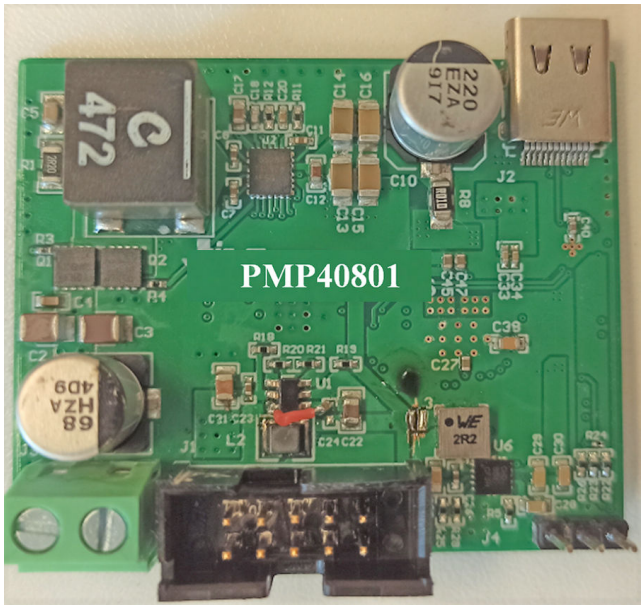
Test Report: PMP40801

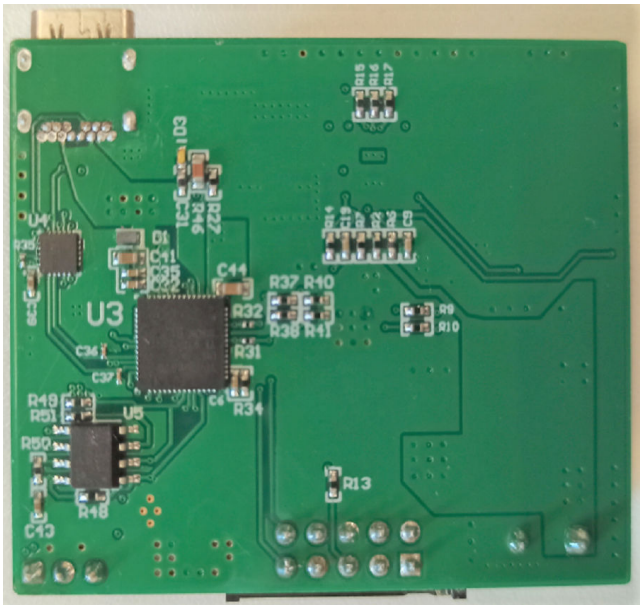
Docking USB Type-C® Power Delivery Reference Design for Personal Electronics Applications

