Application Note

Liquid Detection and Corrosion Mitigation for Type-C PD

Abstract

Since the introduction of USB Type-C® and Power Delivery, many applications have adopted this universally accepted connector as the main USB interface. Portable USB Type-C applications such as bluetooth speakers, E-bikes, and power tools are more likely to be subjected to environments that introduce debris or liquid into the USB Type-C connector. This causes unwanted shorts between the connector pins which in turns accelerates the rate of corrosion on the USB Type-C connector, potentially compromising the connector's integrity and rendering it unusable. With these risks to the Type-C connector, it is important to be able to protect the system from these unexpected shorts. TPS25751A, TPS25752A and TPS26750A supports USB-C PD liquid detection and corrosion mitigation features to protect the system and the USB Type-C connector from corrosion when liquid is detected. This application note describes the hardware and firmware implementation of the liquid detection feature of TPS25751A, TPS25752A, and TPS26750A.

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1 Introduction

1.1 What is Liquid Detection and Why is It Needed?

In a connected state, the VBUS supports up to 20V (SPR) or 48V (EPR), while the CC and VCONN pins reach approximately 5V. Even in an unattached.SNK or unattached.SRC state, a DRP source pulls the CC lines to a voltage between 3V and 5V. This creates a risk of corrosion on the connector pins, which eventually damage the USB interface and the wider system, see corrosive damage to a type-C port in Figure 1-1. To mitigate this, the USB Type-C® Specification (Revision 2.3) introduced a liquid detection mode. This standard requires the device to transition to a 0V state to prevent corrosion.

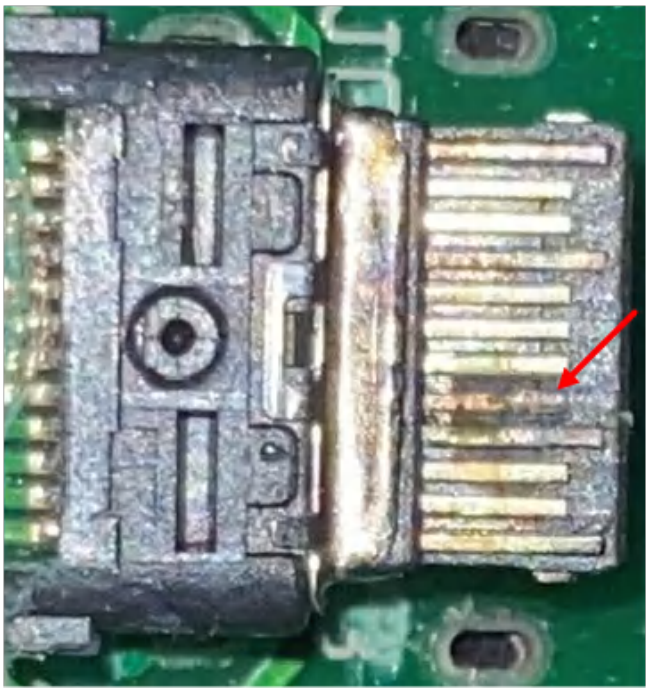


Figure 1-1. Corrosion on Type-C Port

In an attached.SNK or attached.SRC state, the VBUS pins support up to 20V for SPR and a maximum of 48V for EPR along with the CC and Vconn pin reaching up to approximately 5V. Even in an unattached.SNK or unattached.SRC state a source only or DRP USB Type-C connector pulls the CC lines up to 3V-5V. In these states if the connector pins are shorted, the VBUS voltage levels eventually cause corrosion within the connector, damaging the USB interface and possibly the system as well. Having the ability to prevent and reduce corrosion damage can increase the lifetime of the system.

TPS25751A, TPS25752A, and TPS26750A devices from Texas Instruments are able to support the liquid corrosion mitigation method as described in the USB Type-C Specification to determine if a short is present on the USB Type-C connector. This methodology measures the leakage voltage between pins to determine if there is a short using dedicated measurement pin(s). TPS25751A, TPS25752A, and TPS26750A implement this feature using minimal external circuitry. This feature is also customizable through the USBCPD Application Customization Tool.

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1.2 Definitions

This section identifies keywords and definitions within this document. Definitions are based on the USB Power Delivery Specification Revision 3.2.

Corrosion Mitigation	Reduces corrosion risk by driving the CC pins to a near-zero voltage level, preventing unintended current flow during unattached states.
Attached state	The device has detected a valid connection through the CC pin(s) — meaning a cable and/or partner device is plugged in, and the correct pull-up (Rp) / pull-down (Rd) termination has been sensed for a minimum debounce time (tCCDebounce). Once attached, the port locks in its role (source or sink) and moves into states such as Attached.SRC or Attached.SNK.
Unattached state	In this state, a port is actively driving/monitoring its CC pin(s) to *detect* a potential connection. There are typically sub-states like Unattached.SNK and Unattached.SRC, where the port alternates checking whether it should behave as a source or sink, based on pull-up/ pull-down resistor detection on CC.
Entering Liquid Detected state	The port detects electrical behavior on monitoring pins consistent with liquid or contamination, so it assumes water/corrosive material is present. Upon entering this state the port is classified as *wet*.
Exiting Liquid Detected state	The port detects the monitoring pins surpass the dry thresholds— for example, the monitoring pins return to values consistent with the no liquid conditions (indicating the liquid has dried or drained). Upon entering this state the port is classified as *dry*.

1.3 Liquid Detection Method Overview

TPS25751A, TPS25752A, and TPS26750A use pin(s) on the connector as the measurement pin and toggles the known bias level between Ground (0V) and 3.3V when taking measurement samples.

The SBU1/SBU2, CC1/CC2, or Dp/Dm pairs will be utilized for this functionality. The user determines the measurement pins based on specific detection requirements for the system. For details on selecting monitoring pins based on design considerations , see Hardware Implementation and Requirements.

When the measurement lines are biased to 3.3V, the PD controller monitors for shorts to ground (0V). Conversely, when the lines are biased to ground, the PD controller monitors for shorts to any higher-voltage pins on the connector. This dual-bias approach ensures that any unintended shorts between the measurement lines and the VBUS or other active pins are detected.

Once the PD controller successful loads the configuration bundle, sample measurements are compared to the threshold values to ensure no unwanted shorts are occurring. If a short occurs and a high threshold or low threshold is surpassed, the PD controller will enter liquid detected state. If Corrosion Mitigation is enabled the power path is disabled which in turns removes the VBUS voltage and the CC line are set to open. The PD controller continues to sample the voltage reading from measurement line to determine if there is still a short present. When the voltage reading exceeds the no liquid condition , the PD controller exits the liquid detected state.

See Figure 1-2 and Figure 1-3 for the flow diagram for both the CC lines and SBU pins/unused pins implementation respectfully.

