WHITE RABBIT TIMING & TRIGGERING SYSTEM

Reliable precise time with synchronized triggers and gate signals for High Energy Facilities

Accurate White Rabbit based timing and synchronization for the proper functioning, optimization, and safety of particle accelerators. The High Energy Physics White Rabbit Timing System is a standalone device with up to 9 configurable inputs/outputs SMA ports to provide the generation of synchronized triggers and gate signals at a delay resolution below 10ps and output peak to peak jitter below 100ps. The system allows total flexibility when configuring the triggers in terms of direction, number of pulses, pulse rate, pulse width, pulse period and delay.

The Timing System achieves sub-nanosecond sycrhonization levels thanks to WR technology.

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High Accuracy

The White Rabbit technology enables sub-nanosecond synchronization accuracy when the devices is connected to a Safran WR-Z device via optical fiber links. This level of precision is achieved through the use of the White Rabbit protocol, which combines IEEE 1588 Precision Time Protocol, Synchronous Ethernet (SyncE), and precise clock compensation techniques.

FPGA Based

The WR devices are powered by FPGAs, therefore their hardware can be easily reprogrammed and kept up to date.

WR Based

Compatible with White-Rabbit and IEEE-1588 protocols. Seamless integration with our control and monitoring devices like LLRF and BPM.

Configurable triggers/gate signals

The timing system allows the generation of fully configurable triggers signals. Parameters such as the repetition rate, pulse period, pulse width, polarity and number of pulses can be configured individually for each port using the GUI.

Even Counter

The system can operate as an event counter when configuring the ports as inputs. Minimum pulse width configurable to avoid false detections.

Nanosecond timestamping

White Rabbit technology provides a common sense of time to all the nodes connected to the WR network allowing the timing system to perform event timestamping with precision in the order of nanoseconds.

High scalability

The WR technology allows the possibility of adding new nodes to the network without any extra work required. The nodes keep synchronization over distances in the order of tens of kilometers.

No calibration needed

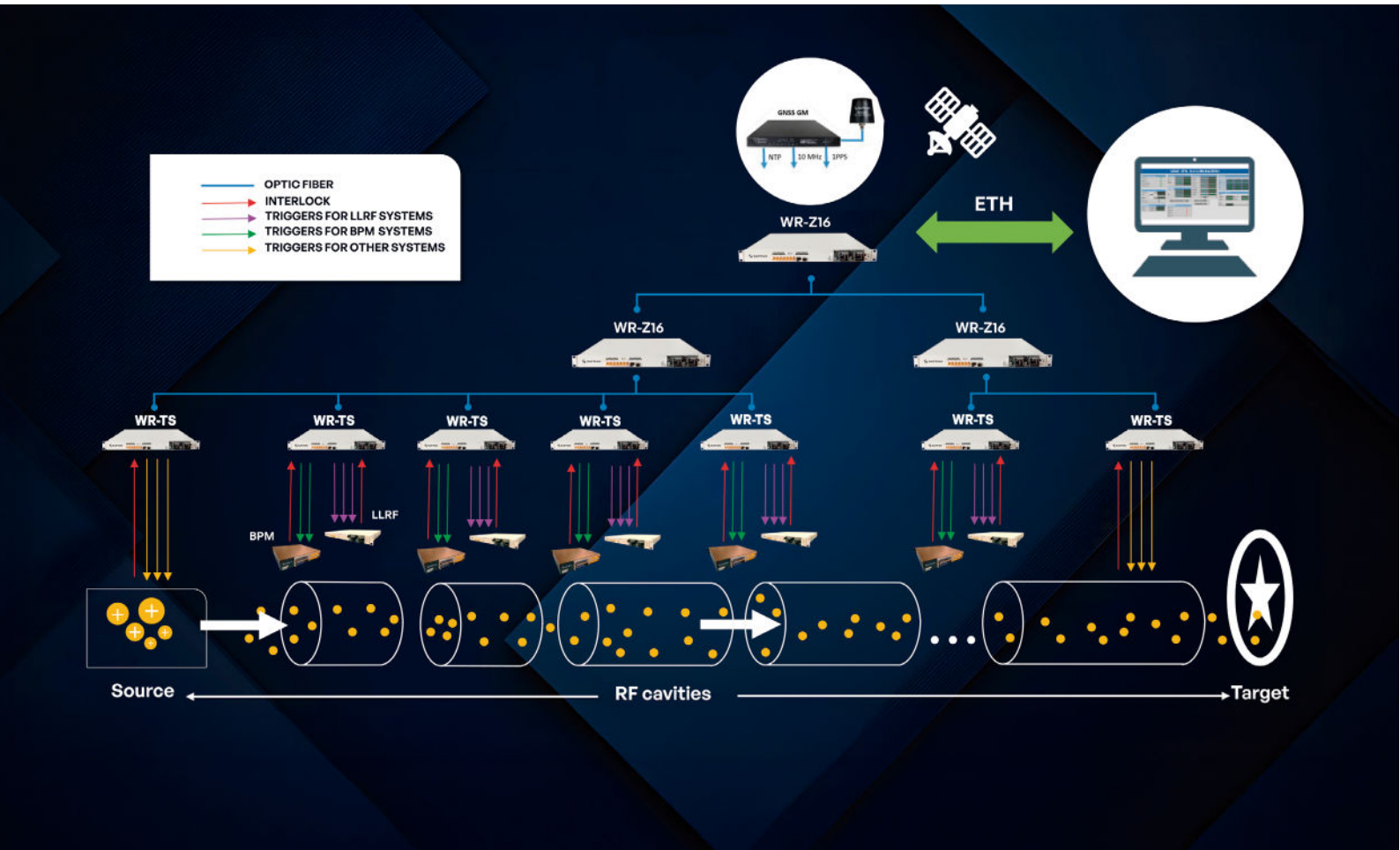
The WR technology performs automatic link calibration.

