



The TMG Technologie und Engineering GmbH

TMG Technologie und Engineering GmbH was founded in Karlsruhe in 1987. As experts of Industrial Communication Technologies we support the factory and process automation industry. In the mean time we can fall back on thirty years of experience in creating basic technology software components as well as integrating these technologies into the devices and systems of our customers.



TMG Technologie und Engineering GmbH, formerly TMG i-tec, together with the IT Research Centre in Karlsruhe (Forschungszentrum Informatik (FZI)) was the pioneer for the successful implementation of PROFIBUS technology in industrial automation technology.



With the trend towards universally networked processes in the companies and the use of Ethernet also on the field level we have broadened our focus. We also took up the challenge of realizing solutions for the international business very successfully.

The biggest challenge to date is the networking of the lowest process level with sensors and actuators with a world-wide accepted standard. TMG Technologie und Engineering is to be sure the most successful and active technology provider with IO-Link and already supports customers in North America, Asia and whole Europe.

The Team

The TMG Technologie und Engineering team consists of very experienced engineers and computer scientists. They are characterized by many years of experience in the industrial information and communication technology and embedded software development as well as by their strong identification with the various technology projects.

Your contacts

Klaus-Peter Willems
Dirk Brauner

Managing Partner
Managing Partner

Marketing and Sales
Development

TMG TE Competence Portfolio

- Communication Software Components / Stacks / Tools
- Product system concepts and specifications
- Development services
- Conformance Test Services
- Workshops and trainings

Consulting

Development

Products

30 years enabling technology

Core competencies:



EtherNet/IP™



Accredited as competence center for PROFIBUS, PROFIBUS & IO-Link
Accredited as test center for IO-Link

Safety over
EtherCAT®

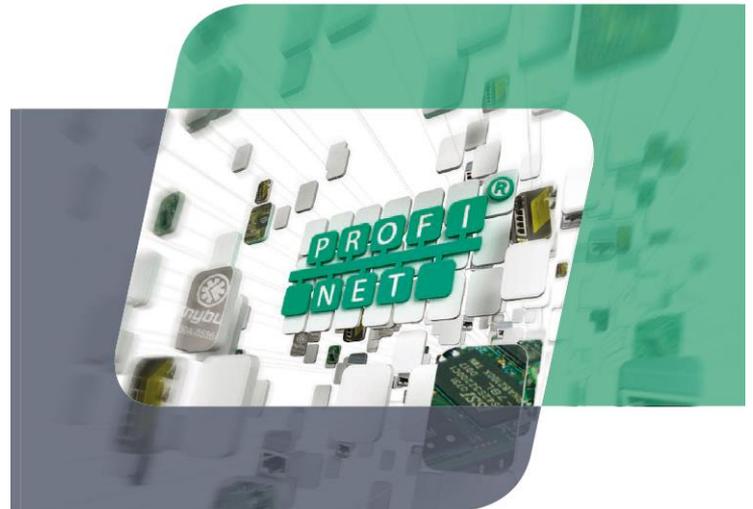


Member of:



PROFINET IO Device

- Integration Services
- Respectively for factory and process automation
- Conformance Test Services
- Stacks and tools



TMG experts have implemented many PROFINET integrations into their customer's devices. PROFINET was integrated into existing device architectures as well as new developments. TMG also has been developed PROFINET IO stacks for customers.

In our projects, we prefer to use the PROFINET IO stack from Molex, which we also sell throughout Europe.



TMG TE is

- **Stack Distributor**
- **Preferred Partner for Services**

Depending on the requirements, we also use the technology components of other providers such as NetX from Hilscher, TPS1 from Renesas/Phoenix or ERTEC from Renesas/Siemens..



With the Molex PROFINET IO stack, we support Renesas RIN32, RZ / T, RZ-N multi-protocol platforms as well as the SITARA and AMIC family from Texas Instruments.



