EMP-9058-16/EMP-9058-32/EMP-9098-16/
EMP-9098-32/EMP-9258-16/EMP-9258-32

SoftPLC Based EMP-9000 Motion Controller Series

Features

- Embedded Windows IoT with SoftPLC runtime and real-time EtherCAT master
- Supports all IEC-61131-3 SoftPLC languages (FBD, LD, IL, ST, and SFC)
- EtherCAT motion control:
  - PLCopen function blocks for single and multiple axes control
  - Supports all standard CiA402 EtherCAT slave driver
  - Control up to 32-axis with 0.5 ms cycle time
- Communication protocol:
  - EtherCAT
  - Modbus TCP/RTU
  - OPC UA server
- Allows third party software integration via shared memory
- HMI driver for eLogger and Indusoft (AVEVA Edge)
- Programming interfaces for C/C++/C#/LabView
- Coupled Control System
  - Built with a second CPU that supports EtherCAT communication retention technology, this system ensures seamless EtherCAT communication and uninterrupted process recipe, even in the event of an OS system or program crash.

Introduction

EMP-9x58-xx is a SoftPLC based motion controller with a high performance processor, an integrated real-time EtherCAT master and a multi-axis motion kernel. The built-in motion engine together with the EtherCAT master are running on a dedicated processor in a real-time environment to achieve a time-deterministic control of the EtherCAT application. The controller uses EtherCAT as its main communications technology.

EMP-9x58-xx combines a PLC-based motion logic system with a Windows IoT operation system, allowing PLC, motion control and Windows application to run simultaneously without affecting each other. This enables the machine-builders to integrate in house developed or third party Windows software, for instance, HMIs, data gathering and processing applications. Programming interfaces and shared memory communication are provided to allow Windows application to directly and rapidly access the PLC data.

The SoftPLC supports all five programming language defined by the IEC61131-3 standard, provides extensive programming libraries including motion control and fieldbus libraries. The motion control function blocks are designed according to PLCopen (part 1, 2, 4) and CiA402, are easy to use and greatly reduces learning and development time. The controller can handle up to 512 EtherCAT slaves and up to 32 EtherCAT servo/stepper drives. It supports the implementation of both simple and complex motion control, such as single- and multi-axis movements and interpolation.

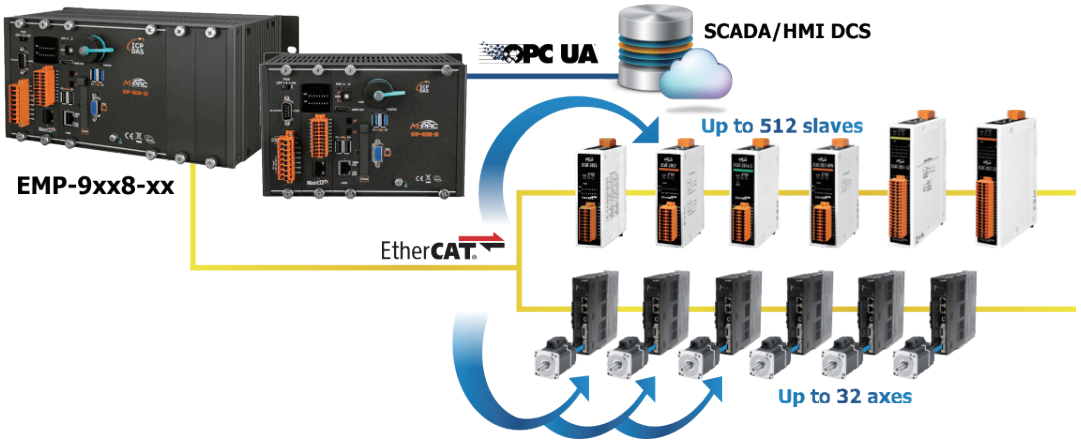
A OPC UA server is part of the PLC runtime and is a secure, open, reliable mechanism for transferring information. OPC UA is used for horizontal communication between machines and vertical communication between the machine and higher-level IT system (SCADA, cloud). All standard OPC UA clients can be directly connected to the motion controller without customization thereby reducing integration or application software development costs.

Equipped with a variety communication interfaces (RS-232/485, Ethernet ports, USB, etc.) the controller makes it easy to integrate peripheral devices such as sensors, machine vision systems, and central computers. In addition expandable communication and IO module are available for ease of customization.

EMP-9x58-xx uses EtherCAT as its main real-time, high speed communication protocol. Beside EtherCAT the Modbus fieldbus (TCP, RTU, ASCII) is an integral part of the SoftPLC which allows the controller to be connected to a Modbus network and act as a Modbus/EtherCAT gateway.

The compact design with robust metal housing saves space in machines and control panels and reduces EMF interference.

Embedded is a software package for configuration, programming and monitoring the multi-axis controller. In addition extensive programming example are provided.



