



65W USB-PD Power Adapter Solution (PAG1P-A3 and PAG1S-A1) Test Report Version 2.1

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1. Introduction



Cypress CYPAP111/2 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. CYPAP111/2 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 (CYPAP111/2) 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 CYPAP111/2 and CYPAS111 is through a Pulse Edged Transformer and its associated circuitry.

This document contains test results of PAG1P + PAG1S based 65W Power Adapter solution board. The tests were performed on this board which is equipped with Cypress CYPAP111/2A3-10SXQ on primary and CYPAS111A1-24LQXQ on secondary section of the converter.

Table 1-1. Test Specification

Parameter	Value
Rated Input Voltage	100~240Vac
Input Frequency	47 – 63Hz
Total Output Power	65W
Main Output Vo / Io	PDO-Fixed: 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/3.25A PDO-PPS: 3.3V – 21V/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



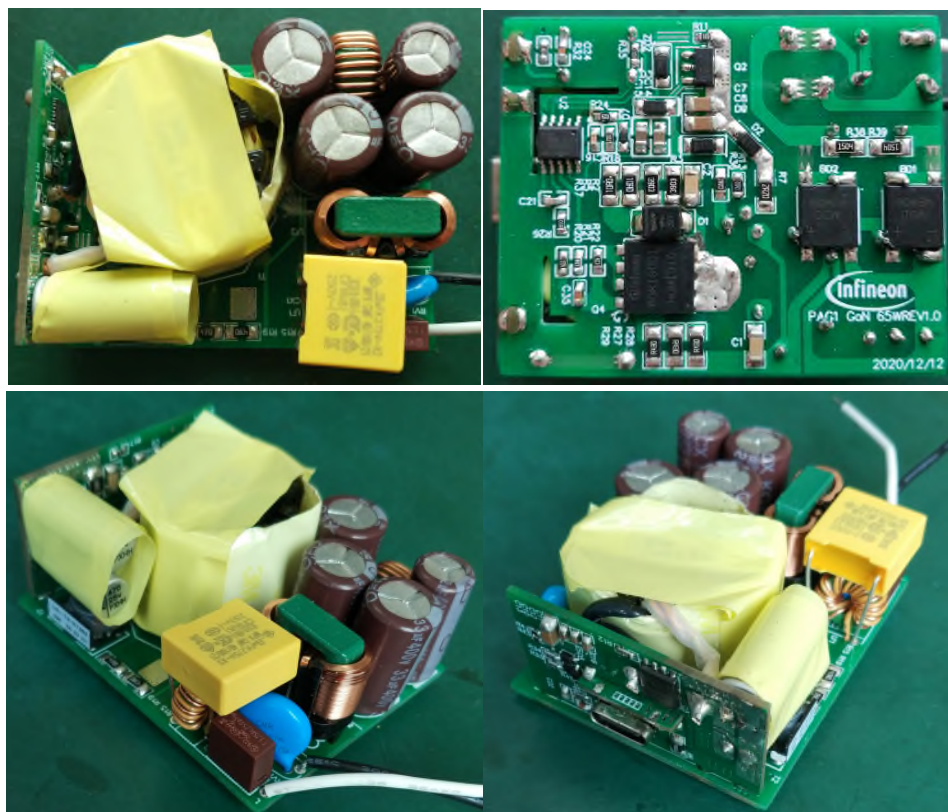
2.1 DUT (Device Under Test)

65W PAG1P+PAG1S Solution Kit: (CYPAP111A3+CYPAS111A1)

Table 2-1. PAG1P-PAG1S Solution Kit Details

DUT contents	Description
CYPAP111A3+CYPAS111A1	Primary and Secondary Controller
Firmware Version	CYPAS111_65w_130k_ZVS_v9

Figure 2-1. PAG1P-PAG1S **Non-XCap Mode** Solution Demo Kit



PCBA Dimensions (in mm): 52(L) x 42(W) x 22(H), Power density: 22.17 W/in³ or 1.35W/CC

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. 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: 12V, 3A FIXED
- PDO 4: 15V, 3A FIXED
- PDO 5: 20V, 3.25A FIXED
- PDO 6: 3.3V-21V, 0-3.25A 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 MDO3024
Power Meter	Yokogawa WT310E
Digital Multimeter (Vo & Io)	FLUKE 17B
Programmable AC Source	JingCe DAL15P
Electronic Load	Chroma 63600-1
Thermal Camera	Fluke Ti200
Automation Software	Chroma 8000
EMI Test Receiver 9k-300MHz	KeHuan KH3932

3. Power Management Test Results



The results documented here are based on the test reports of PAG1P+PAG1S 65W **Non-XCap Mode** Solution Demo Kit.

3.1 Efficiency 4-pt average

3.1.1 Detailed Data

Table 3-1. Efficiency* Results

Parameter	Test Condition	Min Criteria		Unit	Test Result	
		DoE level 6	CoCvt Tier2		115Vac 60Hz	230Vac 50Hz
Four- point Average Efficiency (Average of 25%, 50%, 75%, 100% load)	Vo = 3.3Vdc, Io = 3A	78.63%	78.93%	%	89.94	86.88
	Vo = 5Vdc, Io = 3A	81.39%	81.84%	%	91.20	89.02
	Vo = 9Vdc, Io = 3A	86.62%	87.30%	%	91.81	90.75
	Vo = 12Vdc, Io = 3A	87.40%	88.30%	%	91.89	91.14
	Vo = 15Vdc, Io = 3A	87.73%	88.85%	%	91.77	91.32
	Vo = 20Vdc, Io = 3.25A	88.00%	89.00%	%	91.61	91.78
	Vo = 21Vdc, Io = 3A	88.00%	89.00%	%	91.69	91.67
No load consumption	No USB sink attached	210 Max	150 Max	mW	28	43
CoCvt5 Tier2 10% load Efficiency	Vo = 3.3Vdc, Io = 0.3A	69.66%		%	84.39	71.29
	Vo = 5Vdc, Io = 0.3A	72.48%		%	86.43	77.38
	Vo = 9Vdc, Io = 0.3A	77.30%		%	87.89	81.46
	Vo = 12Vdc, Io = 0.3A	78.30%		%	87.82	83.65
	Vo = 15Vdc, Io = 0.3A	78.85%		%	87.57	84.42
	Vo = 20Vdc, Io = 0.325A	79.00%		%	87.76	85.30
	Vo = 21Vdc, Io = 0.3A	79.00%		%	87.60	85.10

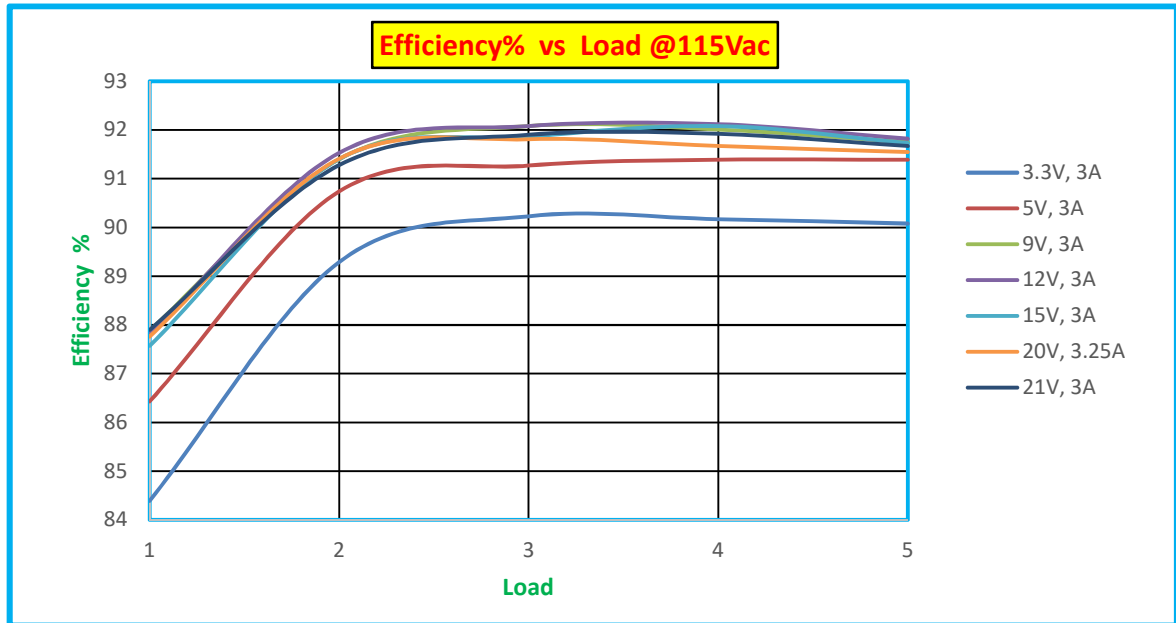
- Peak Efficiency: **92.25%** (At 230Vac-50Hz, 20V-3.25A)

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

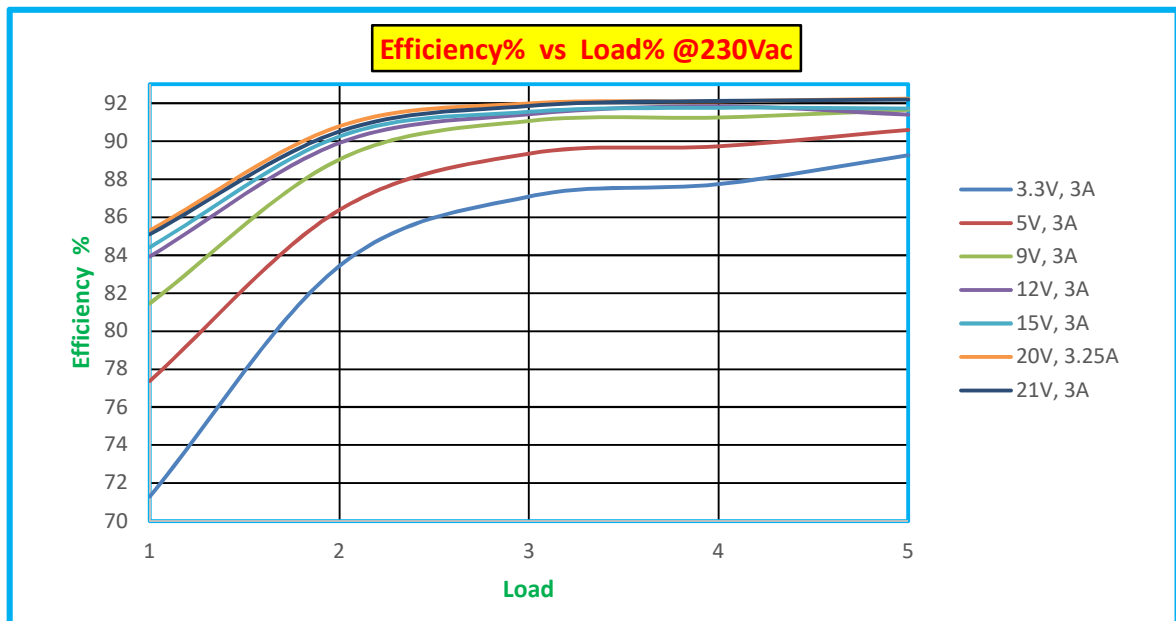
* Variation of $\pm 0.3\%$ in 4-point average efficiency and $\pm 1\%$ in 10% efficiency can be observed.

3.1.2 Graphs

Efficiency at 115Vac, 60Hz



Efficiency at 230Vac, 50Hz



1-5 load means: 10%-25%-50%-75%-100% of full load.

3.2 Standby Power Consumption

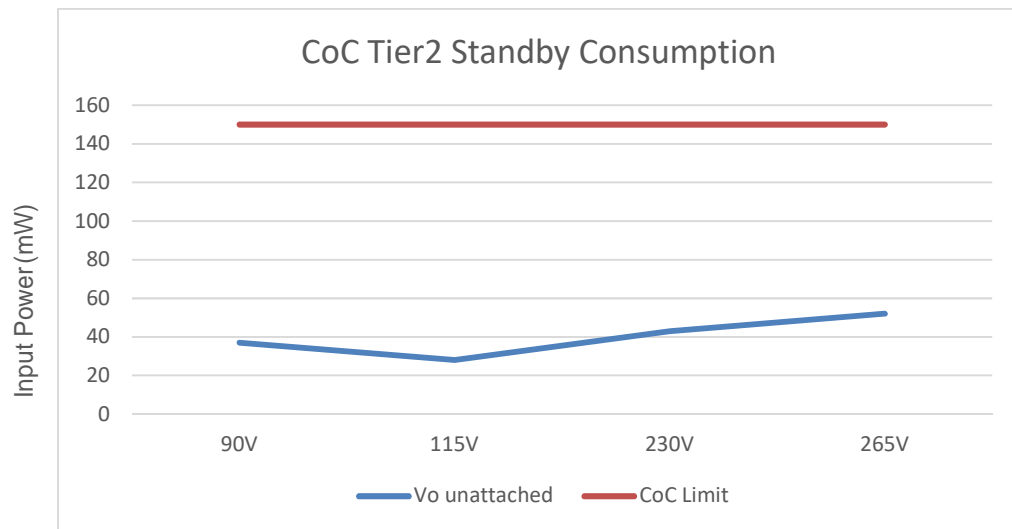
3.2.1 Detailed Data

Table 3-2. Standby Power Results*

Vin (Vac)	90Vac, 60Hz	115Vac, 60Hz	230Vac, 50Hz	265Vac, 50Hz
Input Power (mW)	37	28	43	52

3.2.2 Graph

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



* There should be 5 minutes of warm-up time before starting to measure standby power.