EtherNet/IP Adapter

- Integration Services
- Respectively for factory and process automation
- Conformance Test Services
- Stacks and tools



TMG experts have implemented many EtherNet/IP integrations into their customer's devices. EtherNet/IP was integrated into existing device architectures as well as new developments. In our projects, we prefer to use the EtherNet/IP adapter stack from Molex, which we also sell throughout Europe.

molex

TMG TE is

- Stack Distributor
- Preferred Partner for Services

Depending on the requirements, we also use NetX from Hilscher.



netx

With the Molex Ethernet/IP stack, we support Renesas RIN32, RZ / T, RZ-N multi-protocol platforms as well as the SITARA and AMIC family from Texas Instruments.

RENESAS



With RIN family, SITARA, AMIC or NetX we also offer integration of EtherCAT, MODBUS TCP and others.

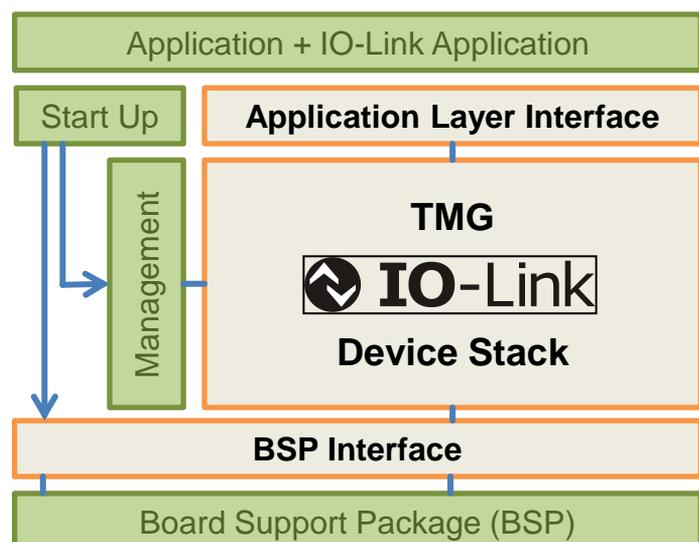
IO-Link Device Stack



- Written in ANSI-C
- Supports all IO-Link functionality according V1.0 and 1.1.2
- All telegram types 0, 1 and 2
- ISDU with 8/16 Bit index and 8 Bit subindex
- Events with and without details
- Compatibility V1.1 to V1.0; Device compatibility
- Modular design following the specification
- Strictly separation of protocol stack, application and hardware abstraction
- Consistent exchange of process data via buffer system
- Synchronization of application and master cycle possible
- Easy adaption to the concrete application

Hardware requirements

- Hardware Timer:
min 1 MHz clock
overflow interrupt
- UART:
receive interrupt,
transmit interrupt (opt.)
- Memory
FLASH 3.5 Kbyte
(configurable smaller)
RAM 350 Byte

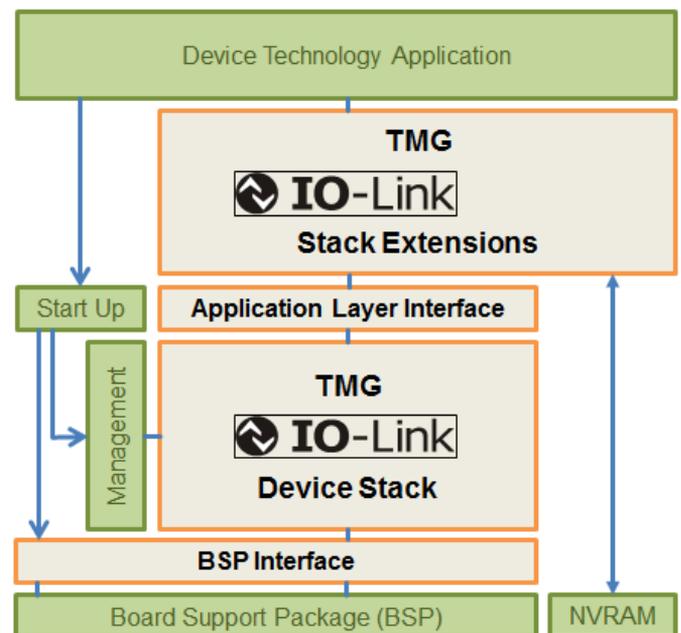


Ported to all relevant μ C platforms and IO-Link transceiver chips e.g. Analog Devices, Atmel, Cypress, Freescale, Infineon, Microchip, NXP, Renesas, ST, Texas Instruments, ...