Specification

Model	EMP-9098-16 EMP-9098-32	EMP-9058-16 EMP-9058-32	EMP-9258-16 EMP-9258-32	EMP-9658-16 EMP-9658-32
Software				
OS	Windows 10 IoT Enterprise (64-bit)			
Framework Support	.Net Framework 3.5 ~ 4.8			
Service	IE11, FTP Server, IIS 7.0, ASP (Java Script, VB Script)			
SDK	Dll for VC, Dll for Visual Studio.Net			
Multilanguage Support	English, German, French, Spanish, Portuguese, Russian, Italian,Korean, Japanese, Simplified Chinese, Traditional Chinese			
Main Unit				
CPU	Intel Atom E3950 (1.6 ~ 2.0 GHz, 4C4T)	Intel® Core ™ i5-8365UE Processor (1.6 ~ 4.1 GHz, 4C8T)		
64-bit Hardware Serial Number	Yes			
System Memory	8 GB DDR4 SDRAM	16 GB DDR4 SDRAM		
Non-Volatile Memory	128 KB MRAM, 16 KB EEPROM			
Storage	64 GB SSD, 32 GB CF card			
Real Time Clock	Provide seconds, minutes, hours, dates, day of week, month, year			
Watchdog Timer	Dual Watchdog Timer			
Display				
Signal	VGA, HDMI			
Resolution	VGA 1280 x 1024 ~ 1920 x 1080 (16 : 9), 640 x 480 ~ 1024 x 768 (4 : 3) HDMI 2560 x 1600 @ 24bpp			
LED Indicators				
Status	1 x System, 3 x Programmable			1 x System, 2 x Programmable
COM Ports				
Ports	1 x RS-485 (3000 VDC Isolated), 1x RS-232/RS-485 (3000 VDC Isolated)			
HMI				
Buzzer	Yes			
Rotary Switch	1 x 10 Position (0 ~ 9)			
Audio				
Jack	Microphone-in and Earphone-out			
Ethernet				
Ports	2 x RJ-45 10/100/1000 Base-TX			
USB				
Ports	4 x USB 2.0			
I/O Expansion				
I/O Type	e9K, I-9K, I-97K series			
Slots	-		2	6
Interpolation				
Circular	Any 2- or 3-axis			
Helical	Any 3-axis			
Linear	Any 2- or 32-axis			
Digital Input				
Channels	8			
Type	Wet Contact			
Sink/Source (NPN/PNP)	Sink/Source			
ON Voltage Level	+19V~+24V			
OFF Voltage Level	+11V Max.			
Isolation	3000VDC			

Digital Output				
Channels	8			
Type	Open Collector			
Sink/Source (NPN/PNP)	Sink			
Load Voltage	+24V			
Load Current	1000 mA/ch			
Isolation	3000Vrms			
EtherCAT				
Ports	1 x RJ-45			
No. of Axes	Max. 16 Max. 32	Max. 16 Max. 32	Max. 16 Max. 32	Max. 16 Max. 32
No. of Nodes	Max. 512			
Data Transfer Medium	Ethernet Cable (Min. CAT 5e), Shielded			
Power				
Input Range	+10 ~ 30 VDC (1 kV Isolated)			
Redundant Power Inputs	Yes			
Consumption	18.5 W			
Mechanical				
Dimensions (mm)	239 x 164 x 133(W x L x H)		300 x 164 x 133 (WxLxH)	422 x 164 x 133 (WxLxH)
Installation	DIN-Rail, Wall mounting			
Environment				
Humidity	10 ~ 90 % RH, Non-condensing			
Operating Temperature	-25 ~ +60 ° C			
Storage Temperature	-30 ~ +80 ° C			

Appications

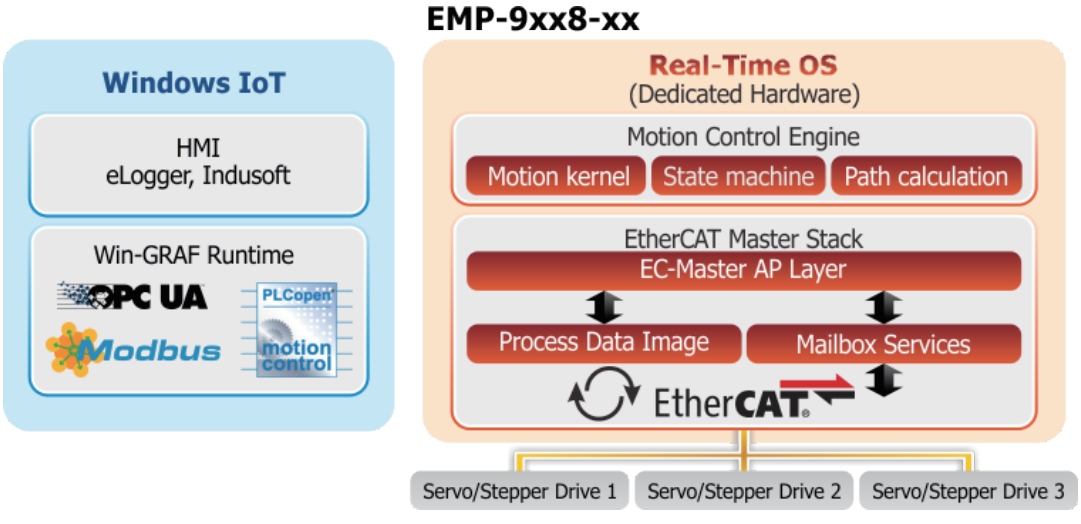
Superior Computing Power:

•The high speed processor enables the EMP-9x58-xx to simultaneously process PLC, motion control, OPC UA server, HMI, and gateway operations required in industrial applications.