3.2.3 Details

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

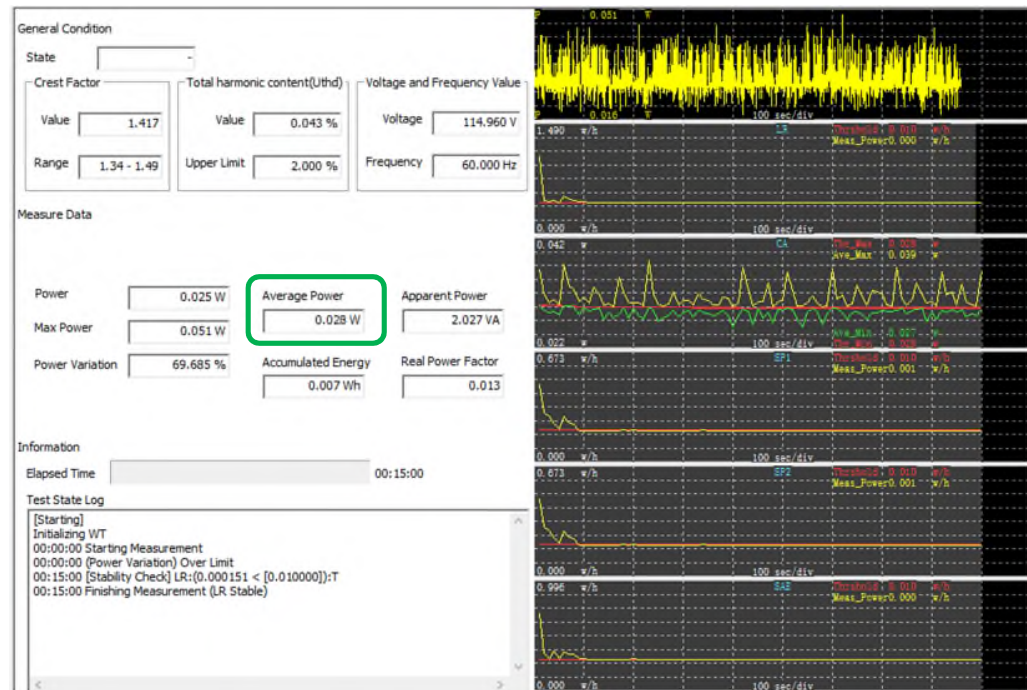
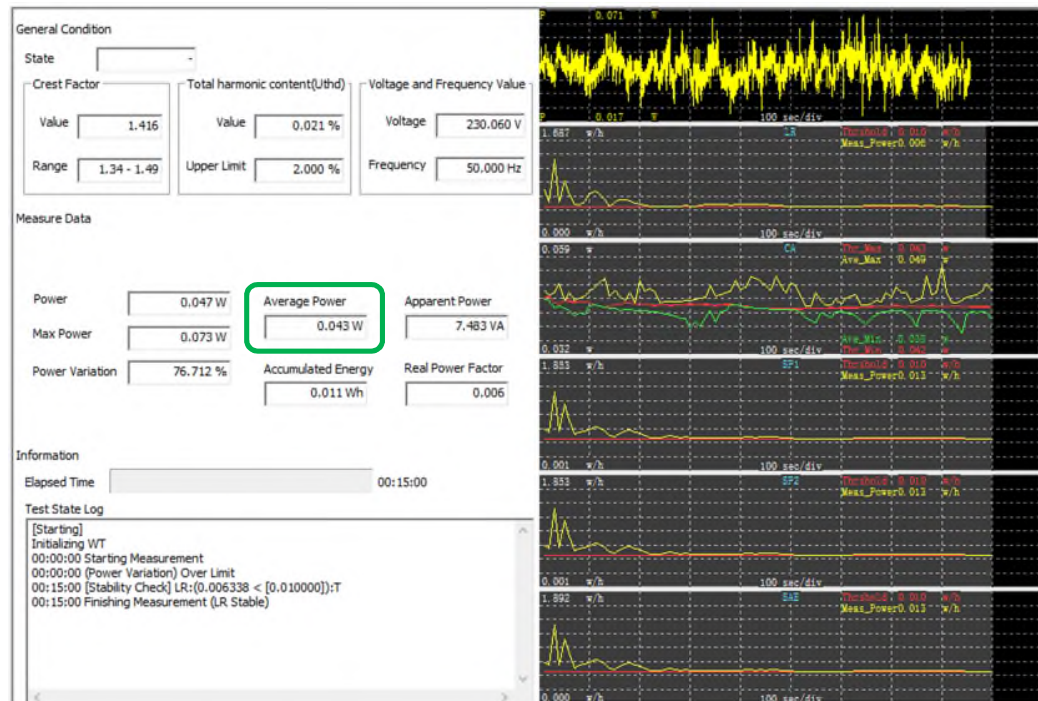


Figure 3-2-3. Detailed Power Measurement Results @230Vac, 50Hz



3.3 Output Voltage Ripple & Noise Peak-Peak

The ripple & noise are measured with 10uF E-cap and 104K ceramic capacitor at Vbus, and the oscilloscope bandwidth is set at 20MHz. The probe is needed to remove the outside plastic protector and GND wire, instead a spring PIN is necessary for directly Grounding. Refer to the below connection picture.

Figure 3-3-1. Ripple probe used (connected at board end)

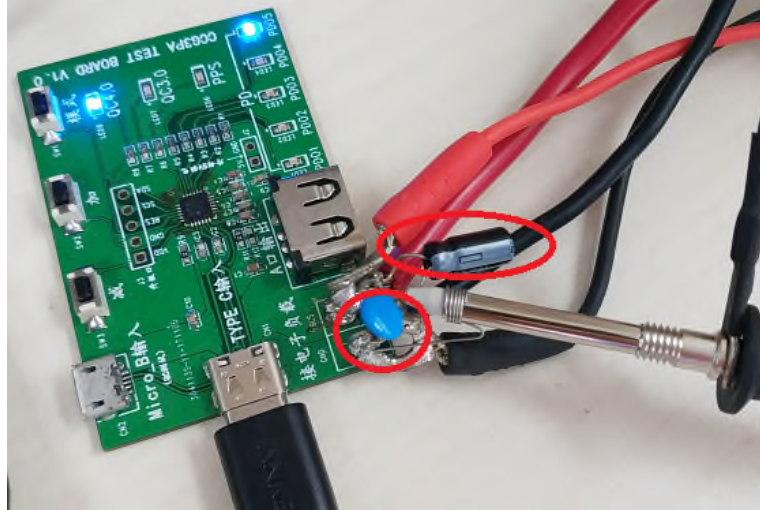
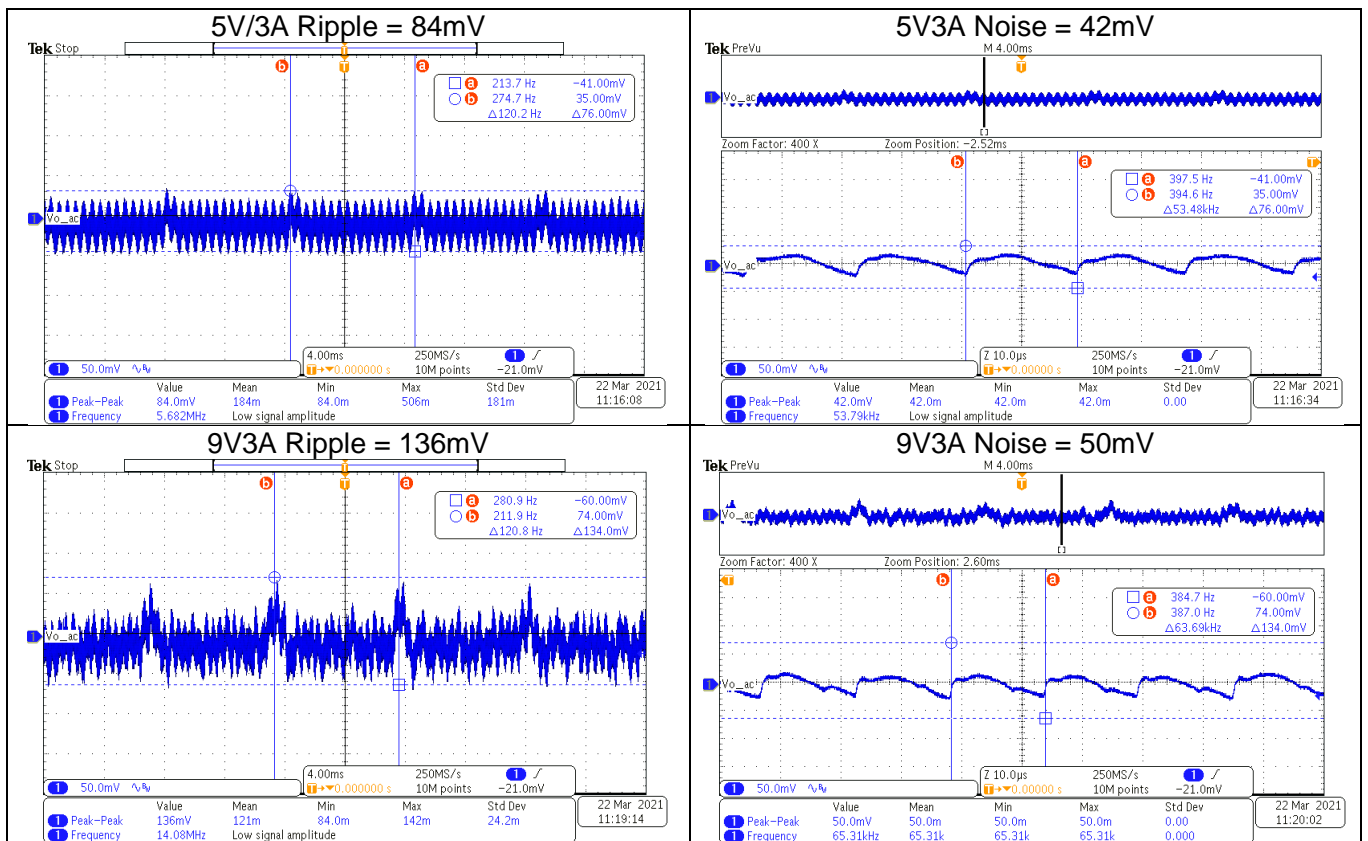


Figure 3-3-2. Ripple & Noise at 100Vac 60Hz (CH1: Vbus_c)



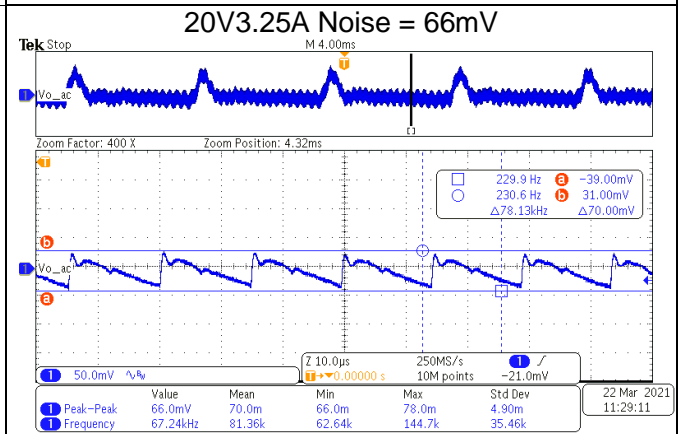
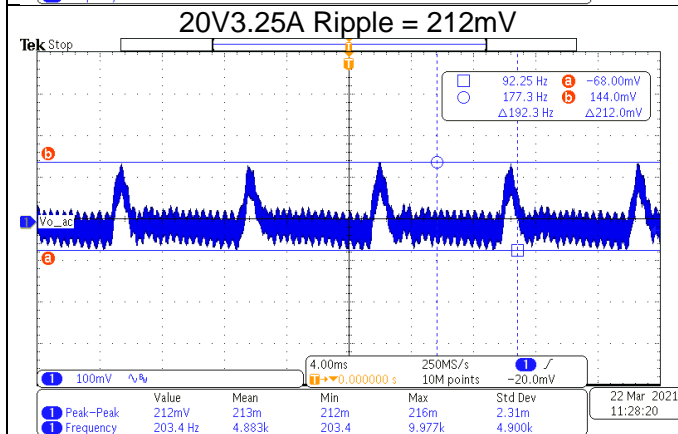
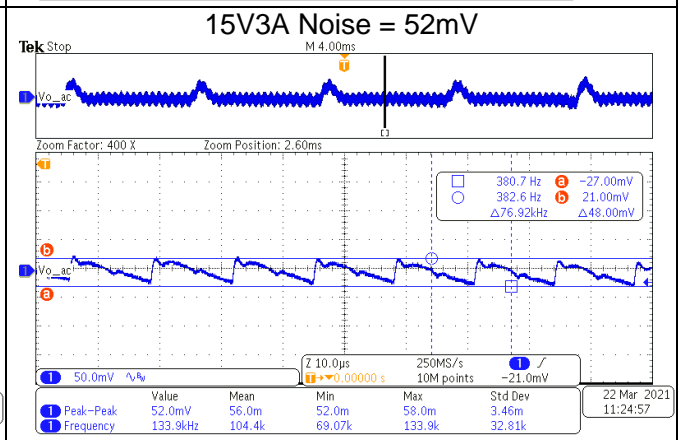
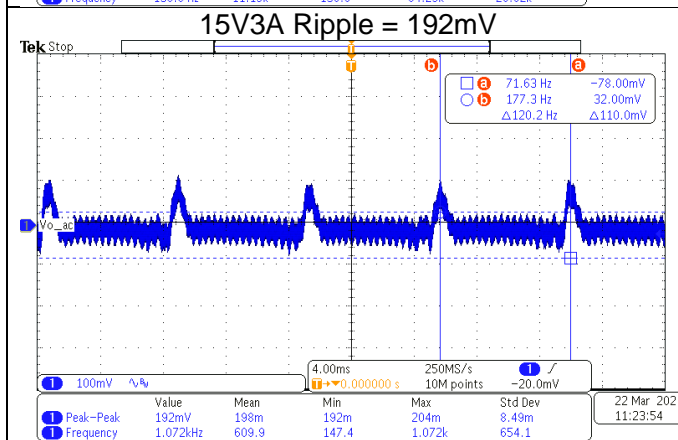
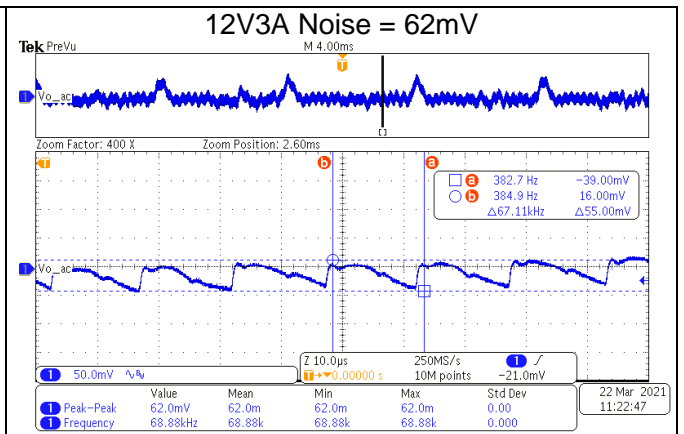
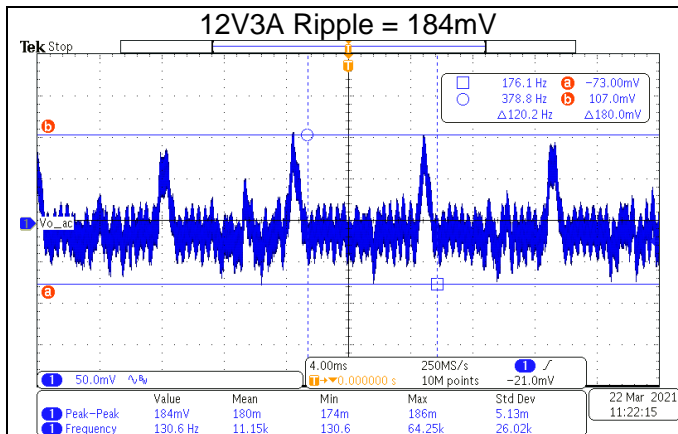
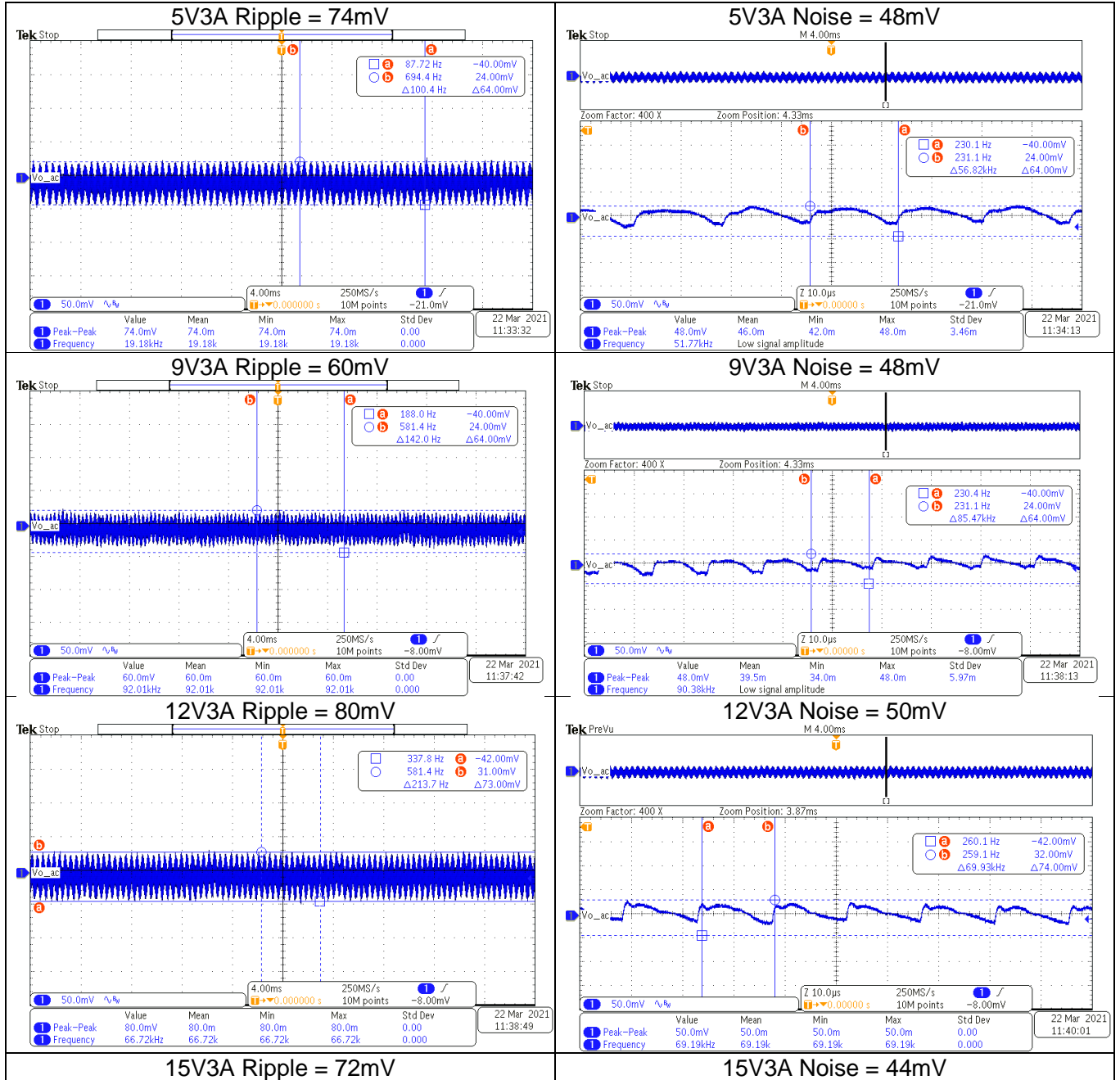
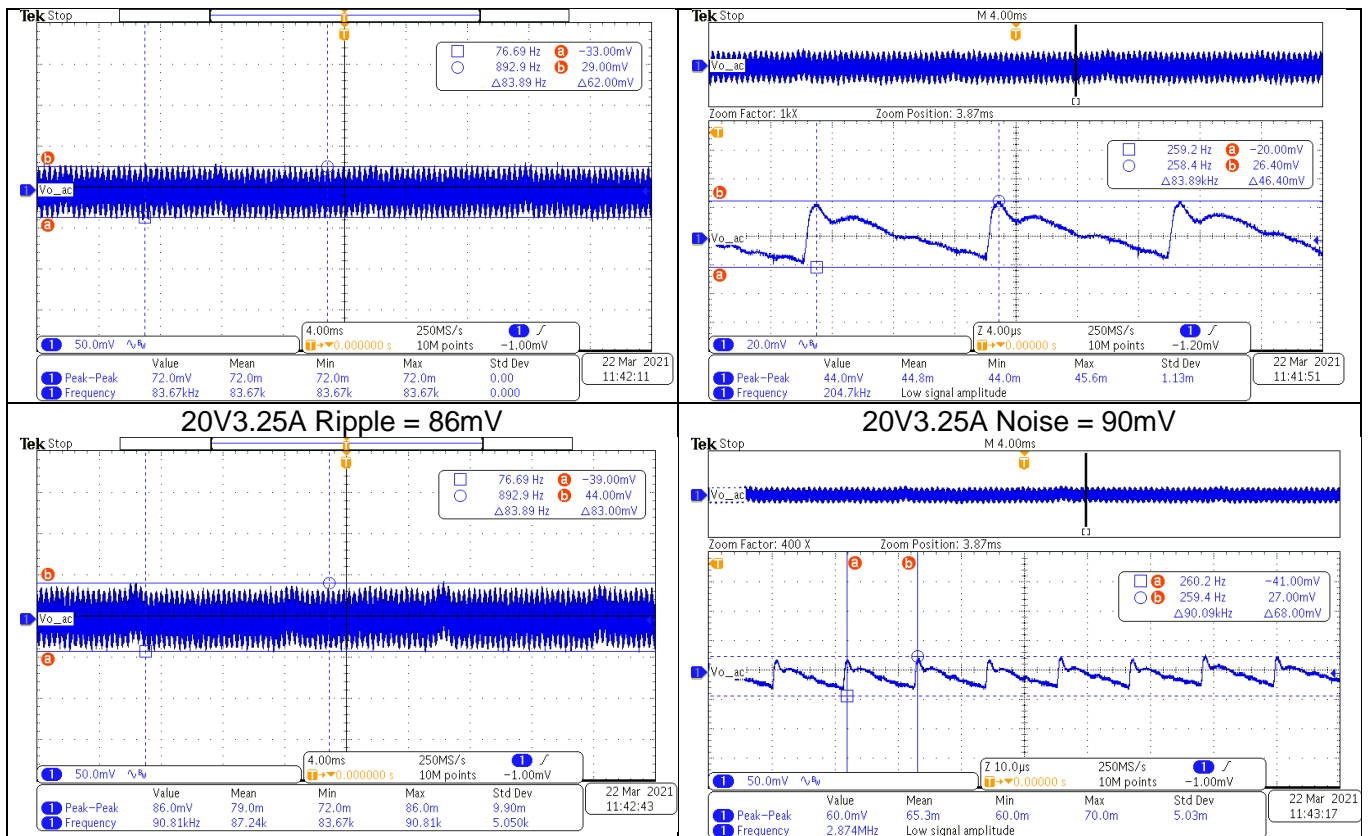


