# DAISY Device Test Guide

**Revision 1.1**

**2022. 11. 08**

**CRZ Technology**

**http://www.crz-tech.com/**

# Document History

| Revision | Date | Change note |
|---|---|---|
| 1.0 | 2021.01.28 | Initial Version |
| 1.1 | 2022.11.08 | Fixed 100G test setup |
| | | |
| | | |

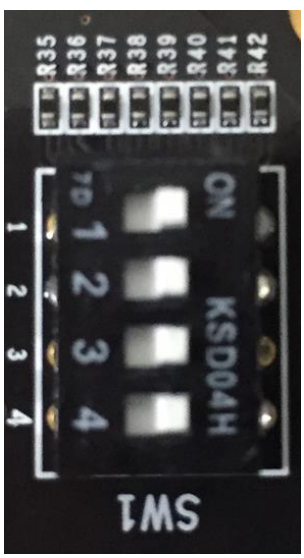
# Index

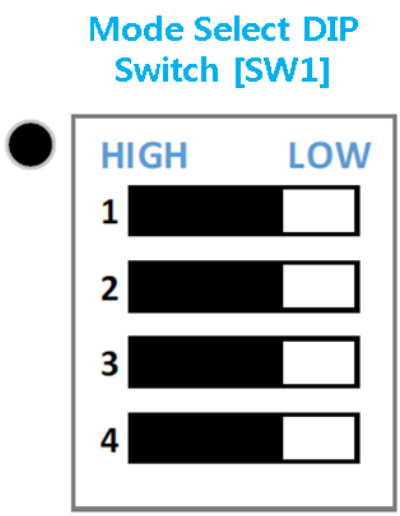
# 1. Overview

This document explains how to test the devices(NVMe M.2, DDR4 DIMM, PCIe x16 endpoint, QSFP28) mounted on DAISY.

## 2. Test Setup

Set mode select dip switch[SW1] to [JTAG / QSPI / SD] mode accordingly.



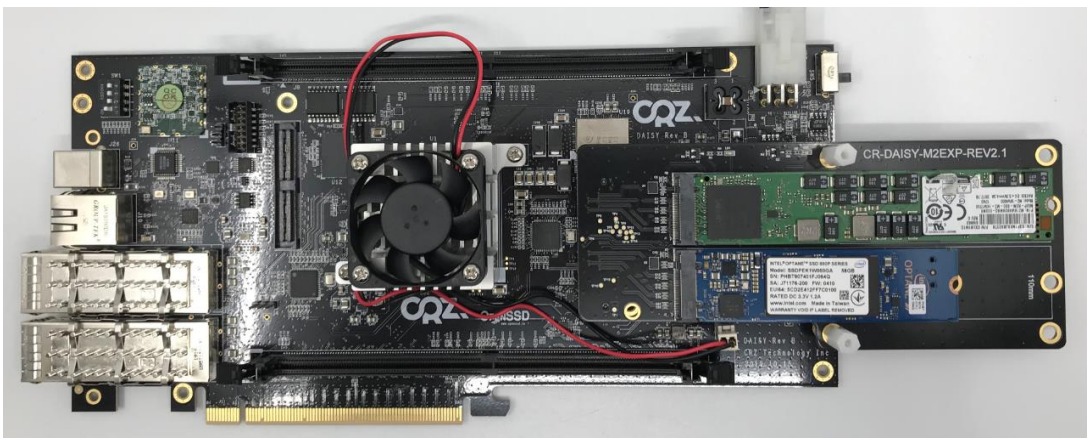




| MODE | Switch | | | |
|---|---|---|---|---|
| | [4] | [3] | [2] | [1] |
| **JTAG** | LOW[ON] | LOW[ON] | LOW[ON] | LOW[ON] |
| **QSPI 32** | LOW[ON] | LOW[ON] | HIGH[OFF] | LOW[ON] |
| **SD1** | HIGH[OFF] | HIGH[OFF] | HIGH[OFF] | LOW[ON] |

# 3. NVMe M.2

Samsung SM963 NVMe M.2 SSD 480GB MLC has been verified on DAISY.

Insert NVMe M.2 SSD to CR-DAISY-M2EXP1-REV2.1 board.
Connect CR-DAISY-M2EXP1-REV2.1 board to DAISY through J25.




Create bootable image for SD boot or QSPI boot by referring to DAISY Petalinux Porting Guide document.

Check if LED0 is turned on during boot. LED0 is on if PCIe link is correctly configured.