Processor:

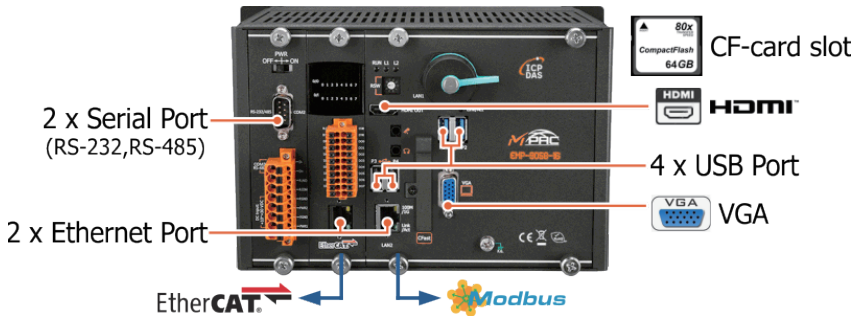
- Intel® Core™ i5 (4.1 GHz)
- Intel Atom® x7 (2.0 GHz)

- The EtherCAT communication and motion control are being processed by a dedicates processor.



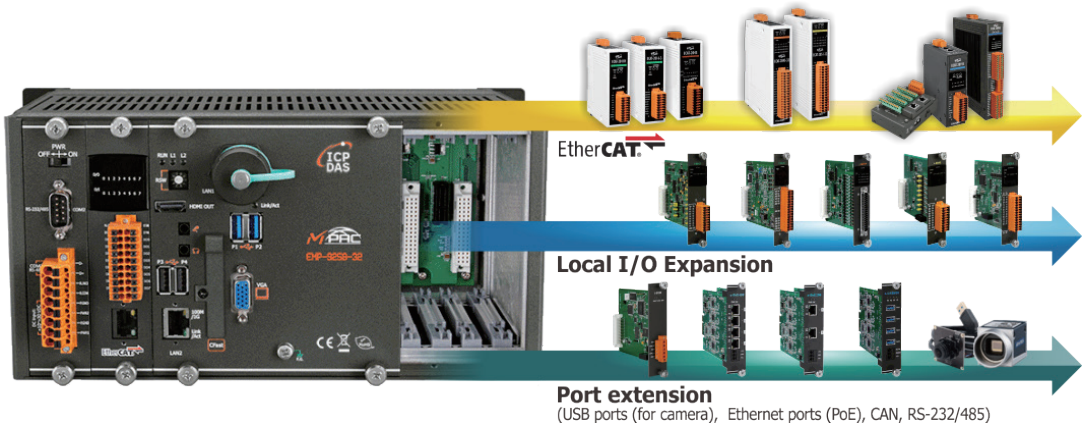
Extensive Interfaces for Periphery Devices:

- Four USB ports
- Two Ethernet ports
- Two serial ports (RS-232, RS-485)
- Monitor ports: HDMI and VGA ports



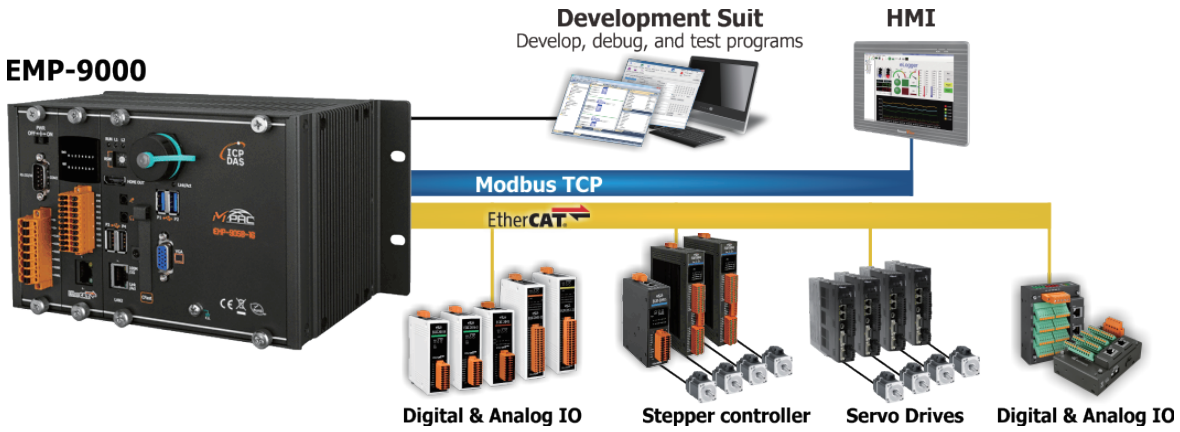
Flexibility and Expandability:

- **EtherCAT slaves:** ICPDAS offers a broad range of EtherCAT slaves from simple IO, stepper control, gateways and junctions.
- **Local IO:** Slots are provided to extend the local IO and communication ports. ICPDAS provides a wide variety of I/O plug-in modules, including DI/O, AI/O, thermal measurement, and communication modules for the EMP-9x58-xx.
- **Communication interfaces:** Serial ports (RS232, RS485), Ethernet ports and USB are expandable via the plug-in modules
- **Memory:** Memory can be increased by plugging a memory card in the CF card slot



EtherCAT:

- Deterministic and fast cycle time (0.5ms)
- Process Data (PDO) communication: DC and free-run mode
- Mailbox communication: CAN over EtherCAT (CoE); utilizing the well known CANopen protocol
- The EtherCAT master recognizes any standard EtherCAT slave (ICP DAS and 3rd party slave systems).



Software Package for Easy Development

The software package provides all the function necessary to setup and design a motion control system.

- Logic programming
- EtherCAT network configuration
- Motion control and configuration
- Visualization Interfaces
- Simulation

EtherCAT Utility:

ICP DAS developed in house a EtherCAT configuration utility to conveniently setup the EtherCAT network in a short period of time without requiring detailed knowledge of the EtherCAT protocol. It minimizes configuration and maintenance burdens on system developers and users.

Key features:

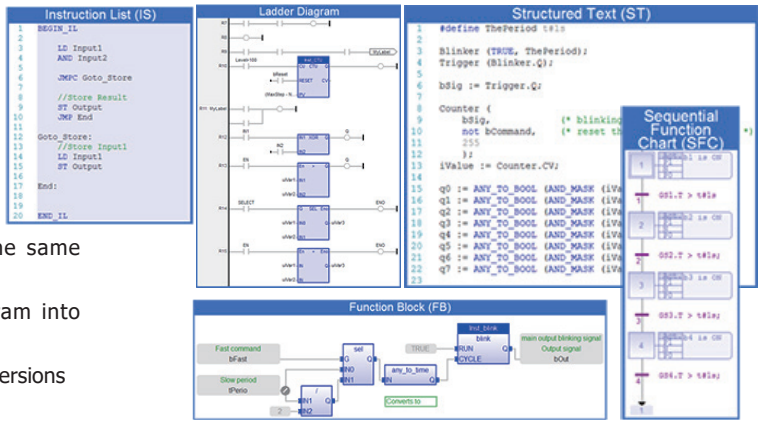
- Detect any slave in the EtherCAT network (ICP DAS and 3rd party)
- Scans the network and automatically create a network information file (ENI). The ENI file describes the network setup such as the address, configuration and process data mapping of each slave.
- Assists in motion control configuration
- Supports single and multi-axis motion simulation and testing. Servo/Stepper drives and I/O points can be directly controlled via the utility.
- Allows complete EtherCAT motion and I/O configuration and function evaluation

Logic Programming:

Win-GRAF workbench is a programming software from ICP DAS developed according to the international standard IEC 61131 and aimed at achieving compatibility and reusability.

Features:

- Conforming to the five programming languages as define by the IEC 61131-3 standard
  - SFC (Sequential Function Chart)
  - ST (Structured Text)
  - FBD (Function Block Diagram)
  - LD (Ladder Diagram)
  - IL (Instruction List)
- Several programming languages can be used in the same application project
- Includes functions for converting an existing program into another programming language
- Supports project comparison for comparing two project versions
- Multitasking programming with priority settings
- Extensive libraries significantly simplifying PLC applications
- Supports creation of user libraries
- Integrated fieldbus support
- Comprehensive online help



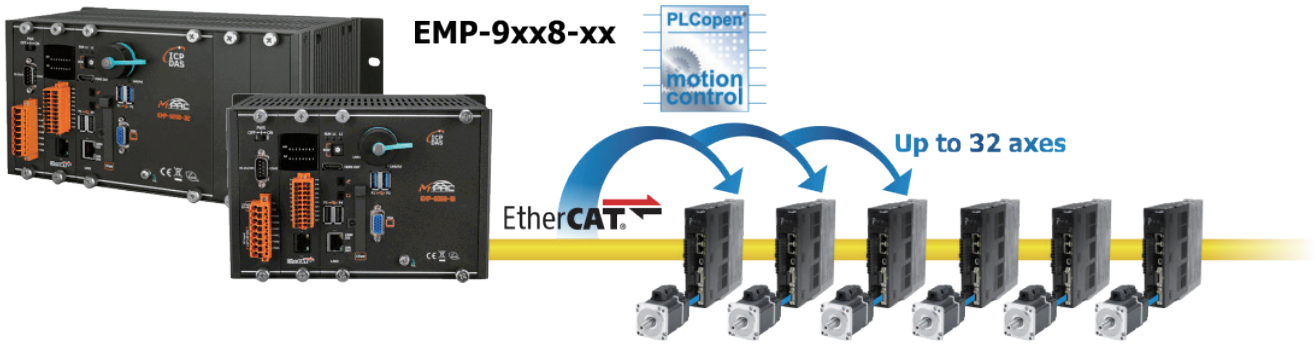
Workbench Tools (Advanced debugging and monitoring tools):

