# Dawar Technologies

## Simple-C User's Guide

Sustaining Quality,
Exceeding Expectations

DawarTouch®

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# 1. Introduction

Simple-C is a monitor driver board developed by Dawar Technologies that uses a single USB-C cable to provide power, video, sound, and USB 2.0 data. Dawar Technologies can provide a complete monitor solution based on our proprietary Simple-C driver board. Simple-C can also be provided as part of a display sub-assembly for incorporation into a customer's monitor.

In order to utilize Simple-C in a monitor, the host computer must have a USB-C host controller that is configured for Alternate Mode Display Port and high voltage drive. This User's Guide provides the information needed to configure the host USB-C controller so it is compatible with Simple-C.

# 2. Simple-C Features

Dawar Technologies designed our Simple-C board to be easily adaptable to any LCD by splitting the design into two boards: a main board that handles all the USB-C functionality, and a daughter board that interfaces to the LCD:

Adding support for a new LCD only requires a new daughter board design, leaving the main board untouched. Dawar Technologies has already developed daughter boards for several of our standard LCDs, and can develop a custom daughter board to mate with almost any LCD on the market.

Simple-C takes advantage of multiple features of the USB-C specification to provide the following features over one USB-C cable:

- Up to 60 Watts of power
- Stereo audio output
- High-quality video
- Left and right speaker outputs
- Four USB 2.0 ports
- Port for an optional menu button board
- Video and backlight outputs

This document provides details of the Simple-C implementation needed by the host USB-C controller that will be connected to Simple-C. This document also provides configuration details for several common USB-C host controllers. And it includes suggestions for additional equipment and programs

needed to develop a USB-C host.

For more information on USB-C features and functionality, refer to the "Dawar Technologies Introduction to USB-C" white paper available on Dawar's website.

# 3. Power Delivery

Simple-C supports two v3 compatible Power Delivery Objects (PDOs). The first PDO is the standard 5 Volts at 3 Amps. The second PDO is customized by Dawar based on the power requirements of the LCD, up to the maximum supported power of 60 Watts (20 Volts at 3 Amps). The USB-C Host must be setup to support the two PDOs used on the Simple-C board. Dawar will provide details on the PDOs needed for your specific design.

Simple-C can also be used with a PD 2 host. When a PD 2 host enumerates a PD 3 device, the enumeration process requires additional time to complete. For that reason, Dawar recommends using a PDO v3 host controller, like the Cypress CCG3 or the Texas Instruments TPS65987.

If an LCD requires more than 60 Watts, an optional power input can be added to the custom daughter board to provide additional power.

# 4. Default Roles

Simple-C defaults to the following roles:

- Upward facing port (UFP)
- Upward facing Display Port (UFP_D)
- Upward facing USB data port (UFP_U)
- Power Consumer (Sink)

These roles cannot be changed (i.e., Dual Role Port (DRP) is not supported by Simple-C).

# 5. USB Data Lanes

Simple-C includes a four-port USB 2.0 compatible hub. One USB 2.0 port is typically dedicated to a Dawar Technologies projected capacitive (PCAP) touch controller. All four USB ports are routed to headers JA1 through JA4. All four connectors have the same pinout:

| Pin # | Descr |
|---|---|
| 1 | VBUS (5 Volts) |
| 2 | D- |
| 3 | D+ |
| 4 | GND |

The header part number is JST S4B-PH-SM4-TB or equivalent. The mating part number is JST PHR-4 or equivalent.

Typically, a panel mount USB-A connector is connected to these headers.

# 6. Alternate Mode Display Port

Simple-C supports the industry standard Alternate Mode Display Port defined by VESA. The SVID is 0xFF01. Simple-C supports a maximum resolution of 1920 x 1200 and a maximum refresh rate of 60Hz. The pixel format can be RGB 4:4:4 or YCbCr 4:4:4.

