

TMG TE

Industrial Communication
without borders

 **IO-Link**

EtherNet/IP

EtherCAT

PROFINET

PROFIBUS

TMG TE GmbH

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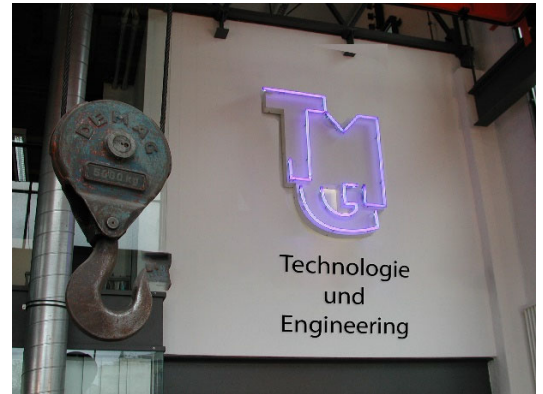
Management:

Klaus-Peter Willems and Dirk Brauner

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TMG Technologie und Engineering GmbH

TMG TE was founded in Karlsruhe in 1987 with the objective of supporting the manufacturing and processing industry in sustainably exploiting the value-enhancing potential of automation technology. In the meantime, the company can draw on more than thirty years of experience as a recognized technology expert.



TMG TE, former TMG i-tec, was one of the pioneers for the successful application of PROFIBUS technology in manufacturing and process automation.

With the trend towards end-to-end networked processes in companies and the use of Ethernet also at the field level, we have expanded our focus to PROFINET, EtherNet/IP and EtherCAT. The biggest challenge so far is the digitalization of the lowest process level with sensors and actuators with a globally accepted standard. TMG TE is the global leader in IO-Link as a technology provider.

As future challenges we see Industry 4.0 with the continuous integration with the IT world and the Internet of Things (IoT) with our own cloud solution as well as the emerging standards for this. New technologies such as 2-wire Ethernet physics (SPE, APL) bring Ethernet-based fieldbus systems closer to the production floor level.

We have also successfully taken on the task of offering our products and services internationally, and today we have predominantly international business worldwide. We have distribution and development partners especially for Asia.






The Team












Our team consists of young dynamic as well as longtime experienced engineers and informatics. In addition to many years of experience in industrial communication technology and embedded software development, the team is characterized by a strong identification with our customers and our technologies.

Your contacts

Klaus-Peter Willems
Dirk Brauner
Kevin Wiktor

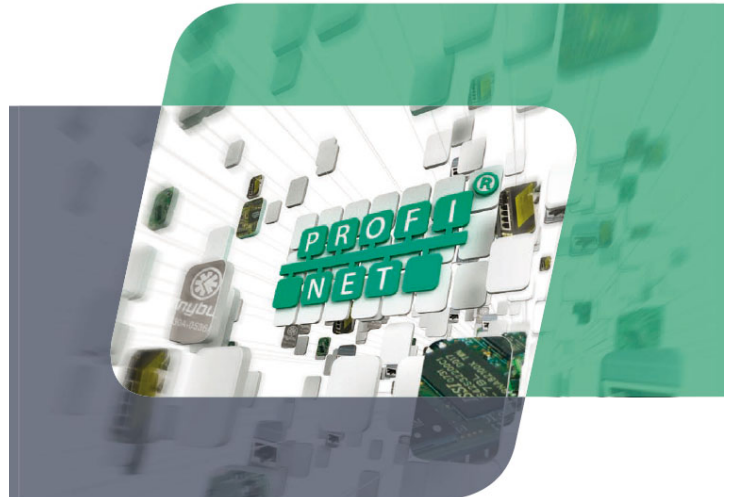
Managing Partner
Managing Partner
Sales

35 Years Enabling Technology	Accredited as PROFIBUS & PROFINET Competence Center	Accredited as IO-Link Competence & Test Center
Consulting	 	
Products	 	
Development	Functional Safety	 Safety over 
Device Engineering, IoT and Edge Gateways		
Device Engineering Tools		 TOOL CALLING INTERFACE
Communication Drivers		
IT Integration		

Communication Stacks	Functional Safety
PROFINET IO Device	 Safety over 
EtherNet/IP Adapter	 FSOE (EtherCat)
PROFIBUS Mst/ Slv	
IO-Link Mst/ Dev	
IO-Link In-Design Solution	
IO-Link Gateway App.	
Memberships	IO-Link Safety Device Tester
 PROFIBUS • PROFINET	 
	
	
	Including TMG IO-Link Device Tool
	 

PROFINET IO Device

- Stack
- Integration Services
- Respectively for factory and process automation
- Conformance Test Services



Our PROFINET IO Device Stack can be used to realize simple devices like IO modules up to high performance devices like drives. The stack is highly portable and can therefore be used on a wide variety of platforms. Option packages such as IRT (Conformance Class C), system redundancy and IO-Link integration make the solution scalable.

- Compliant with the latest PROFINET specification
- Certified with conformance class A, B and C
- Easily portable to many platforms
- Includes the MRP client
- Hardware: Compatible with 32-bit microprocessors
 - e.g. Rx, STM32, RZ/N, Sitara AM2,3,4,6, AMIC or others
- Portable to any real-time operating system
 - e.g. Free RTOS, Embos, TI-RTOS, Linux (with real-time patch)
- supports PROFINET over APL (Advanced Physical Layer)
- Option packages available:
 - IRT (Conformance Class C)
 - System redundancy (S2) and dynamic reconfiguration
 - IO-Link integration



EtherNet/IP Adapter

- **Stack**
- **Integration Services**
- **Respectively for factory and process automation**
- **Conformance Test Services**



Our EtherNet/IP Adapter Stack is universal and can be used for most field devices. The core of the EtherNet/IP Adapter Stack is completely hardware independent and supports 32-bit microprocessors and microcontrollers. A real-time operating system and TCP/IP stack are required for execution. If the performance of the platform is high enough or the cycle time requirements are not very high, Linux with real-time extension can also be used.