Creative Chips, Elmos, HMT, IC Haus, Linear Technology, Maxim, ST, Texas Instruments, ZMDI, ..

IO-Link Device Stack Extensions IO-Link

- Written in ANSI-C
- Supports the application layer IO-Link functionality according to specification 1.1.2
- Add on to the TMG IO-Link Device Stack
- Best practice approach
 - Proved in many projects
 - From very easy devices up to complex ones
 - Sensors and actuators
- Supports
 - Parameter Manager (PM)
 - Data Storage (DS)
 - Block Parameterization (BP)
 - Device Access Locks (DAL)
 - Device Status
 - Detailed Device Status (DDS)
 - Event Dispatcher
 - Production Settings (PS)
 - CRC calculation for DS/PS
 - Common/Smart Sensor Profile
- Hardware requirements
 - NVRAM (e.g. EEPROM) required for parameters
 - Two times of size of all parameters and production setting data (+32Byte)
 - RAM as much as EEPROM
 - Program flash approx. 6 Kbyte
 - Portability
 - Can be used on all micro controller platforms
 - 8,16,32 Bit / little and big endian

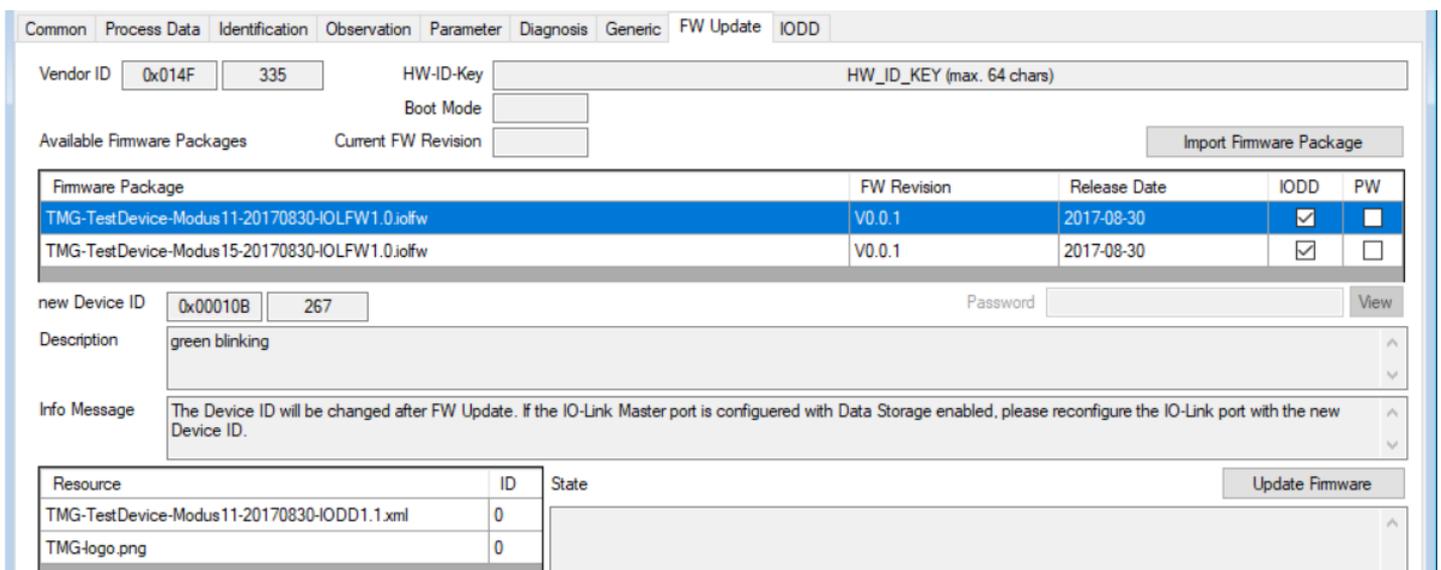


IO-Link Device Firmware Update



IO-Link

- Implementation according to
 - IO-Link Profile BLOB Transfer & Firmware Update V1.0 06/2016
- Bootloader
 - Includes IO-Link Device Stack
 - Can run without using interrupts
 - Interfaces for porting to different platforms
 - Interfaces for encoding support
 - Exemplary RC4 implemented
 - Approx. 8 Kbyte Code
 - Development support for setup bootloader
- Packaging Tool
 - Creates Meta Data File based on IODD info
 - RC4 encoding optional
 - Includes new IODD optional
 - Creates firmware package *.iolfw
- IO-Link Device Tool V5
 - Import of packages into
 - Internal database of firmware packages
 - Automatically takeover of the new IODD
 - Firmware Update for IO-Link Devices
 - With and without IODD