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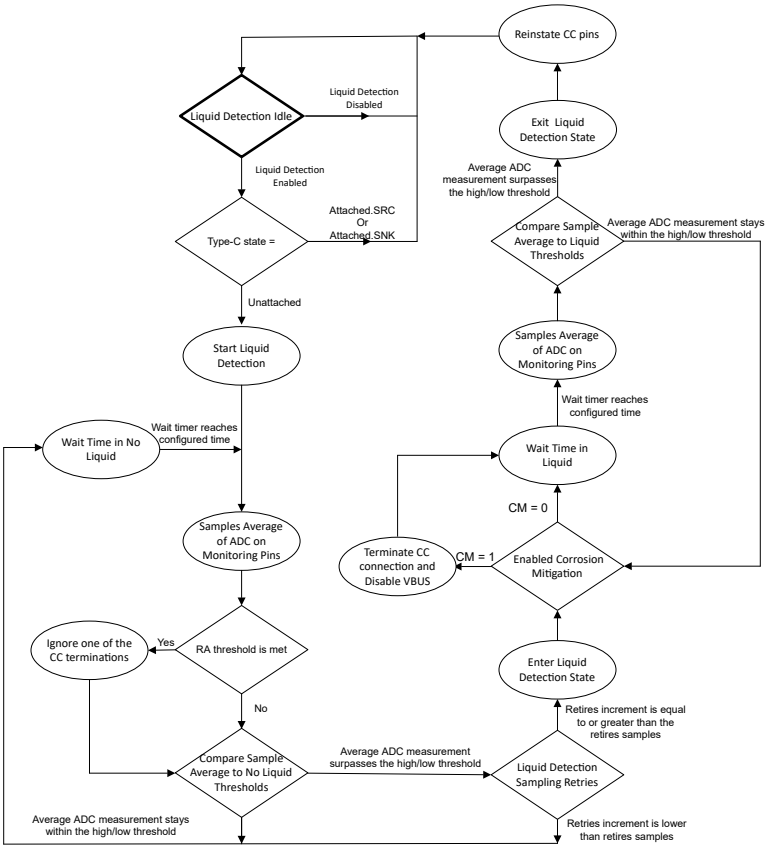


Figure 1-2. CC Pins Flow Diagram

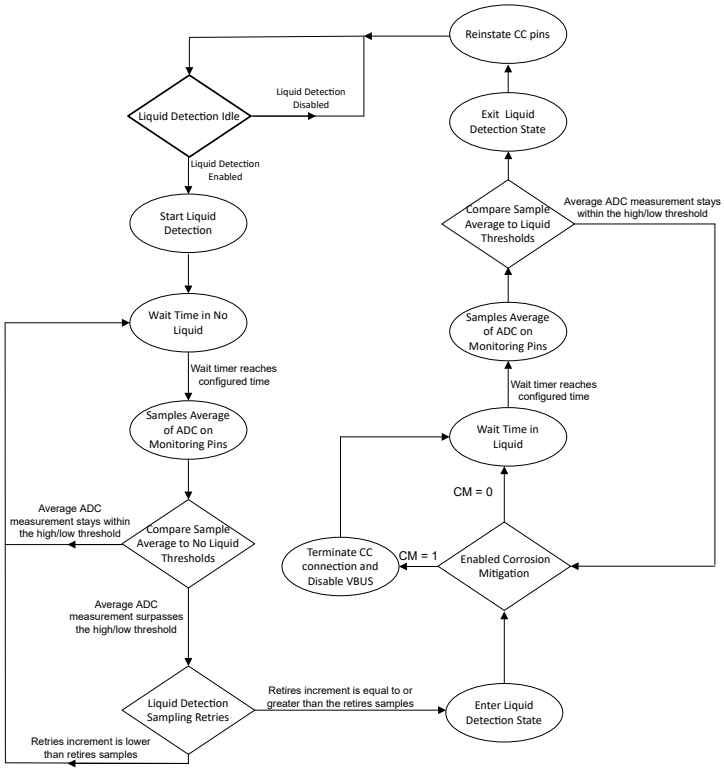


Figure 1-3. SBU Pin/Unused Pins Flow Diagram

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2 Detailed Description

2.1 Hardware Implementation and Requirements

The CC pins or any unused pins, such as SBU or Dp/Dm pins, will be used as the measurement pins on the USB Type-C connector.

TPS25751A, TPS25752A, and TPS26750A do not support Alternate Modes (for example, DisplayPort, Thunderbolt, and so on.), and therefore the SBU pins are a common choice for measurement pins. The SBU pins are close in proximity to the center of the USB Type-C connector, this provides area of sampling to detect shorts of VBUS, CC and Ground. The SBU pins are able to support liquid detection in a attached or unattached state.

The CC lines cannot differentiate between PD communication signals and liquid detection signals. Consequently, liquid detection is only a reliable implemented when the CC pins are in an unattached.SNK or unattached.SRC state. To avoid interference, the CC1 and CC2 lines should only be utilized for sampling when no active PD connection is present.

Once the monitoring pins are selected, they are routed from the connector to TPD4S201 or the TPD4S480 for over-voltage protection (in scenarios if the SBU pins are shorted to higher than 5V) to GPIO0 and GPIO2 of the PD controller. The GPIO pins are rated up to 6V and therefore cannot withstand a short to VBUS event. TPS25751A and TPS25752A are paired with TPD4S201 for SPR applications and TPS26750A is paired with TPD4S480 for EPR applications.

The GPIO0 and GPIO2 pins are used for the ADC Enable configuration, utilizing their built-in ADC functionality to measure voltage. For liquid detection, an additional output GPIOx and input GPIOy are required. Additionally, a GPIOz pin can be used as an optional output. For details on the configuration of the GPIOs used in liquid detection, see Section 2.2.2.

Both the required and optional GPIOs are depicted in Figure 2-1. In this specific example, the CC pins are used for monitoring, while the SBU lines are left floating. For further details on each pin's function, please refer to the Section 2.1.1.

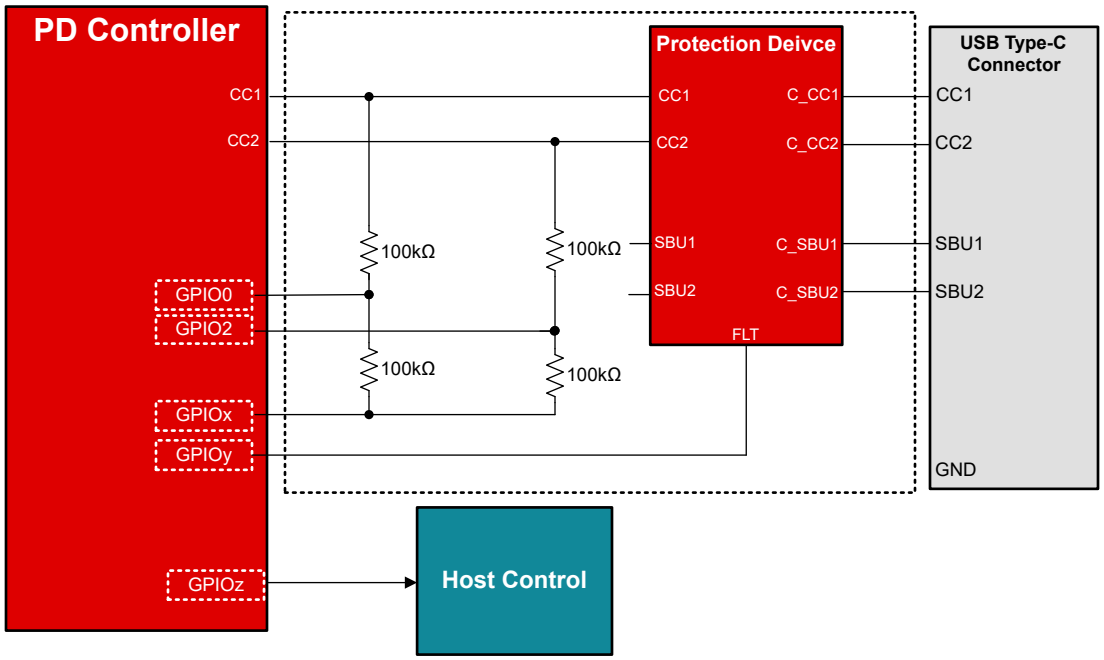


Figure 2-1. CC lines Hardware Implementation

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2.1.1 GPIO Hardware Requirements

As shown in Figure 2-1, GPIOx is used for controlling the bias voltage on the monitoring pins. GPIOx is tied to both GPIO0 and GPIO2 through a resistor. The recommended minimum resistance for the resistor used in the sampling of the measurement pins is 100kΩ.