Simulation and diagnostic tools are included for application development and testing:

- Configuration, programming, debugging and diagnostic tools to assist you throughout the development of your projects.
- **PLC application variables monitoring:**
  - The current values are shown in the workbench next to the variables in the programming and variable editor in real time.
  - Watch window for monitoring variable values and task status. Spy window monitors variable (structures, function blocks) values and selected I/Os.
  - Variable visualization in a time graph (soft-scope, dashboards). For example software oscilloscope provides tuning and diagnostics capabilities by displaying the values of one or more variables over time.
- Online Debugging Tools: Breakpoints, step by step debugging and recipe control
- Cycle time optimization: A task may run several programs. The workbench allows you to set the execution order, the period and phase of each program.
- Control Panel: Graphic objects are available for creating a simple graphic user interface for testing and simulation purpose.
- Network tools for setting up the Modbus master/slave and OPC UA server.
- Local I/O tool: Configuration and variable mapping of the digital and analog I/O slot module.
- HMI integration: Programming interfaces for the HMI software eLogger and Indusoft

Motion Control:

- Supports all EtherCAT slaves with a CiA402 Drive Profile
- Time deterministic motion control: EtherCAT cycle time of 0.5 ms
- Up to 32 axes

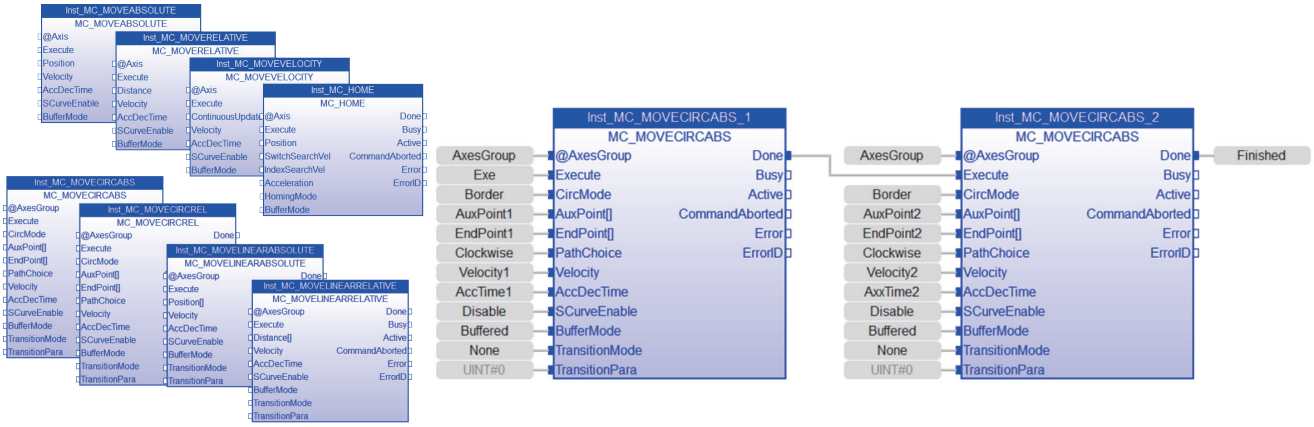


- Complete integration of motion and logic sequence
- Motion functions (command types):
  - Standard PLCopen Function Blocks as defined in the technical specification (part 1, part 2 and part 4) plus ICPDAS generated motion Function Blocks
  - Single axis motion control: point-to-point
  - Interpolation motion control: Controls max 32 axes synchronously
  - Linear and circular interpolation
  - Virtual axes programming
- Supported CiA402 Drive Profiles
  - Profile velocity (PV)
  - Profile position (PP)
  - Homing (HM)
  - Cyclic synchronous velocity (CSV)
  - Cyclic synchronous position (CSP)
- The EtherCAT motion control solution has been verified for interoperability with a variety of 3rd party EtherCAT servo and stepper drives conforming to the CiA402 specification.

Company	Driver	Motor Type
Delta	ASDA A2-E series	AC servo motor
Hiwin	D2 series	AC servo motor
Moons'	STF/RS series	Two-phase stepper motor
Mitsubishi	MR-JET	AC servo motor
Oriental Motor	AZ series multi-axis	Closed loop stepper motor
Panasonic	A5B/A6B series	AC servo motor
Shilin	SDP series	AC servo motor
Sanyo Denki	R series	AC servo motor
Teco	JSDG2/JSDG2S	AC servo motor
Yaskawa	Sigma 7 series	AC servo motor

PLCopen:

Motion commands as defined by PLCopen (part 1, part 2 and part 4). The advantages of using PLCopen for motion applications are that the function blocks are standardized and therefore hardware independent. This reduces the development time and cost by allowing PLCopen application to be ported to a new platform with only minor changes.