Verify PCIe link after logging in linux.

```
root@daisy:~# lspci
0000:00:00.0 PCI bridge: Xilinx Corporation Device 9134
0000:01:00.0 Non-Volatile memory controller: Samsung Electronics Co Ltd NVMe SSD
 Controller SM961/PM961
0001:00:00.0 PCI bridge: Xilinx Corporation Device 9134
root@daisy:~#
```

Check if NVMe SSD is configured as block device.

```
root@daisy:~# lsblk
NAME         MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
mtdblock0     31:0    0    36M  0 disk
mtdblock1     31:1    0     1M  0 disk
mtdblock2     31:2    0    68M  0 disk
mtdblock3     31:3    0    11M  0 disk
mmcblk0      179:0    0  14.9G  0 disk
|-mmcblk0p1 179:1    0     1G  0 part /run/media/mmcblk0p1
`-mmcblk0p2 179:2    0   6.5G  0 part /run/media/mmcblk0p2
nvme0n1      259:0    0 447.1G  0 disk
root@daisy:~#
```

Create disk partition.

```
root@daisy:~# fdisk /dev/nvme0n1

Welcome to fdisk (util-linux 2.32.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0xcb728903.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1):
First sector (2048-937703087, default 2048):
Last sector, +sectors or +size{K,M,G,T,P} (2048-937703087, default 937703087):

Created a new partition 1 of type 'Linux' and of size 447.1 GiB.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
[ 1883.709806]  nvme0n1: p1
Syncing disks.

root@daisy:~#
```

Check new partition name.

```
root@daisy:~# lsblk
NAME         MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
mtdblock0     31:0    0    36M  0 disk
mtdblock1     31:1    0     1M  0 disk
mtdblock2     31:2    0    68M  0 disk
mtdblock3     31:3    0    11M  0 disk
mmcblk0      179:0    0  14.9G  0 disk
|-mmcblk0p1  179:1    0     1G  0 part /run/media/mmcblk0p1
`-mmcblk0p2  179:2    0   6.5G  0 part /run/media/mmcblk0p2
nvme0n1      259:0    0 447.1G  0 disk
`-nvme0n1p1  259:1    0 447.1G  0 part
root@daisy:~#
```

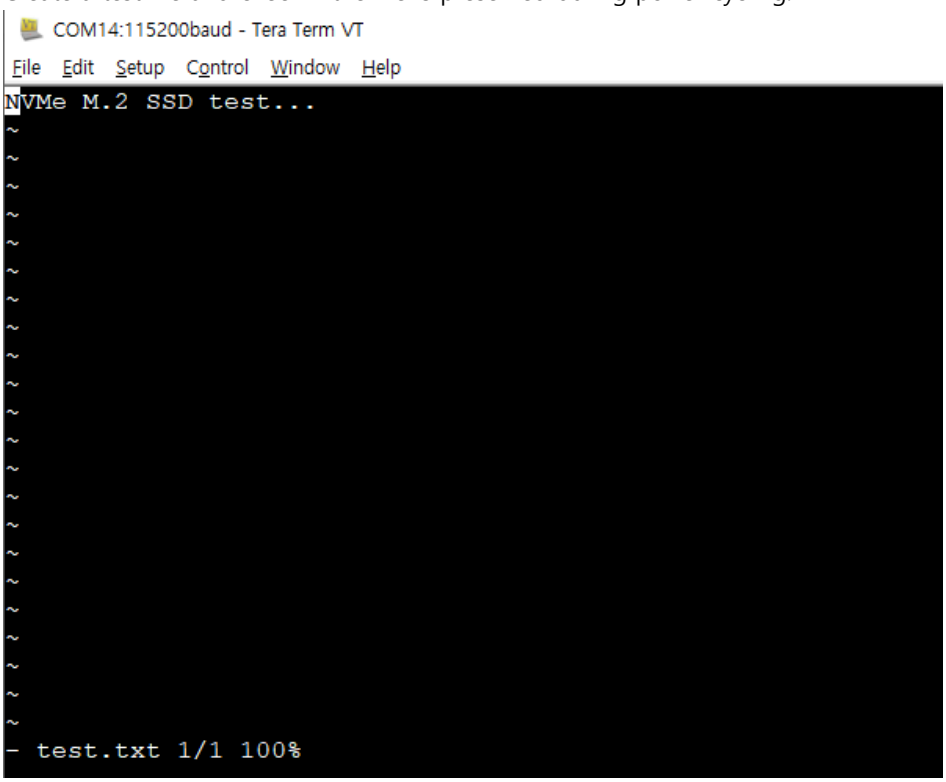
Make file system on new partition.

```
root@daisy:~# mkfs -t ext2 /dev/nvme0n1p1
mke2fs 1.44.3 (10-July-2018)
Discarding device blocks: done
Creating filesystem with 117212630 4k blocks and 29310976 inodes
Filesystem UUID: 15a30903-8a05-4beb-9971-21cf586f1caf
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000, 7962624, 11239424, 20480000, 23887872, 71663616, 78675968,
        102400000

Allocating group tables: done
Writing inode tables: done
Writing superblocks and filesystem accounting information: done

root@daisy:~#
```

Create a directory and mount SSD to the directory.

```
root@daisy:~# mkdir /media/nvme
root@daisy:~# mount /dev/nvme0n1p1 /media/nvme
root@daisy:~# cd /media/nvme
root@daisy:/media/nvme# vi test.txt
```