GPIOy is an input event from the protection device to the PD controller. In the GUI configuration tool, the GPIOy pin must be mapped to the fault input event (33) within the GPIO Mapped Event field. When the input signal is asserted high, the PD controller will enter ErrorRecovery mode and disable the VBUS power supply.

In Figure 2-2, GPIOx is GPIO7 and GPIOy is GPIO1.

An optional GPIOz, may be used to inform a host device when the device is entering or exiting the liquid detected state. Configure the GUI tool to any unused GPIO on the PD controller, and assign the GPIOz pin to liquid detected event (157) in the GPIO Mapped Event field. A 10kΩ pullup resister tied to LDO_3V3 is recommended.

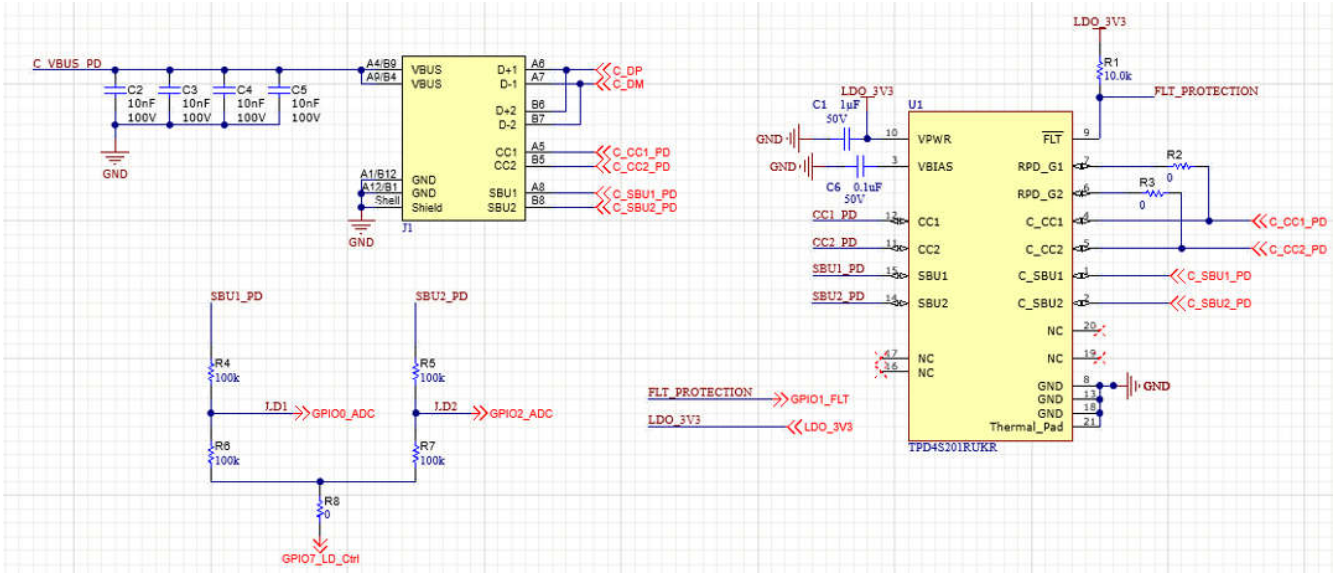


Figure 2-2. *Liquid Detection Example Schematic with TPS25751A and TPD4S201*

2.2 Firmware Implementation and Requirements

The USB-C PD Application Customization Tool enables users to configure liquid detection parameters, including number of samples, timing, and threshold voltage ranges. Please note that the tool's default settings may not align with all application requirements; users should review the individual register descriptions to ensure the configuration is optimized for their specific system.

2.2.1 Interrupt Event/Mask/Clear for I2C1 (register 0x14/0x16/0x18)

The interrupt event/mask/clear registers are intended for systems with an external microcontroller interacting with the PD. The interrupt mask is initialized and configured through the USBCPD Application Customization Tool.

The optional Liquid Detection interrupt triggers during a state transition when entering or exiting liquid detected. When a short is detected, the ADC measurement on the GPIO pins exceeds the 'Dry' threshold, signaling that liquid is present on the USB Type-C connector. Upon an interrupt event, the microcontroller reads the Interrupt Event (0x14) register to identify the trigger. Following the required response, the event is cleared by writing a '1' to the corresponding bit in the Interrupt Clear (0x18) register. To ensure reliable operation, the interrupt masking must be configured via the USBCPD Application Customization Tool and included in the generated configuration file. Modifying masking settings during active PD operation is not recommended, as it interferes with real-time interrupt events.

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2.2.2 GPIO Configuration (register 0x5c)

The USBCPD Application Customization Tool is used to configure all GPIOs. The GPIO Configuration (0x05) register allows the user to configure the GPIO pins of TI PD controllers. Three GPIOs are required for proper liquid detection operation, with one additional optional GPIO to signal a liquid detected event. The GUI tool generates a configuration file (either binary or C array) that is then loaded to the PD controller. It is important to note that the GPIOs cannot be modified during operation.

As shown in Figure 2-2, GPIO0 and GPIO2 are connected to the protected measurement pin through a resistor to the measurement pins of the USB Type-C connector. These GPIOs are multiplexed to the ADC functionality to measure the voltage on the monitoring pins.

Within the IO Configuration (0x05) register, both GPIO0 and GPIO2 must have-

- Multiplexing for GPIO Pin[1:0] field set to Pin Multiplexed to ADC*(0x1)*
- *Analog Input Control [224/226] field* set to *Pin to ADC (0x1)*
- OutputEnable [0/2] disabled and left unchecked

GPIOx (refer to *Figure 2-1*) is configured through the GUI tool. The default configuration for the TPS25751A, GPIO7 is set as the *GPIO Mapped Event [351:344]*[1] as *LIQUID _CONTROL (155)*.

