



EcoStruxureTM Machine Expert – Basic

Programming software for
Modicon M221 logic controller

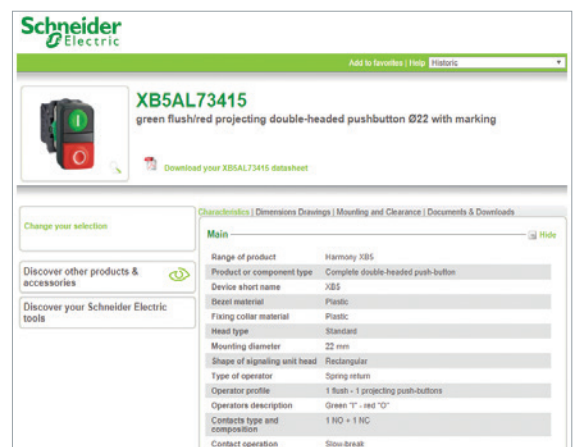
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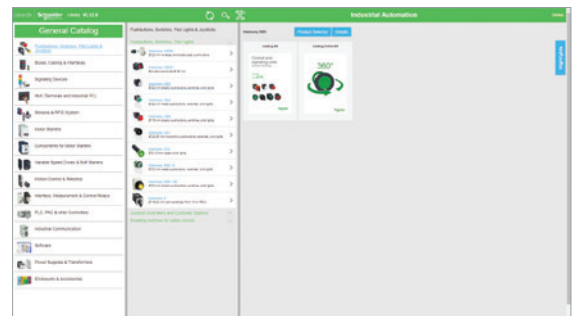
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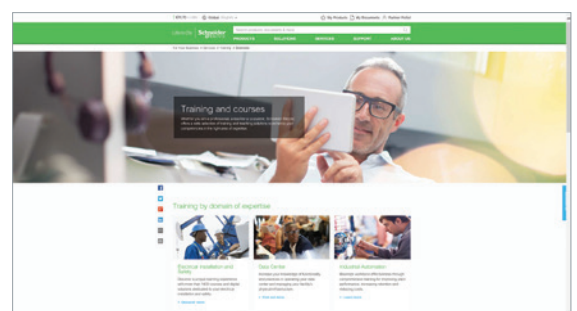


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EcoStruxure™ Machine Expert - Basic

Programming software for Modicon M221 logic controllers

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To be competitive in today's digital era, machine builders must be innovative. Smart machines, those that are better connected, more flexible, more efficient, and safe, are enabling machine builders to innovate in ways never before possible.

EcoStruxure, Schneider Electric's open, IoT-enabled architecture and platform, offers powerful solutions for the digital era. As part of this, EcoStruxure Machine brings powerful opportunities for machine builders and OEMs, empowering them to offer smart machines and compete in the new, digital era.

EcoStruxure Machine brings together key technologies for product connectivity and edge control on premises, and cloud technologies to provide analytics and digital services. EcoStruxure Machine helps you bring more innovation and added value to your customers throughout the entire machine life cycle.

Innovation at Every Level for Machines is full systems across three layers:

- Connected products
Our connected products for measuring, actuating, device level monitoring, and control adhere to open standards to provide unmatched integration opportunities and flexibility
- Edge Control
We are IIoT-ready with a proven set of tested and validated reference architectures that enable the design of end-to-end open, connected, and interoperable systems based on industry standards. Ethernet and OPC UA facilitates IT/OT convergence meaning machine builders reap benefits from web interfaces and cloud.

- Apps, Analytics & Services
Seamless integration of machines to the IT layer allows the collection and aggregation of data ready for analysis – for machine builders and end users alike this means increased uptime and the ability to find information faster for more efficient operations and maintenance.

These levels are completely integrated from shop floor to top floor. And we have cloud offers and end-to-end cybersecurity wrapped around.

EcoStruxure Machine makes it easier for OEMs/ machine builders to offer their customers smarter machines. The advent of smart machines is driven by the changing needs of end users:

- Evolving workforce
- Reducing costs
- Dynamic markets
- Shorter life cycles
- Prioritizing safety and cybersecurity

EcoStruxure Machine provides one solution for the whole machine life cycle:

- With Smart Design & Engineering the time to market is reduced by up to 30% using our automated engineering and the simulation capabilities
- During Commissioning & Operation of the machine, resources such as energy, material and loss can be improved, and with seamless integration to the IT world efficiency can be improved by up to 40%
- Smart Maintenance & Services reduces the time for corrective actions up to 50%

EcoStruxure™ Machine

Innovation At Every Level



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EcoStruxure Machine Expert – Basic software



[DIA3ED2140106EN](#)

Presentation

EcoStruxure™ Machine Expert – Basic programming software is a user-friendly tool designed to develop projects on Modicon M221 or Modicon M221 Book logic controllers (1).

