



Upgrading Field-Programmable Devices

In general terms, field-programmable devices (FPDs) are hardware devices implemented on router cards that support separate upgrades. The term “FPD” has been introduced to collectively and generically describe any type of programmable hardware device on ethernet port adapters (EPAs). FPDs were introduced on the Cisco ASR 1000 Series Routers to support the EPAs.

EPAs are high performance Ethernet port adapters shared across multiple platforms. They come with different functions and designs. Usually, there is one or more FPDs on an EPA. The FPDs are critical for EPA operation. Over the lifespan of an EPA, FPD firmware images may need upgrades for bug fixes and new functionality. Upgrades should be performed in the field with minimum system impact.

This chapter describes the information that you need to know to verify image versions, and to perform EPA FPD upgrades.

This chapter includes the following sections:

- [Release History, page 1](#)
- [FPD Upgrade, page 2](#)
- [Optional FPD Procedures, page 5](#)
- [FPD Image Upgrade Examples, page 8](#)

Release History

[Table 1: FPD Release History, on page 1](#) provides the release history for all FPD-related features on the Cisco ASR 1000 Series Routers.

Table 1: FPD Release History

Release	Modification
Cisco IOS XE Release 3.16	MIPs and EPAs were released on the Cisco ASR 1000 Series Routers for the first time. FPD images were introduced to support these EPAs.

FPD Upgrade

This section provides information to help you upgrade FPDs for EPAs. These instructions are not always feasible for operating network environments. If these methods of upgrade are not suitable for your situation, see other sections of this document for other methods of upgrading FPDs.

This section contains the following topics:

Overview of FPD Images and Packages

With the Cisco ASR 1000 Series Routers, the Cisco IOS image comes bundled with the FPD image. An FPD incompatibility on an EPA disables all interfaces on that EPA until the incompatibility is addressed.

Upgrading Your Cisco IOS Release and FPD Image

To upgrade your Cisco IOS release and your FPD image, do the following steps:

SUMMARY STEPS

1. Download the EPA package for the Cisco IOS release that you are upgrading to. The package contains both the Cisco IOS image and the FPD image.
2. Boot the new version of Cisco IOS. When the new version of Cisco IOS boots, search for the bundled FPD image. The FPD images will be updated automatically as part of the Cisco IOS boot process.
3. When the router has booted, verify the upgrade was successful by entering the `show hw-module all fpd` command.

DETAILED STEPS

-
- | | |
|---------------|---|
| Step 1 | Download the EPA package for the Cisco IOS release that you are upgrading to. The package contains both the Cisco IOS image and the FPD image. |
| Step 2 | Boot the new version of Cisco IOS. When the new version of Cisco IOS boots, search for the bundled FPD image. The FPD images will be updated automatically as part of the Cisco IOS boot process. |
| Step 3 | When the router has booted, verify the upgrade was successful by entering the <code>show hw-module all fpd</code> command. |
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What to Do Next

The time for updating the FPGA can be read in the log messages. The following is a sample for the log message:

```
*Mar 6 11:48:12.632: %FPD_MGMT-3-INCOMP_IMG_VER: Incompatible EPA_10X10G FPGA (FPD ID=38)
image version detected for EPA-10X10GE card in subslot 3/1. Detected version = 1.15, minimum
required version = 1.16. Current HW version = 1.0.
*Mar 6 11:48:12.634: %FPD_MGMT-5-UPGRADE_ATTEMPT: Attempting to automatically upgrade the
FPD image(s) for EPA-10X10GE card in subslot 3/1. Use 'show upgrade fpd progress' command
to view the upgrade progress ...
*Mar 6 11:48:12.671: %FPD_MGMT-6-BUNDLE_DOWNLOAD: Downloading FPD image bundle for EPA-10X10GE
card in subslot 3/1 ...
```

```
*Mar 6 11:48:12.834: %SPA_OIR-6-ONLINECARD: SPA (EPA-10X10GE) online in subslot 3/1
*Mar 6 11:48:14.652: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
EPA-10X10GE card in subslot 3/1 = 00:06:00.
*Mar 6 11:48:14.656: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
in progress for EPA-10X10GE card in subslot 3/1. Updating to version 1.16. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
FPD upgrade in progress on hardware, reload/configuration change on those hardware is not
recommended as it might cause HW programming failure and result in RMA of the hardware.
```

FPD upgrade process requires the EPA to reload once upgrade is complete. The auto FPD upgrade process will perform this step automatically, users do not have to intervene.

