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# Chapter 1. Summary

## 1.1 General Description

The 18W 1C+1A Evaluation Board exemplifies a dual-port charger adaptor design - 18W_USB-C PD 3.0 port, 18W_QC3.0 USB-A port, It also supports port-A trickle charge mode. It is composed of four main parts. AP39303 offers the Quasi-Resonant (QR) Flyback PWM switching. APR347 is a secondary side Synchronous Rectification (SR) Controller. AP43971, an PD3.0/QC4+ decoder, handshakes with the sink device through the CC1/CC2 of Port-C or the D+/D- of Port-A and feedbacks voltage and current regulation information to primary side controller-AP39303 for providing regulation function. AZV831, low-bias current and low voltage operational amplifier, determines if Port-A is in trickle charge mode (<100mA).

## 1.2 Key Features

### 1.2.1 System Key Features

- SSR Topology Implementation with an Opto-coupler for Accurate Step Voltage Controlling
- USB Type-A Port supports the 18W QC2.0/3.0 mode function
- USB Type-C Port supports the 18W PD3 function and PPS 3.3V -11V@20mV/step
- Meets DOE VI and COC Tier 2 Efficiency Requirements
- <75mW No-Load Standby Power
- Low overall system BOM cost

### 1.2.2 AP39303 Key Features

- Quasi-Resonant (QR) operation/ Peak current mode control/ High-Voltage startup/ Soft Start
- Built-in 120V high voltage VCC LDO to guarantee wide range output voltage application (3.3V~20V, PPS)
- Built-in 700V high performance Power MOSFET
- Low VCC operating current reduces stand-by power (<30mW)
- Adaptive burst mode operation with output voltage
- Adaptive output power limit with output voltage
- Non-Audible-Noise Quasi-Resonant control
- Frequency fold back for high average efficiency
- Secondary winding short protection with FOCP
- Frequency dithering for reducing EMI
- VCC maintain mode
- Useful Pin fault protection:
  SENSE Pin floating and FB/Opto-Coupler Open/Short
- Comprehensive system protection feature:
  Programmable External OTP / OLP / BNO / SOVP / SUVP

### 1.2.3 APR347 Key Features

- Synchronous Rectification Works with DCM/ QR Flyback
- Eliminate Resonant Ringing Interference
- Fewest External Components used

### 1.2.4 AP43971 Key Features

- Compatible with QC4/QC4+ Protocol
- Support USB PD 3.0 Version 1.2 including PPS (Programmable Power Supply) Mode
- OTP (One-Time-Programmable) for main firmware
- MTP (Multi-Time-Programmable) for system configuration

## 1.3 Applications

- 18W Dual Port (Port-A/QC3.0 and Port-C/PD3) Wall Charger Adaptor

## 1.4 Main Power Specifications (CV & CC Mode)

| Parameter | | Value |
|---|---|---|
| Input Voltage | | $90V_{AC}$ to $264V_{AC}$ |
| Input standby power | | < 75mW |
| Only Port-C | Fix | 18W PD3.0<br>PDO_5V/3A, 9V2A, 12V1.5A |
| | PPS | 20mV step voltage, 3.3V-5.9V/3A, 3.3V-11V/2A |
| Only Port-A | QC2.0 | 18W QC2.0 (5V3A, 9V2A, 12V1.5A), & QC3.0 |
| | QC3.0 | Continuous mode 200mV, 3.6V-12V |
| Port-A + Port-C | | Port-A: DCP 5V/1.5A<br>Port-C: 5V/2A |
| Efficiency | | Comply with CoC version 5 tier-2 |
| Total Output Power | | 18W / 22W at PPS |
| Protections | | OCP, OVP, UVP, OLP, OTP |
| Dimension | | 35mm x 48mm x 20mm |

## 1.5 Evaluation Board Picture

**EVB Top View**

**EVB Bottom View**

# Chapter 2. Power Supply Specification

## 2.1 Specification and Test Results

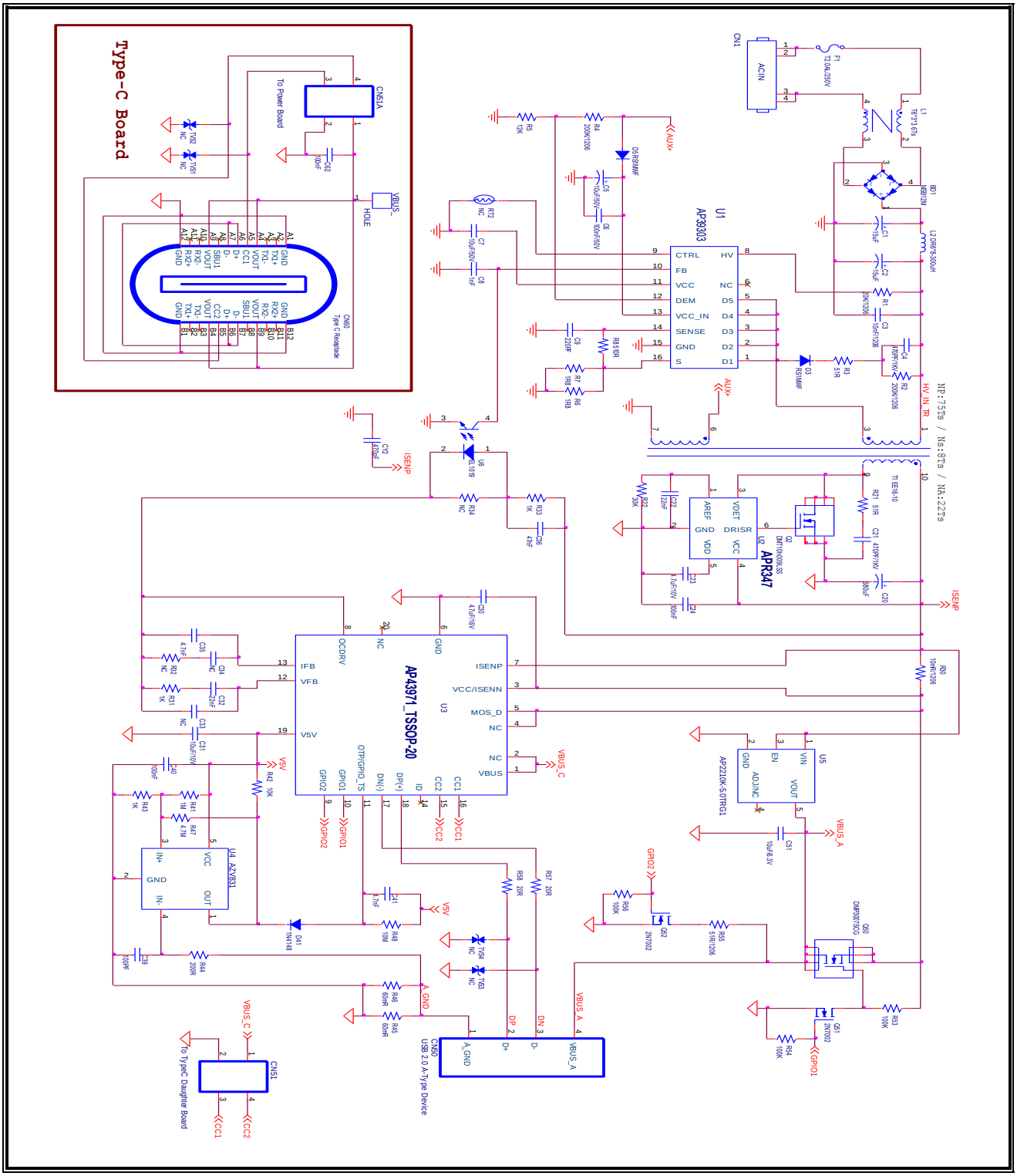
| Parameter | Value | Test Summary |
|---|---|---|
| Input Voltage / Frequency | 90$V_{AC}$ to 264$V_{AC}$ / 47Hz to 63Hz | Test Condition |
| Input Current | <0.5$A_{RMS}$ at 100$V_{AC}$ | |
| Standby Power | <75mW; load disconnected | **PASS,** 56.3mW@115$V_{AC}$/60Hz<br>45.5mW@230$V_{AC}$/60Hz |
| 5V/3A Average Efficiency | DoE VI Efficiency >81.39% | **PASS,** 88.19%@115$V_{AC}$/60Hz<br>87.56%@230$V_{AC}$/50Hz |
| | CoC Version 5, Tier2 Efficiency >81.84% | |
| 5V/0.3A Efficiency (10% Load) | CoC Version 5, Tier2 Efficiency >72.48% | **PASS,** 84.26%@115$V_{AC}$/60Hz<br>81.39%@230$V_{AC}$/50Hz |
| 9V/2A Average Efficiency | DoE VI Efficiency >85.00% | **PASS,** 89.03%@115$V_{AC}$/60Hz<br>88.27%@230$V_{AC}$/50Hz |
| | CoC Version 5, Tier2 Efficiency >85.45% | |
| 9V/0.2A Efficiency (10% Load) | CoC Version 5, Tier2 Efficiency >75.45% | **PASS,** 81.88%@115$V_{AC}$/60Hz<br>80.71%@230$V_{AC}$/50Hz |
| 12V/1.5A Average Efficiency | DoE VI Efficiency >85.00% | **PASS,** 88.66%@115$V_{AC}$/60Hz<br>88.06%@230$V_{AC}$/50Hz |
| | CoC Version 5, Tier2 Efficiency >85.45% | |
| 12V/0.15A Efficiency (10% Load) | CoC Version 5, Tier2 Efficiency >75.45% | **PASS,** 79.30%@115$V_{AC}$/60Hz<br>78.35%@230$V_{AC}$/50Hz |
| Output Voltage Regulation Tolerance | +/- 5% | **PASS,** |
| 5V PPS | 3.3V – 5.9V +/- 5%, 0~3A +/-150mA | **PASS,** |
| 9V PPS | 3.3V – 11V +/- 5%, 0~2A +/-150mA | **PASS,** |
| Conducted EMI | >6dB Margin; according to EN55032 Class B | |
| Radiated EMI | >6dB Margin; according to EN55032 Class B | |

## 2.2 Compliance

| Parameter | Value | Summary |
|---|---|---|
| Output Connector | USB2.0 Type-A | |
| | USB Type-C | |
| Stress | <90% | |
| Dimensions W/D/H | 35 x 48 x 20 (mm) | |

# Chapter 3. Schematic

## 3.1 Schematic



### 3.2 Bill of Material

| Item | Quantity | Designator | Description | Manufacturer Part Number | Manufacturer |
|---|---|---|---|---|---|
| 1 | **1** | **U1** | **AP39303, QR PWM Switcher** | **AP39303S16-13** | **Diodes** |
| 2 | **1** | **U2** | **APR347, SR Controller** | **APR347** | **Diodes** |
| 3 | **1** | **U3** | **AP43971_20L, Decoder** | **AP43971_20L** | **Diodes** |
| 4 | **1** | **U4** | **AZV831, Comparator** | **AZV831KTR-G1** | **Diodes** |
| 5 | **1** | **U5** | **AP2210K-5.0TRG1** | **AP2210K-5.0TRG1** | **Diodes** |
| 6 | **1** | **Q50** | **DMP3007SCG, 30V P-MosFET** | **DMP3007SCGQ-13** | **Diodes** |
| 7 | **1** | **BD1** | **MSB12M, Bridge Rectifier Diode** | **MSB12M-13** | **Diodes** |
| 8 | **1** | **Q2** | **DMT10H009LSS, 100V N-MosFET** | **DMT10H009LSS-13** | **Diodes** |
| 9 | **2** | **Q52,Q51** | **2N7002/SOT23** | **2N7002-13-F** | **Diodes** |
| 10 | **2** | **D3,D5** | **RS1MWF/SOD123** | **RS1MWF-7** | **Diodes** |
| 11 | **1** | **D41** | **1N4148/SOD323** | **1N4148WS-13-F** | **Diodes** |
| 12 | **1** | **U6** | **LTV1009TP-G (CTR-200/400)** | **LTV-1009TP1-G** | **Lite-On** |
| 13 | 1 | C8 | 1nF/50V/X7R/0603 | | |
| 14 | 1 | C9 | 220PF/50V/NPO/0603 | | |
| 15 | 2 | C22,C32 | 22nF/50V/X7R/0603 | | |
| 16 | 1 | C23 | 4.7uF/50V/X7R/0603 | | |
| 17 | 3 | C6,C24,C40 | 100nF/50V/X7R/0603 | | |
| 18 | 1 | C30 | 4.7uF/16V/X7R/0603 | | |
| 19 | 2 | C35,C41 | 4.7nF/50V/X7R/0603 | | |
| 20 | 1 | C36 | 47nF/50V/X7R/0603 | | |
| 21 | 1 | C39 | 100PF/50V/X7R/0603 | | |
| 22 | 1 | C51 | 2.2uF/50V/X5R/0603 | | |
| 23 | 1 | C31 | 10uF/10V | | |
| 24 | 1 | C7 | 10uF/50V/1206 | | |
| 25 | 1 | C3 | 10nF/1KV/1206 | | |
| 26 | 2 | C4,C21 | 470PF/1KV/1206 | | |
| 27 | 2 | C1,C2 | 15uF/400V/10*16 | | |
| 28 | 1 | C5 | 10uF/50V/5*11 | | |
| 29 | 1 | C20 | 680uF/16V/8*12/Polymer CAP | | |
| 30 | 1 | CY2 | 470pF/Y1-CAP | | |
| 31 | 1 | R1 | 20K/5%/1206 | | |
| 32 | 1 | R2 | 200K/5%/1206 | | |
| 33 | 1 | R3 | 51R/5%/0805 | | |
| 34 | 1 | R4 | 200K/1%/1206 | | |
| 35 | 1 | R5 | 12K/1%/0603 | | |
| 36 | 2 | R7,R6 | 1R5/1%/1206 | | |
| 37 | 1 | R8 | 510R/1%/0603 | | |
| 38 | 1 | R21 | 51R/5%/1206 | | |
| 39 | 1 | R22 | 30K/1%/0603 | | |
| 40 | 1 | R30 | 10mR/1%/1206 (Low TCR) | SMB12A1FR010T | SART |
| 41 | 3 | R31,R33,R43 | 1K/1%/0603 | | |
| 42 | 1 | R41 | 1M/1%/0603 | | |
| 43 | 1 | R47 | 4.7M/1%/0603 | | |
| 44 | 1 | R42 | 10K/1%/0603 | | |
| 45 | 1 | R44 | 200R/1%/0603 | | |
| 46 | 2 | R45,R46 | 60mR/1%/1206 | | |
| 47 | 1 | R48 | 10M/1%/0603 | | |
| 48 | 3 | R53,R54,R56 | 100K/5%/0603 | | |
| 49 | 1 | R55 | 51R/5%/1206 | | |
| 50 | 2 | R58,R57 | 20R/5%/0603 | | |