The screenshot shows the 'FW Update' tab of the IO-Link Device Tool V5. It includes fields for Vendor ID (0x014F, 335), HW-ID-Key, Boot Mode, and Current FW Revision. A table lists available firmware packages with columns for Package Name, FW Revision, Release Date, IODD, and PW. Below the table are fields for new Device ID (0x00010B, 267), Description (green blinking), and Info Message. At the bottom, there is a resource table and an 'Update Firmware' button.

Firmware Package	FW Revision	Release Date	IODD	PW
TMG-TestDevice-Modus11-20170830-IOLFW1.0.iolfw	V0.0.1	2017-08-30	<input checked="" type="checkbox"/>	<input type="checkbox"/>
TMG-TestDevice-Modus15-20170830-IOLFW1.0.iolfw	V0.0.1	2017-08-30	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Resource	ID	State
TMG-TestDevice-Modus11-20170830-IODD1.1.xml	0	
TMG-Logo.png	0	

IO-Link Device Integration



Enabling Project

- IO-Link Technology Workshop
 - Target group is product management, sales, support, production preparation and development
- Product Specification – Create IODD – Workshop
 - Kickoff meeting of development project (development)
- Hardware review and help choosing the right components
- Setup IO-Link Device Stack on target hardware
- Implement complete IO-Link application incl. stack extensions
 - based on results of the Kickoff Meeting / IODD
- IO-Link conformance pre test
- Take over workshop
 - Introduction in all software modules
 - Briefing on the integration of the IO-Link software with the device application software
 - Introduction of conformance testing
- Final conformance test workshop (optional)

Best approach for „Time To Market“ and „Know How Transfer“

If required we can also provide further parts of your project. We did projects with the complete device software and also inclusive hardware design.

TMG IO-Link Device Tool V5 - SE

- Standard Edition

- with TMG USB Master V2



IO-Link

The TMG USB Master V2 is done for all use cases where a fieldbus IO-Link master is too complicated and needs 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 and V1
 - Free published interface for graphical user interface 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 (Windows & Linux) and .NET are available.



TMG IO-Link Device Tool V3 - Test System



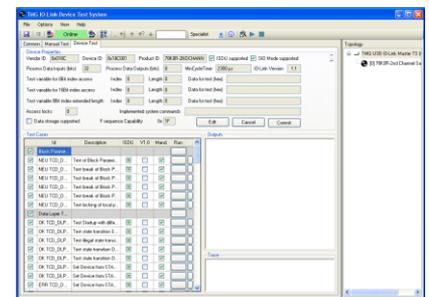
IO-Link

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
 - Test of IO-Link devices V1.1 and V1.0
 - Test configuration from IODD
 - Creates test report for manufacturer declaration
 - Easy to use, even for system integrators
- **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 - 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

