

## D457 Hardware Synchronization

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The Intel® RealSense™ Depth Camera D457 is our first GMSL/Fakra high bandwidth stereo camera. When multiple D457 cameras are being used on one system, often the streams from them need to be synchronized. There are two methods that users can choose to HW sync multiple D457 cameras. One is through the GMSL link without using sync cable wiring; The other one is through the 9-pin AUX connector with 2-wire sync cable which is typically used on USB Intel RealSense cameras like D45x, D43x and D415.

### 1. Method 1: Syncing through the GMSL link:

- SOC provides two external triggers to D457 Depth camera and RGB camera respectively. The two triggers are independent to each other, for example, depth stream runs at 15 fps, RGB stream runs at 30fps. The Deserializer must be MAX9296A or compatible one. The default SerDes script has assigned the following two GPIOs of MAX9296A: **MPF7** and **MPF9**. The external triggers should be connected to **MPF7** and **MPF9** respectively. The **MPF7** is assigned for Depth sync, and the **MPF9** is assigned for RGB sync (Fig-1)

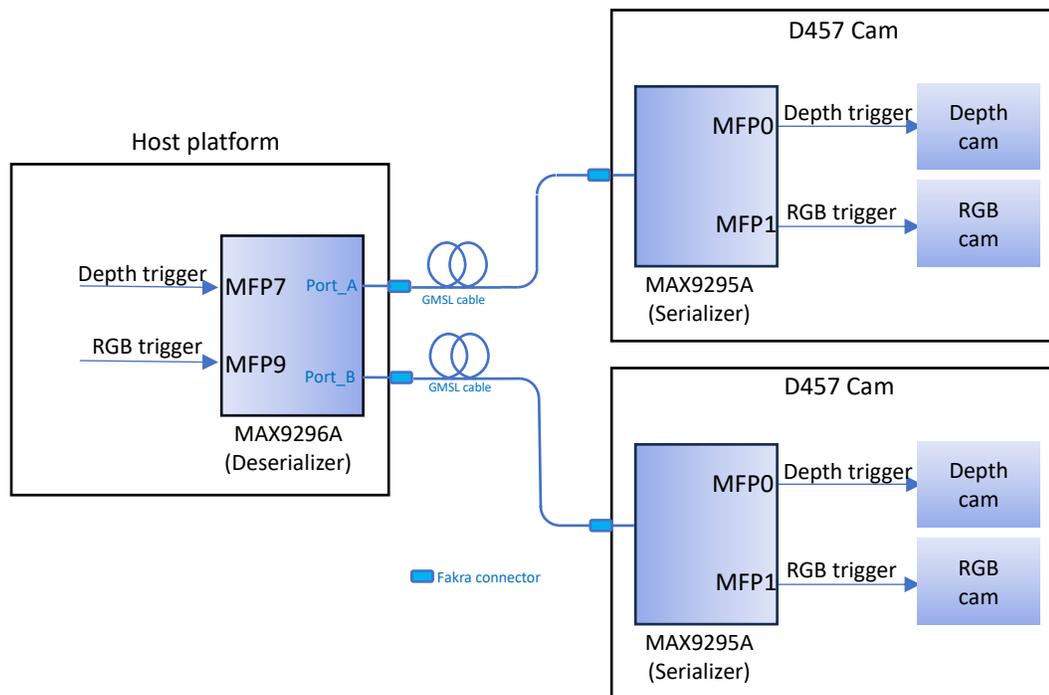


Fig-1

- Same external trigger mechanism can be applied to multiple D457 cameras.
- Positive-edge triggering (the pulse width is not required but recommended range: 1.0 us ~ 1.0 ms). Pulse level = 1.8V. The trigger frequency should be one of the following supported frequencies: i.e. 90FPS, 60FPS, 30FPS, 15FPS and 5FPS depending on image resolutions. Other arbitrary frequencies are not supported.
- In the Intel RealSense Viewer, please set "**Inter\_Cam\_Sync\_Mode**" to "3".