Figure 3-3-3. Ripple & Noise at 240Vac 50Hz (CH1: Vbus_c)





3.4 Output Voltage Ripple Dynamic Response

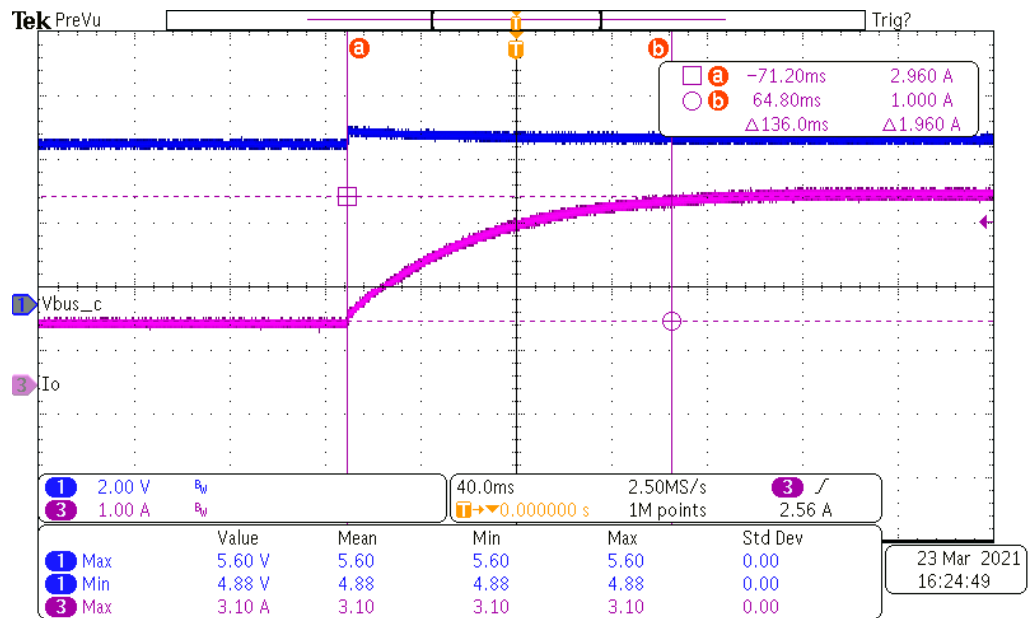
Test condition: Load=100%-10%, T1=20ms, T2=20ms, Slew=0.5A/uS, Vac=115/60Hz (CH1: Vbus_c,)



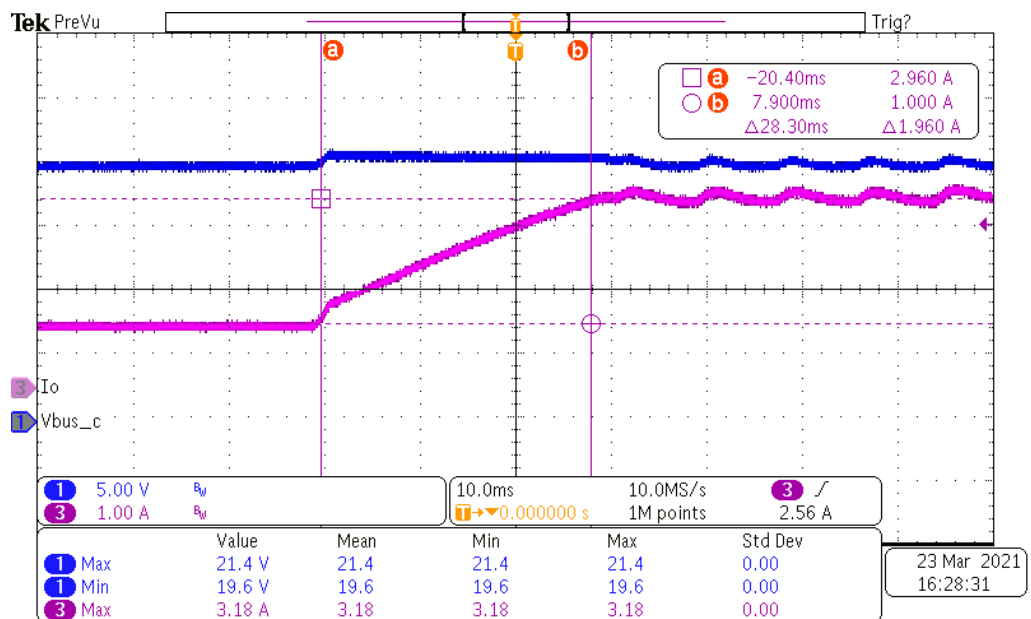
3.5 Output Current Dynamic Response

Test condition: 115Vac, 60Hz, PPS CV mode at E-load.