Create a test file and check if the file is preserved during power cycling.




```
root@daisy:/media/nvme# ls -al
total 24
drwxr-xr-x 3 root root  4096 Nov 28 09:23 .
drwxr-xr-x 3 root root    60 Nov 28 09:20 ..
drwx------ 2 root root 16384 Nov 28 09:18 lost+found
-rw-r--r-- 1 root root    21 Nov 28 09:23 test.txt
root@daisy:/media/nvme#
```

# 4. DDR4 DIMM

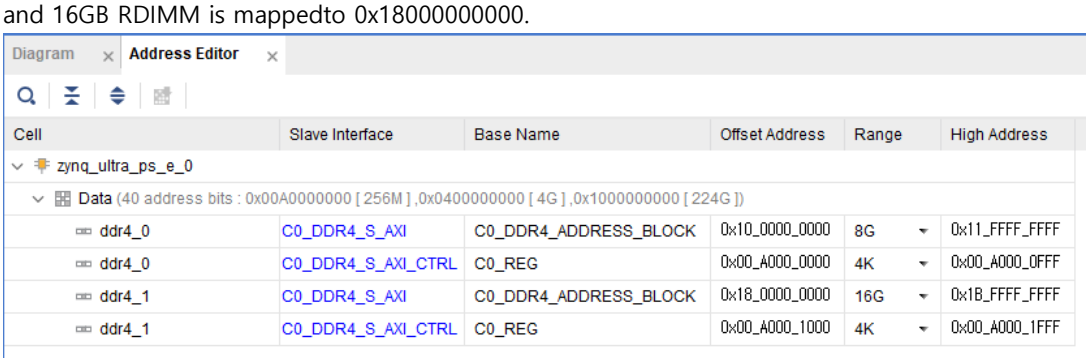
8GB x8 DDR4_M393A1K43BB0-CRC / 16GB x4 DDR4_M393A2K40BB1-CRC have been verified on DAISY.

Connect 8GB x8 DDR4_M393A1K43BB0-CRC RDIMM to J8 and 16GB x4 DDR4_M393A2K40BB1-CRC RDIMM to J9.

Set SW1 to JTAG mode.
Connect USB cable with host PC.
Connect 12V DC power adaptor.
Turn on board power by sliding power switch.

Open dual_mig_x8.zip Vivado project.
Vivado version 2019.1 should be used.

In the Address Editor tab, 8GB RDIMM is mapped to 0x1000000000
and 16GB RDIMM is mappedto 0x18000000000.




| Cell | Slave Interface | Base Name | Offset Address | Range | High Address |
|---|---|---|---|---|---|
| zynq_ultra_ps_e_0 | | | | | |
| Data (40 address bits : 0x00A0000000 [ 256M ] ,0x0400000000 [ 4G ] ,0x1000000000 [ 224G ]) | | | | | |
| ddr4_0 | C0_DDR4_S_AXI | C0_DDR4_ADDRESS_BLOCK | 0x10_0000_0000 | 8G | 0x11_FFFF_FFFF |
| ddr4_0 | C0_DDR4_S_AXI_CTRL | C0_REG | 0x00_A000_0000 | 4K | 0x00_A000_0FFF |
| ddr4_1 | C0_DDR4_S_AXI | C0_DDR4_ADDRESS_BLOCK | 0x18_0000_0000 | 16G | 0x1B_FFFF_FFFF |
| ddr4_1 | C0_DDR4_S_AXI_CTRL | C0_REG | 0x00_A000_1000 | 4K | 0x00_A000_1FFF |

Select “Open Hardware Manager” under “PROGRAM AND DEBUG” in “Flow Navigator”.
Click “Program device”.

Verify if LED0 and LED1 are turned on after FPGA is programmed.
Two LEDs must be turned on if MIG calibration is done correctly.

Run serial terminal to view debug log.

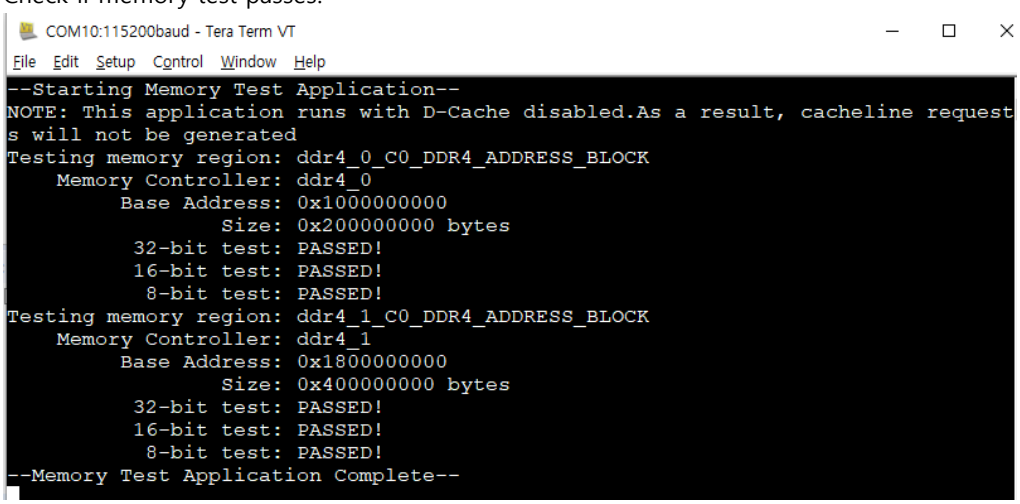
Lauch SDK through “File” -> “Launch SDK” to check if RDIMM can be accessed.

