

EZ-PD™ PAG2S-2P 65 W high-frequency active clamp flyback charger and adapter solution user guide

REF_65W_HFACF_PAG2

About this document

Scope and purpose

This document provides instructions and a quick start guide for the EZ-PD™ PAG2S-2P controller-based Type-C charger and adapter solution (REF_65W_HFACF_PAG2).

Intended audience

This document is primarily intended for EZ-PD™ PAG2S-2P high-frequency active clamp flyback (ACF) charger and adapter solution developers.

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Introduction

Table 1 Critical components bill of materials (BOM)

Designator	Description	Part number	Manufacturer
U2	EZ-PD™ PAG2P primary side startup controller	CYPAP212A1-14SXQ	Infineon Technologies
U3	EZ-PD™ PAG2S USB PD power adapter secondary side controller	CYPAS212A1-32LQXQ	Infineon Technologies
U1	High-side gate driver IC non-inverting	IRS25752LTRPBF	Infineon Technologies
Q1	OptiMOS™ N-channel 30 V 19 A	BSZ0902NS	Infineon Technologies
Q4	OptiMOS™ 6 N-channel 120 V 3.04 mΩ	ISC030N12NM6	Infineon Technologies
Q2, Q3	700 V 150 mΩ E-mode GaN transistor	GS-065-009-6S-L	Infineon Technologies
T1	118 μH ATQ23.7 power transformer	EF-239002	Better Magnetics Corp
T2	Pulse edge transformer	ALTWR-C33TF	Infineon Technologies
C2, C3, C4, C5	Capacitor ALUM 33 μF 400 V 8x25 Radial	KCX 33 μF 400 V 8X25	Sh-ymin
C9, C48	Aluminium organic polymer capacitors 560 μF 25 V (6.3x10)	NPX 560 μF 25 V 6.3x10	Sh-ymin

2 Specifications

Table 2 Test specifications

Parameter	Value
Input voltage and frequency	100 to 240 V AC, 47 to 63 Hz
Max output power	65 W, 20 V to 3.25 A max
Output voltage	Fixed PDOs: 5.0 V / 3.0 A, 9.0 V / 3.0 A, 15.0 V / 3.0 A, 20.0 V / 3.25 A PPS: 5 V to 11 V, 3.0 A; 5 V to 16 V, 3.0 A; 5 V to 21.0 V, 3.25 A with PPS power limit
Peak efficiency	> 94%
Protections	1. Input overvoltage protection 2. Input undervoltage protection 3. V_{BUS_C} overvoltage protection (OVP) 4. V_{BUS_C} undervoltage protection (UVP) 5. Overcurrent protection (OCP) 6. Short-circuit protection (SCP) 7. Over-temperature protection (OTP) 8. V_{BUS_C} to CC short protection
Charging standards supported	1. USB-C PD v3.1 including programmable power supply (PPS) mode 2. Apple Charging 2.4 A 3. Qualcomm QC 2.0, 3.0, 4.0, 5.0 4. Samsung AFC 5. USB BC 1.2
EMI/EMC	1. Conducted emissions, CISPR32 CLASS B, 4 dB margin at 115/220 V AC 2. ESD, IEC61000-4-2, ± 8 kV contact, ± 16 kV air, Criteria A 3. Surge, IEC61000-4-5, ± 1 kV DM and ± 2 kV CM, Criteria B

3 Board overview

The EZ-PD™ PAG2S-2P based 65 W active clamp flyback USB PD charger and adapter solution (REF_65W_HFACF_PAG2) shown in [Figure 2](#) solution board is designed to meet the specifications shown in [Table 2](#).



Figure 2 REF_65W_HFACF_PAG2 solution board

In this solution, the EZ-PD™ PAG2x operates with an optimal frequency of 150 kHz and functions as a secondary-side flyback, ACF controller, and SR controller. Additionally, a high-side driver is used externally to drive the ACF/high-side GaN FET. This solution board consists of three boards:

- Baseboard being primary board with EZ-PD™ PAG2P and other power components
- EMI Board with filters and bulk capacitors
- Secondary board with EZ-PD™ PAG2S, SR MOSFET, and Type-C connector

[Figure 3](#) shows the schematic of EZ-PD™ PAG2S-2P based 65 W high frequency active clamp flyback charger and adapter solution.