The software is delivered as ANSI-C source code incl. user manual and implementation examples.

- Compliant with the latest EtherNet/IP specification
- Easily portable to many platforms
- Support of LLDP (includes LLDP Stack)
- Hardware: Compatible with 32-bit microprocessors
 - e.g. Rx, STM32, RZ/N, Sitara AM2,3,4,6, AMIC or others
- Portable to any real-time operating system
 - e.g. Free RTOS, Embos, TI-RTOS, Linux (with real-time patch)
- Option packages available:
 - DLR (announce based) on all platform
 - DLR (Beacon based) on Renesas RZx and Texas Instruments Sitara

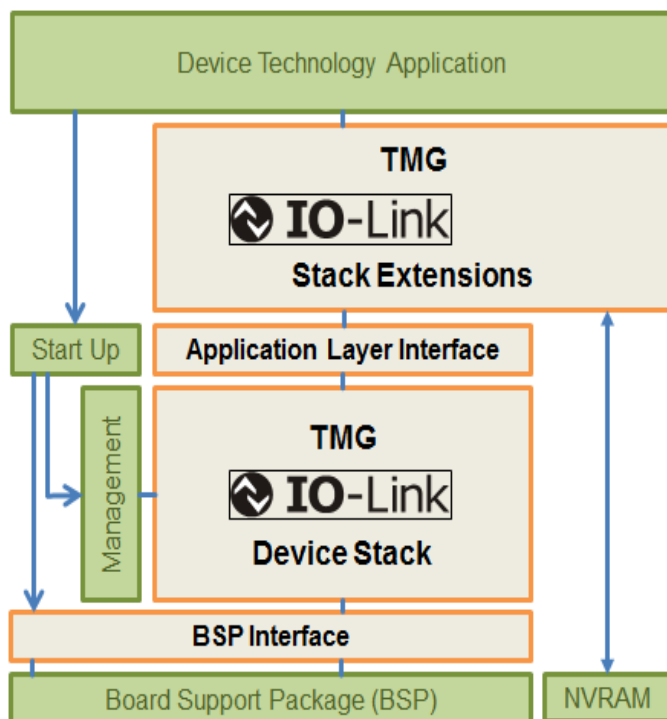


IO-Link Device Software



With the very comfortable TMG TE IO-Link Device Software, simple to complex IO-Link devices can be realized on all platforms in a very short time.

- IO-Link Device Software conformant to the latest IO-Link Specification (V1.1.3)
- Supports all telegram types and bit rates
- Backward compatibility to IO-Link V1.0
- Easy integration on all microcontrollers (8/16/32 Bit)
- Works with all IO-Link transceivers
- Very small footprint
- Application framework available
- IO-Link Device Firmware Update available



IO-Link Device Stack

The Stack implements the IO-Link communication interface and provides the entire IO-Link functionality for this purpose.

IO-Link Device Stack Extensions

The Stack Extensions implement the IO-Link related Device application with:

- Parameter Manager, Data Storage, Block Parameterization, Event Dispatcher, Device Status and Detailed Device Status, Parameter Consistency Check, Application-Reset and Back-to-Box commands

IO-Link Device Firmware Update

- according to the current IO-Link Profile BLOB Transfer & Firmware Update

IO-Link Device Module

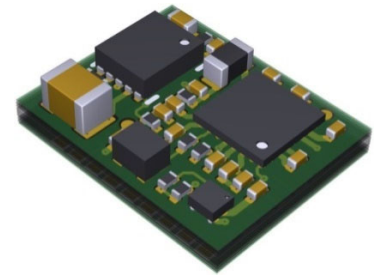
(in preparation)



The IO-Link Device Modules from TMG TE offer the complete functionality according to IO-Link V1.1.3 and are very powerful. Cycle times of up to 400 μ s can be achieved. Due to the firmware update function, the firmware can also be updated later at the end customer.

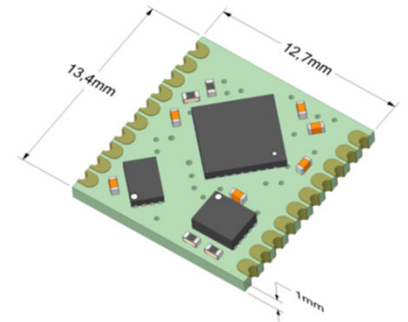
IO-Link Device Module Type 1

Module with a dimension of 8 mm x 10 mm and complete IO-Link function. Suitable for simple to complex solutions.



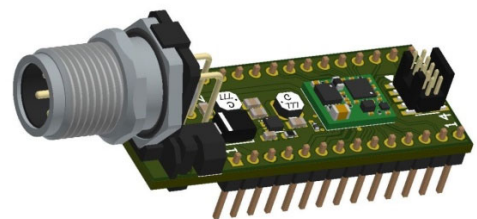
IO-Link Device Module Type 2

Module with a dimension of 12.7 mm x 13.4 mm and complete IO-Link function. Function as Type 1, but for simplified assembly.



Technical Data:

- IO-Link functions:
 - IO-Link Version V1.1.3
 - L+, C/Q, L-
 - Parameter Manager
 - Data Storage
 - Block-Parameterization
 - Device Access Locks
 - Device Status und Detailed Device Status
 - Event Dispatcher
 - Production Settings
 - Common Profile
 - Firmware update profiles for updating the module firmware
- Communication to the host controller via UART (3.3V)
- Control of the green IO-Link device LED
- Configuration
 - Via IO-Link in production (End of Line)
 - Via serial interface from the host



TMG IO-Link Device Tool V5 - SE - Standard Edition



IO-Link

- incl. TMG USB IO-Link Master V2 SE

The TMG USB Master V2 SE is done for all use cases where a fieldbus IO-Link master is too complicated and needs too much additional staff.