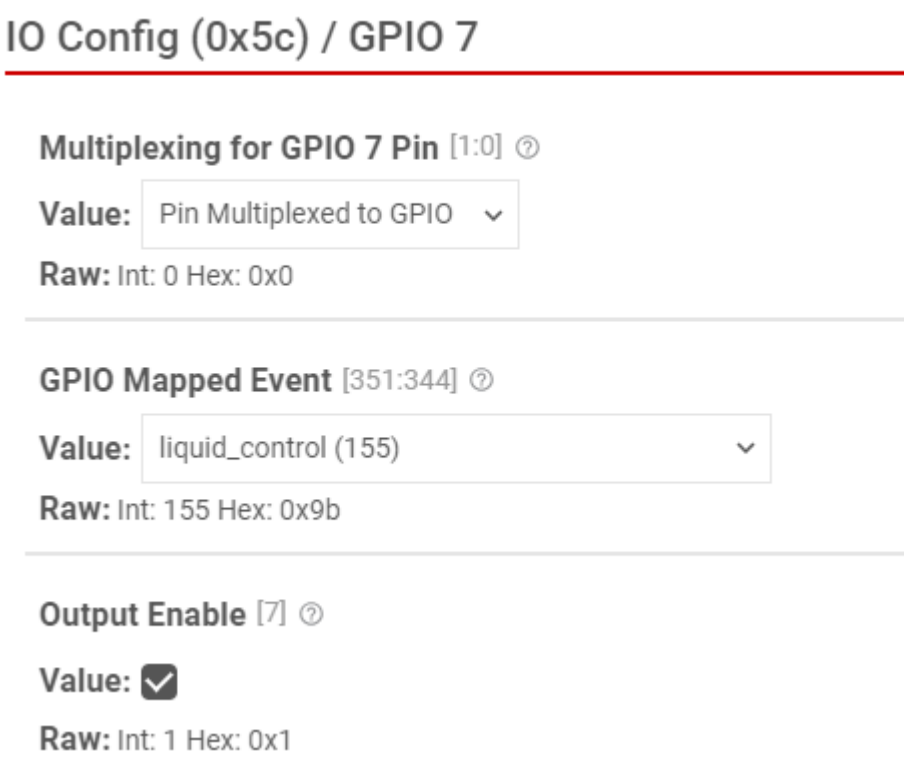


Figure 2-3. *GPIO7 Configured as liquid_control (155)*

An required GPIOy input event *FAULT_INPUT_EVENT_PORT1 (33)* is tied to any available GPIO pin. This input event signal is supplied by the protection device. Upon a fault condition on the protection device, a signal is sent to the input GPIOy, that then send the PD controller into UUSBPD ErrorRecovery.

An optional GPIOz event *LIQUID_DETECTED (157)* can be tied to any available GPIO pins. If GPIOz is configured, it will be driven high when the PD enters a Liquid Detected state and goes low when the PD exits the liquid detection state. Figure 2-3 shows the TPS25751A defaults GPIO6 for liquid detected GPIO event. This

[1] The bit field location for the mapped event varies based on which GPIO is used, the event number remains the same.

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is done by setting *GPIO Mapped Event[343:336]* [1] to *LIQUID_DETECTED (157)* event and Output Enable [6] enabled and checked.

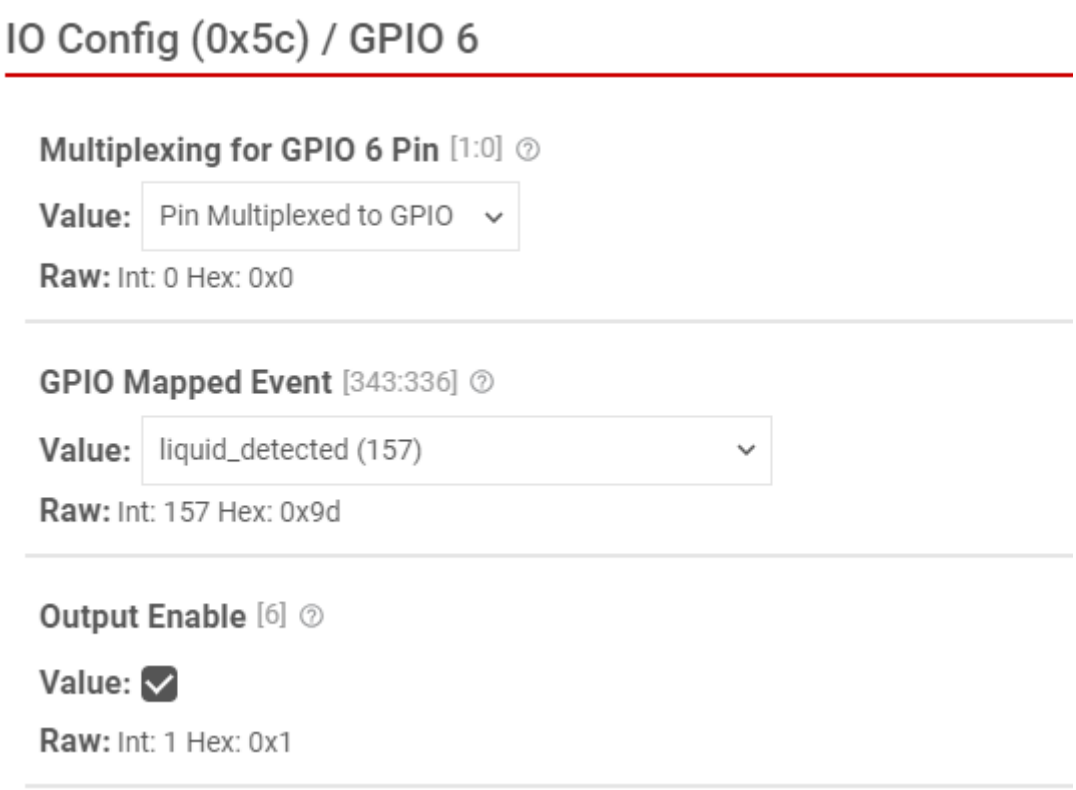


Figure 2-4. *GPIO 6 Configured as liquid_detected (157)*

2.2.3 Liquid Detection Configuration (register 0x98)

The Liquid Detection Configuration register contains all the configurable settings for liquid detection including-

- Number of samples
- Timing between sampling
- Hysteresis range for entering and exiting liquid detected state
- Enable bits for liquid detection and corrosion mitigation
- Enable bits for monitoring during an attached.SNK/attached.SRC state or unattached.SNK/unattached.SRC state

In order to enabled the deafult configuratrion for the liquid detection feature, Question 8 of the Application Cusatimization Tool questionare must be set to "Yes". To perform any modifcations to the defualt settings, the user will need to enter "Advance Mode" within the GUI tool. See the USBCPD Application Customization Tool User Guide Table 4-9 for the default configuration settings used for the TPS25751A, TPS25752A, and TPS26750A.

The configuration settings discussed in the following section is be found in the Application Customization Tool.

2.2.3.1 Wait Timing

The sampling interval defines the time between successive measurements during both wet and dry states. This delay is customized via the 'Wait Time' fields to control the timing of the transition on the USB Type-C connector. Higher wait time results in less power consumption but takes more time to enter/exit liquid detected state depending on when the short(s) occurred and when the sampling takes place. Likewise, shorter wait time allows the PD to detect liquid faster but increases the power consumption.

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2.2.3.1.1 Wait Time in Seconds Non-Liquid [7:0]

During the wait period in a dry state, both VBUS and CC lines remain active for normal operation. As illustrated in Figure 3-4, a wait timer of about 4 seconds is observed to manage the interval between sampling events in a no liquid state.

2.2.3.1.2 Wait Time in Seconds Liquid [15:8]

During the wait timer in a wet state, VBUS and CC are disabled (if *Enable Corrosion Mitigation 81b* is enabled) and the PD is in Liquid Detected state. Figure 3-5, a wait timer of about 6 seconds is observed to manage the interval between sampling events in a liquid state.

2.2.3.2 Sample Timing and Retires

The Sample Time fields enable customizable timing intervals for the toggle signal used to acquire liquid detection measurements on the ADC GPIO pins. A single sampling cycle consists of two square waves on the ADC lines, see one sample period in Figure 3-1. This complete pulse sequence is required to accurately characterize the liquid detection state. Increasing the sample time allows for the voltage reading to settle and may produce more accurate measurements but takes more time for the sampling interval to complete. Likewise, low sample time allows for faster sampling intervals but may produce less accurate measurements if the voltage hasn't fully settled. The sample timing must be considered in conjunction with the number of samples.

The retry fields are activated immediately after the no liquid threshold is crossed. This enables the PD controller to re-sample the ADC results on the measurement pins to confirm that the short persists for a defined duration. If the short was a transient event rather than a true liquid detection, the retry mechanism prevents a false positive by validating the presence of liquid before transitioning to the liquid detected state.

