

White Rabbit Solutions from “Seven Solutions” (PTP distribution appliances)

- Link to online White Rabbit User Guides on our website:
<https://safran-navigation-timing.com/support-hub/white-rabbit/>
- Link to online White Rabbit software updated on our website: <https://safran-navigation-timing.com/portal/public-downloads/latest-white-rabbit-product-update-files/>

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- White Rabbit Solutions” On our website: <https://www.rolia.com/products/timing-sync/white-rabbit-solutions>

Email from Scott Z (21 May 2020) I wanted everyone to be aware of a new product line we will be reselling. The company is Seven Solutions, and the products are called White Rabbit. Basically, it is high accuracy PTP distribution appliance. They have 3 models and once I get the PP presentation, I will send off to all of you to see.

Technical Services will NOT be supporting these appliances they will be supported through the Apps Team. So, at this point, we should not have any interaction with this product line.

Just be aware if you hear these names. I will send more info shortly.

What is White Rabbit?

White Rabbit is a collaborative project including CERN (the European Organization for Nuclear Research), GSI Helmholtz Centre for Heavy Ion Research and other partners from universities and industry to develop a fully deterministic Ethernet-based network for general purpose data transfer and sub-nanosecond accuracy time transfer.

It provides sub-nanosecond synchronization accuracy, which formerly required dedicated hard-wired timing systems, with the flexibility and modularity of real-time Ethernet networks. A White Rabbit network may be used solely to provide timing and synchronization to a distributed electronic system, or to provide both timing and real-time data transfer.

Orolia has partnered with Seven Solutions to offer White Rabbit technologies to our customers.

Time Nodes



Zen TP-FL
WR Master or end node

- ✓ High Accuracy Time Transfer
- ✓ Long Distance Links

Distribution Devices



WR Z16
WR Distribution

- ✓ High Accuracy Time Transfer
- ✓ High Accuracy Fanout

Licenses/Support



PTP License
WR to PRP Interoperability

- ✓ PTP message Types and Message Ratios
- ✓ Profile Support



WR LEN
WR end node

- ✓ High Accuracy Time Transfer



ZEN TP 32BNC
WR Distribution

- ✓ High Accuracy Time Transfer
- ✓ High Accuracy Analog Fanout



Yearly Support
Product Maintenance

- ✓ Firmware Updates
- ✓ Hotline Support

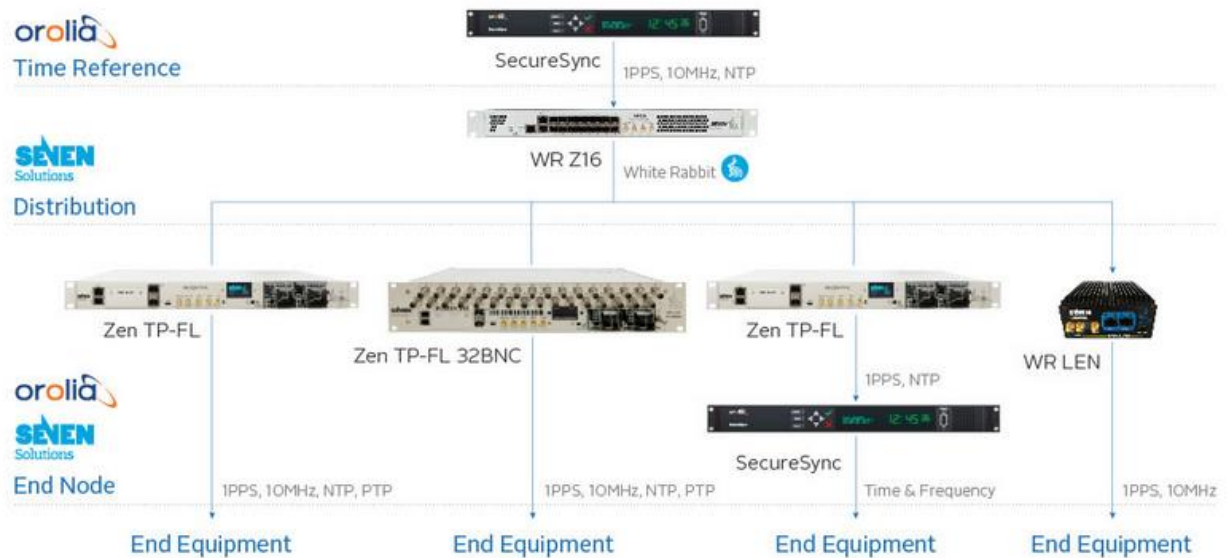
Warranty period

Per Dave Sohn (21 May 2021) White Rabbit devices are **one year** warranty.

Documentation from Rochester Training May 2022:

<https://oroliagroup.sharepoint.com/sites/Business-Engineering/Shared%20Documents/Forms/AllItems.aspx?id=%2Fsites%2FBusiness%2DEngineering%2FShared%20Documents%2FTraining%2FTraining%20Rochester%20May%202022&p=true&ga=1>

How It All Fits Together



MICROTRAINING: WHITE RABBIT PRODUCT SELECTION

- Basic Endpoint: Master or Slave

[WR ZEN TP-FL](#)

1x 1PPS, 1x 10MHz, 2x WR/PTP



- How do I get more signals?

[WR ZEN TP-FL 4pps](#)

Adds 4x 1PPS or 10MHz

[WR ZEN TP-FL 8pps](#)

Adds 8x 1PPS or 10MHz

[WR ZEN TP 32BNC](#)

Adds 16x 1PPS and 16x 10MHz

- How do I get more White Rabbit?

[WR Z16](#)

16x WR/PTP



- How do I get more than basic PTP?

[WR PTP License](#)

Unlock additional PTP profiles (G.8265.1, G.8275.1, C37.238-2011), PTP message ratios, unicast mode

- How do I connect my White Rabbit?

[BX10 ONU Fiber Optic SFP Module](#)

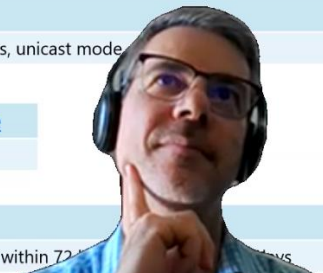
[BX10 OLT Fiber Optic SFP Module](#)

Paired 1000BASE-BX10 SFP modules (One of each per White Rabbit connection)

- How do I get yearly support?

