# 65W USB-PD Power Adapter Solution (PAG1P-A3 and PAG1S-A1) Test Report Version 2.0

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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 CYPAP111A3-10SXQ on primary and CYPAS111/2A3-24LQXQ 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<br>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

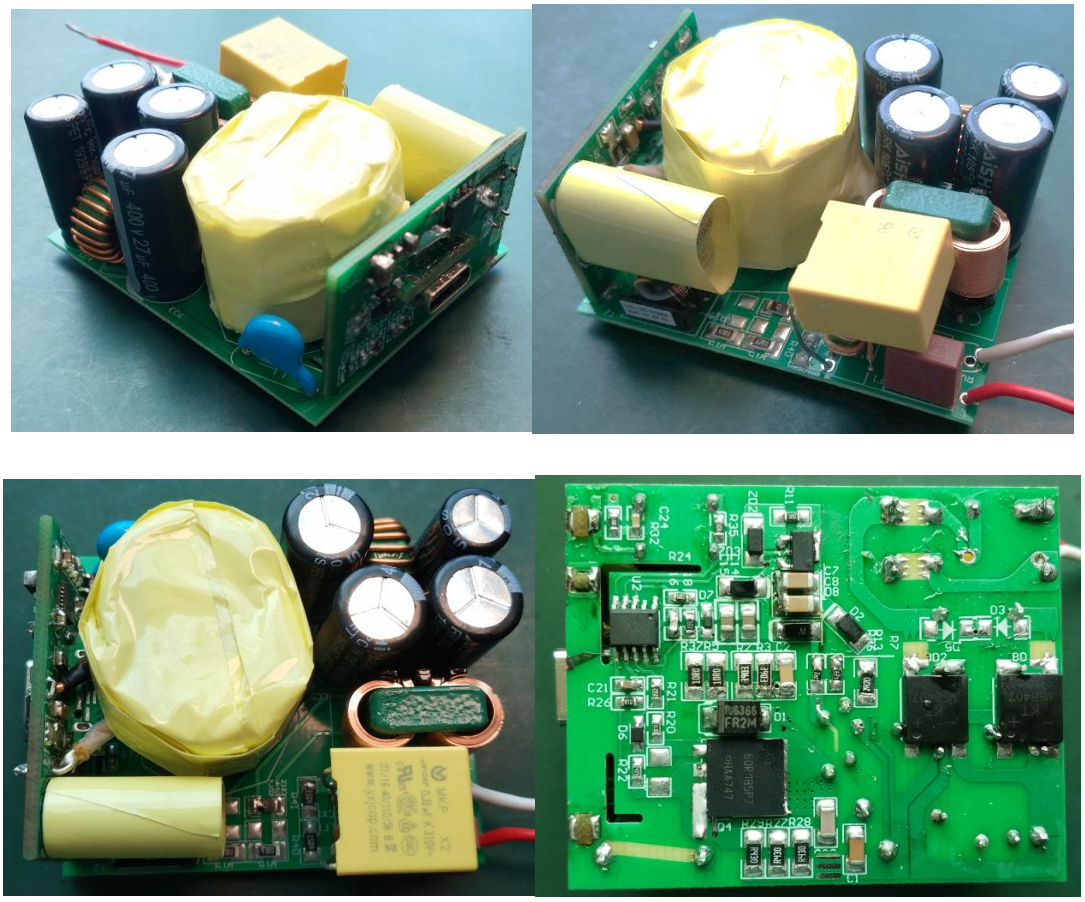
## 2.1 DUT (Device Under Test)

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_v0.12 |

Figure 2-1. PAG1P-PAG1S Solution Demo Kit



Dimensions (in mm): 52(L) x 42(W) x 22(H)

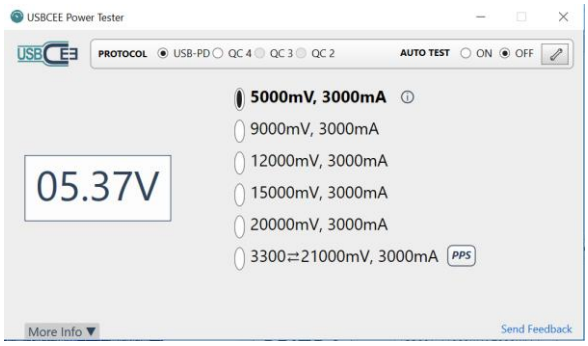
**Note:** All the tests mentioned in this report are carried-out under open-frame condition.

## 2.2 DUT Setup

Figure 2-2. Test set-up



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 4 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, 0-3A 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

**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 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% | % | 89.05 | 85.41 |
| | Vo = 5Vdc, Io = 3A | 81.39% | 81.84% | % | 90.30 | 87.63 |
| | Vo = 9Vdc, Io = 3A | 86.62% | 87.30% | % | 91.03 | 89.55 |
| | Vo = 12Vdc, Io = 3A | 87.40% | 88.30% | % | 91.20 | 90.04 |
| | Vo = 15Vdc, Io = 3A | 87.73% | 88.85% | % | 91.09 | 90.16 |
| | Vo = 20Vdc, Io = 3.25A | 88.00% | 89.00% | % | 90.83 | 90.26 |
| | Vo = 21Vdc, Io = 3A | 88.00% | 89.00% | % | 91.23 | 90.75 |
| | | | | | | |
| DoE No load consumption | No USB sink attached | 150 Max | 150 Max | mW | 27 | 47 |
| | | | | | | |
| CoCv5 Tier2 **10%** load Efficiency | Vo = 3.3Vdc, Io = 0.3A | 69.66% | | % | 83.04 | 74.18 |
| | Vo = 5Vdc, Io = 0.3A | 72.48% | | % | 85.24 | 77.82 |
| | Vo = 9Vdc, Io = 0.3A | 77.30% | | % | 87.11 | 82.22 |
| | Vo = 12Vdc, Io = 0.3A | 78.30% | | % | 87.30 | 83.65 |
| | Vo = 15Vdc, Io = 0.3A | 78.85% | | % | 87.20 | 83.94 |
| | Vo = 20Vdc, Io = 0.325A | 79.00% | | % | 86.29 | 83.57 |
| | Vo = 21Vdc, Io = 0.3A | 79.00% | | % | 87.33 | 85.87 |

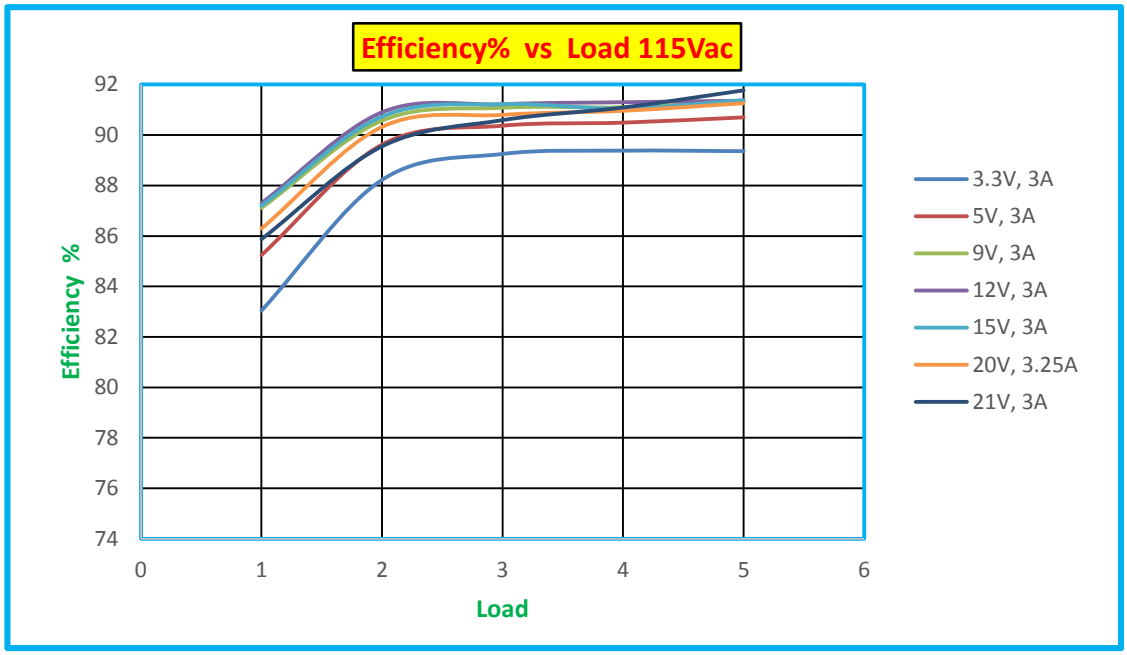
- Peak Efficiency: **91.77%** (At 230Vac-50Hz, 21V-3A)

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

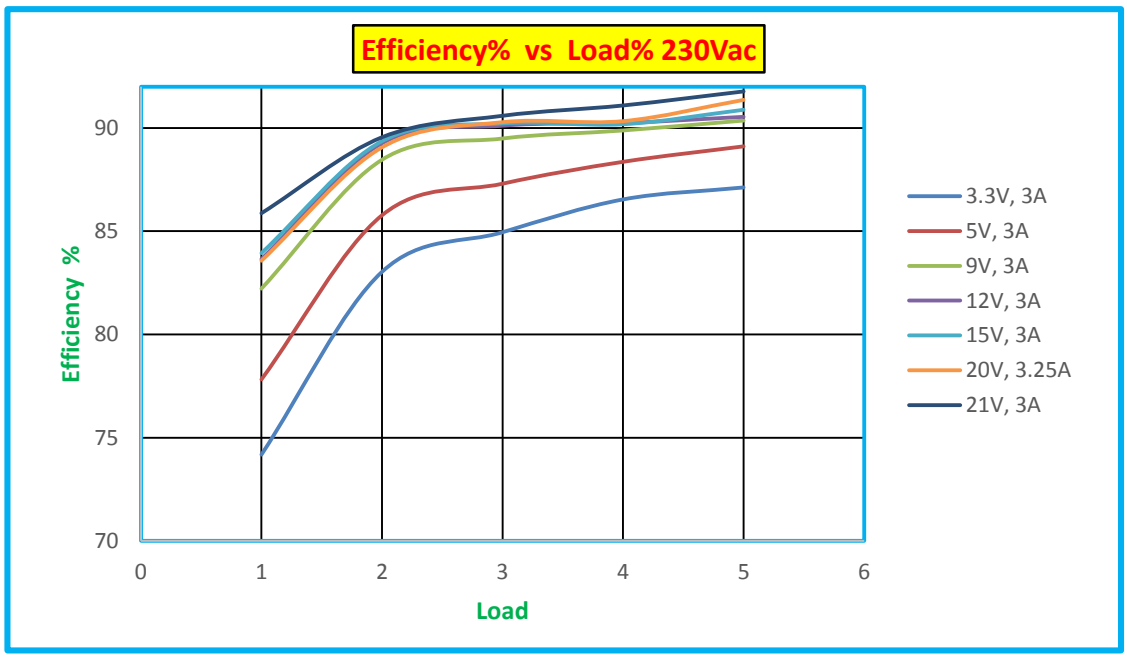
*** Variation of ±0.3% in 4-point average efficiency and ±1% in 10% efficiency can be observed.**

### 3.1.2 Graphs

Efficiency at 115Vac, 60Hz




Efficiency at 230Vac, 50Hz



## 3.2 Standby Power Consumption

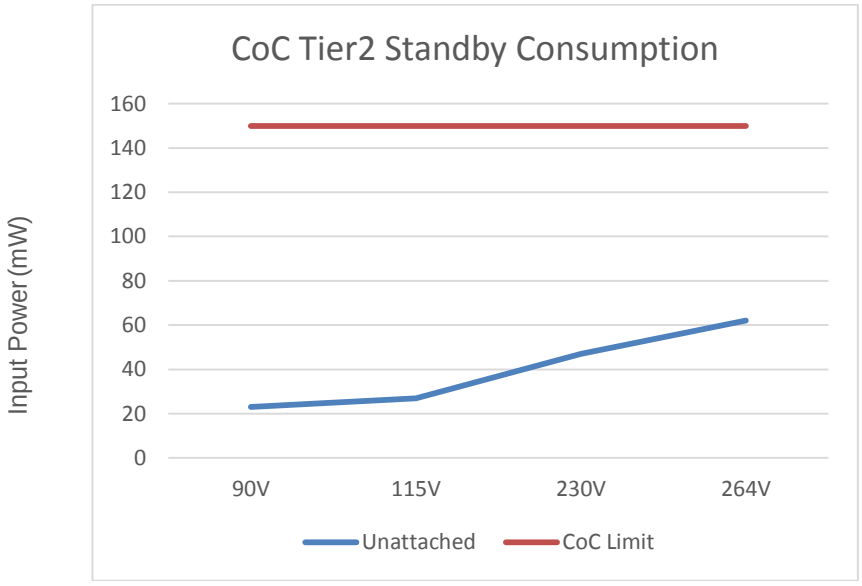
### 3.2.1 Detailed Data

Table 3-2. Standby Power Results*

| Vin (Vac) | 90Vac, 60Hz | 115Vac, 60Hz | 230Vac, 50Hz | 265Vac, 50Hz |
|---|---|---|---|---|
| Input Power (mW) | 23 | 27 | 47 | 62 |