# 7. Audio

Simple-C has stereo speaker outputs CON11 (left) and CON13 (right). The board connectors are TE 640457-2 or equivalent. The mating part is TE 3-640441-2 or equivalent. Both connectors have the same pinout:

| Pin # | Descr |
|---|---|
| 1 | SPKR- |
| 2 | SPKR+ |

The audio circuit is designed for a 1W speaker with 8Ω ±20% impedance. Dawar recommends the Challenge Electronics CS25-01P75-05-1 speaker or an equivalent part.

# 8. Menu Board

Simple-C has an optional menu button board that can be provided by Dawar. The menu board, which plugs into connector CON7, can be used to modify display settings on-screen including contrast, brightness, etc. The monitor housing can be designed so that this menu board mounts onto the enclosure with the buttons available to the user.

Note that certain features controlled by the menu board, such as brightness, can also be controlled through Display Data Channel Command Interface (DDC CI). Supported DDC CI commands are listed in Appendix A. DDC CI implementation is left to the customer.

# 9. USB-C Cabling

Simple-C must be connected to the host using an Electrically Marked Cable Assembly (EMCA) as this is the only type of USB-C cable that supports Alternate Mode Display Port. There are two types of EMCA cables available: Passive and Active. A Passive EMCA does not modify the data signals that pass through it. An Active EMCA provides signal conditioning. For example, an optically isolated USB-C cable must be an Active EMCA.

Typically, any EMCA will work with Simple-C. However, not all cable manufacturers meet the exacting specifications needed to support Alternate Mode Display Port. Dawar recommends that customers qualify specific cable vendors to ensure that their cables fully support Alternate Mode Display Port.

The maximum length of a USB-C cable depends on the amount of data being exchanged between the two USB-C devices. While it is impossible to specify an exact maximum cable length, most USB-C

cables that support Alternate Mode Display Port are limited to 2 meters. If a longer cable is needed, ask Dawar about optical USB-C cables which can be up to 30 meters or more in length.

# 10. USB-C Host Chips

Simple-C requires a supporting USB-C host connection. The host's USB-C must be capable of supporting the higher voltages and currents required by Simple-C. While many single board computers and embedded computers include USB-C ports, very few of them support USB-C voltages greater than 5 Volts. In order to fully utilize all the features of Simple-C, a custom host board will most likely have to be designed.

Fortunately, there are several USB-C chips available that simplify implementation of a high-voltage USB-C host. Several are described in the following sections.

## 10.1. Infineon CCG3

The Infineon (formerly Cypress) CCG3 is a highly configurable USB-C controller that supports PD 3, integrated VCONN, and integrated overcurrent and overvoltage protection circuits. The CCG3 can be easily configured using a USB-to-$I^2C$ bridge and a configuration utility.

## 10.2. Texas Instruments TPS65987

The Texas Instruments TPS65987 is a stand-alone USB-C and PD 3 controller. It includes a high-speed multiplexer for the USB-C lines, robust power protection, and VCONN support. The TPS65987 can be easily configured using a USB-to-SPI bridge and a configuration utility.

