Optimizing efficiency and regulatory compliance

Eurotherm®

E+PLC400 Combination Programmable Logic Controller

Advanced control, data management and visualization, combined with the flexibility of a PLC

eurotherm.com/eplc

WATLOW®
Powered by Possibility

A cost effective combination

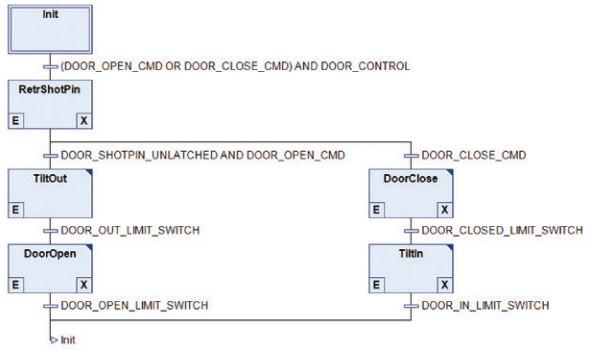
Controlling a process more precisely can reduce energy usage, shorten processing times, minimize waste, and improve final product quality, all of which can increase your overall profitability.

The E+PLC solution combines Eurotherm core expertise in measurement accuracy, precision control and tamper-resistant recording, together with proven PLC functionality.

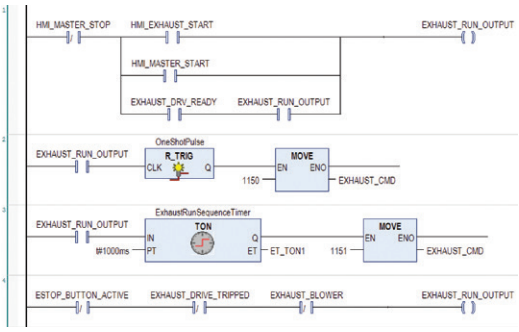
> *Eurotherm PID control in a PLC with recording – it's game changing!*
>
> **OEM engineer**

E **Eurotherm** function block libraries + **PLC** An integrated IEC 61131-3 **PLC** environment

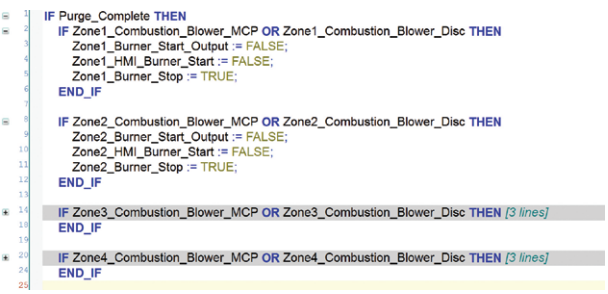
Sequential function chart



Ladder diagram



Structured text



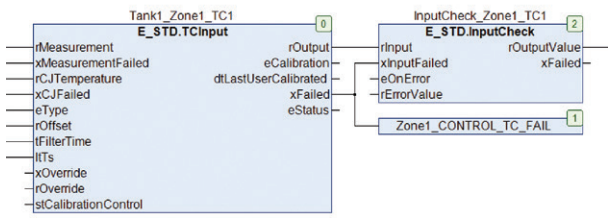
```
IF Purge_Complete THEN
  IF Zone1_Combustion_Blower_MCP OR Zone1_Combustion_Blower_Disc THEN
    Zone1_Burner_Start_Output := FALSE;
    Zone1_HMI_Burner_Start := FALSE;
    Zone1_Burner_Stop := TRUE;
  END_IF

  IF Zone2_Combustion_Blower_MCP OR Zone2_Combustion_Blower_Disc THEN
    Zone2_Burner_Start_Output := FALSE;
    Zone2_HMI_Burner_Start := FALSE;
    Zone2_Burner_Stop := TRUE;
  END_IF

  IF Zone3_Combustion_Blower_MCP OR Zone3_Combustion_Blower_Disc THEN [3 lines]
  END_IF

  IF Zone4_Combustion_Blower_MCP OR Zone4_Combustion_Blower_Disc THEN [3 lines]
  END_IF
```

Continuous function chart



Optimizing efficiency and regulatory compliance

An open PLC designed to offer control and recording… easily

The E+PLC solution is an open standards based PLC platform combined with decades of knowledge in precision PID control and tamper-resistant recording, packaged in easy to use function blocks and libraries for fast implementation.

- Standard CODESYS® platform
- No learning curve – standard IEC 61131-3 programming
- Eurotherm highly respected PID control and tamper-resistant recording built in

Accurate measurement enables better process performance

- Aids control precision for process stability
- Enables consistent repeatability

Precision control and setpoint programmer both enable efficiency optimization

- Reduce processing time
- Contribute to energy saving and cost reduction
- Minimize process waste

Tamper-resistant recording aids compliance to industrial regulations and quality standards