| Item | Quantity | Designator | Description | Manufacturer Part Number | Manufacturer |
|---|---|---|---|---|---|
| | | | | | |
| 51 | 1 | F1 | T2.0AL/250V | | |
| 52 | 1 | T1 | EE16-10 - 750uH_NP:NS:NA=75:8:22 | | |
| 53 | 1 | L1 | T6*3*3 6Ts | | |
| 54 | 1 | L2 | DR6*8-300uH | | |
| 55 | 1 | CN50 | USB 2.0 A-Type Device | | |
| 56 | 2 | TVS3,TVS4 | NC | | |
| 57 | 5 | RT2,R32,C33,R34,C34 | NC | | |
| | | | | | |
| | | | | | |

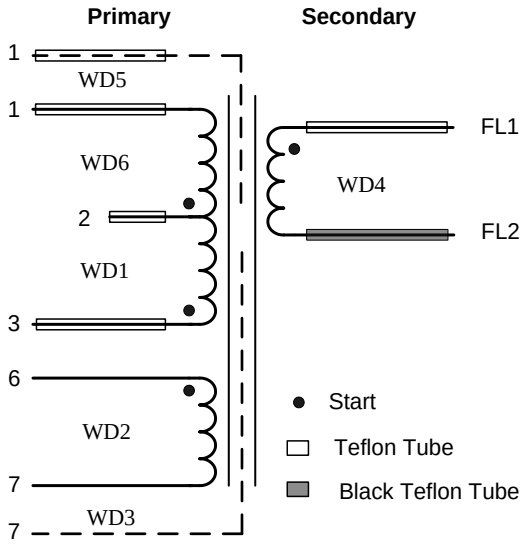
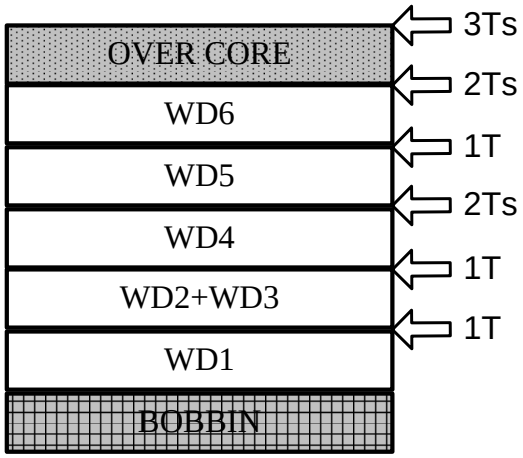
**Type-C Connector Daughter Board**

| Item | Quantity | Designator | Description | Manufacturer Part Number | Manufacturer |
|---|---|---|---|---|---|
| 1 | 1 | CN60 | Type C Connector | UT13513-1180A-7H | Foxconn |
| 2 | 1 | C62 | 100nF/50V/0603 | | |
| 3 | 2 | TVS2,TVS1 | NC | | |

Note:

- Current sense resistor (R30) should use the Low TCR type resistor.

### 3.3 Transformer SPEC

| Circuit： | Cross sectional view： |
|---|---|
|  |  |





| *Definition* | Pin define (Start >> End) | Wire (*Diameter*) | Turn (*Ts*) | Layers | Layers of Tape |
|---|---|---|---|---|---|
| WD1 | 3 >> 2 | 2UEW-B 0.27mm x 1P | 52 | 2 | 1Ts |
| WD2 | 6 >> 7 | 2UEW-B 0.15mm x 1P | 22 | 1 | 1Ts |
| WD3 | 7 >> Null | 2UEW-B 0.15mm x 1P | 22 | | |
| WD4 | FL1 >> FL2 | Triple wire-B 0.70mm x 1P | 8 | 1 | 2Ts |
| WD5 | 1 >> Null | 2UEW-B 0.20mm x 1P | 15 | 1 | 1Ts |
| WD6 | 2 >> 1 | 2UEW-B 0.27mm x 1P | 23 | 1 | 2Ts |
| | OVER CORE | | | | 3Ts |

| *Item* | *Test Condition* | *Rating* |
|---|---|---|
| Primary Inductance | Pin 3-1,all other windings open, measured at 20kHz / 1V | 750uH+/- 5% |
| | | |

## 3.4 Schematics Description

### 3.4.1 Fuse, EMI Filter and Rectifier

The Fuse F1 protects against over-current conditions which occur when some main components failed. The L2 is a common mode choke for the common mode noise suppression. The BD1 is a rectifier which converts alternating current and voltage into direct current and voltage. The C2, L1, C3 are composed of the Pi filter for filtering the differential switching noise back to AC source.

### 3.4.2 AP39303 Quasi-Resonant PWM Switcher

AP39303 is a highly integrated power switcher with a built-in Quasi-Resonant (QR) PWM controller and a 700V high performance Power MOSFET. With its high-voltage start-up circuitry, AP39303 provides an excellent green power solution. It also integrates a 120V VCC LDO circuitry and allows a wide voltage range of VCC_IN. This makes it a great choice in wide output voltage range application such as PD and QC.

### 3.4.3 APR347 Synchronous Rectification (SR) Controller

As a high performance solution, APR347 is a secondary side SR controller to effectively reduce the secondary side rectifier power dissipation which works in DCM operation.

### 3.4.4 AP43971 PD3.0 and QC2.0/3.0 Decoder

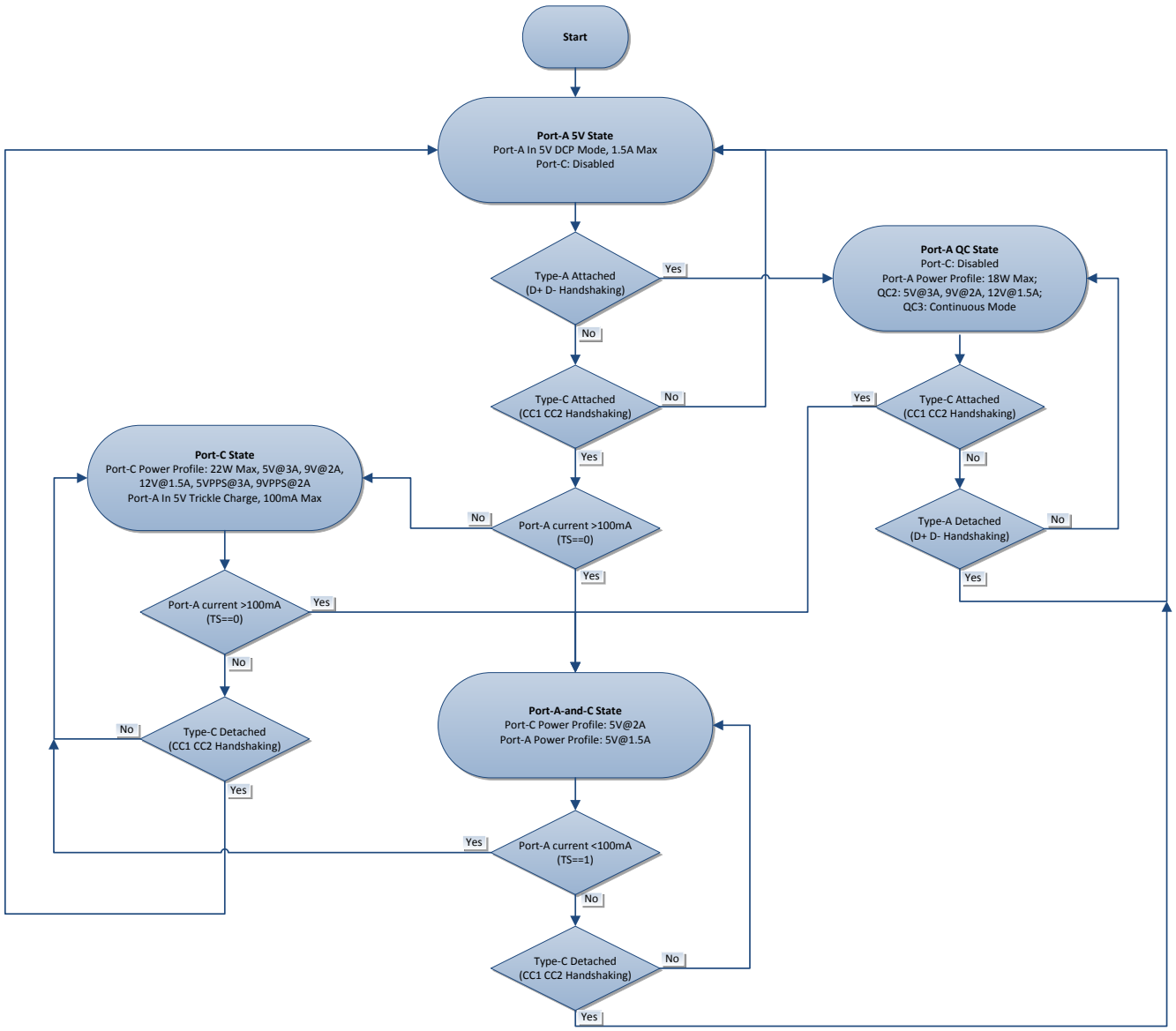
The following pins provide critical protocol decoding and regulation functions in AP43971:

1) **CC1 & CC2 (Pin 11, 10)**: CC1 & CC2 (Configuration Channel 1 & 2) are defined by USB PD spec to provide the channel communication link between power source and sink devices. The CC1& CC2 connected to Port-C and to perform PD3.0 power profile function.
2) **D+ & D- (Pin 13, 12):** While defined under USB PD for data transfer only, D+ and D- are used in QC4+ to provide voltage information and backward compatibility with QC2.0 and QC3.0 devices. The D+ & D- connected to Port-A and to perform QC2.0/QC3.0 power profile function.
3) **Constant Voltage (CV)**: The CV is implemented by sensing VCC (pin 3) via built-in resistor divider and compared with internal reference voltage. The output voltages can be adjusted by firmware programming.
4) **Constant Current (CC)**: The CC is implemented by sensing the current sense resistor (R30, 10mΩ, 1%, Low TCR) and compared with internal programmable reference voltage. The output current can be adjusted by firmware programming.
5) **Loop Compensation:** C32, R31 & C33 form the voltage loop compensation circuit, and C35, R32 & C34 form the current loop compensation circuit.
6) **OCDRV (Pin 5):** It is the key interface link from secondary decoder (AP43971) to primary regulation circuit (AP39303). It is connected to Opto-coupler U6 Pin 2 (Cathode) for feedback information based on all sensed CC1 & CC2, D+ & D- voltage status for getting desired $V_{BUS}$ voltage & current.
7) **GPIO1**: The pin is used to turn on the MOSFET_Q50 to bypass the LDO (U5), when Port-A output current is greater than 100mA.
8) **GPIO2**: The pin is used to turn on the MOSFET_Q52 to enable Port-A discharge function.
9) **GPIO-TS**: The pin connected to current sensing circuit output (U4_pin#1) to detection the Port-A output current. When Port-A output current greater than 100mA, the GPIO-TS is LOW, the Q50 turns on to bypass LDO_U5. The adapter exits 100mA trickle-charge mode and Port-A is capable of providing current greater than 100mA.