This version is foreseen for demonstration or pre-parameterization.

Protocol implementation and tooling is according to the newest IO-Link specification.

The software used for fieldbus masters and IO-Link master modules of remote IO systems has the same basis. By using the tool with its IODD interpreter for certification testing it is the best known tool for IO-Link.

Gladly we offer brand label agreements for the USB IO-Link master V2 including the tool.



■ **Standard Edition (Service and Sales)**

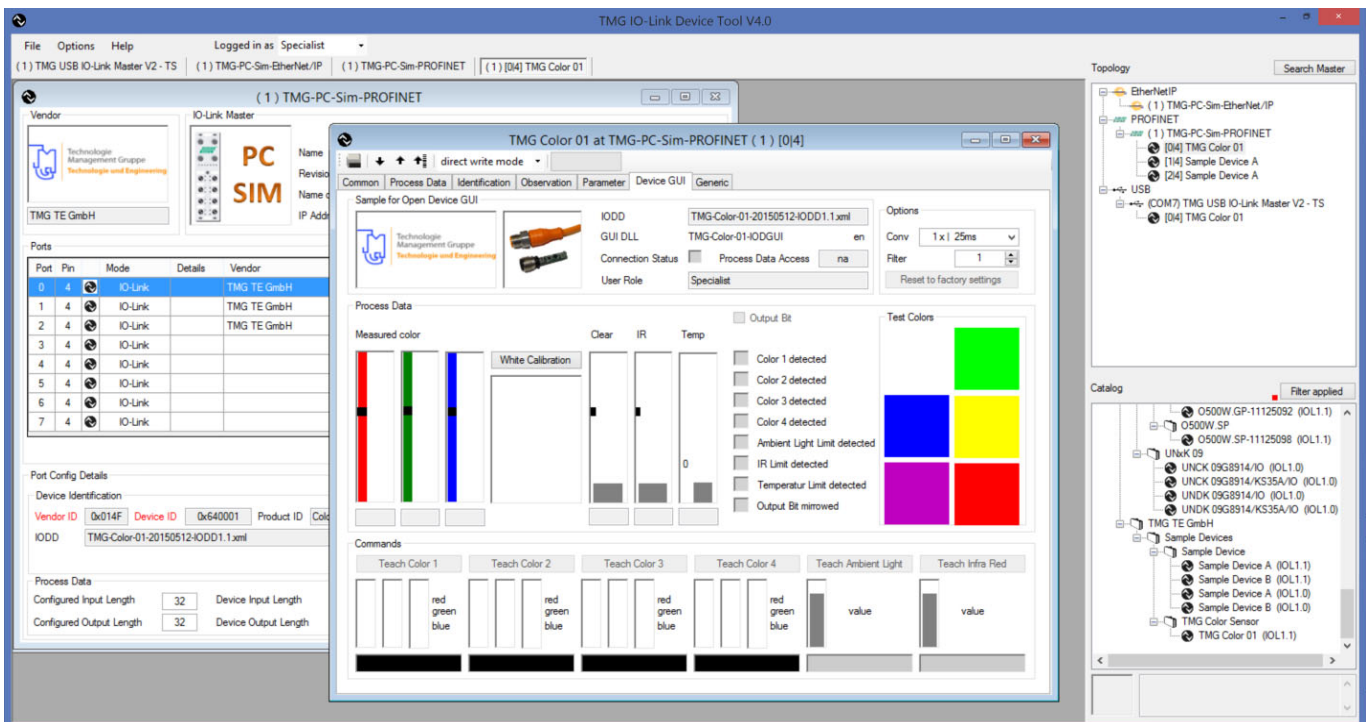
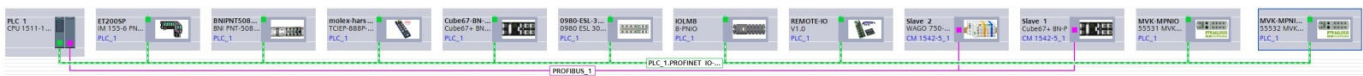
- Parameterization, observation and diagnosis of IO-Link devices
 - Full blown IODD interpreter for IODD V1.0.1, V1.1 and V1.1.3
 - Free published interface for graphical user interfaces for IO-Link Devices
 - Support of IODDFinder and Firmware Update
 - Support of pin 2 DI / DO / IO-Link
 - 2nd IO-Link Device by Y-Cable
 - USB -> 24V / 80mA
 - External power supply with international adapters
-
- **Libraries for using the USB IO-Link Master with own software for C, C# or VB.NET are available.**
 - **IO-Link Safety Extension available.**



TMG IO-Link Device Tool V5



- IO-Link Engineering Tool
- Configuration of IO-Link Masters across manufacturers
- Parameterization of IO-Link Devices via IODD V1.0.1, V1.1 and V1.1.3
- Open IO Device GUI (graphical user interface)
- Prepared for IO-Link safety
- Stand alone PC Tool or integrated in STEP7 and TIA Portal



- Customizing
Special features of masters and devices can be added by master and device GUIs which can be imported into the tool
- Open IO Device GUI is open and published by TMG
- For Master GUI we offer our cooperation
- License Model:
single license; server licenses in preparation

TMG IO-Link Device Tool V5 - PE - Professional Edition



- For IO-Link masters of several manufacturers and for all IO-Link devices.
- Today we support more than 100 different Masters from about 20 manufacturers
- The cross-manufacturer, cross-device and cross-fieldbus version follows the requirements of large IO-Link users.