IO-Link Master Stack



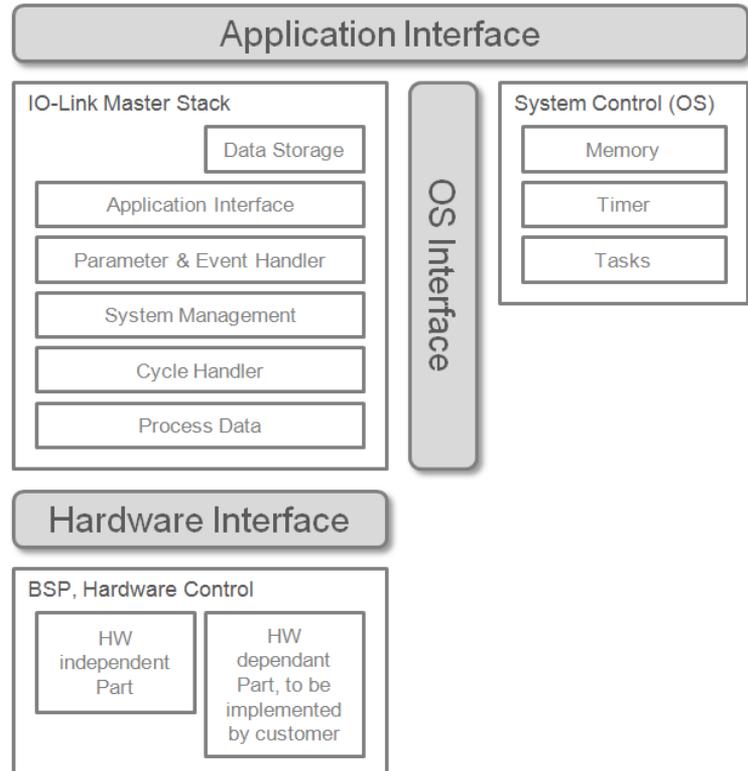
- Support of all IO-Link functionality
- According to IO-Link specification 1.0 and 1.1.2
- Data storage functionality included

- 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
- Consistent exchange of process data via 3 buffer system
- Written in ANSI-C

- Ported to (samples)
 - Rx, V850, 78K0R
 - ARM9
 - CORTEX M0/M3
 - XC 167, PIC32
 - Microblaze
 - ...

- Deliveries:
 - ANSI-C source code
 - Documentation
 - Sample application



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

Single Chip IO-Link Master Solution



- Ready to use solution
- Reduces your time to market
- Proved quality
- Chip provided from **RENESAS**

The SIP Master solution serves a scalable IO Link 2 Port Master solution on base of a Renesas 78K0R/Fx3 microcontroller. The SIP Chip contains all necessary modules for a full usable IO Link V1.1 Master. The link to the Host controller is done by the TMG SPIAPI. The firmware is delivered as binary code. ANSI-C source code is available on demand. The firmware of the SIP can be used as it is.

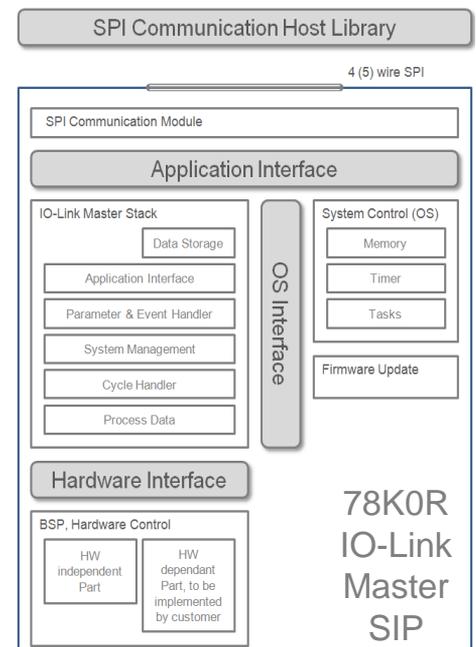
Characteristics:

- 2 Port IO-Link Transceiver on Chip
- Data Flash for non volatile data storage
- TMG IO-Link Master Stack V1.1
 - Data storage functionality included
 - IO-Link cycle time approx 1ms
 - All bit rates (230,4k / 38,4k / 4,8K).
 - All Frame types supported
- 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

TMG SPIAPI:

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)