Description

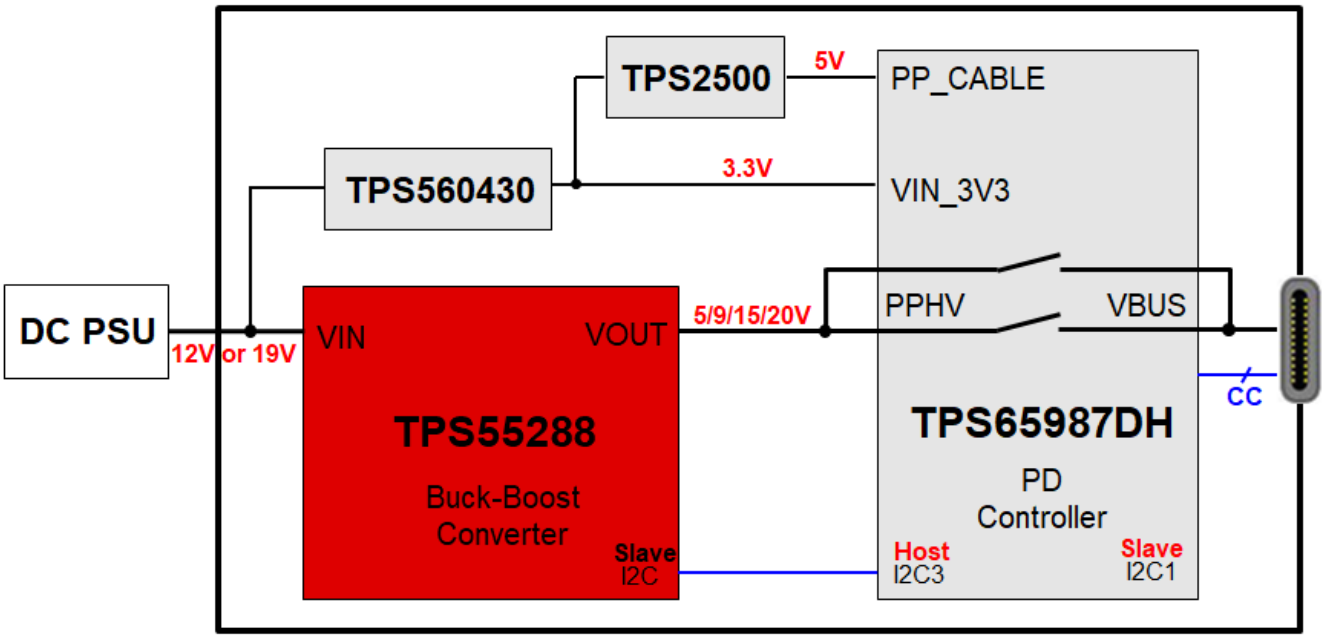
This reference design is the USB Type-C® Power Delivery for personal electronics or automotive applications, where a USB Power Delivery (USB PD) supported buck-boost converter is used to generate a wide range output voltage. The TPS55288 is a synchronous buck-boost converter used to convert 12-V auto-battery voltage or 19-V adaptor voltage into USB-PD power supply rails. The TPS65987DH is a stand-alone USB Type-C® and PD controller with integrated power path, which can automatically set the output of TPS55288 through an I2C interface based on the PD negotiation results. The output specifications are designed to be 5-V to 20-V, 5-A maximum continuous current under 19-V adaptor input and 3-A maximum continuous current under 12-V battery input for considering efficiency and thermal.



Top



Bottom



Block Diagram

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input Voltage	12 V or 19 V
Output Voltage (V_{IN} = 12 V)	5 V, 9 V, 15 V, 20 V
Maximum Output Current (V_{IN} = 12 V)	3 A
Output Voltage (V_{IN} = 19 V)	20 V
Maximum Output Current (V_{IN} = 19 V)	5 A

1.2 Required Equipment

- Multimeter (current): FLUKE 17B
- Multimeter (voltage): FLUKE 17B
- DC Source: Chroma 62024P-100-50
- Electronic Load: Chroma 63103A
- Oscillation: Tektronix DPO3054
- Infrared Thermometer: FLUKE Ti9

1.3 Dimensions

The dimension of this board is 51 mm (length) × 42 mm (width).

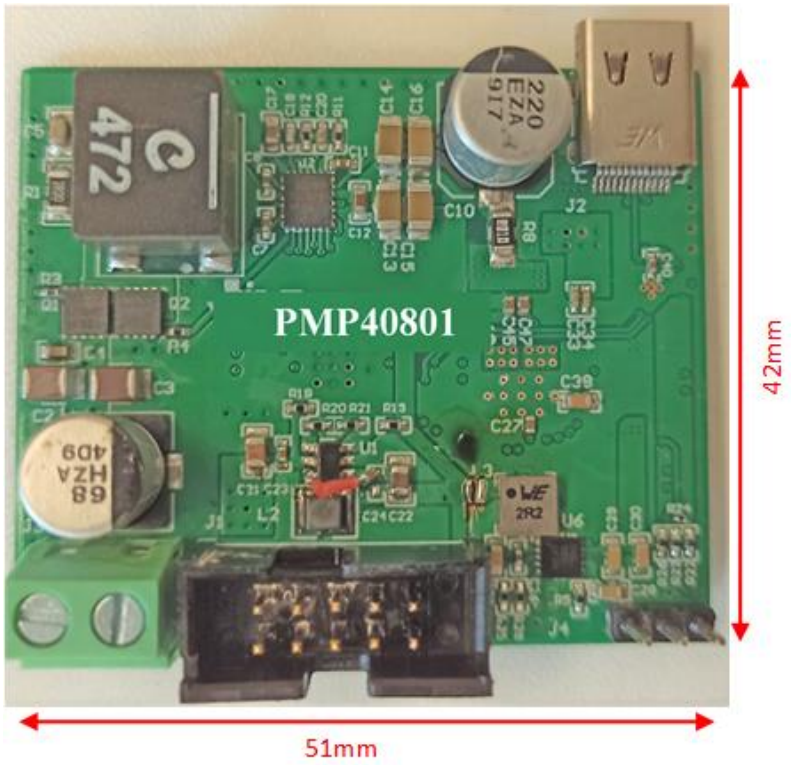


Figure 1-1. Dimension

1.4 Test Setup

The following image illustrates the test setup.