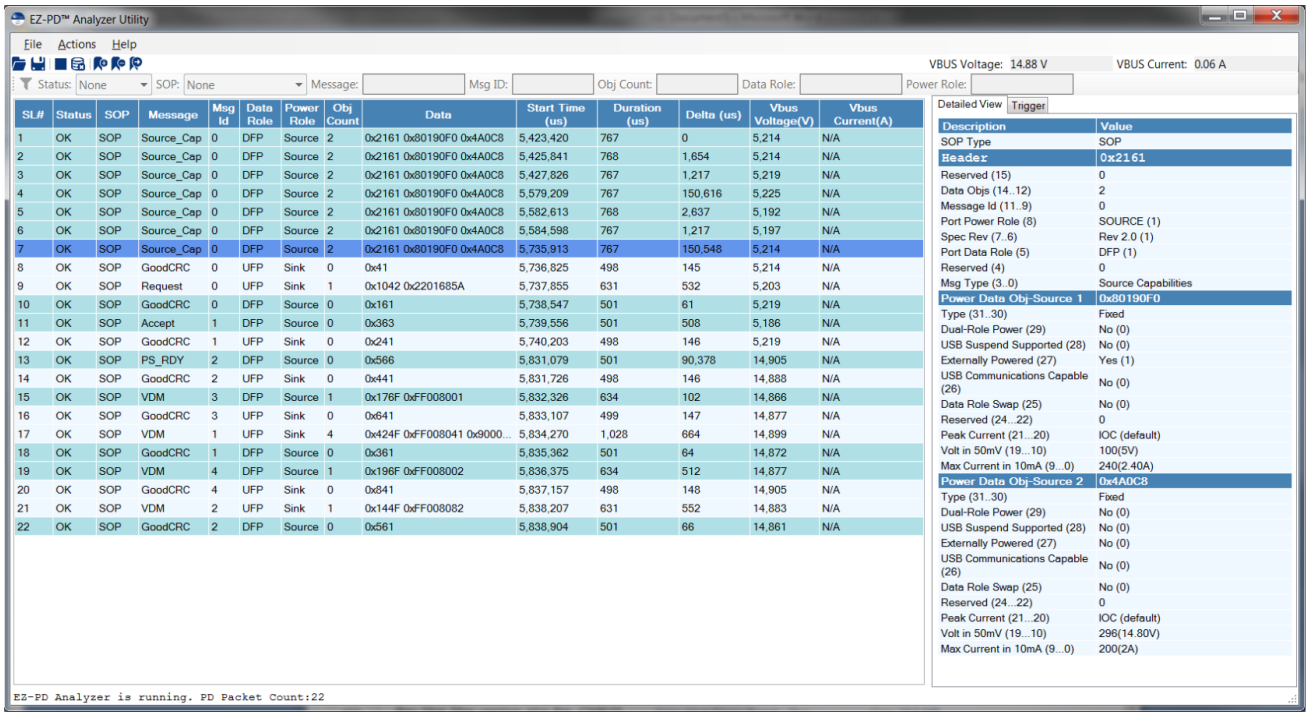
# 11. Development Tools

There are a number of inexpensive development tools and eval kits available for USB-C that can be very helpful during development. A few are listed in the sections below.

## 11.1. Cypress CY4500 EZ-PD Protocol Analyzer

The Cypress CY4500 EZ-PD protocol analyzer allows you to view the power delivery messages exchanged between two USB-C products. The analyzer has two USB-C ports (male and female) so it can be connected in the USB-C data stream between the two devices:

It also has a USB Micro-B port for connecting to a computer running the EZ-PD analyzer software. The software shows every PD message and acknowledgment exchanged between the two devices. It also shows the VBUS voltage and current:




