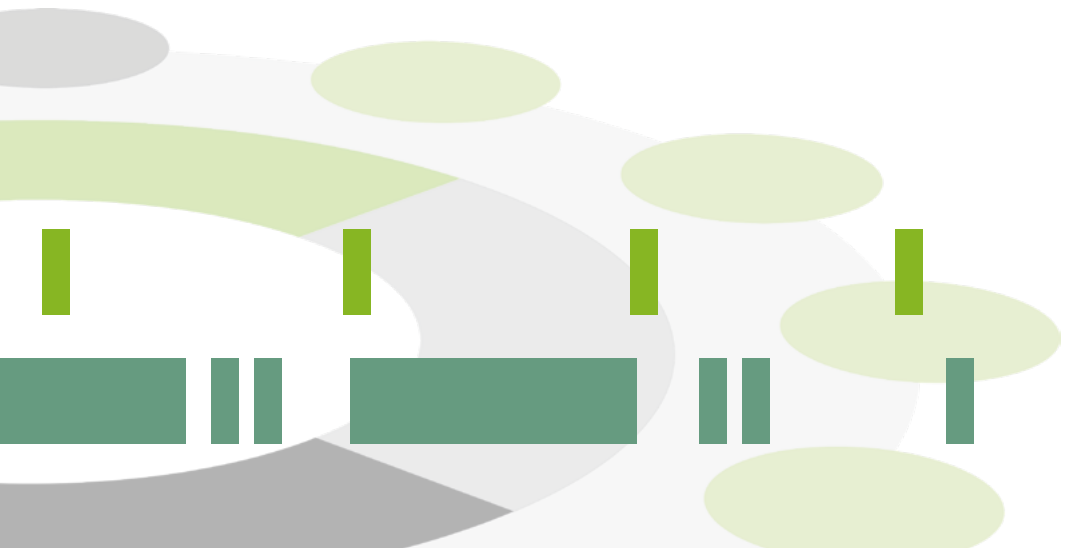


# TSN Systems

Hardware & Software Solutions  
for Time-Sensitive Networks





## About TSN Systems

TSN Systems was founded in 2016 and is a group of experts for time-sensitive networks and specialists from E/E automotive development.

Our passion is Time Sensitive Networking, our goal is to help the automotive industry by providing the measuring and analytics tools to keep the technological changes controllable.



























Our team of 50 developers is working in Fulda and Cape Town, South Africa and has decades of experience in the field of Automotive E/E development along with the expertise of AVB and TSN. We work agile and are close to the needs and wishes of our customers.



# TSN CoreSolution



TSN CoreSolution is a key solution for time-critical networking, providing a comprehensive ecosystem specifically designed to meet the demands and challenges of developing and validating zone architectures. This toolchain includes both hardware (TSN Box) and software (TSN Tools) components. Our innovative suite equips both OEMs and Tier-1 suppliers with all the necessary tools to effectively address the future system and network challenges.

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## TSN BasicSolution



Start today with our Basic Solution and discover how the seamless integration of hardware and software can boost your productivity and help you achieve your goals more quickly. Each Basic Solution includes the essential features of our flagship analysis software, enabling you to successfully tackle even complex tasks and analyses.

	AVB/TSN	PTP	SOME/IP XCP	Audio	A <sup>2</sup> B	CAN/LIN	10BaseT1S	Profinet
	✓	✓	✓	-	-	✓	✓	-
	✓	✓	✓	✓	-	✓	✓	-
	✓	✓	✓	✓	✓	✓	✓	-
	✓	✓	✓	✓	-	✓	-	✓
	✓	✓	-	-	-	-	-	✓
	✓	✓	✓	-	-	-	✓	-
	✓	✓	✓	-	-	-	-	-
	✓	✓	✓	-	-	-	-	-
	✓	✓	✓	-	-	-	-	-
	✓	✓	-	-	-	-	-	✓
	✓	✓	✓	-	-	-	-	-
	✓	✓	✓	-	-	-	-	-
	✓	✓	✓	-	-	-	-	-
	-	✓	-	-	-	✓	-	-



## TSN CoreSolution 4 TSN Box 4 10G & TSN Tools

Configurable Multi G & Multi 1G, Tap and Analyzer for TSN test and measurement applications in the automotive industry, lab, H.i.L. and industrial automation with up to 18x1G taps and up to 5x10G Ethernet Taps.