IO-Link Master Module In Design

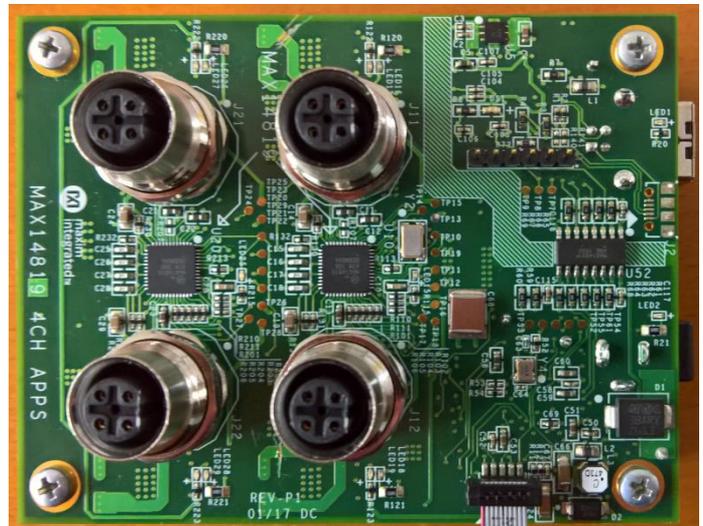


- Ready to use solution
- Reduces your time to market
- Proved quality
- Pre certified firmware for fixed hardware schematics
- 4 Port and 8 Port design available

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 Master. The link to the Host controller is done by the TMG SPIAPI. All software is delivered as binary code. ANSI-C source code is available on demand. The firmware (binary code) can be used as it is.

Characteristics:

- Flash handling for data storage
- TMG IO-Link Master Stack V1.1
 - 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



**Maxim Reference Design
4 Port Demonstrator**



TMG SPIAPI:

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Fieldbus Integration



The fieldbus integration serves a mapping of IO Link services to the fieldbus. TMG TE offers to build up the software for a complete IO-Link master in combination with TMGs fieldbus stacks and IO-Link master solutions.



EtherNet/IP™



EtherCAT®



IO-Link

PROFINET (exemplary)

The PROFINET IO mapping keeps to the most recent PROFINET integration specification for IO-Link. The process data is mapped to the cyclic data of the corresponding PROFINET modules. Asynchronous data is handled by IOL Calls. Each physical port is mapped to a single Slot / Subslot.

Modules: Each physical port can, depending on its usage, assigned to a predefined module. There are the following module types available:

- IO-Link with different modes and process data length
- Digital In (NO / NC), Digital Out

Acyclic data: Acyclic data are mapped onto IOL Calls. This specified mechanism serves a standardized interface for access device parameters. In addition this channel is used for special functions like the control of IO Link fallback ports.

Diagnostic: IO Link Events are mapped onto the diagnostic and alarm system of PROFINET. There are also modules available to serve different diagnostic information by cyclic data transmission.

Master and IO-Link Port configuration: Can be done by GSDML or as option from TMG IO-Link Device Tool. The tool can be used stand alone or integrated in STEP7 or TIA Portal via TCI (Tool Calling Interface). Tool communication is done with TMGs own protocol. So the PROFINET to IO-Link Master can be operated also without PLC.

Industrie 4.0 Support: Beside the fieldbus communication an additional communication channel based on TMGs own protocol provides access for applications like condition monitoring, production control and quality assurance.