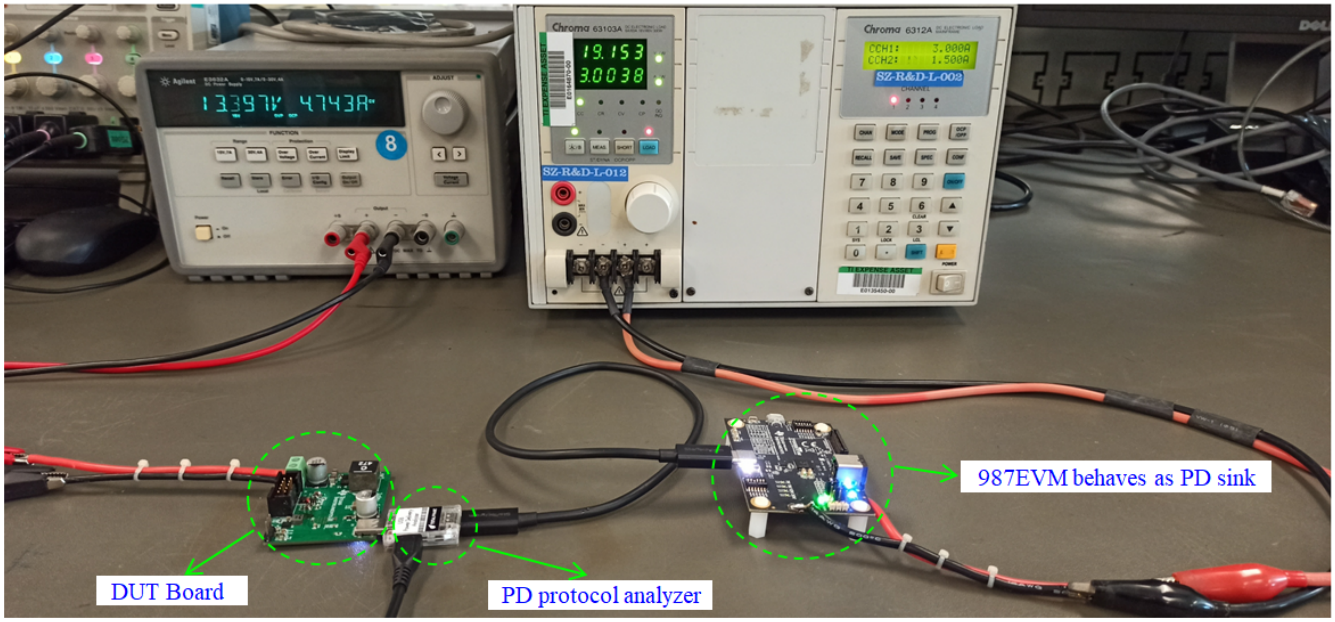
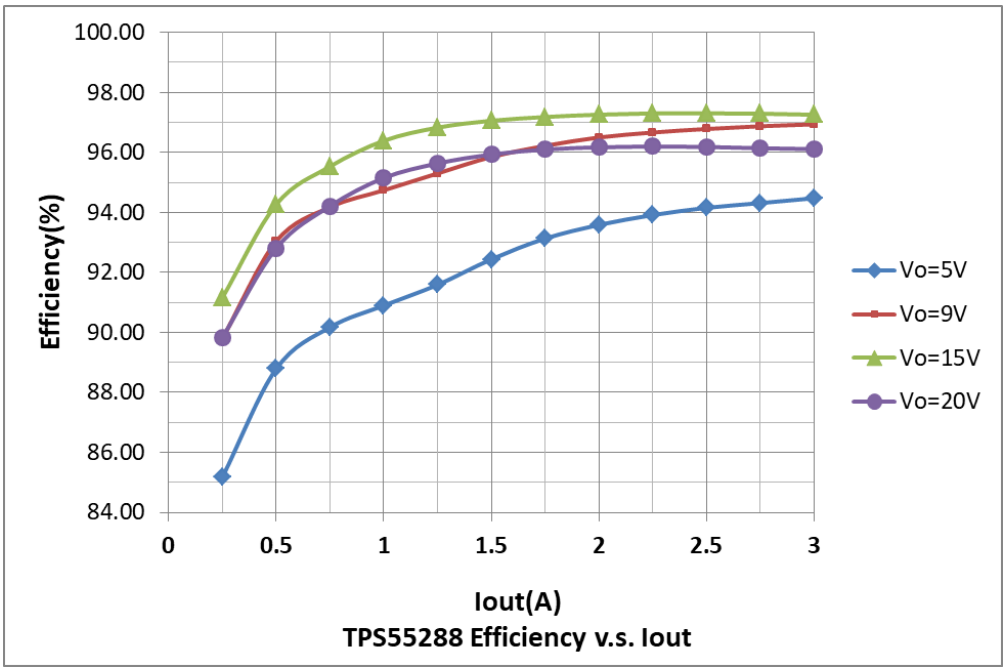