### Analysis Configuration

TSN Tools provides an intuitive, comprehensive and efficient setup for testing, facilitating the seamless integration and assessment of TSN capabilities in both new devices and existing network infrastructures.

### Real-Time Monitoring

The software excels in real-time monitoring of network traffic, enabling rapid validation and efficient identification and resolution of any issues.

### Performance Analysis

With its in-depth performance analysis and testing capability, TSN Tools ensures that networks adhere to the stringent demands of time-sensitive applications.

### Deterministic Data Transfer Analysis

TSN Tools is adept at analyzing and ensuring critical data transfer, guaranteeing that data packets are delivered within set timeframes – a necessity for precision-reliant applications like TSN.

### Latency Analysis

TSN Tools is equipped to analyze data latency and identify bottlenecks, minimizing network latency.

### Improved Bandwidth Management Analysis

By optimizing network resource allocation, TSN Tools enhances bandwidth efficiency, preventing congestion and ensuring a smooth flow of data.

### Fault Tolerance Analysis

Designed to simulate various error scenarios, it can test and improve the network's resilience and ability to maintain operations amidst challenges.

### Security Features Analysis

TSN Tools comes with advanced capabilities for validating cutting-edge security measures, providing robust and secure communication within the network.

### Automated Testing

The suite includes features for full automation and scripting, enabling tests to run autonomously without the need for constant supervision.



## TSN CoreSolution 3 TSN Box 3.2 & TSN Tools

### TSN CoreSolution 3 A<sup>2</sup>B TSN Box 3.2 A<sup>2</sup>B & TSN Tools

Part of the TSN CoreSolution simulation and measurement application for component and system testing, and automotive network development and industrial automation.

As industries continue to evolve towards more interconnected and intelligent systems, measurement and retnet-simulation solutions like TSN Box become increasingly important. With its advanced features and capabilities, TSN Box is well-positioned to drive innovation in automotive and industrial networking, paving the way for next generations smarter, more efficient, and more reliable operations.

The TSN Box 3.2 is an advanced tool designed for the development of automotive networks, particularly focusing on the emerging zonal architectures. It also plays a crucial role in the planning and analysis of contemporary field bus systems in industrial automation, especially those based on OPC-UA/TSN.



## TSN CoreSolution 3 Industrial TSN Box 3.2 Industrial & TSN Tools

To meet the tremendous challenges in the development, validation and deployment in the field, automation equipment manufacturers and shop floor users are increasingly pushed to their limits. The complexity of TSN, PROFINET, OPC UA and other mixed time sensitive technologies requires intelligent, systemic validation solutions that include all aspects of communication: the time-sensitive and the service-oriented part to enable a consistent and thus efficient workflow in the analysis.

TSN CoreSolution is an ecosystem that consistently addresses all aspects and challenges in the development and validation of modern industrial automation networks.

Our products support high-precision data generation and analysis that is crucial for time-sensitive networks. The system integrates many aspects essential to the development and validation process: Automated Testing and High Level Dashboards. This creates a coherent workflow where TSN Box and TSN Tools merge into one product. For the software developer as well as a Field Application Engineer.

## TSN BasicSolution Timepiece TSN Timepiece & TSN Tools Basic

The TSN Systems Timepiece is a sophisticated yet compact device designed to receive Global Navigation Satellite System (GNSS) signals and accurately convert their timing information to the IEEE 802.1AS-2011 standard for precise time synchronization across Ethernet networks acting as a PTP Grandmaster. This device is crucial for applications, high-precision time aware systems (AVB/TSN), such as automotive, industrial automation, broadcasting, and other time-sensitive operations that require a satellite synchronized IEEE 802.1 AS PTP Grandmaster. A variety of hardware interfaces for Ethernet, USB, clocking and status LEDs complete the feature set.