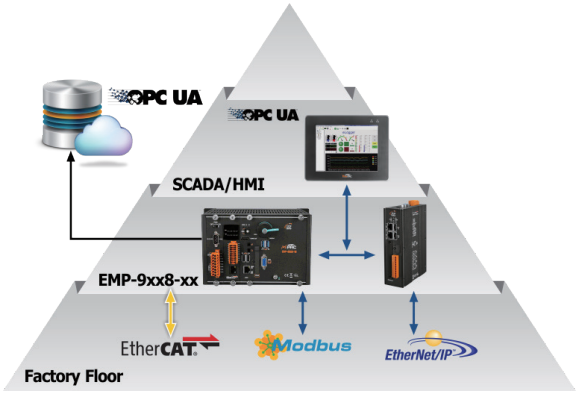
Overview of supported PLCopen function blocks:

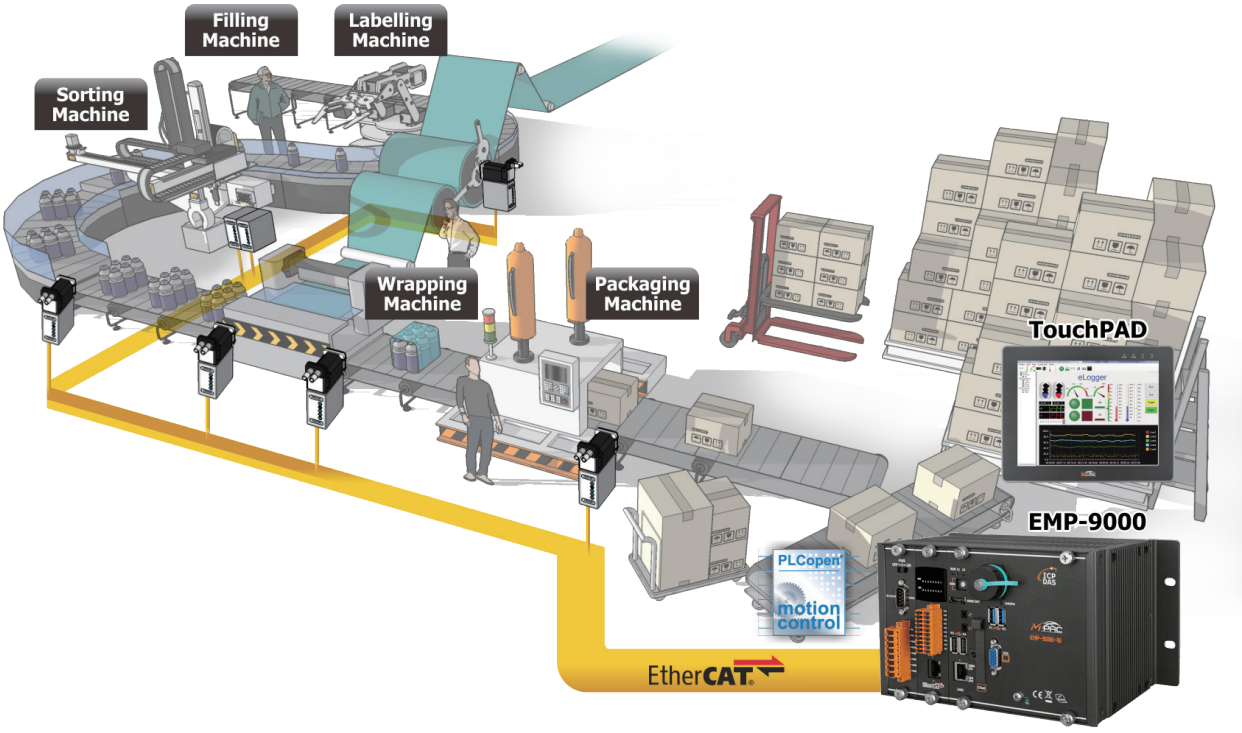
Administrative		Motion	
Single Axis	**Multi-Axis**	**Single Axis**	**Multi-Axis**
MC_Power	MC_AddAxisToGroup	MC_Home	MC_MoveLinearAbsolute
MC_SetPosition	MC_RemoveAxisFromGroup	MC_Stop	MC_MoveLinearRelative
MC_ReadParameter	MC_UngroupAllAxes	MCV_Halt	MC_MoveCircularAbsolute
MC_ReadBoolParameter	MC_GroupReadActualPosition	MC_MoveAbsolute	MC_MoveCircularRelative
MC_WriteParameter	MC_GroupReadActualVelocity	MC_MoveRelative	MCV_GroupMoveIncPath
MC_WriteBoolParameter	MC_GroupStop	MC_MoveVelocity	
MC_ReadDigitalInput	MCV_GroupHalt		
MC_ReadDigitalOutput	MC_GroupInterrupt		
MC_WriteDigitalOutput	MC_GroupContinue		
MC_ReadActualPosition	MC_GroupReadStatus		
MC_ReadActualVelocity	MC_GroupReadError		
MC_ReadStatus	MC_GroupReset		
MC_ReadMotionState			
MC_ReadAxisInfo			
MC_ReadAxisError			
MC_Reset			