### 3.5 Dual Port Power/Current Sharing Control Flowchart

After AC power plugged in, the adapter starts up and enters into default “Port-A 5V State”. In this state, the adapter can provide 5V output to Port-A with less than 1.5A capability, while Port-C is disabled. The adapter remains in this mode until either Port-A handshake through D+/D- for QC or Port-C handshake through CC1/CC2 for PD occurs. If Port-A for QC mode request passes, the adapter enters into “Port-A QC State” and provides up to 18W for QC2.0 or QC3.0 operation through Port-A. If Port-C for PD mode request passes, the adapter further checks if Port-A consumes more than 100mA of current. If so, the adapter enters into “Port-A-and-C state” and provides only 5V to both Port-A with 1.5A and Port-C with 2.0A. Otherwise, the adapter enters in to “Port-C State” and provides up to 18W for PD3.0 operation through Port-C and 5V@100mA for trickle charge through Port-A. The adapter will follow the mode operation described in the flowchart for operation mode change.

Detection of Port-A load is executed by sensing current drawn from Type A receptacle (A_GND pin). Once Port-A output current is greater than 100mA, AZV831 comparator pulls GPIO_TS pin LOW to notify the embedded MCU of AP43971_20L for proper operation mode change.



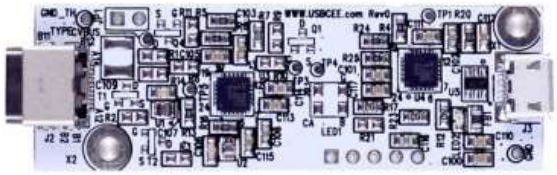
# Chapter 4. Evaluation Board Connections

## 4.1 Quick Start Guide Before Connection

1) Before starting the EVB test, the end user needs to prepare the following tool, software and manuals.

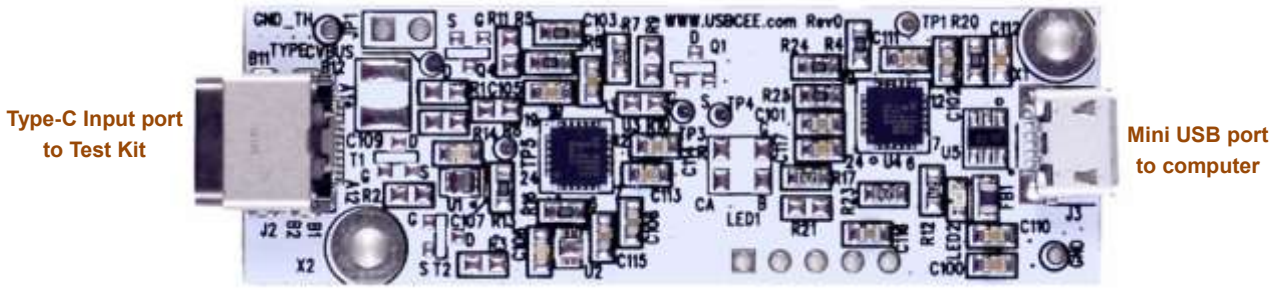
   For details, please contact Canyon Semiconductor local sales for further information.

   - USBCEE PD3.0 Test Kit: USBCEE Power Adapter Tester. https://www.usbcee.com/product-details/4

| USBCEE PAT Tester | GUI Display |
|---|---|
|  |  |



2) Prepare a certified Type-C cable and a Standard-A to Micro-B Cable.
3) Connect the input AC L & N wires to AC power supply output “L and N “wires.
4) Ensure that the AC source is switched OFF or disconnected before the connection steps.
5) Use a type-C cable for the connection between EVB to Tester.
6) Apply E-load at the terminal “JP1” on tester which indicated in figure below.
7) A Standard-A to Micro-B cable to be connected to the Cypress test kit’s Micro-B receptacle & PC Standard-A receptacle respectively.




**The Test Kit Input & Output and E-load Connections**

### 4.2 Connection with E-Load

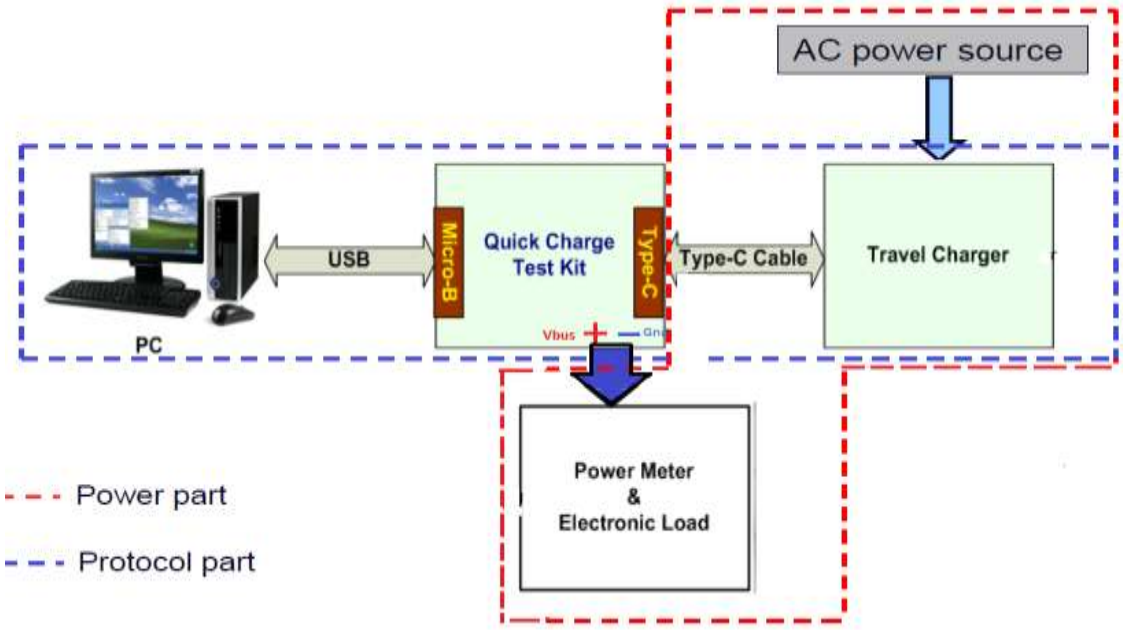
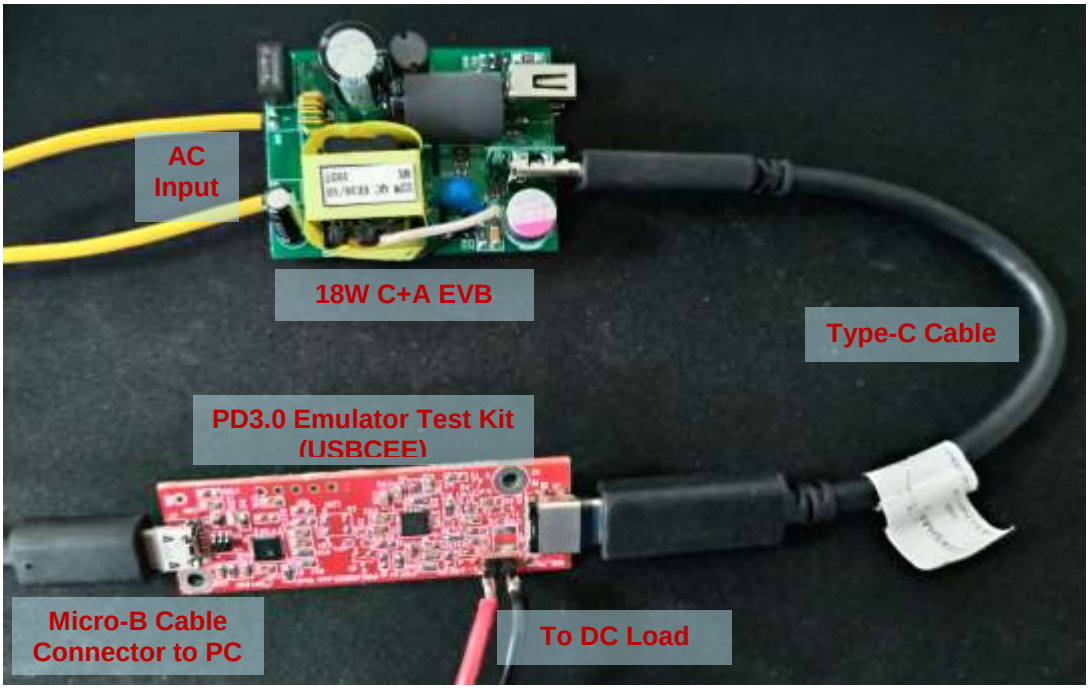



**Diagram of Connections in the Sample Board**

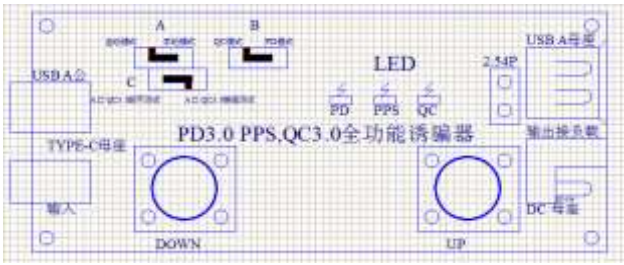



**Wire Connection of Port-C of 18W EVB to Test Kit and PC Computer**

### 4.3 QC2.0/3.0 Emulator connection

Or using the QC2.0/QC3.0 emulator test Kit to testing the QC2.0 & QC3.0 functions, see the connection the between testing sample board to DC load by mean of a USB-C to USB A converting cable.


**Port-A Connected to QC2.0/3.0 Test Kit**




**QC2.0/3.0 Emulator Test Kit**

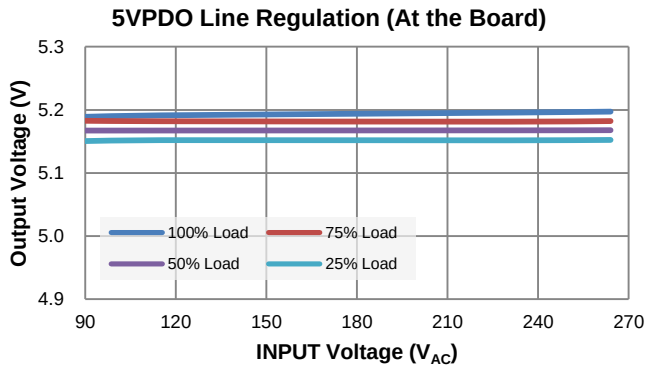
# Chapter 5. Input & Output Characteristics

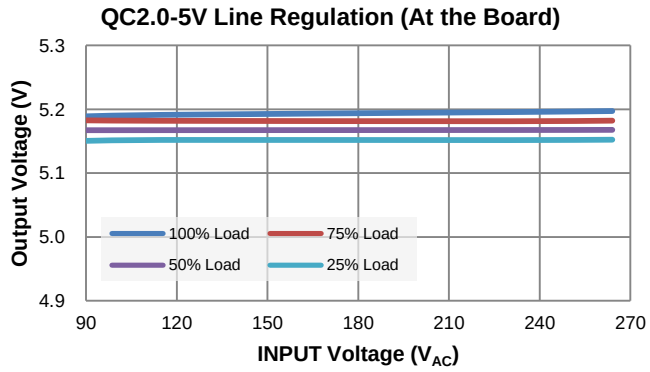
## 5.1 Input Standby Power

| $V_{IN}$ | $V_{OUT}$ | $P_{IN}$ |
|---|---|---|
| **90$V_{AC}$/47Hz** | 5.14V | 41.8mW |
| **115$V_{AC}$/60Hz** | 5.14V | 56.3mW |
| **230$V_{AC}$/50Hz** | 5.14V | 45.5mW |
| **264$V_{AC}$/63Hz** | 5.14V | 48.4mW |