In case of manual upgrade, users need to provide **reload** option in the **fpd upgrade** command for the EPA to reload. New FPGA does not take effect if the EPA is not reloaded. See [Manual FPD Image Upgrade Example](#), on page 9, for more details.

Upgrading Only Your Cisco IOS Release and Retaining Your Current FPD Image

You may choose to upgrade your Cisco IOS release with or without retaining your current FPD image. You may choose to upgrade your Cisco IOS image and retain your current FPD image, although this is not recommended.

SUMMARY STEPS

1. Use the no upgrade fpd auto command to disable the bundled FPD image.
2. Save the configuration before loading the new image.
3. Load the new image.

DETAILED STEPS

-
- Step 1** Use the no upgrade fpd auto command to disable the bundled FPD image.
Note The automatic upgrade feature is disabled once you enter the no upgrade fpd auto command.
- Step 2** Save the configuration before loading the new image.
- Step 3** Load the new image.
Note If your current FPD image is not compatible with the new image, the EPAs do not come online.
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Upgrading FPD Images in a Production System

Adding an EPA to a production system presents the possibility that the EPA may contain versions of FPD images that are incompatible with the Cisco IOS release currently running the router. In addition, the FPD upgrade operation can be a very CPU-intensive operation and therefore the upgrade operation may take more time when it is performed on a production system. The performance impact will vary depending on various factors, including network traffic load, the type of processing engine used, type of EPA, and the type of service configured.

For these reasons, we recommend that one of the following alternatives be used to perform the FPD upgrade on a production system if possible:

Using a Nonproduction System to Upgrade the Cisco ASR 1000 Series Routers EPA FPD Image

Before beginning the upgrade, ensure:

- The spare system is running the same version of the Cisco IOS software release that the target production system is running.
- The automatic upgrade feature is enabled on the spare system. The automatic upgrade feature is enabled by default. It can also be enabled using the **upgrade fpd auto** command.

Use the following procedure to perform an upgrade on a spare system:

SUMMARY STEPS

1. Insert the EPA into the spare system.
2. Verify that the upgrade was successful, by entering the **show hw-module all fpd** command.
3. Remove the EPA from the spare system after the upgrade.
4. Insert the EPA into the target production system.

DETAILED STEPS

-
- Step 1** Insert the EPA into the spare system.
If an upgrade is required, the system will perform the necessary FPD image updates so that when this EPA is inserted to the target production system, it will not trigger an FPD upgrade operation there.
- Step 2** Verify that the upgrade was successful, by entering the **show hw-module all fpd** command.
- Step 3** Remove the EPA from the spare system after the upgrade.
- Step 4** Insert the EPA into the target production system.
-

Verifying System Compatibility First

If a spare system is not available to perform an upgrade, you can check for system compatibility by disabling the automatic upgrade feature before inserting the EPA. The automatic upgrade feature is enabled by default. It can be disabled using the **no upgrade fpd auto** command.

- If the FPD images on the EPA are compatible with the system, you will only need to re-enable the automatic upgrade feature (the automatic upgrade feature can be re-enabled using the **upgrade fpd auto** command).
- If the FPD images on the EPA are not compatible with the system, the EPA is disabled but will not impact system performance by attempting to perform an automatic upgrade.

Use the following procedure to check the FPD images on the EPA for system compatibility:

SUMMARY STEPS

1. Disable the automatic upgrade feature using the **no upgrade fpd auto** global configuration command.
2. Insert the EPA into the system.
3. Re-enable the automatic upgrade feature using the **upgrade fpd auto** global configuration command.