### 3.2.2 Graph

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




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

### 3.2.3 Details

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

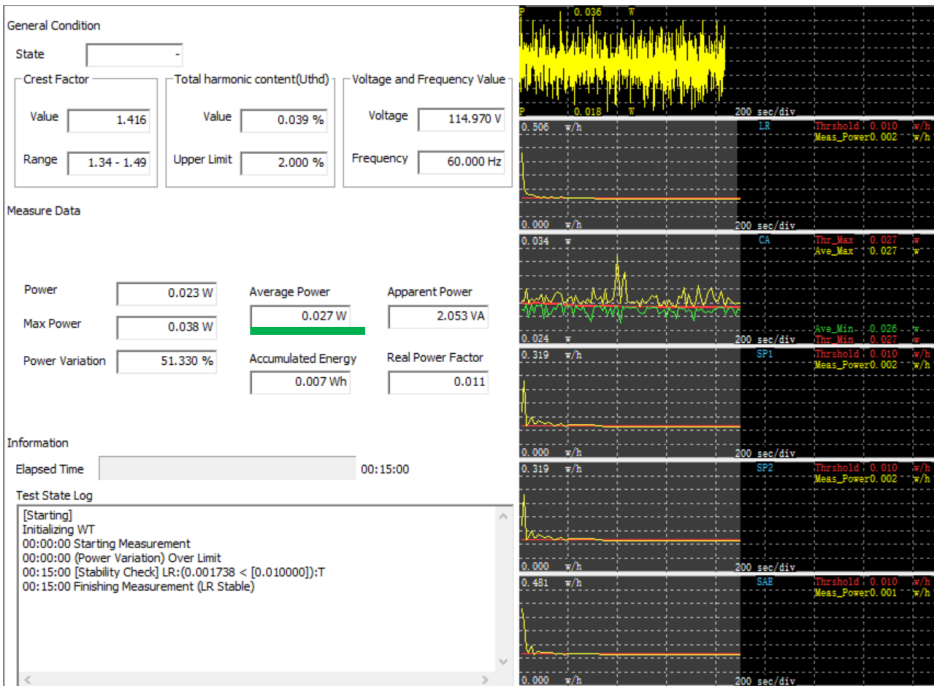



Figure 3-2-3. Detailed Power Measurement Results @230Vac, 50Hz



## 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 prober 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)

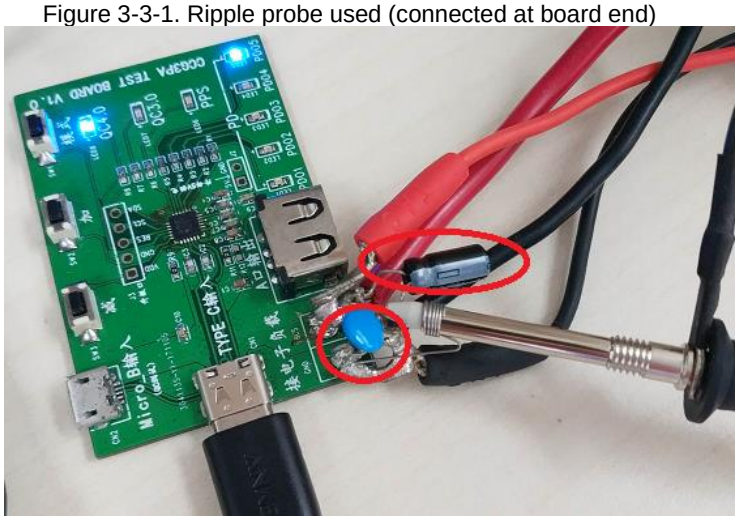
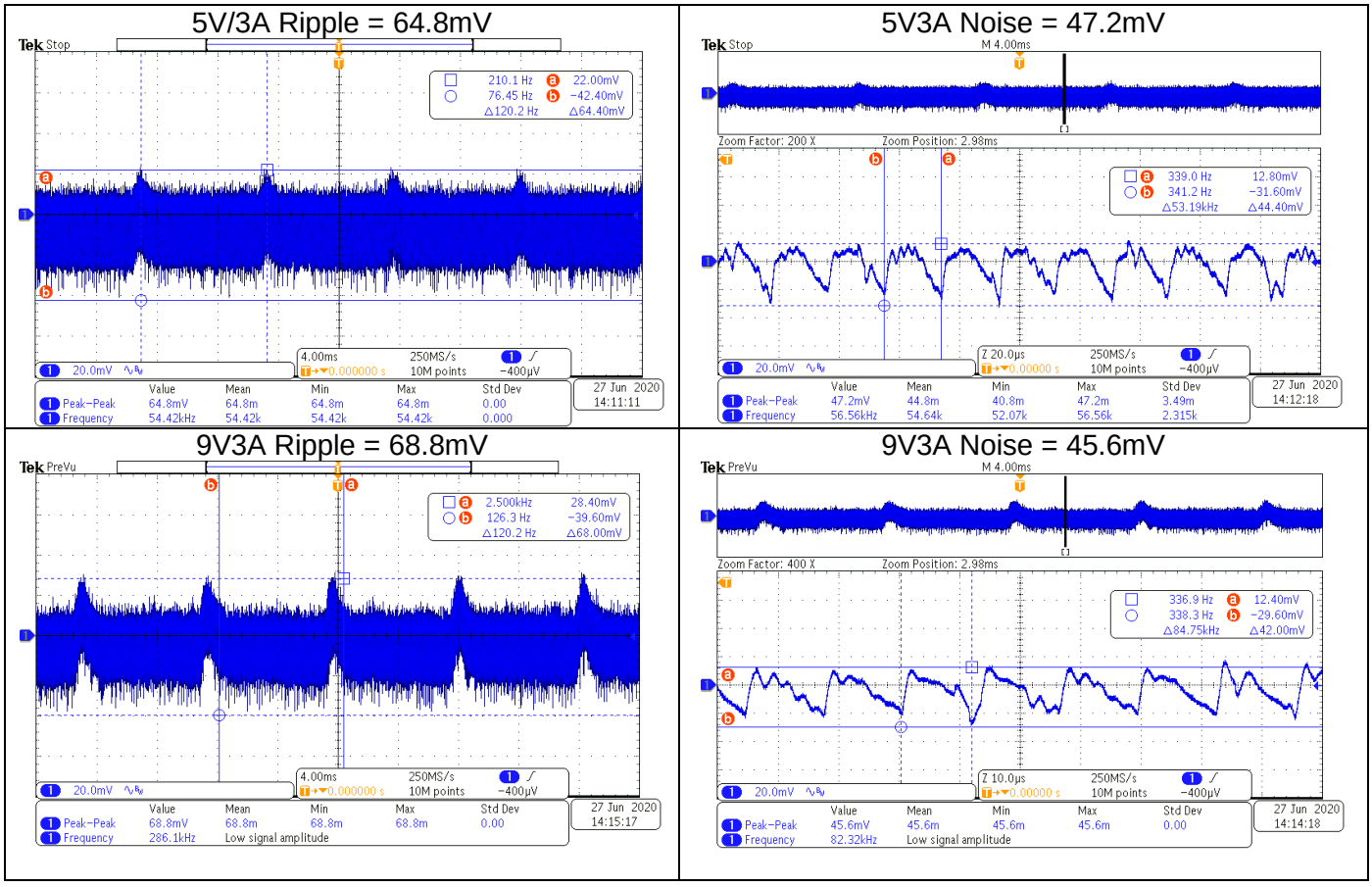
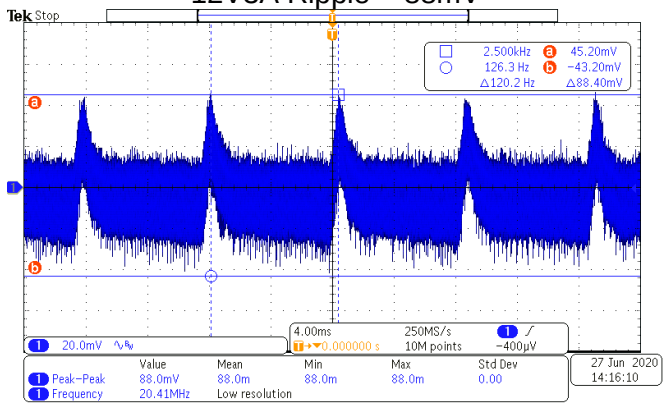


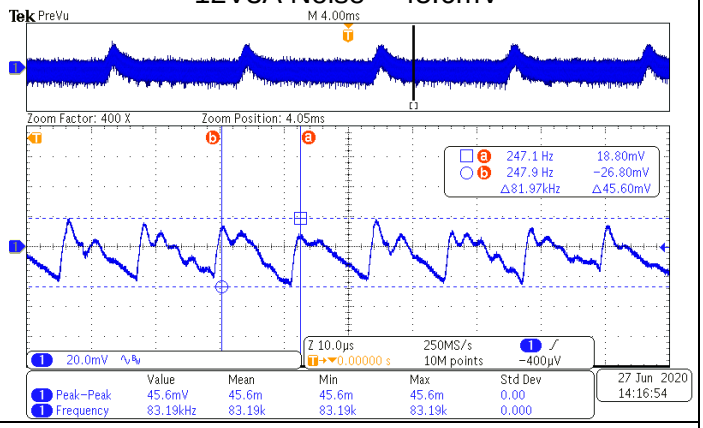
Figure 3-3-2. Ripple & Noise at **90V**ac 60Hz (**CH1:** Vbus_c)



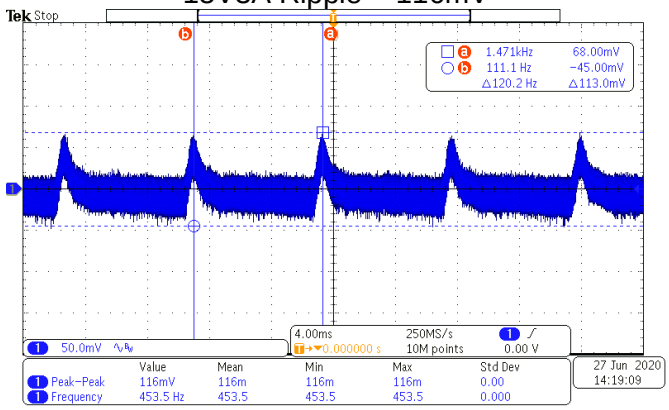
12V3A Ripple = 88mV



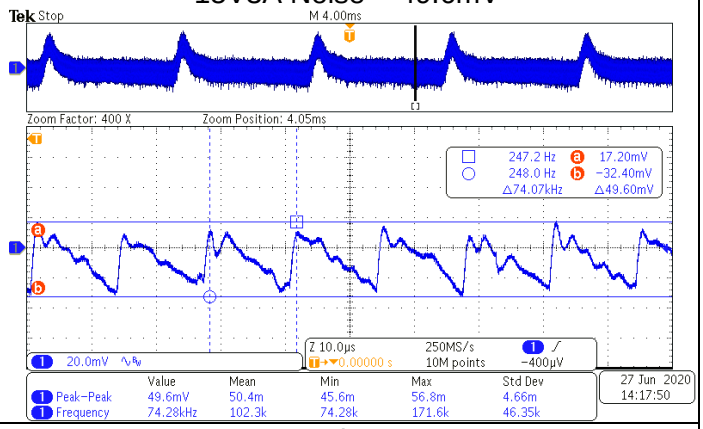

12V3A Noise = 45.6mV



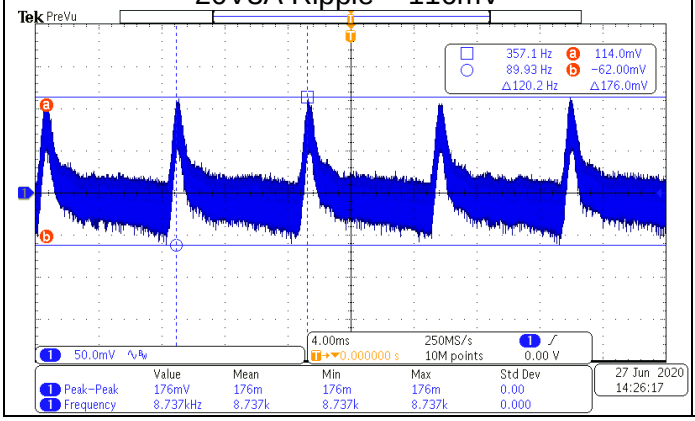

15V3A Ripple = 116mV




15V3A Noise = 49.6mV




20V3A Ripple = 116mV




20V3A Noise = 56mV

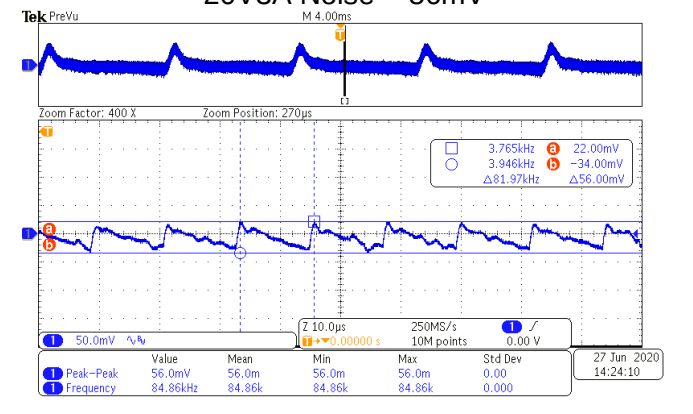


Figure 3-3-3. Ripple & Noise at **100V**ac 60Hz (**CH1:** Vbus_c)

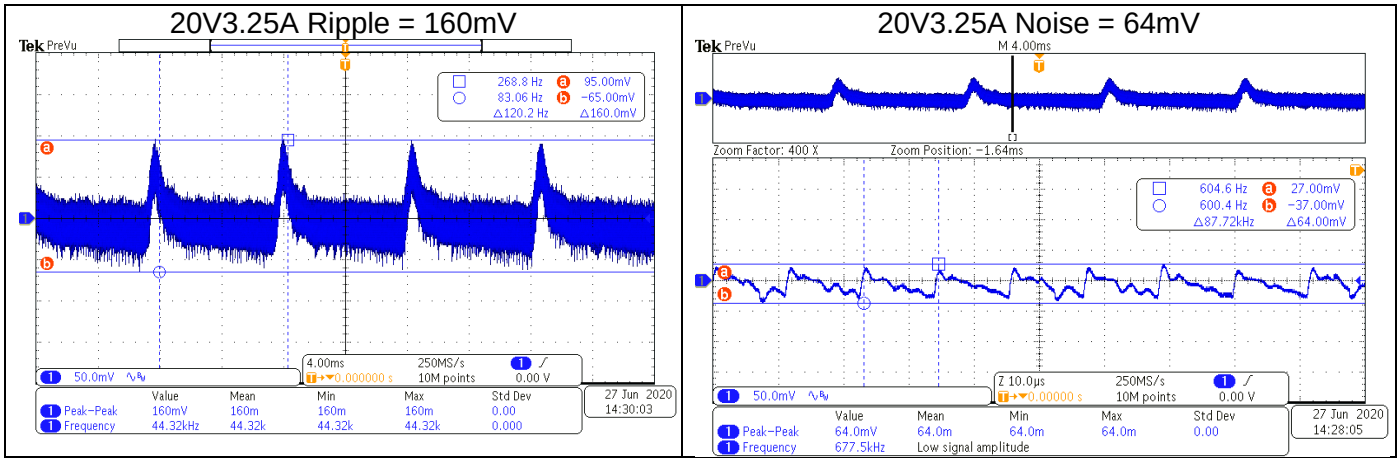
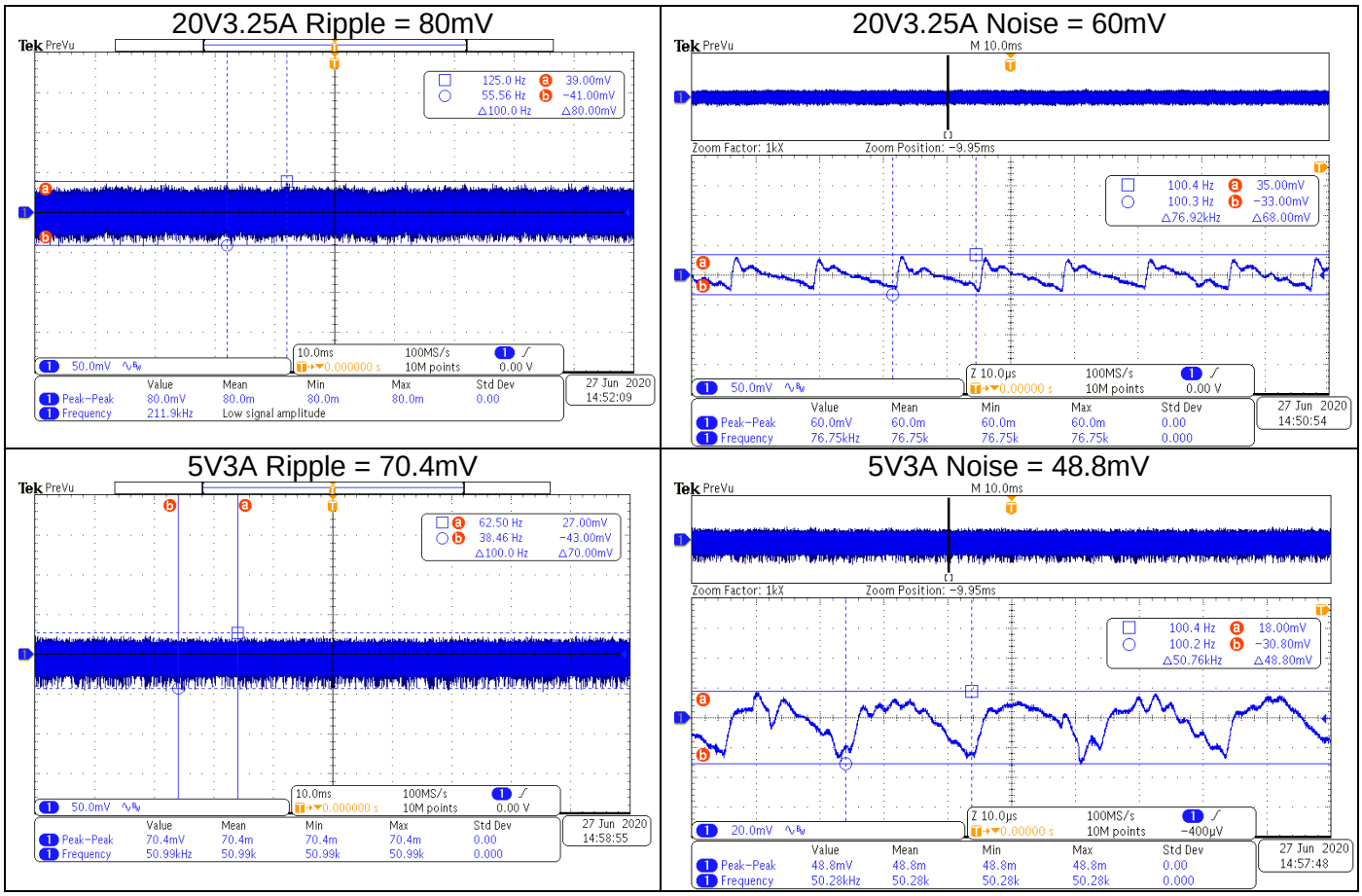