## 5.2 Output Voltage Regulation Performance Curve

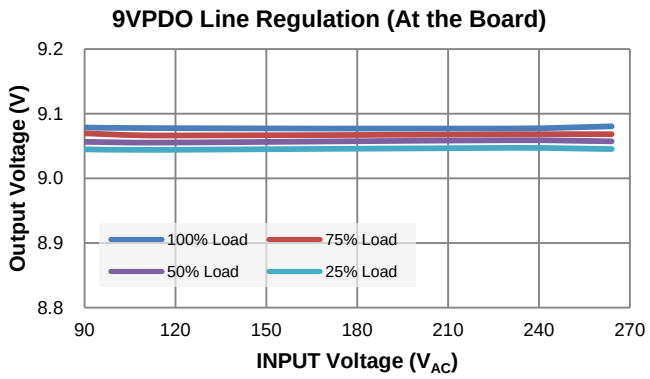
| Port-C PDO 5V/3A Line Regulation (At the Board) | | | | | Port-A QC2.0-5V/3A Line Regulation (At the Board) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **VIN** | **$V_{OUT\_100\%}$** | **$V_{OUT\_75\%}$** | **$V_{OUT\_50\%}$** | **$V_{OUT\_25\%}$** | **VIN** | **$V_{OUT\_100\%}$** | **$V_{OUT\_75\%}$** | **$V_{OUT\_50\%}$** | **$V_{OUT\_25\%}$** |
| **90$V_{AC}$/47Hz** | 5.19V | 5.18V | 5.17V | 5.14V | **90$V_{AC}$/47Hz** | 5.05V | 5.07V | 5.07V | 5.08V |
| **115$V_{AC}$/60Hz** | 5.19V | 5.18V | 5.17V | 5.15V | **115$V_{AC}$/60Hz** | 5.05V | 5.07V | 5.07V | 5.08V |
| **230$V_{AC}$/50Hz** | 5.20V | 5.18V | 5.17V | 5.15V | **230$V_{AC}$/50Hz** | 5.06V | 5.06V | 5.07V | 5.08V |
| **264$V_{AC}$/63Hz** | 5.20V | 5.18V | 5.17V | 5.15V | **264$V_{AC}$/63Hz** | 5.06V | 5.06V | 5.08V | 5.08V |

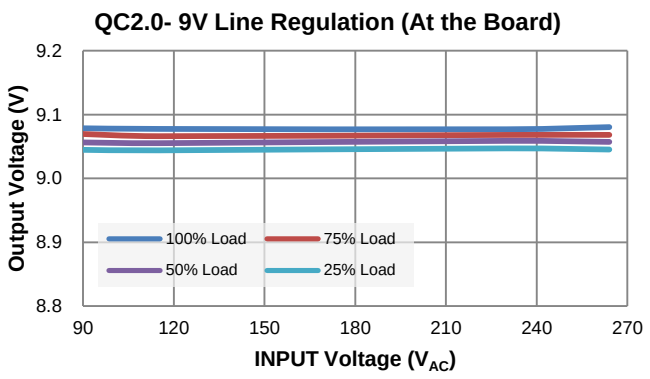


| Port-C PDO 9V/2A Line Regulation (At the Board) | | | | |
|---|---|---|---|---|
| VIN | $V_{OUT\_100\%}$ | $V_{OUT\_75\%}$ | $V_{OUT\_50\%}$ | $V_{OUT\_25\%}$ |
| **90$V_{AC}$/47Hz** | 9.07V | 9.07V | 9.07V | 9.07V |
| **115$V_{AC}$/60Hz** | 9.06V | 9.06V | 9.06V | 9.07V |
| **230$V_{AC}$/50Hz** | 9.06V | 9.06V | 9.07V | 9.07V |
| **264$V_{AC}$/63Hz** | 9.06V | 9.07V | 9.07V | 9.07V |

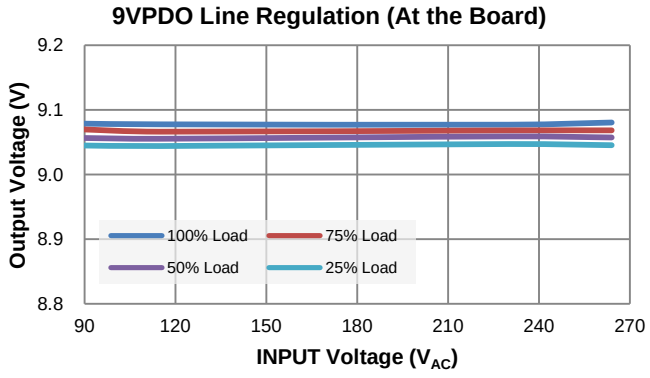
| Port-A QC2.0-9V/2A Line Regulation (At the Board) | | | | |
|---|---|---|---|---|
| VIN | $V_{OUT\_100\%}$ | $V_{OUT\_75\%}$ | $V_{OUT\_50\%}$ | $V_{OUT\_25\%}$ |
| **90$V_{AC}$/47Hz** | 8.93V | 8.94V | 8.95V | 8.95V |
| **115$V_{AC}$/60Hz** | 8.94V | 8.94V | 8.95V | 8.95V |
| **230$V_{AC}$/50Hz** | 8.94V | 8.94V | 8.95V | 8.95V |
| **264$V_{AC}$/63Hz** | 8.94V | 8.94V | 8.95V | 8.95V |

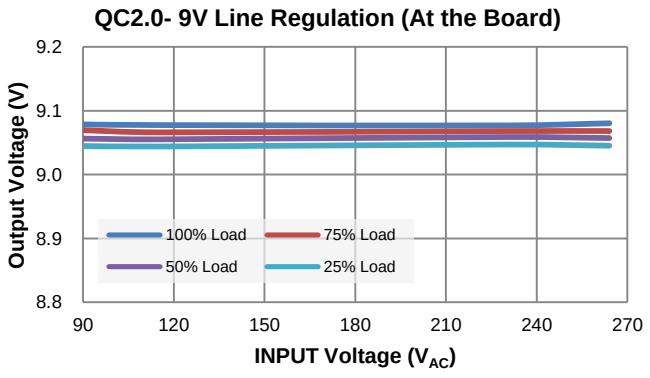



| Port-C PDO 12V/1.5A Line Regulation (At the Board) | | | | |
|---|---|---|---|---|
| VIN | $V_{OUT\_100\%}$ | $V_{OUT\_75\%}$ | $V_{OUT\_50\%}$ | $V_{OUT\_25\%}$ |
| **90$V_{AC}$/47Hz** | 12.08V | 12.07V | 12.06V | 12.05V |
| **115$V_{AC}$/60Hz** | 12.08V | 12.07V | 12.06V | 12.05V |
| **230$V_{AC}$/50Hz** | 12.08V | 12.07V | 12.06V | 12.05V |
| **264$V_{AC}$/63Hz** | 12.08V | 12.07V | 12.06V | 12.05V |

| Port-A QC2.0-12V/1.5A Line Regulation (At the Board) | | | | |
|---|---|---|---|---|
| VIN | $V_{OUT\_100\%}$ | $V_{OUT\_75\%}$ | $V_{OUT\_50\%}$ | $V_{OUT\_25\%}$ |
| **90$V_{AC}$/47Hz** | 11.88V | 11.88V | 11.89V | 11.89V |
| **115$V_{AC}$/60Hz** | 11.88V | 11.88V | 11.88V | 11.89V |
| **230$V_{AC}$/50Hz** | 11.88V | 11.88V | 11.88V | 11.89V |
| **264$V_{AC}$/63Hz** | 11.88V | 11.88V | 11.88V | 11.89V |

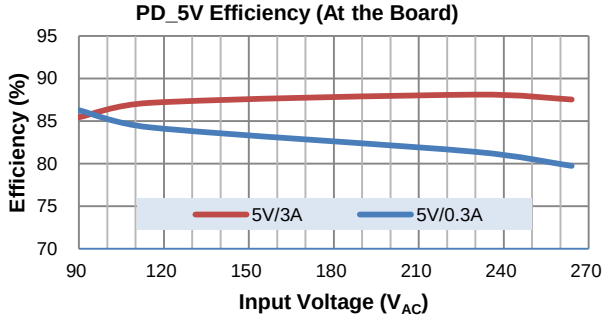


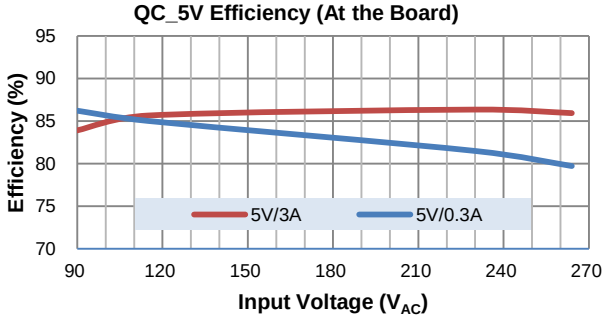
## 5.3 Efficiency vs. AC Line Input Voltage

| Port-C Efficiency (At the Board) | | | | | Port-A QC2.0_5V Efficiency (At the Board) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $V_{IN}$ | $V_{OUT}$ | $I_{OUT}$ | $P_{IN}$ | Efficiency | $V_{IN}$ | $V_{OUT}$ | $I_{OUT}$ | $P_{IN}$ | Efficiency |
| $90V_{AC}$/60Hz | 5.19V | 3.00 | 18.24 W | 85.4% | $90V_{AC}$/60Hz | 5.05V | 3.00 | 18.05 W | 83.9% |
| | 5.14V | 0.30 | 1.79 W | 86.3% | | 5.09V | 0.30 | 1.77 W | 86.2% |
| $110V_{AC}$/60Hz | 5.19V | 3.00 | 17.90 W | 87.1% | $110V_{AC}$/60Hz | 5.05V | 3.00 | 17.69 W | 85.7% |
| | 5.14V | 0.30 | 1.83 W | 84.3% | | 5.09V | 0.30 | 1.79 W | 85.0% |
| $230V_{AC}$/50Hz | 5.20V | 3.00 | 17.72 W | 88.1% | $230V_{AC}$/50Hz | 5.06V | 3.00 | 17.56 W | 86.3% |
| | 5.14V | 0.30 | 1.89 W | 81.4% | | 5.09V | 0.30 | 1.87 W | 81.5% |
| $264V_{AC}$/50Hz | 5.20V | 3.00 | 17.80 W | 87.5% | $264V_{AC}$/50Hz | 5.06V | 3.00 | 17.64 W | 85.9% |
| | 5.15V | 0.30 | 1.93 W | 79.7% | | 5.09V | 0.30 | 1.91 W | 79.7% |

PD_5V Efficiency (At the Board)

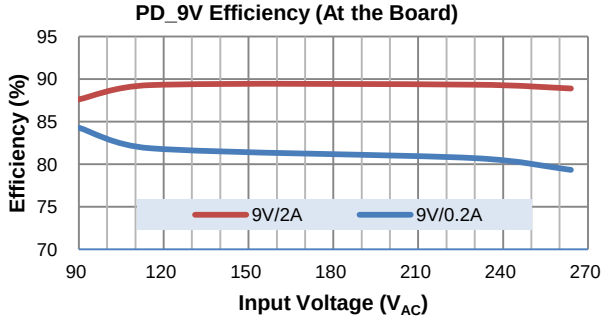



QC_5V Efficiency (At the Board)

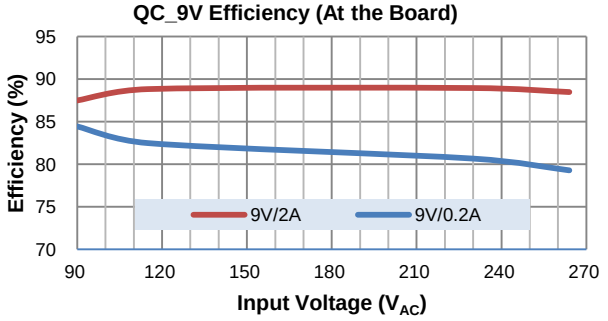



| Port-C Efficiency (At the Board) | | | | | Port-A QC_9V Efficiency (At the Board) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $V_{IN}$ | $V_{OUT}$ | $I_{OUT}$ | $P_{IN}$ | Efficiency | $V_{IN}$ | $V_{OUT}$ | $I_{OUT}$ | $P_{IN}$ | Efficiency |
| $90V_{AC}$/60Hz | 9.08V | 2.00 | 20.73 W | 87.6% | $90V_{AC}$/60Hz | 8.93V | 2.00 | 20.41 W | 87.5% |
| | 9.04V | 0.20 | 2.15 W | 84.3% | | 8.95V | 0.20 | 2.11 W | 84.4% |
| $110V_{AC}$/60Hz | 9.08V | 2.00 | 20.34 W | 89.3% | $110V_{AC}$/60Hz | 8.94V | 2.00 | 20.11 W | 88.8% |
| | 9.04V | 0.20 | 2.22 W | 81.9% | | 8.96V | 0.20 | 2.17 W | 82.5% |
| $230V_{AC}$/50Hz | 9.08V | 2.00 | 20.33 W | 89.3% | $230V_{AC}$/50Hz | 8.94V | 2.00 | 20.08 W | 88.9% |
| | 9.04V | 0.20 | 2.26 W | 80.7% | | 8.96V | 0.20 | 2.21 W | 80.7% |
| $264V_{AC}$/50Hz | 9.08V | 2.00 | 20.44 W | 88.9% | $264V_{AC}$/50Hz | 8.94V | 2.00 | 20.19 W | 88.5% |
| | 9.04V | 0.20 | 2.29 W | 79.3% | | 8.96V | 0.20 | 2.25 W | 79.3% |