[Support package - ZEN family](#)

Product firmware updates available every release with email, hotline, remote support within 72 hours



White Rabbit Various Models

Link to online White Rabbit User Guides on our website:

<https://safran-navigation-timing.com/support-hub/white-rabbit/>

A) TIME NODES

WR-ZEN family (“WR-ZEN TP”, “WR-ZEN-TP-FL”, “WR-ZEN TP-32BNC”, “WR-ZEN-TP-FL 4PPS” and “WR-ZEN-TP-FL 8PPS”)

Link to online WR-ZEN User Guide: <https://safran-navigation-timing.com/support-hub/white-rabbit/>

A) WR-ZEN TP-FL variants



WR-ZEN TP-FL-HO

WR ZEN TP-FL 48VDC

B) WR-ZEN TP-32BNC variants



WR-ZEN TP-32BNC

A) WR ZEN TP-FL and variants



- **List of our WR ZEN “TP-FL” variants and P/Ns (details for each further below)**
 1. **EQP-TMP-FL-01:** *WR ZEN TP-FL (no Holdover capability)*
 2. **EQP-TMP-FL-LJ-01:** *WR ZEN TP-FL Low Jitter*
 3. **EQP-TMP-FL-100:** *WR ZEN TP-FL 48VDC*
 4. **EQP-TMP-FL-LJ-100** *WR ZEN TP-FL Low Jitter 48VDC*
 5. **EQP-TMP-FL-02:** *WR ZEN TP-FL-HO (Holdover capability)*
 6. **EQP-TMP-FL-4-01:** *WR ZEN TP-FL 4pps*
 7. **EQP-TMP-FL-LJ-4-01** *WR ZEN TP-FL Low Jitter 4x1PPS*
 8. **EQP-TMP-FL-8-01:** *WR ZEN TP-FL 8pps*
 9. **EQP-TMP-FL-LJ-8-02** *WR ZEN TP-FL Low Jitter 8x1PPS Holdover capability*
- Link to datasheet on our site: https://safran-navigation-timing.com/product/white-rabbit-zen-tp-fl/?model_interest_c=WR+ZEN+TP-FL

1. EQP-TMP-FL-01: WR ZEN TP-FL (no Holdover capability)

- Our P/N: [EQP-TMP-FL-01](#)
- In Arena: https://app.bom.com/items/detail-spec?item_id=1283621680&version_id=11652204938&orb_msg_single_search_p=1

Description: The fundamental standalone node to provide widely available timing protocols (PTPv2, NTP, 10MHz/PPS)

- * Redundant network interfaces: 2x 1G Optical SFP (cages), 2x ETH RJ45 100/1G.
- * Remote configuration and monitoring: SSH, HTTP, SNMPv3, rsyslog.
- * Redundant & hot-swappable: Power Supplies
- 1U Rack Mount (19 inches).

2. EQP-TMP-FL-LJ-01 WR ZEN TP-FL Low Jitter

- Our P/N: [EQP-TMP-FL-LJ-01](#)
- In Arena: https://app.bom.com/items/detail-spec?item_id=1335589625&version_id=12718807858&orb_msg_single_search_p=1

Description: 1U White Rabbit Precise time provider with low jitter enhancement.

- 2X 1GbE SFP Connectors,
- 5x SMA 3.3V/50 ohm (PPS in, 10MHz In, PPS OUT, CLK Out, 10 MHz Sine Out).
- Dual hot-swap AC supplies

3. EQP-TMP-FL-100 WR ZEN TP-FL 48VDC

Our P/N [EQP-TMP-FL-100](#)

In Arena at https://app.bom.com/items/detail-spec?item_id=1307840711&version_id=12142375138&orb_msg_single_search_p=1

Description: The fundamental standalone node to provide widely available timing protocols (PTPv2, NTP, 10MHz/PPS)

- * Redundant network interfaces: 2x 1G Optical SFP (cages), 2x ETH RJ45 100/1G.
- * Remote configuration and monitoring: SSH, HTTP, SNMPv3, rsyslog.
- * Redundant & hot-swappable: Power Supplies
- 1U Rack Mount (19 inches).

4. EQP-TMP-FL-LJ-100 White Rabbit ZEN TP-FL Low Jitter 48VDC

○ Our P/N: EQP-TMP-FL-LJ-100

○ In Arena: https://app.bom.com/items/detail-spec?item_id=1335589053&version_id=12718796308&orb_msg_single_search_p=1

Description: 1U White Rabbit Precise time provider with low jitter enhancement.

- 2X 1GbE SFP Connectors,
- 5x SMA 3.3V/50 ohm (PPS in, 10MHz In, PPS OUT, CLK Out, 10 MHz Sine Out).
- Dual hot-swap 48VDC supplies

5. [EQP-TMP-FL-02](#): WR ZEN TP-FL-HO (Holdover capability)

Our P/N: EQP-TMP-FL-LJ-01

In Arena: https://app.bom.com/items/detail-spec?item_id=1335589625&version_id=12718807858&orb_msg_single_search_p=1

Description: 1U White Rabbit Precise time provider with low jitter enhancement.

- 2X 1GbE SFP Connectors,
- 5x SMA 3.3V/50 ohm (PPS in, 10MHz In, PPS OUT, CLK Out, 10 MHz Sine Out).
- Dual hot-swap AC supplies

6. EQP-TMP-FL-02: WR ZEN TP-FL-HO (holdover capability)

○ Our P/N: [EQP-TMP-FL-02](#)

- **In Arena** at: https://app.bom.com/items/detail-spec?item_id=1330043730&version_id=12608441478&orb_msg_single_search_p=1
- **Description:** 1U White Rabbit precise time provider **with holdover capability**. 2x 1GbE SFP connectors. 5x SMA 3.3V/50ohm (PPS In, 10Mhz In, PPS Out, CLK Out, 10MHz Sine Out). Dual hot-swap AC supplies.

7. **EQP-TMP-FL-4-01:** *WR ZEN TP-FL 4pps*

- **Our P/N:** EQP-TMP-FL-4-01
- **In Arena** at: https://app.bom.com/items/detail-spec?item_id=1330043730&version_id=12608441478&orb_msg_single_search_p=1
- **Description**

8. **EQP-TMP-FL-8-01:** *WR ZEN TP-FL 8pps*

- **Our P/N** EQP-TMP-FL-8-01
- **In Arena** at https://app.bom.com/items/detail-spec?item_id=1305614845&version_id=12097413418&orb_msg_single_search_p=1
- **Description** the fundamental standalone node to provide widely available timing protocols (PTPv2, NTP, 10MHz/PPS)
 - * Redundant network interfaces: 2x 1G Optical SFP (cages), 2x ETH RJ45 100/1G.
 - * Remote configuration and monitoring: SSH,HTTP, SNMPv3, rsyslog.
 - * Redundant & hot-swappable: Power Supplies
 - 1U Rack Mount (19 inches).

