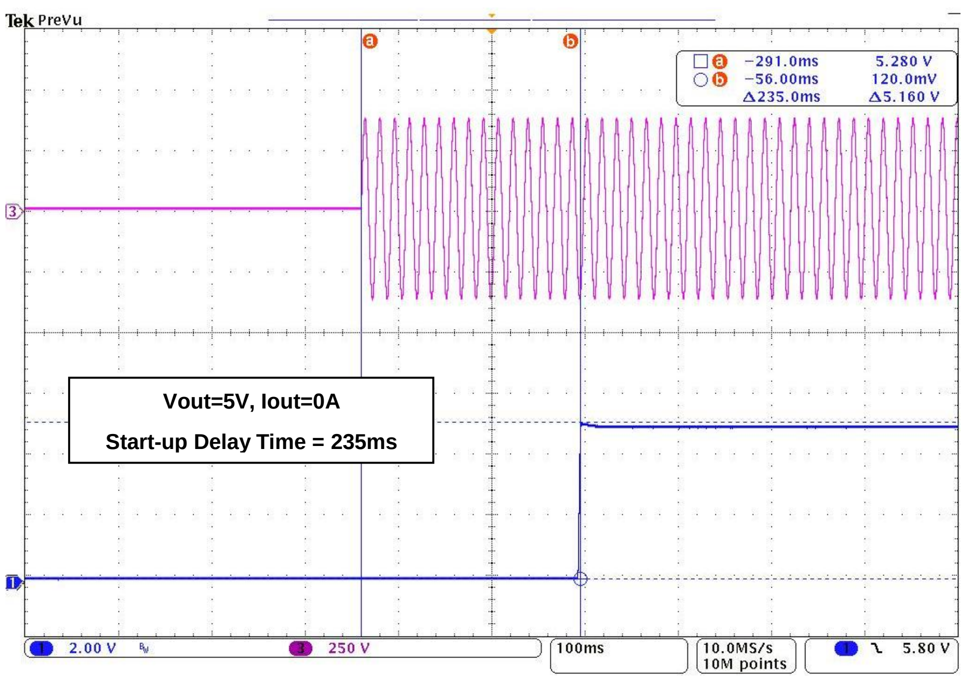


Figure 3-11-4. Start-up Turn-on Delay at 265Vac, 63Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)



3.12 Start-up Rise Time

Figure 3-12-1. Start-up Rise time at 90Vac, 47Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

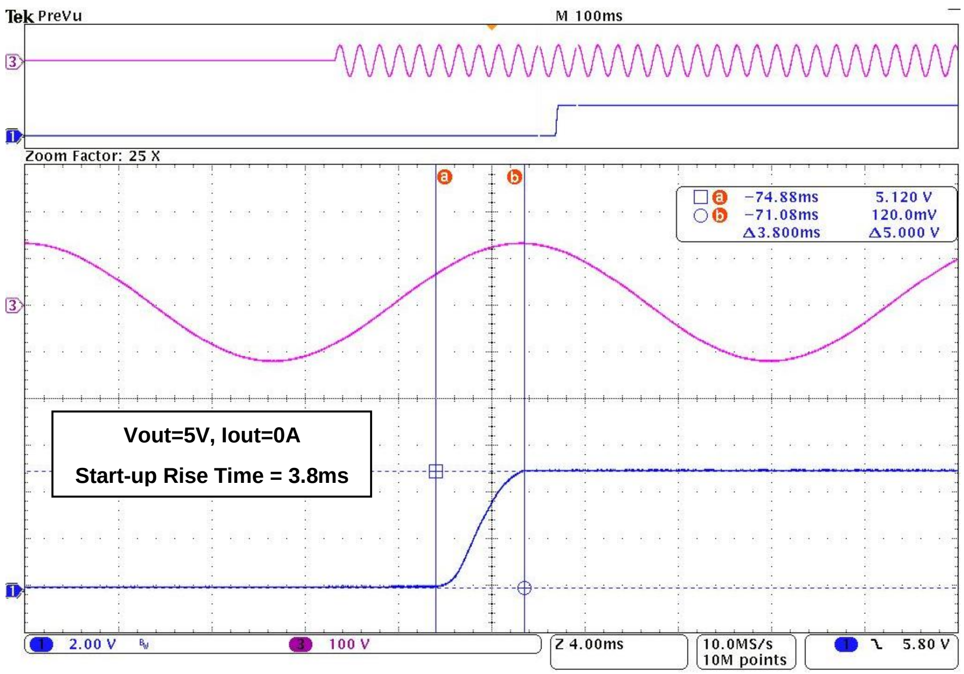


Figure 3-12-2 Start-up Rise time at 115Vac, 60Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

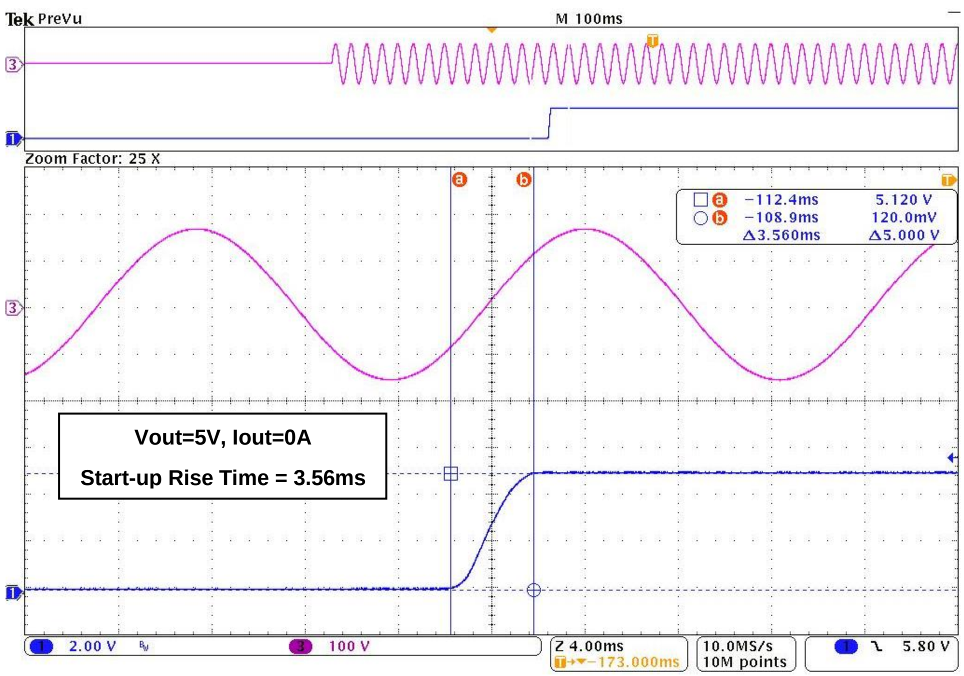


Figure 3-12-3. Start-up Rise time at 230Vac, 50Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

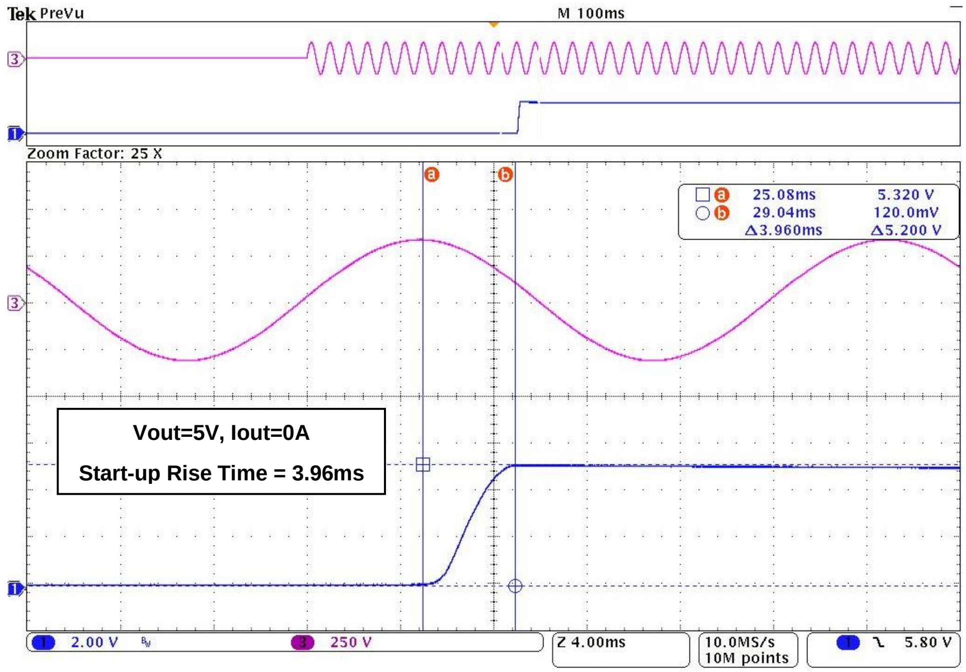
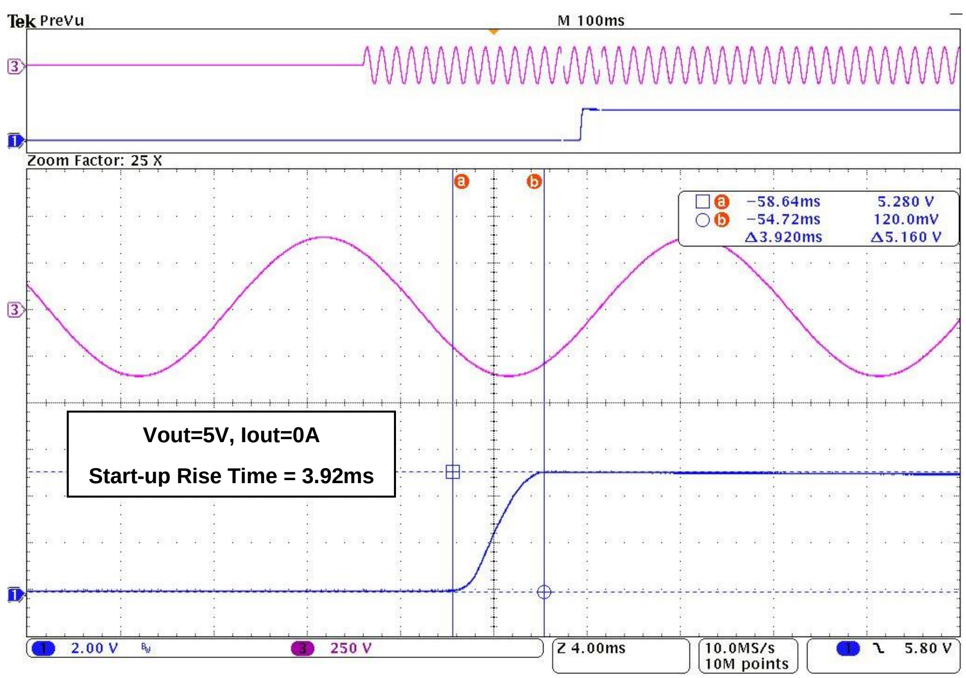


Figure 3-12-4. Start-up Rise time at 265Vac, 63Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)



3.13 Hold-up Time

Figure 3-13-1. Hold-up time at 90Vac, 47Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

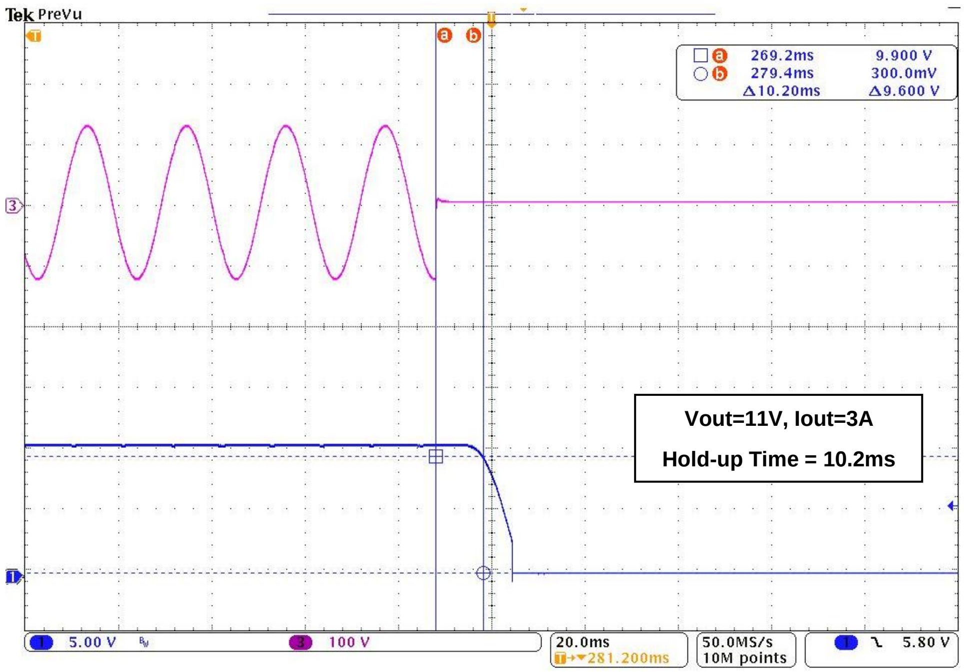


Figure 3-13-2. Hold-up time at 115Vac, 60Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

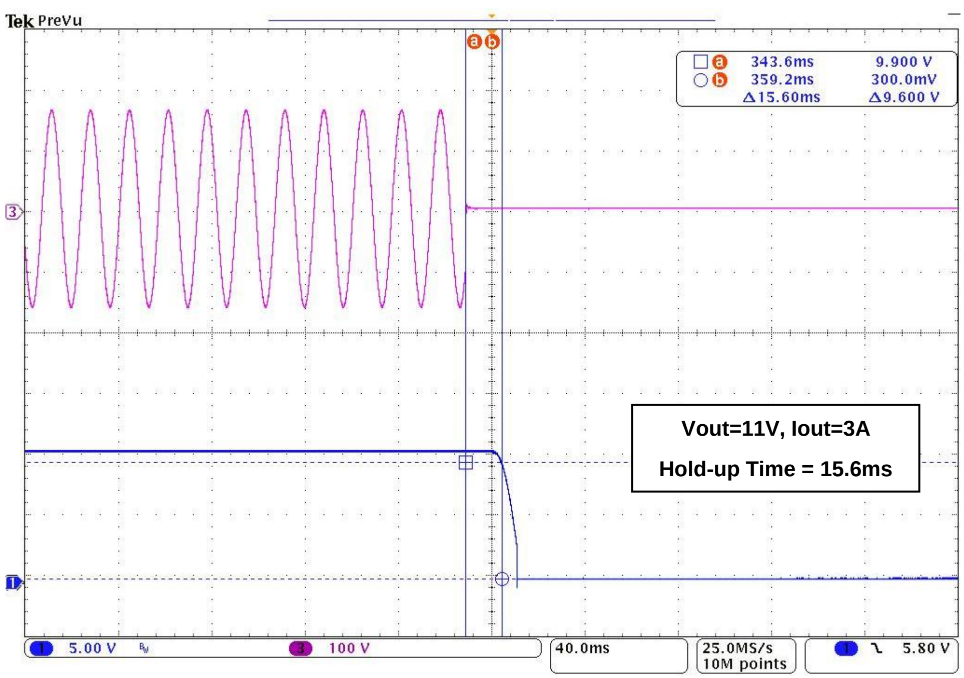


Figure 3-13-3. Hold-up time at 230Vac, 50Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