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Board overview

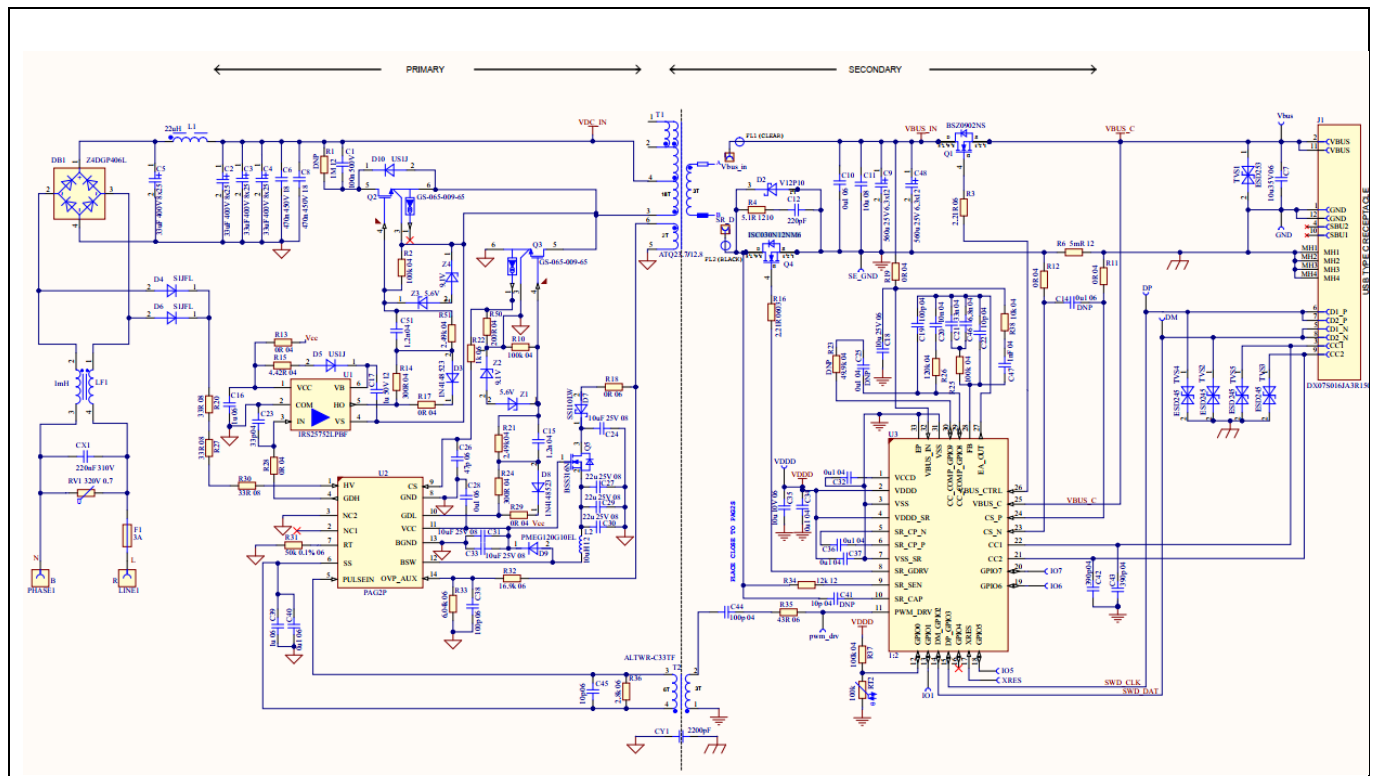


Figure 3 EZ-PD™ PAG2S-2P REF_65W_HFACF_PAG2 Schematic

EZ-PD™ PAG2S uses PSoC™ MiniProg4 (CY8CKIT-005) to program the EZ-PD™ controllers. The EZ-PD™ PAG2S-based board uses a PSoC™ MiniProg4 five-pin connection and a JTAG to Type-C connector board. In this way, one can simply program the EZ-PD™ PAG2S-2P based 65 W active clamp flyback charger and adapter board using a Type-C connector.