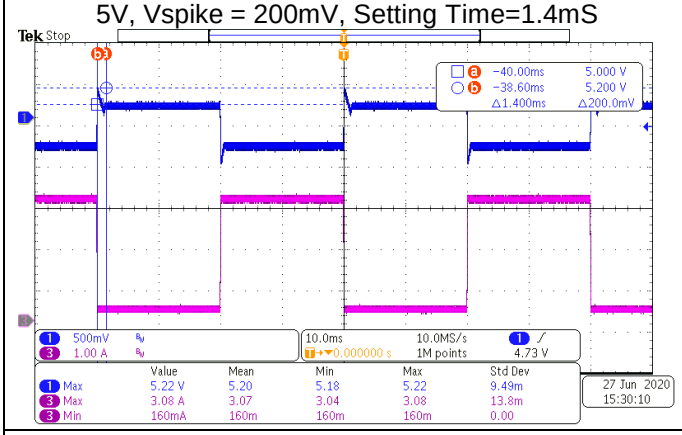

Figure 3-3-4. Ripple & Noise at **264V**ac 50Hz (**CH1:** Vbus_c)



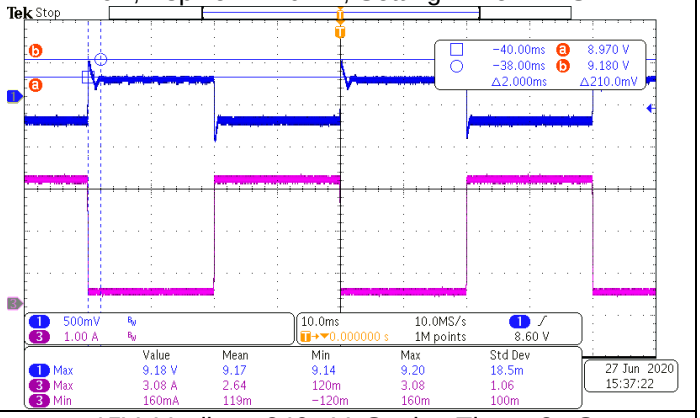
## 3.4 Output Voltage Ripple Dynamic Response

