# KPA EtherCAT Studio

KPA EtherCAT Studio is the second generation of a user-friendly tool for EtherCAT network engineering, installation and diagnostics. This easy-to-use, lightweight, high-performance solution for EtherCAT based Masters provides a set of functions required to create and handle Master configurations and monitoring the EtherCAT network. It is integrable to other design environments to establish a common development workspace with enhanced functionality.

The offered functionalities of KPA EtherCAT Studio are competitive with products offered by other leading suppliers.

## Key features

- Bus scanning and manual configuration
- Cable Redundancy
- Process data configuration
- Custom Process Image variables
- Hot Connect
- Explicit Device Identification
- Distributed Clocks
- Mailbox protocols: AoE, CoE, EoE, FoE, SoE
- Slave-to-Slave communication
- Diagnostic traces and statistics
- Tools: Frame Logger, Data Logger, EEPROM Editor, S2S Editor etc.
- Plugins: Modular device profile, Gateways (CAN, Profibus)
- Brand labeling (BLF)
- Dashboard
- IO-Link device support

## KPA EtherCAT Studio 2 product packages

KPA EtherCAT Studio 2 can be delivered as a standard or branded feature package subject to customer's demands. koenig-pa offers two types of packages: Studio 2 and Studio 2 Evaluation.

The Studio 2 Evaluation package includes almost all functionality of the KPA EtherCAT Studio 2 for working with an EtherCAT network but has restrictions:

- 3 months time limit
- maximum slaves count in ENI - 5
- max Process Image size - 100 Bytes
- not allowed:
  - saving project to file
  - import/export ENI file
  - almost all types of exporting except export Mailbox Init Commands and export DScale Attribute.

- Automation Interface(.NET Remoting)
- tools: ESI and EEPROM Comparator and EEPROM Editor
- Dashboard Customization
- Master Watchdog
- CoE Object Dictionary Writing
- SoE Writing
- EEPROM Editing

## KPA EtherCAT Studio Versions

Depending on KPA EtherCAT Studio version different features are available. All versions of the product are supported during the whole period of their use.

| Name | KPA EtherCAT Studio 1 | KPA EtherCAT Studio 2 |
|---|---|---|
| **Studio** | | |
| Attaching to Master | ✓ | ✓ |
| Automation Interface (.NET Remoting) | – | ✓ |
| Engineering Unit Mapping | ✓ | ✓ |
| Export uESI for Autoconfigurator | – | ✓ |
| Scaling Signal Values | ✓ | ✓ |
| Slaves Library | ✓ | ✓ |
| Project Access Limitation | ✓ | – |
| **Plugins for configuring specific devices** | | |
| CANopen Master/Slave (EL6751) | ✓ | ✓ |
| M2M (EL6692/EL6695) | ✓ | ✓ |
| Modular Devices | ✓ | ✓ |
| Profibus Slave (EL6731-0010) | ✓ | ✓ |
| Virtual Serial COM | ✓ | ✓ |
| **Configuration tools** | | |
| EEPROM Editor | ✓ | ✓ |
| ESI and EEPROM Comparator | ✓ | ✓ |
| Fixed Process Image Editor | ✓ | – |
| Motion Configuration Utility | ✓ | ✓ |
| Process Image Viewer | ✓ | ✓ |
| Projects Comparator | ✓ | – |
| S2S Communication Editor | ✓ | ✓ |

| Name | KPA EtherCAT Studio 1 | KPA EtherCAT Studio 2 |
|---|---|---|
| Sample Rate Editor | ✓ | – |
| **Diagnostic tools** | | |
| Chart Viewer | ✓ | – |
| Data Logger | ✓ | ✓ |
| Dashboard | – | ✓ |
| Dashboard customization | – | ✓ |
| Diagnostic scanner | ✓ | – |
| Emergency Output | ✓ | ✓ |
| Master Output | ✓ | ✓ |
| Runtime Data Logger | – | ✓ |
| Snapshot Viewer | ✓ | ✓ |
| Topology Viewer | ✓ | ✓ |
| Watch Viewer | ✓ | ✓ |
| **Common** | | |
| DC | ✓ | ✓ |
| Power calculation via LVDS | ✓ | ✓ |
| Tasks/Sync Units | – | ✓ |
| **Master** | | |
| Cable Redundancy | ✓ | ✓ |
| Cyclic Commands | ✓ | ✓ |
| ENI Export | ✓ | ✓ |
| ENI Export. XSLT Scheme support | ✓ | ✓ |
| External task | ✓ | ✓ |
| Master Mailbox. AoE | ✓ | ✓ |
| Master Mailbox. EoE | ✓ | ✓ |
| Master Watchdog | ✓ | ✓ |
| PI Alignment | ✓ | ✓ |
| **Slave** | | |
| Configuring Init Commands | ✓ | ✓ |
| Direct EEPROM access | ✓ | ✓ |
| Direct Memory access | ✓ | ✓ |
| Explicit identification | ✓ | ✓ |