Figure 1-2. Test Setup

2 Testing and Results

2.1 Efficiency Graphs

Efficiency is shown in the following figures.



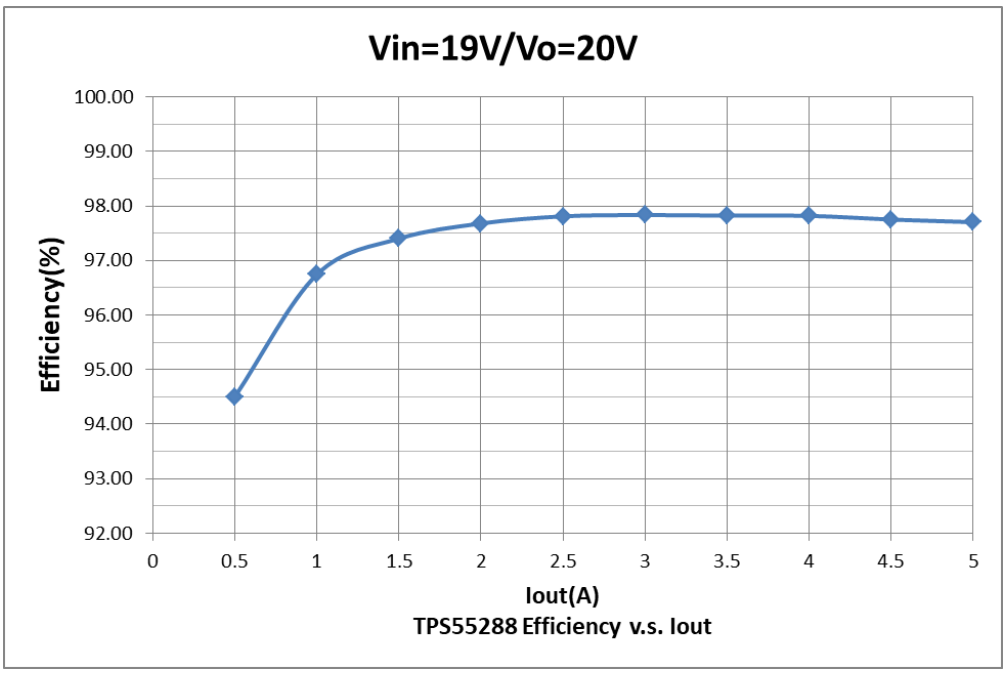
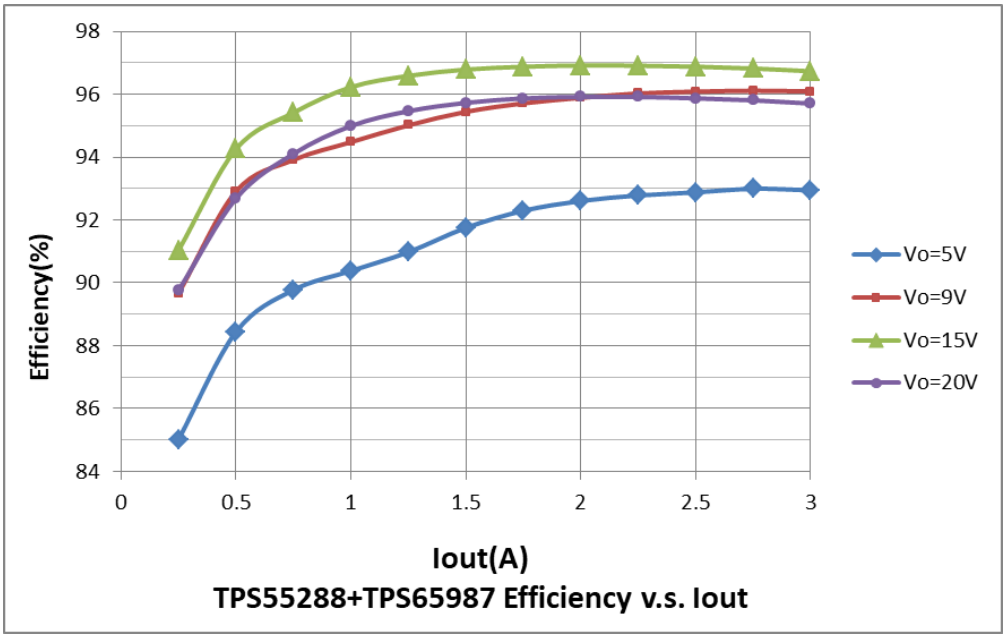