PD_9V Efficiency (At the Board)

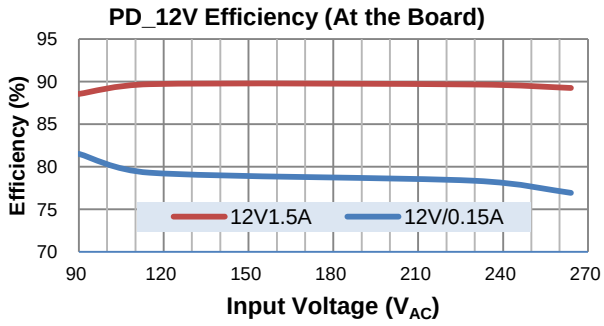


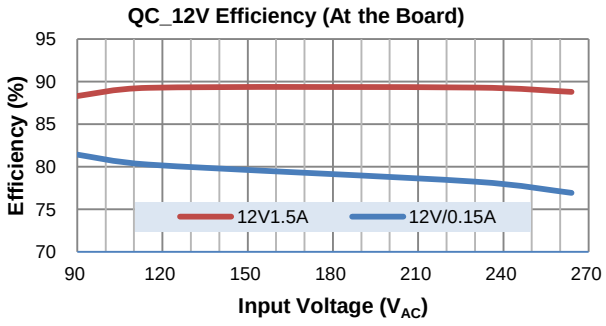

QC_9V Efficiency (At the Board)



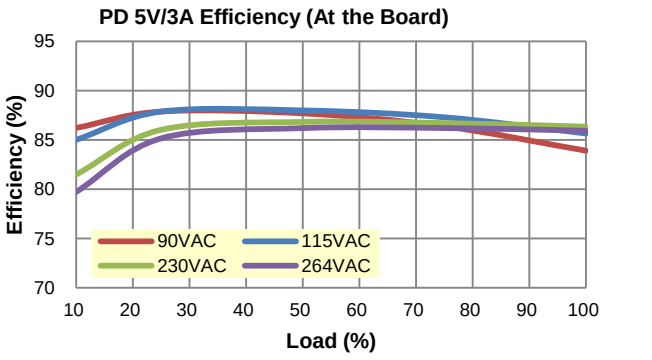

| Port-C Efficiency (At the Board) | Port-A QC_12V Efficiency (At the Board) |
|---|---|

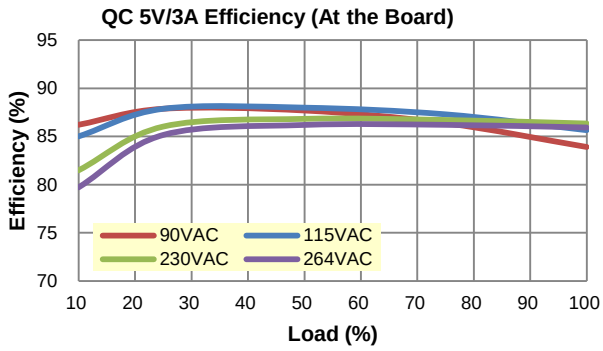
| $V_{IN}$ | $V_{OUT}$ | $I_{OUT}$ | $P_{IN}$ | Efficiency | $V_{IN}$ | $V_{OUT}$ | $I_{OUT}$ | $P_{IN}$ | Efficiency |
|---|---|---|---|---|---|---|---|---|---|
| **90$V_{AC}$/60Hz** | 12.08V | 1.50 | 20.48 W | 88.5% | **90$V_{AC}$/60Hz** | 11.88V | 1.50 | 20.17 W | 88.3% |
| | 12.05V | 0.15 | 2.22 W | 81.5% | | 11.89V | 0.15 | 2.18 W | 81.4% |
| **110$V_{AC}$/60Hz** | 12.08V | 1.50 | 20.20 W | 89.7% | **110$V_{AC}$/60Hz** | 11.88V | 1.50 | 19.95 W | 89.3% |
| | 12.05V | 0.15 | 2.28 W | 79.3% | | 11.89V | 0.15 | 2.21 W | 80.3% |
| **230$V_{AC}$/50Hz** | 12.08V | 1.50 | 20.21 W | 89.6% | **230$V_{AC}$/50Hz** | 11.88V | 1.50 | 19.95 W | 89.3% |
| | 12.05V | 0.15 | 2.31 W | 78.4% | | 11.89V | 0.15 | 2.27 W | 78.3% |
| **264$V_{AC}$/50Hz** | 12.08V | 1.50 | 20.30 W | 89.2% | **264$V_{AC}$/50Hz** | 11.88V | 1.50 | 20.06 W | 88.8% |
| | 12.05V | 0.15 | 2.34 W | 76.9% | | 11.89V | 0.15 | 2.31 W | 76.9% |

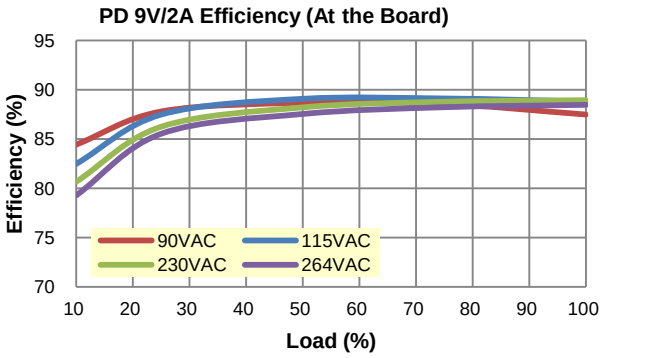


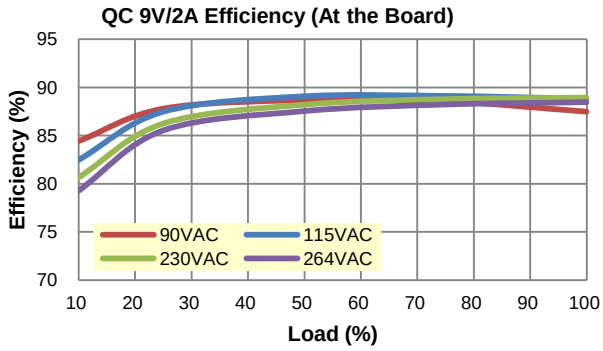



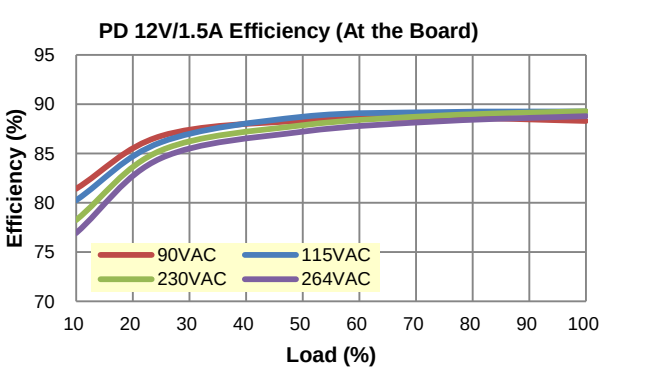
## 5.4 Efficiency vs. Output Load

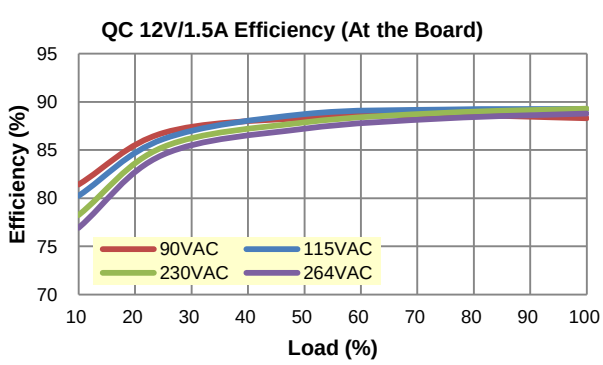


## 5.5 Average Efficiency at Different Loading

### 5.5.1 Port-C Average Efficiency

Port-C PD3.0_PDO_5V / 3A Average Efficiency

| $V_{IN}$ | $I_{OUT}$ | | $V_{OUT}$ | $P_{IN}$ | $P_{OUT}$ | Efficiency | Average Efficiency | CoC Tier 2 required |
|---|---|---|---|---|---|---|---|---|
| 115$V_{AC}$/60Hz | 100.0% | 3.00A | 5.19V | 17.90W | 15.60W | 87.1% | 88.19% | 81.84% |
| | 75.0% | 2.25A | 5.18V | 13.17W | 11.66W | 88.5% | | |
| | 50.0% | 1.50A | 5.17V | 8.74W | 7.76W | 88.8% | | |
| | 25.0% | 0.75A | 5.15V | 4.38W | 3.87W | 88.3% | | |
| | 10.0% | 0.30A | 5.14V | 1.83W | 1.54W | 84.3% | | 72.48% |
| 230$V_{AC}$/50Hz | 100.0% | 3.00A | 5.20V | 17.72W | 15.61W | 88.1% | 87.56% | 81.84% |
| | 75.0% | 2.25A | 5.18V | 13.24W | 11.65W | 88.0% | | |
| | 50.0% | 1.50A | 5.17V | 8.83W | 7.75W | 87.7% | | |
| | 25.0% | 0.75A | 5.15V | 4.47W | 3.86W | 86.4% | | |
| | 10.0% | 0.30A | 5.14V | 1.89W | 1.54W | 81.4% | | 72.48% |

Port-C PD3.0_PDO_9V / 2A Average Efficiency

| $V_{IN}$ | $I_{OUT}$ | | $V_{OUT}$ | $P_{IN}$ | $P_{OUT}$ | Efficiency | Average Efficiency | CoC Tier 2 required |
|---|---|---|---|---|---|---|---|---|
| 115$V_{AC}$/60Hz | 100.0% | 2.00A | 9.08V | 20.34W | 18.16W | 89.3% | 89.03% | 81.84% |
| | 75.0% | 1.50A | 9.07V | 15.23W | 13.61W | 89.4% | | |
| | 50.0% | 1.00A | 9.06V | 10.16W | 9.07W | 89.2% | | |
| | 25.0% | 0.50A | 9.04V | 5.13W | 4.53W | 88.2% | | |
| | 10.0% | 0.20A | 9.04V | 2.22W | 1.82W | 81.9% | | 72.48% |
| 230$V_{AC}$/50Hz | 100.0% | 2.00A | 9.08V | 20.33W | 18.16W | 89.3% | 88.27% | 81.84% |
| | 75.0% | 1.50A | 9.07V | 15.29W | 13.61W | 89.1% | | |
| | 50.0% | 1.00A | 9.06V | 10.27W | 9.07W | 88.3% | | |
| | 25.0% | 0.50A | 9.05V | 5.25W | 4.54W | 86.3% | | |
| | 10.0% | 0.20A | 9.04V | 2.26W | 1.82W | 80.7% | | 72.48% |

Port-C PD3.0_PDO_12V / 1.5A Average Efficiency

| $V_{IN}$ | $I_{OUT}$ | | $V_{OUT}$ | $P_{IN}$ | $P_{OUT}$ | Efficiency | Average Efficiency | CoC Tier 2 required |
|---|---|---|---|---|---|---|---|---|
| 115$V_{AC}$/60Hz | 100.0% | 1.50A | 12.08V | 20.20W | 18.12W | 89.7% | 88.66% | 81.84% |
| | 75.0% | 1.13A | 12.07V | 15.17W | 13.58W | 89.5% | | |
| | 50.0% | 0.75A | 12.06V | 10.17W | 9.05W | 89.0% | | |
| | 25.0% | 0.38A | 12.05V | 5.23W | 4.53W | 86.5% | | |
| | 10.0% | 0.15A | 12.05V | 2.28W | 1.81W | 79.3% | | 72.48% |
| 230$V_{AC}$/50Hz | 100.0% | 1.50A | 12.08V | 20.21W | 18.12W | 89.6% | 88.06% | 81.84% |
| | 75.0% | 1.13A | 12.07V | 15.24W | 13.58W | 89.1% | | |
| | 50.0% | 0.75A | 12.06V | 10.27W | 9.04W | 88.0% | | |
| | 25.0% | 0.38A | 12.05V | 5.30W | 4.53W | 85.4% | | |
| | 10.0% | 0.15A | 12.05V | 2.31W | 1.81W | 78.4% | | 72.48% |