8xPPS out on SMA

 - Output levels: LVTTTL, capable of driving +3.3 V over a 50 Ohm load.

9. **EQP-TMP-FL-LJ-8-02** *WR ZEN TP-FL Low Jitter 8x1PPS Holdover capability*

- **Our P/N** EQP-TMP-FL-LJ-8-02
- **In Arena** at https://app.bom.com/items/detail-spec?item_id=1335589073&version_id=12718796508&orb_msg_single_search_p=1

Description 1U White Rabbit Precise time provider with low jitter enhancement and Holdover capability.

- 2X 1GbE SFP Connectors,
- 5x SMA 3.3V/50 ohm (PPS in, 10MHz In, PPS OUT, CLK Out, 10 MHz Sine Out).
- Additional 8x SMA 3.3V/50 ohm PPS Out,
- 10MHz Sine Out.
- Dual hot-swap AC supplies

Info about/associated with all WR ZEN TP-FL Variants

The fundamental standalone node that provides the White Rabbit features to a wide range of applications making use of its redundant connections. The WR-ZEN TP-FL easily distributes time and frequency to other equipment by implementing widely available timing protocols: PTPv2, NTP, 10MHz/PPS.

The WR-ZEN TP-FL combines ultra-stable clocks with low jitter and temperature compensated clock resources to enhance its synchronization accuracy in a cost-effective 1U form factor.

New feature:

Expansion modules	
FMC 4x1PPS expansion (SMA, 3.3V/50Ω) Configurable options: ▪ 4x 1PPS/10 MHz/xPPS/IRIG-B ▪ 2x1PPS/10 MHz/xPPS/IRIG-B + 2 x1PPS/10 MHz/xPPS/IRIG-B	FMC 8x1PPS expansion (SMA, 3.3V/50Ω) Configurable options: ▪ 8x 1PPS/10 MHz/xPPS/IRIG-B ▪ 4x 1PPS /10 MHz/xPPS/IRIG-B + 4x 1PPS/10 MHz/xPPS/IRIG-B
	

- 4x1PPS expansion board optionally supported. (WR ZEN TP-FL 4PPS / our P/N: EQP-TMP-FL-401)
- 8x1PPS expansion board optionally supported. (WR ZEN TP-FL 8PPS) / our P/N EQP-TMP-FL-8-01)

* Redundant network interfaces: 2x 1G OpticalSFP (cages), 2x ETH RJ45 100/1G.

* Remote configuration and monitoring: SSH, HTTP, SNMPv3, rsyslog.

* Redundant & hot-swappable: Power Supplies 1U Rack Mount (19 inches)

FEATURES

- Sub-nanosecond time accuracy
- Remote configuration and monitoring.
- Distance range: over 80 km using fiber.
- Xilinx Zynq Family (ARM Dual Core).
- WR, PTPv2.
- Robustness & Redundancy.
- 4x1PPS expansion / 8x1PPS expansion boards optionally supported.

Clocks I/O



- **5xSMA coaxial connectors (3V/50Ω):**

- 10 MHz SINOUT ref. clock (PLL)
- CLK OUT(LVTTL)
- PPS OUT (LVTTL)
- PPS IN (LVTTL)
- 10MHz IN (TTL/CMOS/ ECL/clipped sine)

PTP (purchased license is required for PTP)

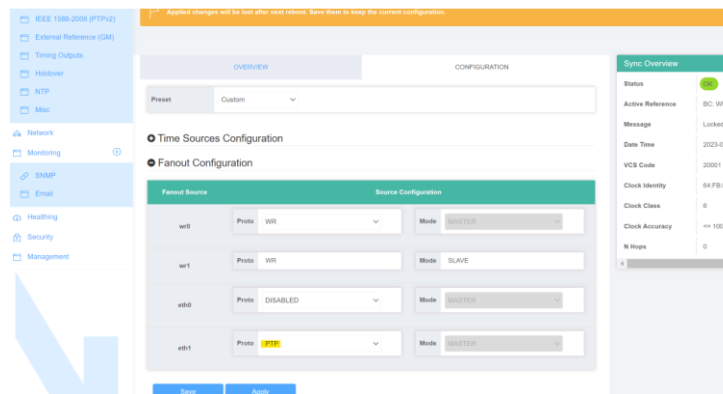
- Refer to WR-ZEN online user guide ("License") at: <https://safran-navigation-timing.com/wp-content/uploads/2023/03/WR-ZEN-UserGuide-v4.0-1.pdf>

- **Enable PTP on Eth1/Fanout Configuration**

- Refer to Salesforce Case 300858

Q "I've successfully installed the license, however I still don't have the ability to enable PTP on eth1

A To enable the eth1 port, access the "Timing > General" tab. In the "Configuration" section, you can find the "Fanout Configuration", where you can set the PTP protocol for the eth1 port. After setting it, the eth1 port will automatically work as a PTP Master port



NTP Provider (no license required)

- Refer to WR-ZEN online user guide ("NTP Provider") at <https://safran-navigation-timing.com/wp-content/uploads/2023/03/WR-ZEN-UserGuide-v4.0-1.pdf>

SNMP

- Refer to WR-ZEN online user guide (“**SNMP**”) <https://safran-navigation-timing.com/wp-content/uploads/2023/03/WR-ZEN-UserGuide-v4.0-1.pdf>

B) **WR ZEN TP-32BNC / WR ZEN TP-32BNC-HO (TP32BNC-02/ EQP-TP32BNC-LJ-02/ EQP-TP32BNC-LJ-03)**



Our WR ZEN TP32BNC Variants and P/Ns:

1. EQP-TP32BNC-02: WR ZEN TP32BNC

- Standard variant (not a low jitter variant)
- In Arena at: https://app.bom.com/items/detail-spec?item_id=1283621729&version_id=11652206488
- The WR ZEN Time Provider with 32x BNC outputs to provide legacy timing for all equipment in your rack.
 - * Sub-nanosecond time accuracy
 - * Remote configuration and monitoring (SNMPv3, Web, SSH)
 - * PTPv2, Sync-E supported
 - * Robustness & Redundancy
 - * 32x BNC configurable timing outputs (16x 10 MHz & 16xPPS/IRIG-B by default)
 - * 2U x 19" rack mounting unit

2. EQP-TP32BNC-LJ-02: White Rabbit ZEN TP-32BNC Low Jitter

- Low Jitter variant introduced on ECO-3323 (~June 2023)
- In Arena at: https://app.bom.com/items/detail-spec?item_id=1335589012&version_id=12718794748&orb_msg_single_search_p=1
- **Description:** 2U White Rabbit Precise time provider with low jitter enhancement.
 - 2X 1GbE SFP Connectors,
 - 5x SMA 3.3V/50 ohm (PPS in, 10MHz In, PPS OUT, CLK Out, 10 MHz Sine Out).
 - 16x BNC 1.7V/50 ohm 10MHz Out.
 - 16x BNC 3.3V/50 ohm PPS Out.
 - Dual hot-swap AC supplies.

