Application Report
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TPS2549 CDP-SDP Auto Switch

Stone Zeng, Yongquiang Sun

ABSTRACT

The TPS2549 device is a USB charging controller and power switch which integrates D+ and D– short to VBUS protection, cable compensation, and IEC ESD protection. TPS2549 also features a charging downstream port (CDP), standard downstream port (SDP) auto switch to support data communication between a device and host controllers. This application note presents background and scheme of the CDP-SDP auto switch.

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1 Introduction to CDP and SDP

SDP is a standard downstream port, if a device is connected to an SDP, the device can implement data communication with a host controller while drawing no more than 500-mA current. A CDP is a charging downstream port which not only supports data communication with devices, but also can provide a maximum current of 1.5 A.

2 Why a CDP-SDP Auto Switch is Incorporated in the TPS2549

According to the BC1.2 specification, the moment a phone is attached to a USB port, the phone will do primary detection and secondary detection to distinguish whether it is attached to an SDP, CDP, or dedicated charging port (DCP). Figure 2 is an actual test waveform when a smartphone is attached to a CDP.

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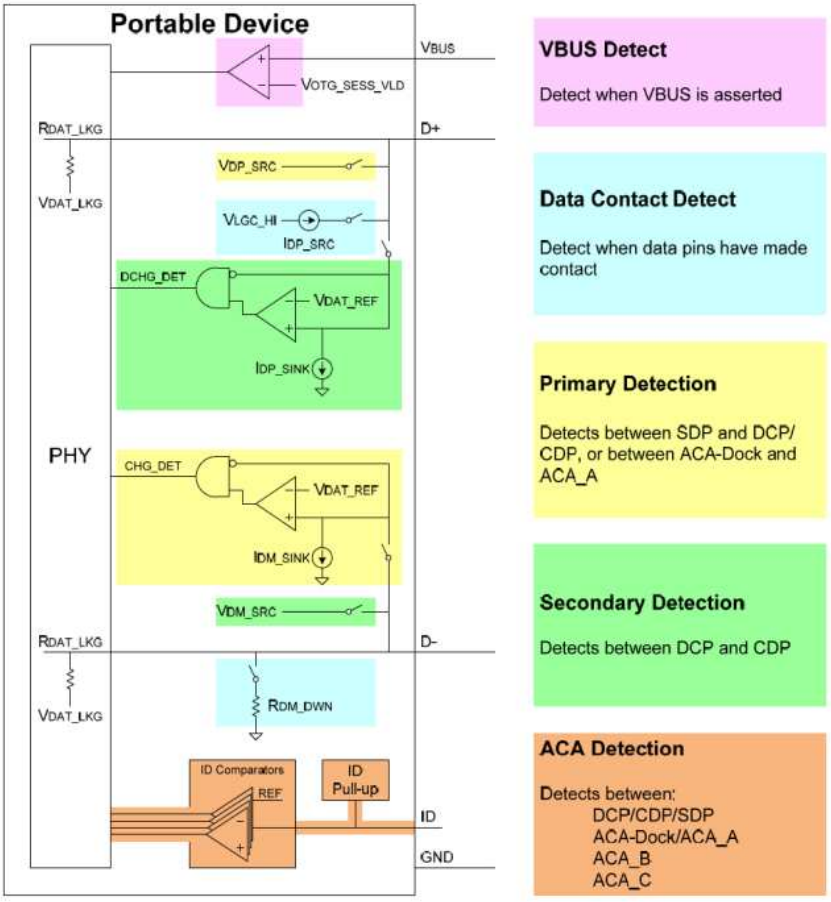

Figure 1. Charger Detection Hardware

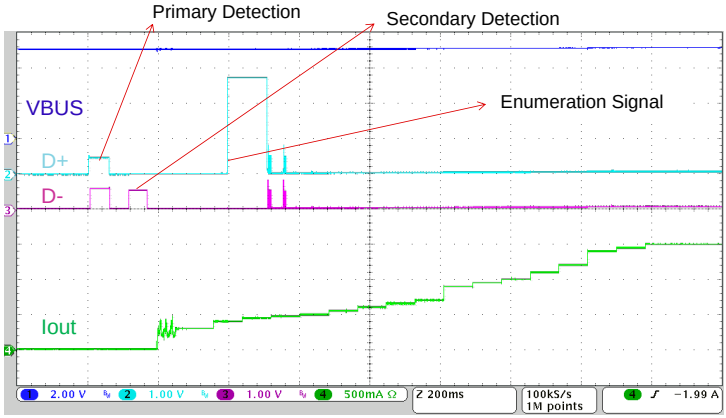

Figure 2. Primary Detection and Secondary Detection

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However, some phones in the market do not comply with the BC1.2 specification. These phones can only communicate data with the host controller in SDP mode. When attached to a USB port, they only do primary detection to distinguish between SDP and non-SDP. Consequently, these phones will classify CDP as non-SDP and they will not communicate data with the host controller but just sink charging current.