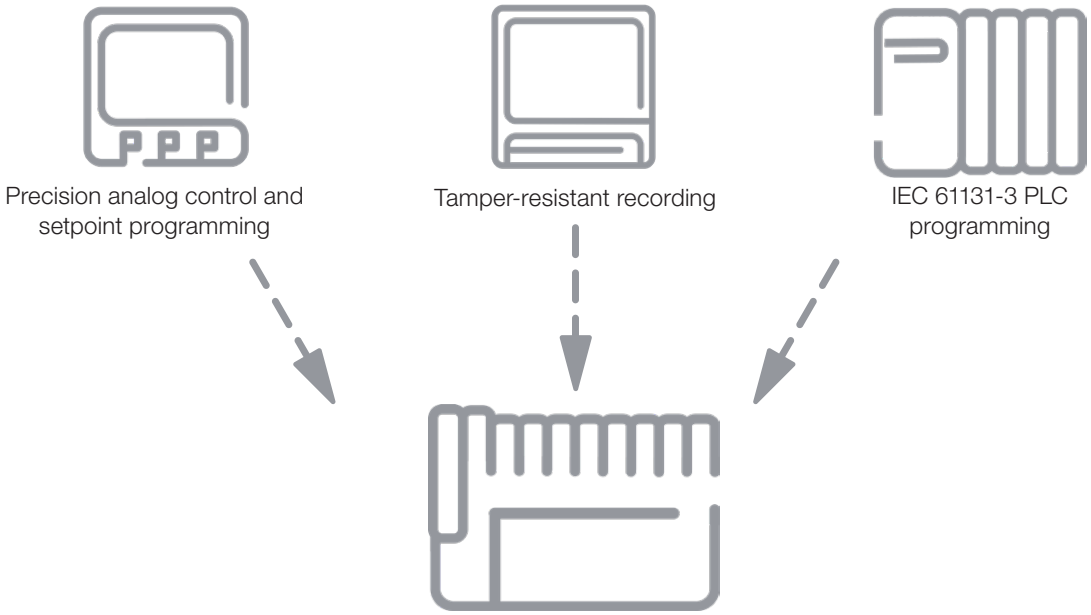
- Data recorded inside the PLC; minimizes the risk of data loss
- Backward compatible file formats for long term archiving and retrieval
- Flexible data management strategies including batch functionality

A PLC designed to offer faster integration

- Reduces product selection time
- Minimizes engineering time
- Reduces equipment and wiring costs
- Provides connectivity features for fast integration with other products

Available as a product or fully engineered system

- Knowledgeable engineering teams for application specific support
- Expertise in machine and process control within general and regulated industries
- Project design, installation and after sales services



E+PLC400 Combination Programmable Logic Controller

CODESYS platform features

The E+PLC solution takes advantage of CODESYS, a leading platform which provides a proven, efficient engineering tool. Control and visualization are built within the single integrated development environment (IDE), reducing the time and cost of implementing a system.

Engineers have the flexibility to develop sophisticated strategies and corresponding HMI functionality, with seamless integration between the two. Advanced Eurotherm algorithms can be readily selected from a library of easily applied function blocks. The resulting solution provides a standard, open platform for application development.

Enhanced visualization for custom views of the process

For ease of use and faster setup, the fully integrated CODESYS Visualization tool offers a modular facility to create enhanced views of the plant.

- Visualization editor with inbuilt graphical elements
- Easy creation of styles for custom look and feel
- Bespoke visualization libraries for application re-use
- Modern HMI techniques for enhanced views of simulation, operation and monitoring of the plant

Keeping up with the latest technology

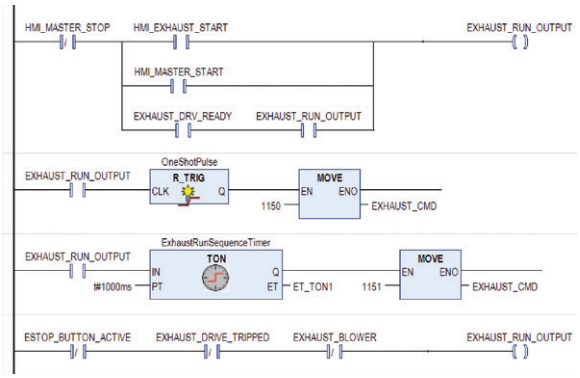
The CODESYS open platform approach facilitates a knowledge sharing culture with numerous support forums

- Continuous maintenance and development of new technologies
- Developed through years of specialist industry knowledge
- Involved in committees that contribute to the international IEC 61131-3 standard

CODESYS

www.codesys.com

Ladder diagram implementation



Flexible programming on an open PLC platform

IEC 61131-3 Programming Languages Supported:

- Continuous Function Chart (CFC)
- Ladder Diagram (LD)
- Sequential Function Chart (SFC)
- Function Block Diagram (FBD)
- Structured Text (ST)
- Instruction List (IL)

Easy engineering, faster commissioning:

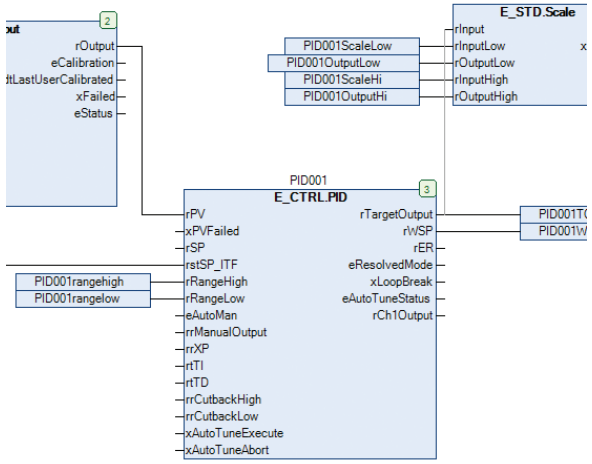
- Comprehensive inbuilt CODESYS libraries of function blocks
- Unique Eurotherm libraries containing function blocks such as precision PID, autotune, setpoint programming, batch recording and archiving
- Custom and 3rd party library support
- Users can define bespoke function blocks and visualization elements for simplified duplication throughout the application, or for reuse across multiple applications.
- Supports a wide range of data types from booleans to 64 bit reals, including the ability for the user to define their own data structures.

