

FUSB15201DV Dual-Port Source USB Type-C PD Controller Evaluation Board User's Manual

EVBUM2810/D

Introduction

The FUSB15201DV evaluation board, in conjunction with firmware and software, provides a platform to evaluate a full dual-port Type-C/PD system. The FUSB15201DV integrates an ARM[®] Cortex-M0+ processor with customized peripherals and supports a fully standalone application with only a power supply.

Description

The FUSB15201DV Evaluation kit is designed to support the full features of dual-port Type-C/PD Source applications for FUSB15201DV or FUSB15201P with a single battery (typ 13.5 V) or power supply, primarily targeting automotive charger applications.

The Evaluation kit is designed to control two individual VBUS outputs from the NCV81599, a buck/boost DC-DC power converter. All components are AEC qualified.

This manual provides information about the evaluation board's interconnection, hardware setting, communication to PC, and detailed information of the board design data.

Key EVB Features

- 120 W, Configurable up to 200 W
- > 94% Efficiency
- Solution Size: 1.7" x 1.9" (20.8cm²) / 1.7" x 1.5" (16.5 cm²) Active Area
- Power Density: 5.77 W/cm² or 7.27 W/cm²
- Highest Board Temperature: 98.061°C at 22°C Ambient at Full Load
- VBUS Output Current Sense
- VBAT Reverse Current Protection

FUSB15201DV Features

- ARM Cortex-M0+ Processor
- 132 KB Flash Memory / 6 KB SRAM
- Integrated VCONN Switch for E-Marked Cables
- Supports Low Power Mode (Idle/ Sleep)
- BC1.2 (SDP, DCP, CDP)/ Apple Divider Mode
- 10 bit ADC for Voltage and General Purpose
- Over Voltage / Over Temperature Protection
- I2C Master/Slave
- SWD Interface for Debugging
- Temperature Sensing using NTC

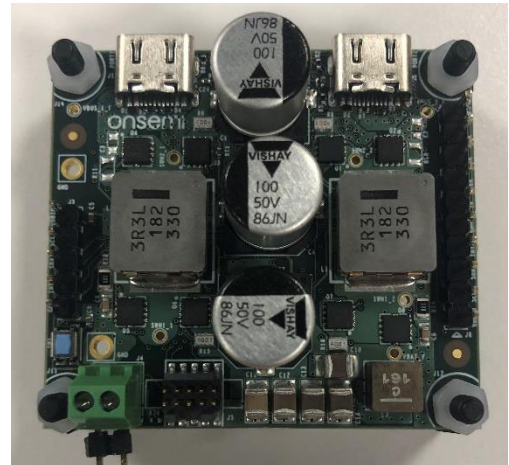


Figure 1. FUSB15201DV Evaluation Board

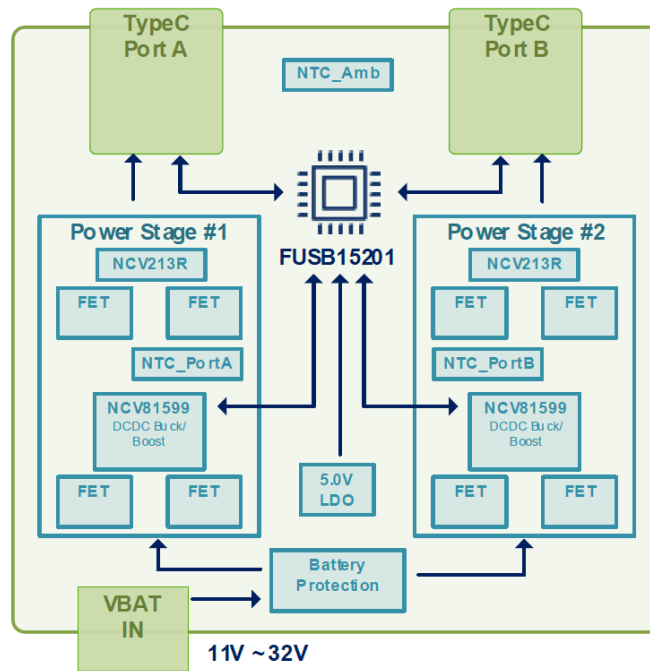


Figure 2. Concept

This Evaluation board is designed to provide a ready-to-use solution for a dual-port Type-C/PD Charging port application. All components are appropriately selected from automotive qualified devices and capable of operating up to 125°C.