Supported PLCopen function blocks

Fieldbus Protocols

- Modbus
  - Master (TCP, RTU, ASCII)
  - Slave: Multi-port Modbus TCP, RTU
- EtherCAT
  - Real-time EtherCAT: DC cycle time 0.5 ms
  - Up to 512 slaves
- OPC UA Server
  - Support certificate and encryption
  - Authentication Methods: Username & password, certificate
  - OPC UA server ensures confidentiality of communication by authenticating clients and user via software certificate exchange



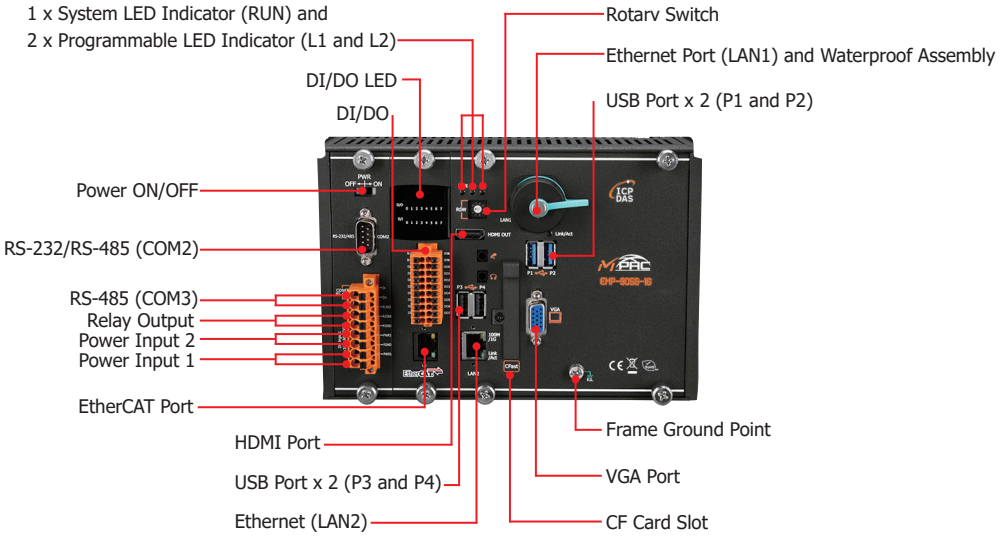


Automation control application

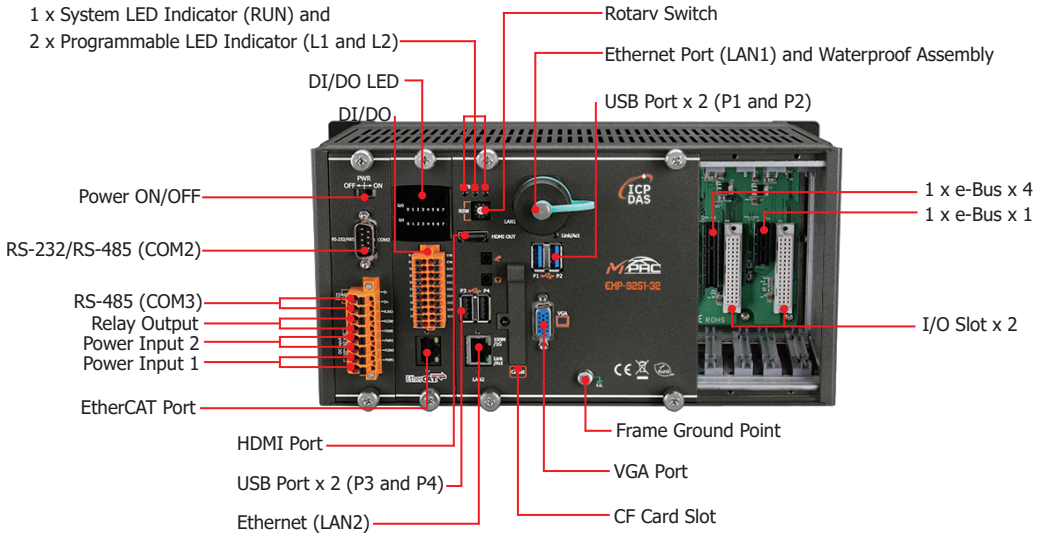
- **Component pick & place**
  - Transfer and stacking device
  - Gantry style pick-and-place
  - Automatically pick up, place, measure and sort components
- **Conveyor system**
  - Positioning of work pieces on the conveyor
  - Carrying and transferring equipment
  - Product inspection
  - In-line palletizer
  - Label machine
- **Warehousing**
  - Automated storage and retrieval systems
  - Automatically store and retrieve pallets from a storage cabinet
- Part assembly system
  1. Precision spot welding machine
  2. Sealing, gluing, bonding application
     - Adding glue to surfaces to join parts
     - Sealing: Spreading sealant to mating faces of parts
     - Dispenser: Spreading adhesive agent
- Cutting, grinding and pressing applications
- Manufacture of semi conductors
  1. IC inspections
  2. IC Chip mounting and assembly
     - Pick components up and place them onto the printed circuit board
  3. Camera inspection:
     - Checking with moving camera
     - Multi point check with a camera.