Preservation of intellectual property

- Application programs are compiled in an encrypted format to mitigate the risk of reverse engineering.

> *The flexibility of programming in CODESYS integrated development environment in combination with the precision control and maths functionality made E+PLC the most convenient solution.*
>
> **OEM Engineer**

CFC Implementation with Eurotherm function blocks



User management

Access rights for individual users or user groups can be conveniently managed from within the IDE. For example, it could be configured so that only a supervisor is able to change controller settings.

Login functionality, password management and user management are available at runtime via the HMI. Password controlled access helps prevent unauthorized use.

Recipe manager

Recipes are available for setting and watching control parameters. These can be saved, loaded and executed via visualization elements, and edited at runtime from within the CODESYS IDE. They can also be combined with the Eurotherm batch data management function blocks to enable batch processing.

Integrated alarm management

Alarms can be based on input signals or other PLC variables, and their conditions displayed on the HMI for acknowledgement by the user. Alarms can be grouped if required, and events can be triggered and processed from within any of the programming languages.

Triggered alarms can be recorded within Eurotherm UHH data files for historical purposes. This can be achieved utilizing function blocks in the Eurotherm data recording library.

Multiple controllers within a single project

CODESYS single engineering and visualization environment allows simple reuse of base code, enabling multiple E+PLC controllers to be combined into a single CODESYS project, or the screens of one project to be displayed on several different HMI devices.

Program portability

CODESYS elements can be imported and exported between projects. The capability to import or export XML files in PLCopen format is also supported, allowing transfer of code to and from any PLC that supports this open standard.

Debugging support

The CODESYS debugging tool provides a number of useful features for validating applications, as well as real time access to running programs from the engineering environment:

- Display of application data at runtime from within E+PLC
- Reading, writing, and forced setting of variable values, from within editors or watch lists
- Setting of conditional and absolute breakpoints, and subsequent code execution in single steps or complete cycles
- Display of application data from a simulation ‘SoftPLC’ enables debugging without hardware

> *I’ve been waiting for this combined functionality for a long time. There are many out of date PLC based systems in the field that require precision PID control. We can now replace these with E+PLC400 combination PLCs.*
>
> **System Integrator Engineer**

Accurate measurement in a PLC

To control precisely you need to measure accurately. Unlike traditional PLCs, E+PLC analog input and output modules offer similar accuracy specifications to our highly respected Eurotherm discrete controller and PAC ranges.

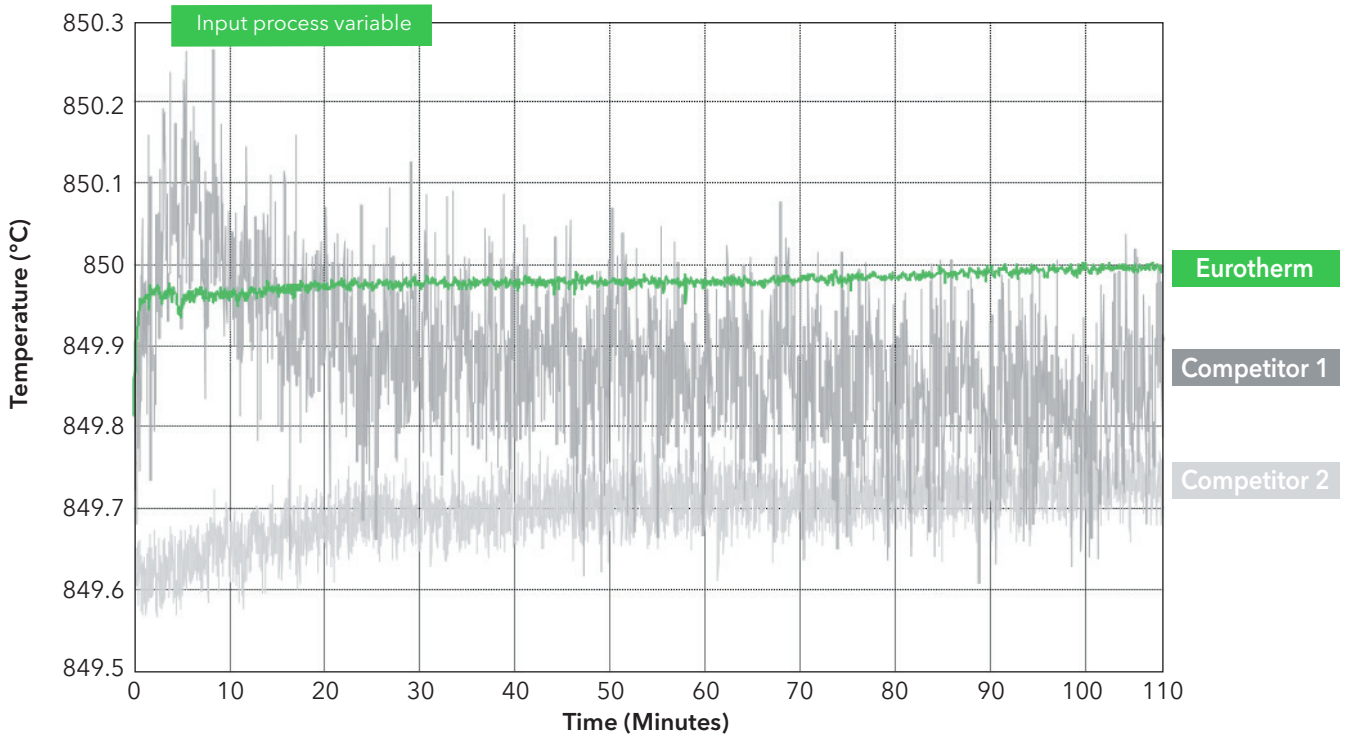
Designed to withstand the challenging conditions of heavy industrial environments, accurate I/O helps to minimize control oscillations and enable tighter control to setpoints within tolerance. The result is high stability repeatable control that aids process optimization and regulatory compliance.