2.2.3.2.1 Sample Time in 10ms No Liquid [19:16]

The PD controller implements a settling delay following a GPIOx transition. This delay allows the pulse to stabilize, compensating for the RC time constant of the hardware implementation. This settling period is required for both high and low-level pulses during a 'dry' condition to prevent false detection before the device transitions to the next state. Figure 3-2, a sample of about 50ms is observed in a no liquid state.

2.2.3.2.2 Sample Time in 10ms Liquid [23:20]

The PD controller implements a settling delay following a GPIOx transition. This delay allows the pulse to stabilize, compensating for the RC time constant of the hardware implementation. This settling period is required for both high and low-level pulses during a 'wet' condition to prevent false detection before the device transitions to the next state. Figure 3-3, a sample of about 40ms is observed in a no liquid state.

2.2.3.2.3 Liquid Detection Retries Wait Time [27:24]

The liquid detection retries wait time functions similarly to the wait time fields but applies specifically during retry sampling. This enables a faster confirmation cycle than the standard sampling interval, accelerating the transition to the liquid detected state. Figure 3-6 shows the wait time differs during the retry mechanism, thus allowing for a reduced wait time in between samples.

2.2.3.2.4 Liquid Detection Retries [31:28]

The liquid detection retries field specifies the number of confirmation cycles required before enter liquid detection state. The retry count controls how many additional sampling cycles must confirm the presence of liquid. Figure 3-6 shows that once the high threshold is exceeded, the device performs the configured number of retries before committing to the state change. This provides a configurable debounce mechanism that is specific to the users hardware characteristics and environmental conditions.

2.2.3.2.5 Number of Samples [39:32]

The number of samples to take for both high and low measurements. This field value is in terms of 2^n samples. As illustrated in Figure 3-1 the monitoring process involves two sampling cycles, appearing as two square waves on the measurement lines during the detection phase.

2.2.3.3 High and Low Threshold Measurements

After the PD has collected 2^n samples for both high and low, it computes two average values for the high and low measurements and compares against the set high and low thresholds. The PD controller allows the

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user to configure the high and low threshold to enter/exit the Liquid Detected state. The high measurement average is compared against the High Threshold ADC values to see if there are any shorts to ground. The low measurement average is compared against the Low Threshold ADC values to see if there any shorts to positive voltage. The high/low threshold value ranges from 3.3V to 0V for the register fields.

It is important to correctly set the high and low threshold voltages. If set incorrectly, the PD controller will falsely detect liquid and remain in the liquid detection state. For example, if the high threshold voltage is set to 3.0V but the analog voltage on the SBU line (in non-liquid condition) is actually 2.7V, this will lead to the PD detecting a false detection. When setting up the high and low thresholds, take into consideration the hardware (resistor value, board impedance, layout) and how to align those measurements properly with the configurable thresholds.

In Figure 2-5, an illustration setting the no liquid and liquid high thresholds at different values. For During a liquid short event, the voltage is pulled below the defined 'High Threshold No liquid.' Setting the 'no liquid' threshold higher than the 'liquid' threshold ensures the device only transitions out of the liquid state once the pins are completely dry.

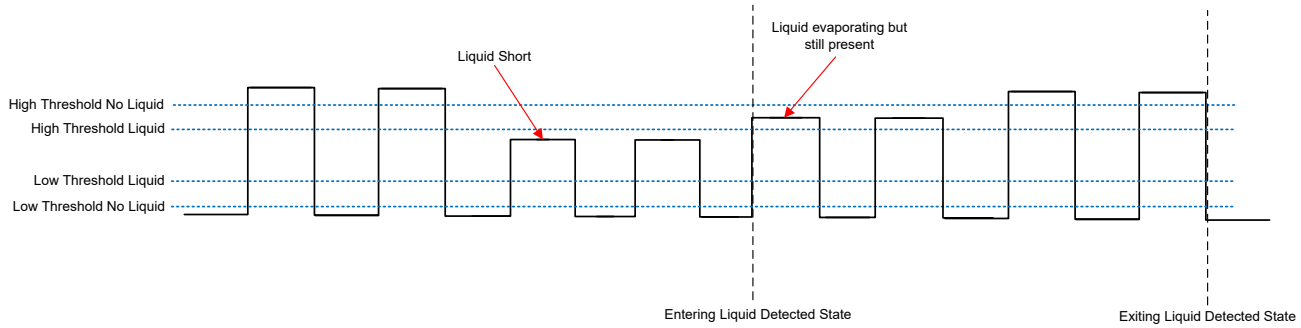


Figure 2-5. *Differentiating the High Thresholds for Liquid Detection*

2.2.3.3.1 Low Threshold ADC No Liquid [47:40]

The low voltage threshold to exit the Liquid Detected state. The PD uses this value to compare against the low samples to determine if there are shorts to positive bias voltage pins. This field must be less than or equal to the Low Threshold ADC Liquid field, otherwise the PD will not be able to exit the Liquid Detected state.

2.2.3.3.2 High Threshold ADC No Liquid [55:48]

The high voltage threshold to exit the Liquid Detected state. The PD uses this value to compare against the high samples to determine if there are shorts to ground level pins (0V). This field must be greater than or equal to the High Threshold ADC Liquid field, otherwise the PD will not be able to exit the Liquid Detected state.

2.2.3.3.3 Low Threshold ADC Liquid [63:56]

The low voltage threshold to enter the Liquid Detected state. The PD uses this value to compare against the low samples to determine if there are shorts to positive bias voltage pins. This field must be greater than or equal to the Low Threshold ADC No Liquid field, otherwise the PD will not be able to enter the Liquid Detected state.

2.2.3.3.4 High Threshold ADC Liquid [71:64]

The high voltage threshold to enter the Liquid Detected state. The PD uses this value to compare against the high samples to determine if there are shorts to ground level pins (0V). This field must be less than or equal to the High Threshold ADC No Liquid field, otherwise the PD will not be able to enter the Liquid Detected state.

2.2.3.4 Enable Liquid Detection [72]

Main control bit to enable liquid detection on the monitoring pins that interact with the PD controller. Enabling liquid detection requires the proper external liquid detection circuitry and configuration in place. An external microcontroller may enable or disable this feature on the fly when the PD is operating, any modification to this field will only take effect the next time the appropriate policy is invoked.

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2.2.3.5 Enable Corrosion Mitigation [73]

If enabled, the PD automatically handles corrosion mitigation. When liquid is detected, the PD will disconnect and disable the port by removing VBUS and releasing the CC pins. If this bit is disabled, the PD will continue normal operation even if liquid is detected on the USB Type-C connector. An external microcontroller may enable or disable this feature on the fly when the PD is operating, any modification to this field will only take effect the next time the appropriate policy is invoked. Figure 3-8 shows the behavior when Corrosion Mitigation is disabled, while Figure 3-6 shows the behavior when Corrosion Mitigation is enabled. Once liquid is detected, the VBUS power and CC signaling remains.

2.2.3.6 Monitor During Attach [74]

The liquid detection mechanism must support sampling during the attached state. Per the USB PD specification, the Attached.SRC (or Attached.Sink) state is the period after a connection is established. Initiating sampling during this window allows the PD controller to verify the integrity of the monitoring pins and ensure no shorts are present before the next attachment event occurs.