DETAILED DESCRIPTION OF EACH BLOCK

Power Stage

All power components are selected to drive output power up to 100 W per port (20 V / 5 A) if thermal performance is under control. Due to the limited PCB size and the space between each heat dissipating component, the initial firmware will provide support for up to 60 W per port (120 W = 2 x 60 W) under control of the hottest board spot to lower than 100°C.

In case higher output power is desired, it is recommended to perform re-sizing of the PCB design with thicker copper planes (>2 oz) for the top and bottom layers and to maintain

enough space between heat dissipating components (FET switches). This board is designed to fit into an application that has limited space, reflecting customer demand for charging ports in automotive cabin areas.

DC-DC Converter

NCV81599 is used as DC to DC converter controller with NVTFS5C460NL and NVTFS5C471NL for FET switches for Buck and Boost mode respectively. Power Inductor (3.3 µH, ETQP6M3R3YLC) is selected for driving output current up to 5.0 A.

In the Unattached state, FUSB15201DV controls EN_1/EN_2 to logic Low which maintains the NCV81599 power-off state for minimizing power consumption. In this state, NCV81599 has no I2C register accessibility. All register values in NCV81599 will reset upon EN_x returning to logic High.

Each NCV81599 ADDR pin is set to a different I2C slave address.

Temperature Sensing

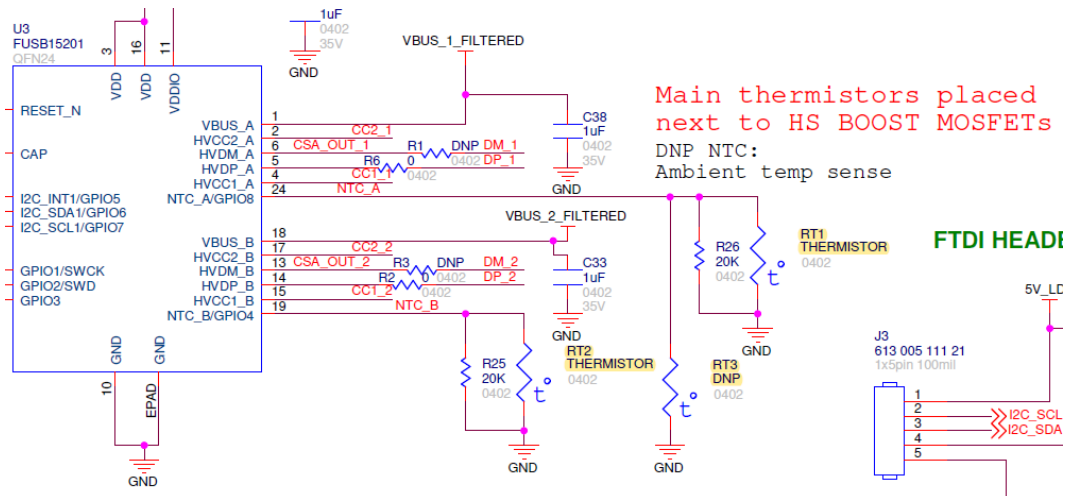


Figure 3.

NTCs (RT1/ RT2) are initially populated nearby the area where the hi-side boost mode FETs (Q1 and Q3) are located. Temperature read data from these spots indicate the hottest temperatures on the entire board area.

If ambient temperature is a higher concern than the FET switch, depopulate RT1 and RT2 and populate RT3 (not populated by default). RT3 is placed at the center between the two Type-C ports, and the temperature reading value will indicate ambient board temperature between these two Type-C ports.