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

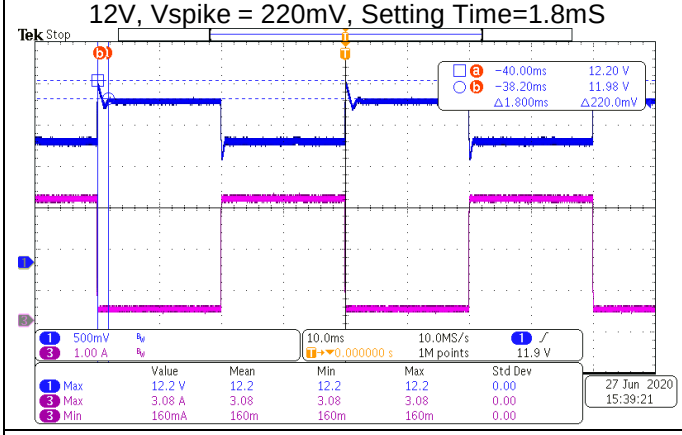
5V, Vspike = 200mV, Setting Time=1.4mS



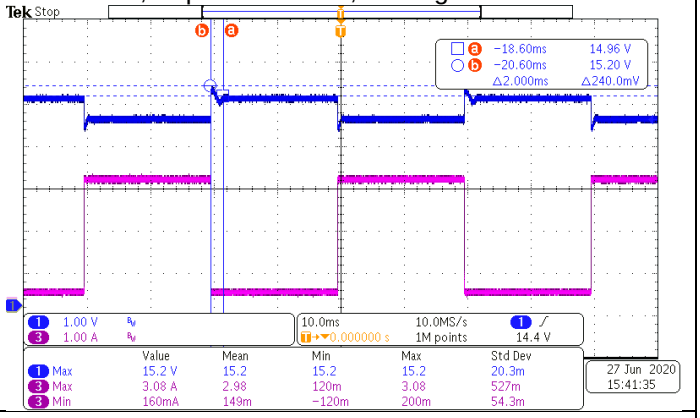

9V, Vspike = 210mV, Setting Time= 2mS



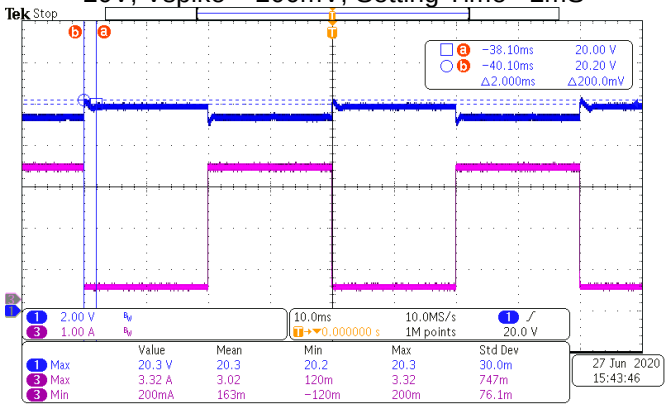

12V, Vspike = 220mV, Setting Time=1.8mS




15V, Vspike = 240mV, Setting Time= 2mS



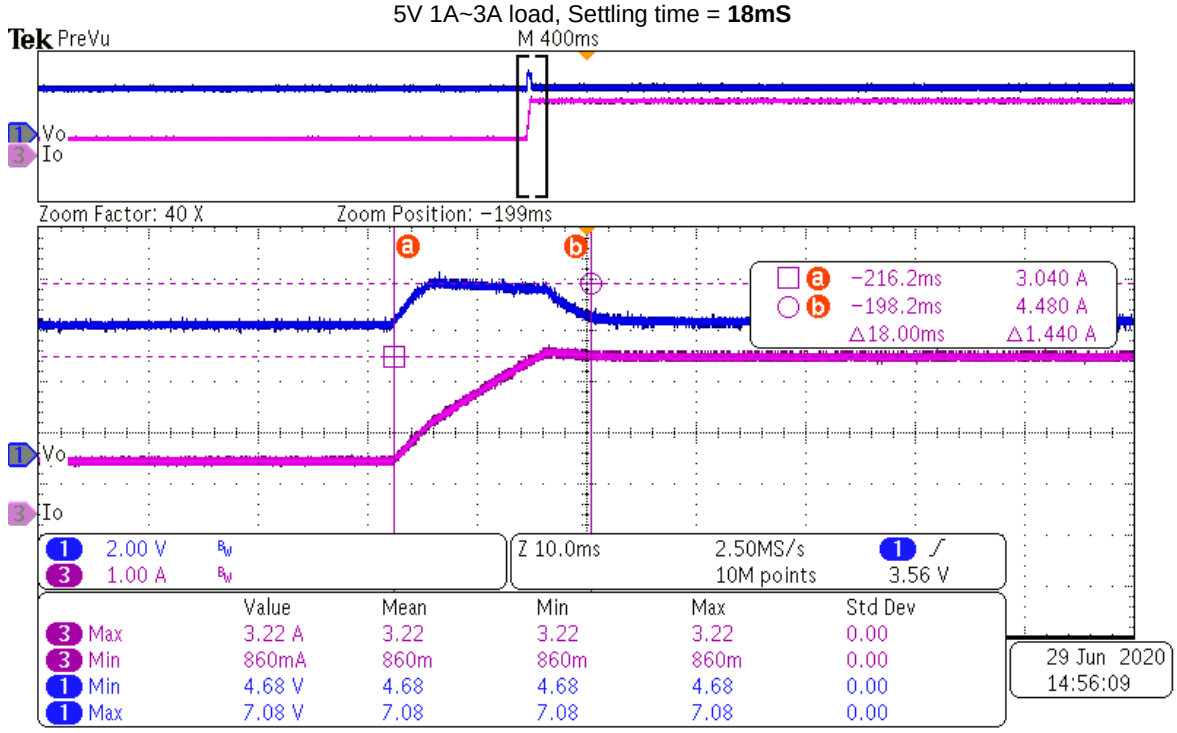

20V, Vspike = 200mV, Setting Time= 2mS



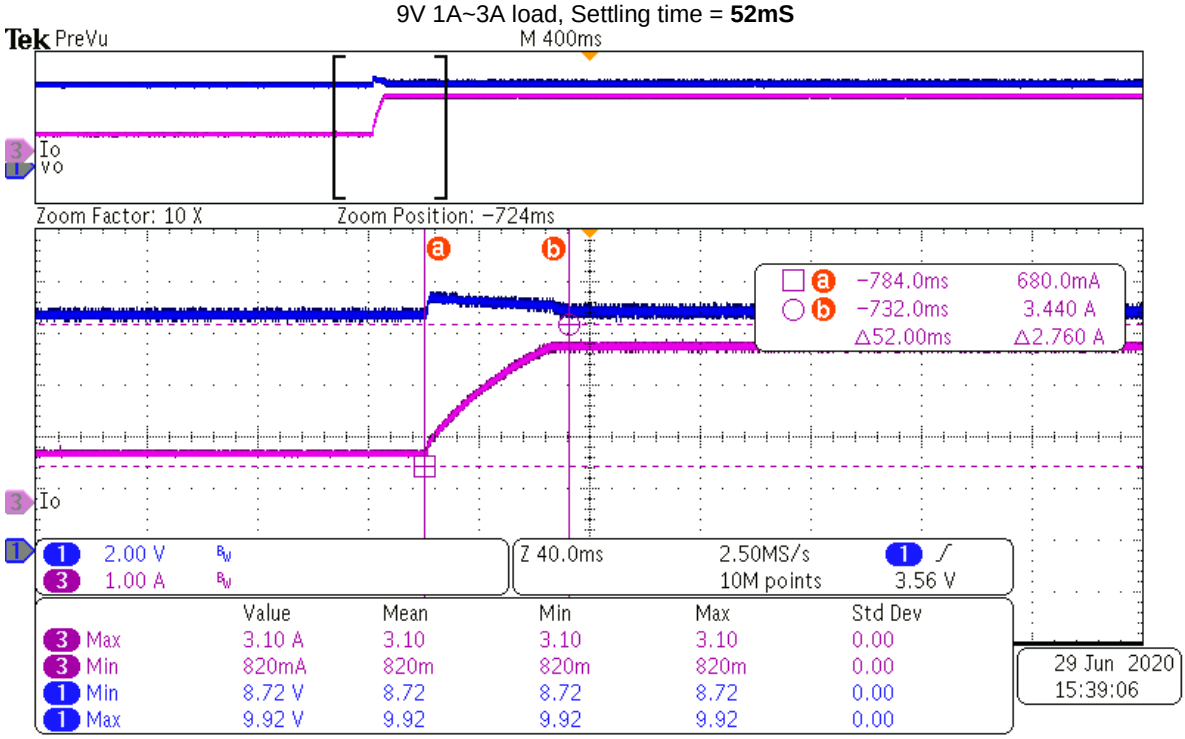
## 3.5 Output Current Dynamic Response

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

5V 1A~3A load, Settling time = **18mS**

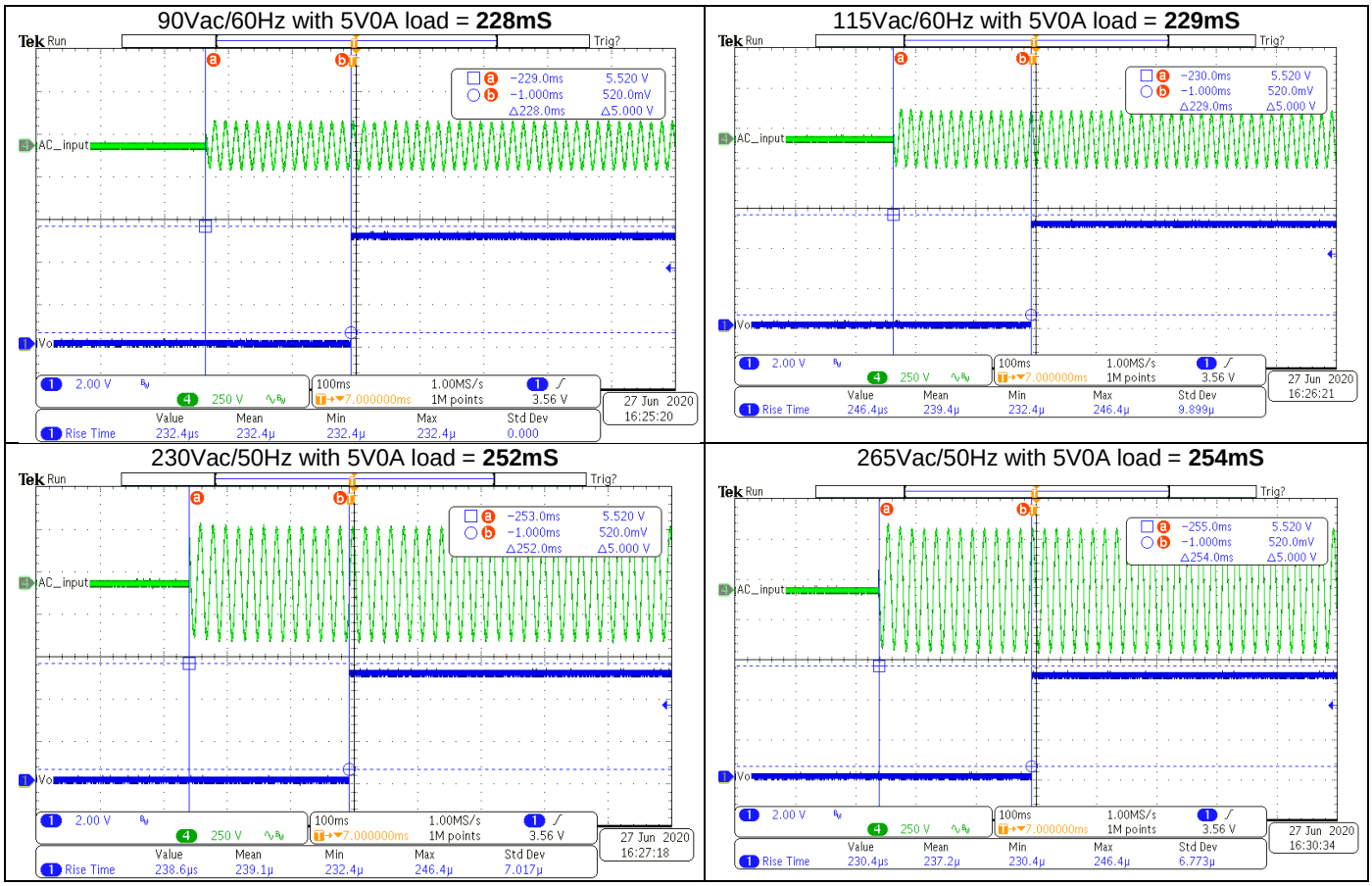



9V 1A~3A load, Settling time = **52mS**



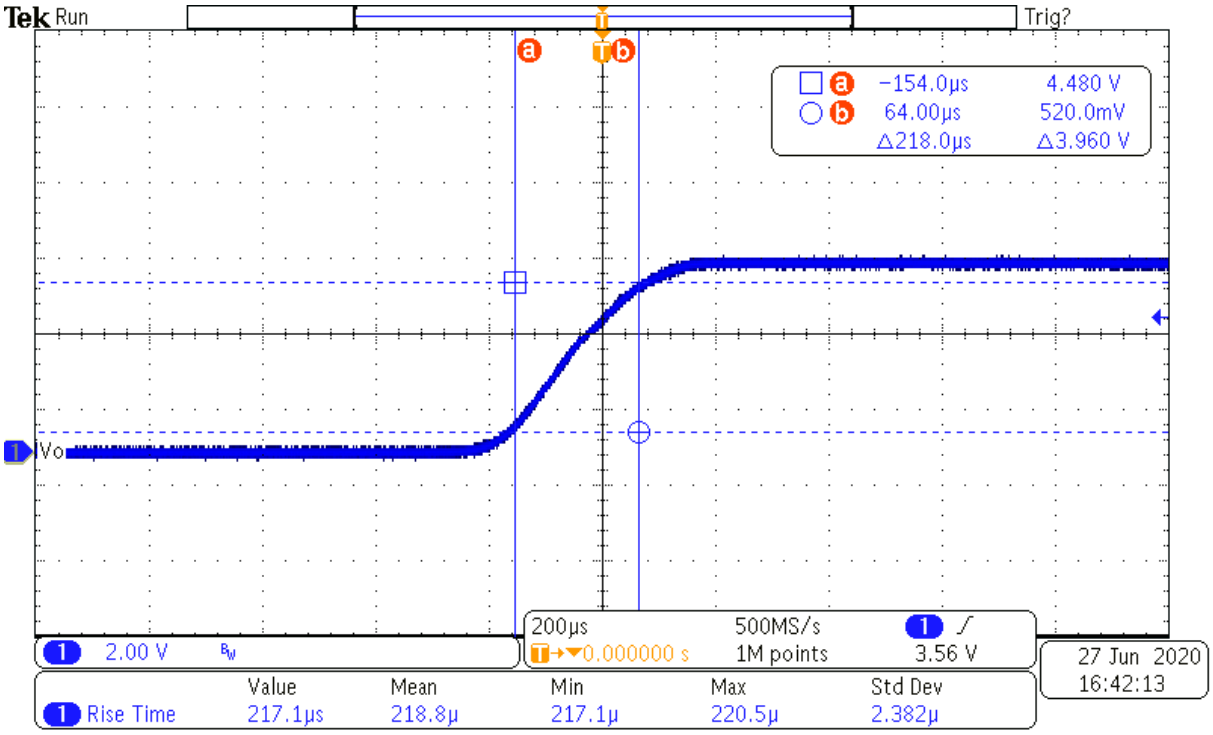
## 3.6 Start-up Turn-on Delay

Figure 3-11-1. Start-up Turn-on Delay at various AC input

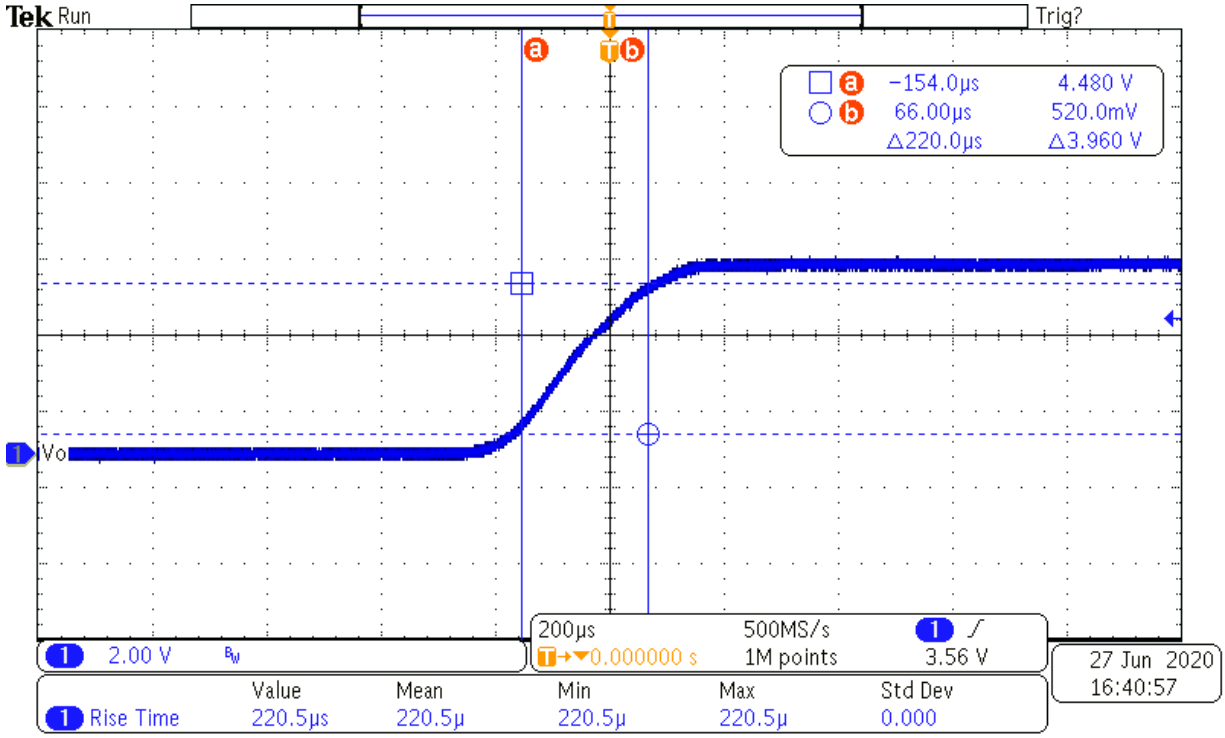


## 3.7 Start-up Turn-on Rise Time

Start-up Rise time at 90Vac/60Hz with 5V0A load =**218uS**

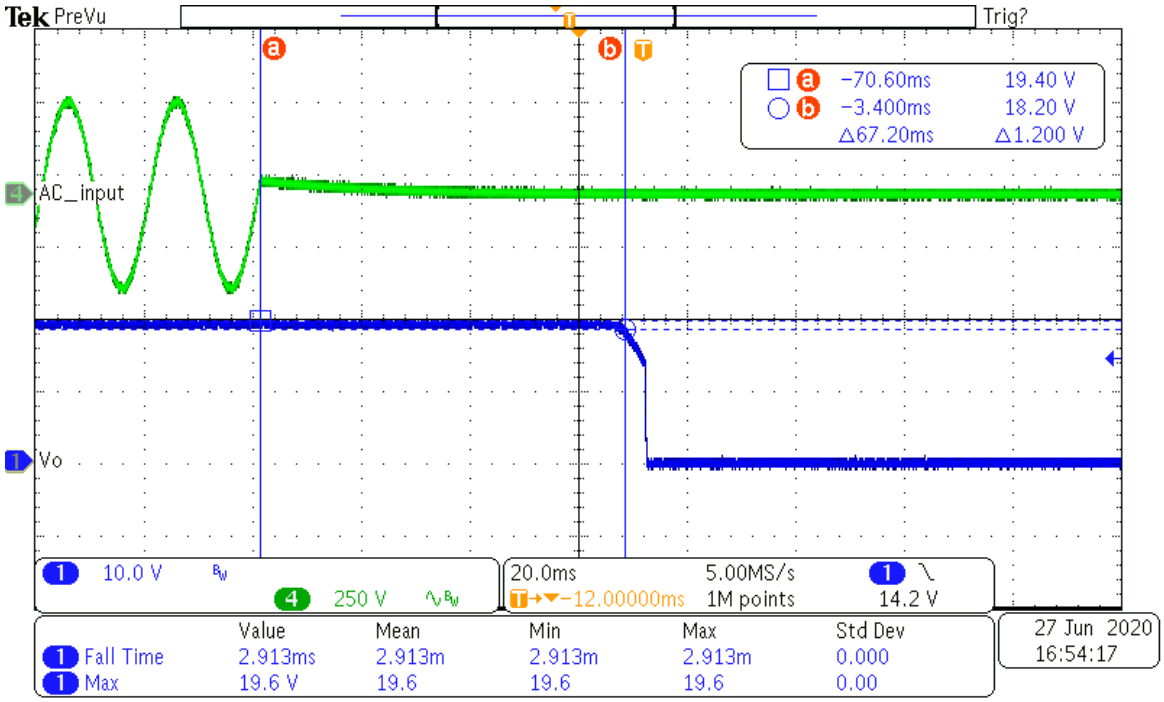



Start-up Rise time at 265Vac/50Hz with 5V0A load =**220uS**

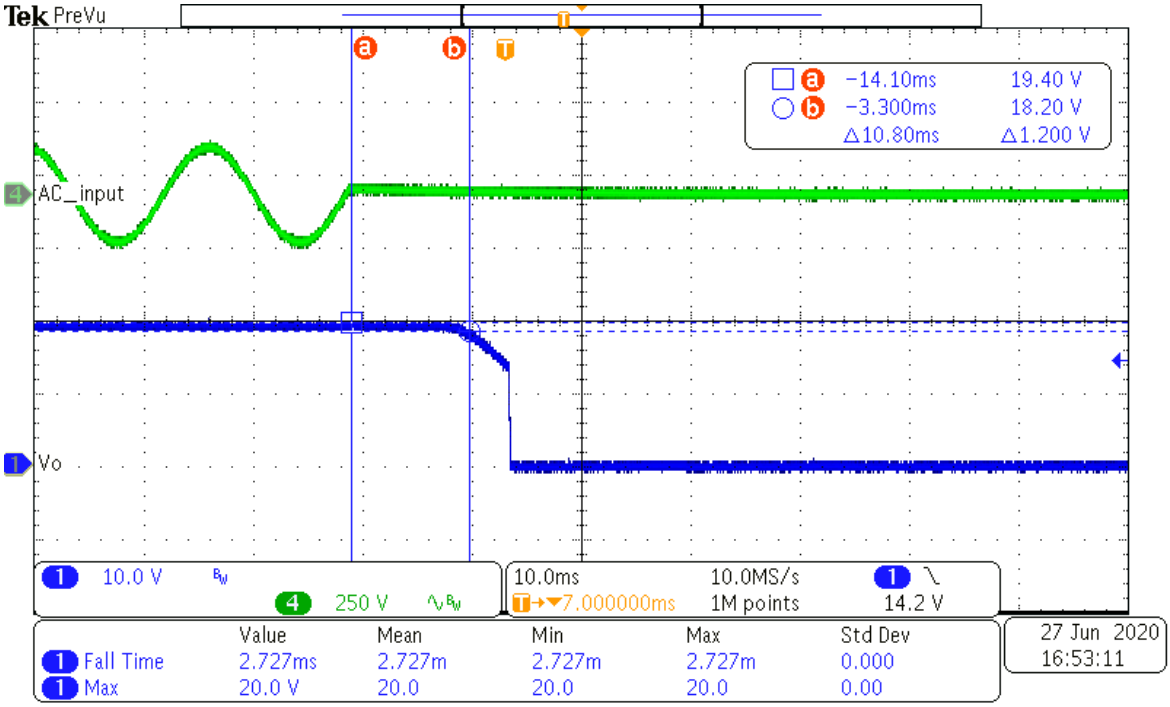


## 3.8 Shut-down Hold-up and Fall Time

230Vac/50Hz with 20V3.25A load, Thold-up = **67.2mS**, Tfall = **2.913mS**



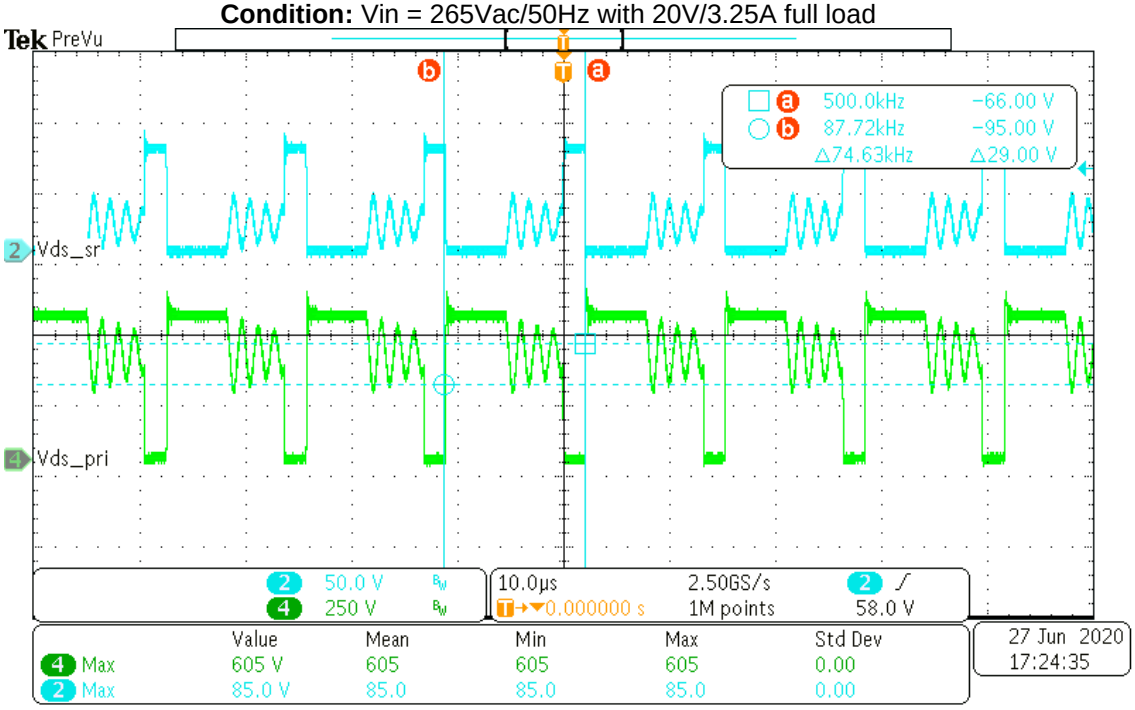

115Vac/60Hz with 20V3.25A load, Thold-up = **10.8mS**, Tfall = **2.727mS**



## 3.9 Switch Voltage Stress

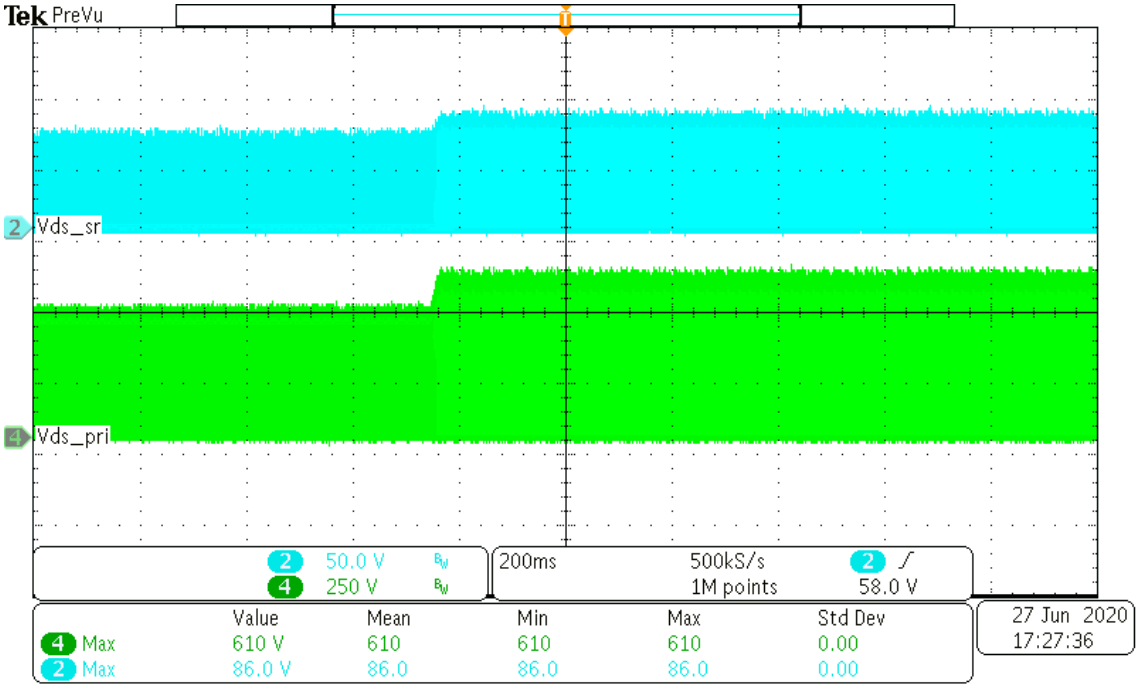
Voltage Stress on Primary FET (**CH2:** Vds_sr**, CH4:** Vds_primary)