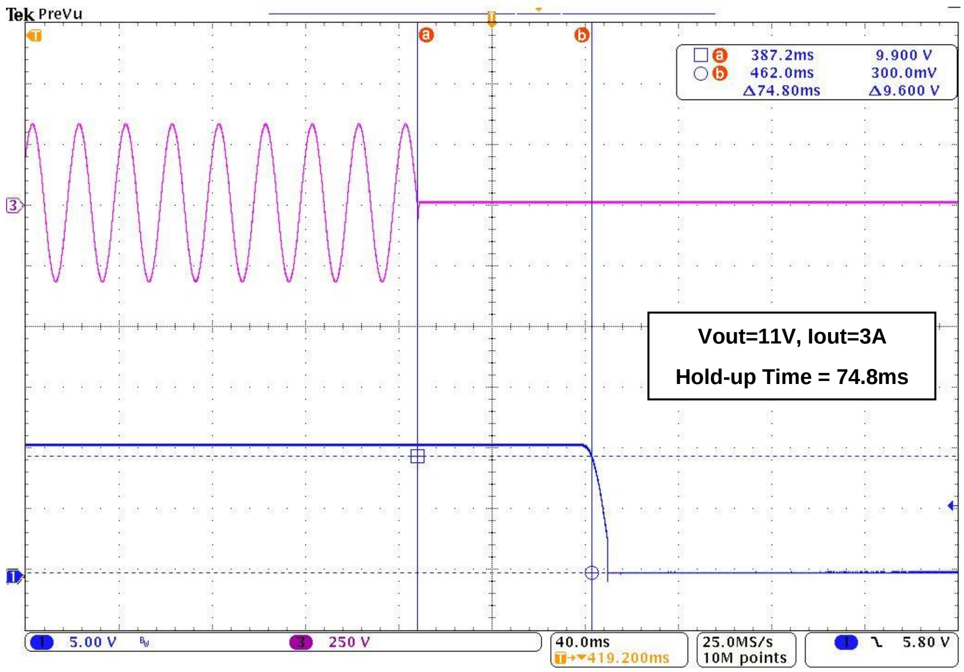
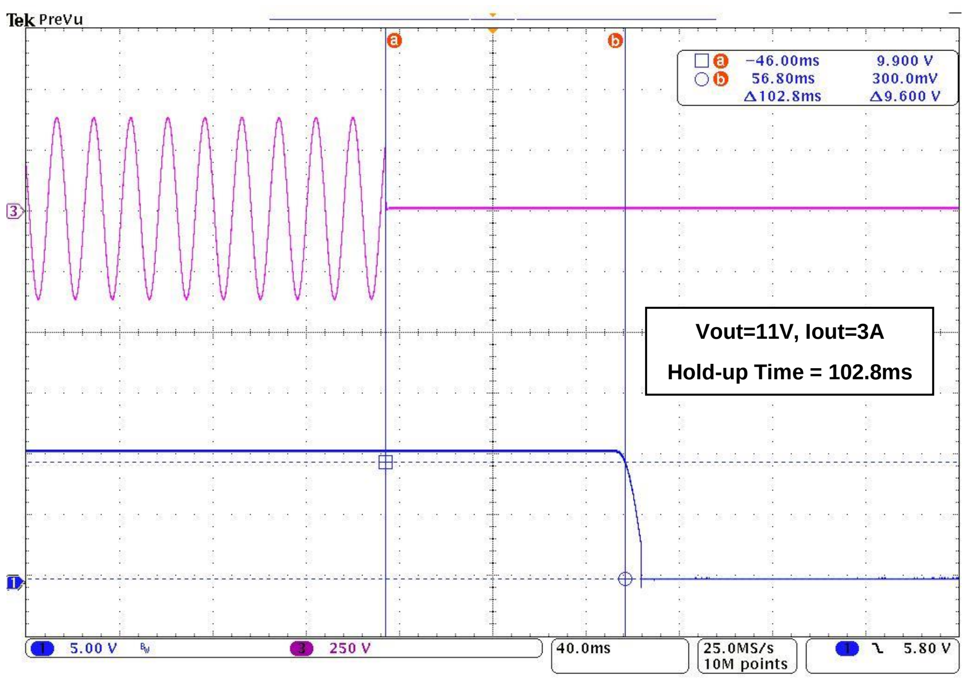


Figure 3-13-4. Hold-up time at 265Vac, 63Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)



3.14 Shut-down Fall Time

Figure 3-14-1. Shut-down Fall time at 90Vac, 47Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

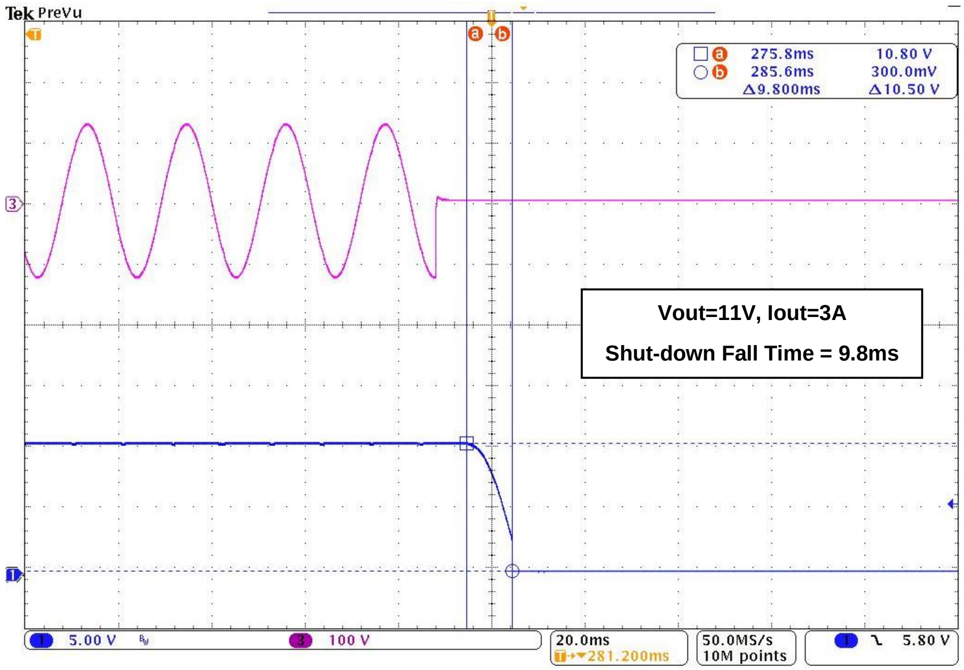


Figure 3-14-2. Shut-down Fall time at 115Vac, 60Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

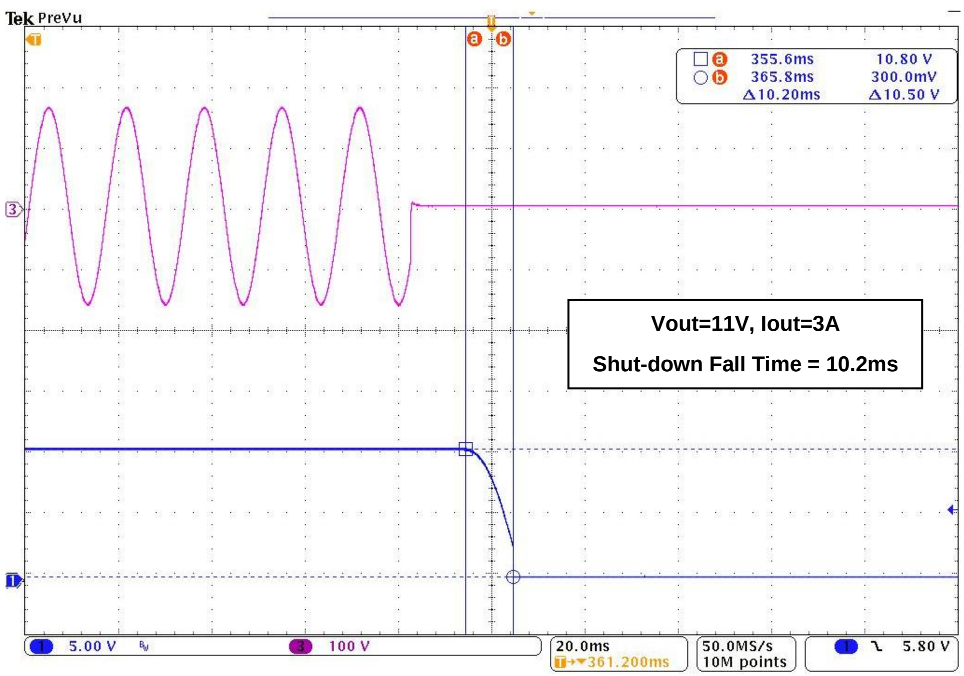


Figure 3-14-3. Shut-down Fall time at 230Vac, 50Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)

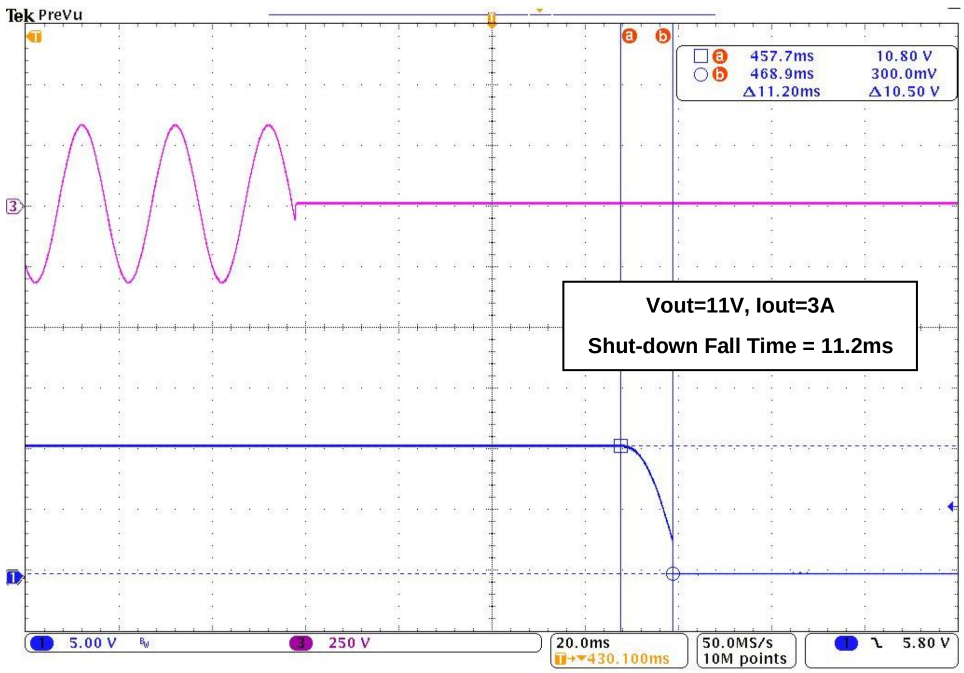
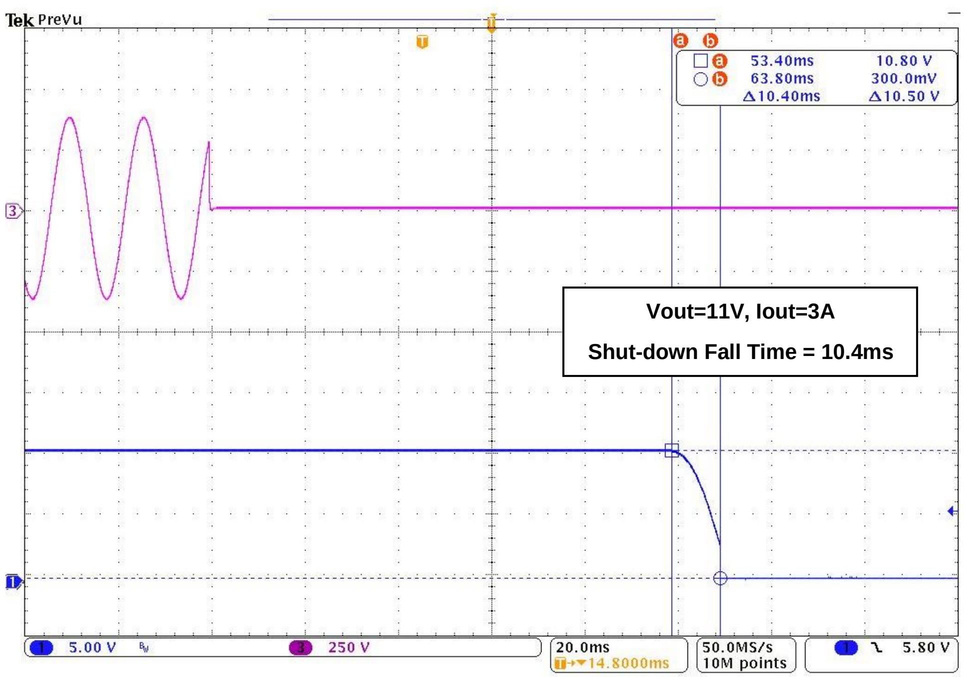


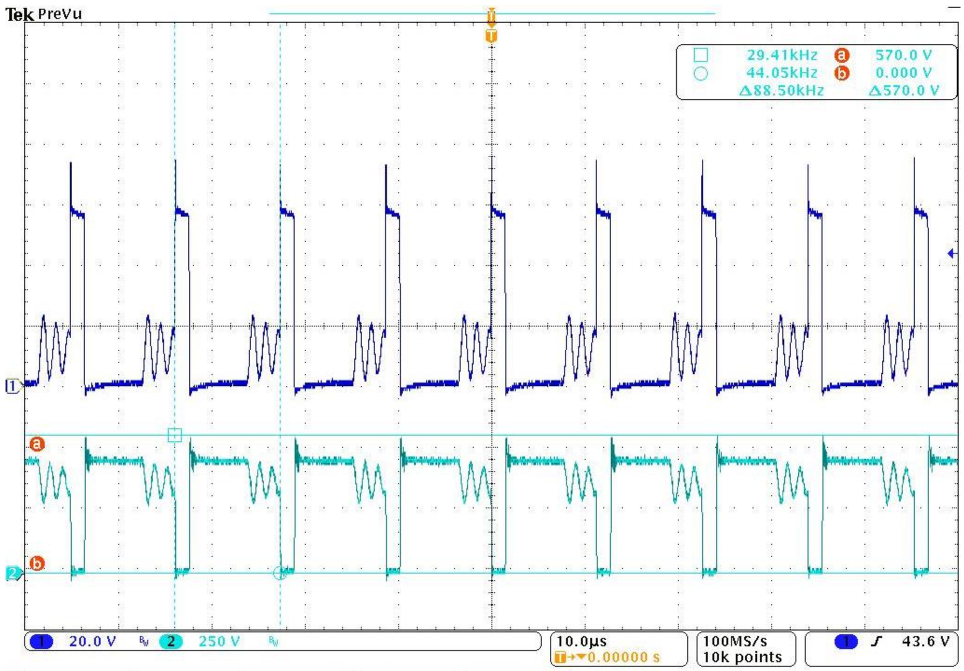
Figure 3-14-4. Shut-down Fall time at 265Vac, 63Hz (**CH1:** Vbus_c**, CH3:** Vin_ac)