Master manufacturer and fieldbus crossing operation

- Executable as independently Windows application
- Integration into PLC engineering tools like TIA Portal

IO-Link master / port configuration

- Operation of IO-Link master without PLC possible
- Master Plug-In for customizing
- Data Storage content transfer and storage
- Multiple Communication interfaces available



**OEM Version
possible!**

IO-Link device operation and observation

- IODD V1.0.1 / V1.1 / V1.1.3 interpreter
- All IO-Link devices world-wide without restriction
- Open IO Device GUI (Extension for graphical user interface)
- IODD Viewer
- IO-Link Device Firmware Update Support
- IO-Link Safety (parameterization and commissioning)
- IODDfinder Support

TMG IO-Link Device Tool V5 - TS - Test System



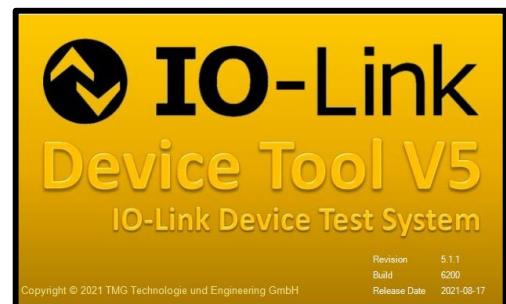
- incl. TMG USB IO-Link Master V2 TS

This version is foreseen for conformance testing and prescribed from the IO-Link Community for manufacturer declaration.



■ Device Test System

- Additional features to the Standard Edition:
 - Trace of IO-Link communication
 - Execution of test cases according to the IO-Link Test Specification V1.1.3
 - Test of IO-Link devices V1.1.3 and V1.1.2
 - Test configuration from IODD
 - Creates test report for manufacturer declaration
 - Easy to use, even for system integrators
 - Option packages available:
 - IO-Link Safety Device Test System
 - Common Profile
 - FW-Update Profile
- **The Test System is based on the IO-Link Engineering Tool for masters and devices, which is the most widespread. It includes the full blown IODD interpreter and an interface for graphical user interfaces for IO-Link Devices.**



TMG USB IO-Link Master V2 – EMC Test Master

This version is foreseen for testing the IO-Link specific EMC robustness tests.

- The test runs independent from a PC
- Powered from 5V USB + 24V external Power Supply
- Test configuration by Application Specific Tag



Edition	TMG IO-Link Device Tool			TMG USB IO-Link Master V2 - EMC
	Standard	Professional	Test-System	
Software included				
TMG IO-Link Device Tool V5.1 - SE	●	-	-	●
IO-Link Device Tool V5.1 - PE	-	●	-	-
TMG IO-Link Device Tool V5.1 - TS	-	-	●	-
Unique Software functionality				
Support of IO-Link Masters from different manufacturers	-	●	-	-
Test Engine to perform the IO-Link Protocol Test	-	-	●	-
IO-Link specific EMC Test Firmware	-	-	-	●
Basic Software functionality				
According to O-Link and IO-Link specification V1.1.3	●	●	●	●
IO-Link standard V1.0.1, V1.1 fully supported	●	●	●	●
TMG IO-Link Master Support	●	●	●	●
IO-Link Viewer	●	●	●	●
IO-Link Finder	●	●	●	●
IO-Link Interpreter	●	●	●	●
IO-Link Device Firmware Update	●	●	●	●
Process data Scope	●	●	●	●
Generic Dialog	●	●	●	●
Scope function	●	●	●	●
Online and offline project engineering	●	●	●	●
Open IO Device GUI	●	●	●	●
Hardware included				
TMG USB IO-Link Master V2 - SE	●	-	-	-
TMG USB IO-Link Master V2 - TS	-	-	●	-
TMG USB IO-Link Master V2 - EMC	-	-	-	●

TMG IO-Link IoT Box (in preparation)



Wireless Connectivity for IO-Link

- WiFi to IO-Link Master / IO-Link Device to WiFi
- Various protocols available
- Smart Interface Protocol (SMI-TCP)
- Cloud Interface (MQTT)
- IO-Link over WiFi



WiFi 2 Port IO-Link Master

- IO-Link Device Tool V5.1
- Windows DLL available

WLAN setup via IO-Link

- as WiFi client
- as WiFi access point



IO-Link Device to WiFi

- Connect WiFi clients to an IO-Link Port

Cloud connectivity in preparation (MQTT)

- Cloud applications for monitoring and predictive maintenance
- Parameterization and Diagnosis with IO-Link Device ToolV5.1 via Cloud

IO-Link Master Software



- Support of all IO-Link functionality
- According to IO-Link specification 1.1.3
- Data storage functionality included

- All bit rates: 230.4, 38.4, 4.8 Kbit
- All telegram types 0, 1 and 2
- ISDU with 8/16 Bit index and 8 Bit subindex
- Events with and without details
- No restriction in number of ports or performance

- Modular design following the specification
- Strictly separation of protocol stack, application and hardware abstraction
- API follows the IO-Link Standardized Master Interface (SMI)
- Includes SMI-TCP protocol stack for engineering, IT and test
- Written in ANSI-C



Ported to (samples)

- Rx, V850, 78K0R
- ARM9, STM32, Sitara AM2,3,4,6 / AMIC, NetX
- CORTEX M0/M3/M4/H7
- XC 167, PIC32
- Microblaze

Deliveries:

- ANSI-C source code
- SMI-TCP
- Test Adapter
- IOLM-Checker
- Documentation
- Sample application

We also assist in integrating the test interface for conformance testing, fieldbus mapping and integration with the IO-Link Device Tool.