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




**Vds_primary = 605V<650V, Vds_sr = 85V<100V.**

**Condition:** Vin = 265Vac/50Hz with load from 5V3A to 20V/3.25A full load

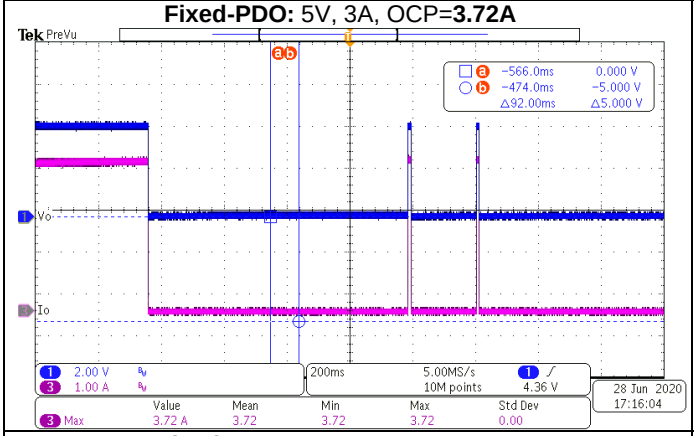



**Vds_primary = 610V<650V, Vds_sr = 86V<100V.**

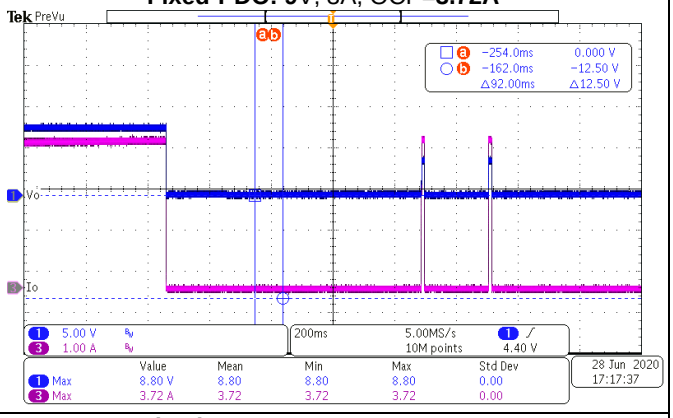
## 3.10 Over Current Protection

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

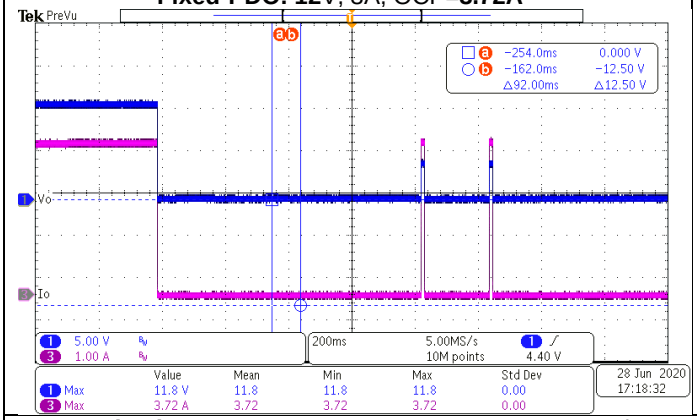
**Fixed-PDO:** 5V, 3A, OCP=**3.72A**



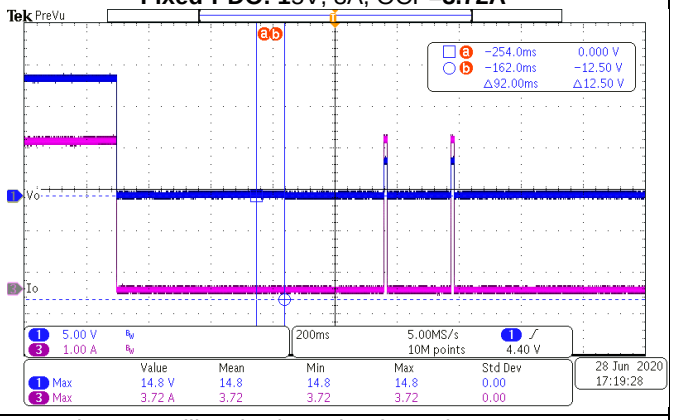

**Fixed-PDO: 9**V, 3A, OCP=**3.72A**



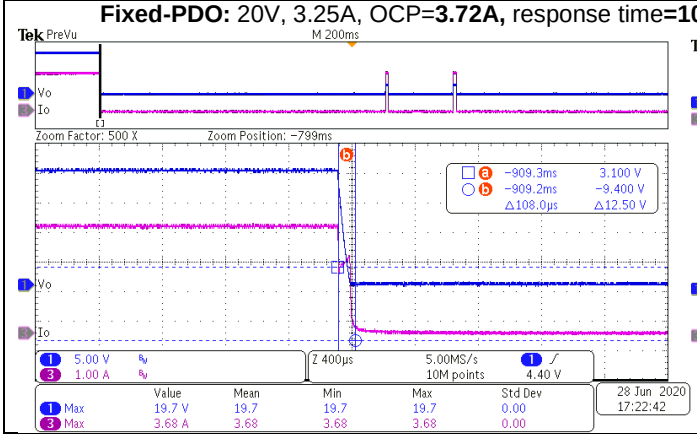

**Fixed-PDO: 12**V, 3A, OCP=**3.72A**

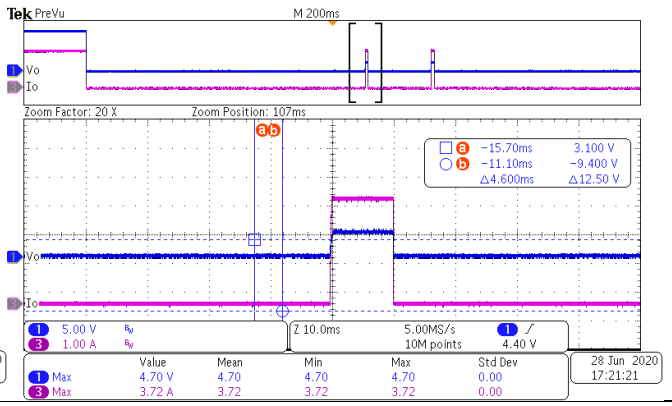



**Fixed-PDO: 15**V, 3A, OCP=**3.72A**



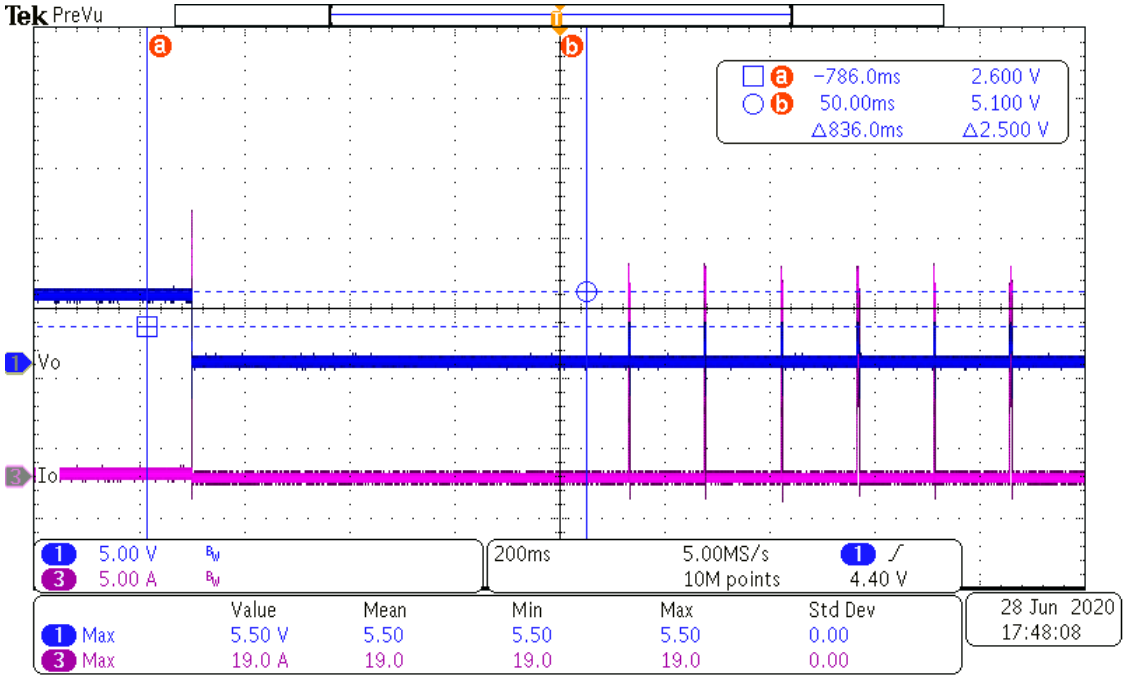

**Fixed-PDO:** 20V, 3.25A, OCP=**3.72A,** response time**=108uS**. The DUT will go latch mode after 2 times retry.

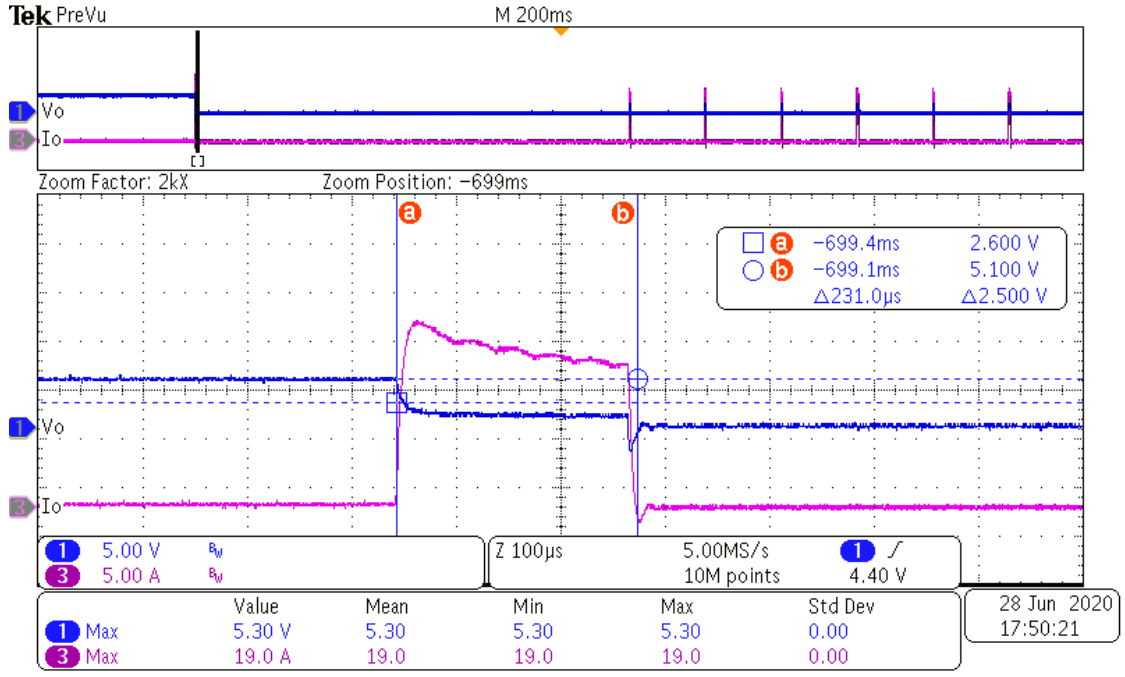


## 3.11 Short Circuit Protection

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

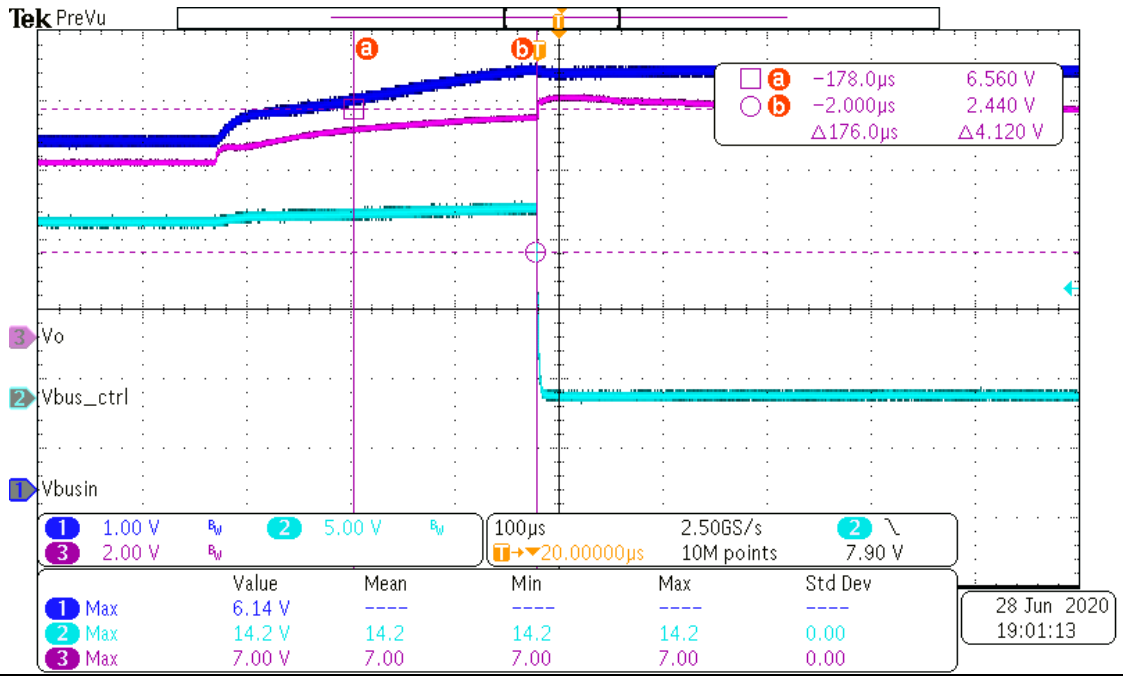


## 3.12 Over Voltage Protection

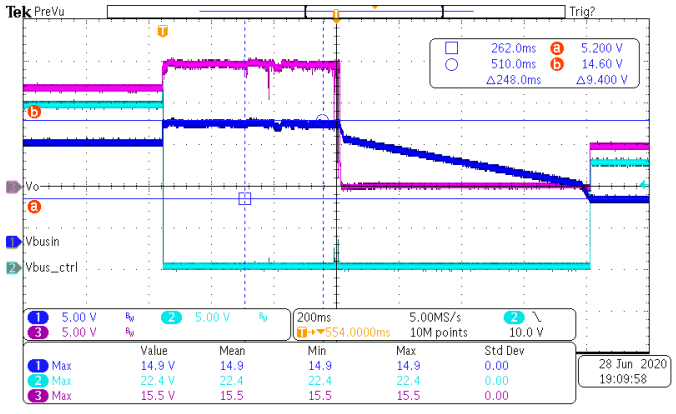
Test Condition: 115Vac, 0A load.

PDO 5V, apply 7V DC source to Vbus & GND. Vovp=**6.14V** on Vbusin

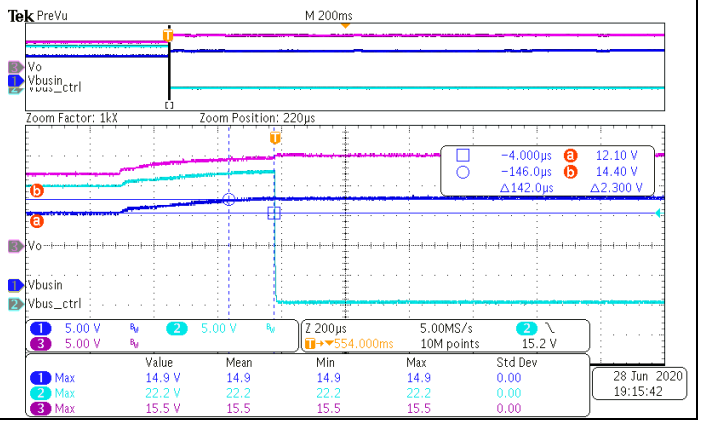



PDO 12V, apply 15V DC source to Vbus & GND, Vovp=**14.9V** on Vbusin.

15V DC is applied in second.




Keep 15V DC Source on Vo.