- EcoStruxure Machine Expert – Basic is organized according to the project development cycle: navigation of the software is easy and intuitive.
- EcoStruxure Machine Expert – Basic offers a modern interface, so that getting started is:
 - User-friendly and fast: the simplified interface helps you find the information you need in two or three clicks maximum
 - Efficient, due to the functions available
- EcoStruxure Machine Expert – Basic creates an operator interface for remote graphic display unit **TMH2GDB**.

Connecting a PC to the controller

There are several ways of connecting a PC to Modicon M221 logic controllers during the programming, debugging, and maintenance phases.

■ Link via connection cables

The PC is connected to the M221 controller via the USB-B port, using cable **TCSXCNAMUM3P** (mini-USB to USB).

■ Link via modem or router

Modems can reduce the frequency of on-site visits for certain maintenance operations.

- The modem connected to the M221 logic controller must be declared in the hardware configuration. It will be initialized by the controller automatically (Hayes initialization string).
- At the PC end, the EcoStruxure Machine Expert – Basic software will associate a special modem connection that will be memorized in the project (including the phone number to use).

■ Ethernet network link

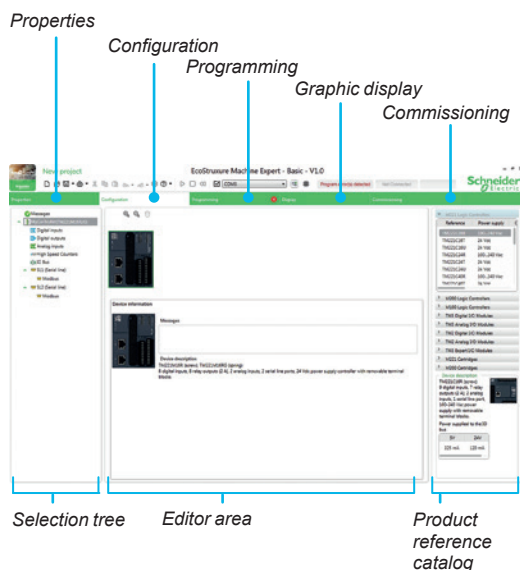
With their embedded Ethernet port **TM221●●E●●** logic controllers can be connected to a PC using the Ethernet network and the Modbus TCP/IP protocol.

■ Bluetooth® wireless link

The Bluetooth® wireless link enables complete freedom of movement within a 10 m/ 33 ft radius around the controller.

Schneider Electric offers Bluetooth® wireless adapters both for the controller side and the PC side. Please consult our website: www.schneider-electric.com

(1) Please consult catalog Ref. [DIA3ED2140106EN](#)



Functions

Navigation

EcoStruxure Machine Expert – Basic offers intuitive and visual navigation.

- The presentation is optimized for selecting the development cycle stage of the project (Properties, Configuration, Programming, Display, Commissioning).
- Each screen is divided into 3 zones:
 - A selection tree
 - An editor area: a streamlined workspace to carry out what is necessary and relevant to the current task, without any superfluous information
 - A product reference catalog organized by range

Project management

The project management function is used to:

- Create a new project
- Open a project from the PC (hard disk, CD-ROM, USB flash drive, etc.)
- Retrieve a project from an M221 logic controller (1)
- Open a Twido project, with automatic conversion
- Create a new project based on an existing project template
- Print a project
- Automatic saving of the project with recovered project

Properties

Screens enabling entry of identification data for a new project, such as:

- Details of the project author
- Details of their company
- Project information
- Project protection
- Application protection

Configuration

Configuration allows:

- Creation of the hardware configuration corresponding to the application by selecting the following from a "catalog":
 - The logic controller: Modicon M221 (1)
 - The I/O expansion modules: Modicon TM3 (2)
 - The standard and application cartridges

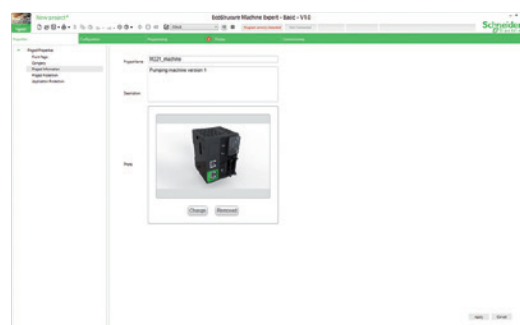
A graphic editor enables easy assembly of the various elements using simple drag & drop.