| Name | KPA EtherCAT Studio 1 | KPA EtherCAT Studio 2 |
|---|---|---|
| FMMU/SM | ✓ | ✓ |
| Hot Connect | ✓ | ✓ |
| Slave Mailbox. AoE | ✓ | ✓ |
| Slave Mailbox. CoE | ✓ | ✓ |
| Slave Mailbox. EoE | ✓ | ✓ |
| Slave Mailbox. FoE | ✓ | ✓ |
| Slave Mailbox. SoE | ✓ | ✓ |
| Slave Watchdog | ✓ | ✓ |
| **Extensions** | | |
| IO-Link (for Beckhoff IO-Link Master devices) | – | * |
| Profibus Master Gateway Profile 3100 | – | * |
| Master Redundancy | – | * |

"✓" - included in the delivery set
"*" - may be included in the delivery set
"–" - not included in the delivery set

# Core functionality

- Master configuration
- Slave configuration
- Slave library
- EtherCAT diagnostics
- KPA EhterCAT Studio development framework (SDF)

# Extensions

Extensions are advanced functional options that can be purchased separately and added to the KPA EtherCAT Studio packages.

## IO-Link

studio 2

Support for IO-Link protocol devices allows to enhance flexibility in managing and automating industrial devices using the IO-Link protocol. IO-Link device can be easily configured directly within the plugin. A built-in expandable library of supported IO-Link devices grants quick and easy integration.

### Profibus Master Gateway Profile 3100

studio 1 studio 2

MDP plugin for Profibus Master Gateway Profile 3100 is intended to configure a slave supporting Profibus Master (3100) profile.

### Master Redundancy

studio 2

Export of Master configuration to an XML file according to the EtherCAT Technology Group (ETG) specification with the extension for KPA Master Redundancy.

## Features description

### Automation Interface (.NET Remoting)

studio 2

This feature makes writing logic for automating tasks that do not require human involvement in project settings possible. It supports the fillowing technology: .NET API, COM API, .NET Remoting.

### Scaling signal values

studio 1 studio 2

It is a possibility to change a representation of signal's value. Scaling signal values is available for integer signals with 16- or 32-bit length. This attribute is used to specify the range of the input data.

### Slaves Library

studio 1 studio 2

Slaves Library is a list of available ESI files which can be used to build up Project configuration. There is an opportunity to work with several Slaves Library collections, change active collection by using custom collection and manage Slaves Library view by setting user attributes for Slaves. It is possible to use as a source for the collection: KPA ESIs Storage, ESI file, ESIs folder, or Installed ESIs folder and save it as KPA ESIs Storage.

### Plugins configuring specific devices

- EL6751:
  - CANopen Master plugin allows the user to adapt CANopen Master configuration got by scanning CAN bus.
  - CAN Interface plugin is intended to configure device in CAN Interface (raw CAN) mode to be used with/without CAN DBC driver on Master side. Data exchange through the driver can be done either through the specified signals (adding messages from a DBC file) or by sending/receiving unspecified messages via driver's queue.
- EL6692/EL6695:
  - M2M plugin - is intended to configure the both sides of the EtherCAT bridge terminal (Primary and Secondary).

- Modular devices:
  - MDP Modules is intended to configure Slave supporting Modular Device Profile with modules specified in its ESI file.
- EL6731-0010:
  - Profibus Slave plugin - is intended to configure device for communication between EtherCAT and PROFIBUS.
- EL600x/EL602x/EP6002/EP6002-0002:
  - koenig-pa offers an easy way of data exchange with devices with serial interface (RS232/RS422/RS485).
    KPA EtherCAT Master supports Virtual COM communication. It allows you to communicate with the serial device (connected via Serial to EtherCAT gateway device) from your Windows application via Virtual COM port. Master transmits data got from the serial terminal or the Virtual COM device to the recipient.
    To set such communication KPA EtherCAT Master requires the KPA Virtual COM driver being installed in the Windows and the corresponding feature must present in Master's license. KPA Virtual COM driver is provided as a separate module and can be installed independently of Master. It is not required additional configuring with COM settings (baud rate, data bits, parity etc.).