Select “Run” -> “Debug History” -> “System Debugger on Local” on SDK menu.

Verify if two LEDs are turned on after FPGA is programmed.

Click Cortex-A53 #0 and press “F8” to execute the program.

Check if memory test passes.



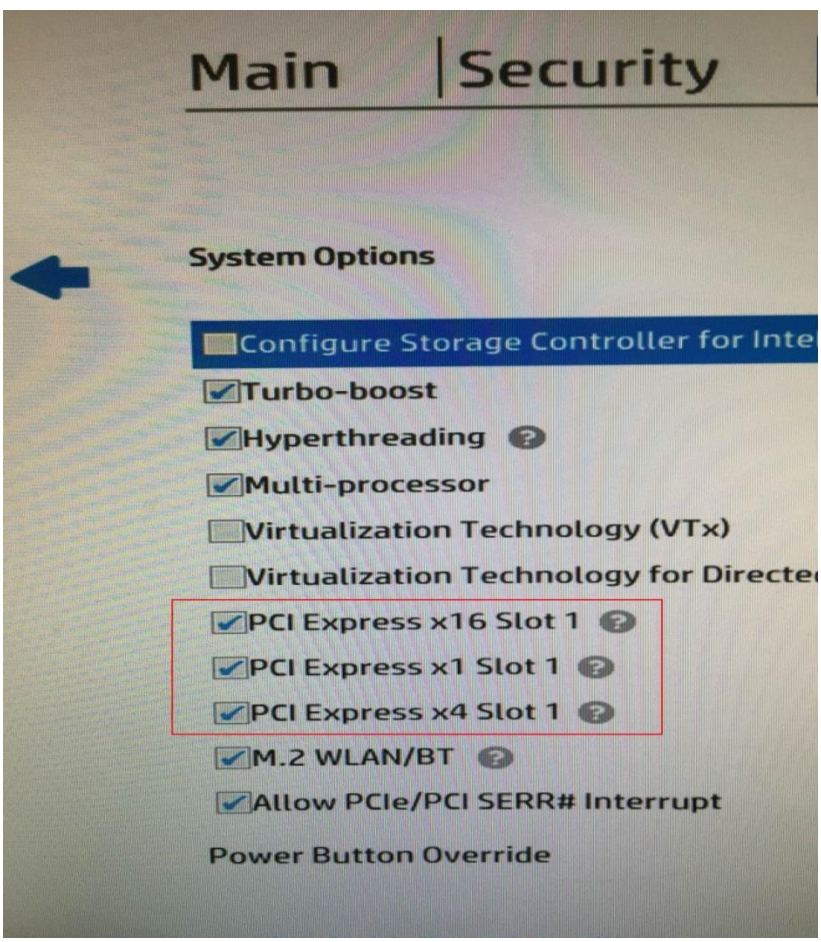
# 5. PCIe x16 Endpoint

During the test, set the Mode Select DIP Switch[SW1] to JTAG mode.

## 5.1. PCIe Host BIOS Setup

PCIe slot must be enabled in PCIe Host BIOS setup.

The host used for verification is HP PRODESK, and the PCIe slot must be activated in the BIOS as shown below.




## 5.2. Verifying the PCIe link

After attaching the PCIe extension cable to the Daisy board, plug it into the PCIe x16 slot of PRODESK (it is the top black slot among the three PCIe slots).

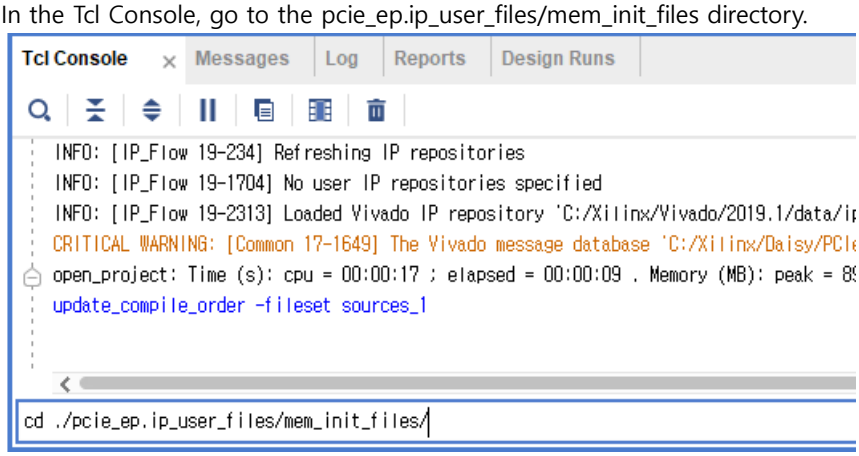
Apply 12V power to the board.