The TSN Systems Timepiece is an essential tool for any organization requiring precise time synchronization over Ethernet networks. Its robust design, high accuracy, and comprehensive feature set make it ideal for a wide range of applications, including satellite synchronized TSN (sub) systems, ensuring reliable and precise time distribution across complex networked systems.





## TSN BasicSolution Switch 10G TSN Switch 10G & TSN Tools Basic

**The full spectrum of connectivity with our cutting-edge 10G automotive switch!**

Upgrade your connectivity with our cutting-edge 10G Automotive Switch! Designed for TSN ethernet, this high-performance switch ensures ultra-fast data transfer, robust network reliability, and seamless integration with advanced automotive systems covering the full Range of 10BaseT1S to 10Gb.



### Key Features:

- All Speeds: Lightning-fast data rates to support everything from half duplex 10BaseT1S to high-definition infotainment, real-time diagnostics, and advanced driver-assistance systems (ADAS).
- Enhanced Reliability: Engineered to withstand the harsh conditions of automotive environments, ensuring consistent performance.
- Seamless Integration: Compatible with the latest automotive network protocols, making it ideal for current and next-generation vehicles.
- Fully manageable with included TSN Tools Basic Software.

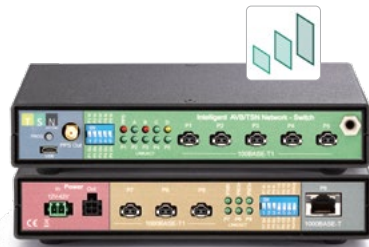
## TSN BasicSolution Switch 1G TSN Switch 1G & TSN Tools Basic

### TSN-capable Automotive Ethernet Switch

The TSN Systems Q50 2.0 1G secure automotive switch is a highly flexible AVB/TSN capable switch intended for use in the lab, car or HIL. The 8-port Ethernet switch offers five fixed 100BASE-T1 ports, two 1000BASE-T1 and one configurable Gigabit port that can be set to either 1000BASE-T1 or 1000BASE-T for maximum flexibility.

A wide range of management capabilities are available, providing easy access and configuration of the device via a custom switch editor for Windows with integrated automatic discovery.

A precision 1PPS output signal is available on an SMA connector to verify and compare sync status on oscilloscopes or other hardware requiring precise 1PPS inputs.



Security features are among the highest possible, designed to protect at the root source for current secure Automotive Ethernet switches to prevent malicious attacks or manipulation to the data streamed in the vehicle. All ports are fully compliant to IEEE802.3 automotive standards and utilize advanced security features to guard against hacking and Denial of Service (DoS) attacks. MAC address blacklisting and whitelisting on all ports is also available.

Deep Packet Inspection (DPI) techniques and Trusted Boot functionality are also deployed to deliver one of the most secure Automotive Ethernet switches available.

## TSN BasicSolution TSNAP 1 TSN TSNAP 1 & TSN Tools Basic

### One button, One mission, no Setup!

TSNAP is an all-in-one data recorder and TAP, ideal for use in test benches, vehicles or Hardware-in-the-Loop (HIL) applications. It features three Ethernet 1G ports (two 1000BASE-T1 and one 1000BASE-T), USB2, USB3, serial, combined with a compact form factor. Accompanying it is an interactive colour-illuminated display tactile remote with speech recording, enabling quick and effortless data recording in any setting without distraction.

TSNAP is designed for simplicity and ease of use, with a one-button operation that makes it suitable for all applications and periods of recording needs. Its compact and lightweight nature allows flexibility for convenient placement in various environments. Operation requires no prior training and is capable of capturing comprehensive high-speed traces



even at full line rate. These traces can be downloaded with a convenient range of methods and analyzed using TSN Tools or Wireshark, making TSNAP a versatile and user-friendly tool for efficient data recording and analysis with minimal familiarization.