▼ 5V 1A~3A load, Settling time = 136mS

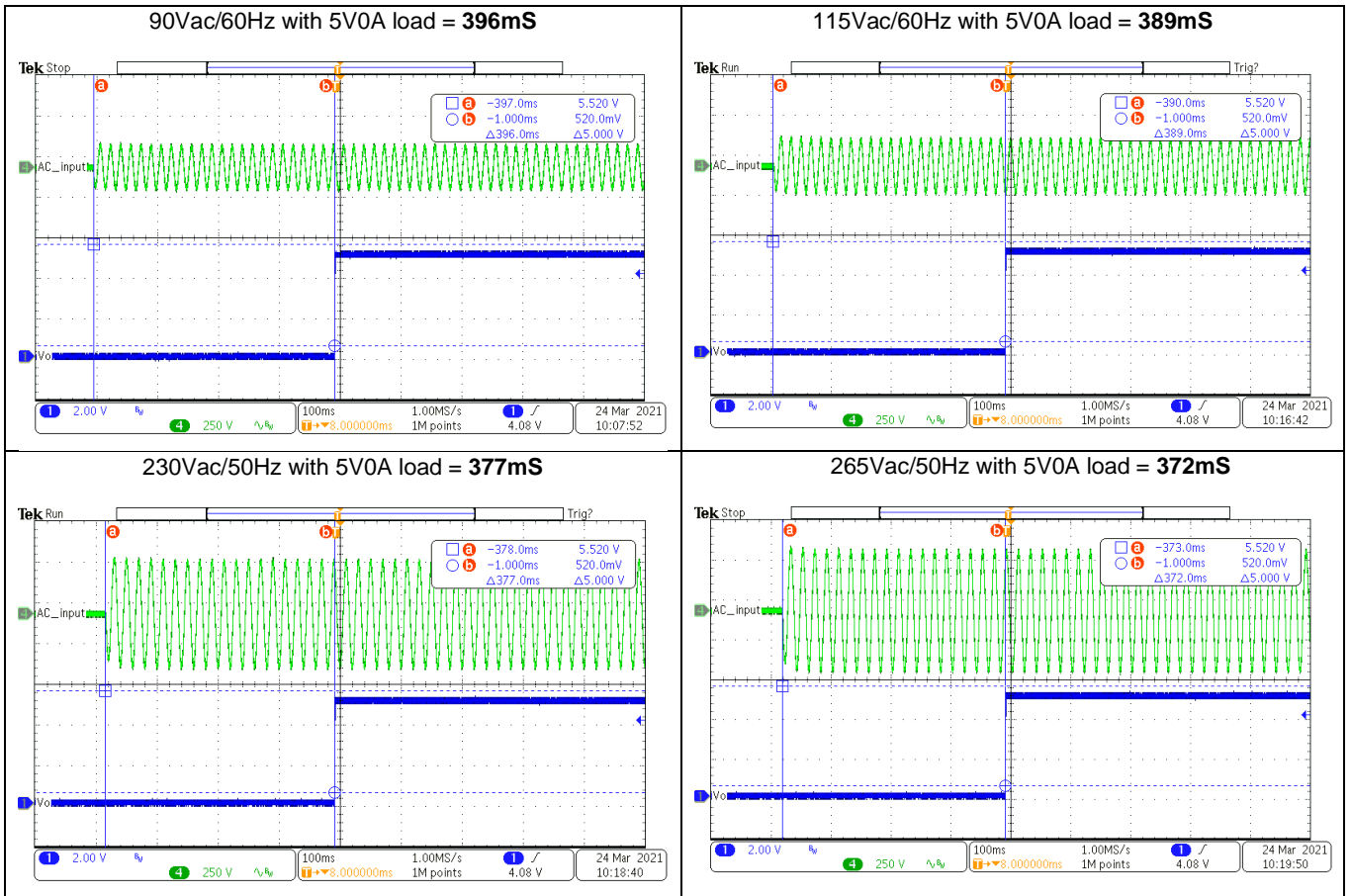


▼ 20V 1A~3A load, Settling time = 28.3mS



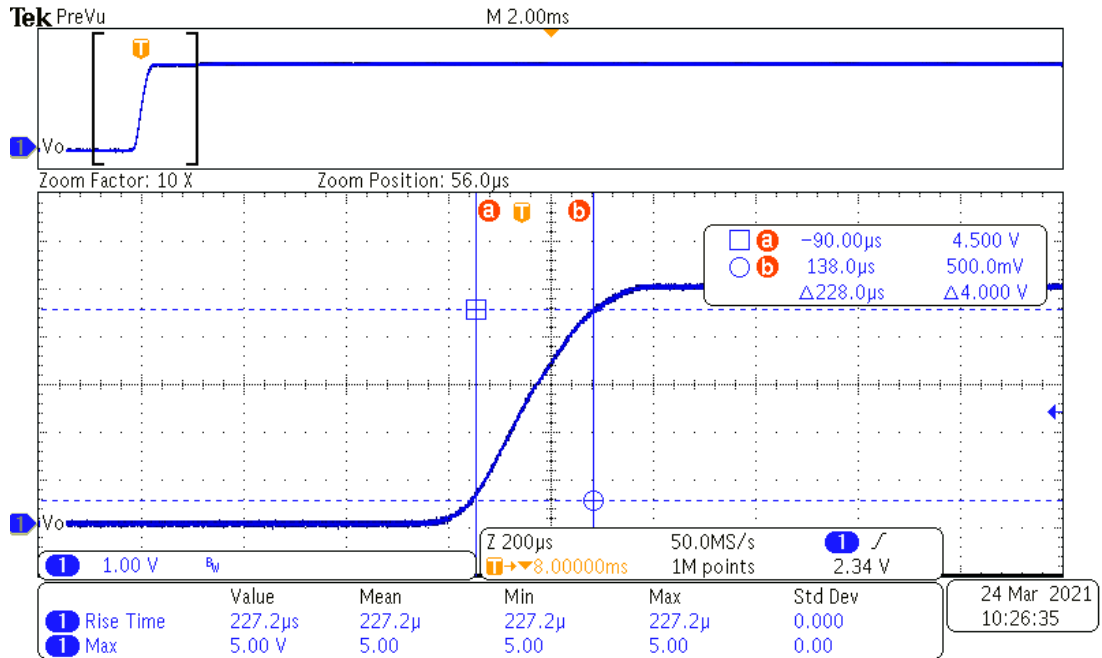
3.6 Start-up Turn-on Delay

Start-up Turn-on Delay at various AC input

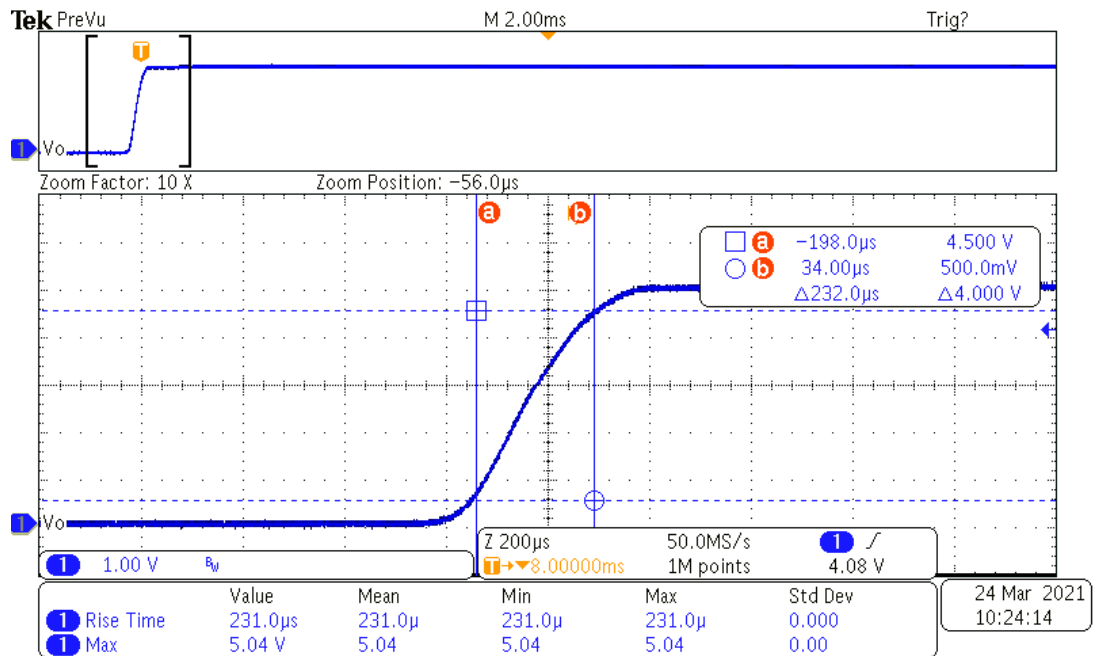


3.7 Start-up Turn-on Rise Time

▼ Start-up Rise time at 90Vac/60Hz with 5V0A load =2227uS

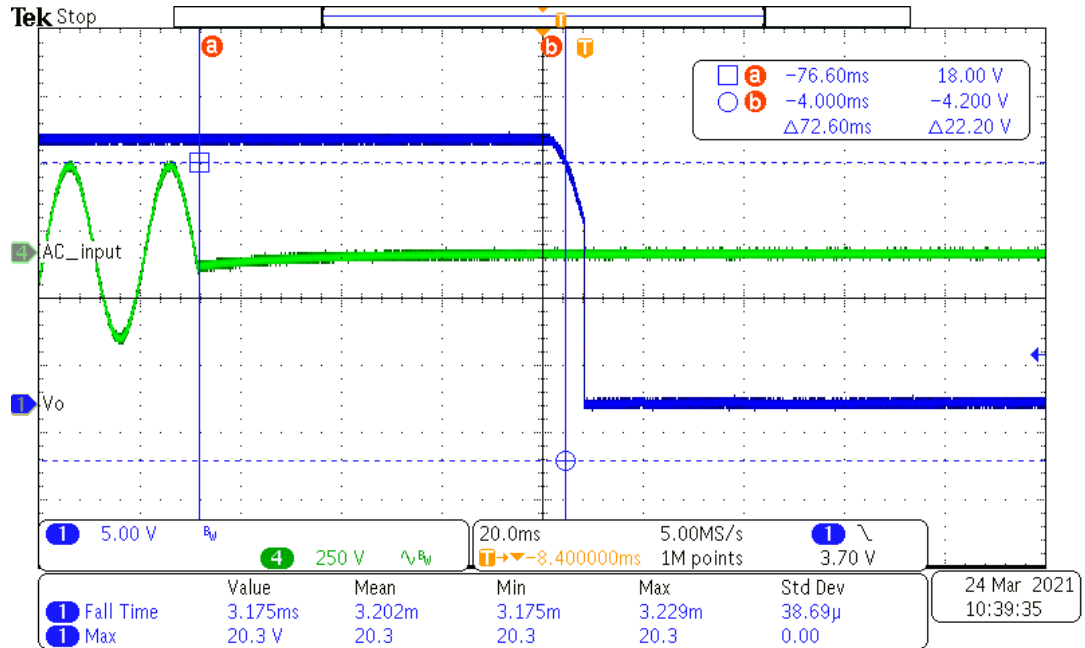


▼ Start-up Rise time at 265Vac/50Hz with 5V0A load =231uS

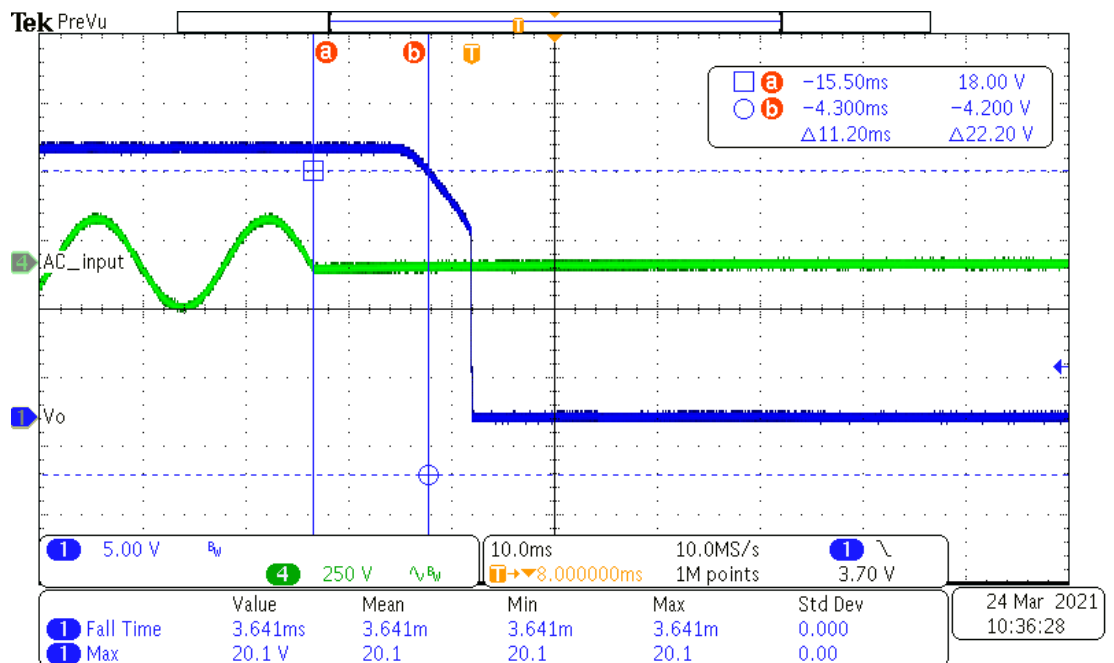


3.8 Shut-down Hold-up and Fall Time

▼ 230Vac/50Hz with 20V3.25A load, Thold-up = 72.6mS, Tfall = 3.175mS



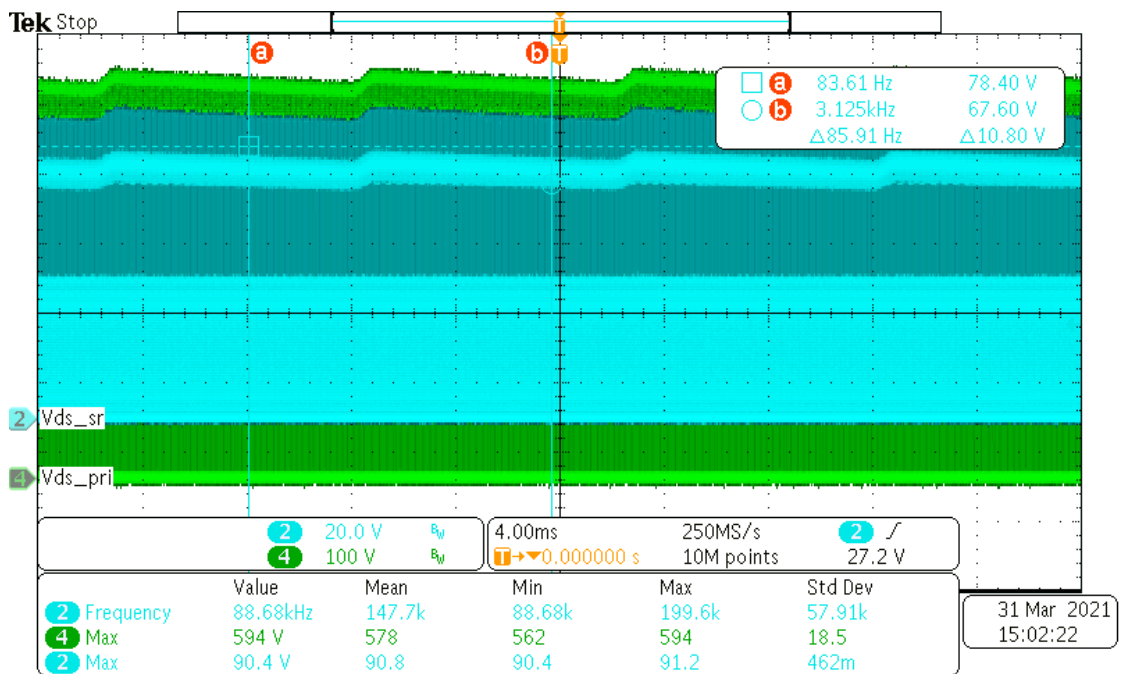
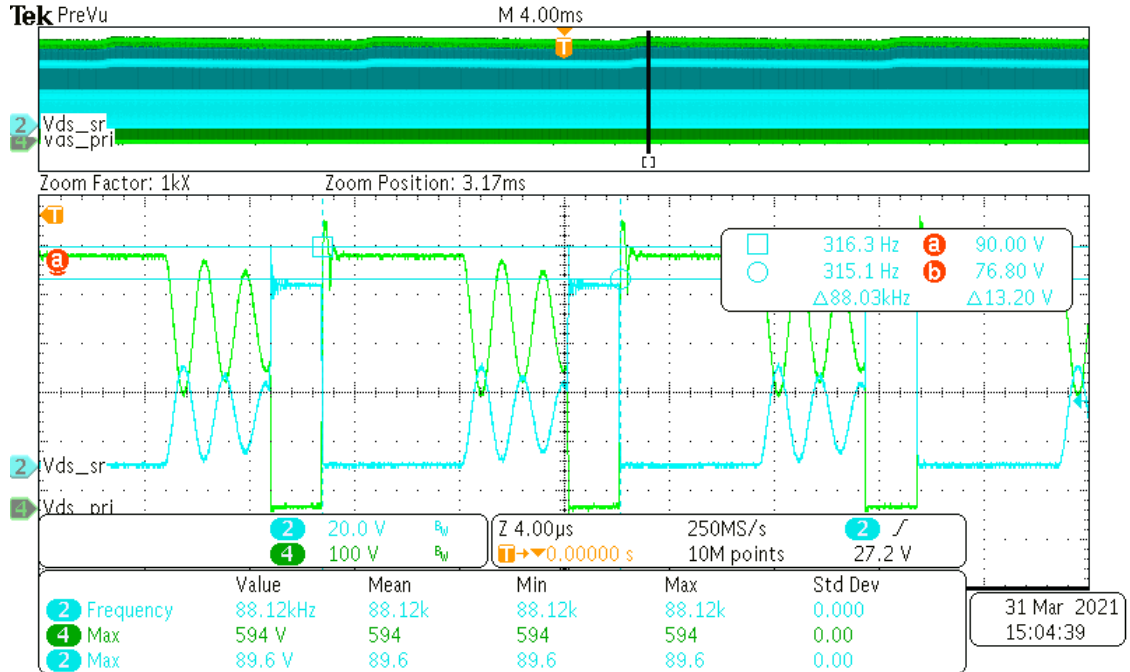
▼ 115Vac/60Hz with 20V3.25A load, Thold-up = 11.2mS, Tfall = 3.641mS



3.9 Switch Voltage Stress

Voltage Stress on Primary CoolGaN and SR FET (**CH2: Vds_sr, CH4: Vds_GaN**)

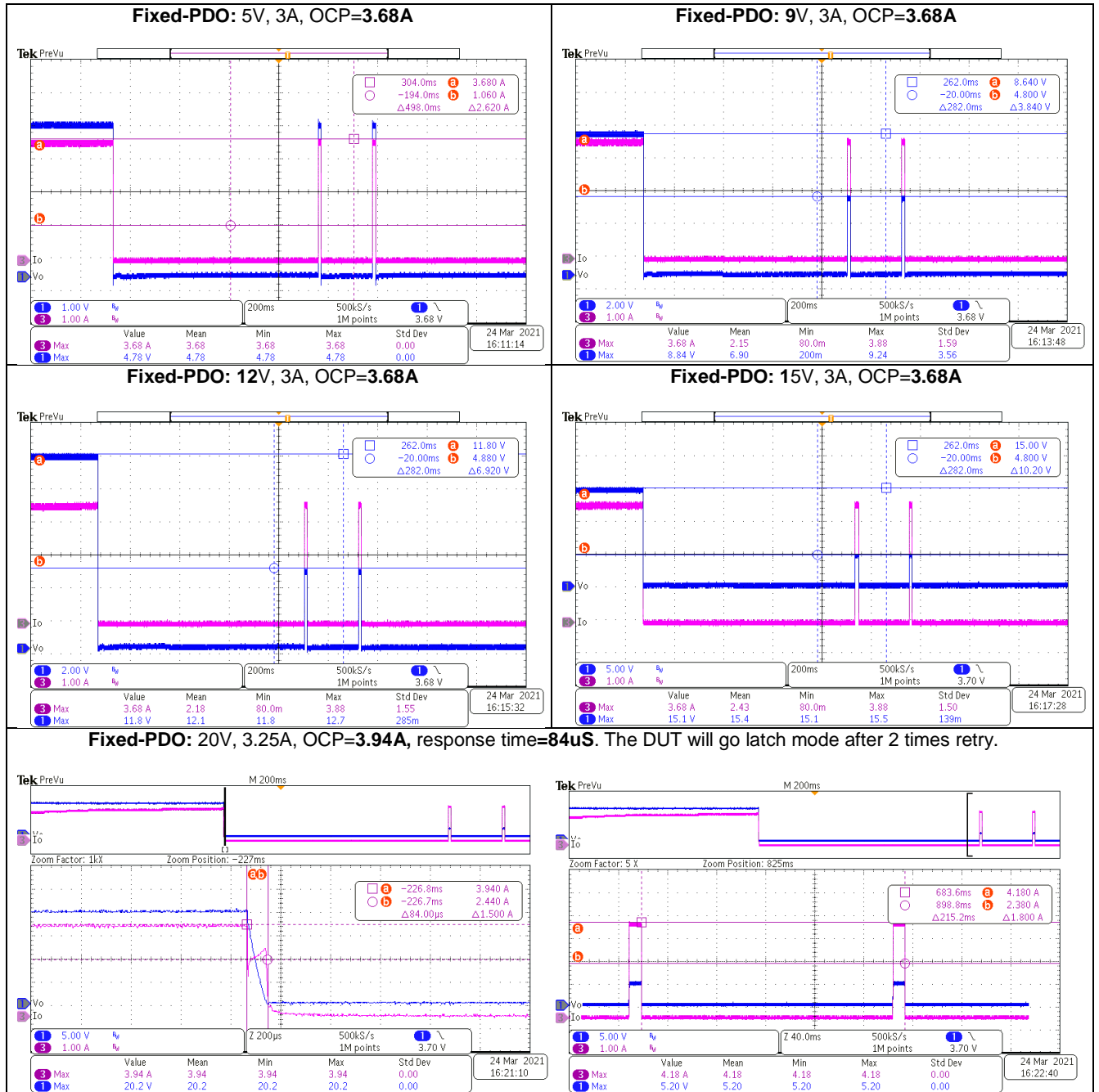
Test Condition: Vin = 265Vac/50Hz with 20V/3.25A full load



Vds_CoolGaN = 594V<650V, Vds_sr = 90.4V<100V.