- Configuration of all the hardware functions selected for the application:

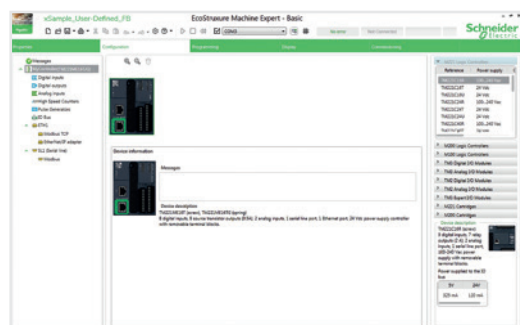
- Discrete, analog I/O
- High speed counter (HSC) inputs
- High speed outputs:
 - Pulse width modulation (PWM)
 - Pulse generator (PLS)
 - Pulse train output (PTO)
 - Frequency generator
- Communication ports (Ethernet, serial links):
 - Ethernet: EtherNet/IP, Modbus TCP client and server, Exchange table
 - Serial links: Modbus RTU or ASCII, ASCII protocol, Display
 - The Modbus Serial I/O Scanner and Modbus TCP I/O Scanner protocols are used to automatically configure an Altivar variable speed drive, a Modicon TM3 Bus coupler (2), an other Schneider device, or a generic device.

(1) Please consult catalog Ref. [DIA3ED2140106EN](#)

(2) Please consult catalog Ref. [DIA3ED2140109EN](#)



Properties



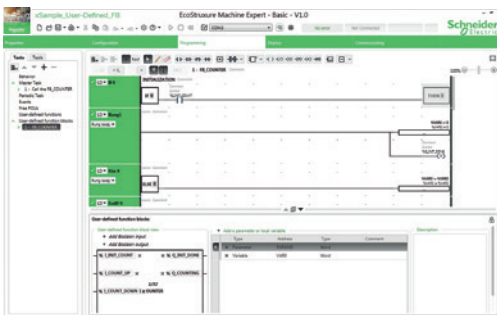
Configuration



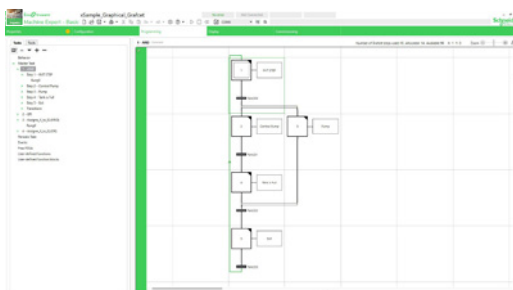
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Programming



Grafcet graphic language



Display

Functions

Programming

- The program is organized in POU (program organization units) or sections. These sections consist of rungs (networks) to simplify both reading and navigation within the program.
- The POUs are associated with various tasks of the application: master, periodic, events. They can be programmed in:
 - Instruction List (IL) language
 - Ladder (LD) language
 - Grafcet graphic language
 - Structured Text (ST) operations
 - User-defined functions
 - User-defined function blocks
- Rungs define all the connectable elements in the application.

Ladder editor

- The Ladder editor provides intuitive and high-performance programming:
 - Drag & drop operation
 - Undo/Redo function
 - Multiple function blocks in the same rung (serial or parallel)
 - Choice of keyboard shortcuts and toolbar according to the user profile
 - Easy connection of Ladder elements using the "Pencil" and "Rubber" tools
 - Assistance with connection of Ladder elements when creating rungs
 - Easy linking of variables to the Ladder elements
 - Context-sensitive online help
 - Instruction search and syntax wizard
 - Project backup, even if the Ladder networks are not complete
 - Automatic analysis and compilation
- Modification online and in Run mode (this mode allows the connected controller program to be modified)
- Animation tables
- Search and replace function with Trace function

Grafcet graphic language

Grafcet (Command Step-Transition Functional Graphic) is the French acronym for "GRAPhe Fonctionnel de Commande Etape-Transition". Grafcet has been standardized under the classification index NF C 03-190. The corresponding European standard is EN 60848.