2.2.3.7 Monitor During Unattached [75]

The liquid detection mechanism must support sampling during the unattached state. Per the USB PD specification, the Unattached.SRC (or Unattached.SNK) state is the period after a connection is broken and before a new connection is established. Initiating sampling during this window allows the PD controller to verify the integrity of the monitoring pins and ensure no shorts are present before the next attachment event occurs.

2.2.3.8 Liquid Pins to Monitor [77:76]

SBU, CC, or Dp/Dm will be used as the measurement pins on the USB Type-C connector. TPS25751A, TPS25752A, and TPS26750A do not support Alternate Modes (i.e. DisplayPort, Thunderbolt, etc.), and therefore the SBU pins are a common choice for measurement pins. The SBU pins and CC pins are close in proximity to the center of the USB Type-C connector, this provides area of sampling to detect shorts of VBUS, CC and Ground. The SBU pin implementation supports liquid detection in a attached or unattached state.

2.2.3.9 Pulldown Threshold ADC [87:88]

During the transition from an unattached to an attached state, the PD controller performs a final sampling cycle to verify the presence of liquid. If an E-marked cable is used, an internal *Ra* resistor is present on the CC line. In this scenario, the liquid detection algorithm must account for this *Ra* resistance during the measurement window. To avoid false detections, the controller compares the measured impedance of both CC1 and CC2 to the low threshold, high thresholds and the Pulldown Threshold. If the Ra threshold is met, the PD controller will ignore the Ra measurement from the CC lines and look to the opposing CC line measurement to compare to the low and high thresholds.

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3 Detailed Application Procedure

This section of the application note highlights common test cases for liquid detection using the TPS25751AEVM.

3.1 Example Liquid Detection Configuration

Table 3-1 is intended for demonstration purposes and slightly differs from the default device settings. The example waveforms found within Section 3.2 will align with the configuration described below unless stated in the description prior to the waveform.

Table 3-1. Example Liquid Detection Configuration

Register	Field Name	Example Value
IO Config (0x5c)	GPIO AI Enable GPIO 0 [224]	Pin to ADC (0x1)
	GPIO AI Enable GPIO 2 [226]	Pin to ADC (0x1)
	GPIO 6 Mapped Event [343:336]	liquid_detected (157)
	GPIO 7 Mapped Event [351:344]	liquid_control (155
Liquid Detection Configuration (0x98)	Wait Time In Sec Non-Liquid	4000ms
	Wait Time In Sec Liquid	6000ms
	Sample Time in 10ms Non-Liquid	50ms
	Sample Time in 10ms Liquid	40ms
	Liquid Detection Retries Wait Time	500ms
	Liquid Detection Retries	3
	Number of Samples	2
	Low Threshold ADC (No) Liquid	504mV
	High Threshold ADC (No) Liquid	2002mV
	Enable Liquid Detection	Enabled
	Enable Corrosion Mitigation	Enabled
	Monitor During Attach/Detach	Enabled
	Liquid Pins to Monitor	SBU
	Single Pin Monitoring	Disabled
	Pulldown Threshold ADC	0mV

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3.2 Application Performance Plots

The following section provides Saleae logic analyzer waveform captures. These traces are intended to illustrate the expected signal transitions and timing behavior and power path transitions based on the Example Liquid Detection Configuration. A resistive short to GND is used to simulate liquid in the waveforms below.

3.2.1 Number of Samples Waveform

Number of Samples example is defined in Table 3-1; see Section 2.2.3.2.5 for description of Number of Samples[39:32].

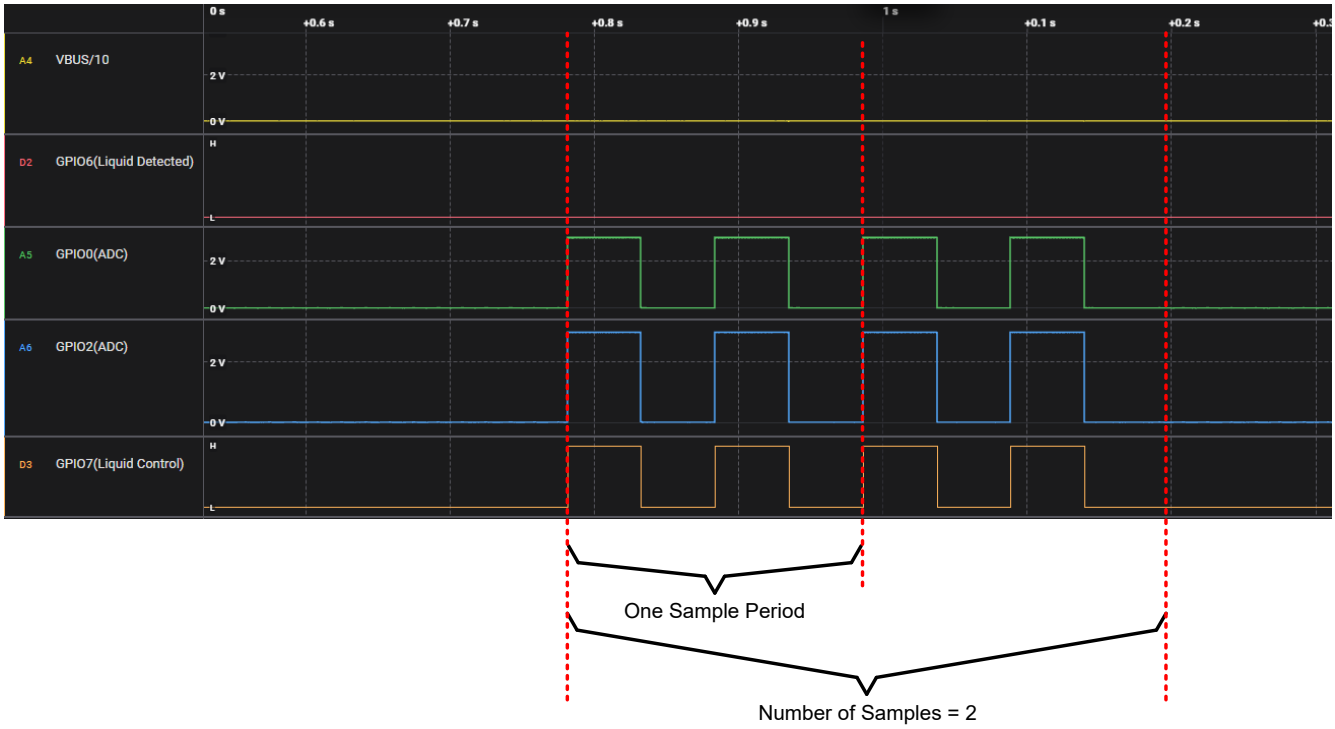


Figure 3-1. Number of Samples Waveform

3.2.2 Sample Time in No Liquid Waveform

Sample Time in No Liquid example configuration is defined in Table 3-1; see Section 2.2.3.2.1 for description of Sample Time in 10ms No Liquid[19:16].