Figure 2-1. Efficiency of TPS55288



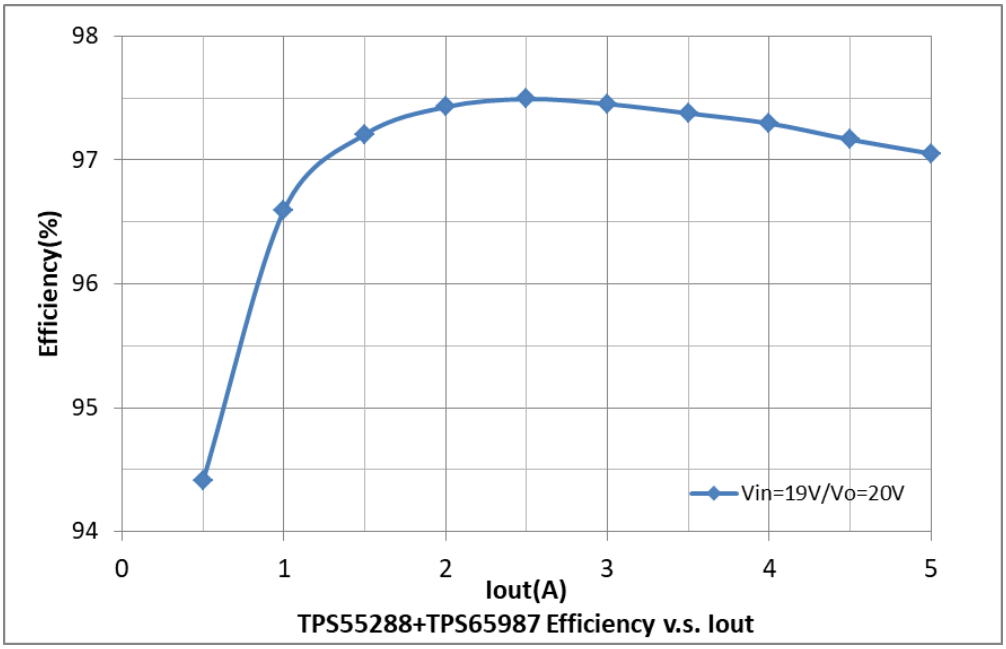


Figure 2-2. Efficiency of TPS55288 and TPS65987

2.2 Thermal Images

The thermal image is shown in the following figure.