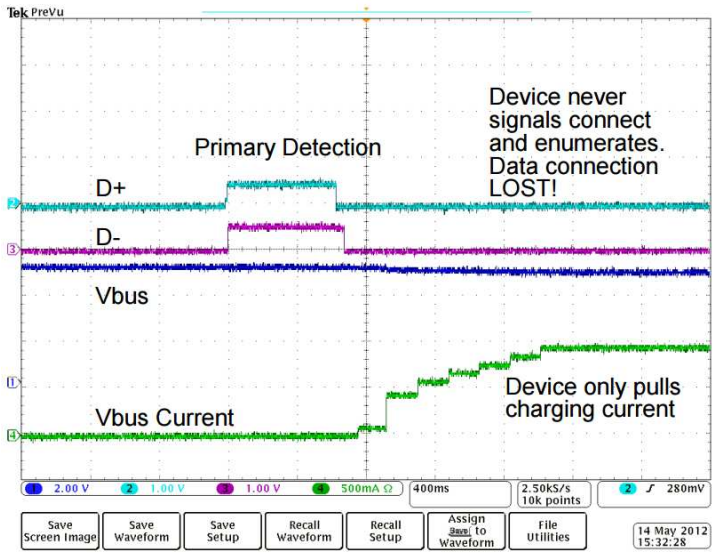

Figure 3. Waveform of a Non-Compliant Phone

3 Making Non-Compliant Phones Communicate With the Host in CDP Mode

In order to ensure that these special phones can communicate data with the host controller in CDP mode, the TPS2549 integrates a CDP-SDP auto switch. When these special phones are attached, the TPS2549 will switch from CDP to SDP automatically so that these phones can communicate data with the host controller.

4 How the TPS2549 Implements the CDP-SDP Auto Switch

1. When a non-complaint phone is attached to USB, the phone will do primary detection, and the TPS2549 will enable a timer.
2. If the TPS2549 device cannot detect the enumeration signal in 2 seconds after primary detection, it will discharge VBUS and switch to SDP mode automatically.
3. After discharging, the TPS2549 operates in SDP mode, and the non-complaint phone can communicate with the host controller.
4. After 2 seconds, the TPS2549 switches back to CDP mode, but the phones responds as if it is attached to an SDP, so it can still communicate with the host controller.

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5 Avoiding the TP2549 out Discharging

1. Set the charging mode before enabling the device.
   The TPS2549-Q1 device monitors the CTL inputs and transitions to the directed charging mode. Allow a charging port to renegotiate current with a portable device, the TPS2549-Q1 device uses the OUT discharge function. This function turns off the power switch while discharging OUT with a 500-Ω resistance, then turns the power switches back on to reassert the OUT voltage. So, in order to avoid mode changing, set CTLX first, before device enable.

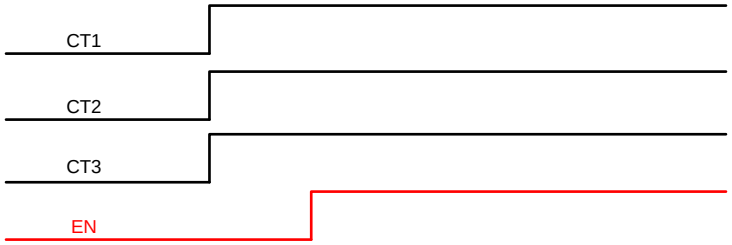

Figure 4. Fix CTx Then Pull EN Pin High

2. Use a delay to avoid triggering the CDP-SDP auto switch.
   If charging mode is CDP, during power-up stage (kernel), some processors may have unexpected 0.6 V on D+ and D– , which triggers the CDP-SDP auto switch, and discharges TPS2549 VBUS. A software delay on the EN pin can be used to fix this, as Figure 5 illustrates.

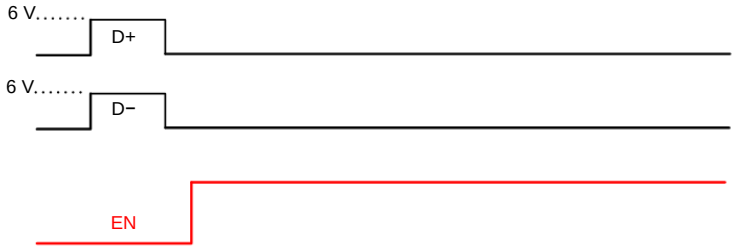

Figure 5. Delay to Avoid CPD-SDP Auto Switch

3. Ensure MCU I/O output configuration.
   The EN input must be at logic high for the TPS2549 to be enabled, usually the MCU I/O type could be push-pull output, default low is required to avoid false trigger during MCU startup, as shown in Figure 6.

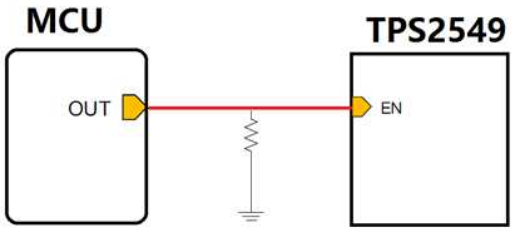

Figure 6. Push-Pull Output (Default low)

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For open drain output, an RC delay is required to avoid false trigger. Enable pin raising threshold is 1 V, the delay time is calculated using t = 0.36 RC.

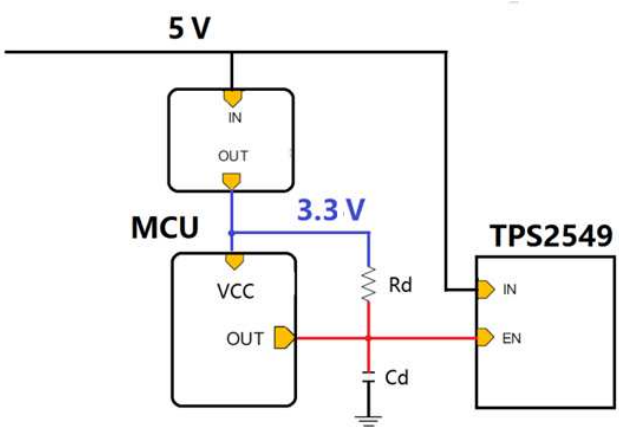

Figure 7. Open-Drain Output With RC Delay

6 References

The following TI documents are available from www.ti.com:

1. TPS2549 USB Charging Port Controller and Power Switch With Cable Compensation (SLUSCP2)
2. USB Specification: USB Implementers's Forum, *Battery Charging Specification*

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