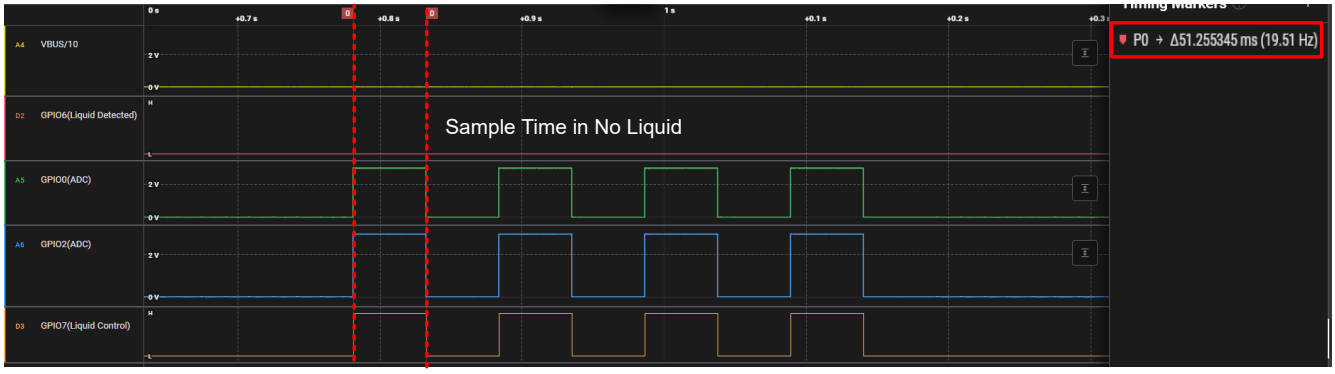


Figure 3-2. Sample Time in No Liquid Waveform

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3.2.3 Sample Time in Liquid Waveform

Sample Time in Liquid example configuration is defined in Table 3-1; see Section 2.2.3.2.2 for description of Sample Time in 10ms No Liquid[23:20].

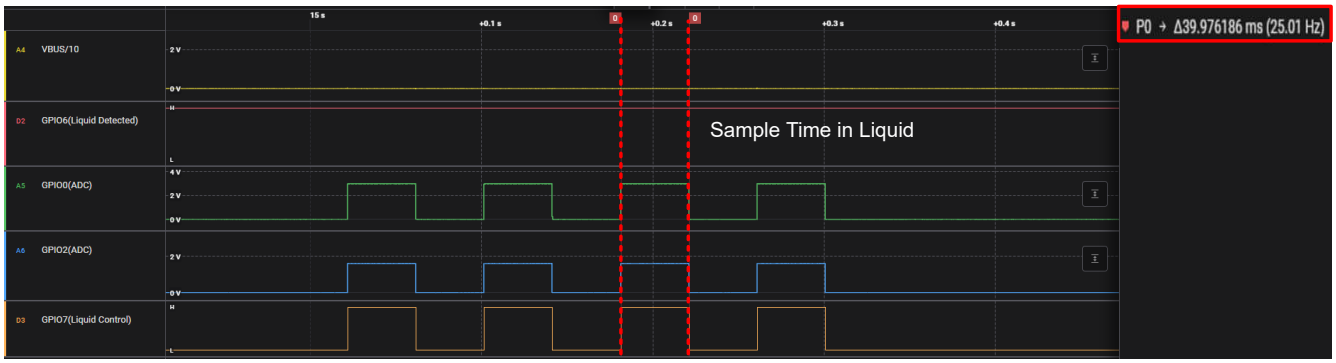


Figure 3-3. Sample Time in Liquid Waveform

3.2.4 Wait Time in No Liquid Waveform

Wait Time in No Liquid example configuration is defined in Table 3-1; see Section 2.2.3.1.1 for description of Wait Time in Seconds Non-Liquid [7:0].

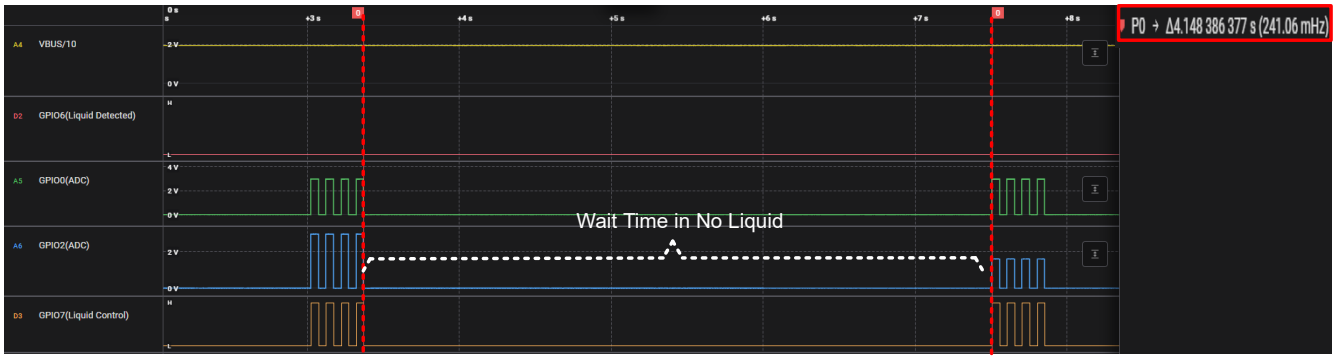


Figure 3-4. Wait Time in No Liquid Waveform

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3.2.5 Wait Time in Liquid Waveform

Wait Time in Liquid example configuration is defined in Table 3-1; see Section 2.2.3.1.2 for description of Wait Time in Seconds Liquid [15:8].

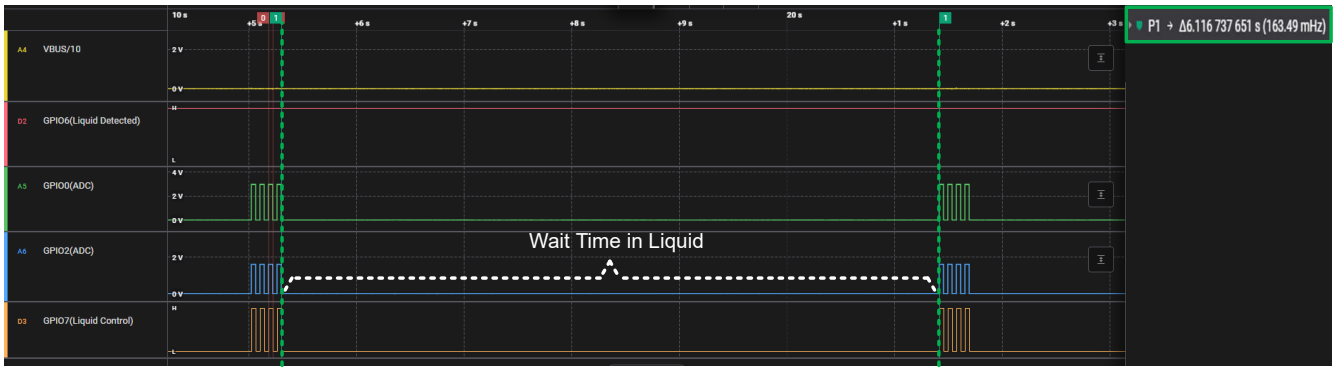


Figure 3-5. Wait time in Liquid Waveform

3.2.6 Entering Liquid Detection Waveform

Entering Liquid Detection Waveform highlights numerous Liquid Detection Configuration Fields that are defined in Section 3.1. Once the short to GND occurs, GPIO0 high voltage reading is seen being pulled to approximately 1.8V. The high threshold in no liquid is surpassed, thus the retry sampling behavior begins. The retry samples ensured the short to GND still remained. The reties sampling occurs three times with a wait time of 500ms in between each sample. Once the retires confirm the short it still present, the PD controller enters the liquid detected state. See Section 2.2.3.2.4 for more on the retires field and Section 2.2.3.2.3For more on the retied wait timer field. Since corrosion mitigation is enabled, see Section 2.2.3.5 for more on the corrosion mitigation filed in the configuration, the VBUS div 10 is disabled due upon entering the liquid detected state.