DETAILED STEPS

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- Step 1** Disable the automatic upgrade feature using the **no upgrade fpd auto** global configuration command.
- Step 2** Insert the EPA into the system.
If the FPD images are compatible, the EPA will operate successfully after bootup.
If the FPD images are not compatible, the EPA is disabled. At this point, we recommend that you wait for a scheduled maintenance when the system is offline to manually perform the FPD upgrade as described in the [Manually Upgrading EPA FPD Images](#), on page 5.
- Step 3** Re-enable the automatic upgrade feature using the **upgrade fpd auto** global configuration command.
-

Optional FPD Procedures

This section provides information for optional FPD-related functions. None of the topics discussed in this section are necessary for completing FPD upgrades, but may be useful in some FPD-related scenarios. It covers the following topics:

Manually Upgrading EPA FPD Images

To manually upgrade the current FPD version on an EPA, use the following command:

```
Router# upgrade hw-module subslot
[slot-number/subslot-number] fpd bundle [reload]
```

In this example, *slot-number* is the slot where the MIP is installed, *subslot-number* is the subslot number where the EPA is located, **fpd** indicates the type of upgrade required, **bundle** selects the bundled FPD package, and **reload** specifies that the EPA is automatically reloaded after the upgrade. Note that **subslot slot-number/subslot-number** is used to specify an EPA FPD upgrade. The EPA will automatically be reloaded to complete the FPD upgrade.



Caution

Sometimes, FPD upgrade can require a long period of time to complete depending on the type of EPA. In such case, monitor the progress using the **show upgrade fpd progress** command.

Upgrading Multiple FPD Images

A single piece of hardware can contain multiple FPD images. The Cisco ASR 1000 Series Routers can upgrade up to three FPD images simultaneously. However, only one FPD upgrade per router slot can occur at a time, so all FPD images on all EPAs in a single slot will have to wait for another FPD upgrade to finish.

Users should note that some FPD images require the EPA to reload to complete. The FPD upgrade process will perform this step automatically, so users do not have to intervene. However, the other FPDs in the hardware of the specified slot will have to wait for this reload to complete before their upgrade process begins.



Note

With a manual upgrade, you must include the **reload** option to cause the EPA to reload automatically. See the [Manually Upgrading EPA FPD Images, on page 5](#).

During an automatic upgrade, the Cisco ASR 1000 Series Routers will upgrade as many FPDs as possible at a time. No user intervention is possible or necessary. The upgrade process will not stop until all FPD images have been updated.

During manual upgrades, it is important to note that users can only specify upgrades for a single piece of hardware each time the **upgrade hw-module subslot** [*slot-number/subslot-number*] command is entered. The maximum of three simultaneous upgrades applies to manual upgrades as well. If you individually specify multiple manual FPD upgrades, only three FPDs can be upgraded simultaneously and that can only occur when the hardware is in different router slots. The FPD upgrade process will stop when all FPDs for the specified hardware have been upgraded.

Displaying Current and Minimum Required FPD Image Versions

To display the current version of FPD images on the EPAs installed on your router, use the **show hw-module slot-number/subslot-number | all] fpd** command, where *slot-number* is the slot number where the MIP is installed, and *subslot-number* is the number of the MIP subslot where a target EPA is located. Entering the **all** keyword shows information for hardware in all router slots.

The following examples show the output when using this **show** command.

The output display in this example shows that FPD versions on the EPAs in the system meet the minimum requirements:

```
Router#show hw-module subslot all fpd
```

Slot	Card Type	H/W Ver.	Field Programmable Device: "ID-Name"	Current Version	Min. Required Version
0/0	BUILT-IN-2T+20X1GE	0.1	22-DB FPGA	1.16	1.16
1/0	SPA-1X10GE-WL-V2	1.0	1-10GE WAN I/O FPG	1.11	1.11
1/1	SPA-10X1GE-V2	1.2	1-GE I/O FPGA 1.10 1.10		
5/0	EPA-10X10GE <DISABLED>	1.0	38-EPA_10X10G FPGA	1.16	1.16 *
5/1	EPA-1X100GE	0.1	37-EPA_1X100G FPGA	1.14	1.14