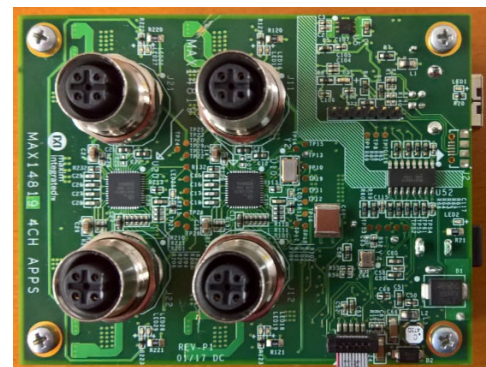
IO-Link Master In Design Solution

- Ready to use solution
- Reduces your time to market
- Proved quality
- Pre certified firmware for fixed hardware schematics
- 4 Port and 8 Port design available

The concept is to offer pre certified solutions which can be easily integrated. The schematics contains all necessary elements for a full usable IO Link V1.1.3 Master. The IO-Link Master controller is connected to its host controller via a serial interface (SPI). All software is delivered as binary code. ANSI-C source code is available as an optional package. The firmware (binary code) can be used as it is.

Characteristics:

- Flash handling for data storage
- TMG IO-Link Master Stack V1.1.3
 - Data storage functionality included
 - IO-Link cycle time 400 μ s
 - All bit rates (230,4k / 38,4k / 4,8K).
- IO Ports for Pin2 (I/O or diagnostic)
- Firmware download over SPI
- TMG SPIAPI interface
- Host Library as ANSI-C source code
- Test report for binary code is available
- Available with STM32F411, STM32G4
- Can be evaluated with
 - MAXIM MAXREFDEF165#
 - Board with STM32G4 available soon



**Maxim Reference Design
4 Port Demonstrator**



maxim
integrated

NOW PART OF



The interface is based on a SPI sum telegram. Because of this technology only one SPI interface with one chip select for up to 8 SIP chips is necessary. Optional a daisy chain addressing can be implemented for modular systems. The host library is delivered as ANSI-C source code and can be ported easily to different host controllers. Host controller requirements:

- SPI interface (4 pins)
- DMA for send and receive
- Up to 8 SIP modules addressable (16 IO-Link Ports)

TMG IO-Link Master Test Device



The TMG IO-Link Master Test Device is intended for the system test of IO-Link masters. Especially for borderline cases there are no, only few or sometimes expensive IO-Link devices. Therefore TMG TE has developed the IO-Link Master Test Device. This provides a selection of different IO-Link configurations, which should simplify the system test and realize a good test depth. We always recommend to perform the protocol test first with the specified test system and after passing the test to perform the system test with TMG IO-Link Master Test Devices on all ports.



Set test configurations

Test Device realizes the different test configurations by device compatibility or by parameterization. So there is no need to load a new firmware to set a new test configuration.

Test Configurations

First of all, there are 36 test configurations to choose from. If you add the compatibility with IO-Link V1.0, then there are almost twice as many.

IO-Link	V1.1 compatible with V1.0 V1.1 not compatible with V1.0	Pre Operate– On-Request Data	1, 2, 8, 32
ISDU	with and without	Operate – On-Request Data	1, 2 ,8, 32
Bitrate	COM1, COM2, COM3	Events	enable/disable
MinCycleTime	400 µs to 132.8 ms	Parameter	
Process Inputdata	0 to 32 Bytes	DirectParameters_2	DirectParameterOverlay
Process Outputdata	0 to 32 Bytes	ISDU	Commands Simple Data Types RecordT ArrayT
Process data simulation	cyclic or static		

Functional Safety

TMG offers a wide range of safety solutions for different communication protocols.

IO-Link Safety

- The next big step for IO-Link
- TMG TE offers
 - Master and Device Stacks
 - Engineering Tool
 - Offsite Engineering Master
 - Safety Device Test System
 - Safe Gateways to
 - PROFIsafe *In preparation*
 - FSOE
 - and others



PROFIsafe

- TMG TE offers
 - Black Channel Device Stack
 - Development services



Safety over EtherCAT (FSOE)