Output VBUS Current Sense

Current sense amplifiers (NCV213R) with 3 mΩ sense resistors are in the circuit for filtered VBUS current measurement. The amplified voltage (x50) goes to CSA_OUT_1/2 for ADC reading. (3m x 5.0 A x 50 = 750 mV @ 5.0 A loading)

J-Link Interconnect

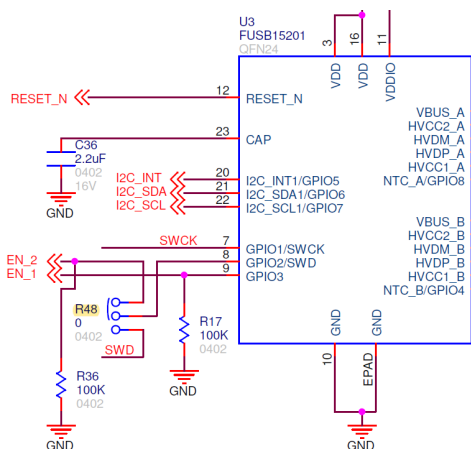


Figure 4.

GPIO2/SWD is being shared between EN_2, which enables NCV81599, and SWD for J-Link debug or download. A 3-pad 0 Ω option (R48) sets the connection to EN_2 by default, so FUSB15201DV can enable or disable NCV81599. When it is desired to connect to the SWD interface using J-Link, move the 0 Ω connection to SWD, then return the connection to EN_2 when the firmware download is complete.

Firmware enables use of SWD for connection to a J-Link debugger if R48 is configured to SWD. Note that if a sink is attached to Port 2, firmware will disable SWD.

Input/Output Voltage Measurement

VBAT_F, VBUS_1_F and VBUS_2_F are routed at the point of source/load as sensing input/output voltage. These can be used for accurate voltage measurement with minimum impact of voltage change by trace impedance, which can be used for efficiency measurements.