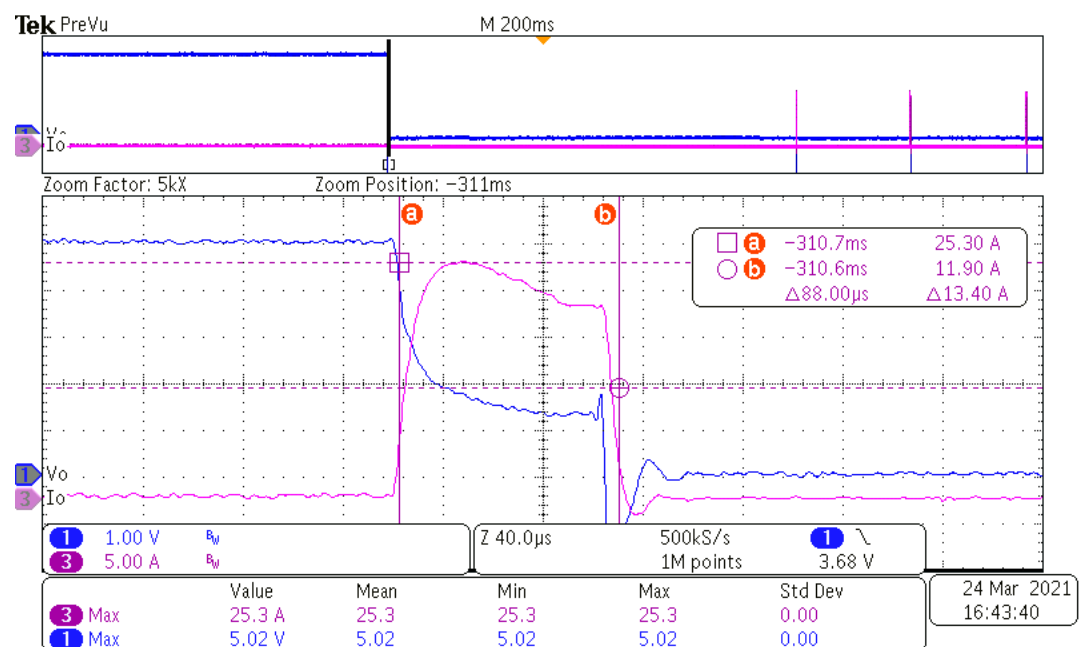
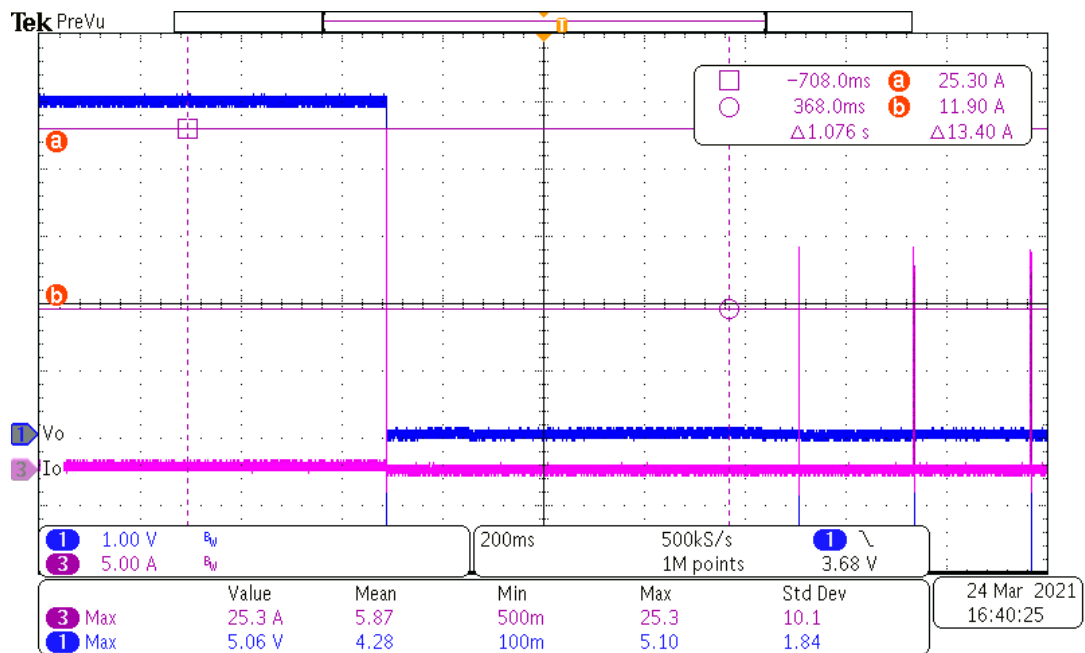
3.10 Over Current Protection

Test Condition: at 115V, 60Hz with full load of each PDO. (CH1: Vbus_c, CH3: Iout)



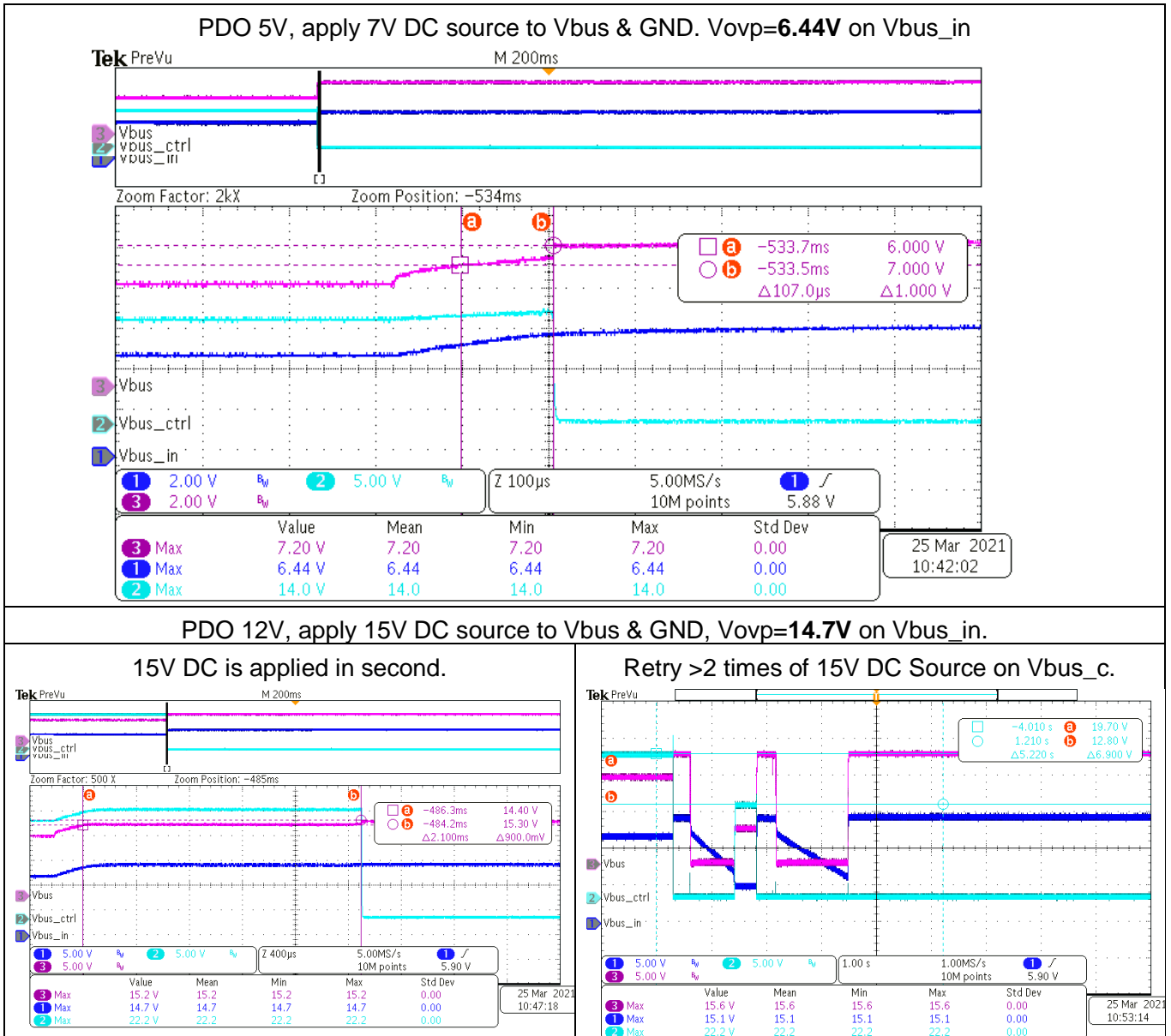
3.11 Short Circuit Protection

Test condition: at 115Vac, 5V0.3A load. Short E-load output.



3.12 Over Voltage Protection

Test Condition: 115Vac, 0A load.



3.13 Over Temperature Protection

OTP trigger point = 100°C

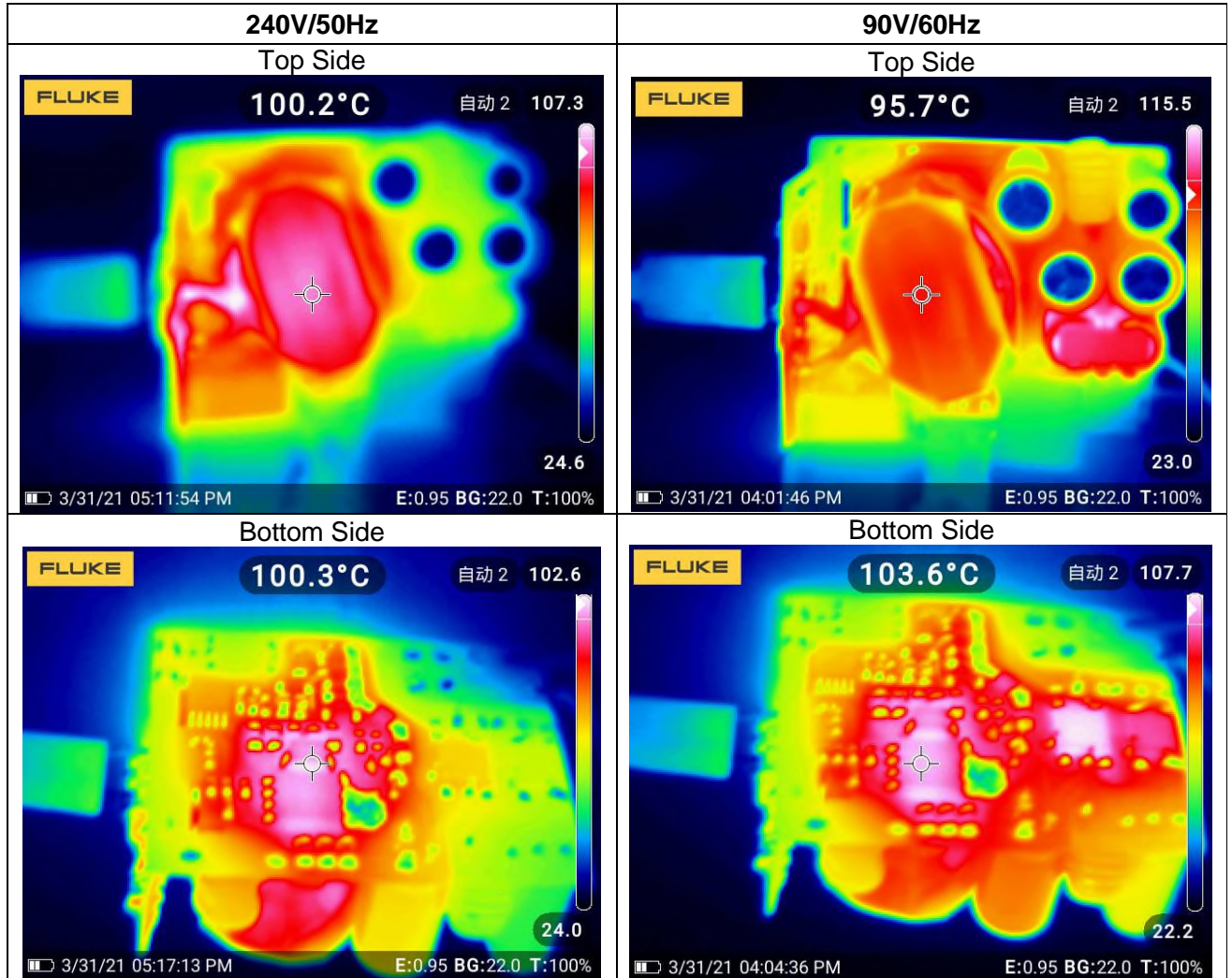
OTP resume point = 60°C

The sense point of temperature is from NTC 100K resistor on the daughter board.

3.14 Thermal Captures

Test Condition: Vout = 20V, Iout = 3.25A Full load

Ambient Condition: 25°C and in Open-frame with free air-flow for running 60 Minutes.