- Measurements accurate to 0.1% of span
- High rejection to industrial electrical noise
- Fast acting cold junction temperature compensation for thermocouples
- Accurate linearization for industry standard thermocouples, resistance thermometers and other sensors
- Accuracy that meets the measurement requirements of Heat Treatment standards AMS2750 and CQI-9

> *Eurotherm group companies are our preferred supplier of discrete control and recording products but in the past we combined these with third party PLCs.*
>
> *We carried out controlled testing to compare the PID control performance of the E+PLC400 product with the discrete controllers. The results were identical, far out performing the standard PID control typically available in traditional PLCs. The E+PLC400 combination PLC is now our preferred solution.*
>
> **System Integration Engineer**

Eurotherm standard library function blocks include:

- ✓ Scaling, linearization, error handling, filtering calibration and override features for mA, RTD, TC and Voltage inputs
- ✓ Signal conditioning, including low pass filtering, sample time generation and input health monitoring



Accurate, low noise inputs contribute to control precision and repeatability of the process. Particularly important in advanced manufacturing processes and regulated industries.

Auto-tuning PID control in a PLC

Unique Eurotherm auto-tuning PID algorithms are contained within the E+PLC solution in the form of easy to use function blocks. Designed to provide similar precision control performance to Eurotherm discrete controller and PAC products, they offer improved process performance and higher quality results in an all in one solution.

Improved process performance helps to:

- Optimize processing time
- Minimize energy usage
- Produce high quality products in accordance to regulatory requirements
- Maximize overall equipment effectiveness (OEE)

Precision control for specialist industries

Cutback and overshoot suppression features enable process variables to ramp to required setpoints quickly, within tight tolerances, improving the stability and repeatability of processes.

An effective autotune algorithm minimizes commissioning and loop setup time.

Eurotherm libraries also contain specialized function blocks that simplify control in industries such as Heat Treatment and Life Sciences.

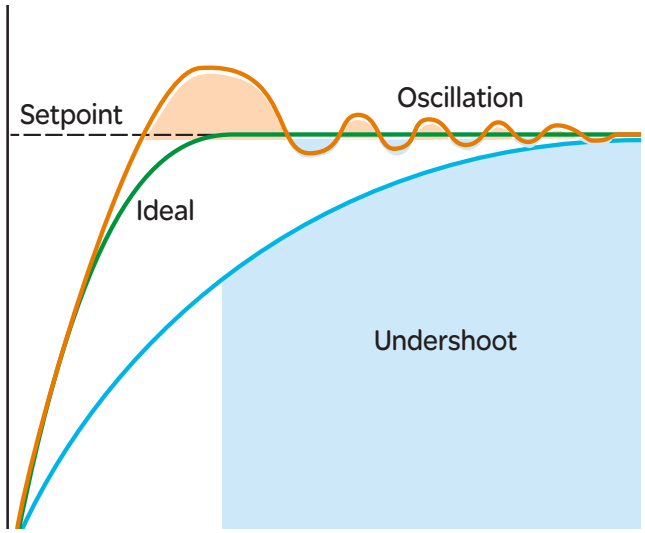
Advanced control with reduced engineering

Eurotherm pre-engineered control function blocks and visualization elements are readily available from Eurotherm libraries within CODESYS integrated development environment. Users need to simply parameterize the blocks and implement them as many times as required.

Comprehensive maths string processing (ASCII & Unicode) functionality is also available from within CODESYS libraries.