Open the provided Vivado project (pcie_ep.zip) and download the bitstream.
Vivado 2019.1 version must be used.

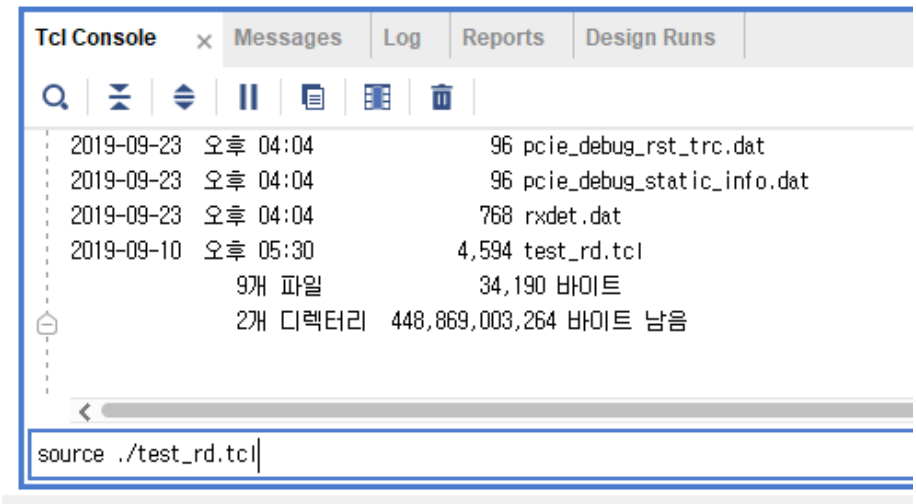
Power on PRODESK and log in to Linux.
At this time, check if LED0 of the board is on.

After logging in to Host Linux, run the command below from the command line to check if the link is established.

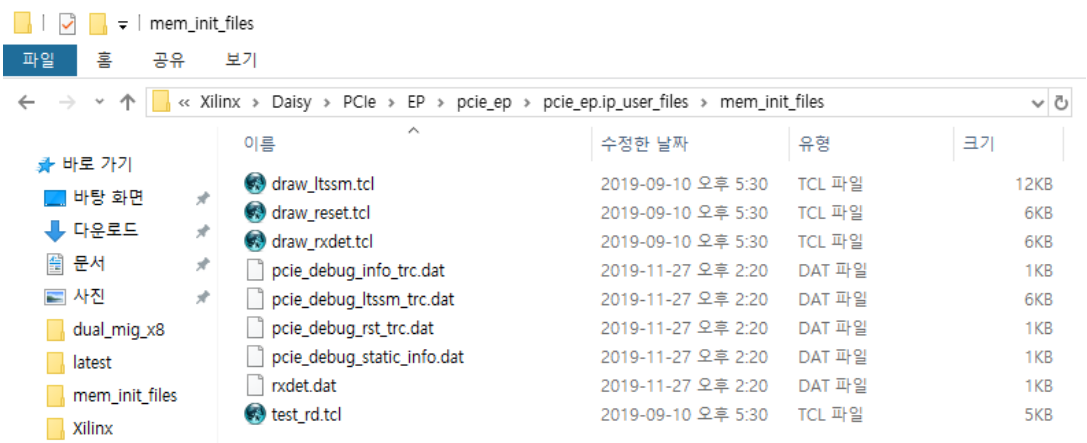

The following is how to verify the PCIe link on the vivado tool. It must be executed with the board and JTAG connected.
In the Tcl Console, go to the pcie_ep.ip_user_files/mem_init_files directory.



Run test_rd.tcl.

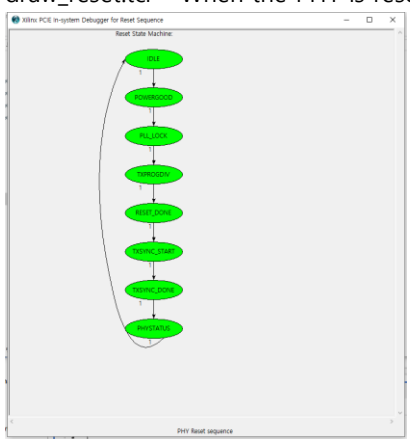



You can see that five dat files such as pcie_debug_info_trc.dat, pcie_debug_ltssm_trc.dat, pcie_debug_rst_trc.dat, pcie_debug_static_info.dat and rxdet.dat have been newly created.