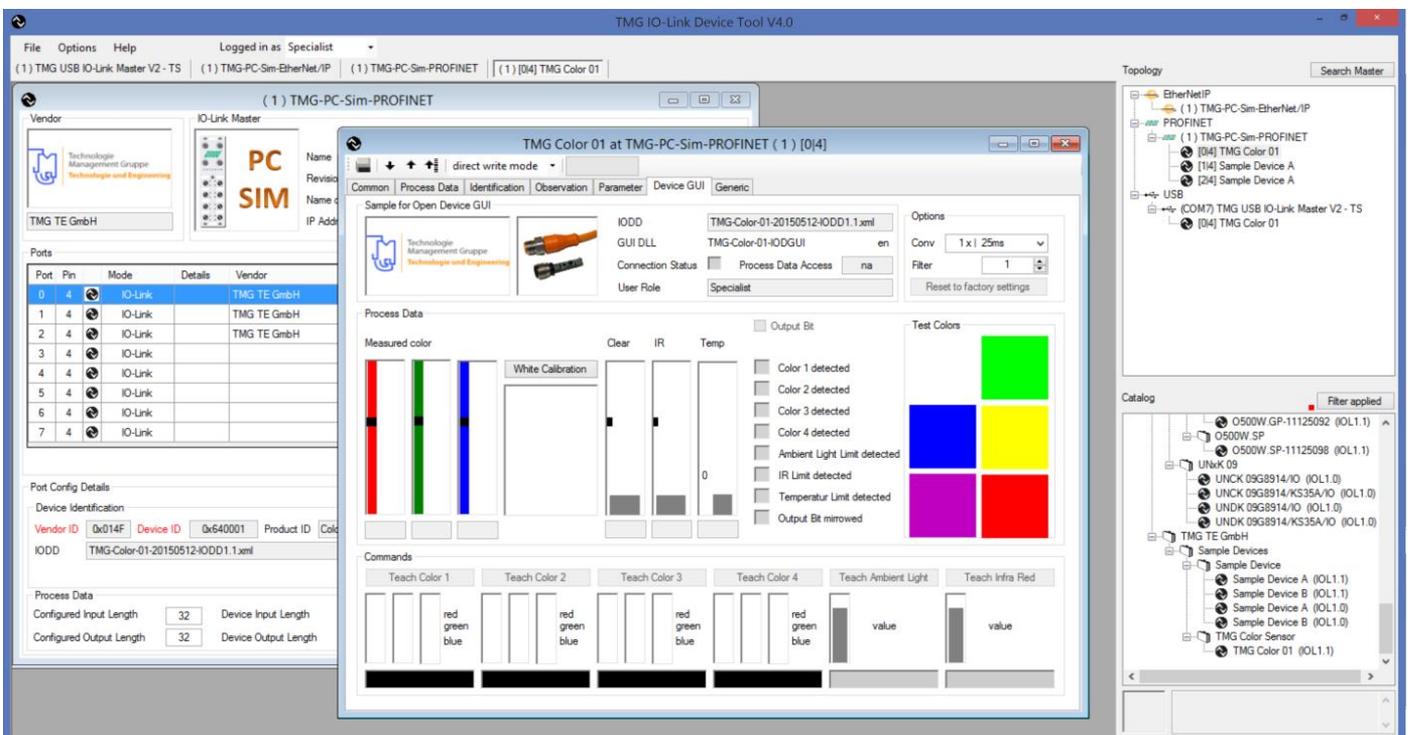
TMG IO-Link Device Tool V5



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



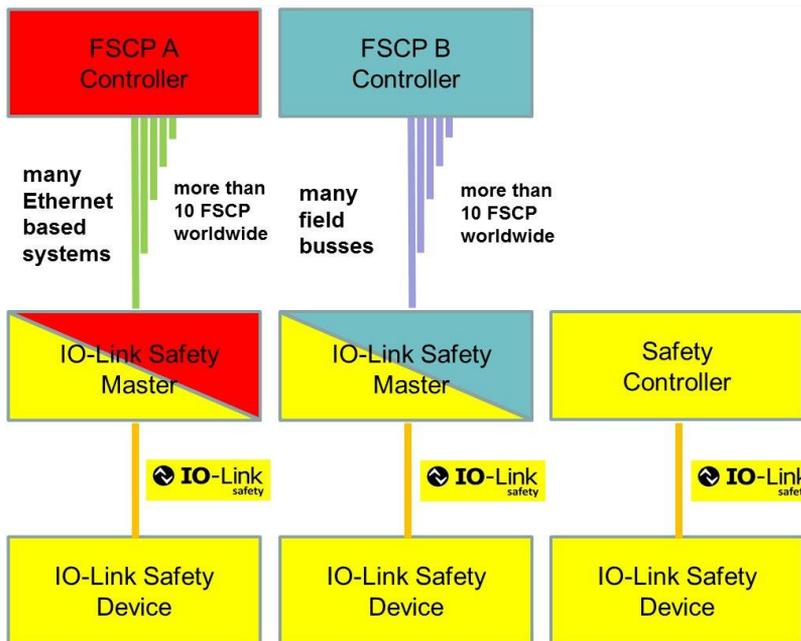
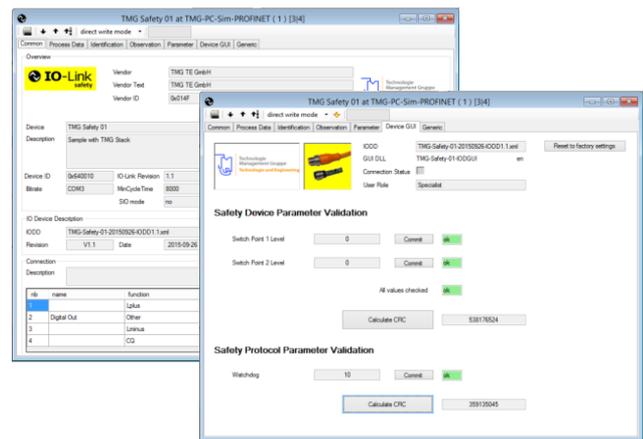
TOOL CALLING INTERFACE