Operating over temperature results in:

- Wasted energy
- Over-heated product
- Possible scrap



Operating under temperature results in:

- Wasted time
- Wasted energy
- Slower throughput
- Possible non-conformance and re-processing

Eurotherm control library function blocks include:

- ✓ Single, dual channel and full sets of On/Off, PID and VPU (valve positioning, unbounded) control
- ✓ Autotune – tune sets and variables for control function blocks
- ✓ Gain Scheduling – six extra PID sets which can be tuned to reach different setpoints
- ✓ Setpoint Generator – for simple control of multiple parameters
- ✓ PID Visualization Faceplate – shows process variable and setpoint values alongside output, represented as a 0-100% horizontal bar graph
- ✓ I/O includes time proportioning output (TPO)

Easy setpoint programming in a PLC

Reduces programming time and helps to optimize the process

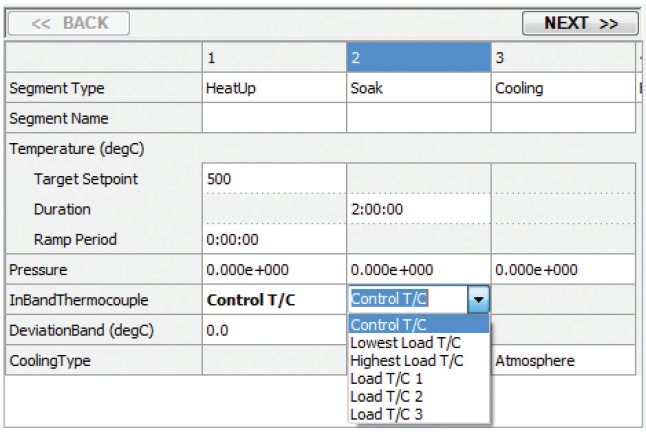
An easy to use flexible setpoint programmer is included within the E+PLC solution providing straightforward configuration that greatly reduces engineering time compared to traditional PLCs. The setpoint programmer closely integrates with Eurotherm PID control to help maintain the setpoint within tight tolerances. Programmed segments can be configured in conjunction with other events, and the different programs can be selected using a recipe function.

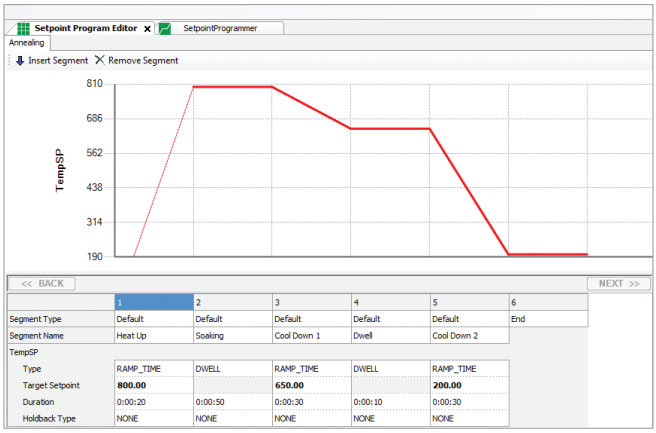
Efficient engineering

- Simple spreadsheet style data entry with drop-down lists
- Programmers can be designed for specific applications
- OEM, system integrator and end customer intellectual property can be embedded in the programmer
- Unlimited segments, setpoints and events (dependent on available application memory only)

Improved process efficiency reduces costs and produces high quality results

- Precise performance against required thermal profile with minimal overshoot during ramps
- Rapid control response
- Holdback function offers ‘Guaranteed Thermal Soak’ time
- Multiple setpoint programs to suit a range of production requirements
- Running programs can be edited
- Inbuilt recovery routines in case of electrical power supply interruption





Visual representation of setpoint changes

Eurotherm setpoint programmer library function blocks include:

- ✓ Programming of multiple channels in segments plus loading and execution of programs
- ✓ Visualization – graphical setpoint program editor element, for loading editing and running programs

Setpoint program editor

- Segment Type is customizable for the use of process relevant terminology
- Segment Name is customizable for any duty on the HMI
- Irrelevant parameters are blanked out to simplify setup
- Names can be customized in a drop-down list to suit the application

A PLC with Integrated visualization

Creating views on to the process

The E+PLC solution provides embedded visualization, which enables dynamic diagnostics of application programs together with concurrent development of the final process. Contained within a single programming environment, process displays are easily created for use where and when you need them. The same process displays are also available in HTML5 format for use on panel HMIs.

- Efficient engineering in a single programming environment with automatic tag browsing
- Dynamic program diagnostics
- Extensive, configurable graphics libraries
- Connect up to two operator panels to an E+PLC400 controller
- HTML5 web server for remote access from mobile devices such as tablets and smartphones

Visualization elements in Eurotherm libraries include:

- Setpoint Program Editor and Profiler
- PID Faceplate
- Runtime Display Data with Historical Trend
- Steel Specification Faceplate, Carbon Diffusion Profiler and Carbon Diffusion Faceplate, for heat treatment applications
- Vacuum Faceplate
- Keyboard Library with keypads and data entry dialogs

Remote operator panels – integrated with the process

Any touch screen operator interface panels which support https communication can be used for local or remote monitoring and operation of the process. Custom libraries allow OEMs, system integrators and end customers to create branded applications utilizing their own IP.