## 3.13 Over Temperature Protection

OTP trigger point = **85℃**

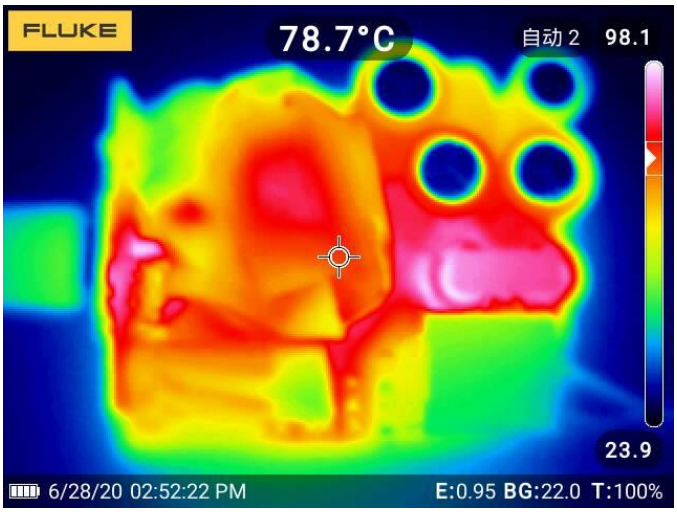
OTP resume point = **60℃**

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

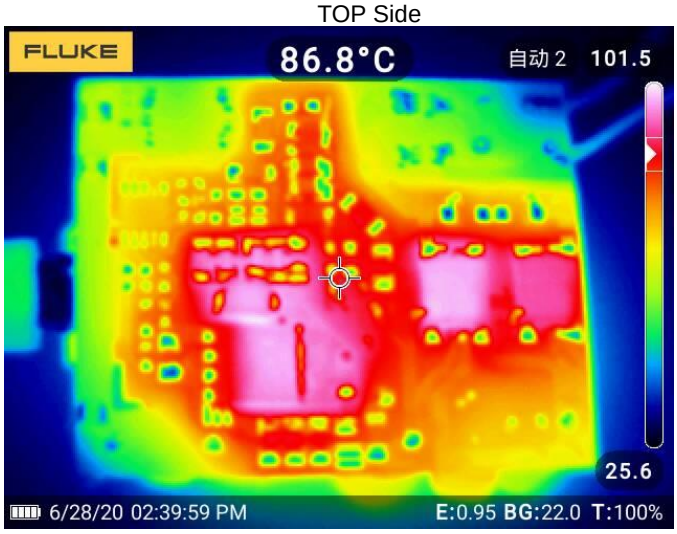
## 3.14 Thermal Captures

**Test Condition: Vin=100Vac/60Hz, Vout = 20V, Iout = 3.25A**

**Ambient Temperature: 27°c and in Open-frame for running >60mins**




TOP Side




Bottom Side

| Measured Key Component | Tem (℃) |
|---|---|
| **Transformer Core** | 83.2 |
| **Transformer Wire** | 88.6 |
| **Primary- MOSFET** | 98.0 |
| **SR MOSFET** | 98.9 |
| **Bridge Diode BD1/BD2** | 98.7/92.5 |
| **PAG1S** | 72.9 |
| **PAG1P** | 70.0 |
| **LDO Transistor** | 79.2 |
| **LF2** | 95.2 |

## 3.15 Conducted Emission

Figure 3-20-1. CE at 115V, 60Hz: LINE **(AV Margin 12.5dB)**

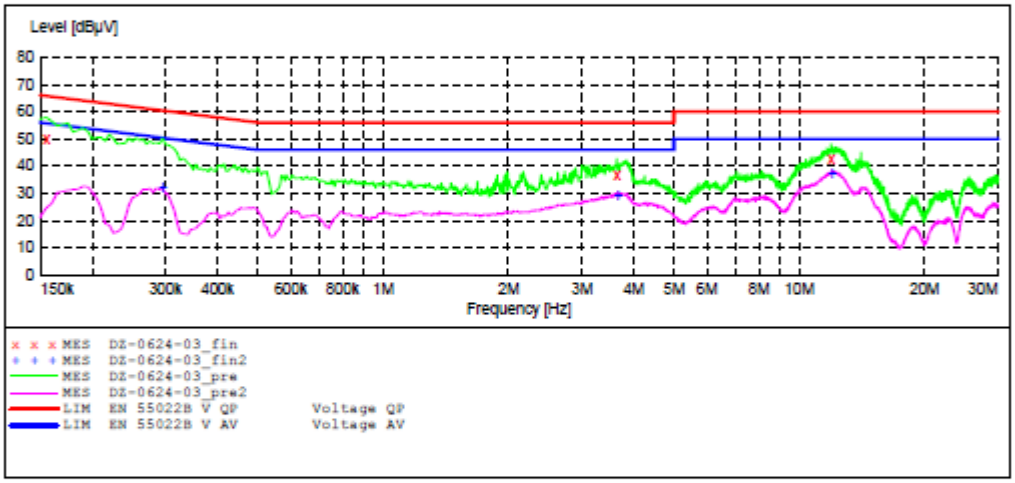
*ACCURATE TECHNOLOGY CO.,LTD*

*CONDUCTED EMISSION STANDARD EN 55032 B*

```
EUT:                  M/N:PAG1 65W 1#
Manufacturer:         FULL LOAD
Operating Condition:  20V/3.25A
Test Site:            1#Shielding Room
Operator:             Ben
Test Specification:   L 110V/60Hz
Comment:
Start of Test:        6/24/2020 / 3:33:15PM
```

*SCAN TABLE: "V 9K-30MHz fin"*

```
  Short Description:                SUB STD VTERM2 1.70
  Start      Stop       Step        Detector   Meas.     IF       Transducer
  Frequency  Frequency  Width                  Time      Bandw.
  9.0 kHz    150.0 kHz  100.0 Hz    QuasiPeak  1.0 s     200 Hz   NSLK8126 2008
                                    Average
  150.0 kHz  30.0 MHz   5.0 kHz     QuasiPeak  1.0 s     9 kHz    NSLK8126 2008
                                    Average
```




*MEASUREMENT RESULT: "DZ-0624-03_fin"*

6/24/2020 3:36PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.155000 | 50.20 | 10.5 | 66 | 15.5 | QP | ??? | GND |
| 3.640000 | 36.70 | 11.1 | 56 | 19.3 | QP | ??? | GND |
| 11.920000 | 42.40 | 11.3 | 60 | 17.6 | QP | ??? | GND |

*MEASUREMENT RESULT: "DZ-0624-03_fin2"*

6/24/2020 3:36PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.295000 | 32.00 | 10.6 | 50 | 18.4 | AV | ??? | GND |
| 3.660000 | 29.60 | 11.1 | 46 | 16.4 | AV | ??? | GND |
| 11.980000 | 37.50 | 11.3 | 50 | 12.5 | AV | ??? | GND |

Figure 3-20-2. CE at 115V, 60Hz: NEUTRAL **(AV Margin 15.2dB)**

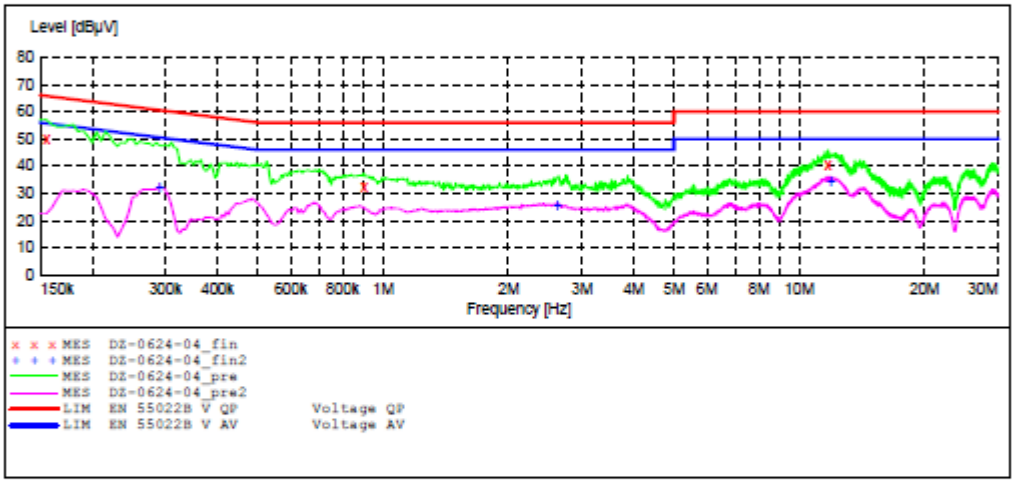
***ACCURATE TECHNOLOGY CO.,LTD***

***CONDUCTED EMISSION STANDARD EN 55032 B***

```
EUT:                  M/N:PAG1 65W 1#
Manufacturer:         FULL LOAD
Operating Condition:  20V/3.25A
Test Site:            1#Shielding Room
Operator:             Ben
Test Specification:   N 110V/60Hz
Comment:
Start of Test:        6/24/2020 / 3:36:45PM
```

***SCAN TABLE: "V  9K-30MHz fin"***

```
  Short Description:                SUB STD VTERM2 1.70
  Start      Stop       Step        Detector   Meas.     IF       Transducer
  Frequency  Frequency  Width                  Time      Bandw.
  9.0 kHz    150.0 kHz  100.0 Hz    QuasiPeak  1.0 s     200 Hz   NSLK8126 2008
                                    Average
  150.0 kHz  30.0 MHz   5.0 kHz     QuasiPeak  1.0 s     9 kHz    NSLK8126 2008
                                    Average
```




***MEASUREMENT RESULT: "DZ-0624-04_fin"***

6/24/2020 3:39PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.155000 | 50.00 | 10.5 | 66 | 15.7 | QP | N | GND |
| 0.900000 | 32.00 | 10.8 | 56 | 24.0 | QP | N | GND |
| 11.725000 | 40.00 | 11.3 | 60 | 20.0 | QP | N | GND |

***MEASUREMENT RESULT: "DZ-0624-04_fin2"***

6/24/2020 3:39PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.290000 | 32.50 | 10.6 | 51 | 18.0 | AV | N | GND |
| 2.620000 | 25.40 | 11.0 | 46 | 20.6 | AV | N | GND |
| 11.890000 | 34.80 | 11.3 | 50 | 15.2 | AV | N | GND |

Figure 3-20-1. CE at 230V, 50Hz: LINE **(AV Margin 6dB)**

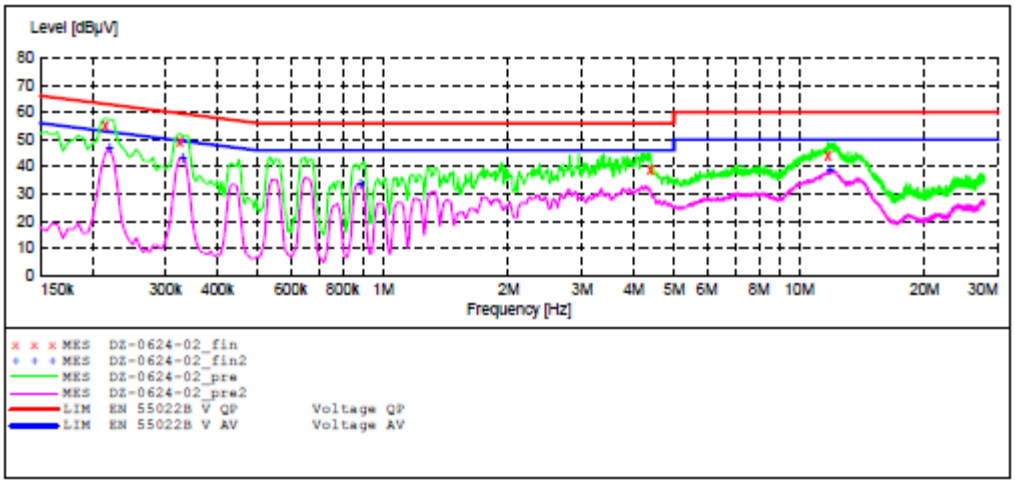
*ACCURATE TECHNOLOGY CO.,LTD*

*CONDUCTED EMISSION STANDARD EN 55032 B*

```
EUT:                    M/N:PAG1 65W 1#
Manufacturer:           FULL LOAD
Operating Condition:    20V/3.25A
Test Site:              1#Shielding Room
Operator:               Ben
Test Specification:     L 230V/50Hz
Comment:
Start of Test:          6/24/2020 / 3:29:38PM
```

*SCAN TABLE: "V 9K-30MHz fin"*

```
  Short Description:                SUB STD VTERM2 1.70
  Start       Stop        Step      Detector  Meas.     IF       Transducer
  Frequency   Frequency   Width               Time      Bandw.
  9.0 kHz     150.0 kHz   100.0 Hz  QuasiPeak 1.0 s     200 Hz   NSLK8126 2008
                                    Average
  150.0 kHz   30.0 MHz    5.0 kHz   QuasiPeak 1.0 s     9 kHz    NSLK8126 2008
                                    Average
```




*MEASUREMENT RESULT: "DZ-0624-02_fin"*

6/24/2020 3:32PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.215000 | 54.70 | 10.5 | 63 | 8.3 | QP | ??? | GND |
| 0.325000 | 48.80 | 10.6 | 60 | 10.8 | QP | ??? | GND |
| 4.380000 | 38.80 | 11.1 | 56 | 17.2 | QP | ??? | GND |
| 11.695000 | 43.80 | 11.3 | 60 | 16.2 | QP | ??? | GND |

*MEASUREMENT RESULT: "DZ-0624-02_fin2"*

6/24/2020 3:32PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.220000 | 46.80 | 10.6 | 53 | 6.0 | AV | ??? | GND |
| 0.330000 | 43.50 | 10.6 | 50 | 6.0 | AV | ??? | GND |
| 0.880000 | 33.50 | 10.8 | 46 | 12.5 | AV | ??? | GND |
| 11.845000 | 39.10 | 11.3 | 50 | 10.9 | AV | ??? | GND |

Figure 3-20-2. CE at 230V, 50Hz: NEUTRAL **(AV Margin 7.7dB)**

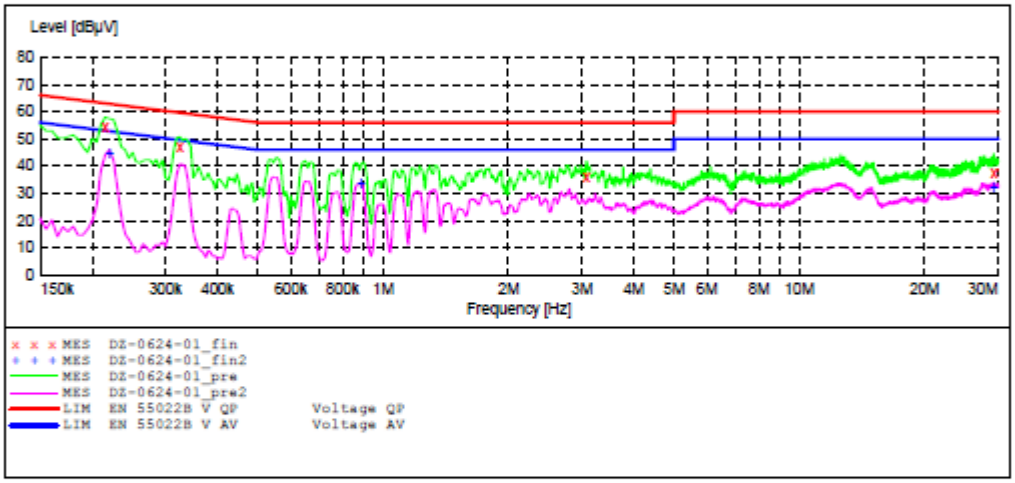
***ACCURATE TECHNOLOGY CO.,LTD***

***CONDUCTED EMISSION STANDARD EN 55032 B***

```
EUT:                  M/N:PAG1 65W 1#
Manufacturer:         FULL LOAD
Operating Condition:  20V/3.25A
Test Site:            1#Shielding Room
Operator:             Ben
Test Specification:   N 230V/50Hz
Comment:
Start of Test:        6/24/2020 / 3:25:56PM
```

***SCAN TABLE: "V 9K-30MHz fin"***

```
Short Description:                    SUB STD VTERM2 1.70
Start       Stop        Step          Detector   Meas.     IF       Transducer
Frequency   Frequency   Width                    Time      Bandw.
9.0 kHz     150.0 kHz   100.0 Hz      QuasiPeak  1.0 s     200 Hz   NSLK8126 2008
                                      Average
150.0 kHz   30.0 MHz    5.0 kHz       QuasiPeak  1.0 s     9 kHz    NSLK8126 2008
                                      Average
```




***MEASUREMENT RESULT: "DZ-0624-01_fin"***

6/24/2020 3:28PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.215000 | 54.10 | 10.5 | 63 | 8.9 | QP | N | GND |
| 0.325000 | 46.80 | 10.6 | 60 | 12.8 | QP | N | GND |
| 3.080000 | 35.90 | 11.1 | 56 | 20.1 | QP | N | GND |
| 29.320000 | 37.60 | 11.5 | 60 | 22.4 | QP | N | GND |