This example shows the output when using the *slot-number/subslot-number* argument to identify a particular EPA:

```
Router# show hw-module subslot 5/1 fpd
=====
H/W Field Programmable Current Min. Required
Slot Card Type Ver. Device: "ID-Name" Version Version
=====
5/1 EPA-1X100GE 0.1 37-EPA_1X100G FPGA 1.14 1.14
=====
```

The output display in this example shows that the EPA in subslot 0/1 is disabled because one of the programmable devices does not meet the minimum version requirements.

```
Router#show hw-module subslot all fpd

=====
Slot Card Type                H/W   Field Programmable   Current   Min. Required
                               Ver.   Device: "ID-Name"    Version   Version
=====
0/0 BUILT-IN-2T+20X1GE         0.1   22-DB FPGA           1.16     1.16
-----
1/0 SPA-1X10GE-WL-V2          1.0   1-10GE WAN I/O FPG   1.11     1.11
-----
5/0 EPA-10X10GE <DISABLED>    1.0   38-EPA_10X10G FPGA   1.16     1.18   *
-----
5/1 EPA-1X100GE              0.1   37-EPA_1X100G FPGA   1.14     1.14
=====
NOTES:
- FPD images that are required to be upgraded are indicated with a '*'
  character in the "Minimal Required Version" field.
```

Displaying Information About the Default FPD Image Package

You can use the **show upgrade fpd package default** command to find out which EPAs are supported with your current Cisco IOS release and which FPD image package you need for an upgrade.

```
Router# show upgrade fpd package default
```

```
*****
This Cisco IOS software image requires the following default FPD Image
Package for the automatic upgrade of FPD images (the package is available
from Cisco.com and is accessible from the Cisco Software Center page where
this IOS software image can be downloaded):
*****
Version: 15.6(20150603:045805)
Package Filename: asr1000-fpd-bundle.pkg
List of card type supported in this package:
Minimal
No. Card Type HW Ver.
-----
1) 4xT SERIAL SPA 0.0
2) 4xT SERIAL SPA 2.0
3) 1xCHSTM1 SPA 0.0
4) 1xCHSTM1 V2 SPA 0.1
5) SPA-1XCHOC12/DS0 0.0
6) SPA-1XCHOC12/DS0 0.0
7) 1xCHOC48STM16 SPA 2.0
8) 2xCT3 SPA 0.100
9) 2xCT3 SPA 0.200
10) 2xCT3 V2 SPA 1.0
< .....output stripped for readability...>
72) 10X10GE EPA 0.0
73) 6X10GE EPA 0.0
74) 8X10GE Built-in EPA 0.0
75) EPA-18X1GE 0.0
```

```
76) BUILT-IN-EPA-8X1G 0.0
77) 1X100GE EPA 0.0
```

Verifying the FPD Image Upgrade Progress

You can use the **show upgrade fpd progress** command to view a snapshot of the upgrade progress while an FPD image upgrade is taking place. The following example shows the type of information this command displays:

```
Router# show upgrade fpd progress

FPD Image Upgrade Progress Table:
=====
Slot Card Type                Field Programmable      Approx.
                               Device : "ID-Name"      Time      Elapsed
                               Needed              Time      State
=====
 0/2 EPA-10X10GE              38-EPA_10X10G FPGA    00:06:00  00:00:48  Updating...
=====
```

FPD Image Upgrade Examples

This section provides examples of automatic and manual FPD image upgrades. It includes the following examples:

Automatic FPD Image Upgrade Example

The following example shows the output displayed when an EPA in slot 0 subslot 3/1 requires an FPD image upgrade and the **upgrade fpd auto** command is *enabled*. The required FPD image is automatically upgraded.

```
*Mar 6 11:48:12.632: %FPD_MGMT-3-INCOMP_IMG_VER: Incompatible EPA_10X10G FPGA (FPD ID=38)
image version detected for EPA-10X10GE card in subslot 3/1. Detected version = 1.15, minimum
required version = 1.16. Current HW version = 1.0.
*Mar 6 11:48:12.634: %FPD_MGMT-5-UPGRADE_ATTEMPT: Attempting to automatically upgrade the
FPD image(s) for EPA-10X10GE card in subslot 3/1. Use 'show upgrade fpd progress' command
to view the upgrade progress ...
*Mar 6 11:48:12.671: %FPD_MGMT-6-BUNDLE_DOWNLOAD: Downloading FPD image bundle for EPA-10X10GE
card in subslot 3/1 ...
*Mar 6 11:48:12.834: %SPA_OIR-6-ONLINECARD: SPA (EPA-10X10GE) online in subslot 3/1
*Mar 6 11:48:14.652: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
EPA-10X10GE card in subslot 3/1 = 00:06:00.
*Mar 6 11:48:14.656: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
in progress for EPA-10X10GE card in subslot 3/1. Updating to version 1.16. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
FPD upgrade in progress on hardware, reload/configuration change
on those hardware is not recommended as it might cause HW programming
failure and result in RMA of the hardware.
.....
*Mar 6 11:49:15.459: FPD MSG HANDLER: upgrade result response from 3/1 received, card
type=0xC54, fpd id=0x26, num retries=1, upgrade result=2, upgrade id=4
*Mar 6 11:49:15.459: %FPD_MGMT-6-UPGRADE_PASSED: EPA_10X10G FPGA (FPD ID=38) image in the
EPA-10X10GE card in subslot 3/1 has been successfully updated from version 1.15 to version
1.16. Upgrading time = 00:01:00.803
*Mar 6 11:49:15.459: %FPD_MGMT-6-OVERALL_UPGRADE: All the attempts to upgrade the required
FPD images have been completed for EPA-10X10GE card in subslot 3/1. Number of
successful/failure upgrade(s): 1/0.
*Mar 6 11:49:15.460: %FPD_MGMT-5-CARD_POWER_CYCLE: EPA-10X10GE card in subslot 3/1 is being
power cycled for the FPD image upgrade to take effect.
*Mar 6 11:49:15.464: %SPA_OIR-6-OFFLINECARD: SPA (EPA-10X10GE) offline in subslot 3/1
```


Manual FPD Image Upgrade Example

In the following example, FPD for the 10X10G EPA in subslot 1/1 is upgraded manually from the bundled FPD image package file. The command excludes the **reload** option so the EPA does not automatically reload.

```
Router# upgrade hw-module subslot 1/1 fpd bundled
% The following FPD will be upgraded for EPA-10X10GE (H/W ver = 1.0) in subslot 1/1:
=====
Field Programmable   Current   Upgrade   Estimated
Device: "ID-Name"   Version   Version   Upgrade Time
=====
38-EPA_10X10G FPGA   1.14     1.15     00:06:00
=====

% NOTES:
- Use 'show upgrade fpd progress' command to view the progress of the FPD
  upgrade.
- You must reload the card after the upgrade. The FPD upgrade is not
  finalized until the card is reloaded.
- The output of 'show hw-module <target> fpd' will not reflect the
  upgraded FPD version until the card is reloaded to finalize the upgrade.
% Are you sure that you want to perform this operation? [no]: yes
% Initiating the upgrade operation on the target card ...
(Use "show upgrade fpd progress" command to see upgrade progress)
Router#
*Feb 2 11:28:03.041: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
EPA-10X10GE card in subslot 1/1 = 00:06:00.
*Feb 2 11:28:03.047: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
in progress for EPA-10X10GE card in subslot 1/1. Updating to version 1.15. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
FPD upgrade in progress on hardware, reload/configuration change
on those hardware is not recommended as it might cause HW programming
failure and result in RMA of the hardware.
*Feb 2 11:28:49.229: %NETCLK-6-SEL_CLOCK_SRC: Synchronization source HundredGigE1/0/0 is
selected by selection process(T0) to synchronize the system and generate T0 output.
*Feb 2 11:29:03.999: FPD MSG HANDLER: upgrade result response from 1/1 received, card
type=0xC54, fpd id=0x26, num retries=1, upgrade result=2, upgrade id=4
*Feb 2 11:29:03.999: %FPD_MGMT-6-UPGRADE_PASSED: EPA_10X10G FPGA (FPD ID=38) image in the
EPA-10X10GE card in subslot 1/1 has been successfully updated from version 1.14 to version
1.15. Upgrading time = 00:01:00.952
*Feb 2 11:29:03.999: %FPD_MGMT-6-OVERALL_UPGRADE: All the attempts to upgrade the required
FPD images have been completed for EPA-10X10GE card in subslot 1/1. Number of
successful/failure upgrade(s): 1/0.
EPA does not reload automatically without the reload option during FPD upgrade. We need to explicitly
reload the EPA for the new FPGA to take effect.
```