- Powerful graphics capability
- Easy creation of operator friendly interfaces from built in visualization elements and libraries
- Custom libraries for OEM branding

> *The visualization libraries in CODESYS IDE gave us the customization we needed to create our own screens and promote our brand.*
>
> **OEM Engineer**

Tamper-resistant recording in a PLC

Compliance with regulatory and quality standards

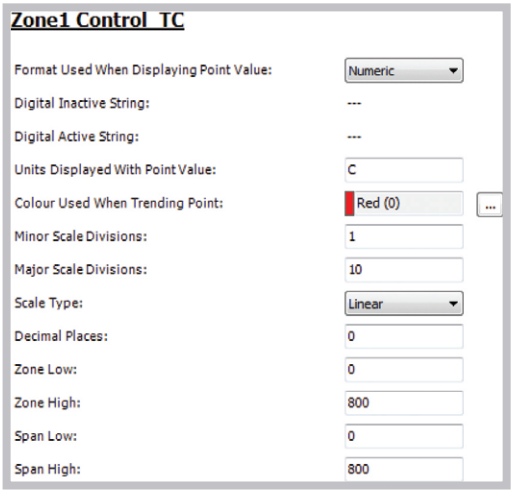
Regulated industries typically require data recording formats that are resistant to tampering, and available for quality control and auditing at a later date. The E+PLC solution utilizes several data management strategies that aid data integrity and file security.

Smart efficient data management

Data files are stored in Eurotherm proprietary tamper-resistant file format (UHH), a better alternative compared to commonly used editable .CSV files. Process data such as operator logins, messages, alarms and other events can also be recorded for traceability.

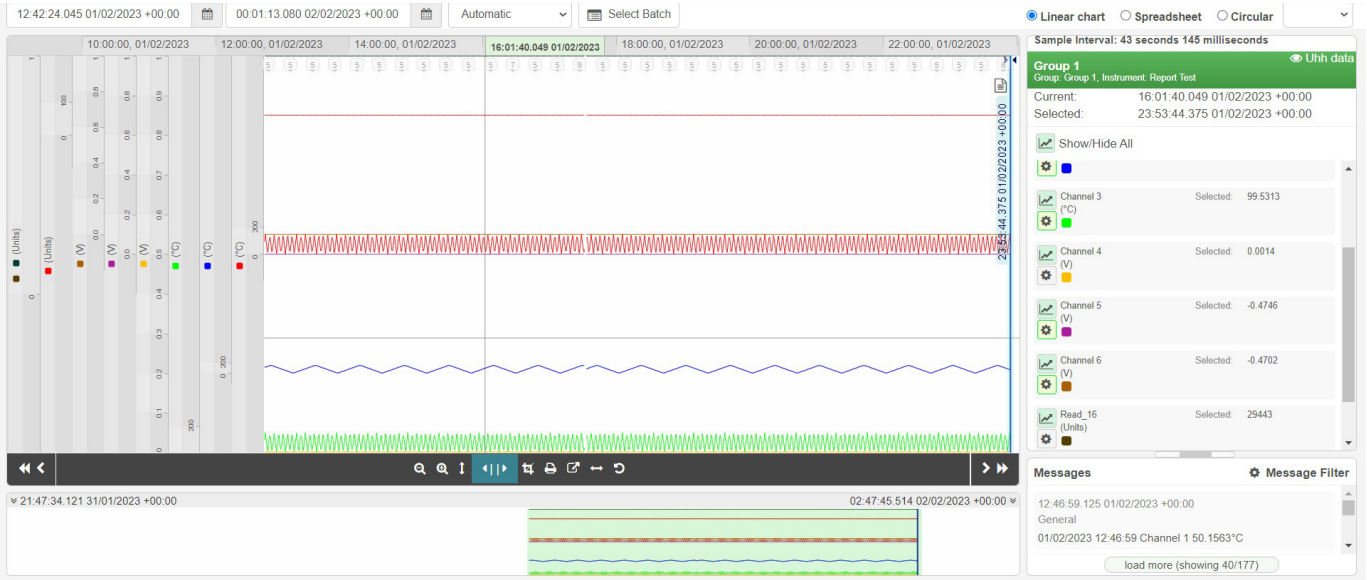
- Integrated recording functionality easily configurable in the CODESYS IDE
- Data is recorded within a dedicated high availability file system on the E+PLC, reducing dependence upon communications to a historian on a remote server
- Data archiving is automatically restarted when communications are available
- Tamper-resistant backward compatible file format
- 'Highly Reliable File System' (HRFS) helps to prevent possible loss or corruption of data due to power interruptions
- Traceability of 'what happened' in the process, and 'when'

Intuitive channel configuration



Eurotherm data recording library function blocks include:

- ✓ Recording of operator and auditor messages, operator login/logout, group alarm notification
- ✓ Memory capacity, duration and status information
- ✓ Setup of archiving via FTP and USB
- ✓ Visualization element – display of runtime and historical data, configurable via an intuitive interface



Recorded data can be retrieved from history files at any time using Eurotherm Data Reviewer for analysis or reporting purposes.

Batch data management in a PLC

Searching for batch data in paper records can be time consuming. With the E+PLC solution, process and metadata associated with a batch can be captured using easily configurable function blocks in the Eurotherm library. Just search by batch code in Eurotherm Data Reviewer software for quick retrieval of the data.