3. EQP-TP32BNC-LJ-03: White Rabbit ZEN TP-32BNC Low Jitter Holdover

- Low Jitter variant introduced on ECO-3323 (~June 2023)
- In Arena at: https://app.bom.com/items/detail-spec?item_id=1335588995&version_id=12718794588&orb_msg_single_search_p=1
- **Description:** 2U White Rabbit Precise time provider with low jitter enhancement and holdover capability.
 - 2X 1GbE SFP Connectors,
 - 5x SMA 3.3V/50 ohm (PPS in, 10MHz In, PPS OUT, CLK Out, 10 MHz Sine Out).
 - 16x BNC 1.7V/50 ohm 10MHz Out.
 - 16x BNC 3.3V/50 ohm PPS Out.
 - Dual hot-swap AC supplies.

➤ Links to Datasheet

- **On our website:** https://safran-navigation-timing.com/product/white-rabbit-zen-tp-32bnc/?model_interest_c=WR+ZEN+TP-32BNC
- **In Arena:** https://app.bom.com/files/detail-summary?file_master_id=1319822800&file_id=1857051709

It is the versatile standalone node that provides the White Rabbit features to a wide range of applications making use of its redundant connections. The WR-ZEN TP-32BNC easily distributes time and frequency to other equipment by implementing standard timing protocols such as PTP, NTP, IRIG-B, etc.

The WR-ZEN TP-32BNC combines ultra-stable clocks with low jitter and temperature compensated clock resources to enhance its synchronization accuracy. In addition, it includes a fanout module to synchronize multiple devices through standard 10 MHz and PPS.

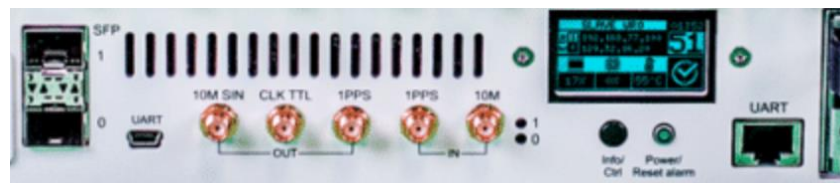
[The WR ZEN Time Provider with 32x BNC outputs to provide legacy timing for all equipment in your rack.](#)

- * [Sub-nanosecond time accuracy](#)
- * [Remote configuration and monitoring \(SNMPv3, Web, SSH\)](#)
- * [PTPv2, Sync-E supported](#)
- * [Robustness & Redundancy](#)
- * [32x BNC configurable timing outputs \(16x 10 MHz & 16x PPS/IRIG-B by default\)](#)
- * [2U x 19" rack mounting unit](#)

✓ FEATURES

- Sub-nanosecond time accuracy
 - Remote configuration and monitoring.
 - Distance range: over 80 km using fiber.
 - PTPv2, Sync-E supported
 - Robustness & Redundancy
 - Dynamic calibration
 - Xilinx Zynq Family (ARM Dual Core)
 - 32 BNC configurable outputs divided in 2 groups:
A&B: 10MHz (xPPS under license) / C&D: xPPS, IRIG-B with selectable 50Ω termination
- Fanout
 - 32 BNC configurable outputs divided in 2 groups (1.7V/50Ω):
 - A&B: 10MHz (xPPS under license) with 50Ω termination
 - C&D: xPPS, IRIG-B with selectable 50Ω termination

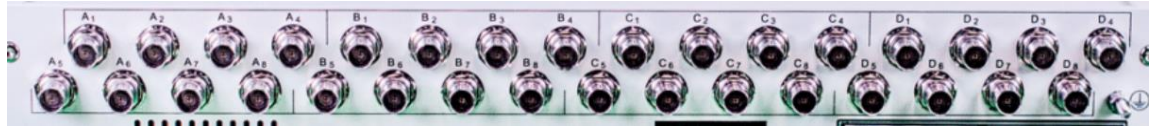
Clocks I/O



- **5xSMA coaxial connectors (3V/50Ω):**
 - 10 MHz SINOUT ref. clock (PLL)
 - CLK OUT(LVTTL)

- PPS OUT/IRIG-B (LVTTTL)
- PPS IN (LVTTTL)
- 10MHz IN (TTL/CMOS/ ECL/clippedsine)

Fanout via 32 BNCs



WR-ZEN TP-32BNC-HO

- Link to datasheet in Arena: https://app.bom.com/files/detail-summary?file_master_id=1319822801&file_id=1857051716

Product Description

2U White Rabbit precise time provider with holdover capability. 2x 1GbE SFP connectors. 5x SMA 3.3V/50ohm (PPS In, 10Mhz In, PPS Out, CLK Out, 10MHz Sine Out). 16x BNC 1.7V/50ohm 10MHz Out. 16x BNC 3.3V/50ohm PPS Out. Dual hot-swap AC supplies.

WR LEN (Lite Embedded Node) and WR LEN Standalone kits

WR LEN (EQP-LEN-01, EQP-LEN-02, EQP-LEN-11)



WR LEN

WR end node

✓ High Accuracy Time Transfer

➤ **Our P/Ns for WR LENs:**

- **EQP-LEN-01:** WR LEN
- **EQP-LEN-02:** WR LEN (with 2x μ DB-9)
 - White Rabbit precise time stand-alone node with 2x μ DB-9. 2x 1GbE SFP connectors. 10MHz programmable in/out. PPS/IRIG-B programmable In/Out.
- **EQP-LEN-11:** WR LEN (with mounting plate)
 - WR LEN (Refer to EQP-LEN-01) with mounting plate for rack shelf installation

➤ **Links to datasheet on our site:**

WR LEN: https://safran-navigation-timing.com/product/white-rabbit-len/?model_interest_c=WR+LEN

It is the competitive White Rabbit alternative capable of supporting daisy chain configurations. It allows a cost effective solution to distribute PPS/10MHz signals or IRIG-B protocol to your equipment.

WR stand-alone node solution to distribute PPS/10MHz signals or IRIG-B protocol. It supports daisy chain configurations.

Optional: 2x μ -DB9 connector for PPSs & 10MHz fan-out or configurable output triggers.