Legacy BC1.2 Charging Port Support

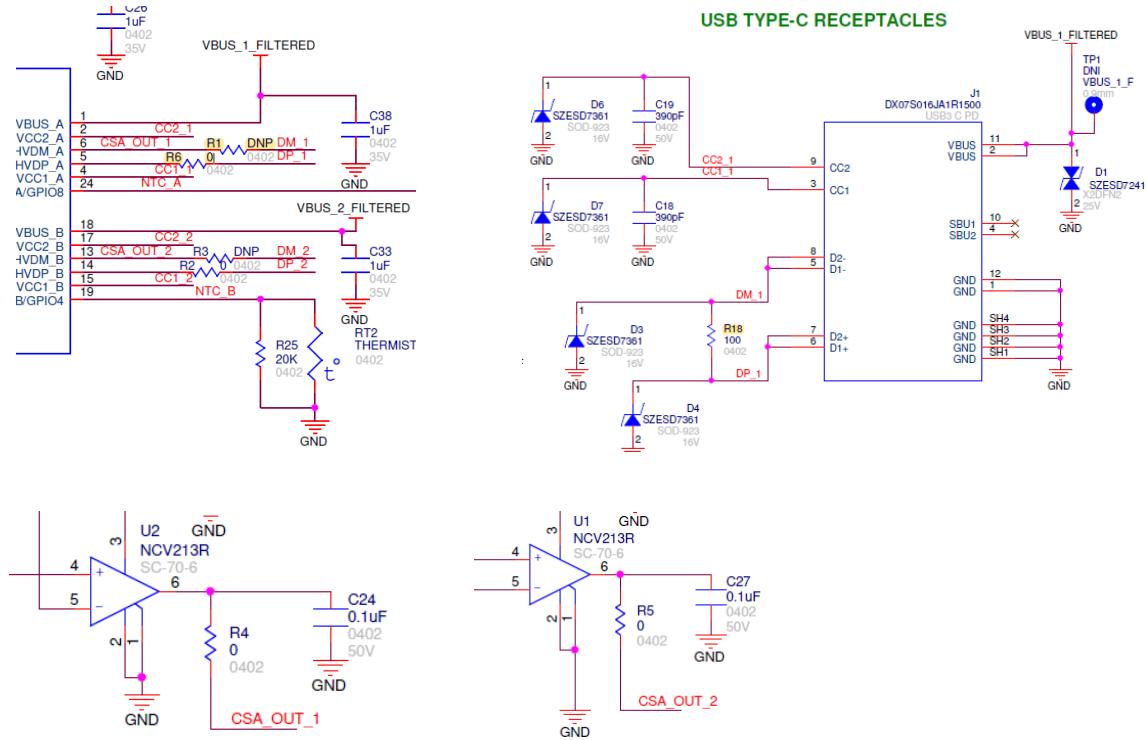


Figure 5.

FUSB15201DV is capable of supporting legacy charging port (Battery Charging 1.2 and voltage divider mode) through a built-in voltage/resistor divider.

The built-in circuit uses HVDP/DM pins for mimicking a legacy charging port. This evaluation board uses the HVDP pin for moisture sensing and the HVDM pin for CSA (Current Sense Amplifier) monitoring by default. An external 0 Ω resistor is placed between HVDP and HVDM for DCP (Dedicated Charging Port) configuration.

- Configuration for DCP with Moisture sensing on HVDP and CSA monitor on HVDM (Default):

- ♦ R1 (PortA) & R3 (PortB): Not Populated
- ♦ R18 (PortA) & R7 (PortB): 100 Ω (~200 Ω)
- ♦ R4 (PortA) & R5 (PortB): 0 Ω
- Configuration for BC1.2 charging port (CDP/DCP) or voltage divider mode:
 - ♦ R1 (PortA) & R3 (PortB): 0 Ω
 - ♦ R18 (PortA) & R7 (PortB): Not populated.
 - ♦ R4 (PortA) & R5 (PortB): Not populated.