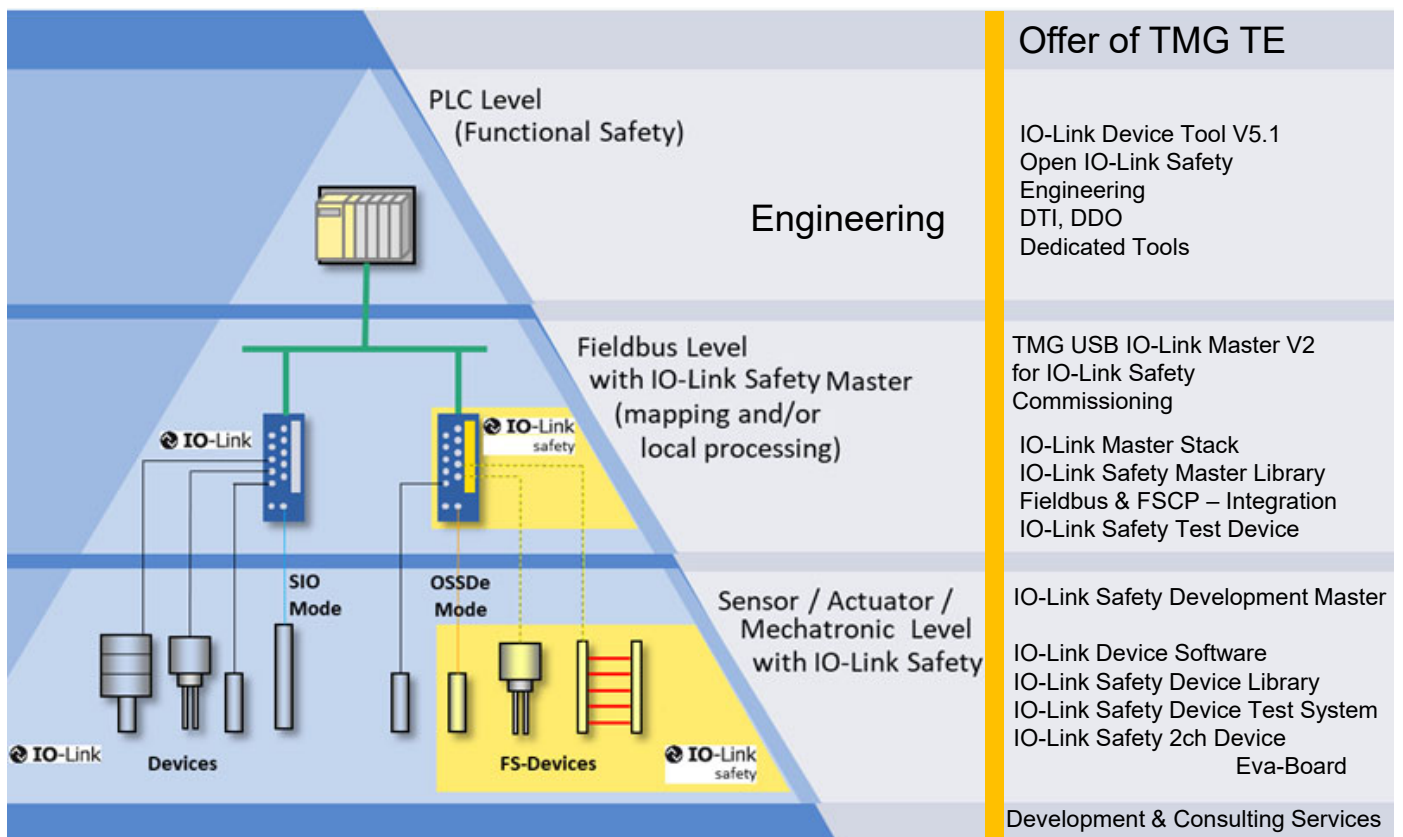
- FSOE Master and Device Stack
- Development services



IO-Link Safety Overview

With the new IO-Link Safety Library, IO-Link safety applications can be implemented more easily than ever before. You don't have to do without any of the advantages of the universal and standardized IO-Link interface. On the contrary, you not only use the full scope of all functions of Black Channel communication, but also have a completely safe system in one at the same time.

IO-Link Safety – Complete Basic Technology and Tools from TMG TE



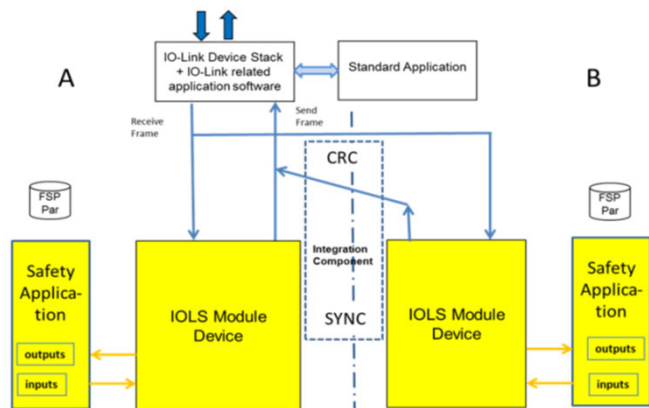
TMG IO-Link Safety Device Library



The library is developed platform-independent and with interfaces that do not place any special requirements on the hardware platform and in particular on the internal communication between the safety controllers. The software is designed for two-channel operation. The safety integrity level SIL 3 can be achieved with the software.

Technical Data

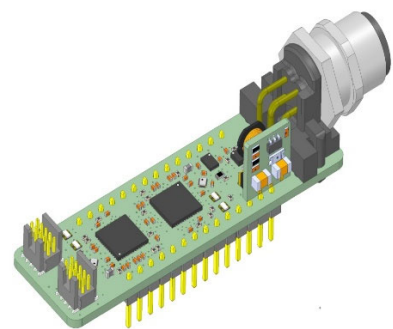
- Supports the IO-Link Safety Specification V1.1.3.
- Easily portable to different platforms
- Consistent separation of safety library (protocol stack) and integration components
- Does not require an operating system
- To check the function together with the development environment and target platform, we supply module test software in addition to the Safety Library, which can be compiled and executed for the target platform. Although this is not mandatory, it is a useful additional measure from our point of view.



TMG IO-Link Safety Device - Evaluationboard

Technical Data

- 2 x ATMEL Cortex M4 microcontrollers
- Each with own clock
- EEPROM
- TIOL 111 IO-Link transceiver
- TMG IO-Link Device Stack and Stack Extensions (I related application functions)
- IO-Link Safety Device Library (2 channel design)
- UART Interface for synchronization
- Serial interfaces (UART, SPI) to device safety application
- GPIO, AIO for "on board" safety application