The following Standalone packages are available (refer to additional info further below)

- **KIT LEN F(Full):** It includes three LEN nodes and their interconnection elements.
- **KIT LEN B(Basic):** Includes two LENs (simple tests)

Thermal protection for WR Len

- Refer to Salesforce Case 284981 (question excerpted below)

Q We have purchased 4 WR-LENs and I have a question regarding them. Do the units have thermal protection? I.e. Do the units power down or do they break become less accurate if operated in over +50C?

A) White Rabbit LEN Standalone Kits

- Link to datasheet on our site: https://safran-navigation-timing.com/product/white-rabbit-len-standalone-kits/?model_interest_c=WR+LEN+STANDALONE+KIT

WR LEN Standalone kits are consist of a set of WR-LENs that offers synchronization over daisy chain configurations, distribute accurate timing from one node to others, synchronizes IRIG-B compliant devices or take advantage of the WR network. It doesn't need any configuration, it runs directly after the unpacking!

4. The following packages are available:

- **KIT LEN F(Full):** It includes **three** LEN nodes **and their interconnection elements**.
- **KIT LEN B(Basic):** Includes **two** LEN nodes (simple tests).

- **=STK-LEN-01 (WR LEN Standalone Kit, Basic)**

- In Arena at https://app.bom.com/items/detail-spec-redline?item_id=1309310798&version_id=12174127408&&redirect_seqno=16362023063
- **Description** White Rabbit LEN starting kit (basic) including 2x WR-LEN with Power Supplies, 1x Pair of SFP transceivers, 1x LC-LC Optical Fiber - 2m, 1x USB (A)-USB(mini) Cable, and 4x SMA (male)-BNC (male) Cable

- **STK-LEN-02 (WR LEN Standalone Kit, Full)**

- In Arena at https://app.bom.com/items/detail-spec-redline?item_id=1309310812&version_id=12174127858&&redirect_seqno=16362047809
- **Description:** White Rabbit LEN starting kit (full) including 3x WR-LEN with Power Supplies, 2x Pair of SFP transceivers, 2x LC-LC Optical Fiber - 2m, 1x USB (A)-USB(mini) Cable, and 4x SMA (male)-BNC (male) Cable

- **STK-SPEC-02 (WR SPEC Starting Kit, Standard)**

- In Arena at: https://app.bom.com/items/detail-spec-redline?item_id=1306344165&version_id=12111560108&&redirect_seqno=16361979493
- The SPEC is WR SPEC Starting Kit, smart solution composed by two nodes

White Rabbit Starting Kits



Overview

The KIT SPEC is the smart solution composed by two nodes. Each node uses one SPEC and one FMC-DIO card that operate as input time- stamping or programmable output pulse generator. The following formats are available:

- **KIT SPEC-B:** The basic one (without SFPs, wires, etc..).
- **KIT SPEC-S:** The standard one. Ready to play.
- **KIT SPEC-A:** Designed for advanced users and conceived to test the dynamic auto-calibration of White Rabbit protocols under variable external conditions. Includes 5 Km optical fiber rail.

This kit should only be considered as a **getting started kit**, you should not plan to use it in larger/final production deployment as one of its main components (Genumm PCIe chip) is obsolete.

B) FANOUT Distribution Devices

EQP-WR-Z16 and optional Low Jitter expansion module (EQP-WR-Z16-LJ-01)



- Our P/N: EQP-WR-Z16-01
- Link to the WR-Z16 online User guide: <https://safran-navigation-timing.com/wp-content/uploads/2023/03/WR-Z16-UserGuide-v4.0-1.pdf>
- Link to datasheet on our site (and DEMO): https://safran-navigation-timing.com/product/white-rabbit-z16/?model_interest_c=WR+Z16

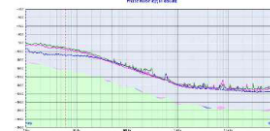
Technical Specifications / WR-Z16

System On-Chip	HIGHLIGHTS
SoC: Xilinx Zynq series	Sub-nanosecond time accuracy
CPU: Dual ARM® Cortex™-A9 MP@1 GHz	16 optical timing ports for WR and PTPv2
Memory: 512 MB DDR3 (32-bit bus) 16GB SD Card	Multi-source time references
Timing: Multi-sources	Distance range over 80 km using fiber
PTP IEEE 1588-2008	Linux OS
NTP	Datacenter Optimized design
Holdover (optional)	Failover mechanisms
Management: OS: Linux (Kernel v4.9 & buildroot)	Holdover capability
Control: CLI & Web-GUI (HTTPS)	Extended monitoring and management
Authentication: RADIUS TACACS+	Redundant hot-swappable power supply & fans
Monitoring: SNMPv3 (SNMPv2) + Traps Smart-Alerts	Health monitoring
Network: SSHv2 (OpenSSH 7.8) + SFTP/SCP DHCP LLDP Rsyslog	
Physical Specification: Dimension: 431 mm x 44 mm x 330 mm	Front Panel
Color: White (Metallic)	UART: RS232 Serial (RJ45 connector)
Certifications: ROHS, FCC, CE	Ethernet: 2x 10G/1000 Base-T RJ45
Environmental Conditions: Temperature: -10°C ~ +50°C	SFP Ports: 16x 1GbE for timing distribution (WR/PTPv2 selectable)
Humidity: 0% ~ 90% RH	Clocks I/O: 4x SMA connectors (3V @500, TTL compatible): 10MHz OUT (LVTTTL) PPS OUT (LVTTTL) 10MHz IN (TTL/CMOS/ECL/clipped sine)
	Back Panel Modules
	Power Supply: 2x Redundant & Hot-swappable 100-240VAC, 50-60 Hz 50W (max. 60W)
	Fan: 2 x Swappable fan modules Airflow: blowing out

(1) 10mm not included in default package

Phase noise (dBc/Hz)

	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz
GM (path reference)	-97.4	-105.2	-117.7	-140.0	-145.7	-145.2
1st hop slave	-92	-100.5	-119.8	-138.9	-145.3	-140.9
2nd hop slave	-90.2	-98.6	-117.6	-138.6	-143.9	-138.9



Ordering information

P/N: EQP-WR-Z16-01

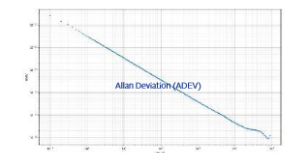
Low jitter expansion module

The low jitter expansion module for the WR-Z16 (optional) includes improved clock circuitry in order to improve the stability and accuracy of the timing outputs. As result of the improved performance, the WR-Z16 is able to meet the most demanding requirements in terms of time and frequency distribution.