Measured Key Component	Temp (°C) @240V/50Hz	Temp (°C) @90V/60Hz
Transformer RM10 Core	100.2	95.7
Transformer RM10 Wire	105.3	100.7
Primary- CoolGaN: IGLD60R190D1S	98.5	103.6
SR MOSFET: BSC0805LS	112.4	103.5
Bridge Diode: MSB407	69.5	107.4
PAG1S	90.4	85.3
PAG1P	76.3	75.9
Primary Snubber Diode	100.3	102.8

3.15 Conducted Emission

CE at 230V, 50Hz: NEUTRAL (AV Margin ≥ 7.4 dB)

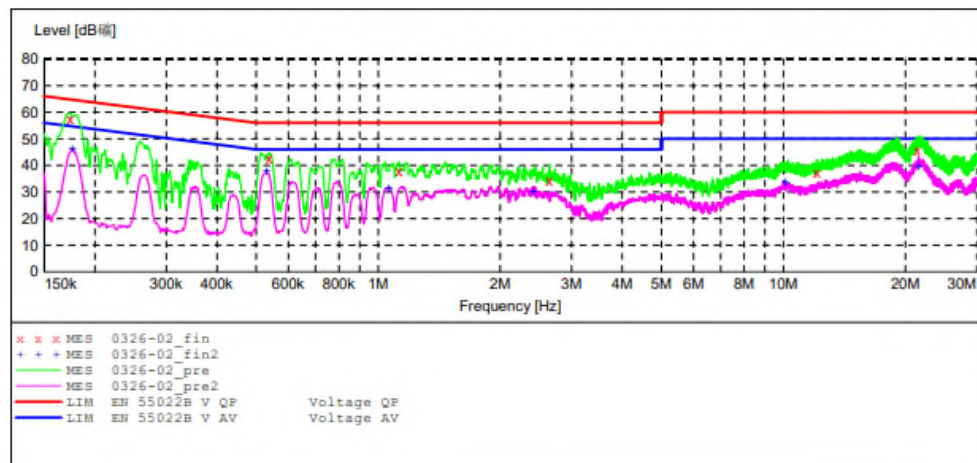
ACCURATE TECHNOLOGY CO., LTD

CONDUCTED EMISSION STANDARD EN 55032B

EUT: M/N:PAG1 GAN 65W
 Manufacturer: SPLS
 Operating Condition: Working
 Test Site: 2#Shielding Room
 Operator: Icey
 Test Specification: N 230V/50Hz
 Comment: Report NO.:
 Start of Test: 2021-3-26 / 10:03:50

SCAN TABLE: "V 150K-30MHz fin"

Short Description: SUB STD VTERM2 1.70
 Start Stop Step Detector Meas. IF Transducer
 Frequency Frequency Width Time Bandw.
 150.0 kHz 30.0 MHz 4.5 kHz QuasiPeak 1.0 s 9 kHz NSLK8126 2008
 Average



MEASUREMENT RESULT: "0326-02_fin"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.174000	57.40	10.8	65	7.4	QP	N	GND
0.538000	42.50	11.0	56	13.5	QP	N	GND
1.126000	37.60	11.2	56	18.4	QP	N	GND
2.645000	34.00	11.3	56	22.0	QP	N	GND
12.080000	37.40	11.6	60	22.6	QP	N	GND
21.400000	45.60	11.7	60	14.4	QP	N	GND

MEASUREMENT RESULT: "0326-02_fin2"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.176000	46.30	10.8	55	8.4	AV	N	GND
0.530000	37.70	11.0	46	8.3	AV	N	GND
1.062000	31.40	11.1	46	14.6	AV	N	GND
2.410000	30.30	11.3	46	15.7	AV	N	GND
10.100000	33.70	11.6	50	16.3	AV	N	GND
21.545000	39.30	11.7	50	10.7	AV	N	GND

CE at 230V, 50Hz: LINE (AV Margin ≥ 4.1 dB)

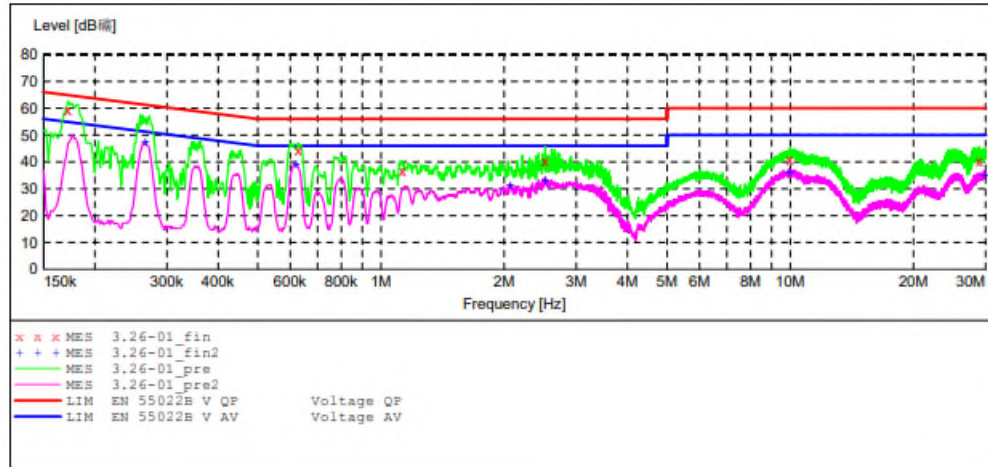
ACCURATE TECHNOLOGY CO., LTD

CONDUCTED EMISSION STANDARD EN 55032B

EUT: M/N:PAG1 GAN 65W
 Manufacturer: SPLS
 Operating Condition: Working
 Test Site: 2#Shielding Room
 Operator: Icey
 Test Specification: L 230V/50Hz
 Comment: Report NO.:
 Start of Test: 2021-3-26 / 10:00:24

SCAN TABLE: "V 150K-30MHz fin"

Short Description: SUB STD VTERM2 1.70
 Start Stop Step Detector Meas. IF Transducer
 Frequency Frequency Width Time Bandw.
 150.0 kHz 30.0 MHz 4.5 kHz QuasiPeak 1.0 s 9 kHz NSLK8126 2008
 Average



MEASUREMENT RESULT: "3.26-01_fin"

2021-3-26 10:02

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.172000	59.00	10.8	65	5.9	QP	L1	GND
0.628000	44.20	11.0	56	11.8	QP	L1	GND
1.130000	36.60	11.2	56	19.4	QP	L1	GND
2.520000	39.90	11.3	56	16.1	QP	L1	GND
9.975000	40.90	11.6	60	19.1	QP	L1	GND
28.940000	40.20	11.8	60	19.8	QP	L1	GND

MEASUREMENT RESULT: "3.26-01_fin2"

2021-3-26 10:02

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.266000	47.10	10.9	51	4.1	AV	L1	GND
0.620000	39.20	11.0	46	6.8	AV	L1	GND
2.070000	31.40	11.3	46	14.6	AV	L1	GND
2.520000	32.80	11.3	46	13.2	AV	L1	GND
9.965000	36.10	11.6	50	13.9	AV	L1	GND
29.890000	35.00	11.8	50	15.0	AV	L1	GND

CE at 110V, 60Hz: LINE (AV Margin ≥ 12.4 dB)

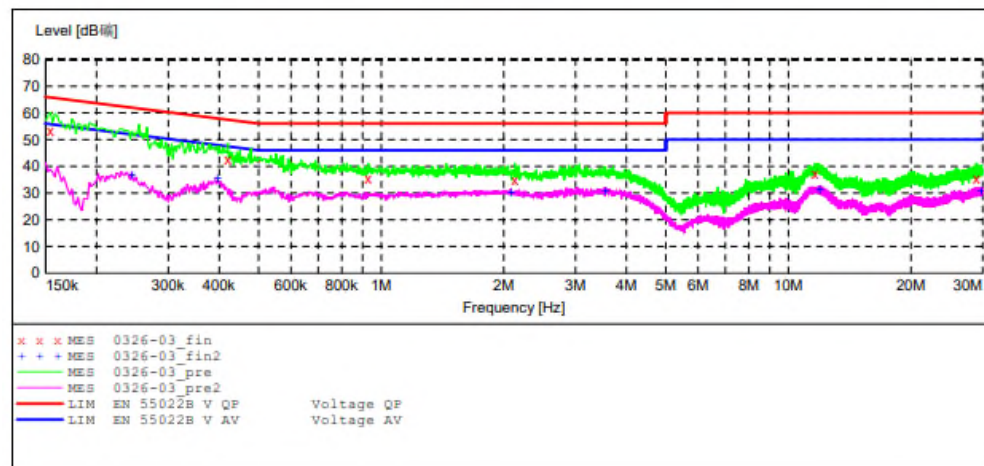
ACCURATE TECHNOLOGY CO., LTD

CONDUCTED EMISSION STANDARD EN 55032B

EUT: M/N:PAG1 GAN 65W
 Manufacturer: SPLS
 Operating Condition: Working
 Test Site: 2#Shielding Room
 Operator: Icey
 Test Specification: L 120V
 Comment: Report NO.:
 Start of Test: 2021-3-26 / 10:07:00

SCAN TABLE: "V 150K-30MHz fin"

Short Description: _SUB STD VTERM2 1.70
 Start Stop Step Detector Meas. IF Transducer
 Frequency Frequency Width Time Bandw.
 150.0 kHz 30.0 MHz 4.5 kHz QuasiPeak 1.0 s 9 kHz NSLK8126 2008
 Average



MEASUREMENT RESULT: "0326-03_fin"

2021-3-26 10:08

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.154000	53.40	10.8	66	12.4	QP	L1	GND
0.420000	42.40	11.0	57	15.0	QP	L1	GND
0.930000	35.10	11.1	56	20.9	QP	L1	GND
2.130000	34.70	11.3	56	21.3	QP	L1	GND
11.630000	37.00	11.6	60	23.0	QP	L1	GND
28.945000	35.60	11.8	60	24.4	QP	L1	GND

MEASUREMENT RESULT: "0326-03_fin2"

2021-3-26 10:08

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.244000	36.70	10.9	52	15.3	AV	L1	GND
0.396000	35.30	11.0	48	12.6	AV	L1	GND
2.080000	30.10	11.3	46	15.9	AV	L1	GND
3.555000	30.70	11.4	46	15.3	AV	L1	GND
11.940000	31.20	11.6	50	18.8	AV	L1	GND
29.710000	30.70	11.8	50	19.3	AV	L1	GND

CE at 120V, 60Hz: NEUTRAL (AV Margin $\geq 12.9\text{dB}$)

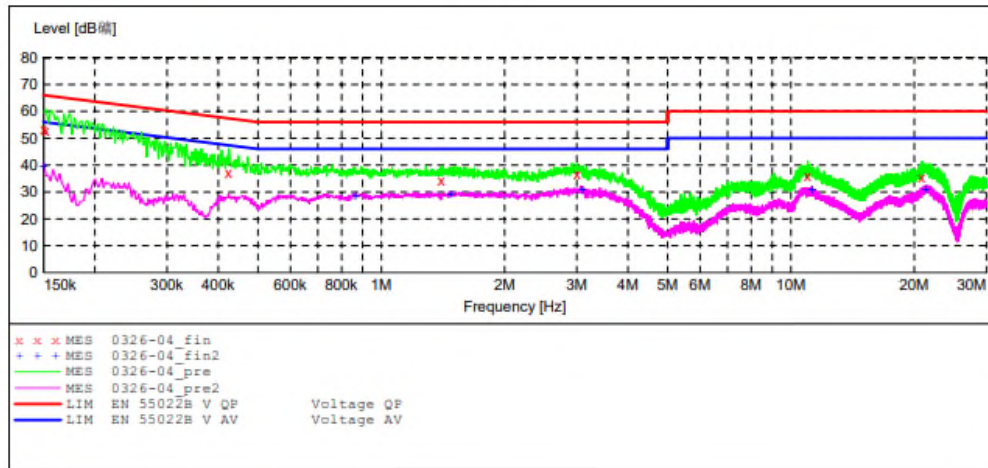
ACCURATE TECHNOLOGY CO., LTD

CONDUCTED EMISSION STANDARD EN 55032B

EUT: M/N:PAG1 GAN 65W
 Manufacturer: SPLS
 Operating Condition: Working
 Test Site: 2#Shielding Room
 Operator: Icey
 Test Specification: N 120V
 Comment: Report NO.:
 Start of Test: 2021-3-26 / 10:09:39

SCAN TABLE: "V 150K-30MHz fin"

Short Description: SUB STD VTERM2 1.70
 Start Stop Step Detector Meas. IF Transducer
 Frequency Frequency Width Time Bandw.
 150.0 kHz 30.0 MHz 4.5 kHz QuasiPeak 1.0 s 9 kHz NSLK8126 2008
 Average



MEASUREMENT RESULT: "0326-04_fin"

2021-3-26 10:11

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.150000	53.10	10.8	66	12.9	QP	N	GND
0.152000	52.50	10.8	66	13.4	QP	N	GND
0.424000	37.20	11.0	57	20.2	QP	N	GND
1.404000	34.10	11.2	56	21.9	QP	N	GND
3.005000	36.30	11.3	56	19.7	QP	N	GND
10.990000	36.00	11.6	60	24.0	QP	N	GND
20.840000	35.40	11.7	60	24.6	QP	N	GND

MEASUREMENT RESULT: "0326-04_fin2"

2021-3-26 10:11

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.150000	39.60	10.8	56	16.4	AV	N	GND
0.866000	28.50	11.1	46	17.5	AV	N	GND
1.474000	28.90	11.2	46	17.1	AV	N	GND
3.095000	30.60	11.3	46	15.4	AV	N	GND
11.245000	30.50	11.6	50	19.5	AV	N	GND
21.325000	30.50	11.7	50	19.5	AV	N	GND

3.16 USB PD Source Test Results (Using Quadramax)

Test Setup for Quadramax



Test Result

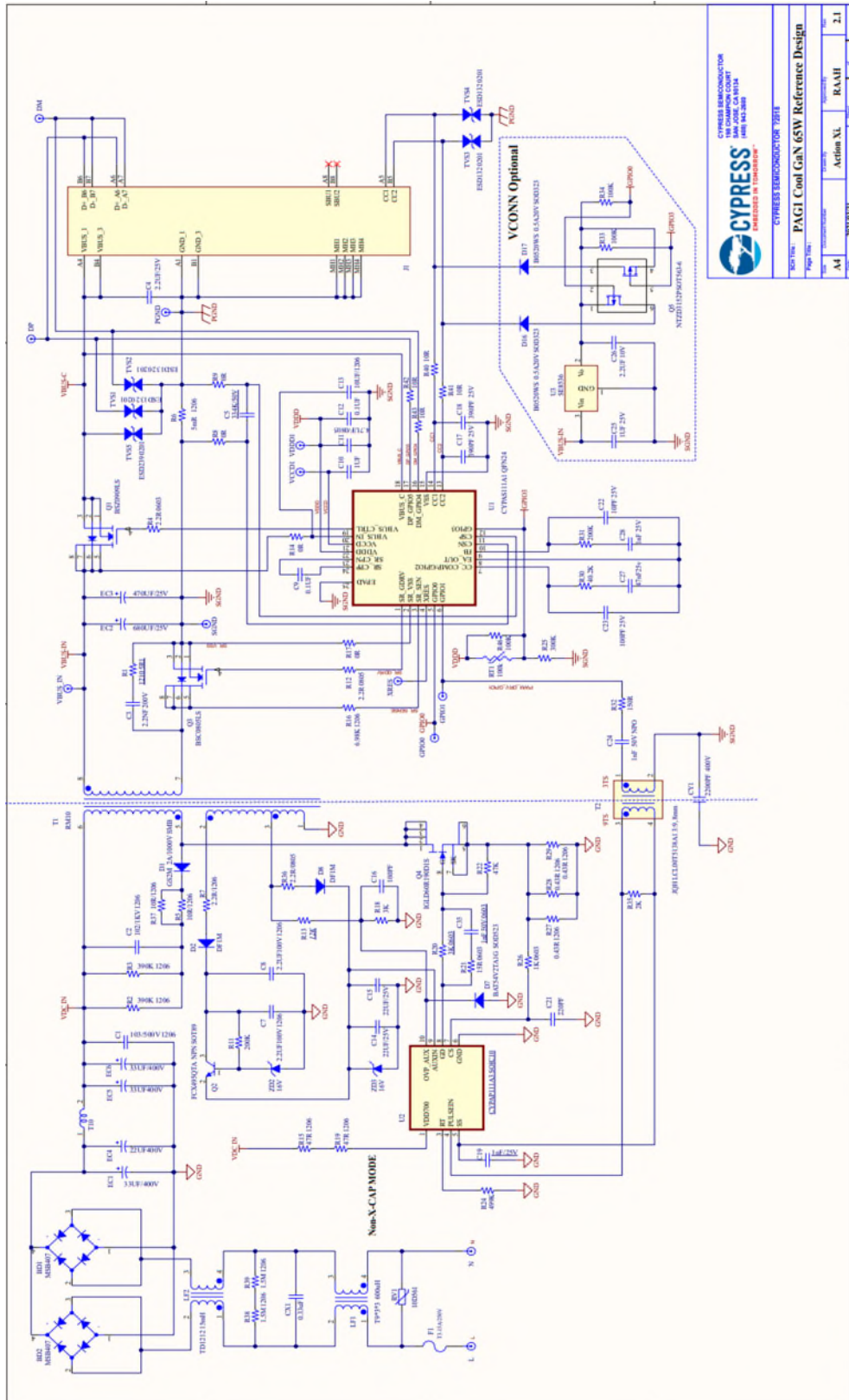
Testing Initialized
2021/3/17 16:03:32
QuadDraw Version: 0.8.7285
QM#103 HWRev:1.4.4 FWST:0.0.1376 FWCCG1:0.10