## EEPROM Editor

studio 1 studio 2

The tool allows to read EEPROM, to generate ESI from a binary file or directly from the Slave, view it by bits or in Hex Editor, to navigate through the EEPROM using quick access to certain parameter, to edit it. Besides working with read data, the user may create new EEPROM categories and add new data. Modified EEPROM can be saved to a binary file, ESI or directly to the Slave.

## ESI and EEPROM Comparator

studio 1 studio 2

The tool enables comparison of EEPROM content acquired directly from a Slave device or provided in a binary file against the content of a file either assigned to the Salve or chosen by a user. Differences are highlighted with customizable colors; properties values are displayed.

## Fixed Process Image Editor

studio 1

The tool allows to assign an area in Process Image to a certain Sync Manager.

## Motion Configuration Utility

studio 1 studio 2

Motion Configuration Utility is intended to configure motion trajectory and generates an INI file with corresponding settings.

## Process Image Viewer

studio 1 studio 2

The tool shows allocation of inputs and outputs in memory. Using this tab you can see location, type, length and offset size of a Signal (including alignment signals).

## Projects Comparator

studio 1

The tool compares two projects. It is possible to compare the project opened in KPA EtherCAT Studio with a project loaded from a file, or just two projects from files. Found differences are highlighted with customizable colors.

## S2S Communication Editor

studio 1 studio 2

The tool allows to map input process data of one device to output process data another device without wiring (via the Master). Copying of the data is handled by the Master stack.

## Sample Rate Editor

studio 1

The tool allows adjusting schedule settings (that is read by the Master) according to which frame data is updated.

## Chart Viewer

studio 1

The tool allows monitoring multiple channels from one or several Slaves simultaneously.

## Data Logger

studio 1 studio 2

The tool manages the data logging on the Master side.

## Dashboard

studio 2

Dashboard displays bus Slaves properties and bus ports parameters. Ports searching includes diagnostic that allows to detect errors in the ports in online mode.

## Dashboard customization

studio 2

Dashboard customization allows customers to set the appropriate appearance of Dashboard and add new Dashboard.

## Diagnostic Scanner

studio 1

The tool scans EtherCAT network and executes diagnostics for possible Slave and connection problems.

## Emergency Output

studio 1 studio 2

Emergency Output displays messages which are sent by Slaves in case of emergency (transmitted via CoE emergency service).

## Frame logger

studio 1 studio 2

The tool is the visualizator of time information on EtherCAT packets: duration of packet assembling, time of received frame parsing, time of setting frame to queue for sending, etc.

## Master Output

studio 1 studio 2

Master output displays raw Master traces that is got from Master.

## Runtime Data Logger

studio 2

The tool manages the data logging on the Master side. The KPA EtherCAT Studio retrieves the stored data and enables building of charts for signals picked from a defined set.

## Snapshot Viewer

studio 1 studio 2

Signal values are gathered during operation and stored to make a snapshot. The viewer then displays the snapshot. Taking snapshots reduces overall load on the system in order not to affect hard real-time performance.

## Topology Viewer

studio 1 studio 2

Displays Network and Master configurations simultaneously. The tool displays Slaves' state. If there is a problem with Slave(s) in configuration, it also will be marked by a corresponding icon and the problems will be displayed in the Slave tooltip.

## Watch Viewer

studio 1 studio 2

The tool allows to monitor changing of selected signals, that allows to control them in separate window.

## Distributed Clocks

studio 1 studio 2

The feature enables synchronization of the Master and all Slave devices on the bus. It is configured on the both sides Master and Slaves.

## LVDS power capabilities

studio 1 studio 2

Monitoring of power supply and consumption of LVDS Slaves on the bus in order to avoid power lack issues in the configuration.

## Task/Sync Units

studio 2

Provides an opportunity to configure Process data update by using tasks and sync units and update particular blocks of Process image in certain time.

## Cable Redundancy

studio 1 studio 2

Cable redundancy makes possible several things that used to be bottle-necks of conventional field bus systems built up on closed ring principles, such as cable feedback for problem finding and system availability in case of cable break. If the ring is interrupted at some point, both branches can be still reached.

## Cyclic commands

studio 1 studio 2

KPA EtherCAT Studio allows to configure and set the values of cyclic commands to send and receive data from bus.

There are three types of cyclic commands available for selection:

- Common logical read/write command
- Separate logical read and logical write commands
- Separate physical read and physical write commands

## External Task

studio 1 studio 2

KPA EtherCAT Studio allows running external tasks (specific applications) on Master side. Sawtooth application, which simulates saw-shaped signals on outputs to show a snapshots diagram. A signal from Slave's analog input is multiplied by a special factor and sent to output without wiring (through memory). The signal sent to output is shaped as a saw.