***MEASUREMENT RESULT: "DZ-0624-01_fin2"***

6/24/2020 3:28PM

| Frequency MHz | Level dBµV | Transd dB | Limit dBµV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.220000 | 45.10 | 10.6 | 53 | 7.7 | AV | N | GND |
| 0.885000 | 33.60 | 10.8 | 46 | 12.4 | AV | N | GND |
| 29.275000 | 32.50 | 11.5 | 50 | 17.5 | AV | N | GND |

## 3.16 USB PD Source Test Results (Using Quadramax)

### Test Setup for Quadramax




### Test Result

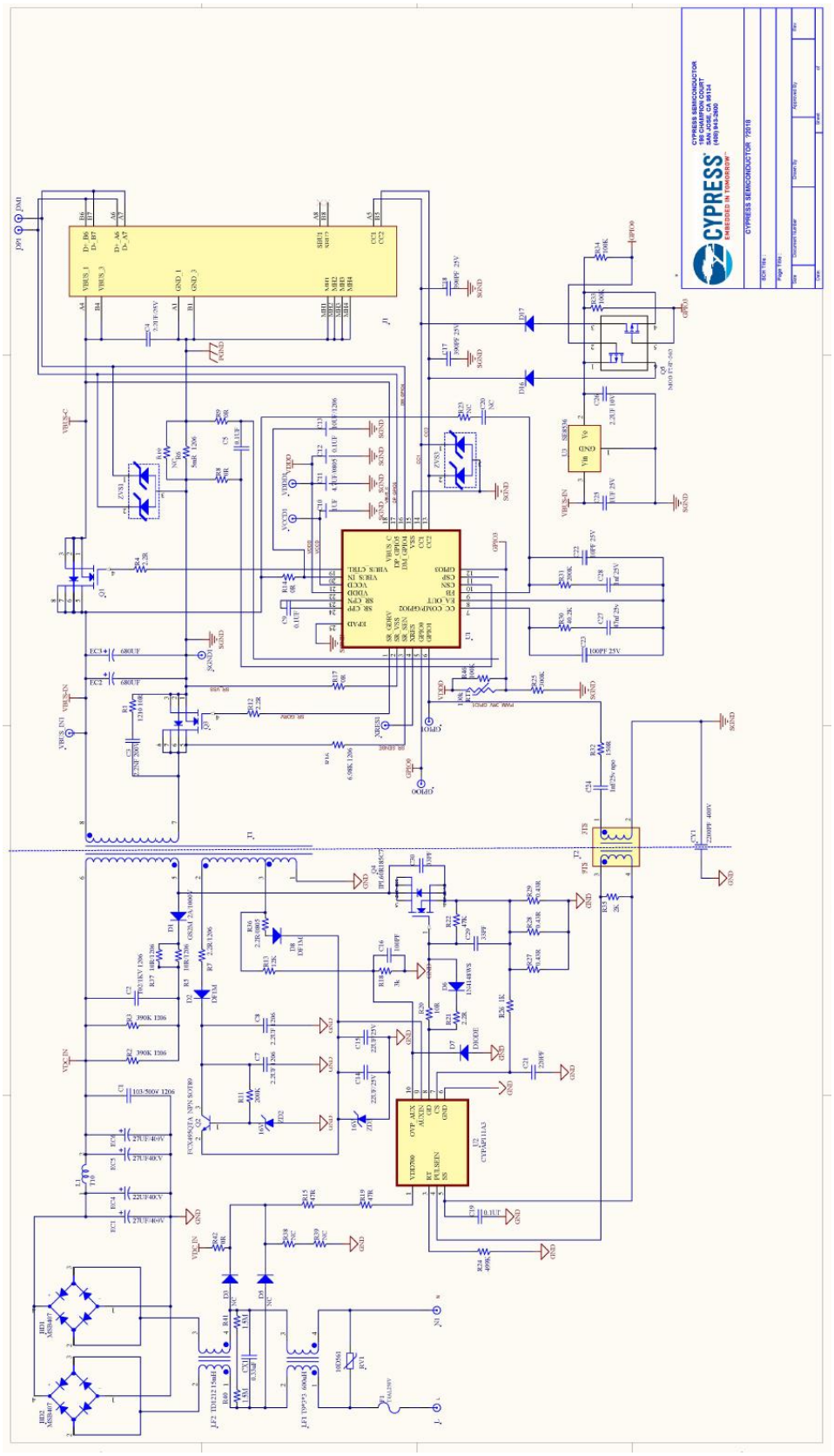
Testing Initialized
2020/6/29 16:37:23
QuadDraw Version: 0.8.7285
QM#103 HWRev:1.4.4 FWST:0.0.1376 FWCCG1:0.10

| 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



## 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 | 10 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 | R46 | 100K OHM 1% 0603 1/10W | 1 | |
| 8 | RT1 | NTC 100KOHM 4250K 0603 | 1 | |
| 9 | R30 | 40.2K OHM 1% 0603 1/10W | 1 | |
| 10 | R31 | 200K OHM 1% 0603 1/10W | 1 | |
| 11 | R33,R34 | 100K OHM 1% 0603 1/10W | 2 | |
| 12 | C5,C9,C12 | 0.1UF 50V X7R 0603 | 3 | SMD Capacitor |
| 13 | C3 | 2.2NF 200V X7R 1206 | 1 | |
| 14 | C10 | 1UF 50V X7R 0603 | 1 | |
| 15 | C11 | 4.7UF 50V X7R 0805 | 1 | |
| 16 | C13 | 10UF/25V X7R 1206 | 1 | |
| 17 | C17,C18 | 390PF 50V X7R 0603 | 2 | |
| 18 | C22 | 10PF 50V X7R 0603 | 1 | |
| 19 | C23 | 100PF 50V X7R 0603 | 1 | |
| 20 | C25 | 1UF 50V X7R 0603 | 1 | |
| 21 | C4, C26 | 2.2UF 25V X7R 0603 | 2 | |
| 22 | C27 | 47NF 50V X7R 0603 | 1 | |
| 23 | C28 | 1NF 50V X7R 0603 | 1 | |
| 24 | D16,D17 | B0520WS 0.5A20V SOD323 | 2 | SMD Schottky Diode |
| 25 | U1 | PAG1S CYPAS111A1-QFN24 | 1 | SMD Chip |
| 26 | U3 | SE8536 LDO3.6V SOT23-3 | 1 | SMD Chip |
| 27 | Q5 | NTZD3152P-20V430mA SOT563-6 | 1 | SMD MOSFET |
| 28 | Q3 | BSC098N10NS5 100V9.8mR PG-TDSON-8 | 1 | SMD MOSFET |
| 29 | Q1 | BSZ0902NS 30V40A 2.6mR TSDSON8 | 1 | SMD MOSFET |
| | | | 39 | |

### Connector Board BOM

| No. | Reference | Part Description | Qty | Part Type |
|---|---|---|---|---|
| 1 | J1 | 16Pin Tape-C Receptor | 1 | Connector |
| 2 | ZVS1,ZVS3 | AZ5515-02F | 2 | ZVS Diode |
| | | | 3 | |

Total component: 101pcs

### 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 | R42 | 0 OHM 5% 1206 1/4W | 1 | |
| 7 | R40,R41 | 1.5M OHM 5% 1206 1/4W | 2 | |
| 8 | R11 | 200K OHM 1% 0603 1/10W | 1 | |
| 9 | R13 | 12K OHM 1% 0805 1/8W | 1 | |
| 10 | R18 | 3K OHM 1% 0603 1/10W | 1 | |
| 11 | R20 | 10 OHM 1% 0603 1/10W | 1 | |
| 12 | R21 | 2.2 OHM 1% 0603 1/10W | 1 | |
| 13 | R22 | 47K OHM 1% 0603 1/10W | 1 | |
| 14 | R24 | 499K OHM 1% 0603 1/10W | 1 | |
| 15 | R35 | 2K OHM 1% 0603 1/10W | 1 | |
| 16 | R26 | 1K OHM 1% 0603 1/10W | 1 | |
| 17 | R27,R28,R29 | 0.43 OHM 1% 1206 1/4W | 3 | |
| 18 | R32 | 150 OHM 1% 0603 1/10W | 1 | |
| 19 | C1 | 103 500V X7R 1206 | 1 | SMD Capacitor |
| 20 | C2 | 102 1000V X7R 1206 | 1 | |
| 21 | C7,C8 | 2.2UF 100V X7R 1206 | 2 | |
| 22 | C14,C15 | 22UF 25V X5R 0805 | 2 | |
| 23 | C16 | 100PF 50V NPO 0603 | 1 | |
| 24 | C19 | 0.1UF 50V X7R 0603 | 1 | |
| 25 | C21 | 220PF 50V NPO 0603 | 1 | |
| 26 | C24 | 1000PF 50V X7R 0603 | 1 | |
| 27 | D6 | 1N4148WS SOD323 | 1 | SMD Diode |
| 28 | D7 | BAT54V2TA1G SOD523 | 1 | SMD Schottky Diode |
| 29 | D1 | GS2M 2A 1000V SMB | 1 | SMD Diode |
| 30 | D2, D8 | DF1M 1A 1000V SOD-123 | 2 | SMD Diode |
| 31 | D3,D5 | N/C | 0 | SMD Diode |
| 32 | BD1,BD2 | MSB407 4A 1000V | 2 | SMD Bridge Diode |
| 33 | ZD2,ZD3 | BET52C16 16V SOD123 | 2 | SMD Zener Diode |
| 34 | Q2 | FCX495QTA SOT89 1A150V NPN | 1 | SMD Transistor |
| 35 | Q4 | IPL60R185C7 185mR 650V ThinPAK 8x8 | 1 | SMD MOSFET |
| 36 | U2 | PAG1P CYPAP111A3 SOIC10 | 1 | SMD Chip |
| 37 | EC1,EC5,EC6 | 27UF 400V AISHI 10*20 2000H | 3 | E-cap |
| 38 | F1 | T3.15A 250V | 1 | Fuse |
| 39 | LF1 | T9*3*3 600uH | 1 | Common mode choke |
| 40 | RV1 | MOV 10D561 | 1 | MOV |
| 41 | LF2 | TD1212 15mH | 1 | Common mode choke |
| 42 | EC4 | 22UF 400V AISHI 8*20 2000H | 1 | E-cap |
| 43 | CY1 | 400V 2200PF | 1 | Y-Cap |
| 44 | T2 | JQH LCL00T5138A1 3:9, 8mm | 1 | PT Transformer |
| 45 | CX1 | 0.33uF/275V | 1 | X-Cap |
| 46 | T1 | RM10 340uH 35:5:18+4 V2 | 1 | Transformer |
| 47 | L1 | T10 10*5*6 900uH | 1 | Inductor |
| | | | 59 | |

## 4.3 PCB Layout

Figure 4-2-1. Top view

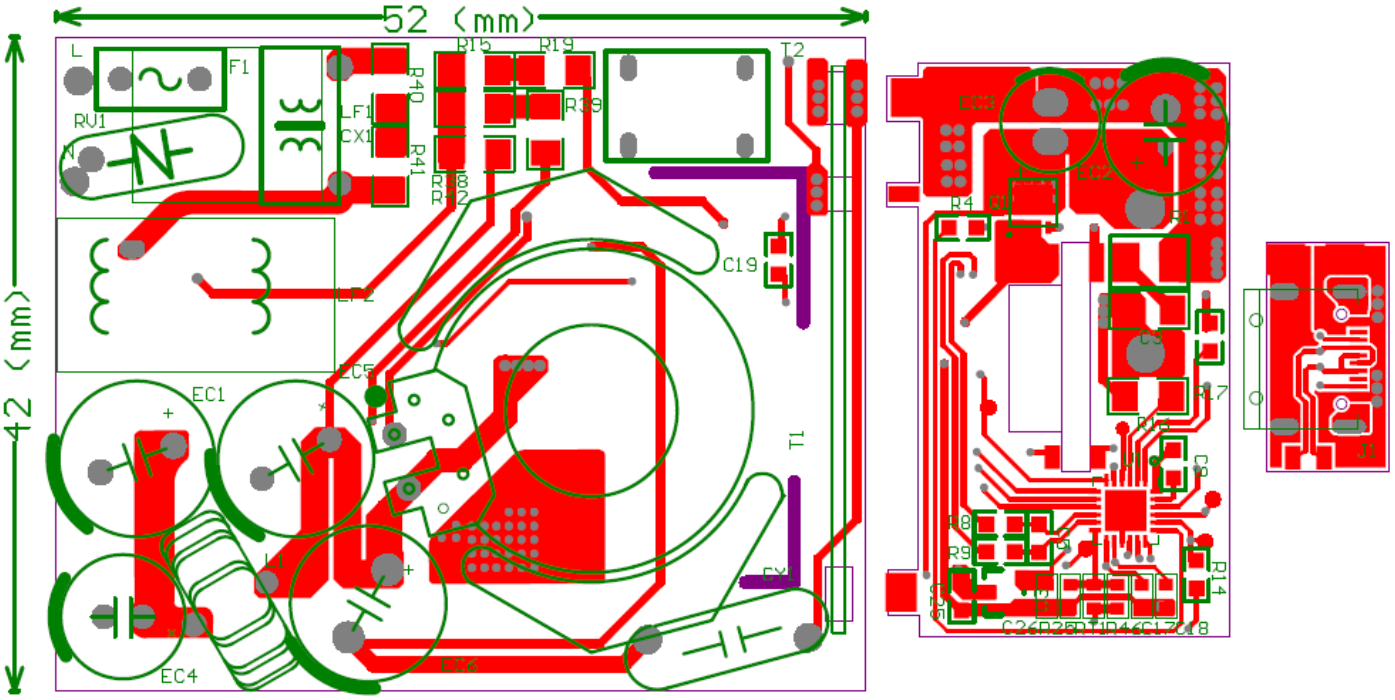
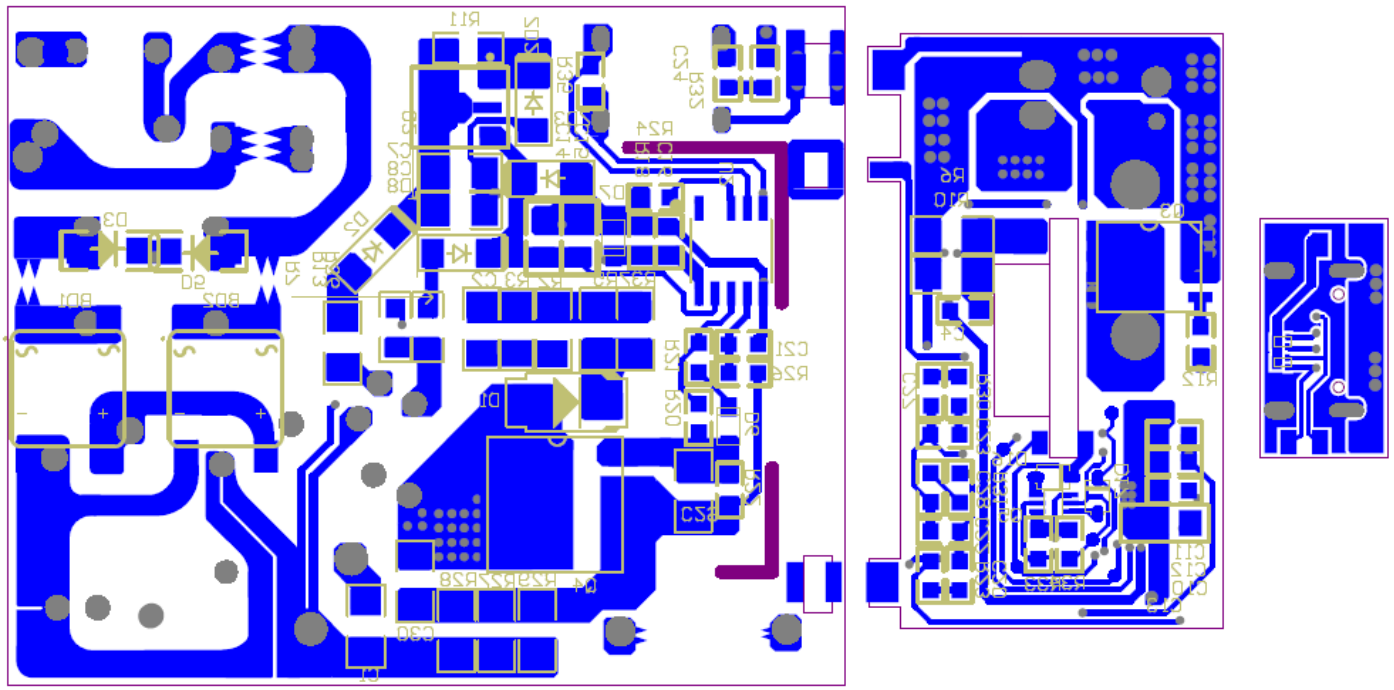


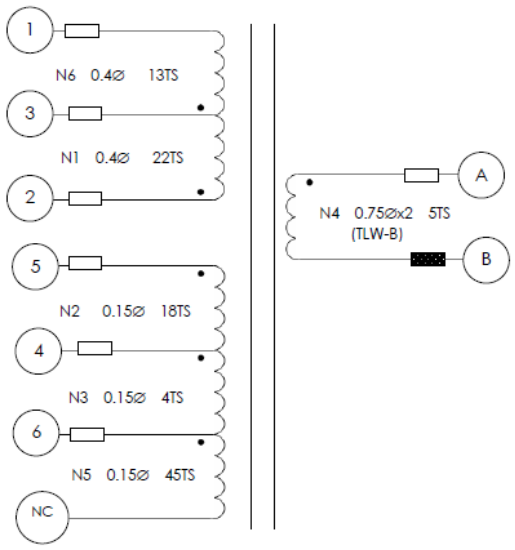

Figure 4-2-2. Bottom view



## 4.4 Transformer Specifications (T1)

Figure 4-3. RM10 Transformer design spec

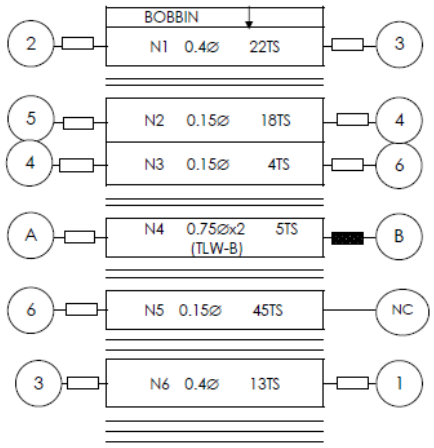
1. SCHEMATICS.