3.15 Switch Voltage Stress

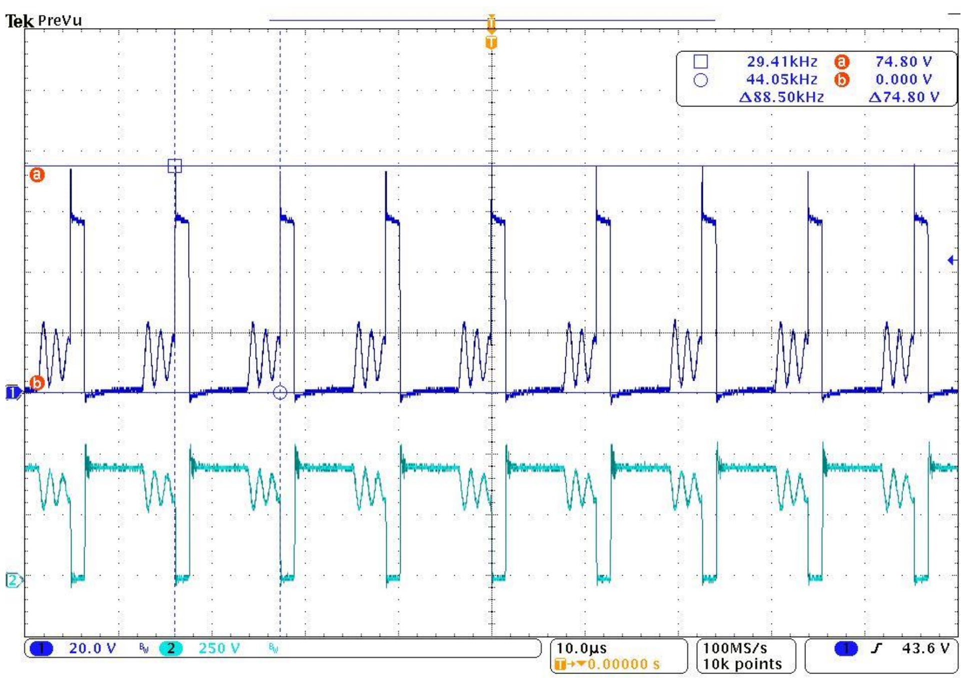
Condition: Vin = 265Vac, 63Hz, Vout=11V & Iout=3A

Figure 3-15-1. Voltage Stress on Primary FET (**CH1:** Vds_secondary**, CH2:** Vds_primary)



Vds_primary = 570V

Figure 3-15-2. Voltage Stress on Secondary FET (**CH1:** Vds_secondary**, CH2:** Vds_primary)

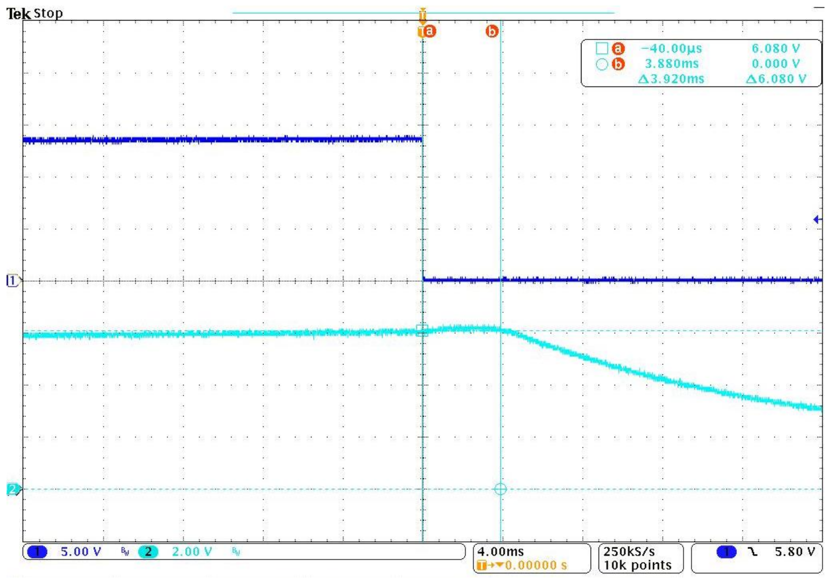


Vds_secondary = 74.8V

3.16 Over Voltage Protection (OVP)

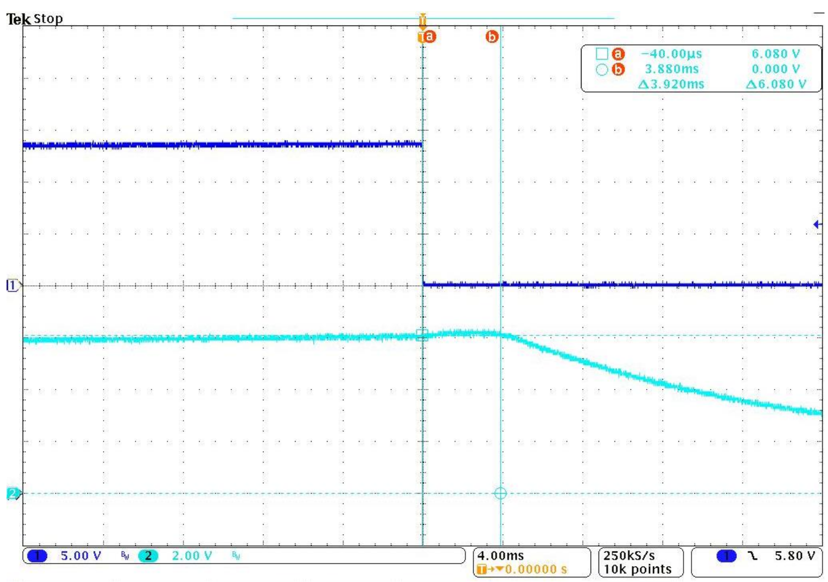
Figure 3-16. OVP at 115Vac, 60Hz (**CH1**: NGDO_Gate[2], **CH2**: Vbus_c)

Vout = 3.3V, OVP_Voltage = 6.080V*
DC Voltage applied on Vbus_c=9V, System Response Time[1] = 3.92ms

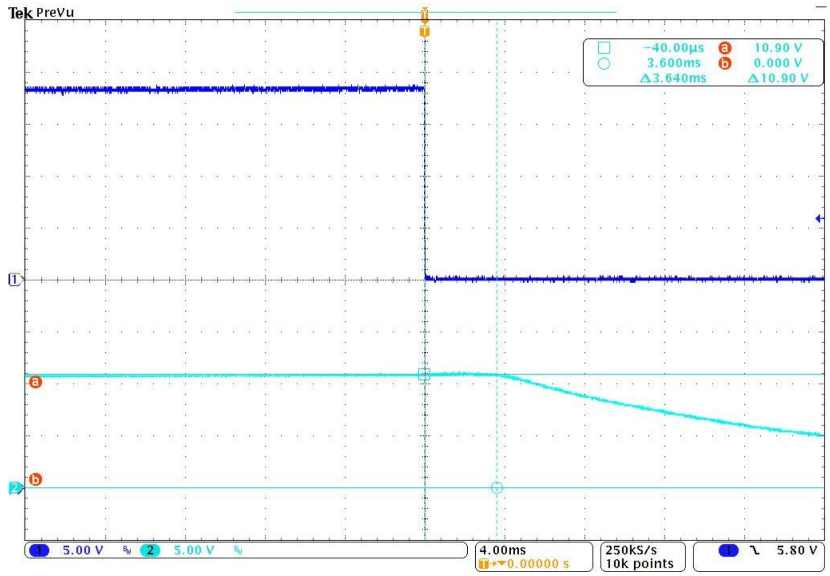


*Minimum OVP Threshold = 6V (Both for 3.3V and 5V)

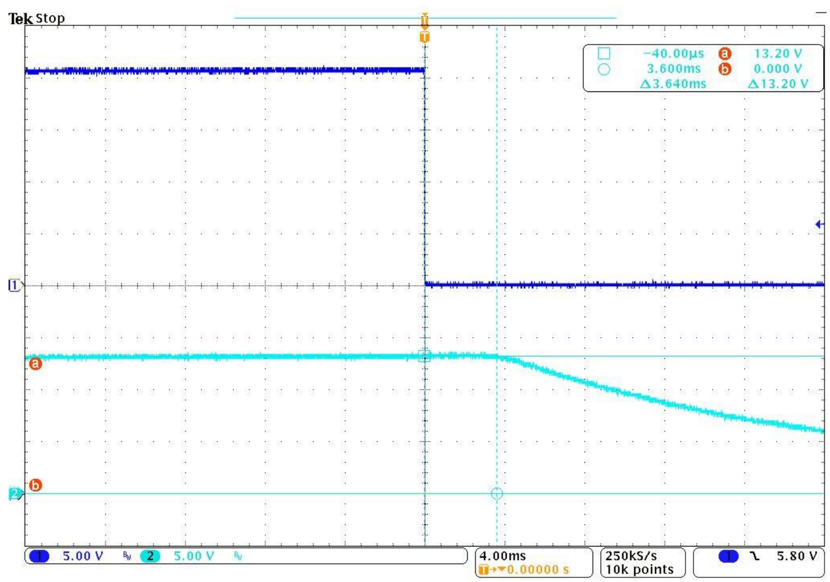
Vout = 5V, OVP_Voltage = 6.080V
DC Voltage applied on Vbus_c=9V, System Response Time[1] = 3.92ms



Vout = 9V, OVP_Voltage = 10.9V
DC Voltage applied on Vbus_c=15V, System Response Time[1] = 3.64ms



Vout = 11V, OVP_Voltage = 13.2V
DC Voltage applied on Vbus_c=18V, System Response Time[1] = 3.64ms



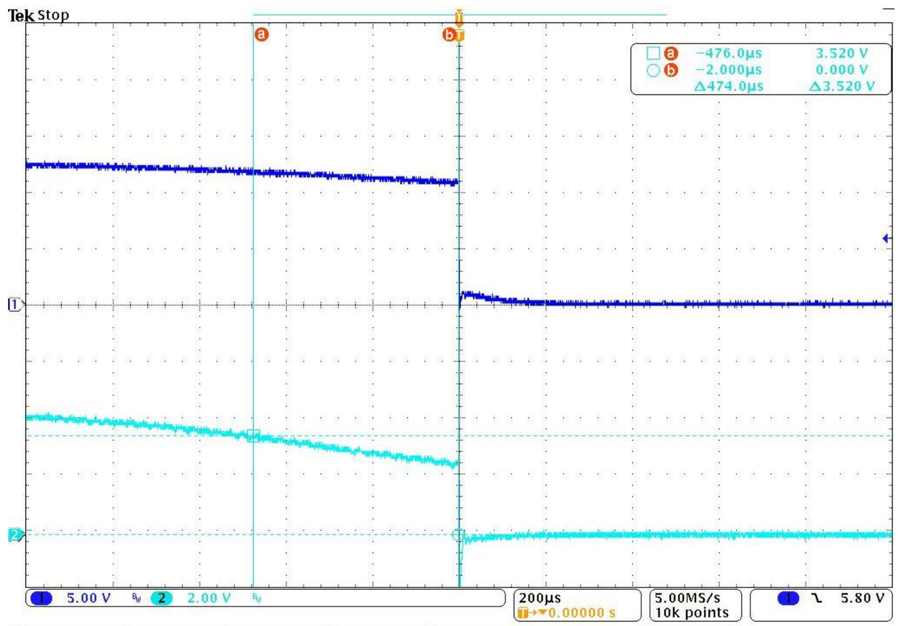
Note:

1. System Response time may vary depending on system design
2. NGDO: NFET Gate driver output (Provider/Output MOSFET)

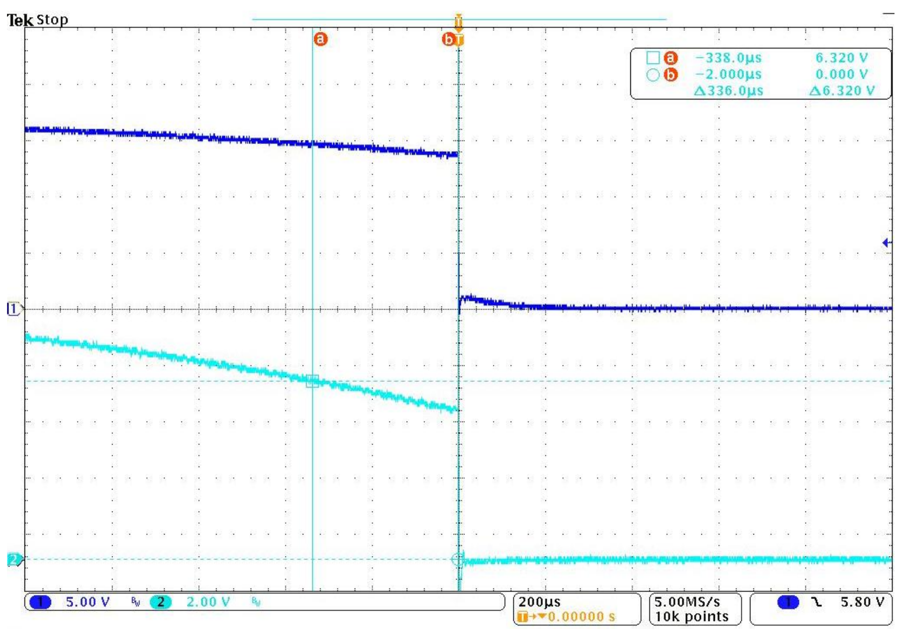
3.17 Under Voltage Protection (UVP)

Figure 3-17-1. UVP at 115Vac, 60Hz: Fixed-PDO (**CH1**: Vbus_C, **CH2**: NGDO_Gate[2])

Vout = 5V, UVP_Voltage = 3.52V*
Load Current applied on Vbus_C=10A, System Response Time[1] = 474µs



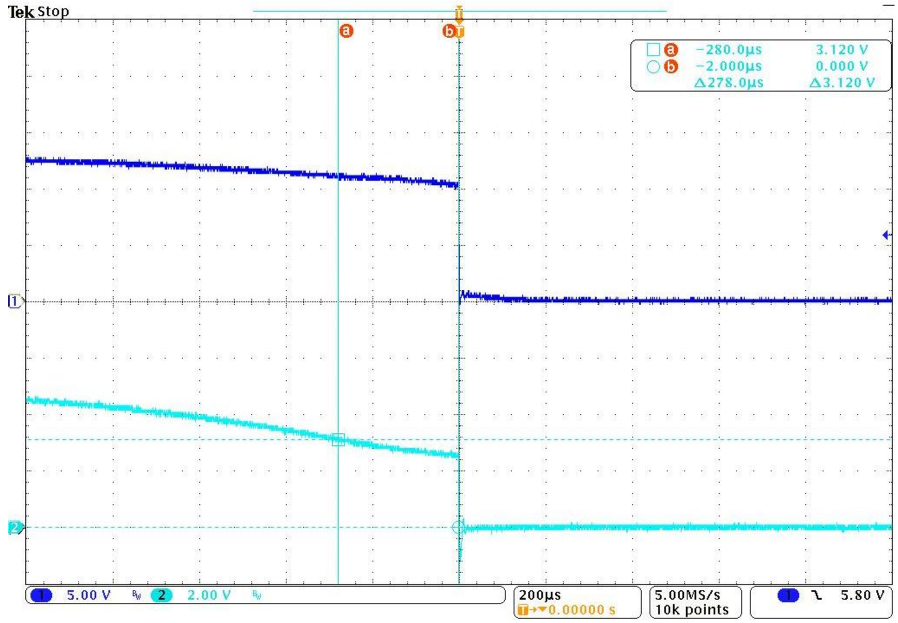
Vout = 9V, UVP_Voltage = 6.32V*
Load Current applied on Vbus_C=10A, System Response Time[1] = 336µs