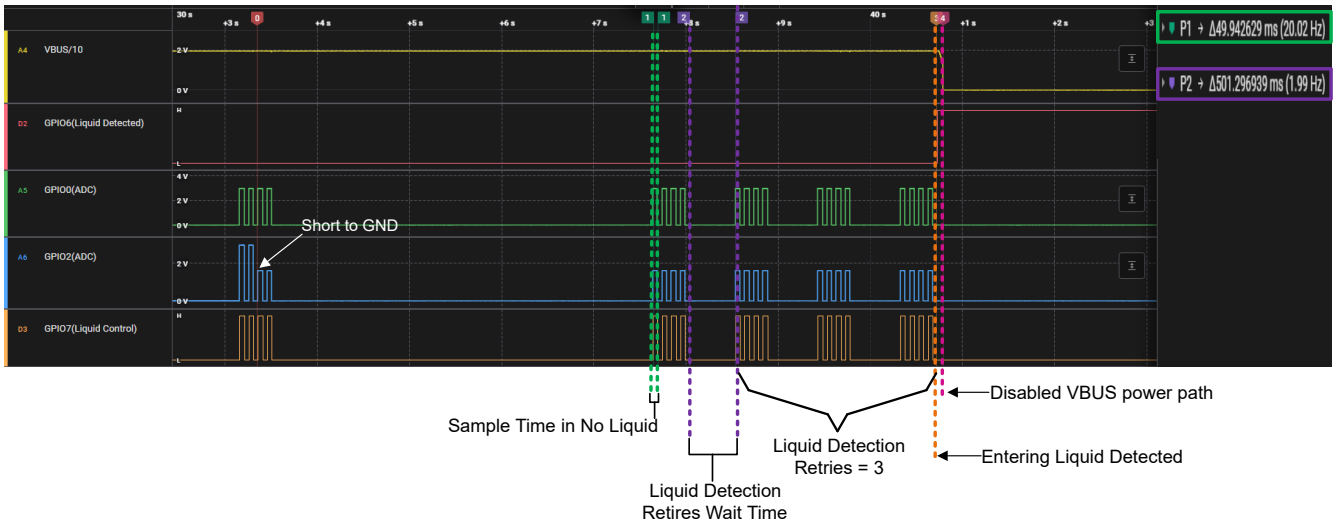


Figure 3-6. Entering Liquid Detection Waveform

3.2.7 Exiting Liquid Detection Waveform

In the Exiting Liquid Detection Waveform, the short to GND connection is present on the PD controller. During the wait time in liquid, the short is removed. Upon the next sampling period the PD controller sees the ADC measurement surpasses the high threshold liquid setting. The PD controllers exits the liquid detected state and asserts the liquid detected GPIO LOW. Corrosion Mitigation is deasserted and the VBUS power path is available.

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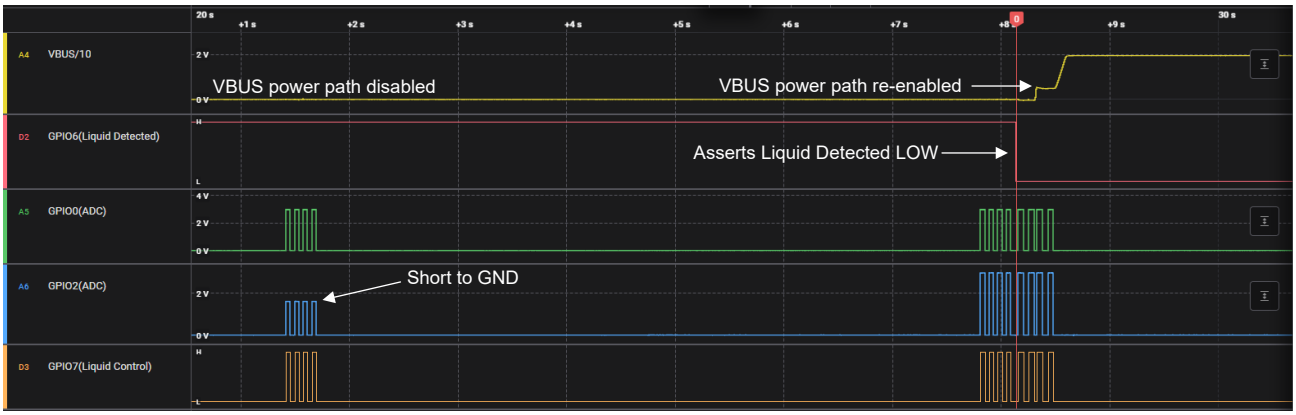


Figure 3-7. Exiting Liquid Detection Waveform

3.2.8 Corrosion Mitigation Disabled Waveform

This example differentiates from the configuration described in Table 3-1. For Corrosion Mitigation Disabled Waveform, the Corrosion Mitigation setting is configured to 0, meaning upon entering the liquid detected state, the VBUS power path remains enabled. This behavior is reflected in the example waveform below, when liquid is detection, the VBUS power path remains intact.

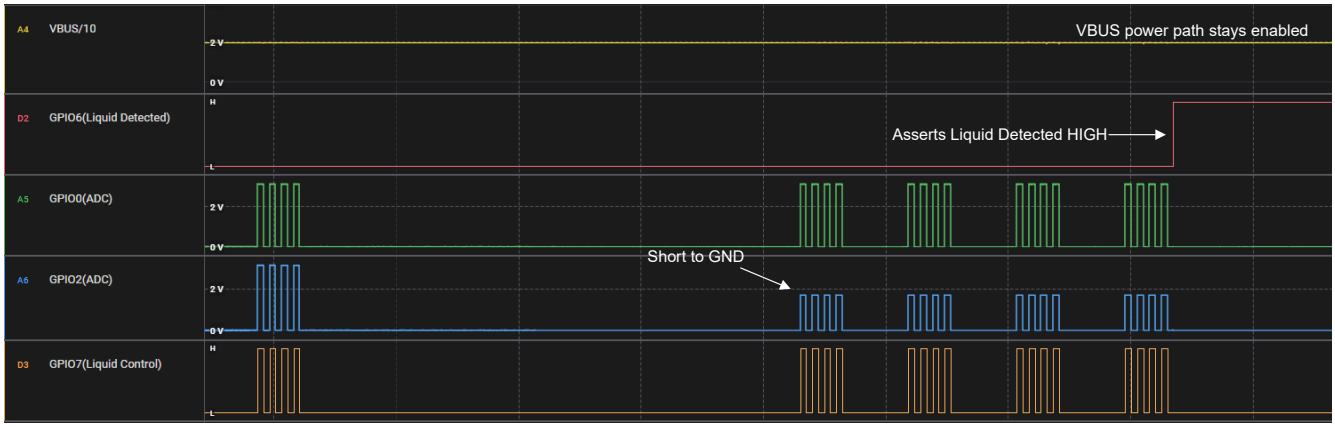


Figure 3-8. Corrosion Mitigation Disabled Waveform

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4 Summary

5 References

1. USB Type C, *USB Type-C | USB-IF*, webpage.
2. USB Power Delivery, *USB Power Delivery | USB-IF*, webpage.
3. USB, *USBCPD_Application_Customization_Tool · Gallery*, webpage.
4. Texas Instruments, *USBCPD Application Customization Tool User Guide*, user's guide.
5. Texas Instruments, *TPS25751A*, product page.
6. Texas Instruments, *TPS25752A*, product page.
7. Texas Instruments, *TPS26750A*, product page.

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Last updated 10/2025