Figure 4 PSoC™ MiniProg4 (CY8CKIT-005) Programmer Kit

Programming interface and settings

The PSoC™ Programmer software is used as a programming interface to program the firmware (.hex file) in an EZ-PD™ PAG2S-based board. For programming, select the “CCGx” platform and update the settings as shown in Figure 5.

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Board overview

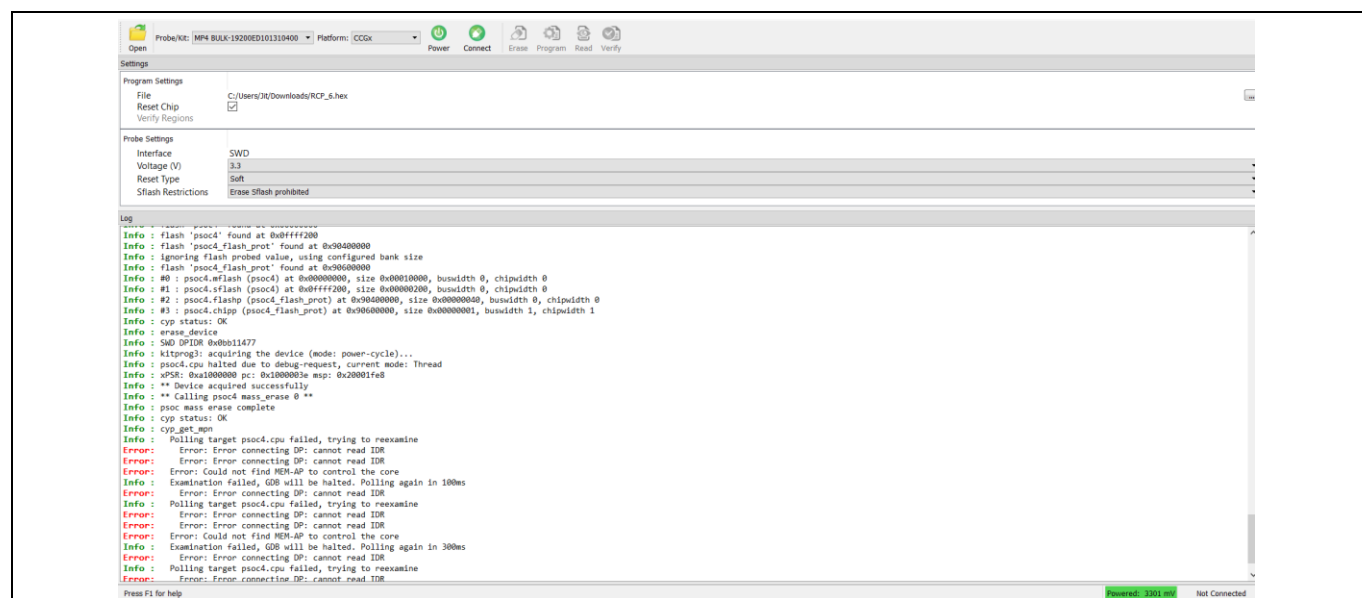


Figure 5 Programming interface to program EZ-PD™ PAG2S board

Test setup

4 Test setup

Figure 6 shows the test setup to capture the electrical data of the DUT. The following is the optimal setup to capture efficiency by capturing:

- Input power using a power meter
- Output power using high-resolution output multimeters