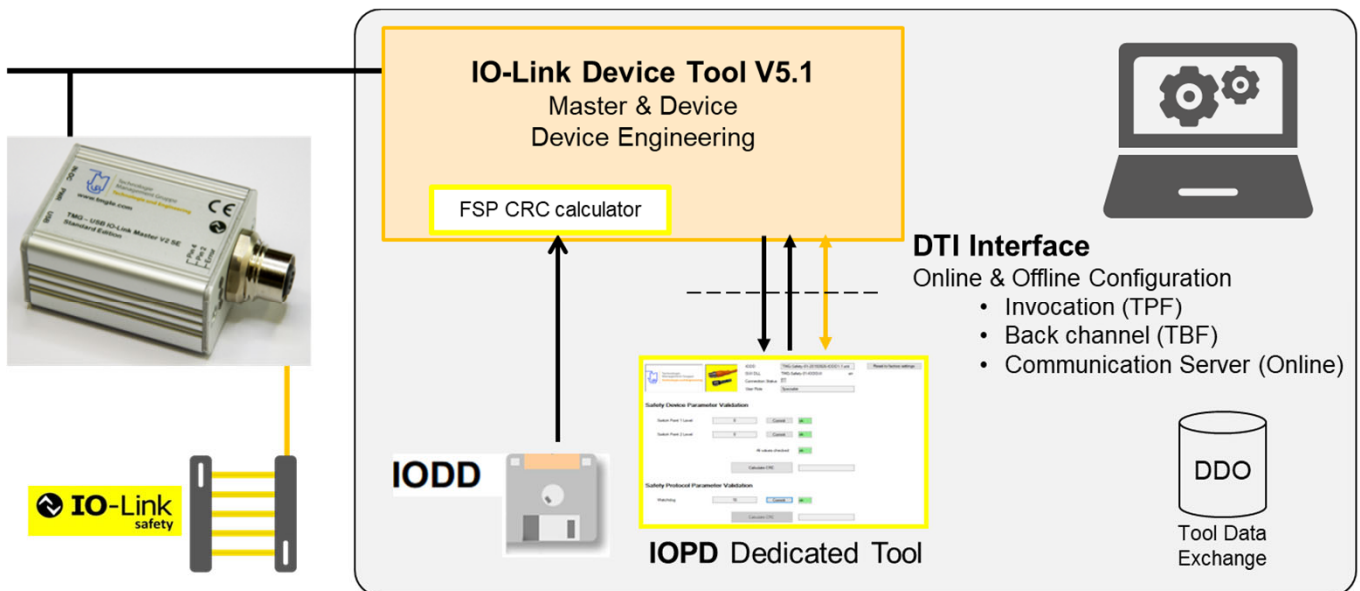


IO-Link Safety - Dedicated Tool



A CRC (Cyclic Redundancy Check) is calculated to protect the safety parameters. A special Dedicated Tool is required for this purpose, with that the safety parameters can be checked, and the CRC can be calculated.

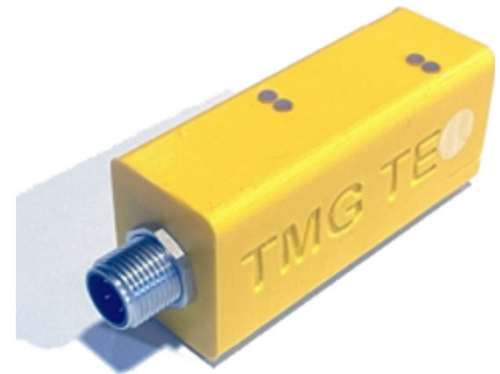
A dedicated tool can communicate with an Engineering Tool via DTI interface. TMG TE has already implemented the DTI interface in the IO-Link Device Tool V5.1 and has also created prototype Dedicated Tools that can be used as the basis for a customer-specific Dedicated Tool. The solution we provide has been certified by TÜV SÜD with a "technical report".



TMG IO-Link Safety Test Device



The TMG IO-Link Safety Test Device is intended for the system test of IO-Link Safety Masters and IO-Link safety Engineering Tools. It does not replace the IO-Link Safety Master Test System for the IO-Link safety protocol test, which tests the correctness of the protocol processing on only one port. The cycle time used for this is very long. For the system test, however, the IO-Link safety Master should be tested on all its ports simultaneously, each with different time behavior, protocol modes and process data lengths.



For IO-Link Safety there are no devices available yet and only a few will be available in the foreseeable future. The TMG IO-Link Safety Test Device does not replace the IO-Link Safety Master Test System and accordingly the protocol tests are not performed according to the test specifications. But there is Error-Injection to run through the most important error scenarios. The TMG IO-Link Safety Test Device provides a selection of different IO-Link Safety configurations to simplify the system test and to realize a good test depth.

IO-Link	V1.1.3	Pre Operate– On-Request Data	8
ISDU	Standard and FS parameters	Operate – On-Request Data	2
Bitrate	COM3	SIO Mode (OSSDe)	With and without
MinCycleTime	900, 1600 ms		
Process Inputdata	6, 10 Bytes		
Process Outputdata	6, 10 Bytes		