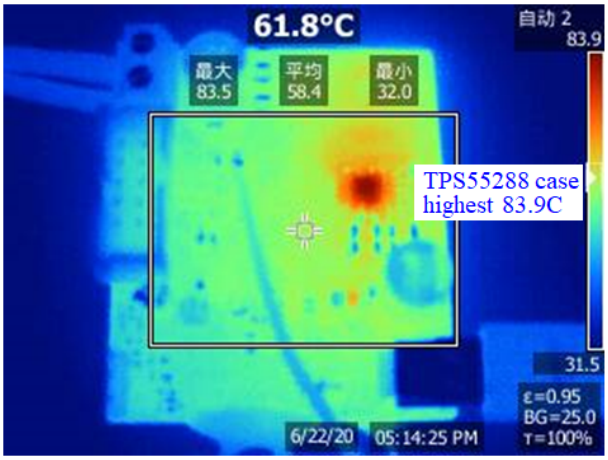


Figure 2-3. Top Side

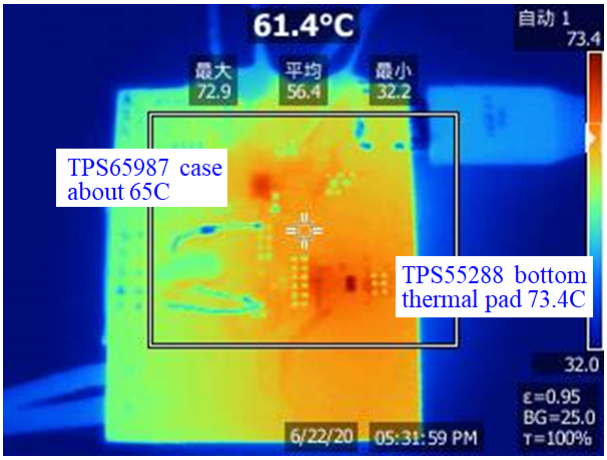


Figure 2-4. Bottom Side

3 Waveforms

3.1 Load Transients

The load transient response is shown in the following figures.