### 5.5.2 Port-A Average Efficiency

Port-A_QC2.0_5V / 3A Average Efficiency

| $V_{IN}$ | $I_{OUT}$ | | $V_{OUT}$ | $P_{IN}$ | $P_{OUT}$ | Efficiency | Average Efficiency | CoC Tier 2 required |
|---|---|---|---|---|---|---|---|---|
| 115$V_{AC}$/60Hz | 100.0% | 3.00A | 5.05V | 17.69W | 15.15W | 85.7% | 87.2% | 85.45% |
| | 75.0% | 2.25A | 5.07V | 13.05W | 11.39W | 87.3% | | |
| | 50.0% | 1.50A | 5.07V | 8.65W | 7.61W | 88.0% | | |
| | 25.0% | 0.75A | 5.08V | 4.33W | 3.81W | 87.9% | | |
| | 10.0% | 0.30A | 5.09V | 1.79W | 1.52W | 85.0% | | 72.48% |
| 230$V_{AC}$/50Hz | 100.0% | 3.00A | 5.06V | 17.56W | 15.16W | 86.3% | 86.48% | 85.45% |
| | 75.0% | 2.25A | 5.06V | 13.14W | 11.39W | 86.7% | | |
| | 50.0% | 1.50A | 5.07V | 8.76W | 7.61W | 86.8% | | |
| | 25.0% | 0.75A | 5.08V | 4.43W | 3.81W | 86.0% | | |
| | 10.0% | 0.30A | 5.09V | 1.87W | 1.52W | 81.5% | | 72.48% |

Port-A_QC2.0_9V / 2A Average Efficiency

| $V_{IN}$ | $I_{OUT}$ | | $V_{OUT}$ | $P_{IN}$ | $P_{OUT}$ | Efficiency | Average Efficiency | CoC Tier 2 required |
|---|---|---|---|---|---|---|---|---|
| 115$V_{AC}$/60Hz | 100.0% | 2.00A | 8.94V | 20.11W | 17.86W | 88.8% | 88.62% | 85.45% |
| | 75.0% | 1.50A | 8.94V | 15.05W | 13.41W | 89.1% | | |
| | 50.0% | 1.00A | 8.95V | 10.04W | 8.94W | 89.1% | | |
| | 25.0% | 0.50A | 8.95V | 5.11W | 4.47W | 87.5% | | |
| | 10.0% | 0.20A | 8.96V | 2.17W | 1.79W | 82.5% | | 72.48% |
| 230$V_{AC}$/50Hz | 100.0% | 2.00A | 8.94V | 20.08W | 17.86W | 88.9% | 88.05% | 85.45% |
| | 75.0% | 1.50A | 8.94V | 15.10W | 13.41W | 88.8% | | |
| | 50.0% | 1.00A | 8.95V | 10.14W | 8.94W | 88.2% | | |
| | 25.0% | 0.50A | 8.95V | 5.18W | 4.47W | 86.3% | | |
| | 10.0% | 0.20A | 8.96V | 2.21W | 1.79W | 80.7% | | 72.48% |

Port-A_QC2.0_12V / 1.5A Average Efficiency

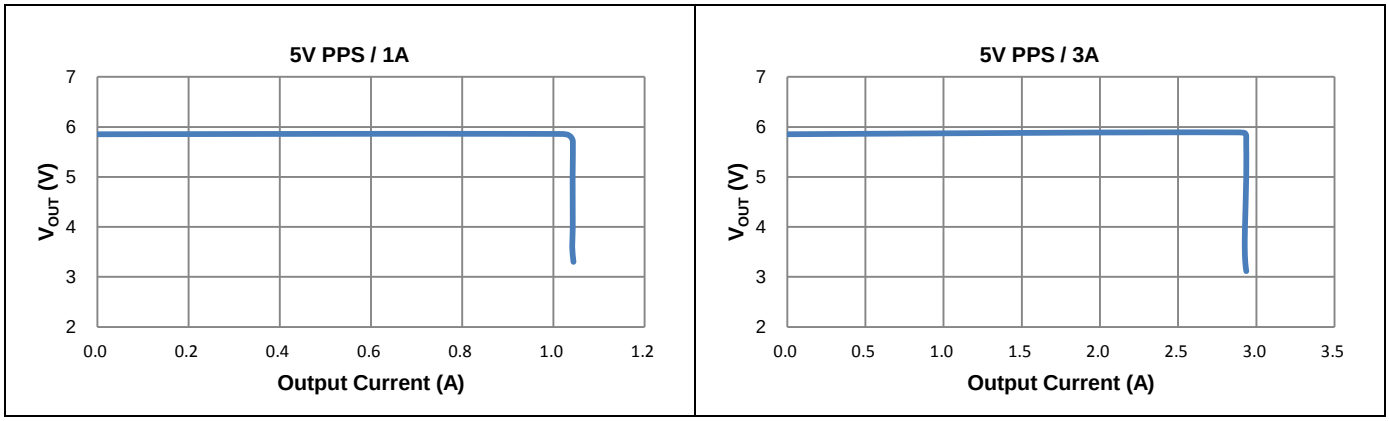
| $V_{IN}$ | $I_{OUT}$ | | $V_{OUT}$ | $P_{IN}$ | $P_{OUT}$ | Efficiency | Average Efficiency | CoC Tier 2 required |
|---|---|---|---|---|---|---|---|---|
| 115$V_{AC}$/60Hz | 100.0% | 1.50A | 11.88V | 19.95W | 17.81W | 89.3% | 88.33% | 85.45% |
| | 75.0% | 1.12A | 11.88V | 14.98W | 13.36W | 89.2% | | |
| | 50.0% | 0.75A | 11.88V | 10.04W | 8.91W | 88.7% | | |
| | 25.0% | 0.37A | 11.89V | 5.17W | 4.46W | 86.1% | | |
| | 10.0% | 0.15A | 11.89V | 2.21W | 1.78W | 80.3% | | 72.48% |
| 230$V_{AC}$/50Hz | 100.0% | 1.50A | 11.88V | 19.95W | 17.81W | 89.3% | 87.83% | 85.45% |
| | 75.0% | 1.12A | 11.88V | 15.03W | 13.36W | 88.9% | | |
| | 50.0% | 0.75A | 11.88V | 10.14W | 8.91W | 87.9% | | |
| | 25.0% | 0.37A | 11.89V | 5.22W | 4.45W | 85.3% | | |
| | 10.0% | 0.15A | 11.89V | 2.27W | 1.78W | 78.3% | | 72.48% |

## 5.6 PD3.0 & PPS Compatible Mode Testing

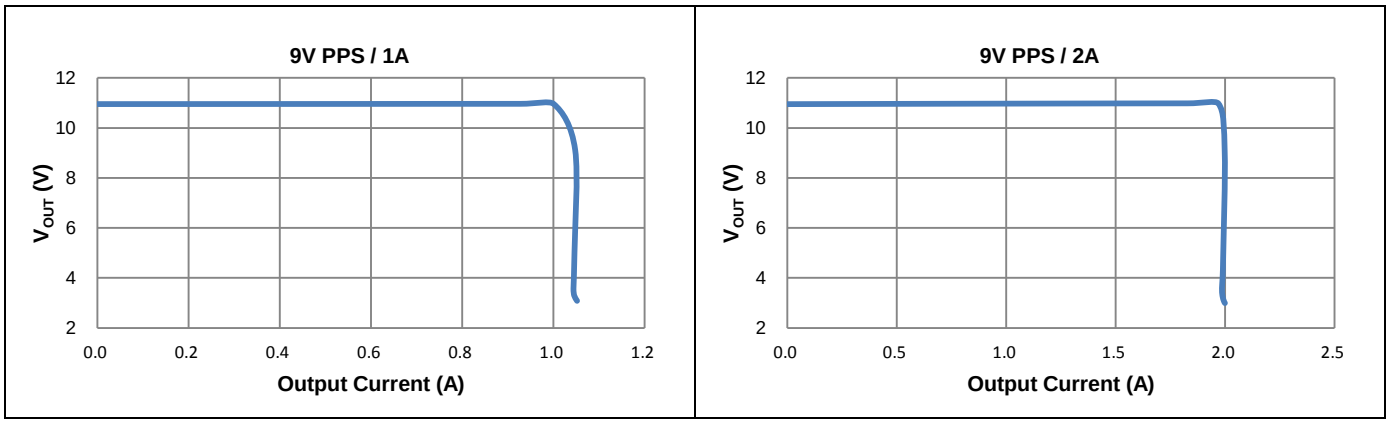
### 5.6.1 CC Mode current limitation function testing

The test is by USBCEE Tester and with E-Load set at CR mode.

To Port-C PPS Mode set 5V-1A & 5V-3A and then increase the current (by reducing R) to see the CC-CV curve

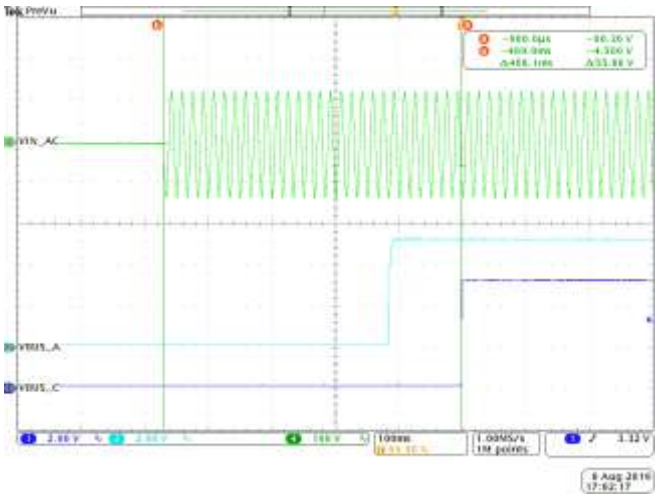



To Port-C PPS Mode set 9V-1A & 9V-2A and then increase the current (by reducing R) to see the CC-CV curve