TMG IO-Link Safety Master Library

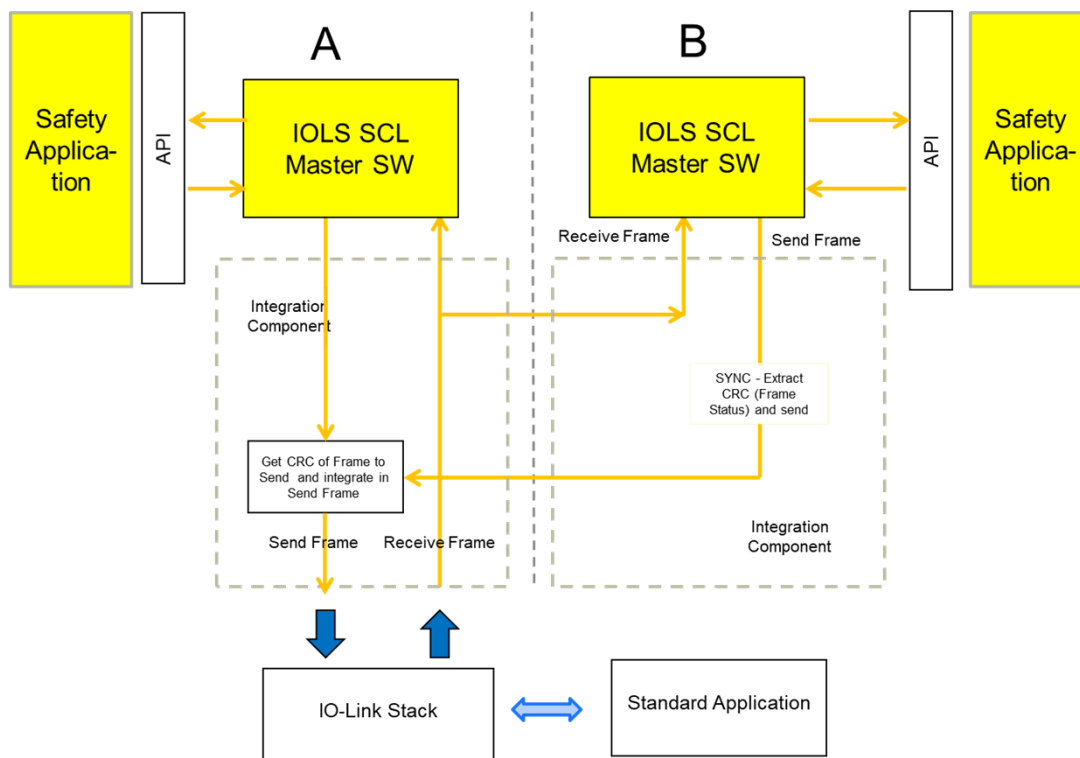


Safety Library with configuration, verification and SCL layer

- Delivered as certified component
- Portable source code, secured against unintentional change
- Platform and architecture independent approach
 - e.g. 2 or 3 microcontrollers, safe operation system or dual core

User and integration manual with sample integration code

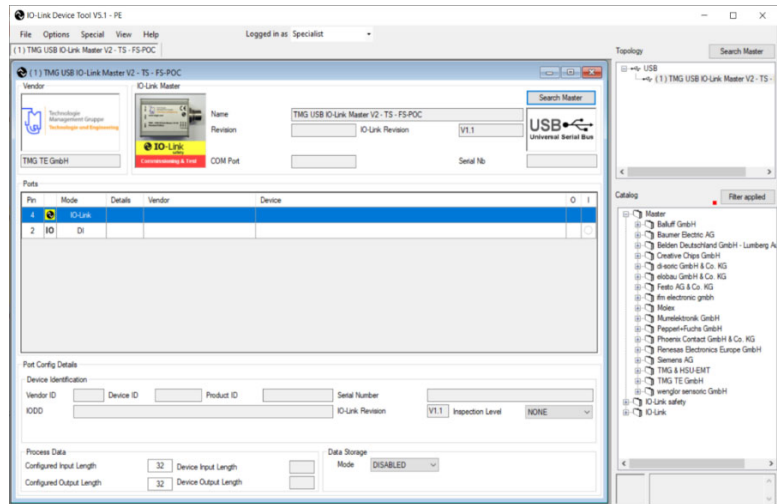
- For synchronization of the safety controllers for SIL 3 design
- Watchdog, Black channel and application interface
- For IO-Link Safety Masters:
 - Standardized Master Interfaces (SMI) for configuration
 - master safety application: FSCP Mapping, Master Test Interface, Safety Application like F-PLC



IO-Link Device Tool V5.1 – Option IOLS



The IO-Link Device Tool V5.1 already supports IO-Link Safety. Our IO-Link Safety Engineering is available as an option package. Our TMG IO-Link Device Tool V5.1 - SE with the IO-Link Safety Engineering Option (IO-Link Device Tool V5.1 - Option IOLS) and the TMG USB IO-Link Master V2 SE (included in the Standard Edition) is a comfortable Tool for pre-parameterization of IO-Link Safety Devices. The safety functions of the IO-Link Safety Devices are fully available in commissioning mode.



With the Professional Edition of the IO-Link Device Tool V5.1 - PE, IO-Link Safety Masters for PROFINET, EtherNet/IP, EtherCAT

or others as well as from different manufacturers can then also be configured and the connected IO-Link Safety Devices parameterized and commissioned. Please ask us if you are interested in integrating your IO-Link Safety Master with our tool.

TMG IO-Link Device Tool V5.1 – TS – Option IOLS

For the development and conformance testing of IO-Link Safety devices we offer our IO-Link device test system (TMG IO-Link Device Tool V5.1 - TS), which is already the most widely used for IO-Link devices and is now extended by the IO-Link Safety test option (TMG IO-Link Device Tool V5.1 - TS - Option IOLS).

While the Standard and Professional Editions only support IO-Link safety communication in commissioning mode, the IO-Link safety device can also be operated with the IO-Link safety device test system in so-called "armed mode" for development purposes.

Category	Process Data	Identification	Observation	Parameter	Diagnose	Scope	Generic	ICDD	R/W	Value	State	Unit
Standard (non-safety) parameter												
				Triggered since power on				no				
				Standard Command				no		Reset Counter Value		
				Standard Command				no		Restore Factory Settings		
Fail-safe technology parameter												
				Read mode				nv		auto		°
				Reach setting				nv		near		
				Resolution				nv		low		°
Fail-safe protocol parameter												
				Authenticity_FSCP_Authenticity_1				nv		0		°
				Authenticity_FSCP_Authenticity_2				nv		0		°
				Authenticity_FSP_Fast				nv		0		°
				Authenticity_FSP_AuthenticCRC				nv		0		°
				Protocol_FSP_Protention				nv		V1		°
				Protocol_FSP_ProtMode				nv		16 Bk CRC		°
				Protocol_FSP_Watchdog				nv		100		°
				Protocol_FSP_ID_SlaveCRC				nv		5115		°
				Protocol_FSP_TechPaCRC				nv		0		°
				Protocol_FSP_ProtPaCRC				nv		0		°
				F3_Password				no				
				Reset_F3_Password				no				

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