- Efficient handling of batch data with intuitive search facility
- Simple traceability of operator actions in the batch
- Batch recording automatically recovers after power interruptions
- Compatible with ISA S88 batch control standard

Eurotherm batch manager function blocks include:

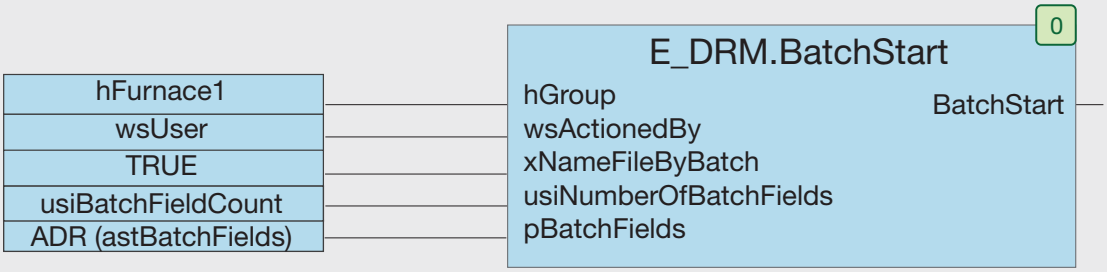
✓ Recording of batch start/stop time and operator names

✓ Custom metadata such as product IDs, customer information and unique batch identifiers

> *We really like the flexibility of the visualization. We can overlay the trend traces to compare the process to the programmed temperature profile, and record it all to review at a later date if we need to.*
>
> **System Integration Engineer**

The batch function can be called from the data recording management library by command buttons or sequences, to record relevant messages into tamper-resistant history files. For example, the status of equipment can be logged to provide end-of-batch information, such as the energy used a by a connected EPack™ compact SCR power controller.

Batch start and stop records can be triggered from any language (FBD, LD, ST etc.) in any work flow and can easily be added to the tamper-resistant recorded history files. The application designer can configure all recorded parameters such as batch field names, to provide an application specific solution.



> *The impact of having recording built into the E+PLC is valuable to us because it offers our customer a more economical data acquisition solution.*
>
> **System Integration Engineer**

Open connectivity to wider systems and Industry 4.0 technologies

Flexible communications designed for easy integration

User data can be exchanged to/from external devices using XML or CSV format. E+PLC products support Modbus communication to enable connection to other instruments and controllers.

- Easy connection of Eurotherm products including controllers, recorders, drives and power controllers
- Modbus library function blocks for quick set up of Eurotherm EPower™ and EPack™ power controllers, Mini8® loop controllers and 3200i indicators

Straightforward integration into wider DCS/SCADA solutions

In addition to Modbus, OPC Server for Windows PC included in CODESYS allows exchange of data from within the E+PLC solution and 3rd party devices, for example HMIs or process data logging programs.

- Includes OPC server, a server configurator, and a logger for debugging
- Simple symbol based configuration linked to E+PLC application variables

Ethernet based protocols enable integration into IIoT/Industry 4.0 technologies and 3rd party devices

- Modbus TCP/IP client/server communications
- Serial Modbus RTU client/server for connection to legacy equipment
- Transfer of process data records via FTP to multiple specified servers
- Inbuilt configurable Webserver allows remote view and control of key parameters through mobile devices
- Open TCP/UDP communications accessible for programmers within applications in the IDE

Multiple E+PLC400 architecture with remote web client and configuration platform

- Multiple E+PLC400 devices can be used for applications where additional precision analog control is required

For more information on architectures - contact your local sales representative www.eurotherm.com/worldwide

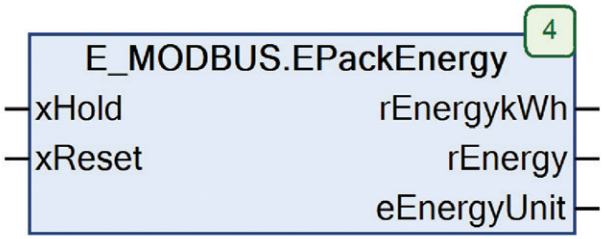
A combined solution for machine control

Easily integrated power control

Eurotherm EPack™ and EPower™ ranges provide advanced strategies that help to minimize energy usage in high energy processes. Modbus TCP communications allow connectivity to the E+PLC network, while inbuilt EPower and EPack address registers selected from the E+PLC Modbus library allow quick and easy integration with the E+PLC platform.

Eurotherm modbus library function blocks include:

- ✓ EPack – for single phase control strategies and alarm status
- ✓ EPower Channel – for single, two-leg 3-phase, and 3-phase control strategies
- ✓ EPower PLM – for Predictive Load Management
- ✓ EPower Alarm Status
- ✓ EPack Energy and EPower Energy – for energy consumption



Eurotherm power controllers Suitable for 1, 2, or 3 phase systems

- QuickStart setup, and advanced configuration using Graphical Wiring Editor
- Advanced firing modes help improve power factor for optimum energy efficiency
- Energy usage data available such as true power, apparent power and power factor for reporting KPIs

EPack compact SCR power controller

EPack compact power controllers

- Compact design ideal for smaller cabinets
- Highly adaptable via flexible software upgrades
- DIN rail and bulkhead mounting
- For applications up to 125A, 500V

EPower advanced power controllers

- Predictive Load Management and load shedding technologies reduce the risk of peak energy fines, by helping to keep the plant within its agreed energy tariff
- Automatic transformer load tap changing strategy for smooth power control with reduced maintenance
- For applications up to 630A, 690V

EPower controller

Watlow Heaters

Watlow's heating solutions are an integral part of the complete thermal systems we provide our customers. Used in some of the most challenging applications, our heating components are accurate, robust and long lasting and many can be configured on-demand to meet your unique requirements.