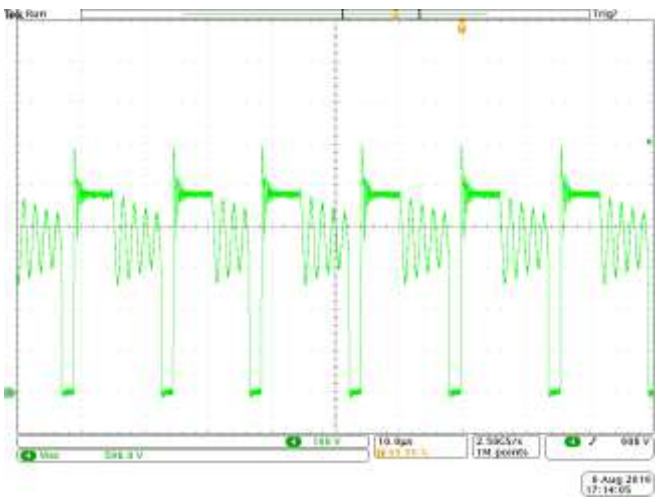
## 5.7 Key Performance Waveforms

### 5.7.1 EVB System Start-up Time

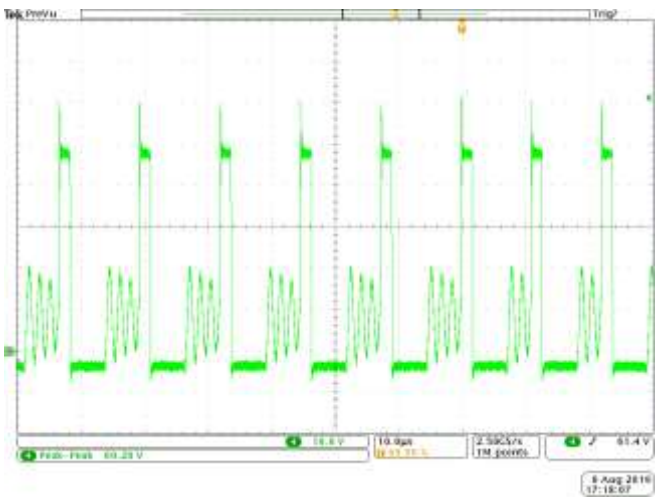


**Input: 90$V_{AC}$ / 60Hz**
**Start-up Time= 486.1ms**

### 5.7.2 VDS_U1 & Q2 MOSFET $V_{DS}$ Stress

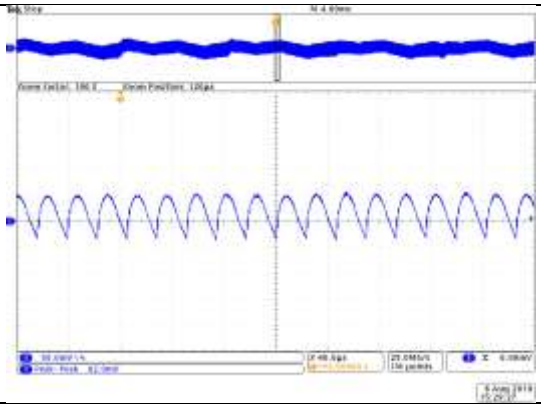
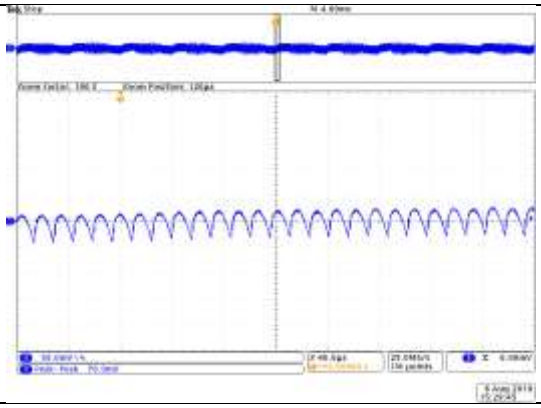
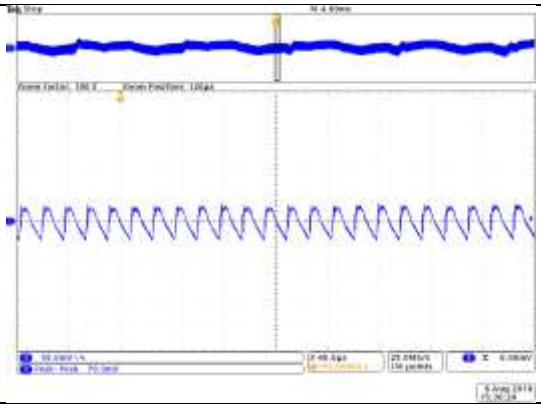
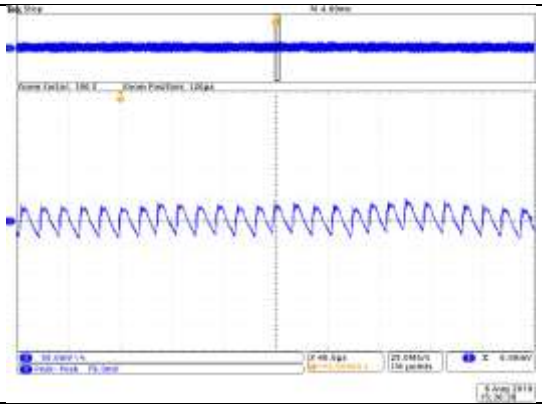
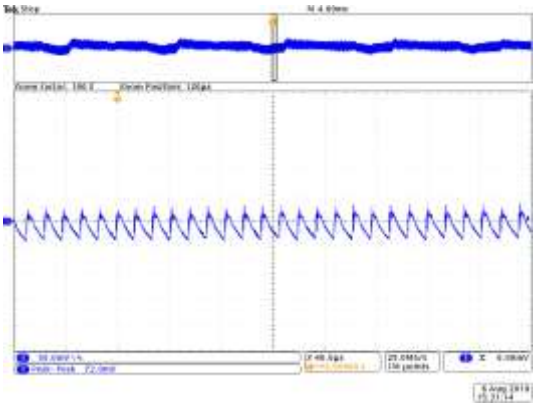
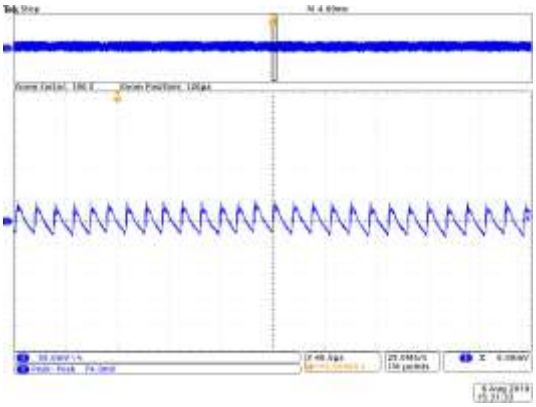


**Input: 264$V_{AC}$ / 60Hz**
**Output: 12V / 1.5A**
**Primary Side Switcher (VDS_U1) $V_{DS}$: 598$V_{MAX}$**

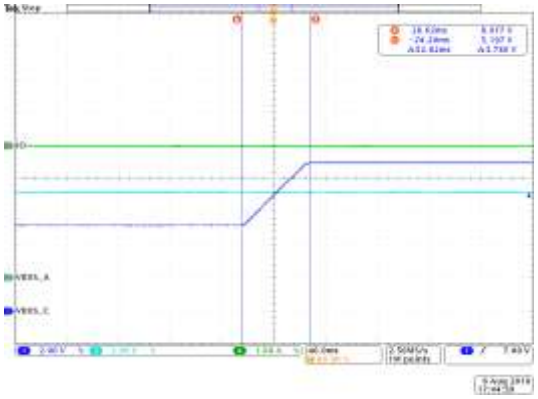


**Input: 264$V_{AC}$ / 60Hz**
**Output: 12V / 1.5A**
**Secondary Side SR MOSFET (Q2) $V_{DS}$: 69.2$V_{MAX}$**

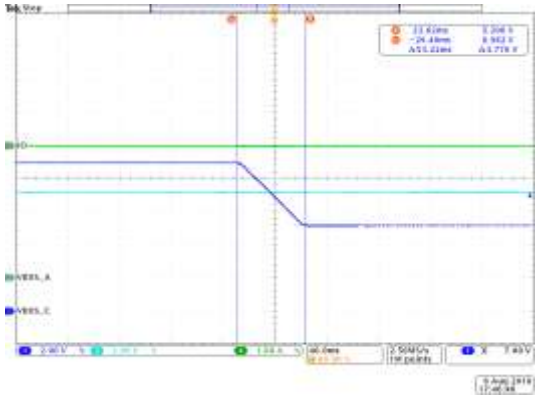
### 5.7.3 Output Ripple & Noise

| | |
|---|---|
|  |  |
| **Input: 90$V_{AC}$ / 60Hz, Output: 5V / 3A**<br>**Output Voltage Ripple Noise $V_{P-P}$: 92mV** | **Input: 264$V_{AC}$ / 60Hz, Output: 5V / 3A**<br>**Output Voltage Ripple Noise $V_{P-P}$: 70mV** |
|  |  |
| **Input: 90$V_{AC}$ / 60Hz, Output: 9V / 2A**<br>**Output Voltage Ripple Noise $V_{P-P}$: 70mV** | **Input: 264$V_{AC}$ / 60Hz, Output: 9V / 2A**<br>**Output Voltage Ripple Noise $V_{P-P}$: 78mV** |
|  |  |
| **Input: 90$V_{AC}$ / 60Hz, Output: 12V / 1.5A**<br>**Output Voltage Ripple Noise $V_{P-P}$: 72mV** | **Input: 264$V_{AC}$ / 60Hz, Output: 12V / 1.5A**<br>**Output Voltage Ripple Noise $V_{P-P}$: 74mV** |

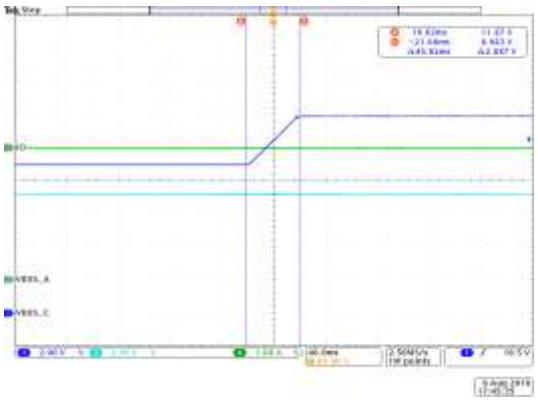
### 5.7.4 Output Voltage Transition Time



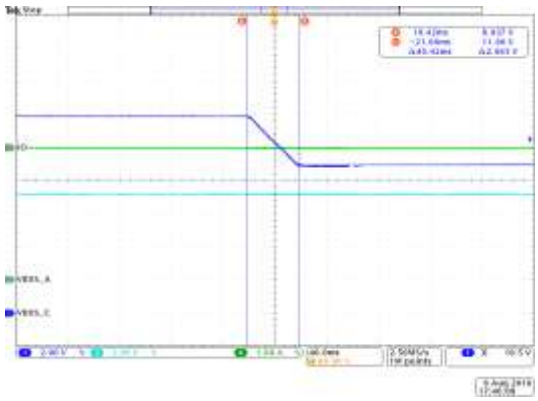
**Input: 115$V_{AC}$ / 60Hz, Output: 5V to 9V**
**Transition Time: 52.82ms**



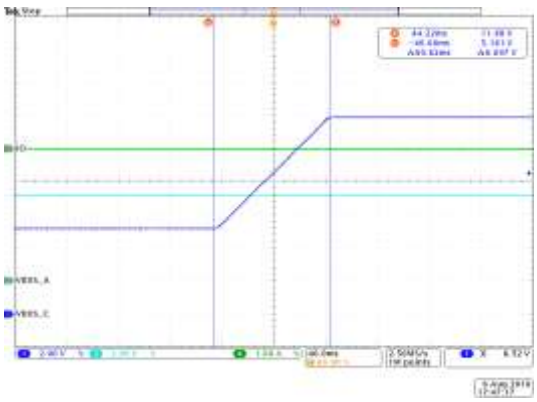
**Input: 115$V_{AC}$ / 60Hz, Output: 9V to 5V**
**Transition Time: 53.22ms**



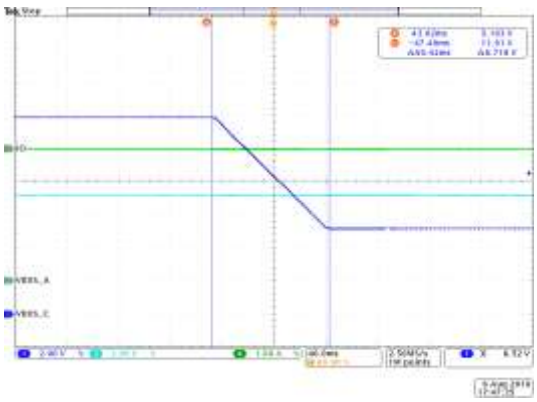
**Input: 115$V_{AC}$ / 60Hz, Output: 9V to 12V**
**Transition Time: 40.82ms**



**Input: 115$V_{AC}$ / 60Hz, Output: 12V to 9V**
**Transition Time: 40.42ms**



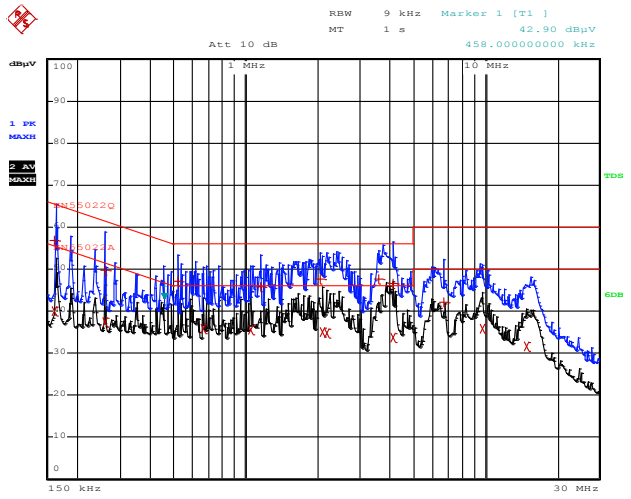
**Input: 115$V_{AC}$ / 60Hz, Output: 5V to 12V**
**Transition Time: 90.82ms**



**Input: 115$V_{AC}$ / 60Hz, Output: 12V to 5V**
**Transition Time: 90.42ms**

### 5.7.5 EMI (Conduction) Testing

**110V$_{AC}$/60Hz 12V/1.5A (L)**

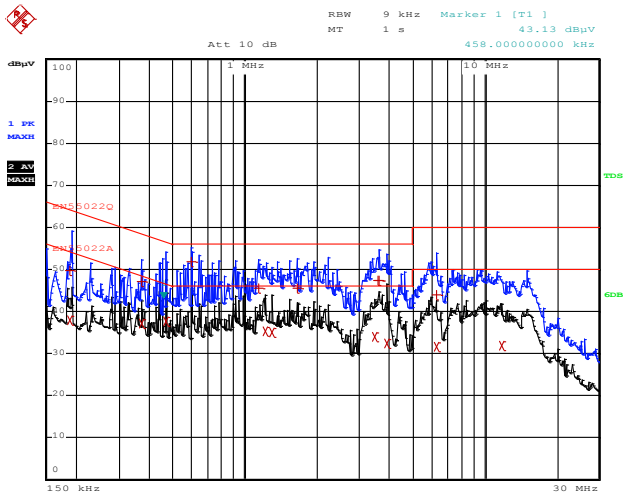



EDIT PEAK LIST (Final Measurement Results)

Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

| | TRACE | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 1 | Quasi Peak | 162 kHz | 56.74 | -8.61 |
| 2 | Average | 162 kHz | 39.96 | -15.39 |
| 1 | Quasi Peak | 258 kHz | 49.78 | -11.70 |
| 2 | Average | 258 kHz | 37.52 | -13.96 |
| 1 | Quasi Peak | 518 kHz | 47.22 | -8.77 |
| 2 | Average | 662 kHz | 35.74 | -10.25 |
| 2 | Average | 1.054 MHz | 35.54 | -10.45 |
| 1 | Quasi Peak | 1.158 MHz | 45.80 | -10.19 |
| 1 | Quasi Peak | 2.054 MHz | 47.70 | -8.29 |
| 2 | Average | 2.098 MHz | 34.98 | -11.01 |
| 2 | Average | 2.19 MHz | 34.87 | -11.12 |
| 1 | Quasi Peak | 3.602 MHz | 47.51 | -8.48 |
| 1 | Quasi Peak | 4.138 MHz | 46.62 | -9.37 |
| 2 | Average | 4.138 MHz | 33.81 | -12.18 |
| 1 | Quasi Peak | 6.75 MHz | 42.24 | -17.75 |
| 2 | Average | 9.722 MHz | 35.71 | -14.28 |
| 2 | Average | 14.898 MHz | 31.75 | -18.24 |

**110V$_{AC}$/60Hz 12V/1.5A (N)**

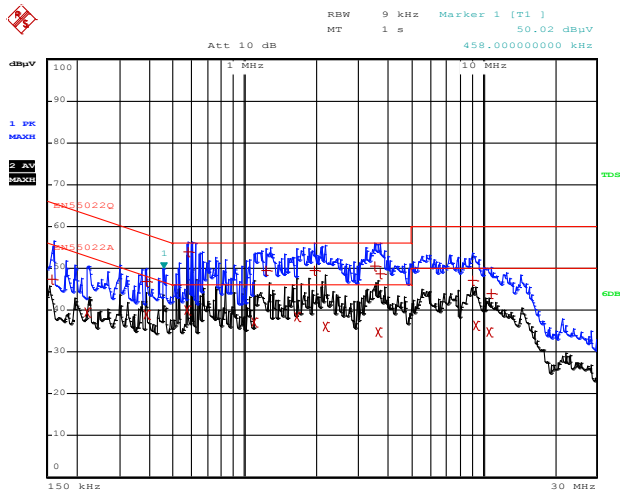



EDIT PEAK LIST (Final Measurement Results)

Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

| | TRACE | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 1 | Quasi Peak | 190 kHz | 49.82 | -14.21 |
| 2 | Average | 190 kHz | 37.87 | -16.16 |
| 1 | Quasi Peak | 370 kHz | 47.04 | -11.45 |
| 2 | Average | 370 kHz | 37.17 | -11.32 |
| 2 | Average | 466 kHz | 37.76 | -8.82 |
| 1 | Quasi Peak | 594 kHz | 51.92 | -4.07 |
| 1 | Quasi Peak | 1.146 MHz | 45.59 | -10.40 |
| 2 | Average | 1.218 MHz | 35.35 | -10.64 |
| 2 | Average | 1.294 MHz | 35.14 | -10.85 |
| 1 | Quasi Peak | 1.666 MHz | 45.48 | -10.51 |
| 2 | Average | 3.478 MHz | 33.92 | -12.08 |
| 1 | Quasi Peak | 3.602 MHz | 47.28 | -8.71 |
| 1 | Quasi Peak | 3.626 MHz | 47.27 | -8.72 |
| 2 | Average | 3.91 MHz | 32.45 | -13.54 |
| 1 | Quasi Peak | 6.298 MHz | 43.89 | -16.10 |
| 2 | Average | 6.298 MHz | 31.70 | -18.29 |
| 2 | Average | 11.79 MHz | 31.94 | -18.05 |

### 220V$_{AC}$/60Hz 12V/1.5A (L)

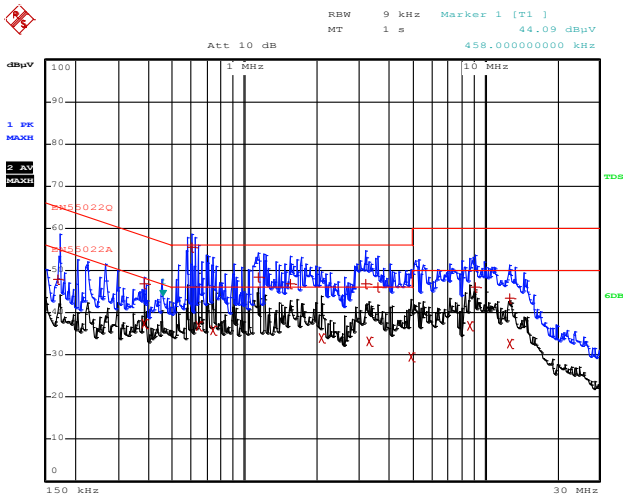



EDIT PEAK LIST (Final Measurement Results)

Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

| TRACE | | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 1 | Quasi Peak | 158 kHz | 47.48 | -18.07 |
| 2 | Average | 222 kHz | 39.53 | -13.20 |
| 1 | Quasi Peak | 386 kHz | 46.89 | -11.25 |
| 2 | Average | 386 kHz | 38.95 | -9.19 |
| 2 | Average | 574 kHz | 39.92 | -6.07 |
| 1 | Quasi Peak | 578 kHz | 53.95 | -2.04 |
| 2 | Average | 1.09 MHz | 37.04 | -8.95 |
| 1 | Quasi Peak | 1.234 MHz | 49.45 | -6.54 |
| 2 | Average | 1.658 MHz | 38.49 | -7.50 |
| 1 | Quasi Peak | 1.958 MHz | 49.42 | -6.57 |
| 2 | Average | 2.186 MHz | 36.08 | -9.91 |
| 1 | Quasi Peak | 3.534 MHz | 50.59 | -5.40 |
| 2 | Average | 3.626 MHz | 34.85 | -11.14 |
| 1 | Quasi Peak | 3.698 MHz | 48.56 | -7.43 |
| 1 | Quasi Peak | 9.094 MHz | 47.03 | -12.96 |
| 2 | Average | 9.314 MHz | 36.37 | -13.62 |
| 2 | Average | 10.61 MHz | 34.75 | -15.24 |
| 1 | Quasi Peak | 10.858 MHz | 43.85 | -16.14 |

### 220V$_{AC}$/60Hz 12V/1.5A (N)




EDIT PEAK LIST (Final Measurement Results)

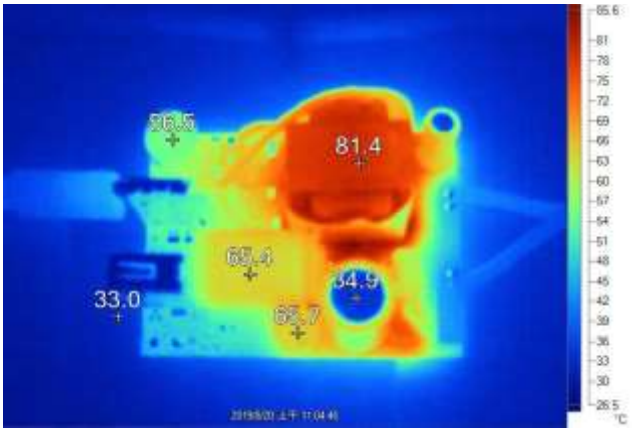
Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

| TRACE | | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 1 | Quasi Peak | 170 kHz | 47.85 | -17.10 |
| 1 | Quasi Peak | 382 kHz | 46.76 | -11.46 |
| 2 | Average | 382 kHz | 37.51 | -10.72 |
| 1 | Quasi Peak | 602 kHz | 55.45 | -0.54 |
| 2 | Average | 642 kHz | 36.75 | -9.24 |
| 2 | Average | 742 kHz | 35.91 | -10.08 |
| 1 | Quasi Peak | 1.142 MHz | 48.46 | -7.53 |
| 1 | Quasi Peak | 1.558 MHz | 46.79 | -9.20 |
| 2 | Average | 2.098 MHz | 33.99 | -12.00 |
| 1 | Quasi Peak | 3.218 MHz | 46.86 | -9.13 |
| 2 | Average | 3.302 MHz | 33.21 | -12.78 |
| 1 | Quasi Peak | 3.606 MHz | 46.06 | -9.94 |
| 2 | Average | 4.958 MHz | 29.43 | -16.56 |
| 2 | Average | 8.694 MHz | 36.76 | -13.24 |
| 1 | Quasi Peak | 9.13 MHz | 46.10 | -13.89 |
| 1 | Quasi Peak | 12.67 MHz | 43.33 | -16.66 |
| 2 | Average | 12.67 MHz | 32.55 | -17.44 |

### 5.7.7 Thermal Testing

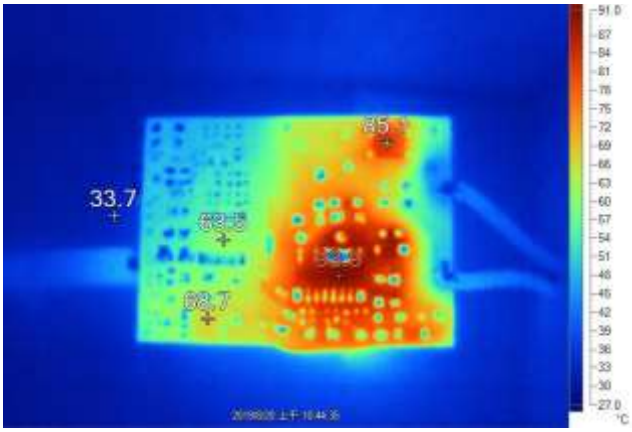
Test Condition: $V_O$=12V, $I_O$=1.5A, Set up the EVB into the closed box (120mm*7.5mm*6mm) at room temperature +25 °C

**90$V_{AC}$ 18W TOP Side**



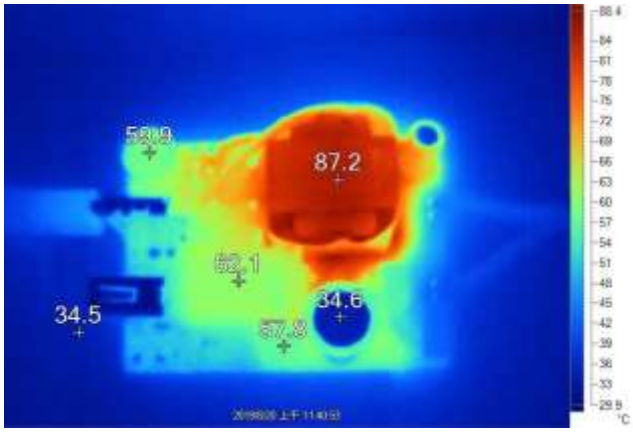

**Ambient Temperature -------- 33.0 °C**
**T1 (Transformer) ---------- 81.4 °C**
**L2 (DR6*8)) ---------- 65.7 °C**
**C2 (15uF/400V) ---------- 65.4 °C**
**C20 (680uF/16V) ----------56.5 °C**

**90$V_{AC}$ 18W Bottom Side**



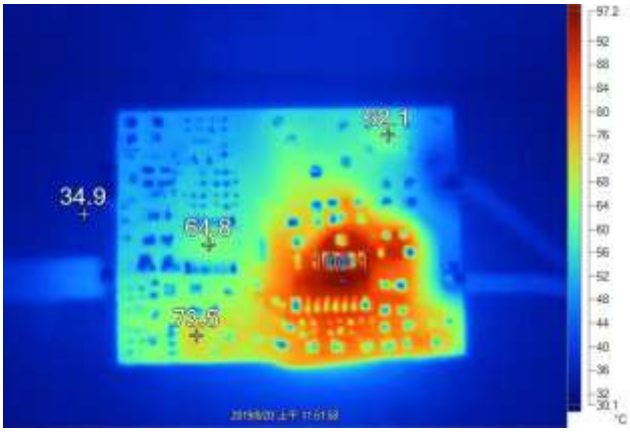

**Ambient Temperature -------- 33.7 °C**
**U1 (AP39303) ---------- 93.9 °C**
**BD1 (MSB12M) ---------- 85.1 °C**
**Q2 (DMT10H009LSS) --------- 68.7 °C**
**U3 (AP43971) ---------- 63.5 °C**

**264$V_{AC}$ 18W TOP Side**




**Ambient Temperature -------- 34.5 °C**
**T1 (Transformer) ---------- 87.2 °C**
**L2 (DR6*8)) ---------- 57.8 °C**
**C2 (15uF/400V) ---------- 62.1 °C**
**C20 (680uF/16V) ----------59.9 °C**

**264$V_{AC}$ 18W Bottom Side**




**Ambient Temperature ------ 34.9 °C**
**U1 (AP39303) ---------- 100.1 °C**
**BD1 (MSB12M) ---------- 62.1 °C**
**Q2 (DMT10H009LSS) --------- 73.5 °C**
**U3 (AP43971) ---------- 64.8 °C**

# Chapter 6. Revision Control

## 6.1 Revision table

| Revision | Items Changed & added | The changing reason |
|---|---|---|
| 1.0 | Release | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

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