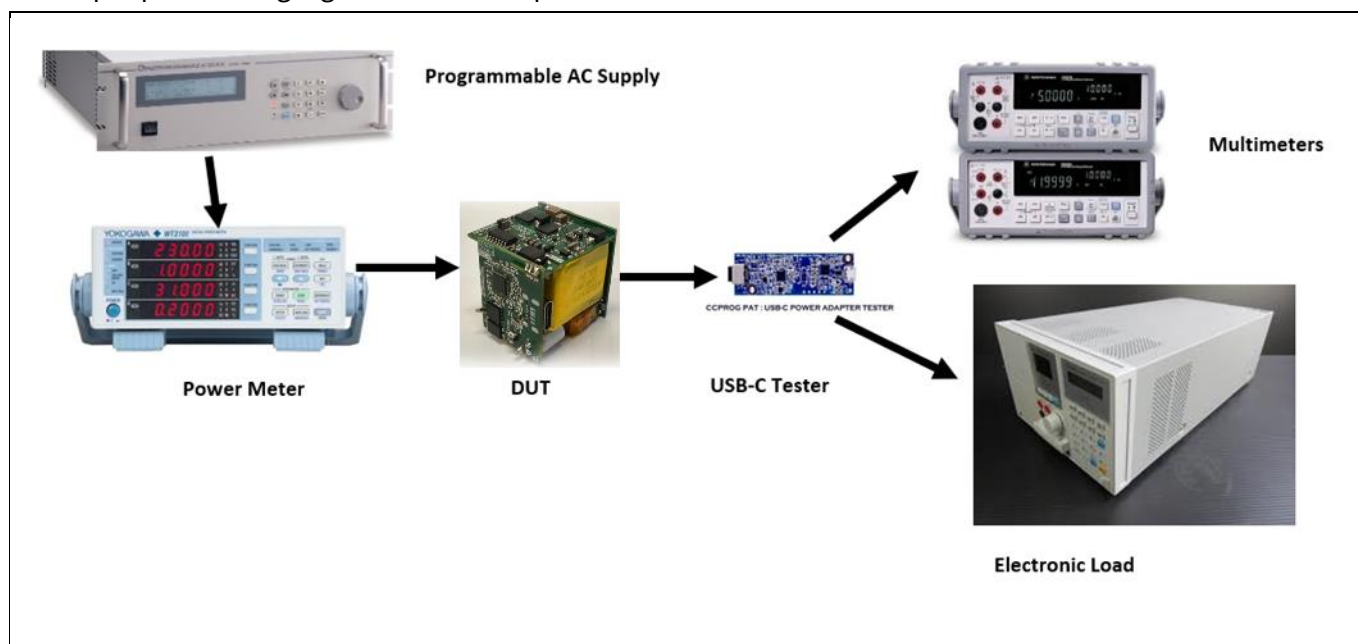


Figure 6 Test equipment connected to the standalone REF_65W_HFACF_PAG2 board

4.1 Test equipment

Table 3 shows the test equipment to measure performance parameters such as efficiency, ripple, regulation, and transient response.

Table 3 Test equipment details

Test setup	Description
Programmable AC source	Chroma 61501
AC power meter	Yokogawa WT310E
PAT tester	USBCEE PAT
Electronic load	Chroma 63102A
Multimeters	Keysight 34465A

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Test setup

4.2 Power adapter tester (PAT)

Connect the DUT to a [USB-C power adapter tester \(PAT\)](#) using a USB Type-C cable. After the connection is established, the PAT UI does a PDO discovery and displays the results.

The EZ-PD™ PAG2S-2P based 65 W active clamp flyback charger and adapter solution is pre-configured with seven PDOs:

- **Fixed PDOs:** 5.0 V / 3.0 A; 9.0 V / 3.0 A; 15.0 V / 3.0 A; 20.0 V / 3.25 A
- **PPS:** 5 V to 11 V, 3.0 A; 5 V to 15.0 V, 3.0 A; 5 V to 21.0 V, 3.25 A (PPS power limited)

Choose a suitable pre-configured PDO or configure a new one using the [EZ-PD™ Configuration Utility](#). Tests in the following sections use pre-configured PDOs.

To know more about the PAT tester, see [USBCEE](#).