To view the full range visit eurotherm.com/heaters

- Cartridge/Insertion Heaters
- Circulation Heaters
- Duct Heaters
- Gas Delivery and Exhaust Heaters
- Immersion Heaters
- Specialty Heaters

Engineering services for a lifetime of support

The innovative technology provided in the E+PLC platform is supported throughout its lifecycle by highly professional teams of engineers who understand the challenges faced in modern industry. We will help you every step of the way, from selecting the right product for your application, through professional project management and engineering services, to comprehensive global technical service and support.

Working with Eurotherm, you will be able to access the decades of knowledge and experience we have in process control, recording and automation. Our experienced, professional engineers can help you get the most from your process by assisting with programming, commissioning and helping to keep operations optimized throughout their lifetime. Our service teams will help you to keep your control well tuned, data appropriately archived, sensors correctly calibrated and systems working efficiently.

- Comprehensive, highly professional global service network, including project delivery, calibration, accreditation and training services
- Deep understanding of control, recording and industrial applications
- Experienced in solving complex control problems
- Customizable service level agreements for cost effective support and peace of mind
- Supported by a long standing team of research and development engineers and leading industry domain experts

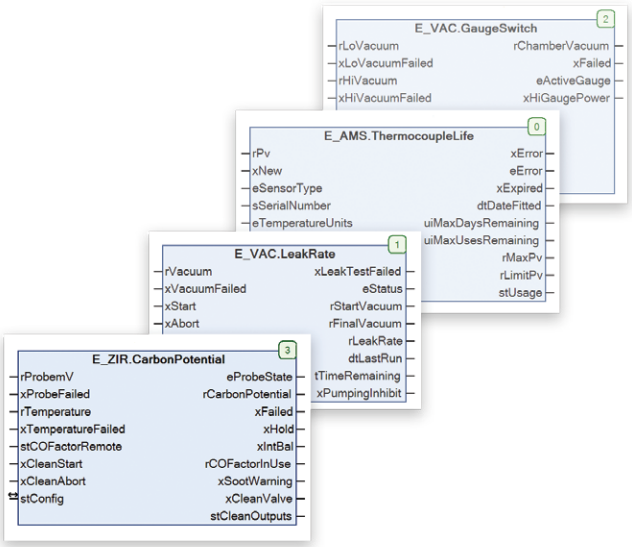
> *The support we received from Eurotherm application engineers enabled us to re-engineer the system in a faster time frame.*
>
> **System Integrator Control Engineer**

Decades of application knowledge in a PLC

The E+PLC solution contains decades of experience and understanding of industrial processes, how to control them well and meet regulatory requirements. Most traditional PLCs have been developed from a sequential control platform. The E+PLC solution is different. It is based on a deep understanding of analog control and data recording, and how these are applied across many industries. In combination with sequential control in CODESYS open platform it offers a 'best of both worlds' solution for machine control applications.

Performance without compromise

- A single, integrated PLC solution with inbuilt advanced control, data management and visualization
- Developed from a deep understanding of precise, analog PID control and the applications in which it is required
- Designed to improve process performance, reduce energy usage and increase profitability
- Rich and versatile functionality to meet the demands of modern advanced processes



Specialized functionality for heat treatment and materials processing

The E+PLC platform contains algorithms specifically designed for Heat Treatment applications. Advanced control and data management provided by the E+PLC solution satisfy the required levels of accuracy and data integrity for this regulated industry, while reducing engineering and operational costs.

Heat Treatment function blocks included in the E+PLC solution

- ✓ Zirconia
- ✓ 3GASIR
- ✓ Carbon Diffusion (online carburizing)
- ✓ Holdback function for 'Guaranteed Soak'
- ✓ Thermocouple Life
- ✓ Vacuum Gauge Switch
- ✓ Vacuum Pump-down Timer
- ✓ Vacuum Input
- ✓ Vacuum Leak Rate – for implementing a leak test
- ✓ Visualization elements including: Steel Specification Faceplate, Carbon Diffusion Profiler and Carbon Diffusion Faceplate, Vacuum Faceplate

The E+PLC solution is suitable for use in Nadcap applications in all furnace classes 1-6, as defined in section 3 of the AMS2750 standard. For more information, see https://www.eurotherm.com/download/nadcap-compliance/

Flexible machine control ideal for:

Automotive | Aerospace | Advanced Materials Processing
Semiconductor | Glass | Fine Chemicals | Plastics
Life Science | Healthcare | Food & Beverage | Water & Waste Water

Industrial furnaces • Ovens • Autoclaves • Climatic Chambers • Annealers • Dryers • Reactors
Sterilizers • Incubators • Boilers • Steam Generators • Disinfection Processes
Industrial Distillation • Extruders • Blow molders • Injection Molders • Melt Pressure Control
Batch Processing • Pilot Plants • Specialist Machines and Test Equipment

To learn more about the Eurotherm E+PLC solution, please visit:

eurotherm.com/eplc

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