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



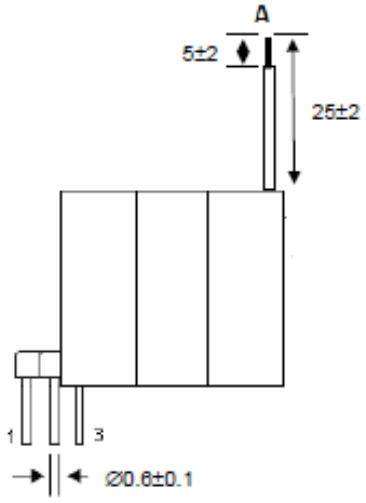

3. MATERIAL LIST.

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

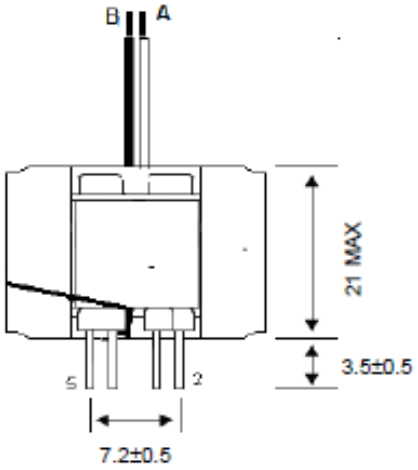
4. ELECTRICAL SPECIFICATION.

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

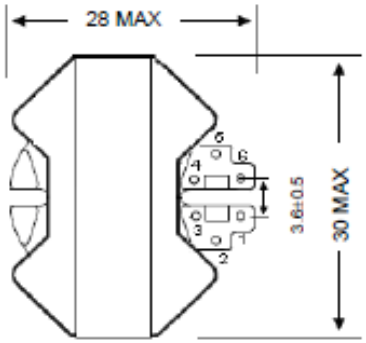
## 5. CONFIGURATION & DIMENSION. (UNIT:mm)




<FRONT VIEW>



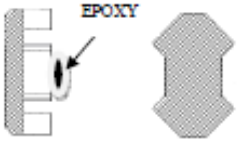

<SIDE VIEW>




<BOTTOM VIEW>

PIN 朝外繞線鐵心中柱點膠固定
底部加隔離膠帶如圖

- 
- 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 25±2MM 含 5MM 鍍錫
- 鐵心中柱點膠固定底部加隔離膠
  帶如圖



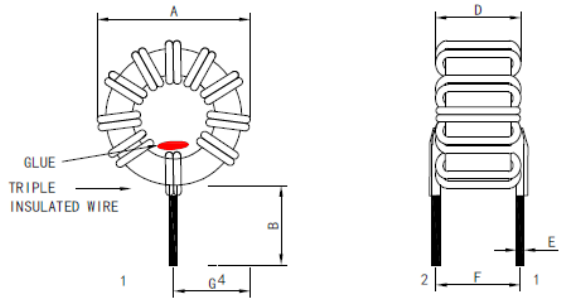

- PIN6 拉一引線至鐵心，成品最後
  沿線包以 20mm 膠帶包兩圈
- MARKING: RM8-341J
  FTC YYWW

| | |
|---|---|
| CUSTOMER: 賽普拉斯 | PART NO: RM10-341J |
| DATE: 2020/06/09 | 育泉科技股份有限公司 |
| REV NO: A / PAGE: 4/4 | FONTAINE TECHNOLOGIES CO.,LTD. |

## 4.5 Inductor Specifications (L1 900uH)

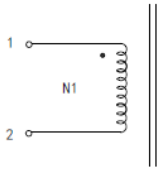
Figure 4-4. Datasheet of pi filter inductor L1

1. 外观图示(单位：mm)/DIMENSION(UNIT:mm)




| A | B | C | D | E | F | |
|---|---|---|---|---|---|---|
| 12 MAX | 3.5 ±0.5 | 1.5 MAX | 6.5 MAX | φ0.60 ±0.1 | 5.5 ±0.5 | |

2. 电气原理/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) | 绕组方式 WINDING CONDITION |
|---|---|---|---|---|
| N1 | φ0.70(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 | AC 1.0KV | CS9929 5mA 60Hz 3S |
| | | COIL-CORE | AC 0.5KV | |
| 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

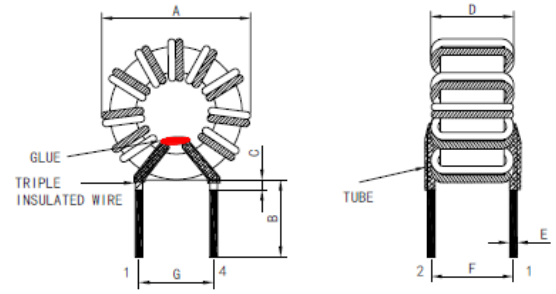
| 序号 NO. | 项目 ITEM | 规格&材质 TYPE & MATERIAL | 供应商 SUPPLIERS | 认证号 UL NO. |
|---|---|---|---|---|
| 1 | 磁芯 CORE | TYPE:T10×6×5 MATERIAL:FH4 A121 | SHENZHEN SHI LI CI ELECTRICAL CO.,LTD. ACME ELECTRONIC CORPORATION OR EQUAL | |
| 2 | 漆包线 WIRE | POLYURETHANE ENAMELED MTLDSG:UEW ANSI TYPE:MW75C THERMAL RATING:130°C | 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(a) 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)

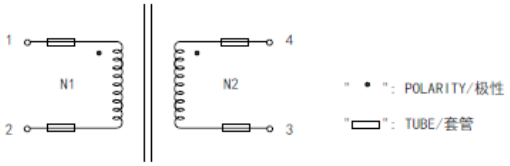
Figure 4-5. Datasheet of Common mode choke

1. 外观图示(单位：mm)/DIMENSION(UNIT:mm)




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 12 MAX | 4.5 ±0.5 | 1.5 MAX | 8.5 MAX | φ0.50 ±0.1 | 6.0 ±0.5 | 6.0 ±0.5 |

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 | |

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




| 电气特性：（at 25℃） | | | | | |
|---|---|---|---|---|---|
| 品号 | 电感量(mH) | 线径 | 直流电阻(mΩ) | 对应圆线径 | 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 | 10.0min | 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 |

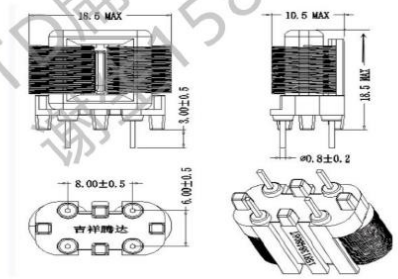
＊ 电感测试频率：1 KHZ 0.25V TD1212替代UU9.8 T16 T14 T12 T10 EE15共模电感 脚位6*8

＊ 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



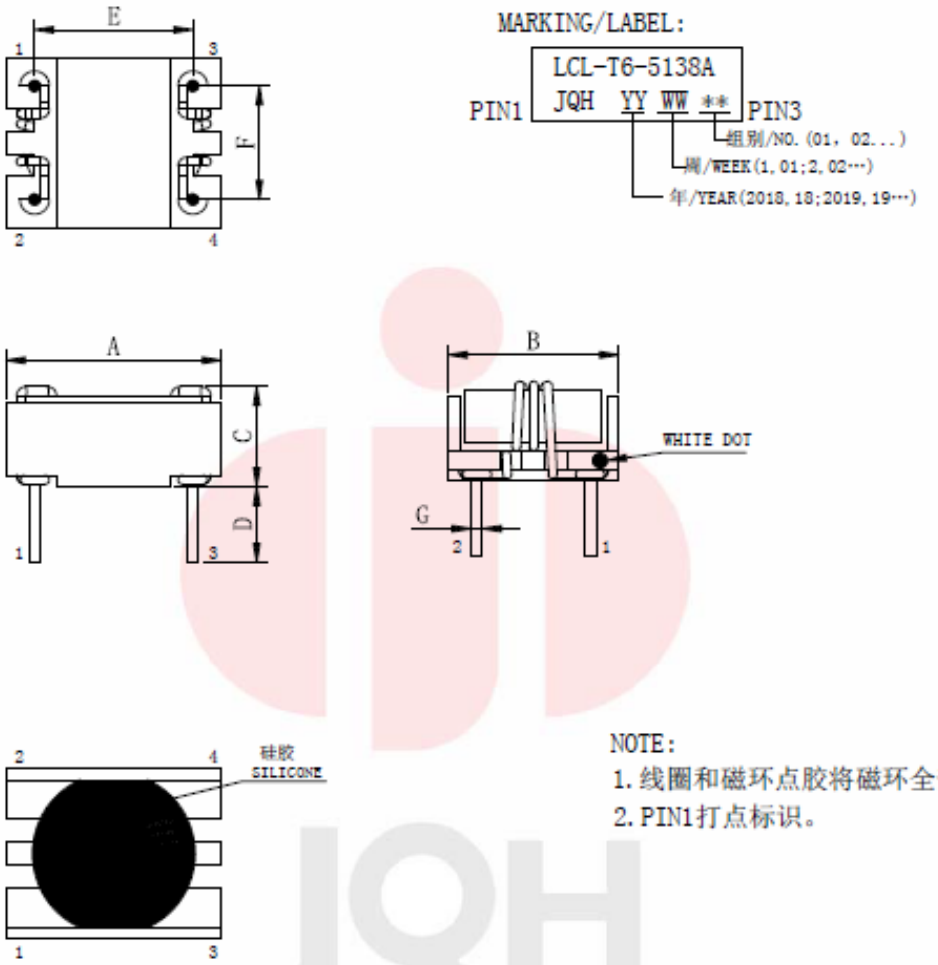

飞黄腾达

吉祥腾达 TD扁平线共模电感 咨询13813848087

## 4.7 Pulse Transformer (T2)

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

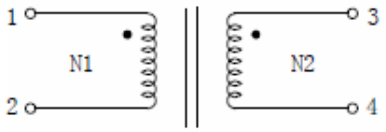
1. 外观图(单位:mm)/DIMENSION(UNIT:mm)




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 |

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<br>100KHz/0.3V, AT 25℃ |
| 2 | 耐压 HI-POT | N1-N2 | 3.0KV AC | CS9929<br>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<br>R10K | HENGDIAN GROUP DMEGC MAGNETICS CO.,LTD<br>ACME | N/A |
| 2 | 底座 BASE | TYPE:Phenolic (PF)<br>MATERIAL:PM-9820/PM-9630<br>THERMAL RATING:150℃ | SUMITOMO BAKELITE CO LTD | E41429 |
| 3 | 三层绝缘线 TRIPLE INSULATED WIRE | TYPE: FIW<br>TYPE: FIW<br>THERMAL RATING:155℃ | HOI LUEN ELECTRICAL MFR CO LTD<br>TAI-I COPPER (GUANZHOU) CO LTD | E257525<br>E234896 |
| 4 | 漆包线 WIRE | MARK DSG:xUEW/155, QA-x/155<br>ANSI TYPE:MW 79-C<br>THERMAL RATING:155℃ | DONG GUAN YIDA INDUSTRIAL CO LTD | E344055 |
| 5 | 硅胶 SILICONE | TYPE:3140<br>THERMAL RATING:200℃ | DOW CORNING CORPORATION | |

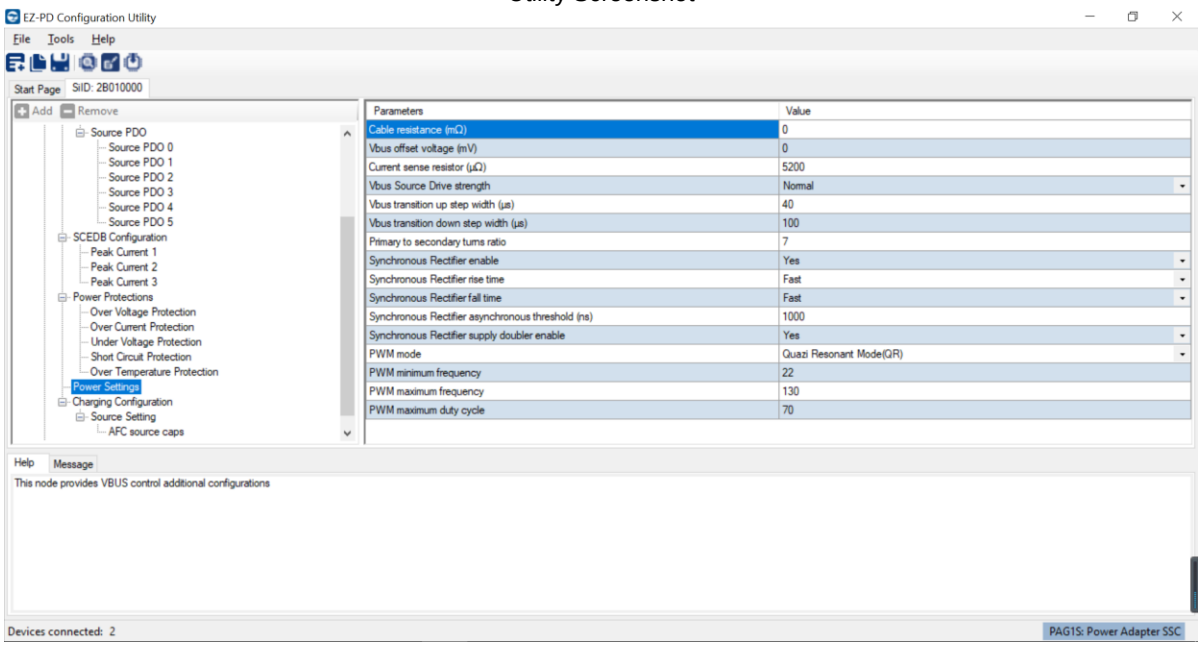
注:产品符合RoHS要求.
Note: The products comply with RoHS requirements.

6. 产品单重/WEIGHT

Net Weight:***g/PC

## 4.8 EZ-PD Configuration Utility

Utility Screenshot




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) | 5200 |
| 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 | Mar 31st 2020 | XUXI | Initial Version |
| REV2 | June 28, 2020 | XUXI | Add High Line CE, Protections, Quadramax etc. |
| | | | |