Although optimized for vehicle use, its guaranteed performance benchmark and ease of use are equally helpful for use in the lab.

## TSN BasicSolution TSNAP 2 Automotive TSN TSNAP 2 Automotive & TSN Tools Basic

TSNAP is an all-in-one data recorder and TAP, ideal for use in test benches, vehicles or Hardware-in-the-Loop (HIL) applications. It features six Ethernet 1G ports (four 1000BASE-T1, two 1000BASE-T) and one 100 Mbit T Ports, USB2, USB3, serial, combined with a compact form factor. Accompanying it is an interactive colour-illuminated display tactile remote with speech recording, enabling quick and effortless data recording in any setting without distraction.

TSNAP is designed for simplicity and ease of use, with a one-button operation that makes it suitable for all applications and periods of



recording needs. Its compact and lightweight nature allows flexibility for convenient placement in various environments. Operation requires no prior training and is capable of capturing comprehensive high-speed traces even at full line rate.

These traces can be downloaded with a convenient range of methods and analyzed using TSN Tools or Wireshark, making TSNAP a versatile and user-friendly tool for efficient data recording and analysis with minimal familiarization. Although optimized for vehicle use, its guaranteed performance benchmark and ease of use are equally helpful for use in the lab.



## TSN BasicSolution TSNAP Industrial TSN TSNAP Industrial & TSN Tools Basic

The TSNAP Industrial Data Recorder can be permanently integrated into the network for continuous plant monitoring. It can even be deployed retroactively during live operations for diagnostic purposes in the event of a fault. Network interruptions or shutdowns are avoided, errors are quickly analyzed, and lengthy reproduction attempts are eliminated. The TSNAP Industrial Data Recorder allows non-intrusive extraction and evaluation of all data traffic online. With two integrated TAPs (Test Access Points), it also supports the analysis of redundant networks.

The TSN Tools software provides access to multiple TSNAP Industrial Data Recorders within a plant. This enables rapid identification and resolution of faults across TSN and PROFINET networks. Network quality can be quickly assessed at any time using key metrics such as network load, data errors, jitter, and more. For the validation of TSN and PROFINET networks, data is extracted

from the recorder(s). The TSN Tools analysis software facilitates measurements and analysis, enabling potential weaknesses to be identified and addressed even before the production phase. This ensures that your plant's availability meets your high standards from the very beginning.

## TSN BasicSolution SMC 10G

### TSN Smart Media Converter 10G & TSN Tools Basic

#### Automotive Ethernet Physical Layer Converter with 10G Auto-Negotiation Algorithms

The TSN Smart Media Converter (SMC) 10G is a highly flexible tool for use in various environments such as laboratory, vehicle or HiL.

The SMC converts 2500/5000/10000BASE-T and 2500/5000/10000BASE-T1 connections. It works completely transparently; no packets are buffered or filtered. This means that the SMC is also suitable for all future time-sensitive applications that use gPTP or TSN protocols in general. All settings can be adjusted intuitively by hand on the device without the need for a PC. The speeds of the T1 ports and the master/slave settings can be set manually using toggle switches. In



addition, the SMC offers a new automated procedure for the master/ slave and link speed settings that is compatible with all T1 PHYs on the market. In this auto mode, the T1 connection automatically synchronizes with its connection partner. This can save an enormous amount of time when used in complex and distributed systems.

The device's firmware can be updated via a supplied USB connection, and terminal access is also possible.

## TSN BasicSolution SMC 1G

### TSN Smart Media Converter 1G & TSN Tools Basic

#### Automotive Ethernet Physical Layer Converter with Auto-Negotiation Algorithms

The TSN Media Converter (MC) is a highly flexible tool for use in multiple environments like the lab, car or HiL.