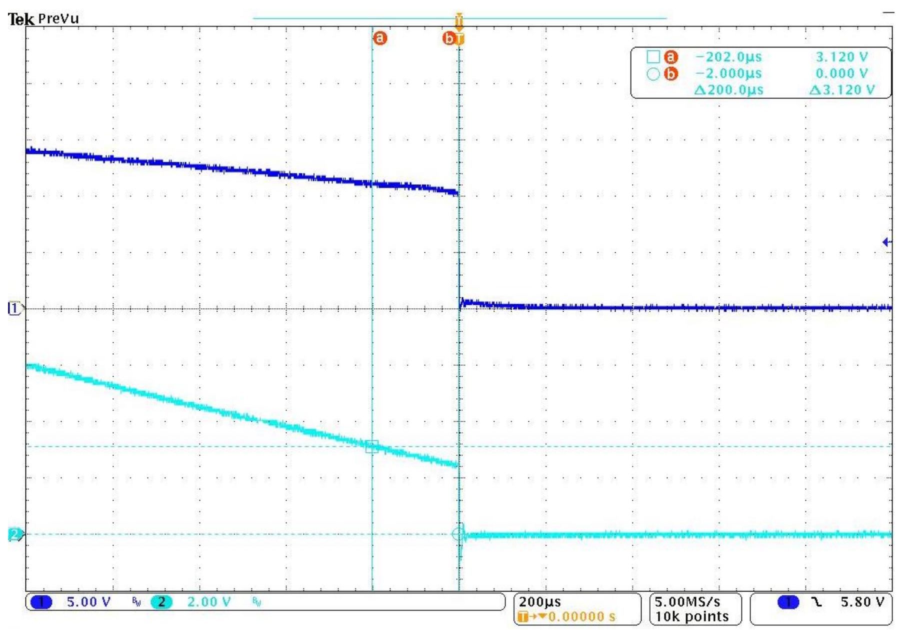
*UVP Threshold = 70% of Vbus_C for Fixed-PDO (Refer Appendix 5.7)

Figure 3-17-2. UVP at 115Vac, 60Hz: PPS-PDO (**CH1**: Vbus_C, **CH2**: NGDO_Gate[2])

Vout = 5V, UVP_Voltage = 3.12V*
Load Current applied on Vbus_C=5A, System Response Time[1] = 278µs



Vout = 9V, UVP_Voltage = 3.12V*
Load Current applied on Vbus_C=5A, System Response Time[1] = 200µs



*UVP Threshold is around 3.1V for PPS-PDO due to Voltage foldback phenomenon

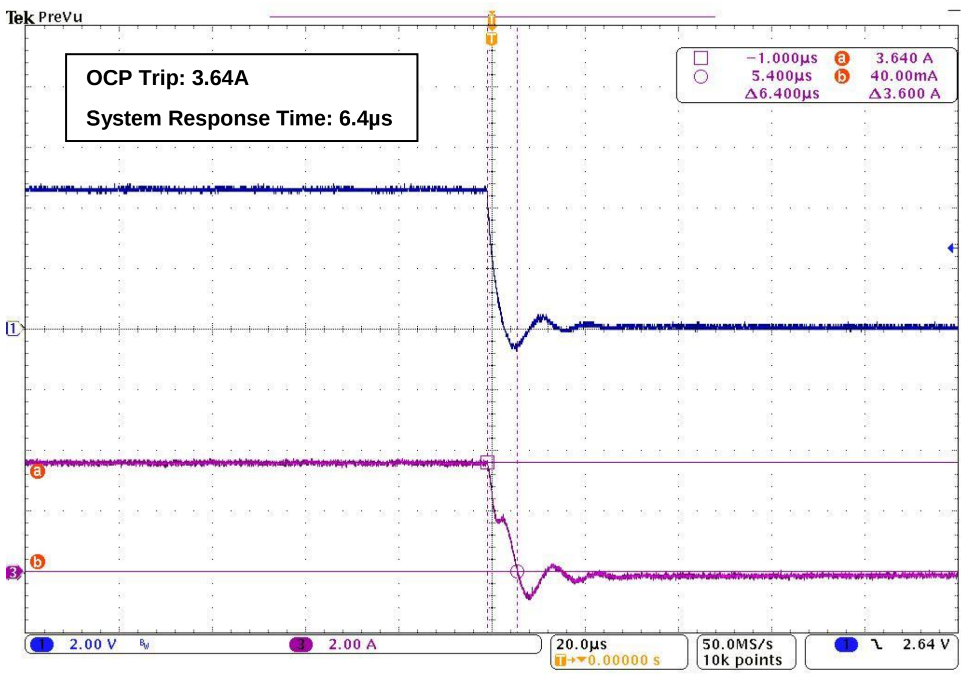
Note:

1. System Response time may vary depending on system design
2. NGDO: NFET Gate driver output (Provider/Output MOSFET)

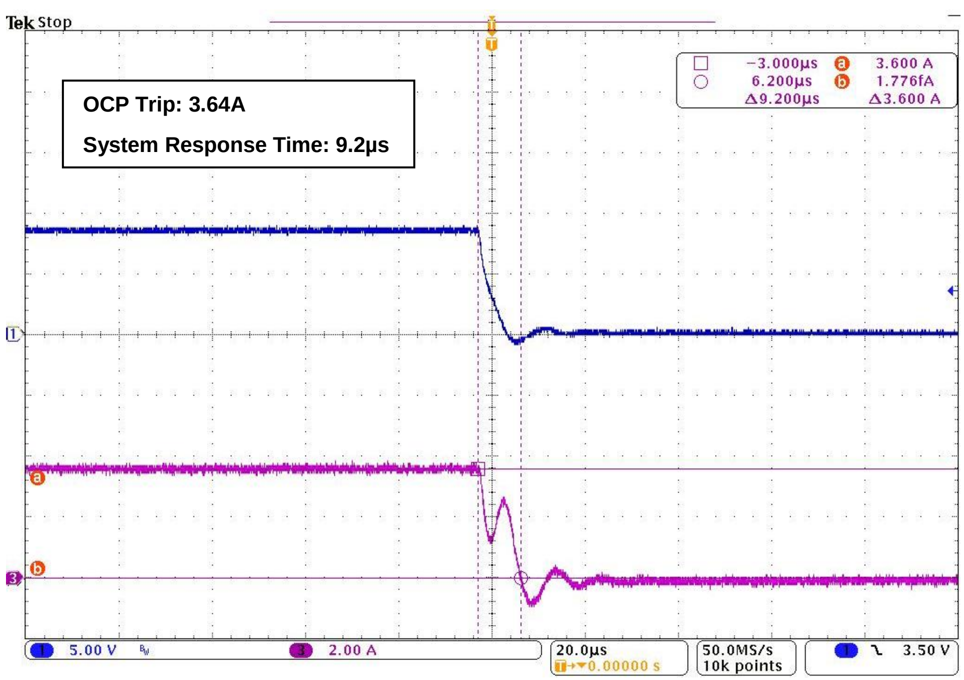
3.18 Over Current Protection (OCP)

Figure 3-18. OCP at 115V, 60Hz (**CH1**: Vbus_c, **CH3**: Iout)

Fixed-PDO: 5V, 3A



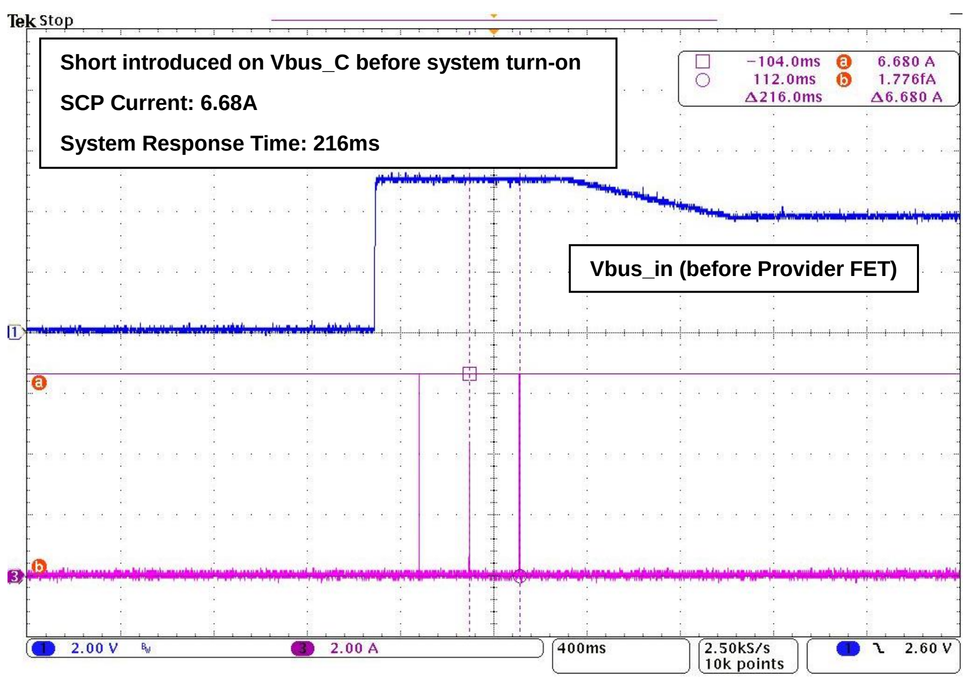
Fixed-PDO: 9V, 3A



3.19 Short-Circuit Protection (SCP)

Figure 3-19-1. SCP for 5V Fixed PDO at 115V, 60Hz (**CH1**: Vbus_c; **CH2**: Iout)

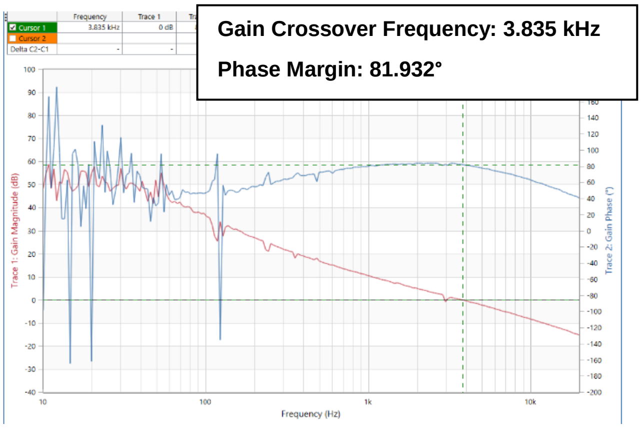
Figure 3-19-2. SCP for 5V Fixed PDO at 115V, 60Hz (**CH1**: Vbus_in; **CH2**: Iout)