Test	Description	Result
TD SPT.1	Load Test	PASS
TD SPT.2	Capabilities Test	PASS
TD SPT.3	Hard Reset Test	PASS
TD SPT.5	Over Current Test	PASS
TD SPT.6	PPS Voltage Step Test	PASS
TD SPT.7	PPS Current Limit Test	PASS

4. Appendix



4.1 Schematics



65W USB-PD Power Adapter Solution
(PAG1P-A3 and PAG1S-A1)
Test Report, Version 2.1

4.2 Bill of Materials

Daughter Board BOM

No.	Reference	Part Description	Qty	Part Type
1	R12,R4	2.2 OHM 1% 0603 1/10W	2	SMD Resistor
2	R1	5.1 OHM 1% 1210 1/2W	1	
3	R6	0.005 OHM 1% 1206 1/4W	1	
4	R8,R9,R14,R17	0 OHM 1% 0603 1/4W	4	
5	R16	6.98K OHM 1% 1206 1/4W	1	
6	R25	300K OHM 1% 0603 1/10W	1	
7	RT1	NTC 100KOHM 4250K 0603	1	
8	R30	40.2K OHM 1% 0603 1/10W	1	
9	R31	200K OHM 1% 0603 1/10W	1	
10	R40,R41,R42,R43	10 OHM 1% 0402	4	
11	R33,R34, R46	100K OHM 1% 0603 1/10W	3	SMD Capacitor
12	C5	0.33UF 50V X7R 0603	1	
13	C9,C12	0.1UF 50V X7R 0603	2	
14	C3	2.2NF 200V X7R 1206	1	
15	C10	1UF 50V X7R 0603	1	
16	C11	4.7UF 25V X7R 0805	1	
17	C13	10UF 25V X7R 1206	1	
18	C17,C18	390PF 50V X7R 0603	2	
19	C22	10PF 50V X7R 0603	1	
20	C23	100PF 50V X7R 0603	1	
21	C25	1UF 50V X7R 0603	1	SMD Schottky Diode
22	C4, C26	2.2UF 25V X7R 0603	2	
23	C27	47NF 50V X7R 0603	1	
24	C28	1NF 50V X7R 0603	1	
25	D16,D17	B0520WS 0.5A20V SOD323	2	
26	U1	PAG1S CYPAS111A1-QFN24	1	
27	U3	SE8536 LDO3.6V SOT23-3	1	
28	Q5	NTZD3152P-20V430mA SOT563-6	1	
29	Q3	BSC0805LS 100V 7mR PG-TDSON-8	1	
30	Q1	BSZ0909LS 30V 3mR TSDSON8	1	
31	EC2	680UF/25V 8*16mm Aishi	1	Solid Cap
32	EC3	470UF/25V 6*15mm Aishi	1	
33	PCB2	37*22mm T=1.2mm FR-4 2OZ	1	PCB
			46	

Connector Board BOM

No.	Reference	Part Description	Qty	Part Type
1	J1	16Pin Tape-C Receptor	1	Connector
2	TVS1-TV54	ESD132 0201 Infineon	4	TVS Diode
3	TVS5	ESD239 0201 Infineon	1	TVS Diode
4	PCB3	15*8mm T=1.2mm FR-4 2OZ	1	PCB
			7	

Total components: 112pcs

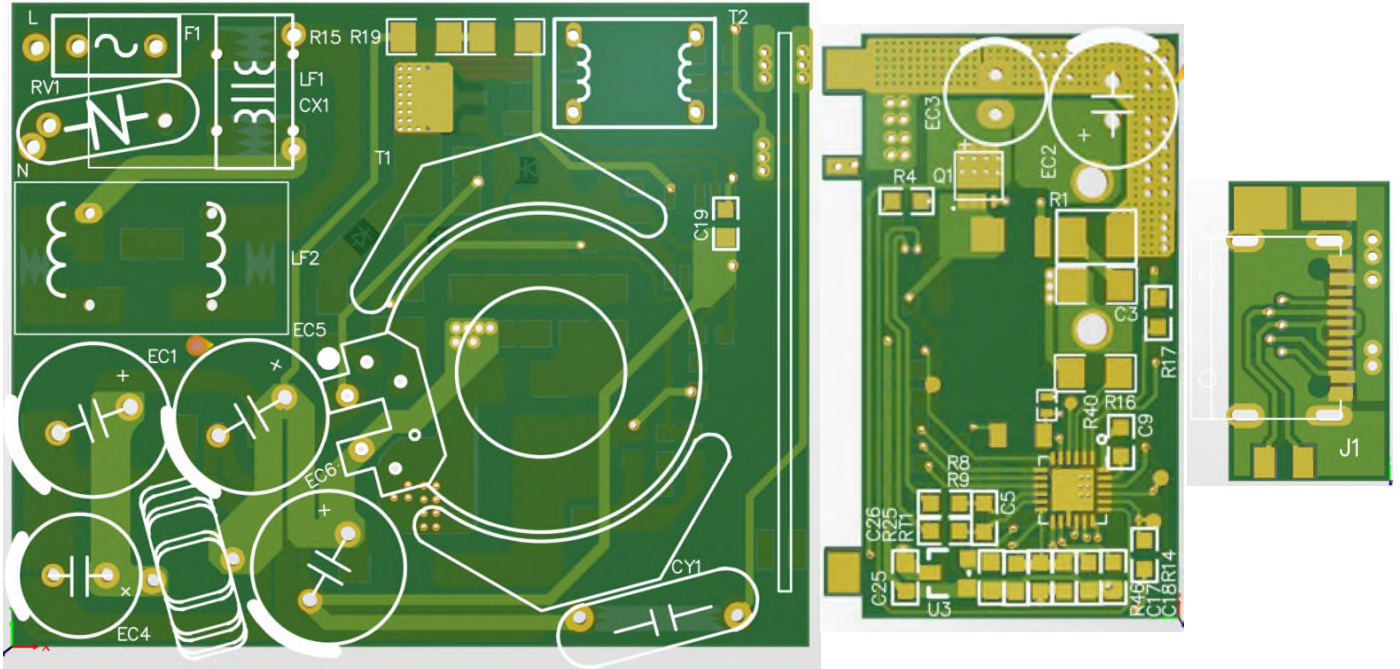
Main Board BOM

No.	Reference	Part Description	Qty	Part Type
1	R19,R15	47 OHM 1% 1206 1/4W	2	SMD Resistor
2	R2,R3	390K OHM 1% 1206 1/4W	2	
3	R5,R37	10 OHM 1% 1206 1/4W	2	
4	R7	2.2 OHM 1% 1206 1/4W	1	
5	R36	2.2 OHM 1% 0805 1/8W	1	
6	R38,R39	1.5M OHM 5% 1206 1/4W	2	
7	R11	200K OHM 1% 0603 1/10W	1	
8	R13	12K OHM 1% 0805 1/8W	1	
9	R18, R20	3K OHM 1% 0603 1/10W	2	
10	R21	15 OHM 1% 0603 1/10W	1	SMD Capacitor
11	R22	47K OHM 1% 0603 1/10W	1	
12	R24	499K OHM 1% 0603 1/10W	1	
13	R35	2K OHM 1% 0603 1/10W	1	
14	R26	1K OHM 1% 0603 1/10W	1	
15	R27,R28,R29	0.43 OHM 1% 1206 1/4W	3	
16	R32	150 OHM 1% 0603 1/10W	1	
17	C1	103K 500V X7R 1206	1	
18	C2	102K 1000V X7R 1206	1	
19	C7,C8	2.2UF 100V X7R 1206	2	
20	C14,C15	22UF 25V X5R 0805	2	SMD Schottky Diode
21	C16	100PF 50V NPO 0603	1	
22	C19	1UF 50V X7R 0603	1	
23	C21	220PF 50V NPO 0603	1	
24	C24	1000PF 50V NPO 0603	1	
25	C35	1NF 50V X7R 0603	1	
26	D7	BAT54V2TA1G SOD523	1	
27	D1	GS2M 2A 1000V SMB	1	
28	D2, D8	DF1M 1A 1000V SOD-123	2	
29	8D1,8D2	MS8407 4A 1000V	2	
30	ZD2,ZD3	BET52C16 16V SOD123	2	SMD Zener Diode
31	Q2	FCX495QTA SOT89 1A150V NPN	1	
32	Q4	IGLD60R190D1S 190mR CoolGaN ThinPAK 8x4	1	
33	U2	PAG1P CYPAP111A3 SOIC10	1	
34	EC1,EC5,EC6	33UF 400V 10*20 RK Series AISHI	3	
35	EC4	22UF 400V AISHI 8*20 2000H	1	
36	F1	T3.15A 250V	1	
37	LF1	T9*3*3 600uH	1	
38	RV1	MOV 10D561	1	
39	LF2	TD1212 15mH	1	
40	CY1	400V 2200PF Z5U or Y5P	1	Y-Cap
41	T2	JQH LCL00T5138A1 3.9, 8mm	1	
42	CX1	0.33uF/310V 334K310VAC Yixingjie	1	
43	T1	RM10 340uH 35.5:22 V2.1 YuQuan	1	
44	L1	T10 10*5*6 900uH	1	
45	PCB1	52*42mm T=1.2mm FR-4 2OZ	1	

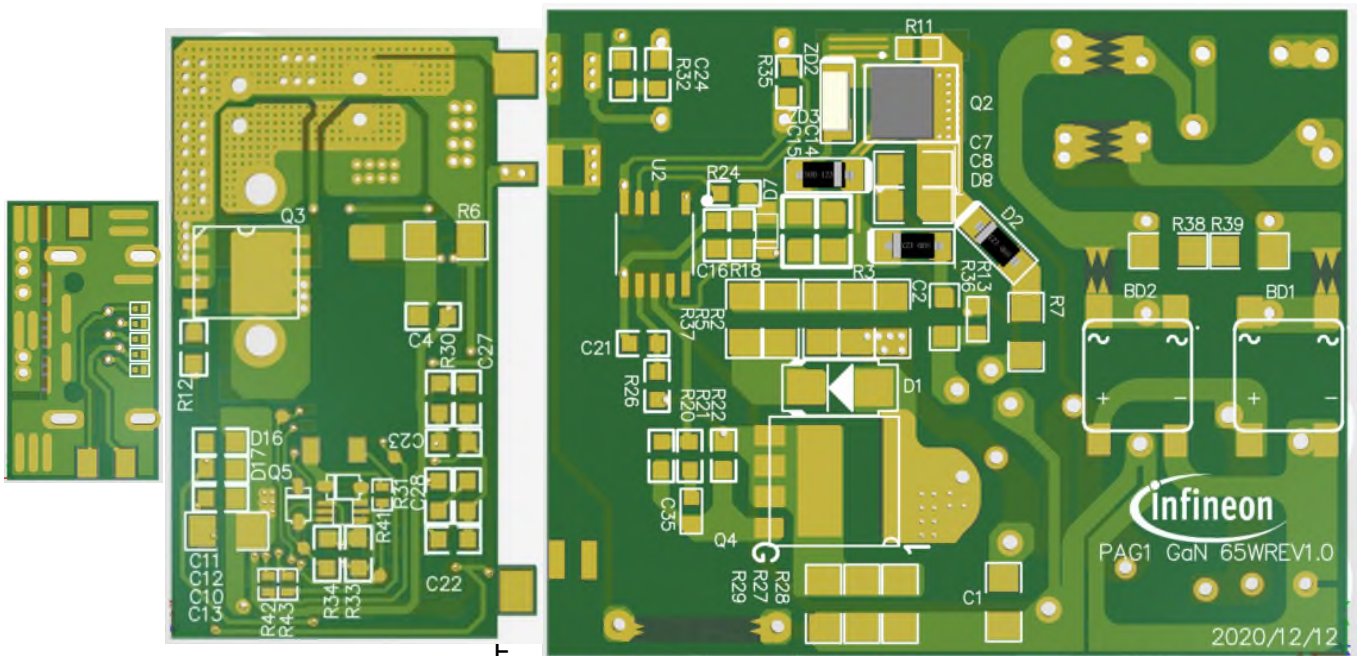
59

4.3 PCB Layout

▼ Top view



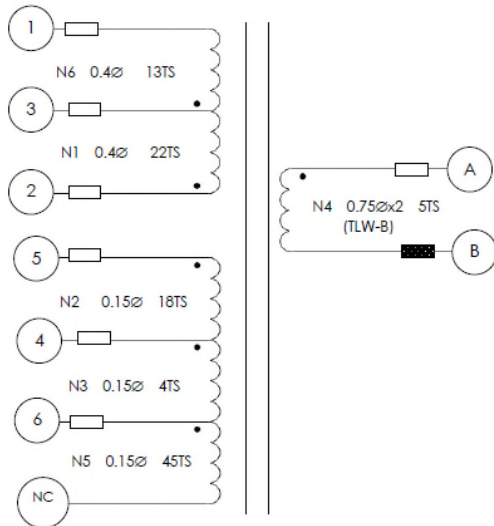
▼ Bottom view



4.4 Transformer Specifications (T1)

Figure 4-4. RM10 Transformer design spec

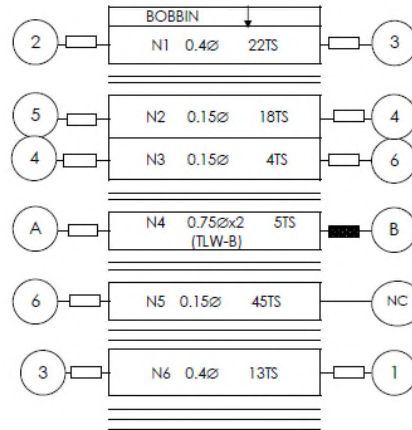
1. SCHEMATICS.



2. WINDING SEQUENCE.

* N2 & N3 並繞

* N4 出線在無 PIN 側頂部，A 加白色 B 加黑色套管，出線長 25MM 含 5MM 鍍錫



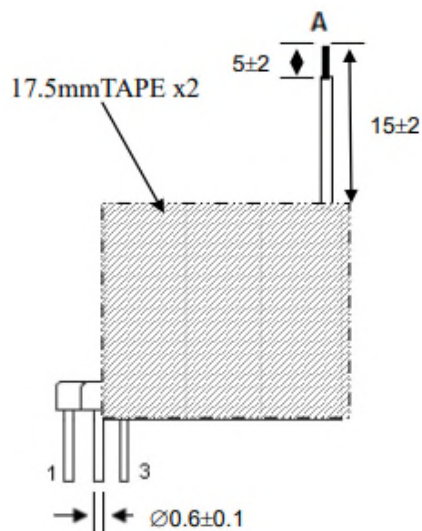
3. MATERIAL LIST.