P/N: EQP-WR-Z16-LJ-01

Long term stability (Allan Deviation)

	0.1 s	1 s	10 s	100 s	1000 s	10000 s	80000 s
ENBW 5 Hz	2.64 ^{ns}	3.13 ^{ns}	3.27 ^{ns}	3.65 ^{ns}	3.91 ^{ns}	4.50 ^{ns}	8.53 ^{ns}



*Measurements taken in temperature-controlled test environment.

Reliable & precise time fan-out solution for White Rabbit (basis for the new IEEE-1588-2019 High Accuracy Default profile) distribution on 1G Ethernet-based networks.

The WR-Z16 is a standalone device with 16 SFP connectors which provides sub-nanosecond accuracy time over plug-and-play optical fiber links.

The WR-Z16 provides very precise IEEE 1588-2008 (PTP) in all its optical interfaces and supports NTP interoperability. Picosecond-level frequency distribution is available through a fully digital clock.

WR-Z16 incorporates failover mechanisms which combine multi-source redundancy and holdover capabilities to ensure continuous operation.

It is the reliable time precise fan-out clock for White Rabbit distribution on 1G Ethernet-based networks.

The WR-Z16-LJ is a standalone device with 16 SFP connectors which easily distributes ultra-accurate time and frequency to all the nodes in the network using a hierarchical architecture. The WR-Z16-LJ incorporates failover mechanisms which combine redundancy in terms of multiple time sources and holdover capabilities in order to ensure continued operation.

***16 optical timing ports** for WR and PTPv2

*Remote configuration and monitoring

*Distance range over 80 km using fiber

*1U Datacenter Optimized design

*Failover mechanisms

*Holdover capability

*Redundant & hot-swappable: Power Supplies

*Enhanced low-jitter and low-phase noise performance

FEATURES

- Sub-nanosecond time accuracy
- 16 optical timing ports for IEEE-1588 & WR
- Multi-source time references
- Designed for Metro Area Network distances and beyond
- Datacenter Optimized design
- Failover & Holdover capabilities
- Extended monitoring and management
- Redundant swappable power supply & fans
- Health monitoring

SPECS

- Size: 431 x 44 x 330 mm
- Environmental Conditions
 - Temperature: -10°C ~ +50°C
 - Humidity: 0% ~ 90% RH
- Timing
- Multi-sources
 - Failover mechanism to ensure continuous operation by switching over several timing sources in case of failure
 - White Rabbit (accuracy <1ns)
 - External references (GNSS, AC) PTP IEEE 1588-2008
 - Supported Profiles: Default
 - G.8265.1[1]
 - G.8275.1[1]
 - IEEE C37.238-2011[1] up to 16 clients
 - NTP v2, v3 & v4
 - Holdover (optional) Accuracy (learning 3 days from GNSS)
 - < 100ns @ 4h
 - < 500ns @ 8h
 - < 1.5us @ 24h

Technical Specifications / WR-Z16

System On-Chip	
SoC	Xilinx Zynq series
CPU	Dual ARM® Cortex™-A9 MP@ 1 GHz
Memory	512 MB DDR3 (32-bit bus) 16GB SD Card
Timing	
Multi-sources	Failover mechanism to ensure continuous operation by switching over several timing sources in case of failure: - White Rabbit (accuracy <1ns) - External references (GNSS, AC)
PTP IEEE 1588-2008	- Supported Profiles: - Default - G.8265.1^[1] - G.8275.1^[1] - IEEE C37.238-2011^[1] up to 16 clients
NTP	NTP v2, v3 & v4
Holdover (optional)	Accuracy (learning 3 days from GNSS) < 100ns @ 4h < 500ns @ 8h < 1.5us @ 24h
Management	
OS	Linux (Kernel v4.9 & buildroot)
Control	CLI & Web-GUI: HTTP(s)
Authentication	- RADIUS - TACACS+
Monitoring	- SNMPv3 (SNMPv2) + Traps - Smart-Alerts
Network	- SSHv2 (OpenSSH 7.8) + SFTP/SCP - DHCP - LLDP - Rsyslog
Physical Specification	
Dimension	431 mm x 44 mm x 330 mm
Color	White (Metallic)
Certifications	ROHS, FCC, CE
Environmental Conditions	
Temperature	-10°C ~ +50°C
Humidity	0% ~ 90% RH

HIGHLIGHTS
Sub-nanosecond time accuracy
16 optical timing ports for WR and PTPv2
Multi-source time references
Distance range over 80 km using fiber
Linux OS
Datacenter Optimized design
Failover mechanisms
Holdover capability
Extended monitoring and management
Redundant hot swappable power supply & fans
Health monitoring

Front Panel	
	
UART	RS232 Serial (RJ45 connector)
Ethernet	2x 100/1000 Base-T RJ45
SFP Ports	16x 1GbE for timing distribution (WR/PTPv2 selectable)
Clocks I/O	4x SMA connectors (3V @50Ω, TTL compatible): 10MHz OUT (LVTTTL) - PPS OUT (LVTTTL) - PPS IN (LVTTTL) 10MHz IN (TTL/CMOS/ECL/clipped sine)
Back Panel Modules	
	
Power Supply	2x Redundant & Hot-swappable 100-240VAC, 50-60 Hz 50W (max. 80W)
Fan	2 x Swappable fan modules Airflow: blowing out

[1] License not included in default package

Optional Low jitter expansion module (EQP-WR-Z16-LJ-0)

The low jitter expansion module for the WR-Z16 (optional) includes improved clock circuitry in order to improve the stability and accuracy of the timing outputs. As result of the improved performance, the WR-Z16 is able to meet the most demanding requirements in terms of time and frequency distribution.

P/N: EQP-WR-Z16-LJ-01

WR-Z16 Front panel



Figure 2-1: WR-Z16 front panel

Table 2-1: Front Panel Legend

#	Name	Information	Ref.
#1	Power button 	Power On/Off the device	
#2	Reset Button	Button used to perform a factory reset or enter the recovery/failsafe mode	"Recovery Mode" on page 130
#3	Status LED	Green, Orange, Red	"System Status" on page 10
#4	1x Management UART (RJ45)	Serial UART RS232 on a RJ45 connector with pinout (USB-RJ45/RS232 adaptor not included) Pin #1: Pin #2: Pin #3: Pin #4: ✖ ✖ RXD GND Pin #5: Pin #6: Pin #7: Pin #8: ✖ TXD ✖ ✖	"Logging from the UART" on page 20
#5	2x Management Ethernet (RJ45)	10/100/1000 ethernet network interface (eth0 & eth1)	"Product Specifications" on page 13
#6	16x SFP Fiber ports	1Gbps SFP compatible	"White Rabbit" on page 58"IEEE 1588-2008 (PTPv2)" on page 62
Timing input			
#7	Timing Input LED	OK: Green; Warning: Yellow; Critical: Red	"Timing Output" on page 11
#8	10 MHz input	● SMA connector (F) ● 50 Ω termination ● 1Veff (+/-30%) digital or sine wave	"External Reference (GM)" on page 73