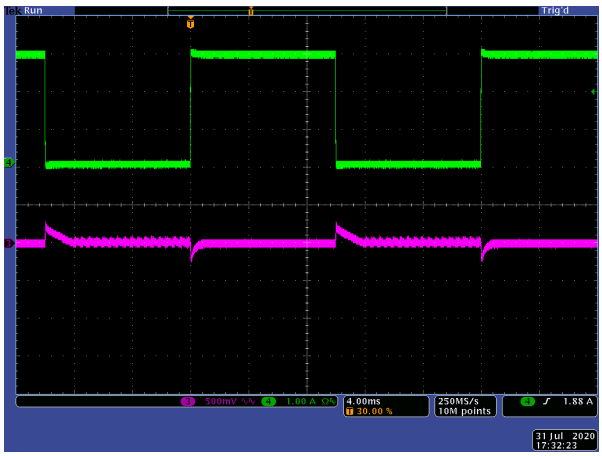


Figure 3-1. V_{IN} = 12 V, V_{OUT} = 5 V, I_{OUT} from 0 A to 3 A

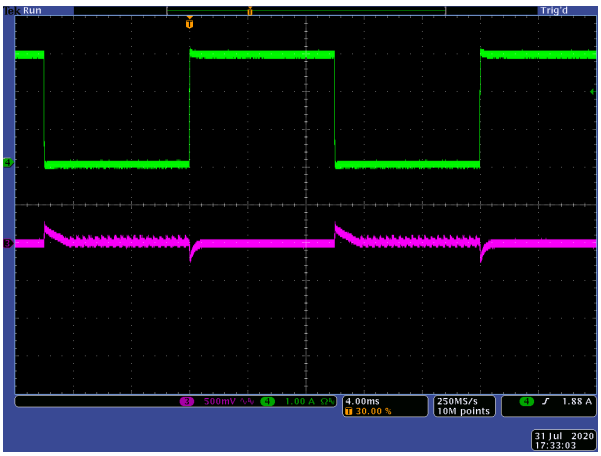


Figure 3-2. V_{IN} = 12 V, V_{OUT} = 9 V, I_{OUT} from 0 A to 3 A

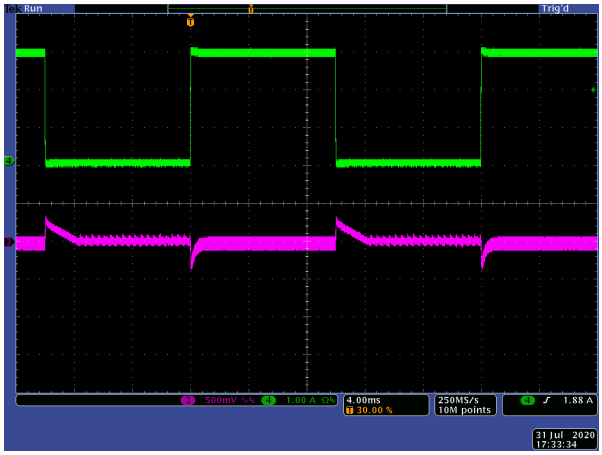


Figure 3-3. V_{IN} = 12 V, V_{OUT} = 15 V, I_{OUT} from 0 A to 3 A

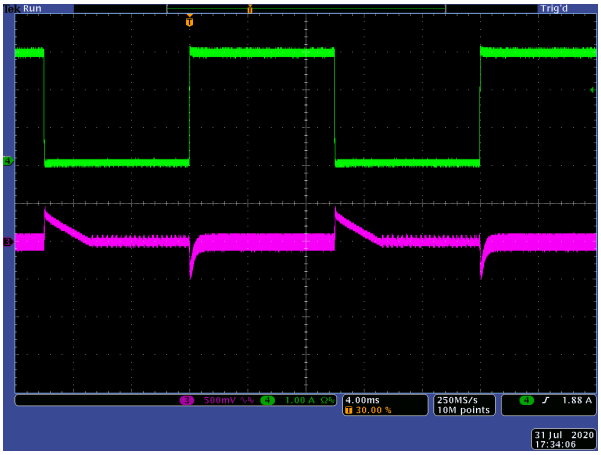


Figure 3-4. V_{IN} = 12 V, V_{OUT} = 20 V, I_{OUT} from 0 A to 3 A

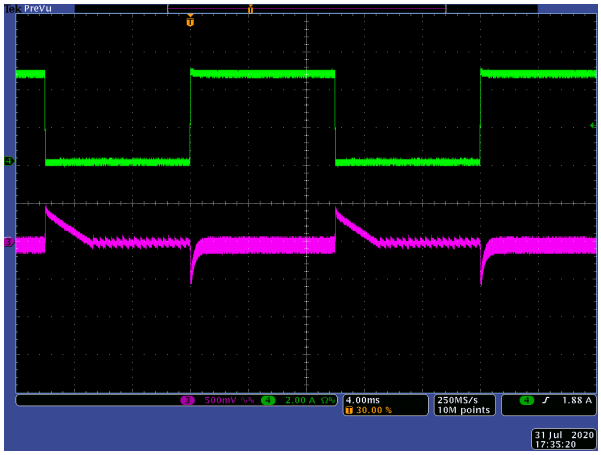


Figure 3-5. V_{IN} = 19 V, V_{OUT} = 20 V, I_{OUT} from 0 A to 5 A

3.2 Start-up and PD Negotiation

Start-up and PD negotiation behavior is shown in the following figures.

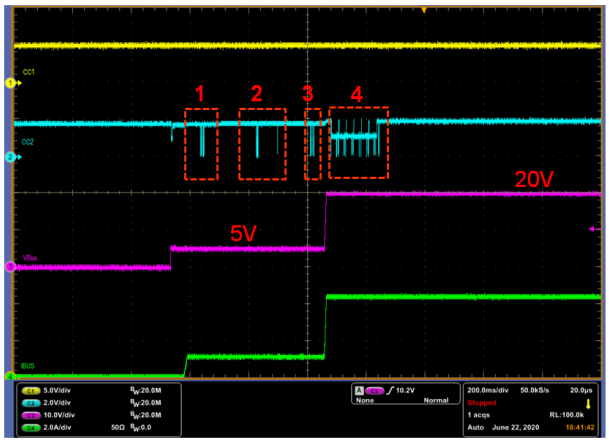


Figure 3-6. Start-up and PD Negotiation

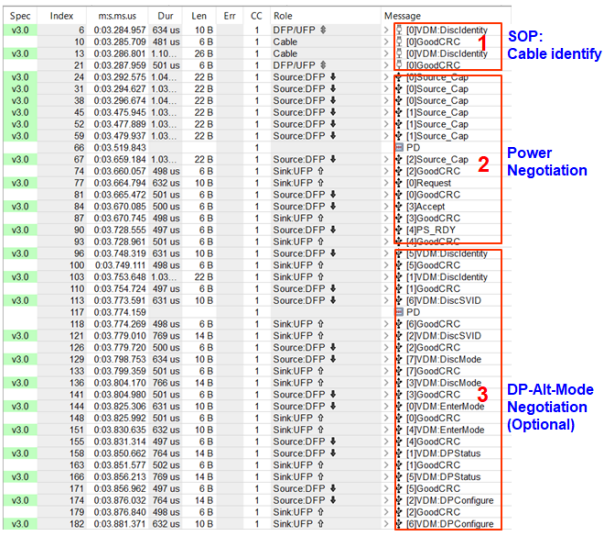


Figure 3-7. PD Negotiation Data

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