In the following example, FPD for the 10X10G EPA in subslot 0/3 is upgraded manually from the bundled FPD image package file. The command includes the **reload** option so that the EPA automatically reloads and the new FPD image takes effect immediately.

```
Router# upgrade hw-module subslot 1/1 fpd bundled reload
% The following FPD will be upgraded for EPA-10X10GE (H/W ver = 1.0) in subslot 1/1:
=====
Field Programmable   Current   Upgrade   Estimated
Device: "ID-Name"   Version   Version   Upgrade Time
=====
38-EPA_10X10G FPGA   1.14     1.15     00:06:00
=====

% NOTES:
- Use 'show upgrade fpd progress' command to view the progress of the FPD
  upgrade.
- You must reload the card after the upgrade. The FPD upgrade is not
  finalized until the card is reloaded.
- The output of 'show hw-module <target> fpd' will not reflect the
  upgraded FPD version until the card is reloaded to finalize the upgrade.
% Are you sure that you want to perform this operation? [no]: yes
% Initiating the upgrade operation on the target card ...
```

```

(Use "show upgrade fpd progress" command to see upgrade progress)
Router#
*Feb 2 11:28:03.041: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
EPA-10X10GE card in subslot 1/1 = 00:06:00.
*Feb 2 11:28:03.047: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
in progress for EPA-10X10GE card in subslot 1/1. Updating to version 1.15. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
FPD upgrade in progress on hardware, reload/configuration change
on those hardware is not recommended as it might cause HW programming
failure and result in RMA of the hardware.
*Feb 2 11:28:49.229: %NETCLK-6-SEL_CLOCK_SRC: Synchronization source HundredGigE1/0/0 is
selected by selection process(T0) to synchronize the system and generate T0 output.
*Feb 2 11:29:03.999: FPD_MSG_HANDLER: upgrade result response from 1/1 received, card
type=0xC54, fpd id=0x26, num retries=1, upgrade result=2, upgrade id=4
*Feb 2 11:29:03.999: %FPD_MGMT-6-UPGRADE_PASSED: EPA_10X10G FPGA (FPD ID=38) image in the
EPA-10X10GE card in subslot 1/1 has been successfully updated from version 1.14 to version
1.15. Upgrading time = 00:01:00.952
*Feb 2 11:29:03.999: %FPD_MGMT-6-OVERALL_UPGRADE: All the attempts to upgrade the required
FPD images have been completed for EPA-10X10GE card in subslot 1/1. Number of
successful/failure upgrade(s): 1/0.
*Feb 2 11:29:03.999: %FPD_MGMT-5-CARD_POWER_CYCLE: EPA-10X10GE card in subslot 1/1 is being
power cycled for the FPD image upgrade to take effect.

```

Verifying a Successful Upgrade

After the upgrade process is complete, you can use the **show hw-module subslot all fpd** command to verify that the FPD image has been successfully upgraded:

```

Router# show hw-module subslot all fpd
=====
Slot Card Type                H/W   Field Programmable   Current   Min. Required
Ver.   Device: "ID-Name"     Version  Version
-----
0/0 EPA-10X10GE             0.1   38-EPA_10X10G FPGA   1.18     1.18
-----
0/1 EPA-1X100GE            0.1   37-EPA_1X100G FPGA   1.14     1.14
-----
5/0 BUILT-IN-2T+20X1GE      1.0   22-DB FPGA           1.16     1.16
=====

```