C) White Rabbit Switches (WRS-01 and WRS-LJ)

1. EQP-WRS-01 White Rabbit network switch (not the Low jitter variant)

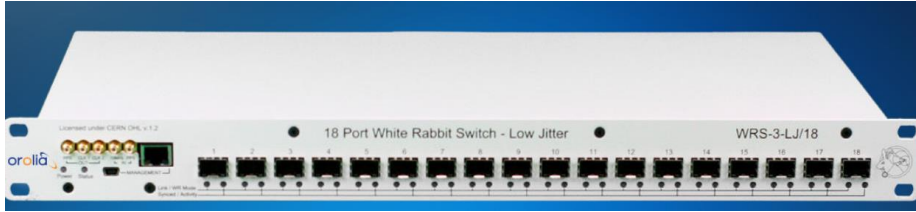


➤ Our P/N: EQP-WRS-01

- 1U White Rabbit Switch. 18x 1GbE SFP connectors. 5x SMC 50ohm (PPS In, 10Mhz In, PPS Out, 10MHz Out, 62.5MHz Out). Single AC supply
- Refer to datasheet, sample excerpts below (and DEMO) on our website:
- In Arena (including datasheet excerpted below) at:
https://app.bom.com/items/detail-spec-redline?item_id=1312786806&version_id=12263103568&orb_msg_single_search_p=1&redirect_segno=16361922166

Technical Specifications / WRS	
FPGA	HIGHLIGHTS
Type: Xilinx Virtex-6 (LX1240T)	✓ Sub-nanosecond time accuracy
Package: 1156-pin BGA	✓ Thousands of nodes
Slices: 37,600 (4 LUTs and 2 Flip-Flops)	✓ 18 SFP 1GbE ports
Memories: 418,000 10-Bit RAM	✓ Time and frequency distribution
Software: LatticeVice2 (LMS32)	✓ Remote monitoring
I/O: 20 GTx transceivers for SFP links	✓ Dynamic calibration
40 GPD for generic purpose (LEDs, SFP selection...)	✓ Open hardware
Monitoring: Temperature sensor control	
On-Chip 32-bit 8-Channel Counter	
PLL : AD9514 (14-Output Clock Generator with Integrated 1.6 GHz VCO)	CPU
Synthesizer : TC10CM500020HBT (20-800MHz)	Type: ARM Atmel AT91SAM9G45
DAC : 2xAD5628R (1.6bit; 2.7-5.54V)	Core: 400MHz (ARM926E)
Front Panel	Memories: 64KIB DDR2 (16-bit bus chip)
Clocks I/O: 2 SMC coaxial connectors:	I/O: 32bit Async Bridge with FPGA
• 20 MHz reference clock input (SFP/Cesium)	100Base-T Ethernet
• 10MHz & 62.5 kHz output reference clock	Software
• 1uPPS input & 1uPPS Output	OS: Linux (kernel v2.6.39)
Ports: 18 x SFP "SFP transceivers are not included in all packages. Seven Solutions recommends 1.25Gbps, 1480/1310 nm, Single Fiber Bi-directional SFP"	Timing: White Rabbit
Management: 100Base-T Ethernet (Remote)	Switching: IEEE802.1x protocols (multicasting, spanning tree, GMRP-QARP)
Debug: USB Mini-B FPGA	VLAN Tagging: 2048P switch management
Input port: RS232	Protocols: TCP/IP, SSH, Sshut, NTP, TFTP, DHCP, ARP, DNS
Compliance	Physical Specifications
Soldering: IPC-A-610 Rev E Class 2	Dimension: 447 mm x 44 mm x 223 mm
Others: ISO-9001, ISO-14001, CE, RoHS, FCC, RE	Color: White (Metallic)
Power Supply	
Input: 100-240VAC, 2.0A 50-60 Hz	
Output: 12V DC, 6.66A ~ 80W max	
Environmental Conditions	
Temperature: +10°C ~ +50°C	
Humidity: 0% ~ 90% RH	

2. EQP-WRS-LJ-01 (White Rabbit Low Jitter network switch)



- **Our P/N: EQP-WRS-LJ-01**
- 1U White Rabbit Switch with Low Jitter enhancement. 18x 1GbE SFP connectors. 5x SMC 50ohm (PPS In, 10Mhz In, PPS Out, 10MHz Out, 62.5MHz Out). Single AC supply.
- In Arena (including datasheet excerpted below) at: https://app.bom.com/items/detail-spec?item_id=1296682634&version_id=11936192088&orb_msg_single_search_p=1
- Refer to datasheet, sample excerpts below (and DEMO) on our website: https://safran-navigation-timing.com/product/white-rabbit-switch-low-jitter/?model_interest_c=White+Rabbit+Switch+%E2%80%93+Low+Jitter

System On Chip	
FPGA	Xilinx Virtex-6
CPU	ARMv7-A11350M45
Core	40nm/65nm/90nm
Memory	64MB DDR2 (64-bit bus chip, 512MB NAND flash chip)

Timing protocols	
White Rabbit	Supported on all SFP ports
IEEE 1588	Full range (Layer 2) supported on all SFP ports
NTTP	NTTP v2, v3, v4 supported in Ethernet interfaces, 160 supported via NTP

Front Panel	
Clocks I/O	5 SMC coaxial connectors: • 10 MHz reference clock input (GPS/Coarse), 50 ohm • 10MHz & 62.5MHz output reference clock, 50 ohm • 10PPS input & 10PPS output, 50 ohm
Ports	18 x SFP cages*
*SFP transceivers are not included in all packages. See our Solutions recommendations, 1.25Gbps, 100G/100nm, Single Fiber Bi-directional SFP, 100Gbps 1 Ethernet (demonstrator) 100Mbps 1 Ethernet (demonstrator) 100Mbps 1 Ethernet (demonstrator)	

Back Panel	
Debug	USB Mini B-CAN, USB Mini B-ARM
Input port	RS232

Certification	
General	ISO 9001, ISO 14001, CE, RoHS, FCC, UL

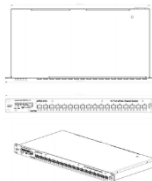
Power Supply	
Input	100-240VAC, 20A 50/60 Hz
Output	12V DC, 6.66A - 80W max

HIGHLIGHTS

- Sub-nanosecond time accuracy
- 18 SFP 1GbE ports
- Time and frequency distribution
- Distance range over 100km in 1-hop
- Remote monitoring
- Improved clocking design in HW and FPGA
- Cleaner and more accurate 10PPS output
- Improved clock jitter and phase noise
- Lower power consumption and better thermal dissipation
- High reliability and improved MTBF

Environmental Conditions	
Temperature	30°C ~ +50°C
Humidity	0% ~ 95% RH

Physical Specification	
Dimension	86.1mm x 48.1mm x 27.1mm
Color	White (Plastic)



Monitoring	
Internal tools	1 SNMP (Supported v1, v2, and v3 with Enterprise MIB)
External tools	Kinga, Grafana, MySQL

SNMP set of data is provided to be used by Kinga and integrated with MySQL. Grafana can be added on the top of the monitoring system for extracting the information introduced by Kinga in the database and visualizing in graphical interface.

