Lesson 3: The Configuration Channel and Using the CY4500 EZ-PD Protocol Analyzer

Hello. My name is Alan Hawse. Welcome back to Cypress Academy. In the previous video I showed you the Cypress CY4531 in action. Now let's get down to some real engineering. What in the world does the negotiation between the Type-C controllers look like? Well, it turns out we have this cool little kit called the CY4500 EZ-PD Protocol Analyzer. I can plug this little dude in line between two Type-C port controllers and look at all of the transactions as they negotiate the power contract.

But, before I get into that, I need to explain the Configuration Channel, also known as CC (yes another Three Letter Acronym…but in this case the T is actually two instead of three). Anyway…CC is how Type-C devices on either end of a connection (and in fact even in the cable) communicate with each other. It is used to negotiate power contracts (both direction as well as voltage/current profile), handle power provider/consumer role swaps, USB upstream and downstream facing port (UFP and DFP) data role swaps, and even cable power provider (called VCONN) role swaps. All of these roles can be swapped on-the-fly as the system adapts to different situations as the user plugs in different peripherals. The CC can even be used to update the firmware on a Cypress CCG device so that the updates required after manufacturing or even in the field can be handled easily. Basically, everything can change, and that is the beauty of our chip. It handles all of this insanity for you.

There are actually 2 CC lines on a Type-C receptacle but only one on a Type-C plug since the plug can be connected in either orientation. One of the lines is used for communication (CC) while the other (Vconn) is used for powering the Type-C controller in the Electronically Marked Cable Assembly (EMCA).

So how does all of this insanity get sorted out? In Type-C, the power provider connects pull up resistors called Rp to the CC lines while the power consumer connects pull-down resistors – Rd - to the CC lines. This allows the port partners to determine which way the cable is plugged in. This is what enables the swapping. Because everything can change rolls, the chip next to the cable is called the port partner.

Some Type-C ports can be dual role ports (DRPs) that can either be a power consumer or a power provider depending on the situation. Remember what I showed you in the previous video where the development kit started out as a power provider to the USB Flash drive but when I plugged in the Type-C charger, it became a power consumer. In this case the DRP contains both Rp as well as Rd – the pull up resistor and the pull down resistor. Our chip toggles each on and off in the

opposite direction until it sees a device with the opposite connection. At that point, a power contract is established that is appropriate to the situation.

Here is a scope trace of the CC line from the CY4531 kit prior to connecting a device. Note that the line toggles as the pullup resistor and the pull down resistor are switched on and off. Once I connect the Multi-port adapter, I start to see CC message traffic. Once the power contract is established, things settle down and it stops flipping.

OK, now let's repeat the experiments from the last video, but this time I will use the CY4500 EZ-PD Protocol Analyzer to view and analyze the messages on the CC line. I will connect the CY4531 to the PC as before but now I will also connect the analyzer to the Type-C port before I connect any other devices.

I will also connect the analyzer directly to a USB port on the PC. That connection will go to the "EZ-PD Analyzer Utility" that comes with the kit. This is the software that lets you to decode USB CC traffic. Once that starts up, I'll click on "Start Capturing" button. Now I'll connect the Multi-port adapter and see what happens. See how I get messages related to the power negotiation? The CY4531 is initially a dual role port. Once it sees a power consumer on the other end, it locks in as a power source and sends out its capabilities. If I click on one of the source capability lines, I see the details on the right. In this case, this kit can supply one of 4 power profiles – 5V/3A, 9V/3A, 15V/3A, or 20V/3A. The power sink sends a GoodCRC response once it receives the source capability message and it requests power profile #1. The power source then responds with a GoodCRC of its own, it accepts the power request, and indicates that the requested power supply is ready. Finally, the power sink says it's received the power supply ready message. Now we have a contract.

Note that the log shows the Vbus voltage as it changes while the top right corner of the GUI shows the Vbus voltage and the current in real-time whenever data is being captured. This allows you to monitor the Vbus voltage and current without requiring a separate voltmeter or ammeter.

Now I'll clear the messages and plug in the flash drive. In this case, the power role doesn't change so I don't see any new messages.

Finally, let's plug in the Type-C power adapter. Notice how the power adapter requests that the power role be swapped. As before, the GoodCRC, Accept, and PS_RDY messages are sent back and forth while the negotiation is taking place. Notice how the power role changes at this point so the downstream facing port is now the power sink instead of the power source. The new power source sends its capabilities. I see that it

supports two profiles: 5V/1.01A and 14.8V/1.4A. The power sink, which is the CY4531 kit, requests the second profile, and after another back and forth communication, that's what happens - see how the Vbus voltage is switched over from 5V to where it's now 14.8V.

OK, that's a brief introduction on how to use the CY4500 kit to examine the Type-C configuration information. In the next video, I'll show you how you can change the configuration of a CCG device to build your own unique application.

As always, you are welcome to email me at alan_hawse@cypress.com or send me a tweet @askiotexpert with your comments, suggestions, criticisms, and questions. Thank you.