Grafcet language is based on a graphic representation that is easy to understand:

- Step: The step represents a partial system state, in which an action has been performed. The step can be active or inactive. The associated action is executed when the step is active, and remains dormant when the step is inactive.
- Transition: This links one or more previous steps to one or more subsequent steps. It describes a change of state.

Two conditions are monitored while moving to the next step:

- Each step preceding the transition must be active (and the actions must have been executed).
- The Boolean condition associated with the transition is "True".

Structured Text operations

Structured Text operations allow Structured Text applications to be easily converted:

- Conditional elements
- Loop elements
- Complex calculation in an operation block

User-defined functions

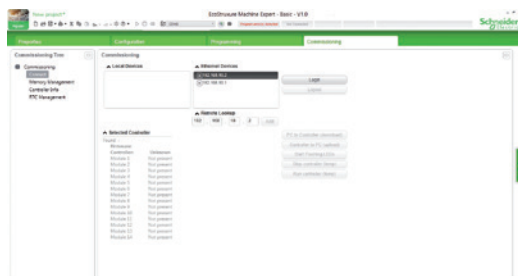
A user-defined function allows you to create new functions with local variables and a return value.

User-defined function blocks

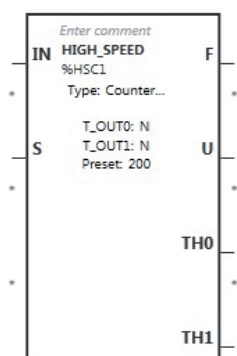
A user-defined function block allows you to create new function blocks with one or more boolean inputs or outputs, local variables, and local function blocks.

Display

- Configuration of the remote graphic display
- Configuration of the Alarm list
- Creation and configuration of an operator interface from predefined pages (menu, monitor, control, bar graph, gage)



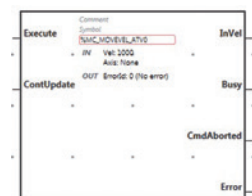
Commissioning



High speed counting (HSC)



Fast counting (FC)



Altivar variable speed drives

Functions

Commissioning

Tasks that are available and can be carried out during application commissioning:

- Connection:
 - Automatic discovery of the controller connected to the PC, according to the type of connection port: USB, Ethernet, Bluetooth®
 - Transfer of application between PC and logic controller
- Firmware update of the logic controllers
- Comparison of opened project with controller application or with another project
- Backup and restoration of all PLC data: memory area and SD card management
- Information about the PLC (logic controller)
- Real-time clock management

Counting

EcoStruxure Machine Expert – Basic offers high speed counting software functions for Modicon M221 logic controllers (2 dual-phase counters or 4 single-phase counters).

- High speed counting (HSC)

The counter is accessed via the 32-bit function block %HSCi. It is programmed for execution of one of the following functions:

 - Up/Down counter
 - Bi-phase up/down counter
 - Frequency meter

The pulses to be counted can come from an incremental encoder or proximity sensors (up/down counting) connected to inputs I0 and I1 of the M221 logic controller.

- Fast counting (FC)

The 16-bit %FCi fast counter enables up or down counting of pulses (rising edge) on the fast inputs of the M221 logic controller.

PTO

18 function blocks are used to manage the fast outputs (PTO) as outputs of the following type:

- Speed
- Position
- S-curve profile
- Execution of a points table (multi-segment)

The PTO function enables position control by pulse train - pulse/direction (P/D) or CW/CCW signals, depending on the type of servo drive. These pulses are generated on outputs %Q0.0 and %Q0.1 of M221 logic controllers (1).

Altivar variable speed drives

There are 7 function blocks available for controlling the following on Altivar variable speed drives:

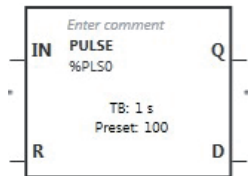
- Power
- Speed
- Jog
- Status

Communication

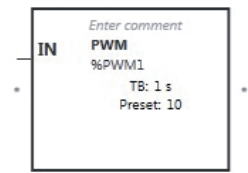
There are 4 function blocks available to facilitate communication:

- Modbus serial link
- Modbus Ethernet link
- Exchanging messages over serial link
- Sending and receiving SMS messages

(1) On TM221C-40U logic controllers, up to 4 outputs support the function (PLS, PWM, frequency generator, or PTO).