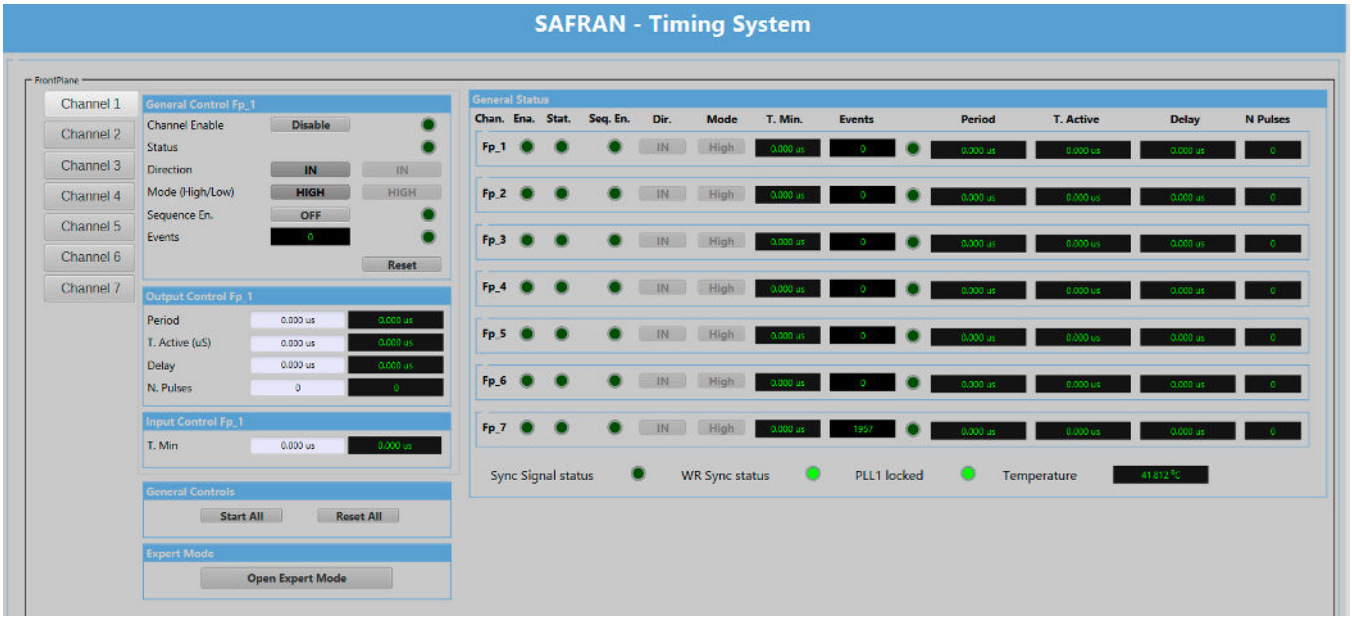
EPICS based

EPICS control system support and intuitive graphic user interface (GUI) to configure and monitor the operation of the system.

Timing Distribution Options

The timing system can operate using various timing distribution methods. White Rabbit based Z16 is recommended for White Rabbit networks. An RF Frequency reference can also be used.





Technical Specifications

- Sub-nanosecond time accuracy
- Up to 9 configurable in/out ports
- Very high scalability and large distance links support
- FPGA based hardware
- Nanosecond timestamping
- Nanoseconds resolution
- White Rabbit technology
- Trigger Generation
- Event Counter
- EPICS Controls
- Central Management Console

System on Chip	
SoC	Xilinx Zynq Ultrascale+ series
CPU	Quad ARM® Cortex™-A53 1.5GHz
Memory	8GB DDR4 16 GB SD card

Time Sync Characteristics

- Up to 9 configurable input/output 3.3V LVCMOS (SMA connector)
- PLL for low phase noise distribution clocks
- Up to 2GB DDR4 for processor and data storage (postmortem analysis)
- ETH & SFP port (White Rabbit compatible)
- uTCA MMC controller
- Fail-safe for overheating mode
- uSD socket, uUSB port.

Triggering Characteristics	
Repetition rate	0.1Hz to 10MHz
Delay	4ns to 10s (4ns step)
Pulse width resolution	4ns
Polarity	Selectable high/low
Pulse burst	1 to infinite pulses
Fine Delay	Below 10 ps

Timestamping Characteristics	
Timestamping accuracy	16ns (4ns enhanced)

Event Counter Characteristics	
Maximum pulses count	2^{32}
Pulse mínimum width configurable for detection	4ns to 10s (4ns step)

Physical Specification	
Dimension	44.45 mm x 482.6 mm x 372.85 mm
Color	RAL9002

Environmental Conditions	
Temperature	-10ºC ~ +50ºC
Humidity	0% ~ 90% RH

Management	
OS	Linux (Kernel v5.10 & buildroot)
Control	EPICS/TANGO
Monitoring	CSS/GUI & Taurus

Performance	
Resolution	4 ns
PPS stability*	< 300ps (peak to peak)
	< 60ps (std. dev)

**Long term measures between master PPS from a WR-Z16 and slave PPS.*

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