

# USB 3.1 ENGINEERING CHANGE NOTICE FORM

**Title: Reference Clock Reqs**

**Applied to: USB 3.1 Specification Release**

## **Brief description of the functional changes:**

Explicitly address the concept of so-called "crystal-less" devices. These products do not use a reference clock, but instead derive a local clock from the incoming SuperSpeed data which is then used as the transmit clock. They introduce technical challenges related to accumulation of low frequency jitter, and require additional steps to carry out compliance testing.

The change explicitly defines what products are allowed to operate without a reference clock (plug devices, devices with passive captive cables), and what products are not allowed to do so (hosts, hubs, all other devices).

The change adds a new subsection (6.5.5) to the physical layer specification.

## **Benefits as a result of the changes:**

Designers and manufacturers of device products have expressed a desire to use crystal-less designs in order to eliminate the cost of the reference clock. Due to their circuit architecture, such devices may accumulate low frequency jitter. The USB3.1 physical layer specification comprehends some LF jitter accumulation based on the expected use of retimers that use the same clocking approach.

The use of crystal-less devices can result in configurations that cascade crystal-less retimers with a crystal-less device such that LF jitter exceeds the amount that we have comprehended in the specification. By restricting the use of the crystal-less approach to products which will not be used with multiple retimers (e.g., plug devices, devices with passive captive cables), the change minimizes the possibility that a system will exceed the LF jitter spec.

In addition, the PHY working group has heard that some suppliers of hubs might also want to follow the same approach. Crystal-less hubs would exacerbate the jitter accumulation issue even further. Therefore, the proposal also explicitly requires that hubs use a reference clock.

## **An assessment of the impact to the existing revision and systems that currently conform to the USB specification:**

No impact.

## **An analysis of the hardware implications:**

Requires that hosts, hubs and devices use an explicit reference clock, with the exception of plug devices and devices that use a captive cable.

## **An analysis of the software implications:**

No impact.

## **An analysis of the compliance testing implications:**

Physical layer compliance testing for devices that do not use a reference clock requires change to the method for transmitter testing. In performing a Tx compliance test, the device under test must be supplied with an incoming data stream that allows it to generate its local clock. In addition, the incoming data signals need to be

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transmitted with random and deterministic jitter consistent with the maximum limits in table 6-15 of section 6.5.1, in order to ensure that the measured jitter reasonably represents the jitter during normal operation.

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## Actual Change

**(a) From Text (and location):**

**(a) To Text (and location): Section 6.5.5, page 6-26**

### 6.5.5 Reference Clock Requirements

The reference clock requirements are:

- A host or a hub shall pass the transmit compliance test without requiring a compliant input signal at its receiver in order to generate a transmit clock.
- A device that uses a passive captive cable may require a compliant input signal to generate a transmit clock in order to pass the transmitter compliance test.
- A device that directly plugs into a host receptacle (e.g., thumb drive, wireless dongle) may require a compliant input signal to generate a transmit clock in order to pass the transmitter compliance test.
- Any other device shall pass the transmit compliance test without requiring a compliant input signal at its receiver in order to generate a transmit clock.