| SL# | Status | SOP | Message | Msg Id | Data Role | Power Role | Obj Count | Data | Start Time (us) | Duration (us) | Delta (us) | Vbus Voltage(V) | Vbus Current(A) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | OK | SOP | Source_Cap | 0 | DFP | Source | 2 | 0x2161 0x80190F0 0x4A0C8 | 5,423,420 | 767 | 0 | 5,214 | N/A |
| 2 | OK | SOP | Source_Cap | 0 | DFP | Source | 2 | 0x2161 0x80190F0 0x4A0C8 | 5,425,841 | 768 | 1,654 | 5,214 | N/A |
| 3 | OK | SOP | Source_Cap | 0 | DFP | Source | 2 | 0x2161 0x80190F0 0x4A0C8 | 5,427,826 | 767 | 1,217 | 5,219 | N/A |
| 4 | OK | SOP | Source_Cap | 0 | DFP | Source | 2 | 0x2161 0x80190F0 0x4A0C8 | 5,579,209 | 767 | 150,616 | 5,225 | N/A |
| 5 | OK | SOP | Source_Cap | 0 | DFP | Source | 2 | 0x2161 0x80190F0 0x4A0C8 | 5,582,613 | 768 | 2,637 | 5,192 | N/A |
| 6 | OK | SOP | Source_Cap | 0 | DFP | Source | 2 | 0x2161 0x80190F0 0x4A0C8 | 5,584,598 | 767 | 1,217 | 5,197 | N/A |
| 7 | OK | SOP | Source_Cap | 0 | DFP | Source | 2 | 0x2161 0x80190F0 0x4A0C8 | 5,735,913 | 767 | 150,548 | 5,214 | N/A |
| 8 | OK | SOP | GoodCRC | 0 | UFP | Sink | 0 | 0x41 | 5,736,825 | 498 | 145 | 5,214 | N/A |
| 9 | OK | SOP | Request | 0 | UFP | Sink | 1 | 0x1042 0x2201685A | 5,737,855 | 631 | 532 | 5,203 | N/A |
| 10 | OK | SOP | GoodCRC | 0 | DFP | Source | 0 | 0x161 | 5,738,547 | 501 | 61 | 5,219 | N/A |
| 11 | OK | SOP | Accept | 1 | DFP | Source | 0 | 0x363 | 5,739,556 | 501 | 508 | 5,186 | N/A |
| 12 | OK | SOP | GoodCRC | 1 | UFP | Sink | 0 | 0x241 | 5,740,203 | 498 | 146 | 5,219 | N/A |
| 13 | OK | SOP | PS_RDY | 2 | DFP | Source | 0 | 0x566 | 5,831,079 | 501 | 90,378 | 14,905 | N/A |
| 14 | OK | SOP | GoodCRC | 2 | UFP | Sink | 0 | 0x441 | 5,831,726 | 498 | 146 | 14,888 | N/A |
| 15 | OK | SOP | VDM | 3 | DFP | Source | 1 | 0x176F 0xFF008001 | 5,832,326 | 634 | 102 | 14,866 | N/A |
| 16 | OK | SOP | GoodCRC | 3 | UFP | Sink | 0 | 0x641 | 5,833,107 | 499 | 147 | 14,877 | N/A |
| 17 | OK | SOP | VDM | 1 | UFP | Sink | 4 | 0x424F 0xFF008041 0x9000... | 5,834,270 | 1,028 | 664 | 14,899 | N/A |
| 18 | OK | SOP | GoodCRC | 1 | DFP | Source | 0 | 0x361 | 5,835,362 | 501 | 64 | 14,872 | N/A |
| 19 | OK | SOP | VDM | 4 | DFP | Source | 1 | 0x196F 0xFF008002 | 5,836,375 | 634 | 512 | 14,877 | N/A |
| 20 | OK | SOP | GoodCRC | 4 | UFP | Sink | 0 | 0x841 | 5,837,157 | 498 | 148 | 14,905 | N/A |
| 21 | OK | SOP | VDM | 2 | UFP | Sink | 1 | 0x144F 0xFF008082 | 5,838,207 | 631 | 552 | 14,883 | N/A |
| 22 | OK | SOP | GoodCRC | 2 | DFP | Source | 0 | 0x561 | 5,838,904 | 501 | 66 | 14,861 | N/A |

| Description | Value |
|---|---|
| SOP Type | SOP |
| **Header** | **0x2161** |
| Reserved (15) | 0 |
| Data Objs (14..12) | 2 |
| Message Id (11..9) | 0 |
| Port Power Role (8) | SOURCE (1) |
| Spec Rev (7..6) | Rev 2.0 (1) |
| Port Data Role (5) | DFP (1) |
| Reserved (4) | 0 |
| Msg Type (3..0) | Source Capabilities |
| **Power Data Obj-Source 1** | **0x80190F0** |
| Type (31..30) | Fixed |
| Dual-Role Power (29) | No (0) |
| USB Suspend Supported (28) | No (0) |
| Externally Powered (27) | Yes (1) |
| USB Communications Capable (26) | No (0) |
| Data Role Swap (25) | No (0) |
| Reserved (24...22) | 0 |
| Peak Current (21...20) | IOC (default) |
| Volt in 50mV (19...10) | 100(5V) |
| Max Current in 10mA (9...0) | 240(2.40A) |
| **Power Data Obj-Source 2** | **0x4A0C8** |
| Type (31..30) | Fixed |
| Dual-Role Power (29) | No (0) |
| USB Suspend Supported (28) | No (0) |
| Externally Powered (27) | No (0) |
| USB Communications Capable (26) | No (0) |
| Data Role Swap (25) | No (0) |
| Reserved (24...22) | 0 |
| Peak Current (21...20) | IOC (default) |
| Volt in 50mV (19...10) | 296(14.80V) |
| Max Current in 10mA (9...0) | 200(2A) |