- 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

Functional Safety

- IO-Link safety
 - The next big step for IO-Link
 - TMG is working on
 - Master and device stacks
 - Engineering tool
 - Master Simulator
 - Device Test System
 - Safe Gateways to
 - PROFIsafe
 - FSOE
 - and others



TMG is engaged in IO-Link Safety working groups for technology and marketing. We are intending to be the first provider which can offer pre certified software for the only open and worldwide accepted solution for functional safety.

- Safety over EtherCAT (FSOE)
 - Master and device stacks
 - Also for usage with others than EtherCAT





TMG TE / Molex Cooperation

- Close Cooperation on PROFINET and EtherNet/IP Technology
- Providing Communication Technology from Molex
- Development services based on Molex stacks
- Support for certification
- Workshops and trainings



PROFINET IO

- Device Stack
- Controller Stack
- Engineering Tool
- PC Card
Controller/Device

EtherNet/IP

- Adapter Stack
- Scanner Stack
- Engineering Tool
- PC Card
Scanner/Adapter

PROFIBUS DP V1 Slave Solution

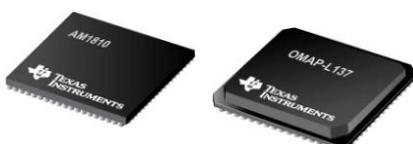
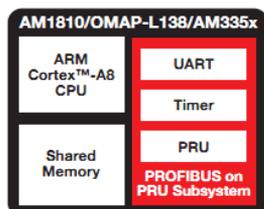
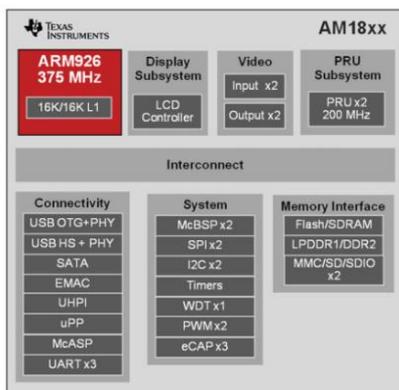


- Realized with standard MCU
- No need of special PROFIBUS ASIC
- 12 MBaud
- More performance for application with less manufacturing costs
- Smaller footprint
- Certified with reference design

TMG TE processed own basic technology for PROFIBUS. The slave stack is the most used stack worldwide with SPC4 ASIC from Siemens. The master stack for ASPC2 from Siemens is proved as well. Now TMG TE developed with partners PROFIBUS slave solutions based on standard MCU. Master solutions are in preparation.



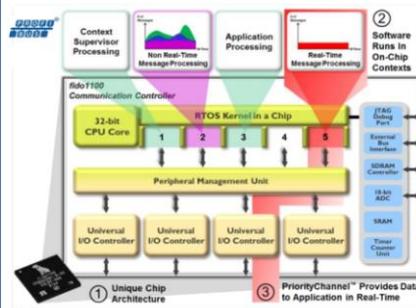
OMAP-L137 AM1810 AM335x



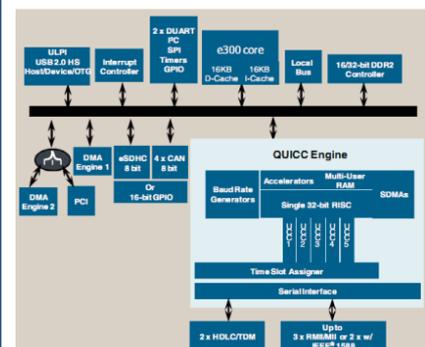
Mono master available



FIDO 1100



MPC 8309 P1021





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