Simple, small and flexible, it seamlessly converts 1000BASE-T and 1000BASE-T1 connections, and is also 100Mbps capable. No packets are buffered or filtered and can be seen as a transparent link. For convenience, all settings are intuitively hardware adjustable without a tethered configuration PC.

T1 port speeds and master/slave settings can be manually forced with switches, or for convenience use a novel auto-negotiation method that does not rely on vendor-

proprietary methods but compatible with all T1 PHYs on the market. In Auto mode, the T1 link will automatically negotiate with its link partner without the user having to investigate the settings or use trial and error. This has been found to be a massive time-saver for use in complex and distributed systems.

Firmware can be updated using a provided USB connection, as well as terminal access for more detailed inspection.





## TSN BasicSolution OctoCAN

### TSN OctoCAN & TSN Tools Basic

The TSN Systems OctoCAN is a versatile I/O device designed for the analysis, simulation, and testing of CAN (Controller Area Network) and LIN networks. Featuring 8 CAN and 8 LIN interfaces, it enables comprehensive monitoring and diagnostics of bus traffic, allowing developers to validate and optimize in-vehicle communication systems.

OctoCAN supports real-time data analysis, logging, playback, and data correlation, making it an essential tool for automotive engineers working on the development, testing, and troubleshooting of ECUs

(Electronic Control Units) and network architectures. When integrated with other devices from the TSN CoreSolution or BasicSolution toolchain, it offers a holistic validation approach, capturing and correlating data from multiple bus and network sources, including Ethernet, TSN, A<sup>2</sup>B, AVB, CAN, LIN, digital media streams, and clocks with nanosecond accuracy.

With its flexibility and advanced capabilities, OctoCAN plays a crucial role in ensuring the reliability and performance of modern in-vehicle networks.

## TSN Tools

### Versatile Data Analysis and Visualization Tool

TSN Tools is a highly adaptable and scalable software solution designed to correlate, analyze and visualize a wide range of data types for a broad spectrum of applications, offering a comprehensive feature set to address the complexities of modern time-sensitive network designs. This tool provides effective solutions for a wide array of scenarios, making it an essential asset for handling intricate network challenges.





## TSN Tools Basic

### Versatile Data Analysis and Visualization Tool Basic Version

TSN Tools Basic contains many essential features of TSN Tools and is a highly adaptable and scalable software solution designed to correlate, analyze and visualize many data types for a broad spectrum of applications, offering a comprehensive feature set to address the complexities of modern time-sensitive network designs. This tool provides effective solutions for a wide array of scenarios, making it a valuable asset for handling many network challenges.



## Comparison of TSN Tools Versions

	 TSN Tools	 TSN Tools Basic
<b>Input</b>		
PCAPNG Import	✓	✓
TSN Box Live Captures	✓	✗
ARXML Import	✓	✗
<b>Data Processing</b>		
Ethernet	✓	✓
gPTP	✓	✓
IPv4, IPv6, ICMPv6	✓	✓
TCP, UDP	✓	✓
IEEE 1733 Audio	✓	✓
IEEE 1722 Audio	✓	✓
SOME/IP + Service Discovery	✓	✓
CAN	✓	✓
XCP	✓	✓
Generic Plotters + Calculators	✓	✓
TSN Box Analog or Digital Audio	✓	✗
TSN Box A²B Audio and Samples	✓	✗
<b>Output</b>		
Packet Timeline	✓	✓
Packet Trace	✓	✓
Charts	✓	✓
Output Data Export	✓	✗
<b>TSN Systems Hardware Interfaces</b>		
TSN Switch Manager	✓	✓
TSN Box Discovery	✓	✗
TSN Box GPIO Events	✓	✗
TSN Box SOME/IP Stack	✓	✗
TSN Box Widget	✓	✗
<b>Plugins</b>		
Plugin Protocol Definitions	✓	✗
Plugin Web Widgets	✓	✗
<b>Scripting</b>		
REST API Scripting	✓	✗



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