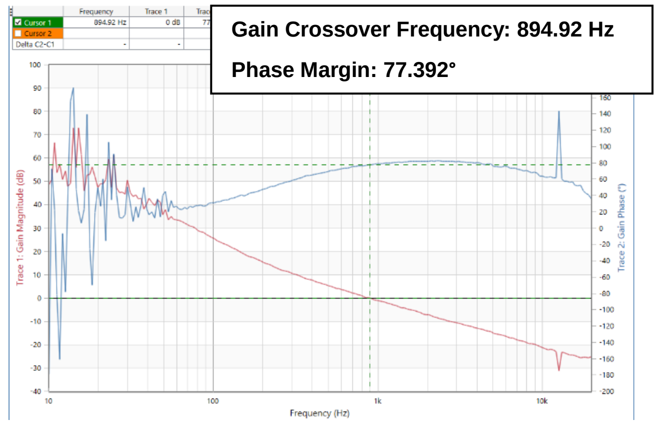
3.20 Loop Stability

3.20.1 At 115Vac, 60Hz

Figure 3-20-1-1 PDO-PPS 11V

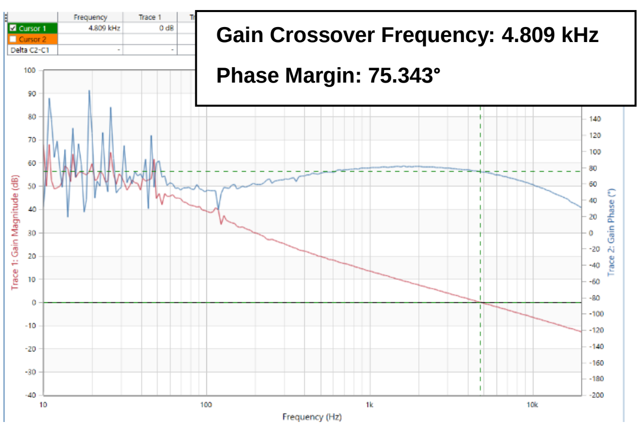


11V-3A

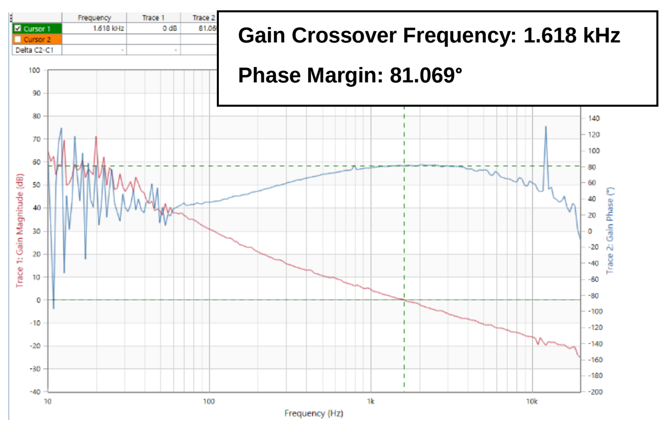


11V-0.3A

Figure 3-20-1-2 PDO-PPS 3.3V



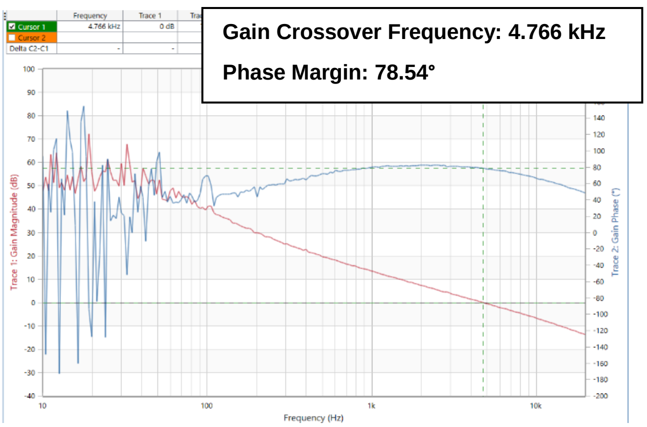
3.3V-3A



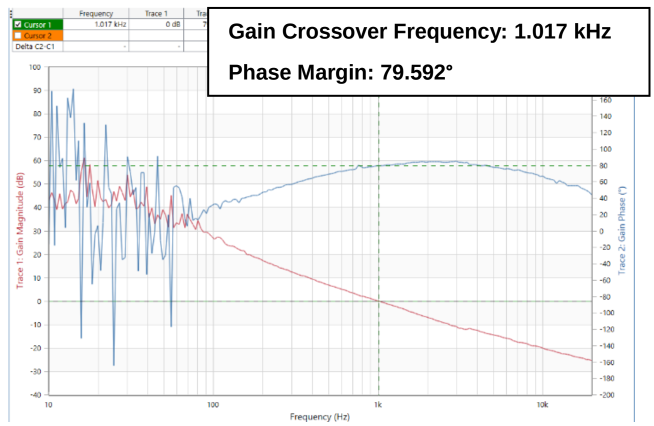
3.3V-0.3A

3.20.2 At 230Vac, 50Hz

Figure 3-20-2-1 PDO-PPS 11V

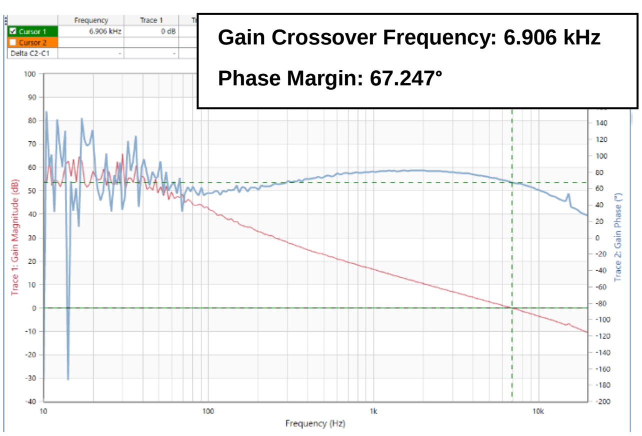


11V-3A

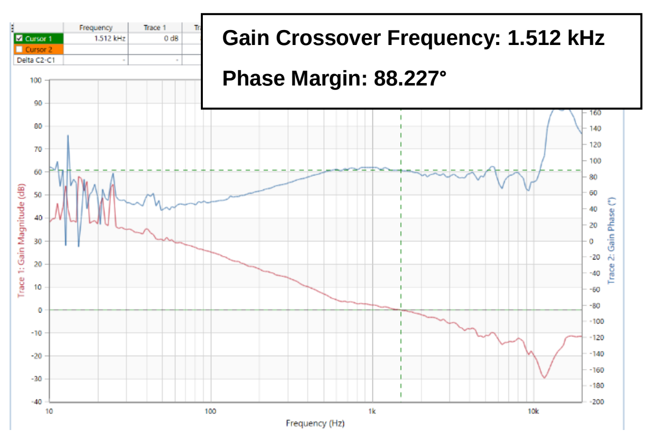


11V-0.3A

Figure 3-20-2-2 PDO-PPS 3.3V



3.3V-3A



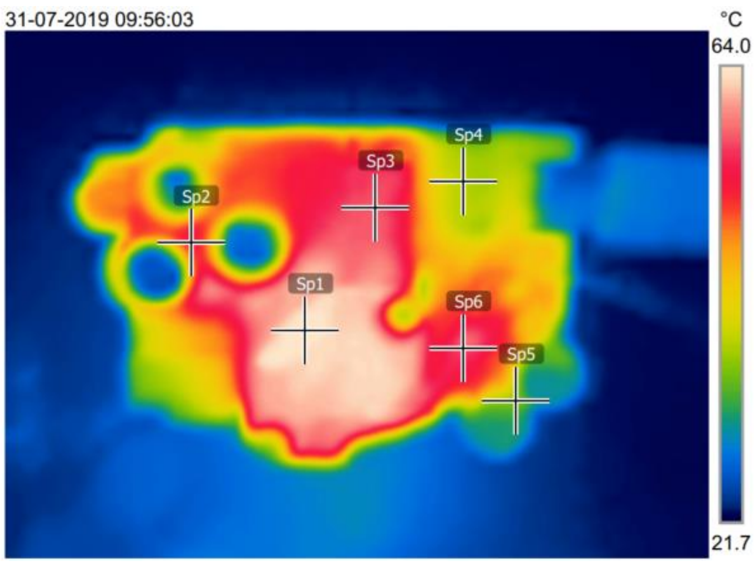
3.3V-0.3A

3.21 Thermal Captures

Test Condition: Vin_ac = 90Vac-47Hz, Vout = 11V, Iout = 3A

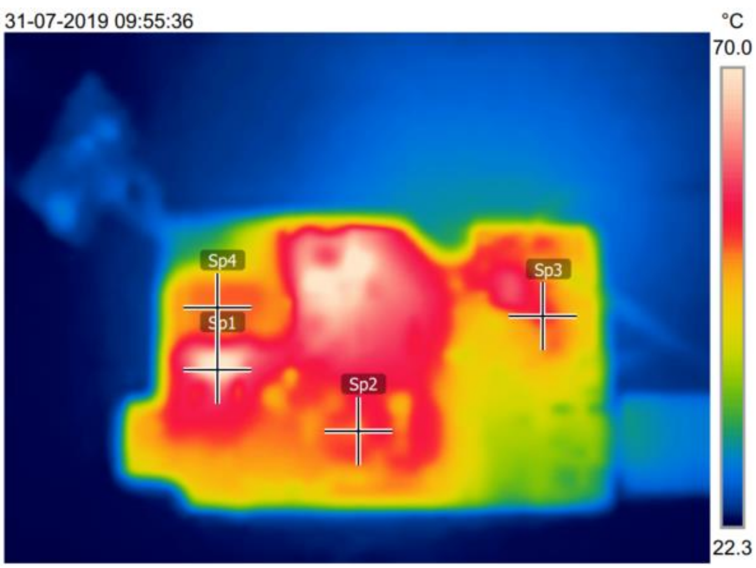
Lab Ambient Temperature: 20°c and in Open-frame for 60mins

Figure 3-21-1. Thermal Capture – PCB (TOP)



Symbol	Description	Temperature
Sp1	Transformer (T1)	65.2 °C
Sp2	Primary Caps (C1, C2, C3)	53.8 °C
Sp3	Primary FET (Q1)	58.2 °C
Sp4	Pulse Transformer (T2)	39.8 °C
Sp5	Output Caps (C8, C9)	36.1 °C
Sp6	Secondary FET (Q3)	58.8 °C

Figure 3-21-2. Thermal Capture – PCB (BOTTOM)



Symbol	Description	Temperature
Sp1	Full Bridge (FB1)	70.5 °C
Sp2	CYPAP111-A1 (U2)	53.4 °C
Sp3	CYPAS111-A1 (U1)	54.9 °C
Sp4	10mH CMC Reversed (LF1)	53.2 °C

3.22 Conducted Emission

Figure 3-22-1. CE at 115V, 60Hz: LINE **(QP Margin 8dB)**

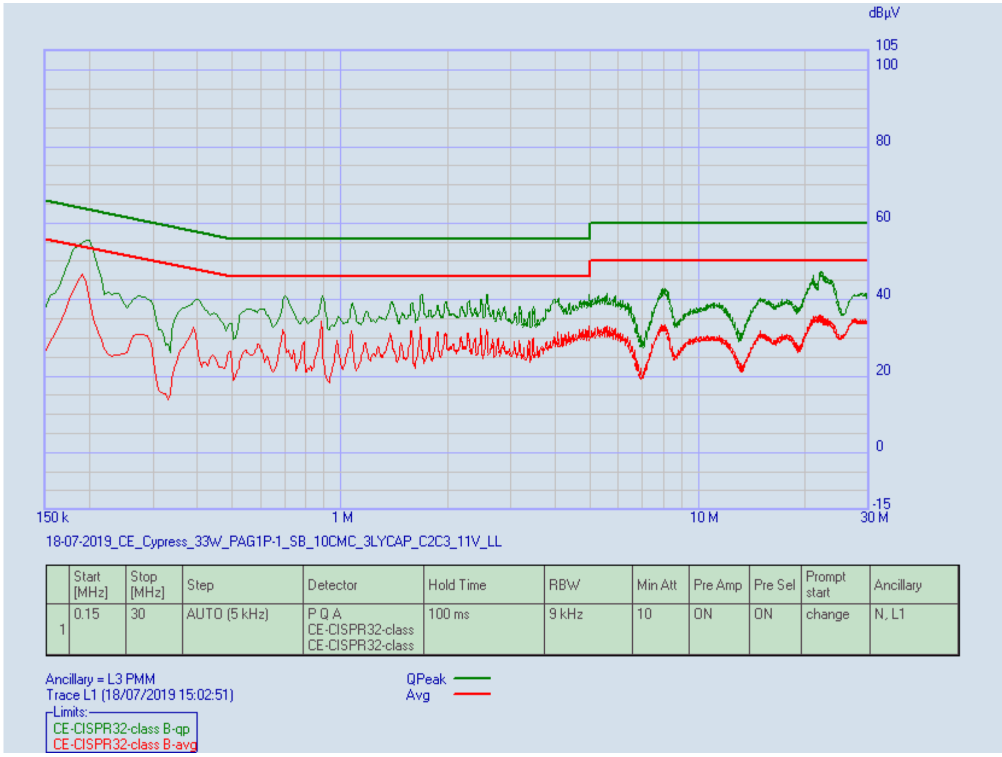


Figure 3-22-2. CE at 115V, 60Hz: NEUTRAL **(QP Margin 9dB)**

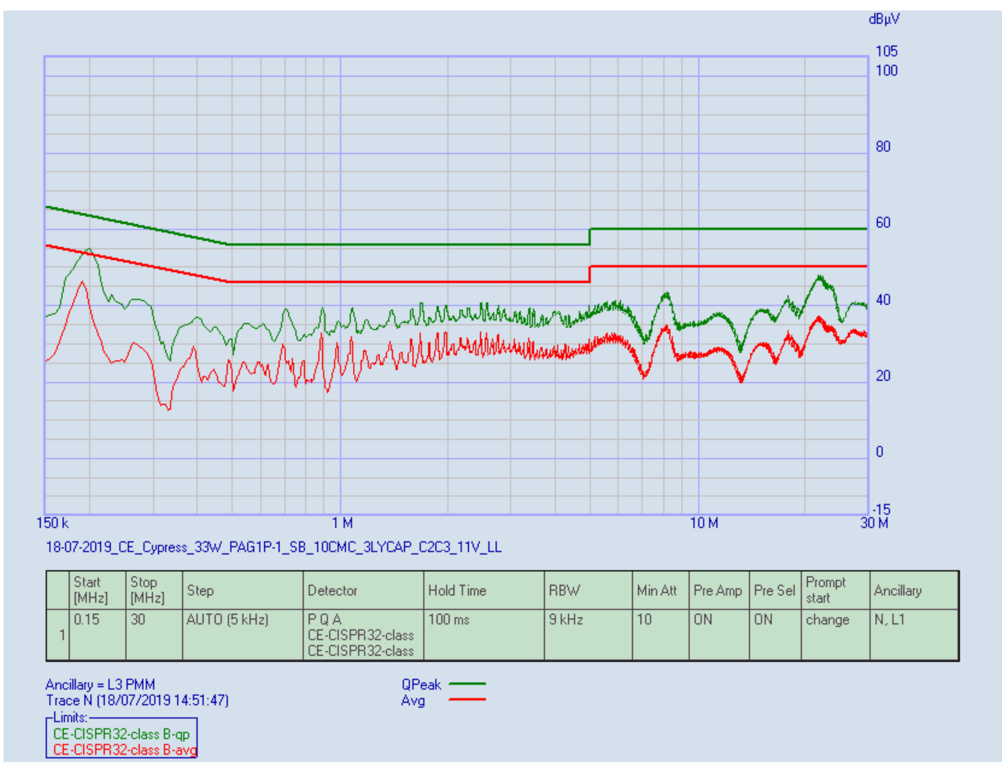


Figure 3-22-3. CE at 230V, 50Hz: LINE **(QP Margin 6dB)**

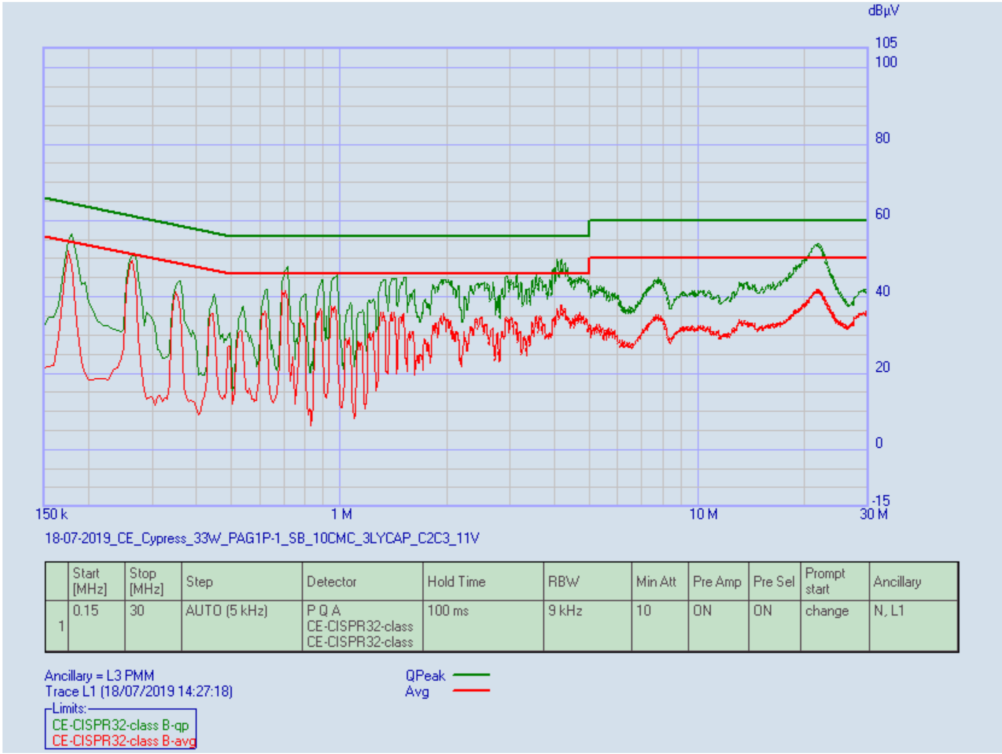
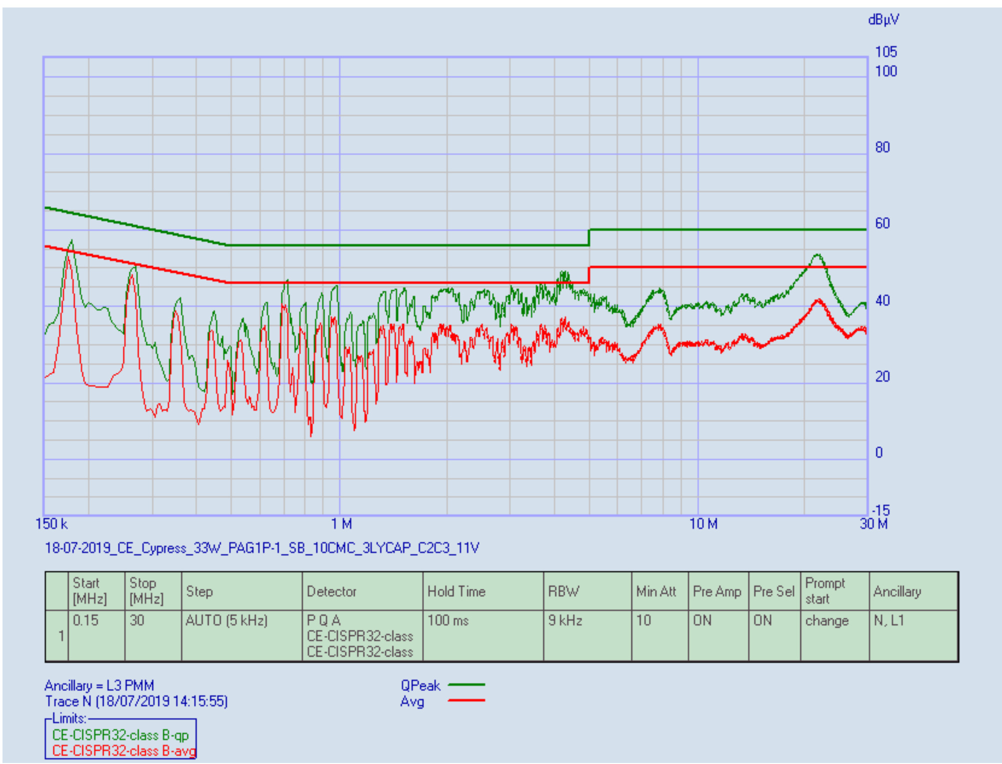