- HW sync command
  - There is a single command that will enable a device to be in either Master, Slave, or Default mode. The HW command is “rs2\_Set\_Option” with argument “rs2\_option\_inter\_cam\_sync\_mode” for option ID, and option value is 0=default, 3=slave in GMSL mode. The pointer can be either the “Sensor” or the “Device”.
- For normal operation we recommend using “Default”. For HW sync, external trigger will apply to all D457s, and all D457s should be set to “Slave” (mode 3).
- Configure depth/RGB frame rate same as the trigger frequency, e.g. if depth camera runs at 30 fps, the external trigger should be 30 Hz as well.
- Now it’s ready to start streaming from Depth camera and/or RGB camera.
- Important Notes:  
The Depth and RGB cameras are sync'd at the time of “*End of Exposure*”(see Fig-2). The time of “*Start of Exposure*” varies upon the Auto-Exposure control.

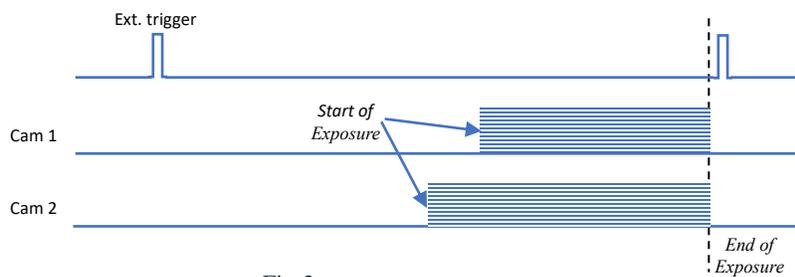


Fig-2

## 2. Method 2: Syncing through the 9-pin AUX connector

- In general, the above **Method 1** is highly recommended for D457 HW sync feature because of better ESD immunity.
- In case a user has to adopt **Method 2**, please refer to the details described in the whitepaper of “[Multi-Cam configuration](#)”, or see below the highlights:
  - While making the sync cable, it’s highly recommended to use an ESD shielded cable and add a 22nF capacitor only at the cable end (Fig-6) which is connected to Slave camera. The 22nF capacitor should be soldered between pin#5 and pin#9 (Fig-4.).

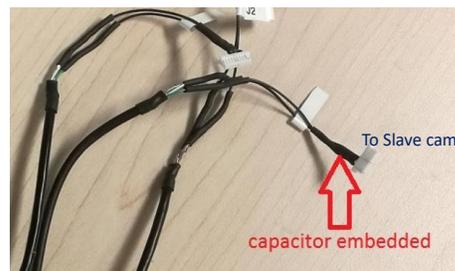


Fig-6

- The P/N of the plug is JST’s [SHR-09V-S](#), and with the crimp tins [SSH-003T-P0.2](#), or 30cm wire assembly [ASSHSSH28K305](#).



- [Option A]: It's recommended to use one D457 for Master camera as it can directly output native reference trigger. And then set all other cameras to Slave mode. In the Intel RealSense Viewer or SDK, set "**Inter\_Cam\_Sync\_Mode**" to "**1**" (Fig-3) for the Master cam, and set "**Inter\_Cam\_Sync\_Mode**" to "**2**" for all Slave cams.
- HW sync command
  - There is a single command that will enable a device to be in either Master, Slave, or Default mode. The HW command is "rs2\_Set\_Option" with argument "rs2\_option\_inter\_cam\_sync\_mode" for option ID, and option value is 0=default, 1=Master, and 2=Slave. The pointer can be either the "Sensor" or the "Device".
  - For normal operation we recommend using "Default". For HW sync, one camera should be told to be the "Master", and all others should be set to "Slave". If an external sync is being provided, then all should be set to slave.
- Always run the Master camera first, and then the Slave cameras. And all cameras must run at same frame rate.
- [Option B]: If an external trigger source is preferred rather than "Option A" using a D457 as a trigger source, please set all D457s to Slave mode – set "**Inter\_Cam\_Sync\_Mode**" to "**2**"
- Fine tune the external trigger frequencies to match the values as shown in the above Table-1. Refer to the *Tips* as described in **Method 1**.
- Turn on the external trigger, and then run all the Slave cams.
- All Slave cameras must run at same frame rate as the trigger frequency.  
 \*\* NOTE: Since the Pin#5 is sensitive to ESD noise, user should take some effort to work out an anti-ESD solution to prevent the slave cam from false triggering caused by ESD interference.