NO/ITEM	MATERIAL	MAKER
3-1. CORE	RM-10 FERRITE CORE. 3C95,V095	FERROXCUBE.,VAKOS
3-2. BOBBIN	RM-10V TYPE W / 6PINS PHENOLIC / T375HF SW-RM10-5	CHANG CHUN PLASTICS CO.,LTD. UL NO.E59481
3-3. WIRE	UEW-2 / 130°C TLW-B	JUNG SHING WIRE CO.,LTD. UL NO.E174837 DAH JIN TECHNOLOGY CO.,LTD UL NO. E236542
3-4. TAPE	POLYESTER TAPE. #1350F-1.	3M COMPANY. UL NO.E17385.
3-5. VARNISH	V-1630FS	ELANTAS PDG,INC/VIKING UL NO.E87039
3-6. TUBING	PTFE / TFL / 150V.	GREAT HOLDING IND CO.,LTD. UL NO.E156256.
3-7. EPOXY	9001A/B	WELLS ELECTRONIC MATERIAL(GUANGZHOU)CO LTD. UL NO.E229633

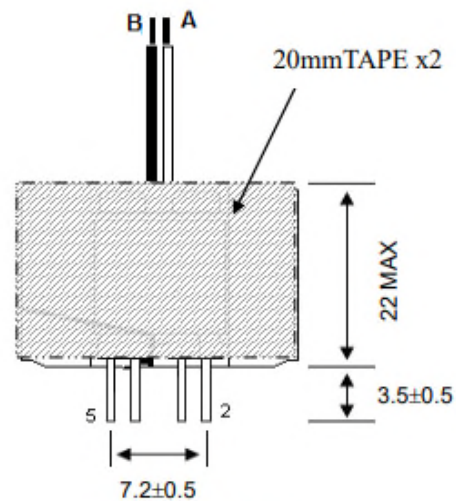
4. ELECTRICAL SPECIFICATION.

- 4-1. INDUCTANCE. P(2-1) 340 μ H \pm 5% @ 40KHz 0.3V HP-4284A
- 4-2. LEAKAGE INDUCTANCE. P(2-1) 5.5 μ H MAX @ 40KHz 0.3V
- 4-3. D.C. RESISTANCE. P(2-1) 0.32 Ω MAX.
- 4-4. HI-POT. PRI TO SEC 3.75KVAC @5mA 3SEC.

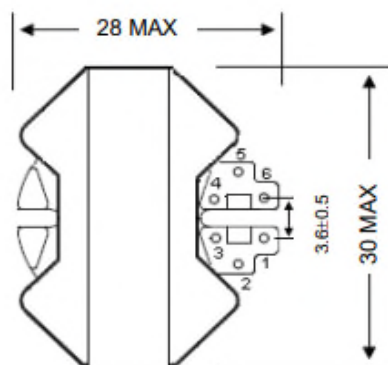
5. CONFIGURATION & DIMENSION. (UNIT:mm)



<FRONT VIEW>

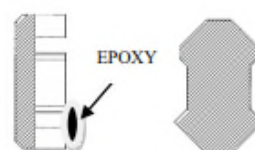


<SIDE VIEW>



<BOTTOM VIEW>

- PIN 朝外繞線 PIN3 CUT1/2
- N2&N3 並繞
- A,B 出線於無 PIN 邊的頂部, A 套白色套管,B 套黑色套管
出線長均 15±2MM 含 5MM 鍍錫
- 鐵心中柱點膠固定底部加隔離膠帶如圖



- PIN6 拉一引線至鐵心，成品最後沿線包以 20mm 膠帶包兩圈沿鐵心以 17.5mm 再包兩圈完全包覆變壓器
- MARKING: RM8-341J
FTC YYWW

CUSTOMER: 賽普拉斯

PART NO: RM10-341J

DATE: 2021/03/09

育泉科技股份有限公司

REV NO: A1

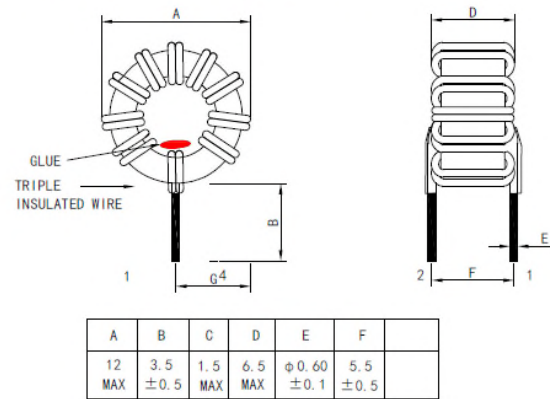
PAGE: 4/4

FONTAINE TECHNOLOGIES CO.,LTD.

4.5 Inductor Specifications (L1 900uH)

Figure 4-4. Datasheet of π filter inductor L1

1. 外观图示(单位: mm)/DIMENSION (UNIT:mm)



2. 电气原理/CIRCUIT DIAGRAM



3. 绕组/WINDING

绕组 WINDING	漆包线 WIRE (mm)	起末端 S-F	圈数 TURNS (Ts)	绕组方式 WINDING CONDITION
N1	$\phi 0.70$ (2UEW)	1-2	19	BIFILAR/并绕

4. 特性/CHARACTERISTIC

序号 NO.	项目 ITEM	测试点 MEASURED POINT	技术要求 TECHNICAL DATA	测试条件及仪器 TESTING CONDITION & INSTRUMENT
4.1	电感量 INDUCTANCE	L (1-2)	900uH MIN	HP-4284A 1KHz/0.25V, AT 25°C
4.2	平衡性 INDUCTANCE BALANCE			
4.3	耐压 HI-POT TEST	COIL-COIL COIL-CORE	AC 1.0KV AC 0.5KV	CS9929 5mA 60Hz 3S
4.4	Operating temperature range: -20°C ~+40°C, 45% ~95%RH			
4.5	Storage temperature range: -20°C ~+70°C, 45% ~95%RH			
4.6	Storage time: 3 months			

5. 材料清单/MATERIAL LIST

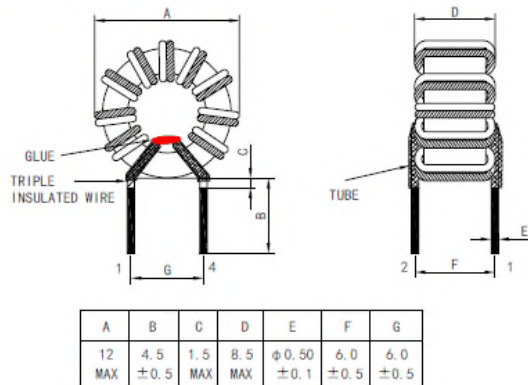
序号 NO.	项目 ITEM	规格&材质 TYPE & MATERIAL	供应商 SUPPLIERS	认证号 UL NO.
1	磁芯 CORE	TYPE:T10 \times 6 \times 5 MATERIAL:FM A121	SHENZHEN SHI LI CI ELECTRICAL CO.,LTD. ACME ELECTRONIC CORPORATION OR EQUAL	
2	漆包线 WIRE	POLYURETHANE ENAMELED MTLDSG:UEW ANSI TYPE:MW75C THERMAL RATING:130°C	TAI-I ELECTRIC WIRE & CABLE CO LTD	E85640
		POLYURETHANE ENAMELED MTLDSG:UEW ANSI TYPE:MW75 THERMAL RATING:130°C	XIN LONG MAGNET WIRE CO LTD	E171082
3	三层绝缘线 TRIPLE INSULATED WIRE	THERMAL RATING:130 C°	FURUKAWA ELECTRIC CO.,LTD OR EQUAL	E206440
4	胶 GLUE	TYPE:2008A/B-X	DONGGUAN EATTO ELECTRONIC MATERIAL CO.,LTD OR EQUAL	E218090
5	套管 TUBE	TYPE:TFT THERMAL RATING:200°C	GREAT HOLDING INDUSTRIAL CO LTD	E156256
		TYPE:2T-TFT THERMAL RATING:200°C	P LEO & CO (B C) LTD	E176865
6	凡立水 VARNISH	TYPE:8562(g) THERMAL RATING:155°C	HANG CHEUNG PETROCHEMICAL LTD	E200154

The filter must be manufactured to comply with the ROHS directive ,use only Pb-free solder

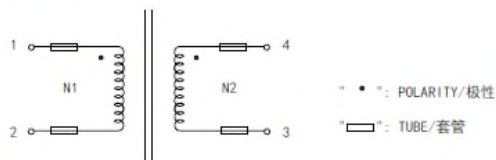
4.6 Common Mode Choke Specifications (LF1 600uH, LF2 15mH)

Figure 4-6. Datasheet of Common mode choke

1. 外观图示 (单位: mm) / DIMENSION (UNIT: mm)



2. 电气原理/CIRCUIT DIAGRAM



3. 绕组/WINDING

绕组 WINDING	漆包线 WIRE (mm)	起末端 S-F	圈数 TURNS (Ts)	绕组方式 WINDING CONDITION
N1	φ0.50 (TEX-E)	1-2	8.5	BIFILAR/并绕
N2	φ0.50	4-3	8.5	

- ① 磁芯规格: TD1212;立式超薄骨架
- ② 使用方形闭合型磁芯, 扁平线自动绕制;
- ③ 定格电压: AC/DC 250V;
- ④ 绝缘耐压: AC1.5kV 60sec;
- ⑤ 工作温度范围: -25°C~+125°C
- ⑥ 保存温度范围: -25°C~+100°C
- ⑦ 功率范围: 20-60W



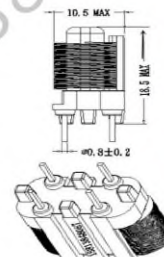
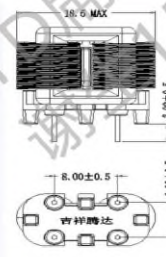
电气特性: (at 25°C)						
品号	电感量(mH)	线径	直流电阻(mΩ)	对应圈径	工作电流(A)	
TD1212-15.0mH	15.0 min	0.10*1.0-52Ts REF	240 Max	0.352	1.0-1.5A	
TD1212-10.0mH	10.0 min	0.13*1.0-45Ts REF	200 Max	0.401	1.5-2.0A	
TD1212-8.0mH	8.0 min	0.15*1.0-38Ts REF	150 Max	0.433	1.8-2.2A	

- * 电感测试频率: 1 KHZ 0.25V TD1212替代U09: 8 T16 T14 T12 T10 EE15共模电感 脚位6+8
- * 可根据客户需求使用其它磁芯材质及线材规格

外形尺寸图: (单位: mm)

PCB 板孔径≥Φ1.4mm

吉祥
如意

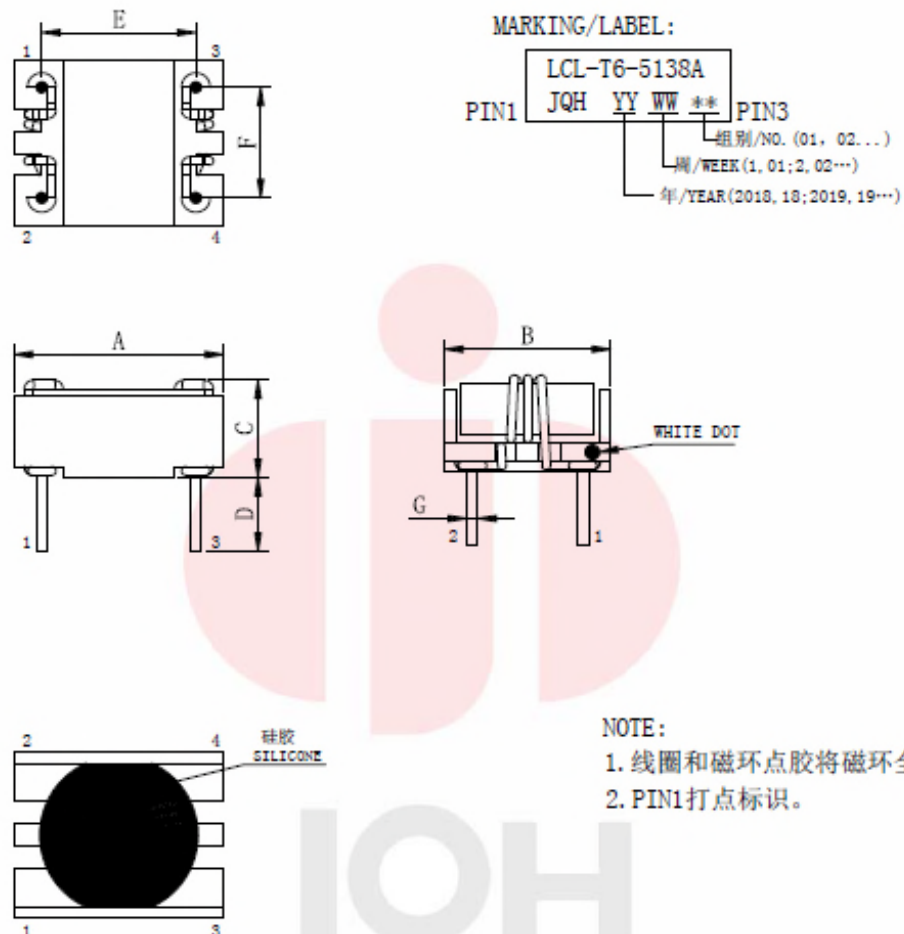


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4.7 Pulse Transformer (T2)

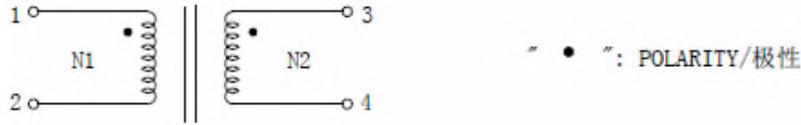
Figure 4-6. Datasheet of pulse transformer LCL-T6-5138A

1. 外观图(单位:mm)/DIMENSION(UNIT:mm)



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

2. 电原理图/CIRCUIT DIAGRAM



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	Φ 0.2mm*1P T, I, W	1-2	3	CLOSE/密绕
N2	Φ 0.2mm*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:2UEW/155, QA-π/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

4.8 EZ-PD Configuration Utility

Utility Screenshot

Parameters	Value
Cable resistance (mΩ)	0
Vbus offset voltage (mV)	0
Current sense resistor (μΩ)	5100
Vbus Source Drive strength	Normal
Vbus transition up step width (μs)	40
Vbus transition down step width (μs)	100
Primary to secondary turns ratio	7
Synchronous Rectifier enable	Yes
Synchronous Rectifier rise time	Fast
Synchronous Rectifier fall time	Fast
Synchronous Rectifier asynchronous threshold (ns)	1000
Synchronous Rectifier supply doubler enable	Yes
PWM mode	Quasi Resonant Mode(QR)
PWM minimum frequency (KHz)	22
PWM maximum frequency (KHz)	130
PWM maximum duty cycle	70
Maximum PWM duty cycle for high line	40
Vbus transition up step width for transitions below 5V (μs)	40
Vbus transition down step width for transitions below 5V (μs)	200

Devices connected: 2

PAG1S: Power Adapter SSC

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 4.8-2. Default Configuration Values

Parameters	Values
Power Settings	
Cable resistance (mΩ)	0
Vbus offset voltage (mV)	0
Current Sense resistor (μΩ)	5100
Vbus Source Drive strength	Normal
Vbus transition up step width (μs)	40
Vbus transition down step width (μs)	100
Primary to secondary turns ratio	7
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)	130
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	NO
Debounce period (μs)	4
Retry count	2
5. Over Temperature Protection	
Enable	Yes
Thermistor type 1	NTC
Cutoff value 1	4800
Restart value 1	4650
Debounce period (ms)	10
Enable Thermistor 2	NO
Thermistor type 2	0
Cutoff value 2	0
Restart value 2	0

4.9 Glossary

Table 4-3. 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: 65W USB-PD Power Adapter Solution (PAG1P+PAG1S)			
Revision	Issue Date	Origin of Change	Description of Change
REV1.0	Jan 25 th 2021	XUXI	Initial with basic function data.
REV2.0	Mar 31 st 2021	XUXI	Complete all the data.
REV2.1	Jan 29 th 2022	XUXI	Update CoolGaN part number.