Management	
OS	Linux (kernel v3.10.36)
Switching	IEEE 802.1x protocols (multicasting, spanning tree, GARP, LACP)
VLAN	802.1Q
Control	SNMP switch management
Control	CLI & Web-GUI (HTTP)
Network	TCP/IP, SSH, SNMP, NTP, TFTP, DHCP, ARP, DNS

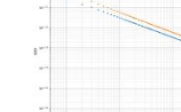
Clock performance (10 MHz output)

Phase noise (dBc/Hz)						
	100	1000	10000	100000	1000000	10000000
GN	-173	-175.2	-177.7	-180.0	-182.7	-185.2
1st Top channel	-92	-100.5	-107.3	-113.2	-118.7	-123.5
2nd Top channel	-100.2	-108.3	-115.5	-121.5	-126.9	-131.8

Long term stability (Allan Deviation)

Time	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
100 Hz	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11
1 kHz	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11
10 kHz	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11
100 kHz	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11
1 MHz	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11
10 MHz	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11	1.0E-11

Signal waveform: LVPECL, 50 ohm, SMD connector



Comparison with standard WRT switch



PPS output

PPS output	
Stability	<10ps
Signal waveform	LVPECL, 50 ohm, SMC connector

1U White Rabbit Switch with Low Jitter enhancement.
18x 1GbE SFP connectors. 5x SMC 50ohm (PPS In, 10Mhz In, PPS Out, 10MHz Out, 62.5MHz Out).
Single AC supply.

The **White Rabbit Switch Low Jitter** is a new version of the White Rabbit Switch which counts with a series of improvements that enable its use in more demanding time and frequency distribution applications. The WRS-LJ **distributes Time and Frequency** within sub-nanosecond accuracy to thousands of nodes through standard optical fiber, **providing very low noise and accurate timing outputs**.

The WRS-LJ provides deterministic delivery and a reliable communication. Currently, highly demanding industrial and scientific facilities in more than fourteen countries are already using WR Switches for time-critical applications.



FEATURES

- Sub-nanosecond time accuracy
- 18 SFP 1GbE ports
- Time and frequency distribution
- Distance range over 100km in 1-hop
- Remote monitoring
- Improved clocking design in HW and [FPGA](#)
- Cleaner and more accurate 1PPS output.
- Improved clock jitter and phase noise
- Lower power consumption and better thermic dissipation
- High reliability and improved MTFB



SPECS

- Size: 447 mm x 44 mm x 223 mm
- Power Input: 100-240VAC, 2.0A 50-60 Hz
- Power Output: 12V DC, 6.66A – 80W max
- Certifications: ISO-9001, ISO-14001, CE, RoHS,FCC,SE
- Environmental Conditions
 - Temperature: -10°C ~ +50°C
 - Humidity: 0% ~ 90% RH
- Timing Protocols / Interfaces
 - White Rabbit: Supported on 18xSFP ports
 - IEEE1588-
 - 2008 (PTP):
 - Default profile (layer 2) supported on 18xSFP ports
 - NTP: v2, v3 & v4 supported in Ethernet interfaces.

D) White Rabbit Licenses

E) SFP Modules

Cisco BX10 SFPs with Monitoring interface

- Cut-in to our system to sell: Refer to **ECO-003070** (in Arena at: https://app.bom.com/changes/detail-summary?change_id=2414570401&orb_msg_single_search_p=1)
- In our system to be able to resell (also search Salesforce for our P/N)

Our P/Ns

- **Link to MFG datasheet:** <https://www.cisco.com/c/en/us/products/collateral/interfaces-modules/fast-ethernet-sfp-modules/datasheet-c78-486906.html>
- MP40R-0009-0001 **BX10 ONU** Fiber Optic SFP Module, Monitoring Interface
 - In Arena at https://app.bom.com/items/detail-spec?item_id=1317574012&version_id=12362188398&orb_msg_single_search_p=1
 - SFP Module for 1000BASE-BX10 fiber optic interface (LC Simplex for 9/125 um cable) with 1Gb networks. ONU transceiver (1310nm Tx, 1490nm Rx)
 - Pair with SFP-FIBER-BX10-OLT Primarily used with White Rabbit products, supports typical 10 km point to point link. Corresponds to Axcen AXGD-1254-0531
- MP40R-0010-0001 **BX10 OLT** Fiber Optic SFP Module, Monitoring Interface
 - In Arena at https://app.bom.com/items/detail-spec?item_id=1317574029&version_id=12362188648&orb_msg_single_search_p=1
 - SFP Module for 1000BASE-BX10 fiber optic interface (LC Simplex for 9/125 um cable) with 1Gb networks. OLT transceiver (1490nm Tx, 1310nm Rx)
 - Pair with SFP-FIBER-BX10-ONU Primarily used with White Rabbit products. Supports typically 10 km point to point link. Corresponds to Axcen AXGD-3454-0531
- MP40R-0011-0001 **C21 DWDM** SFP Module, Monitoring Interface
 - In Arena at https://app.bom.com/items/detail-spec?item_id=1317574040&version_id=12362189078&orb_msg_single_search_p=1
 - SFP Module for 1000BASE-DWDM fiber optic interface with 1Gb networks. LC Duplex, 1560.61 nm, Monitoring interface
 - To be selected for long distance (up to 100 km on 9/125 um Single Mode Fiber) point to point WR link. Requires calibration: a calibration service shall be offered along with this item.
- MP40R-0012-0001 **C22 DWDM** SFP Module, Monitoring Interface

- In Arena at https://app.bom.com/items/detail-spec?item_id=1317574152&version_id=12362190478&orb_msg_single_search_p=1

SFP Module for 1000BASE-DWDM fiber optic interface with 1Gb networks. LC Duplex, 1559.79 nm, Monitoring interface

To be selected for long distance (up to 100 km on 9/125 um Single Mode Fiber) point to point WR link. Requires calibration: a calibration service shall be offered along with this item.