### 3. Fine tune external trigger

The camera sensor is very sensitive to external trigger frequency when it is set to slave mode. The external trigger frequency must be well tuned to match the native frequency of the camera. The accuracy shall be within +/- 0.2%. (see Table-1)

Native Freq (Hz)	30 FPS	15 FPS	5 FPS
Depth cam	30.0089	15.0022	5.0000
RGB cam	29.9713	14.9754	4.8029*

Table -1 Typical frequencies of D457 native frame rates (\*RGB runs 4.8 FPS under 5 FPS)

It's recommended to use oscilloscope to check whether the external trigger frequency well matches the camera native frame rate.

This approach is also applicable to both Method 1 and Method 2 while using external trigger.

- Before powering on D457, switch D457 to USB mode (the switch is hidden under a magnetic lid on the top of D457 body.), then plug the USB3 cable.
- Open Intel RealSense Viewer, set "**Inter\_Cam\_Sync\_Mode**" to "**1**" under Depth control panel (Fig-3)

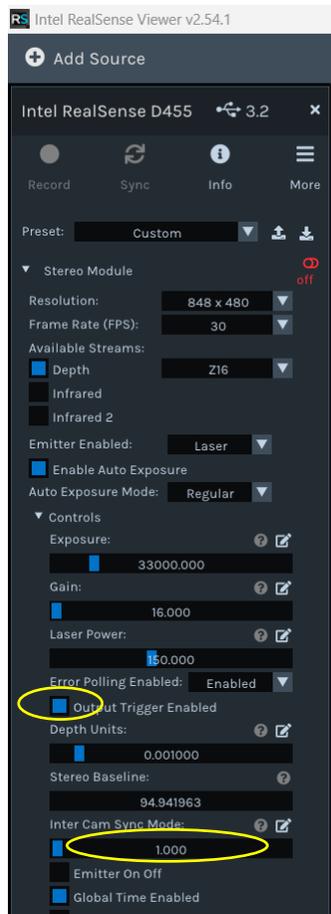


Fig-3

- Make sure the box of “Output Trigger Enabled” is checked.
- Now run the Depth video and use scope probe to check the output sync pulse on the pin#5 of the 9-pin AUX connector (Fig-4)

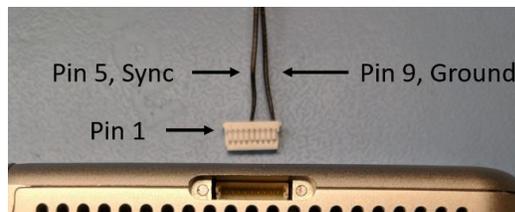


Fig-4

- Use another scope probe to monitor the external trigger.
- If the external trigger frequency well matches the camera sync frequency, it should be appearing no drifting against camera sync pulse. (Fig-5)

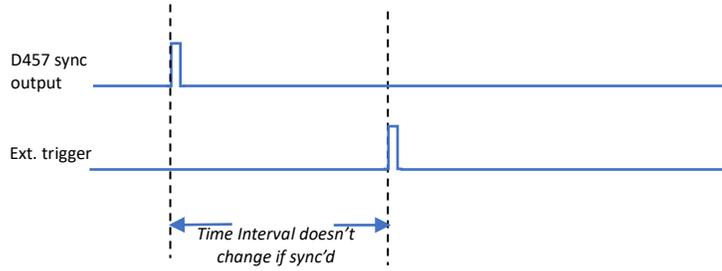


Fig-5

- Set the switch back to GMSL mode and close the magnetic lid after the above procedures finished. Always keep the magnetic lid closed during normal use.