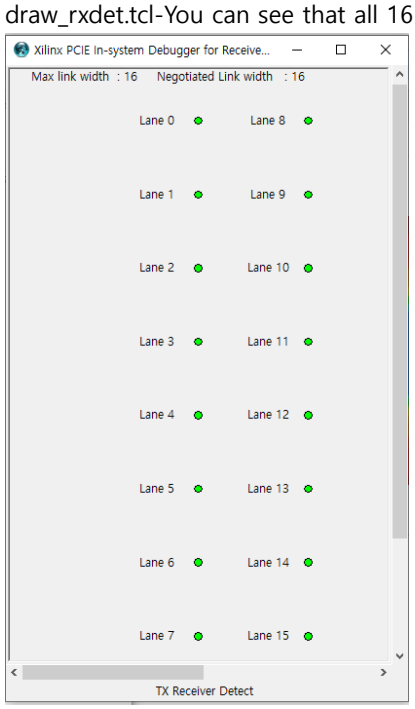


Double-click draw_reset.tcl, draw_rxdet.tcl and draw_ltssm.tcl in Windows Explorer to check if it is normal.

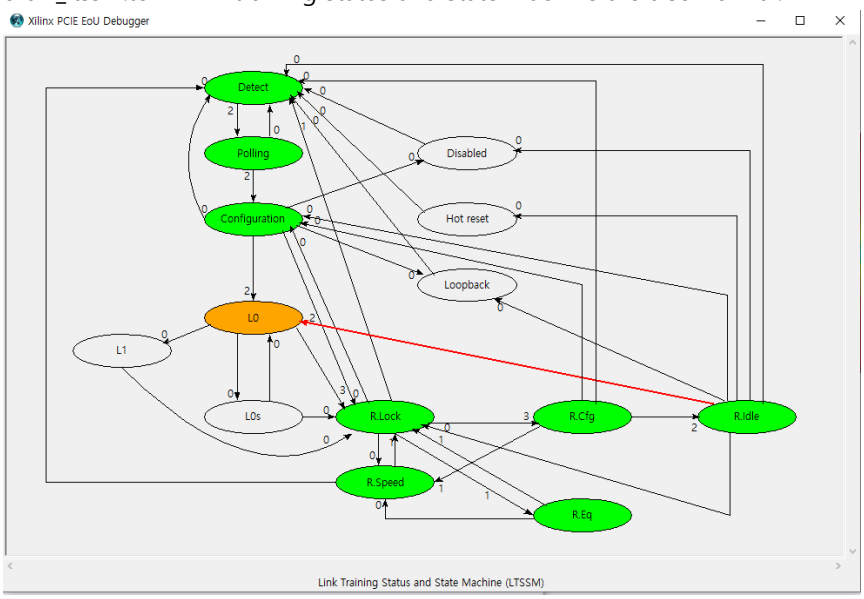
draw_reset.tcl – When the PHY is reset, it can be confirmed that it works normally.



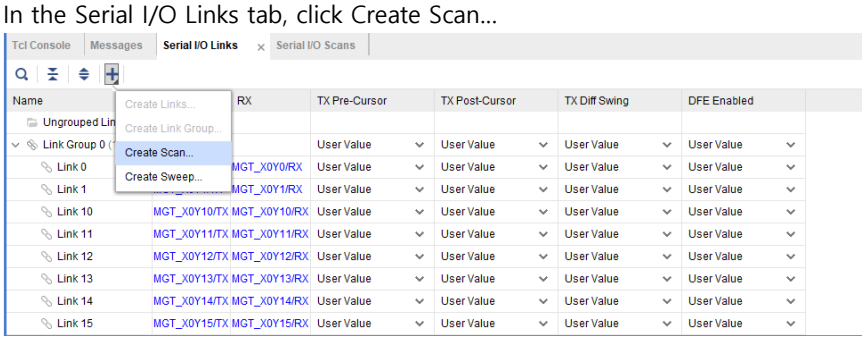

draw_rxdet.tcl-You can see that all 16 lanes are fine.



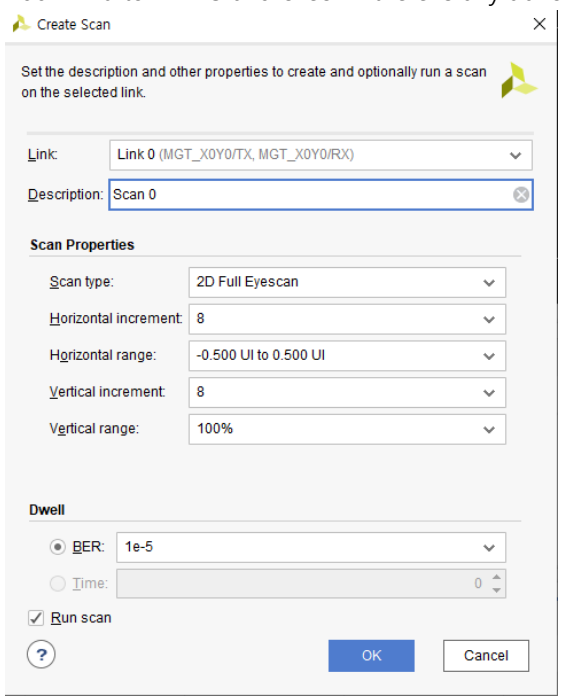
draw_ltssm.tcl – Link training status and state machine are also normal.