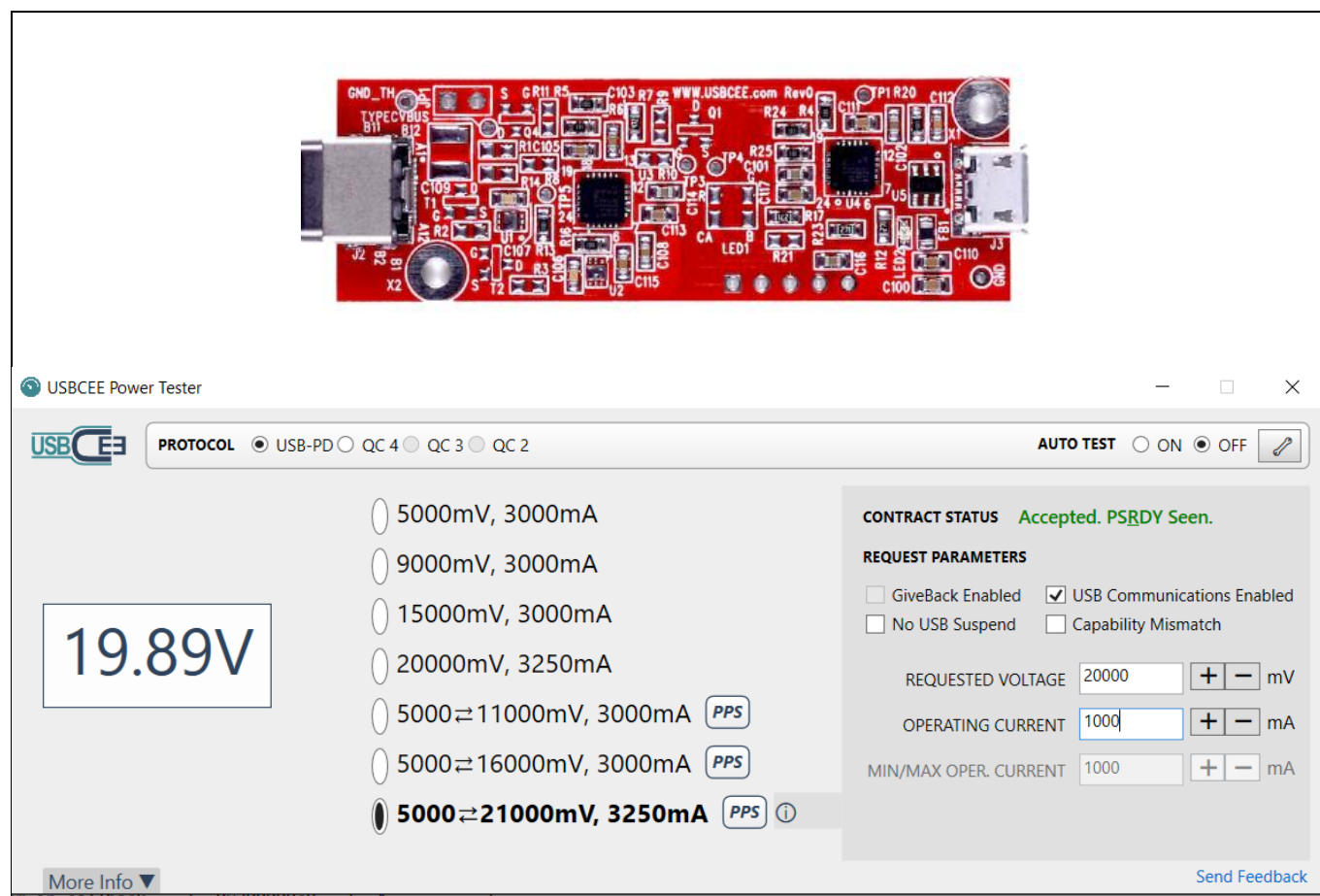


Figure 7 PAT tester and user interface

5 Quick steps for demo

1. Connect the 65-W solution board to the power meter AC terminal (which is already connected to the programmable AC supply) as in [Figure 6](#).
2. Connect a USB PD tester or a power adapter tester (PAT) to the port and ensure that the USB PD tester gets a successful Power Delivery contract as shown in [Figure 7](#).
3. Connect the electronic load at the PAT tester load terminal as in [Figure 6](#).
4. Select the desired voltage on PAT UI and ramp up the load on the electronic load.

References

Datasheets

- [1] [CYPAP211A1-14SXI EZ-PD™ PAG2P, Primary-side startup controller](#)
- [2] [CYPAS212-32LQXQ EZ-PD™ PAG2S-AC integrated USB PD and secondary-side ACF controller](#)

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Revision history

Revision history

Document revision	Date	Description of changes
**	2024-02-15	Initial release

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