Figure 3-22-4. CE at 230V, 50Hz: NEUTRAL **(QP Margin 6dB)**



4. USB PD Source Test Results (using Quadramax)

4.1 Test Setup

Figure 4-1. Quadramax Test Setup

- QuadDraw Version: 0.8.7074
- QM#40 HWRev:1.4.4 FWST:0.0.1356 FWCCG1:0.10

4.2 Test Results

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

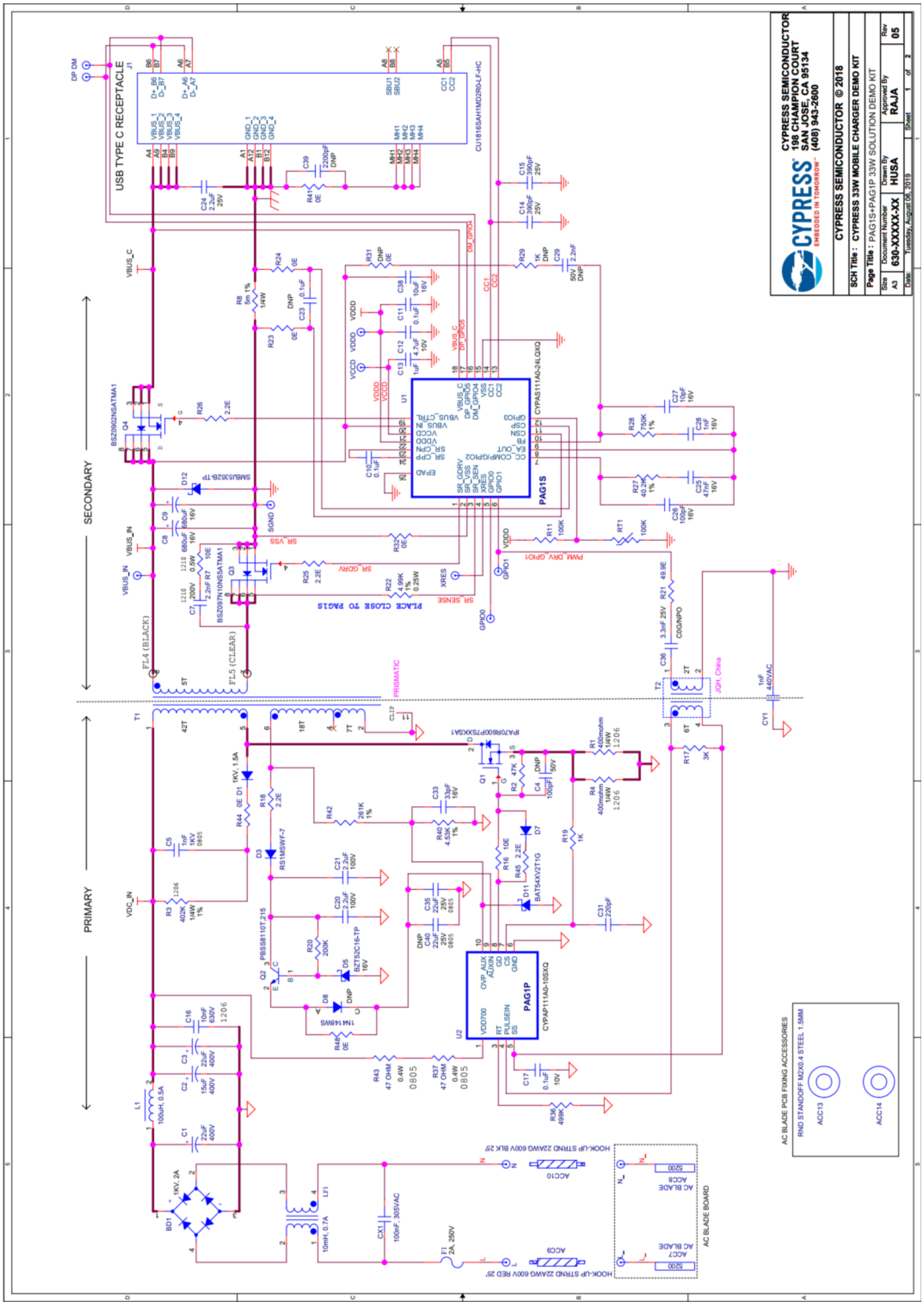
4.3 USB-IF Certification

I. USB ORG device Page: https://cms.usb.org/usb/cms/device/38052

II. USB ORG Test Result Summary (TID: 1475 Panel: One Port PD 3.0 Silicon With PPS): https://cms.usb.org/admin/structure/test_result/85461

5. Appendix

5.1 Schematics



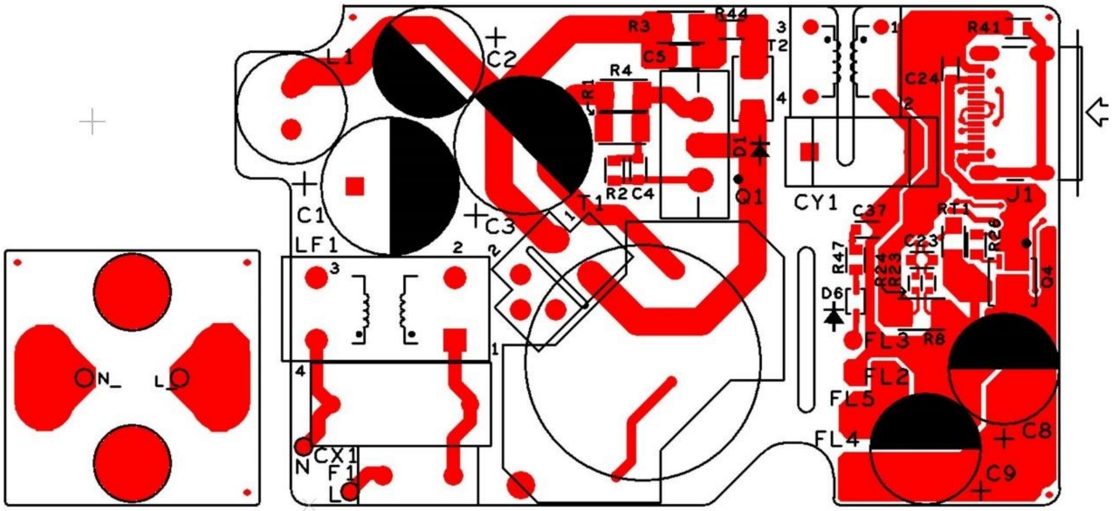
5.2 Bill of Materials:

Sr. No.	Qty	Reference	Value	Description	Manufacturer	MFG Part Number
1	1	BD1	ABS210-13	BRIDGE RECT 1PHASE 1KV 2A 4SOPA	Diodes Incorporated	ABS210-13
2	2	C10, C11	0.1uF	CAP CER 0.1UF 10V X5R 0402	Samsung Electro-Mechanics	CL05A104MP5NNNC
3	1	C17	0.1uF	CAP CER 0.1UF 10V X7R 0603	Yageo	CC0603KRX7R6BB104
4	1	C26	100pF	CAP CER 100PF 16V X7R 0402	Wurth Electronics Inc.	885012006020
5	1	C16	10nF	CAP CER 10000PF 630V X7R 1206	Murata Electronics North America	GRM31BR72J103KW01L
6	1	C33	33pF	CAP CER 33PF 16V C0G/NP0 0603	Wurth Electronics Inc.	885012006017
7	1	C38	10uF	CAP CER 10UF 16V X7R 1206	Samsung Electro-Mechanics	CL31B106MOHNNNE
8	1	C28	1nF	CAP CER 1000PF 16V X7R 0402	KEMET	C0402C102K4RACTU
9	1	C36	3.3nF	CAP CER 3300PF 25V C0G/NP0 0603	KEMET	C0603C332J3GAC7867
10	1	C5	1nF	CAP CER 1000PF 1KV X7R 0805	KEMET	C0805C102MDRACTU
11	1	C13	1uF	CAP CER 1UF 16V X5R 0402	Samsung Electro-Mechanics	CL05A105MO5NNNC
12	1	C7	2.2nF	CAP CER 2200PF 200V NP0 1210	KEMET	C1210C222J2GAC7800
13	2	C20, C21	2.2uF	CAP CER 2.2UF 100V X5R 1206	Samsung Electro-Mechanics	CL31A225KC9LNNC
14	1	C24	2.2uF	CAP CER 2.2UF 25V X5R 0603	Murata Electronics North America	GRM188R61E225KA12D
15	1	C31	220pF	CAP CER 220PF 10V C0G/NP0 0603	KEMET	C0603C221J8GAC7867
16	1	C35	22uF	CAP CER 22UF 25V X5R 0805	Murata Electronics North America	GRM21BR61E226ME44K
17	2	C14, C15	390pF	CAP CER 390PF 25V C0G/NP0 0402	Murata Electronics North America	GRM1555C1E391JA01D
18	1	C12	4.7uF	CAP CER 4.7UF 10V X5R 0402	Murata Electronics North America	GRM155R61A475MEAAD
19	1	C25	47nF	CAP CER 0.047UF 16V X7R 0402	Samsung Electro-Mechanics	CL05B473KO5NNNC
20	1	C27	10pF	CAP CER 10PF 16V C0G/NP0 0402	Wurth Electronics Inc.	885012005029
21	2	C8, C9	680uF	CAP ALUM POLY 680UF 20% 16V T/H	Nichicon	RNL1C681MDS1PX
22	1	CX1	100nF, 305VAC	CAP FILM 0.1UF 20% 305VAC RADIAL	EPCOS (TDK)	B32921C3104M189
23	1	CY1	1000pF	CAP CER 1000PF 440VAC Y5S RADIAL	Vishay BC Components	VY2102M29Y5UG6TV7
24	1	D1	RS2MA-13-F	DIODE GEN PURP 1KV 1.5A SMA	Diodes Incorporated	RS2MA-13-F
25	1	D11	BAT54XV2T1G	DIODE SCHOTTKY 30V 200MA SOD523	ON Semiconductor	BAT54XV2T1G
26	1	D12	SMBJ5352B-TP	DIODE ZENER 15V 5W DO214AA	Micro Commercial Co	SMBJ5352B-TP
27	1	D3	RS1MSWF-7	DIODE GEN PURP 1KV 1A SOD123F	Diodes Incorporated	RS1MSWF-7
28	1	D5	BZT52C16-TP	DIODE ZENER 16V 200MW SOD123	Micro Commercial Co	BZT52C16-TP
29	1	D7	1N4148WS	DIODE GEN PURP 75V 150MA SOD323F	ON Semiconductor	1N4148WS
30	1	F1	RSTA 2 AMMO	FUSE BRD MNT 2A 250VAC/63VDC RAD	Bel Fuse Inc.	RSTA 2 AMMO
31	1	Q1	IPA70R600P7SXKSA1	MOSFET N-CH 700V 8.5A TO220	Infineon Technologies	IPA70R600P7SXKSA1
32	1	Q2	MMBTA06LT1G	TRANS NPN 80V 0.5A SOT23	ON Semiconductor	MMBTA06LT1G
33	1	Q3	BSZ097N10NS5ATMA1	MOSFET N-CH 100V 40A TSDSON-8	Infineon Technologies	BSZ097N10NS5ATMA1
34	1	Q4	BSZ0902NSATMA1	MOSFET N-CH 30V 40A TSDSON-8	Infineon Technologies	BSZ0902NSATMA1
35	1	R11	100K	RES SMD 100K OHM 1% 1/10W 0603	Panasonic Electronic Components	ERJ-3EKF1003V
36	1	R16	10E	RES SMD 10 OHM 1% 1/10W 0603	Panasonic Electronic Components	ERJ-3EKF10R0V
37	1	R7	10E	RES 10 OHM 1% 1/2W 1210	Stackpole Electronics Inc	RMCF1210FT10R0
38	1	R19	1K	RES SMD 1K OHM 1% 1/10W 0603	Panasonic Electronic Components	ERJ-3EKF1001V
39	4	R18, R25, R26, R45	2.2E	RES SMD 2.2 OHM 1% 1/10W 0603	Yageo	RC0603FR-072R2L