The EZ-PD Analyzer is an inexpensive tool for monitoring USB-C PD negotiations, voltage, and current during development.

## 11.2. Cypress CY4531 EZ-PD CCG3 EVK

The Cypress CY4531 EVK is an evaluation kit designed to provide a complete USB-C high power implementation. It aggregates a Display Port input, a high-speed USB-B input, and power into a USB-C output that supports Alternate Mode and power delivery up to 20 Volts at 3 Amps. The default configuration of the CY4531 is compatible with Simple-C.

Dawar has designed a sample host controller based on the Cypress CY4531 EVK. Documentation can be provided on request.

## 11.3. Texas Instruments TPS65987 EVM and DP Expansion

The TI TPS65987 EVM is an evaluation kit designed to provide a complete USB-C high power implementation. A separate expansion board, called DP Expansion, is required to provide Display Port and high-speed USB data which are then aggregated onto the USB-C port by the TPS65987. Note that the EVM does not include a power supply which must be purchased separately. The TPS65987 EVM default configuration must be modified to work with Simple-C by making the following changes:

1) Enable DP mode
2) Enable USB pass through mode

# Appendix A
# DDC CI Commands

The following DDC CI commands and parameters are supported by the Simple-C board.

| Function | VCP Type | VCP opcode | MH (High byte) | ML (Low byte) | SH (High byte) | SL (Low byte) | Remark |
|---|---|---|---|---|---|---|---|
| All Reset | WO | 0x04 | 0 | 1 | 0 | 0x01 | Restore factory defaults |
| Brightness | RW | 0x10 | 0 | 100 | 0 | 0~100 | Set/Get Brightness |
| Contrast | RW | 0x12 | 0 | 100 | 0 | 0~100 | Set/Get Contrast |
| Red Gain | RW | 0x16 | 0 | 100 | 0 | 0~100 | Set/Get Color temperature R/G/B gain value |
| Green Gain | RW | 0x18 | 0 | 100 | 0 | 0~100 | |
| Blue Gain | RW | 0x1A | 0 | 100 | 0 | 0~100 | |
| H-Frequency | RO | 0xAC | 0 | 0x00~0xFF | 0x00~0xFF | 0x00~0xFF | Current time H-frequency (Hz)<br>Example:<br>A reported value of 01h, 21h, 10h indicates a Hz frequency of 74.0KHz |
| V-Frequency | RO | 0xAE | 0xFF | 0x00~0xFF | 0x00~0xFF | 0x00~0xFF | Current time V-frequency (Hz)<br>Example:<br>A reported value of 17h, 7Ah indicates a Hz frequency of (60.1*100) Hz. |
| Language | RW | 0xCC | 0 | 0x0A | 0 | 0x02 | Set OSD language<br>0x01: Chinese (traditional)<br>0x02: English (Default)<br>0x03: French<br>0x04: German<br>0x05: Italian<br>0x06: Japanese<br>0x09: Russian<br>0x0A: Spanish<br>0x0D: Chinese (simplified) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Power Mode | RW | 0xD6 | 0 | 0 | 0 | 0x01: On<br>0x02: Off | |

## Revision History

| | |
|---|---|
| Rev A<br>February 16, 2022 | Initial Release |
| Rev B<br>November 17, 2022 | Added DDC CI commands in Appendix A. |
| Rev C<br>October 21, 2024 | Removed TM symbol |