CC/ VBUS Plot upon Accessory Plug-in

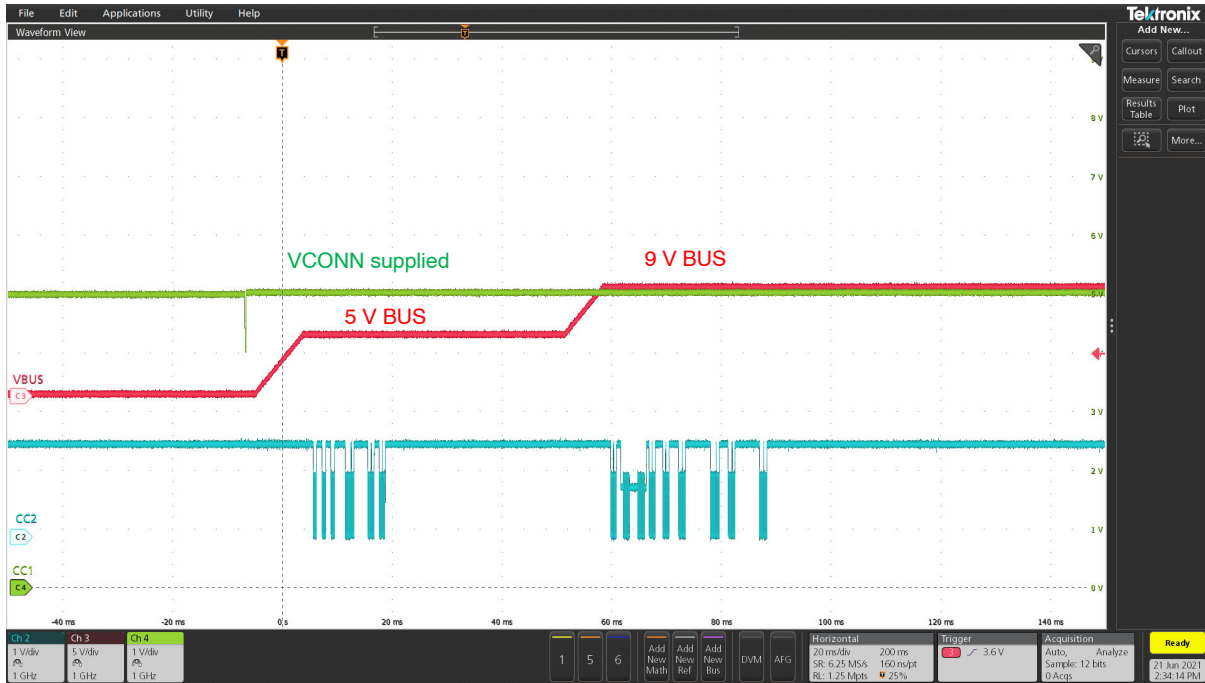


Figure 6. Sink Request 9 V PDO, CC = CC2, VCONN = CC1

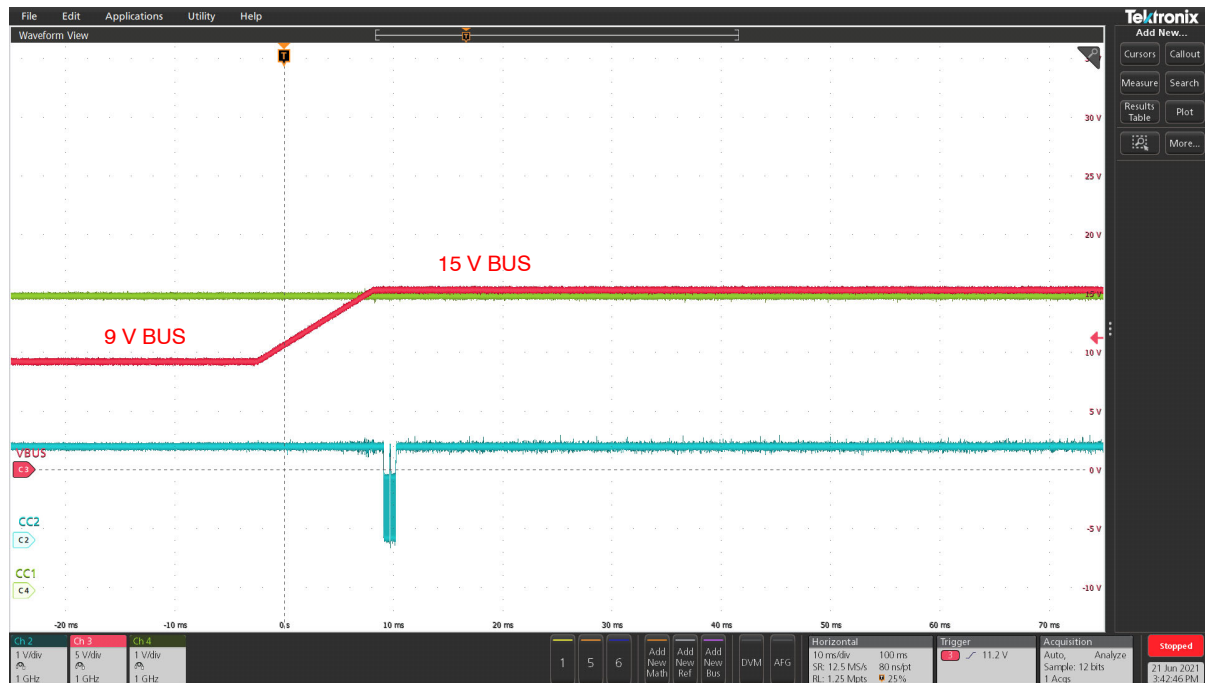


Figure 7. Sink Request 15 V PDO, CC = CC2, VCONN = CC1

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Figure 8. Sink Request 20 V PDO, CC = CC2, VCONN = CC1