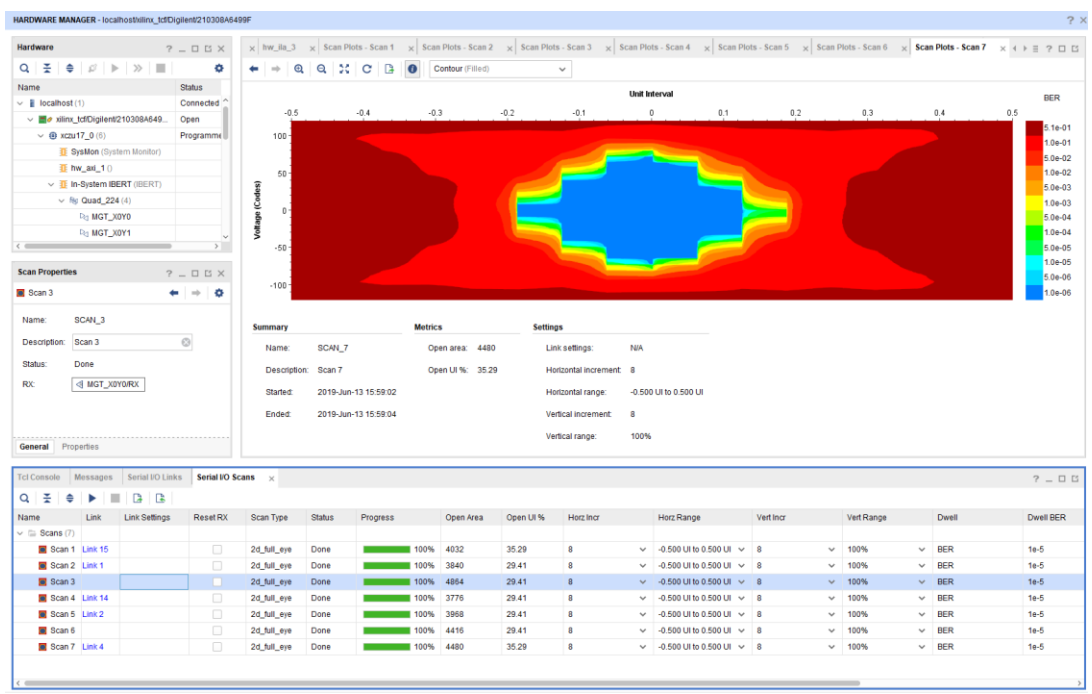



In the Serial I/O Links tab, click Create Scan...



Add Link0 to Link15 and check if there is any abnormality in the eye diagram.



## 5.3. XDMA test

Access the following link and copy the necessary files to Ubuntu 16.04 Host.
https://github.com/Xilinx/dma_ip_drivers

Run the following command to build the XDMA driver kernel module and application program.

```
$ cd XDMA/linux-kernel
$ cd xdma
$ make install
$ cd tools
$ make
$ cd tests
```

Load the XDMA kernel module.

```
$ sudo ./load_driver.sh
```

Test whether XDMA is operating normally.

```
$ ./run_test.sh
```

```
xilinx@xilinx:~/Downloads/dma_ip_drivers-master/XDMA/linux-kernel/tests$ sudo ./
run_test.sh
Info: Number of enabled h2c channels = 1
Info: Number of enabled c2h channels = 1
Info: The PCIe DMA core is memory mapped.
Info: Running PCIe DMA memory mapped write read test
      transfer size:  1024
      transfer count: 1
Info: Writing to h2c channel 0 at address offset 0.
Info: Wait for current transactions to complete.
** Average BW = 1024, 17.526144
Info: Writing to h2c channel 0 at address offset 1024.
Info: Wait for current transactions to complete.
** Average BW = 1024, 11.151161
Info: Writing to h2c channel 0 at address offset 2048.
Info: Wait for current transactions to complete.
** Average BW = 1024, 13.890962
Info: Writing to h2c channel 0 at address offset 3072.
Info: Wait for current transactions to complete.
** Average BW = 1024, 16.115833
Info: Reading from c2h channel 0 at address offset 0.
Info: Wait for the current transactions to complete.
** Average BW = 1024, 2.690623
Info: Reading from c2h channel 0 at address offset 1024.
Info: Wait for the current transactions to complete.
** Average BW = 1024, 4.612342
Info: Reading from c2h channel 0 at address offset 2048.
Info: Wait for the current transactions to complete.
** Average BW = 1024, 4.601089
Info: Reading from c2h channel 0 at address offset 3072.
Info: Wait for the current transactions to complete.
** Average BW = 1024, 4.605227
Info: Checking data integrity.
Info: Data check passed for address range 0 - 1024.
Info: Data check passed for address range 1024 - 2048.
Info: Data check passed for address range 2048 - 3072.
Info: Data check passed for address range 3072 - 4096.
Info: All PCIe DMA memory mapped tests passed.
Info: All tests in run_tests.sh passed.
xilinx@xilinx:~/Downloads/dma_ip_drivers-master/XDMA/linux-kernel/tests$
```

# 6. QSFP28 - 100GB Ethernet

Write daisy_202001_100g_20220610_image.tgz to the microSD card.