KPA EtherCAT Studio allows running external tasks (specific applications) on Master side to manage EtherCAT bus. External tasks are custom developed depending on customer needs.

## ENI Export

studio 1 studio 2

Creation of configuration file for Master (according to EtherCAT Technology Group (ETG) specification (ENI)).

Using KPA EtherCAT Studio it is possible to prepare Master configurations to be used in other systems (for example CODESYS).

KPA EtherCAT Studio provides the following types of Master configuration export:

- Export Master Configuration KPA creates an XML file, which can be imported for further usage by the Master, KPA extensions are included.
- Export Master Configuration ETG Standard creates an XML file according to the ETG specification.
- Export CODESYS PLC Configuration creates a file, which can be imported into CODESYS configuration (includes the Master module configuration).
- Export CODESYS PLC Configuration (Master module) creates a file, which can be imported into CODESYS configuration (without PLC configuration).
- Export encoded configuration creates an XML file in UTF-8 encoding.
- Export C header file creates a C header file with definitions of offsets and lengths of process image signals, which can be used to simplify procedure of process image usage while development of control application/PLC.
- Export C header file including Slave properties creates a C header file with definitions of offsets, lengths and types of signals and Slaves' properties (VendorID, ProductCode, etc.); also, can be used to simplify procedure of process image usage while development of control application/PLC.
- Export IEC61131-3 PLC POU (Program Organization Unit) creates a file, which can be imported into other Master configurations using software which supports IEC61131-3 standards (for example, Structured Text language).
- Export XML Format for IEC 61131-3 PLCopen creates a file, which can be imported into other Master configurations using software which supports IEC61131-3 PLCopen standard.
- Export Master Configuration (comments without CDATA) creates an XML file as Export Master Configuration KPA, but without CDATA in comments.

This feature allows export custom ENI files based on custom XLST scheme support.

## Master Watchdog

studio 1 studio 2

Master watchdog enables and disables the Master watchdog function. If there is PLC program crash or it is hanging and no output value has been set within this timeout, a default or last value (depending on the signal's settings or Master settings) is set by Master to all outputs.

## Process Image Alignment

studio 1 studio 2

KPA EtherCAT Studio allows to set different types of PI alignment depending on the configuration. Users can choose between the five options in the **Alignment mode** list:

- No alignment

- Bit alignment
- CODESYS (PowerPC) alignment
- CODESYS (PowerPC) with Bit-Byte alignment
- CODESYS (x86) alignment

The options listed above present the ways of addresses types alignment in Process Image as different PLC systems acquire different addressing modes. For example, a four-byte signal offset should start with a four-fold address value. Bit alignment enables grouping of one or more bit long signals into one or several sequential bytes.

Alignment is set on Process Image Tab, that allows the user to set variables' values, get a snapshot and watch the fluctuation of variables' value in Chart window. Process Image Tab allows to set and force or unforce variables' values, get a snapshot and watch the fluctuation of variables' value in Chart window.

## Configuring Initialization commands

studio 1 studio 2

Init commands initialize and control processes of communication with a Slave (according to a specification). When a device is configured via Mailbox Initialization Commands, it is possible to set the Operational mode, speed of data exchange, a set of data for exchange, etc. Initialization commands is generated by KPA EtherCAT Studio and can be disabled, added or deleted by a customer.

## Direct EEPROM access

studio 1 studio 2

EEPROM Electrically Erasable Programmable Read Only Memory energy-independent Slave memory. The EtherCAT Slave Controller (ESC) loads its configuration data (e.g. PDI configuration) during start up from the Slave Information Interface (SII) which usually is implemented as EEPROM.

KPA EtherCAT Studio allows read and write data about Slave from or to EPROM and make changes to the Slave description by using EEPROM editor tool.

## Direct Memory access

studio 1 studio 2

KPA EtherCAT Studio allow directly read and write memory register of EtherCAT Slave controller. Also the tool allows mapping memory registers to Process Image by adding new or using known registers. This allows to map registers to Process Image by adding new or using known registers.

## Configuring FMMU/SM

studio 1 studio 2

4 Gb address space is one of the EtherCAT advantages. To use this space the process data of the dedicated device must be mapped to the EtherCAT logical address space. This function is performed by FMMU (Fieldbus Memory Management Units).

On the other hand, the process data itself is located in the physical address space of the controller, access to which is controlled and synchronized by SyncManager (SM). Within the KPA EtherCAT Studio the corresponding technological “pillars” can be configured in the way required to the user.

## Hot Connect

studio 1 studio 2

Hot Connect function allows to connect additional devices flexibly. They can be optionally removed from or added to the data traffic before the start or during operation of the system. Such actions will not cause the damage of the overall functionality. This is called “flexible topology” or Hot Connect.