PLS function



PWM function

Functions

Position control

EcoStruxure Machine Expert – Basic provides 3 positioning software functions for the Modicon M221 logic controllers (1) used, for example, for stepper motor control.

■ PLS function

The PLS function block generates pulses of fixed ratio. In some cases, the frequency can be fixed and in others it is variable (as in control of slopes when driving a stepper motor). The %PLS function block can be programmed to generate a specific number of pulses.

The %PLS function blocks are assigned to the %Q0.0 or %Q0.1 outputs of M221 logic controllers (1).

The pulse generator signal has a variable period, but with a constant duty cycle that establishes an ON to OFF ratio of 50% of the period.

■ PWM function

The PWM function block generates pulses of fixed frequency, with a variable ON to OFF ratio for the output signal. The ON to OFF duration ratio is a dynamic variable called %PWM.R, with a range from 1% to 100%.

The PWM function blocks are assigned to the %Q0.0 or %Q0.1 outputs of M221 logic controllers (1).

The %PWM function block, defined by the user, generates a signal on output %Q0.0 or %Q0.1 of M221 logic controllers.

■ Frequency generator function (FREQGEN)

The frequency generator function generates a square wave signal on the outputs of M221 logic controllers (1) with a fixed duty cycle (50%).

The frequency can be configured from 0.1 Hz to 100 kHz with intervals of 0.1 Hz.

Event processing

Event management by the application.

- Source types:
 - ☐ Events on embedded inputs
 - ☐ Threshold events on the high speed counter (HSC)
 - ☐ Periodic event (Timer)
- Each event executes a single subroutine.

Process control (PID)

- 14 PID programming loops
- Auto-tuning algorithm
- Analog/PWM output
- Linear conversion of measurement input
- 2 alarm levels (high and low) on the measurement
- Control output limits
- Direct and reverse action

Data logging

- A new function block with data logging assistant for configuration can be used to:
 - ☐ Create an historic data record
 - ☐ Create an events log
- Save and restore a batch of memory words by using %S and %SW (same logic as in flash memory)

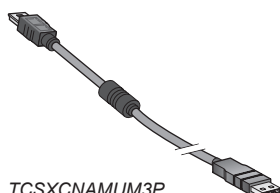
(1) Please consult catalog Ref. [DIA3ED2140106EN](#)



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[EcoStruxure Machine Expert - Basic software](#)



TCSXCNAMUM3P

References

EcoStruxure Machine Expert – Basic software

- EcoStruxure Machine Expert – Basic software ensures full compatibility with SoMachine Basic, and runs on the following configurations:
- Microsoft Windows® 7 Professional Edition 32-bit and 64-bit, Microsoft Windows® 8 Professional Edition 32-bit and 64-bit, Microsoft Windows® 8.1 32-bit and 64-bit, Microsoft Windows® 10
- 1 GHz Premium processor, 1 GB hard disk, and 1 GB RAM minimum
- Recommended minimum screen resolution of 1280 x 800 pixels
- The software is available on our website www.schneider-electric.com. Updates are offered when the PC is connected to the Internet.

Description	■ Programming languages □ User languages	Version	Reference Availability
EcoStruxure Machine Expert – Basic	■ Instruction List (IL) language, Ladder (LD) language, Grafcet graphic language □ Languages available: English, Czech, French, German, Italian, Japanese, Brazilian Portuguese, Simplified Chinese, Spanish, Turkish and Greek	V1.1	<i>Only available as a download from our website www.schneider-electric.com</i>

Cable for connecting a PC to the M221 logic controller

Description	For use		Length	Reference	Weight kg/lb
	From	To			
Programming cable	Type A USB port on programming PC	Mini-B USB port on M221 and M221 Book logic controllers	3 m 9.84 ft	TCSXCNAMUM3P	0.065/ 0.143

Link via modem or router

Modem, VPN industrial router	For remote access for Modicon M221 and Modicon M221 Book logic controllers; please consult our catalog Ref. DIA3ED2160107EN or on our website www.schneider-electric.com
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Downloadable from our website www.schneider-electric.com	
T	
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Schneider Electric Industries SAS

Head Office
35, rue Joseph Monier - CS 30323
F-92500 Rueil-Malmaison Cedex
France

DIA3ED2181201EN
July 2020 - V2.0