Boot two DAISY boards with mciroSD card and connect the QSFP28#1 channels to each other with 100GB 1m copper cable.

Set ip and mtu size in eth1 on board 1.

```
root@daisy:~# ifconfig eth1 down
root@daisy:~# ifconfig eth1 mtu 8192
root@daisy:~# ifconfig eth1 192.168.2.1 up
```

Set ip and mtu size in eth1 on board 2.

```
root@daisy:~# ifconfig eth1 down
root@daisy:~# ifconfig eth1 mtu 8192
root@daisy:~# ifconfig eth1 192.168.2.2 up
```

On boards 1 and 2, ping to see if the other party's ip is connected.

```
root@daisy:~# ping 192.168.2.1
PING 192.168.2.1 (192.168.2.1): 56 data bytes
64 bytes from 192.168.2.1: seq=0 ttl=64 time=0.167 ms
64 bytes from 192.168.2.1: seq=1 ttl=64 time=0.079 ms
64 bytes from 192.168.2.1: seq=2 ttl=64 time=0.071 ms
64 bytes from 192.168.2.1: seq=3 ttl=64 time=0.067 ms
64 bytes from 192.168.2.1: seq=4 ttl=64 time=0.073 ms
64 bytes from 192.168.2.1: seq=5 ttl=64 time=0.188 ms
^C
--- 192.168.2.1 ping statistics ---
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max = 0.067/0.107/0.188 ms
root@daisy:~#
```

```
root@daisy:~# ping 192.168.2.2
PING 192.168.2.2 (192.168.2.2): 56 data bytes
64 bytes from 192.168.2.2: seq=0 ttl=64 time=0.154 ms
64 bytes from 192.168.2.2: seq=1 ttl=64 time=0.205 ms
64 bytes from 192.168.2.2: seq=2 ttl=64 time=0.107 ms
64 bytes from 192.168.2.2: seq=3 ttl=64 time=0.148 ms
^C
--- 192.168.2.2 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0.107/0.153/0.205 ms
root@daisy:~#
```

Set board 1 as an iperf client and board 2 as an iperf server to measure performance.

```
[ 3541.731054] CMAC going to reset
[ 3541.734289] CMAC RX alignment ...:d8
[ 3541.737863] CMAC leaving reset
Connecting to host 192.168.2.4, port 5201
[  5] local 192.168.2.3 port 50502 connected to 192.168.2.4 port 5201
[ ID] Interval           Transfer     Bitrate         Retr  Cwnd
[  5]   0.00-1.00   sec   521 MBytes  4.37 Gbits/sec    0    366 KBytes
[  5]   1.00-2.00   sec   521 MBytes  4.37 Gbits/sec    0    390 KBytes
[  5]   2.00-3.00   sec   521 MBytes  4.37 Gbits/sec    0    390 KBytes
[  5]   3.00-4.00   sec   521 MBytes  4.37 Gbits/sec    0    390 KBytes
[  5]   4.00-5.00   sec   521 MBytes  4.37 Gbits/sec    0    413 KBytes
[  5]   5.00-6.00   sec   521 MBytes  4.37 Gbits/sec    0    723 KBytes
[  5]   6.00-7.00   sec   521 MBytes  4.37 Gbits/sec    0    723 KBytes
[  5]   7.00-8.00   sec   520 MBytes  4.37 Gbits/sec    0    723 KBytes
[  5]   8.00-9.00   sec   521 MBytes  4.37 Gbits/sec    0    723 KBytes
[  5]   9.00-10.00  sec   521 MBytes  4.37 Gbits/sec    0    723 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Retr
[  5]   0.00-10.00  sec  5.09 GBytes  4.37 Gbits/sec    0             sender
[  5]   0.00-10.00  sec  5.09 GBytes  4.37 Gbits/sec                  receiver

iperf Done.
```

```
[ 3564.067944] CMAC going to reset
[ 3564.071185] CMAC RX alignment ...:c0
[ 3564.074766] CMAC leaving reset
-----------------------------------------------------------
Server listening on 5201
-----------------------------------------------------------
Accepted connection from 192.168.2.3, port 50500
[  5] local 192.168.2.4 port 5201 connected to 192.168.2.3 port 50502
[ ID] Interval           Transfer     Bitrate
[  5]   0.00-1.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   1.00-2.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   2.00-3.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   3.00-4.00   sec   522 MBytes  4.37 Gbits/sec
[  5]   4.00-5.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   5.00-6.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   6.00-7.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   7.00-8.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   8.00-9.00   sec   521 MBytes  4.37 Gbits/sec
[  5]   9.00-10.00  sec   521 MBytes  4.37 Gbits/sec
[  5]  10.00-10.00  sec   393 KBytes  4.22 Gbits/sec
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate
[  5]   0.00-10.00  sec  5.09 GBytes  4.37 Gbits/sec                  receiver
-----------------------------------------------------------
```

When measured by iperf, the performance of about 4.37Gbps was confirmed.