## AoE

studio 1 studio 2

ADS over EtherCAT (AoE) is a standard, client-server Mailbox protocol defined by the EtherCAT specification. It is used to build storage area networks (SANs) with low-cost, standard technologies.
AoE is routable and supports the contemporary handling of parallel services, and therefore is particularly suitable for the access to sub-networks via gateway devices (Master devices which are required to operate gateway Slave devices should therefore support AoE). Due to its routability, AoE is also defined as standard protocol for the communication between an EAP (EtherCAT Automation Protocol) network and single EtherCAT fieldbus segments.

Both Master and Slave stacks exist which support basic AoE services, enabling a light and fast implementation of this mailbox protocol in EtherCAT devices.

## CoE

studio 1 studio 2

Event driven standard of access to CANopen Object dictionary and exchange of CANopen Emergency and PDO/SDO messages. With the CoE protocol (CAN application protocol over EtherCAT), EtherCAT provides the same communication mechanisms as in CANopen®-Standard EN 50325-4: Object Dictionary, PDO Mapping (Process Data Objects) and SDO (Service Data Objects) even the network management is similar. This makes it possible to implement EtherCAT with minimal effort in devices that were previously outfitted with CANopen, and large portions of the CANopen Firmware are even reusable. Optionally, the legacy 8-byte PDO limitation can be waived, and it’s also possible to use the enhanced bandwidth of EtherCAT to support the upload of the entire Object Dictionary. The device profiles, such as the drive profile CiA 402, can also be reused for EtherCAT.

## EoE

studio 1 studio 2

The EtherCAT technology is not only fully Ethernet-compatible, but the Ethernet over EtherCAT (EoE) protocol tolerates other Ethernet-based services and protocols on the same physical network. The term Ethernet is also frequently associated with data transfer in IT applications, which are based on a TCP/IP connection. Using the EoE protocol any Ethernet data traffic can be transported within the EtherCAT segment. The Ethernet frames are tunneled through the EtherCAT protocol, similarly to the internet protocols (e.g. TCP/IP, VPN, PPPoE (DSL), etc.), which makes the EtherCAT network completely transparent foe Ethernet devices.

The device with the Switchport property takes care of inserting TCP/IP fragments into the EtherCAT traffic and therefore prevents the network’s real-time properties from being affected. Additionally, EtherCAT devices may also support Ethernet protocols (such as HTTP) and can therefore behave like a standard Ethernet node outside of the EtherCAT segment. The Master device acts as a Layer-2-switch that sends the frames via EoE to the corresponding nodes according to their MAC addresses. This way, all internet technologies, such as an integrated web server, E-mail, FTP transfer, etc. can also be implemented in an EtherCAT environment.

## FoE

studio 1 studio 2

FoE (File Access over EtherCAT) is a mailbox protocol generally intended to transfer file data on an EtherCAT network in both directions, and as such it can be used in any state where the mailbox communication is active (PreOP, SafeOP, OP). The most common use case for FoE is to download a new firmware for update, when the Slave is in Bootstrap state.

EtherCAT provides the FoE protocol for simple file access. For example, the device runs in a boot loader state to support a firmware download to the host controller via the EtherCAT network. Standardizes firmware download to devices is therefore possible, even without the support of TCP/IP.

## SoE

studio 1 studio 2

Servo drive profile over EtherCAT (SoE) communication services are used to access the IDNs of a SoE Slave. The SoE drive profile is a part of an extra Master application, not of the Master itself.

If the EtherCAT Slave supports the Servo Profile over EtherCAT (SoE) protocol the additional tab "SoE" appears in the Mailbox.

Servo drive profile over EtherCAT® (SoE) is a protocol of EtherCAT interface for IEC 61491 servo drive profile.

SoE allows to integrate devices based on IEC 61491 technologies in an EtherCAT bus. It is executed by getting access to the drive parameters and data that defined in IEC 61491. Non-cyclic data exchange is implemented by SoE protocol with help of the EtherCAT SoE Service Channel (SSC) (equivalent of the IEC61491 Service Channel). It allows to access to identifiers (IDN) and their elements.

## Slave Watchdog

studio 1 studio 2

The Slave's watchdogs are used for observing communication and returning to a safe state in case of an error. The ESCs (EtherCAT Slave Controller) support up to two internal watchdogs:

- **Sync Manager watchdog** (SM) is used for monitoring process data accesses by Master (e.g. Master read process data).
- **Process Data Interface watchdog** (PDI) is used for monitoring of firmware viability.

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