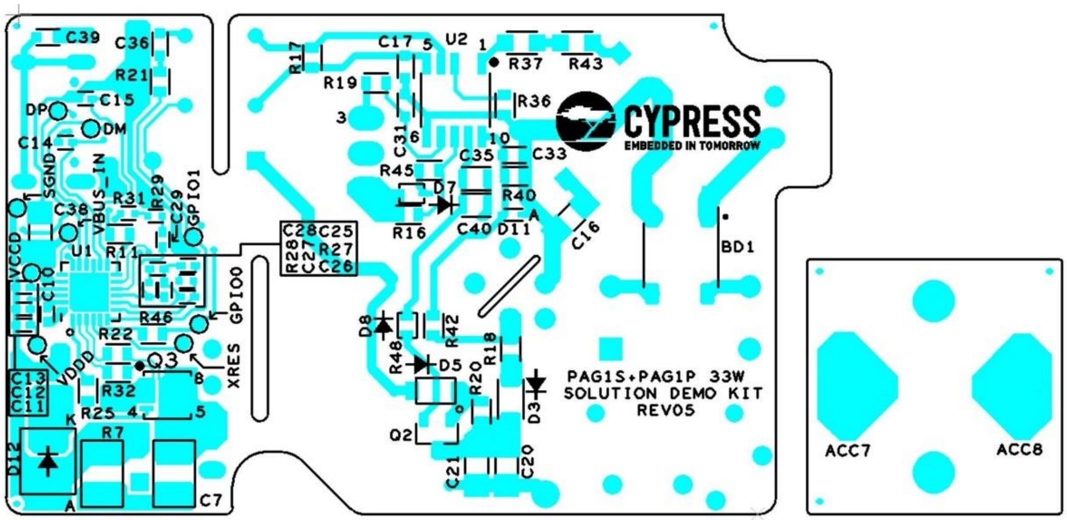
40	1	R20	200K	RES SMD 200K OHM 1% 1/10W 0603	Panasonic Electronic Components	ERJ-3EKF2003V
41	1	R42	261K	RES SMD 261K OHM 1% 1/10W 0603	Yageo	RC0603FR-07261KL
42	1	R17	3K	RES SMD 3K OHM 1% 1/10W 0603	Yageo	RC0603FR-073KL
43	1	R40	4.53K	RES SMD 4.53K OHM 1% 1/10W 0603	Yageo	RC0603FR-074K53L
44	1	R22	4.99K	RES SMD 4.99K OHM 1% 1/4W 0603	Vishay Dale	CRCW06034K99FKEAHP
45	1	R27	40.2K	RES SMD 40.2K OHM 1% 1/16W 0402	Yageo	RC0402FR-0740K2L
46	2	R1, R4	400mohm	RES 0.4 OHM 1% 1/4W 1206	Yageo	RL1206FR-070R4L
47	1	R3	402K	RES SMD 402K OHM 1% 1/4W 1206	Yageo	RC1206FR-07402KL
48	2	R37, R43	47 OHM	RES SMD 47 OHM 5% 0.4W 0805	Rohm Semiconductor	ESR10EZPJ470
49	1	R2	47K	RES SMD 47K OHM 1% 1/10W 0603	Yageo	RC0603FR-0747KL
50	1	R21	49.9E	RES SMD 49.9 OHM 1% 1/10W 0603	Yageo	RC0603FR-0749R9L
51	1	R28	750K	RES SMD 750K OHM 1% 1/16W 0402	Yageo	RC0402FR-07750KL
52	1	R36	499K	RES SMD 499K OHM 1% 1/8W 0603	Vishay Beyschlag	MCT06030C4993FP500
53	1	R8	5m	RES 0.005 OHM 1% 1W 1206	Stackpole Electronics Inc.	CSRF1206FT5L00
54	1	RT1	100K	THERM NTC 100KOHM 4250K 0805	Murata Electronics North America	NCP21WF104J03RA
55	2	C1, C3	22uF	CAP ALUM 22uF 400V RADIAL DIA 10X16	AISHI	EHS2GM220G16OT
56	1	C2	15uF	CAP ALUM 15uF 400V RADIAL DIA 8X16	AISHI	EHF2GM150F16OT
57	1	J1	CU1816SAH1MD2R0-LF-HC	CU18 USB Type-C Receptacle Connector	CviLux Corporation	CU1816SAH1MD2R0-LF-HC
58	1	L1	100uH, 0.5A	100uH D8x10mm 0.5A	Prismatic	
59	1	LF1	10mH, 700mA	10mH / D15 * T7.5mm / 700mA	Wurth	744821110
60	1	T1	RM8 CORE	POWER TRANSFORMER	PRISMATIC	
61	1	T2	1:3	Pulse transformer, 1:3, 4.8uH, 3KV isolation voltage	JQH, China	LCL-T6-4961A
62	1	U1	PAG1S	USB-PD Power Adapter Secondary Side Controller	CYPRESS SEMICONDUCTOR	CYPAS111A0-24LQXQ
63	1	U2	PAG1P	PRIMARY SIDE STARTUP CONTROLLER	CYPRESS SEMICONDUCTOR	CYPAP111A0-10SXQ
Total Components (BOM Count) = 73						
For Test and Debug Purpose						
64	1	ACC10	HOOK-UP STRND 22AWG 600V BLK 25'	HOOK-UP STRND 22AWG 600V BLK 25'	CNC Tech	11047-22-1-0500-001-1-TS
65	1	ACC9	HOOK-UP STRND 22AWG 600V RED 25'	HOOK-UP STRND 22AWG 600V RED 25'	CNC Tech	11047-22-1-0500-004-1-TS
66	2	ACC13, ACC14	RND STANDOFF M2X0.4 STEEL 1.5MM	RND STANDOFF M2X0.4 STEEL 1.5MM	Wurth Electronics Inc.	9774015243R
67	2	ACC7, ACC8	5200	PCB BLADE SNAP THRU POLARIZED	Heyco	5200
68	2	R23, R24	0E	RES SMD 0 OHM JUMPER 1/10W 0402	Panasonic Electronic Components	ERJ-2GE0R00X
69	4	R32, R41, R44, R48	0E	RES SMD 0 OHM JUMPER 1/4W 0603	Vishay Dale	CRCW06030000Z0EAHP
DNP						
70	1	C4	100pF	CAP CER 100PF 50V C0G/NPO 0603	Yageo	CC0603JRNPO9BN101
71	1	C23	0.1uF	CAP CER 0.1UF 35V X7R 0603	Taiyo Yuden	GMK107B7104KAHT
72	1	C29	2.2nF	CAP CER 2200PF 50V X7R 0402	Murata Electronics North America	GCM155R71H222KA37D
73	1	C39	2200pF	CAP CER 2200PF 500V X7R 0603	KEMET	C0603C222KCRAC7867
74	1	C40	22uF	CAP CER 22UF 25V X5R 0805	Murata Electronics North America	GRM21BR61E226ME44K
75	1	D8	1N4148WS	DIODE GEN PURP 75V 150MA SOD323F	ON Semiconductor	1N4148WS
76	1	R29	1K	RES 1K OHM 1% 1/16W 0402	Stackpole Electronics Inc.	RMCF0402FT1K00
77	1	R31	0E	RES 0 OHM JUMPER 1/16W 0402	Stackpole Electronics Inc.	RMCF0402ZT0R00

5.3 PCB Layout:

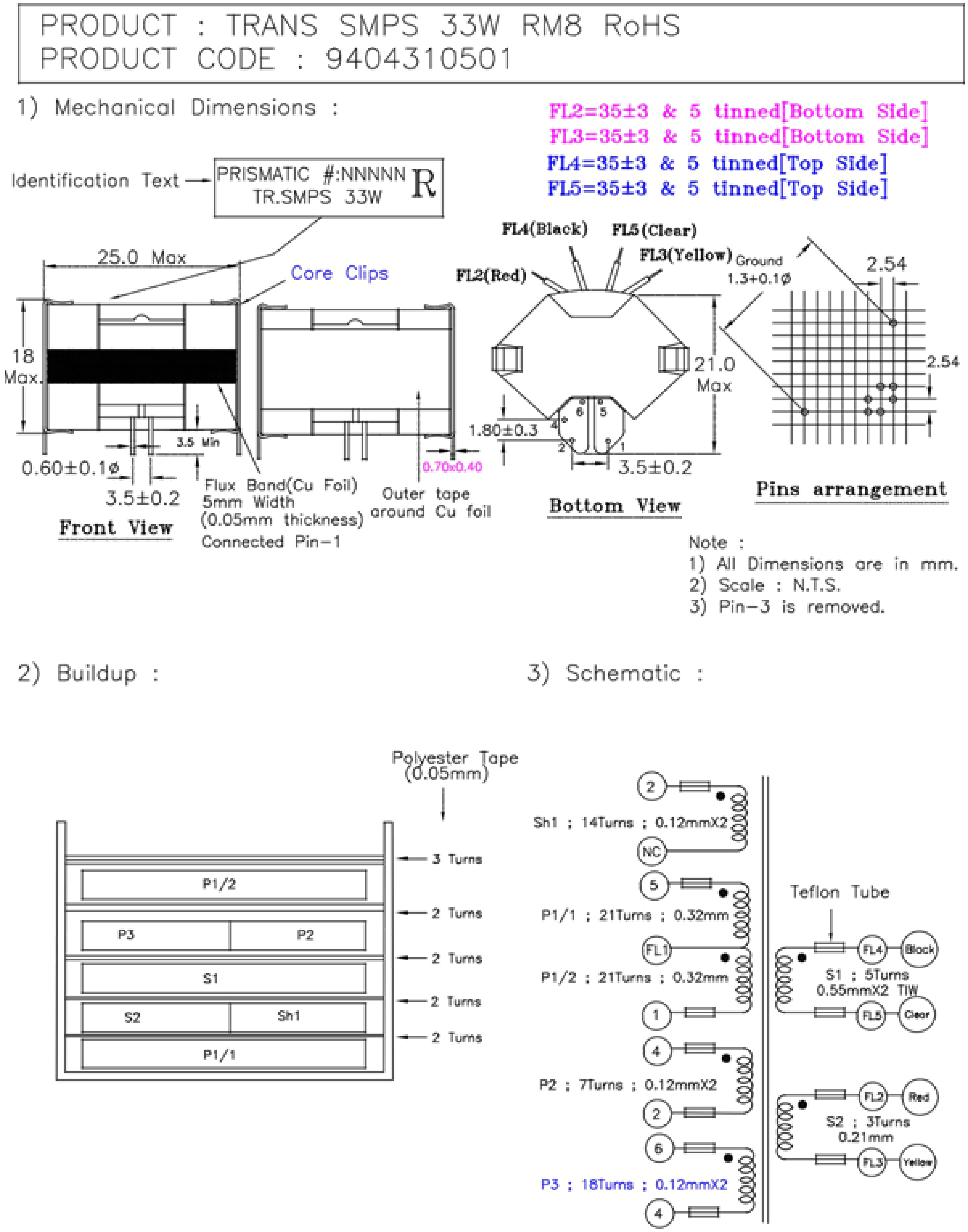
TOP



BOTTOM



5.4 Transformer Specifications (T1)



PRODUCT : TRANS SMPS 33W RM8 RoHS
PRODUCT CODE : 9404310501

4) MATERIAL LIST:

Sl.No.	Item	Material	Supplier of Material	UL No.	UL Material Designation
1)	Core	Ferrite Core RM8 TP4A/N87	TDG/EPCOS or equivalent	----	
2)	Bobbin	Phenolic (6 Pins Vertical)	Chang Chun Plastics Co Ltd. or equivalent	E59481	T375HF
3)	Wire	Polyurethane Enamelled Copper Wire (Class B) Polyurethane Enamelled Copper Wire (Class F)	JUNG SHING WIRE CO LTD Ram Ratna Wire Ltd. Precision Wire India Ltd. or equivalent	E174837 E238786 E174288	UEW-4 RRvSHRAMIK SSFC Preci-9
4)	TIW Wire	TIW [Class B]	FURUKAWA ELECTRIC CO LTD. or equivalent	E206440	Tex-E
5)	Tape	Insulating Polyester Tape	Symbio Inc Sneham International or equivalent	E50292 E323466	35660Y 130°C SI-PLY-T 130°C
6)	Tube	Teflon Tube Polytetrafluoroethylene	Shenzhen Woer Heat--shrinkable Material Co., Ltd DONGGUAN CITY CHANGJIE METALS & PLASTIC PRODUCTS CO LTD. or equivalent	E203950 E338209	WF CJ-TT-L
7)	Varnish	ELMOLUFT 1AFD CLASS F	ELANTAS BECK INDIA LTD. or equivalent	E253938	MW80-C

5) Electrical Specifications:

5.1) Inductance & DC Resistance:

PARAMETER	P1 (5-1)	P2 (4-2)	P3 (6-4)	S1 (FL2-FL3)	S2 (FL4-FL5)	Leakage Inductance (5-1)@0.25V/100KHz
INDUCTANCE @0.25V/100KHz.	420uH ±10%	---	---	---	---	10uH (MAX)
DC RESISTANCE MAX @ 20°C	480mΩ	345mΩ	815mΩ	130mΩ	25mΩ	

5.2) Hi-Pot Test:
Primary to Secondary : 3.75KVac/1mA/5Sec.
Secondary to Core : 3.75KVac/1mA/5Sec.
Primary to Primary[P2,P3] : 0.75KAac/1mA/5Sec.
Primary to Core : 0.75KAac/1mA/5Sec.

5.3) Insulation Resistance:
The insulation resistance between windings should be greater than 100 Mohms at 500V DC.

Rev1 : Design changed
Rev2 : Leakage inductance changed to 10uH Max from 15uH Max
Rev3 : FL2,FL3,FL4,FL5 Lead length changed to 35±3 & 5mm tinned from 25±3 & 10mm tinned
S2 turns changed to 3 from 2 & S2 DCR changed to 25mΩ Max from 20mΩ
Rev4 : P3 turns changed to 18 from 14 & P3 DCR changed to 685mΩ from 675m
Rev5 : Core Clips added with dimensions
Rev6 : P3 & S1 DCR Max Values increased.

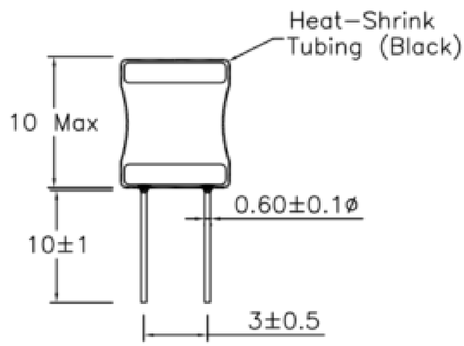
Note: **Transformer undergoes DIP and BAKE varnishing methodology.**

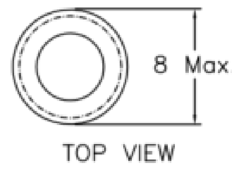
5.5 Inductor Specifications (L1)

PRODUCT: CHOKE DC−100X6X8 100uH/0.3A SLEEVED−RoHS PRODUCT CODE: 9404310401

1) Mechanical Dimensions:

Rev1 : Core details, current ratings & Part number updated. DCR value changed to 310mΩ from 355mΩ UL File details updated.



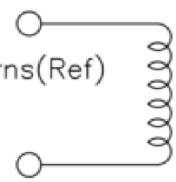


NOTE:

*All Dimensions are in MM
*SCALE: N.T.S

2) Electrical Characteristics:

W1; 60.5T Turns(Ref)
0.27mm



3) Electrical Characteristics:

3.1) Inductance & DC Resistance:

INDUCTANCE @0.3V/1KHz	100uH ±20%
DC RESISTANCE MAX @ 20°C.	310mΩ

3.2) Current Ratings :

a) Rated Current : 0.3A AC rms

b) Saturation current : 0.42A (inductance reduces by 10% of no load value)

3.3) Temperature Range: −20 °C to +80 °C

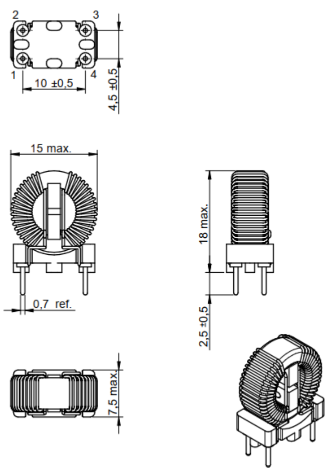
4) MATERIAL LIST:

SL.NO	Item	Material	Supplier of Material	UL No.	UL Material Designation
1)	Core	Ferrite Drum Core 6x8mm (Ni−Zn) TN650 Grade	THEL or equivalent	−−−−	−−−−
2)	Wire	Polyurethane Enamelled Copper Wire (Class B) Polyurethane Enamelled Copper Wire (Class F)	JUNG SHING WIRE CO LTD Ram Ratna Wire Ltd. Precision Wire India Ltd. or equivalent	E174837 E238786 E174288	UEW−4 RRvSHRAMIK SSFC Preci−9
3)	Sleeve	Heat Shrink Sleeve−UL any Colour	Shenzhen Woer Heat−−shrinkable Material Co., Ltd	E203950	RSFR−H

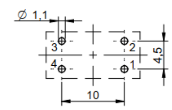
5.6 Common Mode Choke Specifications (LF1)

PRODUCT: Wurth Electronics Inc. CMC 10mH 700MA 2LN TH, WE-CMB Series; MPN: 744821110

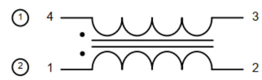
Dimensions: [mm]



Recommended Hole Pattern: [mm]



Schematic:



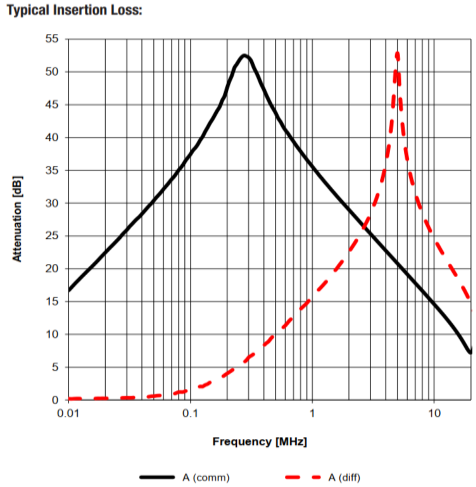
Electrical Properties:

Properties	Test conditions		Value	Unit	Tol.
Inductance	10 kHz/ 0.1 mA	L	2x10	mH	±30
Rated Current	@ 70 °C	I_R	0.7	A	max.
DC Resistance	@ 20 °C	R_{DC}	2x350	mΩ	max.
Rated Voltage	50 Hz	U_R	250	V (AC)	max.
Insulation Test Voltage	50 Hz/ 5 mA/ 2 sec.	U_T	1500	V (AC)	

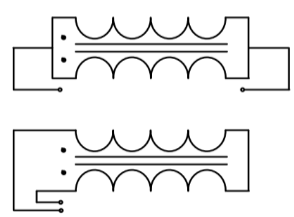
General Properties:

It is recommended that the temperature of the component does not exceed +125°C under worst case conditions	
Storage Temperature (in original packaging)	-20 °C up to +60 °C
Operating Temperature	-40 °C up to +125 °C
Temperature Rise < 55K	
Test conditions of Electrical Properties: +20°C, 33% RH if not specified differently	

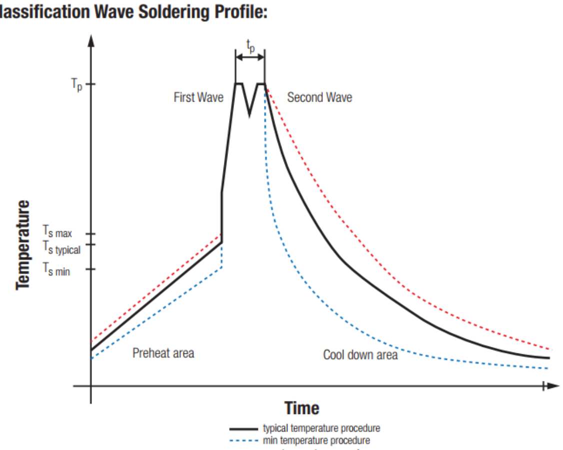
Typical Insertion Loss:



Test Setup:



Classification Wave Soldering Profile:



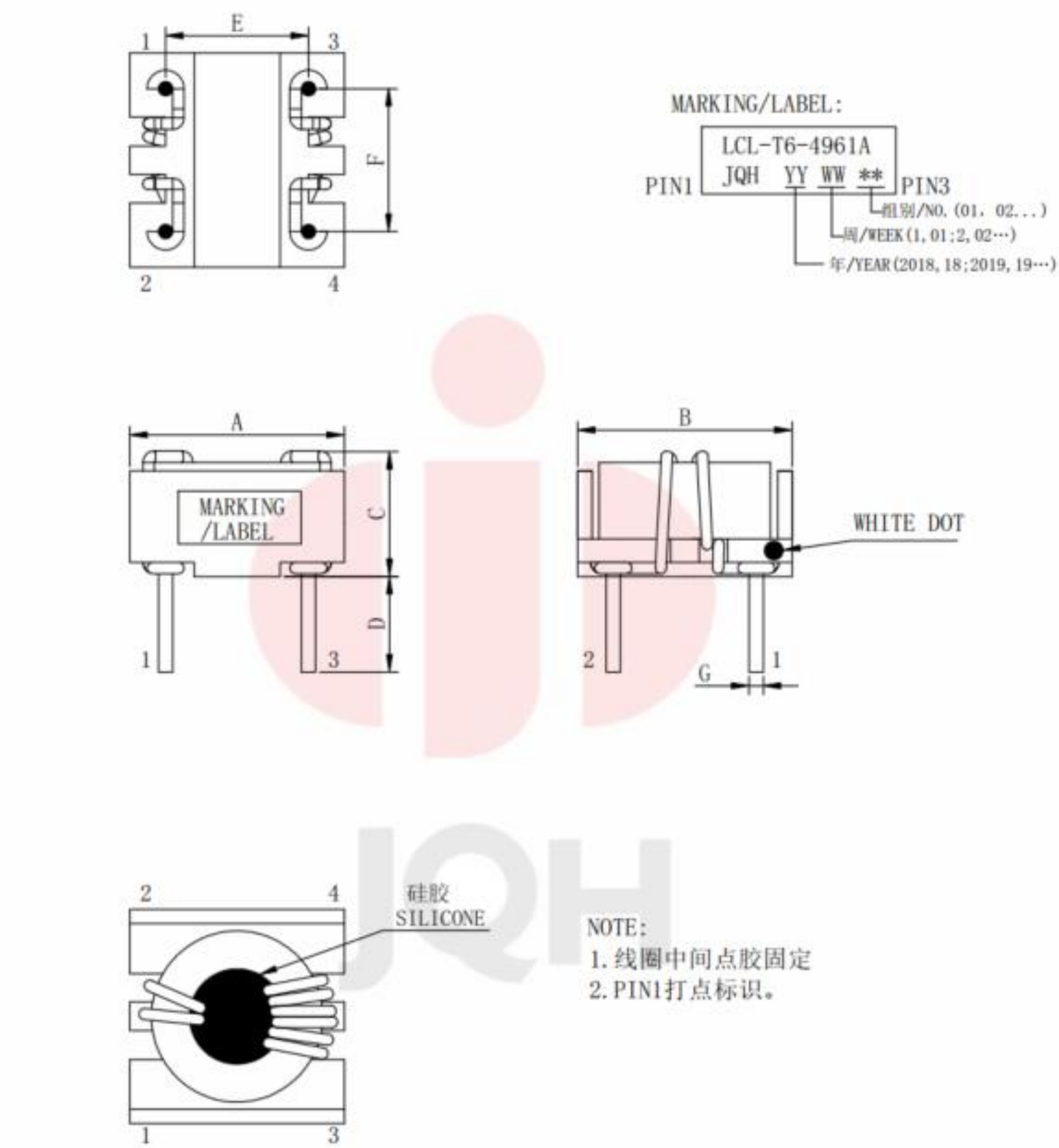
Classification Wave Soldering Profile:

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	ΔT	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 wa
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

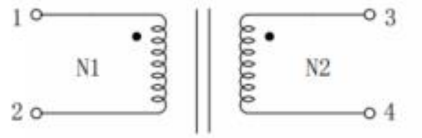
5.7 Pulse Transformer (T2)

1. 外观图(单位:mm)/DIMENSION(UNIT:mm)



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

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	2	CLOSE/密绕
N2	Φ0.2mm*1P T.I.W	3-4	6	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)	4.8uH 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 SICHUAN DG TECHNOLOGY CO., LTD	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	REINFORCED INSULATION TYPE: TEX-E THERMAL RATING:130℃	FURUKAWA ELECTRIC CO LTD	E206440
4	硅胶 SILICONE	TYPE:3140 THERMAL RATING:200℃	DOW CORNING CORPORATION	N/A

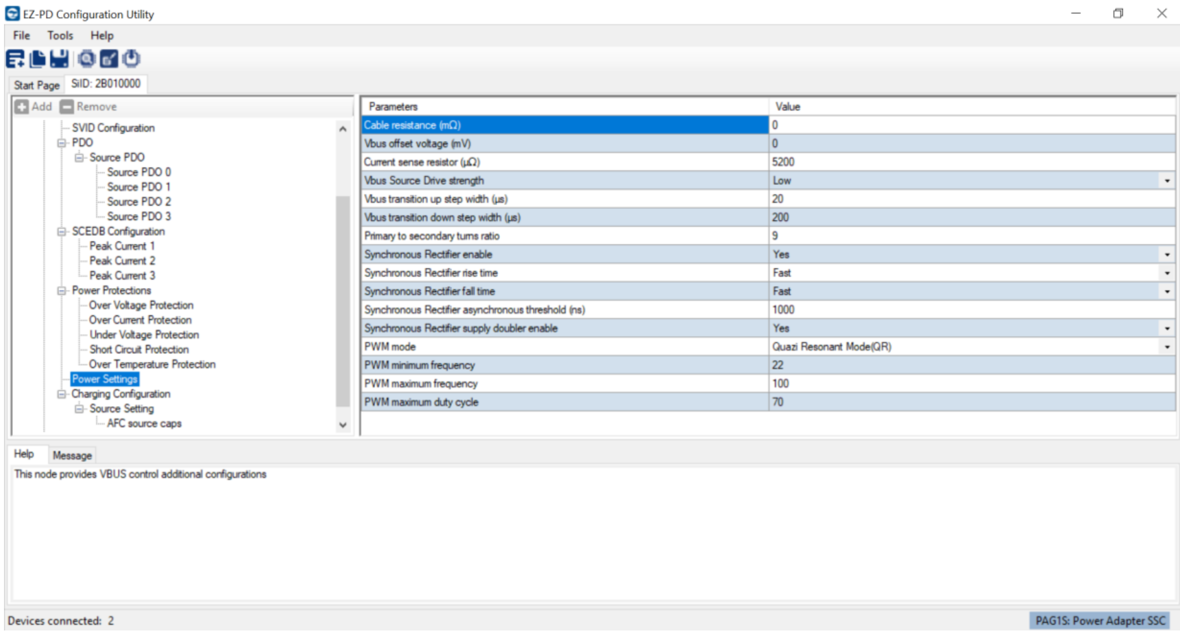
注:产品符合RoHS要求.
Note: The products comply with RoHS requirements.

6. 产品单重/WEIGHT

Net Weight:0.37g/PC

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.

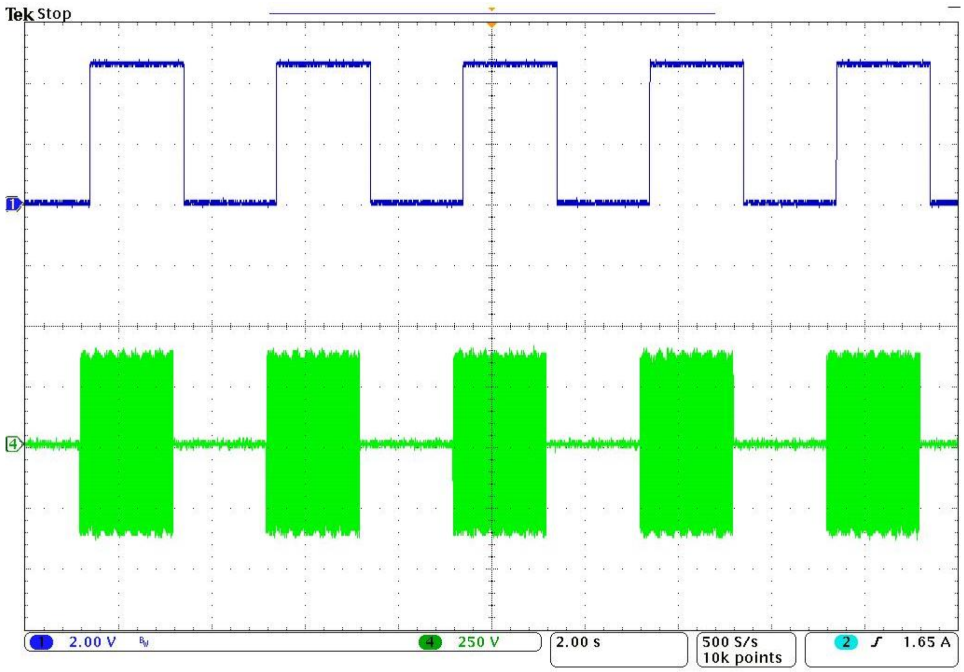
Table 5-7. Default Configuration Values

Parameters	Values
Power Settings	
Cable resistance (mΩ)	0
Vbus offset voltage (mV)	0
Current Sense resistor (µΩ)	5300
Vbus Source Drive strength	Low
Vbus transition up step width (µs)	20
Vbus transition down step width (µs)	200
Primary to secondary turns ratio	9
Synchronous Rectifier enable	Yes
Synchronous Rectifier rise time	Fast
Synchronous Rectifier fall time	Fast
Synchronous Rectifier async threshold (ns)	1000
Synchronous Rectifier doubler enable	Yes

PWM mode	Quasi Resonant Mode (QR)
PWM minimum frequency (kHz)	22
PWM maximum frequency (kHz)	100
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 (µs)	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 (µs)	10
Enable Thermistor 2	Yes
Thermistor type 2	NTC
Cutoff value 2	477
Restart value 2	909

5.9 DUT Burn-in Test

Figure Appendix-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 5-8. 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: 33W USB-PD Power Adapter Solution (PAG1P-PAG1S)			
Revision	**Issue Date**	**Origin of Change**	**Description of Change**
**	15/05/2019	GGAN	Initial Version
*2	20/06/2019	GGAN	1. Updated the efficiency figures and respetive graphs. 2. Updated the Loop stability data and respective BOM components **Hardware Changes:** i. C27 VALUE CHANGED TO 47pF. ii. C17 VALUE CHANGED TO 10uF. iii. C28, C36 VALUES CHANGED TO 1nF. iv. C5,C6 VALUES CHANGED TO 2.2nF, v. R3, R5 VALUES CHANGED TO 200K. vi. C7 VALUE CHANGED TO 2.2nF. R7 CHANGED 10E. vii. C12 VALUE CHANGED TO 4.7uF. viii. CX DISCHARGE D20, D21, R74, R75 ADDED. ix. R23, R24 CHANGED TO 0402 TO ACHIEVE KELVIN CONNECTION. x. R17 CHANGED TO 2K, R40 CHANGED TO 4.53K. xi. R21 CHANGED TO 49.9E, R28 CHANGED TO 499K. xii. C23 MAKE IT AS DNP. xiii. D11 ADDED. xiv. R27 CHANGED TO 40.2K, C25 AS 47nF **Firmware Changes:** i. Improvement in 10% efficiency figures by tweaking valey table
*3	27/06/2019	GGAN	Addition of USB-IF certification, (T1, L1 and LF1) datasheets, EZ-PD config utility default values and Protection data. Schematic Revision updated to Rev3. **Hardware Changes:** i. REMOVED CX DISCHARGE CIRCUITS.

			ii. D12 ADDED BETWEEN VBUS_IN AND SE_GND. iii. C17 CHANGED TO 0.1uF. iv. INSTEAD 2*200K CHANGED TO ONE 402K & 2*2.2nF CHANGED TO 1nF/1KV CAP AND R30 REMOVED. v. C35 CHANGED TO 22uF/25V (0805) AND ADDED C40. vi. C33 CHANGED TO 10pF. vii. D9 REMOVED. viii. D11 PART NUMBER CHANGED TO “BAT54XV2T1G” FOR TWO PIN. ix. C8, C9 CAPS CHANGED TO 8mm DIA, 680uF/16V. x. CHANGED D5 TO 16V ZENER “BZT52C16-TP”. xi. R17 CHANGED TO3K, C36 CHANGED TO 3.3nF, C33 CHANGED TO 33pF, MADE C40 AS DNP. **Firmware Changes:** i. Improving standby power
*3.1	16/07/2019	GGAN	Added Pulse transformer datasheet **Hardware Changes:** i. R17 CHANGED TO3K, C36 CHANGED TO 3.3nF, C33 CHANGED TO 33pF, MADE C40 AS DNP. ii. Q2 CHANGED TO "PBSS8110T,215"
*4	31/07/2019	GGAN	Optimizing hardware for CE tests **Hardware Changes:** i. CMC LF1 PART NUMBER CHANGED TO "744821110". ii. CY1 PART NUMBER CHANGED TO 1nF (VY2102M29Y5UG6TV7). iii. LAYOUT MODIFIED: shorter ground traces for CY1
*4.1	13/08/2019	GGAN	Adding additional stability data
*4.2	19/08/2019	GGAN	Optimizing the schematics under Appendix Section (Removing Feed Fordward winding and related components)