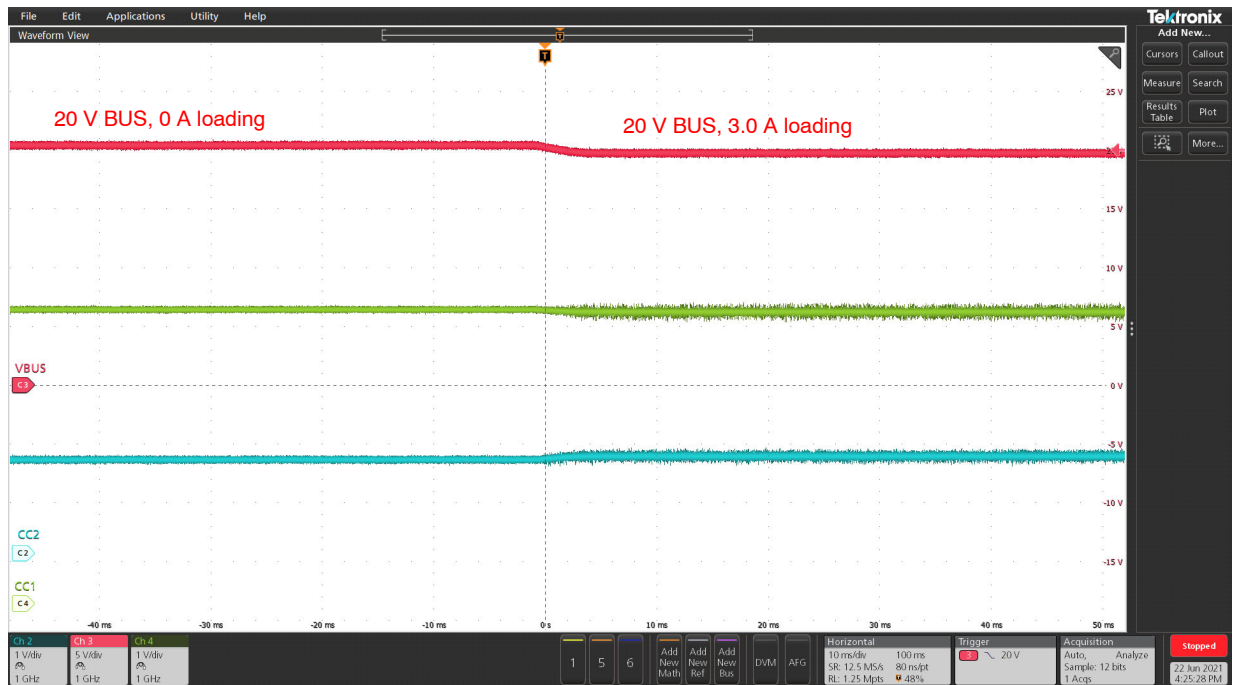


Figure 9. Loading 0 A to 3.0 A @ VBUS = 20 V

onsemi DEVICE LINKS

Device	Description
SZESD7241	ESD Protection Diode Ultra Low Capacitance
SZESD7361	ESD Protection Diode
SZMM3Z18VT1G	Generic SOD-323 Zener Diode
NVTFS5C471NL	Generic u8FL DFN-5 N-Channel Power MOSFET
NVTFS5C460NL	Generic u8FL DFN-5 N-Channel Power MOSFET
NVMFS5A140PLZ	Generic SO8-FL DFN-5 P-Channel Power MOSFET
NCV213R	Current-Shunt Monitor, Voltage Output, Bi-Directional Zero-Drift, Gain = 50V/V
FUSB15201DV	Dual Port USB Type-C & PD Controller
NCV81599	4 Switch Buck-Boost
NCV8730BMTW500	LDO Regulator, 150 mA, 38 V max input, 1 A IQ, with PG Automotive

Other References

FUSB15201DV Flash Programming Guide [UM70093/D].

FUSB15201DV Software Programming Guide [UM70092/D].

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