Appearance

EMP-90XX

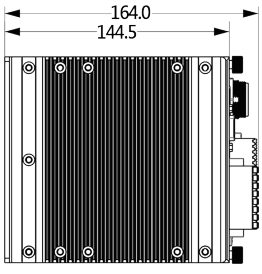


EMP-92XX



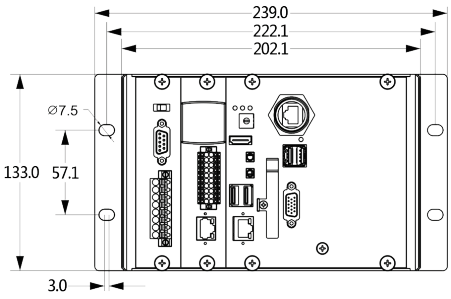
Dimensions (Units: mm)

EMP-9000



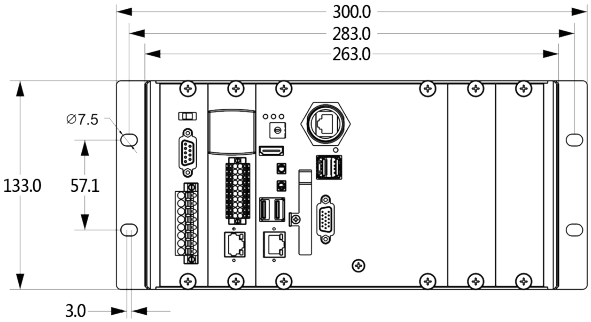
Left Side View

EMP-90XX



Front View

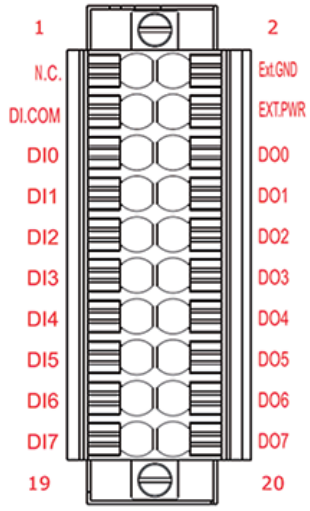
EMP-92XX



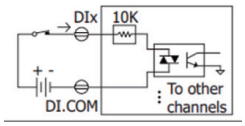
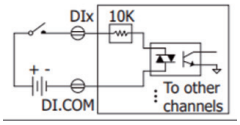
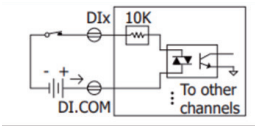
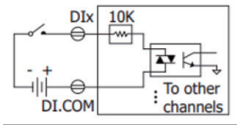
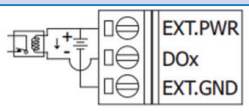
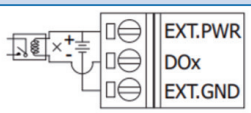
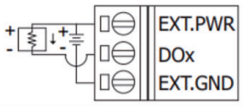
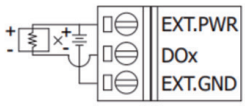
Front View

Pin Assignments

EMP-9000



Wire Connections

Digital Input	Readback as 1	Readback as 0
	+19 ~ +24 V_{DC}	OPEN or < 11 V_{DC}
Sink		
Source		
Digital Output	**ON State Readback as 1**	**OFF State Readback as 0**
Driver Relay		
Resistance Load		

Ordering Information

EMP-9058-16 CR	16 axes Win-GRAF Motion Controller with i5-8365UE CPU and without a slot (RoHS)
EMP-9058-32 CR	32 axes Win-GRAF Motion Controller with i5-8365UE CPU and without a slot (RoHS)
EMP-9098-16 CR	16 axes Win-GRAF Motion Controller with E3950 CPU and without a slot (RoHS)
EMP-9098-32 CR	32 axes Win-GRAF Motion Controller with E3950 CPU and without a slot (RoHS)
EMP-9258-16 CR	16 axes Win-GRAF Motion Controller with i5-8365UE CPU and two slots (RoHS)
EMP-9258-32 CR	32 axes Win-GRAF Motion Controller with i5-8365UE CPU and two slots (RoHS)
EMP-9658-16 CR	16 axes Win-GRAF Motion Controller with i5-8365UE CPU and two slots (RoHS)
EMP-9658-32 CR	32 axes Win-GRAF Motion Controller with i5-8365UE CPU and two slots (RoHS)